Prüfbericht-Nr.: *Test Report No.:*	**50090969 004**	**Auftrags-Nr.:** *Order No.:*	164095986	Seite 1 von 32 *Page 1 of 32*
Kunden-Referenz-Nr.: *Client Reference No.:*	N/A	**Auftragsdatum:** *Order date:*	07.06.2017	

Auftraggeber: *Client:*	Lightcomm Technology Co., Ltd. RM 1808 18F, FO TAN INDUSTRIAL CENTRE, NOS. 26-28 AU PUI WAN STREET, FO TAN SHATIN NEW TERRITORIES, HONGKONG
Prüfgegenstand: *Test item:*	10.1" Flex Tablet for Android with Detachable Keyboard
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	NS-P10A8100K, NS-P10A8100K-C, xxxxxxP10A81xxxxxx, MID1028-MA (x=0-9, A-Z, a-z, - or blank, for market purpose only) (Trademark: INSIGNIA)
Auftrags-Inhalt: *Order content:*	FCC/IC Certification
Prüfgrundlage: *Test specification:*	CFR Title 47 Part 2 Subpart J Section 2.1093 ANSI/IEEE C95.1-1992 IEEE 1528-2003 KDB 447498 D01 v06 RSS-102 Issue 5 March 2015
Wareneingangsdatum: *Date of receipt:*	07.06.2017
Prüfmuster-Nr.: *Test sample No.:*	A000561697-006
Prüfzeitraum: *Testing period:*	16.06.2017 - 08.07.2017
Ort der Prüfung: *Place of testing:*	EMTEK (Shenzhen) Co., Ltd.
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (Shenzhen) Co., Ltd.
Prüfergebnis*: *Test result*:*	Pass

geprüft von / tested by:			**kontrolliert von / reviewed by:**		
12.07.2017	Alex Lan / Project Engineer		12.07.2017	Owen Tian/Technical Certifier	
Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*

Sonstiges / *Other*:

FCC ID: XMF-MID1028
IC: 20064-MID1028 HVIN: NS-P10A8100K

Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:*	Prüfmuster vollständig und unbeschädigt *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
Legend:	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

STATEMENT OF COMPLIANCE

TEST ITEM	SPECIFICATION	RESULT
Specific Absorption Rate - Wi-Fi 802.11 b/g/n - 2.4GHz Band	Exposure Rules 47 C.F.R 2.1093; KDB 447498 D01 General RF Exposure Guidance v06; KDB 248227 D01 802 11 Wi-Fi SAR v02r02; KDB 865664 D01 SAR Measurement 100 MHz to 6GHz v01r04; KDB 865664 D02 RF Exposure Reporting v01r02; KDB 616217 D04 SAR for laptop and tablets v01r02; FCC Inquiry Tracking Number 351814	PASS
Specific Absorption Rate - Wi-Fi 802.11 a - 5GHz Band U-NII-1		PASS
Specific Absorption Rate - Bluetooth BDR/EDR/LE		PASS

This device complies with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (4W/kg) specified in CFR Title 47 Part 2 Subpart J Section 2.1093 and ANSI/IEEE C95.1-1992 for extremity SAR.

This device has been testd in accordance with the measurement methods and procedure specified in Published RF exposure KDB procedures

Refer to the maximum results of Specific Absorption Rate (SAR) durning 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	1.063
802.11 a - 5GHz Band U-NII-1	Body	NII	0.991
802.11 a - 5GHz Band U-NII-3	Body		1.565

Contents

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

EMTEK (Shenzhen) Co., Ltd.

(FCC Registration No.: 709623)
(Test site Industry Canada No.: 4480A-2)

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.

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	5/20/2017	1year
RF Power Meter. Dual Channel	BOONTON	4232A	10539	5/20/2017	1year
Power Sensor	BOONTON	51011EMC	34236/34238	5/20/2017	1year
Wideband Radio Communication Tester	R&S	CMW500	1201.0002K50-140822zk	5/20/2017	1year
Signal Analyzer	Agilent	N9010A	My53470879	5/20/2017	1year
Network Analyzer	Agilent	E5071B	MY42404246	5/20/2017	1year
E-Field Probe	SPEAG	EX3DV4	3970	9/7/2016	1year
DAE	SPEAG	DAE4	1418	9/5/2016	1year
Validation Kit 2450MHz	SPEAG	D2450V2	845	10/12/2016	3years
Dual Directional Coupler	Agilent	EE393	TW5451008	5/20/2017	1year
10dB Attenuator	Mini-Circuits	15542	3 1344	5/20/2017	1year
10dB Attenuator	Mini-Circuits	15542	3 1415	5/20/2017	1year
30dB Attenuator	Mini-Circuits	15542	3 1420	5/20/2017	1year
Power Amplifier	MILMEGA	80RF1000-175	1059345	5/20/2017	1 Year
Power Amplifier	MILMEGA	AS0102-55	1018770	5/20/2017	1 Year
Power Amplifier	MILMEGA	AS1860-50	1059346	5/20/2017	1 Year
Power Meter	Agilent	N1918A	MY54180006	5/20/2017	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
Validation Kit 5GHz	ASPAG	D5GHzV2	1040	6/17/2016	3years
Network Analyzer	Agilent	E5071B	MY42404246	5/20/2017	1year

3. General Product Information

3.1 Product Function and Intended Use

The EUTs are Android 10.1" tablet with Wi-Fi, Bluetooth function.
All models are identical except the model name.
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	10.1" Flex Tablet for Android with Detachable Keyboard
Type Designation	NS-P10A8100K, NS-P10A8100K-C, xxxxxxP10A81xxxxxx, MID1028-MA (x=0-9, A-Z, a-z, - or blank, for market purpose only)
FCC ID	XMF-MID1028
IC	20064-MID1028
HVIN	NS-P10A8100K
Operating Frequency band	2400-2483.5MHz, 5150-5250MHz, 5725-5850MHz
Extreme Temperature Range	0~+45℃
Operation Voltage	DC 3.7V, 6000mAh via butilt-in lithium-ion battery DC 5V via AC/DC adapter
Antenna Gain (dBi)	2.83 dBi for 2.4GHz band, 1.32 dBi for 5GHz Band
Hardware version	MID1028-MA-PCDDR3-VER1.2
Software version	NS-P10A8100K V01.00.00

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 ~ 2462	2412 ~ 2462	2412 ~ 2462	2422 ~ 2452
Channel Number	11	11	11	7
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
Maximum tune-up conducted average output power (dBm)	15.5	14.0	14.0	13.5
Maximum tested output power (dBm)	15.31	13.87	13.88	13.15

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)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	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

Operating mode(s) / WiFi	IEEE 802.11a
Test modulation	OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
Transmit Frequency Range (MHz)	5180 - 5240 5745 - 5825
Channel Number	9
Data Rate (Mbps)	6, 9, 12, 18, 24, 36, 48, 54
Maximum tune-up conducted average output power (dBm	15.0
Maximum tested output power (dBm)	14.63

Table 6: List of WLAN Channel of 5GHz 802.11a

802.11a					
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
36	5180	48	5240	157	5785
40	5200	149	5745	161	5805
44	5220	153	5765	165	5825

Table 7: Technical Specification of Bluetooth (BDR & EDR mode)

Technical Specification	**Value**
Operating Frequency band (MHz)	2400 – 2483.5
Channel separation	1MHz
Extreme Temperature Range	0~+45℃
Modulation	GFSK, 8DPSK, π/4DQPSK
Bluetooth version	Bluetooth 4.2, Dual Mode
Antenna Gain (dBi)	2.83
Maximum tune-up conducted output power (dBm)	0
Maximum tested output power (dBm)	-0.823

Table 8: RF channel and frequency of Bluetooth (BDR & EDR mode)

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	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 9: Technical Specification of Bluetooth (Low Energy mode)

Technical Specification	**Value**
Operating Frequency band	2400 – 2483.5MHz
Channel separation	2MHz
Extreme Temperature Range	0~+45℃
Modulation	GFSK
Bluetooth version	Bluetooth 4.2, Dual Mode
Antenna Gain (dBi)	2.83
Maximum tune-up conducted output power (dBm)	-2
Maximum tested output power (dBm)	-2.731

