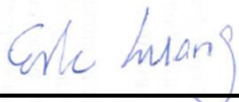


# FCC SAR Test Report

APPLICANT : Motorola Mobility, LLC  
EQUIPMENT : Mobile Cellular Phone  
BRAND NAME : Motorola  
MODEL NAME : 10720  
FCC ID : IHDT56WB2  
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.



Reviewed by: Eric Huang / Manager



Approved by: Jones Tsai / Manager



## 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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### 1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Motorola Mobility, LLC, Mobile Cellular Phone, 10720 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         | 0.13                  | 0.59                        | 0.59                      |                                   |
|                  | GSM1900        | 0.22                  | 0.42                        | 0.42                      |                                   |
|                  | WCDMA II       | 0.35                  | 0.53                        | 0.53                      | 3.23                              |
|                  | WCDMA IV       | 0.43                  | 0.87                        | 0.87                      | 3.13                              |
|                  | WCDMA V        | 0.29                  | 0.75                        | 0.75                      |                                   |
|                  | CDMA2000 BC0   | 0.33                  | 0.87                        | 0.56                      |                                   |
|                  | CDMA2000 BC1   | 0.33                  | 0.38                        | 0.81                      | 3.32                              |
|                  | CDMA2000 BC10  | 0.30                  | 0.71                        | 0.97                      |                                   |
|                  | LTE Band 2     | 0.32                  | 0.43                        | 0.43                      | 2.87                              |
|                  | LTE Band 4     | 0.31                  | 0.72                        | 0.72                      | 2.96                              |
|                  | LTE Band 5     | 0.30                  | 0.66                        | 0.66                      |                                   |
|                  | LTE Band 12    | 0.35                  | 0.68                        | 0.68                      |                                   |
|                  | LTE Band 13    | 0.37                  | 0.60                        | 0.60                      |                                   |
|                  | LTE Band 17    | 0.29                  | 0.67                        | 0.67                      |                                   |
|                  | LTE Band 25    | 0.35                  | 0.55                        | 1.06                      | 3.11                              |
|                  | LTE Band 26    | 0.31                  | 0.67                        | 0.67                      |                                   |
| LTE Band 41      | 0.37           | 1.10                  | 1.10                        |                           |                                   |
| DTS              | 2.4GHz WLAN    | 0.63                  | 0.23                        | 0.34                      |                                   |
| NII              | 5GHz WLAN      | 0.87                  | 0.22                        | 0.21                      | 1.12                              |
| DSS              | Bluetooth      |                       | 0.01                        |                           |                                   |
| 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.)<br>TEL: +886-3-327-3456<br>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



**4. Equipment Under Test (EUT) Information**

**4.1 General Information**

| Product Feature & Specification         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment Name                          | Mobile Cellular Phone                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Brand Name                              | Motorola                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Model Name                              | 10720                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| FCC ID                                  | IHDT56WB2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| IMEI Code                               | 990007530007795                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Wireless Technology and Frequency Range | GSM850: 824.2 MHz ~ 848.8 MHz<br>GSM1900: 1850.2 MHz ~ 1909.8 MHz<br>WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz<br>WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz<br>WCDMA Band V: 826.4 MHz ~ 846.6 MHz<br>CDMA2000 BC0: 824.7 MHz ~ 848.31 MHz<br>CDMA2000 BC1: 1851.25 MHz ~ 1908.75 MHz<br>CDMA2000 BC10: 817.9 MHz ~ 823.1 MHz<br>LTE Band 2: 1850.7 MHz ~ 1909.3 MHz<br>LTE Band 4: 1710.7 MHz ~ 1754.3 MHz<br>LTE Band 5: 824.7 MHz ~ 848.3 MHz<br>LTE Band 12: 699.7 MHz ~ 715.3 MHz<br>LTE Band 13: 779.5 MHz ~ 784.5 MHz<br>LTE Band 17: 706.5 MHz ~ 713.5 MHz<br>LTE Band 25: 1850.7 MHz ~ 1914.3 MHz<br>LTE Band 26: 814.7 MHz ~ 848.3 MHz<br>LTE Band 41: 2498.5 MHz ~ 2687.5 MHz<br>WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz<br>WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz<br>WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz<br>WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz<br>WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz<br>Bluetooth: 2402 MHz ~ 2480 MHz<br>NFC : 13.56 MHz |
| Mode                                    | GSM/GPRS/EGPRS<br>RMC/AMR 12.2Kbps<br>HSDPA<br>HSUPA<br>DC-HSDPA<br>CDMA2000 : 1xRTT/1xEv-Do(Rev.0)/1xEv-Do(Rev.A)<br>LTE: QPSK, 16QAM, 64QAM<br>WLAN 2.4GHz : 802.11b/g/n/ac HT20/VHT20<br>WLAN 5GHz : 802.11a/n/ac HT20/HT40/VHT20/VHT40/VHT80<br>Bluetooth BR/EDR/LE<br>NFC:ASK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 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 include verification of worst case found in the original report and the conducted power also referred to original report, FCC ID: IHDT56WB2 (Sporton Report No. FA733129-04) performed testing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



**4.2 General LTE SAR Test and Reporting Considerations**

| Summarized necessary items addressed in KDB 941225 D05 v02r05 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-------------------------------------------------|--------|--------|--------|----------|--|----------|---------|---------|-------|--------|--------|--------|------|-----|-----|-----|------|------|------|-----|--------|-----|-----|-----|------|------|------|-----|--------|-----|-----|-----|------|------|------|-----|
| FCC ID                                                        | IHDT56WB2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| Equipment Name                                                | Mobile Cellular Phone                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| Operating Frequency Range of each LTE transmission band       | LTE Band 2: 1850.7 MHz ~ 1909.3 MHz<br>LTE Band 4: 1710.7 MHz ~ 1754.3 MHz<br>LTE Band 5: 824.7 MHz ~ 848.3 MHz<br>LTE Band 12: 699.7 MHz ~ 715.3 MHz<br>LTE Band 13: 779.5 MHz ~ 784.5 MHz<br>LTE Band 17: 706.5 MHz ~ 713.5 MHz<br>LTE Band 25: 1850.7 MHz ~ 1914.3 MHz<br>LTE Band 26: 814.7 MHz ~ 848.3 MHz<br>LTE Band 41: 2498.5 MHz ~ 2687.5 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| Channel Bandwidth                                             | LTE Band 02: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz<br>LTE Band 04: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz<br>LTE Band 05: 1.4MHz, 3MHz, 5MHz, 10MHz<br>LTE Band 12: 1.4MHz, 3MHz, 5MHz, 10MHz<br>LTE Band 13: 5MHz, 10MHz<br>LTE Band 17: 5MHz, 10MHz<br>LTE Band 25: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz<br>LTE Band 26: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz<br>LTE Band 41: 5MHz, 10MHz, 15MHz, 20MHz                                                                                                                                                                                                                                                                                                                                                                                                                      |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| uplink modulations used                                       | QPSK, 16QAM, 64QAM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| LTE Voice / Data requirements                                 | Voice and Data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| LTE MPR permanently built-in by design                        | <p align="center"><b>Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3</b></p> <table border="1"> <thead> <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> </thead> <tbody> <tr> <td>QPSK</td> <td>&gt; 5</td> <td>&gt; 4</td> <td>&gt; 8</td> <td>&gt; 12</td> <td>&gt; 16</td> <td>&gt; 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>&gt; 5</td> <td>&gt; 4</td> <td>&gt; 8</td> <td>&gt; 12</td> <td>&gt; 16</td> <td>&gt; 18</td> <td>≤ 2</td> </tr> </tbody> </table> | Modulation | Channel bandwidth / Transmission bandwidth (RB) |        |        |        |          |  | MPR (dB) | 1.4 MHz | 3.0 MHz | 5 MHz | 10 MHz | 15 MHz | 20 MHz | QPSK | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 1 | 16 QAM | ≤ 5 | ≤ 4 | ≤ 8 | ≤ 12 | ≤ 16 | ≤ 18 | ≤ 1 | 16 QAM | > 5 | > 4 | > 8 | > 12 | > 16 | > 18 | ≤ 2 |
| Modulation                                                    | Channel bandwidth / Transmission bandwidth (RB)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |            |                                                 |        |        |        | MPR (dB) |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
|                                                               | 1.4 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3.0 MHz    | 5 MHz                                           | 10 MHz | 15 MHz | 20 MHz |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| QPSK                                                          | > 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | > 4        | > 8                                             | > 12   | > 16   | > 18   | ≤ 1      |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| 16 QAM                                                        | ≤ 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ≤ 4        | ≤ 8                                             | ≤ 12   | ≤ 16   | ≤ 18   | ≤ 1      |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| 16 QAM                                                        | > 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | > 4        | > 8                                             | > 12   | > 16   | > 18   | ≤ 2      |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| LTE A-MPR                                                     | 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)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| Spectrum plots for RB configuration                           | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| Power reduction applied to satisfy SAR compliance             | Yes, when operating in hotspot mode that LTE B2 / B4 / B5 / B12 / B13 / B17 / B25 / B26 power reduction applied to satisfy SAR compliance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| LTE Carrier Aggregation Combinations                          | Inter-Band and Intra-Band possible combinations as below page and the detail power verification please referred to section 12.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |
| LTE Carrier Aggregation Additional Information                | (1) This device supports LTE Carrier Aggregation (CA) in the uplink for LTE Band 41 with two component carriers in the uplink. SAR Measurements and conducted powers were evaluated per FCC Guidance.<br>(2) This device supports maximum of 3 carriers in the downlink and 2 carriers in the uplink. Additional following LTE Release features are not supported: Relay, HetNet, Enhanced MIMO, eICl, WiFi Offloading, MDH, eMBMA, Cross-Carrier Scheduling, Enhanced SC-FDMA.                                                                                                                                                                                                                                                                                                                                                  |            |                                                 |        |        |        |          |  |          |         |         |       |        |        |        |      |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |        |     |     |     |      |      |      |     |



