RE051-16-102424-1-A Ed. 1

This report cancels and replaces the test report RE051-16-102424-1-A Ed. 0

SAR TEST REPORT

According to the standards:
FCC 47 CFR § 2.1093
RF exposure KDB procedures

Equipment under test:
PARROT
SKYCONTROLLER 2

FCC ID: 2AG6ISKC2

Company:
PARROT DRONES SAS

DISTRIBUTION: Mrs. ABOU EL ANOUAR **Company: PARROT DRONES SAS**

Number of pages: 22 with 3 annexes

Ed.	Date	Modified page(s)	Written by / Technical verification Name Visa	Quality Approval Name Visa
1	Jul. 22, 2016	1 and 2 Photos removed	Emmanuel TOUTAIN	Olivier ROY

Duplication of this test report is only permitted for an integral photographic facsimile. It includes the number of pages referenced here above.
This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole production of the tested sample.

EQUIPMENT UNDER TEST:

Reference:	PARROT SKYCONTROLLER 2 *(identical prototype)*
Serial number (S/N):	PI040409D16D000012
Hardware version:	MB: 02 ; BB: 02
Firmware version:	6.37.114.64 (r516176 WLTEST)

MANUFACTURER: -

APPLICANT:

Company:	PARROT DRONES SAS
Address:	174 Quai de Jemmapes 75010 Paris France
Contact person:	Mrs. Meryam ABOU EL ANOUAR

Person(s) present(s) during the test: -

DATE(S) OF TEST(S): June 14, 2016

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 PARROT SKYCONTROLLER 2 are presented.

The measurements were made according to the KDB publications for evaluating compliance with FCC Guidelines (FCC 47 CFR § 2.1093 and IEEE Std C95.1).

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	D01 General RF Exposure Guidance v06	2015
KDB 447498	D03 Supplement C Cross-Reference v01	2014
KDB 248227	D01 SAR Guidance for IEEE 802.11 (Wi-Fi) transmitters v02r02	2015
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
IEEE Std 1528	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Technique	2013
-	*SAR Test Setup Photo exhibit, Annex to the test report RE051-16-102424-1-A including photographs of the equipment*	-

3. PRESENTATION OF EQUIPMENT FOR TESTING PURPOSES

The wireless communication device PARROT SKYCONTROLLER 2 using the IEEE 802.11 b/g/n standard (Wi-Fi on the 2.45GHz frequency band) is shown in *SAR Test Setup Photo exhibit*. The antennas are integrated (up to 4 on the front side in relation with the operating mode, gain = 5.5dBi).

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

4. TESTS RESULTS SUMMARY

Object	Respected Standard ? ≤ 4W/kg in 10g (SAR limit for hands, wrists, feet and ankles)		Remarks
	Yes	No	
SAR measurements at 0cm from the hands of the user	X		SAR value measured: 0.792 W/kg

Conclusion:

The sample PARROT SKYCONTROLLER 2 submitted to test when hand-held is in conformity with the FCC Guidelines, for general population/uncontrolled exposure, according to the FCC published RF exposure KDB procedures.

To declare, or not, the compliance with the specifications, it was not explicitly taken into account of uncertainty associated with the result(s).

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, 15	Aug. 21, 16
	7192	Data acquisition	Speag	DAE3	Aug. 13, 15	Aug. 13, 16
	7324	Phantom	Speag	ELI4	-	-
3 Liquid Measure	-	Software	Hewlett-Packard	HP85070C	-	-
	1402	Network analyzer	Hewlett-Packard	HP8753C	May 07, 15	Jul. 07, 16
	9777	S-Parameter	Hewlett-Packard	HP85047A	May 07, 15	Jul. 07, 16
	7218	Dielectric probe	Hewlett-Packard	HP85070C	-	-
	6980	Thermometer	Testo	922	Mar. 11, 16	Mar. 11, 18
4 System Check	7014	Signal generator	Rohde&Schwarz	SMP22	Feb. 12, 15	Feb. 12, 17
	7209	Amplifier	Mini-circuits	ZHL42	-	-
	7214	Power Supply	Kikusui	PMC18-2	-	-
	7212	Power meter	Rohde&Schwarz	NRVS	Feb. 18, 15	Feb. 18, 17
	7211	Probe power meter	Rohde&Schwarz	NRV-Z31	Feb. 18, 15	Feb. 18, 17
	7035	Power meter	Rohde&Schwarz	NRVD	Sep. 19, 14	Sep. 19, 16
	7034	Probe power meter	Rohde&Schwarz	NRV-Z1	Sep. 19, 14	Sep. 19, 16
	7323	Dipole 2450MHz	Speag	D2450V2	Jun. 16, 16	Jun. 16, 18
	7208	Coupler	Suhner	3877	Feb. 11, 16	Feb. 11, 18
	7213	Attenuator	Weinschel Engineering	33-3-34	Feb. 11, 16	Feb. 11, 18
	7315	Attenuator	Radiall	R411810124 R411806124	Feb. 11, 16	Feb. 11, 18
	9161	50 ohms load	Diconex	17-0193	Feb. 11, 16	Feb. 11, 18
	7313	50 ohms load	Radiall	R404563000	Feb. 11, 16	Feb. 11, 18

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 antennas 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 for each mode according the conducted power results (see 12. Equipment test conditions) with a continuous transmission.
The SAR tests were performed for each mode b, g and n at the centre frequency on the front side (near the antennas) in order to define the worst case for exposure taking into account maximum output powers and antennas configurations. Then the configuration giving rise to the maximum mass-averaged SAR was used to test all positions, and the low-end and the high-end frequencies of the transmitting band for the worst case.

The device was placed against the flat phantom at 0 cm (contact) with its front, rear, left, right, up and down sides as described in *SAR Test Setup Photo exhibit*. The 0 cm separation distance is defined as the distance between the phantom shell and the closest point of the device when positioned.

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

Configuration	Test Position at 0cm	SAR 10g (W/kg) - Limit = 4 W/kg			Meas. date
		Channel 1 2412 MHz	Channel 7 2442 MHz	Channel 11 2462 MHz	
802.11b @ 11Mbps	Front side	0.417	0.632	**0.792**	June 14, 2016
	Rear side	-	0.00651	-	
	Left side	-	0.0650	-	
	Right side	-	0.0484	-	
	Up side	-	0.0482	-	
	Down side	-	0.0328	-	
802.11g @ 9Mbps	Front side	-	0.511	-	
	Rear side	-	-	-	
	Left side	-	-	-	
	Right side	-	-	-	
	Up side	-	-	-	
	Down side	-	-	-	
802.11n @ 6.5Mbps	Front side	-	0.321	-	
	Rear side	-	-	-	
	Left side	-	-	-	
	Right side	-	-	-	
	Up side	-	-	-	
	Down side	-	-	-	

8. GRAPHICAL REPRESENTATIONS OF THE COARSE SCAN

The graphical representations of the coarse scan are shown in Fig. 1 to Fig. 3.

