KDB 865664 D01 SAR Measurement 100MHz to 6GHz
FCC 47 CFR part 2 (2.1093)

SAR EVALUATION REPORT

For

Cubic, Pole Mounted Antenna Assembly with LTE FDD Radio

Model: 5300-57022 REV C

Contains FCC ID: LVCVAL2

REPORT NUMBER UL-SAR-RP13040245-116A V1.0
ISSUE DATE: 16 MARCH 2020

Prepared for

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REVISION HISTORY

Version	Issue Date	Revisions	Revised By
1.0	16 March 2020	Initial Issue	--

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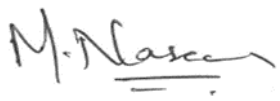
1. Attestation of Test Results

Applicant Name	Cubic Transport Systems Ltd					
Model	Pole Mounted Ant.					
Test Device is	A representative test sample					
Device category	Portable					
Date Tested	07 February 2020 to 18 February 2020					
ICNIRP Guidelines Limits for SAR Exposure Characteristics	General Population/Localised SAR (Head and trunk) – SAR limit 1.6 W/kg General Population/Localised SAR (Extremity) – SAR limit 4.0 W/kg					
The highest reported SAR values	RF Exposure Conditions		Equipment Class			
			Licensed	DTS	U-NII	DSS
	Standalone	Body-Worn	0.76 W/Kg	N/A	N/A	N/A
	Standalone	Extremity	0.89 W/Kg	N/A	N/A	N/A
	Simultaneous Transmission	Body-Worn	N/A	N/A	N/A	N/A
	Simultaneous Transmission	Extremity	N/A	N/A	N/A	N/A
Applicable Standards	FCC 47 CFR part 2 (2.1093) KDB publication					
Test Results	Pass					

UL Verification Services Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties are in accordance with the above standard and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample(s), under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Ltd. 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 UKAS. This report is written to support regulatory compliance of the applicable standards stated above.

Issued By:	Prepared By:
	
Naseer Mirza Lead Project Engineer UL VS Ltd.	Masood Khan Test Engineer UL VS Ltd.

2. Test Specification, Methods and Procedures

2.1. Test Specification

Reference:	KDB Publication Number: 865664 D01 SAR Measurement 100 MHz to 6 GHz
Title:	SAR Measurement Requirements for 100 MHz to 6 GHz
Introduction:	The SAR Measurement procedures for 100MHz to 6GHz are described in this document. Field probes, tissue dielectric properties, SAR scans, measurement accuracy and variability of the measured results are discussed. The field probe and SAR scan requirements are derived from criteria considered in standard IEEE 1528-2013. The wireless product and technology specific procedures in applicable KDB publications are required to be used unless further guidance has been approved by the FCC.
Purpose of Test:	To determine if the Equipment Under Test complies with the Specific Absorption Rate for general population/uncontrolled exposure limit of 1.6 W/kg as specified in FCC 47 CFR part 2 (2.1093).

2.2. Methods and Procedures Reference Documentation

The methods and procedures used were as detailed in:

IEEE 1528:2013

IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques.

FCC KDB Publication:
KDB 447498 D01 General RF Exposure Guidance v06
KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02 RF Exposure Reporting v01r02
KDB 941225 D05 SAR for LTE Devices v02r05

2.3. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Section 4.3 contains a list of the test equipment used.

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

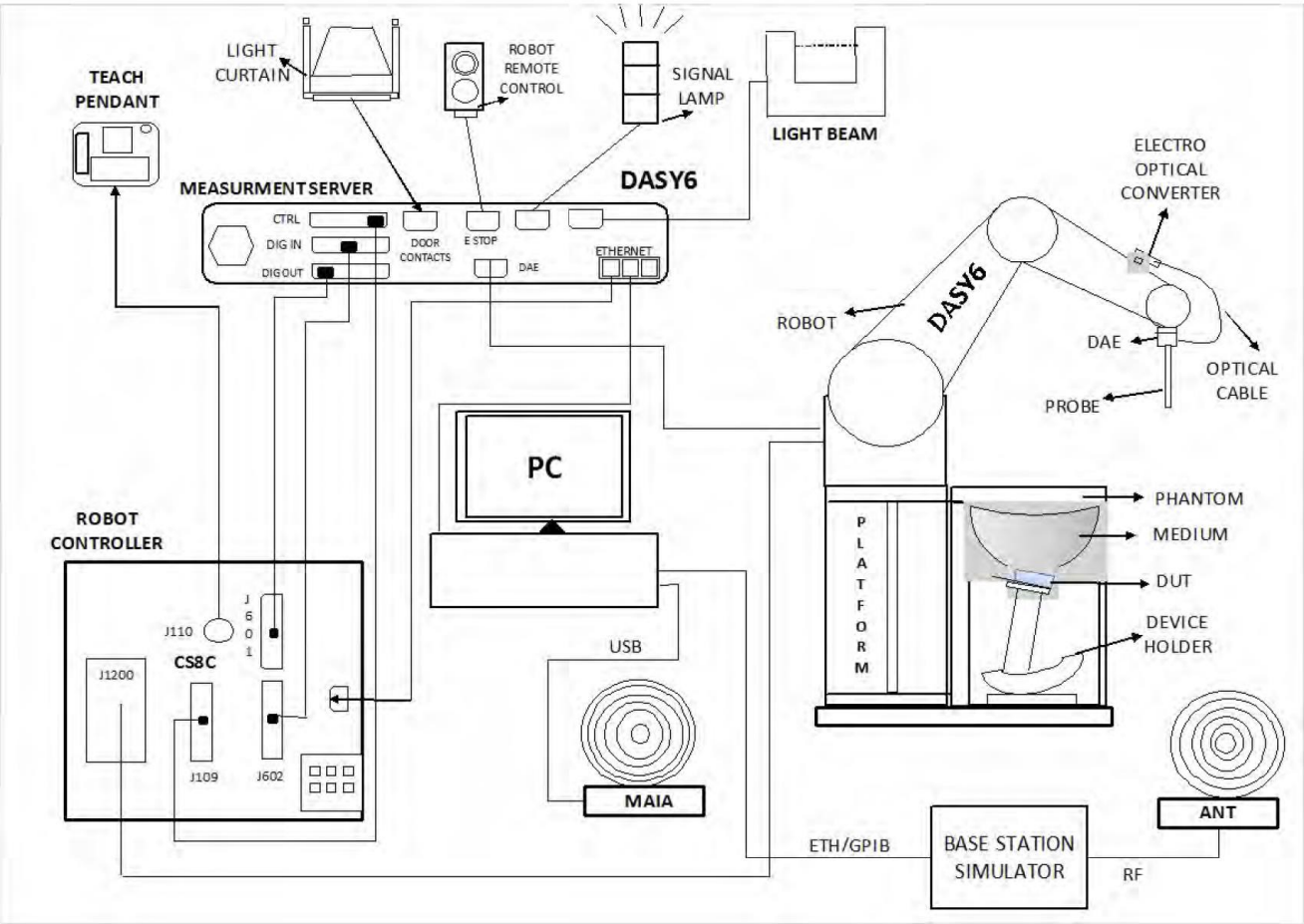
Unit 1-3 Horizon, Kingsland Business Park, Wade Road, Basingstoke, Hampshire, RG24 8AH UK	Facility Type
SAR Lab 59	Controlled Environment Chamber

UL Verification Services Ltd, is accredited by UKAS (United Kingdom Accreditation Service), Laboratory UKAS Code 0644.

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 Win 8.1 or Win 10 and the DASY software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

4.2. SAR Measurement Procedure

4.2.1. Normal SAR Measurement Procedure

The following procedure shall be performed for each of the test conditions Measure the local SAR at a test point within 8 mm of the phantom inner surface that is closest to the DUT.

a) Measure the two-dimensional SAR distribution within the phantom (area scan procedure).
b) The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grid spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3 GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δ ln(2)/2 mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and ln(x) is the natural logarithm. The maximum variation of the sensor-phantom surface distance shall be ± 1 mm for frequencies below 3 GHz and ± 0,5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5°. If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional uncertainty evaluation is needed.
c) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR compliance limit (e.g., 1 W/kg for 1,6 W /kg 1 g limit, or 1,26 W/kg for 2 W /kg, 10 g limit).
d) Measure the three-dimensional SAR distribution at the local maxima locations identified in step c) (zoom scan procedure). The horizontal grid step shall be (24 / f [GHz]) mm or less but not more than 8 mm. The minimum zoom scan size is 30 mm by 30 mm by 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom scan size can be reduced to 22 mm by 22 mm by 22 mm. The grid step in the vertical direction shall be (8-f [GHz]) mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be (12/f [GHz]) mm or less but not more than 4 mm, and the spacing between farther points shall increase by an incremental factor not exceeding 1,5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δ ln(2)/2 mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and ln(x) is the natural logarithm. Separate grids shall be centred on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved if the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5º.
e) Use post processing (e.g. interpolation and extrapolation) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.
f) The local SAR should be measured at the same location as in Step a). SAR drift is assessed and reported in the uncertainty budget.
In the event that the evaluation of measurement drift exceeds the 5 % tolerance, it is required that SAR be reassessed following guidelines contained within this standard.
If the drift is larger than 5 %, then the measurement drift shall be considered a bias, not an uncertainty. A correction shall be applied to the measured SAR value. It is not necessary to record the drift in the uncertainty budget (i.e. ui = 0 %). The uncertainty budget reported in a measurement report should correspond to the highest SAR value reported (after correction, if applicable). Alternatively, the uncertainty budget reported should cover all measurements, i.e., it should report a conservative value.

