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SAR EVALUATION REPORT

Applicant Name:
Motorola Solutions, Inc.
8000 West Sunrise Blvd
Ft Lauderdale FL
United States, 33322

Date of Testing:
04/07/23 – 04/20/23
Test Site/Location:
Element Washington DC LLC,
Columbia, MD, USA
Lab Code: 2451B
FCC Test Site: US1113
Document Serial No.:
1M2304040052-R2.AZ4

FCC ID:	**AZ499FT7164**
IC:	**109U-99FT7164**
APPLICANT:	**MOTOROLA SOLUTIONS, INC.**

DUT Type/Apparatus/Device:	Portable Body-Worn Camera
Application Type:	Certification
FCC Rule Part(s):	CFR §2.1093
IC Specification(s):	RSS-102 Issue 5 (March 2015), Health Canada Safety Code 6
Additional Standard(s)	IEC/IEEE 62209-1528:2020
Radio Equipment Type(s):	Cellular Communications Apparatus, Bluetooth, and Wi-Fi Device
FCC Model Number(s):	WGA00735, WGA00725, WGA00755, WGA00925, WGA01025
HVIN(s):	WGA00745, WGA00755, WGA00825
PMN:	V700
FVIN	1.0.0.56

Equipment Class	Band & Mode	Tx Frequency	SAR 1g Body-Worn (W/kg)
PCE	LTE Band 12	699.7 - 715.3 MHz	0.33
PCE	LTE Band 13	779.5 - 784.5 MHz	0.36
PCE	LTE Band 14	790.5 - 795.5 MHz	0.32
PCE	LTE Band 5 (Cell)	824.7 - 848.3 MHz	0.36
PCE	LTE Band 66 (AWS)	1710.7 - 1779.3 MHz	0.31
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	N/A
PCE	LTE Band 25 (PCS)	1850.7 - 1914.3 MHz	0.21
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	N/A
DTS	2.4 GHz WLAN	2412 - 2462 MHz	0.12
DSS/DTS	Bluetooth EDR/Bluetooth LE	2402 - 2480 MHz	< 0.1
Simultaneous SAR per KDB 690783 D01v01r03:			0.47

Note: This revised Test Report (S/N: 1M2304040052-R2.AZ4) 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.

LTE Band 4 is a subset of LTE Band 66 both LTE bands share the same transmission path and signal characteristics, SAR was only assessed for the band with the larger transmission frequency range.
LTE Band 2 is a subset of LTE Band 25 both LTE bands share the same transmission path and signal characteristics, SAR was only assessed for the band with the larger transmission frequency range.

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

CERT #2041.01

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	Data	699.7 - 715.3 MHz
LTE Band 13	Data	779.5 - 784.5 MHz
LTE Band 14	Data	790.5 - 795.5 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Data	1710.7 - 1779.3 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 25 (PCS)	Data	1850.7 - 1914.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
Bluetooth EDR/Bluetooth LE	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		Modulated Average Output Power (in dBm)
LTE FDD Band 12	Max allowed power	24.0
	Nominal	23.0
LTE FDD Band 13	Max allowed power	24.0
	Nominal	23.0
LTE FDD Band 14	Max allowed power	24.0
	Nominal	23.0
LTE FDD Band 5	Max allowed power	24.0
	Nominal	23.0
LTE FDD Band 4	Max allowed power	24.0
	Nominal	23.0
LTE FDD Band 66	Max allowed power	24.0
	Nominal	23.0
LTE FDD Band 2	Max allowed power	24.0
	Nominal	23.0
LTE FDD Band 25	Max allowed power	24.0
	Nominal	23.0

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1.3.2 2.4 GHz Maximum WLAN Output Power

Mode	Band	IEEE 802.11 (in dBm)					
		b		g		n	
		Nominal	Maximum	Nominal	Maximum	Nominal	Maximum
2.4 GHz WIFI	2.45 GHz	16.0	18.0	13.0	15.0	12.0	14.0

1.3.3 2.4 GHz Maximum Bluetooth Output Power

Mode	Single Antenna	
	Maximum	Nominal
Bluetooth/LE (in dBm)	9.0	7.0

1.4 DUT Antenna Locations

A diagram showing the location of the device antennas can be found in Appendix F.

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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 1-1
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Body
1	LTE + 2.4 GHz WLAN	Yes
2	LTE + 2.4 GHz Bluetooth EDR/Bluetooth LE	Yes

1. 2.4 GHz WLAN and 2.4 GHz Bluetooth EDR/Bluetooth LE share the same antenna path and cannot transmit simultaneously.

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 D05v02r05.

This device supports LTE capabilities with overlapping transmission frequency ranges. When the supported frequency range of an LTE Band falls completely within an LTE band with a larger transmission frequency range, both LTE bands have the same target power (or the band with the larger transmission frequency range has a higher target power), and both LTE bands share the same transmission path and signal characteristics, SAR was only assessed for the band with the larger transmission frequency range.

1.7 Guidance Applied

- IEC/IEEE 62209-1528:2020
- FCC KDB Publication 941225 D01v03r01, D05v02r05, D05Av01r02, D06v02r01 (4G)
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- RSS-102 Issue 5 (March 2015), Health Canada Safety Code 6

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 12.

1.9 Device Mount Types

Only one housing type, is available for this model. The device is only intended to be used in a mount with the back of the device toward the user. The device can be used with different mounts that contain metallic components. The mounts are divided into 3 groups of similar style mounts (WGP02697B, WGP03088), (WGP02798C, WGP03085) and (WGA00668, WGA00669). For each group the mount with the closest distance to the body was chosen for testing according to antenna location and the mount with the further distance from the body was tested on the worst-case measured SAR scenario from each transmitting antenna.

Table 1-2
Mount Groups and Testing Descriptions

Group	Mount	Distance from body licensed antenna (mm)	Distance from body unlicensed antenna (mm)	Mount tested for licensed antenna	Mount tested for unlicensed antenna
1	WGP02697B	17.02	20.99	WGP03088	WGP02697B
	WGP03088	15.53	26.60		
2	WGP02798C	12.15	12.74	WGP02798C	WGP02798C
	WGP03085	20.44	21.04		
3	WGA00668	16.41	16.86	WGA00668	WGA00668
	WGA00669	24.13	24.68		

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2 LTE INFORMATION

LTE Information					
Form Factor	Portable Body-Worn Camera				
Frequency Range of each LTE transmission band	LTE Band 12 (699.7 - 715.3 MHz)				
	LTE Band 13 (779.5 - 784.5 MHz)				
	LTE Band 14 (790.5 - 795.5 MHz)				
	LTE Band 5 (Cell) (824.7 - 848.3 MHz)				
	LTE Band 66 (AWS) (1710.7 - 1779.3 MHz)				
	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)				
	LTE Band 25 (PCS) (1850.7 - 1914.3 MHz)				
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)				
Channel Bandwidths	LTE Band 12: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 13: 5 MHz, 10 MHz				
	LTE Band 14: 5 MHz, 10 MHz				
	LTE Band 5 (Cell): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz				
	LTE Band 66 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz				
	LTE Band 25 (PCS): 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 13: 5 MHz	779.5 (23205)		782 (23230)		784.5 (23255)
LTE Band 13: 10 MHz	N/A		782 (23230)		N/A
LTE Band 14: 5 MHz	790.5 (23305)		793 (23330)		795.5 (23355)
LTE Band 14: 10 MHz	N/A		793 (23330)		N/A
LTE Band 5 (Cell): 1.4 MHz	824.7 (20407)		836.5 (20525)		848.3 (20643)
LTE Band 5 (Cell): 3 MHz	825.5 (20415)		836.5 (20525)		847.5 (20635)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)		836.5 (20525)		846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)		836.5 (20525)		844 (20600)
LTE Band 66 (AWS): 1.4 MHz	1710.7 (131979)		1745 (132322)		1779.3 (132665)
LTE Band 66 (AWS): 3 MHz	1711.5 (131987)		1745 (132322)		1778.5 (132657)
LTE Band 66 (AWS): 5 MHz	1712.5 (131997)		1745 (132322)		1777.5 (132647)
LTE Band 66 (AWS): 10 MHz	1715 (132022)		1745 (132322)		1775 (132622)
LTE Band 66 (AWS): 15 MHz	1717.5 (132047)		1745 (132322)		1772.5 (132597)
LTE Band 66 (AWS): 20 MHz	1720 (132072)		1745 (132322)		1770 (132572)
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 25 (PCS): 1.4 MHz	1850.7 (26047)		1882.5 (26365)		1914.3 (26683)
LTE Band 25 (PCS): 3 MHz	1851.5 (26055)		1882.5 (26365)		1913.5 (26675)
LTE Band 25 (PCS): 5 MHz	1852.5 (26065)		1882.5 (26365)		1912.5 (26665)
LTE Band 25 (PCS): 10 MHz	1855 (26090)		1882.5 (26365)		1910 (26640)
LTE Band 25 (PCS): 15 MHz	1857.5 (26115)		1882.5 (26365)		1907.5 (26615)
LTE Band 25 (PCS): 20 MHz	1860 (26140)		1882.5 (26365)		1905 (26590)
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	The technical description includes all the possible carrier aggregation combinations				
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 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. [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 SAR MEASUREMENT SETUP

4.1 Robotic System

Measurements are performed using the DASY5 automated dosimetric assessment system. The DASY5 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of a high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the SAM phantom containing the head or body equivalent material. The robot is a six-axis industrial robot, performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure 4-1).

