



## **SAR EVALUATION REPORT**

**FCC 47 CFR § 2.1093  
IEEE Std. 1528-2013**

**For  
Portable Bluetooth Speaker**

**FCC ID: APIJBLCHARGE4S  
Model Name: CHARGE4S**

**Report Number: 20180711-2  
Issue Date: July 11, 2018**

**Prepared for  
Harman International Industries, Inc.  
8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES**

**Prepared by  
UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch  
Building 10, Innovation Technology Park, No. 1, Li Bin Road, Song Shan Lake Hi-Tech  
Development Zone Dongguan, People's Republic of China**

**Tel: +86 769 22038881  
Fax: +86 769 33244054  
Website: [www.ul.com](http://www.ul.com)**

### Revision History

| Rev. | Date          | Revisions     | Revised By |
|------|---------------|---------------|------------|
| V1.0 | July 11, 2018 | Initial Issue | \          |
|      |               |               |            |
|      |               |               |            |
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## 1. Attestation of Test Results

|                                                                                                                                              |                                                                                                                                       |                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Applicant Name                                                                                                                               | Harman International Industries, Inc.                                                                                                 |                                                                                                                                            |
| Address                                                                                                                                      | 8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES                                                                            |                                                                                                                                            |
| Manufacturer                                                                                                                                 | Harman International Industries, Inc.                                                                                                 |                                                                                                                                            |
| Address                                                                                                                                      | 8500 Balboa Boulevard, Northridge, CA 91329, UNITED STATES                                                                            |                                                                                                                                            |
| EUT Name                                                                                                                                     | Portable Bluetooth Speaker                                                                                                            |                                                                                                                                            |
| Model Name                                                                                                                                   | CHARGE4S                                                                                                                              |                                                                                                                                            |
| Sample Status                                                                                                                                | Normal                                                                                                                                |                                                                                                                                            |
| Brand                                                                                                                                        | JBL                                                                                                                                   |                                                                                                                                            |
| Sample Received Date                                                                                                                         | July 11, 2018                                                                                                                         |                                                                                                                                            |
| Date of Tested                                                                                                                               | July 11, 2018                                                                                                                         |                                                                                                                                            |
| Applicable Standards                                                                                                                         | FCC 47 CFR § 2.1093<br>IEEE Std. 1528-2013<br>KDB publication                                                                         |                                                                                                                                            |
| <b>SAR Limits (W/Kg)</b>                                                                                                                     |                                                                                                                                       |                                                                                                                                            |
| Exposure Category                                                                                                                            | Peak spatial-average(1g of tissue)                                                                                                    | Extremities (hands, wrists, ankles, etc.)<br>(10g of tissue)                                                                               |
| General population /<br>Uncontrolled exposure                                                                                                | 1.6                                                                                                                                   | 4                                                                                                                                          |
| <b>The Highest Reported SAR (W/kg)</b>                                                                                                       |                                                                                                                                       |                                                                                                                                            |
| RF Exposure Conditions                                                                                                                       | Equipment Class                                                                                                                       |                                                                                                                                            |
|                                                                                                                                              | DSS (BT)                                                                                                                              |                                                                                                                                            |
| Body (1-g)                                                                                                                                   | 1.112                                                                                                                                 |                                                                                                                                            |
| Extremity (10-g)                                                                                                                             | 0.500                                                                                                                                 |                                                                                                                                            |
| Test Results                                                                                                                                 | Pass                                                                                                                                  |                                                                                                                                            |
| Tested By:<br><br>James Qin<br>Engineer Project Associate | Reviewed By:<br><br>Shawn Wen<br>Laboratory Leader | Approved By:<br><br>Stephen Guo<br>Laboratory Manager |

## 2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with IEEE Std. 1528-2013, the following FCC Published RF exposure KDB procedures:

- 447498 D01 General RF Exposure Guidance
- 690783 D01 SAR Listings on Grants
- 865664 D01 SAR measurement 100 MHz to 6 GHz
- 865664 D02 RF Exposure Reporting

