Registration No.788871

TEST REPORT

FOR SAR TESTING

Report No.: SRTC2018-9004(F)-18052301(H)

Product Name: Data terminal

Product Model: N5000

Applicant: Fujian Newland Auto-ID Tech. Co.,Ltd.

Manufacturer: Fujian Newland Auto-ID Tech. Co.,Ltd.

Specification: FCC Part 2.1093

IEEE Std 1528-2013

IEEE Std C95.1-2005

FCC RF Exposure KDB Procedures

FCC ID: SL9N5000

The State Radio_monitoring_center Testing Center (SRTC)

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Contents

1. GENERAL INFORMATION

1.1 Notes of the test report

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The test results relate only to individual items of the samples which have been tested.

1.2 Information about the testing laboratory

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1.4 Manufacturer's details

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1.5 Test Environment

Date of Receipt of test sample at SRTC:	2018.05.23
Testing Start Date:	2018.05.24
Testing End Date:	2018.05.24

Environmental Data:	Temperature (°C)	Humidity (%)
Ambient	22.5	40.0

Normal Supply Voltage (V d.c.):	3.80

2. DESCRIPTION OF THE DEVICE UNDER TEST

2.1 Final Equipment Build Status

Wireless Technology and Frequency Bands	☐GSM Band: ☐WCDMA Band: ☐LTE Band ☒Bluetooth Band: 2.4GHz ☒Wi-Fi Band: 2.4GHz
Mode	GSM ☐Voice (GMSK) ☐GPRS (GMSK) ☐EGPRS (GMSK/8PSK) WCDMA ☐UMTS Rel. 99 (Voice & Data) ☐HSDPA (Rel. 5) ☐HSUPA (Rel. 6) ☐HSPA+ (Rel.) ☐DC-HSDPA (Rel.) Wi-Fi (802.11a/b/g/n) ☐802.11a ☒802.11b ☒802.11g ☒802.11n (20MHz) ☒802.11n (40MHz) ☐802.11ac (20MHz) ☐802.11ac (40MHz) ☐802.11ac (80MHz) Bluetooth ☒BR(GFSK) ☒EDR(π/4 DQPSK , 8-DPSK) ☒BLE(GFSK) LTE ☐QPSK ☐16QAM ☐64QAM
Duty Cycle	GSM Voice: 12.5%; GPRS: 12.5% (1 Slot), 25% (2 Slots), 37.5% (3 Slots), 50% (4 Slots) WCDMA: 100% Wi-Fi 802.11b/g/n: 100% Bluetooth: 32.25% (DH1), 66.68% (DH3), 77.52% (DH5)
GPRS Multi-Slot Class	☐Class 8 - One Up ☐Class 10 - Two Up ☐Class 12 - Four Up
Mobile Phone Capability	☐Class A - Mobile phones can be connected to both GPRS and GSM services simultaneously. ☐Class B - Mobile phones can be attached to both GPRS and GSM services, using one service at a time. ☐Class C - Mobile phones are attached to either GPRS or GSM voice service. You need to switch manually between services
DTM (Dual Transfer Mode)	Not Supported

Note: the device works as DAE, do not support voice speech mode although it has acoustic receiver (Block diagram in ANNEX test setup).

2.2 Support Equipment

The following support equipment was used to exercise the DUT during testing:

State of sample	Normal
Headset	---
Batteries	Li-Lon/SHENZHEN CHOLIPOWER TECHNOLOGY CO., LTD.
H/W Version S/W Version	P0 v1.1.1_03
IMEI	868501020054266
Notes	As the information described above, we use test sample offered by the customer. The relevant tests have been performed in the case which EUT have the worst features.

3. REFERENCE SPECIFICATION

Specification	Version	Title
Part 2.1093	2018	Radiofrequency radiation exposure evaluation: portable devices.
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
IEEE Std C95.1	2005	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields,3 kHz to 300 GHz
IEEE Std 1528a	2005	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques Amendment 1: CAD File for Human Head Model (SAM Phantom)
KDB 447498 D01	v06	General RF Exposure Guidance
KDB 648474 D04	v01r03	Handset SAR
KDB 941225 D01	v03r01	3G SAR Procedures
KDB 941225 D06	v02r01	Hotspot Mode
KDB 248227 D01	v02r02	SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS
KDB 865664 D01	v01r04	SAR Measurement from 100 MHz to 6 GHz
KDB 865664 D02	v01r02	RF Exposure Reporting
KDB 941225 D05	v02r05	SAR for LTE Devices

4. TEST CONDITIONS

4.1 Picture to demonstrate the required liquid depth

The liquid depth in the used SAM phantoms

Liquid depth for SAR Measurement

4.2 Test Signal, Frequencies and Output Power

The device was put into operation by using a call tester. Communication between the device and the call tester was established by air link.
The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence.
In all operating bands the measurements were performed on middle channel, and few of them were also performed on lowest and highest channels.

4.3 SAR Measurement Set-up

The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than ± 0.02mm. Special E-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines (length =300mm) to the data acquisition unit. A cell controller system contains the power supply, robot controller, teaches pendant (Joystick), and remote control, is used to drive the robot motors.

The PC consists of the Micron Pentium IV computer with Win7 system and SAR Measurement Software DASY5 Professional, A/D interface card, monitor, mouse, and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot.
A data acquisition electronic (DAE) circuit performs the signal amplification; signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines.
The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection
The robot uses its own controller with a built in VME-bus computer.

4.4 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528 - 2013.
System checking was performed using the flat section. Body SAR testing also used the flat section between the head profiles.
The SPEAG device holder (see Section 5.1) was used to position the device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

4.5 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEEE 1528 - 2013 and FCC Supplement C to OET Bulletin 65. All tests were carried out using simulants whose dielectric parameters were within ± 5% of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters.
The depth of the tissue simulant was 15.0 ± 0.5 cm measured from the ear reference point during system checking and device measurements.

4.5.1 Tissue Stimulant Recipes

The following tissue stimulants were used for Body and Limbs test:

Name	Broadband tissue-equivalent liquid
Type for Body	MBBL600-6000V6 Body Simulating Liquid

4.6 DESCRIPTION OF THE TEST PROCEDURE

4.6.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy5 system.

Device holder supplied by SPEAG

4.6.2 Body Worn Configuration

The device was placed in the SPEAG holder below the flat section of the phantom. The distance between the device and the phantom was kept at the separation distance using a separate flat spacer that was removed before the start of the measurements. And the distance is 10mm.The device was oriented with its antenna facing the phantom since this orientation gives higher results.

4.6.3 Scan Procedure

First, area scans were used for determination of the field distribution and the approximate location of the local peak SAR values. The SAR distribution is scanned along the inside surface, at least for an area larger than the projection of the handset and antenna. The angle between the probe axis and the surface normal line is recommended but not required to be less than 30°. The SAR distribution is first measured on a 2-D coarse grid. The scan region should cover all areas that are exposed and encompassed by the projection of the handset. There are 15 mm × 15 mm (equal or less than 2GHz), 12 mm × 12 mm (from 2GHz~3GHz) and 10mm x 10mm (above 5GHz) measurement grid used when two staggered one-dimensional cubic splines are used to estimate the maximum SAR location. Next, a zoom scan, a minimum of 7 x 7x7 points covering a volume of at least 30x30x30mm, was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

4.6.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.
The interpolation, extrapolation and maximum search routines within DASY5 are all based on the modified Quadratic Shepard's method (Robert J. Renka,"Multivariate Interpolation of Large Sets of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).
The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighbouring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.
In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

5 RESULT SUMMAR

The maximum reported SAR values are given as follows. The device conforms to the requirements of the standard(s) when the maximum reported SAR value is less than or equal to the limit.