| 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) | Ch. #            | Freq. (MHz) | Ch. #            | Freq. (MHz) |
| L                                                                       | 20407             | 824.7       | 20415            | 825.5       | 20425            | 826.5       | 20425            | 826.5       | 20450            | 829         |                  |             |
| M                                                                       | 20525             | 836.5       | 20525            | 836.5       | 20525            | 836.5       | 20525            | 836.5       | 20525            | 836.5       |                  |             |
| H                                                                       | 20643             | 848.3       | 20635            | 847.5       | 20625            | 846.5       | 20625            | 846.5       | 20600            | 844         |                  |             |
| 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) | Ch. #            | Freq. (MHz) | Ch. #            | Freq. (MHz) |
| L                                                                       | 23017             | 699.7       | 23025            | 700.5       | 23035            | 701.5       | 23035            | 701.5       | 23060            | 704         |                  |             |
| M                                                                       | 23095             | 707.5       | 23095            | 707.5       | 23095            | 707.5       | 23095            | 707.5       | 23095            | 707.5       |                  |             |
| H                                                                       | 23173             | 715.3       | 23165            | 714.5       | 23155            | 713.5       | 23155            | 713.5       | 23130            | 711         |                  |             |
| LTE Band 13                                                             |                   |             |                  |             |                  |             |                  |             |                  |             |                  |             |
|                                                                         | Bandwidth 5 MHz   |             |                  |             | Bandwidth 10 MHz |             |                  |             |                  |             |                  |             |
|                                                                         | Channel #         |             | Freq.(MHz)       |             | Channel #        |             | Freq.(MHz)       |             | Channel #        |             | Freq.(MHz)       |             |
| L                                                                       | 23205             |             | 779.5            |             | 23230            |             | 782              |             |                  |             |                  |             |
| M                                                                       | 23230             |             | 782              |             | 23230            |             | 782              |             |                  |             |                  |             |
| H                                                                       | 23255             |             | 784.5            |             | 23230            |             | 782              |             |                  |             |                  |             |
| LTE Band 17                                                             |                   |             |                  |             |                  |             |                  |             |                  |             |                  |             |
|                                                                         | Bandwidth 5 MHz   |             |                  |             | Bandwidth 10 MHz |             |                  |             |                  |             |                  |             |
|                                                                         | Channel #         |             | Freq.(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) | 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 41                                                             |                   |             |                  |             |                  |             |                  |             |                  |             |                  |             |
|                                                                         | Bandwidth 5 MHz   |             | Bandwidth 10 MHz |             | Bandwidth 15 MHz |             | Bandwidth 20 MHz |             |                  |             |                  |             |
|                                                                         | Ch. #             | Freq. (MHz) | Ch. #            | Freq. (MHz) | Ch. #            | Freq. (MHz) | Ch. #            | Freq. (MHz) | Ch. #            | Freq. (MHz) | Ch. #            | Freq. (MHz) |
| L                                                                       | 39675             | 2498.5      | 39700            | 2501        | 39725            | 2503.5      | 39750            | 2506        |                  |             |                  |             |
| L                                                                       | 40148             | 2545.8      | 40160            | 2547        | 40173            | 2548.3      | 40185            | 2549.5      |                  |             |                  |             |
| M                                                                       | 40620             | 2593        | 40620            | 2593        | 40620            | 2593        | 40620            | 2593        |                  |             |                  |             |
| H                                                                       | 41093             | 2640.3      | 41080            | 2639        | 41068            | 2637.8      | 41055            | 2636.5      |                  |             |                  |             |
| H                                                                       | 41565             | 2687.5      | 41540            | 2685        | 41515            | 2682.5      | 41490            | 2680        |                  |             |                  |             |



### 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 ( $\rho$ ). The equation description is as below:

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

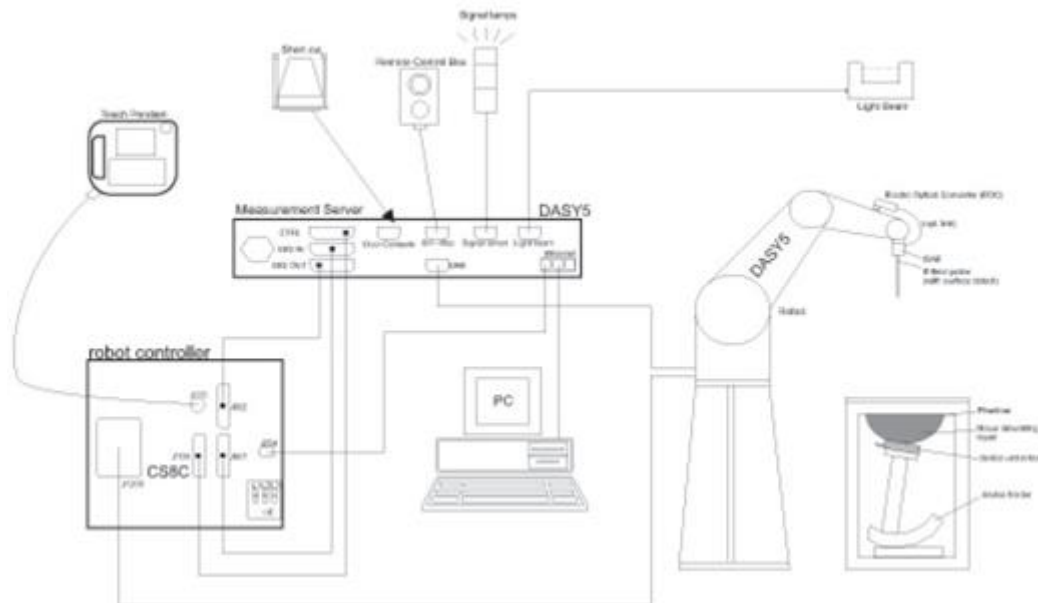
SAR is expressed in units of Watts per kilogram (W/kg)

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

Where:  $\sigma$  is the conductivity of the tissue,  $\rho$  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<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |  |
| Frequency     | 10 MHz – 4 GHz;<br>Linearity: ±0.2 dB (30 MHz – 4 GHz)                                                                                                                           |                                                                                    |
| Directivity   | ±0.2 dB in TSL (rotation around probe axis)<br>±0.3 dB in TSL (rotation normal to probe axis)                                                                                    |                                                                                    |
| Dynamic Range | 5 µW/g – >100 mW/g;<br>Linearity: ±0.2 dB                                                                                                                                        |                                                                                    |
| Dimensions    | Overall length: 337 mm (tip: 20 mm)<br>Tip diameter: 3.9 mm (body: 12 mm)<br>Distance from probe tip to dipole centers: 3.0 mm                                                   |                                                                                    |

