FCC SAR Test Report

APPLICANT	:	**Motorola Mobility LLC**
EQUIPMENT	:	**Mobile Cellular Phone**
BRAND NAME	:	**Motorola**
MODEL NAME	:	**XT1924-3**
FCC ID	:	**IHDT56XA6**
STANDARD	:	**FCC 47 CFR Part 2 (2.1093)** **ANSI/IEEE C95.1-1992** **IEEE 1528-2013**

We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

Mark Qu

Approved by: Mark Qu / Manager

TESTING
NVLAP LAB CODE 600155-0

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA7D2201-01	Rev. 01	Initial issue of report	Mar. 06, 2018

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Motorola Mobility LLC, Mobile Cellular Phone, XT1924-3,** are as follows.

Highest 1g SAR Summary						
Equipment Class	Frequency Band		Head (Separation 0mm)	Hotspot (Separation 5mm)	Body-worn (Separation 5mm)	Highest Simultaneous Transmission 1g SAR (W/kg)
			1g SAR (W/kg)			
Licensed	GSM	GSM850	0.34	0.99	0.99	1.53
		GSM1900	0.24	1.04	1.04	
	WCDMA	Band V	0.49	1.03	1.03	
		Band II	0.50	1.09	1.09	
	LTE	Band 5	0.53	0.96	0.96	
		Band 7	0.40	**1.20**	**1.20**	
		Band 38	0.26	1.13	1.13	
		Band 41	0.24	1.12	1.12	
DTS	WLAN	2.4GHz WLAN	**0.96**	0.80	0.80	1.48
DSS	Bluetooth	2.4GHz Bluetooth				1.53

Equipment Class	Frequency Band		Highest SAR Summary Product Specific 10g SAR (W/kg) (Gap 0mm)
Licensed	GSM	GSM1900	2.96
	WCDMA	Band II	3.69
	LTE	Band 7	**3.77**
		Band 38	2.25
		Band 41	2.26
Date of Testing:			2018/1/21

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Product Specific 10g SAR) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Testing Laboratory	
Test Site	Sporton International (Kunshan) Inc.
Test Site Location	No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China TEL : +86-512-57900158 FAX : +86-512-57900958

Applicant	
Company Name	Motorola Mobility LLC
Address	222 W, Merchandise Mart Plaza, Chicago IL 60654 USA

Manufacturer	
Company Name	Motorola Mobility LLC
Address	222 W, Merchandise Mart Plaza, Chicago IL 60654 USA

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Mobile Cellular Phone
Brand Name	Motorola
Model Name	XT1924-3
FCC ID	IHDT56XA6
IMEI Code	SIM1: 351876090026210 SIM2: 351876090026228
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 7: 2502.5 MHz ~ 2567.5 MHz LTE Band 38: 2572.5 MHz ~ 2617.5 MHz LTE Band 41: 2537.5 MHz ~ 2652.5 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+ (16QAM uplink is not supported) LTE: QPSK, 16QAM WLAN 2.4GHz : 802.11b/g/n HT20 Bluetooth v3.0+EDR, Bluetooth v4.0 LE, Bluetooth v4.1 LE, Bluetooth v4.2 LE
HW Version	DVT1B
SW Version	ahannah-userdebug 8.0.0 OPP27.60 924 intcfg,test-keys
GSM / (E)GPRS Transfer mode	Class B – EUT cannot support Packet Switched and Circuit Switched Network simultaneously but can automatically switch between Packet and Circuit Switched Network.
EUT Stage	Identical Prototype

Remark:

1. 802.11n-HT40 is not supported in 2.4GHz WLAN.
2. This device supports VoIP in GPRS, EGPRS, WCDMA and LTE (e.g. for 3rd-party VoIP).
3. This device 2.4GHz WLAN support hotspot operation and Bluetooth support tethering applications.
4. This device does not support DTM operation and supports GRPS/EGRPS mode up to multi-slot class 12.
5. When the phone is in talking mode and receiver worked, all WWAN powers are full power.
6. When the phone is in talking mode and receiver worked, then power reduction will be implemented immediately in WLAN 2.4GHz.
7. When hotspot mode is enabled, power reduction will be activated to limit the maximum power of GSM850/1900, WCDMA band II/V and LTE band 5/7/38/41.
8. The device employs proximity sensors that detect the presence of the user’s body at the front or back faces of the device. When front or back body worn condition is detected, GSM850/1900, WCDMA band II/V and LTE band 5/7/38/41 reduced power will be active. (P-sensor can’t work at detecting presence of the user’s body at the four edges of the device.)
9. This device hotspot reduced power and P-sensor reduced power level are the same. So only show one reduced power level for hotspot reduced power and P-sensor reduced power for this application.
10. P-sensor can detect handheld state, for bottom side of product specific 10g SAR condition, WCDMA band II reduced powers will be active. For GSM1900 and LTE band 7/38/41, the power levels are the same as the full power.
11. For dual SIM card mobile has two SIM slots and supports dual SIM dual standby. The WWAN radio transmission will be enabled by either one SIM at a time (single active). After pre-scan two SIM cards power, we found test result of the SIM1 was the worse, so we chose SIM1 slot to perform all tests.

4.2 Specification of Accessory

Specification of Accessory				
AC Adapter 1(US)	**Brand Name**	Motorola (Acbel)	**Model Name**	SPN5945A C-P35
	Power Rating	I/P: 100-240 Vac, 300mA, O/P: 5Vdc, 2000mA		
AC Adapter 1(EU)	**Brand Name**	Motorola (Acbel)	**Model Name**	SPN5944A C-P36
	Power Rating	I/P: 100-240 Vac, 300mA, O/P: 5Vdc, 2000mA		
AC Adapter 1(UK)	**Brand Name**	Motorola (Acbel)	**Model Name**	SPN5940A C-P37
	Power Rating	I/P: 100-240 Vac, 300mA, O/P: 5Vdc, 2000mA		
AC Adapter 1(IN)	**Brand Name**	Motorola (Acbel)	**Model Name**	SA18C19493 C-P49
	Power Rating	I/P: 100-240 Vac, 300mA, O/P: 5Vdc, 2000mA		
AC Adapter 2(US)	**Brand Name**	Motorola (Salom)	**Model Name**	SSW-2919UMTJ C-P35 SPN5945A
	Power Rating	I/P: 100-240 Vac, 300mA, O/P: 5Vdc, 2000mA		
AC Adapter 2(EU)	**Brand Name**	Motorola (Salom)	**Model Name**	SSW-2919EU C-P36 SPN5944A
	Power Rating	I/P: 100-240 Vac, 300mA, O/P: 5Vdc, 2000mA		
AC Adapter 2(UK)	**Brand Name**	Motorola (Salom)	**Model Name**	SSW-2919UK C-P37 SPN5940A
	Power Rating	I/P: 100-240 Vac, 300mA, O/P: 5Vdc, 2000mA		
Battery	**Brand Name**	Motorola (Amperex)	**Model Name**	HE50
	Power Rating	3.8Vdc,4850/5000mAh	Type	Li-ion
Earphone	**Brand Name**	Motorola (NEW Leaders)	**Model Name**	NLD-EM300V-01SF
	Signal Line Type	1.2 meter, non-shielded cable, without ferrite core		
USB Cable	**Brand Name**	Motorola (Saibao)	**Model Name**	SLQ-A081A
	Signal Line Type	1.0 meter, non-shielded cable, without ferrite core		

4.3 General LTE SAR Test and Reporting Considerations

<table>
<tr><th colspan="2">Summarized necessary items addressed in KDB 941225 D05 v02r05</th></tr>
<tr><td>FCC ID</td><td>IHDT56XA6</td></tr>
<tr><td>Equipment Name</td><td>Mobile Cellular Phone</td></tr>
<tr><td>Operating Frequency Range of each LTE transmission band</td><td>LTE Band 5: 824.7 MHz ~ 848.3 MHz
LTE Band 7: 2502.5 MHz ~ 2567.5 MHz
LTE Band 38: 2572.5 MHz ~ 2617.5 MHz
LTE Band 41: 2537.5 MHz ~ 2652.5 MHz</td></tr>
<tr><td>Channel Bandwidth</td><td>LTE Band 5:1.4MHz, 3MHz, 5MHz, 10MHz
LTE Band 7: 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 38: 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 41: 5MHz, 10MHz, 15MHz, 20MHz</td></tr>
<tr><td>Uplink Modulations Used</td><td>QPSK / 16QAM</td></tr>
<tr><td>LTE Voice / Data requirements</td><td>Data only</td></tr>
<tr><td>LTE Release Version</td><td>R10, Cat4</td></tr>
<tr><td>CA Support</td><td>Not Supported</td></tr>
<tr><td>LTE MPR permanently built-in by design</td><td>
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (N_{RB})</th><th rowspan="2">MPR (dB)</th></tr>
<tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr>
<tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 3</td></tr>
<tr><td>256 QAM</td><td colspan="6">≥ 1</td><td>≤ 5</td></tr>
</table>
</td></tr>
<tr><td>LTE A-MPR</td><td>In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing and the LTE SAR tests was transmitting on all TTI frames (Maximum TTI)</td></tr>
<tr><td>Spectrum plots for RB configuration</td><td>A properly configured base station simulator was used for the SAR and power measurement; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.</td></tr>
<tr><td>Power reduction applied to satisfy SAR compliance</td><td>Yes
1. When hotspot mode is enabled, power reduction will be activated to limit the maximum power of LTE band 5/7/38/41.
2. The device employs proximity sensors that detect the presence of the user's body at the front or back faces of the device. When front or back body worn condition is detected LTE band 5/7/38/41 reduced power will be active. (P-sensor can't work at detecting presence of the user's body at the four edges of the device.)</td></tr>
</table>

Transmission (H, M, L) channel numbers and frequencies in each LTE band								
LTE Band 5								
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20407	824.7	20415	825.5	20425	826.5	20450	829
M	20525	836.5	20525	836.5	20525	836.5	20525	836.5
H	20643	848.3	20635	847.5	20625	846.5	20600	844
LTE Band 7								
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20775	2502.5	20800	2505	20825	2507.5	20850	2510
M	21100	2535	21100	2535	21100	2535	21100	2535
H	21425	2567.5	21400	2565	21375	2562.5	21350	2560
LTE Band 38								
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	37775	2572.5	37800	2575	37825	2577.5	37850	2580
M	38000	2595	38000	2595	38000	2595	38000	2595
H	38225	2617.5	38200	2615	38175	2612.5	38150	2610
LTE Band 41								
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	40065	2537.5	40090	2540	40115	2542.5	40140	2545
LM	40385	2569.5	40390	2570	40395	2570.5	40400	2571
HM	40705	2601.5	40690	2600	40685	2599.5	40670	2598
H	41215	2652.5	41190	2650	41165	2647.5	41140	2645

5. Re-use of Measured Data

5.1 Introduction Section

This application re-uses data collected on a similar device. The subject device of this application (Model: XT1924-3, FCC ID: IHDT56XA6) is electrically identical to the reference device (Model: XT1924-4, XT1924-5, FCC ID: IHDT56XA5) for the portions of the circuitry corresponding to the data being re-used, as treated by KDB Publication 178919 D01.

5.2 Difference Section

For details concerning the similarity with respect to component placement, mechanical/electrical design etc., please refer to the Product Equality Declaration “PED” file.

The re-used RF data includes the following bands provided in Appendix E (Sporton SAR Report No. FA7D2201 for the reference device Model: XT1924-4, XT1924-5, FCC ID: IHDT56XA5):

- GSM850/1900
- WCDMA Band V/II
- LTE Band 5/7
- WLAN/Bluetooth

LTE Band 38/41 full SAR test, spot check for WWAN (except for LTE Band 38/41) and BT/WLAN are performed for ensure that SAR measurement for both device are the same. So, the original SAR value can represent this application.

5.3 Spot Check Verification Data Section

Band	BW (MHz)	Modulation	RB Size	RB offset	Mode	Test Position	Gap (mm)	Power Mode	Ch.	Freq. (MHz)	Original model (FCC ID: IHDT56XA5)				Spot check model (FCC ID: IHDT56XA6)				Deviation
											Average Power (dBm)	Tune-Up Limit (dBm)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Average Power (dBm)	Tune-Up Limit (dBm)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	
WLAN2.4GHz	-	-	-	-	802.11b 1Mbps	Left Cheek	-	Reduced	11	2462	16.97	17.5	0.835	0.963	16.97	17.5	0.798	0.921	-0.04%
GSM850	-	-	-	-	GPRS 2 Tx slots	Back	5	Reduced	251	848.8	27.88	28.5	0.856	0.987	27.88	28.5	0.854	0.985	0.00%
GSM1900	-	-	-	-	GPRS 4 Tx slots	Back	5	Reduced	661	1880	20.53	21.5	0.833	1.041	20.53	21.5	0.828	1.035	-0.01%
WCDMA Band V	-	-	-	-	RMC 12.2Kbps	Back	5	Reduced	4182	836.4	22.41	23	0.896	1.026	22.41	23	0.742	0.850	-0.17%
WCDMA Band II	-	-	-	-	RMC 12.2Kbps	Back	5	Reduced	9262	1852.4	17.10	17.5	0.998	1.094	17.10	17.5	0.918	1.007	-0.08%
LTE Band 5	10M	QPSK	1	25	-	Back	5	Reduced	20525	836.5	21.83	22.5	0.823	0.960	21.83	22.5	0.780	0.910	-0.05%
LTE Band 7	20M	QPSK	1	49	-	Back	5	Reduced	21350	2560	20.21	20.5	1.120	1.197	20.21	20.5	1.110	1.187	-0.01%

Note: In the table above, all the deviation of SAR test results are compliant with uncertainty budget.

5.4 Reference detail Section

Reference FCC ID	Folder Test/RF Exposure	Report Title/Section
IHDT56XA5	RF Exposure(FA7D2201)	All sections applicable

6. RF Exposure Limits

6.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

6.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

7. Specific Absorption Rate (SAR)

7.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

7.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{dm}}\right) = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\boldsymbol{\rho}\mathbf{dv}}\right)$$

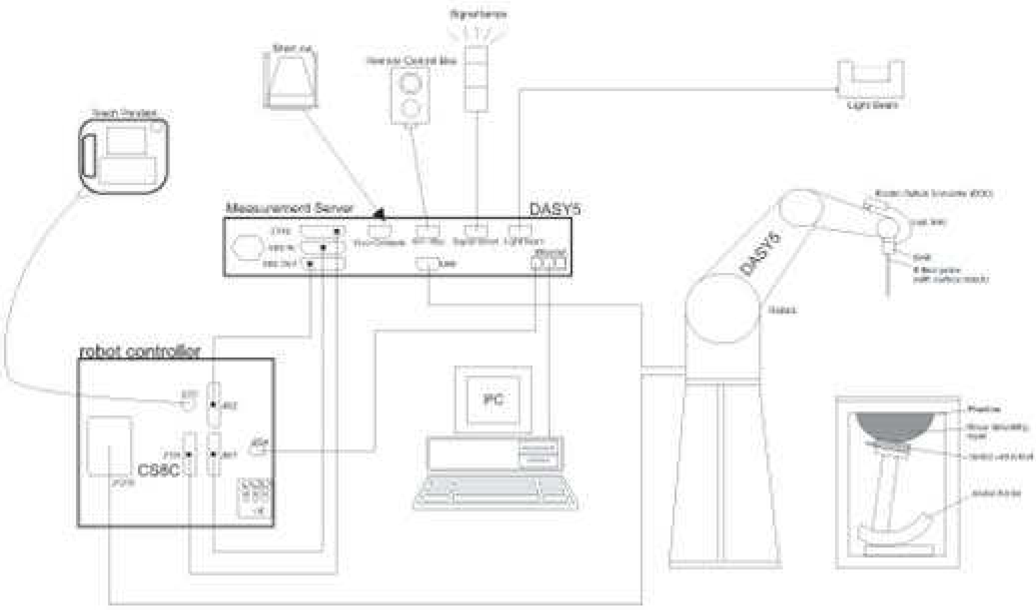
SAR is expressed in units of Watts per kilogram (W/kg)

$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^2}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

8. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

8.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<ES3DV3 Probe>

Construction	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – 4 GHz; Linearity: ±0.2 dB (30 MHz – 4 GHz)	
Directivity	±0.2 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)	
Dynamic Range	5 µW/g – >100 mW/g; Linearity: ±0.2 dB	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm	

8.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.1 Photo of DAE

8.3 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm

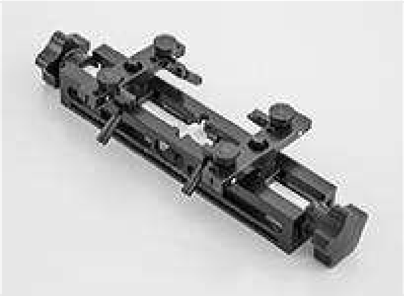
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

8.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

9. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted 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.

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

9.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

9.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

9.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

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

9.4 Zoom Scan

Zoom scans are used assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube shoes base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

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

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the <u>*reported*</u> SAR from the *area scan based 1-g SAR estimation* procedures of KDB 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.

9.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

9.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

10. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2600MHz System Validation Kit	D2600V2	1061	2017/12/7	2018/12/6
SPEAG	Data Acquisition Electronics	DAE4	915	2017/6/16	2018/6/15
SPEAG	Dosimetric E-Field Probe	ES3DV3	3293	2017/9/25	2018/9/24
SPEAG	SAM Twin Phantom	QD 000 P40 CB	TP-1697	NCR	NCR
SPEAG	SAM Twin Phantom	QD 000 P40 CB	TP-1696	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Radio communication analyzer	MT8820C	6201563814	2018/1/18	2019/1/17
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2017/4/18	2018/4/17
SPEAG	DAK Kit	DAK3.5	1146	2017/7/18	2018/7/17
R&S	Signal Generator	SMR40	100455	2018/1/18	2019/1/17
Anritsu	Power Meter	ML2495A	1419002	2017/5/15	2018/5/14
Anritsu	Power Sensor	MA2411B	1339124	2017/5/15	2018/5/14
Anritsu	Power Meter	ML2495A	1218006	2017/10/6	2018/10/5
Anritsu	Power Sensor	MA2411B	1207363	2017/10/6	2018/10/5
WISEWIND	Hygrometer	WISEWIND 0905	0905	2017/4/20	2018/4/19
JM	DIGITAC THERMOMETER	JM222	AA1207166	2017/4/19	2018/4/18
EXA	Spectrum Analyzer	N9010A	MY55150244	2017/4/18	2018/4/17
ARRA	Power Divider	A3200-2	N/A	Note	
MCL	Attenuation1	BW-S10W5+	N/A	Note	
MCL	Attenuation2	BW-S10W5+	N/A	Note	
MCL	Attenuation3	BW-S10W5+	N/A	Note	
AR	Amplifier	5S1G4	333096	Note	
mini-circuits	Amplifier	ZVE-3W-83+	162601250	Note	
Agilent	Dual Directional Coupler	778D	50422	Note	
PASTERNACK	Dual Directional Coupler	PE2214-10	N/A	Note	

Note:
Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.

11. System Verification

11.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.2.