Area Scan Parameters:

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 mm ± 1 mm	$½·\delta·\ln(2)$ mm ± 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.	

Zoom Scan Parameters:

			≤ 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	≤ $1.5·\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

4.3. Test Equipment

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

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A1234	Data Acquisition Electronics	SPEAG	DAE4	450	09 Oct 2019	12
A2765	750 MHz Dipole Kit	SPEAG	D750V3	1147	15 Oct 2019	12
A2588	900 MHz Dipole Kit	SPEAG	D900V2	1d168	15 Oct 2019	12
PRE0178324	900 MHz Dipole Kit	SPEAG	D900V2	1d199	13 Mar 2019	12
PRE0178321	1800 MHz Dipole Kit	SPEAG	D1800V2	2d218	12 Mar 2019	12
PRE0178326	1900 MHz Dipole Kit	SPEAG	D1900V2	5d227	12 Mar 2019	12
PRE0178266	Probe	SPEAG	EX3DV4	7495	28 Mar 2019	12
A2440	Body Handset Positioner	SPEAG	MD4HACV5	None	Calibrated before use	-
A2169	Body Handset Positioner	SPEAG	MD4HACV5	None	Calibrated before use	-
A2811	Body Handset Positioner	SPEAG	MD4HACV5	None	Calibrated before use	-
A2441	Body Handset Positioner	SPEAG	MD4HACV5	None	Calibrated before use	-
PRE0179708	Body Handset Positioner	SPEAG	MD4HACV5-HAC	None	Calibrated as part of system	-
PRE0179706	Body Handset Positioner	SPEAG	MD4HACV5-HAC	None	Calibrated as part of system	-
PRE0179707	Body Handset Positioner	SPEAG	MD4HACV5-HAC	None	Calibrated as part of system	-
M1755	DAK Fluid Probe	SPEAG	SM DAK 040 CA	1089	Calibrated before use	-
A2621	Digital Camera	Nikon	S3600	41010357	N/A	-
M1015	Network Analyser	Agilent	8753ES	US39172406	02 Dec 2019	12
PRE0190819	Phantom	SPEAG	ELI V8.0	2100	Calibrated as part of system	-
PRE0141347	Phantom Support Structure	SPEAG	Phantom Table	-	Calibrated as part of system	-
PRE0159220	PowerSource1	SPEAG	SE UMS 160 AB	1025	10 May 2019	12
PRE0159221	PowerSource1	SPEAG	SE UMS 160 AC	1026	04 Feb 2020	12
PRE0191906	PowerSource1	SPEAG	SE UMS 160 BA	4012	01 Jun 2019	12
M1877	Robot Arm	Staubli	TX60 L	F14/5UA6A1/A/01	Calibrated as part of system	-
G0610	Robot Power Supply	SPEAG	DASY52	F13/5SC6F1/C/01	Calibrated as part of system	-
M1850	RS Hygrometer	RS Components	408-6109	D10Q61	20 Mar 2019	12

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
M1838	Signal Generator	R&S	SME06	831377/005	21 Mar 2019	12
M1023	Dual Channel Power Meter	R&S	NRVD	863715/030	27 Jan 2020	12
M1635	Power Sensor	R&S	NRV-Z1	826515/015	27 Jan 2020	12
M1634	Power Sensor	R&S	NRV-Z1	860462/016	27 Jan 2020	12
S0572	Laboratory DC Power Supply	ISO-TECH	ISO-TECH IPS 2303	227B058G2	Calibrated as part of system	-
PRE0141988	Directional Coupler	RF-Lambda	RFDC5M06G15	12042502539	Calibrated before use	-
A1938	Amplifier	Mini-Circuits	ZHL-42	QA0826002	Calibrated before use	-
PRE0176840	RF Coax Cable	Huber+Suhner	Superflex 126	503318	Calibrated before use	-
PRE0176848	RF Coax Cable	Huber+Suhner	Superflex 126	503319	Calibrated before use	-
PRE0176855	RF Coax Cable	Huber+Suhner	Superflex 126	503321	Calibrated before use	-
PRE0176839	RF Coax Cable	Huber+Suhner	Superflex 126	503324	Calibrated before use	-
PRE0176843	RF Coax Cable	Huber+Suhner	Superflex 126	503326	Calibrated before use	-
PRE0176846	RF Coax Cable	Huber+Suhner	Superflex 126	503322	Calibrated before use	-
M1866	Radio Communication Tester	R&S	CMW500	145922	07 Jan 2019	24

4.4. SAR System Specifications

Robot System	
Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Repeatability:	±0.030 mm
No. of Axis:	6
Serial Number(s):	F13/5SC6F1/A/01
Reach:	920 mm
Payload:	2.0 kg
Control Unit:	CS8C
Programming Language:	V+
Data Acquisition Electronic (DAE) System	
Serial Number:	DAE4 SN:450
PC Controller	
PC:	HP EliteDesk800
Operating System:	Windows 10
Data Card:	DASY Measurement Servers
Data Controller	
Features:	Signal Amplifier, multiplexer, A/D converted and control logic.
Software:	cDASY6 Software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock.
PC Interface Card	
Function:	24 bit (64 MHz) DSP for real time processing Link to DAE4 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.
Phantom	
Phantom:	ELI Phantom
Shell Material:	Fibreglass
Thickness:	2.0 ±0.1 mm
E-Field Probe	
Model:	EX3DV4
Serial No:	7495
Construction:	Triangular core
Frequency:	10MHz to >6GHz
Linearity:	±0.2 dB (30 MHz to 6 GHz)
Probe Length (mm):	337
Probe Diameter (mm):	10
Tip Length (mm):	9
Tip Diameter (mm):	2.5
Sensor X Offset (mm):	1
Sensor Y Offset (mm):	1
Sensor Z Offset (mm):	1

5. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Test Name	Confidence Level	Calculated Uncertainty
Uncertainty- Freq. < 3 GHz Body Configuration 1g	95 %	±28.54 %
Uncertainty- Freq. < 3 GHz Body Configuration 10g	95%	±25.37 %
Uncertainty- Freq. > 3 GHz Body Configuration 1g	95 %	±26.64 %
Uncertainty- Freq. > 3 GHz Body Configuration 10g	95%	±24.70 %

