SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch

FCC SAR TEST REPORT

Application No.:	ZEWM2308001256RG
Applicant:	MIO LABS INC.
Manufacturer:	MIO LABS INC.
Product Name:	Blood Glucose Meter
Model No.(EUT):	TeleBGM 2283-A, TeleBGM 2284-A
FCC ID:	2A7JQTELEBGM2283-A
Standards:	FCC 47CFR §2.1093
Date of Receipt:	2023/08/25
Date of Test:	2023/08/27 to 2023/09/16
Date of Issue:	2023/09/19
Test conclusion:	**PASS ***

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

Authorized Signature:

Ervin Li

Ervin Li
Regulatory Manager

检验检测专用章 Inspection & Testing Services
SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

REVISION HISTORY

Report Number	Revision	Description	Issue Date
ZEWM2308001256RG01	01	Original	2023/09/19

Prepared By	Vito Wang **Vito Wang**
Checked By	Roman Pan **Roman Pan**

TEST SUMMARY

Frequency Band	**Maximum Reported SAR1g(W/kg)**
	CAT-M1 Extremity 0mm
CatM1 LTE Band 2	0.70
CatM1 LTE Band 4	**0.99**
CatM1 LTE Band 12	0.37
CatM1 LTE Band 13	0.31
SAR Limited(W/kg)	4.0

CONTENTS

1 General Information

1.1 Details of Client

Applicant:	MIO LABS INC.
Address:	#1023, ZGC Innovation Center 4500 Great America Pkwy, Santa Clara, California 95054, United States
Manufacturer:	MIO LABS INC.
Address:	#1023, ZGC Innovation Center, 4500 Great America Pkwy, Santa Clara, CA 95054

1.2 Test Location

Company:	SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch
Address:	No. 1 Workshop, M-10, Middle section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China
Post code:	518057
Test engineer:	Messi Chen

1.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **Innovation, Science and Economic Development Canada**

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

• **FCC –Designation Number: CN1336**

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch has been recognized as an accredited testing laboratory.

Designation Number: CN1336. Test Firm Registration Number: 787754.

1.4 General Description of EUT

Device Type :	portable device		
Exposure Category:	uncontrolled environment / general population		
Product Name:	Blood Glucose Meter		
Model No.(EUT):	TeleBGM 2283-A, TeleBGM 2284-A Note: The model TeleBGM 2283-A and TeleBGM 2284-A were fully tested, since according to the declaration from the applicant, the electrical circuit design, layout, components used, internal wiring and functions were identical for all the above models, with only difference on the shell and antenna.		
FCC ID:	2A7JQTELEBGM2283-A		
Product Phase:	Identical Prototype		
SN:	G03BG00132100001		
Hardware Version:	01		
Software Version:	SW2071279		
Antenna Type:	PIFA antenna		
Device Operating Configurations :			
Modulation Mode:	**LTE CAT-M1:** QPSK,16QAM		
Power Class:	3, tested with power control Max power		
Frequency Bands:	Band	Tx (MHz)	Rx (MHz)
	CatM1 Band 2	1850-1910	1930-1990
	CatM1 Band 4	1710-1755	2110-2155
	CatM1 Band 12	699-716	729-746
	CatM1 Band 13	777-787	746-756
Battery Information:	Model:	ZWD633248M	
	Normal Voltage:	DC 3.7V	
	Rated capacity:	1080mAh, 3.996Wh	
	Battery Type:	Rechargeable Li-ion Battery	
	Manufacturer:	Zhongshan Zhongwangde New Energy Technology Co., Ltd	
Note: *Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information, SGS is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion. Remark: As above information is provided and confirmed by the applicant. SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.			

No.1 Workshop, M-10, Middle Section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China 518057 t (86–755) 26012053 www.sgsgroup.com.cn
中国・广东・深圳市南山区科技园中区M-10栋1号厂房 邮编：518057 t (86–755) 26012053 sgs.china@sgs.com

1.4.1 DUT Antenna Locations (Back View)

The DUT Antenna Locations can be referred to Appendix D

1.4.2 Stand-alone SAR test evaluation

The following SAR test exclusion Thresholds based on KDB 447498 D04 Interim General RF Exposure Guidance v01 Appendix B B.4

Bnad	Exposure Condition	f (GHz)	Pmax	Pmax	separation distance(cm)					
			(dBm)	(mw)	Front side	Back side	Left side	Right side	Top side	Bottom side
LTE B2	Extremity 0mm	1.9	21	125.89	0.50	0.50	2.63	0.50	7.26	0.50
LTE B4	Extremity 0mm	1.75	21	125.89	0.50	0.50	2.63	0.50	7.26	0.50
LTE B12	Extremity 0mm	0.75	21	125.89	0.50	0.50	2.63	0.50	7.26	0.50
LTE B13	Extremity 0mm	0.75	21	125.89	0.50	0.50	2.63	0.50	7.26	0.50

Bnad	Blank 1mW Blanket Exemption (mW)	MPE Based Exemption (mm)	MPE Based Exemption (mW)	SAR based Exemption(mW)					
				Front side	Back side	Left side	Right side	Top side	Bottom side
LTE B2	1	25	12.00	8.4	8.4	180.0	8.4	1175.8	8.4
LTE B4	1	27	14.21	9.0	9.0	186.9	9.0	1197.9	9.0
LTE B12	1	67	40.76	28.7	28.7	254.0	28.7	964.4	28.7
LTE B13	1	61	37.08	25.1	25.1	246.4	25.1	995.9	25.1

Bnad	SAR Test(Yes or No)					
	Front side	Back side	Left side	Right side	Top side	Bottom side
LTE B2	Yes	Yes	Yes	Yes	No	Yes
LTE B4	Yes	Yes	Yes	Yes	No	Yes
LTE B12	Yes	Yes	Yes	Yes	No	Yes
LTE B13	Yes	Yes	Yes	Yes	No	Yes

Note:

1. Maximum power is the source-based time-average power and represents the maximum RF output power among production units
2. Per KDB 447498 D04, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
3. Per KDB 447498 D04, standalone SAR test exclusion threshold is applied; If the distance of the antenna to the user is < 5mm, 5mm is used to determine SAR exclusion threshold
4. Per KDB 447498 D04, the 1-g and 10-g SAR test exclusion thresholds for 300 MHz to 6 GHz

Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of §1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance

MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1) (i)(C)] to support an exemption from further evaluation from300 kHz through 100 GHz.

TABLE B.1—THRESHOLDS FOR SINGLE RF SOURCES SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	1,920 R^2
1.34	–	30	35.6 m	–	1.6 m	3,450 R^2/f^2
30	–	300	1.6 m	–	159 mm	3.83 R^2
300	–	1,500	159 mm	–	31.8 mm	0.0128 $R^2 f$
1,500	–	100,000	31.8 mm	–	0.5 mm	19.2R^2

Subscripts L and H are low and high; λ is wavelength.
From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.

SAR-based Exemption

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by Formula (B.2).

$$P_{\text{th}}\ (\text{mW}) = ERP_{20\ \text{cm}}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases} \qquad (\text{B}.1)$$

$$P_{\text{th}}\ (\text{mW}) = \begin{cases} ERP_{20\ \text{cm}}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ \text{cm}} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases} \qquad (\text{B}.2)$$

where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ \text{cm}}\sqrt{f}}\right)$$

and f is in GHz, d is the separation distance (cm), and ERP20cm is per Formula (B.1).
The example values shown in Table B.2 are for illustration only.

