TEST REPORT

No. I17D00257-SAR01

For

Client:	**Qualcomm Atheros, Inc.**
Brand name:	**Qualcomm Atheros**
Production:	**Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 Type Card**
Model Name:	**QCNFA435**
Standard:	**ANSI C95.1-1999**
	FCC 47 CFR Part 2 (2.1093)
	RSS 102 issue 5
FCC ID:	**PPD-QCNFA435**
IC:	**4104A-QCNFA435**
Hardware Version:	**N/A**
Software Version:	**N/A**
Issued date:	**2017-12-14**

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of ECIT Shanghai.

Test Laboratory:

ECIT Shanghai, East China Institute of Telecommunications
Add: 7-8F, G Area, No.668, Beijing East Road, Huangpu District, Shanghai, P. R. China
Tel: (+86)-021-63843300, E-Mail: welcome@ecit.org.cn

Revision Version

Report Number	Revision	Date	Memo
I17D00257-SAR01	00	2017-12-01	Initial creation of test report
I17D00257-SAR01	01	2017-12-11	Second creation of test report
I17D00257-SAR01	02	2017-12-13	Third creation of test report
I17D00257-SAR01	03	2017-12-14	Fourth creation of test report

CONTENTS

1. Test Laboratory

1.1. Testing Location

Company Name:	ECIT Shanghai, East China Institute of Telecommunications
Address:	7-8F, G Area, No. 668, Beijing East Road, Huangpu District, Shanghai, P. R. China
Postal Code:	200001
Telephone:	(+86)-021-63843300
Fax:	(+86)-021-63843301
IC OAT'S Teat Site Registration Number:	10766A-1

1.2. Testing Environment

Normal Temperature:	18-25℃
Relative Humidity:	30-70%
Ambient noise & Reflection:	< 0.012 W/kg

1.3. Project Data

Project Leader:	Lu Fang
Testing Start Date:	2017-11-24
Testing End Date:	2017-11-26

1.4. Signature

Yan Hang
(Prepared this test report)

Fu Erliang
(Reviewed this test report)

Zheng Zhongbin
(Approved this test report)

2. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 Type Card** are as follows (with expanded uncertainty 23.02%)

Equipment Class	Frequency Band	Highest SAR Summary	
		Body 1g SAR (W/kg)	Simultaneous Transmission 1g SAR (W/kg)
DTS	2.4GHz WLAN	1.161	--
NII	5.2GHz WLAN	--	1.238
	5.3GHz WLAN	1.205	
	5.5GHz WLAN	1.158	
	5.8GHz WLAN	1.117	
DSSS(BT)	2.4GHz	0.041	

The SAR values found for the EUT are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1g tissue according to the ANSI C95.1-1999 and RSS 102 issue 5 .

For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with any accessory that contains no metal. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

3. Client Information

3.1. Applicant Information

Company Name:	Qualcomm Atheros, Inc.
Address:	1700 Technology Drive, San Jose, CA 95110
Email:	QCARG@qti.qualcomm.com

3.2. Manufacturer Information

Company Name:	Qualcomm Atheros, Inc.
Address:	1700 Technology Drive, San Jose, CA 95110
Email:	QCARG@qti.qualcomm.com

4. Equipment Under Test (EUT) and Ancillary Equipment (AE)

4.1. About EUT

Description:	Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 Type Card
Model name:	QCNFA435
Operation Model(s):	802.11a/b/g/n HT20/HT40/VHT20/VHT40/VHT80 Bluetooth:2.1 + EDR, 8-DPSK Bluetooth:4.1
Tx Frequency:	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Test device Production information:	Production unit
Device type:	Portable device
Antenna type:	Inner antenna
Accessories/Body-worn configurations:	N/A
Dimensions:	29.5cm × 20.5 cm
FCC ID:	PPD-QCNFA435
IC:	4104A-QCNFA435

Antenna Specification:	Brand	Gain(dBi)			
		2.4GHz	5GHz	2.4GHz	5GHz
		ANT1	ANT1	ANT2	ANT2
	INPAQ	1.05	2.87	0.86	2.9
	Part Number	ANT1: 64451203800070		ANT2: 64451203800050	
	South Star	0.85	1.31	0.37	0.95
	Part Number	ANT1: 64451203800020		ANT2: 64451203800010	
	Note: ANT1 is Main Antenna; ANT2 is Aux Antenna.				

Tested System Details

Product	Manufacturer	Model No.
Notebook / Tablet Computer	Lenovo	Lenovo FLEX 6-11IGM,81A7

4.2. Internal Identification of EUT used during the test

EUT ID*	SN or IMEI	HW Version	SW Version:	Received of date
N01	N/A	N/A	N/A	2017-11-23

*EUT ID: is used to identify the test sample in the lab internally.

4.3. Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
C01	Notebook / Tablet Computer	Lenovo FLEX 6-11IGM,81A7	N/A	LENOVO

*AE ID: is used to identify the test sample in the lab internally.

5. TEST METHODOLOGY

5.1. Applicable Limit Regulations

ANSI C95.1–1999:IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

FCC 47 CFR Part 2 (2.1093): Radiofrequency radiation exposure evaluation: portable devices.

RSS-102 issue 5: 2015: Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands)

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

5.2. Applicable Measurement Standards

IEEE 1528–2013: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

KDB248227 D01 802 11 Wi-Fi SAR v02r02: SAR measurement procedures for 802.112abg transmitters.

KDB447498 D01 General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

KDB865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04:SAR Measurement Requirements for 100 MHz to 6 GHz

KDB865664 D02 RF Exposure Reporting v01r02:provides general reporting requirements as well as certain specific information required to support MPE and SAR compliance.

KDB616217 D04 v01r02 : SAR for laptop and tablets

NOTE: KDB and FCC 47 CFR Part 2 (2.1093) is not in A2LA Scope List.

6. Specific Absorption Rate (SAR)

6.1. Introduction

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

6.2. SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (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 either related to the temperature elevation in tissue by

$$SAR = c\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or 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 tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

7. Tissue Simulating Liquids

7.1. Targets for tissue simulating liquid

Table 7.1: Targets for tissue simulating liquid

Frequency (MHz)	Liquid Type	Conductivity(σ)	± 5% Range	Permittivity(ε)	± 5% Range
2450	Body	1.95	1.85~2.05	52.7	50.1~55.3
5200	Body	5.35	5.08~5.62	49.03	46.58~51.48
5300	Body	5.46	5.19~5.73	48.9	46.46~51.35
5500	Body	5.68	5.40~5.96	48.62	46.19~51.05
5600	Body	5.79	5.50~6.08	48.48	46.06~50.90
5800	Body	6	5.70~6.3	48.2	45.79~50.61

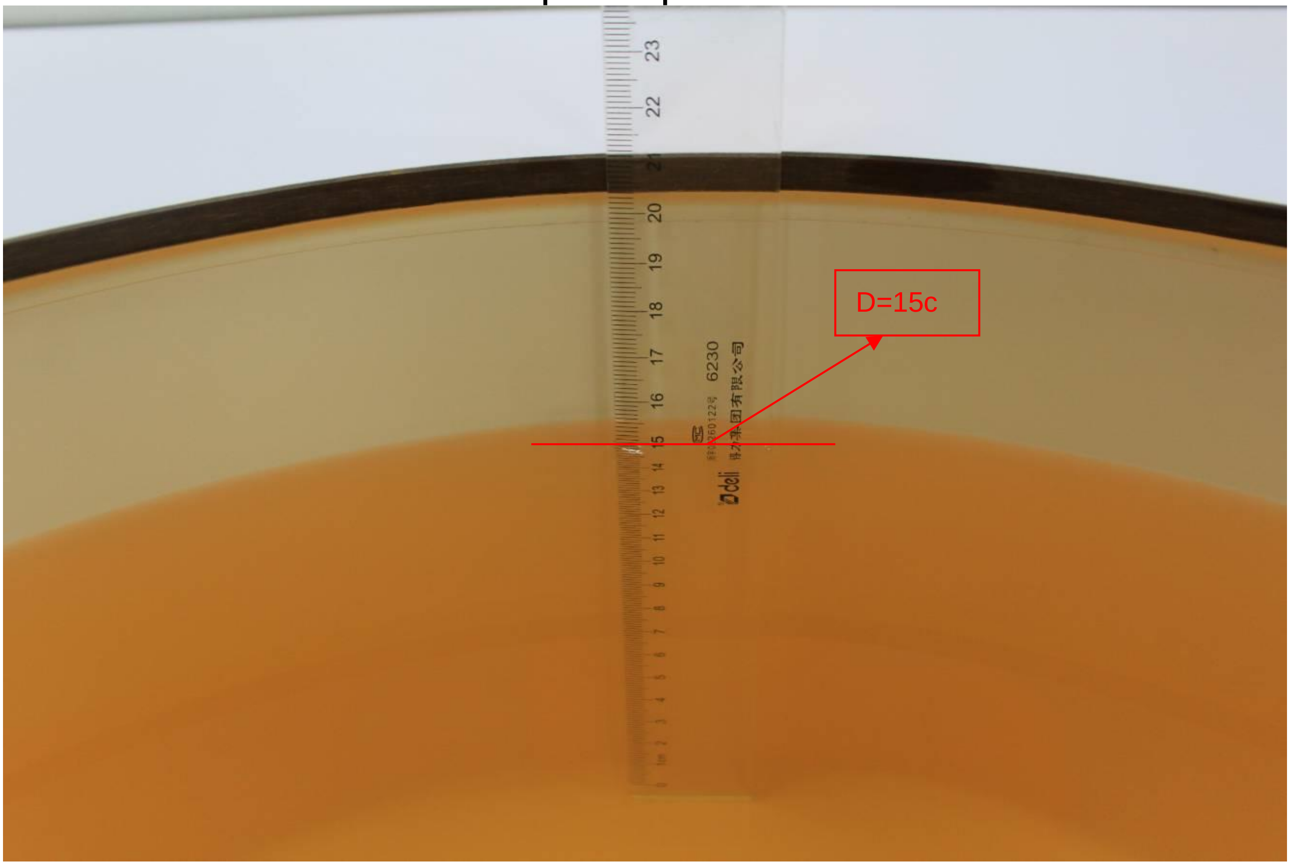
7.2. Dielectric Performance

Table 7.2: Dielectric Performance of Tissue Simulating Liquid

Measurement Value						
Liquid Temperature: 22 ℃						
Type	**Frequency（MHz）**	**Permittivity ε**	**Drift (%)**	**Conductivity σ**	**Drift (%)**	Test Date
Body	2402	51.767	-1.89%	1.885	-0.04%	2017-11-24
Body	2441	51.703	-1.91%	1.942	0.20%	2017-11-24
Body	2480	51.595	-2.03%	1.976	-0.71%	2017-11-24
Body	2412	51.725	-1.94%	1.902	0.06%	2017-11-24
Body	2437	51.704	-1.92%	1.937	0.21%	2017-11-24
Body	2462	51.648	-1.97%	1.963	-0.15%	2017-11-24
Body	5260	48.783	-0.34%	5.509	1.63%	2017-11-25
Body	5280	48.921	-0.01%	5.526	1.53%	2017-11-25
Body	5320	48.776	-0.19%	5.454	-0.60%	2017-11-25
Body	5500	48.611	-0.02%	5.71	0.49%	2017-11-26
Body	5580	48.101	-0.84%	5.989	3.83%	2017-11-26
Body	5720	48.175	-0.28%	6.033	1.97%	2017-11-26
Body	5745	47.807	-0.97%	6.03	1.47%	2017-11-26
Body	5785	47.647	-1.19%	6.236	4.21%	2017-11-26

Body	5825	47.97	-0.42%	6.214	3.22%	2017-11-26

Depth of Liquid

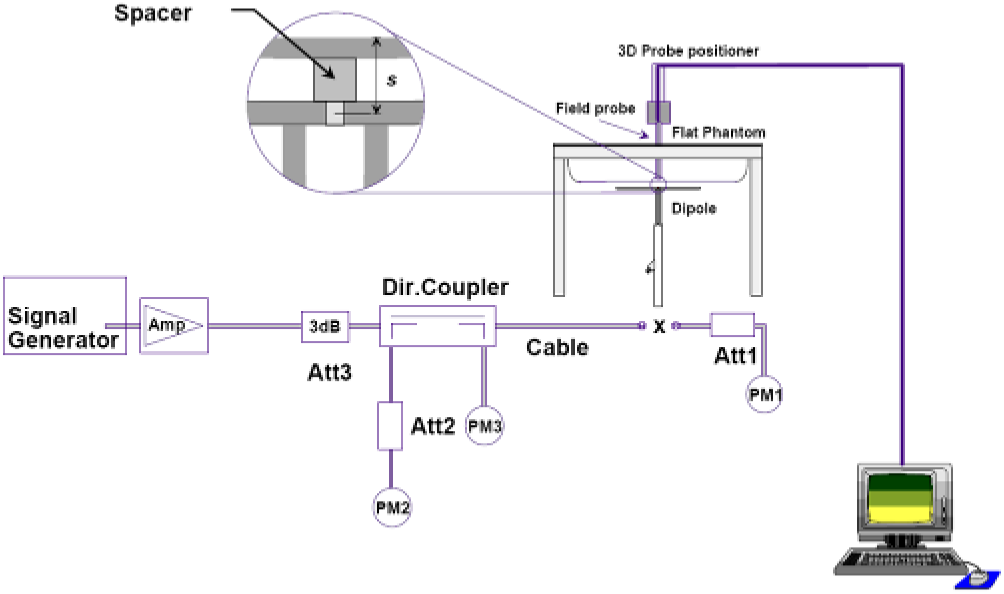


- Note: For SAR testing, the liquid depth is 15cm shown above

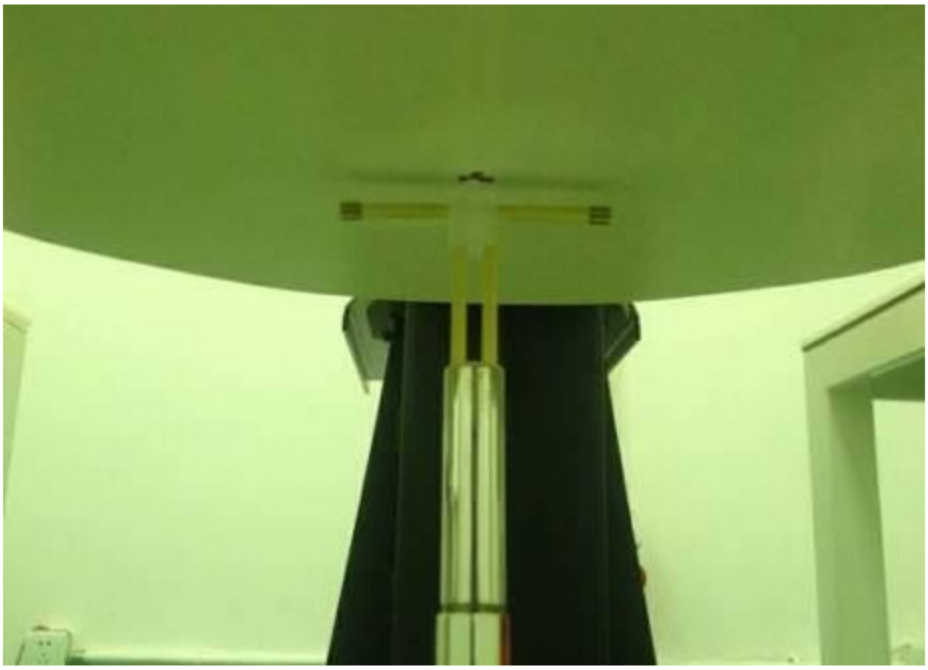
8. System verification

8.1. System Setup

In the simplified setup for system evaluation, the DUT 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:



Picture 8.1 System Setup for System Evaluation



Picture 8.2 Photo of Dipole Setup

8.2. System Verification

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device.

