

SAR TEST REPORT

Equipment Under Test	:	Game Pad
Model No.	:	EI-GP20
Applicant	:	Samsung Electronics Co., Ltd.
Address of Applicant	:	129, Samsung-Ro, Maetan-Dong, Yeongtong-Gu, Suwon-City, Gyeonggi-Do
FCC ID	:	A3LEI-GP20
IC ID	:	649E-EIGP20
Device Category	:	Portable Device
Exposure Category	:	General Population/Uncontrolled Exposure
Date of Receipt	:	2013-11-26
Date of Test(s)	:	2013-12-05
Date of Issue	:	2013-12-09

Standards:

FCC OET Bulletin 65 supplement C
IEEE 1528, 2003
ANSI/IEEE C95.1, C95.3

In the configuration tested, the EUT complied with the standards specified above.

Remarks:

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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Tested by	:	Minhyuk Han		2013-12-09
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Approved by	:	Nicky You		2013-12-09
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APPENDIX

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1. General Information

1.1 Testing Laboratory

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Homepage : All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>

1.2 Details of Manufacturer

Manufacturer : Samsung Electronics Co., Ltd.

Address : 129, Samsung-Ro, Maetan-Dong, Yeongtong-Gu,
Suwon-City, Gyeonggi-Do

Contact Person : Hayeon Cho

Phone No. : 010-3186-8379

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1.3 Version of Report

Version Number	Date	Revision
00	2013-12-08	Initial issue
01	2013-12-09	Revision 01

1.4 Description of EUT(s)

Game Pad

EUT Type	: Game Pad
Model	: EI-GP20
Serial Number	: RSSDAH00041
Mode of Operation	: Bluetooth
Tx Frequency Range	: 2402.00 MHz ~ 2480.00

Attaching a Smart Phone to the Device

Model No		: SCHI535 (Galaxy S3)
FCC ID		: A3LSCHI535
Mode of Operation		: Cell. CDMA/EVDO, PCS CDMA/EVDO GPRS/EDGE 850/1900, LTE Band 13 LTE Band 13, 802.11a,b,g,n, Bluetooth
Tx Frequency Range		: 824.70 MHz ~ 848.31 MHz (Cell. CDMA/EVDO) 1851.25 MHz ~ 1980.75 MHz (PCS CDMA/EVDO) 824.20 MHz ~ 848.80 MHz (GSM/GPRS/EDGE 850) 1850.20 MHz ~ 1909 MHz (GSM/GPRS/EDGE 1900) 782 MHz (LTE Band 13) 2412 MHz ~ 2462 MHz (WLAN 2.4 GHz) 5745 MHz ~ 5825 MHz (WLAN 5.8 GHz) 5180 MHz ~ 5240 MHz, (WLAN 5.2 GHz) 5260 MHz ~ 5320 MHz (WLAN 5.3 GHz) 5500 MHz ~ 5700 MHz, (WLAN 5.5 GHz) 2402.00 MHz ~ 2480.00 MHz (Bluetooth)
Equipment Class	Band	Reported SAR
		1g Body-Worn (W/kg)
PCE	GPRS 850	0.412
	GPRS 1900	0.079
	LTE Band 13	0.204
DSS	Bluetooth	0.067
Simultaneous SAR per KDB 690783 D01v01r02		0.479

1.5 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 44798 D01v05.

Average power for Production					
Mode / Band		Burst Average GMSK (dBm)		Burst Average 8-PSK (dBm)	
		1 Tx Slot	2Tx Slot	1 Tx Slot	2Tx Slot
GPRS/EDGE 850	Maximum	33.50	32.0	27.0	27.0
	Nominal	33.00	31.5	26.5	26.5
GPRS/EDGE 1900	Maximum	30.00	28.0	25.5	25.5
	Nominal	29.50	27.5	25.0	25.0
Tune-up Tolerance: -1.5 dB / + 0.5 dB					
Mode / Band	Maximum & Nominal	Average output power (dBm)			
LTE Band 13	Maximum	23.5			
	Nominal	23.0			
Tune-up Tolerance: -1.5 dB / + 0.5 dB					
Mode / Band	Maximum & Nominal	Average output power (dBm)			
Bluetooth	Maximum	2.00			
	Nominal	0.00			
Tune-up Tolerance: -2.0 dB / + 2.0 dB					

1.6 Test Environment

Ambient temperature	: (22 ± 2) ° C
Tissue Simulating Liquid	: (22 ± 2) ° C
Relative Humidity	: (55 ± 5) % R.H.

1.7 Operation Configuration

The device in GSM/LTE was controlled by using a Communication tester. Communication between the device and the tester was established by air link. The EUT was set to maximum power level during all tests and at the beginning of each test the battery was fully charged. The DASY4 system measures power drift during SAR testing by comparing e-field in the same location at the beginning and at the end of measurement.

1.8 EVALUATION PROCEDURES

- Power Reference Measurement Procedures

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. The minimum distance of probe sensors to surface is 2 and 4 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

1.9 SAR Measurement Procedures

Step 1: 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. The minimum distance of probe sensors to surface is 2 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2 and 3: Area Scan & Zoom Scan Procedures

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 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan.
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1 g and 10 g.

< Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01 >

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

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement 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. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

1.10 The SAR Measurement System

A photograph of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (Speag DASY4 professional system). A Model EX3DV4 3791 E-field probe is used to determine the internal electric fields. The SAR can be obtained from the equation $SAR = \sigma (|E_i|^2) / \rho$ where σ and ρ are the conductivity and mass density of the tissue-simulant. The DASY4 system for performing compliance tests consists of the following items:

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

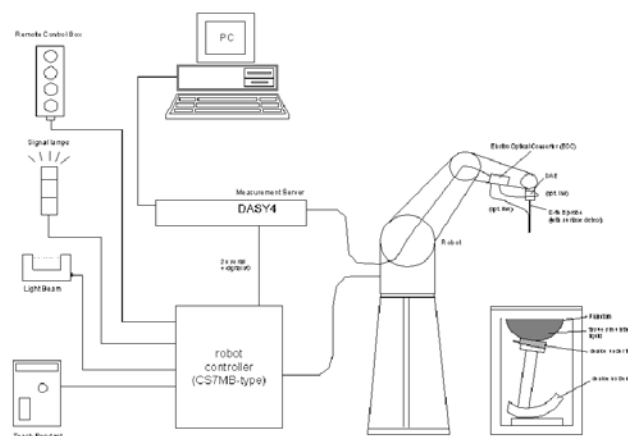


Fig a. The microwave circuit arrangement used for SAR system verification

- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected 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.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows XP.

- DASY4 software: V4.7 Build80.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM phantom enabling testing body usage.
- The device holder for flat phantom.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

1.11 System Components

EX3DV4 E-Field Probe

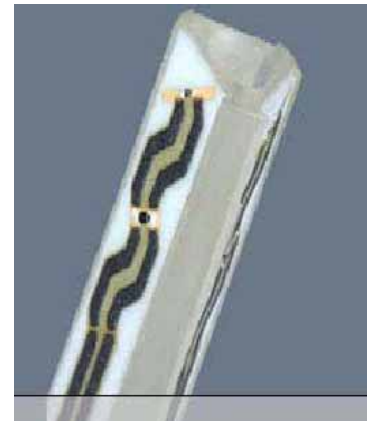
- Construction** : Symmetrical design with triangular core.
 Built-in shielding against static charges.
 PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
- Calibration** : Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 835 and HSL1900.
 Additional CF-Calibration for other liquids and frequencies upon request.
- Frequency** : 10 MHz to 6 GHz; Linearity: ± 0.2 dB (30 MHz to 6 GHz)
- Directivity** : ± 0.3 dB in HSL (rotation around probe axis)
 ± 0.5 dB in tissue material (rotation normal to probe axis)
- Dynamic Range** : 10 μ W/g to > 100 mW/g;
 Linearity: ± 0.2 dB(noise: typically < 1 μ W/g)
- Dimensions** : Overall length: 337 mm (Tip length: 20 mm)
 Tip diameter: 2.5 mm (Body diameter: 12 mm)
 Distance from probe tip to dipole centers: 1 mm
- Application** : High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%
- Construction** : Symmetrical design with triangular core.
 Built-in shielding against static charges.
 PEEK enclosure material (resistant to organic solvents, e.g., DGBE)



EX3DV4 E-Field Probe

ET3DV6 E-Field Probe

- Construction** : Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. glycol).
- Calibration** : In air from 10 MHz to 2.5 GHz In brain simulating tissue (accuracy ± 8 %)
- Frequency** : 10 MHz to >6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
- Directivity** : ± 0.2 dB in brain tissue (rotation around probe axis)
 ± 0.4 dB in brain tissue (rotation normal to probe axis)
- Dynamic Range** : 5 μ W/g to >100 mW/g; Linearity: ± 0.2 dB
- Srfce. Detect** : ± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
- Dimensions** : Overall length: 330 mm
 Tip length: 16 mm
 Body diameter: 12 mm
 Tip diameter: 6.8 mm
 Distance from probe tip to dipole centers: 2.7 mm
- Application** : General dosimetry up to 3 GHz Compliance tests of mobile phone



ET3DV6 E-Field Probe

NOTE:

1. The Probe parameters have been calibrated by the SPEAG. Please reference "APPENDIX C" for the Calibration Certification Report.

SAM Phantom

Construction:

The SAM Phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90 % of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness: 2.0 mm $\pm$ 0.1 mm

Filling Volume: Approx. 25 liters

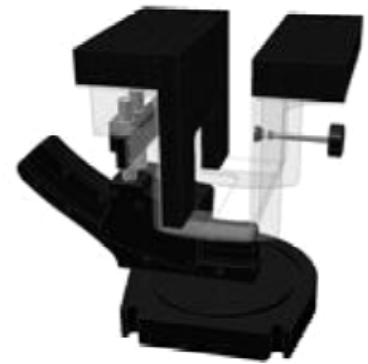


SAM Phantom

DEVICE HOLDER

Construction

Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (a.q. laptops, Cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioned.