DUT: PARROT SKYCONTROLLER 2

Communication System: WIFI 2450; Frequency: 2462 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 2$ mho/m, $\varepsilon_r = 50.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

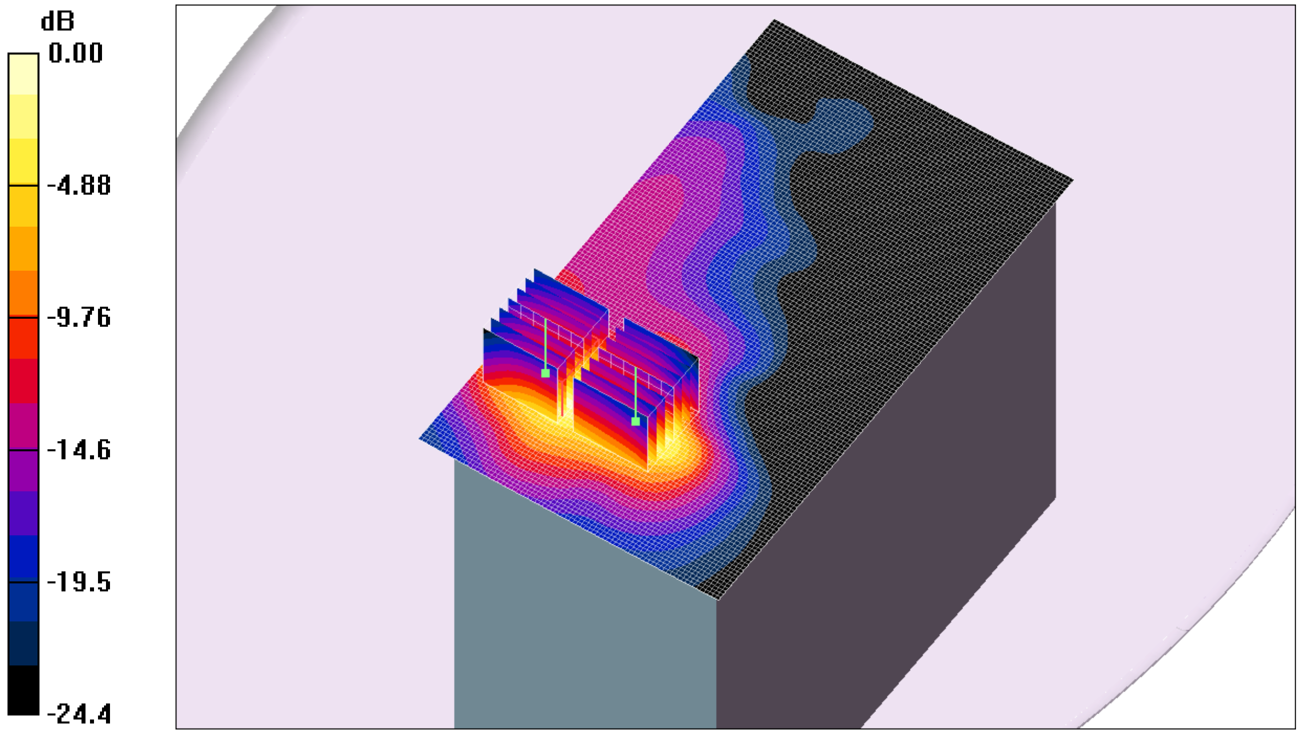
Program Notes: Ambient temperature: 24.2°C, Liquid temperature: 23.4°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.31, 4.31, 4.31); Calibrated: 8/21/2015
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/13/2015
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

d=0mm, High channel/Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.26 mW/g

d=0mm, High channel/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 33.6 V/m; Power Drift = -0.197 dB
Peak SAR (extrapolated) = 3.05 W/kg
SAR(1 g) = 1.58 mW/g; SAR(10 g) = 0.786 mW/g
Maximum value of SAR (measured) = 2.02 mW/g

d=0mm, High channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 33.6 V/m; Power Drift = -0.197 dB
Peak SAR (extrapolated) = 3.09 W/kg
SAR(1 g) = 1.61 mW/g; SAR(10 g) = 0.792 mW/g
Maximum value of SAR (measured) = 2.07 mW/g



0 dB = 2.07mW/g

Fig. 1: SAR distribution for 802.11b at 11Mbps: channel 11 (2462 MHz), front side at 0cm

DUT: PARROT SKYCONTROLLER 2

Communication System: WIFI 2450; Frequency: 2442 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 1.98 mho/m, ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.2°C, Liquid temperature: 23.1°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.31, 4.31, 4.31); Calibrated: 8/21/2015
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/13/2015
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

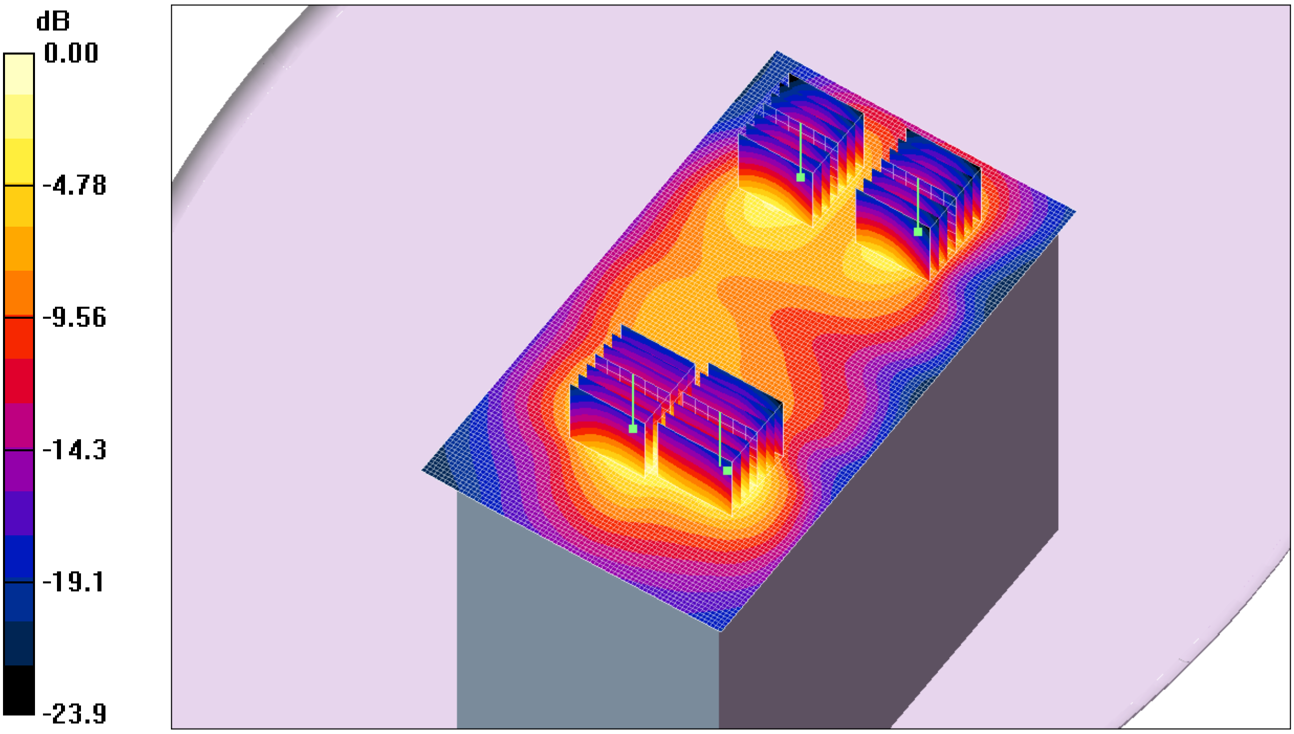
d=0mm, Middle channel/Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.30 mW/g

d=0mm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.3 V/m; Power Drift = -0.128 dB
Peak SAR (extrapolated) = 2.01 W/kg
SAR(1 g) = 1.03 mW/g; SAR(10 g) = 0.511 mW/g
Maximum value of SAR (measured) = 1.32 mW/g

d=0mm, Middle channel/Zoom Scan 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.3 V/m; Power Drift = -0.128 dB
Peak SAR (extrapolated) = 1.59 W/kg
SAR(1 g) = 0.815 mW/g; SAR(10 g) = 0.382 mW/g
Maximum value of SAR (measured) = 1.06 mW/g

d=0mm, Middle channel/Zoom Scan 3 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.3 V/m; Power Drift = -0.128 dB
Peak SAR (extrapolated) = 1.67 W/kg
SAR(1 g) = 0.863 mW/g; SAR(10 g) = 0.407 mW/g
Maximum value of SAR (measured) = 1.12 mW/g

d=0mm, Middle channel/Zoom Scan 4 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.3 V/m; Power Drift = -0.142 dB
Peak SAR (extrapolated) = 1.97 W/kg
SAR(1 g) = 1.01 mW/g; SAR(10 g) = 0.497 mW/g
Maximum value of SAR (measured) = 1.29 mW/g



0 dB = 1.29mW/g

Fig. 2: SAR distribution for 802.11g at 9Mbps: channel 7 (2442 MHz), front side at 0cm

DUT: PARROT SKYCONTROLLER 2

Communication System: WIFI 2450; Frequency: 2442 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 1.98 mho/m, ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.7°C, Liquid temperature: 23.1°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.31, 4.31, 4.31); Calibrated: 8/21/2015
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/13/2015
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1067
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