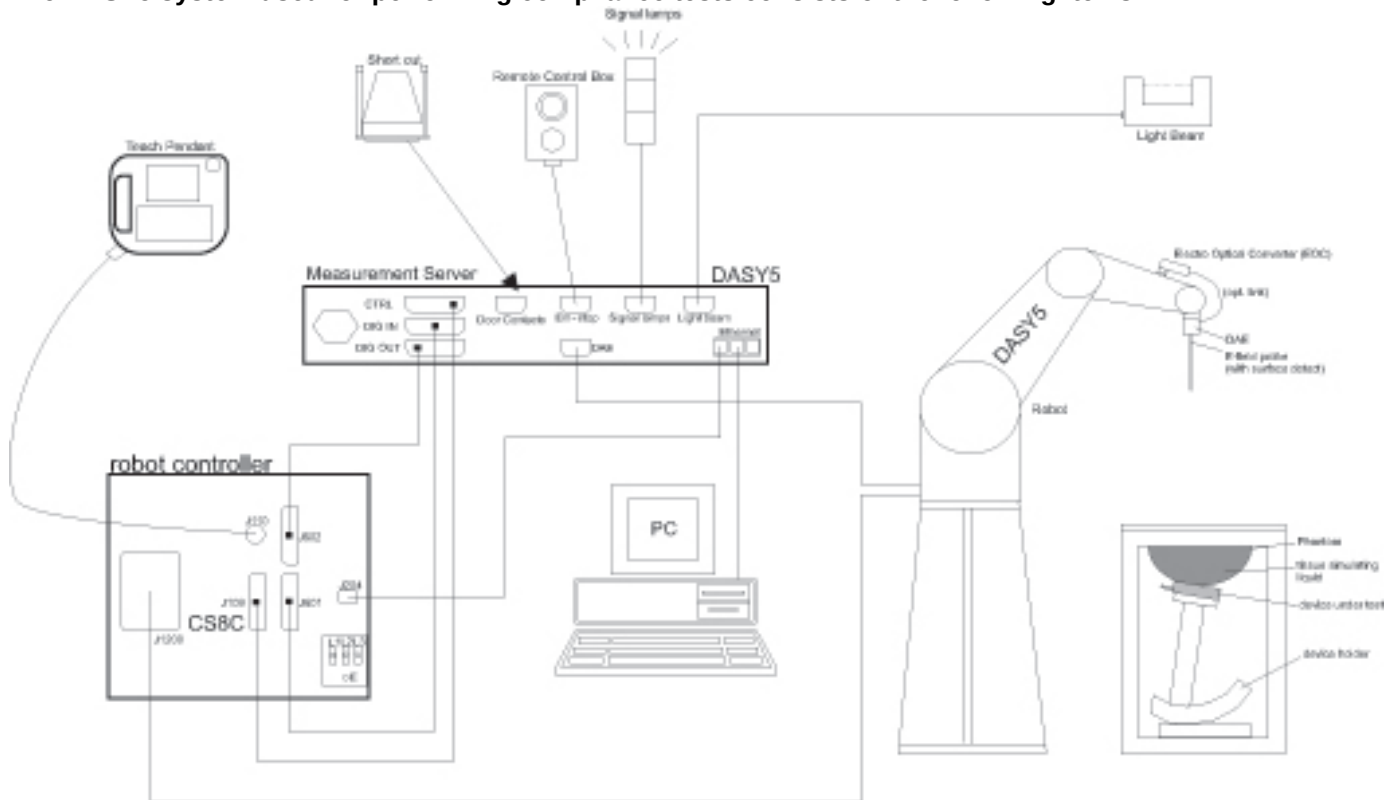
### 3. Facilities and Accreditation

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Location             | UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Address                   | Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Accreditation Certificate | <p><b>A2LA (Certificate No.: 4102.01)</b></p> <p>UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been assessed and proved to be in compliance with A2LA.</p> <p><b>FCC (FCC Recognized No.: CN1187)</b></p> <p>UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules</p> <p><b>IC(Company No.: 21320)</b></p> <p>UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been registered and fully described in a report filed with Industry Canada. The Company Number is 21320.</p> <p><b>VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011)</b></p> <p>UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793.</p> <p>Facility Name:<br/>Chamber D, the VCCI registration No. is G-20019 and R-20004<br/>Shielding Room B , the VCCI registration No. is C-20012 and T-20011</p> |
| Description               | All measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## 4. SAR Measurement System & Test Equipment