**<EX3DV4 Probe>**

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

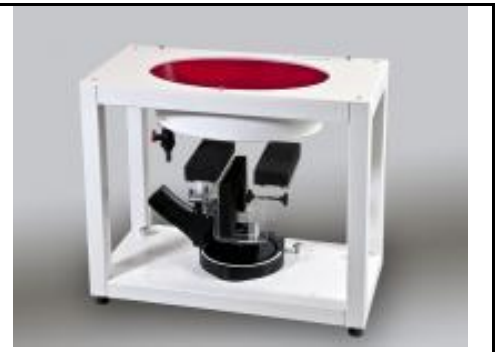
|                   |                                                            |
|-------------------|------------------------------------------------------------|
| Shell Thickness   | 2 ± 0.2 mm;<br>Center ear point: 6 ± 0.2 mm                |
| Filling Volume    | Approx. 25 liters                                          |
| Dimensions        | Length: 1000 mm; Width: 500 mm; Height:<br>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<br>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 from 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: $\Delta x_{Area}, \Delta y_{Area}$                               | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm                                                                                                                                                                                                                            | 3 – 4 GHz: ≤ 12 mm<br>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.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                    | ≤ 3 GHz                                                                              | > 3 GHz                                                                       |                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$                                                                                                                                                                                                                                                                                                                                                                                         |                                    | $\leq 2$ GHz: $\leq 8$ mm<br>2 – 3 GHz: $\leq 5$ mm*                                 | 3 – 4 GHz: $\leq 5$ mm*<br>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<br>4 – 5 GHz: $\leq 3$ mm<br>5 – 6 GHz: $\leq 2$ mm    |                                                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | graded grid                        | $\Delta z_{Zoom}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface | $\leq 4$ mm                                                                   | 3 – 4 GHz: $\leq 3$ mm<br>4 – 5 GHz: $\leq 2.5$ mm<br>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<br>4 – 5 GHz: $\geq 25$ mm<br>5 – 6 GHz: $\geq 22$ mm |                                                                              |
| Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.<br>* When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> 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. 24, 2017 | May. 23, 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.

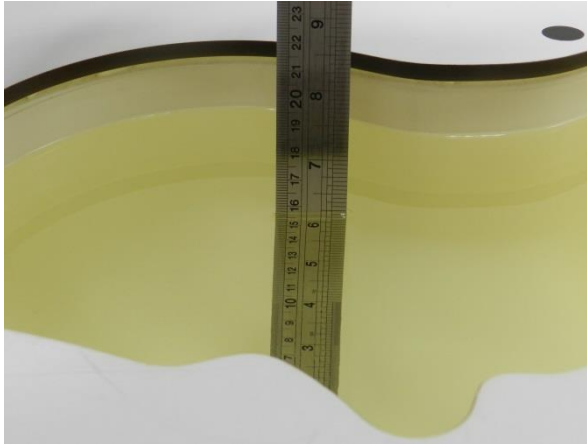


Fig 10.1 Photo of Liquid Height for Head SAR

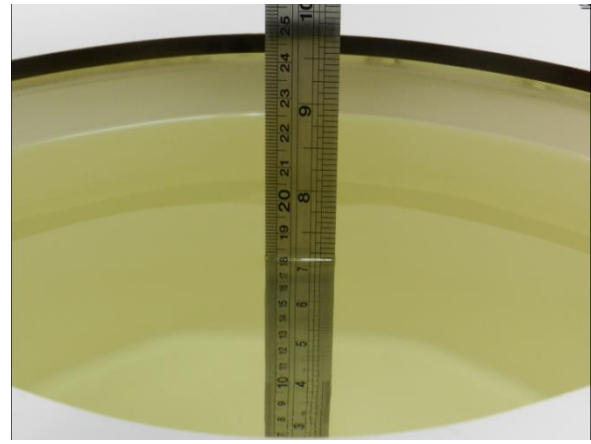


Fig 10.2 Photo of Liquid Height for Body SAR



**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) |
|------------------|-----------|-----------|---------------|----------|---------------|----------|------------------|-------------------|
| <b>For Head</b>  |           |           |               |          |               |          |                  |                   |
| 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              |
| <b>For Body</b>  |           |           |               |          |               |          |                  |                   |
| 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. (°C) | Conductivity (σ) | Permittivity (ε <sub>r</sub> ) | Conductivity Target (σ) | Permittivity Target (ε <sub>r</sub> ) | Delta (σ) (%) | Delta (ε <sub>r</sub> ) (%) | 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 ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Conductivity Target ( $\sigma$ ) | Permittivity Target ( $\epsilon_r$ ) | Delta ( $\sigma$ ) (%) | Delta ( $\epsilon_r$ ) (%) | 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 |
| 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 |
| 1312  | 1712.4          | Body        | 1.477                     | 53.267                        | 1.471                            | 53.471                               | 0.45                   | -0.44                      | ±5        | Jun. 16, 2017 |
| 1413  | 1732.6          | Body        | 1.498                     | 53.195                        | 1.481                            | 53.433                               | 1.19                   | -0.38                      | ±5        | Jun. 16, 2017 |

Table of Low/Middle/High Channel for Liquid Validation



| CH     | Frequency (MHz) | Liquid Type | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Conductivity Target ( $\sigma$ ) | Permittivity Target ( $\epsilon_r$ ) | Delta ( $\sigma$ ) (%) | Delta ( $\epsilon_r$ ) (%) | Limit (%) | Date          |
|--------|-----------------|-------------|---------------------------|-------------------------------|----------------------------------|--------------------------------------|------------------------|----------------------------|-----------|---------------|
| 1513   | 1752.6          | Body        | 1.519                     | 53.131                        | 1.492                            | 53.395                               | 1.94                   | -0.50                      | ±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 |
| 39750  | 2506            | Body        | 2.074                     | 54.408                        | 2.026                            | 52.629                               | 2.16                   | 3.44                       | ±5        | Jun. 16, 2017 |
| 40185  | 2549.5          | Body        | 2.132                     | 54.261                        | 2.087                            | 52.574                               | 1.99                   | 3.16                       | ±5        | Jun. 16, 2017 |
| 40620  | 2593            | Body        | 2.190                     | 54.132                        | 2.150                            | 52.519                               | 1.88                   | 3.11                       | ±5        | Jun. 16, 2017 |
| 41055  | 2636.5          | Body        | 2.257                     | 53.963                        | 2.213                            | 52.464                               | 2.12                   | 2.79                       | ±5        | Jun. 16, 2017 |
| 41490  | 2680            | Body        | 2.320                     | 53.791                        | 2.278                            | 52.409                               | 1.76                   | 2.66                       | ±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 |
| 1312   | 1712.4          | Head        | 1.323                     | 39.588                        | 1.352                            | 40.162                               | -1.97                  | -1.52                      | ±5        | Jun. 18, 2017 |
| 1413   | 1732.6          | Head        | 1.344                     | 39.610                        | 1.362                            | 40.129                               | -1.14                  | -1.22                      | ±5        | Jun. 18, 2017 |
| 1513   | 1752.6          | Head        | 1.365                     | 39.534                        | 1.372                            | 40.095                               | -0.37                  | -1.41                      | ±5        | Jun. 18, 2017 |

Table of Low/Middle/High Channel for Liquid Validation



| CH    | Frequency (MHz) | Liquid Type | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Conductivity Target ( $\sigma$ ) | Permittivity Target ( $\epsilon_r$ ) | Delta ( $\sigma$ ) (%) | Delta ( $\epsilon_r$ ) (%) | Limit (%) | Date          |
|-------|-----------------|-------------|---------------------------|-------------------------------|----------------------------------|--------------------------------------|------------------------|----------------------------|-----------|---------------|
| 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 |
| 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 |
| 39750 | 2506            | Head        | 1.868                     | 40.272                        | 1.857                            | 39.123                               | 0.44                   | 3.00                       | ±5        | Jun. 18, 2017 |
| 40185 | 2549.5          | Head        | 1.914                     | 40.115                        | 1.904                            | 39.065                               | 0.74                   | 2.60                       | ±5        | Jun. 18, 2017 |
| 40620 | 2593            | Head        | 1.963                     | 39.986                        | 1.952                            | 39.009                               | 0.67                   | 2.53                       | ±5        | Jun. 18, 2017 |
| 41055 | 2636.5          | Head        | 2.016                     | 39.814                        | 2.000                            | 38.954                               | 0.82                   | 2.09                       | ±5        | Jun. 18, 2017 |
| 41490 | 2680            | Head        | 2.066                     | 39.616                        | 2.048                            | 38.899                               | 0.80                   | 1.84                       | ±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 |

