FCC SAR TEST REPORT

FCC ID	**:**	**A4RGP4BC**
Equipment	**:**	**Phone**
Applicant	**:**	**Google LLC** **1600 Amphitheatre Parkway,** **Mountain View, California, 94043 USA**
Standard	**:**	**FCC 47 CFR Part 2 (2.1093)**

The product was received on Mar. 21, 2022 and testing was started from Apr. 22, 2022 and completed on Jul. 26, 2022. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been pass the FCC requirement.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Cona Huang / Deputy Manager

Testing Laboratory
1190

Sporton International Inc. EMC & Wireless Communications Laboratory

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History of this test report

Report No.	Version	Description	Issued Date
FA1O2919-06D	01	Initial issue of report	Jun. 06, 2022
FA1O2919-06D	03	Update section1, section11, section12 and section13	Jul. 28, 2022

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Google LLC, Phone, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary				Highest Simultaneous Transmission 1g SAR (W/kg)	Highest Simultaneous Transmission 10g SAR (W/kg)
		Head (Separation 0mm)	Body-worn (Separation 10mm)	Hotspot (Separation 10mm)	Extremity (Separation 0mm)		
		1g SAR (W/kg)		10g SAR (W/kg)			
Licensed	GSM850	1.03	1.02	0.80		1.53	2.89
	GSM1900	0.59	1.04	0.90			
	WCDMA II	0.73	1.14	0.90	2.87		
	WCDMA IV	0.50	1.17	0.89			
	WCDMA V	1.12	1.09	0.85			
	LTE Band 2	1.16	1.18	0.89	1.99		
	LTE Band 7	1.18	1.17	0.87	1.88		
	LTE Band 12/17	0.76	0.39	0.44			
	LTE Band 13	1.12	0.61	0.69			
	LTE Band 14	1.17	0.64	0.71			
	LTE Band 2/25	0.72	1.16	0.89	2.75		
	LTE Band 5/26	1.13	0.84	0.89			
	LTE Band 30	0.41	1.07	0.89	2.35		
	LTE Band 38/41	0.56	0.97	0.89	0.97		
	LTE Band 48	0.10	0.40	0.65			
	LTE Band 4/66	0.95	0.90	0.84			
	LTE Band 71	1.17	0.33	0.42			
	FR1 n2	1.18	1.00	0.89	2.11		
	FR1 n5	1.18	0.88	0.89			
	FR1 n7	0.97	1.00	0.89	1.47		
	FR1 n12	0.77	0.44	0.49			
	FR1 n14	0.85	0.53	0.59			
	FR1 n25	0.60	1.02	0.89	2.89		
	FR1 n30	0.57	1.07	0.87	2.34		
	FR1 n38/n41	1.19	1.18	0.90	1.79		
	FR1 n48	1.13	0.66	0.79			
	FR1 n66	0.97	1.17	0.90	2.61		
	FR1 n71	1.17	0.31	0.45			
	FR1 n77	1.10	0.81	0.85			
DTS	2.4GHz WLAN	1.18	0.77	0.68		1.54	
NII	5GHz WLAN	1.20	1.07	0.64	2.55	1.54	2.89
6XD	6GHz WLAN	0.42	0.30		0.31	1.54	2.89
DSS	Bluetooth	0.20	0.35	0.41		1.53	

Equipment Class	Frequency Band	Head APD (W/m^2)	Body-worn APD (W/m^2)	Product Specific APD (W/m^2)	Reported PD (W/m^2)
6XD	6GHz WLAN	2.63	1.52	6.21	6.28
Date of Testing:		2022/4/22 ~ 2022/7/26			

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation and the FCC designation No. TW1190 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test. This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR, 4.0 W/kg for Product Specific 10g SAR) specified in FCC 47 CFR part 2 (2.1093), Human Exposure to RF Radiation Limits (1.0 mW/cm^2=10 W/m^2) specified in FCC 47 CFR part 1.1310 and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

Reviewed by: Jason Wang

Report Producer: Carlie Tsai

2. Data Reuse Approach

FCC ID: A4RGE2AE (parent model) and FCC ID: A4RGP4BC (variant model)

- **PCB**: The PCB layout is exactly the same with parent model
- **Component Positions**: the position of the components are the same
- **Enclosure, Materials, and From Factor**: the Enclosure, Materials, and From Factor are exactly the same
- **Antenna Structures**: the FR2 antenna modules are depopulated on the Variant Model, but all of the other antennas are physically the same as the reference model.

Due to the same design are identical between parent model and variant model, SAR data reuse is requested and spot check data in this report is used to justify the SAR data reuse.
For variant model 1g SAR and 10g spot check SAR result does not exceed 30% and 1g SAR < 1.2W/kg, 10g SAR < 3.0W/kg of the reference model, the max SAR summary are identical with parent model.
The applicant should take full responsibility that the test data as referenced in this report represent compliance for this FCC ID: A4RGP4BC

3. Model Difference Information

A4RGE2AE and A4RGP4BC use the identical internal printed circuit board layout, and the major differences which may relate to RF are listed below:

- Depopulated the FR2 radio and FR2 antenna Module

The details of similarity and difference can be found in the confidential documents.

