TEST REPORT

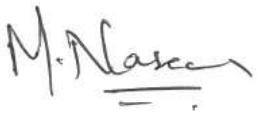
Test of: RockSTAR

To: OET Bulletin 65 Supplement C: (2001-01)
IEEE1528:2003

FCC ID: ZZY-9602

Test Report Serial No:
UL-SAR-RP91065JD01A V4.0

Version 4.0 Supersedes All Previous Versions

This Test Report Is Issued Under The Authority Of Richelieu Quoi, SAR Technology Consultant:	 (APPROVED SIGNATORY)
Checked By: Naseer Mirza	 (APPROVED SIGNATORY)
Issue Date:	**25 July 2013**
Test Dates:	**06 March 2013**

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1. Customer Information

Company Name:	Rock Seven Mobile Services Ltd
Address:	Unit 2, Eastlands Boatyard Coal Park Lane Swanwick Southampton SO31 7GW United Kingdom

2. Summary of Test Results

Test Name	Specification Reference	Result
Specific Absorption Rate - Iridium (1616 MHz to 1626 MHz)	OET Bulletin 65 Supplement C: (2001-01)	
Key to Results	= Complied = Did not comply	

2.1. Highest Reported SAR

Individual Transmitter Evaluation per Band:

Exposure Configuration	Technology Band	Highest Reported 1g -SAR (W/kg)	Equipment Class	Max Rated Source base Avg Power + Max Tolerance [dBm]	Highest Reported 1g-SAR (W/kg)
Body-Worn (Separation Distance 0mm)	Iridium	0.937	TNT	32.2	0.937

2.2. Highest Reported SAR (continued)

Simultaneous Transmitter Evaluation:

Exposure Configuration	Technology Band	Highest Reported 1g SAR (W/kg)	Equipment Class	Max Rated Source base Avg Power + Max Tolerance [dBm]	Highest Reported Sum-SAR 1g-SAR (W/kg)	SPLSR Ratio
BODY-WORN (Separation Distance 0mm)	Iridium	0.937	TNT	32.2	1.019	N/A
	Bluetooth 2.4 GHz	0.082[2a]	DSS	3.0		

Note(s):

1. Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the *reported* standalone SAR of each applicable transmitting antenna. As the calculated sum was < 1.6 W/kg the evaluation was not required.
2. Bluetooth estimated SAR result is calculated as per the formula below following FCC KDB publication 447498.

When standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- *(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)]·[$\sqrt{f_{(GHz)}}/x$] W/kg for test separation distances* ≤ 50 mm;
  where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.
  - **0mm Bluetooth estimated SAR level:**
    a. **Estimated *Bluetooth* SAR =** (1.99 mW/5mm)*(√2.4 / 7.5) = 0.082 W/kg

2.3. SAR measurement variability and measurement uncertainty analysis:

The SAR measurement variability and measurement uncertainty analysis was not required as the maximum measured SAR is < 0.8 W/kg.

Note(s):

The condition for SAR variability was met as the SAR level measured and calculated was below the specified threshold as per KDB publication 865664 D01, section 2.8.1

2.4. Location of Tests

All the measurements described in this report were performed at the premises of
UL, Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG United Kingdom

2.5. Maximum Average Output power Including Tolerances:

Bands	Data Mode	
	Target (dBm)	Tolerance ± (dB)
Iridium Satellite	31.7	0.5

Band	Target (dBm)	Tolerance ± (dB)
Bluetooth	0.0	3.0

Note:

1. The target average source based power and maximum tolerances, declared by manufacturer are shown in the above tables.
2. These are specified maximum allowed average power for all the wireless mode and frequencies supported.

3. Test Specification, Methods and Procedures

3.1. Test Specification

Reference:	OET Bulletin 65 Supplement C: (2001-01)
Title:	Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
Purpose of Test:	To determine whether the equipment met the basic restrictions as defined in OET Bulletin 65 Supplement C: (2001-01) using the SAR averaging method as described in the test specification above.
The Equipment Under Test complied with the Specific Absorption Rate for general population/uncontrolled exposure limit of 1.6 W/kg as specified in FCC 47 CFR part 2 (2.1091) , ANSI C95.1-1992 and in accordance with the reference documents in section 3.2 of this report.	

3.2. Methods and Procedures Reference Documentation

The methods and procedures used were as detailed in:

Federal Communications Commission, “Evaluating compliance with FCC Guidelines for human exposure to radio frequency electromagnetic fields”, OET Bulletin 65 Supplement C, FCC, Washington, D.C, 20554, 2001.

IEEE 1528: 2003
IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

Thomas Schmid, Oliver Egger and Neils Kuster, “Automated E-field scanning system for dosimetric assessments”, IEEE Transaction on microwave theory and techniques,
Vol. 44, pp. 105-113, January 1996.

Neils Kuster, Ralph Kastle and Thomas Schmid, “Dosimetric evaluation of mobile communications equipment with know precision”, IEICE Transactions of communications, Vol. E80-B, No.5, pp. 645-652, May 1997.

FCC KDB Publication:

KDB 447498 D01 General RF Exposure Guidance v05r01

KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r01

KDB 865664 D02 RF Exposure Reporting v01r01

3.3. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Appendix 1 contains a list of the test equipment used.

4. Equipment Under Test (EUT)

4.1. Identification of Equipment Under Test (EUT)

Description:	Portable satellite tracker & 2-way messaging device
Brand Name:	RockSTAR
Model Name or Number:	RockSTAR
Serial Number:	SAR1
IMEI Number:	Not Applicable
Hardware Version Number:	V2 revision D
Software Version Number:	2.0-SAR
Hardware Revision of GSM Module:	Not Applicable
Software Revision of GSM Module:	Not Applicable
FCC ID Number:	ZZY-9602
Country of Manufacture:	United Kingdom
Date of Receipt:	06 March 2013

Note(s):

This sample was used to perform SAR evaluation measurements on Iridium Satellite band only. The sample supports simultaneous transmission with the Iridium Satellite and Bluetooth.

Description:	Portable satellite tracker & 2-way messaging device
Brand Name:	RockSTAR
Model Name or Number:	RockSTAR
Serial Number:	SAR2
IMEI Number:	Not Applicable
Hardware Version Number:	V2 revision D
Software Version Number:	2.0-SAR
Hardware Revision of GSM Module:	Not Applicable
Software Revision of GSM Module:	Not Applicable
FCC ID Number:	ZZY-9602
Country of Manufacture:	United Kingdom
Date of Receipt:	06 March 2013

Note(s):

This sample was used to perform the Conducted Power measurements only. The sample supports simultaneous transmission with the Iridium Satellite and Bluetooth.

4.2. Description of EUT

The Equipment Under Test is a 'Portable satellite tracker & 2-way messaging device' with Iridium 16 GHz Satellite Band. The EUT also has Bluetooth Class 2 capabilities.

4.3. Modifications Incorporated in the EUT

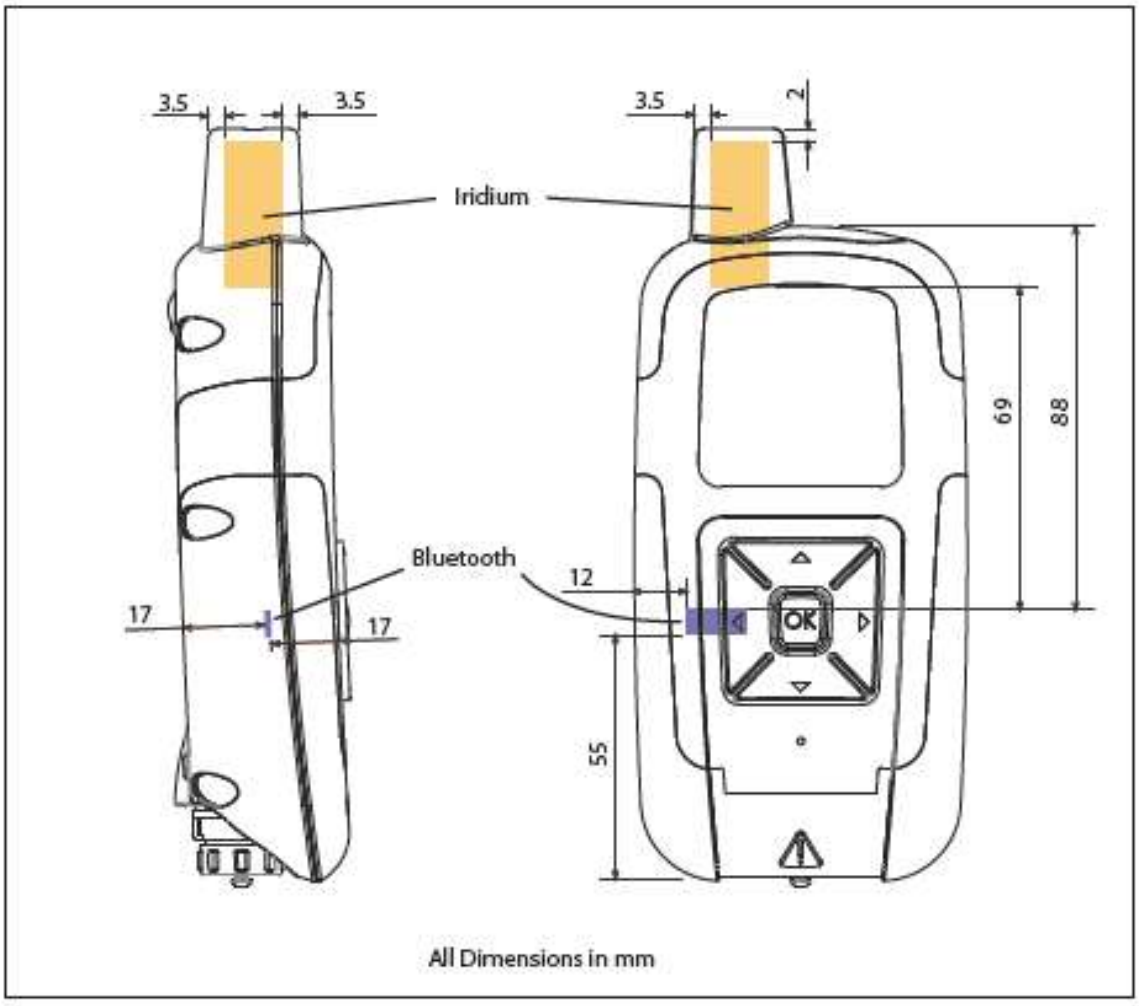
EUT (SN: SAR1) is used to perform SAR measurements only.

EUT (SN: SAR2) is used to perform conducted power measurements only.