Exposure Posltion	Frequency Band	SAR Reported Result (W/kg)	Highest SAR Reported Result (W/kg)	Limit (W/kg)	Result
Body (10mm Gap)	WLAN 2.4GHz Band	0.091(1g)	0.091(1g)	1.60(1g)	pass
Limbs (0mm Gap)	WLAN 2.4GHz Band	0.410(10g)	0.410(10g)	4.00(10g)	pass

Note: the SAR limit for for Body Worn configuration is 1.60w/kg(1-g SAR),and the SAR limit for Limbs(0mm) is 4.00w/kg(10-g SAR)

This Test Report Is Issued by: Mr. Peng Zhen 彭振	Checked by: Mr. Li Bin 李彬
Tested by: Mr. He Dengshun 何邓顺	Issued date: 20180608

6 TEST RESULT

6.1 Manufacturing Tolerance

Bluetooth

GFSK			
Channel	0	39	78
Tolerance (dBm)	-2.5~1.5	-2.5~1.5	-2.5~1.5
π/4DQPSK			
Channel	0	39	78
Tolerance (dBm)	-3.5~-0.5	-3.5~-0.5	-3.5~-0.5
8DPSK			
Channel	0	39	78
Tolerance (dBm)	-3.5~-0.5	-3.5~-0.5	-3.5~-0.5

BLE

GFSK			
Channel	0	19	39
Tolerance (dBm)	-8.5~-4.5	-8.5~-4.5	-8.5~-4.5

Wi-Fi (2.4GHz)

802.11b			
Channel	1	6	11
Tolerance (dBm)	9.0~13.0	9.0~13.0	9.0~13.0
802.11g			
Channel	1	6	11
Tolerance (dBm)	9.0~13.0	9.0~13.0	9.0~13.0
802.11n HT20			
Channel	1	6	11
Tolerance (dBm)	8.0~12.0	8.0~12.0	8.0~12.0
802.11n HT40			
Channel	3	6	9
Tolerance (dBm)	8.0~12.0	8.0~12.0	8.0~12.0

6.2 Bluetooth Measurement result

Modulation type	Test Result (dBm)		
	2402MHz(Ch0)	2441MHz(Ch39)	2480MHz(Ch78)
GFSK	1.28	0.94	1.10
π/4DQPSK	-0.95	-1.43	-1.39
8DPSK	-0.99	-1.43	-1.38

6.3 BLE Measurement result

Modulation type	Test Result (dBm)		
	2402MHz(Ch0)	2440MHz(Ch19)	2480MHz(Ch39)
GFSK	-5.13	-5.14	-4.96

6.4 Wi-Fi Measurement result

WIFI 2.4G

Modulation type		Average power output (dBm)		
		2412MHz	2437MHz	2462MHz
11b	1 Mbps	12.24	11.66	11.22
	2 Mbps	12.19	11.62	11.18
	5.5 Mbps	12.14	11.58	11.15
	11 Mbps	12.09	11.54	11.11
11g	6 Mbps	12.18	11.48	11.07
	9 Mbps	12.02	11.37	10.98
	12 Mbps	11.87	11.25	10.89
	18 Mbps	11.71	11.14	10.80
	24 Mbps	11.55	11.02	10.70
	36 Mbps	11.39	10.91	10.61
	48 Mbps	11.24	10.79	10.52
	54 Mbps	11.08	10.68	10.43
11n HT20	6.5 Mbps	11.35	10.64	10.21
	13 Mbps	11.25	10.55	10.11
	19.5 Mbps	11.15	10.46	10.02
	26 Mbps	11.05	10.37	9.92
	39 Mbps	10.95	10.29	9.82
	52 Mbps	10.85	10.20	9.72
	58.5 Mbps	10.75	10.11	9.63
	65 Mbps	10.65	10.02	9.53
Modulation type		Average power output (dBm)		
		2422MHz	2437MHz	2452MHz
11n HT40	13.5 Mbps	11.26	10.82	10.63
	27 Mbps	11.06	10.61	10.42
	40.5 Mbps	10.86	10.40	10.22
	54 Mbps	10.66	10.19	10.01
	81 Mbps	10.45	9.97	9.80
	108 Mbps	10.25	9.76	9.59
	121.5 Mbps	10.05	9.55	9.39
	135 Mbps	9.85	9.34	9.18

6.5 Standalone SAR Test Exclusion Considerations

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.

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

According to the KDB447498 4.3.1 (1)

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

[(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 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

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

This is equivalent to [(max. power of channel, including tune-up tolerance, mW)/(60/√f(GHz) mW)]·[20 mm/(min.test separation distance, mm)] ≤ 1.0 for 1-g SAR; also see Appendix A for approximate exclusion threshold values at selected frequencies and distances.
According to the KDB447498 appendix A

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	*SAR Test Exclusion Threshold* (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

Summary of Transmitters

When the distance is 10mm(1g-SAR)

Band/Mode	Position	Max.RF output power (mW)	SAR test exclusion Threshold (mW)	SAR Required
(2.4~2.4835)GHz Bluetooth	Body	1.34	19.0	No
(2.4~2.4835)GHz Wifi	Body	16.75	19.0	No(1)

When the distance is 0mm(10g-SAR)

[(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 SAR**

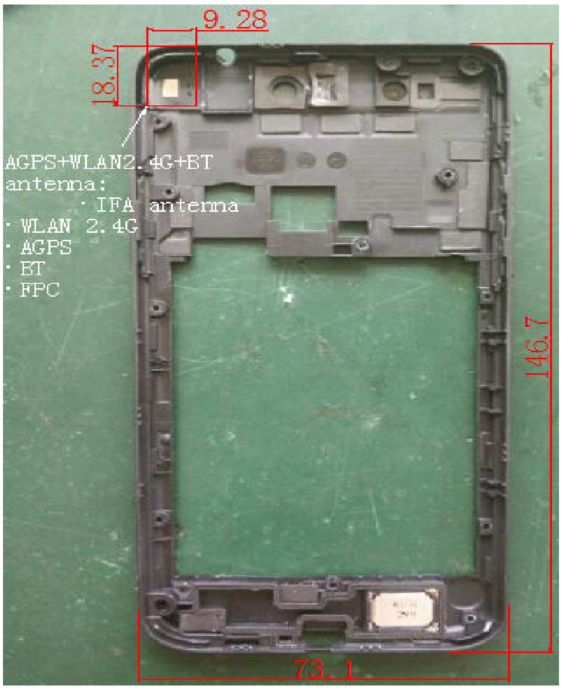
Bluetooth: [1.41(mW) / 5 (mm)] · [√f (2.402GHz)] = 0.44
Wifi: [19.95(mW) / 5 (mm)] · [√f (2.412GHz)] =6.20

Band/Mode	Position	value	limit	SAR Required
(2.4~2.4835)GHz Bluetooth	Limbs	0.44	7.5	No
(2.4~2.4835)GHz Wifi	Limbs	6.20	7.5	No(1)

Note: We test WIFI 2.4G (both 0mm &10mm) although SAR test do not required but close to the exemption limit, and the evaluation could be more reasonable and reliable.

6.6 RF exposure conditions

Refer to the follow picture “Antenna Locations & Separation Distances” for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.



Body-worn Accessory Exposure conditions

For WiFi

Test Configurations	SAR Required	Note
Rear	yes	---
Front	yes	---

Test Configurations	Antenna-to-edge/surface	SAR Test
Edge 1	0 mm<25mm	Yes
Edge 2	73.6 mm>25mm	Yes(1)
Edge 3	63.82 mm>25mm	Yes(1)
Edge 4	0 mm<25mm	Yes

Note: We test all the surfaces (both 0mm &10mm) of WIFI 2.4G without hotspot mode cause the DUT do not support.

6.7 System Checking and Liquid Validation

The manufacturer calibrates the probes annully. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyser. A system check measurement was made following the determination of the dielectric parameters of the simulant, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system checking results (dielectric parameters and SAR values) are given in the table below.

Date Tested	System dipole	T.S. Liquid	SAR measured (normalized to 1W)		Target (Ref.Value)	Delta (%)	Tolerance (%)
2018/5/24	D2450V2	Body	1g	54.00	52.30	3.25	±10
2018/5/24	D2450V2	Body	10g	23.96	24.30	-1.40	±10

Plots of the system checking scans are given in Appendix A.

Tissue Simulants used in the Measurements

For the measurement of the following parameters the SPEAG DAKS-3.5 dielectric parameter probe is used, representing the open-ended coaxial probe measurement procedure.

Date Tested	Freq.(MHz)	Liquid parameters	measured	Target	Delta(%)	Tolerance(%)
2018/5/24	Body 2450	εr	52.459	52.70	-0.46	±5
		σ[S/m]	1.986	1.95	1.85	±5

6.8 Test Result And Estimated SAR Value

In order to determine the largest value of the peak spatial-average SAR of a handset, all device positions, configurations, and operational modes should be tested for each frequency band according to Steps 1 to 3 below if necessary.

Step 1: The tests should be performed at the channel that is closest to the center of the transmit frequency band.
a) All device positions (cheek and tilt, for both left and right sides of the SAM phantom),
b) All configurations for each device position in a), e.g., antenna extended and retracted, and
c) All operational modes for each device position in item a) and configuration in item b) in each frequency band, e.g., analog and digital, If more than three frequencies need to be tested (i.e., Nc > 3), then all frequencies, configurations and modes shall be tested for all of the above test conditions.
Step 2: For the condition providing the highest peak spatial-average SAR determined in Step 1 for each frequency, perform all tests at all other test frequency channels, e.g., 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 should be tested as well.
Step 3: Examine all data to determine the largest value of the peak.
Note:
1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
Scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
Reported SAR (W/kg) = Measured SAR (W/kg)* Scaling Factor
2. Per KDB 447498 D01v06, for each exposure position, if the highest output channel 1g-SAR ≤0.8W/kg, other channels SAR testing are not necessary. And if the highest output channel 10g-SAR ≤2W/kg, other channels SAR testing are not necessary
3. In the report the test position “Mobile phone screen Towards Ground” abbreviated as “TG”, and “Mobile phone screen Towards Phantom” abbreviated as “TP”.
4. The distance between the EUT and the phantom bottom is 10mm and 0mm.

