

Prüfbericht-Nr.: <i>Test Report No.:</i>	50050527 007	Auftrags-Nr.: <i>Order No.:</i>	164090929	Seite 1 von 34 <i>Page 1 of 34</i>	
Kunden-Referenz-Nr.: <i>Client Reference No.:</i>	N/A	Auftragsdatum: <i>Order date:</i>	17.04.2017		
Auftraggeber: <i>Client:</i>	GIEC TECHNOLOGY (HONG KONG) CO., LTD. Unit 7, 22/F., Billion Trade Centre, 31 Hung To Road, Kwun Tong, Hongkong				
Prüfgegenstand: <i>Test item:</i>	11.6" windows tablet				
Bezeichnung / Typ-Nr.: <i>Identification / Type No.:</i>	NS-P11W7100, NS-P11W7100-C, NS-P11xxxxxxxx (x=0-9, A-Z, a-z, -or blank, for market purpose only)				
Auftrags-Inhalt: <i>Order content:</i>	FCC/IC Certification				
Prüfgrundlage: <i>Test specification:</i>	CFR Title 47 Part 2 Subpart J Section 2.1093 ANSI/IEEE C95.1-1992 IEEE 1528-2013 KDB 447498 D01 v06 KDB 248227 D01 v02 RSS-102 Issue 5 March 2015				
Wareneingangsdatum: <i>Date of receipt:</i>	17.04.2017				
Prüfmuster-Nr.: <i>Test sample No.:</i>	A000530521-002				
Prüfzeitraum: <i>Testing period:</i>	26.05.2017 - 27.05.2017				
Ort der Prüfung: <i>Place of testing:</i>	Shenzhen EMTEK Co., Ltd.				
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shenzhen) Co., Ltd.				
Prüfergebnis*: <i>Test result*:</i>	Pass				
geprüft von / tested by: 	kontrolliert von / reviewed by: 				
26-06-2017 Datum Date	Andy Yan/Project Manager Name / Stellung Name / Position	Unterschrift Signature	26-06-2017 Datum Date	Owen Tian/Technical Certifier Name / Stellung Name / Position	Unterschrift Signature
Sonstiges / Other:	FCC ID: 2AIB2-P11W7100W IC: 21456-P11W7100W				
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i>				
* Legende: Legend: P(pass) = entspricht o.g. Prüfgrundlage(n) P(pass) = passed a.m. test specification(s)	1 = sehr gut 1 = very good	2 = gut 2 = good	3 = befriedigend 3 = satisfactory	4 = ausreichend 4 = sufficient	5 = mangelhaft. N/A = nicht anwendbar N/A = not applicable N/T = nicht getestet N/T = not tested
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>					

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STATEMENT OF COMPLIANCE

TEST ITEM	SPECIFICATION	RESULT
Specific Absorption Rate - Wi-Fi 802.11 b/g/n - 2.4GHz Band		PASS
Specific Absorption Rate - Wi-Fi 802.11 a/n/ac - 5GHz Band U-NII-1	Exposure Rules 47 C.F.R 2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices	PASS
Specific Absorption Rate - Wi-Fi 802.11 a/n/ac - 5GHz Band U-NII-2A	KDB 447498 D01 General RF Exposure Guidance v06	PASS
Specific Absorption Rate - Wi-Fi 802.11 a/n/ac - 5GHz Band U-NII-2C	KDB 248227 D01 802.11 Wi-Fi SAR v02r01 KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03	PASS
Specific Absorption Rate - Wi-Fi 802.11 a/n/ac - 5GHz Band U-NII-3	KDB 865664 D02 RF Exposure Reporting v01r01 KDB 616217 D04 SAR for laptop and tablets v01r01	PASS
Specific Absorption Rate – Bluetooth BDR/EDR/LE - 2.4GHz Band		PASS

This device complies with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6W/kg) specified in CFR Title 47 Part 2 Subpart J Section 2.1093 and ANSI/IEEE C95.1-1992.

This device has been tested in accordance with the measurement methods and procedure specified in IEEE 1528-2003 and Published RF exposure KDB procedures

Refer to the maximum results of Specific Absorption Rate (SAR) during testing as below.

FREQUENCY BAND	EXPOSURE POSITION	EQUIPMENT CLASS	HIGHEST REPORTED SAR VALUE (W/KG)
802.11 b/g/n - 2.4GHz Band	Body	DTS	0.659
802.11 a/n/ac - 5GHz Band U-NII-1	Body	NII	0.509
802.11 a/n/ac - 5GHz Band U-NII-2A	Body		0.564
802.11 a/n/ac - 5GHz Band U-NII-2C	Body		0.659
802.11 a/n/ac - 5GHz Band U-NII-3	Body		0.644

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1. General Remarks

1.1 Complementary Materials

All attachments are integral parts of this test report. This applies especially to the following appendix:

Appendix A: System Performance Check and Test Plots
Appendix B: Calibration Certificate

2. Test Sites

2.1 Test Facilities

Shenzhen EMTEK Co., Ltd.

Bldg 69, Majialong Industry Zone, Nanshan District,
Shenzhen, Guangdong, P.R. China

The tests at the test site have been conducted under the supervision of a TÜV engineer.

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2.2 List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
Signal Generator	Agilent	N5181A	MY50145187	2016-05-28	1year
RF Power Meter. Dual Channel	BOONTON	4232A	10539	2016-05-28	1year
Power Sensor	BOONTON	51011EMC	34236/34238	2016-05-28	1year
Wideband Radio Communication Tester	R&S	CMW500	1201.0002K50-140822zk	2016-05-28	1year
Signal Analyzer	Agilent	N9010A	My53470879	2016-05-28	1year
Network Analyzer	Agilent	E5071C	MY46316645	2016-05-28	1year
E-Field Probe	SPEAG	EX3DV4	3970	2016-09-07	1year
DAE	SPEAG	DAE4	1341	2016-09-05	1year
Validation Kit 2450MHz	SPEAG	D2450V2	927	2016-10-02	3years
Validation Kit 5GHz	SPEAG	D5GHzV2	1169	2016-06-17	3years
Dual Directional Coupler	Agilent	EE393	TW5451008	2016-05-28	1year
10dB Attenuator	Mini-Circuits	15542	3 1344	2016-05-28	1year
10dB Attenuator	Mini-Circuits	15542	3 1415	2016-05-28	1year
30dB Attenuator	Mini-Circuits	15542	3 1420	2016-05-28	1year
Power Amplifier	MILMEGA	80RF1000-175	1059345	2016-05-28	1 Year
Power Amplifier	MILMEGA	AS0102-55	1018770	2016-05-28	1 Year
Power Amplifier	MILMEGA	AS1860-50	1059346	2016-05-28	1 Year
Power Meter	Agilent	N1918A	MY54180006	2016-05-28	1 Year
ELI V5.0	SPEAG	QD 0VA 022 AA	1231	N/A	N/A
Device Holder	SPEAG	N/A	N/A	N/A	N/A
SAR Test System	SPEAG	DASY52 SAR TX60XL	F13/5R4XA1/A/01	2016-05-15	1 Year

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3. General Product Information

3.1 Product Function and Intended Use

The EUTs are 11.6" windows tablet with Wi-Fi, Bluetooth function.

These models are identical except the model name.

The EUTs have two antennas, two antennas cannot transmitter simultaneously.

For details refer to the User Manual and Circuit Diagram.

3.2 Ratings and System Details

Table 2: Technical Specification of Wi-Fi

Technical Specification	Value
Kind of Equipment	11.6" windows tablet
Type Designation	NS-P11W7100, NS-P11W7100-C, NS-P11xxxxxxxx (x=0-9, A-Z, a-z, - or blank, for market purpose only)
FCC ID	2AIB2-P11W7100W
IC	21456-P11W7100W
Operating Frequency band	2400 – 2483.5MHz, 5150 – 5850MHz
Extreme Temperature Range	0~+40°C
Operation Voltage	DC 3.7V (via built in battery)
Hardware version:	S116CJR110-CC34A
Software version:	BIOS: BI-11.6-S116CJR100-CC34A-029-S, 5/19/2017
	OS: 10.0.14393 Build 14393(1607)
Antenna Gain	1.6dBi

Table 3: Technical Specification of 2.4GHz, 802.11b/g/n

Item	Description			
	IEEE 802.11b	IEEE 802.11g	IEEE 802.11n (HT20)	IEEE 802.11n (HT40)
Operating Frequency band (MHz)	2412 ~ 2472	2412 ~ 2472	2412 ~ 2472	2422 ~ 2452
Channel Number	13	13	13	9
Modulation	DSSS (DBPSK, DQPSK), CCK	OFDM (DBPSK, DQPSK)	OFDM (BPSK, QPSK, 16-QAM, 64-QAM)	OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
Data Rate (Mbps)	1, 2, 5, 11	6, 9, 12, 18, 24, 36, 48, 54	MCS0 ~ MCS7	MCS0 ~ MCS7
Transmitter Output Power (Typical) (dBm)	13	13	13	13
Media Access Protocol	CSMA/CA with ACK	CSMA/CA with ACK	CSMA/CA with ACK	CSMA/CA with ACK

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Table 4: List of WLAN Channel of 802.11b/g/n

802.11b		802.11g		802.11n (HT20)		802.11n (HT40)	
Channel Number	Frequency (MHz)						
1	2412	1	2412	1	2412	3	2422
2	2417	2	2417	2	2417	4	2427
3	2422	3	2422	3	2422	5	2432
4	2427	4	2427	4	2427	6	2437
5	2432	5	2432	5	2432	7	2442
6	2437	6	2437	6	2437	8	2447
7	2442	7	2442	7	2442	9	2452
8	2447	8	2447	8	2447		
9	2452	9	2452	9	2452		
10	2457	10	2457	10	2457		
11	2462	11	2462	11	2462		

Table 5: Technical Specification of 5GHz, 802.11a/n

Operating mode(s) / WiFi:	IEEE 802.11a	IEEE 802.11n HT20	IEEE 802.11n HT40
Test modulation	OFDM (BPSK, QPSK, 16-QAM, 64-QAM)	OFDM (BPSK, QPSK, 16-QAM, 64-QAM)	OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
Transmit Frequency Range (MHz):	5180 - 5825	5180 - 5825	5180 - 5825
Channel Number	25	25	12
Data Rate (Mbps)	6, 9, 12, 18, 24, 36, 48, 54	MCS0 ~ MCS7	MCS0 ~ MCS7
Maximum tune-up average output power (dBm):	11	9	9
Media Access Protocol	CSMA/CA with ACK	CSMA/CA with ACK	CSMA/CA with ACK

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Table 6: Technical Specification of 5GHz, 802.11ac

Operating mode(s) / WiFi:	IEEE 802.11ac VHT20	IEEE 802.11ac VHT40	IEEE 802.11ac VHT80
Test modulation	OFDM (BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM)	OFDM (BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM)	OFDM (BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM)
Transmit Frequency Range (MHz):	5180 - 5825	5180 - 5825	5180 - 5825
Channel Number	25	12	6
Data Rate (Mbps)	MCS0 ~ MCS8	MCS0 ~ MCS9	MCS0 ~ MCS9
Maximum tune-up average output power (dBm):	10	9	9
Media Access Protocol	CSMA/CA with ACK	CSMA/CA with ACK	CSMA/CA with ACK

Table 7: List of WLAN Channel of 5GHz 802.11a/n

802.11a		802.11n HT20		802.11n HT40	
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
36	5180	36	5180	38	5190
40	5200	40	5200	46	5230
44	5220	44	5220	54	5270
48	5240	48	5240	62	5310
52	5260	52	5260	102	5510
56	5280	56	5280	110	5550
60	5300	60	5300	118	5590
64	5320	64	5320	126	5630 (only for FCC)
100	5500	100	5500	134	5670
104	5520	104	5520	142	5710
108	5540	108	5540	151	5755
112	5560	112	5560	159	5795
116	5580	116	5580		
120	5600 (only for FCC)	120	5600 (only for FCC)		
124	5620 (only for FCC)	124	5620 (only for FCC)		
128	5640 (only for FCC)	128	5640 (only for FCC)		
132	5660	132	5660		
136	5680	136	5680		
140	5700	140	5700		
144	5720	144	5720		
149	5745	149	5745		
153	5765	153	5765		
157	5785	157	5785		
161	5805	161	5805		
165	5825	165	5825		

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Table 8: List of WLAN Channel of 5GHz 802.11ac

802.11ac VHT20		802.11ac VHT40		802.11ac VHT80	
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
36	5180	38	5190	42	5210
40	5200	46	5230	58	5290
44	5220	54	5270	106	5530
48	5240	62	5310	122	5610 (only for FCC)
52	5260	102	5510	138	5690
56	5280	110	5550	155	5775
60	5300	118	5590		
64	5320	126	5630 (only for FCC)		
100	5500	134	5670		
104	5520	142	5710		
108	5540	151	5755		
112	5560	159	5795		
116	5580				
120	5600 (only for FCC)				
124	5620 (only for FCC)				
128	5640 (only for FCC)				
132	5660				
136	5680				
140	5700				
144	5720				
149	5745				
153	5765				
157	5785				
161	5805				
165	5825				

Table 9: Technical Specification of Bluetooth (BDR & EDR mode)

Technical Specification	Value
Kind of Equipment	11.6" windows tablet
Type Designation	NS-P11W7100, NS-P11W7100-C, NS-P11xxxxxxxx (x=0-9, A-Z, a-z, -or blank, for market purpose only)
FCC ID	2AIB2-P11W7100W
IC	21456-P11W7100W
Operating Frequency band	2400 – 2483.5MHz
Channel separation	1MHz
Extreme Temperature Range	0~+40°C
Operation Voltage	DC 3.7V (via built in battery)
Modulation	FHSS, GFSK, 8DPSK, π/4DQPSK
Bluetooth version	4.0, Dual Mode
Antenna Gain	1.6dBi

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Table 10: RF channel and frequency of Bluetooth (BDR & EDR mode)