Table B.2—Example Power Thresholds (mW)

Frequency (MHz)	Distance (mm)									
	5	10	15	20	25	30	35	40	45	50
300	39	65	88	110	129	148	166	184	201	217
450	22	44	67	89	112	135	158	180	203	226
835	9	25	44	66	90	116	145	175	207	240
1900	3	12	26	44	66	92	122	157	195	236
2450	3	10	22	38	59	83	111	143	179	219
3600	2	8	18	32	49	71	96	125	158	195
5800	1	6	14	25	40	58	80	106	136	169

5. when 10-g extremity SAR applies, SAR test exemption may be considered by applying a factor of 2.5 to the SAR-based exemption thresholds.

1.5 Test Specification

Identity	Document Title
FCC 47CFR §2.1093	Radiofrequency Radiation Exposure Evaluation: Portable Devices
ANSI/IEEE C95.1-1992	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.
IEEE 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
KDB 447498 D04	Interim General RF Exposure Guidance v01
KDB 941225 D05	SAR for LTE Devices v02r05
KDB 865664 D01	SAR Measurement 100 MHz to 6 GHz v01r04
KDB 865664 D02	RF Exposure Reporting v01r02

1.6 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain*Trunk)	1.60 mW/g	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

Notes:

* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation.)

2 Laboratory Environment

Temperature	Min. = 18°C, Max. = 25 °C
Relative humidity	Min. = 30%, Max. = 70%
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

Table 1： The Ambient Conditions

3 SAR Measurements System Configuration

3.1 The SAR Measurement System

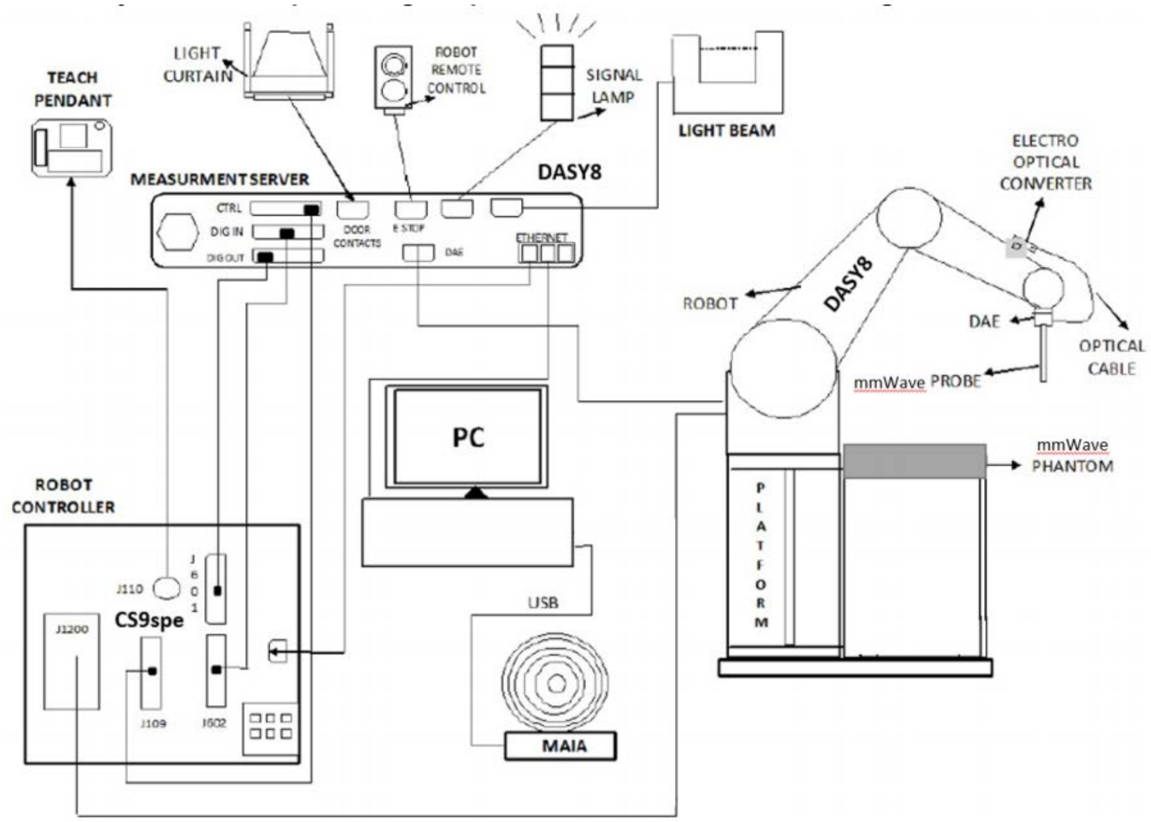
This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (SPEAG DASY professional system). A E-field probe is used to determine the internal electric fields. The SAR can be obtained from the equation SAR= σ (|Ei|2)/ ρ where σ and ρ are the conductivity and mass density of the tissue-Simulate.

The DASY system for performing compliance tests consists of the following items:
A standard high precision 6-axis robot (Stabile RX family) with controller, teach pendant and software An arm extension for accommodation the data acquisition electronics (DAE).

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

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 between optical and electrical of the signals for the digital communication to DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.



F-1. SAR Measurement System Configuration

- 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.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows series.
- DASY software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand, right-hand and Body Worn usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to be validating the proper functioning of the system.

3.2 Isotropic E-field Probe EX3DV4

	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)
Dynamic Range	10 µW/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

3.3 Data Acquisition Electronics (DAE)

Model	DAE	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detectors for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16-bit resolution and two range settings: 4mV,400mV)	
Input Offset Voltage	< 5μV (with auto zero)	
Input Bias Current	< 50 f A	
Dimensions	60 x 60 x 68 mm	

3.4 SAM Twin Phantom

Material	Vinylester, glass fiber reinforced (VE-GF)	
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)	
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)	
Dimensions (incl. Wooden Support)	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	
Wooden Support	SPEAG standard phantom table	

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left- and right-hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.

Twin SAM V5.0 has the same shell geometry and is manufactured from the same material as Twin SAM V4.0 but has reinforced top structure.

3.5 ELI Phantom

Material	Vinylester, glass fiber reinforced (VE-GF)	
Liquid Compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	
Wooden Support	SPEAG standard phantom table	

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

ELI V5.0 has the same shell geometry and is manufactured from the same material as ELI4 but has reinforced top structure.

3.6 Device Holder for Transmitters

F-2. **Device Holder for Transmitters**

- The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centres for both scales are the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.
- The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity ε=3 and loss tangent δ=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

3.7 Measurement procedure

3.7.1 Scanning procedure

Step 1: Power reference measurement

The "reference" and "drift" measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure.

Step 2: *Area scan*

The SAR distribution at the exposed side of the head was measured at a distance of 4mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm*15mm or 12mm*12mm or 10mm*10mm.Based on the area scan data, the area of the maximum absorption was determined by spline interpolation.

Step 3: *Zoom scan*

Around this point, a volume of 32mm*32mm*30mm (f≤2GHz), 30mm*30mm*30mm (f for 2-3GHz) and 24mm*24mm*22mm (f for 5-6GHz) was assessed by measuring 5x5x7 points (f≤2GHz), 7x7x7 points (f for 2-3GHz) and 7x7x12 points (f for 5-6GHz). On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

The data at the surface was extrapolated, since the centre of the dipoles is 2.0mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. (This can be variable. Refer to the probe specification).The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The volume was integrated with the trapezoidal algorithm. One thousand points were interpolated to calculate the average. All neighbouring volumes were evaluated until no neighboring volume with a higher average value was found.

