

FCC SAR Test Report

Equipment : Class Connect
Brand Name : Gemtek
Model No. : MU736
FCC ID : MXF-WRTD303NMU736
Standard : FCC 47 CFR Part 2 (2.1093)
ANSI/IEEE C95.1-1992
IEEE 1528-2003
Applicant : Gemtek
No.15-1 Zhonghua Road, Hsinchu
Industrial Park, Hukou, Hsinchu,
Taiwan, 30352

The product sample received on Oct. 23, 2014 and completely tested on Nov. 3, 2014. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:



Gary Chang / Manager





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Revision History

Report No.	Version	Description	Issued Date
FA4N1312	Rev. 01	Initial issue of report	Dec. 26, 2014



1 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing as follows.

Exposure Position	Frequency Band	Reported 1g SAR (W/kg)	Equipment Class	Highest Reported 1g SAR (W/kg)
Body	WCDMA 850	0.34	PCB	1.02
	WCDMA 1700	0.62		
	WCDMA 1900	1.02		

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003.

1.1 Guidance Standard

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2003
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- FCC KDB 865664 D02 SAR Reporting v01r01
- FCC KDB 447498 D01 General RF Exposure Guidance v05r02
- FCC KDB 941225 D01 3G SAR Procedures v03
- FCC KDB 941225 D06 Hotspot Mode v02

1.2 Testing Location Information

Testing Location	
Wen	ADD : No. 13-1, Ln. 19, Wen 33rd St., Kwei-Shan Hsiag, Tao Yuan Hsien, Taiwan, R.O.C. TEL : 886-3-3180792



2 Equipment Under Test (EUT)

2.1 General Information

Product Feature & Specification	
Equipment Name	Class Connect
Brand Name	Gemtek
Model Name	MU736
FCC ID	MXF-WRTD303NMU736
Frequency Range	Uplink : 826.4~846.6 MHz 1712.4 ~ 1752.6 MHz 1852.4~1907.6 MHz Downlink: 871.4~891.6 MHz 2112.4~2152.6 MHz 1932.4~1987.6 MHz
Antenna type gain	PIFA Antenna 1.25 dBi @ 824~ 849 MHz 1.70 dBi @ 1710 ~ 1785 MHz 1.60 dBi @ 1850 ~ 1910 MHz
EUT Stage	Identical Prototype

The EUT is a 3G module which will be installed in below specific platform. Thus, SAR test configuration is 3G module with this platform.

Platform information	
Brand Name	Gemtek
Product Name	Easy Connect
Model No.	WRTD-303N
FCC ID	MXF-WRTD303N

Specification of Accessory for platform		
Battery	Brand Name	WTE Battery
	Model Name	303N
	Power Rating	7.4V, 4050mAh, 29.97Wh



3 RF Exposure Limits

3.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

3.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
14.02	13.20	13.13

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

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

4 Specific Absorption Rate (SAR)

4.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

4.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\text{SAR} = \frac{d}{dt} \left(\frac{dW}{dm} \right) = \frac{d}{dt} \left(\frac{dW}{\rho dv} \right)$$

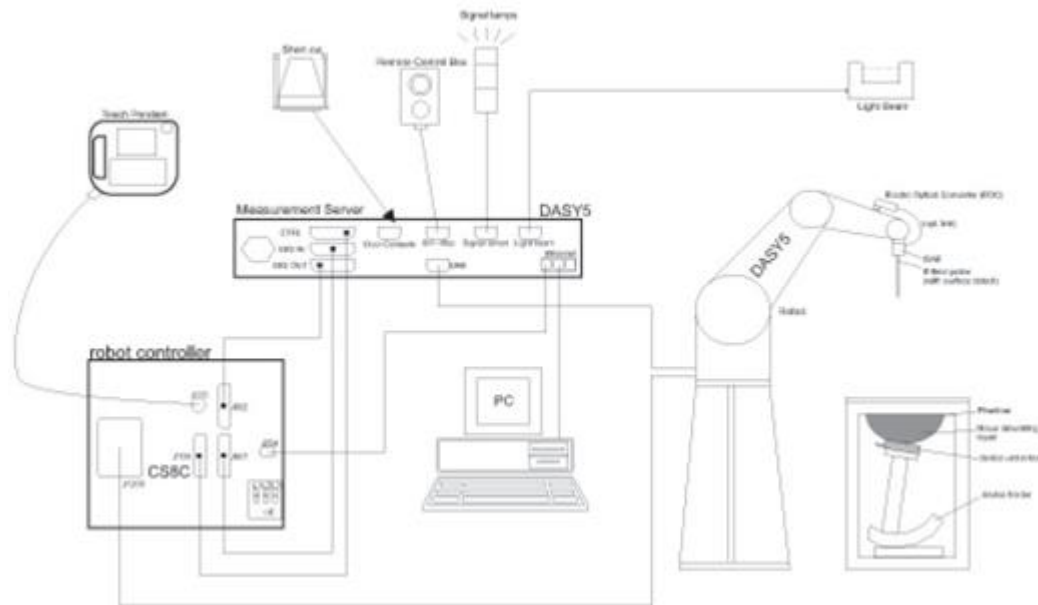
SAR is expressed in units of Watts per kilogram (W/kg)

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

5 System Description and Setup

The DASY system used 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).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- 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 function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 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.

6 Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

- (a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- (b) Read the WWAN RF power level from the base station simulator.
- (c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
- (d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix D demonstrates.
- (c) Set scan area, grid size and other setting on the DASY software.
- (d) Measure SAR results for the highest power channel on each testing position.
- (e) Find out the largest SAR result on these testing positions of each band
- (f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

6.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (g) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (b) Generation of a high-resolution mesh within the measured volume
- (c) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (d) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (e) Calculation of the averaged SAR within masses of 1g and 10g

6.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

6.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0 is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r03 SAR measurement 100 MHz to 6 GHz v01r01.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

6.4 Zoom Scan

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r03 SAR measurement 100 MHz to 6 GHz v01r01.

		≤ 3 GHz	> 3 GHz	
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*	
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm	
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z	≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm	
<p>Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.</p> <p>* When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</p>				

6.5 Volume Scan Procedures

The volume scan is used to assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

6.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASYS measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.



7 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Data Acquisition Electronics	DAE4	1424	2014/2/11	2015/2/10
SPEAG	Dosimetric E-Field Probe	EX3DV4	3976	2014/2/17	2015/2/16
SPEAG	835MHz System Validation Kit	D835V2	4d167	2014/2/6	2015/2/5
SPEAG	1750MHz System Validation Kit	D1750V2	1112	2014/2/11	2015/2/10
SPEAG	1900MHz System Validation Kit	D1900V2	5d185	2014/2/7	2015/2/6
SPEAG	Device Holder	N/A	N/A	NCR	NCR
Mini-Circuits	Power Amplifier	ZHL-42W+	15542	NCR	NCR
Mini-Circuits	Power Amplifier	ZVE-8G+	605601404	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46419201	2014/1/15	2015/1/14
Agilent	Wireless communication test Set	8960	MY53202225	2014/7/7	2015/7/6
Agilent	MXG-B RF Vector Signal Generator	N5182B	MY53050081	2014/4/8	2015/4/7
SPEAG	Dielectric Probe Kit	SM DAK 040CA	1146	NCR	NCR
Anritsu	Power Meter	ML2495A	949003	2014/1/28	2015/1/27
Anritsu	Power sensor	MA2411B	917017	2014/1/28	2015/1/27
SPEAG	Flat Phantom ELI5.0	QD OVA 002 AA	1238	NCR	NCR
Wisewind	Themometer	HTC1	HTC1	2013/12/25	2014/12/24
Wisewind	Themometer	YF-160A	130504609	2013/12/25	2014/12/24

General Note:

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
3. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
4. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.
5. NCR: No calibration request.



8 System Verification

8.1 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (ϵ_r)
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
1800,1900,2000	55.2	0	0	0.3	0.2	44.5	1.40	40.0

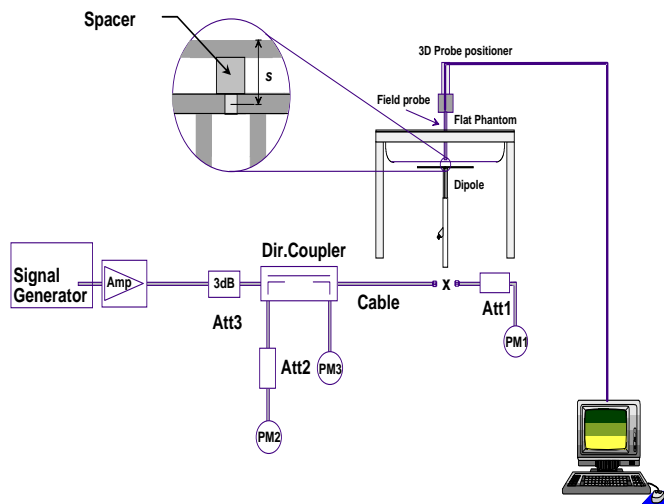
<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (°C)	Conductivity (σ)	Permittivity (ϵ_r)	Conductivity Target (σ)	Permittivity Target (ϵ_r)	Delta (σ) (%)	Delta (ϵ_r) (%)	Limit (%)	Date
835	22.6	0.987	56.289	0.97	55.2	1.75	1.97	±5	2014/11/3
1750	22.8	1.448	53.02	1.49	53.4	-2.82	-0.71	±5	2014/10/31
1900	22.8	1.532	53.918	1.52	53.3	0.79	1.16	±5	2014/10/30
1900	22.9	1.534	53.88	1.52	53.3	0.92	1.09	±5	2014/10/31

8.2 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured SAR (W/kg)	Targeted SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
2014/11/3	835	Body	250	4d167	3976	1424	2.32	9.38	9.28	-1.066
2014/10/31	1750	Body	250	1112	3976	1424	8.9	36.3	35.60	-1.928
2014/10/30	1900	Body	250	5d185	3976	1424	9.69	40.1	38.76	-3.342
2014/10/31	1900	Body	250	5d185	3976	1424	10	40.1	40.00	-0.249