RF Channel	Frequency (MHz)						
0	2402.00	21	2423.00	42	2444.00	63	2465.00
1	2403.00	22	2424.00	43	2445.00	64	2466.00
2	2404.00	23	2425.00	44	2446.00	65	2467.00
3	2405.00	24	2426.00	45	2447.00	66	2468.00
4	2406.00	25	2427.00	46	2448.00	67	2469.00
5	2407.00	26	2428.00	47	2449.00	68	2470.00
6	2408.00	27	2429.00	48	2450.00	69	2471.00
7	2409.00	28	2430.00	49	2451.00	70	2472.00
8	2410.00	29	2431.00	50	2452.00	71	2473.00
9	2411.00	30	2432.00	51	2453.00	72	2474.00
10	2412.00	31	2433.00	52	2454.00	73	2475.00
11	2413.00	32	2434.00	53	2455.00	74	2476.00
12	2414.00	33	2435.00	54	2456.00	75	2477.00
13	2415.00	34	2436.00	55	2457.00	76	2478.00
14	2416.00	35	2437.00	56	2458.00	77	2479.00
15	2417.00	36	2438.00	57	2459.00	78	2480.00
16	2418.00	37	2439.00	58	2460.00		
17	2419.00	38	2440.00	59	2461.00		
18	2420.00	39	2441.00	60	2462.00		
19	2421.00	40	2442.00	61	2463.00		
20	2422.00	41	2443.00	62	2464.00		

Table 11: Technical Specification of Bluetooth (Low Energy mode)

Technical Specification	Value
Kind of Equipment	11.6" windows tablet
Type Designation	NS-P11W7100, NS-P11W7100-C, NS-P11xxxxxxxx (x=0-9, A-Z, a-z, -or blank, for market purpose only)
FCC ID	2AIB2-P11W7100W
IC	21456-P11W7100W
Operating Frequency band	2400 – 2483.5MHz
Channel separation	2MHz
Extreme Temperature Range	0~+40°C
Operation Voltage	DC 3.7V (via built in battery)
Modulation	GFSK
Bluetooth version	4.0, Dual Mode
Antenna Gain	1.6dBi

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Table 12: RF channel and frequency of Bluetooth (Low Energy mode)

RF Channel	Frequency (MHz)						
0	2402.00	11	2424.00	22	2446.00	33	2468.00
1	2404.00	12	2426.00	23	2448.00	34	2470.00
2	2406.00	13	2428.00	24	2450.00	35	2472.00
3	2408.00	14	2430.00	25	2452.00	36	2474.00
4	2410.00	15	2432.00	26	2454.00	37	2476.00
5	2412.00	16	2434.00	27	2456.00	38	2478.00
6	2414.00	17	2436.00	28	2458.00	39	2480.00
7	2416.00	18	2438.00	29	2460.00		
8	2418.00	19	2440.00	30	2462.00		
9	2420.00	20	2442.00	31	2464.00		
10	2422.00	21	2444.00	32	2466.00		

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3.3 Independent Operation Modes

The basic operation modes are:

- A. On, transmitting
 - 1. 802.11b
 - 2. 802.11g
 - 3. 802.11n (HT20)
 - 4. 802.11n (HT40)
 - 5. 802.11a
 - 6. 802.11ac (VHT20)
 - 7. 802.11ac (VHT40)
 - 8. 802.11ac (VHT80)
 - 9. Bluetooth BDR
 - 10. Bluetooth EDR
 - 11. Bluetooth Low Energy
- B. Off

3.4 Submitted Documents

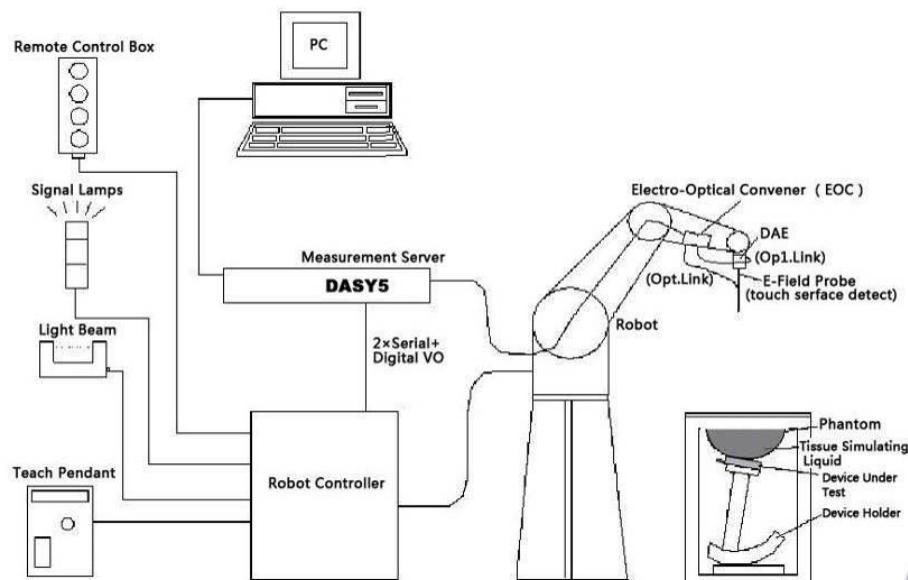
- Bill of Material
- Constructional Drawing
- PCB Layout
- Circuit Diagram
- Instruction Manual
- Rating Label

4. SAR Measurements System Configuration

4.1 SAR Measurements Set-up

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

- A standard high precision 6-axis robot (Stäubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- System validation dipoles allowing to validate the proper functioning of the system.



Picture 1 SAR Lab Test Measurement Set-up

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4.2 DASY5 E-Field Probe System

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

Probe Specifications:

Model: EX3DV4

Frequency Range: 10MHz - 6.0GHz (EX3DV4)

Calibration: In head and body simulating tissue at Frequencies from 835 up to 5800MHz

Linearity: ± 0.2 dB (30 MHz to 6 GHz) for EX3DV4

Dynamic Range: 10 mW/kg - 100W/kg

Probe Length: 330 mm

Probe Tip Length: 20 mm

Body Diameter: 12 mm

Tip Diameter: 2.5 mm

Tip-Center: 1 mm

Application: SAR Dosimetry Testing
Compliance tests of mobile phones
Dosimetry in strong gradient fields**Picture 2 E-field Probe**

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4.3 E-Filed Probe Calibration

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

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

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

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

Where:

Δt = Exposure time (30 seconds),

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

ΔT = Temperature increase due to RF exposure.

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

4.4 Other Test Equipment

4.4.1 Data Acquisition Electronics (DAE)

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

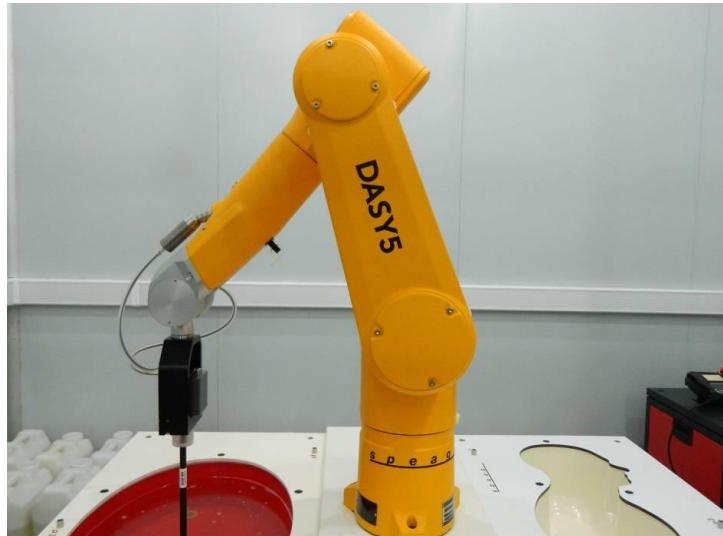
The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

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

4.4.2 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX60XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

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



Picture 3 DASY 5

4.4.3 Measurement Server

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



Picture 4 Server for DASY 5

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a

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watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.

4.4.4 Device Holder for Phantom

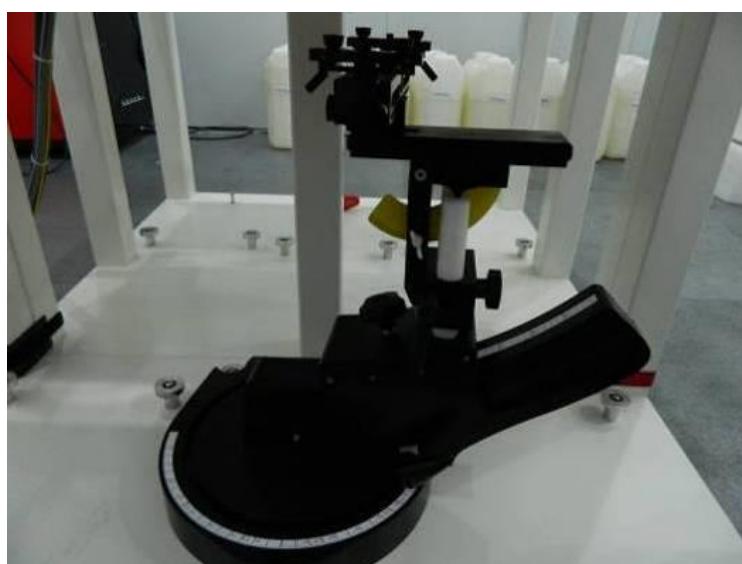
The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of $\pm 0.5\text{mm}$ would produce a SAR uncertainty of $\pm 20\%$. Accurate device positioning is therefore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

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

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

<Laptop Extension Kit>

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



Picture 5 Device Holder

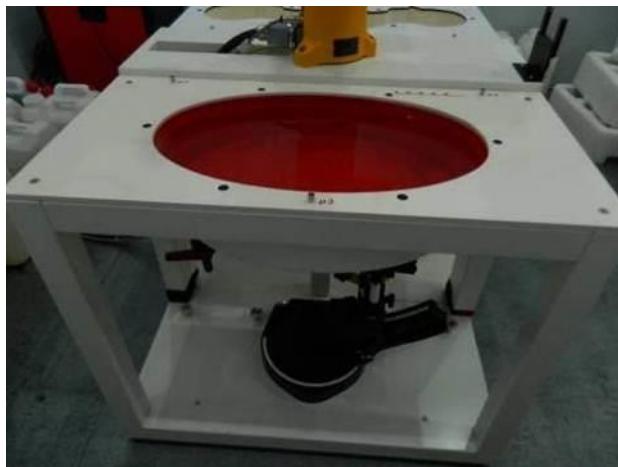
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Page 19 of 34**4.4.5 Phantom**

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

Material	Vinylester, glass fiber reinforced (VE-GF)
Liquid compatibility	Compatible with all SPEAG tissue simulating liquids (incl. DGBE type)
Shell thickness	2.0 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 650 mm, Minor axis: 400 mm
Filling volume	approx. 30 liters
Wooden support	SPEAG standard phantom table



Picture 8 ELI4 Phantom

4.5 Scanning Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. ± 5 %.

The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air

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bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within $\pm 30^\circ$.)

Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing is set according to FCC KDB Publication 865664. During scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

Zoom Scan

After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm.

Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as:

- maximum search
- extrapolation
- boundary correction
- peak search for averaged SAR

During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space.

They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area} , Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom} , Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm) ($\Delta z_{zoom}(n)$)	Minimum Zoom Scan Volume (mm) (x,y,z)
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≥ 30

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2-3 GHz	≤ 12	≤ 5	≤ 5	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≥ 22

4.6 Data Storage and Evaluation

4.6.1 Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DAE4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device set up, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a loss less media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

4.6.2 Data Evaluation by SEMCAD

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters: - Sensitivity Norm_i, a_{i0}, a_{i1}, a_{i2}

- Conversion factor ConvF_i

- Diode compression point Dcp_i

Device parameters: - Frequency f

- Crest factor cf

Media parameters: - Conductivity
- Density

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot c f / dcp_i$$

With V_i = compensated signal of channel i ($i = x, y, z$)

U_i = input signal of channel i ($i = x, y, z$)

cf = crest factor of exciting field (DASY parameter)

dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes: $E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$

H-field probes: $H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1} f + a_{i2} f^2) / f$

With V_i = compensated signal of channel i ($i = x, y, z$)

$Norm_i$ = sensor sensitivity of channel i ($i = x, y, z$)

[mV/(V/m)²] for E-field Probes

$ConvF$ = sensitivity enhancement in solution

a_{ij} = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]

E_i = electric field strength of channel i in V/m

H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = (E_x^2 + E_y^2 + E_z^2)^{1/2}$$

The primary field data are used to calculate the derived field units.

$$SAR = (E_{tot}) 2 \cdot \sigma / (\rho \cdot 1000)$$

with SAR = local specific absorption rate in mW/g

E_{tot} = total field strength in V/m

= conductivity in [mho/m] or [Siemens/m]

= equivalent tissue density in g/cm³

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = E_{tot}^2 / 3770 \text{ or } P_{pwe} = H_{tot}^2 \cdot 37.7$$

with P_{pwe} = equivalent power density of a plane wave in mW/cm²

E_{tot} = total electric field strength in V/m; H_{tot} = total magnetic field strength in A/m

5. Test Set-up and Operation Modes

5.1 Principle of Configuration Selection

The EUT is commanded to operate at maximum transmitting power. The EUT shall use its internal transmitter. The antenna, battery and accessories shall be those specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

Table 13: Configuration of EUT

Operation mode	Frequency Range (MHz)	Modulation	Default Test Channel			Power Control Level
			Low	Middle	High	
802.11b/g/n(HT20)	2412-2462	DSSS, OFDM	CH1	CH6	CH11	Test software was used to configure the EUT to transmit at maximum output power
802.11n(HT40)	2422-2452	OFDM	CH3	CH6	CH9	
802.11a/n(HT20)/ac(VH T20) (Band U-NII-1)	5180-5240	OFDM	CH36	CH40	CH48	
802.11a/n(HT20)/ac(VH T20) (Band U-NII-2A)	5260-5320	OFDM	CH52	CH60	CH64	
802.11a/n(HT20)/ac(VH T20) (Band U-NII-2C)	5500-5720	OFDM	CH100	CH120	CH144	
802.11a/n(HT20)/ac(VH T20) (Band U-NII-3)	5745-5825	OFDM	CH149	CH157	CH165	
802.11n(HT40)/ac(VHT 40) (Band U-NII-1)	5180-5240	OFDM	CH38	---	CH46	
802.11n(HT40)/ac(VHT 40) (Band U-NII-2A)	5260-5320	OFDM	CH54	---	CH62	
802.11n(HT40)/ac(VHT 40) (Band U-NII-2C)	5500-5720	OFDM	CH101	CH118	CH142	
802.11n(HT40)/ac(VHT 40) (Band U-NII-3)	5745-5825	OFDM	CH151	---	CH159	
802.11ac(VHT80) (Band U-NII-1)	5180-5240	OFDM	---	CH42	---	
802.11ac(VHT80) (Band U-NII-2A)	5260-5320	OFDM	---	CH58	---	
802.11ac(VHT80) (Band U-NII-2C)	5500-5720	OFDM	CH106	CH122	CH138	
802.11ac(VHT80) (Band U-NII-3)	5745-5825	OFDM	---	CH155	---	
Bluetooth (BDR & EDR)	2402-2480	FHSS	CH0	CH39	CH78	
Bluetooth (Low Energy)	2402-2480	GFSK	CH0	CH19	CH39	

5.2 Tissue Simulating Liquid Ingredients

The liquid is consisted of Water, Salt, Glycol and DGBE. The liquid has previously been proven to be suited for worst-case. The following table shows the detail solution.