4. Reference detail Section

Rule Part	Equipment Class	Wireless Technology	Frequency Band (MHz)	Reference FCC ID (Parent)	Type Grant/ Permissive Change	Reference Title	FCC ID Filling (Variant)	Test on the variant
Part 2.1093 SAR	DXX	WPT	110KHz ~ 148.5KHz	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Full test
	UWB	UWB	6489.6, 7987.2	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	1mW Low power exclusion
	DSS	Bluetooth	2400~2483.5	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Spot check
	DTS	BLE Wi-Fi	2400~2483.5	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Spot check
	NII	Wi-Fi	5150 ~ 5250 5250 ~ 5350 5470 ~ 5725 5725 ~ 5850 5850 ~ 5895	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Spot check
	6XD	Wi-Fi	5925 ~ 6425 6425 ~ 6525 6525 ~ 6875 6875 ~ 7125	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Spot check
	PCB CBE	GSM	850/1900	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Spot Check
		WCDMA	B2/4/5	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Spot Check
		LTE	B2/4/5/7/12/13/14 /17/25/26/30/38/41 /48/66/71	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Spot check
		5G FR1	n2/5/7/12/14/25/30/ 38/41/48/66/71/77	A4RGE2AE	Original Grant	FA1O2919-05E	A4RGP4BC	Spot check

5. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards, the below KDB standard may not including in the TAF code without accreditation.

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r03
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D01 3G SAR Procedures v03r01
- FCC KDB 941225 D05 SAR for LTE Devices v02r05
- FCC KDB 941225 D05A Rel.10 LTE SAR Test Guidance v01r02
- FCC KDB 941225 D06 Hotspot Mode SAR v02r01
- FCC KDB 941225 D07 UMPC Mini Tablet v01r02
- IEC/IEEE 62209-1528:2020
- SPEAG DASY6 System Handbook
- SPEAG DASY6 Application Note (Interim Procedure for Device Operation at 6GHz-10GHz)

6. Equipment Under Test (EUT) Information

6.1 General Information

Product Feature & Specification	
Equipment Name	Phone
FCC ID	A4RGP4BC
S / N	23051FDH30004S 23051FDH30001B
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 14: 788 MHz ~ 798 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 25: 1850 MHz ~ 1915 MHz LTE Band 26: 814 MHz ~ 849 MHz LTE Band 30: 2305 MHz ~ 2315 MHz LTE Band 38: 2570 MHz ~ 2620 MHz LTE Band 41: 2496 MHz ~ 2690 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz 5G NR n2 : 1850 MHz ~ 1910 MHz 5G NR n5 : 824 MHz ~ 849 MHz 5G NR n7 : 2500 MHz ~ 2570 MHz 5G NR n12 : 699 MHz ~ 716 MHz 5G NR n14 : 788 MHz ~ 798 MHz 5G NR n25 : 1850 MHz ~ 1915 MHz 5G NR n30 : 2305 MHz ~ 2315 MHz 5G NR n38 : 2570 MHz ~ 2620 MHz 5G NR n41 : 2496 MHz ~ 2690 MHz 5G NR n48 : 3550 MHz ~ 3700 MHz 5G NR n66 : 1710 MHz ~ 1780 MHz 5G NR n71 : 663 MHz ~ 698 MHz 5G NR n77: 3450MHz ~ 3550MHz, 3700 MHz ~ 3980 MHz WLAN 2.4 GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2 GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3 GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.6 GHz Band: 5470 MHz ~ 5725 MHz WLAN 5.8 GHz Band: 5725 MHz ~ 5850 MHz WLAN 5.8G UNII4 Band: 5850 MHz ~ 5895 MHz WLAN 6E: 5925 MHz ~ 6425 MHz, 6425 MHz ~ 6525 MHz, 6525 MHz ~ 6875 MHz, 6875 MHz ~ 7125 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz NFC : 13.56 MHz WPT: 110KHz ~ 148.5KHz UWB: 6489.6 MHz, 7987.2 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA, HSUPA LTE: QPSK, 16QAM, 64QAM, 256QAM 5G NR: DFT-s-OFDM/CP-OFDM, Pi/2 BPSK/QPSK/16QAM/64QAM/256QAM WLAN: 802.11a/b/g/n/ac/ax HT20/HT40/VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE NFC/WPT: ASK UWB: BPM-BPSK
GSM / (E)GPRS Transfer mode	Class B – EUT cannot support Packet Switched and Circuit Switched Network simultaneously but can automatically switch between Packet and Circuit Switched Network.

7. RF Exposure Limits

7.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

7.2 Controlled Environment

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). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

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

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

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram 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.