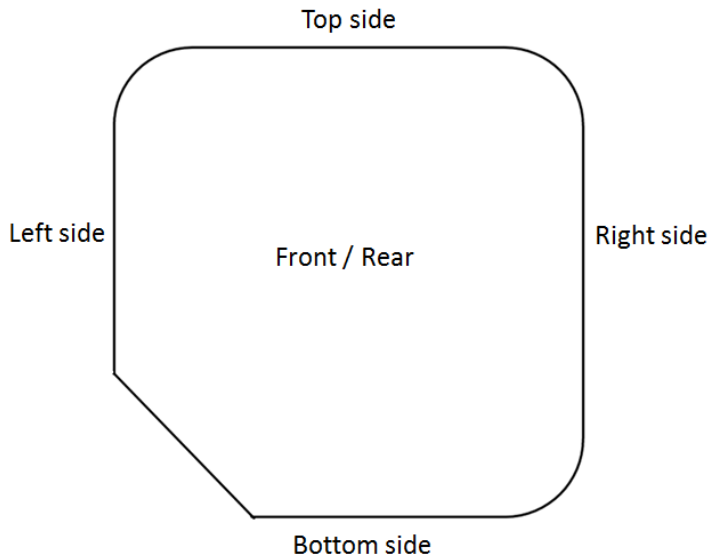
System Performance Check Setup



Setup Photo

9 RF Exposure Positions

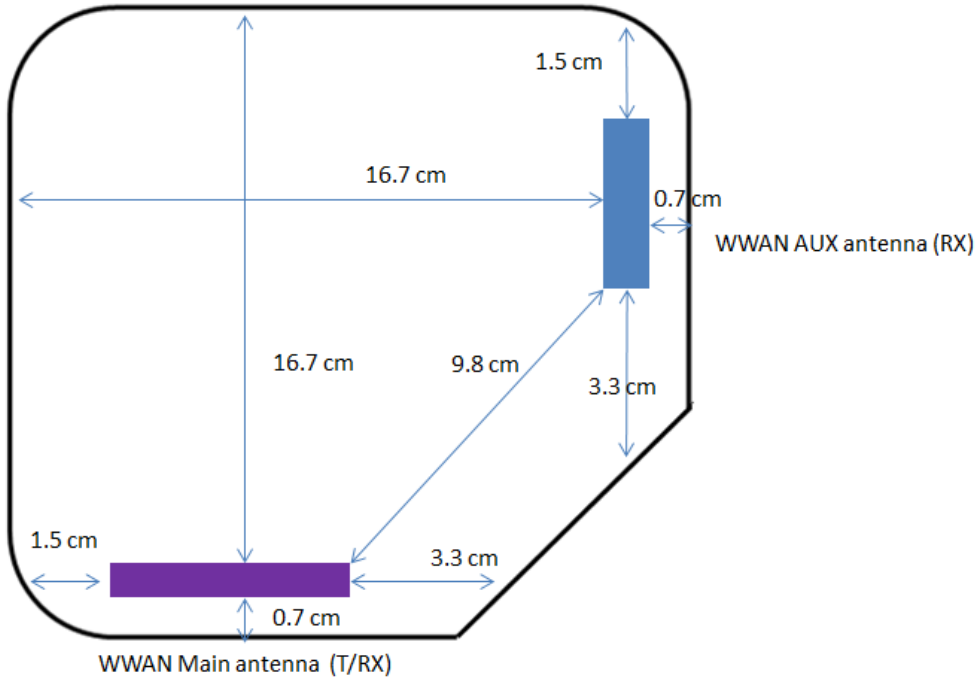
9.1 SAR Testing Position



Please refer to Appendix D. for the test setup photos.

10 Antenna Location and Separation Distance

Rear View



11 Conducted RF Output Power (Unit: dBm)

<WCDMA Conducted Power>

General Note:

1. The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.
2. The procedures in KDB 941225 D01 are applied for 3GPP Rel. 6 HSPA to configure the device in the required sub-test mode(s) to determine SAR test exclusion.

A summary of these settings are illustrated below:

HSDPA Setup Configuration:

- a. The EUT was connected to Base Station Agilent 8960 referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
 1. Set Gain Factors (β_c and β_d) and parameters were set according to each
 2. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
 3. Set RMC 12.2Kbps + HSDPA mode.
 4. Set Cell Power = -86 dBm
 5. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
 6. Select HSDPA Uplink Parameters
 7. Set Delta ACK, Delta NACK and Delta CQI = 8
 8. Set Ack-Nack Repetition Factor to 3
 9. Set CQI Feedback Cycle (k) to 4 ms
 10. Set CQI Repetition Factor to 2
 11. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

Setup Configuration

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: $\Delta_{ACK}, \Delta_{NACK}$ and $\Delta_{CQI} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and $\Delta_{NACK} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$, and $\Delta_{CQI} = 24/15$ with $\beta_{HS} = 24/15 * \beta_c$.

Note 3: CM = 1 for $\beta_c/\beta_d = 12/15, \beta_{HS}/\beta_c = 24/15$. For all other combinations of DPCCH, DPCCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 11/15$ and $\beta_d = 15/15$.



HSDPA Setup Configuration:

- a. The EUT was connected to Base Station Agilent 8960 referred to the Setup Configuration
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting * :
 - 1. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
 - 2. Set the Gain Factors (β_c and β_d) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
 - 3. Set Cell Power = -86 dBm
 - 4. Set Channel Type = 12.2k + HSPA
 - 5. Set UE Target Power
 - 6. Power Ctrl Mode= Alternating bits
 - 7. Set and observe the E-TFCI
 - 8. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
- d. The transmitted maximum output power was recorded.

Setup Configuration
Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note 1)	β_{ec}	β_{ed} (Note 5) (Note 6)	β_{ed} (SF)	β_{ed} (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed1} : 47/15 β_{ed2} : 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: $\Delta_{ACK}, \Delta_{NACK}$ and $\Delta_{CQI} = 30/15$ with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d=12/15, \beta_{hs}/\beta_c=24/15$. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$.

Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 6: β_{ed} can not be set directly, it is set by Absolute Grant Value.

< WCDMA Conducted Power Table >

Band	WCDMA II			WCDMA IV			WCDMA V		
Channel	9262	9400	9538	1312	1413	1513	4132	4182	4233
Frequency	1852.4	1880	1907.6	1712.4	1732.6	1752.6	826.4	836.4	846.6
RMC 12.2K	23.62	23.52	22.86	22.98	23.22	23.00	24.18	23.83	23.62
HSDPA Subtest-1	22.31	22.34	21.40	22.67	22.89	22.73	23.21	22.70	21.74
HSDPA Subtest-2	21.32	21.28	20.42	21.68	21.84	21.69	22.22	21.64	20.77
HSDPA Subtest-3	21.08	21.06	20.19	21.46	21.69	21.44	21.98	21.39	20.52
HSDPA Subtest-4	20.44	20.86	19.96	21.25	21.41	21.18	21.73	21.15	20.27
HSUPA Subtest-1	21.33	21.18	20.16	21.67	21.83	21.73	22.28	21.70	20.80
HSUPA Subtest-2	19.57	19.46	18.56	19.77	19.97	19.86	20.26	19.73	18.79
HSUPA Subtest-3	19.95	20.18	19.30	20.51	20.77	20.52	20.98	20.45	19.55
HSUPA Subtest-4	19.39	19.68	18.68	19.95	20.29	19.96	20.41	19.91	19.02
HSUPA Subtest-5	21.32	21.51	20.66	21.79	21.86	21.74	22.47	21.41	20.51
Tune-Up Limit for RMC 12.2K	24			23.5			24.5		



12 SAR Test Results

General Note:

1. Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
2. Per KDB 447498 D01v05r02, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
 - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
3. Per KDB 941225 D01v03, when maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA is $\leq 1/4$ dB higher than RMC 12.2 kbps or when the highest reported SAR of the RMC 12.2 kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA/HSUPA to RMC 12.2 kbps and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the HSDPA / HSUPA.
4. Per KDB 865664 D01 v01r03, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg

12.1 Body SAR

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
1	WCDMA II	RMC12.2K	Front Face	1	9262	1852.4	23.62	24	1.09	-0.04	0.821	0.90
2		RMC12.2K	Rear Face	1	9262	1852.4	23.62	24	1.09	-0.01	0.193	0.21
3		RMC12.2K	Left Side	1	9262	1852.4	23.62	24	1.09	-0.02	0.034	0.04
4		RMC12.2K	Right Side	1	9262	1852.4	23.62	24	1.09	-0.10	0.037	0.04
5		RMC12.2K	Top Side	1	9262	1852.4	23.62	24	1.09	-0.06	0.025	0.03
6		RMC12.2K	Bottom Side	1	9262	1852.4	23.62	24	1.09	0.03	0.365	0.40
7		RMC12.2K	Front Face	1	9400	1881.0	23.52	24	1.12	-0.01	0.917	1.02
8		RMC12.2K	Front Face	1	9538	1907.6	22.86	24	1.30	-0.01	0.777	1.01

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
9	WCDMA IV	RMC12.2K	Front Face	1	1413	1732.6	23.22	23.5	1.07	0	0.585	0.62
10		RMC12.2K	Rear Face	1	1413	1732.6	23.22	23.5	1.07	-0.05	0.237	0.25
11		RMC12.2K	Left Side	1	1413	1732.6	23.22	23.5	1.07	0.07	0.0271	0.03
12		RMC12.2K	Right Side	1	1413	1732.6	23.22	23.5	1.07	-0.03	0.0614	0.07
13		RMC12.2K	Top Side	1	1413	1732.6	23.22	23.5	1.07	-0.05	0.0267	0.03
14		RMC12.2K	Bottom Side	1	1413	1732.6	23.22	23.5	1.07	-0.01	0.151	0.16

Plot No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
15	WCDMA V	RMC12.2K	Front Face	1	4132	826.4	24.18	24.5	1.08	0.01	0.319	0.34
16		RMC12.2K	Rear Face	1	4132	826.4	24.18	24.5	1.08	-0.01	0.298	0.32
17		RMC12.2K	Left Side	1	4132	826.4	24.18	24.5	1.08	0.03	0.049	0.05
18		RMC12.2K	Right Side	1	4132	826.4	24.18	24.5	1.08	0.02	0.08	0.09
19		RMC12.2K	Top Side	1	4132	826.4	24.18	24.5	1.08	-0.01	0.011	0.01
20		RMC12.2K	Bottom Side	1	4132	826.4	24.18	24.5	1.08	0.02	0.204	0.22

12.2 Repeated SAR Measurement

No.	Band	Mode	Test Position	Gap (cm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
1	WCDMA II	RMC12.2K	Front Face	1	9400	1881.0	23.52	24	1.12	0.06	0.906	1.01

Note: Original Measured SAR / Repeated Measured SAR = 0.917 / 0.906 = 1.012



12.3 Simultaneous Transmission SAR

The EUT (3G module) is installed in a specific host an approved wireless device (FCC ID: MXF-WRTD303N). The host can support 3G and Wi-Fi function to transmit simultaneously. SAR test value of Wi-Fi comes from Sporton test report, report No.FA473072. Blow measured SAR results are the worst value of each position.

