SAR Test Report

Product Name	:	Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card
Model No.	:	QCNFA425
FCC ID	:	PPD-QCNFA425

Host Equipment Name	:	Notebook PC
Model No.	:	TP202N、R214N、J202N

Applicant	:	Qualcomm Atheros, Inc.
Address	:	1700 Technology Drive, San Jose, CA 95110

Date of Receipt	:	Jul. 18, 2017
Date of Test	:	Aug. 10, 2017 ~ Aug. 16, 2017
Issued Date	:	Nov. 13, 2017
Report No.	:	1772100R-HP-US-P03V01
Report Version	:	V2.6

Test Report Certification

Issued Date: Nov. 13, 2017
Report No: 1772100R-HP-US-P03V01

Product Name	:	Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card
Applicant	:	Qualcomm Atheros, Inc.
Address	:	1700 Technology Drive, San Jose, CA 95110
Model No.	:	QCNFA425
EUT Voltage	:	DC 12V,2A
Brand Name	:	Qualcomm Atheros
Applicable Standard	:	FCC KDB Publication 248227 D01v02r02 FCC KDB Publication 447498 D01v06 FCC KDB Publication 865664 D01v01r04 FCC KDB Publication KDB 616217 D04v01r02 IEEE Std. 1528-2013 FCC 47CFR §2.1093 ANSI C95.1-2005
Test Result	:	Max. SAR Measurement (1g) 2.4G Wi-Fi: **0.703** W/kg 5 G Wi-Fi:**0.866** W/kg 5 G Wi-Fi+BT：**0.969** W/kg
Performed Location	:	DEKRA Testing and Certification (Suzhou) Co., Ltd. No.99 Hongye Rd., Suzhou Industrial Park, Suzhou, 215006, Jiangsu, China TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098 FCC Designation Number: CN1199

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(Senior Engineer: Frank He)

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History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
1772100R-HP-US-P03V01	V1.0	Initial Issued Report	Aug. 31, 2017
1772100R-HP-US-P03V01	V2.0	Modified Manufacturer's name & address	Sep. 04, 2017
1772100R-HP-US-P03V01	V2.1	Modified some information on Page 1,2,6	Sep. 14, 2017
1772100R-HP-US-P03V01	V2.2	1. Added average power and use average power for SAR calculation. 2. Modified the test position describution. 3. Add simultaneous transmission.	Sep. 27, 2017
1772100R-HP-US-P03V01	V2.3	1. Delete 2.4GHz WIFI and BT simultaneous transmission. 2. Modified the MAX SAR value on page 2.	Sep. 29, 2017
1772100R-HP-US-P03V01	V2.4	Modified SAR Test Exclusions	Oct.18,2017
1772100R-HP-US-P03V01	V2.5	Modified SAR Test Exclusions on page 36,37,38	Oct.20,2017
1772100R-HP-US-P03V01	V2.6	Update DAE Report Add Bluetooth Power Modified some describe	Nov.13,2017

1. General Information

1.1. EUT Description

Product Name	Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card
Brand Name	Qualcomm Atheros
Model No.	QCNFA425
Host Equipment Name	Notebook PC
Model No	TP202N、R214N、J202N
Working Voltage	12Vdc, 2A
Frequency Range	**For 2.4GHz Band** 802.11b/g/n/ac(20MHz): 2412~2472MHz 802.11n/ac(40MHz): 2422~2462MHz **For 5GHz Band** 802.11a/n/ac(20MHz): 5180~5320MHz, 5500~5580MHz, 5660~5720MHz, 5745~5825MHz 802.11n/ac(40MHz): 5190~5310MHz, 5510~5710MHz, 5755~5795MHz 802.11ac(80MHz):5210MHz,5290MHz,5530MHz,5610MHz ,5690MHz ,5775MHz
Channel Number	**For 2.4GHz Band** 802.11b/g/n(20MHz): 13 802.11n(40MHz): 9 **For 5GHz Band** 802.11a/n/ac(20MHz): 25 802.11n/ac(40MHz): 18 802.11ac(80MHz): 6
Type of Modulation	802.11b: DSSS
	802.11a/b/g/n/ac: OFDM
Data Rate	802.11b: 1/2/5.5/11 Mbps
	802.11a: 6/9/12/18/24/36/48/54 Mbps
	802.11n: up to 150 Mbps
	802.11ac: up to 433.3 Mbps
Antenna Type	Reference to Antenna List
Peak Antenna Gain	Reference to Antenna List
Power Adapter	MFR: PI, M/N: AD2055320 Input: AC100-240V, 50-60Hz, 0.6A Output: DC 12V, 2.0A

Note1: The host equipment is both a notebook and tablet.

2: All models have been evaluated and the worst model(TP202N) was used for testing.

802.11a/ac/b/g/n Antenna List

Antenna	Manufacturer	Model No.	Used in Host Type	Peak Gain
PIFA Antenna	INPAQ	WA-P-LB-02-477	TP202N、R214N、J202N	Notebook: 2.71dBi for 2.40~2.50GHz band Tablet: 2.17dBi for 2.40~2.50GHz band
				Notebook: 1.64dBi for 5.15G~5.85GHz band Tablet: 2.07dBi for 5.15G~5.85GHz band

For 2.4GHz Band

802.11b/g/n/ac(20MHz) Working Frequency of Each Channel:							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
01	2412 MHz	02	2417 MHz	03	2422 MHz	04	2427 MHz
05	2432 MHz	06	2437 MHz	07	2442 MHz	08	2447 MHz
09	2452 MHz	10	2457 MHz	11	2462 MHz	12	2467 MHz
13	2472 MHz	N/A	N/A	N/A	N/A	N/A	N/A
802.11n/ac(40MHz) Working Frequency of Each Channel:							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
03	2422 MHz	04	2427 MHz	05	2432 MHz	06	2437 MHz
07	2442 MHz	08	2447 MHz	09	2452 MHz	10	2457 MHz
11	2462 MHz	N/A	N/A	N/A	N/A	N/A	N/A

For 5.0GHz Band

802.11a/n/ac(20MHz) Working Frequency of Each Channel:							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz	48	5240 MHz
52	5260 MHz	56	5280 MHz	60	5300 MHz	64	5320 MHz
100	5500 MHz	104	5520 MHz	108	5540 MHz	112	5560 MHz
116	5580 MHz	120	5600 MHz	124	5620 MHz	128	5640 MHz
132	5660 MHz	136	5680 MHz	140	5700 MHz	144	5720 MHz
149	5745 MHz	153	5765 MHz	157	5785 MHz	161	5805 MHz
165	5825 MHz	N/A	N/A	N/A	N/A	N/A	N/A
802.11n/ac(40MHz) Working Frequency of Each Channel:							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	54	5270 MHz	62	5310 MHz
102	5510 MHz	110	5550 MHz	118	5590 MHz	126	5630 MHz
134	5670 MHz	142	5710 MHz	N/A	N/A	N/A	N/A
802.11ac(80MHz) Working Frequency of Each Channel:							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210 MHz	58	5290 MHz	106	5530MHz	122	5610 MHz
138	5690 MHz	155	5775MHz	N/A	N/A	N/A	N/A

1.2. Test Environment

Ambient conditions in the laboratory:

Items	Required	Actual
Temperature (°C)	18-25	21.5± 2
Humidity (%RH)	30-70	52

1.3. Power Reduction for SAR

RF Power in this host configuration is maintained at fixed levels reduced from the original modular filing. No sensor based or switched power reduction is implemented in this host configuration.

1.4. Guidance Documents

1) FCC KDB Publication 447498 D01v06 (General SAR Guidance)
2) FCC KDB Publication 865664 D01v01r04(SAR measurement 100 MHz to 6 GHz)
3) FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
4) FCC KDB Publication 616217 D04 v01r02(SAR Evaluation Considerations for

Laptop,Notebook,Netbook and Tablet Computers)

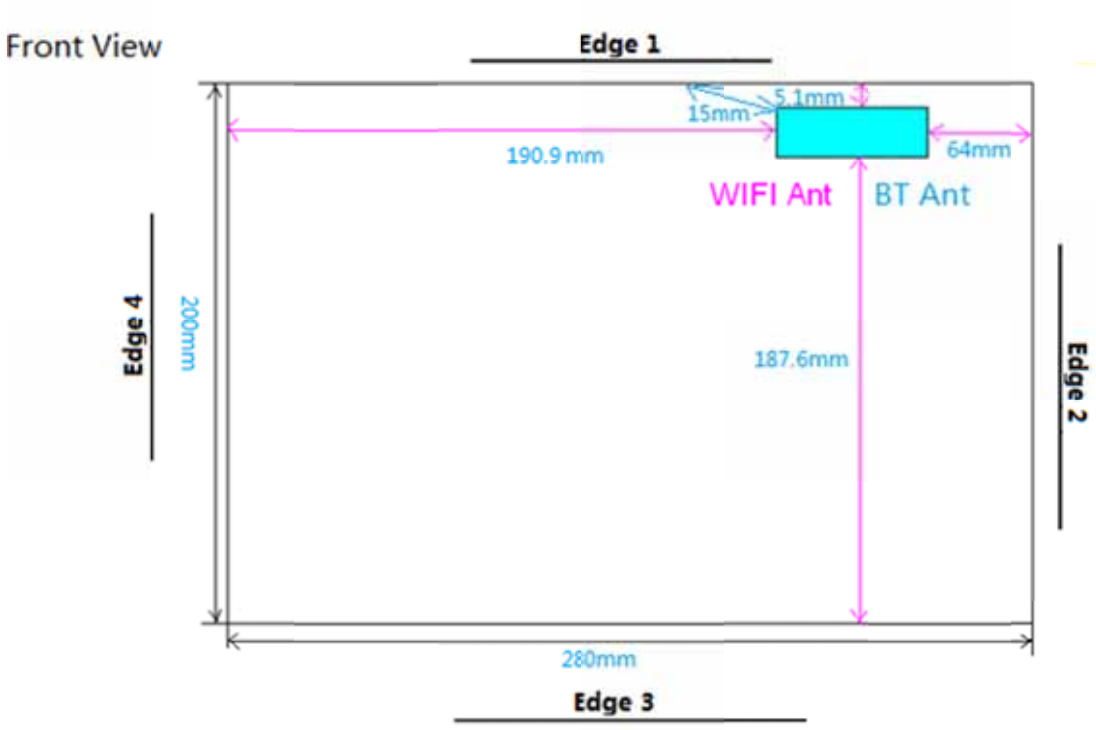
5) IEEE Std. 1528-2013 (IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques)

