FCC SAR Test Report

Report No.	:	**W7L-P23100016-1SA01**
Applicant	:	**Launch Tech Co., Ltd.**
Address	:	**Launch Industrial Park, North of Wuhe Rd., Banxuegang, Longgang, Shenzhen, Guangdong, P.R. China.**
Product	:	**AUTO Smart Diagnostic Tool**
FCC ID	:	**XUJX431V1V40**
Brand	:	**LAUNCH**
Model No.	:	**X-431 V+ V4.0, X-431 PRO5**
Standards	:	**FCC 47 CFR Part 2 (2.1093) / IEEE C95.1:1992 / IEEE 1528:2013** **KDB 865664 D01 v01r04 / KDB 865664 D02 v01r02 / KDB 248227 D01 v02r02** **KDB 447498 D01 v06 / KDB 616217 D04 v01r02**
Sample Received Date	:	**Nov. 13, 2023**
Date of Testing	:	**Nov. 13, 2023 ~ Dec. 06, 2023**
FCC Designation No.	:	**CN1325** **FCC Site Registration No.** : **434559**

CERTIFICATION: The above equipment has been tested by **Huarui 7layers High Technology (Suzhou) Co., Ltd.**, 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 A2LA or any government agencies.

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Release Control Record

Report No.	Reason for Change	Date Issued
SA190522W010-1	Initial release	Jun. 13, 2019
W7L-P23100016SA01	Based on the original product changing the Product name and model name, brand name, FCC ID, applicant and manufacturer information. The new sample data is unchanged and all data in this report is copied from the original report (Original Report No: SA190522W010-1, FCC ID: O57TBX605FC).	Nov. 10, 2023
W7L-P23100016-1SA01	Two additional shells were added to the original product. The worst case of original report was verified. (Original Report No: W7L-P23100016SA01, FCC ID: XUJX431V1V40).	Dec. 06, 2023

1. Summary of Maximum SAR Value

Equipment Class	Mode	Highest Reported Body SAR_{1g} (0~0.9 cm Gap) (W/kg)
DTS	2.4G WLAN	0.65
NII	5.3G WLAN	0.79
	5.6G WLAN	0.77
	5.8G WLAN	0.99
DSS	Bluetooth	0.69

Note:

1. The SAR limit **(Head & Body: SAR_{1g} 1.6 W/kg)** for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.
2. The 2.4G WLAN and 5G WLAN cannot transmit simultaneously.
3. The WLAN and Bluetooth cannot transmit simultaneously, so there is no co-location test requirement for WLAN and Bluetooth.

2. Description of Equipment Under Test

EUT Type	AUTO Smart Diagnostic Tool
FCC ID	XUJX431V1V40
Brand Name	LAUNCH
Model Name	X-431 V+ V4.0, X-431 PRO5
HW Version	Lenovo Tablet TB-X605FC
SW Version	TB-X605FC_RF01_20190611
Tx Frequency Bands (Unit: MHz)	WLAN : 2412 ~ 2462, 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5700, 5745 ~ 5805 Bluetooth : 2402 ~ 2480
Uplink Modulations	802.11b : DSSS 802.11a/g/n/ac : OFDM Bluetooth : GFSK, π/4-DQPSK, 8-DPSK, LE
Maximum Tune-up Conducted Power (Unit: dBm)	Please refer to section 4.5.1 of this report.
Antenna Type	PIFA Antenna
EUT Stage	Production Unit

Note:

1. 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.
2. There were Sample 1, 2, 3, 4, 5 and 6 for this project, the difference is as below:

SAMPLE	EUT CONFIGURATION INFORMATION
1	LCD Panel 1+Photo Camera 1+Photo Camera 3+CPU1+EMMC1+DDR1+speaker 1+speaker 2+motor1+Main Broad 1 + BT/WLAN Module+ Battery 1
2	LCD Panel 2+Photo Camera 2+Photo Camera 4+CPU1+EMMC2+DDR2+speaker 1+speaker 2+motor2+Main Broad 2+ BT/WLAN Module+ Battery 2
3	LCD Panel 1+Photo Camera 1+Photo Camera 3+CPU1+EMMC3+DDR3+speaker 1+speaker 2+motor1+Main Broad 1+ BT/WLAN Module+ Battery 1
4	LCD Panel 2+Photo Camera 2+Photo Camera 4+CPU1+EMMC4+DDR4+speaker 1+speaker 2+motor2+Main Broad 2+ BT/WLAN Module+ Battery 2
5	LCD Panel 1+Photo Camera 1+Photo Camera 3+CPU1+EMMC5+DDR5+speaker 1+speaker 2+motor1+Main Broad 1+ BT/WLAN Module+ Battery 1
6	LCD Panel 2+Photo Camera 2+Photo Camera 4+CPU1+EMMC6+DDR6+speaker 1+speaker 2+motor2+Main Broad 2+ BT/WLAN Module+ Battery 2

3. Sample 1 and 2 are testing in this report.

List of Accessory:

ACCESSORIES	BRAND	MODEL	SPECIFICATION
AC Adapter 1	Salom	SC-41	I/P:100-240Vac, 0.3A O/P: 5Vdc, 2A
Battery 1	SCUD	L16D2P31	Rating: 3.85Vdc, 7000mAh
Battery 2	Celxpert	L16D2P31	Rating: 3.85Vdc, 7000mAh
USB Cable 1	LiQi	L27B-052000100-TCCS	1.0m shielded cable w/o core
LCD Panel1	BOE	TV101WUM-LL4	10.1 "
LCD Panel2	BOE	TV101WUM-LL5	10.1 "
Photo Camera 1	O-film	L4H7A00	8M AF
Photo Camera 2	Q-tech	F4H7YAZ	8M AF
Photo Camera 3	Lianyi	LE5220FM	5M FF
Photo Camera 4	Jinkang	G7B5-QL607XFF	5M FF
CPU	Qualcomm	SDA-450-A-792NSP-TR-01-0-AA	-
EMMC1+DDR1	SAMSUNG	KMRP60014M-B614(4+64)	64G
EMMC2+DDR2	HYNIX	H9TQ52ACLTMCUR-KUM(4+64)	64G
EMMC3+DDR3	SAMSUNG	KMGD6001BM-B421(3+32)	32G
EMMC4+DDR4	HYNIX	H9TQ27ADFTMCUR-KUM(3+32)	32G
EMMC5+DDR5	SAMSUNG	KMQE60013M-B318(2+16)	16G
EMMC6+DDR6	HYNIX	H9TQ17ABJTCCUR-KUM(2+16)	16G
Speaker 1	Xichun	KFSC1712SBC-S-B232-20J-GT	-
Speaker 2	Xichun	KFSC1712SBC-S-B233-20J-W	-
speaker 1	Haosheng	HB171219B08-13-B1F-RH	-
speaker 2	Haosheng	XHB171219B08-14-B1F-RH	-
motor1	Hongzhifa	HZF-Z04BE-RL67B25-90	-
Motor2	Kunwang	CY0408L-021HB-064	-
Main Broad 1	Hongban	Aae_MB_PCB_V3	-
Main Broad 2	Huashen	Aae_MB_PCB_V3	-
BT/WLAN Module	Qualcomm	WCN-3680B-0-79BWLNSP-TR-05-1	-

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 DASY System

DASY 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 DASY5 software defined. The DASY 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.

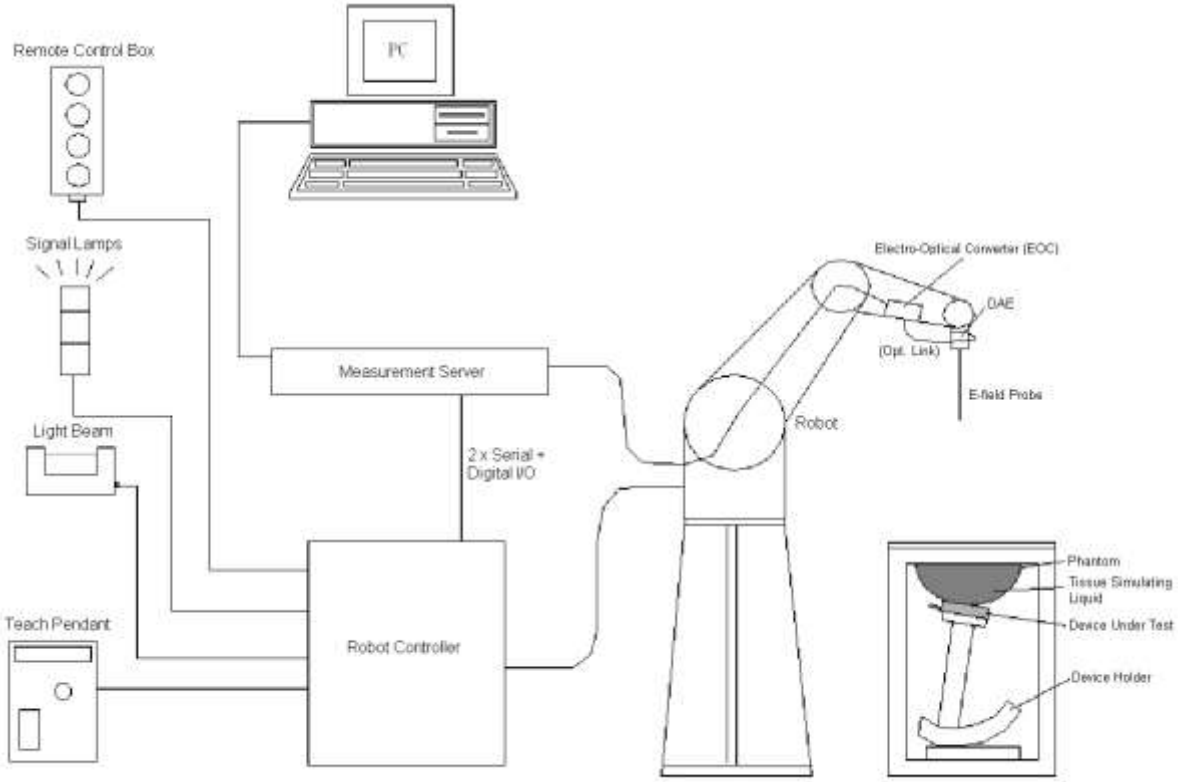


Fig-3.1 DASY System Setup

3.2.1 Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: 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 DASY6

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	10 MHz to 6 GHz Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

Model	ES3DV3	
Construction	Symmetrical design with triangular core. Interleaved sensors. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	5 µW/g to 100 mW/g Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 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	< 5µV (with auto zero)	
Input Bias Current	< 50 fA	
Dimensions	60 x 60 x 68 mm	

3.2.4 Phantoms

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

Model	ELI	
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.	
Material	Vinylester, glass fiber 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	Mounting Device	
Construction	In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).	
Material	POM	

Model	Laptop Extensions Kit	
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.	
Material	POM, Acrylic glass, Foam	

3.2.6 System Validation Dipoles

Model	D-Serial	
Construction	Symmetrical dipole with l/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 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 5% are listed in Table-3.1.

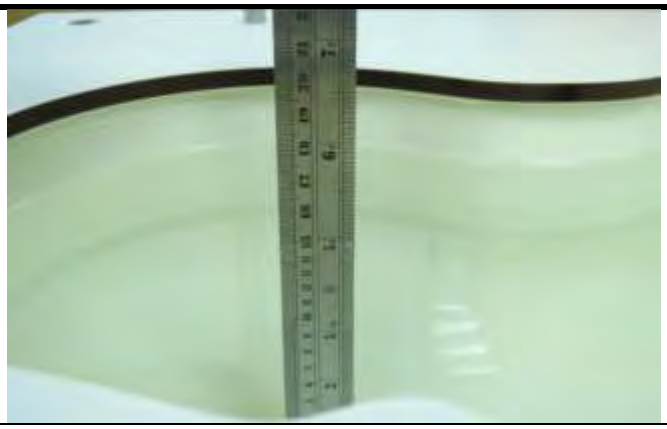
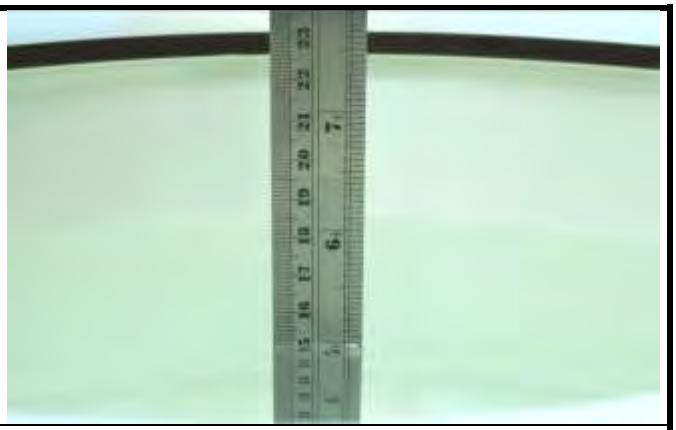
	

Photo of Liquid Height for Head Position	**Photo of Liquid Height for Body Position**

The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528, and KDB 865664 D01 Appendix A. For the body tissue simulating liquids, the dielectric properties are defined in KDB 865664 D01 Appendix A. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using a dielectric assessment kit and a network analyzer.

