Prüfbericht-Nr.: *Test Report No.:*	**10059688 001**	**Auftrags-Nr.:** *Order No.:*	114058586
Kunden-Referenz-Nr.: *Client Reference No.:*	N/A	**Auftragsdatum:** *Order date:*	24-Nov-2016
Auftraggeber: *Client:*	MilDef CReTE Inc 7F, NO. 250, Sec.3, Pei Shen Rd., Shen Keng District, New Taipei City, Taiwan (R.O.C.)		
Prüfgegenstand: *Test item:*	HANDHELD COMPUTER		
Bezeichnung / Typ-Nr.: *Identification / Type No.:*	DF8A		
Auftrags-Inhalt: *Order content:*	FCC		
Prüfgrundlage: *Test specification:*	CFR Title 47 Part 2 Subpart J Section 2.1093 IEEE std 1528-2013 KDB 447498 KDB 865664 KDB 248227 KDB 941225		
Wareneingangsdatum: *Date of receipt:*	3-Feb-2017		
Prüfmuster-Nr.: *Test sample No.:*	A000212113-002		
Prüfzeitraum: *Testing period:*	17-Feb-2017 - 06-Apr-2017		
Ort der Prüfung: *Place of testing:*	TÜV Rheinland Taiwan Ltd.		
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland Taiwan Ltd.		
Prüfergebnis*: *Test result*:*	Pass		

geprüft von / *tested by:*

Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*
7-Apr-2017	SamC.J. Kuo / Engineer	[signature]

kontrolliert von / *reviewed by:*

Datum *Date*	**Name / Stellung** *Name / Position*	**Unterschrift** *Signature*
7-Apr-2017	Jack H.C. Chang / Project Manager	[signature]

Sonstiges / *Other:*

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

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STATEMENT OF COMPLIANCE

TEST ITEM	SPECIFICATION	RESULT
Specific Absorption Rate - Wi-Fi 802.11 b/g/n(20M/40M) - 2.4GHz Band	CFR Title 47 Part 2 Subpart J Section 2.1093 IEEE 1528-2013 KDB 447498 D01 KDB 865664 D01 D02 KDB 248227 D01 KDB 941225 D07	**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 1528-2013 and Published RF exposure KDB procedures.

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

FREQUENCY BAND	EXPOSURE POSITION	HIGHEST REPORTED SAR_{1G} VALUE (W/KG)
802.11 b/g/n - 2.4GHz Band	Body	**1.38**

Revision History

Rev.	Date	Revisions	Revised By
00	1-Mar-2017	Initial Issue	Sam Kuo
01	7-Apr-2017	1st Modification	Sam Kuo

This test report contains a reference to the previous version test report that it replaces.

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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: Photographs of the test set-up
Appendix B: System check
Appendix C: Test Plots of SAR Measurement
Appendix D: Calibration Certificate

2. Test Facilities

TÜVRheinland Taiwan Co., Ltd.
13F. No. 758, Sec. 4, Bade Rd., Taipei 105, Taiwan, R. O. C.

2.1 Test Environment

Ambient Temperature: 20 - 24˚C
Tissue Simulating Liquid: 22 ±2˚C

3. SAR Measurement System

3.1 SAR Measurement System

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

- A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronic (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.
- A unit to operate the optical surface detector which is connected to the EOC.
- The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.
- The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows XP.
- DASY5 software and SEMCAD data evaluation software.
- Remote control with teach panel and 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.

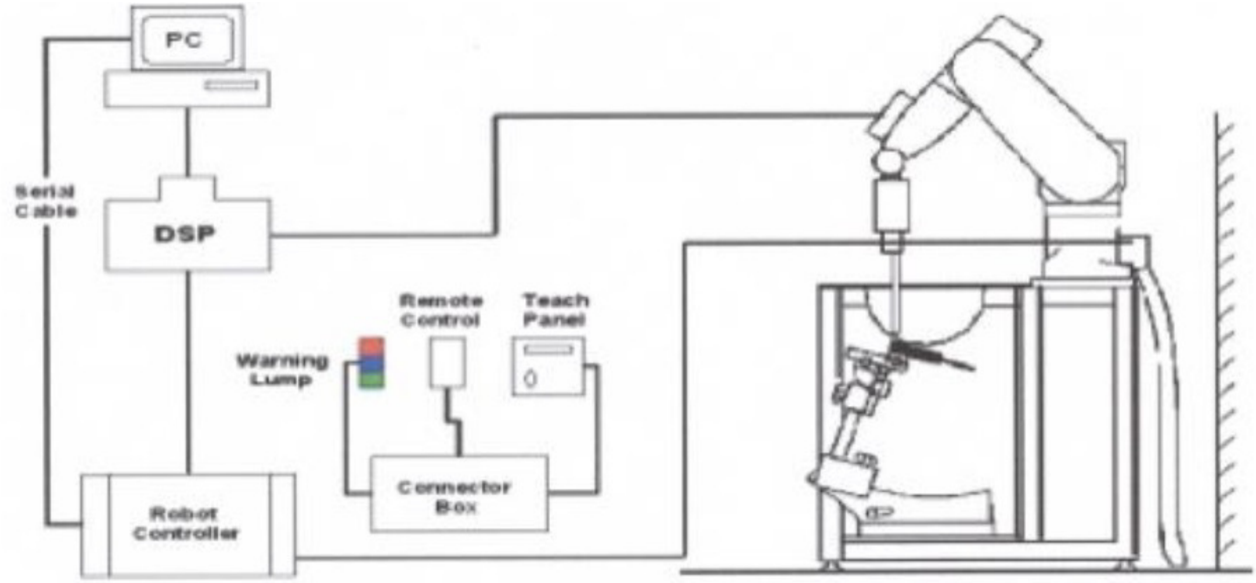


Figure 1. SAR Lab Test Measurement Set-up

3.2 System Components

EX3DV4 Probe Specification

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to > 6 GHz, Linearity: ± 0.2 dB, (30 MHz to 6 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 µW/g to > 100mW/g Linearity: ± 0.2dB (noise: typically < 1 µW/g)
Dimensions	Overall length: 330 mm (Tip: 20mm) Tip diameter: 2.5mm (Body: 12mm) Typical distance From probe tip to dipole centers: 1mm
Application	High precision dosimetric measurements in any exposure scenario. Only probe which enables compliance testing for frequenies up to 6 GHz with precision of better 30%

Device Holder


Device holder for Head-Held Transmitters   Device holder for Laptops and Tablets

The DASY device holder is designed to cope with the die rent positions given in the standard.
It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.
The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the inference of the clamp on the test results could thus be lowered.