6) IEC 62209-2: 2010 (Human exposure to radio frequency fields from hand- held and bodymounted wireless communication devices — Human models, instrumentation, and procedures)

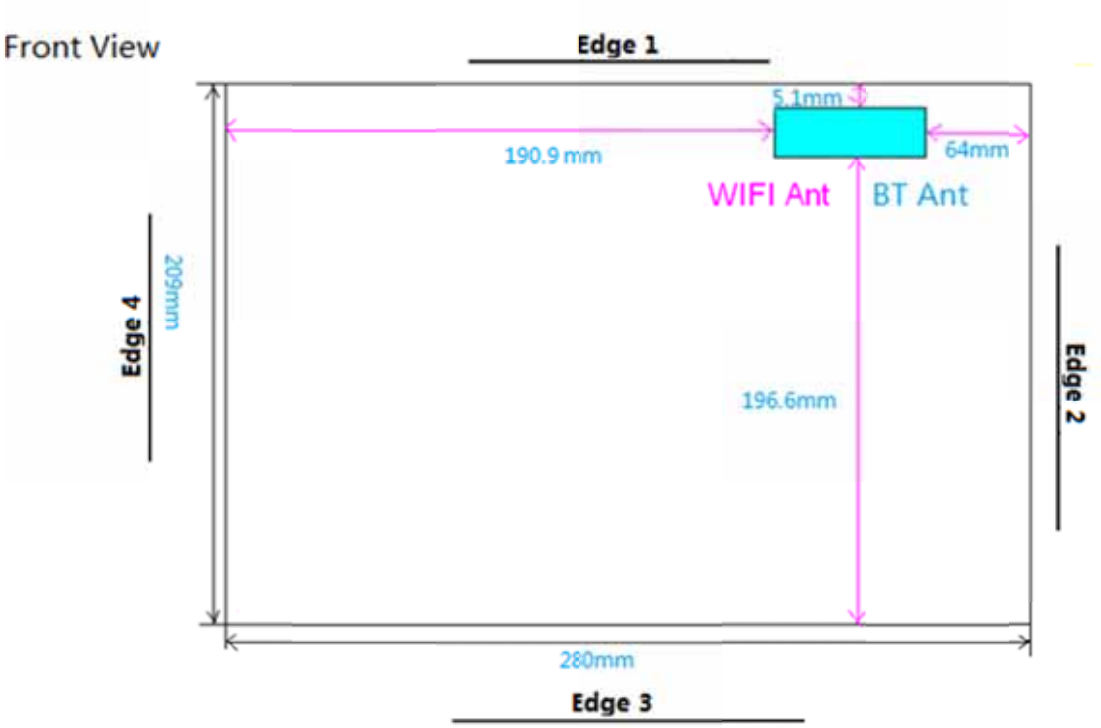
7) FCC 47CFR §2.1093 Radiofrequency radiation exposure evaluation: portable devices

8) ANSI C95.1-2005 - IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

Tablet



Notebook


Front View
Edge 1
5.1mm
190.9 mm
64mm
WIFI Ant
BT Ant
Edge 4
209mm
196.6mm
Edge 2
280mm
Edge 3

1.5. Simultaneous Transmission Configurations

According to FCC KDB Publication 447498 D01v06,transmitter are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneously transmission analysis according to FCC KDB Publication 447498 D01v06 procedures.

Table 1-1

Simultaneous Transmission Scenarios

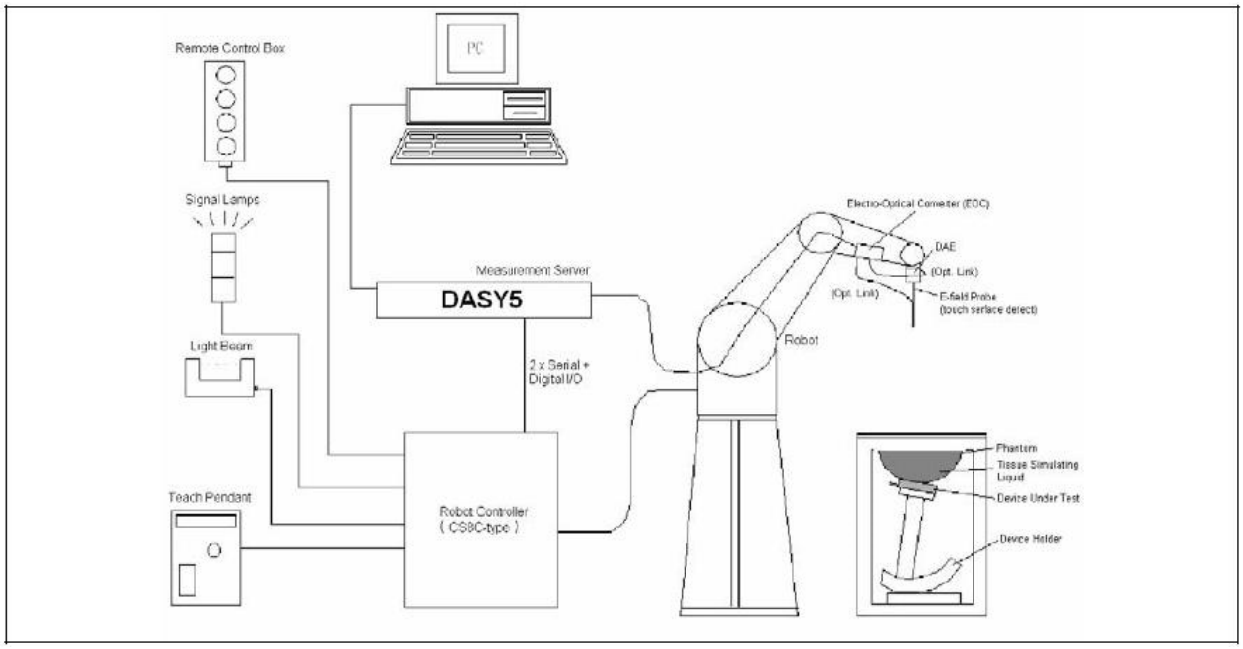
Ref.	Simultaneous Transmit Configurations	Head	Body-Worn
		IEEE1528	FCC KDB447498 D01V06
1	5GHz Wi-Fi + BT	No	Yes

Note1: The 2.4G WLAN and 5G WLAN cannot transmit simultaneously.

2: The 2.4G WLAN and BT cannot transmit simultaneously.

2. SAR Measurement System

2.1. 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 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 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.

2.1.1. Applications

Predefined procedures and evaluations for automated compliance testing with all worldwide standards, e.g., IEEE 1528, OET 65, IEC 62209-1, IEC 62209-2, EN 50360, EN 50383 and others.

2.1.2. Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a 10mm^2 step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE 1528-2013, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan).

2.1.3. Zoom Scan (Cube Scan Averaging)

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. A density of 1000 kg/m^3 is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1 g cube is 10mm, with the side length of the 10 g cube 21,5mm.

The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications utilize a physical step of 7x7x7 (5mmx5mmx5mm) providing a volume of 30mm in the X & Y axis, and 30mm in the Z axis.