4.4. Additional Information Related to Testing

Equipment Category	Iridium / Bluetooth		
Type of Unit	Portable Transceiver		
Intended Operating Environment:	Within Iridium and *Bluetooth* Coverage		
Transmitter Maximum Output Power Characteristics:	Iridium 1600 MHz)	Test Software was used to configure the EUT to transmit at a maximum power of up to 31.4 dBm.	
	Bluetooth	:= 1.99 mW or ~3.00 dBm	
Transmitter Frequency Range:	Iridium 1600 MHz)	1616 to 1626 MHz	
	Bluetooth	2402 to 2480 MHz	
Transmitter Frequency Allocation of EUT When Under Test:	**Channel Number**	**Channel Description**	**Frequency (MHz)**
	1	Low	1616
	152	Middle	1621
	256	High	1626
	0	Low	2402.0
	19	Middle	2440.0
	39	High	2480.0

Additional Information Related to Testing (Continue)	
Modulation(s):	Iridium (DE-QPSK) : 11.2 Hz
Modulation Scheme (Crest Factor):	Iridium (DE-QPSK) : 10.9
Antenna Type:	Internal integral
Antenna Length:	Unknown
Number of Antenna Positions:	1 fixed (Iridium) 1 fixed (*Bluetooth*)
Power Supply Requirement:	3.6V
Battery Type(s):	Li-Po
Antenna(s) Schematics:	



5. Deviations from the Test Specification

Test was performed as per test specification, methods and procedures detailed in section 3 of this report.

6. Operation and Configuration of the EUT during Testing

6.1. Operating Modes

The EUT was tested in the following operating mode(s) unless otherwise stated:

- Iridium 1600 MHz - Data allocated mode using 'TA12003_approvals' software to excise Low, Middle and High Channel with maximum power of up to 31.4 dBm.

6.2. Configuration and Peripherals

The EUT was tested in the following configuration(s) unless otherwise stated:

- Standalone fully charged battery powered.
- The Front and Back of the EUT was tested in direct contact (0mm separation) with the 'SAM' phantom flat section.

Body Configuration

a) The EUT was placed in a normal operating position where the centre of EUT was aligned with the centre reference point on the flat section of the 'SAM' phantom.

b) With the EUT touching the phantom at an imaginary centre line. The EUT was aligned with a marked plane (X and Y axis) consisting of two lines.

c) For the touch-safe position the EUT was gradually moved towards the flat section of the 'SAM' phantom until any point of the EUT touched the phantom.

d) For position(s) greater then 0mm separation the EUT was positioned as per the touch-safe position, and then the vertical height was decreased/adjusted as required.

e) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimise the drift.

f) The device was keyed to operate continuously in the transmit mode for the duration of the test.

g) The location of the maximum spatial SAR distribution (hot spot) was determined relative to the EUT and its antenna.

h) The EUT was transmitting at full power throughout the duration of the test powered by a fully charged battery.

7. Measurements, Examinations and Derived Results

7.1. General Comments

This section contains test results only.

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to section 8 for details of measurement uncertainties.

7.1.1.Conducted Average Power Measurement: (1616 MHz – 1626 MHz)

Channel Number	Frequency (MHZ)	Power (dBm)	Note
1	1616.0	31.3	Conducted
126	1621.0	31.3	Conducted
252	1626.0	31.4	Conducted

7.2. Test Results

For All SAR measurement in this report the SAR limit tested to is 1.6 W/Kg

7.2.1.Specific Absorption Rate – Iridium Satellite Body Configuration 1g

Test Summary:

Tissue Volume:	1g
Maximum Reported Level (W/kg):	0.937
Maximum Measured Level (W/kg):	0.779

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	22.0 to 22.0

Results:

Scan #	EUT Position	CH #	Freq (MHz)	Meas. Avg Power (dBm)	Max Rated Power (dBm)	Meas. Level (W/kg)	Reported SAR (W/kg)	Note(s)	Mod.
1	Front	126	1621.0	31.3	32.2	0.695	0.855	1	DE-QPSK
2	Back	126	1621.0	31.3	32.2	0.460	0.566	1	DE-QPSK
3	Front	1	1616.0	31.3	32.2	0.607	0.747	1	DE-QPSK
4	Front	252	1626.0	31.4	32.2	0.779	0.937	1	DE-QPSK

Note(s):

1. SAR measurements were performed with the EUT in direct contact with (separation distance of 0mm) the 'SAM' phantom flat section.

8. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Test Name	Confidence Level	Calculated Uncertainty
Specific Absorption Rate- Iridium 1640 MHz Body Configuration 1g	95%	±20.04%

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

8.1. Specific Absorption Rate- Iridium Satellite 1640 MHz Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	$c_{i\ (1g)}$	Standard Uncertainty		υ_i or υ_{eff}
							+ u (%)	- u (%)	
B	Probe calibration	6.000	6.000	normal (k=1)	1.0000	1.0000	6.000	6.000	∞
B	Axial Isotropy	0.250	0.250	normal (k=1)	1.0000	1.0000	0.250	0.250	∞
B	Hemispherical Isotropy	1.300	1.300	normal (k=1)	1.0000	1.0000	1.300	1.300	∞
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	∞
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	∞
B	Linearity	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	∞
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	∞
B	Readout Electronics	0.160	0.160	normal (k=1)	1.0000	1.0000	0.160	0.160	∞
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	∞
B	Integration Time	1.730	1.730	Rectangular	1.7321	1.0000	0.999	0.999	∞
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	∞
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	∞
B	Extrapolation and integration/ Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	∞
A	Test Sample Positioning	2.700	2.700	normal (k=1)	1.0000	1.0000	2.700	2.700	10
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	10
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	∞
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	∞
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	∞
A	Liquid Conductivity (measured value)	4.980	4.980	normal (k=1)	1.0000	0.6400	3.187	3.187	5
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	∞
A	Liquid Permittivity (measured value)	4.770	4.770	normal (k=1)	1.0000	0.6000	2.862	2.862	5
	Combined standard uncertainty			t-distribution			10.23	10.23	>250
	Expanded uncertainty			k = 1.96			20.04	20.04	>250

Appendix 1. Test Equipment Used

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A034	Narda 20W Termination	Narda	374BNM	8706	Calibrated as part of system	-
A1097	SMA Directional Coupler	MiDISCO	MDC6223-30	None	Calibrated as part of system	-
A1137	3dB Attenuator	Narda	779	04690	Calibrated as part of system	-
A1174	Dielectric Probe Kit	Agilent Technologies	85070C	Us99360072	Calibrated before use	-
A1328	Handset Positioner	Schmid & Partner Engineering AG	Modification	SD 000 H01 DA	-	-
A1182	Handset Positioner	Schmid & Partner Engineering AG	V3.0	None	-	-
A1234	Data Acquisition Electronics	Schmid & Partner Engineering AG	DAE3	450	22 Jan 2013	12
L1090	Probe	Schmid & Partner Engineering AG	EX3 DV4	3871	20 Aug 2012	12
L1089	1640 MHz Dipole Kit	Schmid & Partner Engineering AG	D1640V2	324	11 Feb 2013	12
A1497	Amplifier	Mini-Circuits	zhl-42w (sma)	e020105	Calibrated as part of system	-
A1566	SAM Phantom	Schmid & Partner Engineering AG	SAM a (Site 56)	002	Calibrated before use	-
A215	20 dB Attenuator	Narda	766-20	9402	Calibrated as part of system	-
A2263	Digital Camera	Samsung	PL211	9453C90B 607487L	-	-
M1015	Network Analyser	Agilent Technologies	8753ES	US39172406	09 Oct 2012	12
C1145	Cable	Rosenberger MICRO-COAX	FA147A F003003030	41843-1	Calibrated as part of system	-
C1146	Cable	Rosenberger MICRO-COAX	FA147A F030003030	41752-1	Calibrated as part of system	-
G0592	Robot Power Supply	Schmid & Partner Engineering AG	DASY53	None	Calibrated before use	-
G087	PSU	Thurlby Thandar	CPX200	100701	Calibrated before use	-
M1680	Robot Arm	Staubli	TX60 L	F12/5MZ7 A1/A/01	Calibrated before use	-
M1647	Signal Generator	Hewlett Packward	8648C	3537A01598	01 Jun 2012	12

UL No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
M1071	Spectrum Analyzer	Agilent	HP8590E	3647U00514	(Monitoring use only)	-
M1270	Digital Thermometer	RS	N/A	N/A	Internal Checked 13 May 2012	12
M1023	Dual Channel Power Meter	R & S	NRVD	863715/030	18 July 2012	12
M1634	Diode Power Sensor	R & S	NRV-Z1	860462/016	27 June 2012	12
M1635	Diode Power Sensor	R & S	NRV-Z1	860462/015	27 June 2012	12
S513	SAR Lab	UL	Site 58	N/A	Calibrated before use	-

Note:

All the assets were in calibration during the course of testing.

A.1.1. Calibration Certificates

This section contains the calibration certificates and data for the Probe(s) and Dipole(s) used, which are not included in the total number of pages for this report.

Checked by [redacted]
DATE: 26-FEB-2013

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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 108

Client UL CCS USA

Certificate No: EX3-3871_Aug12

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3871

Calibration procedure(s): QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date: August 20, 2012

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	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: August 20, 2012

TS ✓

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
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 108

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3871

Manufactured: February 2, 2012
Calibrated: August 20, 2012

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3871

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.40	0.50	0.44	± 10.1 %
DCP (mV)[B]	107.2	96.3	103.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	145.3	±3.5 %
			Y	0.00	0.00	1.00	163.2	
			Z	0.00	0.00	1.00	151.9	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3871

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	43.5	0.87	10.39	10.39	10.39	0.12	1.00	± 13.4 %
750	41.9	0.89	10.04	10.04	10.04	0.80	0.60	± 12.0 %
835	41.5	0.90	9.55	9.55	9.55	0.28	1.06	± 12.0 %
900	41.5	0.97	9.51	9.51	9.51	0.33	0.99	± 12.0 %
1450	40.5	1.20	8.83	8.83	8.83	0.28	1.02	± 12.0 %
1640	40.3	1.29	9.22	9.22	9.22	0.37	0.84	± 12.0 %
1750	40.1	1.37	8.62	8.62	8.62	0.42	0.77	± 12.0 %
1900	40.0	1.40	8.26	8.26	8.26	0.46	0.75	± 12.0 %
1950	40.0	1.40	8.01	8.01	8.01	0.71	0.57	± 12.0 %
2000	40.0	1.40	8.23	8.23	8.23	0.44	0.75	± 12.0 %
2300	39.5	1.67	7.76	7.76	7.76	0.34	0.83	± 12.0 %
2450	39.2	1.80	7.35	7.35	7.35	0.32	0.82	± 12.0 %
2600	39.0	1.96	7.14	7.14	7.14	0.34	0.92	± 12.0 %
3500	37.9	2.91	7.06	7.06	7.06	0.46	0.95	± 13.1 %
3700	37.7	3.12	6.39	6.39	6.39	0.48	0.89	± 13.1 %
4950	36.3	4.40	5.44	5.44	5.44	0.30	1.80	± 13.1 %
5200	36.0	4.66	5.18	5.18	5.18	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.92	4.92	4.92	0.35	1.80	± 13.1 %
5500	35.6	4.96	4.75	4.75	4.75	0.45	1.80	± 13.1 %
5600	35.5	5.07	4.49	4.49	4.49	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.53	4.53	4.53	0.50	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