The measured and reported Body SAR values for the test device are tabulated below:

Mode: Wi-Fi 2.4GHz

fL (MHz)=2412MHz fM (MHz)=2437MHz fH (MHz)= 2462MHz

SAR Values (Wi-Fi 802.11b)

Limit of SAR (W/kg) : <1.6W/kg (1g Average) (Position Gap=10mm)

Test Case		CH	Measure Conducted Power (dBm)	Tune-up limit (dBm)	Scaling Factor	Measure Results (W/kg)	Reported Results (W/kg)
Position	mode					1g Average	1g Average
TG	802.11b	L	12.24	13.00	1.06	0.086	0.091
		M	11.66	13.00	1.11	0.082	0.091
		H	11.22	13.00	1.16	0.062	0.072
TP		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.077	0.085
		H	11.22	13.00	1.16	---	---
EDGE1		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.048	0.053
		H	11.22	13.00	1.16	---	---
EDGE2		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.010	0.011
		H	11.22	13.00	1.16	---	---
EDGE3		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.020	0.022
		H	11.22	13.00	1.16	---	---
EDGE4		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.078	0.087
		H	11.22	13.00	1.16	---	---

Mode: Wi-Fi 2.4GHz

fL (MHz)=2412MHz fM (MHz)=2437MHz fH (MHz)= 2462MHz

SAR Values (Wi-Fi 802.11b)

Limit of SAR (W/kg) : <4.0W/kg (10g Average) (Position Gap=0mm)

Test Case		CH	Measure Conducted Power (dBm)	Tune-up limit (dBm)	Scaling Factor	Measure Results (W/kg)	Reported Results (W/kg)
Position	mode					10g Average	10g Average
TG	802.11b	L	12.24	13.00	1.06	0.387	0.410
		M	11.66	13.00	1.11	0.321	0.356
		H	11.22	13.00	1.16	0.264	0.306
TP		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.260	0.289
		H	11.22	13.00	1.16	---	---
EDGE1		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.077	0.085
		H	11.22	13.00	1.16	---	---
EDGE2		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.017	0.019
		H	11.22	13.00	1.16	---	---
EDGE3		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.027	0.030
		H	11.22	13.00	1.16	---	---
EDGE4		L	12.24	13.00	1.06	---	---
		M	11.66	13.00	1.11	0.208	0.231
		H	11.22	13.00	1.16	---	---

Mode: Bluetooth 2.4GHz

According to the formula (KDB447498 4.3.2) the Bluetooth SAR as follow:
[(max.power of channel, including tune-up tolerance,mw)/(min.test separation distance,mm)]
[√f(GHz)/x] W/kg for test separation distances≦50mm.
Head:
min. test separation distance = 5mm
Body:
min. test separation distance = 10mm
Where x=7.5 for 1-g SAR, and x=18.75 for 10-g SAR.

Eestimated SAR Bluetooth

Mode	Position	F(GHz)	Distance(mm)	Estimated
Bluetooth	Limbs 0mm	2.402	5	0.023(10-g SAR)
	Body10mm	2.402	10	0.029 (1-g SAR)

Note: There is only one antenna, WIFI 2.4G and BT 2.4G cannot transmit simultaneously. so we do consider about simultaneous transmission.

6.9 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; steps 2) through 4) do not apply.
2) When the original highest measured 1g-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 ≥ 1.45 W/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.

The Highest Reported SAR configuration in Each Frequency Band

Frequency band(MHz)	Air interface	Body(1g w/kg)(Position Gap=10mm)
Above 2.4G	WIFI 2.4G	<0.8

Frequency band(MHz)	Air interface	Limbs(10g w/kg)(Position Gap=0mm)
Above 2.4G	WIFI 2.4G	<2.0

Note: For 0mm test separation distance, half of the10g-SAR limit 4.0 w/kg is 2.0 w/kg

7 MEASUREMENT UNCERTAINTY

(0.3 - 3 GHz range)

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	$\sqrt{3}$	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	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
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 %	∞
Modulation Response^{m}	±2.4 %	R	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
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	±0.4 %	R	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±2.0 %	R	$\sqrt{3}$	1	1	±1.2 %	±1.2 %	∞
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 %	∞
Power Scaling^{p}	±0 %	R	$\sqrt{3}$	1	1	±0.0 %	±0.0 %	∞
Phantom and Setup								
Phantom Uncertainty	±6.1 %	R	$\sqrt{3}$	1	1	±3.5 %	±3.5 %	∞
SAR correction	±1.9 %	R	$\sqrt{3}$	1	0.84	±1.1 %	±0.9 %	∞
Liquid Conductivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.78	0.71	±1.1 %	±1.0 %	∞
Liquid Permittivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.26	0.26	±0.3 %	±0.4 %	∞
Temp. unc. - Conductivity^{BB}	±3.4 %	R	$\sqrt{3}$	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity^{BB}	±0.4 %	R	$\sqrt{3}$	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±11.2 %	±11.1 %	361
Expanded STD Uncertainty						**±22.3 %**	**±22.2 %**	

(3 - 6 GHz range)

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 %	∞
Modulation Response^m	±2.4 %	R	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
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	±6.7 %	R	$\sqrt{3}$	1	1	±3.9 %	±3.9 %	∞
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 %	∞
Power Scaling^p	±0 %	R	$\sqrt{3}$	1	1	±0.0 %	±0.0 %	∞
Phantom and Setup								
Phantom Uncertainty	±6.6 %	R	$\sqrt{3}$	1	1	±3.8 %	±3.8 %	∞
SAR correction	±1.9 %	R	$\sqrt{3}$	1	0.84	±1.1 %	±0.9 %	∞
Liquid Conductivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.78	0.71	±1.1 %	±1.0 %	∞
Liquid Permittivity (mea.) ^{DAK}	±2.5 %	R	$\sqrt{3}$	0.26	0.26	±0.3 %	±0.4 %	∞
Temp. unc. - Conductivity ^{BB}	±3.4 %	R	$\sqrt{3}$	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity ^{BB}	±0.4 %	R	$\sqrt{3}$	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±12.3 %	±12.2 %	748
Expanded STD Uncertainty						**±24.6 %**	**±24.5 %**	

8 TEST EQUIPMENTS

The measurements were performed using an automated near-field scanning system, DASY5, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements was the 'advanced extrapolation' algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Model	Serial Number	Calibration date	Calibration Due data
DAE	DAE4	720	2017.10.24	2018.10.23
Dosimetric E-field Probe	EX3DV4	3127	2017.10.11	2018.10.10
Dipole Validation Kit	D2450V2	738	2017.09.18	2018.09.17

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration date	Calibration Due data
Signal Generator	E4428C	MY45280865	2017.08.20	2018.08.19
Power meter	E4417A	MY45101182	2017.08.20	2018.08.19
Power Sensor	E4412A	MY41502214	2017.08.20	2018.08.19
Power Sensor	E4412A	MY41502130	2017.08.20	2018.08.19
Vector Network Analyzer	VNA R140	0011213	2017.10.17	2018.10.16
Dielectric Parameter Probe	DAKS-3.5	1042	2017.10.17	2018.10.16

Detailed information of Isotropic E-field Probe Type ES3DV3

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Optical Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Dynamic Range	5 μW/g to > 100 W/kg; Linearity: ± 0.2 dB
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones

Detailed information of Isotropic E-field Probe Type EX3DV4

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Optical Surface Detection	± 0.3 mm repeatability in air and clear liquids over diffuse reflecting surfaces
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Dynamic Range	10 μW/g to > 100 W/kg Linearity: ± 0.2 dB (noise: typically < 1 μW/g)
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

ANNEX A – TEST PLOTS

Please refer to the attachment.

ANNEX B – RELEVANT PAGES FROM CALIBRATION REPORTS

Please refer to the attachment.

