EMITECH

RE051-18-100576-1-A Ed. 2

This report cancels and replaces the test report N°RE051-18-100576-1 Edition 1

SAR TEST REPORT

According to the standards:
FCC 47 CFR § 2.1093

Equipments under test:
Wireless intercom
APPI-COM LR

FCC ID: 2AG7HBSAPC2U01
IC: 21024-BSAPC2U01

Company:
APPI-TECHNOLOGY SAS

DISTRIBUTION: Mr. COULON **Company: APPI-TECHNOLOGY SAS**

Number of pages: 56 with 3 annexes

Ed.	Date	Modified page(s)	Technical Verification Name-function	Visa	Quality Approval Name-function	Visa
2	June 14, 2018	Identified by a vertical line	Gilles Hyaumet – SAR and EMC lab manager		Eric Coeuret –Technical director	

EQUIPMENTS UNDER TEST:	**Wireless intercom**
Model:	**APPI-COM LR**
Serial number (S/N):	Not identified
Hardware version:	R10D (according to the applicant)
Software version:	2.3 (according to the applicant)
MANUFACTURER:	APPI-TECHNOLOGY SAS
APPLICANT:	
Company:	APPI-TECHNOLOGY SAS
Address:	443 AVENUE JEAN PROUVÉ LE MINOTAURE 30900 NIMES FRANCE
Contact person:	Mr. J. CHAIX
Person(s) present(s) during the test:	-
DATE(S) OF TEST(S):	April 23 and 24, 2018
TEST SITE:	EMITECH ANGERS – MRA : FR00009 - IC : 4452A PA de Lanserre 21 rue de la Fuye 49610 Juigné-sur-Loire France
TESTS OPERATORS:	Antoine BOUCLEY and Gilles HYAUMET
TESTS TUTOR	Gilles HYAUMET

SUMMARY

1. INTRODUCTION

In this test report, Specific Absorption Rate (SAR) measurements for the wireless communication device APPI-COM LR are presented.

EUT, referenced BS-APC2U-0x/Bx, has been already tested according to the reference measurement with the integrated and external antennas.
The tested antennas and the results are listed in the test report N° RE051-16-103329-1-A Ed. 0 delivered by EMITECH

According to the applicant, 2 new references of external antenna have been added, with the increasing of the duration of the RF transmitting and FM deviation value.

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
FCC 47 CFR	§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices	2018
KDB 447498	D01 General RF Exposure Guidance v06	2015
KDB 447498	D03 Supplement C Cross-Reference v01	2014
IEEE Std C95.1a	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. Amendment 1: Specifes Ceiling Limits for Induced and Contact Current, Clarifes Distinctions between Localized Exposure and Spatial Peak Power Density	2010
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

3. PRESENTATION OF EQUIPMENT FOR TESTING PURPOSES

The wireless communication device uses the frequency band 915MHz and is shown in Fig. 1a to Fig. 1c.

Antenna	Half wave	Half wave
Model	DELTA 6A	463 MODEL
Manufacturer	SIRETTA	NEARSON
Gain	4.05 dBi	2.0 dBi
See Fig.	1.b	1.c
APPi-COM type	BS-APC2U-X4	BS-APC2U-X5

EUT is intended to be inserted into a protective cover (rubber cover or an attachment clip allowing separation distance of 5mm to the body) to be used with the neck strap so that its rear side is facing the body of the user as defined by the applicant (using based on the test report N° RE051-16-103329-1-A Ed. 0)

As specified in the user guide (Version 2.0), APPI-COM must be used with the provided Clip or Rubber cover, allowing a minimum distance of 5 mm with the body. (Using based on the test report N° RE051-16-103329-1-A Ed. 0)

For the present measurements, Clip or Rubber cover were not used.

Note: the external antennas are non-detachable as defined by the applicant for the end-users (using based on the test report N° RE051-16-103329-1-A Ed. 0). For this testing purpose, the 2 external antennas were removable and tested on the same sample.

Front and rear sides

Internal views

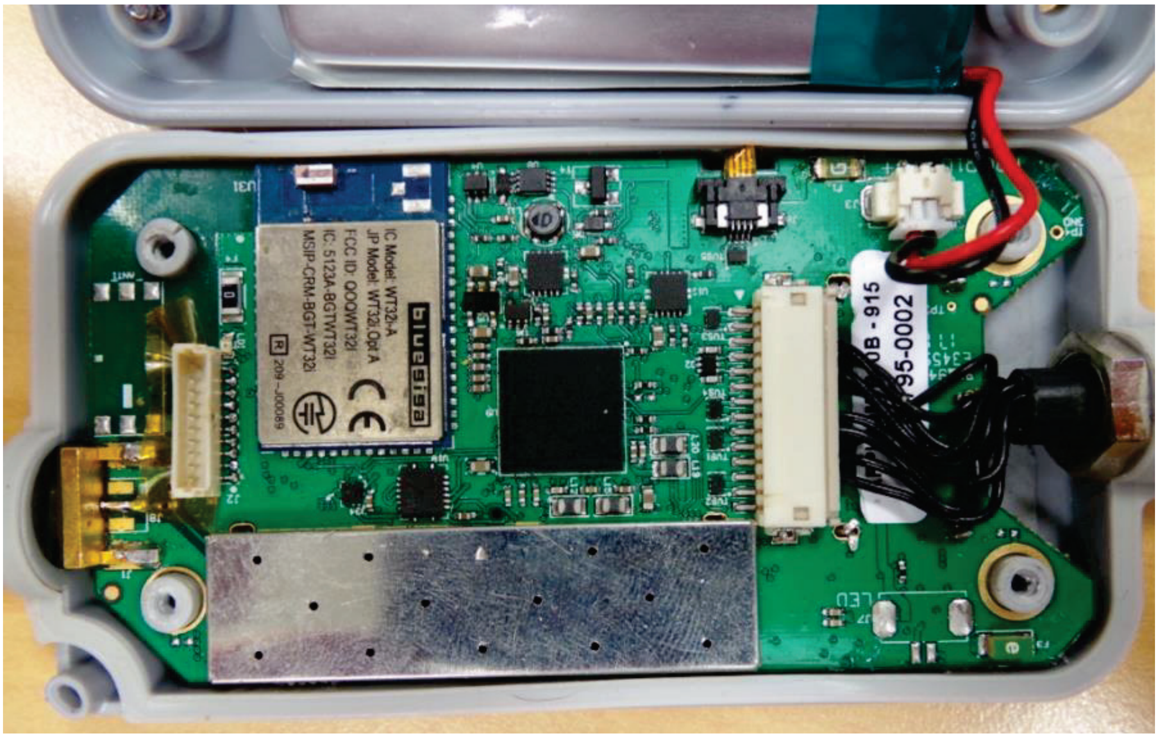
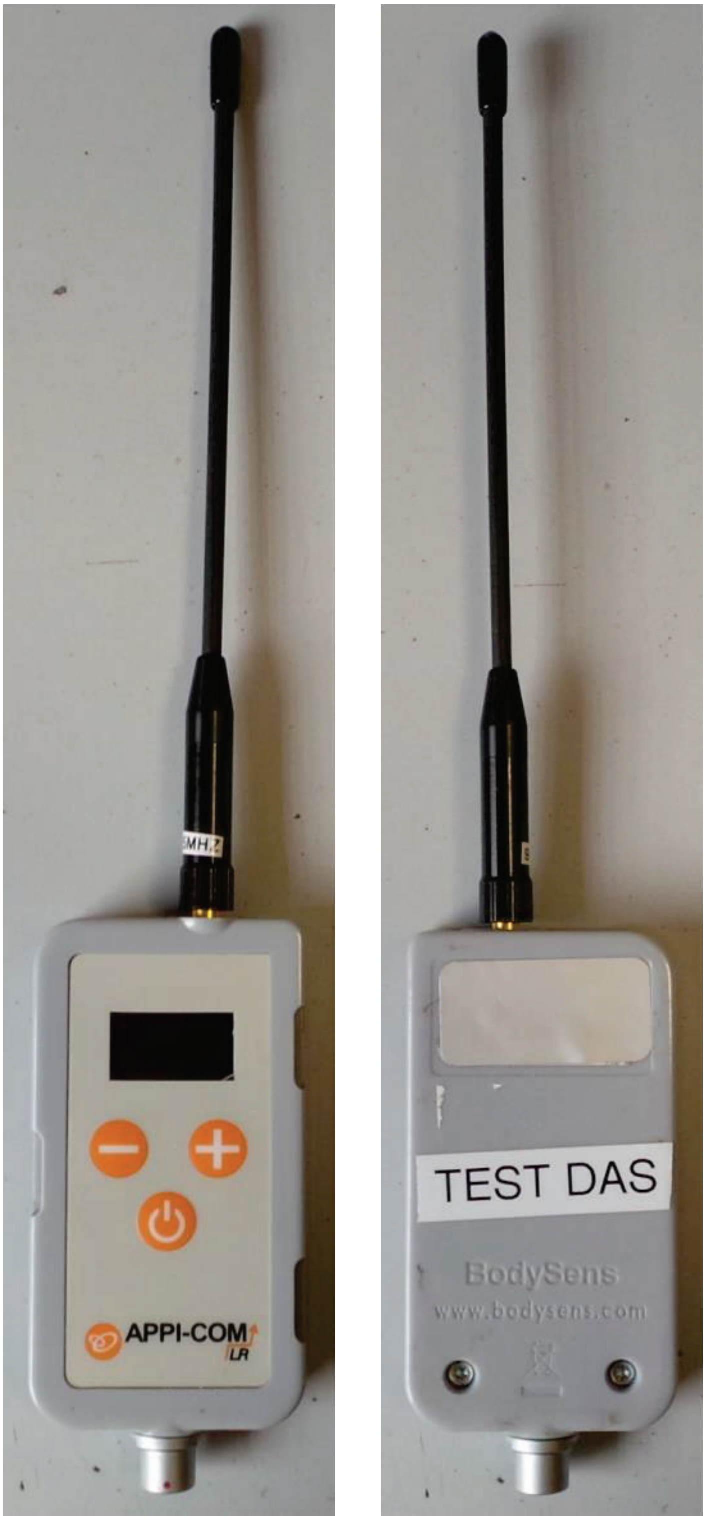


Fig. 1a: APPI-COM without antenna

Front and rear sides

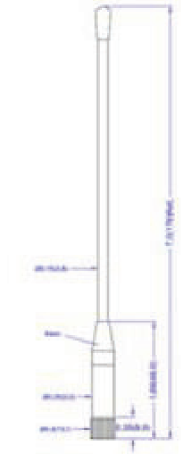
Fig. 1b: APPI-COM with SIRETTA antenna



Front and rear sides

Fig. 1c: APPI-COM with NEARSON antenna

Specifications of the tested antenna, provided by the applicant:

Antenna	Half wave	Half wave
Model	s463xxx-915	DELTA 6A
Manufac	NEARSON	SIRETTA
Gain	2	4,05
see fig		

4. TESTS RESULTS SUMMARY

Object	Respected Standard ? ≤ 1.6W/kg in 1 g ≤ 2W/kg in 10 g		Maximum SAR value measured) in 1g / in 10g (W/kg
	Yes	No	
EUT with SIRETTA antenna SAR measurements at 0 mm from the body	X		0.606 / 0.372
EUT with SIRETTA antenna SAR measurements at 5 mm from the body	X		0.421 / 0.279
EUT with NEARSON antenna SAR measurements at 0 mm from the body	X		0.502 / 0.308

Conclusion:

The sample APPI-COM, fitted with the referenced antennas submitted to test when worn at 0 mm from the body, is in conformity with the FCC Guidelines, for general population/uncontrolled exposure, according to FCC 47 CFR § 2.1093

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 – RF monitoring	8523	Spectrum analyzer	Rohde-Schwarz	FSEM30	Aug 25, 2016	Aug 25, 2018
	8524	Spectrum analyzer	Hewlett-Packard	8591EM	Apr 27, 2016	Apr 27, 2018
2 DASY4	7321	Software	Speag	DASY4	-	-
	9485	E-Field Probe	Speag	ES3DV3	Aug. 23, 16	Aug. 23, 18
	7192	Data acquisition	Speag	DAE3	Aug. 9, 16	Aug. 9, 18
	7194	Dipole 900MHz	Speag	D900V2	Oct 17, 16	Oct 17, 18
	7324	Phantom	Speag	ELI4	-	-
3 Liquid Measure	-	Software	Hewlett-Packard	HP85070C	-	-
	1402	Network analyzer	Hewlett-Packard	HP8753C	Jan 03, 18	Jan 03, 19
	9777	S-Parameter	Hewlett-Packard	HP85047A	Jan 02, 18	Jan 02, 19
	7218	Dielectric probe	Hewlett-Packard	HP85070C	-	-
	6980	Thermometer	Testo	922	Mar. 11, 16	Mar.11, 18 (1)
4 System Validation	7215	Signal generator	Marconi	2024	Feb. 11, 16	Feb.11, 18 (2)
	7209	Amplifier	Mini-circuits	ZHL42	-	-
	7212	Power meter	Rohde-Schwarz	NRVS	Mar 02, 17	Mar 02, 19
	7211	Probe power meter	Rohde-Schwarz	NRV-Z31	Mar 02, 17	Mar 02, 19
	7035	Power meter	Rohde-Schwarz	NRVD	Jan 09, 17	Jan 09, 19
	7034	Probe power meter	Rohde-Schwarz	NRV-Z1	Jan 09, 17	Jan 09, 19
	7210	Coupler	MEB	RK100	Feb. 11, 16	Feb.11, 18 (2)
	7315	Attenuator	Radiall	R411810124 R411806124	Feb. 11, 16	Feb. 11, 18 (2)
	9161	50 ohms load	Diconex	17-0193	Feb. 11, 16	Feb. 11, 18 (2)

(1) validity date extended to 2 months
(2) under the derogation N° EQSDER000S5100085. Calibrated on Apr. 26, 2018.