4.2 System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the SAR Measurement Software DASY52, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, A/D conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal from the DAE and transfers data to the PC card.

4.3 System Electronics

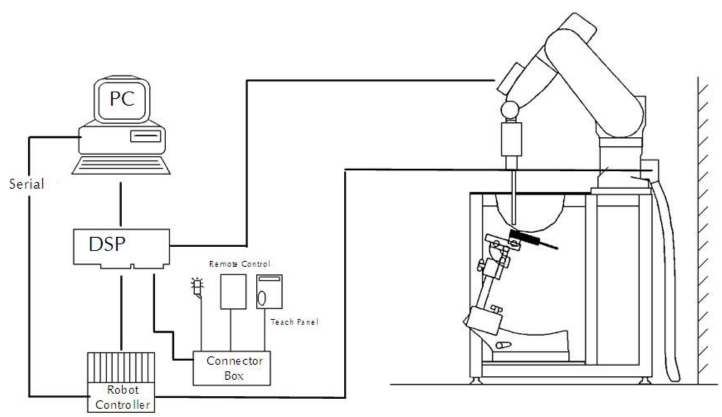

Figure 4-1
SAR Measurement System Setup

The DAE consists of a highly sensitive electrometer-grade auto-zeroing preamplifier, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

4.4 Automated Test System Specifications

Test Software:	SPEAG DASY52 version 52.8 Measurement Software and SPEAG DASY6 version 6.16 Measurement Software
Robot:	Stäubli Unimation Corp. Robot RX60L, Robot TX90XL
Repeatability:	0.02 mm
No. of Axes:	6

Data Acquisition Electronic System (DAE)

Data Converter

Features:	Signal Amplifier, multiplexer, A/D converter & control logic
Software:	SEMCAD X software
Connecting Lines:	Optical Downlink for data and status info Optical upload for commands and clock

PC Interface Card

Function:	Link to DAE 16-bit A/D converter for surface detection system Two Serial & Ethernet link to robotics Direct emergency stop output for robot

Phantom

Type:	SAM Twin Phantom (V4.0/5.0)/ ELI V4.0/5.0/6.0
Shell Material:	Composite
Thickness:	2.0 ± 0.2 mm

Figure 4-2
SAM Phantoms

The SAM Twin Phantom V4.0 and V5.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to represent the 90th percentile of the population. The phantom enables the dosimetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2 mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Figure 4-3
ELI Phantoms

ELI is constructed of a fiberglass shell and can be integrated into standard phantom tables. ELI Phantom is made for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC/IEEE 62209-1528:2020 standard and all known tissue simulating liquids. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The shell phantom has a 2 mm shell thickness.

5 DOSIMETRIC ASSESSMENT

5.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 62209-1528-2020:

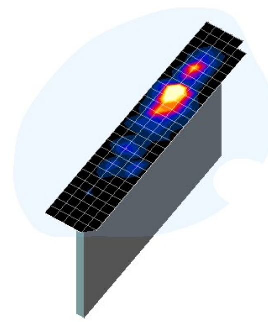

Figure 5-1
Sample SAR Area Scan

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 5-1) and IEEE 62209-1528-2020.
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 5-1) and IEEE 62209-1528-2020. 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 5-1. 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 5-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

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

*Also compliant to IEEE 62209-1528-2020 Table 3/4

6 DASY E-FIELD PROBE SYSTEM

6.1 Probe Measurement System

Figure 6-1
SAR System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration (see Figure 6-3) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY5 software reads the reflection during a software approach and looks for the maximum using a 2nd order curve fitting. The approach is stopped at reaching the maximum.

6.2 Probe Specifications

Model(s):	ES3DV2, ES3DV3, EX3DV4
Frequency Range:	10 MHz – 6.0 GHz (EX3DV4) 10 MHz – 4 GHz (ES3DV3, ES3DV2)
Calibration:	In head and body simulating tissue at Frequencies from 300 up to 6000MHz
Linearity:	± 0.2 dB (30 MHz to 6 GHz) for EX3DV4 ± 0.2 dB (30 MHz to 4 GHz) for ES3DV3, ES3DV2
Dynamic Range:	10 mW/kg – 100 W/kg
Probe Length:	330 mm
Probe Tip Length:	20 mm
Body Diameter:	12 mm
Tip Diameter:	2.5 mm for EX3DV4, 3.9mm for ES3DV3, ES3DV2
Tip-Center:	1 mm for EX3DV4, 2.0 mm for ES3DV3, ES3DV2

Figure 6-2
Near-Field Probe

Figure 6-3
Triangular Probe Configuration

7 TEST CONFIGURATION POSITIONS

7.1 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.
right while placed in this inclined position to the flat phantom.

7.2 Body-Worn Accessory Configurations

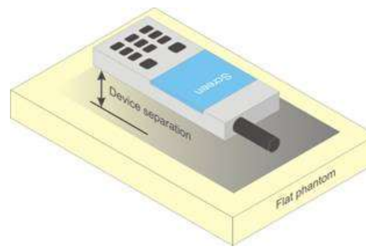

Figure 7-1
Sample Body-Worn Diagram

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 7-1). Per FCC KDB Publication 648474 D04v01r03, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

8 RF EXPOSURE LIMITS

8.1 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.

8.2 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

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.

9 FCC MEASUREMENT PROCEDURES

9.1 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.

9.2 SAR Measurement Conditions for LTE

LTE modes are tested according to FCC KDB 941225 D05v02r05 publication. The device was set to maximum power using testing software and a calibrated signal analyzer. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

9.2.1 Spectrum Plots for RB Configurations

Spectrum plots for RB configurations can be found in Appendix G.

9.2.2 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.

9.2.3 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r05:

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.

9.3 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

9.3.1 General Device Setup

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.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

9.3.2 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

2.4 GHz 802.11 g/n/ax OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

9.3.3 OFDM Transmission Mode and SAR Test Channel Selection

When the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, 802.11n and 802.11ac or 802.11g and 802.11n with the same channel bandwidth, modulation and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. Per April 2019 TCB Workshop guidance, 802.11ax was considered the highest order 802.11 mode. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

9.3.4 Initial Test Configuration Procedure

For OFDM, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order IEEE 802.11 mode. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 9.3.3). When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

9.3.5 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

10 RF CONDUCTED POWERS

10.1 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. Lower bandwidth conducted powers for all LTE bands can be found in the LTE and NR Lower Bandwidth Conducted Power Appendix.

Note: Some bands do not support three non-overlapping channels. Per KDB Publication 941225 D05v02r05., 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.

10.1.1 LTE Band 12

Table 10-1
LTE Band 12 Conducted Power - 10 MHz Bandwidth

LTE Band 12 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	22.43	0	0
	1	25	**22.87**		0
	1	49	22.63		0
	25	0	**21.98**	0-1	1
	25	12	21.87		1
	25	25	21.87		1
	50	0	21.94		1
16QAM	1	0	21.68	0-1	1
	1	25	22.15		1
	1	49	22.05		1
	25	0	21.31	0-2	2
	25	12	21.43		2
	25	25	21.33		2
	50	0	21.35		2

Table 10-2
LTE Band 12 Conducted Power - 5 MHz Bandwidth

LTE Band 12 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	23.28	23.04	23.25	0	0
	1	12	23.26	23.34	23.15		0
	1	24	23.26	22.93	22.95		0
	12	0	22.27	22.15	22.25	0-1	1
	12	6	22.15	22.28	22.36		1
	12	13	22.21	22.13	22.20		1
	25	0	22.27	22.25	22.25		1
16QAM	1	0	21.93	21.92	21.82	0-1	1
	1	12	21.96	21.94	22.10		1
	1	24	21.76	21.79	21.70		1
	12	0	21.59	21.34	21.28	0-2	2
	12	6	21.59	21.49	21.56		2
	12	13	20.97	21.31	21.48		2
	25	0	20.95	21.31	21.34		2

Table 10-3
LTE Band 12 Conducted Power - 3 MHz Bandwidth

LTE Band 12 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	23.19	23.23	23.21	0	0
	1	7	23.15	23.30	23.36		0
	1	14	23.05	23.25	23.11		0
	8	0	22.30	22.30	22.28	0-1	1
	8	4	22.25	22.28	22.31		1
	8	7	22.17	22.18	22.19		1
	15	0	22.07	22.19	22.20		1
16QAM	1	0	21.99	21.90	22.15	0-1	1
	1	7	22.03	22.01	22.55		1
	1	14	21.86	22.02	22.20		1
	8	0	21.53	21.28	21.29	0-2	2
	8	4	21.12	21.27	21.26		2
	8	7	21.24	21.03	21.21		2
	15	0	21.13	21.22	21.58		2

