

SAR Test Report

Product Name : UHF wireless transmitter
Model No. : ARG-TX900M, ARG-TX900MINI
FCC ID : 2ACGIARG-TX900M

Applicant : Audio Resource Group, Inc
Address : 405 Main Ave W, Suite 4G, West Fargo, ND58078, US

Date of Receipt : May. 15, 2014
Test Date : May. 15, 2014
Issued Date : May. 21, 2014
Report No. : 1450381R-HP-US-P03V01
Report Version : V1.4



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Test Report Certification

Issued Date: May. 21, 2014

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Product Name	:	UHF wireless transmitter
Applicant	:	Audio Resource Group, Inc
Address	:	405 Main Ave W, Suite 4G, West Fargo, ND58078,US
Manufacturer	:	Shenzhen Alcors Technology Co., Ltd.
Address	:	South of 4 th FL, BLDG 23, Phase 2, LianChuang Tech-Park, Bulan RD, Buji Town, LongGang District, Shenzhen, China
FCC ID	:	2ACGIARG-TX900M
Model No.	:	ARG-TX900M, ARG-TX900MINI
EUT Voltage	:	DC 3.7V
Brand Name	:	ARG
Test Result	:	Max. SAR Measurement (1g) Body worn: 0.360 W/kg;
Performed Location	:	Suzhou EMC Laboratory No.99 Hongye Rd., Suzhou Industrial Park Loufeng Hi-Tech Development Zone., Suzhou, China TEL: +86-512-6251-5088 / FAX: +86-512-6251-5098 FCC Registration Number: 800392
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Laboratory Information

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Germany	:	TUV Rheinland
Norway	:	Nemko, DNV
USA	:	FCC
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The address and introduction of Quietek Corporation's laboratories can be founded in our Web site :
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1. General Information

1.1. EUT Description

Product Name	UHF wireless transmitter
Model No.	ARG-TX900M, ARG-TX900MINI
Device Category	Portable
RF Exposure Environment	Uncontrolled
Antenna Type	external
Battery Voltage	DC 3.7V/600mAh
Frequency Range	903MHz~927MHz
Channel Number	1~25
Type of Modulation	O-QPSK
Channel Control	Auto
Peak Antenna Gain	1dBi

Note1: The device don't support next to ear function or is not intended to operate next to ear, so the head SAR does not test.

Note2: This device do not specially declared in the standards, so we test every faces within 25mm from the antenna and the phantom, and test directly against the phantom for SAR compliance.

Working Frequency of Each Channel:							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
01	903 MHz	02	904 MHz	03	905 MHz	04	906 MHz
05	907 MHz	06	908 MHz	07	909 MHz	08	910 MHz
09	911 MHz	10	912 MHz	11	913 MHz	12	914 MHz
13	915 MHz	14	916 MHz	15	917 MHz	16	918 MHz
17	919 MHz	18	920 MHz	19	921 MHz	20	922 MHz
21	923 MHz	22	924 MHz	23	925 MHz	24	926 MHz
25	927 MHz	N/A	N/A	N/A	N/A	N/A	N/A

1.2. Test Environment

Ambient conditions in the laboratory:

Items	Required	Actual
Temperature (°C)	18-25	21.5± 2
Humidity (%RH)	30-70	52

1.3. Power Reduction for SAR

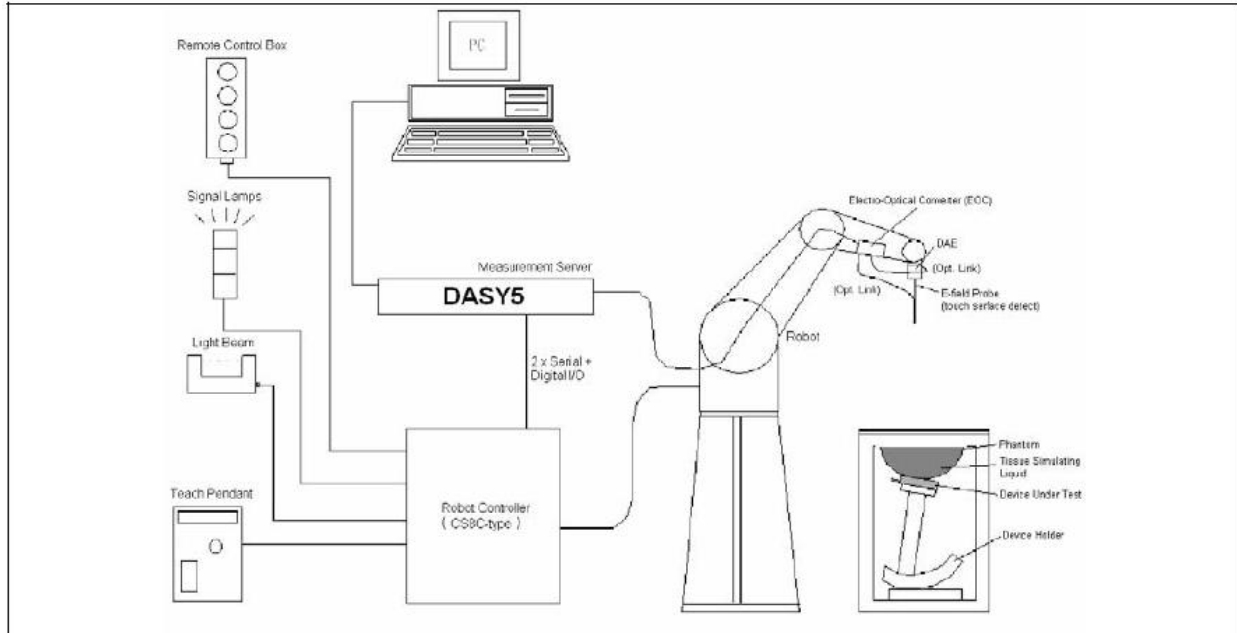
There is no power reduction used for any band/mode implemented in this device for SAR purposes.

1.4. Guidance Documents

- 1) FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- 2) FCC KDB Publication 865664 D01v01r03(SAR measurement 100 MHz to 6 GHz)

2. SAR Measurement System

2.1. DASY5 System Description



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

- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

2.1.1. Applications

Predefined procedures and evaluations for automated compliance testing with all worldwide standards, e.g., IEEE 1528, OET 65, IEC 62209-1, IEC 62209-2, EN 50360, EN 50383 and others.

2.1.2. Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a 10mm^2 step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE 1528-2003, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan).

2.1.3. Zoom Scan (Cube Scan Averaging)

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. A density of 1000 kg/m^3 is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1 g cube is 10mm, with the side length of the 10 g cube 21,5mm.

The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications utilize a physical step of $7\times 7\times 7$ (5mmx5mmx5mm) providing a volume of 30mm in the X & Y axis, and 30mm in the Z axis.

2.1.4. Uncertainty of Inter-/Extrapolation and Averaging

In order to evaluate the uncertainty of the interpolation, extrapolation and averaged SAR calculation algorithms of the Postprocessor, DASY5 allows the generation of measurement grids which are artificially predefined by analytically based test functions. Therefore, the grids of area scans and zoom scans can be filled with uncertainty test data, according to the SAR benchmark functions of IEEE 1528. The three analytical functions shown in equations as below are used to describe the possible range of the expected SAR distributions for the tested handsets. The field gradients are covered by the spatially flat distribution f1, the spatially steep distribution f3 and f2 accounts for H-field cancellation on the phantom/tissue surface.

$$f_1(x, y, z) = Ae^{-\frac{z}{2a}} \cos^2 \left(\frac{\pi \sqrt{x'^2 + y'^2}}{2 \cdot 5a} \right)$$

$$f_2(x, y, z) = Ae^{-\frac{z}{a}} \frac{a^2}{a^2 + x'^2} \left(3 - e^{-\frac{2z}{a}} \right) \cos^2 \left(\frac{\pi y'}{2 \cdot 3a} \right)$$


$$f_3(x, y, z) = A \frac{a^2}{\frac{a^2}{4} + x'^2 + y'^2} \left(e^{-\frac{2z}{a}} + \frac{a^2}{2(a + 2z)^2} \right)$$

2.2. DASY5 E-Field Probe

The SAR measurement is conducted with the dosimetric probe manufactured by SPEAG. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

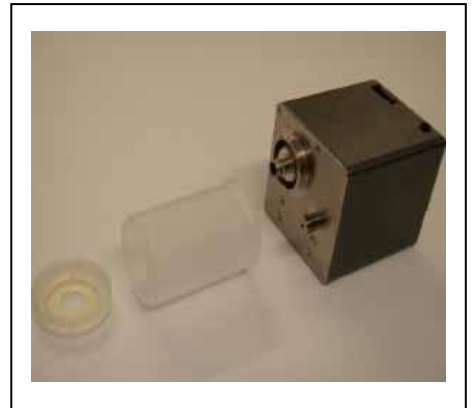
SPEAG conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528, EN 62209-1, IEC 62209, etc.) under ISO 17025. The calibration data are in Appendix D.

2.2.1. Isotropic E-Field Probe Specification

Model	EX3DV4	
Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.	

2.3. Boundary Detection Unit and Probe Mounting Device

The DASY probes use a precise connector and an additional holder for the probe, consisting of a plastic tube and a flexible silicon ring to center the probe. The connector at the DAE is flexibly mounted and held in the default position with magnets and springs. Two switching systems in the connector mount detect frontal and lateral probe collisions and trigger the necessary software response.