Table 8.1: System Verification of Body

Verification Results							
Input power level: 1W							
Frequency	**Target value (W/kg)**		**Measured value (W/kg)**		**Deviation**		**Test date**
	10 g Average	**1 g Average**	**10 g Average**	**1 g Average**	**10 g Average**	**1 g Average**	
2450 MHz	24.7	53.1	23.6	52.4	-4.45%	-1.32%	2017-11-24
5200 MHz	20.2	72.3	21.1	75.5	4.46%	4.43%	2017-11-25
5300 MHz	21.3	76.4	21.9	78	2.82%	2.09%	2017-11-25
5500 MHz	22.2	80	22.7	82.7	2.25%	3.37%	2017-11-26
5600 MHz	22.3	79.4	23.1	83.5	3.59%	5.16%	2017-11-26
5800 MHz	21.2	76.4	22.2	80.1	4.72%	4.84%	2017-11-26

9. Measurement Procedures

9.1. Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in Picture 11.1.

Step 1: The tests described in 11.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom, as described in Chapter 8),

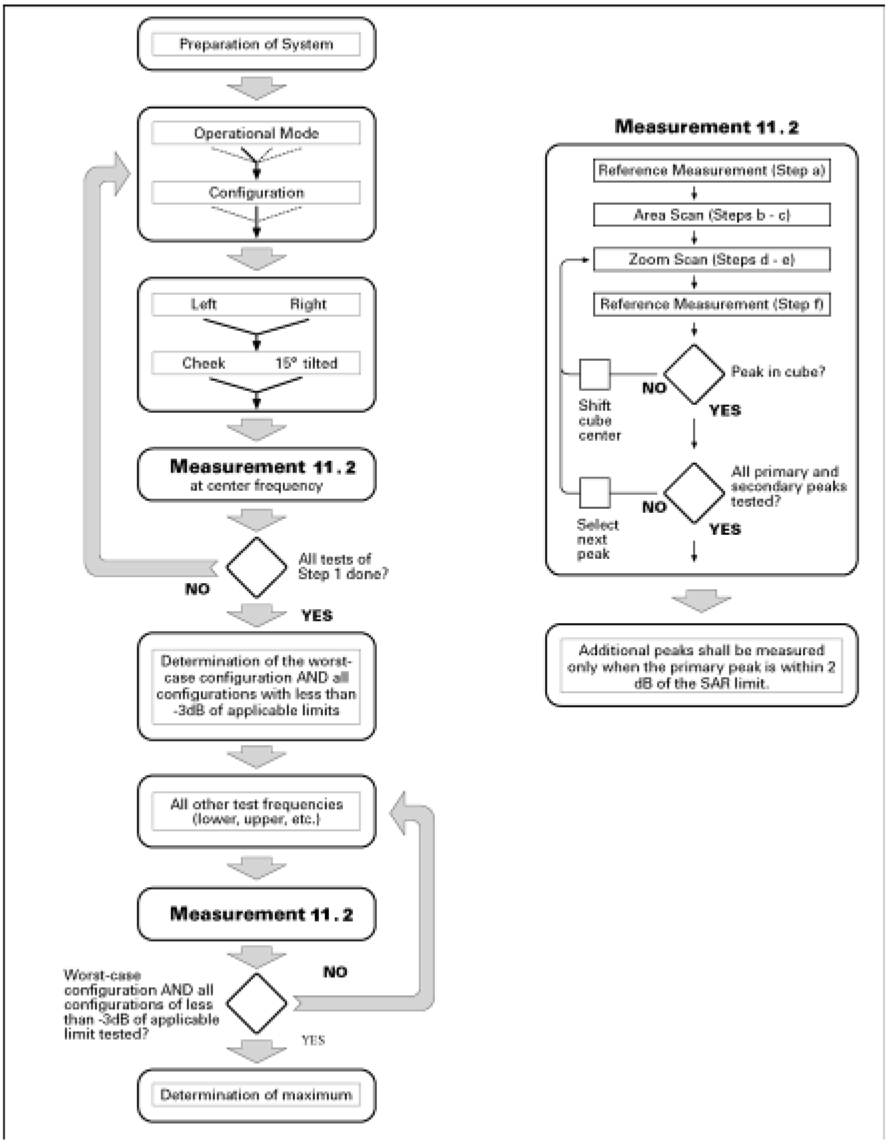
b) all configurations for each device position in a), e.g., antenna extended and retracted, and

c) all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., N_c > 3), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

Step 2: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 11.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

Step 3: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.



Picture 9.1Block diagram of the tests to be performed

9.2. General Measurement Procedure

The following procedure shall be performed for each of the test conditions (see Picture 11.1) described in 11.1:

a) Measure the local SAR at a test point within 8 mm or less in the normal direction from the inner surface of the phantom.

b) Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grip spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δ In(2)/2 mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and In(x) is the natural logarithm. The maximum variation of the sensor-phantom surface shall be ±1 mm for frequencies below 3 GHz and ±0.5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5°. If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional uncertainty evaluation is needed.

c) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;

d) Measure the three-dimensional SAR distribution at the local maxima locations identified in step c). The horizontal grid step shall be (24/f[GHz]) mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grip step in the vertical direction shall be (8-f[GHz]) mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be (12 / f[GHz]) mm or less but not more than 4 mm, and the spacing between father points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δ In(2)/2 mm for frequencies of 3 GHz and greater, where δ is the plane wave skin depth and In(x) is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved is the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5°. If this cannot be achieved an additional uncertainty evaluation is needed.

e) Use post processing(e.g. interpolation and extrapolation) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

9.3. Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure that the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

9.4. Power Drift

To control the output power stability during the SAR test, DASY4 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Section 14 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

10. Conducted Output Power

10.1. Manufacturing tolerance

Table 10.1: WiFi

Mode	Channel	Frequency	Target power	Tolerance
b	1	2412	20.5	19±1.5
	6	2437	20.5	19±1.5
	11	2462	20.5	19±1.5
g	1	2412	17	15.5±1.5
	6	2437	17	15.5±1.5
	11	2462	17	15.5±1.5
20n	1	2412	16.5	15±1.5
	6	2437	16.5	15±1.5
	11	2462	16.5	15±1.5
40n	3	2422	14.5	13±1.5
	6	2437	14.5	13±1.5
	9	2452	13.5	12±1.5

Mode	Channel	Frequency	Target power	Tolerance
a	36	5180	15	13±2
	40	5200	15	13±2
	44	5220	15	13±2
	48	5240	15	13±2
	52	5260	15.5	13.5±2
	56	5280	16	14±2
	60	5300	16	14±2
	64	5320	16	14±2
	100	5500	15	13±2
	112	5560	15.5	13.5±2
	116	5580	15.5	13.5±2
	128	5640	15.5	13.5±2
	144	5720	15.5	13.5±2
	149	5745	16.5	14.5±2
	157	5785	16.5	14.5±2
	165	5825	16.5	14.5±2
n 20	Channel	Frequency		
	36	5180	14.5	12.5±2
	40	5200	14.5	12.5±2
	44	5220	14.5	12.5±2
	48	5240	14.5	12.5±2
	52	5260	15	13±2

	56	5280	15	13±2
	60	5300	15	13±2
	64	5320	15	13±2
	100	5500	15	13±2
	112	5560	15	13±2
	116	5580	15	13±2
	128	5640	15	13±2
	144	5720	15	13±2
	149	5745	16	14±2
	157	5785	16	14±2
	165	5825	16	14±2
n40	38	5190	12	10±2
	46	5230	13.5	11.5±2
	54	5270	14	12±2
	62	5310	12	10±2
	102	5510	13	11±2
	110	5550	13.5	11.5±2
	118	5590	13.5	11.5±2
	126	5630	13.5	11.5±2
	134	5670	13.5	11.5±2
	142	5710	13.5	11.5±2
	151	5755	15	13±2
	159	5795	15	13±2
AC80	42	5210	10.5	8.5±2
	58	5290	11	9±2
	106	5530	12	10±2
	122	5610	13.5	11.5±2
	138	5690	13.5	11.5±2
	155	5775	14	12±2

Table 10.2: Bluetooth

Band / Mode	Target Power(dBm)		
	V3.0 + EDR, GFSK	V3.0 + EDR, π/4-DQPSK	V3.0 + EDR, 8-DPSK
Bluetooth	6	6	6

Band / Mode	Target Power(dBm)
	BLE4.0, GFSK
Bluetooth	6

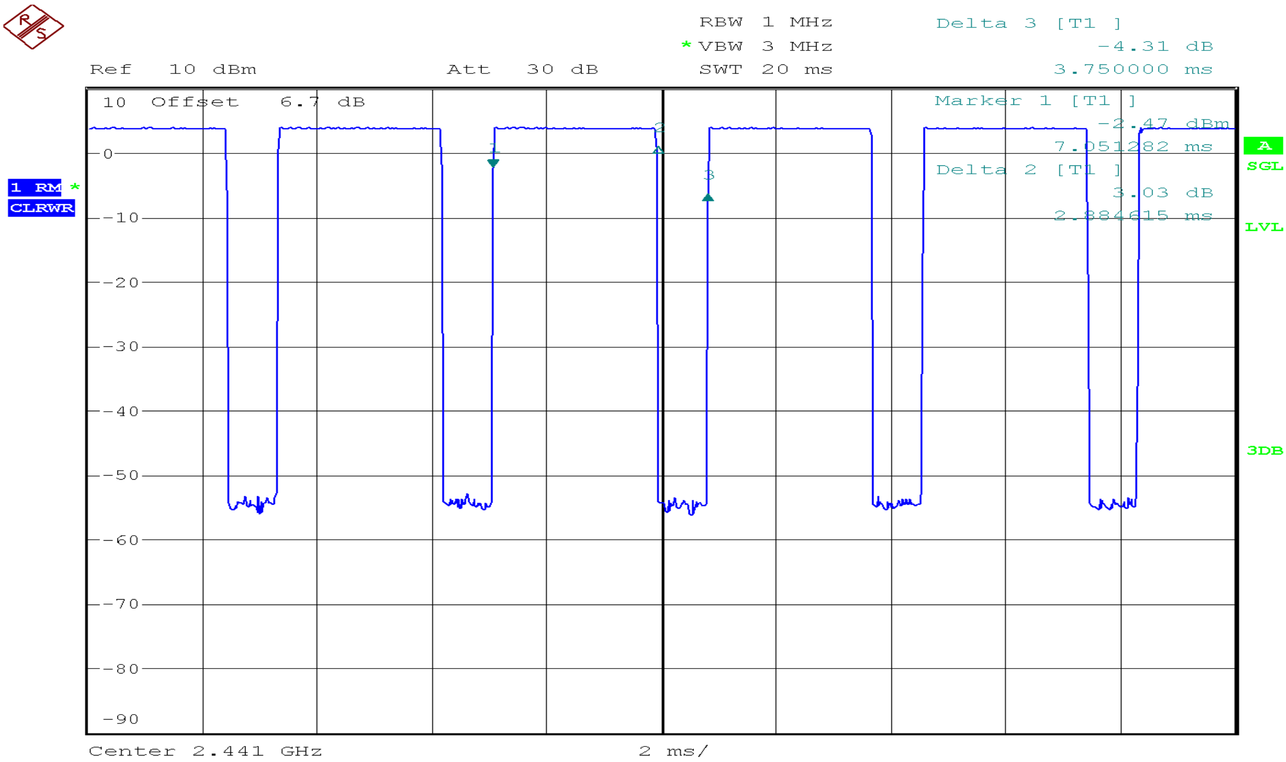
10.2. Wi-Fi and BT Measurement result

Table 10.3: The conducted power for Bluetooth

BT2.1 GFSK			
Channel	Ch0 (2402 MHz)	Ch39 (2441MHz)	CH78 (2480MHz)
Conducted Output Power (dBm)	3.25	3.45	3.42
BT2.1 π/4 DQPSK			
Channel	Ch0 (2402 MHz)	Ch39 (2441MHz)	CH78 (2480MHz)
Conducted Output Power (dBm)	-0.1	0.12	0
BT2.1 8DPSK			
Channel	Ch0 (2402 MHz)	Ch39 (2441MHz)	CH78 (2480MHz)
Conducted Output Power (dBm)	-0.2	-0.01	-0.04
Bluetooth LE			
Channel	Ch0 (2402 MHz)	Ch39 (2441MHz)	CH78 (2480MHz)
Conducted Output Power (dBm)	-2.51	-2.48	-2.22

Bluetooth Duty cycle

Duty Cycle			
Configuration	TX ON (ms)	TX ALL (ms)	Duty Cycle (%)
BR-1Mbps	2.885	3.75	77%



According to RSS 102 issue5 section 2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation, BT standalone SAR are required, because tune up output power is greater than 4mW.

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

The default power measurement procedures are:

a) Power must be measured at each transmit antenna port according to the DSSS and OFDM transmission configurations in each standalone and aggregated frequency band.

b) Power measurement is required for the transmission mode configuration with the highest maximum output power specified for production units.

1) When the same highest maximum output power specification applies to multiple transmission modes, the largest channel bandwidth configuration with the lowest order modulation and lowest data rate is measured.

2) When the same highest maximum output power is specified for multiple largest channel bandwidth configurations with the same lowest order modulation or lowest order modulation and lowest data rate, power measurement is required for all equivalent 802.11 configurations with the same maximum output power.

c) For each transmission mode configuration, power must be measured for the highest and lowest channels; and at the mid-band channel(s) when there are at least 3 channels. For configurations with multiple mid-band channels, due to an even number of channels, both channels should be measured.

d) Apply the default power measurement procedures to measure maximum output power for each standalone and aggregated frequency band.

1) When band gap channels between U-NII-2C band and U-NII-3 band or §15.247 5.8 GHz band are supported and the bands are aggregated for SAR testing according to KDB 248227D01 sections 2.3 and 3.3, apply the following to determine high, middle and low channels for power measurement and SAR test reduction.

i) channels in U-NII-2C band below 5.65 GHz are considered as one band

ii) channels above 5.65 GHz, together with channels in 5.8 GHz U-NII-3 or §15.247 band, are considered as a separate band

2) The maximum output power of band gap channels is limited to the lowest maximum output power certified for the adjacent bands regardless of whether band aggregation is applied for SAR testing.