Table 10-4
LTE Band 12 Conducted Power – 1.4 MHz Bandwidth

LTE Band 12 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	23.12	23.20	23.27	0	0
	1	2	23.22	23.15	23.35		0
	1	5	23.34	23.36	23.07		0
	3	0	23.40	23.29	23.15		0
	3	2	23.48	23.47	23.25		0
	3	3	23.35	23.30	23.14		0
	6	0	22.20	22.37	22.24	0-1	1
16QAM	1	0	22.28	22.16	22.33	0-1	1
	1	2	22.05	22.16	22.12		1
	1	5	22.11	22.12	22.14		1
	3	0	22.34	22.05	22.24		1
	3	2	22.00	22.12	22.20		1
	3	3	22.03	22.01	22.24		1
	6	0	21.06	21.27	21.36	0-2	2

10.1.2 LTE Band 13

Table 10-5
LTE Band 13 Conducted Power - 10 MHz Bandwidth

LTE Band 13 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23230 (782.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.12	0	0
	1	25	**22.77**		0
	1	49	22.00		0
	25	0	21.48	0-1	1
	25	12	**21.63**		1
	25	25	21.57		1
	50	0	21.48		1
16QAM	1	0	21.56	0-1	1
	1	25	21.99		1
	1	49	21.75		1
	25	0	21.00	0-2	2
	25	12	20.99		2
	25	25	20.90		2
	50	0	20.96		2

Table 10-6
LTE Band 13 Conducted Power - 5 MHz Bandwidth

LTE Band 13 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23230 (782.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.26	0	0
	1	12	22.68		0
	1	24	22.69		0
	12	0	21.87	0-1	1
	12	6	21.92		1
	12	13	21.93		1
	25	0	21.98		1
16QAM	1	0	21.79	0-1	1
	1	12	21.89		1
	1	24	21.67		1
	12	0	21.24	0-2	2
	12	6	21.14		2
	12	13	20.92		2
	25	0	20.87		2

10.1.3 LTE Band 14

Table 10-7
LTE Band 14 Conducted Power - 10 MHz Bandwidth

LTE Band 14 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23330 (793.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	20.85	0	0
	1	25	**22.51**		0
	1	49	21.17		0
	25	0	**21.87**	0-1	1
	25	12	21.57		1
	25	25	21.62		1
	50	0	21.75		1
16QAM	1	0	21.05	0-1	1
	1	25	22.04		1
	1	49	21.09		1
	25	0	21.23	0-2	2
	25	12	21.00		2
	25	25	21.03		2
	50	0	21.01		2

Table 10-8
LTE Band 14 Conducted Power - 5 MHz Bandwidth

LTE Band 14 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 23330 (793.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.67	0	0
	1	12	22.89		0
	1	24	22.49		0
	12	0	22.05	0-1	1
	12	6	22.02		1
	12	13	22.06		1
	25	0	22.10		1
16QAM	1	0	21.80	0-1	1
	1	12	22.09		1
	1	24	21.65		1
	12	0	21.30	0-2	2
	12	6	21.12		2
	12	13	21.10		2
	25	0	21.06		2

10.1.4 LTE Band 5

Table 10-9
LTE Band 5 Conducted Power - 10 MHz Bandwidth

LTE Band 5 (Cell) 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 20525 (836.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.40	0	0
	1	25	**22.70**		0
	1	49	22.61		0
	25	0	21.78	0-1	1
	25	12	**21.91**		1
	25	25	21.80		1
	50	0	21.85		1
16QAM	1	0	21.79	0-1	1
	1	25	22.05		1
	1	49	21.87		1
	25	0	21.10	0-2	2
	25	12	21.26		2
	25	25	21.35		2
	50	0	21.08		2

Table 10-10
LTE Band 5 Conducted Power - 5 MHz Bandwidth

LTE Band 5 (Cell) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 20425 (826.5 MHz)	Mid Channel 20525 (836.5 MHz)	High Channel 20625 (846.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.99	23.14	22.80	0	0
	1	12	23.05	23.07	23.11		0
	1	24	22.81	22.95	23.07		0
	12	0	22.11	22.12	22.09	0-1	1
	12	6	22.25	22.26	22.17		1
	12	13	22.32	22.14	22.05		1
	25	0	22.13	22.12	22.23		1
16QAM	1	0	21.58	22.07	21.71	0-1	1
	1	12	22.32	22.22	22.35		1
	1	24	21.73	22.02	21.55		1
	12	0	21.01	21.01	21.24	0-2	2
	12	6	21.26	21.33	21.42		2
	12	13	21.19	21.00	21.15		2
	25	0	21.03	21.06	21.21		2

Table 10-11
LTE Band 5 Conducted Power - 3 MHz Bandwidth

LTE Band 5 (Cell) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20415 (825.5 MHz)	20525 (836.5 MHz)	20635 (847.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.90	23.09	22.92	0	0
	1	7	22.85	23.07	23.05		0
	1	14	23.04	23.12	23.10		0
	8	0	22.05	22.19	22.11	0-1	1
	8	4	22.14	22.17	21.87		1
	8	7	22.21	22.12	22.01		1
	15	0	22.16	22.22	22.28		1
16QAM	1	0	22.08	21.76	22.33	0-1	1
	1	7	21.83	22.14	21.85		1
	1	14	22.14	22.30	21.49		1
	8	0	20.91	21.11	21.10	0-2	2
	8	4	21.06	21.13	21.22		2
	8	7	21.02	21.31	21.19		2
	15	0	21.17	21.15	21.10		2

Table 10-12
LTE Band 5 Conducted Power – 1.4 MHz Bandwidth

LTE Band 5 (Cell) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			20407 (824.7 MHz)	20525 (836.5 MHz)	20643 (848.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.05	23.04	23.02	0	0
	1	2	23.05	23.01	23.05		0
	1	5	23.02	23.07	23.01		0
	3	0	23.17	23.27	23.24		0
	3	2	23.10	23.17	23.11		0
	3	3	23.09	23.24	23.04		0
	6	0	22.11	22.18	21.99	0-1	1
16QAM	1	0	22.24	21.77	21.96	0-1	1
	1	2	22.32	21.74	21.81		1
	1	5	21.77	21.79	21.92		1
	3	0	22.18	22.44	22.64		1
	3	2	22.24	22.61	22.15		1
	3	3	22.21	22.27	22.09		1
	6	0	20.97	20.86	21.02	0-2	2

10.1.5 LTE Band 66

Table 10-13
LTE Band 66 Conducted Power – 20 MHz Bandwidth

LTE Band 66 (AWS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			132072 (1720.0 MHz)	132322 (1745.0 MHz)	132572 (1770.0 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.30	22.15	22.38	0	0
	1	50	**23.03**	22.49	22.21		0
	1	99	22.82	22.17	22.34		0
	50	0	21.38	21.55	21.30	0-1	1
	50	25	21.35	21.34	21.39		1
	50	50	**21.60**	21.38	21.20		1
	100	0	21.48	21.50	21.38		1
16QAM	1	0	21.70	21.74	22.00	0-1	1
	1	50	21.82	21.74	21.65		1
	1	99	21.37	21.54	21.46		1
	50	0	20.95	20.92	20.77	0-2	2
	50	25	20.84	20.77	20.73		2
	50	50	20.93	20.76	20.56		2
	100	0	21.00	20.91	20.82		2

Table 10-14
LTE Band 66 Conducted Power – 15 MHz Bandwidth

LTE Band 66 (AWS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			132047 (1717.5 MHz)	132322 (1745.0 MHz)	132597 (1772.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.52	22.44	22.74	0	0
	1	36	22.83	22.85	22.82		0
	1	74	23.10	22.37	22.63		0
	36	0	21.88	21.92	21.69	0-1	1
	36	18	21.92	21.86	21.58		1
	36	37	22.08	21.78	21.68		1
	75	0	21.86	21.83	21.73		1
16QAM	1	0	21.55	21.71	22.02	0-1	1
	1	36	21.74	21.56	21.52		1
	1	74	21.91	21.68	21.58		1
	36	0	20.74	20.89	20.71	0-2	2
	36	18	20.92	20.82	20.74		2
	36	37	20.74	20.78	20.56		2
	75	0	20.94	20.97	20.74		2

Table 10-15
LTE Band 66 Conducted Power – 10 MHz Bandwidth

LTE Band 66 (AWS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 132022 (1715.0 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132622 (1775.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.72	22.52	22.62	0	0
	1	25	23.22	23.08	22.92		0
	1	49	22.81	22.32	22.84		0
	25	0	21.84	21.92	21.65	0-1	1
	25	12	21.91	21.88	21.69		1
	25	25	21.89	21.93	21.86		1
	50	0	21.97	21.89	21.68		1
16QAM	1	0	21.88	21.77	21.47	0-1	1
	1	25	21.96	21.83	22.31		1
	1	49	22.11	21.62	21.44		1
	25	0	20.98	20.92	20.78	0-2	2
	25	12	21.01	20.88	20.67		2
	25	25	20.97	20.99	20.84		2
	50	0	20.95	20.87	20.72		2

