SAR TEST REPORT

Equipment Under Test	:	AUTO-CHEKT
Model No.	:	GM505YAA
Applicant	:	i-SENS lnc
Address of Applicant	:	#465-14 Wolgye-Dong, Nowon-Gu, Seoul
FCC ID	:	OELGM505YAA
Device Category	:	Portable Device
Exposure Category	:	General Population/Uncontrolled Exposure
Date of Receipt	:	2012-10-10
Date of Test(s)	:	2012-11-16
Date of Issue	:	2012-11-20
Max. SAR	:	0.818 W/kg (GPRS 850)

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:

Tested by	**:**	**Jongwon Ma**	**2012-11-20**
Approved by	**:**	**Feel Jeong**	**2012-11-20**

Contents

APPENDIX

A. DASY5 SAR Report
B. Uncertainty Analysis
C. Calibration certificate

1. General Information

1.1 Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, 435-040, Korea
Telephone : +82 +31 428 5700
FAX : +82 +31 427 2371
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	i-SENS lnc
Address	#465-14 Wolgye-Dong, Nowon-Gu, Seoul
Contact Person	Shin, Hyunyong
Phone No.	+82 2 910 0834
E-mail	hyshin@i-sens.com

1.3 Version of Report

Version Number	Date	Revision
00	2012-11-19	Initial issue

1.4 Description of EUT(s)

EUT Type	AUTO-CHEKT
Model	GM505YAA
Serial Number	: N/A
Mode of Operation	: GSM850, PCS1900
Duty Cycle	: 8.3(1Tx Slot), 4.15(2Tx Slot)
Body worn Accessory	: None
Tx Frequency Range	: 824.2 ㎒ ~ 848.8 ㎒ (GSM850) 1850.2 ㎒ ~ 1909.8 ㎒ (PCS1900)
Conducted Max Power	32.31 ㏈m(GSM850), 29.80 ㏈m(PCS1900),
Battery Type	: 3.7 V d.c. (Lithum-ion Battery)

1.5 Test Environment

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

1.6 Operation Configuration

The device in GSM mode was controlled by using a Communication tester (CMU 200). Communication between the device and the tester was established by air link. Measurements were performed at the lowest, middle and highest channels of the operating band. The EUT was set to maximum power level during all tests and at the beginning of each test the battery was fully charged.

The DASY5 system measures power drift during SAR testing by comparing e-field in the same location at the beginning and at the end of measurement. Based on the RF Power and antenna separation distance, stand-alone BT SAR and simultaneous SAR evaluation are not required.

1.7 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 4 ㎜. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties (for example, 2.0 ㎜ for an EX3DV4 probe type).

- 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.

The probe is calibrated at the center of the dipole sensors that is located 1 ㎜ to 2.0 ㎜ away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within –2 ㏈ of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1 % for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 ㎜.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1 g and 10 g peak evaluations are only available for the predefined cube 7x7x7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 30x30x30 ㎜ contains about 30 g of tissue. The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume. In the last step, a 1 g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

1.8 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 Dasy 5 professional system). A Model EX3DV4 3862 E-field probe is used to determine the internal electric fields. The SAR can be obtained from the equation SAR= σ (|Ei|2)/ ρ where σ and ρ are the conductivity and mass density of the tissue-simulant. The DASY5 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.

