SAR EVALUATION REPORT

IEEE Std 1528-2013

For
LifeVest LV 5100 Wearable Cardiac Defibrillator

FCC ID: W56LV51C1BW0
Model Name: LV 5100 Medical System

Report Number: R14400105-S1V1
Issue Date: 10/12/2022

Prepared for
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ACCREDITED
CERT #0751.06

Revision History

Rev.	Date	Revisions	Revised By
V1	10/12/2022	Initial Issue	--
V2	10/24/2022	Corrected FCC ID	Lariah Ijames

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1. Attestation of Test Results

Applicant Name	ZOLL Mfg Corp	
FCC ID	W56LV51C1BW0	
Model Name	LV 5100 Medical System	
Applicable Standards	Published RF exposure KDB procedures IEEE Std 1528-2013	
Exposure Category	SAR Limits (W/Kg)	
	Peak spatial-average (1g of tissue)	Extremities (hands, wrists, ankles, etc.) (10g of tissue)
General population / Uncontrolled exposure	1.6	4
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)	
	PCE	
Body-worn	0.479	
Date Tested	8/8/2022 to 8/11/2022	
Test Results	Pass	

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

This report contains data provided by the customer which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the U.S. Government, or any agency of the U.S. government.

Approved & Released By:	Prepared By:
	
Dave Weaver Operations Leader UL Verification Services Inc.	Richard Jankovics Operations Leader UL LLC

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures:

- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D05 SAR for LTE Devices v02r05

In addition to the above, the following information was used:

- TCB Workshop October 2014; RF Exposure Procedures (Other LTE Considerations)
- TCB Workshop October 2015; RF Exposure Procedures (KDB 941225 D05A)
- TCB Workshop October 2016; RF Exposure Procedures (DUT Holder Perturbations)
- TCB Workshop April 2019; RF Exposure Procedures (Tissue Simulating Liquids (TSL))

3. Facilities and Accreditation

UL LLC is accredited by A2LA, cert. # 0751.06 for all testing performed within the scope of this report. Testing was performed at the locations noted below.

The test sites and measurement facilities used to collect data are located at 2800 Perimeter Park Dr, Morrisville, NC, USA.