3) The measured maximum output power results are used to reduce the number of channels that need testing.

During WLAN SAR testing EUT is configured with the WLAN continuous TX tool, and the transmission duty factor was monitored on the spectrum analyzer with zero-span setting.
For WLAN SAR testing, WLAN engineering test software installed on the EUT can provide continuous transmitting RF signal.

Duty cycle Form

Band	Mode	Duty cycle(100%)
2.4GHz	Bluetooth	77
	802.11b	99
	802.11g	95
	802.11n 20MHz	94
	802.11n 40MHz	89
5GHz	802.11a	95

	802.11 20MHz	95
	802.11 40MHz	90
	802.11 ac80	82

Table 10.4: The average conducted power for WiFi

WLAN 2.4G

Mode	Channel	Frequency (MHZ)	Target power(dBm)	Tune up tolerance (dBm)	Chain0	Chain1
					Average power (dBm)	
802.11 b	1	2412	20.5	19±1.5	20.45	20.35
	6	2437	20.5	19±1.5	20.40	20.31
	11	2462	20.5	19±1.5	20.17	20.42
802.11 g	1	2412	17	15.5±1.5	Not required	Not required
	6	2437	17	15.5±1.5		
	11	2462	17	15.5±1.5		
802.11 n 20MHz	1	2412	16.5	15±1.5		
	6	2437	16.5	15±1.5		
	11	2462	16.5	15±1.5		
802.11 n 40MHz	3	2422	14.5	13±1.5		
	6	2437	14.5	13±1.5		
	9	2452	13.5	12±1.5		

U-NII-1 Chain0

Mode	Channel	Frequency (MHZ)	Target power(dBm)	Tune up tolerance (dBm)	Chain0	Chain1
					Average Power (dBm)	
802.11 a	36	5180	15	13±2	14.22	14.68
	40	5200	15	13±2	14.51	14.40
	44	5220	15	13±2	14.11	13.96
	48	5240	15	13±2	13.79	13.92
802.11 n 20MHz	36	5180	14.5	12.5±2	Not required	Not required
	40	5200	14.5	12.5±2		
	44	5220	14.5	12.5±2		
	48	5240	14.5	12.5±2		
802.11 n 40MHz	38	5190	12	10±2		
	46	5230	13.5	11.5±2		
802.11 ac80	42	5210	10.5	8.5±2		

U-NII-2A Chain0

Mode	Channel	Frequency (MHZ)	Target power(dBm)	Tune up tolerance (dBm)	Chain0	Chain1
					Average Power (dBm)	
802.11 a	52	5260	15.5	13.5±2	14.76	14.22
	56	5280	16	14±2	15.57	15.30
	60	5300	16	14±2	15.23	15.18
	64	5320	16	14±2	15.50	15.43
802.11 n 20MHz	52	5260	15	13±2	Not required	Not required
	56	5280	15	13±2		
	60	5300	15	13±2		
	64	5320	15	13±2		
802.11 n 40MHz	54	5270	14	12±2		
	62	5310	12	10±2		
802.11 ac80	58	5290	11	9±2		

U-NII-2C Chain0

Mode	Channel	Frequency (MHZ)	Target power(dBm)	Tune up tolerance (dBm)	Chain0	Chain1
					Average Power (dBm)	
802.11 a	100	5500	15	13±2	14.75	14.62
	112	5560	15.5	13.5±2	15.30	15.18
	116	5580	15.5	13.5±2	15.38	15.33
	128	5640	15.5	13.5±2	15.39	15.23
	144	5720	15.5	13.5±2	15.41	15.39
802.11 n 20MHz	100	5500	15	13±2	Not required	Not required
	112	5560	15	13±2		
	116	5580	15	13±2		
	128	5640	15	13±2		
	144	5720	15	13±2		
802.11 n 40MHz	102	5510	13	11±2		
	110	5550	13.5	11.5±2		
	118	5590	13.5	11.5±2		
	126	5630	13.5	11.5±2		
	134	5670	13.5	11.5±2		
	142	5710	13.5	11.5±2		
802.11 ac80	106	5530	12	10±2		
	122	5610	13.5	11.5±2		
	138	5690	13.5	11.5±2		

U-NII-3

Mode	Channel	Frequency	Target power(dBm)	Tune up tolerance (dBm)	Chain0	Chain1
					Average power (dBm)	
802.11 a	149	5745	16.5	14.5±2	16.20	16.01
	157	5785	16.5	14.5±2	15.18	15.32
	165	5825	16.5	14.5±2	15.11	15.28
802.11 n 20MHz	149	5745	16	14±2	Not required	Not required
	157	5785	16	14±2		
	165	5825	16	14±2		
802.11 n 40MHz	151	5755	15	13±2		
	159	5795	15	13±2		
802.11 ac80	155	5775	14	12±2		

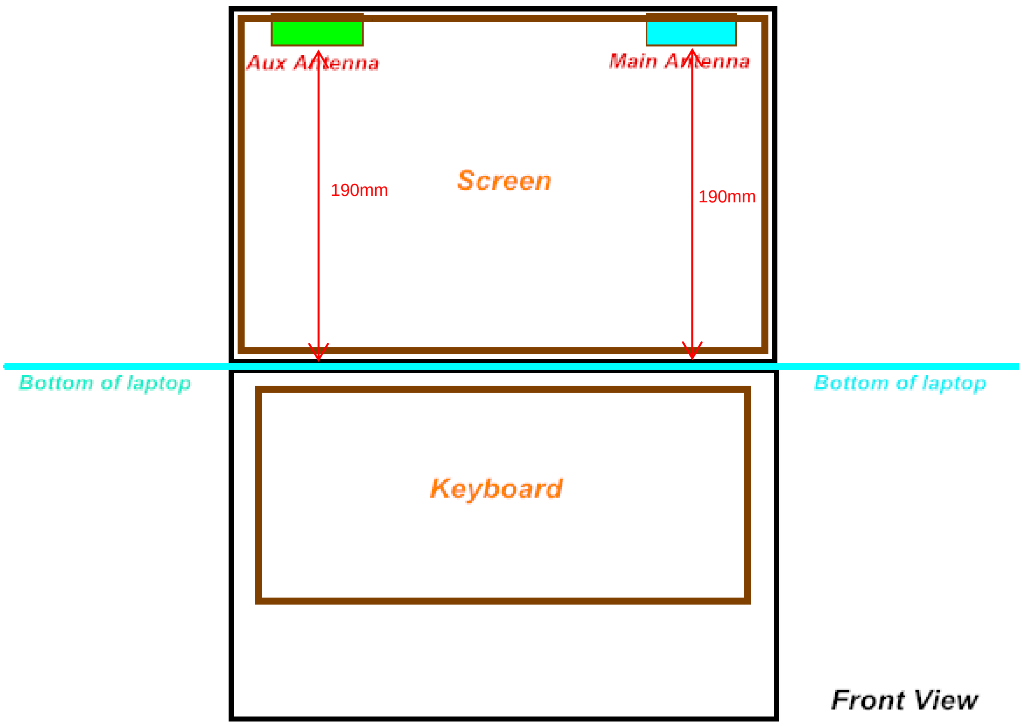
11. Simultaneous TX SAR Considerations

11.1. Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For this device, the BT and Wi-Fi can transmit simultaneous with other transmitters.

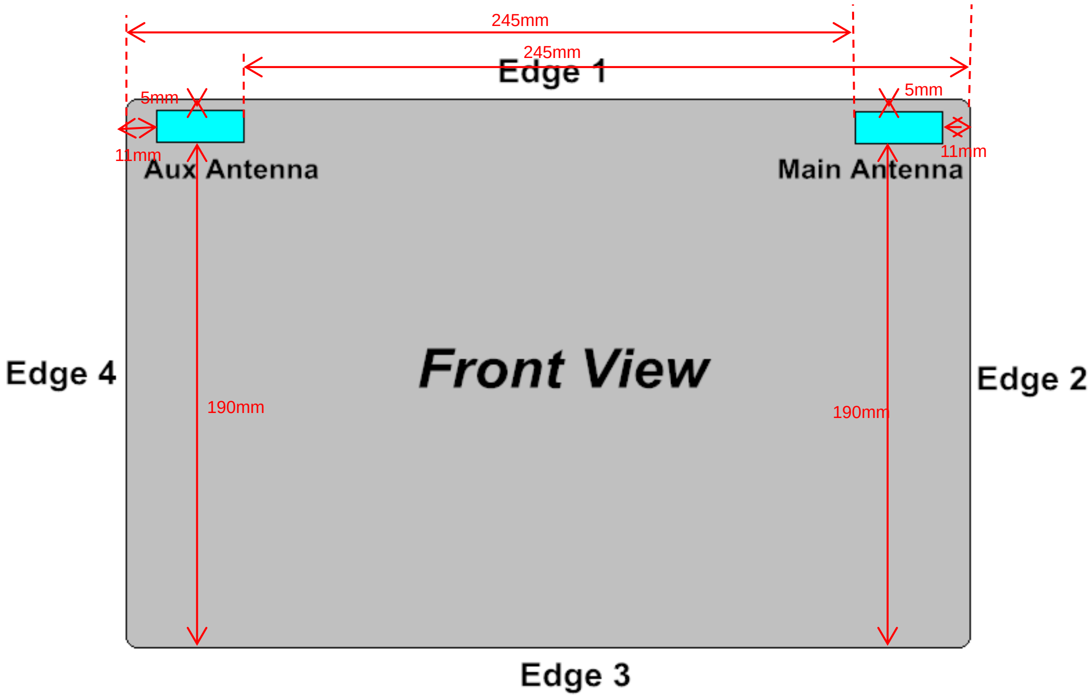
11.2. Transmit Antenna Separation Distances

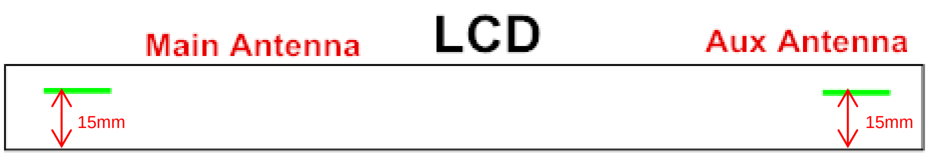
<Notebook>

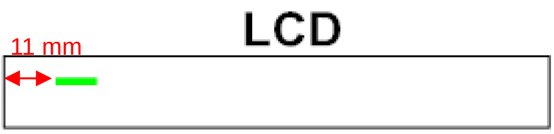


Picture 12.1 Antenna Locations

<Tablet>







11.3. Standalone SAR Test Exclusion Considerations

According to KDB447498 D01 Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] ·

[√f(GHz)] ≤ 3.0 for 1-g SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

According to the KDB447498 appendix A, the SAR test exclusion threshold for 2450MHz at 5mm test separation distances is 10mW.

$$\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} * \sqrt{\text{Frequency (GHz)}} \leq 3.0$$

Based on the above equation, Bluetooth SAR was not required:

Evaluation=1.254 ＜3.0

Based on the above equation, WiFi 2.4GHz SAR was required:

Evaluation=35.34 > 3.0

Based on the above equation, WiFi 5GHz SAR was required:

Evaluation=14.07 > 3.0

According to RSS 102 issue5 section 2.5.1 Exemption Limits for Routine Evaluation – SAR Evaluation, BT standalone SAR are required, because tune up output power is than 4mW. Wifi standalone SAR is required, because maximum average output power is greater than 4mW.

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

11.4. SAR Measurement Positions

The following SAR test exclusion Thresholds based on KDB 447498 D01 General RF Exposure Guidance v06 4.3.1

Exposure Position	Wireless Interface	WLAN		WLAN		Bluetooth
		802.11 b Main	802.11 b Aux	802.11 a Main	802.11 a Aux	GFSK Main
	Maximum power	20.5	20.5	16.5	16.5	6
	Maximum rated power(mW)	112.2	112.2	44.67	44.67	3.98
Rear view	Antenna to user (mm)	15	15	15	15	15
	SAR exclusion threshold（mW）	28.75	28.75	18.69	18.69	28.75
	SAR testing required?	Yes	Yes	Yes	Yes	No
Edge1	Antenna to user (mm)	5	5	5	5	5
	SAR exclusion threshold（mW）	9.58	9.58	6.23	6.23	9.58
	SAR testing required?	Yes	Yes	Yes	Yes	No
Edge2	Antenna to user (mm)	11	245	11	245	11
	SAR exclusion threshold（mW）	21.08	2046	13.7	2046	21.08
	SAR testing required?	Yes	No	Yes	No	No
Edge3	Antenna to user (mm)	190	190	190	190	190
	SAR exclusion threshold（mW）	1496.00	1496.00	1462.28	1462.28	1496.00
	SAR testing required?	No	No	No	No	No
Edge4	Antenna to user (mm)	245	11	245	11	245
	SAR exclusion threshold（mW）	2046	21.08	2046	13.7	2046
	SAR testing required?	No	Yes	No	Yes	No

Note:

1. Maximum power is the source-based time-average power and represents the maximum RF output power among production units
2. Per KDB 447498 D01v06, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
3. Per KDB 447498 D01v06, standalone SAR test exclusion threshold is applied; If the distance of the antenna to the user is < 5mm, 5mm is used to determine SAR exclusion threshold
4. Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[√f(GHz)] ≤ 3.0 for

   1-g SAR and ≤ 7.5 for 10-g extremity SAR

   f(GHz) is the RF channel transmit frequency in GHz

   Power and distance are rounded to the nearest mW and mm before calculation

   The result is rounded to one decimal place for comparison

For < 50 mm distance, we just calculate mW of the exclusion threshold value (3.0) to do compare.

This formula is [3.0] / [√f(GHz)] ·[(*min. test separation distance, mm*)] = exclusion threshold of mW.

5. Per KDB 447498 D01v06, at 100 MHz to 6 GHz and for *test separation distances* > 50 mm, the SAR test exclusion threshold is determined according to the following

   a) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz

   b) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·10] mW at > 1500 MHz and ≤ 6 GHz

6. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

The following SAR test exclusion Thresholds based on RSS102 issue5 2.5.1

Exposure Position	Wireless Interface	**WLAN**		**WLAN**		**Bluetooth**
		802.11 b Main	**802.11 b Aux**	**802.11 a Main**	**802.11 a Aux**	**GFSK Main**
	Maximum power	21.55	21.36	19.37	19.4	7.05
	Maximum rated power(mW)	142.89	136.77	86.50	87.10	5.07
Rear view	Antenna to user (mm)	15	15	15	15	15
	SAR exclusion threshold(mW)	15	15	15	15	15
	SAR testing required?	Yes	Yes	Yes	Yes	No
Edge1	Antenna to user (mm)	5	5	5	5	5
	SAR exclusion threshold(mW)	4	4	1	1	4
	SAR testing required?	Yes	Yes	Yes	Yes	Yes
Edge2	Antenna to user (mm)	11	245	11	245	11
	SAR exclusion threshold(mW)	7	309	6	106	7
	SAR testing required?	Yes	No	Yes	No	No
Edge3	Antenna to user (mm)	190	190	190	190	190
	SAR exclusion threshold(mW)	309	309	106	106	309
	SAR testing required?	No	No	No	No	No
Edge4	Antenna to user (mm)	245	11	245	11	245
	SAR exclusion threshold(mW)	309	7	309	6	309
	SAR testing required?	No	Yes	No	Yes	No

Note:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance .

12. SAR Test Result

Note:

1. Per KDB 447498 D01, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01, for each exposure position, if the highest output channel reported SAR ≤0.8W/kg, other channels SAR testing is not necessary.
3. Per KDB 447498 D01, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

2.4GHz SAR Results for Test Records

INPAQ Antenna

Band	Mode	Configure	Test Position	Dist. (mm)	Freq. (MHZ)	Ant	max Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle Scaling Factor	SAR1g (W/kg)	Scaled SAR1g (W/kg)	Power Drift (dB)	Fig
WLAN 2.4Ghz	802.11b	TB	Edge 1	0	2412	Main	20.45	20.5	1.012	1.01	0.573	0.585	0.13	--
		TB	Edge 1	0	2437	Main	20.40	20.5	1.023	1.01	0.764	0.790	0.04	--
		TB	Edge 1	0	2462	Main	20.17	20.5	1.079	1.01	0.879	0.958	0.10	1
		TB	Rear	0	2412	Main	20.45	20.5	1.012	1.01	0.050	0.051	-0.12	--
		TB	Edge2	0	2412	Main	20.45	20.5	1.012	1.01	0.332	0.339	0.07	--
		NB	Bystander	20	2412	Main	20.45	20.5	1.012	1.01	0.153	0.156	0.12	--
WLAN 2.4Ghz	802.11b	TB	Edge 1	0	2412	Aux	20.35	20.5	1.035	1.01	0.961	0.995	-0.12	--
		TB	Edge 1	0	2437	Aux	20.31	20.5	1.045	1.01	0.887	0.927	0.07	--
		TB	Edge 1	0	2462	Aux	20.42	20.5	1.019	1.01	1.13	1.151	0.18	--
		TB	Rear	0	2462	Aux	20.42	20.5	1.019	1.01	0.175	0.178	0.12	--
		TB	Edge4	0	2462	Aux	20.42	20.5	1.019	1.01	0.219	0.223	-0.12	--
		NB	Bystander	20	2462	Aux	20.42	20.5	1.019	1.01	0.068	0.069	0.07	--
2.4Ghz	GFSK	TB	Edge 1	0	2402	Main	3.25	6	1.884	1.3	0.016	0.030	0.06	--
		TB	Edge 1	0	2441	Main	3.45	6	1.799	1.3	0.023	0.041	0.03	3
		TB	Edge 1	0	2480	Main	3.42	6	1.811	1.3	0.02	0.036	0.17	--
Repeated														
WLAN 2.4Ghz	802.11b	TB	Edge 1	0	2462	Main	20.17	20.5	1.079	1.01	0.873	0.951	-0.12	
WLAN 2.4Ghz	802.11b	TB	Edge 1	0	2462	Aux	20.42	20.5	1.019	1.01	1.14	1.161	-0.10	2

2.4GHz SAR Results for South Star Antenna- Worst case

Band	Mode	Configure	Test Position	Dist. (mm)	Freq. (MHZ)	Ant	max Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle Scaling Factor	SAR1g (W/kg)	Scaled SAR1g (W/kg)	Power Drift (dB)	Fig
WLAN 2.4Ghz	802.11b	TB	Edge 1	0	2462	Main	20.17	20.5	1.079	1.01	0.704	0.760	0.18	--
WLAN 2.4Ghz	802.11b	TB	Edge 1	0	2462	Aux	20.42	20.5	1.019	1.01	1.12	1.141	0.04	--
2.4Ghz	GFSK	TB	Edge 1	0	2441	Main	3.45	6	1.799	1.3	0.02	0.036	-0.05	--

Remark: 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.

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. So 2.4 GHz OFDM mode is not required.

5GHz SAR Results for Test Records for INPAQ Antenna

U-NII-2A Test configuration

Band	Mode	Configure	Test Position	Dist. (mm)	Freq. (MHZ)	Ant	max Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle Scaling Factor	SAR1g (W/kg)	Scaled SAR1g (W/kg)	Power Drift (dB)	Fig
U-NII-2A	802.11a	TB	Edge 1	0	5260	Main	14.76	15.5	1.186	1.053	0.876	1.093	-0.08	--
		TB	Edge 1	0	5280	Main	15.57	16	1.104	1.053	0.982	1.141	-0.16	--
		TB	Edge 1	0	5320	Main	15.50	16	1.122	1.053	1.02	1.205	-0.15	4
		TB	Rear	0	5280	Main	15.57	16	1.104	1.053	0.041	0.048	-0.16	--
		TB	Edge2	0	5280	Main	15.57	16	1.104	1.053	0.503	0.585	-0.09	--
		NB	Bystander	20	5280	Main	15.57	16	1.104	1.053	0.123	0.143	0.08	--
U-NII-2A	802.11a	TB	Edge 1	0	5260	Aux	14.22	15.5	1.343	1.053	0.668	0.944	0.06	--
		TB	Edge 1	0	5280	Aux	15.30	16	1.175	1.053	0.801	0.991	0.09	--
		TB	Edge 1	0	5320	Aux	15.43	16	1.140	1.053	0.912	1.095	0.03	--
		TB	Rear	0	5320	Aux	15.43	16	1.140	1.053	0.041	0.049	-0.03	--
		TB	Edge4	0	5320	Aux	15.43	16	1.140	1.053	0.181	0.217	-0.10	--
		NB	Bystander	20	5320	Aux	15.43	16	1.140	1.053	0.079	0.944	0.15	--
Repeated														
U-NII-2A	802.11a	TB	Edge 1	0	5320	Main	15.50	16	1.122	1.053	0.978	1.155	-0.05	--
U-NII-2A	802.11a	TB	Edge 1	0	5320	Aux	15.43	16	1.140	1.053	1.05	1.197	0.06	5

U-NII-2C Test configuration

Band	Mode	Configure	Test Position	Dist. (mm)	Freq. (MHZ)	Ant	max Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle Scaling Factor	SAR1g (W/kg)	Scaled SAR1g (W/kg)	Power Drift (dB)	Fig
U-NII-2C	802.11a	TB	Edge 1	0	5500	Main	14.75	15	1.059	1.053	0.754	0.841	0.12	--
		TB	Edge 1	0	5580	Main	15.38	15.5	1.028	1.053	1.07	1.158	0.05	6
		TB	Edge 1	0	5720	Main	15.41	15.5	1.021	1.053	0.694	0.746	0.19	--
		TB	Rear	0	5720	Main	15.41	15.5	1.021	1.053	0.036	0.039	-0.19	--
		TB	Edge 2	0	5500	Main	14.75	15	1.059	1.053	0.541	0.603	0.14	--
		TB	Edge 2	0	5580	Main	15.38	15.5	1.028	1.053	0.845	0.914	0.18	--
		TB	Edge2	0	5720	Main	15.41	15.5	1.021	1.053	0.742	0.797	-0.15	--
		NB	Bystander	20	5720	Main	15.41	15.5	1.021	1.053	0.159	0.171	-0.04	--
U-NII-2C	802.11a	TB	Edge 1	0	5500	Aux	14.62	15	1.091	1.053	0.807	0.881	0.03	--
		TB	Edge 1	0	5580	Aux	15.33	15.5	1.040	1.053	1.09	1.134	-0.01	7
		TB	Edge 1	0	5720	Aux	15.39	15.5	1.026	1.053	0.782	0.802	0.14	--
		TB	Rear	0	5720	Aux	15.39	15.5	1.026	1.053	0.019	0.019	0.18	--
		TB	Edge4	0	5720	Aux	15.39	15.5	1.026	1.053	0.124	0.127	-0.15	--
		NB	Bystander	20	5720	Aux	15.39	15.5	1.026	1.053	0.133	0.136	-0.04	--
Repeated														
U-NII-2C	802.11a	TB	Edge 1	0	5580	Main	15.38	15.5	1.028	1.053	0.915	0.941	0.12	--
U-NII-2C	802.11a	TB	Edge 1	0	5580	Aux	15.33	15.5	1.040	1.053	1.01	1.106	0.19	--

U-NII-3 Test configuration

Band	Mode	Configure	Test Position	Dist. (mm)	Freq. (MHZ)	Ant	max Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle Scaling Factor	SAR1g (W/kg)	Scaled SAR1g (W/kg)	Power Drift (dB)	Fig
U-NII-3	802.11a	TB	Edge 1	0	5745	Main	16.20	16.5	1.072	1.053	0.652	0.699	0.19	--
		TB	Edge 1	0	5785	Main	15.18	16.5	1.355	1.053	0.639	0.866	-0.12	--
		TB	Edge 1	0	5825	Main	15.11	16.5	1.377	1.053	0.689	0.949	0.10	--
		TB	Rear	0	5745	Main	16.20	16.5	1.072	1.053	0.039	0.042	0.18	--
		TB	Edge2	0	5745	Main	16.20	16.5	1.072	1.053	0.916	0.982	0.10	8
		TB	Edge2	0	5785	Main	15.18	16.5	1.355	1.053	0.693	0.939	-0.12	--
		TB	Edge2	0	5825	Main	15.11	16.5	1.377	1.053	0.637	0.877	0.03	--
		NB	Bystander	20	5745	Main	16.20	16.5	1.072	1.053	0.16	0.171	0.09	--
U-NII-3	802.11a	TB	Edge 1	0	5745	Aux	16.01	16.5	1.119	1.053	0.863	1.017	0.10	--
		TB	Edge 1	0	5785	Aux	15.32	16.5	1.312	1.053	0.752	1.039	0.18	--
		TB	Edge 1	0	5825	Aux	15.28	16.5	1.324	1.053	0.678	0.945	-0.12	--
		TB	Rear	0	5745	Aux	16.01	16.5	1.119	1.053	0.019	0.022	0.03	--
		TB	Edge4	0	5745	Aux	16.01	16.5	1.119	1.053	0.151	0.178	0.18	--
		NB	Bystander	20	5745	Aux	16.01	16.5	1.119	1.053	0.136	0.160	0.10	--
U-NII-3	802.11a	TB	Edge2	0	5745	Main	16.20	16.5	1.072	1.053	0.848	0.956	-0.12	--
U-NII-3	802.11a	TB	Edge 1	0	5745	Aux	16.01	16.5	1.119	1.053	0.948	1.117	0.10	9

5GHz SAR Results for Test Records for South Star Antenna

Band	Mode	Configure	Test Position	Dist. (mm)	Freq. (MHZ)	Ant	max Power (dBm)	Tune-Up Limit (dBm)	Scaling Factor	Duty Cycle Scaling Factor	SAR1g (W/kg)	Scaled SAR1g (W/kg)	Power Drift (dB)	Fig
U-NII-2A	802.11a	TB	Edge 1	0	5320	Main	15.5	16	1.122	1.053	0.923	1.090	-0.15	--
U-NII-2C		TB	Edge 1	0	5580	Main	15.38	16	1.153	1.053	0.861	1.045	0.06	--
U-NII-3		TB	Edge2	0	5745	Main	16.2	16.5	1.072	1.053	0.796	0.898	0.01	--
U-NII-2A	802.11a	TB	Edge 1	0	5320	Aux	15.43	16	1.140	1.053	0.896	1.075	0.07	--
U-NII-2C		TB	Edge 1	0	5580	Aux	15.33	16	1.167	1.053	0.857	1.053	0.03	--
U-NII-3		TB	Edge 1	0	5745	Aux	16.01	16.5	1.119	1.053	0.916	1.079	0.06	--

Remark: For devices that operate in both U-NII-1 and U-NII-2A 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, each band is 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, each band is tested independently for SAR.

3) The highest reported SAR for main/aux antenna is adjusted by the ratio of U-NII-1 to U-NII-2A specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg . So U-NII-1 mode is not required.

13. 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; steps2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, 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 ≥ 1.45W/kg (~ 10% from the 1-g SAR limit).

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

Table 13.1: SAR Measurement Variability for Body Value (1g)

Frequency		Test	Original SAR	First Repeated	The Ratio	second repeated
MHz	Ch.	Position	(W/kg)	SAR (W/kg)		(1g)(W/kg)
2462	11	Edge 1	0.879	0.873	1.007	--
2462	11	Edge 1	1.13	1.14	1.009	--
5320	64	Edge 1	1.02	0.978	1.043	--
5320	64	Edge 1	0.912	1.05	1.151	--
5580	116	Edge 1	1.07	0.915	1.169	--
5580	116	Edge 1	1.09	1.01	1.079	--
5745	149	Edge 2	0.916	0.848	1.080	--
5745	149	Edge 1	0.863	0.948	1.098	--

Note: According to the KDB 865664 D01repeated measurement is not required when the original highest measured SAR is < 0.8 W/kg.