Measuring equipment specifications:

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 batteries were provided by the manufacturer. The battery is fully charged before each measurement.

The output power and frequency are controlled using a spectrum analyzer. The wireless communication device was set by the applicant to transmit at its highest output peak power level.

The wireless communication was placed against the flat phantom at 0 mm with its rear side. The SAR test was performed for each antenna at the Low, Middle and High frequencies in order to find the worst case.

Then the measurements were repeated at 5 mm as specified in the user guide and in the KDB 447498 for the devices that are designed to operate on the body of users using a conservative minimum test separation distance ≤ 5 mm

Measurement results (SAR values averaged over a mass of 1g):

Configuration	Test Position	SAR 1g (W/kg) - Limit = 1.6 W/kg			Meas. date
		Low channel 903 MHz	Middle channel 915 MHz	High channel 927 MHz	
SIRETTA antenna 4.05dBi Short half wave	Rear side at 0mm	**0.606**	0.574	0.507	April 23, 2018
NEARSON antenna 2dBi Short half wave	Rear side at 0mm	0.397	0.489	0.502	April 24, 2018
SIRETTA antenna 4.05dBi Short half wave	Rear side at 5mm	0.421	0.343	0.251	April 24, 2018

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

Configuration	Test Position	SAR 10g (W/kg) - Limit = 2W/kg			Meas. date
		Low channel 903 MHz	Middle channel 915 MHz	High channel 927 MHz	
SIRETTA antenna 4.05dBi Short half wave	Rear side at 0mm	**0.372**	0.351	0.309	April 23, 2018
NEARSON antenna 2dBi Short half wave	Rear side at 0mm	0.247	0.303	0.308	April 24, 2018
SIRETTA antenna 4.05dBi Short half wave	Rear side at 5mm	0.279	0.225	0.166	April 24, 2018

Simultaneous transmission

The equipment under test is intended to operate simultaneously with 915MHz and Bluetooth.

As the present highest measured SAR value is significantly lower than the one listed in the test report N° RE051-16-103329-1-A Ed. 0, evaluation has not been done again for simultaneous RF transmissions.

The sum of 1g and 10g SAR of all simultaneously transmission mode (ISM 915 MHz and Bluetooth) is assessed within the SAR limit (≤ 1.6 W/kg – 1g, ≤ 2 W/kg - 10g).

8. GRAPHICAL REPRESENTATIONS OF THE COARSE SCAN

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

DUT: APPI-COM_SIRETTA

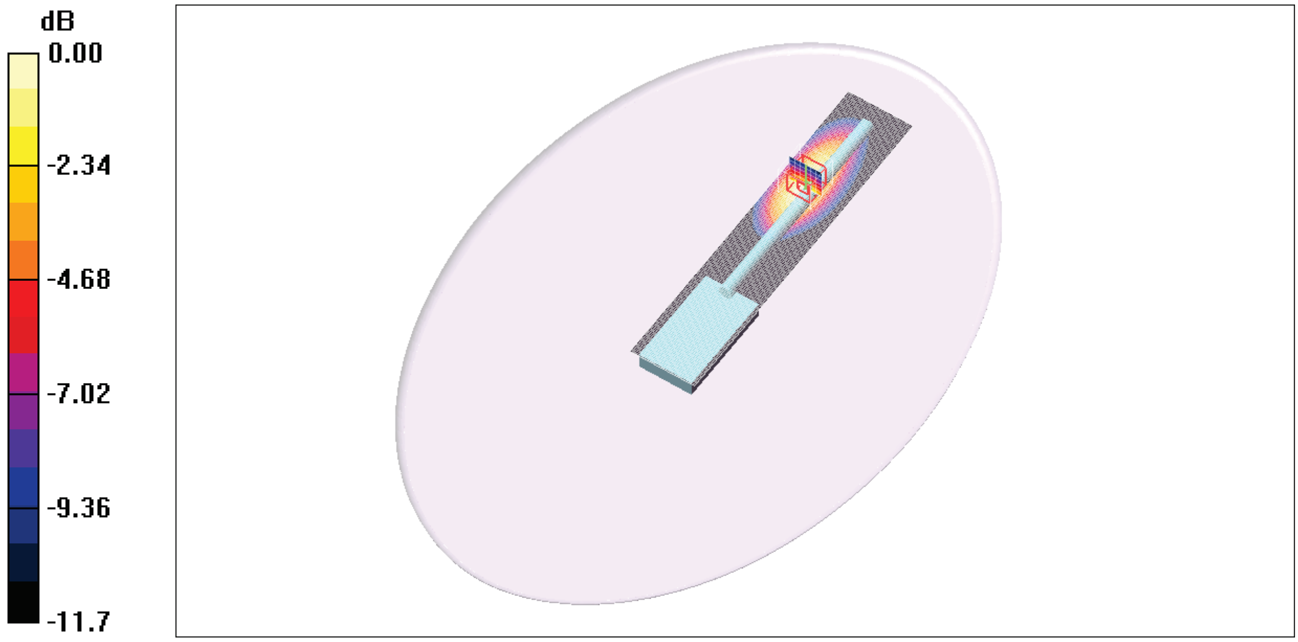
Communication System: APPI-COM; Frequency: 903 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.03001 mho/m, ε_r = 52.9798; ρ = 1000 kg/m³
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.6 °C, Liquid temperature: 22.0 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92)
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Low channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.692 mW/g

Position 0cm, Low channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.4 V/m; Power Drift = 0.024 dB
Peak SAR (extrapolated) = 0.978 W/kg
SAR(1 g) = 0.606 mW/g; SAR(10 g) = 0.372 mW/g
Maximum value of SAR (measured) = 0.724 mW/g



0 dB = 0.724mW/g

Fig. 2: SAR distribution for SIRRETA antenna, Low channel (903 MHz), rear side at 0 mm

DUT: APPI-COM_SIRETTA

Communication System: APPI-COM; Frequency: 915 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.0401 mho/m, ε_r = 52.8573; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.7 °C, Liquid temperature: 22 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92)
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.654 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x8x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.4 V/m; Power Drift = 0.052 dB
Peak SAR (extrapolated) = 0.935 W/kg
SAR(1 g) = 0.574 mW/g; SAR(10 g) = 0.351 mW/g
Maximum value of SAR (measured) = 0.692 mW/g

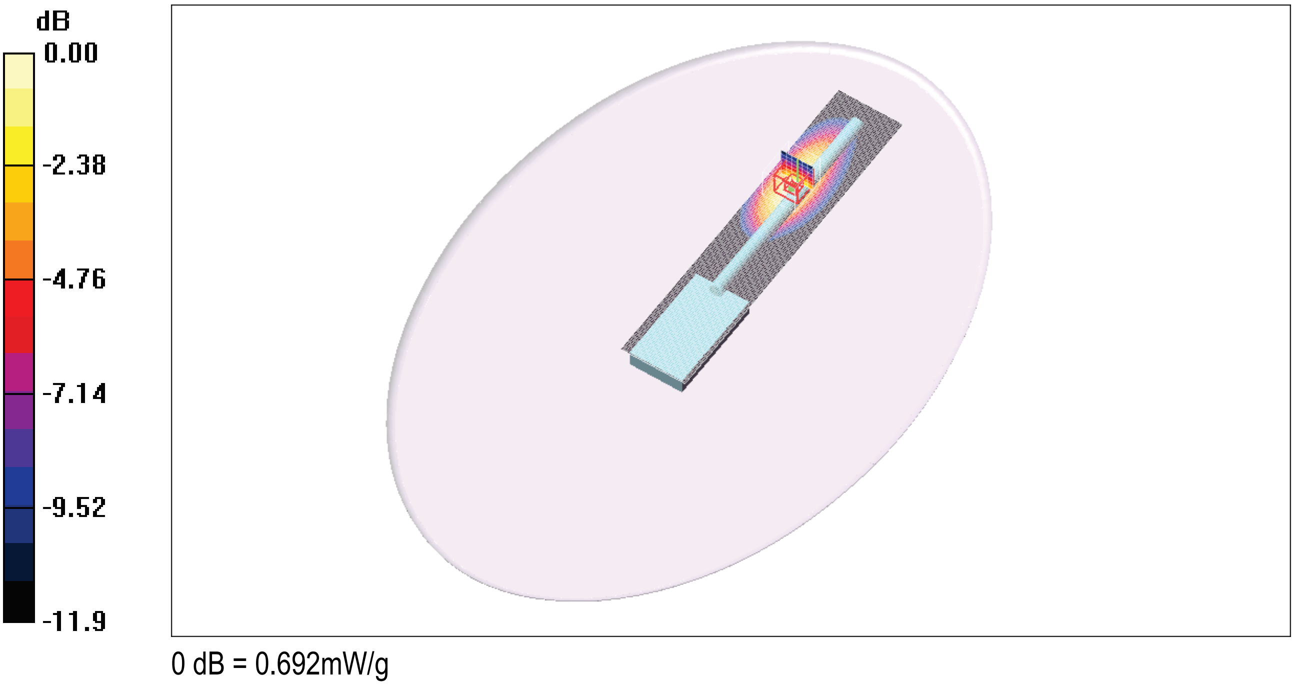


Fig. 3: SAR distribution for SIRRETA antenna, Middle channel (915 MHz), rear side at 0 mm

DUT: APPI-COM_SIRETTA

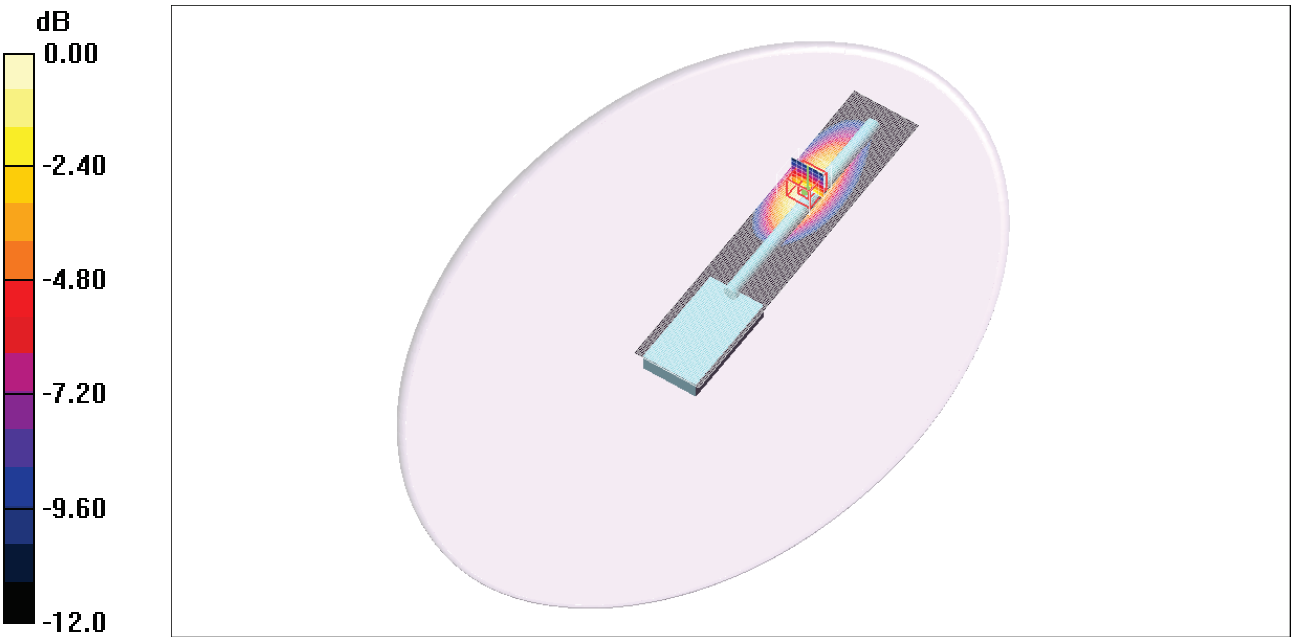
Communication System: APPI-COM; Frequency: 927 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.04865 mho/m, ε_r = 52.7221; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 21.2 °C, Liquid temperature: 21.3 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92)
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, High channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.583 mW/g

