FCC SAR Test Report

APPLICANT	:	Motorola Solutions Inc.
EQUIPMENT 1	:	1)EVOLVE SMART HANDHELD W STD BATTERY 2)EVOLVE SMART HANDHELD W HICAP BATT
EQUIPMENT 2	:	EVOLVE-I IS SMART HANDHELD W IS HICAP BATT
BRAND NAME	:	Motorola Solutions
MODEL NAME 1	:	EVOLVE
MODEL NAME 2	:	EVOLVE-i
MODEL NUMBER 1	:	1)HK2136A 2)HK2156A
MODEL NUMBER 2	:	HK2137A
FCC ID	:	AZ489FT7134
STANDARD	:	FCC 47 CFR Part 2 (2.1093)

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.

Tony Zhang

Reviewed by: Tony Zhang / Supervisor

Kat Yin

Approved by: Kat Yin / Manager

ilac-MRA ACCREDITED Cert #5145.02

Sporton International (Kunshan) Inc.

No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA052616-30	Rev. 01	Initial issue of report	Jan. 11, 2022
FA052616-30	Rev. 02	Updated the Equipment 1's name	Jun. 07, 2022
FA052616-30	Rev. 03	Updated the WLAN 5GHz 802.11ac40M/ac80M tune-up limit	Jun. 21, 2022

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Motorola Solutions Inc., 1)EVOLVE SMART HANDHELD W STD BATTERY, 2)EVOLVE SMART HANDHELD W HICAP BATT, EVOLVE** and **EVOLVE-I IS SMART HANDHELD W IS HICAP BATT, EVOLVE-i** are as follows.

Highest 1g SAR Summary						
Equipment Class	Frequency Band		Head (Separation 0mm)	Hotspot (Separation 10mm)	Body-worn (Separation 0mm)	Highest Simultaneous Transmission 1g SAR (W/kg)
			1g SAR (W/kg)			
Licensed	LTE	Band 42	**0.86**	**0.46**	**0.23**	0.98
Date of Testing:				2021/12/10		

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

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

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR06-KS	CN1257	314309

Applicant	
Company Name	Motorola Solutions Inc.
Address	8000 West Sunrise Boulevard, Fort Lauderdale, Florida

Manufacturer	
Company Name	Motorola Solutions Malaysia Sdn. Bhd.
Address	Plot 2A, Medan Bayan Lepas, Mukim 12, S.W.D. 11900 Bayan Lepas, Penang, Malaysia.

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 616217 D04 SAR for laptop and tablets v01r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05
- FCC KDB 941225 D05A Rel.10 LTE SAR Test Guidance v01r02
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name 1	1)EVOLVE SMART HANDHELD W STD BATTERY 1)EVOLVE SMART HANDHELD W STD BATTERY
Equipment Name 2	EVOLVE-I IS SMART HANDHELD W IS HICAP BATT
Brand Name	Motorola Solutions
Model Name 1	EVOLVE
Model Name 2	EVOLVE-i
Model Number 1	1)HK2136A 2)HK2156A
Model Number 2	HK2137A
FCC ID	AZ489FT7134
IMEI Code	SIM1: 354850210006052 SIM2: 354850215006057
Wireless Technology and Frequency Range	WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 7: 2502.5 MHz ~ 2567.5 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz LTE Band 42: 3552.5 MHz ~ 3597.5 MHz; 3452.5 MHz ~ 3547.5 MHz LTE Band 43: 3602.5 MHz ~ 3697.5MHz LTE Band 48: 3552.5 MHz ~ 3697.5 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	RMC/AMR 12.2Kbps HSDPA HSUPA LTE: QPSK, 16QAM WLAN 2.4GHz 802.11b/g/n HT20/HT40 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
HW Version	P3
SW Version	EVOLVE-userdebug 10 QKQ1.200623.002 R01.03.01 release-keys
EUT Stage	Identical Prototype

Remark:

1. This device supports VoIP in WCDMA and LTE (e.g. for 3rd-party VoIP).
2. This device 2.4GHz WLAN support hotspot operation and Bluetooth support tethering applications.
3. This device WLAN5GHz has no hotspot function.
4. 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.
5. This device support the receiver detection mechanism, the main purpose is to minimize triggering associated with power reduction scenarios by receiver detection mechanisms and provide enhanced user experience. When the phone is in talking mode and receiver worked, WCDMA band II and LTE band 2/4/7/42/43/48 reduced power will be active.
6. There are two batteries which described at the following table.
7. This is a variant report. According to the Product Equality Declaration as Appendix F about the difference between

EVOLVE and EVOLVE-i, the test result is not affected by two samples, we only performed testing with EVOLVE sample. According to the change between P3 and P2.0, only added LTE Band 42(3450MHz~3550MHz) full SAR testing, WLAN/BT chose higher SAR value from the Original test report which can be found on FCC website under original application.

8. This variant report also enable 802.11ac VHT20/VHT40/VHT80 by software, for 802.11ac no need to perform SAR testing base on lower tune up power which can refer to the from Original test report which can be found on FCC website under original application. We only verified WLAN 5G 802.11ac power.

4.2 Specification of Accessory

Accessories Information				
Wired Remote Speaker Mic	**Brand Name**	Motorola Solutions	**P/N**	PMMN4125B
	Signal Line	0.54 meter(normal), 2.5 meter (stretch) shielded cable, without ferrite core		
Bluetooth Wired Speaker Mic	**Brand Name**	Motorola Solutions	**P/N**	PMMN4127A
Bluetooth Earpiece 1	**Brand Name**	Motorola Solutions	**P/N**	EP900
Bluetooth Earpiece 2	**Brand Name**	Motorola Solutions	**P/N**	PMLN8123A
Earpiece	**Brand Name**	Motorola Solutions	**P/N**	PMLN8191A
	Signal Line	1.128meter, non-shielded cable, without ferrite core		
Battery 1	**Brand Name**	Motorola Solutions	**P/N**	BT000593A01
	Rated	5800mAh		
Battery 2	**Brand Name**	Motorola Solutions	**P/N**	BT000592A01
	Rated	2900mAh		
Battery 3	**Brand Name**	Motorola Solutions	**P/N**	BT000594A01
	Rated	5800mAh		
Belt Clip Holster	**Brand Name**	Motorola Solutions	**Model Name**	PMLN6970A
Belt Clip Holster (Long)	**Brand Name**	Motorola Solutions	**Model Name**	NTN8266B
Belt Clip Holster (Short)	**Brand Name**	Motorola Solutions	**Model Name**	PMLN7965A

Remark: Battery 1 and Battery 2 are for EVOLVE sample, Battery 3 is for EVOLVE-i Sample.

4.3 Power Reduction Specification of 3G/4G Main Antenna

The following tables summarize the key power reduction information of 3G/4G main antenna triggered by specific use conditions via receiver detection mechanism. The detailed full power and reduced conducted power measurement results are provided in Section 12 of this report:

WWAN Bands	WWAN Main Antenna		Power Reduction (dB)
	Maximum Tune up Power Limit (dBm)		
	Receiver off (Full Power)	Receiver on (for head)	
UMTS Band II	24.0	19.0	5.0
LTE Band 2	23.0	19.0	4.0
LTE Band 4	23.0	19.5	3.5
LTE Band 7	23.5	16.5	7.0
LTE Band 42	20.5	17.5	3.0
LTE Band 43	20.5	17.5	3.0
LTE Band 48	20.5	17.5	3.0

Note: For Head SAR test of 3G/4G Main Antenna, Head SAR should be evaluated at with audio receiver on. As the audio receiver only works in voice mode when the user is making a call in head scenario, and the lack of the third-party VoIP server and the unstandardized VOIP operating characteristics, so a test script may be used to trigger the receiver on during the test. The test script function is only used to trigger audio receiver on and simulate voice and VOIP usage scene. It can be ensured that the unmodified settings in production units, including maximum output power, amplifier gain and other RF performance or tuning parameters, are used for SAR measurement.

