



FCC SAR Test Report

APPLICANT : TCT Mobile Limited
EQUIPMENT : Tablet PC
BRAND NAME : ALCATEL ONETOUCH
MODEL NAME : I216A
MARKETING NAME : ALCATEL ONETOUCH PIXI 7
FCC ID : RAD512
STANDARD : FCC 47 CFR Part 2 (2.1093)
ANSI/IEEE C95.1-1992
IEEE 1528-2003

We, SPORTON INTERNATIONAL (XI'AN) INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in 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 (XI'AN) INC., the test report shall not be reproduced except in full.

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager



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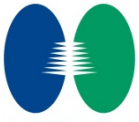


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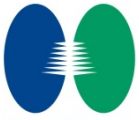


1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **TCT Mobile Limited, Tablet PC, I216A** are as follows.

Equipment Class	Frequency Band	Operating Mode	Highest SAR Summary	
			Body 1g SAR (W/kg)	Simultaneous Transmission SAR (W/kg)
PCB	GSM850	Data	0.50	1.59
	GSM1900	Data	0.88	
	WCDMA Band V	Data	0.50	
	WCDMA Band II	Data	1.45	
DTS	WLAN 2.4GHz Band	Data	0.69	1.59
DSS	Bluetooth	Data		1.52
Date of Testing:			Aug. 15, 2014 ~ Aug. 16, 2014	

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.



2. Administration Data

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL (XI'AN) INC.
Test Site Location	1F, Building A3, No. 39 Chuangye Rd., Xi'an Hi-tech Zone, Shanxi Province, P. R. C. TEL: +86-029-8860-8767 FAX: +86-029-8860-8791

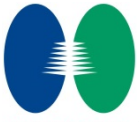
Applicant	
Company Name	TCT Mobile Limited
Address	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203

Manufacturer	
Company Name	TCT Mobile Limited
Address	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203

3. 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 248227 D01 SAR meas for 802 11abg v01r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r01
- FCC KDB 941225 D01 SAR test for 3G devices v02
- FCC KDB 941225 D02 HSPA and 1x Advanced v02r02
- FCC KDB 941225 D03 SAR Test Reduction GSM GPRS EDGE v01



4. Equipment Under Test (EUT)

4.1 General Information

Product Feature & Specification	
Equipment Name	Tablet PC
Brand Name	ALCATEL ONETOUCH
Model Name	I216A
FCC ID	RAD512
IMEI Code	014172000000183
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	<ul style="list-style-type: none"> • GSM/GPRS/EGPRS • RMC/AMR 12.2Kbps • HSDPA • HSUPA • HSPA+ (Downlink Only) • 802.11b/g/n (HT20/HT40) • Bluetooth v3.0+EDR, Bluetooth v4.0 LE
HW Version	v04
SW Version	CDF
GSM / (E)GPRS Transfer mode	Class B – EUT cannot support Packet Switched and Circuit Switched Network simultaneously but can automatically switch between Packet and Circuit Switched Network.
EUT Stage	Production Unit
Remark:	
<ol style="list-style-type: none"> 1. This device 2.4GHz supports hotspot operation. 2. This device supports GRPS/EGPRS mode up to multi-slot class12 and does not have DTM function. 3. The voice is only limited to speakerphone mode and it does not supported near to the ear voice mode during normal using. 	



4.2 Maximum Tune-up Limit

Mode	Burst average power (dBm)			
	GSM 850		GSM 1900	
	Full power mode	Reduced power mode	Full power mode	Reduced power mode
GSM (GMSK, 1 Tx slot)	33.5	25.5	30.5	22.5
GPRS (GMSK, 1 Tx slot)	33.5	25.5	30.5	22.5
GPRS (GMSK, 2 Tx slots)	31.5	24.0	29.0	21.0
GPRS (GMSK, 3 Tx slots)	29.5	22.0	26.5	18.5
GPRS (GMSK, 4 Tx slots)	28.0	20.5	25.0	17.5
EDGE (8PSK, 1 Tx slot)	27.5	19.0	26.5	18.5
EDGE (8PSK, 2 Tx slots)	26.5	18.0	25.5	17.0
EDGE (8PSK, 3 Tx slots)	25.0	17.0	24.0	16.0
EDGE (8PSK, 4 Tx slots)	24.0	16.0	23.0	15.0

Mode	Average power (dBm)			
	WCDMA Band V		WCDMA Band II	
	Full power mode	Reduced power mode	Full power mode	Reduced power mode
AMR 12.2Kbps	23.5	15.5	23.5	16.0
RMC 12.2Kbps	23.5	15.5	23.5	16.0
HSDPA Subtest-1	22.5	15.5	22.5	15.5
HSDPA Subtest-2	22.5	15.5	22.5	15.5
HSDPA Subtest-3	22.0	15.0	22.0	15.0
HSDPA Subtest-4	22.0	15.0	22.0	15.0
HSUPA Subtest-1	20.5	13.5	20.5	13.5
HSUPA Subtest-2	20.5	13.5	20.5	13.5
HSUPA Subtest-3	21.0	14.5	21.0	14.5
HSUPA Subtest-4	20.0	13.5	20.0	13.5
HSUPA Subtest-5	21.0	14.5	21.0	14.5

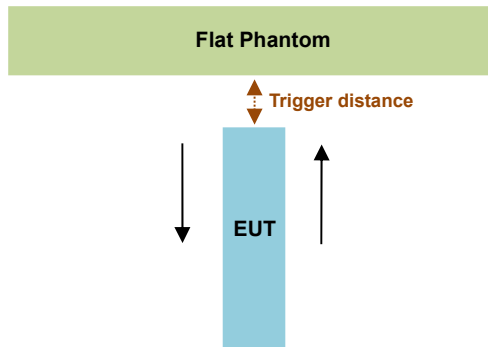
Mode		Maximum Average Power (dBm)
2.4GHz	802.11b	15.0
	802.11g	12.0
	802.11n HT20	11.0
	802.11n HT40	11.0
Bluetooth v3.0 + EDR		6.5
Bluetooth v4.0 LE		-1.5

5. Proximity Sensor Triggering Test

<Proximity Sensor Triggering Distance (KDB 616217 D04 section 6.2)>:

Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed. The details are illustrated in the exhibit “P-Sensor operational description”, and the shortest triggering distances were reported and used for SAR assessment.

In the preliminary triggering distance testing, the tissue-equivalent medium for different frequency bands were used for verification; no other frequency bands tissue-equivalent medium was found to result in shortest triggering distance than that for 1900MHz, and the tissue-equivalent medium for 1900MHz was used for formal proximity sensor triggering testing.



Proximity Sensor Trigger Distance (mm)			
Position	Bottom Face	Edge 1	Curved surface of Edge 1
Minimum	26	22	12

<Proximity Sensor Triggering Coverage (KDB 616217 D04 section 6.3)>:

If a sensor is spatially offset from the antenna(s), it is necessary to verify sensor triggering for conditions where the antenna is next to the user but the sensor is laterally further away to ensure sensor coverage is sufficient for reducing the power to maintain compliance. For p-sensor coverage testing, the device is moved and “along the direction of maximum antenna and sensor offset”.

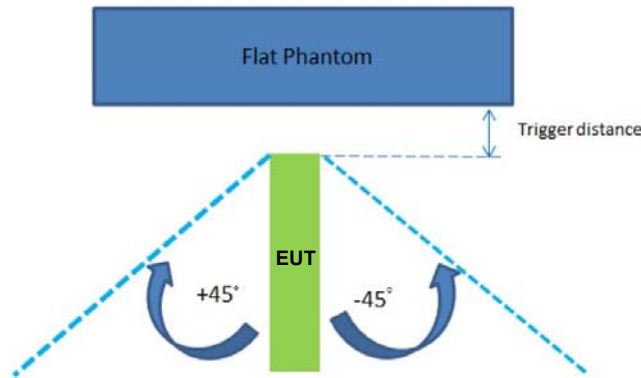
Illustrated in the internal photo exhibit, although the sensor is spatially offset, there is no trigger condition where the antenna is next to the user but the sensor is laterally further away, therefore proximity sensor coverage testing is not required.

This procedure is not required because antenna and sensor are collocated and the peak SAR location is overlapping with the sensor.

<Tablet Tilt angle influences to proximity sensor triggering (KDB 616217 D04 section 6.4)>:

The influence of table tilt angles to proximity sensor triggering was determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at 22 mm separation.

Rotating the tablet around the edge next to the phantom in $\leq 10^\circ$ increments until the tablet is $\pm 45^\circ$ from the vertical position at 0° , and the maximum output power remains in the reduced mode.



Proximity Sensor Trigger Distance (mm)	
Position	Edge 1
Minimum	22

**<Proximity sensor power reduction>**

Exposure Position / wireless mode	Bottom Face ⁽¹⁾	Edge 1 ⁽¹⁾	Edge 2	Edge 4	Curved surface of Edge 1 ⁽¹⁾
GSM850 GSM (GMSK 1 Tx slot) - CS1	8 dB	8 dB	0 dB	0 dB	8 dB
GSM850 GPRS (GMSK 1 Tx slot) - CS1	8 dB	8 dB	0 dB	0 dB	8 dB
GSM850 GPRS (GMSK 2 Tx slots) - CS1	7.5 dB	7.5 dB	0 dB	0 dB	7.5 dB
GSM850 GPRS (GMSK 3 Tx slots) - CS1	7.5 dB	7.5 dB	0 dB	0 dB	7.5 dB
GSM850 GPRS (GMSK 4 Tx slots) - CS1	7.5 dB	7.5 dB	0 dB	0 dB	7.5 dB
GSM850 EDGE (8PSK 1 Tx slot) - MCS5	8.5 dB	8.5 dB	0 dB	0 dB	8.5 dB
GSM850 EDGE (8PSK 2 Tx slots) - MCS5	8.5 dB	8.5 dB	0 dB	0 dB	8.5 dB
GSM850 EDGE (8PSK 3 Tx slots) - MCS5	8 dB	8 dB	0 dB	0 dB	8 dB
GSM850 EDGE (8PSK 4 Tx slots) - MCS5	8 dB	8 dB	0 dB	0 dB	8 dB
GSM1900 GSM (GMSK 1 Tx slot) - CS1	8 dB	8 dB	0 dB	0 dB	8 dB
GSM1900 GPRS (GMSK 1 Tx slot) - CS1	8 dB	8 dB	0 dB	0 dB	8 dB
GSM1900 GPRS (GMSK 2 Tx slots) - CS1	8 dB	8 dB	0 dB	0 dB	8 dB
GSM1900 GPRS (GMSK 3 Tx slots) - CS1	8 dB	8 dB	0 dB	0 dB	8 dB
GSM1900 GPRS (GMSK 4 Tx slots) - CS1	7.5 dB	7.5 dB	0 dB	0 dB	7.5 dB
GSM1900 EDGE (8PSK 1 Tx slot) - MCS5	8 dB	8 dB	0 dB	0 dB	8 dB
GSM1900 EDGE (8PSK 2 Tx slots) - MCS5	8.5 dB	8.5 dB	0 dB	0 dB	8.5 dB
GSM1900 EDGE (8PSK 3 Tx slots) - MCS5	8 dB	8 dB	0 dB	0 dB	8 dB
GSM1900 EDGE (8PSK 4 Tx slots) - MCS5	8 dB	8 dB	0 dB	0 dB	8 dB
WCDMA Band V RMC 12.2kbps	8 dB	8 dB	0 dB	0 dB	8 dB
WCDMA Band II RMC 12.2kbps	7.5 dB	7.5 dB	0 dB	0 dB	7.5 dB

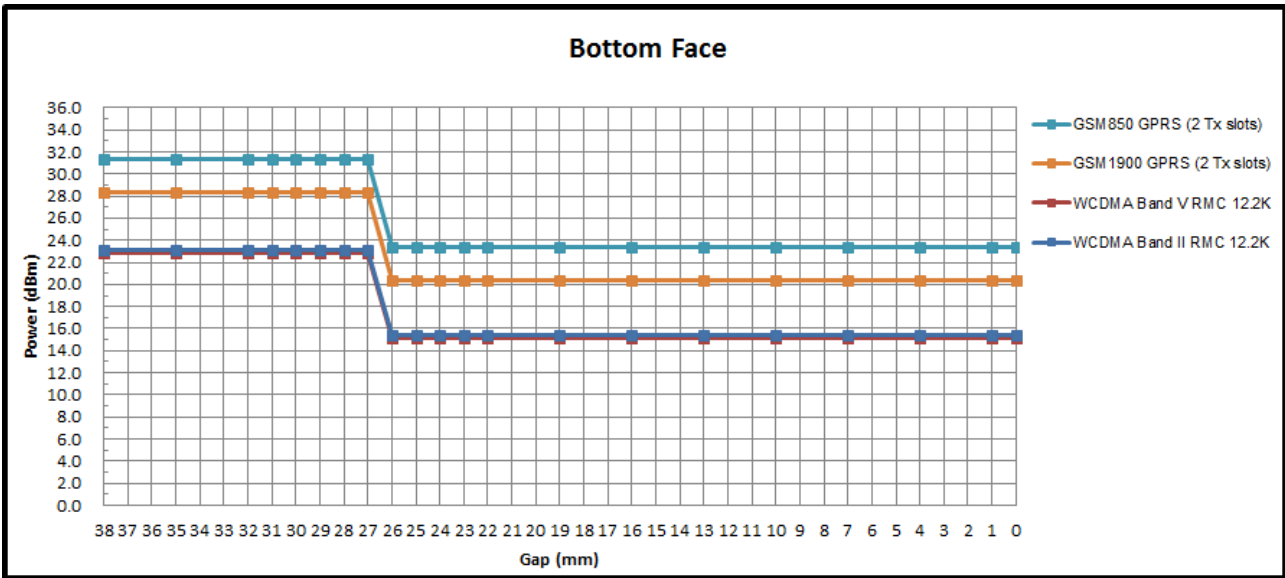
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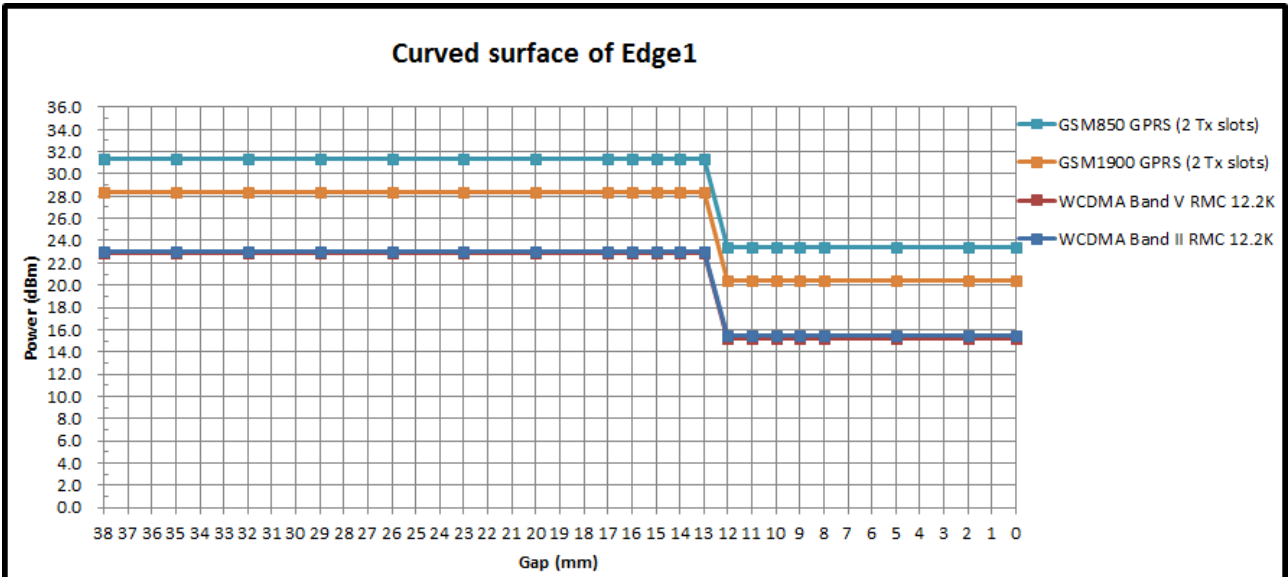
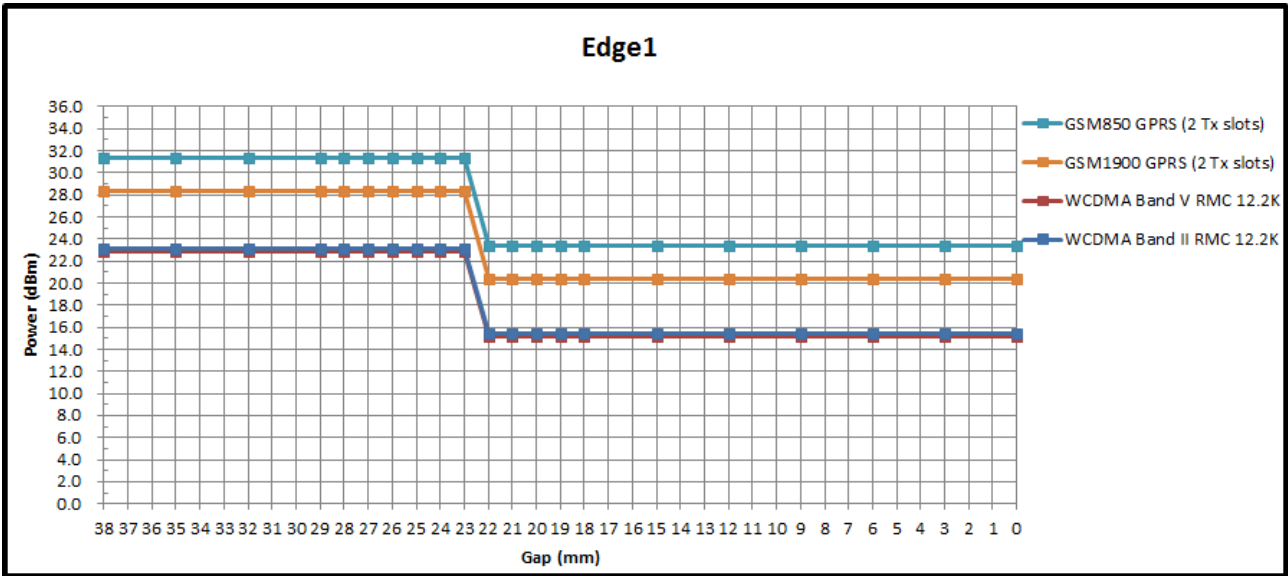
- ⁽¹⁾: Reduced maximum limit applied by activation of proximity sensor.
- Power reduction is not applicable for WLAN and Bluetooth.
- Tests were performed in accordance with KDB 616217 D04 section 6.1, 6.2, 6.3, 6.4 and 6.5 and compliant results are shown and described in exhibit "P-Sensor operational description".
- For verification of compliance of power reduction scheme, additional SAR testing with EUT transmitting at full RF power at a conservative trigger distance was performed:
 - Bottom Face: 10 mm
 - Edge1: 10 mm
 - Curved surface of Edge1: 10 mm



<Power Measurement during Sensor Trigger distance testing>

Band/Mode	Ch #	Measured power reduction (dBm)		Reduction Levels (dB)
		w/o power back-off	w/ power back-off	
GSM850 GPRS (GMSK 2 Tx slots)	189	31.33	23.32	8.01
GSM1900 GPRS (GMSK 2 Tx slots)	661	28.33	20.37	7.96
WCDMA Band V RMC 12.2kbps	4182	22.90	15.14	7.76
WCDMA Band II RMC 12.2kbps	9400	23.08	15.42	7.66







6. RF Exposure Limits

6.1 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.