Table 10: RF channel and frequency of Bluetooth (Low Energy mode)

RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	RF Channel	Frequency (MHz)	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		

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. Bluetooth BDR
   7. Bluetooth EDR
   8. Bluetooth Low Energy

B. Off

3.4 Submitted Documents

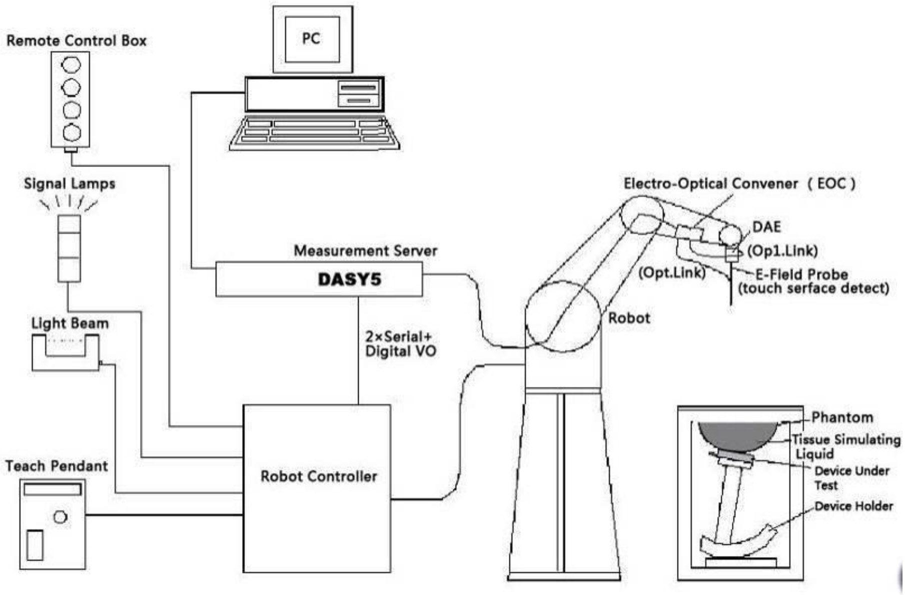
- Application Form
- Block Diagram
- Schematics
- Technical Description
- FCC/IC Label and Location Info
- Photo Document
- User Manual

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

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 2^{nd} 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

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)

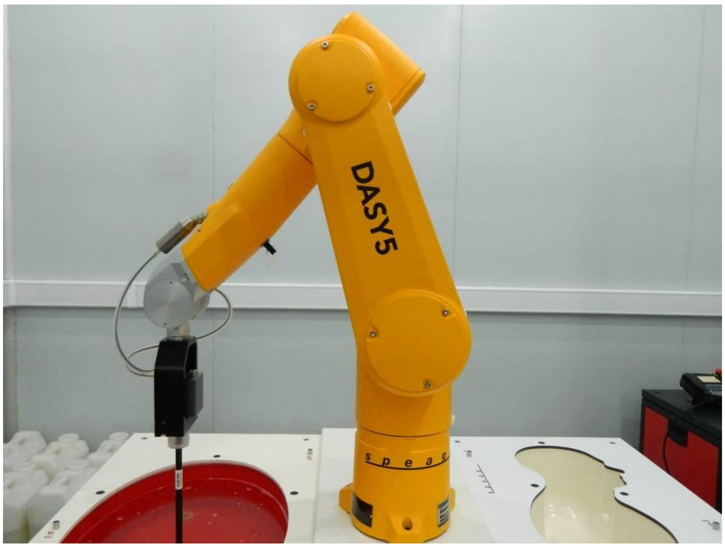
The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical 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 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Picture 3 DAE

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 4 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 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

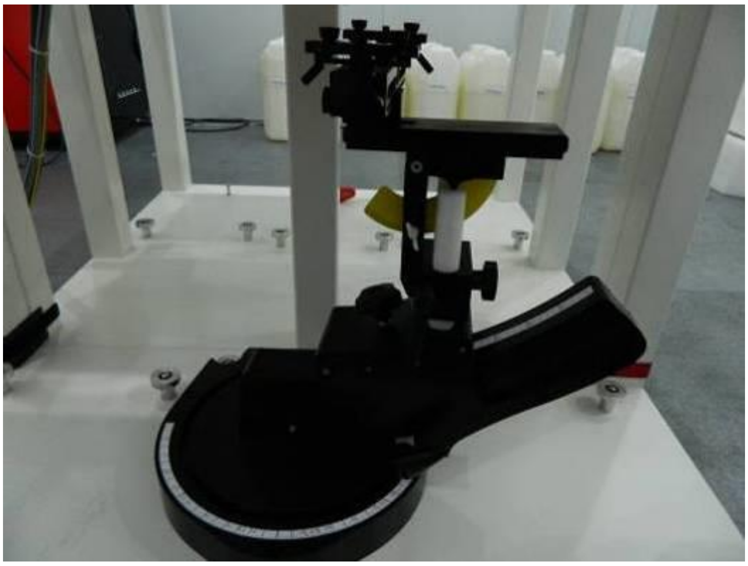
The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate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

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales 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 ε =3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

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

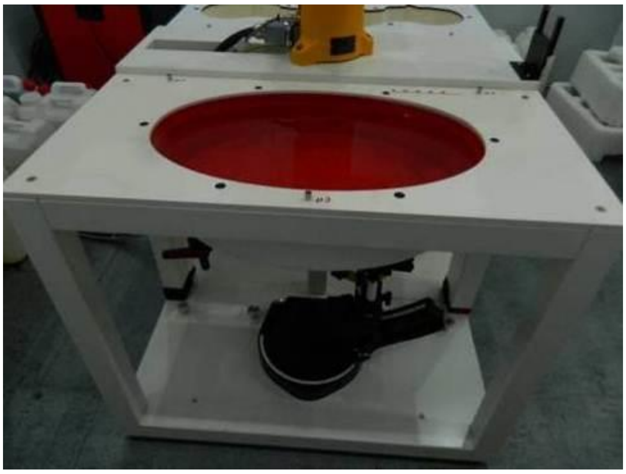


Picture 5 Device Holder

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 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 ± 30°.)

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) (Δxarea, Δyarea)	Maximum Zoom Scan Resolution (mm) (Δxzoom, Δyzoom)	Maximum Zoom Scan Spatial Resolution (mm) Δzzoom(n)	Minimum Zoom Scan Volume (mm) (x,y,z)
≤2 GHz	≤15	≤8	≤5	≥30
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.

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:

$$V_i = U_i + U_i^2 \cdot cf / dcp_i$$

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

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

ρ = equivalent tissue density in g/cm^3

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/cm^2

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 and accessories shall be those specified by the manufacturer. The EUT battery must be fully powered and checked periodically during the test to ascertain uniform power output.

Table 11: 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 (Band U-NII-1)	5180-5240	OFDM	CH36	CH40	CH48	
802.11a (Band U-NII-3)	5745-5825	OFDM	CH149	CH157	CH165	
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.