Position	WCDMA Band II SAR (W/kg)	2.4 GHz W-FI SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
Front Face	1.02	0.77	1.79	0.014	1
Rear Face	0.21	0.43	0.64	-	-
Left Side	0.04	0.07	0.11	-	-
Right Side	0.04	0.17	0.21	-	-
Top Side	0.03	0.38	0.41	-	-
Bottom Side	0.40	0.023	0.423	-	-

Note: Refer to section 12.3 for SPLSR evaluation and analysis

Position	WCDMA Band II SAR (W/kg)	5 GHz W-FI SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
Front Face	1.02	0.28	1.3	-	-
Rear Face	0.21	0.2	0.41	-	-
Left Side	0.04	0.045	0.085	-	-
Right Side	0.04	0.54	0.58	-	-
Top Side	0.03	0.61	0.64	-	-
Bottom Side	0.40	0.03	0.43	-	-

Position	WCDMA Band IV SAR (W/kg)	2.4 GHz W-FI SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
Front Face	0.62	0.77	1.39	-	-
Rear Face	0.25	0.43	0.68	-	-
Left Side	0.03	0.07	0.10	-	-
Right Side	0.07	0.17	0.24	-	-
Top Side	0.03	0.38	0.41	-	-
Bottom Side	0.16	0.023	0.183	-	-

Position	WCDMA Band IV SAR (W/kg)	5 GHz W-FI SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
Front Face	0.62	0.28	0.90	-	-
Rear Face	0.25	0.2	0.45	-	-
Left Side	0.03	0.045	0.075	-	-
Right Side	0.07	0.54	0.61	-	-
Top Side	0.03	0.61	0.64	-	-
Bottom Side	0.16	0.03	0.19	-	-

Position	WCDMA Band V SAR (W/kg)	2.4 GHz W-FI SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
Front Face	0.34	0.77	1.11	-	-
Rear Face	0.32	0.43	0.75	-	-
Left Side	0.05	0.07	0.12	-	-
Right Side	0.09	0.17	0.26	-	-
Top Side	0.01	0.38	0.39	-	-
Bottom Side	0.22	0.023	0.243	-	-

Position	WCDMA Band V SAR (W/kg)	5 GHz W-FI SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
Front Face	0.34	0.28	0.62	-	-
Rear Face	0.32	0.2	0.52	-	-
Left Side	0.05	0.045	0.095	-	-
Right Side	0.09	0.54	0.63	-	-
Top Side	0.01	0.61	0.62	-	-
Bottom Side	0.22	0.03	0.25	-	-

Note: SPLSR evaluation is not required when summed SAR value is < 1.6 W/kg

Conclusion

Simultaneous Transmission SAR is not required since SPLSR is 0.014 < 0.04

12.4 SPLSR Evaluation and Analysis

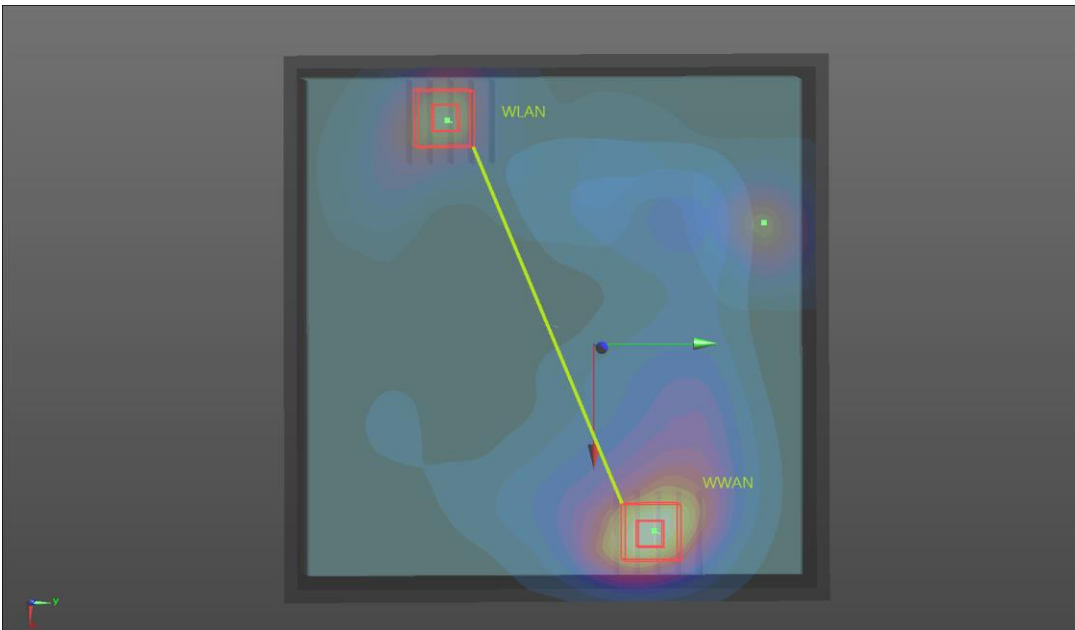
This evaluation is for case 1 of section 12.2 since summed SAR value is > 1.6 W/kg.

Follow below formula to calculate SPLSR ratio.

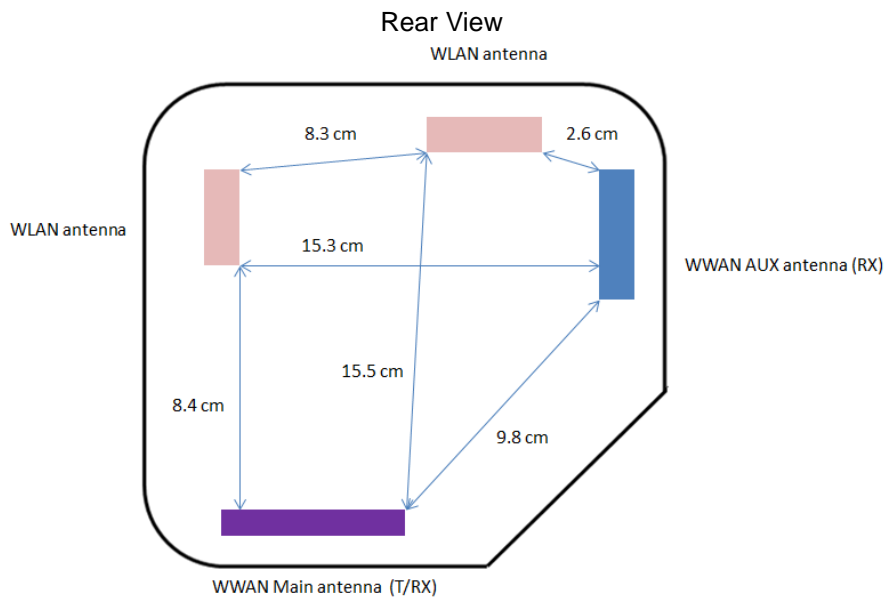
$$SPLSR = (SAR_1 + SAR_2)^{1.5} / R_i$$

R_i is the separation distance between the peak SAR locations for the antenna pair in mm.

Case	Mode	Position	1g-SAR (W/kg)	SAR Peak Location			Gap (cm)	$R_{i,3D}$ distance(mm)	Summed SAR (W/kg)	SPLSR	Simultaneous Transmission SAR
				X(cm)	Y(cm)	Z(cm)					
1	WCDMA II	Front Face	1.02	7.8	3.59	-0.29	1	176.160	1.79	0.014	No
	802.11b	Front Face	0.77	-8	-4.2	-0.3	1				



Refer to Sporton SAR report (Report No. FA473072) for WLAN antenna location.



13 Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture’s specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 14.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor ^(a)	1/k ^(b)	1/√3	1/√6	1/√2

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual “root-sum-squares” (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.



Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (±%) (1g)
Measurement System					
Probe Calibration	6.0	Normal	1.0	1.0	6.0
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.7	1.9
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.7	3.9
Boundary effects	1.0	Rectangular	$\sqrt{3}$	1.0	0.6
Linearity	4.7	Rectangular	$\sqrt{3}$	1.0	2.7
System Detection Limits	1.0	Rectangular	$\sqrt{3}$	1.0	0.6
Modulation Response	2.4	Rectangular	$\sqrt{3}$	1.0	1.4
Readout Electronics	0.3	Normal	1.0	1.0	0.3
Response Time	0.8	Rectangular	$\sqrt{3}$	1.0	0.5
Integration Time	2.6	Rectangular	$\sqrt{3}$	1.0	1.5
RF Ambient Noise	3.0	Rectangular	$\sqrt{3}$	1.0	1.7
RF Ambient Reflections	3.0	Rectangular	$\sqrt{3}$	1.0	1.7
Probe Positioner	0.4	Rectangular	$\sqrt{3}$	1.0	0.2
Probe Positioning	2.9	Rectangular	$\sqrt{3}$	1.0	1.7
Max. SAR Eval.	2.0	Rectangular	$\sqrt{3}$	1.0	1.2
Dipole Related					
Device Positioning	2.9	Normal	1.0	1.0	2.9
Device Holder	3.6	Normal	1.0	1.0	3.6
Power Drift	5.0	Rectangular	$\sqrt{3}$	1.0	2.9
Power Scaling	0.0	Rectangular	$\sqrt{3}$	1.0	0.0
Phantom and Tissue parameters					
Phantom Uncertainty	6.1	Rectangular	$\sqrt{3}$	1.0	3.5
SAR correction	1.9	Normal	1.0	1.0	1.9
Liquid Conductivity (measurement)	2.0	Normal	1.0	0.8	1.6
Liquid Permittivity (measurement)	2.1	Normal	1.0	0.3	0.5
Temp. unc. - Conduct	3.4	Rectangular	$\sqrt{3}$	0.8	1.5
Temp. unc. - Permittivity	0.4	Rectangular	$\sqrt{3}$	0.2	0.1
Combined Standard Uncertainty					11.2
Coverage Factor for 95 %					Kp=2
Expanded Uncertainty					22.4

Uncertainty Budget for frequency range 30 MHz to 3 GHz



Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (±%) (1g)
Measurement System					
Probe Calibration	6.6	Normal	1.0	1.0	6.6
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	0.7	1.9
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	0.7	3.9
Boundary effects	2.0	Rectangular	$\sqrt{3}$	1.0	1.2
Linearity	4.7	Rectangular	$\sqrt{3}$	1.0	2.7
System Detection Limits	1.0	Rectangular	$\sqrt{3}$	1.0	0.6
Modulation Response	2.4	Rectangular	$\sqrt{3}$	1.0	1.4
Readout Electronics	0.3	Normal	1.0	1.0	0.3
Response Time	0.8	Rectangular	$\sqrt{3}$	1.0	0.5
Integration Time	2.6	Rectangular	$\sqrt{3}$	1.0	1.5
RF Ambient Noise	3.0	Rectangular	$\sqrt{3}$	1.0	1.7
RF Ambient Reflections	3.0	Rectangular	$\sqrt{3}$	1.0	1.7
Probe Positioner	0.8	Rectangular	$\sqrt{3}$	1.0	0.5
Probe Positioning	6.7	Rectangular	$\sqrt{3}$	1.0	3.9
Max. SAR Eval.	4.0	Rectangular	$\sqrt{3}$	1.0	2.3
Dipole Related					
Device Positioning	2.9	Normal	1.0	1.0	2.9
Device Holder	3.6	Normal	1.0	1.0	3.6
Power Drift	5.0	Rectangular	$\sqrt{3}$	1.0	2.9
Power Scaling	0.0	Rectangular	$\sqrt{3}$	1.0	0.0
Phantom and Tissue parameters					
Phantom Uncertainty	6.6	Rectangular	$\sqrt{3}$	1.0	3.8
SAR correction	1.9	Normal	1.0	1.0	1.9
Liquid Conductivity (measurement)	2.0	Normal	1.0	0.8	1.6
Liquid Permittivity (measurement)	2.1	Normal	1.0	0.3	0.5
Temp. unc. - Conduct	3.4	Rectangular	$\sqrt{3}$	0.8	1.5
Temp. unc. - Permittivity	0.4	Rectangular	$\sqrt{3}$	0.2	0.1
Combined Standard Uncertainty					12.3
Coverage Factor for 95 %					Kp=2
Expanded Uncertainty					24.7

Uncertainty Budget for frequency range 3 GHz to 6 GHz



14 References

- [1] FCC 47CFR Part 2 , "FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS"
- [2] IEEE Std. C95.1-1992, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz"
- [3] IEEE Std. 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"
- [4] SPEAG DASY System Handbook
- [5] 941225 D03 3G SAR Procedures v03, "3G SAR Measurement Procedures"
- [6] 447498 D01 General RF Exposure Guidance v05r02, "Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies"
- [7] 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03, "SAR Measurement Requirements for 100 MHz to 6 GHz"
- [8] 865664 D02 RF Exposure Reporting v01r01, "RF Exposure Compliance Reporting and Documentation Considerations"
- [9] 941225 D06 Hotspot Mode v02, "SAR evaluation procedure for portable devices with wireless router capabilities"
- [10] SPEAG DASY System Handbook



