FCC TEST REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

for

ActiveTrack

Model No.:
AT11-22-11

Issued to:

UPSTREEM S.A
Rue de Gosselies 13/9
Jumet 6040 Belgium

Issued by

Compliance Certification Services Inc.
Wugu Lab.
No.11, Wugong 6th Rd., Wugu Dist.,
New Taipei City, Taiwan. (R.O.C.)

Issued Date: 4/28/2021

Statements of Conformity
Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	4/28/2021	Initial Issue	ALL	Sky Zhou

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1 Certificate of Compliance (SAR Evaluation)

Applicant UPSTREEM S.A

Rue de Gosselies 13/9 Jumet 6040 Belgium

Manufacturer Ching Leen Electronics Co,. LTD.

No.3, Minsheng St., Tucheng Dist., New Taipei City, Taiwan

Equipment Under Test: ActiveTrack

Trade Name: Upstreem S.A

Model No.: AT11-22-11

Date of Test: Jan 28, 2021 to Apr 27, 2021

Receive EUT Date: Jan 25, 2021

Device Category: PORTABLE DEVICES

Exposure Category: GENERAL POPULATION/UNCONTROLLED EXPOSURE

<table>
<tr><th colspan="2">Applicable Standards</th></tr>
<tr><td>FCC</td><td>● IEEE 1528 2013
● 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
● KDB 941225 D05A LTE Rel.10 KDB Inquiry Sheet v01r02
● KDB 447498 D01 General RF Exposure Guidance v06
● KDB 248227 D01 SAR Meas for 802.11 v02r02</td></tr>
<tr><th>Body (1g) Limit</th><th>Extremity (10g) Limit</th></tr>
<tr><td>1.6 W/kg</td><td>4.0 W/kg</td></tr>
<tr><th colspan="2">Test Result</th></tr>
<tr><td colspan="2">Pass</td></tr>
</table>

The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved by:

Kevin Tsai
Section Manager
Compliance Certification Services Inc.

Tested by:

Sky Zhou
Asst. Section Manager
Compliance Certification Services Inc.

2 Description of Equipment Under Test

Product	ActiveTrack		
Trade Name	Upstreem S.A		
Model No.	AT11-22-11		
Wireless Technology	Operating Mode	TX Freq Range (MHz)	Peak Antenna Gain(dBi)
	LTE Band 2 Cat.M1	1850 ~ 1910	1.26
	LTE Band 4 Cat.M1	1710 ~ 1755	0.65
	LTE Band 12 Cat.M1	699 ~ 716	-3.45
WWAN Antenna Specification	Type	FPC	
Frequency Range	802.11b/g/n HT 20: 2412MHz ~ 2462MHz 802.11n HT40: 2422MHz ~ 2452MHz		
Modulation Technique	Bluetooth:LE		
Antenna Specification	Operating Mode	TX Freq Range (MHz)	Peak Antenna Gain (dBi)
	Bluetooth	2402~2480	-1.12
	Type	Chip	
Battery Options	Standard – Lithium-ion battery, Rating 3.7 Vdc, 650 mAh		

Remark:

1.The sample selected for test was prototype that representative to production product and was provided by manufacturer

2.Disclaimer:Variant information between/among model numbers / trademarks is provided by the applicant, test results of this report are applicable to the sample EUT received of main test model name.

3.Disclaimer:Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received

2.1 Summary of Highest SAR Values

Body

Results for highest reported SAR values for frequency band and mode are as below:

Technology/Band	Test configuration	Mode	Highest Reported 1g-SAR (W/kg)
LTE Band 2 Cat.M1	Front	QPSK	1.31

Sum of the SAR for LTE Band 2 Cat.M1 & BT

Test Position	Standalone SAR (W/kg)		∑ 1-g SAR (W/kg)
	WWAN	BT	WWAN + BT
	①	②	① + ②
Front	1.310	0.090	1.400
Rear	0.681	0.016	0.697
Edge 1	0.033	0.126	0.159
Edge 2	0.806	0.070	0.876
Edge 3	0.654	0.400	1.054
Edge 4	0.179	0.021	0.200

Extremity

Results for highest reported SAR values for frequency band and mode are as below:

Technology/Band	Test configuration	Mode	Highest Reported 10g-SAR (W/kg)
LTE Band 2 Cat.M1	Rear	QPSK	0.366

Sum of the SAR for LTE Band 2 Cat.M1 & BT

Test Position	Standalone SAR (W/kg)		∑ 10-g SAR (W/kg)
	WWAN	BT	WWAN + BT
	①	②	① + ②
Rear	0.366	0.021	0.387

3 Requirements for Compliance Testing Defined

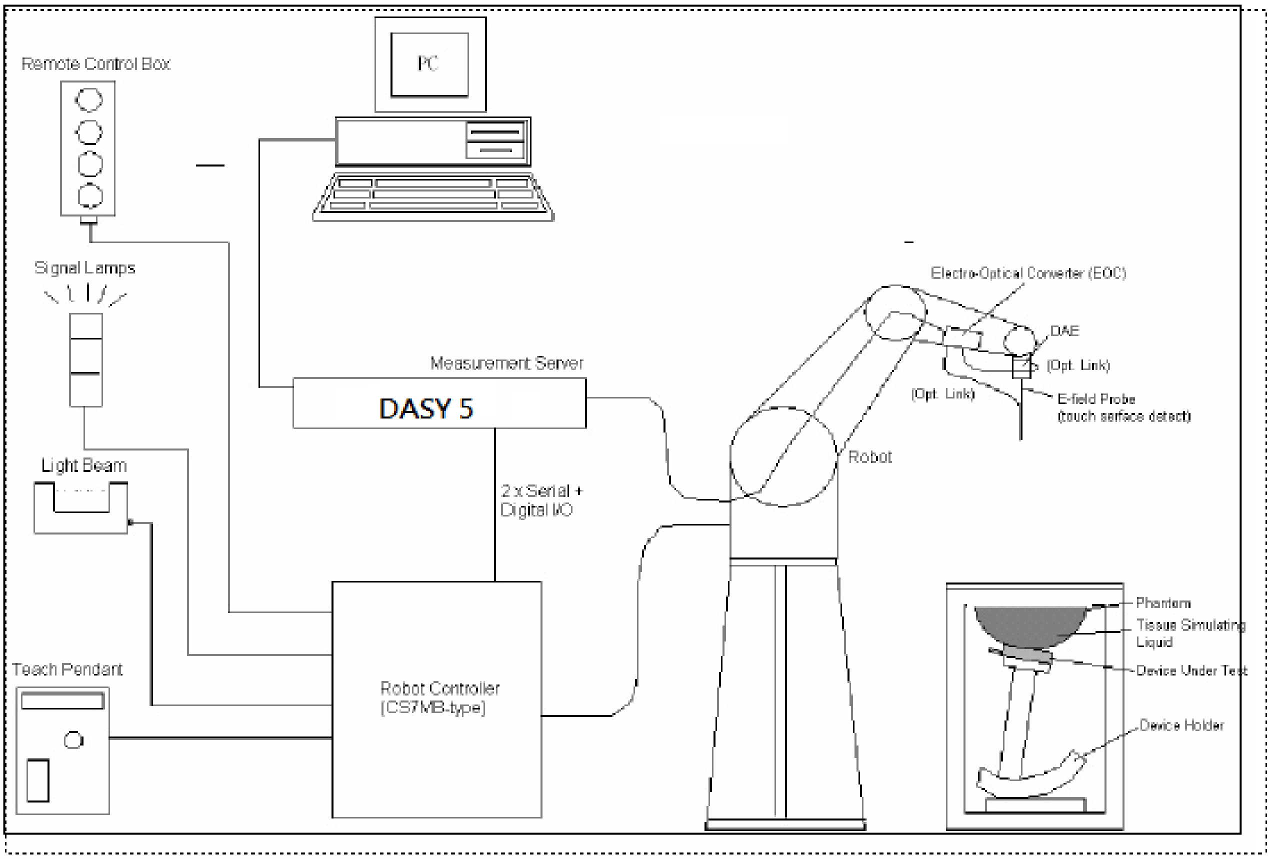
3.1 Requirements for Compliance Testing Defined by the FCC