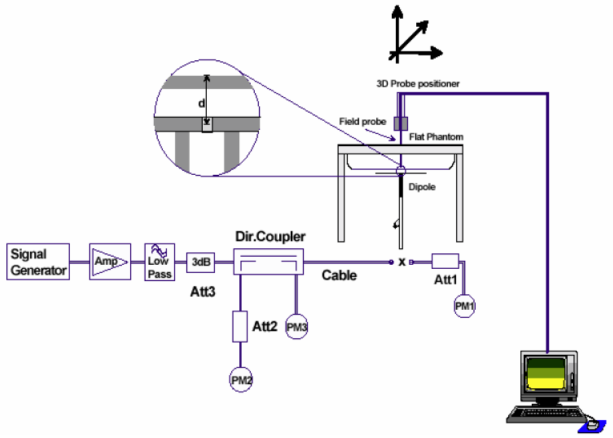
Table 12: Composition of Tissue Simulating Liquid

MIXTURE%(Weight)	FREQUENCY (Body) 2450MHz
Water	73.2
Glycol	26.7
Salt	0.1
Dielectric Parameters Target Value	f=2450MHz ε=52.70 σ=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 ε=49.00 σ=5.30 f=5800MHz ε=48.20 σ=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 (±10 %). System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



Picture 9 System Check Set-up

Table 13: System Check Results of Tissue Simulating Liquid

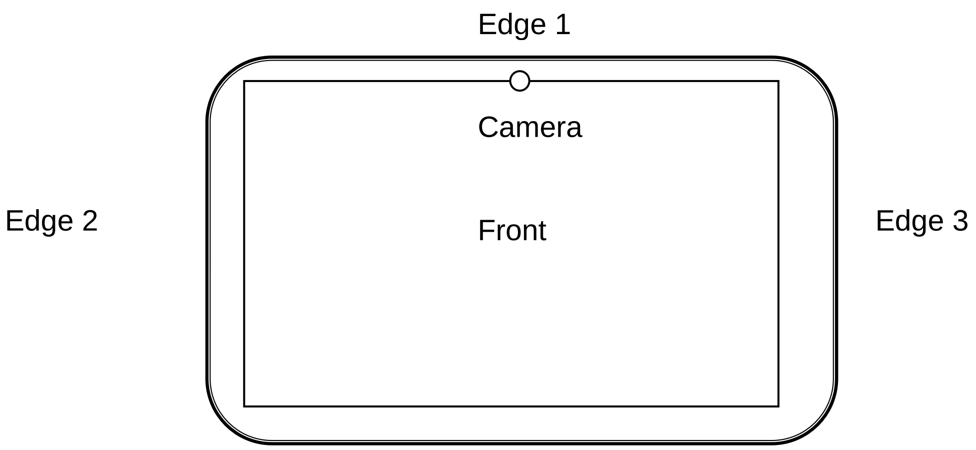
Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	Body	22.5	2.026	52.960	1.95	52.70	3.90	0.49	±5	2017/7/8
5200	Body	22.3	5.159	50.050	5.30	49.00	-2.66	2.14	±5	2017/7/7
5800	Body	22.5	6.124	48.900	6.00	48.20	2.07	1.45	±5	2017/7/7

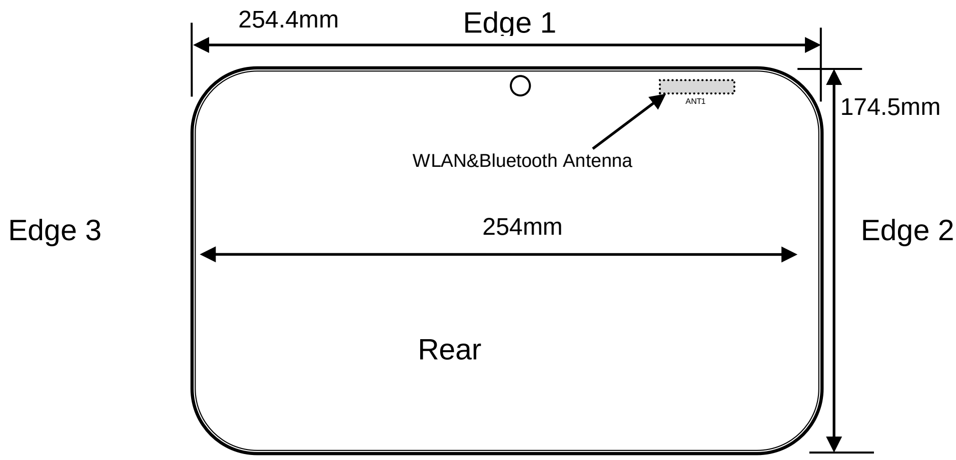
(Liquid depth: 15cm)

Table 14: 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	12.87	51.20	51.48	0.55	2017/7/8
5200	Body	100	1040	3970	1418	7.65	72.90	76.5	4.94	2017/7/7
5800	Body	100	1040	3970	1418	7.39	75.20	73.9	-1.73	2017/7/7

5.4 Exposure Positions Consideration





Remark:
1. The diagonal length of EUT is more than 20cm, hence the test was applied on the rear side, Edge 1 and Edge 2 side only.
2. The test distance of less than 5mm, according to KDB447498 should be considered for the orientation that can satisfy such requirements.

5.5 Test Operation and Test Software

Test operation refers to test setup in chapter 5.

A communication link is set up with the test mode software for WiFi mode test. During the test, at the each test frequency channel, the EUT is operated at the RF continuous emission mode.

802.11 a/b/g/n operating modes are tested independently according to the service requirements in each frquency band. 802.11a/b/g/n modes are tested on channel low/middle/high. However, if output power reduction is necessary for channels lowest and/or highest to meet restricted band requirements the highest output channel closest to each of these channels must be tested instead.

SAR is not required for 2.4GHz 802.11g/n when
a) KDB Publication 447498 D01 SAR test exclusion applies to the OFDM configuration.
b) The highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Each channel should be tested at the lowest data rate, and repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg.

When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing.

5.6 Special Accessories and Auxiliary Equipment

None.

6. Test Results

6.1 Huaman Exposure to Radiofrequency Electromagnetic Fields

RESULT: **Passed**

Date of testing	:	2017-07-07 to 2017-07-08
Test standard	:	CFR Title 47 Part 2 Subpart J Section 2.1093 ANSI/IEEE C95.1-1992
FCC KDB Publication	:	KDB 447498 D01 v06 KDB 248227 D01 v02r02 KDB 865664 D01 v01r04 KDB 616217 D04 v01r02
Limits	:	4W/kg for Extremity

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.

For Bluetooth, The minimum distance for the EUT is 5mm, since maximum peak output power of the transmitter is 2.65mW <10mW, hence the EUT is exclueded from SAR evaluation according to FCC KDB publication 447498 D01: Mobile and Portable RF Exposure.Guidance v06.

For Bluetooth, The maximum peak output power of the transmitter is 2.65mW which less than 4mW. Hence the EUT is exempted from routine evaluation limits (SAR Evaluation) according to clause 2.5.1 of RSS-102 Issue 5.

Table 15: Conducted Power of 802.11b

Channel	Frequency (MHz)	Average power (dBm)				Power Setting	Tune-Up Limit	Duty Cycle %
		Data Rate						100
		1Mbps	2Mbps	5.5Mbps	11Mbps			Max
CH 1	2412	14.96	14.52	14.62	14.38	15	15.5	15.31
CH 6	2437	15.31	15.13	14.95	15.09	15	15.5	
CH 11	2462	14.98	14.64	14.91	14.72	15	15.5	

Table 16: Conducted Power of 802.11g

Channel	Frequency (MHz)	Average power (dBm)								Power Setting	Tune-Up Limit	Duty Cycle %
		Data Rate										100
		6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps			Max
CH 1	2412	13.7	13.29	13.52	13.46	13.19	13.22	13.37	13.75	14	14	13.87
CH 6	2437	13.87	13.56	13.46	13.43	13.71	13.61	13.27	13.43	14	14	
CH 11	2462	13.75	13.59	13.46	13.61	13.53	13.41	13.7	13.29	14	14	

Table 17: Conducted Power of 802.11n-HT20 (2.4G)

Channel	Frequency (MHz)	Average power (dBm)								Power Setting	Tune-up Limit	Duty Cycle %
		MCS Index										100
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7			Max
CH 1	2412	13.65	13.52	13.43	13.26	13.31	13.29	13.51	13.15	14	14	13.88
CH 6	2437	13.88	13.51	13.71	13.61	13.53	13.42	13.34	13.29	14	14	
CH 11	2462	13.68	13.51	13.2	13.6	13.44	13.48	13.24	13.18	14	14	

Table 18: Conducted Power of 802.11n-HT40 (2.4G)

Channel	Frequency (MHz)	Average power (dBm)								Power Setting	Tune-up Limit	Duty Cycle %
		MCS Index										100
		MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7			Max
CH 3	2422	13.12	13.03	12.94	12.68	12.94	12.59	12.89	13.01	13.5	13.5	13.15
CH 6	2437	12.88	12.59	12.64	12.78	12.59	12.67	12.81	12.39	13.5	13.5	
CH 9	2452	13.15	13.02	13.01	12.94	12.89	12.65	12.49	12.61	13.5	13.5	