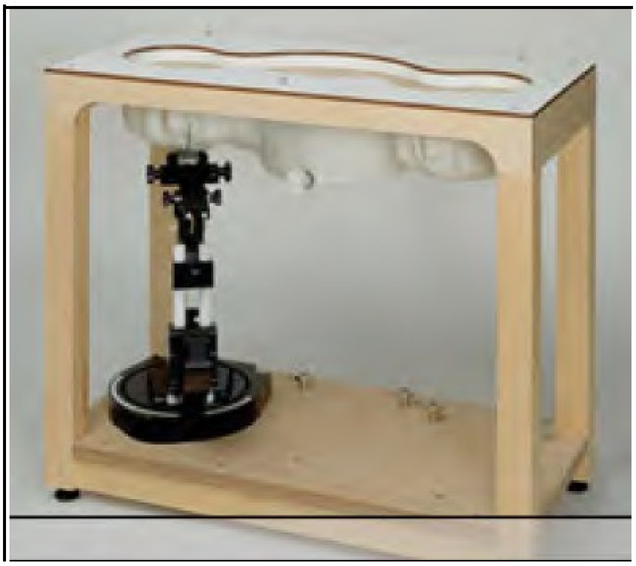
Phantom Description

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.

Shell Thickness: 2±0.2 mm

Filling Volume: Approx. 30 liters

Dimensions: 190×600×0 mm (H x L x W)



3.3 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.

Step 1: Power Reference Measurement

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.

Step 2: 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.

Step 3: 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.

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.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step1.

4. List of Test and Measurement Instruments

Dielectric Property Measurements

Equipment	Manufacturer	Model No.	Serial No.	Last Cal Date	Cal. Due Date
Network Analyzer	Keysight	E5080A	MY55200677	26-Mar-16	25-Mar-18
Dielectric Probe kit	Agilent	85070E	8710-2036	N/A	N/A
Shorting block	Agilent	85070E	60003	N/A	N/A
Digital Thermometer	WISEWIND	1509	509Q24R	16-May-16	15-May-17
Pocket Digital Thermometer	DGS	A9SA-ST9215C	160520302	16-May-16	15-May-17

System check

Equipment	Manufacturer	Model No.	Serial No.	Last Cal Date	Cal. Due Date
Signal Generator	Agilent	N5171B	MY53050377	8-Mar-17	7-Mar-18
Power Sensor	Agilent	U2021XA	MY53480013	8-Mar-17	7-Mar-18
Amplifier	EMCI	EMC2830P	980325	N/A	N/A
Directional coupler	Woken	0110A05601O-10	COM65JW1A3	N/A	N/A
E-Field Probe	Speag	EX3DV4	7400	9-May-16	8-May-17
Data Acquisiton Electronics	Speag	DAE4	855	26-May-16	25-May-17
System Validation Diploe	Speag	D5GHzV2	1235	10-May-16	9-May-17
System Validation Diploe	Speag	D2450V2	804	24-May-16	23-May-17

Other

Equipment	Manufacturer	Model No.	Serial No.	Last Cal Date	Cal. Due Date
Spectrum Analyzer	R&S	FSP30	837866/009	13-Jan-17	12-Jan-18

5. Device Under Test

5.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
2.4 GHz WLAN	Data	2412 – 2462 MHz
Bluetooth	Data	2402 – 2480 MHz

5.2 Conducted Power

This device operates using the following maximum and modulated average output power specifications. SAR values were scaled to the maximum allowed power to determine compliance according to KDB 447498 D01.

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4GHz) - SISO	Maximum	**18**
	Average Output	**17.5**
IEEE 802.11g (2.4GHz) - SISO	Maximum	16
	Average Output	15.7
IEEE 802.11n20M (2.4GHz) – SISO	Maximum	15
	Average Output	14.7
IEEE 802.11n40M (2.4GHz) - SISO	Maximum	15
	Average Output	14.5
Bluetooth	Maximum	3.5
	Average Output	3.2
Bluetooth LE	Maximum	2.5
	Average Output	2.4

5.3 DUT Testing Position

Since this Handheld Computer can be used in close proximity to the human. According to technical standards, this device was tested for SAR compliance in Body-worn specified in KDB 941225 D07.

5.4 SAR Test Considerations (Test Configurations)

1. WLAN and BT share the same antenna path and it can't transmit simultaneously.

2. Per FCC KDB 447498 D01, BT SAR testing is not required because output power is accordance with low-power exclusion levels.

3. For test separation distances ≤50mm or >50mm, and the frequency at >100MHz to 6GHz, the SAR test exclusion threshold is determined according to KDB 447498 D01 Appendix A, B.

Mode	Max. tune-up Power (dBm)	Max. tune-up Power (mW)	Top side			Right side			Left side		
			Ant. To surface (mm)	Exclusion threshold (mW)	Require SAR testing?	Ant. To surface (mm)	Exclusion threshold (mW)	Require SAR testing?	Ant. To surface (mm)	Exclusion threshold (mW)	Require SAR testing?
WLAN 2.45GHz	14.5	28.2	17	29	No	7	10	Yes	75	296	No
Mode	Max. tune-up Power (dBm)	Max. tune-up Power (mW)	Front side			Back side			Bottom side		
			Ant. To surface (mm)	Exclusion threshold (mW)	Require SAR testing?	Ant. To surface (mm)	Exclusion threshold (mW)	Require SAR testing?	Ant. To surface (mm)	Exclusion threshold (mW)	Require SAR testing?
WLAN 2.45GHz	14.5	28.2	Less than 5	10	Yes	Less than 5	10	Yes	129	796	No

5.5 Test Operation and Test Software

For WLAN SAR testing, use chipset specific software to control the EUT, and makes it transmit in maximum power.

5.6 Conducted Power Table

Mode	Channel	Frequency (MHz)	Average power (dBm)				Tune-Up Limit	Duty Cycle %
			Data Rate					100
			1Mbps	2Mbps	5.5Mbps	11Mbps		
802.11b	CH 1	2412	17.4	17.3	17.1	16.9	18	
	CH 6	2437	**17.5**	17.3	17	16.8	18	
	CH 11	2462	17.4	17.2	17	16.8	18	

Mode	Channel	Frequency (MHz)	Average power (dBm)								Tune-Up Limit	Duty Cycle %
			Data Rate									100
			6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps		
802.11g	CH 1	2412	15.6	15.4	15.1	14.9	14.7	14.5	14.3	14.1	16	
	CH 6	2437	15.7	15.5	15.3	15.1	14.9	14.6	14.3	14.1	16	
	CH 11	2462	15.6	15.4	15.1	14.9	14.7	14.4	14.2	14	16	

Mode	Channel	Frequency (MHz)	Average power (dBm)								Tune-Up Limit	Duty Cycle %
			MCS Index									100
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7		
802.11n-HT20	CH 1	2412	14.7	14.5	14.3	14.1	13.9	13.7	13.4	13.1	15	
	CH 6	2437	14.6	14.4	14.1	13.9	13.7	13.5	13.2	13	15	
	CH 11	2462	14.6	14.3	14.1	13.8	13.5	13.3	13.1	12.9	15	