6.2 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
0.4	8.0	20.0

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

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

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.



7. Specific Absorption Rate (SAR)

7.1 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.

7.2 SAR Definition

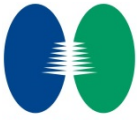
The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

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

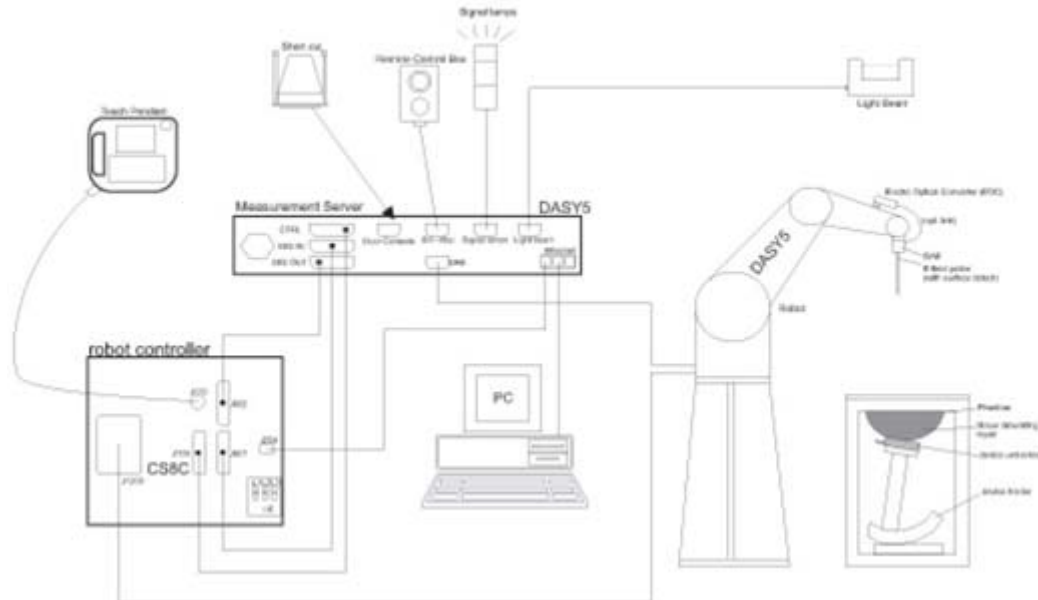
$$SAR = \frac{\sigma |E|^2}{\rho}$$

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

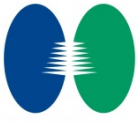


8. System Description and Setup

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.



9. 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

9.1 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
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g



9.2 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.

9.3 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.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 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.	

9.4 Zoom Scan

Zoom scans are used 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 shoes 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.

		≤ 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	
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. * 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.				

9.5 Volume Scan Procedures

The volume scan is used for 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.

9.6 Power Drift Monitoring

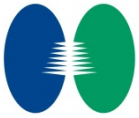
All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field 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.

**10. Test Equipment List**

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	4d151	Mar. 25, 2013	Mar. 23, 2015
SPEAG	1900MHz System Validation Kit	D1900V2	5d170	Mar. 27, 2013	Mar. 25, 2015
SPEAG	2450MHz System Validation Kit	D2450V2	908	Mar. 26, 2013	Mar. 24, 2015
SPEAG	Data Acquisition Electronics	DAE4	1358	Apr. 30, 2014	Apr. 29, 2015
SPEAG	Dosimetric E-Field Probe	EX3DV4	3911	Apr. 22, 2014	Apr. 21, 2015
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
SPEAG	ELI5 Phantom	QD OVA 002 AA	TP-1201	NCR	NCR
Agilent	Wireless Communication Test Set	E5515C	MY52102600	Dec. 30, 2013	Dec. 29, 2014
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	Dec. 30, 2013	Dec. 29, 2014
Agilent	Dielectric Probe Kit	85070E	MY44300751	NCR	NCR
Anritsu	Power Meter	ML2495A	1005002	Feb. 27, 2014	Feb. 26, 2015
Anritsu	Power Sensor	MA2411B	917070	Feb. 27, 2014	Feb. 26, 2015
ARRA	Power Divider	A3200-2	N/A	NA	NA
R&S	Spectrum Analyzer	FSP7	101045	Dec. 30, 2013	Dec. 29, 2014
Agilent	Dual Directional Coupler	778D	50422	Note 1	
Woken	Attenuator	WK0602-XX	N/A	Note 1	
PE	Attenuator	PE7005-10	N/A	Note 1	
PE	Attenuator	PE7005- 3	N/A	Note 1	
AR	Power Amplifier	5S1G4M2	0328767	Note 1	
Mini-Circuits	Power Amplifier	ZVE-3W	162601250	Note 1	
Mini-Circuits	Power Amplifier	ZHL-42W+	13440021344	Note 1	

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.
2. Referring to KDB 865664 D01v01r03, the dipole calibration interval can be extended to 3 years with justification. The dipoles are also not physically damaged, or repaired during the interval.
3. The justification data of dipole D835V2, SN: 4d151, D1900V2, SN: 5d170 and D2450V2, SN: 908 can be found in appendix C. The return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.



11. System Verification

11.1 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 Body								
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. ($^{\circ}$ C)	Conductivity (σ)	Permittivity (ϵ_r)	Conductivity Target (σ)	Permittivity Target (ϵ_r)	Delta (σ) (%)	Delta (ϵ_r) (%)	Limit (%)	Date
835	Body	22.6	0.974	54.246	0.97	55.20	0.41	-1.73	± 5	Aug. 16, 2014
1900	Body	22.5	1.528	55.266	1.52	53.30	0.53	3.69	± 5	Aug. 15, 2014
2450	Body	22.6	1.984	51.165	1.95	52.70	1.74	-2.91	± 5	Aug. 16, 2014

11.2 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 (%)
Aug. 16, 2014	835	Body	250	4d151	3911	1358	2.33	9.43	9.32	-1.17
Aug. 15, 2014	1900	Body	250	5d170	3911	1358	10.10	41.20	40.4	-1.94
Aug. 16, 2014	2450	Body	250	908	3911	1358	13.30	50.40	53.2	5.56

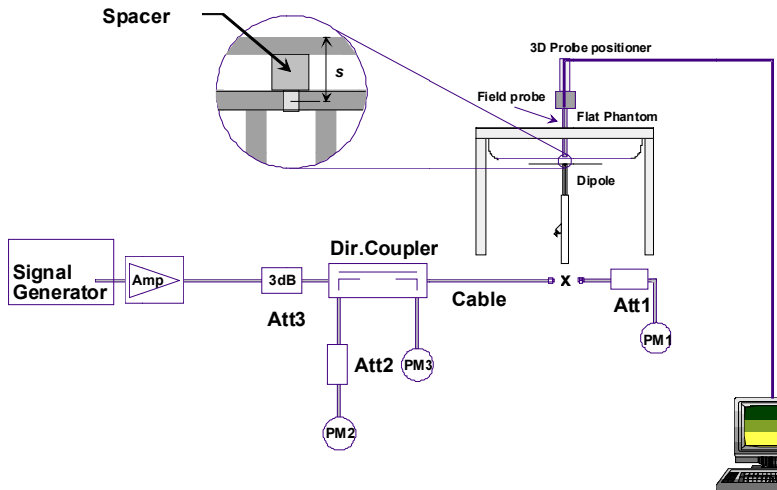


Fig 8.3.1 System Performance Check Setup

Fig 8.3.2 Setup Photo



11.3 SAR Testing for Tablet

This device can be used also in full sized tablet exposure conditions, due to its size. Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR exclusion threshold in KDB 447498 D01v05r02 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

This EUT was tested in five different positions. They are bottom-face of tablet PC, Edge1, Edge2, Edge4 and Curved surface of Edge1. EUT has proximity sensor function, it would be on bottom-face, Edge1 and Curved surface of Edge1 active, the sensor trigger distance is 1.0cm, EUT transmitting full power in normal mode was performed. Additional the surface of EUT is touching with phantom 0 cm for bottom-face, Edge1 and Curved surface of Edge1 with reduce power, Edge2 and Edge 4 with full power were performed.



12. Conducted RF Output Power (Unit: dBm)

<GSM Conducted Power>

General Note:

- Per KDB 447498 D01v05r02, the maximum output power channel is used for SAR testing and for further SAR test reduction.
- For body SAR testing was following KDB 941225 D03v01, the GPRS 2Tx slots modes was selected when EUT operating without power back-off and operating with power back-off, according to the highest frame average output power.

Maximum Average RF Power (Proximity Sensor Inactive)

Band GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	128	189	251		128	189	251	
Tx Channel	128	189	251		128	189	251	
Frequency (MHz)	824.2	836.4	848.8		824.2	836.4	848.8	
GSM (GMSK, 1 Tx slot)	32.98	33.01	33.04	33.5	23.98	24.01	24.04	24.5
GPRS (GMSK, 1 Tx slot) – CS1	32.97	33.00	33.03	33.5	23.97	24.00	24.03	24.5
GPRS (GMSK, 2 Tx slots) – CS1	31.27	31.33	31.37	31.5	25.27	25.33	25.37	25.5
GPRS (GMSK, 3 Tx slots) – CS1	29.29	29.34	29.37	29.5	25.03	25.08	25.11	25.24
GPRS (GMSK, 4 Tx slots) – CS1	27.86	27.92	27.97	28.0	24.86	24.92	24.97	25
EDGE (8PSK, 1 Tx slot) – MCS5	27.26	27.12	27.05	27.5	18.26	18.12	18.05	18.5
EDGE (8PSK, 2 Tx slots) – MCS5	26.08	25.91	25.87	26.5	20.08	19.91	19.87	20.5
EDGE (8PSK, 3 Tx slots) – MCS5	24.85	24.70	24.64	25.0	20.59	20.44	20.38	20.74
EDGE (8PSK, 4 Tx slots) – MCS5	23.65	23.46	23.43	24.0	20.65	20.46	20.43	21
Band GSM1900	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	512	661	810		512	661	810	
Tx Channel	512	661	810		512	661	810	
Frequency (MHz)	1850.2	1880	1909.8		1850.2	1880	1909.8	
GSM (GMSK, 1 Tx slot)	30.03	30.04	30.05	30.5	21.03	21.04	21.05	21.5
GPRS (GMSK, 1 Tx slot) – CS1	30.00	30.01	30.02	30.5	21.00	21.01	21.02	21.5
GPRS (GMSK, 2 Tx slots) – CS1	28.32	28.33	28.34	29.0	22.32	22.33	22.34	23
GPRS (GMSK, 3 Tx slots) – CS1	26.35	26.36	26.38	26.5	22.09	22.10	22.12	22.24
GPRS (GMSK, 4 Tx slots) – CS1	24.90	24.92	24.95	25.0	21.90	21.92	21.95	22
EDGE (8PSK, 1 Tx slot) – MCS5	26.07	26.04	25.89	26.5	17.07	17.04	16.89	17.5
EDGE (8PSK, 2 Tx slots) – MCS5	24.98	24.95	24.78	25.5	18.98	18.95	18.78	19.5
EDGE (8PSK, 3 Tx slots) – MCS5	23.83	23.82	23.64	24.0	19.57	19.56	19.38	19.74
EDGE (8PSK, 4 Tx slots) – MCS5	22.61	22.58	22.41	23.0	19.61	19.58	19.41	20

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

The calculated method are shown as below:

Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB

Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB

Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB

Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB



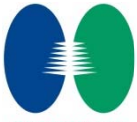
Reduced Average RF Power (Proximity Sensor Active)

Band GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	128	189	251		128	189	251	
Tx Channel	128	189	251		128	189	251	
Frequency (MHz)	824.2	836.4	848.8		824.2	836.4	848.8	
GSM (GMSK, 1 Tx slot)	25.27	25.34	25.40	25.5	16.27	16.34	16.40	16.5
GPRS (GMSK, 1 Tx slot) – CS1	25.26	25.33	25.39	25.5	16.26	16.33	16.39	16.5
GPRS (GMSK, 2 Tx slots) – CS1	23.24	23.32	23.39	24.0	17.24	17.32	17.39	18
GPRS (GMSK, 3 Tx slots) – CS1	21.31	21.38	21.46	22.0	17.05	17.12	17.20	17.74
GPRS (GMSK, 4 Tx slots) – CS1	19.90	19.98	20.07	20.5	16.90	16.98	17.07	17.5
EDGE (8PSK, 1 Tx slot) – MCS5	18.70	18.55	18.50	19.0	9.70	9.55	9.50	10
EDGE (8PSK, 2 Tx slots) – MCS5	17.73	17.57	17.52	18.0	11.73	11.57	11.52	12
EDGE (8PSK, 3 Tx slots) – MCS5	16.66	16.49	16.44	17.0	12.40	12.23	12.18	12.74
EDGE (8PSK, 4 Tx slots) – MCS5	15.59	15.44	15.41	16.0	12.59	12.44	12.41	13
Band GSM1900	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
Tx Channel	512	661	810		512	661	810	
Frequency (MHz)	1850.2	1880	1909.8		1850.2	1880	1909.8	
GSM (GMSK, 1 Tx slot)	22.33	22.38	22.40	22.5	13.33	13.38	13.40	13.5
GPRS (GMSK, 1 Tx slot) – CS1	22.32	22.37	22.39	22.5	13.32	13.37	13.39	13.5
GPRS (GMSK, 2 Tx slots) – CS1	20.30	20.37	20.40	21.0	14.30	14.37	14.40	15
GPRS (GMSK, 3 Tx slots) – CS1	18.25	18.35	18.39	18.5	13.99	14.09	14.13	14.24
GPRS (GMSK, 4 Tx slots) – CS1	16.87	16.93	16.99	17.5	13.87	13.93	13.99	14.5
EDGE (8PSK, 1 Tx slot) – MCS5	18.02	18.01	17.88	18.5	9.02	9.01	8.88	9.5
EDGE (8PSK, 2 Tx slots) – MCS5	16.97	16.93	16.77	17.0	10.97	10.93	10.77	11
EDGE (8PSK, 3 Tx slots) – MCS5	15.83	15.75	15.58	16.0	11.57	11.49	11.32	11.74
EDGE (8PSK, 4 Tx slots) – MCS5	14.65	14.54	14.38	15.0	11.65	11.54	11.38	12

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.

The calculated method are shown as below:

- Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB
- Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB
- Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB
- Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB



<WCDMA Conducted Power>

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.
3. For DC-HSDPA, the device was configured according to the H-Set 12, Fixed Reference Channel (FRC) configuration in Table C.8.1.12 of 3GPP TS 34.121-1, with the primary and the secondary serving HS-DSCH Cell enabled during the power measurement.

A summary of these settings are illustrated below:

HSDPA Setup Configuration:

- a. The EUT was connected to Base Station Agilent E5515C 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:
 - i. Set Gain Factors (β_c and β_d) and parameters were set according to each
 - ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
 - iii. Set RMC 12.2Kbps + HSDPA mode.
 - iv. Set Cell Power = -86 dBm
 - v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
 - vi. Select HSDPA Uplink Parameters
 - vii. Set Delta ACK, Delta NACK and Delta CQI = 8
 - viii. Set Ack-Nack Repetition Factor to 3
 - ix. Set CQI Feedback Cycle (k) to 4 ms
 - x. Set CQI Repetition Factor to 2
 - xi. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

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 DPDCCH, DPCCH 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 $\beta_d = 15/15$.

Setup Configuration

HSUPA Setup Configuration:

- a. The EUT was connected to Base Station Agilent E5515C 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 * :
 - i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
 - ii. 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
 - iii. Set Cell Power = -86 dBm
 - iv. Set Channel Type = 12.2k + HSPA
 - v. Set UE Target Power
 - vi. Power Ctrl Mode= Alternating bits
 - vii. Set and observe the E-TFCl
 - viii. Confirm that E-TFCl is equal to the target E-TFCl of 75 for sub-test 1, and other subtest's E-TFCl
- d. The transmitted maximum output power was recorded.

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-TFCl
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/25	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	$\beta_{ed1}: 47/15$ $\beta_{ed2}: 47/15$	4 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.

Setup Configuration



<WCDMA Conducted Power>

General Note:

- SAR testing in AMR configuration is not required when the maximum average output of each RF channel for AMR 12.2Kbps is less than 0.25dB higher than that measured in RMC 12.2Kbps.
- Per KDB 941225 D02v02r02, RMC 12.2kbps setting is used to evaluate SAR when EUT operating without power back-off and operating with power back-off. If HSDPA/HSUPA output power is < 0.25dB higher than RMC, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.

Maximum Average RF Power (Proximity Sensor Inactive)

Band			WCDMA Band V				WCDMA Band II			
Tx Channel			4132	4182	4233	Tune-up Limit (dBm)	9262	9400	9538	Tune-up Limit (dBm)
Rx Channel			4357	4407	4458		9662	9800	9938	
Frequency (MHz)			826.4	836.4	846.6		1852.4	1880	1907.6	
MPR (dB)	3GPP Rel 99	AMR 12.2Kbps	22.72	22.89	22.82	23.5	23.00	23.05	22.97	23.5
	3GPP Rel 99	RMC 12.2Kbps	22.75	22.90	22.85	23.5	23.01	23.08	22.99	23.5
0	3GPP Rel 6	HSDPA Subtest-1	21.87	21.96	21.92	22.5	22.16	22.21	22.13	22.5
0	3GPP Rel 6	HSDPA Subtest-2	21.86	21.94	21.90	22.5	22.13	22.19	22.11	22.5
0.5	3GPP Rel 6	HSDPA Subtest-3	21.44	21.54	21.46	22.0	21.68	21.77	21.65	22.0
0.5	3GPP Rel 6	HSDPA Subtest-4	21.42	21.53	21.48	22.0	21.71	21.76	21.69	22.0
0	3GPP Rel 6	HSUPA Subtest-1	19.78	19.85	19.82	20.5	19.95	19.98	19.96	20.5
2	3GPP Rel 6	HSUPA Subtest-2	19.87	19.97	19.91	20.5	20.01	20.04	20.02	20.5
1	3GPP Rel 6	HSUPA Subtest-3	20.68	20.73	20.71	21.0	20.83	20.87	20.86	21.0
2	3GPP Rel 6	HSUPA Subtest-4	19.43	19.50	19.49	20.0	19.54	19.59	19.57	20.0
0	3GPP Rel 6	HSUPA Subtest-5	20.46	20.58	20.52	21.0	20.80	20.85	20.84	21.0

Reduced Average RF Power (Proximity Sensor Active)

Band			WCDMA Band V				WCDMA Band II			
Tx Channel			4132	4182	4233	Tune-up Limit (dBm)	9262	9400	9538	Tune-up Limit (dBm)
Rx Channel			4357	4407	4458		9662	9800	9938	
Frequency (MHz)			826.4	836.4	846.6		1852.4	1880	1907.6	
MPR (dB)	3GPP Rel 99	AMR 12.2Kbps	15.03	15.13	14.97	15.5	15.28	15.41	15.29	16.0
	3GPP Rel 99	RMC 12.2Kbps	15.04	15.14	14.98	15.5	15.29	15.42	15.31	16.0
0	3GPP Rel 6	HSDPA Subtest-1	14.98	15.07	14.96	15.5	15.30	15.34	15.31	15.5
0	3GPP Rel 6	HSDPA Subtest-2	14.96	15.01	14.93	15.5	15.28	15.33	15.30	15.5
0.5	3GPP Rel 6	HSDPA Subtest-3	14.53	14.66	14.50	15.0	14.68	14.79	14.74	15.0
0.5	3GPP Rel 6	HSDPA Subtest-4	14.54	14.62	14.49	15.0	14.72	14.78	14.75	15.0
0	3GPP Rel 6	HSUPA Subtest-1	13.09	13.13	13.08	13.5	13.19	13.22	13.20	13.5
2	3GPP Rel 6	HSUPA Subtest-2	13.21	13.26	13.19	13.5	13.33	13.35	13.34	13.5
1	3GPP Rel 6	HSUPA Subtest-3	14.19	14.25	14.16	14.5	14.37	14.40	14.39	14.5
2	3GPP Rel 6	HSUPA Subtest-4	13.08	13.12	13.06	13.5	13.21	13.23	13.22	13.5
0	3GPP Rel 6	HSUPA Subtest-5	14.10	14.14	14.05	14.5	14.19	14.21	14.20	14.5



<WLAN Conducted Power>

General Note:

For 2.4GHz WLAN SAR testing, highest average RF output power channel for the lowest data rate for 802.11b were selected for SAR evaluation. 802.11g/n HT20/HT40 were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of 802.11b mode.