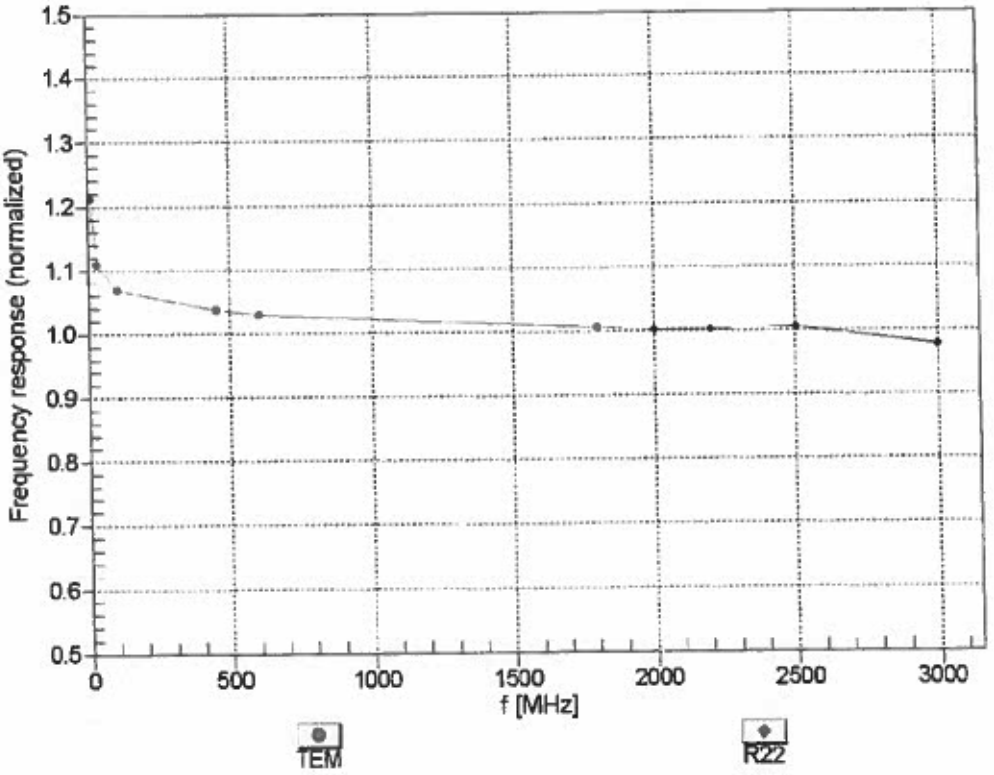
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3871

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	56.7	0.94	11.10	11.10	11.10	0.04	1.00	± 13.4 %
750	55.5	0.96	9.75	9.75	9.75	0.25	1.17	± 12.0 %
835	55.2	0.97	9.68	9.68	9.68	0.28	1.08	± 12.0 %
900	55.0	1.05	9.62	9.62	9.62	0.41	0.90	± 12.0 %
1450	54.0	1.30	8.65	8.65	8.65	0.35	0.89	± 12.0 %
1640	53.8	1.40	8.77	8.77	8.77	0.60	0.69	± 12.0 %
1750	53.4	1.49	8.10	8.10	8.10	0.36	0.85	± 12.0 %
1900	53.3	1.52	7.83	7.83	7.83	0.56	0.68	± 12.0 %
1950	53.3	1.52	8.06	8.06	8.06	0.53	0.70	± 12.0 %
2000	53.3	1.52	7.97	7.97	7.97	0.45	0.75	± 12.0 %
2300	52.9	1.81	7.67	7.67	7.67	0.52	0.67	± 12.0 %
2450	52.7	1.95	7.44	7.44	7.44	0.79	0.54	± 12.0 %
2600	52.5	2.16	7.31	7.31	7.31	0.80	0.50	± 12.0 %
3500	51.3	3.31	6.54	6.54	6.54	0.40	1.09	± 13.1 %
3700	51.0	3.55	6.61	6.61	6.61	0.34	1.18	± 13.1 %
4950	49.4	5.01	4.73	4.73	4.73	0.50	1.90	± 13.1 %
5200	49.0	5.30	4.42	4.42	4.42	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.21	4.21	4.21	0.53	1.90	± 13.1 %
5500	48.6	5.65	4.01	4.01	4.01	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.89	3.89	3.89	0.55	1.90	± 13.1 %
5800	48.2	6.00	4.23	4.23	4.23	0.55	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

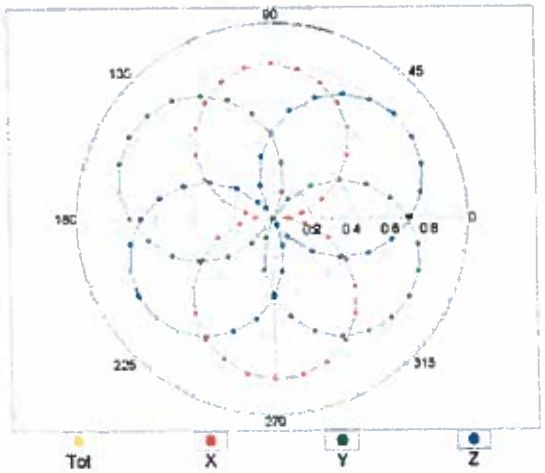
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



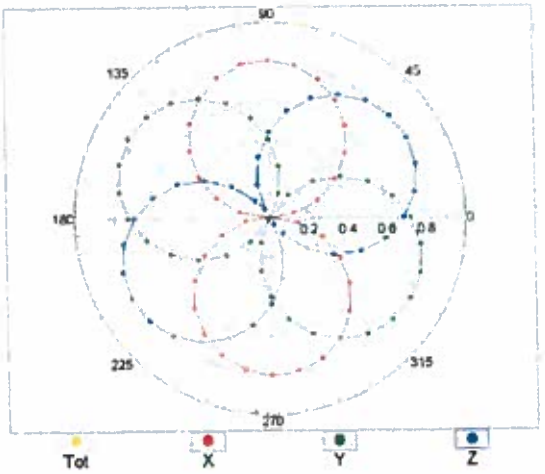
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

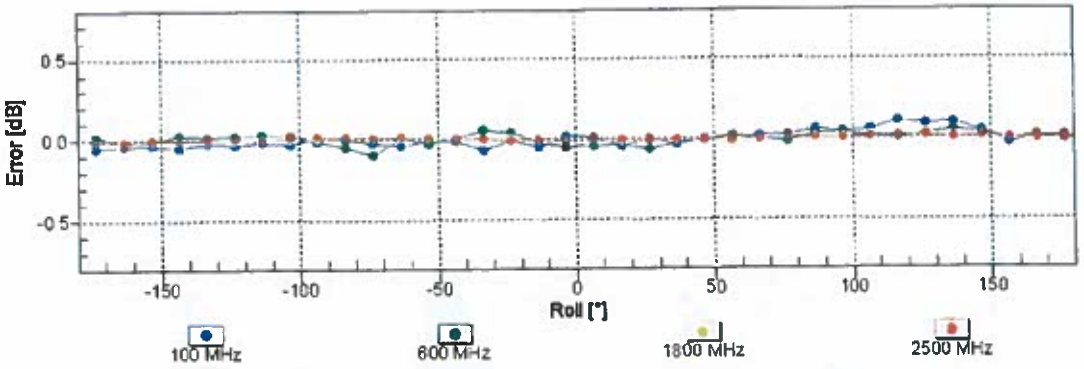
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



