FCC SAR Test Report

APPLICANT	:	**HTC Corporation**
EQUIPMENT	:	**Smartphone**
MODEL NAME	:	**0P9O200**
FCC ID	:	**NM80P9O200**
STANDARD	:	**FCC 47 CFR Part 2 (2.1093)** **ANSI/IEEE C95.1-1992** **IEEE 1528-2003**

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

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

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager

Testing Laboratory
1190

SPORTON INTERNATIONAL INC.
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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA411535	Rev. 01	Initial issue of report	Mar. 24, 2014

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **HTC Corporation, Smartphone, 0P9O200**, are as follows.

Exposure Position	Frequency Band	Reported 1g-SAR (W/kg)	Equipment Class	Highest Reported 1g-SAR (W/kg)
Head	GPRS850	0.29	PCE	0.51
	GPRS1900	0.30		
	WCDMA Band V	0.19		
	LTE Band 7	0.51		
	WLAN 2.4GHz Band	0.24	DTS	0.24
Hotspot (Separation 1cm)	GPRS850	0.48	PCE	1.16
	GPRS1900	0.70		
	WCDMA Band V	0.36		
	LTE Band 7	1.16		
	WLAN 2.4GHz Band	0.49	DTS	0.49
Body-worn (Separation 1cm)	GPRS850	0.48	PCE	1.16
	GPRS1900	0.70		
	WCDMA Band V	0.36		
	LTE Band 7	1.16		
	WLAN 2.4GHz Band	0.49	DTS	0.49

Exposure Position	Frequency Band	Equipment Class	Highest Reported Simultaneous Transmission 1g-SAR (W/kg)
Hotspot (Separation 1cm)	GSM1900	PCE	1.19
	WLAN2.4GHz Band	DTS	

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 INC.
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978

Applicant	
Company Name	HTC Corporation
Address	No.23, Xinghua Rd., Taoyuan City, Taoyuan County 330, Taiwan.

Manufacturer	
Company Name	HTC Corporation
Address	No.23, Xinghua Rd., Taoyuan City, Taoyuan County 330, Taiwan.

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 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r02
- FCC KDB 248227 D01 SAR meas for 802 11abg v01r02
- 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
- FCC KDB 941225 D04 SAR for GSM E GPRS Dual Xfer Mode v01
- FCC KDB 941225 D05 SAR for LTE Devices v02r03
- FCC KDB 941225 D06 Hotspot Mode SAR v01r01

4. Equipment Under Test (EUT)

4.1 General Information

Product Feature & Specification	
Equipment Name	Smartphone
Model Name	0P9O200
FCC ID	NM80P9O200
IMEI Code	356821050012276
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 LTE Band 7: 2500 MHz ~ 2570 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC : 13.56 MHz
Mode	• GSM/GPRS/EGPRS • RMC/AMR 12.2Kbps Rel 99 • HSDPA Rel 7, Cat14 • HSUPA Rel 6, Cat6 • DC-HSDPA Rel 8 Cat24 • LTE: QPSK, 16QAM • 802.11b/g/n HT20 • Bluetooth v3.0+HS，Bluetooth v4.0-LE • NFC:ASK
GSM / (E)GPRS Dual Transfer mode	Class A – EUT can support Packet Switched and Circuit Switched Network simultaneously.
EUT Stage	Identical Prototype

Remark:

1. This device supported VoIP in EGPRS, WCDMA, LTE (e.g. 3rd party VoIP).
2. 802.11n-HT40 is not supported in 2.4GHz WLAN.
3. This device supports GRPS/EGPRS mode up to multi-slot class12 and supports DTM up to multi-slot class11.
4. This product has two kinds of earphone and battery accessories only different is manufacturer, therefore RF exposure evaluation was selected battery1 and earphone 1 performed SAR testing, more detail information please referred to External Photo, report No: EP411535.

4.2 Maximum Tune-up Limit

Mode		Burst average power(dBm)	
		GSM 850	GSM 1900
GSM (GMSK, 1 Tx slot)		34.00	31.00
GPRS (GMSK, 1 Tx slot)		34.00	31.00
GPRS (GMSK, 2 Tx slots)		32.00	29.00
GPRS (GMSK, 3 Tx slots)		30.00	28.00
GPRS (GMSK, 4 Tx slots)		29.00	27.00
EDGE (8PSK, 1 Tx slot)		28.00	27.00
EDGE (8PSK, 2 Tx slots)		27.00	26.00
EDGE (8PSK, 3 Tx slots)		27.00	25.00
EDGE (8PSK, 4 Tx slots)		26.00	24.00
DTM 5	GSM (GMSK, 1 Tx slot)	32.00	29.00
	GPRS (GMSK, 1 Tx slot)	32.00	29.00
DTM 9	GSM (GMSK, 1 Tx slot)	32.00	29.00
	GPRS (GMSK, 1 Tx slot)	32.00	29.00
DTM 11	GSM (GMSK, 1 Tx slot)	30.00	28.00
	GPRS (GMSK, 2 Tx slots)	30.00	28.00
DTM 5	GSM (GMSK, 1 Tx slot)	32.00	29.00
	EDGE (8PSK, 1 Tx slot)	27.00	26.00
DTM 9	GSM (GMSK, 1 Tx slot)	32.00	29.00
	EDGE (8PSK, 1 Tx slot)	27.00	26.00
DTM 11	GSM (GMSK, 1 Tx slot)	30.00	28.00
	EDGE (8PSK, 2 Tx slots)	27.00	25.00

Mode	Average power(dBm)
	WCDMA Band V
AMR 12.2K	24.00
RMC 12.2K	24.00
HSDPA Subtest-1	24.00
DC-HSDPA Subtest-1	24.00
HSUPA Subtest-5	24.00

LTE Band 7				
Average Power (dBm)				
Modulation	BW (MHz)	RB size	MPR	Power
QPSK	20	≤ 18	0	24.00
QPSK	20	> 18	1	23.00
16QAM	20	≤ 18	1	23.00
16QAM	20	> 18	2	22.00
QPSK	15	≤ 16	0	24.00
QPSK	15	> 16	1	23.00
16QAM	15	≤ 16	1	23.00
16QAM	15	> 16	2	22.00
QPSK	10	≤ 12	0	24.00
QPSK	10	> 12	1	23.00
16QAM	10	≤ 12	1	23.00
16QAM	10	> 12	2	22.00
QPSK	5	≤ 8	0	24.00
QPSK	5	> 8	1	23.00
16QAM	5	≤ 8	1	23.00
16QAM	5	> 8	2	22.00

Mode		Maximum Average Power (dBm)
2.4GHz	802.11b	18.00
	802.11g	13.50
	802.11n-HT20	13.50
Bluetooth v3.0+HS		8.00
Bluetooth v4.0+LE		7.00

4.3 General LTE SAR Test and Reporting Considerations

Summarized necessary items addressed in KDB 941225 D05 v02r03	
FCC ID	NM80P9O200
Equipment Name	SMARTPHONE
Operating Frequency Range of each LTE transmission band	LTE Band 7: 2500 MHz ~ 2570 MHz
Channel Bandwidth	LTE Band 7: 5MHz, 10MHz, 15MHz, 20MHz
uplink modulations used	QPSK, and 16QAM
LTE transmitter and antenna implementation (standalone or sharing hardware components / antennas)	A primary antenna is used for LTE and other wireless interfaces (GSM/CDMA/WCDMA) for transmitting and receiving. LTE and other wireless interfaces (GSM/CDMA/WCDMA) share the same antenna, and cannot transmit simultaneously A 2nd antenna is used for LTE and other wireless interfaces (GSM/CDMA/WCDMA) for receiving only
LTE Voice / Data requirements	Data only
LTE MPR permanently built-in by design	Yes, per 3GPP TS 36.101 v11.0.0 (see Table 6.2.3-1 below)
LTE A-MPR	In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing and the LTE SAR tests was transmitting on all TTI frames (Maximum TTI)
Spectrum plots for RB configuration	A properly configured base station simulator was used for the SAR and power measurement; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3

Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

Transmission (H, M, L) channel numbers and frequencies in each LTE band

LTE Band 7								
	Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	20775	2502.5	20800	2505	20775	2502.5	20800	2505
M	21100	2535	21100	2535	21100	2535	21100	2535
H	21425	2567.5	21400	2565	21425	2567.5	21400	2565

5. RF Exposure Limits

5.1 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.

5.2 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

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

6. Specific Absorption Rate (SAR)

6.1 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.

6.2 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:

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

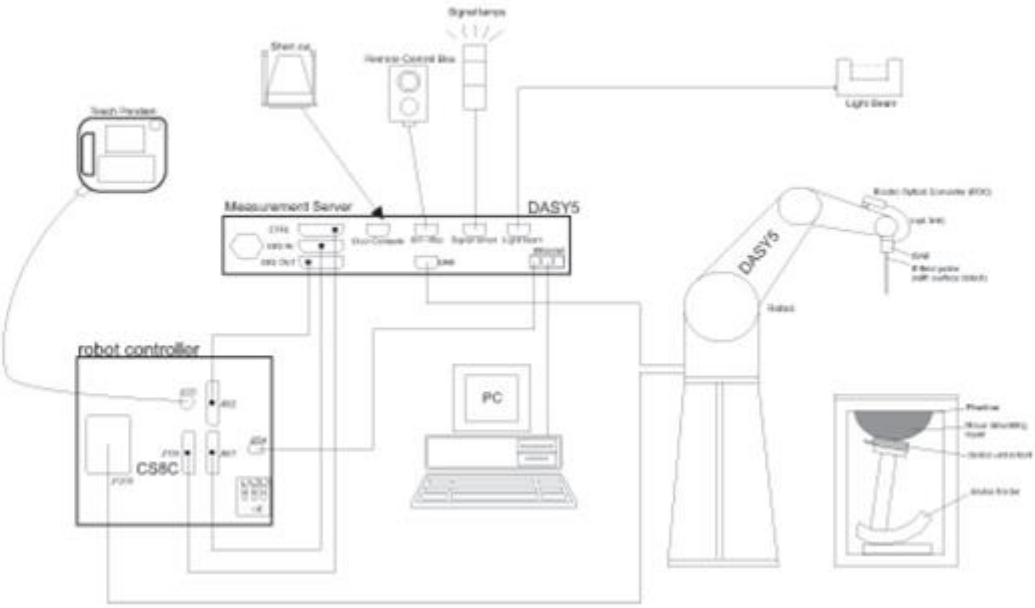
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. 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.

8. 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

8.1 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 form 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

8.2 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.

8.3 Area Scan

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

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

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

8.4 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 v01r01.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*
4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">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 reported SAR from the area scan based 1-g SAR estimation 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.</td></tr>
</table>

8.5 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.

8.6 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.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	4d162	Nov. 11, 2013	Nov. 10, 2014
SPEAG	1900MHz System Validation Kit	D1900V2	5d182	Nov. 12, 2013	Nov. 11, 2014
SPEAG	2450MHz System Validation Kit	D2450V2	924	Nov. 13, 2013	Nov. 12, 2014
SPEAG	2600MHz System Validation Kit	D2600V2	1070	Nov. 13, 2013	Nov. 12, 2014
SPEAG	Data Acquisition Electronics	DAE4	778	Aug. 21, 2013	Aug. 20, 2014
SPEAG	Data Acquisition Electronics	DAE4	1338	Nov. 05, 2013	Nov. 04, 2014
SPEAG	Data Acquisition Electronics	DAE3	495	May. 08, 2013	May. 07, 2014
SPEAG	Data Acquisition Electronics	DAE4	1399	Nov. 07, 2013	Nov. 06, 2014
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 24, 2013	Sep. 23, 2014
SPEAG	Dosimetric E-Field Probe	EX3DV4	3935	Nov. 04, 2013	Nov. 03, 2014
SPEAG	Dosimetric E-Field Probe	EX3DV4	3925	Jun. 12, 2013	Jun. 11, 2014
SPEAG	Dosimetric E-Field Probe	EX3DV4	3955	Nov. 12, 2013	Nov. 11, 2014
Wisewind	Thermometer	ETP-101	TM685	Oct. 22, 2013	Oct. 21, 2014
Wisewind	Thermometer	HTC-1	TM642	Oct. 22, 2013	Oct. 21, 2014
H.M.IRIS	Thermometer	TH-08	TM658	Oct. 22, 2013	Oct. 21, 2014
WonDer	Thermometer	WD-5015	TM225	Dec. 02, 2013	Dec. 01, 2014
Anritsu	Radio Communication Analyzer	MT8820C	6201074414	Feb. 11, 2014	Feb. 10, 2015
Agilent	Wireless Communication Test Set	E5515C	MY48360820	Jan. 10, 2014	Jan. 09, 2015
Agilent	Wireless Communication Test Set	E5515C	GB46311322	Mar. 25, 2013	Mar. 24, 2014
Agilent	Wireless Communication Test Set	E5515C	MY50266977	May. 06, 2013	May. 05, 2014
R&S	Radio communication Tester	CMW500	113998	Oct. 04, 2013	Oct. 03, 2014
SPEAG	Device Holder	N/A	N/A	NCR	NCR
R&S	Signal Generator	SMF 100A	101107	May. 27, 2013	May. 26, 2014
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Jul. 23, 2013	Jul. 22, 2014
Agilent	ENA Network Analyzer	E5071C	MY46316648	Feb. 07, 2014	Feb. 06, 2015
Anritsu	Power Meter	ML2495A	1349001	Dec. 04, 2013	Dec. 03, 2014
Anritsu	Power Sensor	MA2411B	1306099	Dec. 03, 2013	Dec. 02, 2014
Anritsu	Power Meter	ML2495A	1240001	Sep. 11, 2013	Sep. 10, 2014
Anritsu	Power Sensor	MA2411B	1207349	Sep. 11, 2013	Sep. 10, 2014
Agilent	Dual Directional Coupler	778D	50422	Note 2	
Woken	Attenuator 1	WK0602-XX	N/A	Note 2	
PE	Attenuator 2	PE7005-10	N/A	Note 2	
PE	Attenuator 3	PE7005- 3	N/A	Note 2	
AR	Power Amplifier	5S1G4M2	0328767	Note 3	
Mini-Circuits	Power Amplifier	ZVE-3W	162601250	Note 3	
Mini-Circuits	Power Amplifier	ZHL-42W+	13440021344	Note 3	
R&S	Spectrum Analyzer	FSP 7	101131	Jul. 09, 2013	Jul. 08, 2014

General Note:

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
3. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
4. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.

10. System Verification

10.1 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 (εr)
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
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
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
835	Head	22.5	0.926	43.385	0.90	41.50	2.89	4.54	±5	2014/1/21
835	Head	22.6	0.906	42.966	0.90	41.50	0.67	3.53	±5	2014/2/20
835	Body	22.5	0.963	54.539	0.97	55.20	-0.72	-1.20	±5	2014/1/20
835	Body	22.5	0.995	54.886	0.97	55.20	2.58	-0.57	±5	2014/2/20
1900	Head	22.3	1.450	38.500	1.40	40.00	3.57	-3.75	±5	2014/2/21
1900	Body	22.3	1.544	51.591	1.52	53.30	1.58	-3.21	±5	2014/2/21
2450	Head	22.3	1.839	39.306	1.80	39.20	2.17	0.27	±5	2014/3/3
2450	Body	22.3	1.973	54.161	1.95	52.70	1.18	2.77	±5	2014/3/3
2600	Head	22.5	1.970	38.084	1.96	39.00	0.51	-2.35	±5	2014/2/22
2600	Body	22.4	2.170	53.800	2.16	52.50	0.46	2.48	±5	2014/2/24

Table 8.2.1 Measuring Results for Simulating Liquid

10.2 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Table 8.3.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured SAR (W/kg)	Targeted SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
2014/1/21	835	Head	250	D835V2-4d162	3270	778	2.42	9.53	9.68	1.57
2014/2/20	835	Head	250	D835V2-4d162	3955	1399	2.32	9.53	9.28	-2.62
2014/1/20	835	Body	250	D835V2-4d162	3270	778	2.45	9.28	9.80	5.60
2014/2/20	835	Body	250	D835V2-4d162	3955	1399	2.41	9.28	9.64	3.88
2014/2/21	1900	Head	250	D1900V2-5d182	3925	495	10.30	40.10	41.20	2.74
2014/2/21	1900	Body	250	D1900V2-5d182	3955	1399	9.96	39.50	39.84	0.86
2014/3/3	2450	Head	250	D2450V2-924	3935	1338	13.50	52.40	54.00	3.05
2014/3/3	2450	Body	250	D2450V2-924	3925	495	12.50	50.20	50.00	-0.40
2014/2/22	2600	Head	250	D2600V2-1070	3955	1399	13.50	56.60	54.00	-4.59
2014/2/24	2600	Body	250	D2600V2-1070	3935	1338	14.00	55.70	56.00	0.54

Table 8.3.1 Target and Measurement SAR after Normalized

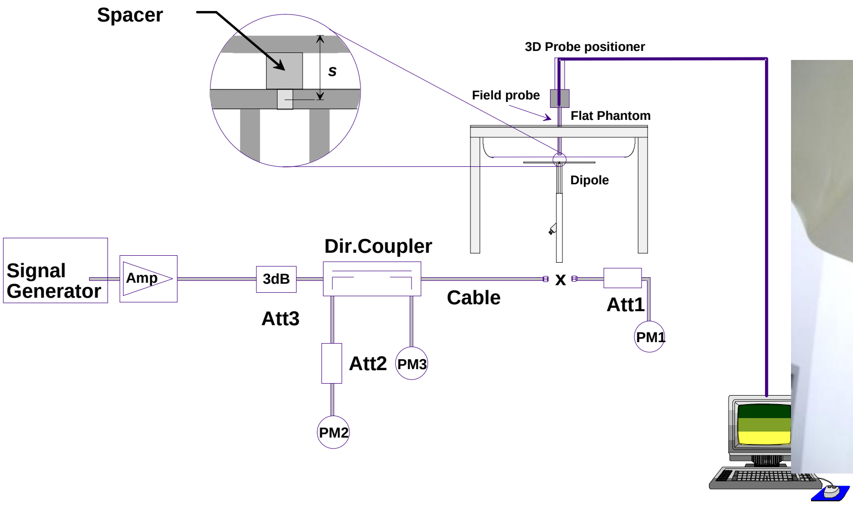


Fig 8.3.1 System Performance Check Setup **Fig 8.3.2 Setup Photo**

11. RF Exposure Positions

11.1 Ear and handset reference point

Figure 9.1.1 shows the front, back, and side views of the SAM phantom. The center-of-mouth reference point is labeled "M," the left ear reference point (ERP) is marked "LE," and the right ERP is marked "RE." Each ERP is 15 mm along the B-M (back-mouth) line behind the entrance-to-ear-canal (EEC) point, as shown in Figure 9.1.2 The Reference Plane is defined as passing through the two ear reference points and point M. The line N-F (neck-front), also called the reference pivoting line, is normal to the Reference Plane and perpendicular to both a line passing through RE and LE and the B-M line (see Figure 9.1.3). Both N-F and B-M lines should be marked on the exterior of the phantom shell to facilitate handset positioning. Posterior to the N-F line the ear shape is a flat surface with 6 mm thickness at each ERP, and forward of the N-F line the ear is truncated, as illustrated in Figure 9.1.2. The ear truncation is introduced to preclude the ear lobe from interfering with handset tilt, which could lead to unstable positioning at the cheek.

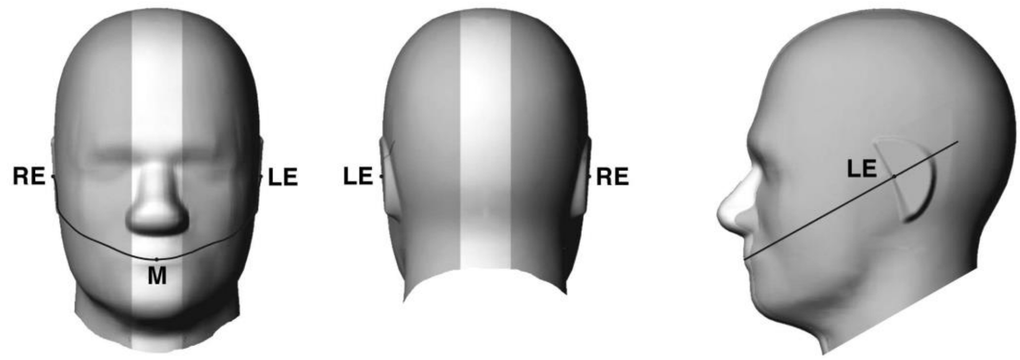


Fig 9.1.1 Front, back, and side views of SAM twin phantom

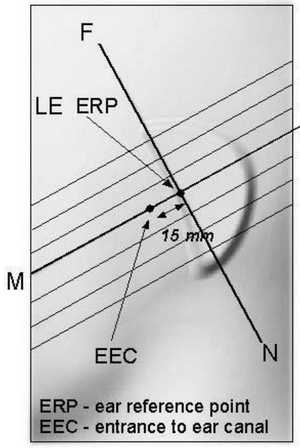


Fig 9.1.2 Close-up side view of phantom showing the ear region.

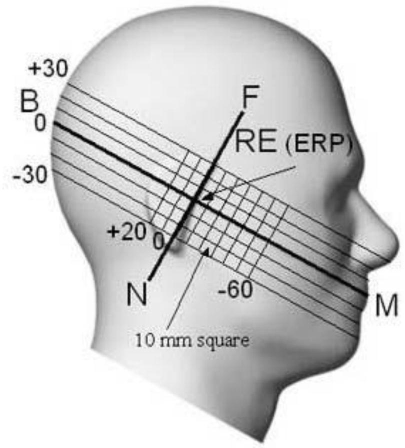


Fig 9.1.3 Side view of the phantom showing relevant markings and seven cross-sectional plane locations

11.2 Definition of the cheek position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. Define two imaginary lines on the handset—the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset—the midpoint of the width wt of the handset at the level of the acoustic output (point A in Figure 9.2.1 and Figure 9.2.2), and the midpoint of the width wb of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 9.2.1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 9.2.2), especially for clamshell handsets, handsets with flip covers, and other irregularly-shaped handsets.
3. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 9.2.3), such that the plane defined by the vertical centerline and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
4. Translate the handset towards the phantom along the line passing through RE and LE until handset point A touches the pinna at the ERP.
5. While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to the plane containing B-M and N-F lines, i.e., the Reference Plane.
6. Rotate the handset around the vertical centerline until the handset (horizontal line) is parallel to the N-F line.
7. While maintaining the vertical centerline in the Reference Plane, keeping point A on the line passing through RE and LE, and maintaining the handset contact with the pinna, rotate the handset about the N-F line until any point on the handset is in contact with a phantom point below the pinna on the cheek. See Figure 9.2.3. The actual rotation angles should be documented in the test report.

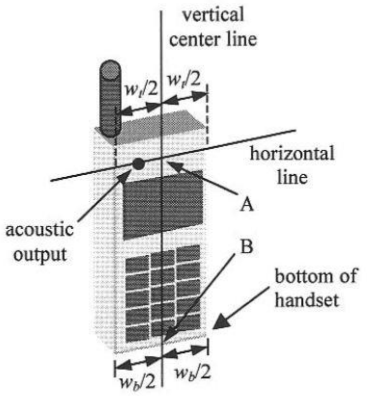


Fig 9.2.1 Handset vertical and horizontal reference lines—"fixed case

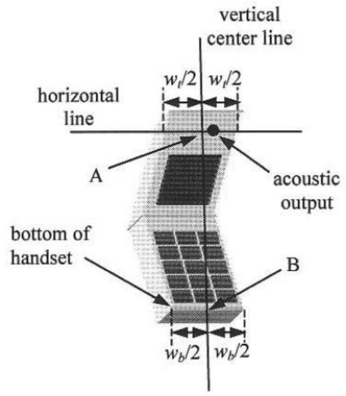


Fig 9.2.2 Handset vertical and horizontal reference lines—"clam-shell case"

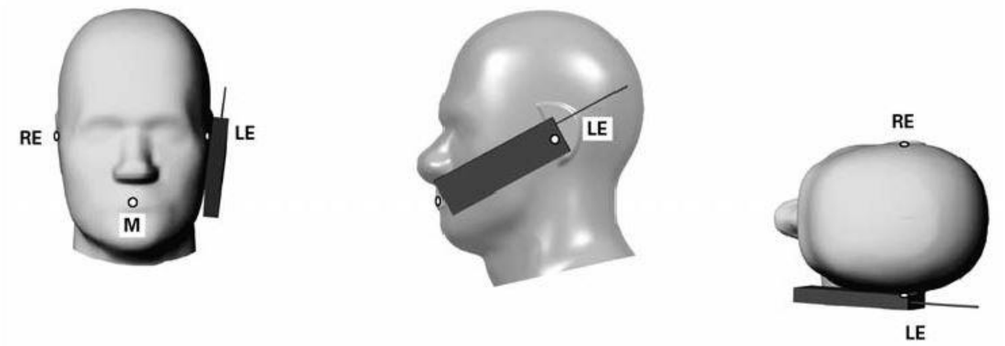


Fig 9.2.3 cheek or touch position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which establish the Reference Plane for handset positioning, are indicated.

11.3 Definition of the tilt position

1. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece (flip cover), open the cover. If the handset can transmit with the cover closed, both configurations must be tested.
2. While maintaining the orientation of the handset, move the handset away from the pinna along the line passing through RE and LE far enough to allow a rotation of the handset away from the cheek by 15°.
3. Rotate the handset around the horizontal line by 15°.
4. While maintaining the orientation of the handset, move the handset towards the phantom on the line passing through RE and LE until any part of the handset touches the ear. The tilt position is obtained when the contact point is on the pinna. See Figure 9.3.1. If contact occurs at any location other than the pinna, e.g., the antenna at the back of the phantom head, the angle of the handset should be reduced. In this case, the tilt position is obtained if any point on the handset is in contact with the pinna and a second point

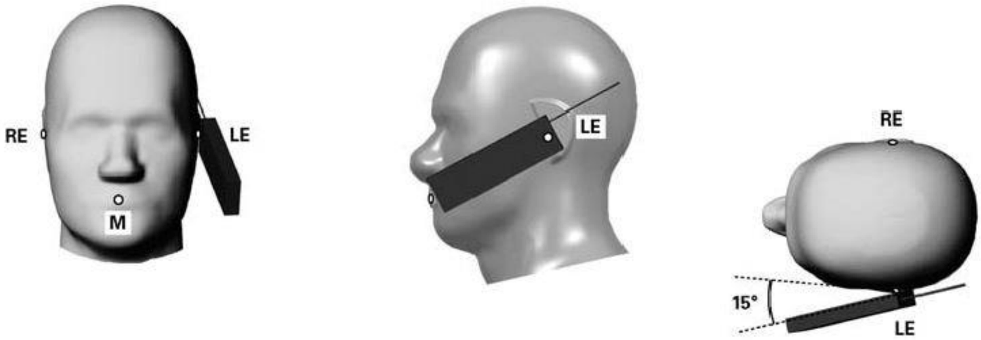


Fig 9.3.1 Tilt position. The reference points for the right ear (RE), left ear (LE), and mouth (M), which define the Reference Plane for handset positioning, are indicated.

11.4 Body Worn Accessory

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 9.4). Per KDB 648471 D04v01r01, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v05r02 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is < 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.

Accessories for body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

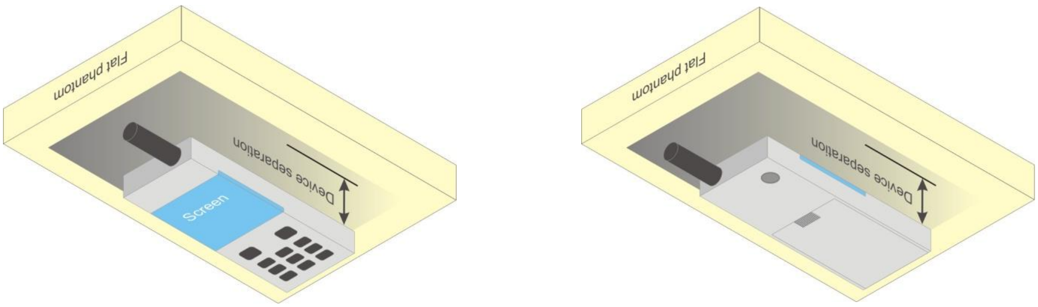


Fig 9.4 Body Worn Position

11.5 Wireless Router

Some battery-operated handsets have the capability to transmit and receive user through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC HDB Publication 941225 D06v01r01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10mm from the front, back and edges of the device containing transmitting antennas within 2.5cm of their edges, determined form general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05r02 publication procedures. The “Portable Hotspot” feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

12. Conducted RF Output Power (Unit: dBm)

<GSM Conducted Power>

General Note:

1. For DTM multi-slot class mode, the device was linked with base station simulator (Agilent E5515C) and transmit maximum power on maximum number of TX slots, i.e. one CS timeslot, and additional PS timeslots (1 for DTM class 5 and 9, 2 for DTM class 11) in one TDMA frame.
2. Agilent E5515C was used to setup the device operated under DTM mode for power measurement and SAR testing. For conducted power, the power of the burst for voice and the power of the bursts for data was reported separately in the table above, and the frame-average power is derived below to determine SAR testing.

   *DTM frame average power (dBm) = 10*log [∑(power of each slot, in mW)/8]*
3. Per KDB 447498 D01v05r02, the maximum output power channel is used for SAR testing and for further SAR test reduction.
4. According to October 2013TCB Workshop, For GSM / EGPRS, the number of time slots to test for SAR should correspond to the highest source-based time-averaged maximum output power configuration, Considering the possibility of e.g. 3rd party VoIP operation for head and body-worn SAR testing, the EUT was set in GPRS (2Tx slots) for GSM850 band and GPRS (4Tx slots) for GSM1900 band due to its highest frame-average power.
5. For hotspot mode SAR testing, GPRS / EDGE should be evaluated, therefore the EUT was set in GPRS 2 Tx slots for GSM850 band and GPRS 4 Tx slots for GSM1900 band due to its highest frame-average power.

Band GSM850		Burst Average Power (dBm)			Frame-Average Power (dBm)		
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)		33.44	33.45	33.37	24.44	24.45	24.37
GPRS (GMSK, 1 Tx slot)		33.48	33.50	33.41	24.48	24.50	24.41
GPRS (GMSK, 2 Tx slots)		31.48	31.55	31.40	25.48	25.55	25.40
GPRS (GMSK, 3 Tx slots)		29.12	29.15	29.10	24.86	24.89	24.84
GPRS (GMSK, 4 Tx slots)		28.09	28.10	28.06	25.09	25.10	25.06
EDGE (8PSK, 1 Tx slot)		26.88	26.92	26.85	17.88	17.92	17.85
EDGE (8PSK, 2 Tx slots)		25.86	25.92	25.82	19.86	19.92	19.82
EDGE (8PSK, 3 Tx slots)		25.58	25.62	25.54	21.32	21.36	21.28
EDGE (8PSK, 4 Tx slots)		24.47	24.58	24.43	21.47	21.58	21.43
DTM 5 (2Tx slots)	GSM (GMSK, 1 Tx slot)	31.28	31.40	31.24	25.04	25.17	25.00
	GPRS (GMSK, 1 Tx slot)	30.83	30.98	30.80			
DTM 9 (2Tx slots)	GSM (GMSK, 1 Tx slot)	31.23	31.40	31.16	25.01	25.18	24.95
	GPRS (GMSK, 1 Tx slot)	30.82	30.99	30.77			
DTM 11 (3Tx slots)	GSM (GMSK, 1 Tx slot)	28.74	28.79	28.70	24.24	24.30	24.21
	GPRS (GMSK, 2 Tx slots)	28.37	28.44	28.35			
DTM 5 (2Tx slots)	GSM (GMSK, 1 Tx slot)	30.89	31.08	30.75	22.99	23.15	22.88
	EDGE (8PSK, 1 Tx slot)	25.64	25.67	25.61			
DTM 9 (2Tx slots)	GSM (GMSK, 1 Tx slot)	31.20	31.42	31.06	23.16	23.35	23.04
	EDGE (8PSK, 1 Tx slot)	25.28	25.35	25.24			
DTM 11 (3Tx slots)	GSM (GMSK, 1 Tx slot)	28.49	28.61	28.42	22.34	22.42	22.27
	EDGE (8PSK, 2 Tx slots)	25.22	25.26	25.14			

Band GSM1900		Burst Average Power (dBm)			Frame-Average Power (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)		30.52	30.56	30.63	21.52	21.56	21.63
GPRS (GMSK, 1 Tx slot)		30.48	30.53	30.61	21.48	21.53	21.61
GPRS (GMSK, 2 Tx slots)		28.91	28.89	28.95	22.91	22.89	22.95
GPRS (GMSK, 3 Tx slots)		27.04	27.09	27.12	22.78	22.83	22.86
GPRS (GMSK, 4 Tx slots)		25.91	25.94	25.99	22.91	22.94	22.99
EDGE (8PSK, 1 Tx slot)		26.04	26.05	26.07	17.04	17.05	17.07
EDGE (8PSK, 2 Tx slots)		25.31	25.36	25.37	19.31	19.36	19.37
EDGE (8PSK, 3 Tx slots)		24.06	24.10	24.13	19.80	19.84	19.87
EDGE (8PSK, 4 Tx slots)		23.07	23.10	23.12	20.07	20.10	20.12
DTM 5 (2Tx slots)	GSM (GMSK, 1 Tx slot)	28.91	28.96	28.99	22.76	22.81	22.85
	GPRS (GMSK, 1 Tx slot)	28.64	28.70	28.74			
DTM 9 (2Tx slots)	GSM (GMSK, 1 Tx slot)	28.84	28.89	28.94	22.71	22.75	22.78
	GPRS (GMSK, 1 Tx slot)	28.62	28.64	28.65			
DTM 11 (3Tx slots)	GSM (GMSK, 1 Tx slot)	26.91	26.98	27.09	22.44	22.50	22.62
	GPRS (GMSK, 2 Tx slots)	26.59	26.65	26.77			
DTM 5 (2Tx slots)	GSM (GMSK, 1 Tx slot)	28.62	28.66	28.71	21.19	21.22	21.27
	EDGE (8PSK, 1 Tx slot)	25.10	25.13	25.16			
DTM 9 (2Tx slots)	GSM (GMSK, 1 Tx slot)	28.61	28.64	28.70	21.18	21.20	21.25
	EDGE (8PSK, 1 Tx slot)	25.09	25.10	25.14			
DTM 11 (3Tx slots)	GSM (GMSK, 1 Tx slot)	26.65	26.69	26.78	20.72	20.75	20.82
	EDGE (8PSK, 2 Tx slots)	23.81	23.83	23.89			

<WCDMA Conducted Power>

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.

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} (Note1, 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: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_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 Δ_{NACK} = 30/15 with β_{hs} = 30/15 * β_c , and Δ_{CQI} = 24/15 with β_{hs} = 24/15 * β_c .

Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, 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 β_c = 11/15 and β_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-TFCI
   viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
d. The transmitted maximum output power was recorded.