Mode	Channel	Frequency (MHz)	Average power (dBm)								Tune-Up Limit	Duty Cycle %
			MCS Index									100
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7		
802.11n-HT40	CH 1	2412	14.4	14.2	14	13.8	13.5	13.2	13	12.7	15	
	CH 6	2437	14.4	14.1	13.9	13.7	13.4	13.1	12.9	12.6	15	
	CH 11	2462	14.5	14.3	14.1	13.9	13.7	13.5	13.2	12.9	15	

Mode	2.4 Bluetooth	Tune-Up Limit
GFSK	2.6	3.5
8-DPSK	**3.2**	3.5
LE	2.4	2.5

5.7 Summary of SAR test results

Band	Mode	Test Position	Gap (cm)	Antenna	Ch.	Freq. (MHz)	Data Rate	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor (%)	Duty Cycle %	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Note
WLAN2.4G	802.11b	Front side	0	Ant1	6	2437	1Mbps	17.5	18	12.2	100	-0.05	0.00717	0.01	
WLAN2.4G	802.11b	Back side	0	Ant1	1	2412	1Mbps	17.4	18	14.82	100	0.12	1.12	1.29	
WLAN2.4G	802.11b	Back side	0	Ant1	6	2437	1Mbps	17.5	18	12.2	100	-0.09	1.23	**1.38**	
WLAN2.4G	802.11b	Back side	0	Ant1	6	2437	1Mbps	17.5	18	12.2	100	-0.19	1.21	1.36	*
WLAN2.4G	802.11b	Back side	0	Ant1	11	2462	1Mbps	17.4	18	14.82	100	0.18	1.13	1.3	
WLAN2.4G	802.11b	Right side	0	Ant1	6	2437	1Mbps	17.4	18	14.82	100	-0.02	0.016	0.02	

Refer to Appendix C for detailed test reports
*- repeated at the highest SAR measurement according to KDB 865664 D01

Notes:

1. Batteries are fully charged at the beginning of the SAR measurements.
2. Liquid tissue depth is at least 15cm for 2.4GHz SAR measurements.
3. SAR results must be scaled to the maximum allowed power according to KDB 447498 D02.
4. SAR measurement procedure for the Handheld computer is described in KDB 941227 D07.
5. According to KDB 865664 D01, SAR measurement variability must be assessed for each frequency band. When the original highest measured SAR is ≥ 0.8 W/kg, repeated that measurement once.

6. System Verification

6.1 Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18˚C to 25˚C and within ±2˚C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.
The depth of the tissue simulant in the flat section of the phantom was ≥ 15 cm (Frequency ≤3GHz) or ≥ 10 cm (Frequency > 3GHz) during all tests.

Measured Tissue Properties

Date	Freq. (MHz)	Liquid Parameters	Measured	Target	Delta (%)	Limit ±(%)
17-Feb-2017	Body 2412	Relative Permittivity (εr)	54.205	52.75	-2.76	5
		Conductivity (σ (S/m))	1.89	1.91	1.24	5
17-Feb-2017	Body 2437	Relative Permittivity (εr)	54.129	52.72	-2.68	5
		Conductivity (σ (S/m))	1.929	1.94	0.44	5
17-Feb-2017	Body 2450	Relative Permittivity (εr)	54.1	52.7	-2.66	5
		Conductivity (σ (S/m))	1.947	1.95	0.15	5
17-Feb-2017	Body 2462	Relative Permittivity (εr)	54.073	52.68	-2.64	5
		Conductivity (σ (S/m))	1.961	1.97	0.31	5

6.2 Test System Check

The SAR system must be validated against its performance specifications before it is depolyed.

A system check measurement was made following the determination of the dielectric parameters of the tissue simulating liquid, using the dipole validation kit. A power level of 250 mW for 2.4GHz band or 100mW for 5GHz band as 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 the following table.

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system **(±10%)**

System Performance Check Results

Date	Frequency (MHz)	Tissue type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Target 1g SAR (W/kg)	Delta (%)
7-Apr-2017	2450	Body	250	804	7400	855	**11.7**	12.7	**-7.87**

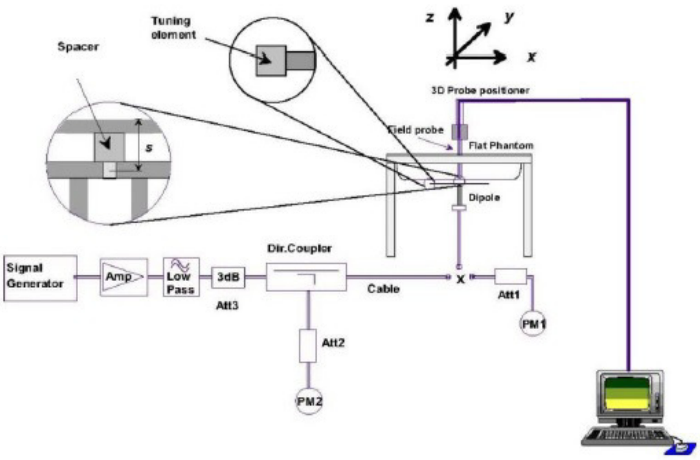


Fig 8.3.1 System Performance Check Setup

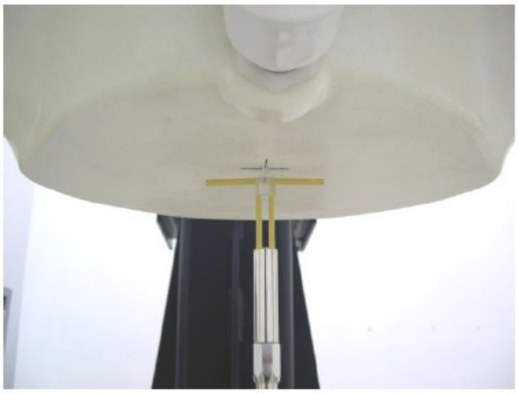
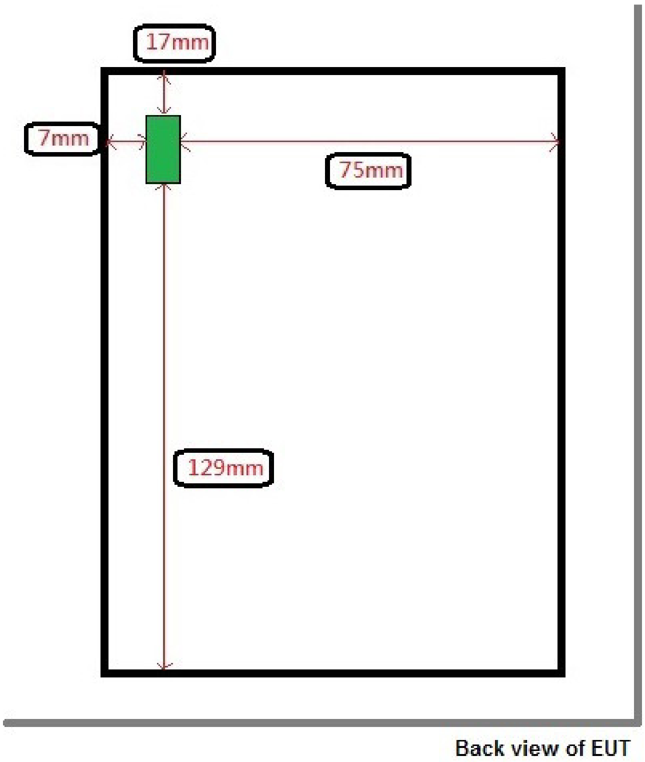