### 4.1. SAR Measurement System

The DASY5 system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win7 and the DASY52 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

## 4.2. SAR Scan Procedures

### Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

### Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 v01r04 SAR Measurement 100 MHz to 6 GHz

|                                                                                                        | $\leq 3$ GHz                                                                                                                                                                                                                                                           | $> 3$ GHz                                              |
|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | $5 \pm 1$ mm                                                                                                                                                                                                                                                           | $\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm     |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location              | $30^\circ \pm 1^\circ$                                                                                                                                                                                                                                                 | $20^\circ \pm 1^\circ$                                 |
| Maximum area scan spatial resolution: $\Delta x_{Area}$ , $\Delta y_{Area}$                            | $\leq 2$ GHz: $\leq 15$ mm<br>$2 - 3$ GHz: $\leq 12$ mm                                                                                                                                                                                                                | $3 - 4$ GHz: $\leq 12$ mm<br>$4 - 6$ GHz: $\leq 10$ mm |
|                                                                                                        | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device. |                                                        |

### Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 v01r04 SAR Measurement 100 MHz to 6 GHz

|                                                                                                                                                                                                                                                                                                             |                                           |                                                                                             | $\leq 3$ GHz                                         | $> 3$ GHz                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------------------|
| Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$                                                                                                                                                                                                                      |                                           |                                                                                             | $\leq 2$ GHz: $\leq 8$ mm<br>2 – 3 GHz: $\leq 5$ mm* | 3 – 4 GHz: $\leq 5$ mm*<br>4 – 6 GHz: $\leq 4$ mm*                            |
| Maximum zoom scan spatial resolution, normal to phantom surface                                                                                                                                                                                                                                             | uniform grid: $\Delta z_{\text{Zoom}}(n)$ |                                                                                             | $\leq 5$ mm                                          | 3 – 4 GHz: $\leq 4$ mm<br>4 – 5 GHz: $\leq 3$ mm<br>5 – 6 GHz: $\leq 2$ mm    |
|                                                                                                                                                                                                                                                                                                             | graded grid                               | $\Delta z_{\text{Zoom}}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface | $\leq 4$ mm                                          | 3 – 4 GHz: $\leq 3$ mm<br>4 – 5 GHz: $\leq 2.5$ mm<br>5 – 6 GHz: $\leq 2$ mm  |
|                                                                                                                                                                                                                                                                                                             |                                           | $\Delta z_{\text{Zoom}}(n>1)$ : between subsequent points                                   | $\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$         |                                                                               |
| Minimum zoom scan volume                                                                                                                                                                                                                                                                                    | x, y, z                                   |                                                                                             | $\geq 30$ mm                                         | 3 – 4 GHz: $\geq 28$ mm<br>4 – 5 GHz: $\geq 25$ mm<br>5 – 6 GHz: $\geq 22$ mm |
| Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.                                                                                                                                                           |                                           |                                                                                             |                                                      |                                                                               |
| * When zoom scan is required and the <u>reported</u> SAR from the area scan based <i>1-g SAR estimation</i> procedures of KDB 447498 is $\leq 1.4$ W/kg, $\leq 8$ mm, $\leq 7$ mm and $\leq 5$ mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz. |                                           |                                                                                             |                                                      |                                                                               |

### Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

### Step 5: Z-Scan (FCC only)

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be greater than the step size in Z-direction.