APPENDIX A. Plots of System Performance Check

System Check_B835_1401103

DUT: Dipole 835 MHz_SN:4d167

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: B835_141103 Medium parameters used: $f = 835$ MHz; $\sigma = 0.987$ S/m; $\epsilon_r = 56.289$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.0 °C; **Liquid Temperature** : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3976; ConvF(10, 10, 10); Calibrated: 2014/2/17;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1424; Calibrated: 2014/2/11
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1238
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.71 W/kg

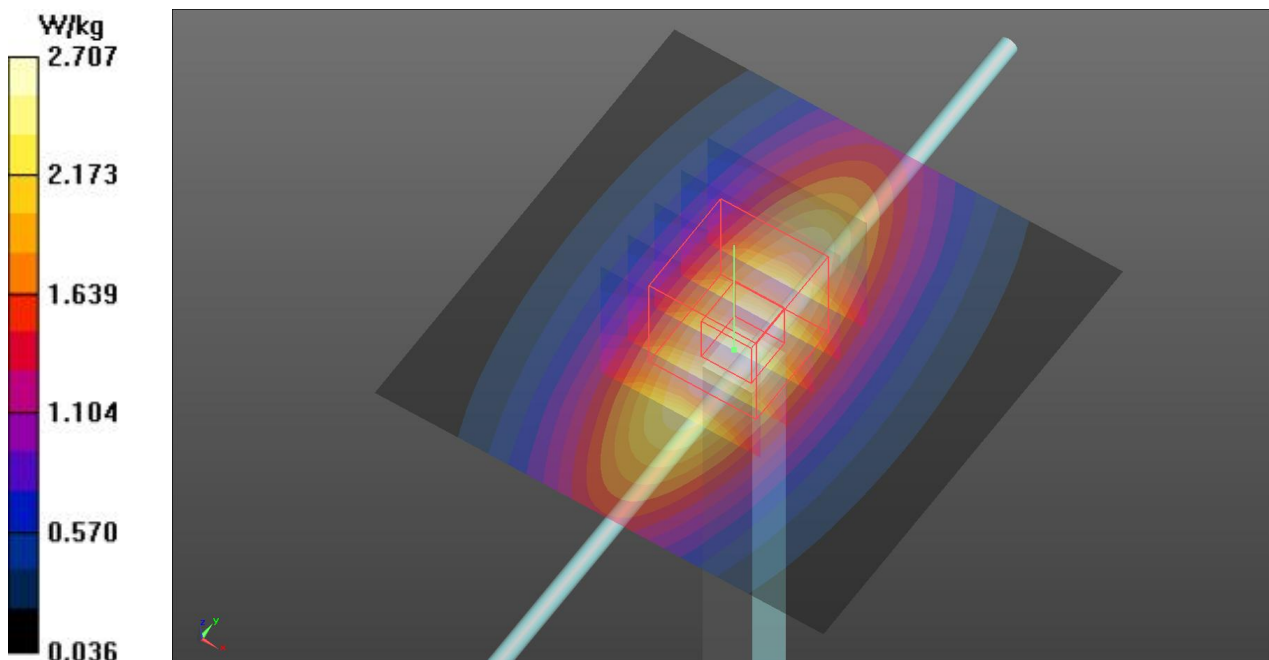
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 52.52 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.41 W/kg

SAR(1 g) = 2.32 W/kg; SAR(10 g) = 1.55 W/kg

Maximum value of SAR (measured) = 2.70 W/kg



System Check_B1750_141031

DUT: Dipole 1750 MHz_SN: 1112

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: B1750_141031 Medium parameters used: $f = 1750$ MHz; $\sigma = 1.448$ S/m; $\epsilon_r = 53.02$; $\rho = 1000$ kg/m³

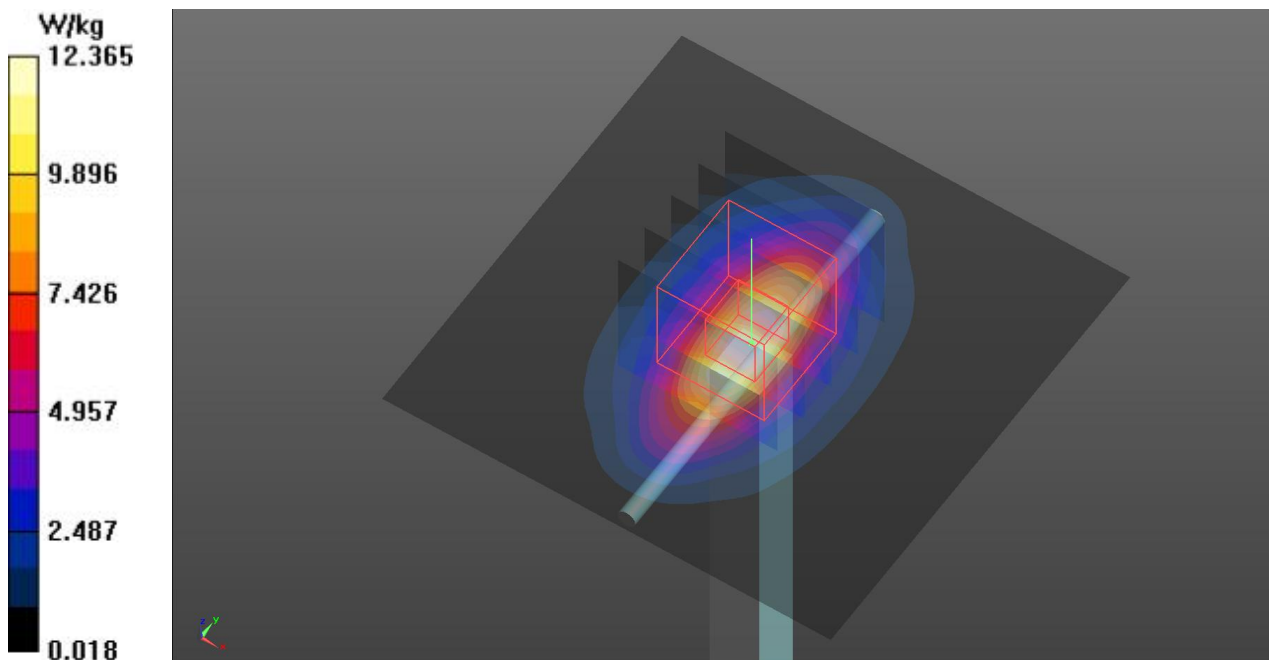
Ambient Temperature : 23.0 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3976; ConvF(8.21, 8.21, 8.21); Calibrated: 2014/2/17;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1424; Calibrated: 2014/2/11
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1238
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 12.4 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 94.11 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 15.1 W/kg
SAR(1 g) = 8.9 W/kg; SAR(10 g) = 4.84 W/kg
Maximum value of SAR (measured) = 12.4 W/kg



System Check_B1900_141030

DUT: Dipole 1900 MHz_SN: 5d185

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: B1900_141030 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.532$ S/m; $\epsilon_r = 53.918$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.0 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3976; ConvF(7.89, 7.89, 7.89); Calibrated: 2014/2/17;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1424; Calibrated: 2014/2/11
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1238
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 13.6 W/kg

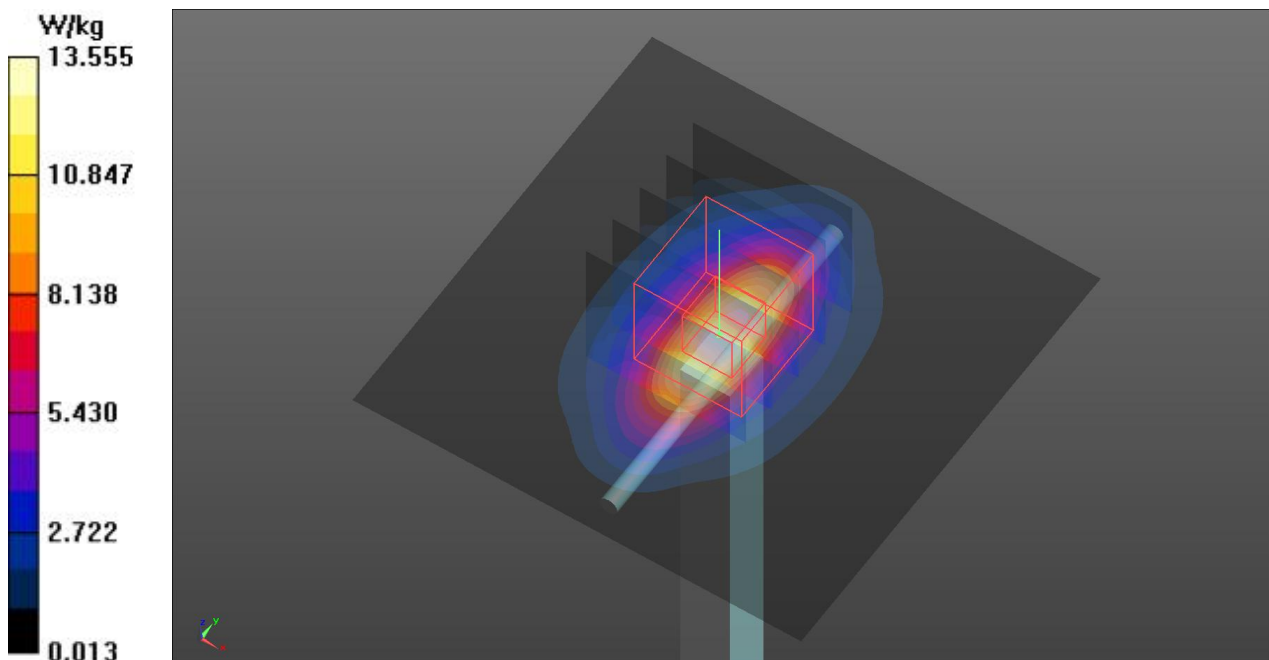
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 96.11 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 9.69 W/kg; SAR(10 g) = 5.14 W/kg

Maximum value of SAR (measured) = 13.6 W/kg



System Check_B1900_141031

DUT: Dipole 1900 MHz_SN: 5d185

Communication System: CW ; Frequency: 1900 MHz;Duty Cycle: 1:1

Medium: B1900_141031 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.534$ S/m; $\epsilon_r = 53.88$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C; **Liquid Temperature** : 22.9 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3976; ConvF(7.89, 7.89, 7.89); Calibrated: 2014/2/17;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1424; Calibrated: 2014/2/11
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1238
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 14.1 W/kg