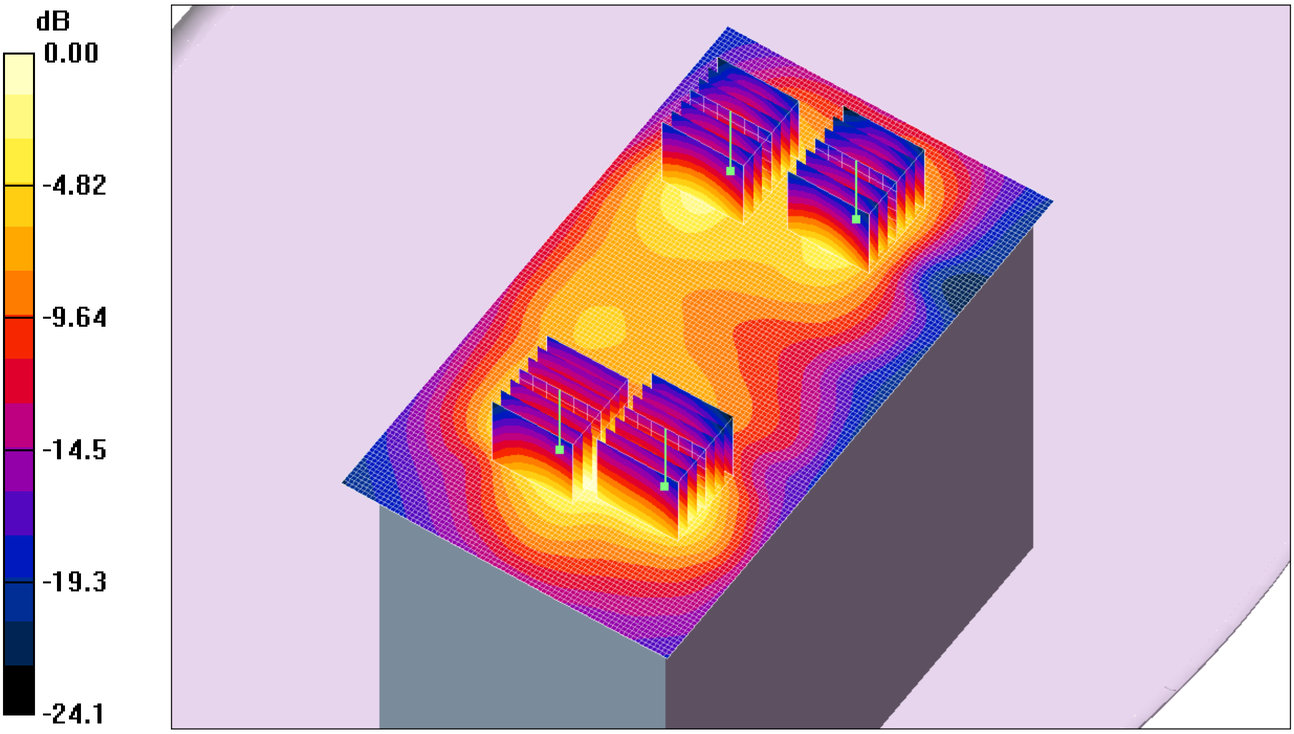
d=0mm, Middle channel/Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.815 mW/g

d=0mm, Middle channel/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.1 V/m; Power Drift = -0.129 dB
Peak SAR (extrapolated) = 1.22 W/kg
SAR(1 g) = 0.625 mW/g; SAR(10 g) = 0.304 mW/g
Maximum value of SAR (measured) = 0.803 mW/g

d=0mm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.1 V/m; Power Drift = -0.129 dB
Peak SAR (extrapolated) = 1.31 W/kg
SAR(1 g) = 0.668 mW/g; SAR(10 g) = 0.321 mW/g
Maximum value of SAR (measured) = 0.833 mW/g

d=0mm, Middle channel/Zoom Scan 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.1 V/m; Power Drift = -0.129 dB
Peak SAR (extrapolated) = 0.981 W/kg
SAR(1 g) = 0.500 mW/g; SAR(10 g) = 0.232 mW/g
Maximum value of SAR (measured) = 0.645 mW/g

d=0mm, Middle channel/Zoom Scan 3 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.1 V/m; Power Drift = -0.129 dB
Peak SAR (extrapolated) = 0.898 W/kg
SAR(1 g) = 0.462 mW/g; SAR(10 g) = 0.215 mW/g
Maximum value of SAR (measured) = 0.596 mW/g



0 dB = 0.596mW/g

Fig. 3: SAR distribution for 802.11n at 6.5Mbps: channel 7 (2442 MHz), front side at 0cm

9. PHOTOGRAPHS OF THE EQUIPMENT UNDER TEST

The photographs of the equipment under test are shown in *SAR Test Setup Photo exhibit*.

10. MEASUREMENT UNCERTAINTY

- Measurement uncertainty of SAR evaluations

The uncertainty of the measurements was evaluated according to the IEEE Std 1528: 2013, Tableau 9 (Handset). The expanded uncertainty is ± 22.8 % in 1g and ± 22.9 % in 10g.

Uncertainty component	Uncertainty Value (%)	Probability Distribution	Divisor	c_i (1g)	c_i (10g)	1g u_i (%)	10g u_i (%)
Measurement system							
Probe calibration	± 6.0	Normal	1	1	1	± 6.0	± 6.0
Probe calibration drift	± 5.0	Rectangular	2√3	1	1	± 1.4	± 1.4
Axial isotropy	± 4.7	Rectangular	√3	0.7	0.7	± 1.9	± 1.9
Hemispherical isotropy	± 9.6	Rectangular	√3	0.7	0.7	± 3.9	± 3.9
Boundary effect	± 1.0	Rectangular	√3	1	1	± 0.6	± 0.6
Linearity	± 4.7	Rectangular	√3	1	1	± 2.7	± 2.7
System detection limits	± 1.0	Rectangular	√3	1	1	± 0.6	± 0.6
Modulation response	± 2.4	Rectangular	√3	1	1	± 1.4	± 1.4
Readout electronics	± 0.3	Normal	1	1	1	± 0.3	± 0.3
Response time	± 0.8	Rectangular	√3	1	1	± 0.5	± 0.5
Integration time	± 2.6	Rectangular	√3	1	1	± 1.5	± 1.5
RF ambient conditions - noise	± 3.0	Rectangular	√3	1	1	± 1.7	± 1.7
RF ambient conditions - reflections	± 3.0	Rectangular	√3	1	1	± 1.7	± 1.7
Probe positioner mechanical tolerance	± 0.4	Rectangular	√3	1	1	± 0.2	± 0.2
Probe positioning with respect to phantom shell	± 2.9	Rectangular	√3	1	1	± 1.7	± 1.7
Extrapolation, interpolation and integration algorithms for max. SAR evaluation	± 2.0	Rectangular	√3	1	1	± 1.2	± 1.2
Test sample related							
Test sample positioning	± 2.9	Normal	1	1	1	± 2.9	± 2.9
Device holder uncertainty	± 3.6	Normal	1	1	1	± 3.6	± 3.6
Output power variation – SAR drift measurement	± 5.0	Rectangular	√3	1	1	± 2.9	± 2.9
SAR scaling	*± 0.0*	*Rectangular*	√3	*1*	*1*	*± 0.0*	*± 0.0*
Phantom and tissue parameters							
Phantom shell uncertainty – shape, thickness and permittivity	± 6.1	Rectangular	√3	1	1	± 3.5	± 3.5
Uncertainty in SAR correction for deviations in permittivity and conductivity	± 1.9	Normal	1	1	0.84	± 1.9	± 1.6
Liquid conductivity measurement	± 2.5	Normal	1	0.78	0.71	± 2.0	± 1.8
Liquid permittivity measurement	± 2.5	Normal	1	0.23	0.26	± 0.6	± 0.7
Liquid conductivity – temperature uncertainty	± 2.8	Rectangular	√3	0.78	0.71	± 1.3	± 1.2
Liquid permittivity – temperature uncertainty	± 1.9	Rectangular	√3	0.23	0.26	± 0.3	± 0.3
Combined standard uncertainty						± 11.4	± 11.4
Expanded uncertainty (95% confidence interval)						± 22.8	± 22.9

- Uncertainty of SAR system validation

The uncertainty of the system validation was evaluated according to the IEEE Std 1528: 2013, Tableau 10 (System validation). The expanded uncertainty is ± 20.5 % in 1g and ± 20.3 % in 10g.

