FCC SAR TEST REPORT

Report No.: SZ(S)2012003-02

Product Name: EF7-2

Brand Name: EVO Ⅱ/ Autel Robotics

Model Name: EF7-2

Test Standards: IEEE 1528:2013; ANSI/IEEE C95.1:2005

Issued Date: 2020-12-25

Report Version: A.0

Issued by

Shenzhen Sunlab Communication Technology Co., Ltd.

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1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing are as follows.

<Highest SAR Summary>

Body SAR

Exposure Configuration	Technolohy Band	Reported 1g-SAR (W/kg)	SAR Test Limit (W/Kg)
Body (Gap 10mm)	SRD 2.4G	1.21	1.6
	SRD 5.8G	1.26	
Test Result		PASS	

Limb SAR

Exposure Configuration	Technolohy Band	Reported 10g-SAR (W/kg)	SAR Test Limit (W/Kg)
Body (Gap 0mm)	SRD 2.4G	1.57	4.0
	SRD 5.8G	2.02	
Test Result		PASS	

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

2. SAR Evaluation compliance

Product Name:	EF7-2
Brand Name:	EVO Ⅱ/ Autel Robotics
Model Name:	EF7-2
Applicant:	Autel Robotics Co.,Ltd.
Address:	9th Floor, Bldg.B1, Zhiyuan, 1001 Xueyuan Rd.,Xili, Nanshan, Shenzhen, China
Manufacturer:	Autel Robotics Co.,Ltd.
Address:	9th Floor, Bldg.B1, Zhiyuan, 1001 Xueyuan Rd.,Xili, Nanshan, Shenzhen, China
Applicable Standard:	· FCC 47 CFR Part 2 (2.1093:2013) · ANSI/IEEE C95.1:2005 · IEEE Std 1528:2013 · KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 · KDB 865664 D02 RF Exposure Reporting v01r02 · KDB 447498 D01 General RF Exposure Guidance v06 · KDB248227 D01 802 11 Wi-Fi SAR v02r02 · KDB 616217 D04 SAR for laptop and tablets
Test Engineer:	
Reviewed By	
Approved By	
Performed Location:	ShenZhen Sunlab Communication Technology Co., Ltd. 1st Floor,Building A, Tefa Information Port,No.2 Kefeng Road,Hi-Tech Park,Nanshan District,Shenzhen,P. R.China, Tel: +86-755- 36615880 Fax: +86-755- 86525532

3. General Information:

3.1 EUT Description:

EUT Information	
Product Name	EF7-2
Brand Name	EVO Ⅱ/ Autel Robotics
Model Name	EF7-2
2.4G	
CE Operation frequency	2405-2460MHz
SRD(5.8G Band)	
CE Operation frequency	5731-5779MHz

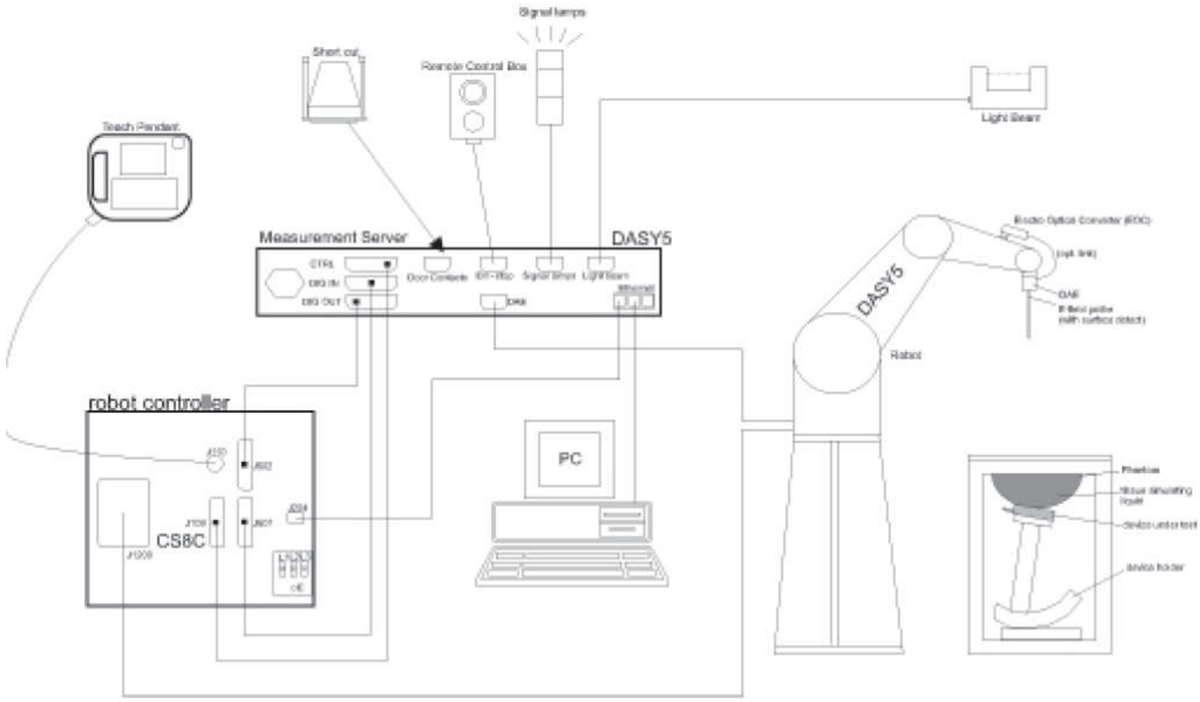
3.2 Test Environment:

Ambient conditions in the SAR laboratory:

Items	**Required**	**Actual**
Temperature (℃)	18-25	22~23
Humidity (%RH)	30-70	55~65

4. SAR Measurement System:

4.1 Dasy5 System Description:



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

- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.

- Validation dipole kits allowing to validate the proper functioning of the system.

5. System Components:

- DASY5 Measurement Server:

The DASY5 measurement server is based on a PC/104 CPU board with a 166MHz low-power pentium, 32MB chipdisk and 64MB RAM. The necessary circuits for communication with either the DAE4 (or DAE3) electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY5 I/O-board, which is directly connected to the PC/104 bus of the CPU board.

Calibration: No calibration required.

- DATA Acquisition Electronics (DAE):

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

Calibration: Recommended once a year

- Dosimetric Probes:

Model: EX3DV4,
Frequency: 10MHz to 6G, Linearity:±0.2dB,
Dynamic Range: 10 μW/g to100 mW/g
Directivity:
± 0.3 dB in HSL (rotation around probe axis)
± 0.5 dB in tissue material (rotation normal to probe axis)

These probes are specially designed and calibrated for use in liquids with high permittivities. They should not be used in air, since the spherical isotropy in air is poor (±2 dB). The dosimetric probes have special calibrations in various liquids at different frequencies.

