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## TEST REPORT FOR SAR TESTING

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Report No.: SRTC2019-9004(F)- 19012901(H)

Product Name: Fi Smart Collar

Product Model: FC1

Applicant: Barking Labs Corp.

Manufacturer: Barking Labs Corp.

Specification: Part 2.1093

IEEE Std 1528

KDB Procedures

FCC ID: 2ARXN-FC1

The State Radio\_monitoring\_center Testing Center (SRTC)

15th Building, No.30 Shixing Street, Shijingshan District, Beijing, P.R. China

Tel: 86-10-57996183 Fax: 86-10-57996388

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## **1 GENERAL INFORMATION**

### **1.1 Notes of the test report**

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written permission of The State Radio\_monitoring\_center Testing Center (SRTC).

The test results relate only to individual items of the samples which have been tested.

The certification and accreditation identifiers used in this report shall not be applicable to the tested or calibrated samples thereof. The manufacturer shall not mark the tested samples or items (or a separate part of the item) with the identifiers of certification and accreditation to mislead relevant parties about the tested samples or items.

### **1.2 Information about the testing laboratory**

|                    |                                                                               |
|--------------------|-------------------------------------------------------------------------------|
| Company:           | The State Radio_monitoring_center Testing Center (SRTC)                       |
| Address:           | 15th Building, No.30 Shixing Street, Shijingshan District, Beijing P.R. China |
| City:              | Beijing                                                                       |
| Country or Region: | P.R. China                                                                    |
| Contacted person:  | Liu Jia                                                                       |
| Tel:               | +86 10 57996183                                                               |
| Fax:               | +86 10 57996388                                                               |
| Email:             | liujiaf@srtc.org.cn                                                           |

### **1.3 Applicant's details**

|                    |                          |
|--------------------|--------------------------|
| Company:           | Barking Labs Corp.       |
| Address:           | 53 Bridge St., Suite 103 |
| City:              | Brooklyn, NY             |
| Country or Region: | USA                      |
| Contacted person:  | Bob Blake                |
| Tel:               | +1-914-249-9347          |
| Fax:               | ---                      |
| Email:             | bob@tryfi.com            |

### **1.4 Manufacturer's details**

|                    |                          |
|--------------------|--------------------------|
| Company:           | Barking Labs Corp.       |
| Address:           | 53 Bridge St., Suite 103 |
| City:              | Brooklyn, NY             |
| Country or Region: | USA                      |
| Contacted person:  | Bob Blake                |
| Tel:               | +1-914-249-9347          |
| Fax:               | ---                      |
| Email:             | bob@tryfi.com            |

## 1.5 Test Environment

|                                         |            |
|-----------------------------------------|------------|
| Date of Receipt of test sample at SRTC: | 2019.01.29 |
| Testing Start Date:                     | 2019.02.22 |
| Testing End Date:                       | 2019.02.24 |

|                     |                  |              |
|---------------------|------------------|--------------|
| Environmental Data: | Temperature (°C) | Humidity (%) |
| Ambient             | 21~23            | 30~33        |

|                                 |      |
|---------------------------------|------|
| Normal Supply Voltage (V d.c.): | 3.85 |
|---------------------------------|------|

## 2 DESCRIPTION OF THE EQUIPMENT UNDER TEST

### 2.1 Final equipment build status

|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wireless Technology and Frequency Bands | <input type="checkbox"/> GSM Band : GSM900/DCS1800<br><input type="checkbox"/> WCDMA Band: 1/8<br><input checked="" type="checkbox"/> Cat.M: Band 2/4/12<br><input type="checkbox"/> Bluetooth Band: 2.4GHz~2.4835GHz<br><input type="checkbox"/> Wi-Fi Band: 2.4GHz~2.4835GHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Mode                                    | GSM<br><input type="checkbox"/> Voice (GMSK)<br><input type="checkbox"/> GPRS (GMSK)<br><input type="checkbox"/> EGPRS (GMSK)<br>WCDMA<br><input type="checkbox"/> UMTS Rel. 99 (Voice & Data)<br><input type="checkbox"/> HSDPA (Rel. 5)<br><input type="checkbox"/> HSUPA (Rel. 6)<br><input type="checkbox"/> HSPA+ (Rel.7)<br><input type="checkbox"/> DC-HSDPA (Rel.8)<br>Wi-Fi (802.11a/b/g/n)<br><input type="checkbox"/> 802.11a<br><input type="checkbox"/> 802.11b<br><input type="checkbox"/> 802.11g<br><input type="checkbox"/> 802.11n (20MHz)<br><input type="checkbox"/> 802.11n (40MHz)<br>Bluetooth<br><input type="checkbox"/> BR(GFSK)<br><input type="checkbox"/> EDR ( $\pi/4$ DQPSK , 8-DPSK)<br><input type="checkbox"/> BLE(GFSK)<br>LTE<br><input type="checkbox"/> QPSK<br><input type="checkbox"/> 16QAM<br><input type="checkbox"/> 64QAM |
| Duty Cycle                              | GSM Voice: 12.5%;<br>GPRS: 12.5% (1 Slot), 25% (2 Slots), 37.5% (3 Slots), 50% (4 Slots)<br>WCDMA: 100%<br>Wi-Fi 802.11b/g/n: 100%<br>Bluetooth: 32.25% (DH1), 66.68% (DH3), 77.52% (DH5)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| GPRS Multi-Slot Class                   | <input type="checkbox"/> Class 8 - One Up<br><input type="checkbox"/> Class 10 - Two Up<br><input type="checkbox"/> Class 12 - Four Up                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Mobile Phone Capability                 | <input type="checkbox"/> Class A - Mobile phones can be connected to both GPRS and GSM services simultaneously.<br><input type="checkbox"/> Class B - Mobile phones can be attached to both GPRS and GSM services, using one service at a time.<br><input type="checkbox"/> Class C - Mobile phones are attached to either GPRS or GSM voice service. You need to switch manually between services                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| DTM (Dual Transfer Mode)                | Not Supported                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## 2.2 Support equipment

The following support equipment was used to exercise the EUT during testing:

|             |                                                                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------------------------|
| Batteries   | JKIT/Li-Lon                                                                                                                |
| H/W Version | Rev.A                                                                                                                      |
| S/W Version | 1.0                                                                                                                        |
| IMEI        | 357812091936846                                                                                                            |
| Notes       | The relevant tests have been performed in order to verify in which combination case the EUT would have the worst features. |

### **3 REFERENCE SPECIFICATION**

| Specification  | Version | Title                                                                                                                                                                                                                                     |
|----------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Part 2.1093    | 2018    | Radiofrequency radiation exposure evaluation: portable devices.                                                                                                                                                                           |
| IEEE Std 1528  | 2013    | IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques                                                          |
| IEEE Std 1528a | 2005    | IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques Amendment 1: CAD File for Human Head Model (SAM Phantom) |
| KDB 447498 D01 | v06     | General RF Exposure Guidance                                                                                                                                                                                                              |
| KDB 648474 D04 | v01r03  | Handset SAR                                                                                                                                                                                                                               |
| KDB 865664 D01 | v01r04  | SAR Measurement from 100 MHz to 6 GHz                                                                                                                                                                                                     |
| KDB 865664 D02 | v01r02  | RF Exposure Reporting                                                                                                                                                                                                                     |
| KDB 941225 D05 | v02r05  | SAR for LTE Devices                                                                                                                                                                                                                       |

## **4 TEST CONDITIONS**

### **4.1 Picture to demonstrate the required liquid depth**

The liquid depth in the used SAM phantoms



Liquid depth for SAR Measurement

### **4.2 Test signal, frequencies and output power**

The device was put into operation by using a call tester. Communication between the device and the call tester was established by air link.

The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence.

In all operating bands the measurements were performed on lowest, middle and highest channels.

### **4.3 SAR measurement set-up**

The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than  $\pm 0.02\text{mm}$ . Special E- probe have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines (length =300mm) to the data acquisition unit. A cell controller system contains the power supply, robot controller, teaches pendant (Joystick), and remote control, is used to drive the robot motors.

The PC consists of the Micron Pentium IV computer with Win7 system and SAR



Measurement Software DASY5 Professional, A/D interface card, monitor, mouse, and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot.

A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines.

The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection

The robot uses its own controller with a built in VME-bus computer.

#### 4.4 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of EN 62209-1 & 2.

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

The SPEAG device holder (see Section 4.6.1) was used to position the device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

#### 4.5 Tissue simulants

Recommended values for the dielectric parameters of the tissue simulants are given in EN 62209-1 & 2. All tests were carried out using simulants whose dielectric parameters were within  $\pm 5\%$  of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters.

The depth of the tissue simulant was  $15.0 \pm 0.5$  cm measured from the ear reference point during system checking and device measurements.

The following tissue stimulants were used for Head and Body test:

|      |                                       |
|------|---------------------------------------|
| Name | Broadband tissue-equivalent liquid    |
| Type | HBBL600-6000V6 Head Simulating Liquid |

## 4.6 Description of the test procedure

### 4.6.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy52 system.



Device holder supplied by SPEAG

## 4.6.2 Test positions

### 4.6.2.1 Against Phantom Head

Measurements were made in “cheek” and “tilt” positions on both the left hand and right hand sides of the phantom.

The positions used in the measurements were according to EN 62209-1 & 2.

### 4.6.2.2 Body Worn Configuration

The device was placed in the SPEAG holder below the flat section of the phantom. The distance between the device and the phantom was kept at the separation distance using a separate flat spacer that was removed before the start of the measurements. And the distances are 5mm for trunk. The device was oriented with its antenna facing the phantom since this orientation gives higher results.

### 4.6.3 Scan Procedure

First, area scans were used for determination of the field distribution and the approximate location of the local peak SAR values. The SAR distribution is scanned along the inside surface, at least for an area larger than the projection of the handset and antenna. The angle between the probe axis and the surface normal line is recommended but not required to be less than 30°. The SAR distribution is first measured on a 2-D coarse grid. The scan region should cover all areas that are exposed and encompassed by the projection of the handset. There are 15 mm × 15 mm (equal or less than 2GHz), 12 mm × 12 mm (from 2GHz~3GHz) and 10mm x 10mm (above 5GHz) measurement grid used when two staggered one-dimensional cubic splines are used to estimate the maximum SAR location. Next, a zoom scan, a minimum of 7 x 7x7 points covering a volume of at least 30x30x30mm, was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

### 4.6.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy5 are all based on the modified Quadratic Shepard's method (Robert J. Renka, “Multivariate Interpolation Of Large Sets Of Scattered Data”, University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).

The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighboring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

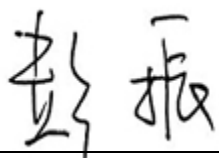
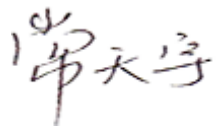
## 5 RESULT SUMMARY

The maximum measured SAR values for Head configuration and Body Worn configuration are given as follows. The device conforms to the requirements of the standard(s) when the maximum measured SAR value is less than or equal to the limit.

| Exposure Position | Mode/Band | 10g-SAR Reported Result (W/kg) | Highest 10g-SAR Reported Result (W/kg) | 10g-Limit (W/kg) | Result |
|-------------------|-----------|--------------------------------|----------------------------------------|------------------|--------|
| Limbs (0mm Gap)   | Band 2    | 0.288                          | 0.29                                   | 4.0              | Pass   |
|                   | Band 4    | 0.179                          |                                        |                  |        |
|                   | Band 12   | 0.198                          |                                        |                  |        |

### Simultaneous Transmission Summary

| Exposure Position | Mode        | Highest 10g-SAR Result(W/kg) | Limit (W/kg)/10g | Result |
|-------------------|-------------|------------------------------|------------------|--------|
| Limbs (0mm Gap)   | Cat M & BLE | 0.30                         | 4.0              | Pass   |

|                                                                                                                                        |                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| This Test Report Is Issued by:<br>Mr. PENG Zhen<br> | Checked by:<br>Mr. LI Bin<br> |
| Tested by:<br>Mr. CHANG Tianyu<br>                  | Issued date:<br><br>20190228                                                                                      |

## 6 TEST RESULTS

### 6.1 Manufacturing Tolerance

#### Cat M

##### Band 2

| 20BW 1RB        |               |               |               |
|-----------------|---------------|---------------|---------------|
| Channel         | Channel 18700 | Channel 18900 | Channel 19100 |
| Tolerance (dBm) | 18.5~22.5     | 18.5~22.5     | 18.5~22.5     |
| 20BW 50%RB      |               |               |               |
| Channel         | Channel 18700 | Channel 18900 | Channel 19100 |
| Tolerance (dBm) | 18.0~22.0     | 18.0~22.0     | 18.0~22.0     |

##### Band 4

| 20BW 1RB        |               |               |               |
|-----------------|---------------|---------------|---------------|
| Channel         | Channel 20050 | Channel 20175 | Channel 20300 |
| Tolerance (dBm) | 19.5~23.5     | 19.5~23.5     | 19.5~23.5     |
| 20BW 50%RB      |               |               |               |
| Channel         | Channel 20050 | Channel 20175 | Channel 20300 |
| Tolerance (dBm) | 18.5~22.5     | 18.5~22.5     | 18.5~22.5     |

##### Band 12

| 10BW 1RB        |               |               |               |
|-----------------|---------------|---------------|---------------|
| Channel         | Channel 23060 | Channel 23095 | Channel 23130 |
| Tolerance (dBm) | 20.0~24.0     | 20.0~24.0     | 20.0~24.0     |
| 10BW 50%RB      |               |               |               |
| Channel         | Channel 23060 | Channel 23095 | Channel 23130 |
| Tolerance (dBm) | 18.5~22.5     | 18.5~22.5     | 18.5~22.5     |

#### Bluetooth (BLE)

| GFSK            |           |           |           |
|-----------------|-----------|-----------|-----------|
| Channel         | 0         | 19        | 39        |
| Tolerance (dBm) | -6.0~-3.0 | -6.0~-3.0 | -6.0~-3.0 |

## 6.2 Cat M Measurement result

### LTE\_CAT.M1\_Band 2

| Modulation | Carrier frequency (MHz) | UL Channel | BW  | RB Size | RB Offset | Conducted Power (dBm) |
|------------|-------------------------|------------|-----|---------|-----------|-----------------------|
| QPSK       | 1850.7                  | 18607      | 1.4 | 1       | 0         | 22.37                 |
|            |                         |            |     | 3       | 0         | 21.48                 |
|            |                         |            |     | 6       | 0         | 20.26                 |
|            | 1880                    | 18900      |     | 1       | 0         | 22.07                 |
|            |                         |            |     | 3       | 0         | 21.58                 |
|            |                         |            |     | 6       | 0         | 20.15                 |
|            | 1909.3                  | 19193      |     | 1       | 0         | 22.03                 |
|            |                         |            |     | 3       | 0         | 21.23                 |
|            |                         |            |     | 6       | 0         | 20.16                 |
| 16QAM      | 1850.7                  | 18607      | 1.4 | 1       | 0         | 21.32                 |
|            |                         |            |     | 1       | 5         | 21.21                 |
|            |                         |            |     | 3       | 0         | 20.63                 |
|            |                         |            |     | 5       | 0         | 20.06                 |
|            |                         |            |     | 5       | 1         | 20.08                 |
|            | 1880                    | 18900      |     | 1       | 0         | 21.26                 |
|            |                         |            |     | 1       | 5         | 21.19                 |
|            |                         |            |     | 3       | 0         | 20.47                 |
|            |                         |            |     | 5       | 0         | 20.04                 |
|            |                         |            |     | 5       | 1         | 20.06                 |
|            | 1909.3                  | 19193      |     | 1       | 0         | 21.28                 |
|            |                         |            |     | 1       | 5         | 21.19                 |
|            |                         |            |     | 3       | 0         | 20.58                 |
|            |                         |            |     | 5       | 0         | 20.01                 |
|            |                         |            |     | 5       | 1         | 20.05                 |
| QPSK       | 1851.7                  | 18615      | 3   | 1       | 0         | 22.34                 |
|            |                         |            |     | 3       | 0         | 21.47                 |
|            |                         |            |     | 6       | 0         | 20.24                 |
|            | 1880                    | 18900      |     | 1       | 0         | 22.06                 |
|            |                         |            |     | 3       | 0         | 21.59                 |
|            |                         |            |     | 6       | 0         | 20.17                 |
|            | 1908.5                  | 19185      |     | 1       | 0         | 22.02                 |
|            |                         |            |     | 3       | 0         | 21.58                 |
|            |                         |            |     | 6       | 0         | 20.21                 |
| 16QAM      | 1851.7                  | 18615      | 3   | 1       | 0         | 21.33                 |
|            |                         |            |     | 1       | 5         | 21.22                 |
|            |                         |            |     | 3       | 0         | 20.38                 |
|            |                         |            |     | 5       | 0         | 20.07                 |
|            |                         |            |     | 5       | 1         | 20.08                 |
|            | 1880                    | 18900      |     | 1       | 0         | 21.27                 |
|            |                         |            |     | 1       | 5         | 21.21                 |
|            |                         |            |     | 3       | 0         | 20.61                 |
|            |                         |            |     | 5       | 0         | 20.02                 |
|            |                         |            |     | 5       | 1         | 20.06                 |
|            | 1908.5                  | 19185      |     | 1       | 0         | 21.26                 |
|            |                         |            |     | 1       | 5         | 21.20                 |
|            |                         |            |     | 3       | 0         | 20.56                 |
|            |                         |            |     | 5       | 0         | 20.03                 |
|            |                         |            |     | 5       | 1         | 20.06                 |