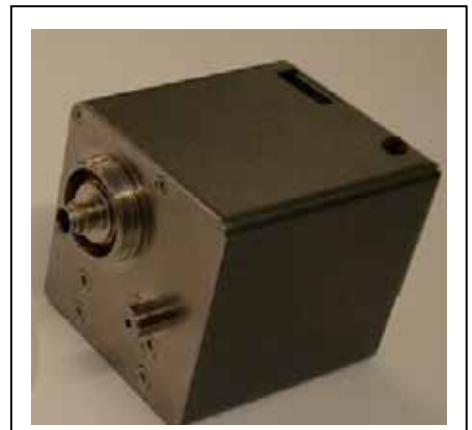


2.4. DATA Acquisition Electronics (DAE) and Measurement Server

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit.

Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE4 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.



The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV Celeron, 128MB chipdisk and 128MB RAM. The necessary circuits for communication with the DAE electronics box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY5 I/O board, which is directly connected to the PC/104 bus of the CPU board.



2.5. Robot

The DASY5 system uses the high precision robots TX90 XL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY5 system, the CS8C robot controller version from Stäubli is used.

The XL robot series have many features that are important for our application:

- High precision (repeatability 0.02 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)
- 6-axis controller



2.6. Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.

The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.



2.7. Device Holder

The DASY5 device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR).

Thus the device needs no repositioning when changing the angles.

The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon_r \approx 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



2.8. SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

- Left head
- Right head
- Flat phantom



The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom tip, three reference markers are provided to identify the phantom position with respect to the robot.

3. Tissue Simulating Liquid

3.1. The composition of the tissue simulating liquid

INGREDIENT (% Weight)	900MHz Body
Water	56
Salt	0.768
Sugar	41.76
HEC	1.21
Preventol	0.27
DGBE	0.00

3.2. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using DASY5 Dielectric Probe Kit and Agilent Vector Network Analyzer E5071C

For FCC:

Body Tissue Simulant Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [°C]
		ϵ_r	σ [s/m]	
900 MHz	Reference result ± 5% window	55.0 52.25 to 57.75	1.05 1.00 to 1.10	N/A
	15-05-2014	53.95	1.03	21.0

3.3. Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

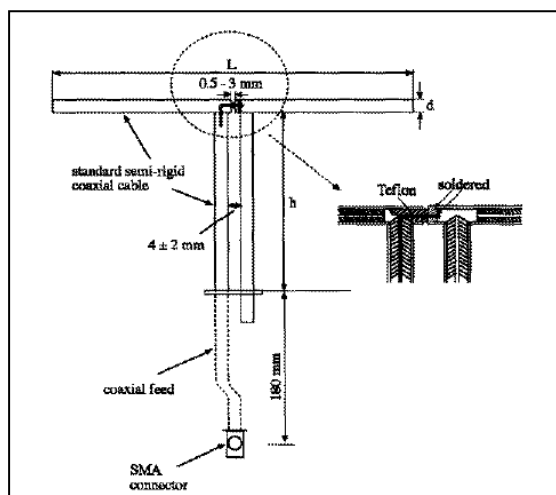
Target Frequency	Head		Body	
(MHz)	ϵ_r	σ (S/m)	ϵ_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ϵ_r = relative permittivity, σ = conductivity and $\rho = 1000 \text{ kg/m}^3$)

4. SAR Measurement Procedure

4.1. SAR System Validation

4.1.1. Validation Dipoles



The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE and FCC Supplement C. the table below provides details for the mechanical and electrical specifications for the dipoles.

Frequency	L (mm)	h (mm)	d (mm)
900MHz	149.0	83.3	3.6

4.1.2. Validation Result

System Performance Check at 900MHz				
Validation Kit: D900V2-SN: 1d096				
Frequency [MHz]	Description	SAR [w/kg] 1g	SAR [w/kg] 10g	Tissue Temp. [°C]
900 MHz	Reference result ± 10% window	10.5 9.45 to 11.55	6.78 6.10 to 7.46	N/A
	15-05-2014	10.8	6.92	21.0
Note: All SAR values are normalized to 1W forward power.				

4.2. SAR Measurement Procedure

The DASY 5 calculates SAR using the following equation,

$$SAR = \frac{\sigma |E|^2}{\rho}$$

σ : represents the simulated tissue conductivity

ρ : represents the tissue density

The EUT is set to transmit at the required power in line with product specification, at each frequency relating to the LOW, MID, and HIGH channel settings.

Pre-scans are made on the device to establish the location for the transmitting antenna, using a large area scan in either air or tissue simulation fluid.

The EUT is placed against the Universal Phantom where the maximum area scan dimensions are larger than the physical size of the resonating antenna. When the scan size is not large enough to cover the peak SAR distribution, it is modified by either extending the area scan size in both the X and Y directions, or the device is shifted within the predefined area.

The area scan is then run to establish the peak SAR location (interpolated resolution set at 1mm^2) which is then used to orient the center of the zoom scan. The zoom scan is then executed and the 1g and 10g averages are derived from the zoom scan volume (interpolated resolution set at 1mm^3).

5. SAR Exposure Limits

SAR assessments have been made in line with the requirements of IEEE-1528, FCC Supplement C, and comply with ANSI/IEEE C95.1-1992 “Uncontrolled Environments” limits. These limits apply to a location which is deemed as “Uncontrolled Environment” which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

Limits for General Population/Uncontrolled Exposure (W/kg)

Type Exposure	Uncontrolled Environment Limit
Spatial Peak SAR (1g cube tissue for brain or body)	1.60 W/kg
Spatial Average SAR (whole body)	0.08 W/kg
Spatial Peak SAR (10g for hands, feet, ankles and wrist)	4.00 W/kg

6. Test Equipment List

Instrument	Manufacturer	Model No.	Serial No.	Cali. Due Date
Stäubli Robot TX60L	Stäubli	TX60L	F10/5C90A1/A/01	N/A
Controller	Stäubli	SP1	S-0034	N/A
Dipole Validation Kits	Speag	D900V2	1d096	2016.02.26
SAM Twin Phantom	Speag	SAM	TP-1561/1562	N/A
Device Holder	Speag	SD 000 H01 HA	N/A	N/A
Data Acquisition Electronic	Speag	DAE4	1220	2015.01.21
E-Field Probe	Speag	EX3DV4	3710	2015.03.03
SAR Software	Speag	DASY5	V5.2 Build 162	N/A
Power Amplifier	Mini-Circuit	ZHL-42	D051404-28	N/A
Directional Coupler	Agilent	778D	20160	N/A
Universal Radio Communication Tester	R&S	CMU 200	117088	2015.03.28
Vector Network	Agilent	E5071C	MY48367267	2015.03.28
Signal Generator	Agilent	E4438C	MY49070163	2015.03.28
Power Meter	Anritsu	ML2495A	0905006	2014.11.01
Wide Bandwidth Sensor	Anritsu	MA2411B	0846014	2014.11.01

7. Measurement Uncertainty

DASY5 Uncertainty								
Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram / 10 gram.								
Error Description	Uncert. value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(vi) V _{eff}
Measurement System								
Probe Calibration	±6.0%	N	1	1	1	±6.0%	±6.0%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	$\sqrt{3}$	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	$\sqrt{3}$	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±11.0%	±10.8%	387
Expanded STD Uncertainty						±22.0%	±21.5%	

DASY5 Uncertainty Measurement uncertainty for 3 GHz to 6 GHz averaged over 1 gram / 10 gram.								
Error Description	Uncert. value	Prob. Dist.	Div.	(ci) 1g	(ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(vi) V _{eff}
Measurement System								
Probe Calibration	±6.55%	N	1	1	1	±6.55%	±6.55%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±2.0%	R	$\sqrt{3}$	1	1	±1.2%	±1.2%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Probe Positioning	±9.9%	R	$\sqrt{3}$	1	1	±5.7%	±5.7%	∞
Max. SAR Eval.	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	$\sqrt{3}$	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	$\sqrt{3}$	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±12.8%	±12.6%	330
Expanded STD Uncertainty						±25.6%	±25.2%	

8. Conducted Power Measurement

Test Mode	Frequency (MHz)	Avg. Burst Power (dBm)	Max. Power (dBm)	Scaling Factor
900MHz wireless transmitter	903	14.84	15.0	1.038
	904	14.87	15.0	1.030
	905	14.96	15.0	1.009
	906	14.90	15.0	1.023
	907	14.92	15.0	1.019
	908	14.96	15.0	1.009
	909	14.94	15.0	1.014
	910	14.95	15.0	1.012
	911	14.94	15.0	1.014
	912	14.96	15.0	1.009
	913	14.93	15.0	1.016
	914	14.95	15.0	1.012
	915	14.97	15.0	1.007
	916	14.88	15.0	1.028
	917	14.92	15.0	1.019
	918	14.94	15.0	1.014
	919	14.94	15.0	1.014
	920	14.87	15.0	1.030
	921	14.92	15.0	1.019
	922	14.97	15.0	1.007
	923	14.92	15.0	1.019
	924	14.92	15.0	1.019
	925	14.94	15.0	1.014
	926	14.93	15.0	1.016
	927	14.88	15.0	1.028

9. Test Procedures

9.1. SAR Test Results Summary

SAR MEASUREMENT									
Ambient Temperature (°C) : 21.5 ± 2					Relative Humidity (%): 52				
Liquid Temperature (°C) : 21.0 ± 2					Depth of Liquid (cm):>15				
Product: UHF wireless transmitter									
Test Mode: wireless transmitter									
Test Position Head	Antenna Position	Frequency		Frame Power (dBm)	Power Drift (<±0.2)	SAR 1g (W/kg)	Scaling Factor	Scaled SAR 1g (W/kg)	Limit (W/kg)
		Channel	MHz						
Body worn	Fixed	01	903	14.84	-0.10	0.347	1.038	0.360	1.6
Body worn	Fixed	13	915	14.97	-0.07	0.283	1.007	0.285	1.6
Body front	Fixed	13	915	14.97	-0.02	0.347	1.007	0.349	1.6
Right side	Fixed	13	915	14.97	0.09	0.286	1.007	0.288	1.6
Body worn	Fixed	25	927	14.88	-0.03	0.337	1.028	0.346	1.6
Note: when the 1-g SAR is ≤ 0.8 W/kg, testing for low and high channel is optional, refer to KDB 447498.									