2.1.4. Uncertainty of Inter-/Extrapolation and Averaging

In order to evaluate the uncertainty of the interpolation, extrapolation and averaged SAR calculation algorithms of the Postprocessor, DASY5 allows the generation of measurement grids which are artificially predefined by analytically based test functions. Therefore, the grids of area scans and zoom scans can be filled with uncertainty test data, according to the SAR benchmark functions of IEEE 1528.The three analytical functions shown in equations as below are used to describe the possible range of the expected SAR distributions for the tested handsets. The field gradients are covered by the spatially flat distribution f1, the spatially steep distribution f3 and f2 accounts for H-field cancellation on the phantom/tissue surface.

$$f_1(x,y,z) = Ae^{-\frac{z}{2a}}\cos^2\left(\frac{\pi}{2}\frac{\sqrt{x'^2+y'^2}}{5a}\right)$$

$$f_2(x,y,z) = Ae^{-\frac{z}{a}}\frac{a^2}{a^2+x'^2}\left(3-e^{-\frac{2z}{a}}\right)\cos^2\left(\frac{\pi}{2}\frac{y'}{3a}\right)$$

$$f_3(x,y,z) = A\frac{a^2}{\frac{a^2}{4}+x'^2+y'^2}\left(e^{-\frac{2z}{a}}+\frac{a^2}{2(a+2z)^2}\right)$$

2.2. DASY5 E-Field Probe

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

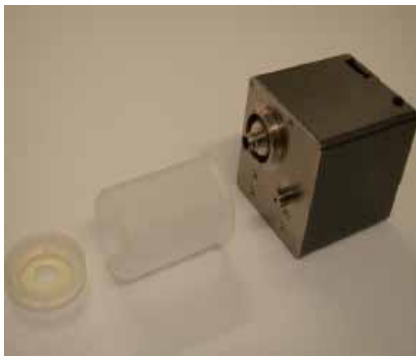
SPEAG conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528, EN 62209-1, IEC 62209, etc.) under ISO 17025. The calibration data are in Appendix D.

2.2.1. Isotropic E-Field Probe Specification

Model	EX3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	

2.3. Boundary Detection Unit and Probe Mounting Device

The DASY probes use a precise connector and an additional holder for the probe, consisting of a plastic tube and a flexible silicon ring to center the probe. The connector at the DAE is flexibly mounted and held in the default position with magnets and springs. Two switching systems in the connector mount detect frontal and lateral probe collisions and trigger the necessary software response.



2.4. DATA Acquisition Electronics (DAE) and Measurement Server

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit.
Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.
The input impedance of the DAE4 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.

The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV Celeron, 128MB chipdisk and 128MB RAM. The necessary circuits for communication with the DAE electronics 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.

2.5. Robot

The DASY5 system uses the high precision robots TX90 XL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY5 system, the CS8C robot controller version from Stäubli is used.
The XL robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller

2.6. Light Beam Unit

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. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

2.7. Device Holder

The DASY5 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 center for both scales is the ear reference point (EPR).
Thus the device needs no repositioning when changing the angles.
The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity εr =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.

2.8. 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 head
- Right head
- 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 tip, three reference markers are provided to identify the phantom position with respect to the robot.

3. Tissue Simulating Liquid

3.1. The composition of the tissue simulating liquid

INGREDIENT (% Weight)	2450MHz Body	5250MHz Body	5600MHz Body	5750MHz Body
Water	73.2	75.68	75.68	75.68
Salt	0.04	0.43	0.43	0.43
Sugar	0.00	0.00	0.00	0.00
HEC	0.00	0.00	0.00	0.00
Preventol	0.00	0.00	0.00	0.00
DGBE	26.7	4.42	4.42	4.42
Triton X-100	0.00	19.47	19.47	19.47

3.2. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using DASY5 Dielectric Probe Kit and Agilent Vector Network Analyzer E5071C

For FCC:

Body Tissue Simulant Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ε r	σ [s/m]	
2450MHz	Reference result ± 5% window	52.7 50.07 to 55.34	1.95 1.85 to 2.05	N/A
	08-12-2017	52.25	1.95	21.0
2412MHz	Reference result ± 5% window	52.81 50.07 to 55.34	1.90 1.85 to 2.05	N/A
	08-12-2017	52.35	1.91	21.0
2437MHz	Reference result ± 5% window	52.75 50.07 to 55.34	1.94 1.85 to 2.05	N/A
	08-12-2017	52.29	1.94	21.0
5250MHz	Reference result ± 5% window	49.0 46.55 to 51.45	5.36 5.09 to 5.63	N/A
	08-12-2017	49.2	5.41	21.0
5180MHz	Reference result ± 5% window	49.17 46.55 to 51.45	5.24 5.09 to 5.63	N/A
	08-12-2017	49.38	5.29	21.0
5200MHz	Reference result ± 5% window	49.12 46.55 to 51.45	5.27 5.09 to 5.63	N/A
	08-12-2017	49.33	5.32	21.0
5300MHz	Reference result ± 5% window	49.11 46.55 to 51.45	5.42 5.09 to 5.63	N/A
	08-12-2017	49.06	5.47	21.0
5580MHz	Reference result ± 5% window	48.56 46.10 to 50.90	5.75 5.48 to 6.06	N/A
	08-12-2017	48.2	5.85	21.0
5600MHz	Reference result ± 5% window	48.5 46.10 to 50.90	5.77 5.48 to 6.06	N/A
	08-12-2017	48.15	5.87	21.0
5750MHz	Reference result ± 5% window	48.3 45.86 to 50.69	5.94 5.65 to 6.24	N/A
	08-12-2017	47.84	6.09	21.0

5785MHz	Reference result ± 5% window	48.18 45.86 to 50.69	5.99 5.65 to 6.24	N/A
	08-12-2017	47.72	6.14	21.0

3.3. Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

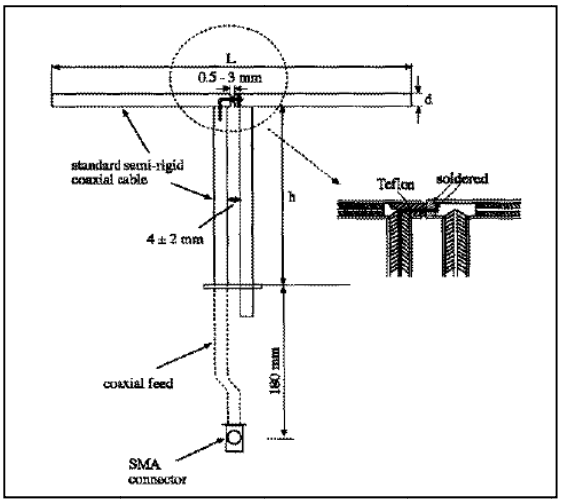
Target Frequency	Head		Body	
(MHz)	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	**52.7**	**1.95**
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	**48.2**	**6.00**

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

4. SAR Measurement Procedure

4.1. SAR System Validation

4.1.1. Validation Dipoles



The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE and FCC Supplement C. the table below provides details for the mechanical and electrical specifications for the dipoles.

Frequency	L (mm)	h (mm)	d (mm)
2450MHz	53.5	30.4	3.6
5250MHz	20.6	14.2	3.6
5600MHz	20.6	14.2	3.6
5750MHz	20.6	14.2	3.6

4.1.2. Validation Result

System Performance Check at 2450MHz, 5250MHz, 5600 MHz and 5750MHz for Body				
Validation Dipole: D2450V2, SN: 839				
2450 MHz	Reference result ± 10% window	49.8 44.82 to 54.78	23.3 20.97 to 25.63	N/A
	08-12-2017	50.0	22.8	21.0
Validation Dipole: D5GHzV2, SN: 1203				
5250 MHz	Reference result ± 10% window	73.7 66.33 to 81.07	20.8 18.72 to 22.88	N/A
	08-12-2017	76.8	21.9	21.0
Validation Dipole: D5GHzV2, SN: 1203				
5600 MHz	Reference result ± 10% window	78.8 70.92 to 86.68	22.3 20.07 to 24.53	N/A
	08-12-2017	79.4	23.8	21.0
Validation Dipole: D5GHzV2, SN: 1203				

5750 MHz	Reference result ± 10% window	75.2 67.68 to 82.72	21.1 18.99 to 23.21	N/A
	08-12-2017	76.3	21.7	21.0
Note: All SAR values are normalized to 1W forward power.				

4.2. SAR Measurement Procedure

The DASY 5 calculates SAR using the following equation,

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

σ: represents the simulated tissue conductivity

ρ: represents the tissue density

The EUT is set to transmit at the required power in line with product specification, at each frequency relating to the LOW, MID, and HIGH channel settings.

Pre-scans are made on the device to establish the location for the transmitting antenna, using a large area scan in either air or tissue simulation fluid.

The EUT is placed against the Universal Phantom where the maximum area scan dimensions are larger than the physical size of the resonating antenna. When the scan size is not large enough to cover the peak SAR distribution, it is modified by either extending the area scan size in both the X and Y directions, or the device is shifted within the predefined area.

The area scan is then run to establish the peak SAR location (interpolated resolution set at $1mm^2$) which is then used to orient the center of the zoom scan. The zoom scan is then executed and the 1g and 10g averages are derived from the zoom scan volume (interpolated resolution set at $1mm^3$).

4.3. SAR Measurement Conditions for 802.11 Device

4.3.1. Duty Factor Control

Unless it is permitted by specific KDB procedures or continuous transmission is specifically restricted by the device, the reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

4.3.2. Initial Test Position SAR Test Reduction Procedure

DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.16 The initial test position procedure is described in the following:

When the reported SAR of the initial test position is ≤ 0.4 W/kg, further SAR measurement is not required for the other (remaining) test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band. SAR is also not required for that exposure configuration in the subsequent test configuration(s).

a) When the reported SAR of the initial test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest extrapolated or estimated 1-g SAR conditions determined by area scans or next closest/smallest test separation distance and maximum RF coupling test positions based on manufacturer justification, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions (left, right, touch, tilt or subsequent surfaces and edges) are tested.

b) For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
Additional power measurements may be required for this step, which should be limited to those necessary for identifying the subsequent highest output power channels.