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std. 1528-2013.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
</table>

Step 4: Power reference measurement (drift)

The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The indicated drift is mainly the variation of the DUT's output power and should vary max. ± 5 %

3.7.2 Data Storage

The DASY software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DAE4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated. The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [m W/g], [m W/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

3.7.3 Data Evaluation by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters: - Sensitivity Normi, ai0, ai1, ai2
- Conversion factor ConvFi
- Diode compression point Dcpi
Device parameters: - Frequency f
- Crest factor cf
Media parameters: - Conductivity ε
- Density ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcp i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$$

H-field probes:

$$H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1} f + a_{i2} f^2) / f$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel I (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = (E_x^2 + E_Y^2 + E_z^2)^{1/2}$$

The primary field data are used to calculate the derived field units.

$$SAR = (Etot^2 \cdot \sigma) / (\varepsilon \cdot 1000)$$

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ= conductivity in [mho/m] or [Siemens/m]
ε= equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = E_{tot}{}^2 2 / 3770 \quad \text{or} \quad P_{pwe} = H_{tot}{}^2 \cdot 37.7$$

with Ppwe = equivalent power density of a plane wave in mW/cm2
Etot = total electric field strength in V/m
Htot = total magnetic field strength in A/m

4 SAR measurement variability and uncertainty

4.1 SAR measurement variability

Per KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. The additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

2) When the original highest measured 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.

The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

4.2 SAR measurement uncertainty

Per KDB865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. The equivalent ratio (1.5/1.6) is applied to extremity and occupational exposure conditions.

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5 Description of Test Position

5.1 Extremity Exposure Condition

Devices that are designed or intended for use on extremities, or mainly operated in extremity only exposure conditions, i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation.
The closest distance from the antenna to an adjacent device surface is used to determine if SAR testing is required for the adjacent surfaces, with the adjacent surface positioned against the phantom and the surface containing the antenna positioned perpendicular to the phantom

6 SAR System Verification Procedure

6.1 Tissue Simulate Liquid

6.1.1 Recipes for Tissue Simulate Liquid

The bellowing tables give the recipes for tissue simulating liquids to be used in different frequency bands：

Ingredients (% by weight)	Frequency (MHz)				
	450	700-900	1750-2000	2300-2500	2500-2700
Water	38.56	40.30	55.24	55.00	54.92
Salt (NaCl)	3.95	1.38	0.31	0.2	0.23
Sucrose	56.32	57.90	0	0	0
HEC	0.98	0.24	0	0	0
Bactericide	0.19	0.18	0	0	0
Tween	0	0	44.45	44.80	44.85

Salt: 99⁺% Pure Sodium Chloride
Sucrose: 98⁺% Pure Sucrose
Water: De-ionized, 16 MΩ⁺ resistivity
HEC: Hydroxyethyl Cellulose
Tween: Polyoxyethylene (20) sorbitan monolaurate

HSL5GHz is composed of the following ingredients：(Manufactured by SPEAG)
Water：50-65%
Mineral oil：10-30%
Emulsifiers：8-25%
Sodium salt：0-1.5%

Table 2： Recipe of Tissue Simulate Liquid

6.1.2 Measurement for Tissue Simulate Liquid

The Conductivity (σ) and Permittivity (ε_r) are listed in bellow table. For the SAR measurement given in this report. The temperature variation of the Tissue Simulate Liquids was 22±2°C.

Tissue Type	Measured Frequency (MHz)	Measured Tissue		Target Tissue (±5%)		Deviation (Within ±5%)		Liquid Temp. (℃)	Test Date
		ε_r	σ(S/m)	ε_r	σ(S/m)	ε_r	σ(S/m)		
750 Head	750	42.700	0.885	41.90	0.89	1.91%	-0.56%	21.8	2023/8/27
1750 Head	1750	40.500	1.390	40.10	1.37	1.00%	1.46%	21.8	2023/8/27
1950 Head	1950	40.200	1.430	40.00	1.40	0.50%	2.14%	21.8	2023/8/27

Table 3： Measurement result of Tissue electric parameters

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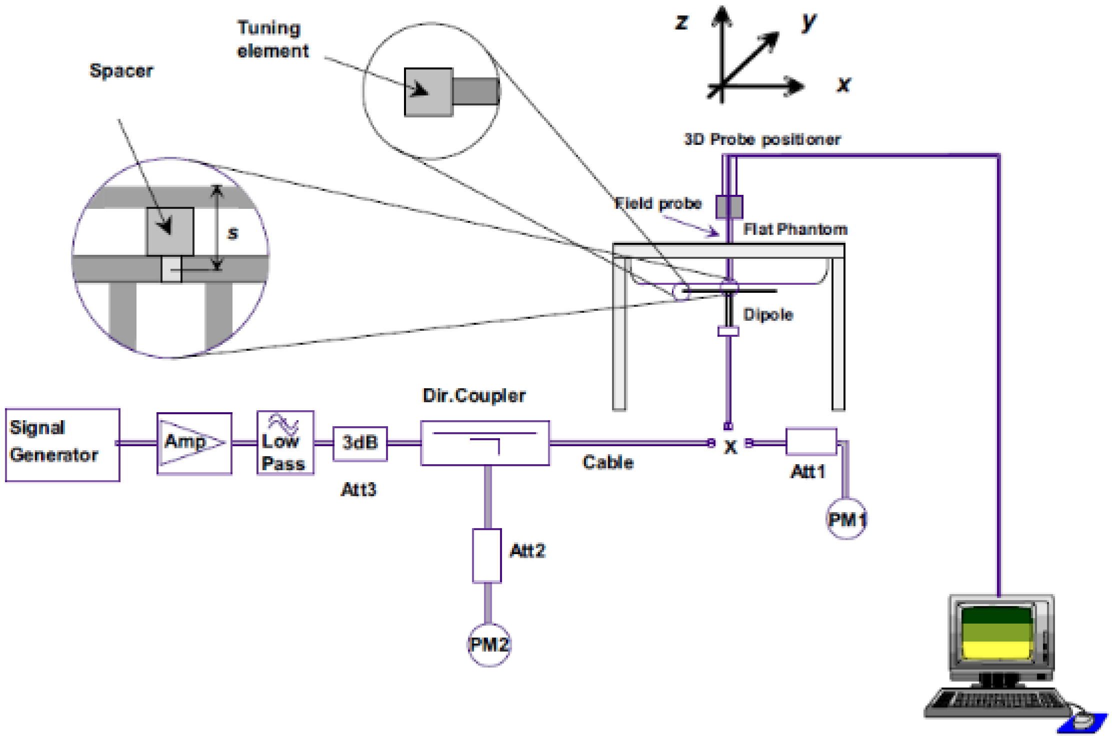
6.2 SAR System Check

The microwave circuit arrangement for system Check is sketched as below. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the following table (A power level of 250mW (below 3GHz) or 100mW (3-6GHz) was input to the dipole antenna). During the tests, the ambient temperature of the laboratory was in the range 22±2°C, the relative humidity was in the range 60% and the liquid depth above the ear reference points was above 15±0.5 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.



F-1. the microwave circuit arrangement used for SAR system check

6.2.1 Justification for Extended SAR Dipole Calibrations

1) Referring to KDB 865664 D01 requirements for dipole calibration, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements. Each measured dipole is expected to evaluate with the following criteria at least on annual interval in Appendix C.
a) There is no physical damage on the dipole.
b) System check with specific dipole is within 10% of calibrated value.
c) Return-loss is within 10% of calibrated measurement.
d) Impedance is within 5Ω from the previous measurement.

2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

6.2.2 Summary System Check Result(s)

Validation Kit		Measured SAR 250mW	Measured SAR 250mW	Measured SAR (normalized to 1W)	Measured SAR (normalized to 1W)	Target SAR (normalized to 1W)	Target SAR (normalized to 1W)	Deviation (Within ±10%)		Liquid Temp. (℃)	Test Date
		1g (W/kg)	10g (W/kg)	1g (W/kg)	10g (W/kg)	1-g(W/kg)	10-g(W/kg)	1-g(W/kg)	10-g(W/kg)		
D750V3	Head	2.20	1.48	8.80	5.92	8.37	5.53	5.14%	7.05%	21.8	2023/8/27
D1750V2	Head	9.26	5.00	37.04	20.00	36.60	19.30	1.20%	3.63%	21.8	2023/8/27
D1950V3	Head	10.90	5.67	43.60	22.68	40.50	20.80	7.65%	9.04%	21.8	2023/8/27

Table 4： SAR System Check Result

6.2.3 Detailed System Check Results

Please see the Appendix A

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7 Test Configuration

7.1 Operation Configurations

7.1.1 LTE CAT-M1 Test Configuration

Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The Radio Communication Analyzer was used for LTE output power measurements and SAR testing. Max power control was used so the UE transmits with maximum output power during SAR testing. SAR must be measured with the maximum TTI (transmit time interval) supported by the device in each LTE configuration.