Uncertainty component	Uncertainty Value (%)	Probability Distribution	Divisor	c_i (1g)	c_i (10g)	1g u_i (%)	10g u_i (%)
Measurement system							
Probe calibration	± 6.0	Normal	1	1	1	± 6.0	± 6.0
Probe calibration drift	± 5.0	Rectangular	2√3	1	1	± 1.4	± 1.4
Axial isotropy	± 4.7	Rectangular	√3	1	1	± 2.7	± 2.7
Hemispherical isotropy	± 9.6	Rectangular	√3	0	0	± 0.0	± 0.0
Boundary effect	± 1.0	Rectangular	√3	1	1	± 0.6	± 0.6
Linearity	± 4.7	Rectangular	√3	1	1	± 2.7	± 2.7
System detection limits	± 1.0	Rectangular	√3	1	1	± 0.6	± 0.6
Modulation response	± 0.0	Rectangular	√3	1	1	± 0.0	± 0.0
Readout electronics	± 0.3	Normal	1	1	1	± 0.3	± 0.3
Response time (CW)	± 0.0	Rectangular	√3	1	1	± 0.0	± 0.0
Integration time	± 0.0	Rectangular	√3	1	1	± 0.0	± 0.0
RF ambient conditions - noise	± 1.0	Rectangular	√3	1	1	± 0.6	± 0.6
RF ambient conditions - reflections	± 1.0	Rectangular	√3	1	1	± 0.6	± 0.6
Probe positioner mechanical tolerance	± 0.4	Rectangular	√3	1	1	± 0.2	± 0.2
Probe positioning with respect to phantom shell	± 2.9	Rectangular	√3	1	1	± 1.7	± 1.7
Extrapolation, interpolation and integration algorithms for max. SAR evaluation	± 2.0	Rectangular	√3	1	1	± 1.2	± 1.2
System validation source							
Deviation of experimental source from numerical source	± 4.0	Normal	1	1	1	± 4.0	± 4.0
Input power and SAR drift measurement	± 3.4	Rectangular	√3	1	1	± 2.0	± 2.0
Other source contributions	± 2.0	Normal	1	1	1	± 2.0	± 2.0
Phantom and tissue parameters							
Phantom shell uncertainty – shape, thickness and permittivity	± 6.1	Rectangular	√3	1	1	± 3.5	± 3.5
Uncertainty in SAR correction for deviations in permittivity and conductivity	± 1.9	Normal	1	1	0.84	± 1.9	± 1.6
Liquid conductivity measurement	± 2.5	Normal	1	0.78	0.71	± 2.0	± 1.8
Liquid permittivity measurement	± 2.5	Normal	1	0.23	0.26	± 0.6	± 0.7
Liquid conductivity – temperature uncertainty	± 2.8	Rectangular	√3	0.78	0.71	± 1.3	± 1.2
Liquid permittivity – temperature uncertainty	± 1.9	Rectangular	√3	0.23	0.26	± 0.3	± 0.3
Combined standard uncertainty						± 10.2	± 10.1
Expanded uncertainty (95% confidence interval)						± 20.5	± 20.3

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 2 mm away from the probe tip. During measurements, the dipole sensors are 3 mm 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 measured.

Standard: Wi-Fi (802.11 b/g/n)
Crest factor: 1
Test program: supplied by the applicant
Max output power:

802.11 b				
Frequency (MHz)	**Conducted power (dBm)**			
	1 Mbps	**2 Mbps**	**5.5 Mbps**	**11 Mbps**
2412	21.98	22.46	22.44	**22.47**
2442	22.05	22.58	22.57	**22.62**
2462	22.03	22.41	22.42	**22.44**

802.11 g								
Frequency (MHz)	**Conducted power (dBm)**							
	6 Mbps	**9 Mbps**	**12 Mbps**	**18 Mbps**	**24 Mbps**	**36 Mbps**	**48 Mbps**	**54 Mbps**
2412 (1)	24.31	**24.35**	24.13	24.02	24.22	24.06	23.94	23.51
2412 (2)	**25.43**	25.42	25.16	25.09	25.34	25.15	25.07	24.68
2442 (1)	24.30	**24.34**	24.09	23.99	24.17	24.02	23.89	23.31
2442 (2)	**25.60**	25.59	25.32	25.21	25.48	25.27	25.20	24.71
2462 (1)	**24.02**	23.99	23.79	23.70	23.92	23.82	23.64	23.18
2462 (2)	**25.51**	**25.51**	25.30	25.20	25.42	25.21	25.12	24.70

802.11 n								
Frequency (MHz)	**Conducted power (dBm)**							
	6.5Mbps	**13 Mbps**	**19.5Mbps**	**26 Mbps**	**39 Mbps**	**52 Mbps**	**58.5Mbps**	**65 Mbps**
2412 (1)	24.29	**24.33**	24.10	24.18	24.14	24.09	23.44	22.57
2412 (2)	**25.43**	25.41	25.14	25.33	25.16	25.11	24.80	23.96
2442 (1)	**24.25**	**24.25**	24.04	24.07	24.01	24.02	23.36	22.47
2442 (2)	**25.56**	25.55	25.21	25.45	25.27	25.28	24.87	23.96
2462 (1)	**24.07**	24.05	23.75	23.86	23.80	23.68	23.02	22.24
2462 (2)	25.51	**25.57**	25.18	25.40	25.18	25.24	24.85	23.95

Note: (1) and (2) are RF paths measured at J102 and J103.

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. 4 shows the system.

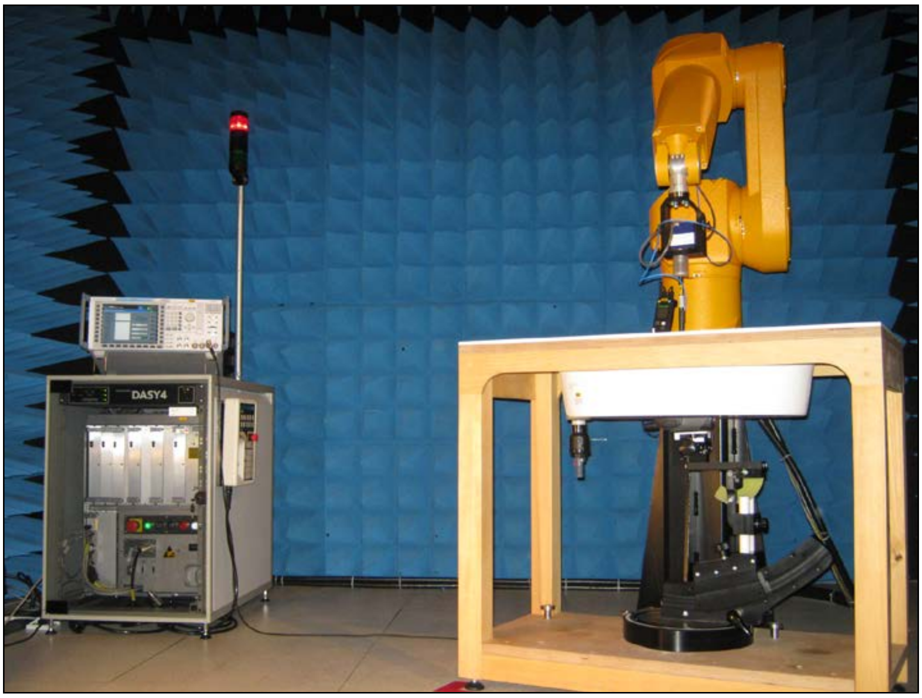


Fig. 4: The measurement setup with equipment under test.

