RE051-13-103173-1-A Ed. 2

This report cancels and replaces the test report RE051-13-103173-1-A Ed. 1

SAR TEST REPORT

According to the standards:

RF Exposure KDB Procedures
RSS-102: 2010

Equipment under test:

Wi-Fi Payment Terminal
INGENICO IWL257

FCC ID: XKB-IWL2XXWBCL
IC: 2586D-IWL2WBCL

Company:

INGENICO

DISTRIBUTION: Mr. GOBION **Company: INGENICO**

Number of pages: 48 with 3 annexes

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0	Oct. 24, 2013	Creation	Emmanuel TOUTAIN	Olivier ROY
1	Mar. 25, 2014	1, 4, 7, 12 and Annexes	Emmanuel TOUTAIN	Olivier ROY
2	Apr. 07, 2014	12 to 19 and 21	Emmanuel TOUTAIN	Olivier ROY

EQUIPMENT UNDER TEST:	Wi-Fi Payment Terminal
Reference:	INGENICO IWL257
Serial number (S/N):	13086WL00000532 *(Identical Prototype)*
Part number (P/N):	-
MANUFACTURER:	-
APPLICANT:	
Company:	INGENICO
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Person(s) present(s) during the test:	-
DATE(S) OF TEST(S):	September 18, 2013
TEST SITE:	EMITECH Le Mans 9 Rue Maurice Trintignant 72100 Le Mans FRANCE
TEST(S) OPERATOR(S):	Emmanuel TOUTAIN

SUMMARY

1. INTRODUCTION

In this test report, Specific Absorption Rate (SAR) measurements for the wireless communication device INGENICO IWL257 are presented.

The measurements were made according to the published RF Exposure KDB Procedures and RSS102 for evaluating compliance with FCC Guidelines (FCC 47 CFR § 2.1093 and IEEE Std C95.1) and SAR limits established in Health Canada's RF exposure guideline, Safety Code 6, for general population/uncontrolled exposure.

2. REFERENCE DOCUMENTS

The reference documents referred throughout this report are listed below.
These reference documents are applicable to the entire report, although extensions (version, date and amendment) are not repeated.

Reference	Document title	Date
KDB 447498	D03 OET Bulletin 65, Supplement C Cross-Reference v01	2014
KDB 447498	D01 General RF Exposure Guidance v05r02	2014
KDB 248227	D01 SAR Measurement Procedures for 802.11 a/b/g Transmitters v01r02	2007
KDB865664	D01 SAR Measurement 100 MHz to 6 GHz v01r03	2014
KDB 865664	D02 RF Exposure Reporting v01r01	2013
FCC 47 CFR	§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices	-
IEEE Std C95.1	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.	1999
RSS102	Radio Standards Specification 102, Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)	Issue 4 2010
Safety Code 6	Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz	2009

3. PRESENTATION OF EQUIPMENT FOR TESTING PURPOSES

The wireless communication device INGENICO IWL257, using the Wi-Fi (802.11 b/g/n) standard in the 2450MHz, is shown in Fig. 1. The antenna is integrated.

The equipment under test is a hand-held device and is intended to be only held in the hand as defined by the applicant.

Note: The also supported Wi-Fi 802.11a standard (5100 to 5800MHz frequency band) is not part of this report. Test exclusion for 10-g extremity SAR according to the KDB 447498 D01 General RF Exposure Guidance v05r01 is reported in the EMITECH test report RE051-13-103173-3-A.

Front and rear sides

Right and left sides

Product marking (Identical Prototype)

Fig. 1: Photographs of the equipment under test

4. TESTS RESULTS SUMMARY

Object	Respected Standard ? ≤ 4W/kg in 10g (SAR limit for hands, wrists, feet, ankles)		Remarks
	Yes	No	
SAR measurements for 802.11 b/g/n	X		SAR value measured: 0.172W/kg

Conclusion:

The sample INGENICO IWL257 (802.11 b/g/n standard) submitted to test when held in the hand is in conformity with the FCC Guidelines (FCC 47 CFR § 2.1093 and IEEE Std C95.1: 1999) and the SAR limits established in Health Canada's RF exposure guideline, Safety Code 6, for general population/uncontrolled exposure according to the KDB 248227 v01r02: 2007 and RSS102 Issue 4: 2010.

5. ENVIRONNEMENTAL CONDITIONS

Condition	Measured Value
Liquid Temperature	*See Graphical Representations and § 14*
Ambient Temperature	*See Graphical Representations and § 14*

6. EQUIPMENT USED FOR THE TESTING

Plateform ID	Emitech N°	Category	Brand	Type	Last calibration	Next calibration
1 -						
2 DASY4	7321	Software	Speag	DASY4	-	-
	9485	E-Field Probe	Speag	ES3DV3	Aug.21, 13	Aug.21, 14
	7192	Data acquisition	Speag	DAE3	Aug.14, 13	Aug.14, 14
	7323	Dipole 2450MHz	Speag	D2450V3	Nov. 12, 11	Nov. 12, 13
	7324	Phantom	Speag	ELI4	-	-
3 Liquid Measure	-	Software	Hewlett-Packard	HP85070C	-	-
	1402	Network analyzer	Hewlett-Packard	HP8753C	Feb. 26, 13	Feb. 26, 14
	9777	S-Parameter	Hewlett-Packard	HP85047A	Feb. 28, 13	Feb. 28, 14
	7218	Dielectric probe	Hewlett-Packard	HP85070C	-	-
	6980	Thermometer	Testo	922	Nov. 10, 11	Nov. 10, 13
4 System Validation	7014	Signal generator	Rohde-Schwarz	SMP22		
	7209	Amplifier	Mini-circuits	ZHL42	-	-
	7214	Power Supply	Kikusui	PMC18-2	-	-
	7212	Power meter	Rohde-Schwarz	NRVS	Dec. 14, 12	Dec. 14, 14
	7211	Probe power meter	Rohde-Schwarz	NRV-Z31	Dec. 14, 12	Dec. 14, 14
	7208	Coupler	Suhner	3877	Oct. 04, 11	Oct. 04, 13
	7213	Attenuator	Weinschel Engineering	33-3-34	Oct. 04, 11	Oct. 04, 13
	7315	Attenuator	Radiall	R411810124 R411806124	Oct. 04, 11	Oct. 04, 13
	9161	50 ohms load	Diconex	17-0193	Nov. 27, 12	Nov. 27, 14
	7313	50 ohms load	Radiall	R404563000	Oct. 04, 11	Oct. 04, 13

ES3DV3 Isotropic E-Field Probe Overview:

Construction	Symmetrical design with triangular core
Calibration	Conversion Factors (CF) for head and body liquid
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm

ELI4 Elliptical phantom Overview:

Dimensions	Length 600 mm ± 5 mm and width 400 mm ± 5 mm
Shape	Ellipse
Thickness	2.0 mm with a tolerance of ± 0.2 mm
Liquid depth	150 mm

System Validation Kit Overview:

Construction	Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with head/body simulating solutions
Return Loss	> 20 dB at specified validation position
Dimensions	D2450V3 dipole length: 51.8 mm

Mounting Device for Transmitters Overview:

Construction	Enables the position of the mounted transmitter device according to IEEE and IEC specifications
Material	POM

7. MEASUREMENT RESULTS

The wireless communication device antenna and battery are those specified by the manufacturer. The battery is fully charged before each measurement.
The output power and frequency are controlled using a test program supplied by the applicant. The wireless communication device is set to transmit at its highest output peak power level with a continuous transmission at the lowest data rate for each mode (b, g or n).
The SAR test was performed for each test positions at the centre frequency of each mode. Then the configuration giving rise to the maximum mass-averaged SAR was used to test the low-end and the high-end frequencies of the transmitting band.

The wireless communication was placed directly against the flat phantom, for those sides of the device that are in contact with the hand during intended use: front, rear, left and right sides as defined in Fig. 1.

Measurement results (SAR values averaged over a mass of 10g):

Configuration	Test Position at 0cm	SAR 10g (W/kg) - Limit = 4W/kg		
		Channel 1 (2412MHz)	Channel 6 (2437MHz)	Channel 11 (2462MHz)
802.11b 1Mbps	Front side	-	0.0253	-
	Rear side	0.171	0.164	**0.172**
	Left side	-	0.0468	-
	Right side	-	0.0184	-
802.11g 6Mbps	Front side	-	-	-
	Rear side	-	0.0871	-
	Left side	-	-	-
	Right side	-	-	-
802.11n (BW 20MHz) 6.5Mbps	Front side	-	-	-
	Rear side	-	0.0803	-
	Left side	-	-	-
	Right side	-	-	-
802.11n (BW 40MHz) 6.5Mbps	Front side	-	-	-
	Rear side	-	0.0285	-
	Left side	-	-	-
	Right side		-	-

8. GRAPHICAL REPRESENTATIONS OF THE COARSE SCAN

The graphical representations of the coarse scan are shown in Fig. 2 to Fig. 10.