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

5.1. Uncertainty – Freq. < 3 GHz Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (1g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	10.100	10.100	normal (k=2)	2.0000	1.0000	5.050	5.050	∞
B	Axial Isotropy	0.500	0.500	Rectangular	1.7321	0.7071	0.204	0.204	∞
B	Hemispherical Isotropy	2.600	2.600	Rectangular	1.7321	0.7071	1.061	1.061	∞
B	Boundary Effect	1.000	1.000	Rectangular	1.7321	1.0000	0.577	0.577	∞
B	Linearity	0.600	0.600	normal (k=2)	2.0000	1.0000	0.300	0.300	∞
B	Detection Limits	0.250	0.250	Rectangular	1.7321	1.0000	0.144	0.144	∞
B	Readout Electronics	0.300	0.300	normal (k=1)	1.0000	1.0000	0.300	0.300	∞
B	Modulation Response Time	9.600	9.600	normal (k=2)	2.0000	1.0000	4.800	4.800	∞
B	Response Time	1.010	1.010	Rectangular	1.7321	1.0000	0.583	0.583	∞
B	Integration Time	4.320	4.320	Rectangular	1.7321	1.0000	2.494	2.494	∞
B	RF Ambient conditions	0.260	0.260	Rectangular	1.7321	1.0000	0.150	0.150	∞
B	Probe Positioner Mechanical Tolerance	0.020	0.020	Rectangular	1.7321	1.0000	0.012	0.012	∞
B	Probe Positioning with regard to Phantom Shell	0.400	0.400	Rectangular	1.7321	1.0000	0.231	0.231	∞
B	Extrapolation and integration/ Maximum SAR evaluation	2.000	2.000	Rectangular	1.7321	1.0000	1.155	1.155	∞
A	Test Sample Positioning	5.730	5.730	normal (k=1)	1.0000	1.0000	5.730	5.730	34.5
A	Device Holder uncertainty	7.480	7.480	normal (k=1)	1.0000	1.0000	7.480	7.480	5
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Phantom Shell Uncertainty	5.700	5.700	Rectangular	1.7321	1.0000	3.291	3.291	∞
B	Uncertainty in SAR correction for deviations in permittivity and conductivity	1.900	1.900	Rectangular	1.7321	1.0000	1.097	1.097	∞
B	Liquid Conductivity (measured value)	10.580	10.580	normal (k=1)	1.0000	0.5543	5.865	5.865	∞
B	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.2261	1.131	1.131	∞
B	Liquid Conductivity (temperature uncertainty)	1.300	1.300	Rectangular	1.7321	1.0000	0.751	0.751	∞
B	Liquid Permittivity (temperature uncertainty)	0.320	0.320	Rectangular	1.7321	1.0000	0.185	0.185	∞
	Combined standard uncertainty			t-distribution			14.27	14.27	63
	Expanded uncertainty			k = 2			28.54	28.54	63

5.2. Uncertainty – Freq. < 3 GHz Body Configuration 10g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (1g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	10.100	10.100	normal (k=2)	2.0000	1.0000	5.050	5.050	∞
B	Axial Isotropy	0.500	0.500	Rectangular	1.7321	0.7071	0.204	0.204	∞
B	Hemispherical Isotropy	2.600	2.600	Rectangular	1.7321	0.7071	1.061	1.061	∞
B	Boundary Effect	1.000	1.000	Rectangular	1.7321	1.0000	0.577	0.577	∞
B	Linearity	0.600	0.600	normal (k=2)	2.0000	1.0000	0.300	0.300	∞
B	Detection Limits	0.250	0.250	Rectangular	1.7321	1.0000	0.144	0.144	∞
B	Readout Electronics	0.300	0.300	normal (k=1)	1.0000	1.0000	0.300	0.300	∞
B	Modulation Response Time	9.600	9.600	normal (k=2)	2.0000	1.0000	4.800	4.800	∞
B	Response Time	1.010	1.010	Rectangular	1.7321	1.0000	0.583	0.583	∞
B	Integration Time	4.320	4.320	Rectangular	1.7321	1.0000	2.494	2.494	∞
B	RF Ambient conditions	0.260	0.260	Rectangular	1.7321	1.0000	0.150	0.150	∞
B	Probe Positioner Mechanical Tolerance	0.020	0.020	Rectangular	1.7321	1.0000	0.012	0.012	∞
B	Probe Positioning with regard to Phantom Shell	0.400	0.400	Rectangular	1.7321	1.0000	0.231	0.231	∞
B	Extrapolation and integration/ Maximum SAR evaluation	2.000	2.000	Rectangular	1.7321	1.0000	1.155	1.155	∞
A	Test Sample Positioning	5.650	5.650	normal (k=1)	1.0000	1.0000	5.650	5.650	34.5
A	Device Holder uncertainty	6.090	6.090	normal (k=1)	1.0000	1.0000	6.090	6.090	5
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Phantom Shell Uncertainty	5.700	5.700	Rectangular	1.7321	1.0000	3.291	3.291	∞
B	Uncertainty in SAR correction for deviations in permittivity and conductivity	1.900	1.900	Rectangular	1.7321	1.0000	1.097	1.097	∞
B	Liquid Conductivity (measured value)	10.580	10.580	normal (k=1)	1.0000	0.3291	3.482	3.482	∞
B	Liquid Permittivity (measured value)	5.000	5.000	normal (k=1)	1.0000	0.1461	0.730	0.730	∞
B	Liquid Conductivity (temperature uncertainty)	1.300	1.300	Rectangular	1.7321	1.0000	0.751	0.751	∞
B	Liquid Permittivity (temperature uncertainty)	0.320	0.320	Rectangular	1.7321	1.0000	0.185	0.185	∞
	Combined standard uncertainty			t-distribution			12.68	12.68	84
	Expanded uncertainty			k = 2			25.37	25.37	84

5.3. Uncertainty – Freq. > 3 GHz Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (1g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	10.100	10.100	normal (k=2)	2.0000	1.0000	5.050	5.050	∞
B	Axial Isotropy	0.500	0.500	Rectangular	1.7321	0.7071	0.204	0.204	∞
B	Hemispherical Isotropy	2.600	2.600	Rectangular	1.7321	0.7071	1.061	1.061	∞
B	Boundary Effect	2.000	2.000	Rectangular	1.7321	1.0000	1.155	1.155	∞
B	Linearity	0.600	0.600	normal (k=2)	2.0000	1.0000	0.300	0.300	∞
B	Detection Limits	0.250	0.250	Rectangular	1.7321	1.0000	0.144	0.144	∞
B	Readout Electronics	0.300	0.300	normal (k=1)	1.0000	1.0000	0.300	0.300	∞
B	Modulation Response Time	9.600	9.600	normal (k=2)	2.0000	1.0000	4.800	4.800	∞
B	Response Time	1.010	1.010	Rectangular	1.7321	1.0000	0.583	0.583	∞
B	Integration Time	2.500	2.500	Rectangular	1.7321	1.0000	1.443	1.443	∞
B	RF Ambient conditions	0.260	0.260	Rectangular	1.7321	1.0000	0.150	0.150	∞
B	Probe Positioner Mechanical Tolerance	0.040	0.040	Rectangular	1.7321	1.0000	0.023	0.023	∞
B	Probe Positioning with regard to Phantom Shell	0.800	0.800	Rectangular	1.7321	1.0000	0.462	0.462	∞
B	Extrapolation and integration/ Maximum SAR evaluation	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
A	Test Sample Positioning	5.730	5.730	normal (k=1)	1.0000	1.0000	5.730	5.730	34.5
A	Device Holder uncertainty	7.480	7.480	normal (k=1)	1.0000	1.0000	7.480	7.480	5
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Phantom Shell Uncertainty	6.100	6.100	Rectangular	1.7321	1.0000	3.522	3.522	∞
B	Uncertainty in SAR correction for deviations in permittivity and conductivity	1.900	1.900	Rectangular	1.7321	1.0000	1.097	1.097	∞
B	Liquid Conductivity (measured value)	6.020	6.020	normal (k=1)	1.0000	0.2466	1.485	1.485	∞
B	Liquid Permittivity (measured value)	4.550	4.550	normal (k=1)	1.0000	0.1987	0.904	0.904	∞
B	Liquid Conductivity (temperature uncertainty)	1.430	1.430	Rectangular	1.7321	1.0000	0.826	0.826	∞
B	Liquid Permittivity (temperature uncertainty)	0.310	0.310	Rectangular	1.7321	1.0000	0.179	0.179	∞
	Combined standard uncertainty			t-distribution			13.18	13.18	45
	Expanded uncertainty			k = 2.021			26.64	26.64	45