Fig 10.1Photo of Liquid Height for Head SAR

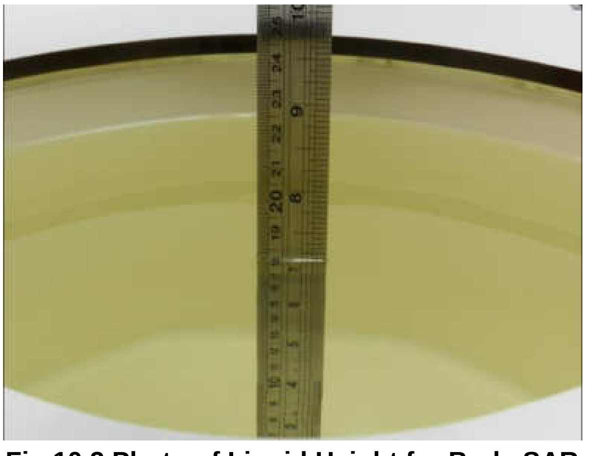


Fig 10.2 Photo of Liquid Height for Body SAR

11.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Head								
2600	54.8	0	0	0.1	0	45.1	1.96	39.0
For Body								
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2600	Head	22.7	2.05	38.661	1.96	39.0	4.59	-0.87	±5	2018/1/21
2600	Body	22.9	2.21	52.876	2.16	52.5	2.31	0.72	±5	2018/1/21

11.3 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

<1g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2018/1/21	2600	Head	250	1061	3293	915	13.5	58.2	54	-7.22
2018/1/21	2600	Body	250	1061	3293	915	13.2	56.4	52.8	-6.38

<10g SAR>

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2018/1/21	2600	Body	250	1061	3293	915	6.28	25	25.12	0.48

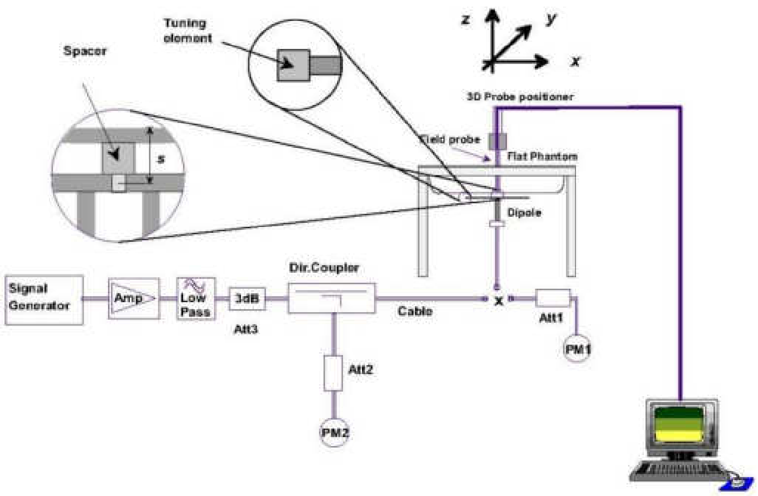


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

12. RF Exposure Positions

12.1 Ear and handset reference point

Figure 9.1.1 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled “M,” the left ear reference point (ERP) is marked “LE,” and the right ERP is marked “RE.” Each ERP is 15 mm along the B-M (back-mouth) line behind the entrance-to-ear-canal (EEC) point, as shown in Figure 9.1.2 The Reference Plane is defined as passing through the two ear reference points and point M. The line N-F (neck-front), also called the reference pivoting line, is normal to the Reference Plane and perpendicular to both a line passing through RE and LE and the B-M line (see Figure 9.1.3). Both N-F and B-M lines should be marked on the exterior of the phantom shell to facilitate handset positioning. Posterior to the N-F line the ear shape is a flat surface with 6 mm thickness at each ERP, and forward of the N-F line the ear is truncated, as illustrated in Figure 9.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

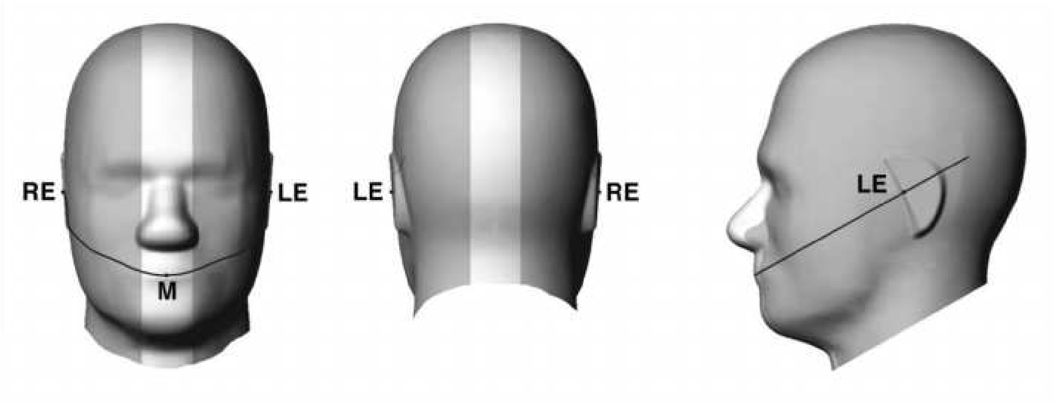


Fig 9.1.1 Front, back, and side views of SAM twin phantom

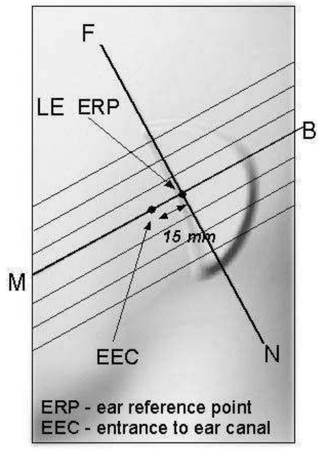


Fig 9.1.2 Close-up side view of phantom showing the ear region.

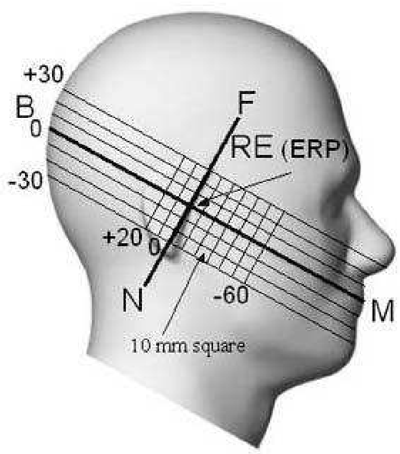


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

12.2 Definition of the cheek position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. Define two imaginary lines on the handset—the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset—the midpoint of the width wt of the handset at the level of the acoustic output (point A in Figure 9.2.1 and Figure 9.2.2), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 9.2.1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 9.2.2), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
3. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 9.2.3), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
4. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.
5. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
6. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.
7. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Figure 9.2.3. The actual rotation angles should be documented in the test report.

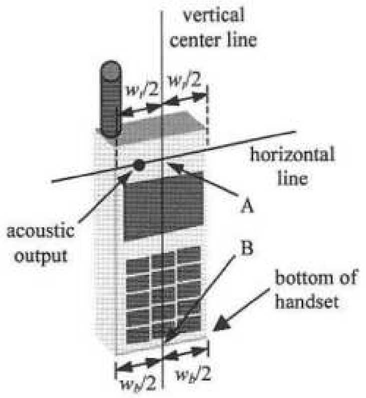


Fig 9.2.1 Handset vertical and horizontal reference lines—"fixed case

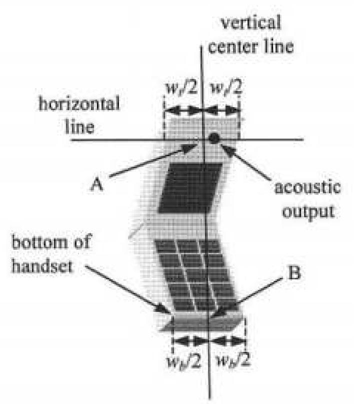


Fig 9.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

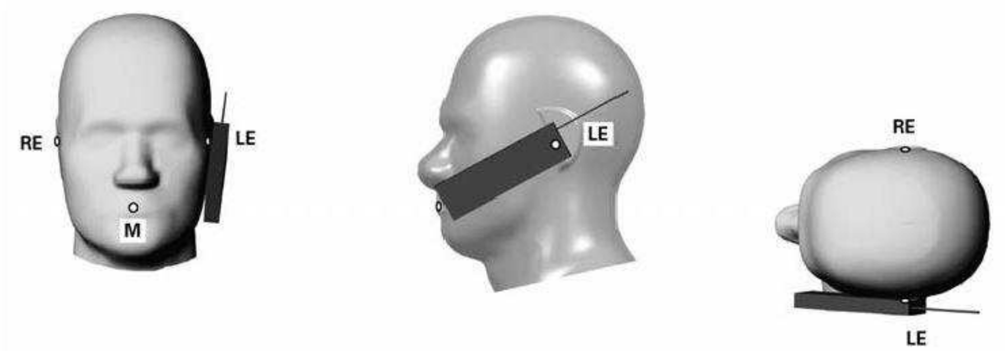


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

12.3 Definition of the tilt position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. While maintaining the orientation of the handset, move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
3. Rotate the handset around the horizontal line by 15°.
4. While maintaining the orientation of the handset, move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Figure 9.3.1. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point

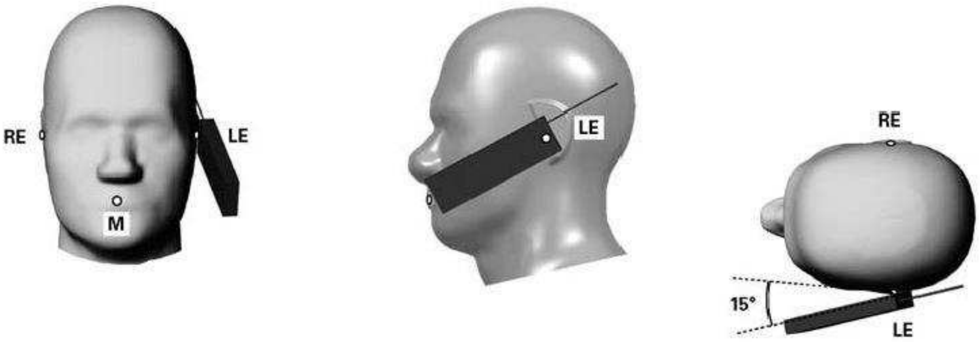


Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

12.4 Body Worn Accessory

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 9.4). Per KDB648474 D04v01r03, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.

Accessories for body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

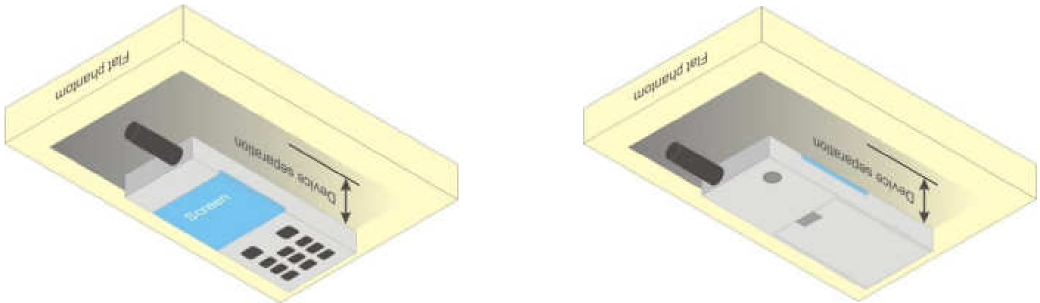


Fig 9.4 Body Worn Position

12.5 Wireless Router

Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v02r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined form general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v06 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

13. Conducted RF Output Power (Unit: dBm)

<LTE Conducted Power>

General Note:

1. Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.
2. Per KDB 941225 D05v02r05, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
3. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
4. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05v02r05, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
6. Per KDB 941225 D05v02r05, 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, 16QAM SAR testing is not required.
7. Per KDB 941225 D05v02r05, Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
8. For LTE B38 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

<TDD LTE SAR Measurement>

TDD LTE configuration setup for SAR measurement

SAR was tested with a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by 3GPP.

a. 3GPP TS 36.211 section 4.2 for Type 2 Frame Structure and Table 4.2-2 for uplink-downlink configurations
b. “special subframe S” contains both uplink and downlink transmissions, it has been taken into consideration to determine the transmission duty factor according to the worst case uplink and downlink cyclic prefix requirements for UpPTS
c. Establishing connections with base station simulators ensure a consistent means for testing SAR and recommended for evaluating SAR. The Anritsu MT8820C (firmware: #22.52#004) was used for LTE output power measurements and SAR testing.

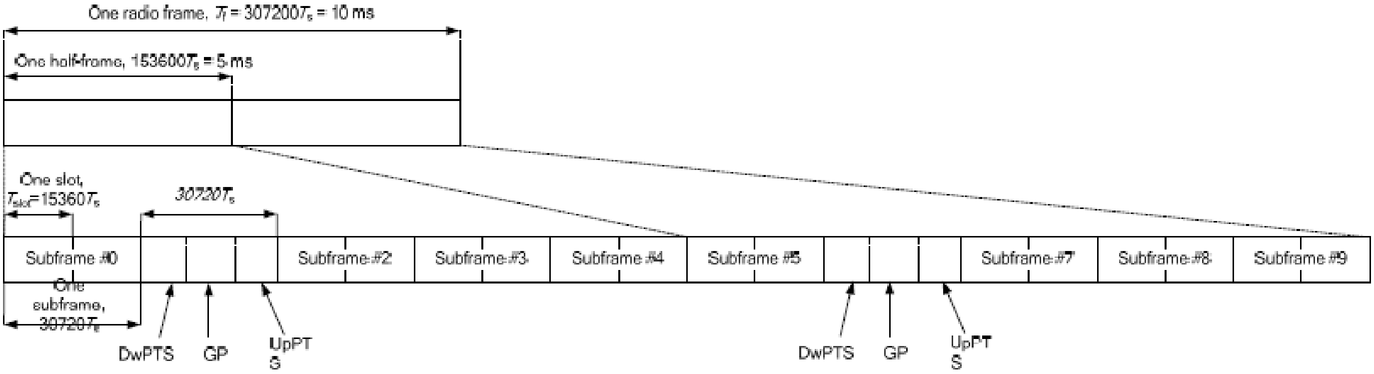


Figure 4.2-1: Frame structure type 2 (for 5 ms switch-point periodicity).

Table 4.2-2: Uplink-downlink configurations.

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS).

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	$6592 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$	$7680 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$
1	$19760 \cdot T_s$			$20480 \cdot T_s$		
2	$21952 \cdot T_s$			$23040 \cdot T_s$		
3	$24144 \cdot T_s$			$25600 \cdot T_s$		
4	$26336 \cdot T_s$			$7680 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$
5	$6592 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$	$20480 \cdot T_s$		
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			$12800 \cdot T_s$		
8	$24144 \cdot T_s$			-	-	-
9	$13168 \cdot T_s$			-	-	-

Special subframe (30720·T_s): Normal cyclic prefix in downlink (UpPTS)			
	Special subframe configuration	**Normal cyclic prefix in uplink**	**Extended cyclic prefix in uplink**
Uplink duty factor in one special subframe	**0~4**	7.13%	8.33%
	5~9	14.3%	16.7%

Special subframe(30720·T_s): Extended cyclic prefix in downlink (UpPTS)			
	Special subframe configuration	**Normal cyclic prefix in uplink**	**Extended cyclic prefix in uplink**
Uplink duty factor in one special subframe	**0~3**	7.13%	8.33%
	4~7	14.3%	16.7%

The highest duty factor is resulted from:

i. Uplink-downlink configuration: 0. In a half-frame consisted of 5 subfames, uplink operation is in 3 uplink subframes and 1 special subframe.

ii. special subframe configuration: 5-9 for normal cyclic prefix in downlink, 4-7 for extended cyclic prefix in downlink

iii. for special subframe with extended cyclic prefix in uplink, the total uplink duty factor in one half-frame is: (3+0.167)/5 = 63.3%

iv. for special subframe with normal cyclic prefix in uplink, the total uplink duty factor in one half-frame is: (3+0.143)/5 = 62.9%

v. For TDD LTE SAR measurement, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix 63.3%/62.9% = 1.006 is applied to scale-up the measured SAR result. The scaled TDD LTE SAR = measured SAR (W/kg)* Tune-up Scaling Factor* scaling factor for extended cyclic prefix.

<Full Power Mode>

<LTE Band 38>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				37850	38000	38150		
Frequency (MHz)				2580	2595	2610		
20	QPSK	1	0	23.25	23.17	23.27	24	0
20	QPSK	1	49	23.18	23.45	23.34		
20	QPSK	1	99	23.29	23.19	23.14		
20	QPSK	50	0	22.23	22.29	22.25	23	1
20	QPSK	50	24	22.21	22.24	22.22		
20	QPSK	50	50	22.21	22.12	22.14		
20	QPSK	100	0	22.22	22.24	22.23		
20	16QAM	1	0	21.72	21.67	21.98	23	1
20	16QAM	1	49	21.84	21.94	21.98		
20	16QAM	1	99	21.85	21.96	21.62		
20	16QAM	50	0	21.25	21.31	21.33	22	2
20	16QAM	50	24	21.25	21.15	21.11		
20	16QAM	50	50	21.2	21.11	21.12		
20	16QAM	100	0	21.21	21.26	21.23		
Channel				37825	38000	38175	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2577.5	2595	2612.5		
15	QPSK	1	0	23.23	23.15	23.16	24	0
15	QPSK	1	37	23.5	23.52	23.54		
15	QPSK	1	74	23.36	23.44	23.13		
15	QPSK	36	0	22.2	22.23	22.15	23	1
15	QPSK	36	20	22.25	22.22	22.3		
15	QPSK	36	39	22.16	22.07	22.05		
15	QPSK	75	0	22.26	22.1	22.06		
15	16QAM	1	0	21.74	21.68	21.7	23	1
15	16QAM	1	37	21.92	22.07	22.09		
15	16QAM	1	74	21.55	22.02	21.75		
15	16QAM	36	0	21.18	21.13	21.17	22	2
15	16QAM	36	20	21.16	21.06	21.13		
15	16QAM	36	39	21.03	21.1	21.1		
15	16QAM	75	0	21.23	21.28	21.13		

Channel				37800	38000	38200	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2575	2595	2615		
10	QPSK	1	0	23.37	23.22	23.32	24	0
10	QPSK	1	25	23.28	23.3	23.24		
10	QPSK	1	49	23.21	23.4	23.27		
10	QPSK	25	0	22.15	22.26	22.24	23	1
10	QPSK	25	12	22.25	22.28	22.23		
10	QPSK	25	25	22.2	22.02	22.09		
10	QPSK	50	0	22.19	22.14	22.15		
10	16QAM	1	0	21.71	21.63	21.86	23	1
10	16QAM	1	25	21.94	21.69	21.9		
10	16QAM	1	49	21.71	21.67	21.58		
10	16QAM	25	0	21.37	21.36	21.42	22	2
10	16QAM	25	12	21.41	21.5	21.35		
10	16QAM	25	25	21.25	21.24	20.95		
10	16QAM	50	0	21.14	21.13	21.1		
Channel				37775	38000	38225	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2572.5	2595	2617.5		
5	QPSK	1	0	23.1	23.14	23.11	24	0
5	QPSK	1	12	23.37	23.45	23.23		
5	QPSK	1	24	23.28	23.07	23.09		
5	QPSK	12	0	22.07	22	22.16	23	1
5	QPSK	12	7	22.08	22.07	22.22		
5	QPSK	12	13	22.15	22.07	22.23		
5	QPSK	25	0	22.09	21.99	22.18		
5	16QAM	1	0	21.92	21.52	21.9	23	1
5	16QAM	1	12	21.94	22.03	22.03		
5	16QAM	1	24	21.84	21.81	21.87		
5	16QAM	12	0	21.04	21.25	21.21	22	2
5	16QAM	12	7	21.17	21.14	21.22		
5	16QAM	12	13	21.35	21.02	21.25		
5	16QAM	25	0	21.26	21.19	21.36		

<LTE Band 41>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Low Ch. / Freq.	Power Middle High Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				40140	40400	40670	41140		
Frequency (MHz)				2545	2571	2598	2645		
20	QPSK	1	0	23.12	23.03	22.95	23.08	24	0
20	QPSK	1	49	23.29	23.45	23.36	23.76		
20	QPSK	1	99	23.24	23.17	22.96	23.02		
20	QPSK	50	0	22.18	22.02	22.08	22.19	23	1
20	QPSK	50	24	22.08	22.08	22.09	22.07		
20	QPSK	50	50	22.04	22.14	22.07	21.94		
20	QPSK	100	0	22.08	22.06	21.93	22.11		
20	16QAM	1	0	21.75	21.59	21.68	21.81	23	1
20	16QAM	1	49	22.02	21.93	21.65	21.74		
20	16QAM	1	99	21.5	21.77	21.44	21.48		
20	16QAM	50	0	20.98	21.02	20.86	21.06	22	2
20	16QAM	50	24	21.02	21.04	21.07	20.96		
20	16QAM	50	50	21.09	20.98	20.96	20.94		
20	16QAM	100	0	21.13	21.15	21.01	20.93		
Channel				40115	40395	40685	41165	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2542.5	2570.5	2599.5	2647.5		
15	QPSK	1	0	23.1	22.97	23.09	23.03	24	0
15	QPSK	1	37	23.32	23.57	23.38	23.34		
15	QPSK	1	74	23.1	23.18	23.03	22.94		
15	QPSK	36	0	22.13	21.99	22.01	22.07	23	1
15	QPSK	36	20	22.15	22.16	22	22.09		
15	QPSK	36	39	22.1	22.14	21.9	21.88		
15	QPSK	75	0	22.11	22.11	21.92	21.93		
15	16QAM	1	0	21.69	21.71	21.4	21.8	23	1
15	16QAM	1	37	21.76	21.94	21.95	21.96		
15	16QAM	1	74	21.44	21.57	21.4	21.63		
15	16QAM	36	0	21.05	20.83	20.85	20.99	22	2
15	16QAM	36	20	20.96	21.14	20.71	20.94		
15	16QAM	36	39	20.94	21.04	20.84	20.86		
15	16QAM	75	0	21.09	21.07	21.1	21.01		