5. SAR Exposure Limits

SAR assessments have been made in line with the requirements of IEEE-1528, FCC Supplement C, and comply with ANSI/IEEE C95.1-1992 “Uncontrolled Environments” limits. These limits apply to a location which is deemed as “Uncontrolled Environment” which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

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

Type Exposure	Uncontrolled Environment Limit
Spatial Peak SAR (1g cube tissue for brain or body)	1.60 W/kg
Spatial Average SAR (whole body)	0.08 W/kg
Spatial Peak SAR (10g for hands, feet, ankles and wrist)	4.00 W/kg

6. Test Equipment List

Instrument	Manufacturer	Model No.	Serial No.	Cali. Due Date
Stäubli Robot TX60L	Stäubli	TX60L	F10/5C90A1/A/01	N/A
Controller	Stäubli	SP1	S-0034	N/A
Dipole Validation Kits	Speag	D2400V2	839	2018.02.09
Dipole Validation Kits	Speag	D5GHzV2	1078	2018.02.09
SAM Twin Phantom	Speag	SAM	TP-1561/1562	N/A
Device Holder	Speag	SD 000 H01 HA	N/A	N/A
Data Acquisition Electronic	Speag	DAE4	1220	2018.02.08
E-Field Probe	Speag	EX3DV4	3710	2018.02.18
SAR Software	Speag	DASY5	V5.2 Build 162	N/A
Power Amplifier	Mini-Circuit	ZVA-183-S+	N657400950	N/A
Directional Coupler	Agilent	778D	20160	N/A
Universal Radio Communication Tester	R&S	CMU 200	117088	2018.03.10
Vector Network	Agilent	E5071C	MY48367267	2018.03.10
Signal Generator	Agilent	E4438C	MY49070163	2018.03.10
Power Meter	Anritsu	ML2495A	0905006	2017.10.29
Wide Bandwidth Sensor	Anritsu	MA2411B	0846014	2017.10.29

7. Measurement Uncertainty

DASY5 Uncertainty according to IEEE std. 1528-2013 Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram / 10 gram.								
Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0%	N	1	1	1	±6.0%	±6.0%	∞
Axial Isotropy	±4.7%	R	√3	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	√3	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	√3	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	√3	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	√3	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	√3	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	√3	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	√3	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	√3	1	1	±0.6%	±0.6%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	√3	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	√3	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	√3	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	√3	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±11.0%	±10.8%	387
Expanded STD Uncertainty						±22.0%	±21.5%	

DASY5 Uncertainty according to IEEE std. 1528-2013 Measurement uncertainty for 3 GHz to 6 GHz averaged over 1 gram / 10 gram.								
Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.55%	N	1	1	1	±6.55%	±6.55%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±2.0%	R	$\sqrt{3}$	1	1	±1.2%	±1.2%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Probe Positioning	±9.9%	R	$\sqrt{3}$	1	1	±5.7%	±5.7%	∞
Max. SAR Eval.	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	$\sqrt{3}$	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	$\sqrt{3}$	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±12.8%	±12.6%	330
Expanded STD Uncertainty						±25.6%	±25.2%	

8. Conducted Power Measurement

For 2.4GHz:

Test Mode	Frequency (MHz)	Avg. Power (dBm)	Duty cycle (%)	Tune-up Power (dBm)	Scaling Factor
802.11b	2412	20.26	100	20.5	1.057
	2437	20.32	100	20.5	1.042
	2462	20.29	100	20.5	1.05
802.11g	2412	18.56	100	20.0	1.393
	2437	20.13	100	20.5	1.089
	2462	17.67	100	19.0	1.358
802.11n(20MHz)	2412	18.22	100	20.0	1.507
	2437	19.94	100	20.0	1.014
	2462	17.49	100	19.0	1.416
802.11n(40MHz)	2422	16.42	100	18.0	1.439
	2437	17.71	100	19.0	1.346
	2452	15.49	100	17.0	1.416
VHT(20MHz)	2412	18.17	100	20.0	1.524
	2437	19.91	100	20.0	1.021
	2462	17.45	100	19.0	1.429
VHT(40MHz):	2422	16.39	100	18.0	1.449
	2437	17.66	100	19.0	1.361
	2452	15.42	100	17.0	1.439

For 5GHz:

Mode 1: Transmit by 802.11a					
Channel No.	Frequency (MHz)	Avg. Power (dBm)	Duty cycle (%)	Tune-up Power (dBm)	Scaling Factor
36	5180	11.48	100	12.5	1.265
40	5200	11.57	100	12.5	1.239
44	5220	11.71	100	12.5	1.199
48	5240	11.6	100	12.5	1.230
52	5260	11.77	100	12.5	1.183
60	5300	11.94	100	12.5	1.138
64	5320	11.79	100	12.5	1.178
100	5500	13.02	100	14.5	1.406
114	5580	14.06	100	14.5	1.107
140	5700	13.03	100	14.5	1.403
149	5745	12.44	100	13.0	1.138
157	5785	12.55	100	13.0	1.109
165	5825	11.54	100	13.0	1.400
Mode 2: Transmit by 802.11n(20MHz)					
Channel No.	Frequency (MHz)	Avg. Power (dBm)	Duty cycle (%)	Tune-up Power (dBm)	Scaling Factor
36	5180	11.21	100	12.5	1.346
40	5200	11.27	100	12.5	1.327
44	5220	11.36	100	12.5	1.300
48	5240	11.15	100	12.5	1.365
52	5260	11.27	100	12.5	1.327
60	5300	11.64	100	12.5	1.219
64	5320	11.31	100	12.5	1.315
100	5500	12.72	100	14.0	1.343
114	5580	13.81	100	14.0	1.044
140	5700	12.77	100	14.0	1.327
149	5745	12.18	100	12.5	1.076
157	5785	11.26	100	12.5	1.330
165	5825	12.09	100	12.5	1.099

Mode 3: Transmit by 802.11n(40MHz)					
Channel No.	Frequency (MHz)	Avg. Power (dBm)	Duty cycle (%)	Tune-up Power (dBm)	Scaling Factor
38	5190	11.19	100	11.5	1.074
46	5230	10.36	100	11.5	1.300
54	5270	11.18	100	11.5	1.076
62	5310	10.83	100	11.5	1.167
102	5510	12.45	100	13.5	1.274
110	5550	13.3	100	13.5	1.047
132	5670	13.28	100	13.5	1.052
151	5755	12.15	100	12.5	1.084
159	5795	12.19	100	12.5	1.074
Mode 4: Transmit by 802.11ac(20MHz)					
Channel No.	Frequency (MHz)	Avg. Power (dBm)	Duty cycle (%)	Tune-up Power (dBm)	Scaling Factor
36	5180	11.20	100	12.5	1.349
40	5200	11.22	100	12.5	1.343
44	5220	11.31	100	12.5	1.315
48	5240	11.09	100	12.5	1.384
52	5260	11.26	100	12.5	1.330
60	5300	11.59	100	12.5	1.233
64	5320	11.27	100	12.5	1.327
100	5500	12.73	100	14.0	1.400
114	5580	13.80	100	14.0	1.047
140	5700	12.74	100	14.0	1.337
149	5745	12.15	100	12.5	1.084
157	5785	11.24	100	12.5	1.337
165	5825	12.02	100	12.5	1.117

Mode 5: Transmit by 802.11ac(40MHz)					
Channel No.	Frequency (MHz)	Avg. Power (dBm)	Duty cycle (%)	Tune-up Power (dBm)	Scaling Factor
38	5190	11.18	100	11.5	1.076
46	5230	10.34	100	11.5	1.306
54	5270	11.16	100	11.5	1.081
62	5310	10.79	100	11.5	1.178
102	5510	12.44	100	13.5	1.276
110	5550	13.32	100	13.5	1.042
132	5670	13.24	100	13.5	1.062
151	5755	12.11	100	12.5	1.094
159	5795	12.17	100	12.5	1.079
Mode 6: Transmit by 802.11ac(80MHz)					
Channel No.	Frequency (MHz)	Avg. Power (dBm)	Duty cycle (%)	Tune-up Power (dBm)	Scaling Factor
42	5210	11.03	100	11.5	1.114
58	5290	11.08	100	11.5	1.102
106	5530	12.39	100	12.5	1.026
155	5775	11.64	100	12.0	1.086

BT

Mode : Bluetooth					
Channel No.	Frequency (MHz)	Avg. Power (dBm)	Duty cycle (%)	Tune-up Power (dBm)	Scaling Factor
00	2402	5.91	100	7.00	1.285
39	2441	6.03	100	7.00	1.250
78	2480	5.94	100	7.00	1.276

9. Test Procedures

9.1. SAR Test Results Summary

SAR MEASUREMENT									
Ambient Temperature (°C) : 21.5 ± 2				Relative Humidity (%): 52					
Liquid Temperature (°C) : 21.0 ± 2				Depth of Liquid (cm):>15					
Product: Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card									
Frequency: 2412 ~ 2472 MHz									
Test Mode: 802.11b									
Test Position Body (0mm gap)	Antenna Position	Frequency (MHz)	Frame Power (dBm)	Power Drift (<±0.2)	SAR 1g (W/kg)	Scaling Factor	Duty factor	Scaled SAR 1g (W/kg)	Limit (W/kg)
Edge 1	Fixed	2437	20.32	-0.10	0.675	1.042	1.0	**0.703**	1.6
Back	Fixed	2437	20.32	-0.03	0.445	1.042	1.0	0.464	1.6
Edge 2	Fixed	2437	20.32	-0.08	0.137	1.042	1.0	0.143	1.6
Edge 1	Fixed	2412	20.32	-0.13	0.618	1.042	1.0	0.644	1.6

Note 1: * - repeated at the highest measured SAR according to the FCC KDB 865664

2: When the reported SAR of the initial test position is > 0.4 W/kg, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions (left, right, touch, tilt or subsequent surfaces and edges) are tested.