| Modulation | Carrier frequency (MHz) | UL Channel | BW | RB Size | RB Offset | Conducted Power (dBm) |
|------------|-------------------------|------------|----|---------|-----------|-----------------------|
| QPSK       | 1852.5                  | 18625      | 5  | 1       | 0         | 22.34                 |
|            |                         |            |    | 3       | 0         | 21.59                 |
|            |                         |            |    | 6       | 0         | 20.27                 |
|            | 1880                    | 18900      |    | 1       | 0         | 22.07                 |
|            |                         |            |    | 3       | 0         | 21.28                 |
|            |                         |            |    | 6       | 0         | 20.16                 |
|            | 1907.5                  | 19175      |    | 1       | 0         | 22.03                 |
|            |                         |            |    | 3       | 0         | 21.30                 |
|            |                         |            |    | 6       | 0         | 20.18                 |
| 16QAM      | 1852.5                  | 18625      | 5  | 1       | 0         | 21.35                 |
|            |                         |            |    | 1       | 5         | 21.25                 |
|            |                         |            |    | 3       | 0         | 20.28                 |
|            |                         |            |    | 5       | 0         | 20.06                 |
|            |                         |            |    | 5       | 1         | 20.09                 |
|            | 1880                    | 18900      |    | 1       | 0         | 21.28                 |
|            |                         |            |    | 1       | 5         | 21.21                 |
|            |                         |            |    | 3       | 0         | 20.48                 |
|            |                         |            |    | 5       | 0         | 20.04                 |
|            |                         |            |    | 5       | 1         | 20.06                 |
|            | 1907.5                  | 19175      |    | 1       | 0         | 21.32                 |
|            |                         |            |    | 1       | 5         | 21.19                 |
|            |                         |            |    | 3       | 0         | 20.18                 |
|            |                         |            |    | 5       | 0         | 20.03                 |
|            |                         |            |    | 5       | 1         | 20.07                 |
| QPSK       | 1855                    | 18650      | 10 | 1       | 0         | 22.38                 |
|            |                         |            |    | 3       | 0         | 21.48                 |
|            |                         |            |    | 6       | 0         | 20.25                 |
|            | 1880                    | 18900      |    | 1       | 0         | 22.11                 |
|            |                         |            |    | 3       | 0         | 21.45                 |
|            |                         |            |    | 6       | 0         | 20.15                 |
|            | 1905                    | 19150      |    | 1       | 0         | 22.08                 |
|            |                         |            |    | 3       | 0         | 21.42                 |
|            |                         |            |    | 6       | 0         | 20.21                 |
| 16QAM      | 1855                    | 18650      | 10 | 1       | 0         | 21.36                 |
|            |                         |            |    | 1       | 5         | 21.22                 |
|            |                         |            |    | 3       | 0         | 20.15                 |
|            |                         |            |    | 5       | 0         | 20.12                 |
|            |                         |            |    | 5       | 1         | 20.17                 |
|            | 1880                    | 18900      |    | 1       | 0         | 21.31                 |
|            |                         |            |    | 1       | 5         | 21.21                 |
|            |                         |            |    | 3       | 0         | 20.45                 |
|            |                         |            |    | 5       | 0         | 20.06                 |
|            |                         |            |    | 5       | 1         | 20.08                 |
|            | 1905                    | 19150      |    | 1       | 0         | 21.29                 |
|            |                         |            |    | 1       | 5         | 21.12                 |
|            |                         |            |    | 3       | 0         | 20.58                 |
|            |                         |            |    | 5       | 0         | 20.03                 |
|            |                         |            |    | 5       | 1         | 20.06                 |

| Modulation | Carrier frequency (MHz) | UL Channel | BW | RB Size | RB Offset | Conducted Power (dBm) |
|------------|-------------------------|------------|----|---------|-----------|-----------------------|
| QPSK       | 1857.5                  | 18675      | 15 | 1       | 0         | 22.39                 |
|            |                         |            |    | 3       | 0         | 21.28                 |
|            |                         |            |    | 6       | 0         | 20.24                 |
|            | 1880                    | 18900      |    | 1       | 0         | 22.12                 |
|            |                         |            |    | 3       | 0         | 21.67                 |
|            |                         |            |    | 6       | 0         | 20.16                 |
|            | 1902.5                  | 19125      |    | 1       | 0         | 22.11                 |
|            |                         |            |    | 3       | 0         | 21.68                 |
|            |                         |            |    | 6       | 0         | 20.21                 |
| 16QAM      | 1857.5                  | 18675      | 15 | 1       | 0         | 21.34                 |
|            |                         |            |    | 1       | 5         | 21.26                 |
|            |                         |            |    | 3       | 0         | 20.17                 |
|            |                         |            |    | 5       | 0         | 20.12                 |
|            |                         |            |    | 5       | 1         | 20.16                 |
|            | 1880                    | 18900      |    | 1       | 0         | 21.34                 |
|            |                         |            |    | 1       | 5         | 21.24                 |
|            |                         |            |    | 3       | 0         | 20.19                 |
|            |                         |            |    | 5       | 0         | 20.12                 |
|            |                         |            |    | 5       | 1         | 20.23                 |
|            | 1902.5                  | 19125      |    | 1       | 0         | 21.31                 |
|            |                         |            |    | 1       | 5         | 21.25                 |
|            |                         |            |    | 3       | 0         | 20.17                 |
|            |                         |            |    | 5       | 0         | 20.12                 |
|            |                         |            |    | 5       | 1         | 20.24                 |
| QPSK       | 1860                    | 18700      | 20 | 1       | 0         | <b>22.43</b>          |
|            |                         |            |    | 3       | 0         | 21.68                 |
|            |                         |            |    | 6       | 0         | 20.25                 |
|            | 1880                    | 18900      |    | 1       | 0         | <b>22.13</b>          |
|            |                         |            |    | 3       | 0         | 21.53                 |
|            |                         |            |    | 6       | 0         | 20.21                 |
|            | 1900                    | 19100      |    | 1       | 0         | <b>22.14</b>          |
|            |                         |            |    | 3       | 0         | 21.70                 |
|            |                         |            |    | 6       | 0         | 20.12                 |
| 16QAM      | 1860                    | 18700      | 20 | 1       | 0         | 21.36                 |
|            |                         |            |    | 1       | 5         | 21.24                 |
|            |                         |            |    | 3       | 0         | 20.38                 |
|            |                         |            |    | 5       | 0         | 20.13                 |
|            |                         |            |    | 5       | 1         | 20.21                 |
|            | 1880                    | 18900      |    | 1       | 0         | 21.32                 |
|            |                         |            |    | 1       | 5         | 21.24                 |
|            |                         |            |    | 3       | 0         | 20.47                 |
|            |                         |            |    | 5       | 0         | 20.21                 |
|            |                         |            |    | 5       | 1         | 20.06                 |
|            | 1900                    | 19100      |    | 1       | 0         | 21.32                 |
|            |                         |            |    | 1       | 5         | 21.25                 |
|            |                         |            |    | 3       | 0         | 20.37                 |
|            |                         |            |    | 5       | 0         | 20.15                 |
|            |                         |            |    | 5       | 1         | 20.18                 |



**LTE\_CAT.M1\_Band 4**

| Modulation | Carrier frequency (MHz) | UL Channel | BW  | RB Size | RB Offset | Conducted Power (dBm) |
|------------|-------------------------|------------|-----|---------|-----------|-----------------------|
| QPSK       | 1710.5                  | 19957      | 1.4 | 1       | 0         | 23.02                 |
|            |                         |            |     | 3       | 0         | 21.37                 |
|            |                         |            |     | 6       | 0         | 20.93                 |
|            | 1732.5                  | 20175      |     | 1       | 0         | 22.86                 |
|            |                         |            |     | 3       | 0         | 21.47                 |
|            |                         |            |     | 6       | 0         | 20.84                 |
|            | 1754.3                  | 20393      |     | 1       | 0         | 22.85                 |
|            |                         |            |     | 3       | 0         | 21.27                 |
|            |                         |            |     | 6       | 0         | 20.79                 |
| 16QAM      | 1710.5                  | 19957      | 1.4 | 1       | 0         | 21.78                 |
|            |                         |            |     | 1       | 5         | 21.64                 |
|            |                         |            |     | 3       | 0         | 21.26                 |
|            |                         |            |     | 5       | 0         | 20.89                 |
|            |                         |            |     | 5       | 1         | 20.93                 |
|            | 1732.5                  | 20175      |     | 1       | 0         | 21.62                 |
|            |                         |            |     | 1       | 5         | 21.57                 |
|            |                         |            |     | 3       | 0         | 21.35                 |
|            |                         |            |     | 5       | 0         | 20.83                 |
|            |                         |            |     | 5       | 1         | 20.86                 |
|            | 1754.3                  | 20393      |     | 1       | 0         | 21.60                 |
|            |                         |            |     | 1       | 5         | 21.58                 |
|            |                         |            |     | 3       | 0         | 21.45                 |
|            |                         |            |     | 5       | 0         | 20.81                 |
|            |                         |            |     | 5       | 1         | 20.84                 |
| QPSK       | 1711.5                  | 19965      | 3   | 1       | 0         | 23.14                 |
|            |                         |            |     | 3       | 0         | 22.10                 |
|            |                         |            |     | 6       | 0         | 21.05                 |
|            | 1732.5                  | 20175      |     | 1       | 0         | 22.98                 |
|            |                         |            |     | 3       | 0         | 21.25                 |
|            |                         |            |     | 6       | 0         | 20.96                 |
|            | 1753.5                  | 20385      |     | 1       | 0         | 22.97                 |
|            |                         |            |     | 3       | 0         | 21.34                 |
|            |                         |            |     | 6       | 0         | 20.91                 |
| 16QAM      | 1711.5                  | 19965      | 3   | 1       | 0         | 21.87                 |
|            |                         |            |     | 1       | 5         | 21.76                 |
|            |                         |            |     | 3       | 0         | 21.28                 |
|            |                         |            |     | 5       | 0         | 21.01                 |
|            |                         |            |     | 5       | 1         | 21.08                 |
|            | 1732.5                  | 20175      |     | 1       | 0         | 21.74                 |
|            |                         |            |     | 1       | 5         | 21.69                 |
|            |                         |            |     | 3       | 0         | 21.39                 |
|            |                         |            |     | 5       | 0         | 20.95                 |
|            |                         |            |     | 5       | 1         | 20.98                 |
|            | 1753.5                  | 20385      |     | 1       | 0         | 21.72                 |
|            |                         |            |     | 1       | 5         | 21.70                 |
|            |                         |            |     | 3       | 0         | 21.45                 |
|            |                         |            |     | 5       | 0         | 20.93                 |
|            |                         |            |     | 5       | 1         | 20.96                 |

| Modulation | Carrier frequency (MHz) | UL Channel | BW | RB Size | RB Offset | Conducted Power (dBm) |
|------------|-------------------------|------------|----|---------|-----------|-----------------------|
| QPSK       | 1712.5                  | 19975      | 5  | 1       | 0         | 23.15                 |
|            |                         |            |    | 3       | 0         | 22.16                 |
|            |                         |            |    | 6       | 0         | 21.06                 |
|            | 1732.5                  | 20175      |    | 1       | 0         | 22.99                 |
|            |                         |            |    | 3       | 0         | 21.20                 |
|            |                         |            |    | 6       | 0         | 20.97                 |
|            | 1752.5                  | 20375      |    | 1       | 0         | 22.98                 |
|            |                         |            |    | 3       | 0         | 21.24                 |
|            |                         |            |    | 6       | 0         | 20.92                 |
| 16QAM      | 1712.5                  | 19975      | 5  | 1       | 0         | 21.91                 |
|            |                         |            |    | 1       | 5         | 21.77                 |
|            |                         |            |    |         |           | 21.15                 |
|            |                         |            |    | 5       | 0         | 21.02                 |
|            |                         |            |    | 5       | 1         | 21.06                 |
|            | 1732.5                  | 20175      |    | 1       | 0         | 21.75                 |
|            |                         |            |    | 1       | 5         | 21.72                 |
|            |                         |            |    | 3       | 0         | 21.10                 |
|            |                         |            |    | 5       | 0         | 20.96                 |
|            |                         |            |    | 5       | 1         | 20.98                 |
|            | 1752.5                  | 20375      |    | 1       | 0         | 21.73                 |
|            |                         |            |    | 1       | 5         | 21.71                 |
|            |                         |            |    | 3       | 0         | 21.30                 |
|            |                         |            |    | 5       | 0         | 20.94                 |
|            |                         |            |    | 5       | 1         | 20.97                 |
| QPSK       | 1715                    | 20000      | 10 | 1       | 0         | 23.27                 |
|            |                         |            |    | 3       | 0         | 22.10                 |
|            |                         |            |    | 6       | 0         | 21.18                 |
|            | 1732.5                  | 20175      |    | 1       | 0         | 23.11                 |
|            |                         |            |    | 3       | 0         | 21.47                 |
|            |                         |            |    | 6       | 0         | 21.09                 |
|            | 1750                    | 20350      |    | 1       | 0         | 23.12                 |
|            |                         |            |    | 3       | 0         | 21.43                 |
|            |                         |            |    | 6       | 0         | 21.04                 |
| 16QAM      | 1715                    | 20000      | 10 | 1       | 0         | 22.21                 |
|            |                         |            |    | 1       | 5         | 21.89                 |
|            |                         |            |    | 3       | 0         | 21.65                 |
|            |                         |            |    | 5       | 0         | 21.14                 |
|            |                         |            |    | 5       | 1         | 21.16                 |
|            | 1732.5                  | 20175      |    | 1       | 0         | 21.87                 |
|            |                         |            |    | 1       | 5         | 21.82                 |
|            |                         |            |    | 3       | 0         | 21.43                 |
|            |                         |            |    | 5       | 0         | 21.08                 |
|            |                         |            |    | 5       | 1         | 21.11                 |
|            | 1750                    | 20350      |    | 1       | 0         | 21.85                 |
|            |                         |            |    | 1       | 5         | 21.83                 |
|            |                         |            |    | 3       | 0         | 21.52                 |
|            |                         |            |    | 5       | 0         | 21.06                 |
|            |                         |            |    | 5       | 1         | 21.07                 |

| Modulation | Carrier frequency (MHz) | UL Channel | BW | RB Size | RB Offset | Conducted Power (dBm) |
|------------|-------------------------|------------|----|---------|-----------|-----------------------|
| QPSK       | 1717.5                  | 20025      | 15 | 1       | 0         | 23.35                 |
|            |                         |            |    | 3       | 0         | 22.19                 |
|            |                         |            |    | 6       | 0         | 21.26                 |
|            | 1732.5                  | 20175      |    | 1       | 0         | 23.19                 |
|            |                         |            |    | 3       | 0         | 22.16                 |
|            |                         |            |    | 6       | 0         | 21.17                 |
|            | 1747.5                  | 20325      |    | 1       | 0         | 23.22                 |
|            |                         |            |    | 3       | 0         | 22.14                 |
|            |                         |            |    | 6       | 0         | 21.12                 |
| 16QAM      | 1717.5                  | 20025      | 15 | 1       | 0         | 22.29                 |
|            |                         |            |    | 1       | 5         | 21.97                 |
|            |                         |            |    | 3       | 0         | 21.56                 |
|            |                         |            |    | 5       | 0         | 21.22                 |
|            |                         |            |    | 5       | 1         | 21.24                 |
|            | 1732.5                  | 20175      |    | 1       | 0         | 21.95                 |
|            |                         |            |    | 1       | 5         | 21.97                 |
|            |                         |            |    | 3       | 0         | 21.43                 |
|            |                         |            |    | 5       | 0         | 21.16                 |
|            |                         |            |    | 5       | 1         | 21.19                 |
|            | 1747.5                  | 20325      |    | 1       | 0         | 21.93                 |
|            |                         |            |    | 1       | 5         | 21.91                 |
|            |                         |            |    | 3       | 0         | 21.42                 |
|            |                         |            |    | 5       | 0         | 21.14                 |
|            |                         |            |    | 5       | 1         | 21.15                 |
| QPSK       | 1720                    | 20050      | 20 | 1       | 0         | <b>23.44</b>          |
|            |                         |            |    | 3       | 0         | 22.31                 |
|            |                         |            |    | 6       | 0         | 21.35                 |
|            | 1732.5                  | 20175      |    | 1       | 0         | <b>23.28</b>          |
|            |                         |            |    | 3       | 0         | 22.47                 |
|            |                         |            |    | 6       | 0         | 21.26                 |
|            | 1745                    | 20300      |    | 1       | 0         | <b>23.29</b>          |
|            |                         |            |    | 3       | 0         | 22.38                 |
|            |                         |            |    | 3       | 0         | 21.21                 |
| 16QAM      | 1720                    | 20050      | 20 | 1       | 0         | 22.38                 |
|            |                         |            |    | 1       | 5         | 22.06                 |
|            |                         |            |    | 3       | 0         | 21.59                 |
|            |                         |            |    | 5       | 0         | 21.31                 |
|            |                         |            |    | 5       | 1         | 21.33                 |
|            | 1732.5                  | 20175      |    | 1       | 0         | 22.04                 |
|            |                         |            |    | 1       | 5         | 21.99                 |
|            |                         |            |    | 3       | 0         | 21.45                 |
|            |                         |            |    | 5       | 0         | 21.25                 |
|            |                         |            |    | 5       | 1         | 21.28                 |
|            | 1745                    | 20300      |    | 1       | 0         | 22.02                 |
|            |                         |            |    | 1       | 5         | 22.08                 |
|            |                         |            |    | 3       | 0         | 21.68                 |
|            |                         |            |    | 5       | 0         | 21.23                 |
|            |                         |            |    | 5       | 1         | 21.24                 |