Calibration: Recommended once a year

➢ Light Beam unit:

Calibration: No calibration required.

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm.

➢ SAM Twin Phantom:

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

• Left hand
• Right hand
• Flat phantom

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

➢ Device Holder for SAM Twin Phantom:

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity "=3 and loss tangent _=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered

6. Tissue Simulating Liquid

6.1 The composition of the tissue simulating liquid:

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

Ingredients (% of weight)	**Head Tissue**						
Frequency Band (MHz)	**750**	**835**	**1750**	**1900**	**2300**	**2450**	**2600**
Water	39.2	41.45	52.64	55.242	62.82	62.7	55.242
Salt (NaCl)	2.7	1.45	0.36	0.306	0.51	0.5	0.306
Sugar	57.0	56.0	0.0	0.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	47.0	44.542	36.67	36.8	44.452
Ingredients (% of weight)	**Body Tissue**						
Frequency Band (MHz)	**750**	**835**	**1750**	**1900**	**2300**	**2450**	**2600**
Water	50.3	52.4	69.91	69.91	73.32	73.2	64.493
Salt (NaCl)	1.60	1.40	0.13	0.13	0.06	0.04	0.024
Sugar	47.0	45.0	0.0	0.0	0.0	0.0	0.0
HEC	0.0	1.0	0.0	0.0	0.0	0.0	0.0
Bactericide	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	0.0	29.96	29.96	26.62	26.7	32.252

Simulating Head Liquid for 5G(HBBL3500-5800MHz), Manufactured by SPEAG:

Ingredients	(% by weight)
Water	50-65%
Mineral oil	10-30%
Emulsifiers	8-25%
Sodium salt	0-1.5%

Tissue dielectric parameters for head and body phantoms				
Target Frequency	Head		Body	
(MHz)	εr	σ(s/m)	εr	σ(s/m)
835	41.5	0.90	55.2	0.97
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
5200	36.00	4.66	49.0	5.30
5400	35.80	4.86	48.9	5.42
5600	35.50	5.07	48.5	5.77
5800	35.30	5.27	48.2	6.00

Liquid depth in the head phantom (2450MHz)

Liquid depth in the body phantom (5GHz)

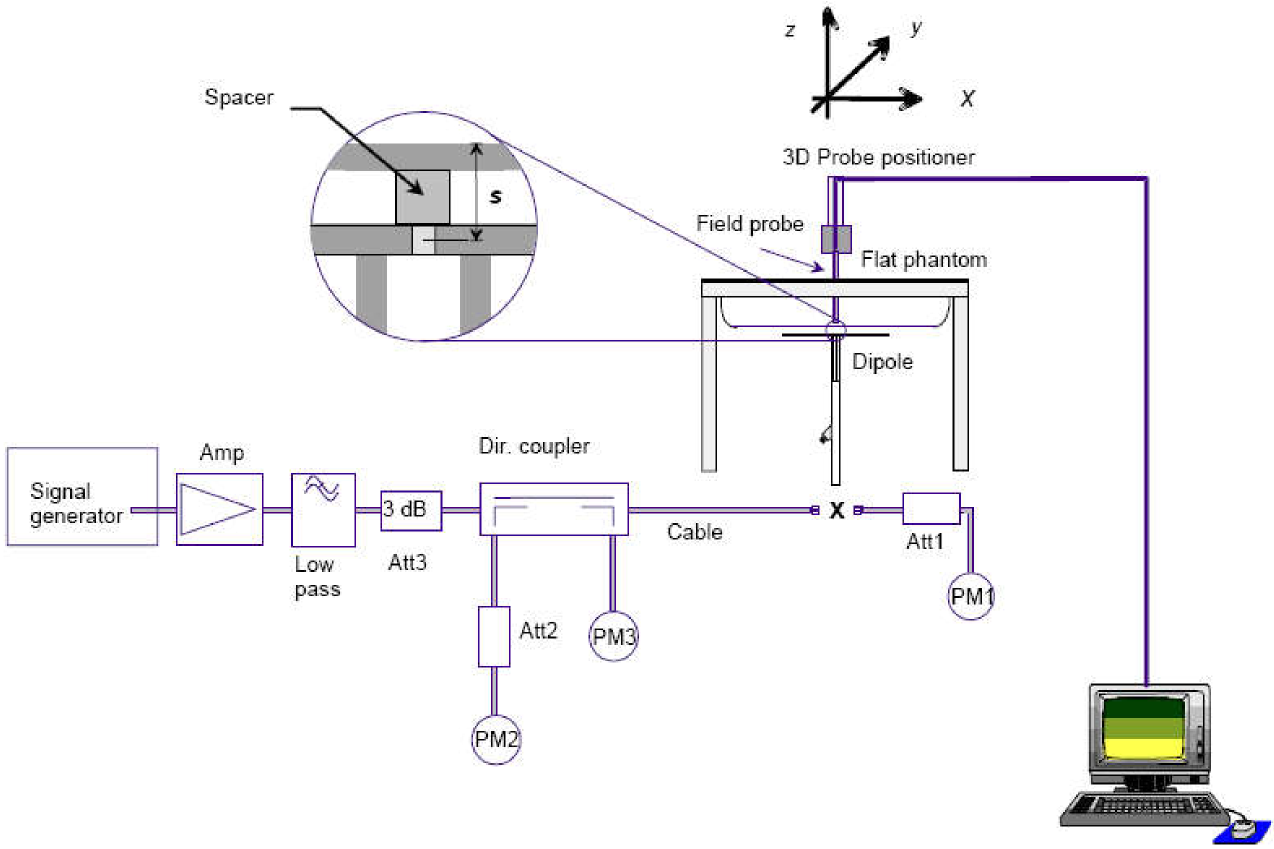
6.2 Tissue Calibration Result:

Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Date
		ε_r	σ	ε_r	Dev. (%)	σ	Dev. (%)		
2450H	2450	39.2	1.80	39.58	1.0	1.86	3.4	22.2	12/21/2020
5750H	5750	35.4	5.22	34.70	-1.98	5.22	0.0	22.5	12/22/2020

7. SAR System Validation

7.1 Validation System:

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:



7.2 Validation Dipoles:

The dipoles used is based on the IEEE-1528/EN62209-1 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE-1528/EN62209-1 and FCC Supplement C.