5.4. Uncertainty – Freq. > 3 GHz Body Configuration 10g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (1g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	10.100	10.100	normal (k=2)	2.0000	1.0000	5.050	5.050	∞
B	Axial Isotropy	0.500	0.500	Rectangular	1.7321	0.7071	0.204	0.204	∞
B	Hemispherical Isotropy	2.600	2.600	Rectangular	1.7321	0.7071	1.061	1.061	∞
B	Boundary Effect	2.000	2.000	Rectangular	1.7321	1.0000	1.155	1.155	∞
B	Linearity	0.600	0.600	normal (k=2)	2.0000	1.0000	0.300	0.300	∞
B	Detection Limits	0.250	0.250	Rectangular	1.7321	1.0000	0.144	0.144	∞
B	Readout Electronics	0.300	0.300	normal (k=1)	1.0000	1.0000	0.300	0.300	∞
B	Modulation Response Time	9.600	9.600	normal (k=2)	2.0000	1.0000	4.800	4.800	∞
B	Response Time	1.010	1.010	Rectangular	1.7321	1.0000	0.583	0.583	∞
B	Integration Time	2.500	2.500	Rectangular	1.7321	1.0000	1.443	1.443	∞
B	RF Ambient conditions	0.260	0.260	Rectangular	1.7321	1.0000	0.150	0.150	∞
B	Probe Positioner Mechanical Tolerance	0.040	0.040	Rectangular	1.7321	1.0000	0.023	0.023	∞
B	Probe Positioning with regard to Phantom Shell	0.800	0.800	Rectangular	1.7321	1.0000	0.462	0.462	∞
B	Extrapolation and integration/ Maximum SAR evaluation	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
A	Test Sample Positioning	5.650	5.650	normal (k=1)	1.0000	1.0000	5.650	5.650	34.5
A	Device Holder uncertainty	6.090	6.090	normal (k=1)	1.0000	1.0000	6.090	6.090	5
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Phantom Shell Uncertainty	6.100	6.100	Rectangular	1.7321	1.0000	3.522	3.522	∞
B	Uncertainty in SAR correction for deviations in permittivity and conductivity	1.900	1.900	Rectangular	1.7321	1.0000	1.097	1.097	∞
B	Liquid Conductivity (measured value)	6.020	6.020	normal (k=1)	1.0000	0.0792	0.477	0.477	∞
B	Liquid Permittivity (measured value)	4.550	4.550	normal (k=1)	1.0000	0.2551	1.161	1.161	∞
B	Liquid Conductivity (temperature uncertainty)	1.430	1.430	Rectangular	1.7321	1.0000	0.826	0.826	∞
B	Liquid Permittivity (temperature uncertainty)	0.310	0.310	Rectangular	1.7321	1.0000	0.179	0.179	∞
	Combined standard uncertainty			t-distribution			12.35	12.35	76
	Expanded uncertainty			k = 2			24.70	24.70	76

6. Device Under Test (DUT) Information

6.1. DUT Description

DUT Description:	DUT is a unit containing one transmit/receive antenna (LTE) and two receive antennae for LTE diversity and GNSS. The unit is intended to be installed typically on public transport vehicles, attached to an internal pole. The antenna unit would be connected to a card-reader (validator) by three coaxial cables. The validator provides Tx & Rx functions, transmitting up to +23dBm on various LTE bands between 700MHz and 2700MHz.		
Validator Serial Number:	T000059	SAR Evaluation	
	T000059	Conducted Power Measurements	
Hardware Version Number:	5300-57022 REV C		
Software Version Number:	TR4HLD1.1		
Country of Manufacture:	USA		
Device dimension	Overall (Height x Width x Depth): 150.0 mm x 43.0 mm x 33.0 mm (excluding mounting pole of approximately 800.0 mm)		
Date of Receipt:	6 February 2019		
Antenna Type:	Internal Integral		
Antenna Length:	As specified in Appendix 12.1		
Number of Antenna Positions:	Main Antenna – Tx / Rx – Cellular		1 fixed
	Diversity Antenna – Rx – Cellular		1 fixed
	GNSS Antenna – Rx		1 fixed
Battery Type(s):	External AC Mains Supply 240 (V), 1 (A)		

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle
LTE ☒ (FDD)	Band 2 Band 4 Band 5 Band 13	QPSK 16QAM	100% (FDD)
	Does this device SV-LTE (1xRTT-LTE)? ☐Yes ☒ No		

Additional Information Related to Testing:

LTE							
Band	**Description**						
LTE FDD 2	Frequency Range: 1850 - 1910 MHz						
	Channel Description	Channel Bandwidth					
		20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz
		Channel No. / Freq. (MHz)					
	Low	18700 / 1860.0	18675 / 1857.5	18650 / 1855.0	18625 / 1852.5	18615 / 1851.5	18607 / 1850.7
	Mid	18900 / 1880.0	18900 / 1880.0	18900 / 1880.0	18900 / 1880.0	18900 / 1880.0	18900 / 1880.0
	High	19100 / 1970.0	19125 / 1972.5	19150 / 1975	19175 / 1977.5	19185 / 1908.5	19193 / 1909.3
LTE FDD 4	Frequency Range: 1710 - 1755 MHz						
	Channel Description	Channel Bandwidth					
		20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz
		Channel No. / Freq. (MHz)					
	Low	20050/ 1720.0	20025/ 1717.5	20000/ 1715.0	19975/ 1712.5	19965/ 1711.5	19957/ 1710.7
	Mid	20175/ 1732.5	20175/ 1732.5	20175/ 1732.5	20175/ 1732.5	20175/ 1732.5	20175/ 1732.5
	High	20300/ 1745.0	20325/ 1747.5	20350/ 1750.0	20375/ 1752.5	20385/ 1753.5	20393/ 1754.3
LTE FDD 5	Frequency Range: 824 - 849 MHz						
	Channel Description	Channel Bandwidth					
		20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz
		Channel No. / Freq. (MHz)					
	Low			20450/ 829.0	20425/ 826.5	20415/ 825.5	20407/ 824.7
	Mid			20525/ 836.5	20525/ 836.5	20525/ 836.5	20525/ 836.5
	High			20600/ 844.0	20625/ 846.5	20635/ 847.5	20643/ 848.3
LTE FDD 13	Frequency Range: 777 - 787 MHz						
	Channel Description	Channel Bandwidth					
		20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz
		Channel No. / Freq. (MHz)					
	Low				23205 / 779.5		
	Mid			23230 / 782.0	23230 / 782.0		
	High				23255 / 784.5		

6.3. Nominal and Maximum Output power

RF Air interface	Mode	Target + Max. Tolerances (dBm)
LTE FDD 2	QPSK (1RB)	23.0
	QPSK (50% RB)	22.0
	QPSK(100% RB)	22.0
	16-QAM (1RB)	22.0
	16-QAM (50% RB)	21.0
	16-QAM (100% RB)	21.0
LTE FDD 4	QPSK (1RB)	23.0
	QPSK (50% RB)	22.0
	QPSK(100% RB)	22.0
	16-QAM (1RB)	22.0
	16-QAM (50% RB)	21.0
	16-QAM (100% RB)	21.0
LTE FDD 5	QPSK (1RB)	23.0
	QPSK (50% RB)	22.0
	QPSK(100% RB)	22.0
	16-QAM (1RB)	22.0
	16-QAM (50% RB)	21.0
	16-QAM (100% RB)	21.0
LTE FDD 13	QPSK (1RB)	23.0
	QPSK (50% RB)	22.0
	QPSK(100% RB)	22.0
	16-QAM (1RB)	22.0
	16-QAM (50% RB)	21.0
	16-QAM (100% RB)	21.0

Note:

1. The nominal and maximum average source based rated powers declared and supplied by manufacturer are shown in the above tables and including of the Upper Tolerance.
2. These are specified maximum allowed average power for all the wireless modes and frequency bands supported.

7. RF Exposure Conditions (Test Configurations)

7.1. Configuration Consideration

Technology Antenna	Configuration	Antenna-to-User Separation	Position	Antenna-to-Edge Separation (mm)	Evaluation Considered
Cellular Antenna WWAN	Extremity[2]	0mm	Front	< 25	Yes
			Back	< 25	Yes
			Edge 1 (Top)	< 25	Yes
			Edge 2 (Right)	< 25	Yes
			Edge 3 (Bottom)	> 25	No
			Edge 4 (Left)	< 25	Yes
Cellular Antenna WWAN	Body-worn[2]	5mm	Front	< 25	Yes
			Back	< 25	Yes
			Edge 1 (Top)	< 25	Yes
			Edge 2 (Right)	< 25	Yes
			Edge 3 (Bottom)	> 25	No
			Edge 4 (Left)	< 25	Yes

Note:

1. The Antenna to edge separation distances are indicated in the 'Antenna Schematics' located in Section 12.1 of this report.
2. Prior to testing, FCC was contacted for test approach and agreed the 0mm and 5mm separation distance for extremity and body-worn configuration respectively.

7.2. SAR Test Exclusion Consideration

Frequency Band	Configuration(s)
	Body
LTE FDD 2	No
LTE FDD 4	No
LTE FDD 5	No
LTE FDD 13	No

Note:

1. As per KDB publication 447498 D01, the frequency bands with rated power including upper tolerance, which qualify for Standalone Test Exclusion, are as per the above table.
2. The details for the Maximum Rated Power and tolerance(s) can be found in section 6.