DUT: INGENICO IWL257

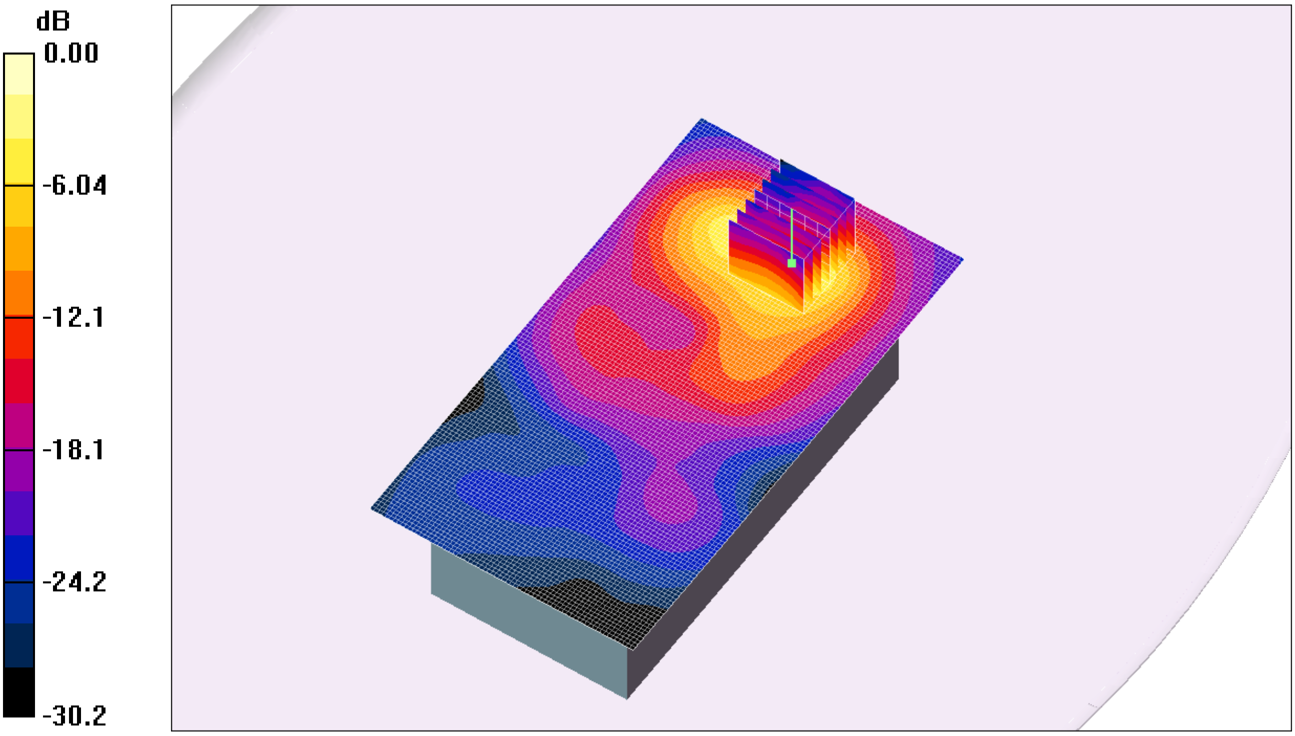
Communication System: WIFI 2450 US; Frequency: 2462 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 2.03$ mho/m, $\varepsilon_r = 52.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 24.5°C, Liquid temperature: 22.8°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, High channel/Area Scan (71x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.556 mW/g

Position 0cm, High channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.7 V/m; Power Drift = -0.046 dB
Peak SAR (extrapolated) = 1.27 W/kg
SAR(1 g) = 0.437 mW/g; SAR(10 g) = 0.172 mW/g
Maximum value of SAR (measured) = 0.646 mW/g



0 dB = 0.646mW/g

Fig. 2: SAR distribution for 802.11b: channel 11 (2462 MHz), rear side at 0cm

DUT: INGENICO iWl257

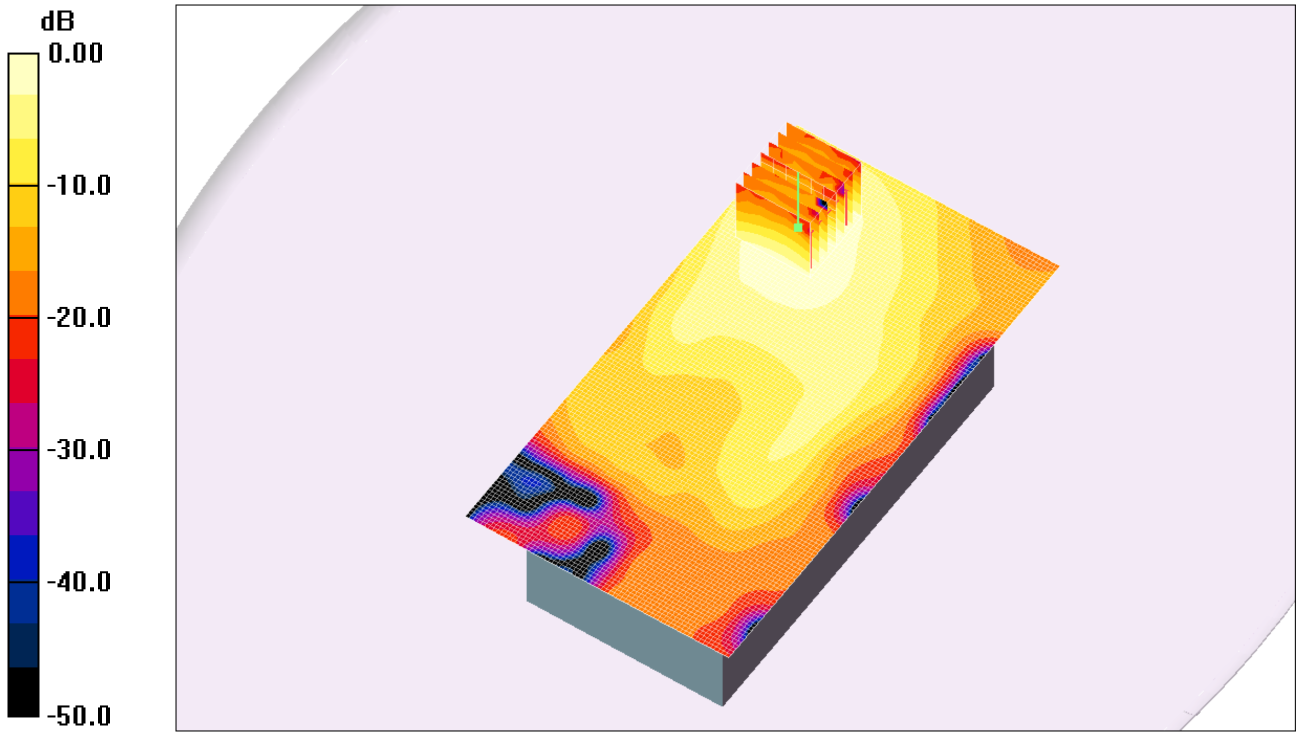
Communication System: WIFI 2450 US; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 2.03$ mho/m, $\varepsilon_r = 52.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.3°C, Liquid temperature: 22.5°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (71x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.060 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.58 V/m; Power Drift = -0.017 dB
Peak SAR (extrapolated) = 0.096 W/kg
SAR(1 g) = 0.048 mW/g; SAR(10 g) = 0.025 mW/g
Maximum value of SAR (measured) = 0.061 mW/g



0 dB = 0.061mW/g

Fig. 3: SAR distribution for 802.11b: channel 6 (2437 MHz), front side at 0cm

DUT: INGENICO iWl257

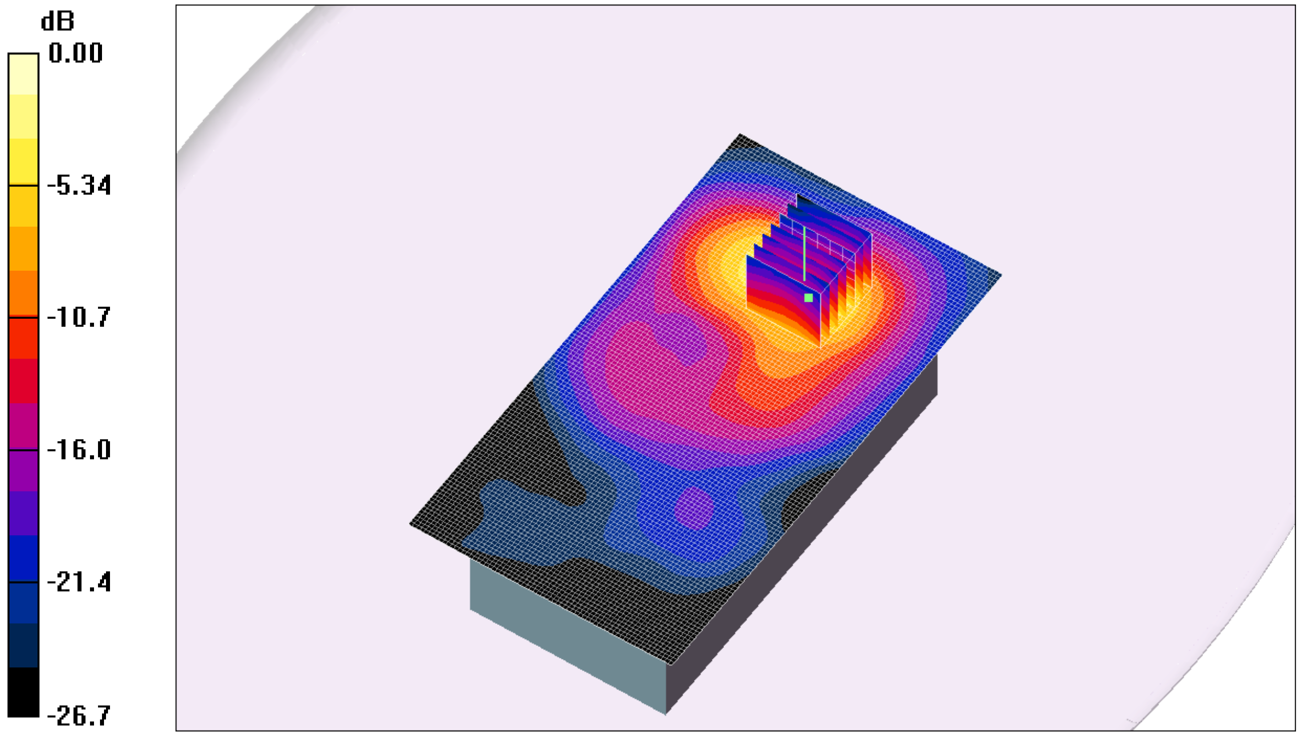
Communication System: WIFI 2450; Frequency: 2412 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 2.03$ mho/m, $\varepsilon_r = 52.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 24.2°C, Liquid temperature: 22.7°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Low channel/Area Scan (71x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.449 mW/g

Position 0cm, Low channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.2 V/m; Power Drift = -0.195 dB
Peak SAR (extrapolated) = 1.26 W/kg
SAR(1 g) = 0.434 mW/g; SAR(10 g) = 0.171 mW/g
Maximum value of SAR (measured) = 0.617 mW/g