The US Federal Communications Commission has released the report and order “Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1]. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 W/kg for an uncontrolled environment and 8.0 mW/g for an occupational/controlled environment as recommended by the FCC 47 CFR §2.1093 and IEEE Std 1528-2013.

4 Dosimetric Assessment System

These measurements were performed with the automated near-field scanning system DASY5 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9 m) which positions the probes with a positional repeatability of better than ± 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetric probe EX3DV4-SN: 3665 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure and found to be better than ±0.25 dB. The phantom used was the ELI Phantom as described in FCC supplement C, IEEE 1528 2013.

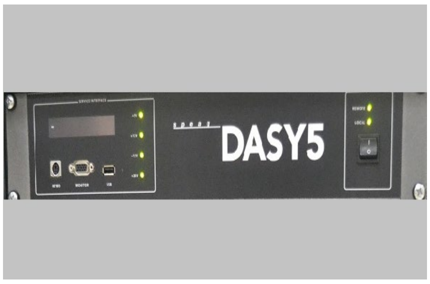
4.1 Measurement System Diagram



The DASY5 system for performing compliance tests consists of the following items:

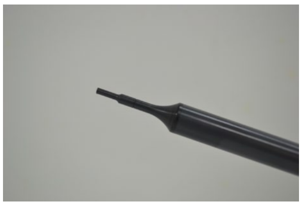
- A standard high precision 6-axis robot (St¨aubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. 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 the DAE and for the analog signal from the optical surface detection. The EOC is connected 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.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7 or Windows XP.
- DASY software version: NEO52 D10.3 S14.6.13.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing validating the proper functioning of the system.

4.2 System Components

DASY5 Measurement Server	
	The DASY5 measurement server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chip disk and 64MB RAM. The necessary circuits for communication with either the DAE4 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY5 I/O-board, which is directly connected to the PC/104 bus of the CPU board. The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation.
	The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.

Data Acquisition Electronics (DAE)	
	The data acquisition electronics (DAE4) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE4 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

EX3DV4 Isotropic E-Field Probe for Dosimetric Measurements



Construction: Symmetrical design with triangular core
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

Calibration: Basic Broad Band Calibration in air: 10-3000 MHz.
Conversion Factors (CF) for HSL 900 and HSL 1800
CF-Calibration for other liquids and frequencies upon request.

Frequency: 10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)

Directivity: ± 0.3 dB in HSL (rotation around probe axis)
± 0.5 dB in HSL (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: 330 mm (Tip: 20 mm)
Tip diameter: 2.5 mm (Body: 12 mm)
Distance from probe tip to dipole centers: 1 mm

Application: High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

SAM Phantom

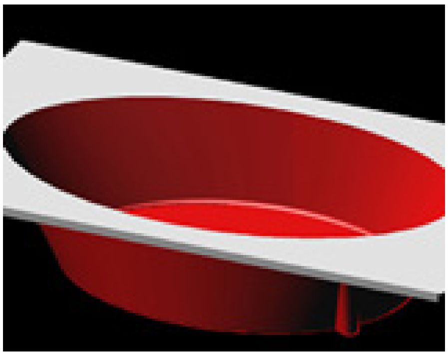
Construction: The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 2013, CENELEC 50361 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.

Shell Thickness: 2 ±0.2 mm

Filling Volume: Approx. 25 liters

Dimensions: Height: 810mm; Length: 1000mm; Width: 500mm

ELI Phantom



Construction: Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 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 supported by software version DASY5 and higher and is compatible with all SPEAG dosimetric probes and dipoles

Shell Thickness: 2.0 ± 0.2 mm (sagging: <1%)

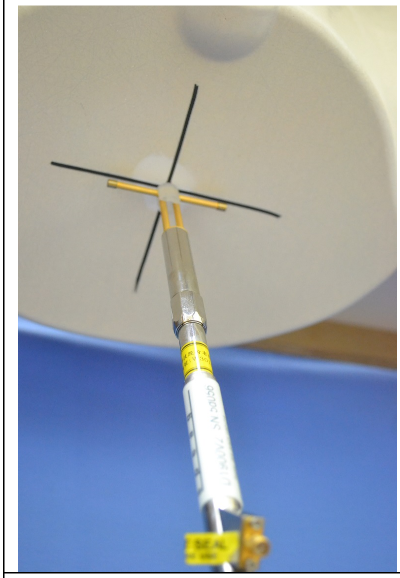
Filling Volume: Approx. 25 liters

Dimensions: Major ellipse axis: 600 mm
Minor axis: 400 mm 500mm

Device Holder for SAM Twin Phantom

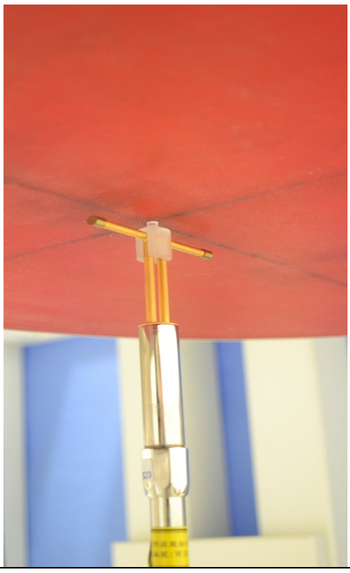
Construction: In combination with the Twin SAM Phantom V4.0 or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, and flat phantom).

