FCC SAR Test Report

Report No. : FA882223

APPLICANT : PAX Technology Limited

EQUIPMENT : Wireless POS Terminal

BRAND NAME : PAX

MODEL NAME : PAX D220 MARKETING NAME : PAX D220

FCC ID : V5P-D2204GMA **STANDARD** : FCC 47 CFR Part 2 (2.1093)

ANSI/IEEE C95.1-1992

IEEE 1528-2013

The product was received on Aug. 22, 2018 and testing was started from Oct. 11, 2018 and completed on Oct. 12, 2018. We, Sporton International (Shenzhen) Inc., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Shenzhen) Inc., the test report shall not be reproduced except in full.

Mark Qu NVLAP LAB CODE 600156-0

Approved by: Mark Qu / Manager

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Issued Date: Dec. 06, 2018 FCC ID: V5P-D2204GMA Form version.: 180516 Page 1 of 38

Issued Date : Dec. 06, 2018 Form version. : 180516

Table of Contents

1. Statement of Compliance	
2. Administration Data	
3. Guidance Applied	
4. Equipment Under Test (EUT) Information	
4.1 General Information	6
4.2 General LTE SAR Test and Reporting Considerations	7
5. RF Exposure Limits	
5.1 Uncontrolled Environment	
5.2 Controlled Environment	
6. Specific Absorption Rate (SAR)	10
6.1 Introduction	
6.2 SAR Definition	
7. System Description and Setup	
7.1 E-Field Probe	
7.2 Data Acquisition Electronics (DAE)	12
7.3 Phantom	
7.4 Device Holder	
8. Measurement Procedures	
8.1 Spatial Peak SAR Evaluation	
8.2 Power Reference Measurement	
8.3 Area Scan	
8.4 Zoom Scan	
8.5 Volume Scan Procedures	
8.6 Power Drift Monitoring	
9. Test Equipment List	
10. System Verification	
10.1 Tissue Simulating Liquids	
10.2 Tissue Verification	
10.3 System Performance Check Results	21
11. RF Exposure Positions	
11.1 Body Position	
12. Conducted RF Output Power (Unit: dBm)	
13. Antenna Location	
14. SAR Test Results	
14.1 Body SAR	
15. Simultaneous Transmission Analysis	
15.1 Body Exposure Conditions	
16. Uncertainty Assessment	
17. References	38
Appendix A. Plots of System Performance Check	
Appendix B. Plots of High SAR Measurement	
Appendix C. DASY Calibration Certificate	
Appendix D. Test Setup Photos	

Revision History

Report No. : FA882223

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA882223	Rev. 01	Initial issue of report	Dec. 06, 2018

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 3 of 38

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for PAX Technology Limited, Wireless POS Terminal, PAX D220, are as follows.

Report No.: FA882223

Highest 1g SAR Summary							
			Highest SAR Summary	Highest			
Equipment Class		uency and	Body (Separation 0mm)	Simultaneous Transmission			
			1g SAR (W/kg)	1g SAR (W/kg)			
	Band 12		0.10				
Licensed	LTE	Band 4	0.52	0.81			
			0.63				
DTS	WLAN	2.4GHz WLAN	0.18	0.81			
DSS	Bluetooth	Bluetooth <0.10 0.70					
Date of	Testing:		2018/10/11 ~ 2018/10/12				

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 specified in FCC 47 CFR part 2 (2.1093) 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.

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Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 4 of 38

2. Administration Data

Testing Laboratory					
Test Site	Sporton International (Shenzhen) Inc.				
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan Shenzhen City Guangdong Province 518055 China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595				

Report No.: FA882223

Applicant Applicant				
Company Name	PAX Technology Limited			
Address	Room 2416, 24/F., Sun Hung Kai Centre, 30 Harbour Road, Wanchai, Hong Kong			

Manufacturer					
Company Name	PAX Computer Technology (Shenzhen) Co., Ltd.				
Address	4/F, No.3 Building, Software Park, Second Central Science-Tech Road, High-Tech industrial Park, Shenzhen, Guangdong, P.R.C.				

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- 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 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 941225 D05 SAR for LTE Devices v02r05

Sporton International (Shenzhen) Inc.

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification				
Equipment Name	Wireless POS Terminal			
Brand Name	PAX			
Model Name	PAX D220			
Marketing Name	PAX D220			
FCC ID	V5P-D2204GMA			
S/N	WWAN Sample S/N: 0840086779 WLAN Sample S/N: 0840086782			
Wireless Technology and Frequency Range	LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC: 13.56 MHz			
Mode	LTE: QPSK, 16QAM WLAN 2.4GHz : 802.11b/g/n HT20 Bluetooth BR/EDR/LE NFC:ASK			
HW Version	n/a			
SW Version	n/a			
EUT Stage	Identical Prototype			
Remark:	eported in 2.4GHz WI AN			

Report No. : FA882223

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 6 of 38

^{1. 802.11}n-HT40 is not supported in 2.4GHz WLAN.

^{2.} This device does not support voice function.

4.2 General LTE SAR Test and Reporting Considerations

Summarize	d necessary ite	ms addres	ssed in KC)B 94122	5 D05 v02	2r05			
FCC ID	V5P-D2204GMA	'5P-D2204GMA							
Equipment Name	Wireless POS Te	erminal							
Operating Frequency Range of each LTE transmission band	LTE Band 4: 17	LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz							
Channel Bandwidth	LTE Band 4:1.4N	LTE Band 2:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 4:1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz LTE Band 12:1.4MHz, 3MHz, 5MHz, 10MHz							
Uplink Modulations Used	QPSK / 16QAM								
LTE Voice / Data requirements	Data only								
LTE Release Version	Release 13, Cat	M1							
CA Support	Not Supported								
	Table 6.2.3EA-1: Maximum Power Reduction (MPR) for Power Class 3 Modulation Channel bandwidth / Transmission bandwidth (NRs) MPR (dB)								
	Modulation	1.4	3.0	vidth / I ra	nsmission 10	15	NRB) 20	MPR (dB)	
LTE MOD	de la	MHz	MHz	MHz	MHz	MHz	MHz	alc les	
LTE MPR permanently built-in by design	QPSK	>2	>2	>1	>4			≤ 1	
	QPSK	>5	>5		1.50			≤ 2	
	16 QAM	≤2	≤ 2	>1	>3	li 🚅 i	2	≤1	
	16QAM	>2	>2	>3	>5		<u> </u>	≤2	
LTE A-MPR	In the base station A-MPR during (Maximum TTI)	SAR testir	ng and the	LTE SA	AR tests v	vas transm	nitting on	all TTI frames	
Spectrum plots for RB configuration	A properly configured base station simulator was used for the SAR and power measurement; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.								

Report No. : FA882223

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date : Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 7 of 38

			Transm	ission (H, I	М, L) с	hanr	nel numbe	rs and freq	uenci	ies in	each LTE	band			
	LTE Band 2														
	Bandwidth	h 1.4 MHz	Bandwid	th 3 MHz	Ban	dwidt	h 5 MHz	Bandwidt	h 10 N	ИHz	Bandwidt	h 15 MHz	Band	widtl	n 20 MHz
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch.	#	Freq. (MHz)	Ch. #	Fre (Mł		Ch. #	Freq. (MHz)	Ch.	#	Freq. (MHz)
L	18607	1850.7	18615	1851.5	1862	25	1852.5	18650	18	55	18675	1857.5	1870	00	1860
М	18900	1880	18900	1880	1890	00	1880	18900	18	08	18900	1880	1890	00	1880
Н	19193	1909.3	19185	1908.5	191	75	1907.5	19150	19	05	19125	1902.5	1910	00	1900
	LTE Band 4														
	Bandwidth 1.4 MHz Bandwidth 3 MHz		th 3 MHz	Bandwidth 5 MHz		Bandwidth 10 MHz Bandwid		Bandwidt	dth 15 MHz Band		andwidth 20 MHz				
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch.	#	Freq. (MHz)	Ch. #	Fre (Mł	eq. Hz)	Ch. #	Freq. (MHz)	Ch.	#	Freq. (MHz)
L	19957	1710.7	19965	1711.5	1997	75	1712.5	20000	17	15	20025	1717.5	2005	50	1720
М	20175	1732.5	20175	1732.5	201	75	1732.5	20175	173	2.5	20175	1732.5	2017	75	1732.5
Н	20393	1754.3	20385	1753.5	203	75	1752.5	20350	17	50	20325	1747.5	2030	00	1745
							LTE Bai	nd 12							
	Ban	dwidth 1.4	MHz	Bar	ndwidth	า 3 M	lHz	Bar	ndwidt	th 5 N	1Hz	Ban	dwidth	10 N	ЛHz
	Ch. #	Fr	eq. (MHz)	Ch. #		Fre	q. (MHz)	Ch. #		Fre	q. (MHz)	Ch. #		Fre	q. (MHz)
L	23017	7	699.7	23025	5		700.5	23035	5		701.5	23060)		704
М	23095	5	707.5	23095	5		707.5	23095	5		707.5	23095	5		707.5
Н	23173	3	715.3	23165	5		714.5	23155	5		713.5	23130)		711

