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SAR EVALUATION REPORT

Applicant Name:
CAN Mobilities
119 Independence Dr
Menlo Park, CA 94025

Date of Testing:
09/22/2022 – 10/18/2022
Test Site/Location:
Element Washington DC LLC,
Columbia, MD, USA
Document Serial No.:
1M2205200062-01-R1.2AVFA

FCC ID:	**2AVFA-YESWECAN** (Contains FCC ID: 2AVFA-CANGO-4G-EC21)
APPLICANT:	**CAN MOBILITIES**

DUT Type: Smart Cane
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): CAN Go

Equipment Class	Band & Mode	Tx Frequency	SAR	
			1g Body (W/kg)	10g Extremity (W/kg)
PCB	LTE Band 12	699.7 - 715.3 MHz	0.17	< 0.1
PCB	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	1.44	< 0.1
PCB	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	1.37	< 0.1
DSS/DTS	Bluetooth Low Energy	2402 - 2480 MHz	< 0.1	< 0.1
Simultaneous SAR per KDB 690783 D01v01r03:			1.44	< 0.1

Note: This revised Test Report (S/N: 1M2205200062-01-R1.2AVFA) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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 1.9 of this report; for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

RJ Ortanez
Executive Vice President

The SAR Tick is an initiative of the Mobile & Wireless Forum (MWF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MWF. Further details can be obtained by emailing: sartick@mwfai.info.

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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
Bluetooth Low Energy	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

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

1.3 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 D01v06.

1.3.1 4G Output Power

Mode / Band	Target Type	Modulated Average Output Power (in dBm)
LTE Band 12	Max Allowed Power	17
	Nominal	15
LTE Band 4	Max Allowed Power	17
	Nominal	15
LTE Band 2	Max Allowed Power	17
	Nominal	15

1.3.2 2.4 GHz Maximum Bluetooth Low Energy Output Power

Mode	Modulated Average (dBm)	
	Maximum	Nomimal
Bluetooth LE 2Mbps	9	5
Bluetooth LE 1Mbps	9	5
Bluetooth LE 500kbps	9	5
Bluetooth LE 125kbps	9	5

1.4 DUT Antenna Locations

The overall dimensions of this device are > 9 x 5 cm. A diagram showing the location of the device antennas can be found in the DUT Antenna Diagram and SAR Test Setup Photographs Appendix.

Table 1-1
Device Edges/Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
LTE Band 12	No	No	Yes	No	Yes	Yes
LTE Band 4	No	No	Yes	No	Yes	Yes
LTE Band 2	No	No	Yes	No	Yes	Yes
Bluetooth Low Energy	No	No	Yes	No	Yes	Yes

Notes: Particular DUT sides and edges were tested according to an FCC KDB Inquiry. Per the KDB Inquiry, right and left sides were tested according to body SAR limits and the top edge was tested according to extremity SAR limits. The distances between the transmit antennas and the edges of the device are included in the filing.

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be operating simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Body Exposure	Extremity Exposure
1	LTE + 2.4 GHz Bluetooth Low Energy	Yes	Yes

1. This device supports VoLTE.

1.6 Miscellaneous SAR Test Considerations

(A) Licensed Transmitter(s)

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02r04.

1.7 Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 941225 D01v03r01, D05v02r04, D05Av01r02, D06v02r01 (2G/3G/4G and Hotspot)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)

1.8 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.

2 LTE INFORMATION

LTE Information					
Form Factor	Smart Cane				
	LTE Band 12 (699.7 - 715.3 MHz)				
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)				
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)				
	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
Channel Numbers and Frequencies (MHz)	Low	Low-Mid	Mid	Mid-High	High
LTE Band 12: 1.4 MHz	699.7 (23017)		707.5 (23095)	715.3 (23173)	
LTE Band 12: 3 MHz	700.5 (23025)		707.5 (23095)	714.5 (23165)	
LTE Band 12: 5 MHz	701.5 (23035)		707.5 (23095)	713.5 (23155)	
LTE Band 12: 10 MHz	704 (23060)		707.5 (23095)	711 (23130)	
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)		1732.5 (20175)	1754.3 (20393)	
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)		1732.5 (20175)	1753.5 (20385)	
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)		1732.5 (20175)	1752.5 (20375)	
LTE Band 4 (AWS): 10 MHz	1715 (20000)		1732.5 (20175)	1750 (20350)	
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)		1732.5 (20175)	1747.5 (20325)	
LTE Band 4 (AWS): 20 MHz	1720 (20050)		1732.5 (20175)	1745 (20300)	
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)		1880 (18900)	1909.3 (19193)	
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)		1880 (18900)	1908.5 (19185)	
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)		1880 (18900)	1907.5 (19175)	
LTE Band 2 (PCS): 10 MHz	1855 (18650)		1880 (18900)	1905 (19150)	
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)		1880 (18900)	1902.5 (19125)	
LTE Band 2 (PCS): 20 MHz	1860 (18700)		1880 (18900)	1900 (19100)	
UE Category	1				
Modulations Supported in UL	QPSK, 16QAM				
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES				
A-MPR (Additional MPR) disabled for SAR Testing?	YES				
LTE Carrier Aggregation Possible Combinations	This device does not support LTE Carrier Aggregation				
LTE Additional Information	This device does not support full CA features on 3GPP Release 15. All uplink communications are identical to the Release 8 Specifications. The following LTE Release 15 Features are not supported: Carrier Aggregation, Relay, HetNet, Enhanced MIMO, eICIC, WIFI Offloading, eMBMS, Cross-Carrier Scheduling, Enhanced SC-FDMA.				