Fig 8.3.2 Setup Photo

7. Antenna Location



8. Measurement Uncertainty

Measurement Uncertainty evaluation template for EUT SAR test
IEEE 1528 30MHz- 6GHz

A	c	D	E	f	g	h=c * f / e	i=c * g / e	k
Source of Uncertainty	Tolerance/ Uncertainty %	Probability Distributioin	Div Value	ci (1g)	ci (10g)	Standard uncertainty	Standard uncertainty	vi, or Veff
Measurement system								
Probe calibration(under 6Ghz)	6.30%	N	1	1	1	6.30%	6.30%	∞
Axial Isotropy	0.50%	R	1.73	1	1	0.29%	0.29%	∞
Hemispherical Isotropy	1.30%	R	1.73	1	1	0.75%	0.75%	∞
Boundary Effect	2.00%	R	1.73	1	1	1.15%	1.15%	∞
Linearity	0.60%	R	1.73	1	1	0.35%	0.35%	∞
Modulation Response	2.40%	R	1.73	1	1	1.39%	1.39%	∞
System Detection Limits	1.00%	R	1.73	1	1	0.58%	0.58%	∞
Readout Electronics	0.30%	N	1	1	1	0.30%	0.30%	∞
Response time	0.80%	R	1.73	1	1	0.46%	0.46%	∞
Integration Time	2.60%	R	1.73	1	1	1.50%	1.50%	∞
RF ambient condition - noise	3.00%	R	1.73	1	1	1.73%	1.73%	∞
RF ambient conditions - reflections	3.00%	R	1.73	1	1	1.73%	1.73%	∞
Probe positioner Mechanical restrictions	0.80%	R	1.73	1	1	0.46%	0.46%	∞
Probe Positioning with respect to phantom shell	6.70%	R	1.73	1	1	3.87%	3.87%	∞
Max SAR Eval	1.00%	R	1.73	1	1	0.58%	0.58%	∞
Test Sample related								
Test sample positioning	2.90%	N	1	1	1	2.90%	2.90%	145
Device Holder Uncertainty	3.60%	N	1	1	1	3.60%	3.60%	5
Power scaling	0.00%	R	1.73	1	1	0.00%	0.00%	∞
Drift of output power	5.00%	R	1.73	1	1	2.89%	2.89%	∞
Phantom and Setup								
Phantom Uncertainty	7.60%	R	1.73	1	1	4.39%	4.39%	∞
SAR correction	1.90%	R	1.73	1	0.84	1.10%	0.92%	M
Liquid conductivity(meas.)	5.00%	R	1.73	0.78	0.71	2.25%	2.05%	M
Liquid permitivity(meas.)	5.00%	R	1.73	0.6	0.49	1.73%	1.41%	M
Temp. unc. - Conductivity	3.40%	R	1.73	0.78	0.71	1.53%	1.39%	M
Temp. unc. - Permittivity	0.40%	R	1.73	0.23	0.26	0.05%	0.06%	M
Combined standard uncertainty		RSS				11.34%	11.23%	748
Expant uncertainty (95% confidence interval), K=2						22.69%	22.46%	

Appendix B: System Check

Date: 6-Jun-2017

Dipole 2450MHz_SN:804

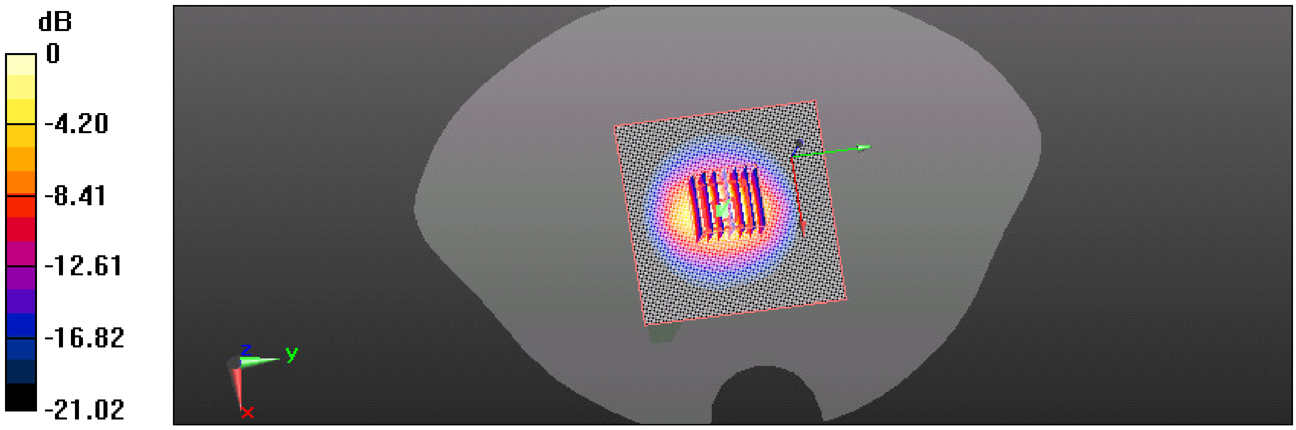
TUV Test Services, a test lab operated by TUV Corporation at Taipei, Taiwan
Communication System: CW;Frequency: 2450 MHz;
Medium parameters used: f = 2450 MHz; σ = 1.947 mho/m; ε_r = 54.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration

- Probe: EX3DV4 - SN7400;ConvF(7.18, 7.18, 7.18);Calibrated: 5/9/2016
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn855;Calibrated: 5/26/2016
- Measurement SW: DASY52, Version 52.6 (2)

Configuration/CW/Area Scan (81x81x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 18.024 mW/g

Configuration/CW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.010 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 23.305 W/kg
SAR(1 g) = 11.7 mW/g; SAR(10 g) = 5.53 mW/g
Maximum value of SAR (measured) = 17.614 mW/g