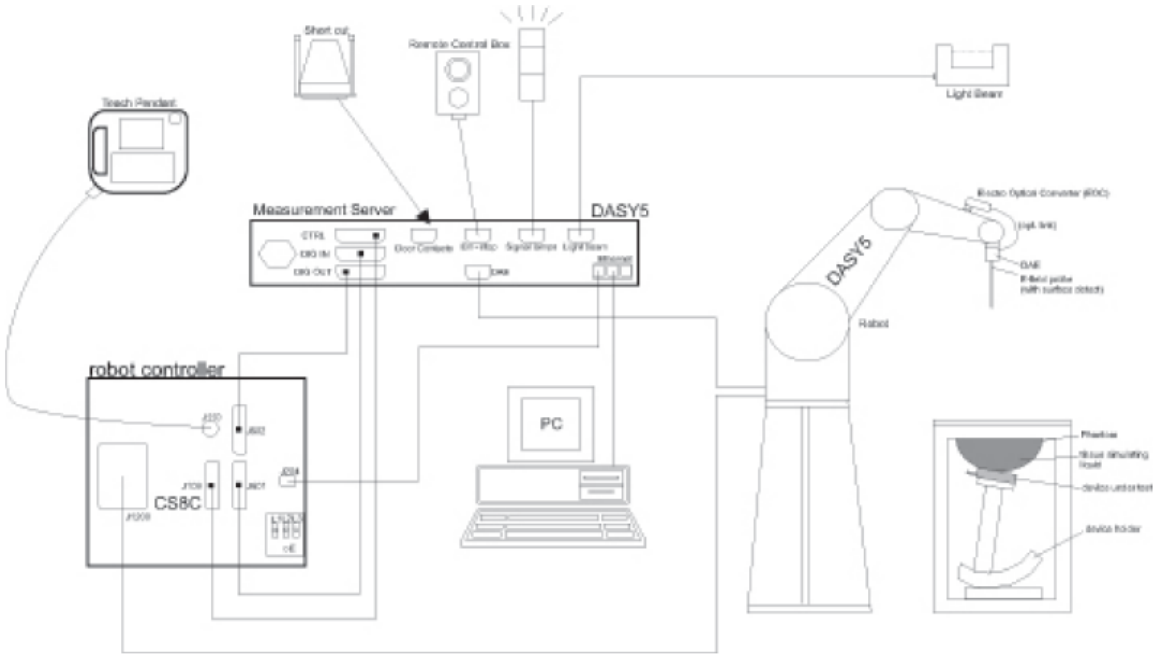


Fig a. The microwave circuit arrangement used for SAR system verification

• 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 7.

• DASY5 software.

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

• The SAM twin 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.

1.9 System Components

Isotropic E-field Probe EX3DV4

Fig. 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)
Frequency	:	10 ㎒ to 6 ㎓; Linearity: ± 0.2 ㏈ (30 ㎒ to 6 ㎓)
Directivity	:	± 0.3 ㏈ in HSL (rotation around probe axis) ± 0.5 ㏈ in tissue material (rotation normal to probe axis)
Dynamic Range	:	10μW/g to > 100 m W/g; Linearity: ± 0.2 ㏈(noise: typically < 1 μW/g)
Dimensions	:	Overall length: 337 ㎜ (Tip length: 20 ㎜) Tip diameter: 2.5 ㎜ (Body diameter: 12 ㎜) Distance from probe tip to dipole centers: 1 ㎜
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 ㎓ 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)

NOTE:

1. The Probe parameters have been calibrated by the SPEAG. Please reference “APPENDIX D” 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 ㎜ ± 0.1 ㎜

Filling Volume: Approx. 25 liters

SAM Phantom

DEVICE HOLDER

Construction In combination with the Twin SAM PhantomV4.0/V4.0C or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Device Holder

1.10 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 +/- 10 % from the target SAR values. These tests were done at 850 ㎒, 1900 ㎒. The tests for EUT were conducted within 24 hours after each validation. 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 ± 2) ° C, the relative humidity was in the range (55 ± 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.

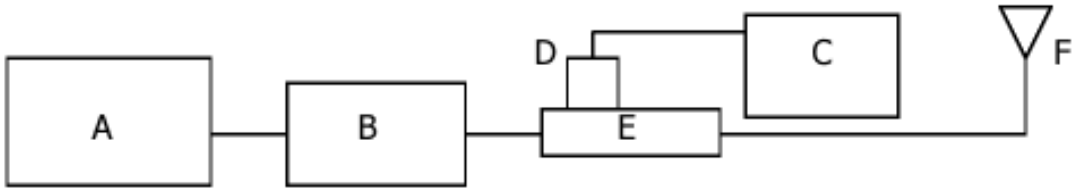


Fig b. The microwave circuit arrangement used for SAR system verification

A. Agilent Model E4421B Signal Generator
B. EMPOWER Model 2001-BBS3Q7ECK Amplifier
C. Agilent Model E4419B Power Meter
D. Agilent Model 9300H Power Sensor
E. Agilent Model 777D/778D Dual directional coupling
F. Reference dipole Antenna