Table 19: Conducted Power of 802.11a

Channel	Frequency (MHz)	Average Power (dBm)								Power Setting	Tune-up Limit	Duty Cycle %
		Data Rate										97.6
		6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps			Max
CH 36	5180	12.36	12.16	12.13	12.25	12.09	12.19	12.03	12.01	12	14	13.55
CH 40	5200	12.79	12.26	12.46	12.41	12.5	12.42	12.34	12.33	12	14	
CH 48	5240	13.55	12.97	13.16	13.29	13.22	13.34	13.17	12.99	12	14	
CH 149	5745	13.42	13.26	13.21	13.24	12.95	13.06	13.07	13.15	12	15	14.63
CH 157	5785	13.14	13.02	12.94	12.99	12.81	12.82	12.64	12.82	12	15	
CH 165	5825	14.63	13.94	14.06	14.15	14.29	14.53	13.97	14.06	12	15	

Table 20: Conducted Power of Bluetooth (BDR & EDR)

Channel	Frequency (MHz)	Bluetooth Average power (dBm)			Tune-up Limit
		1Mbps	2Mbps	3Mbps	
CH 00	2402	3.85	3.82	3.73	4.72
CH 39	2441	4.11	4.09	4.21	
CH 78	2480	4.55	4.52	4.72	

Table 21: Conducted Power of Bluetooth (Low Energy)

Channel	Frequency (MHz)	Bluetooth Average power (dBm)	Tune-up Limit
		GFSK	
CH 00	2402	1.89	1.13
CH 19	2440	1.23	
CH 39	2480	1.13	

Table 22: 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	802.11 b	Edge1	0	1	2412	15	1Mbps	14.96	15.50	1.132	0.07	0.460	0.521	7/8/2017
WLAN2.4G	802.11 b	Edge2	0	1	2412	15	1Mbps	14.96	15.50	1.132	-0.02	0.085	0.096	7/8/2017
WLAN2.4G	802.11 b	Rear	0	1	2412	15	1Mbps	14.96	15.50	1.132	-0.07	0.549	0.622	7/8/2017
WLAN2.4G	802.11 b	Rear with Keyboard	0	1	2412	15	1Mbps	14.96	15.50	1.132	-0.06	0.467	0.529	7/8/2017
WLAN2.4G	802.11 b	Front	0	1	2412	15	1Mbps	14.96	15.50	1.132	-0.16	0.785	0.889	7/8/2017
WLAN2.4G	802.11 b	Front	0	6	2437	15	1Mbps	15.31	15.50	1.045	-0.09	0.906	0.947	7/8/2017
WLAN2.4G	802.11 b	Front	0	11	2462	15	1Mbps	14.98	15.50	1.127	0.06	0.943	1.063	7/8/2017
WLAN5G	802.11 a	Front	0	36	5180	12	6Mbps	12.36	14.00	1.459	-0.01	0.679	0.991	7/7/2017
WLAN5G	802.11 a	Front	0	40	5200	12	6Mbps	12.79	14.00	1.321	-0.11	0.700	0.925	7/7/2017
WLAN5G	802.11 a	Front	0	48	5240	12	6Mbps	13.55	14.00	1.109	-0.04	0.733	0.813	7/7/2017
WLAN5G	802.11 a	Edge1	0	48	5240	12	6Mbps	13.55	14.00	1.109	-0.10	0.426	0.472	7/8/2017
WLAN5G	802.11 a	Edge2	0	48	5240	12	6Mbps	13.55	14.00	1.109	-0.18	0.078	0.087	7/8/2017
WLAN5G	802.11 a	Rear	0	48	5240	12	6Mbps	13.55	14.00	1.109	-0.02	0.333	0.369	7/8/2017
WLAN5G	802.11 a	Rear with Keyboard	0	48	5240	12	6Mbps	13.55	14.00	1.109	-0.03	0.344	0.381	7/8/2017
WLAN5G	802.11 a	Front	0	149	5745	12	6Mbps	13.42	15.00	1.439	-0.03	0.950	1.367	7/7/2017
WLAN5G	802.11 a	Front	0	157	5785	12	6Mbps	13.14	15.00	1.535	-0.12	1.020	1.565	7/7/2017
WLAN5G	802.11 a	Front	0	165	5825	12	6Mbps	14.63	15.00	1.089	-0.01	1.050	1.143	7/7/2017
WLAN5G	802.11 a	Edge1	0	165	5825	12	6Mbps	14.63	15.00	1.089	-0.01	0.662	0.721	7/8/2017

WLAN5G	802.11 a	Edge2	0	165	5825	12	6Mbps	14.63	15.00	1.089	-0.03	0.108	0.118	7/8/2017
WLAN5G	802.11 a	Rear	0	165	5825	12	6Mbps	14.63	15.00	1.089	0.02	0.697	0.759	7/8/2017
WLAN5G	802.11 a	Rear with Keyboard	0	165	5825	12	6Mbps	14.63	15.00	1.089	-0.04	0.725	0.790	7/8/2017

Refer to attached Appendix A for details of test results.

6.2 Measurement Uncertainty

6.2.1 Measurement uncertainty evaluation

This measurement uncertainty budget is suggested by IEEE P1528. The breakdown of the individual uncertainties is as follows:

EMTEK Access to the World

No.	Description	Type	Uncertainty Value(%)	Probability Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	6	N	1	1	1	6	6	∞
2	Isotropy	B	3.0	R	$\sqrt{3}$	0.7	0.7	1.2	1.2	∞
3	Boundary effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	N	1	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	0	R	$\sqrt{3}$	1	1	0	0	∞
10	RF ambient conditions-reflection	B	0	R	$\sqrt{3}$	1	1	0	0	∞
11	Probe positioned mech. restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	∞
12	Probe positioning with respect to phantom shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.4	N	1	1	1	3.4	3.4	5
16	Drift of output power	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.06	N	1	0.64	0.43	1.32	0.89	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	1.6	N	1	0.6	0.49	1.0	0.8	521
continue										
Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						9.20	9.07	257
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						18.40	18.14	\

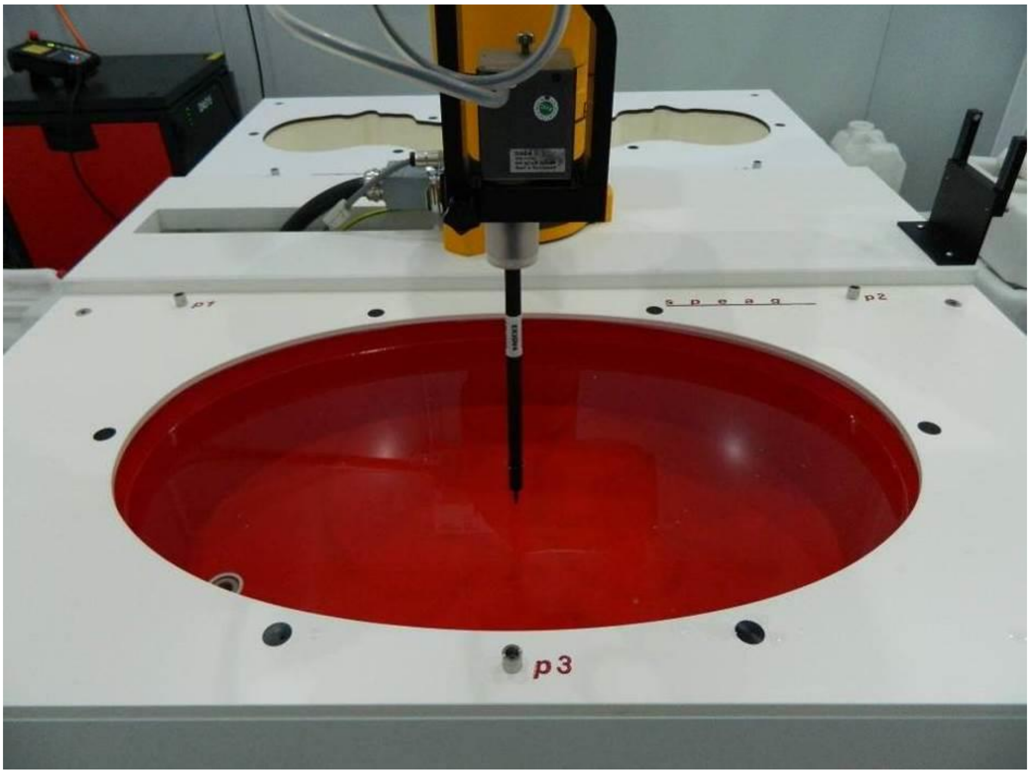
Table 12.1. Uncertainty Budget for frequency range 300 MHz to 3 GHz