Channel				40090	40390	40690	41190	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2540	2570	2600	2650		
10	QPSK	1	0	23.21	23.27	22.92	23.06	24	0
10	QPSK	1	25	23.31	23.36	23.25	23.25		
10	QPSK	1	49	23.06	23.26	22.89	23.14		
10	QPSK	25	0	22.12	21.99	21.93	22.04	23	1
10	QPSK	25	12	22.08	22.2	22.06	21.99		
10	QPSK	25	25	21.94	22.06	21.9	21.78		
10	QPSK	50	0	22.12	22.01	21.95	21.92		
10	16QAM	1	0	21.54	21.71	21.51	21.66	23	1
10	16QAM	1	25	21.71	21.9	21.53	21.72		
10	16QAM	1	49	21.55	21.67	21.44	21.18		
10	16QAM	25	0	21.25	21.15	21.14	21.07	22	2
10	16QAM	25	12	21.28	21.33	21.15	21.14		
10	16QAM	25	25	21.11	21.2	21.06	20.96		
10	16QAM	50	0	21.08	21.06	21.05	21.03		
Channel				40065	40385	40705	41215	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2537.5	2569.5	2601.5	2652.5		
5	QPSK	1	0	23.19	23.12	22.89	23.07	24	0
5	QPSK	1	12	23.51	23.7	23.25	23.3		
5	QPSK	1	24	23.17	23.24	22.9	23.02		
5	QPSK	12	0	22.16	21.93	21.96	21.99	23	1
5	QPSK	12	7	22.16	22.06	21.93	21.96		
5	QPSK	12	13	22.13	22.05	21.91	21.82		
5	QPSK	25	0	22.08	22.1	21.85	21.87		
5	16QAM	1	0	21.69	21.74	21.41	21.44	23	1
5	16QAM	1	12	21.89	21.88	21.84	21.72		
5	16QAM	1	24	21.67	21.76	21.21	21.51		
5	16QAM	12	0	20.97	21	20.76	20.77	22	2
5	16QAM	12	7	21.05	21.02	20.88	20.74		
5	16QAM	12	13	20.97	21.1	20.84	20.88		
5	16QAM	25	0	21.07	21.23	21.03	21.08		

<Reduced Power Mode for Hotspot On/P-Sensor On>

<LTE Band 38>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				37850	38000	38150		
Frequency (MHz)				2580	2595	2610		
20	QPSK	1	0	20.36	20.03	20.26	21	0
20	QPSK	1	49	20.50	20.39	20.44		
20	QPSK	1	99	20.23	20.37	20.2		
20	QPSK	50	0	20.35	20.24	20.31	21	0
20	QPSK	50	24	20.27	20.21	20.21		
20	QPSK	50	50	20.24	20.15	19.98		
20	QPSK	100	0	20.29	20.24	20.22		
20	16QAM	1	0	19.71	19.63	19.64	21	0
20	16QAM	1	49	19.96	19.82	19.97		
20	16QAM	1	99	19.56	19.64	19.59		
20	16QAM	50	0	20.23	20.1	20.18	21	0
20	16QAM	50	24	20.17	20.2	20.1		
20	16QAM	50	50	20.21	20.14	20.05		
20	16QAM	100	0	20.27	20.22	20.2		
Channel				37825	38000	38175	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2577.5	2595	2612.5		
15	QPSK	1	0	20.24	20.26	20.21	21	0
15	QPSK	1	37	20.74	20.47	20.5		
15	QPSK	1	74	20.21	20.31	20.26		
15	QPSK	36	0	20.32	20.12	20.34	21	0
15	QPSK	36	20	20.32	20.08	20.18		
15	QPSK	36	39	20.16	20.11	20.05		
15	QPSK	75	0	20.11	20.06	20.19		
15	16QAM	1	0	20.03	19.6	19.86	21	0
15	16QAM	1	37	20.17	19.8	20.15		
15	16QAM	1	74	19.87	19.73	19.72		
15	16QAM	36	0	20.25	20.13	20.15	21	0
15	16QAM	36	20	20.23	20.09	20.07		
15	16QAM	36	39	20.19	20.15	19.98		
15	16QAM	75	0	20.26	20.23	20.37		

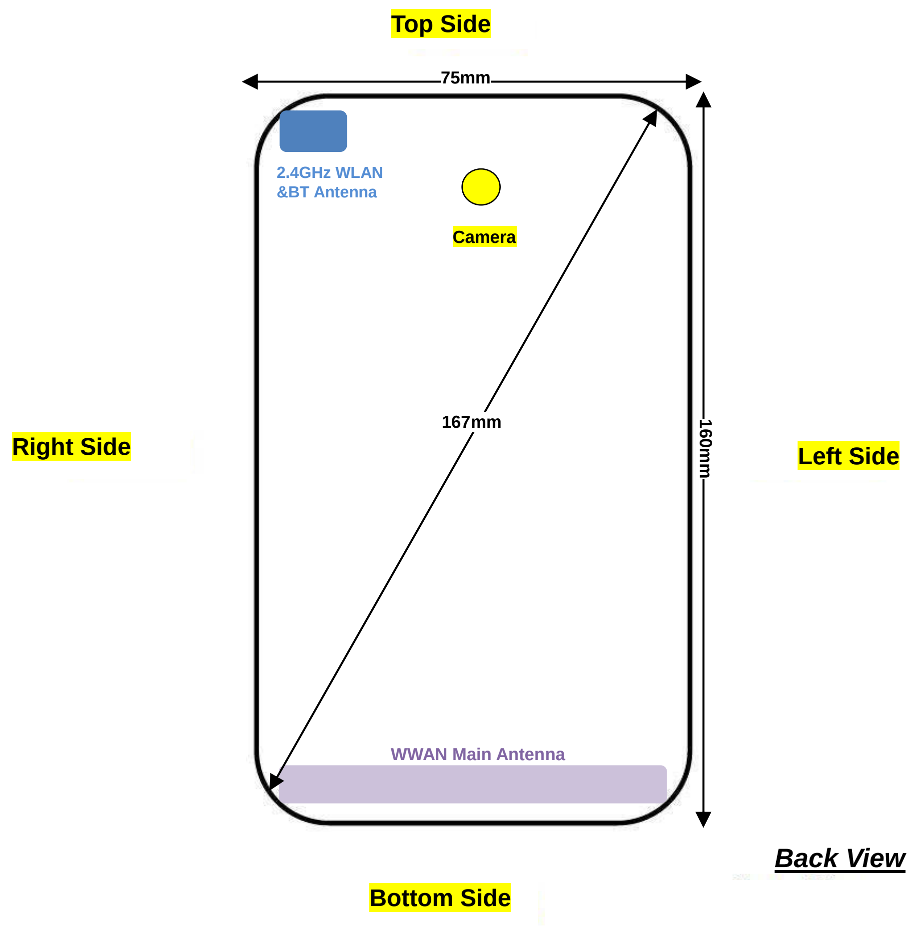
Channel				37800	38000	38200	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2575	2595	2615		
10	QPSK	1	0	20.51	20.19	20.45	21	0
10	QPSK	1	25	20.47	20.29	20.44		
10	QPSK	1	49	20.3	20.39	20.38		
10	QPSK	25	0	20.32	20.13	20.07	21	0
10	QPSK	25	12	20.32	20.16	20.03		
10	QPSK	25	25	20.15	20.16	20.06		
10	QPSK	50	0	20.19	20.19	20.1		
10	16QAM	1	0	19.75	19.57	19.7	21	0
10	16QAM	1	25	19.91	19.85	19.88		
10	16QAM	1	49	19.66	19.6	19.53		
10	16QAM	25	0	20.4	20.32	20.34	21	0
10	16QAM	25	12	20.5	20.33	20.27		
10	16QAM	25	25	20.42	20.28	20.33		
10	16QAM	50	0	20.26	20.17	20.07		
Channel				37775	38000	38225	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2572.5	2595	2617.5		
5	QPSK	1	0	20.23	19.98	20.19	21	0
5	QPSK	1	12	20.54	20.38	20.38		
5	QPSK	1	24	20.17	20.08	20.24		
5	QPSK	12	0	20.12	19.97	20.13	21	0
5	QPSK	12	7	20.13	20.11	20.22		
5	QPSK	12	13	20.14	20.19	20.11		
5	QPSK	25	0	20.19	20.16	20.06		
5	16QAM	1	0	20	19.78	19.7	21	0
5	16QAM	1	12	20.11	20.1	20.01		
5	16QAM	1	24	19.93	19.75	19.83		
5	16QAM	12	0	20.04	19.92	20.06	21	0
5	16QAM	12	7	20.26	20.15	20.13		
5	16QAM	12	13	20.2	20.08	20.12		
5	16QAM	25	0	20.13	20.33	20.33		

<LTE Band 41>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Low Ch. / Freq.	Power Middle High Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit (dBm)	MPR (dB)
Channel				40140	40400	40670	41140		
Frequency (MHz)				2545	2571	2598	2645		
20	QPSK	1	0	20.42	20.42	20.14	20.27	21	0
20	QPSK	1	49	20.63	20.81	20.70	20.83		
20	QPSK	1	99	20.43	20.28	20.4	20.42		
20	QPSK	50	0	20.24	20.20	20.22	20.32	21	0
20	QPSK	50	24	20.21	20.3	20.31	20.31		
20	QPSK	50	50	19.99	20.23	20.24	20.19		
20	QPSK	100	0	20.13	20.16	20.16	20.32		
20	16QAM	1	0	19.84	19.89	19.56	19.63	21	0
20	16QAM	1	49	19.96	20.03	19.78	19.97		
20	16QAM	1	99	19.49	19.72	19.61	19.76		
20	16QAM	50	0	20.22	20.17	20.09	20.07	21	0
20	16QAM	50	24	20.1	20.17	20.18	20.09		
20	16QAM	50	50	20.07	20.3	20.12	20.11		
20	16QAM	100	0	20.11	20.33	20.12	20.14		
Channel				40115	40395	40685	41165	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2542.5	2570.5	2599.5	2647.5		
15	QPSK	1	0	20.48	20.33	20.3	20.46	21	0
15	QPSK	1	37	20.62	20.85	20.82	20.95		
15	QPSK	1	74	20.42	20.46	20.22	20.42		
15	QPSK	36	0	20.28	20.38	20.24	20.37	21	0
15	QPSK	36	20	20.19	20.33	20.3	20.29		
15	QPSK	36	39	20.03	20.19	20.25	20.18		
15	QPSK	75	0	20.3	20.14	20.2	20.24		
15	16QAM	1	0	19.96	20.04	19.61	19.92	21	0
15	16QAM	1	37	19.75	20.27	20.15	20.05		
15	16QAM	1	74	19.62	19.61	19.59	19.87		
15	16QAM	36	0	20.2	20.2	19.95	20.09	21	0
15	16QAM	36	20	20.2	20.15	20.11	20.07		
15	16QAM	36	39	20.08	20.11	20.1	19.96		
15	16QAM	75	0	20.18	20.2	20.19	20.21		

Channel				40090	40390	40690	41190	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2540	2570	2600	2650		
10	QPSK	1	0	20.33	20.35	20.23	20.32	21	0
10	QPSK	1	25	20.57	20.86	20.57	20.72		
10	QPSK	1	49	20.43	20.36	20.34	20.26		
10	QPSK	25	0	20.21	20.35	20.15	20.29	21	0
10	QPSK	25	12	20.27	20.28	20.14	20.32		
10	QPSK	25	25	20.21	20.11	20.18	20.15		
10	QPSK	50	0	20.13	20.19	20.14	20.2		
10	16QAM	1	0	19.71	19.85	19.68	19.82	21	0
10	16QAM	1	25	19.92	19.94	19.91	19.84		
10	16QAM	1	49	19.69	19.56	19.78	19.57		
10	16QAM	25	0	20.23	20.27	20.23	20.29	21	0
10	16QAM	25	12	20.25	20.35	20.21	20.32		
10	16QAM	25	25	20.3	20.19	20.23	20.19		
10	16QAM	50	0	20.13	20.15	20.14	20.11		
Channel				40065	40385	40705	41215	Tune-up limit (dBm)	MPR (dB)
Frequency (MHz)				2537.5	2569.5	2601.5	2652.5		
5	QPSK	1	0	20.3	20.25	20.17	20.43	21	0
5	QPSK	1	12	20.56	20.38	20.41	20.86		
5	QPSK	1	24	20.25	20.2	20.2	20.46		
5	QPSK	12	0	20.06	20.37	20.21	20.15	21	0
5	QPSK	12	7	20.12	20.34	20.1	20.14		
5	QPSK	12	13	20.08	20.3	20.05	20.11		
5	QPSK	25	0	20.05	20.16	20.11	20.14		
5	16QAM	1	0	19.68	19.82	19.73	19.74	21	0
5	16QAM	1	12	20.02	20.1	20.07	19.89		
5	16QAM	1	24	19.64	19.88	19.88	19.74		
5	16QAM	12	0	20.02	20.08	19.92	19.9	21	0
5	16QAM	12	7	20.15	20.07	20.04	19.9		
5	16QAM	12	13	20.09	20.04	19.98	19.97		
5	16QAM	25	0	20.21	20.23	20.19	20.24		

14. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Main	≤ 25mm	≤ 25mm	>25mm	≤ 25mm	≤ 25mm	≤ 25mm
BT&WLAN	≤ 25mm	≤ 25mm	≤ 25mm	>25mm	≤ 25mm	>25mm

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

General Note:
Referring to KDB 941225 D06 v02r01, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

15. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
   c. For TDD LTE SAR measurement, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix 63.3%/62.9% = 1.006 is applied to scale-up the measured SAR result. The Reported TDD LTE SAR = measured SAR (W/kg)* Tune-up Scaling Factor* scaling factor for extended cyclic prefix.
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required when the measured SAR is ≥ 0.8W/kg. Per KDB 865664 D01v01r04, if the extremity repeated SAR is necessary, 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.
4. Per KDB 648474 D04v01r03, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤ 1.2 W/kg, SAR testing with a headset connected to the handset is not required.
5. When the phone is in talking mode and receiver worked, all WWAN powers are full power.
6. When the phone is in talking mode and receiver worked, then power reduction will be implemented immediately in WLAN 2.4GHz.
7. When hotspot mode is enabled, power reduction will be activated to limit the maximum power of GSM850/1900, WCDMA band II/V and LTE band 5/7/38/41.
8. The device employs proximity sensors that detect the presence of the user's body at the front or back faces of the device. When front or back body worn condition is detected, GSM850/1900, WCDMA band II/V and LTE band 5/7/38/41 reduced power will be active. (P-sensor can't work at detecting presence of the user's body at the four edges of the device.)
9. This device hotspot reduced power and P-sensor reduced power level are the same. So only show one reduced power level for hotspot reduced power and P-sensor reduced power for this application.
10. P-sensor can detect handheld state, for bottom side of product specific 10g SAR condition, WCDMA band II reduced powers will be active. For GSM1900 and LTE band 7/38/41, the power levels are the same as the full power.
11. Per KDB648474 D04v01r03, for smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, when hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg, however, when power reduction applies to hotspot mode the measured SAR must be scaled to the maximum output power, including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold.
   a. When hotspot is not worked, GSM1900, WCDMA Band II, LTE Band 7/38/41 product specific 10g SAR is required.
   b. When 10-g product specific 10g SAR is considered, SAR thresholds is specified in the procedures for SAR test reduction and exclusion should be multiplied by 2.5.

LTE Note:

1. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
2. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
3. Per KDB 941225 D05v02r05, For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
4. Per KDB 941225 D05v02r05, 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, 16QAM SAR testing is not required.
5. Per KDB 941225 D05v02r05, Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
6. For LTE B38 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

15.1 Head SAR

<TDD LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB Offset	Test Position	Power Mode	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
01	LTE Band 38	20M	QPSK	1RB	49Offset	Right Cheek	Full	38000	2595	23.45	24	1.135	62.9	1.006	-0.03	0.225	0.257
	LTE Band 38	20M	QPSK	50RB	0Offset	Right Cheek	Full	38000	2595	22.29	23	1.178	62.9	1.006	-0.10	0.152	0.180
	LTE Band 38	20M	QPSK	1RB	49Offset	Right Tilted	Full	38000	2595	23.45	24	1.135	62.9	1.006	0.18	0.081	0.092
	LTE Band 38	20M	QPSK	50RB	0Offset	Right Tilted	Full	38000	2595	22.29	23	1.178	62.9	1.006	-0.03	0.050	0.059
	LTE Band 38	20M	QPSK	1RB	49Offset	Left Cheek	Full	38000	2595	23.45	24	1.135	62.9	1.006	-0.11	0.101	0.115
	LTE Band 38	20M	QPSK	50RB	0Offset	Left Cheek	Full	38000	2595	22.29	23	1.178	62.9	1.006	-0.05	0.065	0.077
	LTE Band 38	20M	QPSK	1RB	49Offset	Left Tilted	Full	38000	2595	23.45	24	1.135	62.9	1.006	-0.06	0.081	0.093
	LTE Band 38	20M	QPSK	50RB	0Offset	Left Tilted	Full	38000	2595	22.29	23	1.178	62.9	1.006	-0.03	0.052	0.061
02	LTE Band 41	20M	QPSK	1RB	49Offset	Right Cheek	Full	41140	2645	23.76	24	1.057	62.9	1.006	-0.02	0.225	0.239
	LTE Band 41	20M	QPSK	50RB	0Offset	Right Cheek	Full	41140	2645	22.19	23	1.205	62.9	1.006	0.03	0.143	0.173
	LTE Band 41	20M	QPSK	1RB	49Offset	Right Tilted	Full	41140	2645	23.76	24	1.057	62.9	1.006	0.06	0.062	0.066
	LTE Band 41	20M	QPSK	50RB	0Offset	Right Tilted	Full	41140	2645	22.19	23	1.205	62.9	1.006	-0.05	0.040	0.048
	LTE Band 41	20M	QPSK	1RB	49Offset	Left Cheek	Full	41140	2645	23.76	24	1.057	62.9	1.006	-0.04	0.106	0.113
	LTE Band 41	20M	QPSK	50RB	0Offset	Left Cheek	Full	41140	2645	22.19	23	1.205	62.9	1.006	0.08	0.066	0.080
	LTE Band 41	20M	QPSK	1RB	49Offset	Left Tilted	Full	41140	2645	23.76	24	1.057	62.9	1.006	0.01	0.068	0.072
	LTE Band 41	20M	QPSK	50RB	0Offset	Left Tilted	Full	41140	2645	22.19	23	1.205	62.9	1.006	-0.04	0.041	0.050