Report No. : FA882223

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 8 of 38

5. RF Exposure Limits

5.1 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.

Report No.: FA882223

5.2 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

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.

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Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 9 of 38

6. Specific Absorption Rate (SAR)

6.1 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.

Report No.: FA882223

6.2 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 (p). The equation description is as below:

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

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

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

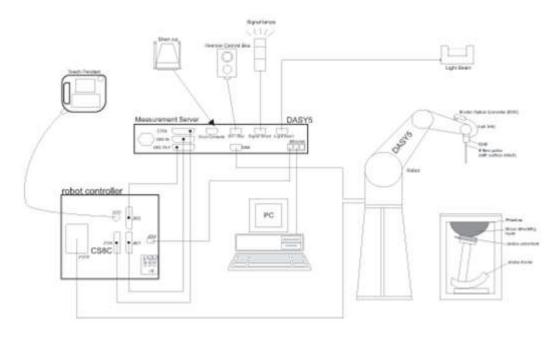
Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version.: 180516 FCC ID: V5P-D2204GMA Page 10 of 38

7. System Description and Setup

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



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positionina.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps.

Page 11 of 38

The phantom, the device holder and other accessories according to the targeted measurement.

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595 FCC ID: V5P-D2204GMA

Issued Date: Dec. 06, 2018 Form version.: 180516

Report No.: FA882223

7.1 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.

<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				
ricquericy	Linearity: ±0.2 dB (30 MHz – 6 GHz)				
Directivity	±0.3 dB in TSL (rotation around probe axis)				
Directivity	±0.5 dB in TSL (rotation normal to probe axis)				
Dynamia Banga	10 μW/g – >100 mW/g				
Dynamic Range	Linearity: ±0.2 dB (noise: typically <1 μW/g)				
	Overall length: 337 mm (tip: 20 mm)				
Dimensions	Tip diameter: 2.5 mm (body: 12 mm)				
Dilliensions	Typical distance from probe tip to dipole centers: 1				
	mm				



Report No. : FA882223

7.2 <u>Data Acquisition Electronics (DAE)</u>

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

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version.: 180516 FCC ID: V5P-D2204GMA Page 12 of 38

7.3 Phantom

<SAM Twin Phantom>

-O7 un 1 Will 1 Halltoill		
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	7 5
Measurement Areas	Left Hand, Right Hand, Flat Phantom	

Report No. : FA882223

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.

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TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version.: 180516 FCC ID: V5P-D2204GMA Page 13 of 38

7.4 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.





Report No.: FA882223

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

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version.: 180516 FCC ID: V5P-D2204GMA Page 14 of 38

8. 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.

Report No.: FA882223

- (b) Read the WWAN RF power level from the base station simulator.
- For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT 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/BT output power

<SAR measurement>

- Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power
- (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.
- Find out the largest SAR result on these testing positions of each band (e)
- 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

8.1 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:

- Extraction of the measured data (grid and values) from the Zoom Scan
- Calculation of the SAR value at every measurement point based on all stored data (A/D values and (b) measurement parameters)
- 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
- Calculation of the averaged SAR within masses of 1g and 10g

FCC ID: V5P-D2204GMA Form version.: 180516 Page 15 of 38

8.2 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.

Report No.: FA882223

8.3 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	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5 \text{ mm}$	
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°	
	\leq 2 GHz: \leq 15 mm 2 – 3 GHz: \leq 12 mm	$3 - 4 \text{ GHz:} \le 12 \text{ mm}$ $4 - 6 \text{ GHz:} \le 10 \text{ mm}$	
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}	When the x or y dimension of measurement plane orientation the measurement resolution of x or y dimension of the test of measurement point on the test	on, is smaller than the above, must be \leq the corresponding levice with at least one	

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Issued Date: Dec. 06, 2018 Form version.: 180516 FCC ID: V5P-D2204GMA Page 16 of 38

8.4 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.

Report No.: FA882223

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

			≤ 3 GHz	> 3 GHz	
Maximum zoom scan s	spatial reso	olution: Δx _{Zoom} , Δy _{Zoom}	\leq 2 GHz: \leq 8 mm 2 - 3 GHz: \leq 5 mm*	$3 - 4 \text{ GHz: } \le 5 \text{ mm}^*$ $4 - 6 \text{ GHz: } \le 4 \text{ mm}^*$	
Maximum zoom scan spatial resolution, normal to phantom surface	uniform	grid: $\Delta z_{Z_{00m}}(n)$	≤ 5 mm	$3 - 4 \text{ GHz}$: $\leq 4 \text{ mm}$ $4 - 5 \text{ GHz}$: $\leq 3 \text{ mm}$ $5 - 6 \text{ GHz}$: $\leq 2 \text{ mm}$	
	graded	Δz _{Zoom} (1): between 1 st two points closest to phantom surface	≤ 4 mm	$3 - 4 \text{ GHz: } \le 3 \text{ mm}$ $4 - 5 \text{ GHz: } \le 2.5 \text{ mm}$ $5 - 6 \text{ GHz: } \le 2 \text{ mm}$	
	grid	Δz _{Zoom} (n>1): between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$		
Minimum zoom scan volume x, y, z			≥ 30 mm	$3 - 4 \text{ GHz:} \ge 28 \text{ mm}$ $4 - 5 \text{ GHz:} \ge 25 \text{ mm}$ $5 - 6 \text{ GHz:} \ge 22 \text{ mm}$	

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.

8.5 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.

8.6 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.

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TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595 Issued Date: Dec. 06, 2018

FCC ID: V5P-D2204GMA Page 17 of 38 Form version. : 180516

When zoom scan is required and the <u>reported</u> SAR from the <u>area scan based 1-g SAR estimation</u> 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.