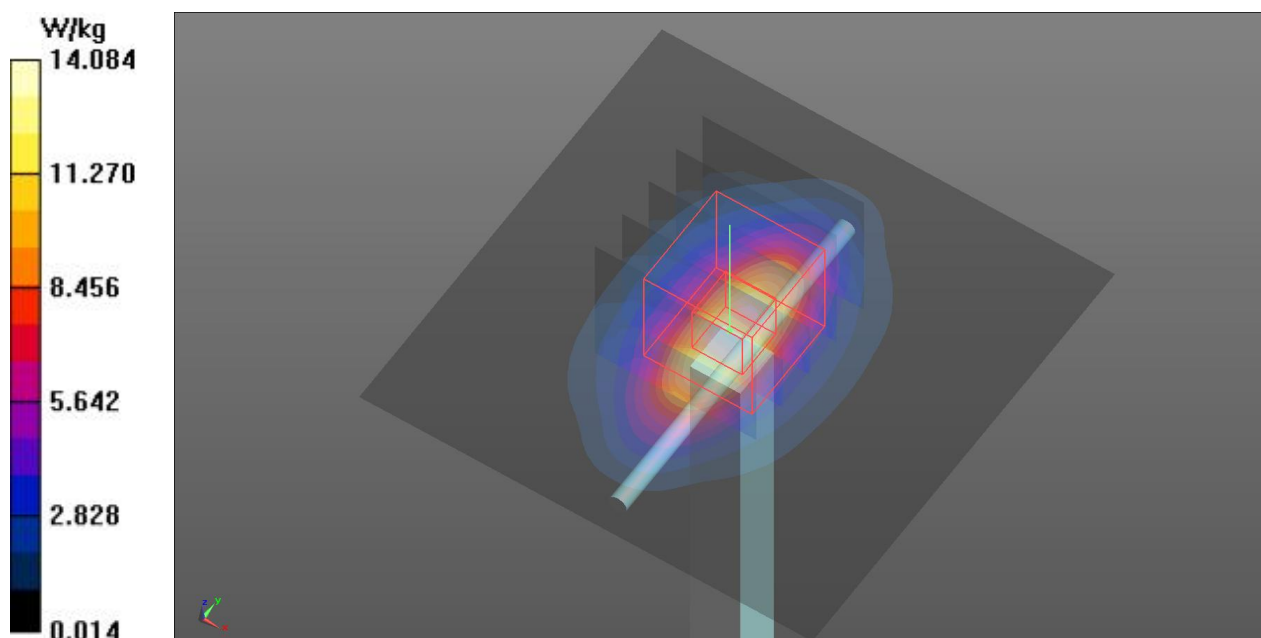
Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 97.73 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.2 W/kg

SAR(1 g) = 10 W/kg; SAR(10 g) = 5.34 W/kg

Maximum value of SAR (measured) = 14.1 W/kg





APPENDIX B. Plots of SAR Measurement

P07 WCDMA II_RMC12.2K_Front Face_1cm_Ch9400

DUT: 402301

Communication System: WCDMA; Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: B1900_141030 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.512$ S/m; $\epsilon_r = 53.969$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.0 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3976; ConvF(7.89, 7.89, 7.89); Calibrated: 2014/2/17;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1424; Calibrated: 2014/2/11
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1238
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch9400/Area Scan (141x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.16 W/kg

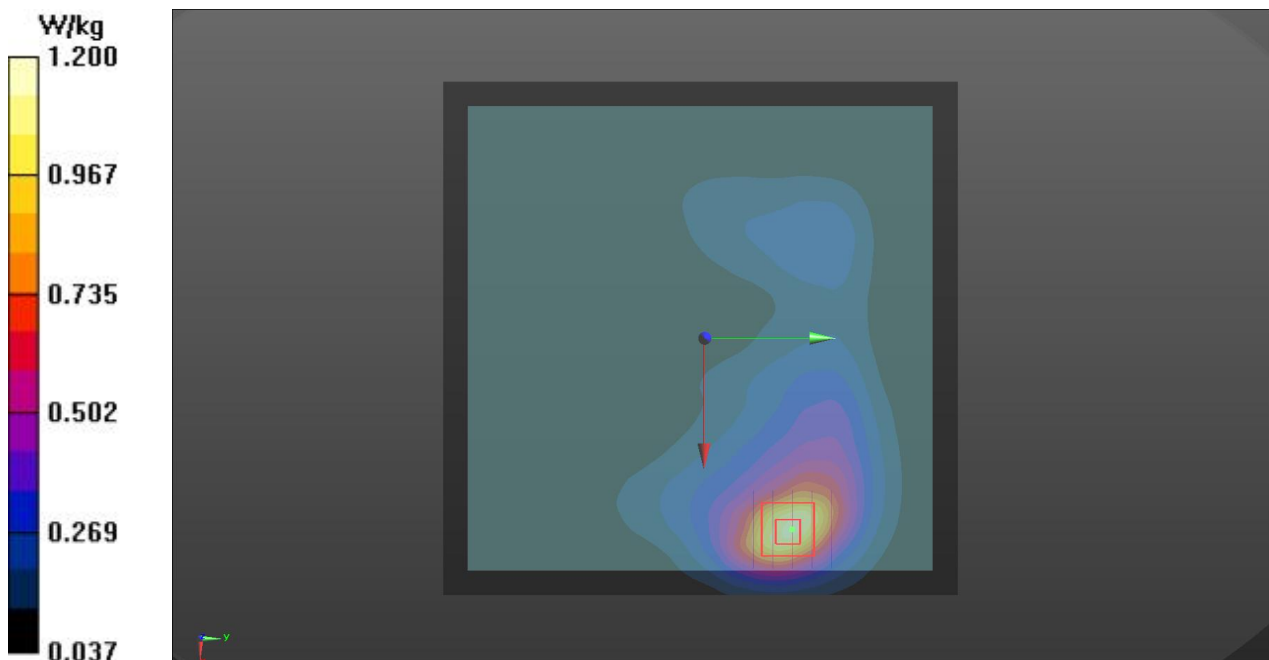
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 27.02 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 1.44 W/kg

SAR(1 g) = 0.917 W/kg; SAR(10 g) = 0.545 W/kg

Maximum value of SAR (measured) = 1.20 W/kg



P09 WCDMA IV_RMC12.2K_Front Face_1cm_Ch1413

DUT: 402301

Communication System: WCDMA; Frequency: 1732.6 MHz; Duty Cycle: 1:1
Medium: B1750_141031 Medium parameters used: $f = 1733$ MHz; $\sigma = 1.432$ S/m; $\epsilon_r = 53.093$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.0 °C; Liquid Temperature : 22.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3976; ConvF(8.21, 8.21, 8.21); Calibrated: 2014/2/17;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1424; Calibrated: 2014/2/11
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1238
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1413/Area Scan (141x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.768 W/kg

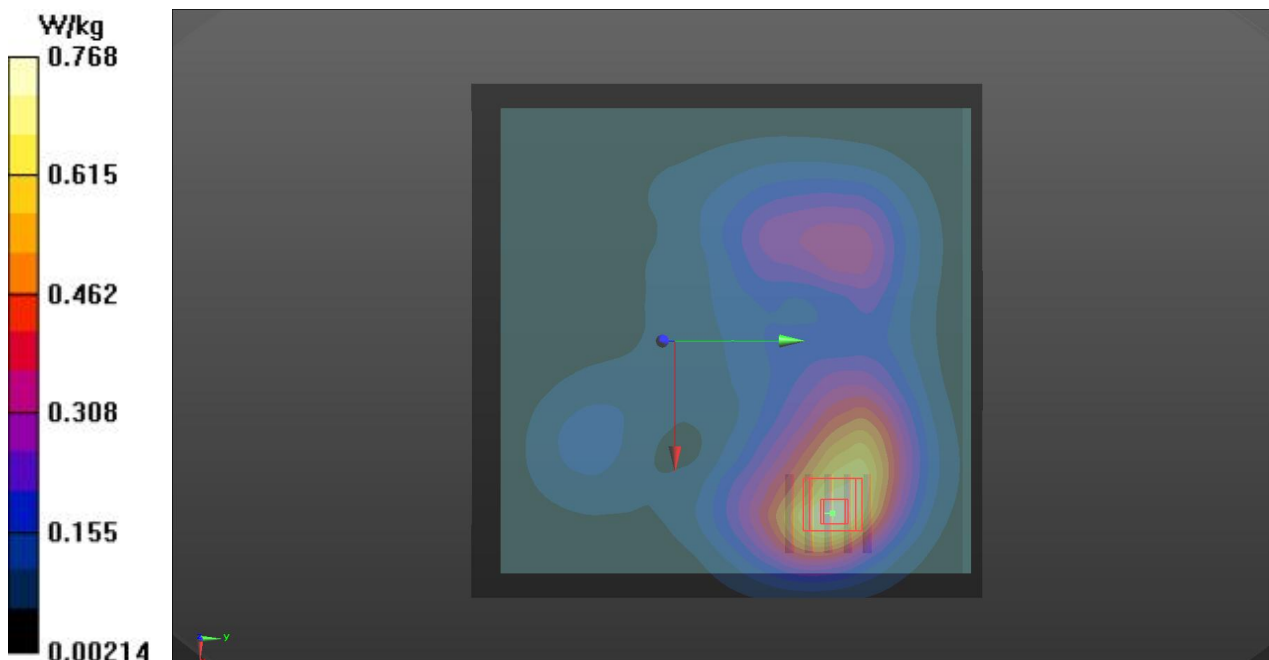
Ch1413/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 22.79 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 0.869 W/kg

SAR(1 g) = 0.585 W/kg; SAR(10 g) = 0.386 W/kg

Maximum value of SAR (measured) = 0.740 W/kg



P15 WCDMA V_RMC12.2K_Front Face_1cm_Ch4132

DUT: 402301

Communication System: WCDMA; Frequency: 826.4 MHz; Duty Cycle: 1:1

Medium: B835_141103 Medium parameters used: $f = 826.4$ MHz; $\sigma = 0.979$ S/m; $\epsilon_r = 56.365$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.0 °C; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3976; ConvF(10, 10, 10); Calibrated: 2014/2/17;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1424; Calibrated: 2014/2/11
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1238
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch4132/Area Scan (141x141x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.401 W/kg

Ch4132/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.51 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.441 W/kg

SAR(1 g) = 0.351 W/kg; SAR(10 g) = 0.279 W/kg

Maximum value of SAR (measured) = 0.401 W/kg

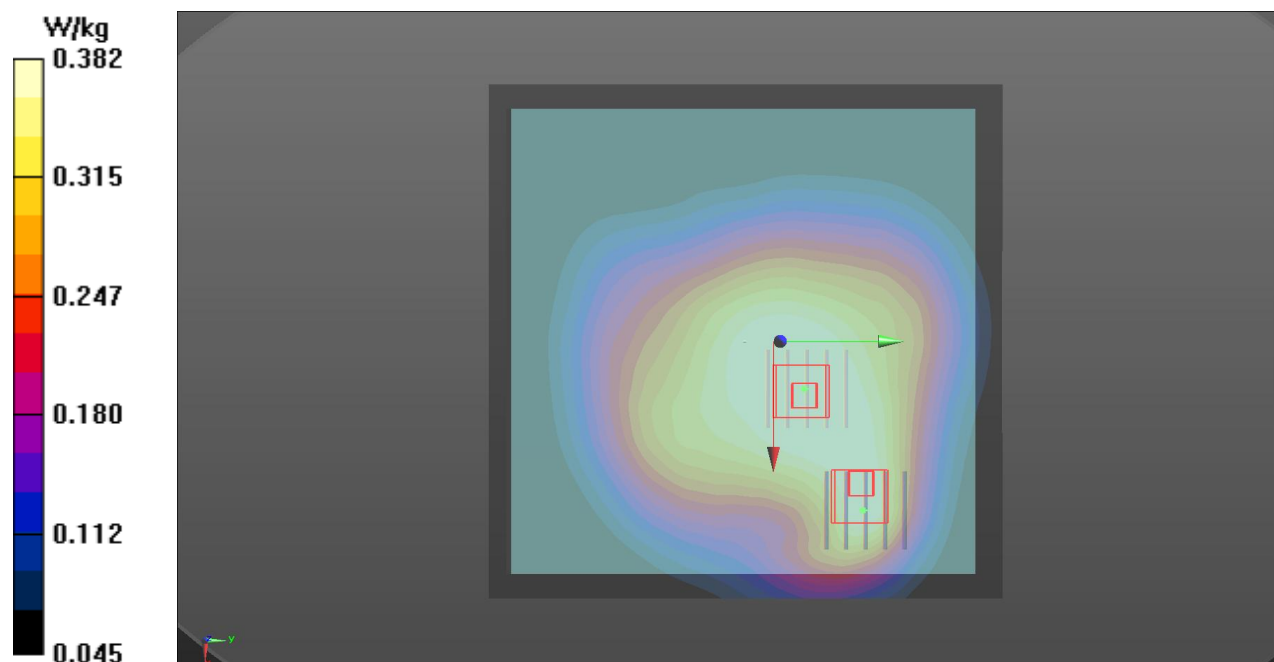
Ch4132/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.51 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.445 W/kg

SAR(1 g) = 0.319 W/kg; SAR(10 g) = 0.230 W/kg

Maximum value of SAR (measured) = 0.382 W/kg





APPENDIX C. DASY Calibration Certificate

IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:

Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:

Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:

To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.



