

SAR Test Report

Report No. : SFBFLF-WTW-P21010278 R1

Applicant : ASUSTeK COMPUTER INC.

Address : 1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan

Product : EXP21 Smartphone

FCC ID : MSQI007D

Brand : ASUS

Model No. : ASUS_I007D

Standards : FCC 47 CFR Part 2 (2.1093), IEEE C95.1:1992, IEEE Std 1528:2013
KDB 865664 D01 v01r04, KDB 865664 D02 v01r02, KDB 248227 D01 v02r02,
KDB 447498 D01 v06, KDB 648474 D04 v01r03, KDB 941225 D01 v03r01,
KDB 941225 D05 v02r05, KDB 941225 D05A v01r02, KDB 941225 D06 v02r01

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CERTIFICATION: The above equipment have been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch-Lin Kou Laboratories**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by TAF or any government agencies.

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Release Control Record

Report No.	Reason for Change	Date Issued
SFBFLF-WTW-P21010278	Initial release	Apr. 27, 2021
SFBFLF-WTW-P21010278 R1	Revise Frequency of 5G NR n78 on page 4	Aug. 02, 2021

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1. Summary of Maximum SAR Value

Equipment Class	Mode	Highest SAR _{1g} Head (W/kg)	Highest SAR _{1g} Body-worn Tested at 15 mm (W/kg)	Highest SAR _{1g} Hotspot Tested at 10 mm (W/kg)	Highest SAR _{10g} Phablet Tested at 0 mm (W/kg)
PCE	GSM850	0.39	0.37	0.65	N/A
	GSM1900	0.06	0.25	0.36	N/A
	WCDMA II	0.97	0.43	0.83	N/A
	WCDMA IV	0.85	0.43	0.96	N/A
	WCDMA V	0.96	0.25	0.50	N/A
	CDMA BC0	0.23	0.27	0.49	N/A
	CDMA BC1	0.15	0.38	0.73	N/A
	CDMA BC10	0.20	0.23	0.43	N/A
	LTE 2	0.98	0.48	0.96	1.74
	LTE 4	0.94	0.37	0.91	N/A
	LTE 5	0.90	0.26	0.29	N/A
	LTE 7	0.91	0.53	1.00	2.42
	LTE 12	0.53	0.16	0.33	N/A
	LTE 13	0.84	0.12	0.22	N/A
	LTE 14	0.62	0.23	0.43	N/A
	LTE 17	0.69	0.15	0.29	N/A
	LTE 25	0.89	0.46	0.66	N/A
	LTE 26	0.85	0.31	0.52	N/A
	LTE 30	0.98	0.64	0.98	1.72
	LTE 38	0.50	0.31	0.75	N/A
	LTE 40	0.79	0.23	0.79	N/A
	LTE 41	0.70	0.31	0.96	N/A
	LTE 42	0.85	0.42	0.79	2.39
	LTE 43	0.70	0.37	0.99	2.46
	LTE 66	1.00	0.36	0.99	1.72
	LTE 71	0.57	0.21	0.21	N/A
	5G NR-n2	0.99	0.30	0.99	N/A
	5G NR-n5	0.98	0.22	0.45	N/A
	5G NR-n7	0.99	0.54	0.97	2.21
	5G NR-n12	0.73	0.16	0.29	N/A
	5G NR-n13	0.05	0.13	0.24	N/A
	5G NR-n14	0.65	0.20	0.44	N/A
	5G NR-n25	1.00	0.32	1.00	1.50
	5G NR-n26	0.08	0.10	0.19	N/A
	5G NR-n30	0.12	0.23	0.55	N/A
	5G NR-n38	0.98	0.48	0.97	2.41
	5G NR-n41	0.94	0.45	0.91	1.13
	5G NR-n66	1.00	0.33	0.97	N/A
	5G NR-n71	0.65	0.19	0.40	N/A
	5G NR-n77	0.99	0.57	0.95	2.49
	5G NR-n78	0.96	0.46	0.87	2.07
CBE	LTE 48	0.83	0.40	0.99	2.38
DTS	2.4G WLAN	1.19	0.35	0.53	N/A
NII	5.2G WLAN	N/A	N/A	0.34	N/A
	5.3G WLAN	1.18	0.48	N/A	2.28
	5.6G WLAN	1.17	0.61	N/A	2.70
	5.8G WLAN	1.14	0.68	0.35	N/A
DSS	Bluetooth	0.16	0.17	0.17	N/A

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Highest Simultaneous Transmission SAR	Highest SAR _{1g} Head (W/kg)	Highest SAR _{1g} Body-worn Tested at 15 mm (W/kg)	Highest SAR _{1g} Hotspot Tested at 10 mm (W/kg)	Highest SAR _{10g} Phablet Tested at 0 mm (W/kg)
	1.58	1.36	1.38	3.98

Note:

- The SAR criteria (**Head & Body: SAR-1g 1.6 W/kg, and Extremity: SAR-10g 4.0 W/kg**) for general population/uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.

Highest WIFI6E Value										
Band & Mode	Tx Frequency MHz	SAR			APD			PD		
		1g Head (W/kg)	1g Body-worn (W/kg)	10g Phablet (W/kg)	Head (W/m ²)	Body-worn (W/m ²)	Phablet (W/m ²)	Head (W/m ²)	Body-worn (W/m ²)	Phablet (W/m ²)
WIFI6E	5925-7125	0.31	0.07	0.39	1.91	0.528	9.42	3.167	2.009	5.180

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2. Description of Equipment Under Test

EUT Type	EXP21 Smartphone
FCC ID	MSQI007D
Brand Name	ASUS
Model Name	ASUS_I007D
Tx Frequency Bands (Unit: MHz)	GSM850 : 824.2 ~ 848.8 GSM1900 : 1850.2 ~ 1909.8 WCDMA Band II : 1852.4 ~ 1907.6 WCDMA Band IV : 1712.4 ~ 1752.6 WCDMA Band V : 826.4 ~ 846.6 CDMA BC0 : 824.7 ~ 848.31 CDMA BC1 : 1851.25 ~ 1908.75 CDMA BC10 : 817.9 ~ 823.1 LTE Band 2 : 1850.7 ~ 1909.3 LTE Band 4 : 1710.7 ~ 1754.3 LTE Band 5 : 824.7 ~ 848.3 LTE Band 7 : 2502.5 ~ 2567.5 LTE Band 12 : 699.7 ~ 715.3 LTE Band 13 : 779.5 ~ 784.5 LTE Band 14 : 790.5 ~ 795.5 LTE Band 17 : 706.5 ~ 713.5 LTE Band 25 : 1850.7 ~ 1914.3 LTE Band 26 : 814.7 ~ 848.3 LTE Band 30 : 2307.5 ~ 2312.5 LTE Band 38 : 2572.5 ~ 2617.5 LTE Band 40 : 2302.5 ~ 2397.5 LTE Band 41 : 2498.5 ~ 2687.5 LTE Band 42 : 3552.5 ~ 3597.5 LTE Band 43 : 3652.5 ~ 3672.5 LTE Band 48 : 3552.5 ~ 3697.5 LTE Band 66 : 1710.7 ~ 1779.3 LTE Band 71 : 665.5 ~ 695.5 5G NR n2 : 1852.5 ~ 1907.5 5G NR n5 : 826.5 ~ 846.5 5G NR n7 : 2502.5 ~ 2567.5 5G NR n12 : 701.5 ~ 713.5 5G NR n14 : 790.5 ~ 795.5 5G NR n25 : 1852.5 ~ 1912.5 5G NR n26 : 816.5 ~ 846.5 5G NR n30 : 2307.5 ~ 2312.5 5G NR n38 : 2572.5 ~ 2617.5 5G NR n41 : 2506.02 ~ 2679.99 5G NR n66 : 1712.5 ~ 1777.5 5G NR n71 : 665.5 ~ 695.5 5G NR n77 : 3710.01 ~ 3969.99 5G NR n78 : 3700 ~ 3800 5G NR n258 : 24250 ~ 27500 5G NR n260 : 37000 ~ 40000 5G NR n261 : 27500 ~ 28350 WLAN : 2412 ~ 2462, 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5720, 5745 ~ 5825, WIFI6E : 5925 - 6425, 6425 ~ 6525, 6525 ~ 6875, 6875 ~ 7125 Bluetooth : 2402 ~ 2480

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Uplink Modulations	WCDMA : QPSK 5G NR / LTE : QPSK, 16QAM, 64QAM, 256QAM 802.11b : DSSS 802.11a/g/n/ac : OFDM 802.11ax : OFDMA Bluetooth : GFSK, $\pi/4$ -DQPSK, 8DPSK
5G NR FR1 SCS	15 / 30 kHz
SA mode only	5G NR-n13 / n26
EN-DC Uplink Combinations	LTE 5/12/13/14/30/66 + 5G NR-n2 LTE 2/7/12/13/30/48/66 + 5G NR-n5 LTE 5/12/13/66 + 5G NR-n7 LTE 2/66 + 5G NR-n12 LTE 2 + 5G NR-n14 LTE 12/66 + 5G NR-n25 LTE 2/5/66 + 5G NR-n30 LTE 2/4/5/12/66/71 + 5G NR-n38 LTE 2/4/12/25/26/40/66 + 5G NR-n41 LTE 2/5/7/12/13/14/30/48/71 + 5G NR-n66 LTE 2/5/7/13/66 + 5G NR-n71 LTE 7/40/41 + 5G NR-n77 LTE 2/4/5/7/12/13/38/40/66/71 + 5G NR-n78
Maximum Tune-up Conducted Power (Unit: dBm)	Please refer to section 4.6.1 of this report
Antenna Type	PIFA Antenna
EUT Stage	Engineering Sample

Note:

- The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

3. SAR Measurement System

3.1 Definition of Specific Absorption Rate (SAR)

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.

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:

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

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

SAR measurement can be related to the electrical field in the tissue by

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

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

3.2 SPEAG DASY6 System

DASY6 system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY6 software defined. The DASY6 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC.

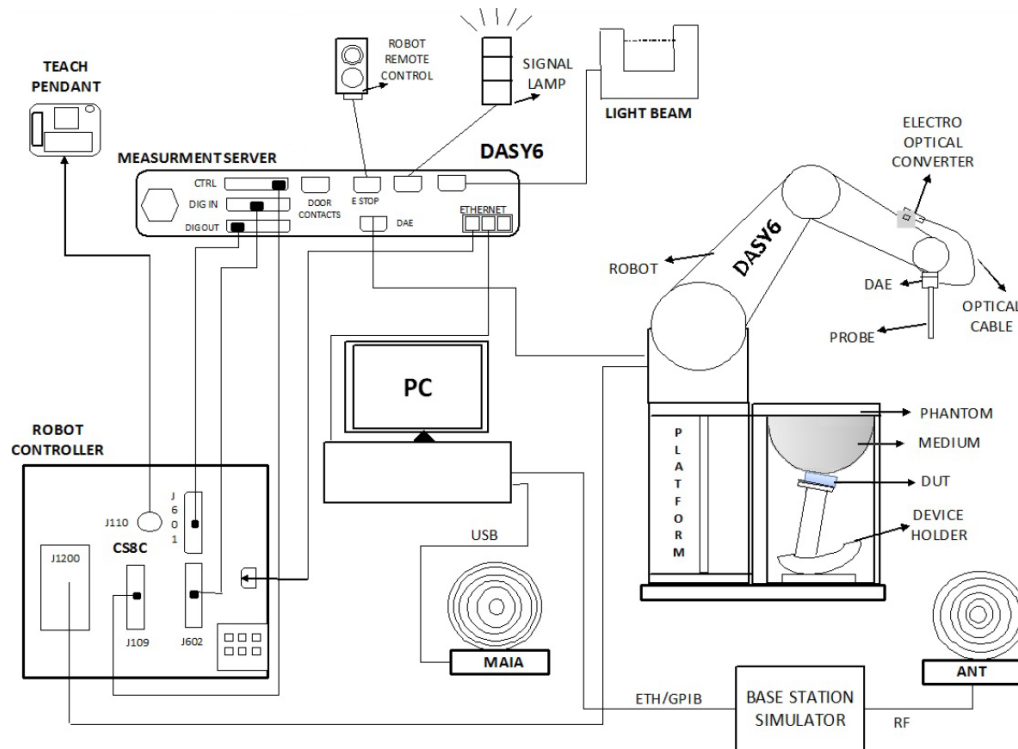


Fig-3.1 SPEAG DASY6 System Setup

3.2.1 Robot

The DASY6 system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version of CS8c from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ± 0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)



Fig-3.2 SPEAG DASY6 System

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3.2.2 Probes

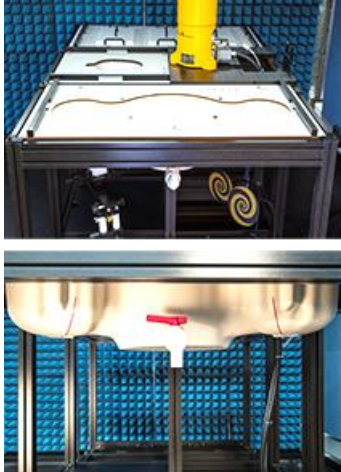
The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

Model	EX3DV4	
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	4 MHz to 10 GHz Linearity: ± 0.2 dB	
Directivity	± 0.1 dB in TSL (rotation around probe axis) ± 0.3 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/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	

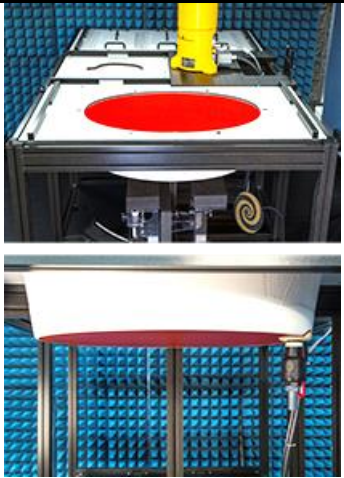
3.2.3 Data Acquisition Electronics (DAE)

Model	DAE3, DAE4	
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.	
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)	
Input Offset Voltage	$< 5\mu$ V (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

3.2.4 Phantoms

Model	SAM-Twin Phantom	
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE Std 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body-mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.	
Material	Vinylester, fiberglass reinforced (VE-GF)	
Shell Thickness	2 $\pm$ 0.2 mm (6 $\pm$ 0.2 mm at ear point)	
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet	
Filling Volume	approx. 25 liters	

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Model	ELI	
Construction	The ELI phantom is used for compliance testing of handheld and body-mounted wireless devices. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.	
Material	Vinylester, fiberglass reinforced (VE-GF)	
Shell Thickness	2.0 ± 0.2 mm (bottom plate)	
Dimensions	Major axis: 600 mm Minor axis: 400 mm	
Filling Volume	approx. 30 liters	

3.2.5 Device Holder

Model	MD4HHTV5 - Mounting Device for Hand-Held Transmitters	
Construction	In combination with the Twin SAM 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).	
Material	Polyoxymethylene (POM)	

Model	MDA4WTV5 - Mounting Device Adaptor for Ultra Wide Transmitters	
Construction	An 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.	
Material	Polyoxymethylene (POM)	

Model	MDA4SPV6 - Mounting Device Adaptor for Smart Phones	
Construction	The solid low-density MDA4SPV6 adaptor assuring no impact on the DUT radiation performance and is conform with any DUT design and shape.	
Material	ROHACELL	

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Model	MD4LAPV5 - Mounting Device for Laptops and other Body-Worn Transmitters	
Construction	In combination with the Twin SAM or ELI phantoms, the Mounting Device (Body-Worn) enables testing of transmitter devices according to IEC 62209-2 specifications. The device holder can be locked for positioning at a flat phantom section.	
Material	Polyoxymethylene (POM), PET-G, Foam	

3.2.6 System Validation Dipoles

Model	D-Serial	
Construction	Symmetrical dipole with 1/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.	
Frequency	750 MHz to 5800 MHz	
Return Loss	> 20 dB	
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)	

3.2.7 Power Source

Model	Powersource1	
Signal Type	Continuous Wave	
Operating Frequencies	600 MHz to 5850 MHz	
Output Power	-5.0 dBm to +17.0 dBm	
Power Supply	5V DC, via USB jack	
Power Consumption	<3 W	
Applications	System performance check and validation with a CW signal.	

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3.2.8 Tissue Simulating Liquids

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 10 % are listed in Table-3.1.

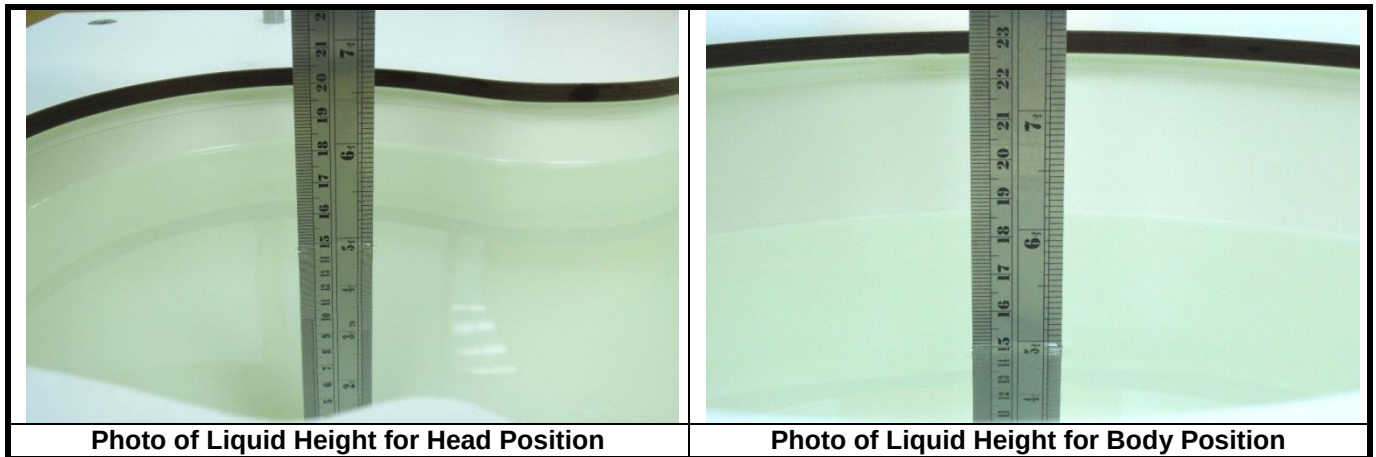


Table-3.1 Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of $\pm 10\%$	Target Conductivity	Range of $\pm 10\%$
450	43.5	39.2 ~ 47.9	0.87	0.78 ~ 0.96
750	41.9	37.7 ~ 46.1	0.89	0.80 ~ 0.98
835	41.5	37.4 ~ 45.7	0.90	0.81 ~ 0.99
900	41.5	37.4 ~ 45.7	0.97	0.87 ~ 1.07
1450	40.5	36.5 ~ 44.6	1.20	1.08 ~ 1.32
1500	40.4	36.4 ~ 44.4	1.23	1.11 ~ 1.35
1640	40.2	36.2 ~ 44.2	1.31	1.18 ~ 1.44
1750	40.1	36.1 ~ 44.1	1.37	1.23 ~ 1.51
1800	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
1900	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
2000	40.0	36.0 ~ 44.0	1.40	1.26 ~ 1.54
2100	39.8	35.8 ~ 43.8	1.49	1.34 ~ 1.64
2300	39.5	35.6 ~ 43.5	1.67	1.50 ~ 1.84
2450	39.2	35.3 ~ 43.1	1.80	1.62 ~ 1.98
2600	39.0	35.1 ~ 42.9	1.96	1.76 ~ 2.16
3000	38.5	34.7 ~ 42.4	2.40	2.16 ~ 2.64
3500	37.9	34.1 ~ 41.7	2.91	2.62 ~ 3.20
4000	37.4	33.7 ~ 41.1	3.43	3.09 ~ 3.77
4500	36.8	33.1 ~ 40.5	3.94	3.55 ~ 4.33
5000	36.2	32.6 ~ 39.8	4.45	4.01 ~ 4.90
5200	36.0	32.4 ~ 39.6	4.66	4.19 ~ 5.13
5400	35.8	32.2 ~ 39.4	4.86	4.37 ~ 5.35
5600	35.5	32.0 ~ 39.1	5.07	4.56 ~ 5.58
5800	35.3	31.8 ~ 38.8	5.27	4.74 ~ 5.80
6000	35.1	31.6 ~ 38.6	5.48	4.93 ~ 6.03

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The dielectric properties of the tissue simulating liquids are defined in IEC 62209-1 and IEC 62209-2. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using a dielectric assessment kit and a network analyzer.