0 dB = 17.610mW/g

Appendix C: Test Plots of SAR Measurement

Date: 6-Jun-2017

WLAN802.11b_Body-worn_Back side_CH6_0mm

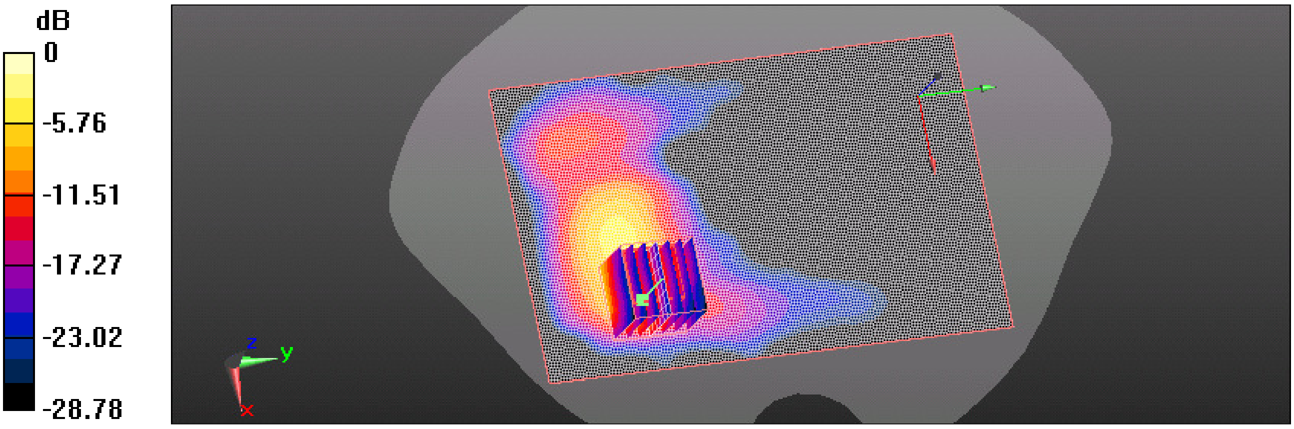
TUV Test Services, a test lab operated by TUV Corporation at Taipei, Taiwan
Communication System: WLAN 2.45G;Frequency: 2437 MHz;
Medium parameters used: f = 2437 MHz; σ = 1.929 mho/m; ε_r = 54.129; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration

- Probe: EX3DV4 - SN7400;ConvF(7.18, 7.18, 7.18);Calibrated: 5/9/2016
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn855;Calibrated: 5/26/2016
- Measurement SW: DASY52, Version 52.6 (2)

Configuration/WLAN b/Area Scan (101x161x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 2.069 mW/g

Configuration/WLAN b/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.580 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 3.722 W/kg
SAR(1 g) = 1.23 mW/g; SAR(10 g) = 0.492 mW/g
Maximum value of SAR (measured) = 2.455 mW/g



0 dB = 2.450mW/g

Date: 6-Jun-2017

WLAN802.11b_Body-worn_Back side_CH6_0mm

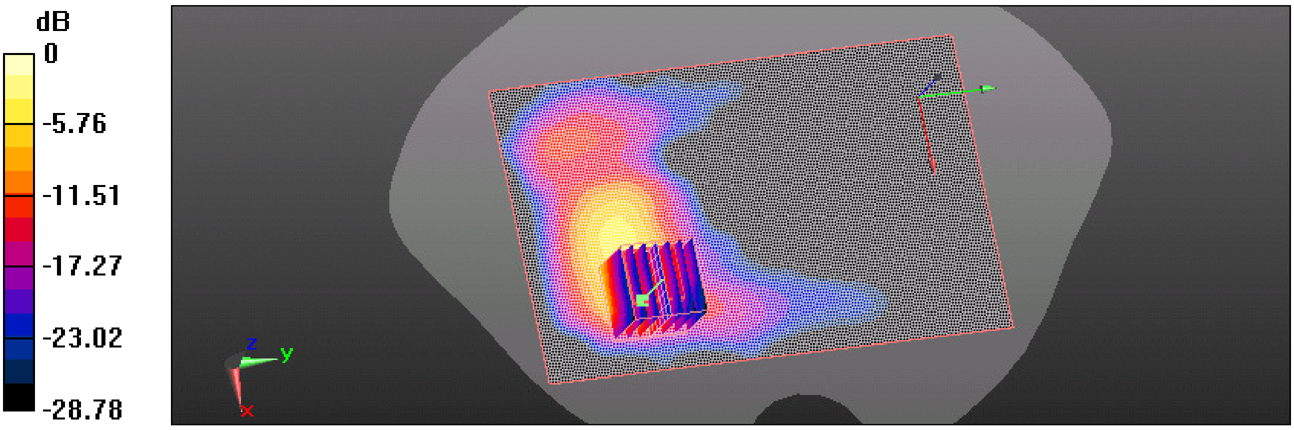
TUV Test Services, a test lab operated by TUV Corporation at Taipei, Taiwan
Communication System: WLAN 2.45G;Frequency: 2437 MHz;
Medium parameters used: f = 2437 MHz; σ = 1.929 mho/m; ε_r = 54.129; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration

- Probe: EX3DV4 - SN7400;ConvF(7.18, 7.18, 7.18);Calibrated: 5/9/2016
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn855;Calibrated: 5/26/2016
- Measurement SW: DASY52, Version 52.6 (2)

Configuration/WLAN b/Area Scan (101x161x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 2.058 mW/g

Configuration/WLAN b/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.442 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 3.722 W/kg
SAR(1 g) = 1.21 mW/g; SAR(10 g) = 0.488 mW/g
Maximum value of SAR (measured) = 2.444 mW/g



0 dB = 2.450mW/g

Date: 6-Jun-2017

WLAN802.11b_Body-worn_Back side_CH1_0mm

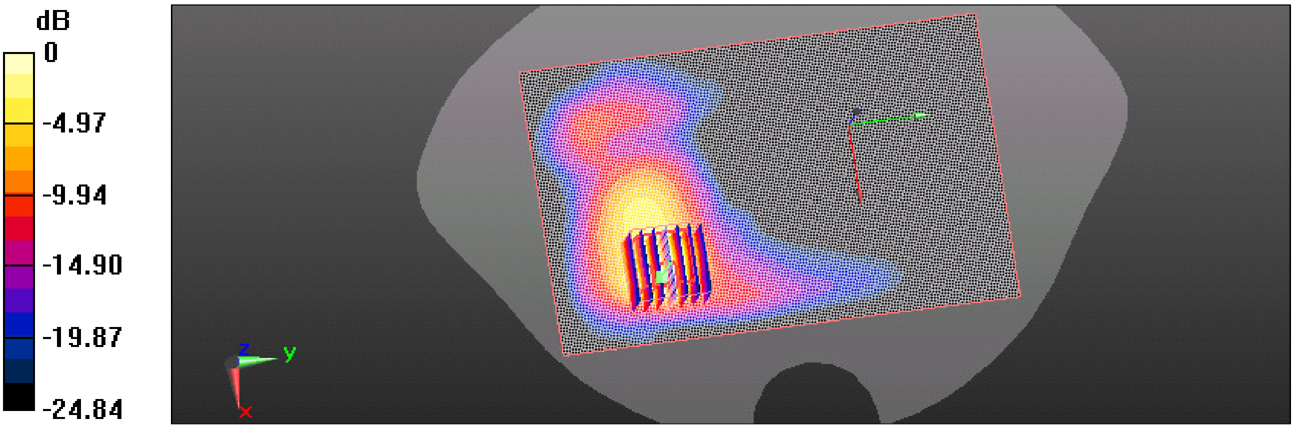
TUV Test Services, a test lab operated by TUV Corporation at Taipei, Taiwan
Communication System: WLAN 2.45G;Frequency: 2412 MHz;
Medium parameters used: f = 2412 MHz; σ = 1.89 mho/m; ε_r = 54.205; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration

- Probe: EX3DV4 - SN7400;ConvF(7.18, 7.18, 7.18);Calibrated: 5/9/2016
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn855;Calibrated: 5/26/2016
- Measurement SW: DASY52, Version 52.6 (2)

Configuration/WLAN b/Area Scan (101x161x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 2.291 mW/g

Configuration/WLAN b/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.696 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 3.293 W/kg
SAR(1 g) = 1.12 mW/g; SAR(10 g) = 0.445 mW/g
Maximum value of SAR (measured) = 1.395 mW/g



0 dB = 1.400mW/g

Date: 6-Jun-2017

WLAN802.11b_Body-worn_Back side_CH11_0mm

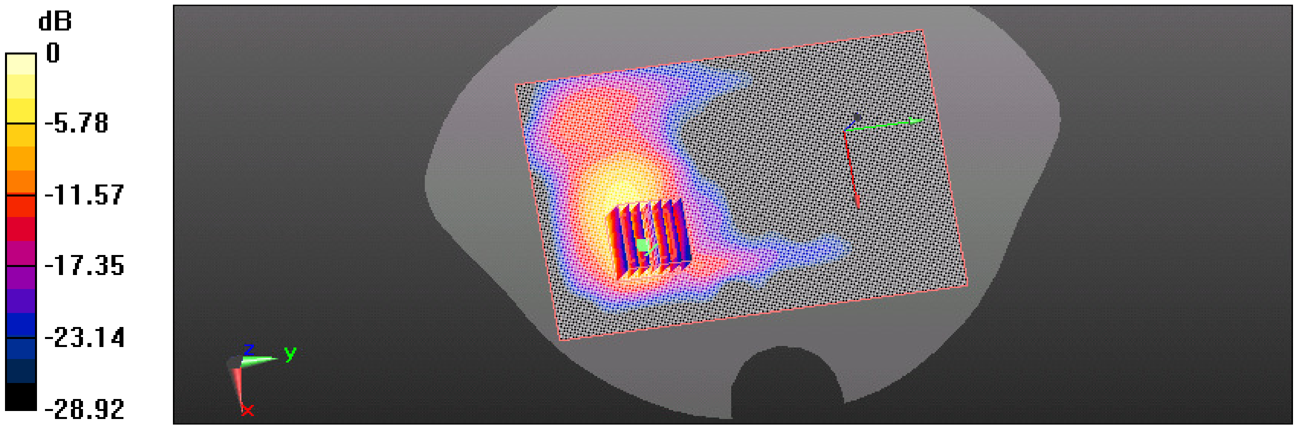
TUV Test Services, a test lab operated by TUV Corporation at Taipei, Taiwan
Communication System: WLAN 2.45G;Frequency: 2462 MHz;
Medium parameters used: f = 2462 MHz; σ = 1.961 mho/m; ε_r = 54.073; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration

- Probe: EX3DV4 - SN7400;ConvF(7.18, 7.18, 7.18);Calibrated: 5/9/2016
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn855;Calibrated: 5/26/2016
- Measurement SW: DASY52, Version 52.6 (2)

Configuration/WLAN b/Area Scan (101x161x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 2.188 mW/g

Configuration/WLAN b/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.099 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 3.348 W/kg
SAR(1 g) = 1.13 mW/g; SAR(10 g) = 0.461 mW/g
Maximum value of SAR (measured) = 2.203 mW/g



0 dB = 2.200mW/g

Date: 6-Jun-2017

WLAN802.11b_Body-worn_Front side_CH6_0mm

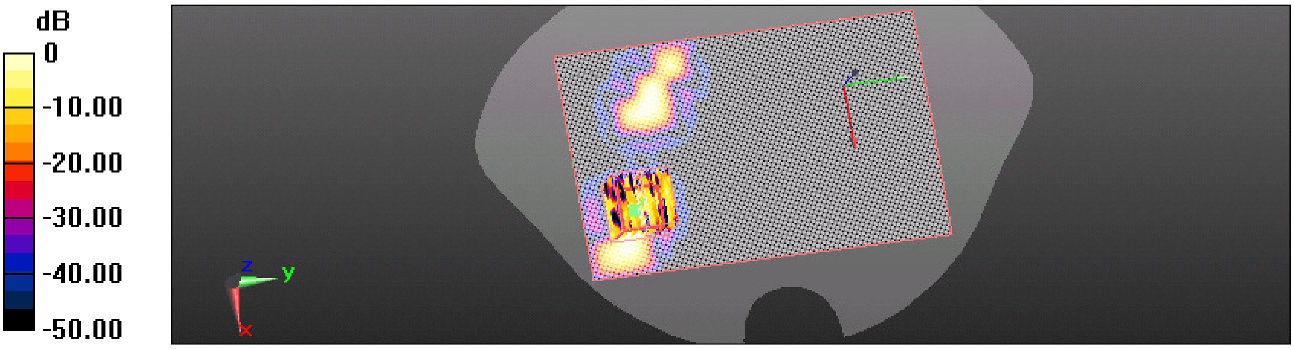
TUV Test Services, a test lab operated by TUV Corporation at Taipei, Taiwan
Communication System: WLAN 2.45G;Frequency: 2437 MHz;
Medium parameters used: f = 2437 MHz; σ = 1.929 mho/m; ε_r = 54.129; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration

- Probe: EX3DV4 - SN7400;ConvF(7.18, 7.18, 7.18);Calibrated: 5/9/2016
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn855;Calibrated: 5/26/2016
- Measurement SW: DASY52, Version 52.6 (2)

Configuration/WLAN b/Area Scan (101x161x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.021 mW/g

Configuration/WLAN b/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.075 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.016 W/kg
SAR(1 g) = 0.00717 mW/g; SAR(10 g) = 0.00258 mW/g
Maximum value of SAR (measured) = 0.010 mW/g



