FCC SAR Test Report

APPLICANT	:	**Motorola Mobility, LLC**
EQUIPMENT	:	**Mobile Cellular Phone**
BRAND NAME	:	**Motorola**
MODEL NAME	:	**9894**
FCC ID	:	**IHDT56WB1**
STANDARD	:	**FCC 47 CFR Part 2 (2.1093)** **ANSI/IEEE C95.1-1992** **IEEE 1528-2013**

We, SPORTON INTERNATIONAL 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 INC., the test report shall not be reproduced except in full.

Eric Huang

Reviewed by: Eric Huang / Manager

Jones Tsai

Approved by: Jones Tsai / Manager

ilac-MRA

TAF Testing Laboratory 1190

SPORTON INTERNATIONAL INC.
No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.)

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA733129-30	Rev. 01	Initial issue of report	Jun. 30, 2017

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Motorola Mobility, LLC, Mobile Cellular Phone, 9894, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary			
		Head (Separation 0mm)	Body-worn (Separation 10mm)	Hotspot (Separation 10mm)	Product Specific (Separation 0mm)
		1g SAR (W/kg)			10g SAR (W/kg)
Licensed	GSM850	0.12	0.38	0.38	
	GSM1900	0.23	0.41	0.41	
	WCDMA II	0.34	0.58	0.58	3.23
	WCDMA V	0.16	0.72	0.72	
	CDMA BC0	0.20	0.58	0.56	
	CDMA BC1	0.37	0.50	0.93	3.63
	LTE Band 2	0.28	0.55	0.55	3.15
	LTE Band 4	0.35	0.48	0.48	2.97
	LTE Band 5	0.22	0.62	0.62	
	LTE Band 7	0.33	0.74	0.74	
	LTE Band 12	0.22	0.97	0.97	
	LTE Band 13	0.20	0.51	0.51	
	LTE Band 17	0.22	0.95	0.95	
	LTE Band 25	0.42	0.56	1.12	2.93
	LTE Band 26	0.18	0.80	0.80	
	LTE Band 66	0.43	0.81	0.95	
DTS	2.4GHz WLAN	0.53	0.22	0.37	
NII	5GHz WLAN	0.84	0.21	0.23	1.44
DSS	Bluetooth		0.02		
Date of Testing:		2017/6/15 ~ 2017/6/19			

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body, 4.0 W/kg for Product Specific) 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 INC.
Test Site Location	No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978

Applicant	
Company Name	Motorola Mobility, LLC
Address	222 W Merchandise Mart Plaza, Suite 1800, Chicago, IL 60654, United States

Manufacturer	
Company Name	Motorola Mobility, LLC
Address	222 W Merchandise Mart Plaza, Suite 1800, Chicago, IL 60654, United States

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 D05A Rel.10 LTE SAR Test Guidance v01r02
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01
- FCC KDB 648474 D03 Wireless Chargers Battery Cover v01r04

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Mobile Cellular Phone
Brand Name	Motorola
Model Name	9894
FCC ID	IHDT56WB1
IMEI Code	353310080024751
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 CDMA2000 BC0: 824.7 MHz ~ 848.31 MHz CDMA 2000 BC1: 1851.25 MHz ~ 1908.75 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 25: 1850.7 MHz ~ 1914.3 MHz LTE Band 26: 814.7 MHz ~ 848.3 MHz LTE Band 66: 1710.7 MHz ~ 1779.3 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 NFC : 13.56 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA CDMA2000 : 1xRTT/1xEv-Do(Rev.0)/1xEv-Do(Rev.A) LTE: QPSK, 16QAM, 64QAM WLAN 2.4GHz : 802.11b/g/n/ac HT20/VHT20 WLAN 5GHz : 802.11a/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE NFC:ASK
HW Version	DVT2
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. Variant report to add WPC accessory to verification worst case found in the original report and the conducted power also referred to original report, FCC ID: IHDT56WB1 (Sporton Report No. FA733129-02) performed testing.	

4.2 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>IHDT56WB1</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 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 25: 1850.7 MHz ~ 1914.3 MHz
LTE Band 26: 814.7 MHz ~ 848.3 MHz
LTE Band 66: 1710.7 MHz ~ 1779.3 MHz</td></tr>
<tr><td>Channel Bandwidth</td><td>LTE Band 02:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 04:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 05:1.4MHz, 3MHz, 5MHz, 10MHz
LTE Band 07: 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 12:1.4MHz, 3MHz, 5MHz, 10MHz
LTE Band 13: 5MHz, 10MHz
LTE Band 17: 5MHz, 10MHz
LTE Band 25:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
LTE Band 26:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz
LTE Band 66:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz</td></tr>
<tr><td>uplink modulations used</td><td>QPSK, 16QAM, 64QAM</td></tr>
<tr><td>LTE Voice / Data requirements</td><td>Voice and Data</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 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (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>
</table>
Table 6.2.3_3.3-1: Maximum Power Reduction (MPR) for Power Class 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth configuration [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>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>
</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, when operating in hotspot mode that LTE B2 / B4 / B5 / B7 / B12 / B13 / B17 / B25 / B26 / B66 power reduction applied to satisfy SAR compliance.</td></tr>
<tr><td>LTE Carrier Aggregation Combinations</td><td>Inter-Band and Intra-Band possible combinations and power verification please following original report section 12.</td></tr>
<tr><td>LTE Carrier Aggregation Additional Information</td><td>This device supports a maximum of 3 carriers in the downlink only. All uplink communications are identical to the Release 8 Specifications. Uplink communications are done on the PCC. Due to carrier capability, only the combinations listed above are supported. The 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 25												
	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	26047	1850.7	26055	1851.5	26065	1852.5	26090	1855	26115	1857.5	26140	1860
M	26340	1880	26340	1880	26340	1880	26340	1880	26340	1880	26340	1880
H	26683	1914.3	26675	1913.5	26665	1912.5	26640	1910	26615	1907.5	26590	1905

LTE Band 26										
	Bandwidth 1.4 MHz		Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	26697	814.7	26705	815.5	26715	816.5	26740	819	26765	821.5
M	26865	831.5	26865	831.5	26865	831.5	26865	831.5	26865	831.5
H	27033	848.3	27025	847.5	27015	846.5	26990	844	26965	841.5

LTE Band 66												
	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	131979	1710.7	131987	1711.5	131997	1712.5	132022	1715	132047	1717.5	132072	1720
M	132322	1745	132322	1745	132322	1745	132322	1745	132322	1745	132322	1745
H	132665	1779.3	132657	1778.5	132647	1777.5	132622	1775	132597	1772.5	132572	1770

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

1. 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:

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

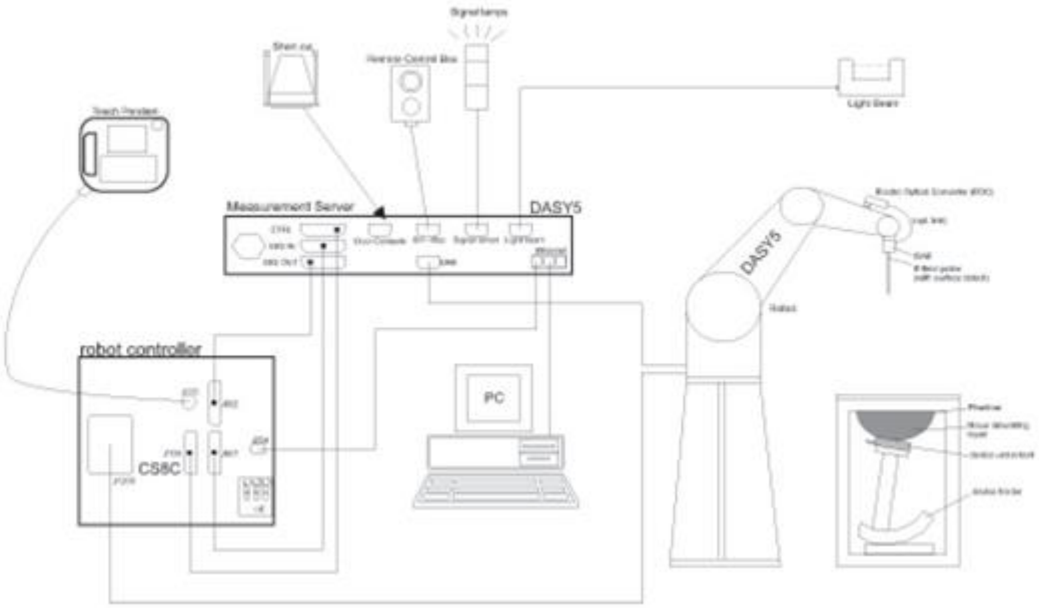
SAR is expressed in units of Watts per kilogram (W/kg)

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

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.

