FCC SAR Test Report

Test Report No. : **OT-206-RWD-035**

AGR No. : **A205A-294**

Applicant : **LG Electronics USA, Inc.**

Address : **1000 Sylvan Ave. Englewood Cliffs, New Jersey, 07632, United States**

Manufacturer : **LG Electronics Inc.**

Address : **222 LG-ro Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, Korea**

Type of Equipment : **Bluetooth Earbud**

IC Certification No. : **ZNFHBSFN6**

Model Name : **HBS-FN6**

Multiple Model Name: HBS-FN5W, HBS-FN5U, HBS-FN4

Serial number : **N/A**

Total page of Report : **86 pages (including this page)**

Date of Incoming : **June 10, 2020**

Date of Test : **June 15, 2020 ~ June 16, 2020**

Date of issue : **June 17, 2020**

SUMMARY

The equipment complies with the regulation; ***CFR §2.1093.***

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:

No Gyun, Im / Senior Manager
ONETECH Corp.

Approved by:

Jung Wook Kim / Technical Manager
ONETECH Corp.

Revision history

Report No.	Reason for Change	Date Issued
OT-206-RWD-035	Initial release	2020-06-17

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1. Summary of Maximum SAR Value

Equipment Class	Band & Mode	Tx Frequency	SAR		
			1 g Head (W/kg)	1 g Body (W/kg)	10g Hands (W/kg)
DSS	Bluetooth	2 402 ~ 2 480 MHz	< 0.10	0.96	0.30
Simultaneous SAR per KDB 690783 D01v01r03:			N/A	N/A	N/A

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 7 of this report;

2. Device Under Test

2.1. DUT Information

DUT Type	Bluetooth Earbud
FCC ID	ZNFHBSFN6
Brand Name	LG
Model Name	HBS-FN6
Additional Model Name(s)	HBS-FN5W, HBS-FN5U, HBS-FN4
Antenna Type	FPCB Antenna
DUT Stage	Identical Prototype

Note: There are four model names for this product. These four models have the same hardware structure and functions, and only the model was divided for the purpose of marketing.

2.2. Device Overview

Band & Mode	Operating Modes	Tx Frequency
Bluetooth	Data	2 402 ~ 2 480 MHz

2.3. Power Reduction for SAR

There is no power reduction used for any band/mode implemented in the device for SAR purposes.

2.4. Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01 v06.

Maximum Bluetooth LE Output Power

Mode / Band		Modulated Average (dBm)
Bluetooth (BDR – 1 Mbps)	Maximum	7.0
	Nominal	5.0
Bluetooth (BDR – 2 Mbps)	Maximum	7.0
	Nominal	5.0
Bluetooth (LE – 1 Mbps)	Maximum	7.0
	Nominal	5.0
Bluetooth (LE - Coded_125 kbps)	Maximum	7.0
	Nominal	5.0

2.5. DUT Antenna Locations

The DUT antenna locations are included in the filing.

2.6. Near Field Communications (NFC) Antenna

This DUT does not support NFC operations.

2.7. Simultaneous Transmission Capabilities

This device is supported only Bluetooth. So, Simultaneous transmission analysis was not considered.

2.8. Miscellaneous SAR Test Considerations

(A) Bluetooth

This device only supports Bluetooth BDR(1 Mbps), EDR(2 Mbps), LE 1 Mbps, and LE Coded_125 kbps.

2.9. Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 690783 D01v01r03 (SAR Listings on Grants)
- October 2016 TCBC Workshop Notes (Bluetooth SAR Testing)
- October 2016 TCBC Workshop Notes (DUT Holder Perturbations)
- April 2019 TCBC Workshop Notes (Tissue Simulating Liquids (TSL))

2.10. Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units. The serial numbers used for each test are indicated alongside the results in Section 10.

3. INTRODUCTION

The FCC and Innovation, Science, and Economic Development Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz and Health Canada RF Exposure Guidelines Safety Code 6. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

3.1. SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density ( ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 3-1).

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

Equation 3-1 SAR Mathematical Equation

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

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

where:

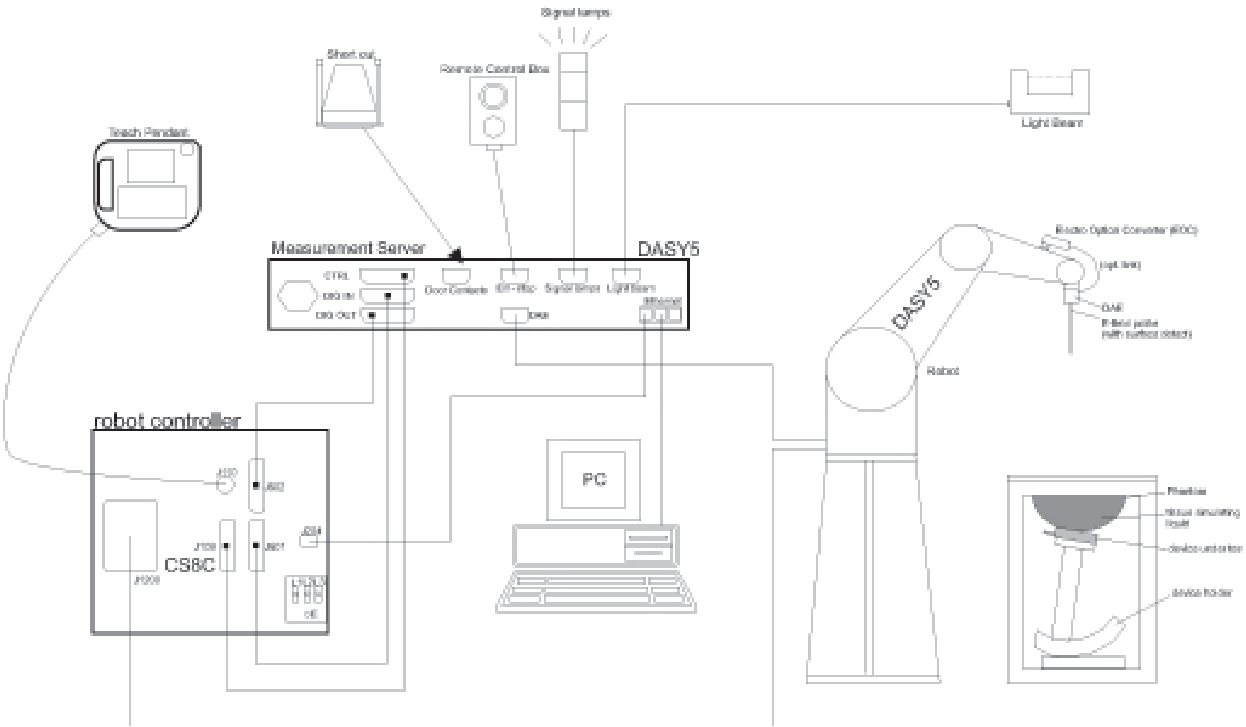
σ = conductivity of the tissue (S/m)
ρ = mass density of the tissue (kg/m^3)
E = rms electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

