Maxwell

SAR TEST REPORT

Report Reference No.................... :	**MWR150500304**
FCC ID. .... :	**2AE2X688I**
Compiled by (position+printed name+signature)..:	File administrators Martin Ao — Martin
Supervised by (position+printed name+signature)..:	Test Engineer Martin Ao — Martin
Approved by (position+printed name+signature)..:	Manager Dixon Hao — Dixon
Date of issue ....:	Jun 29, 2015
Representative Laboratory Name .:	**Maxwell International Co., Ltd.**
Address ....:	Room 509, Hongfa center building, Baoan District, Shenzhen, Guangdong, China
Testing Laboratory Name ....:	**SHENZHEN YIDA JIETONG INFORMATION TECHNOLOGY CO., LTD**
Address ....:	No.12 Building Shangsha, Innovation & Technology Park, Futian District, Shenzhen, P.R.China
Applicant's name............................:	**AMS Communications Inc**
Address ....:	11029 Harry Hines Blvd,Suite B 118,Dallas Tx 75229,USA
Test specification .... :	
Standard..:	**ANSI C95.1–1999** **47CFR §2.1093**
TRF Originator.................................:	**Maxwell International Co., Ltd.**

Test item description .... :	2G Smart Phone
Trade Mark.......................................:	SOHO
Manufacturer..................................:	**Begin Industrial(HK)CO.,Ltd**
Model/Type reference ....:	688I
Listed Models ....:	/
Operation Frequency.........................	GSM 850MHz/PCS1900MHz/WiFi2450
Modulation Type...............................	GSM(GMSK),DSSS(CCK,DQPSK,DBPSK),OFDM(64QAM,16QAM,QPSK, BPSK),
Hardware version ....:	T6_T_V9.18 2015-04-08
Software version ....:	688I_V1.0
Rating..:	DC 3.70V
Result ....:	**PASS**

TEST REPORT

Test Report No. :	**MWR150500304**	Jun 29, 2015 Date of issue

Equipment under Test	:	2G Smart Phone
Model /Type	:	688I
Listed Models	:	/
Applicant	:	**AMS Communications Inc**
Address	:	11029 Harry Hines Blvd, Suite B 118, Dallas Tx 75229, USA
Manufacturer	:	**Begin Industrial(HK)CO.,Ltd**
Address	:	5 floor shanghe community no A111-0022, BAOAN DISTRICT, SHENZHEN CITY, CHINA

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Contents

1. TEST STANDARDS

The tests were performed according to following standards:

IEEE Std C95.1, 1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.
IEEE Std 1528™-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.
KDB 447498 D01 Mobile Portable RF Exposure v05r02: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
KDB865664 D01 SAR measurement 100 MHz to 6 GHz v01r03:SAR Measurement Requirements for 100 MHz to 6 GHz
KDB865664 D02 SAR Reporting v01r01: RF Exposure Compliance Reporting and Documentation Considerations
KDB248227 D01 802.11 Wi-Fi SAR v02r01 : SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation:Portable Devices

KDB 648474 D04, Handset SAR v01r02: SAR Evaluation Considerations for Wireless Handsets

KDB 941225 D01 3G SAR Procedures v03: 3G SAR MEAUREMENT PROCEDURES

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	May10, 2015
Testing commenced on	:	May12, 2015
Testing concluded on	:	May 26, 2015

2.2. Product Description

The **AMS Communications Inc**’s Model: 688I or the “EUT” as referred to in this report; more general information as follows, for more details, refer to the user’s manual of the EUT.

General Description	
Model Number	688I
FCC ID	2AE2X688I
Modilation Type	GMSK for GSM/GPRS;
Antenna Type	Internal
Device category	Portable Device
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Rated Vlotage	DC 3.70 Battery
Hotspot	Not Supported
The EUT is GSM850/PCS1900 mobile phone. the mobile phone is intended for speech and Multimedia Message Service (MMS) transmission. It is equipped with GPRS class 12 for GSM850, PCS1900, WiFi, and camera functions. For more information see the following datasheet	

GSM/EDGE/GPRS	Supported GSM/GPRS
Extreme temp. Tolerance	-30°C to +50°C
Extreme vol. Limits	3.40VDC to 4.20VDC (nominal: 3.70VDC)
GSM Operation Frequency Band	GSM 850MHz/ PCS 1900MHz
GSM Release Version	R99
GPRS operation mode	Class B
DTM mode	Not Supported
GPRS Multislot Class	12
WLAN	Supported 802.11b/802.11g/802.11n
WLAN FCC Modulation Type	IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK) IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)

2.3. Statement of Compliance

The maximum of results of SAR found during testing for 688I are follows:

Head SAR Configuration

Mode	Test Position	Channel /Frequency(MHz)	Limit SAR_{1g} 1.6 W/kg	
			Measured SAR_{1g} (W/kg)	Reported SAR_{1g} (W/kg)
GSM 850	Left/Cheek	190/836.6	0.653	**0.725**
GSM 1900	Left/Cheek	661/1880.0	0.583	0.723
WiFi(802.11b)	Right/Cheek	1/2412	0.383	0.425

Body worn Configuration

Mode	Test Position	Channel /Frequency(MHz)	Limit SAR_{1g} 1.6 W/kg	
			Measured SAR_{1g} (W/kg)	Reported SAR_{1g} (W/kg)
GPRS 850, 4 Txslots	Rear Side	190/836.6	0.937	**1.083**
GPRS 1900, 4 Txslots	Rear Side	661/1880.0	0.865	0.953
WiFi(802.11b)	Rear Side	6/2437	0.401	0.445

The SAR values found for the smart phone are below the maximum recommended levels of 1.6W/Kg as averaged over any 1g tissue accordintg to the ANSI C95.1-1999.
For body worn operation,this devices has been tested and meets FCC RF exposure guidelines when used with any accessory that conrtains no metal and which provides a minimum separation distance of 5mm between this devices and the body of the user.User of other accessories may not ensure compliance with FCC RF exposure guidelines.
The EUT battery must be fully charged and checked periodically during the test to ascertain iniform power output.

Simultaneous transmission SAR for WiFi and GSM

Test Position	SAR Type	GSM850 Reported SAR_{1-g} (W/Kg)	GSM1900 Reported SAR_{1-g} (W/Kg)	WiFi Reported SAR_{1-g} (W/Kg)	MAX. ΣSAR_{1-g} (W/Kg)	SAR_{1-g} Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Left/Cheek	1-g	**0.725**	**0.723**	0.289	1.014	1.6	no	no
Left/Tilt	1-g	0.585	0.641	0.256	0.897	1.6	no	no
Right/Cheek	1-g	0.679	0.554	**0.425**	1.104	1.6	no	no
Right/Tilt	1-g	0.539	0.486	0.363	0.902	1.6	no	no
Rear Side	1-g	**1.083**	**0.953**	**0.445**	**1.528**	1.6	no	no
Front Side	1-g	0.777	0.696	0.385	1.162	1.6	no	no

Note:
1. The value with block color is the maximum values of standalone
2. The value with blue color is the maximum values of $\sum SAR_{1-g}$

2.4. Equipment under Test

Power supply system utilised

Power supply voltage	:	○ 120V / 60 Hz	○ 115V / 60Hz
		○ 12 V DC	○ 24 V DC
		● Other (specified in blank below)	

DC 3.70 V

2.5. Internal Identification of the EUT

IMEI Code	
EUT	SIM1:354769059067894
	SIM2:354769059067895

2.6. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer
○ - supplied by the lab

○	Power Cable	Length (m) :	/
		Shield :	/
		Detachable :	/
○	Multimeter	Manufacturer :	/
		Model No. :	/

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

SHENZHEN YIDA JIETONG INFORMATION TECHNOLOGY CO., LTD

No.12 Building Shangsha, Innovation & Technology Park, Futian District, Shenzhen, P.R.China

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: 7547

SHENZHEN YIDA JIETONG INFORMATION TECHNOLOGY CO., LTD has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: Mar 17, 2015. Valid time is until Mar 17, 2018.

3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	18-25 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

3.4. SAR Limits

FCC Limit (1g Tissue)

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population /Uncontrolled Exposure Environment)	(Occupational /Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

3.5. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Calibration	Calibration Interval
Data Acquisition Electronics DAEx	SPEAG	DAE4	1315	2014/07/22	1
E-field Probe	SPEAG	ES3DV3	3292	2014/08/15	1
System Validation Dipole D835V2	SPEAG	D835V2	4d134	2014/07/24	3
System Validation Dipole 1900V2	SPEAG	D1900V2	5d072	2013/12/12	3
System Validation Dipole 2450V2	SPEAG	D2450V2	884	2014/09/01	3
Network analyzer	Agilent	8753E	US37390562	2015/03/17	1
Universal Radio Communication Tester	ROHDE & SCHWARZ	CMU200	112012	2014/10/22	1
Dielectric Probe Kit	Agilent	85070E	US44020288	See Not 4	
Phantom	SPEAG	Twin Phantom	1765	N.C.R	
Phantom	SPEAG	ELI V5.0	1208	N.C.R	
Phone Positioner	SPEAG	N/A	N/A	N.C.R	
Robot	Stäubli	TX60L	F13/5P6VB1/A/01	N.C.R	
Attenuator 1	PE	PE7005-10	N/A	See Note 5	
Attenuator 2	PE	PE7005- 3	N/A	See Note 5	
Power meter	Agilent	E4417A	GB41292254	2014/10/22	1
Power Meter	Agilent	E7356A	GB54762536	2014/10/25	1
Power sensor	Agilent	8481H	MY41095360	2014/10/22	1
Power Sensor	Agilent	E9327A	Us40441788	2015/03/18	1
Signal generator	IFR	2032	203002/100	2014/10/22	1
Amplifier	Mini-circult	ZHL-42W	QA098002	N.C.R	
The temporary antenna connector	MMCX - SMA	1547 (impedance:50Ω Cable loss:0.6dB)	23657478	2014/10/19	1

Note:
1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evalute with following criteria at least on annual interval.
   a) There is no physical damage on the dipole;
   b) System check with specific dipole is within 10% of calibrated values;
   c) The most recent return-loss results,measued at least annually,deviates by no more than 20% from the previous measurement;
   d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 50 Ω from the provious measurement.
2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.
3) The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.
4) The dielectric probe kit was calibrated via the network analyzer, with the specified procedure (calibrated in pure water) and calibration kit (standard) short circuit, before the dielectric measurement. The specific procedure and calibration kit are provided by Speag.
5) The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.

4. SAR Measurements System configuration

4.1. SAR Measurement Set-up

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

A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).

A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

A data acquisition electronic (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.

A unit to operate the optical surface detector which is connected to the EOC.

The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.

The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY5 software and SEMCAD data evaluation software.