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Peak Spatially Averaged Power Density was evaluated over a circular area of 4cm^2 per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

8. Specific Absorption Rate (SAR)

8.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

8.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\mathbf{SAR} = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\mathbf{dm}}\right) = \frac{\mathbf{d}}{\mathbf{dt}}\left(\frac{\mathbf{dW}}{\boldsymbol{\rho}\mathbf{dv}}\right)$$

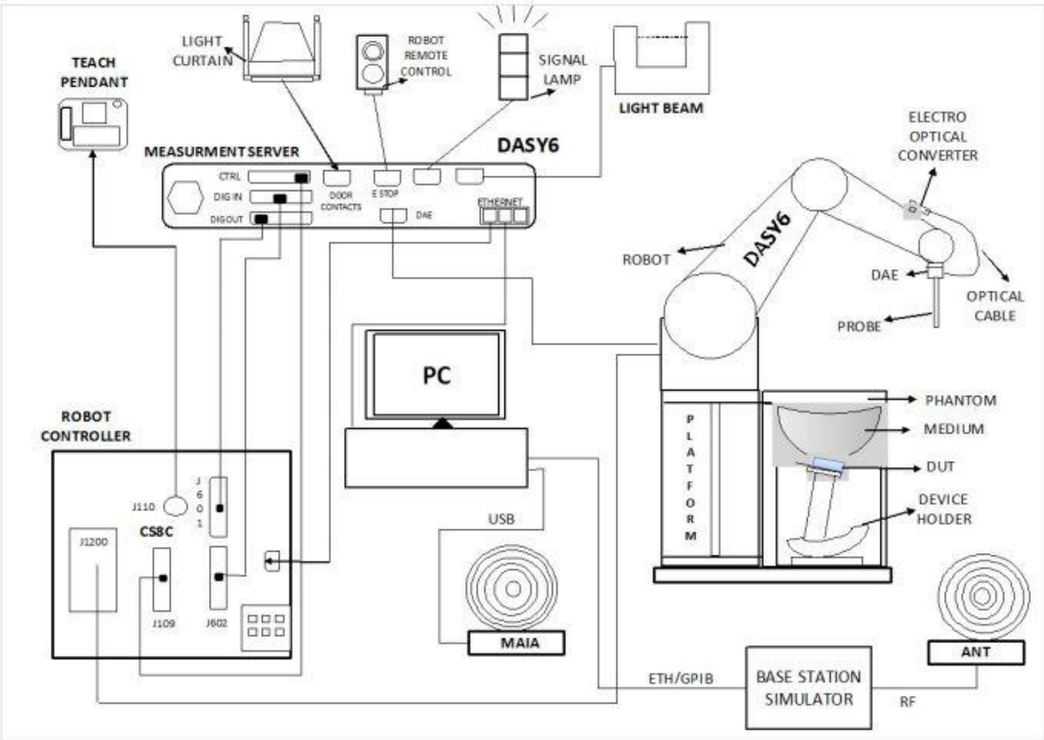
SAR is expressed in units of Watts per kilogram (W/kg)

$$\mathbf{SAR} = \frac{\boldsymbol{\sigma}|\mathbf{E}|^2}{\boldsymbol{\rho}}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

9. System Description and Setup

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



- The DASY system in DASY6/DASY5 V5.2 SAR Configuration is shown above
- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running windows software and the DASY5/DASY6 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

9.1 Test Site Location

The SAR measurement facilities used to collect data are within both Sporton Lab list below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190 and 3786) and the FCC designation No. TW1190 and TW3786 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Test Site	EMC & Wireless Communications Laboratory		Wensan Laboratory		
Test Site Location	TW1190 No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan		TW3786 No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan		
Test Site No.	SAR01-HY	SAR03-HY	SAR08-HY	SAR09-HY	SAR15-HY
	SAR04-HY	SAR05-HY	SAR11-HY	SAR12-HY	
	SAR06-HY	SAR10-HY	SAR13-HY	SAR14-HY	

9.2 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<ES3DV3 Probe>

Construction	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – 4 GHz; Linearity: ±0.2 dB (30 MHz – 4 GHz)
Directivity	±0.2 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)
Dynamic Range	5 µW/g – >100 mW/g; Linearity: ±0.2 dB
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz – >6 GHz Linearity: ±0.2 dB (30 MHz – 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 – >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

9.3 Data Acquisition Electronics (DAE)

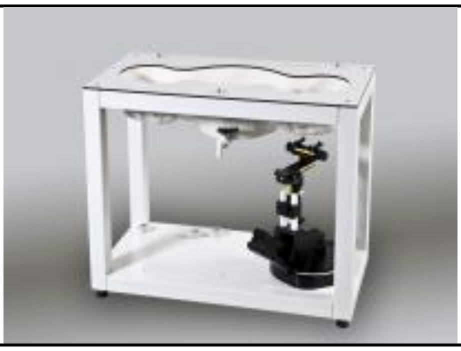
The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.1 Photo of DAE

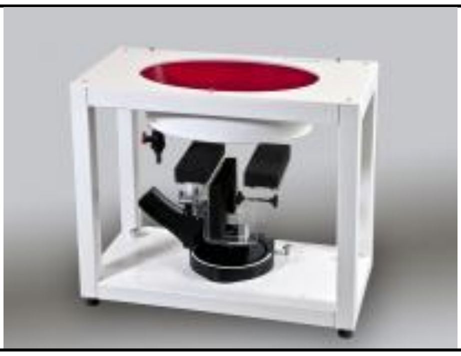
9.4 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
Measurement Areas	Left Hand, Right Hand, Flat Phantom	

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)	
Filling Volume	Approx. 30 liters	
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm	

The ELI phantom is intended 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 standard and all known tissue simulating liquids.