3.2. SAR Measurement Setup

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. Data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server. The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts. The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning. A computer running WinXP, Win7 or Win10 and the DASY5 software. Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc. The phantom, the device holder and other accessories according to the targeted measurement.



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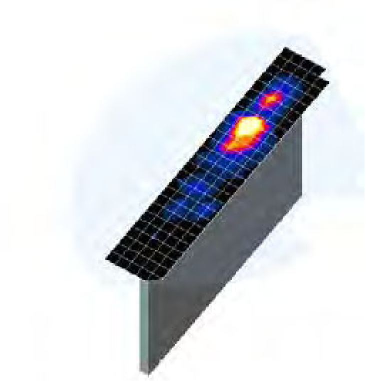
4. DOSIMETRIC ASSESSMENT

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:



1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 5-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR point was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
   a) SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
   b) After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
   c) All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Table 4-1 Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)$*	$\Delta z_{zoom}(n>1)$*	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

5. TEST CONFIGURATION POSITIONS

5.1. Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon = 3$ and loss tangent $\delta = 0.02$.

5.2. Positioning for Testing

Based on FCC guidance and expected exposure conditions, the device was positioned with the outside of the device touching the flat phantom and such that the location of maximum SAR was captured during SAR testing. The SAR test setup photograph is included in Appendix F.

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6. RF EXPOSURE LIMITS

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

6.1. Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

6.2. Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 8-1 SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIROMENT Professional Population (W/kg) or (mW/g)
SPATIAL PEAK SAR[1] Brain	1.60	8.00
SPATIAL AVERAGE SAR[2] Whole Body	0.08	0.40
SPATIAL PEAK SAR[3] Hands, Feet, Ankles, Wrists	4.00	20.00

[1] The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
[2] The Spatial Average value of the SAR averaged over the whole body.
[3] The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

7. FCC MEASUREMENT PROCEDURES

Power measurements for licensed transmitters are performed using a base station simulator under digital average power.

7.1. Measured and Reported SAR

Per FCC KDB Publication 447498 D01v06, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

Per KDB Publication 447498 D01v06, testing of other required channels within the operating mode of a frequency band is not required when the reported 1g or 10g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1g or 10g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1g or 10g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1g or 10g respectively, when the transmission band is ≥ 200 MHz

7.2. Procedures Used to Establish RF Signal for SAR

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR. Devices under test are evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device is tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviates by more than 5%, the SAR test and drift measurements are repeated.

As required by §§ 2.1091(d)(2) and 2.1093(d)(5), RF exposure compliance must be determined at the maximum average power level according to source-based time-averaging requirements to determine compliance for general population exposure conditions. Unless it is specified differently in the *published RF exposure KDB procedures*, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged effective radiated power applies to MPE. When an antenna port is not available on the device to support conducted power measurement, such as for FRS (Part 95) devices and certain Part 15 transmitters with built-in integral antennas, the maximum output power and tolerance allowed for production units should be used to determine RF exposure test exclusion and compliance.

8. RF CONDUCTED POWERS

8.1. Conducted Powers

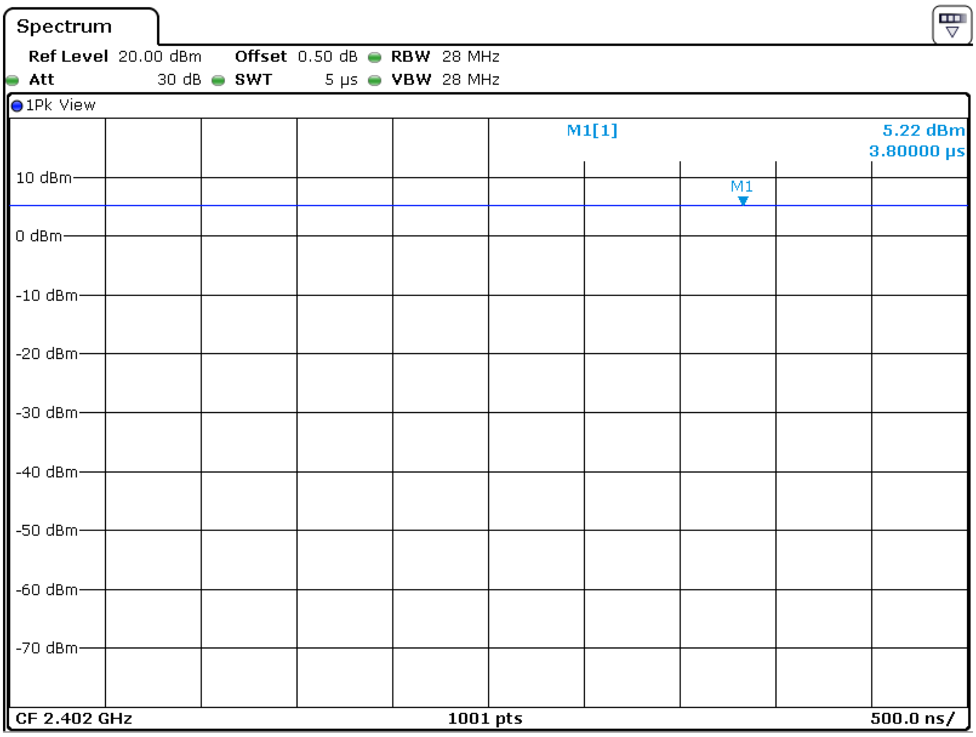
8.1.1. Bluetooth

Table 8-1 Bluetooth Conducted Powers

Right Ear					
Mode	Data Rate	Ch.	Frequency	Average Conducted Power	
				dBm	mW
Bluetooth	1 Mbps	0	2402	5.66	3.68
		39	2441	**5.72**	**3.73**
		78	2480	5.68	3.70
	2 Mbps	0	2402	5.31	3.40
		39	2441	5.24	3.34
		78	2480	5.16	3.28
	LE 1 Mbps	0	2402	5.11	3.24
		19	2440	5.08	3.22
		39	2480	5.14	3.27
	Coded_125 kbps	0	2402	5.05	3.20
		19	2440	5.12	3.25
		39	2480	5.09	3.23

Note: The bolded data rates and channel above were tested for SAR.