ANNEX A – TEST PLOTS

Body liquid

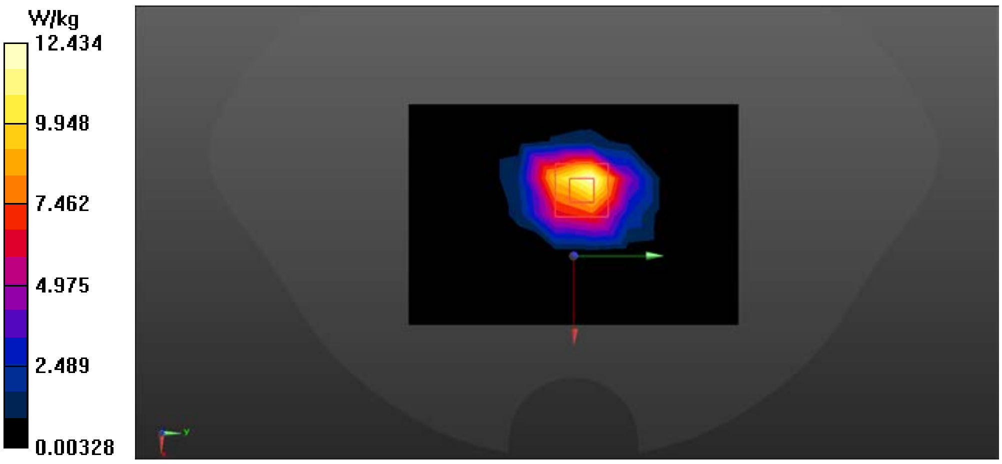
System check	2450MHz

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.986 S/m; ε_r = 52.459; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

System Performance Check at Frequencies 2450 MHz/2450/Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 13.4 W/kg
System Performance Check at Frequencies 2450 MHz/2450/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.67 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 5.99 W/kg
Maximum value of SAR (measured) = 18.5 W/kg



WLAN 2.4GHz

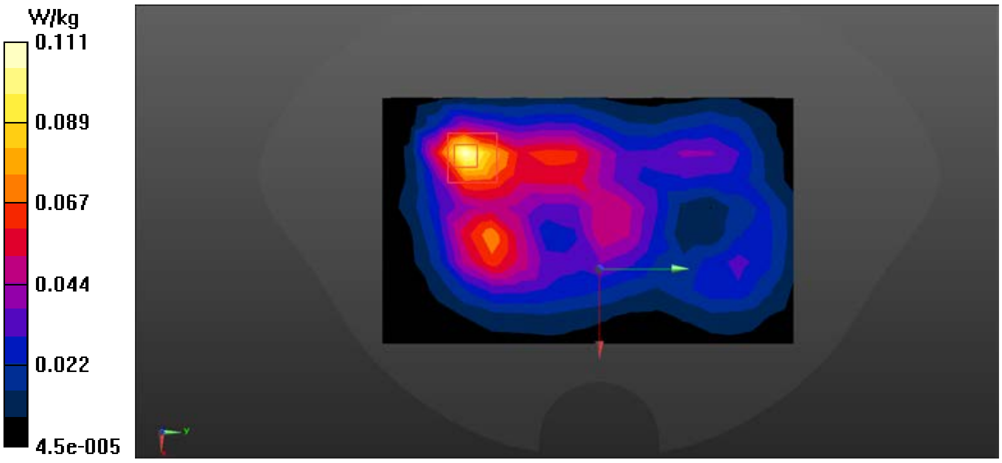
FLAT	Towards ground(10mm) Channel:1

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2412 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.933 S/m; ε_r = 53.16; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG L 10mm/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.110 W/kg
Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG L 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.387 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.178 W/kg
SAR(1 g) = 0.086 W/kg; SAR(10 g) = 0.042 W/kg
Maximum value of SAR (measured) = 0.111 W/kg



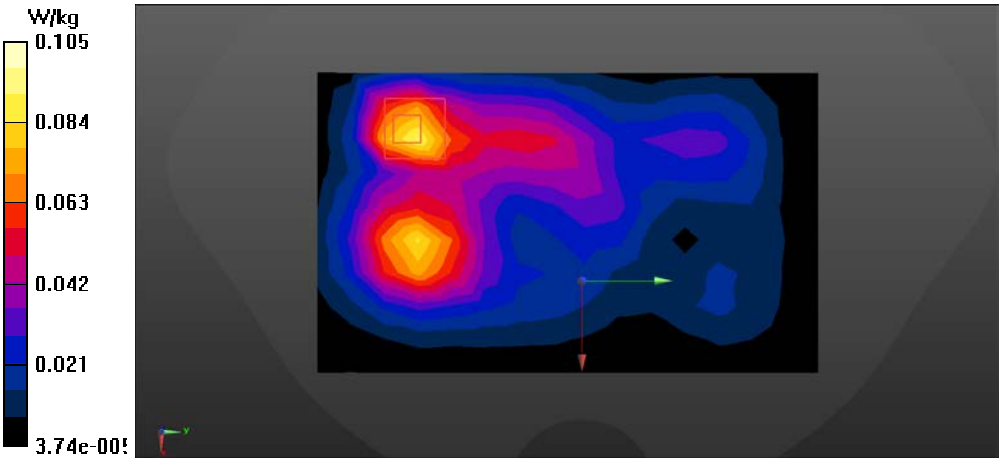
FLAT	Towards ground(10mm) Channel:6

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG M 10mm/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0927 W/kg
Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG M 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.999 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.166 W/kg
SAR(1 g) = 0.082 W/kg; SAR(10 g) = 0.039 W/kg
Maximum value of SAR (measured) = 0.105 W/kg



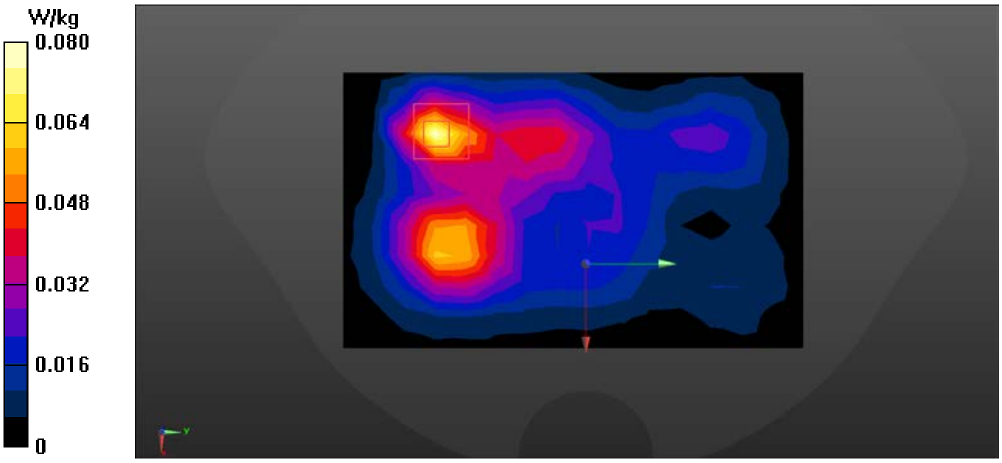
FLAT	Towards ground(10mm) Channel:11

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2462 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2462 MHz; σ = 2.019 S/m; ε_r = 51.992; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG H 10mm/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0789 W/kg
Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG H 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.416 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.130 W/kg
SAR(1 g) = 0.062 W/kg; SAR(10 g) = 0.029 W/kg
Maximum value of SAR (measured) = 0.0804 W/kg

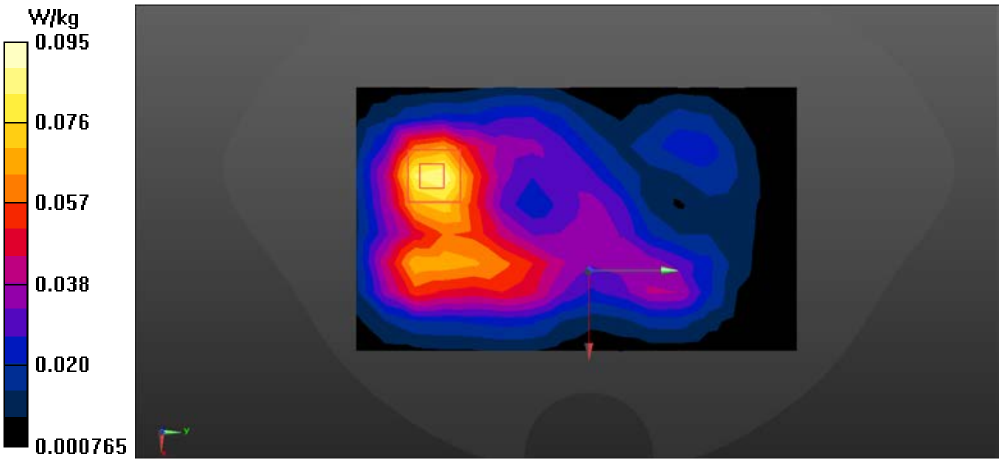


FLAT	Towards phantom(10mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)
  Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TP M 10mm/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
  Maximum value of SAR (measured) = 0.0888 W/kg
  Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TP M 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 4.504 V/m; Power Drift = 0.07 dB
  Peak SAR (extrapolated) = 0.138 W/kg
  SAR(1 g) = 0.077 W/kg; SAR(10 g) = 0.043 W/kg
  Maximum value of SAR (measured) = 0.0951 W/kg