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} *(Note1)*	β_{ec}	β_{ed} *(Note 5) (Note 6)*	β_{ed} *(SF)*	β_{ed} *(Codes)*	CM *(dB) (Note 2)*	MPR *(dB) (Note 2)*	*AG Index (Note 6)*	*E-TFCI*
1	11/15 *(Note 3)*	15/15 *(Note 3)*	64	11/15 *(Note 3)*	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed}1: 47/15 β_{ed}2: 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: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c .

Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_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 β_c = 10/15 and β_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 β_c = 14/15 and β_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

DC-HSDPA 3GPP release 8 Setup Configuration:

a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration below
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 RMC 12.2Kbps + HSDPA mode.
   ii. Set Cell Power = -25 dBm
   iii. Set HS-DSCH Configuration Type to FRC (H-set 12, QPSK)
   iv. Select HSDPA Uplink Parameters
   v. Set Gain Factors (β_c and β_d) and parameters were set according to each Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
      a). Subtest 1: β_c/β_d=2/15
      b). Subtest 2: β_c/β_d=12/15
      c). Subtest 3: β_c/β_d=15/8
      d). Subtest 4: β_c/β_d=15/4
   vi. Set Delta ACK, Delta NACK and Delta CQI = 8
   vii. Set Ack-Nack Repetition Factor to 3
   viii. Set CQI Feedback Cycle (k) to 4 ms
   ix. Set CQI Repetition Factor to 2
   x. Power Ctrl Mode = All Up bits
d. The transmitted maximum output power was recorded.

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification.
A summary of these settings are illustrated below:

C.8.1.12 Fixed Reference Channel Definition H-Set 12

Table C.8.1.12: Fixed Reference Channel H-Set 12

Parameter	Unit	Value
Nominal Avg. Inf. Bit Rate	kbps	60
Inter-TTI Distance	TTI's	1
Number of HARQ Processes	Processes	6
Information Bit Payload (N_{INF})	Bits	120
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bits	960
Total Available SML's in UE	SML's	19200
Number of SML's per HARQ Proc.	SML's	3200
Coding Rate		0.15
Number of Physical Channel Codes	Codes	1
Modulation		QPSK
Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table. Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.		

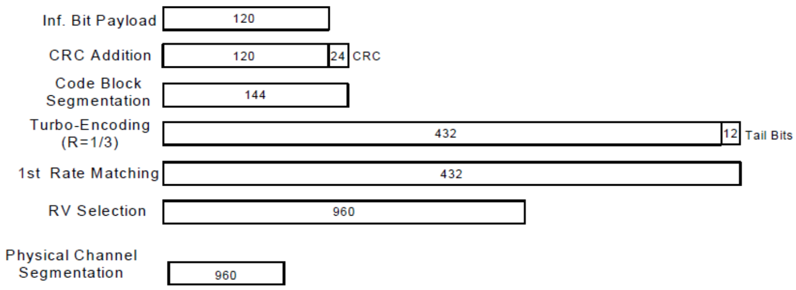


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

Setup Configuration

<WCDMA Conducted Power>

General Note:

1. Per KDB 941225 D02v02r02, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA/DC-HSDPA output power is < 0.25dB higher than RMC, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA/DC-HSDPA SAR evaluation can be excluded.

Band			WCDMA V		
TX Channel			4132	4182	4233
Frequency (MHz)			826.4	836.4	846.6
MPR(dB)	3GPP Rel 99	AMR 12.2Kbps	23.62	23.69	23.64
	3GPP Rel 99	RMC 12.2Kbps	23.65	23.70	23.66
0	3GPP Rel 6	HSDPA Subtest-1	22.76	22.81	22.71
0	3GPP Rel 6	HSDPA Subtest-2	22.71	22.73	22.69
0.5	3GPP Rel 6	HSDPA Subtest-3	22.29	22.28	22.34
0.5	3GPP Rel 6	HSDPA Subtest-4	22.26	22.25	22.28
0	3GPP Rel 8	DC-HSDPA Subtest-1	22.75	22.79	22.69
0	3GPP Rel 8	DC-HSDPA Subtest-2	22.74	22.76	22.67
0.5	3GPP Rel 8	DC-HSDPA Subtest-3	22.27	22.26	22.31
0.5	3GPP Rel 8	DC-HSDPA Subtest-4	22.22	22.23	22.26
0	3GPP Rel 6	HSUPA Subtest-1	22.38	22.24	22.32
2	3GPP Rel 6	HSUPA Subtest-2	21.78	21.72	21.69
1	3GPP Rel 6	HSUPA Subtest-3	21.42	21.38	21.35
2	3GPP Rel 6	HSUPA Subtest-4	21.86	21.82	21.79
0	3GPP Rel 6	HSUPA Subtest-5	22.81	22.77	22.72

<LTE Conducted Power>

General Note:

1. Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.
2. Per KDB 941225 D05v02r03, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.
3. Per KDB 941225 D05v02r03, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.
4. Per KDB 941225 D05v02r03, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05v02r03, when reported SAR of 1RB and 50%RB allocation for QPSK ≤0.8W/kg, and 100%RB with QPSK output power is less than 1RB and 50%RB, 100%RB allocation for QPSK is not required.
6. Per KDB 941225 D05v02r03, when reported SAR of 1RB and 50%RB allocation for QPSK >0.8W/kg for any exposure position, SAR testing of 100%RB allocation for QPSK is performed at the highest power channel.
7. 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, 16QAM SAR testing is not required.
8. Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, smaller bandwidth SAR testing is not required.

<LTE Band 7>

BW [MHz]	Modulation	RB Size	RB Offset	Power Low Ch. / Freq.	Power Middle Ch. / Freq.	Power High Ch. / Freq.	Tune up Limit (dBm)	MPR (dB)
Channel				20850	21100	21350		
Frequency (MHz)				2510	2535	2560		
20	QPSK	1	0	22.85	22.98	22.83	24.00	0
20	QPSK	1	49	22.91	22.85	22.93		
20	QPSK	1	99	22.93	22.87	22.90		
20	QPSK	50	0	21.93	21.99	21.96	23.00	1
20	QPSK	50	24	21.98	21.94	21.96		
20	QPSK	50	49	21.93	21.95	21.98		
20	QPSK	100	0	21.96	21.97	21.94		
20	16QAM	1	0	21.85	21.85	21.83	23.00	1
20	16QAM	1	49	21.84	21.83	21.89		
20	16QAM	1	99	21.83	21.84	21.86		
20	16QAM	50	0	20.92	20.99	20.95	22.00	2
20	16QAM	50	24	20.94	20.96	20.95		
20	16QAM	50	49	20.93	20.94	20.92		
20	16QAM	100	0	20.95	20.99	21.00		

Channel				20825	21100	21375	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				2507.5	2535	2562.5		
15	QPSK	1	0	22.88	22.91	22.92	24.00	0
15	QPSK	1	37	22.87	22.88	22.88		
15	QPSK	1	74	22.87	22.96	22.95		
15	QPSK	36	0	21.96	21.96	21.94	23.00	1
15	QPSK	36	18	21.96	21.96	21.96		
15	QPSK	36	37	21.94	21.95	21.98		
15	QPSK	75	0	21.99	21.99	22.00		
15	16QAM	1	0	21.86	21.91	21.96	23.00	1
15	16QAM	1	37	21.85	21.88	21.88		
15	16QAM	1	74	21.84	21.96	21.91		
15	16QAM	36	0	20.91	20.98	20.97	22.00	2
15	16QAM	36	18	20.91	20.99	20.97		
15	16QAM	36	37	20.95	20.95	20.95		
15	16QAM	75	0	20.98	21.00	20.89		
Channel				20800	21100	21400	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				2505	2535	2565		
10	QPSK	1	0	22.91	22.95	22.95	24.00	0
10	QPSK	1	24	22.88	22.89	22.87		
10	QPSK	1	49	22.94	22.96	22.93		
10	QPSK	25	0	21.92	22.00	21.99	23.00	1
10	QPSK	25	12	21.92	22.00	22.00		
10	QPSK	25	24	21.93	21.99	21.99		
10	QPSK	50	0	21.99	21.98	21.92		
10	16QAM	1	0	21.86	21.99	21.88	23.00	1
10	16QAM	1	24	21.84	21.90	21.86		
10	16QAM	1	49	21.90	21.96	21.95		
10	16QAM	25	0	20.96	20.96	20.94	22.00	2
10	16QAM	25	12	20.95	20.94	20.95		
10	16QAM	25	24	20.95	20.97	20.98		
10	16QAM	50	0	20.96	20.91	20.97		
Channel				20775	21100	21425	Tune up Limit (dBm)	MPR (dB)
Frequency (MHz)				2502.5	2535	2567.5		
5	QPSK	1	0	22.88	22.97	22.87	24.00	0
5	QPSK	1	12	22.87	22.96	22.86		
5	QPSK	1	24	22.92	22.94	22.94		
5	QPSK	12	0	21.97	21.95	21.96	23.00	1
5	QPSK	12	6	22.00	21.96	21.97		
5	QPSK	12	11	21.94	21.94	21.95		
5	QPSK	25	0	21.97	21.99	21.94		
5	16QAM	1	0	21.88	21.97	21.87	23.00	1
5	16QAM	1	12	21.84	21.87	21.89		
5	16QAM	1	24	21.94	21.91	21.91		
5	16QAM	12	0	21.00	20.94	20.94	22.00	2
5	16QAM	12	6	20.99	20.91	20.95		
5	16QAM	12	11	21.00	20.87	20.96		
5	16QAM	25	0	21.00	20.85	20.92		

<WLAN Conducted Power>

General Note:

1. 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 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.

<2.4GHz WLAN>

WLAN 2.4GHz 802.11b Average Power (dBm)					
Power vs. Channel			Power vs. Data Rate		
Channel	Frequency (MHz)	Data Rate 1Mbps	2Mbps	5.5Mbps	11Mbps
CH 1	2412	17.99	17.76	17.76	17.84
CH 6	2437	17.28			
CH 11	2462	17.86			

WLAN 2.4GHz 802.11g Average Power (dBm)									
Power vs. Channel			Power vs. Data Rate						
Channel	Frequency (MHz)	Data Rate 6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
CH 1	2412	13.06	13.02	12.97	12.89	13.03	13.01	12.99	12.98
CH 6	2437	11.82							
CH 11	2462	12.61							

WLAN 2.4GHz 802.11n-HT20 Average Power (dBm)									
Power vs. Channel			Power vs. MCS Index						
Channel	Frequency (MHz)	MCS Index MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
CH 1	2412	13.15	13.10	13.03	12.96	13.09	13.04	13.06	12.91
CH 6	2437	11.92							
CH 11	2462	12.78							

13. Bluetooth Exclusions Applied

Mode Band	Average power(dBm)	
	Bluetooth v3.0+HS	Bluetooth v4.0+LE
2.4GHz Bluetooth	8.0	7.0

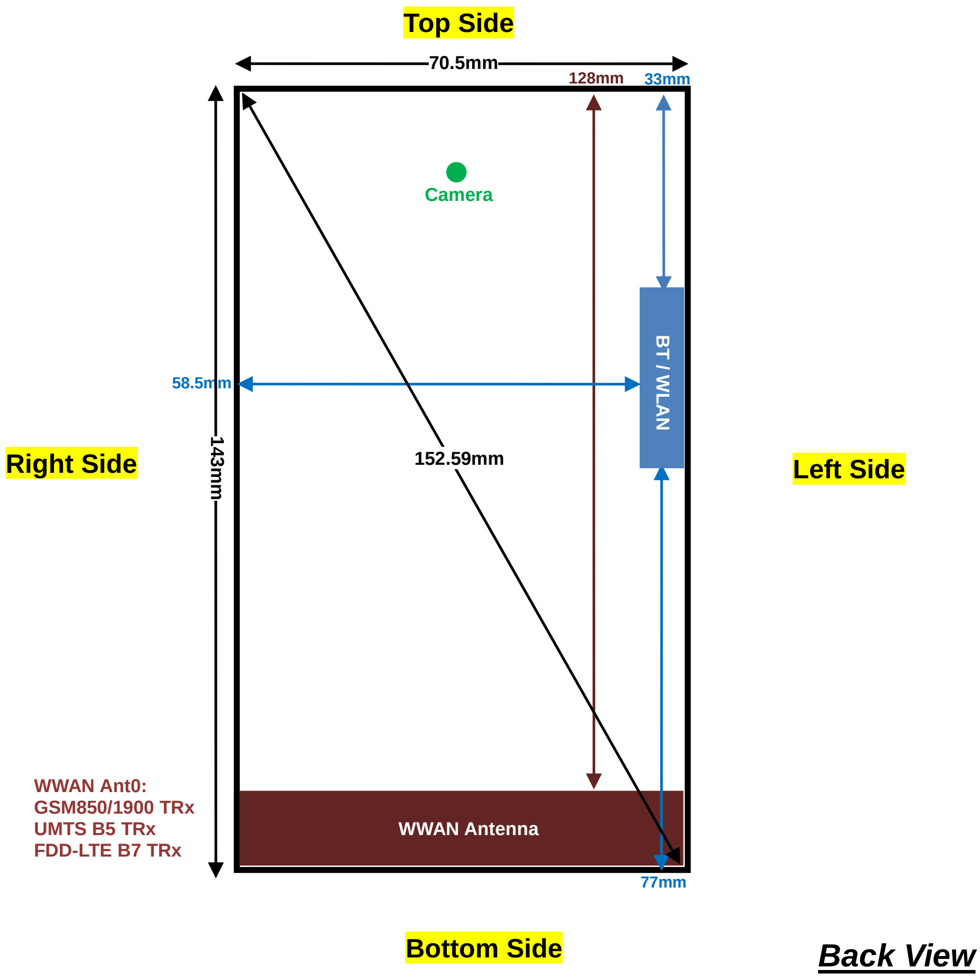
Note:

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:
   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[$\sqrt{f(GHz)}$] ≤ 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

Bluetooth Max Power (dBm)	Test Distance (mm)	Frequency (GHz)	exclusion thresholds
8.0	5	2.48	1.89

2. Per KDB 447498 D01v05r02 exclusion thresholds is 1.89 < 3, RF exposure evaluation is not required.

14. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Antenna	≤ 25mm	≤ 25mm	128mm	≤ 25mm	≤ 25mm	≤ 25mm
BT / WLAN	≤ 25mm	≤ 25mm	33mm	77mm	58.5mm	≤ 25mm
Positions for SAR tests; Hotspot mode						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Antenna	Yes	Yes	No	Yes	Yes	Yes
BT&WLAN	Yes	Yes	No	No	No	Yes

Note:

1. Referring to KDB 941225 D06 v01r01, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

15. SAR Test Results

General Note:

1. Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
    a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
    b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
    c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
    d. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v05r02, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
    - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
    - ≤ 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
3. Per KDB 648474 D04v01r02, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤ 1.2 W/kg, SAR testing with a headset connected to the handset is not required.
4. Per KDB 941225 D02v02r02, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA/DC-HSDPA output power is < 0.25dB higher than RMC, or reported SAR with RMC 12.2kbps setting is ≤ 1.2W/kg, HSDPA/HSUPA/DC-HSDPA SAR evaluation can be excluded..
5. Per KDB 941225 D05v02r03, when reported SAR of 1RB and 50%RB allocation for QPSK ≤0.8W/kg, and 100%RB with QPSK output power is less than 1RB and 50%RB, 100%RB allocation for QPSK is not required.
6. Per KDB 941225 D05v02r03, when reported SAR of 1RB and 50%RB allocation for QPSK >0.8W/kg for any exposure position, SAR testing of 100%RB allocation for QPSK is performed at the highest power channel.
7. 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, 16QAM SAR testing is not required.
8. Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, smaller bandwidth SAR testing is not required.
9. When the WLAN transmission was verified using a spectrum analyzer.

15.1 Head SAR

<GSM SAR>

Plot No.	Band	Mode	Test Position	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)	Right Cheek	189	836.4	31.55	32	1.109	0	0.243	0.270
	GSM850	GPRS (2 Tx slots)	Right Tilted	189	836.4	31.55	32	1.109	0.14	0.146	0.162
01	GSM850	GPRS (2 Tx slots)	Left Cheek	189	836.4	31.55	32	1.109	-0.05	0.257	0.285
	GSM850	GPRS (2 Tx slots)	Left Tilted	189	836.4	31.55	32	1.109	0.06	0.148	0.164
	GSM1900	GPRS (4 Tx slots)	Right Cheek	810	1909.8	25.99	27	1.262	-0.071	0.118	0.149
	GSM1900	GPRS (4 Tx slots)	Right Tilted	810	1909.8	25.99	27	1.262	0.074	0.086	0.109
02	GSM1900	GPRS (4 Tx slots)	Left Cheek	810	1909.8	25.99	27	1.262	0.106	0.235	0.297
	GSM1900	GPRS (4 Tx slots)	Left Tilted	810	1909.8	25.99	27	1.262	0.059	0.067	0.085

<WCDMA SAR>

Plot No.	Band	Mode	Test Position	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 V	RMC 12.2Kbps	Right Cheek	4182	836.4	23.7	24	1.072	0.08	0.167	0.179
	WCDMA V	RMC 12.2Kbps	Right Tilted	4182	836.4	23.7	24	1.072	0.07	0.093	0.100
03	WCDMA V	RMC 12.2Kbps	Left Cheek	4182	836.4	23.7	24	1.072	0	0.180	**0.193**
	WCDMA V	RMC 12.2Kbps	Left Tilted	4182	836.4	23.7	24	1.072	-0.01	0.125	0.134

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	Test Position	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)
	LTE Band 7	20M	QPSK	1	0	Right Cheek	21100	2535	22.98	24	1.265	0.05	0.229	0.290
	LTE Band 7	20M	QPSK	50	0	Right Cheek	21100	2535	21.99	23	1.262	0.1	0.190	0.240
	LTE Band 7	20M	QPSK	1	0	Right Tilted	21100	2535	22.98	24	1.265	0.13	0.148	0.187
	LTE Band 7	20M	QPSK	50	0	Right Tilted	21100	2535	21.99	23	1.262	-0.16	0.111	0.140
04	LTE Band 7	20M	QPSK	1	0	Left Cheek	21100	2535	22.98	24	1.265	0.14	0.402	**0.508**
	LTE Band 7	20M	QPSK	50	0	Left Cheek	21100	2535	21.99	23	1.262	-0.14	0.338	0.426
	LTE Band 7	20M	QPSK	1	0	Left Tilted	21100	2535	22.98	24	1.265	0.19	0.083	0.105
	LTE Band 7	20M	QPSK	50	0	Left Tilted	21100	2535	21.99	23	1.262	0.14	0.067	0.085

<DTS WLAN SAR>

Plot No.	Band	Mode	Test Position	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
05	WLAN2.4GHz	802.11b 1Mbps	Right Cheek	1	2412	17.99	18	1.002	97.63	1.024	-0.02	0.230	**0.236**
	WLAN2.4GHz	802.11b 1Mbps	Right Tilted	1	2412	17.99	18	1.002	97.63	1.024	-0.03	0.100	0.103
	WLAN2.4GHz	802.11b 1Mbps	Left Cheek	1	2412	17.99	18	1.002	97.63	1.024	0	0.104	0.107
	WLAN2.4GHz	802.11b 1Mbps	Left Tilted	1	2412	17.99	18	1.002	97.63	1.024	0.04	0.062	0.064

15.2 Hotspot SAR

Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Antenna	≤ 25mm	≤ 25mm	128mm	≤ 25mm	≤ 25mm	≤ 25mm
BT / WLAN	≤ 25mm	≤ 25mm	33mm	77mm	58.5mm	≤ 25mm
Positions for SAR tests; Hotspot mode						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Antenna	Yes	Yes	No	Yes	Yes	Yes
BT&WLAN	Yes	Yes	No	No	No	Yes

Note:

1. Referring to KDB 941225 D06 v01r01, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10 mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

<GSM 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)
	GSM850	GPRS (2 Tx slots)	Front	1cm	189	836.4	31.55	32	1.109	-0.02	0.329	0.365
06	GSM850	GPRS (2 Tx slots)	Back	1cm	189	836.4	31.55	32	1.109	-0.05	0.435	0.482
	GSM850	GPRS (2 Tx slots)	Left Side	1cm	189	836.4	31.55	32	1.109	-0.07	0.271	0.301
	GSM850	GPRS (2 Tx slots)	Right Side	1cm	189	836.4	31.55	32	1.109	-0.01	0.153	0.170
	GSM850	GPRS (2 Tx slots)	Bottom Side	1cm	189	836.4	31.55	32	1.109	0.01	0.121	0.134
	GSM1900	GPRS (4 Tx slots)	Front	1cm	810	1909.8	25.99	27	1.262	-0.04	0.305	0.385
07	GSM1900	GPRS (4 Tx slots)	Back	1cm	810	1909.8	25.99	27	1.262	0	0.553	0.698
	GSM1900	GPRS (4 Tx slots)	Left Side	1cm	810	1909.8	25.99	27	1.262	0.01	0.178	0.225
	GSM1900	GPRS (4 Tx slots)	Right Side	1cm	810	1909.8	25.99	27	1.262	0.19	0.012	0.015
	GSM1900	GPRS (4 Tx slots)	Bottom Side	1cm	810	1909.8	25.99	27	1.262	0.09	0.311	0.392

<WCDMA 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)
	WCDMA V	RMC 12.2Kbps	Front	1cm	4182	836.4	23.7	24	1.072	0.04	0.259	0.278
08	WCDMA V	RMC 12.2Kbps	Back	1cm	4182	836.4	23.7	24	1.072	0.03	0.340	0.364
	WCDMA V	RMC 12.2Kbps	Left Side	1cm	4182	836.4	23.7	24	1.072	0.16	0.237	0.254
	WCDMA V	RMC 12.2Kbps	Right Side	1cm	4182	836.4	23.7	24	1.072	0.08	0.260	0.279
	WCDMA V	RMC 12.2Kbps	Bottom Side	1cm	4182	836.4	23.7	24	1.072	-0.02	0.091	0.098

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	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)
	LTE Band 7	20M	QPSK	1	0	Front	1cm	21100	2535	22.98	24	1.265	0.095	0.410	0.519
	LTE Band 7	20M	QPSK	50	0	Front	1cm	21100	2535	21.99	23	1.262	-0.087	0.329	0.415
	LTE Band 7	20M	QPSK	1	0	Back	1cm	21100	2535	22.98	24	1.265	-0.104	0.779	0.985
09	LTE Band 7	20M	QPSK	1	0	Back	1cm	20850	2510	22.85	24	1.303	-0.037	0.889	**1.159**
	LTE Band 7	20M	QPSK	1	0	Back	1cm	21350	2560	22.83	24	1.309	-0.192	0.793	1.038
	LTE Band 7	20M	QPSK	50	0	Back	1cm	21100	2535	21.99	23	1.262	-0.041	0.600	0.757
	LTE Band 7	20M	QPSK	100	0	Back	1cm	21100	2535	21.97	23	1.268	-0.053	0.584	0.740
	LTE Band 7	20M	QPSK	1	0	Left Side	1cm	21100	2535	22.98	24	1.265	0.094	0.264	0.334
	LTE Band 7	20M	QPSK	50	0	Left Side	1cm	21100	2535	21.99	23	1.262	-0.048	0.210	0.265
	LTE Band 7	20M	QPSK	1	0	Right Side	1cm	21100	2535	21.99	23	1.262	-0.184	0.017	0.021
	LTE Band 7	20M	QPSK	50	0	Right Side	1cm	21100	2535	22.98	24	1.265	-0.17	0.00676	0.009
	LTE Band 7	20M	QPSK	1	0	Bottom Side	1cm	21100	2535	22.98	24	1.265	-0.02	0.698	0.883
	LTE Band 7	20M	QPSK	1	0	Bottom Side	1cm	20850	2510	22.85	24	1.303	-0.18	0.636	0.829
	LTE Band 7	20M	QPSK	1	0	Bottom Side	1cm	21350	2560	22.83	24	1.309	-0.011	0.689	0.902
	LTE Band 7	20M	QPSK	50	0	Bottom Side	1cm	21100	2535	21.99	23	1.262	0.003	0.591	0.746
	LTE Band 7	20M	QPSK	100	0	Bottom Side	1cm	21100	2535	21.97	23	1.268	-0.09	0.570	0.723

<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	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	1cm	1	2412	17.99	18	1.002	97.63	1.024	0.06	0.061	0.063
10	WLAN2.4GHz	802.11b 1Mbps	Back	1cm	1	2412	17.99	18	1.002	97.63	1.024	0	0.480	**0.493**
	WLAN2.4GHz	802.11b 1Mbps	Left Side	1cm	1	2412	17.99	18	1.002	97.63	1.024	-0.02	0.259	0.266

15.3 Body Worn Accessory SAR

<GSM 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)
	GSM850	GPRS (2 Tx slots)	Front	1cm	189	836.4	31.55	32	1.109	-0.02	0.329	0.365
11	GSM850	GPRS (2 Tx slots)	Back	1cm	189	836.4	31.55	32	1.109	-0.05	0.435	**0.482**
	GSM1900	GPRS (4 Tx slots)	Front	1cm	810	1909.8	25.99	27	1.262	-0.04	0.305	0.385
12	GSM1900	GPRS (4 Tx slots)	Back	1cm	810	1909.8	25.99	27	1.262	0	0.553	**0.698**

<WCDMA 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)
	WCDMA V	RMC 12.2Kbps	Front	1cm	4182	836.4	23.7	24	1.072	0.04	0.259	0.278
13	WCDMA V	RMC 12.2Kbps	Back	1cm	4182	836.4	23.7	24	1.072	0.03	0.340	**0.364**

<LTE SAR>

Plot No.	Band	BW (MHz)	Modulation	RB Size	RB offset	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)
	LTE Band 7	20M	QPSK	1	0	Front	1cm	21100	2535	22.98	24	1.265	0.095	0.410	0.519
	LTE Band 7	20M	QPSK	50	0	Front	1cm	21100	2535	21.99	23	1.262	-0.087	0.329	0.415
	LTE Band 7	20M	QPSK	1	0	Back	1cm	21100	2535	22.98	24	1.265	-0.104	0.779	0.985
14	LTE Band 7	20M	QPSK	1	0	Back	1cm	20850	2510	22.85	24	1.303	-0.037	0.889	**1.159**
	LTE Band 7	20M	QPSK	1	0	Back	1cm	20850	2510	22.85	24	1.303	0	0.806	1.050
	LTE Band 7	20M	QPSK	1	0	Back	1cm	21350	2560	22.83	24	1.309	-0.192	0.793	1.038
	LTE Band 7	20M	QPSK	50	0	Back	1cm	21100	2535	21.99	23	1.262	-0.041	0.600	0.757
	LTE Band 7	20M	QPSK	100	0	Back	1cm	21100	2535	21.97	23	1.268	-0.053	0.584	0.740

<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	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	1cm	1	2412	17.99	18	1.002	97.63	1.024	0.06	0.061	0.063
15	WLAN2.4GHz	802.11b 1Mbps	Back	1cm	1	2412	17.99	18	1.002	97.63	1.024	0	0.480	**0.493**

15.4 Repeated SAR Measurement

No.	Band	BW (MHz)	Modulation	RB Size	RB offset	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)	Ratio	Reported 1g SAR (W/kg)
1st	LTE Band 7	20M	QPSK	1	0	Back	1cm	20850	2510	22.85	24	1.303	-0.037	0.889	-	1.159
2nd	LTE Band 7	20M	QPSK	1	0	Back	1cm	20850	2510	22.85	24	1.303	0	0.806	1.10	1.050

General Note:

1. Per KDB 865664 D01v01r03, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg
2. Per KDB 865664 D01v01r03, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/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	Portable Handset			Note
		Head	Body-worn	Hotspot	
1.	GSM(Voice) + WLAN2.4GHz(data)	Yes	Yes		
2.	WCDMA(Voice) + WLAN2.4GHz(data)	Yes	Yes		
3.	GSM(Voice) + Bluetooth(data)	Yes	Yes		
4.	WCDMA((Voice) + Bluetooth(data)	Yes	Yes		
5.	GPRS/EDGE(Data) + WLAN2.4GHz(data)	Yes	Yes	Yes	2.4GHz Hotspot
6.	WCDMA(Data) + WLAN2.4GHz(data)	Yes	Yes	Yes	2.4GHz Hotspot
7.	LTE(Data) + WLAN2.4GHz(data)	Yes	Yes	Yes	2.4GHz Hotspot
8.	GPRS/EDGE(Data) + Bluetooth(data)	Yes	Yes	Yes	Bluetooth Tethering
9.	WCDMA(Data) + Bluetooth(data)	Yes	Yes	Yes	Bluetooth Tethering
10.	LTE(Data) + Bluetooth(data)	Yes	Yes	Yes	Bluetooth Tethering

General Note:

1. This device supported VoIP in EGPRS, WCDMA, LTE (e.g. 3rd party VoIP).
2. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
3. The Scaled SAR summation is calculated based on the same configuration and test position.
4. Per KDB 447498 D01v05r02, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = (SAR1 + SAR2)1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg
   v) The SPLSR calculated results please refer to section 16.4.
5. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r02 based on the formula below.
   i) (*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[$\sqrt{f(GHz)}/x$] W/kg for *test separation distances* ≤ 50 mm; where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
   ii) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
   iii) 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.

Bluetooth Max Power	Exposure Position	Head	Hotspot / Body worn
	Test separation	0 mm	10 mm
8dBm	Estimated SAR (W/kg)	0.252W/kg	0.126 W/kg

16.1 Head Exposure Conditions

<WWAN + WLAN>

WWAN Band		Exposure Position	WWAN SAR (W/kg)	WLAN DTS SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
GSM	GSM850	Right Cheek	0.270	0.236	**0.51**		
		Right Tilted	0.162	0.103	**0.27**		
		Left Cheek	0.285	0.107	**0.39**		
		Left Tilted	0.164	0.064	**0.23**		
	GSM1900	Right Cheek	0.149	0.236	**0.39**		
		Right Tilted	0.109	0.103	**0.21**		
		Left Cheek	0.297	0.107	**0.40**		
		Left Tilted	0.085	0.064	**0.15**		
WCMDA	Band V	Right Cheek	0.179	0.236	**0.42**		
		Right Tilted	0.100	0.103	**0.20**		
		Left Cheek	0.193	0.107	**0.30**		
		Left Tilted	0.134	0.064	**0.20**		
LTE	Band 7	Right Cheek	0.290	0.236	**0.53**		
		Right Tilted	0.187	0.103	**0.29**		
		Left Cheek	0.508	0.107	**0.62**		
		Left Tilted	0.105	0.064	**0.17**		

<WWAN + Bluetooth>

WWAN Band		Exposure Position	WWAN SAR (W/kg)	Bluetooth DSS Estimated SAR (W/kg)	Summed SAR (W/kg)	SPLSR	Case No
GSM	GSM850	Right Cheek	0.270	0.252	**0.49**		
		Right Tilted	0.162	0.252	**0.36**		
		Left Cheek	0.285	0.252	**0.36**		
		Left Tilted	0.164	0.252	**0.32**		
	GSM1900	Right Cheek	0.149	0.252	**0.49**		
		Right Tilted	0.109	0.252	**0.36**		
		Left Cheek	0.297	0.252	**0.36**		
		Left Tilted	0.085	0.252	**0.32**		
WCMDA	Band V	Right Cheek	0.179	0.252	**0.49**		
		Right Tilted	0.100	0.252	**0.36**		
		Left Cheek	0.193	0.252	**0.36**		
		Left Tilted	0.134	0.252	**0.32**		
LTE	Band 7	Right Cheek	0.290	0.252	**0.49**		
		Right Tilted	0.187	0.252	**0.36**		
		Left Cheek	0.508	0.252	**0.36**		
		Left Tilted	0.105	0.252	**0.32**		

16.2 Hotspot Exposure Conditions

Distance of the Antenna to the EUT surface/edge						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Antenna	≤ 25mm	≤ 25mm	128mm	≤ 25mm	≤ 25mm	≤ 25mm
BT / WLAN	≤ 25mm	≤ 25mm	33mm	77mm	58.5mm	≤ 25mm
Positions for SAR tests; Hotspot mode						
Antennas	Back	Front	Top Side	Bottom Side	Right Side	Left Side
WWAN Antenna	Yes	Yes	No	Yes	Yes	Yes
BT&WLAN	Yes	Yes	No	No	No	Yes
Simultaneous Transmission						
WWAN + BT&WLAN	Yes	Yes	No	No	No	Yes

<WWAN + WLAN>

WWAN Band		Exposure Position	WWAN SAR (W/kg)	WLAN DTS SAR (W/kg)	**Summed SAR (W/kg)**	SPLSR	Case No
GSM	GSM850	Front	0.365	0.063	**0.43**		
		Back	0.482	0.493	**0.98**		
		Left side	0.301	0.266	**0.57**		
	GSM1900	Front	0.385	0.063	**0.45**		
		Back	0.698	0.493	**1.19**		
		Left side	0.225	0.266	**0.49**		
WCMDA	Band V	Front	0.278	0.063	**0.34**		
		Back	0.364	0.493	**0.86**		
		Left side	0.254	0.266	**0.52**		
LTE	Band 7	Front	0.519	0.063	**0.58**		
		Back	1.159	0.493	**1.65**	0.02	Case 1
		Left side	0.334	0.266	**0.60**		

<WWAN + Bluetooth>

WWAN Band		Exposure Position	WWAN SAR (W/kg)	Bluetooth DSS Estimated SAR (W/kg)	**Summed SAR (W/kg)**	SPLSR	Case No
GSM	GSM850	Front	0.365	0.126	**0.19**		
		Back	0.482	0.126	**0.62**		
		Left side	0.301	0.126	**0.39**		
	GSM1900	Front	0.385	0.126	**0.19**		
		Back	0.698	0.126	**0.62**		
		Left side	0.225	0.126	**0.39**		
WCMDA	Band V	Front	0.278	0.126	**0.19**		
		Back	0.364	0.126	**0.62**		
		Left side	0.254	0.126	**0.39**		
LTE	Band 7	Front	0.519	0.126	**0.19**		
		Back	1.159	0.126	**0.62**		
		Left side	0.334	0.126	**0.39**		

16.3 Body-Worn Accessory Exposure Conditions

<WWAN + WLAN>

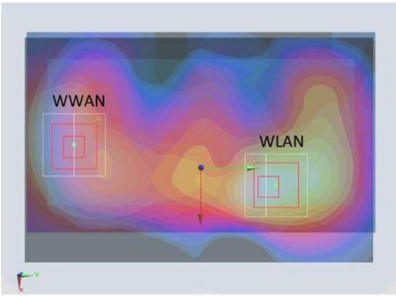
WWAN Band		Exposure Position	WWAN SAR (W/kg)	WLAN DTS SAR (W/kg)	1+2 Summed SAR (W/kg)	SPLSR	Case No
GSM	GSM850	Front	0.365	0.063	**0.43**		
		Back	0.482	0.493	**0.98**		
	GSM1900	Front	0.385	0.063	**0.45**		
		Back	0.698	0.493	**1.19**		
WCMDA	Band V	Front	0.278	0.063	**0.34**		
		Back	0.364	0.493	**0.86**		
LTE	Band 17	Front	0.519	0.063	**0.58**		
		Back	1.159	0.493	**1.65**	0.02	Case 1

<WWAN + Bluetooth>

WWAN Band		Exposure Position	WWAN SAR (W/kg)	Bluetooth DSS Estimated SAR (W/kg)	2+3 Summed SAR (W/kg)	SPLSR	Case No
GSM	GSM850	Front	0.365	0.126	**0.19**		
		Back	0.482	0.126	**0.62**		
	GSM1900	Front	0.385	0.126	**0.19**		
		Back	0.698	0.126	**0.62**		
WCMDA	Band V	Front	0.278	0.126	**0.19**		
		Back	0.364	0.126	**0.62**		
LTE	Band 17	Front	0.519	0.126	**0.19**		
		Back	1.159	0.126	**0.62**		

16.4 SPLSR Evaluation and Analysis

	Band	Position	SAR (W/kg)	Gap (cm)	SAR peak location (m) X	Y	Z	3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
Case 1	LTE Band 7	Back	1.159	1	-0.011	-0.0612	-0.204	94.4	1.65	0.02	Not required
	WLAN2.4GHz		0.493	1	0.0083	0.0312	-0.204				



Test Engineer : San Lin, Domo Hsiao, Angelo Chang, Frank Wu, Iran Wang, Lawrence Chen, and Bevis Chang

17. Uncertainty Assessment

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

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

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

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	1/k[(b)]	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(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 14.1. 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 14.2. 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 248227 D01 v01r02, “SAR Measurement Procedures for 802.11 a/b/g Transmitters”, May 2007

[6] FCC KDB 447498 D01 v05r02, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Feb 2014

[7] FCC KDB 648474 D03 v01r02, “Evaluation and Approval Considerations for Handsets with Specific Wireless Charging Battery Covers” May 2013.