8. Conducted Output Power Measurements

8.1.1. LTE FDD Band 2 – Body/Extremity

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	49 Offset	99 Offset	0 Offset	25 Offset	50 Offset	
20	Body / Extremity	QPSK	18700	1860.0	21.98	21.31	21.05	20.63	20.28	20.31	20.41
			18900	1880.0	21.80	21.44	21.51	20.74	20.48	20.52	20.67
			19100	1900.0	22.10	21.66	21.36	20.95	20.72	20.62	20.82
		16QAM	18700	1860.0	21.31	20.80	20.53	19.67	19.33	19.26	19.50
			18900	1880.0	21.12	20.58	20.68	19.64	19.51	19.54	19.68
			19100	1900.0	21.17	20.79	20.43	20.00	19.71	19.60	19.79
Ch.BW (MHz)	**Config**	**Mode**	**Channel**	**Frequency (MHz)**	**Measured Avg Power (dBm)**						
					1RB			**50%RB**			**100%RB**
					0 Offset	**37 Offset**	**74 Offset**	**0 Offset**	**19 Offset**	**39 Offset**	
15	Body / Extremity	QPSK	18675	1857.5	22.03	21.46	21.41	20.69	20.43	20.33	20.57
			18900	1880.0	21.88	21.55	21.54	20.76	20.59	20.61	20.66
			19125	1902.5	22.22	21.73	21.59	21.01	20.82	20.70	20.87
		16QAM	18675	1857.5	21.20	20.70	20.63	19.75	19.51	19.48	19.47
			18900	1880.0	21.13	20.81	20.82	19.71	19.61	19.63	19.70
			19125	1902.5	21.67	21.24	21.06	20.02	19.82	19.72	19.98
Ch.BW (MHz)	**Config**	**Mode**	**Channel**	**Frequency (MHz)**	**Measured Avg Power (dBm)**						
					1RB			**50%RB**			**100%RB**
					0 Offset	**25 Offset**	**49 Offset**	**0 Offset**	**13 Offset**	**25 Offset**	
10	Body / Extremity	QPSK	18650	1855.0	21.76	21.51	21.43	20.65	20.53	20.48	20.56
			18900	1880.0	21.78	21.56	21.56	20.60	20.52	20.54	20.60
			19150	1905.0	22.01	21.67	21.58	20.86	20.71	20.66	20.75
		16QAM	18650	1855.0	20.75	20.50	20.43	19.71	19.59	19.51	19.59
			18900	1880.0	20.97	20.76	20.77	19.70	19.60	19.60	19.58
			19150	1905.0	21.43	21.16	21.00	19.93	19.80	19.72	19.83
Ch.BW (MHz)	**Config**	**Mode**	**Channel**	**Frequency (MHz)**	**Measured Avg Power (dBm)**						
					1RB			**50%RB**			**100%RB**
					0 Offset	**13 Offset**	**24 Offset**	**0 Offset**	**7 Offset**	**13 Offset**	
5	Body / Extremity	QPSK	18700	1852.5	21.88	21.75	21.69	20.80	20.78	20.70	20.68
			18900	1880.0	21.65	21.61	21.57	20.59	20.54	20.54	20.56
			19175	1907.5	21.89	21.80	21.71	20.77	20.72	20.67	20.74
		16QAM	18700	1852.5	20.91	20.84	20.73	19.79	19.72	19.68	19.81
			18900	1880.0	20.69	20.66	20.65	19.55	19.52	19.53	19.54
			19175	1907.5	20.60	20.42	20.41	19.81	19.74	19.69	19.72
Ch.BW (MHz)	**Config**	**Mode**	**Channel**	**Frequency (MHz)**	**Measured Avg Power (dBm)**						
					1RB			**50%RB**			**100%RB**
					0 Offset	**8 Offset**	**14 Offset**	**0 Offset**	**4 Offset**	**7 Offset**	
3	Body / Extremity	QPSK	18615	1851.5	21.85	21.76	21.74	20.80	20.79	20.82	20.67
			18900	1880.0	21.64	21.62	21.56	20.56	20.50	20.55	20.55
			19185	1908.5	21.75	21.64	21.60	20.74	20.65	20.61	20.67
		16QAM	18615	1851.5	20.87	20.81	20.76	19.87	19.83	19.85	19.84
			18900	1880.0	20.79	20.77	20.71	19.64	19.63	19.67	19.65
			19185	1908.5	21.19	21.12	20.98	19.86	19.79	19.77	19.74
Ch.BW (MHz)	**Config**	**Mode**	**Channel**	**Frequency (MHz)**	**Measured Avg Power (dBm)**						
					1RB			**50%RB**			**100%RB**
					0 Offset	**3 Offset**	**5 Offset**	**0 Offset**	**2 Offset**	**3 Offset**	
1.4	Body / Extremity	QPSK	18607	1850.7	21.73	21.67	21.73	21.76	21.73	21.73	20.73
			18900	1880.0	21.64	21.61	21.61	21.69	21.69	21.68	20.65
			19193	1909.3	21.76	21.67	21.71	21.79	21.76	21.73	20.69
		16QAM	18607	1850.7	20.83	20.77	20.83	20.91	20.92	20.90	19.85
			18900	1880.0	20.85	20.79	20.82	20.50	20.58	20.57	19.66
			19193	1909.3	20.86	20.79	20.78	20.66	20.59	20.59	19.75

8.1.2. LTE FDD Band 4 – Body/Extremity

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	49 Offset	99 Offset	0 Offset	25 Offset	50 Offset	
20	Body / Extremity	QPSK	20050	1720.0	22.01	21.48	21.35	20.92	20.65	20.62	20.79
			20175	1732.5	22.17	21.61	21.63	21.03	20.75	20.78	20.85
			20300	1745.0	22.12	21.72	21.75	21.09	20.89	20.92	21.11
		16QAM	20050	1720.0	21.59	21.04	20.89	19.89	19.61	19.57	19.82
			20175	1732.5	21.41	20.89	20.89	19.94	19.70	19.75	19.91
			20300	1745.0	21.32	20.99	20.88	20.04	19.84	19.85	20.03
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	37 Offset	74 Offset	0 Offset	19 Offset	39 Offset	
15	Body / Extremity	QPSK	20025	1717.5	22.06	21.62	21.56	20.92	20.71	20.66	20.78
			20175	1732.5	22.09	21.72	21.78	20.92	20.78	20.82	20.93
			20325	1747.5	22.28	22.00	22.02	21.20	21.10	21.11	21.16
		16QAM	20025	1717.5	21.43	21.00	20.98	19.97	19.81	19.77	19.81
			20175	1732.5	21.38	21.02	21.01	19.99	19.87	19.88	19.98
			20325	1747.5	21.84	21.54	21.61	20.24	20.10	20.14	20.28
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	25 Offset	49 Offset	0 Offset	13 Offset	25 Offset	
10	Body / Extremity	QPSK	20000	1715	21.80	21.56	21.52	20.79	20.69	20.62	20.70
			20175	1732.5	21.89	21.76	21.69	20.94	20.81	20.77	20.86
			20350	1750	22.22	21.98	22.03	21.15	21.08	21.08	21.14
		16QAM	20000	1715.0	21.01	20.74	20.71	19.88	19.76	19.74	19.80
			20175	1732.5	21.21	20.93	20.94	19.95	19.86	19.86	19.94
			20350	1750.0	21.76	21.55	21.58	20.26	20.18	20.17	20.15
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	13 Offset	24 Offset	0 Offset	7 Offset	13 Offset	
5	Body / Extremity	QPSK	19975	1712.5	21.63	21.59	21.56	20.77	20.68	20.67	20.66
			20175	1732.5	21.86	21.78	21.69	20.85	20.83	20.78	20.79
			20375	1752.5	22.23	22.16	22.25	21.22	21.17	21.16	21.15
		16QAM	19975	1712.5	20.91	20.78	20.76	19.76	19.73	19.70	19.80
			20175	1732.5	20.93	20.87	20.87	19.82	19.77	19.76	19.81
			20375	1752.5	21.01	20.97	20.95	20.25	20.21	20.22	20.17
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	8 Offset	14 Offset	0 Offset	4 Offset	7 Offset	
3	Body / Extremity	QPSK	19965	1851.5	21.67	21.59	21.59	20.72	20.68	20.70	20.67
			20175	1732.5	21.72	21.69	21.69	20.79	20.73	20.75	20.80
			20385	1753.5	22.10	22.07	22.04	21.21	21.15	21.20	21.16
		16QAM	19965	1711.5	20.78	20.73	20.65	19.79	19.76	19.79	19.75
			20175	1732.5	20.98	20.93	20.95	19.88	19.83	19.91	19.96
			20385	1753.5	21.60	21.58	21.51	20.33	20.28	20.29	20.23
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	3 Offset	5 Offset	0 Offset	2 Offset	3 Offset	
1.4	Body / Extremity	QPSK	19957	1710.7	21.68	21.54	21.57	21.64	21.65	21.65	20.69
			20175	1732.5	21.72	21.63	21.66	21.75	21.73	21.64	20.77
			20393	1754.3	22.12	22.13	22.13	22.19	22.17	22.13	21.16
		16QAM	19957	1710.7	20.86	20.80	20.82	20.64	20.61	20.60	19.83
			20175	1732.5	20.98	21.02	21.00	21.00	21.05	20.96	19.97
			20393	1754.3	21.36	21.41	21.42	21.13	21.14	21.18	20.26