4.4 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>AZ489FT7134</td></tr>
<tr><td>Equipment Name</td><td>1)EVOLVE SMART HANDHELD W STD BATTERY
1)EVOLVE SMART HANDHELD W STD BATTERY</td></tr>
<tr><td>Operating Frequency Range of each LTE transmission band</td><td>LTE Band 2: 1850.7 MHz ~ 1909.3 MHz
LTE Band 4: 1710.7 MHz ~ 1754.3 MHz
LTE Band 5: 824.7 MHz ~ 848.3 MHz
LTE Band 7: 2502.5 MHz ~ 2567.5 MHz
LTE Band 12: 699.7 MHz ~ 715.3 MHz
LTE Band 13: 779.5 MHz ~ 784.5 MHz
LTE Band 17: 706.5 MHz ~ 713.5 MHz
LTE Band 42: 3552.5 MHz ~ 3597.5 MHz; 3450 MHz ~ 3550MHz
LTE Band 43: 3602.5 MHz ~ 3697.5MHz
LTE Band 48: 3552.5 MHz ~ 3697.5 MHz</td></tr>
<tr><td>Channel Bandwidth</td><td>LTE Band 2:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 4:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 5:1.4MHz, 3MHz, 5MHz, 10MHz
LTE Band 7: 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 12:1.4MHz, 3MHz, 5MHz, 10MHz
LTE Band 13: 5MHz, 10MHz
LTE Band 17: 5MHz, 10MHz
LTE Band 42: 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 43: 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 48: 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>Voice and Data</td></tr>
<tr><td>LTE Release Version</td><td>R10, Cat6</td></tr>
<tr><td>CA Support</td><td>Downlink only</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>This device support the receiver detection mechanism, When the phone is in talking mode and receiver worked, LTE band 2/4/7/42/43/48 reduced power will be active.</td></tr>
<tr><td>LTE Carrier Aggregation Combinations</td><td>Intra-Band combinations and the detail power verification please referred to section 12.</td></tr>
<tr><td>LTE Carrier Aggregation Additional Information</td><td>This device supports maximum of 2 carriers in the downlink. Additional following LTE Release features are not supported: Relay, HetNet, Enhanced MIMO, eICI, WiFi Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.</td></tr>
</table>

Transmission (H, M, L) channel numbers and frequencies in each LTE band

LTE Band 2

	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	18607	1850.7	18615	1851.5	18625	1852.5	18650	1855	18675	1857.5	18700	1860
M	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880	18900	1880
H	19193	1909.3	19185	1908.5	19175	1907.5	19150	1905	19125	1902.5	19100	1900

LTE Band 4

	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	19957	1710.7	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20393	1754.3	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745

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 12

	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	23017	699.7	23025	700.5	23035	701.5	23060	704
M	23095	707.5	23095	707.5	23095	707.5	23095	707.5
H	23173	715.3	23165	714.5	23155	713.5	23130	711

LTE Band 13

	Bandwidth 5 MHz		Bandwidth 10 MHz	
	Channel #	Freq.(MHz)	Channel #	Freq.(MHz)
L	23205	779.5		
M	23230	782	23230	782
H	23255	784.5		

LTE Band 17

	Bandwidth 5 MHz		Bandwidth 10 MHz	
	Channel #	Freq.(MHz)	Channel #	Freq. (MHz)
L	23755	706.5	23780	709
M	23790	710	23790	710
H	23825	713.5	23800	711

LTE Band 42								
	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	43115	3552.5	43140	3555	43165	3557.5	43190	3560
M	43340	3575	43340	3575	43340	3575	43340	3575
H	43565	3597.5	43540	3595	43515	3592.5	43490	3590
LTE Band 42 3450 MHz ~ 3550MHz								
	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	42115	3452.5	42140	3455	42165	3457.5	42190	3460
M	42590	3500	42590	3500	42590	3500	42590	3500
H	43065	3547.5	43040	3545	43015	3542.5	42990	3540
LTE Band 43								
	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	43615	3602.5	43640	3605	43665	3607.5	43690	3610
M	44090	3650	44090	3650	44090	3650	44090	3650
H	44565	3697.5	44540	3695	44515	3692.5	44490	3690
LTE Band 48								
	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	55265	3552.5	55290	3555	55315	3557.5	55340	3560
LM	55810	3607	55815	3607.5	55820	3608	55830	3609
MH	56170	3643	56165	3642.5	56160	3642	56150	3641
H	56715	3697.5	56690	3695	56665	3692.5	56640	3690

5. RF Exposure Limits

5.1 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.

5.2 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.

6. Specific Absorption Rate (SAR)

6.1 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.

6.2 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:

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

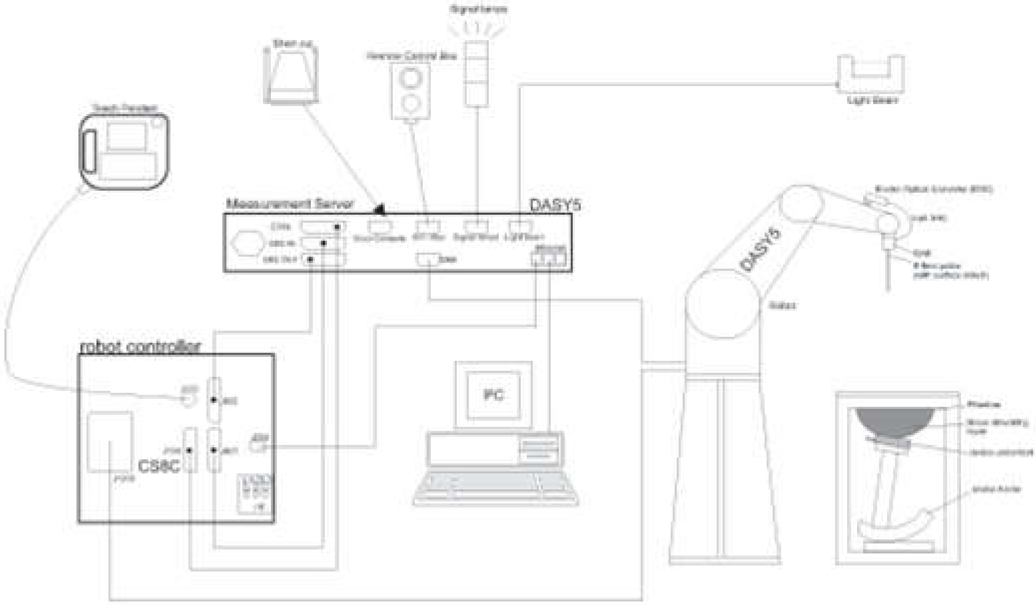
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. 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.

7.1 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.