[8] FCC KDB 941225 D01 v02, “SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do / WCDMA / HSDPA / HSPA”, October 2007

[9] FCC KDB 941225 D02 v02r02, “SAR Guidance for HSPA, HSPA+, DC-HSDPA and 1x-Advanced”, May 2013.

[10] FCC KDB 941225 D03 v01, “Recommended SAR Test Reduction Procedures for GSM / GPRS / EDGE”, December 2008

[11] FCC KDB 941225 D04 v01, “Evaluating SAR for GSM/(E)GPRS Dual Transfer Mode”, January 2010

[12] FCC KDB 941225 D05 v02r03, “SAR Evaluation Considerations for LTE Devices”, Dec 2013

[13] FCC KDB 941225 D06 v01r01, "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", May 2013

[14] FCC KDB 865664 D01 v01r03, "SAR Measurement Requirements for 100 MHz to 6 GHz", Feb 2014.

[15] FCC KDB 865664 D02 v01r01, “RF Exposure Compliance Reporting and Documentation Considerations” May 2013.

Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Head_835MHz_140121

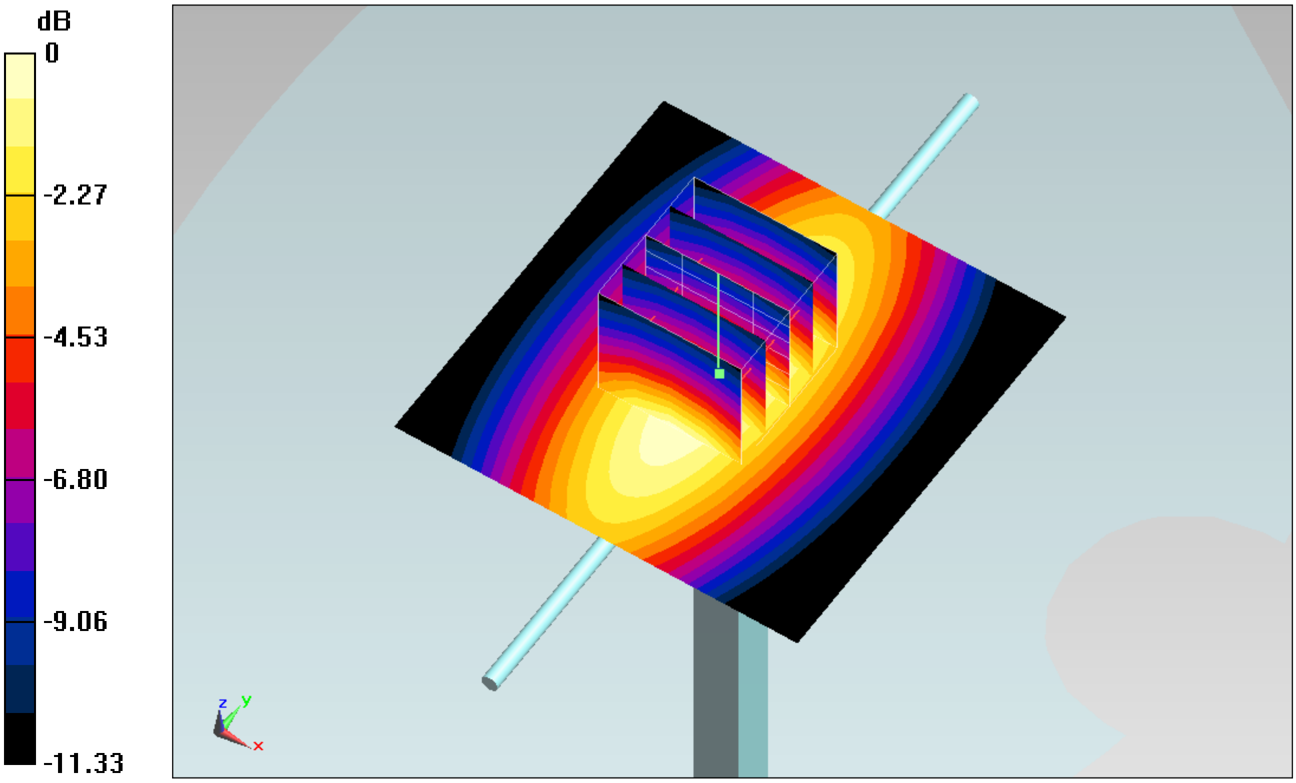
DUT: D835V2-4d162

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: HSL_850_140121 Medium parameters used: f = 835 MHz; σ = 0.926 S/m; ε_r = 43.385; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(6.18, 6.18, 6.18); Calibrated: 2013/9/24;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2013/8/21
- Phantom: SAM Right; Type: QD000P40CC; Serial: TP:1383
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.86 W/kg

Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 57.287 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.61 W/kg
SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.56 W/kg
Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

System Check_Head_835MHz_140220

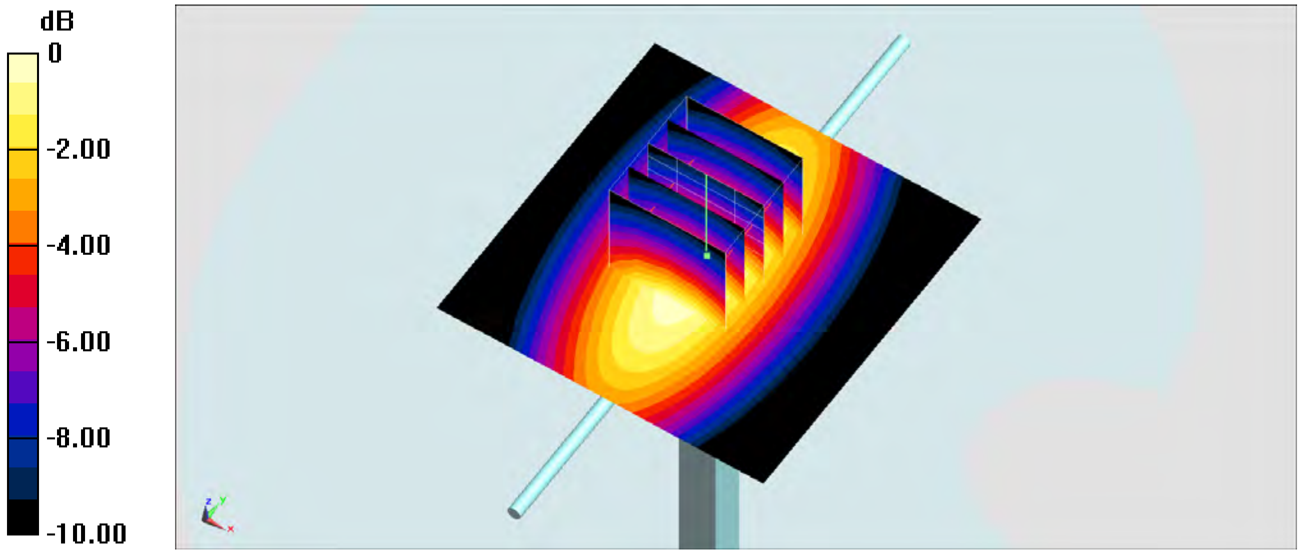
DUT: D835V2-4d162

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: HSL_850_140220 Medium parameters used: f = 835 MHz; σ = 0.906 S/m; ε_r = 42.966; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(9.86, 9.86, 9.86); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM Left; Type: QD000P40CD; Serial: S/N:1796
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.93 W/kg

Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 57.778 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.45 W/kg
SAR(1 g) = 2.32 W/kg; SAR(10 g) = 1.53 W/kg
Maximum value of SAR (measured) = 2.92 W/kg



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

System Check_Body_835MHz_140120

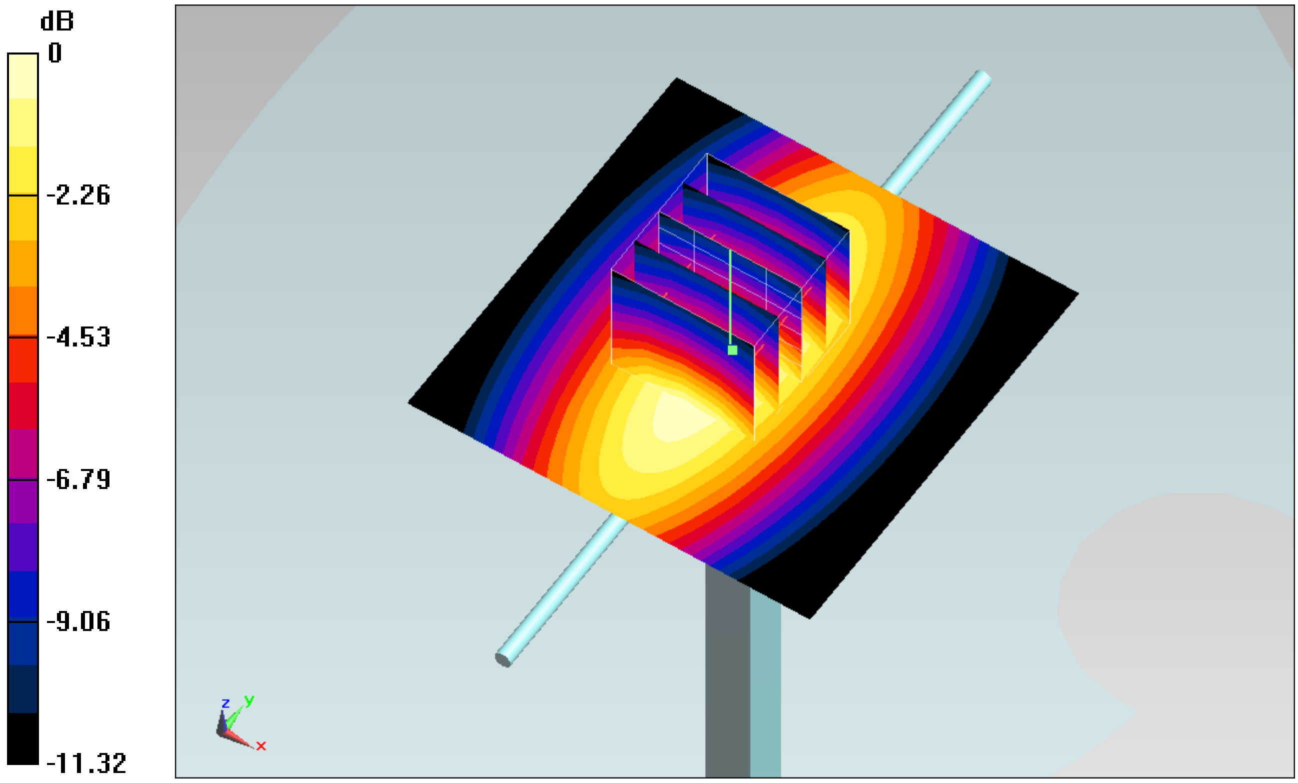
DUT: D835V2-4d162

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: MSL_850_140120 Medium parameters used: f = 835 MHz; σ = 0.963 S/m; ε_r = 54.539; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(6.08, 6.08, 6.08); Calibrated: 2013/9/24;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2013/8/21
- Phantom: SAM Left; Type: QD000P40CD; Serial: TP:1542
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.89 W/kg

Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 56.757 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.62 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.58 W/kg
Maximum value of SAR (measured) = 2.86 W/kg



0 dB = 2.86 W/kg = 4.56 dBW/kg

System Check_Body_835MHz_140220

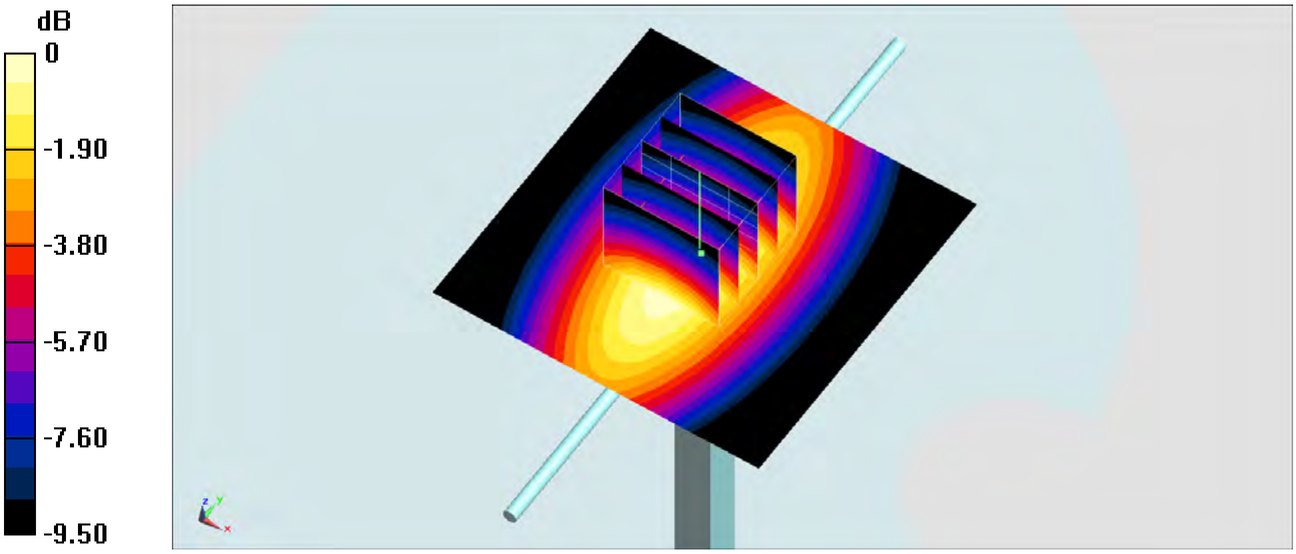
DUT: D835V2-4d162

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: MSL_850_140220 Medium parameters used: f = 835 MHz; σ = 0.995 S/m; ε_r = 54.886; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(9.81, 9.81, 9.81); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM RIGHT; Type: SAM; Serial: 1801
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.05 W/kg

Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 56.609 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 3.55 W/kg
SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.6 W/kg
Maximum value of SAR (measured) = 3.04 W/kg



0 dB = 3.04 W/kg = 4.83 dBW/kg

System Check_Head_1900MHz_140221

DUT: D1900V2-5d182

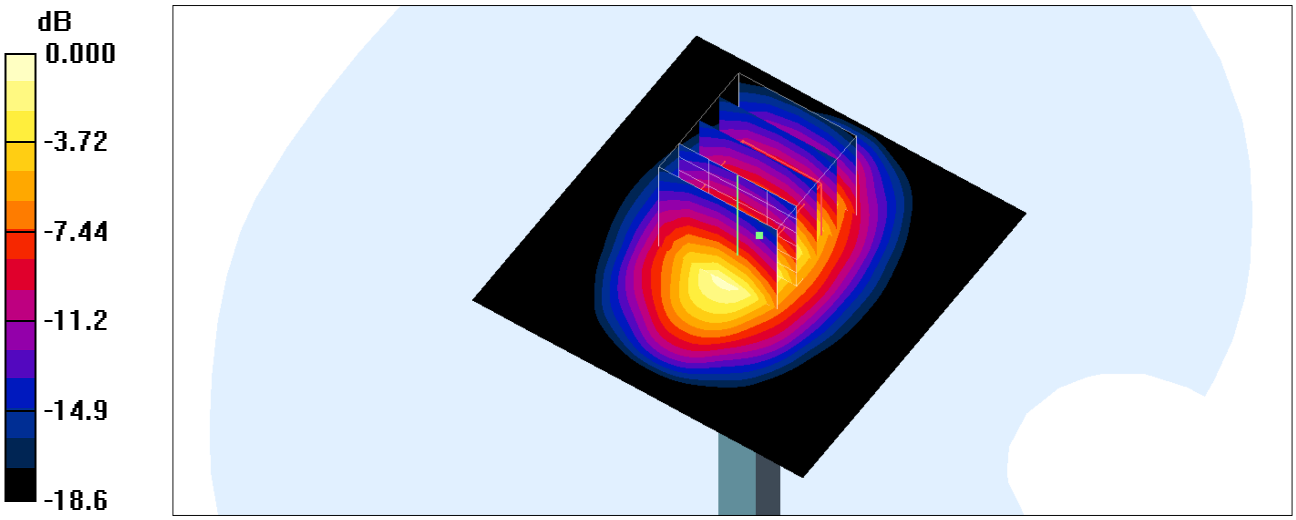
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: HSL_1900_140221 Medium parameters used: f = 1900 MHz; σ = 1.45 mho/m; ε_r = 38.5; ρ = 1000 kg/m^3

Ambient Temperature：23.3℃; Liquid Temperature：22.3 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3925; ConvF(8.13, 8.13, 8.13); Calibrated: 2013/6/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2013/5/8
- Phantom: SAM_Left; Type: SAM; Serial: TP-1150
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 14.6 mW/g

Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 98.1 V/m; Power Drift = 0.335 dB
Peak SAR (extrapolated) = 18.5 W/kg
SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.37 mW/g
Maximum value of SAR (measured) = 14.0 mW/g



0 dB = 14.0mW/g

System Check_Body_1900MHz_140221

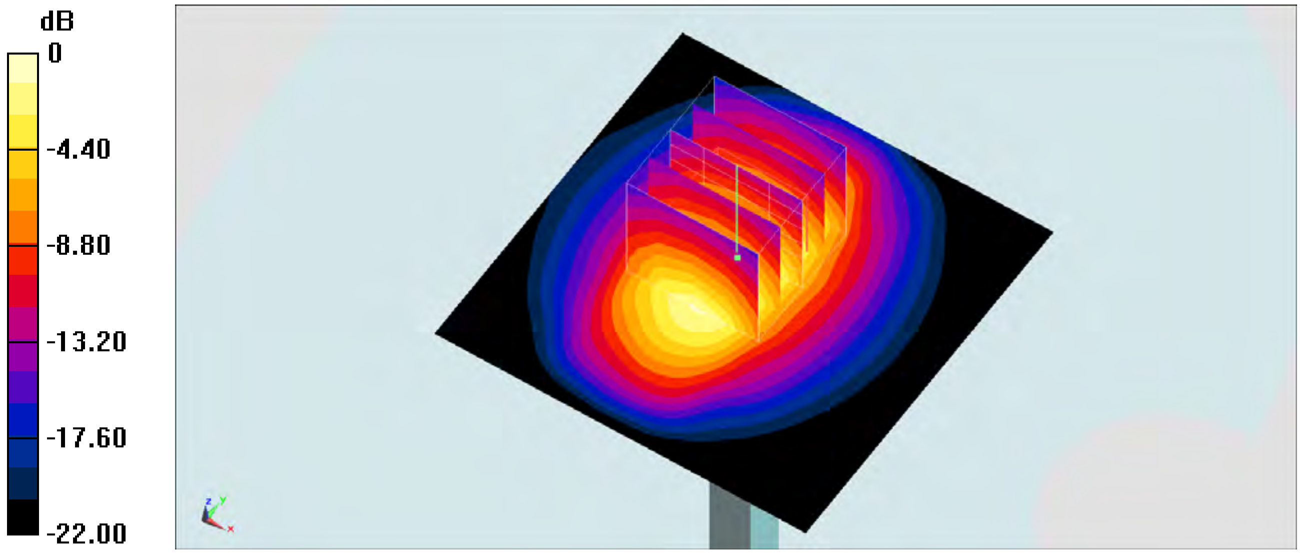
DUT: D1900V2-5d182

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: MSL_1900_140221 Medium parameters used: f = 1900 MHz; σ = 1.544 S/m; ε_r = 51.591; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(8.17, 8.17, 8.17); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM RIGHT; Type: SAM; Serial: 1801
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 13.7 W/kg

Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 90.014 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 16.5 W/kg
SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.37 W/kg
Maximum value of SAR (measured) = 13.5 W/kg



0 dB = 13.5 W/kg = 11.30 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2014/3/3

System Check_Head_2450MHz_140303

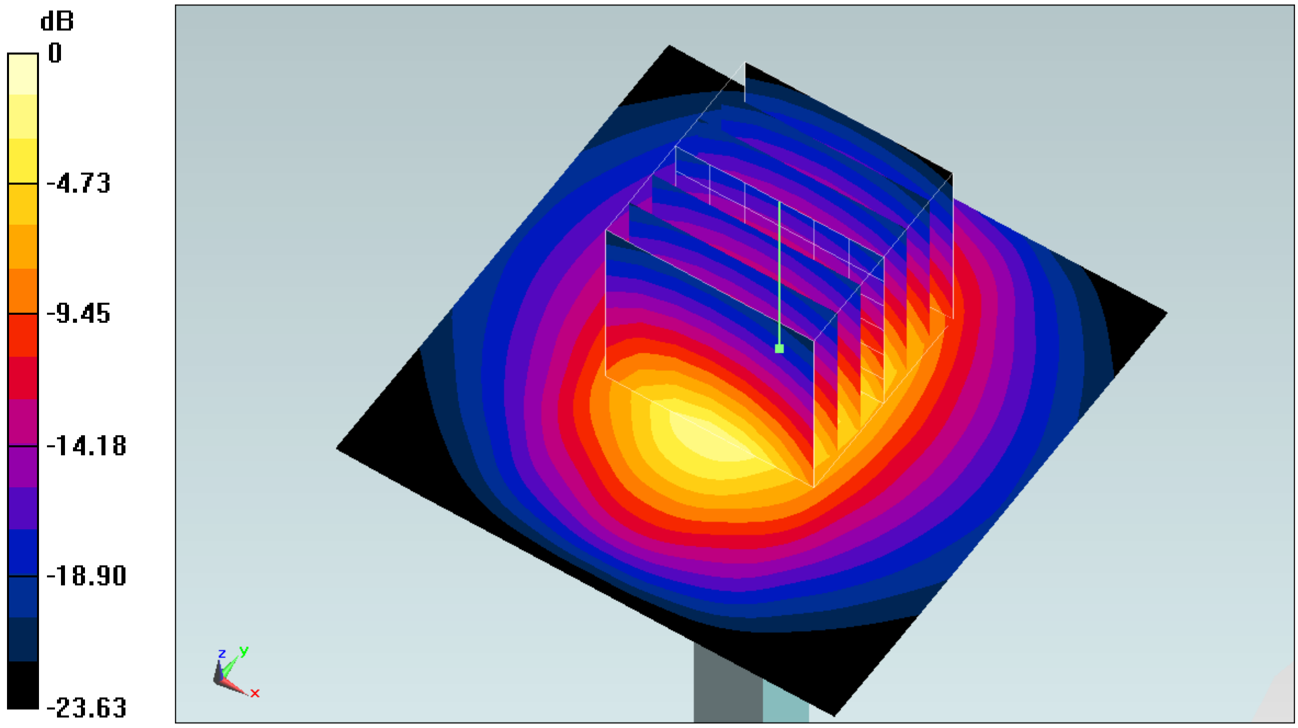
DUT: D2450V2-924

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: HSL_2450_140303 Medium parameters used: f = 2450 MHz; σ = 1.839 S/m; ε_r = 39.306; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(7.43, 7.43, 7.43); Calibrated: 2013/11/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: SAM Left; Type: QD000P40CD; Serial: TP:1542
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 22.5 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 106.5 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 28.9 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.13 W/kg
Maximum value of SAR (measured) = 20.8 W/kg



0 dB = 20.8 W/kg = 13.18 dBW/kg

System Check_Body_2450MHz_140303

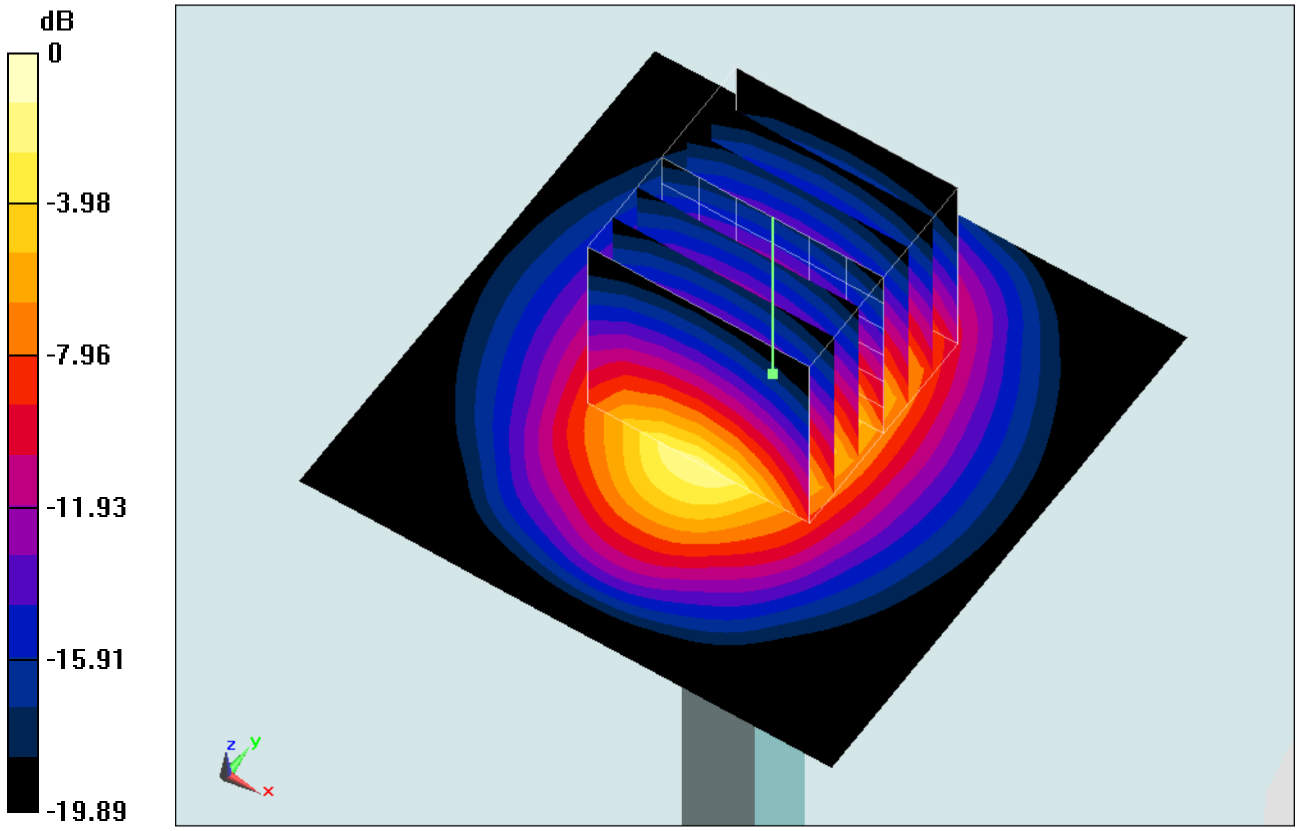
DUT: D2450V2-924

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450_140303 Medium parameters used: f = 2450 MHz; σ = 1.973 S/m; ε_r = 54.161; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3925; ConvF(7.44, 7.44, 7.44); Calibrated: 2013/6/12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2013/5/8
- Phantom: SAM Right; Type: QD000P40CD; Serial: TP:1644
- Measurement SW: DASY52, Version 52.8 (6);SEMCAD X Version 14.6.9 (7117)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 21.4 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.669 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 27.0 W/kg
SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.77 W/kg
Maximum value of SAR (measured) = 19.1 W/kg



0 dB = 19.5 W/kg = 12.90 dBW/kg

System Check_Head_2600MHz_140222

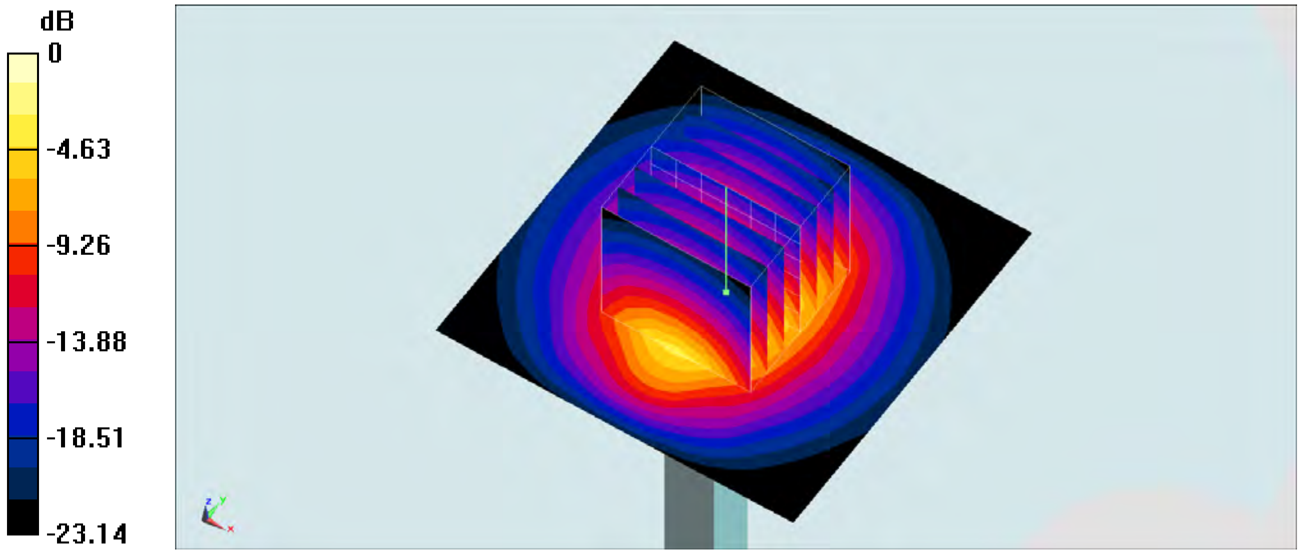
DUT: D2600V2-1070

Communication System: CW ; Frequency: 2600 MHz;Duty Cycle: 1:1
Medium: HSL_2600_140222 Medium parameters used: f = 2600 MHz; σ = 1.97 S/m; ε_r = 38.084; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(7.55, 7.55, 7.55); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM Left; Type: QD000P40CD; Serial: S/N:1796
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 19.8 W/kg

Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 101.4 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 28.2 W/kg
SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6 W/kg
Maximum value of SAR (measured) = 21.0 W/kg



0 dB = 21.0 W/kg = 13.22 dBW/kg

System Check_Body_2600MHz_140224

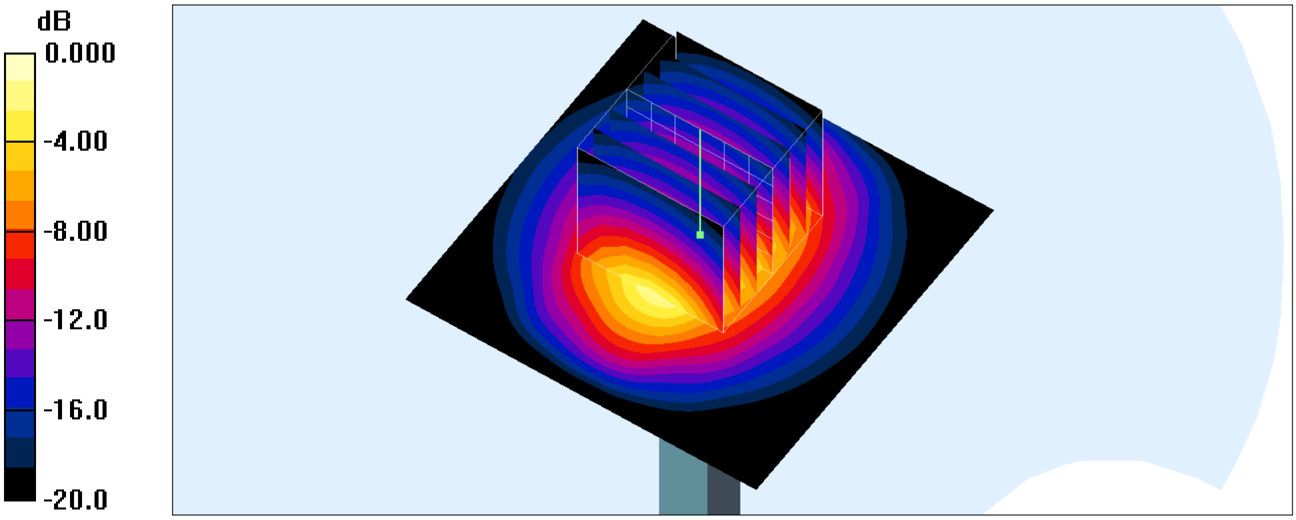
DUT: D2600V2-1070

Communication System: CW; Frequency: 2600 MHz;Duty Cycle: 1:1
Medium: MSL_2600_140224 Medium parameters used: f = 2600 MHz; σ = 2.17 mho/m; ε_r = 53.8; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.4 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(7.08, 7.08, 7.08); Calibrated: 2013/11/4
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 21.6 mW/g

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.5 V/m; Power Drift = 0.053 dB
Peak SAR (extrapolated) = 29.0 W/kg
SAR(1 g) = 14 mW/g; SAR(10 g) = 6.53 mW/g
Maximum value of SAR (measured) = 21.3 mW/g



0 dB = 20.0mW/g

Appendix B. Plots of SAR Measurement

The plots are shown as follows.