0 dB = 0.010mW/g

Date: 6-Jun-2017

WLAN802.11b_Body-worn_Right side_CH6_0mm

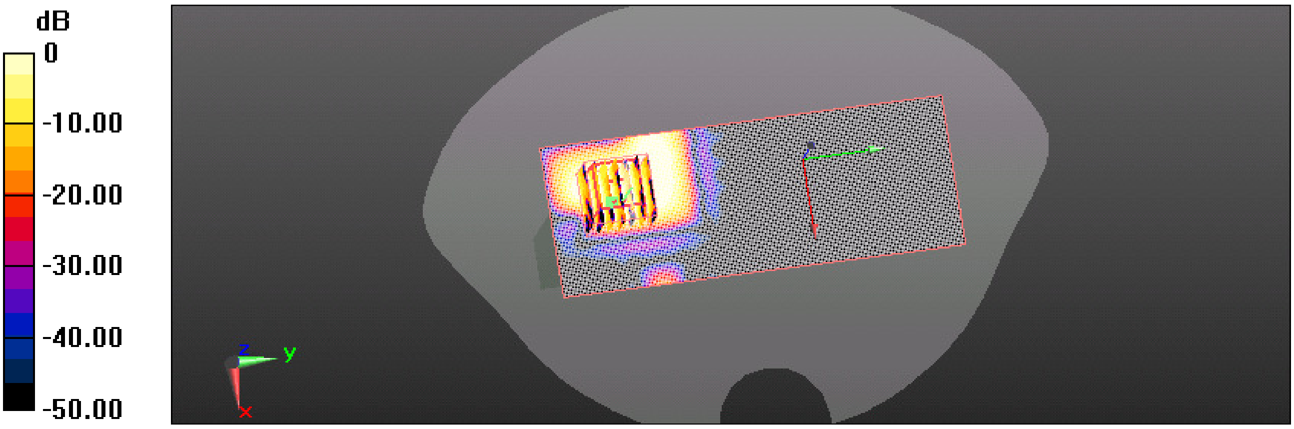
TUV Test Services, a test lab operated by TUV Corporation at Taipei, Taiwan
Communication System: WLAN 2.45G;Frequency: 2437 MHz;
Medium parameters used: f = 2437 MHz; σ = 1.929 mho/m; ε_r = 54.129; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration

- Probe: EX3DV4 - SN7400;ConvF(7.18, 7.18, 7.18);Calibrated: 5/9/2016
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn855;Calibrated: 5/26/2016
- Measurement SW: DASY52, Version 52.6 (2)

Configuration/WLAN b/Area Scan (61x161x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 0.037 mW/g

Configuration/WLAN b/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.281 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.028 W/kg
SAR(1 g) = 0.016 mW/g; SAR(10 g) = 0.00769 mW/g
Maximum value of SAR (measured) = 0.018 mW/g



0 dB = 0.020mW/g

Appendix D: Calibration Certificate

Probe EX3DV4

SN:7400

Manufactured: November 19, 2015
Calibrated: May 9, 2016

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7400

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.40	0.43	0.48	± 10.1 %
DCP (mV)[B]	100.8	97.3	100.8	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	141.2	±3.5 %
		Y	0.0	0.0	1.0		151.5	
		Z	0.0	0.0	1.0		149.5	

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

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7400

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)	Unc (k=2)
2450	39.2	1.80	7.11	7.11	7.11	0.36	0.80	± 12.0 %
5200	36.0	4.66	4.93	4.93	4.93	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.77	4.77	4.77	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.67	4.67	4.67	0.45	1.80	± 13.1 %
5600	35.5	5.07	4.48	4.48	4.48	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.29	4.29	4.29	0.50	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the 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 frequencies 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

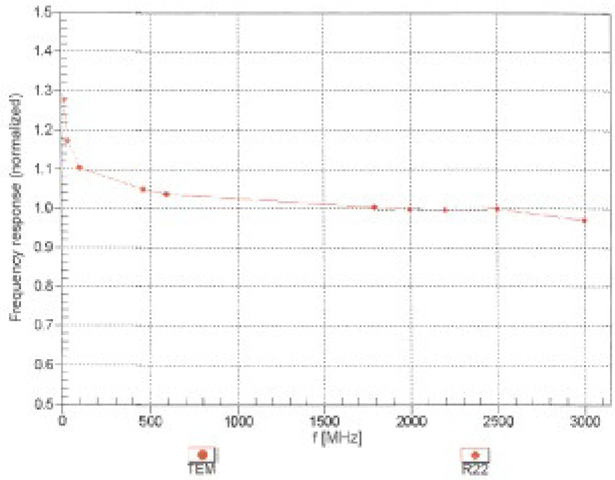
DASY/EASY - Parameters of Probe: EX3DV4 - SN:7400

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)	Unc (k=2)
2450	52.7	1.95	7.18	7.18	7.18	0.39	0.88	± 12.0 %
5200	49.0	5.30	4.59	4.59	4.59	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.34	4.34	4.34	0.55	1.90	± 13.1 %
5500	48.6	5.65	3.79	3.79	3.79	0.60	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.88	3.88	3.88	0.60	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the 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 frequencies 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

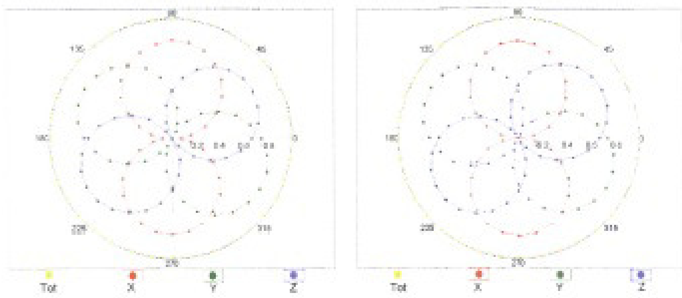
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

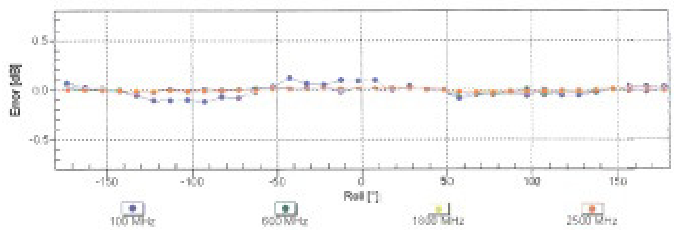


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), $\vartheta = 0°$

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

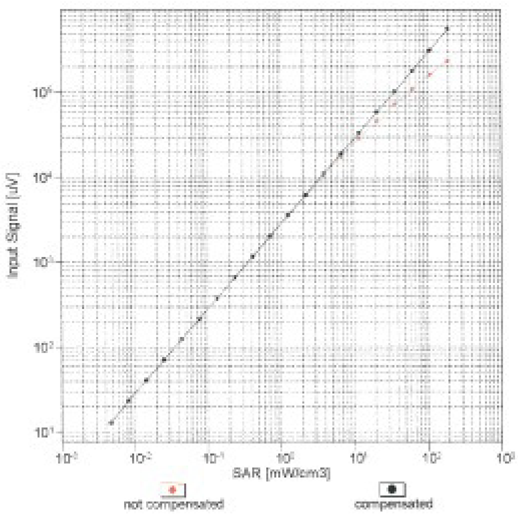


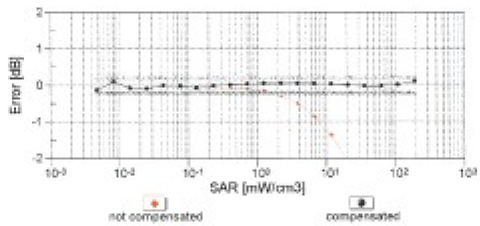


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

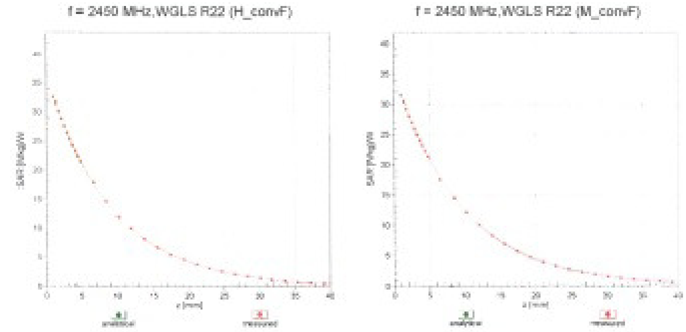
(TEM cell , f_{eval}= 1900 MHz)