0 dB = 0.617mW/g

Fig. 4: SAR distribution for 802.11b: channel 1 (2412 MHz), rear side at 0cm

DUT: INGENICO iWl257

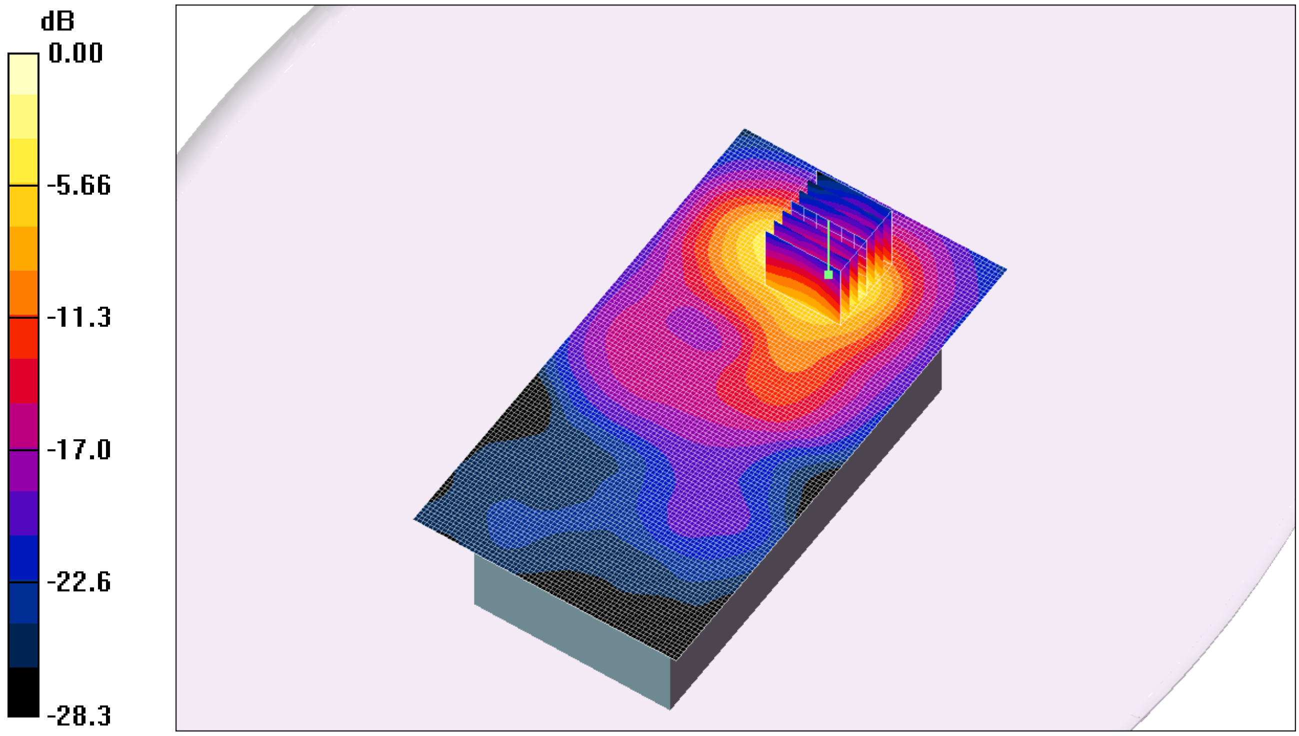
Communication System: WIFI 2450 US; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 2.03 mho/m, ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.5°C, Liquid temperature: 22.5°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (71x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.466 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.5 V/m; Power Drift = 0.137 dB
Peak SAR (extrapolated) = 1.23 W/kg
SAR(1 g) = 0.420 mW/g; SAR(10 g) = 0.164 mW/g
Maximum value of SAR (measured) = 0.625 mW/g



0 dB = 0.625mW/g

Fig. 5: SAR distribution for 802.11b: channel 6 (2437 MHz), rear side at 0cm

DUT: INGENICO iWl257

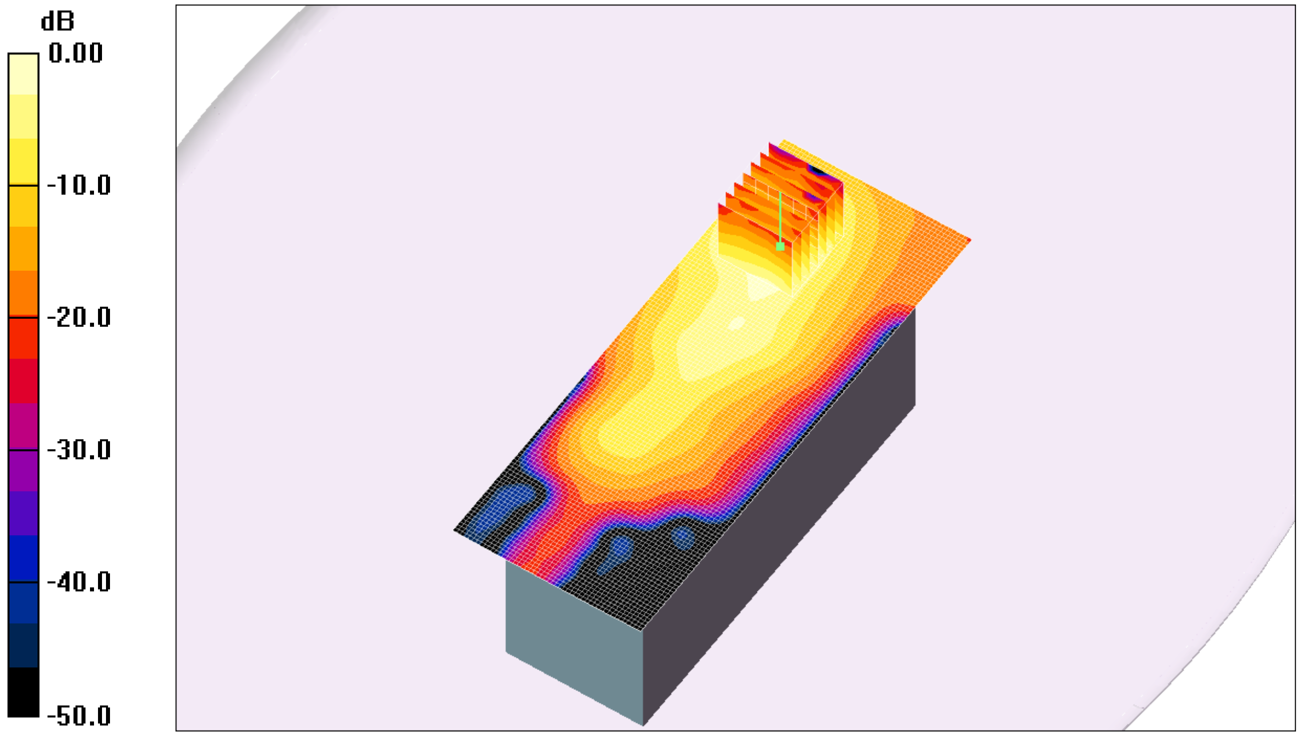
Communication System: WIFI 2450 US; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 2.03 mho/m, ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.5°C, Liquid temperature: 22.5°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (51x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.126 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 8.07 V/m; Power Drift = -0.052 dB
Peak SAR (extrapolated) = 0.200 W/kg
SAR(1 g) = 0.096 mW/g; SAR(10 g) = 0.047 mW/g
Maximum value of SAR (measured) = 0.125 mW/g



0 dB = 0.125mW/g

Fig. 6: SAR distribution for 802.11b: channel 6 (2437 MHz), left side at 0cm

DUT: INGENICO iWl257

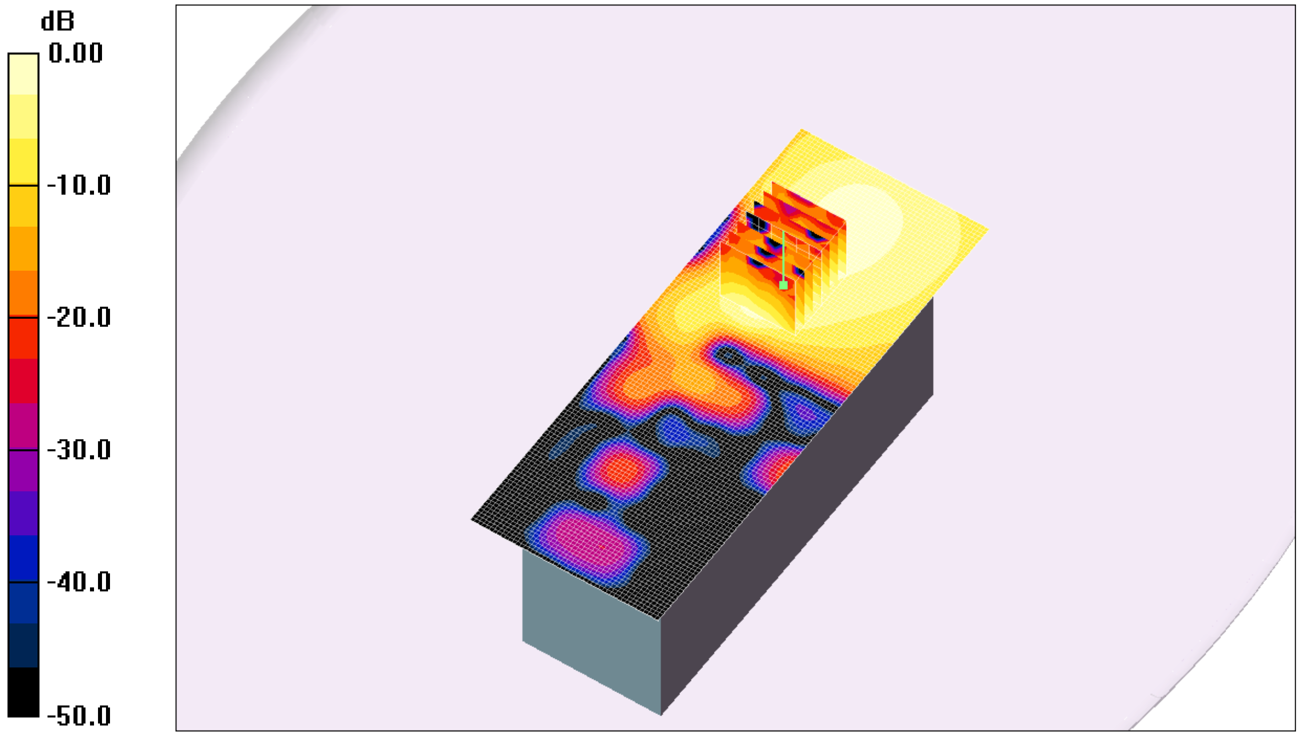
Communication System: WIFI 2450 US; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 2.03 mho/m, ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.8°C, Liquid temperature: 22.6°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (51x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.054 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.62 V/m; Power Drift = 0.208 dB
Peak SAR (extrapolated) = 0.083 W/kg
SAR(1 g) = 0.040 mW/g; SAR(10 g) = 0.018 mW/g
Maximum value of SAR (measured) = 0.050 mW/g