Table of Low/Middle/High Channel for Liquid Validation



| CH  | Frequency (MHz) | Liquid Type | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Conductivity Target ( $\sigma$ ) | Permittivity Target ( $\epsilon_r$ ) | Delta ( $\sigma$ ) (%) | Delta ( $\epsilon_r$ ) (%) | Limit (%) | Date          |
|-----|-----------------|-------------|---------------------------|-------------------------------|----------------------------------|--------------------------------------|------------------------|----------------------------|-----------|---------------|
| 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 |
| 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 |

Table of Low/Middle/High Channel for Liquid Validation



| CH  | Frequency (MHz) | Liquid Type | Conductivity ( $\sigma$ ) | Permittivity ( $\epsilon_r$ ) | Conductivity Target ( $\sigma$ ) | Permittivity Target ( $\epsilon_r$ ) | Delta ( $\sigma$ ) (%) | Delta ( $\epsilon_r$ ) (%) | Limit (%) | Date          |
|-----|-----------------|-------------|---------------------------|-------------------------------|----------------------------------|--------------------------------------|------------------------|----------------------------|-----------|---------------|
| 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 |
| 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       | ES3DV3 - SN3270 | DAE4 Sn778 | 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        | ES3DV3 - SN3270 | DAE4 Sn778 | 2.39                   | 9.45                   | 9.56                     | 1.16          |
| 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                  | 35.60                    | -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                  | 55.60                    | 5.30          |
| 2017/6/16 | 2450            | MSL         | 250              | D2450V2-926       | ES3DV3 - SN3270 | DAE4 Sn778 | 12.40                  | 51.20                  | 49.60                    | -3.13         |
| 2017/6/18 | 2600            | HSL         | 250              | D2600V2-1008      | ES3DV3 - SN3270 | DAE4 Sn778 | 15.20                  | 56.80                  | 60.80                    | 7.04          |
| 2017/6/16 | 2600            | MSL         | 250              | D2600V2-1008      | ES3DV3 - SN3270 | DAE4 Sn778 | 14.60                  | 55.20                  | 58.40                    | 5.80          |
| 2017/6/17 | 5250            | HSL         | 100              | D5GHzV2-1006-5250 | EX3DV4 - SN3931 | DAE3 Sn577 | 8.24                   | 80.60                  | 82.40                    | 2.23          |
| 2017/6/19 | 5250            | MSL         | 100              | D5GHzV2-1006-5250 | EX3DV4 - SN3931 | DAE3 Sn577 | 7.51                   | 75.50                  | 75.10                    | -0.53         |
| 2017/6/17 | 5600            | HSL         | 100              | D5GHzV2-1006-5600 | EX3DV4 - SN3931 | DAE3 Sn577 | 8.84                   | 83.80                  | 88.40                    | 5.49          |
| 2017/6/19 | 5600            | MSL         | 100              | D5GHzV2-1006-5600 | EX3DV4 - SN3931 | DAE3 Sn577 | 8.27                   | 78.60                  | 82.70                    | 5.22          |
| 2017/6/17 | 5750            | HSL         | 100              | D5GHzV2-1006-5750 | EX3DV4 - SN3931 | DAE3 Sn577 | 8.05                   | 80.50                  | 80.50                    | 0.00          |
| 2017/6/19 | 5750            | MSL         | 100              | D5GHzV2-1006-5750 | EX3DV4 - SN3931 | DAE3 Sn577 | 7.47                   | 74.60                  | 74.70                    | 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              | D5GHzV2-1006-5250 | EX3DV4 - SN3931 | DAE3 Sn577 | 2.00                    | 21.20                   | 20.00                     | -5.66         |
| 2017/6/19 | 5600            | MSL         | 100              | D5GHzV2-1006-5600 | EX3DV4 - SN3931 | DAE3 Sn577 | 2.29                    | 22.00                   | 22.90                     | 4.09          |
| 2017/6/19 | 5750            | MSL         | 100              | D5GHzV2-1006-5750 | EX3DV4 - SN3931 | DAE3 Sn577 | 2.08                    | 20.80                   | 20.80                     | 0.00          |

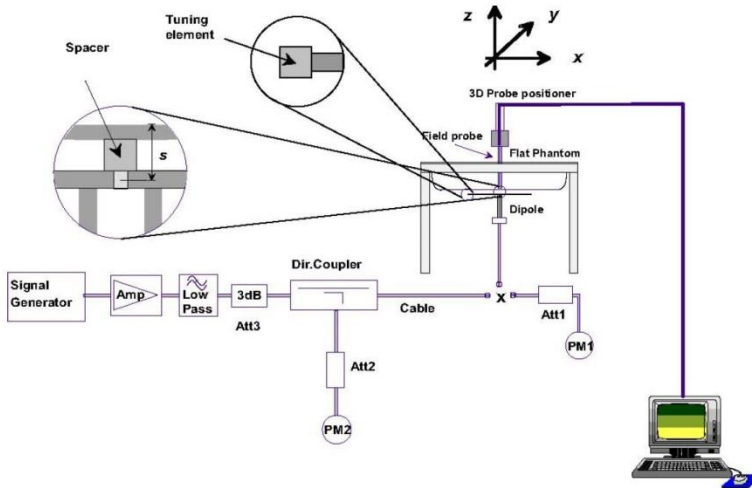


Fig 8.3.1 System Performance Check Setup



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.

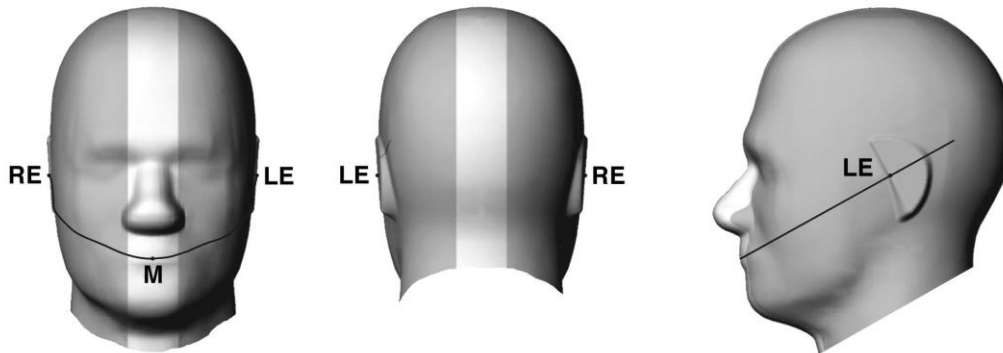


Fig 9.1.1 Front, back, and side views of SAM twin phantom

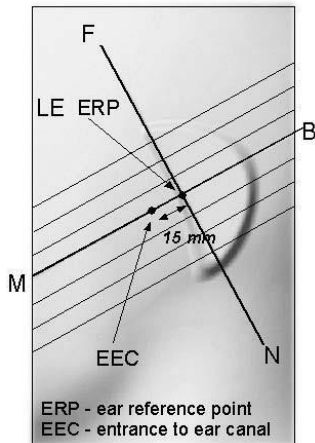


Fig 9.1.2 Close-up side view of phantom showing the ear region.

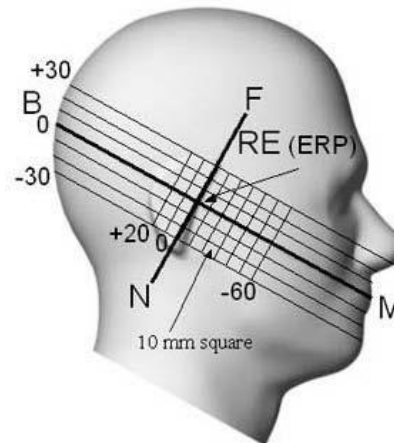


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

**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  $w_t$  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  $w_b$  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.