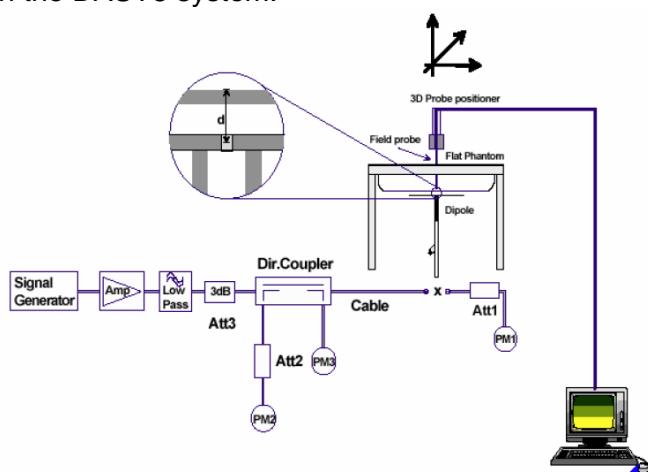
Table 14: Composition of Tissue Simulating Liquid

MIXTURE%(Weight)	FREQUENCY (Body) 2450MHz
Water	73.2
Glycol	26.7
Salt	0.1
Dielectric Parameters Target Value	f=2450MHz $\epsilon=52.70$ $\sigma=1.95$

MIXTURE%(Weight)	FREQUENCY (Body) 5GHz
Water	75.68
DGBE	4.42
Triton X-100	19.47
Salt	0.43
Dielectric Parameters Target Value	f=5200MHz $\epsilon=49.00$ $\sigma=5.30$ f=5300MHz $\epsilon=48.90$ $\sigma=5.42$ f=5500MHz $\epsilon=48.60$ $\sigma=5.65$ f=5600MHz $\epsilon=48.50$ $\sigma=5.77$ f=5800MHz $\epsilon=48.20$ $\sigma=6.00$

5.3 Specific Absorption Rate (SAR) System Check

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyzer. 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 check results (dielectric parameters and SAR values) are given in Appendix A. System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system ($\pm 10\%$). System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



Picture 9 System Check Set-up

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Table 15: System Check Results of Tissue Simulating Liquid

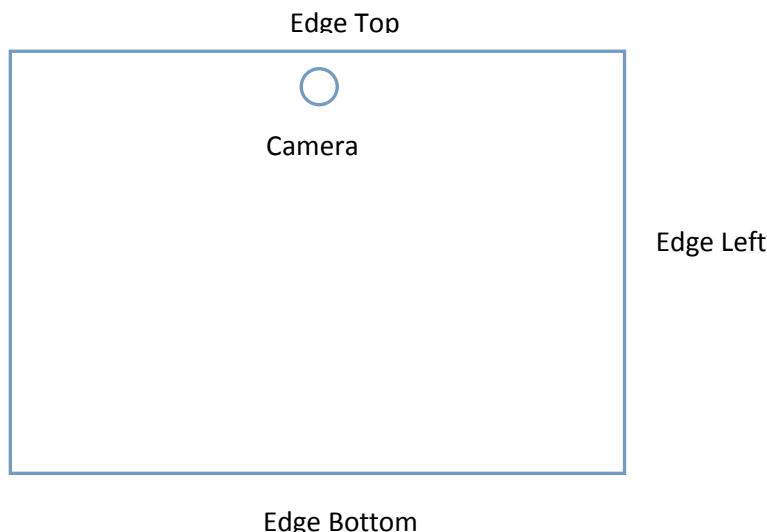
Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity (σ)	Permittivity (ϵ_r)	Conductivity Target (σ)	Permittivity Target (ϵ_r)	Delta (σ) (%)	Delta (ϵ_r) (%)	Limit (%)	Date
2450	Body	22.5	2.026	52.972	1.95	52.70	3.90	0.52	± 5	2017-05-27
5200	Body	22.8	5.164	50.130	5.30	49.00	-2.57	2.31	± 5	2017-05-26
5300	Body	22.7	5.323	49.975	5.42	48.90	-1.79	2.20	± 5	2017-05-26
5600	Body	22.4	5.831	49.380	5.77	48.50	1.06	1.81	± 5	2017-05-27
5800	Body	22.6	6.133	48.881	6.00	48.20	2.22	1.41	± 5	2017-05-27

(Liquid depth: 15cm)

Table 16: System Validation

Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)	Date
2450	Body	250	845	3970	1418	12.39	51.20	49.56	-3.20	2017-05-27
5200	Body	100	1040	3970	1418	7.39	72.90	73.9	1.37	2017-05-26
5300	Body	100	1040	3970	1418	7.56	76.40	75.6	-1.05	2017-05-26
5600	Body	100	1040	3970	1418	7.81	78.40	78.1	-0.38	2017-05-27
5800	Body	100	1040	3970	1418	7.49	75.20	74.9	-0.40	2017-05-27

5.4 Exposure Positions Consideration



Produkte

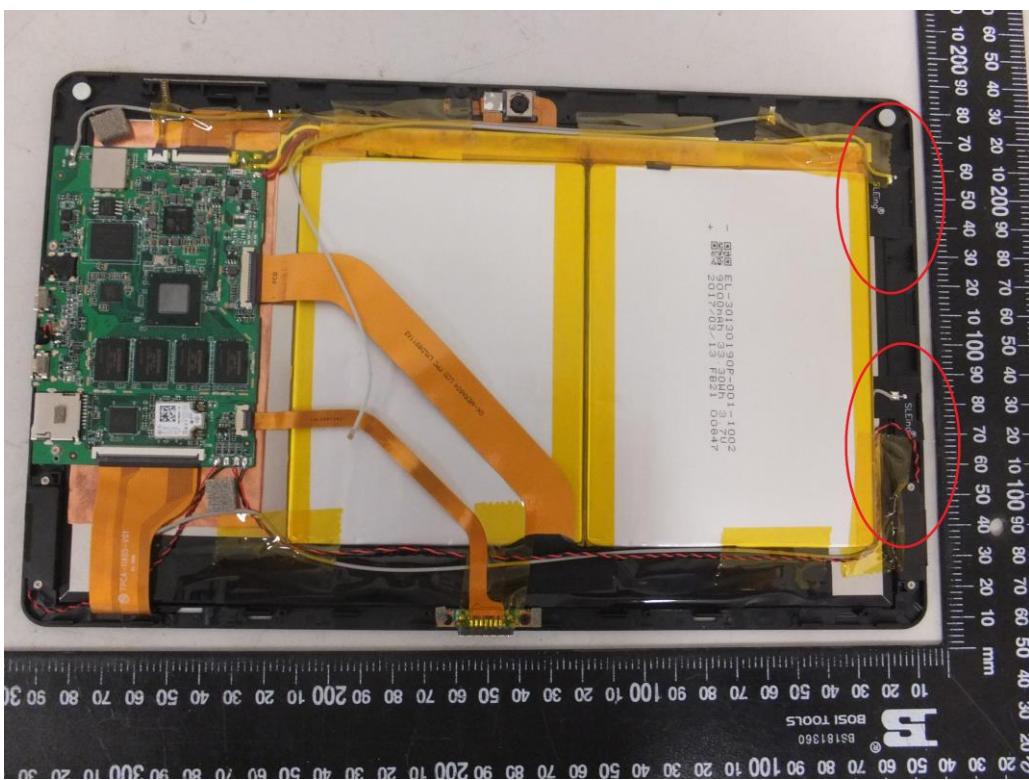
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5.5 Test Operation and Test Software

Test operation refers to test setup in chapter 5.

For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

For the 802.11a/b/g/n/ac SAR tests, a communication link is setup with the test mode software for WiFi mode test, during the test, each test frequency channel, the EUT is operated at the RF continuous emission mode. Each channel should be tested at the lowest data rate. Testing at higher data rates is not required when the maximum average output power is less than 0.25dB higher than those measured at the lowest data rate.

802.11a/b/g/n/ac operating modes are tested independently according to the service requirements in each frequency band. 802.11a/b/g/n/ac modes are tested on the maximum average output channel.

SAR is not required for 802.11g/n channels when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

For the 2.4GHz and 5GHz bands, when the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations, the lower order 802.11 mode is used for SAR measurement.

5.6 Special Accessories and Auxiliary Equipment

None.

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6. Test Results

6.1 Human Exposure to Radiofrequency Electromagnetic Fields

RESULT:
Passed

Date of testing	:	2017-05-26 to 2017-05-27
Test standard	:	CFR Title 47 Part 2 Subpart J Section 2.1093 ANSI/IEEE C95.1-1992 IEEE 1528-2013
FCC KDB Publication	:	KDB 447498 D01 v06 KDB 248227 D01 v01r02 KDB 616217 D04 v01r01 KDB 865664 D01 v01r01
Limits	:	1.6W/kg

Test setup

Operation mode	:	A
Ambient temperature	:	23°C
Relative humidity	:	50%
Atmospheric pressure	:	101.0kPa

Note: Wi-Fi antenna and Bluetooth cannot transmitter simultaneously.

According to the position of antenna and dimension of product, the test was carried out on front face, bottom face & edge 1 (left).

For 2.4GHz 802.11g/n OFDM SAR test, according to clause 5.2.2 b) of KDB 248227 D01 v02r02: the highest report SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is <1.2W/kg, hence this requirement is exclusion.

Test result of Conducted Power of 802.11b

Channel	Channel Frequency (MHz)	Conducted Power (dBm)	
		ANT A	ANT B
Low Channel	2412	12.40	12.17
Middle Channel	2437	12.64	12.83
High Channel	2462	12.19	12.35

Table 17: Test result of Conducted Power of 802.11g

Channel	Channel Frequency (MHz)	Conducted Power (dBm)	
		ANT A	ANT B
Low Channel	2412	11.04	10.52
Middle Channel	2437	11.73	12.95
High Channel	2462	10.20	10.41

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Table 18: Test result of Conducted Power of 802.11n (HT20)

Channel	Channel Frequency (MHz)	Conducted Power (dBm)	
		ANT A	ANT B
Low Channel	2412	10.55	10.33
Middle Channel	2437	12.45	12.72
High Channel	2462	10.68	10.04

Table 19: Test result of Conducted Power of 802.11n (HT40)

Channel	Channel Frequency (MHz)	Conducted Power (dBm)	
		ANT A	ANT B
Low Channel	2422	11.17	10.58
Middle Channel	2437	12.16	11.71
High Channel	2452	10.17	10.56

Table 20: Test result of Conducted Power of Band U-NII-1

Mode	Channel Frequency (MHz)	Conducted Power (dBm)	
		ANT A	ANT B
802.11a	5180	9.92	10.59
	5200	N/A	10.84
	5240	N/A	10.52
802.11n HT20	5180	N/A	7.81
	5200	N/A	8.20
	5240	N/A	8.02
802.11n HT40	5190	N/A	8.62
	5230	N/A	7.86
802.11ac VHT20	5180	N/A	10.12
	5200	N/A	9.79
	5240	N/A	9.54
802.11ac VHT40	5190	N/A	8.54
	5230	N/A	9.03
802.11ac VHT80	5210	N/A	8.43

Table 21: Test result of Conducted Power of Band U-NII-2A

Mode	Channel Frequency (MHz)	Conducted Power (dBm)	
		ANT A	ANT B
802.11a	5260	N/A	10.35
	5280	7.80	10.75
	5320	N/A	10.43
802.11n HT20	5260	N/A	7.84
	5280	N/A	8.28
	5320	N/A	7.83
802.11n HT40	5270	N/A	8.04
	5310	N/A	8.28
802.11ac VHT20	5260	N/A	9.40
	5280	N/A	9.58
	5320	N/A	9.63
802.11ac VHT40	5270	N/A	8.75
	5310	N/A	8.40
802.11ac VHT80	5290	N/A	7.75

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Table 22: Test result of Conducted Power of Band U-NII-2C

Mode	Channel Frequency (MHz)	Conducted Power (dBm)	
		ANT A	ANT B
802.11a	5500	N/A	10.32
	5600	N/A	10.47
	5700	6.91	10.10
802.11n HT20	5500	N/A	8.41
	5600	N/A	7.98
	5700	N/A	7.48
802.11n HT40	5510	N/A	8.39
	5590	N/A	8.26
	5670	N/A	8.51
802.11ac VHT20	5500	N/A	8.41
	5600	N/A	8.23
	5700	N/A	8.26
802.11ac VHT40	5510	N/A	8.53
	5590	N/A	8.54
	5670	N/A	8.62
802.11ac VHT80	5530	N/A	8.55
	5610	N/A	7.85

Table 23: Test result of Conducted Power of Band U-NII-3

Mode	Channel Frequency (MHz)	Conducted Power (dBm)	
		ANT A	ANT B
802.11a	5745	N/A	10.12
	5785	N/A	9.75
	5825	N/A	9.12
802.11n HT20	5745	6.47	7.64
	5785	N/A	7.06
	5825	N/A	6.51
802.11n HT40	5755	N/A	7.60
	5795	N/A	7.13
802.11ac VHT20	5745	N/A	8.63
	5785	N/A	7.11
	5825	N/A	7.57
802.11ac VHT40	5755	N/A	8.70
	5795	N/A	7.26
802.11ac VHT80	5775	N/A	6.99

Maximum Bluetooth Peak Output Power is 4.5dBm which below the threshold of SAR testing 9.5dBm for 2.4GHz ISM Band.

Note: for 5G band, the power of ANT A is less than ANT B, hence only some power were measured as verification.