8.1.3. LTE FDD Band 5 – Body/Extremity

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	25 Offset	49 Offset	0 Offset	13 Offset	25 Offset	
10	Body / Extremity	QPSK	20450	829.0	22.54	22.55	22.41	21.63	21.59	21.57	21.61
			20525	836.5	22.58	22.42	22.30	21.59	21.52	21.47	21.60
			20600	844.0	22.48	22.34	22.20	21.53	21.48	21.43	21.48
		16QAM	20450	829.0	21.76	21.75	21.61	20.78	20.56	20.69	20.68
			20525	836.5	21.97	21.75	21.60	20.69	20.61	20.45	20.56
			20600	844.0	21.72	21.92	21.73	20.64	20.53	20.46	20.50
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	13 Offset	24 Offset	0 Offset	7 Offset	13 Offset	
5	Body / Extremity	QPSK	20425	826.5	22.49	22.57	22.52	21.62	21.61	21.59	21.53
			20525	836.6	22.5	22.50	22.39	21.55	21.52	21.49	21.51
			20625	846.5	22.47	22.39	22.30	21.44	21.38	21.31	21.43
		16QAM	20450	829.0	21.67	21.78	21.66	20.69	20.65	20.60	20.71
			20525	836.6	21.61	21.69	21.54	20.59	20.50	20.47	20.55
			20600	844.0	21.25	21.20	21.13	20.51	20.41	20.44	20.37
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	8 Offset	14 Offset	0 Offset	4 Offset	7 Offset	
3	Body / Extremity	QPSK	20415	825.5	22.57	22.56	22.57	21.69	21.62	21.68	21.57
			20525	836.6	22.47	22.48	22.42	21.62	21.55	21.55	21.58
			20635	847.5	22.39	22.36	22.31	21.45	21.30	21.40	21.34
		16QAM	20415	825.5	21.64	21.71	21.67	20.77	20.74	20.76	20.72
			20525	836.6	21.89	21.73	21.71	20.73	20.71	20.73	20.70
			20635	847.5	21.88	21.84	21.67	20.58	20.53	20.52	20.46
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	3 Offset	5 Offset	0 Offset	2 Offset	3 Offset	
1.4	Body / Extremity	QPSK	20407	824.7	22.59	22.56	22.63	22.60	22.56	22.52	21.59
			20525	836.6	22.49	22.48	22.52	22.57	22.58	22.55	21.59
			20643	848.3	22.37	22.29	22.31	22.39	22.39	22.40	21.33
		16QAM	20407	824.7	21.79	21.77	21.80	21.82	21.85	21.83	20.79
			20525	836.6	21.83	21.82	21.80	21.57	21.46	21.48	20.64
			20643	848.3	21.58	21.57	21.55	21.40	21.40	21.38	20.53

8.1.4. LTE FDD Band 13 – Body/Extremity

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	25 Offset	49 Offset	0 Offset	13 Offset	25 Offset	
10	Body / Extremity	QPSK	-	-	-	-	-	-	-	-	-
			23230	782.0	22.08	22.30	21.73	21.52	21.56	21.53	21.60
			-	-	-	-	-	-	-	-	-
		16QAM	-	-	-	-	-	-	-	-	-
			23230	782.0	21.67	21.82	21.28	20.73	20.72	20.62	20.69
			-	-	-	-	-	-	-	-	-

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm)						
					1RB			50%RB			100%RB
					0 Offset	13 Offset	24 Offset	0 Offset	7 Offset	13 Offset	
5	Body / Extremity	QPSK	23205	779.5	22.44	22.45	22.40	21.58	21.56	21.55	21.51
			23230	782.0	22.44	22.56	22.37	21.54	21.52	21.49	21.51
			23255	784.5	22.51	22.47	22.30	21.46	21.39	21.44	21.49
		16QAM	23205	779.5	21.58	21.61	21.58	20.65	20.65	20.63	20.75
			23230	782.0	21.62	21.66	21.54	20.58	20.51	20.57	20.55
			23255	784.5	21.32	21.24	21.14	20.64	20.58	20.50	20.56

9. Dielectric Property Measurements & System Check

9.1.Tissue Dielectric Parameters

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.

IEEE 1528:2013

Target Frequency (MHz)	Head		Body (FCC only)	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.30	0.76	61.90	0.80
300	45.30	0.87	58.20	0.92
450	43.50	0.87	56.70	0.94
750	41.90	0.89	-	-
835	41.50	0.90	55.20	0.97
900	41.50	0.97	55.00	1.05
915	41.50	0.98	55.00	1.06
1450	40.50	1.20	54.00	1.30
1500	40.40	1.23	-	-
1610	40.30	1.29	53.80	1.40
1640	40.20	1.31	-	-
1750	40.10	1.37	-	-
1800	40.00	1.40	53.30	1.52
1900	40.00	1.40	53.30	1.52
2000	40.00	1.40	53.30	1.52
2100	39.80	1.49	-	-
2300	39.50	1.67	-	-
2450	39.20	1.80	52.70	1.95
2600	39.00	1.96	-	-
3000	38.50	2.40	52.00	2.73
3500	37.90	2.91	-	-
4000	37.40	3.43	-	-
4500	36.80	3.94	-	-
5000	36.20	4.45	49.30	5.07
5100	36.10	4.55	49.10	5.18
5200	36.00	4.66	49.00	5.30
5250	35.90	4.71	48.90	5.36
5300	35.90	4.76	48.90	5.42
5400	35.80	4.86	48.70	5.53
5500	35.60	4.96	48.60	5.65
5600	35.50	5.07	48.50	5.77
5700	35.40	5.17	48.30	5.88
5750	35.40	5.22	48.30	5.94
5800	35.30	5.27	48.20	6.00
6000	35.10	5.48	-	-

NOTE: For convenience, permittivity and conductivity values at some frequencies that are not part of the original data from Drossos et al. [B60] or the extension to 5800 MHz are provided (i.e., the values shown in italics). These values were linearly interpolated between the values in this table that are immediately above and below these values, except the values at 6000 MHz that were linearly extrapolated from the values at 3000 MHz and 5800 MHz.

9.2. 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.

9.3. Reference Target SAR Values

The reference SAR values are obtained from the calibration certificate of system validation dipoles. The measured values are normalised to 1 Watt.

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Numerical Target SAR Values (mW/g)		
				1g/10g	Head	Body
D750V3	1147	15 Oct 2019	750	1g	8.49	8.60
				10g	5.55	5.70
D900V2	1d199	13 Mar 2019	900	1g	10.90	11.10
				10g	6.99	7.17
D900V2	1d168	15 Oct 2019	900	1g	10.90	11.10
				10g	6.99	7.17
D1800V2	2d218	12 Mar 2019	1800	1g	38.40	38.50
				10g	20.10	20.30
D1900V2	5d227	12 Mar 2019	1900	1g	40.10	40.00
				10g	20.90	21.00

9.4. Dielectric Property Measurements & System Check Results

The 1-g SAR 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. The internal limit is set to ± 10%.

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System check 750 Head
Date: 10/02/2020
Validation dipole and Serial Number: D750V3 / SN: 1147

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	750	20.0	19.9	εr	41.96	41.90	-0.10	10.00
				Σ	0.89	0.90	0.44	10.00
				1g (W/kg)	8.49	7.78	-8.34	10.00
				10g (W/kg)	5.55	5.12	-7.60	10.00

Date: 14/02/2020
Validation dipole and Serial Number: D750V3 / SN: 1147

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	750	22.6	22.0	εr	41.96	41.67	-0.70	10.00
				Σ	0.89	0.92	2.89	10.00
				1g (W/kg)	8.49	7.74	-8.81	10.00
				10g (W/kg)	5.55	5.08	-8.32	10.00

Date: 18/02/2020
Validation dipole and Serial Number: D750V3 / SN: 1147

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	750	20.7	20.4	εr	41.96	40.78	-2.80	10.00
				Σ	0.89	0.89	0.21	10.00
				1g (W/kg)	8.49	8.04	-5.27	10.00
				10g (W/kg)	5.55	5.29	-4.59	10.00

System check 900 Head
Date: 10/02/2020
Validation dipole and Serial Number: D900V2 / SN: 1d168