Figure 8-1 Bluetooth Transmission Plot



Equation 8-1 Bluetooth Duty Cycle Calculation for Left ear

- DUTY cycle of this device is 100 %.
- DUTY Cycle [%] = (Pulse / Period) X 100 = (1.000/1.000) X 100 = 100 %

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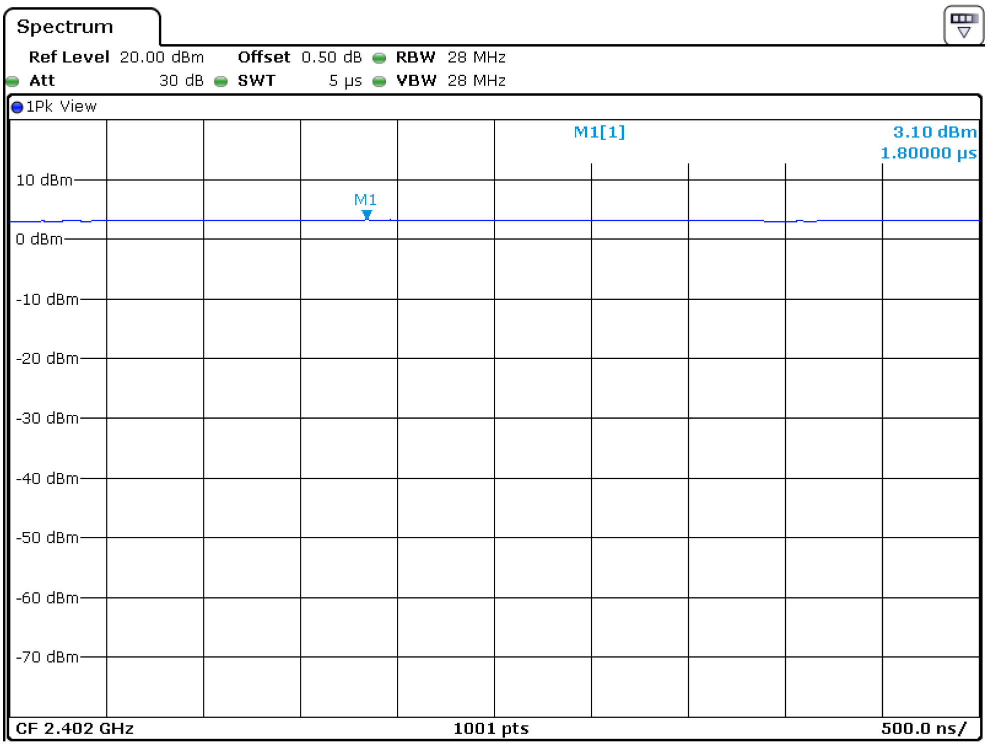
Table 8-2 Bluetooth Conducted Powers

Left Ear					
Mode	Data Rate	Ch.	Frequency	Average Conducted Power	
				dBm	mW
Bluetooth	1 Mbps	0	2402	5.57	3.61
		39	2441	**5.66**	**3.68**
		78	2480	5.60	3.63
	2 Mbps	0	2402	5.38	3.45
		39	2441	5.48	3.53
		78	2480	5.23	3.33
	LE 1 Mbps	0	2402	5.02	3.18
		19	2440	5.11	3.24
		39	2480	5.09	3.23
	Coded_125 kbps	0	2402	5.13	3.26
		19	2440	5.24	3.34
		39	2480	5.19	3.30

Note: The bolded data rates and channel above were tested for SAR.

Figure 8-2 Bluetooth Transmission Plot



Equation 8-2 Bluetooth Duty Cycle Calculation for Right ear

- DUTY cycle of this device is 100 %.
- DUTY Cycle [%] = (Pulse / Period) X 100 = (1.000/1.000) X 100 = 100 %

9. SYSTEM VERIFICATION

9.1. Tissue Verification

Table 9-1 Measured Head Tissue Properties

Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)	Test Date
HSL2450	2 450	21.9	1.823	40.281	1.80	39.2	1.28	2.76	2020.06.15
	2 402		1.766	40.470	1.76	39.3	0.34	2.98	
	2 441		1.812	40.310	1.79	39.2	1.23	2.83	
	2 480		1.855	40.180	1.83	39.2	1.37	2.50	
HSL2450	2 450	21.6	1.856	40.222	1.80	39.2	3.11	2.61	2020.06.16
	2 402		1.801	40.397	1.76	39.3	2.33	2.79	
	2 441		1.845	40.255	1.79	39.2	3.07	2.69	
	2 480		1.890	40.103	1.83	39.2	3.28	2.30	

Tissue Verification Notes:

1. The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.
2. Per April 2019 TCBC Workshop Notes, effective February 19, 2019, FCC has permitted the use of single head-tissue simulating liquid specified in IEC 62209-1 for all SAR tests.

9.2. Test System Verification

Prior to SAR assessment, the system is verified to ±10% of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix E.