No.	Description	Type	Uncertainty Value(%)	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement system										
1	Probe calibration	B	6.6	N	1	1	1	6.6	6.6	∞
2	Isotropy	B	3.0	R	$\sqrt{3}$	0.7	0.7	1.2	1.2	∞
3	Boundary effect	B	2.0	R	$\sqrt{3}$	1	1	1.2	1.2	∞
4	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
5	Detection limit	B	1.0	N	1	1	1	0.6	0.6	∞
6	Readout electronics	B	0.3	R	$\sqrt{3}$	1	1	0.3	0.3	∞
7	Response time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
8	Integration time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	∞
9	RF ambient conditions-noise	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
10	RF ambient conditions-reflection	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
11	Probe positioned mech. restrictions	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	∞
12	Probe positioning with respect to phantom shell	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	∞
13	Post-processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	∞
Test sample related										
14	Test sample positioning	A	3.3	N	1	1	1	3.3	3.3	71
15	Device holder uncertainty	A	3.6	N	1	1	1	3.6	3.6	5
16	Drift of output power	B	3.0	R	$\sqrt{3}$	1	1	1.7	1.7	∞
Phantom and set-up										
17	Phantom uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	∞
18	Liquid conductivity (target)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	∞
19	Liquid conductivity (meas.)	A	2.5	N	1	0.64	0.43	1.6	1.1	43
20	Liquid permittivity (target)	B	5.0	R	$\sqrt{3}$	0.6	0.49	1.7	1.4	∞
21	Liquid permittivity (meas.)	A	2.5	N	1	0.6	0.49	1.5	1.2	520
continue										
Combined standard uncertainty		$u_c' = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.23	10.08	256
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$						20.46	20.16	\