0 dB = 0.050mW/g

Fig. 7: SAR distribution for 802.11b: channel 6 (2437 MHz), right side at 0cm

DUT: INGENICO iWl257

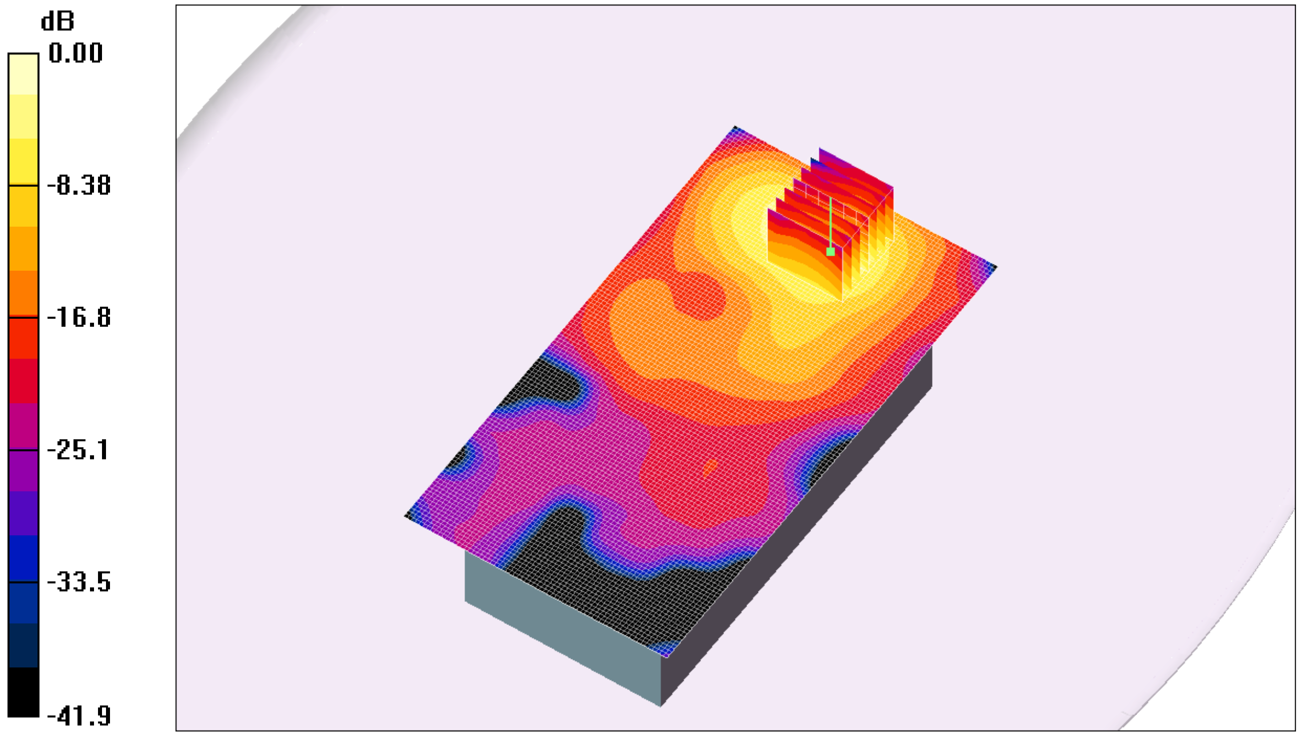
Communication System: WIFI 2450 US; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 2.03 mho/m, ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 24.1°C, Liquid temperature: 22.6°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (71x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.202 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.20 V/m; Power Drift = -0.107 dB
Peak SAR (extrapolated) = 0.675 W/kg
SAR(1 g) = 0.226 mW/g; SAR(10 g) = 0.087 mW/g
Maximum value of SAR (measured) = 0.303 mW/g



0 dB = 0.303mW/g

Fig. 8: SAR distribution for 802.11g: channel 6 (2437 MHz), rear side at 0cm

DUT: INGENICO iWl257

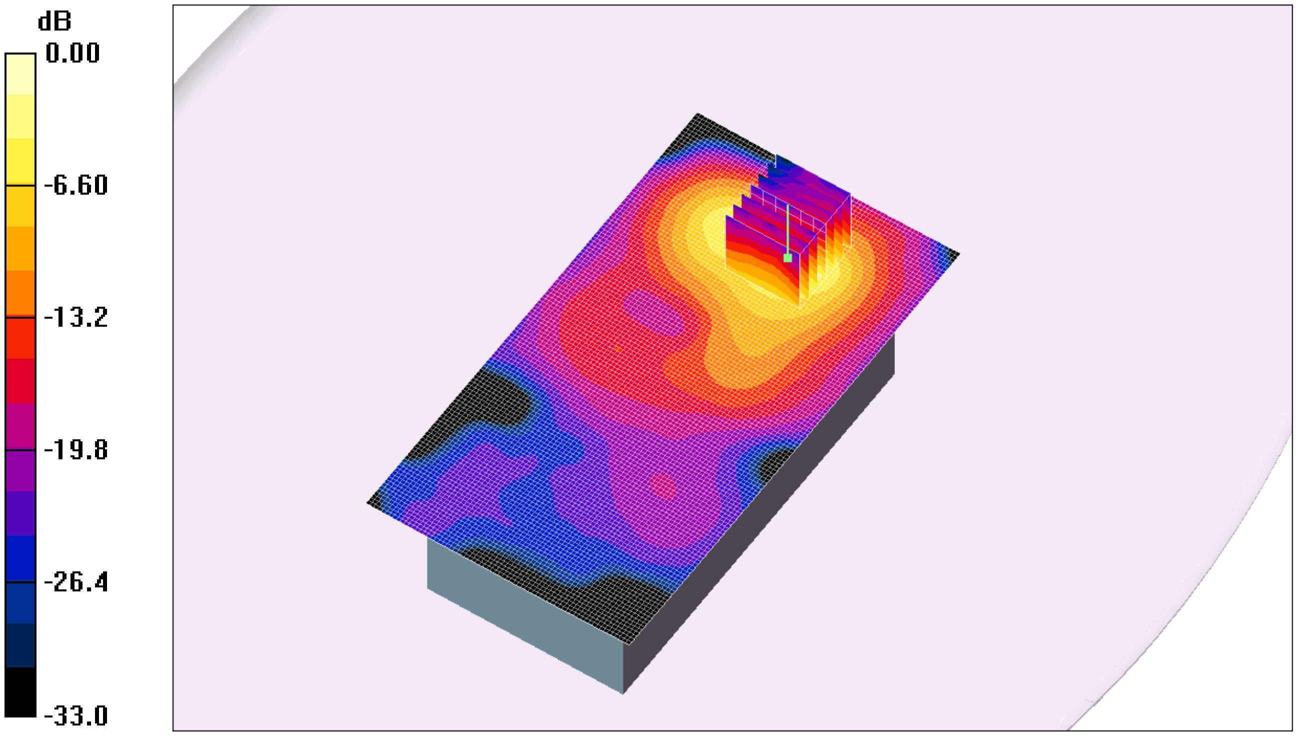
Communication System: WIFI 2450 US; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 2.03 mho/m, ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 24.4°C, Liquid temperature: 22.7°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (71x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.271 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.3 V/m; Power Drift = -0.195 dB
Peak SAR (extrapolated) = 0.588 W/kg
SAR(1 g) = 0.205 mW/g; SAR(10 g) = 0.080 mW/g
Maximum value of SAR (measured) = 0.308 mW/g



0 dB = 0.308mW/g

Fig. 9: SAR distribution for 802.11n (20MHz): channel 6 (2437 MHz), rear side at 0cm

DUT: INGENICO iWl257

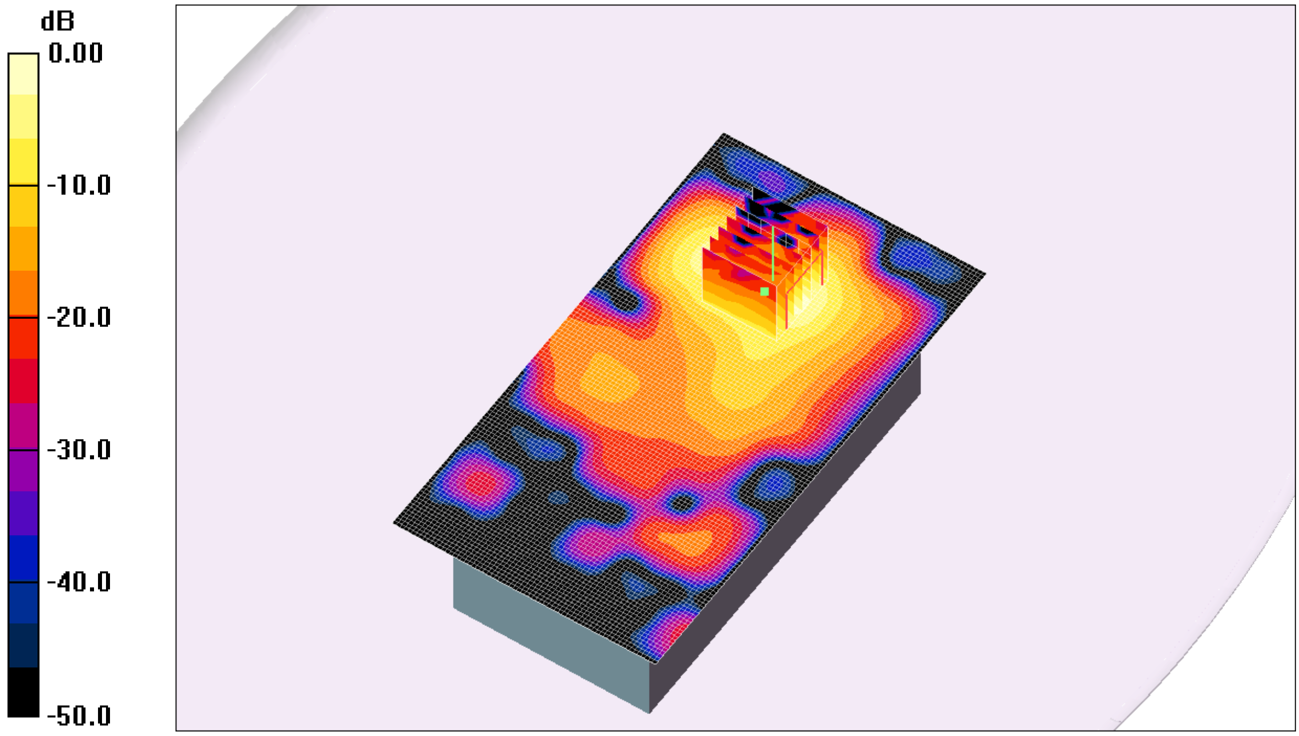
Communication System: WIFI 2450 US; Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 2.03 mho/m, ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 24.4°C, Liquid temperature: 22.7°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (71x131x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.090 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 6.04 V/m; Power Drift = -0.176 dB
Peak SAR (extrapolated) = 0.236 W/kg
SAR(1 g) = 0.076 mW/g; SAR(10 g) = 0.028 mW/g
Maximum value of SAR (measured) = 0.113 mW/g