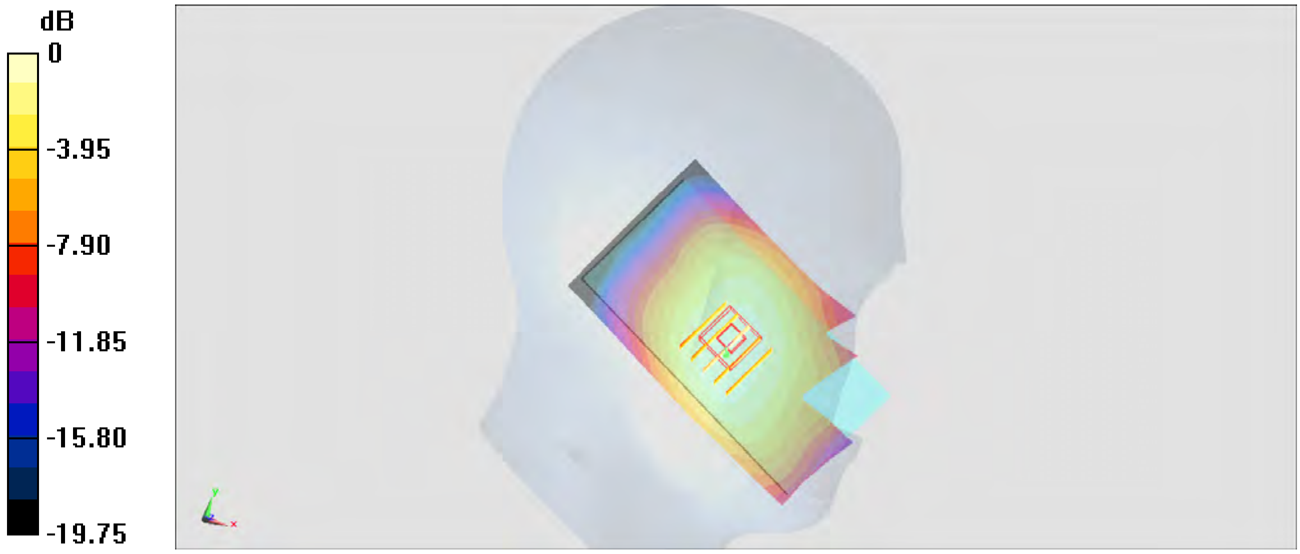
#01_GSM850_GPRS (2 Tx slots)_Left Cheek_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: HSL_850_140220 Medium parameters used: f = 836.4 MHz; σ = 0.907 S/m; ε_r = 42.95; ρ = 1000 kg/m^3
Ambient Temperature：23.6 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(9.86, 9.86, 9.86); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM Left; Type: QD000P40CD; Serial: S/N:1796
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch189/Area Scan (61x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.273 W/kg

Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.046 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.317 W/kg
SAR(1 g) = 0.257 W/kg; SAR(10 g) = 0.202 W/kg
Maximum value of SAR (measured) = 0.290 W/kg



0 dB = 0.290 W/kg = -5.38 dBW/kg

#02_GSM1900_GPRS (4 Tx slots)_Left Cheek_Ch810

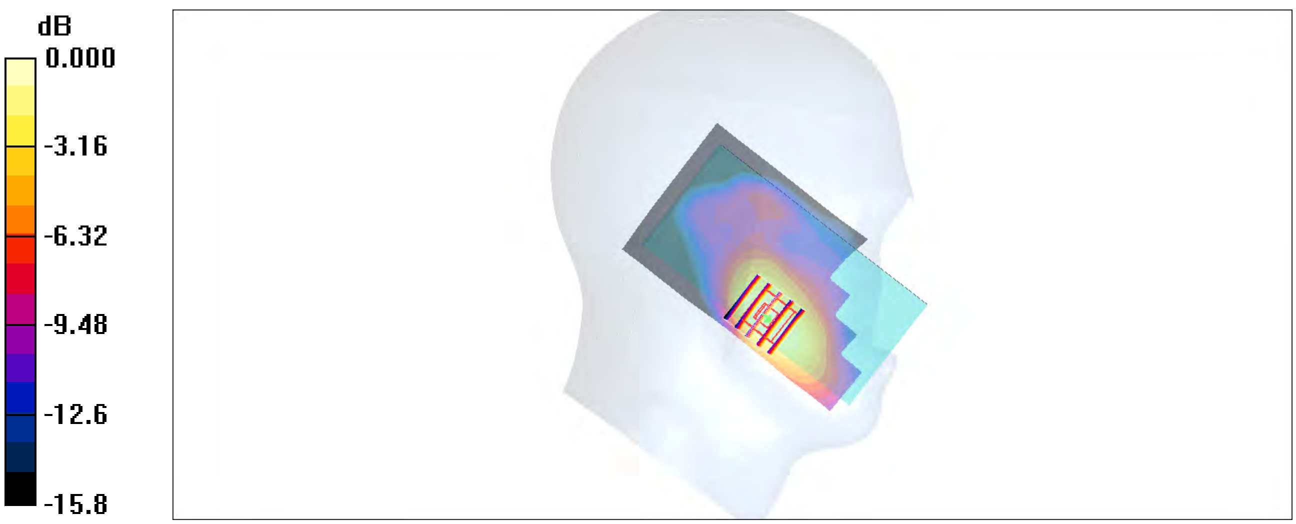
Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:2.08
Medium: HSL_1900_140221 Medium parameters used: f = 1910 MHz; σ = 1.45 mho/m; ε_r = 38.4; ρ = 1000 kg/m^3

Ambient Temperature：23.3℃; Liquid Temperature：22.3 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3925; ConvF(8.13, 8.13, 8.13); Calibrated: 2013/6/12
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2013/5/8
- Phantom: SAM_Left; Type: SAM; Serial: TP-1150
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch810/Area Scan (61x111x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.311 mW/g

Ch810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.6 V/m; Power Drift = 0.106 dB
Peak SAR (extrapolated) = 0.359 W/kg
SAR(1 g) = 0.235 mW/g; SAR(10 g) = 0.143 mW/g
Maximum value of SAR (measured) = 0.305 mW/g



0 dB = 0.305mW/g

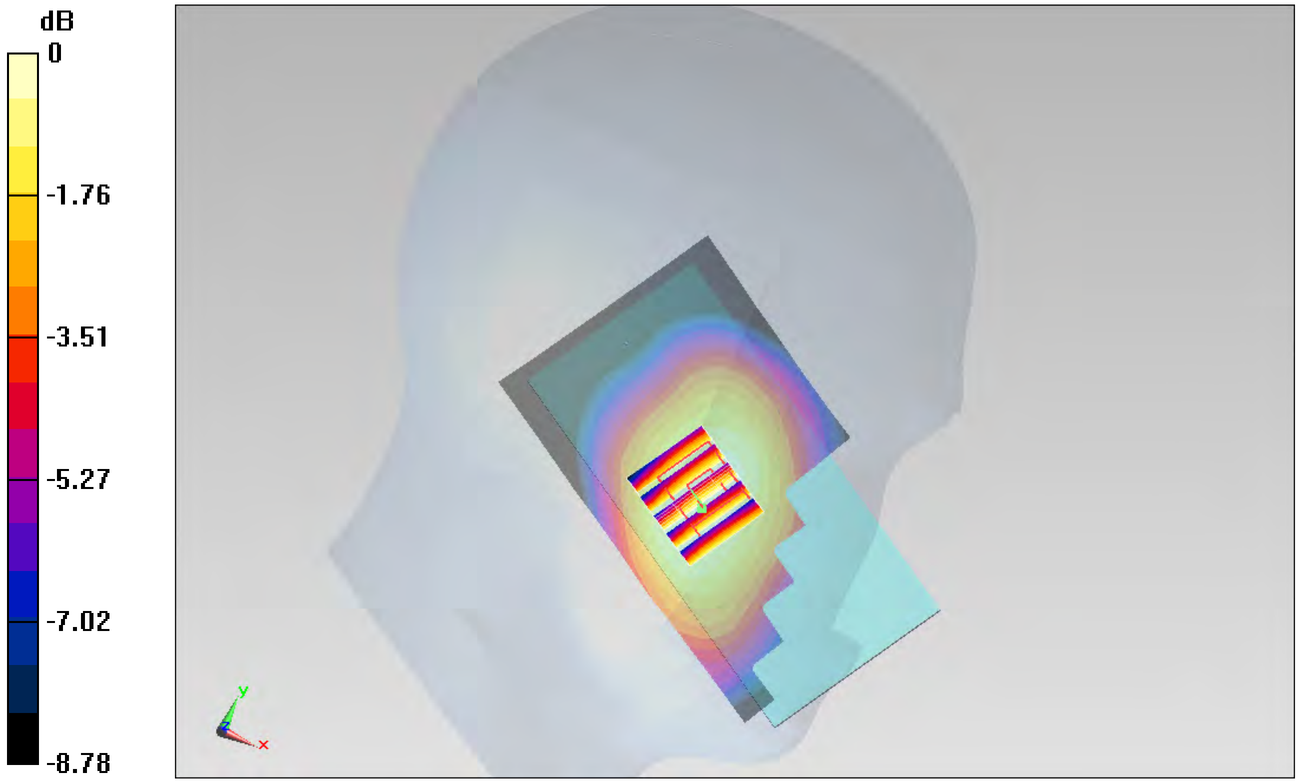
#03_WCDMA V_RMC 12.2Kbps_Left Cheek_Ch4182

Communication System: WCDMA; Frequency: 836.4 MHz;Duty Cycle: 1:1
Medium: HSL_850_140121 Medium parameters used : f = 836.4 MHz; σ = 0.927 S/m; ε_r = 43.369; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(6.18, 6.18, 6.18); Calibrated: 2013/9/24;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2013/8/21
- Phantom: SAM Right; Type: QD000P40CC; Serial: TP:1383
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Ch4182/Area Scan (61x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.197 W/kg

Configuration/Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.942 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.221 W/kg
SAR(1 g) = 0.180 W/kg; SAR(10 g) = 0.139 W/kg
Maximum value of SAR (measured) = 0.196 W/kg



0 dB = 0.196 W/kg = -7.08 dBW/kg

#04_LTE Band 7_20M_QPSK_1RB_0Offset_Left Cheek_Ch21100

Communication System: LTE; Frequency: 2535 MHz;Duty Cycle: 1:1
Medium: HSL_2600_140222 Medium parameters used: f = 2535 MHz; σ = 1.913 S/m; ε_r = 38.41; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(7.55, 7.55, 7.55); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM Left; Type: QD000P40CD; Serial: S/N:1796
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch21100/Area Scan (71x141x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.476 W/kg

Configuration/Ch21100/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.982 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.791 W/kg
SAR(1 g) = 0.402 W/kg; SAR(10 g) = 0.205 W/kg
Maximum value of SAR (measured) = 0.599 W/kg

0 dB = 0.599 W/kg = -2.23 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2014/3/3

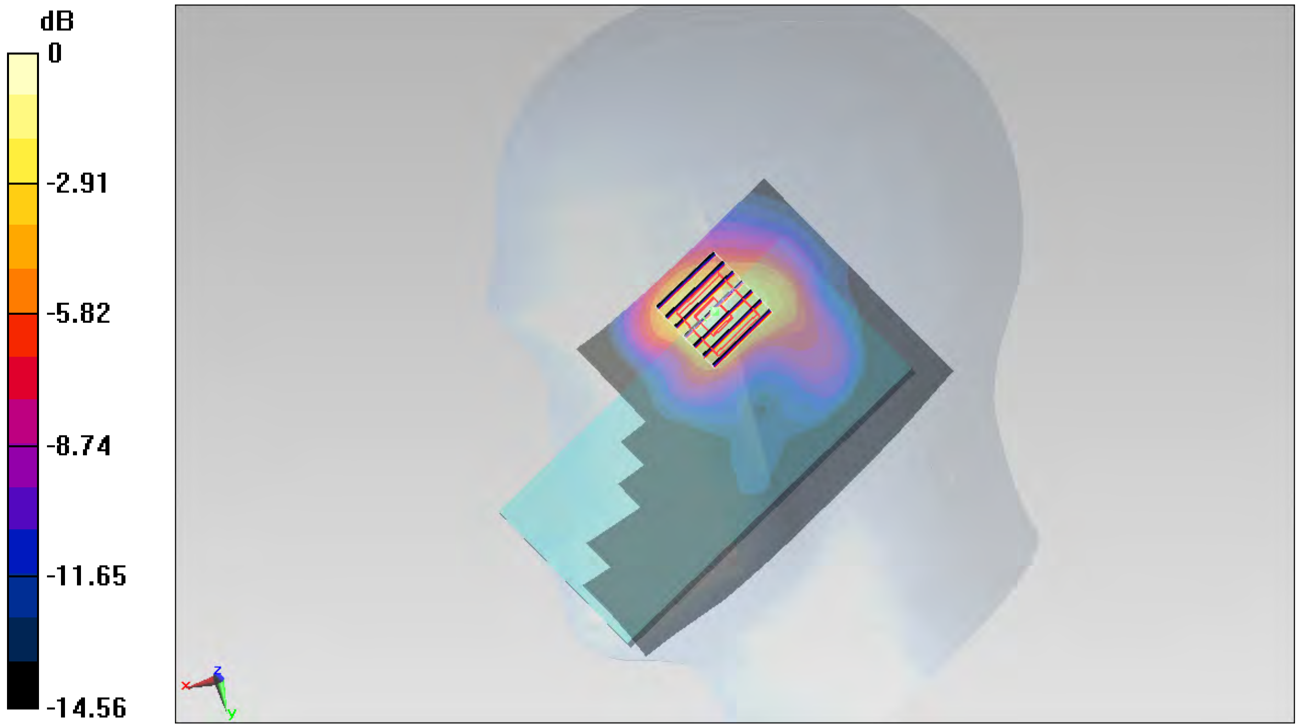
#05_WLAN2.4GHz_802.11b 1Mbps_Right Cheek_Ch1

Communication System: 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1.024
Medium: HSL_2450_140303 Medium parameters used: f = 2412 MHz; σ = 1.798 S/m; ε_r = 39.479; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(7.43, 7.43, 7.43); Calibrated: 2013/11/4;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: SAM Left; Type: QD000P40CD; Serial: TP:1542
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Ch1/Area Scan (91x141x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.327 W/kg

Configuration/Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.731 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.476 W/kg
SAR(1 g) = 0.230 W/kg; SAR(10 g) = 0.116 W/kg
Maximum value of SAR (measured) = 0.344 W/kg



0 dB = 0.344 W/kg = -4.63 dBW/kg

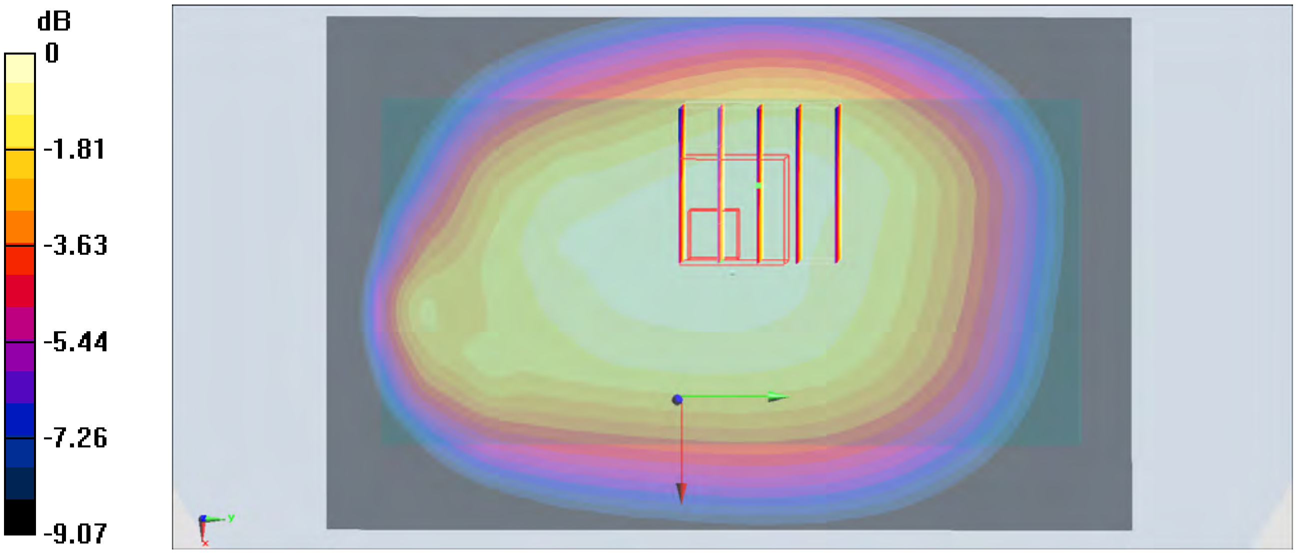
#06_GSM850_GPRS (2 Tx slots)_Back_1cm_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_140220 Medium parameters used: f = 836.4 MHz; σ = 0.997 S/m; ε_r = 54.893; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(9.81, 9.81, 9.81); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM RIGHT; Type: SAM; Serial: 1801
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch189/Area Scan (71x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.480 W/kg

Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.930 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.548 W/kg
SAR(1 g) = 0.435 W/kg; SAR(10 g) = 0.335 W/kg
Maximum value of SAR (measured) = 0.498 W/kg



0 dB = 0.498 W/kg = -3.03 dBW/kg

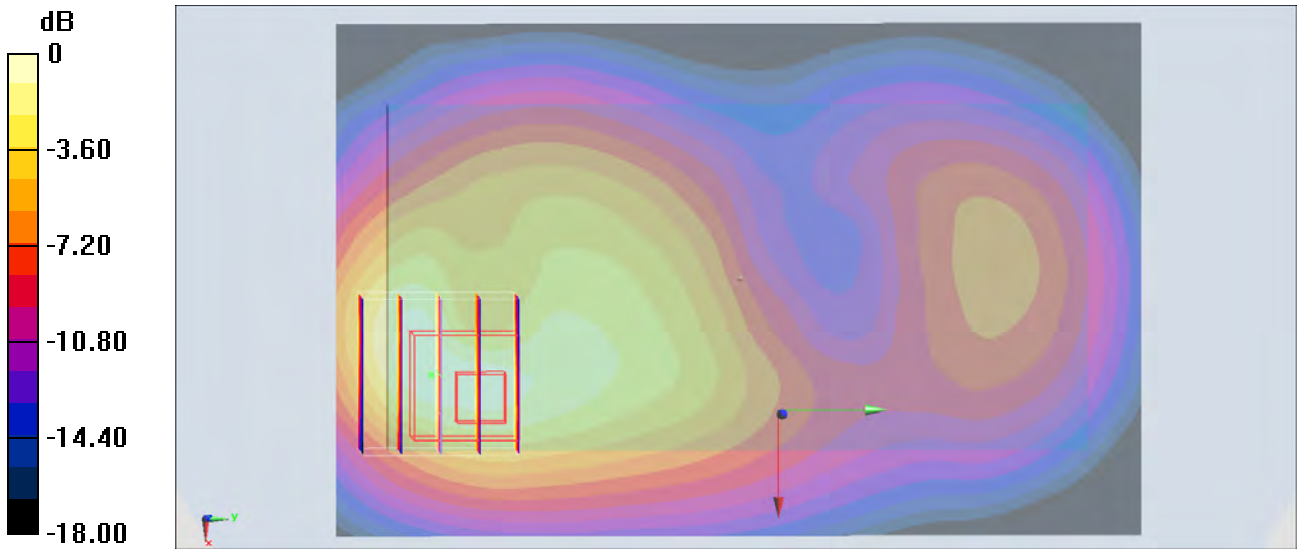
#07_GSM1900_GPRS (4 Tx slots)_Back_1cm_Ch810

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:2.08
Medium: MSL_1900_140221 Medium parameters used: f = 1910 MHz; σ = 1.554 S/m; ε_r = 51.552; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(8.17, 8.17, 8.17); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM RIGHT; Type: SAM; Serial: 1801
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch810/Area Scan (71x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.705 W/kg

Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.376 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.902 W/kg
SAR(1 g) = 0.553 W/kg; SAR(10 g) = 0.317 W/kg
Maximum value of SAR (measured) = 0.744 W/kg



0 dB = 0.744 W/kg = -1.28 dBW/kg

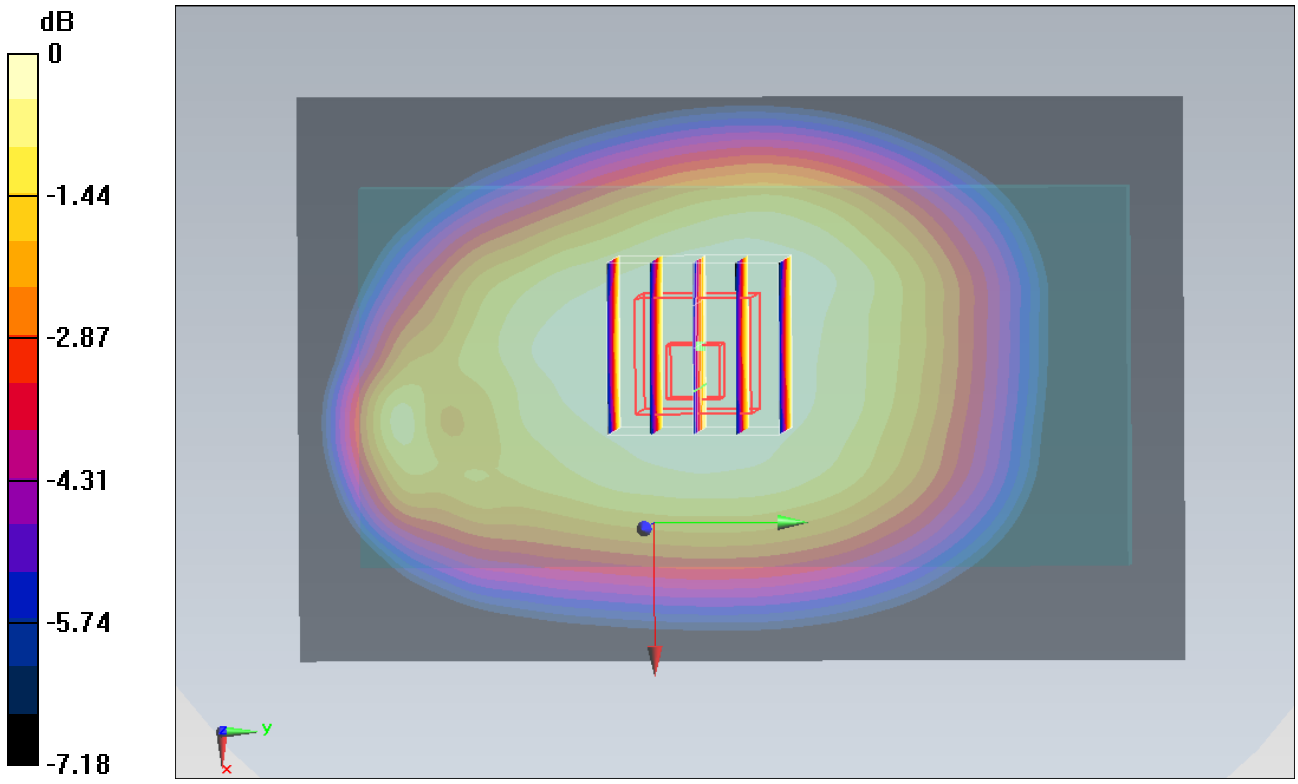
#08_WCDMA V_RMC 12.2Kbps_Back_1cm_Ch4182

Communication System: WCDMA ; Frequency: 836.4 MHz;Duty Cycle: 1:1
Medium: MSL_850_140120 Medium parameters used : f = 836.4 MHz; σ = 0.965 S/m; ε_r = 54.522; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(6.08, 6.08, 6.08); Calibrated: 2013/9/24;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2013/8/21
- Phantom: SAM Left; Type: QD000P40CD; Serial: TP:1542
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Ch4182/Area Scan (71x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.373 W/kg

Configuration/Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.205 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.422 W/kg
SAR(1 g) = 0.340 W/kg; SAR(10 g) = 0.268 W/kg
Maximum value of SAR (measured) = 0.370 W/kg



0 dB = 0.370 W/kg = -4.32 dBW/kg

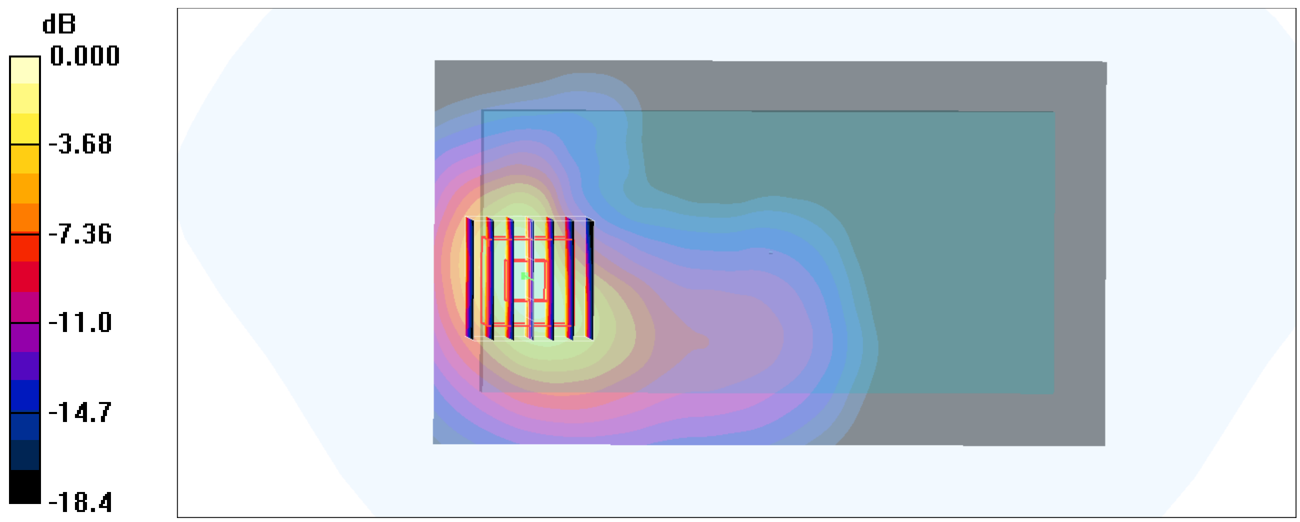
#09_LTE Band 7_20M_QPSK_1RB_0Offset_Back_1cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_140224 Medium parameters used: f = 2510 MHz; σ = 2.07 mho/m; ε_r = 54; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.4 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(7.08, 7.08, 7.08); Calibrated: 2013/11/4
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch20850/Area Scan (81x141x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 1.38 mW/g

Ch20850/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 25.5 V/m; Power Drift = -0.037 dB
Peak SAR (extrapolated) = 1.79 W/kg
SAR(1 g) = 0.889 mW/g; SAR(10 g) = 0.414 mW/g
Maximum value of SAR (measured) = 1.34 mW/g



0 dB = 1.34mW/g

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2014/3/3

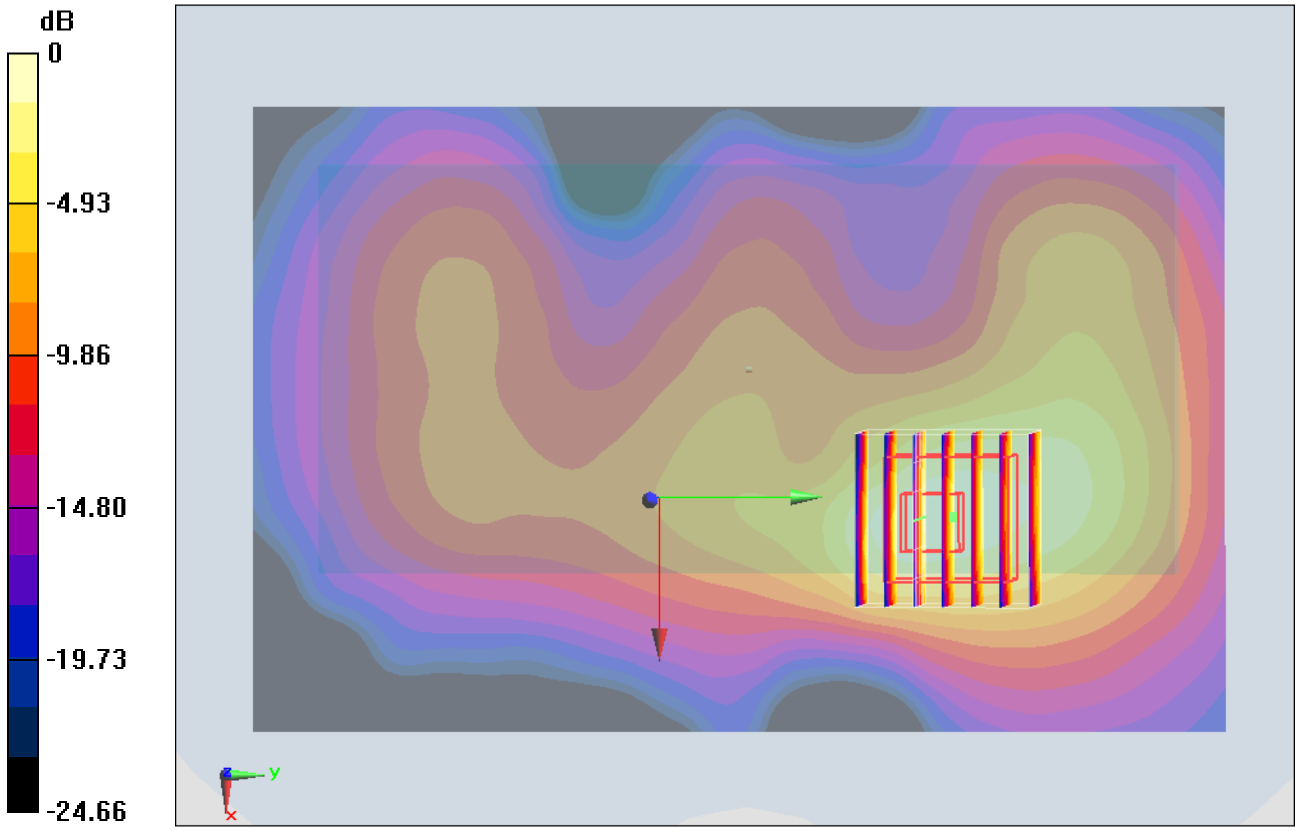
#10_WLAN2.4GHz_802.11b 1Mbps_Back_1cm_Ch1

Communication System: 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1.024
Medium: MSL_2450_140303 Medium parameters used: f = 2412 MHz; σ = 1.92 S/m; ε_r = 54.272; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3925; ConvF(7.44, 7.44, 7.44); Calibrated: 2013/6/12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2013/5/8
- Phantom: SAM Right; Type: QD000P40CD; Serial: TP:1644
- Measurement SW: DASY52, Version 52.8 (6);SEMCAD X Version 14.6.9 (7117)

Configuration/Ch1/Area Scan (91x141x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.696 W/kg

Configuration/Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.906 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 0.954 W/kg
SAR(1 g) = 0.480 W/kg; SAR(10 g) = 0.241 W/kg
Maximum value of SAR (measured) = 0.712 W/kg



0 dB = 0.712 W/kg = -1.48 dBW/kg

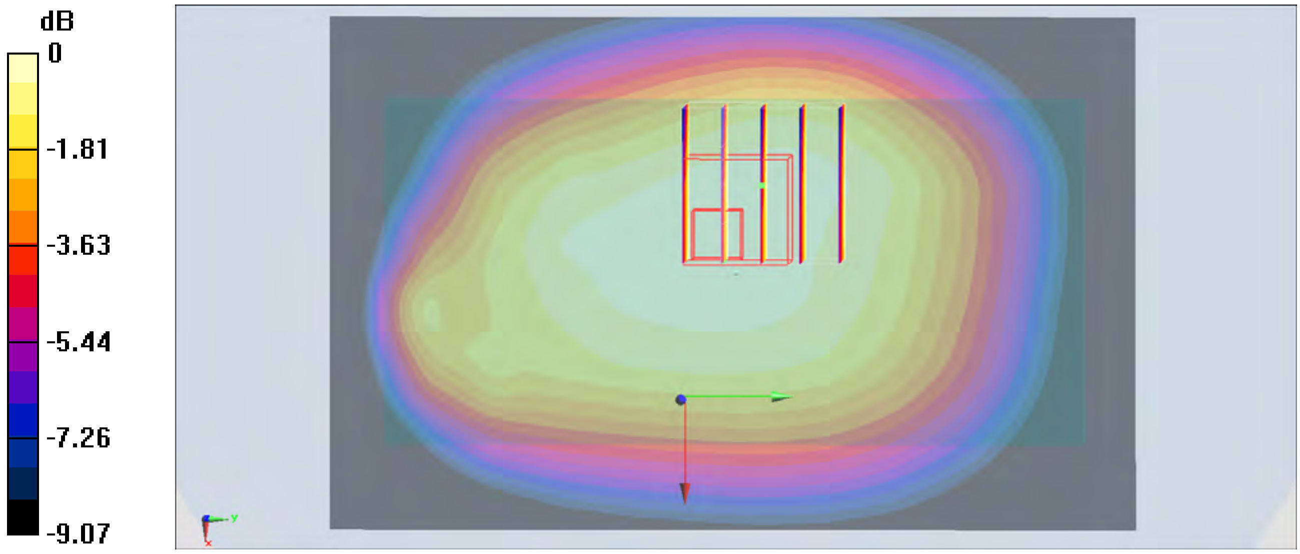
#11_GSM850_GPRS (2 Tx slots)_Back_1cm_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_140220 Medium parameters used: f = 836.4 MHz; σ = 0.997 S/m; ε_r = 54.893; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(9.81, 9.81, 9.81); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM RIGHT; Type: SAM; Serial: 1801
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch189/Area Scan (71x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.480 W/kg

Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.930 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.548 W/kg
SAR(1 g) = 0.435 W/kg; SAR(10 g) = 0.335 W/kg
Maximum value of SAR (measured) = 0.498 W/kg