Since the range of $\pm 10\%$ of the required target values is used to measure relative permittivity and conductivity, the SAR correction procedure is applied to correct measured SAR for the deviations in permittivity and conductivity. Only positive correction has been used to scale up the measured SAR, and SAR result would not be corrected if the correction Δ SAR has a negative sign.

The following table gives the recipes for tissue simulating liquids.

Table-3.2 Recipes of Tissue Simulating Liquid

Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
H750	0.2	-	0.2	1.5	56.0	-	42.1	-
H835	0.2	-	0.2	1.5	57.0	-	41.1	-
H900	0.2	-	0.2	1.4	58.0	-	40.2	-
H1450	-	43.3	-	0.6	-	-	56.1	-
H1640	-	45.8	-	0.5	-	-	53.7	-
H1750	-	47.0	-	0.4	-	-	52.6	-
H1800	-	44.5	-	0.3	-	-	55.2	-
H1900	-	44.5	-	0.2	-	-	55.3	-
H2000	-	44.5	-	0.1	-	-	55.4	-
H2300	-	44.9	-	0.1	-	-	55.0	-
H2450	-	45.0	-	0.1	-	-	54.9	-
H2600	-	45.1	-	0.1	-	-	54.8	-
H3500	-	8.0	-	0.2	-	20.0	71.8	-
H5G	-	-	-	-	-	17.2	65.5	17.3

3.3 SAR System Verification

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.

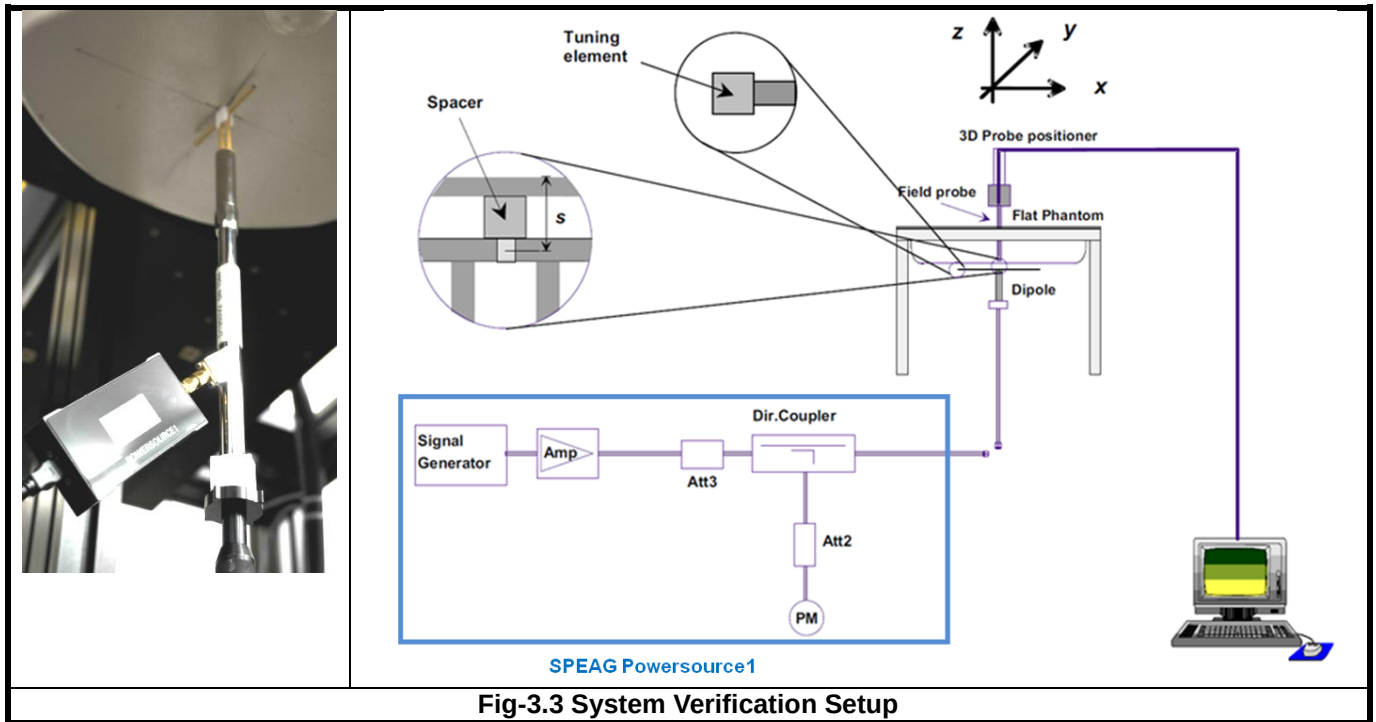


Fig-3.3 System Verification Setup

The SPEAG Powersource1 is a portable and very stable RF source providing a continuous wave (CW) signal. It is designed for conducting SAR system checks and SAR system validation of DASY and is compatible with IEC 62209-1, IEC 62209-2 and IEEE Std 1528 standards. The Powersource1 has been calibrated by SPEAG's ISO/IEC 17025-accredited calibration center. When using Powersource1, the setup can be simplified, as shown in Fig-3.3. The signal purity is warranted by design. Since the Powersource1 is calibrated, no additional equipment is needed and the Powersource1 can directly be connected to the SMA connector of the dipole without a cable as all separate components (signal generator, amplifier, coupler and power meter) are built into the unit.

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The Powersource1 is adjusted for the desired forward power of 17 dBm at the dipole connector and the RF output power would be turned on. After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

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3.4 SAR Measurement Procedure

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

- Power reference measurement
- Area scan
- Zoom scan
- Power drift measurement

The SAR measurement procedures for each of test conditions are as follows:

- Make EUT to transmit maximum output power
- Measure conducted output power through RF cable
- Place the EUT in the specific position of phantom
- Perform SAR testing steps on the DASY system
- Record the SAR value

3.4.1 Area Scan and Zoom Scan Procedure

First area scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an area scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, zoom scan is required. The zoom scan is performed around the highest E-field value to determine the averaged SAR-distribution.

Measure the local SAR at a test point at 1.4 mm of the inner surface of the phantom recommended by SEPAG. The area scan (two-dimensional SAR distribution) is performed cover at least an area larger than the projection of the EUT or antenna. The measurement resolution and spatial resolution for interpolation shall be chosen to allow identification of the local peak locations to within one-half of the linear dimension of the corresponding side of the zoom scan volume. Following table provides the measurement parameters required for the area scan.

Parameter	$f \leq 3 \text{ GHz}$	$3 \text{ GHz} < f \leq 6 \text{ GHz}$
Maximum distance from closest measurement point to phantom surface	5 ± 1	$\delta \ln(2)/2 \pm 0.5$
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$	$\leq 2 \text{ GHz: } \leq 15 \text{ mm}$ $2 - 3 \text{ GHz: } \leq 12 \text{ mm}$	$3 - 4 \text{ GHz: } \leq 12 \text{ mm}$ $4 - 6 \text{ GHz: } \leq 10 \text{ mm}$

From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that will not be within the zoom scan of other peaks. Additional peaks shall be measured only when the primary peak is within 2 dB of the SAR compliance limit (e.g. 1 W/kg for 1.6 W/kg, 1 g limit; or 1.26 W/kg for 2 W/kg, 10 g limit).

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The zoom scan (three-dimensional SAR distribution) is performed at the local maxima locations identified in previous area scan procedure. The zoom scan volume must be larger than the required minimum dimensions. When graded grids are used, which only applies in the direction normal to the phantom surface, the initial grid separation closest to the phantom surface and subsequent graded grid increment ratios must satisfy the required protocols. The 1-g SAR averaging volume must be fully contained within the zoom scan measurement volume boundaries; otherwise, the measurement must be repeated by shifting or expanding the zoom scan volume. The similar requirements also apply to 10-g SAR measurements. Following table provides the measurement parameters required for the zoom scan.

Parameter		$f \leq 3 \text{ GHz}$	$3 \text{ GHz} < f \leq 6 \text{ GHz}$
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$		$\leq 2 \text{ GHz: } \leq 8 \text{ mm}$ $2 - 3 \text{ GHz: } \leq 5 \text{ mm}$	$3 - 4 \text{ GHz: } \leq 5 \text{ mm}$ $4 - 6 \text{ GHz: } \leq 4 \text{ mm}$
Maximum zoom scan spatial resolution, normal to phantom surface	<i>uniform grid:</i> $\Delta z_{\text{Zoom}}(n)$	$\leq 5 \text{ mm}$	$3 - 4 \text{ GHz: } \leq 4 \text{ mm}$ $4 - 5 \text{ GHz: } \leq 3 \text{ mm}$ $5 - 6 \text{ GHz: } \leq 2 \text{ mm}$
	<i>graded grids:</i> $\Delta z_{\text{Zoom}}(1)$	$\leq 4 \text{ mm}$	$3 - 4 \text{ GHz: } \leq 3.0 \text{ mm}$ $4 - 5 \text{ GHz: } \leq 2.5 \text{ mm}$ $5 - 6 \text{ GHz: } \leq 2.0 \text{ mm}$
	$\Delta z_{\text{Zoom}}(n>1)$	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1) \text{ mm}$	
Minimum zoom scan volume (x, y, z)		$\geq 30 \text{ mm}$	$3 - 4 \text{ GHz: } \geq 28 \text{ mm}$ $4 - 5 \text{ GHz: } \geq 25 \text{ mm}$ $5 - 6 \text{ GHz: } \geq 22 \text{ mm}$

Per IEC 62209-2 AMD1, the successively higher resolution zoom scan is required if the zoom scan measured as defined above complies with both of the following criteria, or if the peak spatial-average SAR is below 0.1 W/kg, no additional measurements are needed:

- (1) The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both x and y directions ($\Delta x, \Delta y$). This shall be checked for the measured zoom scan plane conformal to the phantom at the distance z_{M1} .
- (2) The ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (M1) at the x-y location of the measured maximum SAR value shall be at least 30 %.

If one or both of the above criteria are not met, the zoom scan measurement shall be repeated using a finer resolution. New horizontal and vertical grid steps shall be determined from the measured SAR distribution so that the above criteria are met. Compliance with the above two criteria shall be demonstrated for the new measured zoom scan.

3.4.2 Volume Scan Procedure

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.

3.4.3 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 drift more than 5%, the SAR will be retested.

3.4.4 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 from 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

3.4.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

4. Power Density Measurement System

4.1 Definition of Power Density

The power density for an electromagnetic field represents the rate of energy transfer per unit area. The local power density (i.e. Poynting vector) at a given spatial point is deduced from electromagnetic fields by the following formula:

$$S = \frac{1}{2} \text{Re}\{E \times H^*\} \cdot \vec{n}$$

Where: E is the complex electric field peak phasor and H is the complex conjugate magnetic field peak phasor.

The spatial-average power density distribution on the evaluation surface is determined per the IEC TR 63170. The spatial area, A is specified by the applicable exposure limit or regulatory requirements. The circular shape was used.

$$S_{av} = \frac{1}{2A} \Re \left(\int E \times H^* \cdot \hat{n} dA \right)$$

4.2 SPEAG DASY6 System

The SPEAG DASY6 system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY6 software defined. The DASY6 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

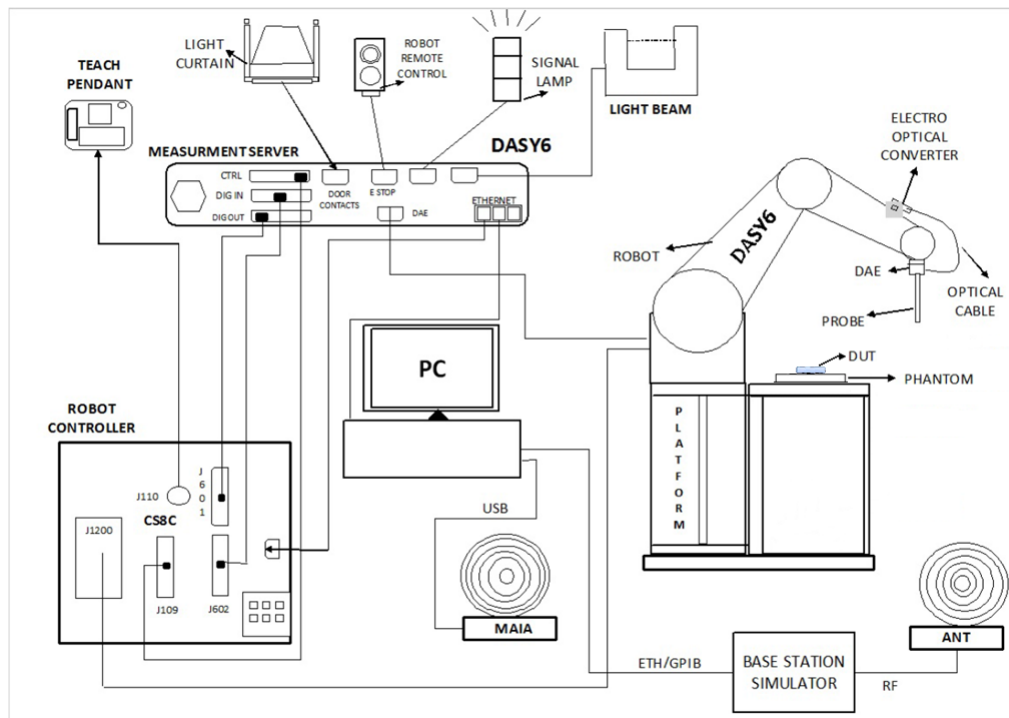


Fig-3.1 SPEAG DASY6 System Configuration

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4.2.1 Robot

The DASY6 system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version of CS8c from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ± 0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)



Fig-3.2 SPEAG DASY6 System

4.2.2 EUmmWV2 mm-Wave Probe

The EUmmWV2 probe is an electric (E) universal (U) field probe with two dipole sensors for field measurements at frequencies up to 110 GHz and as close as 2 mm from any field source or transmitter. The sensors consist of two diode-loaded small dipoles that provide the rectified voltage from the coupled E-field. From the voltages at three different orientations in the field at known angles, both the magnitude of the field component and the field polarization can be calculated. Due to the small size of the sensors, the probe can be used for measurements over an extremely wide frequency range from <1 GHz to 110 GHz. The probe sensors are protected by non-removable 8 mm high-density foam.

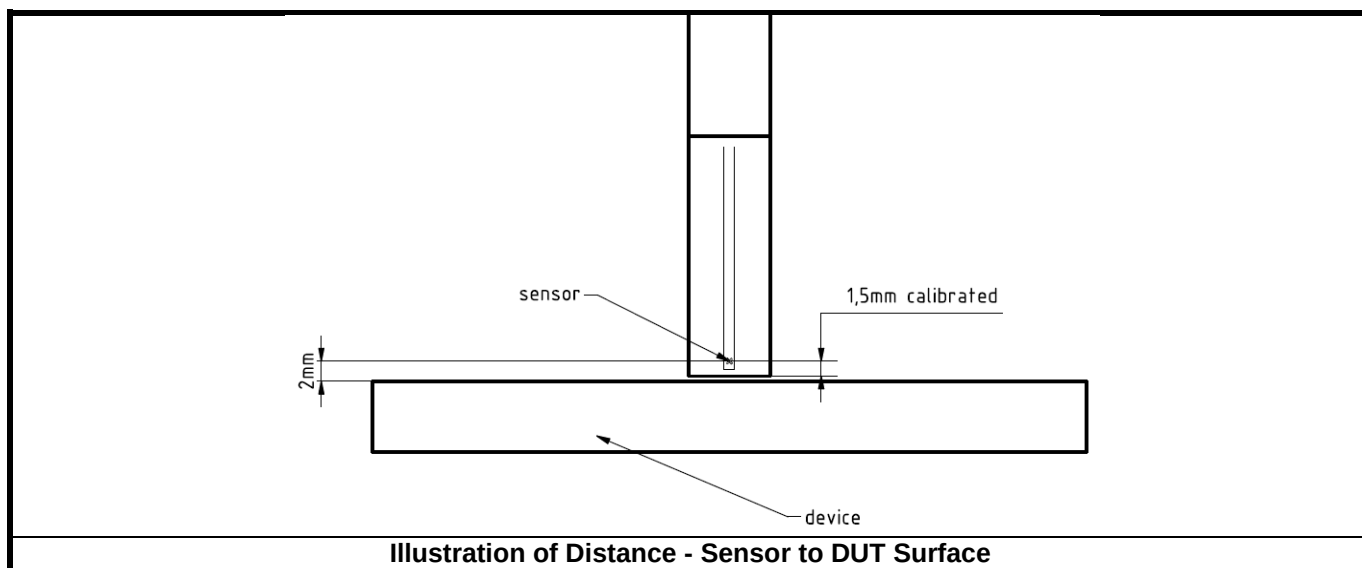
The EUmmWV2 probe is based on the pseudo-vector probe design, which not only measures the field magnitude but also derives its polarization ellipse. This probe concept also has the advantage that the sensor angle errors or distortions of the field by the substrate can be largely nullified by calibration. This is particularly important as, at these very high frequencies, field distortions by the substrate are dependent on the wavelength. The design entails two small 0.8 mm dipole sensors mechanically protected by high-density foam, printed on both sides of a 0.9 mm wide and 0.12 mm thick glass substrate. The body of the probe is specifically constructed to minimize distortion by the scattered fields.

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The probe consists of two sensors with different angles arranged in the same plane in the probe axis. Three or more measurements of the two sensors are taken for different probe rotational angles to derive the amplitude and polarization information. These probes are the most flexible and accurate probes currently available for measuring field amplitude.

The probe design allows measurements at distances as small as 2 mm from the sensors to the surface of the device under test (DUT). The typical sensor to probe tip distance is 1.5 mm. The exact distance is calibrated.

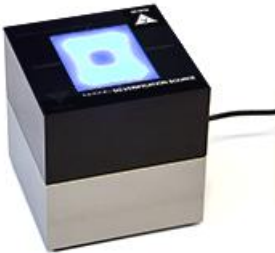
Model	EUmmWV2	
Frequency	750 MHz to 110 GHz	
Dynamic Range	< 20 V/m - 10000 V/m with PRE-10 < 50 V/m - 3000 V/m minimum	
Linearity	< ± 0.2 dB	
Hemispherical Isotropy	< 0.5 dB	
Position Precision	< 0.2 mm	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: encapsulation 8 mm (internal sensor < 1mm) Distance from probe tip to dipole centers: < 2 mm Sensor displacement to probe's calibration point: < 0.3 mm	

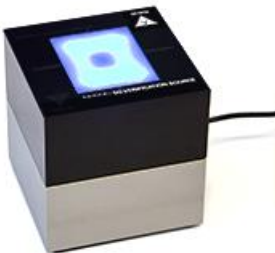


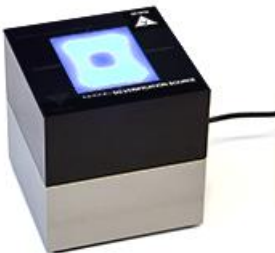
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4.2.3 System Verification Sources

System verification device consists of a horn antenna with corresponding gun oscillator packaged within a cube-shaped housing and power supply provided.

Model	System Verification for Ka-band	
Calibrated Frequency	30 GHz at 10mm from the case surface	
Frequency Accuracy	± 100 MHz	
E-field Polarization	Linear	
Harmonics	-20 dBc	
Total Radiated Power	14 dBm	
Power Stability	0.05 dB	
Power Consumption	5 W	
Size	100 x 100 x 100 mm	
Weight	1 kg	

Model	System Verification for V-band	
Calibrated Frequency	60 GHz at 10mm from the case surface	
Frequency Accuracy	± 100 MHz	
E-field Polarization	Linear	
Harmonics	-20 dBc	
Total Radiated Power	20 dBm	
Power Stability	0.1 dB	
Power Consumption	5 W	
Size	100 x 100 x 100 mm	
Weight	1 kg	

Model	System Verification for W-band	
Calibrated Frequency	90 GHz at 10mm from the case surface	
Frequency Accuracy	± 150 MHz	
E-field Polarization	Linear	
Harmonics	-20 dBc	
Total Radiated Power	16 dBm	
Power Stability	0.15 dB	
Power Consumption	5 W	
Size	100 x 100 x 100 mm	
Weight	1 kg	

4.3 Power Density System Verification

System check provides a fast and reliable method to routinely verify that the measurement system is operational with no system component failures, including probe defects, drifts or deviation from target performance requirements. A system check also verifies the repeatability of the measurement system before compliance testing.

The measurement of a verification source is started from 5G probe installed and the phantom taught. The verification source is placed on the 5G phantom. Due to the internal distance from the horn to the outer surface of the verification source, the measurement distance set in the software should be offset by -4.45 mm; e.g., for measurement of the verification source at 10 mm, the measurement distance set in the software should be 5.55 mm (10mm - 4.45 mm).