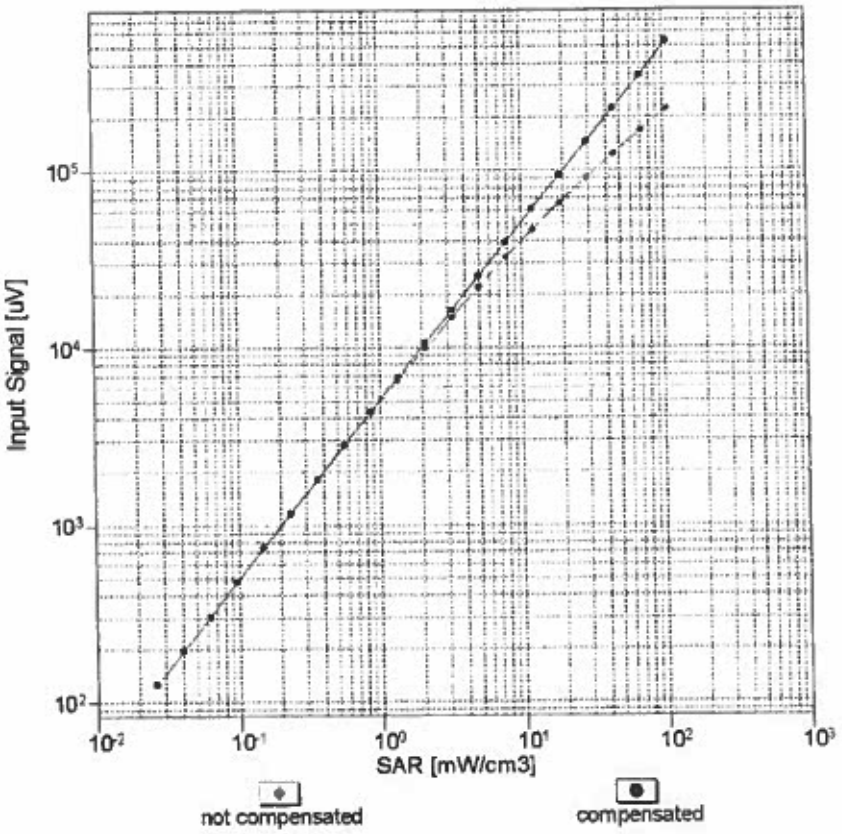
f=1800 MHz,R22

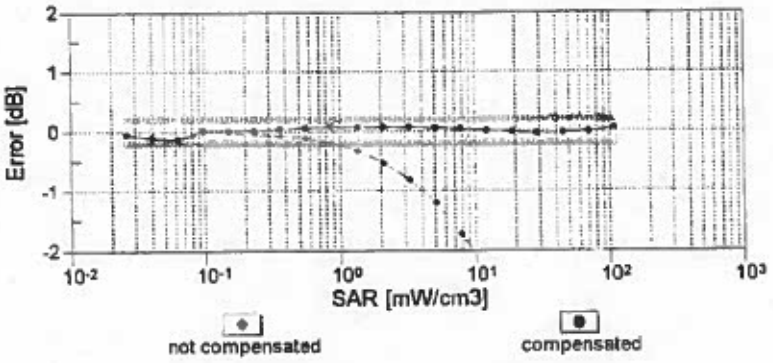




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

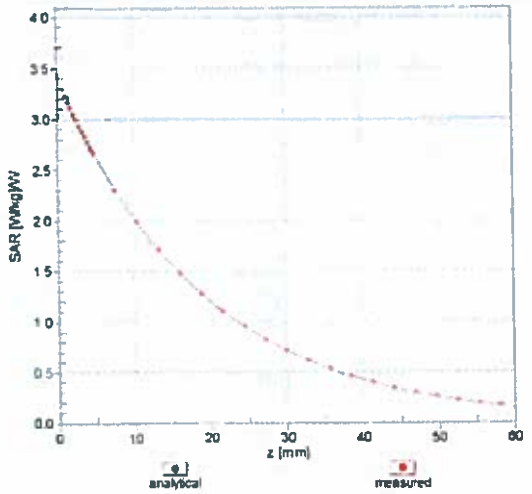




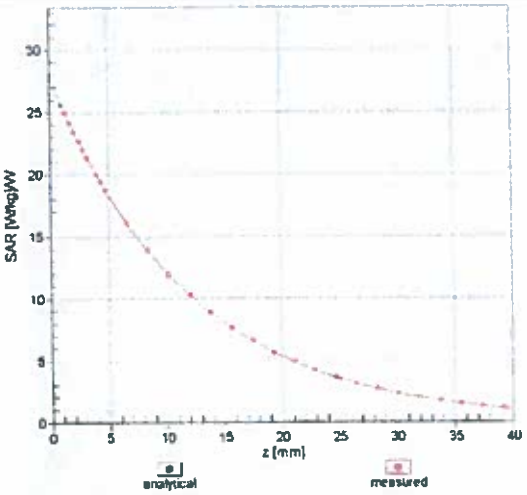
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

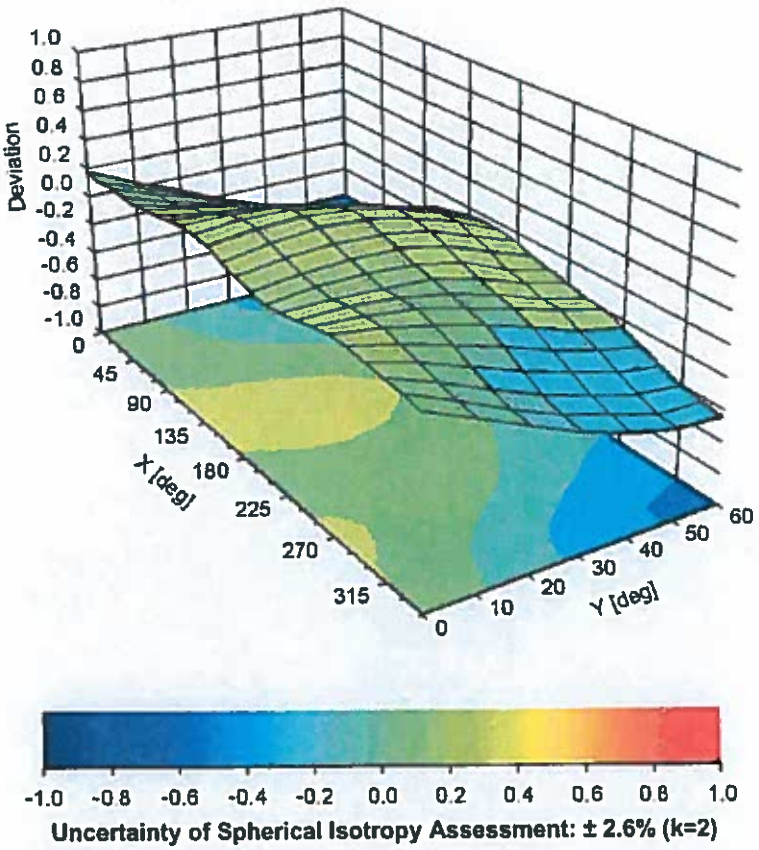


f = 1900 MHz,WGLS R22 (H_convF)



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: EX3DV4 - SN:3871

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	36.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

Checked by: DATE: 26-FEB-2013

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
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 108

Client UL CCS USA L1089 **Certificate No:** D1640V2-324_Feb13

CALIBRATION CERTIFICATE

Object	D1640V2 - SN: 324
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	February 11, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 11, 2013

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1640 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.2	1.31 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.3 ± 6 %	1.35 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	8.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**34.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.70 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**18.6 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.7	1.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.8 ± 6 %	1.43 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	8.32 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**33.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.53 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**18.0 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.5 Ω + 2.3 jΩ
Return Loss	- 31.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.3 Ω + 1.6 jΩ
Return Loss	- 29.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.235 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	April 12, 2007

DASY5 Validation Report for Head TSL

Date: 11.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1640 MHz; Type: D1640V2; Serial: D1640V2 - SN: 324

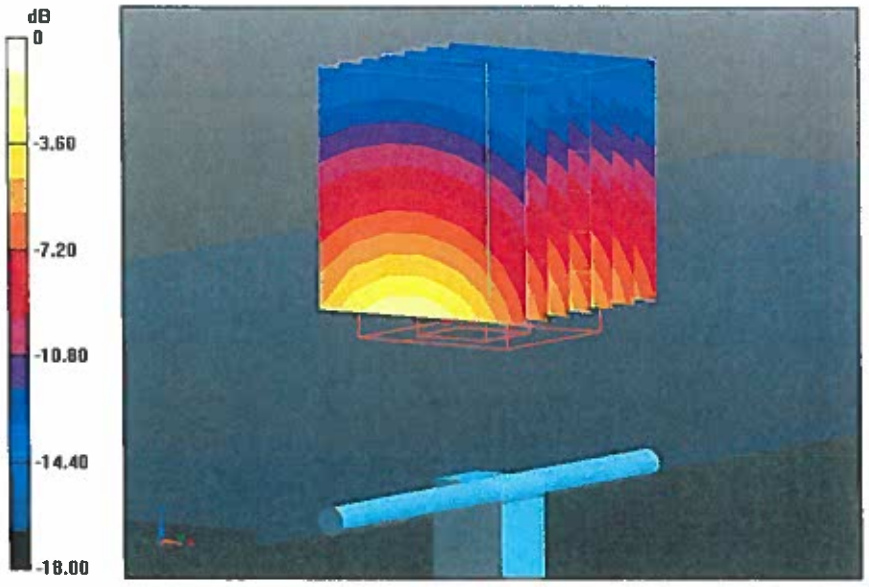
Communication System: CW; Frequency: 1640 MHz
Medium parameters used: f = 1640 MHz; σ = 1.35 S/m; ε_r = 41.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.29, 5.29, 5.29); Calibrated: 28.12.2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

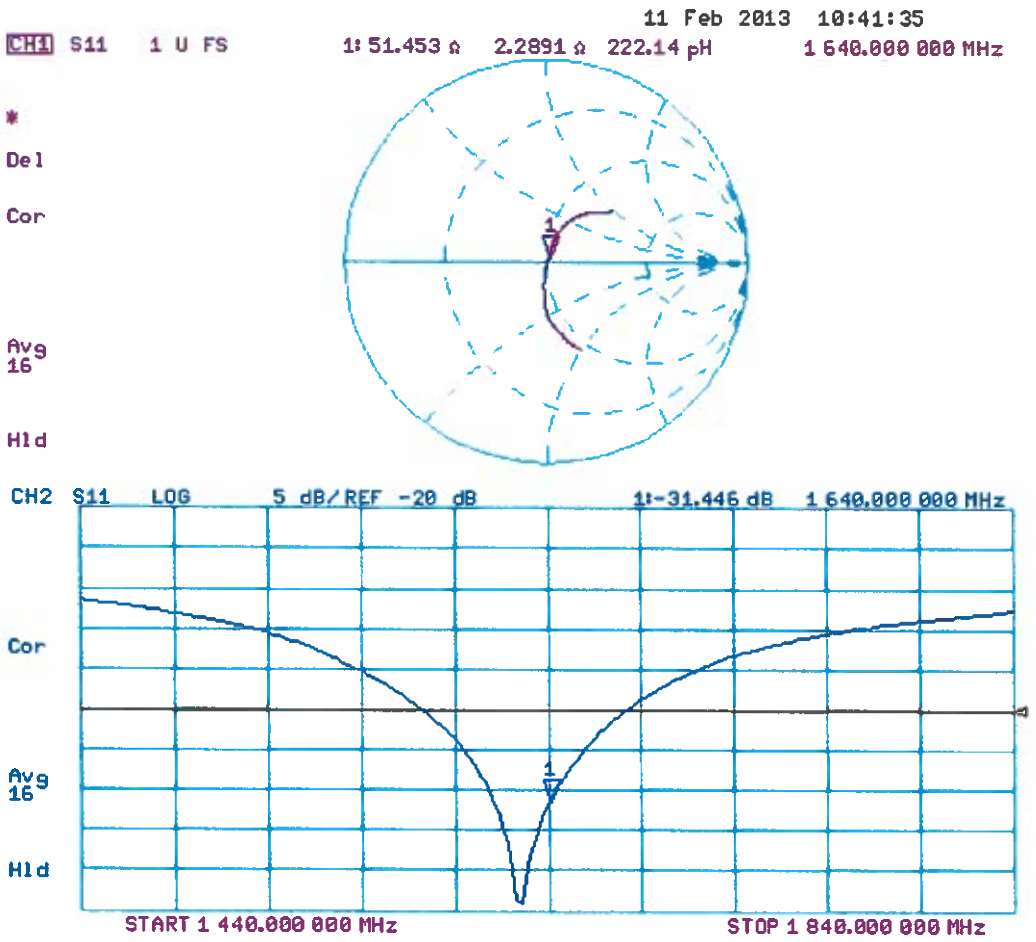
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)

(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.975 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 15.6 W/kg
SAR(1 g) = 8.69 W/kg; SAR(10 g) = 4.7 W/kg
Maximum value of SAR (measured) = 9.47 W/kg



0 dB = 9.47 W/kg = 9.76 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1640 MHz; Type: D1640V2; Serial: D1640V2 - SN: 324