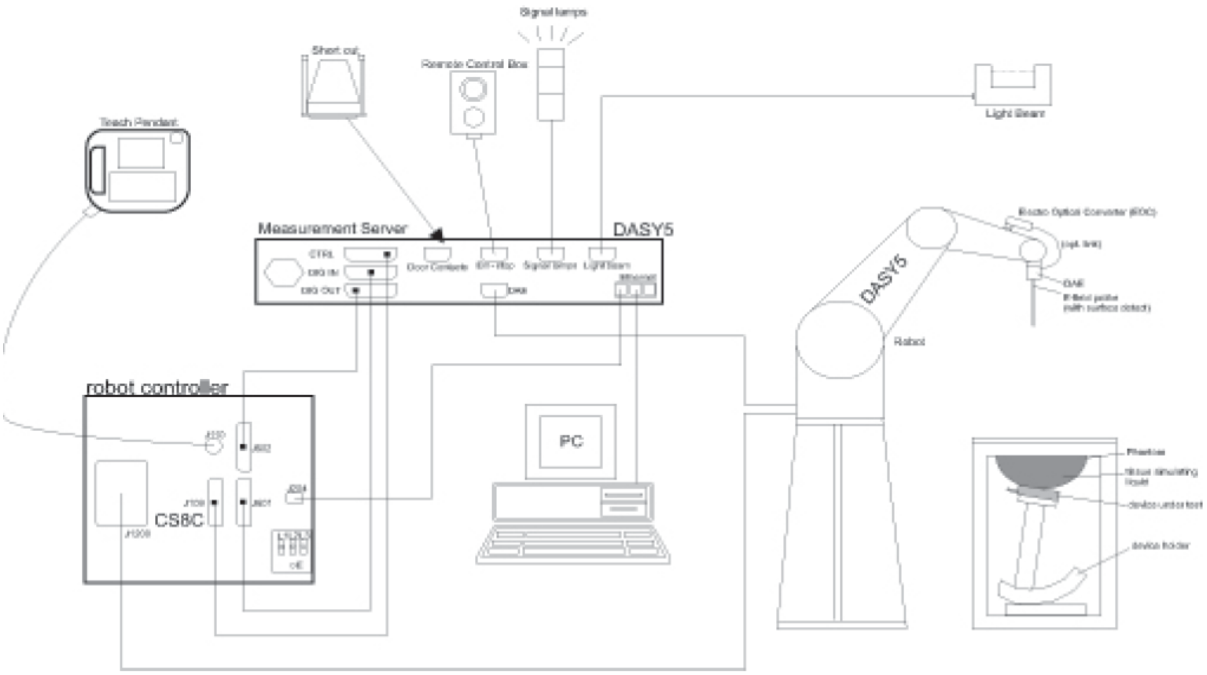
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld mobile phones.

Tissue simulating liquid mixed according to the given recipes.

System validation dipoles allowing to validate the proper functioning of the system.



4.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

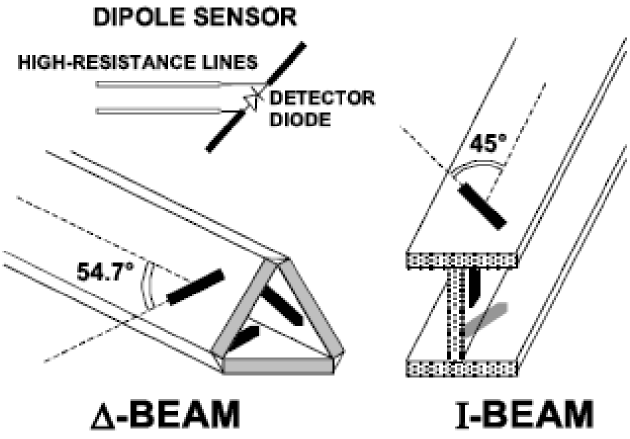
Probe Specification

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



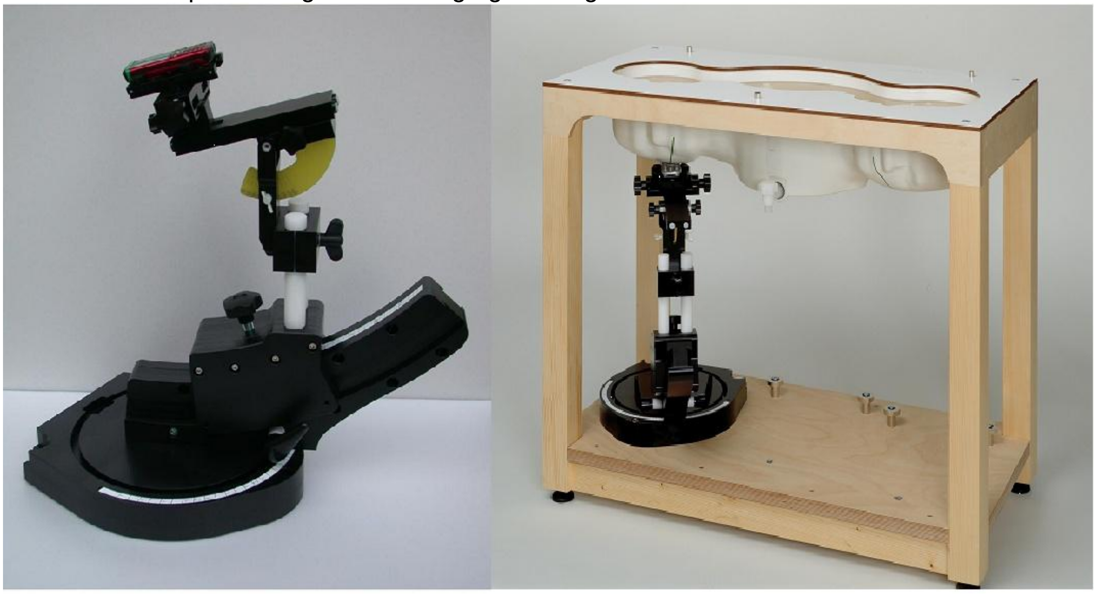
4.3. Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

4.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

4.5. Scanning Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. ± 5 %.
The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

Zoom Scan
Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

Spatial Peak Detection
The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses.The DASY5 system allows evaluations that combine measured data and robot positions, such as: • maximum search • extrapolation • boundary correction • peak search for averaged SAR During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard’s method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard’s method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

Table 1: Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01

			≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 mm ± 1 mm	½·δ·ln(2) mm ± 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.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 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.

4.6. Data Storage and Evaluation

Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcpi = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

$$\mathrm{E-fieldprobes:} \qquad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\mathrm{H-fieldprobes:} \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

4.7. Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

The composition of the tissue simulating liquid

Ingredient	835MHz		1900MHz		1750 MHz		2450MHz		2600MHz	
(% Weight)	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	41.45	52.5	55.242	69.91	55.782	69.82	62.7	73.2	62.3	72.6
Salt	1.45	1.40	0.306	0.13	0.401	0.12	0.50	0.10	0.20	0.10
Sugar	56	45.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Preventol	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEC	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DGBE	0.00	0.00	44.452	29.96	43.817	30.06	36.8	26.7	37.5	27.3

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

4.8. Tissue equivalent liquid properties

Dielectric performance of Head and Body tissue simulating liquid

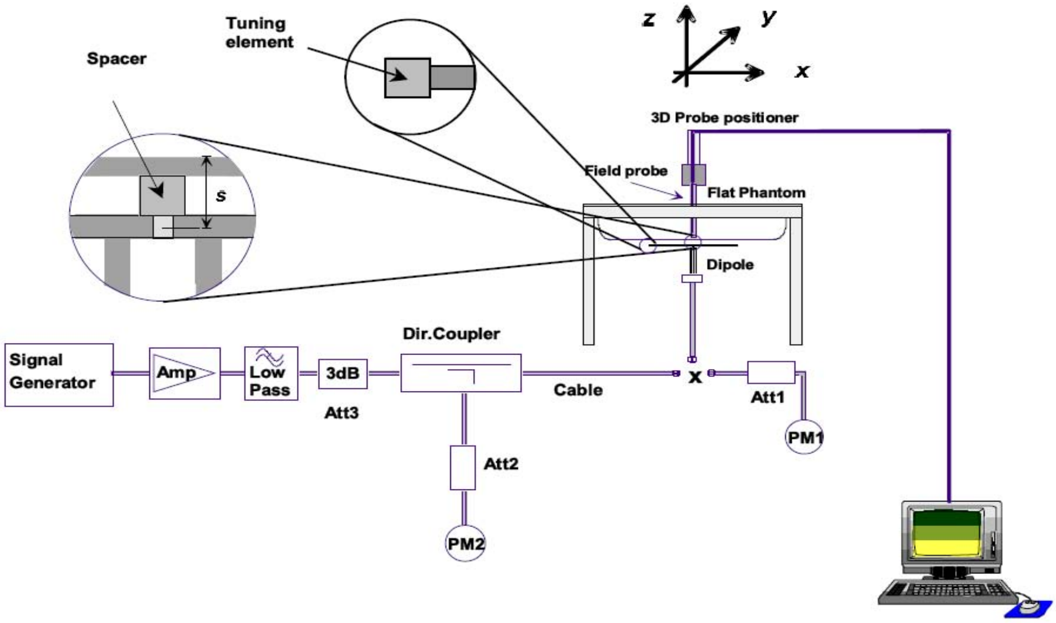
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Data
		ε_r	σ	ε_r	Dev. %	σ	Dev. %		
850H	835	41.5	0.90	41.78	0.7	0.91	1.1	22 degree	2015-05-12
1900H	1900	40.0	1.40	39.73	-0.7	1.46	4.2	22 degree	2015-05-20
2450H	2450	39.2	1.80	39.28	0.2	1.84	2.2	22 degree	2015-05-26
850B	835	55.2	0.97	53.51	-3.1	0.99	2.1	22 degree	2015-05-12
1900B	1900	53.3	1.52	53.00	-0.6	1.53	0.7	22 degree	2015-05-20
2450B	2450	52.7	1.95	52.65	-0.1	2.03	4.1	22 degree	2015-05-26

4.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



The output power on dipole port must be calibrated to 30 dBm (1000mW) before dipole is connected.

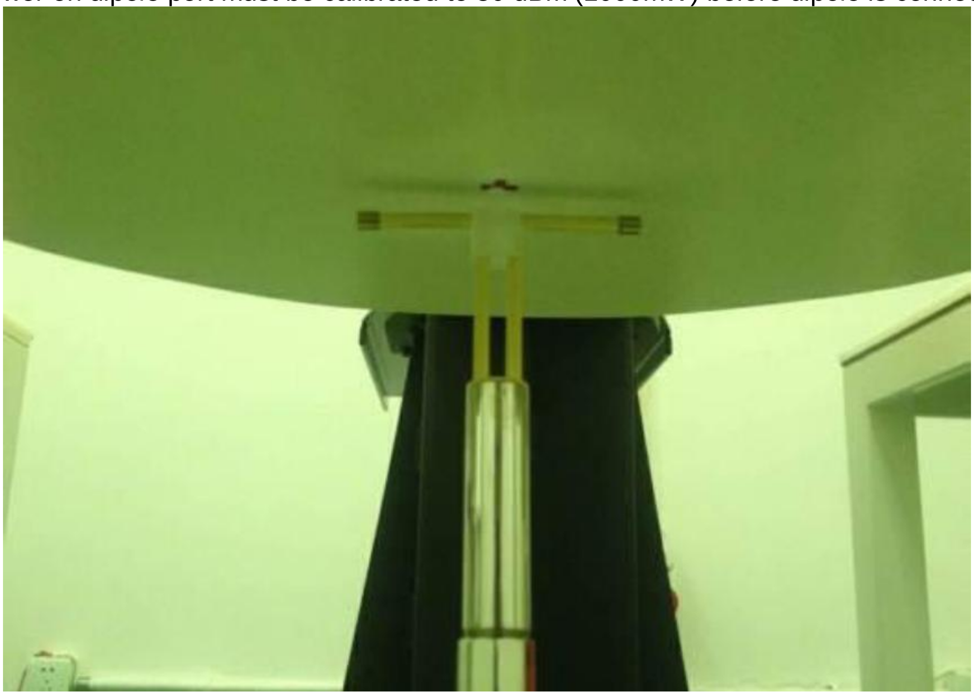


Photo of Dipole Setup

System Validation of Head

Measurement is made at temperature 22.0 ℃ and relative humidity 55%.							
Liquid temperature during the test: 22.0℃							
Measurement Date: 835MHz May 12th, 2015;1900MHz May 20th;2015, 2450MHz May 26th;2015							
Verification results	Frequency (MHz)	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
	835	6.27	9.62	6.25	9.60	-0.32%	-0.21%
	1900	20.20	38.30	20.60	38.90	1.98%	1.57%
	2450	24.60	52.10	25.10	54.00	2.03%	3.65%