9. Test Equipment List

				Calib	ration
Manufacturer	Name of Equipment	Type/Model	Serial Number	Last Cal.	Due Date
SPEAG	750MHz System Validation Kit	D750V3	1099	Dec. 04, 2017	Dec. 03, 2018
SPEAG	1750MHz System Validation Kit	D1750V2	1137	Jul. 30, 2018	Jul. 29, 2019
SPEAG	1900MHz System Validation Kit	D1900V2	5d182	Dec. 06, 2017	Dec. 05, 2018
SPEAG	2450MHz System Validation Kit	D2450V2	924	Mar. 22, 2018	Mar. 21, 2019
SPEAG	Data Acquisition Electronics	DAE4	1303	Dec. 19, 2017	Dec. 18, 2018
SPEAG	Dosimetric E-Field Probe	EX3DV4	3819	Jan. 31, 2018	Jan. 30, 2019
SPEAG	ELI4 Phantom	QD OVA 002 AA	TP-1149	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
R&S	Radiation	CMW500	150791	Jul. 18, 2018	Jul. 17, 2019
Agilent	Network Analyzer	E5071C	MY46523671	Oct. 18, 2017	Oct. 17, 2018
Speag	Dielectric Assessment KIT	DAK-3.5	1071	Nov. 28, 2017	Nov. 27, 2018
Agilent	Signal Generator	N5181A	MY50145381	Dec. 26, 2017	Dec. 25, 2018
Anritsu	Power Senor	MA2411B	1306099	Jul. 30, 2018	Jul. 29, 2019
Anritsu	Power Meter	ML2495A	1349001	Jul. 26, 2018	Jul. 25, 2019
R&S	CBT BLUETOOTH TESTER	CBT	100963	Dec. 26, 2017	Dec. 25, 2018
R&S	Spectrum Analyzer	FSP7	100818	Jul. 18, 2018	Jul. 17, 2019
LKM electronic	Hygrometer	DTM3000	3241	Aug. 10, 2018	Aug. 09, 2019
Anymetre	Thermo-Hygrometer	JR593	2015030903	Jan. 01, 2018	Dec. 31, 2018
ARRA	Power Divider	A3200-2	N/A	No	ote
PASTERNACK	Dual Directional Coupler	PE2214-10	N/A	No	ote
Agilent	Dual Directional Coupler	778D	50422	No	ote
MCL	Attenuation1	BW-S10W5	N/A	No	ote
Weinschel	Attenuation2	3M-20	N/A	No	ote
Zhongjilianhe	Attenuation3	MVE2214-03	N/A	No	ote
mini-circuits	Amplifier	ZHL-42W+	QA1341002	No	ote
mini-circuits	Amplifier	ZVE-3W-83+	599201528	No	ote

Report No.: FA882223

Note:

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.

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 FCC ID: V5P-D2204GMA Page 18 of 38 Form version. : 180516

10. System Verification

10.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.1.

Report No.: FA882223



Fig 10.1 Photo of Liquid Height for Body SAR

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 FCC ID: V5P-D2204GMA Form version. : 180516 Page 19 of 38

10.2 Tissue Verification

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.

Report No. : FA882223

Frequency	Water	Sugar	Cellulose	Salt	Preventol	DGBE	Conductivity	Permittivity			
(MHz)	(%)	(%)	(%)	(%)	(%)	(%)	(σ)	(εr)			
For Body											
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5			
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3			
2450	68.6	0	0	0	0	31.4	1.95	52.7			

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity (σ)	Permittivity (ε _r)	Conductivity Target (σ)	Permittivity Target (ε _r)	Delta (σ) (%)	Delta (ε _r) (%)	Limit (%)	Date
750	Body	22.8	0.970	54.642	0.96	55.50	1.04	-1.55	±5	2018/10/11
1750	Body	22.6	1.527	52.039	1.49	53.40	2.48	-2.55	±5	2018/10/11
1900	Body	22.4	1.578	54.205	1.52	53.30	3.82	1.70	±5	2018/10/11
2450	Body	22.4	2.001	52.089	1.95	52.70	2.62	-1.16	±5	2018/10/12

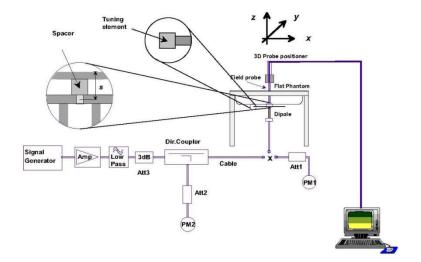
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Issued Date : Dec. 06, 2018 FCC ID: V5P-D2204GMA Form version. : 180516 Page 20 of 38

10.3 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.

Date	Frequency (MHz)	Tissue Type	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 (%)
2018/10/11	750	Body	250	1099	3819	1303	2.15	8.64	8.60	-0.46
2018/10/11	1750	Body	250	1137	3819	1303	8.89	37.00	35.56	-3.89
2018/10/11	1900	Body	250	5d182	3819	1303	10.00	40.40	40.00	-0.99
2018/10/12	2450	Body	250	924	3819	1303	12.80	50.70	51.20	0.99





Report No.: FA882223

Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo

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Issued Date: Dec. 06, 2018 FCC ID: V5P-D2204GMA Page 21 of 38 Form version. : 180516

11. RF Exposure Positions

11.1 Body Position

(a) To position the device parallel to the phantom surface with either keypad up or down.

Report No.: FA882223

- (b) To adjust the device parallel to the flat phantom.
- (c) To adjust the distance between the device surface and the flat phantom to 0 cm.

Please refer to Appendix D for the test setup photos.

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 FCC ID: V5P-D2204GMA Form version. : 180516 Page 22 of 38

12. Conducted RF Output Power (Unit: dBm)

<LTE Conducted Power>

General Note:

 Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.

Report No. : FA882223

- 2. Per KDB 941225 D05v02r05, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
- 3. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
- 4. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
- 5. Per KDB 941225 D05v02r05, for QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
- 6. Per KDB 941225 D05v02r05, 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, 16QAM SAR testing is not required.
- 7. Per KDB 941225 D05v02r05, smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
- 8. For LTE B4 / B12 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, 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.

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<LTE Band 2>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up	MDD
	Cha	innel		18700	18900	19100	limit (dBm)	MPR (dB)
	Frequen	cy (MHz)		1860	1880	1900	, , ,	
20	QPSK	1	0	23.02	23.24	23.80		
20	QPSK	1	5	23.04	23.30	23.88	24.50	0.00
20	QPSK	6	0	23.14	23.34	23.87	24.50	0.00
20	16QAM	1	0	22.86	23.11	23.79	04.50	0.00
20	16QAM	1	5	22.86	23.12	23.69	24.50	0.00
20	16QAM	6	0	22.83	23.06	23.37	24.50	0.00
	Cha	nnel		18675	18900	19125	Tune-up	MPR
	Frequen	cy (MHz)		1857.5	1880	1902.5	limit (dBm)	(dB)
15	QPSK	1	0	22.96	23.18	23.71	24.50	0.00
15	QPSK	1	5	22.99	23.21	23.81	24.50	0.00
15	QPSK	6	0	23.04	23.26	23.81	24.50	0.00
15	16QAM	1	0	22.83	23.01	23.76	24.50	0.00
15	16QAM	1	5	22.80	23.03	23.64	24.50	0.00
15	16QAM	6	0	22.82	23.04	23.32	24.50	0.00
	Cha	innel		18650	18900	19150	Tune-up	MPR
	Frequen	cy (MHz)		1855	1880	1905	limit (dBm)	(dB)
10	QPSK	1	0	22.93	23.20	23.72	24.50	0.00
10	QPSK	1	5	23.03	23.25	23.86	24.50	0.00
10	QPSK	6	0	23.04	23.29	23.80	24.50	0.00
10	16QAM	1	0	22.81	23.02	23.78	24.50	0.00
10	16QAM	1	5	22.76	23.07	23.65	24.50	0.00
10	16QAM	6	0	22.83	23.03	23.31	24.50	0.00
	Cha	nnel		18625	18900	19175	Tune-up limit	MPR
	Frequen	cy (MHz)		1852.5	1880	1907.5	(dBm)	(dB)
5	QPSK	1	0	22.95	23.24	23.78	24.50	0.00
5	QPSK	1	5	22.95	23.22	23.86	24.50	0.00
5	QPSK	6	0	23.13	23.28	23.85	24.50	0.00
5	16QAM	1	0	22.77	23.06	23.74	24.50	0.00
5	16QAM	1	5	22.83	23.08	23.63	24.50	0.00
5	16QAM	6	0	22.82	22.97	23.32	24.50	0.00