7.3 Validation Result:

Frequency (MHz)	**Description**	**SAR(1g) W/Kg**	**SAR(10g) W/Kg**	**Tissue Temp. (℃)**	**Date**
2450 (Head)	Reference	51.9±10% (47.16~57.64)	24.2±10% (21.96~26.84)	NA	12/21/2020
	Measurement	56.8	25.48	22.4	
5750 (Head)	Reference	77.0±10% (69.3~84.7)	21.8±10% (19.62~23.98)	NA	12/22/2020
	Measurement	80	21.9	22.5	

8. SAR Evaluation Procedures:

The procedure for assessing the average SAR value consists of the following steps:

- Power Reference Measurement

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

- Area Scan

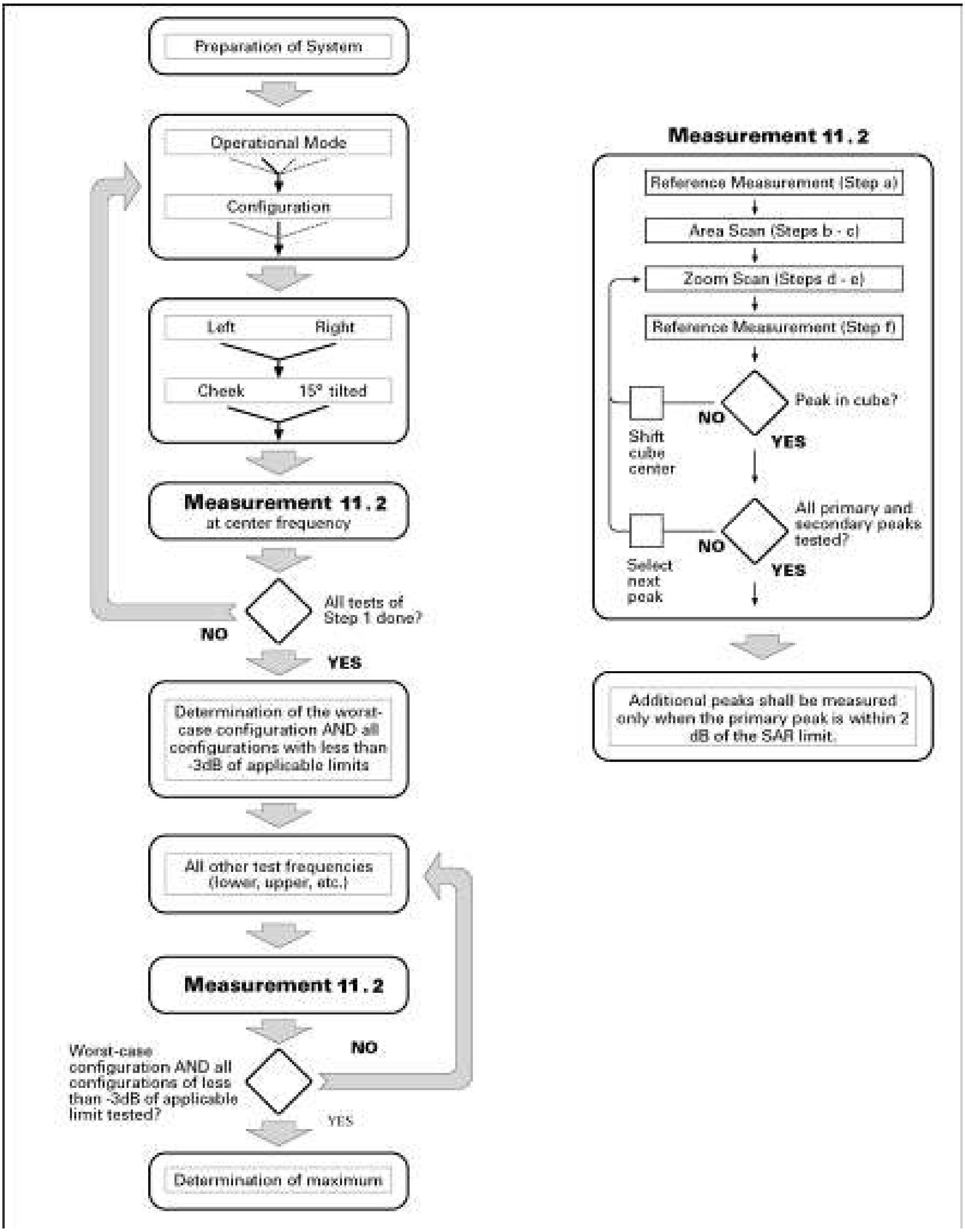
  The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY5 software can find the maximum locations even in relatively coarse grids. The scanning area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the Area Scan's property sheet is brought-up, grid settings can be edited by a user.

- Zoom Scan

  Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan measures 7 x 7 x 7 points (5mmx5mmx5mm) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure.

- Power Drift Measurement

  The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement.



Block diagram of the tests to be performed

9. SAR Exposure Limits

9.1 Uncontrolled Environment

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

9.2 Controlled Environment

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

Limits for Occupational/Controlled Exposure (W/kg)

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

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

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

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

10. Measurement Uncertainty:

NO	Source	Uncert. ai（%）	Prob. Dist.	Div. k	ci (1g)	ci (10g)	Stand. Uncert. ui (1g)	Stand. Uncert. ui (10g)	*Veff*
1	Repeat	0.04	N	1	1	1	0.04	0.04	9
Instrument									
2	Probe calibration	7	N	2	1	1	3.5	3.5	∞
3	Axial isotropy	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	∞
4	Hemispherical isotropy	9.6	R	$\sqrt{3}$	0.7	0.7	3.9	3.9	∞
5	Boundary effect	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
6	Linearity	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
7	Detection limits	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
8	Readout electronics	0.3	N	1	1	1	0.3	0.3	∞
9	Response time	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
10	Integration time	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
11	Ambient noise	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
12	Ambient reflections	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Probe positioner mech. restrictions	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
14	Probe positioning with respect to phantom shell	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
15	Max.SAR evaluation	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related									

16	Device positioning	3.8	N	1	1	1	3.8	3.8	99
17	Device holder	5.1	N	1	1	1	5.1	5.1	5
18	Drift of output power	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	∞
Phantom and set-up									
19	Phantom uncertainty	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
20	Liquid conductivity (target)	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
21	Liquid conductivity (meas)	2.5	N	1	0.64	0.43	1.6	1.2	∞
22	Liquid Permittivity (target)	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.5	∞
23	Liquid Permittivity (meas)	2.5	N	1	0.6	0.49	1.5	1.2	∞
Combined standard			RSS	$U_c = \sqrt{\sum_{i=1}^{n} C_i^2 U_i^2}$			12.2%	11.9%	236
Expanded uncertainty (P=95%)		$U = k\, U_C$,k=2					**24.4%**	**23.8%**	