Position 0cm, High channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 19.8 V/m; Power Drift = 0.018 dB
Peak SAR (extrapolated) = 0.839 W/kg
SAR(1 g) = 0.507 mW/g; SAR(10 g) = 0.309 mW/g
Maximum value of SAR (measured) = 0.619 mW/g



0 dB = 0.619mW/g

Fig. 4: SAR distribution for SIRRETA antenna, High channel (927 MHz), rear side at 0 mm

DUT: APPI-COM_NEARSON

Communication System: APPI-COM; Frequency: 903 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.02157 mho/m, ε_r = 52.532; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.0 °C, Liquid temperature: 21.1 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92)
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Low channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.455 mW/g

Position 0cm, Low channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.3 V/m; Power Drift = -0.026 dB
Peak SAR (extrapolated) = 0.635 W/kg
SAR(1 g) = 0.397 mW/g; SAR(10 g) = 0.247 mW/g
Maximum value of SAR (measured) = 0.477 mW/g

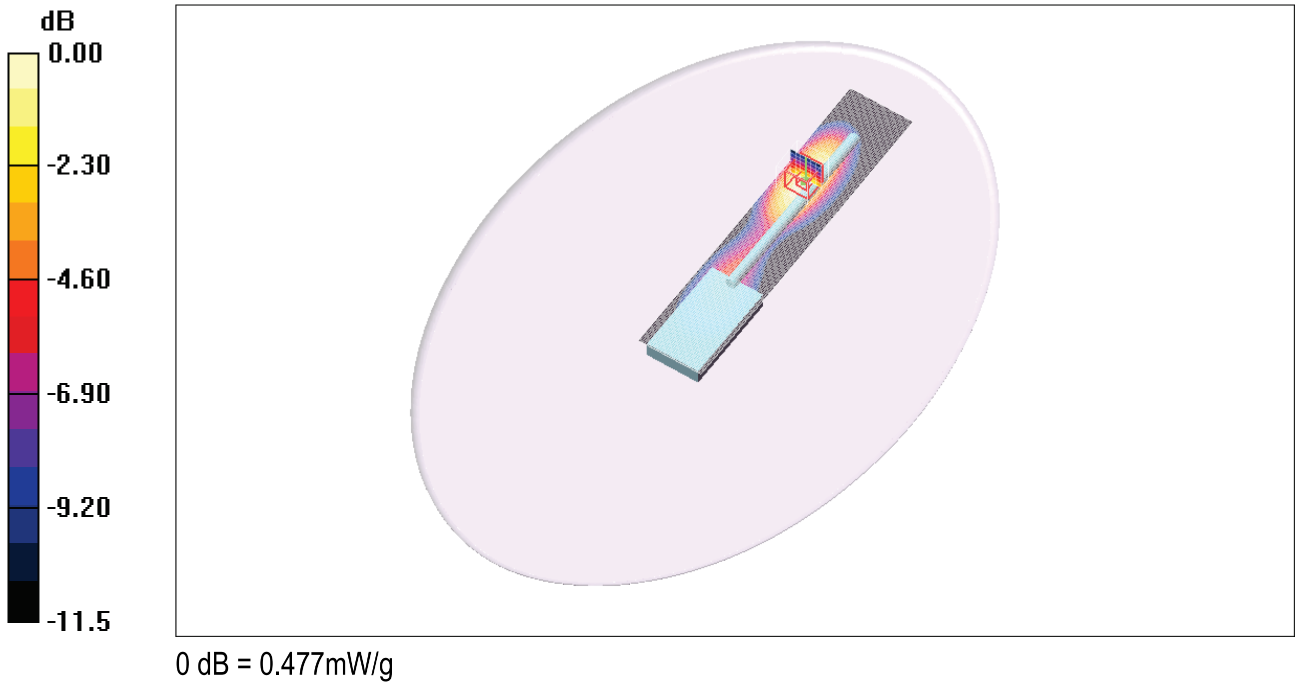


Fig. 5: SAR distribution for NEARSON antenna, Low channel (903 MHz), rear side at 0 mm

DUT: APPI-COM_NEARSON

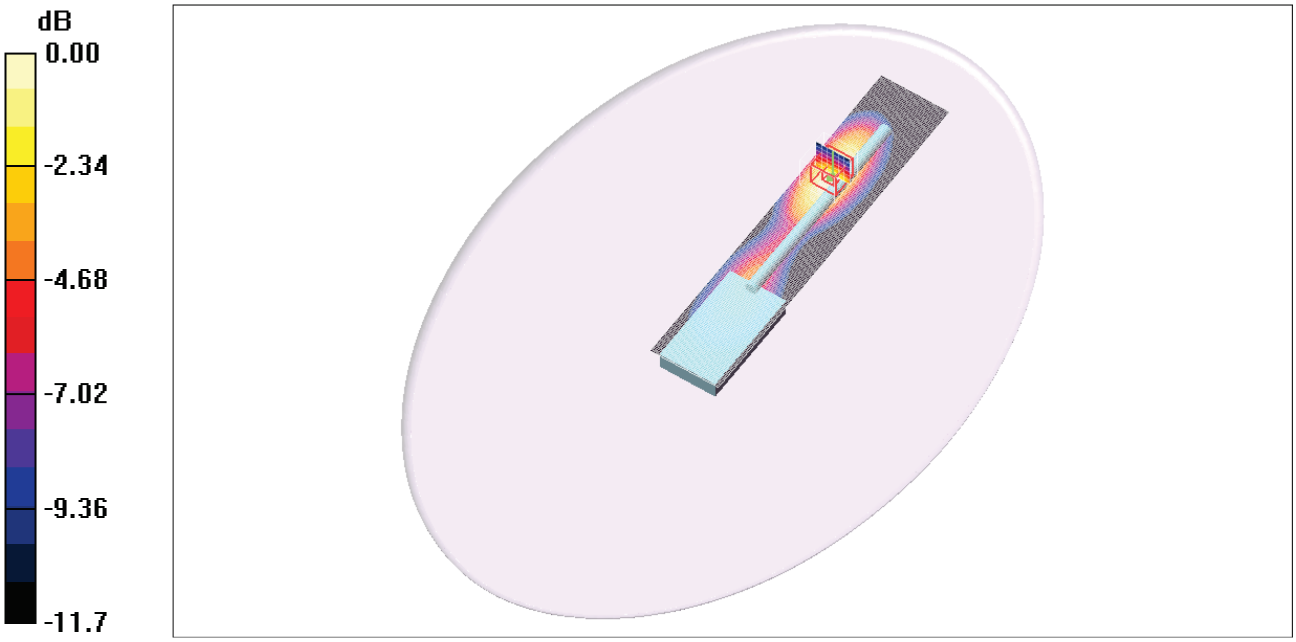
Communication System: APPI-COM; Frequency: 915 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.03373 mho/m, ε_r = 52.4694; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 22.1 °C, Liquid temperature: 21.1 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92)
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, Middle channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.565 mW/g

Position 0cm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.6 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.780 W/kg
SAR(1 g) = 0.489 mW/g; SAR(10 g) = 0.303 mW/g
Maximum value of SAR (measured) = 0.588 mW/g



0 dB = 0.588mW/g

Fig. 6: SAR distribution for NEARSON antenna, Middle channel (915 MHz), rear side at 0 mm

DUT: APPI-COM_NEARSON

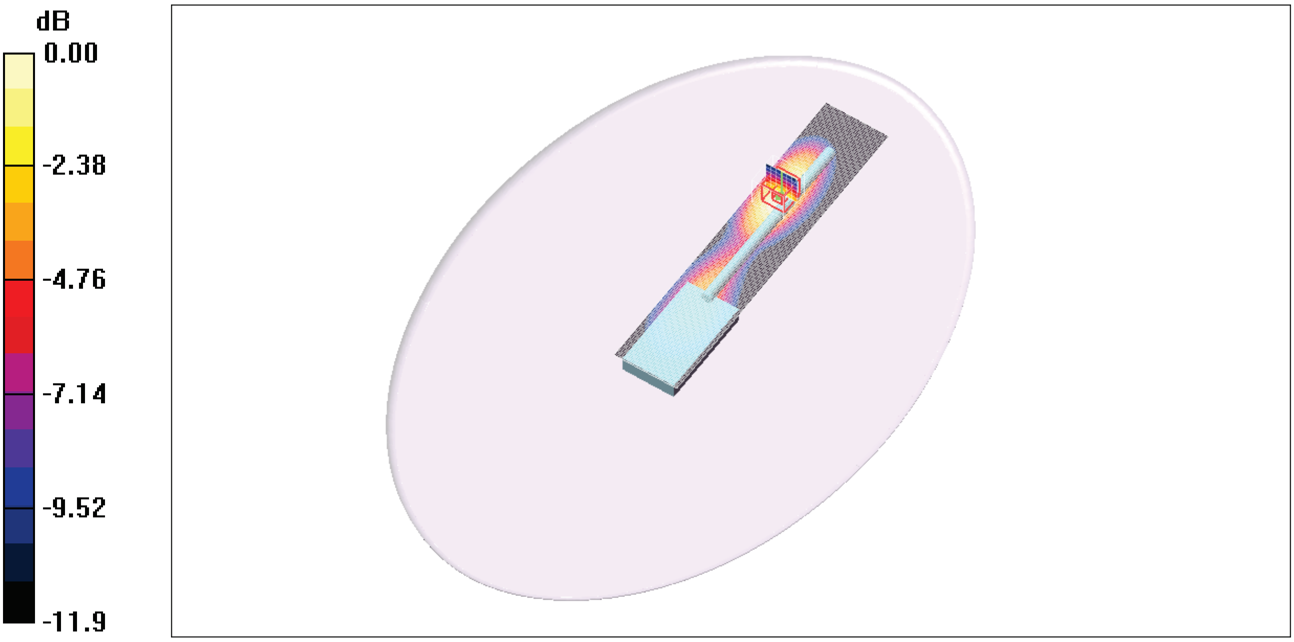
Communication System: APPI-COM; Frequency: 927 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.04425 mho/m, ε_r = 52.4234; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 21.6 °C, Liquid temperature: 21.1 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92); Calibrated: 8/21/2015
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/13/2015
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 0cm, High channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.591 mW/g

Position 0cm, High channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.8 V/m; Power Drift = -0.189 dB
Peak SAR (extrapolated) = 0.817 W/kg
SAR(1 g) = 0.502 mW/g; SAR(10 g) = 0.308 mW/g
Maximum value of SAR (measured) = 0.606 mW/g



0 dB = 0.606mW/g

Fig. 7: SAR distribution for NEARSON antenna, High channel (927 MHz), rear side at 0 mm

DUT: APPI-COM_SIRETTA

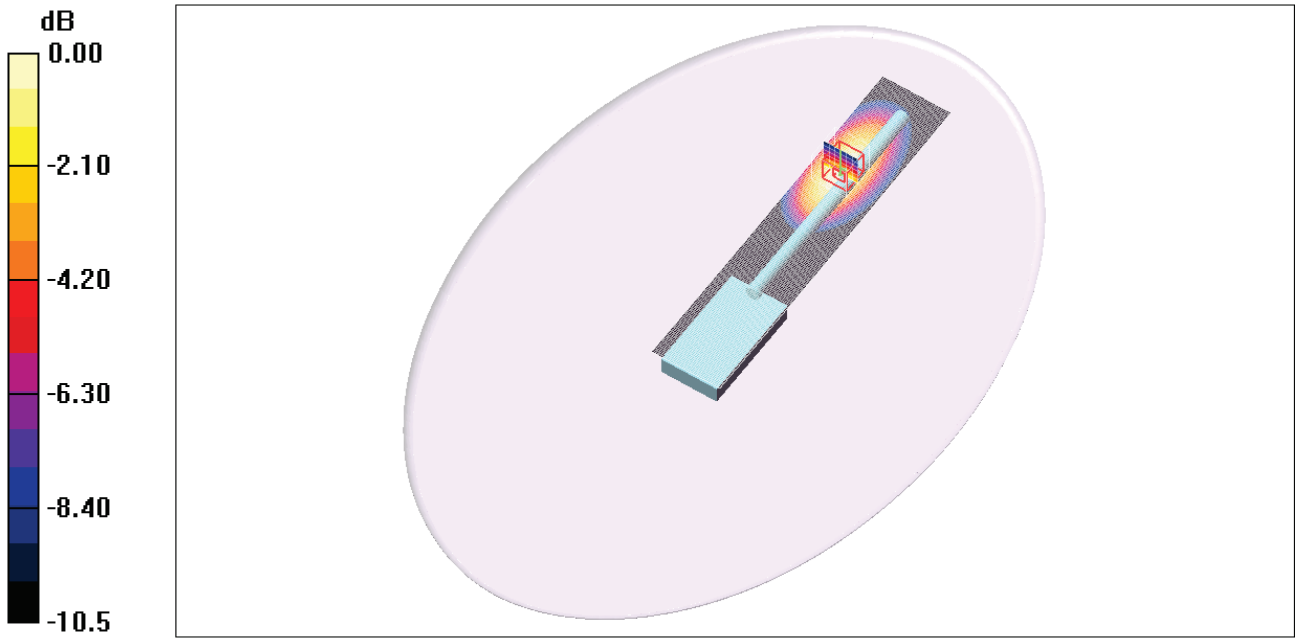
Communication System: APPI-COM; Frequency: 903 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.02157 mho/m, ε_r = 52.532; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 22.2 °C, Liquid temperature: 21.3 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92)
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 5mm, Low channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.482 mW/g