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 6 GHz)	
Directivity	±0.3 dB in TSL (rotation around probe axis) ±0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 μW/g – >100 mW/g Linearity: ±0.2 dB (noise: typically <1 μW/g)	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

7.2 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.

Photo of DAE

7.3 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

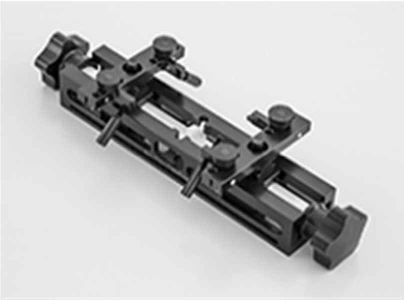
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

7.4 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

8. 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.
(c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, 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

8.1 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

8.2 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.

8.3 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.	

8.4 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.

			$\leq$ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			$\leq$ 2 GHz: $\leq$ 8 mm 2 – 3 GHz: $\leq$ 5 mm*	3 – 4 GHz: $\leq$ 5 mm* 4 – 6 GHz: $\leq$ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		$\leq$ 5 mm	3 – 4 GHz: $\leq$ 4 mm 4 – 5 GHz: $\leq$ 3 mm 5 – 6 GHz: $\leq$ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	$\leq$ 4 mm	3 – 4 GHz: $\leq$ 3 mm 4 – 5 GHz: $\leq$ 2.5 mm 5 – 6 GHz: $\leq$ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		$\geq$ 30 mm	3 – 4 GHz: $\geq$ 28 mm 4 – 5 GHz: $\geq$ 25 mm 5 – 6 GHz: $\geq$ 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 *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 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.				

8.5 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.

8.6 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.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	3500MHz System Validation Kit	D3500V2	1037	Nov. 25, 2020	Nov. 24, 2023
SPEAG	Data Acquisition Electronics	DAE4	690	Mar. 17, 2021	Mar. 16, 2022
SPEAG	Dosimetric E-Field Probe	EX3DV4	7630	Feb. 10, 2021	Feb. 09, 2022
SPEAG	SAM Twin Phantom	SAM Twin	TP-2022	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Radio Communication Analyzer	MT8821C	6201432831	Apr. 13, 2021	Apr. 12, 2022
Agilent	ENA Series Network Analyzer	E5071C	MY46106933	Jul. 31, 2021	Jul. 30, 2022
SPEAG	Dielectric Probe Kit	DAK-3.5	1138	Jun. 09, 2021	Jun. 08, 2022
Anritsu	Vector Signal Generator	MG3710A	6201682672	Jan. 07, 2021	Jan. 06, 2022
Rohde & Schwarz	Power Meter	NRVD	102081	Aug. 12, 2021	Aug. 11, 2022
Rohde & Schwarz	Power Sensor	NRV-Z5	100538	Aug. 12, 2021	Aug. 11, 2022
Rohde & Schwarz	Power Sensor	NRV-Z5	100539	Aug. 12, 2021	Aug. 11, 2022
Testo	Thermo-Hygrometer	608-H1	1241332126	Jan. 07, 2021	Jan. 06, 2022
R&S	CBT BLUETOOTH TESTER	CBT	101246	Apr. 12, 2021	Apr. 11, 2022
EXA	Spectrum Analyzer	FSV7	101632	Jan. 07, 2021	Jan. 06, 2022
FLUKE	DIGITAC THERMOMETER	51II	97240029	Aug. 13, 2021	Aug. 12, 2022
ARRA	Power Divider	A3200-2	N/A	Note 1	
MCL	Attenuator 1	BW-S10W5	N/A	Note 1	
Weinschel	Attenuator 2	3M-20	N/A	Note 1	
Zhongjilianhe	Attenuator 3	MVE2214-03	N/A	Note 1	
BONN	POWER AMPLIFIER	BLMA 0830-3	087193A	Note 1	
BONN	POWER AMPLIFIER	BLMA 2060-2	087193B	Note 1	
Agilent	Dual Directional Coupler	778D	20500	Note 1	
Agilent	Dual Directional Coupler	11691D	MY48151020	Note 1	

Note:

1. 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
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

10. System Verification

10.1 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. 11.1. 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. 11.2.

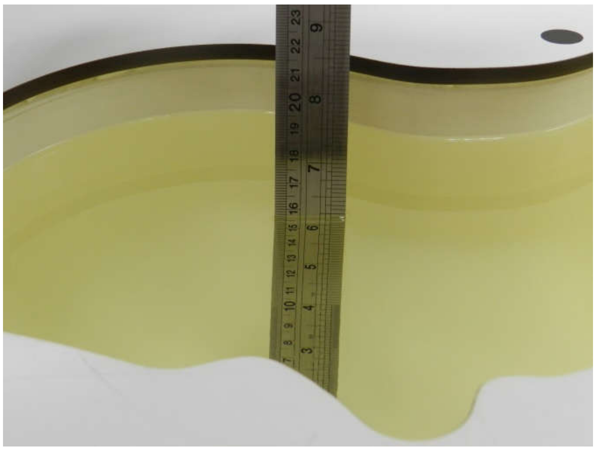


Fig 11.1 Photo of Liquid Height for Head SAR

Fig 11.2 Photo of Liquid Height for Body SAR

10.2 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								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<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
3500	Head	22.9	2.785	38.969	2.91	37.90	-4.30	2.82	±5	2021/12/10

10.3 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 (%)
2021/12/10	3500	Head	50	1037	7630	690	3.20	68.00	64	-5.88

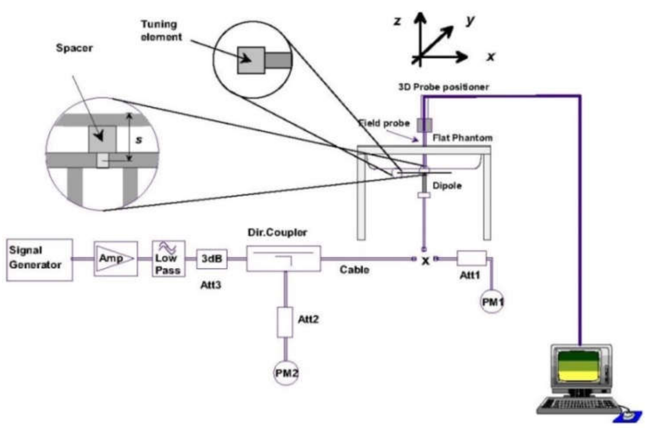


Fig 11.3.1 System Performance Check Setup

Fig 11.3.2 Setup Photo

11. RF Exposure Positions

11.1 Ear and handset reference point

Figure 12.1.1 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 12.1.2 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 12.1.3). 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 12.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

