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## TEST REPORT FOR SAR TESTING

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Report No.: SRTC2019-9004(F)- 19080201(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)

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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: | 2019.08.02 |
| Testing Start Date:                     | 2019.08.10 |
| Testing End Date:                       | 2019.08.12 |

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

|                                 |     |
|---------------------------------|-----|
| Normal Supply Voltage (V d.c.): | 3.8 |
|---------------------------------|-----|

## 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.B                                                                                                                      |
| S/W Version | v1.0                                                                                                                       |
| IMEI        | 357812093107545                                                                                                            |
| 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.

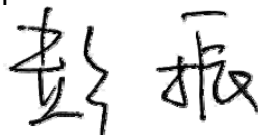
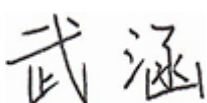
## 5 RESULT SUMMARY

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    | 0.308                          | 0.41                                   | 4.0              | Pass   |
|                   | Band 4    | 0.411                          |                                        |                  |        |
|                   | Band 12   | 0.121                          |                                        |                  |        |

### Simultaneous Transmission Summary

| Exposure Position | Mode        | Highest 10g-SAR Result(W/kg) | Limit (W/kg)/10g | Result |
|-------------------|-------------|------------------------------|------------------|--------|
| Limbs (0mm Gap)   | Cat M & BLE | 0.42                         | 4.0              | Pass   |

|                                                                                                                                        |                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| This Test Report Is Issued by:<br>Mr. Peng Zhen<br> | Checked by:<br>Mr. Li Bin<br> |
| Tested by:<br>Miss. Wu Han<br>                      | Issued date:<br>20190820                                                                                          |

## 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<br>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 (%) |
|-------------|---------------|-------------|---------------------------------|-------|--------------------|-----------|---------------|
| 2019.08.10  | D750V3        | Body        | 10g                             | 5.62  | 5.73               | -1.92     | ±10           |
| 2019.08.11  | D1800V2       | Body        | 10g                             | 20.37 | 20.8               | -2.07     | ±10           |
| 2019.08.12  | D2000V2       | Body        | 10g                             | 19.62 | 20.4               | -3.82     | ±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 (%) |
|-------------|-------------|-------------------|----------|--------|-----------|---------------|
| 2019.08.10  | Body 750    | $\epsilon_r$      | 53.07    | 55.50  | -4.4      | ±5            |
|             |             | $\sigma$ [S/m]    | 0.94     | 0.96   | -2.1      | ±5            |
| 2019.08.11  | Body 1800   | $\epsilon_r$      | 53.22    | 53.30  | -0.2      | ±5            |
|             |             | $\sigma$ [S/m]    | 1.48     | 1.52   | -2.6      | ±5            |
| 2019.08.12  | Body 2000   | $\epsilon_r$      | 52.60    | 53.30  | -1.3      | ±5            |
|             |             | $\sigma$ [S/m]    | 1.50     | 1.52   | -1.3      | ±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           | 0.097                  | 0.106                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Front     |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.170                  | 0.185                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Top       |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.283                  | 0.308                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Bottom    |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.093                  | 0.102                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Left      |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.036                  | 0.039                   |
|           |                        | H       | 22.14                         | 22.50               | 1.09           | ---                    | ---                     |
| Right     |                        | L       | 22.43                         | 22.50               | 1.02           | ---                    | ---                     |
|           |                        | M       | 22.13                         | 22.50               | 1.09           | 0.024                  | 0.026                   |
|           |                        | 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           | 0.093                  | 0.103                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Front     |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.103                  | 0.114                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Top       |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | <b>0.249</b>           | <b>0.276</b>            |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Bottom    |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.072                  | 0.080                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Left      |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.017                  | 0.019                   |
|           |                          | H       | 21.70                         | 22.00               | 1.07           | ---                    | ---                     |
| Right     |                          | L       | 21.68                         | 22.00               | 1.08           | ---                    | ---                     |
|           |                          | M       | 21.53                         | 22.00               | 1.11           | 0.015                  | 0.017                   |
|           |                          | 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           | 0.118                  | 0.124                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Front     |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.225                  | 0.236                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Top       |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.185                  | 0.194                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Bottom    |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | <b>0.391</b>           | <b>0.411</b>            |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Left      |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.024                  | 0.025                   |
|           |                        | H       | 23.29                         | 23.50               | 1.05           | ---                    | ---                     |
| Right     |                        | L       | 23.44                         | 23.50               | 1.01           | ---                    | ---                     |
|           |                        | M       | 23.28                         | 23.50               | 1.05           | 0.053                  | 0.056                   |
|           |                        | 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           | 0.091                  | 0.092                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Front     |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.172                  | 0.174                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Top       |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.142                  | 0.143                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Bottom    |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.322                  | 0.325                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Left      |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.016                  | 0.016                   |
|           |                          | H       | 22.38                         | 22.50               | 1.03           | ---                    | ---                     |
| Right     |                          | L       | 22.31                         | 22.50               | 1.04           | ---                    | ---                     |
|           |                          | M       | 22.47                         | 22.50               | 1.01           | 0.018                  | 0.018                   |
|           |                          | 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           | 0.102                  | 0.109                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Front     |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | <b>0.113</b>           | <b>0.121</b>            |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Top       |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.054                  | 0.058                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Bottom    |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.078                  | 0.083                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Left      |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.056                  | 0.060                   |
|           |                        | H       | 23.82                         | 24.00               | 1.04           | ---                    | ---                     |
| Right     |                        | L       | 23.57                         | 24.00               | 1.10           | ---                    | ---                     |
|           |                        | M       | 23.71                         | 24.00               | 1.07           | 0.041                  | 0.044                   |
|           |                        | 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           | 0.083                  | 0.085                   |
|           |                          | 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           | 0.023                  | 0.023                   |
|           |                          | H       | 22.37                         | 22.50               | 1.03           | ---                    | ---                     |
| Right     |                          | L       | 22.46                         | 22.50               | 1.01           | ---                    | ---                     |
|           |                          | M       | 22.41                         | 22.50               | 1.02           | 0.015                  | 0.016                   |
|           |                          | 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 | 0.411                       |
| BLE   | 0.008                       |
| Sum   | 0.419                       |
| Note  | Bottom:<br>Cat M Band4+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.       | ( $C_i$ ) 1g | ( $C_i$ ) 10g | Std.Unc (1g). | Std.Unc. (10g) | (vi) $V_{eff}$ |
| 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%.

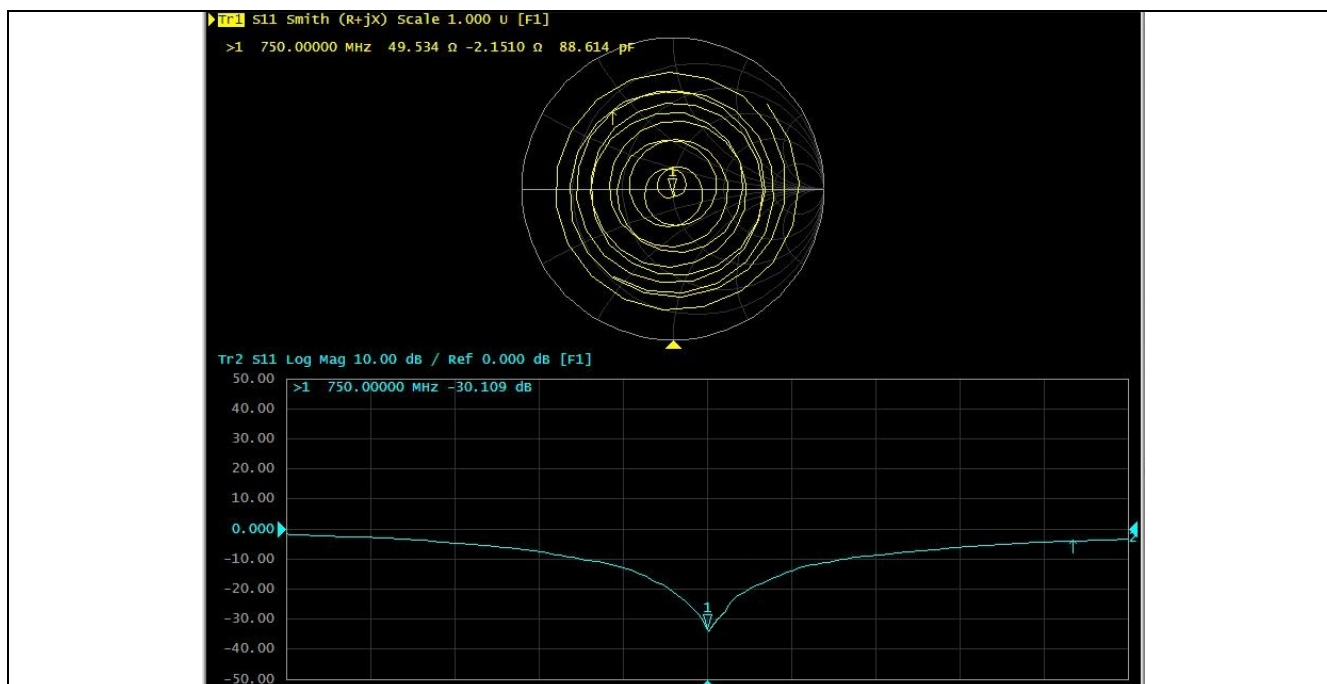
### Impedance and Return loss measured by Network analyzer

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)

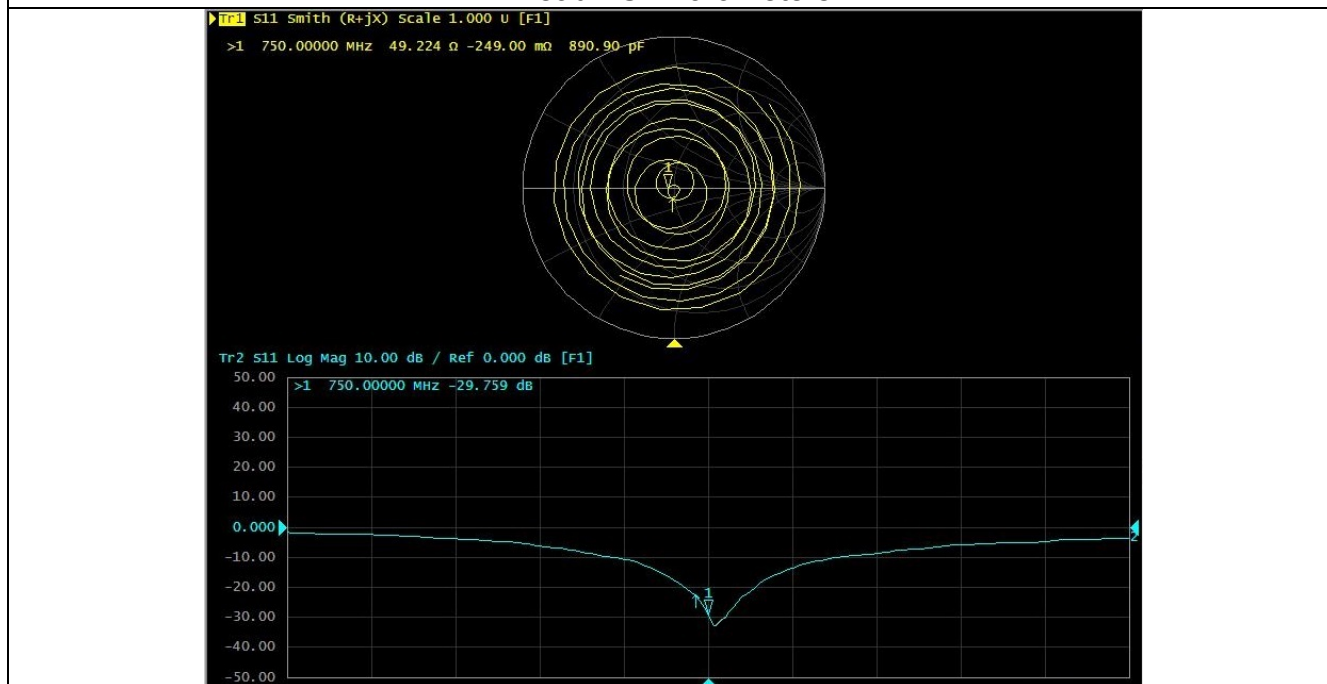
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