Device Holder

1.12 SAR System verification

The microwave circuit arrangement for system verification is sketched in Fig. b. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within $\pm 10\%$ from the target SAR values. These tests were done at 750 MHz, 835 MHz, 1900 MHz. The tests for EUT were conducted within 24 hours after each verification. The obtained results from the system accuracy verification are displayed in the table 1. During the tests, the ambient temperature of the laboratory was in the range $(22 \pm 2)^\circ\text{C}$, the relative humidity was in the range $(55 \pm 5)\%$ R.H. and the liquid depth above the ear reference points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

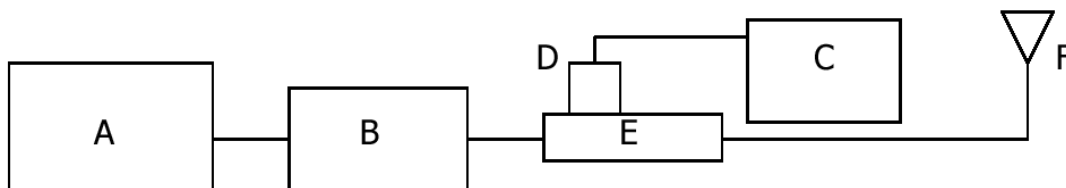


Fig b. The microwave circuit arrangement used for SAR system verification

- A. Agilent Model E4438C Signal Generator
- B. EMPOWER Model 2001-BBS3Q7ECK Amplifier
- C. Agilent Model E4419B Power Meter
- D. Agilent Model 9300H Power Sensor
- E. Agilent Model 86205A Directional RF Bridges
- F. Reference dipole Antenna



Photo of the dipole Antenna

System Verification Results

Verification Kit	Probe S/N	Tissue	Target SAR 1 g from Calibration Certificate (1 W)	Measured SAR 1 g (0.1 W)	Normalized SAR 1 g (1 W)	Deviation (%)	Date	Liquid Temp. (°C)
D750V3 S/N: 1085	1782	750 MHz Body	8.60 W/kg	0.886 W/kg	8.86 W/kg	3.02	12/05/2013	21.5
D835V2 S/N: 4d138	3791	835 MHz Body	9.32 W/kg	0.940 W/kg	9.40 W/kg	0.86	12/05/2013	21.5
D1900V2 S/N: 5d158	3791	1900 MHz Body	39.7 W/kg	3.72 W/kg	37.2 W/kg	-6.30	12/05/2013	21.5

Table 1. Results system verification

1.13 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this simulant fluid were measured by using the Speag Model DAK-3.5 Dielectric Probe in conjunction with Agilent E5070B Network Analyzer(300 kHz - 3 GHz) by using a procedure detailed in Section V.

f (MHz)	Tissue type	Limits / Measured	Dielectric Parameters		
			Permittivity	Conductivity	Simulated Tissue Temp()
750.00	Body	Measured, 12-05-2013	55.7	0.97	21.5
		Recommended Limits	55.5	0.96	21.0 ~ 23.0
		<u>Deviation(%)</u>	<u>0.36</u>	<u>1.04</u>	-
782.00		Measured, 12-05-2013	55.4	1.00	21.5
		<u>Deviation(%)</u>	<u>-0.18</u>	<u>4.00</u>	-
835.00	Body	Measured, 12-05-2013	55.3	0.94	21.5
		Recommended Limits	55.2	0.97	21.0 ~ 23.0
		<u>Deviation(%)</u>	<u>0.18</u>	<u>-3.09</u>	-
824.20		Measured, 12-05-2013	55.36	0.93	21.5
		<u>Deviation(%)</u>	<u>0.29</u>	<u>-4.30</u>	-
836.52		Measured, 12-05-2013	55.2	0.94	21.5
		<u>Deviation(%)</u>	<u>0.00</u>	<u>-3.19</u>	-
848.80		Measured, 12-05-2013	55.12	0.95	21.5
		<u>Deviation(%)</u>	<u>-0.15</u>	<u>-2.11</u>	-
1900.00	Body	Measured, 12-05-2013	52.9	1.57	21.5
		Recommended Limits	55.3	1.52	21.0 ~ 23.0
		<u>Deviation(%)</u>	<u>-4.34</u>	<u>3.29</u>	-
1850.20		Measured, 12-05-2013	53.1	1.51	21.5
		<u>Deviation(%)</u>	<u>-4.14</u>	<u>-0.66</u>	-
1880.00		Measured, 12-05-2013	53.0	1.54	21.5
		<u>Deviation(%)</u>	<u>-4.34</u>	<u>1.30</u>	-
1909.80		Measured, 12-05-2013	52.9	1.58	21.5
		<u>Deviation(%)</u>	<u>-4.54</u>	<u>3.80</u>	-

The composition of the brain & muscle tissue simulating liquid

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.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99 + % Pure Sodium Chloride

Sugar: 98 + % Pure Sucrose

Water: De-ionized, 16 MΩ⁺ resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99 + % Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

1.14 Test System Validation

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the require tissue-equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01v01. Since frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probe and tissue dielectric parameters has been included.

f (MHz)	Date	Probe S/N	Probe Cal point	Tissue Type	Dielectric Parameters		CW Validation			Modulated Validation		
					Permitt ivity	Condu ctivity	Sensitivity	Probe Linearity	Probe Isotropy	Mod. Type	Duty Factor	PAR
750	11/27/2013	1782	750	Body	53.8	0.95	PASS	PASS	PASS	GMSK	PASS	N/A
835	11/25/2013	3791	835	Body	52.8	0.93	PASS	PASS	PASS	GMSK	PASS	N/A
1900	11/25/2013	3791	1900	Body	53.3	1.56	PASS	PASS	PASS	GMSK	PASS	N/A

< SAR System Validation Summary >

1.15 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (“SAR”) in Section 4.2 of “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,” ANSI/IEEE C95.3–2003, Copyright 2003 by the Institute of Electrical and Electronics Engineers, Inc., New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in “Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields,” NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

(1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged

over an 10 grams of tissue (defined as a tissue volume in the shape of a cube). Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.

(2) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Partial Peak SAR (Partial)	1.60 m W/g	8.00 m W/g
Partial Average SAR (Whole Body)	0.08 m W/g	0.40 m W/g
Partial Peak SAR (Hands/Feet/Ankle/Wrist)	4.00 m W/g	20.00 m W/g

Table .2 RF exposure limits

2. Instruments List

Maunfacturer	Device	Type	Serial Number	Cal Date	Cal Interval	Cal Due
Stäubli	Robot	RX90BL	F12/5LP8A1/01	N/A	N/A	N/A
Schmid& Partner Engineering AG	Dosimetric E-Field Probe	ET3V6	1782	03/18/2013	Annual	03/18/2014
Schmid& Partner Engineering AG	Dosimetric E-Field Probe	EX3DV4	3791	06/04/2013	Annual	06/04/2014
Schmid& Partner Engineering AG	750 MHz System Validation Dipole	D750V3	1085	03/25/2013	Biennial	03/25/2015
Schmid& Partner Engineering AG	835 MHz System Validation Dipole	D835V2	4d138	09/27/2013	Biennial	09/27/2015
Schmid& Partner Engineering AG	1900 MHz System Validation Dipole	D1900V2	5d158	09/27/2013	Biennial	09/27/2015
Schmid& Partner Engineering AG	Data acquisition Electronics	DAE3	567	01/25/2013	Annual	01/25/2014
Schmid& Partner Engineering AG	Software	DASY42 V52.8.01	-	N/A	N/A	N/A
Schmid& Partner Engineering AG	Phantom	SAM Phantom V4.0	TP-1720 TP-1721	N/A	N/A	N/A
Agilent	Network Analyzer	E5071C	MY46111535	06/27/2013	Annual	01/03/2014
Schmid& Partner Engineering AG	Dielectric Assessment Kit	DAK-3.5	1107	03/05/2013	Annual	03/05/2014
Agilent	Power Meter	E4419B	GB43311125	06/27/2013	Annual	06/27/2014
Agilent	Power Sensor	E9300H	MY41495314	09/10/2013	Annual	09/10/2014
			MY41495307	09/10/2013	Annual	09/10/2014
Agilent	Signal Generator	E4438C	MY44270498	06/26/2013	Annual	06/26/2014
Empower RF Systems	Power Amplifier	2001-BBS3Q7ECK	1032 D/C 0336	03/29/2013	Annual	03/29/2014
Agilent	Directional RF Bridges	86205A	MY31402302	06/29/2013	Annual	06/29/2014
Microlab	LP Filter	LA-15N LA-30N	N/A	09/09/2013	Annual	09/09/2014
Agilent	Attenuator	8491B	50566	09/09/2013	Annual	09/14/2014
Anritsu	Radio Communication	MT8820C	6200863176	03/13/2013	Annual	03/13/2014

3. Summary of Results

3.1 SAR Evaluation Procedures for Game controllers Devices

Per FCC KDB Publication 941225 D07v01r01, The Game controllers Devices, 10-g extremity SAR must also be measured at zero test separation for all measured 1-g (10 mm) SAR configurations to address hand exposure. A KDB inquiry is required to determine 10 mm is acceptable for measuring 1-g SAR.

3.2 FCC Power Measurement Procedures

Power measurements were performed using a base station simulator under digital average power.

The handset was placed into a simulated call using a base station simulator in shielded chamber. SAR measurements were taken with a fully charged battery. In order to verify that the device was tested and maintained at full power, this was configured with the base station simulator. The SAR measurement Software calculates a reference point at the start and end of the test to check for power drifts. If conducted power deviations of more than 5 % occurred, the tests were repeated.

3.3 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as reported SAR. Test highest reported SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r02.

3.4 SAR measurement Conditions for LTE

3.4.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

3.4.2 MPR

MPR is permanently implemented for this device by the manufacture. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3.-1

3.4.3 A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

3.5 LTE Information

FCC ID	A3LSCHI535		
Form Factor	Handset		
Frequency Range of each LTE transmission band	Band 13: 782 MHz		
Channel Bandwidths	Band 13: 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
	-	782 (Ch 23230)	-
UE Category	UE category 3		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 Section 6.2.3 ~6.2.5?	Yes		
A-MPR(Additional MPR) disabled for SAR Testing?	Yes		
Base station simulator used for Testing	Anritsu MT8820C		

3.6 RF Conducted Power

Attaching a Smart Phone (Galaxy S3) to the Device

GSM Conducted Power

BW (MHz)	Channel	Frequency (MHz)	Mode	UL RB Size	UL RB Offset	Target MPR	Conducted Power (dBm)
10	23230	782.0	QPSK	1	0	0	23.21
				1	24	0	23.18
				1	49	0	23.20
				25	0	1	22.19
				25	12	1	22.21
				25	24	1	22.19
				50	0	1	22.17
			16QAM	1	0	1	22.61
				1	24	1	22.59
				1	49	1	22.59
				25	0	2	21.23
				25	12	2	21.23
				25	24	2	21.22
				50	0	2	21.22

GSM Conducted Power

GSM	Channel	Frequency(MHz)	Burst-Conducted Average Power(dB m)			
			GPRS		EDGE	
			1 Tx Slot	2 Tx Slot	1 Tx Slot	2 Tx Slot
GSM 850 Band	128	824.2	33.04	31.36	26.24	26.04
	190	836.6	33.16	31.41	26.34	26.17
	251	848.8	33.20	31.27	26.44	26.25
PCS 1900 Band	512	1850.2	29.54	27.85	24.98	24.74
	661	1880.0	29.61	27.96	25.38	24.81
	810	1909.8	29.73	27.62	25.41	24.95
GSM	Channel	Frequency(MHz)	Frame-Conducted Average Power(dB m)			
			GPRS		EDGE	
			1 Tx Slot	2 Tx Slot	1 Tx Slot	2 Tx Slot
GSM 850 Band	128	824.2	24.01	25.34	17.21	20.02
	190	836.6	24.13	25.39	17.31	20.15
	251	848.8	24.17	25.25	17.41	20.23
PCS 1900 Band	512	1850.2	20.51	21.83	15.95	18.72
	661	1880.0	20.58	21.94	16.35	18.79
	810	1909.8	20.70	21.60	16.38	18.93

- CS1 coding scheme was used in GPRS output power measurements and SAR Testing, as a condition where GMSK modulation was ensured. Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels or modulation in the GPRS modes.