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Table 24: Initial test configurations Test result of SAR Values

Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Power Setting	configure	Average Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Date
WLAN2.4G	802.11b(A NT a)	Left Edge	0	6	2437	13	1Mbps	12.64	13.00	1.086	-0.07	0.587	0.638	2017-05-27
WLAN2.4G	802.11b(A NT b)	Left Edge	0	6	2437	13	1Mbps	12.83	13.00	1.040	-0.02	0.561	0.583	2017-05-27
WLAN2.4G	802.11b(A NT b)	Bottom Face	0	6	2437	13	1Mbps	12.83	13.00	1.040	-0.12	0.634	0.659	2017-05-27
WLAN2.4G	802.11b(A NT a)	Bottom Face	0	6	2437	13	1Mbps	12.64	13.00	1.086	-0.12	0.388	0.422	2017-05-27
WLAN5G	802.11a(A NT b)	Bottom Face	0	36	5180	11	6Mbps	10.59	11.00	1.099	-0.05	0.463	0.509	2017-05-26
WLAN5G	802.11a(A NT b)	Left Edge	0	36	5180	11	6Mbps	10.59	11.00	1.099	-0.05	0.443	0.487	2017-05-26
WLAN5G	802.11a(A NT b)	Bottom Face	0	56	5280	11	6Mbps	10.75	11.00	1.059	-0.08	0.532	0.564	2017-05-26
WLAN5G	802.11a(A NT b)	Left Edge	0	56	5280	11	6Mbps	10.75	11.00	1.059	-0.08	0.512	0.542	2017-05-26
WLAN5G	802.11a(A NT b)	Bottom Face	0	100	5500	11	6Mbps	10.32	10.50	1.042	-0.02	0.632	0.659	2017-05-27
WLAN5G	802.11a(A NT b)	Left Edge	0	100	5500	11	6Mbps	10.32	10.50	1.042	-0.02	0.413	0.430	2017-05-27
WLAN5G	802.11a(A NT b)	Bottom Face	0	149	5745	11	6Mbps	10.12	10.50	1.091	-0.17	0.59	0.644	2017-05-27
WLAN5G	802.11a(A NT b)	Left Edge	0	149	5745	11	6Mbps	10.12	10.50	1.091	-0.17	0.304	0.332	2017-05-27

Refer to attached Appendix A for details of test results.

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6.2 Measurement Uncertainty

6.2.1 Measurement uncertainty evaluation

The measured SAR were <1.5 W/kg for all frequency bands, therefore per KDB Publication 865664 D01, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports.

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Appendix A

System Performance Check

Test Laboratory: EMTEK (Shenzhen) Co.,Ltd. Date: 27.05.2017

SystemPerformanceCheck-D2450V2-MSL-170527

Communication System: UID 0, CW (0); Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL_2450_170527

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 2.026 \text{ S/m}$; $\epsilon_r = 52.972$; $\rho = 1000 \text{ kg/m}^3$
Ambient Temperature: $23.2 \text{ }^\circ\text{C}$; Liquid Temperature: $22.5 \text{ }^\circ\text{C}$

DASY Configuration:

- Probe: EX3DV4 - SN3873; ConvF(7.30, 7.30, 7.30); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

System Performance Check at Frequency at 2450MHz/d=10mm, Pin=250mW, dist=2.0mm (EX-Probe)/Area Scan (41x61x1): Interpolated grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 17.4 W/kg

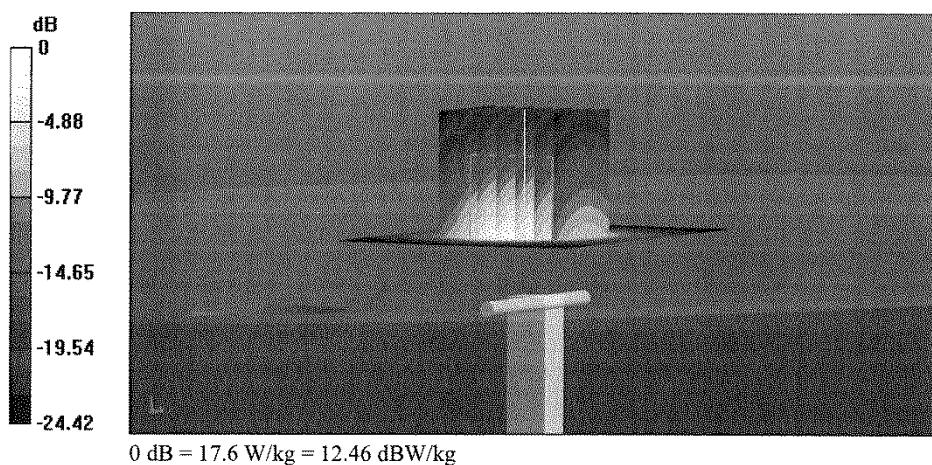
System Performance Check at Frequency at 2450MHz/d=10mm, Pin=250mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.371 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 26.5 W/kg

SAR(1 g) = 12.39 W/kg; SAR(10 g) = 5.78 W/kg

Maximum value of SAR (measured) = 17.6 W/kg



Test Laboratory: EMTEK (Shenzhen) Co.,Ltd.

Date: 26.05.2017

System Performance Check-D5GHzV2-5200MHz-MSL-170526

Communication System: UID 0, CW (0); Frequency: 5200 MHz; Duty Cycle: 1:1
Medium: MSL_5G_170526

Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 5.164 \text{ S/m}$; $\epsilon_r = 50.13$; $\rho = 1000 \text{ kg/m}^3$
Ambient Temperature: 23.2°C ; Liquid Temperature: 22.8°C

DASY Configuration:

- Probe: EX3DV4 - SN3873; ConvF(4.40, 4.40, 4.40); Calibrated: 07.09.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1341; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

System Performance Check at Frequency at 5200MHz/d=10mm, Pin=100mW, dist=1.4mm (EX-Probe)/Area Scan (91x91x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 17.3 W/kg

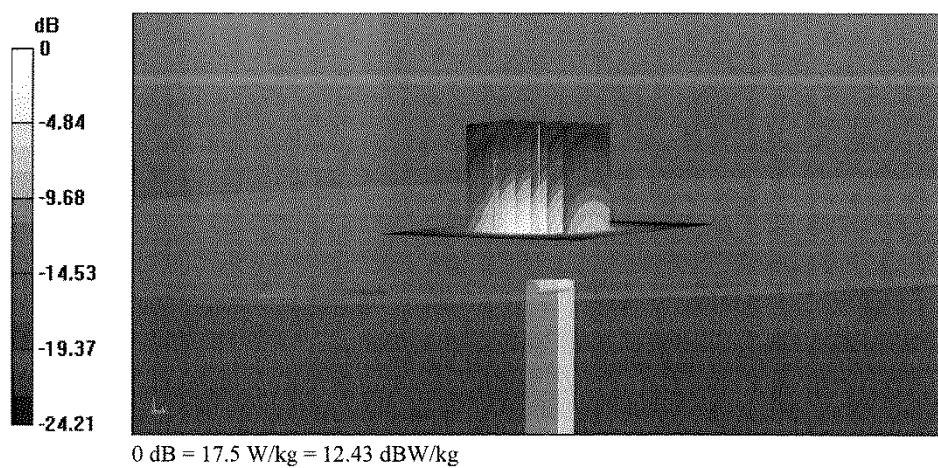
System Performance Check at Frequency at 5200MHz/d=10mm, Pin=100mW, dist=1.4mm (EX-Probe)/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 59.051 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 32.3 W/kg

SAR(1 g) = 7.39 W/kg; SAR(10 g) = 2.051 W/kg

Maximum value of SAR (measured) = 17.5 W/kg



Test Laboratory: EMTEK (Shenzhen) Co.,Ltd.

Date/Time: 26.05.2017

SystemPerformanceCheck-D5GHzV2-5300MHz-MSL-170511

Communication System: UID 0, CW (0); Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: MSL_5G_170526

Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 5.323 \text{ S/m}$; $\epsilon_r = 49.975$; $\rho = 1000 \text{ kg/m}^3$
Ambient Temperature: 23.3 °C; Liquid Temperature: 22.7 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.75, 4.75, 4.75); Calibrated: 07.09.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

System Performance Check at Frequency at 5200MHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Area Scan (41x61x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 17.9 W/kg

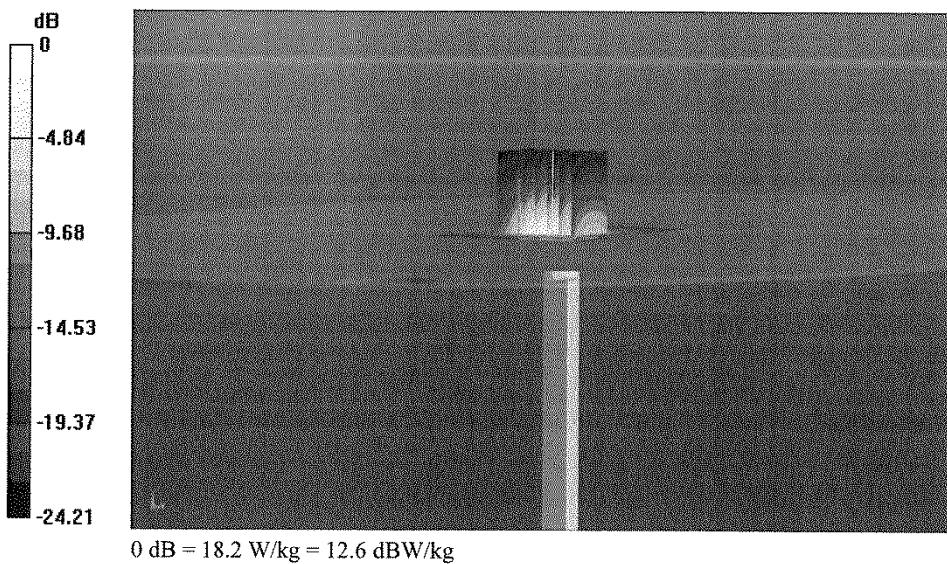
System Performance Check at Frequency at 5200MHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 99.18 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 31.7 W/kg

SAR(1 g) = 7.56 W/kg; SAR(10 g) = 2.31 W/kg

Maximum value of SAR (measured) = 18.2 W/kg



Test Laboratory: EMTEK (Shenzhen) Co.,Ltd.

Date/Time: 27.05.2017

SystemPerformanceCheck-D5GHzV2-5600MHz-MSL-170527

Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: MSL_5G_170527

Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 5.831 \text{ S/m}$; $\epsilon_r = 49.38$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.3 °C; Liquid Temperature: 22.4 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.22, 4.22, 4.22); Calibrated: 07.09.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

System Performance Check at Frequency at 5600MHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Area Scan (41x61x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 17.5 W/kg

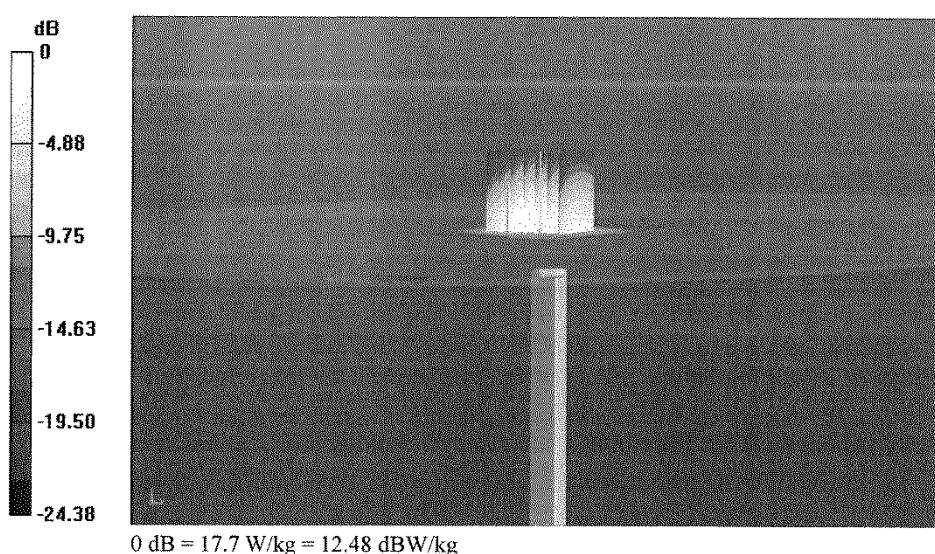
System Performance Check at Frequency at 5600MHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm

Reference Value = 92.3 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 30.6 W/kg

SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.46 W/kg

Maximum value of SAR (measured) = 17.7 W/kg



Test Laboratory: EMTEK (Shenzhen) Co.,Ltd.

Date : 27.05.2017

System Performance Check-D5GHzV2-5800MHz-MSL-170527

Communication System: UID 0, CW (0); Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: MSL_5G_170527

Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 6.133 \text{ S/m}$; $\epsilon_r = 48.881$; $\rho = 1000 \text{ kg/m}^3$
Ambient Temperature: 23.2°C ; Liquid Temperature: 22.6°C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.34, 4.34, 4.34); Calibrated: 07.09.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

System Performance Check at Frequency at 5750MHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Area Scan (41x61x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 17.2 W/kg

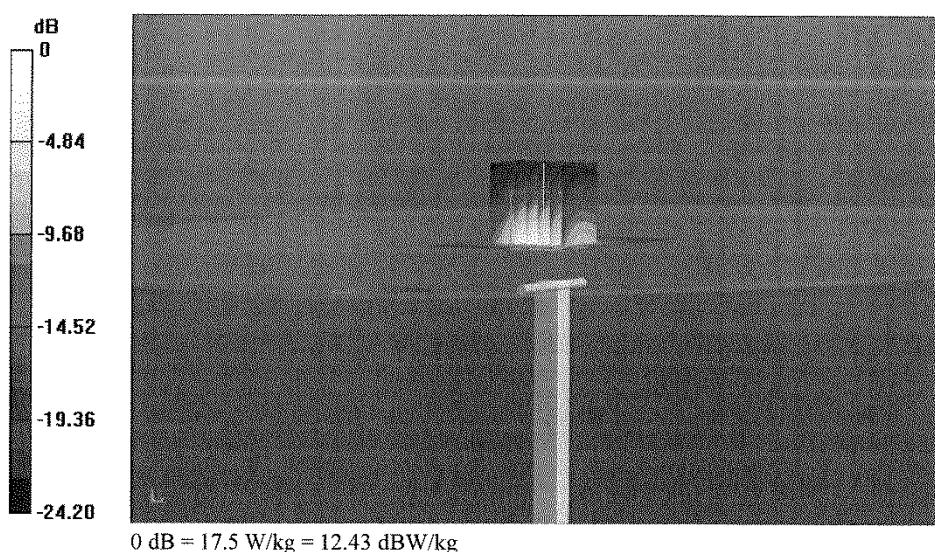
System Performance Check at Frequency at 5750MHz/d=10mm, Pin=100mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.241 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 29.7 W/kg

SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 17.5 W/kg



Appendix A

Test Plots of SAR Measurement

Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 27.05.2017

1-WLAN2.4G-802.11b 1Mbps-Front-0cm-Ant A-Ch6

Communication System: UID 0, WIFI (0); Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL_2450_170527

Medium parameters used: $f = 2437 \text{ MHz}$; $\sigma = 2.007 \text{ S/m}$; $\epsilon_r = 53.007$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.57, 7.57, 7.57); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (101x61x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Reference Value = 9.407 V/m; Power Drift = -0.02 dB

Fast SAR: SAR(1 g) = 0.637 W/kg; SAR(10 g) = 0.256 W/kg

Maximum value of SAR (interpolated) = 1.08 W/kg

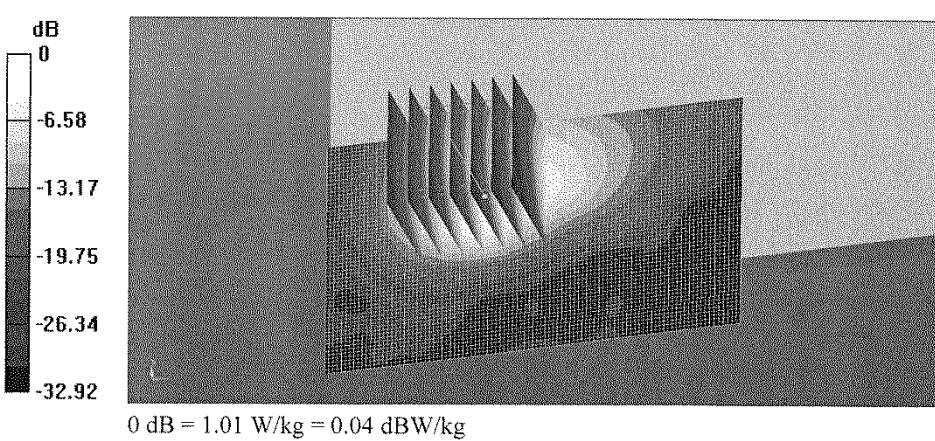
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 9.407 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 1.39 W/kg

SAR(1 g) = 0.587 W/kg; SAR(10 g) = 0.229 W/kg

Maximum value of SAR (measured) = 1.01 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 27.05.2017

2-WLAN2.4G-802.11b 1Mbps-Front-0cm-Ant B-Ch6

Communication System: UID 0, WIFI (0); Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL_2450_170527

Medium parameters used: $f = 2437 \text{ MHz}$; $\sigma = 2.007 \text{ S/m}$; $\epsilon_r = 53.007$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.57, 7.57, 7.57); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (101x61x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.957 W/kg

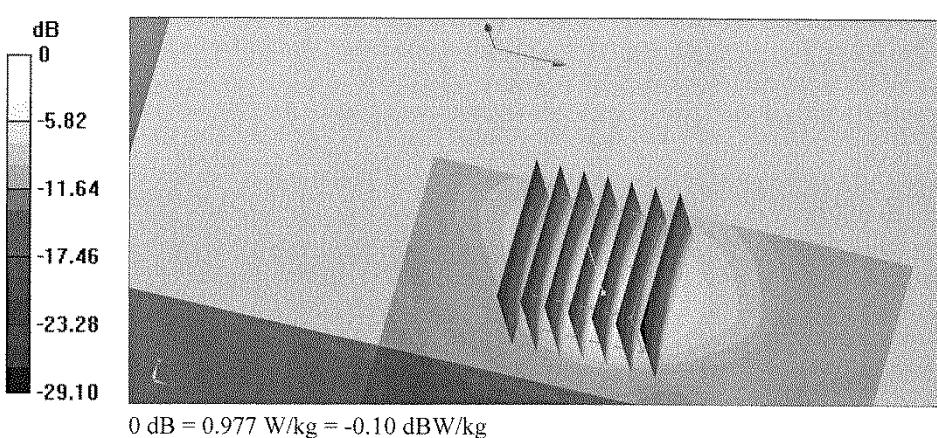
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 13.167 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.49 W/kg

SAR(1 g) = 0.561 W/kg; SAR(10 g) = 0.211 W/kg

Maximum value of SAR (measured) = 0.977 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 27.05.2017

3-WLAN2.4G-802.11b 1Mbps-Back-0cm-Ant B-Ch6

Communication System: UID 0, WIFI (0); Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL_2450_170527

Medium parameters used: $f = 2437 \text{ MHz}$; $\sigma = 2.007 \text{ S/m}$; $\epsilon_r = 53.007$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.57, 7.57, 7.57); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (101x61x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 1.09 W/kg

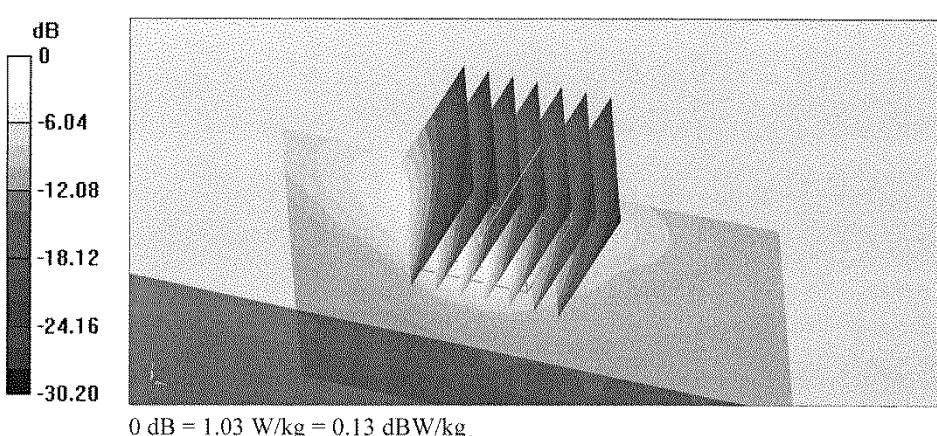
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 10.082 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 1.48 W/kg

SAR(1 g) = 0.634 W/kg; SAR(10 g) = 0.255 W/kg

Maximum value of SAR (measured) = 1.03 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 27.05.2017

4-WLAN2.4G-802.11b 1Mbps-Back-0cm-Ant A-Ch6

Communication System: UID 0, WIFI (0); Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL_2450_170527

Medium parameters used: $f = 2437 \text{ MHz}$; $\sigma = 2.007 \text{ S/m}$; $\epsilon_r = 53.007$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.57, 7.57, 7.57); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (101x61x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.659 W/kg

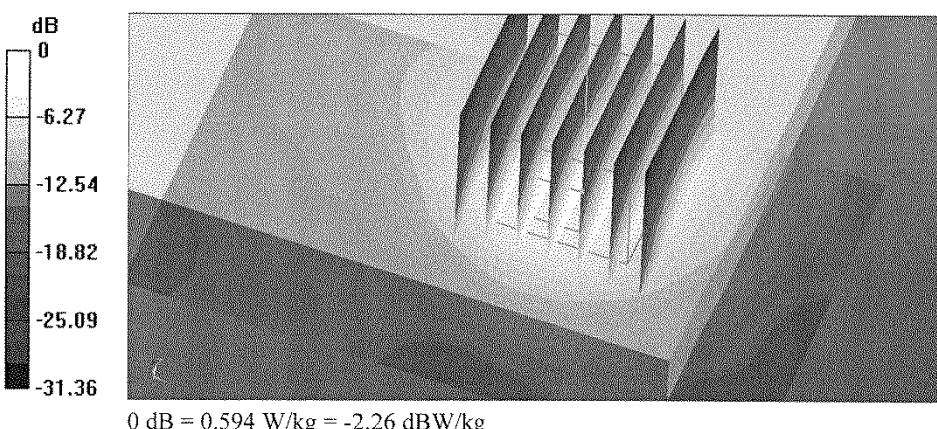
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 4.108 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.880 W/kg

SAR(1 g) = 0.388 W/kg; SAR(10 g) = 0.168 W/kg

Maximum value of SAR (measured) = 0.594 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 26.05.2017

5-WLAN5G-802.11a 6Mbps-Back-0cm-Ant B-Ch36

Communication System: UID 0, WIFI (0); Frequency: 5180 MHz; Duty Cycle: 1:1

Medium: MSL_2450_170526

Medium parameters used: $f = 5180 \text{ MHz}$; $\sigma = 5.1 \text{ S/m}$; $\epsilon_r = 49.986$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

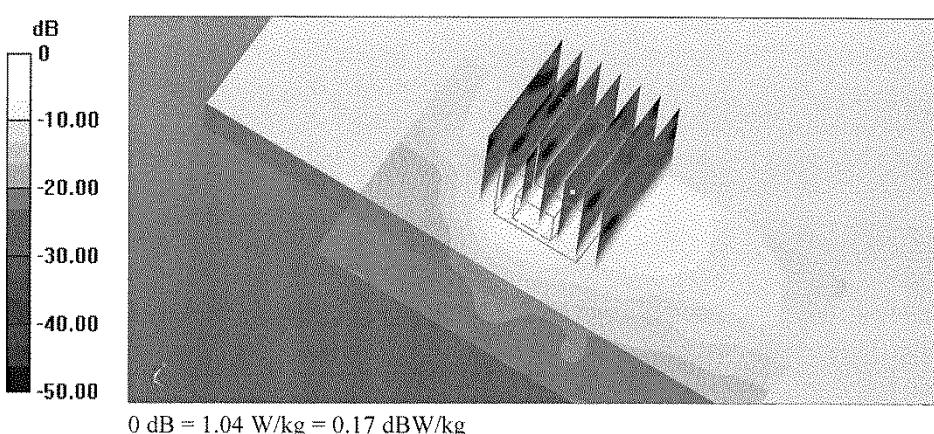
DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.94, 4.94, 4.94); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (101x61x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.797 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
Reference Value = 8.301 V/m; Power Drift = 0.07dB
Peak SAR (extrapolated) = 2.05 W/kg
SAR(1 g) = 0.463 W/kg; SAR(10 g) = 0.160 W/kg
Maximum value of SAR (measured) = 1.04 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 26.05.2017

9-WLAN5G-802.11a 6Mbps-Edge1-0cm-Ant B-Ch36

Communication System: UID 0, WIFI (0); Frequency: 5180 MHz; Duty Cycle: 1:1

Medium: MSL_5G_170526

Medium parameters used: $f = 5180 \text{ MHz}$; $\sigma = 5.1 \text{ S/m}$; $\epsilon_r = 49.986$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.94, 4.94, 4.94); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (41x101x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.971 W/kg

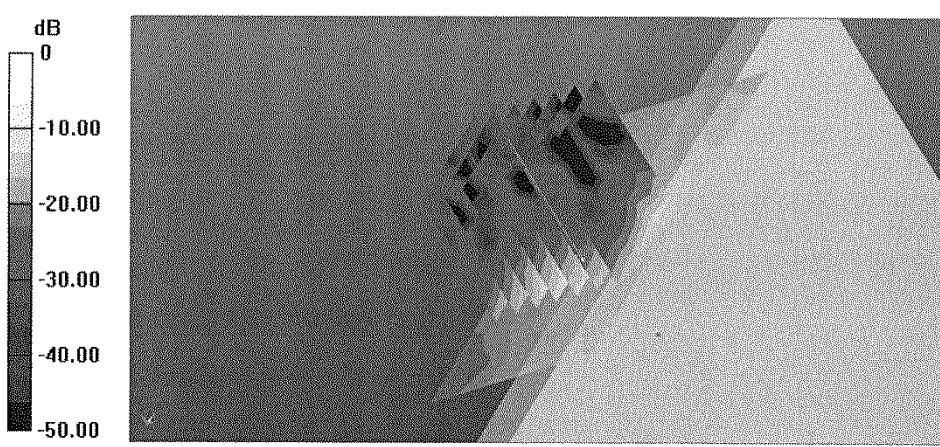
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 11.264 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 2.29 W/kg

SAR(1 g) = 0.443 W/kg; SAR(10 g) = 0.107 W/kg

Maximum value of SAR (measured) = 1.02 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 26.05.2017

6-WLAN5G-802.11a 6Mbps-Back-0cm-Ant B-Ch56

Communication System: UID 0, WIFI (0); Frequency: 5280 MHz; Duty Cycle: 1:1

Medium: MSL_2450_170526

Medium parameters used: $f = 5280 \text{ MHz}$; $\sigma = 5.289 \text{ S/m}$; $\epsilon_r = 49.888$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.75, 4.75, 4.75); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (101x61x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 1.27 W/kg

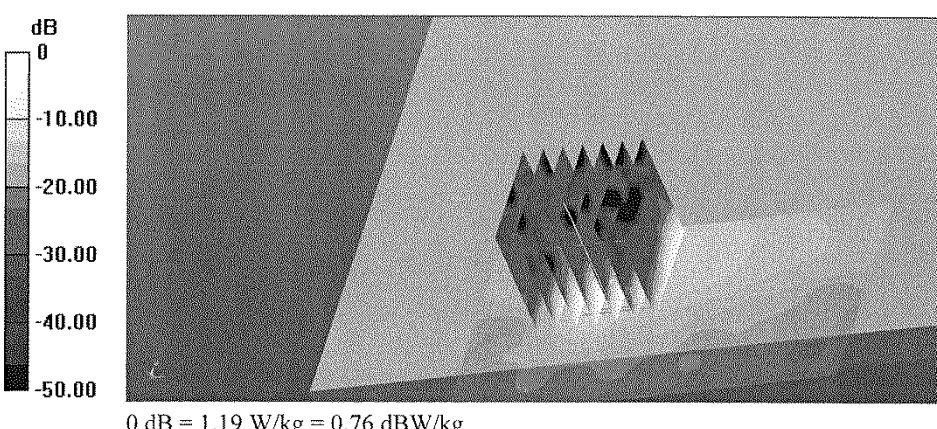
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid; $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.100 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 2.78 W/kg

SAR(1 g) = 0.532 W/kg; SAR(10 g) = 0.175 W/kg

Maximum value of SAR (measured) = 1.19 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 26.05.2017

10-WLAN5G-802.11a 6Mbps-Edge1-0cm-Ant B-Ch56

Communication System: UID 0, WIFI (0); Frequency: 5280 MHz; Duty Cycle: 1:1

Medium: MSL_5G_170526

Medium parameters used: $f = 5280 \text{ MHz}$; $\sigma = 5.289 \text{ S/m}$; $\epsilon_r = 49.888$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.75, 4.75, 4.75); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (41x101x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 1.16 W/kg