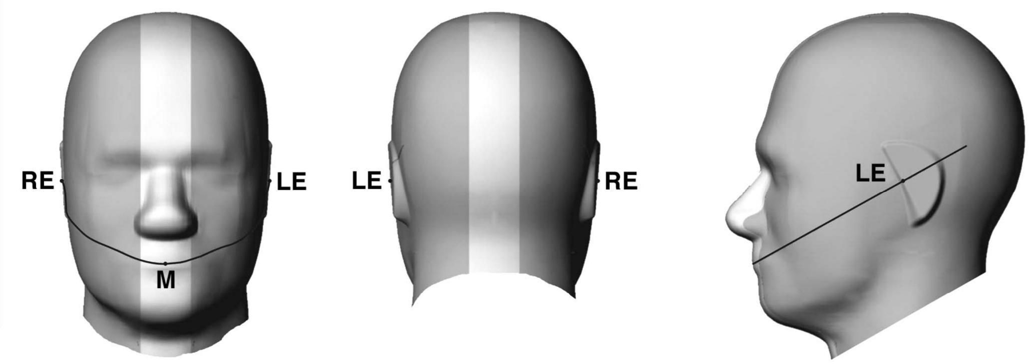


Fig 12.1.1 Front, back, and side views of SAM twin phantom

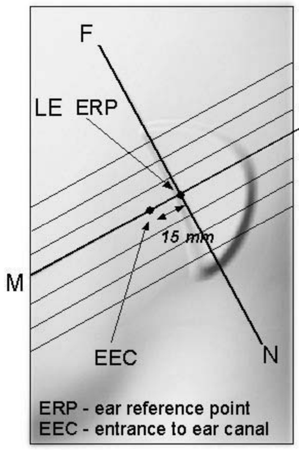


Fig 12.1.2 Close-up side view of phantom showing the ear region.

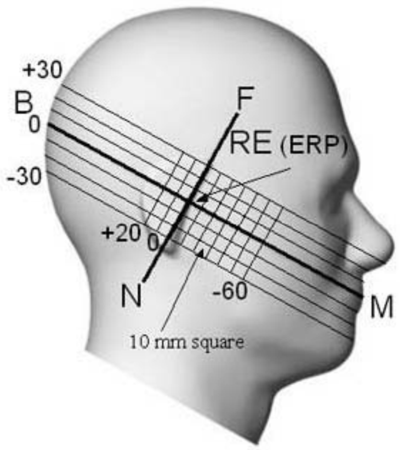


Fig 12.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

11.2 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 12.2.1 and Figure 12.2.2), 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 12.2.1). 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 12.2.2), 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 12.2.3), 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 12.2.3. The actual rotation angles should be documented in the test report.

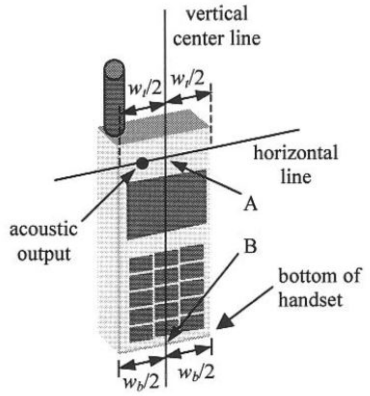


Fig 12.2.1 Handset vertical and horizontal reference lines—"fixed case

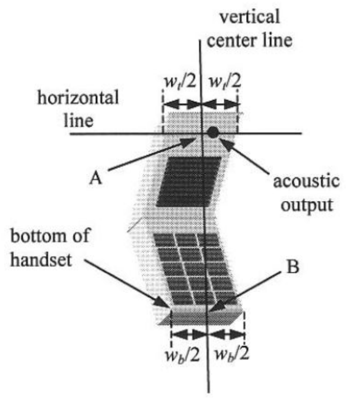


Fig 12.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

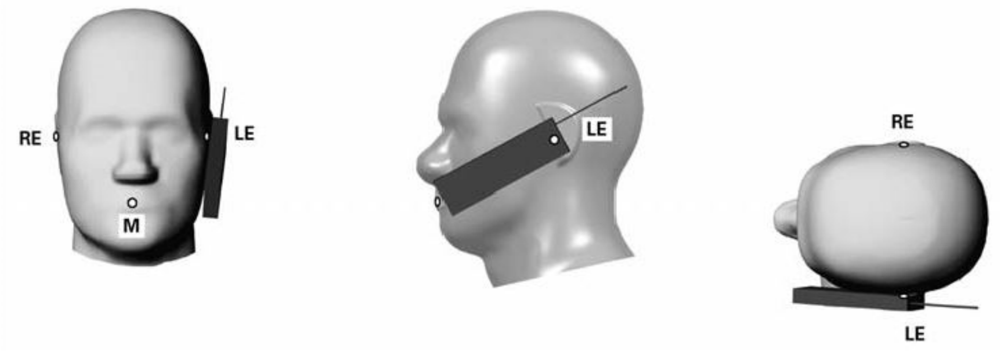


Fig 12.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

11.3 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 12.3.1. 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

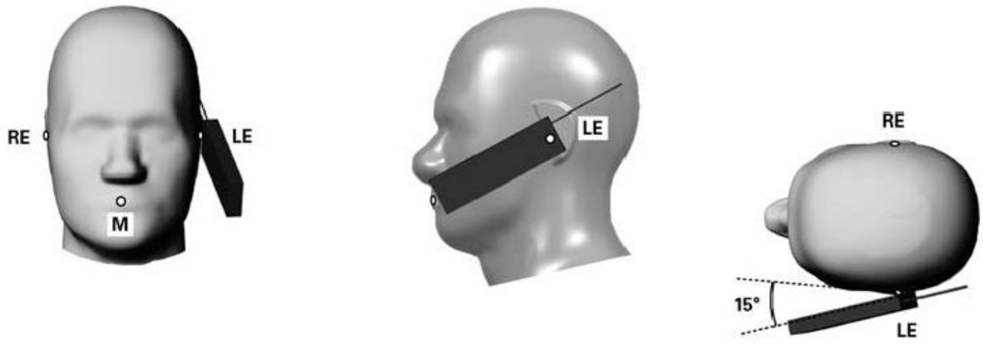


Fig 12.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

11.4 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 12.4). 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.

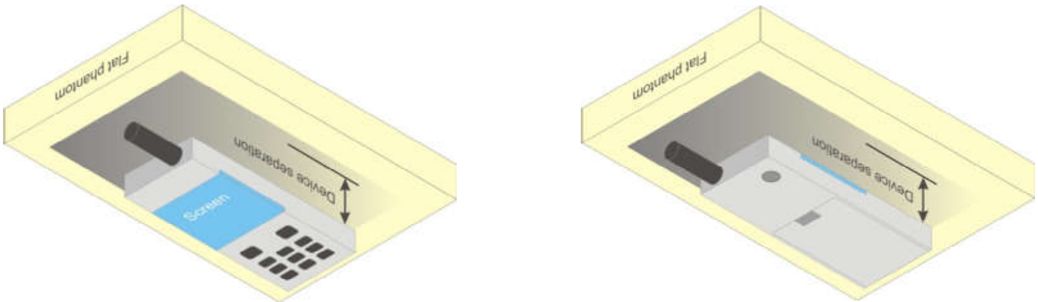


Fig 12.4 Body Worn Position

11.5 Product Specific 10g SAR Exposure

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, According to KDB648474 D04v01r03, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.

2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions.6 The UMPC mini-tablet 1-g SAR at 5 mm is not required. 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.

11.6 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.

12. Conducted RF Output Power (Unit: dBm)

The detailed conducted power table can refer to Appendix E.

<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.