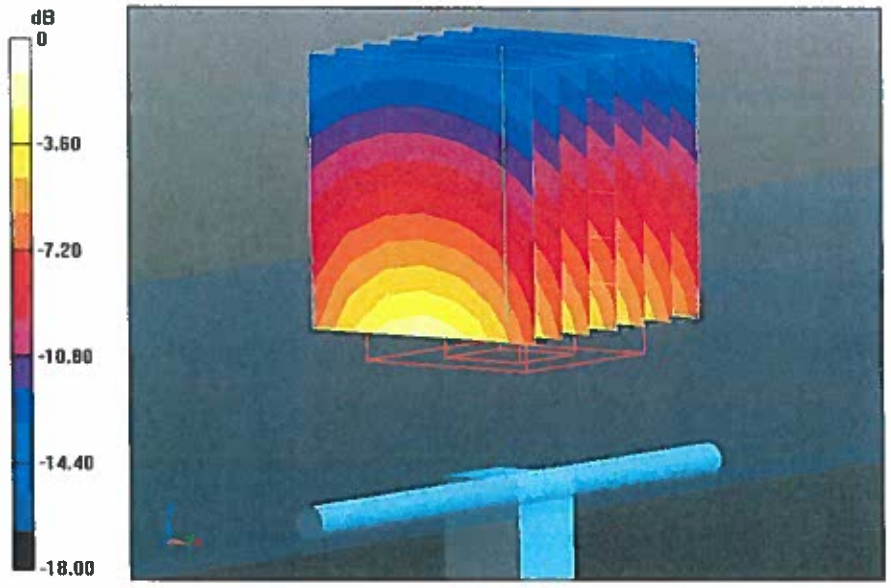
Communication System: CW; Frequency: 1640 MHz
Medium parameters used: f = 1640 MHz; σ = 1.43 S/m; ε_r = 52.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.15, 5.15, 5.15); Calibrated: 28.12.2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

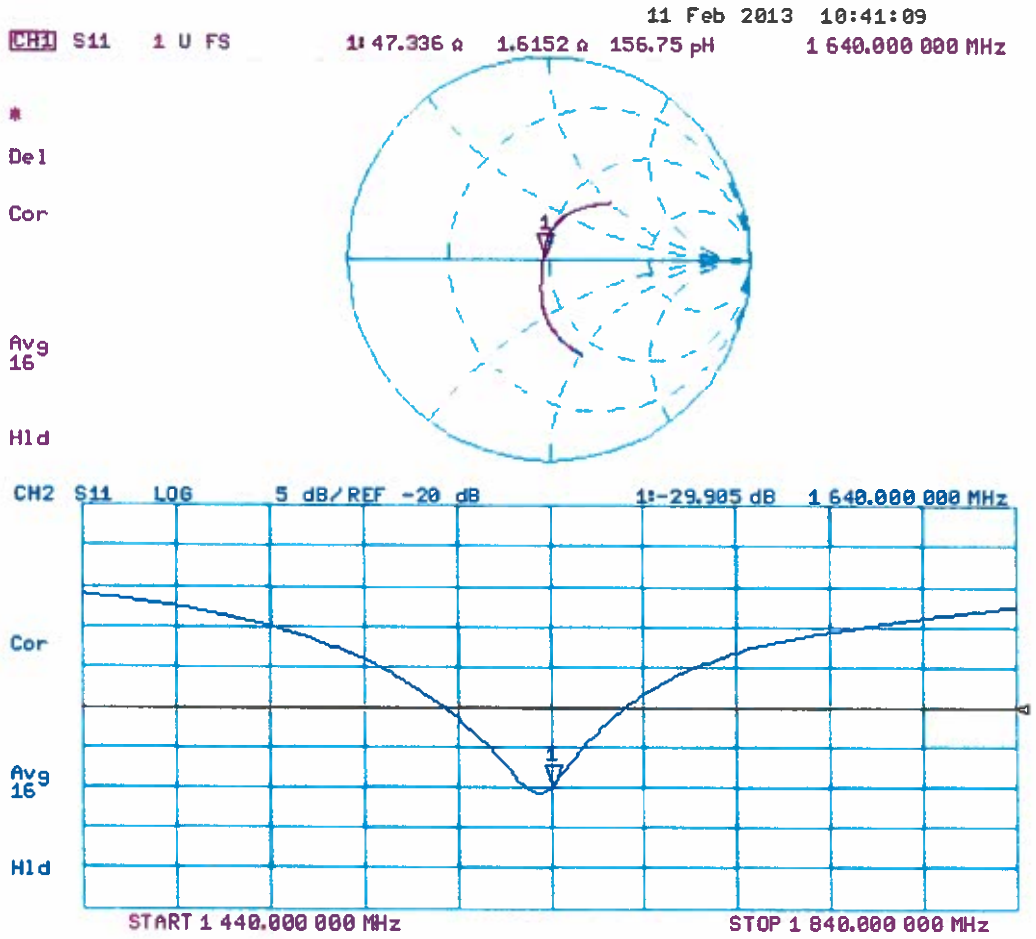
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)

(7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.975 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 14.6 W/kg
SAR(1 g) = 8.32 W/kg; SAR(10 g) = 4.53 W/kg
Maximum value of SAR (measured) = 9.26 W/kg



0 dB = 9.26 W/kg = 9.67 dBW/kg

Impedance Measurement Plot for Body TSL



Appendix 2. Measurement Methods

A.2.1. Evaluation Procedure

The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

a) (i) The evaluation was performed in an applicable area of the phantom depending on the type of device being tested. For devices worn about the ear during normal operation, both the left and right ear positions were evaluated at the centre frequency of the band at maximum power. The side, which produced the greatest SAR, determined which side of the phantom would be used for the entire evaluation. The positioning of the head worn device relative to the phantom was dictated by the test specification identified in section 3.1 of this report.

(ii) For body worn devices or devices which can be operated within 20 cm of the body, the flat section of the SAM phantom was used were the size of the device(s) is normal. for bigger devices and base station the 2mm Oval phantom is used for evaluation. The type of device being evaluated dictated the distance of the EUT to the outer surface of the phantom flat section.

b) The SAR was determined by a pre-defined procedure within the DASY4 software. The exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm or appropriate resolution.

c) A 5x5x7 matrix for measurement < 2.0 GHz, 7x7x7 matrix for measurement 2.0 GHz to 3.0 GHz, and 7x7x12 for > 5.0 GHz was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.

d) If the EUT had any appreciable drift over the course of the evaluation, then the EUT was re-evaluated. Any unusual anomalies over the course of the test also warranted a re-evaluation.

A.2.2. Specific Absorption Rate (SAR) Measurements to OET Bulletin 65 Supplement C: (2001-01)

Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields

SAR measurements were performed in accordance with Appendix D of the standard FCC OET Bulletin 65 Supplement C: 2001, IEEE 1528 and FCC KDB procedures, against appropriate limits for each measurement position in accordance with the standard. In some cases the FCC was contacted using a PBA or KDB process to ensure test is performed correctly.

The test was performed in a shielded enclosure with the temperature controlled to remain between +18.0ºC and +25.0ºC. The tissue equivalent material fluid temperature was controlled to give a maximum variation of ± 2.0ºC

Prior to any SAR measurements on the EUT, system Check and material dielectric property measurements were conducted. In the absence of a detailed procedure within the specification, system Check and material dielectric property measurements were performed in accordance with Appendix C and Appendix D of FCC OET Bulletin 65 Supplement C: 2001 and FCC KDB publication 865664 D01.

Following the successful system Check and material dielectric property measurements, a SAR versus time sweep shall be performed within 10 mm of the phantom inner surface. If the EUT power output is stable after three minutes then the measurement probe will perform a coarse surface level scan at each test position in order to ascertain the location of the maximum local SAR level. Once this area had been established, a 5x5x7 cube of 175 points for frequency below 2.0 GHz, above 2.0GHz up to 3.0 GHz 7x7x7 cube of 343 points and a 7x7x12 cube of 588 points for frequency 5.0 GHz and above will be centred at the area of concern. Extrapolation and interpolation will then be carried out on the 27g of tissue and the highest averaged SAR over a 1g cube determined.

Once the maximum interpolated SAR measurement is complete; the coarse scan is visually assessed to check for secondary peaks within 50% of the maximum SAR level. If there are any further SAR measurements required, extra 5x5x7 or 7x7x7 or 7x7x12 cubes shall be centred on each of these extra local SAR maxima.

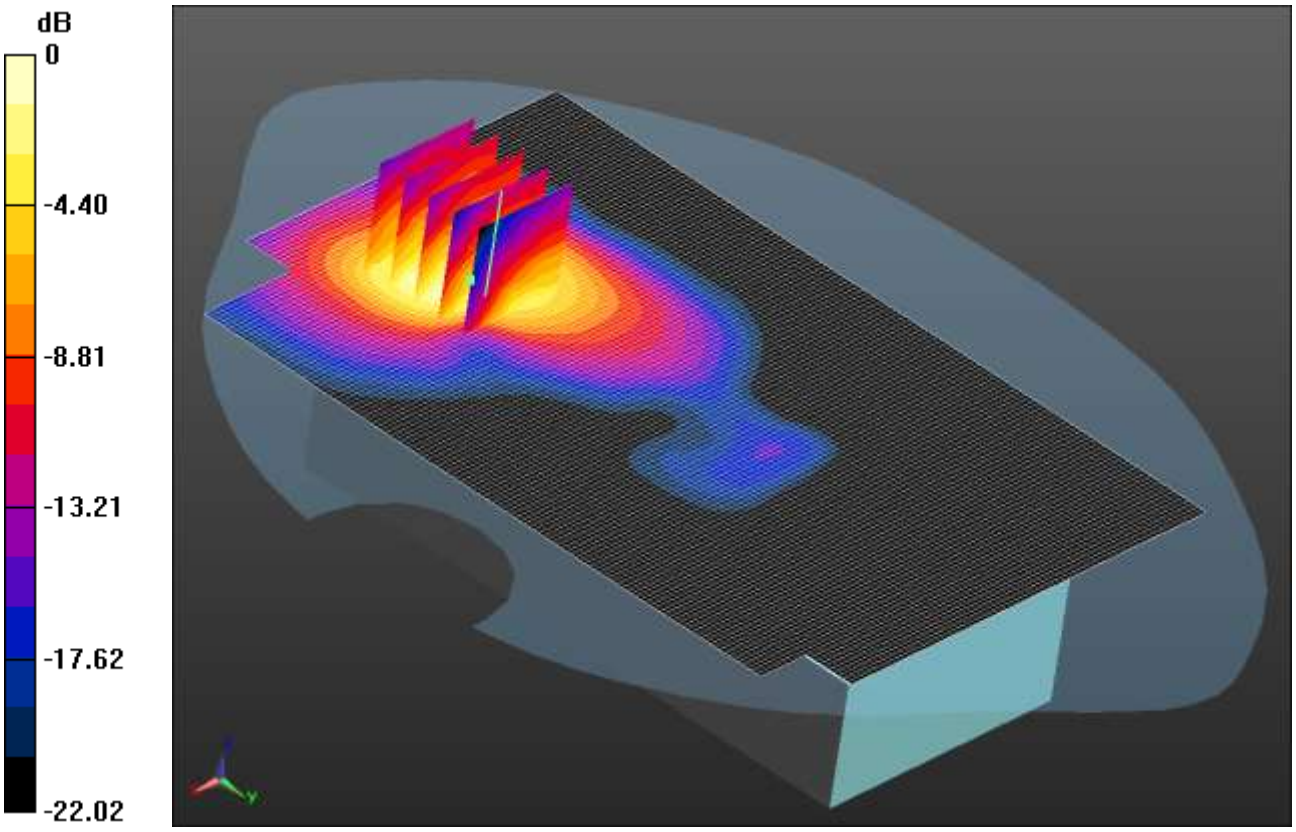
At the end of each position test case a second time sweep shall be performed to check whether the EUT has remained stable throughout the test.