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Accreditation No.: **SCS 108**

Client **Sporton TW (Auden)**

Certificate No: **DAE4-1424_Feb14**

CALIBRATION CERTIFICATE

Object: **DAE4 - SD 000 D04 BM - SN: 1424**

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

Calibration date: **February 11, 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
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:	Name Fin Bomholt	Function Deputy Technical Manager	Signature

Issued: February 11, 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	403.049 \pm 0.02% (k=2)	403.528 \pm 0.02% (k=2)	403.106 \pm 0.02% (k=2)
Low Range	3.96725 \pm 1.50% (k=2)	3.96894 \pm 1.50% (k=2)	3.98334 \pm 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	359.0 $^{\circ}$ \pm 1 $^{\circ}$
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Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200030.76	-3.28	-0.00
Channel X	+ Input	20005.77	1.83	0.01
Channel X	- Input	-20003.61	1.53	-0.01
Channel Y	+ Input	200031.93	-2.16	-0.00
Channel Y	+ Input	20003.24	-0.56	-0.00
Channel Y	- Input	-20004.71	0.63	-0.00
Channel Z	+ Input	200033.53	-0.36	-0.00
Channel Z	+ Input	20002.24	-1.53	-0.01
Channel Z	- Input	-20006.39	-1.21	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.59	-0.04	-0.00
Channel X	+ Input	201.05	0.35	0.17
Channel X	- Input	-198.64	0.66	-0.33
Channel Y	+ Input	2000.93	0.43	0.02
Channel Y	+ Input	200.09	-0.39	-0.19
Channel Y	- Input	-199.95	-0.46	0.23
Channel Z	+ Input	2000.45	-0.11	-0.01
Channel Z	+ Input	199.23	-1.27	-0.64
Channel Z	- Input	-200.99	-1.60	0.80

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-0.83	-2.31
	- 200	3.44	1.74
Channel Y	200	-13.76	-13.63
	- 200	12.11	11.98
Channel Z	200	-8.79	-9.23
	- 200	6.47	6.33

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	3.73	-3.69
Channel Y	200	8.92	-	4.56
Channel Z	200	9.64	7.23	-

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	15956	15499
Channel Y	15857	16025
Channel Z	15899	16257

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	0.88	-0.25	2.52	0.43
Channel Y	1.07	-1.41	2.26	0.49
Channel Z	-0.74	-1.63	0.51	0.41

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



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Accreditation No.: **SCS 108**

Client **Sporton-TW (Auden)**

Certificate No: **D835V2-4d167_Feb14**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d167**

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

Calibration date: **February 06, 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 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: **Claudio Leubler** Laboratory Technician

Signature

Approved by: **Katja Pokovic** Technical Manager

Issued: February 13, 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	835 MHz \pm 1 MHz	

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	54.0 \pm 6 %	1.00 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	2.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.38 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	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.15 W/kg \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.3 Ω - 5.3 j Ω
Return Loss	- 24.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.390 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	November 11, 2013

DASY5 Validation Report for Body TSL

Date: 06.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d167

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 1$ S/m; $\epsilon_r = 54$; $\rho = 1000$ kg/m³

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

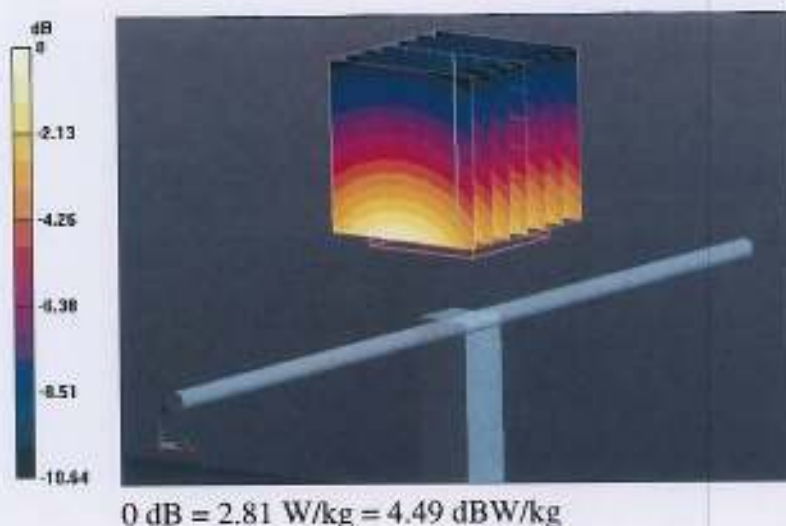
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.958 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.57 W/kg

SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.57 W/kg

Maximum value of SAR (measured) = 2.81 W/kg



Impedance Measurement Plot for Body TSL

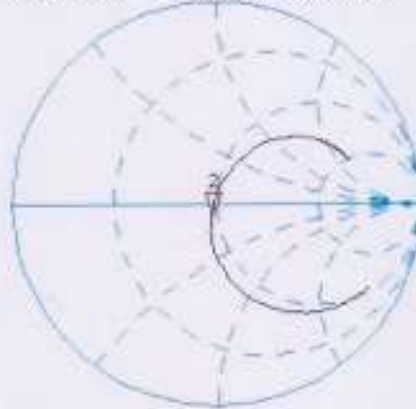
6 Feb 2014 10:37:17

CH1 S11 1 U FS

Zr 47.334 Ω -5.2695 Ω 36.171 pF

835.000 000 MHz

De1
C4
Avg
16
H1d



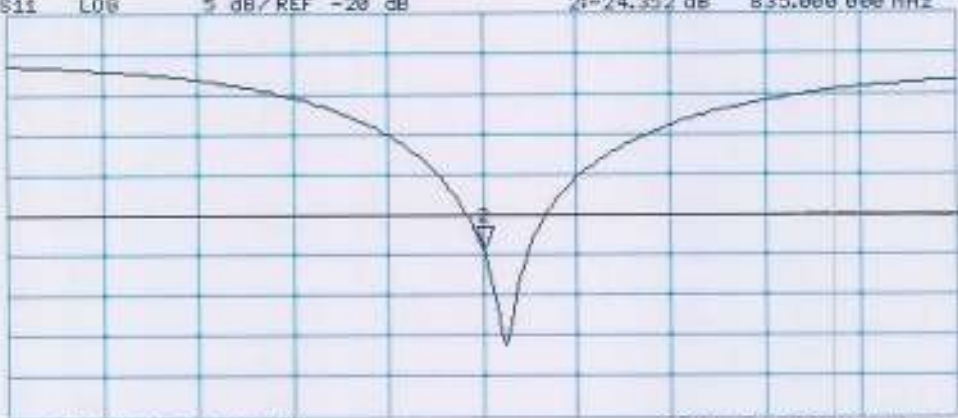
CH2 S11 L00

5 dB/REF -20 dB

2r-24.352 dB

835.000 000 MHz

C4
Avg
16
H1d



START 635.000 000 MHz

STOP 1 835.000 000 MHz



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Accreditation No.: **SCS 108**

Client **Sporton-TW (Auden)**

Certificate No: **D1750V2-1112_Feb14**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1112**

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

Calibration date: **February 11, 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 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: **Jeton Kastati** Laboratory Technician

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: February 14, 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	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz \pm 1 MHz	

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	52.5 \pm 6 %	1.49 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	9.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	36.3 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	4.88 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.5 W/kg \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.6 Ω + 0.4 j Ω
Return Loss	- 29.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.218 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	November 12, 2013

DASY5 Validation Report for Body TSL

Date: 11.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1112

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 52.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.89, 4.89, 4.89); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

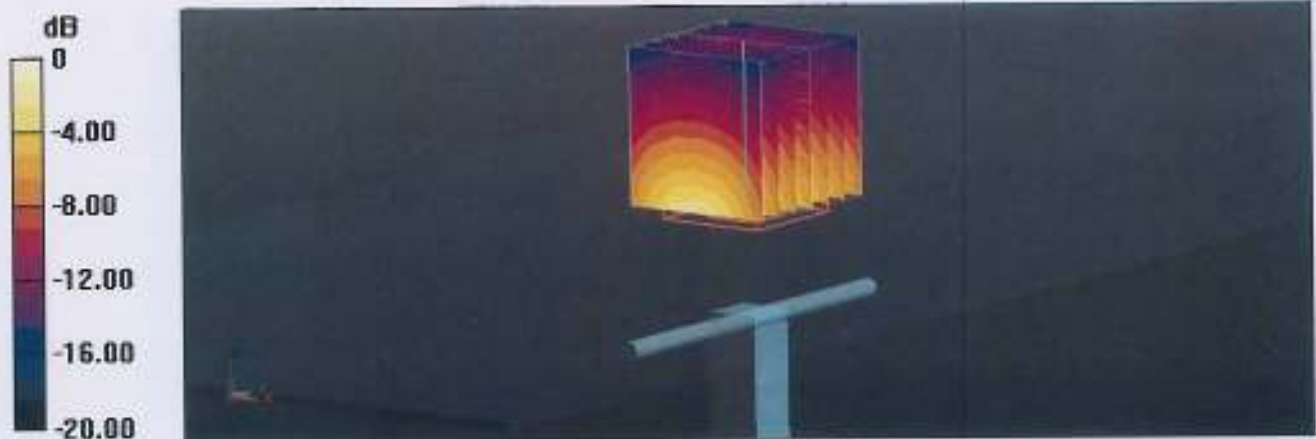
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.472 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 15.7 W/kg