9.5 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.

Mounting Device for Hand-Held Transmitters

Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

Mounting Device for Laptops

10. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

(a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b) Read the WWAN RF power level from the base station simulator.
(c) For WLAN power measurement, use engineering software to configure EUT WLAN continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d) Connect EUT RF port through RF cable to the power meter, and measure WLAN output power

<SAR measurement>

(a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN continuously transmission, at maximum RF power, in the highest power channel.
(b) Place the EUT in the positions as Appendix D demonstrates.
(c) Set scan area, grid size and other setting on the DASY software.
(d) Measure SAR results for the highest power channel on each testing position.
(e) Find out the largest SAR result on these testing positions of each band
(f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement
(b) Area scan
(c) Zoom scan
(d) Power drift measurement

10.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a) Extraction of the measured data (grid and values) from the Zoom Scan
(b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c) Generation of a high-resolution mesh within the measured volume
(d) Interpolation of all measured values form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

10.2 Power Reference Measurement

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

10.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

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

10.4 Zoom Scan

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

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

10.5 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

10.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

11. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit(2)	D835V2	4d167	Nov. 25, 2019	Nov. 22, 2022
SPEAG	1750MHz System Validation Kit	D1750V2	1068	Nov. 25, 2021	Nov. 24, 2022
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Aug. 19, 2021	Aug. 18, 2022
SPEAG	2450MHz System Validation Kit(2)	D2450V2	929	Nov. 21, 2019	Nov. 18, 2022
SPEAG	2600MHz System Validation Kit	D2600V2	1008	Aug. 17, 2021	Aug. 16, 2022
SPEAG	3500MHz System Validation Kit	D3500V2	1014	Jan. 17, 2022	Jan. 16, 2023
SPEAG	3500MHz System Validation Kit	D3500V2	1036	Mar. 23, 2022	Mar. 22, 2023
SPEAG	3700MHz System Validation Kit	D3700V2	1022	Jul. 14, 2021	Jul. 13, 2022
SPEAG	3700MHz System Validation Kit	D3700V2	1006	Jun. 20, 2022	Jun. 19, 2023
SPEAG	3900MHz System Validation Kit	D3900V2	1017	Apr. 22, 2022	Apr. 21, 2023
SPEAG	5GHz System Validation Kit(2)	D5GHzV2	1128	Dec. 16, 2019	Dec. 13, 2022
SPEAG	Data Acquisition Electronics	DAE4	376	Nov. 22, 2021	Nov. 21, 2022
SPEAG	Data Acquisition Electronics	DAE4	914	Jun. 09, 2021	Jun. 08, 2022
SPEAG	Data Acquisition Electronics	DAE4	854	Aug. 19, 2021	Aug. 18, 2022
SPEAG	Dosimetric E-Field Probe	EX3DV4	3642	Apr. 28, 2022	Apr. 27, 2023
SPEAG	Dosimetric E-Field Probe	EX3DV4	3925	Apr. 29, 2022	Apr. 28, 2023
SPEAG	Dosimetric E-Field Probe	EX3DV4	7439	Mar. 02, 2022	Mar. 01, 2023
SPEAG	Dosimetric E-Field Probe	EX3DV4	7590	Mar. 28, 2022	Mar. 27, 2023
Anritsu	Radio Communication Analyzer	MT8821C	6201341950	Oct. 21, 2021	Oct. 20, 2022
Keysight	Wireless Communication Test Set	E5515C	MY50267236	Mar. 02, 2022	Mar. 01, 2023
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Oct. 24, 2021	Oct. 23, 2022
Keysight	ENA Network Analyzer	E5071C	MY46104758	Sep. 19, 2021	Sep. 18, 2022
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 24, 2021	Sep. 23, 2022
LINE SEIKI	Digital Thermometer	DTM3000-spezial	2942	Oct. 26, 2021	Oct. 25, 2022
Anritsu	Power Meter	ML2495A	1419002	Aug. 18, 2021	Aug. 17, 2022
Anritsu	Power Sensor	MA2411B	1911176	Aug. 18, 2021	Aug. 17, 2022
Anritsu	Power Meter	ML2496A	2119003	Jun. 09, 2021	Jun. 08, 2022
Anritsu	Power Meter	ML2496A	2119003	Jun. 22, 2022	Jun. 21, 2023
Anritsu	Power Sensor	MA2411B	1726150	Oct. 09, 2021	Oct. 08, 2022
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jul. 16, 2021	Jul. 15, 2022
Anritsu	Spectrum Analyzer	N9010A	MY53470118	Jan. 12, 2022	Jan. 11, 2023
Agilent	Spectrum Analyzer	E4408B	MY44211028	Aug. 19, 2021	Aug. 18, 2022
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 12, 2021	Oct. 11, 2022
Mini-Circuits	Power Amplifier	ZVE-8G+	479102029	Sep. 06, 2021	Sep. 05, 2022
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

12. System Verification

12.1 Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18℃ to 25℃, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18℃ to 25℃ and within ± 2℃ of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.
The liquid tissue depth was at least 15cm in the phantom for all SAR testing.