3 INTRODUCTION

The FCC adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

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 [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] 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 (ρ). 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).

Equation 3-1
SAR Mathematical Equation

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

SAR is expressed in units of Watts per Kilogram (W/kg).

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

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = Total 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.[6]

4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

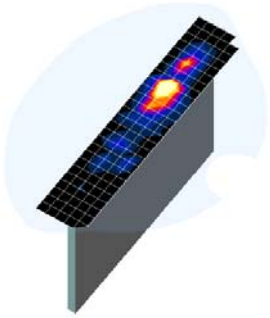

Figure 4-1
Sample SAR Area Scan

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 4-1) 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 point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR 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*Δz_{zoom}(n-1)	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*Δz_{zoom}(n-1)	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*Δz_{zoom}(n-1)	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*Δz_{zoom}(n-1)	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*Δz_{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 ε = 3 and loss tangent δ = 0.02.

5.2 Body Exposure Configurations

Body exposure operating configurations were tested according to the guidance in the KDB Inquiry and in order to address the condition wherein a user's upper thigh is exposed to the sides of the handle and/or upper shaft of the DUT. Per the guidance provided, the DUT was tested for both right and left sides. For each side, the DUT was positioned with 0 mm separation distance, i.e., touching, and with the transmitting antenna near the center of the flat section of the SAM phantom. See the KDB Inquiry and its attachment as well as the test setup photos for additional details.

5.3 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity-only exposure conditions, i.e., hands, wrists, feet, and ankles, may require extremity SAR evaluation. Per the guidance of the KDB Inquiry, extremity SAR is required for this device to address the condition wherein a user's hand is exposed to the top of the device. The top of the DUT was positioned with 0 mm separation distance, i.e., touching, and with the transmitting antenna near the center of the flat section of the SAM phantom. See the KDB Inquiry and its attachment as well as the test setup photos for additional details.

6 RF EXPOSURE LIMITS

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

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT *General Population* (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

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.

7.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01v03r01 “3G SAR Measurement Procedures.”

The device is placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. 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.

7.3 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r04 publication. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 or Anritsu MT8820C simulators are used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

7.3.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

7.3.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

7.3.3 A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

7.3.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r04:

a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
    i. The required channel and offset combination with the highest maximum output power is required for SAR.
    ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
    iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

8 RF CONDUCTED POWERS

8.1 LTE Conducted Powers

Note: Per FCC KDB Publication 941225 D05v02r05, LTE SAR for the lower bandwidths was not required for testing since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg.

Note: Some bands do not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

Note: This device only supports 1RB configurations in 16QAM modulation.

8.1.1 LTE Band 12

Table 8-1
LTE Band 12 Measured Maximum Average Power - 10 MHz Bandwidth

Modulation	RB Size	RB Offset	Mid Channel 23095 (707.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	16.15	0	0
	1	25	**16.30**		0
	1	49	16.08		0
	25	0	14.99	0-1	1
	25	12	**15.20**		1
	25	25	14.97		1
	50	0	14.85		1
16QAM	1	0	14.87	0-1	1
	1	25	15.76		1
	1	49	15.22		1

Table 8-2
LTE Band 12 Measured Maximum Average Power - 5 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 23035 (701.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23155 (713.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	16.13	16.15	16.18	0	0
	1	12	16.08	16.24	16.31		0
	1	24	16.05	16.09	16.10		0
	12	0	14.99	15.45	15.15	0-1	1
	12	6	14.83	15.68	15.19		1
	12	13	14.76	15.45	15.25		1
	25	0	14.89	15.35	15.23		1
16QAM	1	0	15.18	15.22	15.40	0-1	1
	1	12	15.19	15.36	15.31		1
	1	24	15.04	15.55	15.43		1

Table 8-3
LTE Band 12 Measured Maximum Average Power - 3 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 23025 (700.5 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23165 (714.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.99	16.22	16.22	0	0
	1	7	16.20	16.34	16.35		0
	1	14	16.13	16.17	16.23		0
	8	0	14.93	15.21	15.15	0-1	1
	8	4	14.95	15.36	15.26		1
	8	7	14.87	15.27	15.16		1
	15	0	15.05	15.31	15.15		1
16QAM	1	0	15.11	15.14	15.40	0-1	1
	1	7	15.06	15.34	15.36		1
	1	14	15.11	15.28	15.24		1