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 %

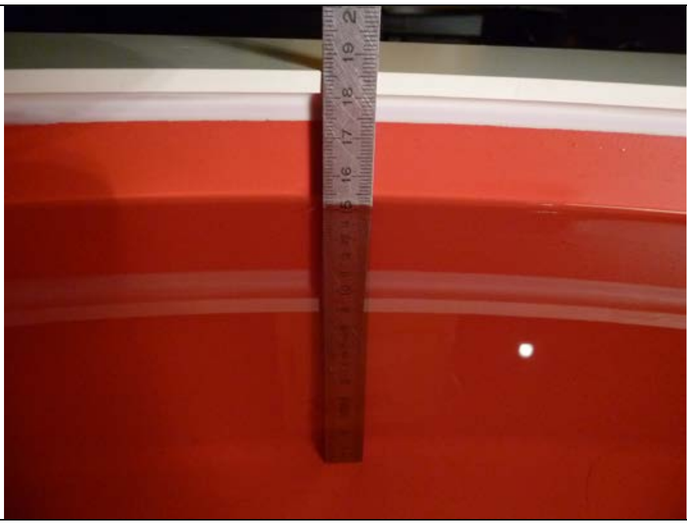
The dielectric parameters of the liquid were controlled prior to assessment (contact probe method).

Dielectric properties measured (Meas. Date: June 14, 2016):

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)
2410	52.8 ± 5 %	50.9	1.91 ± 5 %	1.95	23.0	22.5
2440	52.7 ± 5 %	50.9	1.94 ± 5 %	1.98		
2450	52.7 ± 5 %	50.9	1.95 ± 5 %	1.99		
2460	52.7 ± 5 %	50.8	1.96 ± 5 %	2.00		

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

The liquid depth measured in the phantom was 15.2cm as shown in the attached photograph.



15. SYSTEM CHECK: TEST CONDITIONS & RESULTS

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

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

Measurement results: The results are hereafter below and shown in Fig. 5.

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	Meas. date
2450	12.8 ± 10%	12.4	5.925 ± 10%	5.72	June 14, 2016

DUT: Dipole 2450 MHz

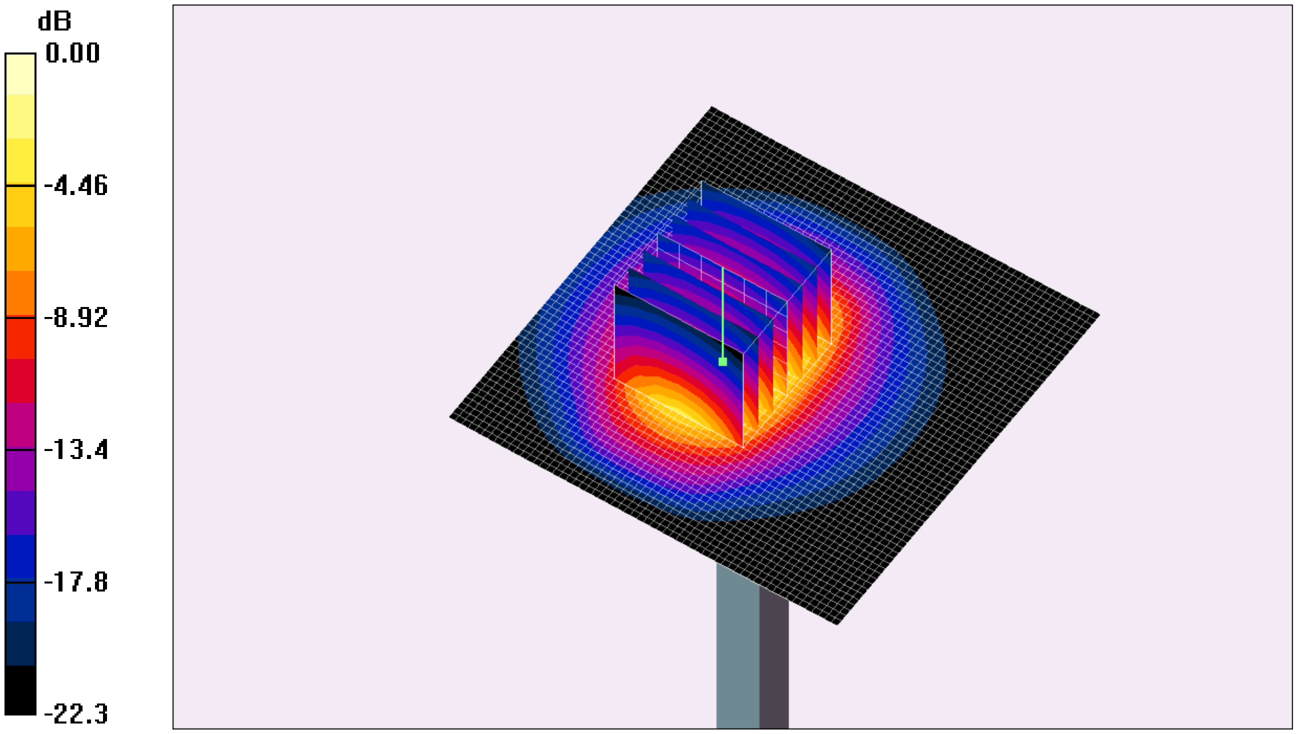
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 1.99 mho/m, ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.5°C, Liquid temperature: 23.1°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.31, 4.31, 4.31); Calibrated: 8/21/2015
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/13/2015
- 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) = 18.0 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.7 V/m; Power Drift = -0.011 dB
Peak SAR (extrapolated) = 26.1 W/kg
SAR(1 g) = 12.4 mW/g; SAR(10 g) = 5.72 mW/g
Maximum value of SAR (measured) = 16.3 mW/g



0 dB = 16.3mW/g

Fig. 5: 2450MHz system check result

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

ANNEX 1: ES3DV3 CALIBRATION CERTIFICATE

ANNEX 2: DAE3 CALIBRATION CERTIFICATE

ANNEX 3: D2450V2 CALIBRATION CERTIFICATE

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

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

Certificate No: ES3-3303_Aug15

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3303

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: August 21, 2015

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	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
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-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 22, 2015

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).

Probe ES3DV3

SN:3303

Manufactured: August 27, 2010
Calibrated: August 21, 2015

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]	1.37	1.39	1.40	± 10.1 %
DCP (mV)[B]	102.8	103.6	101.8	

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	224.5	±3.5 %
		Y	0.0	0.0	1.0		223.7	
		Z	0.0	0.0	1.0		221.8	

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: 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 [G]	Depth [G] (mm)	Unc (k=2)
450	43.5	0.87	6.87	6.87	6.87	0.18	2.20	± 13.3 %
750	41.9	0.89	6.41	6.41	6.41	0.43	1.60	± 12.0 %
900	41.5	0.97	6.12	6.12	6.12	0.74	1.22	± 12.0 %
1810	40.0	1.40	5.04	5.04	5.04	0.80	1.16	± 12.0 %
1950	40.0	1.40	4.91	4.91	4.91	0.60	1.34	± 12.0 %
2150	39.7	1.53	4.84	4.84	4.84	0.64	1.41	± 12.0 %
2300	39.5	1.67	4.78	4.78	4.78	0.67	1.41	± 12.0 %
2450	39.2	1.80	4.45	4.45	4.45	0.80	1.26	± 12.0 %
2600	39.0	1.96	4.39	4.39	4.39	0.80	1.29	± 12.0 %

[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.