Report No. : FA882223

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 24 of 38



SPORTON LAB. FCC SAR Test Report

PORTON LAB. F	CC SAR Te	st Report				Repor	t No. : FA8	82223
	Cha	innel		18615	18900	19185	Tune-up	MPR
	Frequen	cy (MHz)		1851.5	1880	1908.5	limit (dBm)	(dB)
3	QPSK	1	0	23.01	23.24	23.73	24.50	0.00
3	QPSK	1	5	22.96	23.27	23.86	24.50	0.00
3	QPSK	6	0	23.14	23.26	23.85	24.50	0.00
3	16QAM	1	0	22.84	23.05	23.78	24.50	0.00
3	16QAM	1	5	22.82	23.04	23.67	24.50	0.00
3	16QAM	6	0	22.75	23.06	23.31	24.50	0.00
	Cha	innel		18607	18900	19193	Tune-up	MPR
	Frequen	cy (MHz)		1850.7	1880	1909.3	limit (dBm)	(dB)
1.4	QPSK	1	0	23.02	23.21	23.77	24.50	0.00
1.4	QPSK	1	5	22.97	23.30	23.79	24.50	0.00
1.4	QPSK	6	0	23.08	23.33	23.84	24.50	0.00
1.4	16QAM	1	0	22.77	23.08	23.71	24.50	0.00
1.4	16QAM	1	5	22.77	23.06	23.62	24.50	0.00
1.4	16QAM	6	0	22.82	23.04	23.30	24.50	0.00

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 25 of 38

<LTE Band 4>

<u> </u>								
BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit	MPR
	Cha	nnel		20050	20175	20300	(dBm)	(dB)
	Frequen	cy (MHz)		1720	1732.5	1745		
20	QPSK	1	0	23.78	23.64	23.15	24.50	0.00
20	QPSK	1	5	<mark>23.85</mark>	23.66	23.25	24.50	0.00
20	QPSK	6	0	23.82	23.68	23.38	24.50	0.00
20	16QAM	1	0	23.60	23.62	23.20	24.50	0.00
20	16QAM	1	5	23.70	23.48	23.12	24.50	0.00
20	16QAM	6	0	23.58	23.44	23.27	24.50	0.00
	Cha	nnel		20025	20175	20325	Tune-up	MPR
	Frequen	cy (MHz)		1717.5	1732.5	1747.5	limit (dBm)	(dB)
15	QPSK	1	0	23.72	23.60	23.12	24.50	0.00
15	QPSK	1	5	23.74	23.63	23.23	24.50	0.00
15	QPSK	6	0	23.82	23.67	23.30	24.50	0.00
15	16QAM	1	0	23.58	23.56	23.11	24.50	0.00
15	16QAM	1	5	23.67	23.48	23.04		0.00
15	16QAM	6	0	23.53	23.39	23.17	24.50	0.00
	Cha	nnel		20000	20175	20350	Tune-up	MPR
	Frequen	cy (MHz)		1715	1732.5	1750	limit (dBm)	(dB)
10	QPSK	1	0	23.72	23.54	23.07	24.50	0.00
10	QPSK	1	5	23.72	23.62	23.23	24.50	0.00
10	QPSK	6	0	23.79	23.60	23.35	24.50	0.00
10	16QAM	1	0	23.55	23.56	23.15	24.50	0.00
10	16QAM	1	5	23.64	23.45	23.12	24.50	0.00
10	16QAM	6	0	23.52	23.38	23.18	24.50	0.00
	Cha	nnel		19975	20175	20375	Tune-up	MPR
	Frequen	cy (MHz)		1712.5	1732.5	1752.5	limit (dBm)	(dB)
5	QPSK	1	0	23.73	23.55	23.06	24.50	0.00
5	QPSK	1	5	23.78	23.64	23.18	24.50	0.00
5	QPSK	6	0	23.84	23.61	23.37	24.50	0.00
5	16QAM	1	0	23.52	23.61	23.18	24.50	0.00
5	16QAM	1	5	23.69	23.40	23.04	24.50	0.00
5	16QAM	6	0	23.51	23.43	23.17	24.50	0.00

Report No. : FA882223

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 26 of 38



SPORTON LAB. FCC SAR Test Report

PORTON LAB. F	CC SAR Te	st Report				Repor	t No. : FA8	82223
	Cha	nnel		19965	20175	20385	Tune-up	MPR
	Frequen	cy (MHz)		1711.5	1732.5	1753.5	limit (dBm)	(dB)
3	QPSK	1	0	23.69	23.56	23.07	24.50	0.00
3	QPSK	1	5	23.81	23.63	23.15	24.50	0.00
3	QPSK	6	0	23.78	23.62	23.35	24.50	0.00
3	16QAM	1	0	23.52	23.60	23.18	24.50	0.00
3	16QAM	1	5	23.69	23.46	23.03	24.50	0.00
3	16QAM	6	0	23.53	23.38	23.21	24.50	0.00
	Cha	nnel		19957	20175	20393	Tune-up limit	MPR
	Frequen	cy (MHz)		1710.7	1732.5	1754.3	(dBm)	(dB)
1.4	QPSK	1	0	23.78	23.56	23.09	24.50	0.00
1.4	QPSK	1	5	23.72	23.59	23.22	24.50	0.00
1.4	QPSK	6	0	23.77	23.68	23.33	24.50	0.00
1.4	16QAM	1	0	23.50	23.61	23.20	24.50	0.00
1.4	16QAM	1	5	23.67	23.39	23.08	24.50	0.00
1.4	16QAM	6	0	23.51	23.42	23.17	24.50	0.00

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 27 of 38

<LTE Band 12>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune-up limit	MPR
	Cha	nnel		23060	23095	23130	(dBm)	(dB)
	Frequen	cy (MHz)		704	707.5	711		
10	QPSK	1	0	24.01	24.07	24.01	24.50	0.00
10	QPSK	1	5	24.04	24.03	23.98	24.50	0.00
10	QPSK	6	0	23.16	23.18	23.15	24.50	0.00
10	16QAM	1	0	24.01	23.95	23.91	24.50	0.00
10	16QAM	1	5	23.92	24.05	23.95	24.50	0.00
10	16QAM	6	0	23.87	23.89	23.94	24.50	0.00
	Cha	nnel		23035	23095	23155	Tune-up	MPR
	Frequen	cy (MHz)		701.5	707.5	713.5	limit (dBm)	(dB)
5	QPSK	1	0	23.99	23.99	23.97	24.50	0.00
5	QPSK	1	5	24.00	23.96	23.94	24.50	0.00
5	QPSK	6	0	23.15	23.17	23.11	24.50	0.00
5	16QAM	1	0	23.91	23.87	23.90	24.50	0.00
5	16QAM	1	5	23.86	24.03	23.94	24.50	0.00
5	16QAM	6	0	23.80	23.86	23.88	24.50	0.00
	Cha	nnel		23025	23095	23165	Tune-up	MPR
	Frequen	cy (MHz)		700.5	707.5	714.5	limit (dBm)	(dB)
3	QPSK	1	0	23.96	24.02	24.01	24.50	0.00
3	QPSK	1	5	24.01	23.96	23.91	24.50	0.00
3	QPSK	6	0	23.14	23.13	23.09	24.50	0.00
3	16QAM	1	0	23.94	23.95	23.85	24.50	0.00
3	16QAM	1	5	23.89	23.97	23.88	24.50	0.00
3	16QAM	6	0	23.85	23.82	23.84	24.50	0.00
	Cha	nnel		23017	23095	23173	Tune-up limit	MPR
	Frequen	cy (MHz)		699.7	707.5	715.3	(dBm)	(dB)
1.4	QPSK	1	0	24.00	23.97	24.01	24.50	0.00
1.4	QPSK	1	5	23.94	24.02	23.89	24.50	0.00
1.4	QPSK	6	0	23.11	23.17	23.15	24.50	0.00
1.4	16QAM	1	0	23.95	23.95	23.91	24.50	0.00
1.4	16QAM	1	5	23.86	23.95	23.91	24.50	0.00
1.4	16QAM	6	0	23.82	23.85	23.85	24.50	0.00

Report No. : FA882223

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 28 of 38

<WLAN Conducted Power>

General Note:

1. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.