System Validation of Body

Measurement is made at temperature 22.0 ℃ and relative humidity 55%.							
Liquid temperature during the test: 22.0℃							
Measurement Date: 835MHz May 12th, 2015;1900MHz May 20th;2015, 2450MHz May 26th;2015							
Verification results	Frequency (MHz)	Target value (W/kg)		Measured value (W/kg)		Deviation	
		10 g Average	1 g Average	10 g Average	1 g Average	10 g Average	1 g Average
	835	6.50	9.77	6.44	9.63	-0.92%	-1.43%
	1900	21.00	39.90	20.80	39.10	-0.95%	-2.01%
	2450	24.20	51.60	24.30	53.00	0.41%	2.71%

4.10. SAR measurement procedure

The procedure for assessing the average SAR value consists of the following steps:

- Power Reference Measurement

  The Power Reference Measurement and Power Drift Measurement jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

- Area Scan

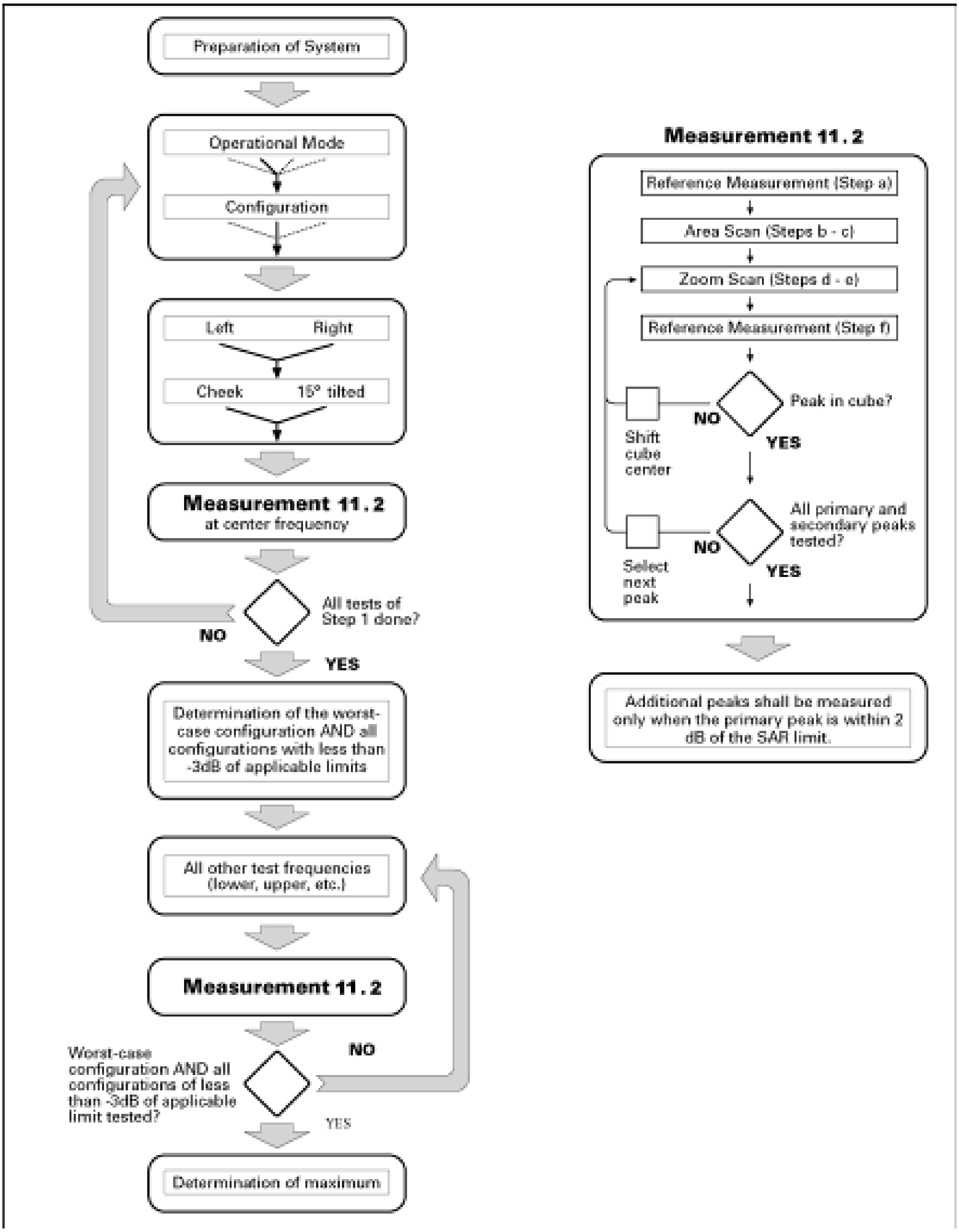
  The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids. The scanning area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the Area Scan's property sheet is brought-up, grid settings can be edited by a user.

- Zoom Scan

  Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan measures 7 x 7 x 7 points (5mmx5mmx5mm) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure.

- Power Drift Measurement

  The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement.



Block diagram of the tests to be performed

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5. TEST CONDITIONS AND RESULTS

5.1. Conducted Power Results

Max Conducted power measurement results and power drift from tune-up tolerance provide by manufacturer:

Conducted Power Measurement Results(GSM 850/1900)

GSM 850		Burst Average Conducted power (dBm)			/	Time-Average Conducted power (dBm)		
		Channel/Frequency(MHz)				Channel/Frequency(MHz)		
		128/824.2	190/836.6	251/848.8		128/824.2	190/836.6	251/848.8
GSM		31.01	31.56	31.71	-9.03dB	21.98	22.53	22.68
GPRS (GMSK)	1TX slot	31.03	31.54	31.69	-9.03dB	22.00	22.51	22.66
	2TX slot	29.26	29.37	29.24	-6.02dB	23.24	23.35	23.22
	3TX slot	28.01	28.03	28.09	-4.26dB	23.75	23.77	2483
	4TX slot	**27.23**	**27.37**	**27.27**	**-3.01dB**	**24.22**	**24.36**	**24.26**
GSM 1900		Burst Average Conducted power (dBm)			/	Time-Average Conducted power (dBm)		
		Channel/Frequency(MHz)				Channel/Frequency(MHz)		
		512/ 1850.2	661/ 1880	810/ 1909.8		512/ 1850.2	661/ 1880	810/ 1909.8
GSM		28.45	29.07	29.06	-9.03dB	19.42	20.04	20.03
GPRS (GMSK)	1TX slot	28.54	29.04	29.14	-9.03dB	19.51	20.01	20.11
	2TX slot	26.33	26.69	26.71	-6.02dB	20.31	20.67	20.69
	3TX slot	25.36	25.43	25.56	-4.26dB	21.10	21.17	21.30
	4TX slot	**24.83**	**25.08**	**25.12**	**-3.01dB**	**21.82**	**22.07**	**22.11**

NOTES:
1) Division Factors

To average the power, the division factor is as follows:
1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB
2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB
3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB
4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB

WLAN

Mode	Channel	Frequency (MHz)	Worst case Data rate of worst case	Conducted Average Output Power (dBm)
802.11b	1	2412	1Mbps	11.56
	6	2437	1Mbps	11.09
	11	2462	1Mbps	10.91
802.11g	1	2412	6Mbps	8.84
	6	2437	6Mbps	8.95
	11	2462	6Mbps	8.89
802.11n HT20	1	2412	6.5 Mbps	8.45
	6	2437	6.5 Mbps	8.27
	11	2462	6.5 Mbps	8.36
802.11n HT40	3	2422	13.5 Mbps	6.69
	6	2437	13.5 Mbps	6.52
	9	2452	13.5 Mbps	7.38

Note: SAR is not required for the following 2.4 GHz OFDM conditions as the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

Manufacturing tolerance

GSM Speech

GSM 850 (GMSK) (Burst Average Power)			
Channel	Channel 251	Channel 190	Channel 190
Target (dBm)	31.00	31.00	31.00
Tolerance ±(dB)	1	1	1
GSM 1900 (GMSK) (Burst Average Power)			
Channel	Channel 810	Channel 661	Channel 512
Target (dBm)	29.00	29.00	29.00
Tolerance ±(dB)	1	1	1

GSM 850 GPRS (GMSK) (Burst Average Power)				
Channel		251	190	128
1 Txslot	Target (dBm)	31.00	31.00	31.00
	Tolerance ±(dB)	1	1	1
2 Txslot	Target (dBm)	29.0	29.0	29.0
	Tolerance ±(dB)	1	1	1
3 Txslot	Target (dBm)	28.0	28.0	28.0
	Tolerance ±(dB)	1	1	1
4 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance ±(dB)	1	1	1
GSM 1900 GPRS (GMSK) (Burst Average Power)				
Channel		810	661	512
1 Txslot	Target (dBm)	29.0	29.0	29.0
	Tolerance ±(dB)	1	1	1
2 Txslot	Target (dBm)	26.0	26.0	26.0
	Tolerance ±(dB)	1	1	1
3 Txslot	Target (dBm)	25.0	25.0	25.0
	Tolerance ±(dB)	1	1	1
4 Txslot	Target (dBm)	24.5	24.5	24.5
	Tolerance ±(dB)	1	1	1

WiFi

802.11b (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	11.0	11.0	11.0
Tolerance ±(dB)	1	1	1
802.11g (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	9.0	9.0	9.0
Tolerance ±(dB)	1	1	1
802.11n HT20 (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	8.0	8.0	8.0
Tolerance ±(dB)	1	1	1
802.11n HT40 (Average)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	7.0	7.0	7.0
Tolerance ±(dB)	1	1	1