0 dB = 0.113mW/g

Fig. 10: SAR distribution for 802.11n (40MHz): channel 6 (2437 MHz), rear side at 0cm

9. PHOTOGRAPHS OF THE EQUIPMENT UNDER TEST

The photographs of the equipment under test are shown in Fig. 11 to Fig. 16.

Fig. 11: Front side at 0cm from the phantom

Fig. 12: Distance from the phantom when front side is positioned at 0cm

Note: The surface of the equipment pointing towards the flat phantom is parallel to the surface of the phantom. The maximum space from the curved parts of the equipment to the phantom surface is 5mm.

Fig. 13: Rear side at 0cm from the phantom

Fig. 14: Distance from the phantom when rear side is positioned at 0cm

Note: The rear side of the equipment is placed against the phantom, the contact points are the feet. The maximum space from the curved part of the equipment to the phantom surface is 15mm.

Fig. 15: Left side at 0cm from the phantom

Fig. 16: Right side at 0cm from the phantom

10. MEASUREMENT UNCERTAINTY

- Measurement uncertainty of SAR evaluations

The expanded uncertainty is ± 21.8 %.

ERROR SOURCES	Uncertainty Value (%)	Probability Distribution	Divisor	Ci	Standard Uncertainty (%)
Measurement Equipment					
Probe Calibration	± 6.0	Normal	1	1	± 6.0
Axial Isotropy	± 4.7	Rectangular	√3	0.7	± 1.9
Hemispherical Isotropy	± 9.6	Rectangular	√3	0.7	± 3.9
Boundary Effect	± 1.0	Rectangular	√3	1	± 0.6
Linearity	± 4.7	Rectangular	√3	1	± 2.7
System Detection Limits	± 1.0	Rectangular	√3	1	± 0.6
Readout Electronics	± 0.3	Normal	1	1	± 0.3
Response Time	± 0.8	Rectangular	√3	1	± 0.5
Integration Time	± 2.6	Rectangular	√3	1	± 1.5
RF Ambient Conditions - Noise	± 3.0	Rectangular	√3	1	± 1.7
RF Ambient Conditions - Reflections	± 3.0	Rectangular	√3	1	± 1.7
Probe Positioner Mechanical Tolerance	± 0.4	Rectangular	√3	1	± 0.2
Probe Positioning with respect to Phantom Shell	± 2.9	Rectangular	√3	1	± 1.7
Extrapolation, Interpolation and Integration Algorithms for Max. SAR Evaluation	± 1.0	Rectangular	√3	1	± 0.6
Test Sample Related					
Test Sample Positioning	± 2.9	Normal	1	1	± 2.9
Device Holder Uncertainty	± 3.6	Normal	1	1	± 3.6
Output Power Variation – SAR drift measurement	± 5.0	Rectangular	√3	1	± 2.9
Phantom and Tissue Parameters					
Phantom Uncertainty (shape and thickness tolerances)	± 4.0	Rectangular	√3	1	± 2.3
Liquid Conductivity Target - Tolerance	± 5.0	Rectangular	√3	0.64	± 1.8
Liquid Conductivity – Measurement Uncertainty	± 2.5	Normal	1	0.64	± 1.6
Liquid Permittivity Target - Tolerance	± 5.0	Rectangular	√3	0.6	± 1.7
Liquid Permittivity – Measurement Uncertainty	± 2.5	Normal	1	0.6	± 1.5
Combined standard uncertainty					± 10.9
Expanded uncertainty (confidence interval of 95%)					± 21.8

- Uncertainty of SAR system verification

The expanded uncertainty is ± 18.4 %.

ERROR DESCRIPTION	Uncertainty Value (%)	Probability Distribution	Divisor	Ci	Standard Uncertainty (%)
Measurement System					
Probe calibration	± 6.0	Normal	1	1	± 6.0
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.7
Hemispherical isotropy	± 9.6	Rectangular	√3	0	± 0.0
Boundary effects	± 1.0	Rectangular	√3	1	± 0.6
Probe linearity	± 4.7	Rectangular	√3	1	± 2.7
System detection limit	± 1.0	Rectangular	√3	1	± 0.6
Readout electronics	± 0.3	Normal	1	1	± 0.3
Response time (CW)	± 0.0	Rectangular	√3	1	± 0.0
Integration time (CW)	± 0.0	Rectangular	√3	1	± 0.0
RF ambient conditions - Noise	± 3.0	Rectangular	√3	1	± 1.7
RF ambient conditions - Reflections	± 3.0	Rectangular	√3	1	± 1.7
Probe positioner	± 0.4	Rectangular	√3	1	± 0.2
Probe positioning	± 2.9	Rectangular	√3	1	± 1.7
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.6
Test Sample Related					
Dipole axis to liquid distance	± 2.0	Rectangular	√3	1	± 1.2
Input power and SAR drift meas.	± 4.7	Rectangular	√3	1	± 2.7
Phantom and Setup					
Phantom uncertainty	± 4.0	Rectangular	√3	1	± 2.3
Liquid conductivity (target)	± 5.0	Rectangular	√3	0.64	± 1.8
Liquid conductivity (meas.)	± 2.5	Normal	1	0.64	± 1.6
Liquid permittivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7
Liquid permittivity (meas.)	± 2.5	Normal	1	0.6	± 1.5
Coverage Factor for 95% (k=2)					
Combined Standard Uncertainty					± 9.2
Expanded Standard Uncertainty					± 18.4

11. SPATIAL PEAK SAR EVALUATION

From Schmid & Partner Engineering AG, [DASY4 Manual, March 2003, Application Note: Spatial Peak SAR Evaluation].

Spatial Peak SAR

The DASY4 software includes all numerical procedures necessary to evaluate the spatial peak SAR values.
The spatial-peak SAR can be computed over any required mass.
The base for the evaluation is a "cube" measurement in a volume of 30mm^3 (7x7x7 points). The measured volume includes the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan. The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes.
The algorithm to find the cube with highest averaged SAR is divided into the following stages:
1. Extraction of the measured data (grid and values) from the Zoom Scan,
2. Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters),
3. Generation of a high-resolution mesh within the measured volume,
4. Interpolation of all measured values from the measurement grid to the high-resolution grid,
5. Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface,
6. Calculation of the averaged SAR within masses of 1g and 10g.

Interpolation, Extrapolation and Detection of Maxima

The probe is calibrated at the center of the dipole sensors which is located at 2mm away from the probe tip. During measurements, the dipole sensors are 3mm above the phantom surface. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated.

The interpolation, extrapolation and maximum search routines are all based on the modified Quadratic Shepard's method [Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148.].

Averaging and Determination of Spatial Peak SAR

The interpolated data is used to average the SAR over the 1g and 10g cubes by spatially discretizing the entire measured volume. The resolution of this spatial grid used to calculate the averaged SAR is 1mm or about 42875 interpolated points. The resulting volumes are defined as cubical volumes containing the appropriate tissue parameters that are centered at the location. The location is defined as the center of the incremental volume (voxel).

12. EQUIPMENT TEST CONDITIONS

The following test conditions are given for information; the maximum output powers were not measured (see Note).

Standard: Wi-Fi (802.11 b/g/n)
Crest factor: 1
Modulation: DSSS for IEEE 802.11b, OFDM for IEEE 802.11g/n
Traffic Channel: low channel: 1 (2412 MHz), middle channel: 6 (2437 MHz), high channel: 11 (2462 MHz)
Test program: “RTTT Version 2.0.0.53” supplied by the applicant
Power:

Channel	Output Power (dBm)
IEEE 802.11b (2.4GHz) - 1 Mbps	
1	15.0
6	15.1
11	15.0
IEEE 802.11g (2.4GHz) - 6 Mbps	
1	14.6
6	14.8
11	14.7
IEEE 802.11n (2.4GHz) - 20MHz - 6.5 Mbps	
1	13.4
6	13.7
11	13.6
IEEE 802.11n (2.4GHz) - 40MHz - 6.5 Mbps	
1	10.6
6	10.7
11	10.7

Note: Conducted power measurements were performed with a temporary antenna connector instead of antenna. The setting up of a temporary antenna connector is not possible on the equipment presented, so these measurements could not be performed before and after each SAR test. These values were communicated by the applicant.