Report No.: FA882223

- 2. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
- 3. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
- 4. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.18 The initial test position procedure is described in the following:
 - a. When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
 - b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
 - c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

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<2.4GHz WLAN>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	
		1	2412	14.63	15.00		
	802.11b 1Mbps	6	2437	14.83	15.00	97.61	
2.4GHz WLAN		11	2462	<mark>15.12</mark>	15.50		
2.4GHZ WLAN		1	2412	13.16	13.50		
	802.11g 6Mbps	6	2437	13.39	13.50	87.16	
		11	2462	13.68	14.00		
		1	2412	11.58	12.00		
	802.11n-HT20 MCS0	6	2437	11.71	12.00	86.32	
		11	2462	11.96	12.50		

Report No. : FA882223

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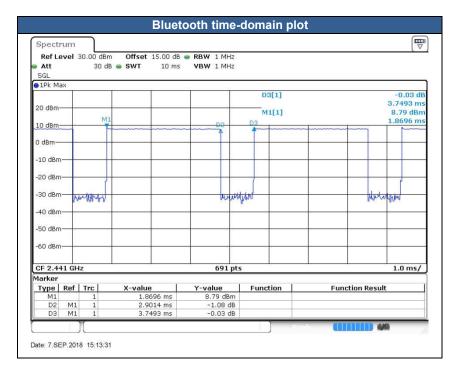
Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 30 of 38

<2.4GHz Bluetooth>

General Note:

- For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power. 1.
- The Bluetooth duty cycle is 77.39 % as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR 2. scaling need further consideration and the theoretical duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation

Report No.: FA882223



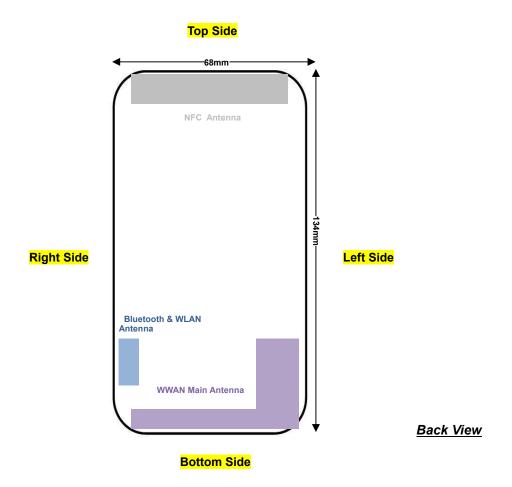
Mode	Channel	Frequency	Average power (dBm)				
iviode	Chamle	(MHz)	1Mbps				
BR/EDR	CH 00	2402	8.99				
	CH 39	2441	9.16				
	CH 78	2480	<mark>9.21</mark>				
	Tune-up limit (dBm)	9.50					

Mode	Channel	Frequency (MHz)	Average power (dBm) GFSK			
	CH 00	2402	7.01			
LE	CH 19	2440	<mark>7.11</mark>			
	CH 39	2480	7.10			
	Tune-up Limit		7.50			

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Issued Date: Dec. 06, 2018 Form version.: 180516 FCC ID: V5P-D2204GMA Page 31 of 38

13. Antenna Location



Report No.: FA882223

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 32 of 38

14. SAR Test Results

General Note:

- 1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.

Report No. : FA882223

- b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
- c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
- d. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
- 2. Per KDB 447498 D01v06, for each exposure position, 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
- Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.

LTE Note:

- 1. Per KDB 941225 D05v02r05, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
- 2. Per KDB 941225 D05v02r05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
- 3. Per KDB 941225 D05v02r05, for QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.
- 4. Per KDB 941225 D05v02r05, 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, 16QAM SAR testing is not required.
- 5. Per KDB 941225 D05v02r05, smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r05, smaller bandwidth SAR testing is not required.
- 6. For LTE B4 / B12 the maximum bandwidth does not support three non-overlapping channels, per KDB 941225 D05v02r05, 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.

WLAN Note:

- 1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
- 2. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is ≤ 0.8 W/kg or all required test position are tested.
- 3. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
- 4. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

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 Issued Date: Dec. 06, 2018

FCC ID : V5P-D2204GMA Page 33 of 38 Form version. : 180516

14.1 Body SAR

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB Offset	Test Position	Gap (mm)	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)
	LTE Band 12	10M	QPSK	1	0	Front	0	23095	707.5	24.07	24.5	1.104	0.06	0.076	0.084
	LTE Band 12	10M	QPSK	1	0	Back	0	23095	707.5	24.07	24.5	1.104	80.0	0.070	0.077
01	LTE Band 12	10M	QPSK	6	0	Front	0	23095	707.5	23.18	24.5	1.355	-0.06	0.074	<mark>0.100</mark>
	LTE Band 12	10M	QPSK	6	0	Back	0	23095	707.5	23.18	24.5	1.355	0.04	0.069	0.094
	LTE Band 4	20M	QPSK	1	5	Front	0	20175	1732.5	23.66	24.5	1.213	0.02	0.106	0.129
02	LTE Band 4	20M	QPSK	1	5	Back	0	20175	1732.5	23.66	24.5	1.213	0.07	0.426	<mark>0.517</mark>
	LTE Band 4	20M	QPSK	6	0	Front	0	20175	1732.5	23.68	24.5	1.208	-0.02	0.108	0.130
	LTE Band 4	20M	QPSK	6	0	Back	0	20175	1732.5	23.68	24.5	1.208	0.04	0.412	0.498
	LTE Band 2	20M	QPSK	1	5	Front	0	19100	1900	23.88	24.5	1.153	0.09	0.069	0.080
	LTE Band 2	20M	QPSK	1	5	Back	0	19100	1900	23.88	24.5	1.153	0.03	0.404	0.466
03	LTE Band 2	20M	QPSK	1	5	Back	0	18700	1860	23.04	24.5	1.400	0.03	0.451	0.631
	LTE Band 2	20M	QPSK	1	5	Back	0	18900	1880	23.30	24.5	1.318	80.0	0.444	0.585
	LTE Band 2	20M	QPSK	6	0	Front	0	19100	1900	23.87	24.5	1.156	0.06	0.100	0.116
	LTE Band 2	20M	QPSK	6	0	Back	0	19100	1900	23.87	24.5	1.156	0.08	0.413	0.477
	LTE Band 2	20M	QPSK	6	0	Back	0	18700	1860	23.14	24.5	1.368	0.04	0.442	0.605
	LTE Band 2	20M	QPSK	6	0	Back	0	18900	1880	23.34	24.5	1.306	0.06	0.445	0.581

Report No. : FA882223

<WLAN2.4G SAR>

PI N	Bann	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Power	Tune-Up Limit (dBm)	Tune-up Scaling Factor		LVCIA	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GI	lz 802.11b 1Mbps	Front	0	11	2462	15.12	15.50	1.090	97.61	1.024	0.07	0.033	0.037
	WLAN2.4GI	lz 802.11b 1Mbps	Back	0	11	2462	15.12	15.50	1.090	97.61	1.024	-0.04	0.133	0.148
0	4 WLAN2.4GI	lz 802.11b 1Mbps	Back	0	1	2412	14.63	15.00	1.088	97.61	1.024	0.03	0.159	0.177
	WLAN2.4GI	lz 802.11b 1Mbps	Back	0	6	2437	14.83	15.00	1.039	97.61	1.024	0.03	0.163	0.173

<Bluetooth SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor		Duty Cycle Scaling Factor	Drift	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Bluetooth	1Mbps	Front	0	78	2480	9.21	9.5	1.068	77.39	1.076	0.07	0.002	0.002
	Bluetooth	1Mbps	Back	0	78	2480	9.21	9.5	1.068	77.39	1.076	0.09	0.028	0.032
05	Bluetooth	1Mbps	Back	0	0	2402	8.99	9.5	1.124	77.39	1.076	0.05	0.055	0.067
	Bluetooth	1Mbps	Back	0	39	2441	9.16	9.5	1.081	77.39	1.076	0.11	0.046	0.053

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FCC ID : V5P-D2204GMA Page 34 of 38 Form version. : 180516

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
1.	LTE + WLAN2.4GHz	Yes
2.	LTE + Bluetooth	Yes

Report No.: FA882223

General Note:

- WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
- The reported SAR summation is calculated based on the same configuration and test position. 2.
- Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - i) Scalar SAR summation < 1.6W/kg and 10g Scalar SAR summation < 4.0W/kg.
 - ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
 - iii) If SPLSR \leq 0.04 for 1g SAR, SPLSR \leq 0.10 for 10g SAR simultaneously transmission SAR measurement is not necessary.
 - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

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Issued Date: Dec. 06, 2018 Form version.: 180516 FCC ID: V5P-D2204GMA Page 35 of 38



15.1 Body Exposure Conditions

			1	2	3	1+2	1+3
WWAN Band		Exposure Position	WWAN	2.4GHz WLAN	Bluetooth	Summed 1g SAR	Summed 1g SAR
		rockion	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	(W/kg)	(W/kg)
	Band 12	Front	0.100	0.037	0.002	0.14	0.10
		Back	0.094	0.177	0.067	0.27	0.16
LTE	Band 4	Front	0.130	0.037	0.002	0.17	0.13
LIE	Danu 4	Back	0.517	0.177	0.067	0.69	0.58
	D 1 O	Front	0.116	0.037	0.002	0.15	0.12
	Band 2	Back	0.631	0.177	0.067	<mark>0.81</mark>	<mark>0.70</mark>

Report No. : FA882223

Test Engineer: Johnny Chen

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date : Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page 36 of 38

16. <u>Uncertainty Assessment</u>

Per KDB 865664 D01 SAR measurement 100MHz to 6GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be \leq 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. For this device, the highest measured 1-g SAR is less 1.5W/kg and highest measured 10-g SAR is less 3.75W/kg. Therefore, the measurement uncertainty table is not required in this report.

Report No. : FA882223

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version.: 180516 FCC ID: V5P-D2204GMA Page 37 of 38

17. References

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

Report No. : FA882223

- [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
- [3] IEEE Std. 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", Sep 2013
- [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 941225 D05 v02r05, "SAR Evaluation Considerations for LTE Devices", Dec 2015
- [8] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [9] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.

Appendix A. Plots of System Performance Check

Report No.: FA882223

The plots are shown as follows.

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System Check_Body_750MHz_181011

DUT: D750V3-SN:1099

Communication System: UID 0, CW (0); Frequency: 750 MHz; Duty Cycle: 1:1 Medium: MSL_750_181011 Medium parameters used: f = 750 MHz; $\sigma = 0.97$ S/m; $\epsilon_r = 54.642$; $\rho = 1000$ kg/m³

Date: 2018.10.11

Ambient Temperature: 23.4 °C; Liquid Temperature: 22.8 °C

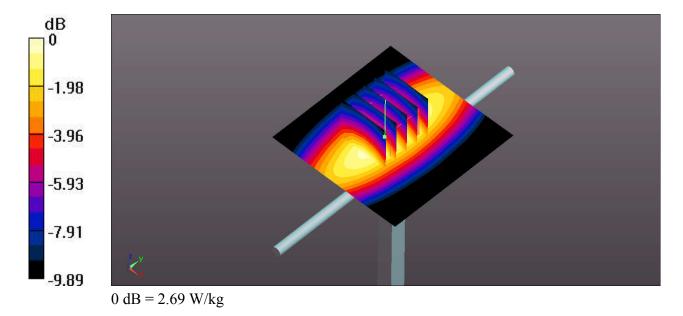
DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(9.7, 9.7, 9.7); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=15mm, dy=15mm Maximum value of SAR (interpolated) = 2.67 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm Reference Value = 53.76 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.10 W/kg SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.45 W/kg

Maximum value of SAR (measured) = 1.45 W/kg



System Check_Body_1750MHz_181011

DUT: D1750V2-SN:1137

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: MSL 1750 181011 Medium parameters used: f = 1750 MHz; $\sigma = 1.527$ S/m; $\varepsilon_r = 52.039$;

Date: 2018.10.11

 $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.4 °C; Liquid Temperature: 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(7.93, 7.93, 7.93); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=15mm, dy=15mm Maximum value of SAR (interpolated) = 12.9 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm Reference Value = 91.54 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 15.3 W/kg SAR(1 g) = 8.89 W/kg; SAR(10 g) = 4.77 W/kg Maximum value of SAR (measured) = 12.5 W/kg

-3.18 -6.37 -9.55 -12.74 -15.92 0 dB = 12.5 W/kg

System Check_Body_1900MHz_181011

DUT: D1900V2-SN:5d182

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL 1900 181011 Medium parameters used: f = 1900 MHz; $\sigma = 1.578$ S/m; $\varepsilon_r = 54.205$;

Date: 2018.10.11

 $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.4 °C; Liquid Temperature: 22.4 °C

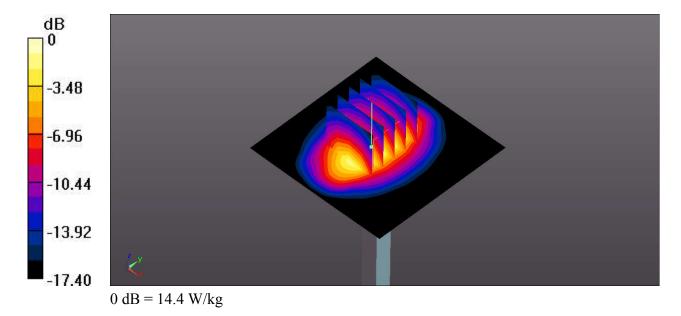
DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(7.69, 7.69, 7.69); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=15mm, dy=15mm Maximum value of SAR (interpolated) = 14.5 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm Reference Value = 85.32 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 18.6 W/kg SAR(1 g) = 10 W/kg; SAR(10 g) = 5.16 W/kg

Maximum value of SAR (measured) = 14.4 W/kg



System Check_Body_2450MHz_181012

DUT: D2450V2-SN:924

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL 2450 181012 Medium parameters used: f = 2450 MHz; $\sigma = 2.001$ S/m; $\varepsilon_r = 52.089$;

Date: 2018.10.12

 $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.4 °C

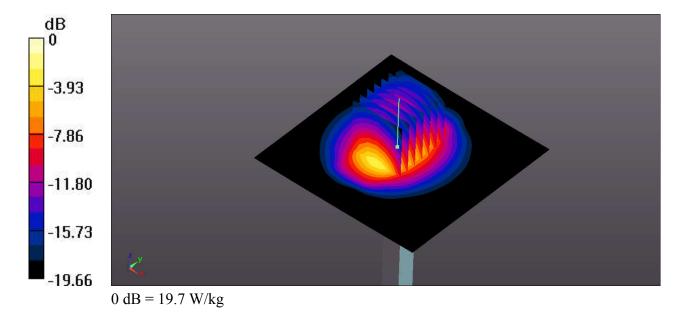
DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(7.46, 7.46, 7.46); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=12mm, dy=12mm Maximum value of SAR (interpolated) = 19.9 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 85.56 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 26.5 W/kg SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.87 W/kg

SAR(10 g) = 12.8 W/kg; SAR(10 g) = 5.87 W/kg Maximum value of SAR (measured) = 19.7 W/kg



Appendix B. Plots of High SAR Measurement

Report No.: FA882223

The plots are shown as follows.