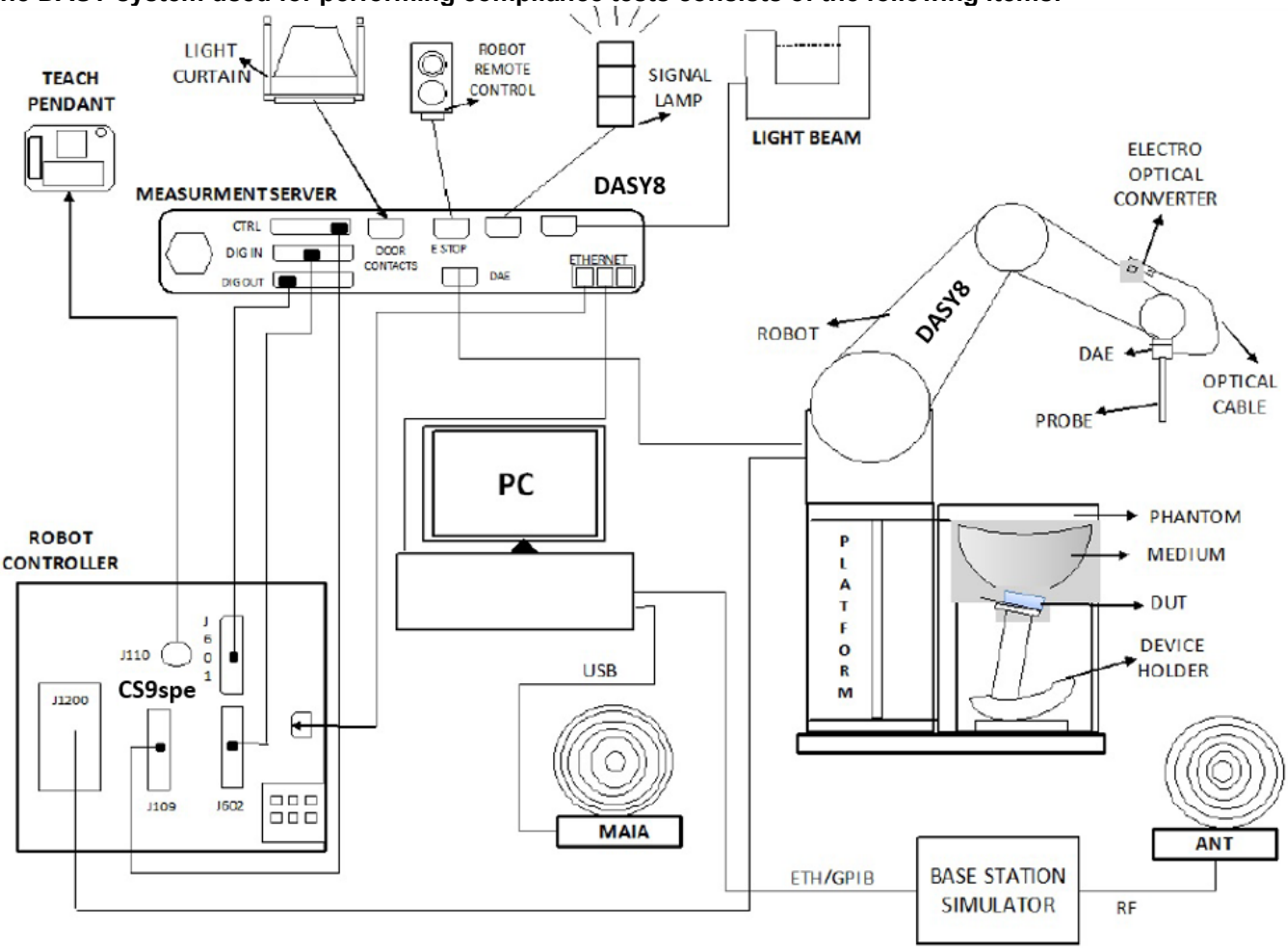
- SAR Lab 1A
- SAR Lab 2B

	Address	ISED CABID	ISED Company Number	FCC Registration
☐	Building: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	825374
☒	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A	US0067	27265	825374

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

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



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running Win10 and the DASY8[1] software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

[1] DASY8 software used: DASY16.0.2.83 and older generations.

4.2. SAR Scan Procedures

Step 1: Power Reference Measurement

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

Step 2: Area Scan

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

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

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

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

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

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Step 4: Power drift measurement

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

4.3. Test Equipment

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

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Keysight	E5063A	MY54100681	08/20/2022
Dielectric Probe	SPEAG	DAKS-3.5	1147	03/13/2023
Shorting Block	SPEAG	DAK-3.5 Short	SMDAK 200 DB	03/13/2023
Thermometer	Fisher Scientific	15-078-181	210204689	03/13/2023

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Signal Generator	Keysight	N5181A	MY50140788	12/09/2022
3-Path Diode Power Sensor	Rohde & Scwarz	NRP8S	112236	05/31/2023
3-Path Diode Power Sensor	Rohde & Scwarz	NRP8S	112237	05/31/2023
Amplifier	MITEQ	AMF-4D-00400600-50-30P	N/A	N/A
Directional coupler	Mini-Circuits	ZUDC10-183+	1438	NA
DC Power Supply	Miteq	PS 15V1	1990186	N/A
RF Power Source	Speag	PowerSource1	4278	06/21/2023

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe	SPEAG	EX3DV4	7549	02/21/2023
E-Field Probe	SPEAG	EX3DV4	7711	03/11/2023
Data Acquisition Electronics	SPEAG	DAE4	1716	03/08/2023
Data Acquisition Electronics	SPEAG	DAE4	1715	02/22/2023
System Validation Dipole	SPEAG	D750V3	1139	10/06/2022
System Validation Dipole	SPEAG	D1750V2	1136	10/12/2022
System Validation Dipole	SPEAG	D1900V2	5d202	10/06/2022
Environmental Indicator	Control Company	06-662-4	200037610	02/24/2023
Environmental Indicator	Control Company	06-662-4	200037635	02/24/2023

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMW 500	170733	11/15/2022
Base Station Simulator	R & S	CMW 500	170732	11/18/2022

5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEC/IEEE 62209-1528 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.

6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Overall (Length x Width x Thickness): 102.5 mm x 186 mm x 56 mm Overall Diagonal: 212.5 mm This is a Body-worn device. Device is contained within a holster that is suspended against the torso by a strap.
Back Cover	The Back Cover is not removable
Battery	The rechargeable battery is not user accessible.
Accessory	LV 5100 Electrode Belt • Hardware Version: 3.1.0 • Software Version: RC1 • Serial Number: P3.1.0_035
Test sample information	**S/N** **IMEI** **Notes** 999010134 353081091161417 Conducted 999010131 353081091154941 Radiated
Hardware Version	3.4
Software Version	0001 + RC2

Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
LTE Cat M1	FDD Band 2 FDD Band 4 FDD Band 12	QPSK 16QAM Rel. 10 Does not support Carrier Aggregation (CA)	100% (FDD) Refer to §6.4
	Does this device support SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No		