System Validation Kits for SAM Phantom



Construction:	Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.
Frequency:	2450, 5300, 5600, 5800 MHz
Return loss:	> 20 dB at specified validation position
Power capability:	> 100 W (f < 1GHz); > 40 W (f > 1GHz)
Dimensions:	D2450V2: dipole length: 51.5 mm; overall height: 290 mm D5GHzV2: dipole length: 20.6 mm; overall height: 300 mm

System Validation Kits for ELI phantom



Construction:	Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.
Frequency:	2450, 5300, 5600, 5800 MHz
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Power capability:	> 100 W (f < 1GHz); > 40 W (f > 1GHz)
Dimensions:	D2450V2: dipole length: 51.5 mm; overall height: 290 mm D5GHzV2: dipole length: 20.6 mm; overall height: 300 mm

5 Evaluation Procedures

Data Evaluation

The DASY5 post processing software (SEMCAD) 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	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter 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:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with	V_i	= Compensated signal of channel i	(i = x, y, z)
	U_i	= 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:

$$E_i = \sqrt{\frac{V_i}{Norm_i \bullet ConvF}}$$

H-field probes:

$$H_i = \sqrt{Vi} \cdot \frac{a_{i10} + a_{i11} f + a_{i12} f^2}{f}$$

with	V_i	= Compensated signal of channel i	(i = x, y, z)
	$Norm_i$	= Sensor sensitivity of channel i	(i = x, y, z)

μV/(V/m)^2 for E0field 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):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with	*SAR*	= local specific absorption rate in W/kg
	E_{tot}	= total field strength in V/m
	σ	= conductivity in [mho/m] or [Siemens/m]
	ρ	= equivalent tissue density in g/cm^3

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 as a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{377} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with	P_{pwe}	= Equivalent power density of a plane wave in mW/cm^2
	E_{tot}	= total electric field strength in V/m
	H_{tot}	= total magnetic field strength in A/m

6 SAR Measurement Procedures

6.1 Normal SAR Test Procedure

- **Power Reference Measurement**

The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

- **Area Scan**

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY5 software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan's property sheet is brought-up, the grid resolution has to less than 15 mm by 15 mm at frequency ≤2GHz; the grid resolution has to less than 12mm by 12 mm at frequency between 2GHz to 4GHz; grid resolution has to less than 10 mm by 10 mm at frequency between 4GHz to 6GHz.

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

<table>
<tr><td></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td>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>Maximum probe abgle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</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>
</table>

- **Zoom Scan**

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures points in accordance with the frequency can be divided into three parts. (1)The zoom scan volume was set to 5x5x7 points at frequency ≤ 2GHz. (2) The zoom scan volume was set to 7x7x7 points at frequency between 2GHz to 4GHz (3) The zoom scan volume was set to 7x7x12 points at frequency between 4GHz to 6GHz. The measures points within a cube whose base faces are centered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more then one maximum, the number of Zoom Scans has to be enlarged accordingly.

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

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</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 1^{st} two points losest 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>Maximum zoom scan volume</td><td>x, y, z</td><td>≥ 30 mm</td><td colspan="2">3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
</table>

- **Power Drift Measurement**

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have DASY5 software stop the measurements if this limit is exceeded.

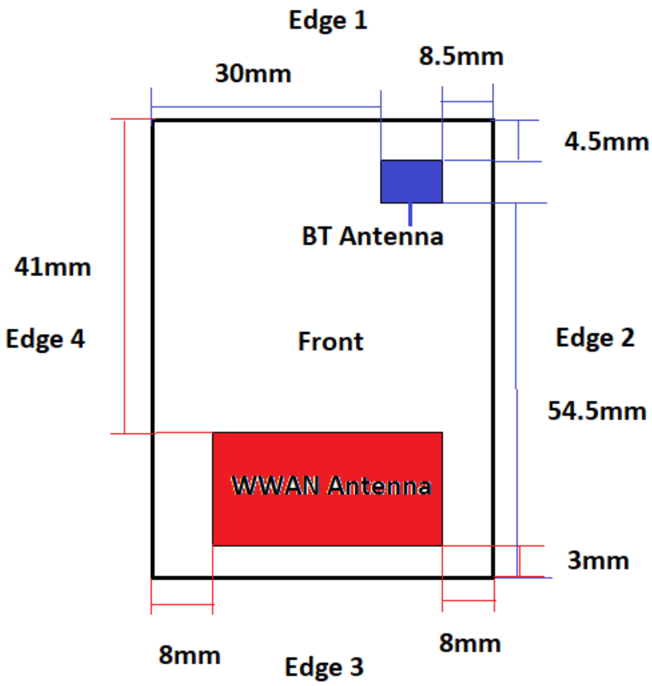
- **Z-Scan**

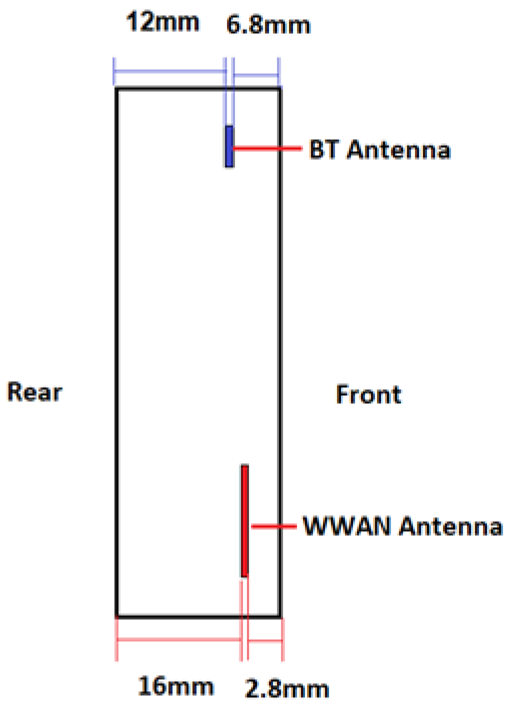
The Z Scan job measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. A user can anchor the grid to the current probe location. As with any other grids, the local Z-axis of the anchor location establishes the Z-axis of the grid.

7 Measurement Uncertainty

According to KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz section 2.8.2, SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

8 Antenna Location





9 RF Exposure Conditions (Test Configurations)

Please refer to chapter 8 for detailed information about antenna-to-antenna distance and antenna-to-edge distance.

9.1. Standalone SAR Test Exclusion Considerations

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

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

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)] ≤ 3.0, for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

When the standalone SAR test exclusion is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- *(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)/x]* W/kg for test separation distances ≤ 50 mm;
  where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

SAR Test Exclusion Calculations

Antennas < 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
		dBm	mW	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4
LTE Band 2 Cat.M1	1910	24.00	251	5	16	41	8	3	8	69.4 -MEASURE-	21.7 -MEASURE-	8.5 -MEASURE-	43.4 -MEASURE-	69.4 -MEASURE-	43.4 -MEASURE-
LTE Band 4 Cat.M1	1755	24.00	251	5	16	41	8	3	8	66.5 -MEASURE-	20.8 -MEASURE-	8.1 -MEASURE-	41.6 -MEASURE-	66.5 -MEASURE-	41.6 -MEASURE-
LTE Band 12 Cat.M1	716	24.00	251	5	16	41	8	3	8	42.5 -MEASURE-	13.3 -MEASURE-	5.2 -MEASURE-	26.5 -MEASURE-	42.5 -MEASURE-	26.5 -MEASURE-
Bluetooth	2480	4.00	3	6.8	12	5	8.5	54.5	30	0.7 -EXEMPT-	0.4 -EXEMPT-	0.9 -EXEMPT-	0.5 -EXEMPT-	> 50 mm	0.2 -EXEMPT-

Note(s):
According to KDB 447498, if the calculated threshold value is >3 then SAR testing is required.