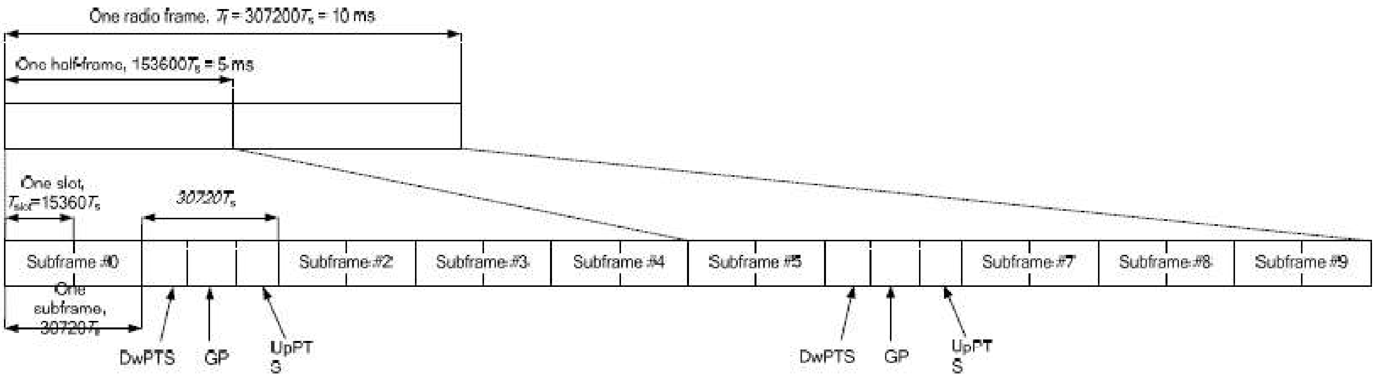


Figure 4.2-1: Frame structure type 2 (for 5 ms switch-point periodicity).

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).

<table>
<tr><th rowspan="3">Special subframe configuration</th><th colspan="3">Normal cyclic prefix in downlink</th><th colspan="3">Extended cyclic prefix in downlink</th></tr>
<tr><th rowspan="2">DwPTS</th><th colspan="2">UpPTS</th><th rowspan="2">DwPTS</th><th colspan="2">UpPTS</th></tr>
<tr><th>Normal cyclic prefix in uplink</th><th>Extended cyclic prefix in uplink</th><th>Normal cyclic prefix in uplink</th><th>Extended cyclic prefix in uplink</th></tr>
<tr><td>0</td><td>$6592 \cdot T_s$</td><td rowspan="5">$2192 \cdot T_s$</td><td rowspan="5">$2560 \cdot T_s$</td><td>$7680 \cdot T_s$</td><td rowspan="4">$2192 \cdot T_s$</td><td rowspan="4">$2560 \cdot T_s$</td></tr>
<tr><td>1</td><td>$19760 \cdot T_s$</td><td>$20480 \cdot T_s$</td></tr>
<tr><td>2</td><td>$21952 \cdot T_s$</td><td>$23040 \cdot T_s$</td></tr>
<tr><td>3</td><td>$24144 \cdot T_s$</td><td>$25600 \cdot T_s$</td></tr>
<tr><td>4</td><td>$26336 \cdot T_s$</td><td>$7680 \cdot T_s$</td><td rowspan="4">$4384 \cdot T_s$</td><td rowspan="4">$5120 \cdot T_s$</td></tr>
<tr><td>5</td><td>$6592 \cdot T_s$</td><td rowspan="5">$4384 \cdot T_s$</td><td rowspan="5">$5120 \cdot T_s$</td><td>$20480 \cdot T_s$</td></tr>
<tr><td>6</td><td>$19760 \cdot T_s$</td><td>$23040 \cdot T_s$</td></tr>
<tr><td>7</td><td>$21952 \cdot T_s$</td><td>$12800 \cdot T_s$</td></tr>
<tr><td>8</td><td>$24144 \cdot T_s$</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>9</td><td>$13168 \cdot T_s$</td><td>-</td><td>-</td><td>-</td></tr>
</table>

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.

<LTE Carrier Aggregation>

General Note:

1. This device supports Carrier Aggregation on downlink for intra band. For the device supports bands and bandwidths and configurations are provided as follow table was according to 3GPP.
2. In applying the existing power measurement procedures of KDB 941225 D05A for DL CA SAR test exclusion, only the subset with the largest number of combinations of frequency bands and CCs in each row need combination, and for this device that all the configurations were choose to power measurement.

Index	2CC
2CC #1	CA_42C

LTE Carrier Aggregation Conducted Power (Downlink)

i. According to KDB941225 D05A v01r02, Uplink maximum output power measurement with downlink carrier aggregation active should be measured, using the highest output channel measured without downlink carrier aggregation, to confirm that uplink maximum output power with downlink carrier aggregation active remains within the specified tune-up tolerance limits and not more than ¼ dB higher than the maximum output measured without downlink carrier aggregation active.

ii. Uplink maximum output power with downlink carrier aggregation active does not show more than ¼ dB higher than the maximum output power without downlink carrier aggregation active, therefore SAR evaluation with downlink carrier aggregation active can be excluded.

iii. The device supports downlink two carrier aggregation. For power measurement were control and acknowledge data is sent on uplink channels that operate identical to specifications when downlink carrier aggregation is inactive.

iv. Selected highest measured power when downlink carrier aggregation is inactive for conducted power comparison with downlink carrier aggregation is active, to confirm that when downlink carrier aggregation is active uplink maximum output power remains within the specified tune-up tolerance limits and not more than ¼ dB higher than the maximum output power measured when downlink carrier aggregation inactive.

v. For inter-band CA, the SCC selected highest bandwidth and near the middle of its transmission band. For SCC DL RB size and offset will base on the PCC corresponding RB allocation.

vi. For non-contiguous intra-band CA, the SCC selected to provide maximum separation from the PCC and must remain fully within the downlink transmission band.

vii. For Intra-band, contiguous CA, the downlink channels selected to perform the uplink power measurement must satisfy 3GPP channel spacing (5.4.1A of 3GPP TS 36.521 or equivalent) and channel bandwidth (5.4.2A) requirements.

$$\text{Nominal channel spacing} = \left\lfloor \frac{BW_{Channel(1)} + BW_{Channel(2)} - 0.1\left|BW_{Channel(1)} - BW_{Channel(2)}\right|}{0.6} \right\rfloor 0.3 \;\; [\text{MHz}]$$

<WLAN Conducted Power>

General Note:

1. For each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode.
2. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6W/kg and SAR peak to location ratio ≤ 0.04, no additional SAR measurements for MIMO.
3. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures. For "Not required", SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band or when MIMO mode was not performed, due to for each antenna, transmit power in SISO operation is larger than (or equal to) the power in MIMO operation, RF exposure compliance of MIMO mode can be deduced from the compliance simultaneous transmission of antennas operating in SISO mode. Additional output power measurements were not necessary.
4. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
5. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
6. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
7. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
   a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
   b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
   c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

13. Antenna Location

The detailed antenna location information can refer to SAR Test Setup Photos.