Table 12.2. Uncertainty Budget for frequency range 3 GHz to 6 GHz

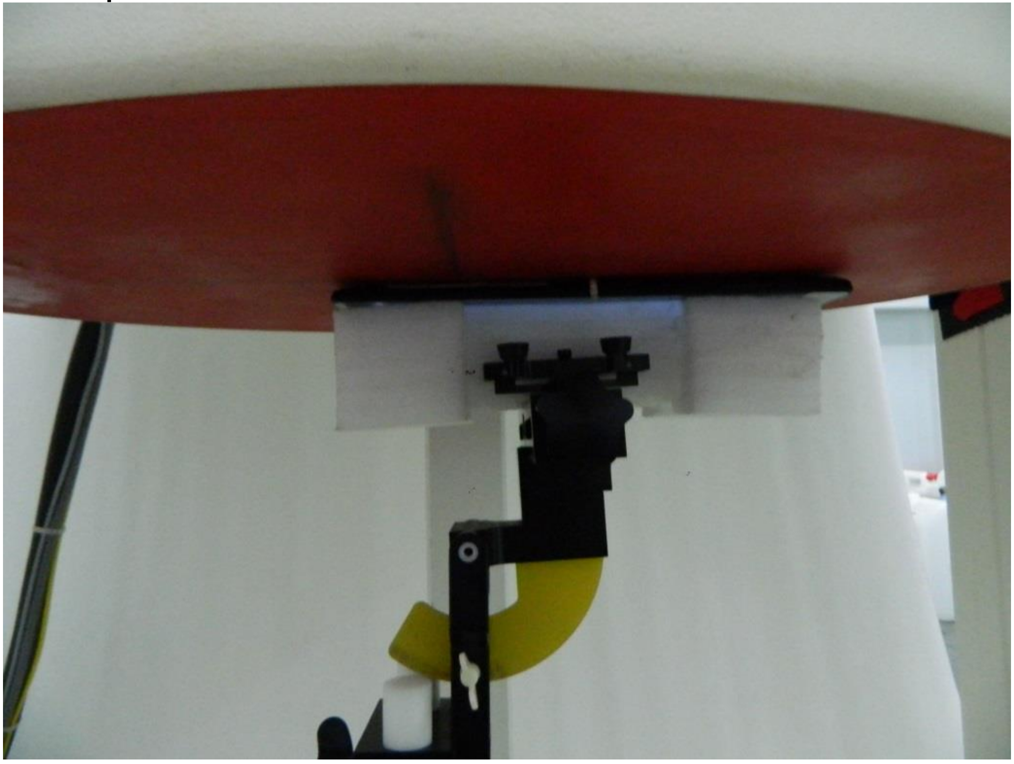
7. Photographs of the Test Set-Up

Photograph 1: Test Layout

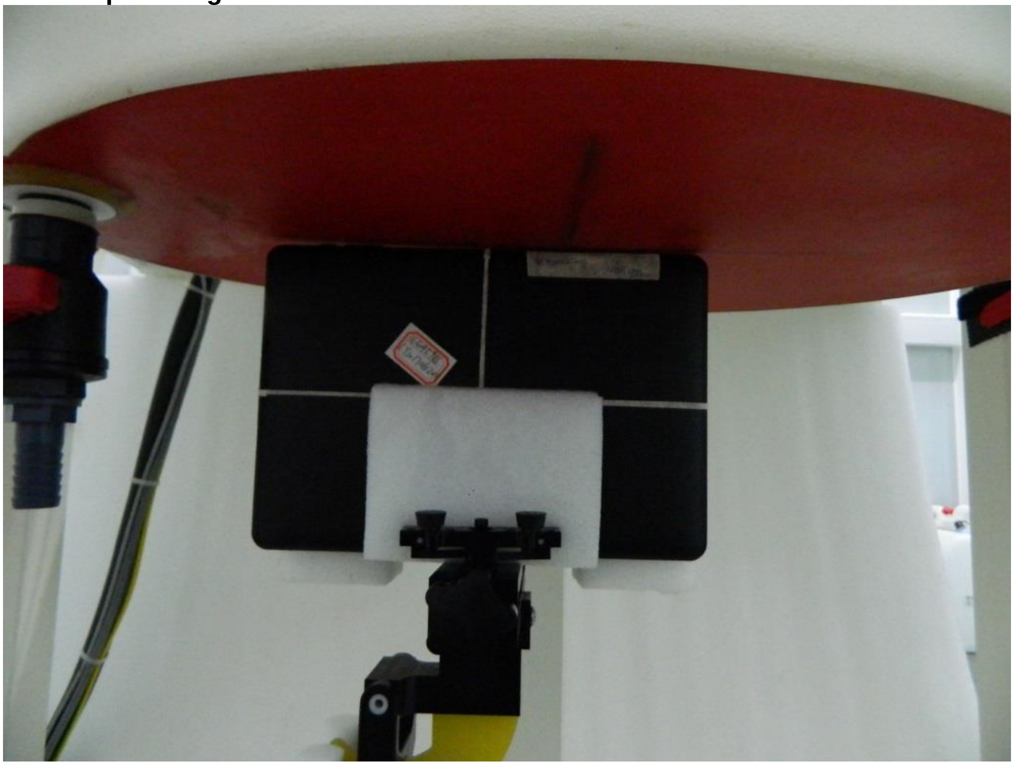


Photograph 2: Set-up for Front Face

Photograph 3: Set-up for Bottom Face



Photograph 4: Set-up for Edge 1



8. List of Tables

9. List of Photographs

Appendix A

System Performance Check

Test Laboratory: EMTEK (Shenzhen) Co.,Ltd. Date/Time: 08.07.2017

SystemPerformanceCheck-D2450V2-HSL-170708

Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: HSL_2450_170708

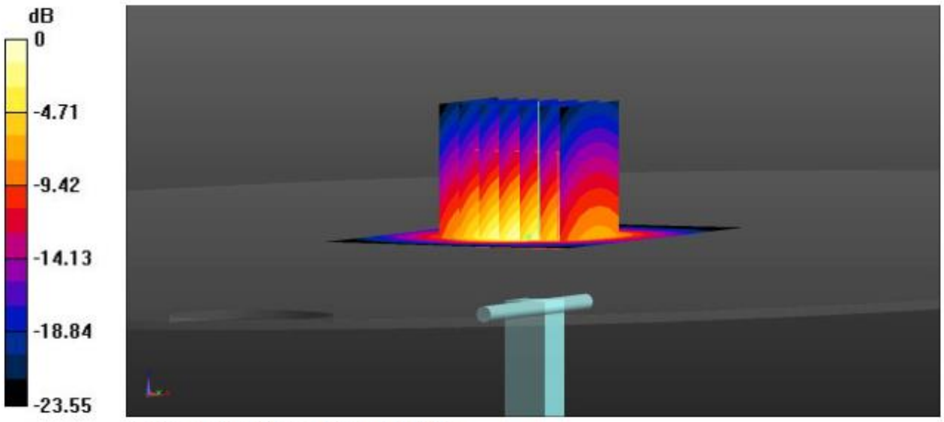
Medium parameters used: f = 2450 MHz; σ = 2.026 S/m; ε_r = 52.96; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(7.36, 7.36, 7.36); 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)

System Performance Check at Frequency at 2450MHz/d=10mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Area Scan (41x61x1): Interpolated grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 20.5 W/kg

System Performance Check at Frequency at 2450MHz/d=10mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.7 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 25.2 W/kg
SAR(1 g) = 12.87 W/kg; SAR(10 g) = 6.01 W/kg
Maximum value of SAR (measured) = 19.7 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 07.07.2017

SystemPerformanceCheck-D5GHzV2-5200MHz-MSL-170707

DUT: Dipole D5GHzV2 SN:1169
Communication System: UID 0, CW (0); Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL_5G_170707

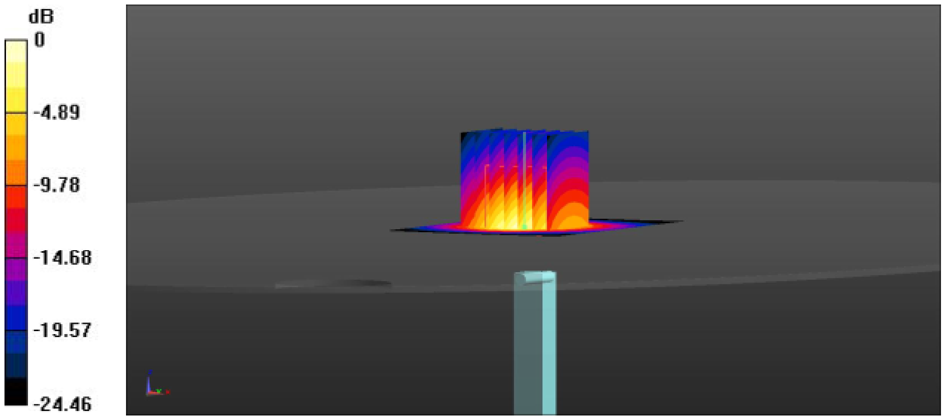
Medium parameters used: f = 5200 MHz; σ = 5.152 S/m; ε_r = 50.110; ρ = 1000 kg/m^3
Ambient Temperature: 23.3 ℃; Liquid Temperature: 22.3℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(5.08, 5.08, 5.08); 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=1.4mm (EX-Probe)/Area Scan (91x91x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 16.6 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 = 66.3 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 28.4 W/kg
SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.18 W/kg
Maximum value of SAR (measured) = 16.8 W/kg



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

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 07.07.2017

SystemPerformanceCheck-D5GHzV2-5800MHz-MSL-170707

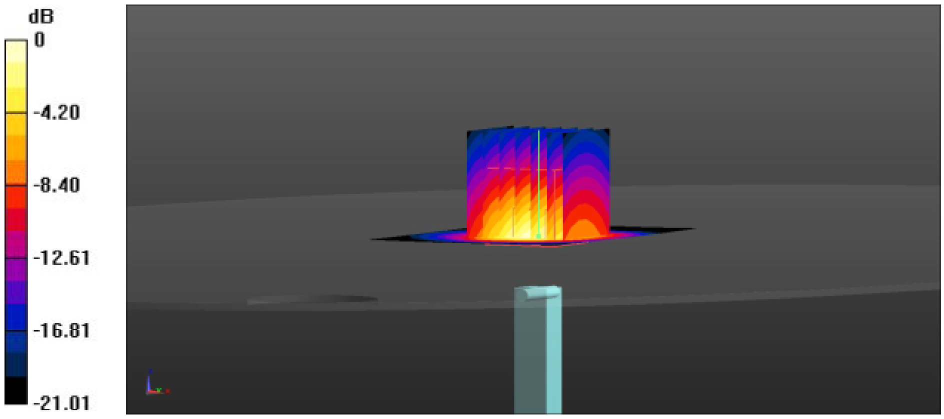
DUT: Dipole D5GHzV2 SN:1169
Communication System: UID 0, CW (0); Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL_5G_170707
Medium parameters used: f = 5800 MHz; σ = 6.131 S/m; ε_r = 48.895; ρ = 1000 kg/m^3 Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

DASY Configuration:

- Probe: EX3DV4 - SN3970; ConvF(4.69, 4.69, 4.69); 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 5800MHz/d=10mm, Pin=100mW, dist=1.4mm (EX-Probe)/Area Scan (91x91x1): Interpolated grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 16.5 W/kg

System Performance Check at Frequency at 5800MHz/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 = 66.9 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 7.39 W/kg; SAR(10 g) = 2.03 W/kg
Maximum value of SAR (measured) = 16.8 W/kg



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

Appendix A

Test Plots of SAR Measurement

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 08.07.2017

1-WLAN2.4GHz-802.11b 1Mbps-Edge1-0cm-Ch1

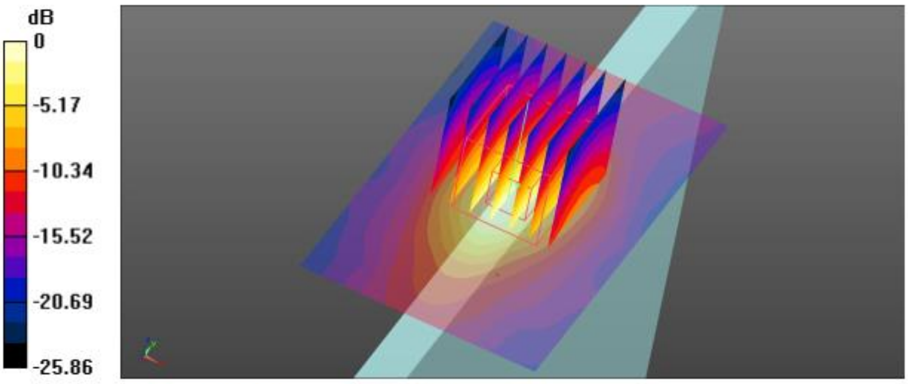
Communication System: UID 0, WIFI (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: MSL_2450_170708
Medium parameters used: f = 2412 MHz; σ = 1.971 S/m; ε_r = 53.056; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.740 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 19.898 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 1.02 W/kg
SAR(1 g) = 0.460 W/kg; SAR(10 g) = 0.196 W/kg
Maximum value of SAR (measured) = 0.741 W/kg



0 dB = 0.741 W/kg = -1.30 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 08.07.2017