5.2. Simultaneous TX SAR Considerations

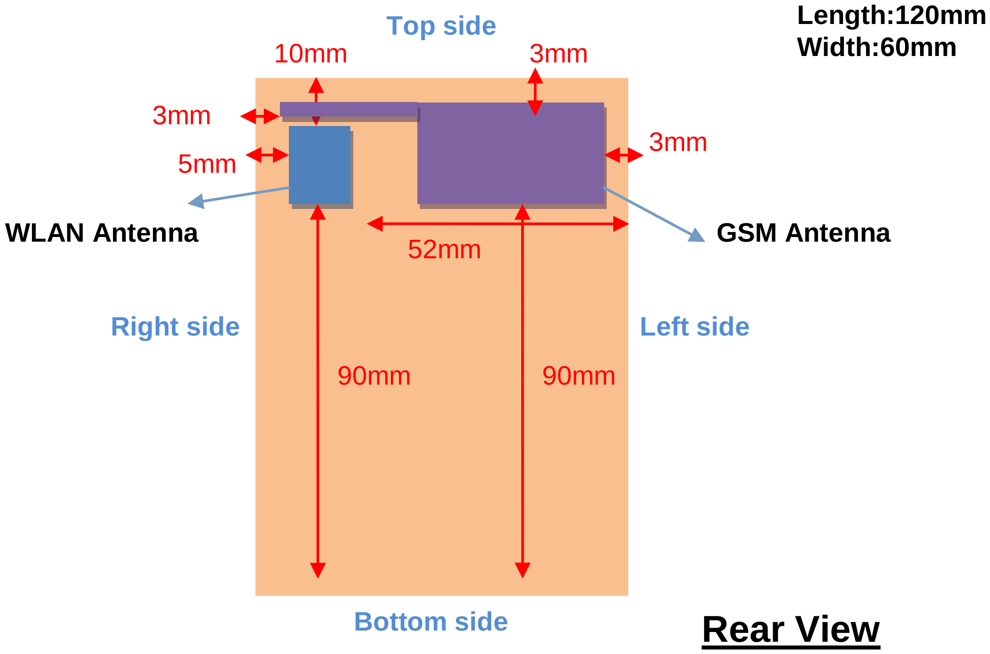
5.2.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g/n devices which may simultaneously transmit with the licensed transmitter.
For the DUT,the WiFi module and GSM sharing difference antennas;

Application Simultaneous Transmission information:

Air-Interface	Band (MHz)	Type	Simultaneous Transmissions	Voice over Digital Transport(Data)
GSM	850	VO	Yes,WLAN	N/A
	1900	VO		
	GPRS	DT	Yes,WLAN	N/A
WLAN	2450	DT	Yes,GSM	N/A
Note:VO-Voice Service only;DT-Digital Transport				

5.2.2 Transmit Antennas and SAR Mesurement Positions



Note:
1). Per KDB648474 D04, because the overall diagonal distance of this devices is 134mm<160mm, it is not considered a “Phablet“ device.
2). The distance between antenna and edge as follows:

The distance between Antenna and Edge

Communication Tye	Top	Left	Bottom	Right
GSM	3 mm	3 mm	90 mm	18 mm
WLAN	10 mm	52 mm	90 mm	5 mm

Body-worn SAR measurement positions

Body-worn mode SAR measurement positions		
mode	front	rear
GSM 850	yes	yes
GSM 1900	yes	yes
WLAN	yes	yes

5.2.2 Standalone SAR Test Exclusion Considerations

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.
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)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- 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

● 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Standalone SAR test exclusion considerations							
Communication system	Frequency (MHz)	Configuration	Maximum Average Power (dBm)	Separation Distance (mm)	Calculation Result	SAR Exclusion Thresholds	Standalone SAR Exclusion
GSM 850	835	Head	22.97	5	36.5	3.0	no
		Body	24.99	5	57.7	3.0	no
GSM 1900	1900	Head	20.97	5	33.7	3.0	no
		Body	22.49	5	48.9	3.0	no
WiFi 2450	2450	Head	12.00	5	5.0	3.0	no
		Body	12.00	5	5.0	3.0	no

Note:
1. Maximum average power including tune-up tolerance;
2. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion

5.2.4 Standalone SAR Test Exclusion Considerations and Estimated SAR

Per KDB447498 requires when the standalone SAR test exclusion of section 4.3.1 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion;
● (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [√ 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.
● 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

Per FCC KD B447498 D01,simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the transmitting antenna in a specific a physical test configuration is ≤1.6 W/Kg.When the sum is greater than the SAR limit,SAR test exclusion is determined by the SAR to peak location separation ratio.

$$\text{Ratio}=\frac{(\text{SAR}_1+\text{SAR}_2)^{1.5}}{(\text{peak location separation,mm})}<0.04$$

5.2.5 Evaluation of Simultaneous SAR

Simultaneous transmission SAR for WiFi and GSM

Test Position	SAR Type	GSM850 Reported $SAR_{1\text{-}g}$ (W/Kg)	GSM1900 Reported $SAR_{1\text{-}g}$ (W/Kg)	WiFi Reported $SAR_{1\text{-}g}$ (W/Kg)	MAX. $\Sigma SAR_{1\text{-}g}$ (W/Kg)	$SAR_{1\text{-}g}$ Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Left/Cheek	1-g	**0.725**	**0.723**	0.289	1.014	1.6	no	no
Left/Tilt	1-g	0.585	0.641	0.256	0.897	1.6	no	no
Right/Cheek	1-g	0.679	0.554	**0.425**	**1.104**	1.6	no	no
Right/Tilt	1-g	0.539	0.486	0.363	0.902	1.6	no	no
Rear Side	1-g	**1.083**	**0.953**	**0.445**	**1.528**	1.6	no	no
Front Side	1-g	0.777	0.696	0.385	1.162	1.6	no	no

Note:
1. The value with block color is the maximum values of standalone
2. The value with blue color is the maximum values of $\sum SAR_{1\text{-}g}$

5.3. SAR Measurement Results

The calculated SAR is obtained by the following formula:

Reported SAR=Measured SAR*$10^{(Ptarget-Pmeasured))/10}$

Scaling factor=$10^{(Ptarget-Pmeasured))/10}$

Reported SAR= Measured SAR* Scaling factor

Where

P_{target} is the power of manufacturing upper limit;

$P_{measured}$ is the measured power;

Measured SAR is measured SAR at measured power which including power drift)

Reported SAR which including Power Drift and Scaling factor

The product with 2 SIMs and 2 SIMs can not used Simultaneous, we tested 2 SIMs(SIM1 and SIM2) and recorded worst case at SIM 1

Duty Cycle

Test Mode	Duty Cycle
Speech for GSM850/1900	1:8
GPRS(4 Tx slots) for GSM850/1900	1:2
WiFi2450	1:1

Table 5: SAR Values [GSM 850 (GSM/GPRS)]

Ch.	*Freq. (MHz)*	*Time slots*	*Test Position*	*Maximum Allowed Power (dBm)*	*Conducted Power (dBm)*	*Power drift*	*Scaling Factor*	*SAR_{1-g} results(W/kg)*		*Graph Results*
								Measured	*Reported*	
measured / reported SAR numbers - Head										
190	836.60	GSM Voice	Left/Cheek	32.00	31.56	-0.04	1.11	0.653	**0.725**	Plot 1
190	836.60	GSM Voice	Left/Tilt	32.00	31.56	-0.02	1.11	0.527	0.585	N/A
190	836.60	GSM Voice	Right/Cheek	32.00	31.56	-0.11	1.11	0.612	0.679	N/A
190	836.60	GSM Voice	Right/Tilt	32.00	31.56	-0.04	1.11	0.486	0.539	N/A
measured / reported SAR numbers - Body (distance 5mm)										
128	824.2	GPRS (4 Tx slots)	Rear Side	28	27.23	-0.04	1.194	0.780	0.931	N/A
190	836.60	GPRS (4 Tx slots)		28	27.37	-0.05	1.156	0.937	**1.083**	Plot 2
251	848.8	GPRS (4 Tx slots)		28	27.27	-0.10	1.183	0.882	1.043	N/A
190	836.60	GPRS (4 Tx slots)	Front Side	28	27.37	0.01	1.156	0.672	0.777	N/A

Note:

1. According to October 2013TCB Workshop, for GSM / GPRS / EGPRS, the number of time slots to test for SAR should correspond to the highest frame-average maximum output power configuration, the EUT was set in **GPRS (4Tx slot)** for GSM850/GSM1900 band due to their highest frame-average power.
2. The value with block color is the maximum Reported SAR Value of each test band.
3. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).

Table 6: SAR Measurement Variability Results [GSM 850 (GSM/GPRS)]

Test Position	Channel/ Frequency (MHz)	Measured SAR_{1-g}	1st Repeated SAR_{1-g}	Ratio	2nd Repeated SAR_{1-g}	3rd Repeated SAR_{1-g}
Rear Side	190/836.6	0.937	0.928	0.99	N/A	N/A

Note: 1) When the original highest measured SAR is ≥ 0.80 W/kg, according to the FCC KDB 865664, repeated SAR at the highest SAR measurement;
2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Table 7: SAR Values [GSM 1900 (GSM/GPRS)]

Ch.	*Freq. (MHz)*	*time slots*	*Test Position*	*Maximum Allowed Power (dBm)*	*Conducted Power (dBm)*	*Power drift*	*Scaling Factor*	*SAR_{1-g} results(W/kg)*		*Graph Results*
								Measured	*Reported*	
measured / reported SAR numbers - Head										
661	1880.0	GSM Voice	Left/Cheek	30.00	29.07	-0.03	1.24	0.583	**0.723**	Plot 3
661	1880.0	GSM Voice	Left/Tilt	30.00	29.07	-0.11	1.24	0.517	0.641	N/A
661	1880.0	GSM Voice	Right/Cheek	30.00	29.07	-0.05	1.24	0.447	0.554	N/A
661	1880.0	GSM Voice	Right/Tilt	30.00	29.07	-0.02	1.24	0.392	0.486	N/A
measured / reported SAR numbers – Body (distance 5mm)										
512	1850.2	GPRS (4 Tx slots)	Rear Side	25.5	24.83	0.04	1.167	0.673	0.785	N/A
661	1880.0	GPRS (4 Tx slots)		25.5	25.08	0.01	1.102	0.865	**0.953**	Plot 4
810	1909.8	GPRS (4 Tx slots)		25.5	25.12	-0.04	1.091	0.814	0.888	N/A
661	1880.0	GPRS (4 Tx slots)	Front Side	25.5	25.08	0.06	1.102	0.632	0.696	N/A

Note:
1. According to October 2013TCB Workshop, for GSM / GPRS / EGPRS, the number of time slots to test for SAR should correspond to the highest frame-average maximum output power configuration, the EUT was set in **GPRS (4Tx slot)** for GSM850/GSM1900 band due to their highest frame-average power.
2.The value with block color is the maximum Reported SAR Value of each test band.
3. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is optional for such test configuration(s).