Table 8-4
LTE Band 12 Measured Maximum Average Power – 1.4 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 23017 (699.7 MHz)	Mid Channel 23095 (707.5 MHz)	High Channel 23173 (715.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	16.08	16.27	16.19	0	0
	1	2	16.16	16.19	16.24		0
	1	5	16.09	16.22	16.16		0
	3	0	15.95	16.06	16.12		0
	3	2	16.05	16.18	16.18		0
	3	3	16.06	16.16	16.23		0
	6	0	14.86	15.32	15.19	0-1	1
16QAM	1	0	15.10	15.29	15.33	0-1	1
	1	2	15.06	15.49	15.14		1
	1	5	15.33	15.34	15.38		1

8.1.2 LTE Band 4

Table 8-5
LTE Band 4 (AWS) Measured Maximum Average Power - 20 MHz Bandwidth

Modulation	RB Size	RB Offset	Mid Channel 20175 (1732.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	**16.49**	0	0
	1	50	15.77		0
	1	99	15.73		0
	50	0	**14.71**	0-1	1
	50	25	14.66		1
	50	50	14.59		1
	100	0	14.68		1
16QAM	1	0	14.71	0-1	1
	1	50	14.14		1
	1	99	14.29		1

Table 8-6
LTE Band 4 (AWS) Measured Maximum Average Power - 15 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 20025 (1717.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20325 (1747.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.41	16.00	15.34	0	0
	1	36	15.59	15.66	15.36		0
	1	74	15.57	15.72	15.68		0
	36	0	14.30	14.80	14.02	0-1	1
	36	18	14.60	14.54	14.29		1
	36	37	14.56	14.48	14.99		1
	75	0	14.37	14.49	14.27		1
16QAM	1	0	14.55	14.66	14.39	0-1	1
	1	36	14.75	14.48	14.42		1
	1	74	14.49	14.38	14.84		1

Table 8-7
LTE Band 4 (AWS) Measured Maximum Average Power - 10 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 20000 (1715.0 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20350 (1750.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.35	15.73	15.40	0	0
	1	25	15.45	15.36	15.68		0
	1	49	15.28	15.37	15.57		0
	25	0	14.10	14.21	14.50	0-1	1
	25	12	14.31	14.16	14.67		1
	25	25	14.40	14.10	14.96		1
	50	0	14.21	14.31	14.68		1
16QAM	1	0	14.27	14.47	13.96	0-1	1
	1	25	14.72	14.39	14.87		1
	1	49	14.56	14.09	14.70		1

Table 8-8
LTE Band 4 (AWS) Measured Maximum Average Power - 5 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 19975 (1712.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20375 (1752.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.61	15.61	15.74	0	0
	1	12	15.77	15.73	15.80		0
	1	24	15.68	15.35	15.88		0
	12	0	14.34	14.55	15.24	0-1	1
	12	6	14.58	14.53	15.56		1
	12	13	14.73	14.51	15.58		1
	25	0	14.60	14.58	15.52		1
16QAM	1	0	14.50	14.76	15.08	0-1	1
	1	12	14.67	14.56	15.42		1
	1	24	14.99	14.59	15.49		1

Table 8-9
LTE Band 4 (AWS) Measured Maximum Average Power - 3 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 19965 (1711.5 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20385 (1753.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.55	15.73	15.70	0	0
	1	7	15.69	15.62	15.84		0
	1	14	15.68	15.50	15.90		0
	8	0	14.22	14.73	15.56	0-1	1
	8	4	14.37	14.66	15.60		1
	8	7	14.54	14.56	15.56		1
	15	0	14.45	14.63	15.59		1
16QAM	1	0	14.32	14.58	15.60	0-1	1
	1	7	14.59	14.75	15.44		1
	1	14	14.60	14.39	15.32		1

Table 8-10
LTE Band 4 (AWS) Measured Maximum Average Power – 1.4 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 19957 (1710.7 MHz)	Mid Channel 20175 (1732.5 MHz)	High Channel 20393 (1754.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.62	15.55	16.28	0	0
	1	2	15.71	15.74	15.89		0
	1	5	15.59	15.65	15.82		0
	3	0	15.63	15.62	15.74		0
	3	2	15.54	15.59	15.88		0
	3	3	15.56	15.54	15.84		0
	6	0	14.47	14.63	15.47	0-1	1
16QAM	1	0	14.15	14.48	15.58	0-1	1
	1	2	14.57	14.49	15.67		1
	1	5	14.34	14.41	15.40		1

8.1.3 LTE Band 2

Table 8-11
LTE Band 2 (PCS) Measured Maximum Average Power - 20 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 18700 (1860.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19100 (1900.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.65	15.79	15.65	0	0
	1	50	**15.92**	15.74	15.85		0
	1	99	15.65	15.71	15.87		0
	50	0	**14.85**	14.72	14.50	0-1	1
	50	25	14.56	14.70	14.58		1
	50	50	14.58	14.64	14.74		1
	100	0	14.72	14.70	14.60		1
16QAM	1	0	14.62	14.59	14.55	0-1	1
	1	50	14.76	14.78	14.60		1
	1	99	14.59	14.45	14.81		1