0 dB = 0.498 W/kg = -3.03 dBW/kg

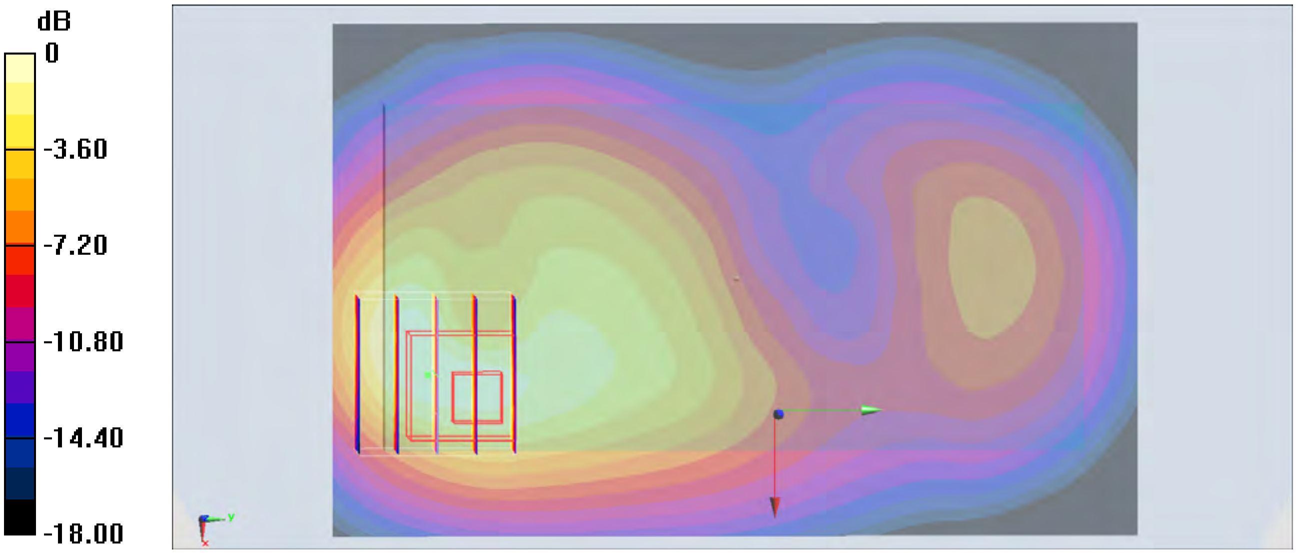
#12_GSM1900_GPRS (4 Tx slots)_Back_1cm_Ch810

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:2.08
Medium: MSL_1900_140221 Medium parameters used: f = 1910 MHz; σ = 1.554 S/m; ε_r = 51.552; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3955; ConvF(8.17, 8.17, 8.17); Calibrated: 2013/12/23;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: SAM RIGHT; Type: SAM; Serial: 1801
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Configuration/Ch810/Area Scan (71x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.705 W/kg

Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.376 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.902 W/kg
SAR(1 g) = 0.553 W/kg; SAR(10 g) = 0.317 W/kg
Maximum value of SAR (measured) = 0.744 W/kg



0 dB = 0.744 W/kg = -1.28 dBW/kg

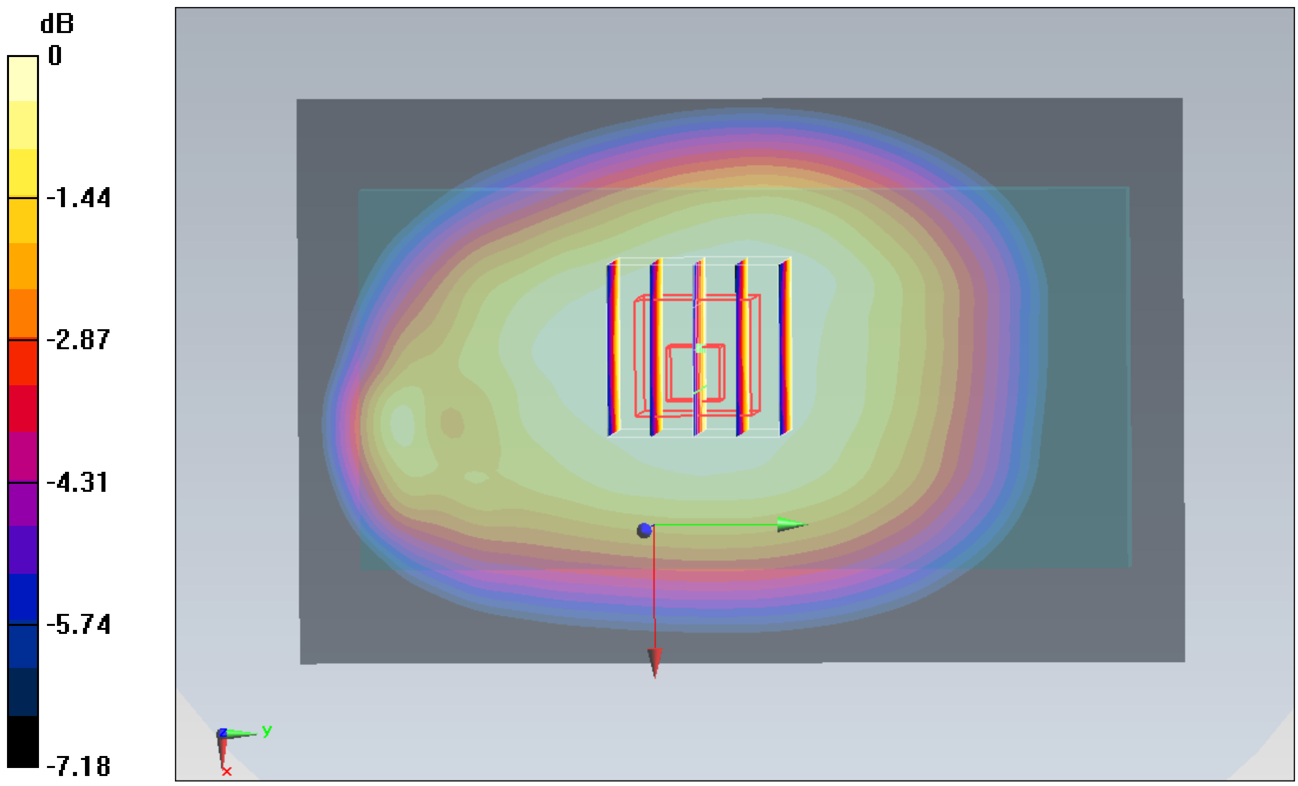
#13_WCDMA V_RMC 12.2Kbps_Back_1cm_Ch4182

Communication System: WCDMA ; Frequency: 836.4 MHz;Duty Cycle: 1:1
Medium: MSL_850_140120 Medium parameters used : f = 836.4 MHz; σ = 0.965 S/m; ε_r = 54.522; ρ = 1000 kg/m^3
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: ES3DV3 - SN3270; ConvF(6.08, 6.08, 6.08); Calibrated: 2013/9/24;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn778; Calibrated: 2013/8/21
- Phantom: SAM Left; Type: QD000P40CD; Serial: TP:1542
- Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Configuration/Ch4182/Area Scan (71x111x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.373 W/kg

Configuration/Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 20.205 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.422 W/kg
SAR(1 g) = 0.340 W/kg; SAR(10 g) = 0.268 W/kg
Maximum value of SAR (measured) = 0.370 W/kg



0 dB = 0.370 W/kg = -4.32 dBW/kg

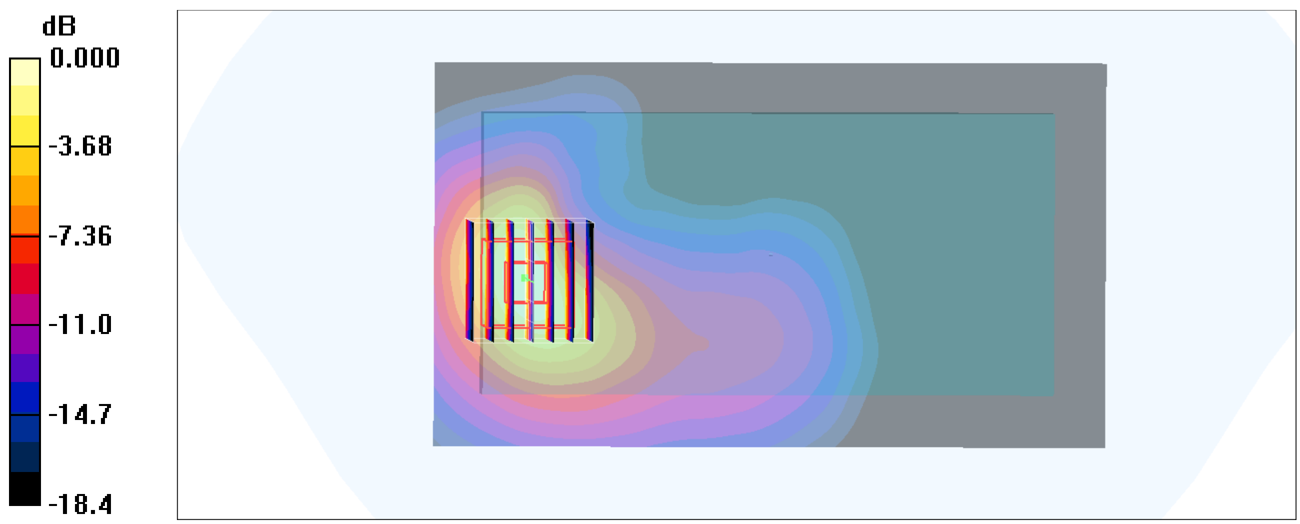
#14_LTE Band 7_20M_QPSK_1RB_0Offset_Back_1cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_140224 Medium parameters used: f = 2510 MHz; σ = 2.07 mho/m; ε_r = 54; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.4 ℃

DASY4 Configuration:
- Probe: EX3DV4 - SN3935; ConvF(7.08, 7.08, 7.08); Calibrated: 2013/11/4
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2013/11/5
- Phantom: SAM_Right; Type: SAM; Serial: TP-1303
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Ch20850/Area Scan (81x141x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (interpolated) = 1.38 mW/g

Ch20850/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 25.5 V/m; Power Drift = -0.037 dB
Peak SAR (extrapolated) = 1.79 W/kg
SAR(1 g) = 0.889 mW/g; SAR(10 g) = 0.414 mW/g
Maximum value of SAR (measured) = 1.34 mW/g



0 dB = 1.34mW/g

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2014/3/3

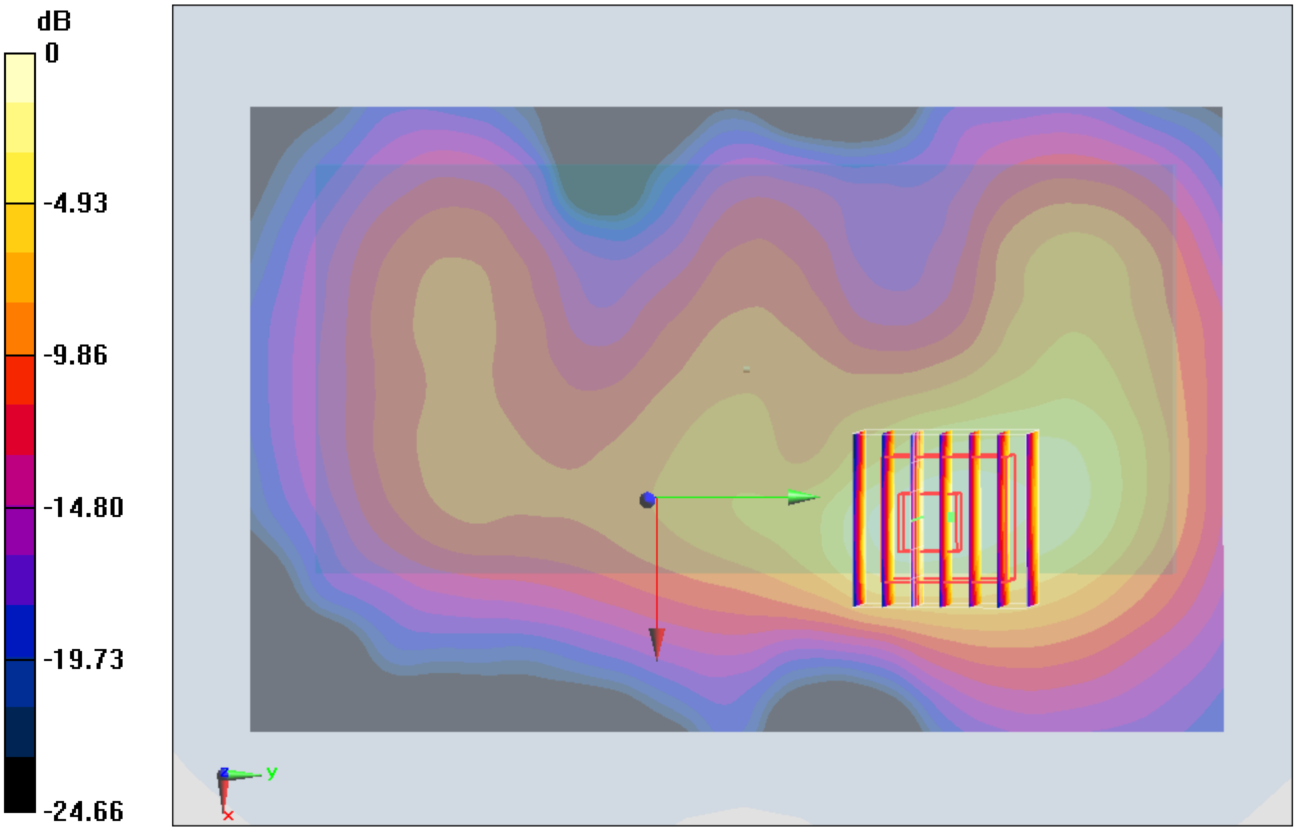
#15_WLAN2.4GHz_802.11b 1Mbps_Back_1cm_Ch1

Communication System: 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1.024
Medium: MSL_2450_140303 Medium parameters used: f = 2412 MHz; σ = 1.92 S/m; ε_r = 54.272; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3925; ConvF(7.44, 7.44, 7.44); Calibrated: 2013/6/12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn495; Calibrated: 2013/5/8
- Phantom: SAM Right; Type: QD000P40CD; Serial: TP:1644
- Measurement SW: DASY52, Version 52.8 (6);SEMCAD X Version 14.6.9 (7117)

Configuration/Ch1/Area Scan (91x141x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.696 W/kg

Configuration/Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.906 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 0.954 W/kg
SAR(1 g) = 0.480 W/kg; SAR(10 g) = 0.241 W/kg
Maximum value of SAR (measured) = 0.712 W/kg



0 dB = 0.712 W/kg = -1.48 dBW/kg

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.

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

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

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

Accreditation No.: SCS 108

Client Sporton-TW (Auden)

Certificate No: D835V2-4d162_Nov13

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d162
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	November 11, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	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: November 12, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 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 ± 0.2) °C	40.8 ± 6 %	0.94 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.53 W/kg ± 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 ± 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 ± 0.2) °C	54.7 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.39 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.28 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.09 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.5 Ω - 3.3 jΩ
Return Loss	- 27.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.1 Ω - 5.9 jΩ
Return Loss	- 23.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.425 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	December 28, 2012

DASY5 Validation Report for Head TSL

Date: 11.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d162

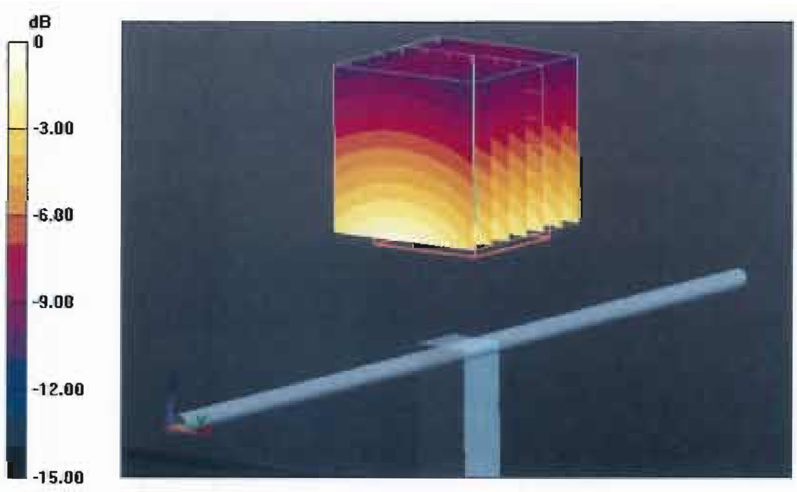
Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

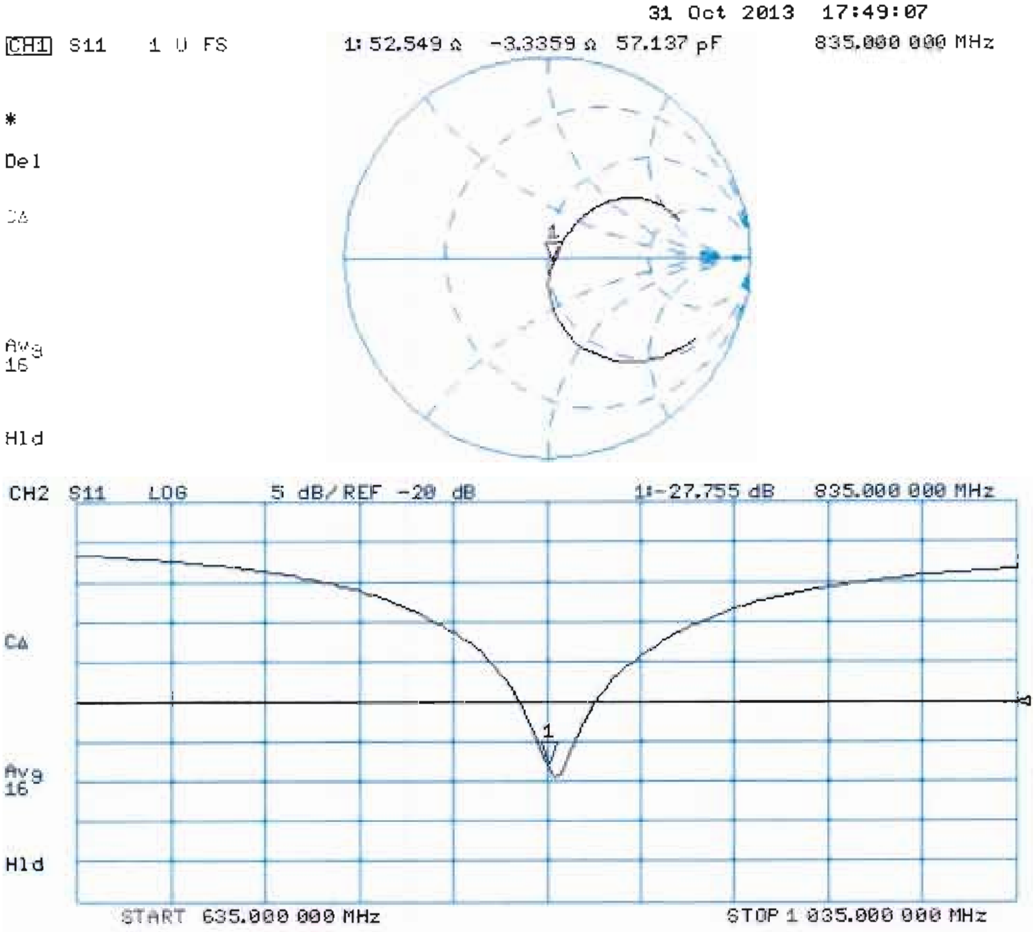
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.399 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 3.76 W/kg
SAR(1 g) = 2.47 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: 11.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d162

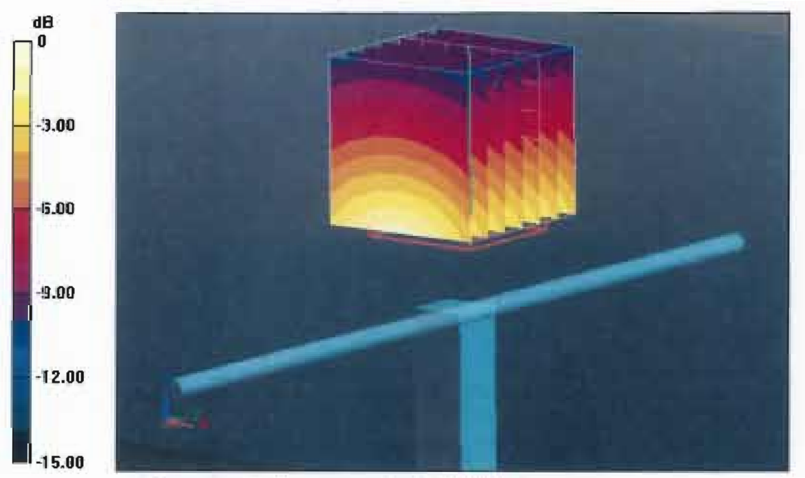
Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.007 S/m; ε_r = 54.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

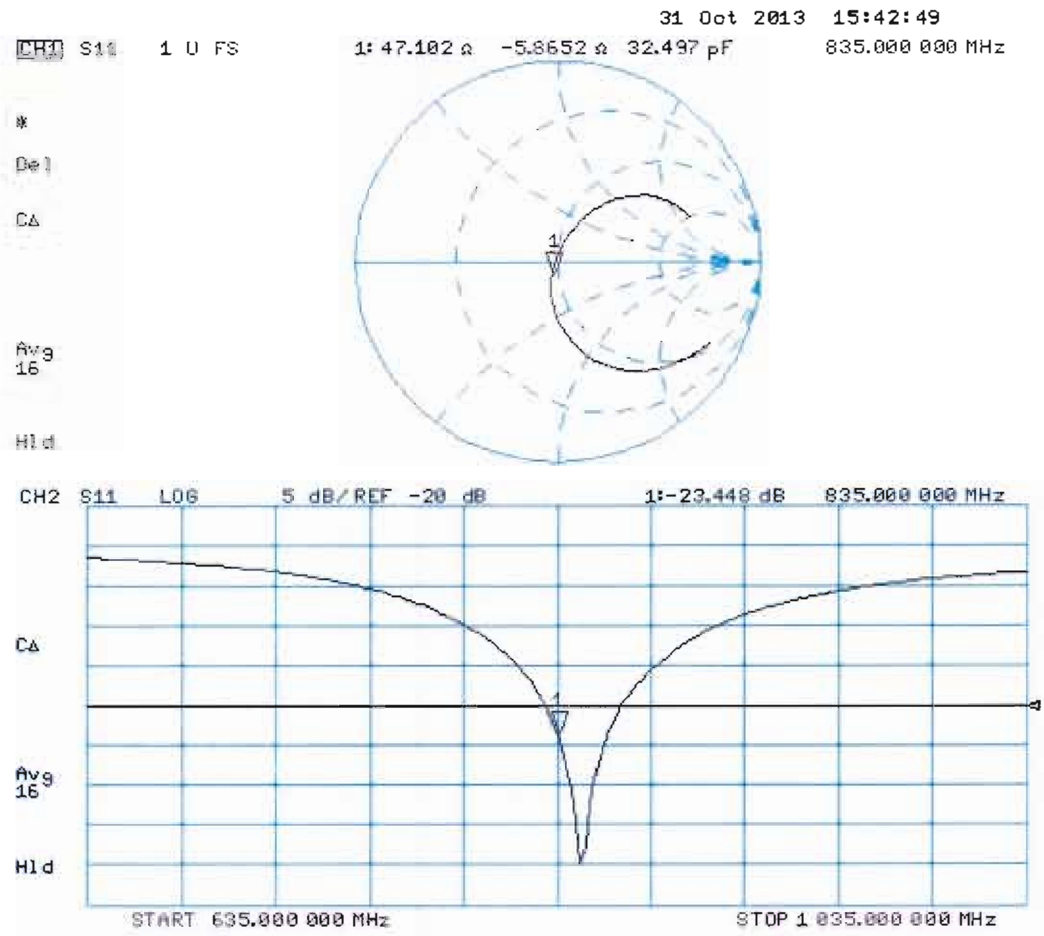
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.559 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.53 W/kg
SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.56 W/kg
Maximum value of SAR (measured) = 2.79 W/kg



0 dB = 2.79 W/kg = 4.46 dBW/kg

Impedance Measurement Plot for Body TSL



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

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

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

Accreditation No.: SCS 108

Client Sporton-TW (Auden)

Certificate No: D1900V2-5d182_Nov13

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d182
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	November 12, 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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 12, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 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 ± 0.2) °C	39.8 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.1 W/kg ± 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	**21.0 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.4 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.82 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**39.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.0 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω + 4.7 jΩ
Return Loss	- 24.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.4 Ω + 5.3 jΩ
Return Loss	- 25.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 23, 2013

DASY5 Validation Report for Head TSL

Date: 12.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

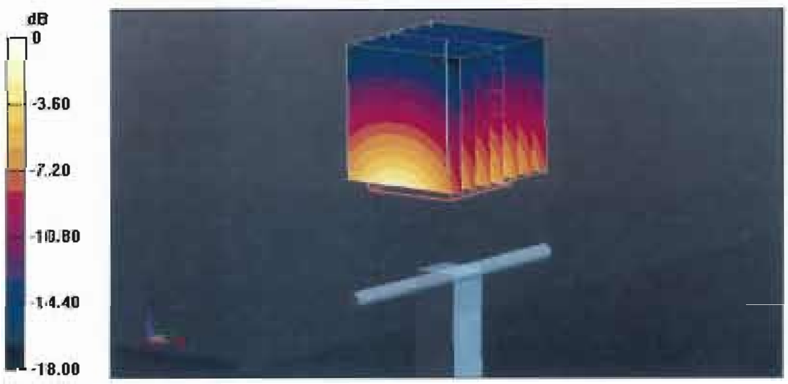
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d182

Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.39 S/m; ε_r = 39.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

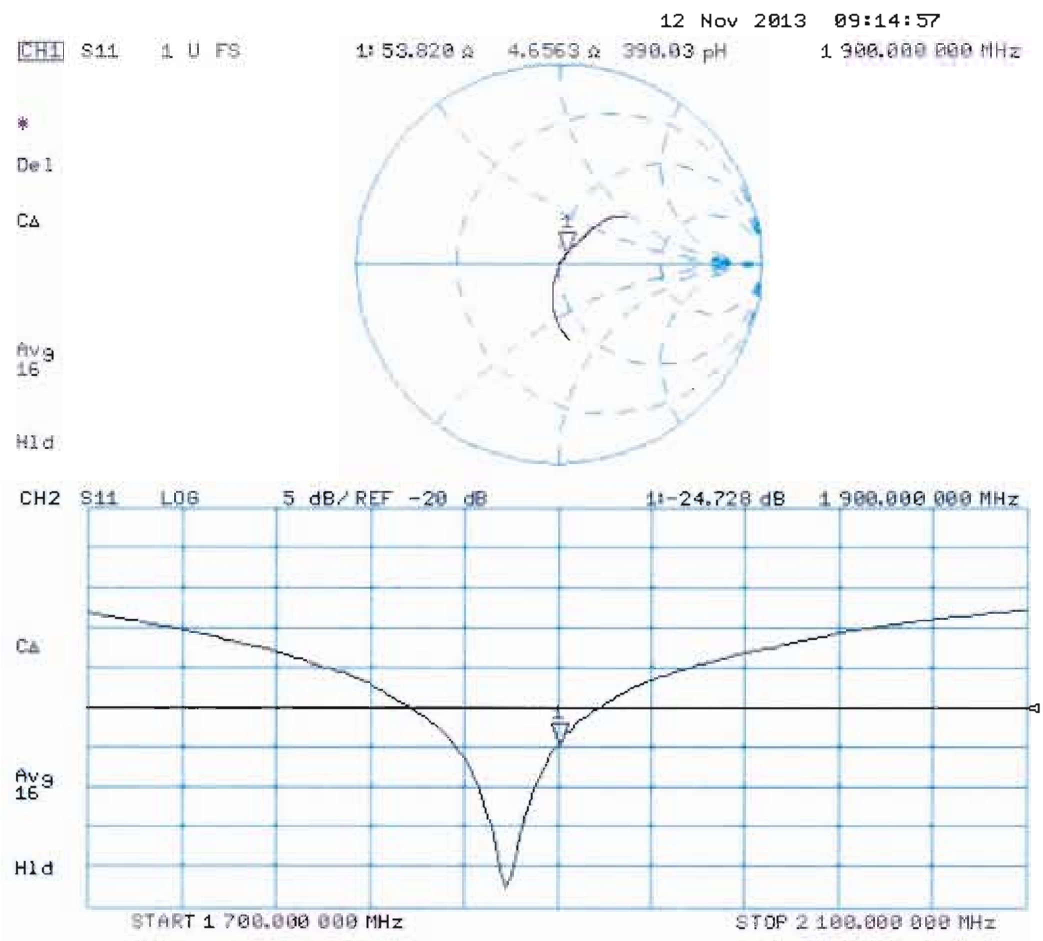
- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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 = 94.302 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 18.3 W/kg
SAR(1 g) = 10 W/kg; SAR(10 g) = 5.25 W/kg
Maximum value of SAR (measured) = 12.3 W/kg



0 dB = 12.3 W/kg = 10.90 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 12.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d182

Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.51 S/m; ε_r = 53.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

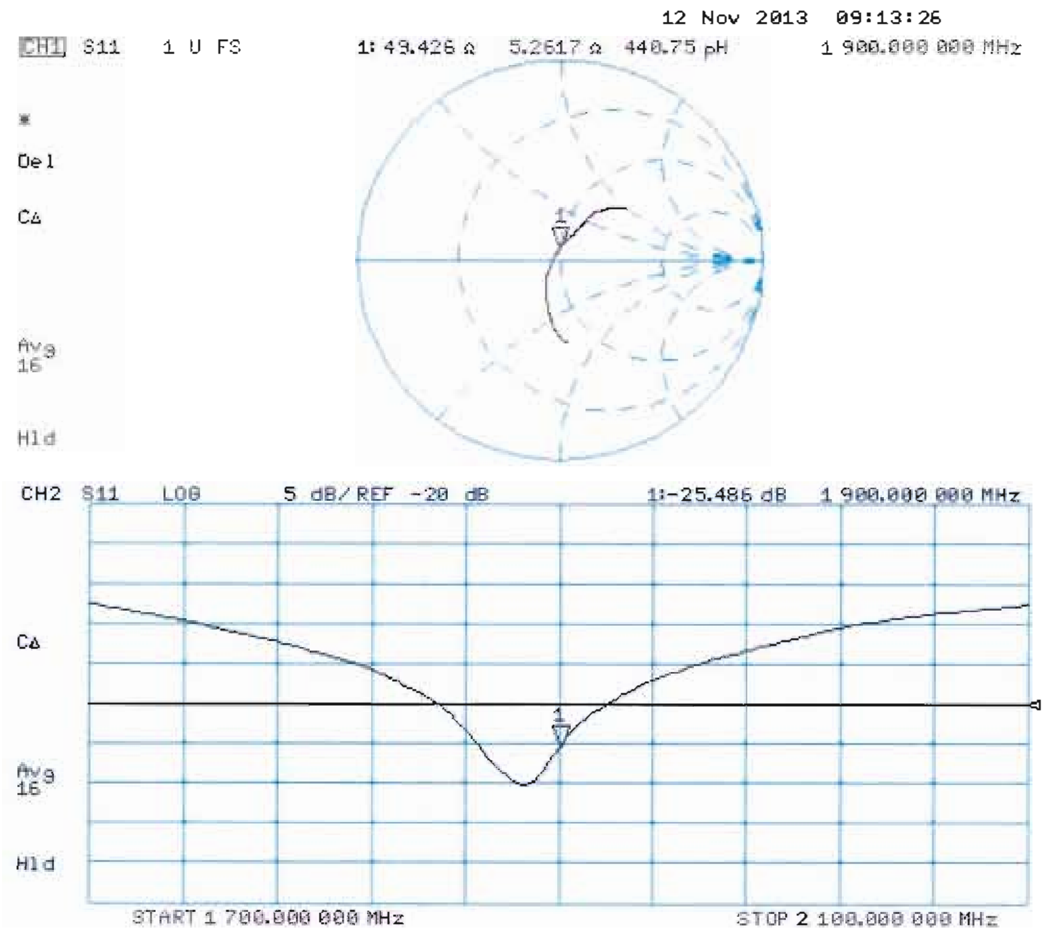
- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.302 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 16.8 W/kg
SAR(1 g) = 9.82 W/kg; SAR(10 g) = 5.23 W/kg
Maximum value of SAR (measured) = 12.2 W/kg

0 dB = 12.2 W/kg = 10.86 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: D2450V2-924_Nov13

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 924
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	November 13, 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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: November 13, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 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 ± 0.2) °C	39.7 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.4 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.1 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**50.2 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.4 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω + 2.6 jΩ
Return Loss	- 28.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω + 4.3 jΩ
Return Loss	- 27.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.154 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 26, 2013

DASY5 Validation Report for Head TSL

Date: 13.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.84 S/m; ε_r = 39.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

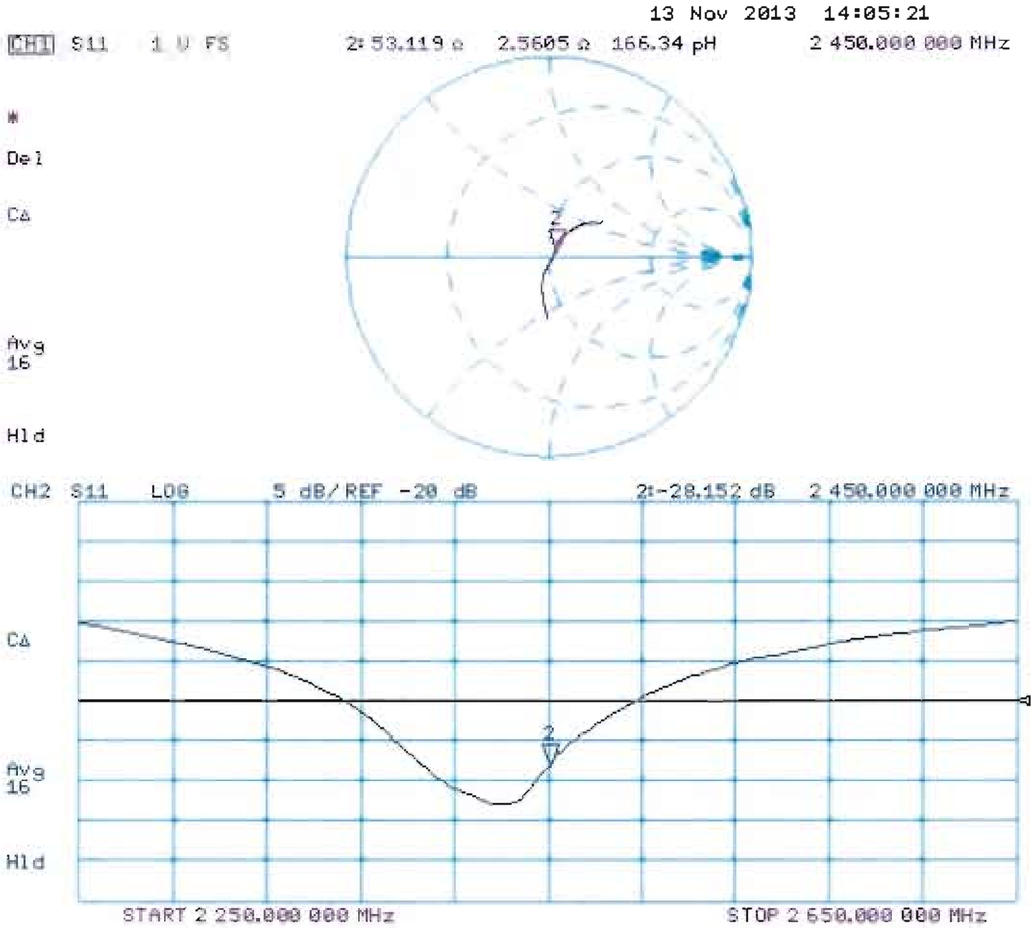
- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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 = 98.75 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.5 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.08 W/kg
Maximum value of SAR (measured) = 16.7 W/kg