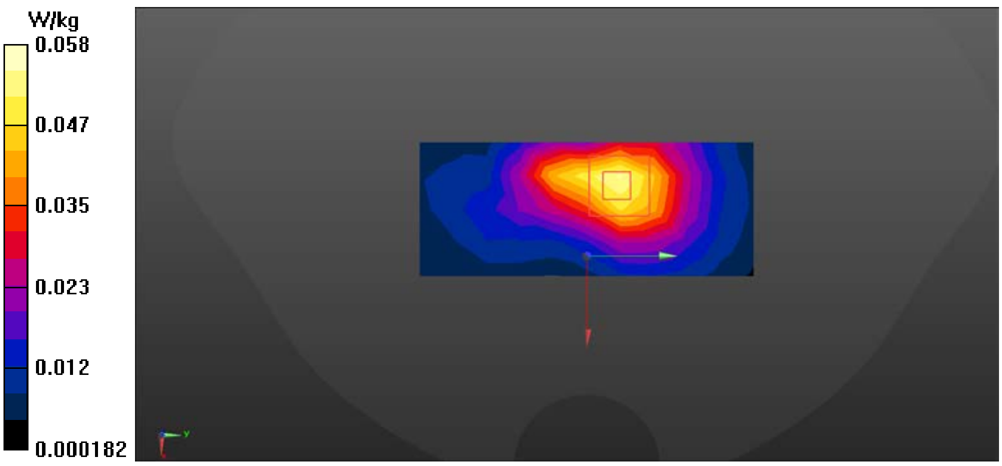
FLAT	EDGE1(10mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b EDGE1&2 HOT/WIFI 2.4 11b EDGE1 10mm/Area Scan (5x11x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0552 W/kg
Flat-Section MSL WIFI 2.4 11b EDGE1&2 HOT/WIFI 2.4 11b EDGE1 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.279 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.0840 W/kg
SAR(1 g) = 0.048 W/kg; SAR(10 g) = 0.026 W/kg
Maximum value of SAR (measured) = 0.0584 W/kg



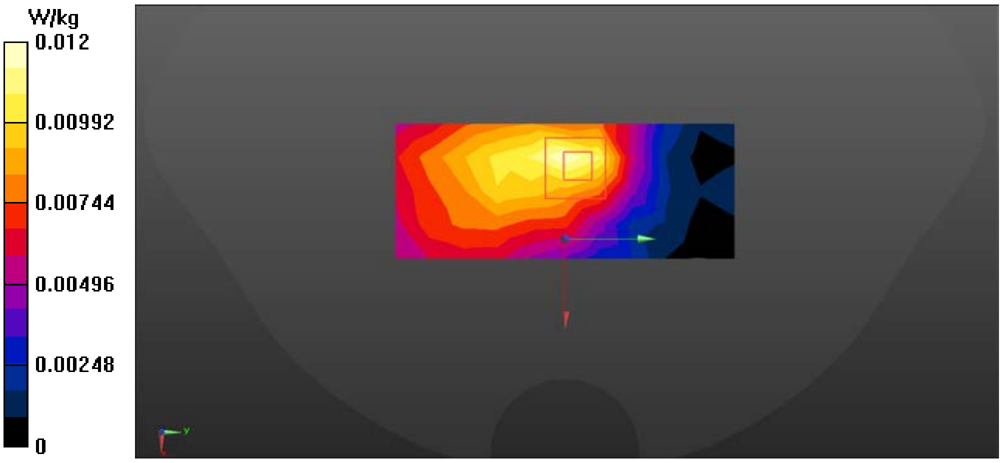
FLAT	EDGE2(10mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b EDGE1&2 HOT/WIFI 2.4 11b EDGE2 10mm/Area Scan (5x11x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0122 W/kg
Flat-Section MSL WIFI 2.4 11b EDGE1&2 HOT/WIFI 2.4 11b EDGE2 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.129 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.0180 W/kg
SAR(1 g) = 0.00984 W/kg; SAR(10 g) = 0.00524 W/kg
Maximum value of SAR (measured) = 0.0124 W/kg



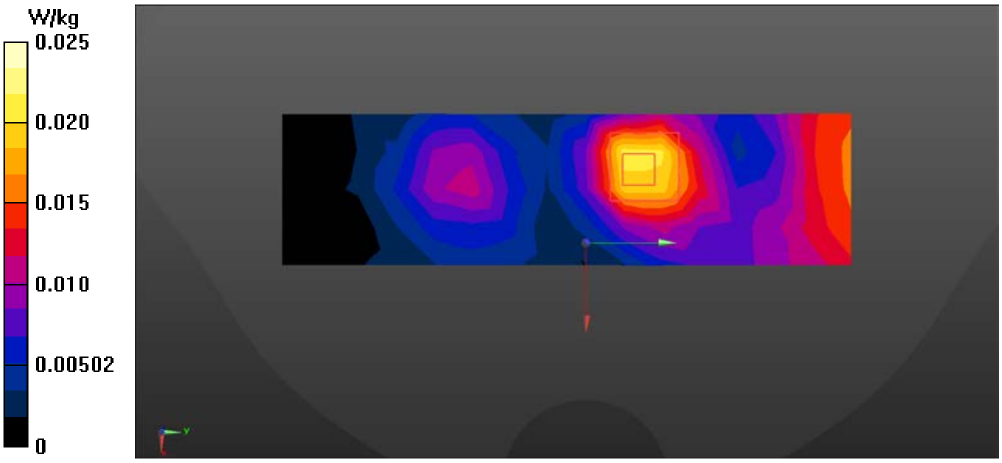
FLAT	EDGE3(10mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b EDGE3&4 HOT/WIFI 2.4 11b EDGE3 10mm/Area Scan (5x16x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0210 W/kg
Flat-Section MSL WIFI 2.4 11b EDGE3&4 HOT/WIFI 2.4 11b EDGE3 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.219 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.0370 W/kg
SAR(1 g) = 0.020 W/kg; SAR(10 g) = 0.011 W/kg
Maximum value of SAR (measured) = 0.0251 W/kg



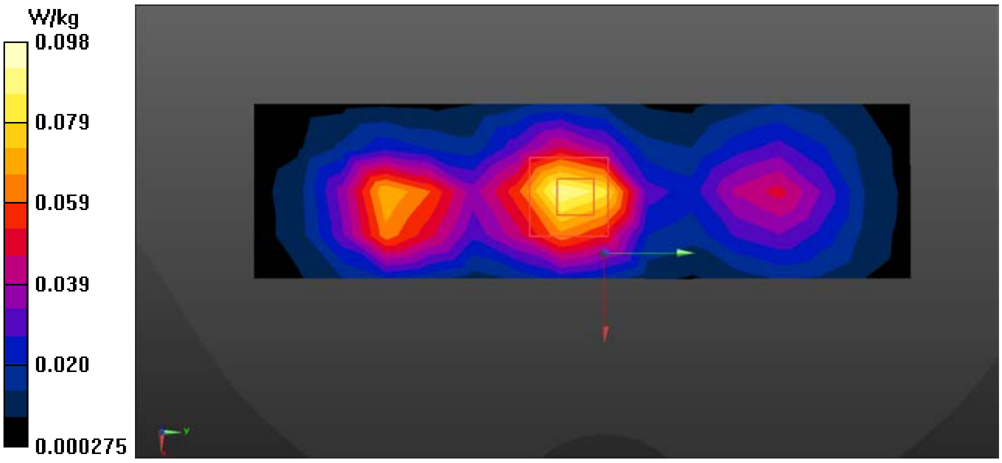
FLAT	EDGE4(10mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b EDGE3&4 HOT/WIFI 2.4 11b EDGE4 10mm/Area Scan (5x16x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0928 W/kg
Flat-Section MSL WIFI 2.4 11b EDGE3&4 HOT/WIFI 2.4 11b EDGE4 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.732 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.150 W/kg
SAR(1 g) = 0.078 W/kg; SAR(10 g) = 0.040 W/kg
Maximum value of SAR (measured) = 0.0982 W/kg



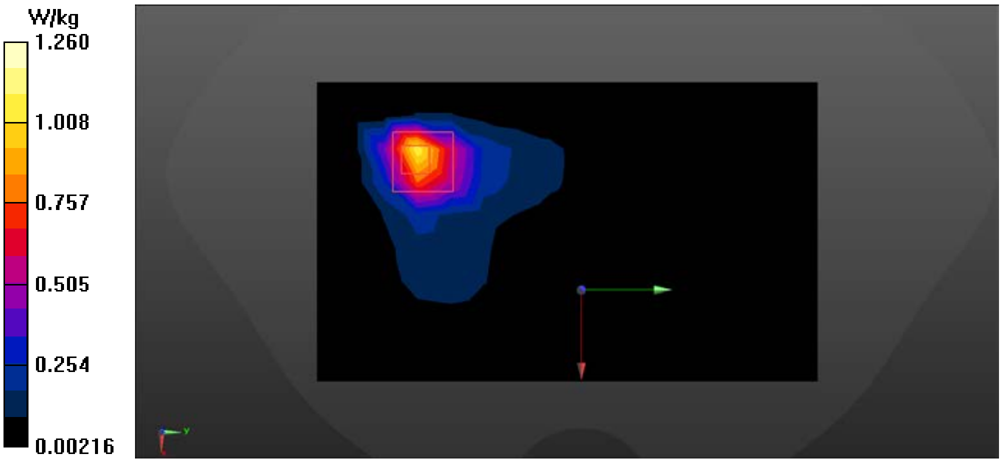
FLAT	Towards ground(0mm) Channel:1

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2412 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.933 S/m; ε_r = 53.16; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG L 0mm/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 1.09 W/kg
Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG L 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.480 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 2.55 W/kg
SAR(1 g) = 0.949 W/kg; SAR(10 g) = 0.387 W/kg
Maximum value of SAR (measured) = 1.26 W/kg