Table 8-12
LTE Band 2 (PCS) Measured Maximum Average Power - 15 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 18675 (1857.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19125 (1902.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.55	15.54	15.57	0	0
	1	36	15.46	15.51	15.61		0
	1	74	15.68	15.50	15.74		0
	36	0	14.48	14.60	14.66	0-1	1
	36	18	14.53	14.53	14.67		1
	36	37	14.58	14.54	14.57		1
	75	0	14.45	14.55	14.72		1
16QAM	1	0	14.36	14.59	14.53	0-1	1
	1	36	14.58	14.45	14.73		1
	1	74	14.38	14.40	14.71		1

Table 8-13
LTE Band 2 (PCS) Measured Maximum Average Power - 10 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 18650 (1855.0 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19150 (1905.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.71	15.81	15.88	0	0
	1	25	15.90	15.74	16.12		0
	1	49	15.89	15.82	15.90		0
	25	0	14.67	14.78	14.69	0-1	1
	25	12	14.71	14.77	14.89		1
	25	25	14.68	14.83	15.00		1
	50	0	14.72	14.72	14.86		1
16QAM	1	0	14.55	14.65	14.64	0-1	1
	1	25	14.72	14.76	14.88		1
	1	49	14.84	14.61	14.82		1

Table 8-14
LTE Band 2 (PCS) Measured Maximum Average Power - 5 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 18625 (1852.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19175 (1907.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.76	15.78	15.83	0	0
	1	12	15.71	15.67	15.93		0
	1	24	15.55	15.74	15.91		0
	12	0	14.64	14.79	15.22	0-1	1
	12	6	14.68	14.72	14.99		1
	12	13	14.70	14.66	15.15		1
	25	0	14.66	14.68	15.11		1
16QAM	1	0	14.62	14.73	15.50	0-1	1
	1	12	14.60	14.88	15.17		1
	1	24	14.73	14.83	15.04		1

Table 8-15
LTE Band 2 (PCS) Measured Maximum Average Power - 3 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 18615 (1851.5 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19185 (1908.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.68	15.88	15.85	0	0
	1	7	15.63	15.87	15.88		0
	1	14	15.78	15.70	15.83		0
	8	0	14.67	14.69	14.88	0-1	1
	8	4	14.72	14.77	14.81		1
	8	7	14.65	14.73	14.72		1
	15	0	14.62	14.70	14.80		1
16QAM	1	0	14.41	15.06	15.28	0-1	1
	1	7	14.65	14.81	15.19		1
	1	14	14.50	14.87	15.13		1

Table 8-16
LTE Band 2 (PCS) Measured Maximum Average Power – 1.4 MHz Bandwidth

Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz)	Mid Channel 18900 (1880.0 MHz)	High Channel 19193 (1909.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	15.63	15.56	15.87	0	0
	1	2	15.73	15.79	15.75		0
	1	5	15.56	15.68	15.72		0
	3	0	15.64	15.59	15.77		0
	3	2	15.62	15.70	15.71		0
	3	3	15.66	15.66	15.78		0
	6	0	14.66	14.78	14.86	0-1	1
16QAM	1	0	14.67	14.68	14.80	0-1	1
	1	2	14.66	14.77	14.92		1
	1	5	14.57	14.69	14.78		1

8.2 Bluetooth Low Energy Conducted Powers

Table 8-17
Bluetooth Low Energy Maximum Average RF Power

Frequency [MHz]	Data Rate [Mbps]	BT Mode	Channel	Avg Conducted Power [dBm]
2402	0.125	LE	0	7.13
2440	0.125	LE	19	7.09
2480	0.125	LE	39	7.53
2402	0.5	LE	0	7.14
2440	0.5	LE	19	7.11
2480	0.5	LE	39	**7.54**
2402	1	LE	0	7.11
2440	1	LE	19	7.22
2480	1	LE	39	7.44
2402	2	LE	0	6.93
2440	2	LE	19	6.89
2480	2	LE	39	7.33