14. SAR Test Results

14.1 Head SAR

<TDD LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Power Reduction	Ch.	Freq. (MHz)	Accessory	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 42 Part27Q	20M	QPSK	1	0	Right Cheek	Reduced	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	16.97	17.50	1.130	62.9	1.006	0.02	0.391	0.444
	LTE Band 42 Part27Q	20M	QPSK	50	0	Right Cheek	Reduced	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	16.87	17.50	1.156	62.9	1.006	-0.01	0.202	0.235
	LTE Band 42 Part27Q	20M	QPSK	1	0	Right Tilted	Reduced	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	16.97	17.50	1.130	62.9	1.006	0.09	0.289	0.328
	LTE Band 42 Part27Q	20M	QPSK	50	0	Right Tilted	Reduced	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	16.87	17.50	1.156	62.9	1.006	-0.03	0.295	0.343
	LTE Band 42 Part27Q	20M	QPSK	1	0	Left Cheek	Reduced	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	16.97	17.50	1.130	62.9	1.006	-0.06	0.325	0.369
	LTE Band 42 Part27Q	20M	QPSK	50	0	Left Cheek	Reduced	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	16.87	17.50	1.156	62.9	1.006	-0.07	0.315	0.366
	LTE Band 42 Part27Q	20M	QPSK	1	0	Left Tilted	Reduced	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	16.97	17.50	1.130	62.9	1.006	0.1	0.637	0.724
	LTE Band 42 Part27Q	20M	QPSK	50	0	Left Tilted	Reduced	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	16.87	17.50	1.156	62.9	1.006	0.04	0.662	0.770
01	LTE Band 42 Part27Q	20M	QPSK	1	0	Left Tilted	Reduced	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	16.97	17.50	1.130	62.9	1.006	0.17	0.754	0.857
	LTE Band 42 Part27Q	20M	QPSK	1	0	Left Tilted	Reduced	42190	3460	Non-IS Sku with 2900mAh Battery and Cover 2	16.80	17.50	1.175	62.9	1.006	0.04	0.530	0.626
	LTE Band 42 Part27Q	20M	QPSK	1	0	Left Tilted	Reduced	42990	3540	Non-IS Sku with 2900mAh Battery and Cover 2	16.84	17.50	1.164	62.9	1.006	0.08	0.623	0.730
	LTE Band 42 Part27Q	20M	QPSK	50	0	Left Tilted	Reduced	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	16.87	17.50	1.156	62.9	1.006	-0.06	0.676	0.786
	LTE Band 42 Part27Q	20M	QPSK	100	0	Left Tilted	Reduced	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	16.91	17.50	1.146	62.9	1.006	0.01	0.653	0.753

14.2 Hotspot SAR

<TDD LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Power Reduction	Ch.	Freq. (MHz)	Accessory	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)
02	LTE Band 42 Part27Q	20M	QPSK	1	0	Front	10mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	20.04	20.50	1.112	62.9	1.006	-0.08	0.407	0.455
	LTE Band 42 Part27Q	20M	QPSK	50	0	Front	10mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	18.99	19.50	1.125	62.9	1.006	0.04	0.179	0.203
	LTE Band 42 Part27Q	20M	QPSK	1	0	Back	10mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	20.04	20.50	1.112	62.9	1.006	0.02	0.258	0.289
	LTE Band 42 Part27Q	20M	QPSK	50	0	Back	10mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	18.99	19.50	1.125	62.9	1.006	-0.09	0.104	0.118
	LTE Band 42 Part27Q	20M	QPSK	1	0	Right Side	10mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	20.04	20.50	1.112	62.9	1.006	0.04	0.358	0.400
	LTE Band 42 Part27Q	20M	QPSK	50	0	Right Side	10mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	18.99	19.50	1.125	62.9	1.006	-0.05	0.283	0.320
	LTE Band 42 Part27Q	20M	QPSK	1	0	Top Side	10mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	20.04	20.50	1.112	62.9	1.006	0.07	0.120	0.134
	LTE Band 42 Part27Q	20M	QPSK	50	0	Top Side	10mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Cover 2	18.99	19.50	1.125	62.9	1.006	-0.14	0.099	0.112
	LTE Band 42 Part27Q	20M	QPSK	1	0	Front	10mm	Full	42590	3500	Non-IS Sku with 5800mAh Battery and Cover 1	20.04	20.50	1.112	62.9	1.006	-0.09	0.200	0.224

14.3 Body Worn Accessory SAR

<TDD LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Power Reduction	Ch.	Freq. (MHz)	Accessory	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)
03	LTE Band 42 Part27Q	20M	QPSK	1	0	Front	0mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and and Belt Clip PMLN7965	20.04	20.50	1.112	62.9	1.006	0.02	0.205	0.229
	LTE Band 42 Part27Q	20M	QPSK	50	0	Front	0mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and and Belt Clip PMLN7965	18.99	19.50	1.125	62.9	1.006	0.08	0.180	0.204
	LTE Band 42 Part27Q	20M	QPSK	1	0	Front	0mm	Full	42590	3500	Non-IS Sku with 5800mAh Battery and Belt Clip PMLN7965	20.04	20.50	1.112	62.9	1.006	-0.01	0.082	0.092
	LTE Band 42 Part27Q	20M	QPSK	1	0	Front	0mm	Full	42590	3500	Non-IS Sku with 2900mAh Battery and Belt Clip NNTN8266	20.04	20.50	1.112	62.9	1.006	-0.08	0.123	0.138

15. Simultaneous Transmission Analysis

No.	Simultaneous Transmission Configurations	Portable Handset			
		Head	Body-worn	Hotspot	Product specific 10g SAR
1.	LTE + WLAN2.4GHz	Yes	Yes	Yes	Yes
2.	LTE + WLAN5GHz	Yes	Yes		Yes
3.	LTE + WLAN5GHz +Bluetooth	Yes	Yes		Yes
4.	LTE + Bluetooth	Yes	Yes	Yes	Yes

General Note:

1. For simultaneously transmission SAR analysis, SAR values only considered which we did perform SAR testing on FA052616-30, and WLAN/BT chose higher SAR value from the original reference report (Sporton Report Number FA052616 and Motorola Solution Inc. with Report ID: P21328-EME-00005).
   The higher WLAN/BT SAR marked blue color means they come from Motorola Solution Inc.
2. This device 2.4GHz WLAN support hotspot operation and Bluetooth support tethering applications.
3. This device 5GHZ WLAN has no hotspot function.
4. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment though they have independent antenna.
5. WLAN 2.4GHz and Bluetooth share the same antenna so can't transmit simultaneously.
6. According to the EUT character, WLAN 5GHz and Bluetooth can transmit simultaneously. WWAN + WLAN5GHz + Bluetooth can represent WWAN + WLAN5GHz or WWAN + Bluetooth, So no need to do co-located analysis separately.
7. Chose the worst zoom scan SAR of WLAN correspondingly for co-located with WWAN analysis.
8. The reported SAR summation is calculated based on the same configuration and test position.
9. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) 1g Scalar SAR summation < 1.6W/kg and 10g Scalar SAR summation < 4.0W/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 for 1g SAR and SPLSR≤ 0.10 for 10g SAR , simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band 1g SAR < 1.6W/kg and 10g SAR < 4.0W/kg.