Photo of the dipole Antenna

System Validation Results

Validation Kit	Tissue Frequency (㎒)	Tissue Type	Liquid Temp (°C)	Input Power (W)	Measured SAR 1 g	Target SAR 1 g	Normalized SAR 1 g	Deviation (%)	Date
D835V2 S/N: 4d138	835	Body	22.2	0.10	**0.977 W/㎏**	9.50 W/㎏ (1 W)	**9.77 W/㎏** (1 W)	**2.84**	2012-11-15
D1900V2 S/N: 5d158	1900	Body	22.3	0.10	**4.180 W/㎏**	40.3 W/㎏ (1 W)	**41.8 W/㎏** (1 W)	**3.72**	2012-11-16

Table 1. Results system validation

1.11 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this simulant fluid were measured by using the Agilent Model 85070D Dielectric Probe (rates frequence band 200 ㎒ to 20 ㎓) in conjunction with Agilent E5070B Network Analyzer(300 ㎑ - 3 ㎓) by using a procedure detailed in Section V.

f (㎒)	Tissue type	Limits / Measured	Dielectric Parameters		
			Permittivity	Conductivity	Simulated Tissue Temp(㎒)
835	Body	Measured, 2012-11-15	**55.88**	**0.96**	22.2
		Recommended Limits	55.20	0.97	21.0 ~ 23.0
		Deviation(%)	**1.23**	**-1.03**	-
1900	Body	Measured, 2012-11-16	**51.28**	**1.52**	22.3
		Recommended Limits	53.30	1.52	21.0 ~ 23.0
		Deviation(%)	**-3.79**	**0.00**	-

The composition of the brain 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 (㎒)									
	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

1.12 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 ㎑ to 300 ㎓,’’ ANSI/IEEE C95.3–2003, Copyright 2003 by the Institute of Electrical and Electronics Engineers, Inc., New York, 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 ㎑ to 6 ㎓. Portable devices that transmit at frequencies above 6 ㎓ 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 ㎓ 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.(Table .4)

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	Due date of Calibration
Stäubli	Robot	RX90BL	F12/5LP8A1/01	N/A
Schmid& Partner Engineering AG	Dosimetric E-Field Probe	ES3DV3	3862	July 19, 2013
Schmid& Partner Engineering AG	835 ㎒ System Validation Dipole	D835V2	4d138	July 10, 2014
Schmid& Partner Engineering AG	1900 ㎒ System Validation Dipole	D1900V2	5d158	July 11, 2014
Schmid& Partner Engineering AG	Data acquisition Electronics	DAE3	1340	July 10, 2013
Schmid& Partner Engineering AG	Software	DASY5: V52.8.1	-	N/A
Schmid& Partner Engineering AG	Phantom	SAM Phantom V4.0	TP-1720 TP-1721	N/A
Agilent	Network Analyzer	E5070B	MY42100282	January 03, 2013
Agilent	Dielectric Probe Kit	85070D	2184	N/A
Agilent	Power Meter	E4419B	GB43311125	July 01, 2013
Agilent	Power Sensor	E9300H	MY41495314	September 18, 2013
			MY41495307	September 18, 2013
Agilent	Signal Generator	E4421B	MY43350132	July 03, 2013
Empower RF Systems	Power Amplifier	2001-BBS3Q7ECK	1032 D/C 0336	March 31, 2013
Agilent	Dual Directional Coupler	778D	50454	April 03, 2013
Microlab	LP Filter	LA-15N LA-30N	N/A	September 14, 2013
R & S	Spectrum Analyzer	FSV30	100768	March 29, 2013
Agilent	Attenuator	8491B	50566	September 14. 2013
R&S	Mobile Test Unit	CMU 200	107279	January 03, 2013

3.Summary of Results

3.1 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.