**LTE\_CAT.M1\_Band 12**

| Modulation | Carrier frequency (MHz) | UL Channel | BW  | RB Size | RB Offset | Conducted Power (dBm) |
|------------|-------------------------|------------|-----|---------|-----------|-----------------------|
| QPSK       | 699.7                   | 23017      | 1.4 | 1       | 0         | 23.49                 |
|            |                         |            |     | 3       | 0         | 22.10                 |
|            |                         |            |     | 6       | 0         | 21.65                 |
|            | 707.5                   | 23095      |     | 1       | 0         | 23.63                 |
|            |                         |            |     | 3       | 0         | 22.37                 |
|            |                         |            |     | 6       | 0         | 21.65                 |
|            | 715.3                   | 23173      |     | 1       | 0         | 23.74                 |
|            |                         |            |     | 3       | 0         | 22.48                 |
|            |                         |            |     | 6       | 0         | 21.78                 |
| 16QAM      | 699.7                   | 23017      | 1.4 | 1       | 0         | 22.38                 |
|            |                         |            |     | 1       | 5         | 22.34                 |
|            |                         |            |     | 3       | 0         | 21.72                 |
|            |                         |            |     | 5       | 0         | 21.58                 |
|            |                         |            |     | 5       | 1         | 21.59                 |
|            | 707.5                   | 23095      |     | 1       | 0         | 22.51                 |
|            |                         |            |     | 1       | 5         | 22.48                 |
|            |                         |            |     | 3       | 0         | 21.73                 |
|            |                         |            |     | 5       | 0         | 21.67                 |
|            |                         |            |     | 5       | 1         | 21.68                 |
|            | 715.3                   | 23173      |     | 1       | 0         | 22.57                 |
|            |                         |            |     | 1       | 5         | 22.54                 |
|            |                         |            |     | 3       | 0         | 21.94                 |
|            |                         |            |     | 5       | 0         | 21.70                 |
|            |                         |            |     | 5       | 1         | 21.72                 |
| QPSK       | 700.5                   | 23025      | 3   | 1       | 0         | 23.50                 |
|            |                         |            |     | 3       | 0         | 22.29                 |
|            |                         |            |     | 6       | 0         | 21.66                 |
|            | 707.5                   | 23095      |     | 1       | 0         | 23.64                 |
|            |                         |            |     | 3       | 0         | 22.36                 |
|            |                         |            |     | 6       | 0         | 21.66                 |
|            | 714.5                   | 23165      |     | 1       | 0         | 23.75                 |
|            |                         |            |     | 3       | 0         | 22.39                 |
|            |                         |            |     | 6       | 0         | 21.79                 |
| 16QAM      | 700.5                   | 23025      | 3   | 1       | 0         | 22.39                 |
|            |                         |            |     | 1       | 5         | 22.35                 |
|            |                         |            |     | 3       | 0         | 21.68                 |
|            |                         |            |     | 5       | 0         | 21.59                 |
|            |                         |            |     | 5       | 1         | 21.60                 |
|            | 707.5                   | 23095      |     | 1       | 0         | 22.52                 |
|            |                         |            |     | 1       | 5         | 22.49                 |
|            |                         |            |     | 3       | 0         | 21.85                 |
|            |                         |            |     | 5       | 0         | 21.68                 |
|            |                         |            |     | 5       | 1         | 21.69                 |
|            | 714.5                   | 23165      |     | 1       | 0         | 22.58                 |
|            |                         |            |     | 1       | 5         | 22.55                 |
|            |                         |            |     | 3       | 0         | 21.84                 |
|            |                         |            |     | 5       | 0         | 21.71                 |
|            |                         |            |     | 5       | 1         | 21.73                 |

| Modulation | Carrier frequency (MHz) | UL Channel | BW | RB Size | RB Offset | Conducted Power (dBm) |
|------------|-------------------------|------------|----|---------|-----------|-----------------------|
| QPSK       | 701.5                   | 23035      | 5  | 1       | 0         | 23.51                 |
|            |                         |            |    | 3       | 0         | 22.10                 |
|            |                         |            |    | 6       | 0         | 21.67                 |
|            | 707.5                   | 23095      |    | 1       | 0         | 23.65                 |
|            |                         |            |    | 3       | 0         | 22.39                 |
|            |                         |            |    | 6       | 0         | 21.67                 |
|            | 713.5                   | 23155      |    | 1       | 0         | 23.76                 |
|            |                         |            |    | 3       | 0         | 22.13                 |
|            |                         |            |    | 6       | 0         | 21.80                 |
| 16QAM      | 701.5                   | 23035      | 5  | 1       | 0         | 22.40                 |
|            |                         |            |    | 1       | 5         | 22.36                 |
|            |                         |            |    | 3       | 0         | 21.83                 |
|            |                         |            |    | 5       | 0         | 21.60                 |
|            |                         |            |    | 5       | 1         | 21.61                 |
|            | 707.5                   | 23095      |    | 1       | 0         | 22.53                 |
|            |                         |            |    | 1       | 5         | 22.50                 |
|            |                         |            |    | 3       | 0         | 21.93                 |
|            |                         |            |    | 5       | 0         | 21.69                 |
|            |                         |            |    | 5       | 1         | 21.70                 |
|            | 713.5                   | 23155      |    | 1       | 0         | 22.59                 |
|            |                         |            |    | 1       | 5         | 22.56                 |
|            |                         |            |    | 3       | 0         | 21.87                 |
|            |                         |            |    | 5       | 0         | 21.72                 |
|            |                         |            |    | 5       | 1         | 21.74                 |
| QPSK       | 704                     | 23060      | 10 | 1       | 0         | <b>23.57</b>          |
|            |                         |            |    | 3       | 0         | 22.46                 |
|            |                         |            |    | 6       | 0         | 21.73                 |
|            | 707.5                   | 23095      |    | 1       | 0         | <b>23.71</b>          |
|            |                         |            |    | 3       | 0         | 22.41                 |
|            |                         |            |    | 6       | 0         | 21.73                 |
|            | 711                     | 23130      |    | 1       | 0         | <b>23.82</b>          |
|            |                         |            |    | 3       | 0         | 22.37                 |
|            |                         |            |    | 6       | 0         | 21.86                 |
| 16QAM      | 704                     | 23060      | 10 | 1       | 0         | 22.46                 |
|            |                         |            |    | 1       | 5         | 22.42                 |
|            |                         |            |    | 3       | 0         | 21.84                 |
|            |                         |            |    | 5       | 0         | 21.66                 |
|            |                         |            |    | 5       | 1         | 21.67                 |
|            | 707.5                   | 23095      |    | 1       | 0         | 22.59                 |
|            |                         |            |    | 1       | 5         | 22.56                 |
|            |                         |            |    | 3       | 0         | 21.94                 |
|            |                         |            |    | 5       | 0         | 21.75                 |
|            |                         |            |    | 5       | 1         | 21.76                 |
|            | 711                     | 23130      |    | 1       | 0         | 22.65                 |
|            |                         |            |    | 1       | 5         | 22.62                 |
|            |                         |            |    | 3       | 0         | 21.92                 |
|            |                         |            |    | 5       | 0         | 21.78                 |
|            |                         |            |    | 5       | 1         | 21.80                 |

### 6.3 Bluetooth Measurement result

| Modulation type  | Test Result (dBm) |                |                |
|------------------|-------------------|----------------|----------------|
|                  | 2402MHz (Ch0)     | 2440MHz (Ch19) | 2480MHz (Ch39) |
| GFSK (LE 1Mbps)) | -3.44             | -3.27          | -3.15          |

## 6.4 Standalone SAR Test Exclusion Considerations

Standalone 10-g limbs SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

### SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and $\leq 50$ mm

According to the KDB447498 4.3.1 (1)

For 100 MHz to 6 GHz and test separation distances  $\leq 50$  mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

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

- $f(\text{GHz})$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is  $\leq 50$  mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test exclusion.

This is equivalent to  $[(\text{max. power of channel, including tune-up tolerance, mW}) / (60 / \sqrt{f}(\text{GHz}) \text{ mW})] \cdot [20 \text{ mm} / (\text{min. test separation distance, mm})] \leq 1.0$  for 1-g SAR; also see Appendix A for approximate exclusion threshold values at selected frequencies and distances.

According to the KDB447498 appendix A

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

| MHz  | 5  | 10 | 15  | 20  | 25  | mm                                      |
|------|----|----|-----|-----|-----|-----------------------------------------|
| 150  | 39 | 77 | 116 | 155 | 194 | SAR Test<br>Exclusion<br>Threshold (mW) |
| 300  | 27 | 55 | 82  | 110 | 137 |                                         |
| 450  | 22 | 45 | 67  | 89  | 112 |                                         |
| 835  | 16 | 33 | 49  | 66  | 82  |                                         |
| 900  | 16 | 32 | 47  | 63  | 79  |                                         |
| 1500 | 12 | 24 | 37  | 49  | 61  |                                         |
| 1900 | 11 | 22 | 33  | 44  | 54  |                                         |
| 2450 | 10 | 19 | 29  | 38  | 48  |                                         |
| 3600 | 8  | 16 | 24  | 32  | 40  |                                         |
| 5200 | 7  | 13 | 20  | 26  | 33  |                                         |
| 5400 | 6  | 13 | 19  | 26  | 32  |                                         |
| 5800 | 6  | 12 | 19  | 25  | 31  |                                         |

Note: 10-g Extremity SAR Test Exclusion Power Thresholds are 2.5 times higher than the 1-g SAR Test Exclusion Thresholds indicated above. These thresholds do not apply, by extrapolation or other means, to occupational exposure limits.

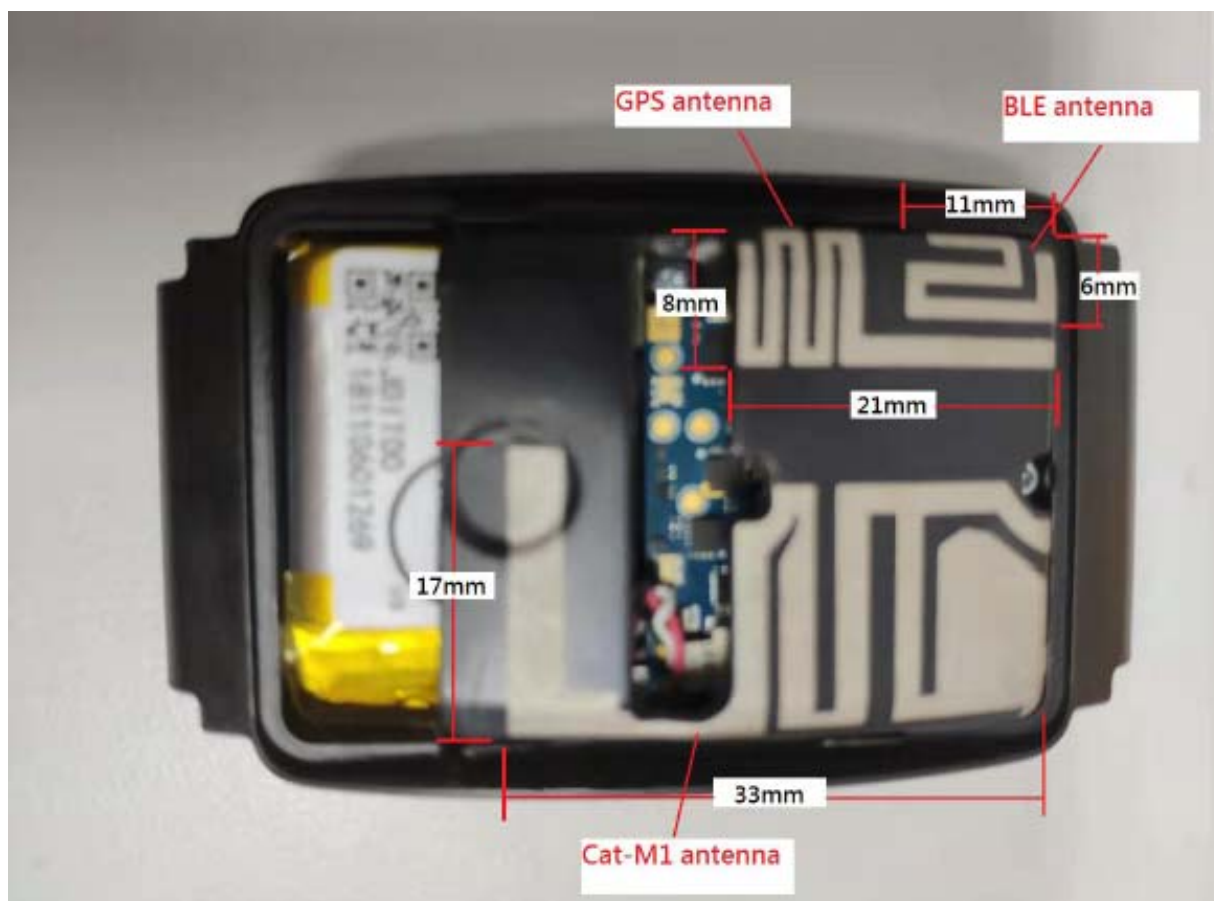
#### Summary of Transmitters

| Band/Mode                  | Position | Max. RF output power (mW) | SAR test exclusion Threshold (mW) | SAR Required |
|----------------------------|----------|---------------------------|-----------------------------------|--------------|
| (2.4~2.4835) GHz Bluetooth | Limbs    | 0.484                     | 25                                | No           |



## 6.5 RF exposure conditions

Refer to the follow picture “Antenna Locations & Separation Distances” for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.



### 6.5.1 Limbs Exposure conditions

#### For WWAN

| Test Configurations | SAR Required | Note |
|---------------------|--------------|------|
| Back                | yes          | /    |
| Front               | yes          | /    |
| Top                 | yes          | /    |
| Bottom              | yes          | /    |
| Left                | yes          | /    |
| Right               | yes          | /    |

## 6.6 System Checking

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyzer. A system check measurement was made following the determination of the dielectric parameters of the simulant, using the dipole validation kit. A power level of 250mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system checking results (dielectric parameters and SAR values) are given in the table below.

| Date Tested | System dipole | T.S. Liquid | SAR measured (normalized to 1W) |       | Target (Ref.Value) | Delta (%) | Tolerance (%) |
|-------------|---------------|-------------|---------------------------------|-------|--------------------|-----------|---------------|
| 2019.02.22  | D750V3        | Body        | 10g                             | 5.88  | 5.73               | 2.6       | ±10           |
| 2019.02.23  | D1800V2       | Body        | 10g                             | 20.12 | 20.8               | -3.3      | ±10           |
| 2019.02.24  | D2000V2       | Body        | 10g                             | 19.12 | 20.4               | -6.3      | ±10           |

Plots of the system checking scans are given in Appendix A.

### Tissue Simulants used in the Measurements

For the measurement of the following parameters the SPEAG DAKS-3.5 dielectric parameter probe is used, representing the open-ended coaxial probe measurement procedure.

| Date Tested | Freq.(MHz) | Liquid parameters | measured | Target | Delta(%) | Tolerance (%) |
|-------------|------------|-------------------|----------|--------|----------|---------------|
| 2019.02.22  | Body 750   | $\epsilon_r$      | 53.28    | 55.50  | -4.0     | ±5            |
|             |            | $\sigma$ [S/m]    | 0.98     | 0.96   | 1.7      | ±5            |
| 2019.02.23  | Body 1800  | $\epsilon_r$      | 53.29    | 53.30  | 0.0      | ±5            |
|             |            | $\sigma$ [S/m]    | 1.50     | 1.52   | -1.3     | ±5            |
| 2019.02.24  | Body 2000  | $\epsilon_r$      | 52.60    | 53.30  | -1.3     | ±5            |
|             |            | $\sigma$ [S/m]    | 1.59     | 1.52   | 4.3      | ±5            |

## 6.7 SAR Test result

In order to determine the largest value of the peak spatial-average SAR of a handset, all device positions, configurations, and operational modes should be tested for each frequency band according to Steps 1 to 3 below.

Step 1: The tests should be performed at the channel that is closest to the centre of the transmit frequency band.

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom),  
b) all configurations for each device position in a), e.g., antenna extended and retracted, and  
c) All operational modes for each device position in item a) and configuration in item b) in each frequency band, e.g., analog and digital, If more than three frequencies need to be tested (i.e.,  $N_c > 3$ ), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

Step 2: For the condition providing the highest peak spatial-average SAR determined in Step 1 for each frequency, perform all tests at all other test frequency channels, e.g., lowest and highest frequencies. In addition, for all other conditions (device position, configuration, and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies should be tested as well.

Step 3: Examine all data to determine the largest value of the peak.

**Note: There is no KDB for Cat M, since Cat M belongs to LTE, KDB 941225 is referred.**

The measured Limbs SAR values for the test device are tabulated below:

Mode: Cat.M Band 2

L:1860MHz M:1880 MHz H:1900MHz

SAR Values Limit of SAR (W/kg): 4.0W/kg (10g Average)

| Test Case |                        | Channel | Measure Conducted Power (dBm) | Tune-up limit (dBm) | Scaling Factor | Measure Results (W/kg) | Reported Results (W/kg) |
|-----------|------------------------|---------|-------------------------------|---------------------|----------------|------------------------|-------------------------|
| position  | Mode                   |         |                               |                     |                | 10g Average            | 10g Average             |
| Back      | 20BW<br>1RB<br>(limbs) | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.139                  | 0.152                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Front     |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.233                  | 0.254                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Top       |                        | L       | 22.43                         | 22.50               | 1.02           | 0.229                  | 0.234                   |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.264                  | <b>0.288</b>            |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | 0.236                  | 0.257                   |
| Bottom    |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.053                  | 0.058                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Left      |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.022                  | 0.024                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Right     |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.023                  | 0.025                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |

| Test Case |                          | Channel | Measure Conducted Power (dBm) | Tune-up limit (dBm) | Scaling Factor | Measure Results (W/kg) | Reported Results (W/kg) |
|-----------|--------------------------|---------|-------------------------------|---------------------|----------------|------------------------|-------------------------|
| position  | Mode                     |         |                               |                     |                | 10g Average            | 10g Average             |
| Back      | 20BW<br>50%RB<br>(limbs) | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.116                  | 0.129                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Front     |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.203                  | 0.225                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Top       |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.237                  | 0.263                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Bottom    |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.018                  | 0.020                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Left      |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.012                  | 0.013                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Right     |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.011                  | 0.012                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |

**Mode: Cat.M Band 4**

L:1720MHz M:1732.5 MHz H:1745MHz

SAR Values Limit of SAR (W/kg): 4.0W/kg (10g Average)

| Test Case |                        | Channel | Measure Conducted Power (dBm) | Tune-up limit (dBm) | Scaling Factor | Measure Results (W/kg) | Reported Results (W/kg) |
|-----------|------------------------|---------|-------------------------------|---------------------|----------------|------------------------|-------------------------|
| position  | Mode                   |         |                               |                     |                | 10g Average            | 10g Average             |
| Back      | 20BW<br>1RB<br>(limbs) | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.059                  | 0.062                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Front     |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.170                  | <b>0.179</b>            |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Top       |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.066                  | 0.069                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Bottom    |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.124                  | 0.130                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Left      |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.011                  | 0.012                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Right     |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.032                  | 0.034                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |

| Test Case |                          | Channel | Measure Conducted Power (dBm) | Tune-up limit (dBm) | Scaling Factor | Measure Results (W/kg) | Reported Results (W/kg) |
|-----------|--------------------------|---------|-------------------------------|---------------------|----------------|------------------------|-------------------------|
| position  | Mode                     |         |                               |                     |                | 10g Average            | 10g Average             |
| Back      | 20BW<br>50%RB<br>(limbs) | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.028                  | 0.028                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Front     |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.092                  | 0.093                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Top       |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.042                  | 0.042                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Bottom    |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.093                  | 0.094                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Left      |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.009                  | 0.009                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Right     |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.017                  | 0.017                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |



**Mode: Cat.M Band 12**

L:704MHz M:707.5 MHz H:711MHz

SAR Values Limit of SAR (W/kg): 4.0W/kg (10g Average)

| Test Case |                        | Channel | Measure Conducted Power (dBm) | Tune-up limit (dBm) | Scaling Factor | Measure Results (W/kg) | Reported Results (W/kg) |
|-----------|------------------------|---------|-------------------------------|---------------------|----------------|------------------------|-------------------------|
| position  | Mode                   |         |                               |                     |                | 10g Average            | 10g Average             |
| Back      | 10BW<br>1RB<br>(limbs) | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.136                  | 0.146                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Front     |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.185                  | <b>0.198</b>            |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Top       |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.081                  | 0.087                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Bottom    |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.086                  | 0.092                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Left      |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.071                  | 0.076                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Right     |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.046                  | 0.049                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |

| Test Case |                          | Channel | Measure Conducted Power (dBm) | Tune-up limit (dBm) | Scaling Factor | Measure Results (W/kg) | Reported Results (W/kg) |
|-----------|--------------------------|---------|-------------------------------|---------------------|----------------|------------------------|-------------------------|
| position  | Mode                     |         |                               |                     |                | 10g Average            | 10g Average             |
| Back      | 10BW<br>50%RB<br>(limbs) | L       | 22.46                         | 22.50               | 1.01           | ---                    | ---                     |
|           |                          | M       | 22.41                         | 22.50               | 1.02           | 0.092                  | 0.094                   |
|           |                          | H       | 22.37                         | 22.50               | 1.03           | ---                    | ---                     |
| Front     |                          | L       | 22.46                         | 22.50               | 1.01           | ---                    | ---                     |
|           |                          | M       | 22.41                         | 22.50               | 1.02           | 0.072                  | 0.073                   |
|           |                          | H       | 22.37                         | 22.50               | 1.03           | ---                    | ---                     |
| Top       |                          | L       | 22.46                         | 22.50               | 1.01           | ---                    | ---                     |
|           |                          | M       | 22.41                         | 22.50               | 1.02           | 0.046                  | 0.047                   |
|           |                          | H       | 22.37                         | 22.50               | 1.03           | ---                    | ---                     |
| Bottom    |                          | L       | 22.46                         | 22.50               | 1.01           | ---                    | ---                     |
|           |                          | M       | 22.41                         | 22.50               | 1.02           | 0.026                  | 0.027                   |
|           |                          | H       | 22.37                         | 22.50               | 1.03           | ---                    | ---                     |
| Left      |                          | L       | 22.46                         | 22.50               | 1.01           | ---                    | ---                     |
|           |                          | M       | 22.41                         | 22.50               | 1.02           | 0.036                  | 0.037                   |
|           |                          | H       | 22.37                         | 22.50               | 1.03           | ---                    | ---                     |
| Right     |                          | L       | 22.46                         | 22.50               | 1.01           | ---                    | ---                     |
|           |                          | M       | 22.41                         | 22.50               | 1.02           | 0.017                  | 0.018                   |
|           |                          | H       | 22.37                         | 22.50               | 1.03           | ---                    | ---                     |

## 6.8 SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required.

- 1) Repeated measurement is not required when the original highest measured SAR is  $< 0.80$  W/kg; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45$  W/kg ( $\sim 10\%$  from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .

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 Highest Reported SAR configuration in Each Frequency Band

| Frequency band | Air interface              | Limbs(w/kg) |
|----------------|----------------------------|-------------|
| 750 MHz        | Cat M BAND12               | $<2.0$      |
| 1800/1900 MHz  | Cat M BAND2<br>Cat M BAND4 | $<2.0$      |

## 6.9 Simultaneous Transmission SAR Analysis

According to the formula (KDB447498 4.3.2) the Bluetooth SAR as follow:

$[(\text{max. power of channel, including tune-up tolerance, mw}) / (\text{min. test separation distance, mm})]$

$[\sqrt{f(\text{GHz})} / x] \text{ W/kg}$  for test separation distances  $\leq 50\text{mm}$ .

Limbs:

min. test separation distance = 5mm

Where  $x=7.5$  for 1-g SAR, and  $x=18.75$  for 10-g SAR.

### Estimated SAR BLE

| Mode | Position | F(GHz) | Distance(mm) | Estimated |
|------|----------|--------|--------------|-----------|
| BLE  | Limbs    | 2.480  | 5            | 0.008     |

### The sum of SAR values for Cat M& BLE

|       | MAXIMUM SAR VALUE FOR LIMBS |
|-------|-----------------------------|
| Cat M | 0.288                       |
| BLE   | 0.008                       |
| Sum   | 0.298                       |
| Note  | Top:<br>Cat M Band2+BLE     |

According to the above tables, the sum of SAR values for Cat M and BLE  $< 4.0 \text{ W/kg}$ . So simultaneous transmission SAR are not required for BLE transmitter.

## 7 MEASUREMENT UNCERTAINTY

| DASY5 Uncertainty Budget    |                   |             |            |                 |                  |                  |                   |              |
|-----------------------------|-------------------|-------------|------------|-----------------|------------------|------------------|-------------------|--------------|
| Error description           | Uncertainty value | Prob. Dist. | Div.       | ( $C_i$ )<br>1g | ( $C_i$ )<br>10g | Std.Unc<br>(1g). | Std.Unc.<br>(10g) | (vi)<br>Veff |
| Measurement system          |                   |             |            |                 |                  |                  |                   |              |
| Probe calibration           | ±6.55%            | N           | 1          | 1               | 1                | ±6.55%           | ±6.55%            | ∞            |
| Axial isotropy              | ±4.7%             | R           | $\sqrt{3}$ | 0.7             | 0.7              | ±1.9%            | ±1.9%             | ∞            |
| Hemispherical isotropy      | ±9.6%             | R           | $\sqrt{3}$ | 0.7             | 0.7              | ±3.9%            | ±3.9%             | ∞            |
| Linearity                   | ±4.7%             | R           | $\sqrt{3}$ | 1               | 1                | ±2.7%            | ±2.7%             | ∞            |
| Modulation Response         | ±2.4%             | R           | $\sqrt{3}$ | 1               | 1                | ±1.4%            | ±1.4%             | ∞            |
| System detection limits     | ±1.0%             | R           | $\sqrt{3}$ | 1               | 1                | ±0.6%            | ±0.6%             | ∞            |
| Boundary effects            | ±2.0%             | R           | $\sqrt{3}$ | 1               | 1                | ±0.6%            | ±1.2%             | ∞            |
| Readout electronics         | ±0.3%             | N           | 1          | 1               | 1                | ±0.3%            | ±0.3%             | ∞            |
| Response time               | ±0.8%             | R           | $\sqrt{3}$ | 1               | 1                | ±0.5%            | ±0.5%             | ∞            |
| Integration time            | ±2.6%             | R           | $\sqrt{3}$ | 1               | 1                | ±1.5%            | ±1.5%             | ∞            |
| RF ambient noise            | ±3.0%             | R           | $\sqrt{3}$ | 1               | 1                | ±1.7%            | ±1.7%             | ∞            |
| RF ambient reflections      | ±3.0%             | R           | $\sqrt{3}$ | 1               | 1                | ±1.7%            | ±1.7%             | ∞            |
| Probe positioner            | ±0.8%             | R           | $\sqrt{3}$ | 1               | 1                | ±0.5%            | ±0.5%             | ∞            |
| Probe positioning           | ±6.7%             | R           | $\sqrt{3}$ | 1               | 1                | ±3.9%            | ±3.9%             | ∞            |
| Post-processing             | ±4.0%             | R           | $\sqrt{3}$ | 1               | 1                | ±2.3%            | ±2.3%             | ∞            |
| Test Sample Related         |                   |             |            |                 |                  |                  |                   |              |
| Device holder               | ±3.6%             | N           | 1          | 1               | 1                | ±3.6%            | ±3.6%             | 5            |
| Device Positioning          | ±2.9%             | N           | 1          | 1               | 1                | ±2.9%            | ±2.9%             | 145          |
| Power Scaling               | ±0%               | R           | $\sqrt{3}$ | 1               | 1                | ±0%              | ±0%               | ∞            |
| Power drift                 | ±5.0%             | R           | $\sqrt{3}$ | 1               | 1                | ±2.9%            | ±2.9%             | ∞            |
| Phantom and Setup           |                   |             |            |                 |                  |                  |                   |              |
| Phantom uncertainty         | ±7.9%             | R           | $\sqrt{3}$ | 1               | 1                | ±4.6%            | ±4.6%             | ∞            |
| SAR correction              | ±1.9%             | R           | $\sqrt{3}$ | 1               | 0.84             | ±1.1%            | ±0.9%             | ∞            |
| Liquid conductivity(meas.)  | ±2.5%             | N           | $\sqrt{3}$ | 0.78            | 0.71             | ±1.1%            | ±1.0%             | ∞            |
| Liquid Permittivity (meas.) | ±2.5%             | N           | $\sqrt{3}$ | 0.26            | 0.26             | ±0.3%            | ±0.4%             | ∞            |
| Temp. unc. - Conductivity   | ±3.4%             | N           | $\sqrt{3}$ | 0.78            | 0.71             | ±1.5%            | ±1.4%             | ∞            |
| Temp. unc. - Permittivity   | ±0.4%             | N           | $\sqrt{3}$ | 0.23            | 0.26             | ±0.1%            | ±0.1%             | ∞            |
| Combined std. Uncertainty   |                   |             |            |                 |                  | ±12.5%           | ±12.5%            | 748          |
| Expanded STD Uncertainty    |                   |             |            |                 |                  | ±25.1%           | ±25.0%            |              |

## 8 TEST EQUIPMENTS

The measurements were performed using an automated near-field scanning system, DASY5, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements was the 'advanced extrapolation' algorithm.

The following table lists calibration dates of SPEAG components which the initial certified product used:

| Test Equipment           | Model   | Serial Number | Calibration date | Calibration Due data |
|--------------------------|---------|---------------|------------------|----------------------|
| DAE                      | DAE4    | 546           | 2018.10.15       | 2019.10.14           |
| Dosimetric E-field Probe | ES3DV3  | 3127          | 2018.11.02       | 2019.11.01           |
| Dipole Validation Kit    | D750V3  | 1011          | 2017.09.13       | 2020.09.12           |
| Dipole Validation Kit    | D1800V2 | 2d084         | 2017.09.15       | 2020.09.14           |
| Dipole Validation Kit    | D2000V2 | 1009          | 2018.02.01       | 2021.01.31           |

According to KDB 865664 D01 section 3.2.2, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements.

- 1) The test laboratory must ensure that the required supporting information and documentation are included in the SAR report to qualify for the three-year extended calibration interval; otherwise, the IEEE Std 1528-2013 recommended annual calibration applies.
- 2) Immediate re-calibration is required for the following conditions.
  - a) After a dipole is damaged and properly repaired to meet required specifications.
  - b) When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions; i.e., the error is not introduced by incorrect measurement procedures or other issues relating to the SAR measurement system.
  - c) When the most recent return-loss result, measured at least annually, deviates by more than 20% from the previous measurement (i.e. value in dB $\times$ 0.2) or not meeting the required 20 dB minimum return-loss requirement.
  - d) When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5  $\Omega$  from the previous measurement.

## Dipole 750

### SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

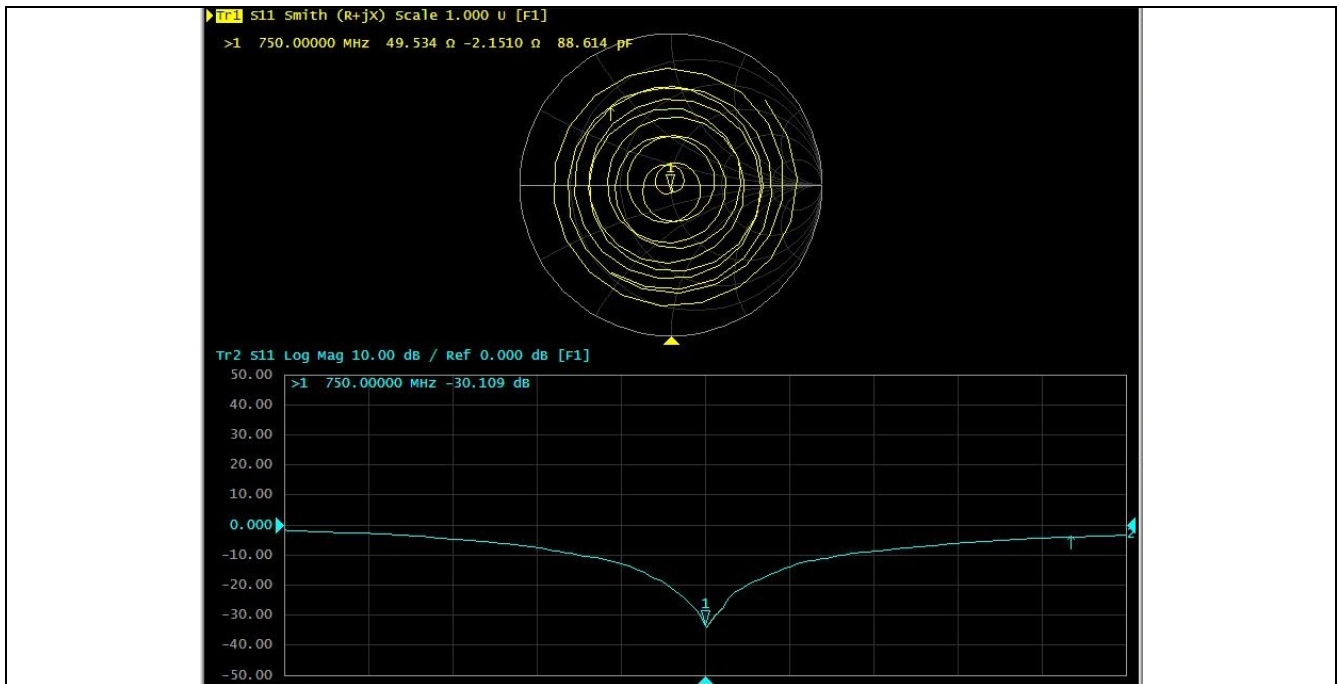
### Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance (measured on 2018.8.20), deviates within  $5\ \Omega$  from the previous measurement. (Data from the last calibration report)

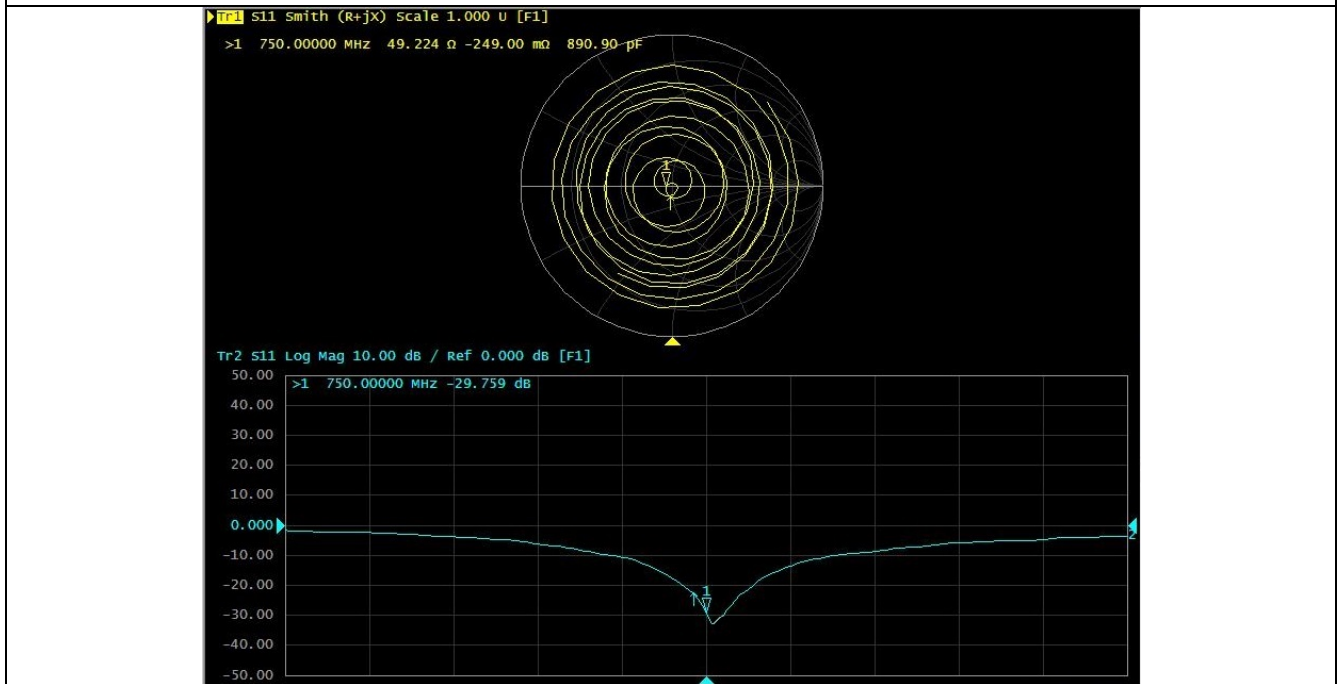
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

| Head TSL Parameters |                          |                          |            |
|---------------------|--------------------------|--------------------------|------------|
| Parameters          | Target (Ref. Value)      | Measured data            | deviation  |
| Impedance           | $51.0\Omega-2.79j\Omega$ | $49.5\Omega-2.15j\Omega$ | $<5\Omega$ |
| Return loss         | -30.7 db                 | -33.1 db                 | $<20\%$    |

| Body TSL Parameters |                          |                          |            |
|---------------------|--------------------------|--------------------------|------------|
| Parameters          | Target (Ref. Value)      | Measured data            | deviation  |
| Impedance           | $46.6\Omega-3.61j\Omega$ | $49.5\Omega-0.22j\Omega$ | $<5\Omega$ |
| Return loss         | -25.8db                  | -28.8db                  | $<20\%$    |