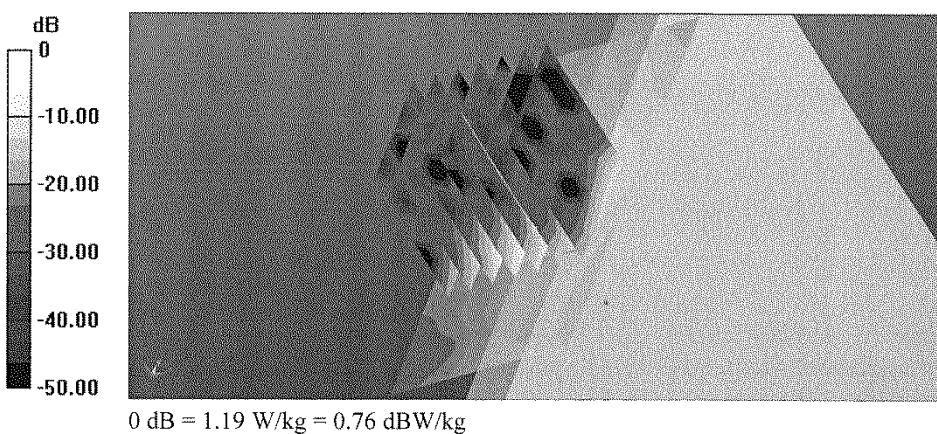
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 11.919 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 3.11 W/kg

SAR(1 g) = 0.512 W/kg; SAR(10 g) = 0.123 W/kg

Maximum value of SAR (measured) = 1.19 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 27.05.2017

7-WLAN5G-802.11a 6Mbps-Back-0cm-Ant B-Ch100

Communication System: UID 0, WIFI (0); Frequency: 5500 MHz; Duty Cycle: 1:1

Medium: MSL_2450_170527

Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 5.63 \text{ S/m}$; $\epsilon_r = 49.528$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.43, 4.43, 4.43); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (101x61x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 1.54 W/kg

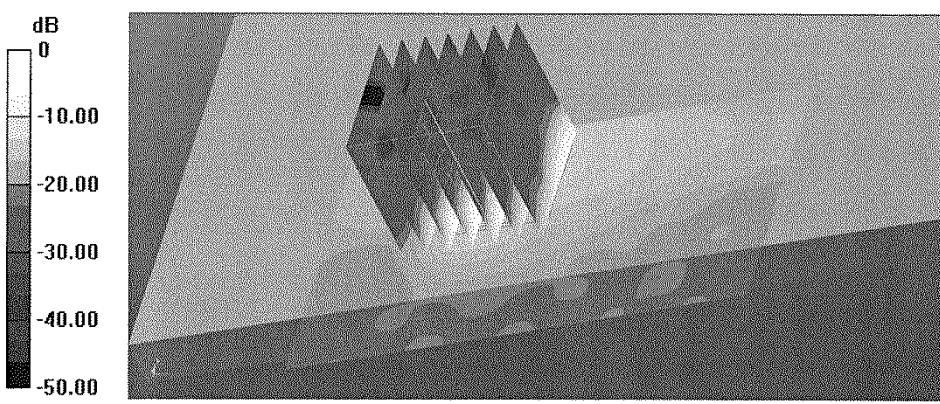
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 5.742 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 3.51 W/kg

SAR(1 g) = 0.632 W/kg; SAR(10 g) = 0.193 W/kg

Maximum value of SAR (measured) = 1.28 W/kg



0 dB = 1.28 W/kg = 1.07 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 27.05.2017

11-WLAN5G-802.11a 6Mbps-Edge1-0cm-Ant B-Ch100

Communication System: UID 0, WIFI (0); Frequency: 5500 MHz; Duty Cycle: 1:1
Medium: MSL_5G_170527

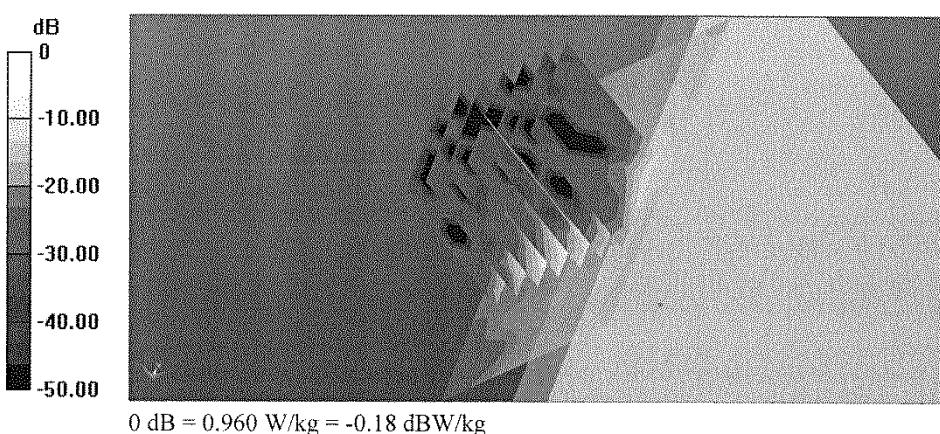
Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 5.63 \text{ S/m}$; $\epsilon_r = 49.528$; $\rho = 1000 \text{ kg/m}^3$
Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.43, 4.43, 4.43); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (41x101x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$
Maximum value of SAR (interpolated) = 0.912 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
Reference Value = 9.839 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 2.51 W/kg
SAR(1 g) = 0.413 W/kg; SAR(10 g) = 0.098 W/kg
Maximum value of SAR (measured) = 0.960 W/kg



Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 27.05.2017

8-WLAN5G-802.11a 6Mbps-Back-0cm-Ant B-Ch149

Communication System: UID 0, WIFI (0); Frequency: 5745 MHz; Duty Cycle: 1:1

Medium: MSL_2450_170527

Medium parameters used: $f = 5745 \text{ MHz}$; $\sigma = 6.012 \text{ S/m}$; $\epsilon_r = 49.062$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.34, 4.34, 4.34); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (101x61x1): Interpolated grid:

$dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 1.11 W/kg

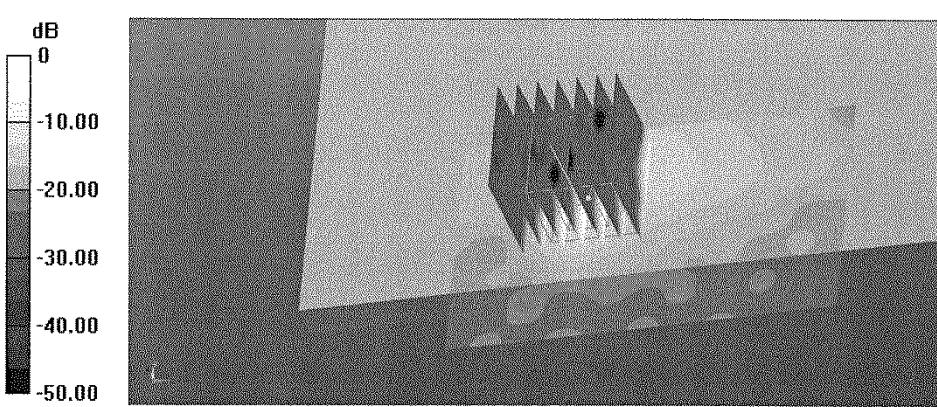
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 6.220 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 3.99 W/kg

SAR(1 g) = 0.590 W/kg; SAR(10 g) = 0.161 W/kg

Maximum value of SAR (measured) = 1.25 W/kg



0 dB = 1.25 W/kg = 0.97 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd.

Date: 27.05.2017

12-WLAN5G-802.11a 6Mbps-Edge1-0cm-Ant B-Ch149

Communication System: UID 0, WIFI (0); Frequency: 5745 MHz; Duty Cycle: 1:1

Medium: MSL_5G_170527

Medium parameters used: $f = 5745 \text{ MHz}$; $\sigma = 6.012 \text{ S/m}$; $\epsilon_r = 49.062$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.34, 4.34, 4.34); Calibrated: 07.09.2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1418; Calibrated: 05.09.2016
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1231
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/Unnamed procedure/Area Scan (41x101x1): Interpolated grid:
 $dx=1.000 \text{ mm}$, $dy=1.000 \text{ mm}$

Maximum value of SAR (interpolated) = 0.733 W/kg

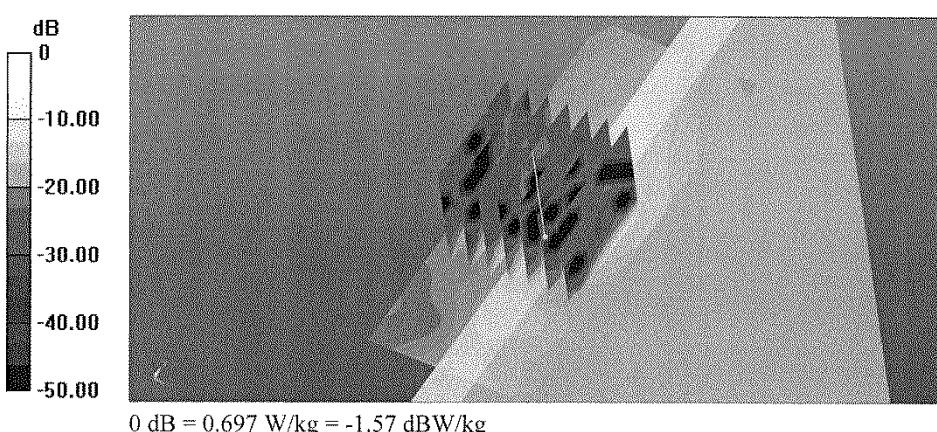
Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid; $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 8.124 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 2.09 W/kg

SAR(1 g) = 0.304 W/kg; SAR(10 g) = 0.073 W/kg

Maximum value of SAR (measured) = 0.697 W/kg



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CNAS L0570

Client : Emtek(Shenzhen)

Certificate No: Z16-97142

CALIBRATION CERTIFICATE

Object DAE4 - SN: 1418

Calibration Procedure(s) FD-Z11-2-002-01
Calibration Procedure for the Data Acquisition Electronics
(DAEx)

Calibration date: September 05, 2016

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)°C 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-June-16 (CTTL, No:J16X04778)	June-17

Calibrated by: Name Yu Zongying Function SAR Test Engineer

Reviewed by: Name Qi Dianyuan Function SAR Project Leader

Approved by: Name Lu Bingsong Function Deputy Director of the laboratory

Issued: September 06, 2016

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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.

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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	$404.120 \pm 0.15\% \text{ (k=2)}$	$404.660 \pm 0.15\% \text{ (k=2)}$	$404.343 \pm 0.15\% \text{ (k=2)}$
Low Range	$3.99101 \pm 0.7\% \text{ (k=2)}$	$4.00248 \pm 0.7\% \text{ (k=2)}$	$3.97821 \pm 0.7\% \text{ (k=2)}$

Connector Angle

Connector Angle to be used in DASY system	$153^\circ \pm 1^\circ$
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CNAS L0570

Client

Emtek(Shenzhen)

Certificate No: Z16-97143

CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3970

Calibration Procedure(s) FD-Z11-2-004-01
Calibration Procedures for Dosimetric E-field Probes

Calibration date: September 07, 2016

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)°C 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-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101548	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
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 7307	19-Feb-16(SPEAG, No.EX3-7307_Feb16)	Feb-17
DAE4	SN 1331	21-Jan-16(SPEAG, No.DAE4-1331_Jan16)	Jan -17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-16 (CTTL, No.J16X04776)	Jun-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan -17

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: September 08, 2016

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Glossary:

TSL	tissue simulating liquid
NORM x,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORM x,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 $\theta=0$ 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, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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:

- **NORM x,y,z :** Assessed for E-field polarization $\theta=0$ ($f \leq 900\text{MHz}$ in TEM-cell; $f > 1800\text{MHz}$: waveguide). NORM x,y,z are only intermediate values, i.e., the uncertainties of NORM x,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 $f \leq 800\text{MHz}$) and inside waveguide using analytical field distributions based on power measurements for $f > 800\text{MHz}$. 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 $\pm 50\text{MHz}$ to $\pm 100\text{MHz}$.
- **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 EX3DV4

SN: 3970

Calibrated: September 07, 2016

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3970

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μ V/(V/m) ²) ^A	0.49	0.63	0.25	±10.8%
DCP(mV) ^B	103.1	105.0	95.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/ μ V	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	188.9	±2.2%
		Y	0.0	0.0	1.0		222.8	
		Z	0.0	0.0	1.0		122.7	

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 E²-field uncertainty inside TSL (see Page 5 and Page 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3970

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	10.01	10.01	10.01	0.35	0.70	±12%
835	41.5	0.90	9.77	9.77	9.77	0.16	1.27	±12%
900	41.5	0.97	9.87	9.87	9.87	0.13	1.40	±12%
1810	40.0	1.40	8.28	8.28	8.28	0.17	1.53	±12%
2000	40.0	1.40	8.13	8.13	8.13	0.15	1.91	±12%
2300	39.5	1.67	7.89	7.89	7.89	0.55	0.75	±12%
2450	39.2	1.80	7.63	7.63	7.63	0.28	1.31	±12%
2600	39.0	1.96	7.48	7.48	7.48	0.65	0.68	±12%
5200	36.0	4.66	5.60	5.60	5.60	0.40	1.45	±13%
5300	35.9	4.76	5.26	5.26	5.26	0.40	1.40	±13%
5500	35.6	4.96	5.07	5.07	5.07	0.40	1.40	±13%
5600	35.5	5.07	4.92	4.92	4.92	0.40	1.40	±13%
5800	35.3	5.27	4.89	4.89	4.89	0.40	1.65	±13%

^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: EX3DV4 – SN: 3970

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	10.05	10.05	10.05	0.40	0.80	±12%
835	55.2	0.97	9.94	9.94	9.94	0.21	1.26	±12%
900	55.0	1.05	9.90	9.90	9.90	0.23	1.19	±12%
1810	53.3	1.52	8.17	8.17	8.17	0.18	1.69	±12%
2000	53.3	1.52	8.05	8.05	8.05	0.18	1.77	±12%
2300	52.9	1.81	7.90	7.90	7.90	0.53	0.81	±12%
2450	52.7	1.95	7.57	7.57	7.57	0.35	1.15	±12%
2600	52.5	2.16	7.41	7.41	7.41	0.43	0.91	±12%
5200	49.0	5.30	4.94	4.94	4.94	0.50	1.45	±13%
5300	48.9	5.42	4.75	4.75	4.75	0.50	1.50	±13%
5500	48.6	5.65	4.43	4.43	4.43	0.50	1.55	±13%
5600	48.5	5.77	4.22	4.22	4.22	0.50	1.70	±13%
5800	48.2	6.00	4.34	4.34	4.34	0.51	1.90	±13%

^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.