Table 10-16
LTE Band 66 Conducted Power – 5 MHz Bandwidth

LTE Band 66 (AWS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 131997 (1712.5 MHz)	Mid Channel 132322 (1745.0 MHz)	High Channel 132647 (1777.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	23.02	23.14	22.68	0	0
	1	12	23.11	22.80	22.83		0
	1	24	22.91	22.91	22.94		0
	12	0	21.97	21.85	21.66	0-1	1
	12	6	22.06	21.70	21.89		1
	12	13	21.96	21.90	21.92		1
	25	0	22.03	21.92	21.93		1
16QAM	1	0	21.64	21.75	21.70	0-1	1
	1	12	21.94	21.68	21.88		1
	1	24	21.82	21.42	21.67		1
	12	0	21.09	21.04	21.11	0-2	2
	12	6	20.97	20.98	20.98		2
	12	13	21.04	21.10	21.11		2
	25	0	20.99	20.94	20.98		2

Table 10-17
LTE Band 66 Conducted Power – 3 MHz Bandwidth

LTE Band 66 (AWS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			131987 (1711.5 MHz)	132322 (1745.0 MHz)	132657 (1778.5 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	23.02	23.11	23.03	0	0
	1	7	23.11	23.06	23.12		0
	1	14	22.78	22.87	22.67		0
	8	0	21.92	21.83	21.69	0-1	1
	8	4	21.88	21.78	21.52		1
	8	7	21.99	21.75	21.59		1
	15	0	21.97	21.82	21.62		1
16QAM	1	0	21.52	21.69	21.53	0-1	1
	1	7	21.83	21.98	22.09		1
	1	14	21.53	21.37	21.62		1
	8	0	20.62	20.86	20.91	0-2	2
	8	4	20.91	20.97	20.71		2
	8	7	20.99	20.81	20.68		2
	15	0	21.03	20.87	20.83		2

Table 10-18
LTE Band 66 Conducted Power – 1.4 MHz Bandwidth

LTE Band 66 (AWS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel	Mid Channel	High Channel	MPR Allowed per 3GPP [dB]	MPR [dB]
			131979 (1710.7 MHz)	132322 (1745.0 MHz)	132665 (1779.3 MHz)		
			Conducted Power [dBm]				
QPSK	1	0	22.53	22.78	22.63	0	0
	1	2	23.13	22.93	22.89		0
	1	5	22.89	22.97	22.64		0
	3	0	22.79	22.85	22.72		0
	3	2	22.89	22.77	22.83		0
	3	3	23.11	22.93	22.71		0
	6	0	21.93	21.72	21.82	0-1	1
16QAM	1	0	21.56	21.77	21.56	0-1	1
	1	2	21.64	22.09	21.42		1
	1	5	21.57	21.79	21.43		1
	3	0	21.63	21.93	21.65		1
	3	2	22.39	22.06	21.81		1
	3	3	21.71	21.89	21.79		1
	6	0	20.89	20.63	20.45	0-2	2

10.1.6 LTE Band 4

Table 10-19
LTE Band 4 Conducted Power – 20 MHz Bandwidth

LTE Band 4 (AWS) 20 MHz Bandwidth					
Modulation	RB Size	RB Offset	Low Channel 20175 (1720.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	21.10	0	0
	1	49	22.65		0
	1	99	21.27		0

Table 10-20
LTE Band 4 Conducted Power – 15 MHz Bandwidth

LTE Band 4 (AWS) 15 MHz Bandwidth					
Modulation	RB Size	RB Offset	Low Channel 20025 (1717.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	21.37	0	0
	1	37	22.00		0
	1	74	21.67		0

Table 10-21
LTE Band 4 Conducted Power – 10 MHz Bandwidth

LTE Band 4 (AWS) 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	Low Channel 20000 (1715.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	21.40	0	0
	1	24	22.41		0
	1	49	21.83		0

Table 10-22
LTE Band 4 Conducted Power – 5 MHz Bandwidth

LTE Band 4 (AWS) 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	Low Channel 19975 (1712.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.14	0	0
	1	12	22.29		0
	1	24	22.20		0

Table 10-23
LTE Band 4 Conducted Power – 3 MHz Bandwidth

LTE Band 4 (AWS) 3 MHz Bandwidth					
Modulation	RB Size	RB Offset	Low Channel 19965 (1711.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.17	0	0
	1	7	22.31		0
	1	14	22.17		0

Table 10-24
LTE Band 4 Conducted Power – 1.4 MHz Bandwidth

LTE Band 4 (AWS) 1.4 MHz Bandwidth					
Modulation	RB Size	RB Offset	Low Channel 19957 (1710.7 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.19	0	0
	1	2	22.18		0
	1	5	22.22		0

10.1.7 LTE Band 25

Table 10-25
LTE Band 25 Conducted Power - 20 MHz Bandwidth

LTE Band 25 (PCS) 20 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 26140 (1860.0 MHz)	Mid Channel 26365 (1882.5 MHz)	High Channel 26590 (1905.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.23	22.24	22.30	0	0
	1	50	**23.10**	22.92	22.71		0
	1	99	22.43	22.26	22.34		0
	50	0	22.11	21.66	21.70	0-1	1
	50	25	22.01	21.62	21.83		1
	50	50	**22.17**	21.60	21.47		1
	100	0	21.85	21.70	21.55		1
16QAM	1	0	21.74	21.73	21.80	0-1	1
	1	50	21.67	21.87	22.00		1
	1	99	21.97	21.95	21.99		1
	50	0	21.00	21.10	21.12	0-2	2
	50	25	21.05	21.08	20.88		2
	50	50	21.10	20.97	20.95		2
	100	0	21.20	21.24	21.15		2

Table 10-26
LTE Band 25 Conducted Power - 15 MHz Bandwidth

LTE Band 25 (PCS) 15 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 26115 (1857.5 MHz)	Mid Channel 26365 (1882.5 MHz)	High Channel 26615 (1907.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.26	22.35	22.83	0	0
	1	36	22.65	22.93	23.15		0
	1	74	22.39	22.27	22.93		0
	36	0	22.11	22.12	22.38	0-1	1
	36	18	22.14	22.07	22.09		1
	36	37	21.92	21.96	22.15		1
	75	0	22.06	22.02	22.21		1
16QAM	1	0	21.47	21.72	21.96	0-1	1
	1	36	21.75	21.97	21.87		1
	1	74	22.23	21.64	22.09		1
	36	0	20.96	21.13	21.31	0-2	2
	36	18	21.02	21.06	21.15		2
	36	37	21.08	21.02	21.17		2
	75	0	21.11	21.19	21.23		2

Table 10-27
LTE Band 25 Conducted Power - 10 MHz Bandwidth

LTE Band 25 (PCS) 10 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 26090 (1855.0 MHz)	Mid Channel 26365 (1882.5 MHz)	High Channel 26640 (1910.0 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.56	22.42	22.82	0	0
	1	25	22.34	22.35	22.34		0
	1	49	22.76	22.34	22.62		0
	25	0	22.10	22.13	22.12	0-1	1
	25	12	22.24	22.11	22.06		1
	25	25	22.13	22.06	22.11		1
	50	0	22.16	22.16	22.09		1
16QAM	1	0	21.67	21.82	22.31	0-1	1
	1	25	22.27	22.31	22.24		1
	1	49	21.82	21.86	22.25		1
	25	0	21.29	21.19	21.17	0-2	2
	25	12	21.32	21.34	21.27		2
	25	25	21.21	20.92	21.16		2
	50	0	21.06	20.98	20.95		2

Table 10-28
LTE Band 25 Conducted Power - 5 MHz Bandwidth

LTE Band 25 (PCS) 5 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 26065 (1852.5 MHz)	Mid Channel 26365 (1882.5 MHz)	High Channel 26665 (1912.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.73	22.82	23.21	0	0
	1	12	22.63	22.87	22.94		0
	1	24	22.57	22.41	23.52		0
	12	0	22.18	22.01	22.13	0-1	1
	12	6	22.35	22.26	22.34		1
	12	13	22.19	22.28	22.32		1
	25	0	21.36	22.31	22.37		1
16QAM	1	0	21.83	22.16	22.14	0-1	1
	1	12	21.71	22.11	22.15		1
	1	24	22.00	22.03	21.95		1
	12	0	21.16	21.15	21.22	0-2	2
	12	6	21.18	21.14	21.31		2
	12	13	21.08	21.06	21.62		2
	25	0	21.02	21.08	21.04		2