<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	

<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)

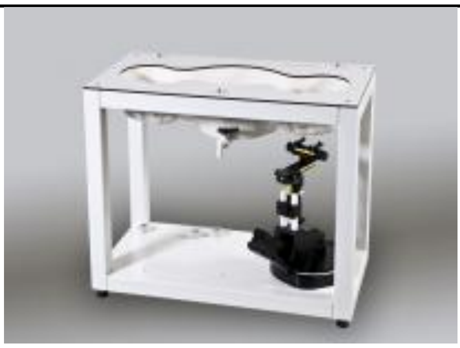
The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an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

Fig 5.1 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	$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ 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	750MHz System Validation Kit	D750V3	1012	May. 22, 2017	May. 21, 2018
SPEAG	835MHz System Validation Kit	D835V2	499	Mar. 21, 2017	Mar. 20, 2018
SPEAG	1750MHz System Validation Kit	D1750V2	1068	Nov. 16, 2016	Nov. 15, 2017
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Sep. 30, 2016	Sep. 29, 2017
SPEAG	2450MHz System Validation Kit	D2450V2	926	Jul. 25, 2016	Jul. 24, 2017
SPEAG	2600MHz System Validation Kit	D2600V2	1008	Aug. 30, 2016	Aug. 29, 2017
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Sep. 27, 2016	Sep. 26, 2017
SPEAG	Data Acquisition Electronics	DAE4	778	May. 22, 2017	May. 21, 2018
SPEAG	Data Acquisition Electronics	DAE3	577	Sep. 28, 2016	Sep. 27, 2017
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Aug. 26, 2016	Aug. 25, 2017
SPEAG	Dosimetric E-Field Probe	EX3DV4	3931	Oct. 03, 2016	Oct. 02, 2017
WonDer	Thermometer	WD-5016	TM281-1	Mar. 17, 2017	Mar. 16, 2018
WonDer	Thermometer	WD-5016	TM281-2	Mar. 17, 2017	Mar. 16, 2018
Anritsu	Radio Communication Analyzer	MT8821C	6201341950	Apr. 20, 2017	Apr. 19, 2018
Agilent	Wireless Communication Test Set	E5515C	GB46311322	Mar. 13, 2017	Mar. 12, 2018
R&S	BT Base Station	CBT32	100522	Mar. 14, 2017	Mar. 13, 2018
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Dec. 09, 2016	Dec. 08, 2017
Agilent	ENA Network Analyzer	E5071C	MY46316648	Jan. 04, 2017	Jan. 03, 2018
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Jul. 19, 2016	Jul. 18, 2017
LINE SEIKI	Digital Thermometer	LKMelectronic	DTM3000SPEZIAL	Sep. 05, 2016	Sep. 04, 2017
Anritsu	Power Meter	ML2495A	1438002	Dec. 06, 2016	Dec. 05, 2017
Anritsu	Power Sensor	MA2411B	1339195	Dec. 06, 2016	Dec. 05, 2017
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 22, 2016	Aug. 21, 2017
Mini-Circuits	Power Amplifier	ZVE-8G+	D120604	Mar. 09, 2017	Mar. 08, 2018
Mini-Circuits	Power Amplifier	ZHL-42W+	QA1344002	Mar. 09, 2017	Mar. 08, 2018
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General 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 source.

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. 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.

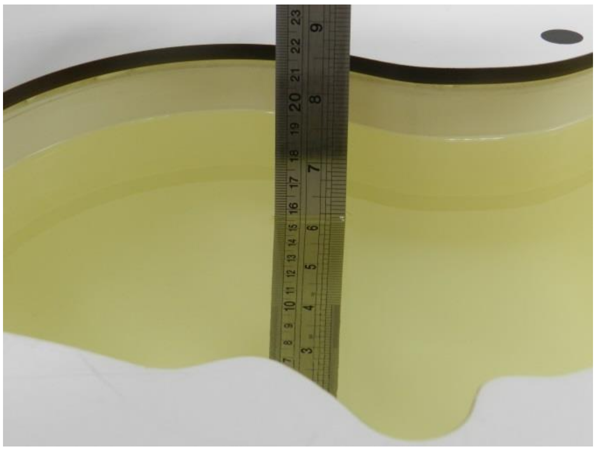


Fig 10.1Photo of Liquid Height for Head SAR

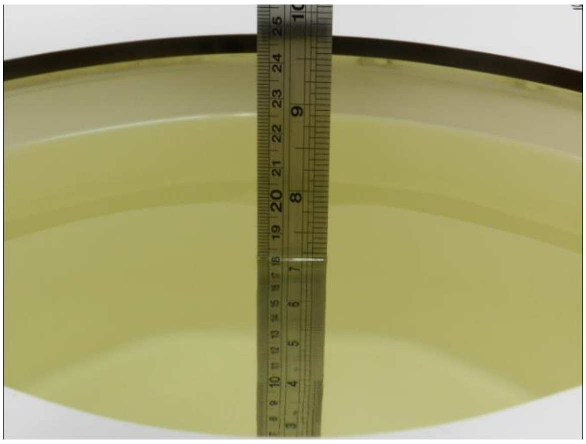


Fig 10.2 Photo of Liquid Height for Body SAR

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
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

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
750	HSL	22.5	0.898	40.752	0.89	41.90	0.90	-2.74	±5	2017/6/15
750	MSL	22.3	0.974	55.566	0.96	55.50	1.46	0.12	±5	2017/6/16
835	HSL	22.5	0.881	42.416	0.90	41.50	-2.11	2.21	±5	2017/6/15
835	MSL	22.3	0.966	55.798	0.97	55.20	-0.41	1.08	±5	2017/6/16
1750	HSL	22.5	1.362	39.541	1.37	40.10	-0.58	-1.39	±5	2017/6/18
1750	MSL	22.3	1.516	53.138	1.49	53.40	1.74	-0.49	±5	2017/6/16
1900	HSL	22.5	1.418	39.936	1.40	40.00	1.29	-0.16	±5	2017/6/18
1900	MSL	22.3	1.522	53.563	1.52	53.30	0.13	0.49	±5	2017/6/16
2450	HSL	22.4	1.809	40.475	1.80	39.20	0.50	3.25	±5	2017/6/18
2450	MSL	22.3	2.002	54.626	1.95	52.70	2.67	3.65	±5	2017/6/16
2600	HSL	22.5	1.972	39.949	1.96	39.00	0.61	2.43	±5	2017/6/18
2600	MSL	22.3	2.201	54.096	2.16	52.50	1.90	3.04	±5	2017/6/16
5250	HSL	22.4	4.498	35.675	4.71	35.95	-4.50	-0.76	±5	2017/6/17
5250	MSL	22.4	5.471	46.977	5.36	48.95	2.07	-4.03	±5	2017/6/19
5600	HSL	22.4	4.834	35.195	5.07	35.50	-4.65	-0.86	±5	2017/6/17
5600	MSL	22.4	5.931	46.373	5.77	48.50	2.79	-4.39	±5	2017/6/19
5750	HSL	22.4	4.989	35.002	5.22	35.35	-4.43	-0.98	±5	2017/6/17
5750	MSL	22.4	6.134	46.142	5.94	48.28	3.27	-4.43	±5	2017/6/19

<Tissue Dielectric Parameter Check for Low / Middle / High Frequencies>

General Note:

The tissue measure results for low / middle / high frequencies list below, the results were used in the Dasy SAR system to perform interpolation to determine the dielectric parameters on the SAR test device. The SAR test plots may slightly difference between the tables below due to the digit rounding in the software calculated.