### 4.3. Test Equipment

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

| Name of equipment             | Manufacturer         | Type/Model             | Serial No. | Cal. Due Date     |
|-------------------------------|----------------------|------------------------|------------|-------------------|
| ENA Network Analyzer          | Keysight             | E5080A                 | MY55100583 | December 11, 2018 |
| Dielectric Probe kit          | SPEAG                | SM DAK 040 SA          | 1155       | NCR               |
| DC power supply               | Keysight             | E36103A                | MY55350020 | December 11, 2018 |
| Signal Generator              | Rohde & Schwarz      | SME06                  | 837633\001 | May 16, 2018      |
| BI-Directional Coupler        | WERLATONE            | C8060-102              | 3423       | December 11, 2018 |
| Peak and Average Power Sensor | Keysight             | E9323A                 | MY55440013 | December 11, 2018 |
| Peak and Average Power Sensor | Keysight             | E9323A                 | MY55420006 | December 11, 2018 |
| Dual Channel PK Power Meter   | Keysight             | N1912A                 | MY55416024 | December 11, 2018 |
| Amplifier                     | CORAD TECHNOLOGY LTD | AMF-4D-00400600-50-30P | 1983561    | NCR               |
| Dosimetric E-Field Probe      | SPEAG                | EX3DV4                 | 7383       | December 13, 2018 |
| Data Acquisition Electronic   | SPEAG                | DAE3                   | 427        | December 3, 2018  |
| Dipole Kit 2450 MHz           | SPEAG                | D2450V2                | 977        | January 13, 2019  |
| Software                      | SPEAG                | DASY52                 | N/A        | NCR               |
| Twin Phantom                  | SPEAG                | SAM V5.0               | 1805       | NCR               |
| ELI Phantom                   | SPEAG                | ELI V5.0               | 1235       | NCR               |
| Thermometer                   | Control Company      | 4242                   | 150709653  | December 11, 2018 |
| Thermometer                   | VICTOR               | VC230                  | /          | December 11, 2018 |

**Note:**

1) Per KDB865664D01 v01r04 requirements for dipole calibration, the test laboratory has adopted three-year extended calibration interval. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.

- There is no physical damage on the dipole;
- System check with specific dipole is within 10% of calibrated value;
- The most recent return-loss result, measured at least annually, deviates by no more than 20% from the previous measurement.
- The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.

2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

## 5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is  $< 1.5$  W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std. 1528-2013 is not required in SAR reports submitted for equipment approval. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

## 6. Device Under Test (DUT) Information

### 6.1. DUT Description

|                                                       |                                                           |
|-------------------------------------------------------|-----------------------------------------------------------|
| The EUT is a portable wireless speaker with BT radio. |                                                           |
| Device Dimension                                      | Overall (Length x Width x Height): 85 mm x 85 mm x 220 mm |
| Battery Options                                       | DC 3.7V 7800mAh Polymer Li-ion built-in battery           |
| Accessory                                             | None                                                      |

### 6.2. Wireless Technology

| Wireless technology | Frequency band |
|---------------------|----------------|
| BT                  | 2.4 GHz        |

## 7. SAR Test Configuration

The EUT supports hand held using scenario, and it may extreme close to the human body when used, so 1-g body SAR (10mm) and extremity SAR evaluation are both considered.

## 8. Conducted Output Power Measurement and tune-up tolerance

### 8.1. BT

| BT 2450 | Channel | Average Conducted Power (dBm) | Tune-up | Duty factor (%) |
|---------|---------|-------------------------------|---------|-----------------|
| DH5     | 0CH     | 15.37                         | 15.5    | 77.6            |
|         | 39CH    | 16.02                         | 16.5    | 77.6            |
|         | 78CH    | 16.78                         | 17.0    | 77.6            |
| 2DH5    | 0CH     | 13.87                         | 14.0    | 77.6            |
|         | 39CH    | 14.57                         | 16.0    | 77.6            |
|         | 78CH    | 15.33                         | 15.5    | 77.6            |
| 3DH5    | 0CH     | 13.86                         | 14.0    | 77.6            |
|         | 39CH    | 14.52                         | 15.0    | 77.6            |
|         | 78CH    | 15.25                         | 15.5    | 77.6            |