Table-3.1 Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of ±5%	Target Conductivity	Range of ±5%
For Head				
750	41.9	39.8 ~ 44.0	0.89	0.85 ~ 0.93
835	41.5	39.4 ~ 43.6	0.90	0.86 ~ 0.95
900	41.5	39.4 ~ 43.6	0.97	0.92 ~ 1.02
1450	40.5	38.5 ~ 42.5	1.20	1.14 ~ 1.26
1640	40.3	38.3 ~ 42.3	1.29	1.23 ~ 1.35
1750	40.1	38.1 ~ 42.1	1.37	1.30 ~ 1.44
1800	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
1900	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2000	40.0	38.0 ~ 42.0	1.40	1.33 ~ 1.47
2300	39.5	37.5 ~ 41.5	1.67	1.59 ~ 1.75
2450	39.2	37.2 ~ 41.2	1.80	1.71 ~ 1.89
2600	39.0	37.1 ~ 41.0	1.96	1.86 ~ 2.06
3500	37.9	36.0 ~ 39.8	2.91	2.76 ~ 3.06
5200	36.0	34.2 ~ 37.8	4.66	4.43 ~ 4.89
5300	35.9	34.1 ~ 37.7	4.76	4.52 ~ 5.00
5500	35.6	33.8 ~ 37.4	4.96	4.71 ~ 5.21
5600	35.5	33.7 ~ 37.3	5.07	4.82 ~ 5.32
5800	35.3	33.5 ~ 37.1	5.27	5.01 ~ 5.53

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.

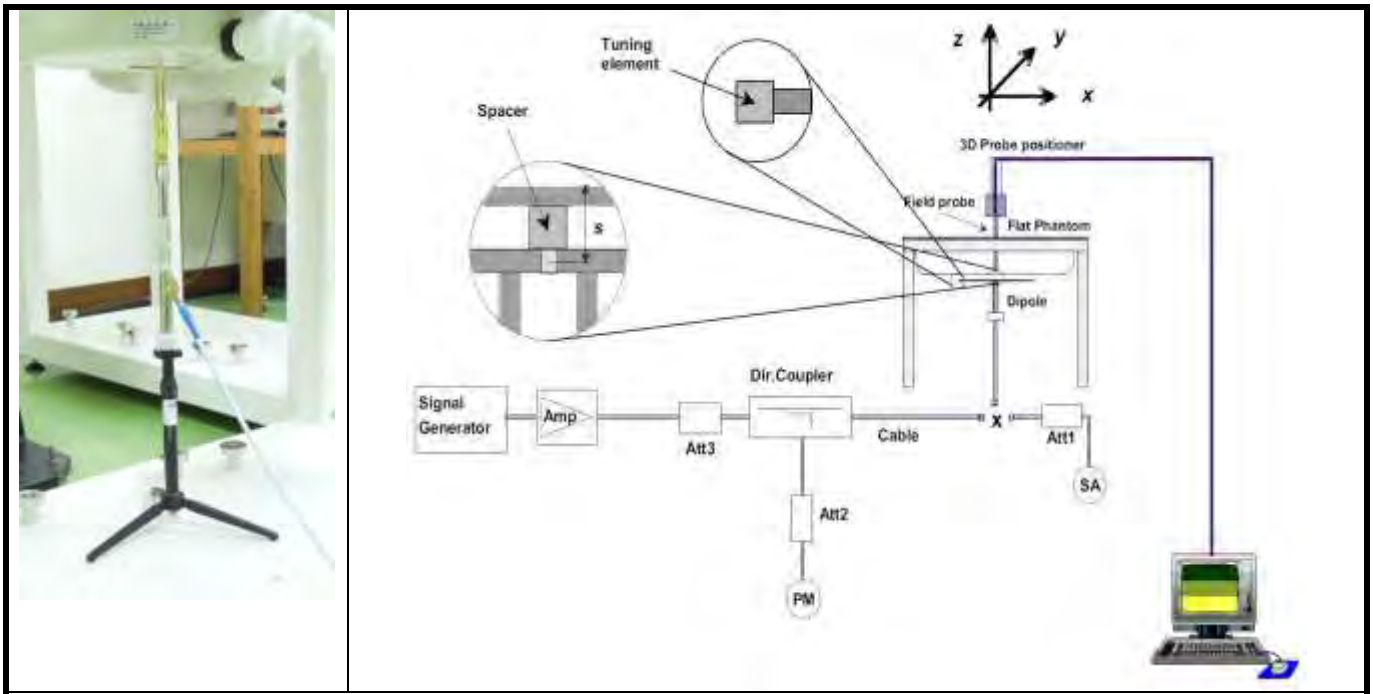


Fig-3.4 System Verification Setup

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 spectrum analyzer measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power (250 mW is used for 700 MHz to 3 GHz, 100 mW is used for 3.5 GHz to 6 GHz) at the dipole connector and the power meter is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter.

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 %.

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:

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

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

(a) Make EUT to transmit maximum output power
(b) Measure conducted output power through RF cable
(c) Place the EUT in the specific position of phantom
(d) Perform SAR testing steps on the DASY system
(e) Record the SAR value

3.4.1 Area & 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 over 10 g. According to KDB 865664 D01, the resolution for Area and Zoom scan is specified in the table below.

Items	<= 2 GHz	2-3 GHz	3-4 GHz	4-5 GHz	5-6 GHz
Area Scan (Δx, Δy)	<= 15 mm	<= 12 mm	<= 12 mm	<= 10 mm	<= 10 mm
Zoom Scan (Δx, Δy)	<= 8 mm	<= 5 mm	<= 5 mm	<= 4 mm	<= 4 mm
Zoom Scan (Δz)	<= 5 mm	<= 5 mm	<= 4 mm	<= 3 mm	<= 2 mm
Zoom Scan Volume	>= 30 mm	>= 30 mm	>= 28 mm	>= 25 mm	>= 22 mm

Note:

When zoom scan is required and report SAR is <= 1.4 W/kg, the zoom scan resolution of Δx / Δy (2-3GHz: <= 8 mm, 3-4GHz: <= 7 mm, 4-6GHz: <= 5 mm) may be applied.

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 form the measurement grid to the high-resolution grid
(e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f) Calculation of the averaged SAR within masses of 1g and 10g

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. SAR Measurement Evaluation

4.1 EUT Configuration and Setting

<Considerations Related to Proximity Sensor>

The device supports WLAN, and Bluetooth capabilities. It is designed with a proximity sensor which can trigger/not trigger power reduction for Wi-Fi on Rear Face of EUT for SAR compliance. Others RF capability (Bluetooth) have no power reduction. The power levels for all wireless technologies and the power reduction please refer to section 4.5 of this report.

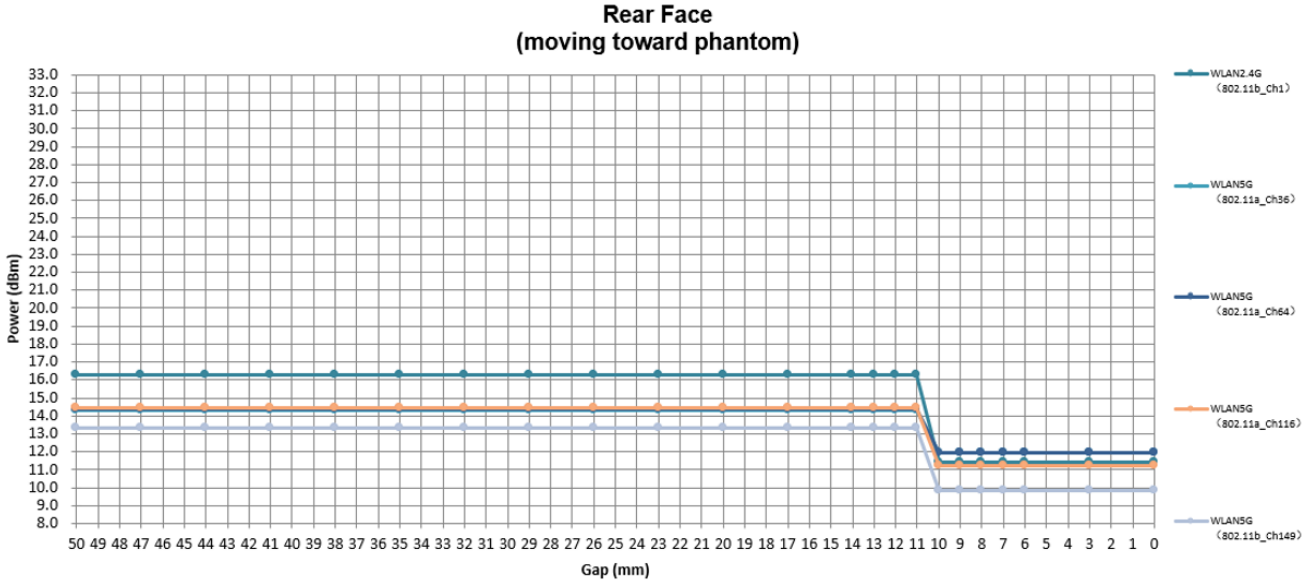
< Proximity Sensor Triggering Distances >

The proximity sensor triggering distance was determined per KDB 616217 section 6.2, and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed.

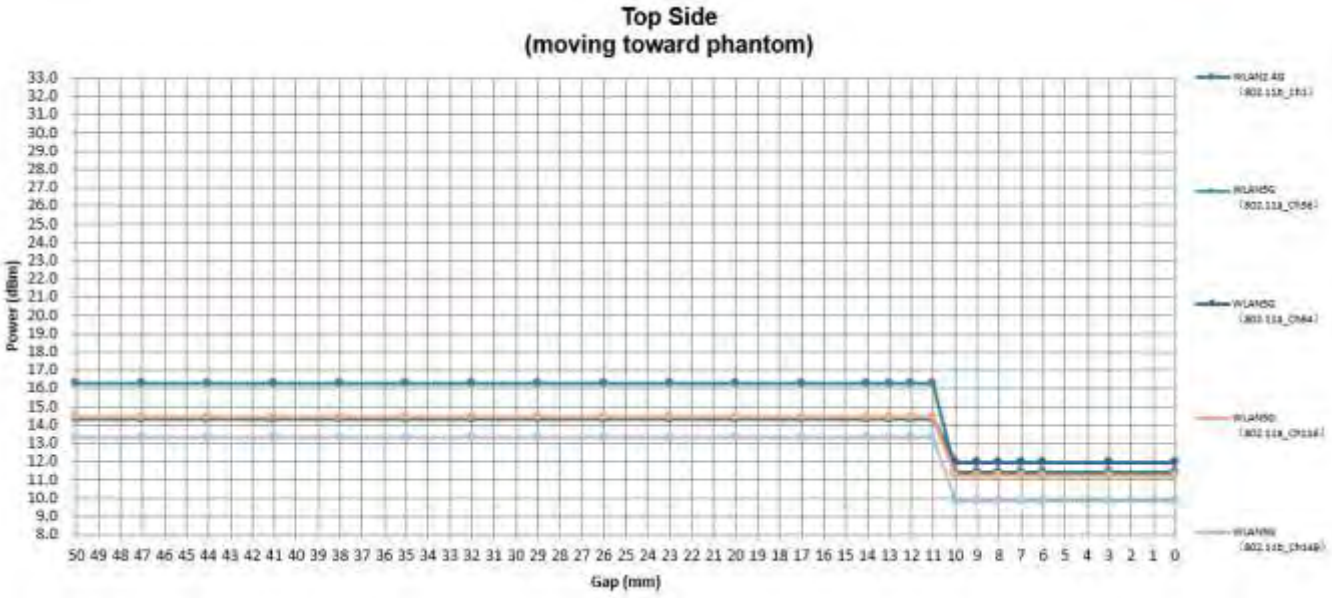
In the preliminary triggering distance testing, the tissue-equivalent medium for different frequency bands were used for verification; no other frequency bands tissue-equivalent medium was found to result in shortest triggering than that for 5700MHz, and the tissue-equivalent medium for 5700MHz was used for formal proximity sensor triggering testing.

Summary for power verification per distance was tabulated in the below table.

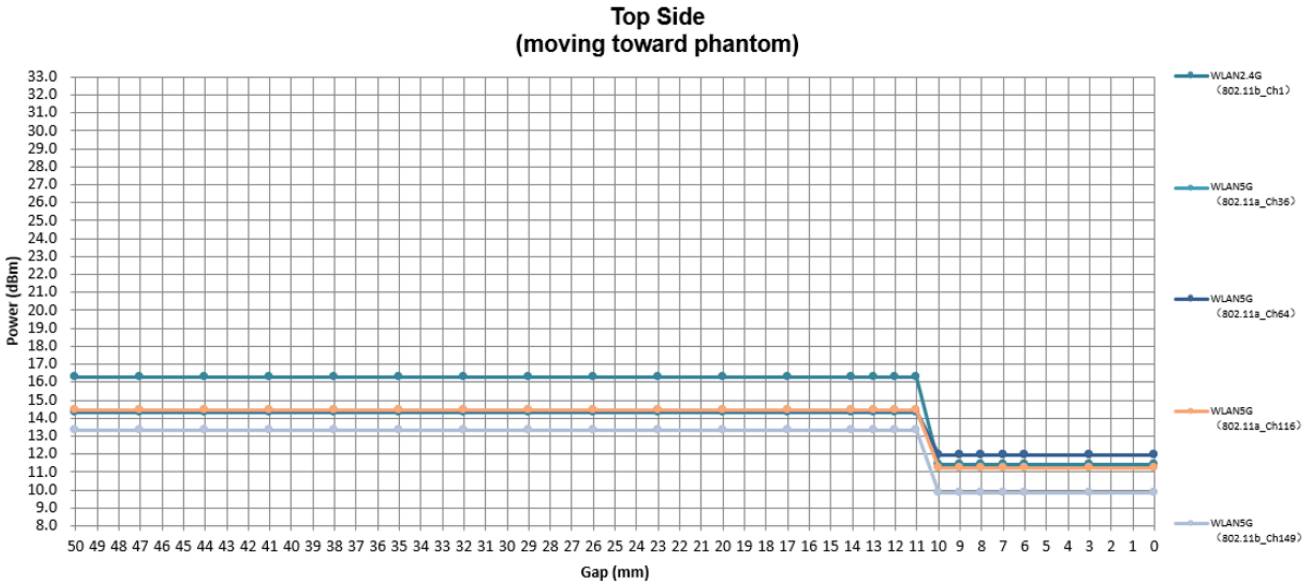
Output Power Verification in dBm for EUT Rear Face (Moving toward phantom)											
Distance (mm)	5	6	7	8	9	10	11	12	13	14	15
WLAN2.4G (802.11b_Ch1)	11.39	11.39	11.39	11.39	11.39	11.39	16.31	16.31	16.31	16.31	16.31
WLAN5G (802.11a_Ch36)	11.93	11.93	11.93	11.93	11.93	11.93	14.34	14.34	14.34	14.34	14.34
WLAN5G (802.11a_Ch64)	11.96	11.96	11.96	11.96	11.96	11.96	14.38	14.38	14.38	14.38	14.38
WLAN5G (802.11a_Ch116)	11.25	11.25	11.25	11.25	11.25	11.25	14.42	14.42	14.42	14.42	14.42
WLAN2.4G (802.11b_Ch149)	9.81	9.81	9.81	9.81	9.81	9.81	13.33	13.33	13.33	13.33	13.33