<WLAN 2.4GHz>

WLAN 2.4GHz 802.11b Average Power (dBm)							Tune up Limit (dBm)
Power vs. Channel			Power vs. Data Rate				
Channel	Frequency (MHz)	Data Rate 1Mbps	Channel	2Mbps	5.5Mbps	11Mbps	
CH 01	2412	14.02	CH 11	14.40	14.50	14.47	15.0
CH 06	2437	14.25					
CH 11	2462	14.51					

WLAN 2.4GHz 802.11g Average Power (dBm)											Tune up Limit (dBm)
Power vs. Channel			Power vs. Data Rate								
Channel	Frequency (MHz)	Data Rate 6Mbps	Channel	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps	
CH 01	2412	11.35	CH 11	11.55	11.49	11.52	11.48	11.54	11.57	11.42	12.0
CH 06	2437	11.45									
CH 11	2462	11.59									

WLAN 2.4GHz 802.11n HT20 Average Power (dBm)											Tune up Limit (dBm)
Power vs. Channel			Power vs. MCS Index								
Channel	Frequency (MHz)	MCS Index MCS0	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
CH 01	2412	10.49	CH 11	10.75	10.61	10.57	10.55	10.51	10.41	10.37	11.0
CH 06	2437	10.55									
CH 11	2462	10.78									

WLAN 2.4GHz 802.11n HT40 Average Power (dBm)											Tune up Limit (dBm)
Power vs. Channel			Power vs. MCS Index								
Channel	Frequency (MHz)	MCS Index MCS0	Channel	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	
CH 03	2422	10.30	CH 09	10.49	10.35	10.26	10.33	10.45	10.51	10.41	11.0
CH 06	2437	10.41									
CH 09	2452	10.55									



13. Bluetooth Exclusions Applied

Mode Band	Average power(dBm)	
	Bluetooth v3.0+EDR	Bluetooth v4.0 LE
2.4GHz Bluetooth	6.5	-1.5

Note:

1. Per KDB 447498 D01v05r02, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for}$$

1-g SAR and ≤ 7.5 for 10-g extremity SAR

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

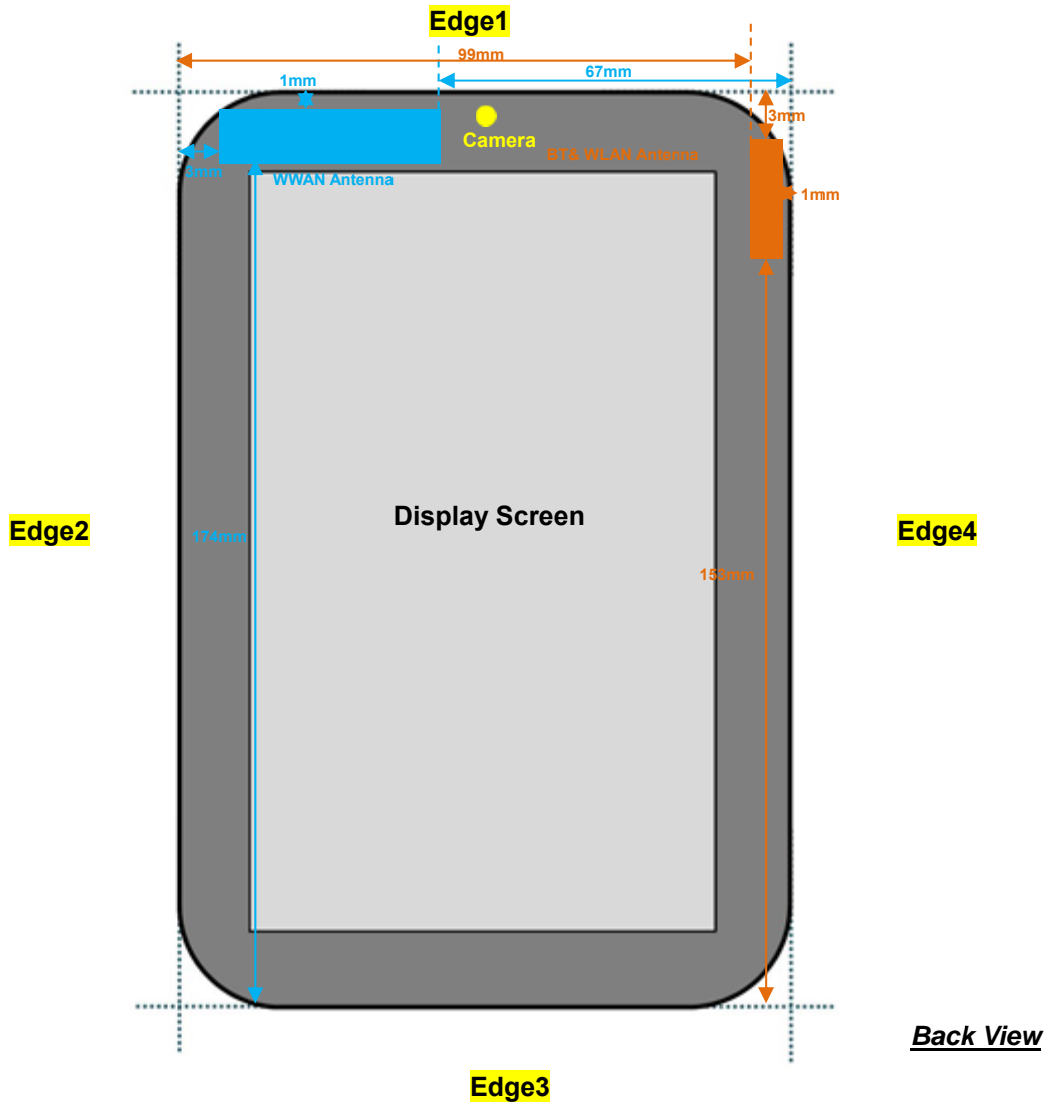
Bluetooth Max Power (dBm)	Separation Distance (mm)	Frequency (GHz)	Exclusion Thresholds
6.5	0	2.48	1.3

Note:

Per KDB 447498 D01v05r02, when the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion. The test exclusion threshold is 1.3 which is ≤ 3, SAR testing is not required.



14. Antenna Location





General Note:

- The below table, when the distance is < 50 mm exclusion threshold is "Ratio", when the distance is > 50 mm exclusion threshold is "mW"
- Maximum power is the source-based time-average power and represents the maximum RF output power among production units
- Per KDB 447498 D01v05r02, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
- Per KDB 447498 D01v05r02, standalone SAR test exclusion threshold is applied; If the test separation distance is < 5mm, 5mm is used to determine SAR exclusion threshold.
- Per KDB 447498 D01v05r02, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
 - $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
 - f(GHz) is the RF channel transmit frequency in GHz
 - Power and distance are rounded to the nearest mW and mm before calculation
 - The result is rounded to one decimal place for comparison
- Per KDB 447498 D01v05r02, at 100 MHz to 6 GHz and for *test separation distances* > 50 mm, the SAR test exclusion threshold is determined according to the following
 - [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · (f(MHz)/150)] mW, at 100 MHz to 1500 MHz
 - [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · 10] mW at > 1500 MHz and ≤ 6 GHz

SAR test exclusion table distance is ≤ 50mm

Exposure Position	Wireless Interface	GPRS850 2Tx slots	GPRS1900 2 Tx slots	WCDMA Band V	WCDMA Band II	802.11b
	Calculated Frequency (MHz)	848.8	1909.8	846.6	1907.6	2462
	Tune-up Maximum power (dBm)	25.5	23	23.5	23.5	15.0
Bottom Face	Antenna to user (mm)	0				0
	SAR exclusion threshold	65	55	41	62	10
	SAR testing required?	Yes	Yes	Yes	Yes	Yes
Edge 1	Antenna to user (mm)	1				3
	SAR exclusion threshold	65	55	41	62	10
	SAR testing required?	Yes	Yes	Yes	Yes	Yes
Edge 2	Antenna to user (mm)	3				
	SAR exclusion threshold	65	55	41	62	
	SAR testing required?	Yes	Yes	Yes	Yes	
Edge 4	Antenna to user (mm)					1
	SAR exclusion threshold					10
	SAR testing required?					Yes

SAR test exclusion table distance is > 50mm

Exposure Position	Wireless Interface	GPRS850 2Tx slots	GPRS1900 2 Tx slots	WCDMA Band V	WCDMA Band II	802.11b
	Calculated Frequency (MHz)	848.8	1909.8	846.6	1907.6	2462
	Tune-up Maximum power (dBm)	25.5	23	23.5	23.5	15.0
	Tune-up Maximum rated power (mW)	355	200	224	224	32
Edge 2	Antenna to user (mm)					99
	SAR exclusion threshold (mW)					586
	SAR testing required?					No
Edge 3	Antenna to user (mm)	174				153
	SAR exclusion threshold (mW)	864	1349	862	1349	1126
	SAR testing required?	No	No	No	No	No
Edge 4	Antenna to user (mm)	67				
	SAR exclusion threshold (mW)	259	279	259	279	
	SAR testing required?	Yes	No	No	No	



15. SAR Test Results

General Note:

- Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - 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.
 - Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
- 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
 - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
 - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
- For body SAR testing was following KDB 941225 D03v01, the GPRS 2Tx slots modes was selected when EUT operating without power back-off and operating with power back-off, according to the highest frame average output power.
- Per KDB 941225 D02v02r02, RMC 12.2kbps setting is used to evaluate SAR when EUT operating without power back-off and operating with power back-off. If HSDPA/HSUPA output power is < 0.25dB higher than RMC, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA SAR evaluation can be excluded.
- For the exposure positions that proximity sensor power reduction is applied for SAR compliance, additional SAR testing with EUT transmitting full power in normal mode was performed; 1.0cm for bottom face, edge1 and Curved surface of Edge1.
- Curved region diagram of the device according to the test setup photo (exterior radius dimension supplied by customer), X=2.53mm, Y=2.51mm, Z=2.48mm and complied X>Z, Y>Z, Per KDB 616217 D04v01r01, curved SAR evaluation should be performed.
- Additional WLAN SAR with Curved surface of Edge1 testing was performed for simultaneous transmission analysis.

15.1 Body SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Power Back-off	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)
	GSM850	GPRS (2 Tx slots)	Bottom Face	0	On	251	848.8	23.39	24.00	1.151	-0.02	0.293	0.337
	GSM850	GPRS (2 Tx slots)	Edge 1	0	On	251	848.8	23.39	24.00	1.151	-0.06	0.185	0.213
	GSM850	GPRS (2 Tx slots)	Edge 2	0	Off	251	848.8	31.37	31.50	1.030	-0.04	0.046	0.047
	GSM850	GPRS (2 Tx slots)	Edge 4	0	Off	251	848.8	31.37	31.50	1.030	-0.07	0.139	0.143
	GSM850	GPRS (2 Tx slots)	Bottom Face	1	Off	251	848.8	31.37	31.50	1.030	-0.08	0.102	0.105
	GSM850	GPRS (2 Tx slots)	Edge 1	1	Off	251	848.8	31.37	31.50	1.030	-0.04	0.094	0.097
	GSM850	GPRS (2 Tx slots)	Curved surface of Edge 1	0	On	251	848.8	23.39	24.00	1.151	-0.09	0.168	0.193
#01	GSM850	GPRS (2 Tx slots)	Curved surface of Edge 1	1	Off	251	848.8	31.37	31.50	1.030	-0.05	0.489	0.504
	GSM1900	GPRS (2 Tx slots)	Bottom Face	0	On	810	1909.8	20.40	21.00	1.148	0.03	0.295	0.339
	GSM1900	GPRS (2 Tx slots)	Edge 1	0	On	810	1909.8	20.40	21.00	1.148	-0.02	0.422	0.485
	GSM1900	GPRS (2 Tx slots)	Edge 2	0	Off	810	1909.8	28.34	29.00	1.164	-0.02	0.754	0.878
	GSM1900	GPRS (2 Tx slots)	Bottom Face	1	Off	810	1909.8	28.34	29.00	1.164	-0.03	0.478	0.556
	GSM1900	GPRS (2 Tx slots)	Edge 1	1	Off	810	1909.8	28.34	29.00	1.164	-0.01	0.677	0.788
	GSM1900	GPRS (2 Tx slots)	Edge 2	0	Off	512	1850.2	28.32	29.00	1.169	-0.05	0.569	0.665
	GSM1900	GPRS (2 Tx slots)	Edge 2	0	Off	661	1880	28.33	29.00	1.167	-0.08	0.668	0.779
	GSM1900	GPRS (2 Tx slots)	Curved surface of Edge 1	0	On	810	1909.8	20.40	21.00	1.148	-0.06	0.386	0.443
#02	GSM1900	GPRS (2 Tx slots)	Curved surface of Edge 1	1	Off	810	1909.8	28.34	29.00	1.164	-0.07	0.755	0.879
	GSM1900	GPRS (2 Tx slots)	Curved surface of Edge 1	1	Off	512	1850.2	28.32	29.00	1.169	-0.07	0.618	0.723
	GSM1900	GPRS (2 Tx slots)	Curved surface of Edge 1	1	Off	661	1880	28.33	29.00	1.167	-0.08	0.667	0.778



<WCDMA SAR>

Plot No.	Band	Mode	Test Position	Gap (cm)	Power Back-off	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)
	WCDMA Band V	RMC 12.2Kbps	Bottom Face	0	On	4182	836.4	15.14	15.50	1.086	0.06	0.248	0.269
	WCDMA Band V	RMC 12.2Kbps	Edge 1	0	On	4182	836.4	15.14	15.50	1.086	-0.04	0.192	0.209
	WCDMA Band V	RMC 12.2Kbps	Edge 2	0	Off	4182	836.4	22.90	23.50	1.148	-0.01	0.118	0.135
	WCDMA Band V	RMC 12.2Kbps	Bottom Face	1	Off	4182	836.4	22.90	23.50	1.148	-0.04	0.074	0.085
	WCDMA Band V	RMC 12.2Kbps	Edge 1	1	Off	4182	836.4	22.90	23.50	1.148	-0.03	0.081	0.093
	WCDMA Band V	RMC 12.2Kbps	Curved surface of Edge 1	0	On	4182	836.4	15.14	15.50	1.086	-0.02	0.200	0.217
#03	WCDMA Band V	RMC 12.2Kbps	Curved surface of Edge 1	1	Off	4182	836.4	22.90	23.50	1.148	-0.05	0.432	0.496
	WCDMA Band II	RMC 12.2Kbps	Bottom Face	0	On	9400	1880	15.42	16.00	1.143	0.06	0.576	0.658
	WCDMA Band II	RMC 12.2Kbps	Edge 1	0	On	9400	1880	15.42	16.00	1.143	-0.09	0.740	0.846
	WCDMA Band II	RMC 12.2Kbps	Edge 2	0	Off	9400	1880	23.08	23.50	1.102	-0.03	1.140	1.256
	WCDMA Band II	RMC 12.2Kbps	Bottom Face	1	Off	9400	1880	23.08	23.50	1.102	-0.01	0.725	0.799
	WCDMA Band II	RMC 12.2Kbps	Edge 1	1	Off	9400	1880	23.08	23.50	1.102	-0.07	1.020	1.124
	WCDMA Band II	RMC 12.2Kbps	Edge 1	0	On	9262	1852.4	15.29	16.00	1.178	-0.09	0.597	0.703
	WCDMA Band II	RMC 12.2Kbps	Edge 1	0	On	9538	1907.6	15.31	16.00	1.172	-0.07	0.667	0.782
	WCDMA Band II	RMC 12.2Kbps	Edge 2	0	Off	9262	1852.4	23.01	23.50	1.119	-0.05	0.824	0.922
	WCDMA Band II	RMC 12.2Kbps	Edge 2	0	Off	9538	1907.6	22.99	23.50	1.125	-0.06	1.040	1.170
	WCDMA Band II	RMC 12.2Kbps	Edge 1	1	Off	9262	1852.4	23.01	23.50	1.119	-0.07	0.785	0.879
	WCDMA Band II	RMC 12.2Kbps	Edge 1	1	Off	9538	1907.6	22.99	23.50	1.125	-0.01	0.915	1.029
	WCDMA Band II	RMC 12.2Kbps	Curved surface of Edge 1	0	On	9400	1880	15.42	16.00	1.143	-0.02	0.750	0.857
#04	WCDMA Band II	RMC 12.2Kbps	Curved surface of Edge 1	1	Off	9400	1880	23.08	23.50	1.102	-0.06	1.320	1.454
	WCDMA Band II	RMC 12.2Kbps	Curved surface of Edge 1	0	On	9262	1852.4	15.29	16.00	1.178	-0.08	0.589	0.694
	WCDMA Band II	RMC 12.2Kbps	Curved surface of Edge 1	0	On	9538	1907.6	15.31	16.00	1.172	-0.03	0.686	0.804
	WCDMA Band II	RMC 12.2Kbps	Curved surface of Edge 1	1	Off	9262	1852.4	23.01	23.50	1.119	-0.05	0.970	1.086
	WCDMA Band II	RMC 12.2Kbps	Curved surface of Edge 1	1	Off	9538	1907.6	22.99	23.50	1.125	-0.03	1.200	1.350

<DTS WLAN 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)
#05	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	0	11	2462	14.51	15.00	1.119	0.07	0.617	0.691
	WLAN 2.4GHz	802.11b 1Mbps	Edge 1	0	11	2462	14.51	15.00	1.119	-0.06	0.117	0.131
	WLAN 2.4GHz	802.11b 1Mbps	Edge 4	0	11	2462	14.51	15.00	1.119	-0.03	0.456	0.510
	WLAN 2.4GHz	802.11b 1Mbps	Curved surface of Edge 1	0	11	2462	14.51	15.00	1.119	0.08	0.123	0.138



15.2 Repeated SAR Measurement

No.	Band	Mode	Test Position	Gap (cm)	Power Back-off	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	WCDMA Band II	RMC 12.2Kbps	Curved surface of Edge 1	1	Off	9400	1880	23.08	23.50	1.102	-0.06	1.320	1	1.454
2nd	WCDMA Band II	RMC 12.2Kbps	Curved surface of Edge 1	1	Off	9400	1880	23.08	23.50	1.102	-0.07	1.230	1.073	1.355

General Note:

1. Per KDB 865664 D01v01r03, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg.
2. Per KDB 865664 D01v01r03, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR < 1.45 W/kg, only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.