Antennas > 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Calculated Threshold Value					
		dBm	mW	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4
LTE Band 2 Cat.M1	1910	24.00	251	5	16	41	8	3	8	< 50 mm	< 50 mm	< 50 mm	< 50 mm	< 50 mm	< 50 mm
LTE Band 4 Cat.M1	1755	24.00	251	5	16	41	8	3	8	< 50 mm	< 50 mm	< 50 mm	< 50 mm	< 50 mm	< 50 mm
LTE Band 12 Cat.M1	716	24.00	251	5	16	41	8	3	8	< 50 mm	< 50 mm	< 50 mm	< 50 mm	< 50 mm	< 50 mm
Bluetooth	2480	4.00	3	6.8	12	5	8.5	54.5	30	< 50 mm	< 50 mm	< 50 mm	< 50 mm	140.3 mW -EXEMPT-	< 50 mm

Note(s):
According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.

9.2. REQUIRED TEST CONFIGURATIONS

The table below identifies the standalone test configurations required for this device according to the findings in Section 9.1:

Test Configurations	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4
LTE Band 2 Cat.M1	Yes	Yes	Yes	Yes	Yes	Yes
LTE Band 4 Cat.M1	Yes	Yes	Yes	Yes	Yes	Yes
LTE Band 12 Cat.M1	Yes	Yes	Yes	Yes	Yes	Yes
Bluetooth	No	No	No	No	No	No

Note(s):

Yes = Testing is required.

No = Testing is not required.

10 Exposure Limit

(A). Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	2.0

(B). Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE: **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. **SAR for hands, wrists, feet and ankles** is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

Population/Uncontrolled Environments:

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

Occupational/Controlled Environments:

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

NOTE
GENERAL POPULATION/UNCONTROLLED EXPOSURE
PARTIAL BODY LIMIT
1.6 W/kg

11 Tissue Dielectric Properties

11.1 Test Liquid Confirmation

Simulating Liquids Parameter Check

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values

The relative permittivity and conductivity of the tissue material should be within ± 5% of the values given in the table below 5% may not be easily achieved at certain frequencies.

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE 1528 2013 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head tissue parameters that have not been specified in IEEE 1528 2013 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE 1528 2013

Target Frequency (MHz)	Head	
	ε_r	σ (S/m)
150	52.3	0.76
300	45.3	0.87
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
915	41.5	0.98
1450	40.5	1.20
1610	40.3	1.29
1800 – 2000	40.0	1.40
2450	39.2	1.80
3000	38.5	2.40
5000	36.2	4.45
5100	36.1	4.55
5200	36.0	4.66
5300	35.9	4.76
5400	35.8	4.86
5500	35.6	4.96
5600	35.5	5.07
5700	35.4	5.17
5800	35.3	5.27

IEEE Std 1528-2013
Refer to Table 3 within the IEEE Std 1528-2013

11.2 Typical Composition of Ingredients for Liquid Tissue Phantoms

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	**Head**	**Body**	**Head**	**Body**	**Head**	**Body**	**Head**	**Body**	**Head**	**Body**
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

alt: 99^{+}% Pure Sodium Chloride
Sugar: 98^{+}% Pure Sucrose
Water: De-ionized, 16 $M\Omega^{+}$ resistivity
HEC: Hydroxy thyl Cellulose
DGBE: 99^{+}% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra-pure): Polyethylene glycol mono [4-(1, 1, 3, 3-tetramethylbutyl)phenyl]ether

Simulating Liquids for 5 GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

11.3 Simulating Liquids Parameter Check Results

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2021/1/29	Head	700	43.64	42.17	3.49	0.86	0.89	-3.49
		750	42.94	41.90	2.48	0.90	0.89	1.46
		790	42.32	41.71	1.46	0.94	0.90	4.92
2021/1/28	Head	1710	38.90	40.14	-3.09	1.31	1.35	-3.04
		1810	38.53	40.00	-3.68	1.39	1.40	-0.86
		1910	38.20	40.00	-4.50	1.46	1.40	4.43
2021/1/29	Head	1710	38.94	40.14	-2.99	1.30	1.35	-3.26
		1810	38.62	40.00	-3.45	1.39	1.40	-0.86
		1910	38.29	40.00	-4.28	1.47	1.40	4.71
2021/2/1	Head	1710	38.89	40.14	-3.11	1.30	1.35	-3.26
		1810	38.49	40.00	-3.78	1.39	1.40	-0.93
		1910	38.18	40.00	-4.55	1.46	1.40	4.43
2021/4/27	Head	1710	38.90	40.14	-3.09	1.31	1.35	-3.04
		1810	38.54	40.00	-3.65	1.39	1.40	-0.64
		1910	38.18	40.00	-4.55	1.46	1.40	4.57
2021/4/27	Head	1920	39.66	40.00	-0.85	1.35	1.40	-3.93
		1950	39.61	40.00	-0.98	1.38	1.40	-1.71
		2000	39.42	40.00	-1.45	1.43	1.40	2.43
2021/4/27	Head	700	42.99	42.17	1.94	0.90	0.89	1.24
		750	42.79	41.90	2.12	0.92	0.89	2.81
		800	42.60	41.66	2.26	0.93	0.90	4.02

12 System Performance Check

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications. The system performance check results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Head simulating liquid of the following parameters.
- The DASY5 system with an E-field probe EX3DV4 SN: 3665 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15 mm (below 1 GHz) and 10 mm (above 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 10mm was aligned with the dipole.
- Special 7x7x7 fine cube was chosen for cube integration (dx=dy= 5 mm, dz= 5 mm).
- Distance between probe sensors and phantom surface was set to 3.0 mm.
- The dipole input power (forward power) was 250 mW±3% (below 2GHz) and 100 mW ±3%
- The results are normalized to 1 W input power.

