



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

SAR EVALUATION REPORT

For

Robert Bosch GmbH, e-Bike motion sensor and communication module with LTE CAT-M1 and NB2-IOT Radio

Model: BCM3100

Contains FCC ID: 2AWRC-BG95M2

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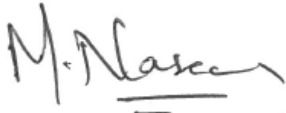
REVISION HISTORY

Version	Issue Date	Revisions	Revised By
1.0	14 February 2022	Initial Issue	--
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1. Attestation of Test Results

Applicant Name	Robert Bosch GmbH					
Model	BCM3100					
Test Device is	A representative test sample					
Device category	Portable					
Date Tested	22 October 2021 to 08 February 2022					
ICNIRP Guidelines Limits for SAR Exposure Characteristics	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	Extremity	0.62 W/Kg	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 International (UK) 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 International (UK) 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 International (UK) Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL International (UK) 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 Operations Leader UL			Kaan Corbacioglu Laboratory Engineer UL			

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 IEC/IEEE 62209-1528:2020. 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:

IEC/IEEE 62209-1528:2020

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

Note: The LTE Cat M1 and LTE NB-IOT conducted power measurements and SAR test plan was agreed with a KDB inquiry with FCC and further approval with TCB.

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

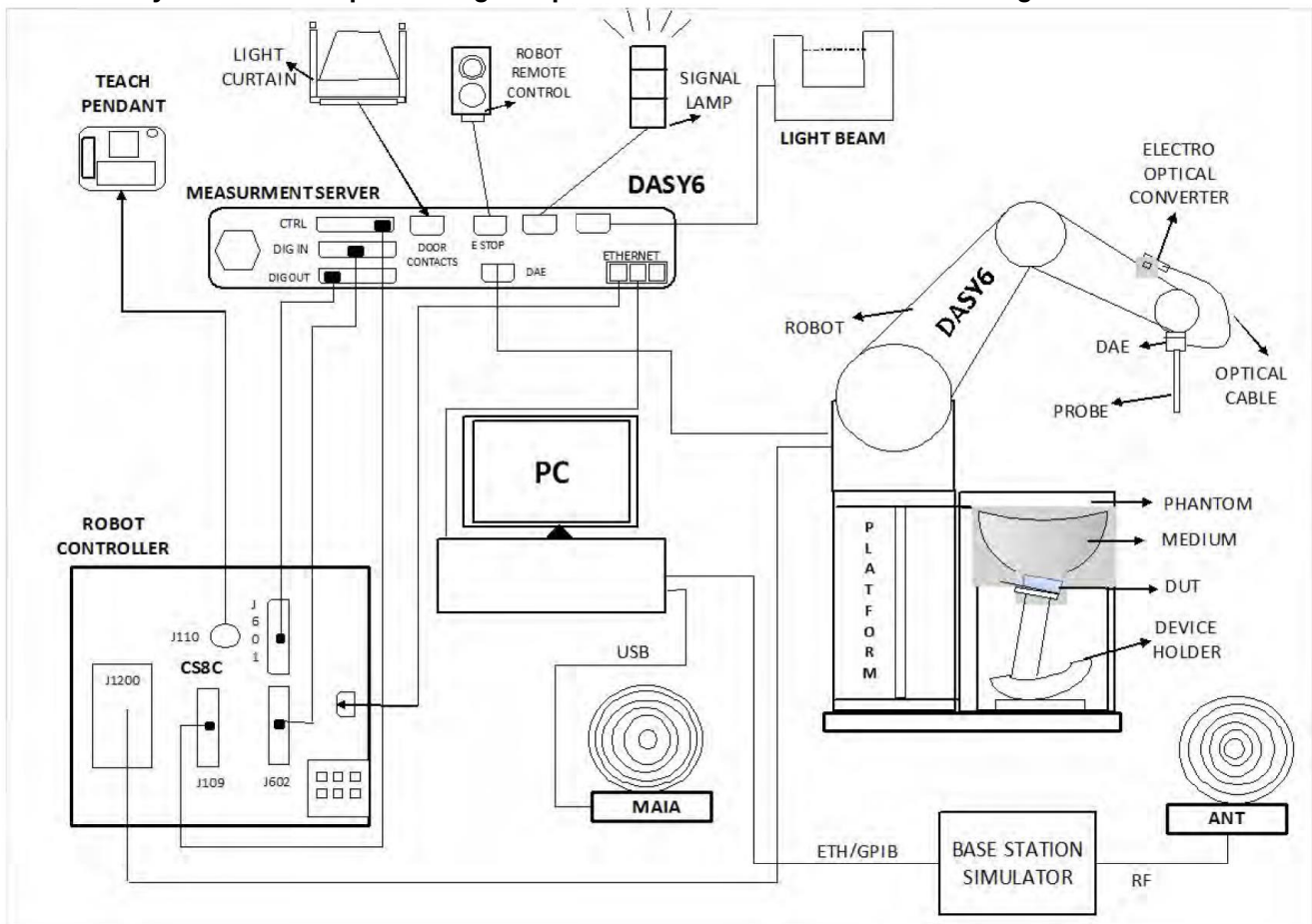
Unit 1-3 Horizon, Kingsland Business Park, Wade Road, Basingstoke, Hampshire, RG24 8AH UK	Facility Type
SAR Lab 60	Controlled Environment Chamber
SAR Lab 65	Controlled Environment Chamber

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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 $(60/f \text{ [GHz]})$ 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 $\delta \ln(2)/2$ 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 $\pm 0,5$ 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 $(24 / f \text{ [GHz]})$ 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 $(8-f \text{ [GHz]})$ 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 $(12/f \text{ [GHz]})$ 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 $\delta \ln(2)/2$ 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 5° .
- 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. $u_i = 0 \%$). 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 $\pm$ 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2)$ mm $\pm$ 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° $\pm$ 1°	20° $\pm$ 1°
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$	≤ 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 $\leq$ 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: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$		≤ 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: $\Delta z_{\text{Zoom}}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$
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 Asset No.	Instrument Name	Manufacturer	Type	Serial No.	Date Last Calibrated	Cal. Interval (Months)
PRE0178266	E-Field Probe	SPEAG	EX3DV4	7495	16 Mar 2021	12
PRE0178314	E-Field Probe	SPEAG	EX3DV4	7496	16 Mar 2021	12
PRE0135114	Data Acquisition Equipment	SPEAG	DAE4	1435	19 Feb 2021	12
PRE0135115	Data Acquisition Equipment	SPEAG	DAE4	1438	12 Apr 2021	12
PRE0191240	Phantom	SPEAG	Twin Sam V5	1817	Cal. as part of system	-
PRE0191235	Phantom	SPEAG	Twin Sam V8	1945	Cal. as part of system	-
PRE0133692	Dipole Antenna	SPEAG	D750V3	1011	15 Feb 2021	12
PRE0135601	Dipole Antenna	SPEAG	D750V3	1147	19 Oct 2021	12
PRE0134199	Dipole Antenna	SPEAG	D900V2	035	15 Feb 2021	12
PRE0135218	Dipole Antenna	SPEAG	D900V2	1d168	19 Oct 2021	12
PRE0178321	Dipole Antenna	SPEAG	D1800V2	2d218	09 Mar 2021	12
PRE0131477	Dipole Antenna	SPEAG	D1800V2	264	20 Oct 2021	12
PRE0178326	Dipole Antenna	SPEAG	D1900V2	5d227	09 Mar 2021	12
PRE0134198	Dipole Antenna	SPEAG	D1900V2	537	16 Feb 2021	12
PRE0131611	Dipole Antenna	SPEAG	D1900V2	540	20 Oct 2021	12
PRE0191906	POWERSOURCE1	SPEAG	SE UMS 160 BA	4012	23 Apr 2021	12
207451	POWERSOURCE1	Speag	SE UMS 160 CA	4248	26 Apr 2021	12
PRE0131118	Dual Channel Power Meter	Rohde & Schwarz	NRVD	826558/004	22 Mar 2021	12
PRE0151441	Power Sensor	Rohde & Schwarz	NRP8S	102481	22 Mar 2021	12
PRE0131120	Power Sensor	Rohde & Schwarz	NRV-Z1	893350/0017	22 Mar 2021	12
PRE0131460	Power Sensor	Rohde & Schwarz	NRV-Z1	893350/0019	22 Mar 2021	12
PRE0176846	Signal Generator	Rohde & Schwarz	SME 06	1038.6002.06	29 Mar 2021	12
PRE0178154	Signal Generator	Rohde & Schwarz	SMB 100A	175325	25 Mar 2021	12
PRE0135432	Amplifier	Mini-Circuits	ZVE-8G	910401427	Cal. as part of system	-
PRE0133544	Amplifier	Mini-Circuits	ZHL-42	QA0826002	Cal. as part of system	-
PRE0134801	DC Power Supply	ISO Tech	IPS 2303	227B058G2	Cal. as part of system	-
PRE0141988	Directional Coupler	RF-Lambda	RFDC5M06G15	12042502539	Cal. as part of system	-
PRE0151451	PMK - Amplifier	ART-FI	ART100850-01	001	Cal. as part of system	-
PRE0176937	RF Coax Cable	Huber+Suhner	SF126	503315/126	Cal. as part of system	-
PRE0176934	RF Coax Cable	Huber+Suhner	SF126	503316/126	Cal. as part of system	-
PRE0152035	RF Coax Cable	Huber+Suhner	Superflex 126	503318	Cal. as part of system	-
PRE0176846	RF Coax Cable	Huber+Suhner	Superflex 126	503322	Cal. as part of system	-
PRE0135070	RS Hygrometer	RS Components	408-6109	D10Q52	02 Mar 2021	12
PRE0135069	RS Hygrometer	RS Components	408-6109	D10Q69	02 Mar 2021	12
PRE0134821	Body Handset Positioner	SPEAG	MD4HACV5	None	Cal. not required	-
PRE0179708	Body Handset Positioner	SPEAG	MD4HACV5	None	Cal. not required	-
PRE0135253	Head Handset Positioner	SPEAG	MD4HHTV5	None	Cal. not required	-
PRE0179703	Head Handset Positioner	SPEAG	MD4HHTV5	None	Cal. not required	-
PRE0135126	Measurement Server	SPEAG	SE UMS 011 EA	1439	Cal. not required	-
PRE0178118	Measurement Server	SPEAG	SE UMS 028 BB	1572	Cal. not required	-
PRE0141348	Phantom Support Structure	SPEAG	Phantom Table	-	Cal. not required	-
PRE0179699	Phantom Support Structure	SPEAG	Phantom Table	-	Cal. not required	-
PRE0135135	Robot Arm	Staubli	TX60 L	F14/5T5ZA1/A/01	Cal. not required	-
PRE0178112	Robot Arm	Staubli	TX60 L	F17/5ENYG1/A/01	Cal. not required	-
PRE0135132	Robot Power Supply	SPEAG	CS8C	F14/5UA6A1/C/01	Cal. not required	-
PRE0178122	Robot Power Supply	SPEAG	CS8C	F17/5ENYG1/C/01	Cal. not required	-
PRE0133828	Communication Test Set	Anritsu	MT8821C	6200938937	01 Dec 2020	24
PRE0133828	Communication Test Set	Anritsu	MT8821C	6200938937	16 Nov 2021*	24
PRE0175234	Power Sensor	Rohde & Schwarz	NRP-Z51	103031-NV	22 Mar 2021	12
PRE0135073	Power Sensor	Rohde & Schwarz	NRP-Z51	103246	05 Mar 2021	12
PRE0175232	Power Sensor	Rohde & Schwarz	NRP-Z51	104649-JG	22 Mar 2021	12
PRE0151154	Vector Network Analyser	Rohde & Schwarz	ZND 132.5170K92	100151	23 Mar 2021	12
PRE0145189	DAK 3.5 Fluid Probe	SPEAG	SM DAK 040 CA	1089	Cal. before use	-
ULEID 212960	Digital Camera	Sony Camera	DSC-HX400V	3245687	Cal. not required	-
PRE0195838	RF Coax Cable	Taoglas	CAB.721		Cal. not required	-
PRE0195840	RF Coax Cable	Taoglas	CAB.721		Cal. not required	-
PRE0136931	RF Coax Cable	-	70530/4PE	-	Cal. not required	-
PRE0140096	RF Coax Cable	Huber+Suhner	ST18/SMAm/Nm/3 6	-	Cal. not required	-

*The equipment was sent for early calibration.

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):	F14/5UA6A1/A/01 F17/5ENYG1/A/01
Reach:	920 mm
Payload:	2.0 kg
Control Unit:	CS8C
Programming Language:	V+
Data Acquisition Electronic (DAE) System	
Serial Number:	DAE4 SN: 1435, 1438
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:	SAM Phantom
Shell Material:	Fibreglass
Thickness:	2.0 ±0.1 mm
E-Field Probe	
Model:	EX3DV4
Serial No:	7495, 7496
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- 300 MHz < Freq. < 3 GHz Body Configuration 1 g	95 %	±25.42 %
Uncertainty- 300 MHz < Freq. < 3 GHz Body Configuration 10 g	95%	±25.33 %

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 – 300 MHz < Freq. < 3 GHz Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (1g)	Standard Uncertainty		u _i or u _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	12.000	12.000	normal (k=2)	2.0000	1.0000	6.000	6.000	∞
B	Probe calibration drift	1.700	1.700	Rectangular	1.7321	1.0000	0.981	0.981	∞
B	Probe Linearity and Detection Limits	4.700	4.700	Rectangular	1.7321	1.0000	2.714	2.714	∞
B	Broadband Signal	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Isotropy	7.600	7.600	Rectangular	1.7321	1.0000	4.388	4.388	∞
B	Data Acquisition	0.300	0.300	normal (k=1)	1.0000	1.0000	0.300	0.300	∞
B	RF Ambient conditions	0.260	0.260	normal (k=1)	1.0000	1.0000	0.260	0.260	∞
B	Probe Positioning	0.700	0.700	normal (k=1)	1.0000	0.1400	0.098	0.098	∞
B	Data Processing Errors	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Uncertainty in SAR correction for deviations in permittivity and conductivity	1.900	1.900	normal (k=1)	1.0000	1.0000	1.900	1.900	∞
B	Liquid Conductivity (measured value)	5.288	5.288	normal (k=2)	2.0000	0.0000	0.000	0.000	∞
B	Liquid Permittivity (measured value)	2.500	2.500	normal (k=2)	2.0000	0.0000	0.000	0.000	∞
B	Liquid Conductivity (temperature uncertainty)	1.430	1.430	Rectangular	1.7321	0.7800	0.644	0.644	∞
B	Liquid Permittivity (temperature uncertainty)	0.310	0.310	Rectangular	1.7321	0.7800	0.140	0.140	∞
B	Phantom Shell Permittivity	14.000	14.000	Rectangular	1.7321	0.2500	2.021	2.021	∞
B	Distance DUT - TSL	2.000	2.000	normal (k=1)	1.0000	2.0000	4.000	4.000	∞
A	Test Sample Positioning	4.240	4.240	normal (k=1)	1.0000	1.0000	4.240	4.240	25
A	Device Holder uncertainty	6.090	6.090	normal (k=1)	1.0000	1.0000	6.090	6.090	5
B	DUT Modulation	2.400	2.400	Rectangular	1.7321	1.0000	1.386	1.386	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
	Combined standard uncertainty			t-distribution			12.71	12.71	90
	Expanded uncertainty			k = 2			25.42	25.42	90

5.2. Uncertainty – 300 MHz < Freq. < 3 GHz Body Configuration 10g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	C _i (10g)	Standard Uncertainty		u _i or u _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	12.000	12.000	normal (k=2)	2.0000	1.0000	6.000	6.000	∞
B	Probe calibration drift	1.700	1.700	Rectangular	1.7321	1.0000	0.981	0.981	∞
B	Probe Linearity and Detection Limits	4.700	4.700	Rectangular	1.7321	1.0000	2.714	2.714	∞
B	Broadband Signal	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Isotropy	7.600	7.600	Rectangular	1.7321	1.0000	4.388	4.388	∞
B	Data Acquisition	0.300	0.300	normal (k=1)	1.0000	1.0000	0.300	0.300	∞
B	RF Ambient conditions	0.260	0.260	normal (k=1)	1.0000	1.0000	0.260	0.260	∞
B	Probe Positioning	0.700	0.700	normal (k=1)	1.0000	0.1400	0.098	0.098	∞
B	Data Processing Errors	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Uncertainty in SAR correction for deviations in permittivity and conductivity	1.900	1.900	normal (k=1)	1.0000	0.8400	1.596	1.596	∞
B	Liquid Conductivity (measured value)	5.288	5.288	normal (k=2)	2.0000	0.0000	0.000	0.000	∞
B	Liquid Permittivity (measured value)	2.500	2.500	normal (k=2)	2.0000	0.0000	0.000	0.000	∞
B	Liquid Conductivity (temperature uncertainty)	1.430	1.430	Rectangular	1.7321	0.7100	0.586	0.586	∞
B	Liquid Permittivity (temperature uncertainty)	0.310	0.310	Rectangular	1.7321	0.7100	0.127	0.127	∞
B	Phantom Shell Permittivity	14.000	14.000	Rectangular	1.7321	0.2500	2.021	2.021	∞
B	Distance DUT - TSL	2.000	2.000	normal (k=1)	1.0000	2.0000	4.000	4.000	∞
A	Test Sample Positioning	4.240	4.240	normal (k=1)	1.0000	1.0000	4.240	4.240	25
A	Device Holder uncertainty	6.090	6.090	normal (k=1)	1.0000	1.0000	6.090	6.090	5
B	DUT Modulation	2.400	2.400	Rectangular	1.7321	1.0000	1.386	1.386	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
	Combined standard uncertainty			t-distribution			12.66	12.66	90
	Expanded uncertainty			k = 2			25.33	25.33	90

6. Device Under Test (DUT) Information

6.1. DUT Description

DUT Description:	The EUT is an e-Bike motion sensor and communication module used for data communication in the event of a detected theft or accident. The EUT had GPS reception and communication capabilities over LTE Cat-M1 and NB-IoT.		
Validator Serial Number:	14026-0002-01-368-00-0000	SAR Evaluation CAT-M1	
	14026-0014-01-368-00-0000	SAR Evaluation NB2-IOT	
	14026-0021-01-368-00-0000	Conducted Power Measurements CAT-M1	
	14025-0001-01-368-00-0000	Conducted Power Measurements NB2-IOT	
Hardware Part Number:	EB13 100 00B		
Hardware Version Number:	7.0.0		
Software Version Number:	0.13.1-pi21-07-4		
Country of Manufacture:	China		
Device dimension	Overall (Height x Width x Depth): 87.1 mm x 35.2 mm x 23 mm		
Date of Receipt:	21 September 2021		
Antenna Type:	Internal Integral		
Antenna Length:	As specified in Appendix 12.1		
Number of Antenna Positions:	Main Antenna – Tx – Cellular	1 fixed	
	GNSS Antenna – Rx	1 fixed	
Battery Type(s):	External DC Power Supply 13.5 (V), 0.3 (A) Internal Built-In Lithium polymer 3.8 (V), 650 (mAh)		

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle
LTE – CAT – M1 ☒ (FDD) Power Class 5	Band 2 Band 4 Band 5 Band 12 Band 13	QPSK 16QAM	30.1% (FDD)
Does this device SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No			
LTE – NB2 – IOT ☒ (FDD) Power Class 5	Band 2 Band 4 Band 5 Band 12 Band 13	BPSK ($\pi/2$) QPSK QPSK ($\pi/4$)	42.0% (FDD)
Does this device SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No			

Additional Information Related to Testing:

LTE							
Band	Description						
LTE CAT-M1 Band 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 / 1900.0	19125 / 1902.5	19150 / 1905.0	19175 / 1907.5	19185 / 1908.5	19193 / 1909.3
LTE CAT-M1 Band 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 CAT-M1 Band 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 CAT-M1 Band 12	Frequency Range: 699 - 716 MHz						
	Channel Description	Channel Bandwidth					
		20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz
	Channel No. / Freq. (MHz)						
	Low			23060 / 704.0	23035 / 701.5	23025 / 700.5	23017 / 699.7
	Mid			23095 / 707.5	23095 / 707.5	23095 / 707.5	23095 / 707.5
	High			23130 / 711.0	23155 / 713.5	23165 / 714.5	23173 / 715.3
LTE CAT-M1 Band 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		

Additional Information Related to Testing (Continued):

LTE NB2-IOT					
Description					
Band	LTE NB2-IOT Band 2	LTE NB2-IOT Band 4	LTE NB2-IOT Band 5	LTE NB2-IOT Band 12	LTE NB2-IOT Band 13
Channel Description	Frequency Range: 1850 - 1910 MHz	Frequency Range: 1710 - 1755 MHz	Frequency Range: 824 - 849 MHz	Frequency Range: 699 - 716 MHz	Frequency Range: 777 - 787 MHz
	Channel Bandwidth 200kHz				
	Channel No. / Freq. (MHz)				
Low	18601 / 1850.1	19551/ 1710.1	20401/ 824.1	23011 / 699.1	23181 / 777.1
Mid	18900 / 1880.0	20175/ 1732.5	20525/ 836.5	23095 / 707.5	23230 / 782.0
High	19198 / 1909.8	20398/ 1754.8	20648/ 848.8	23178 / 715.8	23278 / 786.8

6.3. Nominal and Maximum Output power

RF Air interface	Mode	Target + Max. Tolerances (dBm)
LTE CAT-M1 Band 2	QPSK (1RB)	22.70
	QPSK (50% RB)	22.70
	QPSK(100% RB)	22.70
	16-QAM (1RB)	22.70
	16-QAM (50% RB)	22.70
	16-QAM (100% RB)	22.70
LTE CAT-M1 Band 4	QPSK (1RB)	22.70
	QPSK (50% RB)	22.70
	QPSK(100% RB)	22.70
	16-QAM (1RB)	22.70
	16-QAM (50% RB)	22.70
	16-QAM (100% RB)	22.70
LTE CAT-M1 Band 5	QPSK (1RB)	22.70
	QPSK (50% RB)	22.70
	QPSK(100% RB)	22.70
	16-QAM (1RB)	22.70
	16-QAM (50% RB)	22.70
	16-QAM (100% RB)	22.70
LTE CAT-M1 Band 12	QPSK (1RB)	22.70
	QPSK (50% RB)	22.70
	QPSK(100% RB)	22.70
	16-QAM (1RB)	22.70
	16-QAM (50% RB)	22.70
	16-QAM (100% RB)	22.70
LTE CAT-M1 Band 13	QPSK (1RB)	22.70
	QPSK (50% RB)	22.70
	QPSK(100% RB)	22.70
	16-QAM (1RB)	22.70
	16-QAM (50% RB)	22.70
	16-QAM (100% RB)	22.70

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.
3. MPR implemented in applicable LTE-CAT-M1 cases according to Table 6.2.3EA-2 of 3GPP TS 136-521-1 V14.5.0

RF Air interface	Mode	Target + Max. Tolerances (dBm)
LTE NB2-IOT Band 2	BPSK ($\pi/2$)	22.70
	QPSK ($\pi/4$)	22.70
	QPSK	22.70
LTE NB2-IOT Band 4	BPSK ($\pi/2$)	22.70
	QPSK ($\pi/4$)	22.70
	QPSK	22.70
LTE NB2-IOT Band 5	BPSK ($\pi/2$)	22.70
	QPSK ($\pi/4$)	22.70
	QPSK	22.70
LTE NB2-IOT Band 12	BPSK ($\pi/2$)	22.70
	QPSK ($\pi/4$)	22.70
	QPSK	22.70
LTE NB2-IOT Band 13	BPSK ($\pi/2$)	22.70
	QPSK ($\pi/4$)	22.70
	QPSK	22.70

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.
3. MPR implemented in applicable LTE-NB2-IOT cases according to Table 6.2.3F.3-1 of 3GPP TS 136-521-1 V15.5.0

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 ~ CAT-M1/NB2 Antenna	Extremity	0mm	Front	<25mm	Yes
			Front (Tilt)	<25mm	Yes
			Back	<25mm	Yes
			Edge 1 (Top Edge)	<25mm	Yes
			Edge 2 (Right Edge)	<25mm	Yes
			Edge 3 (Bottom Edge)	>25mm	No
			Edge 4 (Left Edge)	<25mm	Yes

Note:

- The Antenna to edge separation distances are indicated in the 'Antenna Schematics' located in Section 12.1 of this report.
- It was found that a small separation distance between the phantom and DUT (at the location of antenna) was made by positioning the DUT flat to the phantom on the Front configuration. Thus in addition to the Front position "Front (Tilt)" was evaluated by positioning the device by giving a slight tilted angle to reduce the separation distance at the location of the antenna.
- Labelled diagram of the tested edges is located in Section 12.1 of this report.
- In order to test the RF performance of the DUT on its internal battery, the overall worst case was tested with the DC power supply disconnected.

7.2. SAR Test Exclusion Consideration

Frequency Band	Configuration(s)
	Extremity
	Cellular Antenna
LTE CAT-M1 Band 2	No
LTE CAT-M1 Band 4	No
LTE CAT-M1 Band 5	No
LTE CAT-M1 Band 12	No
LTE CAT-M1 Band 13	No
LTE NB2-IOT Band 2	No
LTE NB2-IOT Band 4	No
LTE NB2-IOT Band 5	No
LTE NB2-IOT Band 12	No
LTE NB2-IOT Band 13	No

Note:

- 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.
- The details for the Maximum Rated Power and tolerance(s) can be found in section 6.

8. Conducted Output Power Measurements

8.1. RF Output Average Power Measurement: LTE – CAT – M1

8.1.1. LTE CAT-M1 Band 2

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 7	1@5, 15	3@0, 0	3@3, 7	3@3, 15	6@0, 0	6@0, 7	6@0, 15
20	Extremity	QPSK	18700	1860.0	21.80	21.85	21.80	21.95	21.95	21.95	21.95	22.00	22.05
			18900	1880.0	21.90	21.90	21.80	22.00	21.90	21.95	21.90	22.05	22.05
			19100	1900.0	22.00	21.70	21.65	21.85	21.85	21.80	21.95	21.95	21.90

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 5	1@5, 11	3@0, 0	3@3, 5	3@3, 11	6@0, 0	6@0, 5	6@0, 11
15	Extremity	QPSK	18675	1857.5	21.85	21.95	21.65	22.10	21.80	22.10	22.05	22.05	22.15
			18900	1880.0	22.00	21.75	21.85	21.90	21.85	21.90	22.05	21.85	21.95
			19125	1902.5	21.85	21.70	21.80	21.75	21.80	21.95	21.80	22.05	22.00

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	6@0, 0	6@0, 3	6@0, 7
10	Extremity	QPSK	18650	1855.0	21.90	21.75	21.70	21.90	21.75	21.85	20.85	20.80	20.90
			18900	1880.0	21.95	21.65	21.75	21.85	21.80	21.90	20.90	20.90	21.00
			19150	1905.0	22.10	21.60	21.70	22.00	21.65	21.90	20.80	20.85	20.85

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	6@0, 0	6@0, 1	6@0, 3
5	Extremity	QPSK	18625	1852.50	22.15	21.75	21.55	22.00	21.90	21.90	20.80	20.95	20.95
			18900	1880.00	21.95	21.65	21.75	21.95	21.85	21.80	20.95	21.00	21.00
			19175	1907.50	22.00	21.85	21.90	21.75	21.90	21.75	20.85	20.85	20.90

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	5@0, 0	5@1, 1	5@1, 3
5	Extremity	16-QAM	18625	1852.50	22.10	21.50	21.55	22.15	22.15	22.20	20.95	20.70	20.75
			18900	1880.00	21.95	21.55	21.60	22.25	22.30	22.25	20.90	20.80	20.80
			19175	1907.50	21.75	21.30	21.35	22.00	22.05	22.10	20.80	20.70	20.70

LTE CAT-M1 Band 2 (Continued)

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 0	1@5, 1	3@0, 0	3@3, 0	3@3, 1	6@0, 0		6@0, 1
3	Extremity	QPSK	18615	1851.50	22.30	22.00	22.00	20.95	20.90	20.95	19.85		19.90
			18900	1880.00	22.10	22.10	22.10	21.05	21.00	21.00	19.75		20.00
			19185	1908.50	22.10	21.95	21.95	20.95	20.90	20.90	19.95		19.95
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 0	1@5, 1	3@0, 0	3@3, 0	3@3, 1	5@0, 0	5@1, 0	5@1, 1
3	Extremity	16-QAM	18615	1851.50	21.15	20.60	20.70	20.00	20.00	19.95	20.05	20.00	19.95
			18900	1880.00	21.25	21.10	21.10	20.25	20.00	20.00	20.10	20.10	19.90
			19185	1908.50	21.15	20.55	20.45	20.00	20.00	20.00	20.05	19.80	19.80

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@2, 0	1@5, 0	3@0, 0	3@1, 0	3@3, 0			6@0, 0
1.4	Extremity	QPSK	18607	1850.7	22.15	21.95	21.90	20.95	21.05	20.90			19.90
			18900	1880.0	22.15	22.05	21.95	21.10	21.15	21.05			20.05
			19193	1909.3	22.05	21.85	21.95	20.90	21.00	20.85			19.90
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@2, 0	1@4, 0	3@0, 0	3@1, 0	3@3, 0	5@0, 0	5@1, 0	
1.4	Extremity	16-QAM	18607	1850.7	21.15	21.15	20.95	20.00	20.05	19.85	20.05	19.95	
			18900	1880.0	21.25	21.05	20.95	20.10	20.10	20.10	19.90	19.90	
			19193	1909.3	21.20	21.05	20.90	20.10	20.10	19.95	20.05	19.90	

8.1.2. LTE CAT - M1 Band 4

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 7	1@5, 15	3@0, 0	3@3, 7	3@3, 15	6@0, 0	6@0, 7	6@0, 15
20	Extremity	QPSK	20050	1720.00	21.55	21.55	21.65	21.60	21.65	21.75	21.50	21.70	21.85
			20175	1732.50	21.65	21.45	21.75	21.65	21.70	21.85	21.60	21.75	21.90
			20300	1745.00	21.95	22.00	22.10	21.90	21.90	22.30	21.80	21.90	22.30
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 7	1@5, 15	3@0, 0	3@3, 7	3@3, 15	5@0, 0	5@1, 7	5@1, 15
20	Extremity	16-QAM	20050	1720.00	21.40	21.30	21.35	21.65	21.90	22.00	21.50	21.65	21.90
			20175	1732.50	21.70	21.45	21.90	21.90	22.15	22.50	21.70	21.95	22.05
			20300	1745.00	21.90	21.75	22.00	22.00	22.50	22.60	22.20	22.35	22.15

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 5	1@5, 11	3@0, 0	3@3, 5	3@3, 11	6@0, 0	6@0, 5	6@0, 11
15	Extremity	QPSK	20025	1717.5	21.55	21.50	21.55	21.55	21.60	21.70	21.50	21.65	21.70
			20175	1732.5	21.70	21.45	21.80	21.75	21.75	21.85	21.65	21.80	22.00
			20325	1747.5	22.05	21.85	21.95	22.05	22.00	22.25	22.00	22.05	22.20
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 5	1@5, 11	3@0, 0	3@3, 5	3@3, 11	5@0, 0	5@1, 5	5@1, 11
15	Extremity	16-QAM	20025	1717.5	21.50	21.40	21.30	21.75	21.95	22.05	21.65	21.80	21.95
			20175	1732.5	21.80	21.65	21.90	21.85	22.15	22.35	21.95	21.85	21.95
			20325	1747.5	21.95	21.60	21.90	22.20	22.40	22.50	22.05	21.95	22.10

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	6@0, 0	6@0, 3	6@0, 7
10	Extremity	QPSK	20000	1715.0	21.45	21.20	21.40	21.60	21.40	21.70	20.45	20.50	20.60
			20175	1732.5	21.85	21.70	21.80	21.80	21.65	21.90	20.70	20.85	20.95
			20350	1750.0	22.10	21.95	21.95	22.15	22.10	22.10	21.10	21.15	21.15
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	5@0, 0	5@1, 3	5@1, 7
10	Extremity	16-QAM	20000	1715.0	21.40	21.25	21.60	21.70	21.80	21.95	21.75	21.60	21.60
			20175	1732.5	21.90	21.90	21.90	22.10	22.20	22.25	21.95	21.85	21.90
			20350	1750.0	22.40	21.90	21.90	22.40	22.50	22.50	22.50	22.15	22.25

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	6@0, 0	6@0, 1	6@0, 3
5	Extremity	QPSK	19975	1712.50	21.65	21.45	21.35	21.60	21.50	21.55	20.40	20.45	20.55
			20175	1732.50	21.85	21.65	21.70	21.85	21.75	21.75	20.70	20.85	20.85
			20375	1752.50	22.20	21.95	22.00	22.20	22.15	22.20	21.15	21.20	21.25
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	5@0, 0	5@1, 1	5@1, 3
5	Extremity	16-QAM	19975	1712.50	21.55	21.20	21.25	21.85	21.80	21.80	20.55	20.55	20.55
			20175	1732.50	21.95	21.50	21.45	22.00	22.15	22.20	21.00	20.85	20.85
			20375	1752.50	22.45	21.95	21.95	22.35	22.50	22.55	21.25	21.20	21.25

LTE CAT - M1 Band 4 (Continued)

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 0	1@5, 1	3@0, 0	3@3, 0	3@3, 1	6@0, 0		6@0, 1
3	Extremity	QPSK	19965	1711.50	21.85	21.65	21.65	20.65	20.55	20.55	19.75		19.70
			20175	1732.50	22.05	21.90	21.90	21.00	20.80	20.95	19.90		19.85
			20385	1753.50	22.45	22.40	22.25	21.30	21.35	21.25	20.35		20.30
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 0	1@5, 1	3@0, 0	3@3, 0	3@3, 1	5@0, 0	5@1, 0	5@1, 1
3	Extremity	16-QAM	19965	1711.50	21.00	20.35	20.40	19.65	19.75	19.65	19.90	19.75	19.60
			20175	1732.50	21.05	20.70	20.70	20.10	20.05	20.20	20.00	20.10	20.10
			20385	1753.50	21.55	21.40	21.40	20.35	20.50	20.45	20.60	20.50	20.50

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@2, 0	1@5, 0	3@0, 0	3@1, 0	3@3, 0			6@0, 0
1.4	Extremity	QPSK	19957	1710.7	21.65	21.60	21.40	20.65	20.50	20.50			19.50
			20175	1732.5	21.95	21.95	21.80	20.95	20.95	20.75			19.90
			20393	1754.3	22.30	22.35	22.15	21.35	21.45	21.30			20.45
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@2, 0	1@4, 0	3@0, 0	3@1, 0	3@3, 0	5@0, 0	5@1, 0	
1.4	Extremity	16-QAM	19957	1710.7	20.55	20.00	20.05	19.60	19.75	19.70	19.70	19.65	
			20175	1732.5	21.00	20.95	20.95	20.15	20.15	20.10	20.20	20.10	
			20393	1754.3	21.60	21.60	21.40	20.60	20.60	20.45	20.55	20.45	

8.1.3. LTE CAT - M1 Band 5

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	6@0, 0	6@0, 3	6@0, 7
10	Extremity	QPSK	20450	829.0	21.95	21.40	21.45	21.90	21.65	21.50	20.95	20.90	20.60
			20525	836.5	21.70	21.30	21.40	21.85	21.55	21.60	20.75	20.65	20.65
			20600	844.0	22.00	21.35	21.45	21.80	21.60	21.70	20.75	20.70	20.70
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	5@0, 0	5@1, 3	5@1, 7
10	Extremity	16-QAM	20450	829.0	22.00	21.50	21.60	22.20	21.95	21.95	22.15	21.80	21.65
			20525	836.5	21.90	21.50	21.70	22.00	21.85	21.85	21.95	21.65	21.75
			20600	844.0	21.80	21.60	21.60	21.95	21.90	22.05	21.95	21.65	21.70

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	6@0, 0	6@0, 1	6@0, 3
5	Extremity	QPSK	20425	826.50	21.75	21.45	21.50	21.90	21.70	21.65	20.85	20.80	20.80
			20525	836.50	21.65	21.30	21.40	21.75	21.60	21.60	20.70	20.70	20.65
			20625	846.50	21.75	21.40	21.45	21.75	21.70	21.65	20.75	20.75	20.70
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	5@0, 0	5@1, 1	5@1, 3
5	Extremity	16-QAM	20425	826.50	21.80	21.60	21.55	22.00	22.10	22.05	20.90	20.70	20.80
			20525	836.50	21.90	21.45	21.55	21.95	21.85	21.95	20.90	20.65	20.70
			20625	846.50	21.90	21.60	21.65	22.00	22.00	22.05	20.90	20.60	20.70

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 0	1@5, 1	3@0, 0	3@3, 0	3@3, 1	6@0, 0		6@0, 1
3	Extremity	QPSK	20415	825.50	22.00	21.70	21.80	21.00	20.75	20.80	19.85		19.65
			20525	836.50	21.80	21.50	21.65	20.75	20.60	20.60	19.65		19.55
			20635	847.50	21.85	21.45	21.60	20.75	20.75	20.80	19.65		19.60
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 0	1@5, 1	3@0, 0	3@3, 0	3@3, 1	5@0, 0	5@1, 0	5@1, 1
3	Extremity	16-QAM	20415	825.50	20.90	20.55	20.60	20.05	19.95	20.00	19.90	19.55	19.75
			20525	836.50	20.80	20.45	20.55	19.90	19.90	19.95	19.90	19.50	19.50
			20635	847.50	20.70	20.40	20.40	19.75	19.60	20.00	19.90	19.60	19.50

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@2, 0	1@5, 0	3@0, 0	3@1, 0	3@3, 0			6@0, 0
1.4	Extremity	QPSK	20407	824.7	21.80	21.75	21.65	21.00	20.95	20.70			19.75
			20525	836.5	21.95	21.85	21.65	20.75	20.70	20.55			19.65
			20643	848.3	21.85	21.65	21.55	20.80	20.80	20.55			19.70
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@2, 0	1@4, 0	3@0, 0	3@1, 0	3@3, 0	5@0, 0	5@1, 0	
1.4	Extremity	16-QAM	20407	824.7	20.90	20.55	20.45	20.10	20.20	19.95	19.90	19.65	
			20525	836.5	20.75	20.50	20.40	19.75	19.70	19.80	19.75	19.60	
			20643	848.3	20.70	20.50	20.35	19.70	20.00	19.90	19.85	19.50	

8.1.4. LTE CAT - M1 Band 12

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	6@0, 0	6@0, 3	6@0, 7
10	Extremity	QPSK	23060	704.0	21.75	21.70	21.95	21.70	22.00	22.05	20.75	20.95	20.95
			23095	707.5	21.90	21.90	22.00	22.00	22.05	21.90	20.90	21.00	21.00
			23130	711.0	21.90	21.85	22.05	22.10	22.10	22.10	20.95	21.05	21.05
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	5@0, 0	5@1, 3	5@1, 7
10	Extremity	16-QAM	23060	704.0	21.75	21.55	21.90	22.00	22.25	22.35	22.10	21.95	22.05
			23095	707.5	21.90	21.80	21.85	22.15	22.35	22.40	22.15	22.05	22.10
			23130	711.0	22.00	21.70	21.80	22.20	22.45	22.50	22.30	22.10	22.10

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	6@0, 0	6@0, 1	6@0, 3
5	Extremity	QPSK	23035	701.50	21.75	21.50	21.85	21.90	21.85	21.95	20.65	20.65	20.80
			23095	707.50	22.00	21.95	21.90	21.95	22.05	22.05	20.95	20.95	21.00
			23155	713.50	22.00	21.95	22.00	22.15	22.15	21.90	21.05	21.05	21.05
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	5@0, 0	5@1, 1	5@1, 3
5	Extremity	16-QAM	23035	701.50	21.90	21.55	21.65	21.95	22.10	22.30	20.95	20.60	20.70
			23095	707.50	22.15	21.90	21.85	22.20	22.40	22.45	21.20	21.00	20.95
			23155	713.50	21.95	21.75	21.80	22.25	22.40	22.45	21.20	20.95	20.90

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 0	1@5, 1	3@0, 0	3@3, 0	3@3, 1	6@0, 0		6@0, 1
3	Extremity	QPSK	23025	700.50	21.65	21.50	21.55	20.70	20.60	20.65	19.65		19.70
			23095	707.50	22.00	21.85	21.95	21.00	20.95	21.05	19.95		19.95
			23165	714.50	21.85	21.75	21.85	21.05	20.95	21.00	19.95		19.95
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 0	1@5, 1	3@0, 0	3@3, 0	3@3, 1	5@0, 0	5@1, 0	5@1, 1
3	Extremity	16-QAM	23025	700.50	20.65	20.40	20.55	19.70	19.70	19.85	19.90	19.80	19.85
			23095	707.50	20.95	20.80	20.70	20.05	20.05	20.15	20.00	19.85	19.95
			23165	714.50	21.00	20.70	20.80	20.10	20.00	19.90	20.00	19.80	19.85

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@2, 0	1@5, 0	3@0, 0	3@1, 0	3@3, 0			6@0, 0
1.4	Extremity	QPSK	23017	699.7	21.50	21.65	21.55	20.75	20.70	20.60			19.80
			23095	707.5	21.95	21.90	21.75	21.10	21.05	20.85			20.00
			23173	715.3	21.85	21.85	21.75	21.15	21.05	20.90			20.00
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@2, 0	1@4, 0	3@0, 0	3@1, 0	3@3, 0	5@0, 0	5@1, 0	
1.4	Extremity	16-QAM	23017	699.7	20.45	20.45	20.35	19.65	19.70	19.65	19.60	19.50	
			23095	707.5	20.90	20.85	20.65	20.05	20.15	20.05	20.00	19.90	
			23173	715.3	20.90	20.75	20.45	19.95	19.80	19.95	19.95	19.80	

8.1.5. LTE CAT - M1 Band 13

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	6@0, 0	6@0, 3	6@0, 7
10	Extremity	QPSK	23230	782.0	21.60	21.40	21.40	21.90	21.60	21.50	20.80	20.50	20.50
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 3	1@5, 7	3@0, 0	3@3, 3	3@3, 7	5@0, 0	5@1, 3	5@1, 7
10	Extremity	16-QAM	23230	782.0	22.05	21.30	21.35	22.35	21.85	21.90	22.20	21.70	21.65

Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	6@0, 0	6@0, 1	6@0, 3
5	Extremity	QPSK	23205	779.50	21.90	21.45	21.35	21.90	21.60	21.50	20.85	20.70	20.60
			23230	782.00	21.80	21.30	21.30	21.80	21.50	21.50	20.65	20.65	20.45
			23255	784.50	21.70	21.35	21.40	21.85	21.50	21.55	20.80	20.60	20.55
Ch.BW (MHz)	Config	Mode	Channel	Frequency (MHz)	Measured Avg Power (dBm) nRB @ RB#, NBI								
					1RB			50%RB			100%RB		
					1@0, 0	1@5, 1	1@5, 3	3@0, 0	3@3, 1	3@3, 3	5@0, 0	5@1, 1	5@1, 3
5	Extremity	16-QAM	23205	779.50	21.75	21.30	21.40	22.10	22.00	21.95	21.05	20.65	20.65
			23230	782.00	21.85	21.30	21.55	22.05	21.85	21.95	20.95	20.50	20.60
			23255	784.50	21.75	21.45	21.50	21.95	21.85	21.85	20.95	20.45	20.50

8.2. RF Output Average Power Measurement: LTE – NB2 – IOT**8.2.1. LTE NB2-IOT Band 2**

Ch.BW (kHz)	Config	Subcarrier Spacing (kHz)	SCs (Tone)	Starting SC	Measured Avg Power (dBm)					
					BPSK			QPSK ($\pi/4$)		
					CH 18601	CH 18900	CH 19198	CH 18601	CH 18900	CH 19198
					1850.1 MHz	1880 MHz	1909.8 MHz	1850.1 MHz	1880 MHz	1909.8 MHz
200	Extremity	3.75	1	0	21.90	21.90	22.25	21.90	22.00	22.40
				23	21.65	21.80	22.15	21.80	22.00	22.45
				47	21.65	21.85	22.25	22.05	22.05	22.25
		15	1	0	21.65	21.90	22.00	21.55	21.80	22.20
				5	21.80	22.05	22.10	21.80	22.05	22.10
				11	21.70	21.95	22.25	21.65	21.90	22.20
			Multitone		QPSK					
			3	0	20.95	21.20	21.20			
				3	21.55	21.75	21.75			
				6	21.35	21.70	21.75			
				9	20.75	21.00	21.10			
			6	0	20.15	20.40	20.60			
				6	20.20	20.45	20.60			
			12	0	19.20	19.50	19.55			

8.2.1. LTE NB2-IOT Band 4

Ch.BW (kHz)	Config	Subcarrier Spacing (kHz)	SCs (Tone)	Starting SC	Measured Avg Power (dBm)					
					BPSK			QPSK ($\pi/4$)		
					CH 19951	CH 20175	CH 20398	CH 19951	CH 20175	CH 20398
					1710.1 MHz	1732.5 MHz	1754.8 MHz	1710.1 MHz	1732.5 MHz	1754.8 MHz
200	Extremity	3.75	1	0	21.65	21.95	22.70	21.70	22.05	22.70
				23	21.40	21.60	22.45	21.35	21.70	22.65
				47	21.55	21.90	22.70	21.55	21.80	22.70
		15	1	0	21.40	21.70	22.40	21.35	21.70	22.45
				5	21.45	21.95	22.65	21.45	21.90	22.55
				11	21.35	21.90	22.50	21.25	21.75	22.40
			Multitone		QPSK					
			3	0	20.70	21.15	21.60			
				3	21.25	21.65	22.25			
				6	21.20	21.60	22.20			
				9	20.60	21.05	21.40			
			6	0	19.90	20.50	20.85			
				6	19.95	20.55	20.90			
			12	0	19.05	19.55	20.00			

8.2.1. LTE NB2-IOT Band 5

Ch.BW (kHz)	Config	Subcarrier Spacing (kHz)	SCs (Tone)	Starting SC	Measured Avg Power (dBm)					
					BPSK			QPSK ($\pi/4$)		
					CH 20401	CH 20525	CH 20648	CH 20401	CH 20525	CH 20648
					824.1 MHz	836.5 MHz	848.8 MHz	824.1 MHz	836.5 MHz	848.8 MHz
200	Extremity	3.75	1	0	22.30	22.25	21.95	22.20	22.30	22.10
				23	22.00	22.00	21.55	22.20	22.35	22.00
				47	21.95	22.15	21.95	22.25	22.05	21.85
		15	1	0	22.10	22.00	21.65	22.10	21.95	21.65
				5	22.25	22.00	21.80	22.25	22.00	21.80
				11	22.10	22.00	21.70	22.10	21.95	21.65
			Multitone		QPSK					
			3	0	21.50	21.30	21.15			
				3	22.05	21.80	21.65			
				6	22.15	21.75	21.60			
				9	21.50	21.20	21.05			
			6	0	20.80	20.65	20.45			
				6	20.75	20.70	20.40			
			12	0	19.70	19.60	19.55			

8.2.1. LTE NB2-IOT Band 12

Ch.BW (kHz)	Config	Subcarrier Spacing (kHz)	SCs (Tone)	Starting SC	Measured Avg Power (dBm)					
					BPSK			QPSK ($\pi/4$)		
					CH 23011	CH 23095	CH 23178	CH 23011	CH 23095	CH 23178
					699.1 MHz	707.5 MHz	715.8 MHz	699.1 MHz	707.5 MHz	715.8 MHz
200	Extremity	3.75	1	0	22.15	22.05	22.25	22.25	22.15	22.50
				23	22.10	21.80	22.25	22.20	22.30	22.50
				47	22.15	22.00	22.30	22.05	21.95	22.20
		15	1	0	22.05	22.05	22.35	21.95	22.05	22.30
				5	22.10	22.15	22.50	22.10	22.10	22.50
				11	21.95	22.10	22.35	21.95	22.05	22.30
			Multitone		QPSK					
			3	0	21.35	21.45	21.75			
				3	21.95	21.95	22.30			
				6	21.90	21.80	22.25			
				9	21.25	21.25	21.60			
			6	0	20.70	20.70	21.15			
				6	20.75	20.75	21.20			
			12	0	19.90	19.85	20.15			

8.2.1. LTE NB2-IOT Band 13

Ch.BW (kHz)	Config	Subcarrier Spacing (kHz)	SCs (Tone)	Starting SC	Measured Avg Power (dBm)					
					BPSK			QPSK ($\pi/4$)		
					CH 23181	CH 23230	CH 23278	CH 23181	CH 23230	CH 23278
					777.1 MHz	782 MHz	786.8 MHz	777.1 MHz	782 MHz	786.8 MHz
200	Extremity	3.75	1	0	22.30	22.10	21.80	22.30	22.25	22.10
				23	22.05	21.80	21.60	22.35	22.15	21.95
				47	22.10	22.10	21.85	22.15	21.95	21.85
		15	1	0	22.15	21.90	21.50	22.05	21.80	21.55
				5	22.05	22.05	21.70	22.35	22.00	21.60
				11	22.15	21.90	21.55	22.15	21.85	21.40
			Multitone		QPSK					
			3	0	21.35	21.35	20.95			
				3	21.90	21.85	21.45			
				6	21.85	21.80	21.40			
				9	21.25	21.25	20.85			
			6	0	20.75	20.70	20.35			
				6	20.80	20.70	20.35			
			12	0	19.80	19.70	19.35			

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 $\pm 2^\circ\text{C}$ 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.

IEC/IEEE 62209-1528:2020

Target Frequency (MHz)	Head	
	ϵ_r	σ (S/m)
4	55.00	0.75
13	55.00	0.75
30	55.00	0.75
150	52.30	0.76
300	45.30	0.87
450	43.50	0.87
750	41.90	0.89
835	41.50	0.90
900	41.50	0.97
915	41.50	0.98
1450	40.50	1.20
1500	40.40	1.23
1610	40.30	1.29
1640	40.20	1.31
1750	40.10	1.37
1800	40.00	1.40
1900	40.00	1.40
2000	40.00	1.40
2100	39.80	1.49
2300	39.50	1.67
2450	39.20	1.80
2600	39.00	1.96
3000	38.50	2.40
3500	37.90	2.91
4000	37.40	3.43
4500	36.80	3.94
5000	36.20	4.45
5100	36.10	4.55
5200	36.00	4.66
5250	35.90	4.71
5300	35.90	4.76
5400	35.80	4.86
5500	35.60	4.96
5600	35.50	5.07
5700	35.40	5.17
5750	35.40	5.22
5800	35.30	5.27
6000	35.10	5.48
6500	34.50	6.07
7000	33.90	6.65
7500	33.30	7.24
8000	32.70	7.84
8500	32.10	8.46
9000	31.60	9.08
9500	31.00	9.71
10000	30.40	10.40

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
D750V3	1011	15 Feb 2021	750	1g	8.49
				10g	5.55
D750V3	1147	19 Oct 2021	750	1g	8.49
				10g	5.55
D900V2	035	15 Feb 2021	900	1g	10.90
				10g	6.99
D900V2	1d168	19 Oct 2021	900	1g	10.90
				10g	6.99
D1800V2	2d218	09 Mar 2021	1800	1g	38.40
				10g	20.10
D1800V2	264	20 Oct 2021	1800	1g	38.40
				10g	20.10
D1900V2	5d227	09 Mar 2021	1900	1g	39.70
				10g	20.50
D1900V2	537	16 Feb 2021	1900	1g	39.70
				10g	20.50
D1900V2	540	20 Oct 2021	1900	1g	39.70
				10g	20.50

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 $\pm 10\%$ of the manufacturer calibrated dipole SAR target. The internal limit is set to $\pm 10\%$.

Site 60

1900 Head

Date: 25 Oct 2021

Reference Dipole Antenna: D1900V2 - SN5d227

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1900	20.8	20.4	ϵ_r	41.07	Numerical	40.00	2.68	10
				σ (S/m)	1.36	Numerical	1.40	-3.04	10
				1g (W/kg)	38.71	Experimental	38.90	-0.49	10
						Numerical	39.70	-2.50	15
				10g (W/kg)	20.55	Experimental	20.30	1.24	10
						Numerical	20.50	0.25	15

Site 65

750 Head

Date: 27 Oct 2021

Reference Dipole Antenna: D750V3 - SN1011

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	750	19.8	20.1	ϵ_r	41.56	Numerical	41.94	-0.91	10
				σ (S/m)	0.89	Numerical	0.89	-0.32	10
				1g (W/kg)	8.20	Experimental	8.63	-4.97	10
						Numerical	8.49	-3.40	15
				10g (W/kg)	5.45	Experimental	5.63	-3.12	10
						Numerical	5.55	-1.73	15

750 Head

Date: 05 Nov 2021

Reference Dipole Antenna: D750V3 - SN1147

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	750	23.4	21.7	ϵ_r	42.41	Numerical	41.94	1.13	10
				σ (S/m)	0.91	Numerical	0.89	1.79	10
				1g (W/kg)	8.16	Experimental	8.61	-5.21	10
						Numerical	8.49	-3.87	15
				10g (W/kg)	5.45	Experimental	5.63	-3.12	10
						Numerical	5.55	-1.73	15

750 Head

Date: 29 Dec 2021

Reference Dipole Antenna: D750V3 - SN1147

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	750	20.7	20.6	ϵ_r	43.92	Numerical	41.94	4.72	10
				σ (S/m)	0.89	Numerical	0.89	-0.11	10
				1g (W/kg)	8.16	Experimental	8.61	-5.21	10
						Numerical	8.49	-3.87	15
				10g (W/kg)	5.41	Experimental	5.63	-3.83	10
						Numerical	5.55	-2.45	15

750 Head

Date: 04 Jan 2022

Reference Dipole Antenna: D750V3 - SN1147

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	750	20.7	20.7	ϵ_r	43.35	Numerical	41.94	3.35	10
				σ (S/m)	0.90	Numerical	0.89	0.24	10
				1g (W/kg)	8.00	Experimental	8.61	-7.06	10
						Numerical	8.49	-5.75	15
				10g (W/kg)	5.29	Experimental	5.63	-5.95	10
						Numerical	5.55	-4.60	15

750 Head

Date: 08 Feb 2022

Reference Dipole Antenna: D750V3 - SN1147

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	750	21.9	21.4	ϵ_r	42.47	Numerical	41.94	1.26	10
				σ (S/m)	0.88	Numerical	0.89	-1.69	10
				1g (W/kg)	7.84	Experimental	8.61	-8.91	10
						Numerical	8.49	-7.62	15
				10g (W/kg)	5.18	Experimental	5.63	-8.07	10
						Numerical	5.55	-6.75	15

900 Head

Date: 22 Oct 2021

Reference Dipole Antenna: D900V2 - SN035

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	900	20.5	20.7	ϵ_r	41.36	Numerical	41.50	-0.34	10
				σ (S/m)	0.95	Numerical	0.97	-2.31	10
				1g (W/kg)	10.63	Experimental	11.00	-3.37	10
						Numerical	10.90	-2.48	15
				10g (W/kg)	6.97	Experimental	7.04	-1.04	10
						Numerical	6.99	-0.33	15

900 Head

Date: 01 Nov 2021

Reference Dipole Antenna: D900V2 - SN035

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	900	20.1	20.5	ϵ_r	41.36	Numerical	41.50	-0.34	10
				σ (S/m)	0.93	Numerical	0.97	-4.04	10
				1g (W/kg)	10.51	Experimental	11.00	-4.45	10
						Numerical	10.90	-3.58	15
				10g (W/kg)	6.89	Experimental	7.04	-2.17	10
						Numerical	6.99	-1.47	15

900 Head

Date: 10 Jan 2022

Reference Dipole Antenna: D900V2 - SN1d168

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	900	20.9	20.7	ϵ_r	41.62	Numerical	41.50	0.30	10
				σ (S/m)	0.94	Numerical	0.97	-2.96	10
				1g (W/kg)	10.47	Experimental	11.10	-5.67	10
						Numerical	10.90	-3.94	15
				10g (W/kg)	6.81	Experimental	7.07	-3.71	10
						Numerical	6.99	-2.61	15

1800 Head

Date: 26 Oct 2021

Reference Dipole Antenna: D1800V2 - SN2d218

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1800	19.8	20.1	ϵ_r	39.49	Numerical	40.00	-1.28	10
				σ (S/m)	1.39	Numerical	1.40	-1.04	10
				1g (W/kg)	36.86	Experimental	38.30	-3.75	10
						Numerical	38.40	-4.00	15
				10g (W/kg)	19.75	Experimental	19.80	-0.27	10
						Numerical	20.10	-1.76	15

1800 Head

Date: 15 Nov 2021

Reference Dipole Antenna: D1800V2 - SN264

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1800	20.1	20.3	ϵ_r	39.62	Numerical	40.00	-0.95	10
				σ (S/m)	1.36	Numerical	1.40	-2.64	10
				1g (W/kg)	35.39	Experimental	38.50	-8.07	10
						Numerical	38.40	-7.83	15
				10g (W/kg)	18.79	Experimental	20.00	-6.05	10
						Numerical	20.10	-6.51	15

1800 Head

Date: 20 Dec 2021

Reference Dipole Antenna: D1800V2 - SN264

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1800	21.5	20.0	ϵ_r	40.32	Numerical	40.00	0.80	10
				σ (S/m)	1.36	Numerical	1.40	-3.20	10
				1g (W/kg)	35.91	Experimental	38.50	-6.72	10
						Numerical	38.40	-6.47	15
				10g (W/kg)	19.03	Experimental	20.00	-4.83	10
						Numerical	20.10	-5.30	15

1800 Head

Date: 10 Jan 2022

Reference Dipole Antenna: D1800V2 - SN264

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1800	20.9	20.7	ϵ_r	40.02	Numerical	40.00	0.05	10
				σ (S/m)	1.36	Numerical	1.40	-2.68	10
				1g (W/kg)	35.32	Experimental	38.50	-8.27	10
						Numerical	38.40	-8.03	15
				10g (W/kg)	18.58	Experimental	20.00	-7.12	10
						Numerical	20.10	-7.58	15

1900 Head

Date: 01 Nov 2021

Reference Dipole Antenna: D1900V2 - SN537

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1900	20.1	20.5	ϵ_r	39.59	Numerical	40.00	-1.01	10
				σ (S/m)	1.42	Numerical	1.40	1.46	10
				1g (W/kg)	40.21	Experimental	39.70	1.28	10
						Numerical	39.70	1.28	15
				10g (W/kg)	21.10	Experimental	20.50	2.93	10
						Numerical	20.50	2.93	15

1900 Head

Date: 13 Dec 2021

Reference Dipole Antenna: D1900V2 - SN5d227

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1900	19.4	20.0	ϵ_r	40.02	Numerical	40.00	0.04	10
				σ (S/m)	1.40	Numerical	1.40	-0.32	10
				1g (W/kg)	39.31	Experimental	38.90	1.05	10
						Numerical	39.70	-0.99	15
				10g (W/kg)	20.35	Experimental	20.30	0.25	10
						Numerical	20.50	-0.72	15

1900 Head

Date: 17 Dec 2021

Reference Dipole Antenna: D1900V2 - SN540

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1900	19.5	19.9	ϵ_r	39.11	Numerical	40.00	-2.23	10
				σ (S/m)	1.41	Numerical	1.40	0.81	10
				1g (W/kg)	40.70	Experimental	40.50	0.50	10
						Numerical	39.70	2.53	15
				10g (W/kg)	21.15	Experimental	21.10	0.24	10
						Numerical	20.50	3.17	15

1900 Head

Date: 10 Jan 2022

Reference Dipole Antenna: D1900V2 - SN5d227

Simulant	Frequency (MHz)	Room Temp(°C)	Liquid Temp(°C)	Parameters	Measured Value	Target Type	Target Value	Deviation (%)	Limit (%)
Head	1900	20.9	20.7	ϵ_r	39.89	Numerical	40.00	-0.29	10
				σ (S/m)	1.42	Numerical	1.40	1.59	10
				1g (W/kg)	39.37	Experimental	38.90	1.22	10
						Numerical	39.70	-0.82	15
				10g (W/kg)	20.54	Experimental	20.30	1.19	10
						Numerical	20.50	0.21	15

10. Measurements, Examinations and Derived Results

10.1. Specific Absorption Rate - Test Results – CAT – M1 - Extremity

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.

10.1.1. LTE CAT- M1 Band 2 Body 10g - Extremity**Max Reported SAR = 0.53 (W/kg)**

					For LTE Only			Power (dBm)			10g: SAR Results (W/kg)		
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	NBI	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
Bandwidth 20 MHz													
QPSK	0	Front	19100	1900.0	1	0	0	22.70	22.00	0.28	0.33	-	
QPSK	0	Front (Tilt)	19100	1900.0	1	0	0	22.70	22.00	0.26	0.31	-	
QPSK	0	Back	19100	1900.0	1	0	0	22.70	22.00	0.13	0.15	-	
QPSK	0	Edge 1	19100	1900.0	1	0	0	22.70	22.00	0.06	0.07	-	
QPSK	0	Edge 2	19100	1900.0	1	0	0	22.70	22.00	0.29	0.34	-	
QPSK	0	Edge 4	19100	1900.0	1	0	0	22.70	22.00	0.42	0.49	-	
QPSK	0	Edge 4	18700	1860.0	1	0	0	22.70	21.80	0.43	0.52	-	
QPSK	0	Edge 4	18900	1880.0	1	0	0	22.70	21.90	0.44	0.53	-	
QPSK	0	Front	18900	1880.0	3	0	0	22.70	22.00	0.30	0.35	-	
QPSK	0	Back	18900	1880.0	3	0	0	22.70	22.00	0.12	0.14	-	
QPSK	0	Edge 1	18900	1880.0	3	0	0	22.70	22.00	0.05	0.06	-	
QPSK	0	Edge 2	18900	1880.0	3	0	0	22.70	22.00	0.26	0.31	-	
QPSK	0	Edge 4	18900	1880.0	3	0	0	22.70	22.00	0.43	0.50	-	
QPSK	0	Edge 4	18700	1860.0	3	0	0	22.70	21.95	0.44	0.53	-	
QPSK	0	Edge 4	19100	1900.0	3	0	0	22.70	21.85	0.43	0.52	-	
QPSK	0	Edge 4	18900	1880.0	6	0	15	22.70	22.05	0.43	0.50	2	
QPSK	0	Edge 4	18900	1880.0	1	0	0	22.70	21.90	0.44	0.53	1	001

Note(s):

- Overall worst case has been repeated with the DC power supply disconnected.
- QPSK 100% RB allocation was tested as the highest maximum output power was measured to be higher than 1RB and 50% RB allocations.

10.1.2. LTE CAT- M1 Band 4 Body 10g - Extremity

Max Reported SAR = 0.40 (W/kg)

					For LTE Only			Power (dBm)			10g: SAR Results (W/kg)		
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	NBI	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
Bandwidth 20 MHz													
QPSK	0	Front	20300	1745.0	1	5	15	22.70	22.10	0.34	0.39	-	
QPSK	0	Front (Tilt)	20300	1745.0	1	5	15	22.70	22.10	0.30	0.35	-	
QPSK	0	Back	20300	1745.0	1	5	15	22.70	22.10	0.07	0.08	-	
QPSK	0	Edge 1	20300	1745.0	1	5	15	22.70	22.10	0.04	0.04	-	
QPSK	0	Edge 2	20300	1745.0	1	5	15	22.70	22.10	0.10	0.11	-	
QPSK	0	Edge 4	20300	1745.0	1	5	15	22.70	22.10	0.22	0.25	-	
QPSK	0	Front	20050	1720.0	1	5	15	22.70	21.65	0.30	0.38	-	
QPSK	0	Front	20175	1732.5	1	5	15	22.70	21.75	0.32	0.40	-	
QPSK	0	Front	20300	1745.0	3	3	15	22.70	22.30	0.35	0.38	-	
QPSK	0	Back	20300	1745.0	3	3	15	22.70	22.30	0.07	0.08	-	
QPSK	0	Edge 1	20300	1745.0	3	3	15	22.70	22.30	0.04	0.04	-	
QPSK	0	Edge 2	20300	1745.0	3	3	15	22.70	22.30	0.10	0.11	-	
QPSK	0	Edge 4	20300	1745.0	3	3	15	22.70	22.30	0.29	0.31	-	
QPSK	0	Front	20050	1720.0	3	3	15	22.70	21.75	0.30	0.38	-	
QPSK	0	Front	20175	1732.5	3	3	15	22.70	21.85	0.33	0.40	-	002
QPSK	0	Front	20300	1745.0	6	0	15	22.70	22.30	0.35	0.39	2	
QPSK	0	Front	20175	1732.5	3	3	15	22.70	21.85	0.32	0.39	1	

Note(s):

- Overall worst case has been repeated with the DC power supply disconnected.
- QPSK 100% RB allocation was tested as the highest maximum output power was measured to be higher than 1RB allocation.

10.1.3.LTE CAT- M1 Band 5 Body 10g - Extremity**Max Reported SAR = 0.39 (W/kg)**

					For LTE Only			Power (dBm)			10g: SAR Results (W/kg)		
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	NBI	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
Bandwidth 10 MHz													
QPSK	0	Front	20600	844.0	1	0	0	22.70	22.00	0.28	0.33	-	
QPSK	0	Front (Tilt)	20600	844.0	1	0	0	22.70	22.00	0.25	0.29	-	
QPSK	0	Back	20600	844.0	1	0	0	22.70	22.00	0.13	0.15	-	
QPSK	0	Edge 1	20600	844.0	1	0	0	22.70	22.00	0.02	0.02	-	
QPSK	0	Edge 2	20600	844.0	1	0	0	22.70	22.00	0.23	0.27	-	
QPSK	0	Edge 4	20600	844.0	1	0	0	22.70	22.00	0.30	0.35	-	
QPSK	0	Edge 4	20450	829.0	1	0	0	22.70	21.95	0.28	0.33	-	
QPSK	0	Edge 4	20525	836.5	1	0	0	22.70	21.70	0.30	0.37	-	
QPSK	0	Front	20450	829.0	3	0	0	22.70	21.90	0.33	0.39	-	003
QPSK	0	Back	20450	829.0	3	0	0	22.70	21.90	0.12	0.14	-	
QPSK	0	Edge 1	20450	829.0	3	0	0	22.70	21.90	0.02	0.02	-	
QPSK	0	Edge 2	20450	829.0	3	0	0	22.70	21.90	0.27	0.32	-	
QPSK	0	Edge 4	20450	829.0	3	0	0	22.70	21.90	0.31	0.37	-	
QPSK	0	Front	20525	836.5	3	0	0	22.70	21.85	0.31	0.38	-	
QPSK	0	Front	20600	844.0	3	0	0	22.70	21.80	0.30	0.37	-	
16-QAM	0	Front	20450	829.00	5	0	0	22.70	22.15	0.32	0.37	2	
QPSK	0	Front	20450	829.00	3	0	0	22.70	21.90	0.31	0.37	1	

Note(s):

- Overall worst case has been repeated with the DC power supply disconnected.
- Higher order modulation was tested as the highest output power measurement was found to be more than ½ dB higher than the same configuration in QPSK.

10.1.4.LTE CAT- M1 Band 12 Body 10g - Extremity**Max Reported SAR = 0.25 (W/kg)**

					For LTE Only			Power (dBm)			10g: SAR Results (W/kg)		
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	NBI	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
Bandwidth 10 MHz													
QPSK	0	Front	23130	711.0	1	5	7	22.70	22.05	0.20	0.23	-	
QPSK	0	Front (Tilt)	23130	711.0	1	5	7	22.70	22.05	0.15	0.18	-	
QPSK	0	Back	23130	711.0	1	5	7	22.70	22.05	0.03	0.03	-	
QPSK	0	Edge 1	23130	711.0	1	5	7	22.70	22.05	0.01	0.01	-	
QPSK	0	Edge 2	23130	711.0	1	5	7	22.70	22.05	0.12	0.14	-	
QPSK	0	Edge 4	23130	711.0	1	5	7	22.70	22.05	0.10	0.12	-	
QPSK	0	Front	23060	704.0	1	5	7	22.70	21.95	0.21	0.25	-	
QPSK	0	Front	23095	707.5	1	5	7	22.70	22.00	0.21	0.24	-	
QPSK	0	Front	23130	711.0	3	3	3	22.70	22.10	0.21	0.24	-	
QPSK	0	Back	23130	711.0	3	3	3	22.70	22.10	0.03	0.03	-	
QPSK	0	Edge 1	23130	711.0	3	3	3	22.70	22.10	0.01	0.01	-	
QPSK	0	Edge 2	23130	711.0	3	3	3	22.70	22.10	0.13	0.15	-	
QPSK	0	Edge 4	23130	711.0	3	3	3	22.70	22.10	0.11	0.13	-	
QPSK	0	Front	23060	704.0	3	3	3	22.70	22.00	0.21	0.25	-	
QPSK	0	Front	23095	707.5	3	3	3	22.70	22.05	0.22	0.25	-	
16-QAM	0	Front	23130	711.0	5	0	0	22.70	22.30	0.23	0.25	2	004
16-QAM	0	Front	23130	711.0	5	0	0	22.70	22.30	0.22	0.24	1,2	

Note(s):

- Overall worst case has been repeated with the DC power supply disconnected.
- Higher order modulation was tested as the highest output power measurement was found to be more than ½ dB higher than the same configuration in QPSK.

10.1.5.LTE CAT- M1 Band 13 Body 10g - Extremity**Max Reported SAR = 0.31 (W/kg)**

					For LTE Only			Power (dBm)			10g: SAR Results (W/kg)		
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	#RB	Start RB	NBI	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
Bandwidth 10 MHz													
QPSK	0	Front	23230	782.0	1	0	0	22.70	21.60	0.24	0.31	-	005
QPSK	0	Front (Tilt)	23230	782.0	1	0	0	22.70	21.60	0.19	0.24	-	
QPSK	0	Back	23230	782.0	1	0	0	22.70	21.60	0.06	0.08	-	
QPSK	0	Edge 1	23230	782.0	1	0	0	22.70	21.60	0.01	0.02	-	
QPSK	0	Edge 2	23230	782.0	1	0	0	22.70	21.60	0.18	0.23	-	
QPSK	0	Edge 4	23230	782.0	1	0	0	22.70	21.60	0.17	0.22	-	
QPSK	0	Front	23230	782.0	3	0	0	22.70	21.90	0.25	0.30	-	
QPSK	0	Back	23230	782.0	3	0	0	22.70	21.90	0.06	0.07	-	
QPSK	0	Edge 1	23230	782.0	3	0	0	22.70	21.90	0.01	0.01	-	
QPSK	0	Edge 2	23230	782.0	3	0	0	22.70	21.90	0.18	0.22	-	
QPSK	0	Edge 4	23230	782.0	3	0	0	22.70	21.90	0.18	0.22	-	
16-QAM	0	Front	23230	782.0	5	0	0	22.70	22.20	0.25	0.28	2	
QPSK	0	Front	23230	782.0	1	0	0	22.70	21.60	0.23	0.30	1	

Note(s):

- Overall worst case has been repeated with the DC power supply disconnected.
- Higher order modulation was tested as the highest output power measurement was found to be more than ½ dB higher than the same configuration in QPSK.

10.2. Specific Absorption Rate - Test Results – NB2 – IOT - Extremity

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.

10.2.1. LTE NB2- IOT Band 2 Body 10g - Extremity**Max Reported SAR = 0.62 (W/kg)**

					For LTE Only			Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	SCS (kHz)	Tone	Start. SC	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK ($\pi/4$)	0	Front	19198	1909.8	3.75	1	23	22.70	22.45	0.326	0.35	-	
QPSK ($\pi/4$)	0	Front (Tilt)	19198	1909.8	3.75	1	23	22.70	22.45	0.337	0.36	-	
QPSK ($\pi/4$)	0	Back	19198	1909.8	3.75	1	23	22.70	22.45	0.197	0.21	-	
QPSK ($\pi/4$)	0	Edge 1 (Top)	19198	1909.8	3.75	1	23	22.70	22.45	0.083	0.09	-	
QPSK ($\pi/4$)	0	Edge 2 (Right)	19198	1909.8	3.75	1	23	22.70	22.45	0.370	0.39	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	19198	1909.8	3.75	1	23	22.70	22.45	0.465	0.49	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	18601	1850.1	3.75	1	23	22.70	21.80	0.504	0.62	-	006
QPSK ($\pi/4$)	0	Edge 4 (Left)	18900	1880.0	3.75	1	23	22.70	22.00	0.507	0.60	-	
QPSK	0	Front (Tilt)	18900	1880.0	15	3	3	22.70	21.75	0.081	0.10	-	
QPSK	0	Back	18900	1880.0	15	3	3	22.70	21.75	0.062	0.08	-	
QPSK	0	Edge 1 (Top)	18900	1880.0	15	3	3	22.70	21.75	0.031	0.04	-	
QPSK	0	Edge 2 (Right)	18900	1880.0	15	3	3	22.70	21.75	0.085	0.11	-	
QPSK	0	Edge 4 (Left)	18900	1880.0	15	3	3	22.70	21.75	0.152	0.19	-	
QPSK	0	Edge 4 (Left)	18601	1850.1	15	3	3	22.70	21.55	0.171	0.22	-	
QPSK	0	Edge 4 (Left)	19198	1909.8	15	3	3	22.70	21.75	0.122	0.15	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	18601	1850.1	3.75	1	23	22.70	21.80	0.477	0.59	1	

Notes:

- Overall worst case has been repeated with the DC power supply disconnected.

10.2.2. LTE NB2- IOT Band 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)	SCS (kHz)	Tone	Start. SC	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK ($\pi/4$)	0	Front	20398	1754.8	3.75	1	0	22.70	22.70	0.538	0.54	-	
QPSK ($\pi/4$)	0	Front (Tilt)	20398	1754.8	3.75	1	0	22.70	22.70	0.477	0.48	-	
QPSK ($\pi/4$)	0	Back	20398	1754.8	3.75	1	0	22.70	22.70	0.099	0.10	-	
QPSK ($\pi/4$)	0	Edge 1 (Top)	20398	1754.8	3.75	1	0	22.70	22.70	0.061	0.06	-	
QPSK ($\pi/4$)	0	Edge 2 (Right)	20398	1754.8	3.75	1	0	22.70	22.70	0.180	0.18	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	20398	1754.8	3.75	1	0	22.70	22.70	0.268	0.27	-	
QPSK ($\pi/4$)	0	Front	19951	1710.1	3.75	1	0	22.70	21.70	0.446	0.56	-	
QPSK ($\pi/4$)	0	Front	20175	1732.5	3.75	1	0	22.70	22.05	0.498	0.58	-	
QPSK	0	Front	20398	1754.8	15	3	3	22.70	22.25	0.158	0.18	-	
QPSK	0	Back	20398	1754.8	15	3	3	22.70	22.25	0.026	0.03	-	
QPSK	0	Edge 1 (Top)	20398	1754.8	15	3	3	22.70	22.25	0.014	0.02	-	
QPSK	0	Edge 2 (Right)	20398	1754.8	15	3	3	22.70	22.25	0.051	0.06	-	
QPSK	0	Edge 4 (Left)	20398	1754.8	15	3	3	22.70	22.25	0.108	0.12	-	
QPSK	0	Front	19951	1710.1	15	3	3	22.70	21.25	0.132	0.18	-	
QPSK	0	Front	20175	1732.5	15	3	3	22.70	21.65	0.146	0.19	-	
QPSK ($\pi/4$)	0	Front	20175	1732.5	3.75	1	0	22.70	22.05	0.518	0.60	1	007

Notes:

- Overall worst case has been repeated with the DC power supply disconnected.

10.2.3. LTE NB2- IOT Band 5 Body 10g - Extremity**Max Reported SAR = 0.44 (W/kg)**

					For LTE Only			Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	SCS (kHz)	Tone	Start. SC	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK ($\pi/4$)	0	Front	20525	836.5	3.75	1	23	22.70	22.35	0.360	0.39	-	
QPSK ($\pi/4$)	0	Front (Tilt)	20525	836.5	3.75	1	23	22.70	22.35	0.328	0.36	-	
QPSK ($\pi/4$)	0	Back	20525	836.5	3.75	1	23	22.70	22.35	0.047	0.05	-	
QPSK ($\pi/4$)	0	Edge 1 (Top)	20525	836.5	3.75	1	23	22.70	22.35	0.005	0.01	-	
QPSK ($\pi/4$)	0	Edge 2 (Right)	20525	836.5	3.75	1	23	22.70	22.35	0.224	0.24	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	20525	836.5	3.75	1	23	22.70	22.35	0.372	0.40	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	20401	824.1	3.75	1	23	22.70	22.20	0.386	0.43	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	20648	848.8	3.75	1	23	22.70	22.00	0.347	0.41	-	
QPSK	0	Front	20401	824.1	15	3	6	22.70	22.15	0.117	0.13	-	
QPSK	0	Back	20401	824.1	15	3	6	22.70	22.15	0.058	0.07	-	
QPSK	0	Edge 1 (Top)	20401	824.1	15	3	6	22.70	22.15	0.011	0.01	-	
QPSK	0	Edge 2 (Right)	20401	824.1	15	3	6	22.70	22.15	0.086	0.10	-	
QPSK	0	Edge 4 (Left)	20401	824.1	15	3	6	22.70	22.15	0.126	0.14	-	
QPSK	0	Edge 4 (Left)	20525	836.5	15	3	6	22.70	21.75	0.112	0.14	-	
QPSK	0	Edge 4 (Left)	20648	848.8	15	3	6	22.70	21.60	0.100	0.13	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	20401	824.1	3.75	1	23	22.70	22.20	0.390	0.44	1	008

Notes:

- Overall worst case has been repeated with the DC power supply disconnected.

10.2.4. LTE NB2- IOT Band 12 Body 10g - Extremity**Max Reported SAR = 0.18 (W/kg)**

					For LTE Only			Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	SCS (kHz)	Tone	Start. SC	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
BPSK	0	Front	23178	715.8	15	1	5	22.70	22.50	0.151	0.16	-	
BPSK	0	Front (Tilt)	23178	715.8	15	1	5	22.70	22.50	0.119	0.12	-	
BPSK	0	Back	23178	715.8	15	1	5	22.70	22.50	0.015	0.02	-	
BPSK	0	Edge 1 (Top)	23178	715.8	15	1	5	22.70	22.50	0.003	0.00	-	
BPSK	0	Edge 2 (Right)	23178	715.8	15	1	5	22.70	22.50	0.090	0.09	-	
BPSK	0	Edge 4 (Left)	23178	715.8	15	1	5	22.70	22.50	0.055	0.06	-	
BPSK	0	Front	23011	699.1	15	1	5	22.70	22.10	0.154	0.18	-	009
BPSK	0	Front	23095	707.5	15	1	5	22.70	22.15	0.135	0.15	-	
QPSK	0	Front	23178	715.8	15	3	3	22.70	22.30	0.074	0.08	-	
QPSK	0	Back	23178	715.8	15	3	3	22.70	22.30	0.005	0.01	-	
QPSK	0	Edge 1 (Top)	23178	715.8	15	3	3	22.70	22.30	0.001	0.00	-	
QPSK	0	than	23178	715.8	15	3	3	22.70	22.30	0.046	0.05	-	
QPSK	0	Edge 4 (Left)	23178	715.8	15	3	3	22.70	22.30	0.026	0.03	-	
QPSK	0	Front	23011	699.1	15	3	3	22.70	21.95	0.065	0.08	-	
QPSK	0	Front	23095	707.5	15	3	3	22.70	21.95	0.065	0.08	-	
BPSK	0	Front	23011	699.1	15	1	5	22.70	22.10	0.131	0.15	1	

Notes:

- Overall worst case has been repeated with the DC power supply disconnected.

10.2.5. LTE NB2- IOT Band 13 Body 10g - Extremity**Max Reported SAR = 0.37 (W/kg)**

					For LTE Only			Power (dBm)		10g: SAR Results (W/kg)			
Mode	Dist. (mm)	EUT Position	Channel Number	Freq (MHz)	SCS (kHz)	Tone	Start. SC	Tune Up Limit	Meas.	Meas. SAR Level	Reported SAR	Notes	Plot No.
QPSK ($\pi/4$)	0	Front	23181	777.1	3.75	1	23	22.70	22.35	0.315	0.34	-	
QPSK ($\pi/4$)	0	Front (Tilt)	23181	777.1	3.75	1	23	22.70	22.35	0.271	0.29	-	
QPSK ($\pi/4$)	0	Back	23181	777.1	3.75	1	23	22.70	22.35	0.077	0.08	-	
QPSK ($\pi/4$)	0	Edge 1 (Top)	23181	777.1	3.75	1	23	22.70	22.35	0.018	0.02	-	
QPSK ($\pi/4$)	0	Edge 2 (Right)	23181	777.1	3.75	1	23	22.70	22.35	0.223	0.24	-	
QPSK ($\pi/4$)	0	Edge 4 (Left)	23181	777.1	3.75	1	23	22.70	22.35	0.266	0.29	-	
QPSK ($\pi/4$)	0	Front	23230	782.0	3.75	1	23	22.70	22.15	0.298	0.34	-	
QPSK ($\pi/4$)	0	Front	23278	786.80	3.75	1	23	22.70	21.95	0.270	0.32	-	
QPSK	0	Front	23181	777.1	15	3	3	22.70	21.90	0.083	0.10	-	
QPSK	0	Back	23181	777.1	15	3	3	22.70	21.90	0.034	0.04	-	
QPSK	0	Edge 1 (Top)	23181	777.1	15	3	3	22.70	21.90	0.006	0.01	-	
QPSK	0	Edge 2 (Right)	23181	777.1	15	3	3	22.70	21.90	0.061	0.07	-	
QPSK	0	Edge 4 (Left)	23181	777.1	15	3	3	22.70	21.90	0.086	0.10	-	
QPSK	0	Edge 4 (Left)	23230	782.0	15	3	3	22.70	21.85	0.099	0.12	-	
QPSK	0	Edge 4 (Left)	23278	786.80	15	3	3	22.70	21.45	0.082	0.11	-	
QPSK ($\pi/4$)	0	Front	23181	777.1	3.75	1	23	22.70	22.35	0.340	0.37	1	010

Notes:

- Overall worst case has been repeated with the DC power supply disconnected.

10.3.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 .

Repeat Measurements Results

Note: Since the 10g 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 CAT – M1 Band 2	0.53	PCE	0.62
	LTE CAT – M1 Band 4	0.40		
	LTE CAT – M1 Band 5	0.39		
	LTE CAT – M1 Band 12	0.25		
	LTE CAT – M1 Band 13	0.31		
	LTE NB2 – IOT - Band 2	0.62		
	LTE NB2 – IOT - Band 4	0.60		
	LTE NB2 – IOT - Band 5	0.44		
	LTE NB2 – IOT - Band 12	0.18		
	LTE NB2 – IOT - Band 13	0.37		

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.