11. Conducted Power Measurement:

Mode	Frequency (MHz)	Conducted Output PK Power (dBm)	Conducted Output AV Power (dBm)	Tune-up Power (dBm)
2.4G(1.25 MHz)	2405.00	28.567	13.64	14.0
	2441.00	28.275	13.35	14.0
	2475.00	28.702	13.77	14.0
2.4G(20 MHz)	2412.00	28.44	19.09	19.5
	2436.00	28.50	19.15	19.5
	2460.00	28.47	19.12	19.5
5.8G(1.25 MHz)	5731.00	25.481	10.55	11.0
	5766.00	24.686	9.76	11.0
	5801.00	24.497	9.57	11.0
5.8G(20 MHz)	5740.00	25.49	16.14	16.5
	5780.00	25.56	16.21	16.5
	5820.00	25.47	16.12	16.5

12. Antennas Location :

Distance of The Antenna to the EUT surface and edge						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Left Side**	**Right Side**
SRD 2.4G chain0	N/A	<25mm	<25mm	>25mm	>25mm	>25mm
SRD 2.4G chain1	N/A	<25mm	<25mm	>25mm	>25mm	>25mm
SRD 5.8G chain0	N/A	<25mm	<25mm	>25mm	>25mm	>25mm
SRD 5.8G chain1	N/A	<25mm	<25mm	>25mm	>25mm	>25mm

Positions for SAR tests; Hotspot mode						
Antennas	**Front**	**Back**	**Top Side**	**Bottom Side**	**Left Side**	**Right Side**
SRD 2.4G chain0	No	Yes	Yes	No	No	No
SRD 2.4G chain1	No	Yes	Yes	No	No	No
SRD 5.8G chain0	No	Yes	Yes	No	No	No
SRD 5.8G chain1	No	Yes	Yes	No	No	No

Note:

1. **According to the user manual,in normal use, Front side will not be close to the user.**
2. Referring to KDB 941225 D07, SAR must be measured for all sides and surfaces with a transmitting antenna located with 25mm from that surface or edge.

13. Results and Test photos :

13.1 SAR result summary:

General Note:

1. Per KDB 447498 D01 v06, 2015, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   Scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   Reported SAR(W/kg)= Measured SAR(W/kg) Scaling Factor*

SRD 2.4G Body SAR

Mode	Test Position	Ant Direction	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Gap (cm)	Frequency MHz	Scaling Factor	SAR-1g (W/kg)	Reported SAR-1g (W/kg)	Plot
2.4G(20 MHz)	Back	Horizontal	19.15	19.5	1.00	2436.00	1.084	0.335	0.363	
2.4G(20 MHz)	Back	Vertical	19.15	19.5	1.00	2436.00	1.084	<0.1	<0.1	
2.4G(20 MHz)	Top	Horizontal	19.15	19.5	1.00	2436.00	1.084	<0.1	<0.1	
2.4G(20 MHz)	Top	Vertical	19.09	19.5	1.00	2412.00	1.099	1.03	1.13	
2.4G(20 MHz)	Top	Vertical	19.15	19.5	1.00	2436.00	1.084	1.12	**1.21**	**#1**
2.4G(20 MHz)	Top	Vertical	19.12	19.5	1.00	2460.00	1.091	1.10	1.20	
2.4G(1.25 MHz)	Top	Vertical	13.77	14.0	1.00	2475.00	1.054	0.611	0.644	

SRD 2.4G Limb SAR

Mode	Test Position	Ant Direction	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Gap (cm)	Frequency MHz	Scaling Factor	SAR-10g (W/kg)	Reported SAR-10g (W/kg)	Plot
2.4G(20 MHz)	Back	Horizontal	19.15	19.5	0.00	2436.00	1.084	0.831	0.901	
2.4G(20 MHz)	Back	Vertical	19.15	19.5	0.00	2436.00	1.084	<0.1	<0.1	
2.4G(20 MHz)	Top	Horizontal	19.15	19.5	0.00	2436.00	1.084	<0.1	<0.1	
2.4G(20 MHz)	Top	Vertical	19.09	19.5	0.00	2412.00	1.099	1.12	1.23	
2.4G(20 MHz)	Top	Vertical	19.15	19.5	0.00	2436.00	1.084	1.45	**1.57**	**#2**
2.4G(20 MHz)	Top	Vertical	19.12	19.5	0.00	2460.00	1.091	1.12	1.22	
2.4G(1.25 MHz)	Top	Vertical	13.77	14.0	0.00	2475.00	1.054	0.651	0.686	

SRD 5.8G Body SAR

Mode	Test Position	Ant Direction	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Gap (cm)	Frequency MHz	Scaling Factor	SAR-1g (W/kg)	Reported SAR-1g (W/kg)	Plot
5.8G(20 MHz)	Back	Horizontal	16.21	16.5	1.00	5780.00	1.069	0.527	0.563	
5.8G(20 MHz)	Back	Vertical	16.21	16.5	1.00	5780.00	1.069	<0.1	<0.1	
5.8G(20 MHz)	Top	Horizontal	16.21	16.5	1.00	5780.00	1.069	<0.1	<0.1	
5.8G(20 MHz)	Top	Vertical	16.14	16.5	1.00	5740.00	1.086	1.13	1.23	
5.8G(20 MHz)	Top	Vertical	16.21	16.5	1.00	5780.00	1.069	1.18	**1.26**	**#3**
5.8G(20 MHz)	Top	Vertical	16.12	16.5	1.00	5820.00	1.091	1.09	1.19	
5.8G(1.25 MHz)	Top	Vertical	10.55	11.0	1.00	5731.00	1.109	0.453	0.502	

SRD 5.8G Limb SAR

Mode	Test Position	Ant Direction	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Gap (cm)	Frequency MHz	Scaling Factor	SAR-10g (W/kg)	Reported SAR-10g (W/kg)	Plot
5.8G(20 MHz)	Back	Horizontal	16.21	16.5	0.00	5780.00	1.069	0.567	0.606	
5.8G(20 MHz)	Back	Vertical	16.21	16.5	0.00	5780.00	1.069	<0.1	<0.1	
5.8G(20 MHz)	Top	Horizontal	16.21	16.5	0.00	5780.00	1.069	0.232	0.248	
5.8G(20 MHz)	Top	Vertical	16.14	16.5	0.00	5740.00	1.086	1.71	1.86	
5.8G(20 MHz)	Top	Vertical	16.21	16.5	0.00	5780.00	1.069	1.89	**2.02**	**#4**
5.8G(20 MHz)	Top	Vertical	16.12	16.5	0.00	5820.00	1.091	1.79	1.95	
5.8G(1.25 MHz)	Top	Vertical	10.55	11.0	0.00	5731.00	1.109	0.761	0.844	

Note:

1. Per KDB447498 D01, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8W/kg for 1-g or 2.0W/kg for 10-g respectively, when the transmission band is ≤ 100MHz.
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz.
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz.