The system check is a complete measurement using simple well-defined reference sources. According to the DASY6 specification in the user's manual and SPEAG's recommendation, the deviation threshold of ± 0.66 dB represents the expanded standard uncertainty for system performance check. The system check is successful if the measured results are within ± 0.66 dB tolerances to the target value shown in the calibration certificate of the verification source. The instrumentation and procedures used for system check should ensure the system is ready for performing compliance tests.

System check using 10 GHz source to support 6-7GHz incident-PD results done with EUmWV probe, the test procedure was following by the SPEAG AppNote Procedures for Device Operating at 6 – 10GHz.

Frequency [GHz]	Grid Step	Grid Extent X/Y [mm]	Measurement Points
10	0.25 ($\lambda/4$)	120 / 120	16 x 16

Table-3.1 Settings for Measurement of Verification Sources

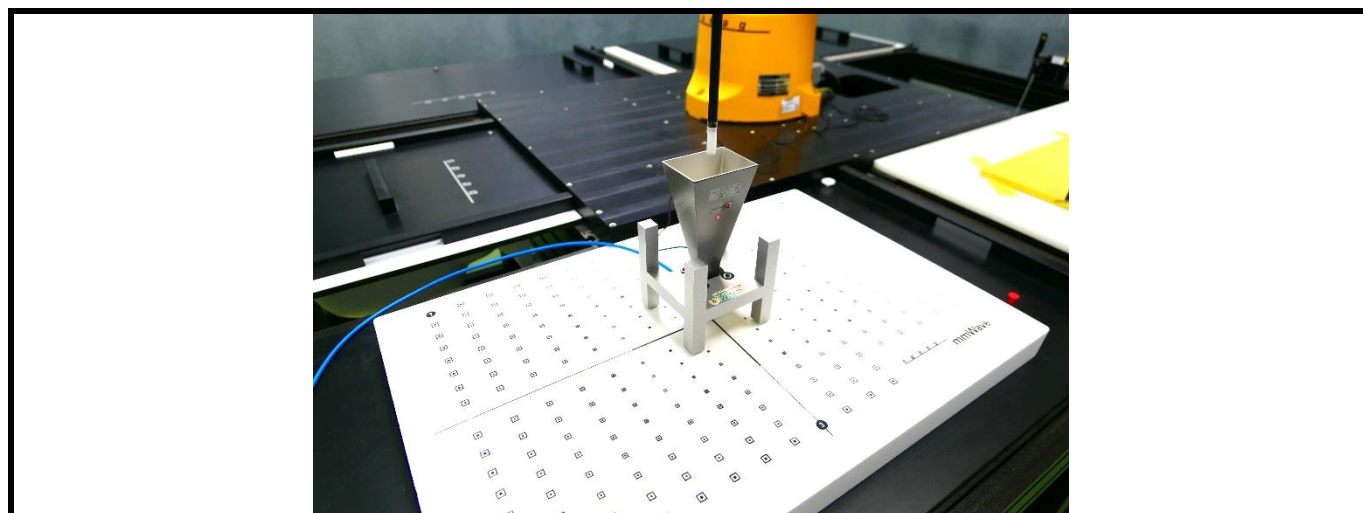


Fig-3.3 System Verification Setup

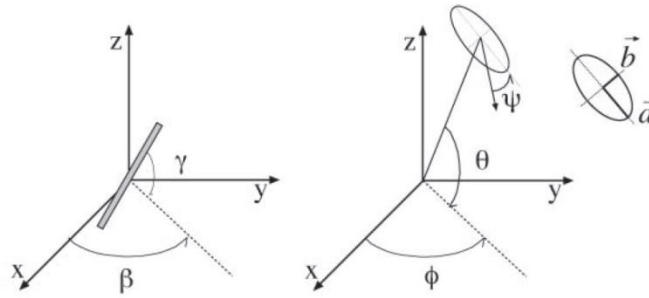
4.4 Power Density Measurement Procedure

Within a short distance from the transmitting source, power density is determined based on both electric and magnetic fields. Generally, the magnitude and phase of two components of either the E-field or H-field are needed on a sufficiently large surface to fully characterize the total E-field and H-field distributions. Nevertheless, solutions based on direct measurement of E-field and H-field can be used to compute power density. When the measurement surface does not correspond to the evaluation surface, reconstruction algorithms are necessary to project or transform the fields from the measurement surface to the evaluation surface. The general measurement approach is summarized in following:

- (a) Measure the E-field on the measurement surface at a reference location where the field is well above the noise level. This reference level will be used at the end of this procedure to assess output power drift of the DUT during the measurement.
- (b) Scan the electric field on the measurement surface. The requirements of measurement surface dimensions and spatial resolution are dependent on the measurement system and assessment methodology applied. Measurements are therefore conducted according to the instructions provided by the measurement system manufacturer.
- (c) Measurement spatial resolution can depend on the measured field characteristic and measurement methodology used by the system. Planar scanners typically require a step size of less than $\lambda / 2$. When measurements are acquired in regions where evanescent modes are not negligible, smaller spatial resolution may be required. Similar criteria also apply to cylindrical scanning systems where the spatial resolution in the vertical direction should be less than $\lambda / 2$.
- (d) Since only E-field is measured on the measurement system, the H-field is calculated from the measured field using a reconstruction algorithm. As power density requires knowledge of both amplitude and phase, reconstruction algorithms can also be used to obtain field information from the measured data (e.g. the phase from the amplitude if only the amplitude is measured). The measurement involves two planes with three different probe rotations on two measurement planes separated by $\lambda / 4$. The grid steps are optimized by the software based on the test frequency. The location of the lowest measurement plane is defined by the distance of first measurement layer from device under test entered by the user. In addition, when the measurement surface does not correspond to the evaluation surface, reconstruction algorithms are employed to project or transform the fields from the measurement surface to the evaluation surface. In substance, reconstruction algorithms are the set of algorithms, mathematical techniques and procedures that are applied to the measured field on the measurement surface to determine E- and H-field (amplitude and phase) on the evaluation surface.
- (e) To determine the spatial-average power density distribution on the evaluation surface. The spatial averaging area, A, is specified by the applicable exposure limits or regulatory requirements. If the shape of the area is not provided by the relevant regulatory requirements, a circular shape is recommended.
- (f) Measure the E-field on the measurement surface position at the reference location chosen in step (a). The power drift of the DUT is estimated as the difference between the squared amplitude of the field values taken in steps (a) and (f). When the drift is smaller than $\pm 5 \%$, this term should be considered in the uncertainty budget. Drifts larger than 5% due to the design and operating characteristics of the device should be accounted for or addressed according to regulatory requirements to determine compliance.

4.4.1 Computation of the Electric Field Polarization Ellipse

For the numerical description of an arbitrarily oriented ellipse in three-dimensional space, five parameters are needed: the semi-major axis (a), the semi-minor axis (b), two angles describing the orientation of the normal vector of the ellipse (Φ , θ), and one angle describing the tilt of the semi-major axis (ψ). For the two extreme cases, i.e., circular and linear polarizations, three parameters only (a , Φ , and θ) are sufficient for the description of the incident field.



For the reconstruction of the ellipse parameters from measured data, the problem can be reformulated as a nonlinear search problem. The semi-major and semi-minor axes of an elliptical field can be expressed as functions of the three angles (Φ , θ , and ψ). The parameters can be uniquely determined towards minimizing the error based on least-squares for the given set of angles and the measured data. In this way, the number of free parameters is reduced from five to three, which means that at least three sensor readings are necessary to gain sufficient information for the reconstruction of the ellipse parameters. However, to suppress the noise and increase the reconstruction accuracy, it is desirable that the system of equations be over-determined. The solution use a probe consisting of two sensors angled by γ_1 and γ_2 toward the probe axis and to perform measurements at three angular positions of the probe, i.e., at β_1 , β_2 , and β_3 , results in over-determinations by a factor of two. If there is a need for more information or increased accuracy, more rotation angles can be added.

The reconstruction of the ellipse parameters can be separated into linear and non-linear parts that are best solved by the givens algorithm combined with a downhill simplex algorithm. To minimize the mutual coupling, sensor angles are set with a shift of 90° ($\gamma_2 = \gamma_1 + 90^\circ$), and, to simplify, the first rotation angle of the probe (β_1) can be set to 0° .

4.4.2 Total Field and Power Flux Density Reconstruction

Computation of the power density in general requires knowledge of the electric (E-) and magnetic (H-) field amplitudes and phases in the plane of incidence. Reconstruction of these quantities from pseudo-vector E-field measurements is feasible, as they are constrained by Maxwell's equations. The SPEAG have developed a reconstruction approach based on the Gerchberg-Saxton algorithm, which benefits from the availability of the E-field polarization ellipse information obtained with the EUmWV2 probe. This reconstruction algorithm, together with the ability of the probe to measure extremely close to the source without perturbing the field, permits reconstruction of the E- and H-fields, as well as of the power density, on measurement planes located as near as $\lambda / 5$ away.

4.4.3 Power Flux Density Averaging

The average of the reconstructed power density is evaluated over a circular area in each measurement plane. The area of the circle is defined by the user; the default is 1 cm². The computed peak average value is displayed in the box at the top right. Note that the average is evaluated only for grid points where the averaging circle is completely filled with values; for points at the edge where the averaging circle is only partly filled with values, the average power density is set to zero. Two average power density values are computed:

- 1) $|\text{Re}(S)|$ is the average total power density.
- 2) $\vec{n} \cdot \text{Re}(S)$ is the average incident power density.

5. SAR Measurement Evaluation

5.1 EUT Configuration and Setting

<Considerations Related to Proximity Sensor>

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The device supports WWAN, WLAN, and Bluetooth capabilities. It is designed with a proximity sensor which can trigger/not trigger power reduction for GSM, WCDMA and LTE on Rear Face, Front Face, Top Side and Right Side of EUT for SAR compliance. Others RF capability (WLAN and Bluetooth) have no power reduction. The power levels for all wireless technologies and the power reduction please refer to section 4.6 of this report.

Ant 3

The device supports WWAN, WLAN, and Bluetooth capabilities. It is designed with a proximity sensor which can trigger/not trigger power reduction for GSM, WCDMA and LTE on Rear Face, Front Face, Top Side and Left Side of EUT for SAR compliance. Others RF capability (WLAN and Bluetooth) have no power reduction. The power levels for all wireless technologies and the power reduction please refer to section 4.6 of this report.

Proximity Sensor Triggering Distances (KDB 616217 D04 §6.2)

The proximity sensor triggering distance was determined per KDB 616217 for rear face and applicable edge. Summary for power verification per distance was tabulated in the below table.

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Output Power Verification in dBm for EUT Rear Face											
Distance (mm)	7	8	9	10	11	12	13	14	15	16	17
GSM850, GPRS 4Tx	32.9	32.4	32.5	32.5	32.7	32.8	32.9	32.5	32.6	32.4	32.6
GSM1900, GPRS 4Tx	29.7	29.6	29.8	29.5	30.0	29.5	29.9	30.0	29.5	29.6	29.5
WCDMA II	23.0	22.8	22.8	23.2	22.9	22.9	22.9	22.8	23.1	22.8	23.2
WCDMA IV	22.9	22.5	22.7	22.5	22.9	22.8	22.6	22.6	22.9	22.9	22.5
WCDMA V	24.0	23.8	24.1	23.8	24.0	24.0	24.0	23.8	23.9	24.0	23.6
CDMA BC0	23.7	23.8	23.7	23.9	23.4	23.8	23.6	23.5	23.5	23.6	23.4
CDMA BC1	23.4	23.6	23.8	23.5	23.6	23.8	23.8	23.8	23.8	23.8	23.6
CDMA BC10	23.4	23.9	23.5	23.4	23.9	23.9	23.6	23.9	23.9	23.7	23.7
LTE 2	23.8	23.9	23.8	23.9	23.7	23.4	23.8	23.5	23.8	23.6	23.6
LTE 4	23.6	23.5	23.9	23.9	23.7	23.6	23.9	24.0	24.0	23.9	24.0
LTE 5	24.6	24.5	24.7	24.6	25.0	24.8	25.0	25.0	24.9	24.7	24.7
LTE 7	20.5	20.6	20.5	20.4	20.9	20.4	23.3	23.7	23.6	23.4	23.5
LTE 12	24.7	24.4	24.7	24.5	24.8	24.4	24.5	24.8	24.8	24.7	24.5
LTE 13	24.4	24.4	24.6	24.7	24.5	24.9	24.4	24.6	24.8	24.7	24.4
LTE 14	24.8	24.5	24.6	24.9	24.7	24.8	25.0	24.7	24.8	24.7	25.0
LTE 17	24.8	24.5	24.7	24.4	24.6	24.3	24.5	24.6	24.7	24.8	24.6
LTE 25	23.8	23.5	23.5	23.3	23.7	23.6	23.8	23.3	23.7	23.3	23.6
LTE 26	24.7	24.7	24.9	24.6	24.9	24.4	24.6	24.5	24.7	24.8	24.6
LTE 30	23.0	22.9	22.8	23.0	23.3	23.0	23.1	23.0	23.1	22.8	23.3
LTE 38	23.8	23.5	23.7	23.4	23.8	23.8	23.3	23.3	23.4	23.4	23.7
LTE 40	23.1	23.6	23.2	23.6	23.5	23.6	23.4	23.3	23.2	23.5	23.4
LTE 41	24.9	25.0	25.1	25.3	25.2	25.3	25.3	25.3	25.2	25.2	24.8
LTE 42	23.5	23.3	23.8	23.4	23.4	23.4	24.5	24.3	24.6	24.5	24.5
LTE 43	23.3	23.3	23.3	23.8	23.6	23.8	24.1	24.4	24.1	24.5	24.2
LTE 48	23.9	23.6	23.4	23.7	23.6	23.7	24.6	24.8	24.5	24.5	24.6
LTE 66	23.7	24.0	23.8	23.7	24.0	23.8	23.7	24.0	23.8	23.9	23.6
LTE 71	24.7	24.5	24.5	25.0	24.6	24.6	24.8	24.7	24.6	24.5	24.8
5G NR N2	23.8	23.8	23.8	23.5	23.7	23.8	23.8	23.8	23.7	23.9	23.6
5G NR N5	24.3	24.4	24.0	24.3	24.4	24.0	24.2	24.5	24.1	24.5	24.5
5G NR N7	23.6	24.0	23.8	23.7	23.6	23.7	23.6	23.9	23.9	23.6	23.9
5G NR N12	24.5	24.7	25.0	24.8	24.9	24.5	24.7	25.0	24.5	25.0	24.8
5G NR N13	23.7	23.5	23.3	23.2	23.6	23.2	23.6	23.3	23.5	23.2	23.4
5G NR N14	24.6	24.7	24.5	24.7	24.4	24.7	24.3	24.5	24.8	24.3	24.8
5G NR N25	23.9	23.9	23.9	23.7	24.0	23.9	24.0	24.0	23.9	24.0	23.9
5G NR N26	24.9	24.7	24.6	24.8	24.7	24.9	24.6	24.9	24.8	24.9	25.0
5G NR N30	23.4	23.9	23.6	23.8	23.8	23.8	23.5	23.9	23.5	23.6	23.8
5G NR N38	24.0	23.8	23.7	23.9	23.6	23.6	23.8	24.0	23.9	24.0	23.9
5G NR N41	26.0	26.0	25.9	25.9	26.0	26.1	26.2	26.2	25.7	26.2	26.1
5G NR N66	23.9	23.5	23.9	24.0	23.7	23.7	23.7	23.9	23.8	23.5	23.9
5G NR N71	24.2	24.1	24.3	24.2	24.1	24.2	24.3	24.3	24.3	24.3	24.6
5G NR N77	22.0	22.0	21.5	21.9	21.8	22.0	24.0	24.3	24.3	23.8	23.9
5G NR N78	22.4	22.0	22.0	22.5	22.2	22.4	24.9	24.8	24.4	24.8	24.6

SAR Test Report

Output Power Verification in dBm for EUT Front Face											
Distance (mm)	6	7	8	9	10	11	12	13	14	15	16
GSM850, GPRS 4Tx	32.5	32.8	32.5	32.5	32.7	32.9	32.5	32.9	32.9	32.7	32.8
GSM1900, GPRS 4Tx	29.8	29.8	29.7	29.7	30.0	29.5	29.7	29.6	29.8	29.9	29.5
WCDMA II	23.1	22.8	23.3	23.3	23.2	23.3	23.3	23.3	23.1	23.1	23.2
WCDMA IV	22.7	22.8	22.6	23.0	22.6	22.7	22.5	22.8	22.9	22.5	22.7
WCDMA V	23.6	23.7	23.7	23.8	23.8	23.7	23.9	23.7	23.6	23.8	23.6
CDMA BC0	23.4	23.4	23.9	23.5	23.4	23.5	23.9	23.9	23.6	23.6	23.7
CDMA BC1	23.9	23.4	23.5	23.6	23.4	23.6	23.9	23.4	23.9	23.6	23.9
CDMA BC10	23.7	23.6	23.7	23.4	23.4	23.8	23.5	23.9	23.9	23.9	23.8
LTE 2	23.7	23.7	23.9	23.8	23.4	23.5	23.6	23.5	23.7	23.8	23.5
LTE 4	24.0	23.8	23.7	24.0	23.6	23.5	23.7	23.8	24.0	23.6	24.0
LTE 5	24.8	24.6	24.6	24.9	24.9	24.8	24.7	24.9	25.0	24.6	24.7
LTE 7	20.5	20.5	20.7	20.5	20.8	20.6	23.7	23.3	23.6	23.6	23.6
LTE 12	24.5	24.6	24.4	24.6	24.7	24.6	24.8	24.8	24.9	24.5	24.4
LTE 13	24.5	24.7	24.5	24.6	24.6	24.4	24.7	24.4	24.8	24.5	24.7
LTE 14	24.6	24.8	24.5	24.8	24.5	24.7	24.6	25.0	24.5	24.9	25.0
LTE 17	24.4	24.3	24.8	24.4	24.4	24.6	24.4	24.3	24.6	24.4	24.5
LTE 25	23.4	23.6	23.6	23.8	23.6	23.5	23.7	23.3	23.7	23.4	23.4
LTE 26	24.5	24.7	24.9	24.4	24.7	24.4	24.5	24.4	24.8	24.8	24.9
LTE 30	22.8	23.3	23.1	23.0	23.3	23.0	23.0	23.3	23.2	22.8	23.2
LTE 38	23.4	23.7	23.3	23.8	23.6	23.3	23.8	23.8	23.3	23.8	23.8
LTE 40	23.2	23.5	23.5	23.6	23.4	23.5	23.4	23.1	23.5	23.1	23.2
LTE 41	24.8	24.9	25.1	24.8	25.3	25.1	24.8	24.8	25.1	24.9	25.0
LTE 42	23.6	23.7	23.8	23.4	23.7	23.7	24.6	24.1	24.4	24.1	24.3
LTE 43	23.5	23.6	23.8	23.3	23.8	23.8	24.1	24.1	24.1	24.1	24.1
LTE 48	23.4	23.4	23.8	23.8	23.5	23.5	24.8	24.3	24.6	24.4	24.4
LTE 66	23.7	23.9	23.5	23.6	23.5	23.5	24.0	23.8	23.6	23.8	23.6
LTE 71	24.7	24.5	25.0	24.8	24.7	24.6	24.9	24.9	24.9	24.5	24.7
5G NR N2	23.6	23.9	23.8	23.7	23.9	23.5	23.7	23.7	23.7	23.8	23.6
5G NR N5	24.4	24.0	24.3	24.4	24.5	24.2	24.3	24.5	24.4	24.2	24.3
5G NR N7	23.5	23.8	23.6	23.9	23.6	23.6	23.9	23.8	23.8	23.8	23.9
5G NR N12	24.5	24.5	24.7	24.6	25.0	24.9	24.6	24.5	24.8	24.9	24.5
5G NR N13	23.6	23.3	23.7	23.6	23.6	23.2	23.3	23.6	23.7	23.6	23.7
5G NR N14	24.6	24.6	24.6	24.8	24.8	24.6	24.3	24.5	24.4	24.6	24.6
5G NR N25	23.5	23.7	23.8	23.8	24.0	23.7	23.6	23.5	23.6	23.6	24.0
5G NR N26	24.8	25.0	24.9	25.0	24.9	24.8	24.8	24.5	24.8	24.8	25.0
5G NR N30	23.6	23.9	23.5	23.4	23.7	23.8	23.7	23.9	23.7	23.4	23.4
5G NR N38	23.9	24.0	23.9	23.9	23.6	23.6	23.5	23.7	23.9	24.0	23.9
5G NR N41	25.7	25.9	25.8	26.2	25.9	25.8	25.8	25.8	25.8	26.2	25.7
5G NR N66	23.8	24.0	23.8	23.5	23.9	23.7	23.5	24.0	23.9	23.6	23.9
5G NR N71	24.3	24.3	24.6	24.6	24.3	24.4	24.1	24.2	24.4	24.2	24.5
5G NR N77	21.5	21.7	21.8	21.8	21.6	21.5	23.9	23.8	24.2	23.9	23.8
5G NR N78	22.5	22.5	22.3	22.3	22.0	22.5	24.8	24.6	24.8	24.5	24.4