Table 10-29
LTE Band 25 Conducted Power - 3 MHz Bandwidth

LTE Band 25 (PCS) 3 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 26055 (1851.5 MHz)	Mid Channel 26365 (1882.5 MHz)	High Channel 26675 (1913.5 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.74	22.82	22.91	0	0
	1	7	22.77	23.11	23.51		0
	1	14	22.83	23.02	23.32		0
	8	0	22.42	22.35	22.13	0-1	1
	8	4	22.65	22.41	22.06		1
	8	7	22.71	22.03	22.14		1
	15	0	22.59	22.24	22.34		1
16QAM	1	0	21.86	21.75	21.96	0-1	1
	1	7	21.93	22.65	22.62		1
	1	14	21.84	22.09	22.17		1
	8	0	20.80	21.19	21.04	0-2	2
	8	4	20.74	21.13	21.09		2
	8	7	20.83	21.11	21.22		2
	15	0	20.87	21.48	21.43		2

Table 10-30
LTE Band 25 Conducted Power – 1.4 MHz Bandwidth

LTE Band 25 (PCS) 1.4 MHz Bandwidth							
Modulation	RB Size	RB Offset	Low Channel 26047 (1850.7 MHz)	Mid Channel 26365 (1882.5 MHz)	High Channel 26683 (1914.3 MHz)	MPR Allowed per 3GPP [dB]	MPR [dB]
			Conducted Power [dBm]				
QPSK	1	0	22.83	22.76	23.40	0	0
	1	2	22.86	22.78	23.21		0
	1	5	22.91	22.62	23.09		0
	3	0	22.61	22.77	23.03		0
	3	2	22.56	22.76	23.12		0
	3	3	22.72	22.77	23.01		0
	6	0	21.70	21.80	21.96	0-1	1
16QAM	1	0	21.88	21.87	21.53	0-1	1
	1	2	21.64	21.75	22.11		1
	1	5	21.84	21.69	21.94		1
	3	0	21.81	22.20	21.89		1
	3	2	21.94	21.89	22.31		1
	3	3	21.74	22.14	21.96		1
	6	0	20.85	20.87	21.04	0-2	2

10.1.8 LTE Band 2

Table 10-31
LTE Band 2 Conducted Power - 20 MHz Bandwidth

LTE Band 2 (PCS) 20 MHz Bandwidth					
Modulation	RB Size	RB Offset	Mid Channel 18900 (1880.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.00	0	0
	1	49	22.43		0
	1	99	21.41		0

Table 10-32
LTE Band 2 Conducted Power - 15 MHz Bandwidth

LTE Band 2 (PCS) 15 MHz Bandwidth					
Modulation	RB Size	RB Offset	High Channel 19125 (1902.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.35	0	0
	1	37	22.45		0
	1	74	21.91		0

Table 10-33
LTE Band 2 Conducted Power - 10 MHz Bandwidth

LTE Band 2 (PCS) 10 MHz Bandwidth					
Modulation	RB Size	RB Offset	High Channel 19150 (1905.0 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.68	0	0
	1	24	22.33		0
	1	49	21.88		0

Table 10-34
LTE Band 2 Conducted Power - 5 MHz Bandwidth

LTE Band 2 (PCS) 5 MHz Bandwidth					
Modulation	RB Size	RB Offset	High Channel 19175 (1907.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.15	0	0
	1	12	22.59		0
	1	24	22.36		0

Table 10-35
LTE Band 2 Conducted Power - 3 MHz Bandwidth

LTE Band 2 (PCS) 3 MHz Bandwidth					
Modulation	RB Size	RB Offset	High Channel 19185 (1908.5 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.51	0	0
	1	7	22.67		0
	1	14	22.36		0

Table 10-36
LTE Band 2 Conducted Power – 1.4 MHz Bandwidth

LTE Band 2 (PCS) 1.4 MHz Bandwidth					
Modulation	RB Size	RB Offset	Low Channel 18607 (1850.7 MHz) Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
QPSK	1	0	22.39	0	0
	1	2	22.55		0
	1	5	22.37		0

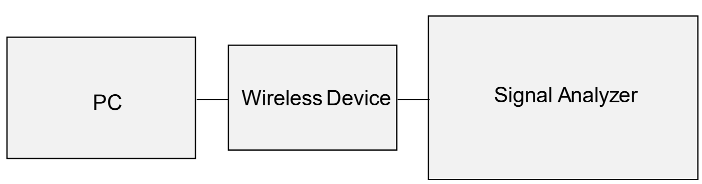

Figure 10-1
Power Measurement Setup – LTE

10.2 WLAN Conducted Powers

Table 10-37
2.4 GHz WLAN Maximum Average RF Power

2.4GHz Conducted Power [dBm]				
Freq [MHz]	Channel	IEEE Transmission Mode		
		802.11b	802.11g	802.11n
		Average	Average	Average
2412	1	16.09	12.18	9.31
2437	6	16.03	11.99	10.84
2462	11	16.02	11.88	10.66

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.

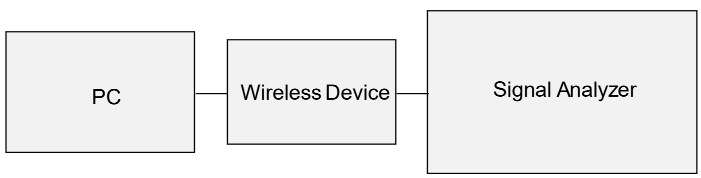

Figure 10-2
Power Measurement Setup

10.3 Bluetooth Conducted Powers

Table 10-38
Bluetooth Maximum Average RF Power

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
			[dBm]	[mW]
2402	1.0	0	7.24	5.292
2441	1.0	39	7.57	5.720
2480	1.0	78	7.22	5.272
2402	2.0	0	5.83	3.827
2441	2.0	39	5.63	3.657
2480	2.0	78	5.11	3.246
2402	3.0	0	6.27	4.239
2441	3.0	39	5.98	3.962
2480	3.0	78	5.43	3.494

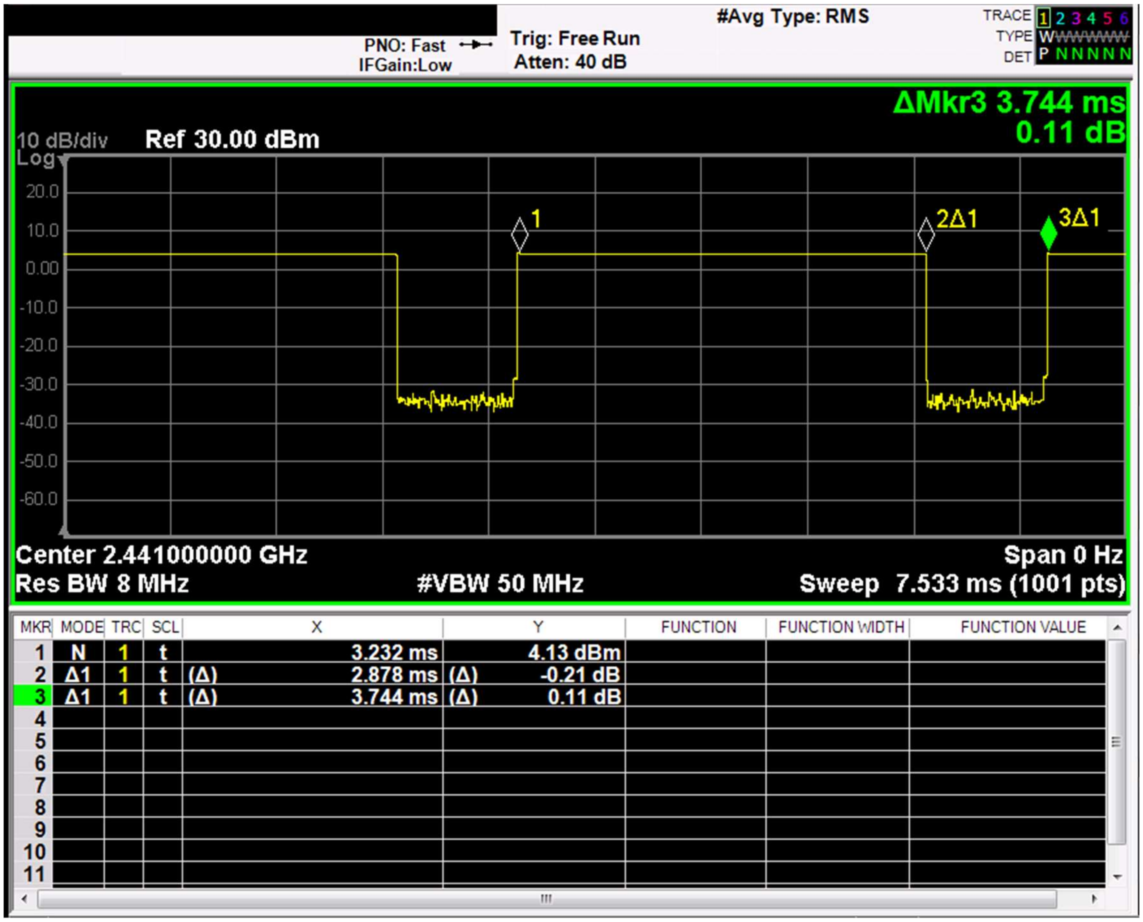

Figure 10-3
Bluetooth Transmission Plot

Equation 10-1
Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.878ms}{3.744ms} * 100\% = 76.9\%$$