Head TSL Parameters



Body TSL Parameters



## Dipole1800

### SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

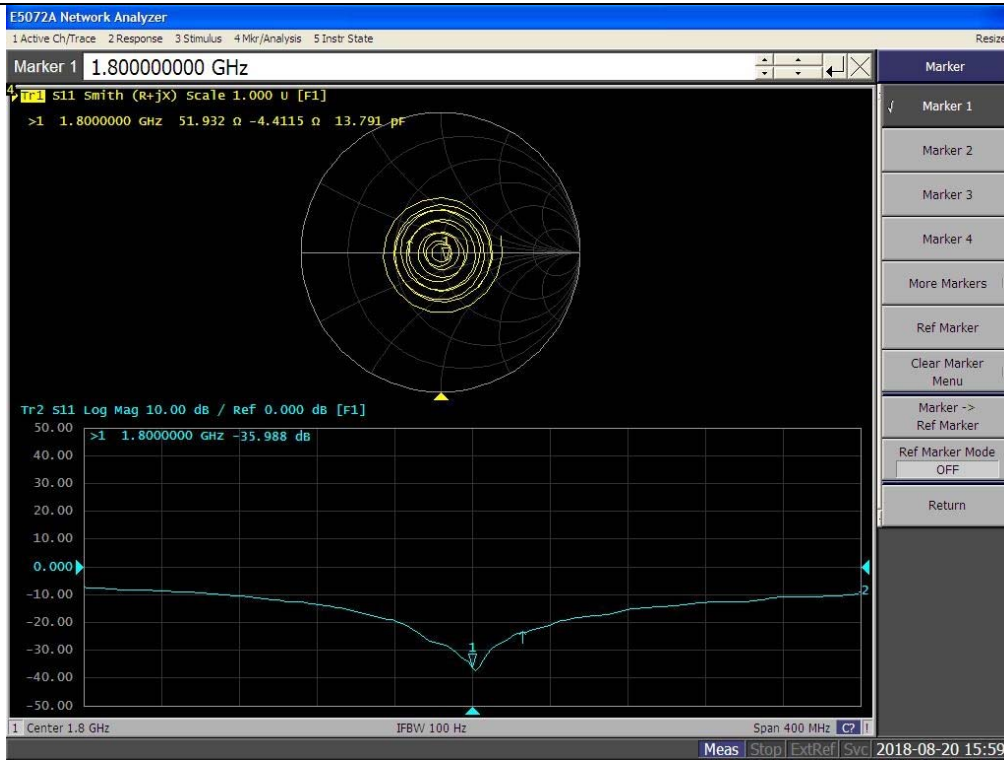
### Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance (measured on 2018.8.20), deviates within  $5\ \Omega$  from the previous measurement. (Data from the last calibration report)

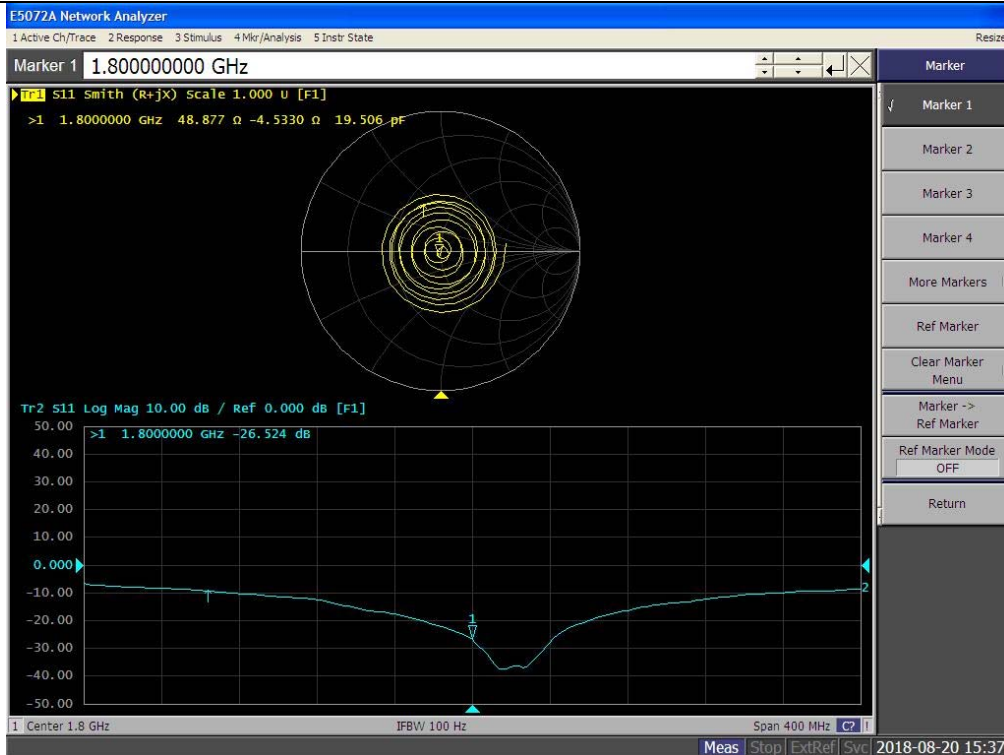
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

| Head TSL Parameters |                          |                          |            |
|---------------------|--------------------------|--------------------------|------------|
| Parameters          | Target (Ref. Value)      | Measured data            | deviation  |
| Impedance           | $49.3\Omega-1.55j\Omega$ | $51.9\Omega-4.41j\Omega$ | $<5\Omega$ |
| Return loss         | -35.4 db                 | -36.0db                  | $<20\%$    |

| Body TSL Parameters |                          |                          |            |
|---------------------|--------------------------|--------------------------|------------|
| Parameters          | Target (Ref. Value)      | Measured data            | deviation  |
| Impedance           | $46.0\Omega-1.32j\Omega$ | $48.9\Omega-4.53j\Omega$ | $<5\Omega$ |
| Return loss         | -27.1db                  | -26.5db                  | $<20\%$    |



Head TSL Parameters



Body TSL Parameters

## Dipole2000

### SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

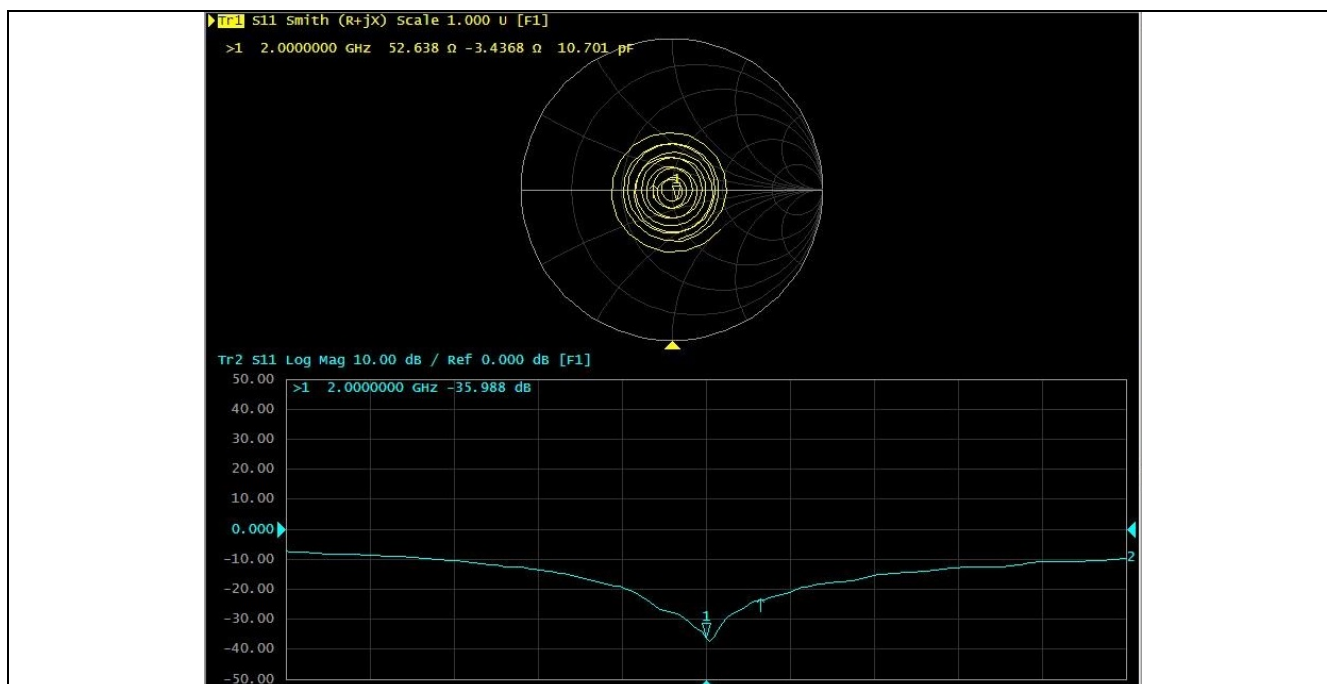
### Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance (measured on 2018.8.20), deviates within 5  $\Omega$  from the previous measurement. (Data from the last calibration report)

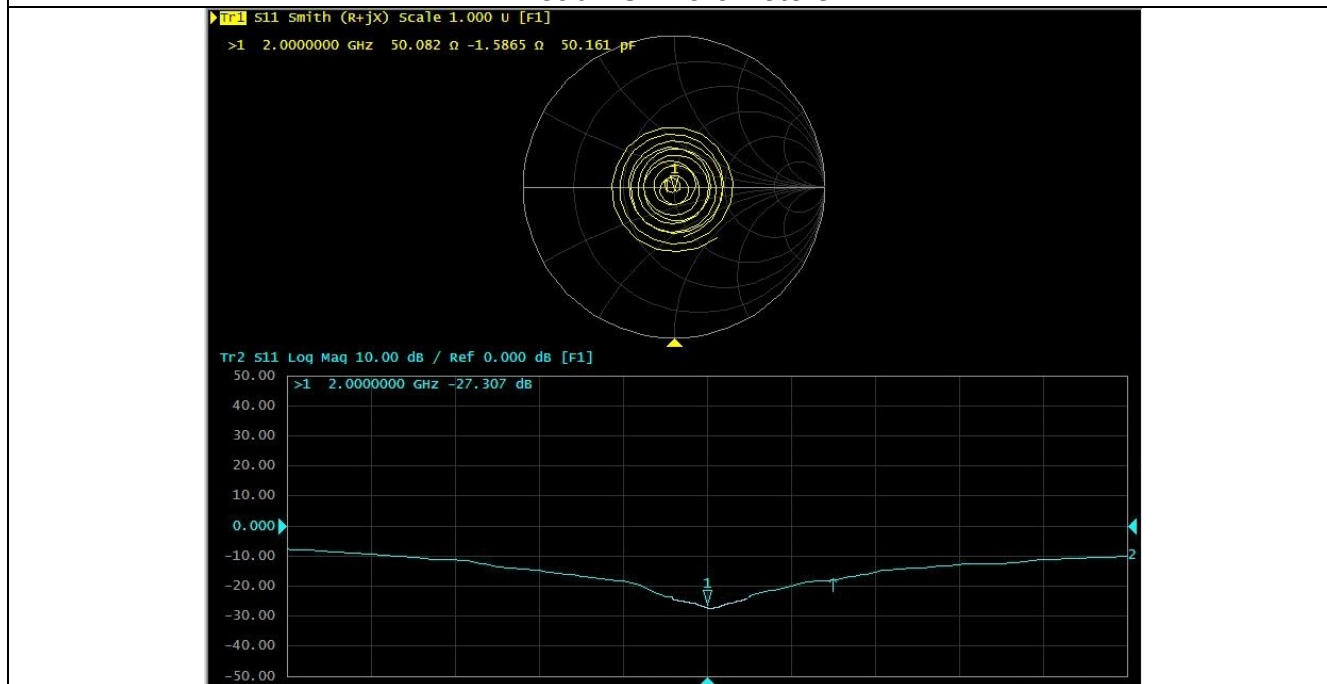
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

| Head TSL Parameters |                               |                                |             |
|---------------------|-------------------------------|--------------------------------|-------------|
| Parameters          | Target (Ref. Value)           | Measured data                  | deviation   |
| Impedance           | 49.8 $\Omega$ -2.08j $\Omega$ | 52.64 $\Omega$ -3.44j $\Omega$ | <5 $\Omega$ |
| Return loss         | -33.6 db                      | -36.0db                        | <20%        |

| Body TSL Parameters |                               |                                |             |
|---------------------|-------------------------------|--------------------------------|-------------|
| Parameters          | Target (Ref. Value)           | Measured data                  | deviation   |
| Impedance           | 46.3 $\Omega$ -1.63j $\Omega$ | 50.08 $\Omega$ -1.59j $\Omega$ | <5 $\Omega$ |
| Return loss         | -27.6db                       | -27.31db                       | <20%        |



Head TSL Parameters



Body TSL Parameters

Additional test equipment used in testing:

| Test Equipment             | Model    | Serial Number | Calibration date | Calibration Due data |
|----------------------------|----------|---------------|------------------|----------------------|
| Signal Generator           | E4428C   | MY45280865    | 2018.08.20       | 2019.08.19           |
| Signal Generator           | SML 03   | 103514        | 2018.08.20       | 2019.08.19           |
| Power meter                | E4417A   | MY45101182    | 2018.08.20       | 2019.08.19           |
| Power Sensor               | E4412A   | MY41502214    | 2018.08.20       | 2019.08.19           |
| Power Sensor               | E4412A   | MY41502130    | 2018.08.20       | 2019.08.19           |
| Power meter                | E4417A   | MY45101004    | 2018.08.20       | 2019.08.19           |
| Power Sensor               | E9300B   | MY41496001    | 2018.08.20       | 2019.08.19           |
| Power Sensor               | E9300B   | MY41496003    | 2018.08.20       | 2019.08.19           |
| Communication Tester       | CMW500   | 134669        | 2018.08.20       | 2019.08.19           |
| Vector Network Analyzer    | VNA R140 | 0011213       | 2018.10.17       | 2019.10.16           |
| Dielectric Parameter Probe | DAKS-3.5 | 1042          | 2018.10.17       | 2019.10.16           |
| Network Analyzer           | E5072A   | MY51100334    | 2018.03.01       | 2019.02.28           |

#### Detailed information of Isotropic E-field Probe Type ES3DV3

|                           |                                                                                                                                                                           |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Construction              | Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration               | Calibration certificate in Appendix C                                                                                                                                     |
| Frequency                 | 10 MHz to 4 GHz;<br>Linearity: $\pm 0.2$ dB (30 MHz to 4 GHz)                                                                                                             |
| Optical Surface Detection | $\pm 0.2$ mm repeatability in air and clear liquids over diffuse reflecting surfaces                                                                                      |
| 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: 2.0 mm                                            |
| Dynamic Range             | 5 $\mu$ W/g to > 100 W/kg; Linearity: $\pm 0.2$ dB                                                                                                                        |
| Application               | General dosimetry up to 4 GHz<br>Dosimetry in strong gradient fields<br>Compliance tests of mobile phones                                                                 |

#### Detailed information of Isotropic E-field Probe Type EX3DV4

|                           |                                                                                                                                                                                                               |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Construction              | Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)                                                         |
| Calibration               | Calibration certificate in Appendix C                                                                                                                                                                         |
| Frequency                 | 10 MHz to > 6 GHz<br>Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)                                                                                                                                                |
| Optical Surface Detection | $\pm 0.3$ mm repeatability in air and clear liquids over diffuse reflecting surfaces                                                                                                                          |
| 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                                                                          |
| Dynamic Range             | 10 $\mu$ W/g to > 100 W/kg<br>Linearity: $\pm 0.2$ dB (noise: typically < 1 $\mu$ W/g)                                                                                                                        |
| Application               | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%. |

### **ANNEX A – TEST PLOTS**

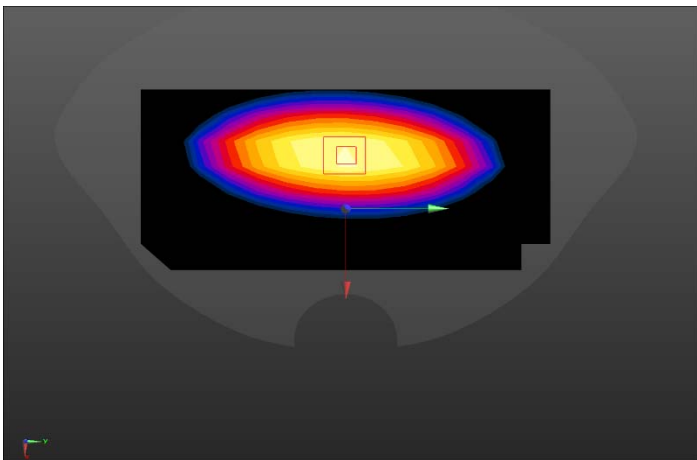
Please refer to the attachment.

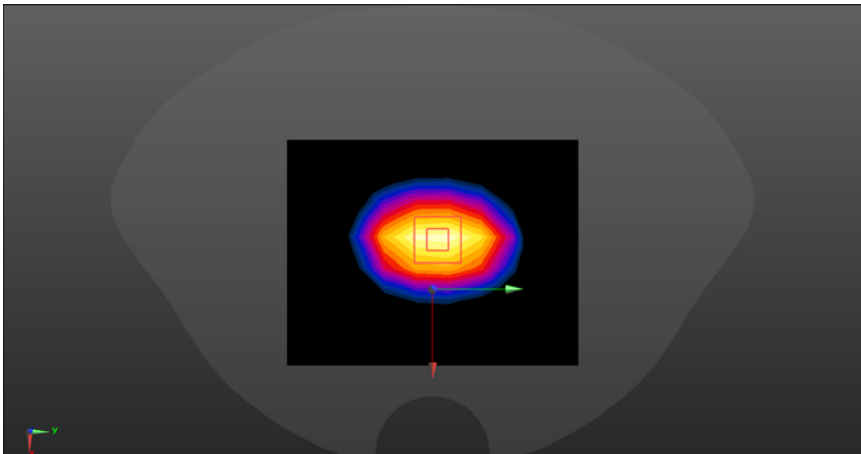
### **ANNEX B – RELEVANT PAGES FROM CALIBRATION REPORTS**

Please refer to the attachment.