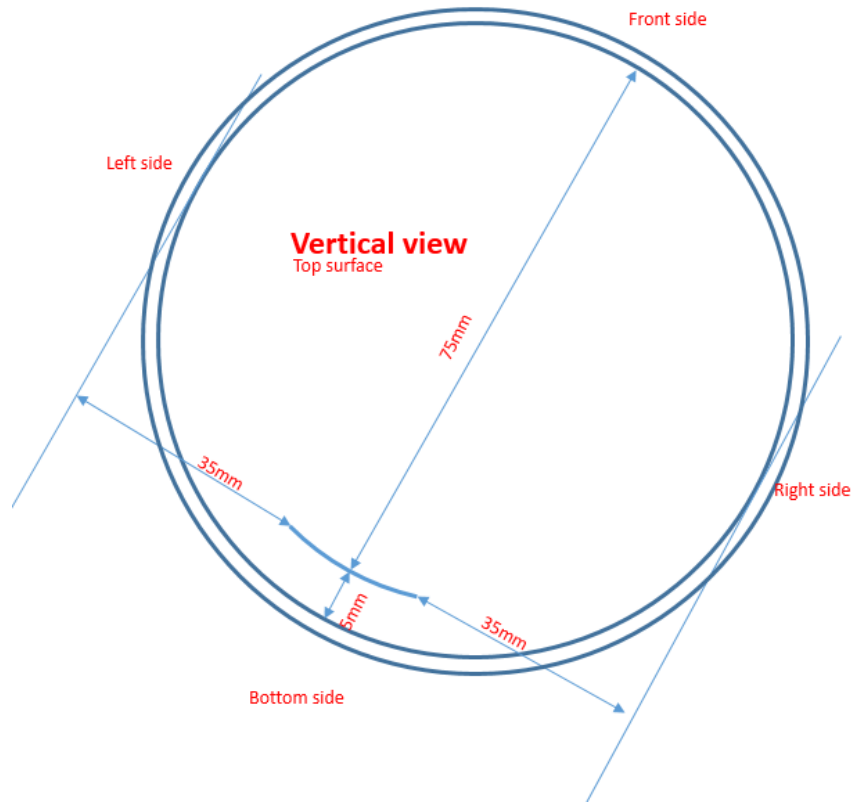
| BT 2450 | Channel | Average Conducted Power (dBm) | Tune-up | Duty factor (%) |
|---------|---------|-------------------------------|---------|-----------------|
| BLE     | 0CH     | 2.75                          | 3.5     | 29.6            |
|         | 19CH    | 3.80                          | 4.5     | 29.6            |
|         | 39CH    | 4.96                          | 5.5     | 29.6            |

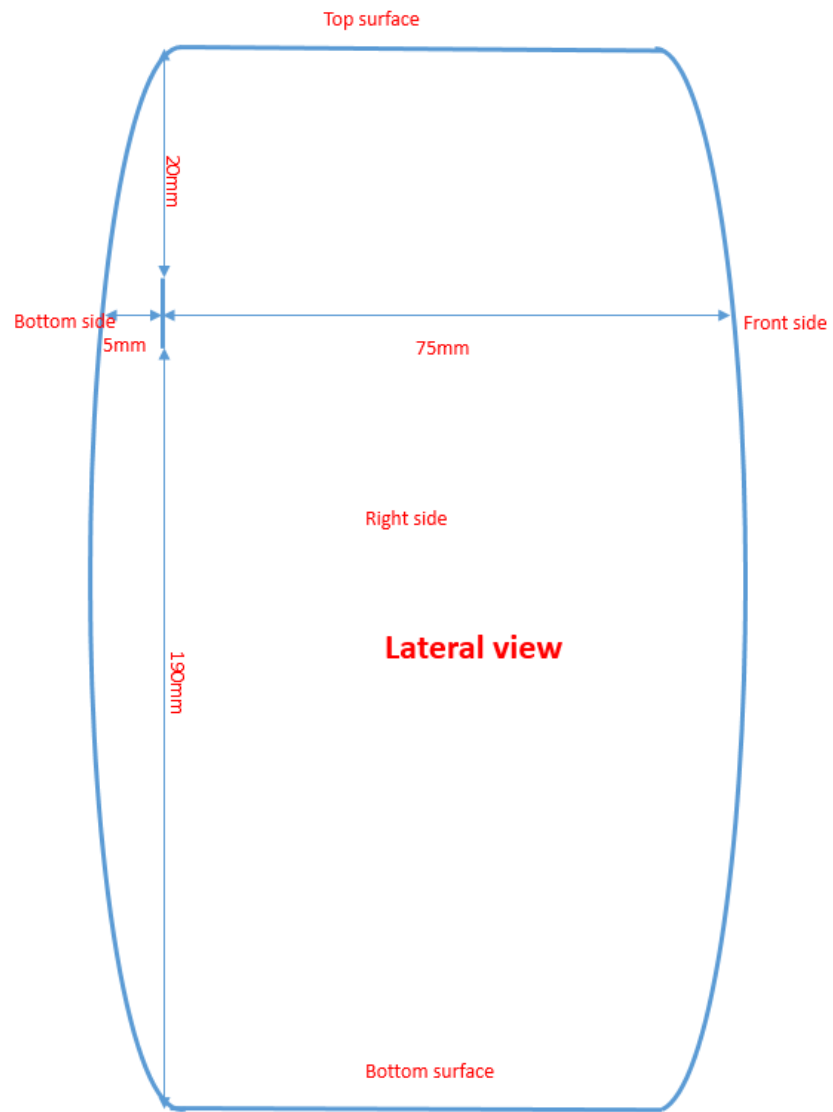
Note:

- 1) As per KDB 447498 sec.4.1.d) at the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit.
- 2) The mode with the highest tune-up tolerance is selected to perform SAR evaluation.

## 9. RF Exposure Conditions

Refer to the diagram of the device which attached below for the specific details of the antenna to outer surface distances.





Per FCC KDB 447498D01:

1. The 1-g SAR and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for product specific 10-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

When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test exclusion.

2. The SAR exclusion threshold for distances  $> 50$  mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

a) at 100 MHz to 1500 MHz

[Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm) · (f(MHz)/150)] mW

b) at  $> 1500$  MHz and  $\leq 6$  GHz

[Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · 10] mW

For 1-g SAR (antenna to outer surface separation distance less than 50mm)

| Position       | Frequency (MHz) | Power (dBm) | Power (mW) | Separation Distance (mm) | Calculation Result | Threshold | SAR Test |
|----------------|-----------------|-------------|------------|--------------------------|--------------------|-----------|----------|
| Top surface    | 2462            | 17.00       | 50.12      | 20.00                    | 3.9                | 3.0       | Required |
| Bottom surface | 2462            | 17.00       | 50.12      | \                        | \                  | \         | \        |
| Left side      | 2462            | 17.00       | 50.12      | 35.00                    | 2.2                | 3.0       | Excluded |
| Right side     | 2462            | 17.00       | 50.12      | 35.00                    | 2.2                | 3.0       | Excluded |
| Front side     | 2462            | 17.00       | 50.12      | \                        | \                  | \         | \        |
| Bottom side    | 2462            | 17.00       | 50.12      | 5.00                     | 15.7               | 3.0       | Required |

Note:

If the calculated result is greater than the threshold, SAR evaluation for the corresponding position is required. If not, SAR evaluation for the corresponding position is not required.

For 2.4G Wi-Fi 1-g SAR (antenna to outer surface separation distance greater than 50mm)

| Position       | Frequency (MHz) | Power (dBm) | Power (mW) | Power allowed at 50mm | Separation Distance (mm) | Calculation Result (mW) | SAR Test |
|----------------|-----------------|-------------|------------|-----------------------|--------------------------|-------------------------|----------|
| Top surface    | 2462            | 17.00       | 50.12      | 95.60                 | \                        | \                       | \        |
| Bottom surface | 2462            | 17.00       | 50.12      | 95.60                 | 190.00                   | 2393.46                 | Excluded |
| Left side      | 2462            | 17.00       | 50.12      | 95.60                 | \                        | \                       | \        |
| Right side     | 2462            | 17.00       | 50.12      | 95.60                 | \                        | \                       | \        |
| Front side     | 2462            | 17.00       | 50.12      | 95.60                 | 75.00                    | 505.93                  | Excluded |
| Bottom side    | 2462            | 17.00       | 50.12      | 95.60                 | \                        | \                       | \        |

Note:

If the power in mW is greater than the calculated result, SAR evaluation for the corresponding position is required.  
If not, SAR evaluation for the corresponding position is not required.