6.2. General LTE SAR Test and Reporting Considerations

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Frequency range, Channel Bandwidth, Numbers and Frequencies</td><td>
<table>
<tr><td rowspan="3">Band 2</td><td colspan="6">Frequency range: 1850 - 1910 MHz (BW = 60 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td>18700 /1860</td><td>18675/ 1857.5</td><td>18650/ 1855</td><td>18625/ 1852.5</td><td>18615/ 1851.5</td><td>18607/ 1850.7</td></tr>
<tr><td>Mid</td><td>18900/ 1880</td><td>18900/ 1880</td><td>18900/ 1880</td><td>18900/ 1880</td><td>18900/ 1880</td><td>18900/ 1880</td></tr>
<tr><td>High</td><td>19100/ 1900</td><td>19125/ 1902.5</td><td>19150/ 1905</td><td>19175/ 1907.5</td><td>19185/ 1908.5</td><td>19193/ 1909.3</td></tr>
<tr><td rowspan="3">Band 4</td><td colspan="6">Frequency range: 1710 - 1755 MHz (BW = 45 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz [1]</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td>20050/ 1720</td><td>20025/ 1717.5</td><td>20000/ 1715</td><td>19975/ 1712.5</td><td>19965/ 1711.5</td><td>19957/ 1710.7</td></tr>
<tr><td>Mid</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td><td>20175/ 1732.5</td></tr>
<tr><td>High</td><td>20300/ 1745</td><td>20325/ 1747.5</td><td>20350/ 1750</td><td>20375/ 1752.5</td><td>20385/ 1753.5</td><td>20393/ 1754.3</td></tr>
<tr><td rowspan="3">Band 12</td><td colspan="6">Frequency range: 699 – 716 MHz (BW = 17 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz [1]</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td></td><td></td><td>23060/ 704</td><td>23035/ 701.5</td><td>23025/ 700.5</td><td>23017/ 699.7</td></tr>
<tr><td>Mid</td><td></td><td></td><td>23095/ 707.5</td><td>23095/ 707.5</td><td>23095/ 707.5</td><td>23095/ 707.5</td></tr>
<tr><td>High</td><td></td><td></td><td>23130/ 711</td><td>23155/ 713.5</td><td>23165/ 714.5</td><td>23173/ 715.3</td></tr>
</table>
</td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td>Refer to Appendix A.</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td>
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (N_{RB})</th><th rowspan="2">MPR (dB)</th></tr>
<tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr>
<tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 3</td></tr>
<tr><td>256 QAM</td><td colspan="6">≥ 1</td><td>≤ 5</td></tr>
</table>
MPR Built-in by design
The manufacturer MPR values are always within the 3GPP maximum MPR allowance but may not follow the default MPR values.
A-MPR (additional MPR) was disabled during SAR testing
</td></tr>
<tr><td>Power reduction</td><td>No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td>A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.</td></tr>
</table>

Notes:

1. Maximum bandwidth does not support at least three non-overlapping channels in certain channel bandwidths. 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 per KDB 941225 D05 SAR for LTE Devices.
2. SAR Testing for LTE was performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

7.1. Standalone SAR Test Exclusion Considerations

Since the *Dedicated Host Approach* is applied, the standalone SAR test exclusion procedure in KDB 447498 § 4.3.1 is applied in conjunction with KDB 616217 § 4.3 to determine the minimum test separation distance:

- When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
- When the separation distance from the antenna to an adjacent edge is > 5 mm, the actual antenna-to-edge separation distance is applied to determine SAR test exclusion.

SAR Test Exclusion Calculations for WWAN

Antennas < 50mm to adjacent edges

Antenna	Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
			dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front
Full Power																
Cellular	LTE Band 2	1900	24.00	251	10.2	-	-	-	-	11.4	34.6 -MEASURE-	-	-	-	-	31.5 -MEASURE-
Cellular	LTE Band 4	1754.3	24.00	251	10.2	-	-	-	-	11.4	33.2 -MEASURE-	-	-	-	-	30.2 -MEASURE-
Cellular	LTE Band 12	711	24.00	251	10.2	-	-	-	-	11.4	21.2 -MEASURE-	-	-	-	-	19.2 -MEASURE-

Note(s):

1. According to KDB 447498, if the calculated threshold value is >3 then SAR testing is required.
2. The device is body worn, with only the front and rear surfaces being placed against the body. Edge exposure conditions are not consistent with normal use, per the manufacturer. Device is contained within a holster that is suspended against the torso by a strap.

7.2. Required Test Configurations

The table below identifies the standalone test configurations required for this device according to the findings in Section 7.1:

Test Configurations	Rear	Edge 1 (Top Edge)	Edge 2 (Right Edge)	Edge 3 (Bottom Edge)	Edge 4 (Left Edge)	Front
LTE Band 2	Yes	No	No	No	No	Yes
LTE Band 4	Yes	No	No	No	No	Yes
LTE Band 12	Yes	No	No	No	No	Yes

Note(s):

Yes = Testing is required.