14. Evaluation of Simultaneous

	Position	Applicable Combination
Simultaneous Transmission	Body	WLAN 5GHz+ Bluetooth

The EUT only one TX antenna, So simultaneous transmission SAR evaluation is not required。

Note:

1. The EUT supports the Main antenna with TX/RX diversity function for WLAN and Bluetooth, the Auxiliary antenna with TX/RX diversity function for WLAN.
2. WLAN 2.4GHz and Bluetooth will not be transmitting at same time.
3. WLAN 2.4GHz and WLAN 5GHz will not be transmitting at same time.
4. The reported SAR summation is calculated based on the same configuration and test position.
5. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   1) Scalar SAR summation < 1.6W/kg.
   2) SPLSR = (SAR1 + SAR2)1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan
   If SPLSR ≤ 0.04, simultaneously transmission SAR is compliant
   3) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg

SUM ∑SAR1g Chain0 Bluetooth + Chain1 WLAN 5GHz				
Position	Distance	Standalone SAR(1g) [W/kg]		SUM SAR(1g)[W/kg]
	[mm]	Aux Antenna WLAN 5G	Main Antenna Bluetooth	Aux ant 5G+ Main ant BT
Edge 1	0	1.197	0.041	1.238

15. Measurement Uncertainty

Measurement uncertainty for 30 MHz to 3 GHz averaged over 1 gram						
Uncertainty Component	Uncertainty	Prob.	Div.	$c_{i\,(1g)}$	Std. Unc. (1-g)	v_i or Veff
Measurement System						
Probe Calibration (*k*=1)	6.00	Normal	1	1	6.00	∞
Probe Isotropy	0.50	Rectangular	√3	0.7	0.20	∞
Modulation Response	2.40	Rectangular	√3	1	1.39	∞
Hemispherical Isotropy	2.60	Rectangular	√3	0.7	1.05	∞
Boundary Effect	0.80	Rectangular	√3	1	0.46	∞
Linearity	0.60	Rectangular	√3	1	0.35	∞
System Detection Limit	1.00	Rectangular	√3	1	0.58	∞
Readout Electronics	0.70	Normal	1	1	0.70	∞
Response Time	0.00	Rectangular	√3	1	0.00	∞
Integration Time	2.60	Rectangular	√3	1	1.50	∞
RF Ambient Noise	3.00	Rectangular	√3	1	1.73	∞
RF Ambient Reflections	3.00	Rectangular	√3	1	1.73	∞
Probe Positioner	1.50	Rectangular	√3	1	0.87	∞
Probe Positioning	2.90	Rectangular	√3	1	1.67	∞
Max. SAR Evaluation	1.00	Rectangular	√3	1	0.58	∞
Test sample Related						
Test sample Positioning	2.9	Normal	1	1	2.9	145
Device Holder Uncertainty	3.6	Normal	1	1	3.6	5
Dipole						
Power drift	5	Rectangular	√3	1	2.89	∞
Dipole Positioning	2	Normal	1	1	2.00	∞
Dipole Input Power	5	Normal	1	1	5.00	∞
Power Scaling	0	Rectangular	√3	1	0.00	∞
Phantom and Tissue Parameters						
Phantom Uncertainty	6.1	Rectangular	√3	1	3.52	∞
SAR correction	1.9	Rectangular	√3	1	1.10	∞
Liquid Conductivity (target)	5	Rectangular	√3	0.64	1.85	∞
Liquid Conductivity (meas)	2.5	Rectangular	√3	0.78	1.13	∞
Liquid Permittivity (target)	5	Rectangular	√3	0.6	1.73	∞
Liquid Permittivity (meas)	2.5	Rectangular	√3	0.26	0.38	∞
Temp. unc. - Conductivity	0.18	Rectangular	√3	0.78	0.08	∞
Temp. unc. - Permittivity	0.54	Rectangular	√3	0.23	0.07	∞
Combined Std.		RSS			11.51	387

Uncertainty						
Expanded STD Uncertainty		*k*=2			23.02%	

16. Main Test Instrument

Table 16.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	N5242A	MY51221755	Jan 6, 2017	1 year
02	Power meter	NRVD	102257	May 11, 2017	1 year
03	Power sensor	NRV-Z5	100644		
			100241		
04	Signal Generator	E4438C	MY49072044	May 11, 2017	1 Year
05	Amplifier	NTWPA-0086010F	12023024	No Calibration Requested	
06	Coupler	778D	MY4825551	May 11, 2017	1 year
07	BTS	E5515C	MY50266468	Jan 6, 2017	1 year
08	E-field Probe	EX3DV4	3798	July 26, 2017	1 year
09	DAE	SPEAG DAE4	1245	July 20, 2017	1 year
10	Dipole	SPEAG D2450V2	858	Oct 30.2015	3 year
11	Dipole	SPEAG D5GHzV2	1121	March 24,2017	1 year

ANNEX A. GRAPH RESULTS

IEEE802.11b Body Edge 1 CH11 Chain0

Date/Time: 2017/11/24
Electronics: DAE4 Sn1245
Medium parameters used: f = 2462 MHz; σ = 1.963 S/m; ε_r = 51.648; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: IEEE 802.11b ; Frequency: 2462 MHz; Duty Cycle: 1:1.01
Probe: EX3DV4 - SN3798ConvF(7.32, 7.32, 7.32); Calibrated: 7/26/2017
IEEE802.11b Body Edge 1 CH11 Chain0/Area Scan (91x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 1.78 W/kg
IEEE802.11b Body Edge 1 CH11 Chain0/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.799 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 2.34 W/kg
SAR(1 g) = 0.879 W/kg; SAR(10 g) = 0.341 W/kg
Maximum value of SAR (measured) = 1.36 W/kg

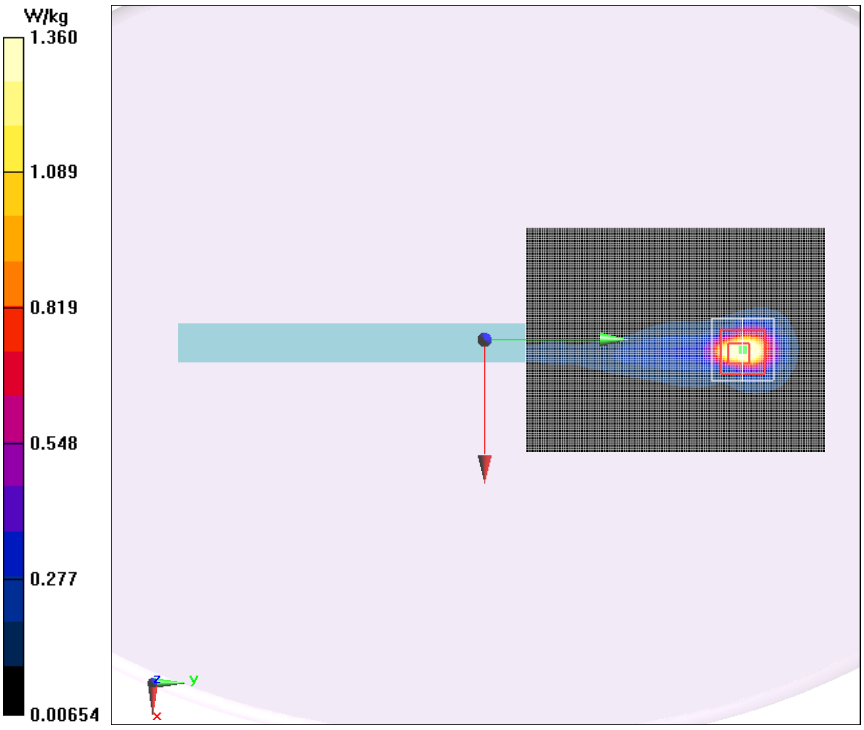


Fig.1 IEEE802.11b Body Edge 1 CH11 Chain0

IEEE802.11b Body Edge 1 CH11 Chain1 repeated

Date/Time: 2017/11/24
Electronics: DAE4 Sn1245
Medium parameters used: f = 2462 MHz; σ = 1.963 S/m; ε_r = 51.648; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: IEEE 802.11b ; Frequency: 2462 MHz; Duty Cycle: 1:1.01
Probe: EX3DV4 - SN3798ConvF(7.32, 7.32, 7.32); Calibrated: 7/26/2017

IEEE802.11b Body Edge 1 CH11 Chain1 repeated/Area Scan (91x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 2.29 W/kg

IEEE802.11b Body Edge1 CH11 Chain1 repeated/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.894 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 2.67 W/kg
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.484 W/kg
Maximum value of SAR (measured) = 1.87 W/kg

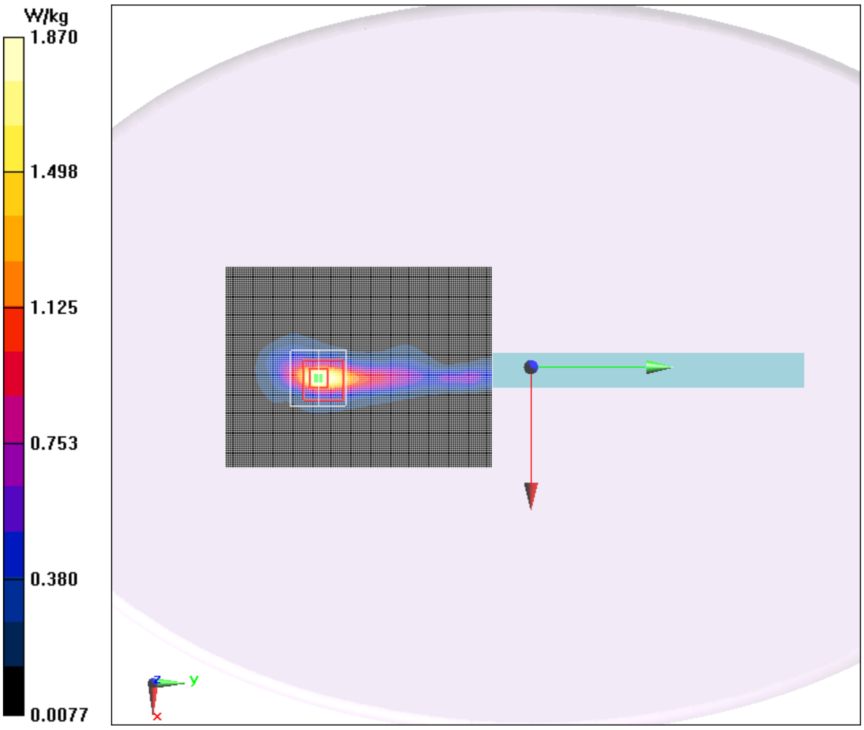


Fig.2 IEEE802.11b Body Edge 1 CH11 Chain1 repeated

BT2.1 Body Edge 1 CH39 Chain0

Date/Time: 2017/11/24
Electronics: DAE4 Sn1245
Medium parameters used: f = 2441 MHz; σ = 1.942 S/m; ε_r = 51.703; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: BT ; Frequency: 2441 MHz; Duty Cycle: 1:1.299
Probe: EX3DV4 - SN3798ConvF(7.32, 7.32, 7.32); Calibrated: 7/26/2017
BT2.1 Body Edge 1 CH39 Chain0/Area Scan (91x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.0319 W/kg
BT2.1 Body Edge 1 CH39 Chain0/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.8500 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.0550 W/kg
SAR(1 g) = 0.023 W/kg; SAR(10 g) = 0.00871 W/kg
Maximum value of SAR (measured) = 0.0429 W/kg

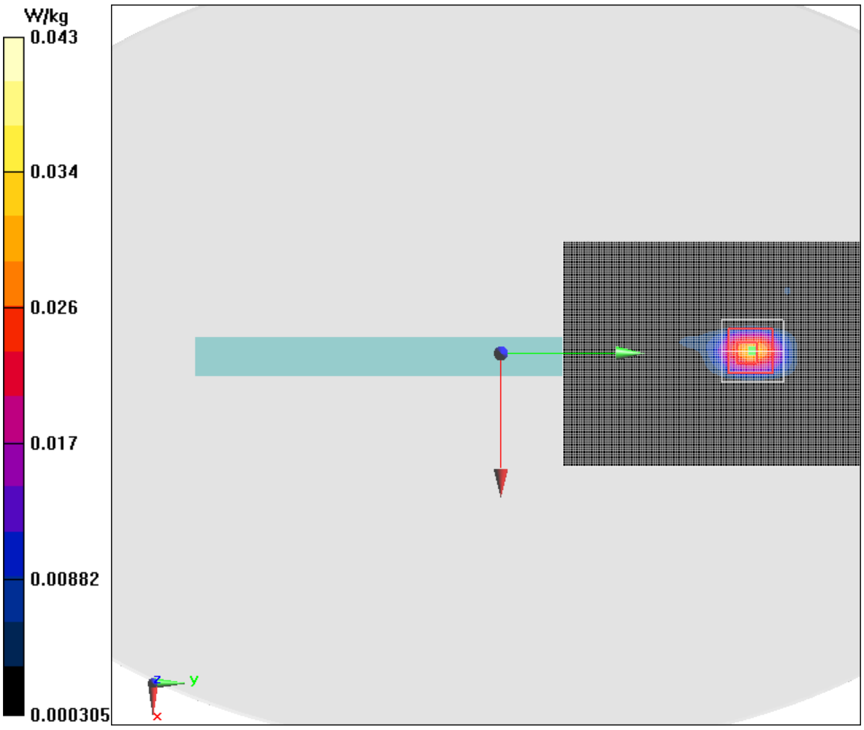


Fig.3 BT2.1 Body Edge 1 CH39 Chain0

U-NII-2A Body Edge 1 CH64 Chain0

Date/Time: 2017/11/25
Electronics: DAE4 Sn1245
Medium parameters used: f = 5320 MHz; σ = 5.454 S/m; ε_r = 48.776; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: IEEE 802.11 a ; Frequency: 5320 MHz; Duty Cycle: 1:1.053
Probe: EX3DV4 - SN3798ConvF(4.67, 4.67, 4.67); Calibrated: 7/26/2017
U-NII-2A Body Edge 1 CH64 Chain0/Area Scan (91x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 1.80 W/kg
U-NII-2A Body Edge 1 CH64 Chain0/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 3.232 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 5.33 W/kg
SAR(1 g) = 1.02 W/kg; SAR(10 g) = 0.284 W/kg
Maximum of SAR (measured) = 2.82 W/kg

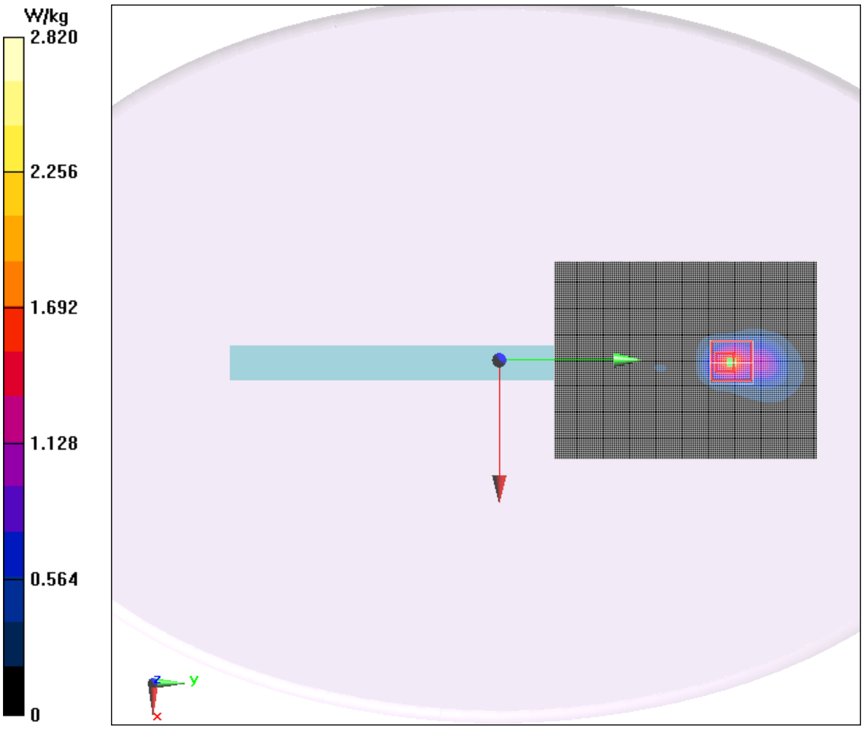


Fig.4 U-NII-2A Body Edge 1 CH64 Chain0

U-NII-2A Body Edge 1 CH64 Chain1 repeated

Date/Time: 2017/11/25
Electronics: DAE4 Sn1245
Medium parameters used: f = 5320 MHz; σ = 5.454 S/m; ε_r = 48.776; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: IEEE 802.11 a ; Frequency: 5320 MHz; Duty Cycle: 1:1.053
Probe: EX3DV4 - SN3798ConvF(4.67, 4.67, 4.67); Calibrated: 7/26/2017
U-NII-2A Body Edge 1 CH64 Chain1 repeated/Area Scan (91x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 2.99 W/kg
U-NII-2A Body Edge 1 CH64 Chain1 repeated/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.831 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 5.60 W/kg
SAR(1 g) = 1.05 W/kg; SAR(10 g) = 0.288 W/kg
Maximum of SAR (measured) = 2.89 W/kg