SAR Test Report

Output Power Verification in dBm for EUT Right Edge											
Distance (mm)	8	9	10	11	12	13	14	15	16	17	18
GSM850, GPRS 4Tx	32.6	32.4	32.7	32.7	32.7	32.5	32.4	32.4	32.7	32.4	32.9
GSM1900, GPRS 4Tx	29.9	29.5	29.5	29.6	29.9	29.7	30.0	29.6	29.8	29.9	29.8
WCDMA II	23.3	23.1	23.2	23.0	22.8	23.3	23.2	22.8	23.2	23.2	22.9
WCDMA IV	22.8	22.7	22.8	23.0	22.9	22.9	23.0	22.7	22.8	22.9	22.5
WCDMA V	23.8	23.9	23.8	24.1	23.9	23.7	23.8	24.1	23.8	24.0	23.8
CDMA BC0	23.8	23.5	23.8	23.7	23.4	23.8	23.8	23.6	23.4	23.9	23.9
CDMA BC1	23.7	23.5	23.8	23.4	23.6	23.7	23.5	23.4	23.5	23.8	23.5
CDMA BC10	23.8	23.5	23.5	23.5	23.8	23.4	23.8	23.9	23.5	23.7	23.9
LTE 2	23.7	23.6	23.5	23.6	23.8	23.9	23.6	23.8	23.9	23.5	23.7
LTE 4	23.5	23.9	23.6	23.5	23.6	24.0	23.5	23.7	23.9	23.8	23.6
LTE 5	25.0	24.7	24.8	24.8	24.8	24.9	24.6	25.0	24.6	24.7	24.9
LTE 7	20.5	20.6	20.7	20.6	20.6	20.5	23.6	23.7	23.7	23.7	23.5
LTE 12	24.4	24.4	24.4	24.8	24.9	24.5	24.6	24.9	24.7	24.5	24.6
LTE 13	24.5	24.7	24.4	24.8	24.4	24.5	24.4	24.6	24.8	24.9	24.9
LTE 14	24.8	24.7	24.6	24.6	24.6	24.5	24.5	24.5	24.6	25.0	24.9
LTE 17	24.3	24.6	24.6	24.5	24.7	24.4	24.7	24.4	24.3	24.6	24.4
LTE 25	23.7	23.4	23.3	23.6	23.3	23.7	23.3	23.3	23.8	23.5	23.7
LTE 26	24.7	24.4	24.9	24.5	24.4	24.9	24.7	24.5	24.8	24.6	24.6
LTE 30	22.8	22.9	23.1	23.1	23.0	22.8	23.3	22.9	22.8	23.3	23.0
LTE 38	23.4	23.8	23.5	23.3	23.8	23.3	23.7	23.4	23.6	23.3	23.5
LTE 41	25.1	25.2	25.1	25.0	25.2	25.3	25.1	25.2	25.2	25.2	24.9
LTE 42	23.8	23.6	23.3	23.6	23.3	23.5	24.1	24.4	24.5	24.4	24.5
LTE 43	23.5	23.5	23.6	23.6	23.6	23.8	24.6	24.2	24.4	24.2	24.2
LTE 48	23.6	23.9	23.5	23.7	23.5	23.6	24.3	24.3	24.5	24.6	24.8
LTE 66	23.5	23.7	23.5	23.7	23.8	23.5	23.6	23.8	23.9	23.5	23.5
LTE 71	24.7	24.6	25.0	24.8	25.0	24.9	24.7	24.5	24.9	24.7	24.5
5G NR N2	23.7	23.8	23.7	23.6	23.9	23.5	24.0	23.5	23.8	23.9	23.9
5G NR N5	24.5	24.1	24.1	24.2	24.3	24.5	24.2	24.0	24.5	24.0	24.1
5G NR N7	24.0	23.7	23.5	23.5	23.8	24.0	23.7	23.7	23.9	23.7	23.7
5G NR N12	24.5	24.9	25.0	24.9	24.7	24.8	24.8	24.6	24.8	24.5	24.8
5G NR N13	23.5	23.7	23.2	23.3	23.4	23.2	23.5	23.5	23.7	23.3	23.3
5G NR N14	24.7	24.7	24.6	24.5	24.8	24.7	24.6	24.7	24.4	24.7	24.7
5G NR N25	23.5	23.6	23.8	23.8	24.0	24.0	23.6	23.9	23.9	23.9	23.5
5G NR N26	24.5	24.5	25.0	24.8	24.6	24.9	24.7	24.9	25.0	24.8	24.9
5G NR N30	23.7	23.7	23.8	23.8	23.4	23.9	23.9	23.5	23.6	23.7	23.4
5G NR N38	23.5	23.5	23.5	23.5	23.9	23.6	24.0	23.8	24.0	23.7	23.8
5G NR N41	26.1	25.7	26.0	25.7	26.1	25.9	25.7	25.7	25.9	25.9	26.2
5G NR N66	23.5	23.8	24.0	23.5	24.0	23.9	23.8	23.7	23.8	24.0	23.8
5G NR N71	24.1	24.4	24.5	24.2	24.5	24.1	24.4	24.6	24.4	24.5	24.6
5G NR N77	21.5	21.7	21.7	21.5	21.7	22.0	24.0	23.8	24.0	24.2	23.9
5G NR N78	22.5	22.3	22.2	22.1	22.4	22.1	24.8	24.4	24.9	24.5	24.6

SAR Test Report

Ant 1

Output Power Verification in dBm for EUT Rear Face											
Distance (mm)	11	12	13	14	15	16	17	18	19	20	21
GSM850, GPRS 4Tx	32.9	32.9	32.5	32.8	32.7	32.8	32.7	32.4	32.4	32.8	32.4
GSM1900, GPRS 4Tx	30.0	29.9	29.6	29.5	29.9	30.0	29.8	29.9	29.7	29.6	29.7
WCDMA II	22.9	23.3	22.8	22.9	22.9	23.3	22.9	22.8	23.3	23.2	22.8
WCDMA IV	22.5	22.9	23.0	22.8	22.9	23.0	23.0	22.9	22.5	23.0	22.7
WCDMA V	24.0	23.6	24.0	23.9	23.9	24.1	24.0	23.9	23.8	24.1	23.7
CDMA BC0	23.6	23.5	23.5	23.4	23.4	23.5	23.5	23.8	23.5	23.9	23.4
CDMA BC1	23.4	23.8	23.8	23.8	23.7	23.8	23.9	23.7	23.5	23.6	23.5
CDMA BC10	23.9	23.6	23.8	23.7	23.5	23.4	23.9	23.6	23.9	23.6	23.5
LTE 2	23.9	23.8	23.8	23.6	23.5	23.5	23.8	23.7	23.6	23.6	23.9
LTE 4	23.5	23.6	23.6	24.0	23.9	23.8	23.8	23.7	23.6	23.6	23.9
LTE 5	24.7	24.8	24.5	24.9	24.5	24.6	25.0	24.6	24.6	24.9	24.8
LTE 7	20.7	20.7	20.5	20.7	20.4	20.9	23.6	23.8	23.4	23.8	23.7
LTE 12	24.6	24.7	24.4	24.7	24.5	24.7	24.9	24.7	24.8	24.9	24.6
LTE 13	24.5	24.7	24.8	24.7	24.5	24.7	24.6	24.4	24.5	24.6	24.9
LTE 14	24.6	24.8	25.0	24.8	24.9	24.6	24.9	24.9	24.6	24.5	24.8
LTE 17	24.5	24.5	24.6	24.8	24.8	24.8	24.4	24.8	24.7	24.7	24.3
LTE 25	23.8	23.5	23.8	23.7	23.3	23.4	23.3	23.6	23.3	23.7	23.4
LTE 26	24.7	24.8	24.8	24.5	24.9	24.6	24.7	24.8	24.5	24.4	24.6
LTE 30	23.2	22.8	23.1	22.8	23.3	23.0	22.8	22.9	23.3	22.9	22.8
LTE 38	23.4	23.5	23.8	23.3	23.4	23.8	23.4	23.6	23.4	23.4	23.5
LTE 40	23.5	23.3	23.3	23.4	23.2	23.2	23.3	23.6	23.2	23.3	23.3
LTE 41	25.3	24.9	25.2	25.2	25.3	25.0	25.3	24.9	25.1	25.2	25.1
LTE 42	23.6	23.3	23.3	23.7	23.5	23.4	24.2	24.3	24.6	24.1	24.5
LTE 43	23.5	23.3	23.8	23.6	23.3	23.8	24.1	24.2	24.6	24.4	24.1
LTE 48	23.7	23.7	23.7	23.5	23.5	23.9	24.3	24.4	24.8	24.4	24.3
LTE 66	24.0	24.0	23.5	23.8	23.5	23.9	23.8	24.0	23.8	24.0	23.5
LTE 71	24.7	24.9	25.0	24.6	24.5	24.6	25.0	24.8	24.8	24.5	24.5
5G NR N2	23.7	23.8	23.7	23.7	23.6	24.0	23.6	23.9	23.6	23.6	23.5
5G NR N5	24.4	24.1	24.2	24.2	24.1	24.5	24.0	24.5	24.3	24.0	24.4
5G NR N7	23.6	23.9	23.9	23.9	23.8	24.0	24.0	24.0	23.7	23.7	23.8
5G NR N12	24.7	24.9	25.0	25.0	24.7	24.8	24.8	24.9	25.0	24.7	24.5
5G NR N13	23.7	23.3	23.6	23.3	23.5	23.7	23.6	23.7	23.2	23.7	23.4
5G NR N14	24.3	24.6	24.8	24.7	24.6	24.5	24.6	24.6	24.7	24.4	24.6
5G NR N25	23.8	23.7	24.0	23.9	24.0	23.7	24.0	24.0	23.8	23.6	23.8
5G NR N26	24.8	24.9	24.7	24.7	24.5	24.6	25.0	24.6	24.6	24.6	24.7
5G NR N30	23.8	23.4	23.9	23.4	23.6	23.6	23.7	23.6	23.7	23.5	23.6
5G NR N38	24.0	23.7	23.5	23.9	23.9	23.5	23.7	23.6	23.8	23.7	23.6
5G NR N41	25.8	25.8	26.1	25.7	25.7	25.9	25.8	26.1	25.9	26.2	26.0
5G NR N66	23.9	23.5	23.5	23.9	23.9	23.6	23.7	23.6	23.6	23.6	23.5
5G NR N71	24.6	24.2	24.2	24.2	24.5	24.4	24.3	24.4	24.3	24.6	24.5
5G NR N77	21.6	22.0	21.7	22.0	22.0	21.8	24.1	24.0	23.8	23.8	24.1
5G NR N78	22.1	22.3	22.4	22.3	22.1	22.4	24.7	24.4	24.7	24.9	24.9

SAR Test Report

Output Power Verification in dBm for EUT Front Face											
Distance (mm)	6	7	8	9	10	11	12	13	14	15	16
GSM850, GPRS 4Tx	32.5	32.8	32.8	32.6	32.8	32.9	32.8	32.7	32.8	32.7	32.5
GSM1900, GPRS 4Tx	29.9	29.5	29.6	29.6	29.5	30.0	29.9	30.0	29.8	29.9	29.7
WCDMA II	23.0	23.0	23.2	22.9	23.0	22.9	23.1	22.8	23.3	23.0	23.1
WCDMA IV	23.0	22.8	23.0	22.6	22.5	22.9	22.8	22.6	23.0	22.7	22.8
WCDMA V	23.6	24.0	23.9	23.8	23.8	23.8	24.1	23.7	24.1	23.9	23.8
CDMA BC0	23.4	23.9	23.6	23.4	23.6	23.7	23.8	23.9	23.9	23.8	23.7
CDMA BC1	23.5	23.5	23.5	23.9	23.6	23.8	23.4	23.5	23.5	23.5	23.8
CDMA BC10	23.4	23.5	23.8	23.6	23.4	23.5	23.5	23.5	23.7	23.9	23.4
LTE 2	23.6	23.7	23.5	23.4	23.5	23.5	23.6	23.7	23.9	23.6	23.6
LTE 4	23.6	23.7	23.5	24.0	23.5	24.0	24.0	24.0	24.0	23.9	23.5
LTE 5	24.9	24.7	24.8	24.8	24.8	25.0	24.5	24.5	24.7	24.7	25.0
LTE 7	20.9	20.8	20.6	20.4	20.4	20.9	23.6	23.3	23.4	23.8	23.4
LTE 12	24.8	24.5	24.6	24.4	24.5	24.8	24.5	24.7	24.8	24.9	24.9
LTE 13	24.4	24.5	24.9	24.5	24.9	24.4	24.6	24.4	24.8	24.7	24.4
LTE 14	24.9	24.7	24.5	24.7	24.9	24.8	25.0	24.9	24.6	24.9	25.0
LTE 17	24.4	24.6	24.6	24.7	24.7	24.7	24.8	24.6	24.8	24.3	24.5
LTE 25	23.4	23.4	23.3	23.6	23.8	23.3	23.5	23.5	23.8	23.8	23.7
LTE 26	24.4	24.9	24.6	24.9	24.8	24.4	24.5	24.5	24.6	24.5	24.8
LTE 30	23.1	23.2	23.0	22.8	23.2	23.3	23.0	22.9	22.8	23.2	23.3
LTE 38	23.7	23.7	23.7	23.6	23.7	23.5	23.7	23.4	23.7	23.6	23.5
LTE 41	24.9	25.3	25.1	24.9	25.1	25.1	24.9	24.8	24.8	24.9	25.1
LTE 42	23.4	23.4	23.7	23.3	23.3	23.6	24.3	24.4	24.5	24.4	24.2
LTE 43	23.5	23.5	23.8	23.6	23.4	23.7	24.2	24.1	24.5	24.4	24.4
LTE 48	23.4	23.5	23.4	23.8	23.7	23.4	24.6	24.6	24.5	24.8	24.5
LTE 66	24.0	23.7	23.9	23.8	23.9	23.9	23.8	23.9	23.6	24.0	23.9
LTE 71	24.8	24.5	24.8	24.9	24.8	24.7	25.0	25.0	25.0	24.6	24.9
5G NR N2	23.5	23.6	23.8	23.9	24.0	23.6	23.5	23.7	23.9	23.8	23.7
5G NR N5	24.5	24.3	24.5	24.5	24.1	24.5	24.2	24.5	24.1	24.5	24.1
5G NR N7	23.5	23.8	24.0	23.6	23.7	23.6	23.7	23.5	24.0	23.5	23.8
5G NR N12	24.8	24.6	24.6	24.9	24.9	24.6	24.6	24.6	25.0	24.7	24.5
5G NR N13	23.6	23.3	23.6	23.5	23.2	23.6	23.3	23.2	23.2	23.7	23.7
5G NR N14	24.3	24.5	24.8	24.3	24.3	24.5	24.8	24.4	24.6	24.3	24.3
5G NR N25	23.8	24.0	23.6	23.8	23.8	23.6	23.7	23.5	23.8	23.8	23.9
5G NR N26	24.5	25.0	24.9	24.9	24.8	25.0	24.6	24.8	24.8	24.5	24.5
5G NR N30	23.9	23.7	23.4	23.5	23.8	23.6	23.8	23.9	23.4	23.7	23.4
5G NR N38	23.5	23.8	23.6	23.7	23.9	23.7	23.8	23.5	23.6	23.6	23.6
5G NR N41	26.1	25.9	25.9	25.8	26.0	26.2	26.2	25.8	26.0	25.7	25.9
5G NR N66	23.9	23.8	23.8	23.5	24.0	23.5	23.8	23.9	23.6	23.7	23.7
5G NR N71	24.6	24.6	24.2	24.6	24.1	24.3	24.2	24.5	24.5	24.6	24.5
5G NR N77	21.5	21.7	21.6	22.0	21.6	22.0	24.3	23.9	24.3	23.9	23.9
5G NR N78	22.0	22.0	22.3	22.0	22.0	22.0	24.8	24.9	24.5	24.6	24.9

SAR Test Report

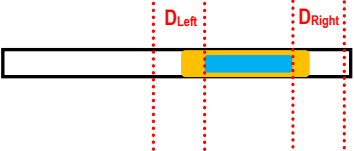
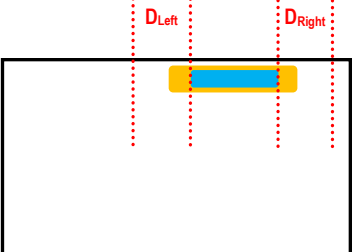
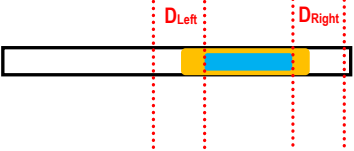
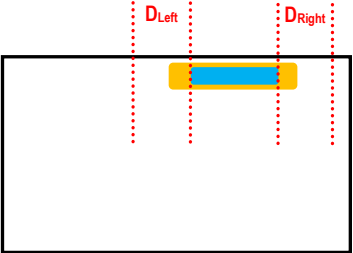
Output Power Verification in dBm for EUT Right Edge											
Distance (mm)	6	7	8	9	10	11	12	13	14	15	16
GSM850, GPRS 4Tx	32.8	32.6	32.6	32.5	32.9	32.6	32.8	32.4	32.7	32.9	32.5
GSM1900, GPRS 4Tx	29.5	29.9	29.9	30.0	29.7	29.9	29.9	29.5	29.8	29.7	29.9
WCDMA II	23.2	22.8	22.8	23.1	22.9	22.8	22.9	22.9	23.0	23.3	22.8
WCDMA IV	22.6	22.6	22.9	22.6	22.8	23.0	23.0	22.8	22.7	22.6	22.9
WCDMA V	23.8	24.0	23.8	23.8	24.0	24.0	24.1	23.7	24.0	24.0	24.0
CDMA BC0	23.5	23.4	23.6	23.8	23.7	23.7	23.5	23.8	23.7	23.7	23.4
CDMA BC1	23.7	23.9	23.4	23.8	23.8	23.8	23.4	23.7	23.8	23.8	23.4
CDMA BC10	23.6	23.7	23.7	23.8	23.9	23.8	23.6	23.9	23.5	23.4	23.6
LTE 2	23.7	23.4	23.9	23.7	23.7	23.9	23.9	23.4	23.5	23.5	23.6
LTE 4	23.8	23.7	23.5	24.0	24.0	24.0	23.8	24.0	23.6	23.6	23.6
LTE 5	24.9	24.9	24.5	24.5	24.7	24.5	24.8	24.9	25.0	24.5	24.9
LTE 7	20.6	20.5	20.8	20.5	20.8	20.9	23.6	23.8	23.3	23.8	23.5
LTE 12	24.6	24.4	24.9	24.8	24.8	24.9	24.5	24.7	24.6	24.5	24.4
LTE 13	24.5	24.4	24.8	24.5	24.7	24.4	24.6	24.8	24.9	24.9	24.8
LTE 14	24.6	24.8	24.7	24.5	25.0	24.9	24.9	24.7	24.6	24.5	24.7
LTE 17	24.5	24.4	24.7	24.5	24.8	24.7	24.5	24.8	24.4	24.4	24.3
LTE 25	23.8	23.5	23.6	23.7	23.7	23.8	23.5	23.6	23.8	23.8	23.7
LTE 26	24.4	24.7	24.5	24.7	24.5	24.5	24.6	24.6	24.4	24.4	24.9
LTE 30	22.9	23.0	22.9	23.1	22.9	23.0	23.1	23.2	23.3	23.3	23.3
LTE 38	23.7	23.4	23.7	23.6	23.6	23.6	23.3	23.8	23.7	23.5	23.3
LTE 41	24.9	25.0	25.1	25.3	25.0	24.8	25.1	24.9	24.8	24.9	25.2
LTE 42	23.6	23.5	23.8	23.3	23.8	23.7	24.4	24.6	24.3	24.3	24.3
LTE 43	23.5	23.7	23.4	23.4	23.4	23.5	24.5	24.5	24.1	24.3	24.1
LTE 48	23.9	23.8	23.6	23.6	23.7	23.7	24.5	24.6	24.4	24.7	24.3
LTE 66	23.5	23.6	23.5	23.8	23.7	23.9	23.8	23.7	23.9	23.6	23.6
LTE 71	25.0	24.8	24.8	24.8	24.7	24.6	25.0	25.0	24.7	24.6	24.9
5G NR N2	23.8	23.8	23.8	23.7	23.8	23.6	23.7	23.9	23.8	23.9	23.6
5G NR N5	24.5	24.5	24.2	24.4	24.1	24.0	24.1	24.2	24.5	24.2	24.5
5G NR N7	23.5	23.9	23.9	23.9	23.7	23.6	23.9	23.7	23.6	23.9	23.6
5G NR N12	24.9	24.8	24.5	24.5	24.8	24.5	25.0	24.7	25.0	24.6	24.6
5G NR N13	23.7	23.6	23.4	23.3	23.2	23.6	23.3	23.3	23.2	23.3	23.7
5G NR N14	24.4	24.4	24.7	24.4	24.4	24.5	24.3	24.7	24.6	24.6	24.5
5G NR N25	23.5	24.0	23.7	23.7	23.7	23.7	23.6	23.8	23.8	23.8	23.5
5G NR N26	24.7	24.7	24.6	24.9	24.5	24.7	24.8	25.0	24.8	24.9	24.5
5G NR N30	23.6	23.4	23.5	23.5	23.7	23.4	23.5	23.5	23.4	23.8	23.5
5G NR N38	23.6	23.5	23.5	24.0	23.9	23.6	23.6	23.9	23.9	23.7	23.9
5G NR N41	26.0	25.8	26.0	25.7	26.1	26.0	26.2	26.2	25.7	25.8	26.2
5G NR N66	23.6	23.7	23.6	23.9	23.9	23.6	23.8	24.0	23.6	24.0	23.9
5G NR N71	24.6	24.4	24.6	24.2	24.4	24.1	24.5	24.6	24.4	24.2	24.6
5G NR N77	21.9	22.0	21.8	21.8	21.5	21.6	23.9	24.2	24.1	23.8	24.0
5G NR N78	22.0	22.4	22.2	22.3	22.3	22.4	24.6	24.5	24.6	24.4	24.4