A) Spectrum Plots for RB Configurations
A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.
B) MPR
MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.521-1 Section 6.2.3EA under Table 6.2.3EA-2.

Modulation	Channel bandwidth / Transmission bandwidth (N_{RB})						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	>2	>2	>3	>5	-	-	≤ 1
QPSK	>5	>5	-	-	-	-	≤ 2
16 QAM	≤ 2	≤ 2	>3	>5	-	-	≤ 1
16QAM	>2	>2	>5	-	-	-	≤ 2

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

D) Largest channel bandwidth standalone SAR test requirements
1) QPSK with 1 RB allocation
Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 50% limit SAR value, testing of the remaining RB offset configurations and required test channels is not required for 1 RB allocation; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is >90% limit SAR value, SAR is required for all three RB offset configurations for that required test channel.

2) QPSK with 50%RB
For QPSK with 50%RB, SAR is not required when the highest maximum output power for 50%RB is not higher than the maximum output power in 1 RB allocations and the highest reported SAR for 1 RB in 1) is ≤ 75% limit SAR value. Otherwise, SAR is only required measure for the worst case of 1RB allocation used the highest maximum output power channel and if the reported SAR is> 90% limit SAR value, the remaining required test channels must also be tested.

3) QPSK 100%RB allocation
For QPSK 100% RB allocation, SAR is not required when the highest maximum output power for 100%RB allocation is not higher than the maximum output power in 1 RB allocations and the highest reported SAR for 1

RB in 1) is ≤ 75% limit SAR value. Otherwise, SAR is only required measure for the worst case of 1RB allocation used the highest maximum output power channel and if the reported SAR is> 90% limit SAR value, the remaining required test channels must also be tested.

4) Higher order modulations
For each modulation besides QPSK; e.g., 16QAM, apply the QPSK procedures in above sections to determine the QAM configurations that may need SAR measurement. For each configuration identified as required for testing, SAR is required only when the highest maximum output power for the configuration in the higher order modulation is > ½ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 90% limit SAR value.

E) Other channel bandwidth standalone SAR test requirements

For the other channel bandwidths used by the device in a frequency band, apply all the procedures required for the largest channel bandwidth in section A) to determine the channels and RB configurations that need SAR testing and only measure SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is > ½ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 90% limit SAR value.

8 Test Result

8.1 Measurement of RF conducted Power

8.1.1 Conducted Power of LTE

LTE CatM1 Band 2				Conducted Power(dBm)			
Bandwidth	Modulation	RB size	RB offset	Channel 18607	Channel 18900	Channel 19193	Tune up
1.4MHz	QPSK	1	0	19.98	19.78	19.99	20.0
		1	2	19.83	19.9	19.76	20.0
		1	5	19.69	19.69	19.86	20.0
		3	0	19.35	19.76	19.52	20.0
		3	2	19.62	19.79	19.46	20.0
		3	3	19.96	19.59	19.46	20.0
		6	0	19.67	19.81	19.52	20.0
	16QAM	1	0	19.61	19.54	19.45	20.5
		1	2	19.64	20	19.66	20.5
		1	5	19.59	19.45	19.4	20.0
		3	0	19.86	19.9	19.4	20.0
		3	2	19.78	19.63	19.43	20.0
		3	3	19.7	19.45	19.45	20.0
		6	0	19.57	19.21	19.15	20.0
Bandwidth	Modulation	RB size	RB offset	Channel 18615	Channel 18900	Channel 19185	Tune up
3MHz	QPSK	1	0	19.82	19.85	19.88	20.0
		1	2	19.36	19.65	19.94	20.0
		1	5	19.68	19.76	19.74	20.0
		3	0	19.26	19.63	19.46	20.0
		3	2	19.43	19.55	19.34	20.0
		3	3	19.33	19.47	19.48	20.0
		6	0	19.45	19.38	19.38	20.0
	16QAM	1	0	19.55	19.4	19.35	20.0
		1	2	19.41	18.91	19.24	20.0
		1	5	19.36	19.4	19.38	20.0
		3	0	19.25	19.31	19.02	20.0
		3	2	19.12	19.15	18.84	20.0
		3	3	19.26	19.25	18.8	20.0
		6	0	19.34	18.99	19.22	20.0
Bandwidth	Modulation	RB size	RB offset	Channel 18625	Channel 18900	Channel 19175	Tune up
5MHz	QPSK	1	0	20.21	20.27	20.18	20.5
		1	2	19.53	19.76	20.17	20.5
		1	5	19.69	19.78	19.97	20.0
		3	0	19.26	19.53	19.41	20.0
		3	2	19.33	19.56	19.19	20.0
		3	3	19.27	19.43	19.31	20.0
		6	0	19.34	19.29	19.38	20.0
	16QAM	1	0	19.93	20.06	20.06	20.5
		1	2	19.32	18.61	19.36	20.0
		1	5	19.78	19.65	19.66	20.0
		3	0	19.54	19.49	19.07	20.0
		3	2	19.33	19.19	18.87	20.0
		3	3	19.14	19.16	18.84	20.0
		6	0	19.24	18.85	19.21	20.0
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Tune up

				18650	18900	19150	
10MHz	QPSK	1	0	20.26	20.27	20.36	20.5
		1	2	19.95	19.78	20.13	20.5
		1	5	19.71	20.01	19.91	20.5
		3	0	19.32	19.71	19.54	20.0
		3	2	19.62	19.61	19.4	20.0
		3	3	19.35	19.47	19.44	20.0
		6	0	19.35	19.43	19.49	20.0
	16QAM	1	0	19.9	20.14	20.14	20.5
		1	2	19.63	19.69	19.65	20.0
		1	5	19.79	19.78	19.72	20.0
		3	0	19.56	19.41	19.07	20.0
		3	2	19.22	19.14	18.94	20.0
		3	3	19.56	19.16	18.81	20.0
		6	0	19.44	18.9	19.12	20.0
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Tune up
				18675	18900	19125	
15MHz	QPSK	1	0	20.3	20.3	20.27	20.5
		1	2	19.97	20.04	20.13	20.5
		1	5	19.63	19.95	19.83	20.0
		3	0	19.43	19.62	19.5	20.0
		3	2	19.56	19.51	19.34	20.0
		3	3	19.27	19.51	19.41	20.0
		6	0	19.54	19.39	19.47	20.0
	16QAM	1	0	20.05	20.11	20.02	20.5
		1	2	19.34	19.68	19.34	20.0
		1	5	19.61	19.72	19.8	20.0
		3	0	19.36	19.48	19.04	20.0
		3	2	19.23	19.14	18.94	20.0
		3	3	19.45	19.17	18.86	20.0
		6	0	19.55	18.92	18.77	20.0
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Tune up
				18700	18900	19100	
20MHz	QPSK	1	0	20.21	20.24	20.19	21.0
		1	2	20.09	20.11	20.27	21.0
		1	5	19.71	19.94	19.98	21.0
		3	0	19.39	19.67	19.4	20.0
		3	2	19.68	19.58	19.43	20.0
		3	3	19.48	19.5	19.46	20.0
		6	0	19.65	19.38	19.37	20.0
	16QAM	1	0	19.91	20.06	20.05	20.5
		1	2	19.66	20.08	19.42	20.5
		1	5	19.94	19.5	19.9	20.0
		3	0	19.53	19.29	19.09	20.0
		3	2	19.42	19.18	18.95	20.0
		3	3	19.52	19.07	18.87	20.0
		6	0	19.27	19.05	18.58	20.0