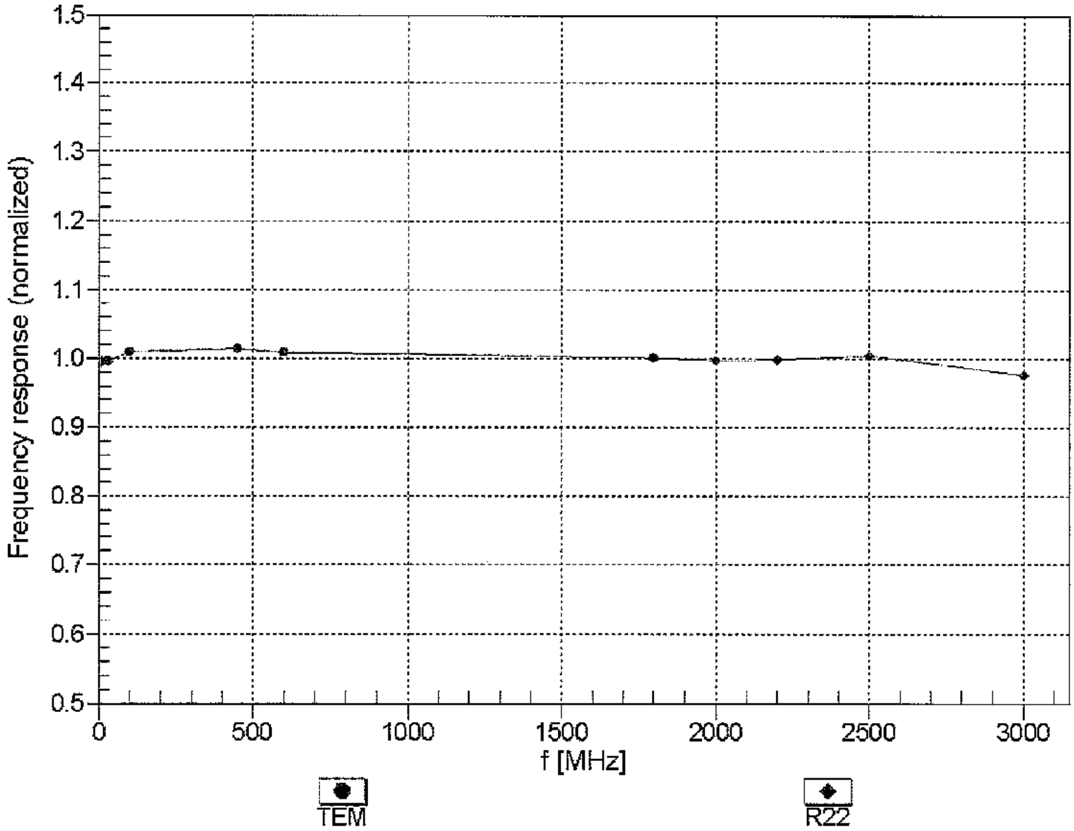
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3303

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 [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	6.08	6.08	6.08	0.55	1.35	± 12.0 %
900	55.0	1.05	5.92	5.92	5.92	0.61	1.30	± 12.0 %
1810	53.3	1.52	4.76	4.76	4.76	0.68	1.34	± 12.0 %
2000	53.3	1.52	4.79	4.79	4.79	0.63	1.38	± 12.0 %
2450	52.7	1.95	4.31	4.31	4.31	0.80	1.17	± 12.0 %

[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.

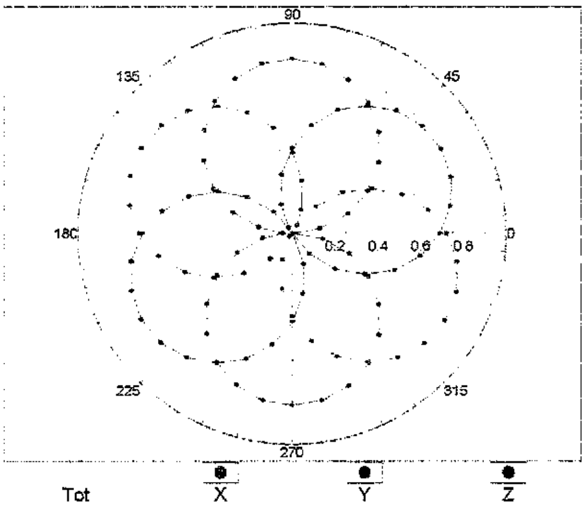
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



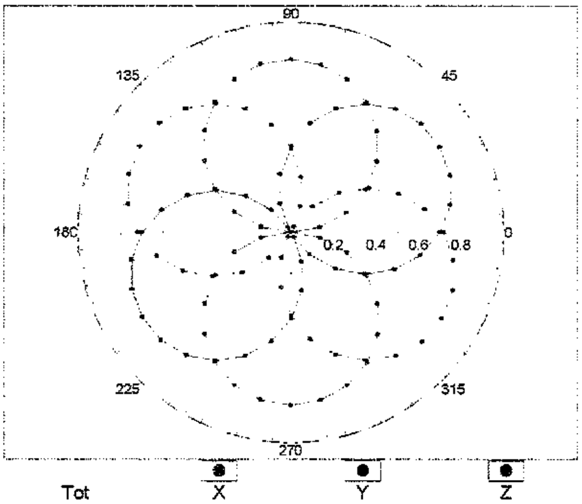
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

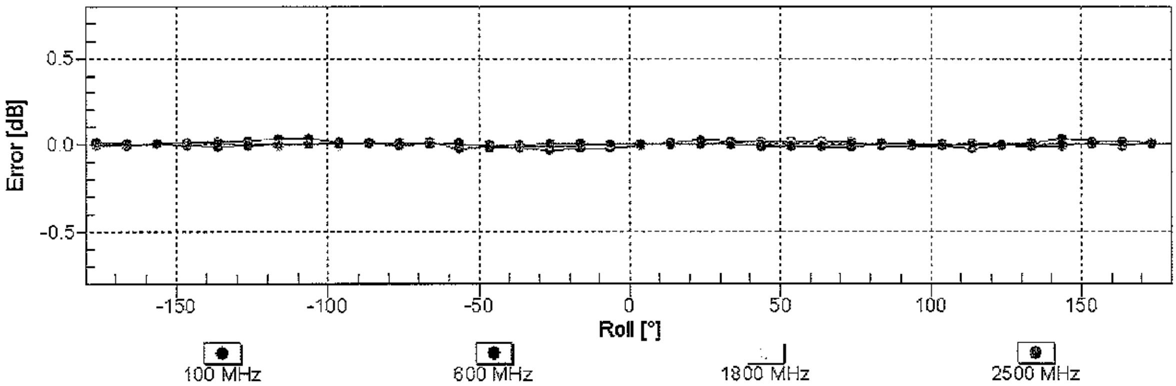
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