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
835	22.5	0.918	42.410	0.90	41.50	2.00	2.19	±5	2022/5/14
1750	22.5	1.375	40.019	1.37	40.10	0.36	-0.20	±5	2022/5/13
1900	22.5	1.391	39.766	1.40	40.00	-0.64	-0.59	±5	2022/5/13
2450	22.7	1.787	38.623	1.80	39.20	-0.72	-1.47	±5	2022/4/29
2600	22.5	2.016	39.308	1.96	39.00	2.86	0.79	±5	2022/5/14
3500	22.5	2.999	38.807	2.91	37.90	3.06	2.39	±5	2022/5/15
3500	22.5	2.994	38.417	2.91	37.90	2.89	1.36	±5	2022/7/26
3700	22.5	3.187	38.508	3.12	37.70	2.15	2.14	±5	2022/5/15
3700	22.5	3.208	38.215	3.12	37.70	2.82	1.37	±5	2022/7/26
3900	22.5	3.392	38.230	3.33	37.51	1.86	1.92	±5	2022/5/15
3900	22.5	3.421	38.027	3.33	37.51	2.73	1.38	±5	2022/7/26
5250	22.5	4.678	35.904	4.71	35.95	-0.68	-0.13	±5	2022/4/22
5250	22.4	4.614	35.684	4.71	35.95	-2.04	-0.74	±5	2022/4/23
5250	22.5	4.830	36.961	4.71	35.95	2.55	2.81	±5	2022/6/3

12.2 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Test Site	Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Deviation (%)
SAR01	2022/5/14	835	50	D835V2-4d167	EX3DV4 - SN7439	DAE4 Sn376	0.446	9.55	8.92	-6.60				
SAR01	2022/5/13	1750	50	D1750V2-1068	EX3DV4 - SN7439	DAE4 Sn376	1.780	36.60	35.6	-2.73	0.970	19.30	19.4	0.52
SAR01	2022/5/13	1900	50	D1900V2-5d041	EX3DV4 - SN7439	DAE4 Sn376	1.840	40.60	36.8	-9.36	0.957	21.10	19.14	-9.29
SAR06	2022/4/29	2450	250	D2450V2-929	EX3DV4 - SN7590	DAE4 Sn854	13.100	53.10	52.4	-1.32				
SAR01	2022/5/14	2600	250	D2600V2-1008	EX3DV4 - SN7439	DAE4 Sn376	14.100	58.00	56.4	-2.76				
SAR01	2022/5/15	3500	50	D3500V2-1014	EX3DV4 - SN7439	DAE4 Sn376	3.130	67.20	62.6	-6.85				
SAR05	2022/7/26	3500	100	D3500V2-1036	EX3DV4 - SN3642	DAE4 Sn854	6.600	67.40	66	-2.08				
SAR01	2022/5/15	3700	100	D3700V2-1022	EX3DV4 - SN7439	DAE4 Sn376	6.250	68.20	62.5	-8.36				
SAR05	2022/7/26	3700	100	D3700V2-1006	EX3DV4 - SN3642	DAE4 Sn854	6.530	65.60	65.3	-0.46				
SAR10	2022/5/15	3900	50	D3900V2-1017-3900	EX3DV4 - SN3925	DAE4 Sn914	3.480	68.70	69.6	1.31				
SAR05	2022/7/26	3900	100	D3900V2-1017	EX3DV4 - SN3642	DAE4 Sn854	6.750	68.70	67.5	-1.75				
SAR06	2022/4/22	5250	100	D5GHzV2-1128	EX3DV4 - SN7590	DAE4 Sn854	7.690	80.00	76.9	-3.87				
SAR06	2022/4/23	5250	100	D5GHzV2-1128	EX3DV4 - SN7590	DAE4 Sn854	7.520	80.00	75.2	-6.00				
SAR05	2022/6/3	5250	100	D5GHzV2-1128	EX3DV4 - SN3642	DAE4 Sn854					2.460	22.90	24.6	7.42

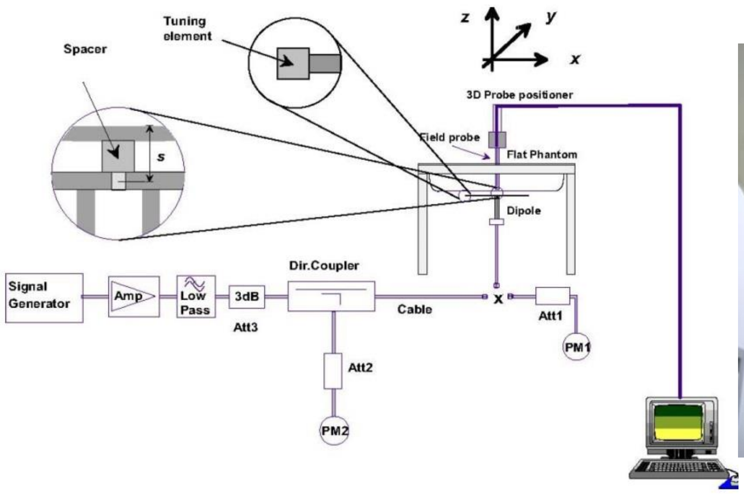


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

13. Spot Check SAR Results

General Note:

1. SAR spot check verification on the worst cases from the original model was performed to demonstrate the test data from original model remains representative for the variant model.
2. If the 1-g SAR spot check result "does not exceed 30%, but larger than 1.2 W/kg", more spot check on the next-higher exposure position until the spot check result does not exceed 1.2 W/kg.
3. The spot check results don't show the SAR increase more than 30%, therefore referring to the guidance in the KDB inquiry, SAR data reuse is justified.