9.2. Test position and configuration

1. Batteries are fully charged at the beginning of the SAR measurements.
2. Liquid tissue depth was at least 15.0 cm for all frequencies.
3. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
4. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05r02.
5. This device do not specially declared in the standards, so we test every faces within 25mm from the antenna and the phantom, and test directly touch the phantom for SAR compliance. According to the Antenna position, Body worn, Body front and right side are chosen to test SAR which was against with the SAR phantom directly.

Appendix A. SAR System Validation Data

Date/Time: 15-05-2014

Test Laboratory: QuieTek Lab

System Check Body 900MHz

DUT: Dipole 900 MHz D900V2; Type: D900V2

Communication System: UID 10000, CW; Communication System Band: D900 (900.0 MHz); Duty Cycle: 1:1; Frequency: 900 MHz; Medium parameters used: $f = 900$ MHz; $\sigma = 1.03$ S/m; $\epsilon_r = 53.95$; $\rho = 1000$ kg/m³; Phantom section: Flat Section; Input Power=250mW

Ambient temperature (°C): 21.5, Liquid temperature (°C): 21.0

DASY5 Configuration:

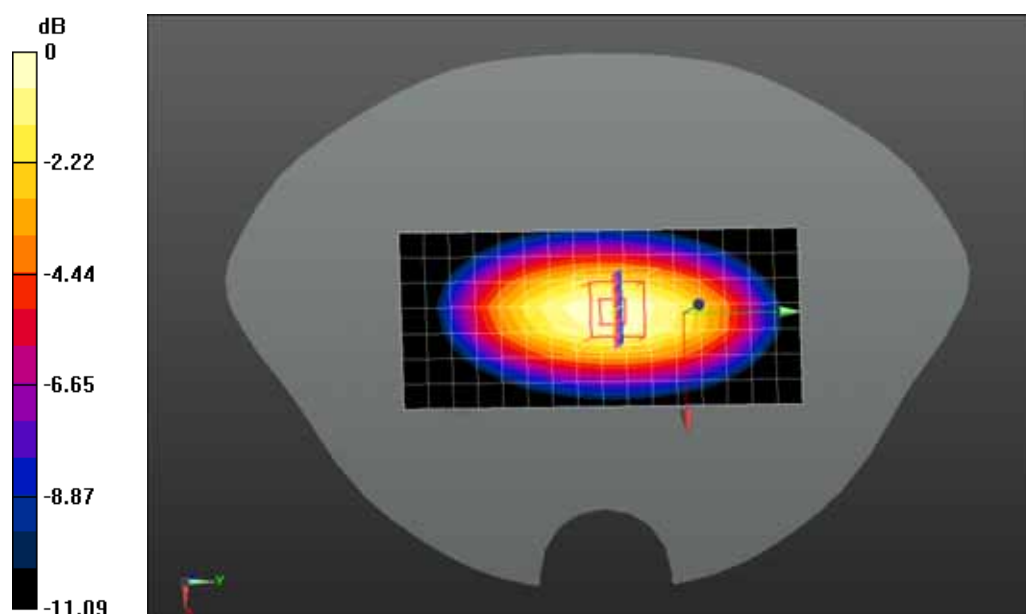
- Probe: EX3DV4 - SN3710; ConvF(9.04, 9.04, 9.04); Calibrated: 04/03/2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 22/01/2014
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/System Check Body 900MHz/Area Scan (8x17x1): Measurement grid: dx=10mm, dy=10mm, Maximum value of SAR (measured) = 2.85 W/kg

Configuration/System Check Body 900MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm, Reference Value = 53.069 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 4.17 W/kg

SAR(1 g) = 2.7 W/kg; SAR(10 g) = 1.73 W/kg Maximum value of SAR (measured) = 2.92 W/kg



0 dB = 2.92 W/kg = 4.65 dBW/kg

Appendix B. SAR measurement Data

Date/Time: 15-05-2014

Test Laboratory: QuieTek Lab

Radio transmitter 903MHz Body-worn

DUT: UHF wireless transmitter; Type: ARG-TX900M, ARG-TX900MINI

Communication System: UID 0, radio transmitter (0); Communication System Band: 900; Duty Cycle: 1:1.0;

Frequency: 903 MHz; Medium parameters used: $f = 903 \text{ MHz}$; $\sigma = 1.03 \text{ S/m}$; $\epsilon_r = 53.96$; $\rho = 1000 \text{ kg/m}^3$;

Phantom section: Flat Section

Ambient temperature ($^{\circ}\text{C}$): 21.5, Liquid temperature ($^{\circ}\text{C}$): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(9.04, 9.04, 9.04); Calibrated: 04/03/2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 22/01/2014
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Radio transmitter 903MHz Body-worn/Area Scan (5x7x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

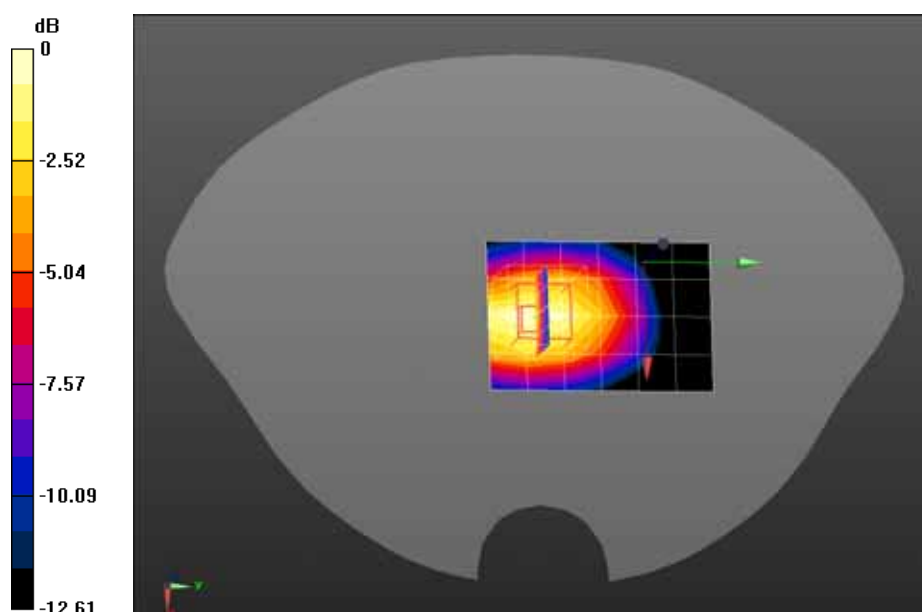
Maximum value of SAR (measured) = 0.364 W/kg

Configuration/Radio transmitter 903MHz Body-worn/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

$dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$, Reference Value = 18.947 V/m; Power Drift = -0.10 dB

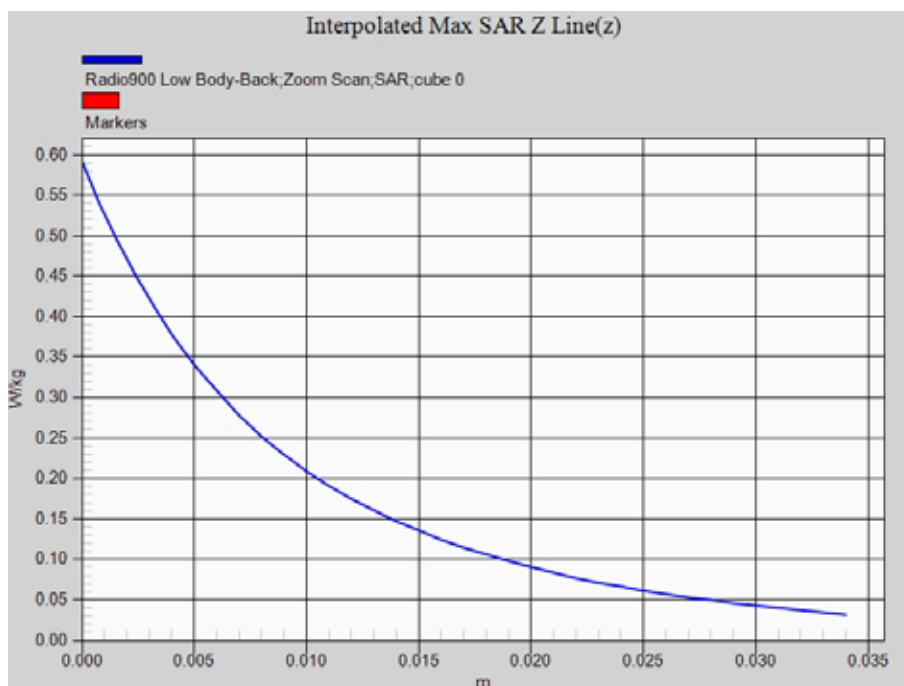
Peak SAR (extrapolated) = 0.592 W/kg

SAR(1 g) = 0.347 W/kg; SAR(10 g) = 0.210 W/kg Maximum value of SAR (measured) = 0.377 W/kg