Table 9-2 System Verification Results – 1 g

SAR System #	Amb. Temp (℃)	Liquid Temp. (℃)	Test Date	Tissue Type	Frequency (MHz)	Input Power (mW)	1W Target SAR-1 g (W/kg)	Measured SAR-1 g (W/kg)	Normalized to 1W SAR-1 g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N
4	22.4	21.9	2020.06.15	Head	2 450	100	53.10	5.15	51.50	- 3.01	923	3832
4	22.1	21.6	2020.06.16	Head	2 450	100	53.10	5.24	52.40	- 1.32	923	3832

Table 9-3 System Verification Results – 10 g

SAR System #	Amb. Temp (℃)	Liquid Temp. (℃)	Test Date	Tissue Type	Frequency (MHz)	Input Power (mW)	1W Target SAR-10 g (W/kg)	Measured SAR-10 g (W/kg)	Normalized to 1W SAR-10 g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N
4	22.4	21.9	2020.06.15	Head	2 450	100	24.70	2.37	23.70	- 4.05	923	3832
4	22.1	21.6	2020.06.16	Head	2 450	100	24.70	2.41	24.10	- 2.43	923	3832

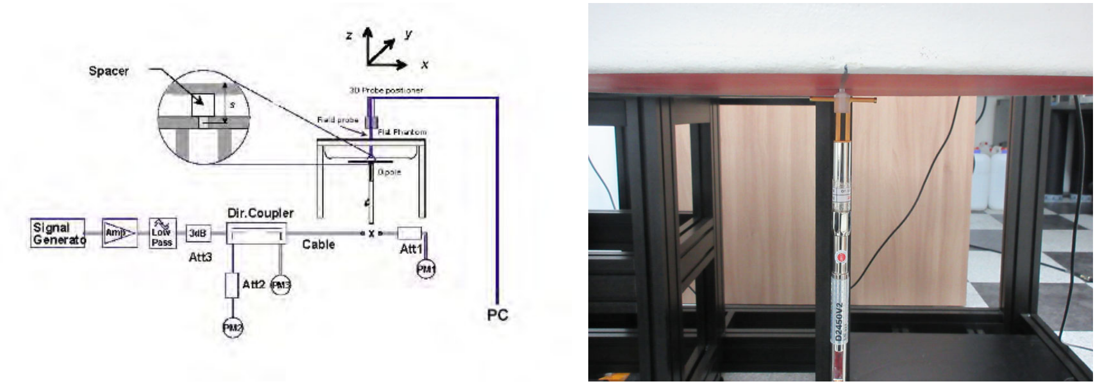


Figure 9-1 System Verification Setup Diagram and Photo

10. SAR TEST DATA SUMMARY

10.1. Standalone Head SAR Data

Table 10-1 Bluetooth Head SAR

Plot No.	Device Serial Number	Frequency MHz	Frequency Ch.	Band	Mode	Test Position	Spacing (cm)	Maximum Allowed Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor (Duty Cycle)	Scaling Factor (Power)	Power Drift (dB)	Measured SAR 1 g (W/kg)	Reported SAR 1 g (W/kg)	Measured SAR 10 g (W/kg)	Reported SAR 10 g (W/kg)
1	SAR#1	2441	39	2.4 GHz	Bluetooth	Right Ear	0	7.0	5.72	1.000	1.343	- 0.180	0.015	0.020	0.00563	0.008
4	SAR#1	2441	39	2.4 GHz	Bluetooth	Left Ear	0	7.0	5.66	1.000	1.361	- 0.120	0.013	0.018	0.00514	0.007
ANSI / IEEE C95.1 1992 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population									Head / Body 1.6 W/kg (mW/g) Averaged over 1 gram				Limbs (Hands) 4.0 W/kg (mW/g) Averaged over 10 gram			

10.2. Standalone Body/Hands SAR Data

Table 10-2 Bluetooth Body/Hands SAR

Plot No.	Device Serial Number	Earphone Side	Frequency MHz	Frequency Ch.	Band	Mode	Test Position	Spacing (cm)	Maximum Allowed Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor (Duty Cycle)	Scaling Factor (Power)	Power Drift (dB)	Measured SAR 1 g (W/kg)	Reported SAR 1 g (W/kg)	Measured SAR 10 g (W/kg)	Reported SAR 10 g (W/kg)
	SAR#1	Right Ear	2 441	39	2.4 GHz	Bluetooth	Top	0	7.0	5.72	1.000	1.343	0.020	0.036	0.048	0.013	0.017
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Bottom	0	7.0	5.72	1.000	1.343	0.010	0.019	0.026	0.00682	0.009
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Front	0	7.0	5.72	1.000	1.343	- 0.190	0.603	0.810	0.187	0.251
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Rear	0	7.0	5.72	1.000	1.343	- 0.180	0.015	0.020	0.00563	0.008
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Right	0	7.0	5.72	1.000	1.343	0.190	0.185	0.248	0.066	0.089
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Left	0	7.0	5.72	1.000	1.343	- 0.010	0.101	0.136	0.039	0.052
	SAR#1		2 402	0	2.4 GHz	Bluetooth	Front	0	7.0	5.66	1.000	1.361	- 0.190	0.582	0.792	0.180	0.245
14	**SAR#1**		**2 480**	**78**	**2.4 GHz**	**Bluetooth**	**Front**	**0**	**7.0**	**5.68**	**1.000**	**1.355**	**- 0.180**	**0.629**	**0.852**	**0.195**	**0.264**
	SAR#1	Left Ear	2 441	39	2.4 GHz	Bluetooth	Top	0	7.0	5.66	1.000	1.361	- 0.120	0.052	0.071	0.021	0.029
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Bottom	0	7.0	5.66	1.000	1.361	0.120	0.020	0.027	0.00804	0.011
17	**SAR#1**		**2 441**	**39**	**2.4 GHz**	**Bluetooth**	**Front**	**0**	**7.0**	**5.66**	**1.000**	**1.361**	**- 0.010**	**0.703**	**0.957**	**0.220**	**0.300**
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Rear	0	7.0	5.66	1.000	1.361	- 0.120	0.013	0.018	0.00514	0.007
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Right	0	7.0	5.66	1.000	1.361	- 0.010	0.077	0.105	0.031	0.042
	SAR#1		2 441	39	2.4 GHz	Bluetooth	Left	0	7.0	5.66	1.000	1.361	0.170	0.086	0.117	0.035	0.048
	SAR#1		2 402	0	2.4 GHz	Bluetooth	Front	0	7.0	5.57	1.000	1.390	0.170	0.673	0.935	0.211	0.293
	SAR#1		2 480	78	2.4 GHz	Bluetooth	Front	0	7.0	5.60	1.000	1.380	0.100	0.559	0.772	0.177	0.244
ANSI / IEEE C95.1 1992 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population										Head / Body 1.6 W/kg (mW/g) Averaged over 1 gram				Limbs (Hands) 4.0 W/kg (mW/g) Averaged over 10 gram			

10.3. SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Device was tested using a fixed spacing for body testing. A separation distance of 0 cm was considered because the manufacturer has determined that there will be body available in the marketplace for users to support this separation distance.
7. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds below.
8. Per FCC KDB 865664 D01v01r04, variability SAR tests may be performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg. Since the measured SAR results of this device were less than or equal to 0.8 W/kg, repeated SAR measurements are not required.
9. Per FCC KDB 447498 D01v06, SAR Testing was performed on the Flat Phantom for normal use for Head. Additional SAR Testing was performed on the location closest to the Antenna of similar configuration to demonstrate compliance.
10. Right ear means tested with right earbud.
11. Left ear means tested with left earbud.