1st as parent model

2nd as variant model

13.1 Head SAR

<WWAN SAR>

Plot No.	No.	Band	Mode	Test Position	Gap (mm)	Power Index	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Deviation
	1st	GSM850_Ant 0	GPRS (4 Tx slots)	Left Cheek	0mm	2/3	189	836.4	28.54	30.50	1.570	-0.11	0.361	0.567	-54.5%
01	2nd	GSM850_Ant 0	GPRS (4 Tx slots)	Left Cheek	0mm	2/3	189	836.4	29.21	30.50	1.346	0.01	0.192	0.258	
	1st	LTE Band 2_Ant 5	20M_QPSK_1_0	Left Cheek	0mm	2	18700	1860	23.42	25.30	1.542	-0.11	0.755	1.164	-13.5%
02	2nd	LTE Band 2_Ant 5	20M_QPSK_1_0	Left Cheek	0mm	2	18700	1860	24.01	25.30	1.346	-0.02	0.748	1.007	
	1st	LTE Band 7_Ant 2	20M_QPSK_1_0	Right Cheek	0mm	2	21350	2560	23.78	25.30	1.419	-0.19	0.830	1.178	-31.7%
03	2nd	LTE Band 7_Ant 2	20M_QPSK_1_0	Right Cheek	0mm	2	21350	2560	23.33	25.30	1.574	-0.13	0.511	0.804	
	1st	FR1 n2_Ant 1	20M_BPSK_1_1	Right Tilted	0mm	2	372000	1860	17.13	18.70	1.435	-0.09	0.819	1.176	-0.3%
04	2nd	FR1 n2_Ant 1	20M_BPSK_1_1	Right Tilted	0mm	2	372000	1860	17.49	18.70	1.321	0.16	0.887	1.172	
	1st	FR1 n48_Ant 7	10M_BPSK_1_1	Right Cheek	0mm	2/3	641666	3624.99	23.00	24.20	1.318	-0.01	0.150	0.198	-14.6%
05	2nd	FR1 n48_Ant 7	10M_BPSK_1_1	Right Cheek	0mm	2/3	641666	3624.99	22.86	24.20	1.361	-0.17	0.124	0.169	
	1st	FR1 n77_Ant 6	100M_BPSK_1_1	Left Cheek	0mm	2/3	656000	3840	23.99	24.10	1.026	-0.08	0.227	0.233	-1.7%
06	2nd	FR1 n77_Ant 6	100M_BPSK_1_1	Left Cheek	0mm	2/3	656000	3840	24.03	24.10	1.016	-0.16	0.225	0.229	

<WLAN SAR>

Plot No.	No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Index	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Deviation
	1st	WLAN5GHz	802.11n-HT40 MCS0	Left Cheek	0mm	Ant 4+8(4)	1	54	5270	19.60	20.00	1.096	86.84	1.152	-0.04	0.946	1.195	-19.75%
		WLAN5GHz	802.11n-HT40 MCS0	Left Cheek	0mm	Ant 4+8(8)	1	54	5270	19.25	20.00	1.189	86.84	1.152	-0.04	0.676	0.926	
07	2nd	WLAN5GHz	802.11n-HT40 MCS0	Left Cheek	0mm	Ant 4+8(4)	1	54	5270	19.60	20.00	1.096	86.84	1.152	0.04	0.759	0.959	
		WLAN5GHz	802.11n-HT40 MCS0	Left Cheek	0mm	Ant 4+8(8)	1	54	5270	19.25	20.00	1.189	86.84	1.152	0.04	0.473	0.648	