Table 8: SAR Measurement Variability Results [GSM 1900 (GSM/GPRS)]

Test Position	Channel/ Frequency (MHz)	Measured SAR_{1-g}	1^{st} Repeated SAR_{1-g}	Ratio	2^{nd} Repeated SAR_{1-g}	3^{rd} Repeated SAR_{1-g}
Rear Side	661/1880.0	0.865	0.857	0.99	N/A	N/A

Note: 1) When the original highest measured SAR is ≥ 0.80 W/kg, according to the FCC KDB 865664, repeated SAR at the highest SAR measurement;
2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Table 9: SAR Values [WiFi 802.11b/g/n]

Ch.	*Freq. (MHz)*	*Service*	*Test Position*	*Maximum Allowed Power (dBm)*	*Conducted Power (dBm)*	*Power drift*	*Scaling Factor*	*SAR_{1-g} results(W/kg)*		*Graph Results*
								Measured	*Reported*	
measured / reported SAR numbers - Head										
1	2412	DSSS	Left/Cheek	12.00	11.56	-0.03	1.11	0.260	0.289	N/A
1	2412	DSSS	Left/Tilt	12.00	11.56	-0.02	1.11	0.231	0.256	N/A
1	2412	DSSS	Right/Cheek	12.00	11.56	-0.10	1.11	0.383	**0.425**	Plot 5
1	2412	DSSS	Right/Tilt	12.00	11.56	-0.05	1.11	0.327	0.363	N/A
measured / reported SAR numbers - Body (distance 5mm)										
1	2412	DSSS	Rear Side	12.00	11.56	-0.03	1.11	0.401	**0.445**	Plot 6
1	2412	DSSS	Front Side	12.00	11.56	-0.05	1.11	0.347	0.385	N/A

Note:
1. The value with block color is the maximum Reported SAR Value of each test band.
2.According to KDB248227, When the reported SAR of the highest measured maximum output power channel for theexposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
3. Per KDB 248227-When the reported SAR of the highest measured maximum output power channel (section 3.1) for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration, When the reported SAR is > 0.8 W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel; i.e., all channels require testing
3. Per KDB 248227-SAR is measured using the highest measured maximum output power channel for the initial test configuration.
4. Per KDB 248227- When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement. And when there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.
5. Per KDB 248227- When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg. （The highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power was 0.287 W/kg (0.445*(10/15.85)=0.287W/kg）,the OFDM SAR test is not required.

5.4. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured SAR is ≥ 0.80 W/kg. If the measured SAR value of the initial repeated measurement is < 1.45 W/kg with ≤ 20% variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required. The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.19 The repeated measurement results must be clearly identified in the SAR report. All measured SAR, including the repeated results, must be considered to determine compliance and for reporting according to KDB 690783.Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.

1) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20

5.5. Measurement Uncertainty (300MHz-3GHz)

Relative DSAY5 Uncertainty Budget for SAR Tests										
No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	5.50%	N	1	1	1	5.50%	5.50%	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90%	∞
3	Hemispherical isotropy	B	9.60%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90%	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70%	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50%	∞
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
11	RF ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
12	Probe positioned mech. restrictions	B	0.40%	R	$\sqrt{3}$	1	1	0.20%	0.20%	∞
13	Probe positioning with respect to phantom shell	B	2.90%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
14	Max.SAR evalation	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
Test Sample Related										
15	Test sample positioning	A	1.86%	N	1	1	1	1.86%	1.86%	∞
16	Device holder uncertainty	A	1.70%	N	1	1	1	1.70%	1.70%	∞
17	Drift of output power	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
Phantom and Set-up										
18	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
19	Liquid conductivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
20	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	∞
21	Liquid permittivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
22	Liquid cpermittivity	A	0.16%	N	1	0.64	0.43	0.10%	0.07%	∞

	(meas.)										
Combined standard uncertainty	$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	/	10.20%	10.00%	∞
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$		/	R	K=2	/	/	20.40%	20.00%	∞

Uncertainty of a System Performance Check with DASY5 System										
No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	6.00%	N	1	1	1	5.50%	5.50%	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90%	∞
3	Hemispherical isotropy	B	0.00%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90%	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70%	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50%	∞
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
11	RF Ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
12	Probe positioned mech. restrictions	B	0.80%	R	$\sqrt{3}$	1	1	0.20%	0.20%	∞
13	Probe positioning with respect to phantom shell	B	6.70%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
14	Max.SAR Evalation	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
15	Modulation Response	B	2.40%	R	$\sqrt{3}$	1	1	1.40%	1.40%	∞
Test Sample Related										
16	Test sample positioning	A	0.00%	N	1	1	1	0.00%	0.00%	∞
17	Device holder uncertainty	A	2.00%	N	1	1	1	2.00%	2.00%	∞
18	Drift of output power	B	3.40%	R	$\sqrt{3}$	1	1	2.00%	2.00%	∞
Phantom and Set-up										
19	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
20	SAR correction	B	1.90%	R	$\sqrt{3}$	1	0.84	1.11%	0.90%	∞
21	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	∞
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.64	0.43	1.80%	1.20%	∞
23	Temp.Unc.-Conductivity	B	1.70%	R	$\sqrt{3}$	0.78	0.71	0.80%	0.80%	∞

24	Temp.Unc.-Permittivity	B	0.40%	R	$\sqrt{3}$	0.23	0.26	0.10%	0.10%	∞
Combined standard uncertainty	$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	/	12.90%	12.70%	∞
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$		/	R	K=2	/	/	18.92%	18.71%	∞

5.6. System Check Results

System Performance Check at 835 MHz Head

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d134

Date: 12/05/2015

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

Medium parameters used (interpolated): f = 835 MHz; σ = 0.91 S/m; ε_r = 41.78; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3292; ConvF(6.23,6.23, 6.23); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.5 (6469)

Area Scan (71x71x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 10.3 W/Kg

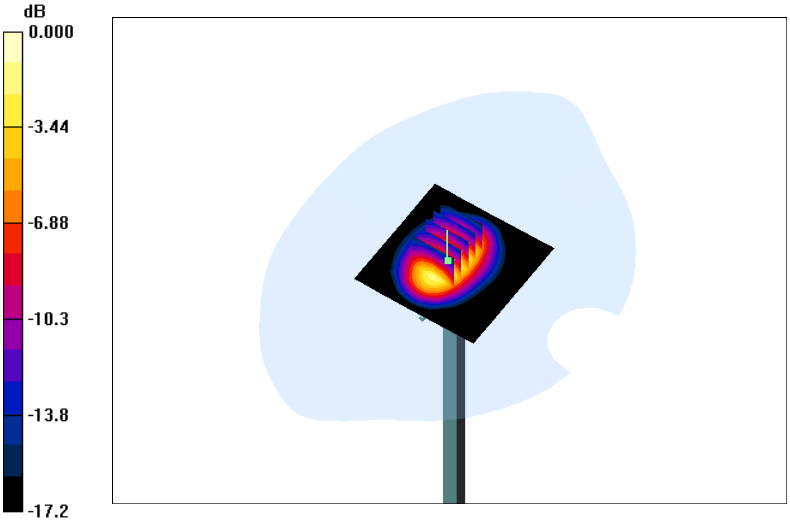
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 100.3 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 11.40 W/kg

SAR(1 g) = 9.60 W/Kg; SAR(10 g) = 6.25 W/Kg

Maximum value of SAR (measured) = 11.3 W/Kg



0 dB = 11.3 W/Kg

System Performance Check 835MHz Head 1000 mW

System Performance Check at 835 MHz Body

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d134

Date: 12/05/2015

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

Medium parameters used (interpolated): f = 835 MHz; σ = 0.99 S/m; ε_r = 53.51; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3292; ConvF(6.11,6.11, 6.11); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.5 (6469)

Area Scan (71x71x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 10.3 W/Kg

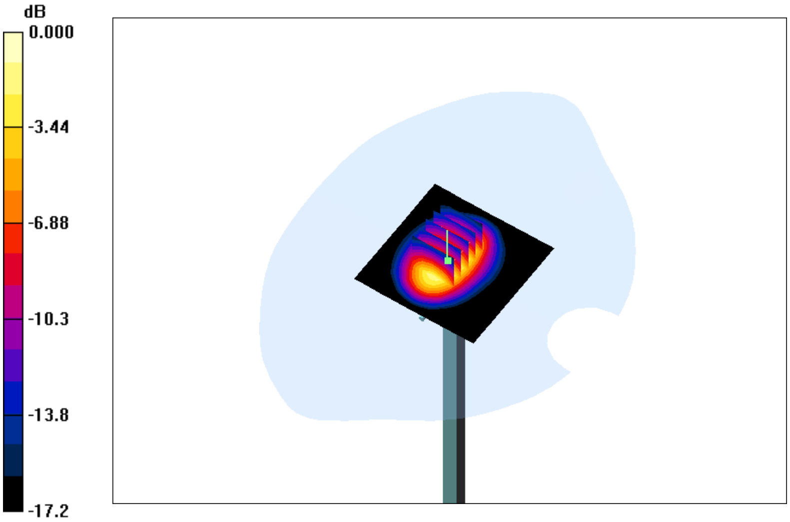
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 109.9 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 13.1 W/kg

SAR(1 g) = 9.63 W/Kg; SAR(10 g) = 6.44 W/Kg

Maximum value of SAR (measured) = 10.8 W/Kg



0 dB = 10.80 W/Kg

System Performance Check 835MHz Body 1000mW

System Performance Check at 1900 MHz Head

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d072

Date: 20/05/2015

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

Medium parameters used (interpolated): f = 1900 MHz; σ = 1.46 S/m; ε_r = 39.73; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3292; ConvF(5.03,5.03, 5.03); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (71x71x71): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 48.9 W/Kg

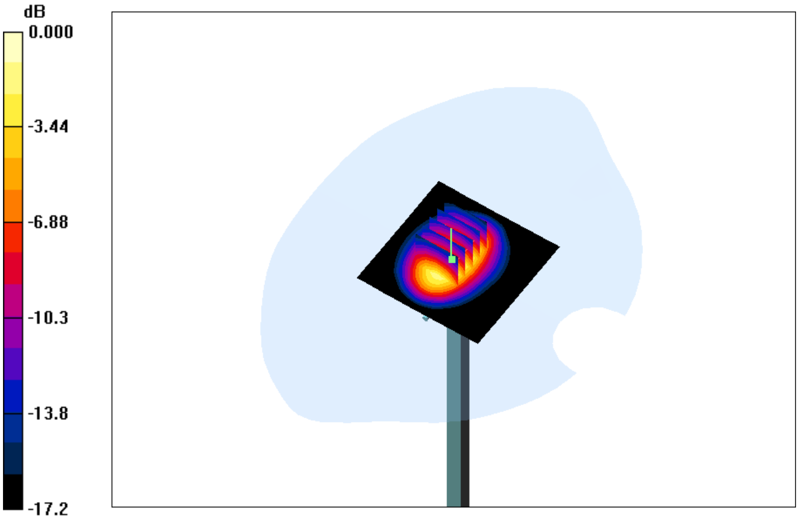
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 178.7 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 69.8 W/Kg

SAR(1 g) = 38.90 W/Kg; SAR(10 g) = 20.60 W/Kg

Maximum value of SAR (measured) = 44.2 W/Kg



0 dB = 44.20 W/Kg

System Performance Check 1900MHz Head 1000mW

System Performance Check at 1900 MHz Body

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d072

Date: 20/05/2015

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

Medium parameters used (interpolated): f = 1900 MHz; σ = 1.53 S/m; ε_r =53.00; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3292; ConvF(4.66,4.66, 4.66); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (71x71x71): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 51.50 W/Kg

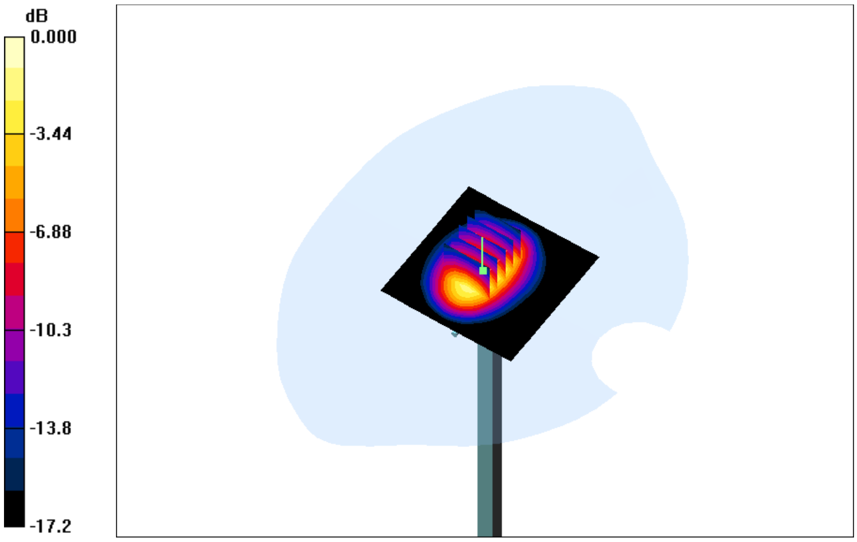
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 175.60 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 59.8 W/Kg