Reference SAR Values for System Performance Check

The reference SAR values can be obtained from the calibration certificate of system validation dipoles

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (W/kg)	
				1g/10g	Head
D750V3	1015	2020/08/13	750	1g	8.48
				10g	5.53
D1750V2	1008	2020/8/14	1750	1g	36.0
				10g	18.9
D1900V2	5d173	2020/4/22	1900	1g	39.4
				10g	20.5
D1900V2	5d142	2020/6/24	1900	1g	40.1
				10g	20.8

12.1 System Performance Check Results

Date	Tissue Type	Dipole S/N	Input Power (mW)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Delta 1g ±10 (%)	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Delta 10g ±10 (%)	Plot No.
2021/1/29	Head	D750V3-1015	250	2.16	8.48	8.64	1.89	1.40	5.53	5.6	1.27	1
2021/1/29	Head	D1750V2-1008	250	9.04	36.00	36.16	0.44	4.78	18.90	19.12	1.16	2
2021/2/1	Head	D1750V2-1008	250	9.04	36.00	36.16	0.44	4.78	18.90	19.12	1.16	3
2021/1/28	Head	D1900V2-5d173	250	10.30	39.40	41.2	4.57	5.43	20.50	21.72	5.95	4
2021/4/27	Head	D750V3-1015	250	2.13	8.48	8.52	0.47	1.38	5.53	5.52	-0.18	5
2021/4/27	Head	D1750V2-1008	250	8.73	36.00	34.92	-3.00	4.61	18.90	18.44	-2.43	6
2021/4/27	Head	D1900V2-5d142	250	9.81	40.10	39.24	-2.14	4.98	20.80	19.92	-4.23	7

13 RF Output Power Measurement

LTE Band 2 Cat.M1 Measured Results

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						18700	18900	19100
						1860 MHz	1880 MHz	1900 MHz
LTE Band 2	20	QPSK	1	0	0	23.15	23.37	23.08
			1	2	0	22.92	23.13	22.96
			1	5	0	23.10	22.89	22.90
			3	0	0	22.75	23.12	22.60
			3	2	0	22.81	23.04	22.34
			3	3	0	22.76	22.48	22.55
			6	0	0	22.91	23.27	22.58
		16QAM	1	0	0	22.84	22.95	22.79
			1	2	0	22.81	22.95	22.55
			1	5	0	22.95	22.57	22.34
			3	0	0	22.43	23.06	22.70
			3	2	0	22.33	22.85	22.31
			3	3	0	22.59	22.54	22.39
			6	0	0	22.37	22.65	22.43
Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						18675	18900	19125
						1857.5 MHz	1880 MHz	1902.5 MHz
LTE Band 2	15	QPSK	1	0	0	23.02	23.29	22.89
			1	2	0	22.79	23.27	22.92
			1	5	0	22.93	22.70	22.95
			3	0	0	22.52	23.17	22.50
			3	2	0	22.76	22.90	22.24
			3	3	0	22.82	22.40	22.41
			6	0	0	22.94	23.16	22.45
		16QAM	1	0	0	22.78	22.91	22.70
			1	2	0	22.81	22.83	22.40
			1	5	0	22.84	22.51	22.21
			3	0	0	22.45	23.13	22.51
			3	2	0	22.37	22.91	22.27
			3	3	0	22.62	22.63	22.37
			6	0	0	22.61	22.37	22.27

LTE Band 2 Cat.M1 Measured Results(continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						18650	18900	18150
						1855 MHz	1880 MHz	1905 MHz
LTE Band 2	10	QPSK	1	0	0	22.92	23.32	22.84
			1	2	0	22.87	23.28	22.86
			1	5	0	23.03	22.72	22.97
			3	0	0	22.59	23.00	22.50
			3	2	0	22.66	22.84	22.20
			3	3	0	22.91	22.60	22.20
			6	0	0	21.95	22.41	22.06
		16QAM	1	0	0	22.75	23.07	22.50
			1	2	0	22.70	22.92	22.39
			1	5	0	22.92	22.47	22.47
			3	0	0	22.50	23.13	22.51
			3	2	0	22.33	22.99	22.45
			3	3	0	22.33	22.33	22.22
			6	0	0	22.16	22.38	21.95

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						18625	18900	19175
						1852.5 MHz	1880 MHz	1907.5 MHz
LTE Band 2	5	QPSK	1	0	0	23.13	23.31	22.83
			1	2	0	22.85	23.03	22.70
			1	5	0	23.06	22.58	22.83
			3	0	0	22.20	22.36	22.16
			3	2	0	22.23	22.45	21.91
			3	3	0	22.10	22.03	21.85
			6	0	0	22.15	22.58	22.20
		16QAM	1	0	0	23.02	23.13	22.54
			1	2	0	22.96	22.91	22.17
			1	5	0	22.75	22.37	22.18
			3	0	0	22.20	22.39	22.18
			3	2	0	21.87	22.30	22.06
			3	3	0	22.10	21.98	22.05
			6	0	0	21.15	21.54	21.17

LTE Band 2 Cat.M1 Measured Results(continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						18615	18900	19185
						1851.5 MHz	1880 MHz	1908.5 MHz
LTE Band 2	3	QPSK	1	0	0	22.92	23.34	22.96
			1	2	0	22.86	23.24	22.83
			1	5	0	22.95	22.71	22.85
			3	0	0	22.19	22.64	22.13
			3	2	0	22.09	22.29	21.92
			3	3	0	22.10	21.96	21.97
			6	0	0	21.16	21.47	21.26
		16QAM	1	0	0	22.08	22.42	22.16
			1	2	0	21.99	22.55	22.12
			1	5	0	22.05	22.13	21.86
			3	0	0	21.20	21.45	20.99
			3	2	0	20.89	21.35	20.94
			3	3	0	20.99	20.82	21.02
			6	0	0	21.11	21.38	21.23

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						18607	18900	19193
						1850.7 MHz	1880 MHz	1909.3 MHz
LTE Band 2	1.4	QPSK	1	0	0	22.85	23.13	22.73
			1	2	0	22.90	23.17	22.69
			1	5	0	22.69	22.73	22.76
			3	0	0	21.89	22.24	21.91
			3	2	0	21.91	22.28	21.90
			3	3	0	21.96	21.85	21.88
			6	0	0	21.00	21.35	21.12
		16QAM	1	0	0	22.03	22.39	21.86
			1	2	0	22.19	22.32	21.89
			1	5	0	21.90	22.12	21.92
			3	0	0	21.08	21.70	21.07
			3	2	0	21.11	21.37	20.97
			3	3	0	20.98	20.97	21.01
			6	0	0	21.16	21.37	21.14

LTE Band 4 Cat.M1 Measured Results

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						20050	20175	20300
						1720 MHz	1732.5 MHz	1745 MHz
LTE Band 4	20	QPSK	1	0	0	23.32	23.89	23.05
			1	2	0	23.08	23.14	22.87
			1	5	0	23.15	23.15	22.78
			3	0	0	22.97	23.29	22.69
			3	2	0	22.67	22.82	22.71
			3	3	0	22.55	22.65	22.67
			6	0	0	22.96	23.26	22.70
		16QAM	1	0	0	23.05	23.42	22.86
			1	2	0	23.02	22.77	22.71
			1	5	0	22.57	22.66	22.56
			3	0	0	23.16	23.54	22.62
			3	2	0	22.82	23.00	22.40
			3	3	0	22.57	22.77	22.29
			6	0	0	22.50	22.82	22.49
Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						20025	20175	20325
						1717.5 MHz	1732.5 MHz	1747.5 MHz
LTE Band 4	15	QPSK	1	0	0	23.52	23.74	22.88
			1	2	0	22.96	23.04	23.05
			1	5	0	23.06	23.12	22.77
			3	0	0	22.95	23.28	22.79
			3	2	0	22.58	22.91	22.60
			3	3	0	22.68	22.74	22.62
			6	0	0	23.01	23.42	22.57
		16QAM	1	0	0	22.85	23.18	22.86
			1	2	0	22.77	22.72	22.43
			1	5	0	22.59	22.73	22.61
			3	0	0	22.79	23.49	22.53
			3	2	0	22.64	22.72	22.36
			3	3	0	22.55	22.68	22.50
			6	0	0	22.37	22.59	22.34