SAR(1 g) = 9.1 W/kg; SAR(10 g) = 4.88 W/kg

Maximum value of SAR (measured) = 11.4 W/kg



Impedance Measurement Plot for Body TSL

11 Feb 2014 10:37:46

CH1 S11 1 U FS

1: 46.627 Ω 8.4121 Ω 37.479 μH

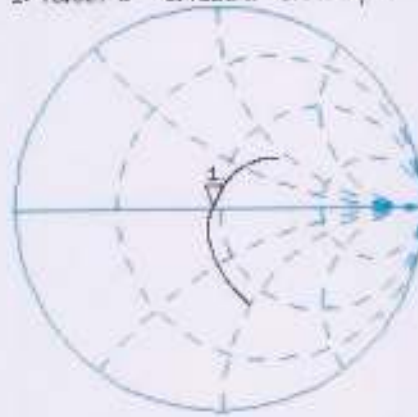
1 750.000 000 MHz

De1

Cor

avg
16

H1 d

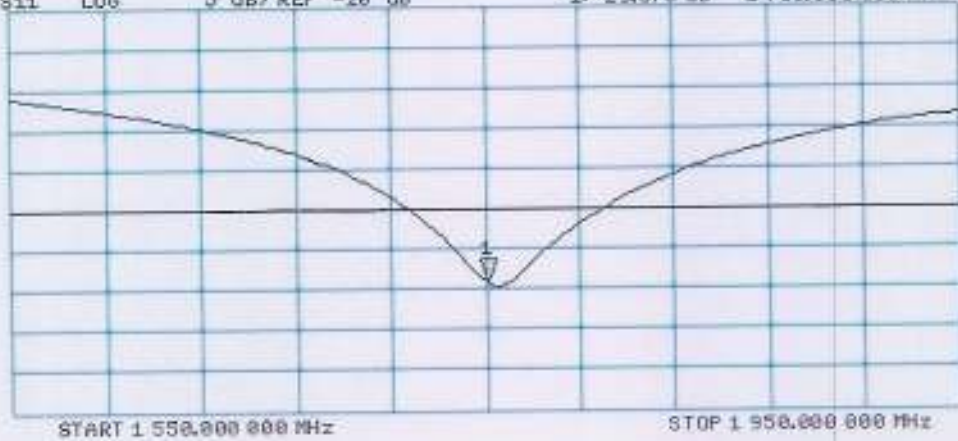


CH2 S11 LOG 5 dB/REF -20 dB 1: -23.075 dB 1 750.000 000 MHz

Cor

avg
16

H1 d





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Accreditation No.: **SCS 108**

Client **Sporton-TW (Auden)**

Certificate No: **D1900V2-5d185_Feb14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d185**

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

Calibration date: **February 07, 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 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: **Claudio Leubler** Name: Claudio Leubler Function: Laboratory Technician

Approved by: **Katja Pokovic** Name: Katja Pokovic Function: Technical Manager

Signature

Issued: February 13, 2014

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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	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz \pm 1 MHz	

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	52.8 \pm 6 %	1.49 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	9.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.1 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	5.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.2 W/kg \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.8 \Omega + 5.4 j\Omega$
Return Loss	- 25.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 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	August 23, 2013

DASY5 Validation Report for Body TSL

Date: 07.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d185

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 52.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

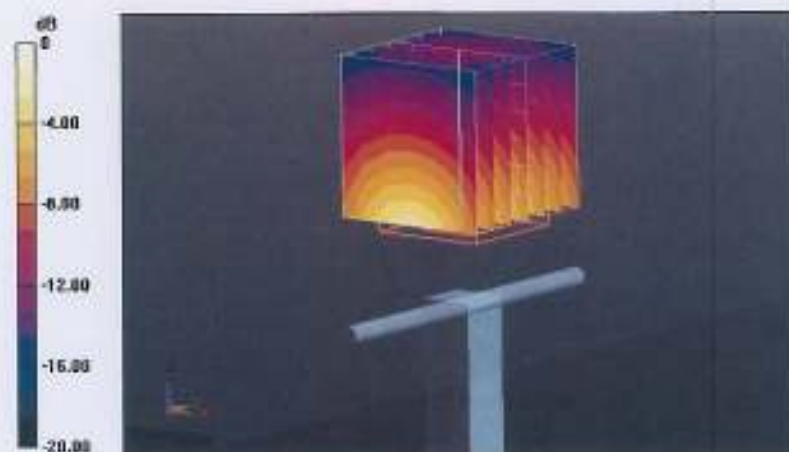
Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 95.445 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.4 W/kg

SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.26 W/kg

Maximum value of SAR (measured) = 12.6 W/kg



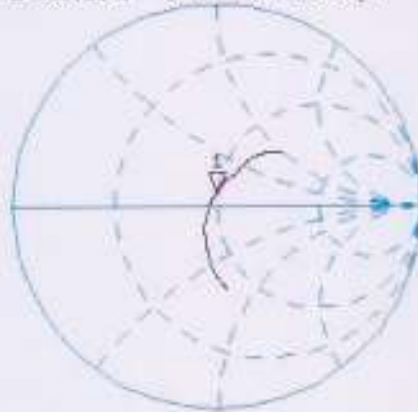
0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Body TSL

7 Feb 2014 13:22:55

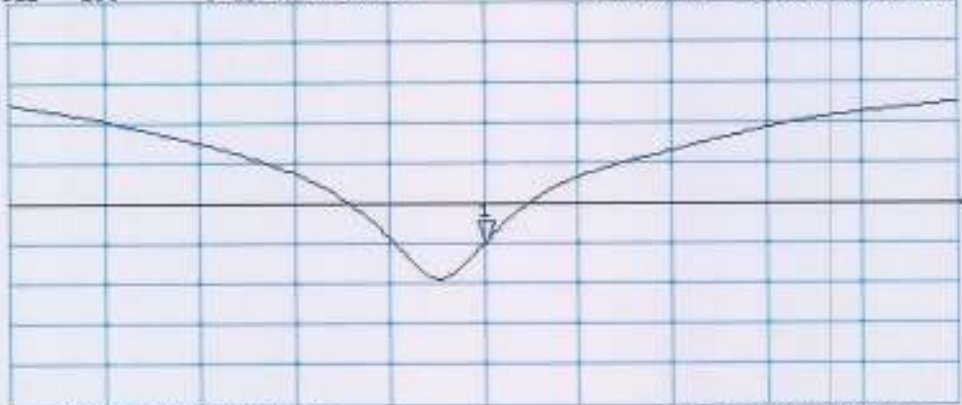
CH1 S11 1 U FS 1:46.812 α 5.4355 α 455.31 μ H 1 900.000 000 MHz

*
De1
Ca
Avg
16
H1d



CH2 S11 L06 5 dB/REF -20 dB 1: -24.998 dB 1 900.000 000 MHz

Ca
Avg
16
H1d





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Accreditation No.: **SCS 108**

Client **Sporton-TW (Auden)**

Certificate No: **EX3-3976_Feb14**

CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3976**

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

Calibration date: **February 17, 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	US3642UD1700	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: February 19, 2014

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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).

Probe EX3DV4

SN:3976

Manufactured: November 5, 2013
Calibrated: February 17, 2014

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3976

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.49	0.51	0.55	$\pm 10.1 \%$
DCP (mV) ^B	100.4	99.2	98.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^C (k=2)
0	CW	X	0.0	0.0	1.0	0.00	143.0	$\pm 2.5 \%$
		Y	0.0	0.0	1.0		132.3	
		Z	0.0	0.0	1.0		129.8	

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

^A The uncertainties of Norm X,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 5).

^B Numerical linearization parameter: uncertainty not required.

^C 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:3976

Calibration Parameter Determined in Body Tissue Simulating Media

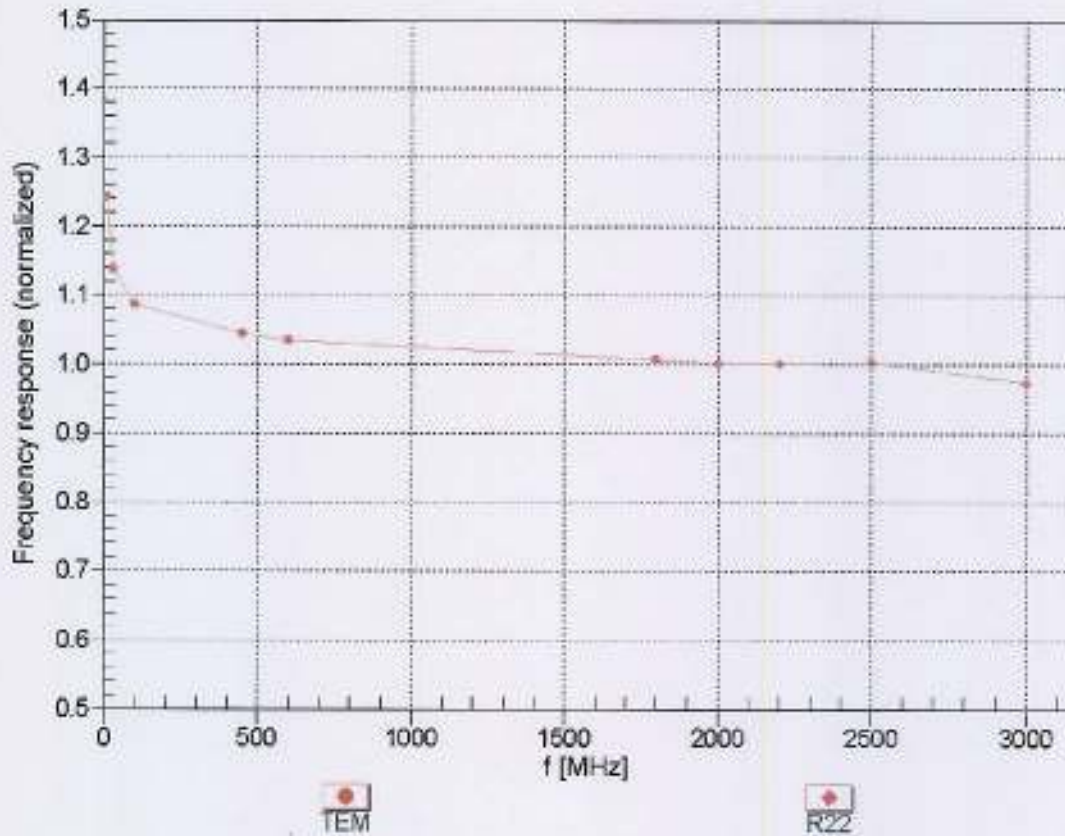
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth (mm) ^G	Unct. (k=2)
750	55.5	0.96	10.12	10.12	10.12	0.27	1.15	± 12.0 %
835	55.2	0.97	10.00	10.00	10.00	0.50	0.78	± 12.0 %
900	55.0	1.05	9.78	9.78	9.78	0.25	1.21	± 12.0 %
1750	53.4	1.49	8.21	8.21	8.21	0.54	0.77	± 12.0 %
1900	53.3	1.52	7.89	7.89	7.89	0.27	1.12	± 12.0 %
2000	53.3	1.52	7.91	7.91	7.91	0.47	0.75	± 12.0 %
2450	52.7	1.95	7.40	7.40	7.40	0.80	0.58	± 12.0 %
2600	52.5	2.16	7.03	7.03	7.03	0.76	0.57	± 12.0 %
3500	37.9	2.91	6.79	6.79	6.79	0.37	1.14	± 13.1 %
3700	37.7	3.12	6.56	6.56	6.56	0.27	1.62	± 13.1 %
5200	36.0	4.66	4.61	4.61	4.61	0.45	1.90	± 13.1 %
5300	35.9	4.76	4.39	4.39	4.39	0.45	1.90	± 13.1 %
5500	35.6	4.96	4.17	4.17	4.17	0.45	1.90	± 13.1 %
5600	35.5	5.07	3.69	3.69	3.69	0.60	1.90	± 13.1 %
5800	35.3	5.27	4.26	4.26	4.26	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.