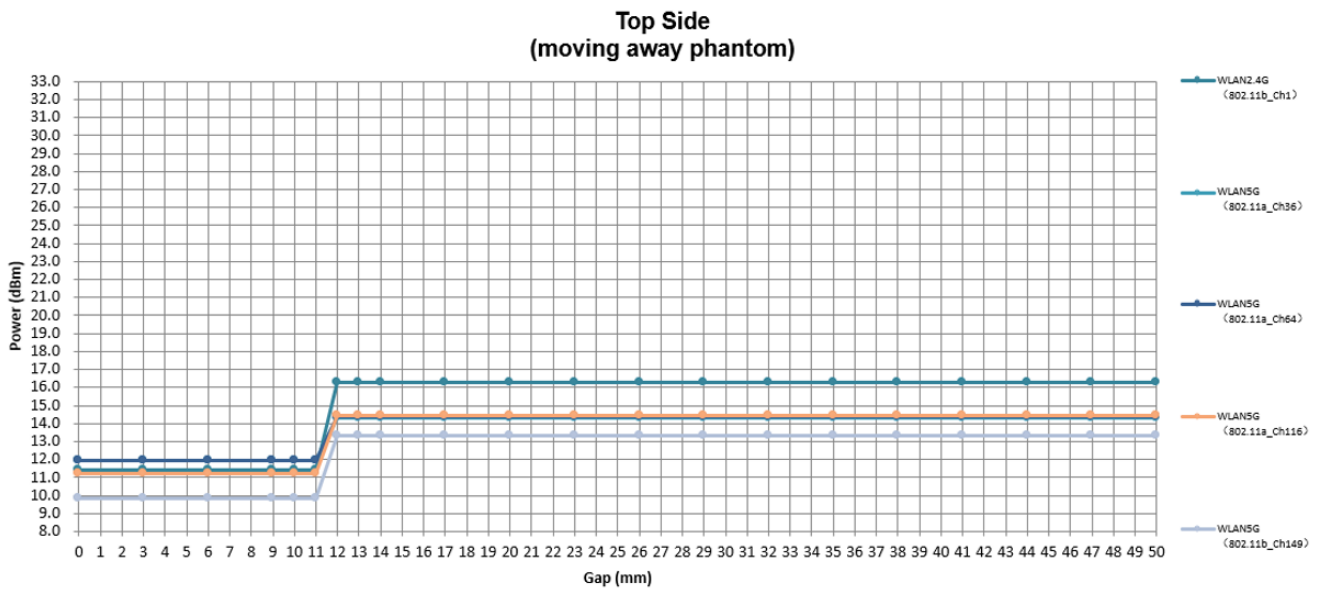
Output Power Verification in dBm for EUT Rear Face (Moving away phantom)											
Distance (mm)	6	7	8	9	10	11	12	13	14	15	16
WLAN2.4G （802.11b_Ch1）	11.39	11.39	11.39	11.39	11.39	11.39	16.31	16.31	16.31	16.31	16.31
WLAN5G （802.11a_Ch36）	11.93	11.93	11.93	11.93	11.93	11.93	14.34	14.34	14.34	14.34	14.34
WLAN5G （802.11a_Ch64）	11.96	11.96	11.96	11.96	11.96	11.96	14.38	14.38	14.38	14.38	14.38
WLAN5G （802.11a_Ch116）	11.25	11.25	11.25	11.25	11.25	11.25	14.42	14.42	14.42	14.42	14.42
WLAN2.4G （802.11b_Ch149）	9.81	9.81	9.81	9.81	9.81	9.81	13.33	13.33	13.33	13.33	13.33



Output Power Verification in dBm for EUT Top Side (Moving toward phantom)											
Distance (mm)	5	6	7	8	9	10	11	12	13	14	15
WLAN2.4G (802.11b_Ch1)	11.39	11.39	11.39	11.39	11.39	11.39	16.31	16.31	16.31	16.31	16.31
WLAN5G (802.11a_Ch36)	11.93	11.93	11.93	11.93	11.93	11.93	14.34	14.34	14.34	14.34	14.34
WLAN5G (802.11a_Ch64)	11.96	11.96	11.96	11.96	11.96	11.96	14.38	14.38	14.38	14.38	14.38
WLAN5G (802.11a_Ch116)	11.25	11.25	11.25	11.25	11.25	11.25	14.42	14.42	14.42	14.42	14.42
WLAN2.4G (802.11b_Ch149)	9.81	9.81	9.81	9.81	9.81	9.81	13.33	13.33	13.33	13.33	13.33



Output Power Verification in dBm for EUT Top Side (Moving away phantom)											
Distance (mm)	6	7	8	9	10	11	12	13	14	15	16
WLAN2.4G (802.11b_Ch1)	11.39	11.39	11.39	11.39	11.39	11.39	16.31	16.31	16.31	16.31	16.31
WLAN5G (802.11a_Ch36)	11.93	11.93	11.93	11.93	11.93	11.93	14.34	14.34	14.34	14.34	14.34
WLAN5G (802.11a_Ch64)	11.96	11.96	11.96	11.96	11.96	11.96	14.38	14.38	14.38	14.38	14.38
WLAN5G (802.11a_Ch116)	11.25	11.25	11.25	11.25	11.25	11.25	14.42	14.42	14.42	14.42	14.42
WLAN2.4G (802.11b_Ch149)	9.81	9.81	9.81	9.81	9.81	9.81	13.33	13.33	13.33	13.33	13.33



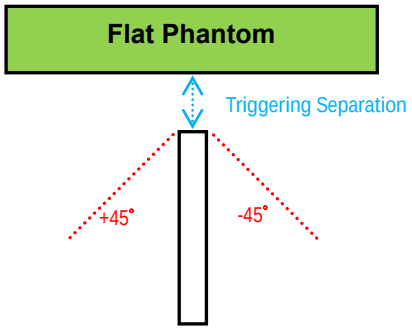
< Proximity Sensor Coverage >

In KDB 616217 section 6.3, if a sensor is spatially offset from the antenna(s), it is necessary to verify sensor triggering for conditions where the antenna is next to the user, but the sensor is laterally further away to ensure sensor coverage is sufficient for reducing the power to maintain compliance. For p-sensor coverage testing, the device is moved and "along the direction of maximum antenna and sensor offset".

However, this device uses a capacitive proximity sensor that is same metallic component as the transmitting antenna to facilitate triggering in any condition the user may use the device in proximity of the antenna in the device. Therefore, no further sensor coverage assessments were required.

<Proximity Sensor Tilt Angle Influences>

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.



Orientation	Separation Distance (mm)	Tilt Angle										
		-45°	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	45°
Top Side	10	On	On	On	On	On	On	On	On	On	On	On

<Summary for Proximity Sensor Triggering Test>

According to the procedures noticed in KDB 616217 D04, the proximity sensor triggering distance is 11 mm for EUT Rear Face. The separation distance of 11 mm determined by the smallest triggering distance on Rear Face 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 Rear Face. The details can be found in technical document. 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 9mm for EUT Rear Face is used to test SAR.

WWAN Ant-1 Proximity Sensor Trigger Distance (mm)		
Position	Rear Face	Top Side
Minimum	10	10

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.

<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.

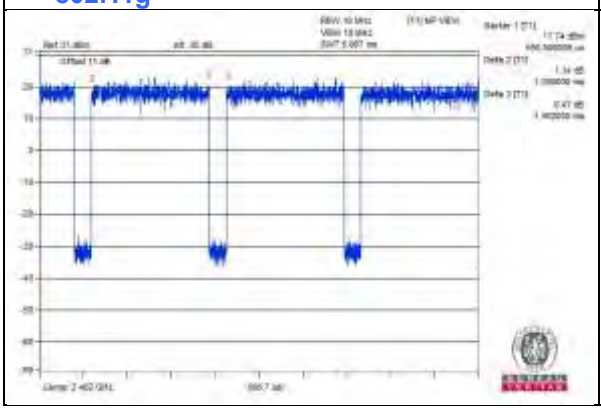
<Duty Cycle of Test Signal>

WIFI 2.4GHz

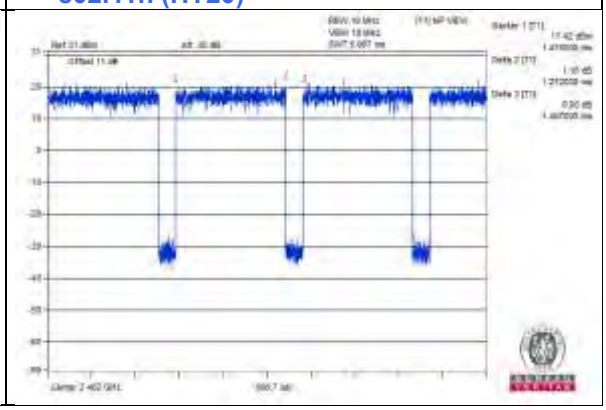
802.11b: Duty cycle = 8.184/8.424 = 0.972,
802.11g: Duty cycle = 1.356/1.562 = 0.868,
802.11n (HT20): Duty cycle = 1.272/1.487 = 0.855,

802.11b

802.11g



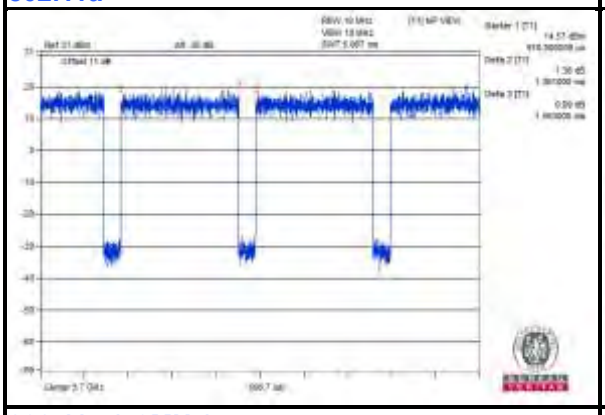
802.11n (HT20)



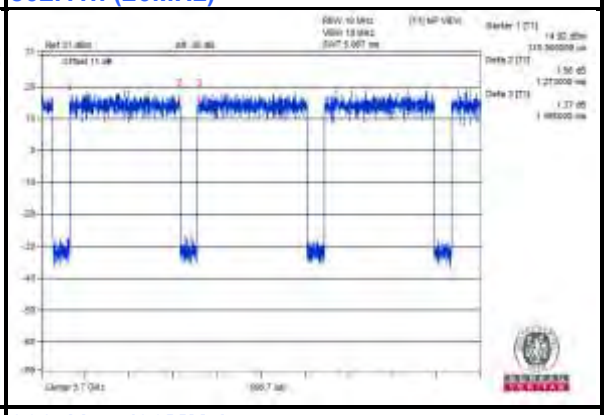
WIFI 5GHz

802.11a: Duty cycle = 1.361/1.563 = 0.871,
802.11n (20MHz): Duty cycle = 1.273/1.495 = 0.852,
802.11n (40MHz): Duty cycle = 0.636/0.848 = 0.750,
802.11ac (80MHz): Duty cycle = 0.244/0.450 = 0.542,

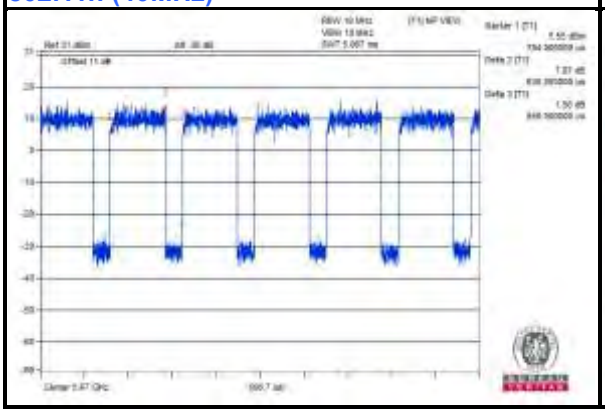
802.11a



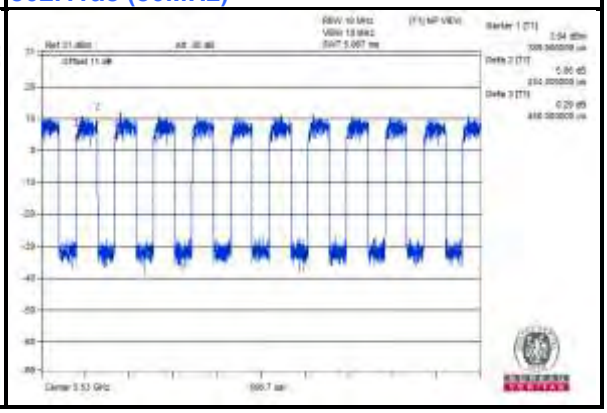
802.11n (20MHz)



802.11n (40MHz)



802.11ac (80MHz)