13. MEASUREMENT SYSTEM DESCRIPTION

The automated near-field scanning system Dosimetric Assessment System DASY4 from Schmid & Partner Engineering AG was used. The measurement is performed using platform n° 2 (DASY4) referenced in paragraph 6 of this test report. The system consists of a computer controlled, high precision robotics system, robot controller, extreme near-field probes and the phantom containing the liquid. The six axis robot precisely positions the probe at the points of maximum electromagnetic field. A device holder made of low-loss dielectric material is used to maintain the test position of the equipment under test against the phantom. The measurements were conducted in an RF controlled environment (i.e. semi anechoic room). Fig. 17 shows the system.

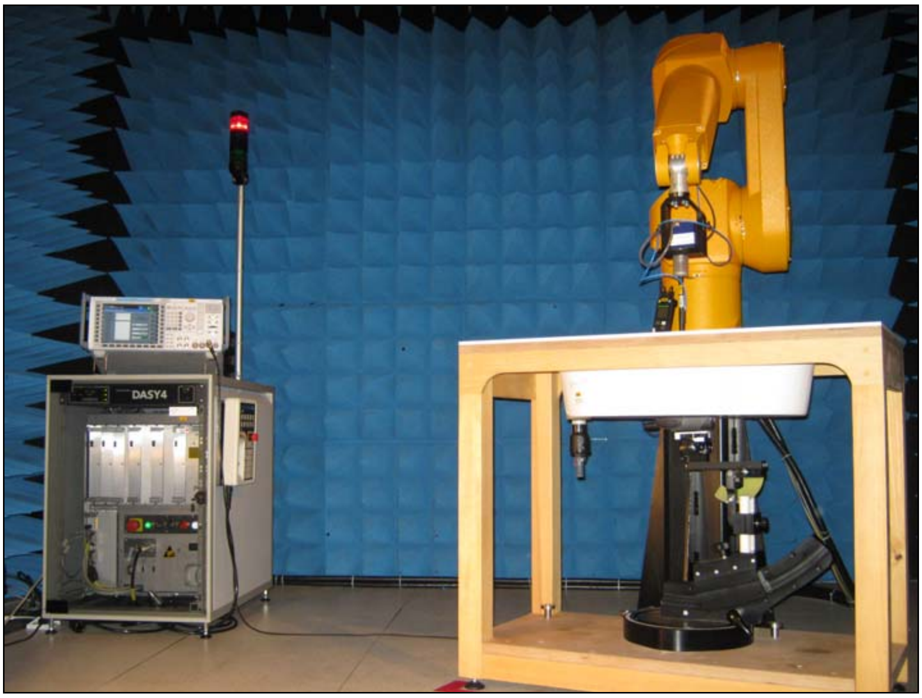


Fig. 17: The measurement setup with equipment under test.

14. LIQUID MEASUREMENT: TEST CONDITIONS & RESULTS

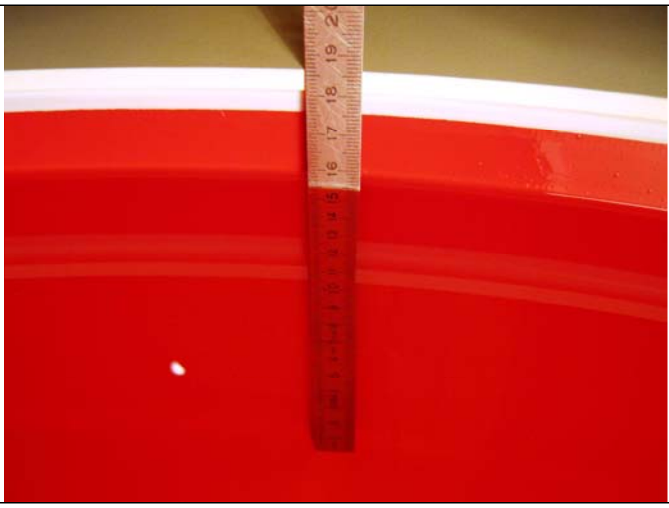
The liquid measurement is performed using platform n° 3 (Liquid measure) referenced in paragraph 6 of this test report. The following ingredients (in % by weight) are theoretical and given for information.

2450 MHz liquid: Diethylenglykol-monobutylether 26.70 %
De-ionised water 73.20 %
NaCl salt 0.04 %

The dielectric parameters of the liquid were controlled prior to assessment (contact probe method). Dielectric properties measured:

Frequency (MHz)	ε_r (F/m) Targeted value	ε_r (F/m) Measured value	σ (S/m) Targeted value	σ (S/m) Measured value	Liquid temperature (°C)	Ambient temperature (°C)
2440	52.7 ± 5 %	52.8	1.94 ± 5 %	2.03	22.5	23.0
2450	52.7 ± 5 %	52.7	1.95 ± 5 %	2.02		

The phantom shall be filled with tissue-equivalent liquid to a depth of at least 15cm.

The liquid depth measured in the phantom was 15.4cm as shown in the attached photograph.	

15. SYSTEM VALIDATION: TEST CONDITIONS & RESULTS

The system validation is performed using platform n° 4 (System validation) referenced in paragraph 6 of this test report.

Measurement conditions: The measurements were performed with the ELI4 phantom filled with liquids. The validation dipole input power was 250mW.
Prior to the assessment, the validation dipole were used to check whether the system was operating within its specification of ± 10 %.

Measurement results: The results are hereafter below and shown in Fig. 18.

Frequency (MHz)	SAR 1g (W/kg) Targeted value	SAR 1g (W/kg) Measured value	SAR 10g (W/kg) Targeted value	SAR 10g (W/kg) Measured value
2450	12.8 ± 10%	13.1	5.925 ± 10%	5.99

DUT: Dipole 2450 MHz

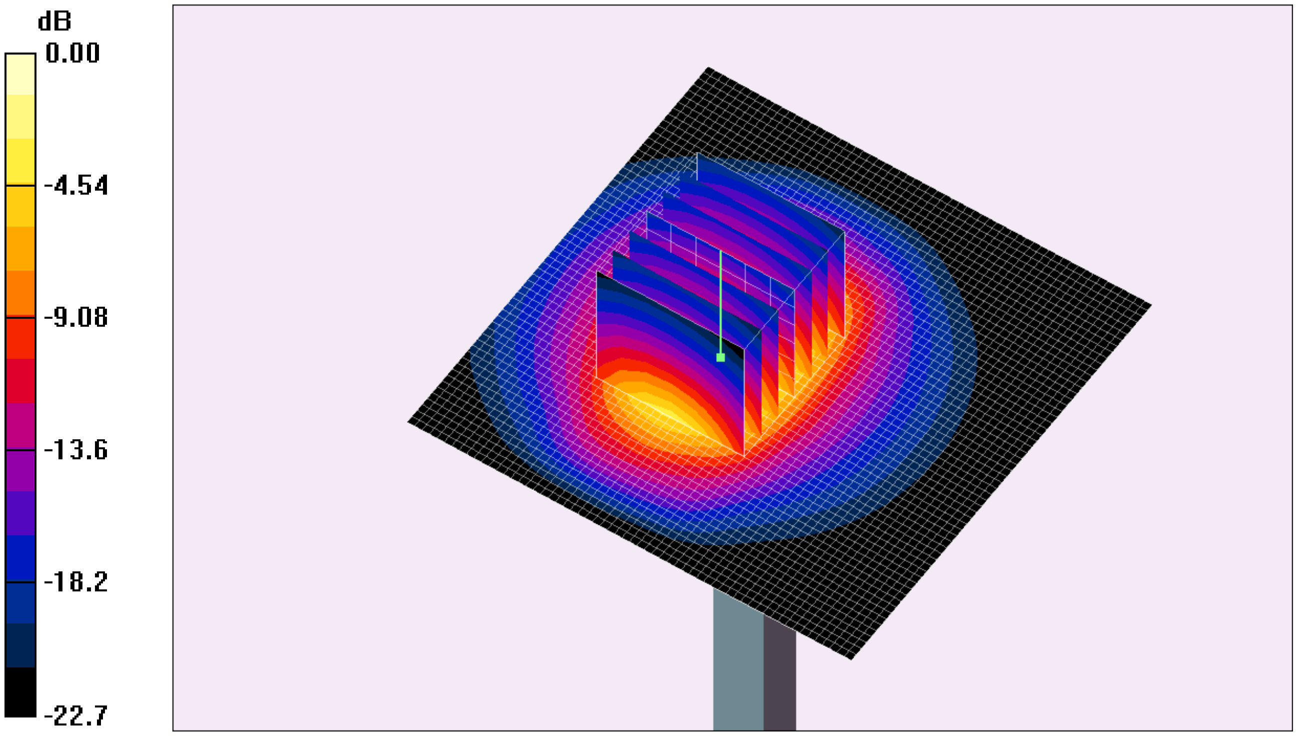
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 2.02 mho/m, ε_r = 52.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 24.3°C, Liquid temperature: 22.8°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

d=10mm, Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 18.3 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 85.7 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 27.7 W/kg
SAR(1 g) = 13.1 mW/g; SAR(10 g) = 5.99 mW/g
Maximum value of SAR (measured) = 17.1 mW/g



0 dB = 17.1mW/g

Fig. 18: 2450MHz validation result

□□□ End of report, 3 annexes to be forwarded □□□

ANNEX 1: ES3DV3 CALIBRATION CERTIFICATE

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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 108

Client EMITECH Le Mans

Certificate No: ES3-3303_Aug13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3303
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v8, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	August 21, 2013

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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 21, 2013

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

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

Accreditation No.: SCS 108

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, “IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, December 2003

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

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.