Position 5mm, Low channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.5 V/m; Power Drift = -0.025 dB
Peak SAR (extrapolated) = 0.614 W/kg
SAR(1 g) = 0.421 mW/g; SAR(10 g) = 0.279 mW/g
Maximum value of SAR (measured) = 0.489 mW/g



0 dB = 0.489mW/g

Fig. 8: SAR distribution for SIRRETA antenna, Low channel (903 MHz), rear side at 5 mm

DUT: APPI-COM_SIRETTA

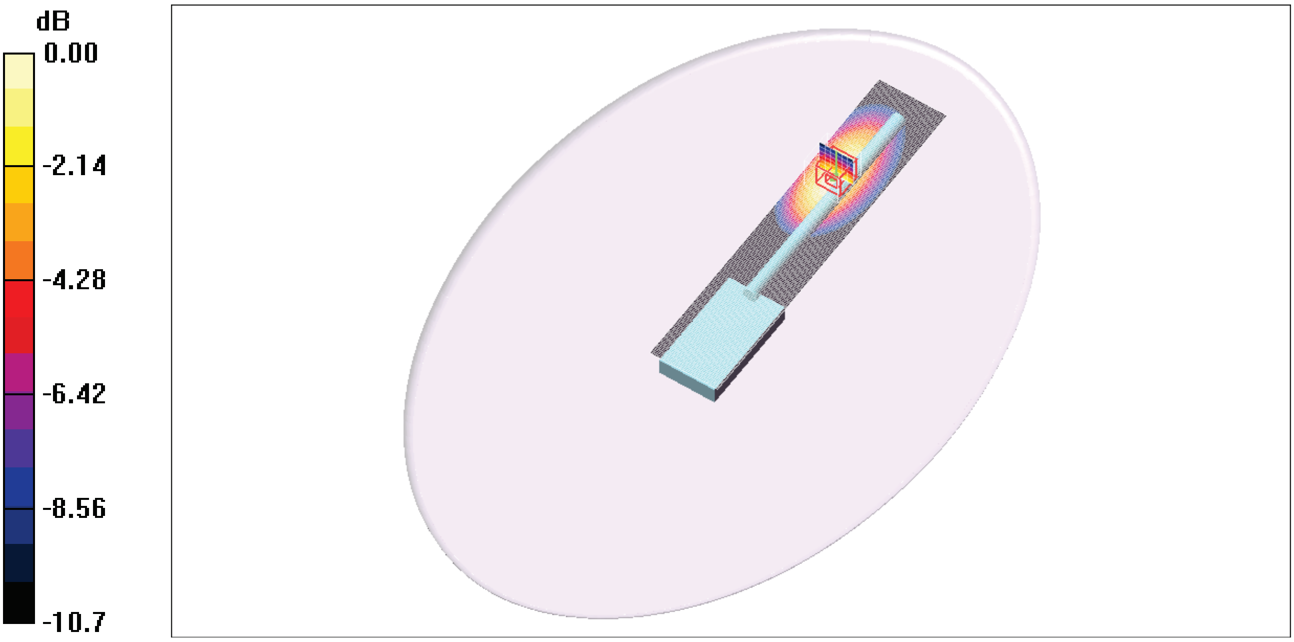
Communication System: APPI-COM; Frequency: 915 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.03373 mho/m, ε_r = 52.4694; ρ = 1000 kg/m³
Phantom section: Flat Section

Program Notes: Ambient temperature: 22.9 °C, Liquid temperature: 21.2°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92); Calibrated: 8/21/2015
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402; Calibrated: 8/13/2015
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 5mm, Middle channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.390 mW/g

Position 5mm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.7 V/m; Power Drift = -0.028 dB
Peak SAR (extrapolated) = 0.513 W/kg
SAR(1 g) = 0.343 mW/g; SAR(10 g) = 0.225 mW/g
Maximum value of SAR (measured) = 0.404 mW/g



0 dB = 0.404mW/g

Fig. 9: SAR distribution for SIRRETA antenna, Middle channel (915 MHz), rear side at 5 mm

DUT: APPI-COM_SIRETTA

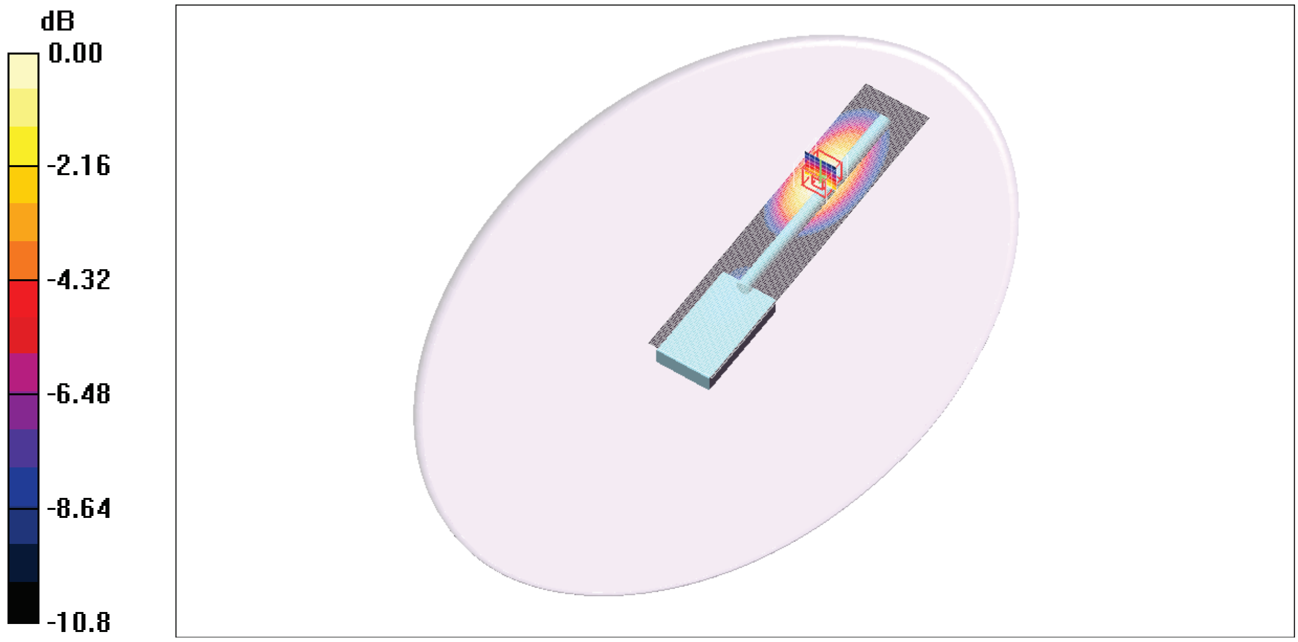
Communication System: APPI-COM; Frequency: 927 MHz; Duty Cycle: 1:8.33
Medium parameters used: σ = 1.04425 mho/m, ε_r = 52.4234; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 23.1 °C, Liquid temperature: 21.3 °C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(5.92, 5.92, 5.92)
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

Position 5mm, Middle channel/Area Scan (41x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.291 mW/g

Position 5mm, Middle channel/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.1 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.373 W/kg
SAR(1 g) = 0.251 mW/g; SAR(10 g) = 0.166 mW/g
Maximum value of SAR (measured) = 0.294 mW/g



0 dB = 0.294mW/g

Fig. 10: SAR distribution for SIRRETA antenna, High channel (927 MHz), rear side at 5 mm