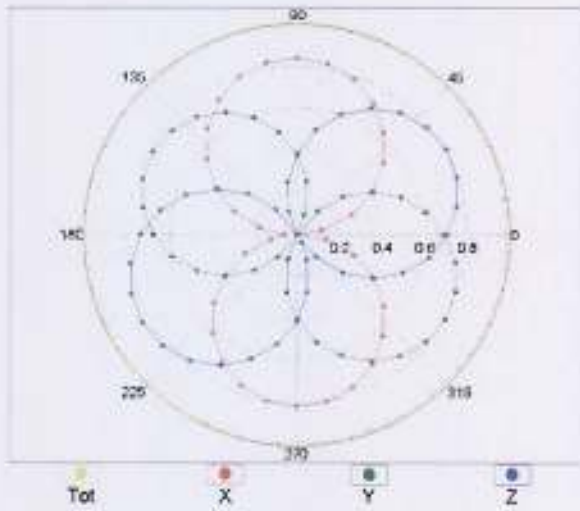
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



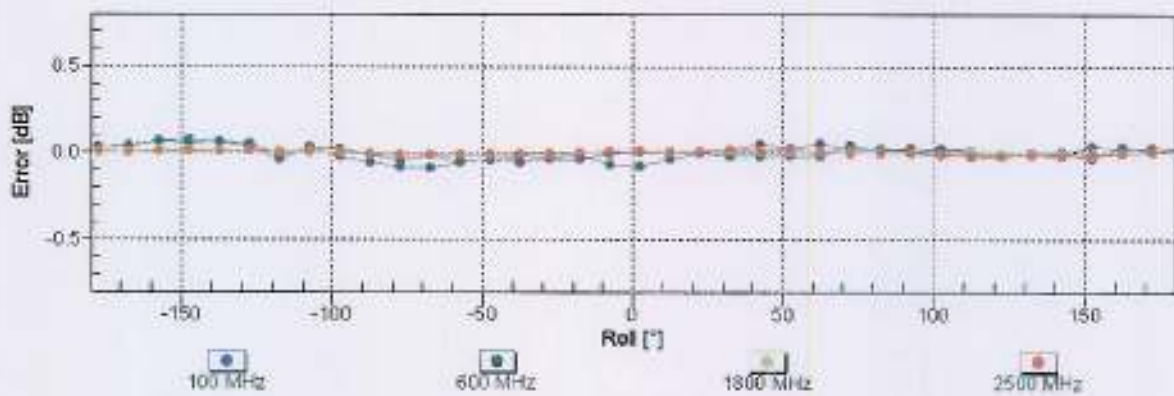
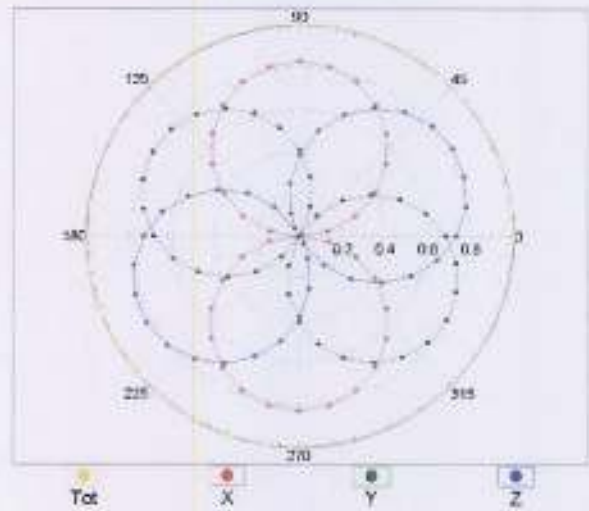
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

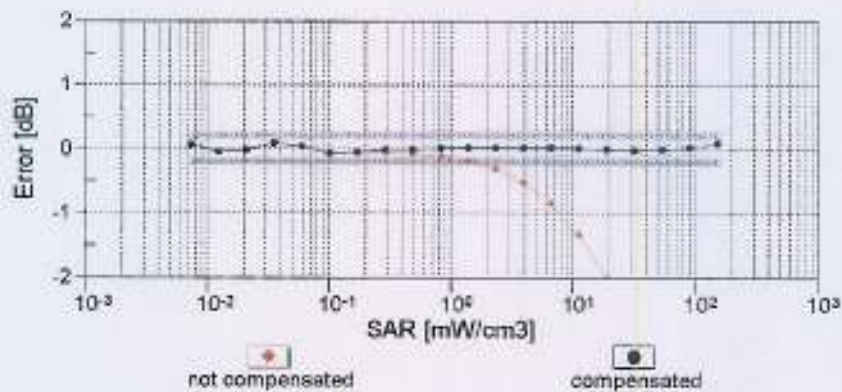
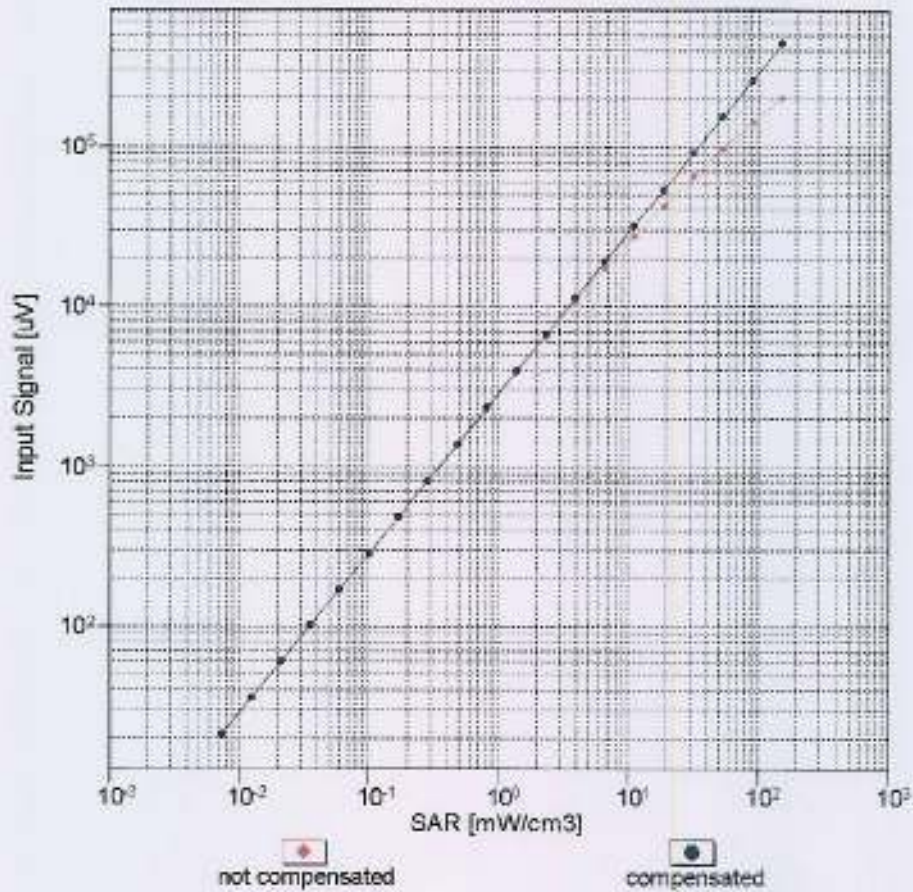


f=1800 MHz,R22



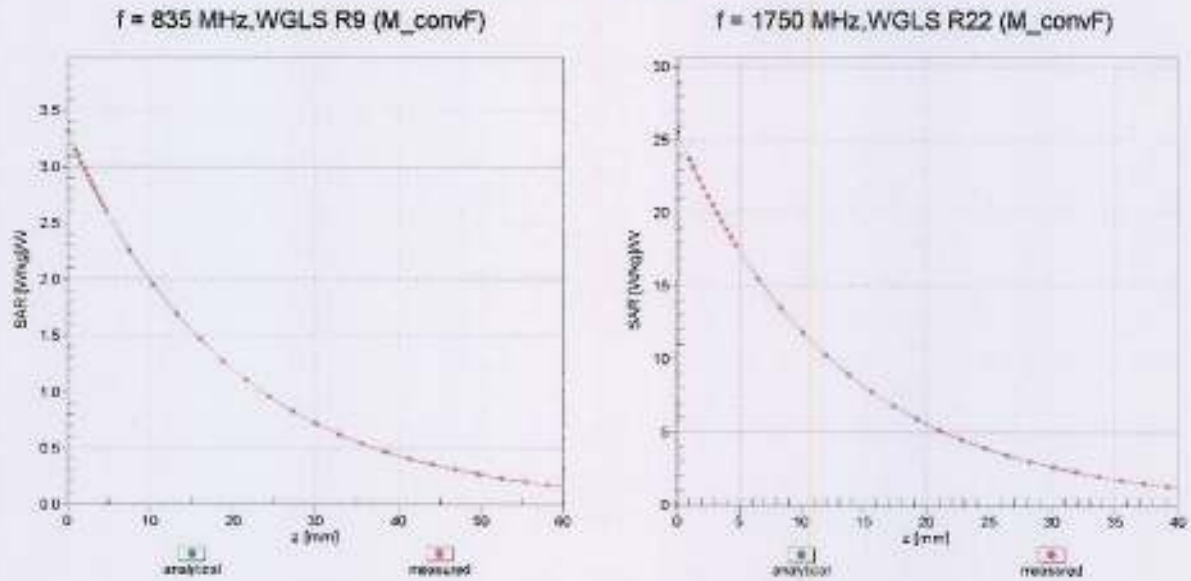
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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

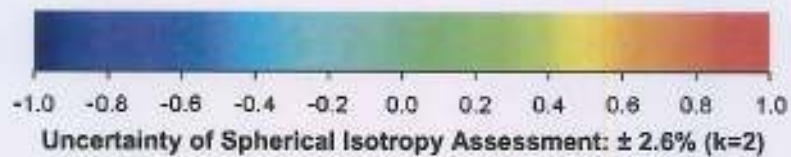
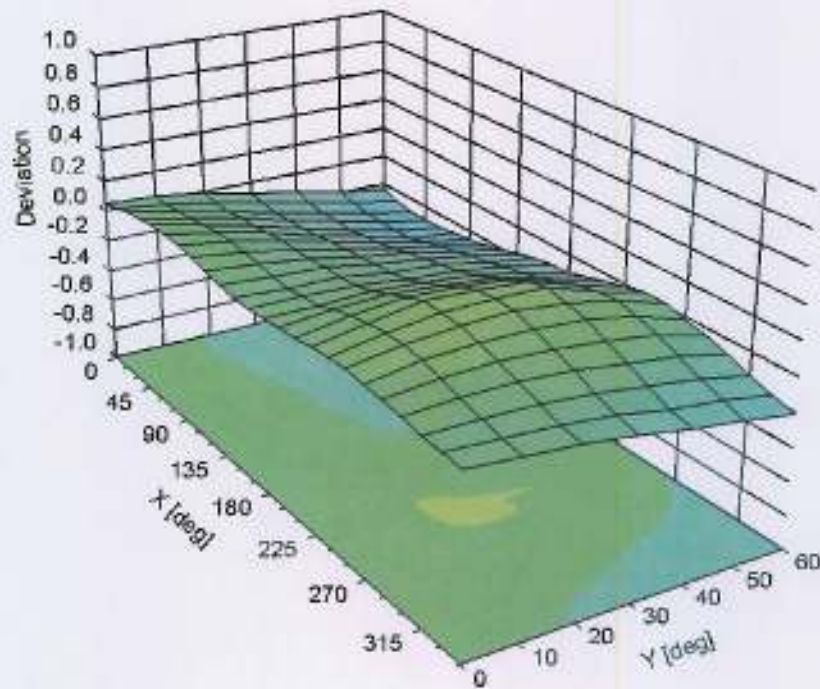


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, θ), f = 900 MHz



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3976**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-7.6
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