3: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

4: Reported SAR were scaled to the maximum duty factor to demonstrate compliance per FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02.

5: All the tests were bsed on the host(Host name: Notebook PC;Host model: TP202N、R214N、J202N).

SAR MEASUREMENT									
Ambient Temperature (°C) : 21.5 ± 2				Relative Humidity (%): 52					
Liquid Temperature (°C) : 21.0 ± 2				Depth of Liquid (cm):>15					
Product: Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card									
Frequency: 5180~5785MHz									
Test Mode:802.11a									
Test Position Body (0mm gap)	Antenna Position	Frequency (MHz)	Frame Power (dBm)	Power Drift (<±0.2)	SAR 1g (W/kg)	Scaling Factor	Duty factor	Scaled SAR 1g (W/kg)	Limit (W/kg)
Edge 1	Fixed	5200	11.57	-0.04	0.400	1.239	1.0	0.496	1.6
Back	Fixed	5200	11.57	0.10	0.143	1.239	1.0	0.177	1.6
Edge 2	Fixed	5200	11.57	0.19	0.047	1.239	1.0	0.058	1.6
Edge 1	Fixed	5180	11.48	0.11	0.362	1.265	1.0	0.458	1.6
Edge 1	Fixed	5300	11.94	0.00	0.761	1.138	1.0	**0.866**	1.6
Back	Fixed	5300	11.94	0.00	0.211	1.138	1.0	0.240	1.6
Edge 1	Fixed	5580	14.06	-0.12	0.770	1.107	1.0	0.852	1.6
Back	Fixed	5580	14.06	0.04	0.272	1.107	1.0	0.301	1.6
Edge 1	Fixed	5785	12.55	0.01	0.430	1.109	1.0	0.477	1.6

Note 1: * - repeated at the highest measured SAR according to the FCC KDB 865664

2: When the reported SAR of the initial test position is > 0.4 W/kg, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions (left, right, touch, tilt or subsequent surfaces and edges) are tested.

3: For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.

4: Reported SAR were scaled to the maximum duty factor to demonstrate compliance per FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02.

5: All the tests were bsed on the host(Host name: Notebook PC;Host model: TP202N、R214N、J202N).

9.2. Test position and configuration

1. Liquid tissue depth was at least 15.0 cm for all frequencies.
2. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
3. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
4. Reported SAR were scaled to the maximum duty factor to demonstrate compliance per FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02.
5. SAR was performed with the device configured in the positions according to KDB 447498 D01 SAR Procedures for general, body SAR was performed with the device to phantom separation distance of 0mm.
6. Because of the screen can ratating, so addition tests are performed at three positions(Edge 1, Back, Edge 2).

WLAN Notes:

When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the reported 1g averaged SAR is <0.8 W/kg, SAR testing on other default channels is not required.

9.3. SAR Test Exclusions Applied

Wi-Fi/Bluetooth

Per FCC KDB 447498 D01v06, the SAR exclusion threshold for distances<50mm is defined by the following equation:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Test\ Separation\ Dist\ (mm)} * \sqrt{Frequency(GHz)} \leq 3.0$$

Per FCC KDB 447498 D01v06, the SAR exclusion threshold for distances>50mm is defined by the following equation:

$$\frac{[\text{Power allowed at numeric threshold for 50 mm in step 1}) + (\text{Test separation distance} - 50\ \text{mm}) \cdot (\text{Frequency(MHz)}/150)]\ \text{mW}}{\text{Test Separation Dist(mm)}} * \sqrt{Frequency(GHz)}$$

The power exclusion threshold :

2.4G Bluetooth Antenna	Separation distances (mm)	Frequency	Tune-up (mW)	Calculated Threshold Value (≤3.0 SAR is not required)	Calculated Threshold Value (SAR test exclusion power,mW)	Test SAR (Y/N)
				Separation distances ≤50mm	Separation distances > 50mm	
Back	15	2480	5.012	0.526	--	N
Edge 1	5.1	2480	5.012	1.548	--	N
Edge 2	64	2480	5.012	--	235.25	N
Edge 3	187.6	2480	5.012	--	1471.25	N
Edge 4	190.9	2480	5.012	--	1504.25	N

2.4G WiFi Antenna	Separation distances (mm)	Frequency	Tune-up (mW)	Calculated Threshold Value (≤3.0 SAR is not required)	Calculated Threshold Value (SAR test exclusion power,mW)	Test SAR (Y/N)
				Separation distances ≤50mm	Separation distances > 50mm	
Back	15	2437	112.201	11.677	--	Y
Edge 1	5.1	2437	112.201	34.345	--	Y
Edge 2	64	2437	112.201	--	236.086	N
Edge 3	187.6	2437	112.201	--	1472.086	N
Edge 4	190.9	2437	112.201	--	1505.086	N

5G WiFi Antenna	Separation distances (mm)	Frequency	Tune-up（mW）	Calculated Threshold Value (≤3.0 SAR is not required)	Calculated Threshold Value (SAR test exclusion power,mW)	Test SAR (Y/N)
				Separation distances ≤50mm	Separation distances > 50mm	
Back	15	5240	28.184	4.301	--	Y
Edge 1	5.1	5240	28.184	12.650	--	Y
Edge 2	64	5240	28.184	--	205.528	N
Edge 3	187.6	5240	28.184	--	1441.528	N
Edge 4	190.9	5240	28.184	--	1474.528	N

5G WiFi Antenna	Separation distances (mm)	Frequency	Tune-up（mW）	Calculated Threshold Value (≤3.0 SAR is not required)	Calculated Threshold Value (SAR test exclusion power,mW)	Test SAR (Y/N)
				Separation distances ≤50mm	Separation distances > 50mm	
Back	15	5320	28.184	4.333	--	Y
Edge 1	5.1	5320	28.184	12.746	--	Y
Edge 2	64	5320	28.184	--	205.034	N
Edge 3	187.6	5320	28.184	--	1441.034	N
Edge 4	190.9	5320	28.184	--	1474.034	N

5G WiFi Antenna	Separation distances (mm)	Frequency	Tune-up（mW）	Calculated Threshold Value (≤3.0 SAR is not required)	Calculated Threshold Value (SAR test exclusion power,mW)	Test SAR (Y/N)
				Separation distances ≤50mm	Separation distances > 50mm	
Back	15	5700	28.184	4.486	--	Y
Edge 1	5.1	5700	28.184	13.194	--	Y
Edge 2	64	5700	28.184	--	202.827	N
Edge 3	187.6	5700	28.184	--	1438.827	N
Edge 4	190.9	5700	28.184	--	1471.827	N

5G WiFi Antenna	Separation distances (mm)	Frequency	Tune-up (mW)	Calculated Threshold Value (≤3.0 SAR is not required)	Calculated Threshold Value (SAR test exclusion power,mW)	Test SAR (Y/N)
				Separation distances ≤50mm	Separation distances > 50mm	
Back	15	5825	28.184	4.535	--	Y
Edge 1	5.1	5825	28.184	13.338	--	Y
Edge 2	64	5825	28.184	--	202.15	N
Edge 3	187.6	5825	28.184	--	1438.15	N
Edge 4	190.9	5825	28.184	--	1471.15	N

Note: The host NB's Antenna distance ＞200mm,so the NB SAR is not appliable.

Simultaneous Transmission Analysis

Estimation SAR of BT

2.4G Bluetooth Antenna	Separation distances(mm)	Tune-up（mW）	Estimation SAR(W/kg)	Test SAR(Y/N)
Back	15	5.015	0.070	N
Edge 1	5.1	5.015	0.103	N
Edge 2	64	5.015	0.008	N
Edge 3	187.6	5.015	0.003	N
Edge 4	190.9	5.015	0.003	N

Note: Based on the maximum conducted power of Bluetooth and the antenna to use separation distance,

[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)]·[$\sqrt{f_{(GHz)}}/x$] W/kg, for *test separation distances* ≤ 50 mm;

where $x = 7.5$ for 1-g SAR and $x = 18.75$ for 10-g SAR.