Probe ES3DV3

SN:3303

Manufactured: August 27, 2010
Calibrated: August 21, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3303

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.38	1.39	1.42	± 10.1 %
DCP (mV)[B]	98.2	100.7	98.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	167.9	±3.0 %
		Y	0.0	0.0	1.0		165.8	
		Z	0.0	0.0	1.0		169.6	

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 NormX,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: ES3DV3 - SN:3303

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	Depth (mm)	Unct. (k=2)
450	43.5	0.87	6.83	6.83	6.83	0.17	1.99	± 13.4 %
900	41.5	0.97	6.01	6.01	6.01	0.34	1.73	± 12.0 %
1810	40.0	1.40	5.09	5.09	5.09	0.47	1.53	± 12.0 %
1950	40.0	1.40	4.99	4.99	4.99	0.47	1.66	± 12.0 %
2150	39.7	1.53	4.86	4.86	4.86	0.60	1.39	± 12.0 %
2450	39.2	1.80	4.46	4.46	4.46	0.80	1.28	± 12.0 %
2600	39.0	1.96	4.35	4.35	4.35	0.80	1.31	± 12.0 %

[C] Frequency validity 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.
[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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3303

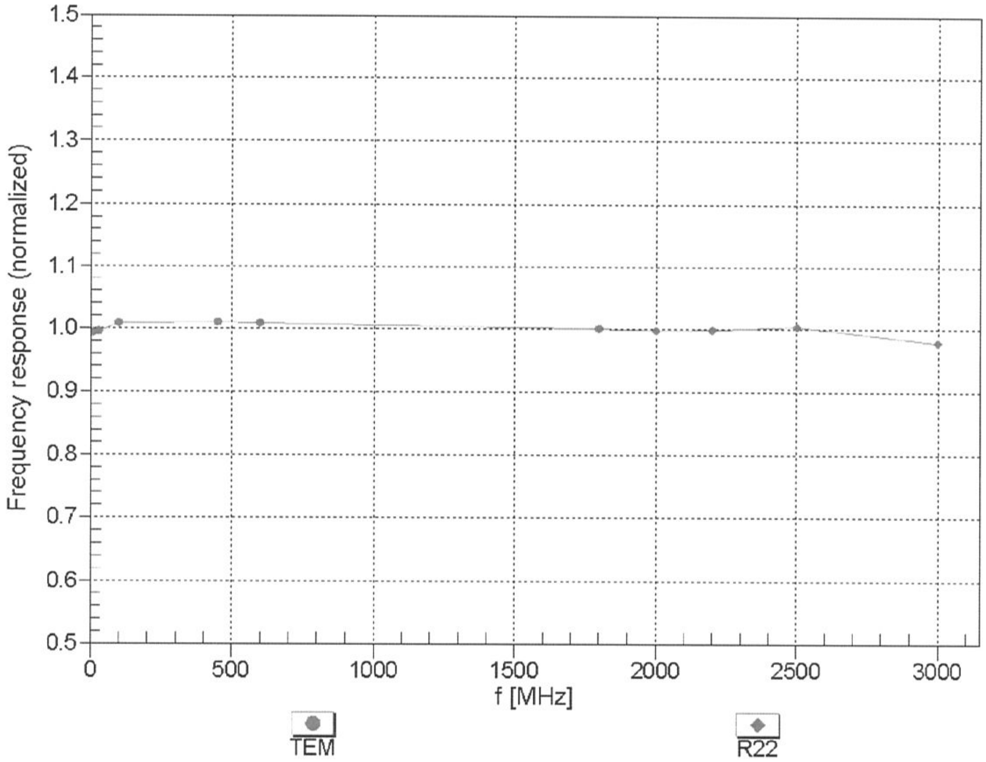
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
900	55.0	1.05	5.87	5.87	5.87	0.80	1.14	± 12.0 %
1810	53.3	1.52	4.74	4.74	4.74	0.52	1.57	± 12.0 %
2450	52.7	1.95	4.17	4.17	4.17	0.80	1.14	± 12.0 %

[C] Frequency validity 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.
[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.

Frequency Response of E-Field

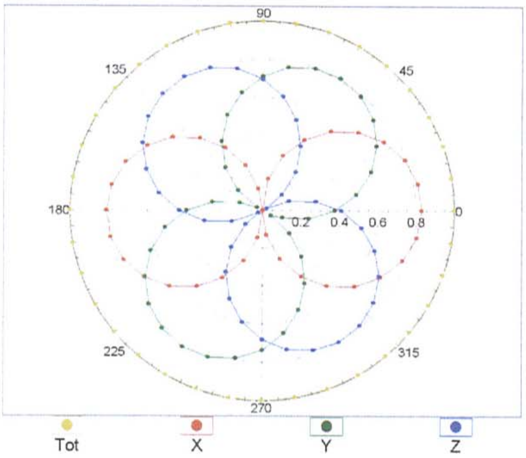
(TEM-Cell:ifi110 EXX, Waveguide: R22)



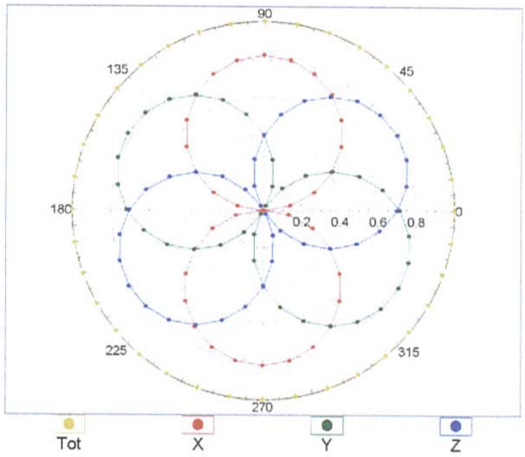
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

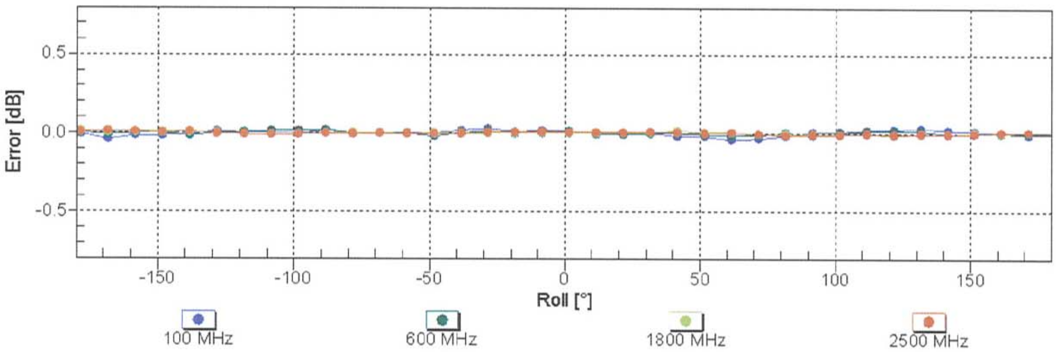
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



f=1800 MHz,R22

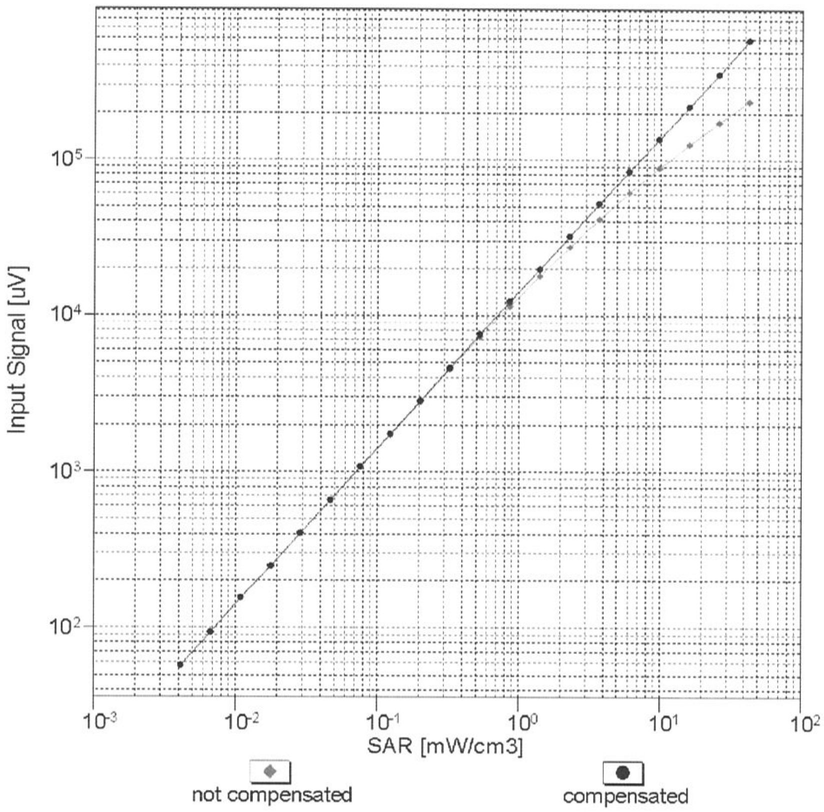


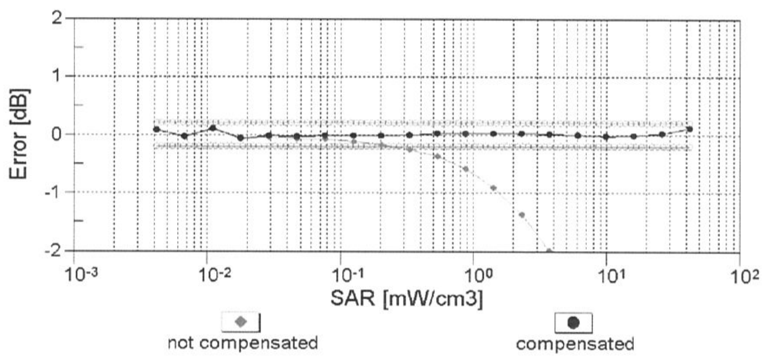


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f = 900 MHz)





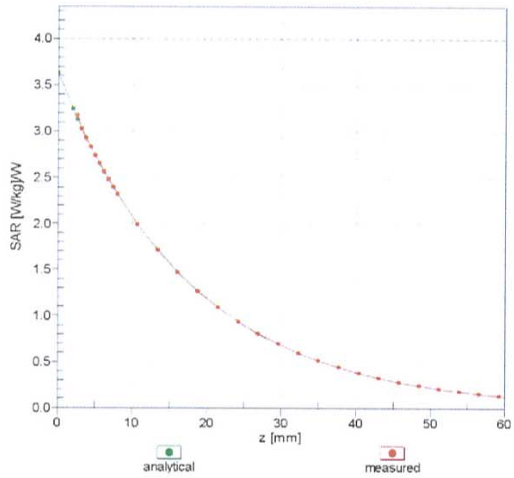
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ES3DV3– SN:3303