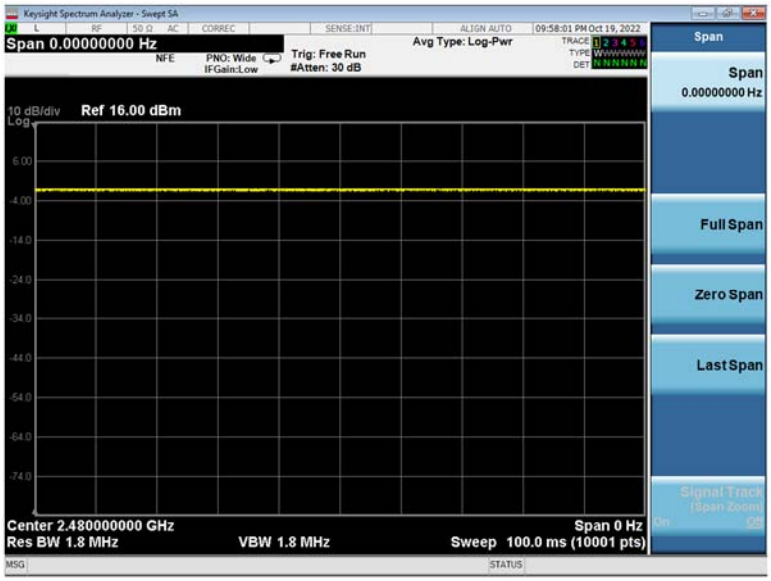

Figure 8-1
Bluetooth Antenna 1 Transmission Plot

Equation 8-1
Bluetooth Antenna 1 Duty Cycle Calculation

$$\boldsymbol{Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{100ms}{100ms} * 100\% = 100\%}$$

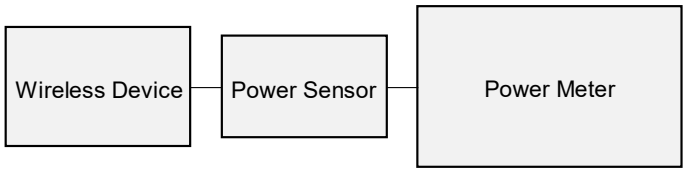

Figure 8-2
Power Measurement Setup

9 SYSTEM VERIFICATION

9.1 Tissue Verification

Table 9-1
Measured Body Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration ('C)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	Target Conductivity, σ (s/M)	Target Dielectric Constant, ε	% dev σ	% dev ε
10/18/2022	750 Body	23.5	695	0.921	54.986	0.959	55.745	-3.96%	-1.36%
			700	0.923	54.974	0.959	55.726	-3.75%	-1.35%
			710	0.927	54.948	0.960	55.687	-3.44%	-1.33%
			725	0.933	54.910	0.961	55.629	-2.91%	-1.29%
			750	0.942	54.853	0.964	55.531	-2.28%	-1.22%
10/18/2022	1750 Body	23.5	1710	1.415	53.234	1.463	53.537	-3.28%	-0.57%
			1720	1.422	53.223	1.469	53.511	-3.20%	-0.54%
			1745	1.440	53.192	1.485	53.445	-3.03%	-0.47%
			1750	1.444	53.184	1.488	53.432	-2.96%	-0.46%
			1770	1.457	53.147	1.501	53.379	-2.93%	-0.43%
10/18/2022	1900 Body	23.5	1850	1.506	53.035	1.520	53.300	-0.92%	-0.50%
			1860	1.513	53.023	1.520	53.300	-0.46%	-0.52%
			1880	1.526	53.003	1.520	53.300	0.39%	-0.56%
			1900	1.541	52.982	1.520	53.300	1.38%	-0.60%
			1905	1.544	52.976	1.520	53.300	1.58%	-0.61%
			1910	1.548	52.971	1.520	53.300	1.84%	-0.62%
09/22/2022	2450 Body	20.6	2400	1.957	51.697	1.902	52.767	2.89%	-2.03%
			2450	2.026	51.492	1.950	52.700	3.90%	-2.29%
			2480	2.069	51.402	1.993	52.662	3.81%	-2.39%

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 the SAR System Validation Appendix.

Table 9-2
System Verification Results – 1g

System Verification TARGET & MEASURED												
SAR System	Tissue Frequency (MHz)	Tissue Type	Date	Amb. Temp. (C)	Liquid Temp. (C)	Input Power (W)	Source SN	Probe SN	Measured SAR1g (W/kg)	1W Target SAR1g (W/kg)	1W Normalized SAR 1g (W/kg)	Deviation1g (%)
A	750	BODY	10/18/2022	22.9	23.4	0.20	1161	7718	1.760	8.79	8.800	0.11%
A	1750	BODY	10/18/2022	23.5	23.4	0.10	1150	7718	3.620	37.80	36.200	-4.23%
A	1900	BODY	10/18/2022	23.8	23.4	0.10	5d149	7718	3.890	40.40	38.900	-3.71%
A	2450	BODY	09/22/2022	24.4	21.5	0.10	719	7718	4.790	52.00	47.900	-7.88%

Table 9-3
System Verification Results – 10g

System Verification TARGET & MEASURED												
SAR System	Tissue Frequency (MHz)	Tissue Type	Date	Amb. Temp. (C)	Liquid Temp. (C)	Input Power (W)	Source SN	Probe SN	Measured SAR10g (W/kg)	1W Target SAR10g (W/kg)	1W Normalized SAR10g (W/kg)	Deviation10g (%)
A	750	BODY	10/18/2022	22.9	23.4	0.20	1161	7718	1.180	5.84	5.900	1.03%
A	1750	BODY	10/18/2022	23.5	23.4	0.10	1150	7718	1.970	20.00	19.700	-1.50%
A	1900	BODY	10/18/2022	23.8	23.4	0.10	5d149	7718	2.050	21.10	20.500	-2.84%
A	2450	BODY	09/22/2022	24.4	21.5	0.10	719	7718	2.230	24.70	22.300	-9.72%