No = Testing is not required.

Edges were not considered because they are not appropriate exposure conditions given how the device is worn.

8. Dielectric Property Measurements & System Check

8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.

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

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

The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEC/IEEE 62209-1528, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

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

IEC/IEEE 62209-1528

Table 2 – Dielectric properties of the tissue-equivalent medium

Frequency MHz	Real part of the complex relative permittivity, ε_r'	Conductivity, σ S/m	Penetration depth (E-field), δ mm
4	*55,0*	*0,75*	293,0
13	*55,0*	*0,75*	165,5
30	55,0	0,75	112,8
150	52,3	0,76	62,0
300	45,3	0,87	46,1
450	43,5	0,87	43,0
750	*41,9*	*0,89*	39,8
835	41,5	0,90	39,0
900	41,5	0,97	36,2
1 450	40,5	1,20	28,6
1 800	40,0	1,40	24,3
1 900	40,0	1,40	24,3
1 950	40,0	1,40	24,3
2 000	40,0	1,40	24,3
2 100	*39,8*	*1,49*	22,8
2 450	39,2	1,80	18,7
2 600	*39,0*	*1,96*	17,2
3 000	38,5	2,40	14,0
3 500	*37,9*	*2,91*	11,4
4 000	*37,4*	*3,43*	10,0
4 500	*36,8*	*3,94*	9,7
5 000	*36,2*	*4,45*	1,5
5 200	*36,0*	*4,66*	8,4
5 400	*35,8*	*4,86*	8,1
5 600	*35,5*	*5,07*	7,5
5 800	35,3	5,27	7,3
6 000	*35,1*	*5,48*	7,0
6 500	*34,5*	*6,07*	6,7
7 000	*33,9*	*6,65*	6,4
7 500	*33,3*	*7,24*	6,1
8 000	*32,7*	*7,84*	5,9
8 500	*32,1*	*8,46*	5,3
9 000	*31,6*	*9,08*	4,8
9 500	*31,0*	*9,71*	4,4
10 000	*30,4*	*10,40*	4,0

NOTE For convenience, permittivity and conductivity values are linearly interpolated for frequencies that are not a part of the original data from Drossos et al. [2]. They are shown in italics in Table 2. The italicized values are linearly interpolated (below 5800 MHz) or extrapolated (above 5800 MHz) from the non-italicized values that are immediately above and below these values.

Dielectric Property Measurements Results:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
1A	2022-08-08	750	Head	750	43.3	42.0	3.31	0.90	0.89	0.97
				660	43.6	42.4	2.82	0.87	0.89	-1.64
				820	43.2	41.6	3.72	0.92	0.90	2.90
1A	2022-08-08	1750	Head	1750	41.3	40.1	3.03	1.38	1.37	0.66
				1710	41.3	40.1	2.90	1.35	1.35	0.27
				1755	41.3	40.1	3.05	1.38	1.37	0.67
2B	2022-08-09	1900	Head	1900	39.3	40.0	-1.80	1.46	1.40	4.29
				1850	39.5	40.0	-1.37	1.42	1.40	1.43
				1910	39.2	40.0	-1.90	1.47	1.40	5.00

8.2. System Check

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

System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was recorded and the results are normalized to 1 W input power.

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within ±10% of the manufacturer calibrated dipole SAR target. Refer to Appendix B for the SAR System Check Plots.

SAR Lab	Date	Tissue Type	Dipole Type_Serial #	Dipole Cal. Due Data	Dipole Power (dBm)	Measured Results for 1g SAR				Measured Results for 10g SAR				Plot No.
						Zoom Scan	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
1A	8/8/2022	Head	D750V3 SN: 1139	10/6/2022	17.0	0.435	8.68	8.12	6.89	0.286	5.71	5.41	5.48	1
1A	8/8/2022	Head	D1750V2 SN: 1136	10/12/2022	17.0	1.890	37.71	34.44	9.50	0.998	19.91	18.63	6.89	2
2B	8/9/2022	Head	D1900V2 SN: 5d202	10/6/2022	17.0	2.010	40.10	37.86	5.93	1.040	20.75	20.26	2.42	3

9. Conducted Output Power Measurements

Tune-Up Power Limits provided by the manufacturer are used to scale measured SAR values.

9.1. LTE

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS36.101 specification.

UE Power Class: 3 (23 +/- 2dBm). The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS36.101.

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3

Modulation	Channel bandwidth / Transmission bandwidth (N_{RB})						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2
64 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 2
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 3
256 QAM	≥ 1						≤ 5

The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS36.101 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of “NS_01”.

Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)

Network Signalling value	Requirements (subclause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	N/A

Maximum Output Power (Tune-up Limit) for LTE

Maximum bandwidth does not support at least three non-overlapping channels in certain channel bandwidths. 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 per KDB 941225 D05 SAR for LTE Devices.

LTE QPSK configuration has the highest maximum average output power per 3GPP standard.

SAR measurement is not required for the 16QAM. When the highest maximum output power for 16QAM is ≤ ½ dB higher than the QPSK or when the reported SAR for the QPSK configuration is ≤ 1.45 W/kg.

Please refer to section 6.3. for LTE detail test channels.

Note that for Cat-M1 LTE, QPSK max RB is 6 and 50% is 3, while 16QAM max RB is 5 (needing offset 0 and 1), and 50% is 3.

RF Air interface	Mode	Tune-up Pow erLimit (dBm)
		Main Antenna
		Maximum
LTE Band 2	QPSK	24.00
LTE Band 4	QPSK	24.00
LTE Band 12	QPSK	24.00

LTE Band 2 Measured Result

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				18700	18900	19100		
				1860 MHz	1880 MHz	1900 MHz		
20 MHz	QPSK	1	0	22.5	22.5	22.5	0	24
		1	3	22.6	22.6	22.5	0	24
		1	5	22.5	22.7	22.4	0	24
		3	0	22.1	22.4	22.4	0	24
		3	1	22.2	22.4	22.5	0	24
		3	3	22.1	22.3	22.3	0	24
		6	0	22.1	22.3	22.4	0	24
	16QAM	1	0	22.7	23.0	22.5	0	24
		1	3	22.9	23.0	22.5	0	24
		1	5	22.8	23.0	22.4	0	24
		3	0	22.6	22.6	22.3	0	24
		3	1	22.6	22.6	22.3	0	24
		3	3	22.6	22.4	22.4	0	24
		5	0	22.5	22.5	22.5	0	24
		5	1	22.6	22.5	22.6	0	24
BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				18675	18900	19125		
				1857.5 MHz	1880 MHz	1902.5 MHz		
15 MHz	QPSK	1	0	22.2	22.3	22.3	0	24
		1	3	22.1	22.3	22.3	0	24
		1	5	22.3	22.1	22.3	0	24
		3	0	22.2	22.5	22.4	0	24
		3	1	22.2	22.4	22.3	0	24
		3	3	22.1	22.2	22.4	0	24
		6	0	22.1	22.3	22.4	0	24
	16QAM	1	0	22.6	22.8	22.4	0	24
		1	3	22.2	22.3	22.5	0	24
		1	5	22.7	22.1	22.3	0	24
		3	0	22.6	22.8	22.8	0	24
		3	1	22.6	22.7	22.4	0	24
		3	3	22.5	22.7	22.7	0	24
		5	0	22.4	22.6	22.7	0	24
		5	1	22.5	22.5	22.6	0	24

LTE Band 2 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				18650	18900	19150		
				1855 MHz	1880 MHz	1905 MHz		
10 MHz	QPSK	1	0	22.5	22.3	22.4	0	24
		1	3	22.4	22.4	22.4	0	24
		1	5	22.3	22.3	22.4	0	24
		3	0	22.2	22.3	22.3	0	24
		3	1	22.3	22.6	22.4	0	24
		3	3	22.3	22.3	22.5	0	24
		6	0	21.4	21.4	21.3	1	23
	16QAM	1	0	22.8	22.8	22.8	0	24
		1	3	22.8	22.9	22.9	0	24
		1	5	22.7	22.8	22.9	0	24
		3	0	22.6	22.5	22.6	0	24
		3	1	22.4	22.8	22.7	0	24
		3	3	22.5	22.5	22.6	0	24
		5	0	21.5	21.8	21.4	1	23
		5	1	21.5	21.8	21.4	1	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				18625	18900	19175		
				1852.5 MHz	1880 MHz	1907.5 MHz		
5 MHz	QPSK	1	0	22.2	22.3	22.4	1	23
		1	3	22.2	22.4	22.3	1	23
		1	5	22.2	22.5	22.3	1	23
		3	0	21.2	21.5	21.5	1	23
		3	1	21.2	21.5	21.6	1	23
		3	3	21.2	21.4	21.3	1	23
		6	0	21.2	21.5	21.3	1	23
	16QAM	1	0	22.7	22.9	22.7	0	24
		1	3	22.8	23.0	23.0	0	24
		1	5	22.8	23.0	22.9	0	24
		3	0	21.5	21.7	21.6	1	23
		3	1	21.6	21.8	21.9	1	23
		3	3	21.6	21.4	21.6	1	23
		5	0	20.5	20.8	20.8	2	22
		5	1	20.5	20.9	20.8	2	22