15.2 Hotspot SAR

<TDD LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB Offset	Test Position	Gap (mm)	Power Mode	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	LTE Band 38	20M	QPSK	1	49	Front	5	Reduced	38000	2595	20.39	21	1.151	62.9	1.006	-0.02	0.815	0.944
	LTE Band 38	20M	QPSK	50	0	Front	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.17	0.788	0.944
	LTE Band 38	20M	QPSK	100	0	Front	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.03	0.784	0.940
03	LTE Band 38	20M	QPSK	1	49	Back	5	Reduced	38000	2595	20.39	21	1.151	62.9	1.006	0.04	0.972	1.125
	LTE Band 38	20M	QPSK	50	0	Back	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	0.06	0.916	1.098
	LTE Band 38	20M	QPSK	100	0	Back	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.16	0.924	1.107
	LTE Band 38	20M	QPSK	1	49	Left Side	5	Reduced	38000	2595	20.39	21	1.151	62.9	1.006	-0.14	0.107	0.124
	LTE Band 38	20M	QPSK	50	0	Left Side	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.04	0.110	0.132
	LTE Band 38	20M	QPSK	1	49	Right Side	5	Reduced	38000	2595	20.39	21	1.151	62.9	1.006	-0.02	0.335	0.388
	LTE Band 38	20M	QPSK	50	0	Right Side	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	0.12	0.322	0.386
	LTE Band 38	20M	QPSK	1	49	Bottom Side	5	Reduced	38000	2595	20.39	21	1.151	62.9	1.006	0.05	0.964	1.116
	LTE Band 38	20M	QPSK	50	0	Bottom Side	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.03	0.918	1.100
	LTE Band 38	20M	QPSK	100	0	Bottom Side	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.02	0.912	1.093
	LTE Band 41	20M	QPSK	1	49	Front	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	-0.1	0.798	0.835
	LTE Band 41	20M	QPSK	1	49	Front	5	Reduced	40140	2545	20.63	21	1.089	62.9	1.006	-0.1	0.743	0.814
	LTE Band 41	20M	QPSK	1	49	Front	5	Reduced	40400	2571	20.81	21	1.045	62.9	1.006	-0.01	0.786	0.826
	LTE Band 41	20M	QPSK	1	49	Front	5	Reduced	40670	2598	20.70	21	1.072	62.9	1.006	-0.01	0.804	0.867
	LTE Band 41	20M	QPSK	50	0	Front	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	-0.06	0.830	0.977
	LTE Band 41	20M	QPSK	50	0	Front	5	Reduced	40140	2545	20.24	21	1.191	62.9	1.006	-0.19	0.707	0.847
	LTE Band 41	20M	QPSK	50	0	Front	5	Reduced	40400	2571	20.20	21	1.202	62.9	1.006	-0.03	0.770	0.931
	LTE Band 41	20M	QPSK	50	0	Front	5	Reduced	40670	2598	20.22	21	1.197	62.9	1.006	-0.05	0.807	0.972
	LTE Band 41	20M	QPSK	100	0	Front	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	-0.07	0.823	0.968
04	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	0.13	1.073	1.123
	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	40140	2545	20.63	21	1.089	62.9	1.006	0.14	0.803	0.880
	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	40400	2571	20.81	21	1.045	62.9	1.006	0.03	0.858	0.902
	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	40670	2598	20.70	21	1.072	62.9	1.006	-0.17	0.918	0.990
	LTE Band 41	20M	QPSK	50	0	Back	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	0.12	0.855	1.006
	LTE Band 41	20M	QPSK	50	0	Back	5	Reduced	40140	2545	20.24	21	1.191	62.9	1.006	-0.04	0.811	0.972
	LTE Band 41	20M	QPSK	50	0	Back	5	Reduced	40400	2571	20.20	21	1.202	62.9	1.006	0.07	0.832	1.006
	LTE Band 41	20M	QPSK	50	0	Back	5	Reduced	40670	2598	20.22	21	1.197	62.9	1.006	0.04	0.834	1.004
	LTE Band 41	20M	QPSK	100	0	Back	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	0.05	0.861	1.013
	LTE Band 41	20M	QPSK	1	49	Left Side	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	0.02	0.114	0.119
	LTE Band 41	20M	QPSK	50	0	Left Side	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	-0.13	0.112	0.132
	LTE Band 41	20M	QPSK	1	49	Right Side	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	0.01	0.308	0.322
	LTE Band 41	20M	QPSK	50	0	Right Side	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	0.19	0.306	0.360
	LTE Band 41	20M	QPSK	1	49	Bottom Side	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	0.18	1.070	1.119
	LTE Band 41	20M	QPSK	1	49	Bottom Side	5	Reduced	40140	2545	20.63	21	1.089	62.9	1.006	-0.02	0.858	0.940
	LTE Band 41	20M	QPSK	1	49	Bottom Side	5	Reduced	40400	2571	20.81	21	1.045	62.9	1.006	0.14	0.935	0.983
	LTE Band 41	20M	QPSK	1	49	Bottom Side	5	Reduced	40670	2598	20.70	21	1.072	62.9	1.006	0.16	0.991	1.068
	LTE Band 41	20M	QPSK	50	0	Bottom Side	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	-0.04	0.950	1.118
	LTE Band 41	20M	QPSK	50	0	Bottom Side	5	Reduced	40140	2545	20.24	21	1.191	62.9	1.006	-0.11	0.850	1.019
	LTE Band 41	20M	QPSK	50	0	Bottom Side	5	Reduced	40400	2571	20.20	21	1.202	62.9	1.006	0.14	0.919	1.112
	LTE Band 41	20M	QPSK	50	0	Bottom Side	5	Reduced	40670	2598	20.22	21	1.197	62.9	1.006	0.07	0.923	1.111
	LTE Band 41	20M	QPSK	100	0	Bottom Side	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	0.01	0.912	1.073

15.3 Body Worn Accessory SAR

<TDD LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB Offset	Test Position	Gap (mm)	Power Mode	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	LTE Band 38	20M	QPSK	1	49	Front	5	Reduced	38000	2595	20.39	21	1.151	62.9	1.006	-0.02	0.815	0.944
	LTE Band 38	20M	QPSK	50	0	Front	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.17	0.788	0.944
	LTE Band 38	20M	QPSK	100	0	Front	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.03	0.784	0.940
05	LTE Band 38	20M	QPSK	1	49	Back	5	Reduced	38000	2595	20.39	21	1.151	62.9	1.006	0.04	0.972	**1.125**
	LTE Band 38	20M	QPSK	50	0	Back	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	0.06	0.916	1.098
	LTE Band 38	20M	QPSK	100	0	Back	5	Reduced	38000	2595	20.24	21	1.191	62.9	1.006	-0.16	0.924	1.107
	LTE Band 41	20M	QPSK	1	49	Front	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	-0.1	0.798	0.835
	LTE Band 41	20M	QPSK	1	49	Front	5	Reduced	40140	2545	20.63	21	1.089	62.9	1.006	-0.1	0.743	0.814
	LTE Band 41	20M	QPSK	1	49	Front	5	Reduced	40400	2571	20.81	21	1.045	62.9	1.006	-0.01	0.786	0.826
	LTE Band 41	20M	QPSK	1	49	Front	5	Reduced	40670	2598	20.70	21	1.072	62.9	1.006	-0.01	0.804	0.867
	LTE Band 41	20M	QPSK	50	0	Front	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	-0.06	0.830	0.977
	LTE Band 41	20M	QPSK	50	0	Front	5	Reduced	40140	2545	20.24	21	1.191	62.9	1.006	-0.19	0.707	0.847
	LTE Band 41	20M	QPSK	50	0	Front	5	Reduced	40400	2571	20.20	21	1.202	62.9	1.006	-0.03	0.770	0.931
	LTE Band 41	20M	QPSK	50	0	Front	5	Reduced	40670	2598	20.22	21	1.197	62.9	1.006	-0.05	0.807	0.972
	LTE Band 41	20M	QPSK	100	0	Front	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	-0.07	0.823	0.968
06	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	0.13	1.073	**1.123**
	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	40140	2545	20.63	21	1.089	62.9	1.006	0.14	0.803	0.880
	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	40400	2571	20.81	21	1.045	62.9	1.006	0.03	0.858	0.902
	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	40670	2598	20.70	21	1.072	62.9	1.006	-0.17	0.918	0.990
	LTE Band 41	20M	QPSK	50	0	Back	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	0.12	0.855	1.006
	LTE Band 41	20M	QPSK	50	0	Back	5	Reduced	40140	2545	20.24	21	1.191	62.9	1.006	-0.04	0.811	0.972
	LTE Band 41	20M	QPSK	50	0	Back	5	Reduced	40400	2571	20.20	21	1.202	62.9	1.006	0.07	0.832	1.006
	LTE Band 41	20M	QPSK	50	0	Back	5	Reduced	40670	2598	20.22	21	1.197	62.9	1.006	0.04	0.834	1.004
	LTE Band 41	20M	QPSK	100	0	Back	5	Reduced	41140	2645	20.32	21	1.169	62.9	1.006	0.05	0.861	1.013

15.4 Product specific 10g SAR

<TDD LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB Offset	Test Position	Gap (mm)	Power Mode	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
07	LTE Band 38	20M	QPSK	1RB	49Offset	Bottom Side	0	Full	38000	2595	23.45	24	1.135	62.9	1.006	0.01	1.970	2.249
	LTE Band 38	20M	QPSK	50RB	0Offset	Bottom Side	0	Full	38000	2595	22.29	23	1.178	62.9	1.006	0.03	1.570	1.860
	LTE Band 38	20M	QPSK	100RB	0Offset	Bottom Side	0	Full	38000	2595	22.24	23	1.191	62.9	1.006	-0.05	1.580	1.893
	LTE Band 41	20M	QPSK	1RB	49Offset	Bottom Side	0	Full	41140	2645	23.76	24	1.057	62.9	1.006	0.01	1.800	1.914
	LTE Band 41	20M	QPSK	1RB	49Offset	Bottom Side	0	Full	40140	2545	23.29	24	1.178	62.9	1.006	0.02	1.610	1.907
	LTE Band 41	20M	QPSK	1RB	49Offset	Bottom Side	0	Full	40400	2571	23.45	24	1.135	62.9	1.006	0.05	1.680	1.918
08	LTE Band 41	20M	QPSK	1RB	49Offset	Bottom Side	0	Full	40670	2598	23.36	24	1.159	62.9	1.006	-0.01	1.940	2.262
	LTE Band 41	20M	QPSK	50RB	0Offset	Bottom Side	0	Full	41140	2645	22.19	23	1.205	62.9	1.006	-0.05	1.420	1.721
	LTE Band 41	20M	QPSK	50RB	0Offset	Bottom Side	0	Full	40140	2545	22.18	23	1.208	62.9	1.006	0.01	1.250	1.519
	LTE Band 41	20M	QPSK	50RB	0Offset	Bottom Side	0	Full	40400	2571	22.02	23	1.253	62.9	1.006	0.05	1.310	1.651
	LTE Band 41	20M	QPSK	50RB	0Offset	Bottom Side	0	Full	40670	2598	22.08	23	1.236	62.9	1.006	-0.05	1.540	1.915
	LTE Band 41	20M	QPSK	100RB	0Offset	Bottom Side	0	Full	41140	2645	22.11	23	1.227	62.9	1.006	0.01	1.480	1.828

15.5 Repeated SAR Measurement

No.	Band	BW (MHz)	Modulation	RB Size	RB Offset	Test Position	Gap (mm)	Power Mode	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	0.13	1.073	1	1.123
2nd	LTE Band 41	20M	QPSK	1	49	Back	5	Reduced	41140	2645	20.83	21	1.040	62.9	1.006	0.13	1.050	1.022	1.098

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg for 1g SAR and measured SAR is ≥2.0W/Kg for 10g SAR.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

16. Simultaneous Transmission Analysis

No.	Simultaneous Transmission Configurations	Portable Handset			Note
		Head	Body-worn	Hotspot	
1.	GSM Voice + WLAN2.4GHz	Yes	Yes		
2.	GPRS/EDGE + WLAN2.4GHz	Yes	Yes	Yes	WLAN Hotspot
3.	WCDMA + WLAN2.4GHz	Yes	Yes	Yes	WLAN Hotspot
4.	LTE + WLAN2.4GHz	Yes	Yes	Yes	WLAN Hotspot
5.	GSM Voice + Bluetooth		Yes		
6.	GPRS/EDGE + Bluetooth		Yes	Yes	BT Tethering
7.	WCDMA + Bluetooth		Yes	Yes	BT Tethering
8.	LTE + Bluetooth		Yes	Yes	BT Tethering

General Note:

1. For simultaneously transmission SAR analysis, WWAN SAR values only considered LTE Band 38/41 which we did perform SAR testing on FA7D2201-01, spot check for other test results and found the original SAR value can represent this application. So except for LTE Band 38/41, we chose the original data which released from original report (Sporton Report Number FA7D2201 or refer to Appendix E) to do co-located analysis.
2. This device supports VoIP in GPRS, EGPRS, WCDMA and LTE (e.g. for 3rd-party VoIP).
3. EUT will choose each GSM, WCDMA, and LTE according to the network signal condition; therefore, they will not operate simultaneously at any moment.
4. This device WLAN 2.4GHz supports hotspot operation and Bluetooth support tethering applications.
5. WLAN 2.4GHz and Bluetooth share the same antenna so can't transmit simultaneously.
6. The reported SAR summation is calculated based on the same configuration and test position.
7. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
8. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 based on the formula below.
   i) (*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[√f(GHz)/*x*] W/kg for *test separation distances* ≤ 50 mm; where *x* = 7.5 for 1-g SAR, and *x* = 18.75 for 10-g SAR.
   ii) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
   iii) 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.

Bluetooth Max Power	Exposure Position	Hotspot & Body worn
	Test separation	5 mm
9.0 dBm	Estimated 1g SAR (W/kg)	0.336 W/kg

16.1 Head Exposure Conditions

WWAN Band		Exposure Position	1 WWAN 1g SAR (W/kg)	2 2.4GHz WLAN 1g SAR (W/kg)	1+2 Summed 1g SAR (W/kg)
GSM	GSM850	Right Cheek	0.315	0.401	0.72
		Right Tilted	0.200	0.456	0.66
		Left Cheek	0.344	0.963	1.31
		Left Tilted	0.205	0.837	1.04
	GSM1900	Right Cheek	0.240	0.401	0.64
		Right Tilted	0.125	0.456	0.58
		Left Cheek	0.163	0.963	1.13
		Left Tilted	0.155	0.837	0.99
WCDMA	Band V	Right Cheek	0.487	0.401	0.89
		Right Tilted	0.316	0.456	0.77
		Left Cheek	0.486	0.963	1.45
		Left Tilted	0.295	0.837	1.13
	Band II	Right Cheek	0.495	0.401	0.90
		Right Tilted	0.227	0.456	0.68
		Left Cheek	0.350	0.963	1.31
		Left Tilted	0.321	0.837	1.16
LTE	Band 5	Right Cheek	0.533	0.401	0.93
		Right Tilted	0.331	0.456	0.79
		Left Cheek	0.514	0.963	1.48
		Left Tilted	0.311	0.837	1.15
	Band 7	Right Cheek	0.401	0.401	0.80
		Right Tilted	0.188	0.456	0.64
		Left Cheek	0.206	0.963	1.17
		Left Tilted	0.158	0.837	1.00
	Band 38	Right Cheek	0.257	0.401	0.66
		Right Tilted	0.092	0.456	0.55
		Left Cheek	0.115	0.963	1.08
		Left Tilted	0.093	0.837	0.93
	Band 41	Right Cheek	0.239	0.401	0.64
		Right Tilted	0.066	0.456	0.52
		Left Cheek	0.113	0.963	1.08
		Left Tilted	0.072	0.837	0.91

16.2 Hotspot Exposure Conditions

WWAN Band		Exposure Position	1	2	3	1+2			1+3
			WWAN	2.4GHz WLAN	Bluetooth				Summed 1g SAR (W/kg)
			1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)	Summed 1g SAR (W/kg)	SPLSR	Case No	
GSM	GSM850	Front	0.550	0.586	0.336	1.14			0.89
		Back	0.987	0.795	0.336	**1.78**	**0.02**	**#01**	1.32
		Left Side	0.413		0.336	0.41			0.75
		Right Side	0.377	0.795	0.336	1.17			0.71
		Top Side		0.785	0.336	0.79			0.34
		Bottom Side	0.183		0.336	0.18			0.52
	GSM1900	Front	0.303	0.586	0.336	0.89			0.64
		Back	1.041	0.795	0.336	**1.84**	**0.02**	**#02**	1.38
		Left Side	0.026		0.336	0.03			0.36
		Right Side	0.068	0.795	0.336	0.86			0.40
		Top Side		0.785	0.336	0.79			0.34
		Bottom Side	0.651		0.336	0.65			0.99
WCDMA	Band V	Front	0.851	0.586	0.336	1.44			1.19
		Back	1.026	0.795	0.336	**1.82**	**0.02**	**#03**	1.36
		Left Side	0.611		0.336	0.61			0.95
		Right Side	0.538	0.795	0.336	1.33			0.87
		Top Side		0.785	0.336	0.79			0.34
		Bottom Side	0.310		0.336	0.31			0.65
	Band II	Front	0.315	0.586	0.336	0.90			0.65
		Back	1.094	0.795	0.336	**1.89**	**0.02**	**#05**	1.43
		Left Side	0.053		0.336	0.05			0.39
		Right Side	0.067	0.795	0.336	0.86			0.40
		Top Side		0.785	0.336	0.79			0.34
		Bottom Side	0.654		0.336	0.65			0.99

WWAN Band		Exposure Position	1	2	3	1+2			1+3
			WWAN	2.4GHz WLAN	Bluetooth				Summed 1g SAR (W/kg)
			1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)	Summed 1g SAR (W/kg)	SPLSR	Case No	
LTE	Band 5	Front	0.744	0.586	0.336	1.33			1.08
		Back	0.960	0.795	0.336	**1.76**	**0.02**	**#06**	1.30
		Left Side	0.557		0.336	0.56			0.89
		Right Side	0.580	0.795	0.336	1.38			0.92
		Top Side		0.785	0.336	0.79			0.34
		Bottom Side	0.253		0.336	0.25			0.59
	Band 7	Front	0.888	0.586	0.336	1.47			1.22
		Back	1.197	0.795	0.336	**1.99**	**0.02**	**#09**	1.53
		Left Side	0.127		0.336	0.13			0.46
		Right Side	0.438	0.795	0.336	1.23			0.77
		Top Side		0.785	0.336	0.79			0.34
		Bottom Side	1.101		0.336	1.10			1.44
	Band 38	Front	0.944	0.586	0.336	1.53			1.28
		Back	1.125	0.795	0.336	**1.92**	**0.02**	**#10**	1.46
		Left Side	0.132		0.336	0.13			0.47
		Right Side	0.388	0.795	0.336	1.18			0.72
		Top Side		0.785	0.336	0.79			0.34
		Bottom Side	1.116		0.336	1.12			1.45
	Band 41	Front	0.977	0.586	0.336	1.56			1.31
		Back	1.123	0.795	0.336	**1.92**	**0.02**	**#11**	1.46
		Left Side	0.132		0.336	0.13			0.47
		Right Side	0.360	0.795	0.336	1.16			0.70
		Top Side		0.785	0.336	0.79			0.34
		Bottom Side	1.119		0.336	1.12			1.46

16.3 Body-Worn Accessory Exposure Conditions

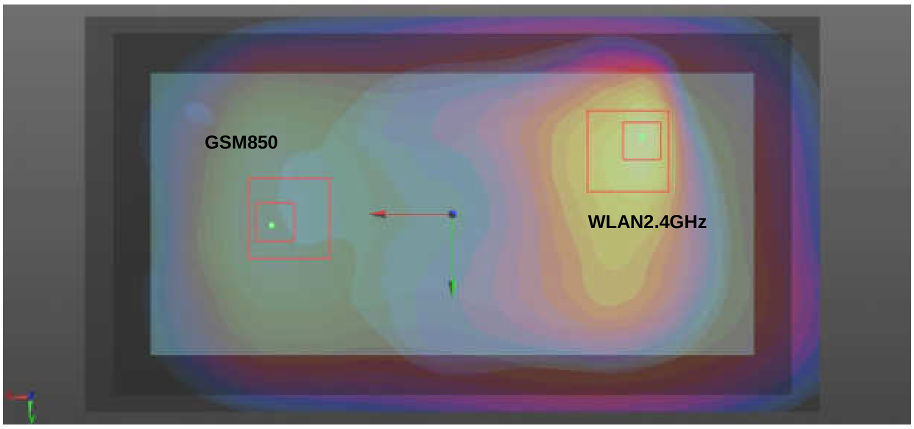
WWAN Band		Exposure Position	1 WWAN 1g SAR (W/kg)	2 2.4GHz WLAN 1g SAR (W/kg)	3 Bluetooth Estimated 1g SAR (W/kg)	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)	SPLSR	Case No
GSM	GSM850	Front	0.550	0.586	0.336	1.14	0.89		
		Back	0.987	0.795	0.336	**1.78**	1.32	**0.02**	**#01**
	GSM1900	Front	0.303	0.586	0.336	0.89	0.64		
		Back	1.041	0.795	0.336	**1.84**	1.38	**0.02**	**#02**
WCDMA	Band V	Front	0.851	0.586	0.336	1.44	1.19		
		Back	1.026	0.795	0.336	**1.82**	1.36	**0.02**	**#03**
	Band II	Front	0.315	0.586	0.336	0.90	0.65		
		Back	1.094	0.795	0.336	**1.89**	1.43	**0.02**	**#05**
LTE	Band 5	Front	0.744	0.586	0.336	1.33	1.08		
		Back	0.960	0.795	0.336	**1.76**	1.30	**0.02**	**#06**
	Band 7	Front	0.888	0.586	0.336	1.47	1.22		
		Back	1.197	0.795	0.336	**1.99**	1.53	**0.03**	**#09**
	Band 38	Front	0.944	0.586	0.336	1.53	1.28		
		Back	1.125	0.795	0.336	**1.92**	1.46	**0.02**	**#10**
	Band 41	Front	0.977	0.586	0.336	1.56	1.31		
		Back	1.123	0.795	0.336	**1.92**	1.46	**0.02**	**#11**

16.4 SPLSR Evaluation and Analysis

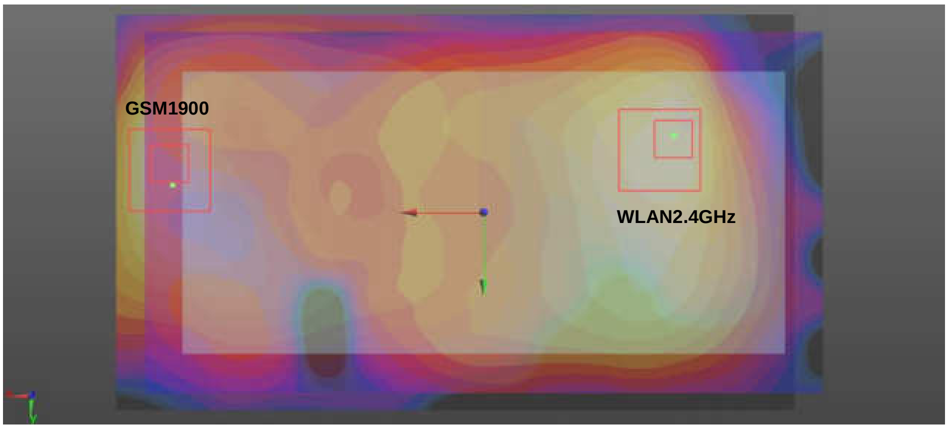
General Note:

1. When standalone SAR is measured for both antennas in the pair, the peak location separation distance is computed by the square root of [(x1−x2)2 + (y1−y2)2 + (z1−z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates in the area scans or extrapolated peak SAR locations in the zoom scans, as appropriate.
2. SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (*min. separation distance, mm*). If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.