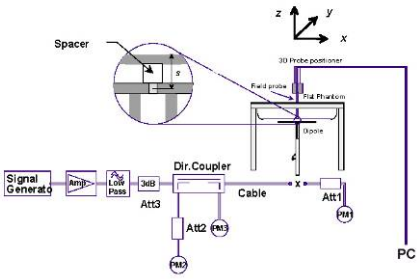

Figure 9-1
System Verification Setup Diagram

Figure 9-2
System Verification Setup Photo

10 SAR DATA SUMMARY

10.1 Standalone Body SAR Data

Table 10-1
LTE Band 12 Body SAR

MEASUREMENT RESULTS																				
FREQUENCY			Side	Spacing	Mode	Device Serial Number	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Maximum Allowed Power [dBm]	Conducted Power [dBm]	MPR [dB]	Power Drift [dB]	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	right	0 mm	LTE Band 12	22/410-1	10	QPSK	1	25	17.0	16.30	0	0.03	1:1	0.018	1.175	0.021	
707.50	23095	Mid	right	0 mm	LTE Band 12	22/410-1	10	QPSK	25	12	16.0	15.20	1	0.20	1:1	0.014	1.202	0.017	
707.50	23095	Mid	left	0 mm	LTE Band 12	22/410-1	10	QPSK	1	25	17.0	16.30	0	-0.20	1:1	0.143	1.175	0.168	A1
707.50	23095	Mid	left	0 mm	LTE Band 12	22/410-1	10	QPSK	25	12	16.0	15.20	1	0.00	1:1	0.111	1.202	0.133	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram												

Table 10-2
LTE Band 4 (AWS) Body SAR

MEASUREMENT RESULTS																				
FREQUENCY			Side	Spacing	Mode	Device Serial Number	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Maximum Allowed Power [dBm]	Conducted Power [dBm]	MPR [dB]	Power Drift [dB]	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	right	0 mm	LTE Band 4 (AWS)	22/410-1	20	QPSK	1	0	17.0	16.49	0	0.21	1:1	0.023	1.125	0.026	
1732.50	20175	Mid	right	0 mm	LTE Band 4 (AWS)	22/410-1	20	QPSK	50	0	16.0	14.71	1	-0.20	1:1	0.023	1.346	0.031	
1732.50	20175	Mid	left	0 mm	LTE Band 4 (AWS)	22/410-1	20	QPSK	1	0	17.0	16.49	0	0.13	1:1	1.280	1.125	**1.440**	A2
1732.50	20175	Mid	left	0 mm	LTE Band 4 (AWS)	22/410-1	20	QPSK	50	0	16.0	14.71	1	0.03	1:1	1.040	1.346	1.400	
1732.50	20175	Mid	left	0 mm	LTE Band 4 (AWS)	22/410-1	20	QPSK	100	0	16.0	14.68	1	0.02	1:1	1.030	1.355	1.396	
1732.50	20175	Mid	left	0 mm	LTE Band 4 (AWS)	22/410-1	20	QPSK	1	0	17.0	16.49	0	0.00	1:1	1.150	1.125	1.294	
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 measurement

Table 10-3
LTE Band 2 (PCS) Body SAR

MEASUREMENT RESULTS																				
FREQUENCY			Side	Spacing	Mode	Device Serial Number	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Maximum Allowed Power [dBm]	Conducted Power [dBm]	MPR [dB]	Power Drift [dB]	Duty Cycle	SAR (1g)	Scaling Factor	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	right	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	1	50	17.0	15.92	0	-0.20	1:1	0.029	1.282	0.037	
1860.00	18700	Low	right	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	50	0	16.0	14.85	1	-0.10	1:1	0.020	1.303	0.026	
1860.00	18700	Low	left	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	1	50	17.0	15.92	0	0.01	1:1	0.833	1.282	1.068	
1880.00	18900	Mid	left	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	1	50	17.0	15.74	0	0.18	1:1	0.929	1.337	1.242	A3
1900.00	19100	High	left	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	1	50	17.0	15.85	0	0.20	1:1	0.831	1.303	1.083	
1860.00	18700	Low	left	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	50	0	16.0	14.85	1	0.02	1:1	0.754	1.303	0.982	
1880.00	18900	Mid	left	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	50	0	16.0	14.72	1	0.03	1:1	0.710	1.343	0.954	
1900.00	19100	High	left	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	50	0	16.0	14.50	1	-0.01	1:1	0.763	1.413	1.078	
1860.00	18700	Low	left	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	100	0	16.0	14.72	1	0.00	1:1	0.691	1.343	0.928	
1880.00	18900	Mid	left	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	1	50	17.0	15.74	0	0.09	1:1	0.870	1.337	1.163	
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 measurement