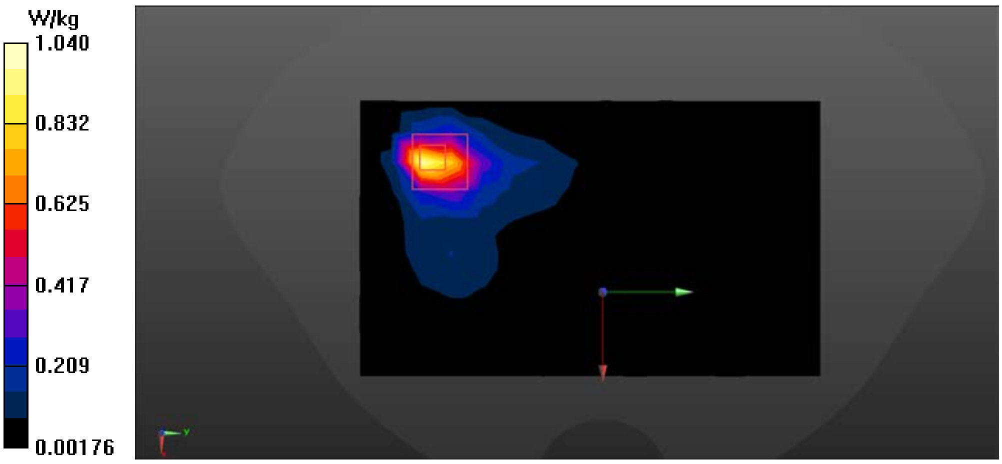


FLAT	Towards ground(0mm) Channel:6

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)
  Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG 0mm/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
  Maximum value of SAR (measured) = 0.998 W/kg
  Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 2.633 V/m; Power Drift = 0.09 dB
  Peak SAR (extrapolated) = 2.12 W/kg
  SAR(1 g) = 0.786 W/kg; SAR(10 g) = 0.321 W/kg
  Maximum value of SAR (measured) = 1.04 W/kg



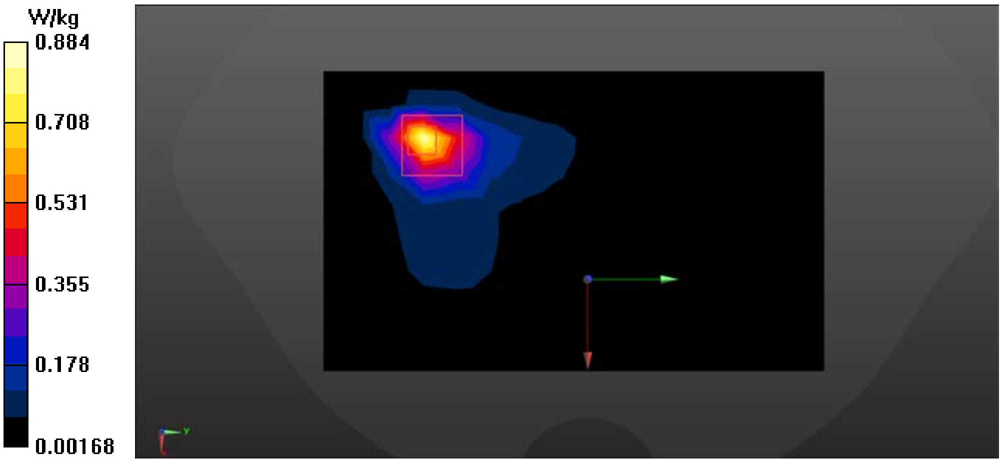
FLAT	Towards ground(0mm) Channel:11

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2462 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2462 MHz; σ = 2.019 S/m; ε_r = 51.992; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG H 0mm/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.851 W/kg
Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TG H 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.834 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 1.79 W/kg
SAR(1 g) = 0.649 W/kg; SAR(10 g) = 0.264 W/kg
Maximum value of SAR (measured) = 0.884 W/kg



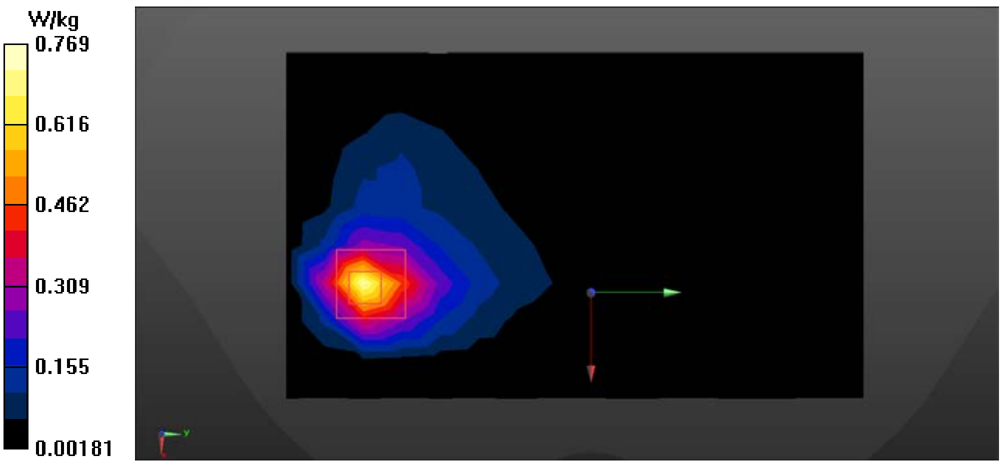
FLAT	Towards phantom(0mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TP 0mm/Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.735 W/kg
Flat-Section MSL WIFI 2.4 11b TG&TP/WIFI 2.4 11b TP 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.782 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 1.29 W/kg
SAR(1 g) = 0.581 W/kg; SAR(10 g) = 0.260 W/kg
Maximum value of SAR (measured) = 0.769 W/kg



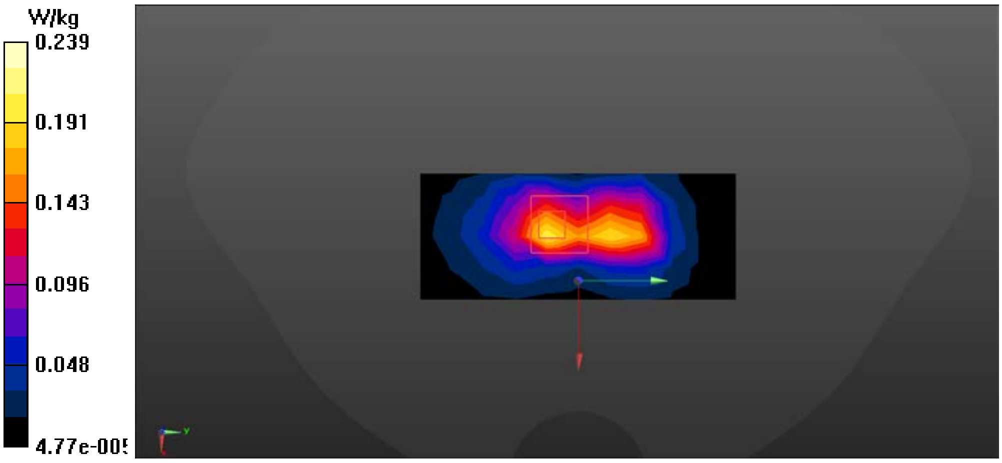
FLAT	EDGE1(0mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b EDGE1&2 HOT/WIFI 2.4 11b EDGE1 0mm/Area Scan (5x11x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.206 W/kg
Flat-Section MSL WIFI 2.4 11b EDGE1&2 HOT/WIFI 2.4 11b EDGE1 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.113 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.374 W/kg
SAR(1 g) = 0.176 W/kg; SAR(10 g) = 0.077 W/kg
Maximum value of SAR (measured) = 0.239 W/kg



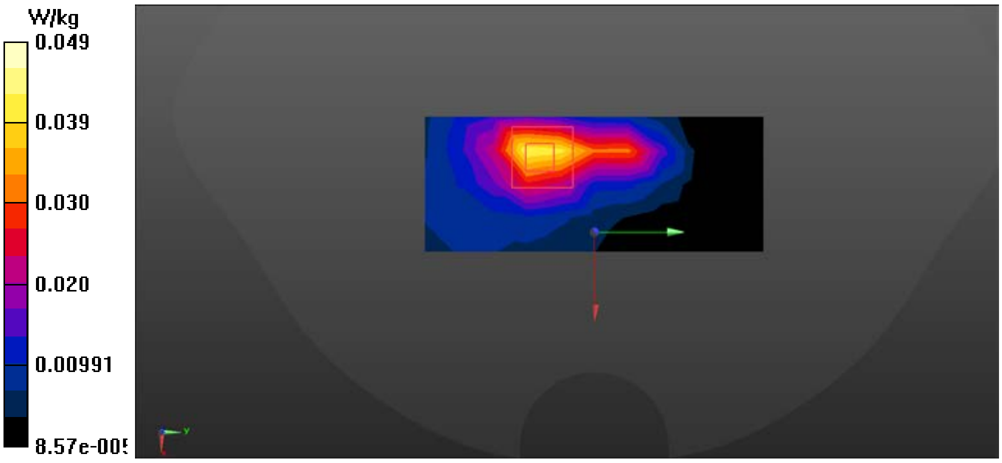
FLAT	EDGE2(0mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)

Flat-Section MSL WIFI 2.4 11b EDGE1&2 HOT/WIFI 2.4 11b EDGE2 0mm/Area Scan (5x11x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 0.0431 W/kg
Flat-Section MSL WIFI 2.4 11b EDGE1&2 HOT/WIFI 2.4 11b EDGE2 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.623 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.0810 W/kg
SAR(1 g) = 0.037 W/kg; SAR(10 g) = 0.017 W/kg
Maximum value of SAR (measured) = 0.0492 W/kg

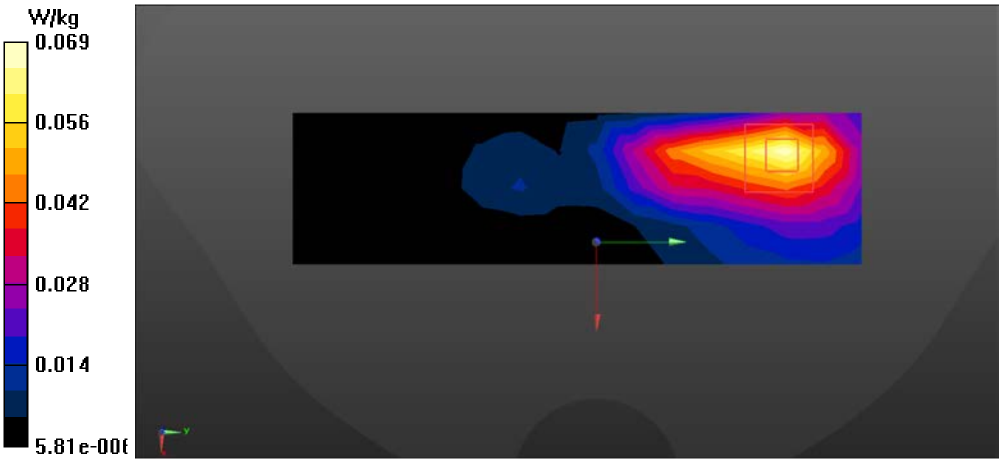


FLAT	EDGE3(0mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)
  Flat-Section MSL WIFI 2.4 11b EDGE3&4 HOT/WIFI 2.4 11b EDGE3 0mm/Area Scan (5x16x1): Measurement grid: dx=12mm, dy=12mm
  Maximum value of SAR (measured) = 0.0683 W/kg
  Flat-Section MSL WIFI 2.4 11b EDGE3&4 HOT/WIFI 2.4 11b EDGE3 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 1.878 V/m; Power Drift = 1.03 dB
  Peak SAR (extrapolated) = 0.112 W/kg
  SAR(1 g) = 0.054 W/kg; SAR(10 g) = 0.027 W/kg
  Maximum value of SAR (measured) = 0.0694 W/kg

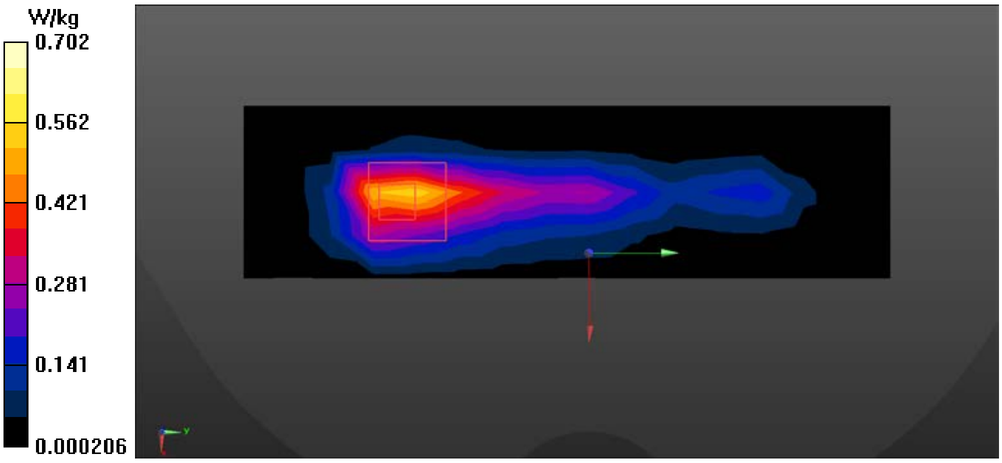


FLAT	EDGE4(0mm)

Communication System: UID 0, IEEE 802.11b WiFi 2.4 GHz (DSSS,1Mbps) (0); Frequency: 2437 MHz;Duty Cycle: 1:1.09901
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.968 S/m; ε_r = 52.699; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: ES3DV3 - SN3127; ConvF(4.28, 4.28, 4.28); Calibrated: 10/11/2017;
- Sensor-Surface: 3mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn720; Calibrated: 10/23/2017
- Phantom: Twin-SAM 1560; Type: QD 000 P40 CD; Serial: 1560
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7373)
  Flat-Section MSL WIFI 2.4 11b EDGE3&4 HOT/WIFI 2.4 11b EDGE4 0mm/Area Scan (5x16x1): Measurement grid: dx=12mm, dy=12mm
  Maximum value of SAR (measured) = 0.555 W/kg
  Flat-Section MSL WIFI 2.4 11b EDGE3&4 HOT/WIFI 2.4 11b EDGE4 0mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
  Reference Value = 12.94 V/m; Power Drift = -0.16 dB
  Peak SAR (extrapolated) = 1.21 W/kg
  SAR(1 g) = 0.495 W/kg; SAR(10 g) = 0.208 W/kg
  Maximum value of SAR (measured) = 0.702 W/kg



ANNEX B – RELEVANT PAGES FROM CALIBRATION REPORTS

DAE4 Sn:720

In Collaboration with speag CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Client : SRTC Certificate No: Z17-97215

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 720
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	October 24, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Process Calibrator 753	1971018	27-Jun-17 (CTTL, No.J17X05858)	June-18

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

Issued: October 26, 2017

In Collaboration with speag CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Glossary:

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

Methods Applied and Interpretation of Parameters:

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.

In Collaboration with speag CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DC Voltage Measurement

A/D - Converter Resolution nominal
High Range: 1LSB = 6.1μV , full range = -100...+300 mV
Low Range: 1LSB = 61nV , full range = -1.......+3mV
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.393 ± 0.15% (k=2)	404.822 ± 0.15% (k=2)	403.251 ± 0.15% (k=2)
Low Range	3.95425 ± 0.7% (k=2)	3.96391 ± 0.7% (k=2)	3.95540 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	24.5° ± 1 °

ES3DV3 Sn:3127

In Collaboration with s p e a g CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client SRTC Certificate No: Z17-97142

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3127

Calibration Procedure(s): FF-Z11-004-01
Calibration Procedures for Dosimetric E-field Probes

Calibration date: October 11, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Power sensor NRP-Z91	101547	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Power sensor NRP-Z91	101548	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Reference10dBAttenuator	18N50W-10dB	13-Mar-16(CTTL,No.J16X01547)	Mar-18
Reference20dBAttenuator	18N50W-20dB	13-Mar-16(CTTL, No.J16X01548)	Mar-18
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 549	13-Dec-16(SPEAG, No.DAE4-549_Dec16)	Dec -17
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
SignalGeneratorMG3700A	6201052605	27-Jun-17 (CTTL, No.J17X05858)	Jun-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan -18

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

Issued: October 12, 2017

In Collaboration with s p e a g CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

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

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Probe ES3DV3

SN: 3127

Calibrated: October 11, 2017

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	1.28	1.29	1.22	±10.0%
DCP(mV)[B]	103.2	105.3	105.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	282.3	±2.5%
		Y	0.0	0.0	1.0		280.9	
		Z	0.0	0.0	1.0		275.1	

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

[A] The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5 and Page 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