Simultaneous Transmission Scenario with Bluetooth

Simult Tx	Configuration	5G WLAN SAR (W/kg)	Estimation Bluetooth SAR (W/kg)	∑ SAR (W/kg)
Body	Back	0.301	0.070	0.371
	Edge 1	0.866	0.103	0.969
	Edge 2	0.058	0.008	0.066
	Edge 3	--	0.003	0.003
	Edge 4	--	0.003	0.003

Appendix A. SAR System Validation Data

Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

System Check Body 2450MHz

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2

Communication System: UID 0, CW; Communication System Band: D2450(2450MHz); Duty Cycle: 1:1;

Frequency: 2450 MHz; Medium parameters used: f = 2450 MHz; σ = 1.95 S/m; εr = 52.25; ρ = 1000 kg/m3 ;

Phantom section: Flat Section ; Input Power=250mW

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

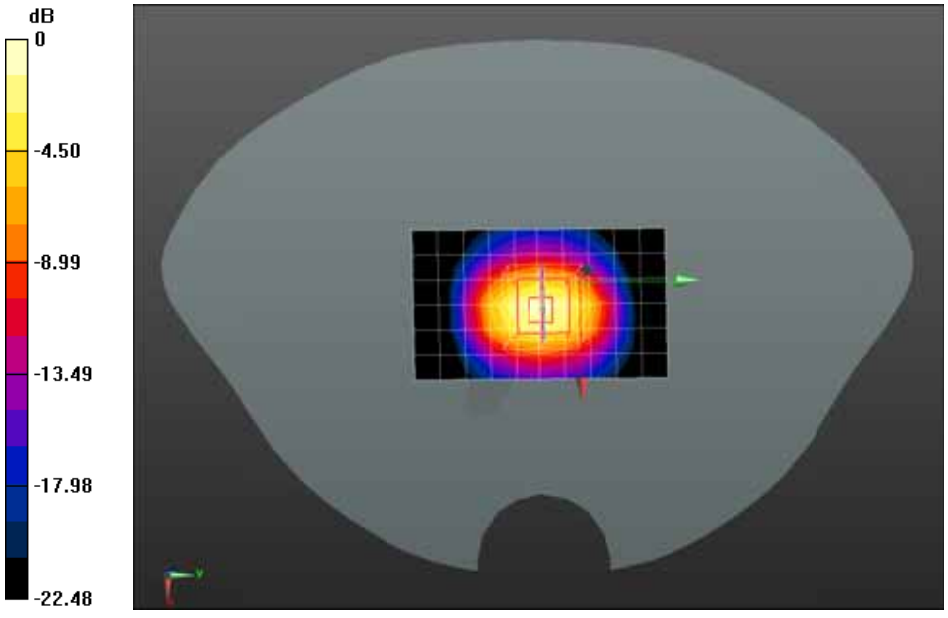
- Probe: EX3DV4 - SN3710; ConvF(7.52, 7.52, 7.52); Calibrated: 23/02/2017;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM2; Type: SAM; Serial: TP1562
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/System Check Body 2450MHz/Area Scan (7x11x1): Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 11.9 W/kg

Configuration/System Check Body 2450MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm, Reference Value = 75.15 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 24.7 W/kg

SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.7 W/kg Maximum value of SAR (measured) = 13.4 W/kg



0 dB = 13.4 W/kg = 11.27 dBW/kg

Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

System Check Body 5250MHz

DUT: Dipole D5GHzV2; Type: D5GHzV2

Communication System: UID 0, CW (0); Communication System Band: 5GHz(5000.0-6000.0MHz); Duty Cycle: 1:1; Frequency: 5250 MHz; Medium parameters used: f = 5250 MHz; σ = 5.41 S/m; εr = 49.2; ρ = 1000 kg/m3 ; Phantom section: Flat Section ; Input Power=100mW

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(4.51, 4.51, 4.51); Calibrated: 23/02/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM2; Type: SAM; Serial: TP1562
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/Body 5250MHz/Area Scan (6x6x1): Measurement grid: dx=10mm, dy=10mm

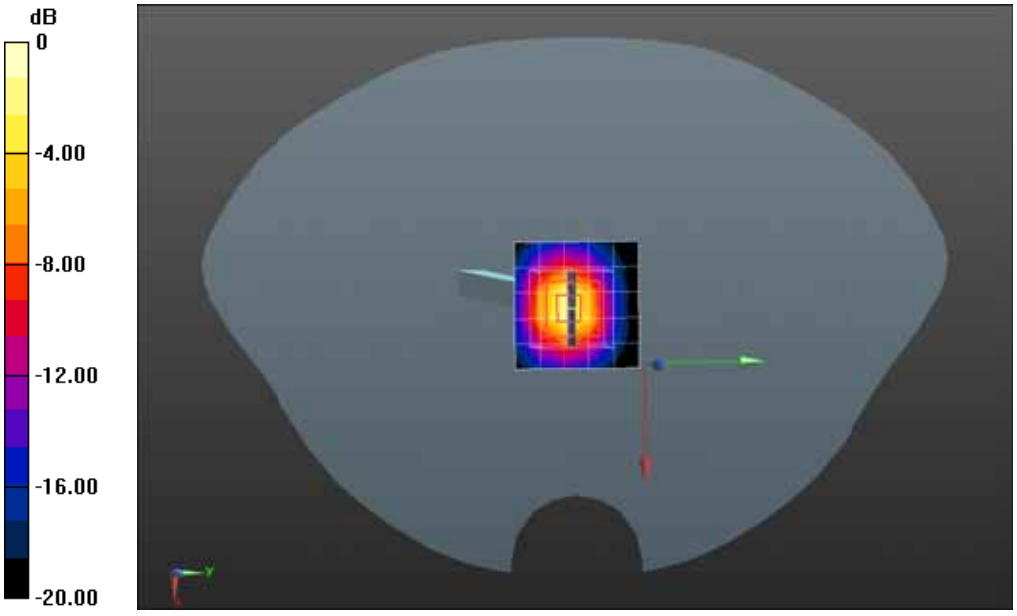
Maximum value of SAR (measured) = 7.69 W/kg

Configuration/Body 5250MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm;Reference Value = 39.37 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 43.5 W/kg

SAR(1 g) = 7.68 W/kg; SAR(10 g) = 2.19 W/kg

Maximum value of SAR (measured) = 9.61 W/kg



0 dB = 9.61 W/kg = 9.83 dBW/kg

Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

System Check Body 5600MHz

DUT: Dipole D5GHzV2; Type: D5GHzV2

Communication System: UID 0, CW (0); Communication System Band: 5GHz(5000.0-6000.0MHz); Duty Cycle: 1:1; Frequency: 5600 MHz; Medium parameters used: f = 5600 MHz; σ = 5.87 S/m; εr = 48.15; ρ = 1000 kg/m3 ; Phantom section: Flat Section ; Input Power=100mW

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(4.01, 4.01, 4.01); Calibrated: 23/02/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM2; Type: SAM; Serial: TP1562
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/Body 5600MHz/Area Scan (6x6x1): Measurement grid: dx=10mm, dy=10mm

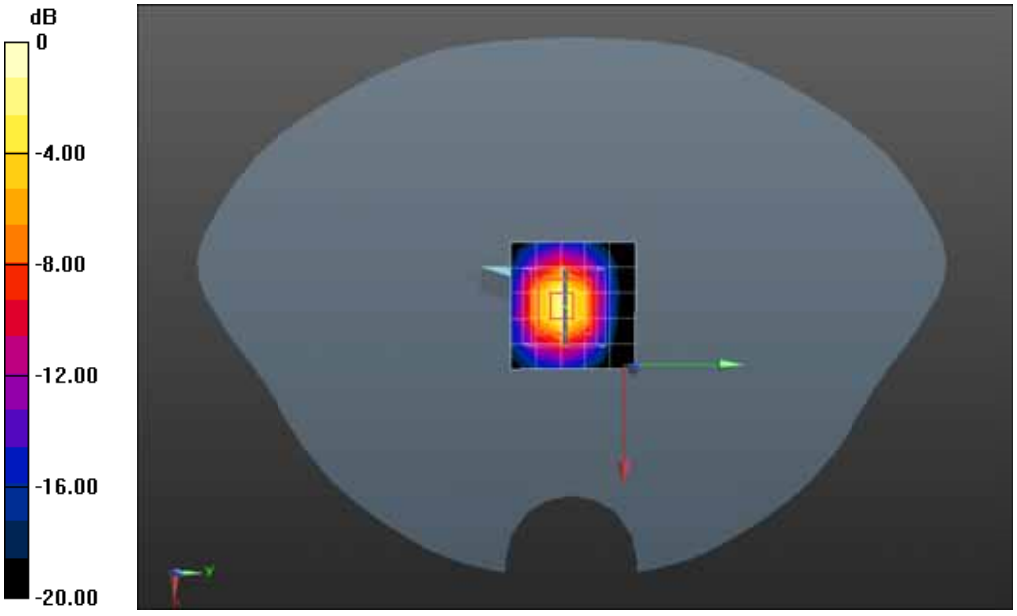
Maximum value of SAR (measured) = 9.08 W/kg

Configuration/Body 5600MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm;Reference Value = 41.00 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 70.5 W/kg

SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.38 W/kg

Maximum value of SAR (measured) = 11.9 W/kg



0 dB = 11.9 W/kg = 10.76 dBW/kg

Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

System Check Body 5750MHz

DUT: Dipole D5GHzV2; Type: D5GHzV2

Communication System: UID 0, CW (0); Communication System Band: 5GHz(5000.0-6000.0MHz); Duty Cycle: 1:1; Frequency: 5750 MHz; Medium parameters used: f = 5750 MHz; σ = 6.09 S/m; εr = 47.84; ρ = 1000 kg/m3 ; Phantom section: Flat Section ; Input Power=100mW

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(4.09, 4.09, 4.09); Calibrated: 23/02/2017;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM2; Type: SAM; Serial: TP1562
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/Body 5750MHz/Area Scan (5x8x1): Measurement grid: dx=10mm, dy=10mm