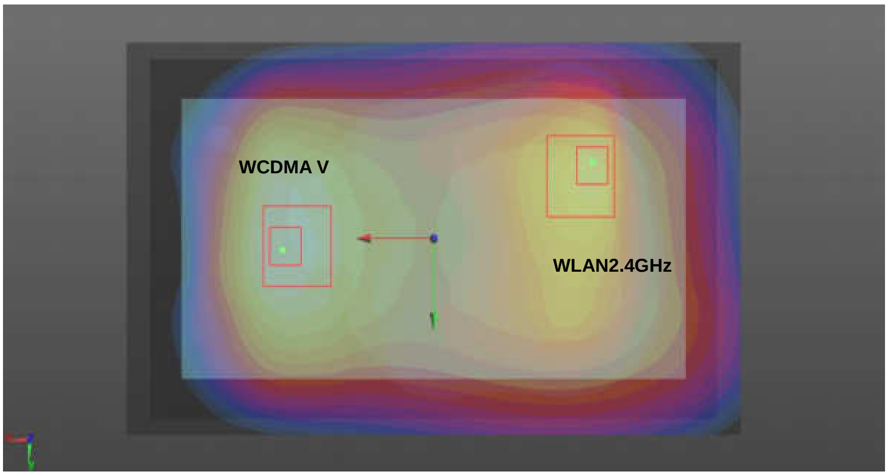
Case	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
#01	GSM850	Back	0.987	5	7.49	0.45	0.54	129.1	1.78	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				



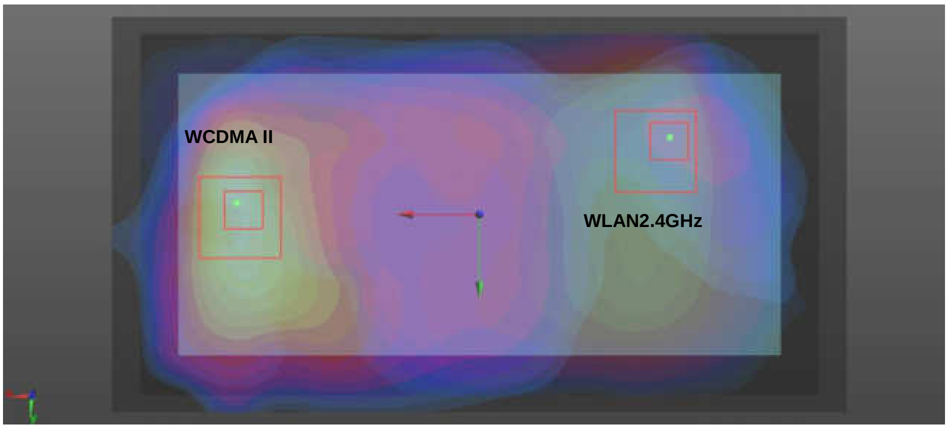
Case	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
#02	GSM1900	Back	1.041	5	8.25	-1.39	0.41	134.2	1.84	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				



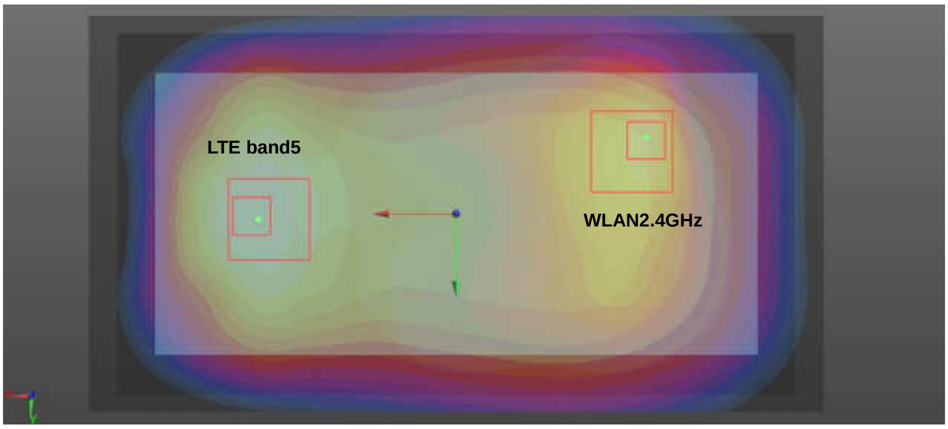
Case	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case #03	WCDMA V	Back	1.026	5	5.12	-0.02	0.41	105.0	1.82	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				



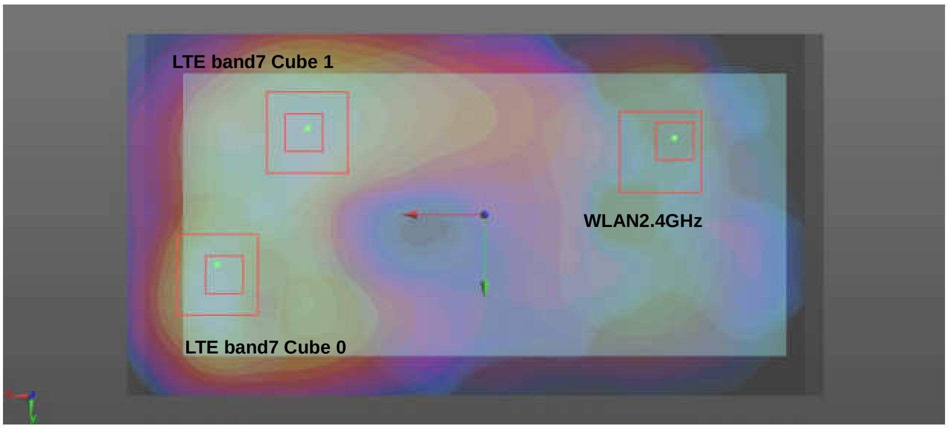
Case	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case #05	WCDMA II	Back	1.094	5	6.13	-0.14	0.42	114.6	1.89	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				



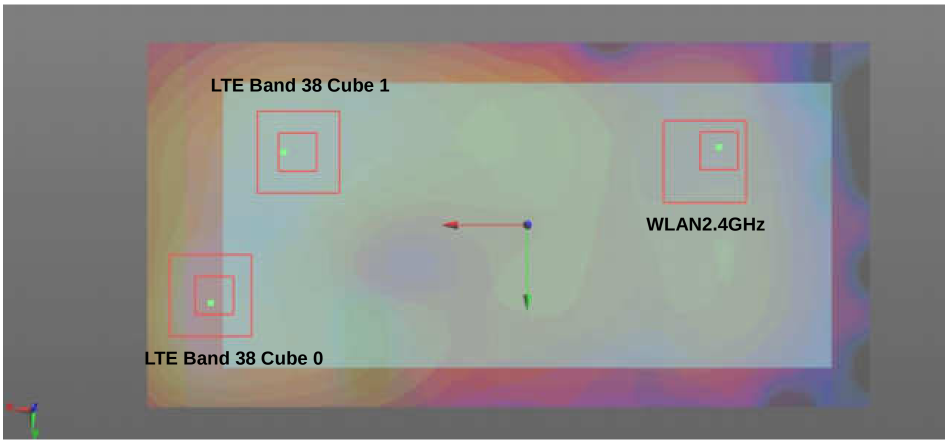
Case	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case #06	LTE Band 5	Back	0.960	5	5.73	-0.01	0.41	111.0	1.76	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				



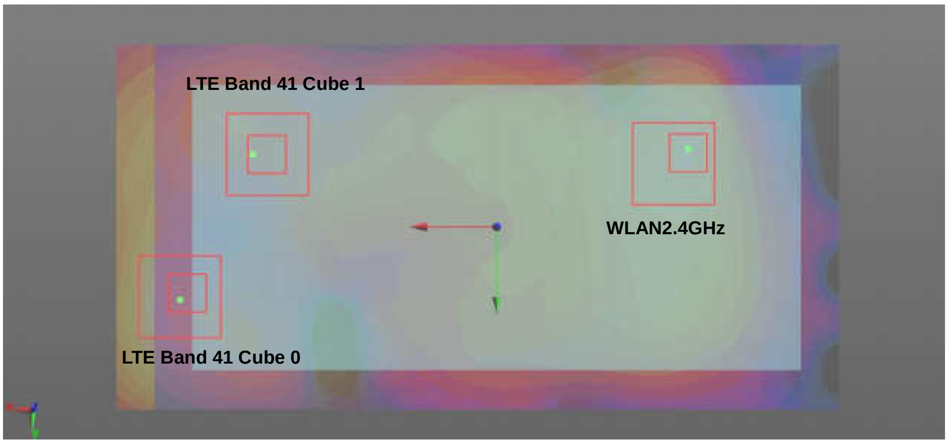
Case	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case #09	LTE Band 7 Cube 0	Back	1.197	5	6.8	1.52	0.4	125.2	1.99	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				
	LTE Band 7 Cube 1		0.757	5	5	-2.08	0.38	101.4	1.55	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				



	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case #10	LTE Band 38 Cube 0	Back	1.125	5	8.12	1.84	0.4	138.7	1.92	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				
	LTE Band 38 Cube 1		1.005	5	6.30	-1.82	0.36	114.5	1.80	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				



	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
Case #11	LTE Band 41 Cube 0	Back	1.123	5	8.02	1.84	0.40	137.8	1.92	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				
	LTE Band 41 Cube 1		0.872	5	6.20	-1.82	0.37	113.5	1.67	0.02	Not required
	WLAN2.4GHz		0.795	5	-5.14	-2.24	0.37				



Test Engineer: Nick Hu

17. Uncertainty Assessment

Pre KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

18. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

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

[4] SPEAG DASY System Handbook

[5] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[6] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[7] FCC KDB 648474 D04 v01r03, “SAR Evaluation Considerations for Wireless Handsets”, Oct 2015.

[8] FCC KDB 941225 D01 v03r01, “3G SAR MEAUREMENT PROCEDURES”, Oct 2015

[9] FCC KDB 941225 D05 v02r05, “SAR Evaluation Considerations for LTE Devices”, Dec 2015

[10] FCC KDB 941225 D06 v02r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", Oct 2015.

[11] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[12] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Head_2600MHz

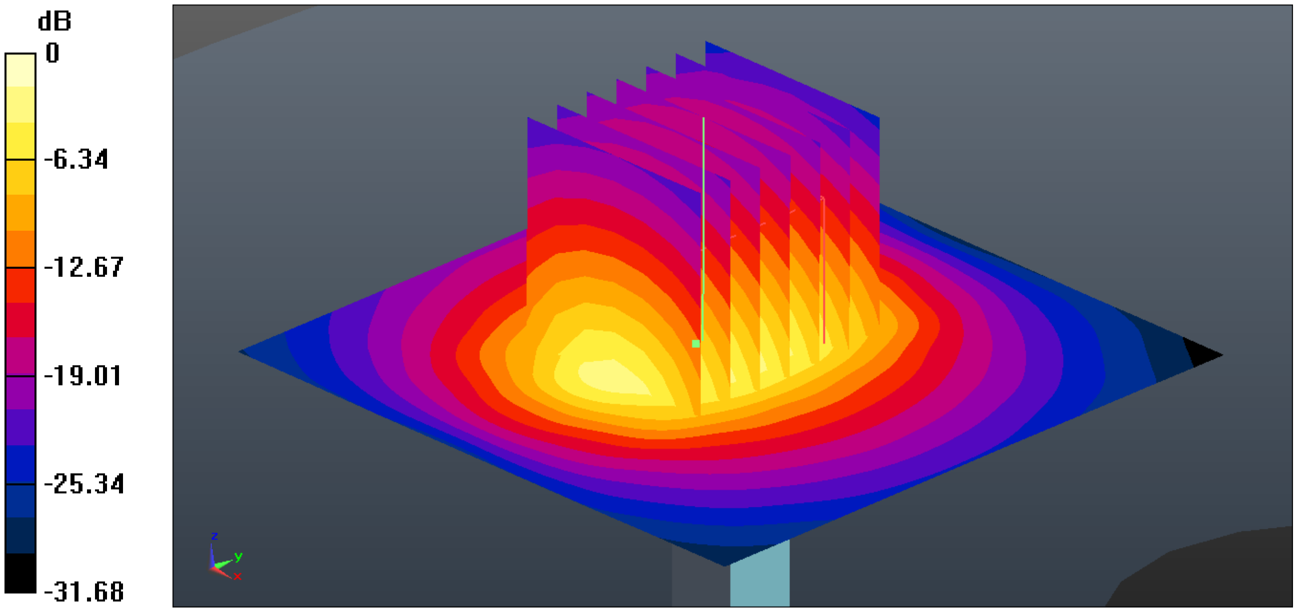
DUT: D2600V2 - SN:1061

Communication System: UID 0, CW; Frequency: 2600 MHz;Duty Cycle: 1:1
Medium: HSL_2600 Medium parameters used: f = 2600 MHz; σ = 2.05 S/m; ε_r = 38.661; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.5, 4.5, 4.5); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM1; Type: SAM; Serial: TP-1697
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

Pin=250mW/Area Scan (71x71x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 20.55 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 82.18 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 11.7 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.35 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 19 W/kg = 12.86 dBW/kg

System Check_Body_2600MHz

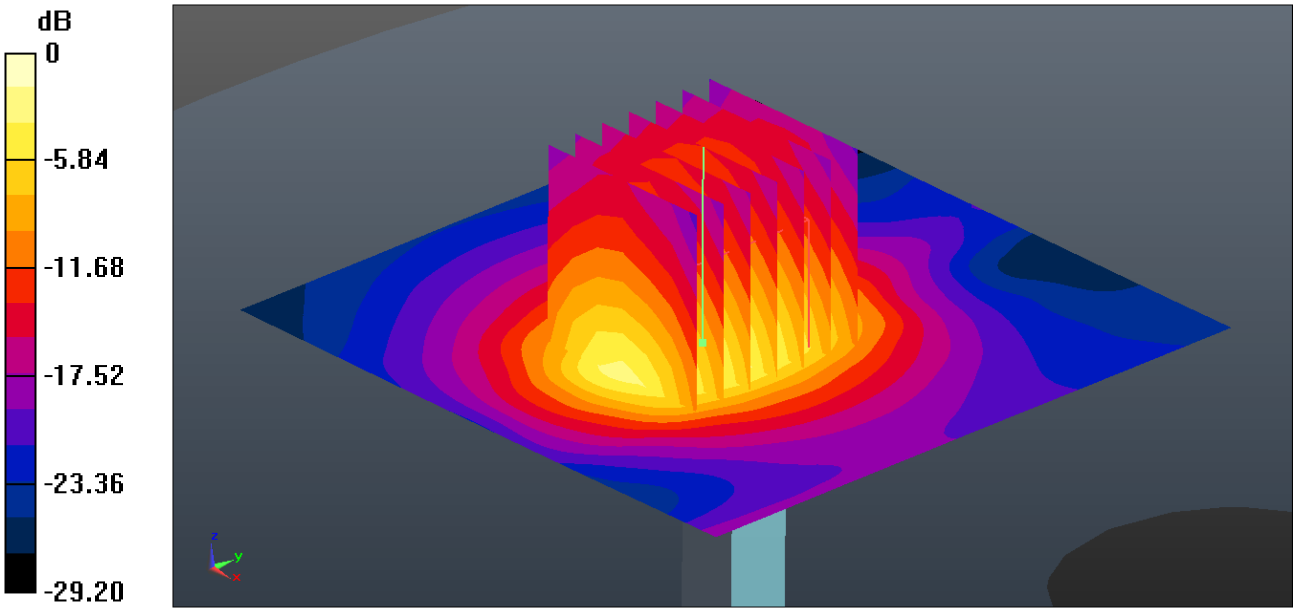
DUT: D2600V2 - SN:1061

Communication System: UID 0, CW (0); Frequency: 2600 MHz;Duty Cycle: 1:1
Medium: MSL_2600 Medium parameters used: f = 2600 MHz; σ = 2.21 S/m; ε_r = 52.876; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.16, 4.16, 4.16); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM3; Type: SAM; Serial: TP-1696
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 19.3 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 82.18 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 22.2 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.28 W/kg
Maximum value of SAR (measured) = 19.0 W/kg



0 dB = 19.3 W/kg = 12.86 dBW/kg

Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.1.21

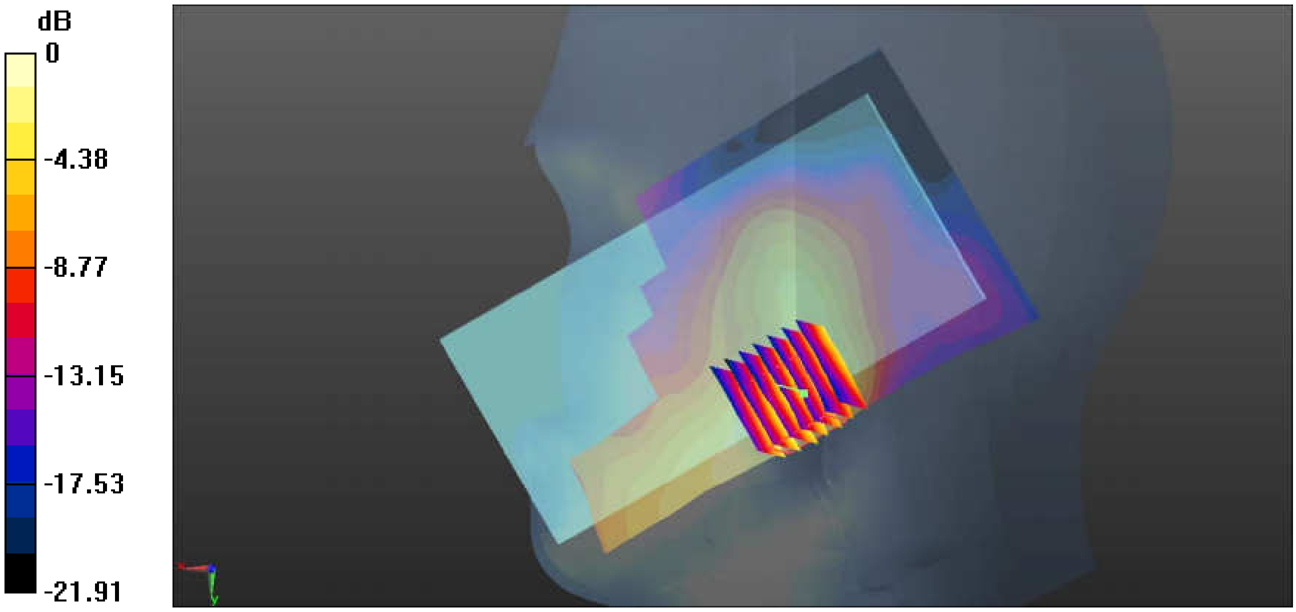
01_LTE Band 38_20M_QPSK_1RB_49Offset_Right Cheek_0mm_Ch38000

Communication System: UID 0, TDD_LTE (0); Frequency: 2595 MHz;Duty Cycle: 1:1.59
Medium: HSL_2600 Medium parameters used : f = 2595 MHz; σ = 2.044 S/m; ε_r = 38.679; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.5, 4.5, 4.5); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM1; Type: SAM; Serial: TP-1697
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

Ch38000/Area Scan (81x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.357 W/kg

Ch38000/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.138 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.436 W/kg
SAR(1 g) = 0.225 W/kg; SAR(10 g) = 0.116 W/kg
Maximum value of SAR (measured) = 0.315 W/kg



0 dB = 0.357 W/kg = -4.47 dBW/kg

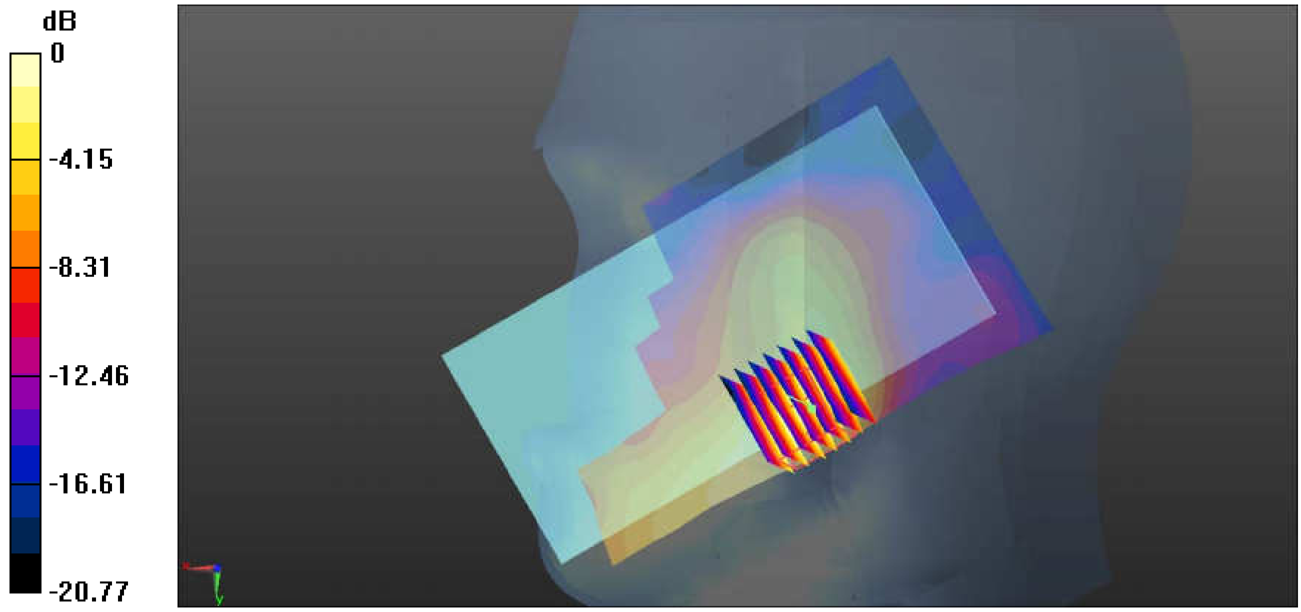
02_LTE Band 41_20M_QPSK_1RB_49Offset_Right Cheek_0mm_Ch41140

Communication System: UID 0, TDD_LTE (0); Frequency: 2645 MHz;Duty Cycle: 1:1.59
Medium: HSL_2600 Medium parameters used : f = 2645 MHz; σ = 2.103 S/m; ε_r = 38.477; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.5, 4.5, 4.5); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
 Phantom: SAM1; Type: SAM; Serial: TP-1697
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

Ch41140/Area Scan (81x151x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.339 W/kg

Ch41140/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.835 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.439 W/kg
SAR(1 g) = 0.225 W/kg; SAR(10 g) = 0.114 W/kg
Maximum value of SAR (measured) = 0.320 W/kg



0 dB = 0.339 W/kg = -4.70 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.1.21

03_LTE Band 38_20M_QPSK_1RB_49Offset_Back_5mm_Ch38000

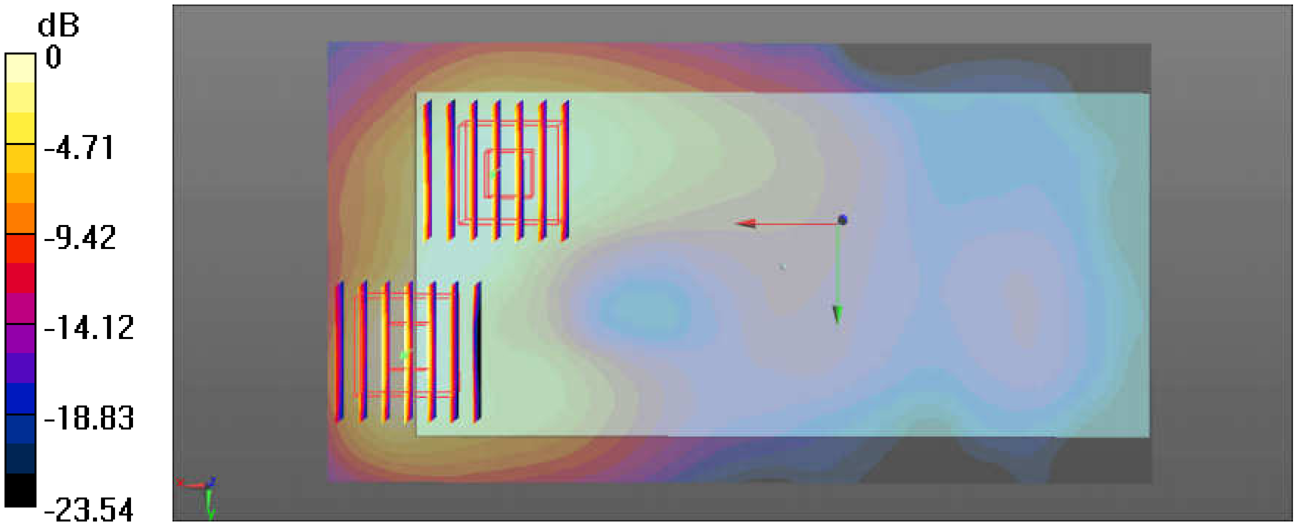
Communication System: UID 0, TDD_LTE (0); Frequency: 2595 MHz;Duty Cycle: 1:1.59
Medium: MSL_2600 Medium parameters used: f = 2595 MHz; σ = 2.203 S/m; ε_r = 52.891; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.16, 4.16, 4.16); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM3; Type: SAM; Serial: TP-1696
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch38000/Area Scan (151x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.64 W/kg

Ch38000/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.292 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 2.243 W/kg
SAR(1 g) = 0.972 W/kg; SAR(10 g) = 0.364 W/kg
Maximum value of SAR (measured) = 1.56 W/kg

Ch38000/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.752 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.85 W/kg
SAR(1 g) = 0.911 W/kg; SAR(10 g) = 0.441 W/kg
Maximum value of SAR (measured) = 1.32 W/kg



0 dB = 1.32 W/kg = 1.21 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.1.21

04_LTE Band 41_20M_QPSK_1RB_49Offset_Back_5mm_Ch41140

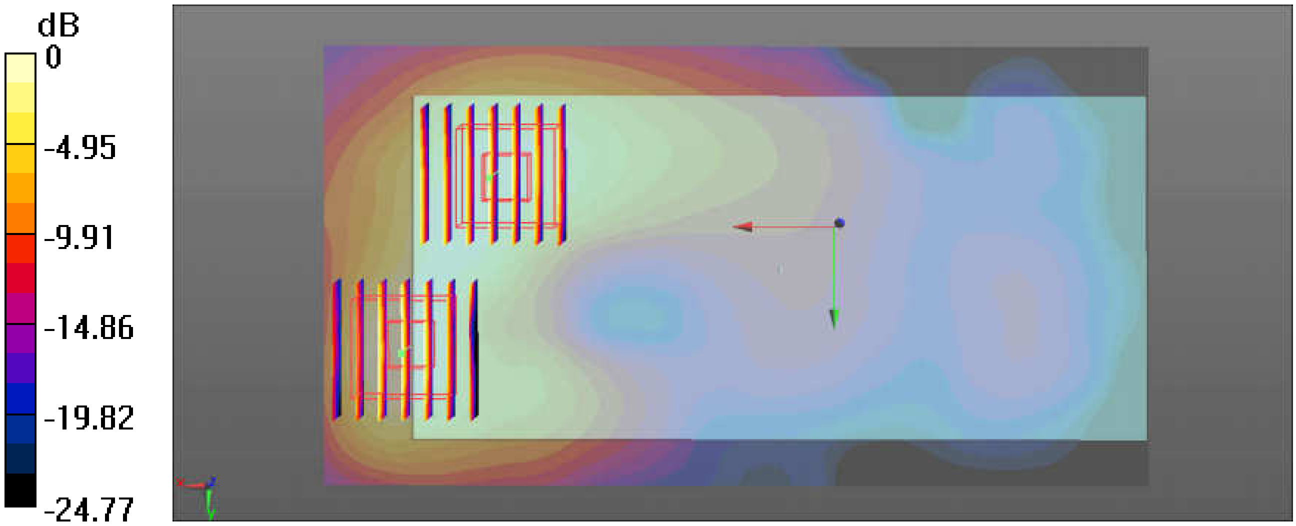
Communication System: UID 0, TDD_LTE (0); Frequency: 2645 MHz;Duty Cycle: 1:1.59
Medium: MSL_2600 Medium parameters used: f = 2645 MHz; σ = 2.275 S/m; ε_r = 52.694; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.16, 4.16, 4.16); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM3; Type: SAM; Serial: TP-1696
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch41140/Area Scan (151x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.80 W/kg

Ch41140/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.965 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 3.35 W/kg
SAR(1 g) = 1.073 W/kg; SAR(10 g) = 0.368 W/kg
Maximum value of SAR (measured) = 2.22 W/kg

Ch41140/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.965 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 1.94 W/kg
SAR(1 g) = 0.834 W/kg; SAR(10 g) = 0.387 W/kg
Maximum value of SAR (measured) = 1.37 W/kg



0 dB = 1.37 W/kg = 1.37 dBW/kg

05_LTE Band 38_20M_QPSK_1RB_49Offset_Back_5mm_Ch38000

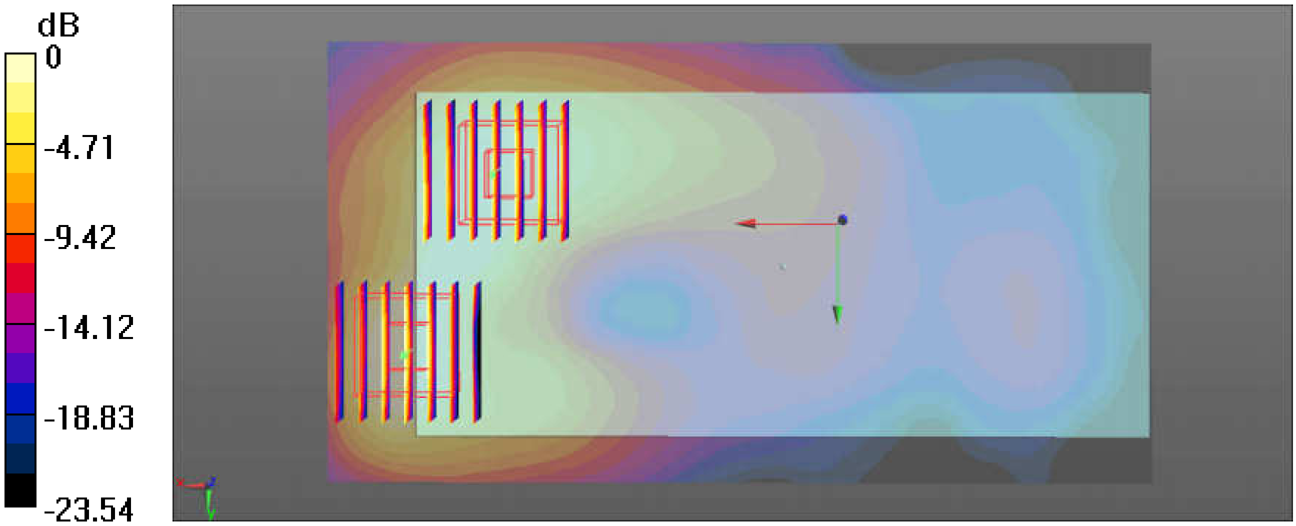
Communication System: UID 0, TDD_LTE (0); Frequency: 2595 MHz;Duty Cycle: 1:1.59
Medium: MSL_2600 Medium parameters used: f = 2595 MHz; σ = 2.203 S/m; ε_r = 52.891; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.16, 4.16, 4.16); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM3; Type: SAM; Serial: TP-1696
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch38000/Area Scan (151x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.64 W/kg

Ch38000/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.292 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 2.243 W/kg
SAR(1 g) = 0.972 W/kg; SAR(10 g) = 0.364 W/kg
Maximum value of SAR (measured) = 1.56 W/kg

Ch38000/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.752 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.85 W/kg
SAR(1 g) = 0.911 W/kg; SAR(10 g) = 0.441 W/kg
Maximum value of SAR (measured) = 1.32 W/kg



0 dB = 1.32 W/kg = 1.21 dBW/kg

06_LTE Band 41_20M_QPSK_1RB_49Offset_Back_5mm_Ch41140

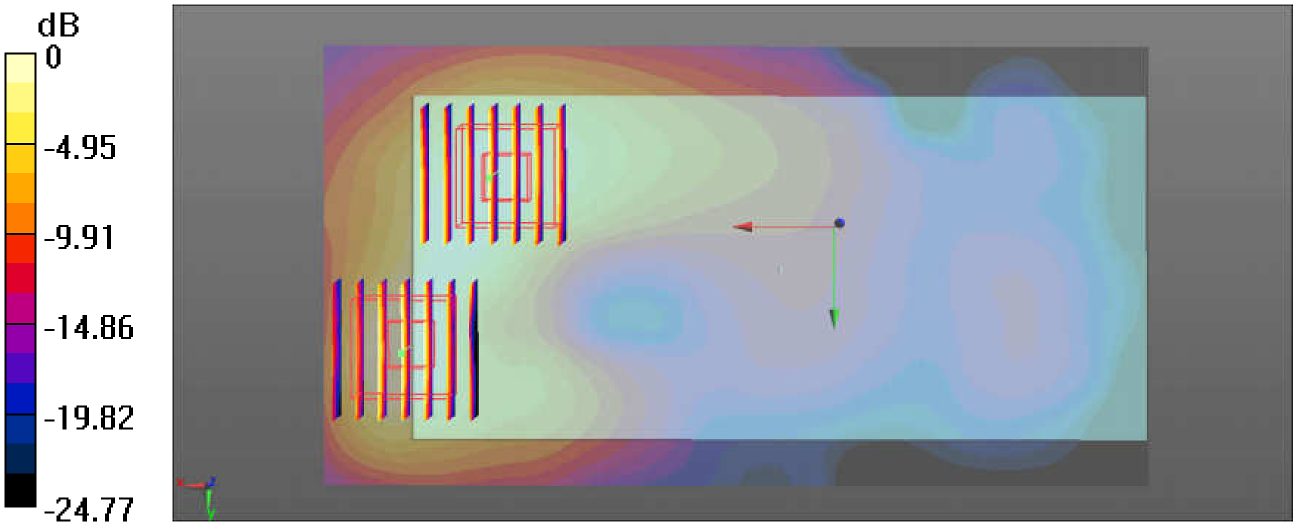
Communication System: UID 0, TDD_LTE (0); Frequency: 2645 MHz;Duty Cycle: 1:1.59
Medium: MSL_2600 Medium parameters used: f = 2645 MHz; σ = 2.275 S/m; ε_r = 52.694; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.16, 4.16, 4.16); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM3; Type: SAM; Serial: TP-1696
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch41140/Area Scan (151x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.80 W/kg

Ch41140/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.965 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 3.35 W/kg
SAR(1 g) = 1.073 W/kg; SAR(10 g) = 0.368 W/kg
Maximum value of SAR (measured) = 2.22 W/kg

Ch41140/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.965 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 1.94 W/kg
SAR(1 g) = 0.834 W/kg; SAR(10 g) = 0.387 W/kg
Maximum value of SAR (measured) = 1.37 W/kg



0 dB = 1.37 W/kg = 1.37 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.1.21

07_LTE Band 38_20M_QPSK_1RB_49Offset_Bottom Side_0mm_Ch38000

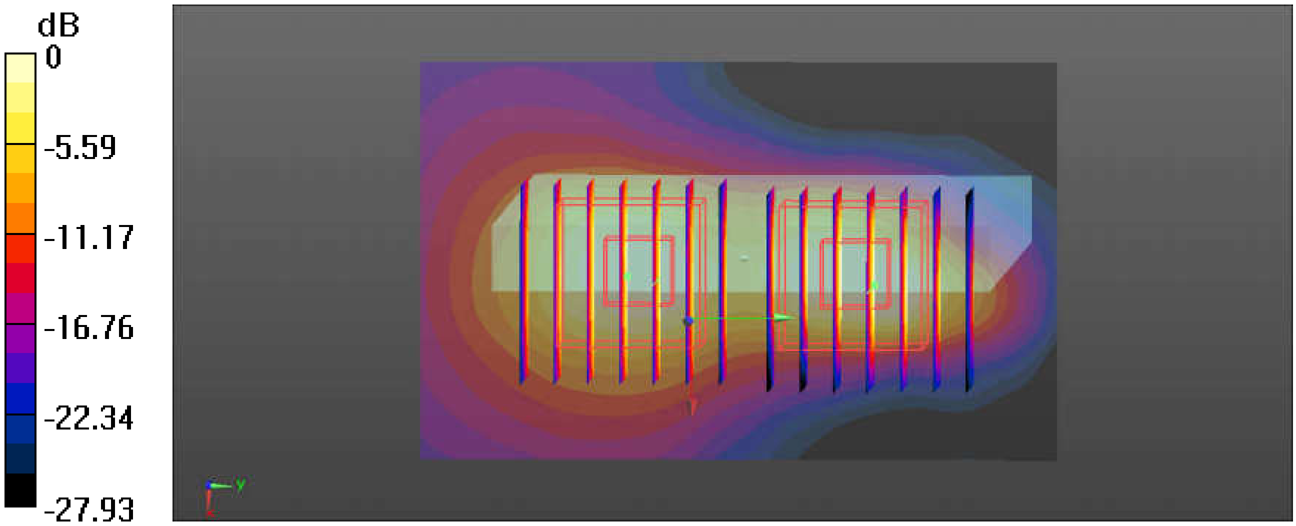
Communication System: UID 0, TDD_LTE (0); Frequency: 2595 MHz;Duty Cycle: 1:1.59
Medium: MSL_2600 Medium parameters used: f = 2595 MHz; σ = 2.203 S/m; ε_r = 52.891; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.16, 4.16, 4.16); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM3; Type: SAM; Serial: TP-1696
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch38000/Area Scan (51x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 10.6 W/kg

Ch38000/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 40.72 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 17.5 W/kg
SAR(1 g) = 6.39 W/kg; SAR(10 g) = 1.970 W/kg
Maximum value of SAR (measured) = 11.2 W/kg

Ch38000/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 40.72 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 10.8 W/kg
SAR(1 g) = 4.7 W/kg; SAR(10 g) = 1.9 W/kg
Maximum value of SAR (measured) = 7.31 W/kg



0 dB = 7.31 W/kg = 8.64 dBW/kg

08_LTE Band 41_20M_QPSK_1RB_49Offset_Bottom Side_0mm_Ch40670

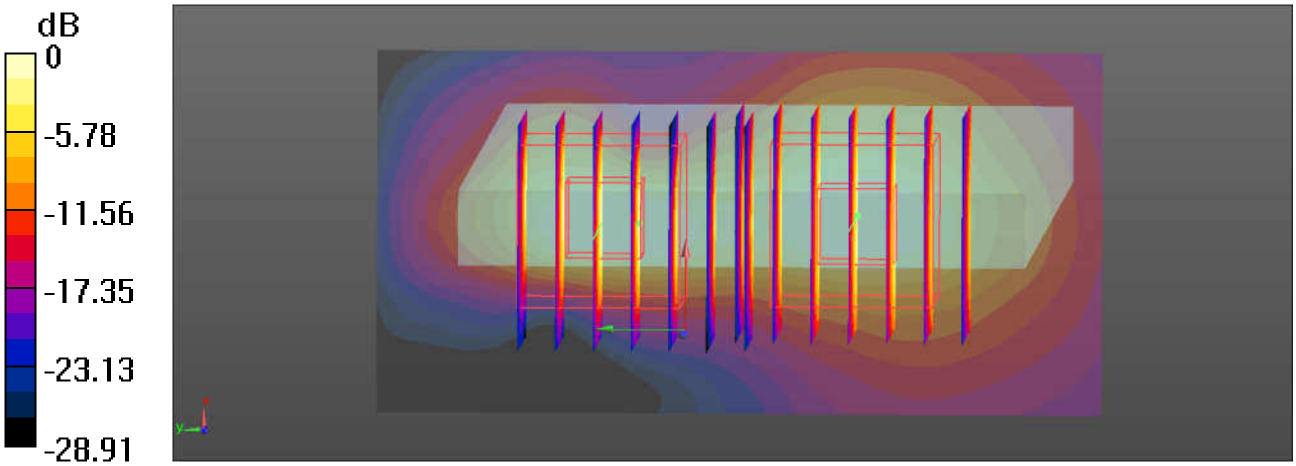
Communication System: UID 0, TDD_LTE (0); Frequency: 2598 MHz;Duty Cycle: 1:1.59
Medium: MSL_2600 Medium parameters used: f = 2598 MHz; σ = 2.239 S/m; ε_r = 52.248; ρ = 1000 kg/m^3
Ambient Temperature：23.2 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3293; ConvF(4.16, 4.16, 4.16); Calibrated: 2017.9.25;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn915; Calibrated: 2017.6.16
- Phantom: SAM3; Type: SAM; Serial: TP-1696
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch40670/Area Scan (41x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 9.73 W/kg

Ch40670/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.75 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 17.5 W/kg
SAR(1 g) = 6.44 W/kg; SAR(10 g) = 1.940 W/kg
Maximum value of SAR (measured) = 11.4 W/kg

Ch40670/Zoom Scan (7x7x7)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.75 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 10.7 W/kg
SAR(1 g) = 4.64 W/kg; SAR(10 g) = 1.88 W/kg
Maximum value of SAR (measured) = 7.42 W/kg



0 dB = 7.42 W/kg = 8.70 dBW/kg

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.

In Collaboration with
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CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
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E-mail: cttl@chinattl.com http://www.chinattl.cn

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client **Sporton** **Certificate No: Z17-97255**

CALIBRATION CERTIFICATE

Object	D2600V2 - SN: 1061
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	December 7, 2017

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 3617	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: December 10, 2017

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

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Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.10.0.1446
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.4 ± 6 %	1.99 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**58.2 mW /g ± 18.8 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.50 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**26.0 mW /g ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.6 ± 6 %	2.13 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**56.4 mW /g ± 18.8 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.23 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**25.0 mW /g ± 18.7 % (k=2)**

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Appendix(Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.4Ω- 6.08jΩ
Return Loss	- 24.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.2Ω- 5.19jΩ
Return Loss	- 23.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.013 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 12.07.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1061

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2600 MHz; σ = 1.985 S/m; εr = 39.42; ρ = 1000 kg/m3

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.3, 7.3, 7.3); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

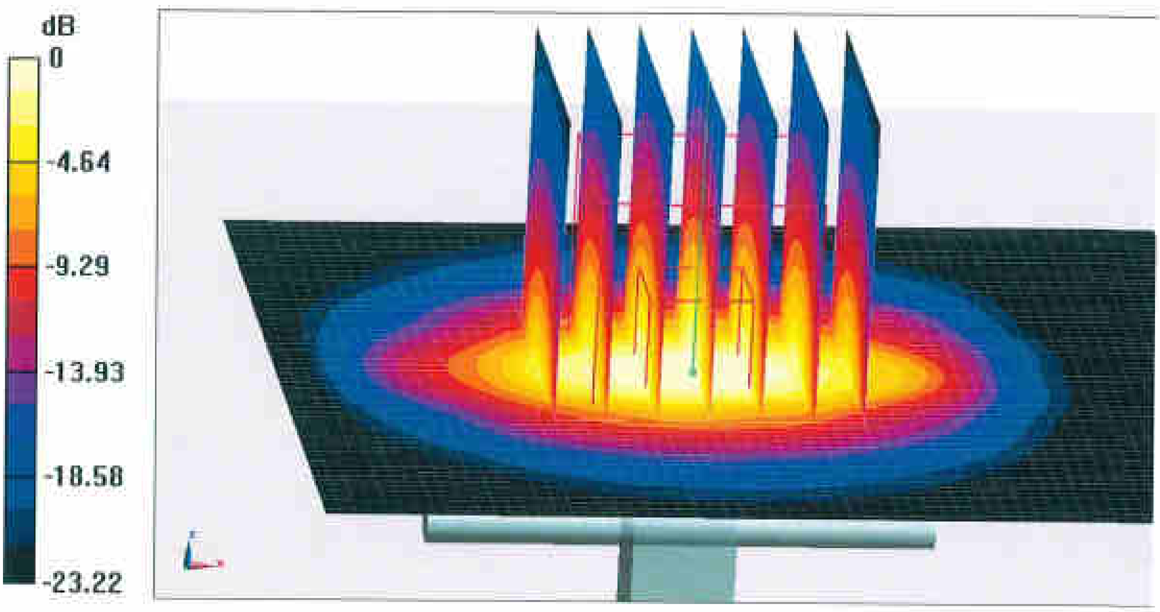
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.7 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 14.6 W/kg; SAR(10 g) = 6.5 W/kg

Maximum value of SAR (measured) = 25.1 W/kg



0 dB = 25.1 W/kg = 14.00 dBW/kg

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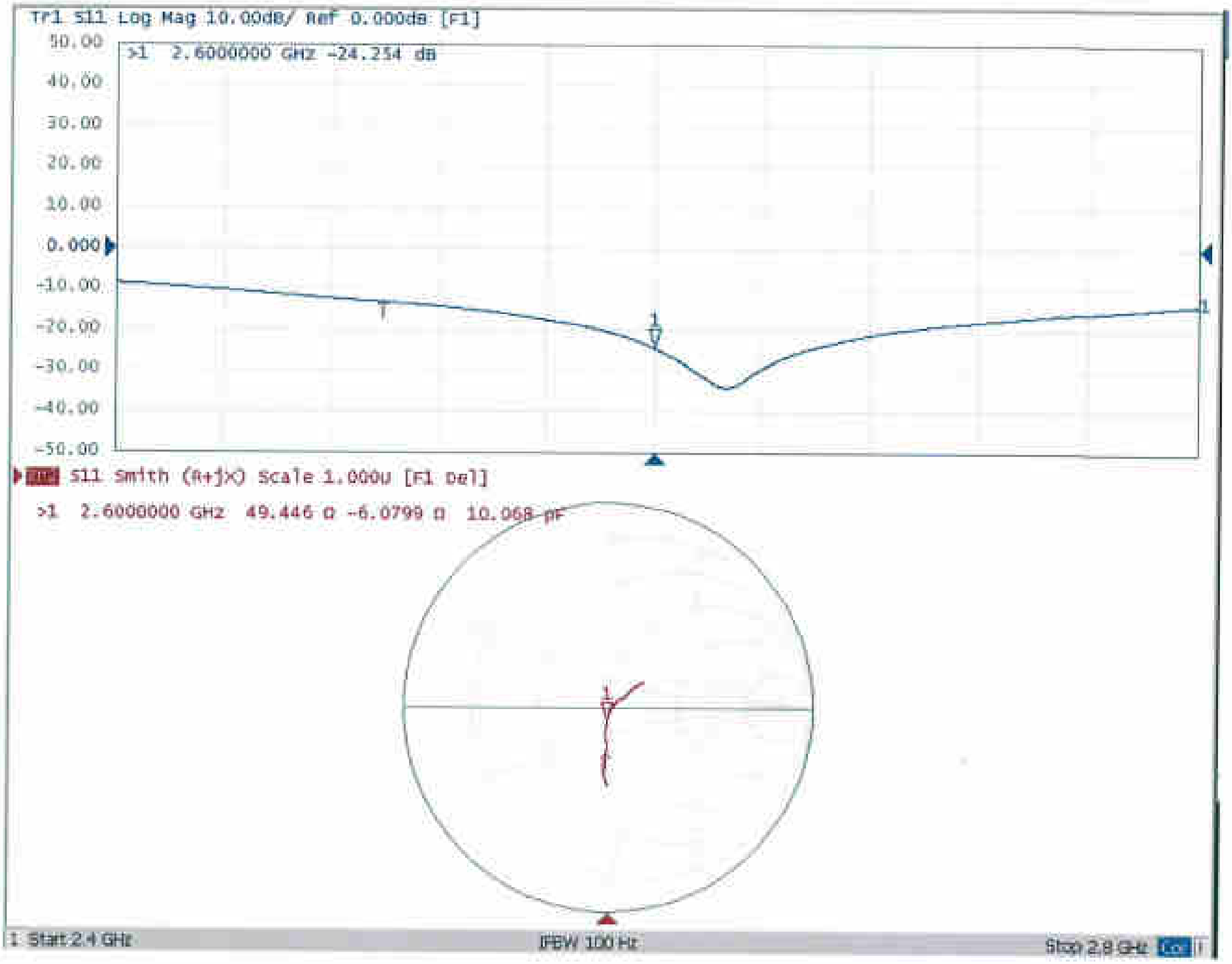
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 12.07.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1061

Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2600 MHz; $\sigma = 2.127$ S/m; $\varepsilon_r = 52.63$; $\rho = 1000$ kg/m^3

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.48, 7.48, 7.48); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

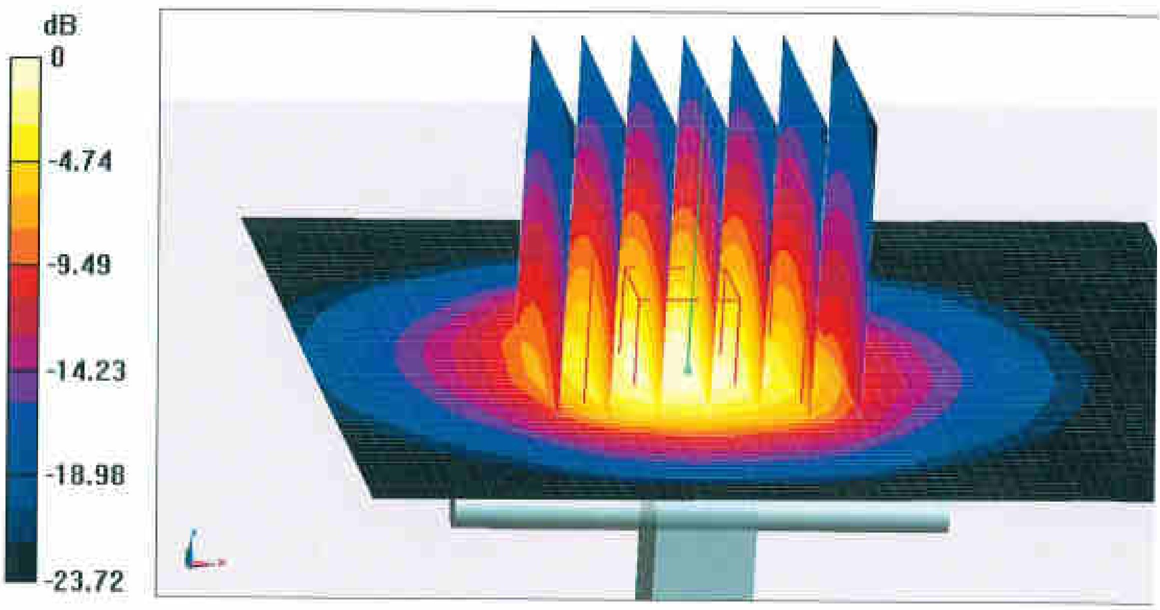
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.43 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 30.0 W/kg

SAR(1 g) = 14 W/kg; SAR(10 g) = 6.23 W/kg

Maximum value of SAR (measured) = 23.8 W/kg



0 dB = 23.8 W/kg = 13.77 dBW/kg

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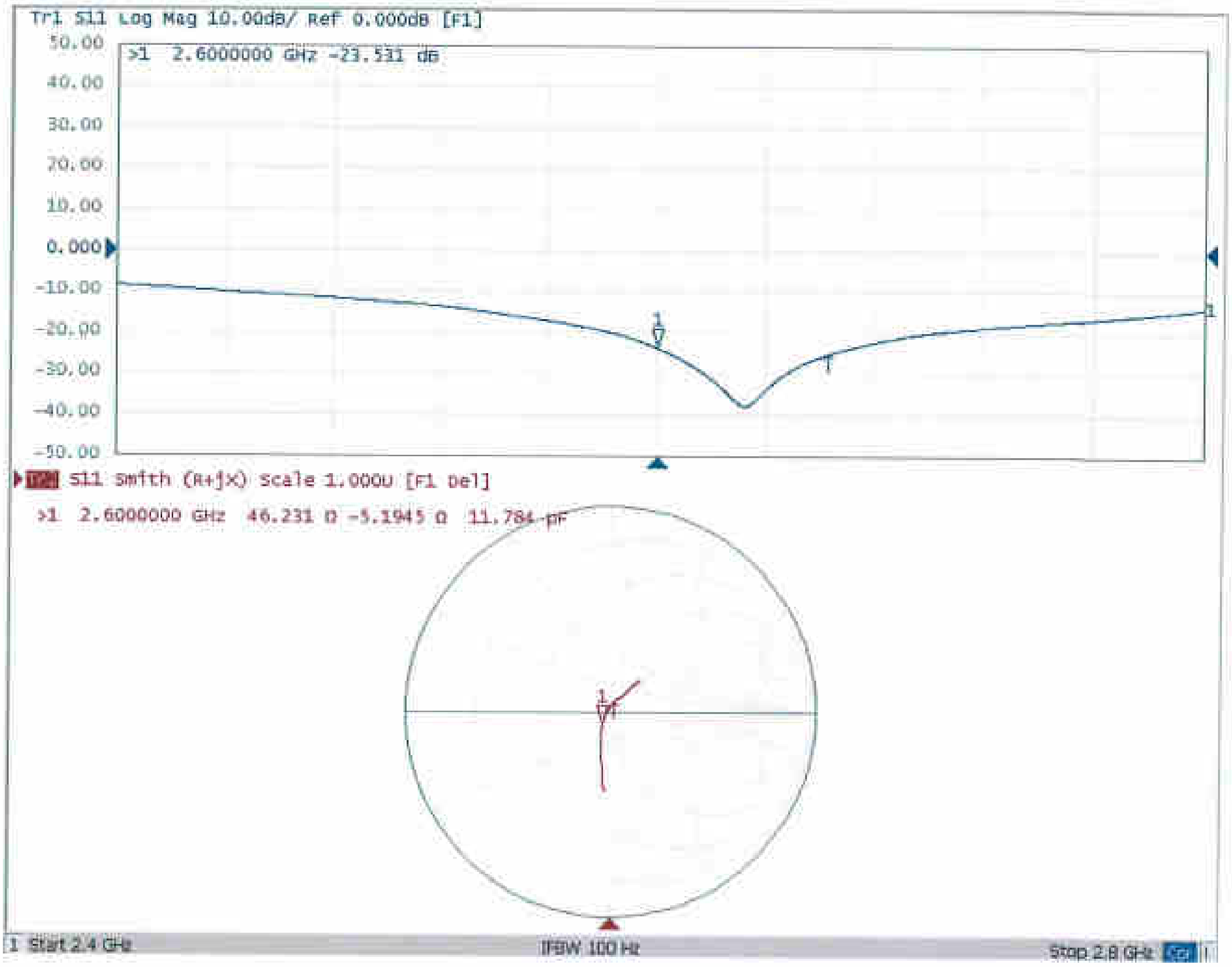
Impedance Measurement Plot for Body TSL



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IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client Auden

Certificate No: DAE4-915_Jun17

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BK - SN: 915
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	June 16, 2017

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	09-Sep-16 (No:19065)	Sep-17
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-17 (in house check)	In house check: Jan-18
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-17 (in house check)	In house check: Jan-18

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: June 16, 2017

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.270 ± 0.02% (k=2)	404.412 ± 0.02% (k=2)	404.743 ± 0.02% (k=2)
Low Range	3.97876 ± 1.50% (k=2)	3.99515 ± 1.50% (k=2)	3.98839 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	115.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200035.45	1.45	0.00
Channel X	+ Input	20005.57	0.83	0.00
Channel X	- Input	-20002.65	2.63	-0.01
Channel Y	+ Input	200042.17	8.68	0.00
Channel Y	+ Input	20005.49	0.84	0.00
Channel Y	- Input	-20005.61	-0.27	0.00
Channel Z	+ Input	200035.40	-4.00	-0.00
Channel Z	+ Input	20003.55	-0.96	-0.00
Channel Z	- Input	-20006.81	-1.32	0.01

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2000.99	0.13	0.01
Channel X	+ Input	201.24	0.41	0.20
Channel X	- Input	-198.67	0.56	-0.28
Channel Y	+ Input	2000.59	-0.24	-0.01
Channel Y	+ Input	200.55	-0.27	-0.13
Channel Y	- Input	-199.51	-0.27	0.13
Channel Z	+ Input	2000.64	-0.11	-0.01
Channel Z	+ Input	199.75	-0.97	-0.48
Channel Z	- Input	-200.42	-1.11	0.56

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	-15.06	-16.32
	- 200	18.64	16.76
Channel Y	200	-5.13	-5.50
	- 200	4.34	4.43
Channel Z	200	-1.15	-1.30
	- 200	-0.70	-0.95

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	3.31	-3.48
Channel Y	200	8.37	-	4.21
Channel Z	200	10.27	6.52	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16111	17514
Channel Y	15972	16571
Channel Z	15895	17158

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.96	-0.08	2.02	0.45
Channel Y	0.28	-0.96	1.60	0.46
Channel Z	-0.41	-1.19	0.62	0.37

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

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Client **Sporton International INC** **Certificate No: Z17-97152**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3293
Calibration Procedure(s)	FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	September 25, 2017

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Power sensor NRP-Z91	101547	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Power sensor NRP-Z91	101548	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Reference10dBAttenuator	18N50W-10dB	13-Mar-16(CTTL,No.J16X01547)	Mar-18
Reference20dBAttenuator	18N50W-20dB	13-Mar-16(CTTL, No.J16X01548)	Mar-18
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 549	13-Dec-16(SPEAG, No.DAE4-549_Dec16)	Dec -17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-17 (CTTL, No.J17X05858)	Jun-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan -18

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Zhao Jing	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: September 27, 2017

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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center) θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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Probe ES3DV3