SAR Test Report

Proximity Sensor Coverage (KDB 616217 D04 §6.3)

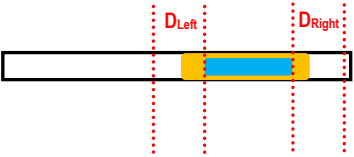
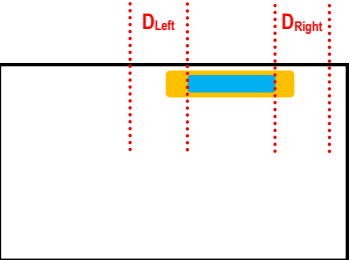
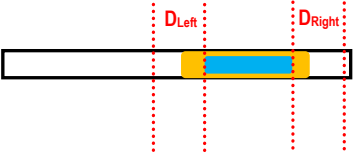
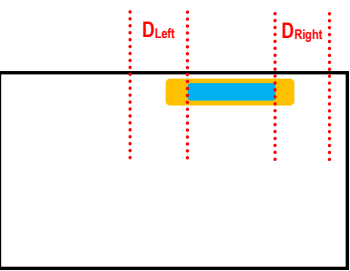
The proximity sensor coverage was determined per KDB 616217 for rear face and applicable edge. Summary for proximity sensor active region is illustrated in below.

Ant 0

	
P-sensor Coverage for Rear Face: D_{Left} is 3 mm, D_{Right} is 3 mm	P-sensor Coverage for Front Face: D_{Left} is 2 mm, D_{Right} is 2 mm
	
P-sensor Coverage for Top Side: D_{Left} is 3 mm, D_{Right} is 2 mm	P-sensor Coverage for Right Side: D_{Left} is 3 mm, D_{Right} is 2 mm

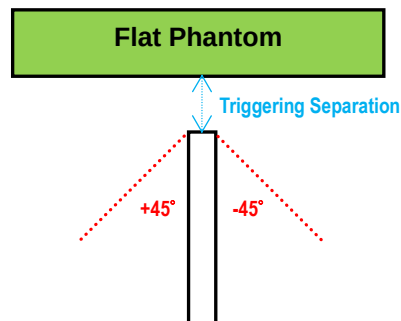
SAR Test Report

Ant 3

 Antenna	 Antenna
P-sensor Coverage for Rear Face: D_{Left} is 3 mm, D_{Right} is 3 mm	P-sensor Coverage for Front Face: D_{Left} is 3 mm, D_{Right} is 2 mm
 Antenna	 Antenna
P-sensor Coverage for Top Side: D_{Left} is 4 mm, D_{Right} is 3 mm	P-sensor Coverage for Left Side: D_{Left} is 3 mm, D_{Right} is 2 mm

Proximity Sensor Tilt Angle Influences (KDB 616217 D04 §6.4)

The proximity sensor tilt angle influence was determined per KDB 616217 for applicable edge. Summary for proximity sensor tilt angle influence is shown in below.



Ant 0

Orientation	Separation Distance (mm)	Tilt Angle										
		-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
Top Edge	14	On	On	On	On	On	On	On	On	On	On	On
Right Edge	13	On	On	On	On	On	On	On	On	On	On	On

Ant 1

Orientation	Separation Distance (mm)	Tilt Angle										
		-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
Top Edge	12	On	On	On	On	On	On	On	On	On	On	On
Left Edge	11	On	On	On	On	On	On	On	On	On	On	On

SAR Test Report

Summary for Proximity Sensor Triggering Test

Ant 0

According to the procedures noticed in KDB 616217 D04, the proximity sensor triggering distance is 14 mm for EUT Top Side, and 13 mm for Right Side. The separation distance of 14 mm determined by the smallest triggering distance on Top Side is used to access the tilt angle influence and the sensor does not release during ± 45 degree. Therefore, the smallest separation distance for tilt angle influence is 13 mm for the Right Side. The conservation triggering distances based on the separation distance for the sensor trigger / not triggered as EUT with power reduction at 0 mm, and EUT without power reduction at 14 mm for EUT Top Side, and 13 mm for Right Side were used to test SAR.

Ant 1

According to the procedures noticed in KDB 616217 D04, the proximity sensor triggering distance is 12 mm for EUT Top Side, and 11 mm for Left Side. The separation distance of 12 mm determined by the smallest triggering distance on Top Side is used to access the tilt angle influence and the sensor does not release during ± 45 degree. Therefore, the smallest separation distance for tilt angle influence is 11 mm for the Left Side. The conservation triggering distances based on the separation distance for the sensor trigger / not triggered as EUT with power reduction at 0 mm, and EUT without power reduction at 12 mm for EUT Top Side, and 11 mm for Left Side were used to test SAR.

The power reduction is depends on the proximity sensor input. For a steady SAR test, the power reduction was enabled or disabled manually by engineering software during SAR testing.

SAR Test Report

<Connections between EUT and System Simulator>

For WWAN SAR testing, the EUT was linked and controlled by base station emulator. Communication between the EUT and the emulator was established by air link. The distance between the EUT and the communicating antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT. The EUT was set from the emulator to radiate maximum output power during SAR testing.

<Considerations Related to GSM / GPRS / EDGE for Setup and Testing>

The maximum multi-slot capability supported by this device is as below.

1. This EUT is class B device
2. This EUT supports GPRS multi-slot class 33 (max. uplink: 4, max. downlink: 5, total timeslots: 6)
3. This EUT supports EDGE multi-slot class 33 (max. uplink: 4, max. downlink: 5, total timeslots: 6)

For GSM850 frequency band, the power control level is set to 5 for GSM mode and GPRS (GMSK: CS1), and set to 8 for EDGE (GMSK: MCS1, 8PSK: MCS9). For GSM1900 frequency band, the power control level is set to 0 for GSM mode and GPRS (GMSK: CS1), and set to 2 for EDGE (GMSK: MCS1, 8PSK: MCS9).

SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested.

SAR Test Report

<Considerations Related to WCDMA for Setup and Testing>

WCDMA Handsets Head SAR

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode.

WCDMA Handsets Body-worn SAR

SAR for body-worn configurations is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCH_n configurations supported by the handset with 12.2 kbps RMC as the primary mode.

Handsets with Release 5 HSDPA

The 3G SAR test reduction procedure is applied to HSDPA body-worn configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSDPA using the HSDPA body SAR procedures in the "Release 5 HSDPA Data Devices", for the highest reported SAR body-worn exposure configuration in 12.2 kbps RMC. Handsets with both HSDPA and HSUPA are tested according to Release 6 HSPA test procedures.

Handsets with Release 6 HSUPA

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body-worn configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures in the "Release 6 HSPA Data Devices", for the highest reported body-worn exposure SAR configuration in 12.2 kbps RMC. When VOIP is applicable for next to the ear head exposure in HSPA, the 3G SAR test reduction procedure is applied to HSPA with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body-worn measurements is tested for next to the ear head exposure.

Release 5 HSDPA Data Devices

The 3G SAR test reduction procedure is applied to body SAR with 12.2 kbps RMC as the primary mode. Otherwise, body SAR for HSDPA is measured using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, for the highest reported SAR configuration in 12.2 kbps RMC without HSDPA. HSDPA is configured according to the applicable UE category of a test device. The number of HS-DSCH / HS-PDSCHs, HARQ processes, minimum inter-TTI interval, transport block sizes and RV coding sequence are defined by the H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the H-set for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 4 ms and a CQI repetition factor of 2 to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors (β_c , β_d), and HS-DPCCH power offset parameters (Δ_{ACK} , Δ_{NACK} , Δ_{CQI}) are set according to values indicated in below. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the H-set.

SAR Test Report

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	$\beta_{HS}^{(1)(2)}$	CM ⁽³⁾ (dB)	MPR ⁽³⁾ (dB)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 ⁽⁴⁾	15/15 ⁽⁴⁾	64	12/15 ⁽⁴⁾	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and $\Delta_{NACK} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$, and $\Delta_{CQI} = 24/15$ with $\beta_{HS} = 24/15 * \beta_c$.

Note 3: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{HS}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$.

Release 6 HSPA Data Devices

The 3G SAR test reduction procedure is applied to body SAR with 12.2 kbps RMC as the primary mode. Otherwise, body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 and power control algorithm 2, according to the highest reported body SAR configuration in 12.2 kbps RMC without HSPA. When VOIP applies to head exposure, the 3G SAR test reduction procedure is applied with 12.2 kbps RMC as the primary mode. Otherwise, the same HSPA configuration used for body SAR measurements are applied to head exposure testing. Due to inner loop power control requirements in HSPA, a communication test set is required for output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA are configured according to the β values indicated in below.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	$\beta_{HS}^{(1)}$	β_{ec}	$\beta_{ed}^{(4)(5)}$	β_{ed} (SF)	β_{ed} (Codes)	CM ⁽²⁾ (dB)	MPR ⁽²⁾⁽⁶⁾ (dB)	AG ⁽⁵⁾ Index	E-TFCI
1	11/15 ⁽³⁾	15/15 ⁽³⁾	64	11/15 ⁽³⁾	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed1}: 47/15$ $\beta_{ed2}: 47/15$	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15	0	-	-	5/15	5/15	47/15	4	1	1.0	0.0	12	67

Note 1: For sub-test 1 to 4, Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$. For sub-test 5, Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 5/15$ with $\beta_{HS} = 5/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{HS}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

Note 4: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 5: β_{ed} can not be set directly; it is set by Absolute Grant Value.

Note 6: For subtests 2, 3 and 4, UE may perform E-DPDCH power scaling at max power which could results in slightly smaller MPR values.

SAR Test Report

HSPA+ SAR Guidance

The 3G SAR test reduction procedure is applied to HSPA+(uplink) with 12.2 kbps RMC as the primary mode. Otherwise, when SAR is required for Rel. 6 HSPA, SAR is required for Rel. 7 HSPA+. Power is measured for HSPA+ that supports uplink 16QAM according to configurations in Table C.11.1.4 of 3GPP TS 34.121-1 to determine SAR test reduction.

Sub-test	$\beta_c^{(3)}$	β_d	$\beta_{HS}^{(1)}$	β_{ec}	$\beta_{ed}^{(4)}$ (2xSF2)	$\beta_{ed}^{(4)}$ (2xSF4)	CM ⁽²⁾ (dB)	MPR ⁽²⁾ (dB)	AG ⁽⁴⁾ Index	E-TFCI ⁽⁵⁾	E-TFCI (boost)
1	1	0	30/15	30/15	β_{ed1} : 30/15 β_{ed2} : 30/15	β_{ed3} : 24/15 β_{ed4} : 24/15	3.5	2.5	14	105	105

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$.
Note 2: CM = 3.5 and the MPR is based on the relative CM difference, MPR = MAX(CM-1,0).
Note 3: DPDCH is not configured, therefore the β_c is set to 1 and $\beta_d = 0$ by default.
Note 4: β_{ec} can not be set directly; it is set by Absolute Grant Value.
Note 5: All the sub-tests require the UE to transmit 2SF2+2SF4 16QAM EDCH and they apply for UE using E-DPDCH category 7. E-DCH TTI is set to 2ms TTI and E-DCH table index = 2. To support these E-DCH configurations DPDCH is not allocated. The UE is signalled to use the extrapolation algorithm.

DC-HSDPA SAR Guidance

The 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Otherwise, when SAR is required for Rel. 5 HSDPA, SAR is required for Rel. 8 DC-HSDPA. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.

<Considerations Related to CDMA for Setup and Testing>

CDMA 1xRTT Handsets Head SAR

SAR for next to the ear head exposure is measured in RC3 with the handset configured to transmit at full rate in SO55. The 3G SAR test reduction procedure is applied to RC1 with RC3 as the primary mode. Otherwise, SAR is required for the channel with maximum measured output in RC1 using the head exposure configuration that results in the highest reported SAR in RC3.

CDMA 1xRTT Handsets Body-worn SAR

Body-worn SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCH_n), with FCH only as the primary mode. Otherwise, SAR is required for multiple code channel configuration (FCH + SCH_n), with FCH at full rate and SCH₀ enabled at 9600 bps, using the highest reported SAR configuration for FCH only. The 3G SAR test reduction procedure is applied to body-worn SAR in RC1 with RC3 as the primary mode. Otherwise, SAR is required for RC1, with SO55 and full rate, using the highest reported SAR configuration for body-worn exposure in RC3.

Handsets with built-in EV-DO

The 3G SAR test reduction procedure is applied to EV-DO Rev. 0 with 1xRTT RC3 as the primary mode to determine body-worn test requirements. Otherwise, body-worn SAR is required for Rev. 0, at 153.6 kbps, using the highest reported SAR configuration for body-worn exposure in RC3. The 3G SAR test reduction procedure is applied separately to Rev. A and Rev. B, with Rev. 0 as the primary mode to determine body-worn SAR test requirements. When SAR is not required for Rev. 0, the 3G SAR test reduction is applied with 1xRTT RC3 as the primary mode. Otherwise, SAR is required for Rev. A or Rev. B, with a Reverse Data Channel payload size of 4096 bits and a Termination Target of 16 slots defined for Subtype 2 and 3 Physical Layer configurations, using the highest reported SAR configuration for body-worn exposure in Rev. 0 or RC3, as appropriate. A Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with ACK Channel transmitting in all slots is configured in the downlink for Rev. 0, Rev. A and Rev. B.

EV-DO Data Devices

SAR is measured using the F/R TAP configurations required for Rev. 0, Rev. A and Rev. B. The AT is tested with a Reverse Data Channel rate of 153.6 kbps in Subtype 0/1 Physical Layer configurations. A Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots are used for Subtype 2 and 3. FTAP, FETAP and FMCTAP are all configured with a Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with ACK Channel transmitting in all slots. AT power control is in "All Bits Up" conditions for the TAP/ETAP/MCTAP. Body-worn and other body SAR are measured using Subtype 0/1 Physical Layer configurations for Rev. 0. The 3G SAR test reduction procedure is applied to Rev. A, Subtype 2 Physical layer configuration, with Rev. 0 as the primary mode. Otherwise, SAR is measured for Rev. A using the highest reported SAR configuration for body-worn exposure in Rev. 0. SAR is required for Rev. B, Subtype 3; it is measured by applying both the "test 2" and "test 3" configurations used for power measurement.

EV-DO Data Devices Support 1xRTT

The 3G SAR test reduction procedure is applied to 1xRTT RC3 and RC1 with EV-DO Rev. 0, Rev. A and Rev. B as the respective primary modes. Otherwise, the "CDMA 1xRTT Handsets Body-worn SAR" procedures are applied.

1x-Advanced SAR Guidance

The 3G SAR test reduction procedure is applied to 1x-Advanced with 1xRTT RC3 as the primary mode. When SAR measurement is required, the 1x-Advanced power measurement configurations are used. The 1x Advanced SAR procedures are applied separately to head, body-worn and other exposure conditions.

SAR Test Report

<Considerations Related to LTE for Setup and Testing>

This device contains LTE transmitter which follows 3GPP standards, is category 3, supports both QPSK and 16QAM modulations, and supported LTE band and channel bandwidth is listed in below. The output power was tested per 3GPP TS 36.521-1 maximum transmit procedures for both QPSK and 16QAM modulation. The results please refer to section 4.6 of this report.

EUT Supported LTE Band and Channel Bandwidth						
LTE Band	BW 1.4 MHz	BW 3 MHz	BW 5 MHz	BW 10 MHz	BW 15 MHz	BW 20 MHz
2	V	V	V	V	V	V
4	V	V	V	V	V	V
5	V	V	V	V		
7			V	V	V	V
12	V	V	V	V		
13			V	V		
14			V	V		
17			V	V		
25	V	V	V	V	V	V
26	V	V	V	V	V	
30			V	V		
38			V	V	V	V
41			V	V	V	V
42			V	V	V	V
43			V	V	V	V
66	V	V	V	V	V	V
71			V	V	V	V

The LTE maximum power reduction (MPR) in accordance with 3GPP TS 36.101 is active all times during LTE operation. The allowed MPR for the maximum output power is specified in below.

Modulation	Channel Bandwidth / RB Configurations						LTE MPR Setting (dB)
	BW 1.4 MHz	BW 3 MHz	BW 5 MHz	BW 10 MHz	BW 15 MHz	BW 20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1
16QAM	<= 5	<= 4	<= 8	<= 12	<= 16	<= 18	1
16QAM	> 5	> 4	> 8	> 12	> 16	> 18	2
64QAM	<= 5	<= 4	<= 8	<= 12	<= 16	<= 18	2
64QAM	> 5	> 4	> 8	> 12	> 16	> 18	3
256QAM	>= 1						5

Note: MPR is according to the standard and implemented in the circuit (mandatory).

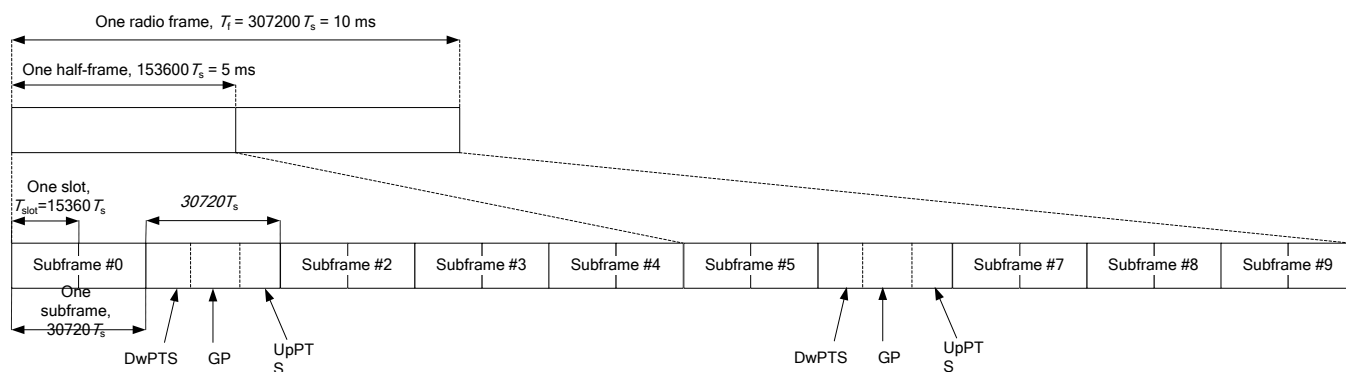
In addition, the device is compliant with additional maximum power reduction (A-MPR) requirements defined in 3GPP TS 36.101 section 6.2.4 that was disabled for all FCC compliance testing.