   When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.
2. According to the above table, the initial test position for body is “Back”, and its reported SAR is≤ 0.4W/kg. Thus further SAR measurement is not required for the other (remaining) test positions. Because the reported SAR of the highest measured maximum output power channel for the exposureconfiguration is ≤ 0.8W/kg, no further SAR testing is required for 802.11b DSSS in that exposureconfiguration.

3. When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied (section 5.3 of of KDB 248227D01v02r01). SAR is not required for the following 2.4 GHz OFDM conditions.

1) When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration.

2) When the highest *reported* SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

4. An **Initial Test Configuration** is determined for OFDM transmission modes 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. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2 of KDB 248227D01). SAR test reduction of subsequent highest output test channels is based on the *reported* SAR of the **Initial Test Configuration**.

5. **WiFi 5G SAR Test Procedures**

For devices that operate in only one of the U-NII-1 and U-NII-2A bands, the normally required SAR procedures for OFDM configurations are applied. 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); otherwise, both bands are tested independently for SAR.

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; otherwise, both bands are tested independently for SAR.

6. **OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements**

The **Initial Test Configuration** for 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the **Initial Test Configuration** is measured using the highest maximum output power channel determined by the default power measurement procedures. When multiple configurations in a frequency band have the same specified maximum output power, the **Initial Test Configuration** is determined according to the following steps applied sequentially.

1) The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.

2) If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.

3) If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.

4) When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; 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. These channel selection procedures apply to both the **Initial Test Configuration** and subsequent test configuration(s), with respect to the default power measurement procedures or additional power measurements required for further SAR test reduction. The same procedures also apply to subsequent highest output power channel(s) selection.

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.

13.2 Scaled Reported SAR:

SRD 2.4G Body SAR

Mode	Test Position	Ant Direction	Frequency MHz	Actual duty factor	maximum duty factor	Reported SAR-1g (W/kg)	Scaled reported SAR (1g)(W/kg)
2.4G(20 MHz)	Back	Horizontal	2436.00	100%	100%	0.363	0.363
2.4G(20 MHz)	Back	Vertical	2436.00	100%	100%	<0.1	<0.1
2.4G(20 MHz)	Top	Horizontal	2436.00	100%	100%	<0.1	<0.1
2.4G(20 MHz)	Top	Vertical	2412.00	100%	100%	1.13	1.13
2.4G(20 MHz)	Top	Vertical	2436.00	100%	100%	**1.21**	**1.21**
2.4G(20 MHz)	Top	Vertical	2460.00	100%	100%	1.20	1.20
2.4G(1.25 MHz)	Top	Vertical	2475.00	100%	100%	0.644	0.644

SRD 2.4G Limb SAR

Mode	Test Position	Ant Direction	Frequency MHz	Actual duty factor	maximum duty factor	Reported SAR-1g (W/kg)	Scaled reported SAR (1g)(W/kg)
2.4G(20 MHz)	Back	Horizontal	2436.00	100%	100%	0.901	0.901
2.4G(20 MHz)	Back	Vertical	2436.00	100%	100%	<0.1	<0.1
2.4G(20 MHz)	Top	Horizontal	2436.00	100%	100%	<0.1	<0.1
2.4G(20 MHz)	Top	Vertical	2412.00	100%	100%	1.23	1.23
2.4G(20 MHz)	Top	Vertical	2436.00	100%	100%	**1.57**	**1.57**
2.4G(20 MHz)	Top	Vertical	2460.00	100%	100%	1.22	1.22
2.4G(1.25 MHz)	Top	Vertical	2475.00	100%	100%	0.686	0.686

SRD 5.8G Body SAR

Mode	Test Position	Ant Direction	Frequency MHz	Actual duty factor	maximum duty factor	Reported SAR-1g (W/kg)	Scaled reported SAR (1g)(W/kg)
5.8G(20 MHz)	Back	Horizontal	5780.00	100%	100%	0.563	0.563

5.8G(20 MHz)	Back	Vertical	5780.00	100%	100%	<0.1	<0.1
5.8G(20 MHz)	Top	Horizontal	5780.00	100%	100%	<0.1	<0.1
5.8G(20 MHz)	Top	Vertical	5740.00	100%	100%	1.23	1.23
5.8G(20 MHz)	Top	Vertical	5780.00	100%	100%	**1.26**	**1.26**
5.8G(20 MHz)	Top	Vertical	5820.00	100%	100%	1.19	1.19
5.8G(1.25 MHz)	Top	Vertical	5731.00	100%	100%	0.502	0.502

SRD 5.8G Limb SAR

Mode	Test Position	Ant Direction	Frequency MHz	Actual duty factor	maximum duty factor	Reported SAR-1g (W/kg)	Scaled reported SAR (1g)(W/kg)
5.8G(20 MHz)	Back	Horizontal	5780.00	100%	100%	0.606	0.606
5.8G(20 MHz)	Back	Vertical	5780.00	100%	100%	<0.1	<0.1
5.8G(20 MHz)	Top	Horizontal	5780.00	100%	100%	0.248	0.248
5.8G(20 MHz)	Top	Vertical	5740.00	100%	100%	1.86	1.86
5.8G(20 MHz)	Top	Vertical	5780.00	100%	100%	**2.02**	**2.02**
5.8G(20 MHz)	Top	Vertical	5820.00	100%	100%	1.95	1.95
5.8G(1.25 MHz)	Top	Vertical	5731.00	100%	100%	0.844	0.844

13.3 Simultaneous Transmission Analysis:

No.	Simultaneous Transmission Configurations	Body
1	2.4G Ant + 5.8G Ant	No

General note:

1. 2.4G and 5.8G share an antenna. So they can not transmitt simultaneously.
2. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01 based on the formula below
   a) [(max. Power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)/x]W/kg for test separation distances ≦50mm; whetn x=7.5 for 1-g SAR, and x=18.75 for 10-g SAR.
   b) When the minimum separation distance is <5mm, the distance is used 5mm to determine SAR test exclusion
   c) 0.4 W/kg for 1-g SAR and 1.0W/kg for 10-g SAR, when the test separation distances is >50mm.