*

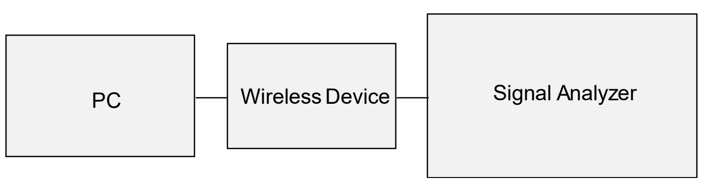

Figure 10-4
Power Measurement Setup

11 SYSTEM VERIFICATION

11.1 Tissue Verification

Table 11-1
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
04/10/2023	750 Body	20.5	680	0.933	55.870	0.958	55.804	-2.61%	0.12%
			695	0.939	55.868	0.959	55.745	-2.09%	0.22%
			700	0.940	55.860	0.959	55.726	-1.98%	0.24%
			710	0.943	55.830	0.960	55.687	-1.77%	0.26%
			725	0.947	55.764	0.961	55.629	-1.46%	0.24%
			750	0.955	55.676	0.964	55.531	-0.93%	0.26%
			770	0.963	55.649	0.965	55.453	-0.21%	0.35%
			785	0.970	55.631	0.966	55.395	0.41%	0.43%
			800	0.976	55.602	0.967	55.336	0.93%	0.48%
04/07/2023	835 Body	20.3	815	0.936	55.980	0.968	55.271	-3.31%	1.28%
			820	0.938	55.970	0.969	55.258	-3.20%	1.29%
			835	0.945	55.943	0.970	55.200	-2.58%	1.35%
			850	0.951	55.923	0.988	55.154	-3.74%	1.39%
04/12/2023	1750 Body	19.5	1710	1.448	52.362	1.463	53.537	-1.03%	-2.19%
			1720	1.455	52.343	1.469	53.511	-0.95%	-2.18%
			1745	1.473	52.303	1.485	53.445	-0.81%	-2.14%
			1750	1.477	52.295	1.488	53.432	-0.74%	-2.13%
			1770	1.492	52.272	1.501	53.379	-0.60%	-2.07%
			1790	1.506	52.245	1.514	53.326	-0.53%	-2.03%
04/12/2023	1900 Body	19.5	1850	1.549	52.165	1.520	53.300	1.91%	-2.13%
			1860	1.556	52.156	1.520	53.300	2.37%	-2.15%
			1880	1.571	52.124	1.520	53.300	3.36%	-2.21%
			1900	1.587	52.098	1.520	53.300	4.41%	-2.26%
			1905	1.591	52.093	1.520	53.300	4.67%	-2.26%
			1910	1.596	52.090	1.520	53.300	5.00%	-2.27%
04/07/2023	2450 Body	20.3	2300	1.896	53.603	1.809	52.900	4.81%	1.33%
			2310	1.906	53.596	1.816	52.887	4.96%	1.34%
			2320	1.916	53.591	1.826	52.873	4.93%	1.36%
			2400	1.989	53.478	1.902	52.767	4.57%	1.35%
			2450	2.040	53.416	1.950	52.700	4.62%	1.36%
			2480	2.066	53.364	1.993	52.662	3.66%	1.33%
			2500	2.084	53.320	2.021	52.636	3.12%	1.30%
			2510	2.094	53.299	2.035	52.623	2.90%	1.28%
			2535	2.122	53.255	2.071	52.592	2.46%	1.26%
			2550	2.138	53.237	2.092	52.573	2.20%	1.26%
			2560	2.148	53.223	2.106	52.560	1.99%	1.26%
			2600	2.185	53.149	2.163	52.509	1.02%	1.22%
			2650	2.236	53.057	2.234	52.445	0.09%	1.17%
			2680	2.267	53.022	2.277	52.407	-0.44%	1.17%
			2700	2.284	52.993	2.305	52.382	-0.91%	1.17%

Note: All frequencies were measured to be within 5% of targets listed in IEC/IEEE 62209-1528:2020 (Head) and RSS 102, Annex D (Body). Per IEC/IEEE 62209-1528:2020, since the dielectric properties of the tissue simulating are all equal or less than 5% of the target values, SAR was not scaled. The measurement uncertainty of 5% for deviation of conductivity and liquid permittivity from the target was added to the uncertainty budget in Section 14.2

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 62209-1528-2020 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.

11.2 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 E.

Table 11-2
System Verification Results

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	DAE	Measured SAR 1g (W/kg)	1W Target SAR 1g (W/kg)	1W Normalized SAR 1g (W/kg)	Deviation 1g (%)	Measured SAR 10g (W/kg)	1W Target SAR 10g (W/kg)	1W Normalized SAR 10g (W/kg)	Deviation 10g (%)
O	750	BODY	04/10/2023	23.1	20.5	0.20	1161	7570	1558	1.690	8.790	8.450	-3.87%	1.130	5.840	5.650	-3.25%
O	835	BODY	04/07/2023	22.3	20.5	0.20	4d132	7570	1558	2.040	9.810	10.200	3.98%	1.340	6.440	6.700	4.04%
O	1750	BODY	04/12/2023	22.3	19.5	0.10	1008	7570	1558	3.800	37.800	38.000	0.53%	2.010	19.900	20.100	1.01%
O	1900	BODY	04/12/2023	22.3	19.5	0.10	5d149	7570	1558	4.270	40.400	42.700	5.69%	2.210	21.100	22.100	4.74%
O	2450	BODY	04/07/2023	22.3	20.5	0.10	981	7570	1558	4.850	50.300	48.500	-3.58%	2.240	23.700	22.400	-5.49%

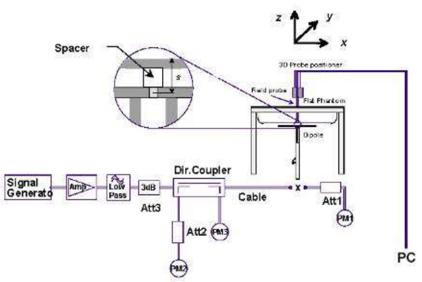

Figure 11-1
System Verification Setup Diagram

Figure 11-2
System Verification Setup Photo

12 SAR DATA SUMMARY

12.1 Standalone Body-Worn SAR Data

Table 12-1
LTE Band 12 Body-Worn SAR

MEASUREMENT RESULTS																				
FREQUENCY			Side	Spacing	Mode	Mount Type	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	back	0 mm	LTE Band 12	WGP03088	BWL7-000995	10	QPSK	1	25	24.0	22.87	0	0.11	1:1	0.154	1.297	0.200	
707.50	23095	Mid	back	0 mm	LTE Band 12	WGP02798C	BWL7-000995	10	QPSK	1	25	24.0	22.87	0	0.00	1:1	0.198	1.297	0.257	
707.50	23095	Mid	back	0 mm	LTE Band 12	WGA00668	BWL7-000995	10	QPSK	1	25	24.0	22.87	0	-0.05	1:1	0.255	1.297	0.331	A1
707.50	23095	Mid	back	0 mm	LTE Band 12	WGP03088	BWL7-000995	10	QPSK	25	0	23.0	21.98	1	0.06	1:1	0.118	1.265	0.149	
707.50	23095	Mid	back	0 mm	LTE Band 12	WGP02798C	BWL7-000995	10	QPSK	25	0	23.0	21.98	1	0.06	1:1	0.147	1.265	0.186	
707.50	23095	Mid	back	0 mm	LTE Band 12	WGA00668	BWL7-000995	10	QPSK	25	0	23.0	21.98	1	0.05	1:1	0.190	1.265	0.240	
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 12-2
LTE Band 13 Body-Worn SAR

MEASUREMENT RESULTS																				
FREQUENCY			Side	Spacing	Mode	Mount Type	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)	
782.00	23230	Mid	back	0 mm	LTE Band 13	WGP03088	BWL7-000995	10	QPSK	1	25	24.0	22.75	0	0.04	1:1	0.188	1.334	0.251	
782.00	23230	Mid	back	0 mm	LTE Band 13	WGP02798C	BWL7-000995	10	QPSK	1	25	24.0	22.75	0	-0.10	1:1	0.212	1.334	0.283	
782.00	23230	Mid	back	0 mm	LTE Band 13	WGA00668	BWL7-000995	10	QPSK	1	25	24.0	22.75	0	0.12	1:1	0.268	1.334	0.358	A2
782.00	23230	Mid	back	0 mm	LTE Band 13	WGP02697B	BWL7-000995	10	QPSK	1	25	24.0	22.75	0	-0.13	1:1	0.204	1.334	0.272	
782.00	23230	Mid	back	0 mm	LTE Band 13	WGP03085	BWL7-000995	10	QPSK	1	25	24.0	22.75	0	0.05	1:1	0.132	1.334	0.176	
782.00	23230	Mid	back	0 mm	LTE Band 13	WGA00669	BWL7-000995	10	QPSK	1	25	24.0	22.75	0	0.06	1:1	0.132	1.334	0.176	
782.00	23230	Mid	back	0 mm	LTE Band 13	WGP03088	BWL7-000995	10	QPSK	25	12	23.0	21.63	1	0.00	1:1	0.156	1.371	0.214	
782.00	23230	Mid	back	0 mm	LTE Band 13	WGP02798C	BWL7-000995	10	QPSK	25	12	23.0	21.63	1	0.01	1:1	0.182	1.371	0.250	
782.00	23230	Mid	back	0 mm	LTE Band 13	WGA00668	BWL7-000995	10	QPSK	25	12	23.0	21.63	1	-0.01	1:1	0.230	1.371	0.315	
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 12-3
LTE Band 14 Body-Worn SAR