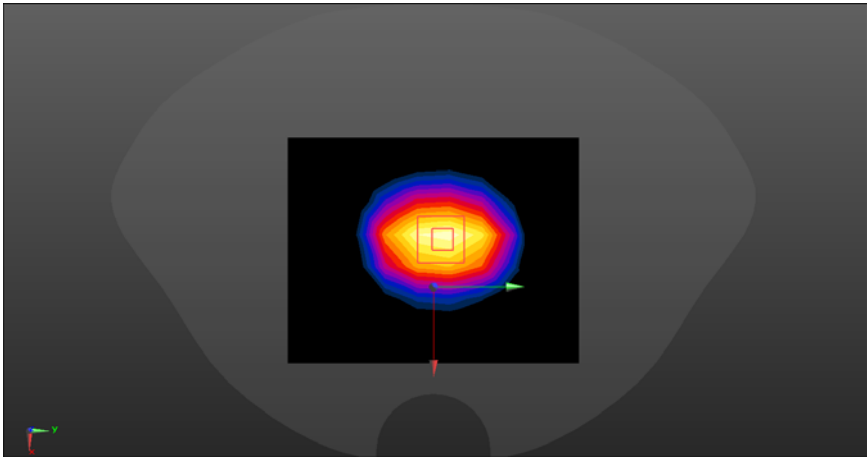
## ANNEX A – TEST PLOTS

### Body liquid

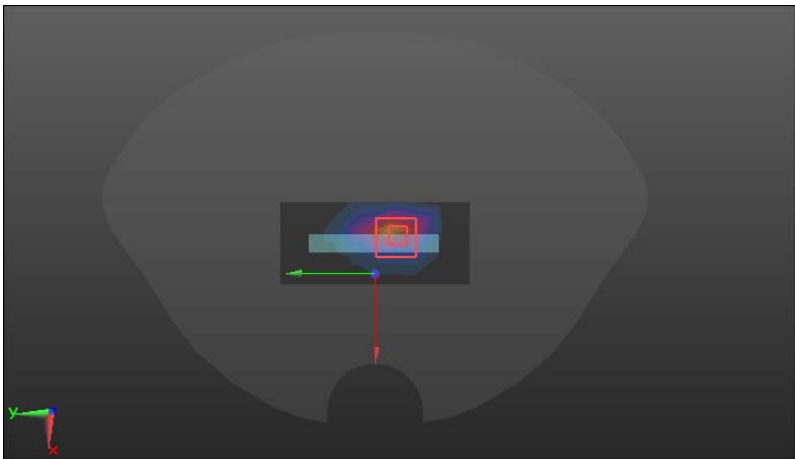
| System check                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 750MHz |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| <p>Communication System: UID 0, CW (0); Communication System Band: D750 (750.0 MHz); Frequency: 750 MHz; Communication System PAR: 0 dB<br/>Medium parameters used: <math>f = 750 \text{ MHz}</math>; <math>\sigma = 0.976 \text{ S/m}</math>; <math>\epsilon_r = 53.279</math>; <math>\rho = 1000 \text{ kg/m}^3</math><br/>Phantom section: Flat Section</p> <p>DASY Configuration:</p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3127; ConvF(6.34, 6.34, 6.34); Calibrated: 2018/11/2;</li> <li>Sensor-Surface: 3mm (Mechanical Surface Detection), <math>z = -3.0, 32.0</math></li> <li>Electronics: DAE4 Sn546; Calibrated: 2018/10/15</li> <li>Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx</li> <li>DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)</li> </ul> <p><b>System Performance Check at Frequencies 750MHz/d=15mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Area Scan (8x15x1):</b> Measurement grid: <math>dx=15\text{mm}</math>, <math>dy=15\text{mm}</math><br/>Maximum value of SAR (measured) = 2.31 W/kg</p> <p><b>System Performance Check at Frequencies 750MHz/d=15mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:</b> Measurement grid: <math>dx=5\text{mm}</math>, <math>dy=5\text{mm}</math>, <math>dz=5\text{mm}</math><br/>Reference Value = 41.26 V/m; Power Drift = 0.13 dB<br/>Peak SAR (extrapolated) = 3.45 W/kg<br/><b>SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.47 W/kg</b><br/>Maximum value of SAR (measured) = 2.66 W/kg</p>  |        |

| System check                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1800MHz |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <p>Communication System: UID 0, CW (0); Frequency: 1800 MHz<br/> Medium parameters used: <math>f = 1800 \text{ MHz}</math>; <math>\sigma = 1.502 \text{ S/m}</math>; <math>\epsilon_r = 53.287</math>; <math>\rho = 1000 \text{ kg/m}^3</math><br/> Phantom section: Flat Section</p> <p>DASY5 Configuration:</p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3127; ConvF(4.76, 4.76, 4.76); Calibrated: 2018/11/2;</li> <li>Sensor-Surface: 3mm (Mechanical Surface Detection)</li> <li>Electronics: DAE4 Sn546; Calibrated: 2018/10/15</li> <li>Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx</li> </ul> <p>Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)<br/> <b>Configuration 1800/1800/Area Scan (8x10x1):</b> Measurement grid: <math>dx=15\text{mm}</math>, <math>dy=15\text{mm}</math><br/> Maximum value of SAR (measured) = 11.5 W/kg<br/> <b>Configuration 1800/1800/Zoom Scan (7x7x7) (7x7x7)/Cube 0:</b> Measurement grid: <math>dx=5\text{mm}</math>, <math>dy=5\text{mm}</math>, <math>dz=5\text{mm}</math><br/> Reference Value = 80.17 V/m; Power Drift = 0.05 dB<br/> Peak SAR (extrapolated) = 17.8 W/kg<br/> <b>SAR(1 g) = 9.60 W/kg; SAR(10 g) = 5.03 W/kg</b><br/> Maximum value of SAR (measured) = 12.4 W/kg</p>  |         |

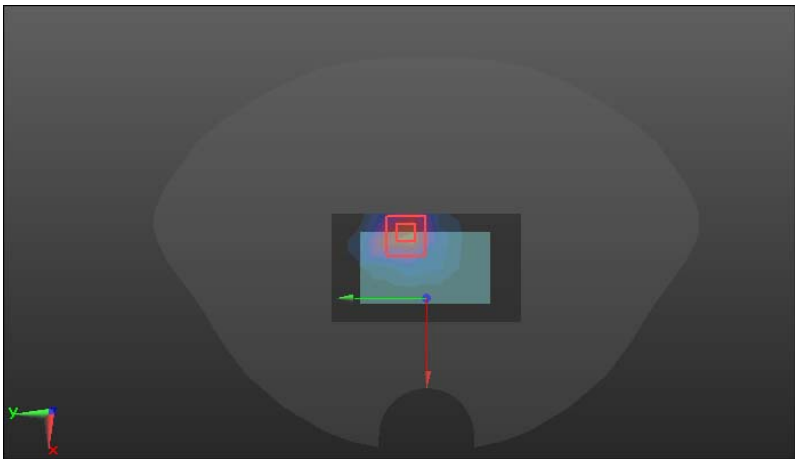


| System check                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2000MHz |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <p>Communication System: UID 0, CW (0); Frequency: 2000 MHz<br/> Medium parameters used: <math>f = 2000 \text{ MHz}</math>; <math>\sigma = 1.586 \text{ S/m}</math>; <math>\epsilon_r = 52.557</math>; <math>\rho = 1000 \text{ kg/m}^3</math><br/> Phantom section: Flat Section</p> <p>DASY5 Configuration:</p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3127; ConvF(4.80, 4.80, 4.80); Calibrated: 2018/11/2;</li> <li>Sensor-Surface: 3mm (Mechanical Surface Detection)</li> <li>Electronics: DAE4 Sn546; Calibrated: 2018/10/15</li> <li>Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx</li> <li>Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)</li> </ul> <p><b>Configuration 2000/2000/Area Scan (8x10x1):</b> Measurement grid: <math>dx=12\text{mm}</math>, <math>dy=12\text{mm}</math><br/> Maximum value of SAR (measured) = 11.1 W/kg<br/> <b>Configuration 2000/2000/Zoom Scan (7x7x7) (7x7x7)/Cube 0:</b> Measurement grid: <math>dx=5\text{mm}</math>, <math>dy=5\text{mm}</math>, <math>dz=5\text{mm}</math><br/> Reference Value = 78.14 V/m; Power Drift = 0.05 dB<br/> Peak SAR (extrapolated) = 17.8 W/kg<br/> <b>SAR(1 g) = 9.71 W/kg; SAR(10 g) = 4.78 W/kg</b><br/> Maximum value of SAR (measured) = 12.1 W/kg</p>  |         |

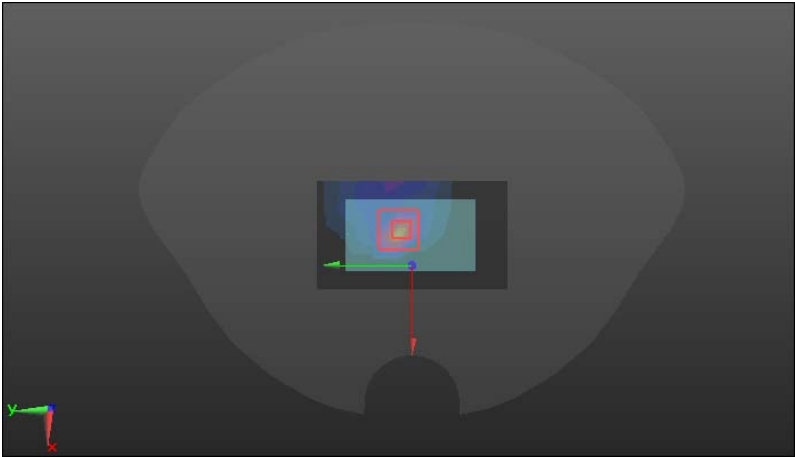
## Cat M Band2

| Limbs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Top |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <p>Communication System: UID 0, LTE band 02 (0); Frequency: 1880 MHz<br/> Medium parameters used (interpolated): <math>f = 1880</math> MHz; <math>\sigma = 1.526</math> S/m; <math>\epsilon_r = 53.291</math>; <math>\rho = 1000</math> kg/m<sup>3</sup><br/> Phantom section: Flat Section<br/> Measurement Standard: DASYS</p> <p>DASY Configuration:</p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3127; ConvF(4.76, 4.76, 4.76); Calibrated: 2018/11/2;</li> <li>Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection), <math>z = -3.0, 32.0</math></li> <li>Electronics: DAE4 Sn546; Calibrated: 2018/10/15</li> <li>Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx</li> <li>DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)</li> </ul> <p><b>TOP/LTE2/Area Scan (4x8x1):</b> Measurement grid: <math>dx=15</math>mm, <math>dy=15</math>mm<br/> Maximum value of SAR (measured) = 0.670 W/kg<br/> <b>TOP/LTE2/Zoom Scan (7x7x7)/Cube 0:</b> Measurement grid: <math>dx=5</math>mm, <math>dy=5</math>mm, <math>dz=5</math>mm<br/> Reference Value = 17.51 V/m; Power Drift = 0.08 dB<br/> Peak SAR (extrapolated) = 1.63 W/kg<br/> <b>SAR(1 g) = 0.651 W/kg; SAR(10 g) = 0.264 W/kg</b><br/> Maximum value of SAR (measured) = 0.907 W/kg</p> |     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |     |

## Cat M Band4

| Limbs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Front |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <p>Communication System: UID 0, LTE band 4 (0); Frequency: 1732.5 MHz<br/> Medium parameters used (interpolated): <math>f = 1732.5</math> MHz; <math>\sigma = 1.477</math> S/m; <math>\epsilon_r = 53.46</math>; <math>\rho = 1000</math> kg/m<sup>3</sup><br/> Phantom section: Flat Section<br/> Measurement Standard: DASY5</p> <p>DASY Configuration:</p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3127; ConvF(4.76, 4.76, 4.76); Calibrated: 2018/11/2;</li> <li>Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection), <math>z = -3.0, 32.0</math></li> <li>Electronics: DAE4 Sn546; Calibrated: 2018/10/15</li> <li>Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx</li> <li>DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)</li> </ul> <p><b>FRONT/LTE4/Area Scan (5x8x1):</b> Measurement grid: <math>dx=15</math>mm, <math>dy=15</math>mm<br/> Maximum value of SAR (measured) = 0.330 W/kg<br/> <b>FRONT/LTE4/Zoom Scan (7x7x7)/Cube 0:</b> Measurement grid: <math>dx=5</math>mm, <math>dy=5</math>mm, <math>dz=5</math>mm<br/> Reference Value = 8.307 V/m; Power Drift = 0.01 dB<br/> Peak SAR (extrapolated) = 0.849 W/kg<br/> <b>SAR(1 g) = 0.382 W/kg; SAR(10 g) = 0.170 W/kg</b><br/> Maximum value of SAR (measured) = 0.510 W/kg</p> |       |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |       |

## Cat M Band12

| Limbs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Front |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <p>Communication System: UID 0, LTE Band 12 (0); Frequency: 707.5 MHz<br/> Medium parameters used (interpolated): <math>f = 707.5</math> MHz; <math>\sigma = 0.955</math> S/m; <math>\epsilon_r = 55.657</math>; <math>\rho = 1000</math> kg/m<sup>3</sup><br/> Phantom section: Flat Section<br/> Measurement Standard: DASY5</p> <p>DASY Configuration:</p> <ul style="list-style-type: none"> <li>Probe: ES3DV3 - SN3127; ConvF(6.33, 6.33, 6.33); Calibrated: 2018/11/2;</li> <li>Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection), <math>z = -3.0, 32.0</math></li> <li>Electronics: DAE4 Sn546; Calibrated: 2018/10/15</li> <li>Phantom: 1659; Type: QD 000 P40 CD; Serial: xxxx</li> <li>DASY52 52.8.8(1258); SEMCAD X 14.6.10(7373)</li> </ul> <p><b>FRONT/LTE12/Area Scan (5x8x1):</b> Measurement grid: <math>dx=15</math>mm, <math>dy=15</math>mm<br/> Maximum value of SAR (measured) = 0.597 W/kg</p> <p><b>FRONT/LTE12/Zoom Scan (7x7x7)/Cube 0:</b> Measurement grid: <math>dx=5</math>mm, <math>dy=5</math>mm, <math>dz=5</math>mm<br/> Reference Value = 19.03 V/m; Power Drift = 0.17 dB<br/> Peak SAR (extrapolated) = 2.53 W/kg<br/> <b>SAR(1 g) = 0.572 W/kg; SAR(10 g) = 0.185 W/kg</b><br/> Maximum value of SAR (measured) = 0.796 W/kg</p>  |       |

## ANNEX B - RELEVANT PAGES FROM CALIBRATION REPORTS

DAE4 Sn:546

| In Collaboration with<br><b>TTL</b> <b>s p e a g</b><br>CALIBRATION LABORATORY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |         | In Collaboration with<br><b>TTL</b> <b>s p e a g</b><br>CALIBRATION LABORATORY |                       |                                          |                       |                        |         |                                |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------------------------------------------------------------------------|-----------------------|------------------------------------------|-----------------------|------------------------|---------|--------------------------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <p>Client: SRTC</p> <p>Certificate No: Z18-60400</p> <p><b>CALIBRATION CERTIFICATE</b></p> <p>Object: DAE4 - SN: 546</p> <p>Calibration Procedure(s): FF-Z11-002-01<br/>Calibration Procedure for the Data Acquisition Electronics (DAE4)</p> <p>Calibration date: October 15, 2018</p> <p>This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(23±3)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date(Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Process Calibrator 753</td> <td>1971018</td> <td>20-Jun-18 (CTTL, No.J18X05034)</td> <td>June-19</td> </tr> </tbody> </table> <p>Calibrated by: Yu Zongying SAR Test Engineer</p> <p>Reviewed by: Lin Hao SAR Test Engineer</p> <p>Approved by: Qi Diaryuan SAR Project Leader</p> <p>Issued: October 17, 2018</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> |         | Primary Standards                                                              | ID #                  | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration | Process Calibrator 753 | 1971018 | 20-Jun-18 (CTTL, No.J18X05034) | June-19 | <p>Glossary:</p> <p>DAE: data acquisition electronics</p> <p>Connector angle: information used in DASY system to align probe sensor X to the robot coordinate system.</p> <p><b>Methods Applied and Interpretation of Parameters:</b></p> <ul style="list-style-type: none"> <li>• <b>DC Voltage Measurement:</b> Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.</li> <li>• <b>Connector angle:</b> The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.</li> <li>• The report provide only calibration results for DAE, it does not contain other performance test results.</li> </ul> |  |
| Primary Standards                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ID #    | Cal Date(Calibrated by, Certificate No.)                                       | Scheduled Calibration |                                          |                       |                        |         |                                |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Process Calibrator 753                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1971018 | 20-Jun-18 (CTTL, No.J18X05034)                                                 | June-19               |                                          |                       |                        |         |                                |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Certificate No: Z18-60400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |         | Page 2 of 3                                                                    |                       |                                          |                       |                        |         |                                |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------|-----------------------|---|---|------------|-----------------------|-----------------------|-----------------------|-----------|----------------------|----------------------|----------------------|-------------------------------------------|-----------|
| <p>Address: No.51 Xuyuan Road, Haidian District, Beijing, 100191, China</p> <p>Tel: +86-10-6250433-2312 Fax: +86-10-6250433-2504</p> <p>E-mail: csl@ttsat.com.cn Http://www.ttsat.com.cn</p> <p><b>DC Voltage Measurement</b></p> <p>AD - Converter Resolution nominal</p> <p>High Range: 1LSB = 8.1uV full range = -100...+300 mV</p> <p>Low Range: 1LSB = 81uV full range = -1...+3mV</p> <p>DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Calibration Factors</th> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>High Range</td> <td>405.306 ± 0.15% (k=2)</td> <td>404.059 ± 0.15% (k=2)</td> <td>404.180 ± 0.15% (k=2)</td> </tr> <tr> <td>Low Range</td> <td>3.98993 ± 0.7% (k=2)</td> <td>3.95876 ± 0.7% (k=2)</td> <td>3.98021 ± 0.7% (k=2)</td> </tr> </tbody> </table> <p><b>Connector Angle</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>Connector Angle to be used in DASY system</td> <td>238° ± 1°</td> </tr> </tbody> </table> |                       | Calibration Factors   | X                     | Y | Z | High Range | 405.306 ± 0.15% (k=2) | 404.059 ± 0.15% (k=2) | 404.180 ± 0.15% (k=2) | Low Range | 3.98993 ± 0.7% (k=2) | 3.95876 ± 0.7% (k=2) | 3.98021 ± 0.7% (k=2) | Connector Angle to be used in DASY system | 238° ± 1° |
| Calibration Factors                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | X                     | Y                     | Z                     |   |   |            |                       |                       |                       |           |                      |                      |                      |                                           |           |
| High Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 405.306 ± 0.15% (k=2) | 404.059 ± 0.15% (k=2) | 404.180 ± 0.15% (k=2) |   |   |            |                       |                       |                       |           |                      |                      |                      |                                           |           |
| Low Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3.98993 ± 0.7% (k=2)  | 3.95876 ± 0.7% (k=2)  | 3.98021 ± 0.7% (k=2)  |   |   |            |                       |                       |                       |           |                      |                      |                      |                                           |           |
| Connector Angle to be used in DASY system                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 238° ± 1°             |                       |                       |   |   |            |                       |                       |                       |           |                      |                      |                      |                                           |           |
| Certificate No: Z18-60400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                       |                       |                       |   |   |            |                       |                       |                       |           |                      |                      |                      |                                           |           |