LTE Band 4 Cat.M1 Measured Results(continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						20000	20175	20350
						1715 MHz	1732.5 MHz	1750 MHz
LTE Band 4	10	QPSK	1	0	0	23.35	23.51	22.92
			1	2	0	22.99	23.14	22.94
			1	5	0	22.90	23.04	22.89
			3	0	0	23.04	23.30	22.57
			3	2	0	22.84	22.65	22.72
			3	3	0	22.34	22.71	22.45
			6	0	0	22.43	22.75	22.16
		16QAM	1	0	0	22.86	23.35	22.76
			1	2	0	22.70	22.66	22.49
			1	5	0	22.62	22.69	22.48
			3	0	0	22.86	23.39	22.57
			3	2	0	22.68	23.02	22.64
			3	3	0	22.53	22.58	22.41
			6	0	0	22.45	22.72	22.26

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						19975	20175	20375
						1712.5 MHz	1732.5 MHz	1752.5 MHz
LTE Band 4	5	QPSK	1	0	0	23.22	23.54	22.92
			1	2	0	22.94	23.15	22.96
			1	5	0	22.87	22.81	22.89
			3	0	0	22.65	22.93	22.08
			3	2	0	22.32	22.48	22.04
			3	3	0	22.10	22.27	21.95
			6	0	0	22.51	22.69	22.04
		16QAM	1	0	0	22.89	23.18	22.74
			1	2	0	22.79	22.80	22.53
			1	5	0	22.64	22.50	22.27
			3	0	0	22.41	22.77	22.13
			3	2	0	22.13	22.44	22.03
			3	3	0	22.15	22.10	22.01
			6	0	0	21.55	21.60	21.33

LTE Band 4 Cat.M1 Measured Results(continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						19965	20175	20385
						1711.5 MHz	1732.5 MHz	1753.5 MHz
LTE Band 4	3	QPSK	1	0	0	23.22	23.54	22.95
			1	2	0	23.18	23.12	22.98
			1	5	0	22.71	22.93	22.64
			3	0	0	22.47	22.68	22.16
			3	2	0	22.34	22.37	22.16
			3	3	0	21.90	22.23	21.93
			6	0	0	21.52	21.91	21.08
		16QAM	1	0	0	22.48	22.88	22.09
			1	2	0	22.20	22.37	22.05
			1	5	0	22.14	21.99	21.85
			3	0	0	21.57	21.91	21.19
			3	2	0	21.20	21.43	21.00
			3	3	0	21.23	21.11	21.02
			6	0	0	21.44	21.77	21.15

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						19957	20175	20393
						1710.7 MHz	1732.5 MHz	1754.3 MHz
LTE Band 4	1.4	QPSK	1	0	0	23.20	23.73	22.93
			1	2	0	22.90	23.12	22.99
			1	5	0	22.83	22.81	22.85
			3	0	0	22.53	22.81	22.04
			3	2	0	22.34	22.40	22.14
			3	3	0	21.89	22.29	21.95
			6	0	0	21.44	21.75	21.13
		16QAM	1	0	0	22.33	22.84	22.16
			1	2	0	22.11	22.25	22.03
			1	5	0	22.20	22.15	22.08
			3	0	0	21.58	21.82	21.33
			3	2	0	21.39	21.48	21.21
			3	3	0	21.17	21.34	20.98
			6	0	0	21.25	21.89	21.10

LTE Band 12 Cat.M1 Measured Results

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						23060	23095	23130
						704 MHz	707.5 MHz	711 MHz
LTE Band 12	10	QPSK	1	0	0	23.34	23.82	23.11
			1	2	0	23.28	23.32	23.11
			1	5	0	23.12	23.13	22.76
			3	0	0	23.08	23.55	22.78
			3	2	0	23.10	23.00	22.77
			3	3	0	22.84	22.72	22.78
			6	0	0	22.45	22.94	22.17
		16QAM	1	0	0	23.15	23.64	22.90
			1	2	0	23.02	22.90	22.64
			1	5	0	22.75	22.99	22.72
			3	0	0	23.25	23.46	22.82
			3	2	0	22.80	22.83	22.79
			3	3	0	22.87	22.67	22.74
			6	0	0	22.64	22.90	22.36

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						23035	23095	23155
						701.5 MHz	707.5 MHz	713.5 MHz
LTE Band 12	5	QPSK	1	0	0	23.56	23.62	22.92
			1	2	0	23.21	23.28	22.99
			1	5	0	23.03	22.99	22.74
			3	0	0	22.77	22.71	22.16
			3	2	0	22.25	22.35	22.01
			3	3	0	22.27	22.29	22.10
			6	0	0	22.57	22.65	22.16
		16QAM	1	0	0	23.28	23.50	22.86
			1	2	0	23.00	22.93	22.84
			1	5	0	22.78	22.78	22.65
			3	0	0	22.62	22.73	22.18
			3	2	0	22.28	22.47	22.26
			3	3	0	22.24	22.01	21.94
			6	0	0	21.58	21.84	21.08

LTE Band 12 Cat.M1 Measured Results(continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						23025	23095	23165
						700.5 MHz	707.5 MHz	714.5 MHz
LTE Band 12	3	QPSK	1	0	0	23.39	23.68	23.08
			1	2	0	23.07	23.31	23.02
			1	5	0	22.95	23.16	22.89
			3	0	1	22.41	22.88	22.16
			3	2	1	22.11	22.35	22.12
			3	3	1	22.02	22.29	22.07
			6	0	1	21.63	21.71	21.21
		16QAM	1	0	1	22.46	22.91	22.20
			1	2	1	22.23	22.48	22.15
			1	5	1	22.16	22.30	22.09
			3	0	2	21.49	21.77	21.18
			3	2	2	21.29	21.39	21.23
			3	3	2	21.10	21.21	20.99
			6	0	2	21.41	21.87	21.10

Band	BW (MHz)	Mode	RB Allocation	RB offset	MPR	Max. Meas. Avg Pwr (dBm)		
						23017	23095	23173
						699.7 MHz	707.5 MHz	715.3 MHz
LTE Band 12	1.4	QPSK	1	0	0	23.41	23.59	22.97
			1	2	0	23.09	23.30	22.91
			1	5	0	23.11	22.91	22.91
			3	0	0	22.55	22.97	22.25
			3	2	0	22.33	22.40	21.89
			3	3	0	22.19	21.96	21.96
			6	0	0	21.78	21.86	21.18
		16QAM	1	0	0	22.48	22.70	22.16
			1	2	0	22.26	22.52	21.98
			1	5	0	22.14	22.14	21.95
			3	0	0	21.46	21.97	21.05
			3	2	0	21.15	21.40	21.05
			3	3	0	21.16	21.31	20.95
			6	0	0	21.52	21.76	21.02

13.1 Bluetooth.

Average Power

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
Bluetooth	BLE	1 Mbps	0	2402	3.03	4	No
			20	2442	2.97		
			39	2480	2.95		

Note:

The Bluetooth power reference module report E2/2017/80018.