MEASUREMENT RESULTS																				
FREQUENCY			Side	Spacing	Mode	Mount Type	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)	
793.00	23330	Mid	back	0 mm	LTE Band 14	WGP03088	BWL7-000995	10	QPSK	1	25	24.0	22.51	0	-0.03	1:1	0.150	1.409	0.211	
793.00	23330	Mid	back	0 mm	LTE Band 14	WGP02798C	BWL7-000995	10	QPSK	1	25	24.0	22.51	0	-0.08	1:1	0.174	1.409	0.245	
793.00	23330	Mid	back	0 mm	LTE Band 14	WGA00668	BWL7-000995	10	QPSK	1	25	24.0	22.51	0	-0.07	1:1	0.224	1.409	0.316	A3
793.00	23330	Mid	back	0 mm	LTE Band 14	WGP03088	BWL7-000995	10	QPSK	25	0	23.0	21.87	1	0.01	1:1	0.137	1.297	0.178	
793.00	23330	Mid	back	0 mm	LTE Band 14	WGP02798C	BWL7-000995	10	QPSK	25	0	23.0	21.87	1	-0.04	1:1	0.161	1.297	0.209	
793.00	23330	Mid	back	0 mm	LTE Band 14	WGA00668	BWL7-000995	10	QPSK	25	0	23.0	21.87	1	0.02	1:1	0.220	1.297	0.285	
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 12-4
LTE Band 5 Body-Worn SAR

MEASUREMENT RESULTS

FREQUENCY			Side	Spacing	Mode	Mount Type	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)	
836.50	20525	Mid	back	0 mm	LTE Band 5 (Cell)	WGP03088	BWL7-000995	10	QPSK	1	25	24.0	22.70	0	-0.16	1:1	0.185	1.349	0.250	
836.50	20525	Mid	back	0 mm	LTE Band 5 (Cell)	WGP02798C	BWL7-000995	10	QPSK	1	25	24.0	22.70	0	-0.10	1:1	0.204	1.349	0.275	
836.50	20525	Mid	back	0 mm	LTE Band 5 (Cell)	WGA00668	BWL7-000995	10	QPSK	1	25	24.0	22.70	0	-0.07	1:1	0.263	1.349	0.355	A4
836.50	20525	Mid	back	0 mm	LTE Band 5 (Cell)	WGP03088	BWL7-000995	10	QPSK	25	12	23.0	21.91	1	-0.01	1:1	0.141	1.285	0.181	
836.50	20525	Mid	back	0 mm	LTE Band 5 (Cell)	WGP02798C	BWL7-000995	10	QPSK	25	12	23.0	21.91	1	0.00	1:1	0.169	1.285	0.217	
836.50	20525	Mid	back	0 mm	LTE Band 5 (Cell)	WGA00668	BWL7-000995	10	QPSK	25	12	23.0	21.91	1	-0.03	1:1	0.215	1.285	0.276	

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 12-5
LTE Band 66 Body-Worn SAR

MEASUREMENT RESULTS

FREQUENCY			Side	Spacing	Mode	Mount Type	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)	
1720.00	132072	Low	back	0 mm	LTE Band 66 (AWS)	WGP03088	BWL7-000995	20	QPSK	1	50	24.0	23.03	0	0.05	1:1	0.129	1.250	0.161	
1720.00	132072	Low	back	0 mm	LTE Band 66 (AWS)	WGP02798C	BWL7-000995	20	QPSK	1	50	24.0	23.03	0	-0.17	1:1	0.245	1.250	0.306	A5
1720.00	132072	Low	back	0 mm	LTE Band 66 (AWS)	WGA00668	BWL7-000995	20	QPSK	1	50	24.0	23.03	0	0.02	1:1	0.155	1.250	0.194	
1720.00	132072	Low	back	0 mm	LTE Band 66 (AWS)	WGP03088	BWL7-000995	20	QPSK	50	50	23.0	21.60	1	0.11	1:1	0.110	1.380	0.152	
1720.00	132072	Low	back	0 mm	LTE Band 66 (AWS)	WGP02798C	BWL7-000995	20	QPSK	50	50	23.0	21.60	1	0.03	1:1	0.193	1.380	0.266	
1720.00	132072	Low	back	0 mm	LTE Band 66 (AWS)	WGA00668	BWL7-000995	20	QPSK	50	50	23.0	21.60	1	-0.03	1:1	0.129	1.380	0.178	

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 12-6
LTE Band 25 Body-Worn SAR

MEASUREMENT RESULTS

FREQUENCY			Side	Spacing	Mode	Mount Type	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	26140	Low	back	0 mm	LTE Band 25 (PCS)	WGP03088	BWL7-000995	20	QPSK	1	50	24.0	23.10	0	-0.08	1:1	0.112	1.230	0.138	
1860.00	26140	Low	back	0 mm	LTE Band 25 (PCS)	WGP02798C	BWL7-000995	20	QPSK	1	50	24.0	23.10	0	0.08	1:1	0.173	1.230	0.213	A6
1860.00	26140	Low	back	0 mm	LTE Band 25 (PCS)	WGA00668	BWL7-000995	20	QPSK	1	50	24.0	23.10	0	0.04	1:1	0.116	1.230	0.143	
1860.00	26140	Low	back	0 mm	LTE Band 25 (PCS)	WGP03088	BWL7-000995	20	QPSK	50	50	23.0	22.17	1	0.01	1:1	0.079	1.211	0.096	
1860.00	26140	Low	back	0 mm	LTE Band 25 (PCS)	WGP02798C	BWL7-000995	20	QPSK	50	50	23.0	22.17	1	-0.06	1:1	0.125	1.211	0.151	
1860.00	26140	Low	back	0 mm	LTE Band 25 (PCS)	WGA00668	BWL7-000995	20	QPSK	50	50	23.0	22.17	1	0.07	1:1	0.085	1.211	0.103	

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 12-7
DTS Body-Worn SAR

MEASUREMENT RESULTS

FREQUENCY		Side	Spacing	Mode	Service	Mount Type	Device Serial Number	Bandwidth [MHz]	Data Rate (Mbps)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.													(W/kg)			(W/kg)	
2412	1	back	0 mm	802.11b	DSSS	WGP02697B	BWL7-000995	22	1	18.0	16.09	0.15	100.00	0.034	1.552	1.000	0.053	
2412	1	back	0 mm	802.11b	DSSS	WGP02798C	BWL7-000995	22	1	18.0	16.09	-0.02	100.00	0.074	1.552	1.000	0.115	A7
2412	1	back	0 mm	802.11b	DSSS	WGA00668	BWL7-000995	22	1	18.0	16.09	-0.20	100.00	0.052	1.552	1.000	0.081	
2412	1	back	0 mm	802.11b	DSSS	WGP03088	BWL7-000995	22	1	18.0	16.09	-0.03	100.00	0.026	1.552	1.000	0.040	
2412	1	back	0 mm	802.11b	DSSS	WGP03085	BWL7-000995	22	1	18.0	16.09	0.11	100.00	0.062	1.552	1.000	0.096	
2412	1	back	0 mm	802.11b	DSSS	WGA00669	BWL7-000995	22	1	18.0	16.09	0.08	100.00	0.019	1.552	1.000	0.029	

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 12-8
DSS Body-Worn SAR

MEASUREMENT RESULTS																
FREQUENCY		Side	Spacing	Mode	Service	Mount Type	Device Serial Number	Data Rate (Mbps)	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Duty Cycle (%)	SAR (1g)	Scaling Factor (Cond Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.												(W/kg)			(W/kg)	
2441	39	back	0 mm	Bluetooth	FHSS	WGP02697B	BWL7-000995	1	9.0	7.57	0.03	76.90	0.005	1.390	1.300	0.009	
2441	39	back	0 mm	Bluetooth	FHSS	WGP02798C	BWL7-000995	1	9.0	7.57	0.06	76.90	0.007	1.390	1.300	0.013	A8
2441	39	back	0 mm	Bluetooth	FHSS	WGA00668	BWL7-000995	1	9.0	7.57	0.15	76.90	0.006	1.390	1.300	0.011	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram								