15.1 Head Exposure Conditions

WWAN Band	Exposure Position	1 WWAN 1g SAR (W/kg)	2 WLAN2.4GHz 1g SAR (W/kg)	3 WLAN5GHz 1g SAR (W/kg)	4 Bluetooth 1g SAR (W/kg)	1+2 Summed 1g SAR (W/kg)	1+3+4 Summed 1g SAR (W/kg)
LTE Band 42	Right Cheek	0.444	0.272	0.089	0.086	0.72	0.62
	Right Tilted	0.343	0.198	0.080	0.083	0.53	0.49
	Left Cheek	0.369	0.080	0.061	0.029	0.45	0.46
	Left Tilted	0.857	0.094	0.074	0.047	0.95	0.98

15.2 Hotspot Exposure Conditions

WWAN Band	Exposure Position	1 WWAN 1g SAR (W/kg)	2 WLAN2.4GHz 1g SAR (W/kg)	4 Bluetooth 1g SAR (W/kg)	1+2 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)
LTE Band 42	Front	0.455	0.068	0.027	0.52	0.48
	Back	0.289	0.120	0.049	0.41	0.34
	Left side		0.114	0.044	0.11	0.04
	Right side	0.400			0.40	0.40
	Top side	0.134	0.020	0.013	0.15	0.15

15.3 Body-Worn Accessory Exposure Conditions

WWAN Band	Exposure Position	1 WWAN 1g SAR (W/kg)	2 WLAN2.4GHz 1g SAR (W/kg)	3 WLAN5GHz 1g SAR (W/kg)	4 Bluetooth 1g SAR (W/kg)	1+2 Summed 1g SAR (W/kg)	1+3+4 Summed 1g SAR (W/kg)
LTE Band 42	Front	0.229	0.027	0.045	0.010	0.26	0.28

Test Engineer : Nick Hu, Seven Xu, Bruce Li

16. Uncertainty Assessment

Per 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.

17. 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 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
[6] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.
[7] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015
[8] FCC KDB 648474 D04 v01r03, “SAR Evaluation Considerations for Wireless Handsets”, Oct 2015.
[9] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.
[10] FCC KDB 616217 D04 v01r02, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, Oct 2015
[11] FCC KDB 941225 D01 v03r01, “3G SAR MEAUREMENT PROCEDURES”, Oct 2015
[12] FCC KDB 941225 D05 v02r05, “SAR Evaluation Considerations for LTE Devices”, Dec 2015
[13] FCC KDB 941225 D05A v01r02, “Rel. 10 LTE SAR Test Guidance and KDB Inquiries”, Oct 2015
[14] FCC KDB 941225 D06 v02r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", Oct 2015.

------THE END------

Appendix A. Plots of System Performance Check

The plots are shown as follows.

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2021.12.10

System Check_Head_3500MHz

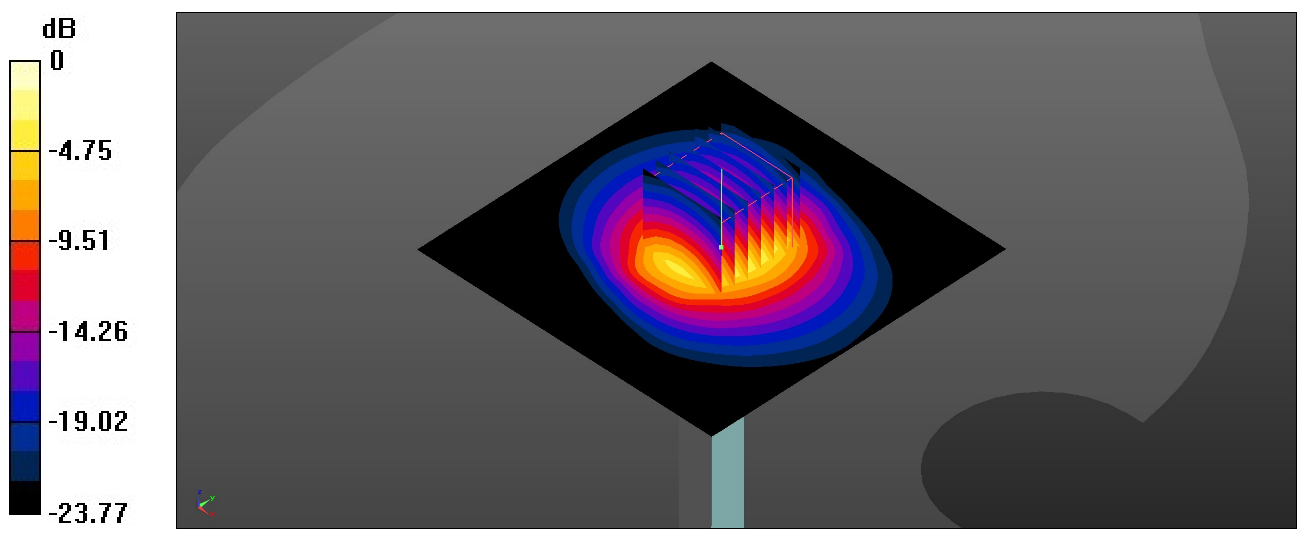
DUT: D3500V2 - SN:1037

Communication System: UID 0, CW (0); Frequency: 3500 MHz;Duty Cycle: 1:1
Medium: HSL_3500 Medium parameters used: f = 3500 MHz; σ = 2.785 S/m; ε_r = 38.969; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7630; ConvF(7.19, 7.19, 7.19); Calibrated: 2021.2.10
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn690; Calibrated: 2021.3.17
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-2022
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=50mW/Area Scan (91x91x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 5.29 W/kg

Pin=50mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 36.07 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 7.71 W/kg
SAR(1 g) = 3.2 W/kg; SAR(10 g) = 1.19 W/kg
Maximum value of SAR (measured) = 5.91 W/kg



0 dB = 5.91 W/kg = 7.72 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: 2021.12.10

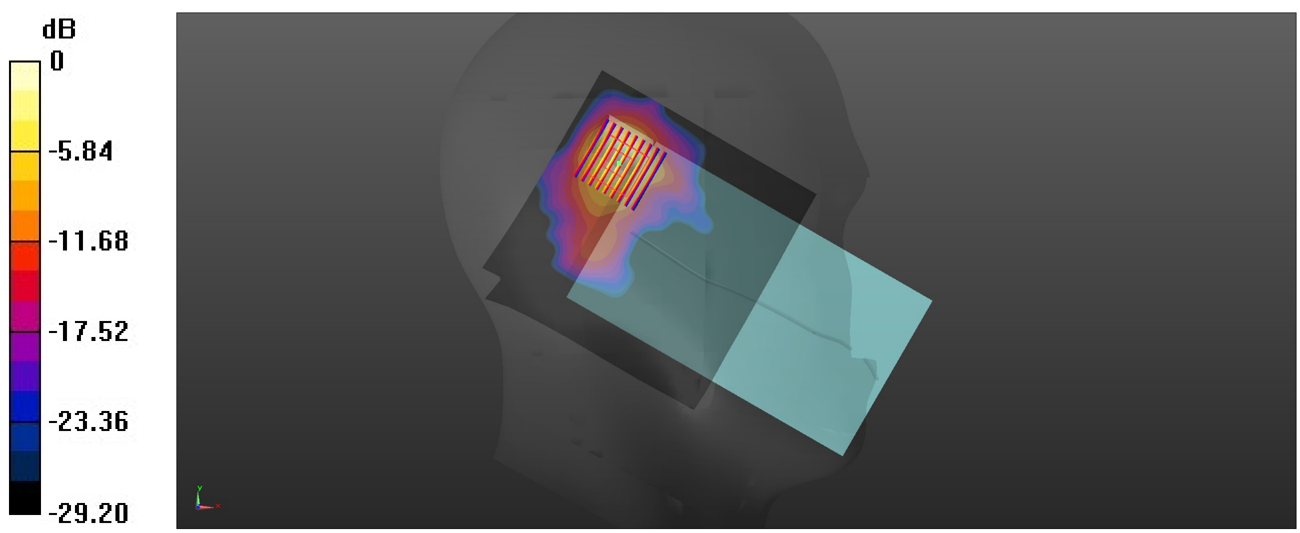
01_LTE Band 42_20M_QPSK_1RB_0Offset_Left Tilted_0mm_Ch42590