ES3DV3 Sn:3127

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**TTL S p e a q**  
CALIBRATION LABORATORY  
Add: No.51 Xuyuan Road, Huaihai District, Beijing, 100191, China  
Tel: +86-10-6296633-2312 Fax: +86-10-6296633-2304  
E-mail: cti@tstnet.com http://www.tstnet.cn

Client: **SRTC** Certificate No: **Z18-60398**

**CALIBRATION CERTIFICATE**

Object: **ES3DV3 - SN3127**

Calibration Procedure(s): **FF-Z11-004-01**  
Calibration Procedures for Dosimetric E-field Probes

Calibration date: **November 02, 2018**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(23±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards       | ID #        | Cal Date(Calibrated by Certificate No.) | Scheduled Calibration |
|-------------------------|-------------|-----------------------------------------|-----------------------|
| Power Meter NRP2        | 101919      | 20-Jun-18 (CTTL No.J18X05032)           | Jun-19                |
| Power sensor NRP-Z01    | 101547      | 20-Jun-18 (CTTL No.J18X05032)           | Jun-19                |
| Power sensor NRP-Z01    | 101548      | 20-Jun-18 (CTTL No.J18X05032)           | Jun-19                |
| Reference10dBAttenuator | 18N50W-10dB | 09-Feb-18(CTTL No.J18X01133)            | Feb-20                |
| Reference20dBAttenuator | 18N50W-20dB | 09-Feb-18(CTTL No.J18X01133)            | Feb-20                |
| Reference Probe EX30V4  | SN 3846     | 25-Jan-18(SPEAG No.EK3-3846_Jan18)      | Jan-19                |
| DAE4                    | SN 777      | 15-Dec-17(SPEAG No.DAE4-777_Dec17)      | Dec-18                |

| Secondary Standards     | ID #       | Cal Date(Calibrated by Certificate No.) | Scheduled Calibration |
|-------------------------|------------|-----------------------------------------|-----------------------|
| SignalGeneratorMG3700A  | 6201052605 | 21-Jun-18 (CTTL No.J18X05033)           | Jun-19                |
| Network Analyzer ES071C | MY46110673 | 14-Jan-18 (CTTL No.J18X00561)           | Jan-19                |

Calibrated by: **Yu Zongying** SAR Test Engineer

Reviewed by: **Lin Hao** SAR Test Engineer

Approved by: **Qi Dianyan** SAR Project Leader

Issued: November 04, 2018

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Tel: +86-10-6296633-2312 Fax: +86-10-6296633-2304  
E-mail: cti@tstnet.com http://www.tstnet.cn

**Glossary:**

TSL: tissue simulating liquid  
NORM<sub>x,y,z</sub>: sensitivity in free space  
ConvF: sensitivity in TSL / NORM<sub>x,y,z</sub>  
DCP: diode compression point  
CF: crest factor (1/duty\_cycle) of the RF signal  
A,B,C,D: modulation dependent linearization parameters  
Polarization  $\Phi$ :  $\Phi$  rotation around probe axis  
Polarization  $\theta$ :  $\theta$  rotation around an axis that is in the plane normal to probe axis (at measurement center),  $\theta=0$  is normal to probe axis

Connector Angle: information used in DASY system to align probe sensor X to the robot coordinate system

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013  
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016  
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010  
d) K28 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Methods Applied and Interpretation of Parameters:**

- NORM<sub>x,y,z</sub>: Assessed for E-field polarization  $\theta=0$  (1500MHz in TEM-cell;  $>1800$ Mhz waveguide). NORM<sub>x,y,z</sub> are only immediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$  field uncertainty inside TSL (see below ConvF).
- NORM<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR, PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A<sub>x,y,z</sub>, B<sub>x,y,z</sub>, C<sub>x,y,z</sub>, V<sub>0x,y,z</sub>, A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. V<sub>0</sub> is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for 1500MHz) and inside waveguide using analytical field distributions based on power measurements for  $f < 600$ Mhz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> ConvF whereas the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from 50MHz to 100MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORM<sub>x</sub> (no uncertainty required).

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Probe ES3DV3

SN: 3127

Calibrated: November 02, 2018

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-42304633-2512 Fax: +86-10-42304633-2504  
E-mail: cti@china.ttl.com.cn http://www.china.ttl.com.cn

### DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

#### Basic Calibration Parameters

|                                           | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|-------------------------------------------|----------|----------|----------|-----------|
| Norm(pV/(V/m) <sup>2</sup> ) <sup>a</sup> | 1.27     | 1.25     | 1.21     | ±10.0%    |
| DCP(mV) <sup>b</sup>                      | 103.3    | 104.4    | 105.0    |           |

#### Modulation Calibration Parameters

| UID | Communication System Name | A dB  | B dBμV | C   | D dB | VR mV | Unc <sup>c</sup> |
|-----|---------------------------|-------|--------|-----|------|-------|------------------|
| 0   | CW                        | X 0.0 | 0.0    | 1.0 | 0.00 | 285.6 | ±2.2%            |
|     |                           | Y 0.0 | 0.0    | 1.0 |      | 287.9 |                  |
|     |                           | Z 0.0 | 0.0    | 1.0 |      | 282.9 |                  |

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

<sup>a</sup> The uncertainties of Norm X, Y, Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 5 and Page 6).  
<sup>b</sup> Numerical linearization parameter; uncertainty not required.  
<sup>c</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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E-mail: cti@china.ttl.com.cn http://www.china.ttl.com.cn

### DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

#### Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] <sup>c</sup> | Relative Permittivity <sup>d</sup> | Conductivity (S/m) <sup>e</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>g</sup> | Depth <sup>h</sup> (mm) | Unc <sup>i</sup> (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|------------------------|
| 750                  | 41.9                               | 0.89                            | 6.34    | 6.34    | 6.34    | 0.40               | 1.35                    | ±12.1%                 |
| 835                  | 41.5                               | 0.90                            | 6.18    | 6.18    | 6.18    | 0.35               | 1.58                    | ±12.1%                 |
| 1810                 | 40.0                               | 1.40                            | 5.07    | 5.07    | 5.07    | 0.86               | 1.24                    | ±12.1%                 |
| 2000                 | 40.0                               | 1.40                            | 4.96    | 4.96    | 4.96    | 0.70               | 1.20                    | ±12.1%                 |
| 2300                 | 39.5                               | 1.67                            | 4.79    | 4.79    | 4.79    | 0.90               | 1.08                    | ±12.1%                 |
| 2450                 | 39.2                               | 1.80                            | 4.66    | 4.66    | 4.66    | 0.90               | 1.08                    | ±12.1%                 |
| 2600                 | 39.0                               | 1.96                            | 4.40    | 4.40    | 4.40    | 0.80               | 1.21                    | ±12.1%                 |

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

<sup>d</sup> At frequency below 3 GHz, the validity of tissue parameters (x and y) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (x and y) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

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Tel: +86-10-42304633-2512 Fax: +86-10-42304633-2504  
E-mail: cti@china.ttl.com.cn http://www.china.ttl.com.cn

### DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

#### Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz] <sup>c</sup> | Relative Permittivity <sup>d</sup> | Conductivity (S/m) <sup>e</sup> | ConvF X | ConvF Y | ConvF Z | Alpha <sup>g</sup> | Depth <sup>h</sup> (mm) | Unc <sup>i</sup> (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|------------------------|
| 750                  | 55.5                               | 0.96                            | 6.33    | 6.33    | 6.33    | 0.40               | 1.40                    | ±12.1%                 |
| 835                  | 55.2                               | 0.97                            | 6.13    | 6.13    | 6.13    | 0.37               | 1.62                    | ±12.1%                 |
| 1810                 | 53.3                               | 1.52                            | 4.76    | 4.76    | 4.76    | 0.65               | 1.27                    | ±12.1%                 |
| 2000                 | 53.3                               | 1.52                            | 4.80    | 4.80    | 4.80    | 0.87               | 1.27                    | ±12.1%                 |
| 2300                 | 52.9                               | 1.81                            | 4.46    | 4.46    | 4.46    | 0.90               | 1.15                    | ±12.1%                 |
| 2450                 | 52.7                               | 1.95                            | 4.31    | 4.31    | 4.31    | 0.78               | 1.28                    | ±12.1%                 |
| 2600                 | 52.5                               | 2.16                            | 4.14    | 4.14    | 4.14    | 0.90               | 1.10                    | ±12.1%                 |

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

<sup>d</sup> At frequency below 3 GHz, the validity of tissue parameters (x and y) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (x and y) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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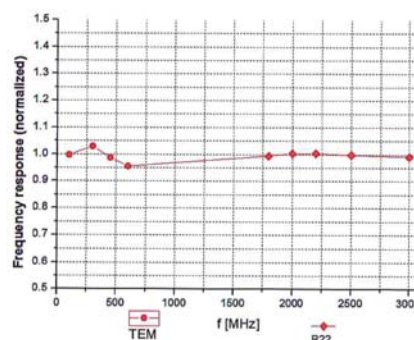
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Tel: +86-10-42304633-2512 Fax: +86-10-42304633-2504  
E-mail: cti@china.ttl.com.cn http://www.china.ttl.com.cn

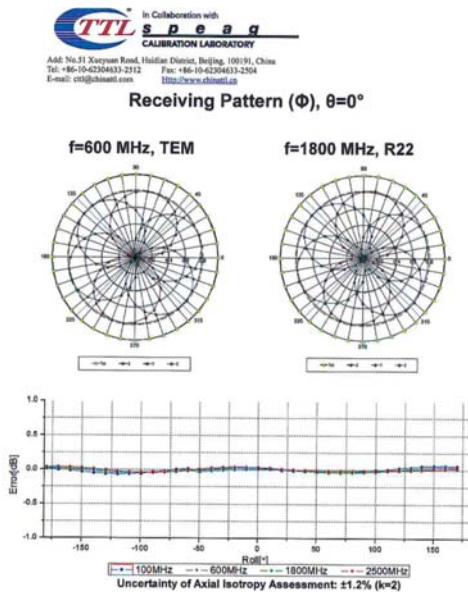
### Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



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

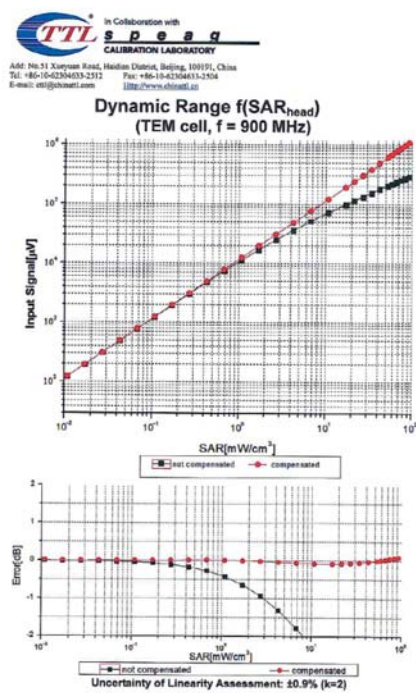
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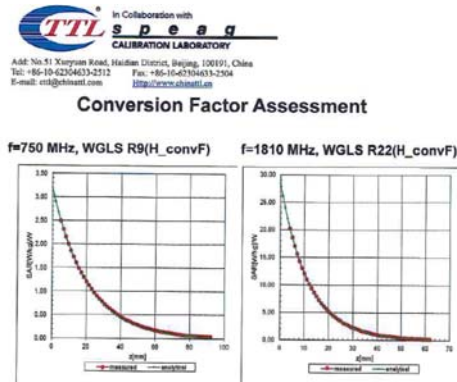
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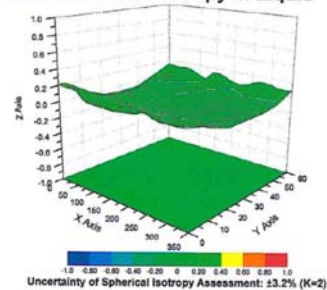


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### Deviation from Isotropy in Liquid



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Add: No.51 Xuyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62504633-2312 Fax: +86-10-62504633-2304  
E-mail: cti@chinaetl.com <http://www.chinaetl.com>

**Appendix: Modulation Calibration Parameters**

| UID   | Communication System Name                | PAR  | A dB                       | B dB/μV                 | C                       | VR mV                   | Unc <sup>±</sup> (k=2) |
|-------|------------------------------------------|------|----------------------------|-------------------------|-------------------------|-------------------------|------------------------|
| 0     | CW                                       | 0.00 | X 0.0<br>Y 0.0<br>Z 0.0    | 0.0<br>0.0<br>0.0       | 1.0<br>1.0<br>1.0       | 282.3<br>280.9<br>275.1 | $\pm 2.5\%$            |
| 10012 | IEEE 802.11b WIFI 2.4 GHz (DSSS, 1 Mbps) | 1.87 | X 2.77<br>Y 2.75<br>Z 2.71 | 68.02<br>68.05<br>67.79 | 18.46<br>18.52<br>18.25 | 143.0<br>145.0<br>142.3 | $\pm 1.8\%$            |
| 10100 | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) | 5.67 | X 6.13<br>Y 6.15<br>Z 6.09 | 66.4<br>66.49<br>66.32  | 18.97<br>19.06<br>18.90 | 141.9<br>144.2<br>140.9 | $\pm 1.9\%$            |
| 10108 | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK) | 5.80 | X 6.09<br>Y 6.10<br>Z 6.05 | 66.24<br>66.33<br>66.19 | 19.07<br>19.15<br>19.05 | 139.5<br>141.5<br>138.0 | $\pm 1.9\%$            |
| 10154 | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)  | 5.75 | X 5.81<br>Y 5.82<br>Z 5.79 | 65.85<br>65.92<br>65.89 | 18.93<br>19.01<br>18.97 | 136.1<br>137.8<br>134.7 | $\pm 1.9\%$            |
| 10169 | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)    | 5.73 | X 4.84<br>Y 4.82<br>Z 4.80 | 65.92<br>65.98<br>66.00 | 19.20<br>19.27<br>19.29 | 130.8<br>131.3<br>129.1 | $\pm 1.9\%$            |
| 10175 | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)    | 5.72 | X 4.88<br>Y 4.83<br>Z 4.79 | 66.14<br>66.08<br>66.02 | 19.40<br>19.33<br>19.29 | 131.6<br>130.9<br>129.3 | $\pm 1.9\%$            |
| 10297 | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)  | 5.81 | X 6.19<br>Y 6.13<br>Z 6.14 | 66.61<br>66.43<br>66.52 | 19.42<br>19.26<br>19.33 | 141.9<br>140.7<br>139.6 | $\pm 1.9\%$            |

Certificate No: Z17-97142

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D750V3 Sn:1101

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CNAS L0570

Client: **SRTC** Certificate No: **Z17-97134**

### CALIBRATION CERTIFICATE

Object: D750V3 - SN: 1101

Calibration Procedure(s): FF-Z11-003-01  
Calibration Procedures for dipole validation kits

Calibration date: September 13, 2017

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

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

Calibration Equipment used (M&E critical for calibration)

| Primary Standards      | ID #    | Cal Date(Calibrated by Certificate No.) | Scheduled Calibration |
|------------------------|---------|-----------------------------------------|-----------------------|
| Power Meter NRV0       | 102196  | 02-Mar-17 (CTTL No.J17X01254)           | Mar-18                |
| Power sensor NRV-Z5    | 100596  | 02-Mar-17 (CTTL No.J17X01254)           | Mar-18                |
| Reference Probe EX3DV4 | SN 7433 | 26-Sep-16(SPEAG No EX3-7433_Sep16)      | Sep-17                |
| DAE4                   | SN 1331 | 19-Jan-17(CTTL-SPEAG No.Z17-97015)      | Jan-18                |

| Secondary Standards     | ID #       | Cal Date(Calibrated by Certificate No.) | Scheduled Calibration |
|-------------------------|------------|-----------------------------------------|-----------------------|
| Signal Generator E4438C | MY49071430 | 13-Jan-17 (CTTL No.J17X00280)           | Jan-18                |
| Network Analyzer E5071C | MY46111013 | 13-Jan-17 (CTTL No.J17X00285)           | Jan-18                |

Calibrated by: Zhao Jing Function: SAR Test Engineer Signature: [Signature]

Reviewed by: Yu Zongying Function: SAR Test Engineer Signature: [Signature]

Approved by: Qi Diqian Function: SAR Project Leader Signature: [Signature]

Issued: September 16, 2017

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**Glossary:**  
TSL: tissue simulating liquid  
CorrF: sensitivity in TSL / NORMx,y,z  
N/A: not applicable or not measured