LTE CatM1 Band 4				**Conducted Power(dBm)**			
Bandwidth	Modulation	RB size	RB offset	Channel 19957	Channel 20175	Channel 20393	Tune up
1.4MHz	QPSK	1	0	20.32	20.04	20.33	20.5
		1	2	19.82	19.25	20.2	20.5
		1	5	19.82	19.61	19.53	20.0
		3	0	19.71	19.63	19.52	20.0
		3	2	19.9	19.57	19.59	20.0
		3	3	19.32	19.26	19.66	20.0
		6	0	19.8	18.93	18.97	20.0
	16QAM	1	0	19.41	19.97	19.28	20.0
		1	2	19.48	19.69	19.36	20.0
		1	5	19.56	19.6	19.43	20.0
		3	0	19.35	19.67	19.14	20.0
		3	2	19.12	19.28	19.06	20.0
		3	3	19.4	19.1	19.09	20.0
		6	0	19.35	18.57	19.17	20.0
Bandwidth	Modulation	RB size	RB offset	Channel 19965	Channel 20175	Channel 20385	Tune up
3MHz	QPSK	1	0	20.3	20.24	20.25	20.5
		1	2	19.79	19.42	19.49	20.5
		1	5	19.83	19.73	19.56	20.5
		3	0	19.69	20.06	19.85	20.5
		3	2	19.92	19.93	19.51	20.0
		3	3	19.79	19.68	19.55	20.0
		6	0	19.85	19.4	18.92	20.0
	16QAM	1	0	19.46	19.69	19.65	20.5
		1	2	19.83	18.61	19.4	20.5
		1	5	20.15	18.65	19.47	20.5
		3	0	19.31	19.49	19.12	20.0
		3	2	19.15	19.23	19.1	20.0
		3	3	19.44	19.39	18.83	20.0
		6	0	18.81	18.99	18.74	19.0
Bandwidth	Modulation	RB size	RB offset	Channel 19975	Channel 20175	Channel 20375	Tune up
5MHz	QPSK	1	0	20.21	20.17	20.33	20.5
		1	2	20.19	19.4	19.65	20.5
		1	5	19.8	19.53	19.64	20.0
		3	0	19.77	19.41	19.5	20.0
		3	2	19.84	19.55	19.5	20.0
		3	3	19.7	19.34	19.56	20.0
		6	0	19.82	19.38	19.03	20.0
	16QAM	1	0	19.94	19.66	19.33	20.0
		1	2	19.77	19.56	19.34	20.0
		1	5	19.14	19.01	19.46	20.0
		3	0	19.34	19.63	19.57	20.0
		3	2	19.14	19.57	18.98	20.0
		3	3	18.96	19.19	19.04	20.0
		6	0	18.86	19.02	19.35	20.0

Bandwidth	Modulation	RB size	RB offset	Channel 20000	Channel 20175	Channel 20350	Tune up
10MHz	QPSK	1	0	20.29	20.32	20.12	20.5
		1	2	20	19.95	19.6	20.5
		1	5	19.82	19.65	19.62	20.0
		3	0	19.75	19.61	19.68	20.0
		3	2	19.86	19.6	19.59	20.0
		3	3	19.72	19.66	19.62	20.0
		6	0	19.77	18.95	19.03	20.0
	16QAM	1	0	19.89	19.43	19.75	20.5
		1	2	19.78	19.52	19.79	20.5
		1	5	20.01	19.43	19.76	20.5
		3	0	19.33	19.41	19.57	20.0
		3	2	19.49	19.09	19.23	20.0
		3	3	19.45	19.11	19.11	20.0
		6	0	18.84	19.01	19.24	20.0
Bandwidth	Modulation	RB size	RB offset	Channel 20025	Channel 20175	Channel 20325	Tune up
15MHz	QPSK	1	0	20.38	20.33	19.98	20.5
		1	2	19.82	19.48	19.66	20.0
		1	5	19.41	19.64	19.47	20.5
		3	0	19.73	19.68	19.62	20.0
		3	2	19.64	19.55	19.54	20.0
		3	3	19.78	19.6	19.68	20.0
		6	0	19.85	18.97	19.12	20.0
	16QAM	1	0	19.41	19.37	19.65	20.5
		1	2	20.05	19.56	19.49	20.5
		1	5	19.95	19.64	19.77	20.0
		3	0	19.34	19.71	19.15	20.0
		3	2	19.33	19.55	19.01	20.0
		3	3	19.39	19.1	18.92	20.0
		6	0	18.81	18.6	18.8	19.0
Bandwidth	Modulation	RB size	RB offset	Channel 20050	Channel 20175	Channel 20300	Tune up
20MHz	QPSK	1	0	20.52	20.39	20.44	21.0
		1	2	19.99	20.2	20.22	21.0
		1	5	19.43	19.61	19.93	21.0
		3	0	19.77	19.6	19.53	20.0
		3	2	19.86	19.61	19.62	20.0
		3	3	19.75	19.58	19.55	20.0
		6	0	19.81	19.35	18.96	20.0
	16QAM	1	0	19.46	19.62	19.87	20.5
		1	2	19.81	19.6	19.78	20.5
		1	5	20.16	19.46	19.77	20.5
		3	0	19.32	19.31	19.31	20.0
		3	2	19.11	19.29	19.33	20.0
		3	3	19.4	19.1	18.95	20.0
		6	0	18.84	18.62	18.86	19.0

LTE CatM1 Band 12				**Conducted Power(dBm)**			
Bandwidth	Modulation	RB size	RB offset	Channel 23017	Channel 23095	Channel 23173	Tune up
1.4MHz	QPSK	1	0	20.03	19.71	20.14	20.5
		1	2	19.91	20.03	19.88	20.5
		1	5	19.91	19.7	19.92	20.5
		3	0	19.6	19.88	20.03	20.5
		3	2	19.83	19.88	19.87	20.0
		3	3	19.62	19.86	19.89	20.0
		6	0	19.6	19.19	19.3	20.0
	16QAM	1	0	19.75	19.93	20.09	20.5
		1	2	19.47	19.41	19.75	20.5
		1	5	19.64	19.48	19.46	20.0
		3	0	19.45	19.3	19.4	20.0
		3	2	19.06	19.43	19.53	20.0
		3	3	19.24	18.93	19.43	20.0
		6	0	18.65	18.79	19.47	20.0
Bandwidth	Modulation	RB size	RB offset	Channel 23025	Channel 23095	Channel 23165	Tune up
3MHz	QPSK	1	0	20.07	19.8	19.76	20.5
		1	2	19.82	19.34	19.8	20.5
		1	5	19.77	19.66	19.66	20.5
		3	0	19.63	19.93	20.01	20.5
		3	2	19.67	19.89	20.01	20.5
		3	3	19.63	19.84	20.01	20.5
		6	0	19.68	19.27	19.37	20.0
	16QAM	1	0	19.64	19.7	19.68	20.0
		1	2	19.44	19.47	19.49	20.0
		1	5	19.4	19.65	19.7	20.0
		3	0	19.62	19.4	19.78	20.0
		3	2	19.49	19.09	19.72	20.0
		3	3	19.37	19.08	19.46	20.0
		6	0	19.36	18.85	19.45	20.0
Bandwidth	Modulation	RB size	RB offset	Channel 23035	Channel 23095	Channel 23155	Tune up
5MHz	QPSK	1	0	20.02	20.11	20.09	20.5
		1	2	19.89	19.61	19.93	20.0
		1	5	19.44	19.43	19.83	20.0
		3	0	19.52	19.51	19.67	20.0
		3	2	19.76	19.44	19.85	20.0
		3	3	19.69	19.5	19.61	20.0
		6	0	19.77	19.28	19.41	20.0
	16QAM	1	0	19.84	20.08	20.02	20.5
		1	2	19.74	19.36	19.98	20.0
		1	5	19.66	19.58	19.55	20.0
		3	0	19.55	19.36	19.75	20.0
		3	2	19.47	19.12	19.46	20.0
		3	3	19.42	19.05	19.39	20.0
		6	0	19.26	18.92	19.2	20.0
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Tune up