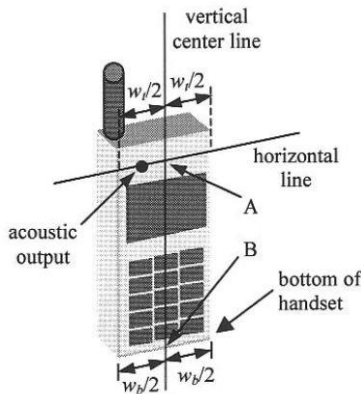


Fig 9.2.1 Handset vertical and horizontal reference lines—“fixed case”

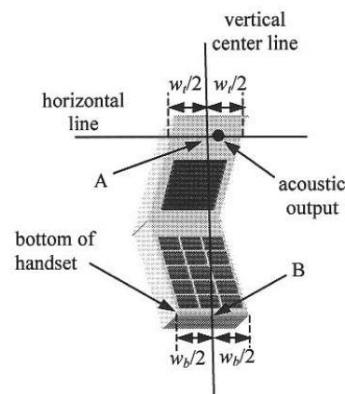


Fig 9.2.2 Handset vertical and horizontal reference lines—“clam-shell case”

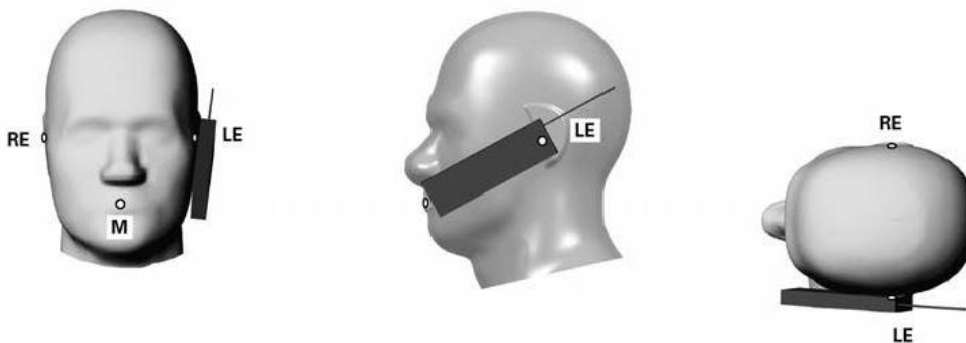


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

**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

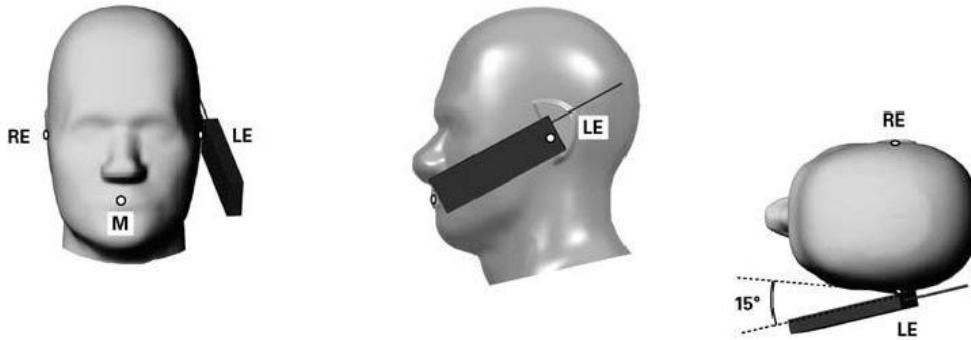
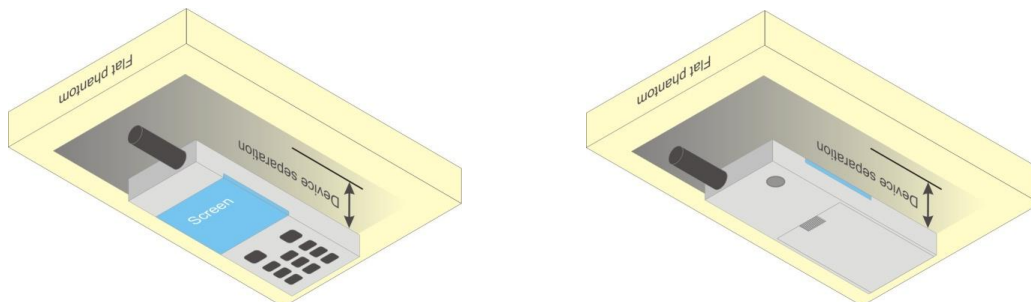


Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

**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 headset 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. 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  $\leq 25$  mm from that surface or edge, in direct contact with a flat phantom, for 10-g Product Specific SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions.<sup>6</sup> The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g Product Specific SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.

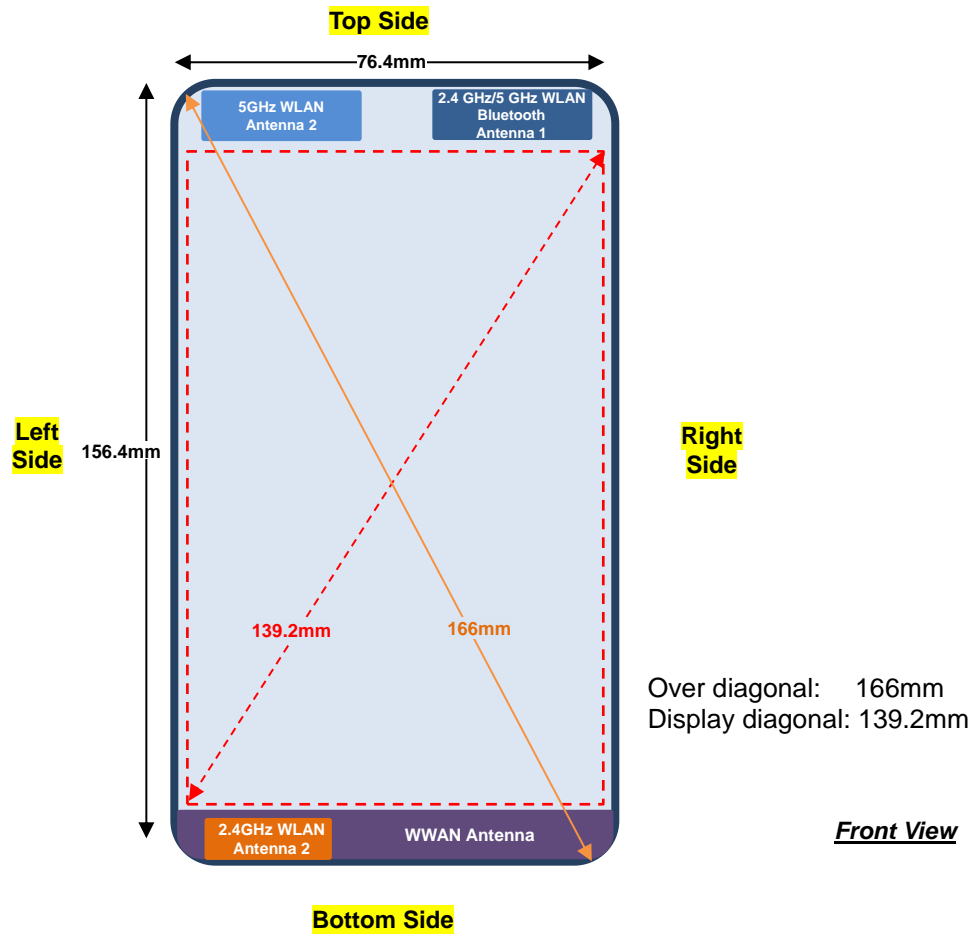
### **11.6 Wireless Router**

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 ( $L \times W \geq 9$  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 from 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
  - e. For TDD LTE SAR measurement, the duty cycle 1:1.59 (62.9 %) was used perform testing and considering the theoretical duty cycle of 63.3% for extended cyclic prefix in the uplink, and the theoretical duty cycle of 62.9% for normal cyclic prefix in uplink, a scaling factor of extended cyclic prefix  $63.3\%/62.9\% = 1.006$  is applied to scale-up the measured SAR result.  
The Reported TDD LTE SAR = measured SAR (W/kg)\* Tune-up Scaling Factor\* scaling factor for extended cyclic prefix.
2. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8\text{W/kg}$ .
3. 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.
4. 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       | 26.34               | 27.00               | 1.164                  | -0.09            | 0.115                  | 0.134                  |
| 02       | GSM1900 | GPRS (4 Tx slots) | Left Cheek    | 0mm      | 810 | 1909.8      | 22.63               | 24.50               | 1.538                  | 0.1              | 0.140                  | 0.215                  |