13.2 Hotspot SAR

<WWAN SAR>

Plot No.	No.	Band	Mode	Test Position	Gap (mm)	Power Index	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Deviation
	1st	WCDMA II_Ant 2	RMC 12.2Kbps	Right side	10mm	4	9262	1852.4	23.21	23.50	1.069	-0.07	0.836	0.894	-1.6%
08	2nd	WCDMA II_Ant 2	RMC 12.2Kbps	Right side	10mm	4	9262	1852.4	22.72	23.50	1.197	-0.11	0.735	0.880	
	1st	LTE Band 2_Ant 1	20M_QPSK_1_0	Top Side	10mm	4	18900	1880	20.51	21.20	1.172	-0.15	0.758	0.889	-3.7%
09	2nd	LTE Band 2_Ant 1	20M_QPSK_1_0	Top Side	10mm	4	18900	1880	20.09	21.20	1.291	-0.05	0.663	0.856	
	1st	FR1 n41_Ant 5	100M_BPSK_1_1	Right Side	10mm	4	518598	2592.99	21.49	21.70	1.050	-0.19	0.854	0.896	-9.2%
10	2nd	FR1 n41_Ant 5	100M_BPSK_1_1	Right Side	10mm	4	518598	2592.99	20.73	21.70	1.250	-0.1	0.651	0.814	
	1st	FR1 n48_Ant 6	10M_BPSK_1_1	Left Side	10mm	4	641666	3624.99	24.68	24.70	1.005	0.1	0.790	0.794	-3.0%
11	2nd	FR1 n48_Ant 6	10M_BPSK_1_1	Left Side	10mm	4	641666	3624.99	24.29	24.70	1.099	0.06	0.701	0.770	
	1st	FR1 n77_Ant 7	100M_BPSK_1_1	Right Side	10mm	4	656000	3840	22.68	24.00	1.355	0.02	0.625	0.847	-1.65%
12	2nd	FR1 n77_Ant 7	100M_BPSK_1_1	Right Side	10mm	4	656000	3840	22.30	24.00	1.479	-0.07	0.563	0.833	
	1st	FR1 n66_Ant 0	40M_BPSK_1_108	Bottom Side	10mm	4	349000	1745	18.39	19.10	1.178	-0.18	0.763	0.899	-5.5%
13	2nd	FR1 n66_Ant 0	40M_BPSK_1_108	Bottom Side	10mm	4	349000	1745	19.05	19.10	1.012	-0.18	0.840	0.850	

<WLAN SAR>

Plot No.	No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Index	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Deviation
	1st	WLAN2.4GHz	802.11g 6Mbps	Left Side	10mm	Ant 4+3(3)	7	6	2437	19.00	21.00	1.585	93.4	1.071	-0.09	0.400	0.679	-2.80%
14	2nd	WLAN2.4GHz	802.11g 6Mbps	Left Side	10mm	Ant 4+3(3)	7	6	2437	19.00	21.00	1.585	93.4	1.071	-0.17	0.389	0.660	

13.3 Body-Worn SAR

<WWAN SAR>

Plot No.	No.	Band	Mode	Test Position	Gap (mm)	Power Index	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Deviation
	1st	WCDMA IV_Ant 2	RMC 12.2Kbps	Back	10mm	5	1513	1752.6	24.03	25.30	1.340	0.13	0.876	1.174	-5.7%
15	2nd	WCDMA IV_Ant 2	RMC 12.2Kbps	Back	10mm	5	1513	1752.6	23.73	25.30	1.435	-0.07	0.771	1.107	
	1st	LTE Band 2_Ant 1	20M_QPSK_1_0	Front	10mm	5	18900	1880	23.47	24.70	1.327	-0.16	0.886	1.176	-13.9%
16	2nd	LTE Band 2_Ant 1	20M_QPSK_1_0	Front	10mm	5	18900	1880	23.25	24.70	1.396	0.07	0.725	1.012	
	1st	FR1 n2_Ant 5	20M_BPSK_50_28	Back	10mm	5	376000	1880	24.03	25.30	1.340	0.13	0.600	0.804	-32.5%
17	2nd	FR1 n2_Ant 5	20M_BPSK_50_28	Back	10mm	5	376000	1880	24.12	25.30	1.312	-0.11	0.414	0.543	
	1st	FR1 n41_Ant 0	100M_BPSK_135_69	Front	10mm	5	518598	2592.99	22.30	23.60	1.349	0.02	0.876	1.181	-31.7%
18	2nd	FR1 n41_Ant 0	100M_BPSK_135_69	Front	10mm	5	518598	2592.99	21.64	23.60	1.570	-0.06	0.514	0.807	
	1st	FR1 n48_Ant 6	10M_BPSK_1_1	Back	10mm	5/6	641666	3624.99	24.68	24.70	1.005	0.01	0.657	0.660	-7.1%
19	2nd	FR1 n48_Ant 6	10M_BPSK_1_1	Back	10mm	5/6	641666	3624.99	24.29	24.70	1.099	-0.11	0.558	0.613	
	1st	FR1 n77_Ant 7	100M_BPSK_1_1	Back	10mm	Index5/6	656000	3840	22.68	24.00	1.355	0.02	0.501	0.679	-12.37%
20	2nd	FR1 n77_Ant 7	100M_BPSK_1_1	Back	10mm	Index5/6	656000	3840	22.30	24.00	1.479	-0.02	0.402	0.595	

<WLAN SAR>

Plot No.	No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Index	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Deviation
	1st	WLAN5GHz	802.11n-HT40 MCS0	Back	10mm	Ant 4+8(4)	5	54	5270	19.30	21.00	1.479	86.84	1.152	-0.13	0.409	0.697	-7.38%
		WLAN5GHz	802.11n-HT40 MCS0	Back	10mm	Ant 4+8(8)	5	54	5270	19.25	21.00	1.496	86.84	1.152	-0.13	0.621	1.070	
21	2nd	WLAN5GHz	802.11n-HT40 MCS0	Back	10mm	Ant 4+8(4)	5	54	5270	19.30	21.00	1.479	86.84	1.152	-0.1	0.261	0.445	
		WLAN5GHz	802.11n-HT40 MCS0	Back	10mm	Ant 4+8(8)	5	54	5270	19.25	21.00	1.496	86.84	1.152	-0.1	0.575	0.991	