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FCC ID: V5P-D2204GMA Page B1 of B1 Form version.: 180516

Communication System: UID 0, LTE (0); Frequency: 707.5 MHz; Duty Cycle: 1:1

Medium: MSL 750 181011 Medium parameters used: f = 707.5 MHz; $\sigma = 0.941$ S/m; $\varepsilon_r = 55.606$;

Date: 2018.10.11

 $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.4 °C; Liquid Temperature: 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(9.7, 9.7, 9.7); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch23095/Area Scan (61x111x1): Interpolated grid: dx=15mm, dy=15mm Maximum value of SAR (interpolated) = 0.0942 W/kg

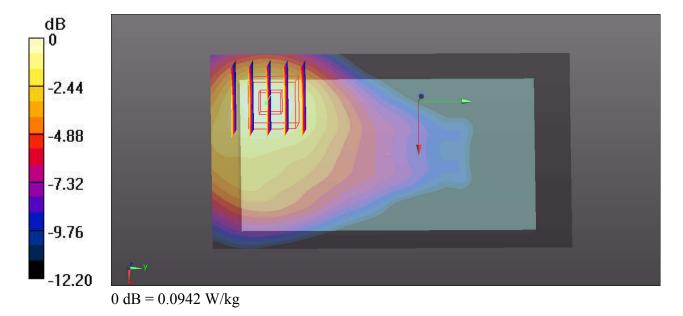
Ch23095/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 0.9910 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.124 W/kg

SAR(1 g) = 0.074 W/kg; SAR(10 g) = 0.046 W/kg

Maximum value of SAR (measured) = 0.0995 W/kg



02 LTE Band 4 20M QPSK 1RB 5Offset Back 0mm Ch20175

Communication System: UID 0, LTE (0); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: MSL_1750_181011 Medium parameters used: f = 1732.5 MHz; $\sigma = 1.507$ S/m; $\varepsilon_r =$

Date: 2018.10.11

52.114; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.4 °C; Liquid Temperature: 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(7.93, 7.93, 7.93); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

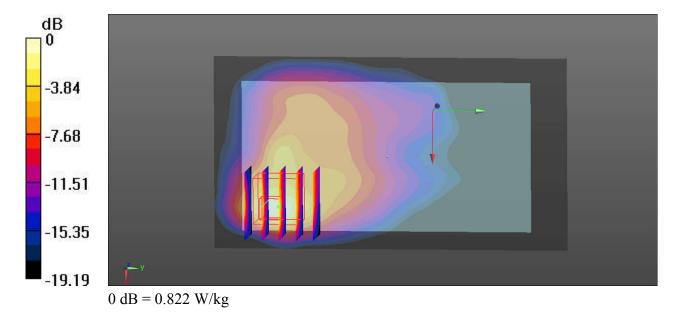
Ch20175/Area Scan (61x111x1): Interpolated grid: dx=15mm, dy=15mm Maximum value of SAR (interpolated) = 0.822 W/kg

Ch20175/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm Reference Value = 0.8640 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.940 W/kg

SAR(1 g) = 0.426 W/kg; SAR(10 g) = 0.204 W/kg

Maximum value of SAR (measured) = 0.691 W/kg



03 LTE Band 2 20M QPSK 1RB 5Offset Back 0mm Ch18700

Communication System: UID 0, LTE (0); Frequency: 1860 MHz; Duty Cycle: 1:1

Medium: MSL_1900_181011 Medium parameters used: f = 1860 MHz; $\sigma = 1.534$ S/m; $\varepsilon_r = 54.351$;

Date: 2018.10.11

 $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.4 °C; Liquid Temperature: 22.4 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(7.69, 7.69, 7.69); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

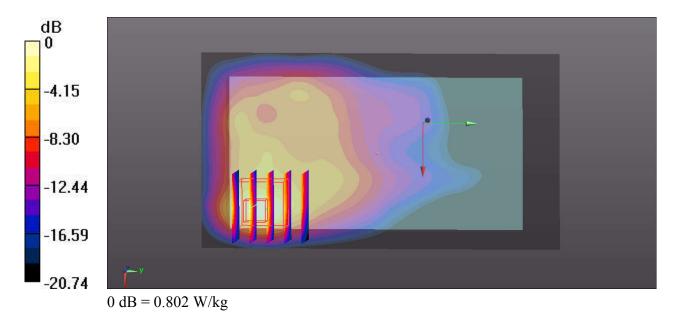
Ch18700/Area Scan (61x111x1): Interpolated grid: dx=15mm, dy=15mm Maximum value of SAR (interpolated) = 0.802 W/kg

Ch18700/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm Reference Value = 0.8890 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.961 W/kg

SAR(1 g) = 0.451 W/kg; SAR(10 g) = 0.200 W/kg

Maximum value of SAR (measured) = 0.772 W/kg



04_WLAN2.4GHz_802.11b 1Mbps_Back_0mm_Ch1

Communication System: UID 0, WIFI (0); Frequency: 2412 MHz; Duty Cycle: 1:1.024

Medium: MSL 2450 181012 Medium parameters used: f = 2412 MHz; $\sigma = 1.954$ S/m; $\varepsilon_r = 52.252$;

Date: 2018.10.12

 $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.4 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(7.46, 7.46, 7.46); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1/Area Scan (81x141x1): Interpolated grid: dx=12mm, dy=12mm Maximum value of SAR (interpolated) = 0.362 W/kg

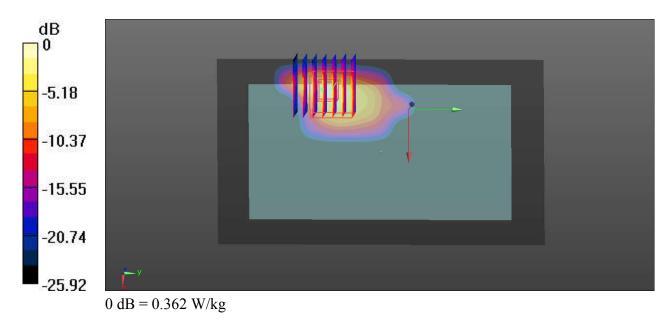
Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0.7190 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.503 W/kg

SAR(1 g) = 0.159 W/kg; SAR(10 g) = 0.061 W/kg

Maximum value of SAR (measured) = 0.292 W/kg



05_Bluetooth_DH5 1Mbps_Back_0mm_Ch0

Communication System: UID 0, Bluetooth (0); Frequency: 2402 MHz; Duty Cycle: 1:1.292

Medium: MSL_2450_181012 Medium parameters used: f = 2402 MHz; $\sigma = 1.942$ S/m; $\varepsilon_r = 52.292$;

Date: 2018.10.12

 $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.4 °C

DASY5 Configuration:

- Probe: EX3DV4 SN3819; ConvF(7.46, 7.46, 7.46); Calibrated: 2018.01.31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2017.12.19
- Phantom: SAM3; Type: QDOVA002AA; Serial: TP:1149
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

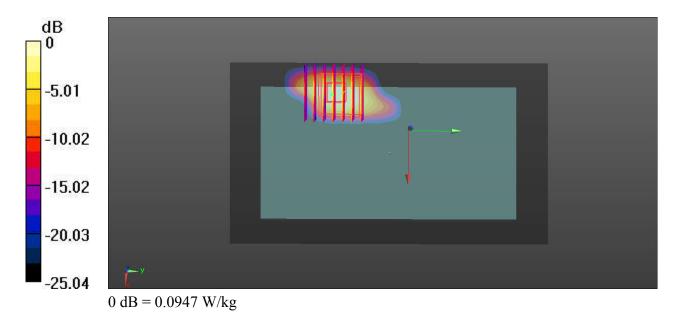
Ch0/Area Scan (81x141x1): Interpolated grid: dx=12mm, dy=12mm Maximum value of SAR (interpolated) = 0.183 W/kg

Ch0/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 0.5940 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.173 W/kg

SAR(1 g) = 0.055 W/kg; SAR(10 g) = 0.022 W/kg

Maximum value of SAR (measured) = 0.0947 W/kg



Appendix C. **DASY Calibration Certificate**

Report No.: FA882223

The DASY calibration certificates are shown as follows.

Sporton International (Shenzhen) Inc.