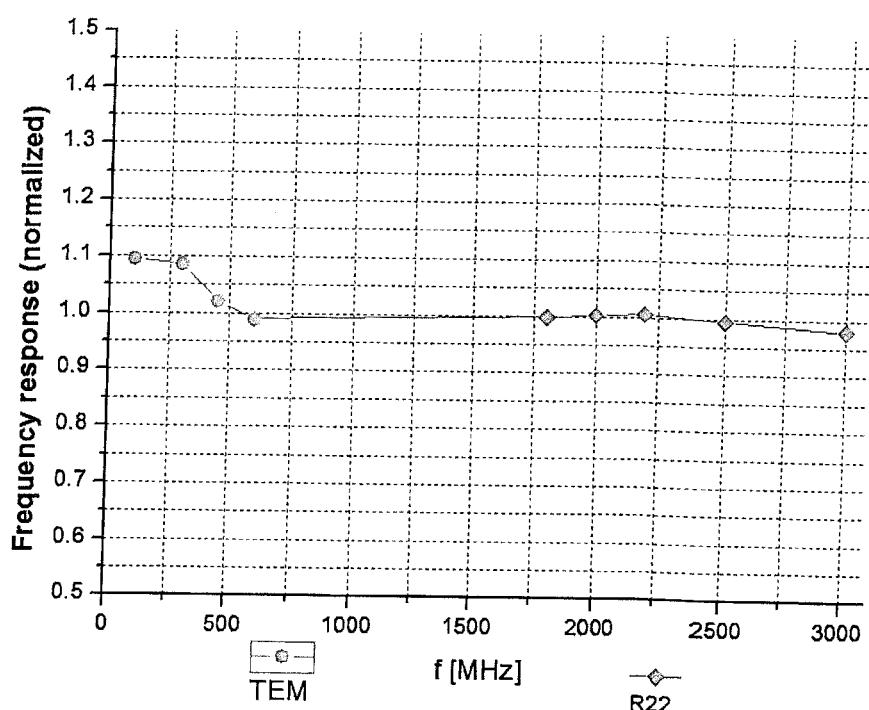
^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from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



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



Uncertainty of Frequency Response of E-field: $\pm 7.5\%$ ($k=2$)



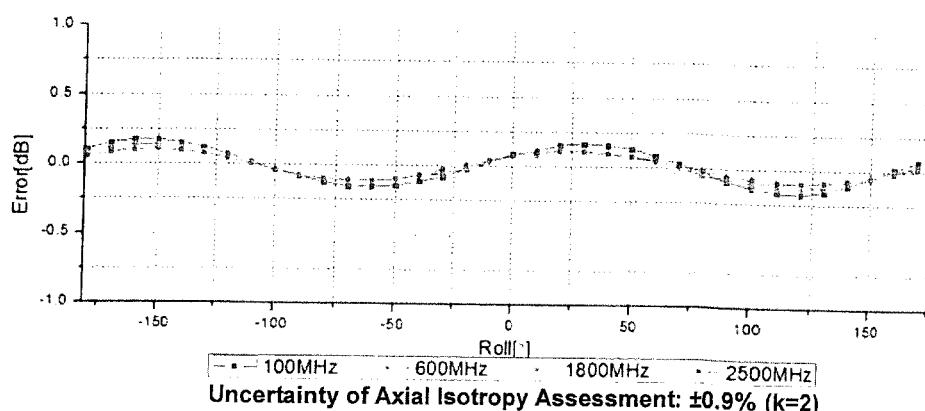
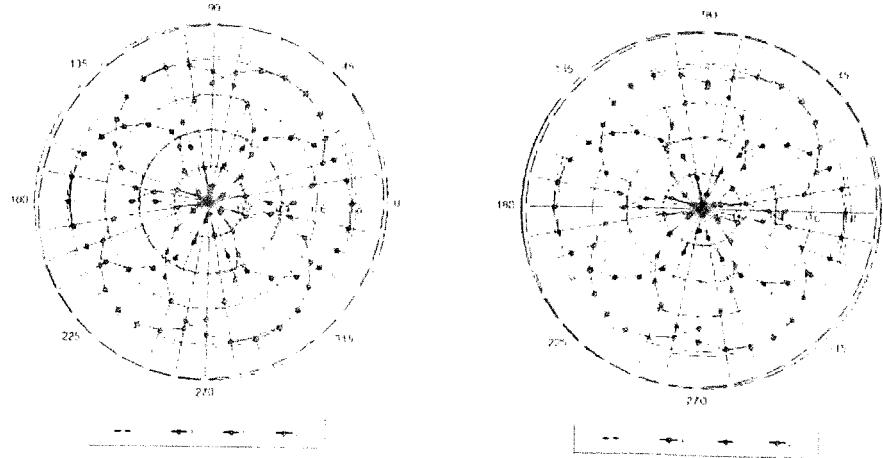
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Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM

f=1800 MHz, R22

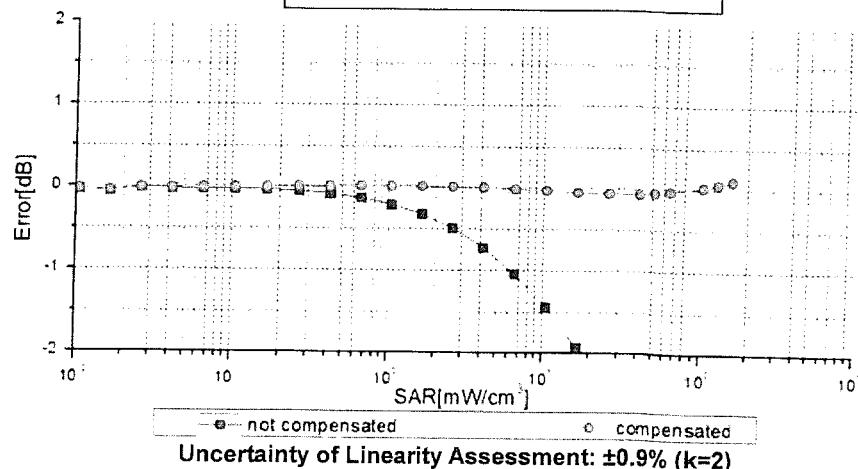
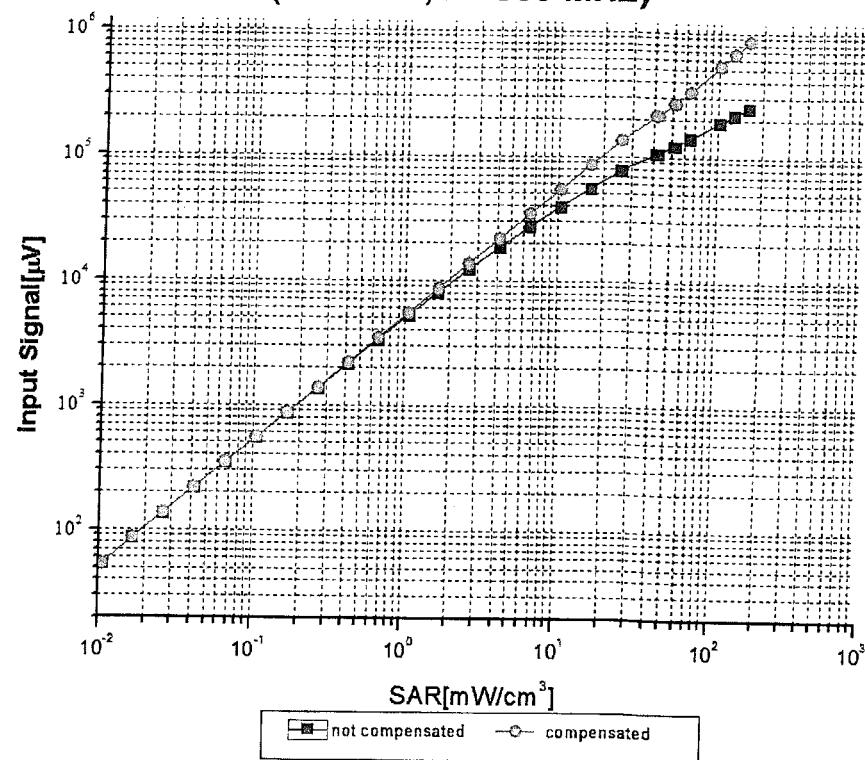




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**Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)**



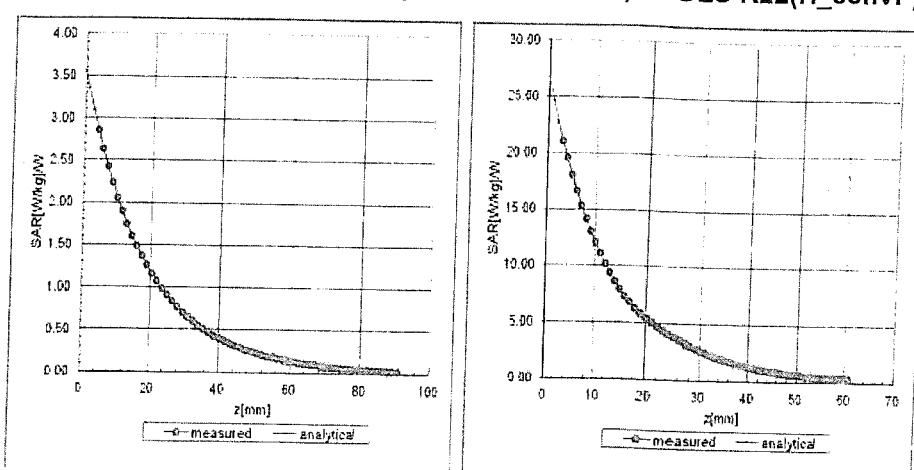


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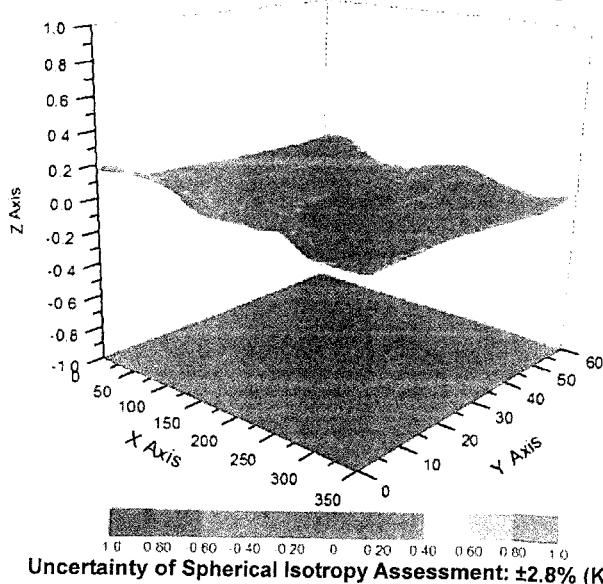
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
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Conversion Factor Assessment

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



Deviation from Isotropy in Liquid





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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3970

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	159.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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CNAS L0570

Client Tejet

Certificate No: Z16-97175

CALIBRATION CERTIFICATE

Object D2450V2 - SN: 845

Calibration Procedure(s) FD-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: October 12, 2016

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) $^{\circ}$ C 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-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe ES3DV3	SN 3149	15-Apr-16(CTTL-SPEAG, No.J16-97035)	Apr-17
DAE4	SN 777	22-Aug-16(CTTL-SPEAG, No.Z16-97138)	Aug-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Liu Wei	Deputy Director of SEM Department	

Issued: October 14, 2016

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, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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	52.8.8.1258
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	39.0 ± 6 %	1.78 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	13.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.3 mW / g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.09 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.4 mW / g ± 20.4 % (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	52.9 ± 6 %	1.92 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	12.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	51.2 mW / g ± 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.99 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.1 mW / g ± 20.4 % (k=2)



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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9Ω+ 4.93jΩ
Return Loss	- 25.7dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.5Ω+ 6.56jΩ
Return Loss	- 23.7dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.270 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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DASY5 Validation Report for Head TSL

Date: 10.12.2016

Test Laboratory: TTLL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 845

Communication System: UID 0. CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.777$ S/m; $\epsilon_r = 39.03$; $\rho = 1000$ kg/m³

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.51, 4.51, 4.51); Calibrated: 4/15/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52. Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

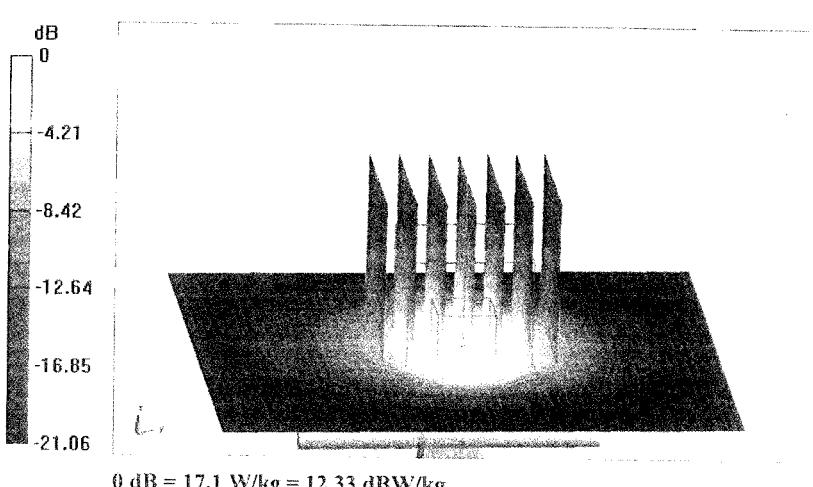
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm,
dy=5mm, dz=5mm**

Reference Value = 99.65 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 26.7 W/kg

SAR(1 g) = 13 W/kg; SAR(10 g) = 6.09 W/kg

Maximum value of SAR (measured) = 17.1 W/kg



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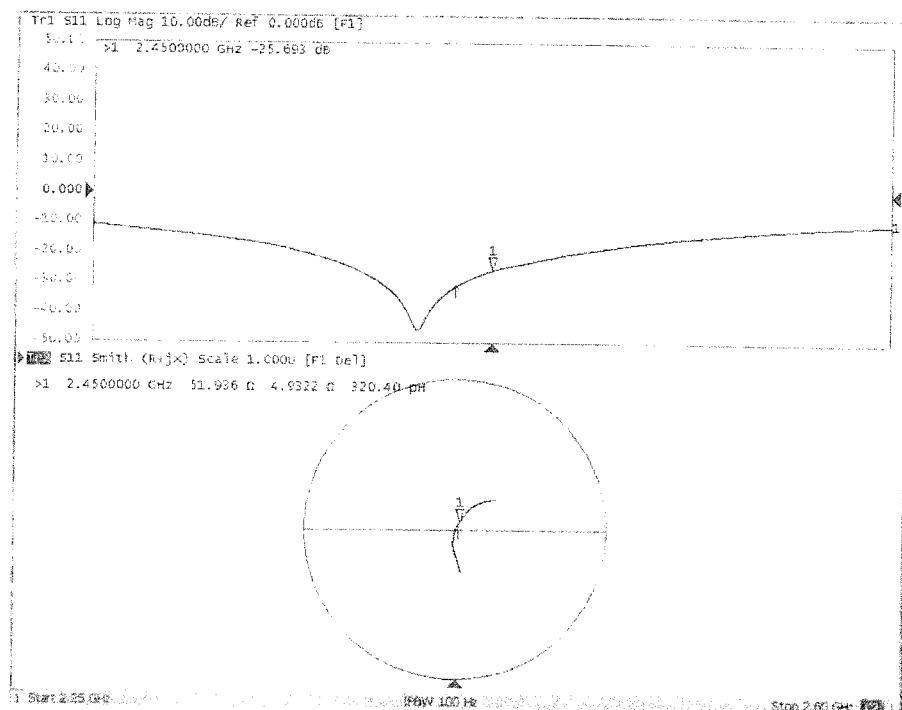


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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 10.12.2016

Test Laboratory: CTLL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 845

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.923 \text{ S/m}$; $\epsilon_r = 52.91$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3149; ConvF(4.23, 4.23, 4.23); Calibrated: 4/15/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn777; Calibrated: 8/22/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

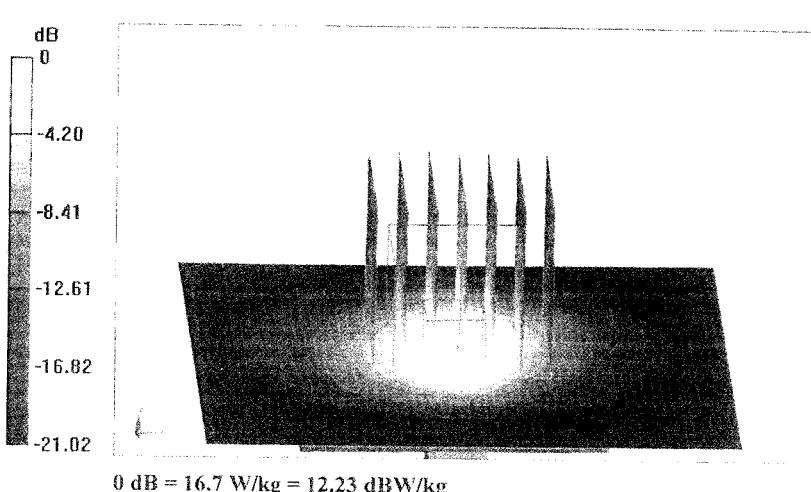
**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm,
dy=5mm, dz=5mm**

Reference Value = 97.85 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 24.8 W/kg

SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.99 W/kg

Maximum value of SAR (measured) = 16.7 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

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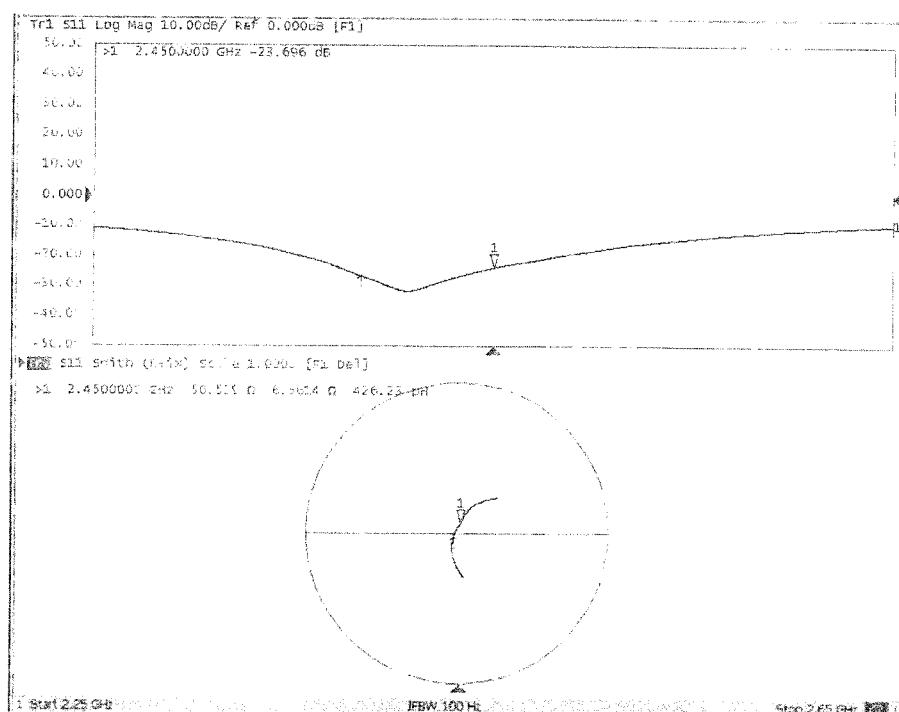


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Impedance Measurement Plot for Body TSL



**Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **Audien**

Certificate No: D5GHzV3-1040 | Jun16

CALIBRATION CERTIFICATE

Object D5GHzV2 - SN:1040

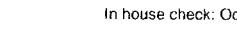
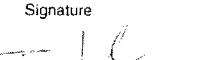
Calibration procedure(s) QA CAL-22.v2
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: June 17, 2016

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)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	31-Dec-15 (No. EX3-3503_Dec15)	Dec-16
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 6481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 6481A	SN: MY41092317	07-Oct-15 (No. 217-02223)	In house check: Oct-16
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Jun-15)	In house check: Oct-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16
Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 20, 2016

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Calibration Laboratory of
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S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
SCS Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,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 62209-2, "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
- c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- d) 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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.54 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.68 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

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Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.64 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.7 W / kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.3 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.3 ± 6 %	4.83 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.6 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.2 ± 6 %	4.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.5 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.9 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.9 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	75.9 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.41 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.35 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	72.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.53 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.70 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.5 ± 6 %	5.80 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.6 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.19 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.7 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.3 ± 6 %	5.95 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.90 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.4 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.9 W/kg ± 19.5 % (k=2)

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Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.0 ± 6 %	6.23 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.58 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.2 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.8 W/kg ± 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	50.2 Ω - 8.5 $j\Omega$
Return Loss	- 21.4 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	47.8 Ω - 3.3 $j\Omega$
Return Loss	- 27.8 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.0 Ω - 5.9 $j\Omega$
Return Loss	- 24.6 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	56.4 Ω - 3.3 $j\Omega$
Return Loss	- 23.3 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.3 Ω - 2.3 $j\Omega$
Return Loss	- 26.6 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	50.7 Ω - 7.0 $j\Omega$
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.6 Ω - 1.6 $j\Omega$
Return Loss	- 33.4 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	50.3 Ω - 4.4 $j\Omega$
Return Loss	- 27.2 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	57.9 Ω - 2.3 $j\Omega$
Return Loss	- 22.4 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	54.6 Ω - 0.7 $j\Omega$
Return Loss	- 27.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns
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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
Manufactured on	December 30, 2005

DASY5 Validation Report for Head TSL

Date: 17.06.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1040

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 4.54 \text{ S/m}$; $\epsilon_r = 34.8$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 4.64 \text{ S/m}$; $\epsilon_r = 34.6$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 4.83 \text{ S/m}$; $\epsilon_r = 34.3$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 4.93 \text{ S/m}$; $\epsilon_r = 34.2$; $\rho = 1000 \text{ kg/m}^3$. Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 5.14 \text{ S/m}$; $\epsilon_r = 33.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.59, 5.59, 5.59); Calibrated: 31.12.2015, ConvF(5.25, 5.25, 5.25); Calibrated: 31.12.2015, ConvF(5.18, 5.18, 5.18); Calibrated: 31.12.2015, ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.95, 4.95, 4.95); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.41 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 7.68 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 17.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.35 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 30.6 W/kg

SAR(1 g) = 8.24 W/kg; SAR(10 g) = 2.36 W/kg

Maximum value of SAR (measured) = 18.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.02 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 30.8 W/kg

SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.26 W/kg

Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 71.08 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.32 W/kg

Maximum value of SAR (measured) = 19.0 W/kg

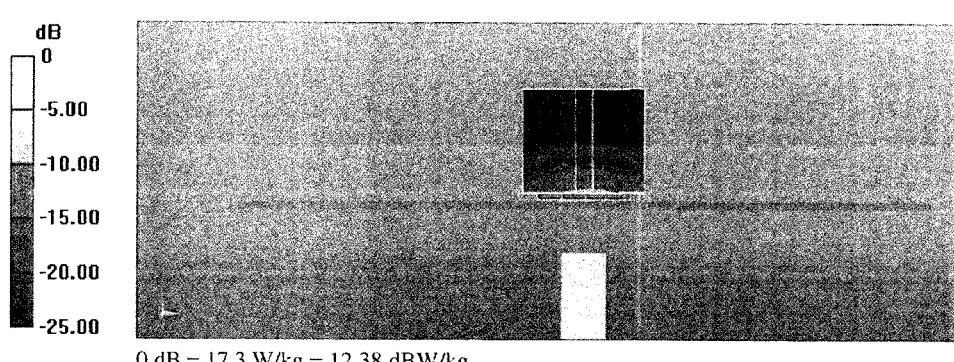
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 67.92 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 31.4 W/kg

SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.19 W/kg

Maximum value of SAR (measured) = 18.4 W/kg



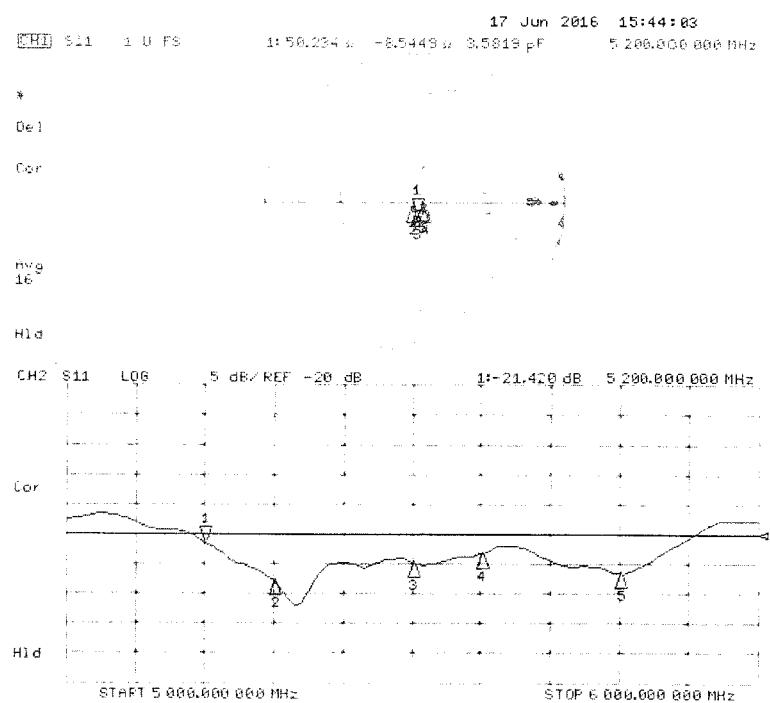
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Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.06.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1040

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 5.41 \text{ S/m}$; $\epsilon_r = 47.1$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 5.53 \text{ S/m}$; $\epsilon_r = 46.9$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 5.8 \text{ S/m}$; $\epsilon_r = 46.5$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 5.95 \text{ S/m}$; $\epsilon_r = 46.3$; $\rho = 1000 \text{ kg/m}^3$, Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 6.23 \text{ S/m}$; $\epsilon_r = 46$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.99, 4.99, 4.99); Calibrated: 31.12.2015, ConvF(4.75, 4.75, 4.75); Calibrated: 31.12.2015, ConvF(4.4, 4.4, 4.4); Calibrated: 31.12.2015, ConvF(4.35, 4.35, 4.35); Calibrated: 31.12.2015, ConvF(4.27, 4.27, 4.27); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.34 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 27.4 W/kg
SAR(1 g) = 7.35 W/kg; SAR(10 g) = 2.07 W/kg
Maximum value of SAR (measured) = 16.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 68.02 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 29.2 W/kg
SAR(1 g) = 7.7 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 17.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.81 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 31.7 W/kg
SAR(1 g) = 7.92 W/kg; SAR(10 g) = 2.19 W/kg
Maximum value of SAR (measured) = 18.6 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 67.28 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 32.5 W/kg

SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 18.6 W/kg

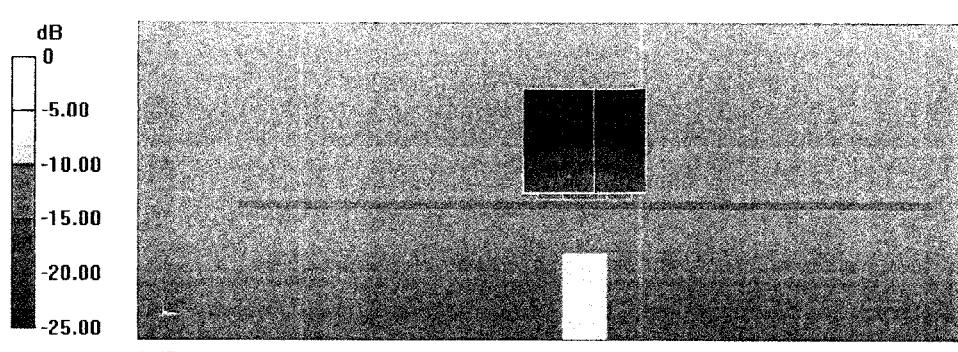
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 65.14 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 32.9 W/kg

SAR(1 g) = 7.58 W/kg; SAR(10 g) = 2.1 W/kg

Maximum value of SAR (measured) = 18.3 W/kg



0 dB = 16.8 W/kg = 12.25 dBW/kg

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Impedance Measurement Plot for Body TSL