CH	Frequency (MHz)	Liquid Type	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
128	824.2	Head	0.871	42.551	0.899	41.551	-3.18	2.29	±5	Jun. 15, 2017
189	836.4	Head	0.883	42.398	0.902	41.500	-1.91	2.16	±5	Jun. 15, 2017
251	848.8	Head	0.894	42.248	0.915	41.500	-1.72	1.80	±5	Jun. 15, 2017
4132	826.4	Head	0.873	42.524	0.899	41.540	-2.96	2.47	±5	Jun. 15, 2017
4182	836.4	Head	0.883	42.398	0.902	41.500	-1.91	2.16	±5	Jun. 15, 2017
4233	846.6	Head	0.892	42.274	0.912	41.500	-1.94	1.87	±5	Jun. 15, 2017
20450	829	Head	0.876	42.492	0.899	41.528	-2.69	2.39	±5	Jun. 15, 2017
20525	836.5	Head	0.883	42.397	0.902	41.500	-1.90	2.16	±5	Jun. 15, 2017
20600	844	Head	0.890	42.304	0.910	41.500	-2.21	1.94	±5	Jun. 15, 2017
1013	824.7	Head	0.872	42.544	0.899	41.548	-3.13	2.52	±5	Jun. 15, 2017
384	836.52	Head	0.883	42.397	0.902	41.500	-1.90	2.16	±5	Jun. 15, 2017
777	848.31	Head	0.894	42.254	0.914	41.500	-1.77	1.82	±5	Jun. 15, 2017
476	817.9	Head	0.865	42.631	0.898	41.580	-3.85	2.48	±5	Jun. 15, 2017
580	820.5	Head	0.868	42.598	0.898	41.568	-3.57	2.40	±5	Jun. 15, 2017
684	823.1	Head	0.870	42.566	0.899	41.556	-3.30	2.32	±5	Jun. 15, 2017
26765	821.5	Head	0.869	42.586	0.898	41.564	-3.46	2.37	±5	Jun. 15, 2017
26865	831.5	Head	0.878	42.459	0.900	41.516	-2.42	2.31	±5	Jun. 15, 2017
26965	841.5	Head	0.888	42.334	0.907	41.500	-2.47	2.01	±5	Jun. 15, 2017
26865	831.5	Head	0.878	42.459	0.898	41.564	-2.42	2.06	±5	Jun. 15, 2017
26915	836.5	Head	0.883	42.397	0.900	41.516	-1.90	2.16	±5	Jun. 15, 2017
26965	841.5	Head	0.888	42.334	0.907	41.500	-2.47	2.01	±5	Jun. 15, 2017
23060	704	Head	0.855	41.335	0.887	42.145	-3.98	-1.82	±5	Jun. 15, 2017
23095	707.5	Head	0.858	41.312	0.887	42.127	-3.63	-1.87	±5	Jun. 15, 2017
23130	711	Head	0.861	41.288	0.887	42.108	-3.28	-1.93	±5	Jun. 15, 2017
23230	782	Head	0.927	40.354	0.894	42.145	4.20	-4.15	±5	Jun. 15, 2017
23780	709	Head	0.859	41.303	0.887	42.119	-3.50	-1.89	±5	Jun. 15, 2017
23790	710	Head	0.860	41.295	0.887	42.113	-3.39	-1.91	±5	Jun. 15, 2017
23800	711	Head	0.861	41.288	0.887	42.108	-3.28	-1.93	±5	Jun. 15, 2017
128	824.2	Body	0.956	55.904	0.969	55.238	-1.47	1.28	±5	Jun. 16, 2017
189	836.4	Body	0.966	55.786	0.972	55.196	-0.38	1.06	±5	Jun. 16, 2017
251	848.8	Body	0.978	55.669	0.987	55.158	-1.19	0.85	±5	Jun. 16, 2017
512	1850.2	Body	1.467	53.736	1.520	53.300	-3.49	0.82	±5	Jun. 16, 2017
661	1880	Body	1.500	53.636	1.520	53.300	-1.35	0.63	±5	Jun. 16, 2017
810	1909.8	Body	1.533	53.534	1.520	53.300	0.84	0.44	±5	Jun. 16, 2017
9262	1852.4	Body	1.470	53.730	1.520	53.300	-3.32	0.81	±5	Jun. 16, 2017
9400	1880	Body	1.500	53.636	1.520	53.300	-1.35	0.63	±5	Jun. 16, 2017
9538	1907.6	Body	1.530	53.539	1.520	53.300	0.68	0.45	±5	Jun. 16, 2017
4132	826.4	Body	0.958	55.885	0.969	55.230	-1.28	1.24	±5	Jun. 16, 2017
4182	836.4	Body	0.966	55.786	0.972	55.196	-0.38	1.06	±5	Jun. 16, 2017
4233	846.6	Body	0.976	55.689	0.984	55.164	-0.44	0.89	±5	Jun. 16, 2017

Table of Low/Middle/High Channel for Liquid Validation

CH	Frequency (MHz)	Liquid Type	Conductivity (σ)	Permittivity (εr)	Conductivity Target (σ)	Permittivity Target (εr)	Delta (σ) (%)	Delta (εr) (%)	Limit (%)	Date
18700	1860	Body	1.478	53.701	1.520	53.300	-2.76	0.75	±5	Jun. 16, 2017
18900	1880	Body	1.500	53.636	1.520	53.300	-1.35	0.63	±5	Jun. 16, 2017
19100	1900	Body	1.522	53.563	1.520	53.300	0.13	0.49	±5	Jun. 16, 2017
20050	1720	Body	1.484	53.236	1.474	53.456	0.97	-0.49	±5	Jun. 16, 2017
20175	1732.5	Body	1.497	53.196	1.481	53.433	1.18	-0.38	±5	Jun. 16, 2017
20300	1745	Body	1.511	53.151	1.487	53.409	1.39	-0.47	±5	Jun. 16, 2017
23230	782	Body	1.006	55.251	0.964	55.684	4.76	-0.81	±5	Jun. 16, 2017
26140	1860	Body	1.478	53.701	1.520	53.300	-2.76	0.75	±5	Jun. 16, 2017
26340	1880	Body	1.500	53.636	1.520	53.300	-1.35	0.63	±5	Jun. 16, 2017
26590	1905	Body	1.527	53.545	1.520	53.300	0.48	0.46	±5	Jun. 16, 2017
23780	709	Body	0.937	56.020	0.960	55.660	-2.40	0.57	±5	Jun. 16, 2017
23790	710	Body	0.938	56.020	0.960	55.660	-2.29	0.57	±5	Jun. 16, 2017
23800	711	Body	0.938	56.000	0.960	55.660	-2.29	0.54	±5	Jun. 16, 2017
23060	704	Body	0.932	56.070	0.960	55.680	-2.92	0.66	±5	Jun. 16, 2017
23095	707.5	Body	0.935	56.040	0.960	55.670	-2.60	0.61	±5	Jun. 16, 2017
23130	711	Body	0.938	56.000	0.960	55.660	-2.29	0.54	±5	Jun. 16, 2017
20450	829	Body	0.960	55.860	0.970	55.220	-1.03	1.20	±5	Jun. 16, 2017
20525	836.5	Body	0.966	55.790	0.970	55.200	-0.41	1.07	±5	Jun. 16, 2017
20600	844	Body	0.973	55.710	0.980	55.170	-0.71	0.92	±5	Jun. 16, 2017
26765	821.5	Body	0.953	55.930	0.970	55.250	-1.75	1.14	±5	Jun. 16, 2017
26865	831.5	Body	0.962	55.830	0.970	55.210	-0.82	1.14	±5	Jun. 16, 2017
26965	841.5	Body	0.971	55.740	0.980	55.180	-0.92	0.98	±5	Jun. 16, 2017
132072	1720	Body	1.484	53.240	1.470	53.500	0.95	-0.49	±5	Jun. 16, 2017
132322	1745	Body	1.511	53.150	1.490	53.420	1.41	-0.47	±5	Jun. 16, 2017
132572	1770	Body	1.536	53.070	1.500	53.350	2.40	-0.62	±5	Jun. 16, 2017
1013	824.7	Body	0.956	55.900	0.970	55.240	-1.44	1.27	±5	Jun. 16, 2017
384	836.52	Body	0.966	55.790	0.970	55.200	-0.41	1.07	±5	Jun. 16, 2017
777	848.31	Body	0.978	55.670	0.990	55.160	-1.21	0.85	±5	Jun. 16, 2017
25	1851.25	Body	1.468	53.730	1.520	53.300	-3.42	0.81	±5	Jun. 16, 2017
600	1880	Body	1.500	53.640	1.520	53.300	-1.32	0.64	±5	Jun. 16, 2017
1175	1908.75	Body	1.532	53.540	1.520	53.300	0.79	0.45	±5	Jun. 16, 2017
20850	2510	Body	2.079	54.398	2.034	52.620	2.43	3.42	±5	Jun. 16, 2017
21100	2535	Body	2.112	54.312	2.069	52.587	2.02	3.25	±5	Jun. 16, 2017
21350	2560	Body	2.148	54.226	2.104	52.553	2.30	3.09	±5	Jun. 16, 2017
0	2402	Body	1.934	54.831	1.904	52.764	1.80	3.85	±5	Jun. 16, 2017
39	2441	Body	1.989	54.659	1.941	52.712	2.51	3.72	±5	Jun. 16, 2017
78	2480	Body	2.038	54.517	1.950	52.700	4.49	3.45	±5	Jun. 16, 2017
1	2412	Body	1.948	54.789	1.914	52.751	1.97	3.77	±5	Jun. 16, 2017
3	2422	Body	1.961	54.744	1.923	52.737	2.14	3.88	±5	Jun. 16, 2017
6	2437	Body	1.983	54.676	1.938	52.717	2.21	3.75	±5	Jun. 16, 2017
9	2452	Body	2.004	54.620	1.953	52.697	2.79	3.64	±5	Jun. 16, 2017
11	2462	Body	2.017	54.589	1.967	52.684	2.40	3.58	±5	Jun. 16, 2017
132072	1720	Head	1.331	39.619	1.369	40.089	-2.83	-1.20	±5	Jun. 18, 2017
132322	1745	Head	1.357	39.556	1.384	40.046	-1.65	-1.11	±5	Jun. 18, 2017
132572	1770	Head	1.382	39.474	1.395	40.015	-0.61	-1.32	±5	Jun. 18, 2017
20050	1720	Head	1.331	39.619	1.356	40.149	-2.11	-1.20	±5	Jun. 18, 2017
20175	1732.5	Head	1.344	39.611	1.362	40.129	-1.15	-1.22	±5	Jun. 18, 2017
20300	1745	Head	1.357	39.556	1.368	40.108	-0.94	-1.36	±5	Jun. 18, 2017