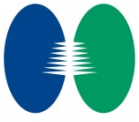
16. Simultaneous Transmission Analysis

NO	Simultaneous Transmission Configurations	Tablet	Note
		Body	
1.	GPRS/EDGE(data) + WLAN2.4GHz(data)	Yes	2.4GHz Hotspot
2.	WCDMA(data) + WLAN2.4GHz(data)	Yes	2.4GHz Hotspot
3.	GPRS/EDGE(data) + Bluetooth(data)	Yes	Bluetooth Tethering
4.	WCDMA(data) + Bluetooth(data)	Yes	Bluetooth Tethering

General Note:

1. This device 2.4GHz WLAN supports hotspot operation.
2. EUT will choose either GSM or WCDMA according to the network signal condition; therefore, they will not operate simultaneously at any moment.
3. Bluetooth and WLAN Antenna share the same antenna, and cannot transmit simultaneously.
4. For simultaneous transmission analysis for exposure position of edge1 1.0cm and bottom face 1.0cm, WLAN SAR tested at 0mm separation is worse and the test data is used for conservative SAR summation.
5. The reported SAR summation is calculated based on the same configuration and test position.
6. Per KDB 447498 D01v05r02, simultaneous transmission SAR is compliant if,
 - i) Scalar SAR summation < 1.6W/kg.
 - ii) $SPLSR = (SAR_1 + SAR_2)^{1.5} / (min. \text{ separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
 - iii) If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
 - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
7. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r02 based on the formula below.
 - i) $(max. \text{ power of channel, including tune-up tolerance, mW}) / (min. \text{ test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})} / x] \text{ W/kg}$ for test separation distances $\leq 50 \text{ mm}$; where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.
 - ii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.
 - iii) If the test separation distance (antenna-user) is < 5mm, 5mm is used for excluded SAR calculation.
 - iv) In this report, 50mm separation is applied to conservatively estimate SAR value for separation distance > 50mm.

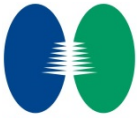
Max Power	Exposure Position	Bottom Face	Bottom Face	Edge 1	Edge 1	Edge 2	Edge 4	Curved surface of Edge 1	Curved surface of Edge 1
	Test separation (mm)	0	10	0	10	0	0	0	10
6.5 dBm	Antenna to user distance (mm)	0	10	3	13	99	153	3	13
	Estimated SAR (W/kg)	0.168	0.084	0.168	0.065	0.017	0.017	0.168	0.065



16.1 Tablet Body Exposure Conditions

<WWAN PCB + WLAN DTS>

WWAN Band		Exposure Position	WWAN PCB	WLAN DTS	Summed SAR (W/kg)
			Max. WWAN SAR (W/kg)	Max. WLAN SAR (W/kg)	
GSM	GSM850	Bottom Face at 1.0cm	0.105	0.691	0.80
		Edge1 at 1.0cm	0.097	0.131	0.23
		Curved surface of Edge 1 at 1.0cm	0.504	0.138	0.64
		Bottom Face at 0cm	0.337	0.691	1.03
		Edge1 at 0cm	0.213	0.131	0.34
		Edge2 at 0cm	0.047		0.05
		Edge4 at 0cm	0.143	0.510	0.65
		Curved surface of Edge 1 at 0cm	0.193	0.138	0.33
	GSM1900	Bottom Face at 1.0cm	0.556	0.691	1.25
		Edge1 at 1.0cm	0.788	0.131	0.92
		Curved surface of Edge 1 at 1.0cm	0.879	0.138	1.02
		Bottom Face at 0cm	0.339	0.691	1.03
		Edge1 at 0cm	0.485	0.131	0.62
		Edge2 at 0cm	0.878		0.88
WCMDA	Band V	Edge4 at 0cm		0.510	0.51
		Curved surface of Edge 1 at 0cm	0.443	0.138	0.58
		Bottom Face at 1.0cm	0.085	0.691	0.78
		Edge1 at 1.0cm	0.093	0.131	0.22
		Curved surface of Edge 1 at 1.0cm	0.496	0.138	0.63
		Bottom Face at 0cm	0.269	0.691	0.96
		Edge1 at 0cm	0.209	0.131	0.34
		Edge2 at 0cm	0.135		0.14
	Band II	Edge4 at 0cm		0.510	0.51
		Curved surface of Edge 1 at 0cm	0.217	0.138	0.36
		Bottom Face at 1.0cm	0.799	0.691	1.49
		Edge1 at 1.0cm	1.124	0.131	1.26
		Curved surface of Edge 1 at 1.0cm	1.454	0.138	1.59
		Bottom Face at 0cm	0.658	0.691	1.35
	Edge1 at 0cm	0.846	0.131	0.98	
	Edge2 at 0cm	1.256		1.26	
	Edge4 at 0cm		0.510	0.51	
	Curved surface of Edge 1 at 0cm	0.857	0.138	1.00	



<WWAN PCB + Bluetooth DSS>

WWAN Band		Exposure Position	WWAN PCB	Bluetooth DSS	Summed SAR (W/kg)
			Max. WWAN SAR (W/kg)	Max. Bluetooth SAR (W/kg)	
GSM	GSM850	Bottom Face at 1.0cm	0.105	0.084	0.19
		Edge1 at 1.0cm	0.097	0.065	0.16
		Curved surface of Edge 1 at 1.0cm	0.504	0.065	0.57
		Bottom Face at 0cm	0.337	0.168	0.51
		Edge1 at 0cm	0.213	0.168	0.38
		Edge2 at 0cm	0.047	0.017	0.06
		Edge4 at 0cm	0.143	0.017	0.16
		Curved surface of Edge 1 at 0cm	0.193	0.168	0.36
	GSM1900	Bottom Face at 1.0cm	0.556	0.084	0.64
		Edge1 at 1.0cm	0.788	0.065	0.85
		Curved surface of Edge 1 at 1.0cm	0.879	0.065	0.94
		Bottom Face at 0cm	0.339	0.168	0.51
		Edge1 at 0cm	0.485	0.168	0.65
		Edge2 at 0cm	0.878	0.017	0.90
Edge4 at 0cm			0.017	0.02	
Curved surface of Edge 1 at 0cm		0.443	0.168	0.61	
WCMDA	Band V	Bottom Face at 1.0cm	0.085	0.084	0.17
		Edge1 at 1.0cm	0.093	0.065	0.16
		Curved surface of Edge 1 at 1.0cm	0.496	0.065	0.56
		Bottom Face at 0cm	0.269	0.168	0.44
		Edge1 at 0cm	0.209	0.168	0.38
		Edge2 at 0cm	0.135	0.017	0.15
		Edge4 at 0cm		0.017	0.02
		Curved surface of Edge 1 at 0cm	0.217	0.168	0.39
	Band II	Bottom Face at 1.0cm	0.799	0.084	0.88
		Edge1 at 1.0cm	1.124	0.065	1.19
		Curved surface of Edge 1 at 1.0cm	1.454	0.065	1.52
		Bottom Face at 0cm	0.658	0.168	0.83
		Edge1 at 0cm	0.846	0.168	1.01
		Edge2 at 0cm	1.256	0.017	1.27
Edge4 at 0cm			0.017	0.02	
Curved surface of Edge 1 at 0cm		0.857	0.168	1.03	

Test Engineer : Kat Yin

17. 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 below.

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

Table 17.1. 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.



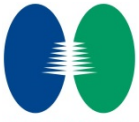
Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Ci (10g)	Standard Uncertainty (1g)	Standard Uncertainty (10g)
Measurement System							
Probe Calibration	6.0	Normal	1	1	1	± 6.0 %	± 6.0 %
Axial Isotropy	4.7	Rectangular	√3	0.7	0.7	± 1.9 %	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	0.7	± 3.9 %	± 3.9 %
Boundary Effects	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Linearity	4.7	Rectangular	√3	1	1	± 2.7 %	± 2.7 %
System Detection Limits	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Readout Electronics	0.3	Normal	1	1	1	± 0.3 %	± 0.3 %
Response Time	0.8	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	1	± 1.5 %	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Probe Positioner	0.4	Rectangular	√3	1	1	± 0.2 %	± 0.2 %
Probe Positioning	2.9	Rectangular	√3	1	1	± 1.7 %	± 1.7 %
Max. SAR Eval.	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Test Sample Related							
Device Positioning	2.9	Normal	1	1	1	± 2.9 %	± 2.9 %
Device Holder	3.6	Normal	1	1	1	± 3.6 %	± 3.6 %
Power Drift	5.0	Rectangular	√3	1	1	± 2.9 %	± 2.9 %
Phantom and Setup							
Phantom Uncertainty	4.0	Rectangular	√3	1	1	± 2.3 %	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	0.43	± 1.8 %	± 1.2 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	0.43	± 1.6 %	± 1.1 %
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	0.49	± 1.7 %	± 1.4 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	0.49	± 1.5 %	± 1.2 %
Combined Standard Uncertainty						± 11.0 %	± 10.8 %
Coverage Factor for 95 %						K=2	
Expanded Uncertainty						± 22.0 %	± 21.5 %

Table 17.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz



18. References

- [1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”
- [2] ANSI/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”, September 1992
- [3] IEEE Std. 1528-2003, “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, December 2003
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 865664 D01 v01r03, “SAR Measurement Requirements for 100 MHz to 6 GHz”, February 2014.
- [6] FCC KDB 865664 D02 v01r01, “RF Exposure Compliance Reporting and Documentation Considerations” May 2013.
- [7] FCC KDB 447498 D01 v05r02, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, February 2014.
- [8] FCC KDB 248227 D01 v01r02, “SAR Measurement Procedures for 802.11 a/b/g Transmitters”, May 2007.
- [9] FCC KDB 616217 D04 v01r01, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, May 2013.
- [10] FCC KDB 941225 D01 v02, “SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do / WCDMA / HSDPA / HSPA”, October 2007.
- [11] FCC KDB 941225 D02 v02r02, “SAR Guidance for HSPA, HSPA+, DC-HSDPA and 1x-Advanced”, May 2013.
- [12] FCC KDB 941225 D03 v01, “Recommended SAR Test Reduction Procedures for GSM / GPRS / EDGE”, December 2008.



Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Body_835MHz_140816

DUT: D835V2 - SN: 4d151

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

Medium: MSL_835_140816 Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.974 \text{ S/m}$; $\epsilon_r = 54.246$; $\rho = 1000 \text{ kg/m}^3$

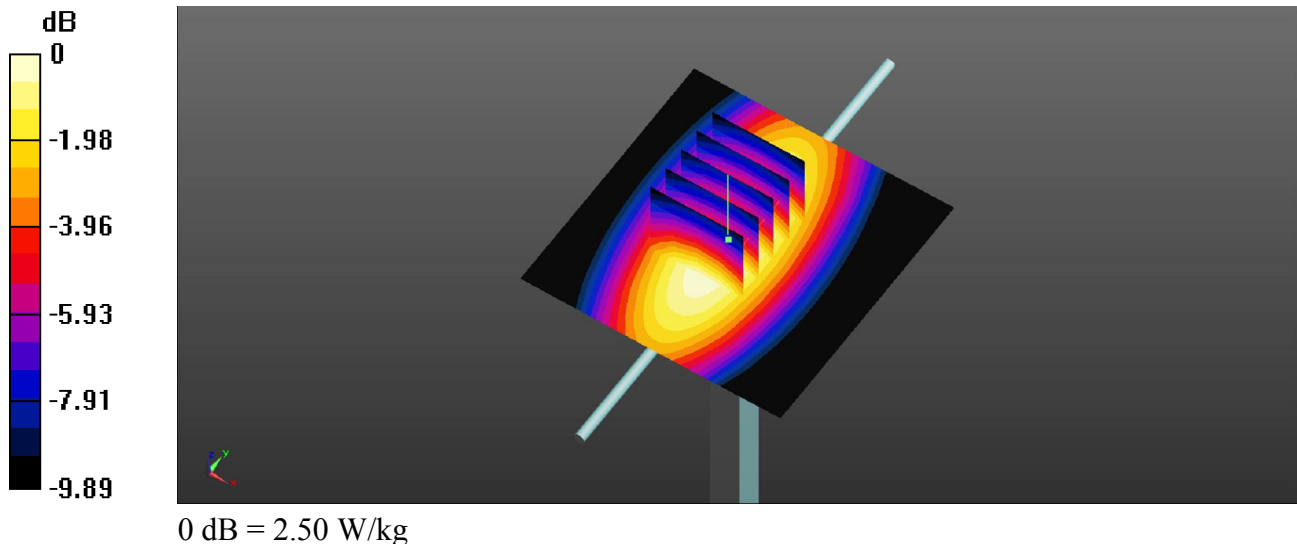
Ambient Temperature : $23.5 \text{ }^\circ\text{C}$; Liquid Temperature : $22.6 \text{ }^\circ\text{C}$

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(10.02, 10.02, 10.02); Calibrated: 2014/4/22;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2014/4/30
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1201
- Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.8 (7028)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Maximum value of SAR (interpolated) = 2.53 W/kg

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
Reference Value = 50.553 V/m ; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 3.41 W/kg
SAR(1 g) = 2.33 W/kg ; SAR(10 g) = 1.56 W/kg
Maximum value of SAR (measured) = 2.50 W/kg



System Check_Body_1900MHz_140815

DUT: D1900V2 - SN: 5d170

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

Medium: MSL_1900_140815 Medium parameters used: $f = 1900$ MHz; $\sigma = 1.528$ S/m; $\epsilon_r = 55.266$; $\rho = 1000$ kg/m³

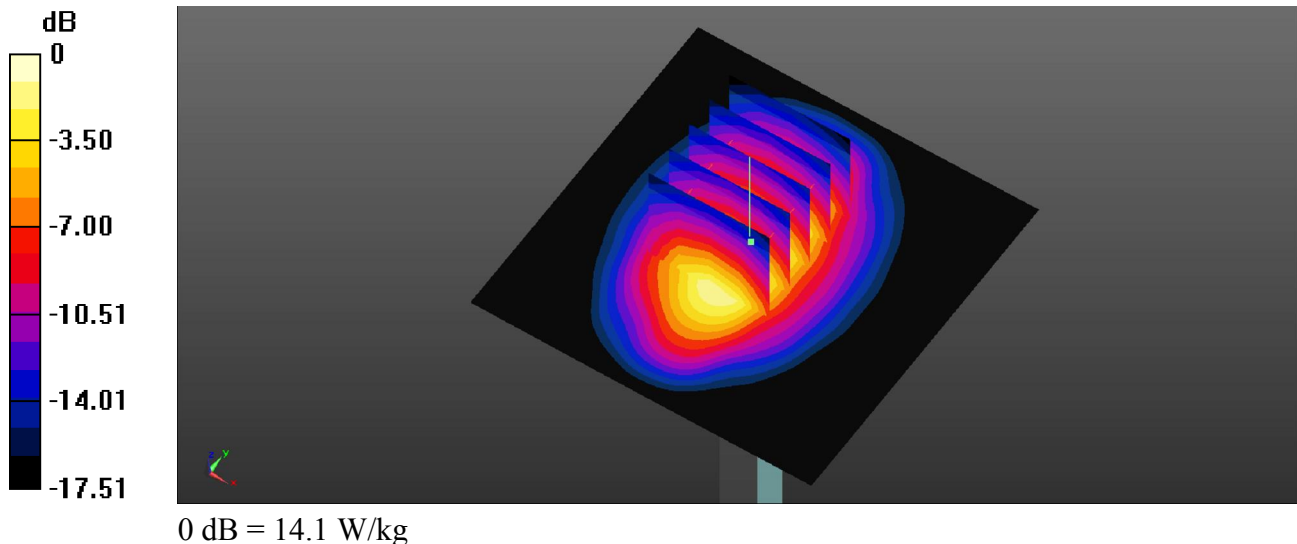
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.83, 7.83, 7.83); Calibrated: 2014/4/22;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2014/4/30
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1201
- Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.8 (7028)

Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=15mm, dy=15mm
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 = 83.879 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 17.8 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.31 W/kg
Maximum value of SAR (measured) = 14.1 W/kg



System Check_Body_2450MHz_140816

DUT: D2450V2 - SN: 908

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL_2450_140816 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.984$ S/m; $\epsilon_r = 51.165$; $\rho = 1000$ kg/m³

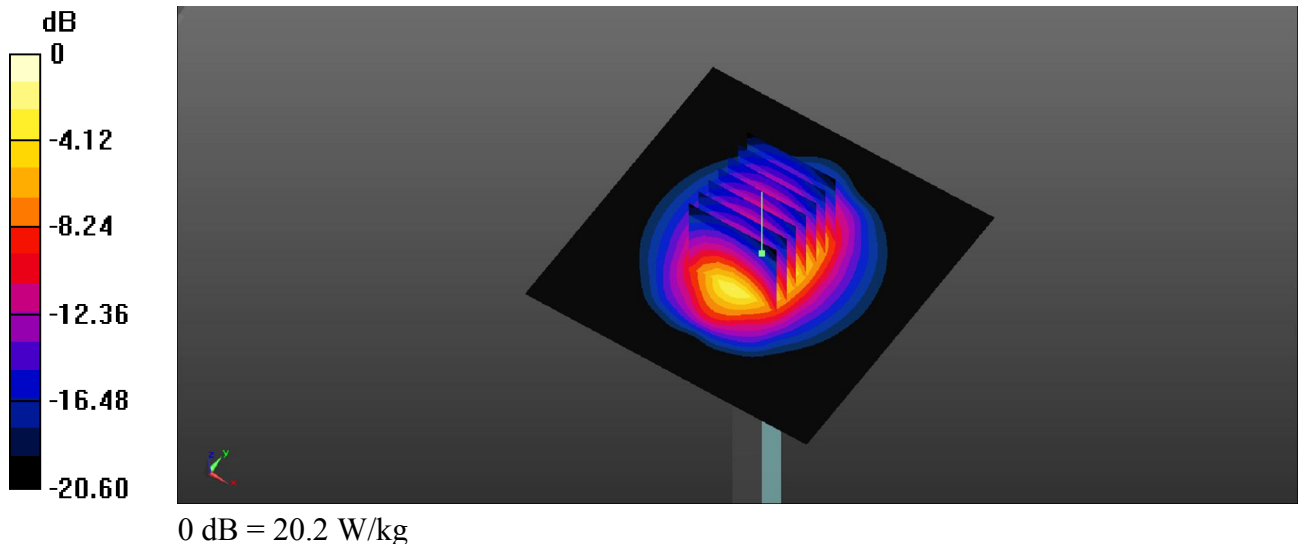
Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