Table 10-4
Bluetooth Low Energy Body SAR

MEASUREMENT RESULTS																	
FREQUENCY		Side	Spacing	Mode	Service	Device Serial Number	Data Rate (Mbps)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Maximum Duty Cycle (%)	Duty Cycle (%)	SAR (1g)	Scaling Factor (Cond Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												(W/kg)			(W/kg)	
2480	39	right	0 mm	BT LE	DSSS	22/1209-2	0.500	9.0	7.54	-0.06	100.00	100.00	0.000	1.400	1.000	0.000	
2480	39	left	0 mm	BT LE	DSSS	22/1209-2	0.500	9.0	7.54	-0.20	100.00	100.00	0.002	1.400	1.000	**0.003**	A4
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**								**Body** **1.6 W/kg (mW/g)** averaged over 1 gram									

10.2 Standalone Extremity SAR Data

Table 10-5
LTE Band 12 Extremity SAR

MEASUREMENT RESULTS																		
FREQUENCY			Side	Spacing	Mode	Device Serial Number	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Maximum Allowed Power [dBm]	Conducted Power [dBm]	MPR [dB]	Power Drift [dB]	Duty Cycle	SAR (10g)	Scaling Factor	Reported SAR (10g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
707.50	23095	Mid	top	0 mm	LTE Band 12	22/410-1	10	QPSK	1	25	17.0	16.30	0	-0.10	1:1	0.009	1.175	0.011	A5
707.50	23095	Mid	top	0 mm	LTE Band 12	22/410-1	10	QPSK	25	12	16.0	15.20	1	-0.16	1:1	0.008	1.202	0.010	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**								**Extremity** **4.0 W/kg (mW/g)** averaged over 10 grams										

Table 10-6
LTE Band 4 (AWS) Extremity SAR

MEASUREMENT RESULTS																		
FREQUENCY			Side	Spacing	Mode	Device Serial Number	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Maximum Allowed Power [dBm]	Conducted Power [dBm]	MPR [dB]	Power Drift [dB]	Duty Cycle	SAR (10g)	Scaling Factor	Reported SAR (10g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	top	0 mm	LTE Band 4 (AWS)	22/410-1	20	QPSK	1	0	17.0	16.49	0	0.15	1:1	0.017	1.125	**0.019**	A6
1732.50	20175	Mid	top	0 mm	LTE Band 4 (AWS)	22/410-1	20	QPSK	50	0	16.0	14.71	1	-0.07	1:1	0.016	1.346	**0.022**	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**								**Extremity** **4.0 W/kg (mW/g)** averaged over 10 grams										

Table 10-7
LTE Band 2 (PCS) Extremity SAR

MEASUREMENT RESULTS																		
FREQUENCY			Side	Spacing	Mode	Device Serial Number	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Maximum Allowed Power [dBm]	Conducted Power [dBm]	MPR [dB]	Power Drift [dB]	Duty Cycle	SAR (10g)	Scaling Factor	Reported SAR (10g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1860.00	18700	Low	top	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	1	50	17.0	15.92	0	0.20	1:1	0.009	1.282	0.012	A7
1860.00	18700	Low	top	0 mm	LTE Band 2 (PCS)	22/410-1	20	QPSK	50	0	16.0	14.85	1	-0.20	1:1	0.007	1.303	0.009	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**								**Extremity** **4.0 W/kg (mW/g)** averaged over 10 grams										

Table 10-8
Bluetooth Low Energy Extremity SAR

MEASUREMENT RESULTS																
FREQUENCY		Side	Spacing	Mode	Service	Device Serial Number	Data Rate (Mbps)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift	Maximum Duty Cycle (%)	Duty Cycle (%)	SAR (10g)	Scaling Factor (Cond Power)	Scaling Factor (Duty Cycle)	Reported SAR (10g)	Plot #
MHz	Ch.												(W/kg)			(W/kg)	
2480	39	top	0 mm	BT LE	DSSS	22/1209-2	0.500	9.0	7.54	0.07	100.00	100.00	0.000	1.400	1.000	**0.000**	A8
ANSI / IEEE C95.1 1992 - SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/General Population**								**Extremity** **4.0 W/kg (mW/g)** averaged over 10 grams									

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 mm was used according to an FCC KDB Inquiry.
7. Per FCC KDB 865664 D01v01r04, variability SAR tests were 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. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the 1g thresholds for the equivalent test cases.

LTE Notes:

1. LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r04. The general test procedures used for testing can be found in Section 7.3.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 and MCC=001 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

Bluetooth Notes

1. Bluetooth SAR was measured with the device transmitting via a manufacturer test mode. Per October 2016 TCB Workshop Notes, the reported SAR was scaled to the 100% transmission duty factor to determine compliance. See Section 9 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 VARIABILITY RESULTS													
Band	FREQUENCY		Mode	Service	Side	Spacing	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)	
1750	1732.50	20175	LTE Band 4 (AWS), 20 MHz Bandwidth	QPSK, 1 RB, 0 RB Offset	Left	0 mm	1.280	1.150	1.11	N/A	N/A	N/A	N/A
1900	1880.00	18900	LTE Band 2 (PCS), MHz Bandwidth	QPSK, 1 RB, 50 RB Offset	Left	0 mm	0.929	0.870	1.07	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram						