**<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        | 22.23               | 24.00               | 1.503                  | 0.11             | 0.235                  | 0.353                  |
| 04       | WCDMA IV | RMC 12.2Kbps | Left Cheek    | 0mm      | 1312 | 1712.4      | 22.28               | 24.00               | 1.486                  | 0.06             | 0.291                  | 0.432                  |
| 05       | WCDMA V  | RMC 12.2Kbps | Right Cheek   | 0mm      | 4132 | 826.4       | 22.62               | 24.00               | 1.374                  | 0.02             | 0.213                  | 0.293                  |

**<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) |
|----------|-----------|----------------|---------------|----------|------|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 06       | CDMA BC0  | 1xRTT RC3 SO55 | Right Cheek   | 0mm      | 1013 | 824.7       | 24.30               | 25.00               | 1.175                  | 0.03             | 0.283                  | 0.332                  |
| 07       | CDMA BC1  | 1xRTT RC3 SO55 | Left Cheek    | 0mm      | 25   | 1851.25     | 23.74               | 25.00               | 1.337                  | 0.07             | 0.248                  | 0.331                  |
| 08       | CDMA BC10 | 1xRTT RC3 SO55 | Right Cheek   | 0mm      | 580  | 820.5       | 24.43               | 25.00               | 1.140                  | 0.01             | 0.264                  | 0.301                  |

**<FDD 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) |
|----------|-------------|----------|------------|---------|-----------|---------------|----------|-------|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 09       | LTE Band 2  | 20M      | QPSK       | 1       | 0         | Left Cheek    | 0mm      | 19100 | 1900        | 22.72               | 24.00               | 1.343                  | -0.15            | 0.241                  | 0.324                  |
| 10       | LTE Band 4  | 20M      | QPSK       | 1       | 0         | Right Cheek   | 0mm      | 20175 | 1732.5      | 22.63               | 24.00               | 1.371                  | 0.1              | 0.229                  | 0.314                  |
| 11       | LTE Band 5  | 10M      | QPSK       | 1       | 0         | Right Cheek   | 0mm      | 20525 | 836.5       | 22.52               | 24.00               | 1.406                  | -0.01            | 0.213                  | 0.299                  |
| 12       | LTE Band 12 | 10M      | QPSK       | 1       | 0         | Right Cheek   | 0mm      | 23095 | 707.5       | 22.33               | 24.00               | 1.469                  | 0.02             | 0.236                  | 0.347                  |
| 13       | LTE Band 13 | 10M      | QPSK       | 1       | 0         | Right Cheek   | 0mm      | 23230 | 782         | 22.39               | 24.00               | 1.449                  | 0.02             | 0.256                  | 0.371                  |
| 14       | LTE Band 17 | 10M      | QPSK       | 1       | 49        | Right Cheek   | 0mm      | 23790 | 710         | 22.35               | 24.00               | 1.462                  | -0.1             | 0.198                  | 0.290                  |
| 15       | LTE Band 25 | 20M      | QPSK       | 1       | 0         | Left Cheek    | 0mm      | 26590 | 1905        | 22.71               | 24.00               | 1.346                  | 0.15             | 0.259                  | 0.349                  |
| 16       | LTE Band 26 | 15M      | QPSK       | 1       | 0         | Right Cheek   | 0mm      | 26865 | 831.5       | 22.77               | 24.00               | 1.327                  | 0.08             | 0.232                  | 0.308                  |

**<TDD 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 | Duty Cycle % | Duty Cycle Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|-------------|----------|------------|---------|-----------|---------------|----------|-------|-------------|---------------------|---------------------|------------------------|--------------|---------------------------|------------------|------------------------|------------------------|
| 17       | LTE Band 41 | 20M      | QPSK       | 1       | 0         | Right Cheek   | 0mm      | 41490 | 2680        | 25.63               | 27.00               | 1.371                  | 42.9         | 1.009                     | -0.06            | 0.269                  | 0.372                  |

**<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) |
|----------|------------|---------------------|---------------|----------|---------|-----|-------------|---------------------|---------------------|------------------------|--------------|---------------------------|------------------|------------------------|------------------------|
| 18       | WLAN2.4GHz | 802.11b 1Mbps       | Left Cheek    | 0mm      | Ant 1   | 11  | 2462        | 15.85               | 16.50               | 1.161                  | 100          | 1.000                     | -0.14            | 0.543                  | 0.631                  |
|          | WLAN2.4GHz | 802.11b 1Mbps       | Left Cheek    | 0mm      | Ant 2   | 1   | 2412        | 15.90               | 16.50               | 1.148                  | 100          | 1.000                     | 0.1              | 0.030                  | 0.034                  |
| 19       | WLAN5GHz   | 802.11n-HT40 MCS0   | Left Tilted   | 0mm      | Ant 1   | 54  | 5270        | 14.79               | 15.00               | 1.050                  | 89.62        | 1.116                     | 0.04             | 0.368                  | 0.431                  |
|          | WLAN5GHz   | 802.11n-HT40 MCS0   | Right Cheek   | 0mm      | Ant 2   | 54  | 5270        | 14.86               | 15.00               | 1.033                  | 90.48        | 1.105                     | -0.01            | 0.316                  | 0.361                  |
| 20       | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Left Tilted   | 0mm      | Ant 1   | 106 | 5530        | 14.91               | 15.00               | 1.021                  | 86.51        | 1.156                     | 0.03             | 0.440                  | 0.519                  |
|          | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Right Tilted  | 0mm      | Ant 2   | 106 | 5530        | 14.88               | 15.00               | 1.028                  | 85.71        | 1.167                     | -0.16            | 0.366                  | 0.439                  |
|          | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Left Tilted   | 0mm      | Ant 1   | 155 | 5775        | 14.63               | 15.00               | 1.089                  | 86.51        | 1.156                     | 0.12             | 0.437                  | 0.550                  |
| 21       | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Right Tilted  | 0mm      | Ant 2   | 155 | 5775        | 14.79               | 15.00               | 1.050                  | 85.71        | 1.167                     | -0.17            | 0.707                  | 0.866                  |

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**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) |
|----------|---------|-------------------|---------------|----------|-----|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 22       | GSM850  | GPRS (4 Tx slots) | Front         | 10mm     | 128 | 824.2       | 26.34               | 27.5                | 1.306                  | -0.14            | 0.453                  | 0.592                  |
| 23       | GSM1900 | GPRS (4 Tx slots) | Back          | 10mm     | 810 | 1909.8      | 22.63               | 24.50               | 1.538                  | -0.06            | 0.272                  | 0.418                  |

**<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) |
|----------|----------|--------------|---------------|----------|------|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 24       | WCDMA II | RMC 12.2Kbps | Back          | 10mm     | 9262 | 1852.4      | 21.15               | 23.00               | 1.531                  | 0                | 0.346                  | 0.530                  |
| 25       | WCDMA IV | RMC 12.2Kbps | Back          | 10mm     | 1513 | 1752.6      | 20.55               | 22.50               | 1.567                  | -0.02            | 0.553                  | 0.866                  |
| 26       | WCDMA V  | RMC 12.2Kbps | Back          | 10mm     | 4182 | 836.4       | 21.62               | 23                  | 1.374                  | -0.01            | 0.545                  | 0.749                  |

**<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) |
|----------|-----------|----------------|---------------|----------|------|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 27       | CDMA BC0  | RTAP 153.6Kbps | Back          | 10mm     | 1013 | 824.7       | 22.76               | 24                  | 1.330                  | 0.03             | 0.417                  | 0.555                  |
| 28       | CDMA BC1  | RTAP 153.6Kbps | Bottom Side   | 10mm     | 1175 | 1908.75     | 21.74               | 23.00               | 1.337                  | 0                | 0.609                  | 0.814                  |
| 29       | CDMA BC10 | RTAP 153.6Kbps | Front         | 10mm     | 580  | 820.5       | 24.47               | 25                  | 1.130                  | -0.14            | 0.857                  | 0.968                  |