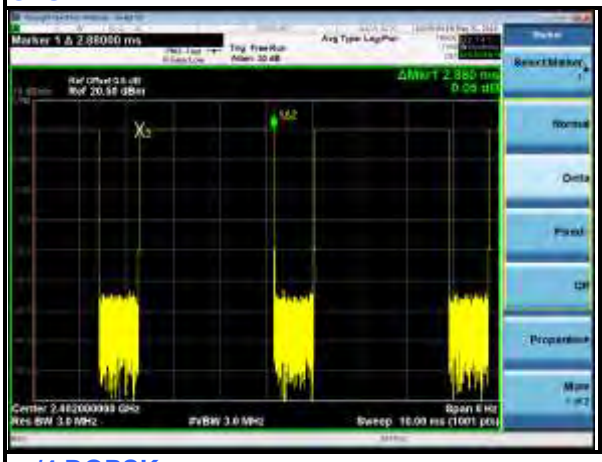
Bluetooth

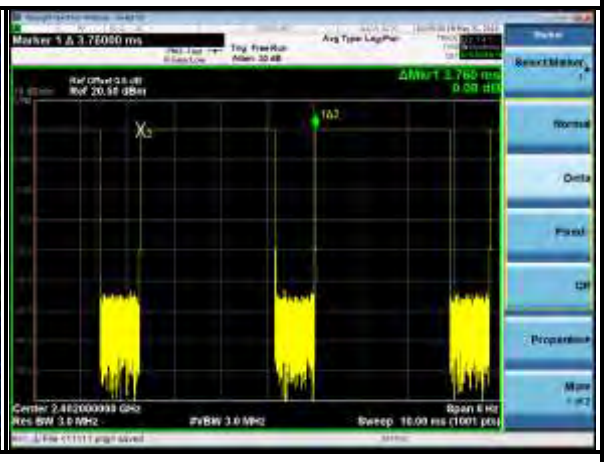
GFSK: Duty cycle = 2.88/3.76 = 0.766,

π/4 DQPSK: Duty cycle = 2.88/3.76 = 0.766,

8DPSK: Duty cycle = 2.88/3.74 = 0.770;

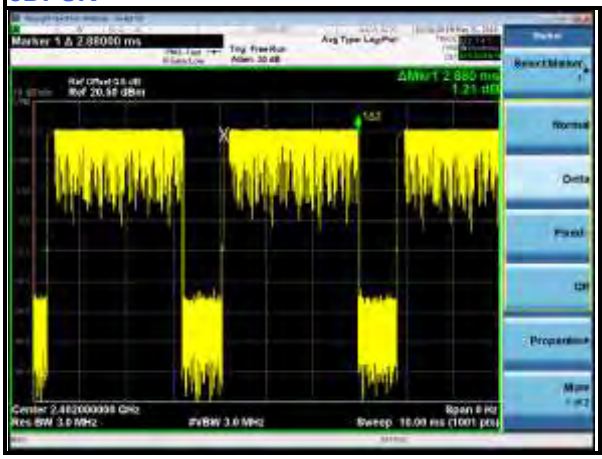
GFSK

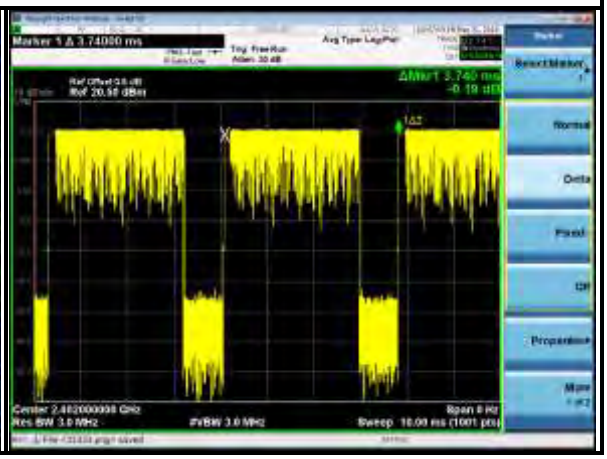




π/4 DQPSK

8DPSK

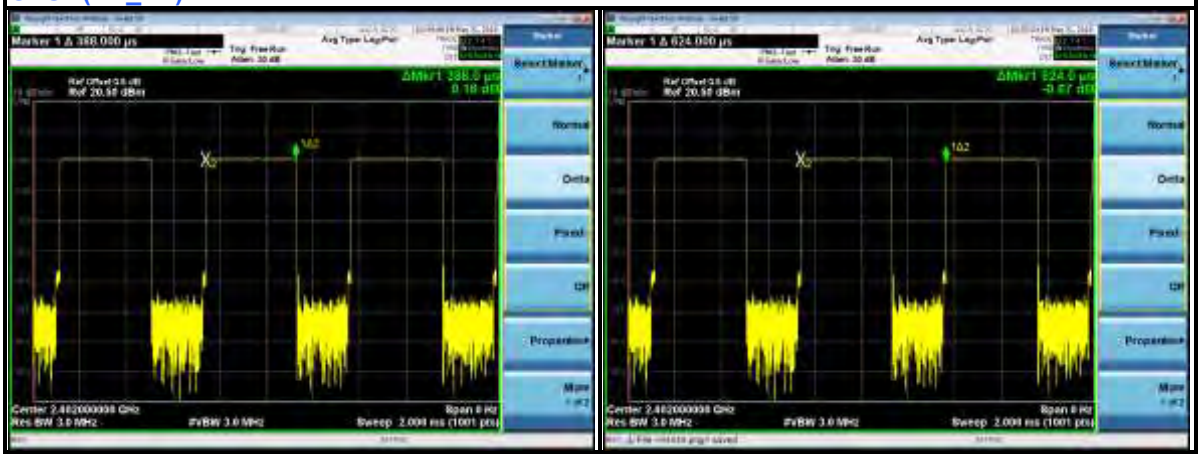




BT_LE

GFSK: Duty cycle = 0.388/0.624 = 0.622,

GFSK(BT_LE)



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.

4.2 EUT Testing Position

4.2.1 Body Exposure Conditions

For full-size tablet, according to KDB 616217 D04, SAR evaluation is required for back surface and edges of the devices. The back surface and edges of the tablet are tested with the tablet touching the phantom. Exposures from antennas through the front surface of the display section of a tablet are generally limited to the user's hands. Exposures to hands for typical consumer transmitters used in tablets are not expected to exceed the extremity SAR limit; therefore, SAR evaluation for the front surface of tablet display screens are generally not necessary. When voice mode is supported on a tablet and it is limited to speaker mode or headset operations only, additional SAR testing for this type of voice use is not required.

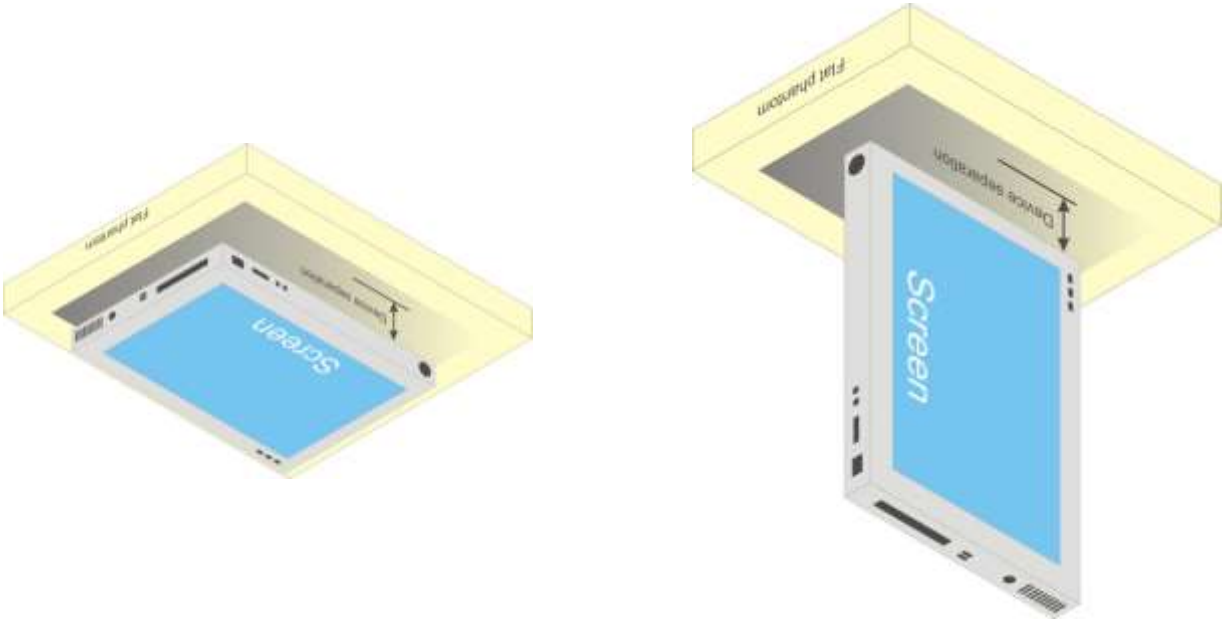


Fig-4.1 Illustration for Tablet Setup

4.2.2 SAR Test Exclusion Evaluations

According to KDB 447498 D01, the SAR test exclusion condition is based on source-based time-averaged maximum conducted output power, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The SAR exclusion threshold is determined by the following formula.

1. For the test separation distance <= 50 mm

$$\frac{\textbf{Max. Tune up Power}_{(mW)}}{\textbf{Min. Test Separation Distance}_{(mm)}} \times \sqrt{f_{(GHz)}} \leq 3.0 \text{ for SAR-1g, } \leq 7.5 \text{ for SAR-10g}$$

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

2. For the test separation distance > 50 mm, and the frequency at 100 MHz to 1500 MHz

$$\left[(\text{Threshold at 50 mm in Step 1}) + (\text{Test Separation Distance} - 50\text{ mm}) \times \left(\frac{f_{(MHz)}}{150}\right)\right]_{(mW)}$$

3. For the test separation distance > 50 mm, and the frequency at > 1500 MHz to 6 GHz

$$[(\text{Threshold at 50 mm in Step 1}) + (\text{Test Separation Distance} - 50\text{ mm}) \times 10]_{(mW)}$$

Mode	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Rear Face			Left Side			Right Side			Top Side			Bottom Side		
			Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?	Ant. to Surface (mm)	Calculated Result (mW)	Require SAR Testing?
WLAN 2.4G	17.0	50.12	5	15.7	Yes	52	116	No	160	1196	No	5	15.7	Yes	154	1136	No
WLAN 5.2G	15.0	31.62	5	14.5	Yes	52	86	No	160	1166	No	5	14.5	Yes	154	1106	No
WLAN 5.3G	15.0	31.62	5	14.6	Yes	52	85	No	160	1165	No	5	14.6	Yes	154	1105	No
WLAN 5.6G	15.0	31.62	5	15.1	Yes	52	83	No	160	1163	No	5	15.1	Yes	154	1103	No
WLAN 5.8G	14.0	25.12	5	12.1	Yes	52	82	No	160	1162	No	5	12.1	Yes	154	1102	No
BT	11.5	14.13	5	4.4	Yes	52	115	No	160	1195	No	5	4.4	Yes	154	1135	No

Note:

1. When separation distance <= 50 mm and the calculated result shown in above table is <= 3.0 for SAR-1g exposure condition, or <= 7.5 for SAR-10g exposure condition, the SAR testing exclusion is applied.
2. When separation distance > 50 mm and the device output power is less than the calculated result (power threshold, mW) shown in above table, the SAR testing exclusion is applied.

4.3 Tissue Verification

The measuring results for tissue simulating liquid are shown as below.

Tissue Type	Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)	Test Date
HSL2450	2450	22.5	1.817	39.293	1.80	39.20	0.94	0.24	Dec. 04, 2023
HSL5250	5250	22.4	4.632	36.191	4.71	35.90	-1.66	0.81	Dec. 04, 2023
HSL5600	5600	22.4	5.015	35.630	5.07	35.50	-1.08	0.37	Dec. 04, 2023
HSL5750	5750	22.6	5.215	35.335	5.22	35.40	-0.10	-0.18	Dec. 04, 2023

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within ±5% of the target values. Liquid temperature during the SAR testing must be within ±2 ℃.

4.4 System Verification

The measuring result for system verification is tabulated as below.

Test Date	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Dec. 04, 2023	2450	52.8	13.47	53.88	2.05	1048	7612	1633
Dec. 04, 2023	5250	76.9	7.95	79.50	3.38	1315	7612	1633
Dec. 04, 2023	5600	81.9	7.81	78.10	-4.64	1315	7612	1633
Dec. 04, 2023	5750	76.1	7.63	76.30	0.26	1315	7612	1633

Note:

Comparing to the reference SAR value provided by SPEAG, the validation data should be within its specification of 10 %. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

4.5 Maximum Output Power

4.5.1 Maximum Conducted Power

The maximum conducted average power (Unit: dBm) including tune-up tolerance is shown as below.

Mode	2.4G WLAN (without Power Reduction)	2.4G WLAN (with Power Reduction)	Power Reduction (dB)
802.11b	17.0	12.0	5
802.11g	16.0	11.5	4.5
802.11n HT20	15.0	11.5	3.5

Mode	5.2G WLAN (without Power Reduction)	5.2G WLAN (with Power Reduction)	Power Reduction (dB)
802.11a	15.0	12.5	2.5
802.11n HT20	15.0	12.5	2.5
802.11n HT40	13.0	12.0	1.0
802.11ac VHT80	13.5	10.5	2.5

Mode	5.3G WLAN (without Power Reduction)	5.3G WLAN (with Power Reduction)	Power Reduction (dB)
802.11a	15.0	12.5	2.5
802.11n HT20	15.0	12.5	2.5
802.11n HT40	13.0	12.0	1.0
802.11ac VHT80	13.5	10.5	2.5

Mode	5.6G WLAN (without Power Reduction)	5.6G WLAN (with Power Reduction)	Power Reduction (dB)
802.11a	15.0	12.5	2.5
802.11n HT20	15.0	12.5	2.5
802.11n HT40	13.0	12.0	1.0
802.11ac VHT80	13.5	10.5	2.5

Mode	5.8G WLAN (without Power Reduction)	5.8G WLAN (with Power Reduction)	Power Reduction (dB)
802.11a	14.0	10.5	3.5
802.11n HT20	14.0	10.5	3.5
802.11n HT40	13.0	8.5	4.5
802.11ac VHT80	12.0	8.5	3.5

Mode	2.4G Bluetooth
GFSK	11.5
π/4-DQPSK	9.0
8-DPSK	9.0
LE	2.0

4.5.2 Measured Conducted Power Result

The measuring conducted average power (Unit: dBm) is shown as below.