Table of Low/Middle/High Channel for Liquid Validation

CH	Frequency (MHz)	Liquid Type	Conductivity (σ)	Permittivity (εr)	Conductivity Target (σ)	Permittivity Target (εr)	Delta (σ) (%)	Delta (εr) (%)	Limit (%)	Date
512	1850.2	Head	1.364	40.102	1.400	40.000	-2.54	0.26	±5	Jun. 18, 2017
661	1880	Head	1.398	40.004	1.400	40.000	-0.17	0.01	±5	Jun. 18, 2017
810	1909.8	Head	1.428	39.889	1.400	40.000	2.00	-0.28	±5	Jun. 18, 2017
9262	1852.4	Head	1.367	40.095	1.400	40.000	-2.38	0.24	±5	Jun. 18, 2017
9400	1880	Head	1.398	40.004	1.400	40.000	-0.17	0.01	±5	Jun. 18, 2017
9538	1907.6	Head	1.426	39.902	1.400	40.000	1.82	-0.24	±5	Jun. 18, 2017
25	1851.25	Head	1.366	40.099	1.400	40.000	-2.46	0.25	±5	Jun. 18, 2017
600	1880	Head	1.398	40.004	1.400	40.000	-0.17	0.01	±5	Jun. 18, 2017
1175	1908.75	Head	1.427	39.897	1.400	40.000	1.92	-0.26	±5	Jun. 18, 2017
18700	1860	Head	1.375	40.062	1.400	40.000	-1.78	0.15	±5	Jun. 18, 2017
18900	1880	Head	1.398	40.004	1.400	40.000	-0.17	0.01	±5	Jun. 18, 2017
19100	1900	Head	1.418	39.936	1.400	40.000	1.29	-0.16	±5	Jun. 18, 2017
26140	1860	Head	1.375	40.062	1.400	40.000	-1.78	0.15	±5	Jun. 18, 2017
26340	1880	Head	1.398	40.004	1.400	40.000	-0.17	0.01	±5	Jun. 18, 2017
26590	1905	Head	1.423	39.915	1.400	40.000	1.65	-0.21	±5	Jun. 18, 2017
20850	2510	Head	1.873	40.260	1.864	39.120	0.68	2.97	±5	Jun. 18, 2017
21100	2535	Head	1.898	40.178	1.891	39.087	0.40	2.76	±5	Jun. 18, 2017
21350	2560	Head	1.928	40.074	1.917	39.053	0.43	2.49	±5	Jun. 18, 2017
1	2412	Head	1.764	40.641	1.766	39.268	-0.35	3.41	±5	Jun. 18, 2017
3	2422	Head	1.775	40.595	1.775	39.250	-0.31	3.56	±5	Jun. 18, 2017
6	2437	Head	1.792	40.526	1.788	39.223	0.14	3.38	±5	Jun. 18, 2017
9	2452	Head	1.811	40.468	1.802	39.197	0.62	3.24	±5	Jun. 18, 2017
11	2462	Head	1.822	40.443	1.813	39.184	0.67	3.17	±5	Jun. 18, 2017
36	5180	Body	5.386	47.100	5.276	49.027	2.00	-3.88	±5	Jun. 19, 2017
38	5190	Body	5.397	47.088	5.288	49.013	2.02	-3.90	±5	Jun. 19, 2017
40	5200	Body	5.408	47.066	5.300	49.000	2.03	-3.95	±5	Jun. 19, 2017
42	5210	Body	5.420	47.047	5.312	48.990	2.08	-3.99	±5	Jun. 19, 2017
44	5220	Body	5.434	47.023	5.323	48.980	2.14	-4.03	±5	Jun. 19, 2017
46	5230	Body	5.449	47.001	5.335	48.970	2.23	-4.08	±5	Jun. 19, 2017
48	5240	Body	5.462	46.992	5.346	48.960	2.09	-4.10	±5	Jun. 19, 2017
52	5260	Body	5.484	46.949	5.370	48.940	2.12	-3.99	±5	Jun. 19, 2017
54	5270	Body	5.499	46.930	5.381	48.930	2.22	-4.03	±5	Jun. 19, 2017
56	5280	Body	5.516	46.917	5.393	48.920	2.33	-4.06	±5	Jun. 19, 2017
58	5290	Body	5.527	46.906	5.404	48.910	2.36	-4.08	±5	Jun. 19, 2017
60	5300	Body	5.538	46.894	5.416	48.900	2.18	-4.10	±5	Jun. 19, 2017
62	5310	Body	5.549	46.875	5.428	48.787	2.19	-3.95	±5	Jun. 19, 2017
64	5320	Body	5.563	46.852	5.439	48.673	2.25	-3.79	±5	Jun. 19, 2017
100	5500	Body	5.795	46.550	5.650	48.600	2.57	-4.22	±5	Jun. 19, 2017
102	5510	Body	5.808	46.540	5.661	48.590	2.61	-4.24	±5	Jun. 19, 2017
104	5520	Body	5.819	46.521	5.673	48.580	2.64	-4.28	±5	Jun. 19, 2017
106	5530	Body	5.833	46.501	5.685	48.570	2.70	-4.32	±5	Jun. 19, 2017
108	5540	Body	5.848	46.479	5.696	48.560	2.59	-4.36	±5	Jun. 19, 2017
110	5550	Body	5.864	46.460	5.708	48.550	2.69	-4.40	±5	Jun. 19, 2017
112	5560	Body	5.875	46.454	5.720	48.540	2.72	-4.22	±5	Jun. 19, 2017
116	5580	Body	5.897	46.405	5.743	48.520	2.74	-4.32	±5	Jun. 19, 2017

Table of Low/Middle/High Channel for Liquid Validation

CH	Frequency (MHz)	Liquid Type	Conductivity (σ)	Permittivity (εr)	Conductivity Target (σ)	Permittivity Target (εr)	Delta (σ) (%)	Delta (εr) (%)	Limit (%)	Date
120	5600	Body	5.931	46.373	5.770	48.500	2.79	-4.39	±5	Jun. 19, 2017
122	5610	Body	5.945	46.365	5.778	48.485	2.85	-4.40	±5	Jun. 19, 2017
124	5620	Body	5.957	46.352	5.790	48.470	2.88	-4.43	±5	Jun. 19, 2017
126	5630	Body	5.970	46.336	5.801	48.455	2.93	-4.46	±5	Jun. 19, 2017
128	5640	Body	5.984	46.319	5.813	48.440	2.99	-4.30	±5	Jun. 19, 2017
132	5660	Body	6.013	46.287	5.837	48.410	2.96	-4.37	±5	Jun. 19, 2017
134	5670	Body	6.023	46.274	5.848	48.395	2.95	-4.39	±5	Jun. 19, 2017
136	5680	Body	6.033	46.249	5.860	48.380	2.96	-4.44	±5	Jun. 19, 2017
138	5690	Body	6.049	46.219	5.872	48.365	3.04	-4.51	±5	Jun. 19, 2017
140	5700	Body	6.065	46.205	5.883	48.350	3.15	-4.54	±5	Jun. 19, 2017
142	5710	Body	6.082	46.197	5.895	48.335	3.25	-4.35	±5	Jun. 19, 2017
144	5720	Body	6.094	46.188	5.907	48.320	3.12	-4.37	±5	Jun. 19, 2017
149	5745	Body	6.128	46.151	5.936	48.283	3.16	-4.45	±5	Jun. 19, 2017
151	5755	Body	6.142	46.131	5.947	48.268	3.22	-4.49	±5	Jun. 19, 2017
153	5765	Body	6.156	46.119	5.959	48.253	3.28	-4.52	±5	Jun. 19, 2017
155	5775	Body	6.167	46.108	5.971	48.238	3.30	-4.34	±5	Jun. 19, 2017
157	5785	Body	6.176	46.086	5.982	48.223	3.28	-4.39	±5	Jun. 19, 2017
159	5795	Body	6.190	46.057	5.994	48.208	3.34	-4.45	±5	Jun. 19, 2017
161	5805	Body	6.208	46.039	6.000	48.200	3.47	-4.48	±5	Jun. 19, 2017
165	5825	Body	6.238	46.016	6.030	48.200	3.44	-4.53	±5	Jun. 19, 2017
36	5180	Head	4.432	35.785	4.639	36.023	-4.49	-0.60	±5	Jun. 17, 2017
38	5190	Head	4.442	35.769	4.650	36.012	-4.47	-0.64	±5	Jun. 17, 2017
40	5200	Head	4.452	35.757	4.660	36.000	-4.47	-0.67	±5	Jun. 17, 2017
42	5210	Head	4.459	35.747	4.670	35.990	-4.52	-0.70	±5	Jun. 17, 2017
44	5220	Head	4.466	35.728	4.680	35.980	-4.56	-0.76	±5	Jun. 17, 2017
46	5230	Head	4.476	35.707	4.690	35.970	-4.56	-0.82	±5	Jun. 17, 2017
48	5240	Head	4.487	35.687	4.700	35.960	-4.54	-0.87	±5	Jun. 17, 2017
52	5260	Head	4.506	35.662	4.720	35.940	-4.54	-0.66	±5	Jun. 17, 2017
54	5270	Head	4.514	35.646	4.730	35.930	-4.56	-0.71	±5	Jun. 17, 2017
56	5280	Head	4.524	35.629	4.740	35.920	-4.55	-0.75	±5	Jun. 17, 2017
58	5290	Head	4.535	35.614	4.750	35.910	-4.52	-0.80	±5	Jun. 17, 2017
60	5300	Head	4.545	35.600	4.760	35.900	-4.52	-0.84	±5	Jun. 17, 2017
62	5310	Head	4.555	35.591	4.770	35.887	-4.52	-0.86	±5	Jun. 17, 2017
64	5320	Head	4.563	35.578	4.781	35.873	-4.54	-0.90	±5	Jun. 17, 2017
100	5500	Head	4.729	35.324	4.967	35.633	-4.85	-0.77	±5	Jun. 17, 2017
102	5510	Head	4.740	35.309	4.977	35.620	-4.82	-0.82	±5	Jun. 17, 2017
104	5520	Head	4.752	35.298	4.987	35.607	-4.77	-0.85	±5	Jun. 17, 2017
106	5530	Head	4.763	35.285	4.998	35.593	-4.73	-0.88	±5	Jun. 17, 2017
108	5540	Head	4.774	35.275	5.008	35.580	-4.71	-0.91	±5	Jun. 17, 2017
110	5550	Head	4.783	35.264	5.018	35.567	-4.72	-0.94	±5	Jun. 17, 2017
112	5560	Head	4.791	35.256	5.029	35.553	-4.76	-0.97	±5	Jun. 17, 2017
116	5580	Head	4.812	35.218	5.049	35.527	-4.71	-0.79	±5	Jun. 17, 2017
120	5600	Head	4.834	35.195	5.070	35.500	-4.65	-0.86	±5	Jun. 17, 2017
122	5610	Head	4.843	35.181	5.080	35.490	-4.66	-0.90	±5	Jun. 17, 2017
124	5620	Head	4.855	35.167	5.090	35.480	-4.62	-0.94	±5	Jun. 17, 2017
126	5630	Head	4.866	35.153	5.100	35.470	-4.59	-0.98	±5	Jun. 17, 2017
128	5640	Head	4.877	35.140	5.110	35.460	-4.55	-1.01	±5	Jun. 17, 2017