SAR(1 g) = 39.10 W/Kg; SAR(10 g) = 20.80 W/Kg

Maximum value of SAR (measured) = 45.20 W/Kg



0 dB = 45.20 W/Kg

System Performance Check 1900MHz Body 1000mW

System Performance Check at 2450 MHz Head

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 884

Date: 26/05/2015

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

Medium parameters used (interpolated): f = 2450 MHz; σ = 1.84 S/m; ε_r = 39.28; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3292; ConvF(4.43,4.43, 4.43); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (71x71x71): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 63.8 W/Kg

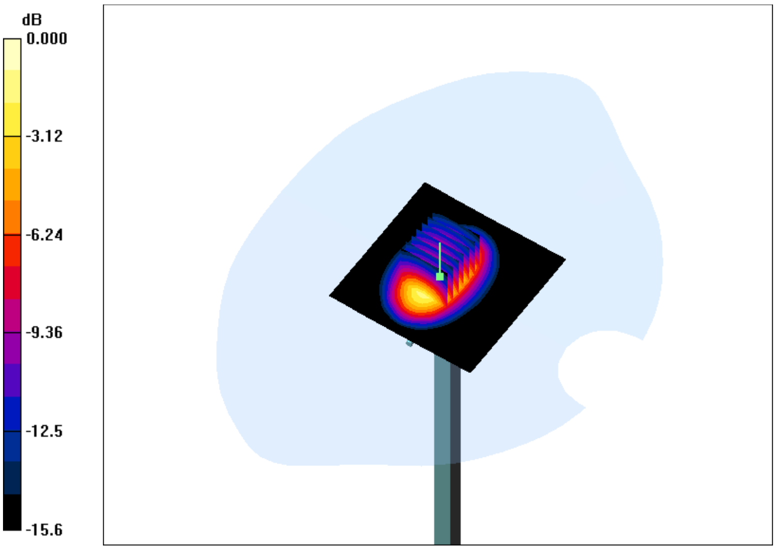
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 188.8 V/m; Power Drift = -0.11 dB

Peak SAR (extrapolated) = 120.10 W/Kg

SAR(1 g) = 54.00 W/Kg; SAR(10 g) = *25.10* W/Kg

Maximum value of SAR (measured) = 61.9 W/Kg



0 dB = 61.9 W/Kg

System Performance Check 2450MHz Head 1000mW

System Performance Check at 2450 MHz Body

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 884

Date: 26/05/2015

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

Medium parameters used (interpolated): f = 2450 MHz; σ = 2.03 S/m; ε_r = 52.65; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 – SN3292; ConvF(4.23,4.23, 4.23); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

Area Scan (71x71x71): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 66.2 W/Kg

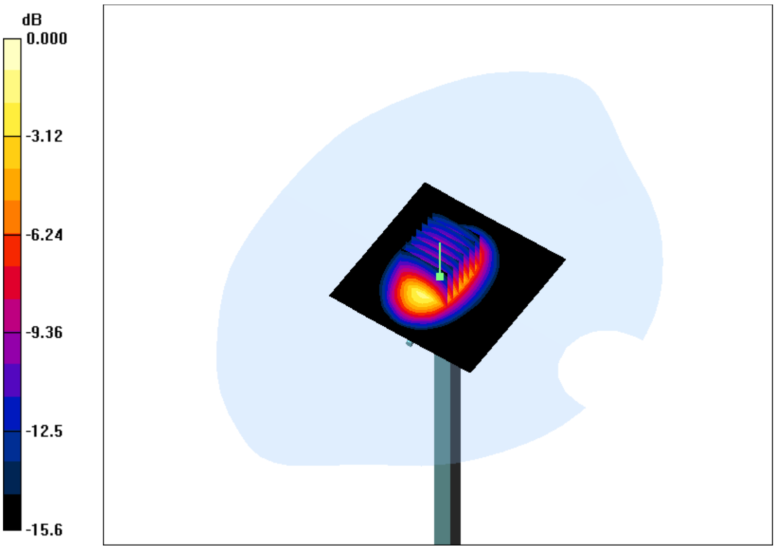
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 176.6 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 111.6 W/Kg

SAR(1 g) = 53.00 W/Kg; SAR(10 g) = 24.30 W/Kg

Maximum value of SAR (measured) = 60.9 W/Kg



0 dB = 60.9 W/Kg

System Performance Check 2450MHz Body 1000mW

5.7. SAR Test Graph Results

SAR plots for **the highest measured SAR** in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02

GSM850 Left Head Cheek Middle Channel

Date: 12/05/2015

Communication System: Customer System; Frequency: 836.6 MHz;Duty Cycle:1:8

Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.91 S/m; ε_r = 41.61; ρ = 1000 kg/m^3

Phantom section : Left Section

Probe: ES3DV3 – SN3292; ConvF(6.23,6.23, 6.23); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x121x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.582 W/Kg

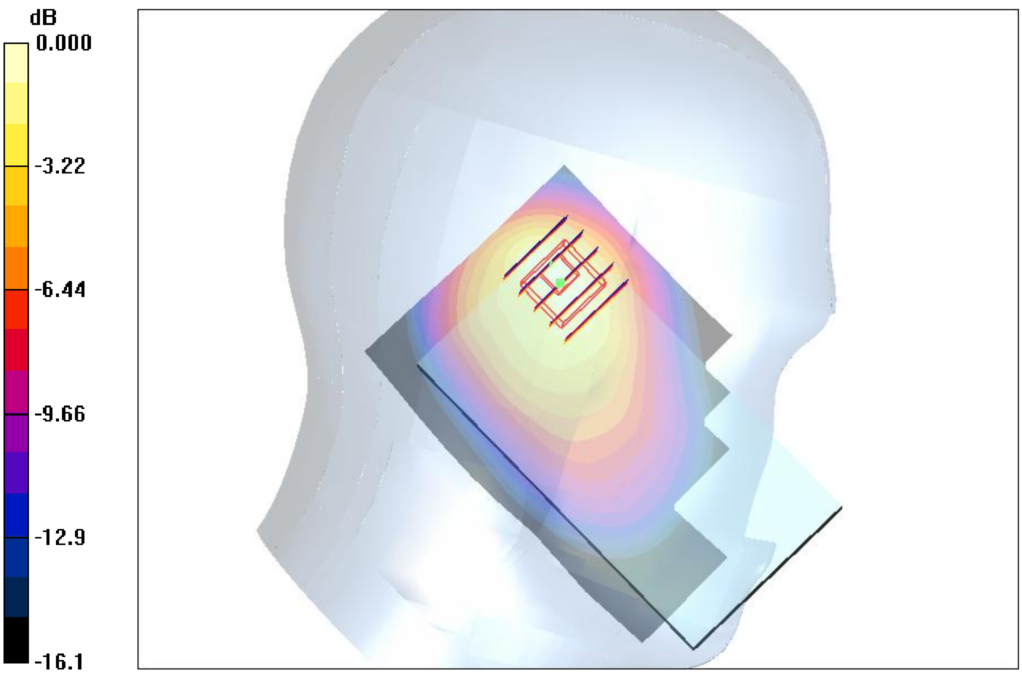
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 6.421 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.771 W/Kg

SAR(1 g) = 0.653 W/Kg; SAR(10 g) = 0.486 W/Kg

Maximum value of SAR (measured) = 0.753 W/Kg



0 dB = 0.753 W/Kg

Plot 1: Left Head Cheek (GSM850 Middle Channel)

GSM850 Body worn rear side Middle Channel

Date: 12/05/2015

Communication System: Customer System; Frequency: 836.6 MHz;Duty Cycle:1:2

Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.99 S/m; ε_r = 53.51; ρ = 1000 kg/m^3

Phantom section : Body- worn

Probe: ES3DV3 – SN3292; ConvF(6.11,6.11, 6.11); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x121x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.903 W/kg

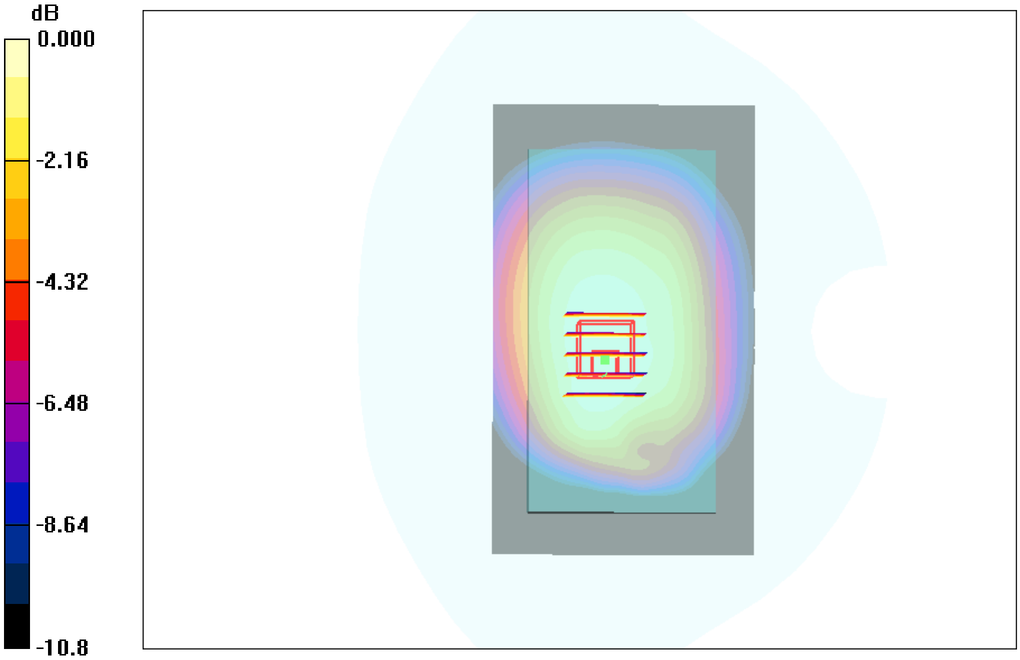
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 29.656 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 1.24 W/kg

SAR(1 g) = 0.937 W/kg; SAR(10 g) = 0.668 W/kg

Maximum value of SAR (measured) = 1.15 W/kg



0dB = 1.15 W/kg

Plot 2: Body Rear Side (GSM850 Middle Channel)

GSM1900 Left Head Cheek Middle Channel

Date: 20/05/2015

Communication System: Customer System; Frequency: 1880.0 MHz;Duty Cycle:1:8

Medium parameters used (interpolated): f = 1880.0 MHz; σ =1.45 S/m; ε_r = 39.97; ρ = 1000 kg/m^3