| 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%.

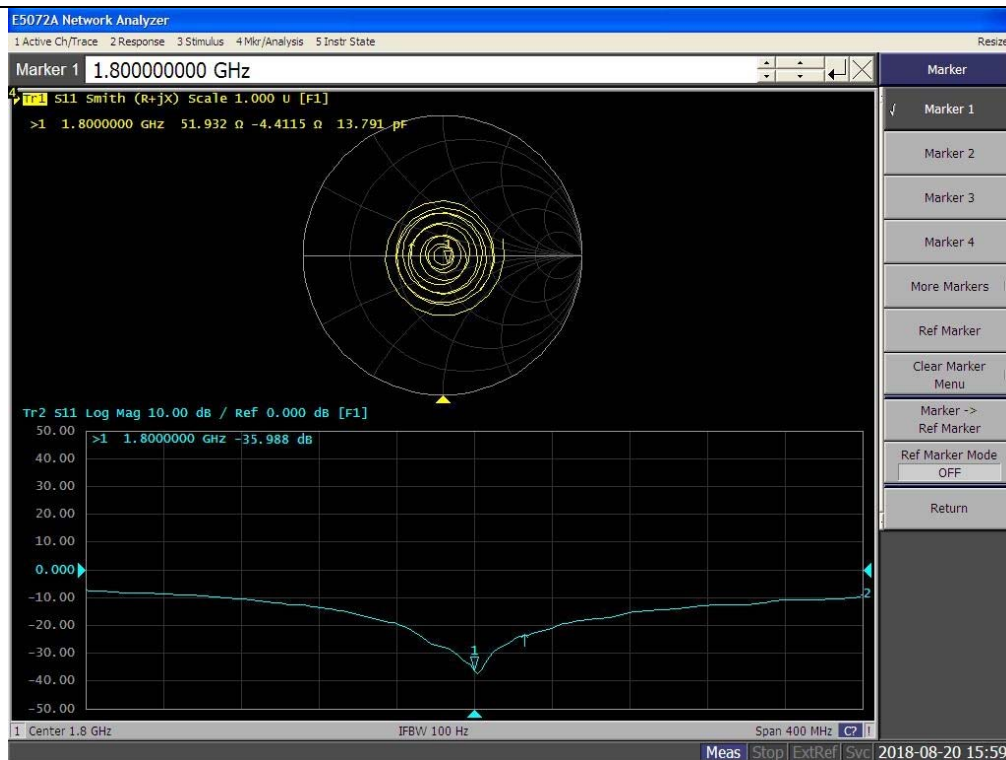
### Impedance and Return loss measured by Network analyzer

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)