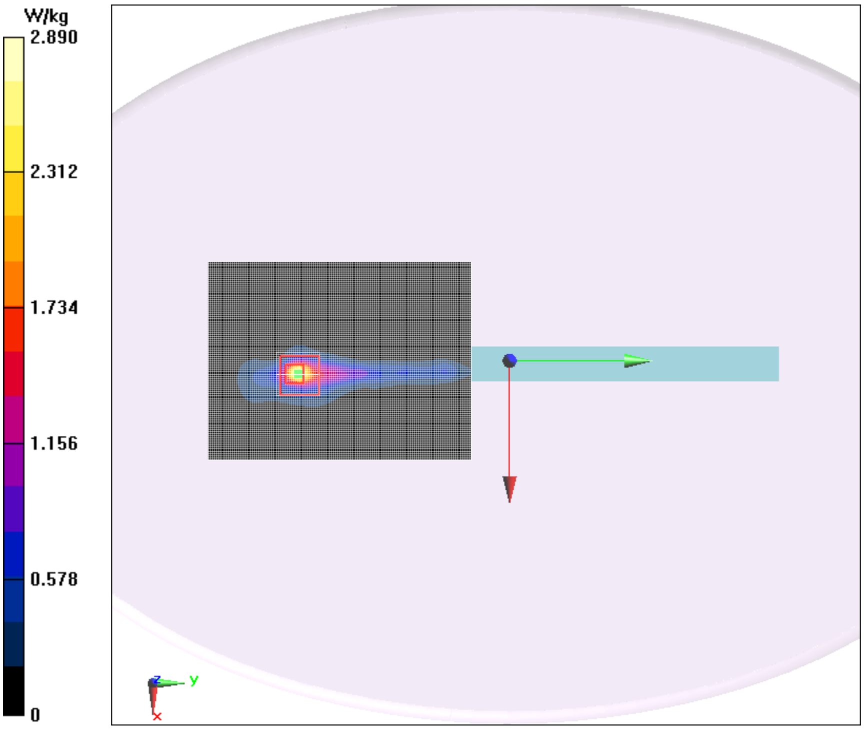


Fig.5 U-NII-2A Body Edge 1 CH64 Chain1 repeated

U-NII-2C Body Edge 1 CH116 Chain0

Date/Time: 2017/11/26
Electronics: DAE4 Sn1245
Medium parameters used: f = 5580 MHz; σ = 5.898 S/m; ε_r = 48.101; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: IEEE 802.11 a ; Frequency: 5580 MHz; Duty Cycle: 1:1.053
Probe: EX3DV4 - SN3798ConvF(4.18, 4.18, 4.18); Calibrated: 7/26/2017
U-NII-2C Body Edge 1 CH116 Chain0 /Area Scan (101x131x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 2.92 W/kg
U-NII-2C Body Edge 1 CH116 Chain0 /Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.353 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 5.63 W/kg
SAR(1 g) = 1.07 W/kg; SAR(10 g) = 0.356 W/kg
Maximum of SAR (measured) = 2.83 W/kg

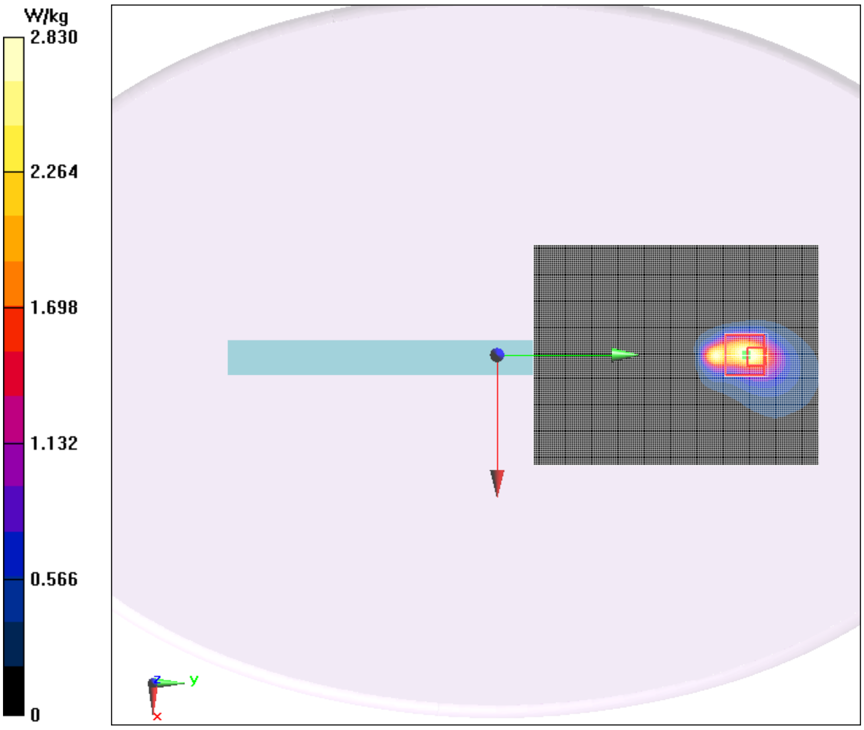


Fig.6 U-NII-2C Body Edge 1 CH116 Chain0

U-NII-2C Body Edge 1 CH116 Chain1

Date/Time: 2017/11/26
Electronics: DAE4 Sn1245
Medium parameters used: f = 5580 MHz; σ = 5.898 S/m; ε_r = 48.101; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: IEEE 802.11 a ; Frequency: 5580 MHz; Duty Cycle: 1:1.053
Probe: EX3DV4 - SN3798ConvF(4.18, 4.18, 4.18); Calibrated: 7/26/2017
U-NII-2C Body Edge 1 CH116 Chain1/Area Scan (91x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 2.19 W/kg
U-NII-2C Body Edge 1 CH116 Chain1/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 4.838 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 5.88 W/kg
SAR(1 g) = 1.09 W/kg; SAR(10 g) = 0.317 W/kg
Maximum of SAR (measured) = 2.96 W/kg

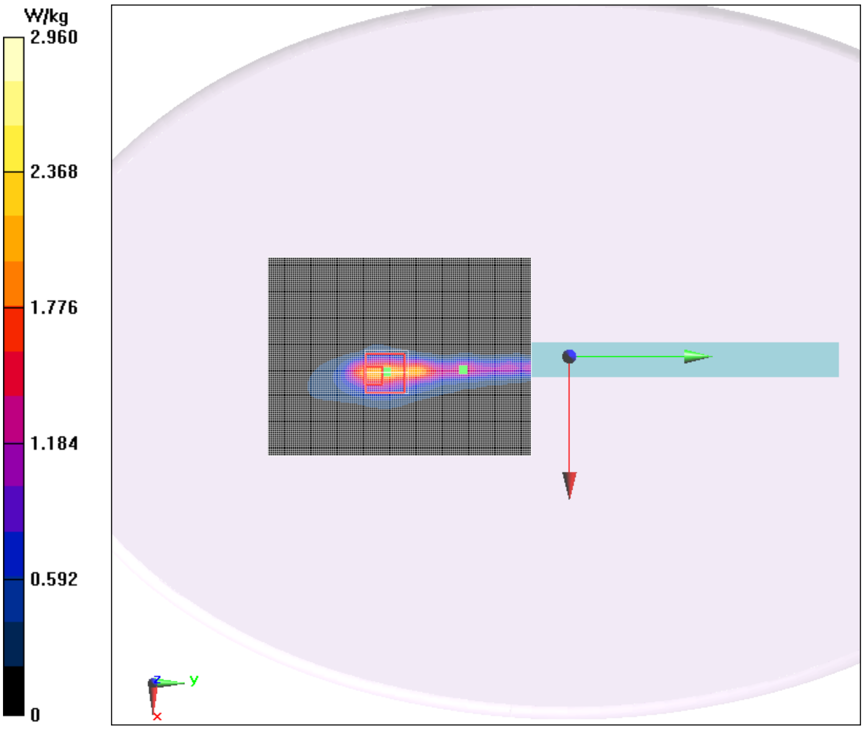


Fig.7 U-NII-2C Body Edge 1 CH116 Chain1

U-NII-3 Body Edge 2 CH149 Chain0

Date/Time: 2017/11/26
Electronics: DAE4 Sn1245
Medium parameters used: f = 5745 MHz; σ = 6.03 S/m; ε_r = 47.807; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: 5GHz U-NII-3 ; Frequency: 5745 MHz; Duty Cycle: 1:1.053
Probe: EX3DV4 - SN3798ConvF(4.45, 4.45, 4.45); Calibrated: 7/26/2017
U-NII-3 Body Edge 2 CH149 Chain0/Area Scan (91x91x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 1.94 W/kg
U-NII-3 Body Edge 2 CH149 Chain0/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 7.643 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 4.82 W/kg
SAR(1 g) = 0.916 W/kg; SAR(10 g) = 0.304 W/kg
Maximum of SAR (measured) = 2.39 W/kg

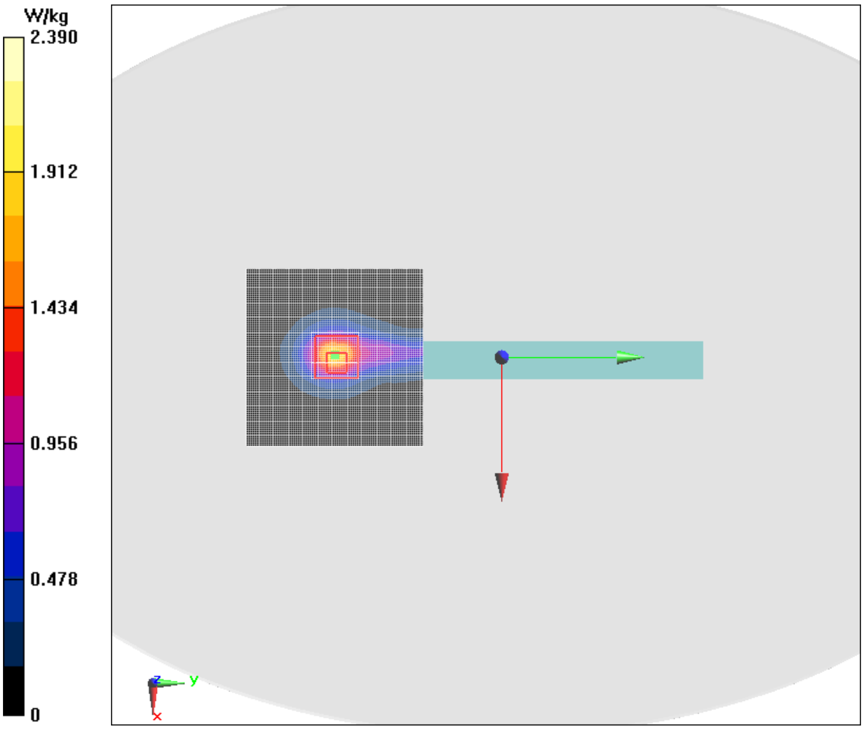


Fig.8 U-NII-2A Body Edge 2 CH149 Chain0

U-NII-3 Body Edge 1 CH149 Chain1 repeated

Date/Time: 2017/11/26
Electronics: DAE4 Sn1245
Medium parameters used: f = 5745 MHz; σ = 6.03 S/m; ε_r = 47.807; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: IEEE 802.11 a ; Frequency: 5745 MHz; Duty Cycle: 1:1.053
Probe: EX3DV4 - SN3798ConvF(4.45, 4.45, 4.45); Calibrated: 7/26/2017
U-NII-3 Body Edge 1 CH149 Chain1 repeated/Area Scan (91x121x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 1.81 W/kg
U-NII-3 Body Edge 1 CH149 Chain1 repeated/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.619 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 5.33 W/kg
SAR(1 g) = 0.948 W/kg; SAR(10 g) = 0.272 W/kg
Maximum of SAR (measured) = 2.62 W/kg

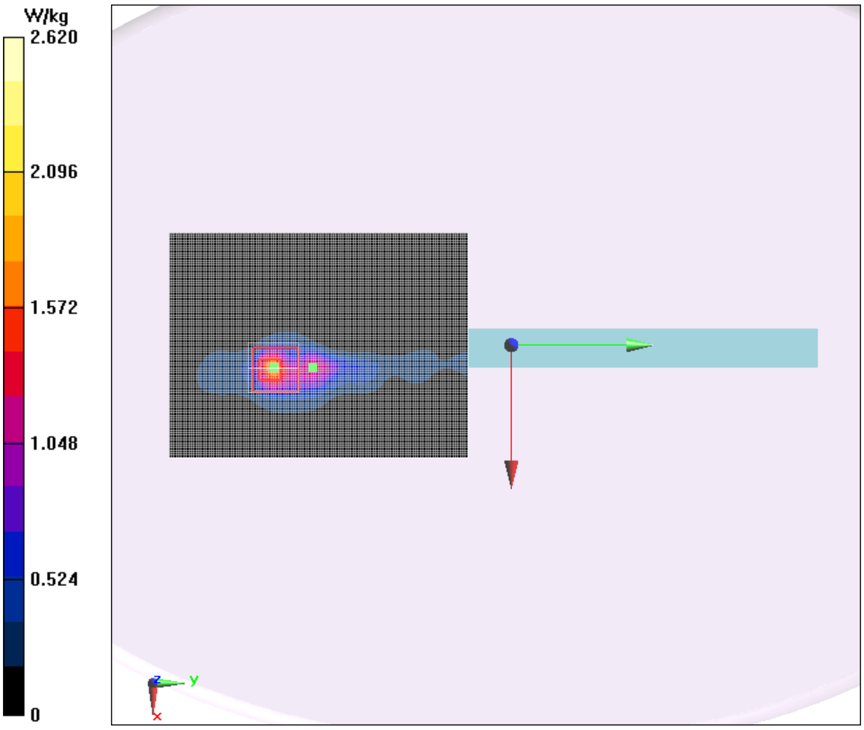
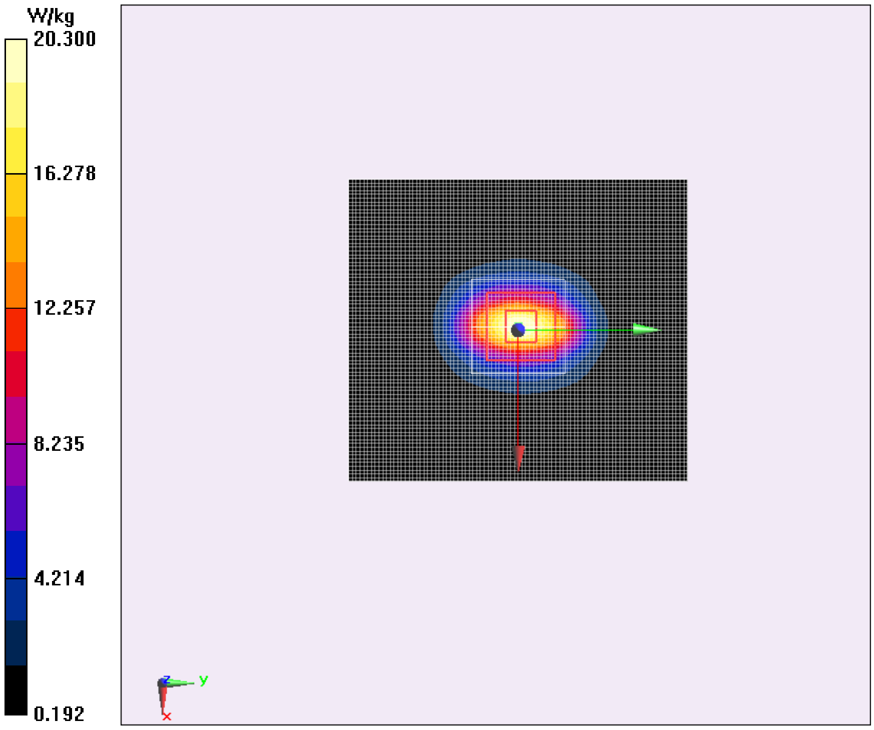