Phantom section : Left Section

Probe: ES3DV3 – SN3292; ConvF(5.03,5.03, 5.03); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x121x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.527 W/Kg

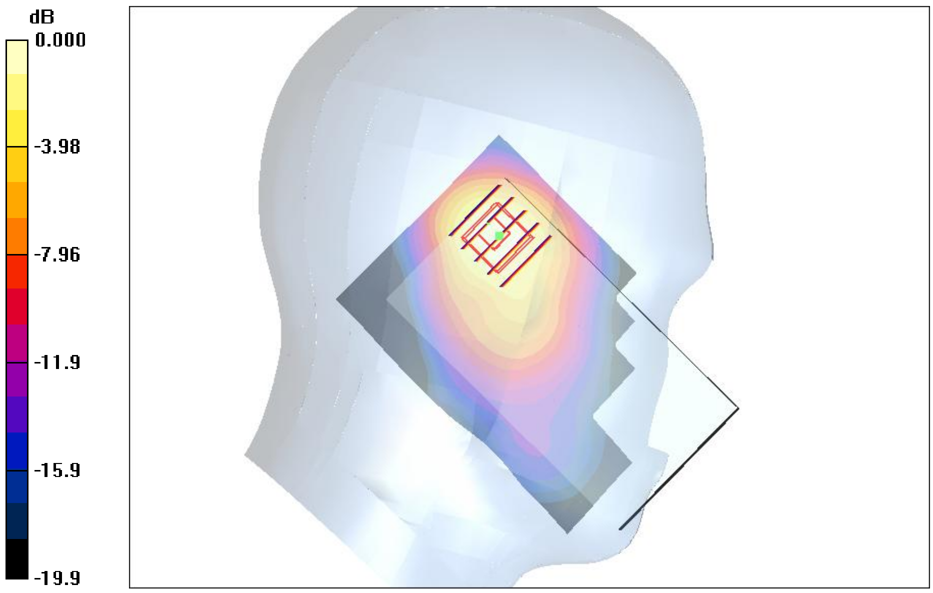
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.295 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.689 W/Kg

SAR(1 g) = 0.583 W/Kg; SAR(10 g) = 0.366 W/Kg

Maximum value of SAR (measured) = 0.617 W/Kg



0dB = 0.617 W/kg

Plot 3: Left Head Cheek (GSM1900 Middle Channel)

GSM1900 Body worn rear side Middle Channel

Date: 20/05/2015

Communication System: Customer System; Frequency: 1880.0 MHz;Duty Cycle:1:2

Medium parameters used (interpolated): f = 1880.0 MHz; σ = 1.50 S/m; ε_r = 53.10; ρ = 1000 kg/m^3

Phantom section : Body- worn

Probe: ES3DV3 – SN3292; ConvF(4.66,4.66, 4.66); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x121x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.891 W/Kg

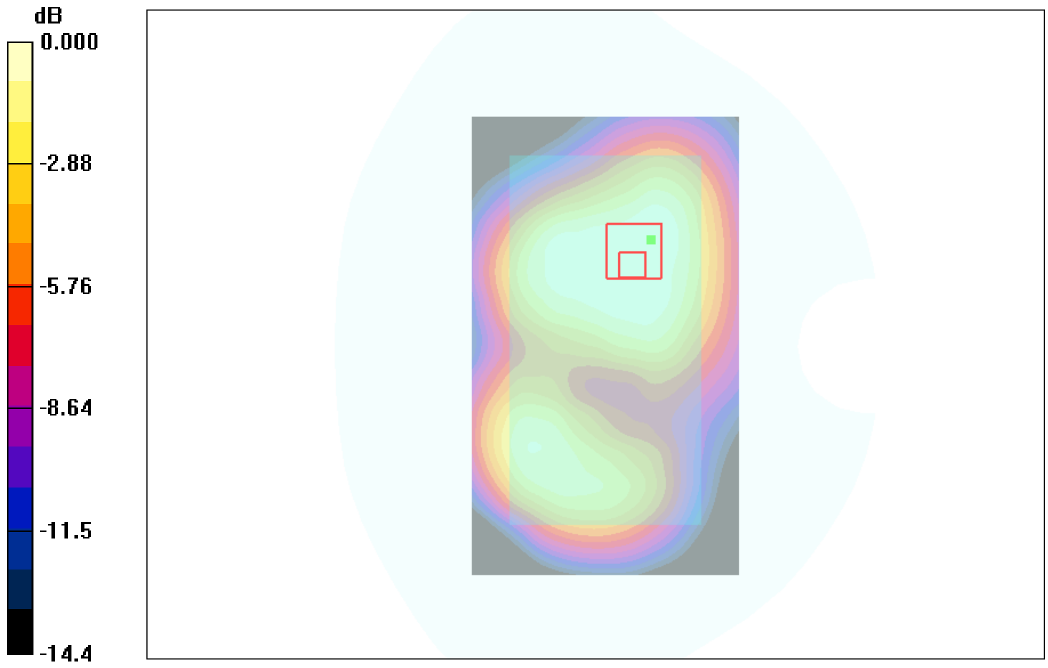
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.546 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.893 W/Kg

SAR(1 g) = 0.865 W/Kg; SAR(10 g) = 0.645 W/Kg

Maximum value of SAR (measured) = 0.895 W/Kg



0dB = 0.895 W/Kg

Plot 4: Body Rear Side (GSM1900 Middle Channel)

WiFi2450 Right Head Cheek Low-Channel (WiFi2450 Low Channel-Channel 1-2412MHz (1Mbps))

Date: 26/05/2015

Communication System: Customer System; Frequency: 2412.0 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 2412.0 MHz; σ = 1.79 S/m; ε_r = 39.46; ρ = 1000 kg/m^3

Phantom section : Right Section

Probe: ES3DV3 – SN3292; ConvF(4.43,4.43, 4.43); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x121x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) =0.381 W/Kg

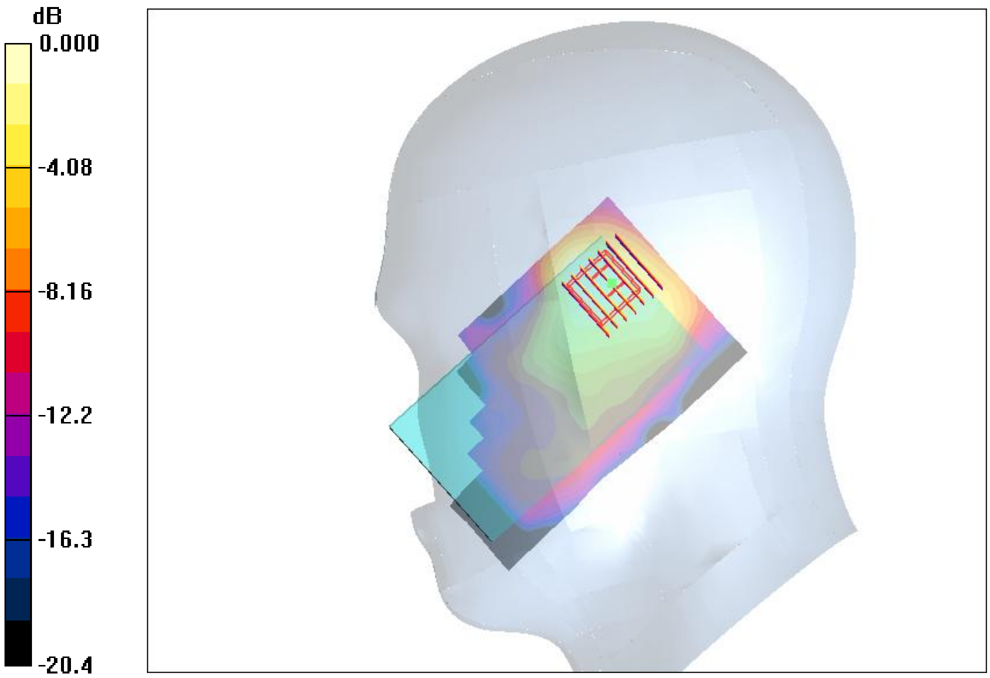
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.322 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.436 W/Kg

SAR(1 g) = 0.383 W/Kg; SAR(10 g) = 0.265 W/Kg

Maximum value of SAR (measured) = 0.456 W/Kg



0 dB = 0.456 W/Kg

Plot 5: Right Head Cheek (WiFi2450 low Channel-Channel 1-2412MHz (1Mbps))

WiFi2450 Body worn rear side low Channel (WiFi2450 Low Channel-Channel 1-2412MHz (1Mbps))

Date: 26/05/2015

Communication System: Customer System; Frequency: 2412.0 MHz;Duty Cycle:1:1

Medium parameters used (interpolated): f = 2412.0 MHz; σ = 2.00 S/m; ε_r = 52.80; ρ = 1000 kg/m^3

Phantom section : Body- worn

Probe: ES3DV3 – SN3292; ConvF(4.23,4.23, 4.23); Calibrated: 08/15/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 07/22/2014;

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

Area Scan (61x121x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 0.466 W/Kg

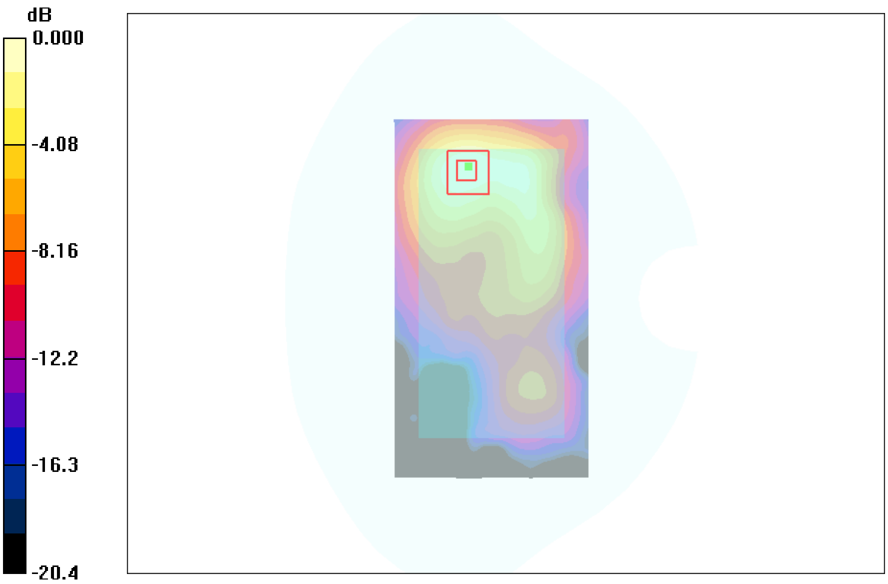
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.451 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.452 W/kg

SAR(1 g) = 0.401 W/Kg; SAR(10 g) = 0.287 W/Kg

Maximum value of SAR (measured) = 0.435 W/kg



0 dB = 0.435 W/Kg

Plot 6: Body Rear Side (WiFi2450 Low Channel-Channel 1-2412MHz (1Mbps))

6. Calibration Certificate

6.1. Probe Calibration Certificate

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 **CIQ (Auden)**

Certificate No: **ES3-3292_Aug14**

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3292

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

Calibration date: August 15, 2014

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: August 15, 2014

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

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

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

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

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, 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 ES3DV3