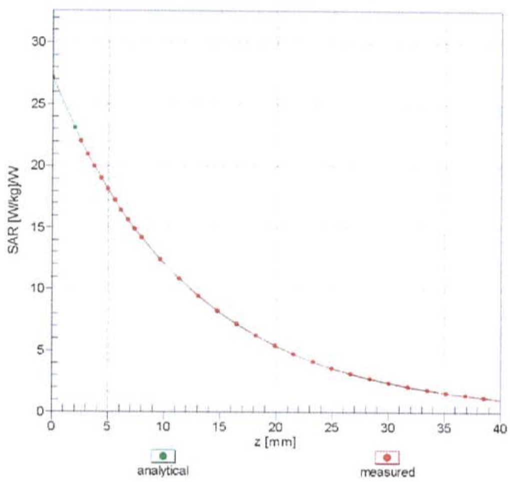
August 21, 2013

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

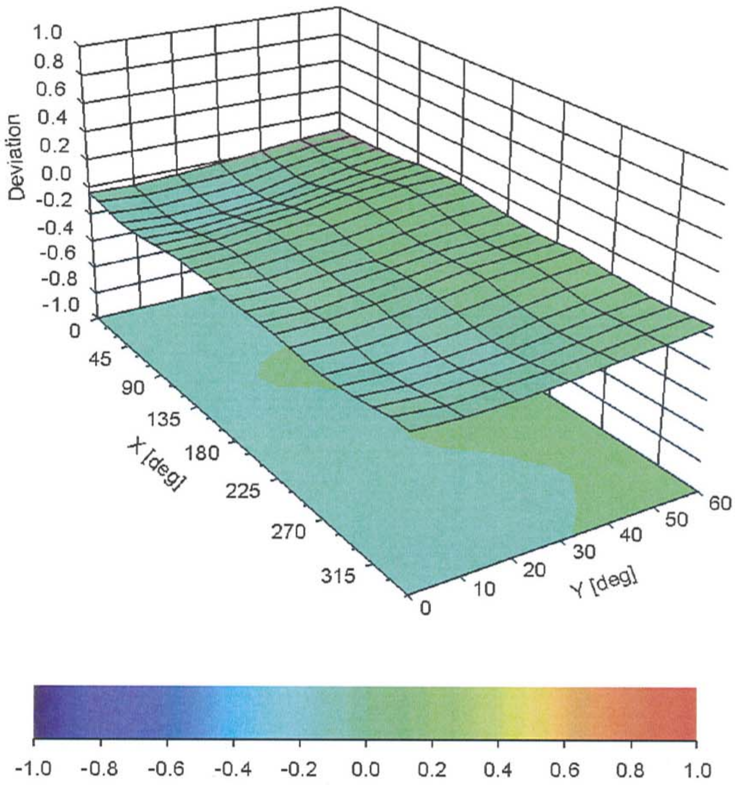


f = 1810 MHz,WGLS R22 (H_convF)



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: ES3DV3 - SN:3303

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-138.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

ANNEX 2: DAE3 CALIBRATION CERTIFICATE

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

ilac-MRA

SWISS CALIBRATION

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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 108

Client **EMITECH Le Mans**

Certificate No: DAE3-402_Aug13

CALIBRATION CERTIFICATE

Object	DAE3 - SD 000 D03 AA - SN: 402
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	August 14, 2013

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	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

	Name	Function	Signature
Calibrated by:	R.Mayoraz	Technician	R. Mayoraz
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V. Blumel

Issued: August 14, 2013

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

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

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Accreditation No.: **SCS 108**

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.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100…+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1…….+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.313 ± 0.02% (k=2)	403.225 ± 0.02% (k=2)	403.795 ± 0.02% (k=2)
Low Range	3.93434 ± 1.50% (k=2)	3.95932 ± 1.50% (k=2)	3.96401 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	242.5 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199996.96	-0.90	-0.00
Channel X	+ Input	20009.10	8.22	0.04
Channel X	- Input	-19994.77	5.97	-0.03
Channel Y	+ Input	199997.51	-0.37	-0.00
Channel Y	+ Input	20005.41	4.43	0.02
Channel Y	- Input	-19999.15	1.47	-0.01
Channel Z	+ Input	199997.44	-0.33	-0.00
Channel Z	+ Input	19998.72	-2.17	-0.01
Channel Z	- Input	-20008.30	-7.73	0.04

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.98	-0.03	-0.00
Channel X	+ Input	202.06	0.53	0.26
Channel X	- Input	-198.28	0.02	-0.01
Channel Y	+ Input	2000.89	-0.18	-0.01
Channel Y	+ Input	201.47	-0.02	-0.01
Channel Y	- Input	-198.65	-0.39	0.20
Channel Z	+ Input	2001.10	0.09	0.00
Channel Z	+ Input	200.98	-0.47	-0.23
Channel Z	- Input	-199.22	-0.82	0.41

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	6.44	5.00
	- 200	-3.93	-5.87
Channel Y	200	-1.24	-1.73
	- 200	0.70	0.50
Channel Z	200	1.03	0.98
	- 200	-2.55	-2.49

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	3.24	-2.06
Channel Y	200	8.46	-	4.26
Channel Z	200	7.96	5.62	-

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	16306	17157
Channel Y	15885	16167
Channel Z	16456	16650

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	0.85	-0.08	2.10	0.39
Channel Y	-0.28	-1.82	1.06	0.44
Channel Z	-0.87	-1.82	0.25	0.37

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

ANNEX 3: D2450V2 CALIBRATION CERTIFICATE

EMITECH GROUPE

CALIBRATION CERTIFICATE

Equipment under calibration:
Designation: 2450MHz dipole
Brand: Schmid & Partner Engineering AG
Type: D2450V2
Serial number: 831
Emitech number: 7323

Calibration date: February 20, 2014

Operator: Emmanuel TOUTAIN

Calibration procedure: PRTFIC000MET00050

Environnemental conditions :
Ambient Temperature: 23.8°C
Liquid Temperature: 22.3°C
Hygrometry: 30% HR

Equipment used:

EMITECH N°	DESIGNATION	BRAND	TYPE	CALIBRATION PERIODICITY	CALIBRATION DATE
1402	Network Analyser	Hewlett Packard	8753C	12 months	Feb. 26, 2013
7217	Calibration kit	Hewlett Packard	85033D	24 months	Feb. 28, 2013

Liquid measurements:

Frequency (MHz)	Liquid : Head		Liquid : Body (1)	
	Sigma	Epsilon	Sigma	Epsilon
2450	-	-	2.01	50.3

Note (1): dielectric properties according to Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01)

Return loss measurements:

Dipole	Frequency (MHz)	Liquid : Head		Liquid : Body	
		Return loss (dB)	Verdict (2) ≤ -20dB	Return loss (dB)	Verdict (2) ≤ -20dB
D2450V2	2450	-	-	-26.4	PASS

Note (2): The reference dipole shall have a return loss better than –20 dB.

Conclusion: In Tolerance
(in body tissue at 2450MHz according to the Supplement C to OET Bulletin 65)

Visa:

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SAR measurements:

2450MHz at 10mm	Liquid : Head		Liquid : Body	
	SAR1g (W/kg)	SAR10g (W/kg)	SAR1g (W/kg)	SAR10g (W/kg)
SAR measured (Pin = 250mW)	-	-	13.0	5.96
SAR normalized (P = 250mW)	-	-	12.8	5.925
SAR normalized to 1 W (3)	-	-	51.2	23.7
SAR for nominal liquid parameters (4)	-	-	51.7	23.9

Note (3): Numerical reference SAR values for SPEAG dipoles and flat phantom filled with body or head tissue simulating liquid.

Note (4): Correction to nominal liquid parameters according to SPEAG Application Note "SAR Sensitivities"

The expanded uncertainty (k=2) is ±18.4 % in 1g and ± 17.8 % in 10g.

Impedance measurement:

Impedance	47.9 Ω - 4.2 jΩ

EMITECH GROUPE

DUT: Dipole 2450 MHz

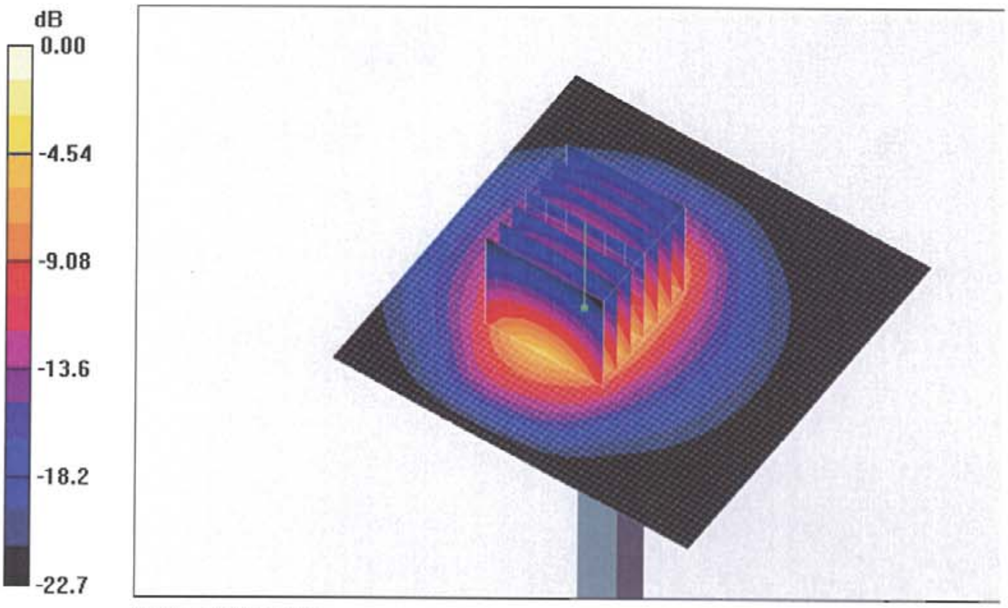
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 2.01$ mho/m, $\varepsilon_r = 50.3$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 24.3°C, Liquid temperature: 22.8°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.17, 4.17, 4.17); Calibrated: 8/21/2013
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/14/2013
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

d=10mm, Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 18.2 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 85.7 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 13 mW/g; SAR(10 g) = 5.96 mW/g
Maximum value of SAR (measured) = 17.0 mW/g



0 dB = 17.0mW/g

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