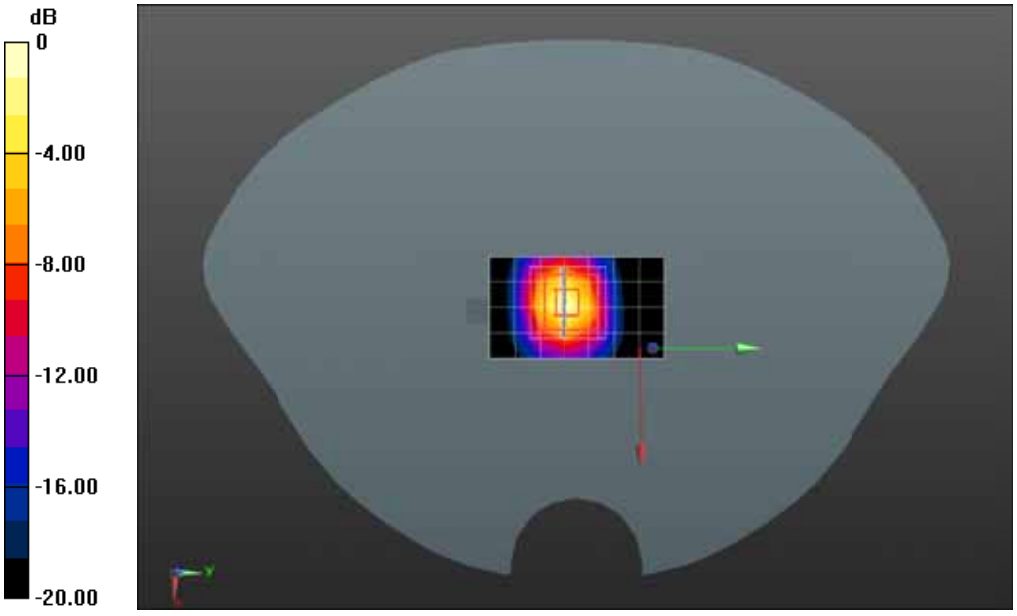
Maximum value of SAR (measured) = 29.8 W/kg

Configuration/Body 5750MHz/Zoom Scan (8x8x10)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm;Reference Value = 45.49 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 61.2 W/kg

SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 28.6 W/kg



0 dB = 28.6 W/kg = 14.56 dBW/kg

Appendix B. SAR measurement Data

Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

802.11b 2437MHz Body-Edge 1

DUT: Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card; Type: QCNFA425

Communication System: UID 0, Wi-Fi (0); Communication System Band: 802.11b; Duty Cycle: 1:1.0;

Frequency: 2437 MHz; Medium parameters used: f = 2437 MHz; σ = 1.94 S/m; εr = 52.29; ρ = 1000 kg/m3 ;

Phantom section: Flat Section

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

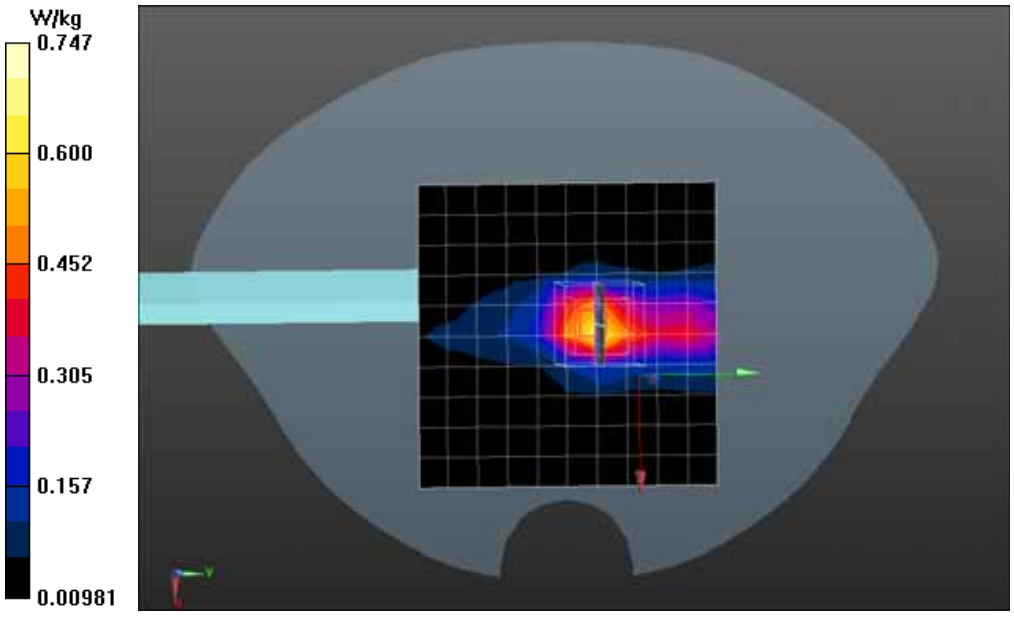
- Probe: EX3DV4 - SN3710; ConvF(7.52, 7.52, 7.52); Calibrated: 23/02/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM2; Type: SAM; Serial: TP1562
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/802.11b 2437MHz Body-Edge 1/Area Scan (11x11x1): Measurement grid: dx=12mm, dy=12mm;Maximum value of SAR (measured) = 0.660 W/kg

Configuration/802.11b 2437MHz Body-Edge 1/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm;Reference Value = 15.62 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 1.58 W/kg

SAR(1 g) = 0.675 W/kg; SAR(10 g) = 0.305 W/kg;Maximum value of SAR (measured) = 0.747 W/kg



Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

802.11b 2437MHz Body-Back

DUT: Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card; Type: QCNFA425

Communication System: UID 0, Wi-Fi (0); Communication System Band: 802.11b; Duty Cycle: 1:1.0;

Frequency: 2437 MHz; Medium parameters used: f = 2437 MHz; σ = 1.94 S/m; εr = 52.29; ρ = 1000 kg/m3 ;

Phantom section: Flat Section

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(7.52, 7.52, 7.52); Calibrated: 23/02/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/802.11b 2437MHz Body-back/Area Scan (11x11x1): Measurement grid: dx=12mm, dy=12mm

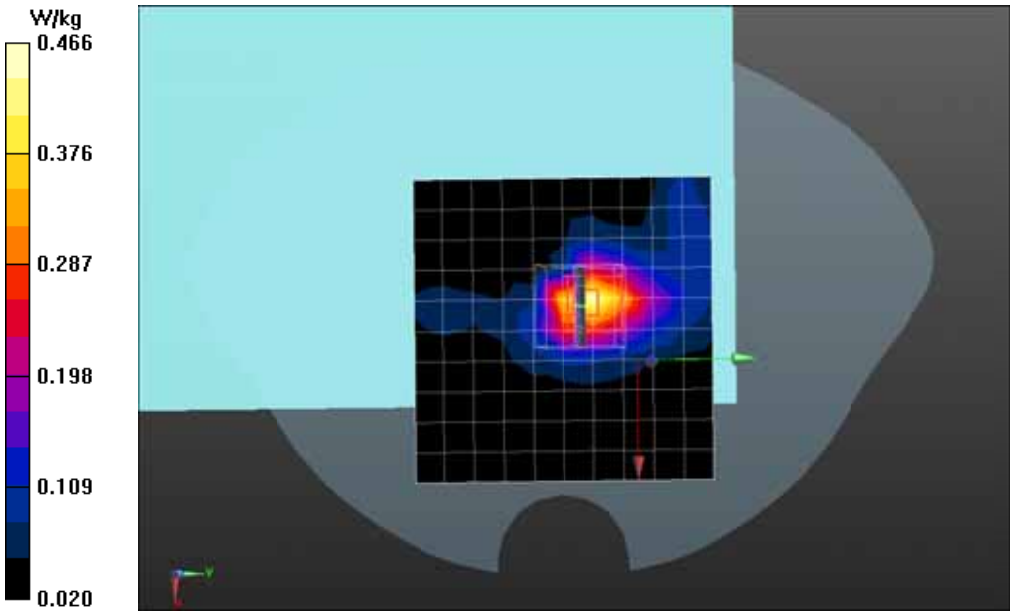
Maximum value of SAR (measured) = 0.451 W/kg

Configuration/802.11b 2437MHz Body-back/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm;Reference Value = 14.27 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.11 W/kg

SAR(1 g) = 0.445 W/kg; SAR(10 g) = 0.214 W/kg

Maximum value of SAR (measured) = 0.466 W/kg



Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

802.11b 2437MHz Body-Edge 2

DUT: Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card; Type: QCNFA425

Communication System: UID 0, Wi-Fi (0); Communication System Band: 802.11b; Duty Cycle: 1:1.0;

Frequency: 2437 MHz; Medium parameters used: f = 2437 MHz; σ = 1.94 S/m; εr = 52.29; ρ = 1000 kg/m3 ;

Phantom section: Flat Section

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(7.52, 7.52, 7.52); Calibrated: 23/02/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