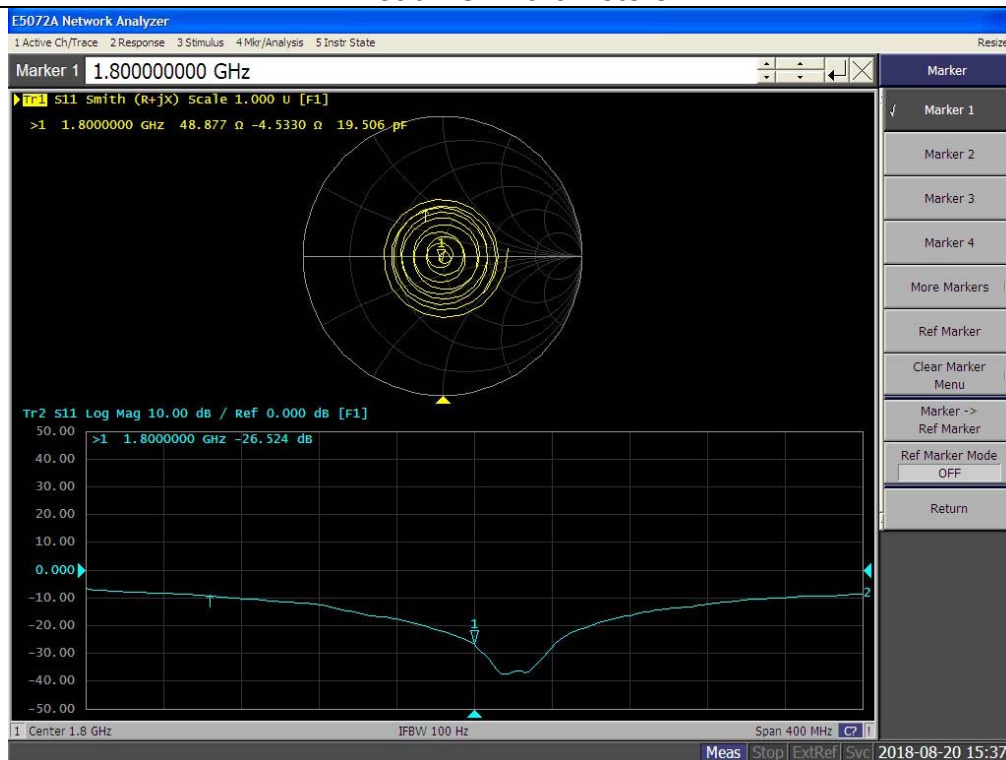
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

| 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%.

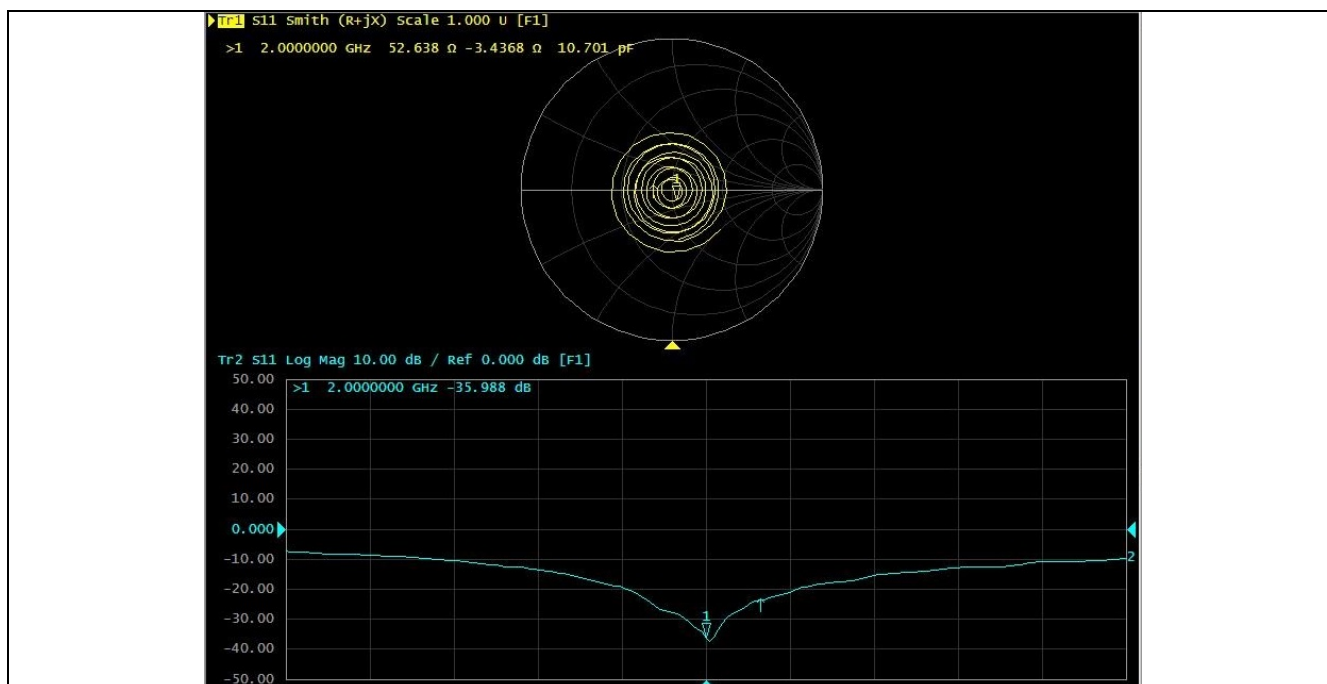
### Impedance and Return loss measured by Network analyzer