Bluetooth Notes:

1. Bluetooth SAR was measured with hopping disabled with DH5 operation and Tx Tests test mode type. Per October 2016 TCBC Workshop Notes, the reported SAR was scaled to the 100 % transmission duty factor to determine compliance. See Section 8.1.1 for the time domain plot and calculation for the duty factor of the device.
2. Per FCC KDB Publication 447498 D01v06, if the reported (Scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg for 1g evaluations then testing at the other channels is not required for such test configuration(s). When the maximum output power variation across the required test channels is > 1/2 dB, instead of the middle channel, the highest output power channel was used.

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

11. EQUIPMENT LIST

Manufacturer	Model	Description	Cal. Date	Cal. Interval	CaL.Due	Serial No.
SY Corp.	SAR ROOM #4	SAR Shield Room	N/A	N/A	N/A	N/A
STAUBLI	TX90XL	DASY6 Robot	N/A	N/A	N/A	F17/59RBA1/A/01
STAUBLI	CS8C Speag TX90	DASY6 Controller	N/A	N/A	N/A	F17/59RBA1/C/01
Speag	SE UMS 028 BB	DASY6 Measurement Server	N/A	N/A	N/A	1544
STAUBLI	SP1	Robot Remote Control	N/A	N/A	N/A	D 211 426 06B
Speag	SE UKS 030 AA	LightBeam SAR #4	N/A	N/A	N/A	1040
Speag	TP-1381	Twin SAM Phantom	N/A	N/A	N/A	TP-1381
Speag	MD4HHTV5	Mounting Device	N/A	N/A	N/A	N/A
Speag	EX3DV4	SAR Probe	2020-03-27	Annual	2021-03-27	3832
Speag	DAE4	Data Acquisition Electronics	2020-03-20	Annual	2021-03-20	557
Speag	D2450V2	Dipole Antenna	2019-11-21	Biennal	2021-11-21	923
HP	8665B	RF Signal Generator	2019-08-21	Annual	2020-08-21	3744A01349
EMPOWER	BBS3Q7ECK-2001	RF Power Amplifier	2019-08-22	Annual	2020-08-22	1045D/C0536
Agilent	E4419B	Power Meter	2019-08-22	Annual	2020-08-22	MY45100284
Anritsu	ML2495A	Power Meter	2019-07-26	Annual	2020-07-26	1924013
HP	8481H	Power Sensor	2019-08-23	Annual	2020-08-23	3318A17600
HP	8481A	Power Sensor	2019-08-23	Annual	2020-08-23	US37290447
Anritsu	MA2411B	Pulse Power Sensor	2019-07-26	Annual	2020-07-26	1726430
HP	11692D	Dual Directional Coupler	2019-08-21	Annual	2020-08-21	1212A05057
Bird	50-6A-MFN-30	Attenuator	2019-08-21	Annual	2020-08-21	N/A
HP	8491A	Attenuator	2019-08-21	Annual	2020-08-21	63272
WAINWRIGHT	WLJS1500-6EF	Low Pass Filter	2019-08-22	Annual	2020-08-22	1
Speag	DAK-3.5	Dielectric Assessment Kit	2019-11-19	Annual	2020-11-19	1040
Agilent	E8357A	Network Analyzer	2019-08-21	Annual	2020-08-21	US41070399
ROHDE & SCHWARZ	FSP	Spectrum Analyzer	2019-07-25	Annual	2020-07-25	100017
ROHDE & SCHWARZ	FSV40	SIGNAL ANALYZER	2020-02-21	Annual	2021-02-21	101009
LKM Electronic GmbH	DTM3000-Spezial	Hand-Held Thermometers	2019-08-23	Annual	2020-08-23	3247
CAS	TE-201	Temperature hygrometer	2019-08-26	Annual	2020-08-26	14011777-1

Notes:

1. CBT (Calibration Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.
2. All equipment was used solely within its calibration period.