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 Number
Agilent	E4404B	Spectrum Analyzer	N/A	N/A	N/A	MY45113242
Agilent	E4438C	ESG Vector Signal Generator	2/14/2022	Annual	2/14/2023	MY42082385
Agilent	8753ES	S-Parameter Vector Network Analyzer	2/11/2022	Annual	2/11/2023	MY40003841
Agilent	8753ES	S-Parameter Vector Network Analyzer	12/17/2021	Annual	12/17/2022	MY40000670
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433974
Anritsu	ML2496A	Power Meter	3/31/2022	Annual	3/31/2023	1138001
Anritsu	ML2496A	Power Meter	3/29/2022	Annual	3/29/2023	1306009
Anritsu	MS2028C	Vector Network Analyzer	5/4/2022	Annual	5/4/2023	1204153
Anritsu	MA24106A	USB Power Sensor	6/1/2022	Annual	6/1/2023	1349514
Anritsu	MA24106A	USB Power Sensor	4/12/2022	Annual	4/12/2023	1244524
Anritsu	ML2496A	Power Meter	3/31/2022	Annual	3/31/2023	1138001
Anritsu	MA2411B	Pulse Power Sensor	3/2/2022	Annual	3/2/2023	1126066
Control Company	4353	Long Stem Thermometer	10/28/2020	Biennial	10/28/2022	200670623
Control Company	4040	Therm./ Clock/ Humidity Monitor	3/12/2021	Biennial	3/12/2023	210202100
Keysight Technologies	N6705B	DC Power Analyzer	5/5/2021	Triennial	5/5/2024	MY53004059
Keysight Technologies	N9020A	MXA Signal Analyzer	4/14/2022	Annual	4/14/2023	MY48010233
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini-Circuits	PWR-4GHS	Power Sensor	5/3/2022	Annual	5/3/2023	12108190029
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2050
Mitutoyo	500-196-30	CD-6"ASX 6Inch Digital Caliper	2/16/2022	Triennial	2/16/2025	A20238413
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE5011-1	Torque Wrench	12/21/2021	Biennial	12/21/2023	82475
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	4/8/2022	Annual	4/8/2023	162125
SPEAG	DAK-3.5	Dielectric Assessment Kit	1/6/2022	Annual	1/6/2023	1278
SPEAG	D1750V2	1750 MHz SAR Dipole	10/22/2021	Annual	10/22/2022	1150
SPEAG	D1900V2	1900 MHz SAR Dipole	9/21/2021	Biennial	9/21/2023	5d149
SPEAG	D750V3	750 MHz SAR Dipole	10/19/2021	Annual	10/19/2022	1161
SPEAG	D2450V2	2450 MHz SAR Dipole	8/18/2021	Biennial	8/18/2023	719
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/16/2022	Annual	3/16/2023	1368
SPEAG	EX3DV4	SAR Probe	3/11/2022	Annual	3/11/2023	7718
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1509

Note: 1) All equipment was used solely within its respective calibration period. 2) CBT (Calibrated 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.

13 MEASUREMENT UNCERTAINTIES

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c_i 1gm	c_i 10 gms	1gm u_i (± %)	10gms u_i (± %)	v_i
Measurement System									
Probe Calibration	E.2.1	7	N	1	1	1	7.0	7.0	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	E.2.3	2	R	1.732	1	1	1.2	1.2	∞
Linearity	E.2.4	0.3	N	1	1	1	0.3	0.3	∞
System Detection Limits	E.2.4	0.25	R	1.732	1	1	0.1	0.1	∞
Modulation Response	E.2.5	4.8	R	1.732	1	1	2.8	2.8	∞
Readout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time	E.2.7	0.8	R	1.732	1	1	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.732	1	1	1.5	1.5	∞
RF Ambient Conditions - Noise	E.6.1	3	R	1.732	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	3	R	1.732	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.732	1	1	0.5	0.5	∞
Probe Positioning w/ respect to Phantom	E.6.3	6.7	R	1.732	1	1	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	4	R	1.732	1	1	2.3	2.3	∞
Test Sample Related									
Test Sample Positioning	E.4.2	3.12	N	1	1	1	3.1	3.1	35
Device Holder Uncertainty	E.4.1	1.67	N	1	1	1	1.7	1.7	5
Output Power Variation - SAR drift measurement	E.2.9	5	R	1.732	1	1	2.9	2.9	∞
SAR Scaling	E.6.5	0	R	1.732	1	1	0.0	0.0	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	E.3.3	4.3	N	1	0.78	0.71	3.3	3.0	76
Liquid Permittivity - measurement uncertainty	E.3.3	4.2	N	1	0.23	0.26	1.0	1.1	75
Liquid Conductivity - Temperature Uncertainty	E.3.4	3.4	R	1.732	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	E.3.4	0.6	R	1.732	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)			RSS				12.2	12.0	191
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.4	24.0	

The above measurement uncertainties are according to IEEE Std. 1528-2013

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. [3]

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