Table of Low/Middle/High Channel for Liquid Validation

CH	Frequency (MHz)	Liquid Type	Conductivity (σ)	Permittivity (εr)	Conductivity Target (σ)	Permittivity Target (εr)	Delta (σ) (%)	Delta (εr) (%)	Limit (%)	Date
132	5660	Head	4.897	35.124	5.130	35.440	-4.54	-0.78	±5	Jun. 17, 2017
134	5670	Head	4.905	35.116	5.140	35.430	-4.57	-0.80	±5	Jun. 17, 2017
136	5680	Head	4.914	35.098	5.150	35.420	-4.58	-0.85	±5	Jun. 17, 2017
138	5690	Head	4.926	35.077	5.160	35.410	-4.54	-0.91	±5	Jun. 17, 2017
140	5700	Head	4.937	35.064	5.170	35.400	-4.51	-0.95	±5	Jun. 17, 2017
142	5710	Head	4.947	35.054	5.180	35.390	-4.49	-0.98	±5	Jun. 17, 2017
144	5720	Head	4.956	35.042	5.190	35.380	-4.51	-1.01	±5	Jun. 17, 2017
149	5745	Head	4.983	35.007	5.215	35.355	-4.53	-1.11	±5	Jun. 17, 2017
151	5755	Head	4.994	34.994	5.225	35.345	-4.51	-0.87	±5	Jun. 17, 2017
153	5765	Head	5.005	34.985	5.235	35.335	-4.48	-0.89	±5	Jun. 17, 2017
155	5775	Head	5.014	34.980	5.245	35.325	-4.49	-0.91	±5	Jun. 17, 2017
157	5785	Head	5.022	34.970	5.255	35.315	-4.52	-0.93	±5	Jun. 17, 2017
159	5795	Head	5.030	34.951	5.265	35.305	-4.55	-0.99	±5	Jun. 17, 2017
161	5805	Head	5.041	34.933	5.275	35.295	-4.52	-1.04	±5	Jun. 17, 2017
165	5825	Head	5.063	34.909	5.296	35.275	-4.47	-1.11	±5	Jun. 17, 2017

Table of Low/Middle/High Channel for Liquid Validation

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.

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 (%)
2017/6/15	750	HSL	250	D750V3-1012	EX3DV4 - SN3931	DAE3 Sn577	2.21	8.22	8.84	7.54
2017/6/16	750	MSL	250	D750V3-1012	ES3DV3 - SN3270	DAE4 Sn778	2.34	8.71	9.36	7.46
2017/6/15	835	HSL	250	D835V2-499	EX3DV4 - SN3931	DAE3 Sn577	2.36	9.45	9.44	-0.11
2017/6/16	835	MSL	250	D835V2-499	ES3DV3 - SN3270	DAE4 Sn778	2.58	9.67	10.32	6.72
2017/6/18	1750	HSL	250	D1750V2-1068	ES3DV3 - SN3270	DAE4 Sn778	8.90	36.60	35.6	-2.73
2017/6/16	1750	MSL	250	D1750V2-1068	ES3DV3 - SN3270	DAE4 Sn778	9.21	36.20	36.84	1.77
2017/6/18	1900	HSL	250	D1900V2-5d041	ES3DV3 - SN3270	DAE4 Sn778	9.87	40.50	39.48	-2.52
2017/6/16	1900	MSL	250	D1900V2-5d041	ES3DV3 - SN3270	DAE4 Sn778	9.88	38.80	39.52	1.86
2017/6/18	2450	HSL	250	D2450V2-926	ES3DV3 - SN3270	DAE4 Sn778	13.90	52.80	55.6	5.30
2017/6/16	2450	MSL	250	D2450V2-926	ES3DV3 - SN3270	DAE4 Sn778	12.40	51.20	49.6	-3.13
2017/6/18	2600	HSL	250	D2600V2-1008	ES3DV3 - SN3270	DAE4 Sn778	15.20	56.80	60.8	7.04
2017/6/16	2600	MSL	250	D2600V2-1008	ES3DV3 - SN3270	DAE4 Sn778	14.60	55.20	58.4	5.80
2017/6/17	5250	HSL	100	D5GHzV2-1006	EX3DV4 - SN3931	DAE3 Sn577	8.24	80.60	82.4	2.23
2017/6/19	5250	MSL	100	D5GHzV2-1006	EX3DV4 - SN3931	DAE3 Sn577	7.51	75.50	75.1	-0.53
2017/6/17	5600	HSL	100	D5GHzV2-1006	EX3DV4 - SN3931	DAE3 Sn577	8.84	83.80	88.4	5.49
2017/6/19	5600	MSL	100	D5GHzV2-1006	EX3DV4 - SN3931	DAE3 Sn577	8.27	78.60	82.7	5.22
2017/6/17	5750	HSL	100	D5GHzV2-1006	EX3DV4 - SN3931	DAE3 Sn577	8.05	80.50	80.5	0.00
2017/6/19	5750	MSL	100	D5GHzV2-1006	EX3DV4 - SN3931	DAE3 Sn577	7.47	74.60	74.7	0.13

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 10g SAR (W/kg)	Deviation (%)
2017/6/16	1750	MSL	250	D1750V2-1068	ES3DV3 - SN3270	DAE4 Sn778	5.12	19.40	20.48	5.57
2017/6/16	1900	MSL	250	D1900V2-5d041	ES3DV3 - SN3270	DAE4 Sn778	5.26	20.60	21.04	2.14
2017/6/19	5250	MSL	100	D5GHzV2-1006	EX3DV4 - SN3931	DAE3 Sn577	2.00	21.20	20	-5.66
2017/6/19	5600	MSL	100	D5GHzV2-1006	EX3DV4 - SN3931	DAE3 Sn577	2.29	22.00	22.9	4.09

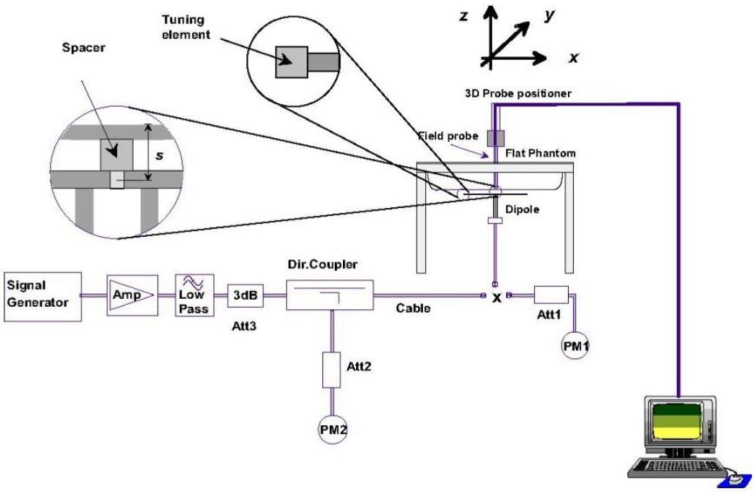


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

11. RF Exposure Positions

11.1 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.