Fig.9 U-NII-3 Body Edge 1 CH149 Chain1 repeated

ANNEX B. SYSTEM VALIDATION RESULTS

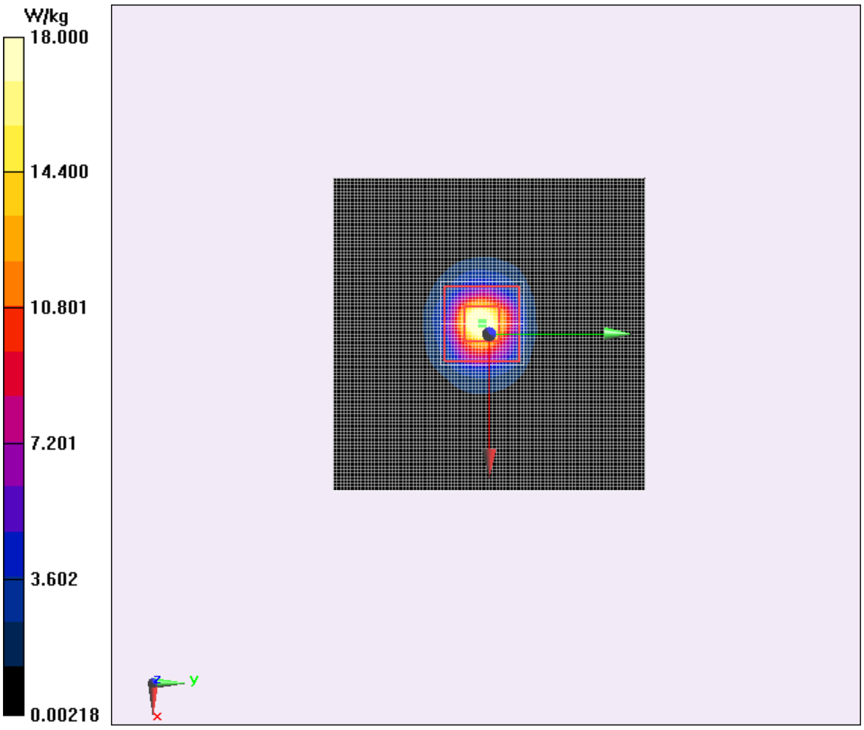
Body 2450MHz

Date/Time: 2017/11/24
Electronics: DAE4 Sn1245
Medium parameters used: f = 2450 MHz; σ = 1.951 S/m; ε_r = 51.705; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: ; Frequency: 2450 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3798ConvF(7.32, 7.32, 7.32); Calibrated: 7/26/2017
Pin=250 mW, dist=10mm (EX-Probe)/Area Scan (81x91x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 20.2 W/kg
Pin=250 mW, dist=10mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.3 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 28.45 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 5.90 W/kg
Maximum value of SAR (measured) = 20.3 W/kg



Body 5200MHz

Date/Time: 2017/11/25
Electronics: DAE4 Sn1245
Medium parameters used: f = 5200 MHz; σ = 5.339 S/m; ε_r = 49.16; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: ; Frequency: 5200 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3798ConvF(4.81, 4.81, 4.81); Calibrated: 7/26/2017
d=10mm, Pin=100mW, f=5200 MHz/Area Scan (91x91x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 20.5 W/kg
d=10mm, Pin=100mW, f=5200 MHz/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.62 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 35.5 W/kg
SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 18.0 W/kg

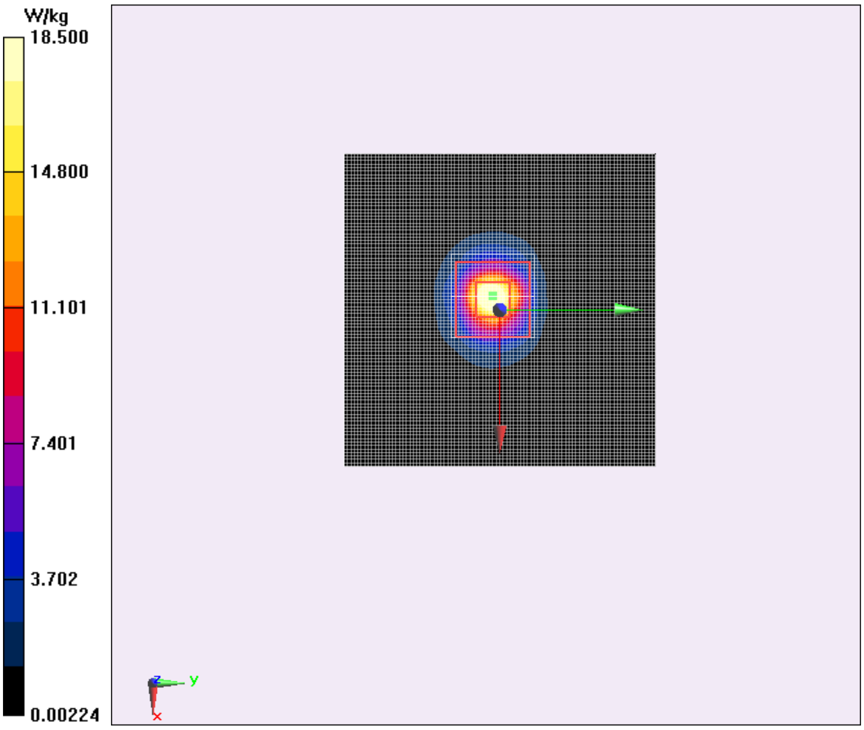


Body 5300MHz

Date/Time: 2017/11/25
Electronics: DAE4 Sn1245
Medium parameters used: f = 5300 MHz; σ = 5.475 S/m; ε_r = 48.955; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: ; Frequency: 5300 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3798ConvF(4.67, 4.67, 4.67); Calibrated: 7/26/2017

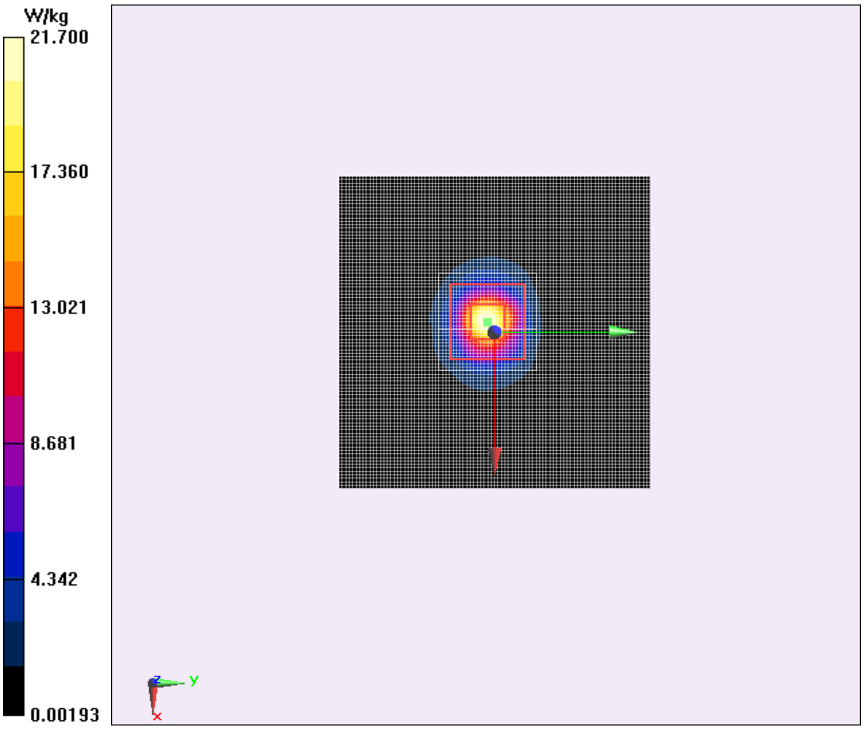
d=10mm, Pin=100mW, f=5300 MHz/Area Scan (91x91x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 21.5 W/kg

d=10mm, Pin=100mW, f=5300 MHz/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.97 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 37.9 W/kg
SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.19 W/kg
Maximum of SAR (measured) = 18.5 W/kg



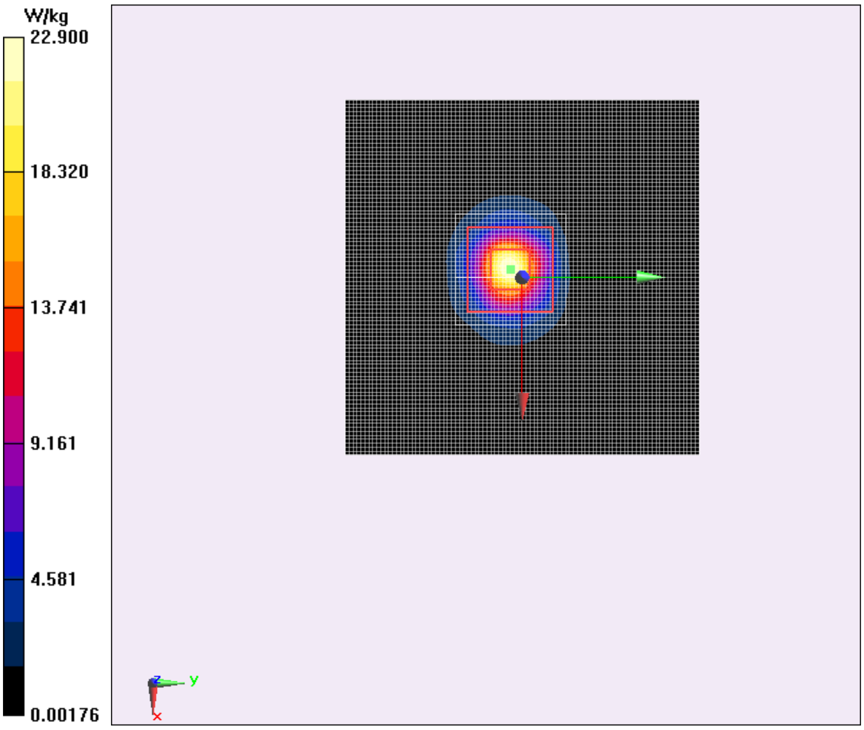
Body 5500MHz

Date/Time: 2017/11/26
Electronics: DAE4 Sn1245
Medium parameters used: f = 5500 MHz; σ = 5.71 S/m; ε_r = 48.611; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: ; Frequency: 5500 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3798ConvF(4.26, 4.26, 4.26); Calibrated: 7/26/2017
d=10mm, Pin=100mW, f=5500 MHz/Area Scan (91x91x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 22.5 W/kg
d=10mm, Pin=100mW, f=5500 MHz/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.20 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 41.0 W/kg
SAR(1 g) = 8.27 W/kg; SAR(10 g) = 2.27 W/kg
Maximum value of SAR (measured) = 21.7 W/kg



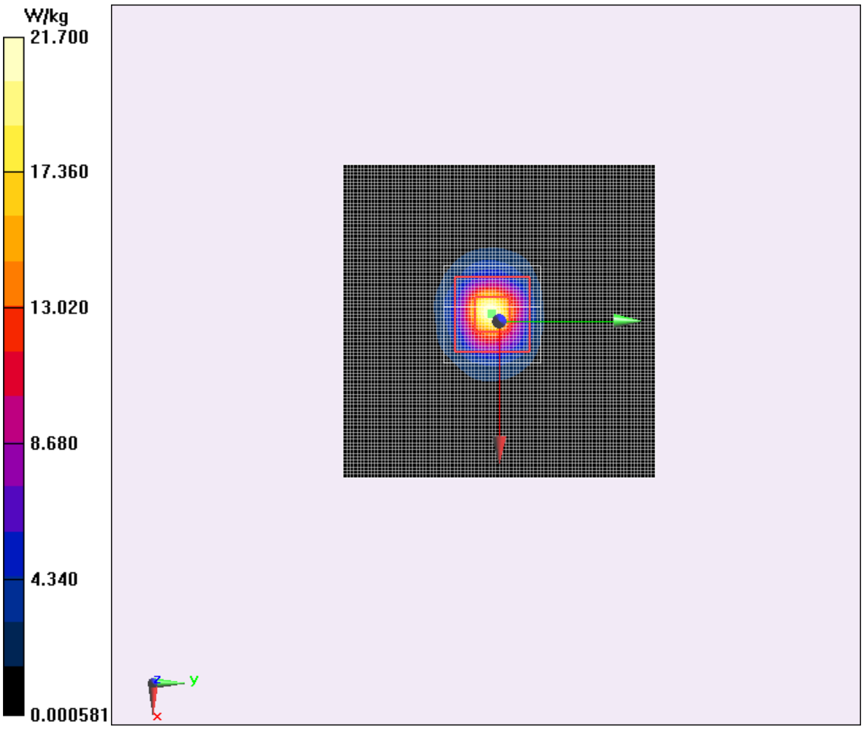
Body 5600MHz

Date/Time: 2017/11/26
Electronics: DAE4 Sn1245
Medium parameters used: f = 5600 MHz; σ = 5.898 S/m; ε_r = 48.325; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: ; Frequency: 5600 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3798ConvF(4.18, 4.18, 4.18); Calibrated: 7/26/2017
d=10mm, Pin=100mW, f=5600 MHz 2/Area Scan (91x91x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 23.2 W/kg
d=10mm, Pin=100mW, f=5600 MHz 2/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.54 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 43.5 W/kg
SAR(1 g) = 8.35 W/kg; SAR(10 g) = 2.31 W/kg
Maximum value of SAR (measured) = 22.9 W/kg