LTE Band 2 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				18615	18900	19185		
				1851.5 MHz	1880 MHz	1908.5 MHz		
3 MHz	QPSK	1	0	22.6	22.5	22.2	0	24
		1	3	22.5	22.5	22.3	0	24
		1	5	22.5	22.4	22.2	0	24
		3	0	21.4	21.3	21.4	1	23
		3	1	21.3	21.6	21.4	1	23
		3	3	21.4	21.6	21.5	1	23
		6	0	20.2	20.5	20.4	2	22
	16QAM	1	0	21.9	22.2	22.1	1	23
		1	3	22.1	22.3	22.1	1	23
		1	5	21.9	22.3	22.1	1	23
		3	0	20.4	20.5	20.6	2	22
		3	1	20.1	20.7	20.3	2	22
		3	3	20.2	20.4	20.5	2	22
		5	0	20.3	20.4	20.6	2	22
		5	1	20.2	20.4	20.6	2	22

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				18607	18900	19193		
				1850.7 MHz	1880 MHz	1909.3 MHz		
1.4 MHz	QPSK	1	0	22.5	22.3	22.2	0	24
		1	3	22.6	22.4	22.3	0	24
		1	5	22.5	22.3	22.3	0	24
		3	0	21.5	21.4	21.3	1	23
		3	1	21.3	21.8	21.7	1	23
		3	3	21.3	21.5	21.4	1	23
		6	0	20.3	20.5	20.3	2	22
	16QAM	1	0	22.0	22.3	21.8	1	23
		1	3	22.1	22.4	22.2	1	23
		1	5	22.0	22.3	22.1	1	23
		3	0	20.2	20.0	20.1	2	22
		3	1	20.3	20.2	20.3	2	22
		3	3	20.1	20.3	20.2	2	22
		5	0	20.3	20.3	20.3	2	22
		5	1	20.2	20.3	20.3	2	22

LTE Band 4 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				[redacted]	20175	[redacted]		
					1732.5 MHz			
20 MHz	QPSK	1	0		23.3		0	24
		1	3		23.3		0	24
		1	5		23.2		0	24
		3	0		22.7		0	24
		3	1		22.7		0	24
		3	3		22.7		0	24
		6	0		22.8		0	24
	16QAM	1	0		22.6		0	24
		1	3		22.9		0	24
		1	5		22.7		0	24
		3	0		22.7		0	24
		3	1		23.0		0	24
		3	3		22.6		0	24
		5	0		22.8		0	24
		5	1		22.8		0	24

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20025	20175	20325		
				1717.5 MHz	1732.5 MHz	1747.5 MHz		
15 MHz	QPSK	1	0	22.6	22.6	22.5	0	24
		1	3	22.6	22.7	22.4	0	24
		1	5	22.6	22.5	22.4	0	24
		3	0	22.6	22.7	22.5	0	24
		3	1	22.8	22.8	22.5	0	24
		3	3	22.7	22.6	22.3	0	24
		6	0	22.7	22.6	22.6	0	24
	16QAM	1	0	22.9	23.0	22.7	0	24
		1	3	23.3	23.2	22.8	0	24
		1	5	22.9	23.0	22.8	0	24
		3	0	23.0	22.9	22.7	0	24
		3	1	22.9	22.8	22.6	0	24
		3	3	23.0	22.9	22.6	0	24
		5	0	23.0	22.8	22.5	0	24
		5	1	23.0	22.8	22.4	0	24

LTE Band 4 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20000	20175	20350		
				1715 MHz	1732.5 MHz	1750 MHz		
10 MHz	QPSK	1	0	22.7	22.6	22.5	0	24
		1	3	22.7	22.8	22.6	0	24
		1	5	22.7	22.6	22.5	0	24
		3	0	22.6	22.6	22.4	0	24
		3	1	22.7	22.7	22.6	0	24
		3	3	22.6	22.6	22.6	0	24
		6	0	21.7	21.6	21.6	1	23
	16QAM	1	0	23.0	22.8	22.9	0	24
		1	3	23.0	22.9	22.9	0	24
		1	5	23.0	22.9	22.9	0	24
		3	0	22.9	22.9	22.7	0	24
		3	1	23.0	22.7	22.6	0	24
		3	3	22.9	22.9	22.8	0	24
		5	0	21.9	21.8	21.7	1	23
		5	1	21.9	21.8	21.7	1	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				19975	20175	20375		
				1712.5 MHz	1732.5 MHz	1752.5 MHz		
5 MHz	QPSK	1	0	22.8	22.6	22.6	1	23
		1	3	22.6	22.7	22.6	1	23
		1	5	22.6	22.5	22.5	1	23
		3	0	21.6	21.6	21.6	1	23
		3	1	21.7	21.7	21.6	1	23
		3	3	21.7	21.6	21.6	1	23
		6	0	21.7	21.7	21.6	1	23
	16QAM	1	0	23.0	23.1	22.9	0	24
		1	3	23.0	23.1	22.9	0	24
		1	5	23.0	23.0	22.9	0	24
		3	0	21.9	21.8	21.9	1	23
		3	1	22.0	21.9	21.6	1	23
		3	3	21.8	21.8	21.8	1	23
		5	0	20.7	20.7	20.7	2	22
		5	1	20.7	20.6	20.6	2	22