0 dB = 16.7 W/kg = 12.23 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 52.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

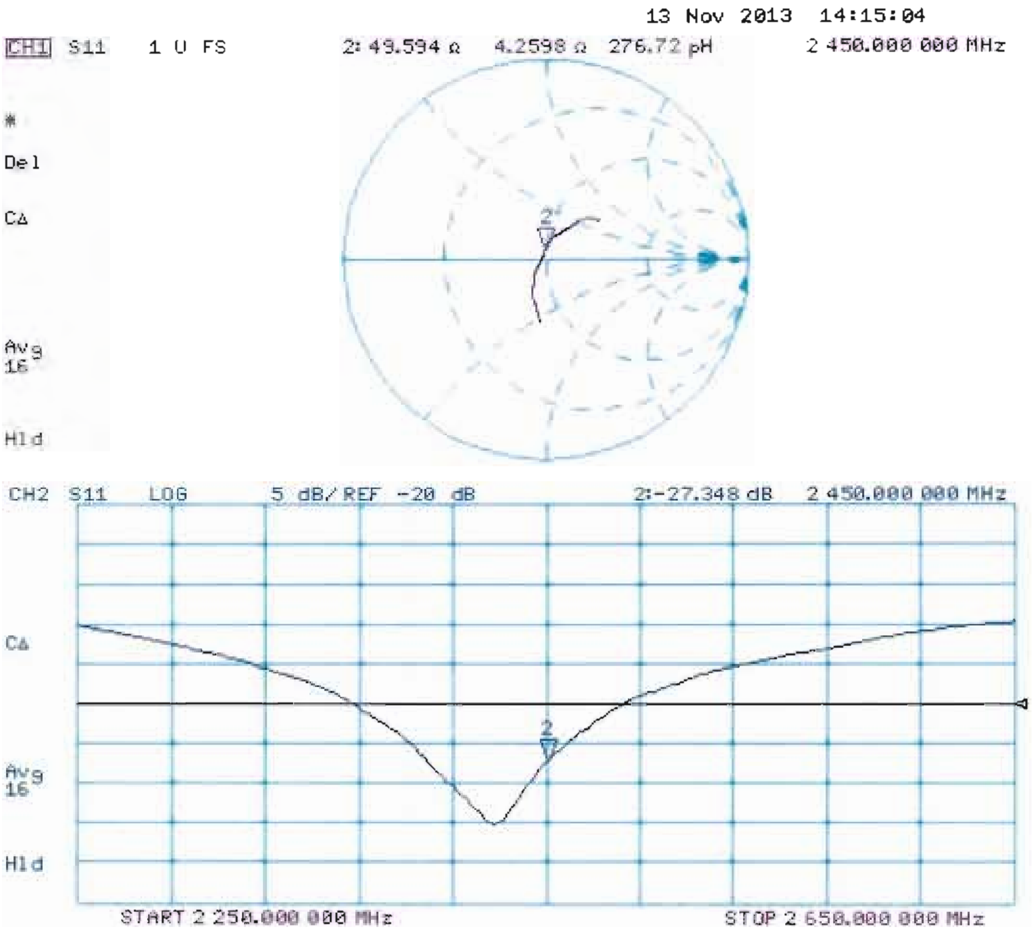
- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.726 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 26.8 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.92 W/kg
Maximum value of SAR (measured) = 16.8 W/kg

0 dB = 16.8 W/kg = 12.25 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: D2600V2-1070_Nov13

CALIBRATION CERTIFICATE

Object	D2600V2 - SN: 1070
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	November 13, 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	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-15
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: November 13, 2013

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.1 ± 6 %	2.01 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	14.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**56.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.5	2.16 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.7 ± 6 %	2.20 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	14.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**55.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.22 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**24.7 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.3 Ω - 5.0 jΩ
Return Loss	- 25.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.5 Ω - 4.0 jΩ
Return Loss	- 22.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.147 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	July 17, 2013

DASY5 Validation Report for Head TSL

Date: 13.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1070

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.01 S/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

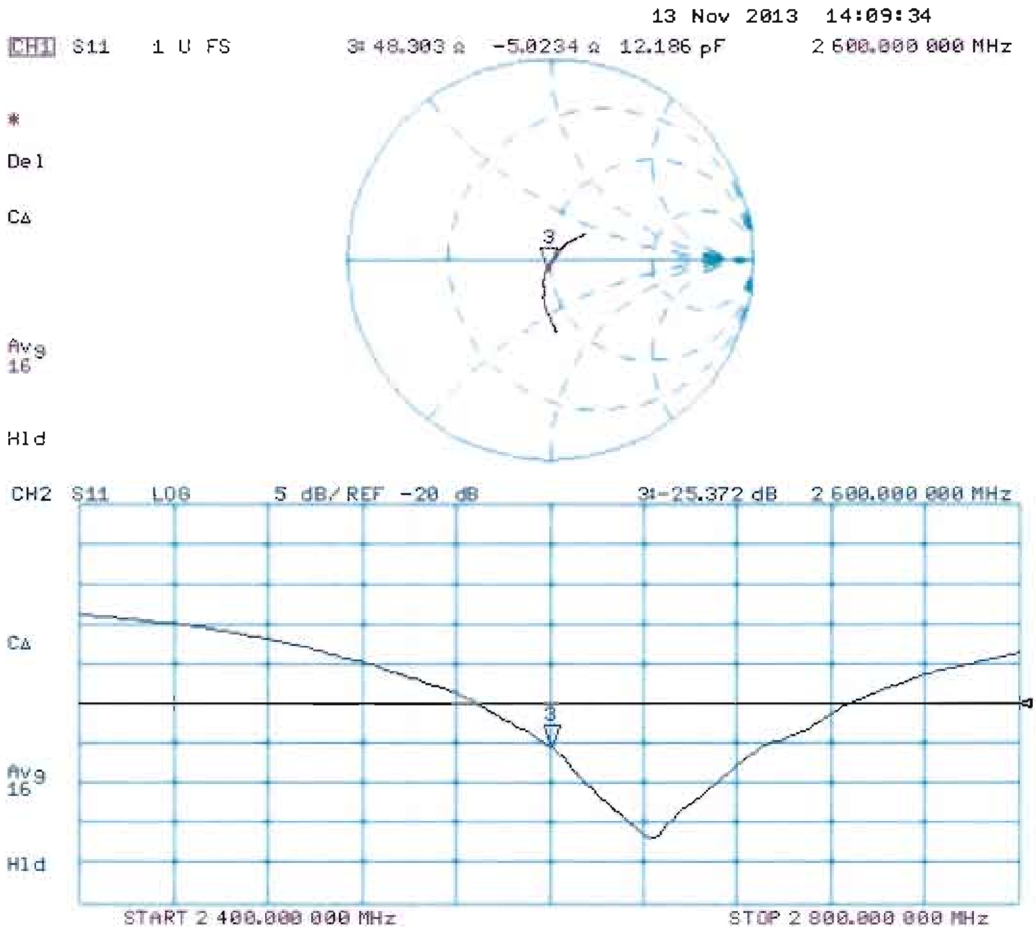
- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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 = 99.401 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.0 W/kg
SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.33 W/kg
Maximum value of SAR (measured) = 18.4 W/kg

0 dB = 18.4 W/kg = 12.65 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1070

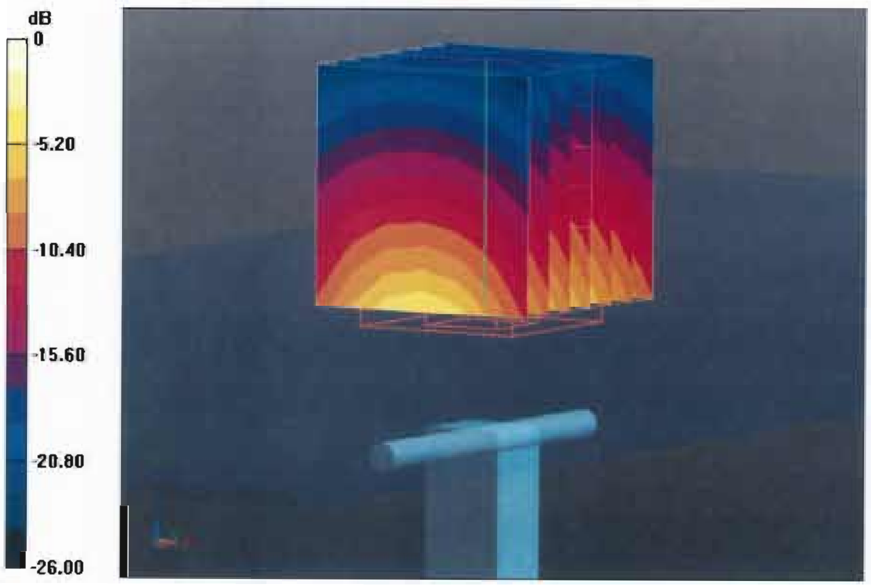
Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; σ = 2.2 S/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

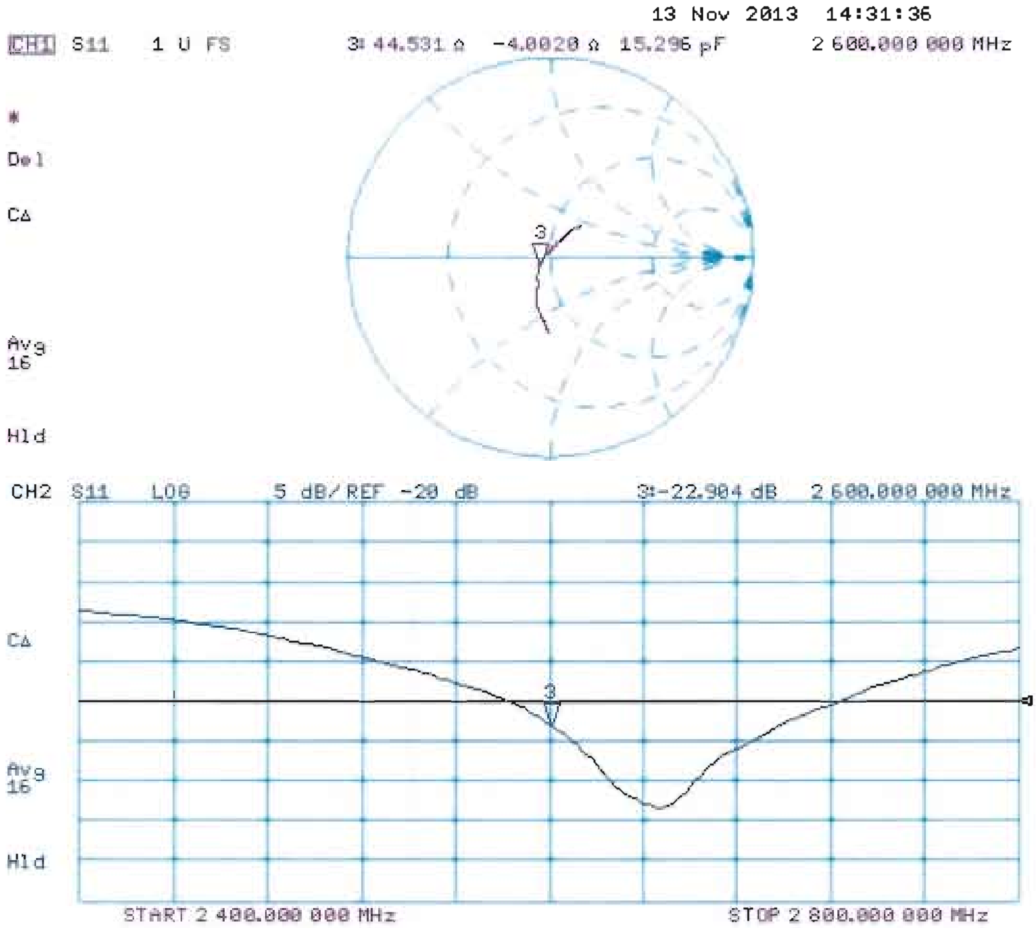
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.096 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 30.7 W/kg
SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.22 W/kg
Maximum value of SAR (measured) = 18.7 W/kg



0 dB = 18.7 W/kg = 12.72 dBW/kg

Impedance Measurement Plot for Body TSL



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IMPORTANT NOTICE

USAGE OF THE DAE 4

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

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

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

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

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

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

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

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

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

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Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: DAE4-778_Aug13

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 778
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	August 21, 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
Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

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

Issued: August 21, 2013

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

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

Calibration Factors	X	Y	Z
High Range	404.656 ± 0.02% (k=2)	403.459 ± 0.02% (k=2)	405.006 ± 0.02% (k=2)
Low Range	3.98558 ± 1.50% (k=2)	3.96461 ± 1.50% (k=2)	3.99935 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	283.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199995.77	0.06	0.00
Channel X	+ Input	20002.53	2.55	0.01
Channel X	- Input	-19999.49	1.92	-0.01
Channel Y	+ Input	199997.44	1.64	0.00
Channel Y	+ Input	20001.15	1.28	0.01
Channel Y	- Input	-20001.01	0.48	-0.00
Channel Z	+ Input	199996.91	1.45	0.00
Channel Z	+ Input	19997.43	-2.47	-0.01
Channel Z	- Input	-20003.75	-2.20	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.81	0.69	0.03
Channel X	+ Input	201.01	0.45	0.23
Channel X	- Input	-198.36	0.93	-0.46
Channel Y	+ Input	2000.40	0.37	0.02
Channel Y	+ Input	199.54	-0.90	-0.45
Channel Y	- Input	-200.61	-1.22	0.61
Channel Z	+ Input	2000.36	0.26	0.01
Channel Z	+ Input	199.66	-0.86	-0.43
Channel Z	- Input	-200.42	-1.13	0.56

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	-4.53	-5.58
	- 200	7.17	6.04
Channel Y	200	-1.81	-2.21
	- 200	-0.01	-0.08
Channel Z	200	-8.38	-9.43
	- 200	7.65	7.91

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	-	-1.57	-3.03
Channel Y	200	8.98	-	0.17
Channel Z	200	4.34	6.37	-

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	16059	17241
Channel Y	16174	15934
Channel Z	16438	15805

5. Input Offset Measurement

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

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.80	-0.20	1.81	0.38
Channel Y	-0.87	-2.38	0.78	0.61
Channel Z	-0.59	-1.80	0.66	0.51

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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IMPORTANT NOTICE

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

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

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

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

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

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

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

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

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Accreditation No.: SCS 108

Client **Sporton - TW (Auden)**

Certificate No: DAE4-1338_Nov13

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1338
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	November 05, 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
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-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

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

Issued: November 5, 2013

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

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

Calibration Factors	X	Y	Z
High Range	403.588 ± 0.02% (k=2)	404.163 ± 0.02% (k=2)	404.121 ± 0.02% (k=2)
Low Range	3.97535 ± 1.50% (k=2)	3.97840 ± 1.50% (k=2)	4.00168 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	61.5 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199991.54	-2.49	-0.00
Channel X	+ Input	19998.72	-0.84	-0.00
Channel X	- Input	-20001.49	-0.25	0.00
Channel Y	+ Input	199992.13	-1.44	-0.00
Channel Y	+ Input	19998.12	-1.38	-0.01
Channel Y	- Input	-20002.84	-1.55	0.01
Channel Z	+ Input	199991.31	-2.03	-0.00
Channel Z	+ Input	19996.91	-2.55	-0.01
Channel Z	- Input	-20003.07	-1.77	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.08	1.13	0.06
Channel X	+ Input	200.79	0.33	0.16
Channel X	- Input	-199.30	0.27	-0.14
Channel Y	+ Input	2000.90	1.18	0.06
Channel Y	+ Input	199.73	-0.49	-0.25
Channel Y	- Input	-200.57	-0.83	0.41
Channel Z	+ Input	2000.53	0.81	0.04
Channel Z	+ Input	199.26	-1.03	-0.52
Channel Z	- Input	-201.38	-1.66	0.83

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	7.85	6.28
	- 200	-4.77	-6.78
Channel Y	200	-21.63	-20.91
	- 200	19.72	19.81
Channel Z	200	-2.76	-2.99
	- 200	0.47	0.46

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	-	3.56	-3.27
Channel Y	200	8.51	-	4.88
Channel Z	200	9.57	6.01	-

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	16248	15963
Channel Y	16289	16472
Channel Z	16098	16221

5. Input Offset Measurement

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

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-0.93	-2.76	0.02	0.42
Channel Y	-1.27	-2.49	-0.40	0.43
Channel Z	-1.95	-3.07	-0.93	0.35

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 **Amphenol-TW (Auden)**

Certificate No: DAE3-495_May13

CALIBRATION CERTIFICATE

Object	DAE3 - SD 000 D03 AA - SN: 495
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	May 08, 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
Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

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

Issued: May 8, 2013

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Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

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

Calibration Factors	X	Y	Z
High Range	404.352 ± 0.02% (k=2)	405.328 ± 0.02% (k=2)	405.665 ± 0.02% (k=2)
Low Range	3.95207 ± 1.50% (k=2)	3.99043 ± 1.50% (k=2)	3.96554 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	78.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199989.76	-4.83	-0.00
Channel X	+ Input	20001.54	1.31	0.01
Channel X	- Input	-19995.66	4.92	-0.02
Channel Y	+ Input	199995.02	0.52	0.00
Channel Y	+ Input	19999.41	-0.85	-0.00
Channel Y	- Input	-19999.04	1.61	-0.01
Channel Z	+ Input	199994.06	-0.35	-0.00
Channel Z	+ Input	20002.32	2.10	0.01
Channel Z	- Input	-19998.30	2.51	-0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.20	0.48	0.02
Channel X	+ Input	201.11	0.01	0.00
Channel X	- Input	-198.46	0.25	-0.12
Channel Y	+ Input	2000.81	0.07	0.00
Channel Y	+ Input	200.89	-0.19	-0.09
Channel Y	- Input	-198.51	0.20	-0.10
Channel Z	+ Input	2000.56	-0.12	-0.01
Channel Z	+ Input	199.55	-1.51	-0.75
Channel Z	- Input	-199.07	-0.42	0.21

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	3.21	2.06
	- 200	-1.80	-2.79
Channel Y	200	0.11	-0.16
	- 200	-1.32	-1.56
Channel Z	200	3.11	2.75
	- 200	-4.96	-4.85

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	-	-1.15	-2.03
Channel Y	200	7.90	-	-0.39
Channel Z	200	5.07	5.33	-

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	15807	16438
Channel Y	15756	16559
Channel Z	15893	15989

5. Input Offset Measurement

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

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-3.55	-4.78	-2.32	0.53
Channel Y	0.18	-1.48	1.84	0.63
Channel Z	-0.04	-1.63	1.85	0.71

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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IMPORTANT NOTICE

USAGE OF THE DAE 4

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

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

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

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

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

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

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

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

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

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Accreditation No.: SCS 108

Client **Sporton - TW (Auden)**

Certificate No: DAE4-1399_Nov13

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1399
Calibration procedure(s)	QA CAL-06.v26 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	November 07, 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
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-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

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

Issued: November 7, 2013

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

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

Calibration Factors	X	Y	Z
High Range	403.576 ± 0.02% (k=2)	403.837 ± 0.02% (k=2)	403.694 ± 0.02% (k=2)
Low Range	3.99338 ± 1.50% (k=2)	3.98864 ± 1.50% (k=2)	3.95341 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	303.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199997.26	-0.61	-0.00
Channel X	+ Input	20001.91	1.03	0.01
Channel X	- Input	-19999.07	1.82	-0.01
Channel Y	+ Input	199998.80	1.10	0.00
Channel Y	+ Input	19999.34	-1.47	-0.01
Channel Y	- Input	-20001.19	-0.12	0.00
Channel Z	+ Input	199998.69	1.55	0.00
Channel Z	+ Input	19998.02	-2.80	-0.01
Channel Z	- Input	-20002.75	-1.69	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2002.09	1.09	0.05
Channel X	+ Input	201.25	-0.05	-0.02
Channel X	- Input	-198.06	0.36	-0.18
Channel Y	+ Input	2001.83	0.90	0.04
Channel Y	+ Input	200.93	-0.36	-0.18
Channel Y	- Input	-198.96	-0.48	0.24
Channel Z	+ Input	2001.86	1.03	0.05
Channel Z	+ Input	200.25	-0.93	-0.46
Channel Z	- Input	-199.87	-1.30	0.65

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	-4.61	-6.77
	- 200	8.22	6.43
Channel Y	200	-5.41	-6.04
	- 200	5.24	4.85
Channel Z	200	-7.82	-7.62
	- 200	5.24	5.18

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	-	5.08	-1.79
Channel Y	200	9.74	-	6.74
Channel Z	200	8.83	7.35	-

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Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: ES3-3270_Sep13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3270
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 24, 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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Apr-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-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: September 26, 2013

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3270

Manufactured: February 25, 2010
Calibrated: September 24, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3270

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.11	1.20	1.22	± 10.1 %
DCP (mV)[B]	99.9	102.5	100.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√µV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	194.6	±2.7 %
		Y	0.0	0.0	1.0		153.1	
		Z	0.0	0.0	1.0		149.9	

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3270

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	41.5	0.90	6.18	6.18	6.18	0.40	1.59	± 12.0 %
900	41.5	0.97	6.06	6.06	6.06	0.80	1.10	± 12.0 %
1750	40.1	1.37	5.26	5.26	5.26	0.80	1.09	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.58	1.37	± 12.0 %
2000	40.0	1.40	5.06	5.06	5.06	0.59	1.35	± 12.0 %
2450	39.2	1.80	4.53	4.53	4.53	0.80	1.26	± 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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3270

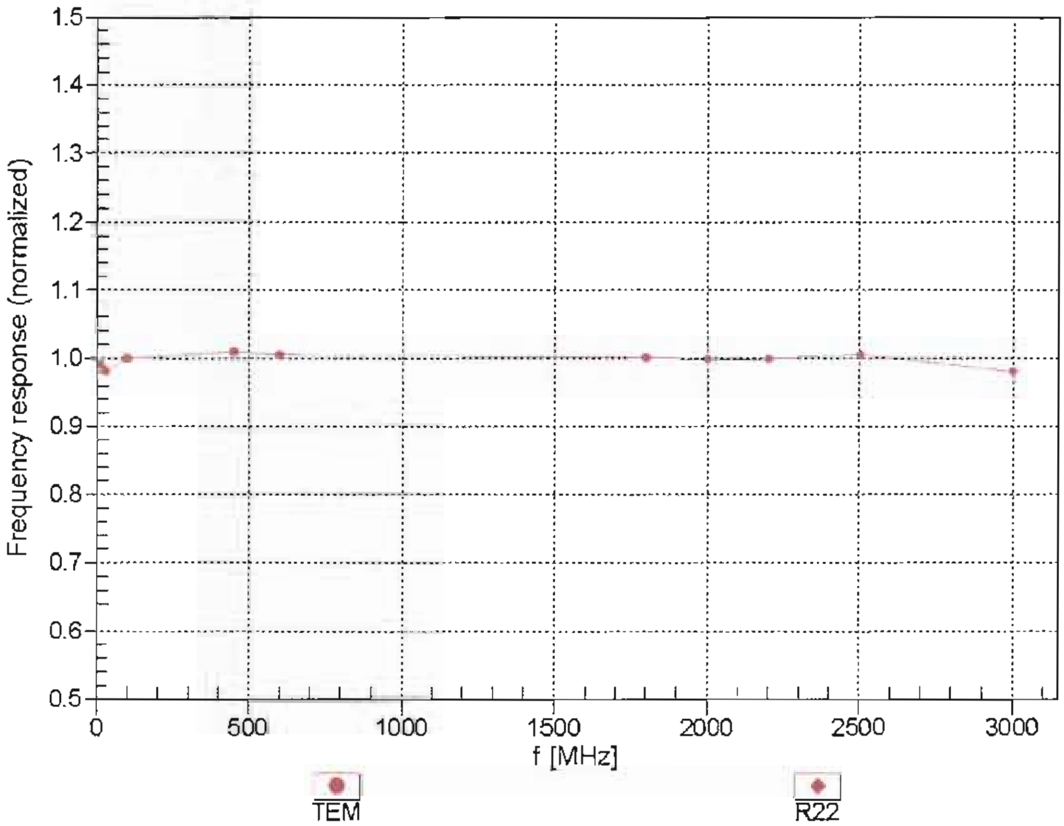
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	6.08	6.08	6.08	0.57	1.38	± 12.0 %
900	55.0	1.05	5.98	5.98	5.98	0.80	1.14	± 12.0 %
1750	53.4	1.49	4.91	4.91	4.91	0.55	1.50	± 12.0 %
1900	53.3	1.52	4.71	4.71	4.71	0.57	1.50	± 12.0 %
2000	53.3	1.52	4.78	4.78	4.78	0.60	1.46	± 12.0 %
2450	52.7	1.95	4.28	4.28	4.28	0.80	1.09	± 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.

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

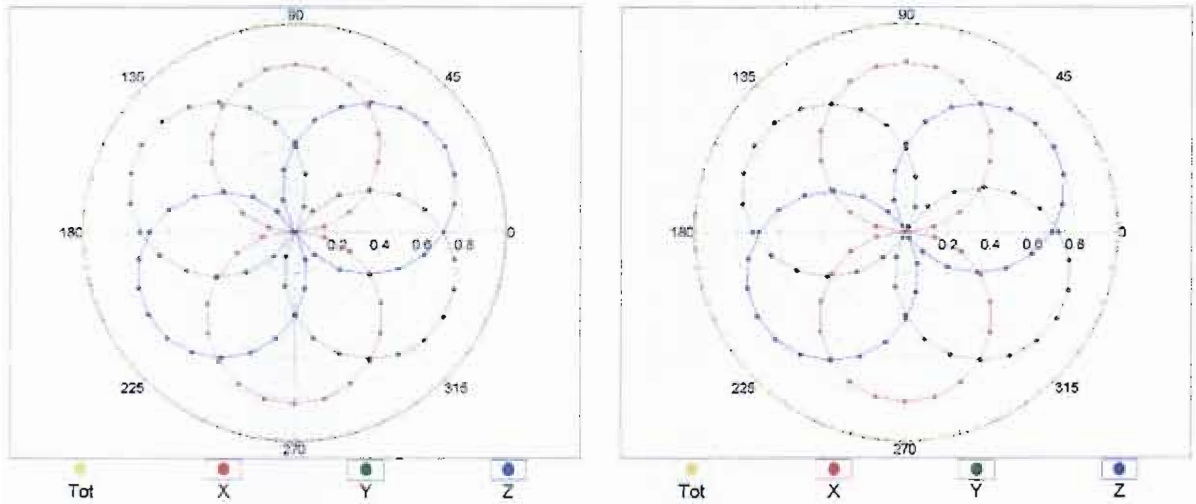


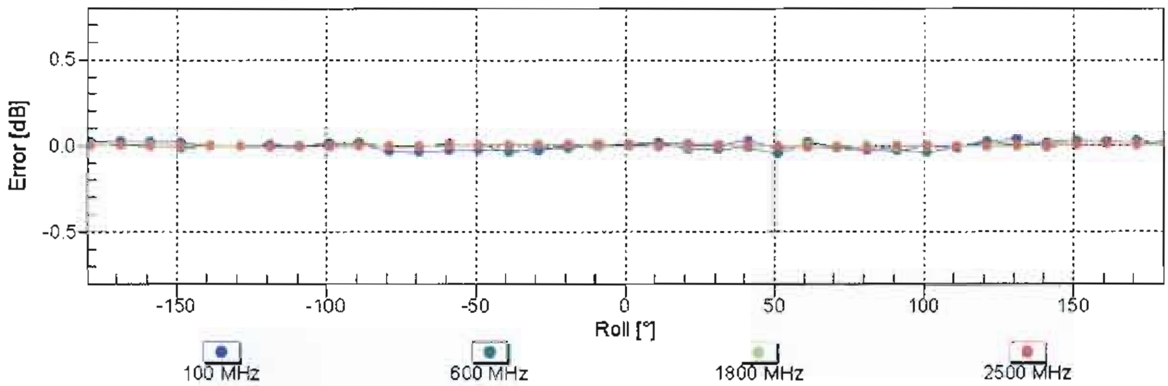
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM

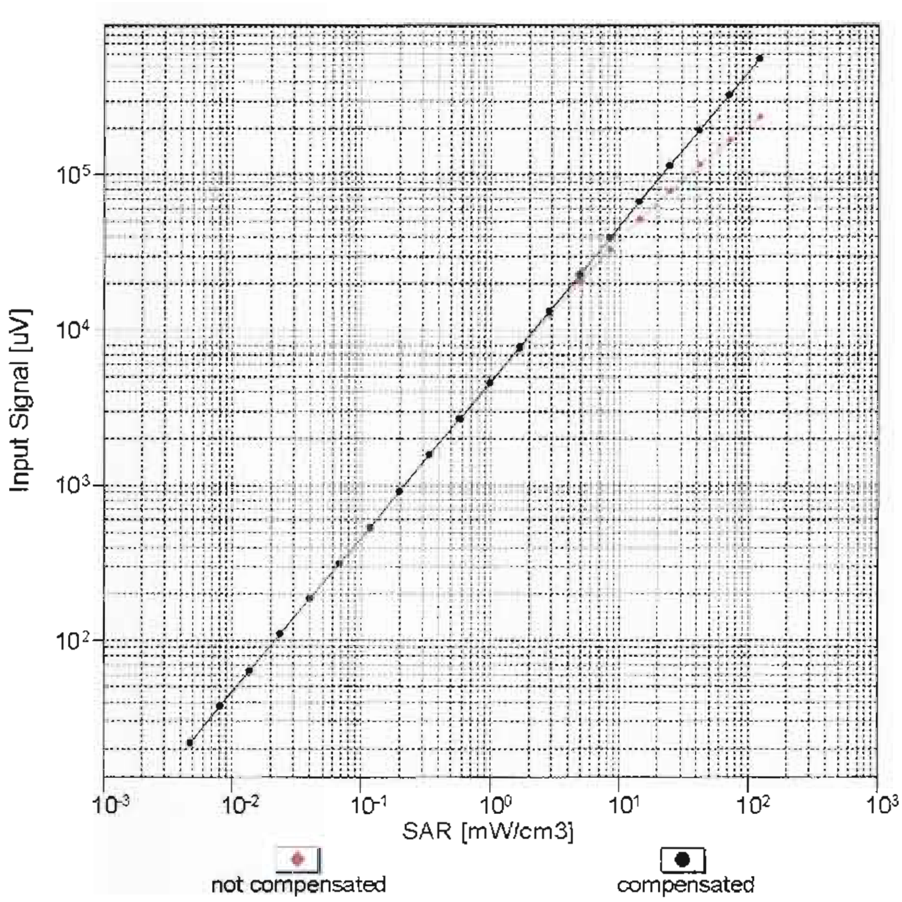
f=1800 MHz,R22

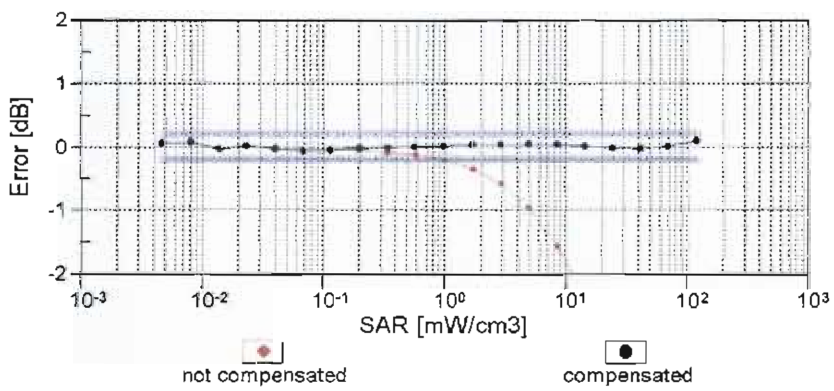




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

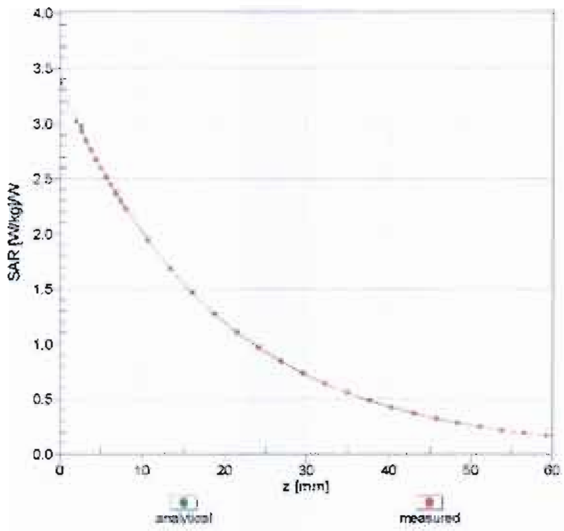




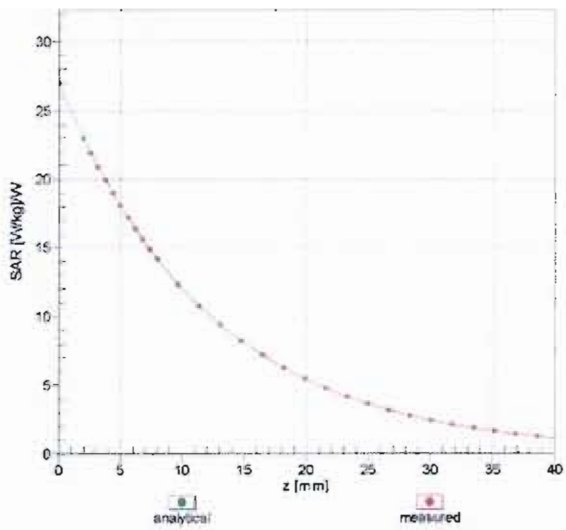
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

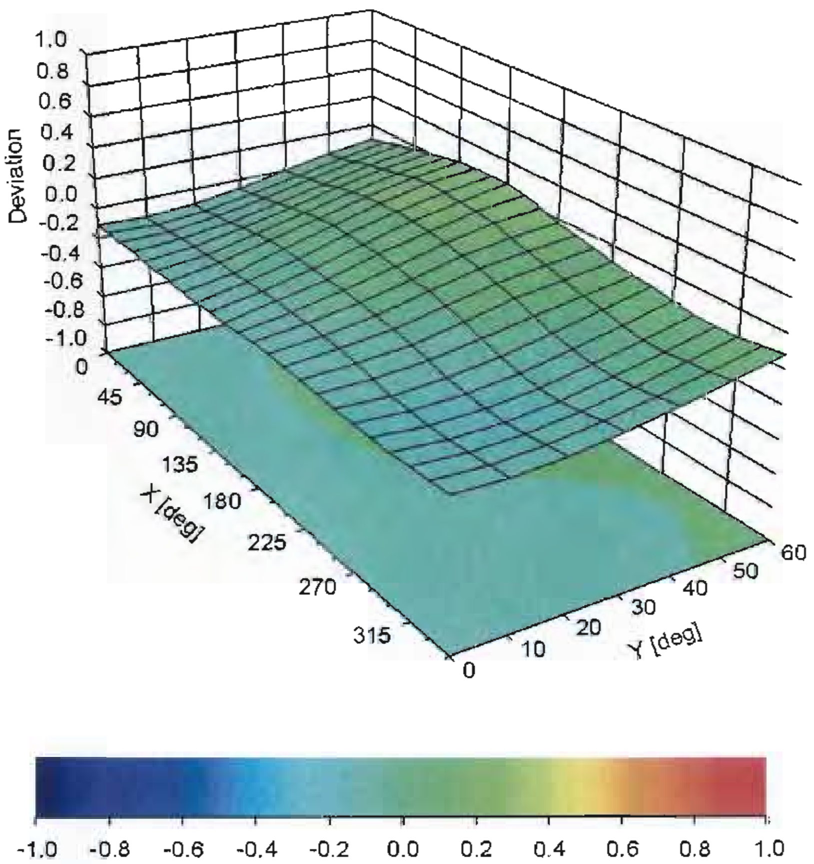


f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3270

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-18.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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