SN:3292

Manufactured:	July 6, 2010
Repaired:	July 28, 2014
Calibrated:	August 15, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.89	0.95	1.46	± 10.1 %
DCP (mV)[B]	107.1	106.1	103.9	

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	209.7	±3.8 %
		Y	0.0	0.0	1.0		218.8	
		Z	0.0	0.0	1.0		198.5	

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 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:3292

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
450	43.5	0.87	6.71	6.71	6.71	0.18	1.80	± 13.3 %
835	41.5	0.90	6.23	6.23	6.23	0.80	1.11	± 12.0 %
900	41.5	0.97	6.71	6.71	6.71	0.71	1.17	± 12.0 %
1810	40.0	1.40	5.07	5.07	5.07	0.61	1.36	± 12.0 %
1900	40.0	1.40	5.03	5.03	5.03	0.45	1.55	± 12.0 %
2100	39.8	1.49	5.04	5.04	5.04	0.77	1.17	± 12.0 %
2450	39.2	1.80	4.43	4.43	4.43	0.73	1.23	± 12.0 %

[C] Frequency validity above 300 MHz 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. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[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: ES3DV3 - SN:3292

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unct. (k=2)
450	56.7	0.94	7.10	7.10	7.10	0.13	1.00	± 13.3 %
835	55.2	0.97	6.11	6.11	6.11	0.36	1.78	± 12.0 %
900	55.0	1.05	5.97	5.97	5.97	0.73	1.22	± 12.0 %
1810	53.3	1.52	4.79	4.79	4.79	0.59	1.45	± 12.0 %
1900	53.3	1.52	4.66	4.66	4.66	0.41	1.79	± 12.0 %
2100	53.2	1.62	4.77	4.77	4.77	0.63	1.42	± 12.0 %
2450	52.7	1.95	4.23	4.23	4.23	0.66	0.98	± 12.0 %

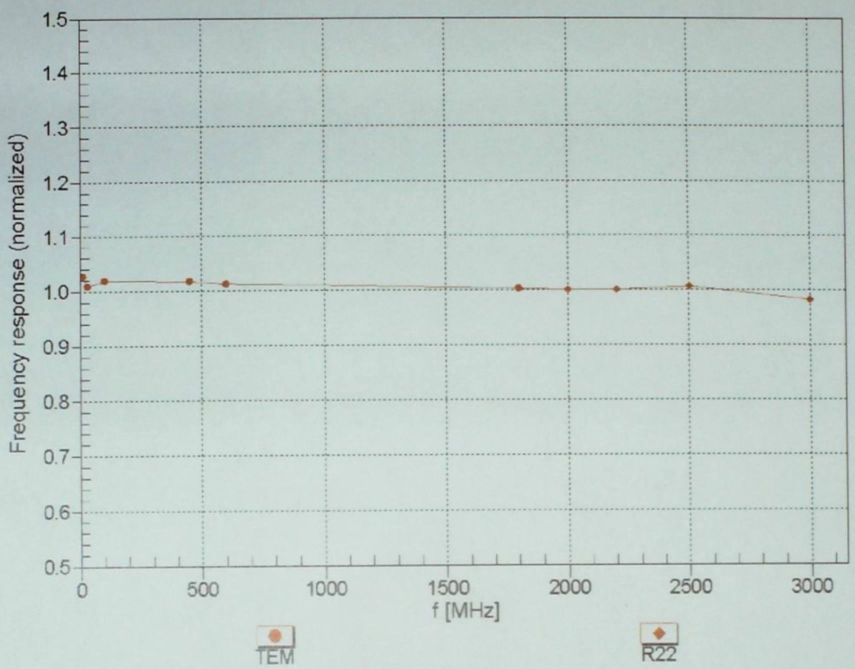
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

[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

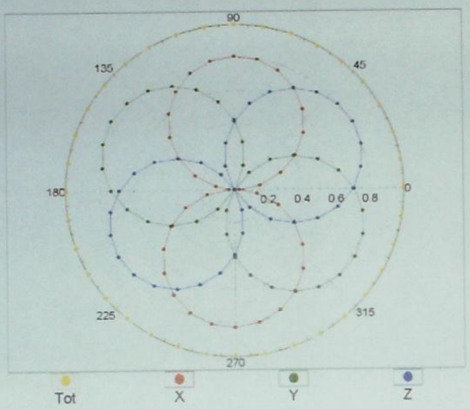
(TEM-Cell:ifi110 EXX, Waveguide: R22)



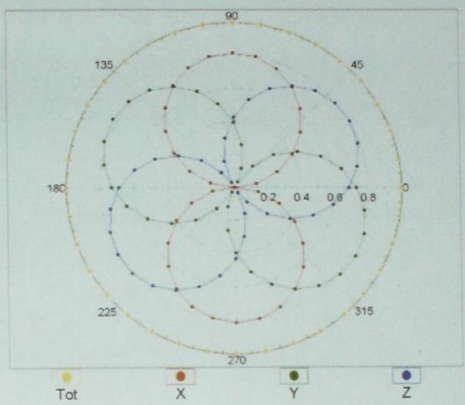
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

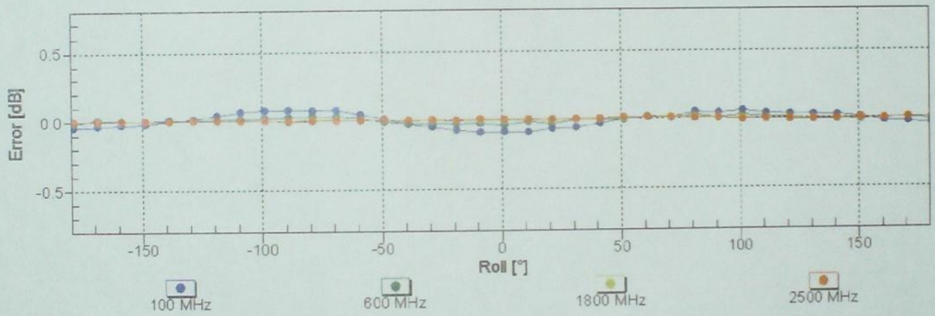
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

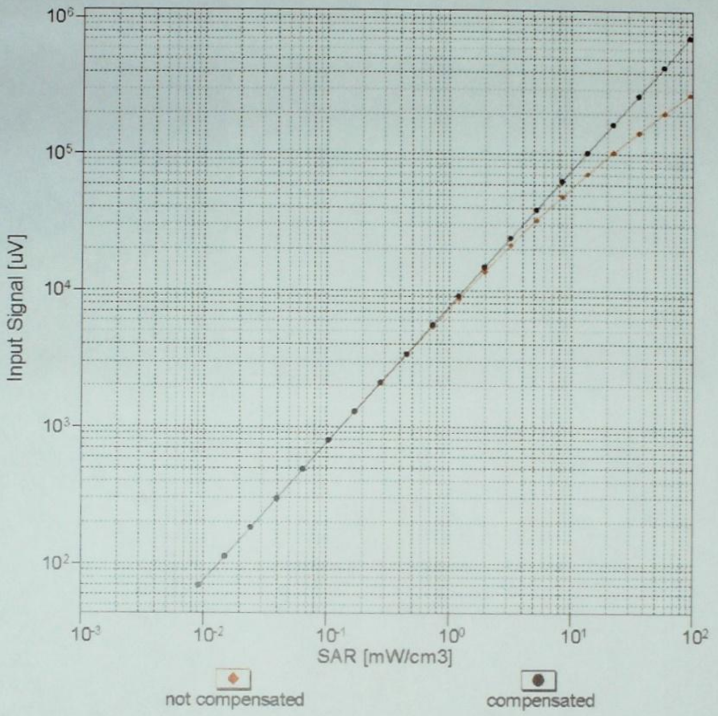


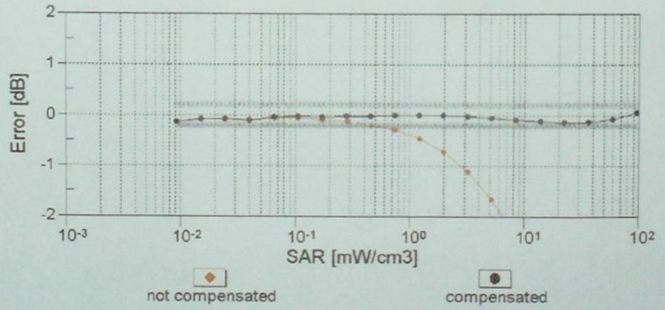


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

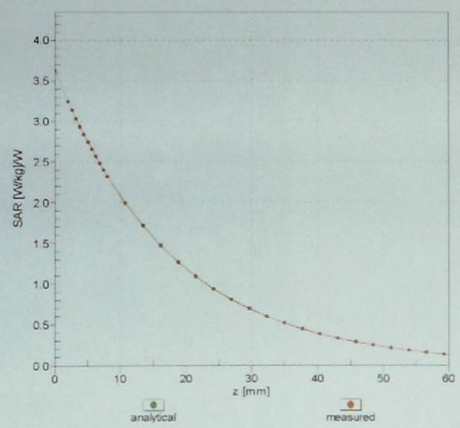
(TEM cell , f_{eval}= 1900 MHz)

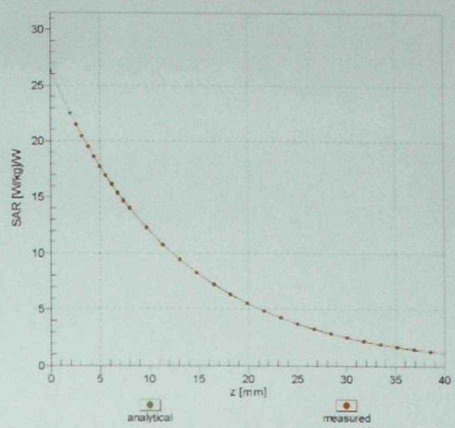




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

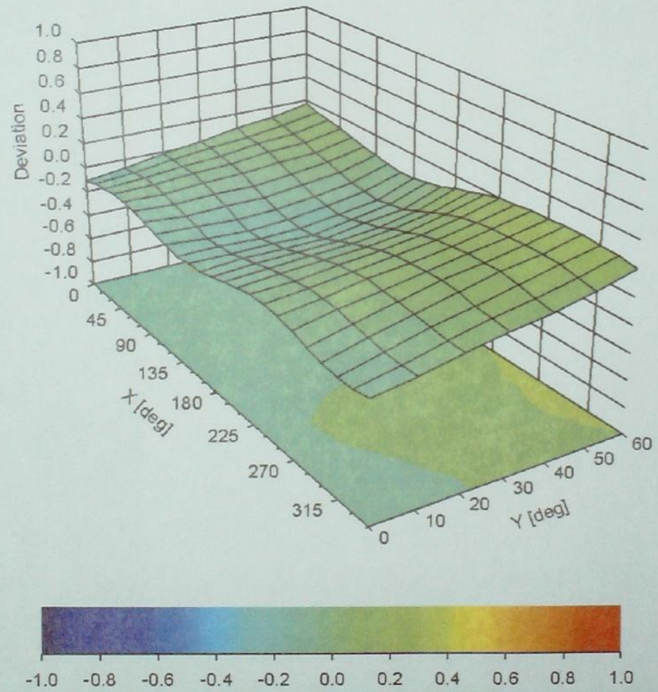
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-8.9
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