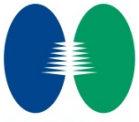
DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.32, 7.32, 7.32); Calibrated: 2014/4/22;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2014/4/30
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1201
- Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.8 (7028)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 19.9 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.868 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 26.9 W/kg
SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.24 W/kg
Maximum value of SAR (measured) = 20.2 W/kg





Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

#01 GSM850_GPRS(GMSK 2 Tx slots)_Curved surface of Edge 1_1.0cm_Ch251_sensor off

Communication System: GPRS (GMSK 2 Tx slot); Frequency: 848.8 MHz; Duty Cycle: 1:4.15

Medium: MSL_835_140816 Medium parameters used: $f = 848.8$ MHz; $\sigma = 0.987$ S/m; $\epsilon_r = 54.118$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(10.02, 10.02, 10.02); Calibrated: 2014/4/22;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2014/4/30
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1201
- Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.8 (7028)

Ch251/Area Scan (31x91x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.607 W/kg

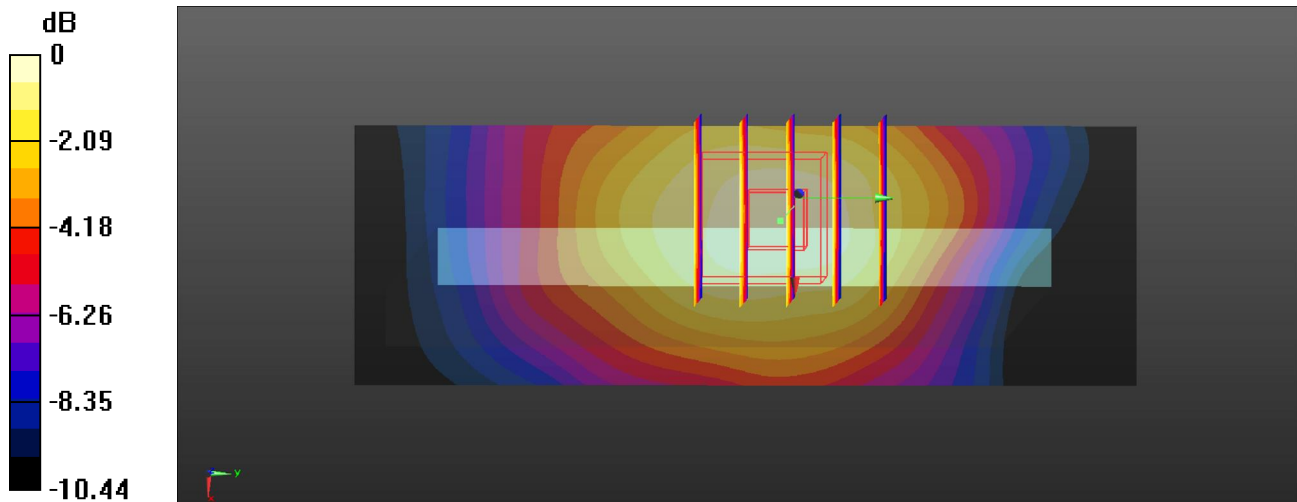
Ch251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.177 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.659 W/kg

SAR(1 g) = 0.489 W/kg; SAR(10 g) = 0.346 W/kg

Maximum value of SAR (measured) = 0.589 W/kg



0 dB = 0.589 W/kg

#02 GSM1900_GPRS(GMSK 2 Tx slots)_Curved surface of Edge 1_1.0cm_Ch810_sensor off

Communication System: GPRS (GMSK 2 Tx slot); Frequency: 1909.8 MHz; Duty Cycle: 1:4.15

Medium: MSL_1900_140815 Medium parameters used: $f = 1909.8$ MHz; $\sigma = 1.54$ S/m; $\epsilon_r = 55.188$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.83, 7.83, 7.83); Calibrated: 2014/4/22;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2014/4/30
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1201
- Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.8 (7028)

Ch810/Area Scan (31x91x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.906 W/kg

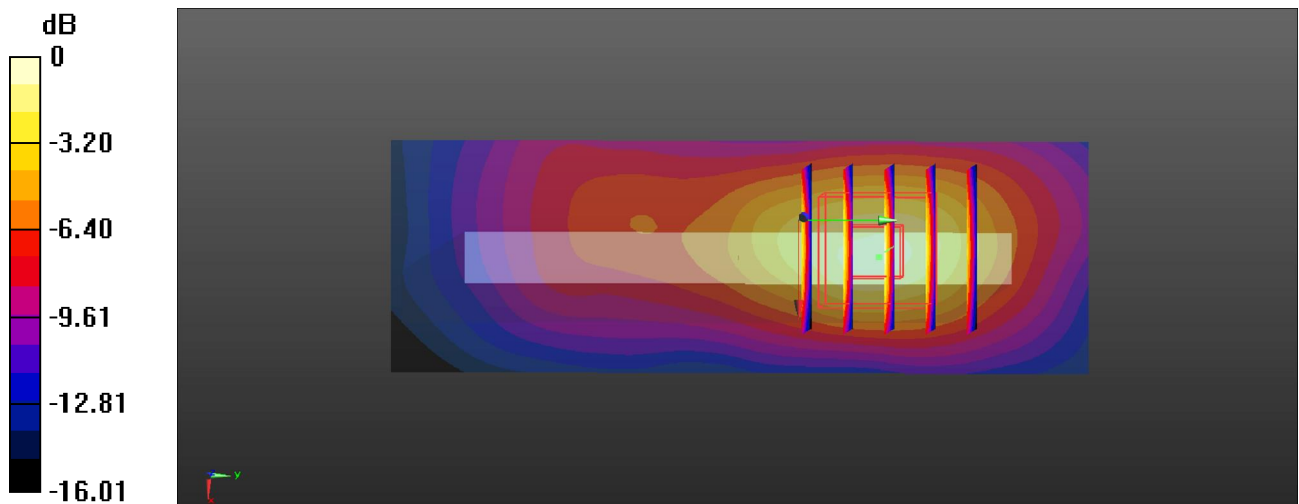
Ch810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.136 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 1.20 W/kg

SAR(1 g) = 0.755 W/kg; SAR(10 g) = 0.412 W/kg

Maximum value of SAR (measured) = 1.03 W/kg



0 dB = 1.03 W/kg

#03 WCDMA Band V_RMC 12.2K_Curved surface of Edge 1_1.0cm_Ch4182_sensor off

Communication System: WCDMA ; Frequency: 836.4 MHz;Duty Cycle: 1:1

Medium: MSL_835_140816 Medium parameters used: $f = 836.4$ MHz; $\sigma = 0.975$ S/m; $\epsilon_r = 54.233$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(10.02, 10.02, 10.02); Calibrated: 2014/4/22;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2014/4/30
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1201
- Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.8 (7028)

Ch4182/Area Scan (31x91x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.533 W/kg

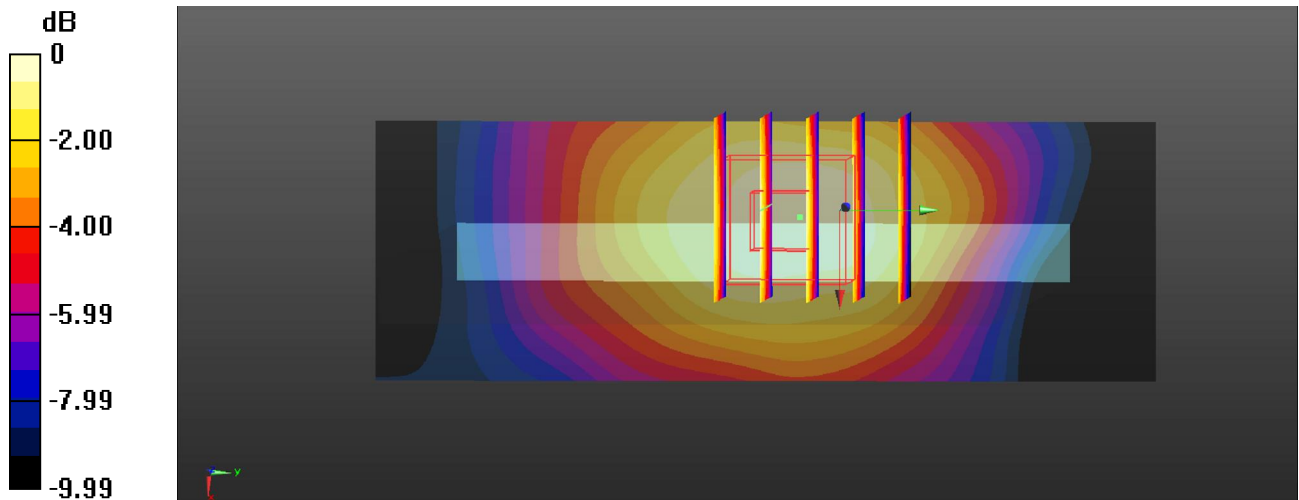
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.064 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.555 W/kg

SAR(1 g) = 0.432 W/kg; SAR(10 g) = 0.309 W/kg

Maximum value of SAR (measured) = 0.503 W/kg



0 dB = 0.503 W/kg

#04 WCDMA Band II_RMC 12.2K_Curved surface of Edge 1_1.0cm_Ch9400_sensor off

Communication System: WCDMA ; Frequency: 1880 MHz;Duty Cycle: 1:1

Medium: MSL_1900_140815 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.509$ S/m; $\epsilon_r = 55.377$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.83, 7.83, 7.83); Calibrated: 2014/4/22;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2014/4/30
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1201
- Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.8 (7028)

Ch9400/Area Scan (31x91x1): Interpolated grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.67 W/kg

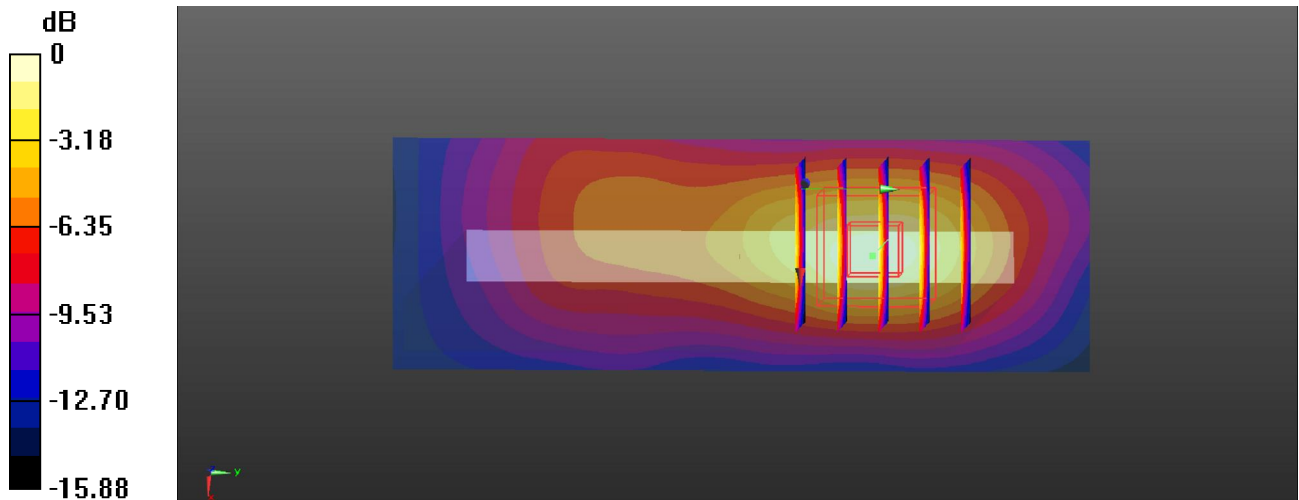
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 18.446 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 2.08 W/kg

SAR(1 g) = 1.320 W/kg; SAR(10 g) = 0.720 W/kg

Maximum value of SAR (measured) = 1.79 W/kg



0 dB = 1.79 W/kg

#05 WLAN 2.4GHz_802.11b 1Mbps_Bottom face_0cm_Ch11

Communication System: 802.11b; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: MSL_2450_140816 Medium parameters used: $f = 2462$ MHz; $\sigma = 2.002$ S/m; $\epsilon_r = 51.118$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.5 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.32, 7.32, 7.32); Calibrated: 2014/4/22;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1358; Calibrated: 2014/4/30
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1201
- Measurement SW: DASY52, Version 52.8 (5); SEMCAD X Version 14.6.8 (7028)

Ch11/Area Scan (101x71x1): Interpolated grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 0.944 W/kg

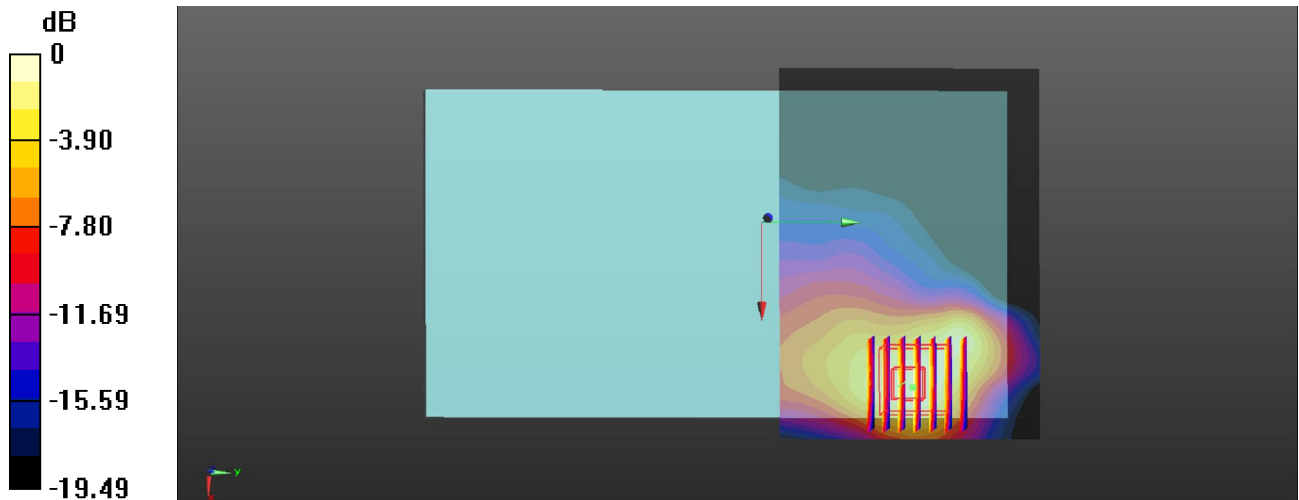
Ch11/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 3.504 V/m; Power Drift = 0.07 dB

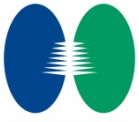
Peak SAR (extrapolated) = 1.14 W/kg

SAR(1 g) = 0.617 W/kg; SAR(10 g) = 0.338 W/kg

Maximum value of SAR (measured) = 0.865 W/kg



0 dB = 0.865 W/kg



Appendix C. DASYS Calibration Certificate

The DASYS calibration certificates are shown as follows.



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

Accreditation No.: **SCS 108**

Client **Sporton-KS (Auden)**

Certificate No: **D835V2-4d151_Mar13**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d151**

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

Calibration date: **March 25, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: March 26, 2013

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



Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
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 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	40.9 \pm 6 %	0.94 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.49 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.18 W/kg \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	54.1 \pm 6 %	1.02 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	2.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.43 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	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.23 W/kg \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 2.2 j Ω
Return Loss	- 31.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.1 Ω - 4.3 j Ω
Return Loss	- 25.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 ns
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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	March 27, 2012

DASY5 Validation Report for Head TSL

Date: 25.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d151

Communication System: CW; Frequency: 835 MHz

Medium parameters used; $f = 835$ MHz; $\sigma = 0.94$ S/m; $\epsilon_r = 40.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

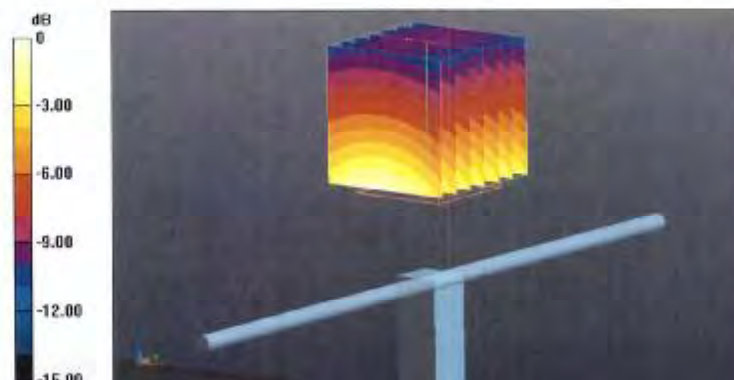
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.742 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.74 W/kg

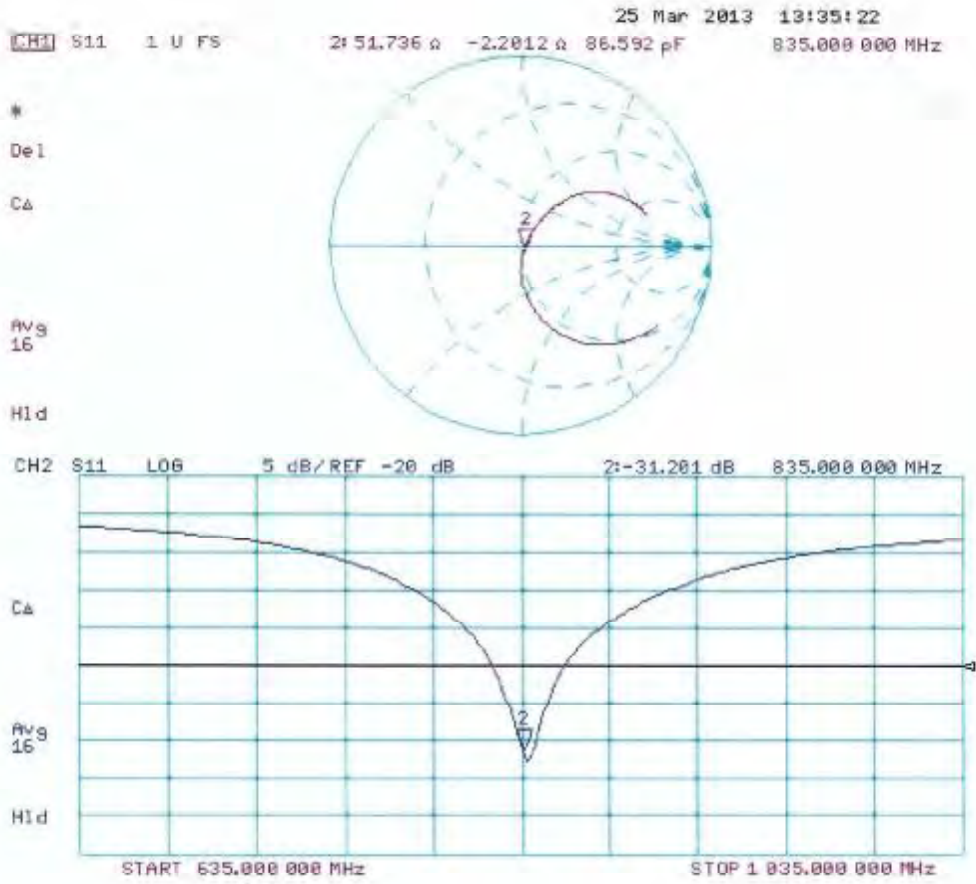
SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 2.88 W/kg