2-WLAN2.4GHz-802.11b 1Mbps-Bottom-0cm-Ch1

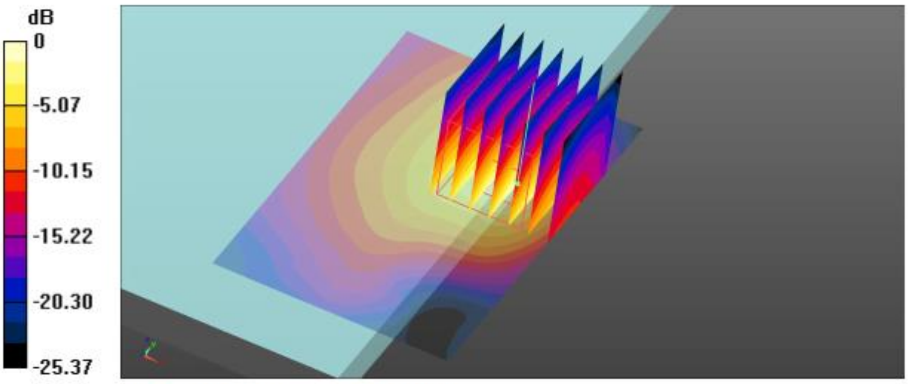
Communication System: UID 0, WIFI (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: MSL_2450_170708
Medium parameters used: f = 2412 MHz; σ = 1.971 S/m; ε_r = 53.056; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.826 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.254 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 1.32 W/kg
SAR(1 g) = 0.549 W/kg; SAR(10 g) = 0.235 W/kg
Maximum value of SAR (measured) = 0.925 W/kg



0 dB = 0.925 W/kg = -0.34 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 07.08.2017

2-WLAN2.4GHz-802.11b 1Mbps-Keyboard-Back-0cm-Ch1

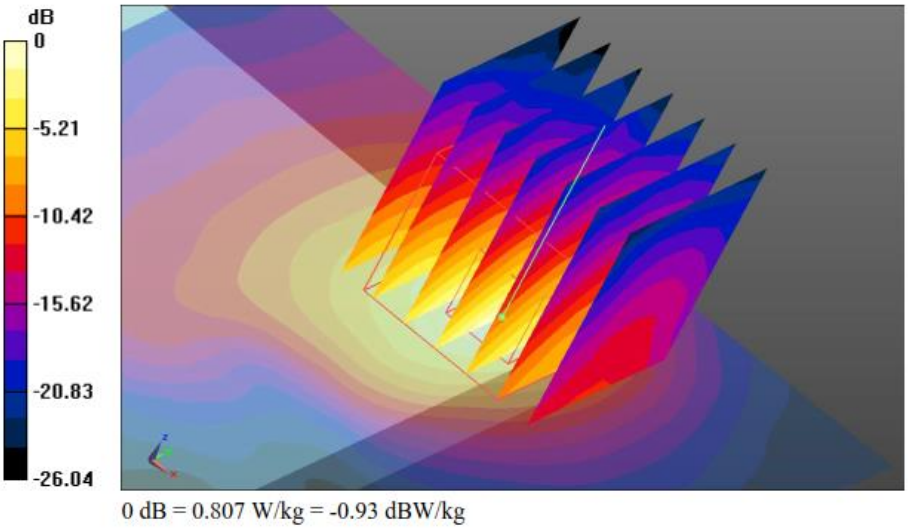
Communication System: UID 0, WIFI (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: MSL_2450_170805
Medium parameters used: f = 2412 MHz; σ = 1.971 S/m; ε_r = 53.056; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

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 (101x141x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.792 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.835 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 1.15 W/kg
SAR(1 g) = 0.467 W/kg; SAR(10 g) = 0.188 W/kg
Maximum value of SAR (measured) = 0.807 W/kg



0 dB = 0.807 W/kg = -0.93 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 08.07.2017

3-WLAN2.4GHz-802.11b 1Mbps-Front-0cm-Ch1

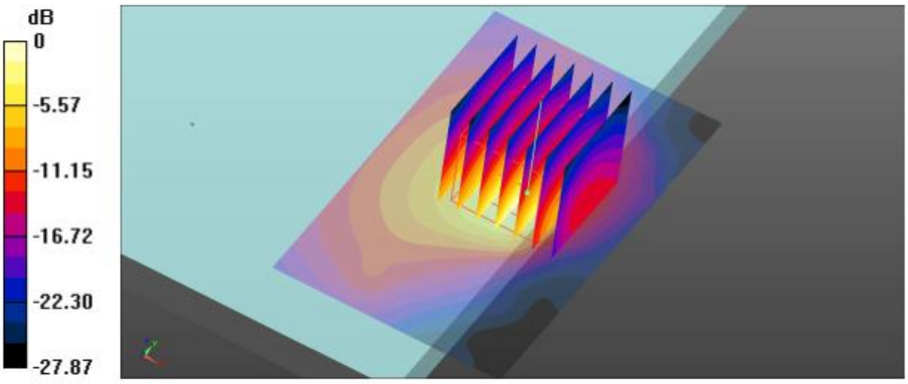
Communication System: UID 0, WIFI (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: MSL_2450_170708
Medium parameters used: f = 2412 MHz; σ = 1.971 S/m; ε_r = 53.056; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.38 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.263 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 1.98 W/kg
SAR(1 g) = 0.785 W/kg; SAR(10 g) = 0.315 W/kg
Maximum value of SAR (measured) = 1.37 W/kg



0 dB = 1.37 W/kg = 1.37 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 08.07.2017

4-WLAN2.4GHz-802.11b 1Mbps-Front-0cm-Ch6

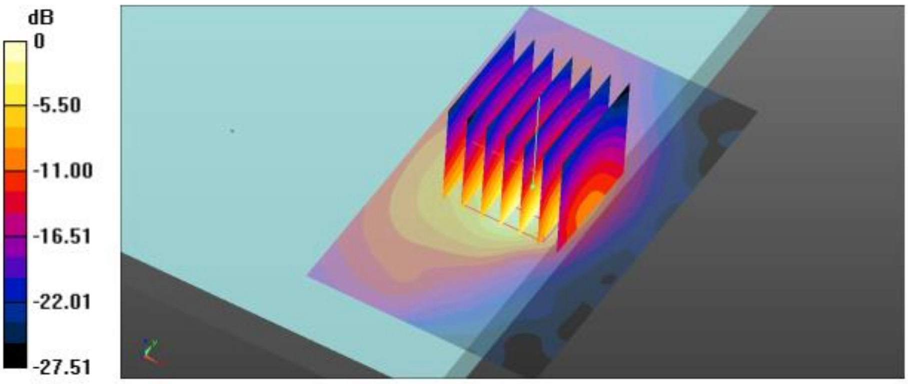
Communication System: UID 0, WIFI (0); Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_170708
Medium parameters used: f = 2437 MHz; σ = 2.007 S/m; ε_r = 53.007; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.59 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 28.778 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 2.29 W/kg
SAR(1 g) = 0.906 W/kg; SAR(10 g) = 0.357 W/kg
Maximum value of SAR (measured) = 1.44 W/kg



0 dB = 1.44 W/kg = 1.58 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 08.07.2017

5-WLAN2.4GHz-802.11b 1Mbps-Front-0cm-Ch11

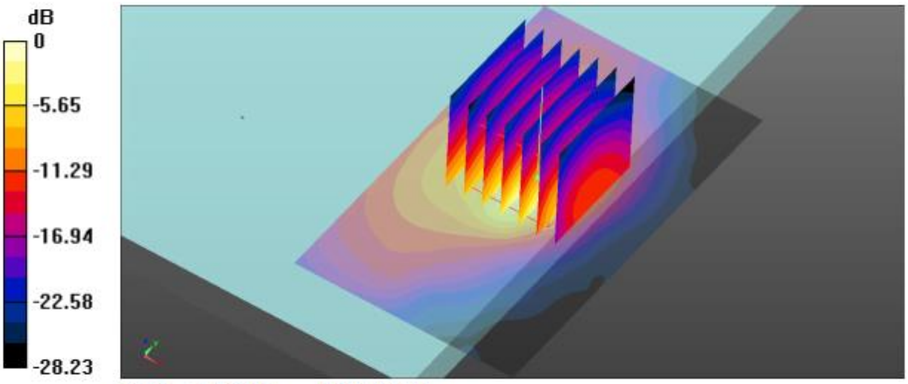
Communication System: UID 0, WIFI (0); Frequency: 2462 MHz;Duty Cycle: 1:1
Medium: MSL_2450_170708
Medium parameters used: f = 2462 MHz; σ = 2.044 S/m; ε_r = 52.919; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.81 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 27.560 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 2.39 W/kg
SAR(1 g) = 0.943 W/kg; SAR(10 g) = 0.370 W/kg
Maximum value of SAR (measured) = 1.57 W/kg