9. PHOTOGRAPHS OF THE EQUIPMENT UNDER TEST

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

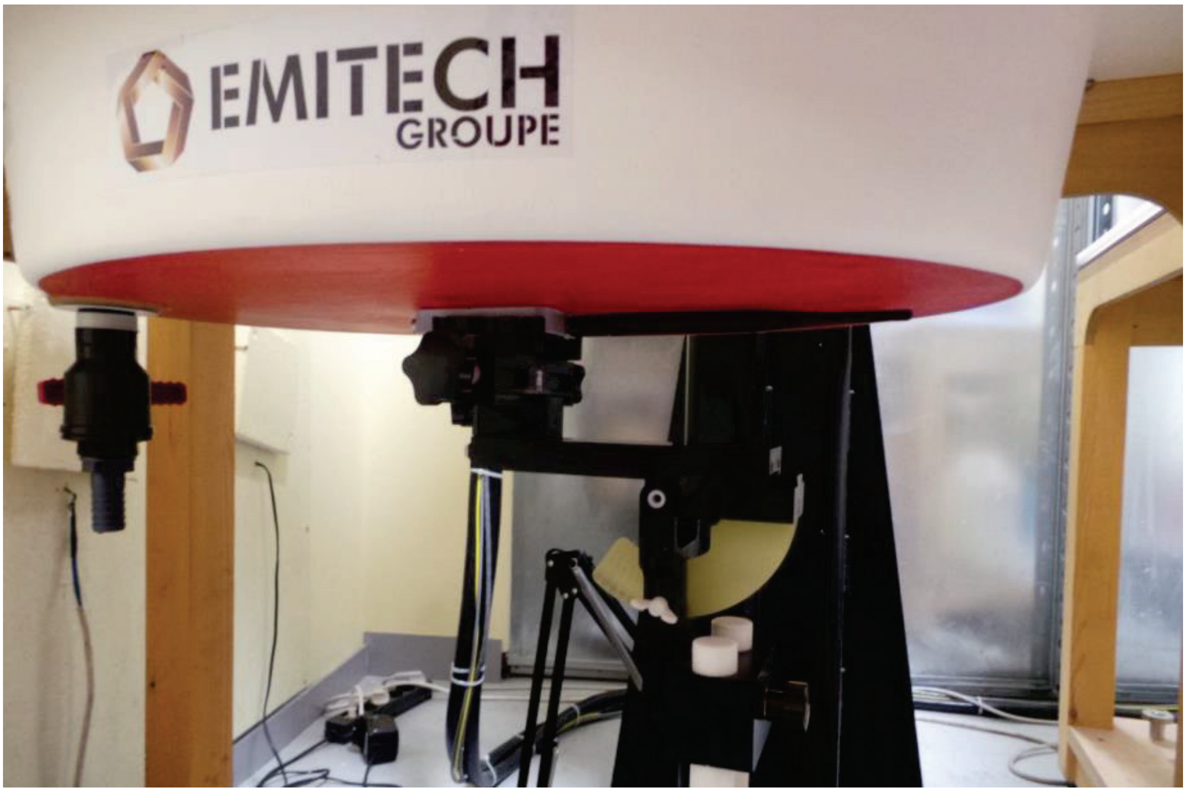


Fig. 11: SIRETTA antenna, rear side at 0 mm from the phantom

Fig. 12: SIRETTA antenna, rear side at 0 mm from the phantom

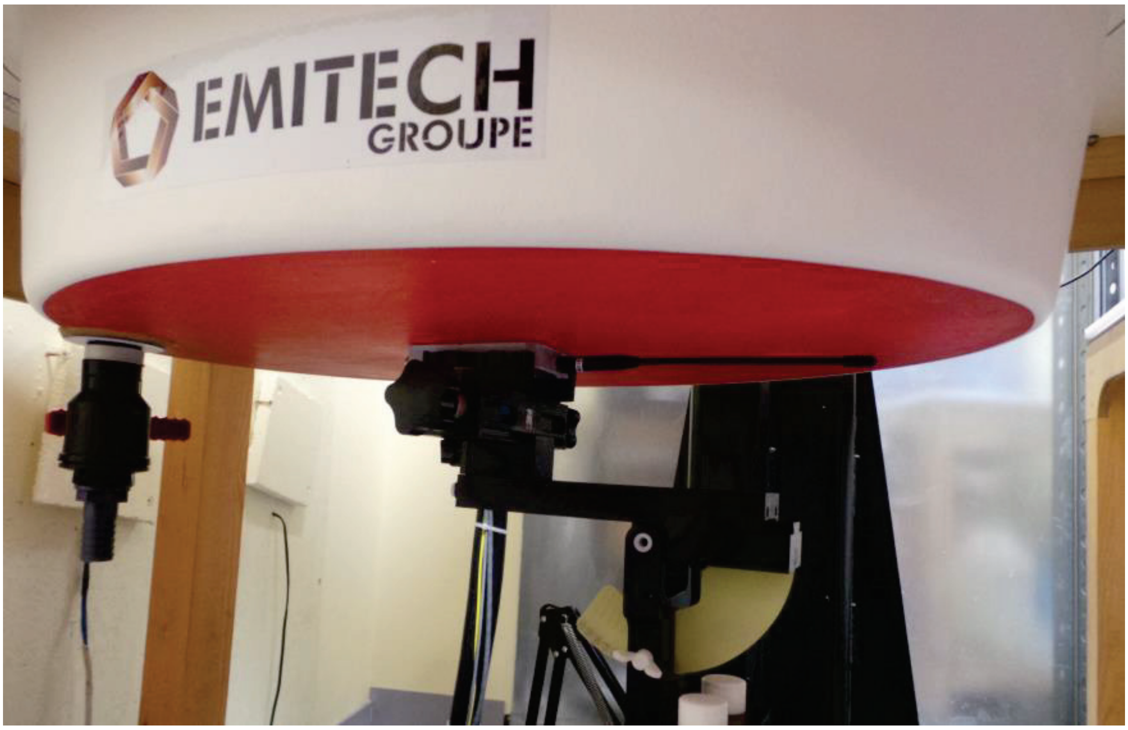


Fig. 13: NEARSON antenna, rear side at 0 mm from the phantom


Fig. 14: NEARSON antenna, rear side at 0 mm from the phantom

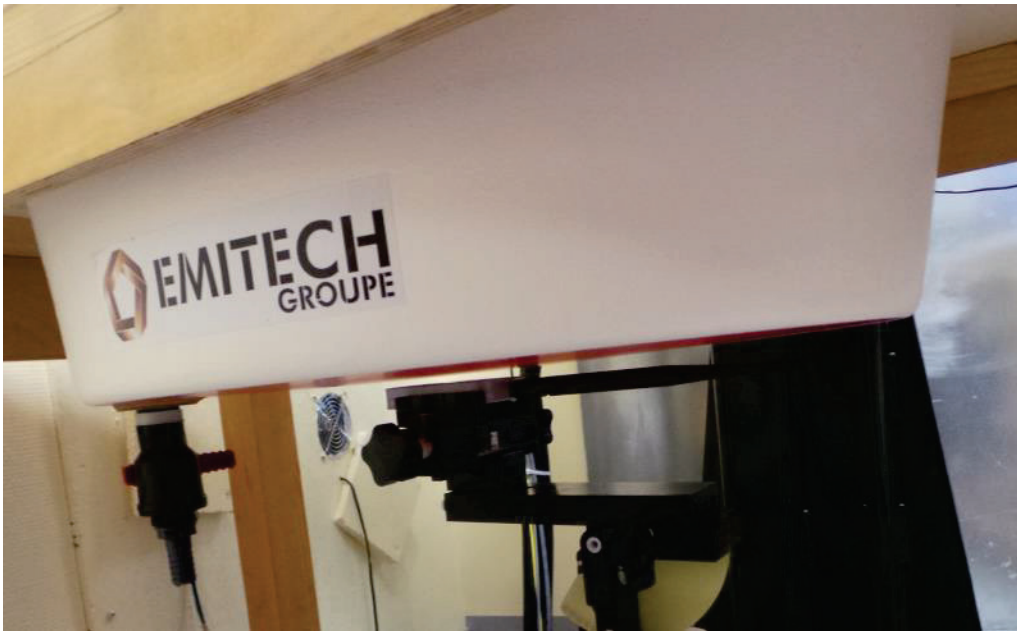


Fig. 15: SIRETTA antenna, rear side at 5 mm from the phantom

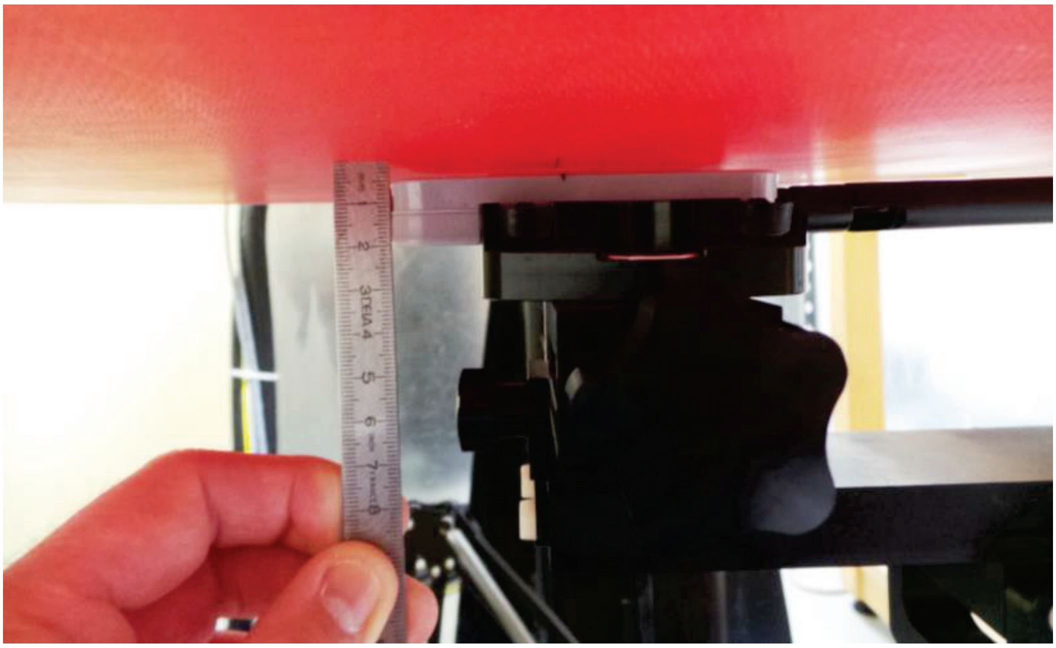


Fig. 16: SIRETTA antenna, rear side at 5 mm from the phantom

10. MEASUREMENT UNCERTAINTY

- Measurement uncertainty of SAR evaluations

The uncertainty of the measurements was evaluated according to the IEEE Std 1528, Tableau 9 (Handset). The expanded uncertainty is ± 26.4 % in 1g.

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	± 7.0	Rectangular	2√3	1	1	± 2.0	± 2.0
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	± 5.0	Rectangular	√3	1	1	± 2.9	± 2.9
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						± 13.2	± 13.2
Expanded uncertainty (95% confidence interval)						± 26.4	± 26.4

- Uncertainty of SAR system validation

The uncertainty of the system validation was evaluated according to the IEEE Std 1528 Tableau 10 (System validation). The expanded uncertainty is ± 24 % in 1g.

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	± 7.0	Rectangular	2√3	1	1	± 2.0	± 2.0
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	± 2.0	Rectangular	√3	1	1	± 1.2	± 1.2
RF ambient conditions - reflections	± 2.0	Rectangular	√3	1	1	± 1.2	± 1.2
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						± 12.0	± 12.0
Expanded uncertainty (95% confidence interval)						± 24.0	± 24.0

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).

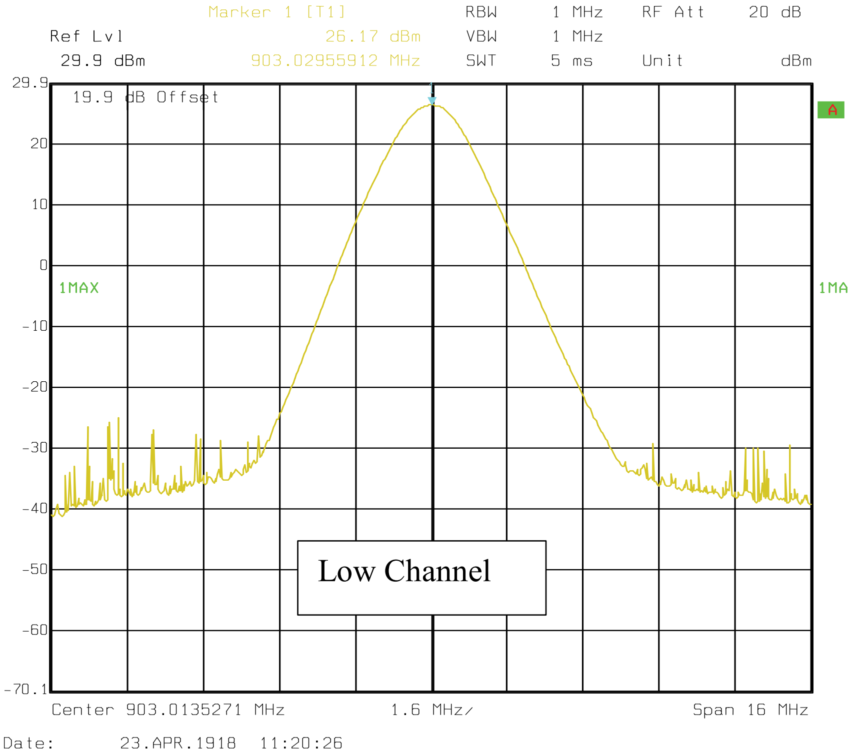
12. EQUIPMENT TEST CONDITIONS

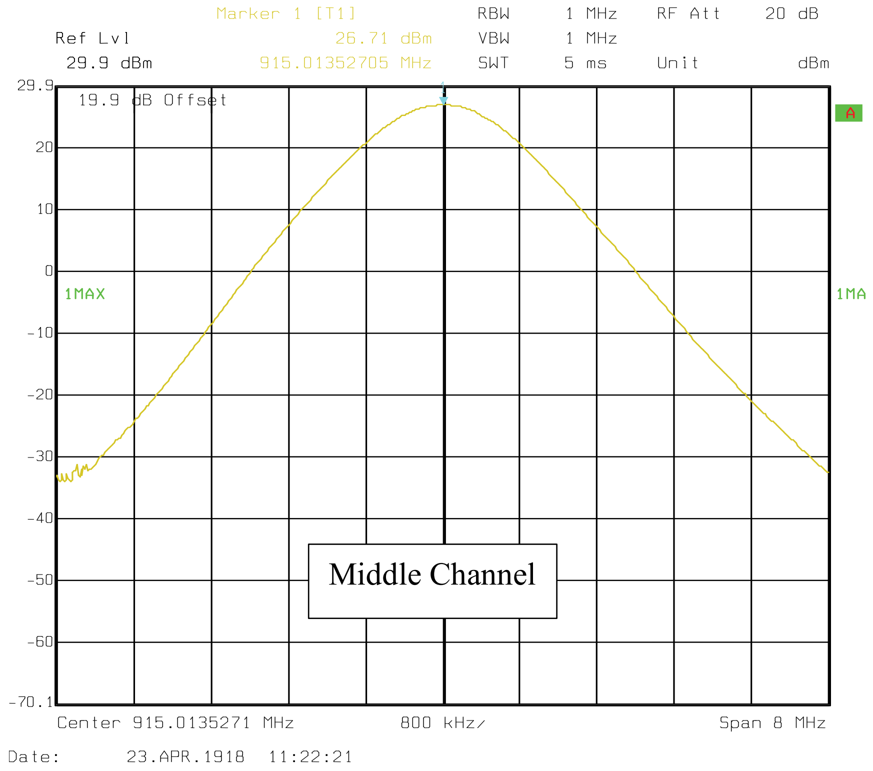
The following test conditions are given for information; the maximum output powers were measured with a spectrum analyser