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	20.0	19.9	εr	41.50	41.48	-0.06	10.00
				Σ	0.97	0.96	-1.26	10.00
				1g (W/kg)	10.90	10.03	-7.96	10.00
				10g (W/kg)	6.99	6.52	-6.59	10.00

Date: 14/02/2020
Validation dipole and Serial Number: D900V2 / SN: 1d199

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	22.6	22.0	εr	41.50	41.32	-0.43	10.00
				Σ	0.97	0.97	-0.03	10.00
				1g (W/kg)	10.90	9.97	-8.47	10.00
				10g (W/kg)	6.99	6.46	-7.51	10.00

Date: 18/02/2020
Validation dipole and Serial Number: D900V2 / SN: 1d199

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	900	20.7	20.4	εr	41.50	40.55	-2.30	10.00
				Σ	0.97	0.95	-1.82	10.00
				1g (W/kg)	10.90	9.99	-8.32	10.00
				10g (W/kg)	6.99	6.44	-7.73	10.00

System check 1800 Head

Date: 07/02/2020

Validation dipole and Serial Number: D1800V2 / SN: 2d218

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1800	22.0	21.3	**εr**	40.00	38.80	-2.99	10.00
				Σ	1.40	1.40	-0.09	10.00
				1g (W/kg)	38.40	35.31	-8.03	10.00
				10g (W/kg)	20.10	18.63	-7.28	10.00

Date: 10/02/2020

Validation dipole and Serial Number: D1800V2 / SN: 2d218

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1800	20.0	19.9	**εr**	40.00	39.49	-1.27	10.00
				Σ	1.40	1.39	-0.46	10.00
				1g (W/kg)	38.40	35.47	-7.62	10.00
				10g (W/kg)	20.10	18.87	-6.11	10.00

Date: 14/02/2020

Validation dipole and Serial Number: D1800V2 / SN: 2d218

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1800	22.6	22.0	**εr**	40.00	39.55	-1.12	10.00
				Σ	1.40	1.40	0.17	10.00
				1g (W/kg)	38.40	36.11	-5.95	10.00
				10g (W/kg)	20.10	19.07	-5.10	10.00

Date: 18/02/2020

Validation dipole and Serial Number: D1800V2 / SN: 2d218

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1800	20.7	20.4	**εr**	40.00	38.71	-3.24	10.00
				Σ	1.40	1.40	-0.27	10.00
				1g (W/kg)	38.40	39.05	1.70	10.00
				10g (W/kg)	20.10	20.78	3.38	10.00

System check 1900 Head

Date: 06/02/2020

Validation dipole and Serial Number: D1900V2 / SN: 5d227

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	22.0	21.3	**εr**	40.00	38.67	-3.34	10.00
				Σ	1.40	1.45	3.88	10.00
				1g (W/kg)	39.70	38.10	-4.00	10.00
				10g (W/kg)	20.50	19.73	-3.74	10.00

Date: 10/02/2020

Validation dipole and Serial Number: D1900V2 / SN: 5d227

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	20.0	19.9	**εr**	40.00	39.32	-1.70	10.00
				Σ	1.40	1.45	3.82	10.00
				1g (W/kg)	39.70	39.01	-1.72	10.00
				10g (W/kg)	20.50	20.42	-0.37	10.00

Date: 14/02/2020

Validation dipole and Serial Number: D1900V2 / SN: 5d227

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	22.6	22.0	**εr**	40.00	39.41	-1.46	10.00
				Σ	1.40	1.46	4.43	10.00
				1g (W/kg)	39.70	38.90	-1.99	10.00
				10g (W/kg)	20.50	20.35	-0.72	10.00

Date: 18/02/2020

Validation dipole and Serial Number: D1900V2 / SN: 5d227

Simulant	Frequency (MHz)	Room Temp (℃)	Liquid Temp (℃)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Head	1900	20.7	20.4	**εr**	40.00	38.61	-3.48	10.00
				Σ	1.40	1.46	4.56	10.00
				1g (W/kg)	39.70	42.99	8.30	10.00
				10g (W/kg)	20.50	22.41	9.33	10.00

10. Measurements, Examinations and Derived Results

10.1.Specific Absorption Rate - Test Results

In order to determine the highest value of the peak spatial-average SAR, all required device positions, configurations and operating modes were tested per each frequency band. SAR measurement was performed on the highest output channel, and overall worst case configurations was tested on remaining channels,

In case the reported SAR levels were higher than half of the SAR limit, remaining channels on that particular test position were also evaluated.

Note: Refer to section 7 for the configuration considered for SAR test.

10.2. Specific Absorption Rate - Test Results – Extremity

10.2.1. LTE FDD 2 Body 10g - Extremity

Max Reported SAR = 0.82 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK	0	Front	19100	1900.0	1	0	23.00	22.10	0.66	0.82	-	001
QPSK	0	Front	18700	1860.0	1	0	23.00	21.98	0.47	0.60	-	
QPSK	0	Front	18900	1880.0	1	0	23.00	21.80	0.60	0.79	-	
QPSK	0	Front	19100	1900.0	50	0	22.00	20.95	0.49	0.62	-	
QPSK	0	Back	19100	1900.0	1	0	23.00	22.10	0.01	0.01	-	
QPSK	0	Back	19100	1900.0	50	0	22.00	20.95	0.01	0.01	-	
QPSK	0	Edge 1	19100	1900.0	1	0	23.00	22.10	0.15	0.19	-	
QPSK	0	Edge 1	19100	1900.0	50	0	22.00	20.95	0.11	0.15	-	
QPSK	0	Edge 2	19100	1900.0	1	0	23.00	22.10	0.56	0.69	-	
QPSK	0	Edge 2	19100	1900.0	50	0	22.00	20.95	0.41	0.52	-	
QPSK	0	Edge 4	19100	1900.0	1	0	23.00	22.10	0.54	0.66	-	
QPSK	0	Edge 4	19100	1900.0	50	0	22.00	20.95	0.40	0.51	-	

Note(s):

10.2.2. LTE FDD 4 Body 10g - Extremity

Max Reported SAR = 0.60 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK	0	Front	20175	1732.5	1	0	23.00	22.17	0.43	0.52	-	
QPSK	0	Front	20050	1720.0	1	0	23.00	22.01	0.35	0.44	-	
QPSK	0	Front	20300	1745.0	1	0	23.00	22.12	0.49	0.60	-	002
QPSK	0	Front	20300	1745.0	50	0	22.00	21.09	0.42	0.52	-	
QPSK	0	Back	20175	1732.5	1	0	23.00	22.17	0.01	0.01	-	
QPSK	0	Back	20300	1745.0	50	0	22.00	21.09	0.01	0.01	-	
QPSK	0	Edge 1	20175	1732.5	1	0	23.00	22.17	0.03	0.04	-	
QPSK	0	Edge 1	20300	1745.0	50	0	22.00	21.09	0.05	0.06	-	
QPSK	0	Edge 2	20175	1732.5	1	0	23.00	22.17	0.18	0.22	-	
QPSK	0	Edge 2	20300	1745.0	50	0	22.00	21.09	0.20	0.25	-	
QPSK	0	Edge 4	20175	1732.5	1	0	23.00	22.17	0.14	0.17	-	
QPSK	0	Edge 4	20300	1745.0	50	0	22.00	21.09	0.16	0.20	-	

Note(s):

10.2.3. LTE FDD 5 Body 10g - Extremity

Max Reported SAR = 0.89 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK	0	Front	20525	836.5	1	0	23.00	22.58	0.73	0.80	-	
QPSK	0	Front	20450	829.0	1	0	23.00	22.54	0.80	0.89	-	003
QPSK	0	Front	20600	844.0	1	0	23.00	22.48	0.71	0.80	-	
QPSK	0	Front	20450	829.0	25	0	22.00	21.63	0.60	0.65	-	
QPSK	0	Back	20525	836.5	1	0	23.00	22.58	0.01	0.01	-	
QPSK	0	Back	20450	829.0	25	0	22.00	21.63	0.01	0.01	-	
QPSK	0	Edge 1	20525	836.5	1	0	23.00	22.58	0.03	0.03	-	
QPSK	0	Edge 1	20450	829.0	25	0	22.00	21.63	0.03	0.03	-	
QPSK	0	Edge 2	20525	836.5	1	0	23.00	22.58	0.58	0.64	-	
QPSK	0	Edge 2	20450	829.0	25	0	22.00	21.63	0.46	0.50	-	
QPSK	0	Edge 4	20525	836.5	1	0	23.00	22.58	0.46	0.51	-	
QPSK	0	Edge 4	20450	829.0	25	0	22.00	21.63	0.40	0.44	-	

Note(s):