During LTE SAR testing, the related parameters of operating band, channel bandwidth, uplink channel number, modulation type, and RB was set in base station simulator. When the EUT has registered and communicated to base station simulator, the simulator set to make EUT transmitting the maximum radiated power.

SAR Test Report

TDD-LTE Setup Configurations

According to KDB 941225 D05, SAR testing for TDD-LTE device must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP TDD-LTE configurations. The TDD-LTE of this device supports frame structure type 2 defined in 3GPP TS 36.211 section 4.2, and the frame structure configuration can be referred to below.



3GPP TS 36.211 Figure 4.2-1: Frame Structure Type 2

Special Subframe Configuration	Normal Cyclic Prefix in Downlink			Extended Cyclic Prefix in Downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal Cyclic Prefix in Uplink	Extended Cyclic Prefix in Uplink		Normal Cyclic Prefix in Uplink	Extended Cyclic Prefix in Uplink
0	6592 • Ts	2192 • Ts	2560 • Ts	7680 • Ts	2192 • Ts	2560 • Ts
1	19760 • Ts			20480 • Ts		
2	21952 • Ts			23040 • Ts		
3	24144 • Ts			25600 • Ts		
4	26336 • Ts	4384 • Ts	5120 • Ts	7680 • Ts	4384 • Ts	5120 • Ts
5	6592 • Ts			20480 • Ts		
6	19760 • Ts			23040 • Ts		
7	21952 • Ts			12800 • Ts		
8	24144 • Ts	-	-	-	-	-
9	13168 • Ts			-	-	-

3GPP TS 36.211 Table 4.2-1: Configuration of Special Subframe

SAR Test Report

Uplink-Downlink Configuration	Downlink-to-Uplink Switch-Point Periodicity	Subframe Number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

3GPP TS 36.211 Table 4.2-2: Uplink-Downlink Configurations

The variety of different TD-LTE uplink-downlink configurations allows a network operator to allocate the network's capacity between uplink and downlink traffic to meet the needs of the network. The uplink duty cycle of these seven configurations can readily be computed and shown in below.

UL-DL Configuration	0	1	2	3	4	5	6
Highest Duty-Cycle	63.33%	43.33%	23.33%	31.67%	21.67%	11.67%	53.33%

Considering the highest transmission duty cycle, TDD-LTE was tested using Uplink-Downlink Configuration 0 with 6 uplink subframe and 2 special subframe. The special subframe was set to special subframe configuration 7 using extended cyclic prefix uplink. Therefore, SAR testing for TDD-LTE was performed at the maximum output power with highest transmission duty cycle of 63.33%.

Considering the highest transmission duty cycle, TDD-LTE was tested using Uplink-Downlink Configuration 6 with 5 uplink subframe and 2 special subframe. The special subframe was set to special subframe configuration 7 using extended cyclic prefix uplink. Therefore, SAR testing for TDD-LTE was performed at the maximum output power with highest transmission duty cycle of 53.33%.

LTE Downlink Carrier Aggregation(CA) Setup Configurations

LTE Carrier Aggregation (CA) was defined in 3GPP release 10 and higher. The LTE device in CA mode has one Primary Component Carrier (PCC) and one or more Secondary Component Carriers (SCC). PCC acts as the anchor carrier and can optionally cross-schedule data transmission on SCC. The RRC connection is only handled by one cell, the PCC for downlink and uplink communications. After making a data connection to the PCC, the LTE device adds the SCC on the downlink only. All uplink communications and acknowledgements remain identical to release 8 specifications on the PCC. The combinations of downlink carrier aggregation supported by this device are listed in below.

Refer to Appendix H

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LTE Uplink Carrier Aggregation (CA) Setup Configurations

This device supports LTE uplink CA for band 41 only with a maximum of two 20 MHz carrier components in the uplink. The maximum output power for uplink intra-band contiguous CA specified in Table 6.2.2A-1 of 3GPP TS 36.101 is the same as single carrier specified in Table 6.2.2-1 of 3GPP TS 36.101. In Table 6.2.3A-1 of 3GPP TS 36.101, the MPR (maximum power reduction) for several dB is allowed due to modulation and contiguously aggregated transmit bandwidth configuration. All the RF parameters in this device have followed above 3GPP criteria.

This device does not support full CA (Carrier Aggregation) features on 3GPP release 12. Its capability for LTE CA is for LTE band 41 only and supported configuration is shown in above. For network enhancement features, it does not support Wi-Fi Offloading, Enhanced SC-FDMA, Uplink MIMO, CoMP, HetNet, Relay, SON, Cross-Carrier Scheduling, eICIC, Enhanced Downlink MIMO, MBMS, M2M/D2D. All other uplink communications are identical to the LTE Release 8 specifications.

<Considerations Related to WLAN for Setup and Testing>

In general, various vendor specific external test software and chipset based internal test modes are typically used for SAR measurement. These chipset based test mode utilities are generally hardware and manufacturer dependent, and often include substantial flexibility to reconfigure or reprogram a device. A Wi-Fi device must be configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools for SAR measurement. The test frequencies established using test mode must correspond to the actual channel frequencies. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. In addition, a periodic transmission duty factor is required for current generation SAR systems to measure SAR correctly. The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

According to KDB 248227 D01, this device has installed WLAN engineering testing software which can provide continuous transmitting RF signal. During WLAN SAR testing, this device was operated to transmit continuously at the maximum transmission duty with specified transmission mode, operating frequency, lowest data rate, and maximum output power.

Initial Test Configuration

An initial test configuration is determined for OFDM transmission modes in 2.4 GHz and 5 GHz bands according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. 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 in the initial test configuration, for each frequency band.

Subsequent Test Configuration

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units. Additional power measurements may be required to determine if SAR measurements are required for subsequent highest output power channels in a subsequent test configuration. When the highest reported SAR for the initial test configuration according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for that subsequent test configuration.

SAR Test Configuration and Channel Selection

When multiple channel bandwidth configurations in a frequency band have the same specified maximum output power, the initial test configuration is using largest channel bandwidth, lowest order modulation, lowest data rate, and lowest order 802.11 mode (i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n). After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following.

- 1) The channel closest to mid-band frequency is selected for SAR measurement.
- 2) For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

Test Reduction for U-NII-1 (5.2 GHz) and U-NII-2A (5.3 GHz) Bands

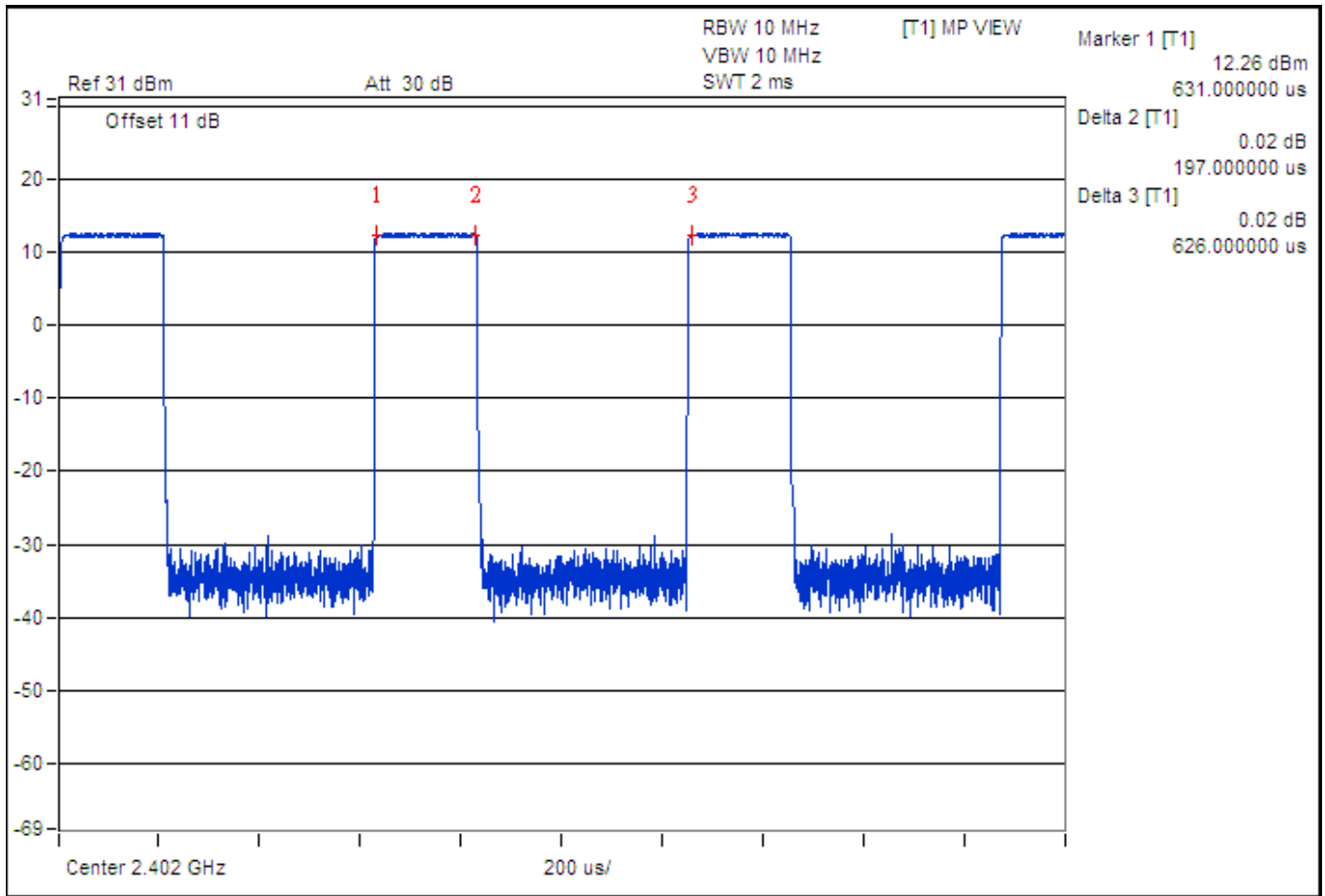
For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following.

- 1) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition).
- 2) When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration.

<Considerations Related to Bluetooth for Setup and Testing>

This device has installed Bluetooth engineering testing software which can provide continuous transmitting RF signal. During Bluetooth SAR testing, this device was operated to transmit continuously at the maximum transmission duty with specified transmission mode, operating frequency, lowest data rate, and maximum output power.

The Bluetooth call box has been used during SAR measurement and the EUT was set to DH5 mode at the maximum output power. Its duty factor was calculated as below and the measured SAR for Bluetooth would be scaled to the 100% transmission duty factor to determine compliance.



Time-domain plot for Bluetooth transmission signal

The duty factor of Bluetooth signal has been calculated as following.

Duty Factor = Pulse Width / Total Period = 197 / 626 = 31.5 %

5.2 EUT Testing Position

This variant report is made for verification. All the worst SAR configurations specified in the original SAR report was repeated and verified to ensure the device remains compliant.

According to KDB 648474 D04, handsets are tested for SAR compliance in head, body-worn accessory and other use configurations described in the following subsections.

5.2.1 Head Exposure Conditions

Head exposure is limited to next to the ear voice mode operations. Head SAR compliance is tested according to the test positions defined in IEEE Std 1528-2003 using the SAM phantom illustrated as below.

1. Define two imaginary lines on the handset
 - (a) The vertical centerline passes through two points on the front side of the handset - the midpoint of the width w_t of the handset at the level of the acoustic output, and the midpoint of the width w_b of the bottom of the handset.
 - (b) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.
 - (c) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.

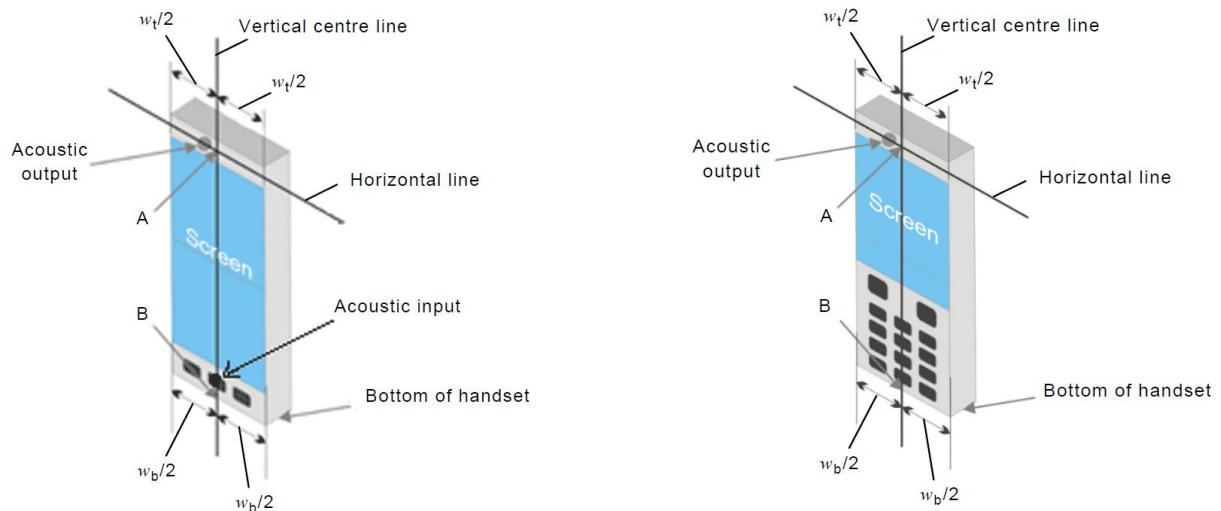


Fig-4.1 Illustration for Handset Vertical and Horizontal Reference Lines

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2. Cheek Position

- To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.
- To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see Fig-4.2).

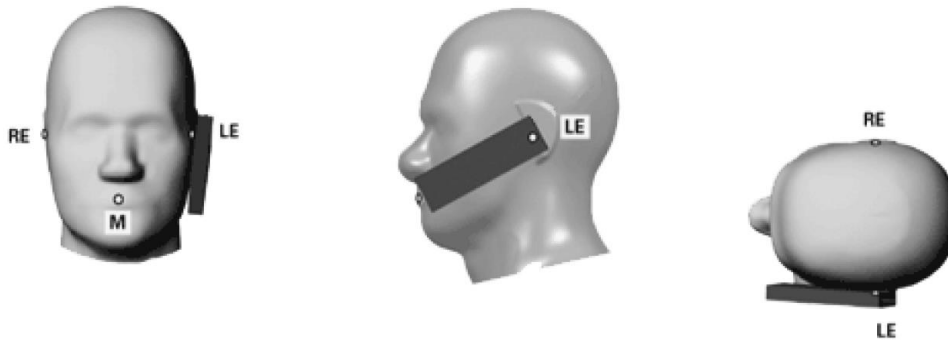


Fig-4.2 Illustration for Cheek Position

3. Tilted Position

- To position the device in the “cheek” position described above.
- While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig-4.3).

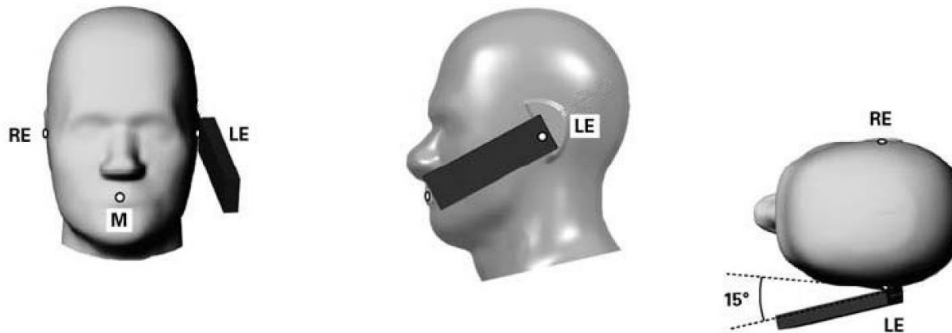


Fig-4.3 Illustration for Tilted Position

5.2.2 Body-worn Accessory Exposure Conditions

Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in KDB 447498 are used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is $> 1.2 \text{ W/kg}$, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Body-worn accessories that do not contain metallic or conductive components may be tested according to worst-case exposure configurations, typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics. All body-worn accessories containing metallic components are tested in conjunction with the host device.

Body-worn accessory SAR compliance is based on a single minimum test separation distance for all wireless and operating modes applicable to each body-worn accessory used by the host, and according to the relevant voice and/or data mode transmissions and operations. If a body-worn accessory supports voice only operations in its normal and expected use conditions, testing of data mode for body-worn compliance is not required.

A conservative minimum test separation distance for supporting off-the-shelf body-worn accessories that may be acquired by users of consumer handsets is used to test for body-worn accessory SAR compliance. This distance is determined by the handset manufacturer, according to the requirements of Supplement C 01-01. Devices that are designed to operate on the body of users using lanyards and straps, or without requiring additional body-worn accessories, will be tested using a conservative minimum test separation distance $\leq 5 \text{ mm}$ to support compliance.

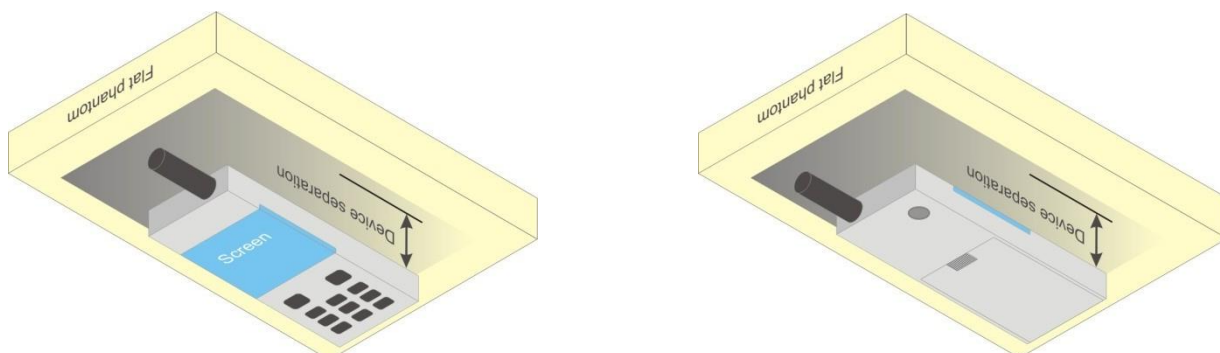
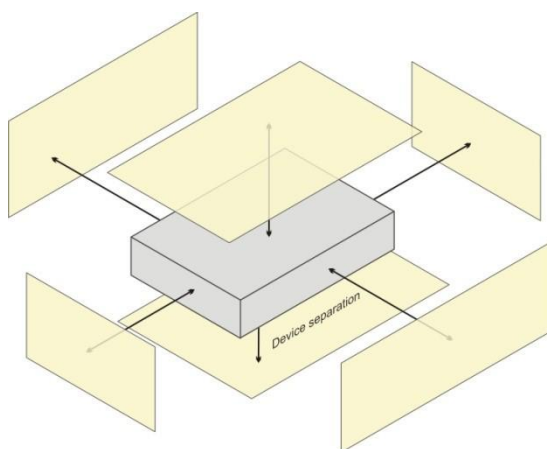


Fig-4.4 Illustration for Body Worn Position

5.2.3 Hotspot Mode Exposure Conditions

For handsets that support hotspot mode operations, with wireless router capabilities and various web browsing functions, the relevant hand and body exposure conditions are tested according to the hotspot SAR procedures in KDB 941225 D06. A test separation distance of 10 mm is required between the phantom and all surfaces and edges with a transmitting antenna located within 25 mm from that surface or edge. When the form factor of a handset is smaller than 9 cm x 5 cm, a test separation distance of 5 mm (instead of 10 mm) is required for testing hotspot mode. When the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, in the same wireless mode and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface).



Based on the antenna location shown on appendix D of this report, the SAR testing required for hotspot mode is listed as below.

Antenna	Front Face	Rear Face	Left Side	Right Side	Top Side	Bottom Side
WWAN Ant-0	V	V	V	V		V
WWAN Ant-1	V	V	V		V	
WLAN / BT	V	V		V	V	

5.2.4 Product Specific (Phablet) Exposure Conditions

For smart phones with a display diagonal dimension > 15 cm or an overall diagonal dimension > 16 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance.

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.
2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g SAR > 1.2 W/kg. The normal tablet procedures in KDB 616217 are required when the over diagonal dimension of the device is > 20 cm. Hotspot mode SAR is not required when normal tablet procedures are applied. Extremity 10-g SAR is also not required for the front (top) surface of large form factor full size tablets. The more conservative tablet SAR results can be used to support the 10-g extremity SAR for phablet mode.
3. The simultaneous transmission operating configurations applicable to voice and data transmissions for both phone and mini-tablet modes must be taken into consideration separately for 1-g and 10-g SAR to determine the simultaneous transmission SAR test exclusion and measurement requirements for the relevant wireless modes and exposure conditions.