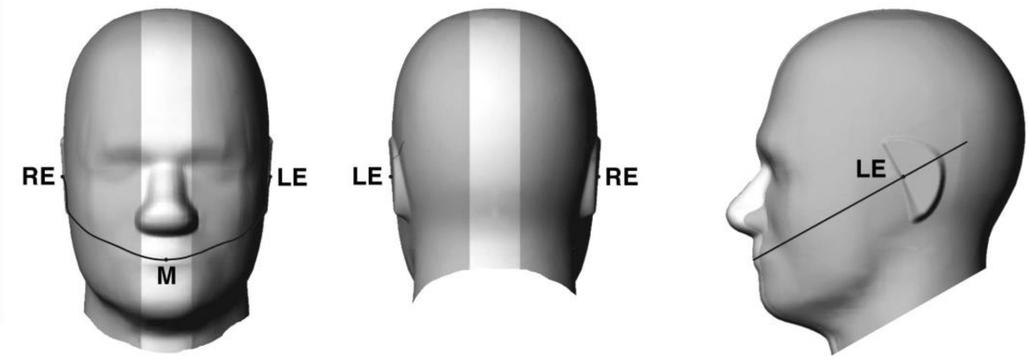


Fig 9.1.1 Front, back, and side views of SAM twin phantom

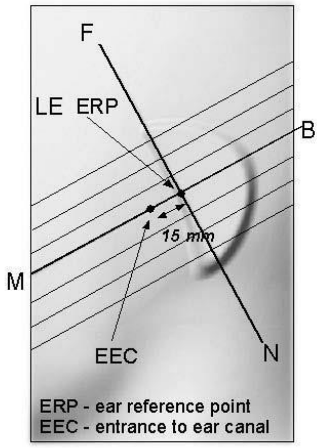


Fig 9.1.2 Close-up side view of phantom showing the ear region.

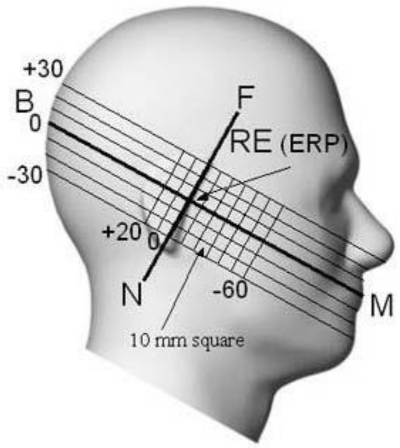


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

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 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.

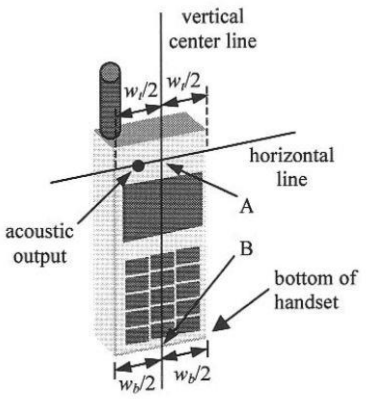


Fig 9.2.1 Handset vertical and horizontal reference lines—"fixed case

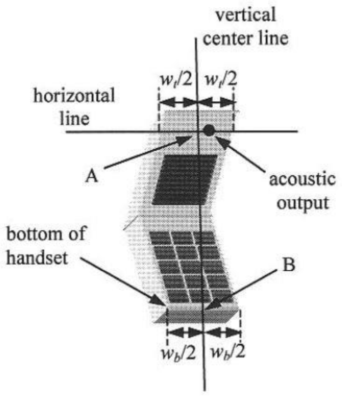


Fig 9.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

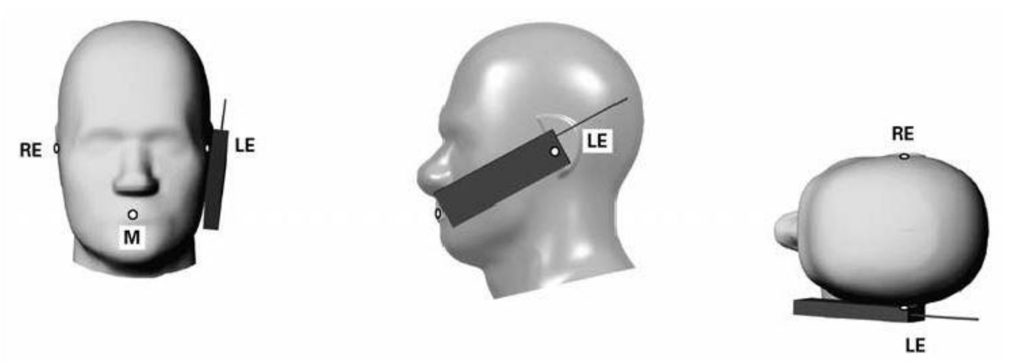


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

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 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

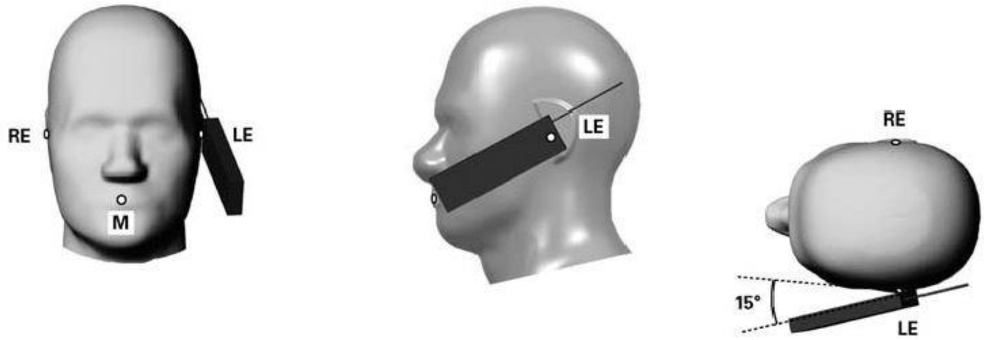


Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

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 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.

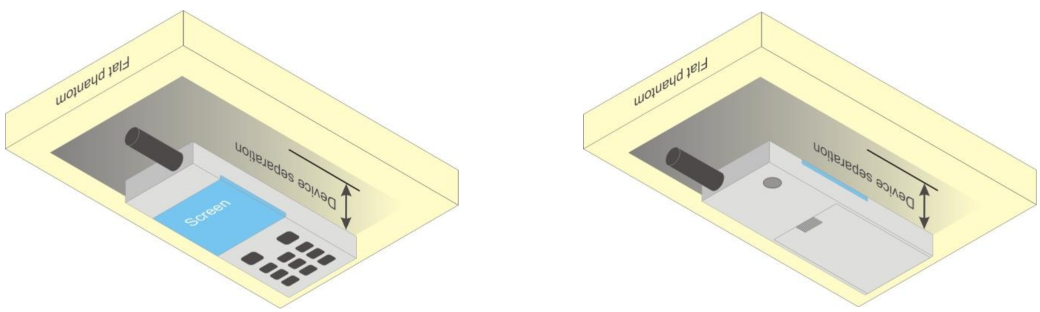


Fig 9.4 Body Worn Position

11.5 Product Specific

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.

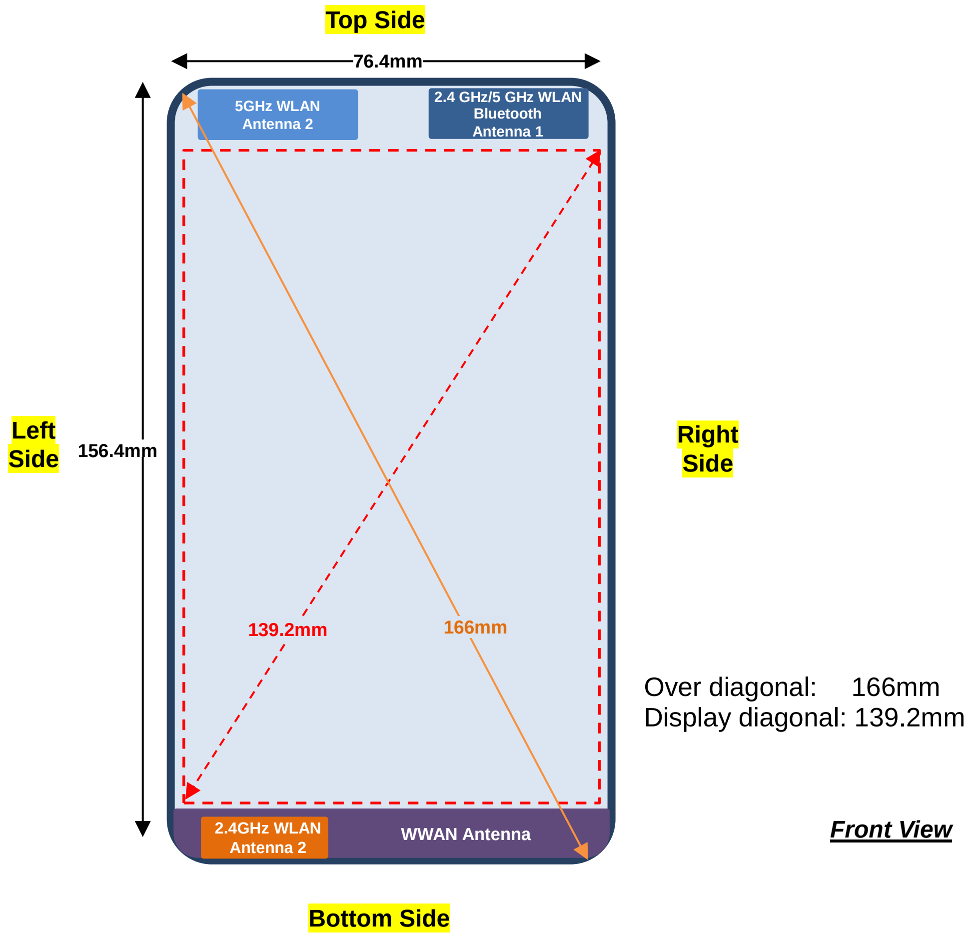
11.6 Wireless Router

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. Antenna Location

<Mobile Phone>



13. 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. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
   d. For WLAN / Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
3. 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.
4. Per KDB 648474 D03v01r04, the highest SAR reported for each wireless technology (1xRTT, EVDO, WCDMA, GSM, Wi-Fi etc.), frequency band, operating mode (different modes/configurations within each wireless technology) and exposure condition (head, body-worn accessory, hotspot mode, etc.) must be repeated using the wireless charging battery cover.
5. Per KDB 648474 D03v01r04, for test cases where the measured SAR for a handset with normal battery cover is greater than 1.2 W/kg, these tests should be repeated with the wireless charging battery cover.