3.2 RF Conducted Power

Band	Channel	Frequency(㎒)	GPRS Data	
			GPRS 1 TX Slot (dB m)	GPRS 2 TX Slot (dB m)
GSM 850	128	824.2	32.31	32.21
	190	836.6	31.66	31.59
	251	848.8	31.59	31.57
PCS 1900	512	1850.2	29.80	29.76
	661	1880.0	29.77	29.72
	810	1909.8	29.59	29.58

Ambient Temperature (°C)	23.1	23.3
Liquid Temperature (°C)	22.2	22.3
Date	2012-11-15	2012-11-16

GSM Body SAR

Test Mode	EUT Position	Slot	Traffic Channel		Power Drift(dB)	1 g SAR (W/kg)		1 g SAR Limits (W/kg)
			Frequency (Mhz)	Channel				
GPRS850	Front	1 Tx	836.6	190	0.01	0.273		1.6
	Rear	1 Tx	836.6	190	-0.01	0.302		
	Rear	2 Tx	836.6	190	0.02	0.580		
GPRS1900	Front	1 Tx	1880.0	661	-0.01	0.358		
	Rear	1 Tx	1880.0	661	-0.01	0.414		
	Rear	2 Tx	1880.0	661	-0.04	Cube0	0.817	
						Cube1	0.567	
	Rear	2 Tx	1850.2	512	0.00	**0.818**		
	Rear	2 Tx	1909.8	810	0.00	Cube0	0.748	
						Cube1	0.653	

<Note>

1. The test data reported are the worst-case SAR value with the position set in a typical configuration.
2. All modes of operation were investigated, and worst-case results are reported.
3. Battery is fully charged for all readings and the standard batteries are the only options.
4. Liquid tissue depth was at least 15 ㎝.
5. The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
6. Justification for reduced test configuration : Per FCC/OET Bulletin 65 Supplement C [July 2001], if the SAR measured at the middle channel for each test configuration is at least 3.0 ㏈ lower than the SAR limit, testing at the high and low channel is optional for such test configurations.
7. The distance from EUT to flat phantom for testing Body SAR is 10 ㎜.

Appendix

List

Appendix A	DASY5 Report (Plots of the SAR Measurements)	-850 ㎒ Validation Test -1900 ㎒ Validation Test - GSM Test
Appendix B	Uncertainty Analysis	
Appendix C	Calibration Certificate	- PROBE - DAE - DIPOLE

Appendix A

Test Plot – DASY5 Report

835 MHz Validation Test_Body

Date: 2012-11-15

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 850MHz Validation.da53:0

Input Power : 100 mW

Ambient Temp : 23.1 ℃ Tissue Temp : 22.2 ℃

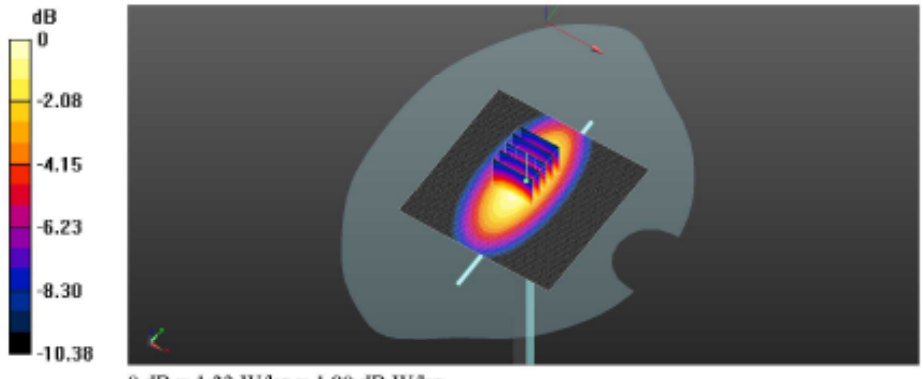
DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:490

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium parameters used: f = 835 MHz; σ = 0.964 mho/m; ε_r = 55.88; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(9.37, 9.37, 9.37); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

Validation/850MHz Validation/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.22 W/kg

Validation/850MHz Validation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.320 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 1.424 mW/g
SAR(1 g) = 0.977 mW/g; SAR(10 g) = 0.648 mW/g
Maximum value of SAR (measured) = 1.23 W/kg