0 dB = 2.88 W/kg = 4.59 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d151

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $f = 835$ MHz; $\sigma = 1.02$ S/m; $\epsilon_r = 54.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9I.; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

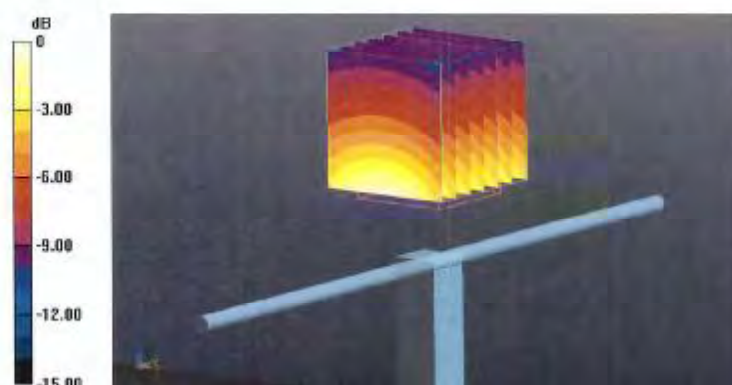
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.816 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.63 W/kg

SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.61 W/kg

Maximum value of SAR (measured) = 2.87 W/kg

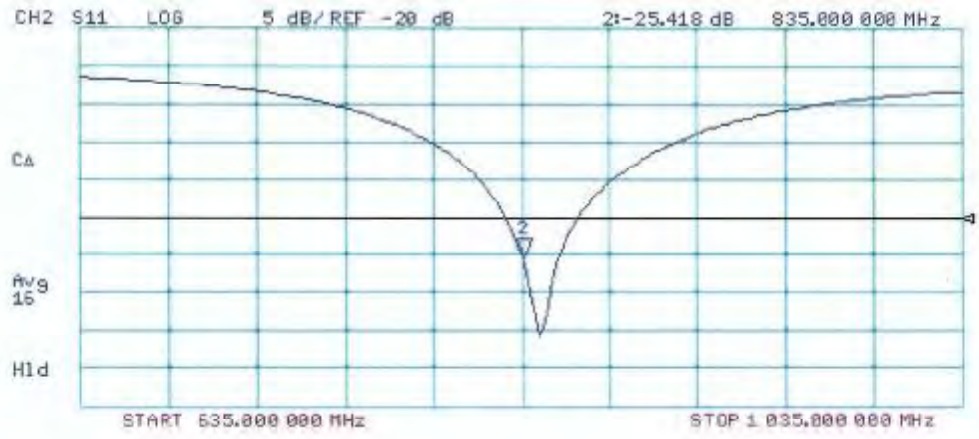
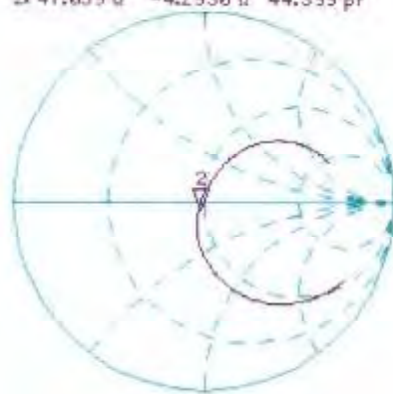


0 dB = 2.87 W/kg = 4.58 dBW/kg

Impedance Measurement Plot for Body TSL

25 Mar 2013 13:05:09
 CH1 S11 1 U FS 2x 47.059 Ω -4.2938 Ω 44.399 pF 835.000 000 MHz

 De1
 Ca
 Avg
 16
 H1d

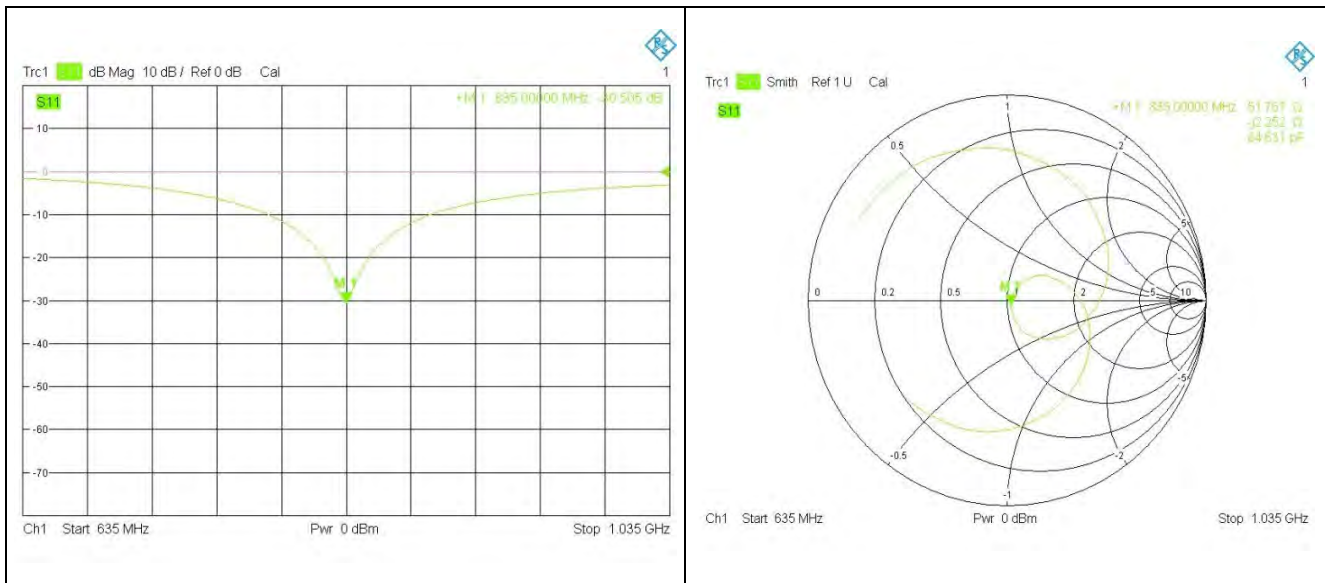


Extended Dipole Calibrations

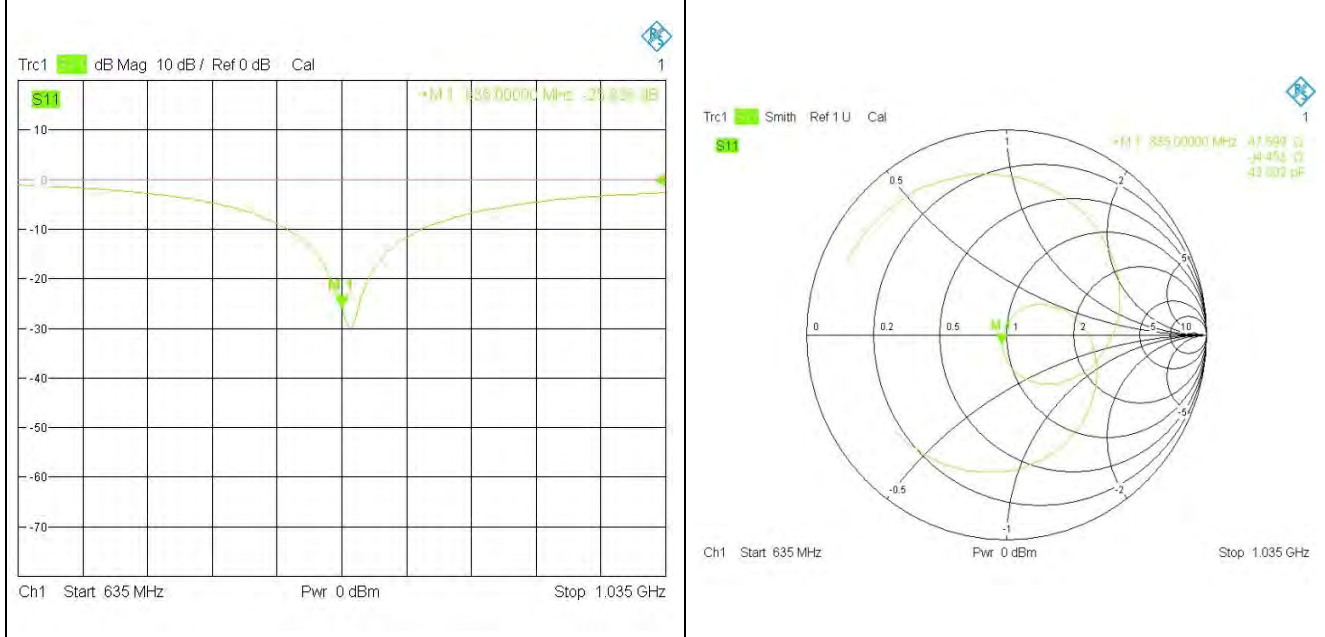
Referring to KDB 865664 D01 v01r03, if dipoles are verified in return loss (<-20 dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

<Dipole Verification Data> - D835V2, serial no. 4d151(Date of Measurement 03.24.2014)

835MHz - Head



835MHz – Body





<Justification of the extended calibration>

D835V2 – serial no. 4d151												
TSL	Head						Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
03.25.2013	-31.201		51.736		-2.201		-25.418		47.059		-4.2930	
03.24.2014	-30.505	2.23	51.767	0.031	-2.252	-0.051	-25.828	-1.613	47.599	0.54	-4.453	-0.16

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration.
Therefore the verification result should support extended calibration.



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Accreditation No.: **SCS 108**

Client **Sporton KS (Auden)**

Certificate No: **D1900V2-5d170_Mar13**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d170**

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

Calibration date: **March 27, 2013**

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

All calibrations have been conducted in the closed laboratory facility; environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / D6327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP B753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Leif Klysner** Name: **Leif Klysner** Function: **Laboratory Technician**

Signature

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

Issued: March 27, 2013

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



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Multilateral Agreement for the recognition of calibration certificates

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 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	39.3 \pm 6 %	1.38 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.2 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.1 W/kg \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	51.8 \pm 6 %	1.53 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	10.4 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	41.2 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	5.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.8 W/kg \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53,8 \Omega + 4,7 j\Omega$
Return Loss	- 24,7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49,6 \Omega + 5,0 j\Omega$
Return Loss	- 26,0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 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	June 08, 2012

DASY5 Validation Report for Head TSL

Date: 27.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d170

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

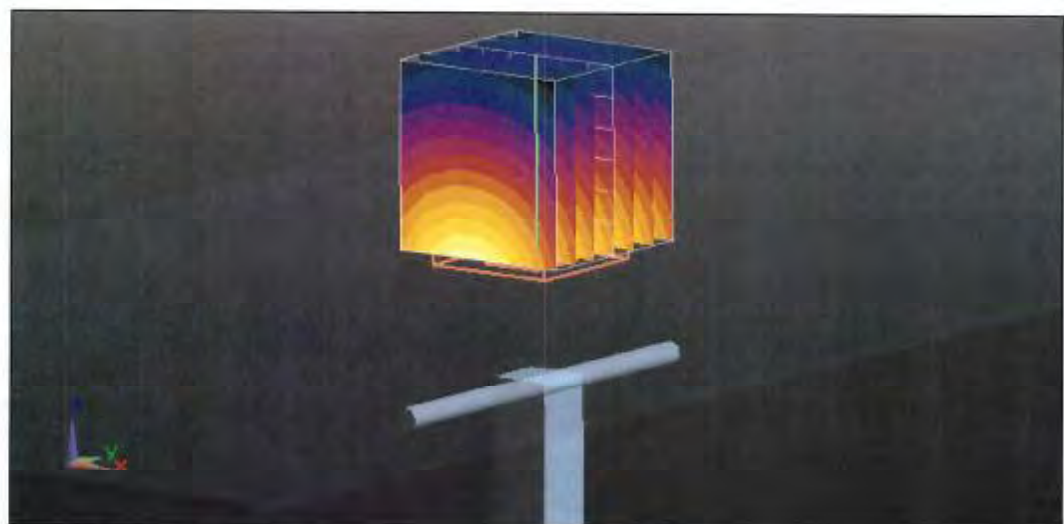
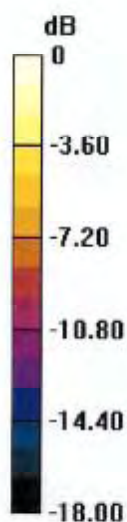
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.871 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 18.2 W/kg

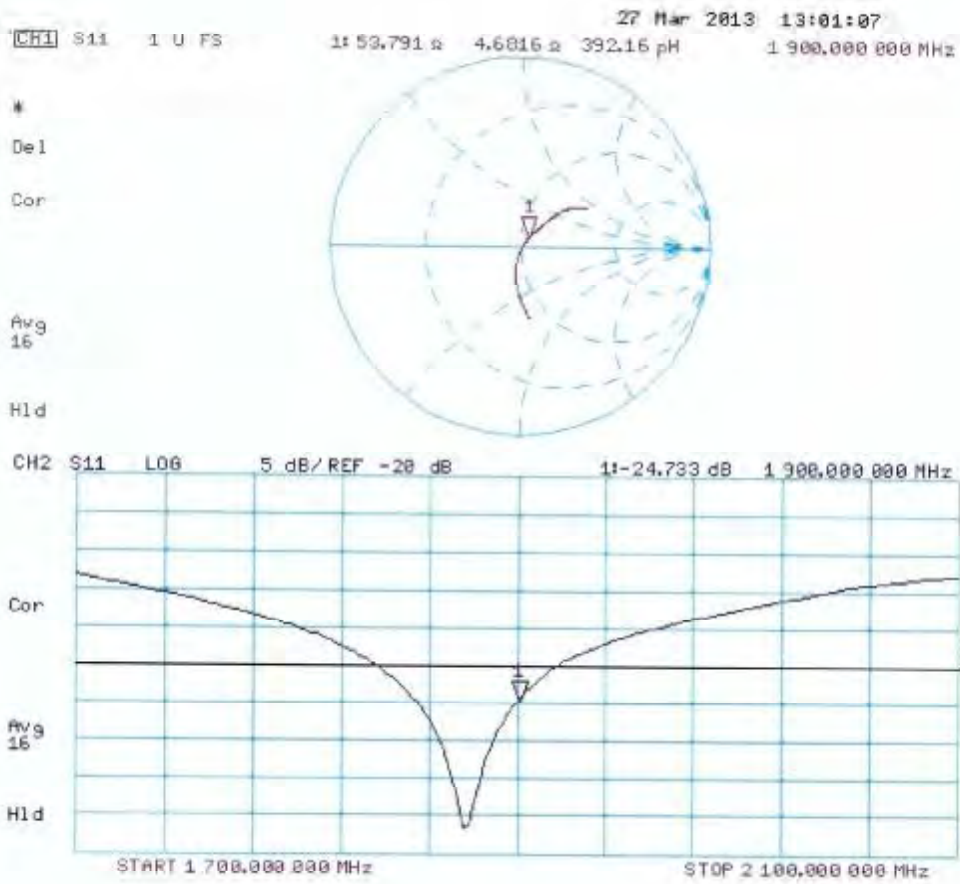
SAR(1 g) = 10 W/kg; SAR(10 g) = 5.25 W/kg

Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12,4 W/kg = 10,93 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 27.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d170

Communication System: CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.53$ S/m; $\epsilon_r = 51.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface; 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

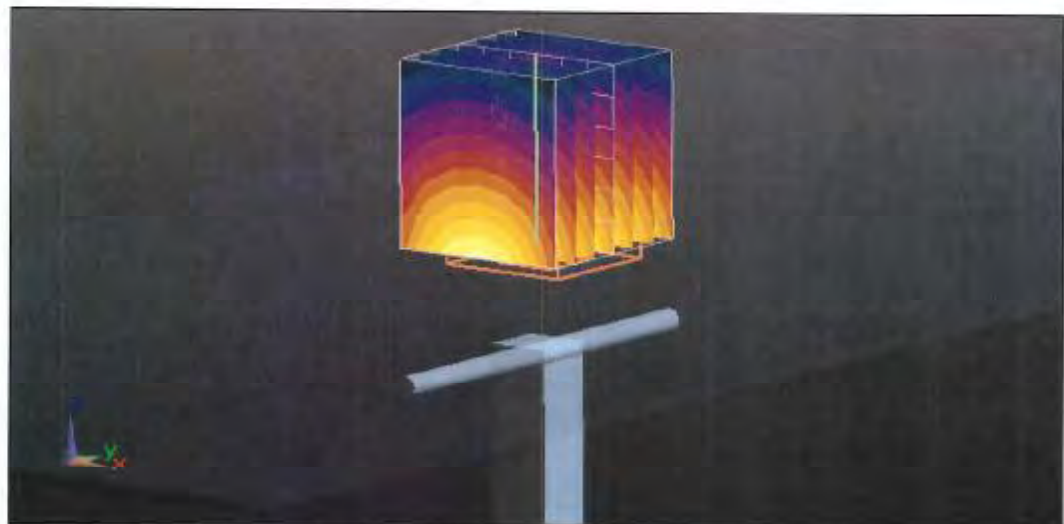
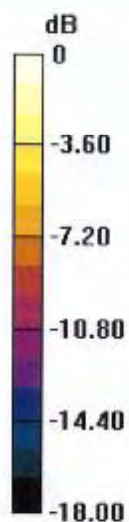
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.871 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.0 W/kg

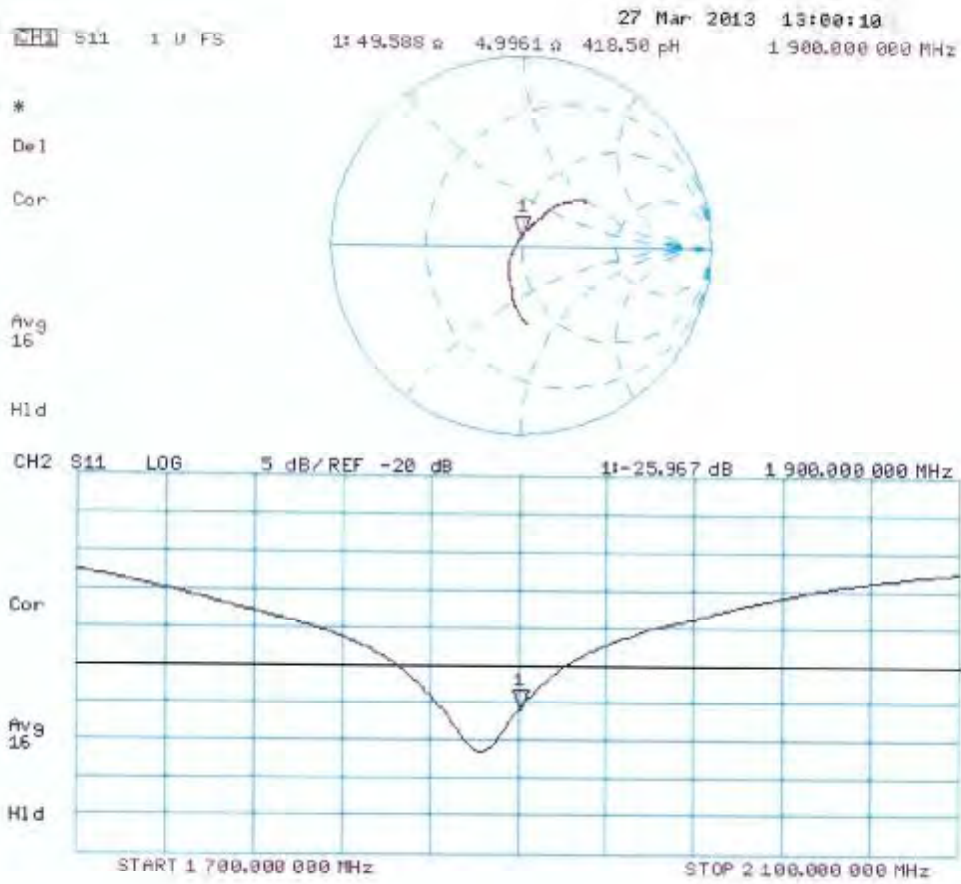
SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.49 W/kg