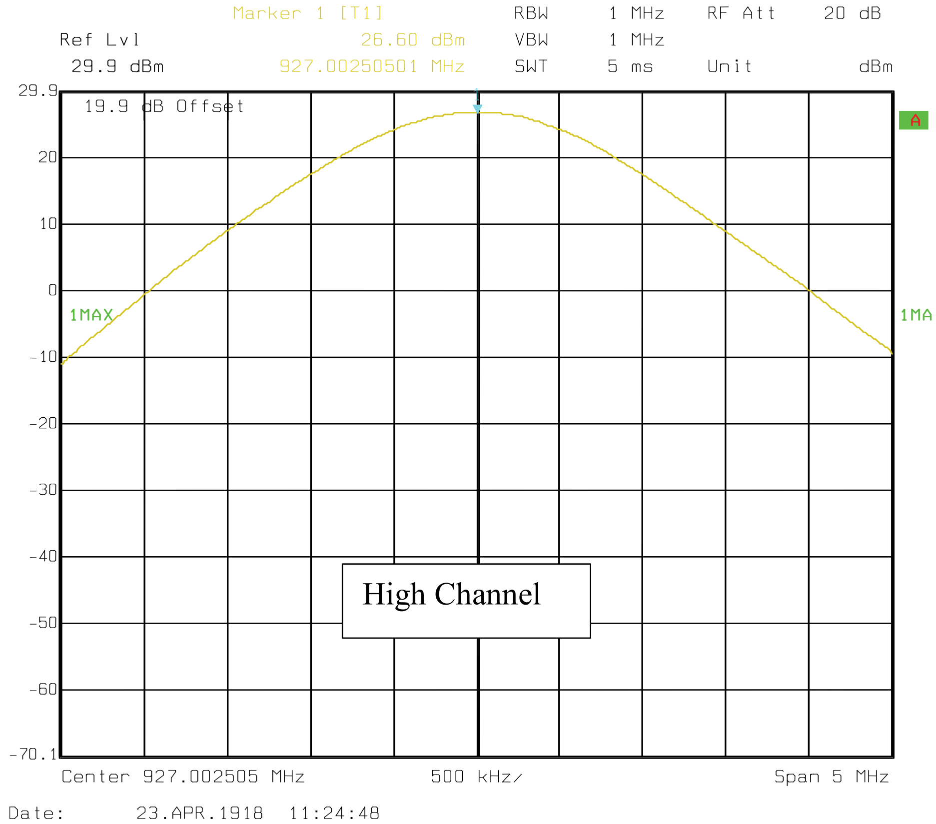
Frequency range: 902MHz – 928MHz, FHSS, according to the test report N°RE051-16-103329-1-A Ed.0
Modulation: FM, according to the test report N°RE051-16-103329-1-A Ed.0
Test program: supplied by the applicant

Measured output power: RBW 1MHz

Frequency (MHz)	Conducted maximum peak power (dBm)
903 (Low)	26.2
915 (Middle)	26.7
927 (High)	26.6

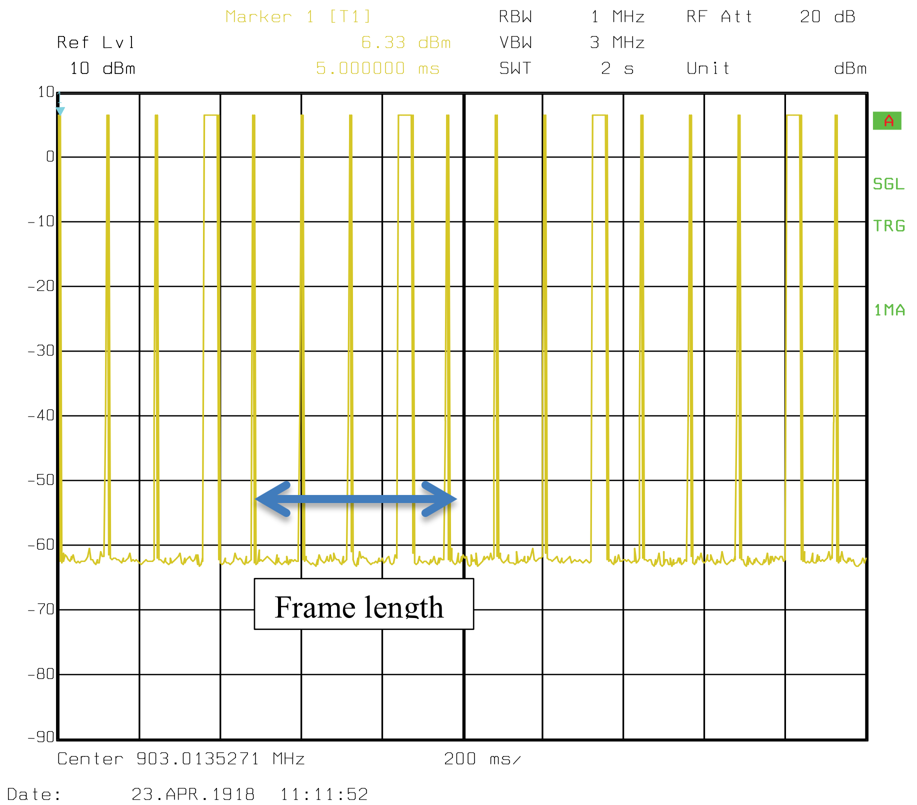


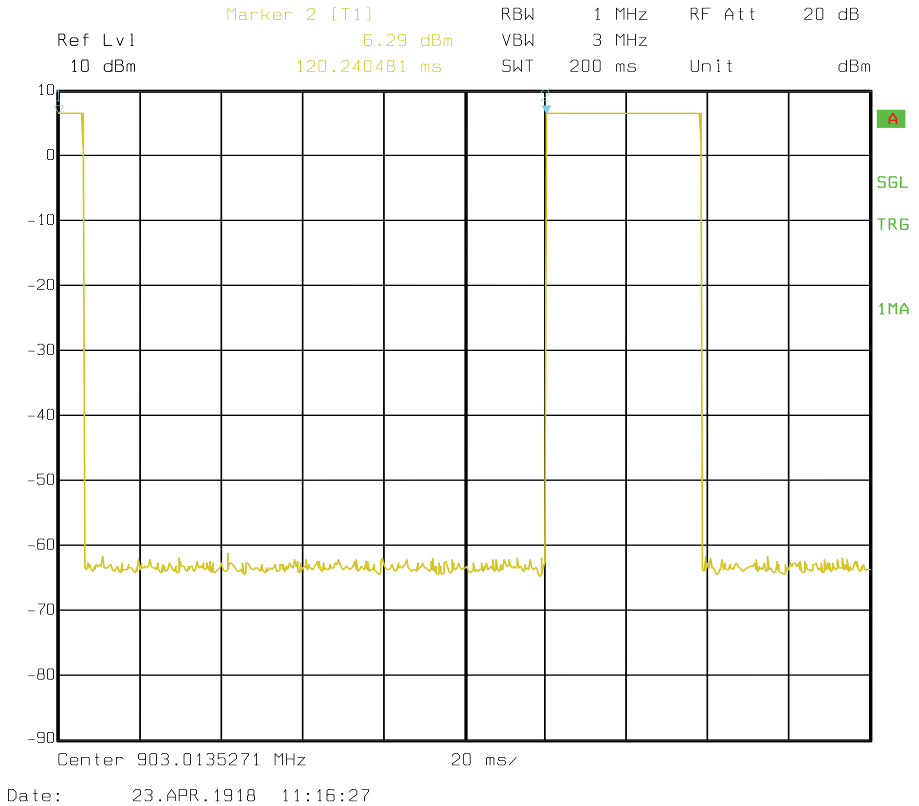

Marker 1 [T1]
RBW 1 MHz
RF Att 20 dB
Ref Lvl
26.71 dBm
VBW 1 MHz
29.9 dBm
915.01352705 MHz
SWT 5 ms
Unit dBm
19.9 dB Offset
1MAX
1MA
A
Middle Channel
Center 915.0135271 MHz
800 kHz/
Span 8 MHz
Date: 23.APR.1918 11:22:21

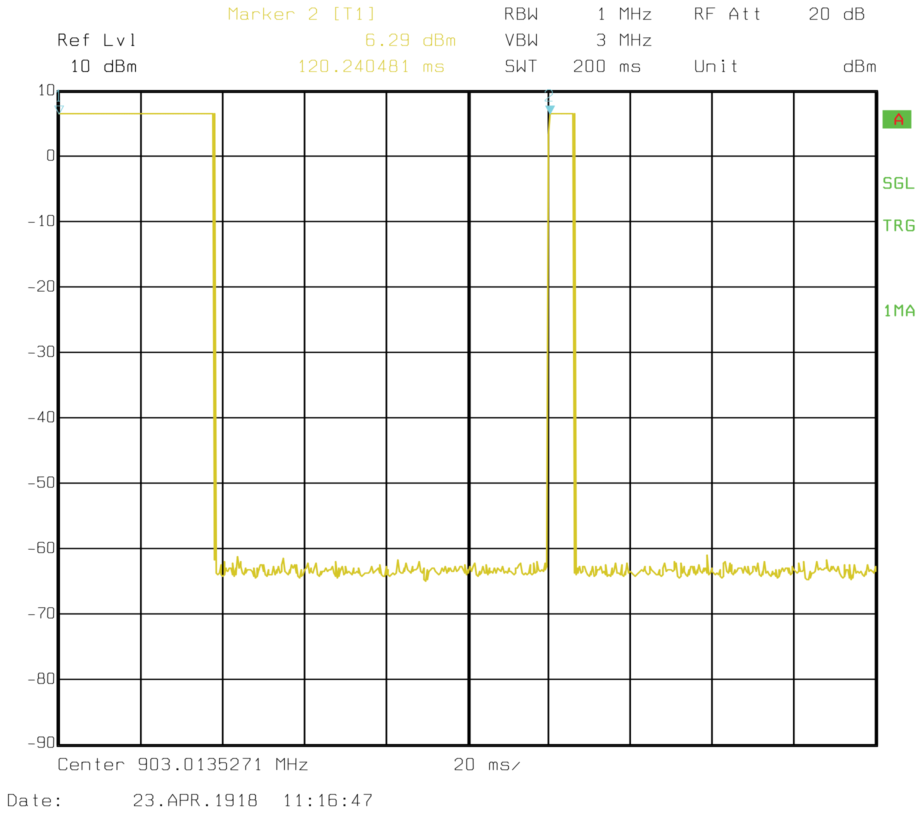

Marker 1 [T1]
RBW 1 MHz
RF Att 20 dB
Ref Lvl
26.60 dBm
VBW 1 MHz
29.9 dBm
927.00250501 MHz
SWT 5 ms
Unit dBm
19.9 dB Offset
1MAX
1MA
A
High Channel
Center 927.002505 MHz
500 kHz/
Span 5 MHz
Date: 23.APR.1918 11:24:48

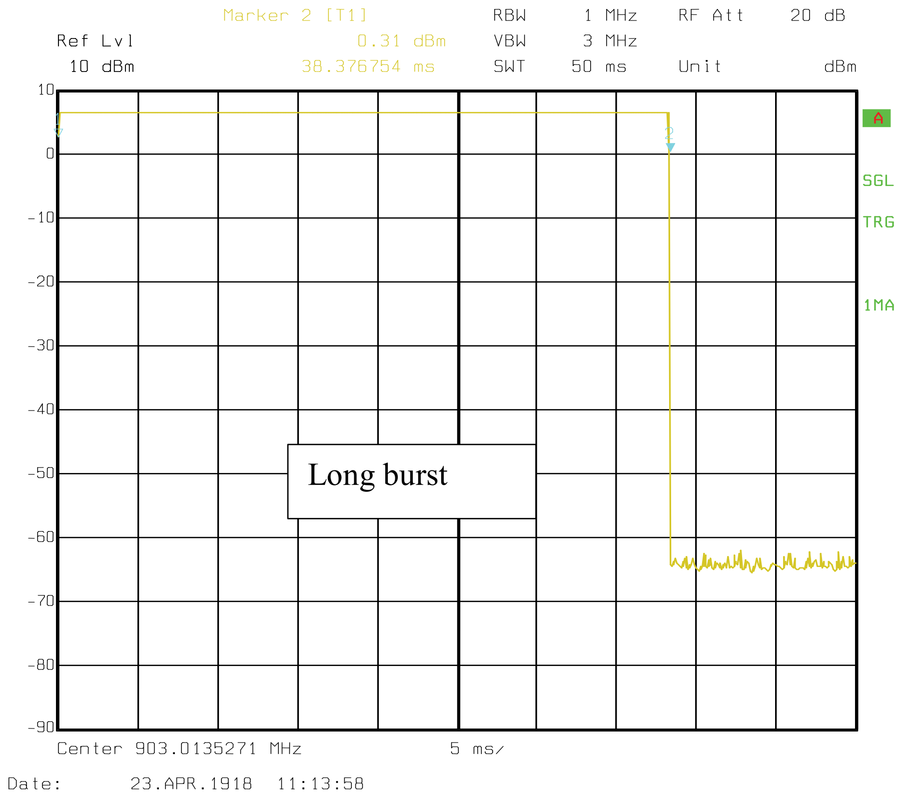
Measured Crest factor: 8.33 (total Tx duration is 57.6ms within a frame length of 480ms)