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)

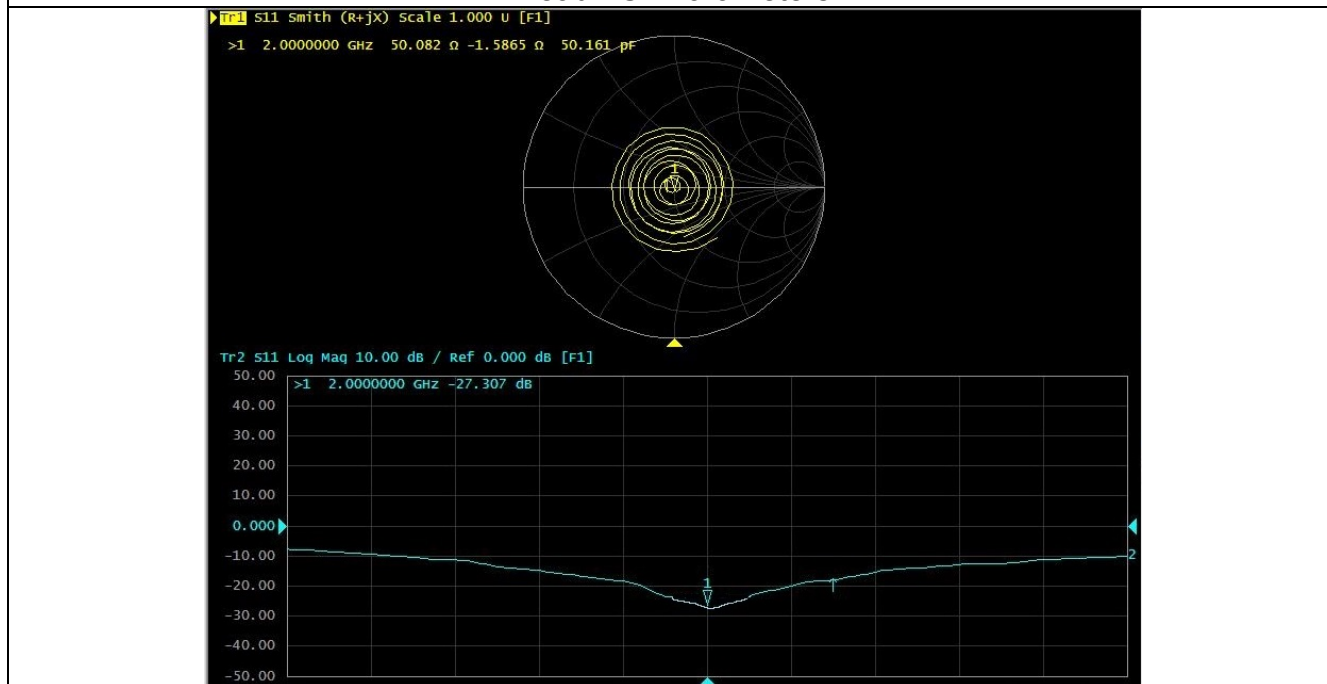
The most recent return-loss result (measured on 2018.8.20) deviates within 20% from the previous measurement. (Data from the last calibration report)

| 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.