EI-GP20 Game Pad

Bluetooth Conducted Power

Channel	Frequency (MHz)	GFSK (dB m)
Low	2402	-0.22
Middle	2441	-0.16
High	2480	0.01

3.7 SAR Test Exclusions Applied

Per FCC KDB 447498 D01v05, the SAR exclusion threshold for distances < 50 mm is defined by the following equation:

$$\frac{\text{Max Power of Channel (mW)}}{\text{Test Separation Distance (mm)}} * \sqrt{\text{Frequency(GHz)}} \leq 3.0$$

Game Pad SAR test exclusion threshold

Frequency: 2 480 MHz (min. Separation Distances = 5 mm)

SAR test exclusion thresholds (5 mm) = $(3 \times 5) / \sqrt{2.480} = 9.525$ mW

Maximum Tune-up Tolerances power(mW)	SAR Test Exclusion Thresholds(5 mm) (mW)
1.585	9.525

Bluetooth Mode (Game Pad) Calculation value: $1.585(\text{mW}) / 5(\text{mm}) \times \sqrt{2.480} = 0.50$

So, Calculation value ≤ 3.0

Bluetooth Mode (Game Pad) Conclusion: SAR is not required

3.8 Galaxy S3 SAR Data Summary

LTE Band13 Body

Ambient Temperature (°C)	23.4
Liquid Temperature (°C)	21.5
Date	12/05/2013

Test Mode	EUT Position	Mode	Traffic Channel		RB		Distance (mm)	Measured Power [dB m]	Tune-Up Limit [dB m]	1 g SAR (W/kg)	Scaling SAR (1g)	1 g SAR Limits (W/kg)
			Frequency (MHz)	Channel	Size	Offset						
LTE Band13	Back	QPSK	782.00	23230	1	0	0	23.21	23.50	0.191	0.204	1.6
LTE Band13	Back	QPSK	782.00	23230	25	12	0	22.21	22.50	0.175	0.187	

GPRS850 Body

Ambient Temperature (°C)	23.4
Liquid Temperature (°C)	21.5
Date	12/05/2013

Test Mode	EUT Position	Traffic Channel		Distance (mm)	Measured Power [dB m]	Tune-Up Limit [dB m]	1 g SAR (W/kg)	Scaling SAR (1g)	1 g SAR Limits (W/kg)
		Frequency (MHz)	Channel						
GPRS850 2Tx	Back	836.6	190	0	31.41	32.00	0.360	0.412	1.6

GPRS1900 Body

Ambient Temperature (°C)	23.4
Liquid Temperature (°C)	21.5
Date	12/05/2013

Test Mode	EUT Position	Traffic Channel		Distance (mm)	Measured Power [dB m]	Tune-Up Limit [dB m]	1 g SAR (W/kg)	Scaling SAR (1g)	1 g SAR Limits (W/kg)
		Frequency (MHz)	Channel						
GPRS1900 2Tx	Back	1880.0	661	0	27.96	28.0	0.078	0.079	1.6

SAR Test Notes

General Notes :

- The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC/OET Bulletin 65, Supplement C [June 2001] and FCC KDB Publication 447498 D01v05.
- All modes of operation were investigated, and worst-case results are reported.
- Battery is fully charged for all readings and the standard batteries are the only options.
- The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
- The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
- SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.

7. Per FCC KDB Publication 648474 D04v01, SAR was evaluated without a headset connected to the device. Since the reported SAR was ≤ 1.2 W/kg, no additional SAR evaluations using a headset cable were required.

8. Per FCC KDB Publication 941225 D07v01r01, The distance from Game controller to flat phantom for testing is no Gap.

LTE Notes

1. Per KDB Publication 941225 D05v02r02, when reported SAR of 1RB and 50%RB allocation for QPSK > 0.8 W/kg for any exposure position, SAR testing of 100RB allocation for QPSK is performed at the highest power channel.
2. Per KDB Publication 941225 D05v02r02, 16QAM output power for each RB allocation configuration is $>$ not $\frac{1}{2}$ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02, 16QAM SAR testing is not required.

3.9 FCC Multi-TX SAR considerations

3.9.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05 are applicable to handsets with built-in unlicensed transmitters such as Bluetooth devices which may simultaneously transmit with the licensed transmitter.

3.9.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. When standalone SAR is not required to be measured per FCC KDB 447498 D01v05 4.3.2.2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission involving that transmitter.

$$\text{Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{7.5} * \frac{(\text{Max Power of channel, mW})}{\text{Min. Separation Distance, mm}}$$

Mode	Frequency	Maximum Allowed Power	Separation Distance	Estimated SAR
	[MHz]	[mW]	[mm]	[W/kg]
Bluetooth	2450	1.585	5	0.067

<Tablet.3 Estimated SAR >

3.9.3 Body SAR Simultaneous Transmission Analysis

Simultaneous Transmission Summation Scenario with Worst Case (Game Pad + Samsung Smart Phone)

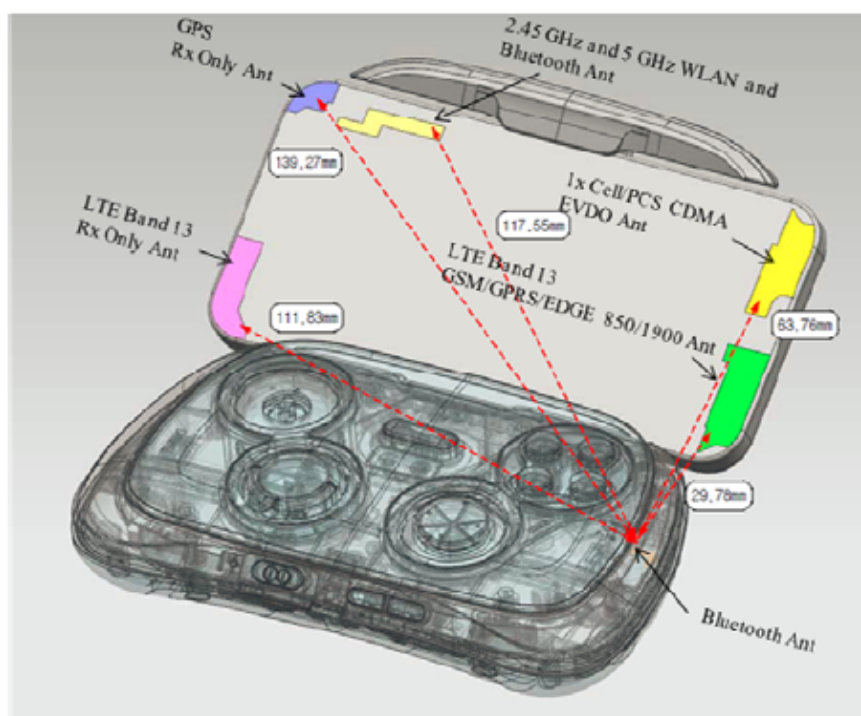
Simultaneous TX	configuration	Bluetooth SAR (W/kg)	LTE Band13(W/kg)	Σ SAR (W/kg)
Body	Back	0.067	0.204	0.271
	configuration	Bluetooth SAR (W/kg)	GPRS850(W/kg)	Σ SAR (W/kg)
	Back	0.067	0.412	0.479
	configuration	Bluetooth SAR (W/kg)	GPRS1900(W/kg)	Σ SAR (W/kg)
	Back	0.067	0.079	0.146
	configuration	Bluetooth SAR (W/kg)	CDMA(W/kg)	Σ SAR (W/kg)
	Back	0.067	Worst Limit 1.60	1.667
	configuration	Bluetooth SAR (W/kg)	WLAN(W/kg)	Σ SAR (W/kg)
	Back	0.067	Worst Limit 1.60	1.667

3.10 SPLSR Evaluation Analysis

When the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04 , simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

$$\text{Distance}_{Tx1-Tx2} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}$$

$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$



Antenna Pair		Standalong 1g SAR (W/kg)	Estimated 1g SAR (W/kg)	1g SAR Sum (W/kg)	Separation Distance (mm)	SPLS Ratio	SPLS Ratio Limit
Ant "a"	Ant "b"	a	b	a + b	D _{a-b}	(a+b) ^{1.5} / D _{a-b}	
LTE Band 13	B.T	0.204	0.067	0.271	29.78	0.005	≤ 0.04
GSM/GPRS850		0.412		0.479	29.78	0.011	
GSM/GPRS1900		0.079		0.146	29.78	0.002	
Cell. CDMA/EVDO		1.60		1.667	63.76	0.034	
PCS CDMA/EVDO		1.60		1.667	63.76	0.034	
WLAN 2.4 GHz		1.60		1.667	117.55	0.018	
WLAN 5 GHz		1.60		1.667	117.55	0.018	

Simultaneous Transmission conclusion

The above numerical summed SAR results and SPLSR analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB publication 447498 D01 v05.



Appendix

List

Appendix A	DASY4 Report (Plots of the SAR Measurements)	- 750 MHz, 835 MHz, 1900 MHz, - LTE Band 13 Test - GPRS850/1900 Test
Appendix B	Uncertainty Analysis	
Appendix C	Calibration Certificate	- PROBE - DAE - DIPOLE



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Appendix A

Test Plot - DASY4 Report

750 MHz Verification Test

Date: 2013-12-05

Test Laboratory: SGS Korea (Gunpo Laboratory)
 File Name: [750MHz_Verification.da4](#)

Input Power : 100 mW

Ambient Temp : 23.4 °C Tissue Temp : 21.5 °C

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1085
 Program Name: Verification

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.971 \text{ mho/m}$; $\epsilon_r = 55.7$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1782; ConvF(6.32, 6.32, 6.32); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2013-01-25
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

750MHz_Body Verification/Area Scan (61x101x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.948 mW/g

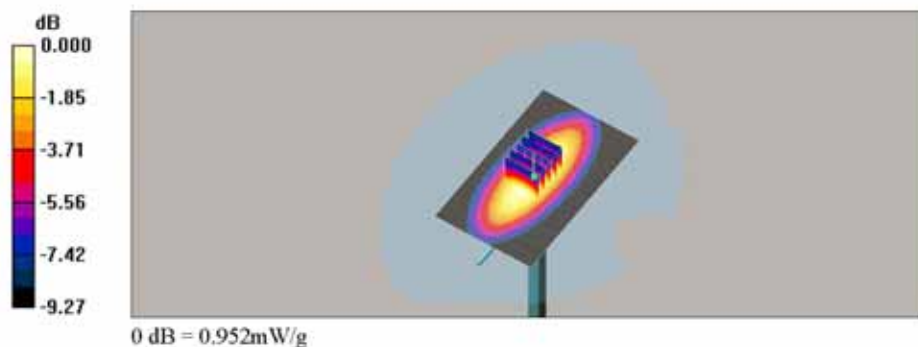
750MHz_Body Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 32.2 V/m; Power Drift = 0.012 dB

Peak SAR (extrapolated) = 1.22 W/kg

SAR(1 g) = 0.886 mW/g; SAR(10 g) = 0.606 mW/g

Maximum value of SAR (measured) = 0.952 mW/g



835 MHz Verification Test

Date: 2013-12-05

Test Laboratory: SGS Korea (Gunpo Laboratory)
 File Name: [835MHz_Verification.da4](#)

Input Power : 100 mW

Ambient Temp : 23.4 °C Tissue Temp : 21.5 °C

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d138
 Program Name: Verification

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.937 \text{ mho/m}$; $\epsilon_r = 55.3$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(8.7, 8.7, 8.7); Calibrated: 2013-06-04
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2013-01-25
- Phantom: SAM with CRP_2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

835MHz_Body Verification/Area Scan (61x91x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 1.17 mW/g

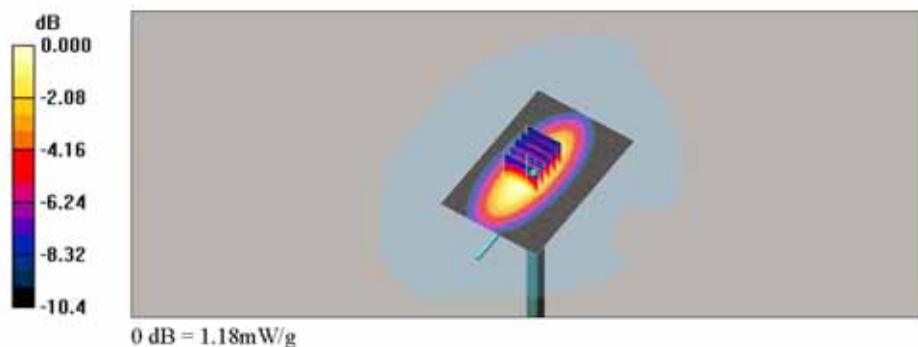
835MHz_Body Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 35.1 V/m; Power Drift = -0.083 dB