Maximum value of SAR (measured) = 13.2 W/kg



0 dB = 13.2 W/kg = 11.21 dBW/kg

Impedance Measurement Plot for Body TSL

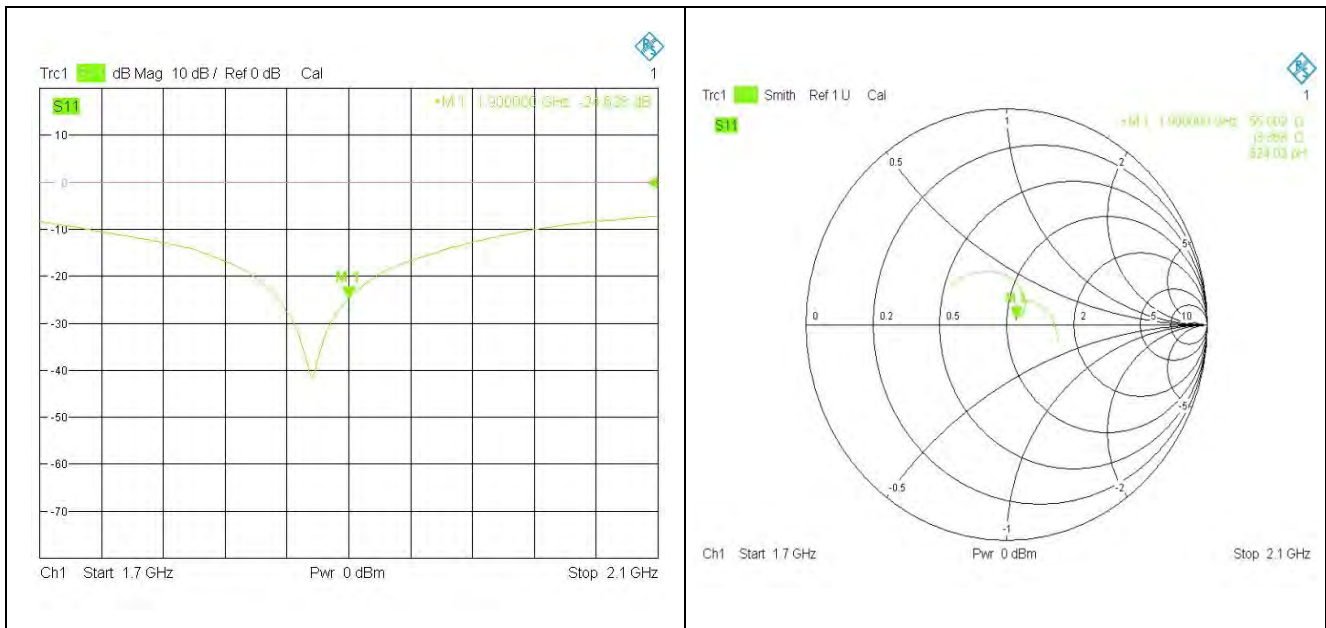


Extended Dipole Calibrations

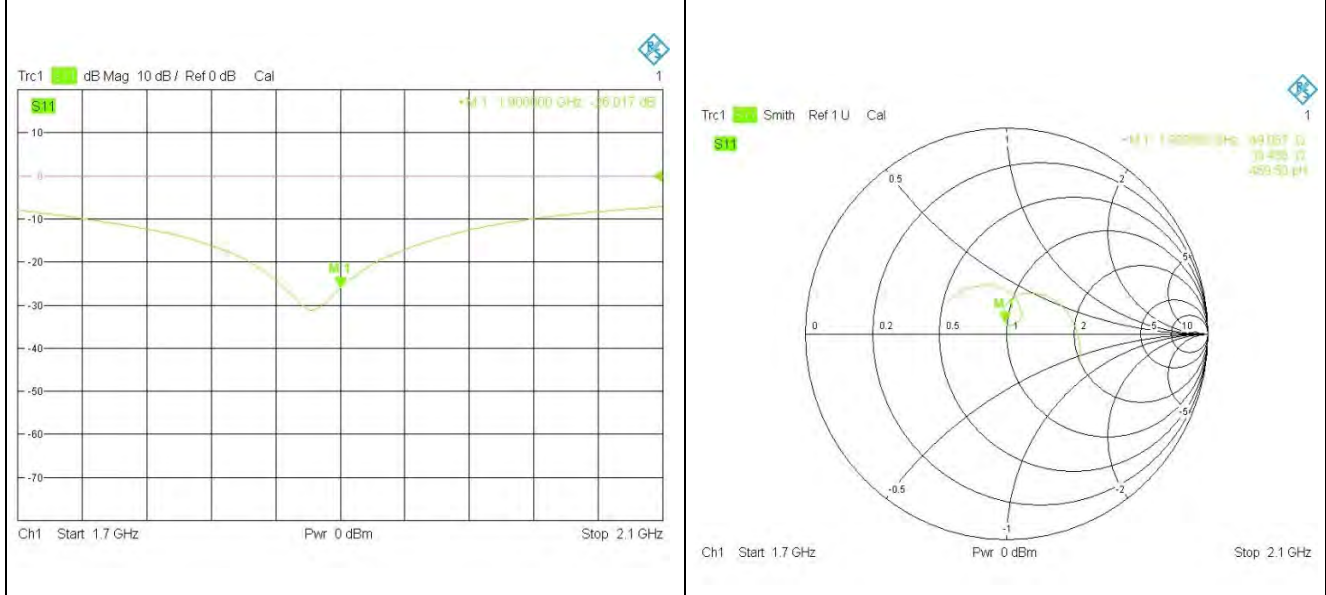
Referring to KDB 865664 D01 v01r03, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

<Dipole Verification Data> - D1900V2, serial no. 5d170(Date of Measurement 03.26.2014)

1900MHz - Head



1900MHz – Body





<Justification of the extended calibration>

D1900V2 – serial no. 5d170												
TSL	Head						Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
03.27.2013	-24.733		53.791		4.682		-25.967		49.588		4.996	
03.26.2014	-24.628	0.425	55.002	1.211	3.868	-0.814	-26.017	-0.193	49.067	-0.521	5.486	0.490

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.



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Accreditation No.: **SCS 108**

Client **Sporton-KS (Auden)**

Certificate No: **D2450V2-908_Mar13**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 908**

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

Calibration date: **March 26, 2013**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047,3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (In house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (In house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (In house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 54206	18-Oct-01 (In house check Oct-12)	In house check: Oct-13

Calibrated by: **Name** Claudio Leubler **Function** Laboratory Technician

Signature

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

Issued: March 26, 2013

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Multilateral Agreement for the recognition of calibration certificates

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:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	37.8 \pm 6 %	1.85 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	54.0 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.1 W/kg \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	50.7 \pm 6 %	2.01 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	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	50.4 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	5.94 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	23.4 W/kg \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	56.5 Ω - 0.1 j Ω
Return Loss	- 24.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.6 Ω + 1.9 j Ω
Return Loss	- 30.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 ns
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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	December 19, 2012

DASY5 Validation Report for Head TSL

Date: 26.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ S/m; $\epsilon_r = 37.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

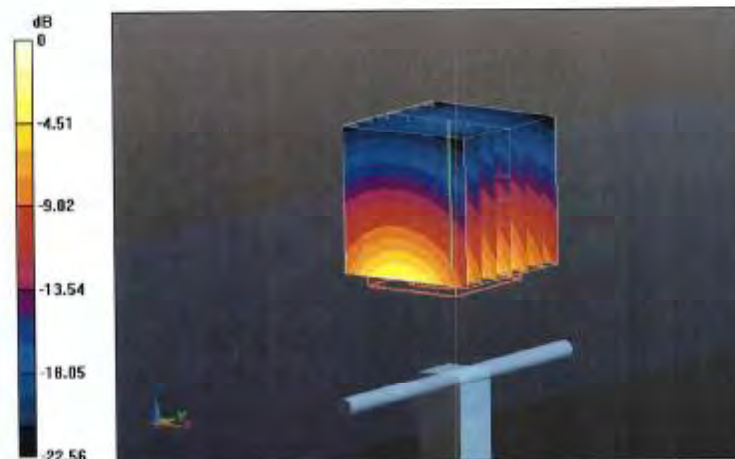
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.957 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 28.8 W/kg

SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.36 W/kg

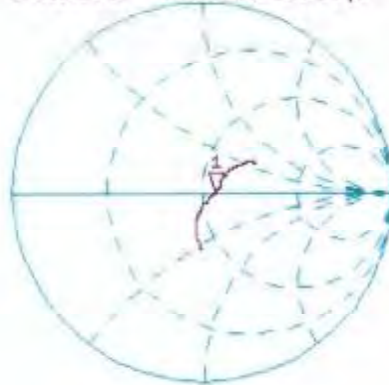
Maximum value of SAR (measured) = 17.9 W/kg



Impedance Measurement Plot for Head TSL

25 Mar 2013 18:42:12
CH1 S11 1 U FS Δ : 56.531 \angle -125.00 m Ω 519.69 pF 2 450.000 000 MHz

De1
Ca
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-24.254 dB 2 450.000 000 MHz

CA
Avg
16
H1d



DASY5 Validation Report for Body TSL

Date: 26.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 908

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.01$ S/m; $\epsilon_r = 50.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

Dipole Calibration for Body Tissue/ $P_{in}=250$ mW, $d=10$ mm/Zoom Scan (7x7x7)/Cube 0:

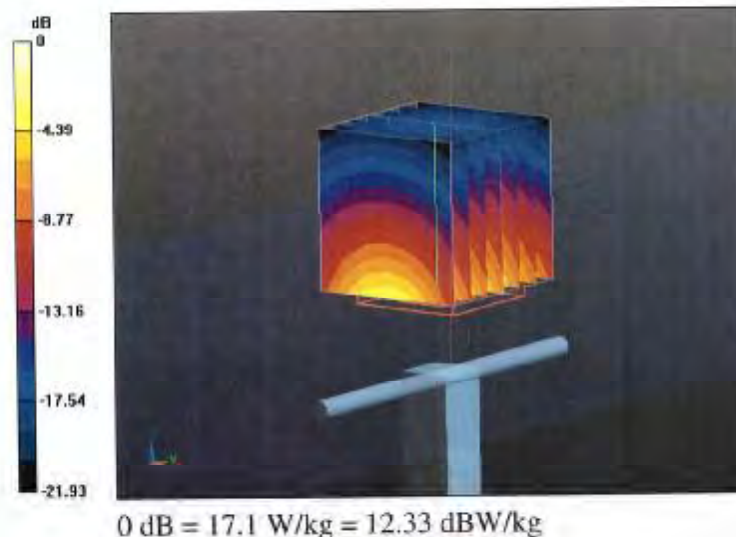
Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 94.957 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 27.0 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.94 W/kg

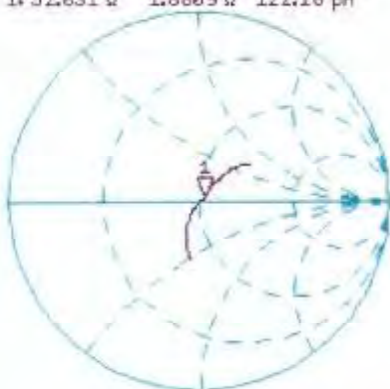
Maximum value of SAR (measured) = 17.1 W/kg



Impedance Measurement Plot for Body TSL

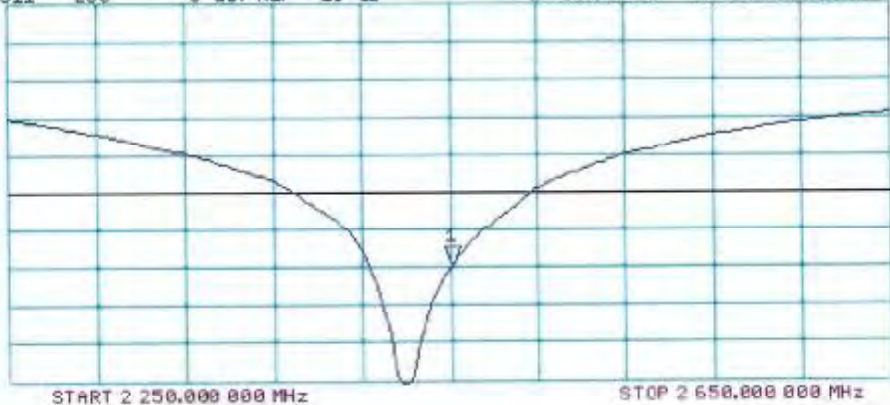
26 Mar 2013 10:42:53
 CH1 S11 1 U FS 1: 52.631 Ω 1.8809 Ω 122.18 μH 2 450.000 000 MHz

*
 Del
 CA
 Avg
 15
 H1d



CH2 S11 LOG 5 dB/REF -20 dB 1: -38.033 dB 2 450.000 000 MHz

CA
 Avg
 15
 H1d

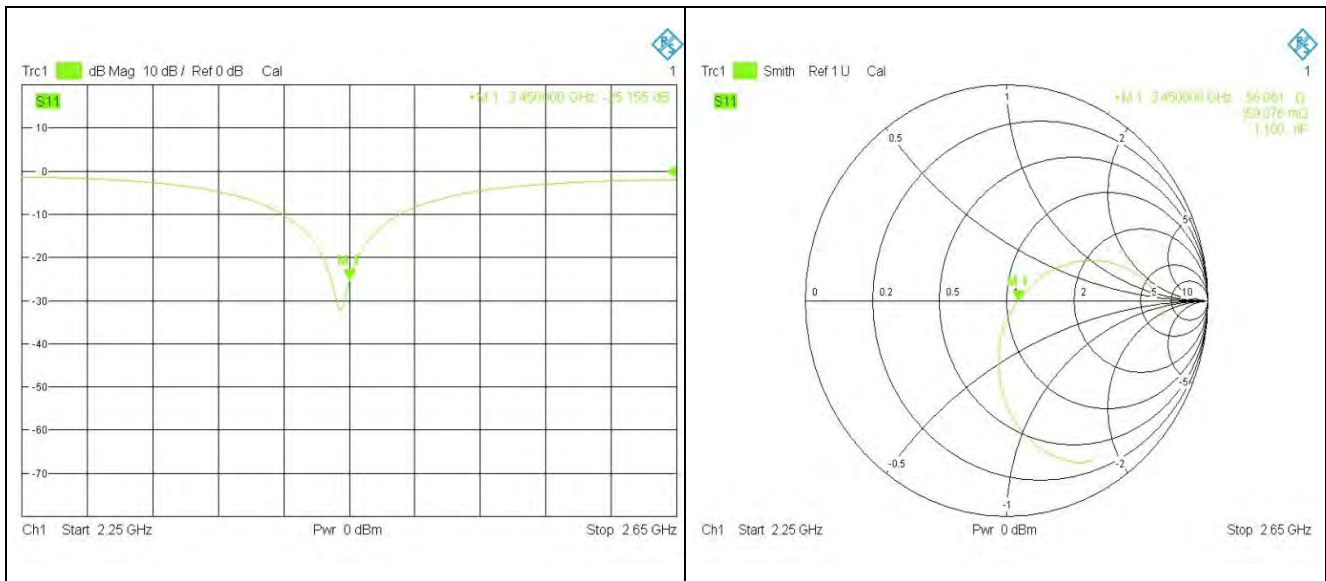


Extended Dipole Calibrations

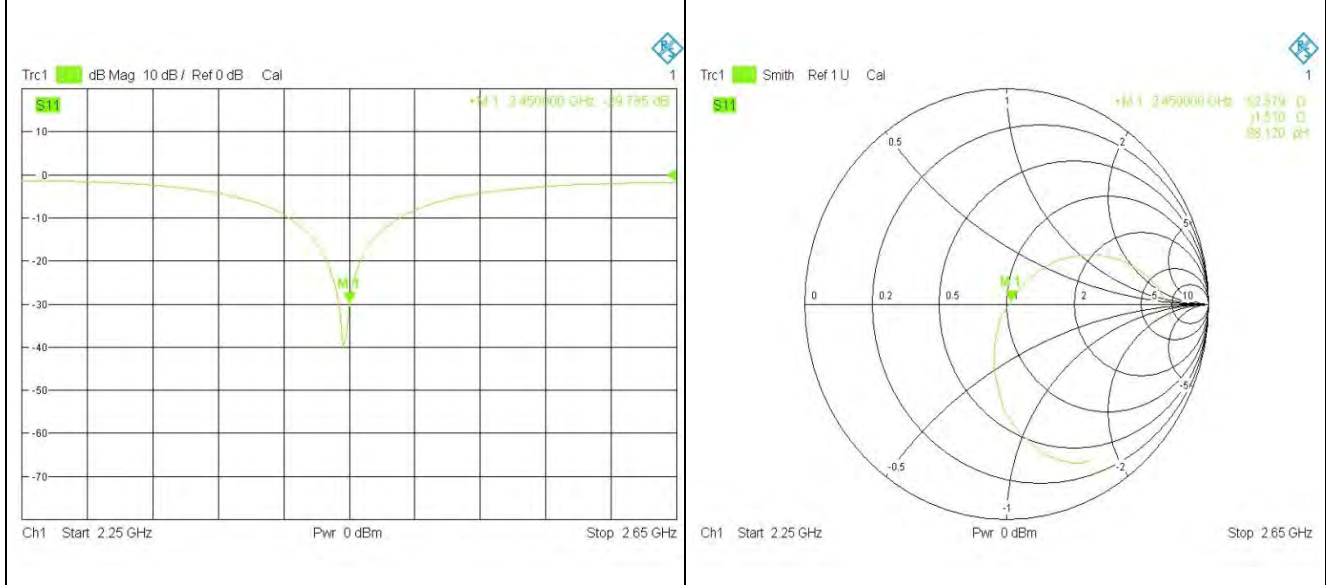
Referring to KDB 865664 D01 v01r03, if dipoles are verified in return loss ($< -20\text{dB}$, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

<Dipole Verification Data> - D2450V2, serial no. 908(Date of Measurement 03.25.2014)

2450MHz - Head



2450MHz – Body





<Justification of the extended calibration>

D2450V2 – serial no. 908												
TSL	Head						Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
03.26.2013	-24.251		56.531		-0.125		-30.033		52.631		1.881	
03.25.2014	-25.155	-0.373	56.061	-0.47	-0.059	0.066	-29.785	0.826	52.379	-0.252	1.510	-0.371

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.