TEL: +86-755-8637-9589 / FAX: +86-755-8637-9595

Issued Date: Dec. 06, 2018 Form version. : 180516 FCC ID: V5P-D2204GMA Page C1 of C1



In Collaboration with

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Fax: +86-10-62304633-2504

Tel: +86-10-62304633-2079 http://www.chinattl.cn E-mail: cttl@chinattl.com

Client

Sporton





CALIBRATION **CNAS L0570**

Certificate No:

Z17-97246

<u>Gaeibration Gertificatie</u>

Object

D750V3 - SN: 1099

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

December 4, 2017

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
		Mar-18
		Mar-18
		Jan-18
SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
ID#	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18
	ID# MY49071430	102196 02-Mar-17 (CTTL, No.J17X01254) 100596 02-Mar-17 (CTTL, No.J17X01254) SN 3617 23-Jan-17 (SPEAG,No.EX3-3617_Jan17) SN 536 09-Oct-17 (CTTL-SPEAG,No.Z17-97198) ID# Cal Date (Calibrated by, Certificate No.) MY49071430 13-Jan-17 (CTTL, No.J17X00286)

Name

Function

Calibrated by:

Zhao Jing

SAR Test Engineer

Reviewed by:

Lin Hao

SAR Test Engineer

Approved by:

Qi Dianyuan

SAR Project Leader

Issued: December 8, 2017

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: Z17-97246

Page 1 of 8

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Fax: +86-10-62304633-2504 Tel: +86-10-62304633-2079 http://www.chinattl.cn E-mail: cttl@chinattl.com

Glossary:

TSL ConvF tissue simulating liquid

sensitivity in TSL / NORMx,y,z

not applicable or not measured N/A

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

Certificate No: Z17-97246

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

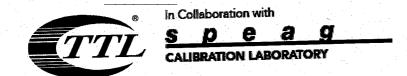
- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.

Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.

SAR measured: SAR measured at the stated antenna input power.

- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.



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Measurement Conditions

nfiguration, as far as not given on page 1.

ASY system configuration, as fair as DASY Version	DASY52	52.10.0.1446	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	15 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	750 MHz ± 1 MHz		

Head TSL parameters

he following parameters and calculations were	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.4 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

result with Head TSL

R result with Head ISL		
SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.10 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	8.33 mW /g ± 18.8 % (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.39 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	5.53 mW /g ± 18.7 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

he following parameters and calculations were	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.2 ± 6 %	0.94 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C		

ult with Body TSI

	T"
Condition	
250 mW input power	2.12 mW / g
normalized to 1W	8.64 mW /g ± 18.8 % (k=2)
Condition	
250 mW input power	1.41 mW / g
normalized to 1W	5.72 mW /g ±18.7 % (k=2)
	250 mW input power normalized to 1W Condition 250 mW input power

Certificate No: Z17-97246

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Fax: +86-10-62304633-2504 Tel: +86-10-62304633-2079

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

and the state of t	·	
Impedance, transformed to feed point		51.4Ω- 4.24jΩ
		- 27.1dB
Return Loss		

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.4Ω- 3.51jΩ
Return Loss	- 28.1dB

General Antenna Parameters and Design

[The third Delay (one direction)	0.900 ns
	Electrical Delay (one direction)	
L		

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

. [Manufactured by		SPEAG
Ì	Manufactured by	<u> </u>	

DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1099

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 750 MHz; $\sigma = 0.896$ S/m; $\epsilon_r = 41.36$; $\rho = 1000$ kg/m³

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

Probe: EX3DV4 - SN3617; ConvF(10.05, 10.05, 10.05); Calibrated: 1/23/2017;

Date: 12.04.2017

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm,

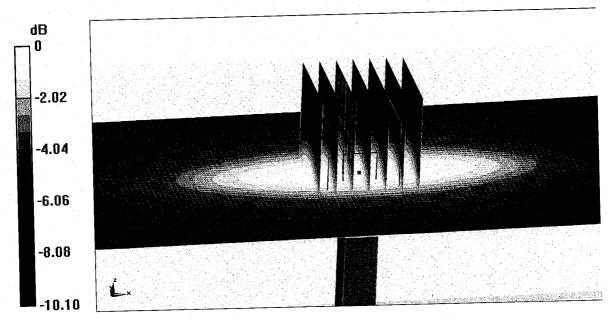
dy=5mm, dz=5mm

Reference Value = 55.18 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.20 W/kg

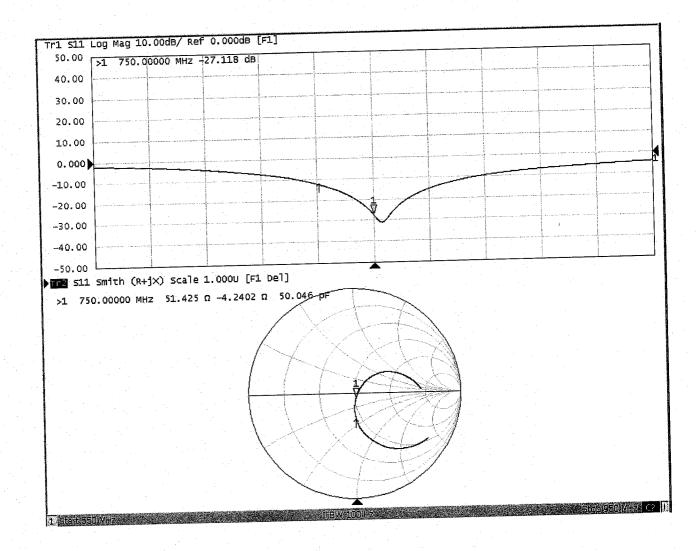
SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.39 W/kg

Maximum value of SAR (measured) = 2.82 W/kg

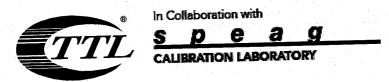


0 dB = 2.82 W/kg = 4.50 dBW/kg

Impedance Measurement Plot for Head TSL



Certificate No: Z17-97246



DASY5 Validation Report for Body TSL

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1099

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 750 MHz; $\sigma = 0.936$ S/m; $\epsilon_r = 55.23$; $\rho = 1000$ kg/m³

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

Probe: EX3DV4 - SN3617; ConvF(9.8, 9.8, 9.8); Calibrated: 1/23/2017;

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE3 Sn536; Calibrated: 10/9/2017

• Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1

 Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Date: 12.04.2017

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm,

dy=5mm, dz=5mm

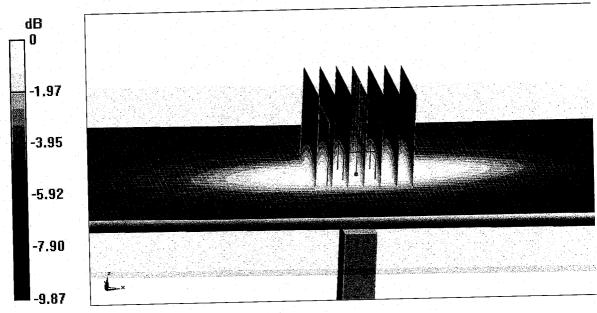
Certificate No: Z17-97246

Reference Value = 53.78 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.12 W/kg

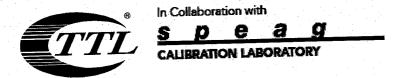
SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.41 W/kg

Maximum value of SAR (measured) = 2.79 W/kg

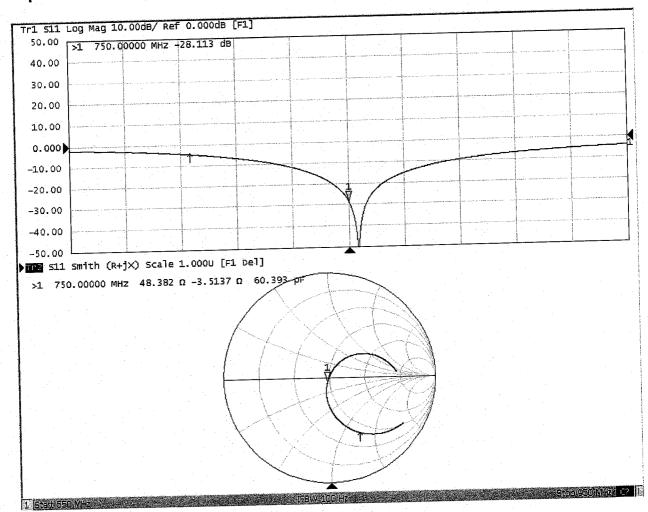


0 dB = 2.79 W/kg = 4.46 dBW/kg

Page 7 of 8



Impedance Measurement Plot for Body TSL



Certificate No: Z17-97246