Peak SAR (extrapolated) = 1.40 W/kg

SAR(1 g) = 0.940 mW/g; SAR(10 g) = 0.621 mW/g

Maximum value of SAR (measured) = 1.18 mW/g



1900 MHz Verification Test

Date: 2013-12-05

Test Laboratory: SGS Korea (Gunpo Laboratory)
 File Name: [1900MHz_Verification.da4](#)

Input Power : 100 mW

Ambient Temp : 23.4 °C Tissue Temp : 21.5 °C

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d158
 Program Name: Verification

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.57 \text{ mho/m}$; $\epsilon_r = 52.9$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(7.15, 7.15, 7.15); Calibrated: 2013-06-04
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2013-01-25
- Phantom: SAM MIC #2000-93 with CRP_Right; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

1900MHz_Body Verification/Area Scan (61x91x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 5.35 mW/g

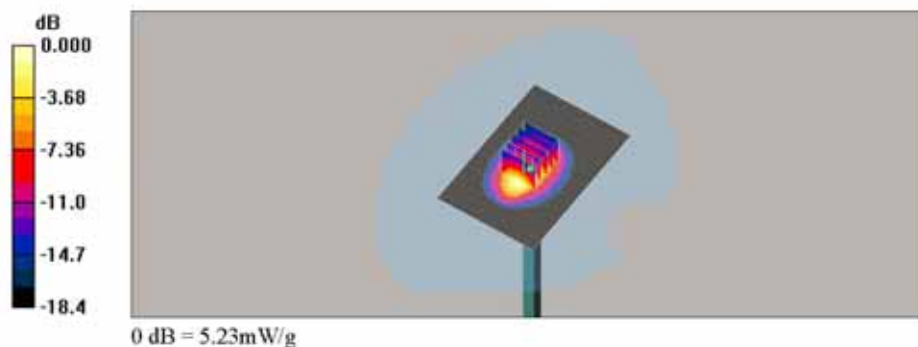
1900MHz_Body Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 58.1 V/m; Power Drift = -0.067 dB

Peak SAR (extrapolated) = 6.68 W/kg

SAR(1 g) = 3.72 mW/g; SAR(10 g) = 1.94 mW/g

Maximum value of SAR (measured) = 5.23 mW/g



LTE Band13 Body SAR Test

Date: 2013-12-05

Test Laboratory: SGS Korea (Gunpo Laboratory)
 File Name: [LTE Band13 10MHz QPSK 1RB RB Offset 0 Rear CH23230.da4](#)

Ambient Temp : 23.4 °C Tissue Temp : 21.5 °C

DUT: EI-GP20; Type: Game Pad; Serial: RSSDAH00041
 Program Name: LTE Band13 Body

Communication System: LTE Band13; Frequency: 782 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 782 \text{ MHz}$; $\sigma = 1 \text{ mho/m}$; $\epsilon_r = 55.4$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

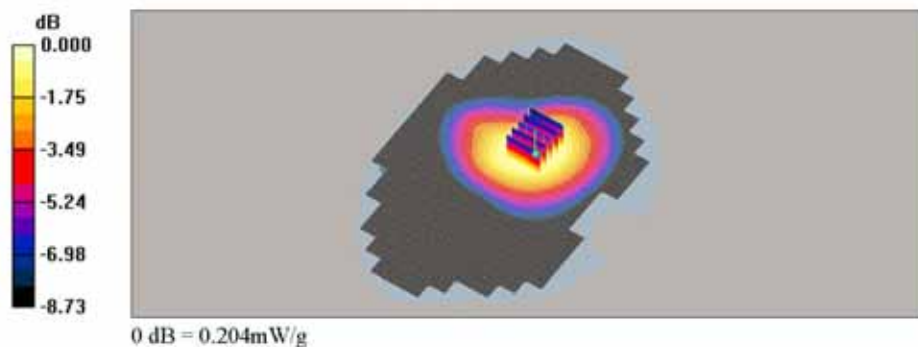
- Probe: ET3DV6 - SN1782; ConvF(6.32, 6.32, 6.32); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2013-01-25
- Phantom: SAM with CRP 2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

LTE Band13 10MHz QPSK 1RB RB Offset 0 Rear CH23230/Area Scan (121x181x1):

Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.207 mW/g

LTE Band13 10MHz QPSK 1RB RB Offset 0 Rear CH23230/Zoom Scan (5x5x7)/Cube 0:

Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
 Reference Value = 12.4 V/m; Power Drift = 0.003 dB
 Peak SAR (extrapolated) = 0.239 W/kg
 SAR(1 g) = 0.191 mW/g; SAR(10 g) = 0.141 mW/g
 Maximum value of SAR (measured) = 0.204 mW/g



0 dB = 0.204mW/g

Date: 2013-12-05

Test Laboratory: SGS Korea (Gunpo Laboratory)
 File Name: [LTE Band13 10MHz QPSK 25RB RB Offset 12 Rear CH23230.da4](#)

Ambient Temp : 23.4 °C Tissue Temp : 21.5 °C

DUT: EI-GP20; Type: Game Pad; Serial: RSSDAH00041
 Program Name: LTE Band13 Body

Communication System: LTE Band13; Frequency: 782 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 782 \text{ MHz}$; $\sigma = 1 \text{ mho/m}$; $\epsilon_r = 55.4$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

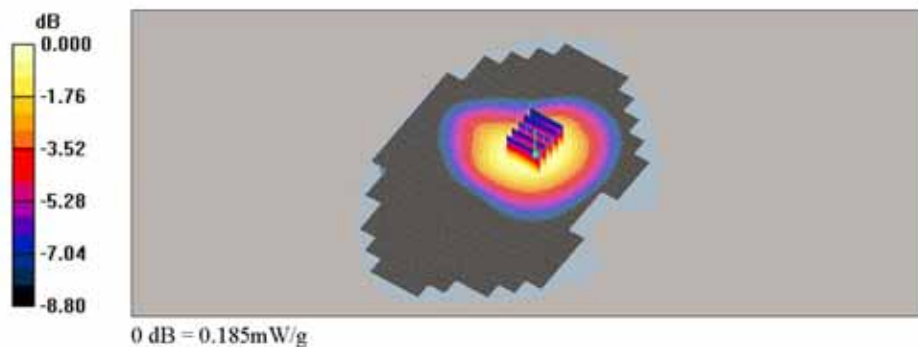
- Probe: ET3DV6 - SN1782; ConvF(6.32, 6.32, 6.32); Calibrated: 2013-03-18
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2013-01-25
- Phantom: SAM with CRP 2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

LTE Band13 10MHz QPSK 25RB RB Offset 12 Rear CH23230/Area Scan (121x181x1):

Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.184 mW/g

LTE Band13 10MHz QPSK 25RB RB Offset 12 Rear CH23230/Zoom Scan (5x5x7)/Cube

0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$
 Reference Value = 11.7 V/m; Power Drift = 0.006 dB
 Peak SAR (extrapolated) = 0.223 W/kg
 SAR(1 g) = 0.175 mW/g; SAR(10 g) = 0.129 mW/g
 Maximum value of SAR (measured) = 0.185 mW/g



GSM850 Body SAR Test

Date: 2013-12-05

Test Laboratory: SGS Korea (Gunpo Laboratory)
 File Name: [GPRS850 Rear CH190 2Tx.da4](#)

Ambient Temp : 23.4 °C Tissue Temp : 21.5 °C

DUT: EI-GP20; Type: Game Pad; Serial: RSSDAH00041
 Program Name: GPRS850 Body

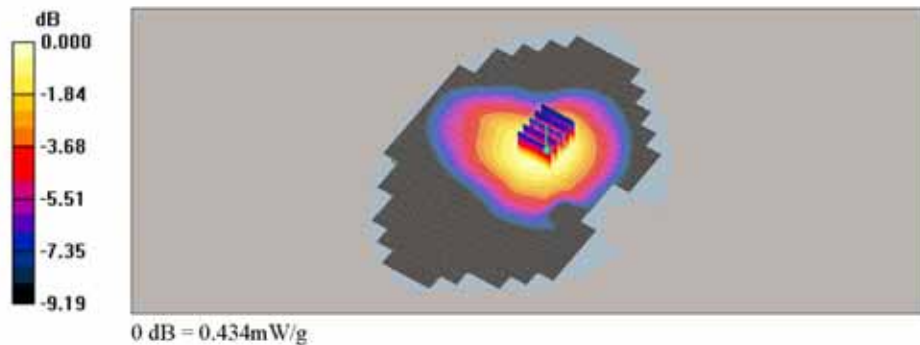
Communication System: GSM850; Frequency: 836.6 MHz; Duty Cycle: 1:4.15
 Medium parameters used: $f = 837 \text{ MHz}$; $\sigma = 0.939 \text{ mho/m}$; $\epsilon_r = 55.2$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(8.7, 8.7, 8.7); Calibrated: 2013-06-04
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2013-01-25
- Phantom: SAM with CRP 2011(left); Type: SAM; Serial: TP-1645
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

GPRS850 Rear CH190 2Tx/Area Scan (121x181x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
 Maximum value of SAR (interpolated) = 0.441 mW/g

GPRS850 Rear CH190 2Tx/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$,
 $dz=5\text{mm}$
 Reference Value = 19.6 V/m; Power Drift = 0.002 dB
 Peak SAR (extrapolated) = 0.491 W/kg
 SAR(1 g) = 0.360 mW/g; SAR(10 g) = 0.261 mW/g
 Maximum value of SAR (measured) = 0.434 mW/g



GSM1900 Body SAR Test

Date: 2013-12-05

Test Laboratory: SGS Korea (Gunpo Laboratory)
 File Name: [GPRS1900 Rear CH661 2Tx.da4](#)

Ambient Temp : 23.4 °C Tissue Temp : 21.5 °C

DUT: EI-GP20; Type: Game Pad; Serial: RSSDAH00041
 Program Name: GPRS1900 Body

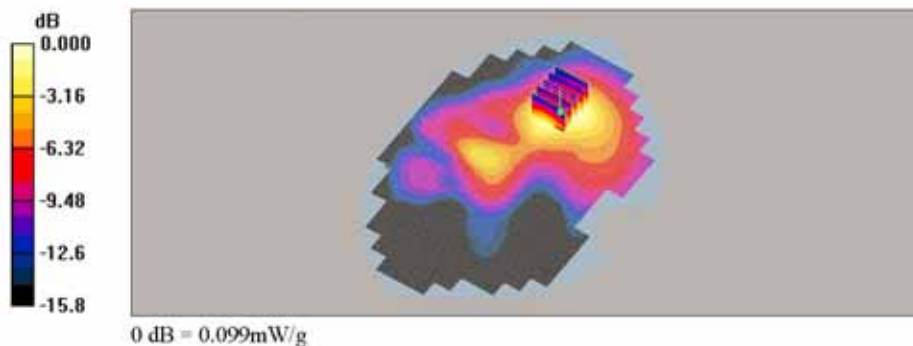
Communication System: PCS 1900; Frequency: 1880 MHz; Duty Cycle: 1:4.15
 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.54$ mho/m; $\epsilon_r = 53$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV4 - SN3791; ConvF(7.15, 7.15, 7.15); Calibrated: 2013-06-04
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn567; Calibrated: 2013-01-25
- Phantom: SAM MIC #2000-93 with CRP Right; Type: SAM MIC #2000-93; Serial: TP-1300
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