Body 5800MHz

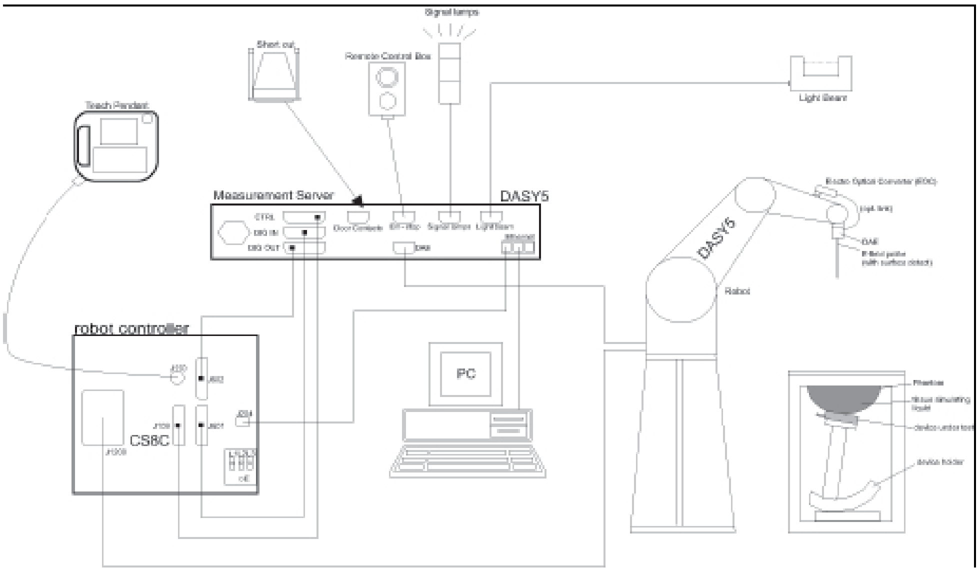
Date/Time: 2017/11/26
Electronics: DAE4 Sn1245
Medium parameters used: f = 5800 MHz; σ = 6.267 S/m; ε_r = 47.855; ρ = 1000 kg/m^3
Ambient Temperature:22°C Liquid Temperature:22°C
Communication System: ; Frequency: 5800 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3798ConvF(4.45, 4.45, 4.45); Calibrated: 7/26/2017
d=10mm, Pin=100mW, f=5800 MHz 2/Area Scan (91x91x1):
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 21.6 W/kg
d=10mm, Pin=100mW, f=5800 MHz 2/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 62.98 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 43.0 W/kg
SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 21.7 W/kg



ANNEX C. SAR Measurement Setup

C.1. Measurement Set-up

The DASY5 system for performing compliance tests is illustrated above graphically. This system consists of the following items:



Picture C.1 SAR Lab Test Measurement Set-up

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

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

C.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY5 software reads the reflection durning a software approach and looks for the maximum using 2^{nd}ord curve fitting. The approach is stopped at reaching the maximum.

Probe Specifications:

Model: **EX3DV4**

Frequency Range: **700MHz — 6GHz**

Calibration: **In head and body simulating tissue at Frequencies from 835 up to 6000MHz**

Linearity: **± 0.2 dB(700MHz — 6.0GHz)**

Dynamic Range: 10 mW/kg — 100W/kg

Probe Length: **330 mm**

Probe Tip Length: **20 mm**

Body Diameter: **12 mm**

Tip Diameter: **2.5 mm**

Tip-Center: **1 mm**

Application:SAR Dosimetry Testing

Compliance tests of mobile phones

Dosimetry in strong gradient fields

Picture C.2 Near-field Probe

Picture C.3 E-field Probe

C.3. E-field Probe Calibration

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm^2) using an RF Signal generator, TEM cell, and RF Power Meter.

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/ cm^2.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$SAR = C\frac{\Delta T}{\Delta t}$$

Where:

Δt = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

ΔT = Temperature increase due to RF exposure.

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

C.4. Other Test Equipment

C.4.1. Data Acquisition Electronics(DAE)

The data acquisition electronics consist 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 with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

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

PictureC.4: DAE

C.4.2. Robot

The SPEAG DASY system uses the high precision robots (DASY5: RX90L) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

Picture C.5 DASY 5

C.4.3. Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5: 128MB), RAM (DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O broad, which is directly connected to the PC/104 bus of the CPU broad.

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.

Picture C.6 Server for DASY 5

C.4.4. Device Holder for Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

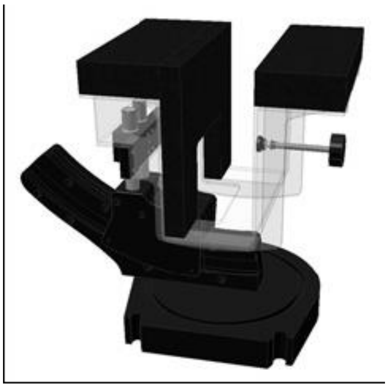
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference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

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε =3 and loss tangent δ =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.

<Laptop Extension Kit>

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

Picture C.7: Device Holder



Picture C.8: Laptop Extension Kit

C.4.5. Phantom

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 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 supported by software version DASY5.5 and higher and is compatible with all SPEAG dosimetric probes and dipoles

Shell Thickness: 2 ± 0. 2 mm

Filling Volume: Approx. 25 liters

Dimensions: 600 x 400 x 500 mm (H x L x W)

Available: Special

Picture C.9: ELI4 Phantom

ANNEX D. Position of the wireless device in relation to the phantom

D.1. Tablet mode considerations

This EUT was tested in four different positions. They are rear side of tablet, Edge 1, Edge 2, Edge 4.In these positions, the surface of EUT is touching with phantom 0cm.

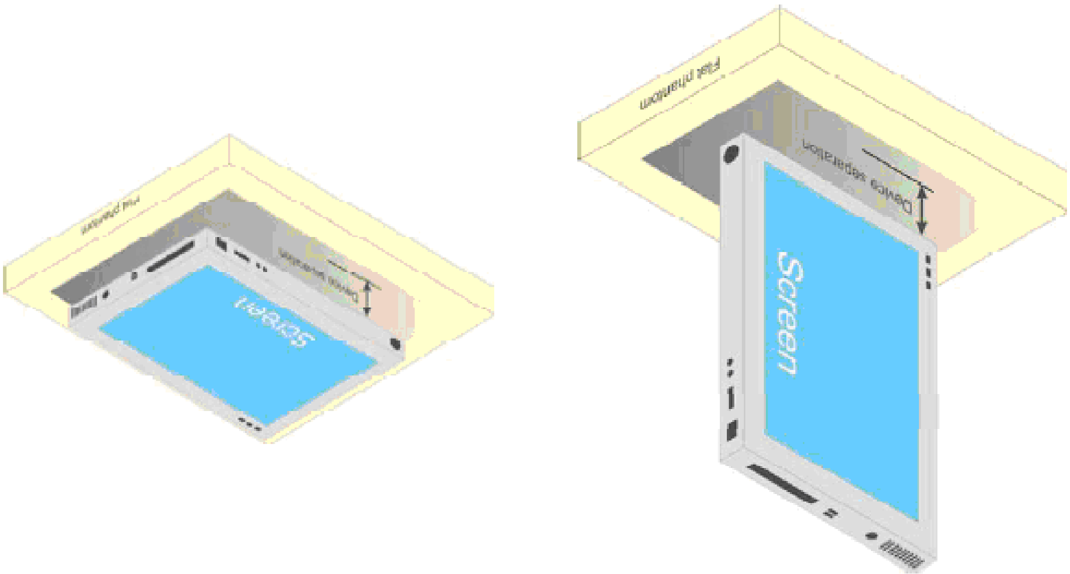
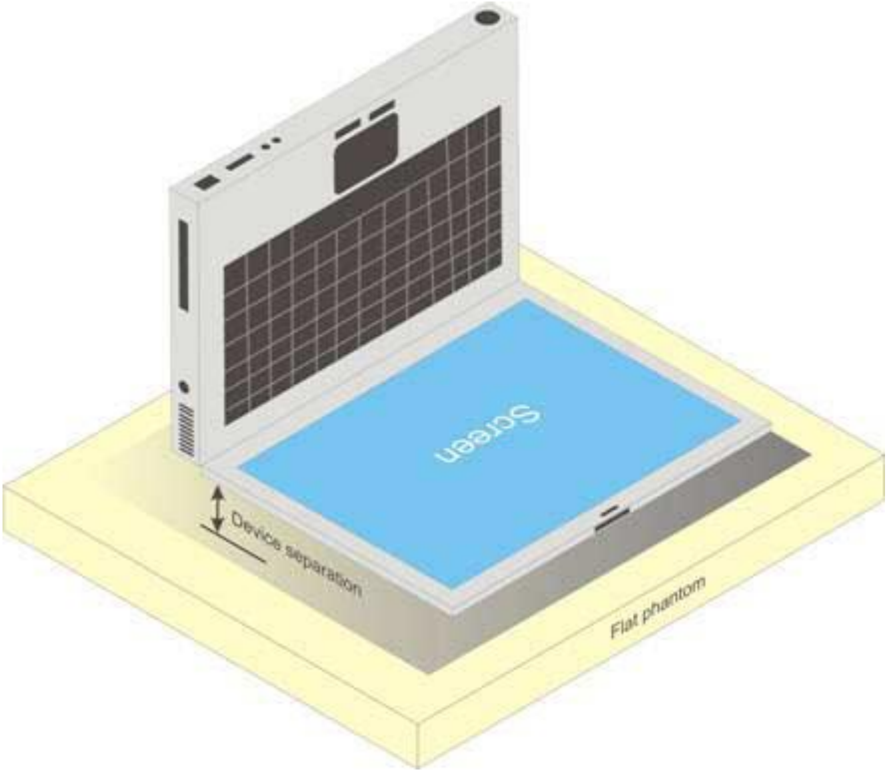


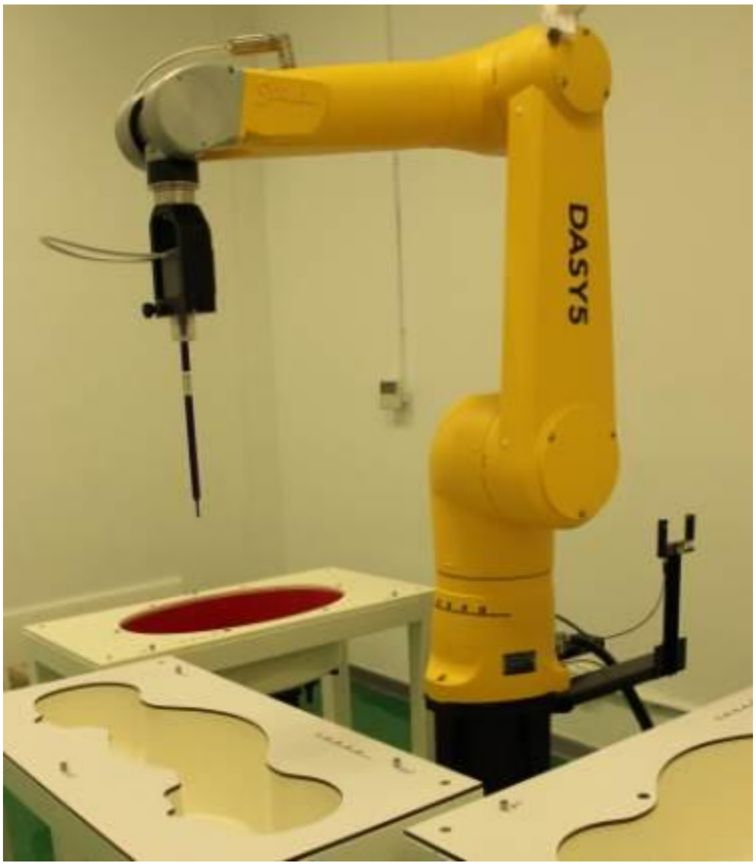
Fig Illustration for Lap-touching Position

D.2. Notebook bystanders mode considerations

The integrated antenna(s) are located in the back side of the display screen, the back side shall be facing towards the flat phantom at a distance is 20 mm.



D.4. DUT Setup Photos



Picture D.6 DASY5 system Set-up

Note:

The photos of test sample and test positions show in additional document.

ANNEX E. Equivalent Media Recipes

The liquid used for the frequency range of 800-3000 MHz consisted of water, sugar, salt, preventol, glycol monobutyl and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table E.1 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

Table E.1: Composition of the Tissue Equivalent Matter

Frequency (MHz)	835 Head	835 Body	1900 Head	1900 Body	2450 Head	2450 Body
Ingredients (% by weight)						
Water	41.45	52.5	55.242	69.91	58.79	72.60
Sugar	56.0	45.0	\	\	\	\
Salt	1.45	1.4	0.306	0.13	0.06	0.18
Preventol	0.1	0.1	\	\	\	\
Cellulose	1.0	1.0	\	\	\	\
Glycol Monobutyl	\	\	44.452	29.96	41.15	27.22
Dielectric Parameters Target Value	ε=41.5 σ=0.90	ε=55.2 σ=0.97	ε=40.0 σ=1.40	ε=53.3 σ=1.52	ε=39.2 σ=1.80	ε=52.7 σ=1.95

Table E.2: Simulating Liquids for 5 GHz, Manufactured by SPEAG

Ingredients	**(% by weight)**
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

ANNEX F. System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must bevalidated with the SAR system(s) that operates with such components.

Table F.1: System Validation Part 1

System No.	Probe SN.	Liquid name	Validation date	Frequency point	**Permittivity ε**	**Conductivity σ (S/m)**
1	3798	Body 2450MHz	2017-11-24	2402MHz	51.767	1.885
2	3798	Body 2450MHz	2017-11-24	2441 MHz	51.703	1.942
3	3798	Body 2450MHz	2017-11-24	2480 MHz	51.595	1.976
4	3798	Body 2450MHz	2017-11-24	2412 MHz	51.725	1.902
5	3798	Body 2450MHz	2017-11-24	2437 MHz	51.704	1.937
6	3798	Body 2450MHz	2017-11-24	2462 MHz	51.648	1.963
7	3798	Body 5000MHz	2017-11-25	5260 MHz	48.783	5.509
8	3798	Body 5000MHz	2017-11-25	5280 MHz	48.921	5.526
9	3798	Body 5000MHz	2017-11-25	5320 MHz	48.776	5.454
10	3798	Body 5000MHz	2017-11-26	5500 MHz	48.611	5.71
11	3798	Body 5000MHz	2017-11-26	5580 MHz	48.101	5.989
12	3798	Body 5000MHz	2017-11-26	5720 MHz	48.175	6.033
13	3798	Body 5000MHz	2017-11-26	5745 MHz	47.807	6.03
14	3798	Body 5000MHz	2017-11-26	5785 MHz	47.647	6.236
15	3798	Body 5000MHz	2017-11-26	5825 MHz	47.97	6.214

Table F.2: System Validation Part 2

CW Validation	Sensitivity	PASS	PASS
	Probe linearity	PASS	PASS
	Probe Isotropy	PASS	PASS
Mod Validation	MOD.type	GMSK	GMSK
	MOD.type	OFDM	OFDM
	Duty factor	PASS	PASS
	PAR	PASS	PASS

ANNEX G. Probe and DAE Calibration Certificate

ANNEX H. Accreditation Certificate

ilac-MRA A2LA

Accredited Laboratory

A2LA has accredited

EAST CHINA INSTITUTE OF TELECOMMUNICATIONS

Shanghai, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 15th day of March 2017.

President and CEO
For the Accreditation Council
Certificate Number 3682.01
Valid to February 28, 2019

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

**********END OF REPORT**********