13.4 Product Specific SAR

<WWAN SAR>

Plot No.	No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	Gap (mm)	Power Index	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)	Deviation
	1st	FR1 n25_Ant 0	40M	BPSK	108	54	Bottom Side	0mm	6	376500	1882.5	20.66	20.80	1.033	-0.12	2.120	2.189	-2.2%
22	2nd	FR1 n25_Ant 0	40M	BPSK	108	54	Bottom Side	0mm	6	376500	1882.5	20.80	20.80	1.000	-0.06	2.140	2.140	
	1st	FR1 n66_Ant 1	40M	BPSK	1	1	Top Side	0mm	5	349000	1745	22.41	23.70	1.346	0	1.940	2.611	-10.5%
23	2nd	FR1 n66_Ant 1	40M	BPSK	1	1	Top Side	0mm	5	349000	1745	22.19	23.70	1.416	-0.12	1.650	2.336	

<WLAN SAR>

Plot No.	No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Index	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 10g SAR (W/kg)	Reported 10g SAR (W/kg)	Deviation
	1st	WLAN5GHz	802.11n-HT40 MCS0	Right Side	0mm	Ant 4+8(4)	5	54	5270	19.25	21.00	1.496	86.84	1.152	-0.04	1.480	2.551	-3.37%
24	2nd	WLAN5GHz	802.11n-HT40 MCS0	Right Side	0mm	Ant 4+8(4)	5	54	5270	19.25	21.00	1.496	86.84	1.152	0.14	1.430	2.465	

Conclusion:

The spot check results don’t show the SAR increase more than 30%, and all below 1.2W/kg for 1-g SAR, below 3W/kg for 10-g SAR. Referring to the guidance in the KDB inquiry, SAR data reuse is justified.

Test Engineer：Jay Chien, Rain Chiu and Dennis Hsieh

14. Uncertainty Assessment

Declaration of Conformity:
The test results with all measurement uncertainty excluded is presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor(a)	1/k(b)	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

The judgment of conformity in the report is based on the measurement results excluding the measurement uncertainty.

Applicable for SAR Measurements:

Uncertainty Budget (4 MHz - 10 GHz range)							
Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	18.60	N	2	1	1	9.3	9.3
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9
Linearity	4.70	R	1.732	1	1	2.7	2.7
Modulation Response	4.68	R	1.732	1	1	2.7	2.7
System Detection Limits	1.00	R	1.732	1	1	0.6	0.6
Boundary Effects	2.00	R	1.732	1	1	1.2	1.2
Readout Electronics	0.30	N	1	1	1	0.3	0.3
Response Time	0.00	R	1.732	1	1	0.0	0.0
Integration Time	2.60	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2
Probe Positioning	6.70	R	1.732	1	1	3.9	3.9
Post-processing	4.00	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Holder	3.60	N	1	1	1	3.6	3.6
Test sample Positioning	3.03	N	1	1	1	3.0	3.0
Power Scaling	0.00	R	1.732	1	1	0.0	0.0
Power Drift	5.00	R	1.732	1	1	2.9	2.9
Phantom and Setup							
Phantom Uncertainty	7.60	R	1.732	1	1	4.4	4.4
SAR correction	0.00	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.03	N	1	0.78	0.77	0.0	0.0
Liquid Conductivity (target)	5.00	R	1.732	0.78	0.77	2.3	2.2
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.77	1.1	1.1
Temp. unc. - Conductivity	3.68	R	1.732	0.78	0.77	1.7	1.6
Liquid Permittivity Repeatability	0.02	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.00	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.84	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						14.5%	14.2%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						29.0%	28.4%

15. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

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[4] SPEAG DASY System Handbook

[5] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[6] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[7] FCC KDB 648474 D04 v01r03, “SAR Evaluation Considerations for Wireless Handsets”, Oct 2015.

[8] FCC KDB 941225 D01 v03r01, “3G SAR MEAUREMENT PROCEDURES”, Oct 2015

[9] FCC KDB 941225 D05 v02r05, “SAR Evaluation Considerations for LTE Devices”, Dec 2015

[10] FCC KDB 941225 D05A v01r02, “Rel. 10 LTE SAR Test Guidance and KDB Inquiries”, Oct 2015

[11] FCC KDB 941225 D06 v02r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", Oct 2015.

[12] FCC KDB 941225 D07 v01r02, " SAR Evaluation Procedures for UMPC Mini-Tablet Devices", Oct 2015.

[13] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[14] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

[15] IEC/IEEE 62209-1528:2020, “Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)”, Oct. 2020

[16] SPEAG DASY6 System Handbook

[17] SPEAG DASY6 Application Note (Interim Procedure for Device Operation at 6GHz-10GHz)