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

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

Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: EX3-3935_Nov13

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3935
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 4, 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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-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-15
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: November 4, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3935

Manufactured: July 24, 2013
Calibrated: November 4, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.50	0.54	0.49	± 10.1 %
DCP (mV)[B]	103.3	98.8	100.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	167.0	±2.7 %
		Y	0.0	0.0	1.0		172.1	
		Z	0.0	0.0	1.0		171.9	

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

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)
835	41.5	0.90	10.11	10.11	10.11	0.34	0.96	± 12.0 %
900	41.5	0.97	9.98	9.98	9.98	0.39	0.85	± 12.0 %
1750	40.1	1.37	8.54	8.54	8.54	0.78	0.62	± 12.0 %
1900	40.0	1.40	8.27	8.27	8.27	0.62	0.72	± 12.0 %
2000	40.0	1.40	8.25	8.25	8.25	0.42	0.83	± 12.0 %
2300	39.5	1.67	7.81	7.81	7.81	0.40	0.81	± 12.0 %
2450	39.2	1.80	7.43	7.43	7.43	0.62	0.63	± 12.0 %
2600	39.0	1.96	7.27	7.27	7.27	0.37	0.85	± 12.0 %
3500	37.9	2.91	6.99	6.99	6.99	0.41	1.00	± 13.1 %
5200	36.0	4.66	5.29	5.29	5.29	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.03	5.03	5.03	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.90	4.90	4.90	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.62	4.62	4.62	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.52	4.52	4.52	0.40	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

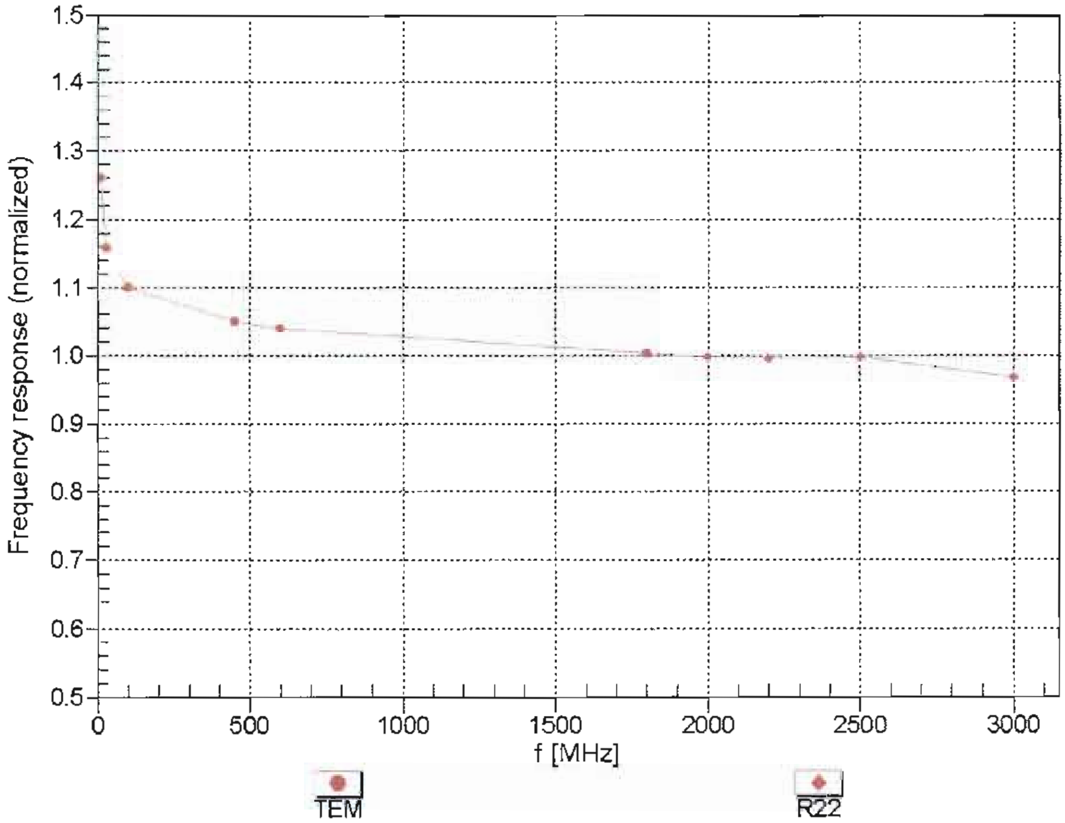
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

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)
835	55.2	0.97	10.09	10.09	10.09	0.38	0.89	± 12.0 %
900	55.0	1.05	9.86	9.86	9.86	0.43	0.87	± 12.0 %
1750	53.4	1.49	8.30	8.30	8.30	0.76	0.62	± 12.0 %
1900	53.3	1.52	7.85	7.85	7.85	0.58	0.68	± 12.0 %
2000	53.3	1.52	7.95	7.95	7.95	0.51	0.71	± 12.0 %
2300	52.9	1.81	7.62	7.62	7.62	0.62	0.68	± 12.0 %
2450	52.7	1.95	7.32	7.32	7.32	0.78	0.59	± 12.0 %
2600	52.5	2.16	7.08	7.08	7.08	0.80	0.50	± 12.0 %
3500	51.3	3.31	6.78	6.78	6.78	0.30	1.35	± 13.1 %
5200	49.0	5.30	4.61	4.61	4.61	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.18	4.18	4.18	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.83	3.83	3.83	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.69	3.69	3.69	0.55	1.90	± 13.1 %
5800	48.2	6.00	4.09	4.09	4.09	0.50	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

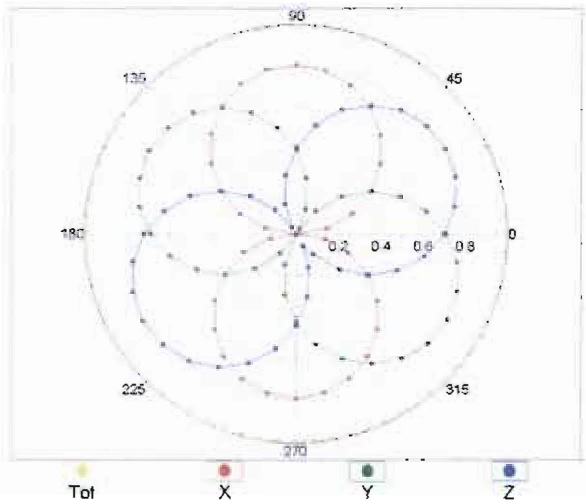
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



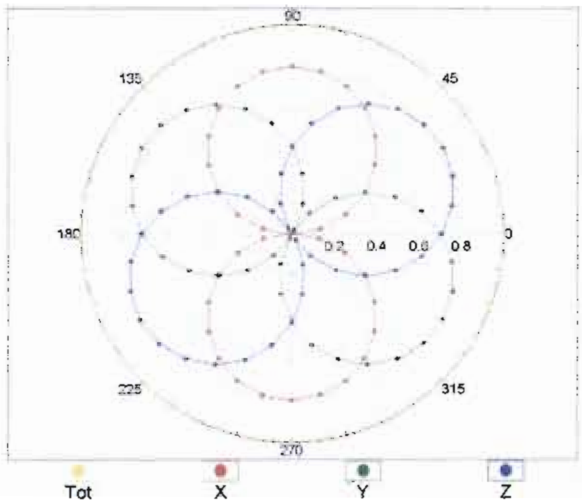
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

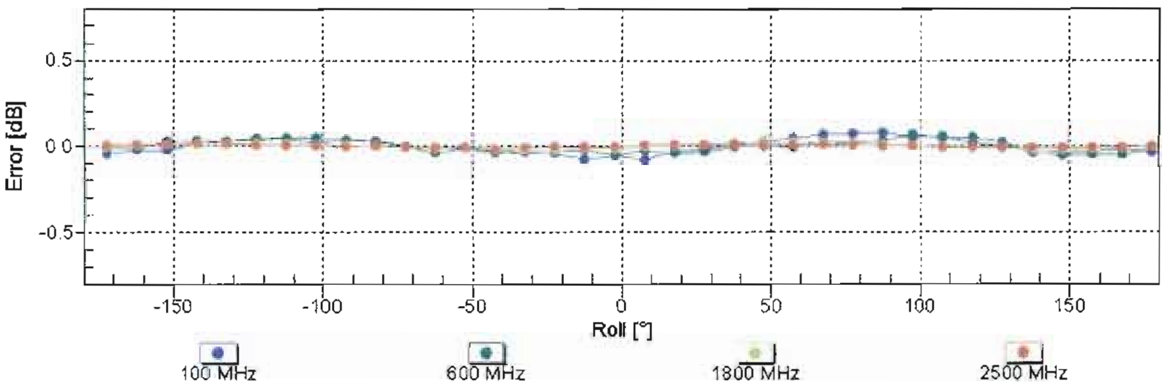
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

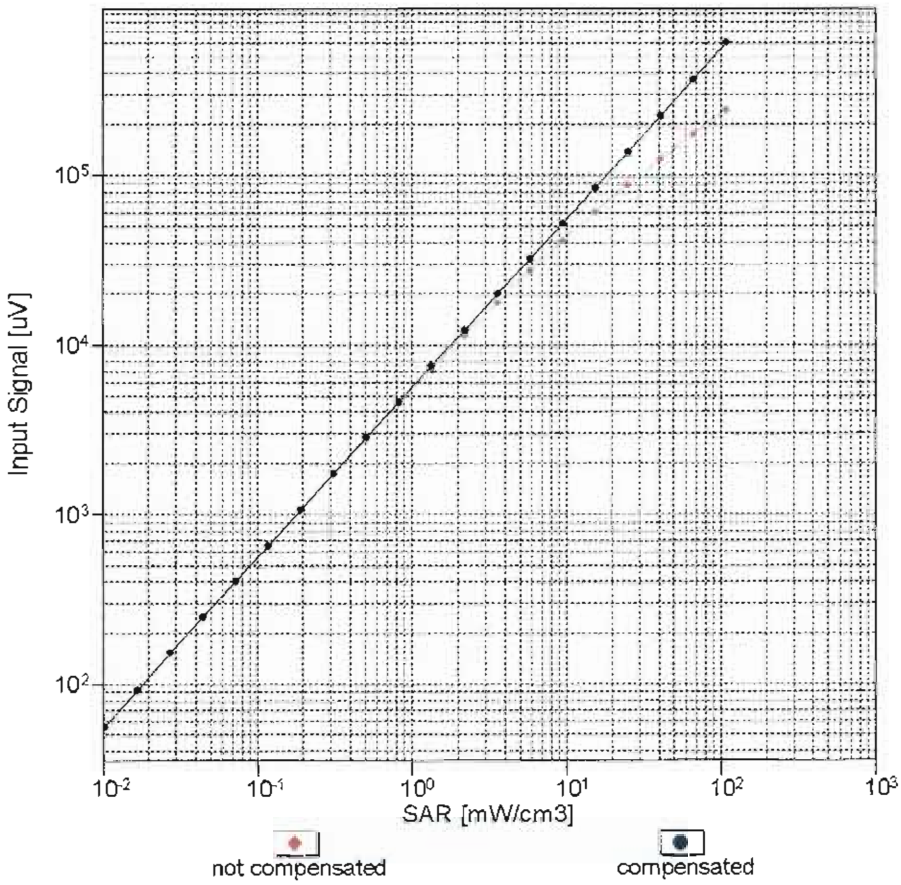


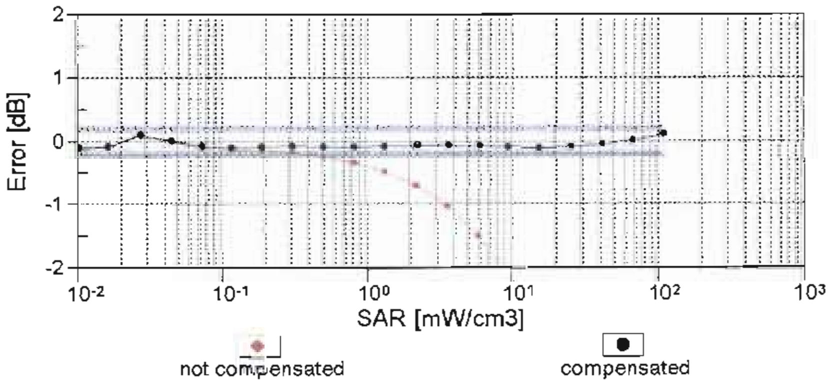


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f = 900 MHz)

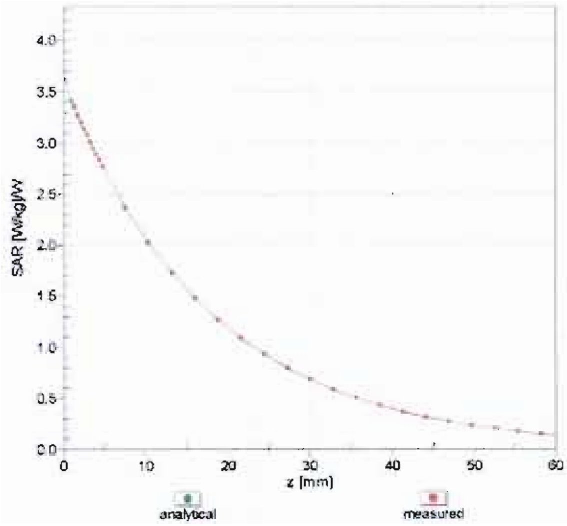




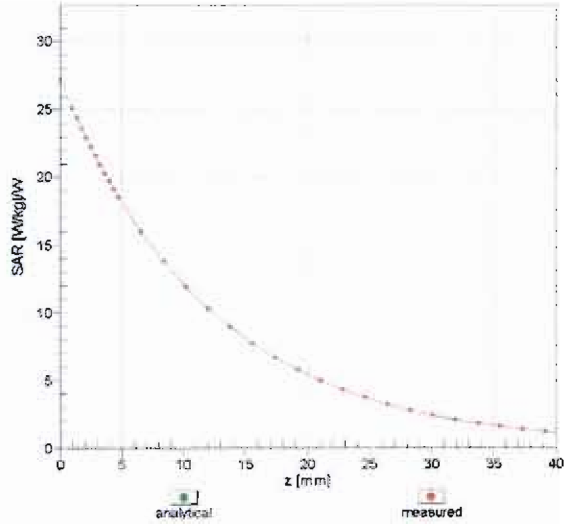
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

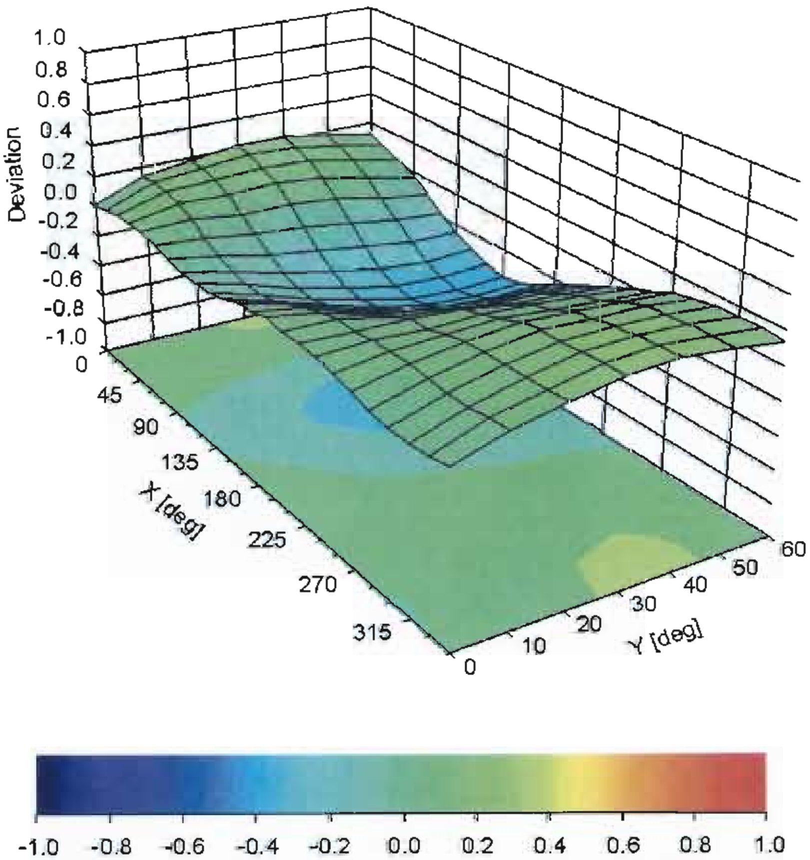


f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3935

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-142.2
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

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

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

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

Accreditation No.: **SCS 108**

Client **Sporton -TW (Auden)**

Certificate No: **EX3-3925_Jun13**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3925
Calibration procedure(s)	QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	June 12, 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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-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-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 12, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3925

Manufactured: March 8, 2013
Calibrated: June 12, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3925

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.59	0.52	0.50	± 10.1 %
DCP (mV)[B]	98.2	98.5	98.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.8	±3.5 %
		Y	0.0	0.0	1.0		175.7	
		Z	0.0	0.0	1.0		169.4	

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3925

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	10.34	10.34	10.34	0.44	0.80	± 12.0 %
835	41.5	0.90	9.87	9.87	9.87	0.29	0.99	± 12.0 %
1750	40.1	1.37	8.36	8.36	8.36	0.56	0.72	± 12.0 %
1900	40.0	1.40	8.13	8.13	8.13	0.37	0.91	± 12.0 %
2150	39.7	1.53	7.89	7.89	7.89	0.54	0.74	± 12.0 %
2450	39.2	1.80	7.25	7.25	7.25	0.59	0.72	± 12.0 %
5200	36.0	4.66	5.25	5.25	5.25	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.01	5.01	5.01	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.89	4.89	4.89	0.30	1.80	± 13.1 %
5600	35.5	5.07	4.73	4.73	4.73	0.30	1.80	± 13.1 %
5800	35.3	5.27	4.48	4.48	4.48	0.40	1.80	± 13.1 %

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

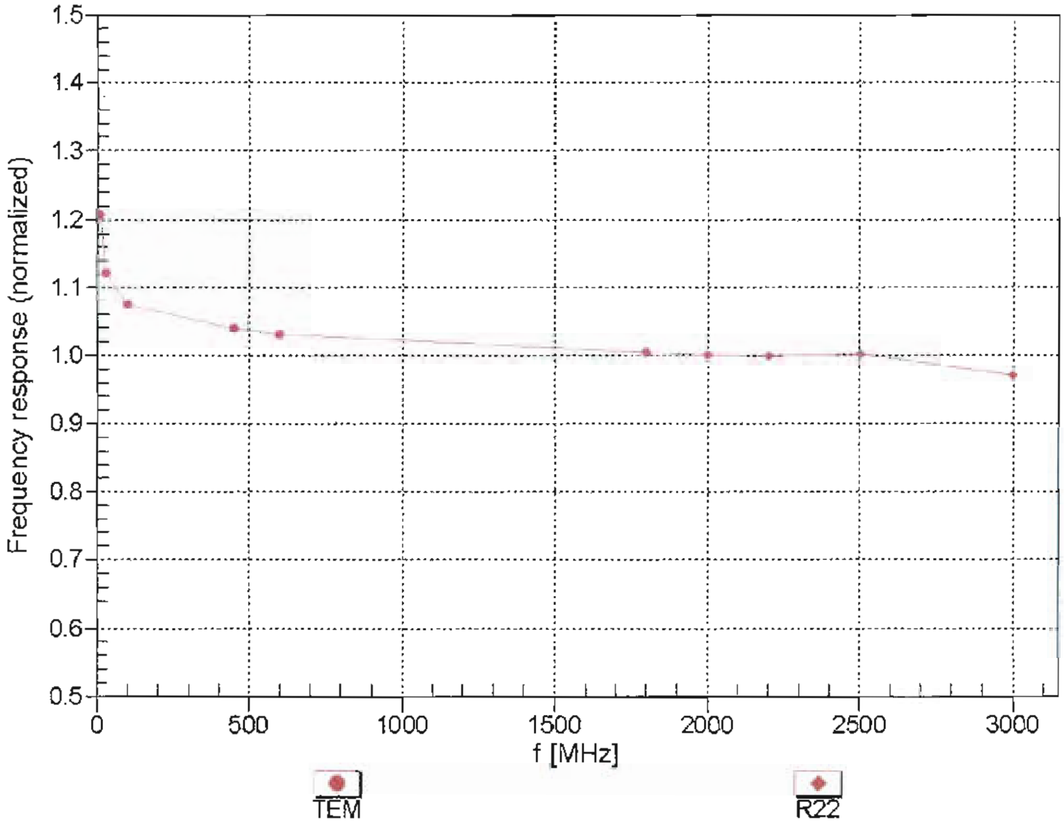
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3925

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	10.24	10.24	10.24	0.34	0.99	± 12.0 %
835	55.2	0.97	10.02	10.02	10.02	0.47	0.84	± 12.0 %
1750	53.4	1.49	8.31	8.31	8.31	0.79	0.61	± 12.0 %
1900	53.3	1.52	7.91	7.91	7.91	0.36	0.91	± 12.0 %
2150	53.1	1.66	7.80	7.80	7.80	0.64	0.66	± 12.0 %
2450	52.7	1.95	7.44	7.44	7.44	0.80	0.57	± 12.0 %
5200	49.0	5.30	4.41	4.41	4.41	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.26	4.26	4.26	0.40	1.90	± 13.1 %
5500	48.6	5.65	3.98	3.98	3.98	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.78	3.78	3.78	0.50	1.90	± 13.1 %
5800	48.2	6.00	4.00	4.00	4.00	0.50	1.90	± 13.1 %

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

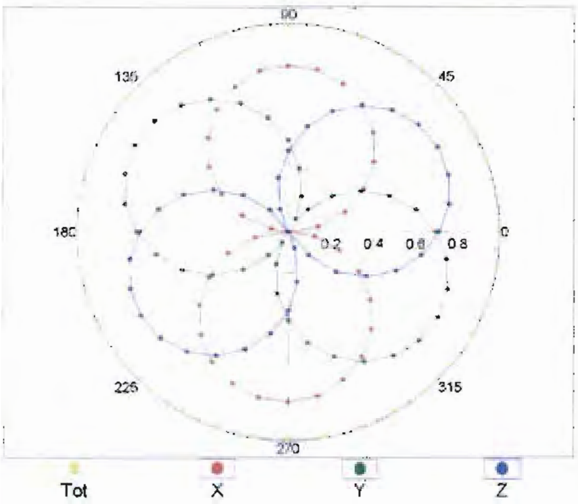
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



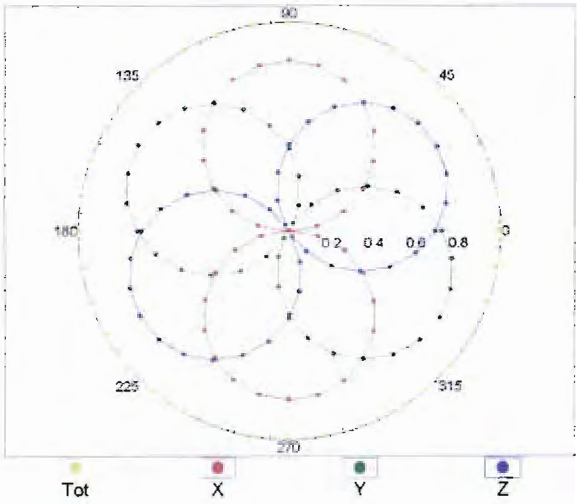
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

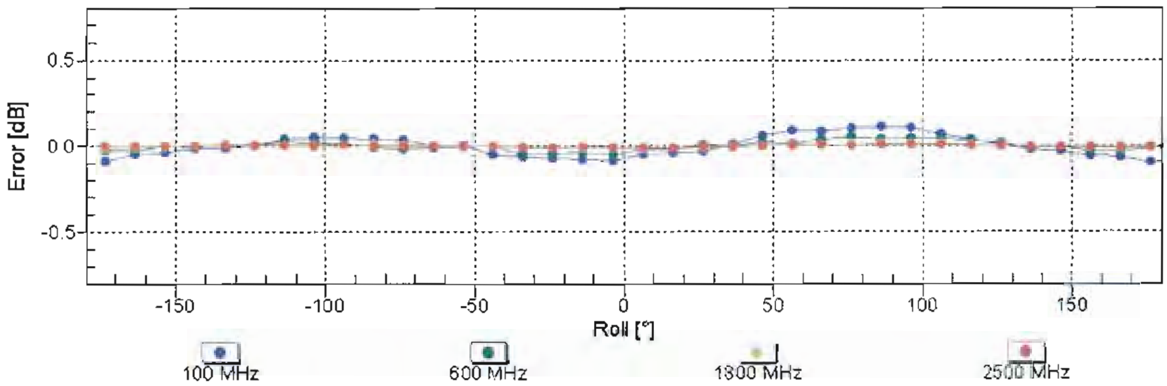
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



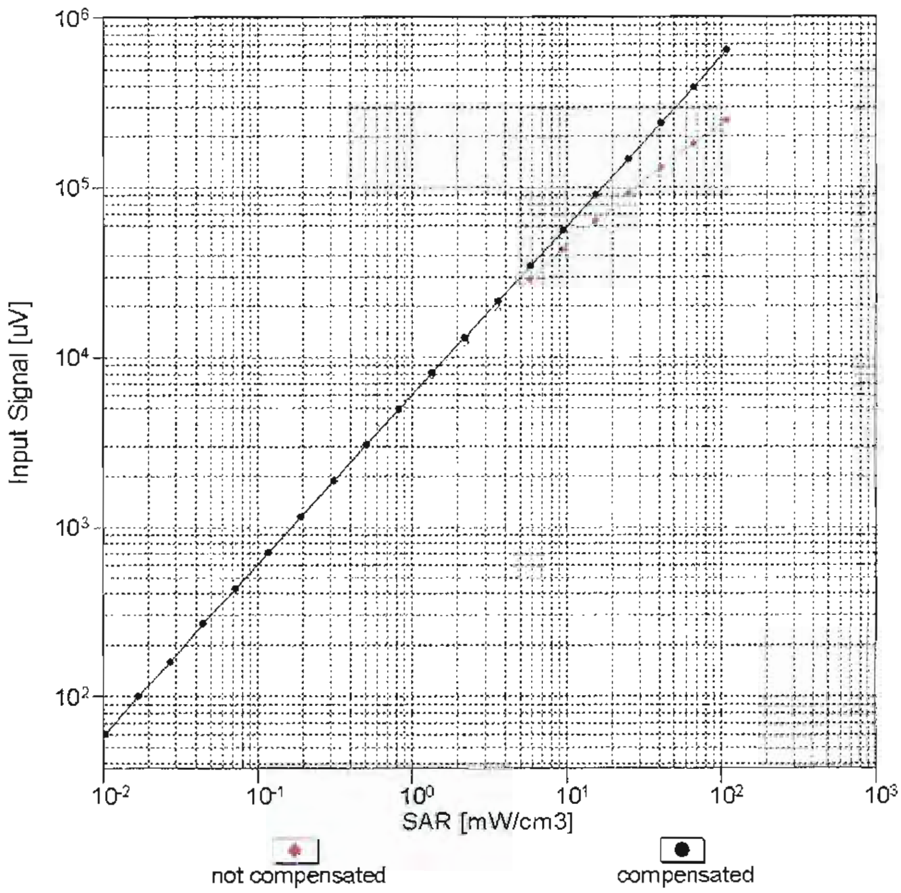
f=1800 MHz,R22

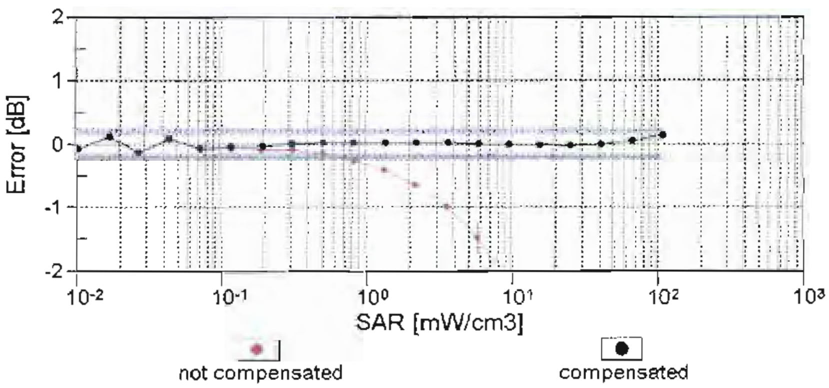




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

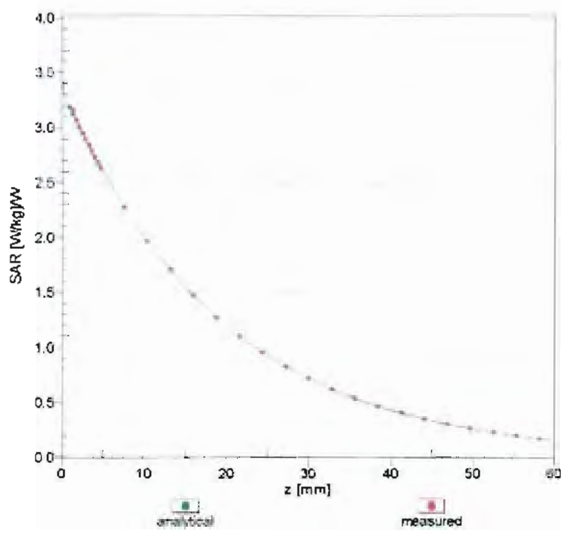




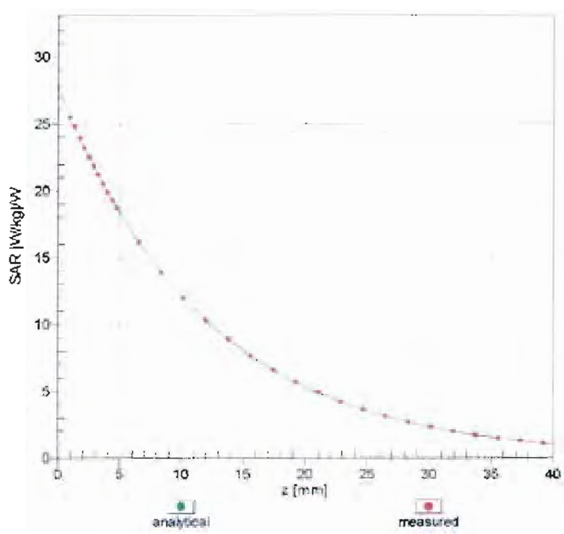
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

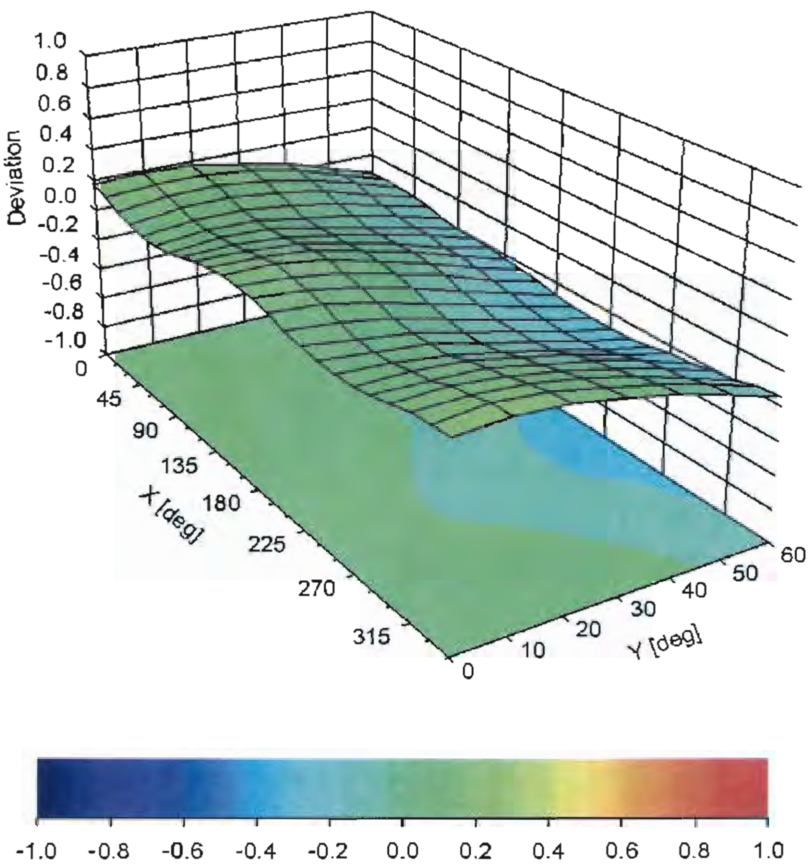


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3925

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-93.4
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

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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S Servizio svizzero di taratura
Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **Sporton-TW (Auden)**

Certificate No: EX3-3955_Nov13

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3955
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	November 12, 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 E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-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-15
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: November 12, 2013

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3955

Manufactured: August 6, 2013
Calibrated: November 12, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3955

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.35	0.41	0.32	± 10.1 %
DCP (mV)[B]	99.7	103.0	102.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	134.5	±2.7 %
		Y	0.0	0.0	1.0		144.1	
		Z	0.0	0.0	1.0		161.3	

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

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3955

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	10.24	10.24	10.24	0.29	1.08	± 12.0 %
2450	39.2	1.80	7.29	7.29	7.29	0.34	0.81	± 12.0 %
5200	36.0	4.66	5.14	5.14	5.14	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.86	4.86	4.86	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.83	4.83	4.83	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.64	4.64	4.64	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.61	4.61	4.61	0.40	1.80	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