**<FDD 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) |
|----------|-------------|----------|------------|---------|-----------|---------------|----------|-------|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 30       | LTE Band 2  | 20M      | QPSK       | 1       | 0         | Back          | 10mm     | 18700 | 1860        | 21.88               | 23.00               | 1.294                  | -0.09            | 0.331                  | 0.428                  |
| 31       | LTE Band 4  | 20M      | QPSK       | 100     | 0         | Back          | 10mm     | 20175 | 1732.5      | 20.96               | 22.00               | 1.271                  | 0                | 0.568                  | 0.722                  |
| 32       | LTE Band 5  | 10M      | QPSK       | 1       | 0         | Back          | 10mm     | 20525 | 836.5       | 21.86               | 23                  | 1.300                  | 0                | 0.504                  | 0.655                  |
| 33       | LTE Band 12 | 10M      | QPSK       | 1       | 0         | Back          | 10mm     | 23095 | 707.5       | 21.74               | 23                  | 1.337                  | -0.08            | 0.509                  | 0.680                  |
| 34       | LTE Band 13 | 10M      | QPSK       | 1       | 0         | Back          | 10mm     | 23230 | 782         | 21.24               | 22.5                | 1.337                  | 0                | 0.449                  | 0.600                  |
| 35       | LTE Band 17 | 10M      | QPSK       | 1       | 0         | Back          | 10mm     | 23790 | 710         | 21.7                | 23                  | 1.349                  | 0.05             | 0.499                  | 0.673                  |
| 36       | LTE Band 25 | 20M      | QPSK       | 1       | 0         | Bottom Side   | 10mm     | 26140 | 1860        | 21.71               | 23.00               | 1.346                  | -0.03            | 0.786                  | 1.058                  |
| 37       | LTE Band 26 | 15M      | QPSK       | 1       | 0         | Back          | 10mm     | 26865 | 831.5       | 22.02               | 23                  | 1.253                  | 0.01             | 0.537                  | 0.673                  |



<TDD 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 | Duty Cycle % | Duty Cycle Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|-------------|----------|------------|---------|-----------|---------------|----------|-------|-------------|---------------------|---------------------|------------------------|--------------|---------------------------|------------------|------------------------|------------------------|
| 38       | LTE Band 41 | 20M      | QPSK       | 1       | 0         | Front         | 10mm     | 41490 | 2680        | 25.63               | 27                  | 1.371                  | 42.9         | 1.009                     | 0.03             | 0.798                  | 1.104                  |

<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                     | -0.03            | 0.107                  | 0.123                  |
| 39       | WLAN2.4GHz | 802.11b 1Mbps       | Bottom Side   | 10mm     | Ant 2   | 11  | 2462        | 15.60               | 16.50               | 1.230                  | 100          | 1.000                     | -0.05            | 0.278                  | 0.342                  |
| 40       | WLAN5GHz   | 802.11a 6Mbps       | Front         | 10mm     | Ant 1   | 36  | 5180        | 18.16               | 19.00               | 1.213                  | 94.16        | 1.062                     | 0.14             | 0.100                  | 0.129                  |
|          | WLAN5GHz   | 802.11a 6Mbps       | Back          | 10mm     | Ant 2   | 36  | 5180        | 18.10               | 19.00               | 1.230                  | 94.85        | 1.054                     | 0.14             | 0.051                  | 0.066                  |
|          | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Back          | 10mm     | Ant 1   | 155 | 5775        | 18.18               | 19.00               | 1.208                  | 86.51        | 1.156                     | 0.12             | 0.039                  | 0.054                  |
| 41       | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Top Side      | 10mm     | Ant 2   | 155 | 5775        | 18.30               | 19.00               | 1.175                  | 85.71        | 1.167                     | -0.17            | 0.156                  | 0.214                  |

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) |
|----------|----------|--------------|---------------|----------|------|-------------|---------------------|---------------------|------------------------|------------------|-------------------------|-------------------------|
| 42       | WCDMA II | RMC 12.2Kbps | Bottom Side   | 0mm      | 9262 | 1852.4      | 22.51               | 24.00               | 1.409                  | -0.17            | 2.290                   | 3.227                   |
| 43       | WCDMA IV | RMC 12.2Kbps | Bottom Side   | 0mm      | 1513 | 1752.6      | 22.12               | 24.00               | 1.542                  | 0.04             | 2.030                   | 3.130                   |

<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) |
|----------|----------|----------------|---------------|----------|------|-------------|---------------------|---------------------|------------------------|------------------|-------------------------|-------------------------|
| 44       | CDMA BC1 | RTAP 153.6Kbps | Bottom Side   | 0mm      | 1175 | 1908.75     | 22.55               | 24.00               | 1.396                  | -0.11            | 2.380                   | 3.323                   |

<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) |
|----------|-------------|----------|------------|---------|-----------|---------------|----------|-------|-------------|---------------------|---------------------|------------------------|------------------|-------------------------|-------------------------|
| 45       | LTE Band 2  | 20M      | QPSK       | 1       | 0         | Bottom Side   | 0mm      | 19100 | 1900        | 22.72               | 24.00               | 1.343                  | -0.02            | 2.140                   | 2.874                   |
| 46       | LTE Band 4  | 20M      | QPSK       | 1       | 0         | Bottom Side   | 0mm      | 20175 | 1732.5      | 22.63               | 24.00               | 1.371                  | -0.11            | 2.160                   | 2.961                   |
| 47       | LTE Band 25 | 20M      | QPSK       | 1       | 0         | Bottom Side   | 0mm      | 26140 | 1860        | 22.56               | 24.00               | 1.393                  | -0.12            | 2.230                   | 3.107                   |

<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) |
|----------|----------|---------------------|---------------|----------|---------|-----|-------------|---------------------|---------------------|------------------------|--------------|---------------------------|------------------|-------------------------|-------------------------|
| 48       | WLAN5GHz | 802.11a 6Mbps       | Front         | 0mm      | Ant 1   | 64  | 5320        | 18.26               | 19.00               | 1.185                  | 94.16        | 1.062                     | -0.13            | 0.709                   | 0.893                   |
|          | WLAN5GHz | 802.11a 6Mbps       | Front         | 0mm      | Ant 2   | 64  | 5320        | 18.13               | 19.00               | 1.222                  | 94.85        | 1.054                     | -0.1             | 0.450                   | 0.580                   |
|          | WLAN5GHz | 802.11ac-VHT80 MCS0 | Front         | 0mm      | Ant 1   | 138 | 5690        | 18.25               | 19.00               | 1.190                  | 86.51        | 1.156                     | -0.17            | 0.456                   | 0.627                   |
| 49       | WLAN5GHz | 802.11ac-VHT80 MCS0 | Top Side      | 0mm      | Ant 2   | 138 | 5690        | 18.00               | 19.00               | 1.259                  | 85.71        | 1.167                     | -0.17            | 0.760                   | 1.117                   |



### 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) |
|----------|---------|-------------------|---------------|----------|-----|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 50       | GSM850  | GPRS (4 Tx slots) | Front         | 10mm     | 128 | 824.2       | 26.34               | 27.50               | 1.306                  | -0.14            | 0.453                  | 0.592                  |
| 51       | GSM1900 | GPRS (4 Tx slots) | Back          | 10mm     | 810 | 1909.8      | 22.63               | 24.50               | 1.538                  | -0.06            | 0.272                  | 0.418                  |

#### <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) |
|----------|----------|--------------|---------------|----------|------|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 52       | WCDMA II | RMC 12.2Kbps | Back          | 10mm     | 9262 | 1852.4      | 21.15               | 23.00               | 1.531                  | 0                | 0.346                  | 0.530                  |
| 53       | WCDMA IV | RMC 12.2Kbps | Back          | 10mm     | 1513 | 1752.6      | 20.55               | 22.50               | 1.567                  | -0.02            | 0.553                  | 0.866                  |
| 54       | WCDMA V  | RMC 12.2Kbps | Back          | 10mm     | 4182 | 836.4       | 21.62               | 23.00               | 1.374                  | -0.01            | 0.545                  | 0.749                  |

#### <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) |
|----------|-----------|----------------|---------------|----------|------|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 55       | CDMA BC0  | 1xRTT RC3 SO32 | Front         | 10mm     | 384  | 836.52      | 22.75               | 24.00               | 1.334                  | -0.1             | 0.654                  | 0.872                  |
| 56       | CDMA BC1  | 1xRTT RC3 SO32 | Back          | 10mm     | 1175 | 1908.75     | 21.80               | 23.00               | 1.318                  | -0.06            | 0.285                  | 0.376                  |
| 57       | CDMA BC10 | 1xRTT RC3 SO32 | Back          | 10mm     | 580  | 820.5       | 24.42               | 25.00               | 1.143                  | -0.05            | 0.620                  | 0.709                  |