## 10. Dielectric Property Measurements & System Check

### 10.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within  $\pm 2^\circ\text{C}$  of the temperature when the tissue parameters are characterized.

The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.

Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

#### Tissue Dielectric Parameters

FCC KDB 865664 D01 v01r04 SAR Measurement 100 MHz to 6 GHz

| Target Frequency (MHz) | Head         |                | Body         |                |
|------------------------|--------------|----------------|--------------|----------------|
|                        | $\epsilon_r$ | $\sigma$ (S/m) | $\epsilon_r$ | $\sigma$ (S/m) |
| 150                    | 52.3         | 0.76           | 61.9         | 0.80           |
| 300                    | 45.3         | 0.87           | 58.2         | 0.92           |
| 450                    | 43.5         | 0.87           | 56.7         | 0.94           |
| 835                    | 41.5         | 0.90           | 55.2         | 0.97           |
| 900                    | 41.5         | 0.97           | 55.0         | 1.05           |
| 915                    | 41.5         | 0.98           | 55.0         | 1.06           |
| 1450                   | 40.5         | 1.20           | 54.0         | 1.30           |
| 1610                   | 40.3         | 1.29           | 53.8         | 1.40           |
| 1800 – 2000            | 40.0         | 1.40           | 53.3         | 1.52           |
| 2450                   | 39.2         | 1.80           | 52.7         | 1.95           |
| 3000                   | 38.5         | 2.40           | 52.0         | 2.73           |
| 5000                   | 36.2         | 4.45           | 49.3         | 5.07           |
| 5100                   | 36.1         | 4.55           | 49.1         | 5.18           |
| 5200                   | 36.0         | 4.66           | 49.0         | 5.30           |
| 5300                   | 35.9         | 4.76           | 48.9         | 5.42           |
| 5400                   | 35.8         | 4.86           | 48.7         | 5.53           |
| 5500                   | 35.6         | 4.96           | 48.6         | 5.65           |
| 5600                   | 35.5         | 5.07           | 48.5         | 5.77           |
| 5700                   | 35.4         | 5.17           | 48.3         | 5.88           |
| 5800                   | 35.3         | 5.27           | 48.2         | 6.00           |

IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

**Dielectric Property Measurements Results:**

| Liquid    | Freq. | Liquid Parameters |      |                |      | Delta(%)       |       | Limit (%) | Temp. (°C) | Test Date     |
|-----------|-------|-------------------|------|----------------|------|----------------|-------|-----------|------------|---------------|
|           |       | Measured          |      | Target         |      |                |       |           |            |               |
|           |       | ϵ <sub>r</sub>    | σ    | ϵ <sub>r</sub> | σ    | ϵ <sub>r</sub> | σ     |           |            |               |
| Body 2450 | 2360  | 51.76             | 1.85 | 52.82          | 1.86 | -2.01          | -0.81 | ±5        | 23.8       | July 11, 2018 |
|           | 2450  | 51.76             | 1.95 | 52.70          | 1.95 | -1.78          | 0.15  | ±5        |            |               |
|           | 2540  | 51.34             | 2.07 | 52.59          | 2.08 | -2.38          | -0.58 | ±5        |            |               |

## 10.2. System Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

### System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness:  $2.0 \pm 0.2$  mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be  $\geq 15.0$  cm for SAR measurements  $\leq 3$  GHz and  $\geq 10.0$  cm for measurements  $> 3$  GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm (above 1GHz) and 15mm (below 1GHz) from dipole center to the simulating liquid surface.
- For area scan, standard grid spacing for head measurements is 15 mm in x- and y- dimension( $\leq 2$ GHz), 12 mm in x- and y-dimension(2-4 GHz) and 10mm in x- and y- dimension(4-6GHz).
- For zoom scan,  $\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}} \leq 2$ GHz -  $\leq 8$ mm, 2-4GHz -  $\leq 5$  mm and 4-6 GHz- $\leq 4$ mm;  $\Delta z_{\text{zoom}} \leq 3$ GHz -  $\leq 5$  mm, 3-4 GHz-  $\leq 4$ mm and 4-6GHz- $\leq 2$ mm.
- Distance between probe sensors and phantom surface was set to 3 mm except for 5 GHz band. For 5GHz band, Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was set to 100 mW or 250 mW depend on the certificate of the dipoles.
- The results are normalized to 1 W input power.