GPRS1900 Rear CH661 2Tx/Area Scan (121x181x1): Measurement grid: dx=15mm, dy=15mm
 Maximum value of SAR (interpolated) = 0.102 mW/g

GPRS1900 Rear CH661 2Tx/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
 Reference Value = 3.38 V/m; Power Drift = 0.126 dB
 Peak SAR (extrapolated) = 0.121 W/kg
SAR(1 g) = 0.078 mW/g; SAR(10 g) = 0.047 mW/g
 Maximum value of SAR (measured) = 0.099 mW/g



Appendix B

Uncertainty Analysis

Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram

a	b	c	d	e = f(d,k)	g	i = cxg/e	k
Uncertainty Component	Section in P1528	Tol (%)	Prob . Dist.	Div.	Ci (1g)	1g ui (%)	Vi (Veff)
Probe calibration	E.2.1	6.0	N	1	1	6.00	∞
Axial isotropy	E.2.2	0.25	R	1.73	1	0.14	∞
hemispherical isotropy	E.2.2	1.3	R	1.73	1	0.75	∞
Boundary effect	E.2.3	0.4	R	1.73	1	0.23	∞
Linearity	E.2.4	0.3	R	1.73	1	0.17	∞
System detection limit	E.2.5	0.25	R	1.73	1	0.14	∞
Readout electronics	E.2.6	0.3	N	1	1	0.30	∞
Response time	E.2.7	0.8	R	1.73	1	0.46	∞
Integration time	E.2.8	2.6	R	1.73	1	1.50	∞
RF ambient Condition -Noise	E.6.1	3.0	R	1.73	1	1.73	∞
RF ambient Condition - reflections	E.6.1	3.0	R	1.73	1	1.73	∞
Probe positioning- mechanical tolerance	E.6.2	1.5	R	1.73	1	0.87	∞
Probe positioning- with respect to phantom	E.6.3	2.9	R	1.73	1	1.67	∞
Max. SAR evaluation	E.5.2	1.0	R	1.73	1	0.58	∞
Test sample positioning	E.4.2	5.84	N	1	1	5.84	9
Device holder uncertainty	E.4.1	3.6	N	1	1	3.60	∞
Output power variation -SAR drift measurement	6.62	5.0	R	1.73	1	2.89	∞
Phantom uncertainty (shape and thickness tolerances)	E.3.1	6.6	R	1.73	1	3.81	∞
Liquid conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	1.85	∞
Liquid conductivity - measurement uncertainty	E.3.2	0.70	N	1	0.64	0.45	5
Liquid permittivity - deviation from target values	E.3.3	5.0	R	1.73	0.6	1.73	∞
Liquid permittivity - measurement uncertainty	E.3.3	0.56	N	1	0.6	0.34	5
Combined standard uncertainty				RSS		11.22	123
Expanded uncertainty (95% CONFIDENCE INTERVAL)				K=2		22.44	



Report File No. : F690501/RF-SAR002137-A1
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Appendix C

Calibration Certificate

- PROBE

- DAE

- 835 MHz, 1900 MHz DIPOLE

- PROBE Calibration Certificate

Probe (SN: 1782)

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

다종원

Client **SGS (Dymstec)**

Certificate No: ET3-1782_Mar13

CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1782**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-12.v7, QA CAL-23.v4, QA CAL-25.v4**
Calibration procedure for dosimetric E-field probes

Calibration date: **March 18, 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	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498067	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
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-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			Issued: March 18, 2013

Certificate No: ET3-1782_Mar13

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

ET3DV6 -- SN:1782

March 18, 2013

Probe ET3DV6

SN:1782

Manufactured: April 15, 2003
Calibrated: March 18, 2013

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

ET3DV6- SN:1782

March 18, 2013

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1782

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	2.06	1.65	1.90	$\pm 10.1 \%$
DCP (mV) ^B	96.8	97.8	96.9	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	152.9	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		139.4	
		Z	0.0	0.0	1.0		145.9	

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.

ET3DV6- SN:1782

March 18, 2013

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1782

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^c	Relative Permittivity ^e	Conductivity (S/m) ^f	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
300	45.3	0.87	7.65	7.65	7.65	0.31	1.63	± 13.4 %
450	43.5	0.87	6.92	6.92	6.92	0.17	2.31	± 13.4 %
750	41.9	0.89	6.79	6.79	6.79	0.33	2.76	± 12.0 %
835	41.5	0.90	6.38	6.38	6.38	0.29	3.00	± 12.0 %
900	41.5	0.97	6.32	6.32	6.32	0.29	3.00	± 12.0 %
1640	40.3	1.29	5.49	5.49	5.49	0.66	2.38	± 12.0 %
1810	40.0	1.40	5.10	5.10	5.10	0.80	2.15	± 12.0 %
1900	40.0	1.40	5.04	5.04	5.04	0.76	2.29	± 12.0 %
2450	39.2	1.80	4.48	4.48	4.48	0.80	1.95	± 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.

^e 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.

ET3DV6- SN:1782

March 18, 2013

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1782

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)
450	56.7	0.94	7.54	7.54	7.54	0.16	2.32	± 13.4 %
750	55.5	0.96	6.32	6.32	6.32	0.30	3.00	± 12.0 %
835	55.2	0.97	6.20	6.20	6.20	0.29	3.00	± 12.0 %
1900	53.3	1.52	4.58	4.58	4.58	0.80	2.41	± 12.0 %
2450	52.7	1.95	4.11	4.11	4.11	0.67	1.23	± 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.

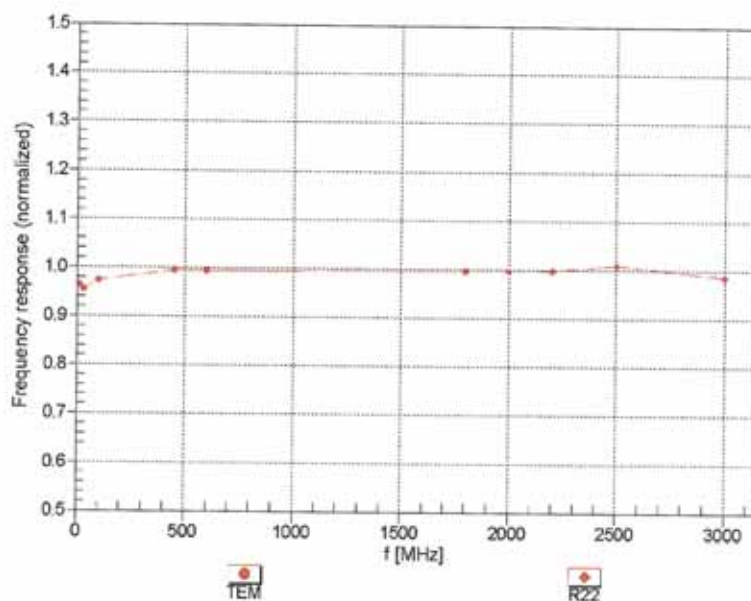
^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty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

ET3DV6- SN:1782

March 18, 2013

Frequency Response of E-Field

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

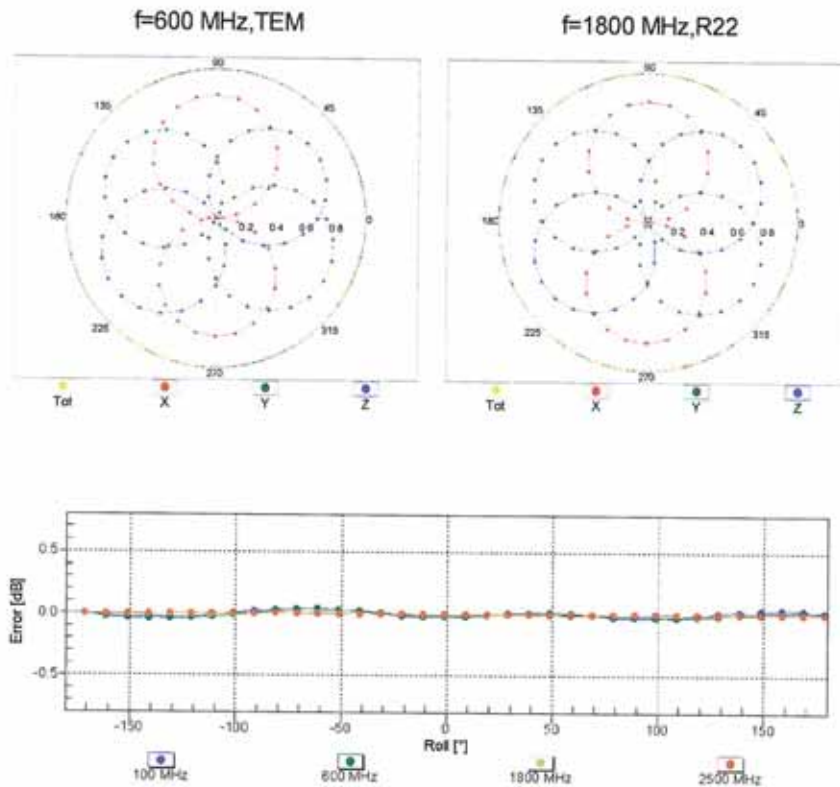


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

ET3DV6- SN:1782

March 18, 2013

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

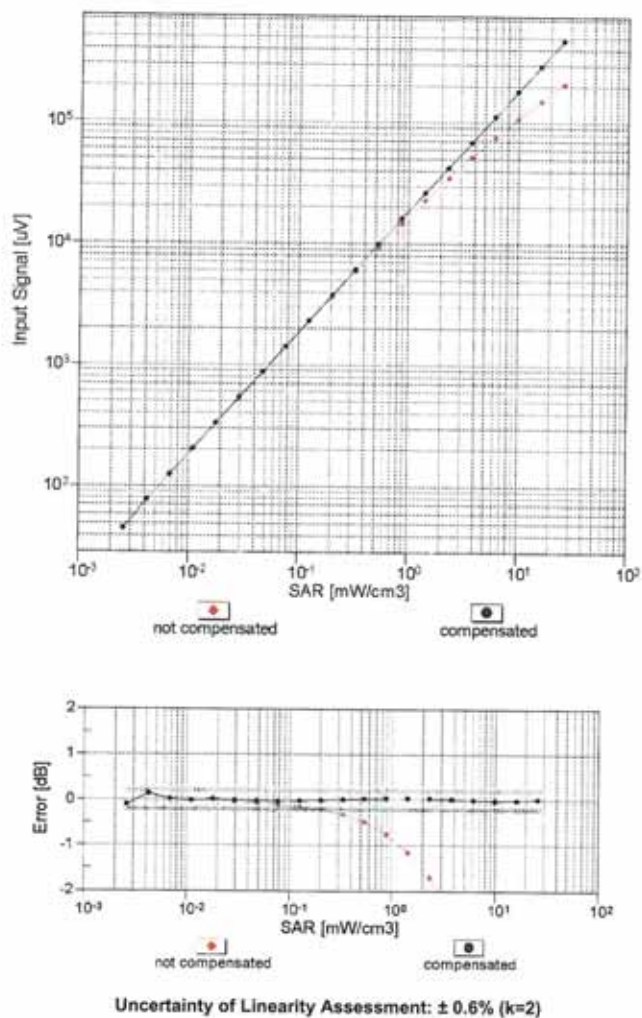


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

ET3DV6- SN:1782

March 18, 2013

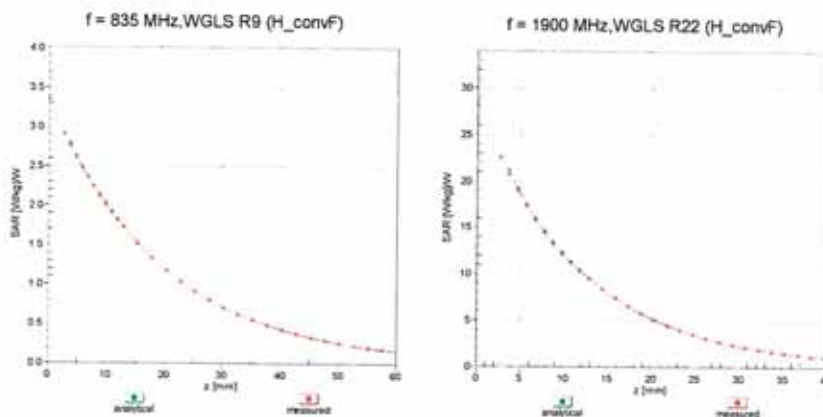
Dynamic Range f(SAR_{head}) (TEM cell , f = 900 MHz)