LTE Band 4 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				19965	20175	20385		
				1711.5 MHz	1732.5 MHz	1753.5 MHz		
3 MHz	QPSK	1	0	22.5	22.4	22.2	0	24
		1	3	22.6	22.5	22.4	0	24
		1	5	22.5	22.4	22.4	0	24
		3	0	21.7	21.7	21.6	1	23
		3	1	21.9	21.9	21.6	1	23
		3	3	21.8	21.8	21.6	1	23
		6	0	20.8	20.7	20.6	2	22
	16QAM	1	0	22.1	22.1	21.6	1	23
		1	3	22.2	22.2	22.0	1	23
		1	5	22.1	22.1	22.1	1	23
		3	0	20.5	20.5	20.9	2	22
		3	1	20.6	20.5	20.4	2	22
		3	3	20.3	20.4	20.4	2	22
		5	0	20.6	20.7	20.5	2	22
		5	1	20.7	20.6	20.6	2	22

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				19957	20175	20393		
				1710.7 MHz	1732.5 MHz	1754.3 MHz		
1.4 MHz	QPSK	1	0	22.5	22.4	22.4	0	24
		1	3	22.6	22.5	22.4	0	24
		1	5	22.5	22.5	22.3	0	24
		3	0	21.7	21.7	21.5	1	23
		3	1	21.8	21.9	21.7	1	23
		3	3	21.7	21.7	21.5	1	23
		6	0	20.7	20.6	20.6	2	22
	16QAM	1	0	22.2	22.2	21.6	1	23
		1	3	22.4	22.3	21.9	1	23
		1	5	22.2	22.1	21.9	1	23
		3	0	20.5	20.3	20.4	2	22
		3	1	20.8	21.0	20.4	2	22
		3	3	20.5	20.3	20.1	2	22
		5	0	20.7	20.6	20.4	2	22
		5	1	20.7	20.6	20.5	2	22

LTE Band 12 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				[redacted]	23095	[redacted]		
					707.5 MHz			
10 MHz	QPSK	1	0		23.2		0	24
		1	3		23.3		0	24
		1	5		23.3		0	24
		3	0		23.2		0	24
		3	1		23.2		0	24
		3	3		23.2		0	24
		6	0		22.3		1	23
	16QAM	1	0		23.6		0	24
		1	3		23.6		0	24
		1	5		23.7		0	24
		3	0		23.3		0	24
		3	1		23.1		0	24
		3	3		23.5		0	24
		5	0		22.6		1	23
		5	1		22.6		1	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				23035	23095	23155		
				701.5 MHz	707.5 MHz	713.5 MHz		
5 MHz	QPSK	1	0	23.0	23.0	22.9	1	23
		1	3	23.0	22.9	22.9	1	23
		1	5	23.0	23.0	23.0	1	23
		3	0	22.1	22.1	22.2	1	23
		3	1	22.3	22.4	22.3	1	23
		3	3	22.2	22.2	22.2	1	23
		6	0	22.1	22.3	22.3	1	23
	16QAM	1	0	23.6	23.7	23.6	0	24
		1	3	23.7	23.8	23.7	0	24
		1	5	23.7	23.8	23.8	0	24
		3	0	22.6	22.5	22.6	1	23
		3	1	22.5	22.4	22.5	1	23
		3	3	22.6	22.5	22.7	1	23
		5	0	21.5	21.5	21.7	2	22
		5	1	21.6	21.6	21.6	2	22

LTE Band 12 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				23025	23095	23165		
				700.5 MHz	707.5 MHz	714.5 MHz		
3 MHz	QPSK	1	0	23.4	23.1	23.1	0	24
		1	3	23.5	23.2	23.2	0	24
		1	5	23.4	23.2	23.1	0	24
		3	0	22.4	22.3	22.3	1	23
		3	1	22.3	22.4	22.4	1	23
		3	3	22.4	22.2	22.3	1	23
		6	0	21.4	21.3	21.3	2	22
	16QAM	1	0	21.8	22.8	22.6	1	23
		1	3	21.8	22.8	22.7	1	23
		1	5	21.8	22.8	22.7	1	23
		3	0	21.0	21.0	21.1	2	22
		3	1	21.1	21.0	21.2	2	22
		3	3	21.0	21.1	20.9	2	22
		5	0	21.5	21.2	21.2	2	22
		5	1	21.5	21.2	21.2	2	22