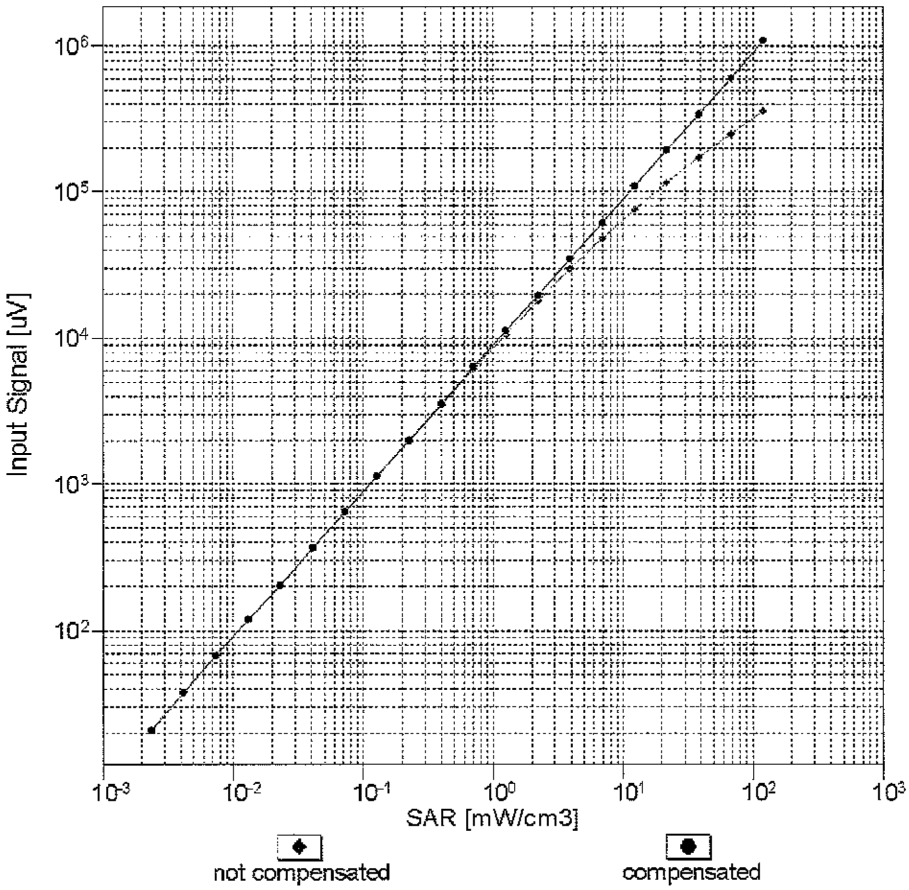
f=1800 MHz,R22

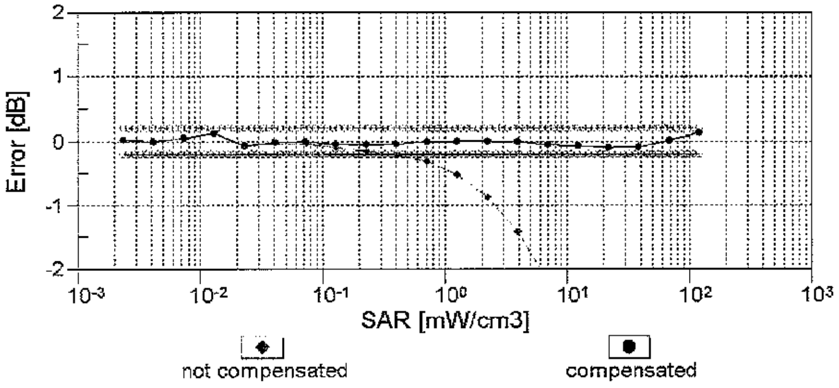




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)
(TEM cell , f_{eval}= 1900 MHz)

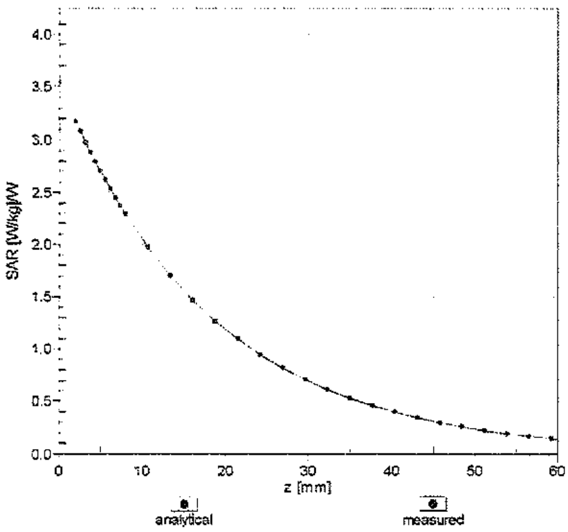




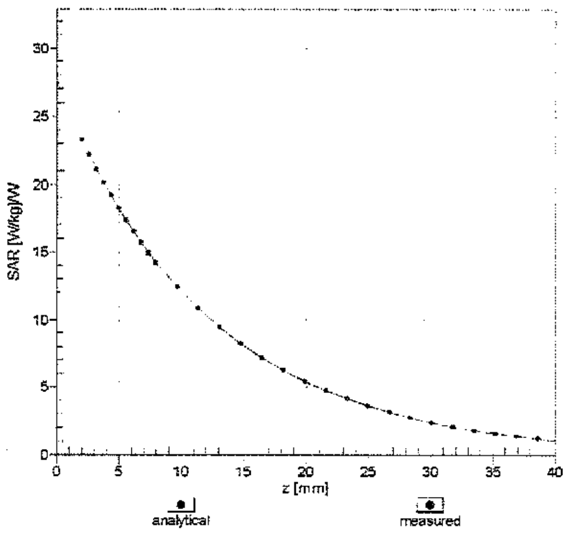
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

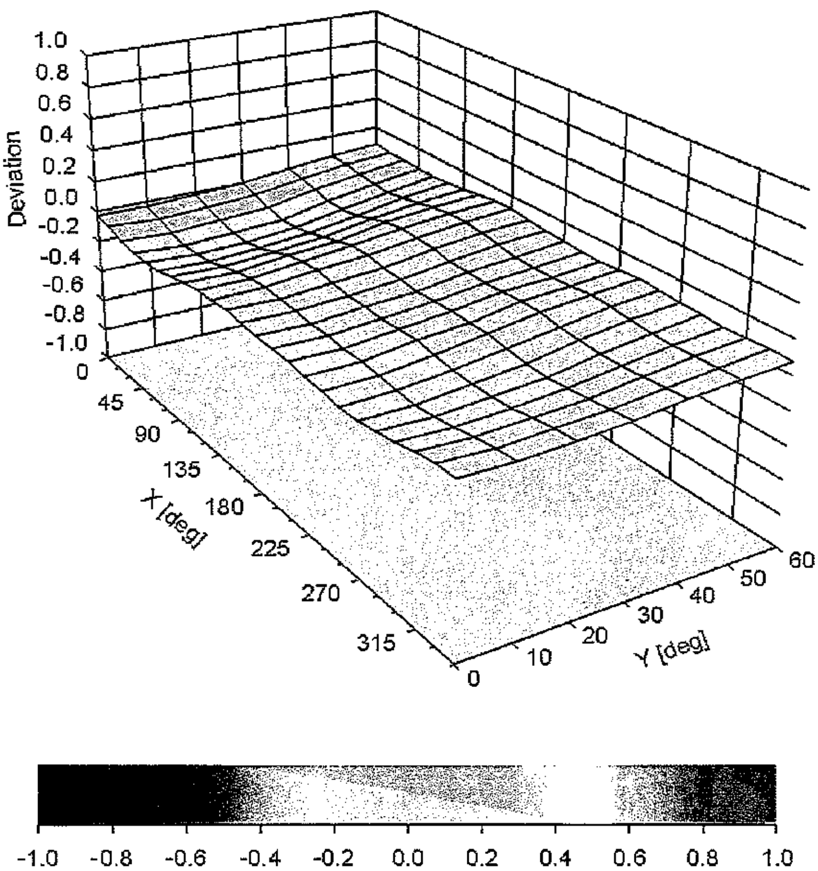


f = 1810 MHz,WGLS R22 (H_convF)



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 (°)	43.6
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

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

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
Servizio svizzero di taratura
S **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 **EMITECH Le Mans**

Certificate No: DAE3-402_Aug15

CALIBRATION CERTIFICATE

Object: DAE3 - SD 000 D03 AA - SN: 402

Calibration procedure(s): QA CAL-06.v29
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: August 13, 2015

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	03-Oct-14 (No:15573)	Oct-15
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	06-Jan-15 (in house check)	In house check: Jan-16
Calibrator Box V2.1	SE UMS 006 AA 1002	06-Jan-15 (in house check)	In house check: Jan-16

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

Issued: August 13, 2015

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	403.413 ± 0.02% (k=2)	403.326 ± 0.02% (k=2)	403.896 ± 0.02% (k=2)
Low Range	3.93614 ± 1.50% (k=2)	3.96076 ± 1.50% (k=2)	3.96564 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	241.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199996.18	-0.02	-0.00
Channel X	+ Input	20009.97	8.77	0.04
Channel X	- Input	-19995.07	5.69	-0.03
Channel Y	+ Input	199997.64	1.44	0.00
Channel Y	+ Input	20004.89	3.55	0.02
Channel Y	- Input	-19999.87	0.79	-0.00
Channel Z	+ Input	199998.51	2.21	0.00
Channel Z	+ Input	19999.97	-1.22	-0.01
Channel Z	- Input	-20008.99	-8.17	0.04

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.59	0.48	0.02
Channel X	+ Input	202.20	0.78	0.39
Channel X	- Input	-198.38	0.07	-0.04
Channel Y	+ Input	2001.14	0.02	0.00
Channel Y	+ Input	201.19	-0.32	-0.16
Channel Y	- Input	-198.67	-0.33	0.16
Channel Z	+ Input	2000.93	-0.11	-0.01
Channel Z	+ Input	200.68	-0.72	-0.36
Channel Z	- Input	-199.16	-0.70	0.35

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	7.13	5.00
	- 200	-4.05	-6.00
Channel Y	200	-1.18	-1.41
	- 200	1.18	0.70
Channel Z	200	0.83	0.82
	- 200	-2.48	-2.76