10.2.4. LTE FDD 13 Body 10g - Extremity

Max Reported SAR = 0.36 (W/kg)

					For LTE Only		Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK	0	Front	23230	782.0	1	25	23.00	22.30	0.25	0.30	-	
QPSK	0	Front	23230	782.0	25	13	22.00	21.56	0.23	0.25	-	
QPSK	0	Back	23230	782.0	1	25	23.00	22.30	0.01	0.01	-	
QPSK	0	Back	23230	782.0	25	13	22.00	21.56	0.01	0.01	-	
QPSK	0	Edge 1	23230	782.0	1	25	23.00	22.30	0.03	0.04	-	
QPSK	0	Edge 1	23230	782.0	25	13	22.00	21.56	0.03	0.03	-	
QPSK	0	Edge 2	23230	782.0	1	25	23.00	22.30	0.27	0.32	-	
QPSK	0	Edge 2	23230	782.0	25	13	22.00	21.56	0.25	0.27	-	
QPSK	0	Edge 4	23230	782.0	1	25	23.00	22.30	0.31	0.36	-	004
QPSK	0	Edge 4	23230	782.0	25	13	22.00	21.56	0.28	0.31	-	

Note(s):

10.3. Specific Absorption Rate - Test Results - Body

10.3.1. LTE FDD 2 Body 1g - Body

Max Reported SAR = 0.72 (W/kg)

					For LTE Only		Power (dBm)		1g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK	5	Front	19100	1900.0	1	0	23.00	22.10	0.58	0.72	-	005
QPSK	5	Front	18700	1860.0	1	0	23.00	21.98	0.33	0.42	-	
QPSK	5	Front	18900	1880.0	1	0	23.00	21.80	0.50	0.66	-	
QPSK	5	Front	19100	1900.0	50	0	22.00	20.95	0.43	0.55	-	
QPSK	5	Back	19100	1900.0	1	0	23.00	22.10	0.01	0.01	-	
QPSK	5	Back	19100	1900.0	50	0	22.00	20.95	0.01	0.01	-	
QPSK	5	Edge 1	19100	1900.0	1	0	23.00	22.10	0.06	0.07	-	
QPSK	5	Edge 1	19100	1900.0	50	0	22.00	20.95	0.04	0.05	-	
QPSK	5	Edge 2	19100	1900.0	1	0	23.00	22.10	0.50	0.62	-	
QPSK	5	Edge 2	19100	1900.0	50	0	22.00	20.95	0.37	0.46	-	
QPSK	5	Edge 4	19100	1900.0	1	0	23.00	22.10	0.48	0.59	-	
QPSK	5	Edge 4	19100	1900.0	50	0	22.00	20.95	0.37	0.47	-	

Note(s):

10.3.2. LTE FDD 4 Body 1g - Body

Max Reported SAR = 0.53 (W/kg)

					For LTE Only		Power (dBm)		1g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK	5	Front	20175	1732.5	1	0	23.00	22.17	0.39	0.47	-	
QPSK	5	Front	20050	1720.0	1	0	23.00	22.01	0.28	0.35	-	
QPSK	5	Front	20300	1745.0	1	0	23.00	22.12	0.43	0.53	-	006
QPSK	5	Front	20300	1745.0	50	0	22.00	21.09	0.37	0.46	-	
QPSK	5	Back	20175	1732.5	1	0	23.00	22.17	0.01	0.01	-	
QPSK	5	Back	20300	1745.0	50	0	22.00	21.09	0.01	0.01	-	
QPSK	5	Edge 1	20175	1732.5	1	0	23.00	22.17	0.04	0.05	-	
QPSK	5	Edge 1	20300	1745.0	50	0	22.00	21.09	0.06	0.07	-	
QPSK	5	Edge 2	20175	1732.5	1	0	23.00	22.17	0.15	0.19	-	
QPSK	5	Edge 2	20300	1745.0	50	0	22.00	21.09	0.18	0.22	-	
QPSK	5	Edge 4	20175	1732.5	1	0	23.00	22.17	0.12	0.14	-	
QPSK	5	Edge 4	20300	1745.0	50	0	22.00	21.09	0.14	0.18	-	

Note(s):

10.3.3. LTE FDD 5 Body 1g - Body
Max Reported SAR = 0.76 (W/kg)

					For LTE Only		Power (dBm)		1g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK	5	Front	20525	836.5	1	0	23.00	22.58	0.66	0.72	-	
QPSK	5	Front	20450	829.0	1	0	23.00	22.54	0.66	0.74	-	
QPSK	5	Front	20600	844.0	1	0	23.00	22.48	0.67	0.76	-	007
QPSK	5	Front	20450	829.0	25	0	22.00	21.63	0.55	0.60	-	
QPSK	5	Back	20525	836.5	1	0	23.00	22.58	0.01	0.01	-	
QPSK	5	Back	20450	829.0	25	0	22.00	21.63	0.01	0.01	-	
QPSK	5	Edge 1	20525	836.5	1	0	23.00	22.58	0.03	0.04	-	
QPSK	5	Edge 1	20450	829.0	25	0	22.00	21.63	0.03	0.03	-	
QPSK	5	Edge 2	20525	836.5	1	0	23.00	22.58	0.35	0.39	-	
QPSK	5	Edge 2	20450	829.0	25	0	22.00	21.63	0.27	0.29	-	
QPSK	5	Edge 4	20525	836.5	1	0	23.00	22.58	0.57	0.63	-	
QPSK	5	Edge 4	20450	829.0	25	0	22.00	21.63	0.50	0.54	-	

Note(s):

10.3.4. LTE FDD 13 Body 1g - Body
Max Reported SAR = 0.48 (W/kg)

					For LTE Only		Power (dBm)		1g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK	5	Front	23230	782.0	1	25	23.00	22.30	0.36	0.43	-	
QPSK	5	Front	23230	782.0	25	13	22.00	21.56	0.33	0.36	-	
QPSK	5	Back	23230	782.0	1	25	23.00	22.30	0.01	0.01	-	
QPSK	5	Back	23230	782.0	25	13	22.00	21.56	0.01	0.01	-	
QPSK	5	Edge 1	23230	782.0	1	25	23.00	22.30	0.02	0.03	-	
QPSK	5	Edge 1	23230	782.0	25	13	22.00	21.56	0.02	0.02	-	
QPSK	5	Edge 2	23230	782.0	1	25	23.00	22.30	0.36	0.42	-	
QPSK	5	Edge 2	23230	782.0	25	13	22.00	21.56	0.33	0.37	-	
QPSK	5	Edge 4	23230	782.0	1	25	23.00	22.30	0.41	0.48	-	008
QPSK	5	Edge 4	23230	782.0	25	13	22.00	21.56	0.37	0.41	-	

Note(s):

10.4.SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 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.

10g-SAR (Extremity)

1) Repeated measurement is not required when the original highest measured SAR is < 2.0 W/Kg; steps 2) through 4) do not apply.
2) When the original highest measured 10g-SAR is ≥ 2.00 W/Kg , 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 ≥ 3.625 W/kg (~ 10% from the 10g-SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 3.75 W/Kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

1g-SAR (Body-worn)

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg ; steps 2) through 4) do not apply.
2) When the original highest measured 1g-SAR is ≥ 0.80 W/kg, 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 W/kg (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Repeat Measurements Results

Note: Since the 1g measured SAR for none of the runs was > 0.8 W/Kg or 10 measured SAR for none of the runs was > 2.0 W/Kg, repeat measurements were not performed.

11. Highest Standalone SAR

11.1. Highest Standalone Reported SAR

Individual Transmitter Evaluation per Band:

Exposure Configuration	Technology Band	Reported 10g - SAR (W/Kg)	Equipment Class	Highest Reported 10g-SAR (W/Kg)
Extremity (Separation Distance 0mm)	LTE FDD 2	0.82	PCE	0.89
	LTE FDD 4	0.60		
	LTE FDD 5	0.89		
	LTE FDD 13	0.36		

Exposure Configuration	Technology Band	Reported 1g - SAR (W/Kg)	Equipment Class	Highest Reported 1g-SAR (W/Kg)
Body (Separation Distance 10mm)	LTE FDD 2	0.72	PCE	0.76
	LTE FDD 4	0.53		
	LTE FDD 5	0.76		
	LTE FDD 13	0.48		

11.2. Simultaneous Transmission analysis

Simultaneous transmission SAR test analysis is determined for each operating configuration and exposure condition according to the *reported* standalone SAR of each applicable simultaneous transmitting antenna.

The worst case simultaneous transmission analysis is considered for the following cases:

Note: As none of transmitting antenna can simultaneously transmit, no simultaneous transmission analysis is required.