13.4 DUT and setup photos:

Rear of the EUT 0 mm Gap (Ant Horizontal)

Rear of the EUT 0 mm Gap (Ant Vertical)

Top of the EUT 0 mm Gap (Ant Horizontal)

Top of the EUT 0 mm Gap (Ant Vertical)

Rear of the EUT 10 mm Gap (Ant Horizontal)

Rear of the EUT 10 mm Gap (Ant Vertical)

Top of the EUT 10 mm Gap (Ant Horizontal)

Top of the EUT 10 mm Gap (Ant Vertical)

14. SAR Measurement Variability :

SAR measurement variability must be 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.

The following procedures are applied to determine if repeated measurements are required.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg or 2.0W/kg for 10-g respectively; steps 2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg or 2.0W/kg for 10-g respectively, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit) or 3.6W/kg for 10-g respectively.

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg or 3.75W/kg for 10-g respectively and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Table 14.1: SAR Measurement Variability for Body 2.4G (1g)

Frequency MHz	Test Position	Spacing (mm)	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
2412.00	Top	10	1.03	1.01	1.02	/
2436.00	Top	10	1.12	1.09	1.03	/
2460.00	Top	10	1.10	1.07	1.03	/

Table 14.2: SAR Measurement Variability for Body 5.8G(1g)

Frequency MHz	Test Position	Spacing (mm)	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio	Second Repeated SAR (W/kg)
5740.00	Top	10	1.13	1.10	1.03	/
5780.00	Top	10	1.18	1.15	1.03	/
5820.00	Top	10	1.09	1.07	1.02	/

15. Equipment List:

NO.	Instrument	Manufacturer	Model	S/N	Cal. Date	Cal. Due Date
1	E-field Probe	Speag	EX3DV4	3836	2020-12-14	2021-12-13
2	DAE	Speag	DAE4	760	2020-7-28	2021-7-27
3	Dielectric Probe Kit	Agilent	85070E	1038	N/A	N/A
4	SAM TWIN phantom	Speag	SAM	1432/1360	N/A	N/A
5	Robot	Stabuli	TX90L	N/A	N/A	N/A
6	Device Holder	Speag	SD000H	N/A	N/A	N/A
7	Vector Network	Agilent	E5071C	MY4610761	2020-07-02	2021-07-02
8	Signal Generator	R&S	SME06	SN829445	2020-10-18	2021-10-17
9	Amplifier	Mini-circult	ZHL-42W	QA098002	N/A	N/A
10	Power Meter	Agilent	N1914A	MY5000156	2020-10-18	2021-10-17
11	Power Meter	Agilent	E4416A	MY4510083	2020-07-02	2021-07-02
12	Power Sensor	Agilent	N8481H	MY5102001	2020-10-18	2021-10-17
13	Power Sensor	Agilent	E9323A	US40410134	2020-07-02	2021-07-02
14	Directional Coupler	Agilent	772D	MY4615127	2020-07-02	2021-07-02
15	Dipole 2450MHz	Speag	D2450V2	955	2018-09-21	2021-09-20
16	Dipole 5GHz	Speag	5GHzV2	1042	2018-09-28	2021-09-27
17	Measurement SW	Speag	DASY52 52.8.8	1222	N/A	N/A

Appendix A. System validation plots:

Date: 12/21/2020

DUT: Dipole 2450 MHz ; Type: D2450V2; Serial: D2450V2 - SN:955

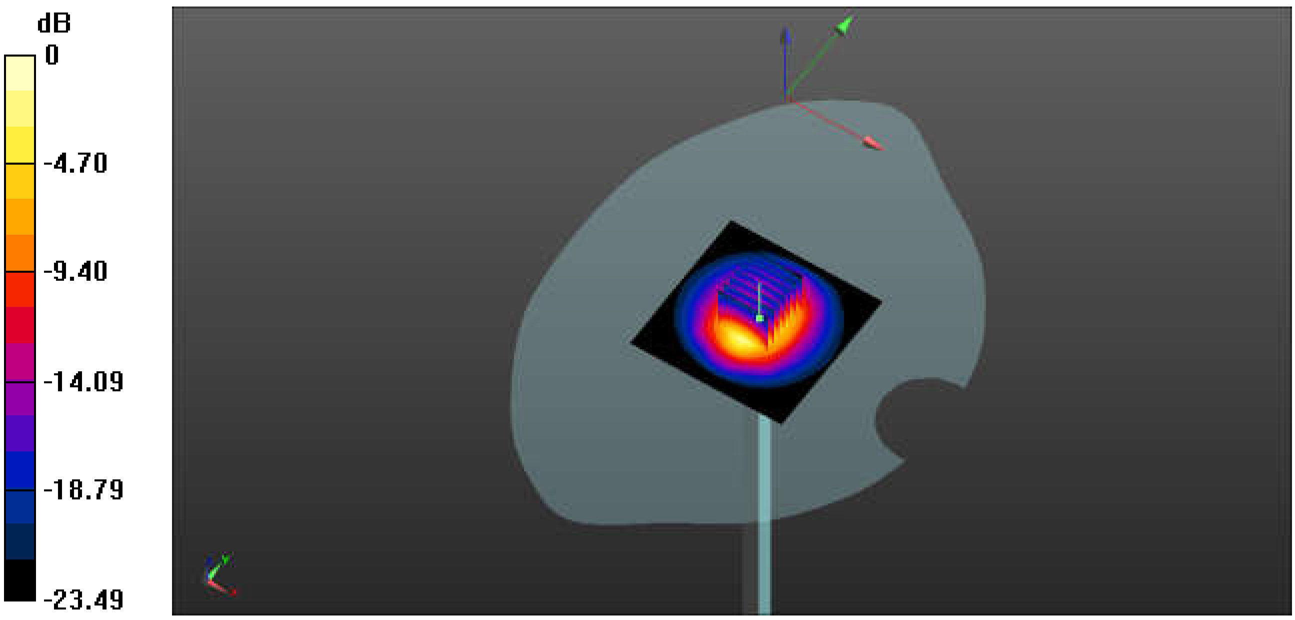
Communication System: UID 0, CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.861 S/m; ε_r = 39.575; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3836; ConvF(7.28, 7.28, 7.28); Calibrated: 12/14/2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 7/28/2020
- Phantom: SAM 1 ; Type: QD 000 P40 CB; Serial: TP - 1438
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 16.1 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.10 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 31.7 W/kg
SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.37 W/kg
Maximum value of SAR (measured) = 16.1 W/kg



Date: 12/22/2020

DUT: Dipole 5GHz ; Type: D5GHzV2; Serial: D5GHzV2

Communication System: UID 0, CW (0); Frequency: 5750 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5750 MHz; σ = 5.22 S/m; ε_r = 34.70; ρ = 1000 kg/m^3
Phantom section: Flat Section