Communication System: UID 0, LTE-TDD (0); Frequency: 3500 MHz;Duty Cycle: 1:1.59
Medium: HSL_3500 Medium parameters used: f = 3500 MHz; σ = 2.785 S/m; ε_r = 38.969; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7630; ConvF(7.19, 7.19, 7.19); Calibrated: 2021.2.10
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn690; Calibrated: 2021.3.17
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-2022
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (121x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.28 W/kg

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 4.182 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 1.73 W/kg
SAR(1 g) = 0.754 W/kg; SAR(10 g) = 0.285 W/kg
Maximum value of SAR (measured) = 1.39 W/kg



0 dB = 1.39 W/kg = 1.43 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2021.12.10

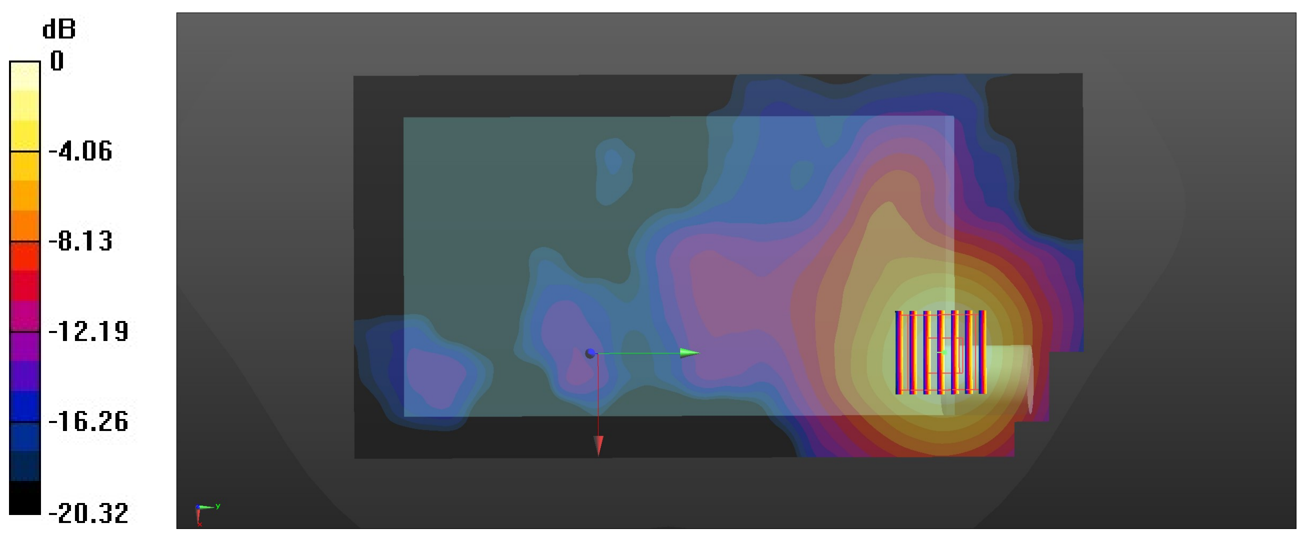
02_LTE Band 42_20M_QPSK_1RB_0Offset_Front_10mm_Ch42590

Communication System: UID 0, LTE-TDD (0); Frequency: 3500 MHz;Duty Cycle: 1:1.59
Medium: HSL_3500 Medium parameters used: f = 3500 MHz; σ = 2.785 S/m; ε_r = 38.969; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7630; ConvF(7.19, 7.19, 7.19); Calibrated: 2021.2.10
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn690; Calibrated: 2021.3.17
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-2022
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (111x211x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.681 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 3.439 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.878 W/kg
SAR(1 g) = 0.407 W/kg; SAR(10 g) = 0.191 W/kg
Maximum value of SAR (measured) = 0.691 W/kg



0 dB = 0.691 W/kg = -1.61 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2021.12.10

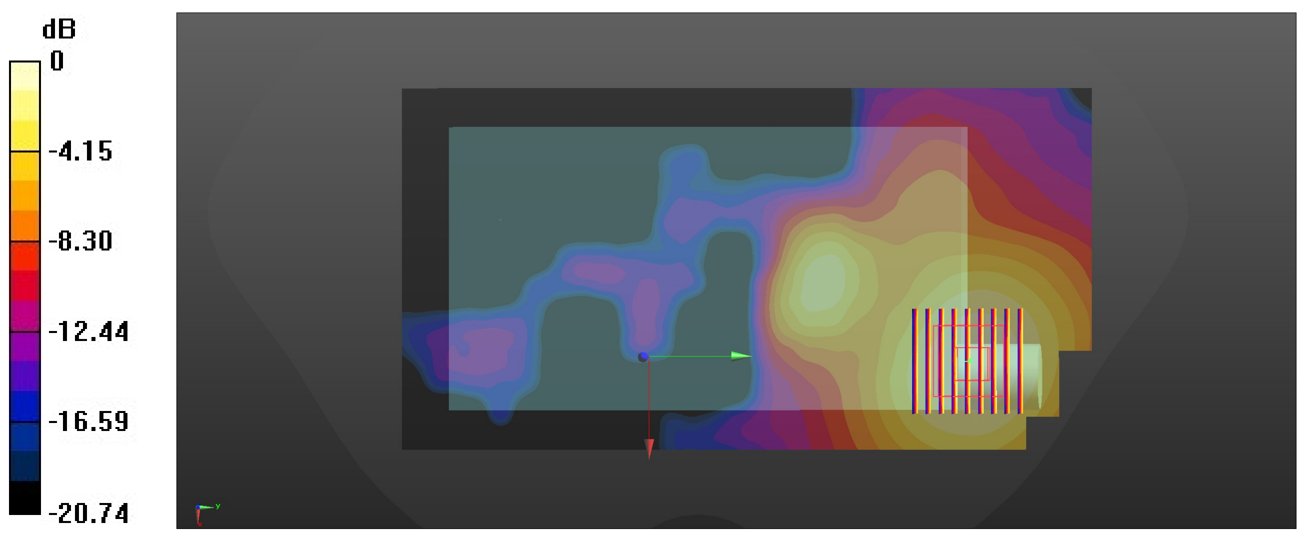
03_LTE Band 42_20M_QPSK_1RB_0Offset_Front_0mm_Ch42590

Communication System: UID 0, LTE-TDD (0); Frequency: 3500 MHz;Duty Cycle: 1:1.59
Medium: HSL_3500 Medium parameters used: f = 3500 MHz; σ = 2.785 S/m; ε_r = 38.969; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7630; ConvF(7.19, 7.19, 7.19); Calibrated: 2021.2.10
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn690; Calibrated: 2021.3.17
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-2022
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (111x211x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.340 W/kg

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.136 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.431 W/kg
SAR(1 g) = 0.205 W/kg; SAR(10 g) = 0.106 W/kg
Maximum value of SAR (measured) = 0.339 W/kg



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

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.