13.1 Head SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
01	GSM850	GPRS (4 Tx slots)	Right Cheek	0mm	128	824.2	26.10	27.50	1.380	0.19	0.090	0.124
02	GSM1900	GPRS (4 Tx slots)	Left Cheek	0mm	810	1909.8	22.50	24.50	1.585	0.1	0.146	0.231

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
03	WCDMA II	RMC 12.2Kbps	Left Cheek	0mm	9400	1880	22.42	24.00	1.439	0.11	0.234	0.337
04	WCDMA V	RMC 12.2Kbps	Right Cheek	0mm	4132	826.4	22.80	22.80	1.000	0.11	0.155	0.155

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
05	CDMA2000 BC0	1xRTT RC3 SO55	Right Cheek	0mm	1013	824.7	23.91	25.00	1.285	0.07	0.154	0.198
06	CDMA2000 BC1	1xRTT RC3 SO55	Left Cheek	0mm	25	1851.25	23.42	25.00	1.439	-0.1	0.257	0.370

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
07	LTE Band 2	20M	QPSK	1	0	Left Cheek	0mm	19100	1900	22.90	24.00	1.288	-0.1	0.219	0.282
08	LTE Band 4	20M	QPSK	1	0	Right Cheek	0mm	20175	1732.5	22.83	24.00	1.309	0.12	0.269	0.352
09	LTE Band 5	10M	QPSK	1	0	Right Cheek	0mm	20525	836.5	22.57	24.00	1.390	0.07	0.157	0.218
10	LTE Band 7	20M	QPSK	1	0	Right Cheek	0mm	21350	2560	22.14	24.00	1.535	-0.01	0.214	0.328
11	LTE Band 12	10M	QPSK	1	0	Right Cheek	0mm	23095	707.5	22.36	24.00	1.459	-0.07	0.151	0.220
12	LTE Band 13	10M	QPSK	1	0	Right Cheek	0mm	23230	782	22.37	24.00	1.455	0.08	0.137	0.199
13	LTE Band 17	10M	QPSK	1	0	Right Cheek	0mm	23790	710	22.43	24.00	1.435	0.01	0.154	0.221
14	LTE Band 25	20M	QPSK	1	0	Left Cheek	0mm	26590	1905	22.88	24.00	1.294	-0.17	0.326	0.422
15	LTE Band 26	15M	QPSK	1	0	Left Cheek	0mm	26865	831.5	22.63	24.00	1.371	0.11	0.134	0.184
16	LTE Band 66	20M	QPSK	1	0	Left Cheek	0mm	132572	1770	22.89	24.00	1.291	-0.08	0.330	0.426

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
14	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 1	11	2462	15.85	16.50	1.161	100	1.000	-0.19	0.460	0.534
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	0mm	Ant 2	1	2412	15.90	16.50	1.148	100	1.000	-0.17	0.016	0.018
15	WLAN5GHz	802.11n-HT40 MCS0	Left Tilted	0mm	Ant 1	54	5270	14.79	15.00	1.050	89.62	1.116	0.07	0.389	0.456
	WLAN5GHz	802.11n-HT40 MCS0	Right Cheek	0mm	Ant 2	54	5270	14.86	15.00	1.033	90.48	1.105	-0.09	0.394	0.450
19	WLAN5GHz	802.11ac-VHT80 MCS0	Left Tilted	0mm	Ant 1	106	5530	14.91	15.00	1.021	86.51	1.156	-0.01	0.496	0.585
	WLAN5GHz	802.11ac-VHT80 MCS0	Right Tilted	0mm	Ant 2	106	5530	14.88	15.00	1.028	85.71	1.167	0	0.382	0.458
	WLAN5GHz	802.11ac-VHT80 MCS0	Left Tilted	0mm	Ant 1	155	5775	14.63	15.00	1.089	86.51	1.156	0.11	0.392	0.493
20	WLAN5GHz	802.11ac-VHT80 MCS0	Right Tilted	0mm	Ant 2	155	5775	14.79	15.00	1.050	85.71	1.167	-0.11	0.682	0.835

13.2 Hotspot SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
21	GSM850	GPRS (4 Tx slots)	Back	10mm	128	824.2	26.10	27.50	1.380	0.04	0.276	0.381
22	GSM1900	GPRS (4 Tx slots)	Back	10mm	810	1909.8	22.50	24.50	1.585	0.04	0.256	0.406

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
23	WCDMA II	RMC 12.2Kbps	Back	10mm	9262	1852.4	21.24	23.00	1.500	-0.05	0.388	0.582
24	WCDMA V	RMC 12.2Kbps	Back	10mm	4233	846.6	21.82	23.50	1.472	0.03	0.490	0.721

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
25	CDMA2000 BC0	RTAP 153.6Kbps	Back	10mm	777	848.31	22.74	24.00	1.337	-0.02	0.417	0.557
26	CDMA2000 BC1	RTAP 153.6Kbps	Bottom Side	10mm	1175	1908.75	21.41	23.00	1.442	-0.03	0.642	0.926

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
27	LTE Band 2	20M	QPSK	1	0	Back	10mm	18700	1860	21.91	23.00	1.285	-0.02	0.428	0.550
28	LTE Band 4	20M	QPSK	100	0	Back	10mm	20175	1732.5	21.16	22.00	1.213	-0.01	0.392	0.476
29	LTE Band 5	10M	QPSK	1	0	Front	10mm	20525	836.5	21.99	23.50	1.416	-0.1	0.438	0.620
30	LTE Band 7	20M	QPSK	1	0	Back	10mm	21100	2535	21.33	23.00	1.469	-0.08	0.505	0.742
31	LTE Band 12	10M	QPSK	1	0	Front	10mm	23095	707.5	21.60	23.00	1.380	0.02	0.701	0.968
32	LTE Band 13	10M	QPSK	1	0	Back	10mm	23230	782	21.14	22.50	1.368	0.05	0.375	0.513
33	LTE Band 17	10M	QPSK	1	0	Front	10mm	23790	710	21.58	23.00	1.387	0	0.684	0.949
34	LTE Band 25	20M	QPSK	1	0	Bottom Side	10mm	26140	1860	21.73	23.00	1.340	-0.06	0.839	1.124
35	LTE Band 26	15M	QPSK	1	0	Front	10mm	26865	831.5	21.58	23.00	1.387	-0.1	0.574	0.796
36	LTE Band 66	20M	QPSK	50	0	Bottom Side	10mm	132572	1770	20.89	22.00	1.291	-0.01	0.734	0.948

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	Ant 1	1	2412	15.90	16.50	1.148	100	1.000	0.09	0.119	0.137
37	WLAN2.4GHz	802.11b 1Mbps	Bottom Side	10mm	Ant 2	11	2462	15.60	16.50	1.230	100	1.000	-0.07	0.300	0.369
38	WLAN5GHz	802.11a 6Mbps	Front	10mm	Ant 1	36	5180	18.16	19.00	1.213	94.16	1.062	0.19	0.100	0.129
	WLAN5GHz	802.11a 6Mbps	Back	10mm	Ant 2	36	5180	18.10	19.00	1.230	94.85	1.054	0.17	0.041	0.053
	WLAN5GHz	802.11ac-VHT80 MCS0	Back	10mm	Ant 1	155	5775	18.18	19.00	1.208	86.51	1.156	0.18	0.038	0.053
39	WLAN5GHz	802.11ac-VHT80 MCS0	Top Side	10mm	Ant 2	155	5775	18.30	19.00	1.175	85.71	1.167	-0.11	0.166	0.228

13.3 Product Specific SAR

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
40	WCDMA II	RMC 12.2Kbps	Bottom Side	0mm	9262	1852.4	22.51	24.00	1.409	0.06	2.290	3.227

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
41	CDMA BC1	RTAP 153.6Kbps	Bottom Side	0mm	1175	1908.75	22.48	24.00	1.419	-0.16	2.560	3.633