ET3DV6- SN:1782

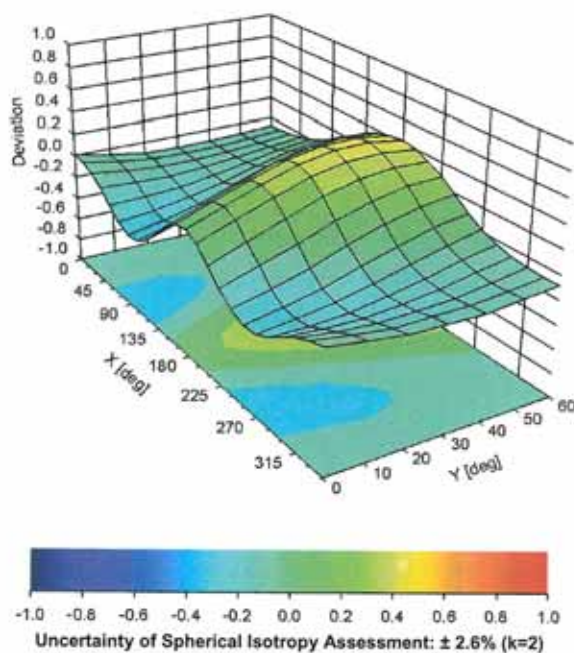
March 18, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



ET3DV6- SN:1782

March 18, 2013

DASY/EASY - Parameters of Probe: ET3DV6 - SN:1782

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	48.7
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	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	4 mm

Probe (SN: 3791)

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



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Accreditation No.: SCS 108

Client SGS (Dymstec)

Certificate No: EX3-3791_Jun13

CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3791

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 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	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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			Issued: June 4, 2013

Certificate No: EX3-3791_Jun13

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}; A, B, C, D** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.



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EX3DV4 – SN:3791

June 4, 2013

Probe EX3DV4

SN:3791

Manufactured: February 18, 2011
Calibrated: June 4, 2013

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

EX3DV4- SN:3791

June 4, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3791

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$) ^A	0.55	0.54	0.53	$\pm 10.1 \%$
DCP (mV) ^B	103.1	99.9	101.4	

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	168.0	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		165.4	
		Z	0.0	0.0	1.0		171.3	

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.

EX3DV4- SN:3791

June 4, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3791

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	8.46	8.46	8.46	0.28	1.10	± 12.0 %
900	41.5	0.97	8.33	8.33	8.33	0.61	0.68	± 12.0 %
1750	40.1	1.37	7.85	7.85	7.85	0.58	0.71	± 12.0 %
1900	40.0	1.40	7.61	7.61	7.61	0.57	0.70	± 12.0 %
2450	39.2	1.80	6.74	6.74	6.74	0.49	0.77	± 12.0 %
2600	39.0	1.96	6.56	6.56	6.56	0.36	0.92	± 12.0 %
5200	36.0	4.66	4.71	4.71	4.71	0.45	1.80	± 13.1 %
5300	35.9	4.76	4.68	4.68	4.68	0.30	1.80	± 13.1 %
5500	35.6	4.96	4.52	4.52	4.52	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.31	4.31	4.31	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.24	4.24	4.24	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.

EX3DV4- SN:3791

June 4, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3791

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	8.70	8.70	8.70	0.66	0.68	± 12.0 %
900	55.0	1.05	8.58	8.58	8.58	0.77	0.66	± 12.0 %
1750	53.4	1.49	7.52	7.52	7.52	0.35	0.92	± 12.0 %
1900	53.3	1.52	7.15	7.15	7.15	0.25	1.06	± 12.0 %
2450	52.7	1.95	6.62	6.62	6.62	0.76	0.60	± 12.0 %
2600	52.5	2.16	6.33	6.33	6.33	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.23	4.23	4.23	0.40	1.90	± 13.1 %
5300	48.9	5.42	4.07	4.07	4.07	0.40	1.90	± 13.1 %
5500	48.6	5.65	3.95	3.95	3.95	0.40	1.90	± 13.1 %
5600	48.5	5.77	3.79	3.79	3.79	0.40	1.90	± 13.1 %
5800	48.2	6.00	4.00	4.00	4.00	0.50	1.90	± 13.1 %

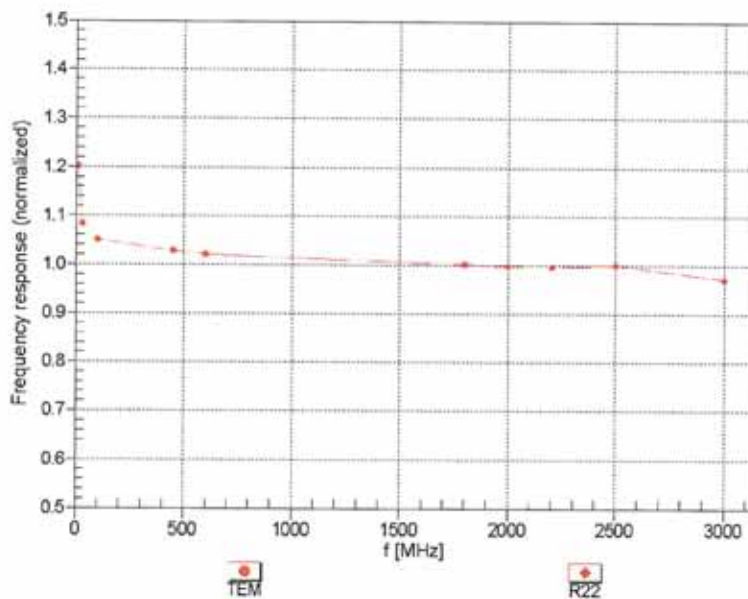
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^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.

EX3DV4- SN:3791

June 4, 2013

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



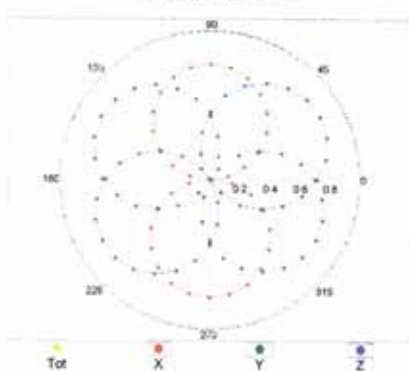
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

EX3DV4- SN:3791

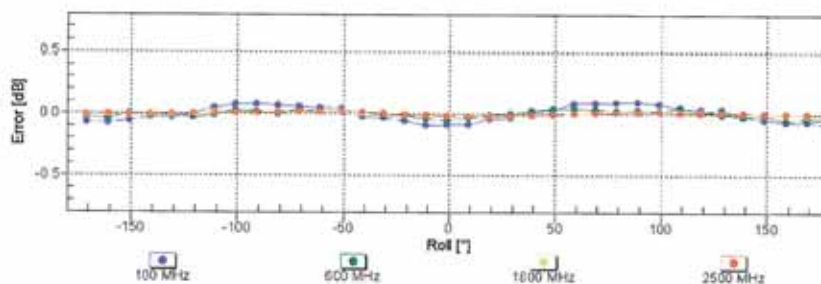
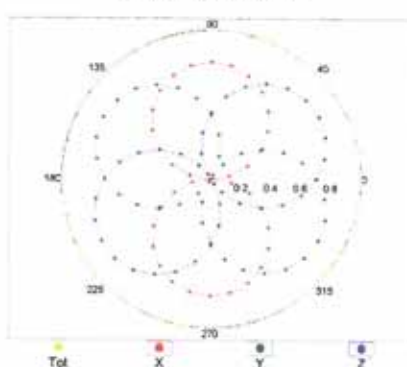
June 4, 2013

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

f=600 MHz,TEM



f=1800 MHz,R22

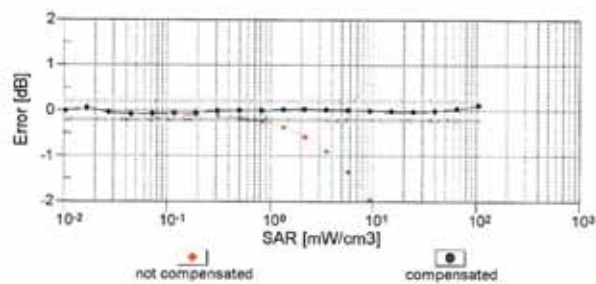
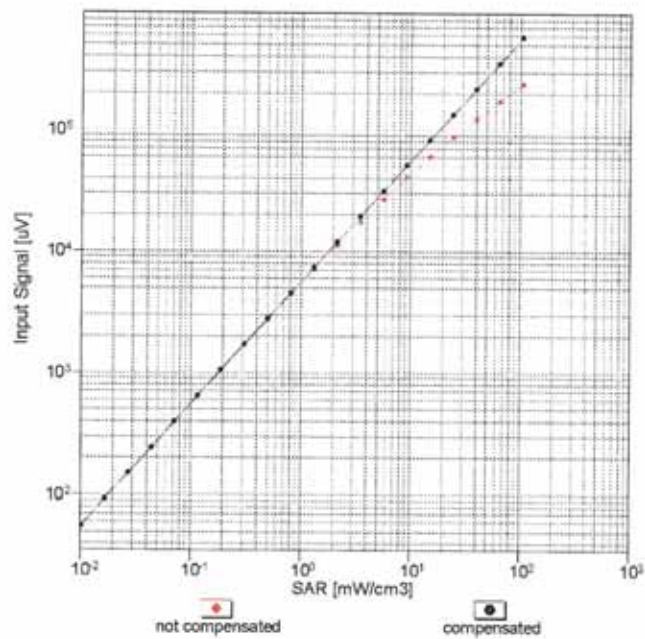


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

EX3DV4- SN:3791

June 4, 2013

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$)