<WLAN 2.4G>

Mode	802.11b		
Channel / Frequency (MHz)	1 (2412)	6 (2437)	11 (2462)
EUT without Power Reduction (P-Sensor NOT Triggered)			
Average Power	**16.31**	16.09	15.51
EUT with Power Reduction (P-Sensor Triggered)			
Average Power	**11.39**	10.19	10.66
Mode	802.11g		
Channel / Frequency (MHz)	1 (2412)	6 (2437)	11 (2462)
EUT without Power Reduction (P-Sensor NOT Triggered)			
Average Power	**15.10**	14.44	14.63
EUT with Power Reduction (P-Sensor Triggered)			
Average Power	**10.75**	10.58	10.72
Mode	802.11n (HT20)		
Channel / Frequency (MHz)	1 (2412)	6 (2437)	11 (2462)
EUT without Power Reduction (P-Sensor NOT Triggered)			
Average Power	14.05	**14.53**	14.19
EUT with Power Reduction (P-Sensor Triggered)			
Average Power	**10.99**	10.57	10.97

WLAN 5.2G>

Mode	802.11a			
Channel / Frequency (MHz)	36 (5180)	40 (5200)	44 (5220)	48 (5240)
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	**14.34**	14.10	14.15	14.11
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	**11.93**	10.43	10.55	10.83
Mode	802.11n (HT20)			
Channel / Frequency (MHz)	36 (5180)	40 (5200)	44 (5220)	48 (5240)
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	**14.44**	14.17	14.20	14.39
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	**12.01**	10.69	10.55	10.88
Mode	802.11n (HT40)			
Channel / Frequency (MHz)	38 (5190)		46 (5230)	
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	12.03		**12.37**	
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	11.37		**11.57**	
Mode	802.11ac (VHT80)			
Channel / Frequency (MHz)	42 (5210)			
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	**12.74**			
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	**9.81**			

<WLAN 5.3G>

Mode	802.11a			
Channel / Frequency (MHz)	52 (5260)	56 (5280)	60 (5300)	64 (5320)
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	14.16	14.11	14.06	**14.38**
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	11.63	11.72	11.76	**11.96**
Mode	802.11n (HT20)			
Channel / Frequency (MHz)	52 (5260)	56 (5280)	60 (5300)	64 (5320)
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	14.02	14.06	14.12	**14.27**
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	10.69	10.77	**10.91**	10.87
Mode	802.11n (HT40)			
Channel / Frequency (MHz)	54 (5270)		62 (5310)	
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	**12.60**		12.46	
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	11.51		**11.54**	
Mode	802.11ac (VHT80)			
Channel / Frequency (MHz)	58 (5290)			
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	**12.73**			
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	**9.87**			

<WLAN 5.6G>

Mode	802.11a							
Channel / Frequency (MHz)	100 (5500)	104 (5520)	108 (5540)	112 (5560)	116 (5580)	132 (5660)	136 (5680)	140 (5700)
EUT without Power Reduction (P-Sensor NOT Triggered)								
Average Power	14.13	14.19	14.23	14.33	**14.42**	14.25	14.08	14.15
EUT with Power Reduction (P-Sensor Triggered)								
Average Power	11.11	11.14	10.99	10.86	**11.25**	11.14	10.91	10.96
Mode	802.11n (HT20)							
Channel / Frequency (MHz)	100 (5500)	104 (5520)	108 (5540)	112 (5560)	116 (5580)	132 (5660)	136 (5680)	140 (5700)
EUT without Power Reduction (P-Sensor NOT Triggered)								
Average Power	**14.36**	14.29	14.22	14.17	14.19	14.24	14.27	14.28
EUT with Power Reduction (P-Sensor Triggered)								
Average Power	**11.12**	11.01	10.78	10.85	10.98	11.01	10.93	10.76
Mode	802.11n (HT40)							
Channel / Frequency (MHz)	102 (5510)				134 (5670)			
EUT without Power Reduction (P-Sensor NOT Triggered)								
Average Power	12.22				**12.42**			
EUT with Power Reduction (P-Sensor Triggered)								
Average Power	11.59				**11.83**			
Mode	802.11ac (VHT80)							
Channel / Frequency (MHz)	106 (5530)							
EUT without Power Reduction (P-Sensor NOT Triggered)								
Average Power	**12.92**							
EUT with Power Reduction (P-Sensor Triggered)								
Average Power	**9.92**							

<WLAN 5.8G>

Mode	802.11a			
Channel / Frequency (MHz)	149 (5745)	153 (5765)	157 (5785)	161 (5805)
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	13.33	13.23	13.11	13.14
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	9.81	9.68	9.48	9.57
Mode	802.11n (HT20)			
Channel / Frequency (MHz)	149 (5745)	153 (5765)	157 (5785)	161 (5805)
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	13.28	13.12	13.05	13.23
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	9.61	9.43	9.59	9.49
Mode	802.11n (HT40)			
Channel / Frequency (MHz)	151 (5755)		159 (5795)	
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	12.22		12.12	
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	7.76		7.63	
Mode	802.11ac (VHT80)			
Channel / Frequency (MHz)	155 (5775)			
EUT without Power Reduction (P-Sensor NOT Triggered)				
Average Power	**11.38**			
EUT with Power Reduction (P-Sensor Triggered)				
Average Power	**7.67**			

<Bluetooth>

Mode	Bluetooth GFSK		
Channel / Frequency (MHz)	0 (2402)	39 (2441)	78 (2480)
Average Power	**10.81**	10.32	9.81
Mode	Bluetooth π/4-DQPSK		
Channel / Frequency (MHz)	0 (2402)	39 (2441)	78 (2480)
Average Power	**8.36**	8.10	7.64
Mode	Bluetooth 8-DPSK		
Channel / Frequency (MHz)	0 (2402)	39 (2441)	78 (2480)
Average Power	**8.33**	8.08	7.61
Mode	Bluetooth LE		
Channel / Frequency (MHz)	0 (2402)	19 (2440)	39 (2480)
Average Power	**1.18**	0.51	0.02

4.6 SAR Testing Results

4.6.1 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

<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 5 GHz, 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.

4.6.2 SAR Results of Original Product for Body Exposure Condition

Band	Mode	Test Position	Separation Distance (cm)	Ch.	Sample	Sensor	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Duty Cycle	Duty Cycle Factor	Scaling Factor	Scaled SAR-1g (W/kg)
WLAN2.4G	802.11b	Rear Face	0	1	1	on	12.0	11.39	0.00	0.547	97.2	1.03	1.15	**0.65**
WLAN2.4G	802.11b	Top Side	0	1	1	off	17.0	16.31	0.03	0.497	97.2	1.03	1.17	0.60
WLAN2.4G	802.11b	Rear Face	0.9	1	1	off	17.0	16.31	0.08	0.058	97.2	1.03	1.17	0.07
WLAN2.4G	802.11b	Rear Face	0	1	2	on	12.0	11.39	0.00	0.543	97.2	1.03	1.15	0.64
WLAN5G	802.11a	Rear Face	0	64	1	on	12.5	11.96	0.00	0.605	87.1	1.15	1.13	**0.79**
WLAN5G	802.11a	Top Side	0	64	1	off	15.0	14.38	0.18	0.452	87.1	1.15	1.15	0.60
WLAN5G	802.11a	Rear Face	0.9	64	1	off	15.0	14.38	0.03	0.102	87.1	1.15	1.15	0.14
WLAN5G	802.11a	Rear Face	0	64	2	on	12.5	11.96	0.03	0.581	87.1	1.15	1.13	0.76
WLAN5G	802.11a	Rear Face	0	116	1	on	12.5	11.25	0.00	0.506	87.1	1.15	1.33	**0.77**
WLAN5G	802.11a	Top Side	0	116	1	off	15.0	14.42	0.08	0.322	87.1	1.15	1.14	0.42
WLAN5G	802.11a	Rear Face	0.9	116	1	off	15.0	14.42	0.03	0.126	87.1	1.15	1.14	0.17
WLAN5G	802.11a	Rear Face	0	116	2	on	12.5	11.25	-0.03	0.485	87.1	1.15	1.33	0.74
WLAN5G	802.11a	Rear Face	0	149	1	on	10.5	9.81	0.00	0.734	87.1	1.15	1.17	**0.99**
WLAN5G	802.11a	Top Side	0	149	1	off	14.0	13.33	0.13	0.328	87.1	1.15	1.17	0.44
WLAN5G	802.11a	Rear Face	0.9	149	1	off	14.0	13.33	0.00	0.105	87.1	1.15	1.17	0.14
WLAN5G	802.11a	Rear Face	0	149	2	on	10.5	9.81	0.00	0.545	87.1	1.15	1.17	0.73
BT	GFSK	Rear Face	0	0	1	-	11.5	10.81	0.00	0.543	76.6	1.09	1.17	**0.69**
BT	GFSK	Top Side	0	0	1	-	11.5	10.81	0.16	0.121	76.6	1.09	1.17	0.15
BT	GFSK	Rear Face	0.9	0	1	-	11.5	10.81	0.09	0.056	76.6	1.09	1.17	0.07
BT	GFSK	Rear Face	0	0	2	-	11.5	10.81	0.00	0.522	76.6	1.09	1.17	0.67

Note: All data is copied from the original report. (Report No: W7L-P23100016SA01, FCC ID: XUJX431V1V40)

4.6.3 SAR Verification Results of Variant Product for Body Exposure Condition

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Ch.	Sample	Sensor	Shell	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Power Drift (dB)	Measured SAR-1g (W/kg)	Duty Cycle	Duty Cycle Factor	Tune-up Scaling Factor	Scaled SAR-1g (W/kg)
	WLAN2.4G	802.11b	Rear Face	0	1	1	on	1	12.0	11.39	0.01	0.036	97.2	1.03	1.15	0.04
P01	WLAN2.4G	802.11b	Rear Face	0	1	1	on	2	12.0	11.39	-0.06	0.119	97.2	1.03	1.15	0.14
	WLAN5G	802.11a	Rear Face	0	64	1	on	1	12.5	11.96	0.05	0.059	87.1	1.15	1.13	0.08
P02	WLAN5G	802.11a	Rear Face	0	64	1	on	2	12.5	11.96	-0.07	0.145	87.1	1.15	1.13	0.19
	WLAN5G	802.11a	Rear Face	0	116	1	on	1	12.5	11.25	-0.05	0.088	87.1	1.15	1.33	0.14
P03	WLAN5G	802.11a	Rear Face	0	116	1	on	2	12.5	11.25	-0.01	0.204	87.1	1.15	1.33	0.31
	WLAN5G	802.11a	Rear Face	0	149	1	on	1	10.5	9.81	0.13	0.064	87.1	1.15	1.17	0.09
P04	WLAN5G	802.11a	Rear Face	0	149	1	on	2	10.5	9.81	-0.05	0.236	87.1	1.15	1.17	0.32
	BT	GFSK	Rear Face	0	0	1	-	1	11.5	10.81	0.04	0.030	76.6	1.09	1.17	0.04
P05	BT	GFSK	Rear Face	0	0	1	-	2	11.5	10.81	-0.01	0.102	76.6	1.09	1.17	0.13

Note: Verify worst case based on original report data. (Report No: W7L-P23100016SA01, FCC ID: XUJX431V1V40)

4.6.4 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 may be 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.

Since all the measured SAR are less than 0.8 W/kg, the repeated measurement is not required.

5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Dipole	SPEAG	D2450V2	1048	Oct. 21, 2021	3 Years
System Validation Dipole	SPEAG	D5GHzV2	1315	Oct. 22, 2021	3 Years
Data Acquisition Electronics	SPEAG	DAE4	1633	Feb. 08, 2023	1 Year
Dosimetric E-Field Probe	SPEAG	EX3DV4	7612	Feb. 28, 2023	1 Year
Vector Network Analyzer	SPEAG	VNA R140	0121219	Feb. 17, 2023	1 Year
dielectric parameter probes	SPEAG	DAK-3.5	1119	Feb. 20, 2023	1 Year
Power Meter	Rohde&Schwarz	NRX	102380	Feb. 15, 2022	2 Years
Power Sensor	Rohde&Schwarz	NRP6A	102942	Feb. 15, 2022	2 Years
Power Sensor	Rohde&Schwarz	NRP6A	102943	Feb. 15, 2022	2 Years
ESG Analog Signal Generator	Rohde&Schwarz	SMB100A03	182185	Feb. 16, 2022	2 Years
Coupler	Woken	0110A056020-10	COM27RW1A3	May. 10, 2023	1 Year
Temp.&Humi.Recorder	ANYMETER	JR912	SZ01	Jun. 19, 2022	2 Years

Note:

1. Referring to KDB 865664 D01 v01r04, the dipole calibration interval can be extended to 3 years with justification. The dipole is also not physically damaged or repaired during the interval. The dipole justification can be found in appendix C.
   The return loss is $<$ -20dB, within 20% of prior calibration, the impedance is with 5ohm of prior calibration.

6. Measurement Uncertainty

DASY6 Uncertainty Budget According to IEEE 1528-2013 and IEC 62209-1/2016 (0.3 - 3 GHz range)								
Error Description	**Uncertainty Value (±%)**	**Probability**	**Divisor**	**(Ci) 1g**	**(Ci) 10g**	**Standard Uncertainty (1g) (±%)**	**Standard Uncertainty (10g) (±%)**	**(Vi) Veff**
Measurement System								
Probe Calibration	6.05	N	1	1	1	6.1	6.1	∞
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9	∞
Boundary Effects	2.0	R	1.732	1	1	1.2	1.2	∞
Linearity	4.7	R	1.732	1	1	2.7	2.7	∞
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6	∞
Modulation Response	3.2	R	1.732	1	1	1.8	1.8	∞
Readout Electronics	0.3	N	1	1	1	0.3	0.3	∞
Response Time	0.0	R	1.732	1	1	0.0	0.0	∞
Integration Time	2.6	R	1.732	1	1	1.5	1.5	∞
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7	∞
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7	∞
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2	∞
Probe Positioning	6.7	R	1.732	1	1	3.9	3.9	∞
Max. SAR Eval.	4.0	R	1.732	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	4.0	N	1	1	1	4.0	4.0	35
Device Holder	4.9	N	1	1	1	4.9	4.9	12
Power Drift	5.0	R	1.732	1	1	2.9	2.9	∞
Power Scaling	0.0	R	1.732	1	1	0.0	0.0	∞
Phantom and Setup								
Phantom Uncertainty	6.6	R	1.732	1	1	3.8	3.8	∞
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0	∞
Liquid Conductivity Repeatability	0.14	N	1	0.78	0.71	0.1	0.1	5
Liquid Conductivity (target)	10.0	R	1.732	0.78	0.71	4.5	4.1	∞
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0	∞
Temp. unc. - Conductivity	2.61	R	1.732	0.78	0.71	1.2	1.1	∞
Liquid Permittivity Repeatability	0.03	N	1	0.23	0.26	0.0	0.0	5
Liquid Permittivity (target)	10.0	R	1.732	0.23	0.26	1.3	1.5	∞
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4	∞
Temp. unc. - Permittivity	1.78	R	1.732	0.23	0.26	0.2	0.3	∞
Combined Std. Uncertainty						13.6%	13.5%	578
Coverage Factor for 95 %						K=2	K=2	
Expanded STD Uncertainty						27.2%	26.9%	

Uncertainty budget for frequency range 300 MHz to 3 GHz

DASY6 Uncertainty Budget According to IEC 62209-2/2010 (30 MHz - 6 GHz range)								
Error Description	**Uncertainty Value (±%)**	**Probability**	**Divisor**	**(Ci) 1g**	**(Ci) 10g**	**Standard Uncertainty (1g) (±%)**	**Standard Uncertainty (10g) (±%)**	**(Vi) Veff**
Measurement System								
Probe Calibration	6.65	N	1	1	1	6.7	6.7	∞
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9	∞
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9	∞
Boundary Effects	2.0	R	1.732	1	1	1.2	1.2	∞
Linearity	4.7	R	1.732	1	1	2.7	2.7	∞
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6	∞
Modulation Response	3.2	R	1.732	1	1	1.8	1.8	∞
Readout Electronics	0.3	N	1	1	1	0.3	0.3	∞
Response Time	0.0	R	1.732	1	1	0.0	0.0	∞
Integration Time	2.6	R	1.732	1	1	1.5	1.5	∞
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7	∞
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7	∞
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2	∞
Probe Positioning	6.7	R	1.732	1	1	3.9	3.9	∞
Max. SAR Eval.	4.0	R	1.732	1	1	2.3	2.3	∞
Test Sample Related								
Device Positioning	4.3	N	1	1	1	4.3	4.3	35
Device Holder	4.9	N	1	1	1	4.9	4.9	12
Power Drift	5.0	R	1.732	1	1	2.9	2.9	∞
Power Scaling	0.0	R	1.732	1	1	0.0	0.0	∞
Phantom and Setup								
Phantom Uncertainty	6.6	R	1.732	1	1	3.8	3.8	∞
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0	∞
Liquid Conductivity Repeatability	0.16	N	1	0.78	0.71	0.1	0.1	5
Liquid Conductivity (target)	10.0	R	1.732	0.78	0.71	4.5	4.1	∞
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0	∞
Temp. unc. - Conductivity	3.64	R	1.732	0.78	0.71	1.6	1.5	∞
Liquid Permittivity Repeatability	0.08	N	1	0.23	0.26	0.0	0.0	5
Liquid Permittivity (target)	10.0	R	1.732	0.23	0.26	1.3	1.5	∞
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4	∞
Temp. unc. - Permittivity	1.78	R	1.732	0.23	0.26	0.2	0.3	∞
Combined Std. Uncertainty						14.0%	13.9%	624
Coverage Factor for 95 %						K=2	K=2	
Expanded STD Uncertainty						28.0%	27.7%	

Uncertainty budget for frequency range 3 GHz to 6 GHz

7. Information on the Testing Laboratories

We, Huarui 7layers High Technology (Suzhou) Co., Ltd., were founded in 2020 to provide our best service in EMC, Radio, Telecom and Safety consultation.

If you have any comments, please feel free to contact us at the following:

Add: Tower N, Innovation Center, 88 Zuyi Road, High-tech District, Suzhou City, Anhui Province
Tel: +86 (0557) 368 1008

The road map of all our labs can be found in our web site also
Web: http://www.7Layers.com

---END---

Appendix A. SAR Plots of System Verification

The plots for system verification with largest deviation for each SAR system combination are shown as follows.

Test Laboratory: ritt 7 Layers SAR/HAC Testing Lab Date: 2023/12/04

System Check_HSL2450_231204

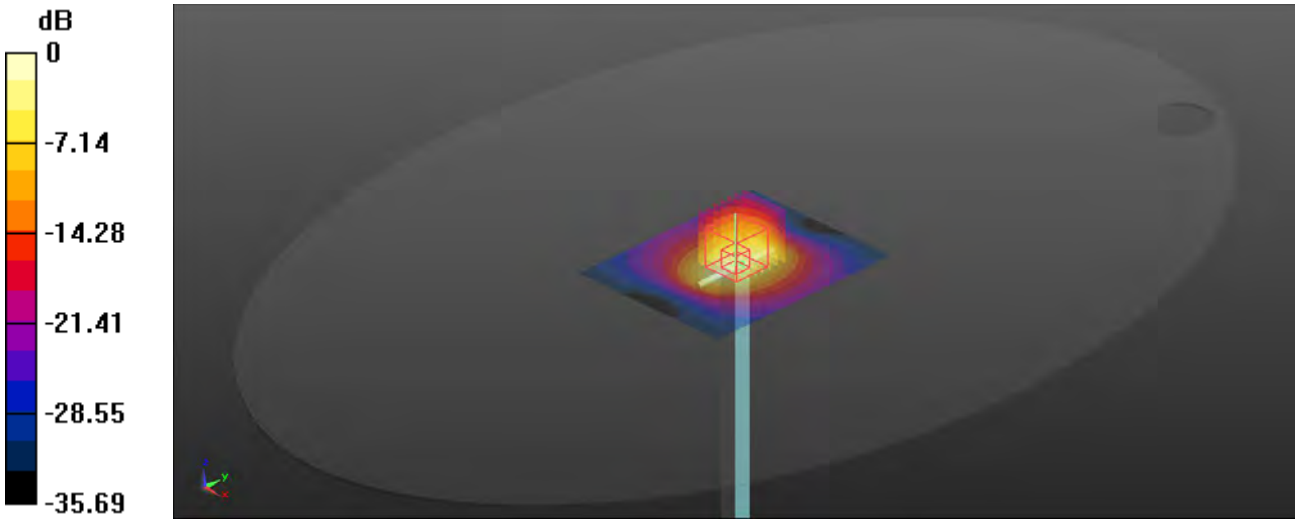
DUT: Dipole 2450 MHz; Type: D2450V2

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: HSL2450_1204 Medium parameters used: f = 2450 MHz; σ = 1.817 S/m; ε_r = 39.293; ρ = 1000 kg/m^3
Ambient Temperature：23.3℃； Liquid Temperature：22.5℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(8.11, 8.11, 8.11) @ 2450 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

Pin=250mW/Area Scan (81x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 22.4 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.94 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.8 W/kg
SAR(1 g) = 13.47 W/kg; SAR(10 g) = 6.15 W/kg
Maximum value of SAR (measured) = 22.2 W/kg



0 dB = 22.2 W/kg

System Check_HSL5250_231204

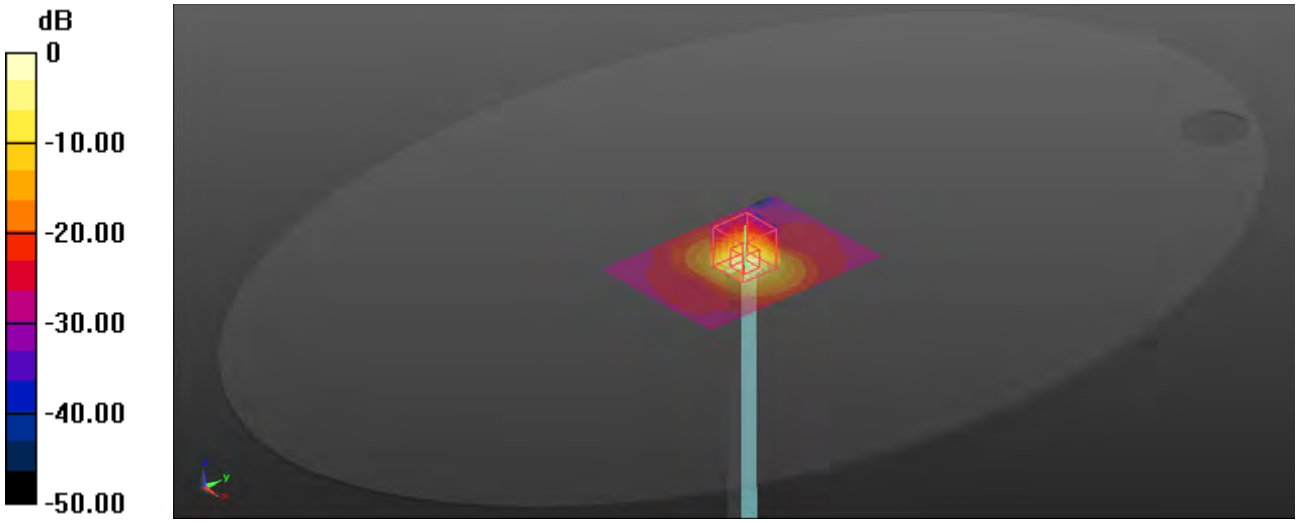
DUT: Dipole 5GHz; Type: D5GHzV2

Communication System: CW; Frequency: 5250 MHz;Duty Cycle: 1:1
Medium: HSL5G_1204 Medium parameters used: f = 5250 MHz; σ = 4.632 S/m; ε_r = 36.191; ρ = 1000 kg/m^3
Ambient Temperature：23.4℃； Liquid Temperature：22.4℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(5.7, 5.7, 5.7) @ 5250 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

Pin=100mW/Area Scan (81x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.7 W/kg

Pin=100mW/Zoom Scan (7x7x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 45.77 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 20.8 W/kg



0 dB = 20.8 W/kg

System Check_HSL5600_231204

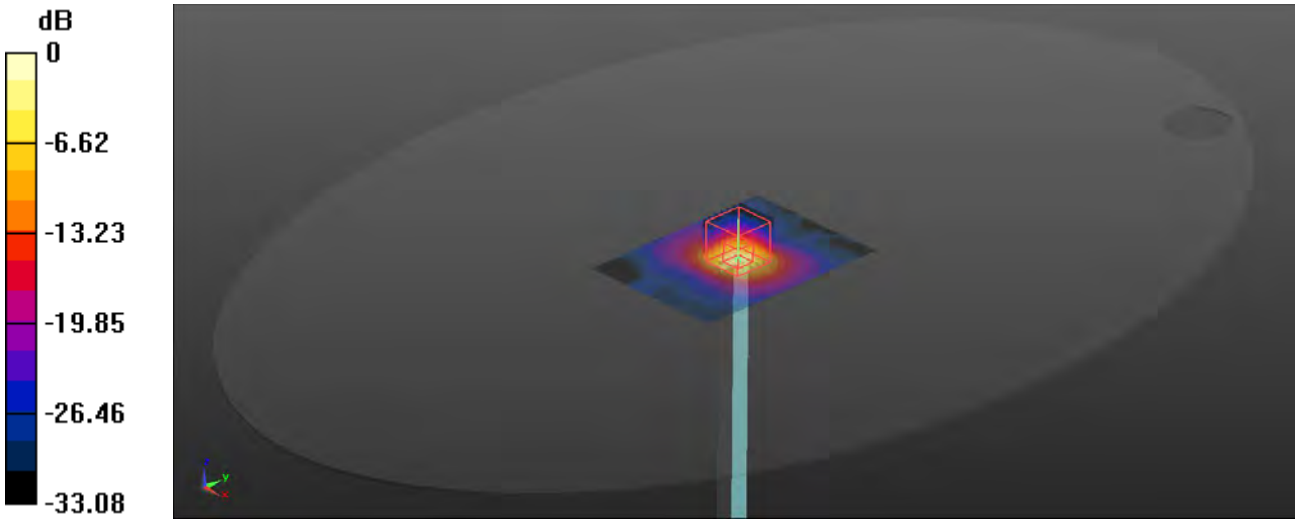
DUT: Dipole 5GHz; Type: D5GHzV2

Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: HSL5G_1204 Medium parameters used: f = 5600 MHz; σ = 5.015 S/m; ε_r = 35.63; ρ = 1000 kg/m^3
Ambient Temperature：23.6℃； Liquid Temperature：22.4℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(5.1, 5.1, 5.1) @ 5600 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

Pin=100mW/Area Scan (81x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 21.3 W/kg

Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 44.34 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 29.2 W/kg
SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 21.1 W/kg