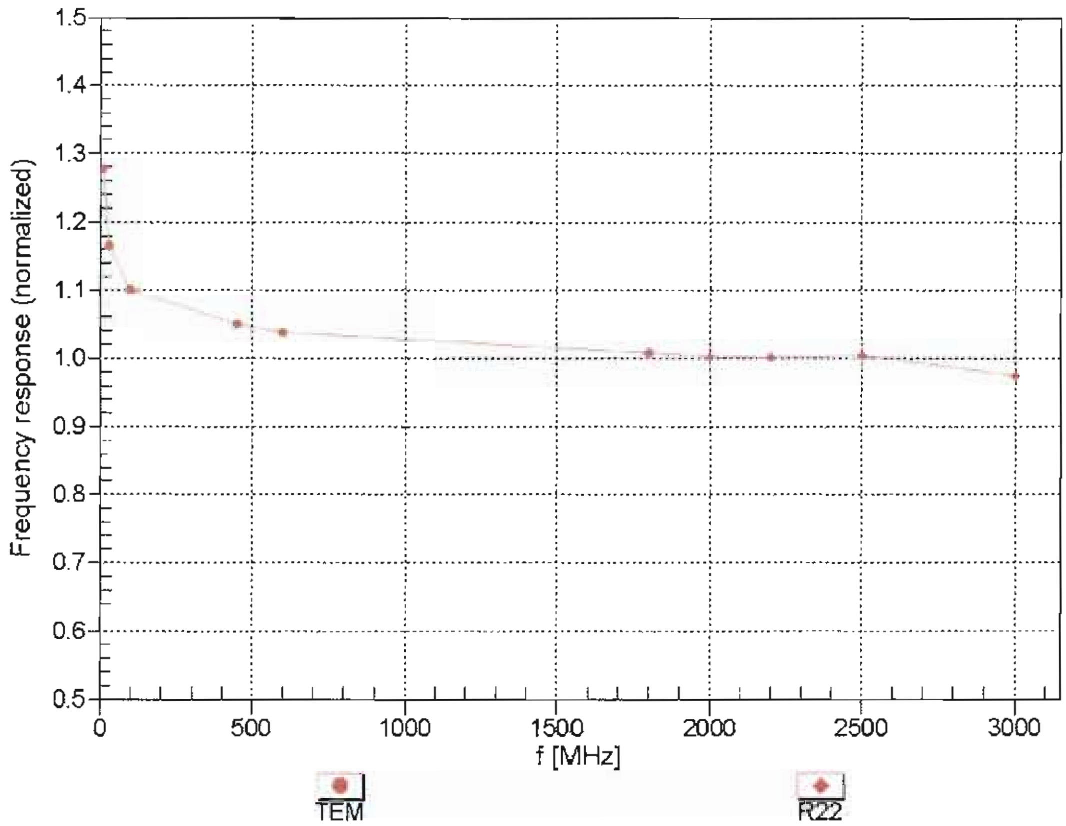
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3955

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	9.89	9.89	9.89	0.37	0.93	± 12.0 %
2450	52.7	1.95	7.42	7.42	7.42	0.76	0.58	± 12.0 %
5200	49.0	5.30	4.64	4.64	4.64	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.36	4.36	4.36	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.32	4.32	4.32	0.40	1.90	± 13.1 %
5600	48.5	5.77	4.27	4.27	4.27	0.30	1.90	± 13.1 %
5800	48.2	6.00	4.25	4.25	4.25	0.45	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

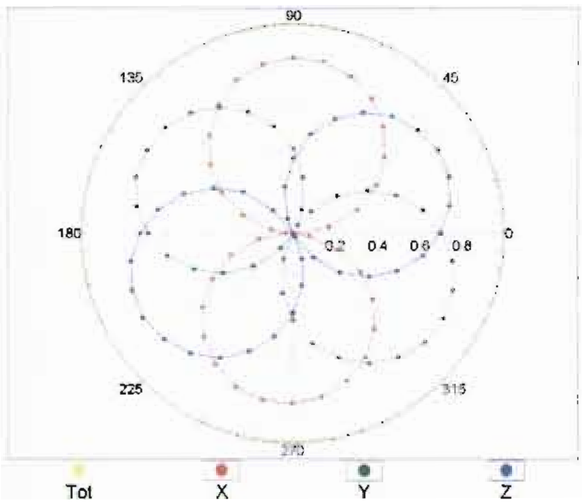
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



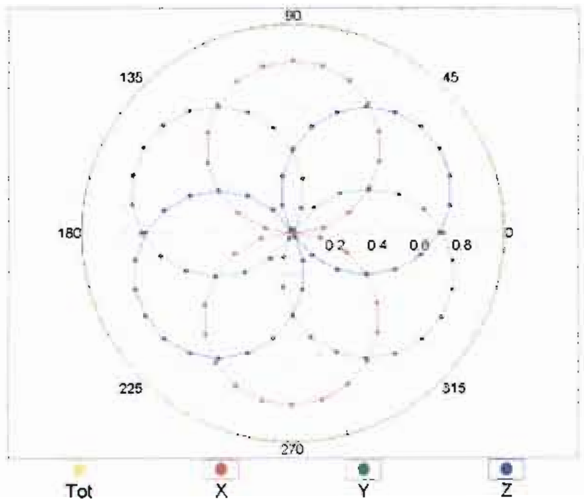
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

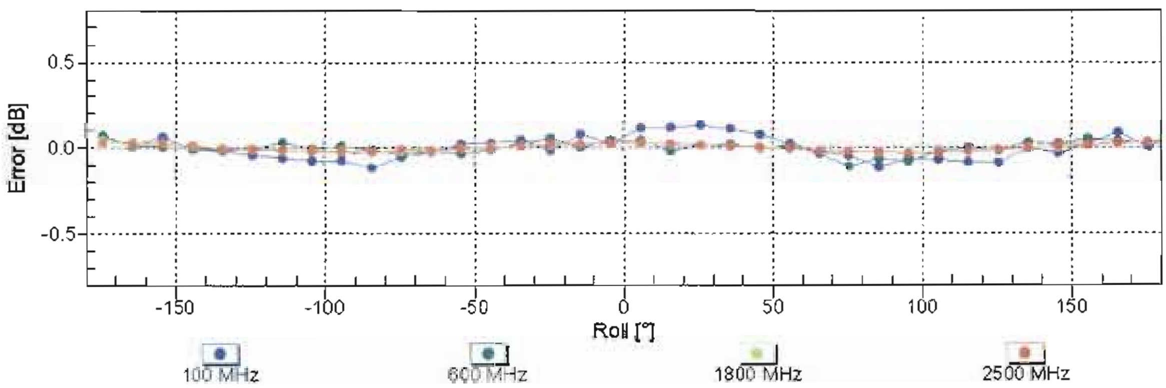
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



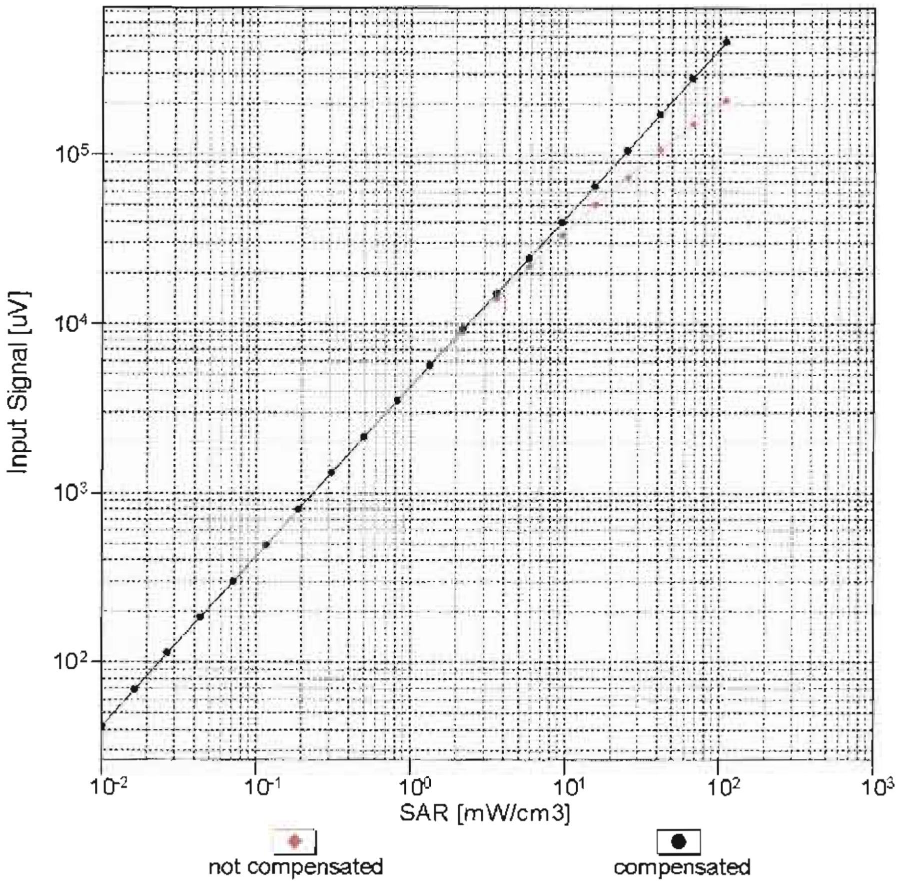
f=1800 MHz,R22

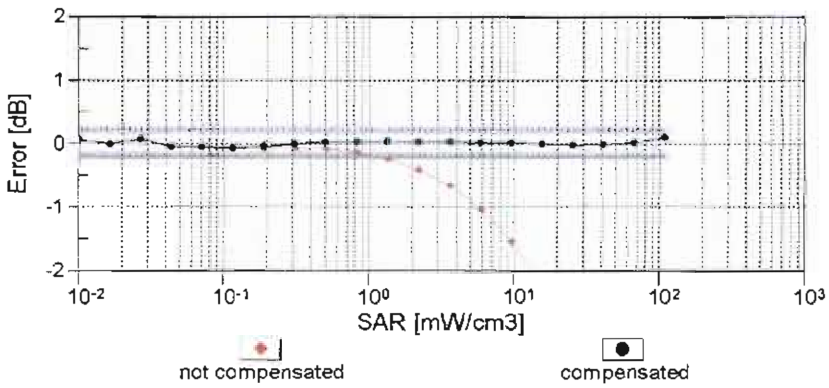




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

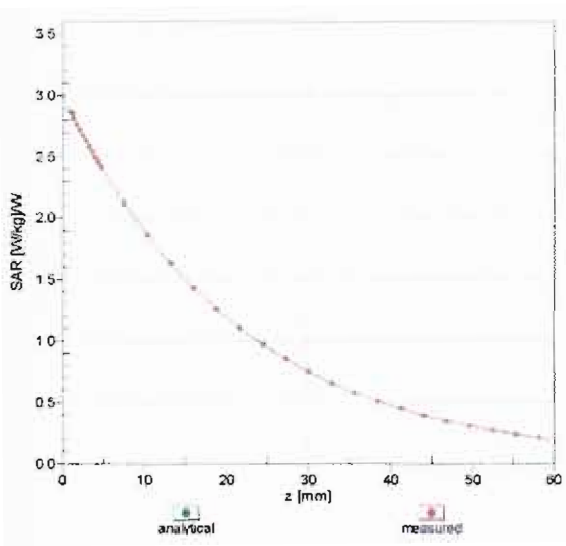
Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

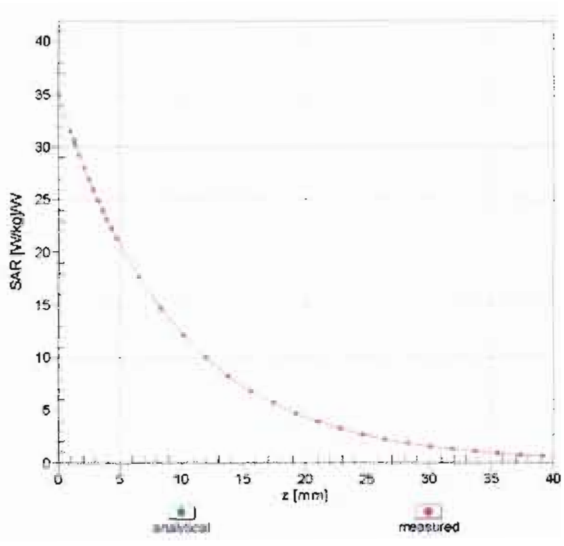




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

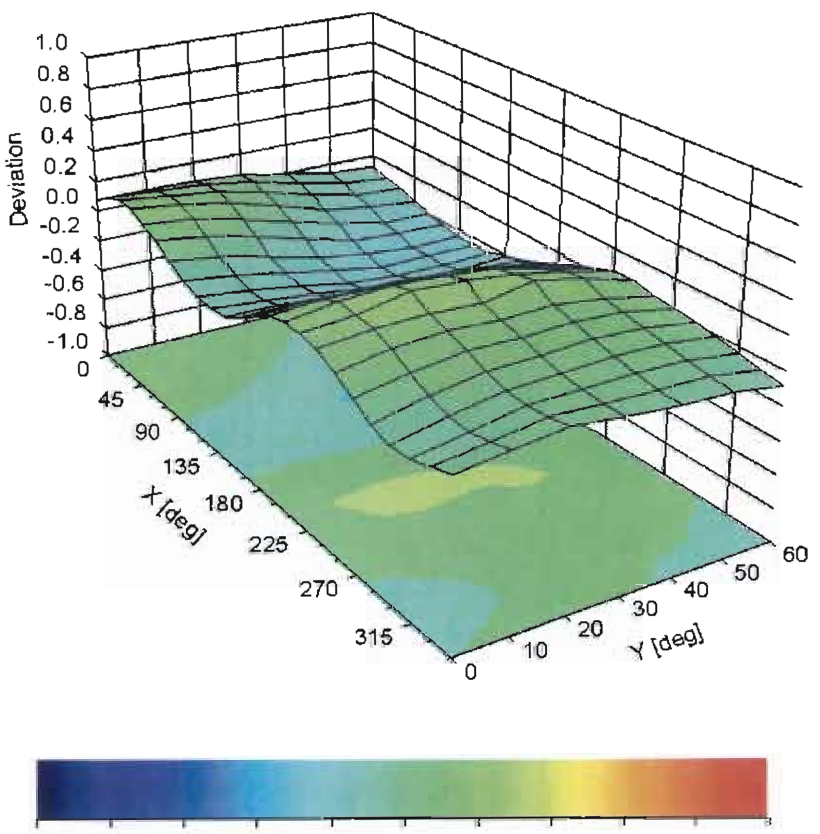
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3955

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-54.2
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

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校 准
CNAS L0442

Client **Sporton-TW** **Certificate No: J13-2-3185**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3955
Calibration Procedure(s)	TMC-OS-E-02-195 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	December 23, 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)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Power sensor NRP-Z91	101547	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Power sensor NRP-Z91	101548	01-Jul-13 (TMC, No.JW13-044)	Jun-14
Reference10dBAttenuator	BT0520	12-Dec-12(TMC,No.JZ12-867)	Dec-14
Reference20dBAttenuator	BT0267	12-Dec-12(TMC,No.JZ12-866)	Dec-14
Reference Probe EX3DV4	SN 3846	03-Sep-13(SPEAG,No.EX3-3846_Sep13)	Sep-14
DAE4	SN 777	22-Feb-13 (SPEAG, DAE4-777_Feb13)	Feb -14
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	01-Jul-13 (TMC, No.JW13-045)	Jun-14
Network Analyzer E5071C	MY46110673	15-Feb-13 (TMC, No.JZ13-781)	Feb-14

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: December 25, 2013

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Glossary:

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

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 300MHz to 3GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

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Probe EX3DV4

SN: 3955

Calibrated: December 23, 2013

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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DASY – Parameters of Probe: EX3DV4 - SN: 3955

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	0.35	0.40	0.30	±10.8%
DCP(mV)[B]	110.8	104.5	101.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	112.8	±4.8%
		Y	0.0	0.0	1.0		123.6	
		Z	0.0	0.0	1.0		100.5	

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

[A] The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5 and Page 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly 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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DASY – Parameters of Probe: EX3DV4 - SN: 3955

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
850	41.5	0.92	9.86	9.86	9.86	0.12	1.53	±12%
900	41.5	0.97	9.98	9.98	9.98	0.13	1.53	±12%
1810	40.0	1.40	8.23	8.23	8.23	0.13	2.30	±12%
1900	40.0	1.40	8.31	8.31	8.31	0.15	1.81	±12%
2600	39.0	1.96	7.55	7.55	7.55	0.48	0.82	±12%

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

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DASY – Parameters of Probe: EX3DV4 - SN: 3955

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
850	55.2	0.99	9.81	9.81	9.81	0.17	1.46	±12%
900	55.0	1.05	9.86	9.86	9.86	0.27	1.09	±12%
1810	53.3	1.52	8.17	8.17	8.17	0.14	2.85	±12%
1900	53.3	1.52	7.84	7.84	7.84	0.16	2.64	±12%
2600	52.5	2.16	7.58	7.58	7.58	0.50	0.85	±12%

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

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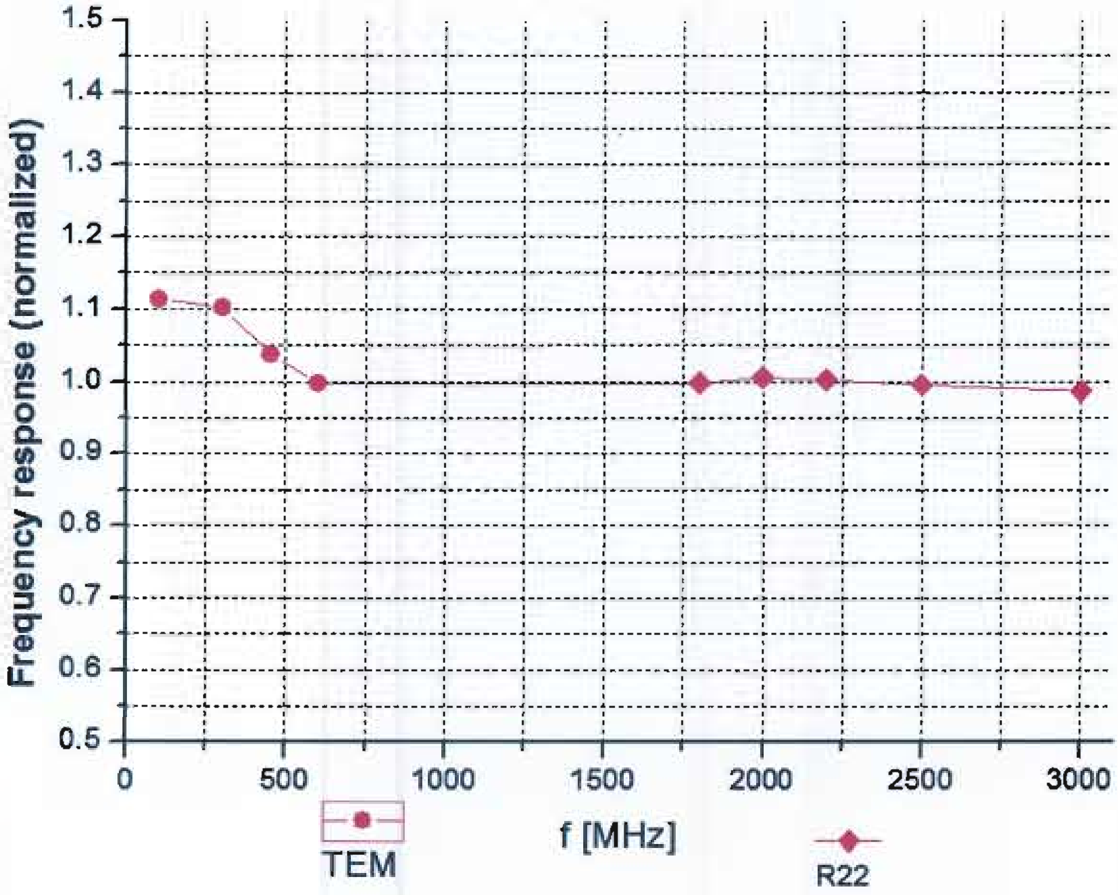
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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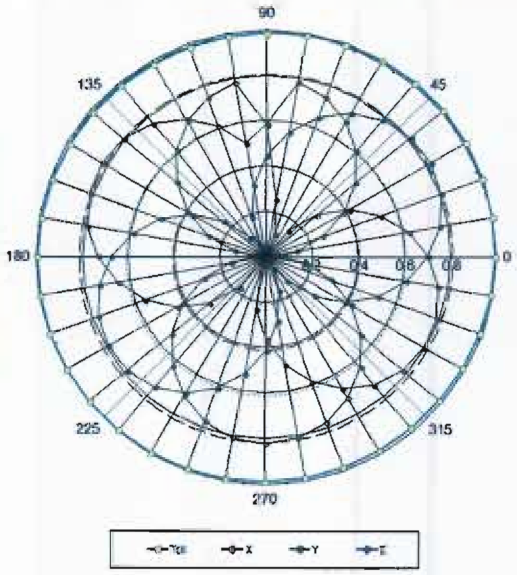
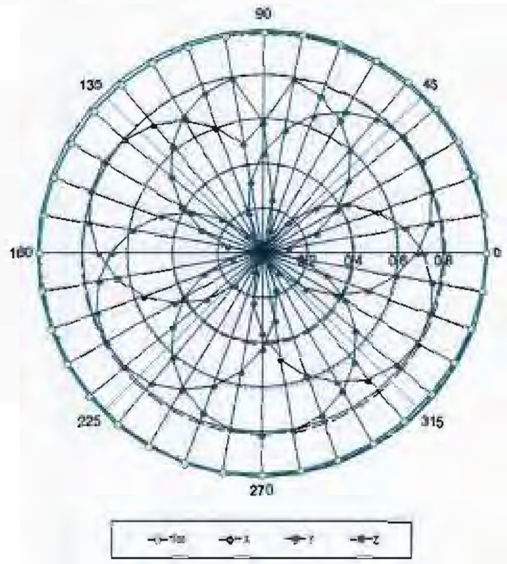
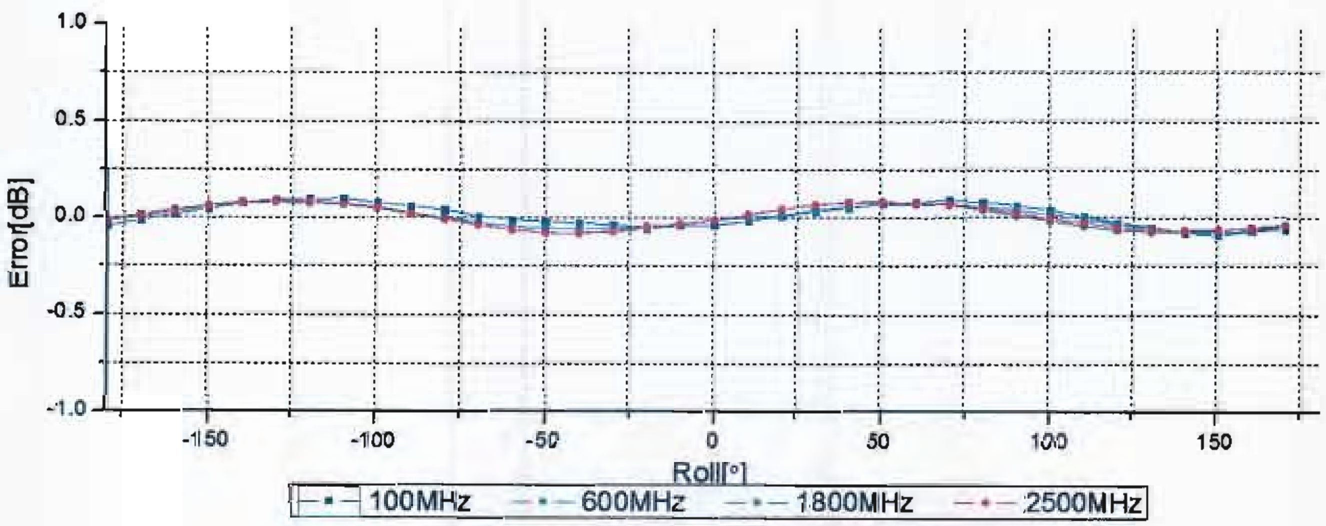
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)

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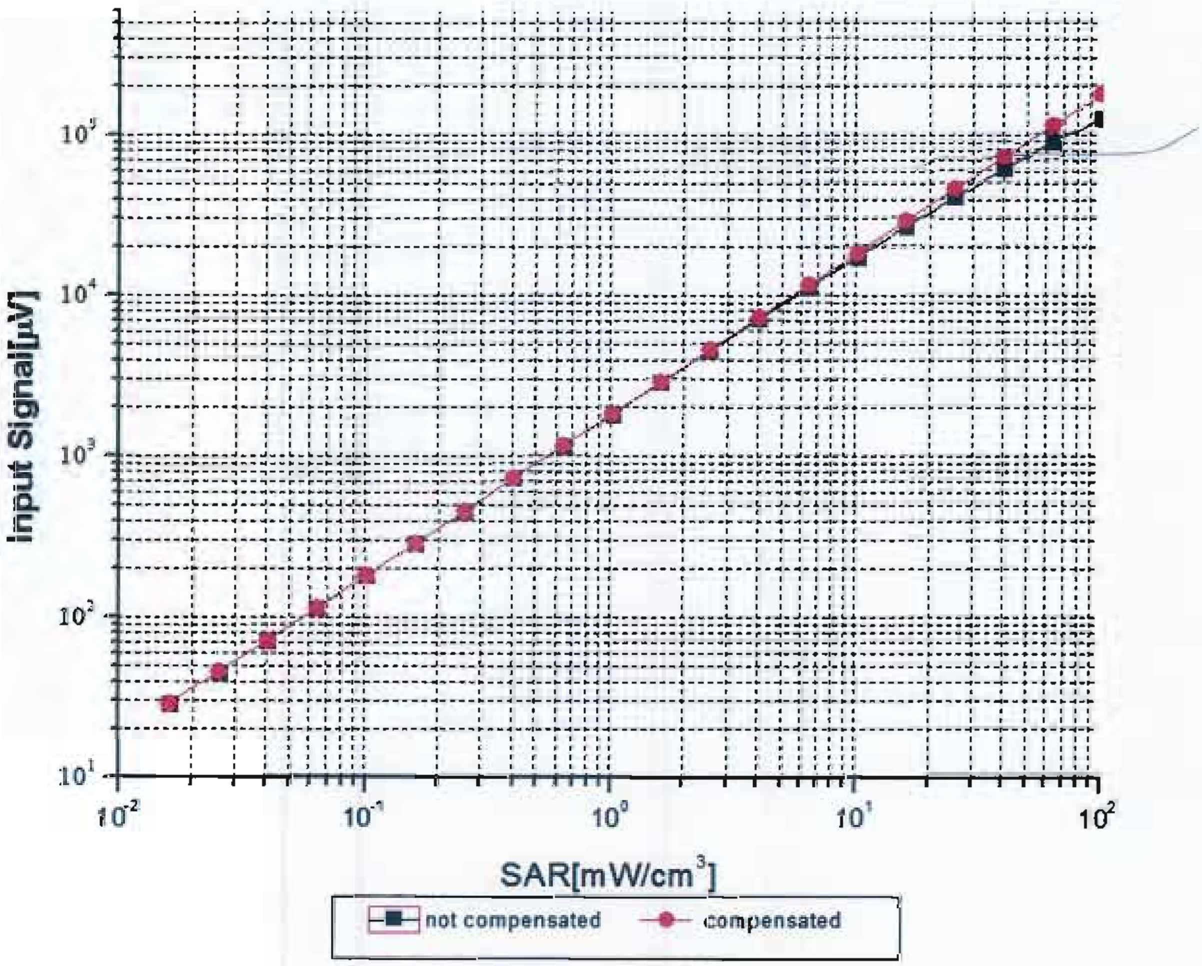
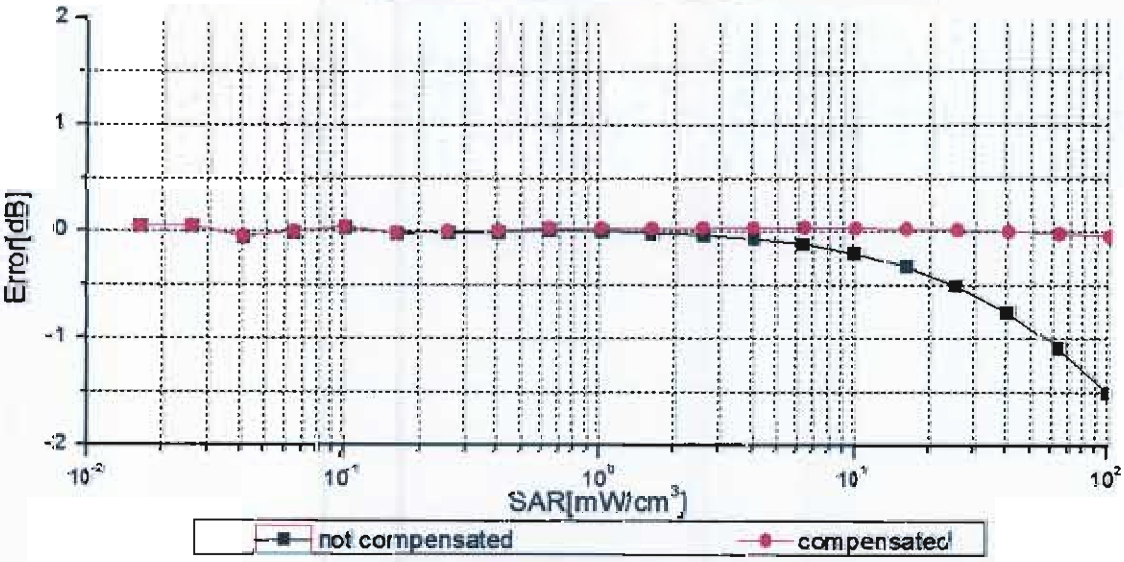
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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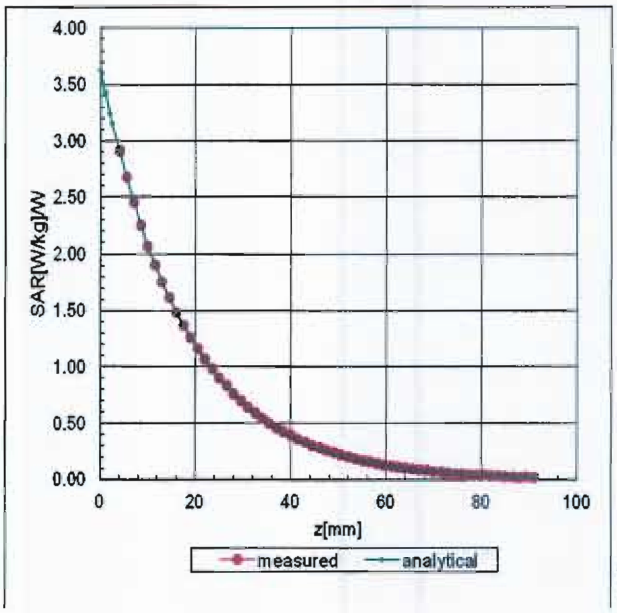
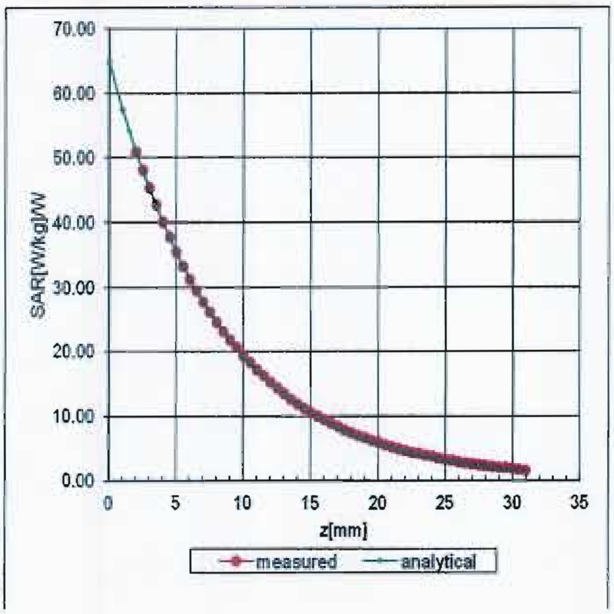
Conversion Factor Assessment

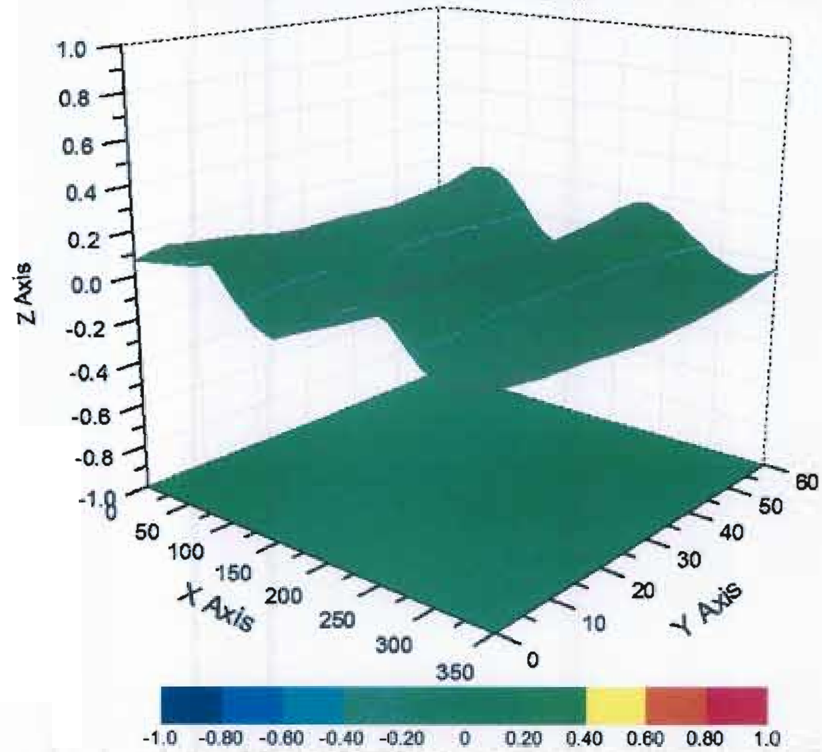
f=900 MHz, WGLS R9(H_convF)



f=2600 MHz, WGLS R26(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

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DASY - Parameters of Probe: EX3DV4 - SN: 3955

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	128
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	2mm

Acceptable Conditions for SAR Measurements Using Probes and Dipoles Calibrated under the SPEAG-TMC Dual-Logo Calibration Program to Support FCC Equipment Certification

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by TMC (*Telecommunication Metrology Center of MITT in Beijing, China*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and TMC, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following.

1) The agreement established between SPEAG and TMC is only applicable to calibration services performed by TMC where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. This agreement is subject to renewal at the end of each calendar year between SPEAG and TMC. TMC shall inform the FCC of any changes or early termination to the agreement.
2) Only a subset of the calibration services specified in the SPEAG-TMC agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
   a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
      i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by TMC, are excluded and cannot be used for measurements to support FCC equipment certification.
      ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
   b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
   c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
   d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
   e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
   f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.

3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
   a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
   b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
   c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
   d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.

Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.