**Calibration is Performed According to the Following Standards:**

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

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

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

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### Measurement Conditions

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

|                              |                          |              |
|------------------------------|--------------------------|--------------|
| DASY Version                 | DASY52                   | 52.10.0.1446 |
| Extrapolation                | Advanced Extrapolation   |              |
| Phantom                      | Triple Flat Phantom 5.1C |              |
| Distance Dipole Center - TSL | 15 mm                    | with Spacer  |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |              |
| Frequency                    | 750 MHz ± 1 MHz          |              |

### Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 41.9         | 0.89 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 41.5 ± 6 %   | 0.88 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Head TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                            |
|---------------------------------------------------------|--------------------|----------------------------|
| SAR measured                                            | 250 mW input power | 2.05 mW / g                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 8.26 mW / g ± 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                            |
| SAR measured                                            | 250 mW input power | 1.34 mW / g                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 5.39 mW / g ± 18.7 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 55.5         | 0.96 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 55.4 ± 6 %   | 0.95 mho/m ± 6 % |
| Body TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Body TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   | Condition          |                            |
|---------------------------------------------------------|--------------------|----------------------------|
| SAR measured                                            | 250 mW input power | 2.15 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 8.69 mW / g ± 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                            |
| SAR measured                                            | 250 mW input power | 1.42 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 5.73 mW / g ± 18.7 % (k=2) |

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### Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 53.90 ± 0.24 Ω |
| Return Loss                          | - 28.4 dB      |

#### Antenna Parameters with Body TSL

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 52.0 Ω; 2.22 Ω |
| Return Loss                          | - 30.6 dB      |

#### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.136 ns |
|----------------------------------|----------|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

#### Additional EUT Data

|                 |       |
|-----------------|-------|
| Manufactured by | SPEAG |
|-----------------|-------|

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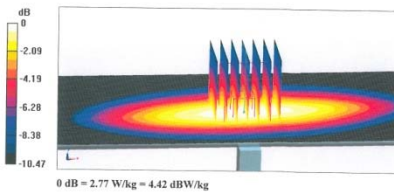
## D750V3 Sn:1101



**DASY5 Validation Report for Head TSL** Date: 09.13.2017  
Test Laboratory: CTTL, Beijing, China  
**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1101**  
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.879$  S/m;  $\epsilon_r = 41.54$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Left Section  
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)  
DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(10.01, 10.01, 10.01); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 53.10 V/m; Power Drift = -0.05 dB  
Peak SAR (extrapolated) = 3.17 W/kg  
**SAR(1 g) = 2.05 W/kg; SAR(10 g) = 1.34 W/kg**  
Maximum value of SAR (measured) = 2.77 W/kg

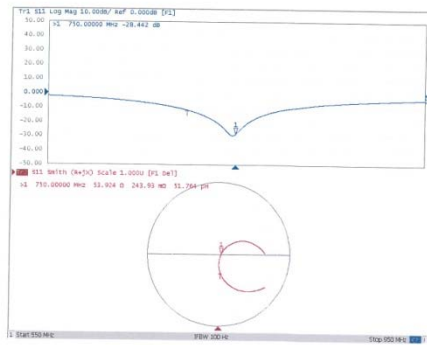


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### Impedance Measurement Plot for Head TSL



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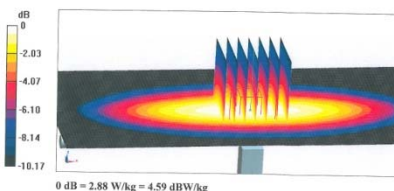
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**DASY5 Validation Report for Body TSL** Date: 09.13.2017  
Test Laboratory: CTTL, Beijing, China  
**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1101**  
Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.946$  S/m;  $\epsilon_r = 55.41$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Center Section  
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)  
DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.83, 9.83, 9.83); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 53.35 V/m; Power Drift = -0.02 dB  
Peak SAR (extrapolated) = 3.27 W/kg  
**SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.42 W/kg**  
Maximum value of SAR (measured) = 2.88 W/kg

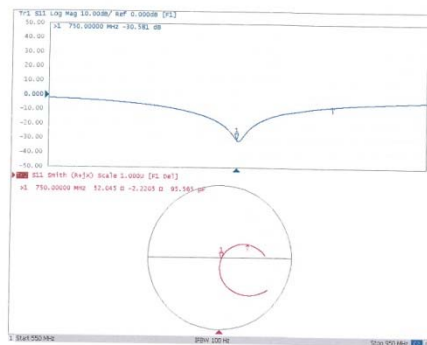


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### Impedance Measurement Plot for Body TSL



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D1800V2 Sn:2d084

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E-mail: cti@china.ttl.com.cn http://www.china.ttl.com.cn

Client: **SRTC** Certificate No: **Z17-97138**

### CALIBRATION CERTIFICATE

Object: D1800V2 - SN: 2d084

Calibration Procedure(s): FF-Z11-003-01  
Calibration Procedures for dipole validation kits

Calibration date: September 15, 2017

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(23±3)°C and humidity<70%.

Calibration Equipment used (M&E critical for calibration):

| Primary Standards      | ID #    | Cal Date/Calibrated by, Certificate No.) | Scheduled Calibration |
|------------------------|---------|------------------------------------------|-----------------------|
| Power Meter NRP2       | 102196  | 02-Mar-17 (CITL No.J17X01254)            | Mar-18                |
| Power sensor NRP-Z91   | 100596  | 02-Mar-17 (CITL No.J17X01254)            | Mar-18                |
| Reference Probe EX3DVA | SN 7433 | 26-Sep-16(SPEAG No EX3-7433_Sep16)       | Sep-17                |
| DAE4                   | SN 1331 | 19-Jan-17(CITL-SPEAG No Z17-97015)       | Jan-18                |

| Secondary Standards     | ID #       | Cal Date/Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|------------------------------------------|-----------------------|
| Signal Generator E4438C | MY43071430 | 13-Jan-17 (CITL No.J17X02286)            | Jan-18                |
| Network Analyzer E5071C | MY46110873 | 13-Jan-17 (CITL No.J17X02286)            | Jan-18                |

Calibrated by: Zhao Jing Function: SAR Test Engineer Signature: [Signature]

Reviewed by: Yu Zongying Function: SAR Test Engineer Signature: [Signature]

Approved by: Qi Dianyan Function: SAR Project Leader Signature: [Signature]

Issued: September 18, 2017

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

**Calibration is Performed According to the Following Standards:**

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB665664, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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

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

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### Measurement Conditions

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

| DASY Version                 | DASY52                   | 52.10.5.1446 |
|------------------------------|--------------------------|--------------|
| Extrapolation                | Advanced Extrapolation   |              |
| Phantom                      | Triple Flat Phantom 5.1C |              |
| Distance Dipole Center - TSL | 10 mm                    | with Spacer  |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |              |
| Frequency                    | 1800 MHz ± 1 MHz         |              |

### Head TSL parameters

The following parameters and calculations were applied:

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 40.0         | 1.40 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 40.4 ± 6 %   | 1.42 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Head TSL

|                                                         | Condition          |                            |
|---------------------------------------------------------|--------------------|----------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   |                    |                            |
| SAR measured                                            | 250 mW input power | 9.78 mW / g                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 38.9 mW / g ± 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL |                    |                            |
| SAR measured                                            | 250 mW input power | 5.12 mW / g                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 20.4 mW / g ± 18.7 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied:

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 53.3         | 1.52 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 53.8 ± 6 %   | 1.50 mho/m ± 6 % |
| Body TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Body TSL

|                                                         | Condition          |                            |
|---------------------------------------------------------|--------------------|----------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL   |                    |                            |
| SAR measured                                            | 250 mW input power | 9.84 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 39.7 mW / g ± 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL |                    |                            |
| SAR measured                                            | 250 mW input power | 5.18 mW / g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 20.8 mW / g ± 18.7 % (k=2) |

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### Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 49.30 - 1.55jΩ |
| Return Loss                          | - 35.4dB       |

#### Antenna Parameters with Body TSL

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 46.00 - 1.32jΩ |
| Return Loss                          | - 27.1dB       |

#### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.318 ns |
|----------------------------------|----------|

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

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

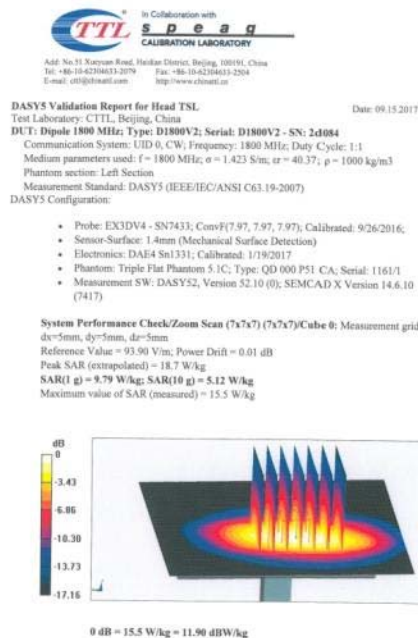
#### Additional EUT Data

|                 |       |
|-----------------|-------|
| Manufactured by | SPEAG |
|-----------------|-------|

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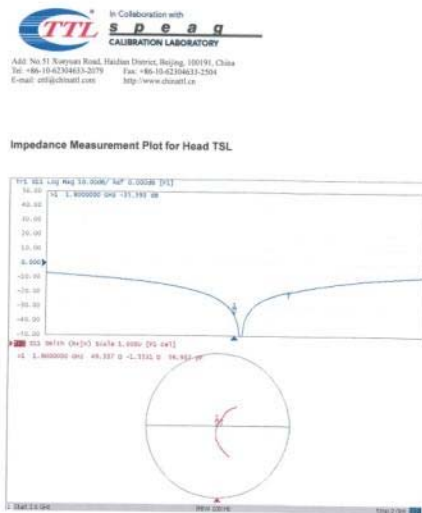
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D1800V2 Sn:2d084



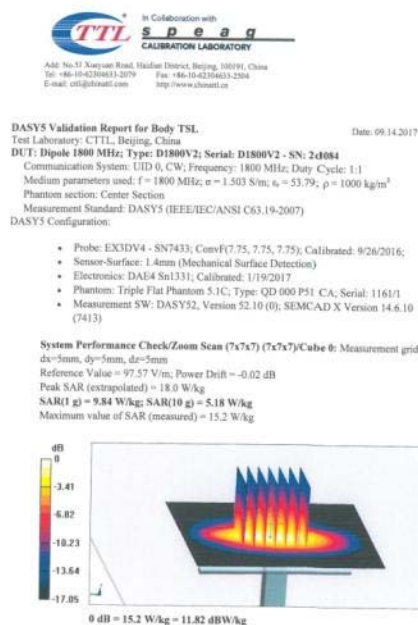
Certificate No: Z17-97138

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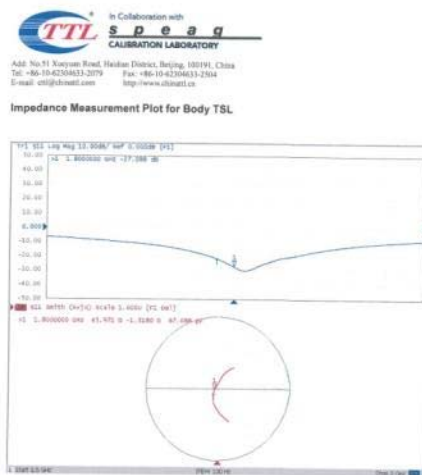
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D2000V2 Sn:1009

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Tel: +86-10-42304633-2079 Fax: +86-10-42304633-2504  
E-mail: cti@china-test.com http://www.china-test.com

Client: **SRTC** Certificate No: **Z18-97021**

### CALIBRATION CERTIFICATE

Object: D2000V2 - SN: 1009

Calibration Procedure(s): FF-Z11-003-01  
Calibration Procedures for dipole validation kits

Calibration date: February 1, 2018

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

All calibrations have been conducted in the closed laboratory facility: environment temperature(23±3) °C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards      | ID #    | Cal Date/Calibrated by: Certificate No. | Scheduled Calibration |
|------------------------|---------|-----------------------------------------|-----------------------|
| Power Meter NRVD       | 102196  | 02-Mar-17 (CTTL No.J17X01254)           | Mar-18                |
| Power sensor NRV-25    | 102096  | 02-Mar-17 (CTTL No.J17X01254)           | Mar-18                |
| Reference Probe EX3DV4 | SN 1464 | 12-Sep-17(SPEAG)No.CX3-7464_Sep17)      | Sep-18                |
| DAE4                   | SN 1525 | 02-Oct-17(SPEAG)No.DAE4-1525_Oct17)     | Oct-18                |

| Secondary Standards     | ID #       | Cal Date/Calibrated by: Certificate No. | Scheduled Calibration |
|-------------------------|------------|-----------------------------------------|-----------------------|
| Signal Generator E4438C | MY49071430 | 23-Jan-18 (CTTL No.J18X00590)           | Jan-19                |
| Network Analyzer E5071C | MY40110073 | 24-Jan-18 (CTTL No.J18X00591)           | Jan-19                |

Calibrated by: Zhao Jing SAR Test Engineer Signature: [Signature]

Reviewed by: Lin Hao SAR Test Engineer Signature: [Signature]

Approved by: Qi Dianyun SAR Project Leader Signature: [Signature]

Issued: February 4, 2018

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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**Glossary:**  
TSL: Issue simulating liquid  
ConvF: sensitivity in TSL / NORM<sub>x,y,z</sub>  
N/A: not applicable or not measured

**Calibration is Performed According to the Following Standards:**  
a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013  
b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016  
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010  
d) KDS895654, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**  
a) DAS14/5 System Handbook

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

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

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### Measurement Conditions

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

| DASY Version                 | DASY52                   | 52.10.0.1448 |
|------------------------------|--------------------------|--------------|
| Extrapolation                | Advanced Extrapolation   |              |
| Phantom                      | Triple Flat Phantom 5.1C |              |
| Distance Dipole Center - TSL | 10 mm                    | with Spacer  |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |              |
| Frequency                    | 2000 MHz ± 1 MHz         |              |

### Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 40.0         | 1.40 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 38.9 ± 6 %   | 1.42 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Head TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 10.2 mW/g                |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 40.3 mW/g ± 18.5 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 5.17 mW/g                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 20.5 mW/g ± 18.7 % (k=2) |

### Body TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 53.3         | 1.52 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 51.8 ± 6 %   | 1.56 mho/m ± 6 % |
| Body TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Body TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | Condition          |                          |
|-------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                          | 250 mW input power | 10.3 mW/g                |
| SAR for nominal Body TSL parameters                   | normalized to 1W   | 40.3 mW/g ± 18.8 % (k=2) |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | Condition          |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR measured                                            | 250 mW input power | 5.18 mW/g                |
| SAR for nominal Body TSL parameters                     | normalized to 1W   | 20.4 mW/g ± 18.7 % (k=2) |

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### Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 48.80 - 2.09j(Ω) |
|--------------------------------------|------------------|
| Return Loss                          | -33.6dB          |

#### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 48.30 - 1.63j(Ω) |
|--------------------------------------|------------------|
| Return Loss                          | -27.6dB          |

#### General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.047 ns |
|----------------------------------|----------|
|----------------------------------|----------|

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

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

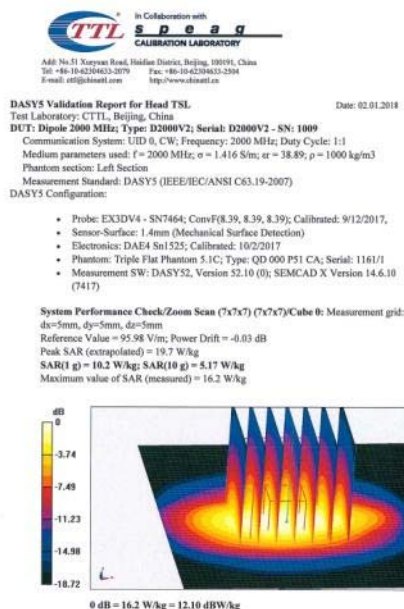
#### Additional EUT Data

| Manufactured by | SPEAG |
|-----------------|-------|
|-----------------|-------|

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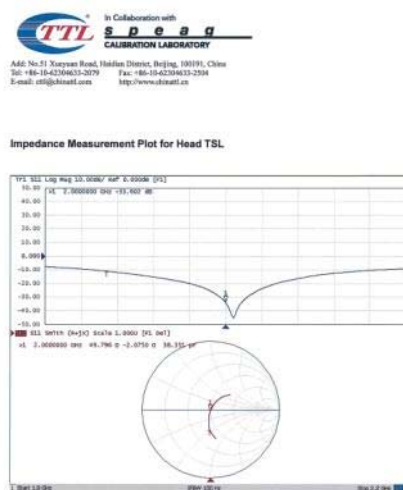
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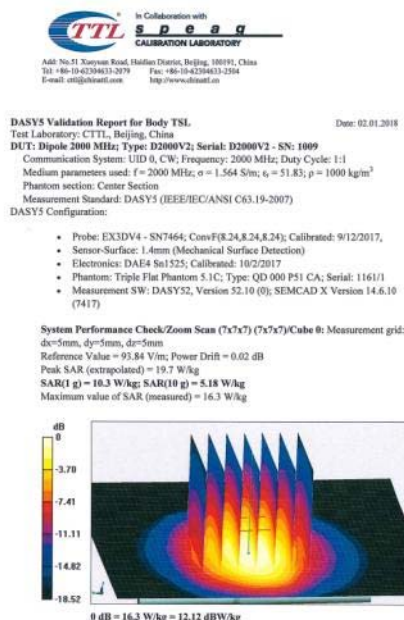
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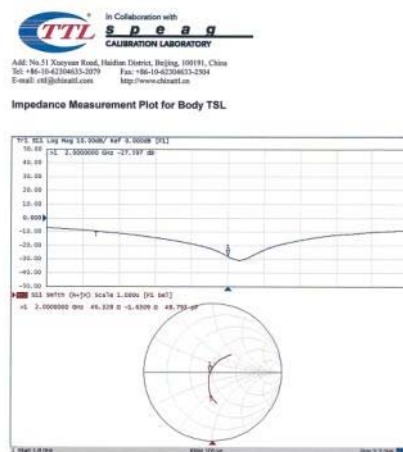
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-----End of the test report-----