0 dB = 1.23 W/kg = 1.80 dB W/kg

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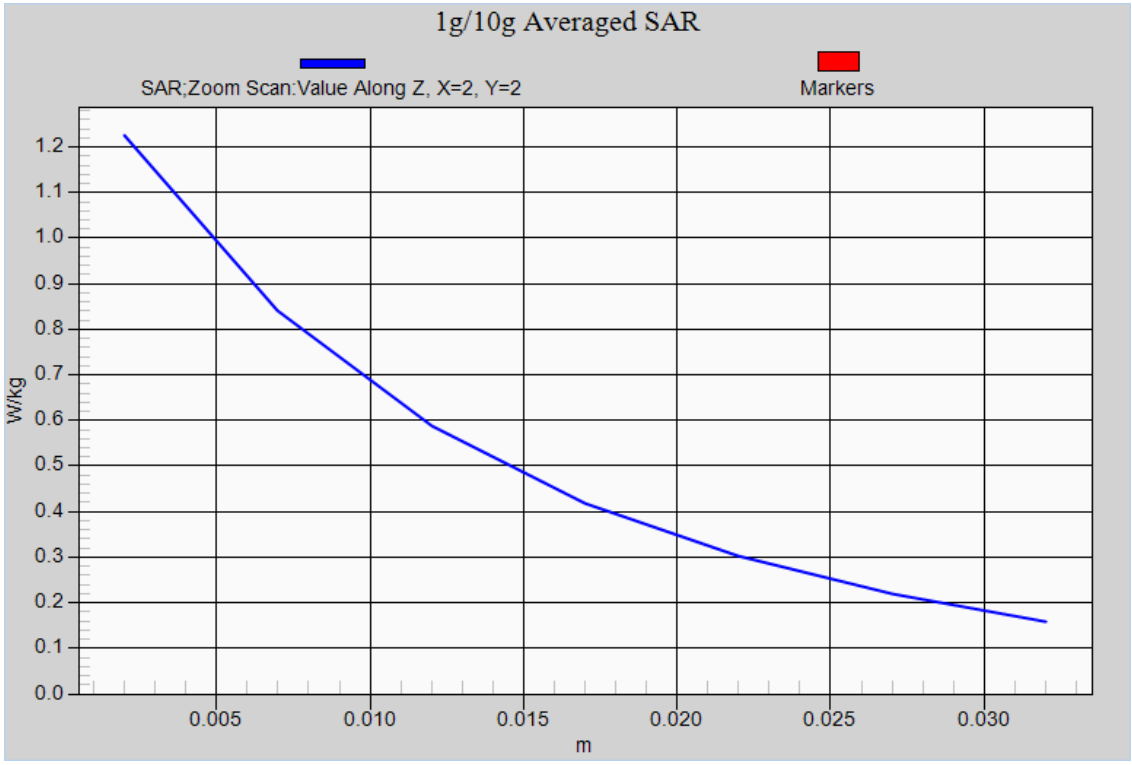
Z Scan


1g/10g Averaged SAR
SAR;Zoom Scan:Value Along Z, X=2, Y=2
Markers
W/kg
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.005
0.010
0.015
0.020
0.025
0.030
m

1900 MHz Validation Test_Body

Date: 2012-11-16

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: 1900MHz Validation.da53:0

Input Power : 100 mW

Ambient Temp : 23.3 ℃ Tissue Temp : 22.3 ℃

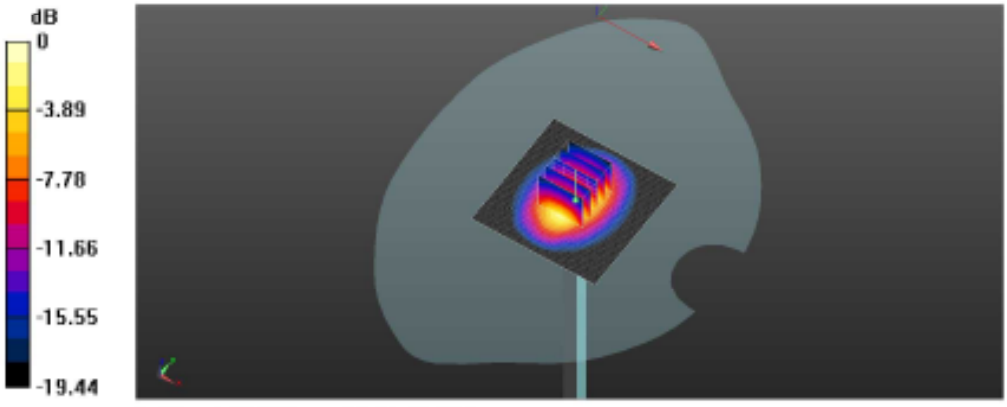
DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:5d033