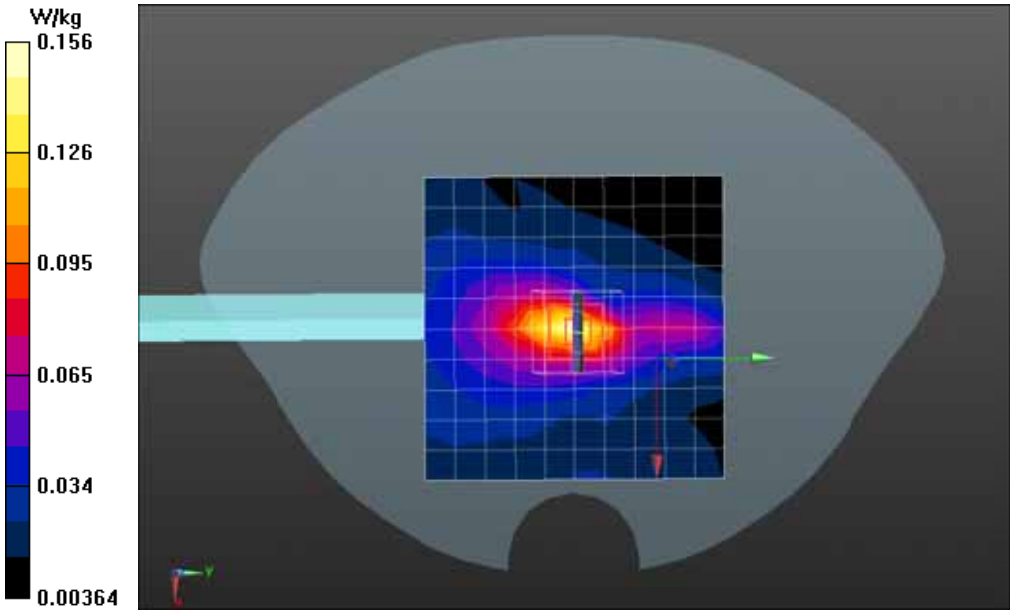
Configuration/802.11b 2437MHz Body-Edge 2/Area Scan (11x11x1): Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (measured) = 0.156 W/kg

Configuration/802.11b 2437MHz Body-Edge 2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm;Reference Value = 6.243 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.284 W/kg

SAR(1 g) = 0.137 W/kg; SAR(10 g) = 0.069 W/kg;Maximum value of SAR (measured) = 0.119 W/kg



Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

802.11b 2412MHz Body-Edge 1

DUT: Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card; Type: QCNFA425

Communication System: UID 0, Wi-Fi (0); Communication System Band: 802.11b; Duty Cycle: 1:1.0;

Frequency: 2412 MHz; Medium parameters used: f = 2412 MHz; σ = 1.91 S/m; εr = 52.35; ρ = 1000 kg/m3 ;

Phantom section: Flat Section

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(7.52, 7.52, 7.52); Calibrated: 23/02/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/802.11b 2412MHz Body-Edge 1/Area Scan (11x11x1): Measurement grid: dx=12mm, dy=12mm

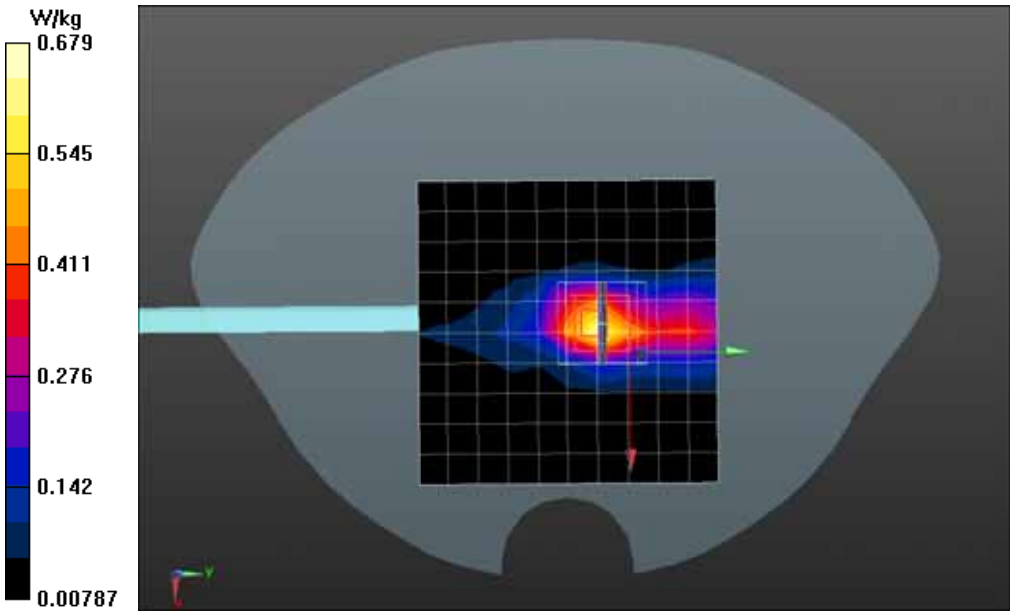
Maximum value of SAR (measured) = 0.639 W/kg

Configuration/802.11b 2412MHz Body-Edge 1/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm;Reference Value = 14.43 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 1.40 W/kg

SAR(1 g) = 0.618 W/kg; SAR(10 g) = 0.283 W/kg

Maximum value of SAR (measured) = 0.679 W/kg



Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

802.11a 5200MHz Body-Edge 1

DUT: Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card; Type: QCNFA425

Communication System: UID 0, CW (0); Communication System Band: 5GHz(5000.0-6000.0MHz); Duty Cycle: 1:1.0; Frequency: 5200 MHz; Medium parameters used: f = 5200 MHz; σ = 5.32 S/m; εr = 49.33; ρ = 1000 kg/m3 ; Phantom section: Flat Section

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(4.51, 4.51, 4.51); Calibrated: 23/02/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM2; Type: SAM; Serial: TP1562
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/802.11a 5200Hz Body-Edge 1/Area Scan (9x11x1): Measurement grid: dx=10mm, dy=10mm

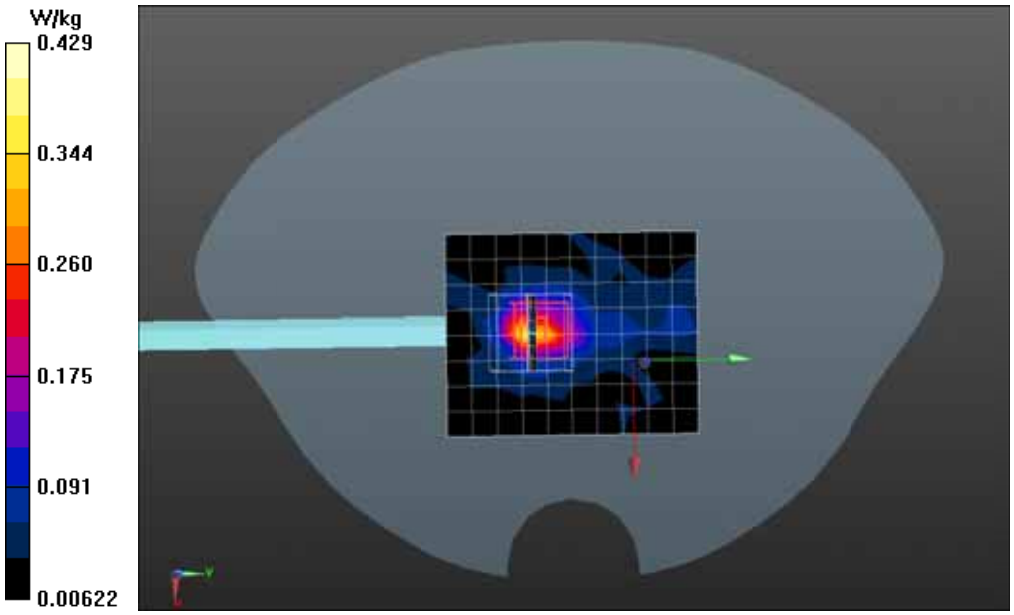
Maximum value of SAR (measured) = 0.367 W/kg

Configuration/802.11a 5200Hz Body-Edge 1/Zoom Scan (7x7x6)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=2mm;Reference Value = 5.243 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 1.76 W/kg

SAR(1 g) = 0.400 W/kg; SAR(10 g) = 0.130 W/kg

Maximum value of SAR (measured) = 0.429 W/kg



Date/Time: 08/12/2017

Test Laboratory: DEKRA Lab

802.11a 5200MHz Body-Back

DUT: Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 1216 Type Card; Type: QCNFA425

Communication System: UID 0, CW (0); Communication System Band: 5GHz(5000.0-6000.0MHz); Duty Cycle: 1:1.0; Frequency: 5200 MHz; Medium parameters used: f = 5200 MHz; σ = 5.32 S/m; εr = 49.33; ρ = 1000 kg/m3 ; Phantom section: Flat Section

Ambient temperature (℃): 21.5, Liquid temperature (℃): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(4.51, 4.51, 4.51); Calibrated: 23/02/2017;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 21/02/2017
- Phantom: SAM2; Type: SAM; Serial: TP1562
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/802.11a 5200Hz Body-Back/Area Scan (9x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.142 W/kg

Configuration/802.11a 5200Hz Body-Back/Zoom Scan (7x7x6)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=2mm;Reference Value = 3.810 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 0.345 W/kg

SAR(1 g) = 0.143 W/kg; SAR(10 g) = 0.115 W/kg

Maximum value of SAR (measured) = 0.161 W/kg