12.2 SAR Test Notes

General Notes:

1. HVIN: WGA00825 was used during evaluation.
2. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 62209-1528-2020, and FCC KDB Publication 447498 D01v06.
3. Per RSS-102, Issue 5 Section 3, SAR evaluations were made in accordance with the latest version of IEC/IEEE 62209-1528:2020. FCC KDB Publications listed in RSS-102 were used to supplement the limited technology specific testing protocols described in the international standards.
4. Per IEC/IEEE 62209-1528:2020 guidance, SAR testing was performed using probes calibrated for the modulation specific signal.
5. Batteries are fully charged at the beginning of the SAR measurements.
6. Liquid tissue depth was at least 15.0 cm for all frequencies.
7. 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.
8. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
9. The device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 0 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance. The device was tested with each accessory containing a unique metallic component. Since multiple accessories share the same metallic components the accessories with the shortest distance between the device and the body were tested, and the worst case of each antenna was tested with the accessories with the larger distances from the device and the body.
10. Per FCC KDB Publication 865664 D01v01r04, variability SAR tests were not required since measured SAR results for all frequency bands were less than 0.8 W/kg. Please see Section 14 for variability analysis.
11. 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 D05v02r05. The general test procedures used for testing can be found in Section 9.2.3.
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.

WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 9.3.2 for more information.
2. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg for 1g evaluations or all test channels were measured.
3. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance.
4. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

Bluetooth Notes

1. Per October 2016 TCB Workshop Notes, the reported SAR was scaled to the 100% transmission duty factor to determine compliance. See Section 8 for the time domain plot and calculation for the duty factor of the device.

13 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

13.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

13.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 4.3.2 and IEC/IEEE 62209-1528:2020 Section 7.4.4, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1g or 10g SAR.

13.3 Body SAR Simultaneous Transmission Analysis

Simultaneous Transmission Scenario with 2.4 GHz WLAN Body-Worn

Configuration	Mode	4G SAR (W/kg)	2.4 GHz WLAN (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	LTE Band 12	0.331	0.115	0.446
	LTE Band 13	0.358	0.115	**0.473**
	LTE Band 14	0.316	0.115	0.431
	LTE Band 5 (Cell)	0.355	0.115	0.470
	LTE Band 66 (AWS)	0.306	0.115	0.421
	LTE Band 25 (PCS)	0.213	0.115	0.328

Table 13-1
Simultaneous Transmission Scenario with Bluetooth Body-Worn

Configuration	Mode	4G SAR (W/kg)	2.4 GHz Bluetooth SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body-Worn SAR	LTE Band 12	0.331	0.013	0.344
	LTE Band 13	0.358	0.013	0.371
	LTE Band 14	0.316	0.013	0.329
	LTE Band 5 (Cell)	0.355	0.013	0.368
	LTE Band 66 (AWS)	0.306	0.013	0.319
	LTE Band 25 (PCS)	0.213	0.013	0.226

13.4 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 .

14 SAR MEASUREMENT VARIABILITY

14.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, variability SAR tests were not required since measured SAR results for all frequency bands were less than 0.8 W/kg for 1g SAR and less than 2.0 W/kg for 10g SAR.

14.2 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 62209-1528-2020 was not required.

15 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	N5182A	MXG Vector Signal Generator	7/4/2022	Annual	7/4/2023	MY48180366
Agilent	8753ES	S-Parameter Vector Network Analyzer	6/14/2022	Annual	6/14/2023	US39170118
Amplifier Research	150A100C	Amplifier	CBT	N/A	CBT	350132
Anritsu	MA2411B	Pulse Power Sensor	10/20/2022	Annual	10/20/2023	1339018
Mini-Circuits	PWR-4GHS	USB Power Sensor	11/11/2022	Annual	11/11/2023	11710030062
Control Company	4352	Long Stem Thermometer	9/10/2021	Biennial	9/10/2023	210774678
Control Company	4352	Long Stem Thermometer	9/10/2021	Biennial	9/10/2023	210774685
Mitutoyo	500-196-30	CD-6"ASX 6Inch Digital Caliper	2/16/2022	Triennial	2/16/2025	A20238413
Keysight Technologies	N6705B	DC Power Analyzer	5/5/2021	Triennial	5/5/2024	MY53004059
Keysight Technologies	N9020A	MXA Signal Analyzer	3/15/2023	Annual	3/15/2024	US46470561
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
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	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2050
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2111
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Seekonk	TSF-100	Torque Wrench	7/11/2022	Annual	7/11/2023	47639-29
SPEAG	DAK-3.5	Dielectric Assessment Kit	12/15/2022	Annual	12/15/2023	1278
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/15/2022	Annual	8/15/2023	1041
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	7/5/2022	Annual	7/5/2023	1039
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1379
SPEAG	CLA-13	Confined Loop Antenna	9/13/2022	Annual	9/13/2023	1002
SPEAG	D750V3	750 MHz SAR Dipole	10/18/2021	Biennial	2/14/2023	1161
SPEAG	D835V2	835 MHz SAR Dipole	1/21/2021	Triennial	1/21/2024	4d132
SPEAG	D1765V2	1750 MHz SAR Dipole	5/14/2021	Biennial	5/14/2023	1150
SPEAG	D1900V2	1900 MHz SAR Dipole	9/21/2021	Biennial	9/21/2023	5d149
SPEAG	D2450V2	2450 MHz SAR Dipole	11/25/2021	Biennial	11/25/2023	981
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/17/2023	Annual	1/17/2024	1558
SPEAG	EX3DV4	SAR Probe	1/11/2023	Annual	1/11/2024	7570

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.

16 MEASUREMENT UNCERTAINTIES

a			c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Symbol	Uncertainty Component	IEC/IEEE 62209-1528 ref.	Tol. (± %)*	Prob. Dist.	Div.	c_i 1gm	c_i 10 gms	1gm u_i (± %)	10gms u_i (± %)	v_i
				Measurement System Errors						
CF	Probe Calibration	8.4.1.1	18.6	N	2	1.0	1.0	9.3	9.3	∞
CFdrift	Probe Calibration Drift	8.4.1.2	1.7	R	1.73	1.0	1.0	1.0	1.0	∞
LIN	Probe Linearity	8.4.1.3	4.7	R	1.73	1.0	1.0	2.7	2.7	∞
BBS	Broadband Signal	8.4.1.4	2.8	R	1.73	1.0	1.0	1.6	1.6	∞
ISO	Probe Isotropy	8.4.1.5	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
DAE	Other Probe and data acquisition errors	8.4.1.6	0.3	N	1	1.0	1.0	0.3	0.3	∞
AMB	RF ambient and noise	8.4.1.7	1.8	N	1	1.0	1.0	1.8	1.8	∞
Δxyz	Probe Positioning errors	8.4.1.8	±0.005 mm	N	1	0.50	0.50	0.25	0.25	∞
DAT	Data processing errors	8.4.1.9	3.5	N	1	1.0	1.0	3.5	3.5	∞
				Phantom and Device Errors						
LIQ(σ)	Conductivity (Meas.)	8.4.2.1	2.5	N	1	0.78	0.71	2.0	1.8	∞
LIQ(T_σ)	Conductivity (Temp.)	8.4.2.2	2.4	R	1.73	0.78	0.71	1.1	1.0	∞
EPS	Phantom Permitivity	8.4.2.3	14.0	R	1.73	0.50	0.50	4.0	4.0	∞
DIS	Distance DUT - TSL	8.4.2.4	2.0	N	1	2.00	2.00	4.0	4.0	∞
Dxyz	Test Sample Positioning	8.4.2.5	3.1	N	1	1.0	1.0	3.1	3.1	35
H	Device Holder Uncertainty	8.4.2.6	1.7	N	1	1.0	2.0	1.7	3.4	5
MOD	Modulation Response	8.4.2.7	4.8	R	1.73	1.0	1.0	2.8	2.8	∞
TAS	Time-average SAR	8.4.2.8	1.7	R	1.73	1.0	1.0	1.0	1.0	∞
RFdrift	Output Power Variation - SAR drift measurement	8.4.2.9	2.5	N	1	1.0	1.0	2.5	2.5	∞
				Corrections to the SAR result						
C(ε', σ)	Deviations to TSL targets	8.4.3.1	0.0	N	1	1.00	0.84	0.0	0.0	∞
C(ε', σ)	Deviations to TSL targets	8.4.3.1	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
C(R)	SAR Scaling	8.4.3.2	0.0	R	1.73	1.0	1.0	0.0	0.0	∞
	Combined Standard Uncertainty (k=1)			RSS				14.2	14.4	40
	Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				28.3	28.8	

The above measurement uncertainties are according to IEC/IEEE Std.62209-1528:2020
* Unit for Probe Positioning Errors is as indicated per IEC/IEEE Std.62209-1528:2020

17 CONCLUSION

17.1 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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