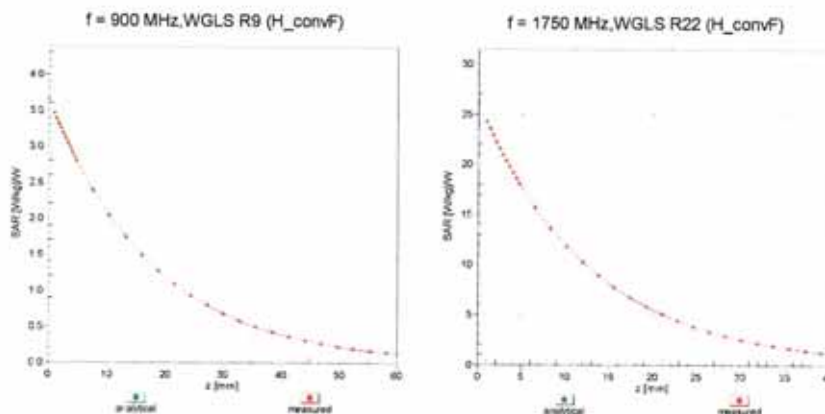


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

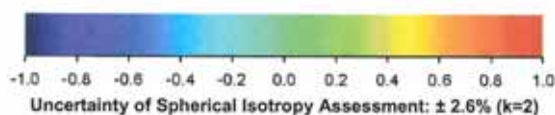
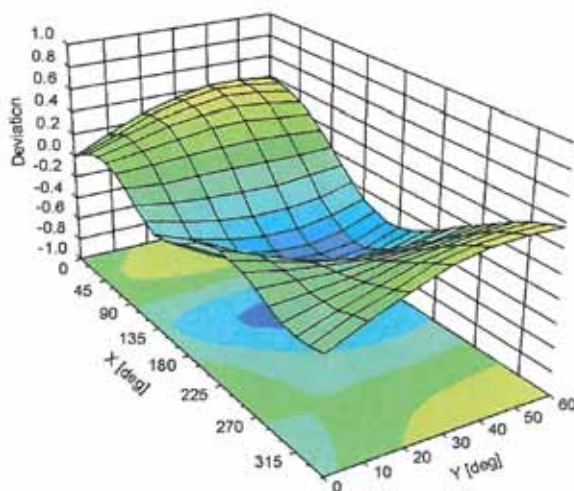
EX3DV4- SN:3791

June 4, 2013

Conversion Factor Assessment



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



EX3DV4- SN:3791

June 4, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3791

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-111.1
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

- DAE3 Calibration Certificate

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **SGS (Dymstec)**

Certificate No: **DAE3-567_Jan13**

CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 567**

Calibration procedure(s) **QA CAL-06.v25**
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **January 25, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0610278	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

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

Issued: January 25, 2013

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Accreditation No.: **SCS 108**

Glossary

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

Methods Applied and Interpretation of Parameters

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

DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.652 $\pm$ 0.02% (k=2)	404.401 $\pm$ 0.02% (k=2)	404.491 $\pm$ 0.02% (k=2)
Low Range	3.95362 $\pm$ 1.55% (k=2)	3.97148 $\pm$ 1.55% (k=2)	3.96078 $\pm$ 1.55% (k=2)

Connector Angle

Connector Angle to be used in DASY system	7 $^{\circ}$ $\pm$ 1 $^{\circ}$
---	---------------------------------

Appendix

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199995.32	-0.62	-0.00
Channel X + Input	20002.46	1.32	0.01
Channel X - Input	-19998.40	1.69	-0.01
Channel Y + Input	199997.71	1.34	0.00
Channel Y + Input	19999.63	-1.28	-0.01
Channel Y - Input	-19997.89	2.47	-0.01
Channel Z + Input	199996.03	0.01	0.00
Channel Z + Input	19998.99	-1.92	-0.01
Channel Z - Input	-19998.51	1.81	-0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2002.18	0.83	0.04
Channel X + Input	201.83	0.08	0.04
Channel X - Input	-198.32	-0.18	0.09
Channel Y + Input	2001.92	0.81	0.04
Channel Y + Input	201.24	-0.29	-0.15
Channel Y - Input	-199.03	-0.72	0.36
Channel Z + Input	2001.88	0.72	0.04
Channel Z + Input	200.70	-0.97	-0.48
Channel Z - Input	-199.17	-0.97	0.49

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	3.30	1.64
	- 200	0.20	-1.94
Channel Y	200	-0.21	-0.42
	- 200	0.96	0.59
Channel Z	200	4.66	3.87
	- 200	-5.94	-6.09

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	-	-0.86	-3.62
Channel Y	200	7.58	-	-0.08
Channel Z	200	5.96	5.73	-

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	16316	14587
Channel Y	16163	15684
Channel Z	15966	15490

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	0.52	-0.92	1.43	0.45
Channel Y	-0.20	-2.46	1.17	0.46
Channel Z	-0.70	-1.79	0.17	0.39

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

- 750 MHz Dipole Calibration Certificate

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Accreditation No.: SCS 108

Client **SGS (Dymstec)**

Certificate No: D750V3-1085_Mar13

2013.4.15
Aa

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1085**

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

Calibration date: **March 25, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

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

Calibrated by: **Jeton Kastrati** (Name) **Laboratory Technician** (Function)  (Signature)

Approved by: **Katja Pokovic** (Name) **Technical Manager** (Function)  (Signature)

Issued: March 25, 2013

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Certificate No: D750V3-1085_Mar13

Page 1 of 8

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.5
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.1 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.39 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.47 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.2 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.60 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.47 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.71 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.0 Ω - 1.2 j Ω
Return Loss	- 28.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.4 Ω - 3.6 j Ω
Return Loss	- 28.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.034 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	March 06, 2013

DASY5 Validation Report for Head TSL

Date: 25.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1085

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.92 \text{ S/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.28, 6.28, 6.28); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

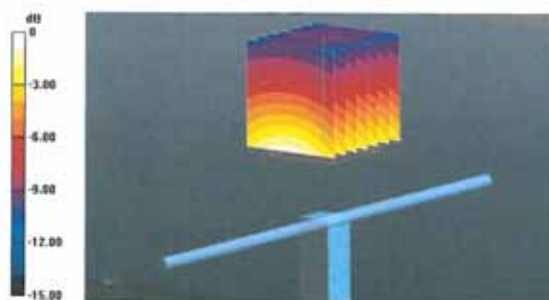
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 52.364 V/m; Power Drift = 0.04 dB

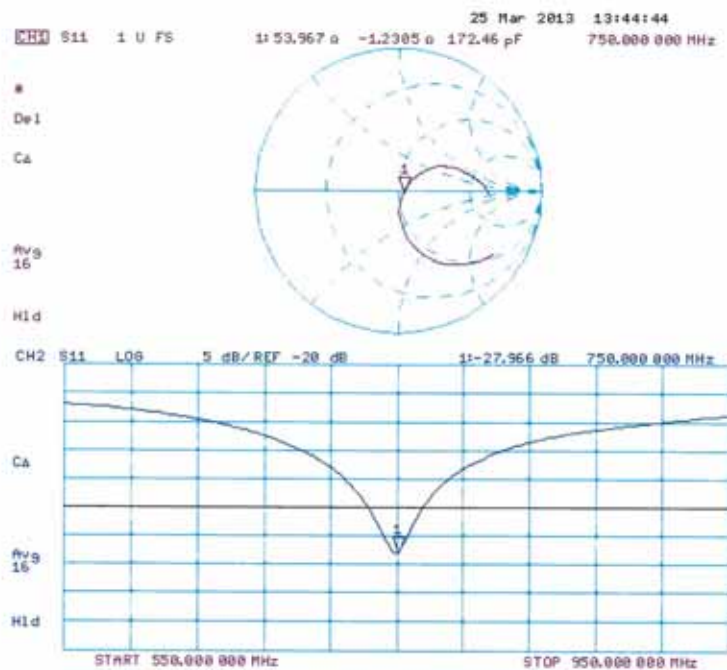
Peak SAR (extrapolated) = 3.33 W/kg

SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.4 W/kg

Maximum value of SAR (measured) = 2.53 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.03.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1085

Communication System: CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 1 \text{ S/m}$; $\epsilon_r = 54.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.11, 6.11, 6.11); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

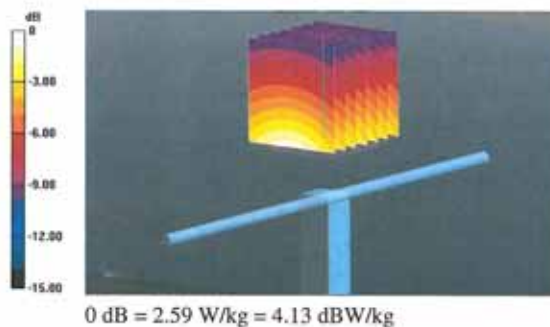
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 52.364 V/m; Power Drift = 0.04 dB

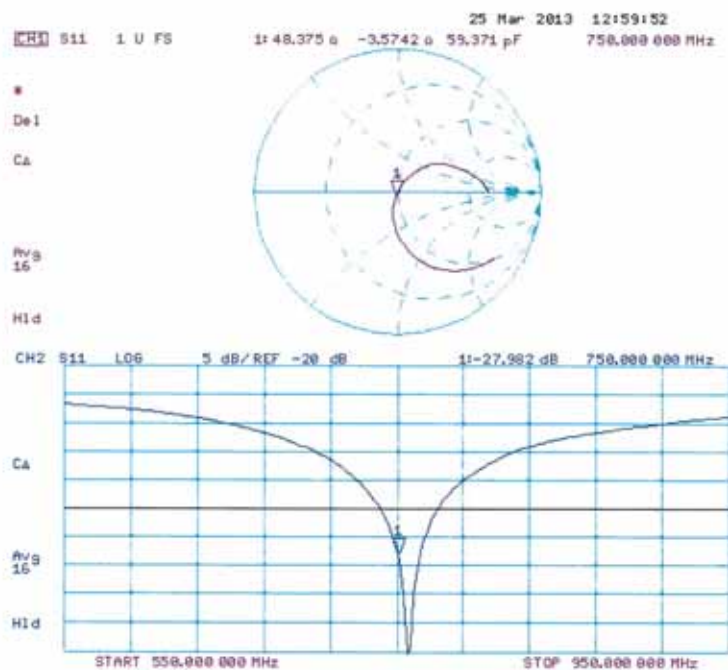
Peak SAR (extrapolated) = 3.28 W/kg

SAR(1 g) = 2.23 W/kg; SAR(10 g) = 1.47 W/kg

Maximum value of SAR (measured) = 2.59 W/kg



Impedance Measurement Plot for Body TSL



- 835 MHz Dipole Calibration Certificate

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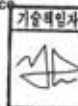


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Accreditation No.: SCS 108

2013.10.14



Client **SGS (Dymstec)**

Certificate No: D835V2-4d138_Sep13

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d138**

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

Calibration date: **September 27, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	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
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Jeton Kastrati** Name: **Jeton Kastrati** Function: **Laboratory Technician** Signature:

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

Issued: September 27, 2013

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Certificate No: D835V2-4d138_Sep13

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.4 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.44 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.16 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.4 $\pm$ 6 %	1.01 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.32 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.12 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.6 Ω -2.1 j Ω
Return Loss	- 31.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7 Ω - 4.4 j Ω
Return Loss	- 24.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.397 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 22, 2011

DASY5 Validation Report for Head TSL

Date: 27.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d138

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

Medium parameters used: $f = 835$ MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 41.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 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:

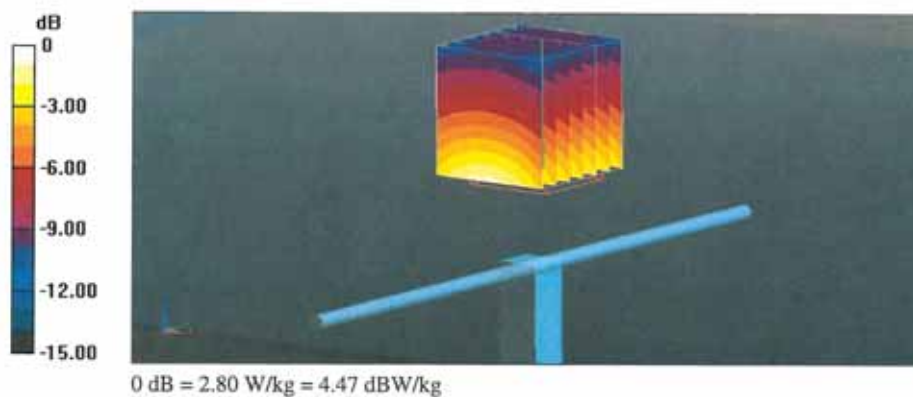
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.671 V/m; Power Drift = 0.04 dB