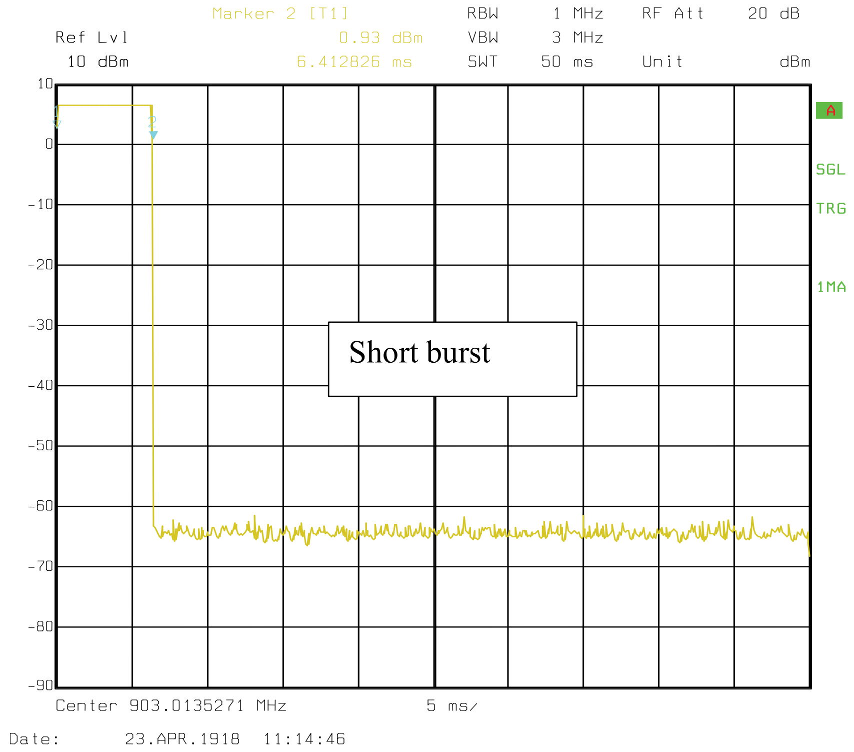
903MHz:






Marker 2 [T1]
Ref Lvl
10 dBm
6.29 dBm
120.240481 ms
RBW 1 MHz
VBW 3 MHz
SWT 200 ms
RF Att 20 dB
Unit dBm
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
A
SGL
TRG
1MA
Center 903.0135271 MHz
20 ms/
Date: 23.APR.1918 11:16:47


Marker 2 [T1]
Ref Lvl
10 dBm
0.31 dBm
38.376754 ms
RBW 1 MHz
VBW 3 MHz
SWT 50 ms
RF Att 20 dB
Unit dBm
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
A
SGL
TRG
1MA
Long burst
Center 903.0135271 MHz
5 ms/
Date: 23.APR.1918 11:13:58



Secondary transmitter:Bluetooth Module : see the test report N° °RE051-16-103329-1-A Ed.0

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. Fig. 17 shows the system.

Fig. 17: The measurement setup

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.

900 MHz liquid:
- Sugar 41.76 %
- De-ionised water 56.0 %
- NaCl salt 0.76 %
- HEC 1.21 %
- Bactericide 0.27 %

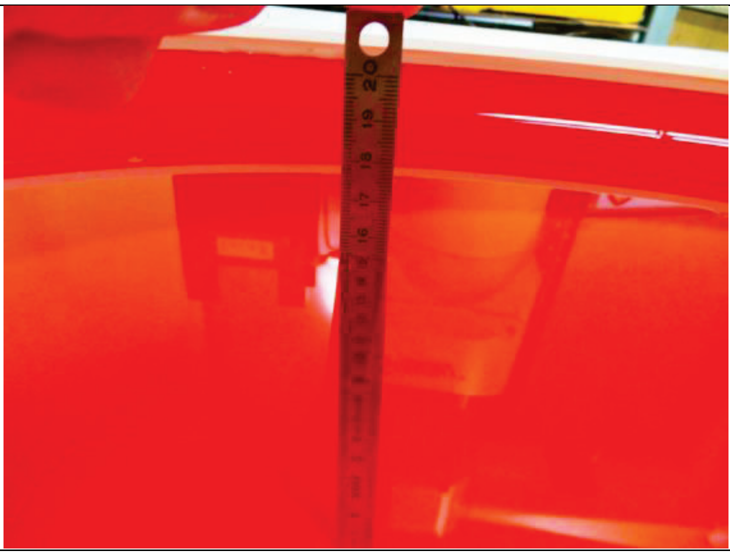
The dielectric parameters of the liquid were controlled prior to assessment (contact probe method).

Dielectric properties measured:

Date	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)
April 23	900	55.0 ± 5 %	53.1	1.05 ± 5 %	1.02	21.8	21.7
	905	55.0 ± 5 %	53	1.05 ± 5 %	1.03		
	915	55.0 ± 5 %	52.9	1.06 ± 5 %	1.04		
	925	55.0 ± 5 %	52.7	1.06 ± 5 %	1.05		
April 24	900	55.0 ± 5 %	52.6	1.05 ± 5 %	1.02	21.8	22.5
	905	55.0 ± 5 %	52.5	1.05 ± 5 %	1.03		
	915	55.0 ± 5 %	52.5	1.06 ± 5 %	1.03		
	925	55.0 ± 5 %	52.4	1.06 ± 5 %	1.04		

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 this 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 liquid. The validation dipole input power was 250 mW.
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 is below and shown in Fig. 18

Meas. date	**Frequency (MHz)**	**SAR 1g (W/kg)** Targeted value	**SAR 1g (W/kg)** Measured value
Apr. 23	900	2.775 ± 10%	2.700

DUT: Dipole 900 MHz

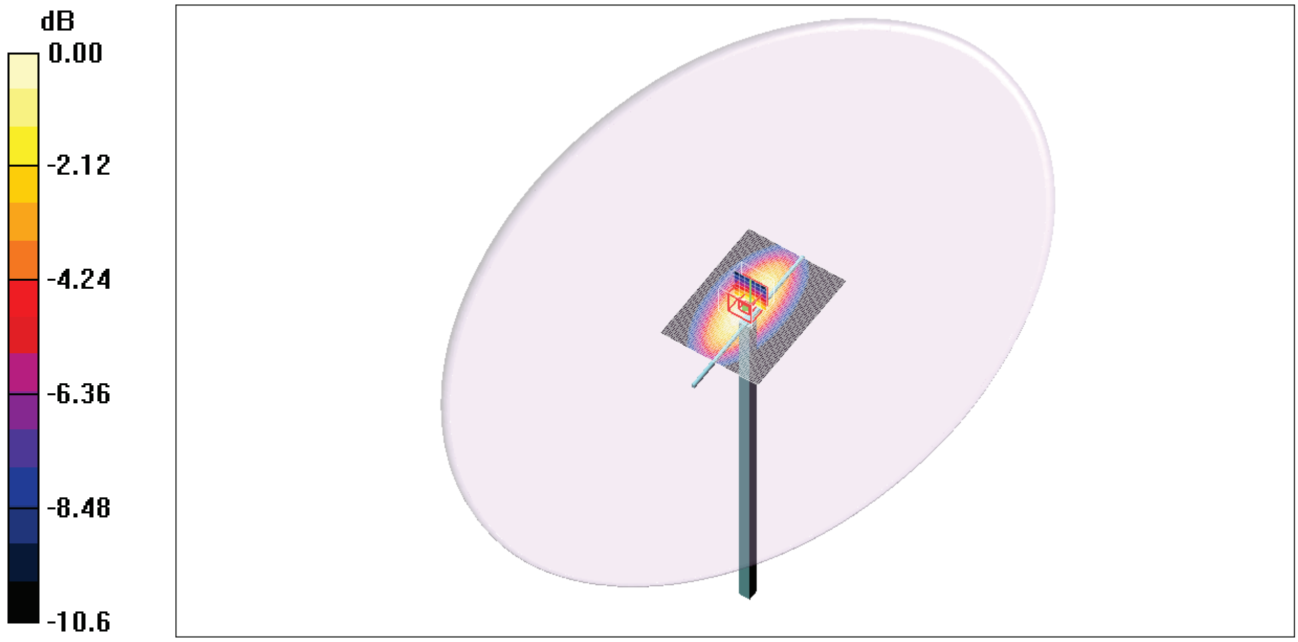
Communication System: CW; Frequency: 900 MHz; Duty Cycle: 1:1
Medium parameters used: σ = 1.02483 mho/m, ε_r = 53.0886; ρ = 1000 kg/m^3
Phantom section: Flat Section

Program Notes: Ambient temperature: 21.7 °C, Liquid temperature: 21.8°C

DASY4 Configuration:
- Probe: ES3DV3 - SN3303; ConvF(6.29, 6.29, 6.29)
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn402
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 145

d=15mm, Pin=250mW/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 3.16 mW/g

d=15mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.4 V/m; Power Drift = -0.040 dB
Peak SAR (extrapolated) = 4.01 W/kg
SAR(1 g) = 2.7 mW/g; SAR(10 g) = 1.76 mW/g
Maximum value of SAR (measured) = 3.17 mW/g



0 dB = 3.17mW/g

Fig. 18: 900MHz validation result

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

ANNEX 1: DAE3 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 0108**

Client **EMITECH Le Mans**

Certificate No: **DAE3-402_Aug16**

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 09, 2016

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	09-Sep-15 (No:17153)	Sep-16
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: August 9, 2016

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

Certificate No: DAE3-402_Aug16 Page 1 of 5

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**

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	403.396 ± 0.02% (k=2)	403.316 ± 0.02% (k=2)	403.886 ± 0.02% (k=2)
Low Range	3.93593 ± 1.50% (k=2)	3.96106 ± 1.50% (k=2)	3.96586 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	241.0 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	200037.48	2.13	0.00
Channel X	+ Input	20013.38	8.54	0.04
Channel X	- Input	-20000.08	5.30	-0.03
Channel Y	+ Input	200037.31	1.89	0.00
Channel Y	+ Input	20011.20	6.51	0.03
Channel Y	- Input	-20005.18	0.25	-0.00
Channel Z	+ Input	200038.65	3.05	0.00
Channel Z	+ Input	20003.69	-0.95	-0.00
Channel Z	- Input	-20014.52	-9.04	0.05

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2001.18	0.15	0.01
Channel X	+ Input	201.28	0.22	0.11
Channel X	- Input	-198.57	0.24	-0.12
Channel Y	+ Input	2000.82	-0.12	-0.01
Channel Y	+ Input	200.60	-0.39	-0.20
Channel Y	- Input	-199.38	-0.36	0.18
Channel Z	+ Input	2000.71	-0.07	-0.00
Channel Z	+ Input	199.90	-0.95	-0.47
Channel Z	- Input	-200.15	-1.04	0.52

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	7.24	5.36
	- 200	-4.30	-5.84
Channel Y	200	-1.36	-1.47
	- 200	0.98	0.39
Channel Z	200	0.55	0.71
	- 200	-2.54	-2.93

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	-	2.78	-2.08
Channel Y	200	8.00	-	3.96
Channel Z	200	8.11	5.41	-

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	16283	15573
Channel Y	15888	17336
Channel Z	16453	17177

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	1.28	0.48	2.74	0.36
Channel Y	0.43	-0.70	1.50	0.33
Channel Z	-0.54	-1.47	0.39	0.36

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 2: E-FIELD PROBE 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 0108

Client Emitech Le Mans

Certificate No: ES3-3303_Aug16

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 23, 2016

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

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

Issued: August 23, 2016

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 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3303

Manufactured: August 27, 2010
Calibrated: August 23, 2016

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 (µV/(V/m)^2)[A]	1.32	1.35	1.36	± 10.1 %
DCP (mV)[B]	102.5	101.5	102.1	

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	229.1	±3.5 %
		Y	0.0	0.0	1.0		233.9	
		Z	0.0	0.0	1.0		223.8	

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	6.93	6.93	6.93	0.20	2.20	± 13.3 %
750	41.9	0.89	6.79	6.79	6.79	0.53	1.45	± 12.0 %
900	41.5	0.97	6.37	6.37	6.37	0.80	1.14	± 12.0 %
1810	40.0	1.40	5.35	5.35	5.35	0.77	1.20	± 12.0 %
1950	40.0	1.40	5.14	5.14	5.14	0.72	1.27	± 12.0 %
2150	39.7	1.53	5.10	5.10	5.10	0.80	1.16	± 12.0 %
2300	39.5	1.67	4.96	4.96	4.96	0.80	1.22	± 12.0 %
2450	39.2	1.80	4.65	4.65	4.65	0.65	1.40	± 12.0 %
2600	39.0	1.96	4.55	4.55	4.55	0.76	1.35	± 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	6.24	6.24	6.24	0.80	1.11	± 12.0 %
900	55.0	1.05	6.29	6.29	6.29	0.80	1.19	± 12.0 %
1810	53.3	1.52	5.01	5.01	5.01	0.57	1.45	± 12.0 %
2000	53.3	1.52	5.01	5.01	5.01	0.75	1.28	± 12.0 %
2450	52.7	1.95	4.52	4.52	4.52	0.80	1.10	± 12.0 %