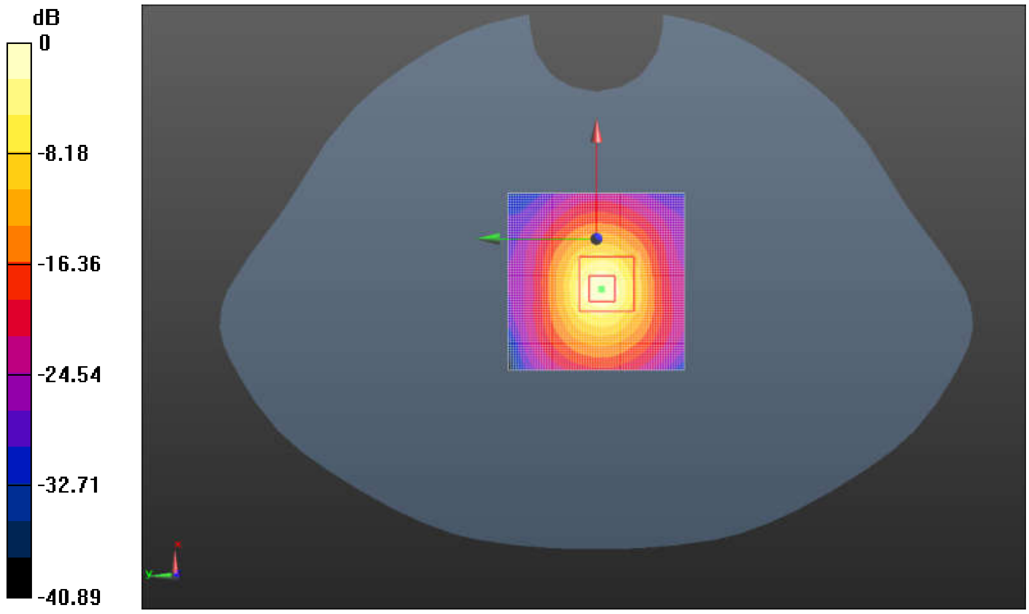
DASY5 Configuration:

- Probe: EX3DV4 - SN3836; ConvF(4.78, 4.78, 4.78); Calibrated: 12/14/2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 7/28/2020
- Phantom: SAM 1 ; Type: QD 000 P40 CB; Serial: TP - 1438
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 18.9 W/kg

Configuration/Pin=100mW/ Zoom Scan (8x8x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 58.65 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 33.1 W/kg
SAR(1 g) = 8 W/kg; SAR(10 g) = 2.19 W/kg

Maximum value of SAR (measured) = 19.9 W/kg



System Performance Check 5750MHz 100mW

Appendix B. SAR Test plots:

#1

Date: 12/21/2020

Procedure Name: 2.4G 10mm

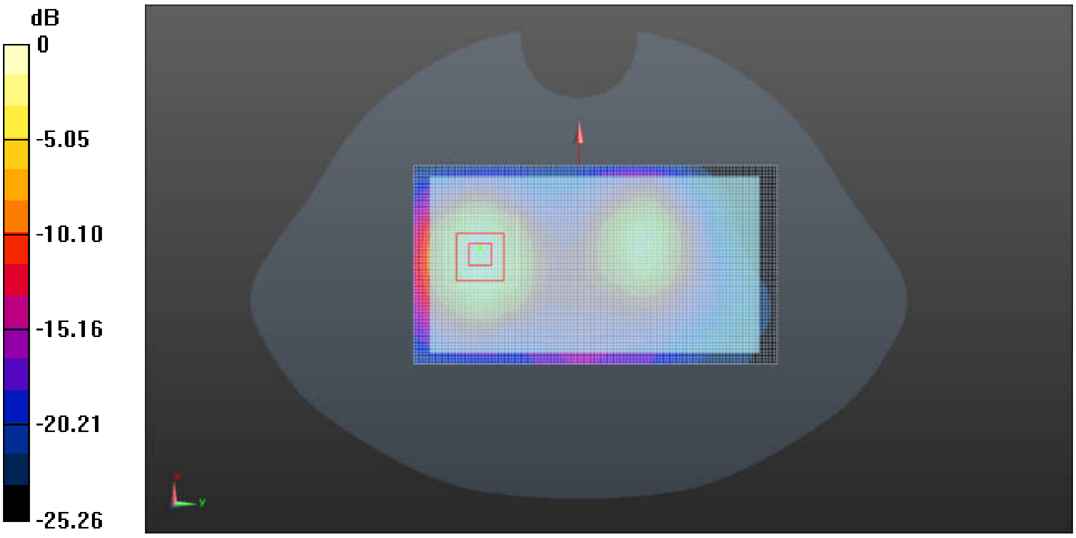
Communication System: UID 0, WLAN2450 (0); Frequency: 2436 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2436 MHz; σ = 1.795 S/m; εr = 38.991; ρ = 1000 kg/m3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3836; ConvF(7.28, 7.28, 7.28); Calibrated: 12/14/2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 7/28/2020
- Phantom: SAM 1 ; Type: QD 000 P40 CB; Serial: TP - 1438
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Area Scan (71x51x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.01 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.764 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 2.49 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.516 W/kg
Maximum value of SAR (measured) = 1.92 W/kg



0 dB = 1.92 W/kg = 2.83 dBW/kg

#2

Date: 12/21/2020

Procedure Name: SRD2.4G 0mm

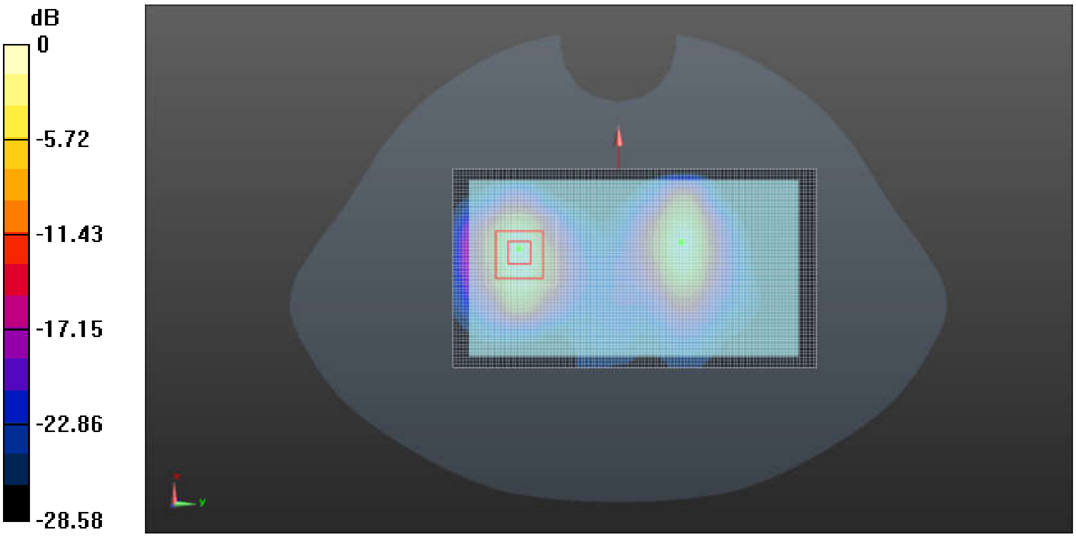
Communication System: UID 0, WLAN2450 (0); Frequency: 2436 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2436 MHz; σ = 1.795 S/m; εr = 38.991; ρ = 1000 kg/m3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3836; ConvF(7.28, 7.28, 7.28); Calibrated: 12/14/2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 7/28/2020
- Phantom: SAM 1 ; Type: QD 000 P40 CB; Serial: TP - 1438
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Area Scan (71x51x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 8.24 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.131 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 10.2 W/kg
SAR(1 g) = 3.76 W/kg; SAR(10 g) = 1.45 W/kg
Maximum value of SAR (measured) = 7.46 W/kg



0 dB = 7.46 W/kg = 8.73 dBW/kg

#3

Date: 12/22/2020

SRD 5.8G 10mm

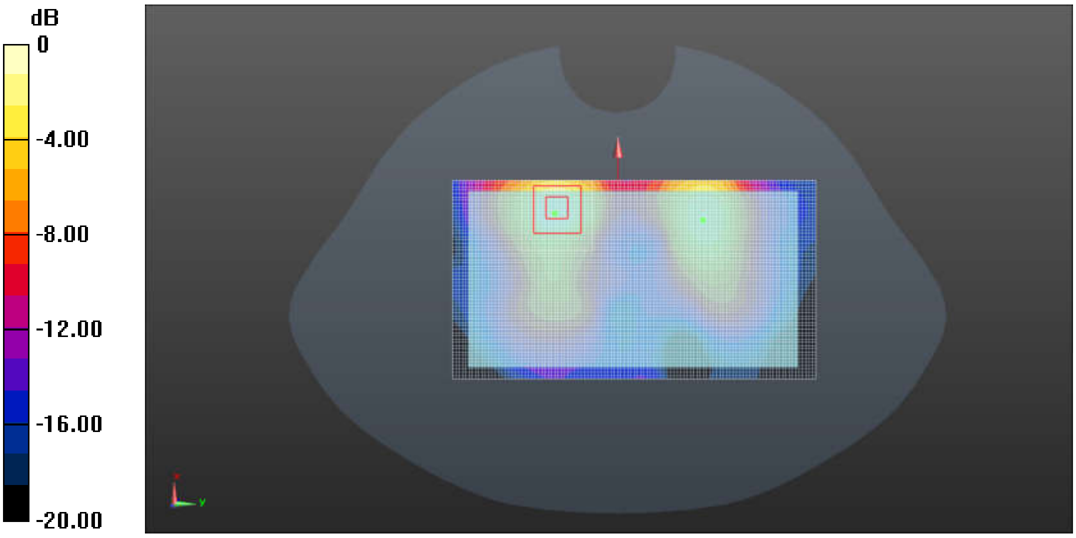
Communication System: UID 0, 802.11a (0); Frequency: 5780 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5780 MHz; σ = 5.106 S/m; ε_r = 35.974; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3836; ConvF(4.78, 4.78, 4.78); Calibrated: 12/14/2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 7/28/2020
- Phantom: SAM 1 ; Type: QD 000 P40 CB; Serial: TP - 1438
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Area Scan (71x51x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.95 W/kg

Zoom Scan (8x8x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 3.375 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 6.58 W/kg
SAR(1 g) = 1.18 W/kg; SAR(10 g) = 0.425 W/kg
Maximum value of SAR (measured) = 2.80 W/kg



2.80 W/kg = 4.47 dBW/kg

#4

Date: 12/22/2020

SRD 5.8G 0mm

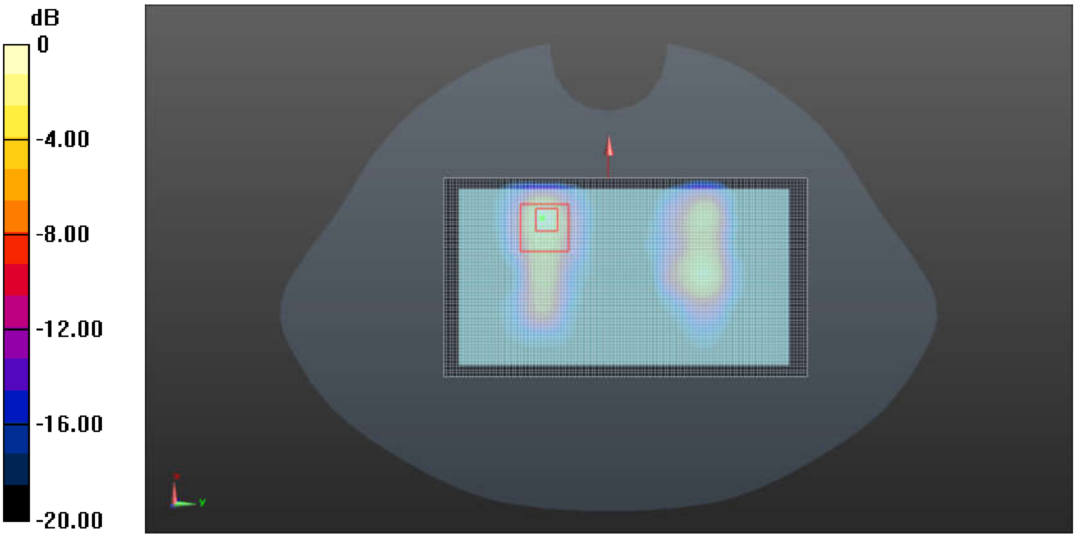
Communication System: UID 0, 802.11a (0); Frequency: 5780 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5780 MHz; σ = 5.106 S/m; ε_r = 35.974; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3836; ConvF(4.78, 4.78, 4.78); Calibrated: 12/14/2020;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 7/28/2020
- Phantom: SAM 1 ; Type: QD 000 P40 CB; Serial: TP - 1438
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Area Scan (71x51x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 21.4 W/kg

Zoom Scan (8x8x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 4.073 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 55.4 W/kg
SAR(1 g) = 7.51 W/kg; SAR(10 g) = 1.89 W/kg
Maximum value of SAR (measured) = 22.4 W/kg



22.4 W/kg = 13.50 dBW/kg