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)
42	LTE Band 2	20M	QPSK	1	0	Bottom Side	0mm	19100	1900	22.78	24.00	1.324	-0.19	2.380	3.152
43	LTE Band 4	20M	QPSK	1	0	Bottom Side	0mm	20175	1732.5	22.76	24.00	1.330	-0.11	2.230	2.967
44	LTE Band 25	20M	QPSK	1	0	Bottom Side	0mm	26140	1860	22.63	24.00	1.371	-0.15	2.140	2.934

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 1	64	5320	18.26	19.00	1.186	94.16	1.062	-0.07	0.535	0.674
45	WLAN5GHz	802.11a 6Mbps	Front	0mm	Ant 2	64	5320	18.13	19.00	1.222	94.85	1.054	-0.11	0.705	0.908
	WLAN5GHz	802.11ac-VHT80 MCS0	Front	0mm	Ant 1	138	5690	18.25	19.00	1.189	86.51	1.156	0.01	0.365	0.501
46	WLAN5GHz	802.11ac-VHT80 MCS0	Top Side	0mm	Ant 2	138	5690	18.00	19.00	1.259	85.71	1.167	-0.18	0.981	1.441

13.4 Body Worn Accessory SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
47	GSM850	GPRS (4 Tx slots)	Back	10mm	128	824.2	26.10	27.50	1.380	0.04	0.276	0.381
48	GSM1900	GPRS (4 Tx slots)	Back	10mm	810	1909.8	22.50	24.50	1.585	0.04	0.256	0.406

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
49	WCDMA II	RMC 12.2Kbps	Back	10mm	9262	1852.4	21.24	23.00	1.500	-0.05	0.388	0.582
50	WCDMA V	RMC 12.2Kbps	Back	10mm	4233	846.6	21.82	23.50	1.472	0.03	0.490	0.721

<CDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
51	CDMA2000 BC0	1xRTT RC3 SO32	Back	10mm	777	848.31	22.71	24.00	1.346	0	0.427	0.575
52	CDMA2000 BC1	1xRTT RC3 SO32	Back	10mm	1175	1908.75	21.34	23.00	1.466	-0.06	0.342	0.501

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
53	LTE Band 2	20M	QPSK	1	0	Back	10mm	18700	1860	21.91	23.00	1.285	-0.02	0.428	0.550
54	LTE Band 4	20M	QPSK	100	0	Back	10mm	20175	1732.5	21.16	22.00	1.213	-0.01	0.392	0.476
55	LTE Band 5	10M	QPSK	1	0	Front	10mm	20525	836.5	21.99	23.50	1.416	-0.1	0.438	0.620
56	LTE Band 7	20M	QPSK	1	0	Back	10mm	21100	2535	21.33	23.00	1.469	-0.08	0.505	0.742
57	LTE Band 12	10M	QPSK	1	0	Front	10mm	23095	707.5	21.60	23.00	1.380	0.02	0.701	0.968
58	LTE Band 13	10M	QPSK	1	0	Back	10mm	23230	782	21.14	22.50	1.368	0.05	0.375	0.513
59	LTE Band 17	10M	QPSK	1	0	Front	10mm	23790	710	21.58	23.00	1.387	0	0.684	0.949
60	LTE Band 25	20M	QPSK	1	0	Back	10mm	26140	1860	21.73	23.00	1.340	-0.02	0.419	0.561
61	LTE Band 26	15M	QPSK	1	0	Front	10mm	26865	831.5	21.58	23.00	1.387	-0.1	0.574	0.796
62	LTE Band 66	20M	QPSK	50	0	Front	10mm	132322	1745	20.96	22.00	1.271	0.04	0.638	0.811

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	1	2412	15.90	16.50	1.148	100	1.000	0.09	0.119	0.137
63	WLAN2.4GHz	802.11b 1Mbps	Back	10mm	11	2462	15.60	16.50	1.230	100	1.000	0.05	0.177	0.218
	WLAN5GHz	802.11a 6Mbps	Front	10mm	64	5320	18.26	19.00	1.186	94.16	1.062	-0.18	0.076	0.096
64	WLAN5GHz	802.11a 6Mbps	Back	10mm	56	5280	18.00	19.00	1.259	94.85	1.054	0.16	0.107	0.142
	WLAN5GHz	802.11ac-VHT80 MCS0	Back	10mm	138	5690	18.25	19.00	1.189	86.51	1.156	0.14	0.022	0.030
65	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	138	5690	18.00	19.00	1.259	85.71	1.167	0.19	0.130	0.191
	WLAN5GHz	802.11ac-VHT80 MCS0	Back	10mm	155	5775	18.18	19.00	1.208	86.51	1.156	0.18	0.038	0.053
66	WLAN5GHz	802.11ac-VHT80 MCS0	Front	10mm	155	5775	18.30	19.00	1.175	85.71	1.167	0.16	0.150	0.206

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	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)
67	Bluetooth	1Mbps	Back	10mm	78	2480	14.16	16.00	1.087	76.6	1.305	-0.06	0.012	0.017

13.5 Repeated SAR Measurement

No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	LTE Band 25	20M	QPSK	1	0	Bottom Side	10mm	26140	1860	21.73	23.00	1.340	-0.06	0.839	-	1.124
2nd	LTE Band 25	20M	QPSK	1	0	Bottom Side	10mm	26140	1860	21.73	23.00	1.340	-0.01	0.800	1.05	1.072

No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Ratio	Reported 10g SAR (W/kg)
1st	CDMA BC1	RTAP 153.6Kbps	Bottom Side	0mm	1175	1908.75	22.48	24.00	1.419	-0.16	2.560	-	3.633
2nd	CDMA BC1	RTAP 153.6Kbps	Bottom Side	0mm	1175	1908.75	22.48	24.00	1.419	0.04	2.440	1.05	3.463

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Ratio	Reported 10g SAR (W/kg)
1st	LTE Band 4	20M	QPSK	1	0	Bottom Side	0mm	20175	1732.5	22.76	24.00	1.330	-0.11	2.230	-	2.967
2nd	LTE Band 4	20M	QPSK	1	0	Bottom Side	0mm	20175	1732.5	22.76	24.00	1.330	0.08	2.110	1.06	2.807

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.
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. 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. The ratio is the difference in percentage between original and repeated *measured SAR*.
5. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

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14. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	1/k[(b)]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 15.1. Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.00	N	1	1	1	6.0	6.0
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.00	R	1.732	1	1	0.6	0.6
Linearity	4.70	R	1.732	1	1	2.7	2.7
System Detection Limits	1.00	R	1.732	1	1	0.6	0.6
Modulation Response	4.68	R	1.732	1	1	2.7	2.7
Readout Electronics	0.30	N	1	1	1	0.3	0.3
Response Time	0.00	R	1.732	1	1	0.0	0.0
Integration Time	2.60	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2
Probe Positioning	2.90	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.00	R	1.732	1	1	1.2	1.2
Test Sample Related							
Device Positioning	3.03	N	1	1	1	3.0	3.0
Device Holder	3.60	N	1	1	1	3.6	3.6
Power Drift	5.00	R	1.732	1	1	2.9	2.9
Power Scaling	0.00	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.10	R	1.732	1	1	3.5	3.5
SAR correction	0.00	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.03	N	1	0.78	0.71	0.0	0.0
Liquid Conductivity (target)	5.00	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.68	R	1.732	0.78	0.71	1.7	1.5
Liquid Permittivity Repeatability	0.02	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.00	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.84	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						11.6%	11.6%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						23.2%	23.1%

Table 15.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.55	N	1	1	1	6.6	6.6
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	2.00	R	1.732	1	1	1.2	1.2
Linearity	4.70	R	1.732	1	1	2.7	2.7
System Detection Limits	1.00	R	1.732	1	1	0.6	0.6
Modulation Response	4.68	R	1.732	1	1	2.7	2.7
Readout Electronics	0.30	N	1	1	1	0.3	0.3
Response Time	0.00	R	1.732	1	1	0.0	0.0
Integration Time	2.60	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2
Probe Positioning	6.70	R	1.732	1	1	3.9	3.9
Max. SAR Eval.	4.00	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Positioning	3.03	N	1	1	1	3.0	3.0
Device Holder	3.60	N	1	1	1	3.6	3.6
Power Drift	5.00	R	1.732	1	1	2.9	2.9
Power Scaling	0.00	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.60	R	1.732	1	1	3.8	3.8
SAR correction	0.00	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.03	N	1	0.78	0.71	0.0	0.0
Liquid Conductivity (target)	5.00	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.68	R	1.732	0.78	0.71	1.7	1.5
Liquid Permittivity Repeatability	0.02	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.00	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.84	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						12.7%	12.6%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						25.4%	25.3%

Table 15.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz

15. 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 D05A v01r02, "Rel. 10 LTE SAR Test Guidance and KDB Inquiries", Oct 2015

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

[12] FCC KDB 616217 D04 v01r02, "SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers", Oct 2015

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

[14] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.

[15] FCC KDB 648474 D03 v01r04, "Evaluation and Approval Considerations for Handsets with Specific Wireless Charging Battery Covers" Dec 2015.