0 dB = 21.1 W/kg

System Check_HSL5750_231204

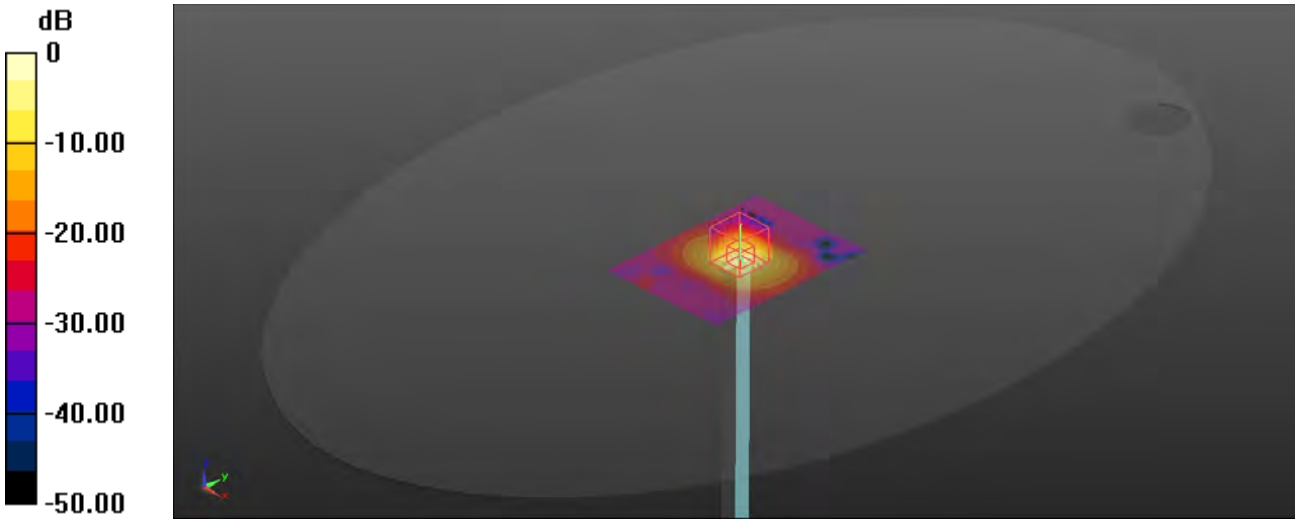
DUT: Dipole 5GHz; Type: D5GHzV2

Communication System: CW; Frequency: 5750 MHz;Duty Cycle: 1:1
Medium: HSL5G_1204 Medium parameters used: f = 5750 MHz; σ = 5.215 S/m; ε_r = 35.335; ρ = 1000 kg/m^3
Ambient Temperature：23.5℃； Liquid Temperature：22.6℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(5.21, 5.21, 5.21) @ 5750 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

Pin=100mW/Area Scan (81x111x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 20.2 W/kg

Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 43.23 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 34.8 W/kg
SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.13 W/kg
Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg

Appendix B. SAR Plots of SAR Measurement

The SAR plots for highest measured SAR in each exposure configuration, wireless mode and frequency band combination, and measured SAR > 1.5 W/kg are shown as follows.

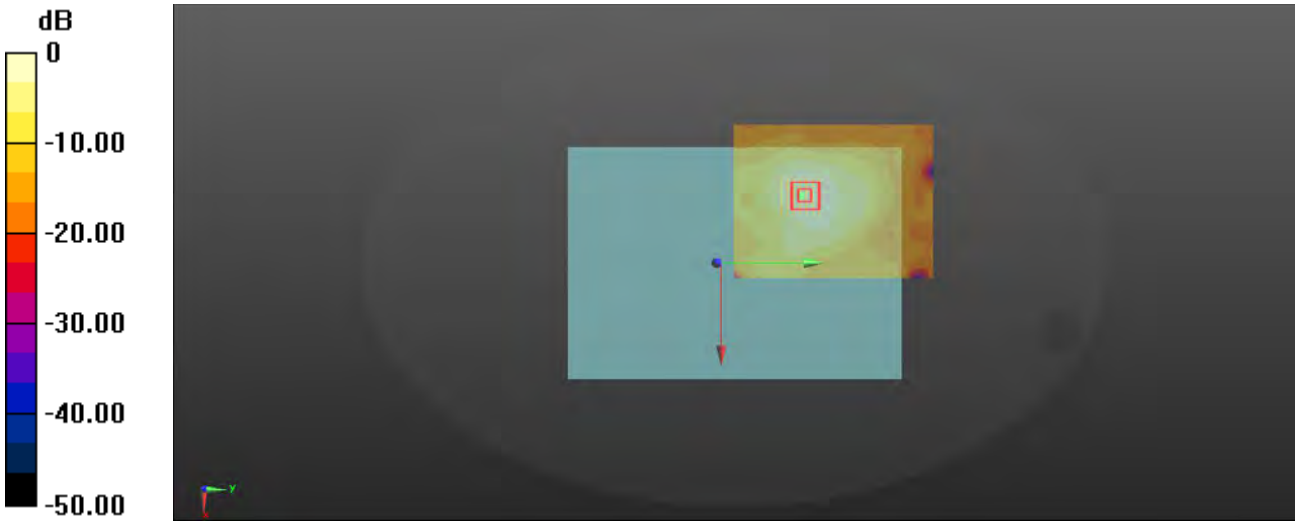
P01 WLAN2.4G_802.11b_Rear Face_0cm_Ch1

Communication System: 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: HSL2450_1204 Medium parameters used: f = 2412 MHz; σ = 1.788 S/m; ε_r = 39.363; ρ = 1000 kg/m^3
Ambient Temperature：23.3℃； Liquid Temperature：22.5℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(8.11, 8.11, 8.11) @ 2412 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

-Area Scan (101x131x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.0550 W/kg

-Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.485 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 0.1680 W/kg
SAR(1 g) = 0.119 W/kg; SAR(10 g) = 0.06 W/kg
Maximum value of SAR (measured) = 0.155 W/kg



0 dB = 0.155 W/kg

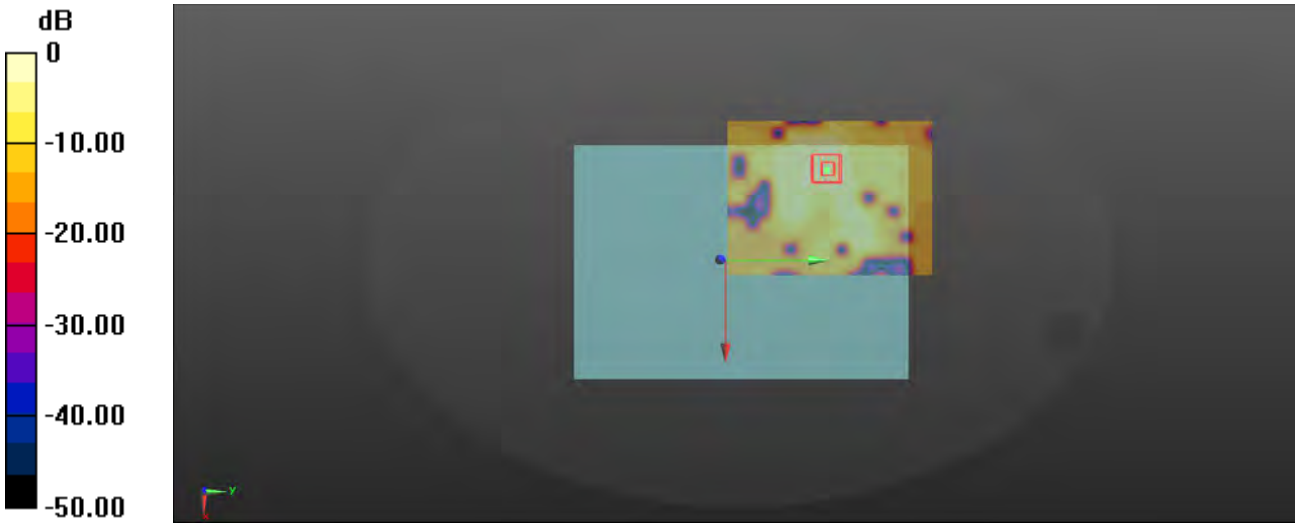
P02 WLAN5G_802.11a_Rear Face_0cm_Ch64

Communication System: 802.11a; Frequency: 5320 MHz;Duty Cycle: 1:1
Medium: HSL5G_1204 Medium parameters used: f = 5320 MHz; σ = 4.685 S/m; ε_r = 35.988; ρ = 1000 kg/m^3
Ambient Temperature：23.4℃； Liquid Temperature：22.4℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(5.7, 5.7, 5.7) @ 5320 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

-Area Scan (121x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.241 W/kg

-Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 1.226 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 0.216 W/kg
SAR(1 g) = 0.145 W/kg; SAR(10 g) = 0.044 W/kg
Maximum value of SAR (measured) = 0.235 W/kg



0 dB = 0.235 W/kg

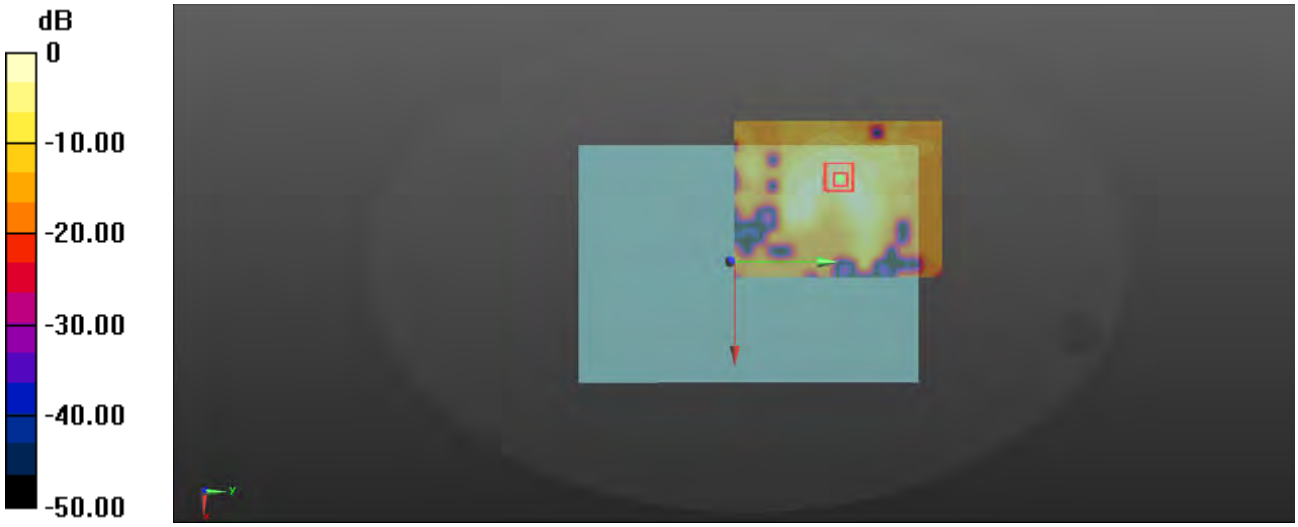
P03 WLAN5G_802.11a_Rear Face_0cm_Ch116

Communication System: 802.11a; Frequency: 5580 MHz;Duty Cycle: 1:1
Medium: HSL5G_1204 Medium parameters used: f = 5580 MHz; σ = 4.992 S/m; ε_r = 35.674; ρ = 1000 kg/m^3
Ambient Temperature：23.6℃； Liquid Temperature：22.4℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(5.1, 5.1, 5.1) @ 5580 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

-Area Scan (121x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.315 W/kg

-Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0.7630 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.453 W/kg
SAR(1 g) = 0.204 W/kg; SAR(10 g) = 0.060 W/kg
Maximum value of SAR (measured) = 0.306 W/kg



0 dB = 0.306 W/kg

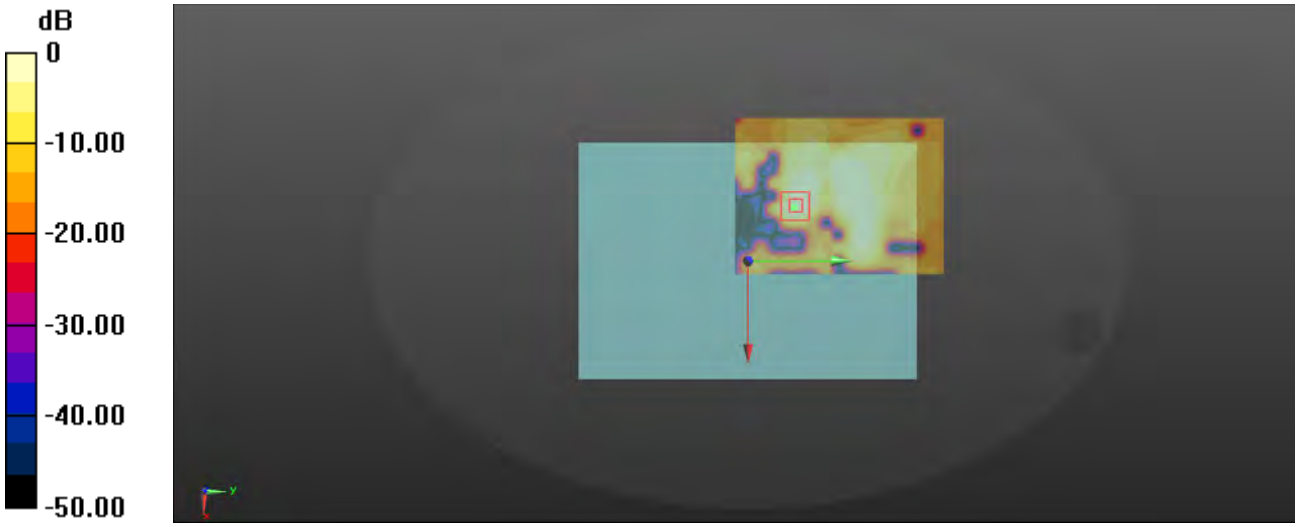
P04 WLAN5G_802.11a_Rear Face_0cm_Ch149

Communication System: 802.11a; Frequency: 5745 MHz;Duty Cycle: 1:1
Medium: HSL5G_1204 Medium parameters used: f = 5745 MHz; σ = 5.149 S/m; ε_r = 35.347; ρ = 1000 kg/m^3
Ambient Temperature：23.5℃； Liquid Temperature：22.6℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(5.21, 5.21, 5.21) @ 5745 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