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				23017	23095	23173		
				699.7 MHz	707.5 MHz	715.3 MHz		
1.4 MHz	QPSK	1	0	23.4	23.0	23.1	0	24
		1	3	23.6	23.1	23.2	0	24
		1	5	23.5	23.0	23.2	0	24
		3	0	22.4	22.3	22.3	1	23
		3	1	22.3	22.2	22.6	1	23
		3	3	22.4	22.3	22.3	1	23
		6	0	21.3	21.3	21.4	2	22
	16QAM	1	0	21.8	22.7	22.7	1	23
		1	3	21.9	22.9	22.9	1	23
		1	5	21.7	22.7	22.8	1	23
		3	0	21.0	21.1	21.1	2	22
		3	1	21.0	21.0	21.6	2	22
		3	3	21.0	20.8	21.1	2	22
		5	0	21.4	21.2	21.3	2	22
		5	1	21.4	21.2	21.3	2	22

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

- Reported SAR(W/kg) for WWAN = Measured SAR *Tune-up Scaling Factor

KDB 447498 D01 General RF Exposure Guidance:

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

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

KDB 941225 D05 SAR for LTE Devices:

SAR test reduction is applied using the following criteria:

- Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
- When the reported SAR is > 0.8 W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel.
- Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are > 0.8 W/kg. Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation < 1.45 W/kg.
- Testing for 16-QAM modulation is not required because the reported SAR for QPSK is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of QPSK.
- Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.
- For LTE bands that do not support at least three non-overlapping channels in certain channel bandwidths, test the available non-overlapping channels instead. 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; therefore, the requirement for H, M and L channels may not fully apply.

10.1. LTE Band 2 (20MHz Bandwidth)

RF Exposure Conditions	Mode	Power State	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
										Tune-up Limit	Meas.	Meas.	Scaled	
Body-Worn (In Holster)	QPSK	Maximum	Main	0	Rear	18900	1880.0	1	5	24.0	22.7	0.305	0.411	
						19100	1900.0	3	1	24.0	22.5	0.339	**0.479**	1
					Front	18900	1880.0	1	5	24.0	22.7	0.082	0.111	
						19100	1900.0	3	1	24.0	22.5	0.117	0.165	

10.2. LTE Band 4 (20MHz Bandwidth)

RF Exposure Conditions	Mode	Power State	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
										Tune-up Limit	Meas.	Meas.	Scaled	
Body-Worn (In Holster)	QPSK	Maximum	Main	0	Rear	20175	1732.5	1	3	24.0	23.3	0.277	0.325	
								3	1	24.0	22.7	0.299	0.403	2
					Front	20175	1732.5	1	3	24.0	23.3	0.036	0.042	
								3	1	24.0	22.7	0.039	0.053	

10.3. LTE Band 12 (10MHz Bandwidth)

RF Exposure Conditions	Mode	Power State	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
										Tune-up Limit	Meas.	Meas.	Scaled	
Body-Worn (In Holster)	QPSK	Maximum	Main	0	Rear	23095	707.5	1	3	24.0	23.3	0.159	0.187	
								3	3	24.0	23.2	0.164	0.197	3
					Front	23095	707.5	1	3	24.0	23.3	0.083	0.098	
								3	3	24.0	23.2	0.088	0.106	

11. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is < 0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	First Repeated		Second Repeated		Third Repeated
						Measured SAR (W/kg)	Largest to Smallest SAR Ratio	Measured SAR (W/kg)	Largest to Smallest SAR Ratio	Measured SAR (W/kg)
700	LTE Band 12	Body	Rear	No	0.164	N/A	N/A	N/A	N/A	N/A
1700	LTE Band 4	Body	Rear	No	0.299	N/A	N/A	N/A	N/A	N/A
1900	LTE Band 2	Body	Rear	No	0.339	N/A	N/A	N/A	N/A	N/A

Note(s):

Repeated measurement is not required since the original highest measured SAR is <0.8 W/kg (1-g) or 2 W/kg (10-g) .

Appendixes

Refer to separated files for the following appendixes.

Appendix A: SAR Setup Photos

Appendix B: SAR System Check Plots

Appendix C: SAR Highest Test Plots

Appendix D: SAR Tissue Ingredients

Appendix E: SAR Probe Certificates

Appendix F: SAR Dipole Certificates

END OF REPORT