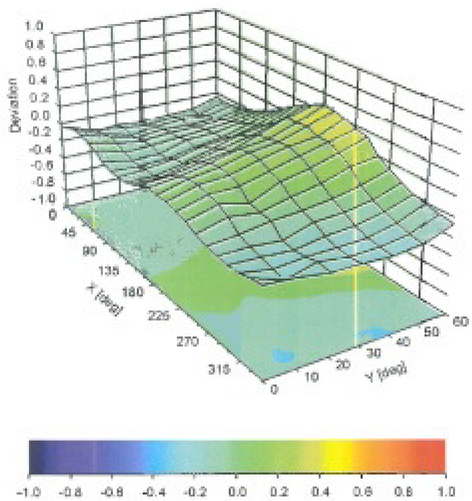
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7400

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-22.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

TÜVRheinland®

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ilac-MRA

S Schweizerischer Kalibrierdienst
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S Servizio svizzero di taratura
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**

Client **TÜV TW (Auden)**

Certificate No: **D2450V2-804_May16**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 804
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 24, 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: 7349	31-Dec-15 (No. EX3-7349_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 8481A	SN: US37292783	07-Oct-15 (No. 217-02222)	In house check: Oct-16
Power sensor HP 8481A	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

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 27, 2016

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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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 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", 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"

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%.

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	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**50.1 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.5 W/kg ± 16.5 % (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	52.6 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °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 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.93 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.5 W/kg ± 16.5 % (k=2)**

DASY5 Validation Report for Head TSL

Date: 24.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

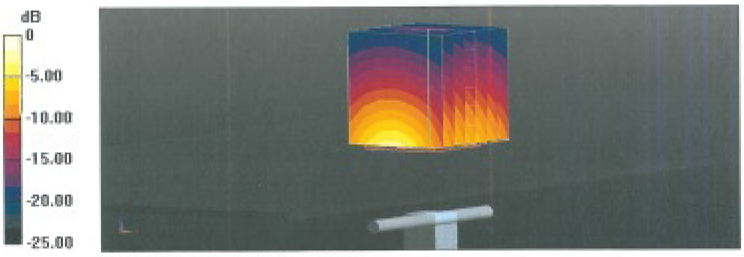
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 804

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.87 S/m; ε_r = 38.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.76, 7.76, 7.76); 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 111.3 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 25.8 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.95 W/kg
Maximum value of SAR (measured) = 20.8 W/kg



0 dB = 20.8 W/kg = 13.18 dBW/kg

Certificate No: D2450V2-804_May16 Page 5 of 8

DASY5 Validation Report for Body TSL

Date: 24.05.2016

Test Laboratory: SPEAG, Zurich, Switzerland

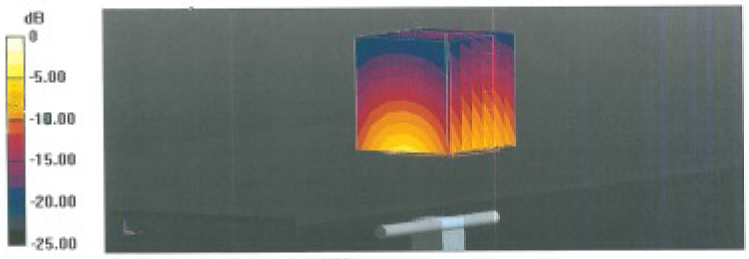
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 804

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 2.02$ S/m; $\varepsilon_r = 52.6$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.79, 7.79, 7.79); 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)

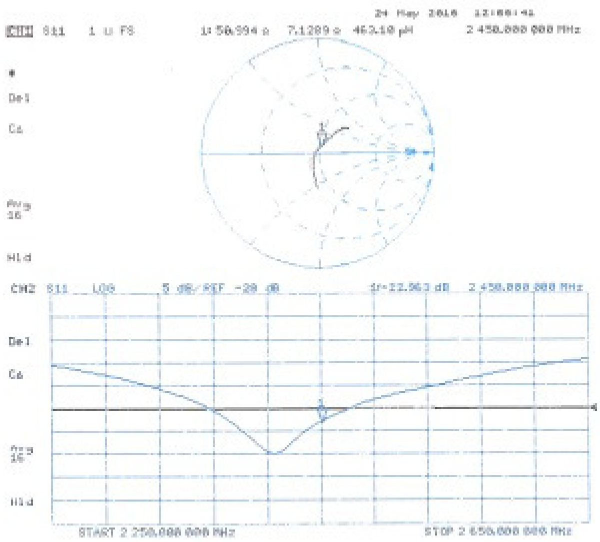
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 104.4 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 25.5 W/kg
SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.93 W/kg
Maximum value of SAR (measured) = 20.8 W/kg



0 dB = 20.8 W/kg = 13.18 dBW/kg

Certificate No: D2450V2-804_May16 Page 7 of 8

Impedance Measurement Plot for Body TSL



Schmid & Partner Engineering AG

s p e a g

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info@speag.com, http://www.speag.com

IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

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TN_BR040315AD DAE4.doc 11.12.2009

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client TÜV TW (Auden)

Certificate No: DAE4-855_May16

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 855
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	May 26, 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
Keithley Multimeter Type 2001	SN: 0810278	09-Sep-15 (No:17153)	Sep-16
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	F. Bomholt

Issued: May 26, 2016

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

Certificate No: DAE4-855_May16 Page 1 of 5

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Accreditation No.: SCS 0108

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 following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

Certificate No: DAE4-855_May16 Page 2 of 5

4. **AD-Converter Values with inputs shorted**
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16225	16066
Channel Y	16093	16725
Channel Z	16612	16919

5. **Input Offset Measurement**
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	1.12	-0.11	2.62	0.53
Channel Y	-0.59	-1.99	0.81	0.56
Channel Z	-0.71	-2.04	0.54	0.44

6. **Input Offset Current**
Nominal Input circuitry offset current on all channels: <25fA

7. **Input Resistance** (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. **Low Battery Alarm Voltage** (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. **Power Consumption** (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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Accreditation No.: SCS 0108

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", 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:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect 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 with CW signal (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; Dx,y,z; VRx,y,z: A, B, C, D* 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 ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values 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 ± 50 MHz to ± 100 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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