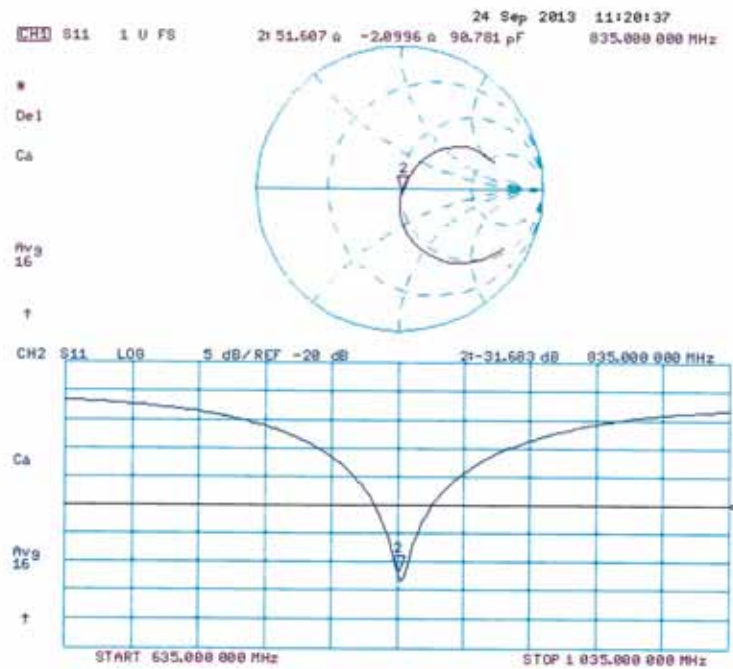
Peak SAR (extrapolated) = 3.63 W/kg

SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 2.80 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 26.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d138

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.01 \text{ S/m}$; $\epsilon_r = 54.4$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 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:

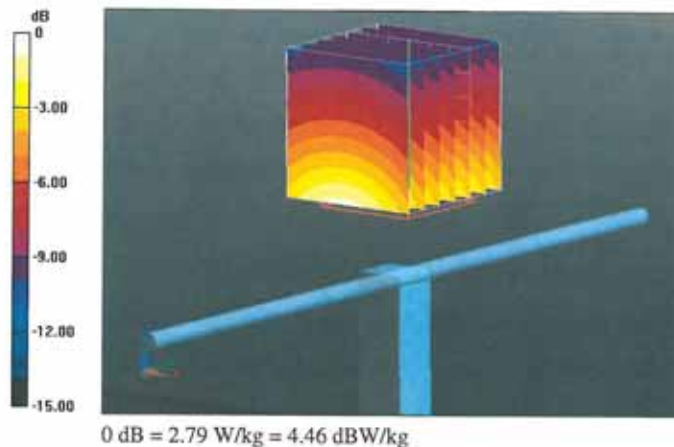
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 54.246 V/m; Power Drift = 0.04 dB

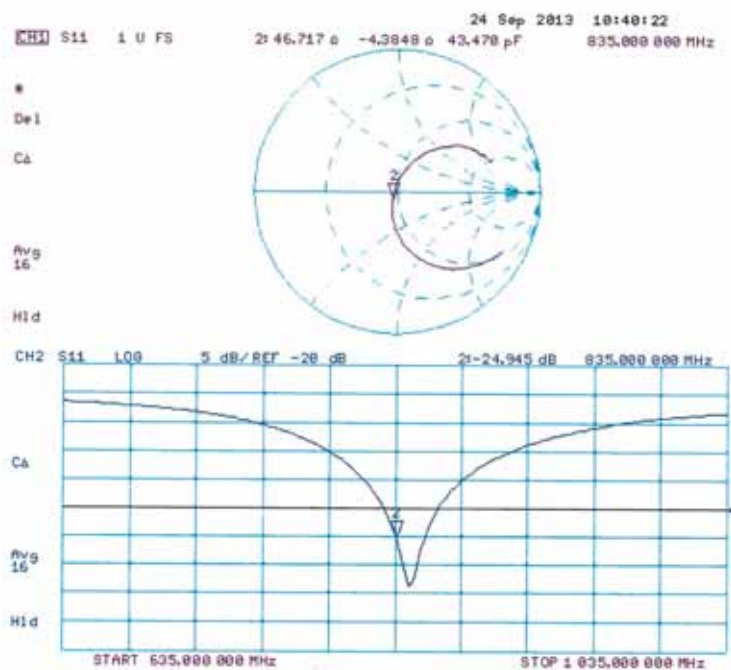
Peak SAR (extrapolated) = 3.53 W/kg

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

Maximum value of SAR (measured) = 2.79 W/kg



Impedance Measurement Plot for Body TSL



- 1900 MHz Dipole Calibration Certificate

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Accreditation No.: SCS 108

2013.10.14

Client **SGS (Dymstec)**

Certificate No: D1900V2-5d158_Sep13

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d158**

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

Calibration date: **September 27, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292763	01-Nov-12 (No. 217-01640)	Oct-13
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
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Israa El-Naouq** Function: **Laboratory Technician** Signature: *Israa El-Naouq*

Approved by: **Katja Pokovic** Technical Manager Signature: *Katja Pokovic*

Issued: September 27, 2013

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Certificate No: D1900V2-5d158_Sep13

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.7 $\pm$ 6 %	1.37 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.0 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	53.2 $\pm$ 6 %	1.49 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.80 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.2 \Omega + 4.8 j\Omega$
Return Loss	- 25.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.1 \Omega + 5.0 j\Omega$
Return Loss	- 25.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 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 20, 2011

DASY5 Validation Report for Head TSL

Date: 27.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d158

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.37$ S/m; $\epsilon_r = 39.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 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:

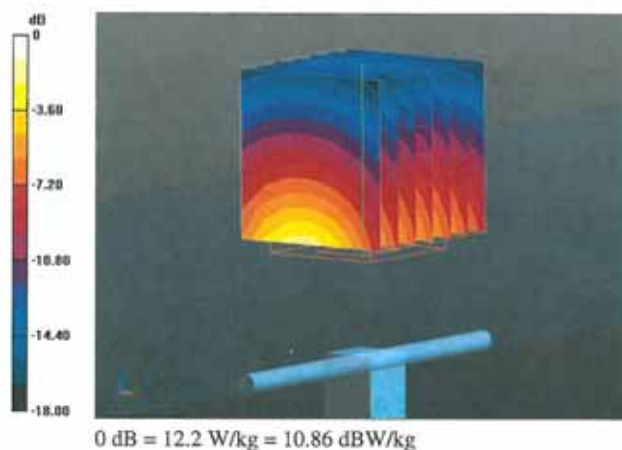
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.878 V/m; Power Drift = 0.05 dB

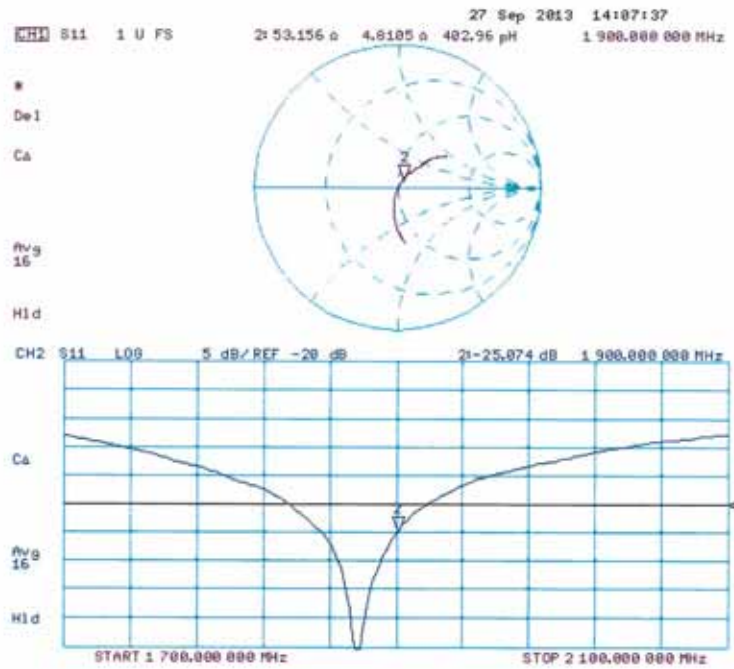
Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 9.92 W/kg; SAR(10 g) = 5.22 W/kg

Maximum value of SAR (measured) = 12.2 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 27.09.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d158

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 53.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 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:

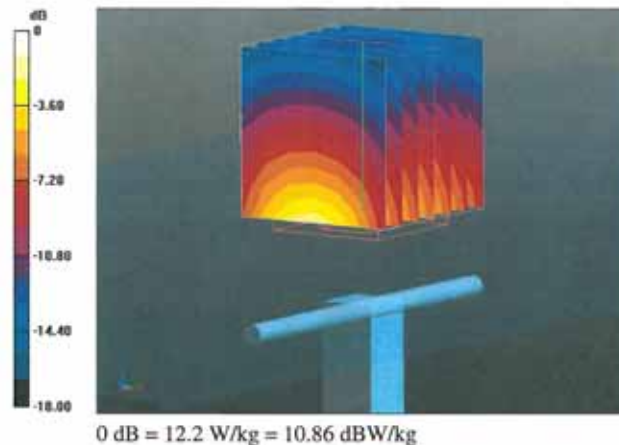
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.878 V/m; Power Drift = 0.02 dB

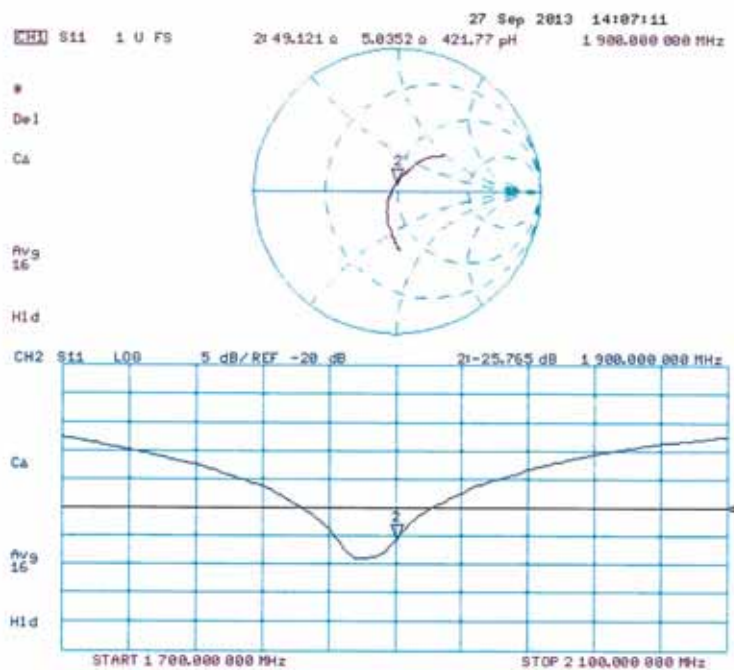
Peak SAR (extrapolated) = 16.8 W/kg

SAR(1 g) = 9.8 W/kg; SAR(10 g) = 5.23 W/kg

Maximum value of SAR (measured) = 12.2 W/kg



Impedance Measurement Plot for Body TSL



-THE END-