-Area Scan (121x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.394 W/kg

-Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0.8910 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.473 W/kg
SAR(1 g) = 0.236 W/kg; SAR(10 g) = 0.066 W/kg
Maximum value of SAR (measured) = 0.358 W/kg



0 dB = 0.358 W/kg

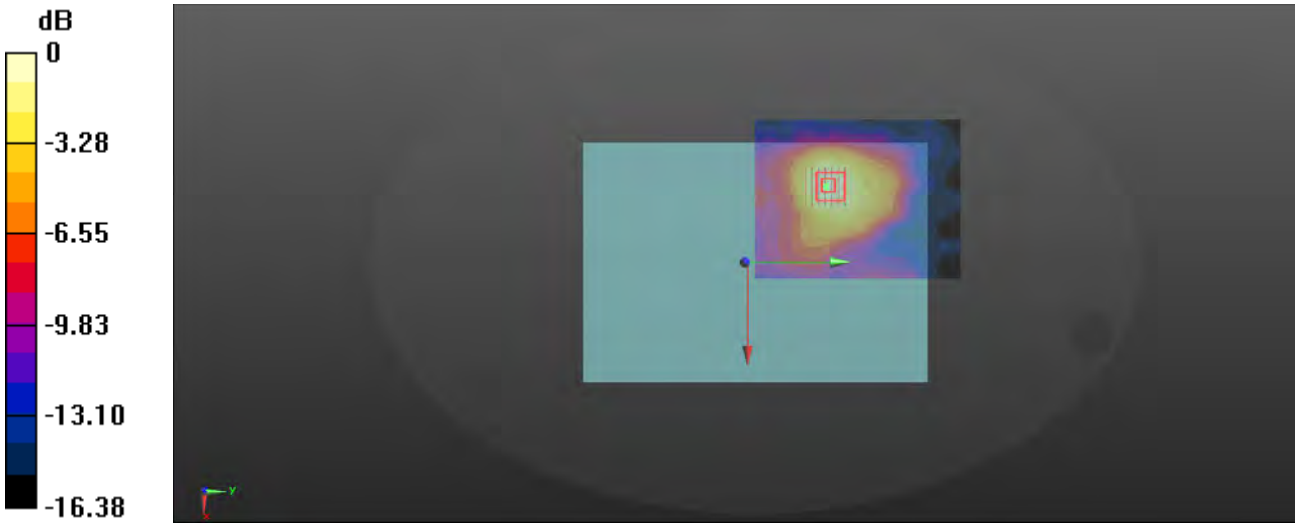
P05 BT_GFSK_Rear Face_0cm_Ch0

Communication System: BT; Frequency: 2402 MHz;Duty Cycle: 1:1
Medium: HSL2450_1204 Medium parameters used: f = 2402 MHz; σ = 1.782 S/m; ε_r = 39.381; ρ = 1000 kg/m^3
Ambient Temperature：23.3℃； Liquid Temperature：22.5℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7612; ConvF(8.11, 8.11, 8.11) @ 2402 MHz; Calibrated: 2023/02/28
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1633; Calibrated: 2023/02/08
- Phantom: ELI V8.0; Type: QD OVA 004 Ax; Serial: 2128
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.12 (7450)

-Area Scan (101x131x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.0465 W/kg

-Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.458 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.0560 W/kg
SAR(1 g) = 0.102 W/kg; SAR(10 g) = 0.052 W/kg
Maximum value of SAR (measured) = 0.0459 W/kg



0 dB = 0.0459 W/kg

Appendix C. Calibration Certificate for Probe and Dipole

The SPEAG calibration certificates are shown as follows.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2117
E-mail: emf@caict.ac.cn http://www.caict.ac.cn

中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client : **7layers** **Certificate No: Z23-60064**

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 1633
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	February 08, 2023

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	14-Jun-22 (CTTL, No.J22X04180)	Jun-23

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: February 14, 2023

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

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2117
E-mail: emf@caict.ac.cn http://www.caict.ac.cn

Glossary:

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.

- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.

- The report provide only calibration results for DAE, it does not contain other performance test results.

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2117
E-mail: emf@caict.ac.cn http://www.caict.ac.cn

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100…+300 mV
Low Range: 1LSB = 61nV , full range = -1…….+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	405.258 ± 0.15% (k=2)	405.540 ± 0.15% (k=2)	405.038 ± 0.15% (k=2)
Low Range	4.00096 ± 0.7% (k=2)	4.00014 ± 0.7% (k=2)	4.01156 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	318° ± 1 °

In Collaboration with
TTL s p e a g
CALIBRATION LABORATORY
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ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570 CAICT

Client **7layers** **Certificate No: Z23-60063**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN : 7612
Calibration Procedure(s)	FF-Z11-004-02 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	February 28, 2023

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Power sensor NRP-Z91	101547	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Power sensor NRP-Z91	101548	14-Jun-22(CTTL, No.J22X04181)	Jun-23
Reference 10dBAttenuator	18N50W-10dB	19-Jan-23(CTTL, No.J23X00212)	Jan-25
Reference 20dBAttenuator	18N50W-20dB	19-Jan-23(CTTL, No.J23X00211)	Jan-25
Reference Probe EX3DV4	SN 3846	20-May-22(SPEAG, No.EX3-3846_May22)	May-23
DAE4	SN 1555	25-Aug-22(SPEAG, No.DAE4-1555_Aug22)	Aug-23
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
SignalGenerator MG3700A	6201052605	14-Jun-22(CTTL, No.J22X04182)	Jun-23
Network Analyzer E5071C	MY46110673	10-Jan-23(CTTL, No.J23X00104)	Jan-24

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: March 06, 2023

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

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2117
E-mail: emf@caict.ac.cn http://www.caict.ac.cn

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

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

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7612

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (*k*=2)
Norm(μV/(V/m)²)[A]	0.67	0.62	0.82	±10.0%
DCP(mV)[B]	112.3	109.6	113.2	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max Dev.	Max Unc[E] (*k*=2)
0	CW	X	0.0	0.0	1.0	0.00	220.2	±2.3%	±4.7%
		Y	0.0	0.0	1.0		204.9		
		Z	0.0	0.0	1.0		249.9		
10352-AAA	Pulse Waveform (200Hz, 10%)	X	1.52	60.17	5.75		60	±3.5%	±9.6%
		Y	1.50	60.00	5.62	10.00	60		
		Z	1.69	60.00	5.91		60		
10353-AAA	Pulse Waveform (200Hz, 20%)	X	6.00	68.00	7.00		80	±4.1%	±9.6%
		Y	0.89	60.00	4.44	6.99	80		
		Z	1.15	60.00	4.91		80		
10354-AAA	Pulse Waveform (200Hz, 40%)	X	0.00	127.35	0.97		95	±3.5%	±9.6%
		Y	0.89	159.99	20.66	3.98	95		
		Z	0.69	60.00	3.86		95		
10355-AAA	Pulse Waveform (200Hz, 60%)	X	1.08	159.17	4.39		120	±2.1%	±9.6%
		Y	10.60	158.13	17.10	2.22	120		
		Z	0.46	60.00	2.96		120		
10387-AAA	QPSK Waveform, 1 MHz	X	0.66	62.07	9.72		150	±5.5%	±9.6%
		Y	0.84	63.77	11.09	1.00	150		
		Z	0.85	64.58	11.39		150		
10388-AAA	QPSK Waveform, 10 MHz	X	1.34	63.81	12.24		150	±1.7%	±9.6%
		Y	1.49	65.09	13.41	0.00	150		
		Z	1.52	65.84	13.80		150		
10396-AAA	64-QAM Waveform, 100 kHz	X	1.96	66.68	17.13		150	±1.0%	±9.6%
		Y	2.06	68.23	18.99	3.01	150		
		Z	2.31	70.69	20.00		150		
10414-AAA	WLAN CCDF, 64-QAM, 40MHz	X	4.01	65.50	14.75		150	±5.6%	±9.6%
		Y	4.29	66.06	15.34	0.00	150		
		Z	4.19	65.98	15.28		150		

Note: For details on UID parameters see Appendix

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

[A] The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 7612

Sensor Model Parameters

	C1 fF	C2 fF	α V^{-1}	T1 $ms.V^{-2}$	T2 $ms.V^{-1}$	T3 ms	T4 V^{-2}	T5 V^{-1}	T6
X	14.21	101.46	32.36	2.36	0.00	4.90	0.65	0.00	1.02
Y	17.81	130.11	33.90	5.13	0.00	4.90	0.35	0.03	1.02
Z	17.10	122.92	33.01	12.07	0.00	4.90	0.76	0.00	1.02

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	16.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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DASY/EASY – Parameters of Probe: EX3DV4 – SN:7612

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (*k*=2)
750	41.9	0.89	11.35	11.35	11.35	0.17	1.22	±12.7%
835	41.5	0.90	10.88	10.88	10.88	0.16	1.35	±12.7%
900	41.5	0.97	10.81	10.81	10.81	0.16	1.41	±12.7%
1450	40.5	1.20	9.77	9.77	9.77	0.10	1.20	±12.7%
1750	40.1	1.37	9.05	9.05	9.05	0.25	1.01	±12.7%
1900	40.0	1.40	8.68	8.68	8.68	0.25	1.09	±12.7%
2100	39.8	1.49	8.72	8.72	8.72	0.24	1.16	±12.7%
2300	39.5	1.67	8.41	8.41	8.41	0.65	0.67	±12.7%
2450	39.2	1.80	8.11	8.11	8.11	0.65	0.67	±12.7%
2600	39.0	1.96	7.85	7.85	7.85	0.50	0.79	±12.7%
3300	38.2	2.71	7.45	7.45	7.45	0.39	0.95	±13.9%
3500	37.9	2.91	7.30	7.30	7.30	0.39	0.92	±13.9%
3700	37.7	3.12	7.10	7.10	7.10	0.35	1.01	±13.9%
3900	37.5	3.32	6.95	6.95	6.95	0.30	1.50	±13.9%
4100	37.2	3.53	6.90	6.90	6.90	0.30	1.40	±13.9%
4200	37.1	3.63	6.85	6.85	6.85	0.30	1.50	±13.9%
4400	36.9	3.84	6.75	6.75	6.75	0.35	1.35	±13.9%
4600	36.7	4.04	6.65	6.65	6.65	0.40	1.30	±13.9%
4800	36.4	4.25	6.55	6.55	6.55	0.40	1.38	±13.9%
4950	36.3	4.40	6.35	6.35	6.35	0.40	1.38	±13.9%
5250	35.9	4.71	5.70	5.70	5.70	0.45	1.30	±13.9%
5600	35.5	5.07	5.10	5.10	5.10	0.50	1.30	±13.9%
5750	35.4	5.22	5.21	5.21	5.21	0.50	1.30	±13.9%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[F] At frequency up to 6 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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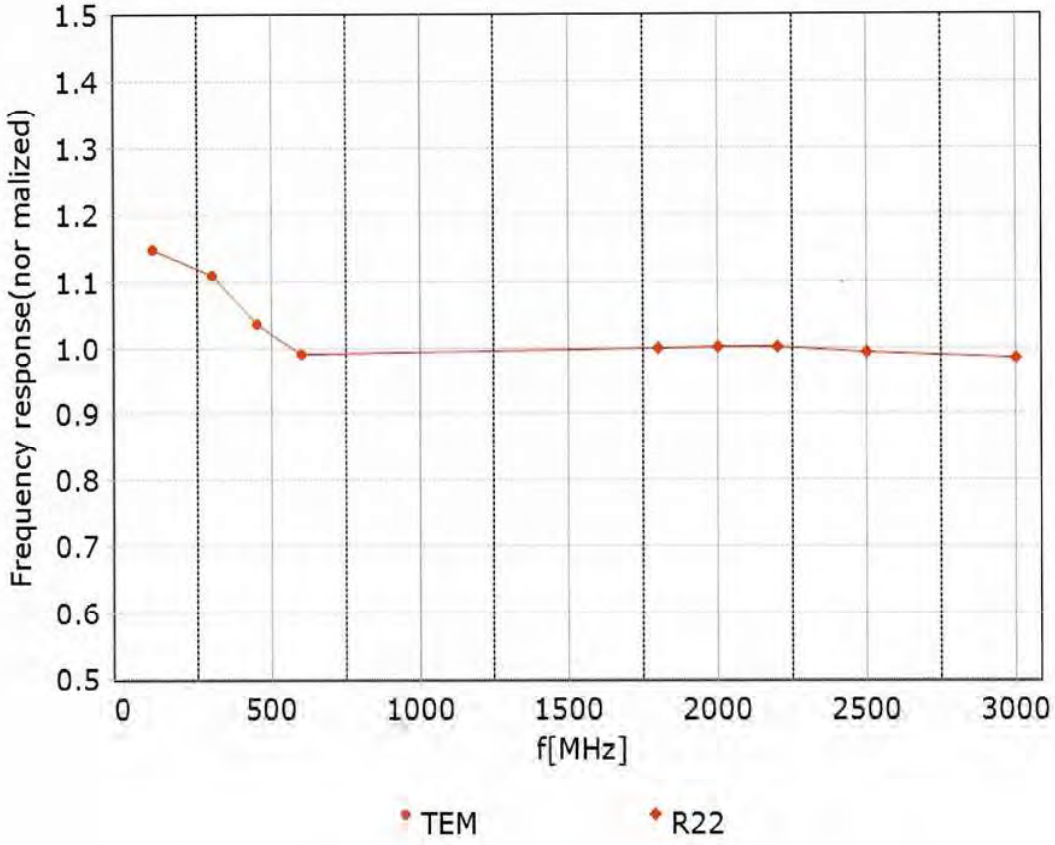
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (*k*=2)