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5.3 Tissue Verification

Refer to Appendix A

5.4 System Validation

Refer to Appendix A

5.5 System Verification

Refer to Appendix A-1

5.6 System Verification for Power Density

Refer to Appendix L.

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5.7 Maximum Output Power

5.7.1 Time-Averaging Algorithm for RF Exposure Compliance

The P_{limit} is calculated by linearly scaling with the measured SAR at the P_{max} to correspond to the SAR_{design_target} . The P_{limit} determination for each exposure scenario corresponding to SAR_{design_target} are shown in below.

Device State Index (DSI)	P_{limit} Determination Scenarios
DSI = 0	The worst-case SAR exposure is determined as maximum SAR normalized to the limit among: 1. Body-worn SAR 2. Extremity SAR measured at 10 mm spacing
DSI = 1	P_{limit} is calculated based on 1g Head SAR
DSI = 2	P_{limit} is calculated based on 1g Hotspot SAR at 10 mm
DSI = 3	P_{limit} is calculated based on 10g Extremity SAR at 0 mm

Note :

For DSI = 0, P_{limit} is calculated by

$$P_{limit} = \min \{ P_{limit} \text{ corresponding to 1g Body-worn SAR evaluation at 15 mm spacing, } P_{limit} \text{ corresponding to 10g Extremity SAR evaluation at 10 mm spacing } \}$$

The Smart Transmit algorithm maintains the time-averaged transmit power, in turn, time-averaged RF exposure of SAR_{design_target} , below the predefined time-averaged power limit (i.e., P_{limit} for sub-6 radio), for each characterized technology and band (see RF Exposure Part 0 Test Report, report SFBFLF-WTW-P21010278-2).

Smart Transmit allows the device to transmit at higher power instantaneously, as high as P_{max} , when needed, but enforces power limiting to maintain time-averaged transmit power to P_{limit} . Below table shows P_{limit} EFS settings and maximum tune up output power P_{max} configured for this EUT for various transmit conditions (Device State Index DSI). Note that the device uncertainty for sub-6GHz WWAN is 1.0dB for this EUT.

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SAR Characterizations

Exposure Scenario		Head	Body-worn	Hotspot	Phablet (Grip off)	Phablet (Grip On)	Pmax
Averaging Volume		1g	1g	1g	10g	10g	
DSI		1	0	2	0	3	
Test Distance (mm)		0	15	10	10	0	
WWAN Bands	Antenna	Plimit					
GSM850	0	29.8	30.0	27.5	30.0	27.5	28.8
GSM1900	1	35.2	28.7	27.0	28.7	27.0	25.8
WCDMA Band II	1	30.6	26.6	23.8	26.6	23.8	23.0
	2	23.2	30.7	24.6	30.7	24.6	23.0
	8	31.5	30.8	24.6	30.8	24.6	23.0
WCDMA Band IV	1	31.8	26.7	23.2	26.7	23.2	23.0
	2	23.7	31.8	25.3	31.8	25.3	23.0
	8	34.0	33.9	26.5	33.9	26.5	23.0
WCDMA Band V	0	30.0	30.1	27.0	30.1	27.0	24.0
	2	24.2	30.7	27.7	30.7	27.7	24.0
CDMA BC0	0	29.4	28.7	26.2	28.7	26.2	23.0
CDMA BC1	1	31.2	27.3	24.4	27.3	24.4	23.0
CDMA BC10	0	30.0	29.4	26.7	29.4	26.7	23.0
LTE B2	1	31.9	26.2	24.5	26.2	24.5	23.0
	2	22.2	31.8	25.9	31.8	25.9	23.0
	8	32.1	31.8	25.7	31.8	25.7	23.0
	9	17.5	28.3	21.5	28.3	25.5	23.0
LTE B4	1	32.2	26.9	24.0	26.9	24.0	23.0
	2	23.2	33.1	26.7	33.1	26.7	23.0
	8	35.3	35.0	28.4	35.0	28.4	23.0
	9	16.5	29.5	22.8	29.5	22.8	23.0
LTE B5	0	31.3	30.0	29.4	30.0	29.4	24.0
	2	24.5	34.0	30.1	34.0	30.1	24.0
LTE B7	1	31.3	25.7	22.8	25.7	23.1	23.0
	2	22.5	29.5	24.6	29.5	24.6	23.0
	8	31.2	32.8	27.2	32.8	27.2	23.0
	9	18.7	29.5	22.8	29.5	21.3	23.0
LTE B12	0	31.7	31.5	28.9	31.5	28.9	24.0
	2	26.8	35.1	33.9	35.1	33.9	24.0
LTE B13	0	37.9	35.7	32.7	35.7	32.7	24.0
	2	24.8	33.2	30.6	33.2	30.6	24.0
LTE B14	0	31.8	30.0	27.3	30.0	27.3	24.0
	2	25.8	33.6	30.7	33.6	30.7	24.0
LTE B17	0	31.2	32.3	29.5	32.3	29.5	24.0
	2	25.6	33.7	30.8	33.7	30.8	24.0
LTE B25	1	31.2	26.4	24.8	26.4	24.8	23.0
	2	22.1	31.7	25.5	31.7	25.5	23.0
	8	32.5	31.3	25.3	31.3	25.3	23.0
LTE B26	0	31.0	29.1	26.9	29.1	26.9	24.0
	2	24.8	34.9	30.7	34.9	30.7	24.0
LTE B30	1	29.4	24.8	22.9	24.8	25.5	23.0
	2	21.5	31.0	24.5	31.0	24.5	23.0
	8	29.1	32.1	26.5	32.1	26.5	23.0

SAR Test Report

Exposure Scenario		Head	Body-worn	Hotspot	Phablet (Grip off)	Phablet (Grip On)	Pmax
Averaging Volume		1g	1g	1g	10g	10g	
DSI		1	0	2	0	3	
Test Distance (mm)		0	15	10	10	0	
WWAN Bands	Antenna	Plimit					
LTE B38	1	29.0	26.1	20.3	26.1	20.3	21.0
	2	22.1	30.7	21.8	30.7	21.8	21.0
	8	27.7	32.0	26.0	32.0	26.0	21.0
LTE B40	1	32.0	29.8	24.2	29.8	24.2	21.0
	2	19.5	27.3	20.0	27.3	20.0	21.0
	8	27.8	31.1	24.6	31.1	24.6	21.0
LTE B41 (PC3)	1	30.6	25.6	20.7	25.6	20.7	22.5
	2	22.1	28.1	23.1	28.1	23.1	22.5
	8	29.0	31.7	27.5	31.7	27.5	22.5
LTE B41 (PC2)	1	30.1	25.1	20.2	25.1	20.2	21.9
	2	21.6	27.2	22.8	27.2	22.8	21.9
	8	28.6	31.3	27.5	31.3	27.5	21.9
LTE B42	5	20.8	26.6	23.5	26.6	23.5	22.0
	11	22.5	23.7	20.1	23.7	19.3	22.0
LTE B43	5	21.6	26.9	24.4	26.9	24.4	22.0
	11	22.5	24.4	19.0	24.4	20.0	22.0
LTE B48	5	20.8	26.4	24.8	26.4	24.8	22.0
	11	22.6	24.1	19.1	24.1	20.0	22.0
LTE B66	1	31.5	27.5	23.1	27.5	23.1	23.0
	2	23.1	32.1	25.9	32.1	25.9	23.0
	8	35.5	34.6	28.1	34.6	28.1	23.0
	9	17.2	29.3	21.0	29.3	25.6	23.0
LTE B71	0	31.9	30.7	30.8	30.7	30.8	24.0
	2	26.4	33.7	32.1	33.7	32.1	24.0
5G NR n2	1	32.2	28.2	23.2	28.2	23.2	23.0
	2	22.4	33.7	26.4	33.7	26.4	23.0
	8	35.5	31.9	25.5	31.9	25.5	23.0
	9	17.2	29.0	23.1	29.0	23.1	23.0
5G NR n5	0	33.0	30.8	27.6	30.8	27.6	24.0
	2	20.7	30.5	27.5	30.5	27.5	24.0
5G NR n7	1	31.1	25.7	20.6	25.7	24.5	23.0
	2	22.3	31.6	25.2	31.6	25.2	23.0
	8	35.5	33.5	28.6	33.5	28.6	23.0
	9	17.0	29.6	23.8	29.6	23.8	23.0
5G NR n12	0	32.1	32.0	29.5	32.0	29.5	24.0
	2	25.4	33.7	29.9	33.7	29.9	24.0
5G NR n13	0	37.0	33.0	30.1	33.0	30.1	24.0
	2	46.5	51.8	51.5	51.8	51.5	24.0
5G NR n14	0	32.0	30.9	27.6	30.9	27.6	24.0
	2	25.9	33.3	29.8	33.3	29.8	24.0
5G NR n25	1	32.7	28.0	23.2	28.0	23.2	23.0
	2	23.9	32.2	26.3	32.2	26.3	23.0
	8	30.5	32.1	25.6	32.1	25.6	23.0
	9	16.3	28.2	21.9	28.2	26.2	23.0

SAR Test Report

Exposure Scenario		Head	Body-worn	Hotspot	Phablet (Grip off)	Phablet (Grip On)	Pmax
Averaging Volume		1g	1g	1g	10g	10g	
DSI		1	0	2	0	3	
Test Distance (mm)		0	15	10	10	0	
WWAN Bands	Antenna	Plimit					
5G NR n26	0	35.0	34.0	31.3	34.0	31.3	24.0
	2	41.9	52.3	50.1	52.3	50.1	24.0
5G NR n30	1	33.4	29.4	25.6	29.4	25.6	23.0
	2	32.4	43.1	36.9	43.1	36.9	23.0
	8	32.4	31.2	26.8	31.2	26.8	23.0
5G NR n38	1	31.2	26.2	20.9	26.2	24.1	23.0
	2	24.6	31.0	23.2	31.0	23.2	23.0
	8	31.9	33.6	28.9	33.6	28.9	23.0
	9	17.7	29.3	24.6	29.3	24.6	23.0
5G NR n41 (PC3)	1	33.1	29.0	27.5	29.0	27.5	23.0
	2	27.2	32.2	28.7	32.2	30.0	23.0
	8	35.2	35.6	30.9	35.6	30.9	23.0
	9	18.4	31.5	25.9	31.5	25.9	23.0
5G NR n41 (PC2)	1	33.1	29.0	27.5	29.0	27.5	25.5
	2	27.2	32.2	28.7	32.2	30.0	25.5
	8	35.2	35.6	30.9	35.6	30.9	25.5
	9	18.4	31.5	25.9	31.5	25.9	25.5
5G NR n66	1	35.8	27.8	23.7	27.8	23.7	23.0
	2	24.7	33.2	26.1	33.2	26.1	23.0
	8	36.4	35.9	28.2	35.9	28.2	23.0
	9	16.7	35.6	23.2	35.6	23.2	23.0
5G NR n71	0	31.4	31.2	28.0	31.2	28.0	24.0
	2	25.9	33.9	32.4	33.9	32.4	24.0
5G NR n77 (PC2)	5	23.2	27.0	27.7	27.0	27.7	24.0
	7	52.2	26.7	27.0	26.7	27.0	24.0
	10	30.5	30.4	27.8	30.4	27.8	24.0
	11	24.2	26.4	21.3	26.4	21.0	24.0
5G NR n78 (PC2)	5	24.2	30.6	27.7	30.6	27.7	24.0
	7	41.1	29.2	26.2	29.2	26.2	24.0
	10	31.2	30.9	28.5	30.9	28.5	24.0
	11	26.2	27.4	20.4	27.4	22.8	24.0

SAR Test Report

Note :

1. When $P_{max} < P_{limit}$, the DUT will operate at a power level up to P_{max} .
2. All P_{limit} EFS and maximum tune up output power P_{max} levels entered in above Table correspond to average power levels after accounting for duty cycle in the case of TDD modulation schemes (e.g. GSM and LTE TDD).
3. Maximum tune up output power P_{max} is used to configure EUT during RF tune up procedure. The maximum allowed output power is equal to maximum Tune up output power + 1dB device design uncertainty.
4. The maximum time-averaged output power (dBm) for any 2G/3G/4G/5G Sub6 WWAN technology, band, and DSI = minimum of " P_{limit} EFS" and "Maximum tune up output power P_{max} " + 1dB device uncertainty. SAR values in this report were scaled to this maximum time-averaged output power to determine compliance per KDB Publication 447498 D01v06.
5. The purpose of this report (Part 1 test) is to demonstrate that the EUT meets FCC SAR limits when transmitting in static transmission scenario at maximum allowable time-averaged power levels.

5.7.2 Maximum Target Conducted Power

Refer to Appendix E

5.7.3 Measured Conducted Power Result

Refer to Appendix F

5.8 SAR Testing Results

5.8.1 SAR Test Reduction Considerations

<KDB 447498 D01, General RF Exposure Guidance>

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

- (1) ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- (2) ≤ 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
- (3) ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

When SAR is not measured at the maximum power level allowed for production units, the measured SAR will be scaled to the maximum tune-up tolerance limit to determine compliance. The scaling factor for the tune-up power is defined as maximum tune-up limit (mW) / measured conducted power (mW). The reported SAR would be calculated by measured SAR x tune-up power scaling factor.

The SAR has been measured with highest transmission duty factor supported by the test mode tools for WLAN and/or Bluetooth. When the transmission duty factor could not achieve 100%, the reported SAR will be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up power. The scaling factor for the duty factor is defined as 100% / transmission duty cycle (%). The reported SAR would be calculated by measured SAR x tune-up power scaling factor x duty cycle scaling factor.

<KDB 941225 D01, 3G SAR Measurement Procedures>

The mode tested for SAR is referred to as the primary mode. The equivalent modes considered for SAR test reduction are denoted as secondary modes. Both primary and secondary modes must be in the same frequency band. When the maximum output power and tune-up tolerance specified for production units in a secondary mode is $\leq 1/4$ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

<KDB 941225 D05, SAR Evaluation Considerations for LTE Devices>

(1) QPSK with 1 RB and 50% RB allocation

Start with the largest channel bandwidth and measure SAR, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.

(2) 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.

(3) Higher order modulations

SAR is required only when the highest maximum output power for the configuration in the higher order modulation is $> 1/2$ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.

(4) Other channel bandwidth

SAR is required when the highest maximum output power of the smaller channel bandwidth is $> 1/2$ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the reported SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

SAR Test Report

<Power Confirmation for SAR Test Exclusion for LTE Downlink CA>

According to KDB 941225 D05A, the uplink maximum output power below was measured with downlink CA active on the channel with highest measured maximum output power when downlink CA is inactive. The downlink SCC channel was paired with the uplink channel as normal operation. For intra-band contiguous CA, the downlink channel spacing between the component carriers was set to multiple of 300 kHz less than the nominal channel spacing per section 5.4.1A of 3GPP TS36.521. For intra-band non-contiguous CA, the downlink channel spacing between the component carriers was set to maximum separation from PCC and remain fully within the downlink transmission band. For Inter-band CA, the SCC downlink channel was set to near the middle of its transmission band.

<May 2017 TCB Workshop, SAR Test Exclusion for LTE DL 4x4 MIMO>

Per FCC guidance, SAR testing for LTE DL 4x4 MIMO is not required when the uplink maximum output power with downlink MIMO active remains within the specified tune-up tolerance and not more than 0.25 dB higher than the maximum output power with downlink MIMO inactive. Per power confirmation results, the SAR test exclusion applies to LTE downlink MIMO operation.

Refer to Appendix I

Summary for SAR Test Exclusion for LTE Downlink CA

Per power confirmation results in above, the uplink maximum output power with downlink CA active remains within the specified tune-up tolerance and not more than 0.25 dB higher than the maximum output power with downlink CA inactive. According to KDB 941225 D05A, the SAR test exclusion applies to LTE downlink CA operation.

<Power Confirmation for SAR Testing for LTE Uplink CA>

The conducted power for uplink CA active was measured on the highest reported SAR configuration for each exposure condition with both two carrier components was set to largest channel bandwidth.

Refer to Appendix J

SAR Measurements for Intra-Band Contiguous CA

The SAR testing was performed with the single carrier (uplink CA is inactive) for all test positions for each exposure condition. The LTE uplink CA active was verified with maximum output power on the highest SAR configuration of single carrier for each exposure condition. For intra-band contiguous CA, the SCC channel was set to closest available contiguous channel.

SAR Test Report

<May 2017 TCB Workshop, SAR Test Exclusion for LTE B41 Power Class 2>

Per FCC guidance, the LTE B41 power class 3 is expected to be the dominant use configuration and SAR should be tested as normally required. The LTE B41 power class 2 is tested using the highest SAR test configuration in power class 3 according to the highest time-averaged power for all applicable uplink-downlink configuration in power class 2. Separate SAR testing for power class 2 is not required when the reported SAR and power can be linearly scaled with < 10% discrepancy between power classes and all reported SAR are < 1.4 W/kg.

	LTE Band 41 Power Class 3	LTE Band 41 Power Class 2
Head Exposure Condition		
Measured Power (dBm)	25.26	26.02
Duty Cycle (%)	63.3%	43.3%
Time-Averaged Power (mW)	213	173
Maximum Measured SAR (W/kg)	0.658	0.496
Deviation from Expected Linearity (%)	-7.49%	
Separate SAR Test Require?	No	
Body-worn Exposure Condition		
Measured Power (dBm)	25.04	26.02
Duty Cycle (%)	63.3%	43.3%
Time-Averaged Power (mW)	202	173
Maximum Measured SAR (W/kg)	0.283	0.223
Deviation from Expected Linearity (%)	-8.07%	
Separate SAR Test Require?	NO	
Hotspot Exposure Condition		
Measured Power (dBm)	25.04	26.02
Duty Cycle (%)	63.3%	43.3%
Time-Averaged Power (mW)	202	173
Maximum Measured SAR (W/kg)	0.868	0.671
Deviation from Expected Linearity (%)	-9.82%	
Separate SAR Test Require?	NO	

<KDB 248227 D01, SAR Guidance for Wi-Fi Transmitters>

- (1) For handsets operating next to ear, hotspot mode or mini-tablet configurations, the initial test position procedures were applied. The test position with the highest extrapolated peak SAR will be used as the initial test position. When the reported SAR of initial test position is ≤ 0.4 W/kg, SAR testing for remaining test positions is not required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured.
- (2) For WLAN 2.4 GHz, the highest measured maximum output power channel for DSSS was selected for SAR measurement. When the reported SAR is ≤ 0.8 W/kg, no further SAR testing is required. Otherwise, SAR is evaluated at the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel. For OFDM modes (802.11g/n), SAR is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and it is ≤ 1.2 W/kg.
- (3) For WLAN 5GHz, the initial test configuration was selected according to the transmission mode with the highest maximum output power. When the reported SAR of initial test configuration is > 0.8 W/kg, SAR is required for the subsequent highest measured output power channel until the reported SAR result is ≤ 1.2 W/kg or all required channels are measured. For other transmission modes, SAR is not required when the highest reported SAR for initial test configuration is adjusted by the ratio of subsequent test configuration to initial test configuration specified maximum output power and it is ≤ 1.2 W/kg.
- (4) For WLAN MIMO mode, the power-based standalone SAR test exclusion or the sum of SAR provision in KDB 447498 to determine simultaneous transmission SAR test exclusion should be applied. Otherwise, SAR for MIMO mode will be measured with all applicable antennas transmitting simultaneously at the specified maximum output power of MIMO operation.

<KDB 648474 D04, SAR Guidance for Dynamic Antenna Tuning>

This device supports dynamic antenna tuning for LTE 2 / 4 / 7 / 5 / 12 / 13 / 14 / 17 / 25 / 30 / 38 / 40 / 41 / 66 / 71.

According to KDB 648474 D04 and FCC guidance in October 2015 TCBC workshop, the following test procedure was followed to demonstrate that SAR results in this report represented the appropriate SAR test conditions. For bands with dynamic tuning implemented, SAR was measured according to the required FCC SAR test procedures with the dynamic tuner active to allow the device to automatically tune to the antenna state for the respective RF exposure test configurations. The tuning state determined by the auto-tune was verified before and after SAR measurement for the highest reported SAR configuration for each band and testing configuration to confirm the antenna state of auto-tune is the same. Additional single point SAR time-sweep measurements were evaluated for other tuner states to determine that the other tuner configurations would result in equivalent or lower SAR values. The additional tuner hardware has no influence to the antenna characteristics, other than impedance matching.

To evaluate all of the tuner states, the 144 tuner states were divided among the aggregate band, mode and exposure combinations so that each combination was evaluated for at least 24 tuner states. Single point time-sweep measurements were performed at the peak SAR location determined by the zoom scan of the configuration with the highest reported SAR for each combination. The tuner state was able to be established remotely by QRCT software installed in laptop PC through a micro USB cable connected between the DUT and the laptop PC, so that the DUT was not moved and the probe remained stationary at the same position throughout the entire series of single point measurements for each combination.

The operational description contains more information about the design and implementation of the dynamic antenna tuning.

Supplemental Data Refer to Appendix K

SAR Test Report

5.8.2 SAR Results for Head Exposure Condition

Refer to Appendix B

5.8.3 SAR Results for Body-worn Exposure Condition (Test Separation Distance is 15 mm)

Refer to Appendix B

5.8.4 SAR Results for Hotspot Exposure Condition (Test Separation Distance is 10 mm)

Refer to Appendix B

5.8.5 SAR Results for Product Specific (Phablet) Exposure Condition (Test Separation Distance is 0 mm)

Refer to Appendix B

5.8.6 Power Density Test Results

Refer to Appendix M.

5.8.7 SAR Measurement Variability

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10 , the highest SAR configuration for either head or body tissue-equivalent medium maybe used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR repeated measurement procedure:

1. When the highest measured SAR is < 0.80 W/kg, repeated measurement is not required.
2. When the highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3. If the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 , or when the original or repeated measurement is ≥ 1.45 W/kg, perform a second repeated measurement.
4. If the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 , and the original, first or second repeated measurement is ≥ 1.5 W/kg, perform a third repeated measurement.

SAR Test Report

Plot	Band	Mode	Test Position	Ch.	Original Measured SAR-1g (W/kg)	1st Repeated SAR-1g (W/kg)	L/S Ratio	2nd Repeated SAR-1g (W/kg)	L/S Ratio	3rd Repeated SAR-1g (W/kg)	L/S Ratio
R901	WCDA II Ant 2	RMC12.2K	Right Tilted	9538	0.828	0.805	1.03	N/A	N/A	N/A	N/A
R906	LTE 2 Ant 2	QPSK20M	Right Tilted	19100	0.963	0.952	1.01	N/A	N/A	N/A	N/A
R907	LTE 2 Ant 8	QPSK20M	Right Cheek	18700	0.824	0.804	1.02	N/A	N/A	N/A	N/A
R908	LTE 4 Ant 2	QPSK20M	Right Tilted	20300	0.897	0.864	1.04	N/A	N/A	N/A	N/A
R909	LTE 4 Ant 9	QPSK20M	Right Cheek	20300	0.926	0.904	1.02	N/A	N/A	N/A	N/A
R910	LTE 5 Ant 2	QPSK10M	Right Cheek	20450	0.853	0.821	1.04	N/A	N/A	N/A	N/A
R911	LTE 7 Ant 2	QPSK20M	Left Tilted	21350	0.9	0.849	1.06	N/A	N/A	N/A	N/A
R912	LTE 7 Ant 9	QPSK20M	Right Cheek	21100	0.849	0.824	1.03	N/A	N/A	N/A	N/A
R913	LTE 13 Ant 2	QPSK10M	Right Cheek	23230	0.827	0.804	1.03	N/A	N/A	N/A	N/A
R914	LTE 25 Ant 2	QPSK20M	Right Tilted	26590	0.842	0.821	1.03	N/A	N/A	N/A	N/A
R915	LTE 30 Ant 2	QPSK10M	Right Tilted	27710	0.949	0.915	1.04	N/A	N/A	N/A	N/A
R921	LTE 66 Ant 2	QPSK20M	Left Tilted	132072	0.857	0.833	1.03	N/A	N/A	N/A	N/A
R917	LTE 66 Ant 9	QPSK20M	Right Cheek	132572	0.944	0.918	1.03	N/A	N/A	N/A	N/A
R922	5GNR-n2 Ant 2	DFTS QPSK20M	Left Tilted	380000	0.982	0.965	1.02	N/A	N/A	N/A	N/A
R923	5GNR-n2 Ant 9	DFTS QPSK20M	Left Tilted	372000	0.889	0.869	1.02	N/A	N/A	N/A	N/A
R923	5GNR-n5 Ant 2	DFTS QPSK20M	Right Cheek	167800	0.963	0.951	1.01	N/A	N/A	N/A	N/A
R941	5GNR-n7 Ant 2	DFTS QPSK50M	Right Cheek	509000	0.924	0.901	1.03	N/A	N/A	N/A	N/A
R943	5GNR-n7 Ant 9	DFTS QPSK50M	Right Cheek	505000	0.825	0.814	1.01	N/A	N/A	N/A	N/A
R925	5GNR-n7 Ant 2	DFTS QPSK40M	Right Cheek	510000	0.929	0.919	1.01	N/A	N/A	N/A	N/A
R926	5GNR-n7 Ant 9	DFTS QPSK40M	Right Cheek	504000	0.852	0.782	1.09	N/A	N/A	N/A	N/A
R928	5GNR-n25 Ant 2	DFT-S QPSK40M	Left Tilted	376500	0.813	0.801	1.01	N/A	N/A	N/A	N/A
R929	5GNR-n25 Ant 9	DFT-S QPSK40M	Right Cheek	376500	0.896	0.895	1.00	N/A	N/A	N/A	N/A
R930	5GNR-n38 Ant 9	DFT-S QPSK40M	Right Cheek	518000	0.973	0.942	1.03	N/A	N/A	N/A	N/A
R932	5GNR-n41 Ant 9	DFT-S QPSK100M	Right Cheek	518598	0.936	0.904	1.04	N/A	N/A	N/A	N/A
R935	5GNR-n66 Ant 9	DFT-S QPSK40M	Right Cheek	352000	0.934	0.923	1.01	N/A	N/A	N/A	N/A
R937(FCC)	5GNR-n77 Ant 5	DFT-S QPSK100M	Right Cheek	653000	0.842	0.821	1.03	N/A	N/A	N/A	N/A
R938(IC)	5GNR-n77 Ant 5	DFT-S QPSK100M	Right Cheek	636666	0.801	0.785	1.02	N/A	N/A	N/A	N/A
R939(FCC)	5GNR-n78 Ant 5	DFT-S QPSK100M	Right Cheek	650000	0.933	0.921	1.01	N/A	N/A	N/A	N/A
R125	WLAN2.4G Ant 6	802.11b	Right Cheek	11	1.14	1.13	1.01	N/A	N/A	N/A	N/A
R126	WLAN5.3G Ant 6+4	802.11ac VHT160	Left Cheek	50	1.11	1.06	1.05	N/A	N/A	N/A	N/A
R127(FCC)	WLAN5.6G Ant 4	802.11ac VHT160	Left Cheek	114	1.11	1.07	1.04	N/A	N/A	N/A	N/A
R127(FCC)	WLAN5.6G Ant 4	802.11ac VHT80	Left Cheek	138	1.17	1.15	1.02	N/A	N/A	N/A	N/A
R128	WLAN5.8G	802.11ac VHT80	Left Cheek	155	1.12	1.11	1.01	N/A	N/A	N/A	N/A

SAR Test Report

5.8.8 Simultaneous Multi-band Transmission Evaluation

<Possibilities of Simultaneous Transmission>

The simultaneous transmission possibilities for this device are listed as below.

Simultaneous TX Combination	Capable Transmit Configurations	Head Exposure Condition	Body-worn Exposure Condition	Hotspot Exposure Condition
1	WWAN + WLAN2.4G Ant 3	Yes	Yes	Yes
2	WWAN + WLAN2.4G Ant 4	Yes	Yes	Yes
3	WWAN + WLAN2.4G Ant 6	No	Yes	No
4	WWAN + WLAN5G Ant 3	Yes	Yes	Yes
5	WWAN + WLAN5G Ant 4	Yes	Yes	Yes
6	WWAN + WLAN5G Ant 6	No	Yes	No
7	WWAN + BT Ant 3	Yes	Yes	Yes
8	WWAN + BT Ant 4	Yes	Yes	Yes
9	WWAN + BT Ant 6	No	Yes	No
10	WLAN2.4G Ant 3 + WLAN5G Ant 6	Yes	Yes	Yes
11	WLAN2.4G Ant 4 + WLAN5G Ant 6	Yes	Yes	Yes
12	WLAN2.4G Ant 6 + WLAN5G Ant 3/Ant 4	Yes	Yes	Yes
13	WLAN2.4G Ant 3 + BT Ant 6	Yes	Yes	Yes
14	WLAN2.4G Ant 4 + BT Ant 6	Yes	Yes	Yes
15	WLAN2.4G Ant 6 + BT Ant 3/Ant 4	No	Yes	No
16	WLAN5G Ant 3 + BT Ant 6	Yes	Yes	Yes
17	WLAN5G Ant 4 + BT Ant 6	Yes	Yes	Yes
18	WLAN5G Ant 6 + BT Ant 3/Ant 4/Ant 6	No	Yes	No
19	WWAN + WLAN2.4G Ant 3 + WLAN5G Ant 6	Yes	Yes	Yes
20	WWAN + WLAN2.4G Ant 4 + WLAN5G Ant 6	Yes	Yes	Yes
21	WWAN + WLAN2.4G Ant 6 + WLAN5G Ant 3/Ant 4	No	Yes	No
22	WWAN + WLAN2.4G Ant 3 + BT Ant 6	Yes	Yes	Yes
23	WWAN + WLAN2.4G Ant 4 + BT Ant 6	Yes	Yes	Yes
24	WWAN + WLAN2.4G Ant 6 + BT Ant 3/Ant 4	Yes	Yes	Yes
25	WWAN + WLAN5G Ant 3 + BT Ant 6	Yes	Yes	Yes
26	WWAN + WLAN5G Ant 4 + BT Ant 6	Yes	Yes	Yes
27	WWAN + WLAN5G Ant 6 + BT Ant 3/Ant 4/Ant 6	No	Yes	No
28	WWAN + WLAN2.4G MIMO (Ant 3 + Ant 6)	Yes	Yes	Yes
29	WWAN + WLAN2.4G MIMO (Ant 4 + Ant 6)	Yes	Yes	Yes
30	WWAN + WLAN5G MIMO (Ant 3 + Ant 6)	No	Yes	No
31	WWAN + WLAN5G MIMO (Ant 4 + Ant 6)	Yes	Yes	Yes
32	WLAN5G MIMO Ant 3/Ant 6 + BT Ant 3/Ant 6	Yes	Yes	Yes
33	WLAN5G MIMO Ant 4/Ant 6 + BT Ant 4/Ant 6	No	Yes	No
34	WWAN + WLAN2.4G Ant 3 + WLAN5G Ant 6 + BT Ant 6	Yes	Yes	Yes
35	WWAN + WLAN2.4G Ant 4 + WLAN5G Ant 6 + BT Ant 6	Yes	Yes	Yes
36	WWAN + WLAN2.4G Ant 6 + WLAN5G Ant 3 + BT Ant 3	Yes	Yes	Yes
37	WWAN + WLAN2.4G Ant 6 + WLAN5G Ant 4 + BT Ant 4	Yes	Yes	Yes
38	WWAN + WLAN5G MIMO (Ant 3 + Ant 6) + BT Ant 3/Ant 6	Yes	Yes	Yes
39	WWAN + WLAN5G MIMO (Ant 4 + Ant 6) + BT Ant 4/Ant 6	No	Yes	No
40	WLAN2.4G MIMO (Ant 3 + Ant 6) + WLAN5G MIMO (Ant 3 + Ant 6)	Yes	Yes	Yes
41	WLAN2.4G MIMO (Ant 4 + Ant 6) + WLAN5G MIMO (Ant 4 + Ant 6)	Yes	Yes	Yes

SAR Test Report

WIFI6E				
Simultaneous TX Combination	Capable Transmit Configurations	Head Exposure Condition	Body-worn Exposure Condition	Hotspot Exposure Condition
42	WWAN + WIFI6E Ant 3	Yes	Yes	Yes
43	WWAN + WIFI6E Ant 4	Yes	Yes	Yes
44	WWAN + WIFI6E Ant 6	No	Yes	No
45	WIFI6E Ant 3 + BT Ant 6	Yes	Yes	Yes
46	WIFI6E Ant 4 + BT Ant 6	Yes	Yes	Yes
47	WIFI6E Ant 6 + BT Ant 3/Ant 4/Ant 6	No	Yes	No
48	WWAN + WIFI6E Ant 3 + BT Ant 6	Yes	Yes	Yes
49	WWAN + WIFI6E Ant 4 + BT Ant 6	Yes	Yes	Yes
50	WWAN + WIFI6E Ant 6 + BT Ant 3/Ant 4/Ant 6	No	Yes	No
51	WWAN + WIFI6E MIMO (Ant 3 + Ant 6)	No	Yes	No
52	WWAN + WIFI6E MIMO (Ant 4 + Ant 6)	Yes	Yes	Yes
53	WIFI6E MIMO Ant 3/Ant 6 + BT Ant 3/Ant 6	Yes	Yes	Yes
54	WIFI6E MIMO Ant 4/Ant 6 + BT Ant 4/Ant 6	No	Yes	No
55	WWAN + WIFI6E MIMO (Ant 3 + Ant 6) + BT Ant 3/Ant 6	Yes	Yes	Yes
56	WWAN + WIFI6E MIMO (Ant 4 + Ant 6) + BT Ant 4/Ant 6	No	Yes	No

Note. WWAN is included 2G/3G/4G/EN-DC(LTE + FR1)/EN-DC(LTE + FR2).

<SAR Summation Analysis>

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR_{1g} of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit(SAR_{1g} 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR_{1g} is greater than the SAR limit (SAR_{1g} 1.6 W/kg), SAR test exclusion is determined by the SPLSR.

Refer to Appendix G

SAR Test Report

<Total Exposure Ratio Analysis>

The fields generated by the antennas can be correlated or uncorrelated. At different frequencies, fields are always uncorrelated, and the aggregate power density contributions can be summed according to spatially averaged values of corresponding sources at any point in space, r , to determine the total exposure ratio (TER). Assuming I sources, the TER at each point in space is equal to

$$TER^{uncorr}(r) = \sum_{i=1}^I ER_i = \sum_{i=1}^I \frac{S_{av,i}(r, f_i)}{S_{lim}(f_i)}$$

where $S_{av,i}$ is the power density for the source i operating at a frequency f_i , and S_{lim} is the power density limit as specified by the relevant standard.

Exposure from transmitters operating above and below 6 GHz, where 6 GHz denotes the transition frequency where the basic restrictions change from being defined in terms of SAR to being defined in terms of power density, are therefore uncorrelated and the TER is determined as

$$TER^{uncorr}(r) = TER(r)_{f \leq 6GHz} + TER(r)_{f > 6GHz}$$

According to the FCC guidance in Oct 2018 TCBC workshop and IEC TR 63170, the total exposure ratio calculated by taking ratio of maximum reported SAR divided by SAR limit and adding it to maximum measured power density divided by power density limit. Numerical sum of the ratios should be less than 1.

The TER analysis for this device, refer to Appendix G.

Note: The PD evaluation for mmWave was assessed in separate SAR report (by BVADT, report number PFBFLF-WTW-P21010278-1), and the maximum SAR value here referred from that SAR report.

Test Engineer : Willy Chang, and Zeke Wang

SAR Test Report

6. Calibration of Test Equipment

<SAR>

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D750V3	1013	Aug. 13, 2020	1 Year
System Validation Dipole	SPEAG	D835V2	4d121	Aug. 13, 2020	1 Year
System Validation Dipole	SPEAG	D1750V2	1055	Aug. 14, 2020	1 Year
System Validation Dipole	SPEAG	D1900V2	5d036	Jan. 22, 2021	1 Year
System Validation Dipole	SPEAG	D2300V2	1004	Jan. 22, 2021	1 Year
System Validation Dipole	SPEAG	D2450V2	737	Aug. 13, 2020	1 Year
System Validation Dipole	SPEAG	D2600V2	1020	Aug. 13, 2020	1 Year
System Validation Dipole	SPEAG	D3500V2	1007	Jan. 19, 2021	1 Year
System Validation Dipole	SPEAG	D3700V2	1017	Sep. 14, 2020	1 Year
System Validation Dipole	SPEAG	D3900V2	1020	May. 22, 2020	1 Year
System Validation Dipole	SPEAG	D4600V2	1020	May. 25, 2020	1 Year
System Validation Dipole	SPEAG	D4900V2	1009	May. 25, 2020	1 Year
System Validation Dipole	SPEAG	D5GHzV2	1019	Mar. 13, 2020	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	7554	Sep. 28, 2020	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	7555	Sep. 28, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE4	679	May. 06, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1431	Mar. 18, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1277	Jan. 19, 2021	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1585	May. 28, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1589	Sep. 15, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1590	Sep. 15, 2020	1 Year
Universal Radio Communication Tester	Anritsu	MT8821C	6201381727	Jun. 11, 2020	1 Year
Universal Radio Communication Tester	Anritsu	MT8821C	6201502978	Jul. 09, 2020	1 Year
Universal Radio Communication Tester	R&S	CMW500	164864	Apr. 16, 2020	1 Year
ENA Series Network Analyzer	Agilent	E5071C	MY46214281	Jun. 19, 2020	1 Year
Thermometer	YFE	YF-160A	120702365	Aug. 12, 2020	1 Year
Thermometer	YFE	YF-160A	150601220	May. 25, 2020	1 Year
Thermometer	YFE	YF-160A	191100743	Apr. 21, 2020	1 Year

<Power Density>

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
cDASY6 Module mmWave Software	SPEAG	V1.4.0.14682	N/A	N/A	N/A
E-Field Probe	SPEAG	EUmmWV3	9361	Sep. 24, 2020	1 Year
E-Field Probe	SPEAG	EUmmWV4	9454	Sep. 24, 2020	1 Year
System Verification Source	SPEAG	5G Verification Source 10 GHz	1025	Jan. 19, 2021	1 Year
Data Acquisition Electronics	SPEAG	DAE4	679	May. 06, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE4	861	May. 27, 2020	1 Year
Data Acquisition Electronics	SPEAG	DAE4	1589	Sep. 15, 2020	1 Year

7. Measurement Uncertainty

According to KDB 865664 D01, SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR, and ≥ 3.75 W/kg for 10-g SAR. The procedures described in IEEE Std 1528-2013 should be applied. The expanded SAR measurement uncertainty must be $\leq 30\%$ for a confidence interval of $k = 2$. When the highest measured SAR within a frequency band is < 1.5 W/kg for 1-g and < 3.75 W/kg for 10-g, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval. Hence, the measurement uncertainty analysis is not required in this SAR report because the test result met the condition.

Applicable for Power Density Measurement:

Source of Uncertainty	Uncertainty ($\pm$ dB)	Probability Distribution	Divisor	Ci	Standard Uncertainty ($\pm$ dB)	Vi
Measurement System						
Probe Calibration	0.49	Normal	1	1	0.49	∞
Hemispherical Isotropy	0.50	Rectangular	$\sqrt{3}$	1	0.29	∞
Linearity	0.20	Rectangular	$\sqrt{3}$	1	0.12	∞
System Detection Limits	0.04	Rectangular	$\sqrt{3}$	1	0.02	∞
Modulation Response	0.40	Rectangular	$\sqrt{3}$	1	0.23	∞
Readout Electronics	0.03	Normal	1	1	0.03	∞
Response Time	0.00	Rectangular	$\sqrt{3}$	1	0.00	∞
Integration Time	0.00	Rectangular	$\sqrt{3}$	1	0.00	∞
RF Ambient Conditions – Noise	0.20	Rectangular	$\sqrt{3}$	1	0.12	∞
RF Ambient Conditions – Reflections	0.20	Rectangular	$\sqrt{3}$	1	0.12	∞
Probe Positioner Mechanical Tolerance	0.04	Rectangular	$\sqrt{3}$	1	0.02	∞
Probe Positioning with Respect to Phantom	0.30	Rectangular	$\sqrt{3}$	1	0.17	∞
S _{avg} Reconstruction	2.00	Rectangular	$\sqrt{3}$	1	1.15	∞
Test Sample Related						
Power Drift of Measurement	0.20	Rectangular	$\sqrt{3}$	1	0.12	∞
Input Power	0.00	Normal	1	1	0.00	∞
Combined Standard Uncertainty					± 1.34	
Expanded Uncertainty (K=2)					± 2.68	

Uncertainty Budget for Wi-Fi 6E Power Density Measurement

8. Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

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The road map of all our labs can be found in our web site also.

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