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	-	3.34	-2.47
Channel Y	200	7.78	-	4.22
Channel Z	200	8.29	5.64	-

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	16293	16445
Channel Y	15883	16533
Channel Z	16454	17086

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	0.66	-0.12	1.39	0.34
Channel Y	-0.21	-1.54	0.97	0.32
Channel Z	-0.29	-1.16	0.86	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

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: June 16, 2016

Operator: Emmanuel TOUTAIN

Calibration procedure: PRTFIC000MET00050

Environnemental conditions :
Ambient Temperature: 23.1°C
Liquid Temperature: 22.8°C
Hygrometry: 33% HR

Equipment used:

EMITECH N°	DESIGNATION	BRAND	TYPE	CALIBRATION PERIODICITY	CALIBRATION DUE DATE
1402	Network Analyser	Hewlett Packard	8753C	12 months	Jul. 07, 2016
7217	Calibration kit	Hewlett Packard	85033D	24 months	Jul. 07, 2016

Liquid measurements:

Frequency (MHz)	Liquid : Head		Liquid : Body (1)	
	Sigma	Epsilon	Sigma	Epsilon
2450	-	-	1.99	51.4

Note (1): dielectric properties according to KDB865664, A.1. Tissue Dielectric Parameters

Return loss measurements:

Dipole	Frequency (MHz)	Liquid : Head		Liquid : Body	
		Return loss (dB)	Verdict (2) ≤ -20dB	Return loss (dB)	Verdict (2) ≤ -20dB
D2450V2	2450	-	-	-27.5	**PASS**

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

Conclusion: In Tolerance

Visa:

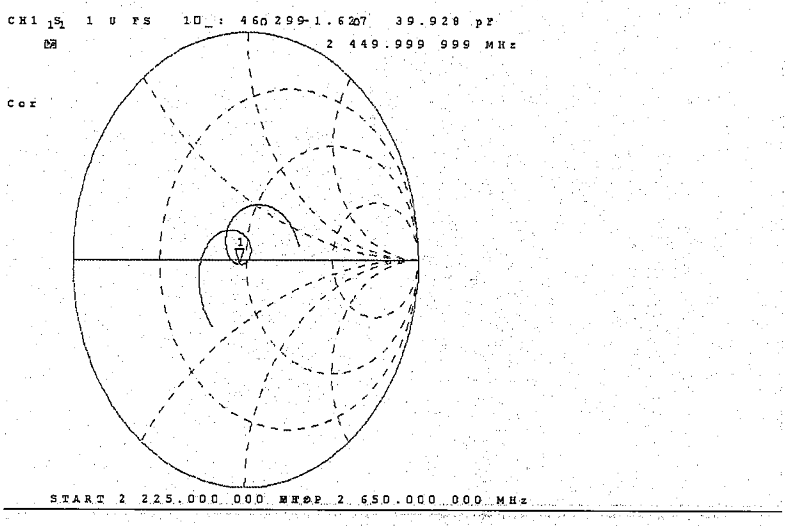
SAR measurements:

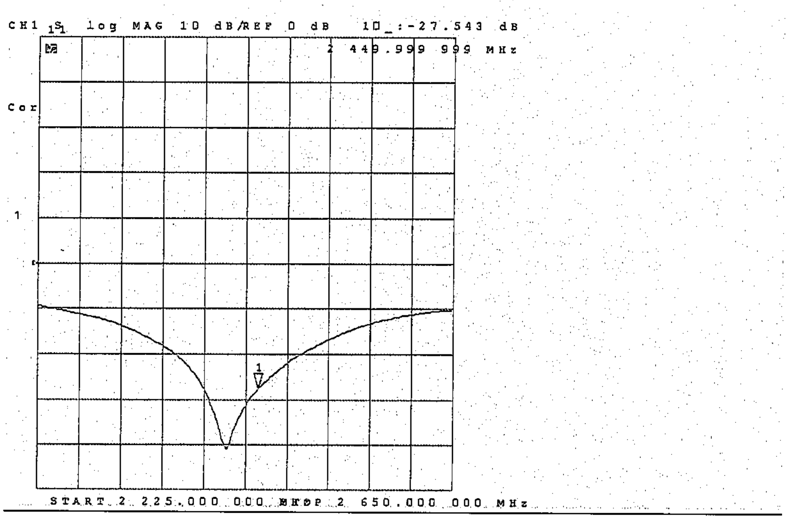
2450MHz at 10mm	Liquid : Head		Liquid : Body	
	SAR1g (W/kg)	SAR10g (W/kg)	SAR1g (W/kg)	SAR10g (W/kg)
SAR measured (Pin = 250mW)	-	-	12.5	5.81
SAR normalized to 1 W	-	-	50.0	23.24

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

Impedance measurement:

Impedance	46.3 Ω - 1.6 jΩ





DUT: Dipole 2450 MHz

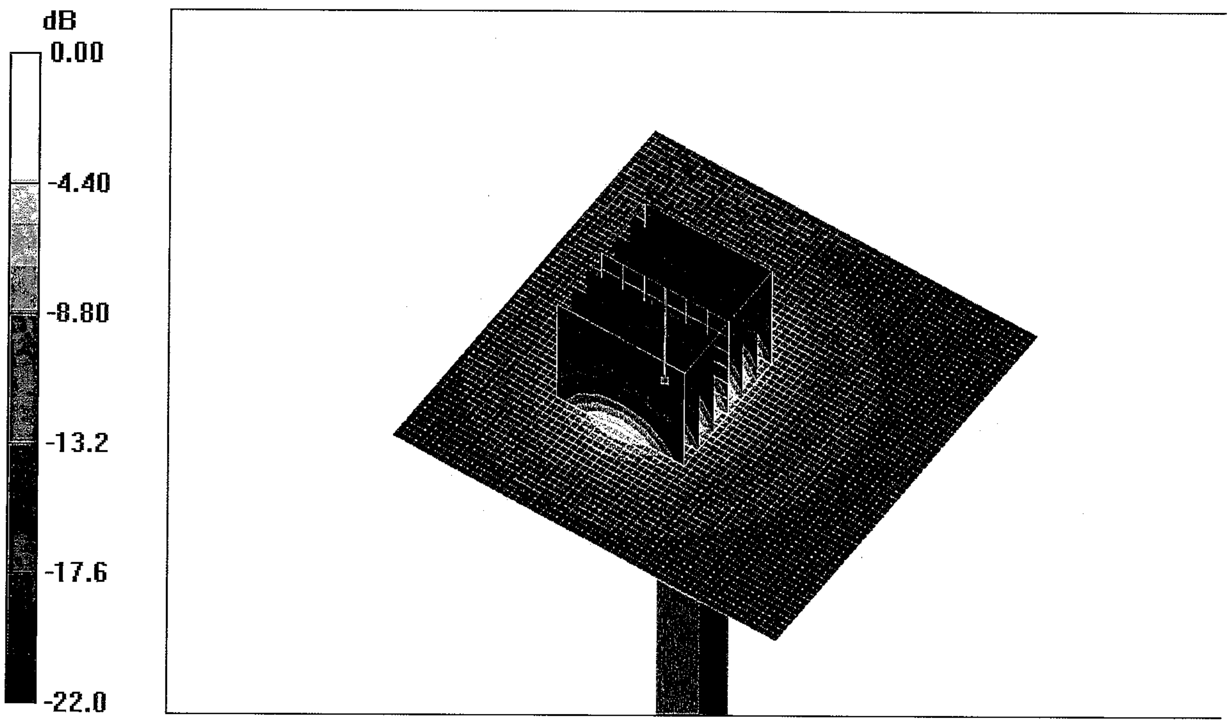
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium parameters used: $\sigma = 1.99$ mho/m, $\varepsilon_r = 51.4$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.3°C, Liquid temperature: 22.9°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(4.31, 4.31, 4.31); Calibrated: 8/21/2015
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/13/2015
- 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) = 18.1 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.1 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 26.0 W/kg
SAR(1 g) = 12.5 mW/g; SAR(10 g) = 5.81 mW/g
Maximum value of SAR (measured) = 16.3 mW/g



0 dB = 16.3mW/g