ES3DV3 Sn:3127

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity[F]	Conductivity (S/m)[F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	41.9	0.89	6.26	6.26	6.26	0.60	1.20	±12.1%
900	41.5	0.97	6.15	6.15	6.15	0.37	1.62	±12.1%
1810	40.0	1.40	5.06	5.06	5.06	0.67	1.23	±12.1%
2000	40.0	1.40	4.88	4.88	4.88	0.67	1.23	±12.1%
2300	39.5	1.67	4.71	4.71	4.71	0.90	1.06	±12.1%
2450	39.2	1.80	4.58	4.58	4.58	0.90	1.10	±12.1%
2600	39.0	1.96	4.32	4.32	4.32	0.90	1.09	±12.1%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz][C]	Relative Permittivity[F]	Conductivity (S/m)[F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
750	55.5	0.96	6.18	6.18	6.18	0.45	1.45	±12.1%
900	55.0	1.05	6.06	6.06	6.06	0.46	1.48	±12.1%
1810	53.3	1.52	4.83	4.83	4.83	0.65	1.29	±12.1%
2000	53.3	1.52	4.69	4.69	4.69	0.44	1.69	±12.1%
2300	52.9	1.81	4.43	4.43	4.43	0.90	1.15	±12.1%
2450	52.7	1.95	4.28	4.28	4.28	0.72	1.34	±12.1%
2600	52.5	2.16	4.07	4.07	4.07	0.90	1.16	±12.1%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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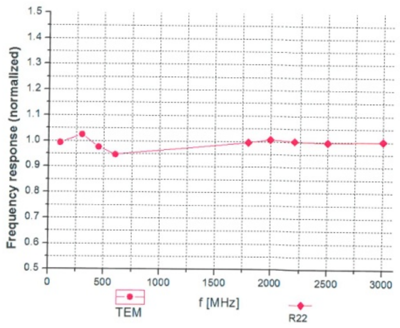
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



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

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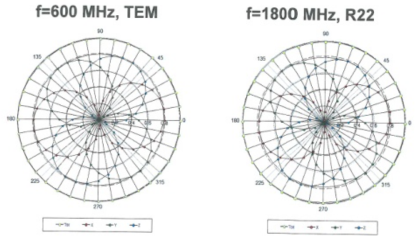
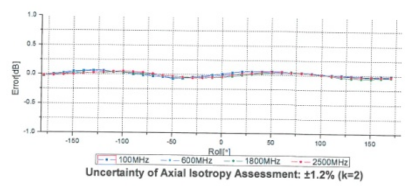
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM   f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

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ES3DV3 Sn:3127

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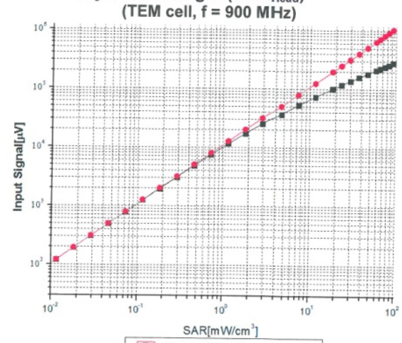
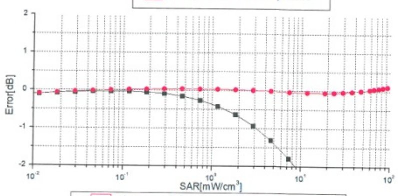
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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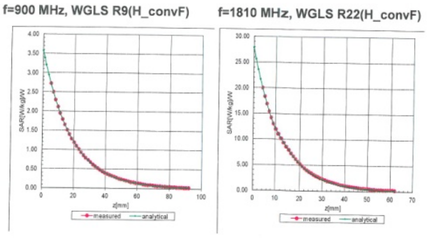
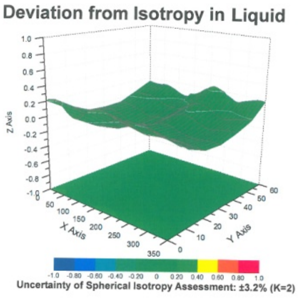
Conversion Factor Assessment

f=900 MHz, WGLS R9(H_convF) f=1810 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (K=2)

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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3127

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	165.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	10mm
Tip Diameter	4mm
Probe Tip to Sensor X Calibration Point	2mm
Probe Tip to Sensor Y Calibration Point	2mm
Probe Tip to Sensor Z Calibration Point	2mm
Recommended Measurement Distance from Surface	3mm

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Appendix: Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB√μV	C	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.0	0.0	1.0	282.3	±2.5%
			Y	0.0	0.0	1.0	280.9	
			Z	0.0	0.0	1.0	275.1	
10012	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	1.87	X	2.77	68.02	18.46	143.0	±1.8%
			Y	2.75	68.05	18.52	145.0	
			Z	2.71	67.79	18.25	142.3	
10100	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	5.67	X	6.13	66.4	18.97	141.9	±1.9%
			Y	6.15	66.49	19.06	144.2	
			Z	6.09	66.32	18.90	140.9	
10108	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	5.80	X	6.09	66.24	19.07	139.5	±1.9%
			Y	6.10	66.33	19.15	141.5	
			Z	6.05	66.19	19.05	138.0	
10154	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	5.75	X	5.81	65.85	18.93	136.1	±1.9%
			Y	5.82	65.92	19.01	137.8	
			Z	5.79	65.89	18.97	134.7	
10169	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	5.73	X	4.84	65.92	19.20	130.8	±1.9%
			Y	4.82	65.98	19.27	131.3	
			Z	4.80	66.00	19.29	129.1	
10175	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	5.72	X	4.88	66.14	19.40	131.6	±1.9%
			Y	4.83	66.08	19.33	130.9	
			Z	4.79	66.02	19.29	129.3	
10297	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	5.81	X	6.19	66.61	19.42	141.9	±1.9%
			Y	6.13	66.43	19.26	140.7	
			Z	6.14	66.52	19.33	139.6	

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D2450V2 Sn:738

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CALIBRATION
CNAS L0570

Client SRTC Certificate No: Z17-97140

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 738
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	September 18, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 1331	19-Jan-17(CTTL-SPEAG,No.Z17-97015)	Jan-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

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

Issued: September 21, 2017

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

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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

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Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.10.0.1446
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.7 ± 6 %	1.79 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**52.4 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.10 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 mW /g ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.5 ± 6 %	1.98 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**52.3 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.3 mW /g ± 18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.3Ω+ 5.92jΩ
Return Loss	- 24.5dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.6Ω+ 6.39jΩ
Return Loss	- 23.1dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.268 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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D2450V2 Sn:738

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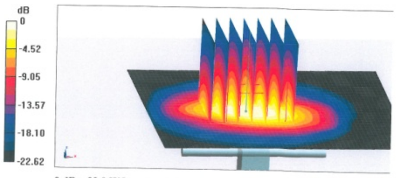
DASY5 Validation Report for Head TSL Date: 09.18.2017
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 738
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.788 S/m; εr = 38.67; ρ = 1000 kg/m3
Phantom section: Left Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.45, 7.45, 7.45); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.1 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.8 W/kg
SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.1 W/kg
Maximum value of SAR (measured) = 22.0 W/kg



0 dB = 22.0 W/kg = 13.42 dBW/kg

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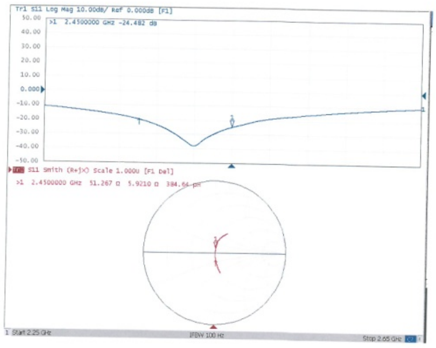
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



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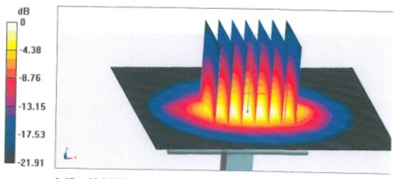
DASY5 Validation Report for Body TSL Date: 09.18.2017
Test Laboratory: CTTL, Beijing, China
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 738
Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.983 S/m; ε_r = 52.51; ρ = 1000 kg/m^3
Phantom section: Center Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.46, 7.46, 7.46); Calibrated: 9/26/2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 1/19/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.41 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 27.8 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.1 W/kg
Maximum value of SAR (measured) = 22.3 W/kg



0 dB = 22.3 W/kg = 13.48 dBW/kg

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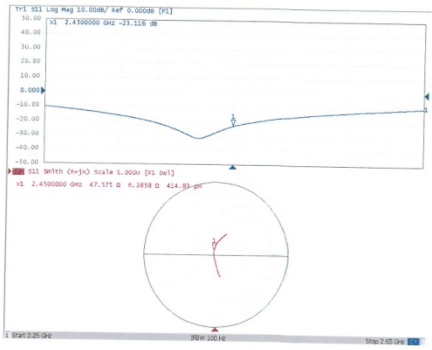
Impedance Measurement Plot for Body TSL



--End of the test report---