Appendix 3. SAR Distribution Scans

This appendix contains SAR distribution scans which are not included in the total number of pages for this report.

Scan Reference Number	Title
SCN/91065JD01/001	Front of EUT Facing Phantom 1621MHz CH126
SCN/91065JD01/002	Back of EUT Facing Phantom 1621MHz CH126
SCN/91065JD01/003	Front of EUT Facing Phantom 1616MHz CH1
SCN/91065JD01/004	Front of EUT Facing Phantom 1626MHz CH252
SCN/91065JD01/005	System Performance Check 1640MHz Body 06 03 13

SCN/91065JD01/001: Front of EUT Facing Phantom 1621MHz CH126
Date: 06/03/2013
DUT: Rock Seven Mobile; Type: RockSTAR; Serial: SAR TEST1

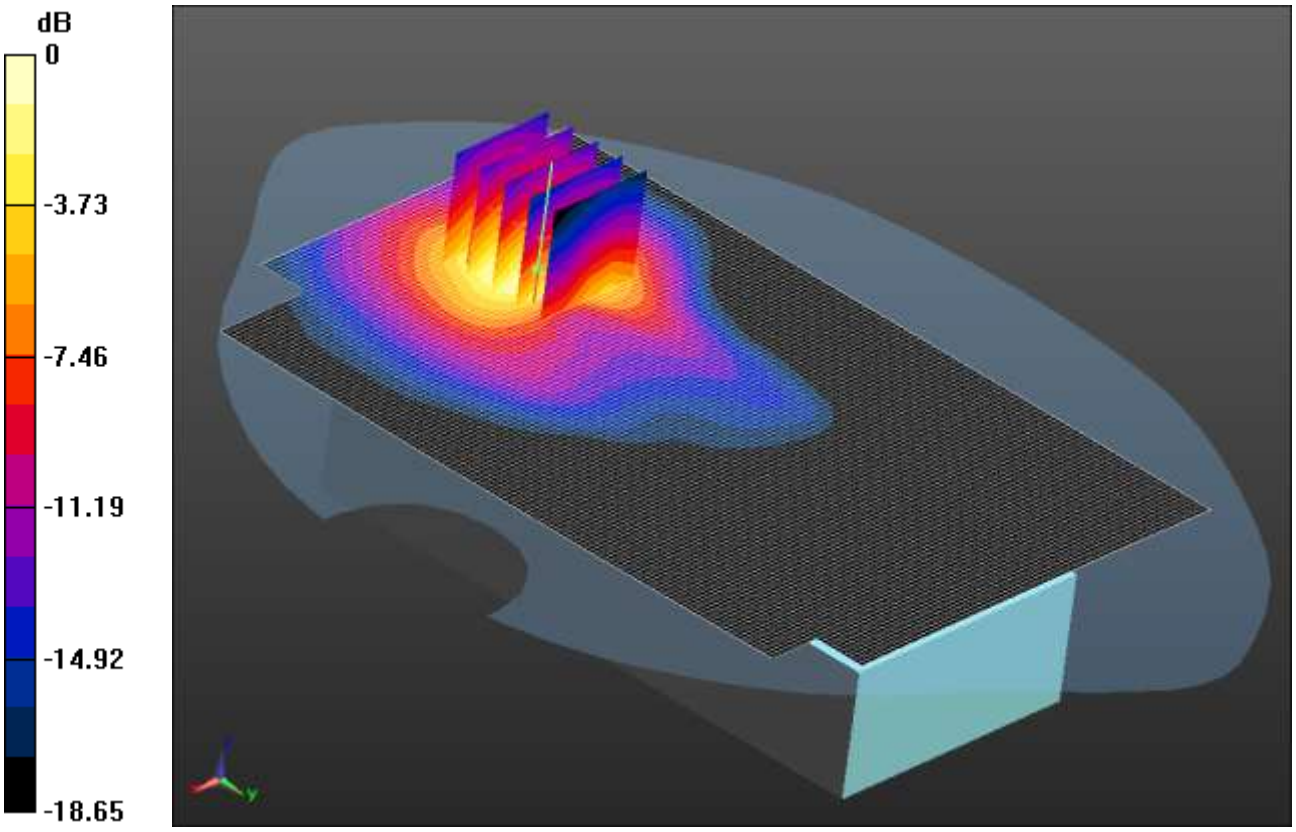


0 dB = 0.749 W/kg = -1.26 dBW/kg

Communication System: 1640MHz Band; Frequency: 1621 MHz;Duty Cycle: 1:10.8993
Medium: 1640 MHz MSL Medium parameters used (interpolated): f = 1621 MHz; σ = 1.37 mho/m; ε_r = 52.727; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY4 Configuration:
- Probe: EX3DV4 - SN3871; ConvF(8.77, 8.77, 8.77); Calibrated: 20/08/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 22/01/2013
- Phantom: SAM A (Site 58); Type: QD000P40Ca; Serial: TP:1193
- ; SEMCAD X Version 14.6.7 (6848)

Configuration/Front - Middle/Area Scan (91x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.895 W/kg
Configuration/Front - Middle/Zoom Scan 2 2 (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.130 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.24 W/kg
SAR(1 g) = 0.695 W/kg; SAR(10 g) = 0.384 W/kg
Maximum value of SAR (measured) = 0.749 W/kg

SCN/91065JD01/002: Back of EUT Facing Phantom 1621MHz CH126
Date: 06/03/2013
DUT: Rock Seven Mobile; Type: RockSTAR; Serial: SAR TEST1

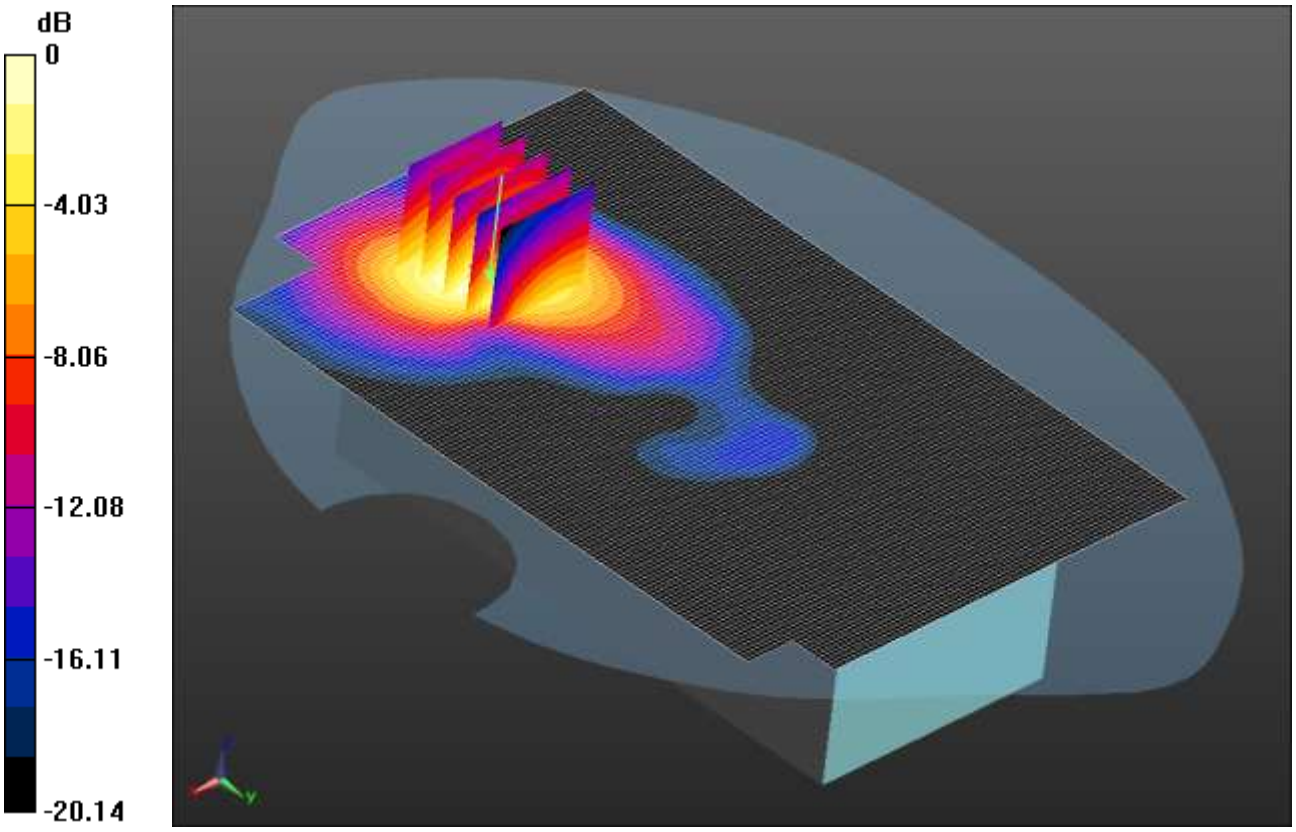


0 dB = 0.517 W/kg = -2.87 dBW/kg

Communication System: 1640MHz Band; Frequency: 1621 MHz;Duty Cycle: 1:10.8993
Medium: 1640 MHz MSL Medium parameters used (interpolated): f = 1621 MHz; σ = 1.37 mho/m; ε_r = 52.727; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY4 Configuration:
- Probe: EX3DV4 - SN3871; ConvF(8.77, 8.77, 8.77); Calibrated: 20/08/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 22/01/2013
- Phantom: SAM A (Site 58); Type: QD000P40Ca; Serial: TP:1193
- ; SEMCAD X Version 14.6.7 (6848)

Configuration/Back - Middle/Area Scan (91x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.518 W/kg
Configuration/Back - Middle/Zoom Scan 2 2 (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.227 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.791 W/kg
SAR(1 g) = 0.460 W/kg; SAR(10 g) = 0.252 W/kg
Maximum value of SAR (measured) = 0.517 W/kg

SCN/91065JD01/003: Front of EUT Facing Phantom 1616MHz CH1
Date: 06/03/2013
DUT: Rock Seven Mobile; Type: RockSTAR; Serial: SAR TEST1