14 Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

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

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

KDB 941225 D05 SAR for LTE Devices:

SAR test reduction is applied using the following criteria:

- Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
- When the reported SAR is > 0.8 W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel.
- Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are > 0.8 W/kg. Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation < 1.45 W/kg.
- Testing for 16-QAM modulation is not required because the reported SAR for QPSK is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of QPSK.
- Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.

For LTE bands that do not support at least three non-overlapping channels in certain channel bandwidths, test the available non-overlapping channels instead. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing; therefore, the requirement for H, M and L channels may not fully apply.

Body

14.1. LTE Band 2 Cat.M1 (20MHz Bandwidth)

Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	
QPSK	0	Front	18700	1860	1	0	24.0	23.15	0.980	1.192	
					3	2	24.0	22.81	0.972	1.278	
			18900	1880	1	0	24.0	23.37	0.924	1.068	
					3	0	24.0	23.12	0.922	1.129	
					6	0	24.0	23.27	0.889	1.052	
			19100	1900	1	0	24.0	23.08	0.960	1.187	
					3	0	24.0	22.60	0.949	1.310	1
		Rear around a curved head region	18900	1880	1	0	24.0	23.37	0.576	0.666	
					3	0	24.0	23.12	0.556	0.681	
		Rear flat bottom phantom	18900	1880	1	0	24.0	23.37	0.379	0.438	
					3	0	24.0	23.12	0.389	0.476	
		Edge 1	18900	1880	1	0	24.0	23.37	0.021	0.024	
					3	0	24.0	23.12	0.027	0.033	
		Edge 2	18900	1880	1	0	24.0	23.37	0.634	0.733	
					3	0	24.0	23.12	0.658	0.806	
		Edge 3	18900	1880	1	0	24.0	23.37	0.535	0.619	
					3	0	24.0	23.12	0.534	0.654	
		Edge 4	18900	1880	1	0	24.0	23.37	0.147	0.170	
					3	0	24.0	23.12	0.146	0.179	

14.2. LTE Band 4 Cat.M1 (20MHz Bandwidth)

Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up Limit	Meas.	Meas.	Scaled	
0	Front	20175	1732.5	1	0	24.0	23.89	0.001	0.001	
				3	0	24.0	23.29	0.003	0.004	
	Rear around a curved head region	20175	1732.5	1	0	24.0	23.89	0.000	0.000	
				3	0	24.0	23.29	0.000	0.000	
	Rear flat bottom phantom	20175	1732.5	1	0	24.0	23.89	0.000	0.000	
				3	0	24.0	23.29	0.000	0.000	
	Edge 1	20175	1732.5	1	0	24.0	23.89	0.000	0.000	
				3	0	24.0	23.29	0.000	0.000	
	Edge 2	20175	1732.5	1	0	24.0	23.89	0.000	0.000	
				3	0	24.0	23.29	0.000	0.000	
	Edge 3	20175	1732.5	1	0	24.0	23.89	0.000	0.000	
				3	0	24.0	23.29	0.077	0.091	2
	Edge 4	20175	1732.5	1	0	24.0	23.89	0.000	0.000	
				3	0	24.0	23.29	0.000	0.000	

14.3. LTE Band 12 Cat.M1 (10MHz Bandwidth)

Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	
QPSK	0	Front	23095	707.5	1	0	24.0	23.82	0.016	0.017	
					3	0	24.0	23.55	0.016	0.018	
		Rear around a curved head region	23095	707.5	1	0	24.0	23.82	0.018	0.019	
					3	0	24.0	23.55	0.022	**0.025**	3
		Rear flat bottom phantom	23095	707.5	1	0	24.0	23.82	0.000	0.000	
					3	0	24.0	23.55	0.000	0.000	
		Edge 1	23095	707.5	1	0	24.0	23.82	0.002	0.002	
					3	0	24.0	23.55	0.002	0.002	
		Edge 2	23095	707.5	1	0	24.0	23.82	0.000	0.000	
					3	0	24.0	23.55	0.000	0.000	
		Edge 3	23095	707.5	1	0	24.0	23.82	0.000	0.000	
					3	0	24.0	23.55	0.000	0.000	
		Edge 4	23095	707.5	1	0	24.0	23.82	0.001	0.001	
					3	0	24.0	23.55	0.001	0.001	

Extremity

14.4. LTE Band 2 Cat.M1 (20MHz Bandwidth)

Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		10-g SAR (W/kg)		Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	
QPSK	0	Rear around a curved head region	18900	1880	1	0	24.0	23.37	0.317	**0.366**	4
					3	0	24.0	23.12	0.297	0.364	
		Rear flat bottom phantom	18900	1880	1	0	24.0	23.37	0.241	0.279	
					3	0	24.0	23.12	0.247	0.302	

14.5. LTE Band 4 Cat.M1 (20MHz Bandwidth)

Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		10-g SAR (W/kg)		Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	
QPSK	0	Rear around a curved head region	20175	1732.5	1	0	24.0	23.89	0.000	0.000	
					3	0	24.0	23.29	0.000	0.000	
		Rear flat bottom phantom	20175	1732.5	1	0	24.0	23.89	0.000	0.000	
					3	0	24.0	23.29	0.000	0.000	

14.6. LTE Band 12 Cat.M1 (10MHz Bandwidth)

Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		10-g SAR (W/kg)		Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	
QPSK	0	Rear around a curved head region	23095	707.5	1	0	24.0	23.82	0.010	0.011	
					3	0	24.0	23.55	0.013	**0.014**	5
		Rear flat bottom phantom	23095	707.5	1	0	24.0	23.82	0.000	0.000	
					3	0	24.0	23.55	0.000	0.000	

Note:

The absence of metal components in the strap does not affect the test results.

15 SAR Measurement Variability

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

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

Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio
							Original	Repeated	
QPSK	0	Front	19100	1900	3	0	0.980	0.978	1.00

Note(s):

Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is < 1.20.