12. MEASUREMENT UNCERTAINTIES

Table 13-1 Uncertainty of SAR equipment for measurement Body 0.3 GHz to 3 GHz

No.		Error Description	Uncertainty Value (1 g) (%)	Uncertainty Value (10 g) (%)	Probe Dist.	Div.	C_i (1 g)	C_i (10 g)	$U_i(y)$ (1 g)	$U_i(y)$ (10 g)	V_i or V_{eff}
1	$U(PR_C)$	Probe Calibration	6.30	6.30	N	1.00	1.00	1.00	6.30	6.30	∞
2	$U(PR_I)$	Isotropy	1.87	1.87	R	$\sqrt{3}$	1.00	1.00	1.08	1.08	∞
3	$U(L)$	Linearity	0.60	0.60	R	$\sqrt{3}$	1.00	1.00	0.35	0.35	∞
4	$U(PR_{MR})$	Probe modulation response	2.40	2.40	R	$\sqrt{3}$	1.00	1.00	1.39	1.39	∞
6	$U(DL)$	Detection Limits	1.00	1.00	R	$\sqrt{3}$	1.00	1.00	0.58	0.58	∞
5	$U(BE)$	Boundary effect	1.00	1.00	R	$\sqrt{3}$	1.00	1.00	0.58	0.58	∞
7	$U(RE)$	Readout Electronics	0.30	0.30	N	1.00	1.00	1.00	0.30	0.30	∞
8	$U(T_{RT})$	Response Time	0.80	0.80	R	$\sqrt{3}$	1.00	1.00	0.46	0.46	∞
9	$U(T_{IT})$	Integration Time	2.60	2.60	R	$\sqrt{3}$	1.00	1.00	1.50	1.50	∞
10	$U(A_{NO})$	RF ambient conditions–noise	3.00	3.00	R	$\sqrt{3}$	1.00	1.00	1.73	1.73	∞
11	$U(A_{RF})$	RF ambient conditions–reflections	3.00	3.00	R	$\sqrt{3}$	1.00	1.00	1.73	1.73	∞
12	$U(PR_{PT})$	Probe positioner mech. Restrictions	0.40	0.40	R	$\sqrt{3}$	1.00	1.00	0.23	0.23	∞
13	$U(PR_{PP})$	Probe positioning with respect to phantom shell	2.90	2.90	R	$\sqrt{3}$	1.00	1.00	1.67	1.67	∞
14	$U(PP_{MSE})$	Post-processing(for max. SAR evaluation)	2.00	2.00	R	$\sqrt{3}$	1.00	1.00	1.15	1.15	∞
15	$U(DU)$	Device Holder Uncertainty	3.60	3.60	N	1.00	1.00	1.00	3.60	3.60	5.00
16	$U(PO_{EUT})$	Test sample positioning	0.92	0.94	N	1.00	1.00	1.00	0.92	0.94	9.00
17	$U(PS)$	Power scaling	0.00	0.00	R	$\sqrt{3}$	1.00	1.00	0.00	0.00	∞
18	$U(PD)$	Drift of output power(measured SAR drift)	5.00	5.00	R	$\sqrt{3}$	1.00	1.00	2.89	2.89	∞
19	$U(PU)$	Phantom Uncertainty	6.10	6.10	R	$\sqrt{3}$	1.00	1.00	3.52	3.52	∞
20	$U(CS_{DPC})$	Algorithm for correcting SAR for deviations in permittivity and conductivity	1.90	1.90	N	1.00	1.00	0.84	1.90	1.60	∞
21	$U(LC_M)$	Liquid Conductivity (meas.)	1.39	1.26	N	1.00	0.78	0.71	1.08	0.89	5.00
22	$U(LP_M)$	Liquid Permittivity (meas.)	0.34	0.38	N	1.00	0.23	0.26	0.08	0.10	5.00
23	$U(LC_{TU})$	Liquid conductivity(temperature uncertainty)	1.87	1.71	R	$\sqrt{3}$	0.78	0.71	0.84	0.70	∞
24	$U(LP_{TU})$	Liquid permittivity(temperature uncertainty)	0.11	0.13	R	$\sqrt{3}$	0.23	0.26	0.01	0.02	∞
		Uc(sar) Combined standard uncertainty (%)							9.82	9.73	275
		Extended uncertainty *U*(%)							19.63	19.47	

13. CONCLUSION

13.1. Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Innovation, Science, and Economic Development Canada, with respect to all parameters subject to this test.
These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

13.2. Information on the Testing Laboratories

We, Onetech Corp. Laboratory were founded in 1989 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Fax: +82-31-799-9599

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APPENDIX A: SYSTEM VERIFICATION

Test Laboratory: ONETECH CO., LTD. Lab Date: 6/15/2020

System Verification for 2450 MHz

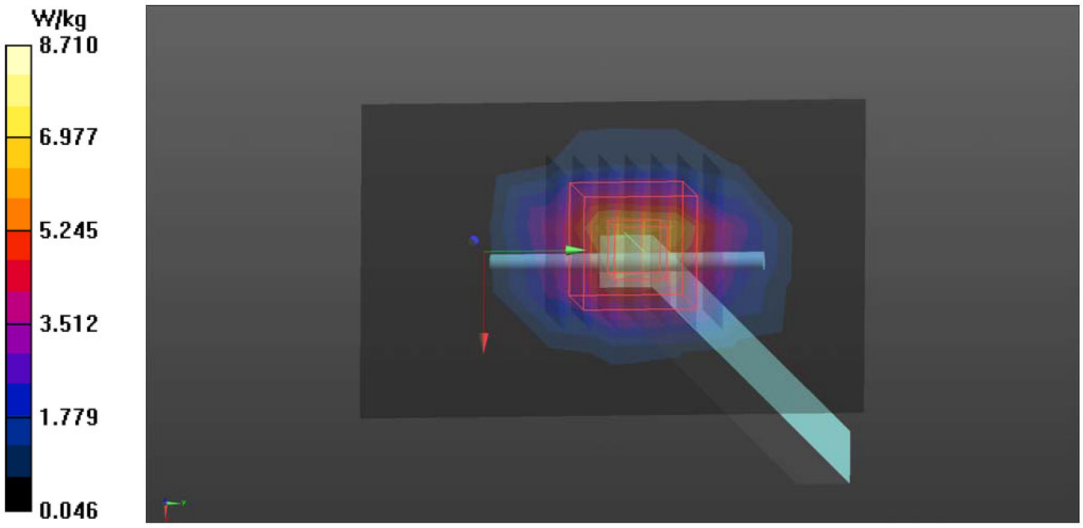
DUT: D2450V2 - SN:923

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: HSL2450 Medium parameters used: f = 2450 MHz; σ = 1.823 S/m; ε_r = 40.281; ρ = 1000 kg/m^3
Ambient Temperature : 22.4 °C; Liquid Temperature : 21.9 °C

DASY5 Configuration:
- Probe: EX3DV4 - SN3832; ConvF(7.3, 7.3, 7.3) @ 2450 MHz; Calibrated: 3/27/2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn557; Calibrated: 3/20/2020
- Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1381
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=100mW 2/Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 6.80 W/kg

Pin=100mW 2/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 70.32 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 10.8 W/kg
SAR(1 g) = 5.15 W/kg; SAR(10 g) = 2.37 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 47.9%
Maximum value of SAR (measured) = 8.71 W/kg



Test Laboratory: ONETECH CO., LTD. Lab Date: 6/16/2020

System Verification for 2450 MHz

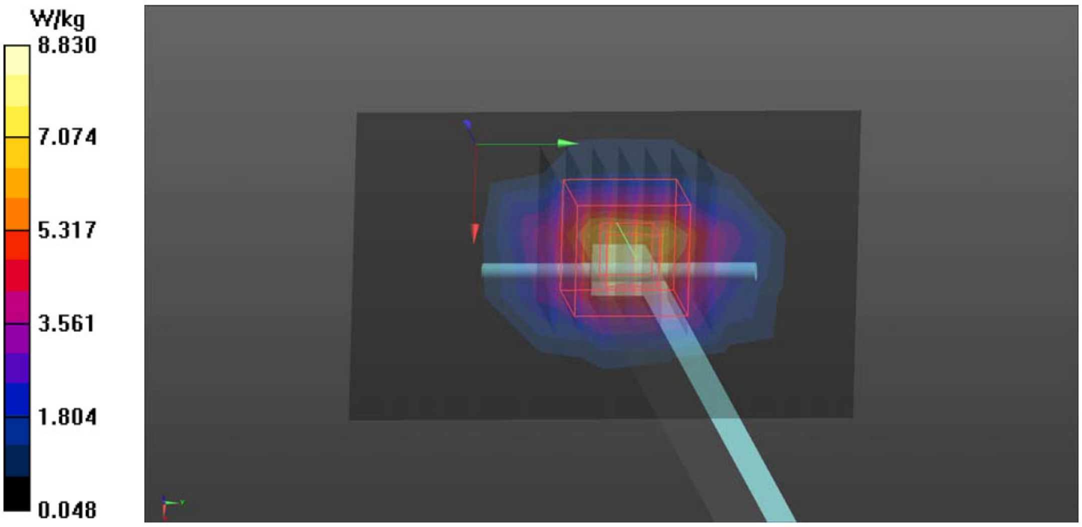
DUT: D2450V2 - SN:923

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: HSL2450 Medium parameters used: f = 2450 MHz; σ = 1.856 S/m; ε_r = 40.222; ρ = 1000 kg/m^3
Ambient Temperature：22.1 ℃; Liquid Temperature：21.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3832; ConvF(7.3, 7.3, 7.3) @ 2450 MHz; Calibrated: 3/27/2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn557; Calibrated: 3/20/2020
- Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1381
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Pin=100mW/Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 6.94 W/kg

Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 70.30 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 11.0 W/kg
SAR(1 g) = 5.24 W/kg; SAR(10 g) = 2.41 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 47.9%
Maximum value of SAR (measured) = 8.83 W/kg



APPENDIX B: SAR TEST DATA

Test Laboratory: ONETECH CO., LTD. Lab Date: 6/15/2020

P01_2.4 GHz Band_Bluetooth_Right Ear_0 cm_Ch.39

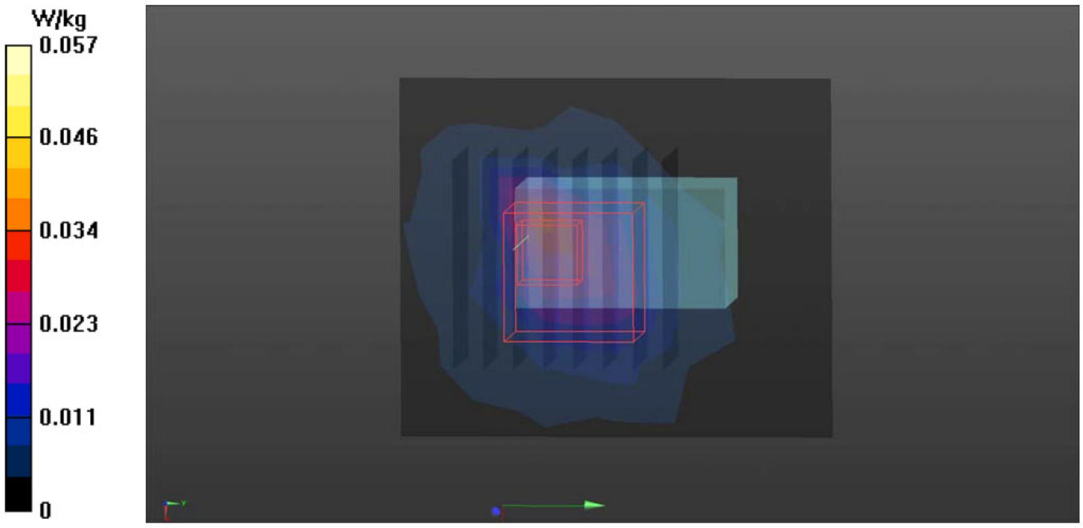
DUT: HBS-FN6

Communication System: Bluetooth; Frequency: 2441 MHz;Duty Cycle: 1:1
Medium: HSL2450 Medium parameters used: f = 2441 MHz; σ = 1.812 S/m; ε_r = 40.31; ρ = 1000 kg/m^3
Ambient Temperature : 22.4 °C; Liquid Temperature : 21.9 °C

DASY5 Configuration:
- Probe: EX3DV4 - SN3832; ConvF(7.3, 7.3, 7.3) @ 2441 MHz; Calibrated: 3/27/2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn557; Calibrated: 3/20/2020
- Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1381
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

- **Area Scan (6x7x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0326 W/kg

- **Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.498 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 0.106 W/kg
SAR(1 g) = 0.015 W/kg; SAR(10 g) = 0.00563 W/kg
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 40.1%
Maximum value of SAR (measured) = 0.0574 W/kg



Test Laboratory: ONETECH CO., LTD. Lab Date: 6/16/2020

P04_2.4 GHz Band_Bluetooth_Left Ear_0 cm_Ch.39

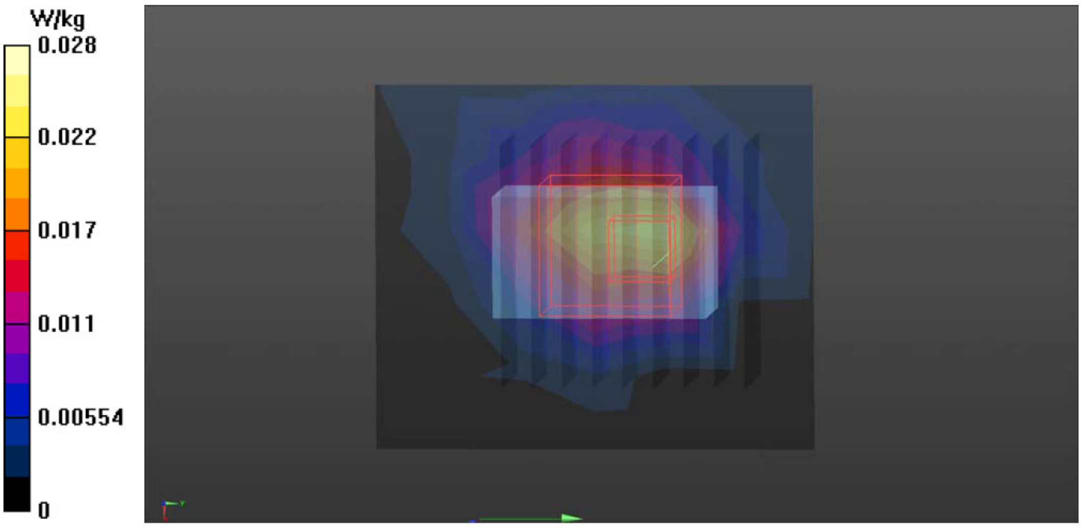
DUT: HBS-FN6

Communication System: Bluetooth; Frequency: 2441 MHz;Duty Cycle: 1:1
Medium: HSL2450 Medium parameters used: f = 2441 MHz; $\sigma = 1.845$ S/m; $\varepsilon_r = 40.255$; $\rho = 1000$ kg/m^3
Ambient Temperature：22.1 °C; Liquid Temperature：21.6 °C

DASY5 Configuration:
- Probe: EX3DV4 - SN3832; ConvF(7.3, 7.3, 7.3) @ 2441 MHz; Calibrated: 3/27/2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn557; Calibrated: 3/20/2020
- Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1381
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

- **Area Scan (6x7x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0238 W/kg

- **Zoom Scan (9x9x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.995 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.0420 W/kg
SAR(1 g) = 0.013 W/kg; SAR(10 g) = 0.00514 W/kg
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
Ratio of SAR at M2 to SAR at M1 = 37%
Maximum value of SAR (measured) = 0.0277 W/kg



Test Laboratory: ONETECH CO., LTD. Lab Date: 6/15/2020

P14_2.4 GHz Band_Bluetooth_Front_0 cm_Ch.78_Right Ear

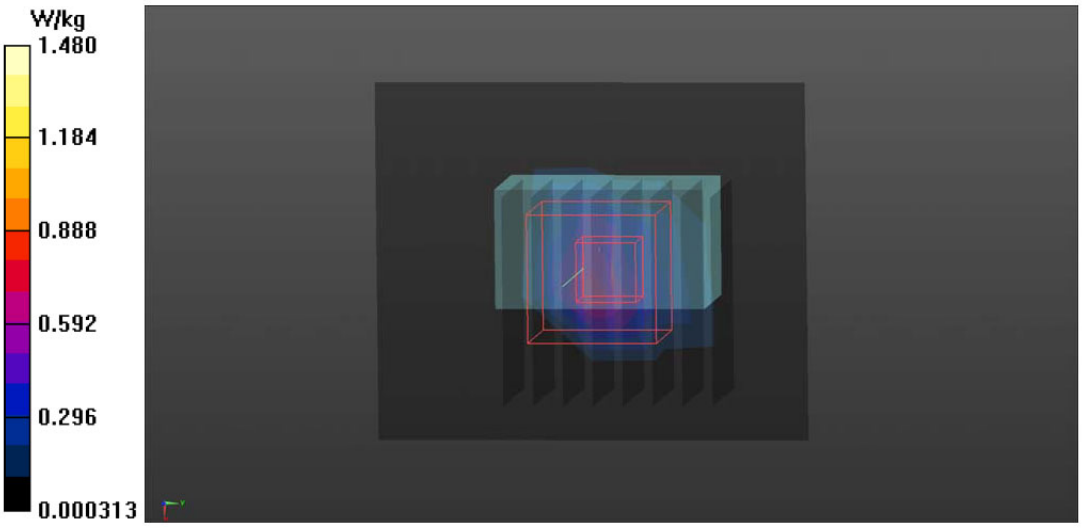
DUT: HBS-FN6

Communication System: Bluetooth; Frequency: 2480 MHz;Duty Cycle: 1:1
Medium: HSL2450 Medium parameters used: f = 2480 MHz; σ = 1.855 S/m; ε_r = 40.18; ρ = 1000 kg/m^3
Ambient Temperature：22.4 ℃; Liquid Temperature：21.9 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3832; ConvF(7.3, 7.3, 7.3) @ 2480 MHz; Calibrated: 3/27/2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn557; Calibrated: 3/20/2020
- Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1381
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

- **Area Scan (6x7x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.686 W/kg

- **Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 28.40 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 2.25 W/kg
SAR(1 g) = 0.629 W/kg; SAR(10 g) = 0.195 W/kg
Smallest distance from peaks to all points 3 dB below = 8.1 mm
Ratio of SAR at M2 to SAR at M1 = 35.7%
Maximum value of SAR (measured) = 1.48 W/kg



Test Laboratory: ONETECH CO., LTD. Lab Date: 6/16/2020

P17_2.4 GHz Band_Bluetooth_Front_0 cm_Ch.39_Left Ear

DUT: HBS-FN6

Communication System: Bluetooth; Frequency: 2441 MHz;Duty Cycle: 1:1
Medium: HSL2450 Medium parameters used: f = 2441 MHz; σ = 1.845 S/m; ε_r = 40.255; ρ = 1000 kg/m^3
Ambient Temperature : 22.1 °C; Liquid Temperature : 21.6 °C

DASY5 Configuration:
- Probe: EX3DV4 - SN3832; ConvF(7.3, 7.3, 7.3) @ 2441 MHz; Calibrated: 3/27/2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn557; Calibrated: 3/20/2020
- Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1381
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

- **Area Scan (6x7x1):** Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 1.02 W/kg

- **Zoom Scan (8x8x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.786 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 2.52 W/kg
SAR(1 g) = 0.703 W/kg; SAR(10 g) = 0.220 W/kg
Smallest distance from peaks to all points 3 dB below = 7.6 mm
Ratio of SAR at M2 to SAR at M1 = 37.5%
Maximum value of SAR (measured) = 1.54 W/kg