				23060	23095	23130	
10MHz	QPSK	1	0	20.36	20.47	20.17	21.0
		1	2	19.89	19.65	19.97	21.0
		1	5	19.76	19.83	19.83	21.0
		3	0	19.6	19.99	19.83	20.5
		3	2	19.86	19.89	19.96	20.5
		3	3	19.69	19.83	19.96	20.5
		6	0	19.77	19.24	19.35	20.0
	16QAM	1	0	19.6	19.86	19.73	20.0
		1	2	19.63	19.7	19.69	20.0
		1	5	19.52	19.44	19.81	20.0
		3	0	19.19	19.78	19.65	20.0
		3	2	19.08	19.15	19.51	20.0
		3	3	19.02	19.35	19.51	20.0
		6	0	19.03	18.89	19.35	20.0

LTE CatM1 Band 13				**Conducted Power(dBm)**			
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Tune up
				23205	23230	23255	
5MHz	QPSK	1	0	20.19	19.83	19.59	20.5
		1	2	20.14	19.64	19.69	20.5
		1	5	19.92	19.73	19.72	20.5
		3	0	19.94	20	20	20.5
		3	2	20.09	19.85	19.89	20.5
		3	3	19.92	19.87	20.01	20.5
		6	0	20.03	19.29	19.45	20.5
	16QAM	1	0	19.68	19.95	20.51	20.5
		1	2	19.99	19.47	20.21	20.5
		1	5	20.26	18.74	19.77	20.5
		3	0	19.65	19.76	19.65	20.0
		3	2	19.44	19.47	19.76	20.0
		3	3	19.77	19.38	19.46	20.0
		6	0	19.56	19.1	19.85	20.0
Bandwidth	Modulation	RB size	RB offset	Channel	Channel	Channel	Tune up
				23230	23230	23230	
10MHz	QPSK	1	0	20.28	20.34	19.97	21.0
		1	2	19.3	19.26	19.36	21.0
		1	5	19.83	20.02	20.09	21.0
		3	0	19.98	20.15	20.05	20.5
		3	2	19.97	20.01	19.85	20.5
		3	3	19.82	19.92	19.94	20.5
		6	0	20.04	19.46	19.84	20.5
	16QAM	1	0	19.34	19.45	19.96	20.0
		1	2	19.86	19.15	19.96	20.0
		1	5	19.99	18.96	19.74	20.0
		3	0	19.97	19.93	19.83	20.0
		3	2	19.38	19.28	19.18	20.0
		3	3	19.59	19.42	19.34	20.0
		6	0	19.33	19.15	19.66	20.0

8.2 Measurement of SAR Data

Note:

1) The maximum Scaled SAR value is marked in bold. Graph results refer to Appendix B.

2) Per KDB447498 D04, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

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

3) If the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg(2.0W/kg for 10g) then testing at the other channels is not required for such test configuration(s).

8.2.1 SAR Result of LTE Band 2

LTE Band 2 SAR Test Record (TeleBGM 2284-A)											
Test position	**BW.**	**Test mode**	**Test ch./Freq.**	**Duty Cycle**	**SAR (W/kg) 1-g**	**Power drift (dB)**	**Conducted Power(dBm)**	**Tune up Limit(dBm)**	**Scaled factor**	**Scaled SAR 1-g (W/kg)**	**Liquid Temp.(℃)**
Extremity Test data (Separate 0mm 1RB)											
Front side	20	QPSK 1_2	19100/1900	1:1	0.286	0.02	20.27	21.00	1.183	0.338	21.8
Back side	20	QPSK 1_2	19100/1900	1:1	0.541	0.03	20.27	21.00	1.183	0.640	21.8
Left side	20	QPSK 1_2	19100/1900	1:1	0.063	-0.14	20.27	21.00	1.183	0.075	21.8
Right side	20	QPSK 1_2	19100/1900	1:1	0.308	0.15	20.27	21.00	1.183	0.364	21.8
Bottom side	20	QPSK 1_2	19100/1900	1:1	0.591	-0.02	20.27	21.00	1.183	**0.699**	21.8
Extremity Test data (Separate 0mm 50%RB)											
Front side	20	QPSK 3_2	18700/1860	1:1	0.294	0.02	19.68	20.00	1.076	0.316	21.8
Back side	20	QPSK 3_2	18700/1860	1:1	0.515	0.15	19.68	20.00	1.076	0.554	21.8
Left side	20	QPSK 3_2	18700/1860	1:1	0.057	-0.13	19.68	20.00	1.076	0.061	21.8
Right side	20	QPSK 3_2	18700/1860	1:1	0.287	0.00	19.68	20.00	1.076	0.309	21.8
Bottom side	20	QPSK 3_2	18700/1860	1:1	0.632	-0.05	19.68	20.00	1.076	0.680	21.8
LTE Band 2 SAR Test Record (TeleBGM 2283-A)											
Test position	**BW.**	**Test mode**	**Test ch./Freq.**	**Duty Cycle**	**SAR (W/kg) 1-g**	**Power drift (dB)**	**Conducted Power(dBm)**	**Tune up Limit(dBm)**	**Scaled factor**	**Scaled SAR 1-g (W/kg)**	**Liquid Temp.(℃)**
Extremity Test data (Separate 0mm 1RB)											
Front side	20	QPSK 1_2	19100/1900	1:1	0.383	0.03	20.27	21.00	1.183	0.453	21.8
Back side	20	QPSK 1_2	19100/1900	1:1	0.422	0.05	20.27	21.00	1.183	0.499	21.8
Left side	20	QPSK 1_2	19100/1900	1:1	0.057	0.07	20.27	21.00	1.183	0.067	21.8
Right side	20	QPSK 1_2	19100/1900	1:1	0.270	-0.05	20.27	21.00	1.183	0.319	21.8
Bottom side	20	QPSK 1_2	19100/1900	1:1	0.508	0.12	20.27	21.00	1.183	0.601	21.8
Extremity Test data (Separate 0mm 50%RB)											
Front side	20	QPSK 3_2	18700/1860	1:1	0.430	-0.10	19.68	20.00	1.076	0.463	21.8
Back side	20	QPSK 3_2	18700/1860	1:1	0.460	-0.08	19.68	20.00	1.076	0.495	21.8
Left side	20	QPSK 3_2	18700/1860	1:1	0.077	0.13	19.68	20.00	1.076	0.083	21.8
Right side	20	QPSK 3_2	18700/1860	1:1	0.266	0.10	19.68	20.00	1.076	0.286	21.8
Bottom side	20	QPSK 3_2	18700/1860	1:1	0.584	0.02	19.68	20.00	1.076	0.629	21.8

Table 5： SAR of LTE CAT-M1 Band 2 for Extremity.