SN: 3293

Calibrated: September 25, 2017

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3293

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)^A	1.12	0.90	0.76	±10.0%
DCP(mV)^B	105.5	108.7	109.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	286.1	±2.8%
		Y	0.0	0.0	1.0		254.6	
		Z	0.0	0.0	1.0		232.5	

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

^{A} The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5 and Page 6).
^{B} Numerical linearization parameter: uncertainty not required.
^{E} Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3293

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	6.47	6.47	6.47	0.60	1.15	±12.1%
835	41.5	0.90	6.30	6.30	6.30	0.41	1.47	±12.1%
900	41.5	0.97	6.34	6.34	6.34	0.41	1.49	±12.1%
1450	40.5	1.20	5.45	5.45	5.45	0.32	1.67	±12.1%
1750	40.1	1.37	5.32	5.32	5.32	0.64	1.25	±12.1%
1900	40.0	1.40	5.23	5.23	5.23	0.68	1.23	±12.1%
2000	40.0	1.40	4.98	4.98	4.98	0.43	1.60	±12.1%
2300	39.5	1.67	4.90	4.90	4.90	0.90	1.10	±12.1%
2450	39.2	1.80	4.73	4.73	4.73	0.88	1.14	±12.1%
2600	39.0	1.96	4.50	4.50	4.50	0.90	1.10	±12.1%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3293

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	55.5	0.96	6.43	6.43	6.43	0.60	1.25	±12.1%
835	55.2	0.97	6.19	6.19	6.19	0.40	1.60	±12.1%
1750	53.4	1.49	5.05	5.05	5.05	0.66	1.27	±12.1%
1900	53.3	1.52	4.86	4.86	4.86	0.84	1.17	±12.1%
2450	52.7	1.95	4.39	4.39	4.39	0.76	1.31	±12.1%
2600	52.5	2.16	4.16	4.16	4.16	0.90	1.15	±12.1%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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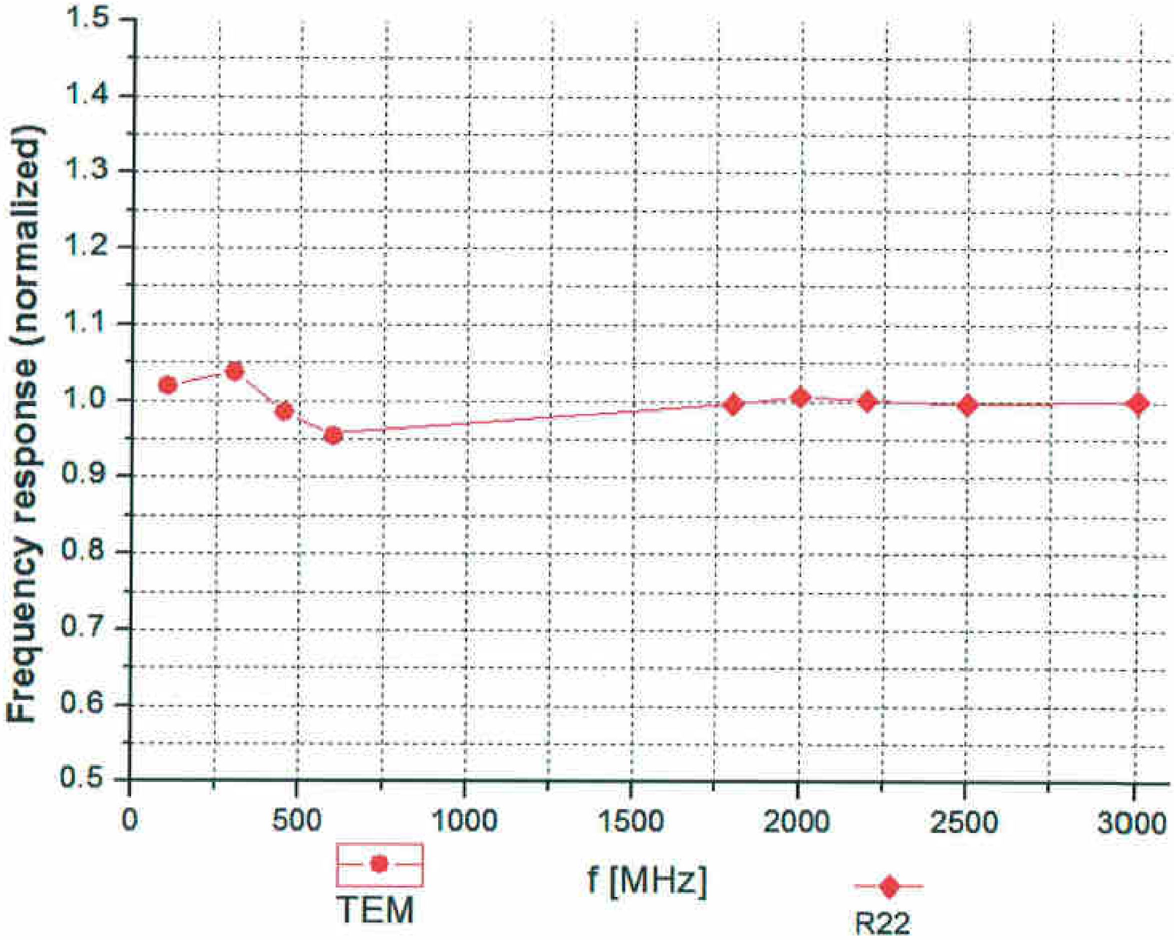
Frequency Response of E-Field

(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

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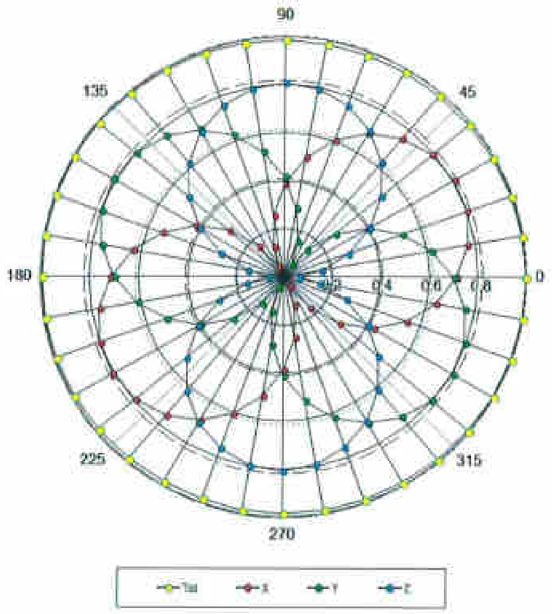
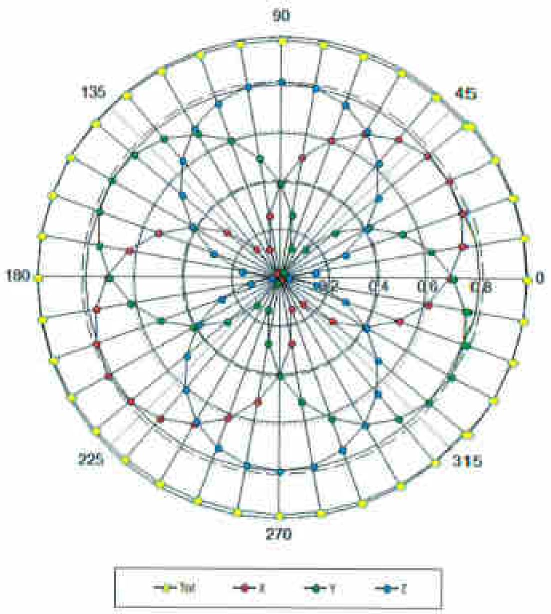
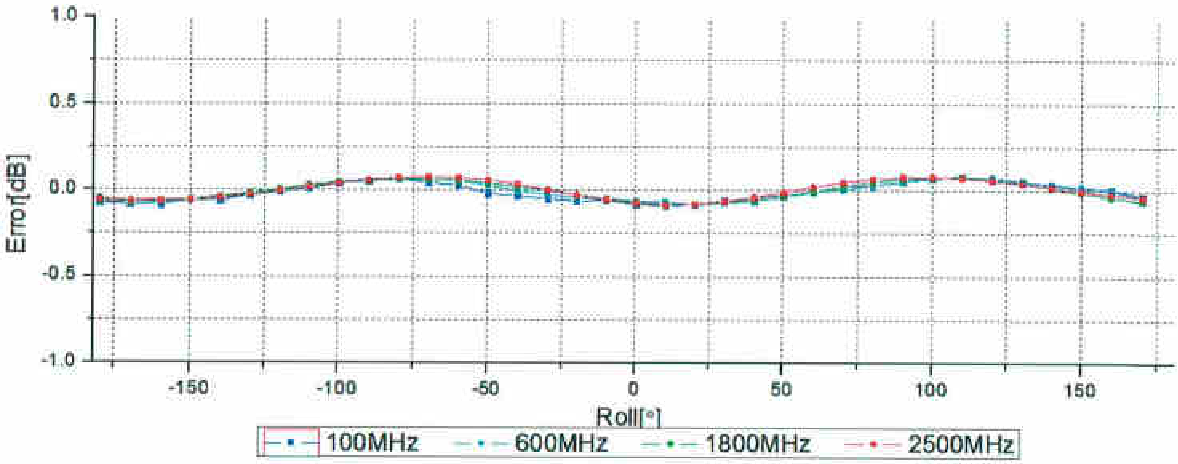
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

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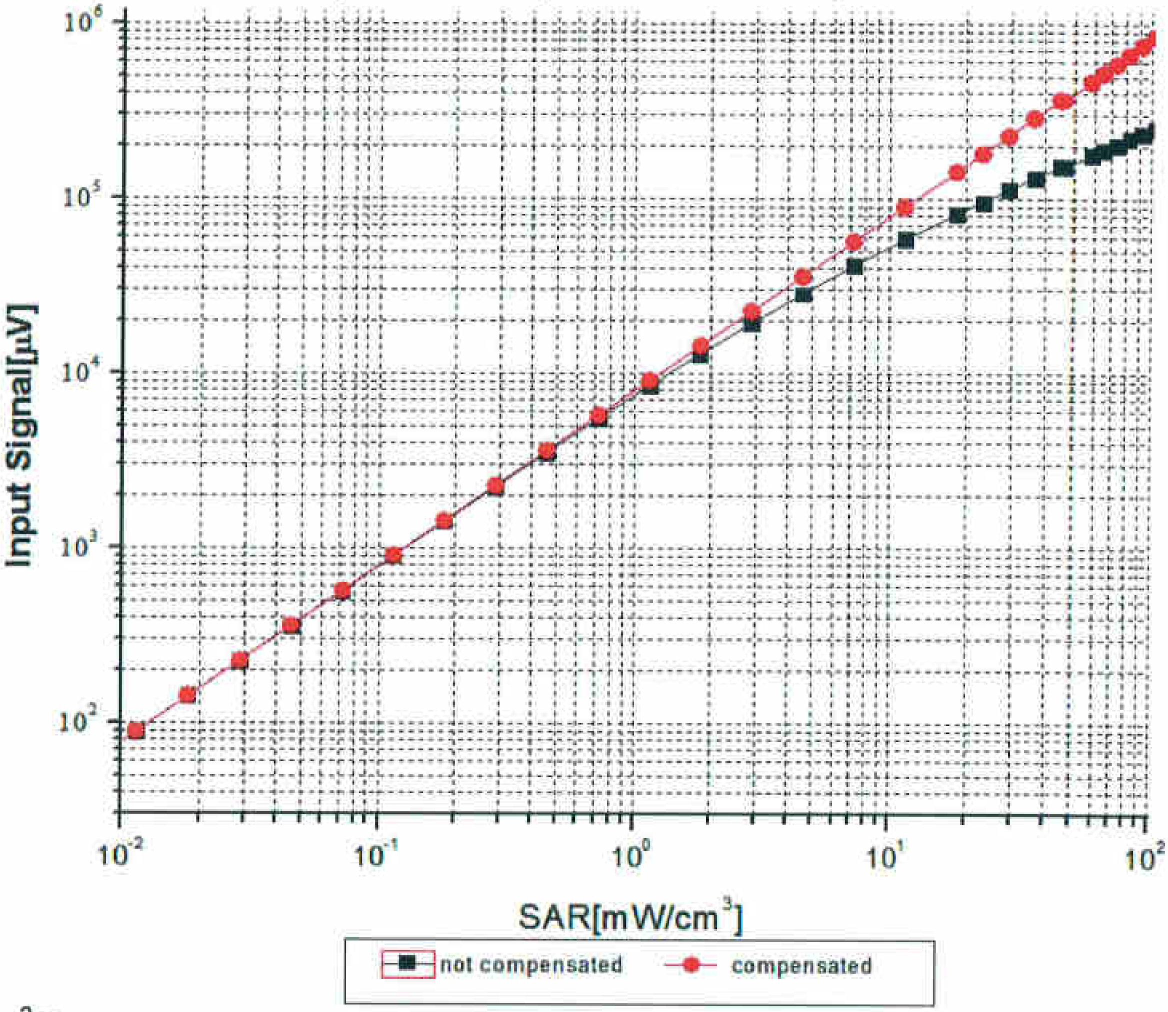
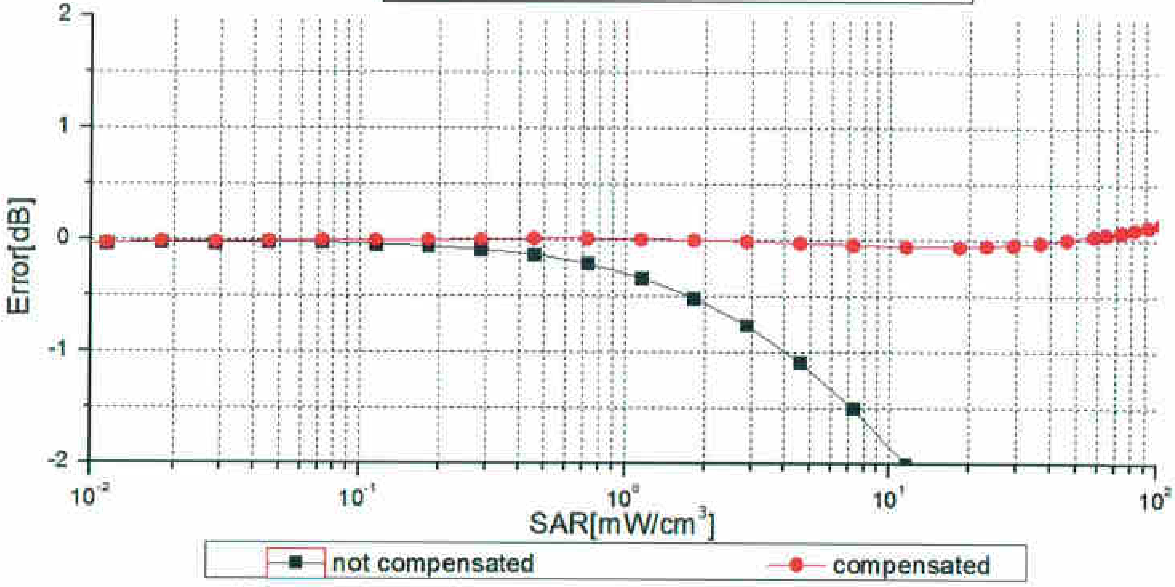
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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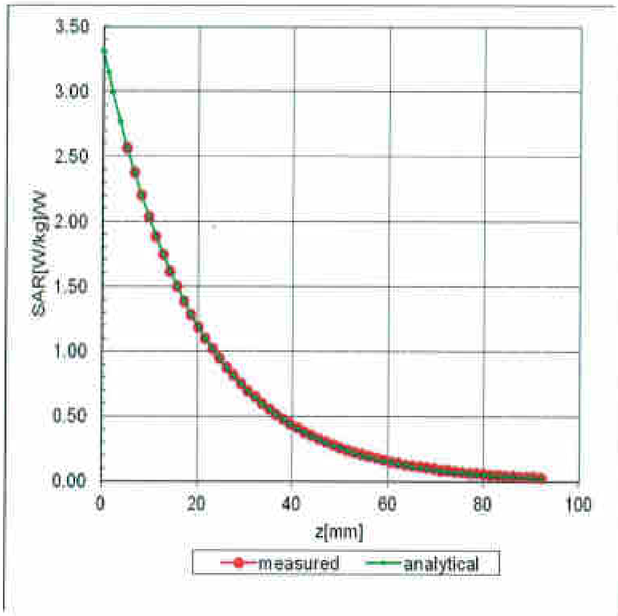
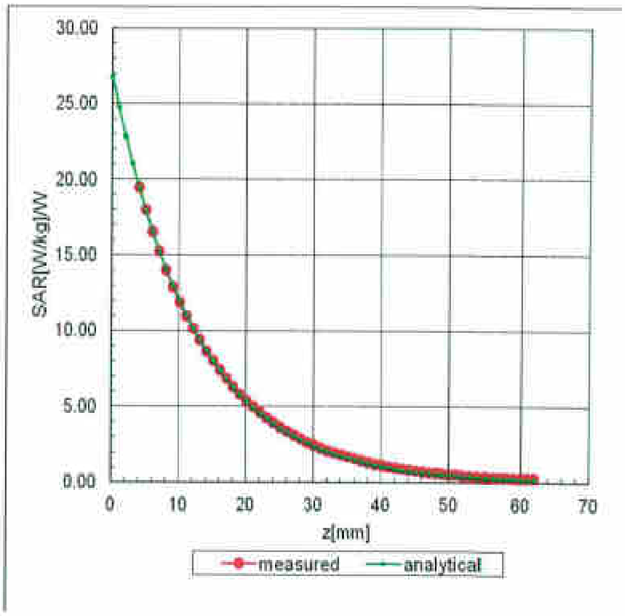
Conversion Factor Assessment

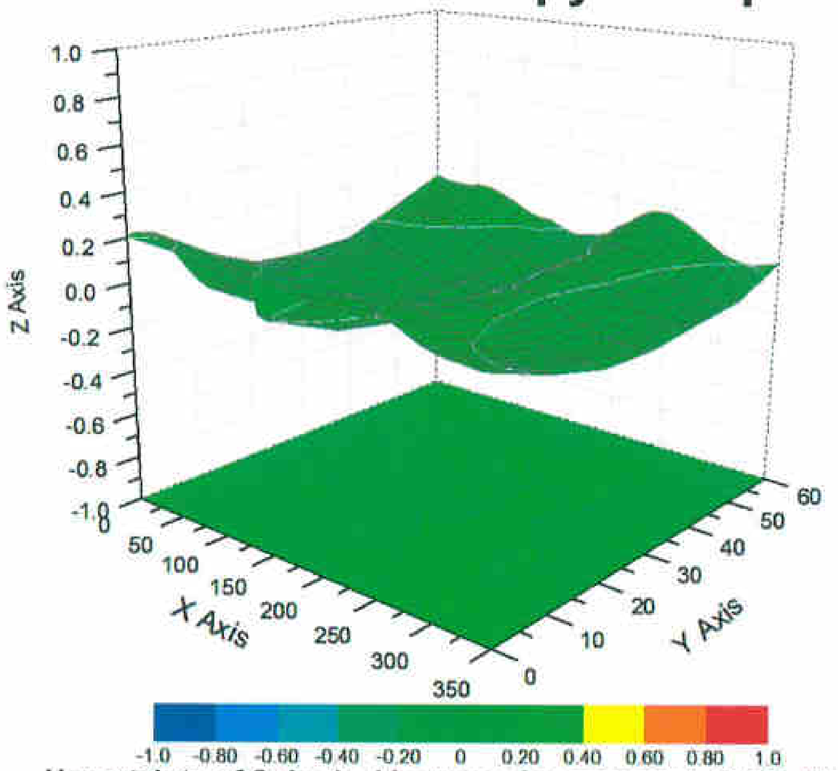
f=835 MHz, WGLS R9(H_convF)



f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (K=2)

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3293

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	7.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	10mm
Tip Diameter	4mm
Probe Tip to Sensor X Calibration Point	2mm
Probe Tip to Sensor Y Calibration Point	2mm
Probe Tip to Sensor Z Calibration Point	2mm
Recommended Measurement Distance from Surface	3mm

Appendix E. Reference Report

Please refer to Sporton report number FA7D2201 which is issued separately.