16 Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance explains how to calculate the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$

Where:

SAR_1 is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR_2 is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of **$[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$**

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$(SAR_1 + SAR_2)^{1.5} / Ri \le 0.04$

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations		
Standalone	1	LTE	+	BT

Estimated SAR for Simultaneous Transmission SAR Analysis
Considerations for SAR estimation

1. When standalone SAR test exclusion applies, standalone SAR must also be estimated to determine simultaneous transmission SAR test exclusion.
2. Dedicated Host Approach criteria for SAR test exclusion is likewise applied to SAR estimation, with certain distinctions between test exclusion and SAR estimation:
   - When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied for SAR estimation; this is the same between test exclusion and SAR estimation calculations.
   - When the separation distance from the antenna to an adjacent edge is > 5 mm but ≤ 50 mm, the actual antenna-to-edge separation distance is applied for SAR estimation.
   - When the minimum test separation distance is > 50 mm, the estimated SAR value is 0.4 W/kg
3. Please refer to Estimated SAR Tables to see which test positions are inherently compliant as they consist of only estimated SAR values for all applicable transmitters and consequently will always have sum of SAR values < 1.2 W/kg. Simultaneous transmission SAR analysis was therefore not performed for these test positions.

Estimated SAR for Body

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)						Estimated 1-g SAR Value (W/kg)					
		dBm	mW	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Front	Rear	Edge 1	Edge 2	Edge 3	Edge 4
LTE Band 2 Cat.M1	1910	24.00	251	5	16	41	8	3	8	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-
LTE Band 4 Cat.M1	1755	24.00	251	5	16	41	8	3	8	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-
LTE Band 12 Cat.M1	716	24.00	251	5	16	41	8	3	8	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-	-MEASURE-
Bluetooth	2480	4.00	3	6.8	12	5	8.5	54.5	30	0.090	0.052	0.126	0.070	0.400	0.021

Estimated SAR for Extremity

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)	Estimated 10-g SAR Value (W/kg)
		dBm	mW	Rear	Rear
LTE Band 2 Cat.M1	1910	24.00	251	16	-MEASURE-
LTE Band 4 Cat.M1	1755	24.00	251	16	-MEASURE-
LTE Band 12 Cat.M1	716	24.00	251	16	-MEASURE-
Bluetooth	2480	4.00	3	12	0.021

Body

16.1 Sum of the SAR for LTE Band 2 Cat.M1 & BT

Test Position	Standalone SAR (W/kg)		∑ 1-g SAR (W/kg)
	WWAN	BT	WWAN + BT
	①	②	① + ②
Front	1.310	0.090	1.400
Rear	0.681	0.016	0.697
Edge 1	0.033	0.126	0.159
Edge 2	0.806	0.070	0.876
Edge 3	0.654	0.400	1.054
Edge 4	0.179	0.021	0.200

16.2 Sum of the SAR for LTE Band 4 Cat.M1 & BT

Test Position	Standalone SAR (W/kg)		∑ 1-g SAR (W/kg)
	WWAN	BT	WWAN + BT
	①	②	① + ②
Front	0.004	0.090	0.094
Rear	0.000	0.016	0.016
Edge 1	0.000	0.126	0.126
Edge 2	0.000	0.070	0.070
Edge 3	0.091	0.400	0.491
Edge 4	0.000	0.021	0.021

16.3 Sum of the SAR for LTE Band 12 Cat.M1 & BT

Test Position	Standalone SAR (W/kg)		∑ 1-g SAR (W/kg)
	WWAN	BT	WWAN + BT
	①	②	① + ②
Front	0.018	0.090	0.108
Rear	0.025	0.016	0.041
Edge 1	0.002	0.126	0.128
Edge 2	0.000	0.070	0.070
Edge 3	0.000	0.400	0.400
Edge 4	0.001	0.021	0.022

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because either the sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is < 0.04 for all circumstances that require SPLSR calculation.

Extremity

16.4 Sum of the SAR for LTE Band 2 Cat.M1 & BT

Test Position	Standalone SAR (W/kg)		∑ 10-g SAR (W/kg)
	WWAN	BT	WWAN + BT
	①	②	① + ②
Rear	0.366	0.021	0.387

16.5 Sum of the SAR for LTE Band 4 Cat.M1 & BT

Test Position	Standalone SAR (W/kg)		∑ 10-g SAR (W/kg)
	WWAN	BT	WWAN + BT
	①	②	① + ②
Rear	0.000	0.021	0.021

16.6 Sum of the SAR for LTE Band 12 Cat.M1 & BT

Test Position	Standalone SAR (W/kg)		∑ 10-g SAR (W/kg)
	WWAN	BT	WWAN + BT
	①	②	① + ②
Rear	0.014	0.021	0.035

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because either the sum of the 10-g SAR is < 4.0 W/kg.

17 Equipment List & Calibration Status

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Dielectric Assessment Kit	SPEAG	DAKS-3.5	1053	2021/1/27
Dielectric Assessment Kit	SPEAG	DAKS-3.5	1101	2021/5/26
Thermometer	LKM	DTM3000	EC14010603	2021/10/12

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Agilent	N5181A	MY50141235	2021/5/3
Power Meter	Agilent	E4417A	MY51410006	2021/3/8
Power Sensor	Agilent	E9301H	MY51470001	2021/3/8
Power Sensor	Agilent	E9301H	MY51470002	2021/3/8
Power Meter	Agilent	E4417A	MY52240003	2021/10/17
Power Sensor	Agilent	E9301H	MY52200004	2021/10/18
Power Sensor	Agilent	E9301H	MY52200004	2021/10/18
Dual Directional Coupler	Agilent	772D	MY46151242	2021/8/16
Amplifier	EMCI	ZVE-8G	980190	N/A
Dosimetric E-Field Probe	SPEAG	EX3DV4	3665	2021/8/19
Data Acquisition Electronice	SPEAG	DAE4	558	2021/11/24
System Validation Dipole	SPEAG	D750V3	1015	2021/8/13
System Validation Dipole	SPEAG	D1750V2	1008	2021/8/14
System Validation Dipole	SPEAG	D1900V2	5d173	2021/4/22
System Validation Dipole	SPEAG	D1900V2	5d142	2021/6/24
Humidity/Temp meter	TECPEL	DTM-303A	TP130074	2021/4/9
Humidity/Temp meter	TECPEL	DTM-303A	TP130077	2021/9/29
Thermometer	LKM	DTM3000	EC14010603	2021/10/12

Software Version
DASY NEO52 D10.3 S14.6.13
SEMCAD-X-PostPro

18 Facilities

All measurement facilities used to collect the measurement data are located at

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)

19 Reference

[1] Federal Communications Commission, \Report and order: Guidelines for evaluating the environ-mental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.

[2] David L. Means Kwok Chan, Robert F. Cleveland, \Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commision, O_ce of Engineering & Technology, Washington, DC, 1997.

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-_eld scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105{113, Jan. 1996.

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20 Attachments

Exhibit	Content
1	System Performance Check Plots
2	SAR Test Data Plots
3	SAR Equipment calibration report
4	T201116W03-SF PHOTOs

END OF REPORT