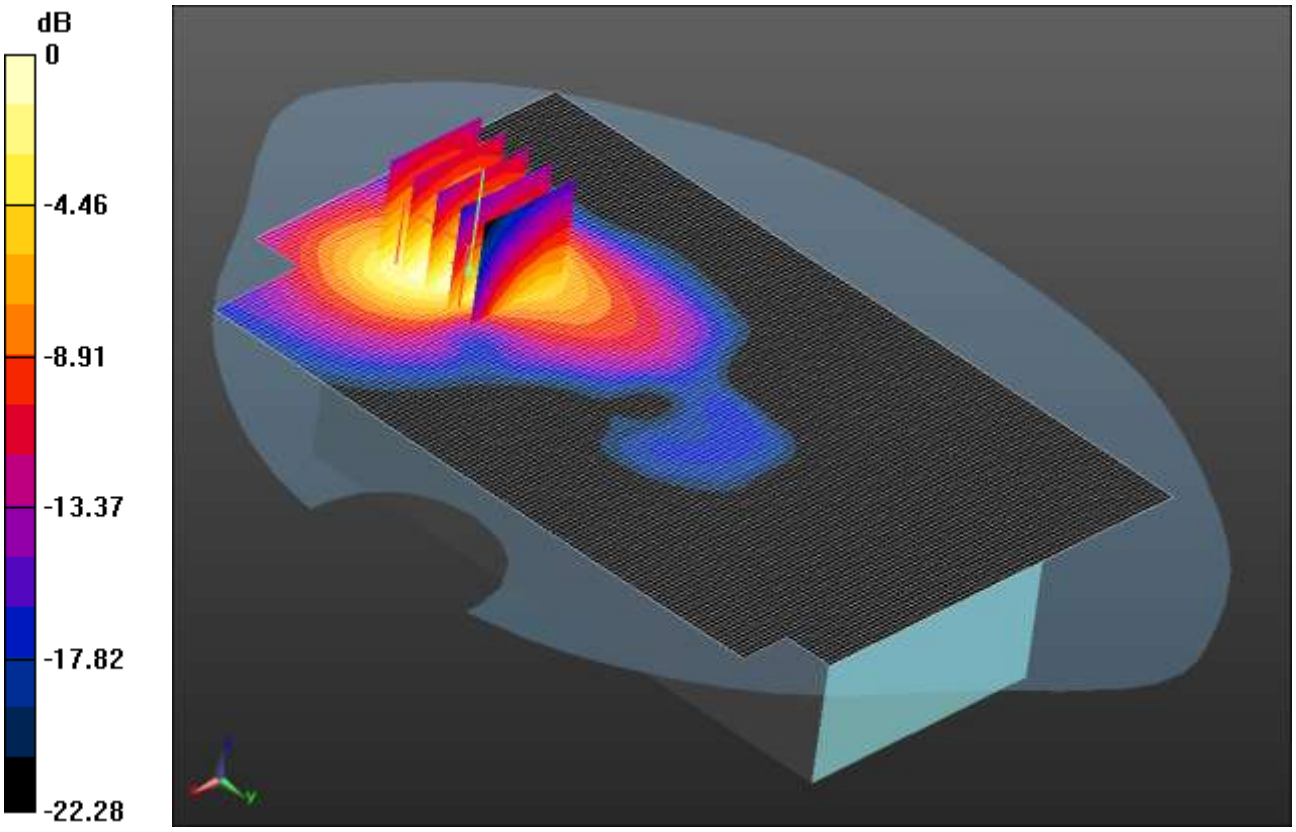


0 dB = 0.631 W/kg = -2.00 dBW/kg

Communication System: 1640MHz Band; Frequency: 1616 MHz;Duty Cycle: 1:10.8993
Medium: 1640 MHz MSL Medium parameters used (interpolated): f = 1616 MHz; σ = 1.367 mho/m; ε_r = 52.74; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY4 Configuration:
- Probe: EX3DV4 - SN3871; ConvF(8.77, 8.77, 8.77); Calibrated: 20/08/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 22/01/2013
- Phantom: SAM A (Site 58); Type: QD000P40Ca; Serial: TP:1193
- ; SEMCAD X Version 14.6.7 (6848)

Configuration/Front - Low/Area Scan (91x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.715 W/kg
Configuration/Front - Low/Zoom Scan 2 2 (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.131 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.09 W/kg
SAR(1 g) = 0.607 W/kg; SAR(10 g) = 0.337 W/kg
Maximum value of SAR (measured) = 0.631 W/kg

SCN/91065JD01/004: Front of EUT Facing Phantom 1626MHz CH252
Date: 06/03/2013
DUT: Rock Seven Mobile; Type: RockSTAR; Serial: SAR TEST1

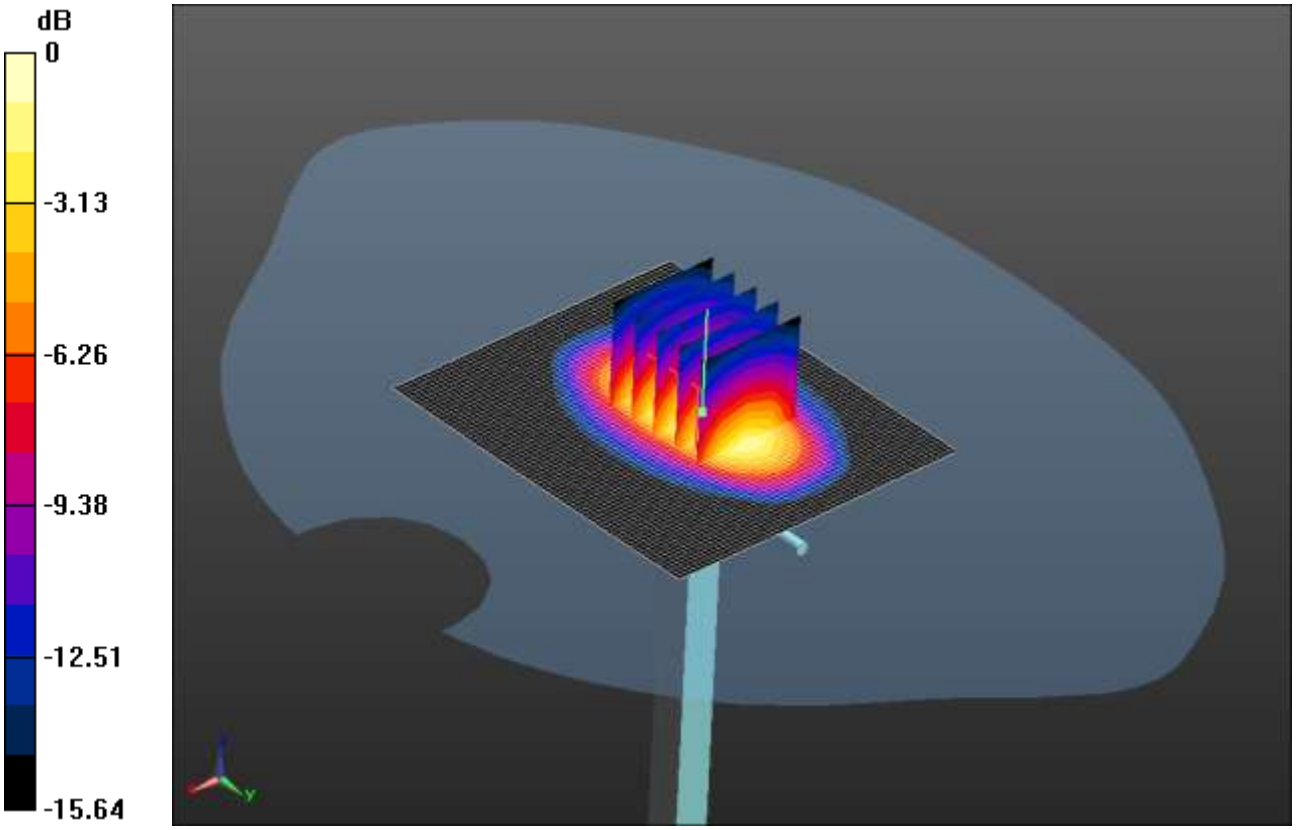


0 dB = 0.831 W/kg = -0.80 dBW/kg

Communication System: 1640MHz Band; Frequency: 1626 MHz;Duty Cycle: 1:10.8993
Medium: 1640 MHz MSL Medium parameters used (interpolated): f = 1626 MHz; σ = 1.373 mho/m; ε_r = 52.714; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY4 Configuration:
- Probe: EX3DV4 - SN3871; ConvF(8.77, 8.77, 8.77); Calibrated: 20/08/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 22/01/2013
- Phantom: SAM A (Site 58); Type: QD000P40Ca; Serial: TP:1193
- ; SEMCAD X Version 14.6.7 (6848)

Configuration/Front - High/Area Scan (91x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.955 W/kg
Configuration/Front - High/Zoom Scan 2 2 (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.889 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.37 W/kg
SAR(1 g) = 0.779 W/kg; SAR(10 g) = 0.432 W/kg
Maximum value of SAR (measured) = 0.831 W/kg

SCN/91065JD01/005: System Performance Check 1640MHz Body 06 03 13
Date: 06/03/2013
DUT: Dipole 1640 MHz D1640V2; Type: D1640V2; Serial: D1640V2 - SN324



0 dB = 9.39 W/kg = 9.73 dBW/kg
Communication System: CW; Frequency: 1640 MHz;Duty Cycle: 1:1
Medium: 1640 MHz MSL Medium parameters used (interpolated): f = 1640 MHz; σ = 1.381 mho/m; ε_r = 52.678; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY4 Configuration:
- Probe: EX3DV4 - SN3871; ConvF(8.77, 8.77, 8.77); Calibrated: 20/08/2012;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn450; Calibrated: 22/01/2013
- Phantom: SAM A (Site 58); Type: QD000P40Ca; Serial: TP:1193
- ; SEMCAD X Version 14.6.7 (6848)

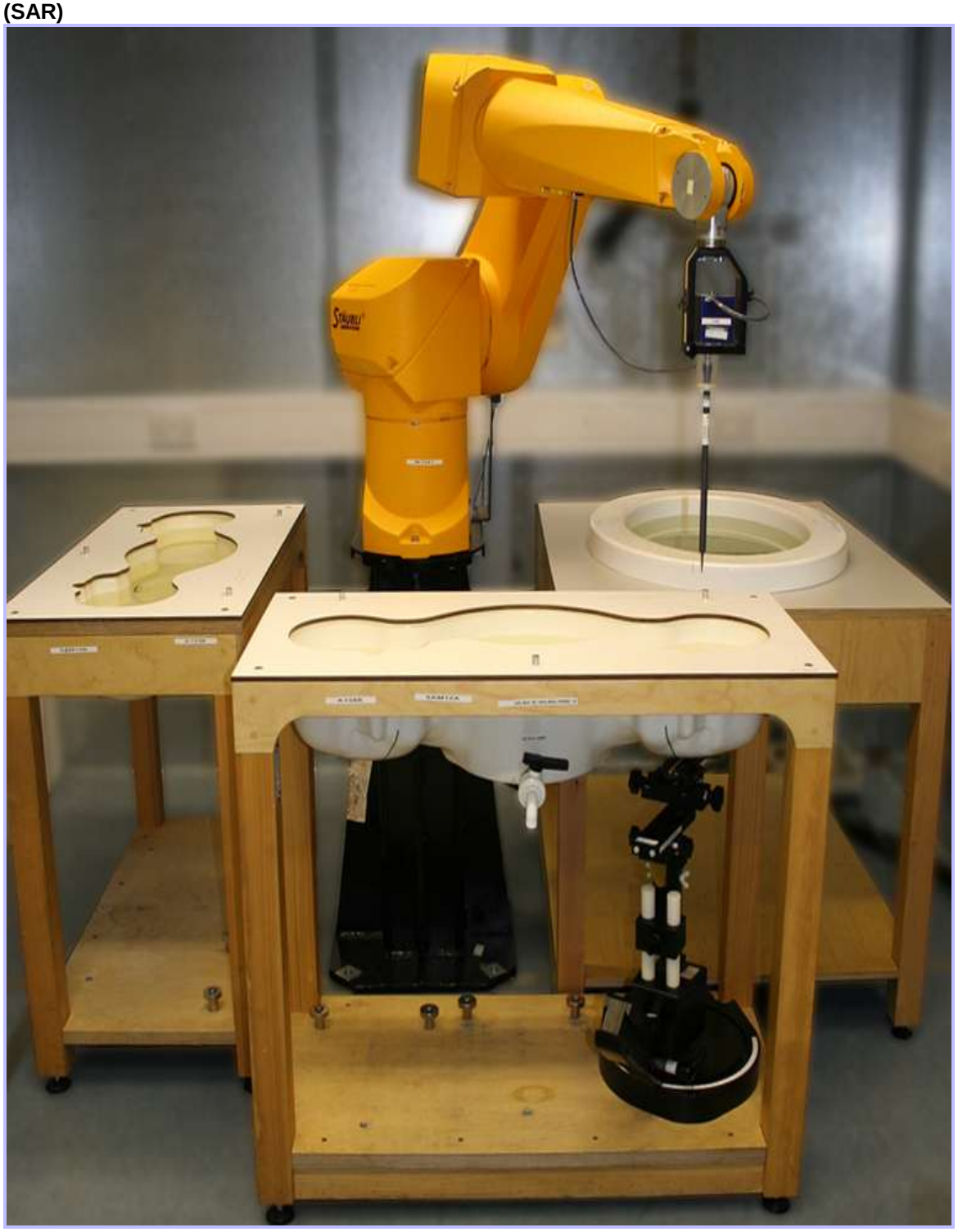
SAR/d=10mm, Pin=250 mW, dist=10.0mm (ET-Probe) 2/Area Scan (61x71x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 10.3 W/kg
SAR/d=10mm, Pin=250 mW, dist=10.0mm (ET-Probe) 2/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 81.449 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 14.6 W/kg
SAR(1 g) = 8.39 W/kg; SAR(10 g) = 4.56 W/kg
Maximum value of SAR (measured) = 9.39 W/kg

Appendix 4. Photographs

This appendix contains the following photographs:

Photo Reference Number	Title
PHT/91065JD01/001	Test configuration for the measurement of Specific Absorption Rate (SAR)
PHT/91065JD01/002	Front of EUT Facing Phantom at 0mm Separation
PHT/91065JD01/003	Back of EUT Facing Phantom at 0mm Separation
PHT/91065JD01/004	Front View of EUT
PHT/91065JD01/005	Back View of EUT (Radiated Sample)
PHT/91065JD01/006	Back View of EUT (Conducted Sample)
PHT/91065JD01/007	Internal View of EUT
PHT/91065JD01/008	1640MHz Body Fluid Level

PHT/91065JD01/001: Test configuration for the measurement of Specific Absorption Rate (SAR)



PHT/91065JD01/002: Front of EUT Facing Phantom at 0mm Separation

PHT/91065JD01/003: Back of EUT Facing Phantom at 0mm Separation

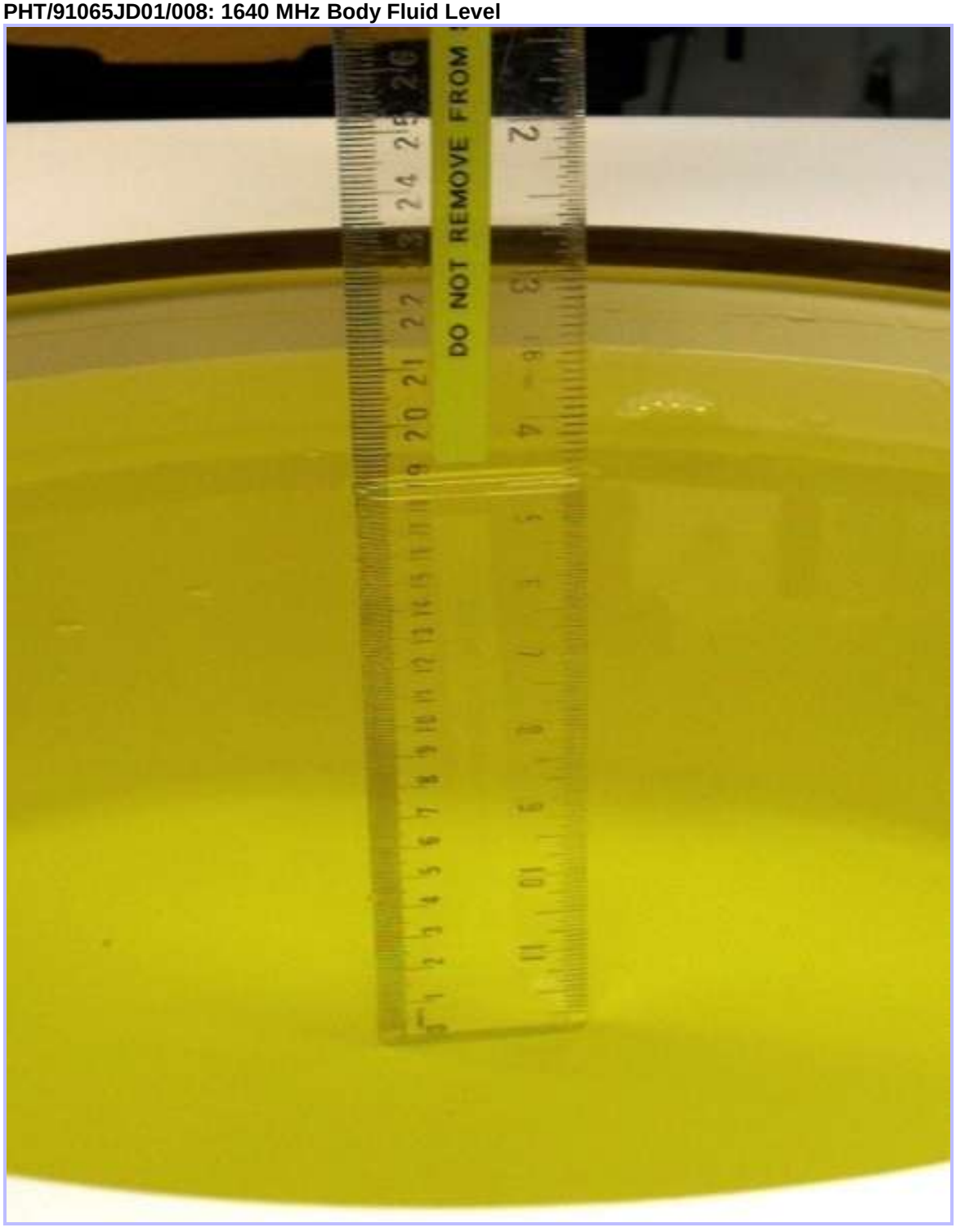
PHT/91065JD01/004: Front View of EUT

PHT/91065JD01/005: Back View of EUT (Radiated Sample)

PHT/91065JD01/006: Back View of EUT (Conducted Sample)

PHT/91065JD01/007: Internal View of EUT

PHT/91065JD01/008: 1640 MHz Body Fluid Level



Appendix 5. System Check

Prior to the assessment, the system was verified in the flat region of the phantom.
A 1640 MHz dipole was used. A forward power of 250 mW was applied to the dipole and the system was verified to a tolerance of ±5% for the 1640 MHz dipole.

The applicable verification normalised to 1 Watt.

System Check 1640 Body:
Date: 06/03/2013
Validation Dipole and Serial Number: D1640V2; SN: 324

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	1640	24.0 ºC	22.0 ºC	ε_r	53.80	52.68	-2.08	5.00
				σ	1.40	1.38	-1.42	5.00
				1g SAR	33.00	33.56	1.69	5.00
				10g SAR	18.00	18.24	1.33	5.00

Appendix 6. Simulated Tissues

The body mixture consists of water, Polysorbate (Tween 20) and salt. Visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

Ingredient (% by weight)	Frequency
	1640MHz Body
De-Ionized Water	71.50
Polysorbate 20 (Tween 20)	28.00
Salt	0.50

Appendix 7. DASY4 System Details

A.7.1. DASY4 SAR Measurement System

UL, SAR measurement facility utilises the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY4 system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, and the SAM phantom containing brain or muscle equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller; teach pendant (Joystick), and remote control. This is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. The data acquisition electronics (DAE) performs signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection etc. The DAE is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The DAE3 utilises a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching mulitplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

A.7.2. DASY4 SAR System Specifications

Robot Arm	
Positioner:	Stäubli Unimation Corp. Robot Model: TX60L
Repeatability:	±0.030 mm
No. of Axis:	6
Serial Number:	F12/5MZ7A1/A/01
Reach:	920 mm
Payload:	2.0 kg
Control Unit:	CS8C
Programming Language:	V+
Data Acquisition Electronic (DAE) System	
Serial Number:	DAE3 SN:450
PC Controller	
PC:	Dell Precision 340
Operating System:	Windows 2000
Data Card:	DASY5 Measurement Server
Serial Number:	1080
Data Converter	
Features:	Signal Amplifier, multiplexer, A/D converted and control logic.
Software:	DASY5 Software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock.
PC Interface Card	
Function:	24 bit (64 MHz) DSP for real time processing Link to DAE3 16 nit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.

DASY4 SAR System Specifications (Continued)	
Model:	EX3DV4
Serial No:	3871
Construction:	Triangular core
Frequency:	10 MHz to >6 GHz
Linearity:	±0.2 dB (30 MHz to 6 GHz)
Probe Length (mm):	337
Probe Diameter (mm):	10
Tip Length (mm):	9
Tip Diameter (mm):	2.5
Sensor X Offset (mm):	1
Sensor Y Offset (mm):	1
Sensor Z Offset (mm):	1
Phantom	
Phantom:	SAM Phantom
Shell Material:	Fibreglass
Thickness:	2.0 ±0.1 mm