0 dB = 0.377 W/kg = -4.24 dBW/kg

Z-Axis Plot



Date/Time: 15-05-2014

Test Laboratory: QuieTek Lab

Radio transmitter 915MHz Body-worn

DUT: UHF wireless transmitter; Type: ARG-TX900M, ARG-TX900MINI

Communication System: UID 0, radio transmitter (0); Communication System Band: 900; Duty Cycle: 1:1.0;

Frequency: 915 MHz; Medium parameters used: $f = 915$ MHz; $\sigma = 1.04$ S/m; $\epsilon_r = 53.82$; $\rho = 1000$ kg/m³ ;

Phantom section: Flat Section

Ambient temperature (°C): 21.5, Liquid temperature (°C): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(9.04, 9.04, 9.04); Calibrated: 04/03/2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 22/01/2014
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Radio transmitter 915MHz Body-worn /Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm

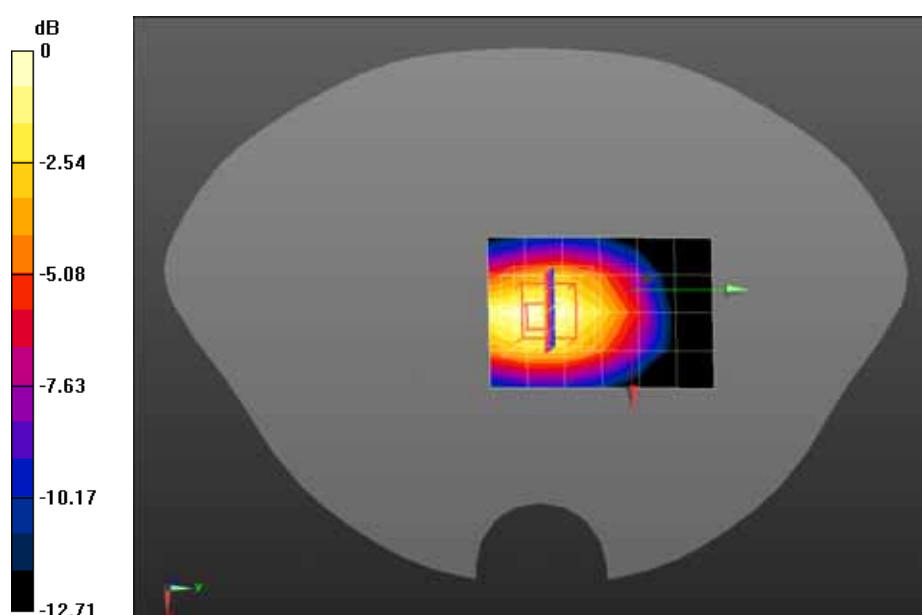
Maximum value of SAR (measured) = 0.362 W/kg

Configuration/Radio transmitter 915MHz Body-worn/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=8mm, dy=8mm, dz=5mm, Reference Value = 18.744 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.590 W/kg

SAR(1 g) = 0.347 W/kg; SAR(10 g) = 0.210 W/kg Maximum value of SAR (measured) = 0.376 W/kg



0 dB = 0.376 W/kg = -4.25 dBW/kg

Date/Time: 15-05-2014

Test Laboratory: QuieTek Lab

Radio transmitter 915MHz Body -front

DUT: UHF wireless transmitter; Type: ARG-TX900M, ARG-TX900MINI

Communication System: UID 0, radio transmitter (0); Communication System Band: 900; Duty Cycle: 1:1.0;

Frequency: 915 MHz; Medium parameters used: $f = 915$ MHz; $\sigma = 1.04$ S/m; $\epsilon_r = 53.82$; $\rho = 1000$ kg/m³ ;

Phantom section: Flat Section

Ambient temperature (°C): 21.5, Liquid temperature (°C): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(9.04, 9.04, 9.04); Calibrated: 04/03/2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 22/01/2014
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Radio transmitter 915MHz Body-front /Area Scan (6x7x1): Measurement grid: dx=15mm, dy=15mm

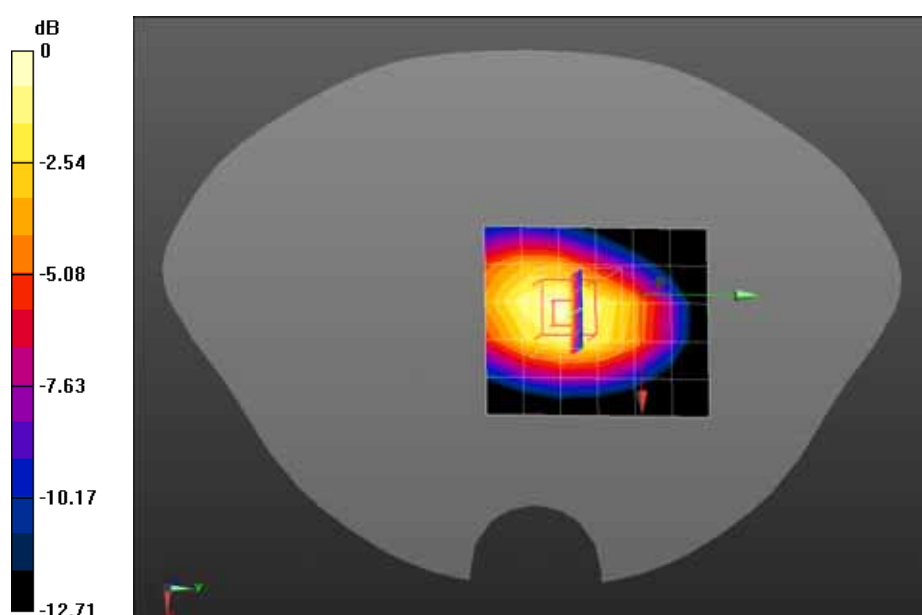
Maximum value of SAR (measured) = 0.283 W/kg

Configuration/Radio transmitter 915MHz Body-front/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=8mm, dy=8mm, dz=5mm, Reference Value = 16.328 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 0.467 W/kg

SAR(1 g) = 0.283 W/kg; SAR(10 g) = 0.174 W/kg Maximum value of SAR (measured) = 0.308 W/kg



0 dB = 0.308 W/kg = -5.11 dBW/kg

Date/Time: 15-05-2014

Test Laboratory: QuieTek Lab

Radio transmitter 915MHz Right side

DUT: UHF wireless transmitter; Type: ARG-TX900M, ARG-TX900MINI

Communication System: UID 0, radio transmitter (0); Communication System Band: 900; Duty Cycle: 1:1.0;

Frequency: 915 MHz; Medium parameters used: $f = 915$ MHz; $\sigma = 1.04$ S/m; $\epsilon_r = 53.82$; $\rho = 1000$ kg/m³ ;

Phantom section: Flat Section

Ambient temperature (°C): 21.5, Liquid temperature (°C): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(9.04, 9.04, 9.04); Calibrated: 04/03/2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 22/01/2014
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Radio transmitter 915MHz Right side /Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm

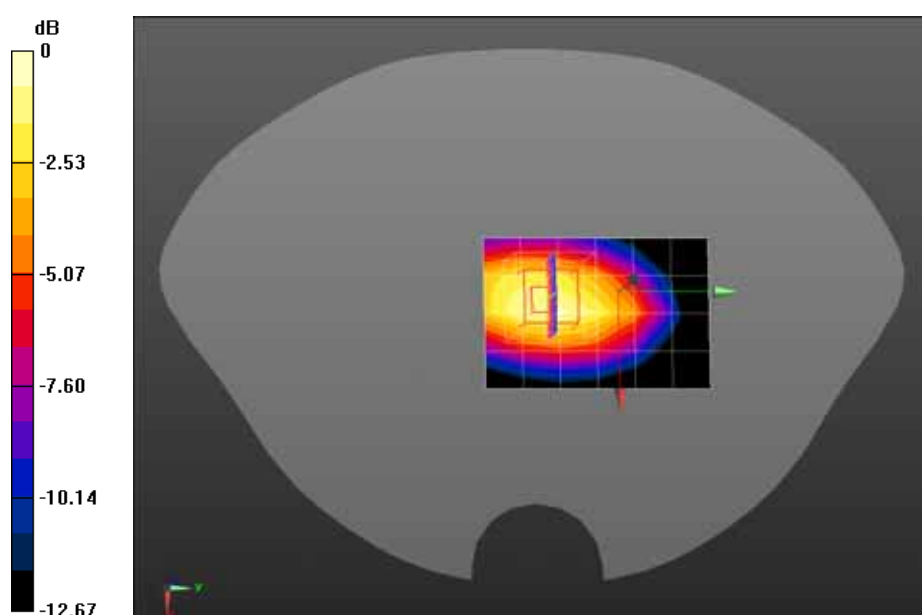
Maximum value of SAR (measured) = 0.281 W/kg