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 CN (Auden)**

Certificate No: **DAE4-1358_Apr14**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 1358**

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

Calibration date: **April 30, 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

	Name	Function	Signature
Calibrated by:	R.Mayoraz	Technician	<i>R. Mayoraz</i>

Approved by:	Fin Bomholt	Deputy Technical Manager	<i>F. Bomholt</i>
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Issued: April 30, 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	403.476 \pm 0.02% (k=2)	403.505 \pm 0.02% (k=2)	403.509 \pm 0.02% (k=2)
Low Range	3.96075 \pm 1.50% (k=2)	3.98590 \pm 1.50% (k=2)	3.99195 \pm 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	136.0 $^{\circ}$ \pm 1 $^{\circ}$
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Appendix

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	200038.03	1.76	0.00
Channel X + Input	20005.43	1.37	0.01
Channel X - Input	-20004.06	1.92	-0.01
Channel Y + Input	200034.40	-1.98	-0.00
Channel Y + Input	20002.81	-0.99	-0.00
Channel Y - Input	-20005.22	0.94	-0.00
Channel Z + Input	200037.68	1.44	0.00
Channel Z + Input	20002.59	-1.11	-0.01
Channel Z - Input	-20007.07	-0.94	0.00

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2000.15	-0.26	-0.01
Channel X + Input	201.04	0.44	0.22
Channel X - Input	-198.78	0.53	-0.27
Channel Y + Input	2000.38	0.18	0.01
Channel Y + Input	200.06	-0.29	-0.15
Channel Y - Input	-200.10	-0.50	0.25
Channel Z + Input	2000.16	-0.17	-0.01
Channel Z + Input	198.55	-1.98	-0.99
Channel Z - Input	-201.27	-1.72	0.86

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	23.14	21.30
	- 200	-20.01	-21.49
Channel Y	200	-27.07	-27.39
	- 200	27.21	26.98
Channel Z	200	-11.40	-11.75
	- 200	9.24	9.23

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	-	3.10	-3.59
Channel Y	200	9.08	-	3.89
Channel Z	200	9.17	6.05	-

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	15575	16462
Channel Y	16051	15758
Channel Z	16070	16201

5. Input Offset Measurement

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

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	-1.05	-2.31	-0.30	0.37
Channel Y	-0.30	-1.37	0.51	0.40
Channel Z	-1.60	-2.40	-0.66	0.37

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9



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Accreditation No.: **SCS 108**

Client **Sporton-CN (Auden)**

Certificate No: **EX3-3911_Apr14**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3911**

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

Calibration date: **April 22, 2014**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: April 23, 2014

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Accreditation No.: **SCS 108**

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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:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

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 E^2 -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:3911

Manufactured: September 4, 2012
Calibrated: April 22, 2014

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3911

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.46	0.45	0.55	$\pm 10.1\%$
DCP (mV) ^B	100.0	96.7	97.5	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	131.2	$\pm 3.5\%$
		Y	0.0	0.0	1.0		131.9	
		Z	0.0	0.0	1.0		144.7	

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	10.27	10.27	10.27	0.25	1.18	± 12.0 %
835	41.5	0.90	9.84	9.84	9.84	0.38	0.86	± 12.0 %
900	41.5	0.97	9.62	9.62	9.62	0.23	1.23	± 12.0 %
1750	40.1	1.37	8.52	8.52	8.52	0.80	0.50	± 12.0 %
1900	40.0	1.40	8.09	8.09	8.09	0.36	0.78	± 12.0 %
2000	40.0	1.40	7.98	7.98	7.98	0.80	0.54	± 12.0 %
2300	39.5	1.67	7.56	7.56	7.56	0.70	0.59	± 12.0 %
2450	39.2	1.80	7.04	7.04	7.04	0.56	0.67	± 12.0 %
2600	39.0	1.96	6.87	6.87	6.87	0.44	0.80	± 12.0 %

^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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3911

Calibration Parameter Determined in Body Tissue Simulating Media

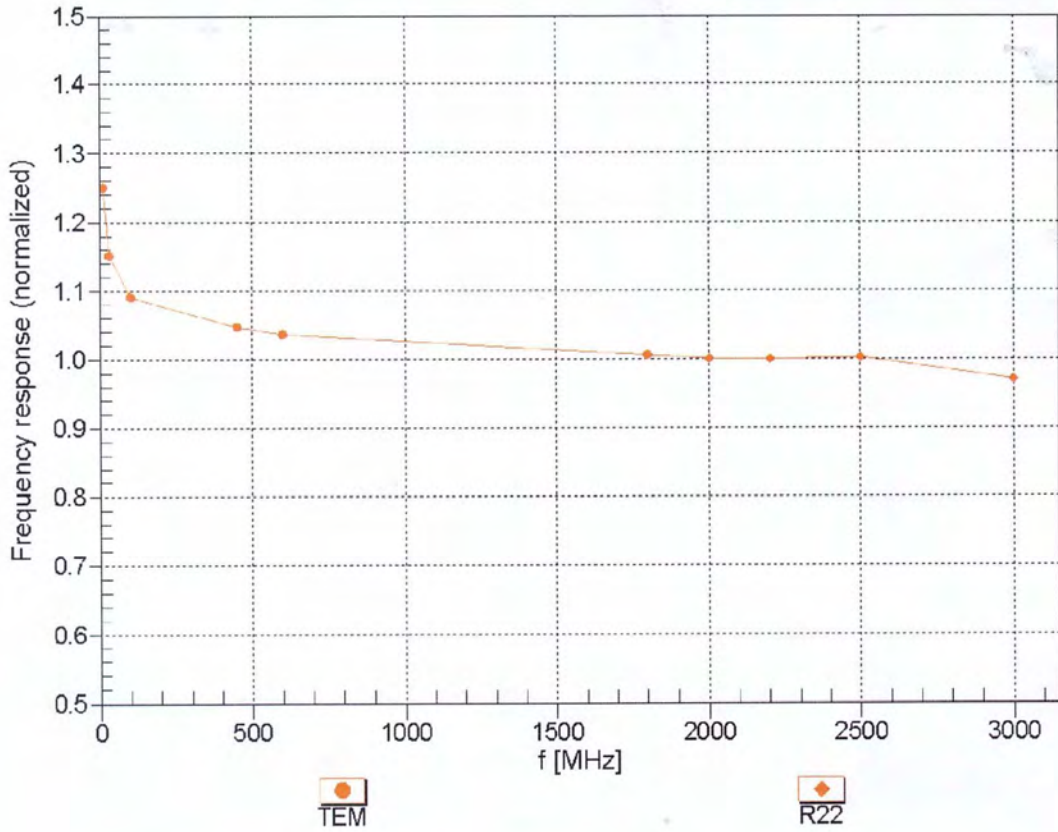
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	10.06	10.06	10.06	0.24	1.17	± 12.0 %
835	55.2	0.97	10.02	10.02	10.02	0.46	0.80	± 12.0 %
900	55.0	1.05	9.74	9.74	9.74	0.28	1.04	± 12.0 %
1750	53.4	1.49	8.11	8.11	8.11	0.36	0.84	± 12.0 %
1900	53.3	1.52	7.83	7.83	7.83	0.32	0.92	± 12.0 %
2000	53.3	1.52	7.94	7.94	7.94	0.51	0.72	± 12.0 %
2300	52.9	1.81	7.53	7.53	7.53	0.38	0.83	± 12.0 %
2450	52.7	1.95	7.32	7.32	7.32	0.80	0.56	± 12.0 %
2600	52.5	2.16	7.09	7.09	7.09	0.80	0.57	± 12.0 %

^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.

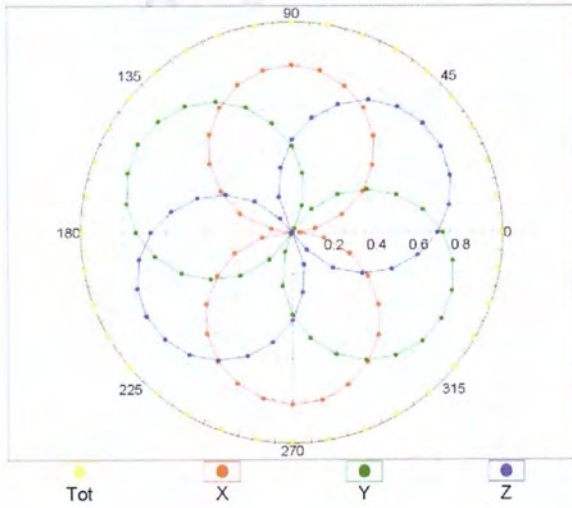
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



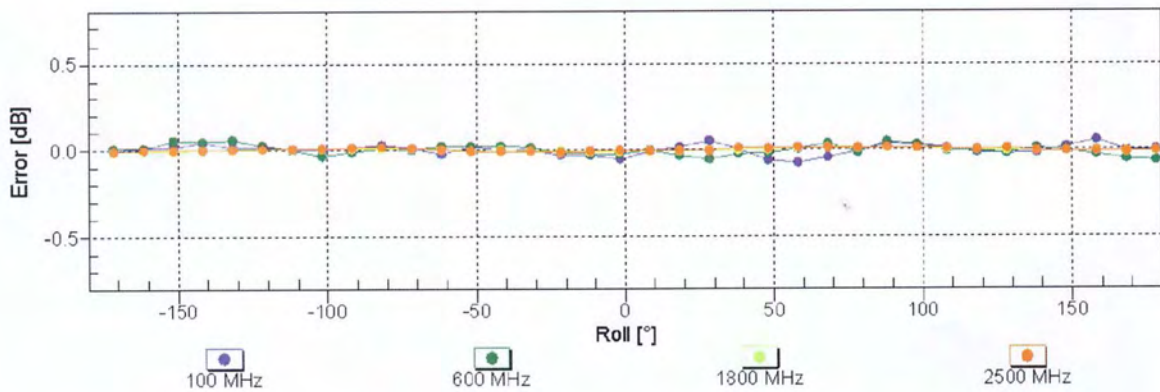
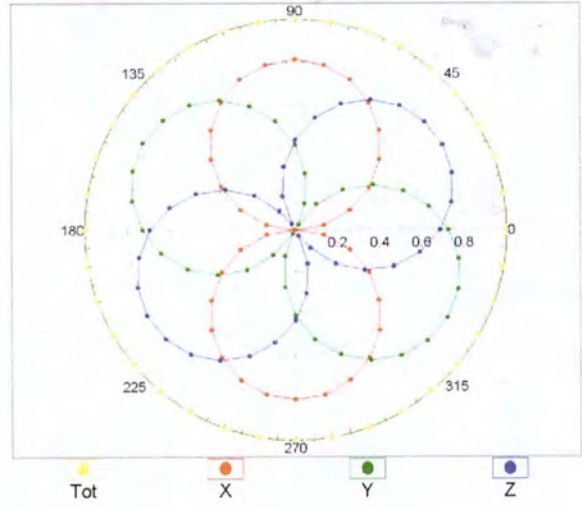
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

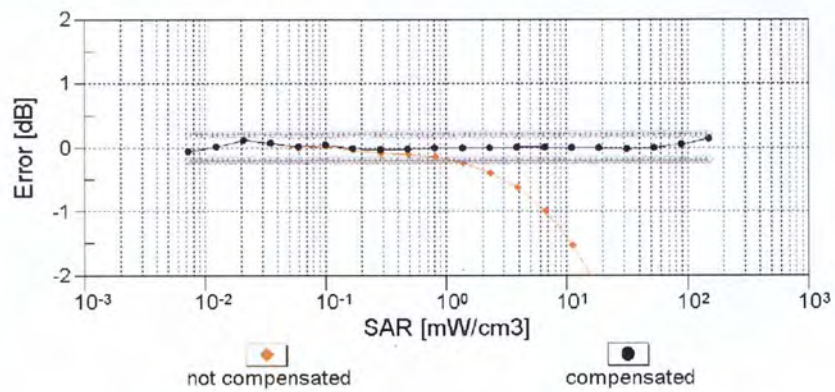
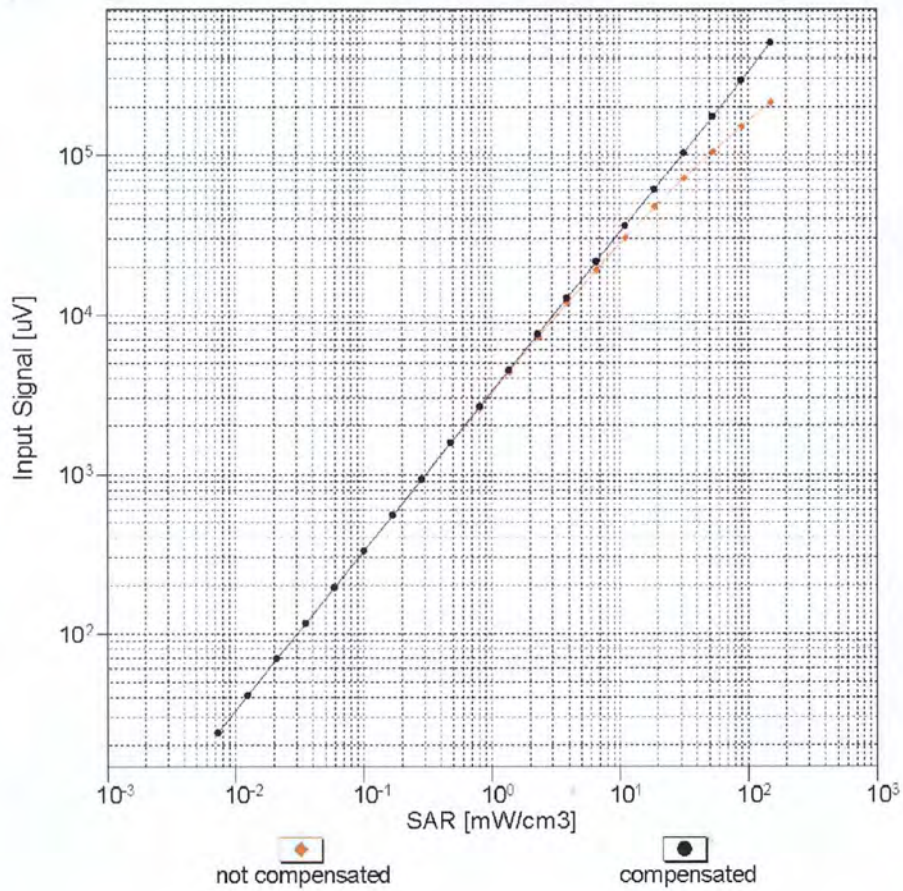


f=1800 MHz,R22



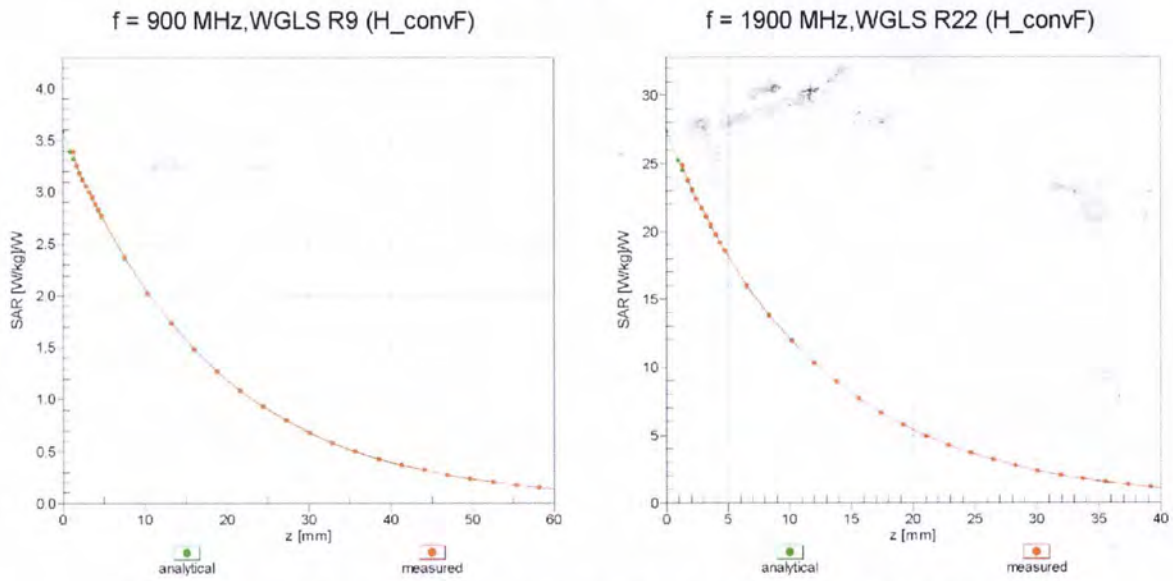
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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

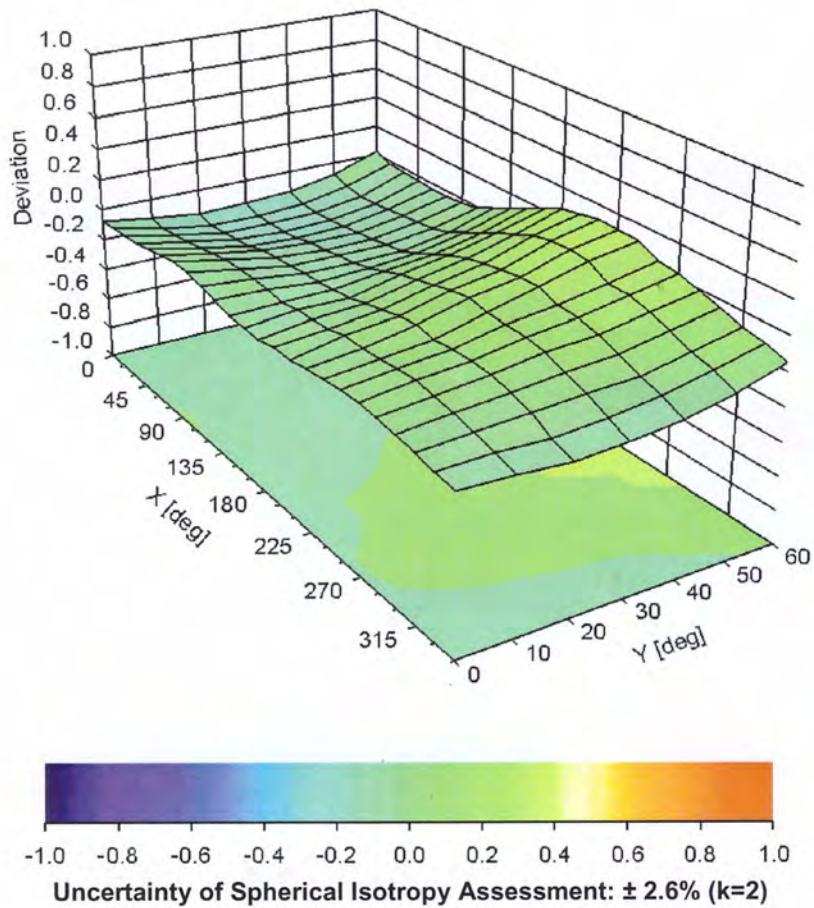


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



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



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Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	8.2
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