### System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

| System Dipole | T.S. Liquid |     | Measured Results |                        | Target (Ref. value) | Delta (%) | Limit (%) | Temp. (°C) | Test Date     |
|---------------|-------------|-----|------------------|------------------------|---------------------|-----------|-----------|------------|---------------|
| Serial #      |             |     | Zoom Scan (W/Kg) | Normalize to 1W (W/Kg) |                     |           |           |            |               |
| 977           | Body 2450   | 1g  | 12.100           | 48.40                  | 51.70               | -6.38     | ±10       | 23.8       | July 11, 2018 |
|               |             | 10g | 5.730            | 22.92                  | 24.30               | -5.68     |           |            |               |

## 11. Measured and Reported (Scaled) SAR Results

As per KDB 447498 sec.4.1.e), When SAR or MPE is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported.

### Scaled SAR calculation formula:

Scaled SAR = Tune-up in mW / Conducted power in mW \* Duty cycle (if available) \* SAR value

### SAR Test Reduction criteria are as follows:

#### KDB 447498 D01 General RF Exposure Guidance:

A) Per KDB447498 D01 v06, all SAR measurement results are scaled to the maximum tune-up tolerance limit to demonstrate SAR compliance.

B) Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- $\leq 0.8$  W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\leq 100$  MHz.
- $\leq 0.6$  W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz.
- $\leq 0.4$  W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is  $\geq 200$  MHz.

#### Per KDB865664 D01 v01r04:

For each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8$ W/Kg; if the deviation among the repeated measurement is  $\leq 20\%$ , and the measured SAR  $< 1.45$ W/Kg, only one repeated measurement is required.

### 11.1. SAR Test Results of BT

| Test Position<br>(Body 0mm) | Test Mode | Channel/<br>Frequency | Power (dBm) |       | SAR Value             |                        | Power<br>Drift | Duty<br>Factor<br>(%) | Scaled<br>1-g<br>(W/Kg) | Scaled<br>10-g<br>(W/Kg) |
|-----------------------------|-----------|-----------------------|-------------|-------|-----------------------|------------------------|----------------|-----------------------|-------------------------|--------------------------|
|                             |           |                       | Tune-up     | Meas. | 1-g<br>(Zoom<br>Scan) | 10-g<br>(Zoom<br>Scan) |                |                       |                         |                          |
| Bottom side                 | DH5       | 78/2480               | 17.00       | 16.78 | 0.756                 | 0.338                  | -0.12          | 77.6                  | 1.025                   | 0.458                    |
| Top surface                 | DH5       | 78/2480               | 17.00       | 16.78 | 0.164                 | 0.080                  | -0.04          | 77.6                  | 0.222                   | 0.108                    |
| Bottom side                 | DH5       | 39/2441               | 16.50       | 16.04 | 0.776                 | 0.349                  | 0.01           | 77.6                  | 1.112                   | 0.500                    |
| Bottom side                 | DH5       | 0/2402                | 16.50       | 16.37 | 0.070                 | 0.311                  | -0.02          | 77.6                  | 0.092                   | 0.413                    |

**Note:**

Because the SAR result evaluated at 0mm meet the limit of 1-g SAR and 10-g SAR at the same time, so individual SAR evaluation at 10mm for 1-g SAR is not needed any more.

## **12. Simultaneous Transmission SAR Analysis**

There is only one antenna assembled, so simultaneous transmission doesn't exist.

## **Appendixes**

**Refer to separated files for the following appendixes.**

**20180711-2\_App A Photo**

**20180711-2\_App B System Check Plot**

**20180711-2\_App C Highest Test Plot**

**20180711-2\_App D Cal. Certificates**

-----End of Report-----