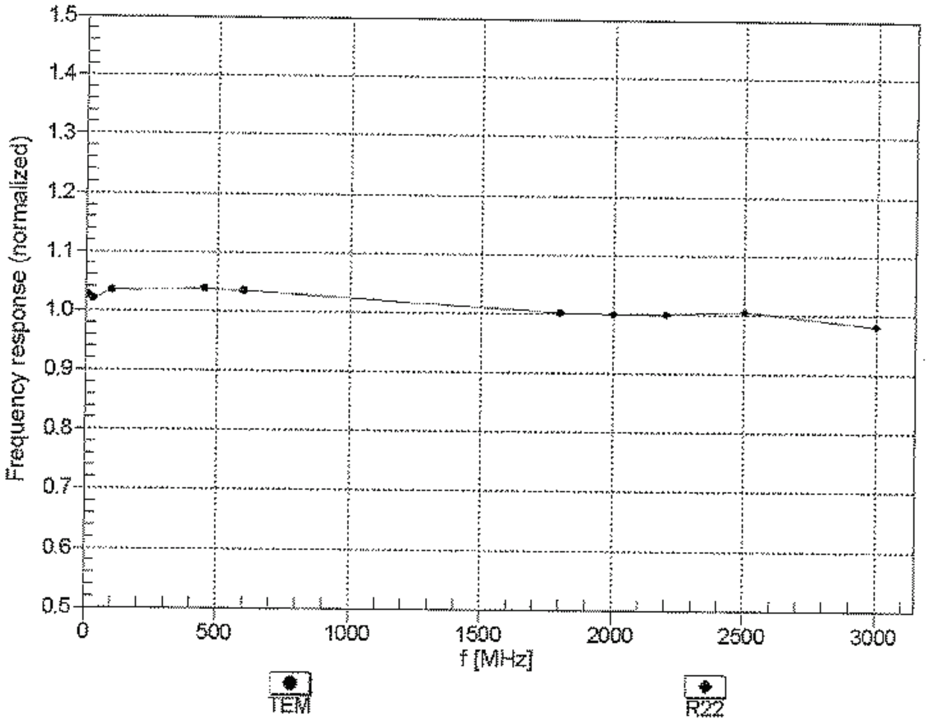
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz 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.

ES3DV3– SN:3303

August 23, 2016

Frequency Response of E-Field

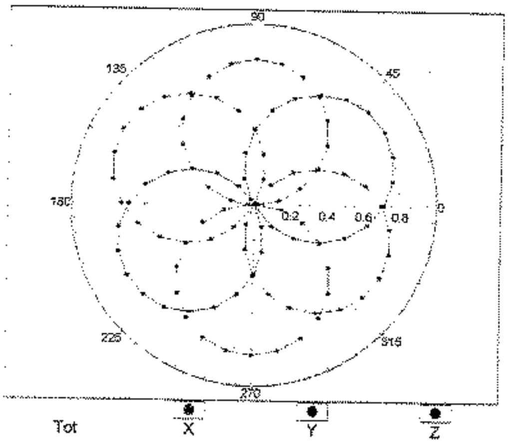
(TEM-Cell:ifi110 EXX, Waveguide: R22)



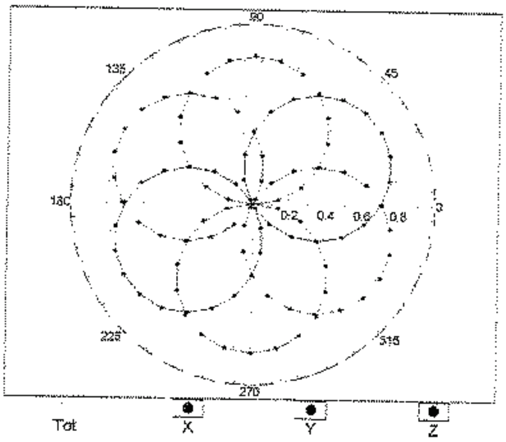
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

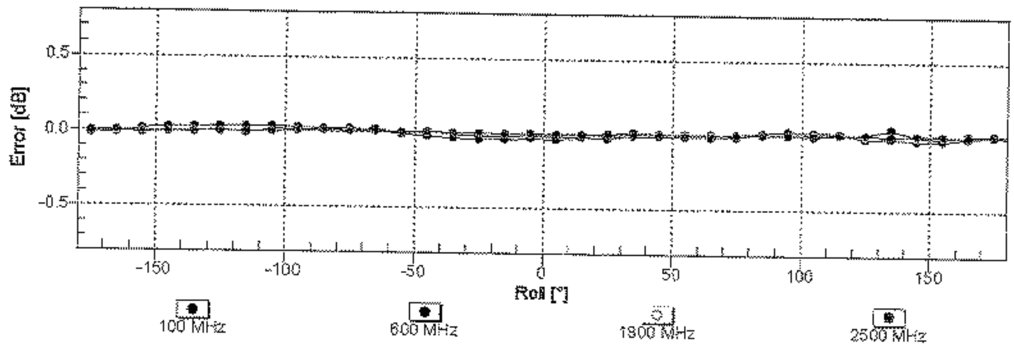
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

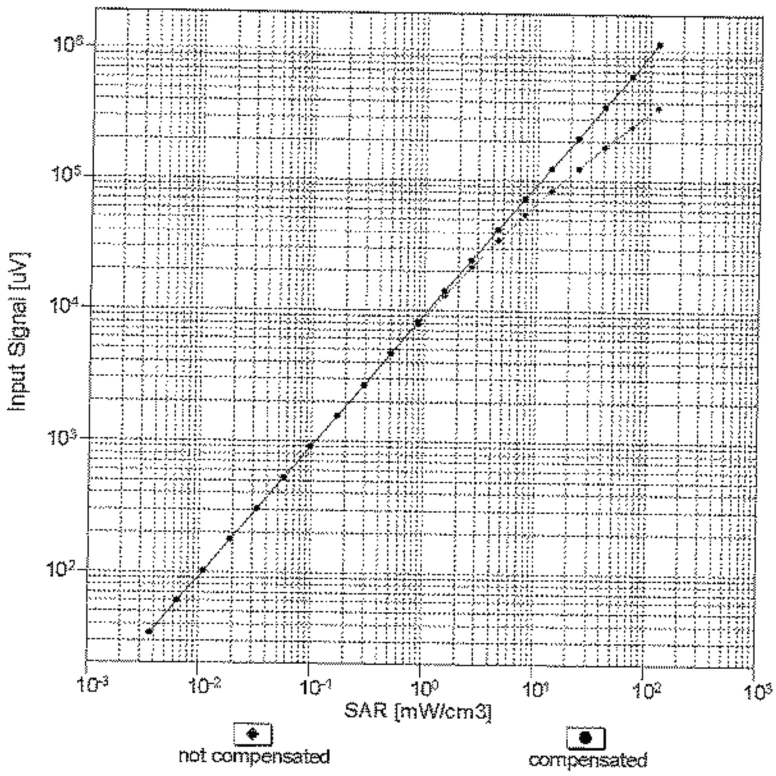


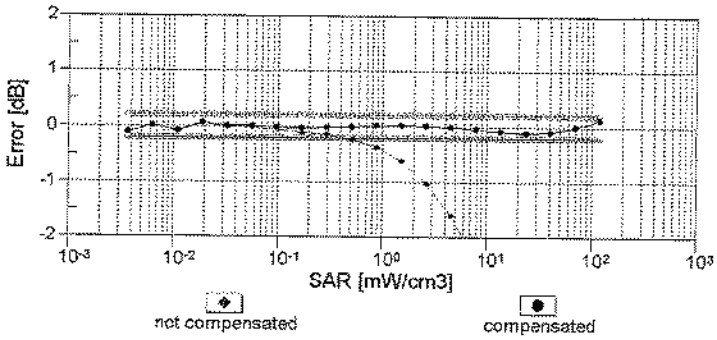


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

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



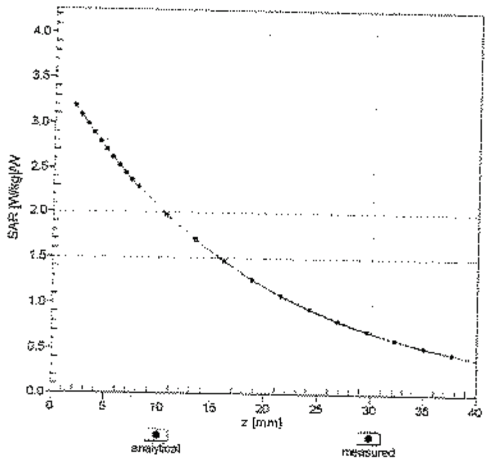


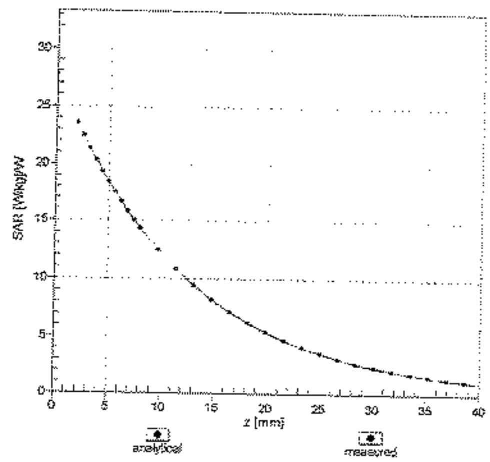
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ES3DV3– SN:3303

August 23, 2016

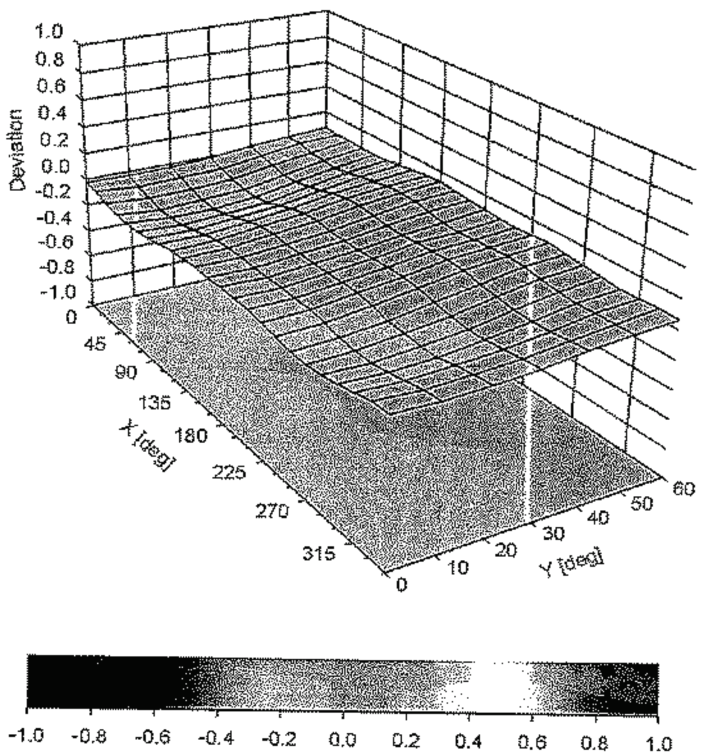
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	44.7
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 3: D900V2 CALIBRATION CERTIFICATE

EMITECH GROUPE

CALIBRATION CERTIFICATE

Equipment under calibration:
Designation: 900MHz dipole
Brand: Schmid & Partner Engineering AG
Type: D900V2
Serial number: 086
Emitech number: 7194

Calibration date: October 17, 2016

Operator: Emmanuel TOUTAIN

Calibration procedure: PRTFIC000MET00050

Environnemental conditions :
Ambient Temperature: 21.3°C
Liquid Temperature: 20.1°C
Hygrometry: 38% HR

Equipment used:

EMITECH N°	DESIGNATION	BRAND	TYPE	CALIBRATION PERIODICITY	CALIBRATION DATE
1402	Network Analyser	Hewlett Packard	8753C	12 months	October 04, 2016
7217	Calibration kit	Hewlett Packard	85033D	12 months	October 04, 2016

Liquid measurements:

Frequency (MHz)	Liquid : Head (1)		Liquid : Body	
	Sigma	Epsilon	Sigma	Epsilon
900	0.95	40.8	-	-

Note (1): dielectric properties according to EN62209-1: 2006 and EN62209-2: 2010

Return loss measurements:

Dipole	Frequency (MHz)	Liquid : Head		Liquid : Body	
		Return loss (dB)	Verdict (2) ≤ -20dB	Return loss (dB)	Verdict (2) ≤ -20dB
D900V2	900	-23.3	PASS	-	-

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

Conclusion: In Tolerance
(in head/body tissue at 900MHz according to EN62209-1 and EN62209-2)

Visa: