FCC SAR Test Report

Report No.	:	**OT-198-RWD-033**
AGR. No.	:	**A197A-024R**
Applicant	:	**Williams Sound, LLC**
Address	:	**10300 Valley View Road, Eden Prairie, Minnesota, 55344, United States**
DUT Type	:	**Portable Conference Transceiver**
FCC ID	:	**CNMDLT400**
Brand	:	**Williams Sound, LLC**
Model No.	:	**DLT 400**
FCC Rule Part(s)	:	**CFR §2.1093**
Sample Received Date	:	**2019-08-01**
Date of Testing	:	**2019-08-09**
Issue Date	:	**2019-08-13**

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Tested By :

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Approved By :

Jung Wook Kim / Technical Manager

Revision history

Report No.	Reason for Change	Date Issued
OT-198-RWD-033	Initial release	2019-08-13

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1. Summary of Maximum SAR Value

Equipment Class	Band & Mode	Tx Frequency	SAR 1 g Body (W/kg)
DSS	2.4 GHz ISM Band	2402 ~ 2476 MHz	0.935
Simultaneous SAR per KDB 690783 D01v01r03:			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	Portable Conference Transceiver
FCC ID	CNMDLT400
Brand Name	Williams Sound, LLC
Model Name	DLT 400
Additional Model Name(s)	-
Antenna Type	Fixed Internal Antenna
DUT Stage	Identical Prototype

2.2. Device Overview

Band & Mode	Operating Modes	Tx Frequency
2.4 GHz ISM Band	Data	2402 ~ 2476 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 FSK Output Power

Mode / Band		Modulated Average (dBm)
2.4 GHz ISM Band	Maximum	18.0
	Nominal	17.5

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2.5. DUT Antenna Locations

This device is also operating at hand-held use near body. So, FCC KDB Publication 941225 D07 is apply to this condition. 1g SAR test is evaluated to some position (distance from to the edge/side is within 2.5 cm) at 0 mm. so 10g SAR is not required.

Table 2-1 Device Edges/Sides for SAR Testing

Mode	Top	Bottom	Front	Rear	Right	Left
2.4 GHz ISM Band (FSK)	Yes	No	Yes	Yes	Yes	Yes

Note: Particular DUT edges were not required to be evaluated for wireless router SAR or phablet SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D07 and October 2016 TCBC Workshop Note. The distances between the transmit antenna and the edges of the device are included in the filing.

2.6. Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 2-1 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

This device contains single transmitters that may not operate simultaneously, and therefore not requires a simultaneous transmission analysis.

Path 1

2.4 GHz ISM Band (FSK)

Figure 2-1 Simultaneous Transmission Paths

2.7. Miscellaneous SAR Test Considerations

(A) 2.4 GHz ISM Band (FSK)

The modulation type of this DUT is FSK and modulation technique is FHSS. The RF module supports from 2402 MHz to 2476 MHz for frequency hopping. (Total number of hopping channels: 16)

During the SAR test, hopping mode was disabled.

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2.8. Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D07v01r02 (UMPC Mini Tablet)
- 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 (SAR Testing for Non-Standard Form Factor Devices – SAR for Generic Device)

2.9. 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:

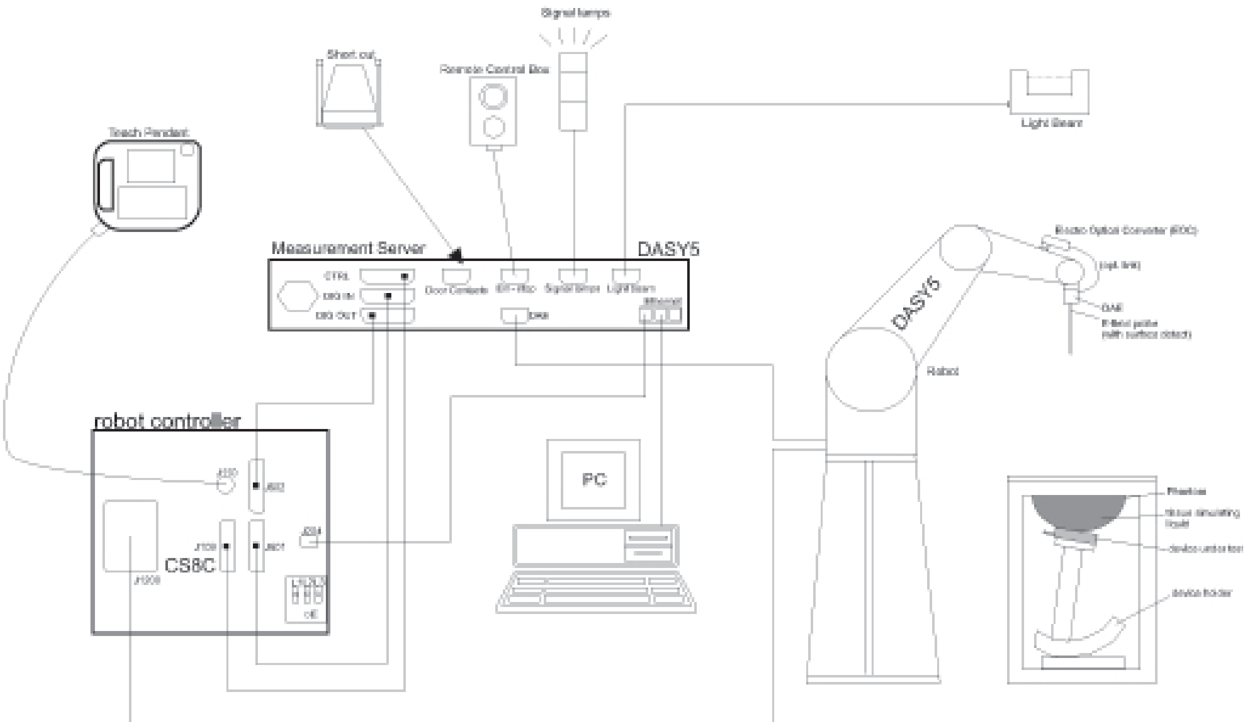
σ = conductivity of the tissue (S/m)
ρ = mass density of the tissue (kg/m^3)
E = rms electric field strength (V/m)

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

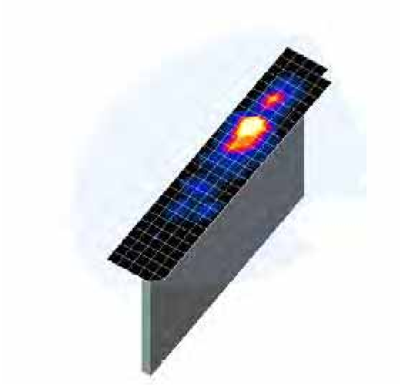
A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE). An isotropic Field probe optimized and calibrated for the targeted measurement. Data acquisition electronics (DAE) which performs the signal amplification, 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.



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	$\leq 1.5^*\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	$\leq 1.5^*\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	$\leq 1.5^*\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	$\leq 1.5^*\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	$\leq 1.5^*\Delta z_{zoom}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

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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. 2.4 GHz ISM Band Conducted Powers

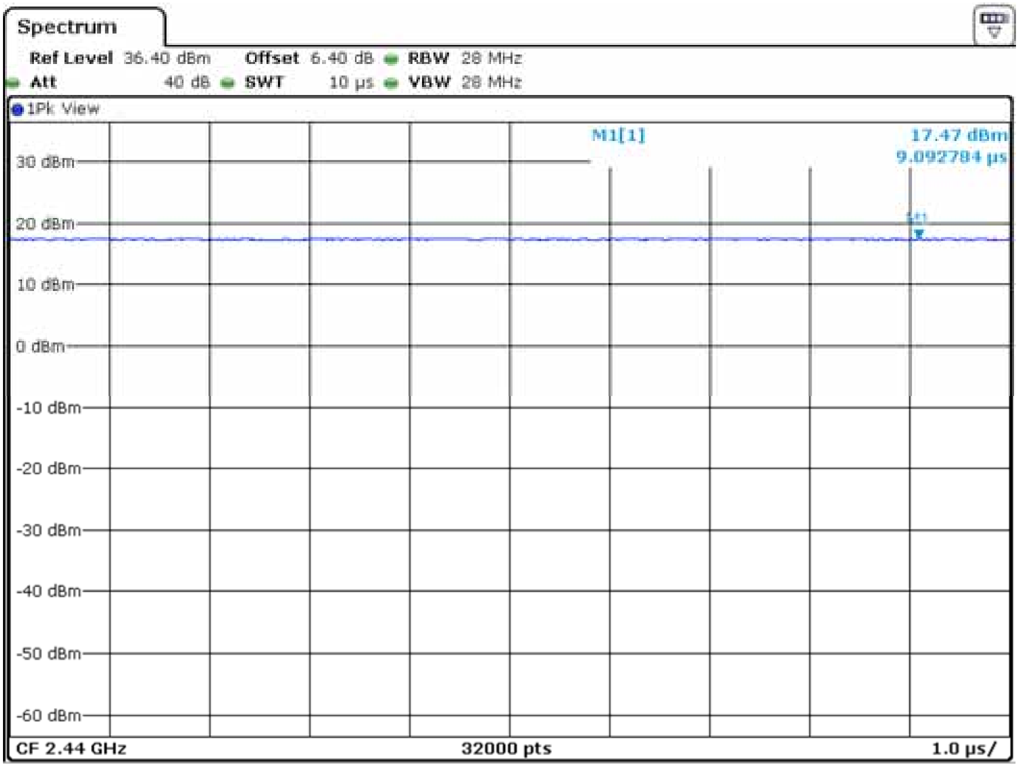
8.1.1. 2.4 GHz ISM Band

Table 8-1 2.4 GHz ISM Band Conducted Powers

Frequency [MHz]	Modulation	Channel No.	Average Conducted Power [dBm]	Average Conducted Power [mW]
2402	FSK	1	17.41	55.08
2440	FSK	2	**17.69**	**58.75**
2476	FSK	3	17.21	52.60

Note: The Bolded channel above were tested for SAR.

Figure 8-1 2.4 GHz ISM Band Transmission Plot



Equation 8-1 2.4 GHz ISM Band Duty Cycle Calculation

- DUTY cycle of this device is 100 %.
- DUTY Cycle [%] = (Pulse / Period) X 100 = (1/1) X 100 = 100 %

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9. SYSTEM VERIFICATION

9.1. Tissue Verification

Table 9-1 Measured Body 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
MSL2450	2450	21.7	2.019	50.705	1.95	52.7	3.54	-3.79	2019.08.09
	2402		1.957	50.838	1.89	52.8	3.54	-3.72	
	2440		2.005	50.726	1.94	52.7	3.35	-3.75	
	2476		2.050	50.640	1.98	52.7	3.54	-3.91	

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.

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	22.1	21.7	2019.08.09	Body	2450	100	49.80	5.08	50.80	2.01	716	3832

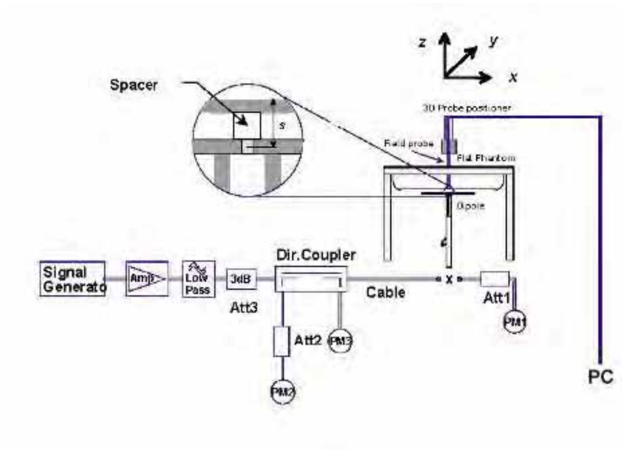

Figure 9-1 System Verification Setup Diagram and Photo

10. SAR TEST DATA SUMMARY

10.1. Standalone Body SAR Data

Table 10-1 2.4 GHz ISM Band Body SAR

Plot No.	Device Serial Number	Frequency		Band	Mode	Test Position	Separation Distance (cm)	Maximum Allowed Power (dBm)	Measured Conducted Power (dBm)	Duty Cycle	Scaling Factor (Duty Cycle)	Scaling Factor (Power)	Power Drift (dB)	Measured SAR 1 g (W/kg)	Reported SAR 1 g (W/kg)
		MHz	Ch.												
	SAR#1	2440	2	2.4 GHz Band	FSK	Top	0.5	18.0	17.69	100 %	1.000	1.074	-0.030	0.628	0.674
2	**SAR#1**	**2440**	**2**	**2.4 GHz Band**	**FSK**	**Front**	**0.5**	**18.0**	**17.69**	**100 %**	**1.000**	**1.074**	**0.180**	**0.871**	**0.935**
	SAR#1	2440	2	2.4 GHz Band	FSK	Rear	0.5	18.0	17.69	100 %	1.000	1.074	0.070	0.557	0.598
	SAR#1	2440	2	2.4 GHz Band	FSK	Right	0.5	18.0	17.69	100 %	1.000	1.074	0.040	0.016	0.017
	SAR#1	2440	2	2.4 GHz Band	FSK	Left	0.5	18.0	17.69	100 %	1.000	1.074	0.100	0.171	0.184
	SAR#1	2402	1	2.4 GHz Band	FSK	Front	0.5	18.0	17.41	100 %	1.000	1.146	-0.030	0.782	0.896
	SAR#1	2476	3	2.4 GHz Band	FSK	Front	0.5	18.0	17.21	100 %	1.000	1.199	-0.070	0.455	0.546
	SAR#1	2440	2	2.4 GHz Band	FSK	Front	0.5	18.0	17.69	100 %	1.000	1.074	-0.010	0.864	0.928
	SAR#1	2440	2	2.4 GHz Band	FSK	Front	0.5	18.0	17.69	100 %	1.000	1.074	0.050	0.662	0.711
ANSI / IEEE C95.1 1992 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population									**Body 1.6 W/kg (mW/g) Averaged over 1 gram**						

Note: Blue entry represents variability data. & Yellow entry is result of connecting headphone to DUT.

10.2. 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 5 mm was considered per FCC KDB Publication 447498 D01v06, 941225 D07.
7. Per FCC KDB Publication 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. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 11 for variability analysis.
8. The test was measured under the higher condition between the test result of the headphone connected to the DUT and the test result of the headphone not connected.

2.4 GHz ISM Band Notes:

1. This device does support FSK modulation for 2.4 GHz ISM Band. And 2.4 GHz ISM Band SAR was measured with hopping disabled.
2. Duty cycle of this device is 100 %. So, it was tested by 100 % duty cycle. See Section 8.1.1 for the time domain plot and calculation for the duty factor of the device.

11. SAR MEASUREMENT VARIABILITY

11.1. Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg.
5) When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

Table 11-1 Body SAR Measurement Variability Results

BODY VARIABLITY RESULTS													
Band	Frequency		Band	Mode	Test Position	Separation Distance (cm)	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
2450	2440	2	2.4 GHz Band	FSK	Front	0.5	0.871	0.864	1.01	N/A	N/A	N/A	N/A

11.2. Measurement Uncertainty

The measured SAR was < 1.5 W/kg for 1g and < 3.75 W/kg for 10g for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

12. 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	QD OVA 004 AA	ELI4 Phantom V8.0	N/A	N/A	N/A	TP-2056
Speag	MD4HHTV5	Mounting Device	N/A	N/A	N/A	N/A
Speag	EX3DV4	SAR Probe	2019-02-27	Annual	2020-02-27	3832
Speag	DAE4	Data Acquisition Electronics	2019-02-28	Annual	2020-02-28	557
Speag	D2450V2	Dipole Antenna	2019-05-28	Annual	2020-05-28	716
HP	8665B	RF Signal Generator	2018-08-28	Annual	2019-08-28	3744A01349
EMPOWER	BBS3Q7ECK-2001	RF Power Amplifier	2018-08-28	Annual	2019-08-28	1045D/C0536
Agilent	E4419B	Power Meter	2018-08-27	Annual	2019-08-27	MY45100284
Agilent	E4419B	Power Meter	2018-08-27	Annual	2019-08-27	MY45100286
HP	8481H	Power Sensor	2018-08-27	Annual	2019-08-27	3318A17600
HP	8481A	Power Sensor	2018-08-27	Annual	2019-08-27	US37290447
HP	8481A	Power Sensor	2018-08-27	Annual	2019-08-27	3318A89373
HP	11692D	Dual Directional Coupler	2018-08-27	Annual	2019-08-27	1212A05057
Bird	50-6A-MFN-30	Attenuator	2018-08-27	Annual	2019-08-27	N/A
HP	8491A	Attenuator	2018-08-28	Annual	2019-08-28	63272
WAINWRIGHT	WLJS3000-6EF	Low Pass Filter	2018-08-28	Annual	2019-08-28	1
Speag	DAK-3.5	Dielectric Assessment Kit	2018-11-20	Annual	2019-11-20	1140
Agilent	E8357A	Network Analyzer	2018-08-27	Annual	2019-08-27	US41070399
ROHDE & SCHWARZ	FSV30	SIGNAL ANALYZER	2018-08-23	Annual	2019-08-23	101372
LKM Electronic GmbH	DTM3000-Spezial	Hand-Held Thermometers	2018-08-28	Annual	2019-08-28	3247
CAS	TE-201	Temperature hygrometer	2018-08-28	Annual	2019-08-28	14011777-1
KIKUSHI	PAS40-9	DC POWER SUPPLY	2019-04-06	Annual	2020-04-06	QK000851

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.

13. 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	$U(PR_{PR})$	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	

14. CONCLUSION

14.1. 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.

14.2. 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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APPENDIX A: SYSTEM VERIFICATION

Test Laboratory: ONETECH CO., LTD. Lab Date: 8/9/2019

System Verification for 2450 MHz

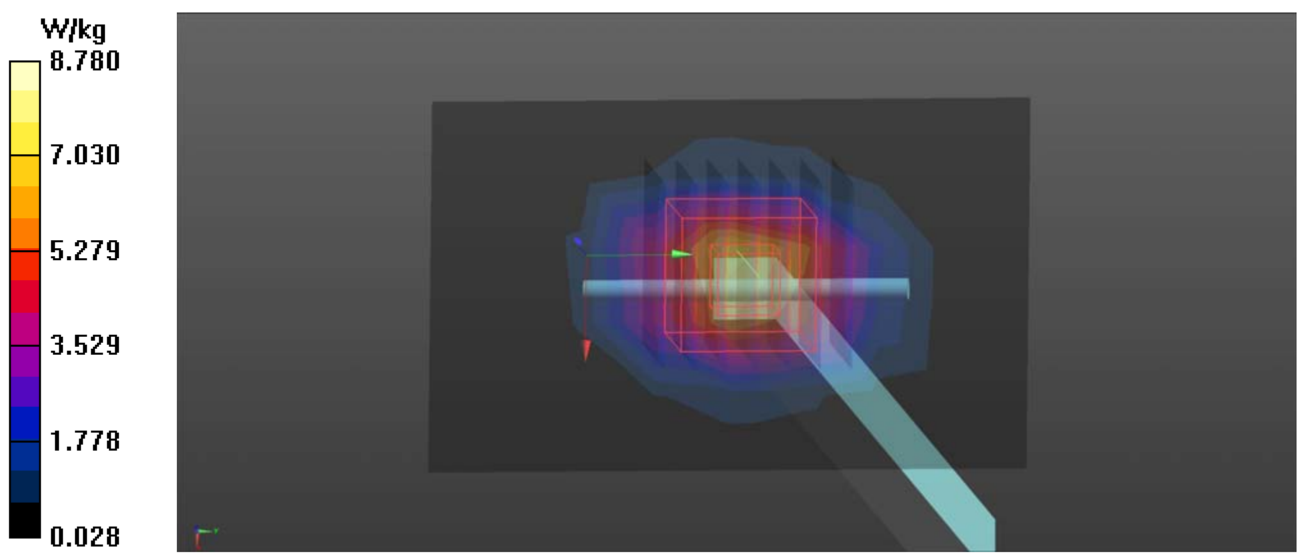
DUT: D2450V2 - SN:716

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL2450 Medium parameters used: f = 2450 MHz; σ = 2.019 S/m; ε_r = 50.705; ρ = 1000 kg/m^3
Ambient Temperature：22.1 ℃; Liquid Temperature：21.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3832; ConvF(7.19, 7.19, 7.19) @ 2450 MHz; Calibrated: 2/27/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn557; Calibrated: 2/28/2019
- Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1381
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

Pin=100mW/Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 6.79 W/kg

Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 72.28 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 11.2 W/kg
SAR(1 g) = 5.08 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 8.78 W/kg



APPENDIX B: SAR TEST DATA

Test Laboratory: ONETECH CO., LTD. Lab Date: 8/9/2019

P02_2.4 GHz Band_FSK_Front_0.5 cm_Ch.2

DUT: DLT 400

Communication System: 2.4 GHz ISM Band; Frequency: 2440 MHz;Duty Cycle: 1:1
Medium: MSL2450 Medium parameters used: f = 2440 MHz; σ = 2.005 S/m; ε_r = 50.726; ρ = 1000 kg/m^3
Ambient Temperature：22.1 °C; Liquid Temperature：21.7 °C

DASY5 Configuration:
- Probe: EX3DV4 - SN3832; ConvF(7.19, 7.19, 7.19) @ 2440 MHz; Calibrated: 2/27/2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn557; Calibrated: 2/28/2019
- Phantom: Twin-SAM V4.0; Type: QD 000 P40 CC; Serial: 1381
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

- Area Scan (9x14x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 1.41 W/kg

- Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.55 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 1.80 W/kg
SAR(1 g) = 0.871 W/kg; SAR(10 g) = 0.430 W/kg
Maximum value of SAR (measured) = 1.43 W/kg