Configuration/Radio transmitter 915MHz Right side/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=8mm, dy=8mm, dz=5mm, Reference Value = 16.461 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 0.493 W/kg

SAR(1 g) = 0.286 W/kg; SAR(10 g) = 0.168 W/kg Maximum value of SAR (measured) = 0.318 W/kg



0 dB = 0.318 W/kg = -4.98 dBW/kg

Date/Time: 15-05-2014

Test Laboratory: QuieTek Lab

Radio transmitter 927MHz Body-worn

DUT: UHF wireless transmitter; Type: ARG-TX900M, ARG-TX900MINI

Communication System: UID 0, radio transmitter (0); Communication System Band: 900; Duty Cycle: 1:1.0;

Frequency: 927 MHz; Medium parameters used: $f = 927 \text{ MHz}$; $\sigma = 1.05 \text{ S/m}$; $\epsilon_r = 53.72$; $\rho = 1000 \text{ kg/m}^3$;

Phantom section: Flat Section

Ambient temperature ($^{\circ}\text{C}$): 21.5, Liquid temperature ($^{\circ}\text{C}$): 21.0

DASY5 Configuration:

- Probe: EX3DV4 - SN3710; ConvF(9.04, 9.04, 9.04); Calibrated: 04/03/2014;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1220; Calibrated: 22/01/2014
- Phantom: SAM1; Type: SAM; Serial: TP1561
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Radio transmitter 927MHz Body-worn/Area Scan (5x7x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

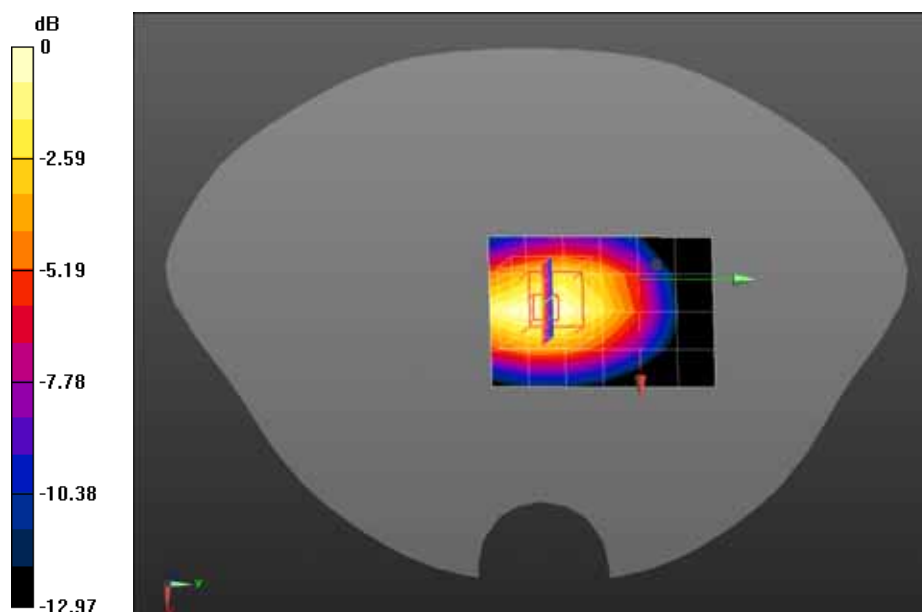
Maximum value of SAR (measured) = 0.366 W/kg

Configuration/Radio transmitter 927MHz Body-worn/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

$dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$, Reference Value = 18.822 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.578 W/kg

SAR(1 g) = 0.337 W/kg; SAR(10 g) = 0.203 W/kg Maximum value of SAR (measured) = 0.367 W/kg



0 dB = 0.367 W/kg = -4.35 dBW/kg

Appendix C. Test Setup Photographs & EUT Photographs

SAR Test Setup Photographs



Body-worn



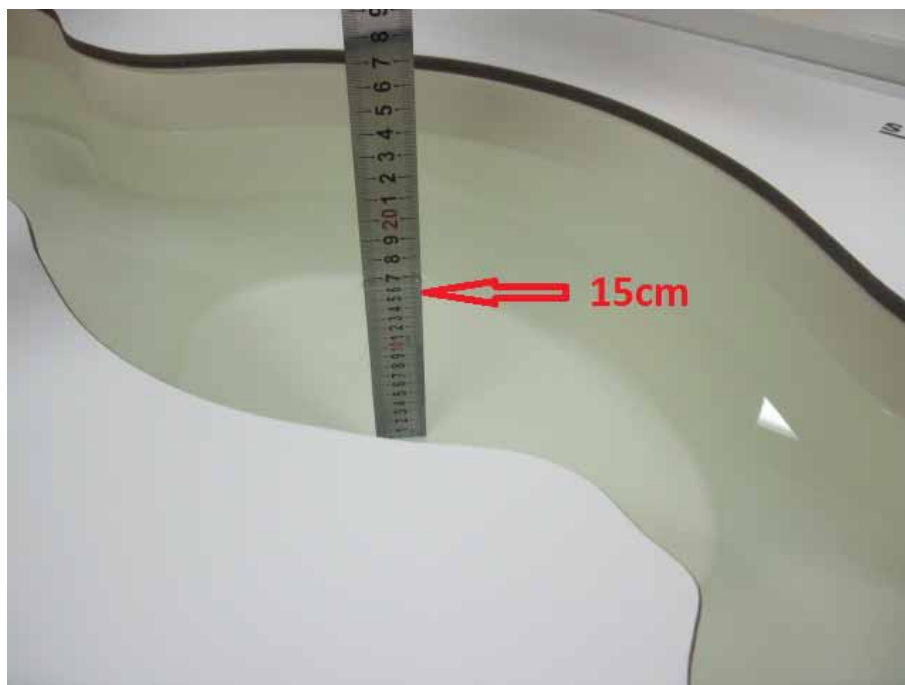
Body-front



Body-Right side

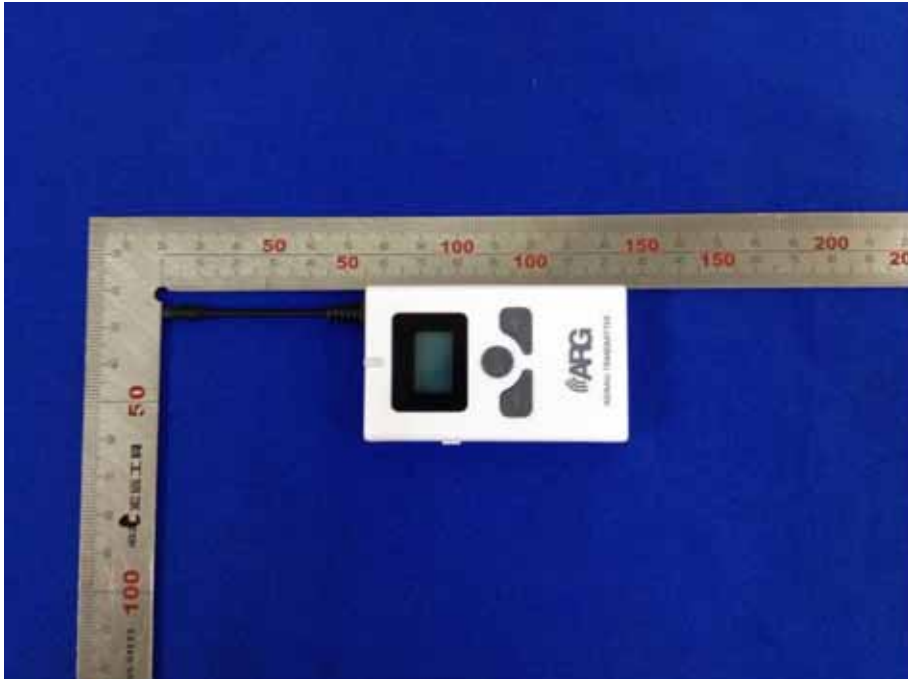
Depth of the liquid in the phantom – Zoom in

Note: The position used in the measurements were according to IEEE 1528 - 2003

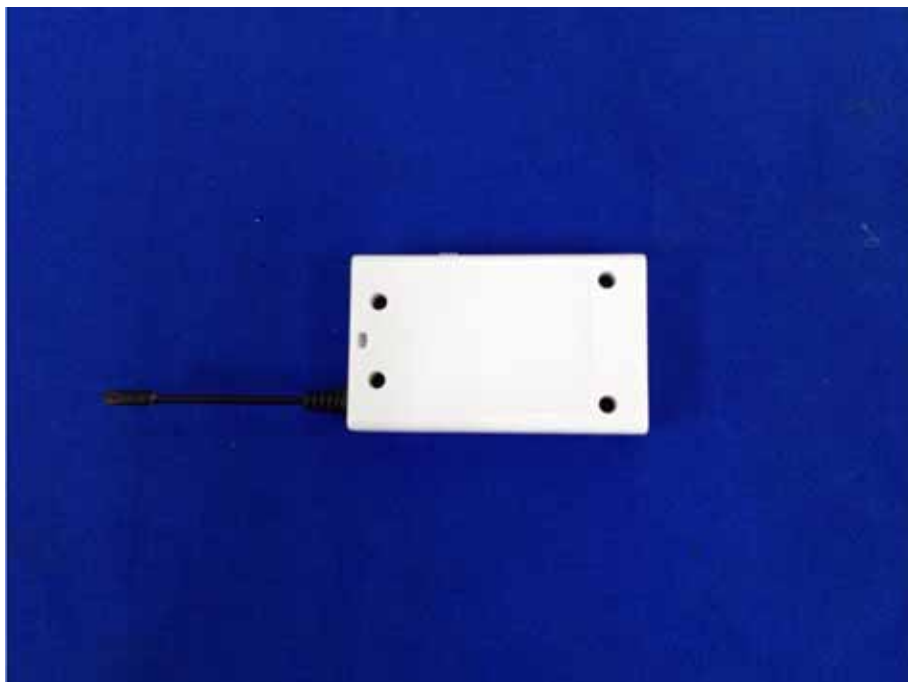


External photos

(1) EUT Photo



(2) EUT Photo



(3) EUT Photo



(4) EUT Photo



Appendix D. Probe Calibration Data

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



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

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

Accreditation No.: **SCS 108**

Client **Quietek (Auden)**

Certificate No: **EX3-3710_Mar14**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3710**

Calibration procedure(s) **QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5,
QA CAL-25.v6
Calibration procedure for dosimetric E-field probes**

Calibration date: **March 4, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: March 4, 2014			

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

**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
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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., $\vartheta = 0$ 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:

- 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
- 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:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,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.
- DCP_{x,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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 $f \leq 800$ 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 NORM_{x,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 NORM_x (no uncertainty required).

EX3DV4 – SN:3710

March 4, 2014

Probe EX3DV4

SN:3710

Manufactured: July 21, 2009
Calibrated: March 4, 2014

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

EX3DV4- SN:3710

March 4, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3710

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.51	0.56	0.44	± 10.1 %
DCP (mV) ^B	100.3	97.6	101.3	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	137.9	±3.5 %
		Y	0.0	0.0	1.0		136.7	
		Z	0.0	0.0	1.0		139.8	

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 NormX,Y,Z do not affect the E²-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.

EX3DV4- SN:3710

March 4, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3710

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)	Unct. (k=2)
450	43.5	0.87	10.42	10.42	10.42	0.17	2.22	± 13.3 %
750	41.9	0.89	9.76	9.76	9.76	0.62	0.69	± 12.0 %
835	41.5	0.90	9.56	9.56	9.56	0.57	0.69	± 12.0 %
900	41.5	0.97	9.42	9.42	9.42	0.53	0.72	± 12.0 %
1810	40.0	1.40	7.74	7.74	7.74	0.41	0.94	± 12.0 %
1900	40.0	1.40	7.72	7.72	7.72	0.49	0.85	± 12.0 %
2450	39.2	1.80	7.04	7.04	7.04	0.39	1.03	± 12.0 %
2600	39.0	1.96	6.87	6.87	6.87	0.60	0.80	± 12.0 %
3500	37.9	2.91	6.82	6.82	6.82	0.55	0.88	± 13.1 %
5200	36.0	4.66	4.91	4.91	4.91	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.63	4.63	4.63	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.43	4.43	4.43	0.40	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.

^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.

EX3DV4- SN:3710

March 4, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3710

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)	Unct. (k=2)
450	56.7	0.94	10.53	10.53	10.53	0.10	1.00	± 13.3 %
750	55.5	0.96	9.28	9.28	9.28	0.39	0.93	± 12.0 %
835	55.2	0.97	9.22	9.22	9.22	0.65	0.72	± 12.0 %
900	55.0	1.05	9.04	9.04	9.04	0.75	0.67	± 12.0 %
1810	53.3	1.52	7.36	7.36	7.36	0.80	0.62	± 12.0 %
1900	53.3	1.52	7.25	7.25	7.25	0.55	0.76	± 12.0 %
2450	52.7	1.95	6.88	6.88	6.88	0.80	0.58	± 12.0 %
2600	52.5	2.16	6.67	6.67	6.67	0.80	0.50	± 12.0 %
3500	51.3	3.31	6.29	6.29	6.29	0.44	1.02	± 13.1 %
5200	49.0	5.30	4.22	4.22	4.22	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.91	3.91	3.91	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.00	4.00	4.00	0.50	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.

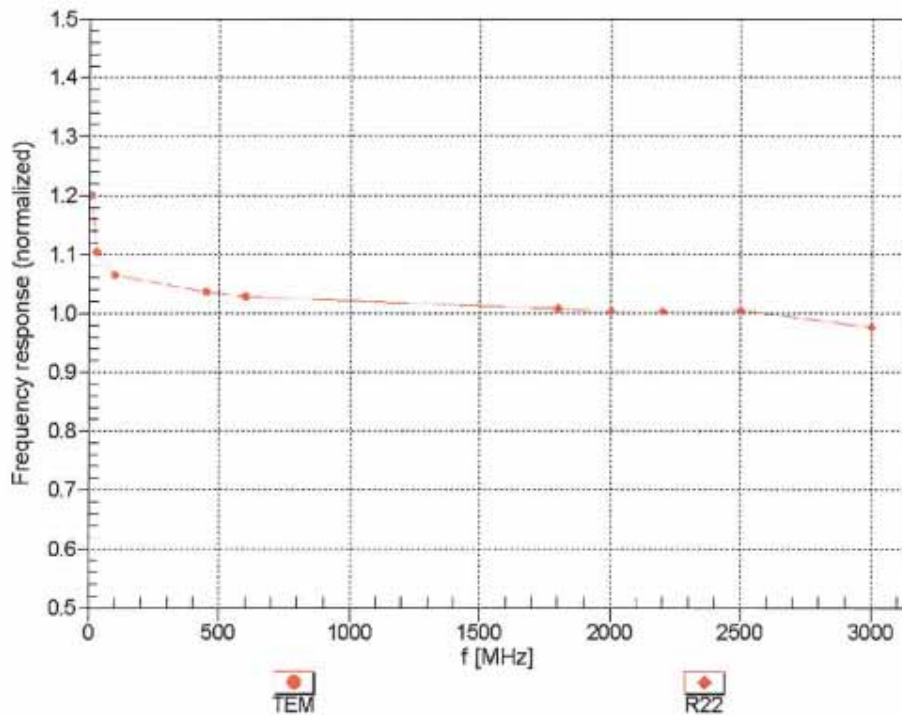
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

^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.

EX3DV4-SN:3710

March 4, 2014

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



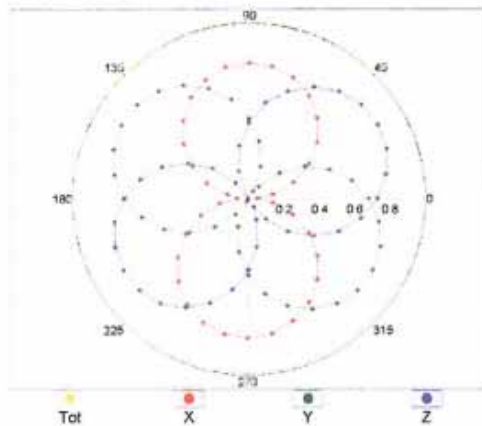
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

EX3DV4- SN:3710

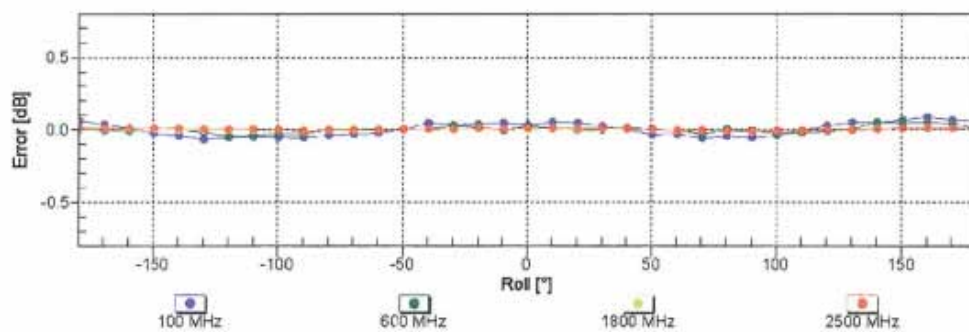
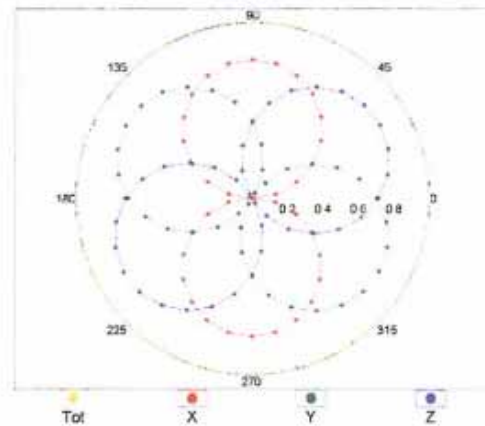
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Receiving Pattern (ϕ), $\theta = 0^\circ$

f=600 MHz,TEM



f=1800 MHz,R22

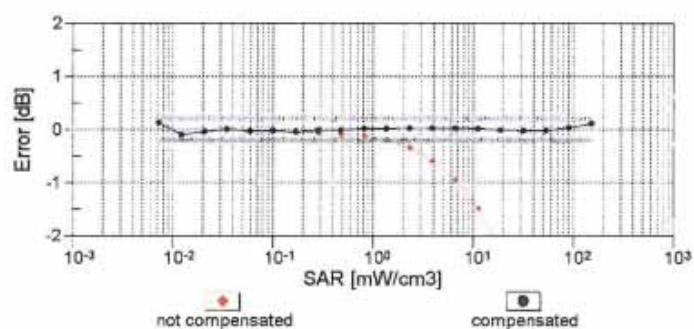
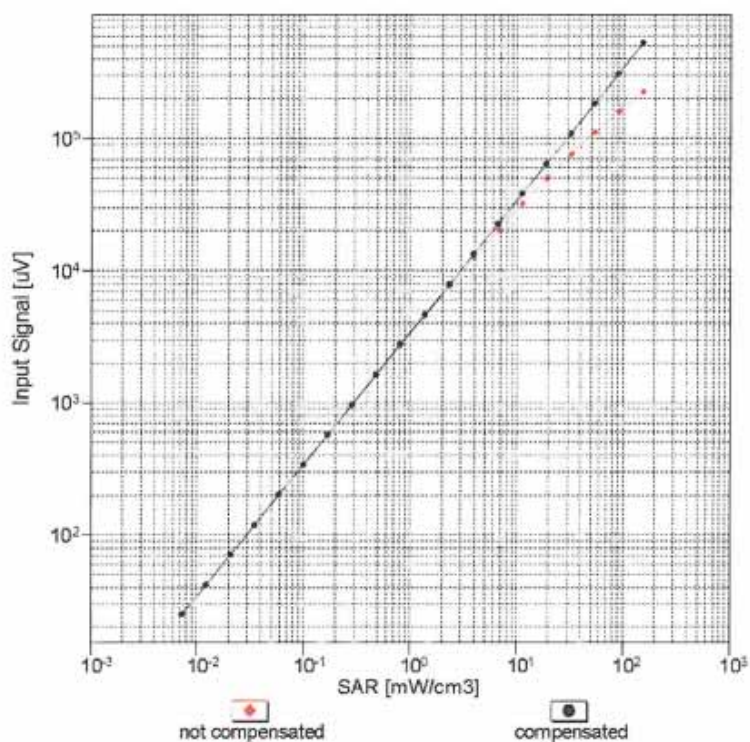


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

EX3DV4- SN:3710

March 4, 2014

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

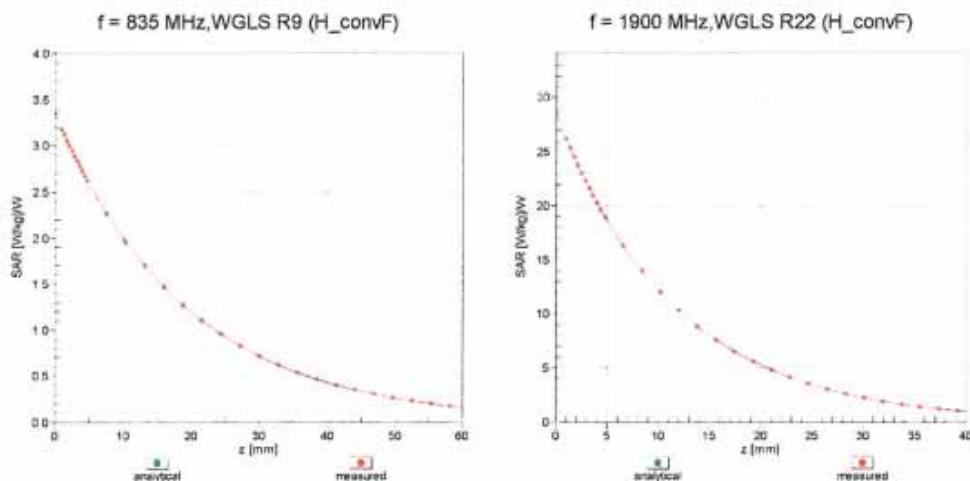


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

EX3DV4- SN:3710

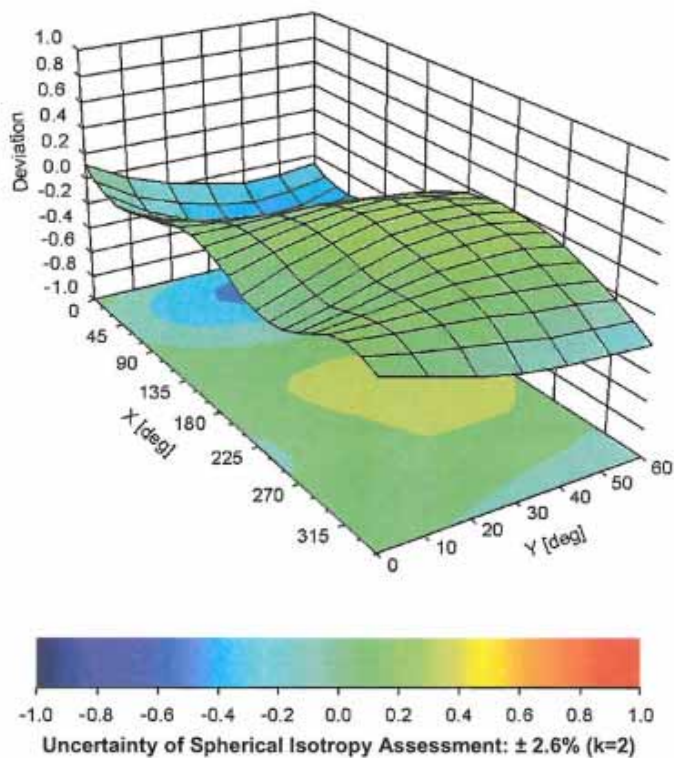
March 4, 2014

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900$ MHz



EX3DV4- SN:3710

March 4, 2014

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3710

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-19.6
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

Appendix E. Dipole Calibration Data

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Accreditation No.: **SCS 108**

Client **Quitek-CN (Auden)**

Certificate No: **D900V2-1d096_Feb14**

CALIBRATION CERTIFICATE

Object **D900V2 - SN: 1d096**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **February 27, 2014**

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 $(22 \pm 3)^{\circ}\text{C}$ 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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: February 28, 2014

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Accreditation No.: **SCS 108**

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:

- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	900 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.97 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	40.4 \pm 6 %	0.95 mho/m \pm 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	2.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	10.4 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.64 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.61 W/kg \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.0	1.05 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	53.9 \pm 6 %	1.03 mho/m \pm 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	2.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	10.5 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.68 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.78 W/kg \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.7 Ω + 0.6 j Ω
Return Loss	- 31.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.4 Ω - 1.6 j Ω
Return Loss	- 30.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.410 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	September 22, 2009

DASY5 Validation Report for Head TSL

Date: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d096

Communication System: UID 0 - CW; Frequency: 900 MHz

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.95 \text{ S/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.09, 6.09, 6.09); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

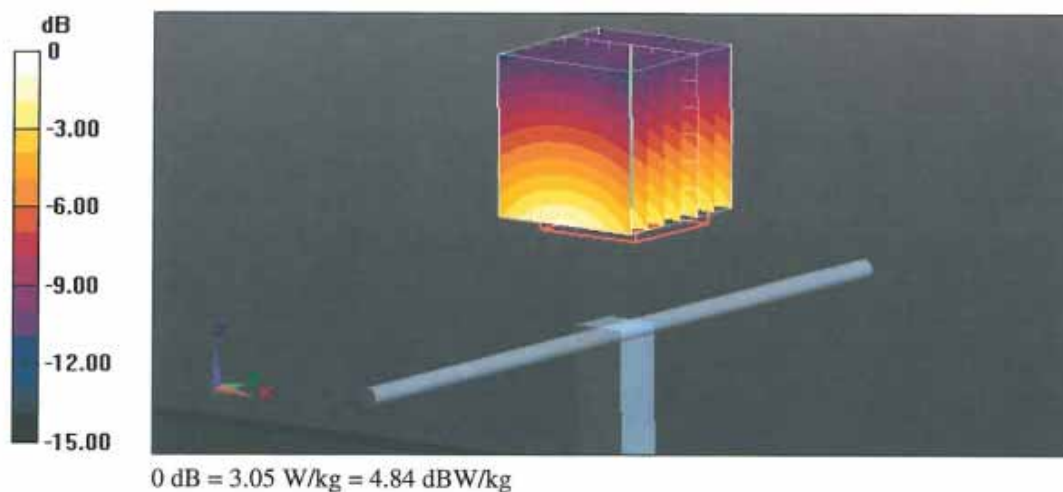
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.465 V/m; Power Drift = -0.01 dB

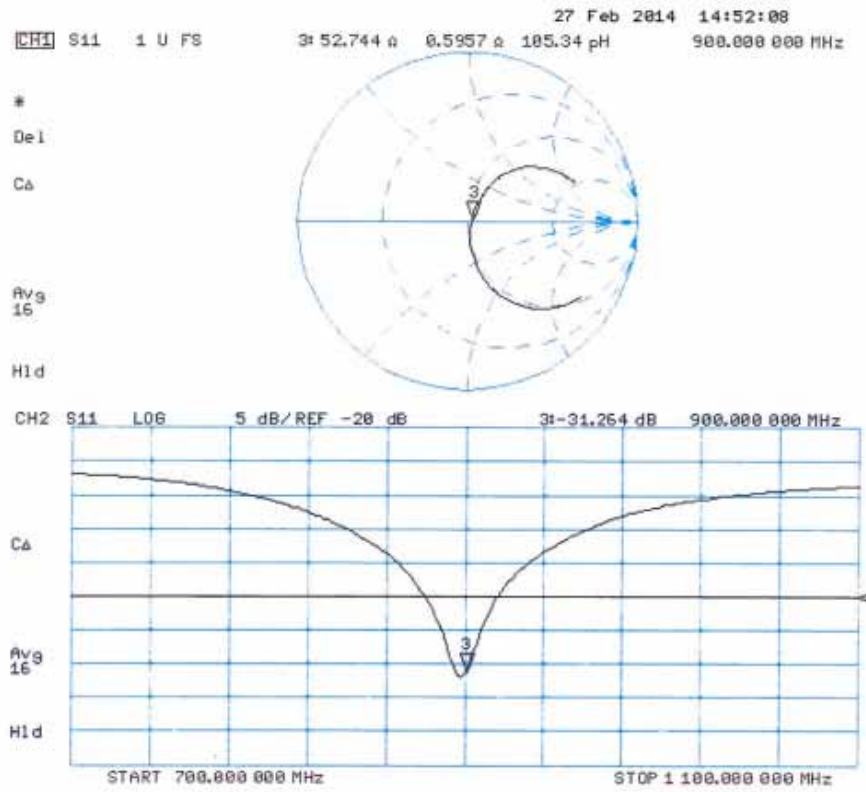
Peak SAR (extrapolated) = 3.93 W/kg

SAR(1 g) = 2.57 W/kg; SAR(10 g) = 1.64 W/kg

Maximum value of SAR (measured) = 3.05 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 1d096

Communication System: UID 0 - CW; Frequency: 900 MHz

Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 1.03 \text{ S/m}$; $\epsilon_r = 53.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.98, 5.98, 5.98); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:

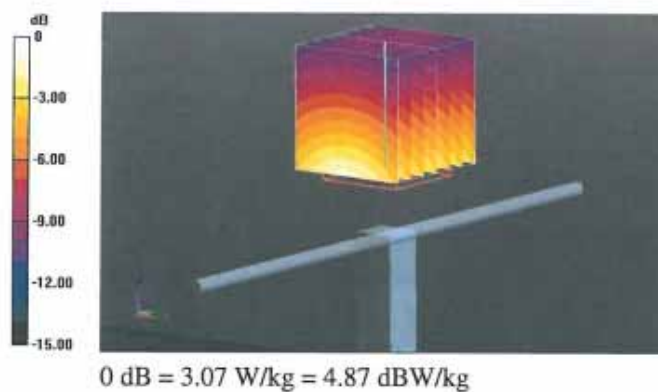
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 56.513 V/m; Power Drift = 0.01 dB

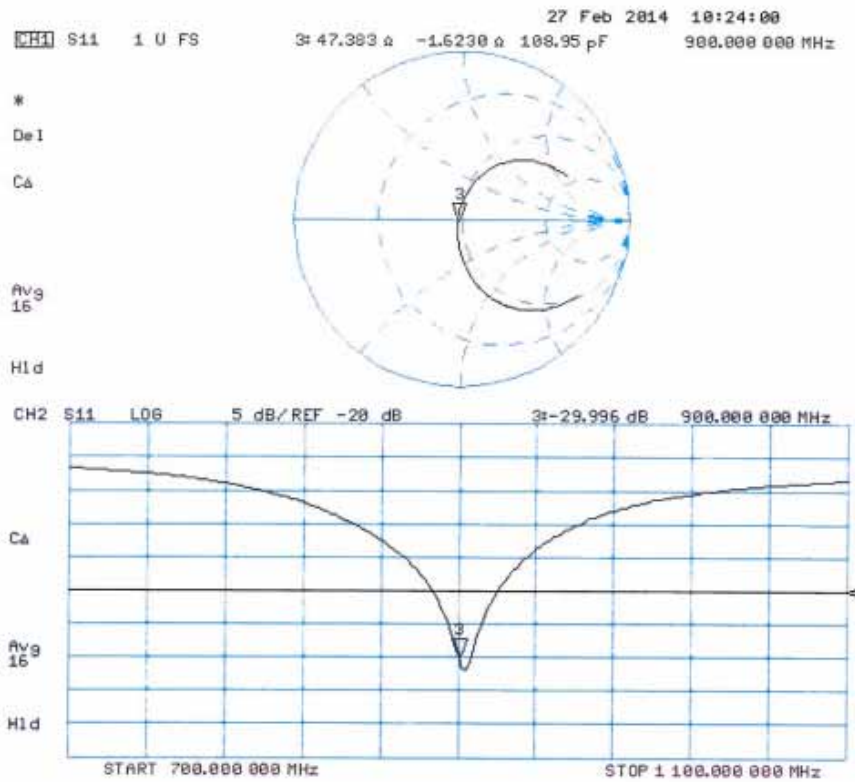
Peak SAR (extrapolated) = 3.91 W/kg

SAR(1 g) = 2.61 W/kg; SAR(10 g) = 1.68 W/kg

Maximum value of SAR (measured) = 3.07 W/kg



Impedance Measurement Plot for Body TSL



Appendix F. DAE Calibration Data

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Accreditation No.: SCS 108

Client **Quietek-CN (Auden)**

Certificate No: DAE4-1220_Jan14

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 1220**

Calibration procedure(s) **QA CAL-06.v26**
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **January 22, 2014**

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 $(22 \pm 3)^{\circ}\text{C}$ 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	01-Oct-13 (No:13976)	Oct-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-14 (in house check)	In house check: Jan-15
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-14 (in house check)	In house check: Jan-15

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

Issued: January 22, 2014

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Accreditation No.: **SCS 108**

Glossary

DAE data acquisition electronics
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- **DC Voltage Measurement:** Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- **Connector angle:** The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - **DC Voltage Measurement Linearity:** Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - **Common mode sensitivity:** Influence of a positive or negative common mode voltage on the differential measurement.
 - **Channel separation:** Influence of a voltage on the neighbor channels not subject to an input voltage.
 - **AD Converter Values with inputs shorted:** Values on the internal AD converter corresponding to zero input voltage
 - **Input Offset Measurement:** Output voltage and statistical results over a large number of zero voltage measurements.
 - **Input Offset Current:** Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - **Input resistance:** Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - **Low Battery Alarm Voltage:** Typical value for information. Below this voltage, a battery alarm signal is generated.
 - **Power consumption:** Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V , 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	405.217 \pm 0.02% (k=2)	404.944 \pm 0.02% (k=2)	404.170 \pm 0.02% (k=2)
Low Range	3.97747 \pm 1.50% (k=2)	3.99640 \pm 1.50% (k=2)	3.98639 \pm 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	176.5 $^{\circ}$ \pm 1 $^{\circ}$
---	-------------------------------------

Appendix

1. DC Voltage Linearity

High Range		Reading (μ V)	Difference (μ V)	Error (%)
Channel X	+ Input	199996.00	0.76	0.00
Channel X	+ Input	20002.66	1.98	0.01
Channel X	- Input	-19998.07	2.88	-0.01
Channel Y	+ Input	199996.91	1.60	0.00
Channel Y	+ Input	20001.20	0.56	0.00
Channel Y	- Input	-20001.74	-0.74	0.00
Channel Z	+ Input	199994.91	-0.44	-0.00
Channel Z	+ Input	20000.27	-0.23	-0.00
Channel Z	- Input	-20001.65	-0.63	0.00

Low Range		Reading (μ V)	Difference (μ V)	Error (%)
Channel X	+ Input	2001.09	0.27	0.01
Channel X	+ Input	202.00	0.81	0.40
Channel X	- Input	-197.89	0.69	-0.35
Channel Y	+ Input	2000.99	0.22	0.01
Channel Y	+ Input	200.07	-1.02	-0.50
Channel Y	- Input	-201.19	-2.34	1.18
Channel Z	+ Input	2000.92	0.16	0.01
Channel Z	+ Input	200.20	-0.82	-0.41
Channel Z	- Input	-199.32	-0.45	0.23

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 (μ V)	Low Range Average Reading (μ V)
Channel X	200	10.55	8.63
	- 200	-6.76	-8.77
Channel Y	200	-9.89	-10.34
	- 200	7.59	7.71
Channel Z	200	12.72	12.38
	- 200	-13.94	-14.25

3. Channel separation

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

	Input Voltage (mV)	Channel X (μ V)	Channel Y (μ V)	Channel Z (μ V)
Channel X	200	-	1.02	-3.16
Channel Y	200	8.35	-	2.35
Channel Z	200	10.56	5.06	-

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	15888	15493
Channel Y	16012	15900
Channel Z	15706	16099

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	1.13	-0.62	2.79	0.50
Channel Y	-0.89	-2.63	0.76	0.48
Channel Z	-0.60	-2.36	0.94	0.50

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