8.2.2 SAR Result of LTE Band 4

LTE Band 4 SAR Test Record (TeleBGM 2284-A)										
Test position	**BW.**	**Test mode**	**Test ch./Freq.**	**Duty Cycle**	**SAR (W/kg) 1-g**	**Power drift (dB)**	**Conducted Power(dBm)**	**Tune up Limit(dBm)**	**Scaled factor**	**Scaled SAR 1-g (W/kg)**	**Liquid Temp.(℃)**
Extremity Test data (Separate 0mm 1RB)											
Front side	20	QPSK 1_0	20050/1720	1:1	0.458	-0.02	20.52	21.00	1.117	0.512	21.8
Back side	20	QPSK 1_0	20050/1720	1:1	0.551	-0.01	20.52	21.00	1.117	0.615	21.8
Left side	20	QPSK 1_0	20050/1720	1:1	0.109	-0.13	20.52	21.00	1.117	0.122	21.8
Right side	20	QPSK 1_0	20050/1720	1:1	0.318	-0.14	20.52	21.00	1.117	0.355	21.8
Bottom side	20	QPSK 1_0	20050/1720	1:1	0.882	0.04	20.52	21.00	1.117	**0.985**	21.8
Bottom side Repeated	20	QPSK 1_0	20050/1720	1:1	0.866	-0.01	20.52	21.00	1.117	0.967	21.8
Bottom side	20	QPSK 1_2	20175/1732.5	1:1	0.809	-0.01	20.20	21.00	1.202	0.973	21.8
Bottom side	20	QPSK 1_0	20300/1745	1:1	0.803	0.06	20.44	21.00	1.138	0.914	21.8
Extremity Test data (Separate 0mm 50%RB)											
Front side	20	QPSK 3_3	20050/1720	1:1	0.417	-0.10	19.86	20.00	1.033	0.431	21.8
Back side	20	QPSK 3_3	20050/1720	1:1	0.572	-0.15	19.86	20.00	1.033	0.591	21.8
Left side	20	QPSK 3_3	20050/1720	1:1	0.101	0.06	19.86	20.00	1.033	0.104	21.8
Right side	20	QPSK 3_3	20050/1720	1:1	0.294	0.07	19.86	20.00	1.033	0.304	21.8
Bottom side	20	QPSK 3_3	20050/1720	1:1	0.831	-0.04	19.86	20.00	1.033	0.858	21.8
Bottom side	20	QPSK 3_3	20175/1732.5	1:1	0.850	-0.13	19.61	20.00	1.094	0.930	21.8
Bottom side	20	QPSK 3_0	20300/1745	1:1	0.837	0.00	19.62	20.00	1.091	0.914	21.8
Extremity Test data (Separate 0mm 100%RB)											
Bottom side	20	QPSK 6_0	20175/1732.5	1:1	0.818	-0.01	19.81	20.00	1.045	0.855	21.8

LTE Band 4 SAR Test Record (TeleBGM 2283-A)											
Test position	**BW.**	**Test mode**	**Test ch./Freq.**	**Duty Cycle**	**SAR (W/kg) 1-g**	**Power drift (dB)**	**Conducted Power(dBm)**	**Tune up Limit(dBm)**	**Scaled factor**	**Scaled SAR 1-g (W/kg)**	**Liquid Temp.(℃)**
Extremity Test data (Separate 0mm 1RB)											
Front side	20	QPSK 1_0	20050/1720	1:1	0.529	0.03	20.52	21.00	1.117	0.591	21.8
Back side	20	QPSK 1_0	20050/1720	1:1	0.517	0.08	20.52	21.00	1.117	0.577	21.8
Left side	20	QPSK 1_0	20050/1720	1:1	0.095	-0.02	20.52	21.00	1.117	0.106	21.8
Right side	20	QPSK 1_0	20050/1720	1:1	0.245	-0.13	20.52	21.00	1.117	0.274	21.8
Bottom side	20	QPSK 1_0	20050/1720	1:1	0.693	0.05	20.52	21.00	1.117	0.774	21.8
Extremity Test data (Separate 0mm 50%RB)											
Front side	20	QPSK 3_3	20050/1720	1:1	0.457	0.07	19.86	20.00	1.033	0.472	21.8
Back side	20	QPSK 3_3	20050/1720	1:1	0.363	0.09	19.86	20.00	1.033	0.375	21.8
Left side	20	QPSK 3_3	20050/1720	1:1	0.076	-0.10	19.86	20.00	1.033	0.078	21.8
Right side	20	QPSK 3_3	20050/1720	1:1	0.222	0.04	19.86	20.00	1.033	0.229	21.8
Bottom side	20	QPSK 3_3	20050/1720	1:1	0.633	0.06	19.86	20.00	1.033	0.654	21.8

Table 6： SAR of LTE CAT-M1 Band 4 for Extremity.

Test Position	**Channel/ Frequency**	**Measured SAR (1g)**	**1st Repeated**	**Ratio**	**2nd Repeated**	**3rd Repeated**
	(MHz)		**SAR (1g)**		**SAR (1g)**	**SAR (1g)**
Bottom side	20050/1720	0.882	0.866	1.018	N/A	N/A
Note: 1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.						
2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).						
3) A third repeated measurement was preformed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.						
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg						

8.2.3 SAR Result of LTE Band 12

LTE Band 12 SAR Test Record (TeleBGM 2284-A)										
Test position	**BW.**	**Test mode**	**Test ch./Freq.**	**Duty Cycle**	**SAR (W/kg) 1-g**	**Power drift (dB)**	**Conducted Power(dBm)**	**Tune up Limit(dBm)**	**Scaled factor**	**Scaled SAR 1-g (W/kg)**	**Liquid Temp.(℃)**
Extremity Test data (Separate 0mm 1RB)											
Front side	10	QPSK 1_0	23095/707.5	1:1	0.245	-0.08	20.47	21.00	1.130	0.277	21.8
Back side	10	QPSK 1_0	23095/707.5	1:1	0.329	-0.01	20.47	21.00	1.130	**0.372**	21.8
Left side	10	QPSK 1_0	23095/707.5	1:1	0.194	-0.06	20.47	21.00	1.130	0.219	21.8
Right side	10	QPSK 1_0	23095/707.5	1:1	0.191	0.06	20.47	21.00	1.130	0.216	21.8
Bottom side	10	QPSK 1_0	23095/707.5	1:1	0.185	0.00	20.47	21.00	1.130	0.209	21.8
Extremity Test data (Separate 0mm 50%RB)											
Front side	10	QPSK 3_2	23130/711	1:1	0.235	-0.05	19.99	20.50	1.125	0.264	21.8
Back side	10	QPSK 3_2	23130/711	1:1	0.327	-0.01	19.99	20.50	1.125	0.368	21.8
Left side	10	QPSK 3_2	23130/711	1:1	0.194	-0.10	19.99	20.50	1.125	0.218	21.8
Right side	10	QPSK 3_2	23130/711	1:1	0.190	0.00	19.99	20.50	1.125	0.214	21.8
Bottom side	10	QPSK 3_2	23130/711	1:1	0.177	-0.03	19.99	20.50	1.125	0.199	21.8

LTE Band 12 SAR Test Record (TeleBGM 2283-A)											
Test position	**BW.**	**Test mode**	**Test ch./Freq.**	**Duty Cycle**	**SAR (W/kg) 1-g**	**Power drift (dB)**	**Conducted Power(dBm)**	**Tune up Limit(dBm)**	**Scaled factor**	**Scaled SAR 1-g (W/kg)**	**Liquid Temp.(℃)**
Extremity Test data (Separate 0mm 1RB)											
Front side	10	QPSK 1_0	23095/707.5	1:1	0.242	0.04	20.47	21.00	1.130	0.273	21.8
Back side	10	QPSK 1_0	23095/707.5	1:1	0.270	0.09	20.47	21.00	1.130	0.305	21.8
Left side	10	QPSK 1_0	23095/707.5	1:1	0.280	-0.01	20.47	21.00	1.130	0.316	21.8
Right side	10	QPSK 1_0	23095/707.5	1:1	0.298	-0.06	20.47	21.00	1.130	0.337	21.8
Bottom side	10	QPSK 1_0	23095/707.5	1:1	0.210	0.13	20.47	21.00	1.130	0.237	21.8
Extremity Test data (Separate 0mm 50%RB)											
Front side	10	QPSK 3_2	23130/711	1:1	0.270	0.12	19.99	20.50	1.125	0.304	21.8
Back side	10	QPSK 3_2	23130/711	1:1	0.238	-0.05	19.99	20.50	1.125	0.268	21.8
Left side	10	QPSK 3_2	23130/711	1:1	0.267	-0.06	19.99	20.50	1.125	0.300	21.8
Right side	10	QPSK 3_2	23130/711	1:1	0.279	0.05	19.99	20.50	1.125	0.314	21.8
Bottom side	10	QPSK 3_2	23130/711	1:1	0.130	0.08	19.99	20.50	1.125	0.146	21.8

Table 7： SAR of LTE CAT-M1 Band 12 for Extremity.

8.2.4 SAR Result of LTE Band 13

LTE Band 13 SAR Test Record (TeleBGM 2284-A)										
Test position	**BW.**	**Test mode**	**Test ch./Freq.**	**Duty Cycle**	**SAR (W/kg) 1-g**	**Power drift (dB)**	**Conducted Power(dBm)**	**Tune up Limit(dBm)**	**Scaled factor**	**Scaled SAR 1-g (W/kg)**	**Liquid Temp.(℃)**
Extremity Test data (Separate 0mm 1RB)											
Front side	10	QPSK 1_0	23230/782	1:1	0.239	0.17	20.34	21.00	1.164	0.278	21.8
Back side	10	QPSK 1_0	23230/782	1:1	0.269	0.02	20.34	21.00	1.164	**0.313**	21.8
Left side	10	QPSK 1_0	23230/782	1:1	0.156	0.01	20.34	21.00	1.164	0.182	21.8
Right side	10	QPSK 1_0	23230/782	1:1	0.148	0.00	20.34	21.00	1.164	0.172	21.8
Bottom side	10	QPSK 1_0	23230/782	1:1	0.161	0.02	20.34	21.00	1.164	0.187	21.8
Extremity Test data (Separate 0mm 50%RB)											
Front side	10	QPSK 3_0	23230/782	1:1	0.203	-0.16	20.15	20.50	1.084	0.220	21.8
Back side	10	QPSK 3_0	23230/782	1:1	0.253	-0.04	20.15	20.50	1.084	0.274	21.8
Left side	10	QPSK 3_0	23230/782	1:1	0.144	-0.04	20.15	20.50	1.084	0.156	21.8
Right side	10	QPSK 3_0	23230/782	1:1	0.160	-0.01	20.15	20.50	1.084	0.173	21.8
Bottom side	10	QPSK 3_0	23230/782	1:1	0.150	-0.01	20.15	20.50	1.084	0.163	21.8

LTE Band 13 SAR Test Record (TeleBGM 2283-A)											
Test position	**BW.**	**Test mode**	**Test ch./Freq.**	**Duty Cycle**	**SAR (W/kg) 1-g**	**Power drift (dB)**	**Conducted Power(dBm)**	**Tune up Limit(dBm)**	**Scaled factor**	**Scaled SAR 1-g (W/kg)**	**Liquid Temp.(℃)**
Extremity Test data (Separate 0mm 1RB)											
Front side	10	QPSK 1_0	23230/782	1:1	0.193	-0.02	20.34	21.00	1.164	0.225	21.8
Back side	10	QPSK 1_0	23230/782	1:1	0.207	0.02	20.34	21.00	1.164	0.241	21.8
Left side	10	QPSK 1_0	23230/782	1:1	0.128	0.05	20.34	21.00	1.164	0.149	21.8
Right side	10	QPSK 1_0	23230/782	1:1	0.219	0.03	20.34	21.00	1.164	0.255	21.8
Bottom side	10	QPSK 1_0	23230/782	1:1	0.133	0.13	20.34	21.00	1.164	0.155	21.8
Extremity Test data (Separate 0mm 50%RB)											
Front side	10	QPSK 3_0	23230/782	1:1	0.197	0.05	20.15	20.50	1.084	0.214	21.8
Back side	10	QPSK 3_0	23230/782	1:1	0.200	-0.04	20.15	20.50	1.084	0.217	21.8
Left side	10	QPSK 3_0	23230/782	1:1	0.164	0.07	20.15	20.50	1.084	0.178	21.8
Right side	10	QPSK 3_0	23230/782	1:1	0.202	-0.03	20.15	20.50	1.084	0.219	21.8
Bottom side	10	QPSK 3_0	23230/782	1:1	0.122	0.06	20.15	20.50	1.084	0.132	21.8

Table 8: SAR of LTE CAT-M1 Band 13 for Extremity.

9 Equipment list

Test Platform		SPEAG DASY Professional				
Description		SAR Test System (Frequency range 300MHz-6GHz)				
Software Reference		DASY8 Module SAR V16.2.4.2524				
Hardware Reference						
Equipment		Manufacturer	Model	Serial Number	Calibration Date	Due date of calibration
☒	Twin Phantom	SPEAG	SAM 8	2146	NCR	NCR
☒	DAE	SPEAG	DAE4ip	1803	2023/07/14	2024/07/13
☒	E-Field Probe	SPEAG	EX3DV4	7821	2023/07/17	2024/07/16
☒	Validation Kits	SPEAG	D750V3	1160	2022/06/06	2025/06/05
☒	Validation Kits	SPEAG	D1750V2	1149	2022/06/17	2025/06/16
☒	Validation Kits	SPEAG	D1950V3	1138	2022/10/31	2025/10/30
☒	Dielectric parameter probes	SPEAG	DAKS-3.5	0005	2023/6/15	2024/6/14
☒	Vector Network Analyzer and Vector Reflectometer	SPEAG	DAKS_VNA R140	0140913	2023/6/7	2024/6/6
☒	Radio Communication Analyzer	Anritsu	MT8820C	6201616273	2023/02/16	2024/02/15
☒	Universal Radio Communication tester	R&S	CMW500	154501	2023/03/20	2024/03/19
☒	RF Bi-Directional Coupler	Agilent	86205-60001	MY31400031	NCR	NCR
☒	Signal Generator	Agilent	N5171B	MY53050736	2023/02/16	2024/02/15
☒	Preamplifier	Mini-Circuits	ZHL-42W	15542	NCR	NCR
☒	Preamplifier	Compliance Directions Systems Inc.	AMP28-3W	073501433	NCR	NCR
☒	Power Meter	Agilent	E4416A	GB41292095	2023/02/16	2024/02/15
☒	Power Sensor	Agilent	8481H	MY41091234	2023/02/16	2024/02/15
☒	Power Sensor	R&S	NRP-Z92	100025	2023/02/16	2024/02/15
☒	Attenuator	SHX	TS2-3dB	30704	NCR	NCR
☒	Speed reading thermometer	MingGao	T809	NA	2023/05/26	2024/05/25
☒	Humidity and Temperature Indicator	KIMTOKA	KIMTOKA	NA	2023/02/17	2024/02/16
☒	Humidity and Temperature Indicator	CHIGAO	HTC-1	ZGL2020120550471	2023/05/26	2024/05/25
☒	Humidity and Temperature Indicator	CHIGAO	HTC-1	ZGL2020120550472	2023/05/26	2024/05/25

Note: All the equipments are within the valid period when the tests are performed.

10 Calibration certificate

Please see the Appendix C

11 Photographs

Please see the Appendix D

Appendix A: Detailed System Check Results

Appendix B: Detailed Test Results

Appendix C: Calibration certificate

Appendix D: Photographs

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No.1 Workshop, M-10, Middle Section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China 518057 t (86-755) 26012053 www.sgsgroup.com.cn
中国・广东・深圳市南山区科技园中区M-10栋1号厂房 邮编: 518057 t (86-755) 26012053 sgs.china@sgs.com