0 dB = 1.57 W/kg = 1.96 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 07.07.2017

6-WLAN5GHz-802.11a 6Mbps-Front-0cm-Ch36

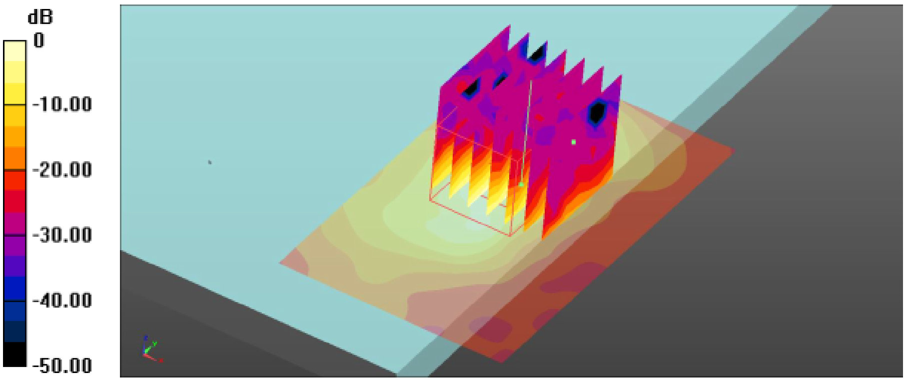
Communication System: UID 0, WIFI (0); Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL_5G_170707
Medium parameters used: f = 5180 MHz; σ = 5.129 S/m; ε_r = 50.086; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.46 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.996 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.59 W/kg
SAR(1 g) = 0.679 W/kg; SAR(10 g) = 0.186 W/kg
Maximum value of SAR (measured) = 1.55 W/kg



0 dB = 1.55 W/kg = 1.90 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 07.07.2017

7-WLAN5GHz-802.11a 6Mbps-Front-0cm-Ch40

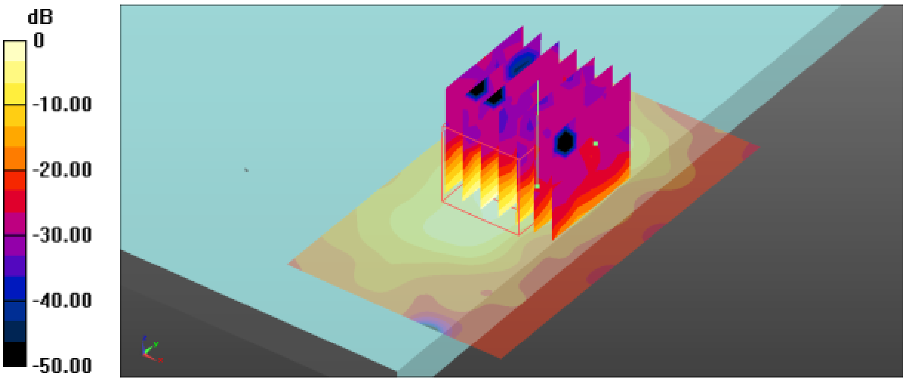
Communication System: UID 0, WIFI (0); Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL_5G_170707
Medium parameters used: f = 5200 MHz; σ = 5.159 S/m; ε_r = 50.05; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 °C; Liquid Temperature: 22.5 °C

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.15 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 11.829 V/m; Power Drift = -0.11dB
Peak SAR (extrapolated) = 3.88 W/kg
SAR(1 g) = 0.700 W/kg; SAR(10 g) = 0.190 W/kg
Maximum value of SAR (measured) = 1.53 W/kg



0 dB = 1.53 W/kg = 1.85 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 07.07.2017

8-WLAN5GHz-802.11a 6Mbps-Front-0cm-Ch48

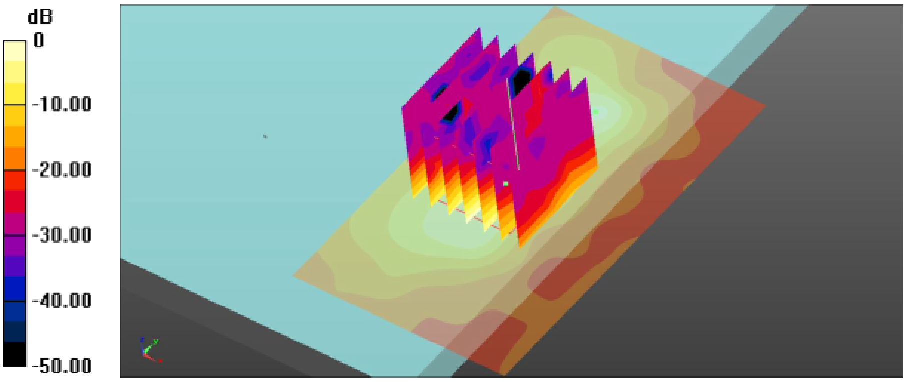
Communication System: UID 0, WIFI (0); Frequency: 5240 MHz;Duty Cycle: 1:1
Medium: MSL_5G_170707
Medium parameters used: f = 5240 MHz; σ = 5.222 S/m; ε_r = 50.023; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.24 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.710 V/m; Power Drift = -0.04dB
Peak SAR (extrapolated) = 3.99 W/kg
SAR(1 g) = 0.733 W/kg; SAR(10 g) = 0.205 W/kg
Maximum value of SAR (measured) = 1.62 W/kg



0 dB = 1.62 W/kg = 2.10 dBW/kg

Test Laboratory: Shenzhen EMTEK Co.,Ltd. Date: 07.08.2017

5-WLAN5GHz-802.11a 6Mbps-Edge1-0cm-Ch48

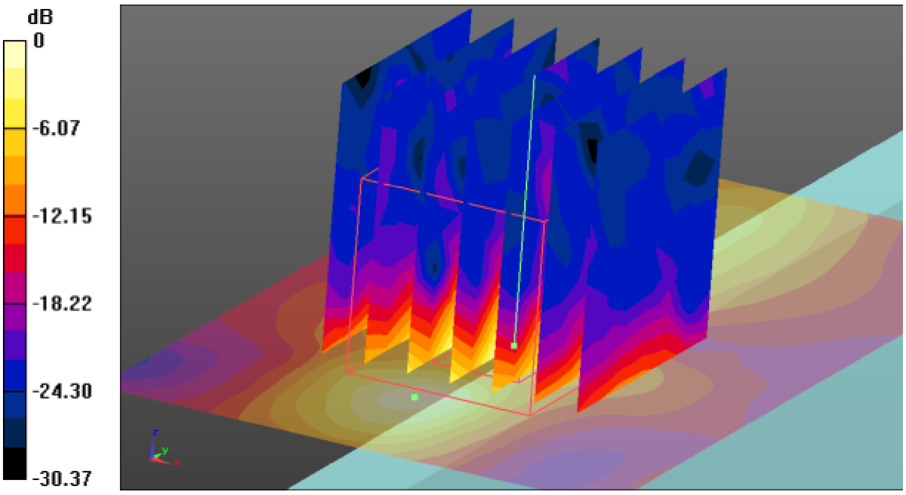
Communication System: UID 0, WIFI (0); Frequency: 5240 MHz;Duty Cycle: 1:1
Medium: MSL_5G_170807
Medium parameters used: f = 5240 MHz; σ = 5.222 S/m; ε_r = 50.023; ρ = 1000 kg/m^3
Ambient Temperature: 23.5 ℃; Liquid Temperature: 22.5 ℃

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 (61x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.885 W/kg

Configuration/Unnamed procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.818 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 2.45 W/kg
SAR(1 g) = 0.426 W/kg; SAR(10 g) = 0.095 W/kg
Maximum value of SAR (measured) = 0.948 W/kg



0 dB = 0.948 W/kg = -0.23 dBW/kg