#### <FDD 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) |
|----------|-------------|----------|------------|---------|-----------|---------------|----------|-------|-------------|---------------------|---------------------|------------------------|------------------|------------------------|------------------------|
| 58       | LTE Band 2  | 20M      | QPSK       | 1       | 0         | Back          | 10mm     | 18700 | 1860        | 21.88               | 23.00               | 1.294                  | -0.09            | 0.331                  | 0.428                  |
| 59       | LTE Band 4  | 20M      | QPSK       | 100     | 0         | Back          | 10mm     | 20175 | 1732.5      | 20.96               | 22.00               | 1.271                  | 0                | 0.568                  | 0.722                  |
| 60       | LTE Band 5  | 10M      | QPSK       | 1       | 0         | Back          | 10mm     | 20525 | 836.5       | 21.86               | 23.00               | 1.300                  | 0                | 0.504                  | 0.655                  |
| 61       | LTE Band 12 | 10M      | QPSK       | 1       | 0         | Back          | 10mm     | 23095 | 707.5       | 21.74               | 23.00               | 1.337                  | -0.08            | 0.509                  | 0.680                  |
| 62       | LTE Band 13 | 10M      | QPSK       | 1       | 0         | Back          | 10mm     | 23230 | 782         | 21.24               | 22.50               | 1.337                  | 0                | 0.449                  | 0.600                  |
| 63       | LTE Band 17 | 10M      | QPSK       | 1       | 0         | Back          | 10mm     | 23790 | 710         | 21.70               | 23.00               | 1.349                  | 0.05             | 0.499                  | 0.673                  |
| 64       | LTE Band 25 | 20M      | QPSK       | 1       | 0         | Back          | 10mm     | 26140 | 1860        | 21.71               | 23.00               | 1.346                  | -0.09            | 0.406                  | 0.546                  |
| 65       | LTE Band 26 | 15M      | QPSK       | 1       | 0         | Back          | 10mm     | 26865 | 831.5       | 22.02               | 23.00               | 1.253                  | 0.01             | 0.537                  | 0.673                  |

#### <TDD 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 | Duty Cycle % | Duty Cycle Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|----------|-------------|----------|------------|---------|-----------|---------------|----------|-------|-------------|---------------------|---------------------|------------------------|--------------|---------------------------|------------------|------------------------|------------------------|
| 66       | LTE Band 41 | 20M      | QPSK       | 1       | 0         | Front         | 10mm     | 41490 | 2680        | 25.63               | 27.00               | 1.371                  | 42.9         | 1.009                     | 0.03             | 0.798                  | 1.104                  |



<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                     | -0.03            | 0.107                  | 0.123                  |
| 67       | WLAN2.4GHz | 802.11b 1Mbps       | Back          | 10mm     | Ant 2   | 11  | 2462        | 15.60               | 16.50               | 1.230                  | 100          | 1.000                     | -0.05            | 0.183                  | 0.225                  |
| 68       | WLAN5GHz   | 802.11a 6Mbps       | Front         | 10mm     | Ant 1   | 64  | 5320        | 18.26               | 19.00               | 1.185                  | 94.16        | 1.062                     | 0.07             | 0.166                  | 0.209                  |
|          | WLAN5GHz   | 802.11a 6Mbps       | Back          | 10mm     | Ant 2   | 56  | 5280        | 18.00               | 19.00               | 1.259                  | 94.85        | 1.054                     | 0.18             | 0.064                  | 0.085                  |
|          | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Back          | 10mm     | Ant 1   | 138 | 5690        | 18.25               | 19.00               | 1.190                  | 86.51        | 1.156                     | 0.11             | 0.024                  | 0.033                  |
| 69       | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Front         | 10mm     | Ant 2   | 138 | 5690        | 18.00               | 19.00               | 1.259                  | 85.71        | 1.167                     | 0.16             | 0.146                  | 0.214                  |
|          | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Back          | 10mm     | Ant 1   | 155 | 5775        | 18.18               | 19.00               | 1.208                  | 86.51        | 1.156                     | 0.12             | 0.039                  | 0.054                  |
| 70       | WLAN5GHz   | 802.11ac-VHT80 MCS0 | Front         | 10mm     | Ant 2   | 155 | 5775        | 18.30               | 19.00               | 1.175                  | 85.71        | 1.167                     | 0.17             | 0.158                  | 0.217                  |

<Bluetooth 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) |
|----------|-----------|-------|---------------|----------|---------|-----|-------------|---------------------|---------------------|------------------------|--------------|---------------------------|------------------|------------------------|------------------------|
| 71       | Bluetooth | 1Mbps | Back          | 10mm     | Ant 1   | 78  | 2480        | 14.16               | 16.00               | 1.528                  | 76.6         | 1.087                     | 0.1              | 0.008                  | 0.014                  |

13.5 Repeated SAR Measurement

| 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) | Ratio | Reported 1g SAR (W/kg) |
|-----|-----------|----------------|---------------|----------|-----|-------------|---------------------|---------------------|------------------------|------------------|------------------------|-------|------------------------|
| 1st | CDMA BC10 | RTAP 153.6Kbps | Front         | 10mm     | 580 | 820.5       | 24.47               | 25                  | 1.130                  | -0.14            | 0.857                  | -     | 0.968                  |
| 2nd | CDMA BC10 | RTAP 153.6Kbps | Front         | 10mm     | 580 | 820.5       | 24.47               | 25                  | 1.130                  | 0.09             | 0.830                  | 1.04  | 0.938                  |

| 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     | 22.55               | 24.00               | 1.396                  | -0.11            | 2.380                   | -     | 3.323                   |
| 2nd | CDMA BC1 | RTAP 153.6Kbps | Bottom Side   | 0mm      | 1175 | 1908.75     | 22.55               | 24.00               | 1.396                  | 0.06             | 2.180                   | 1.09  | 3.044                   |

| 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      | 22.63               | 24.00               | 1.371                  | -0.11            | 2.160                   | -     | 2.961                   |
| 2nd | LTE Band 4 | 20M      | QPSK       | 1       | 0         | Bottom Side   | 0mm      | 20175 | 1732.5      | 22.63               | 24.00               | 1.371                  | 0.09             | 2.070                   | 1.04  | 2.838                   |

General Note:

- Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8$ W/kg.
- Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is  $\leq 1.2$  and the measured SAR  $< 1.45$ W/kg, only one repeated measurement is required.
- 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.
- The ratio is the difference in percentage between original and repeated *measured SAR*.
- All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

Test Engineer : Bevis Chang

## 14. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A 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 <sup>(a)</sup> | 1/k <sup>(b)</sup> | 1/√3        | 1/√6       | 1/√2    |

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

(b)  $\kappa$  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) (±%) |
|-----------------------------------|------------------------|-------------|---------|---------|----------|--------------------------------|---------------------------------|
| <b>Measurement System</b>         |                        |             |         |         |          |                                |                                 |
| 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                             |
| <b>Test Sample Related</b>        |                        |             |         |         |          |                                |                                 |
| 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                             |
| <b>Phantom and Setup</b>          |                        |             |         |         |          |                                |                                 |
| 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                             |
| <b>Combined Std. Uncertainty</b>  |                        |             |         |         |          | 11.6%                          | 11.6%                           |
| <b>Coverage Factor for 95 %</b>   |                        |             |         |         |          | K=2                            | K=2                             |
| <b>Expanded STD Uncertainty</b>   |                        |             |         |         |          | 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) (±%) |
|-----------------------------------|------------------------|-------------|---------|---------|----------|--------------------------------|---------------------------------|
| <b>Measurement System</b>         |                        |             |         |         |          |                                |                                 |
| 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                             |
| <b>Test Sample Related</b>        |                        |             |         |         |          |                                |                                 |
| 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                             |
| <b>Phantom and Setup</b>          |                        |             |         |         |          |                                |                                 |
| 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                             |
| <b>Combined Std. Uncertainty</b>  |                        |             |         |         |          | 12.7%                          | 12.6%                           |
| <b>Coverage Factor for 95 %</b>   |                        |             |         |         |          | K=2                            | K=2                             |
| <b>Expanded STD Uncertainty</b>   |                        |             |         |         |          | 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"
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- [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
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- [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.