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.518 mho/m; ε_r = 51.283; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.9, 7.9, 7.9); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1720
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

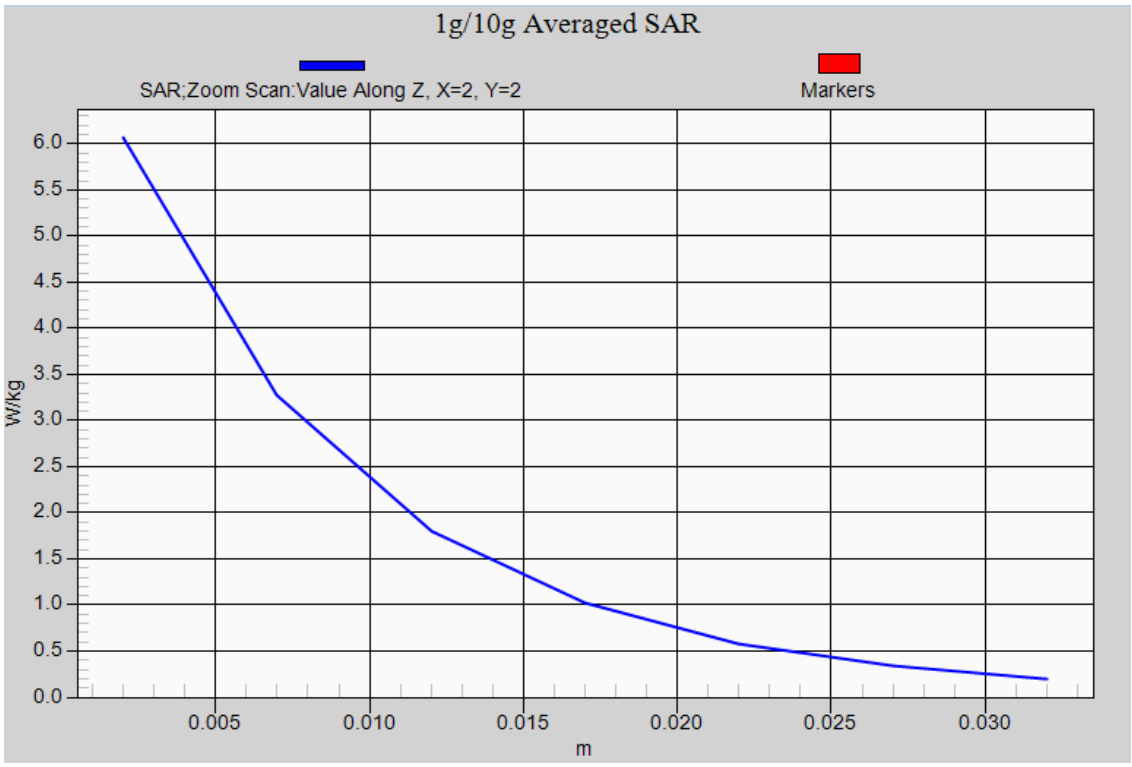
Validation/1900MHz Validation/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 6.05 W/kg

Validation/1900MHz Validation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 64.354 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 7.774 mW/g
SAR(1 g) = 4.18 mW/g; SAR(10 g) = 2.11 mW/g
Maximum value of SAR (measured) = 6.07 W/kg



0 dB = 6.07 W/kg = 15.66 dB W/kg

Z Scan


1g/10g Averaged SAR
SAR;Zoom Scan:Value Along Z, X=2, Y=2
Markers
W/kg
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.005
0.010
0.015
0.020
0.025
0.030
m

GSM850 Body SAR Test

Date: 2012-11-15

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS850_Front_CH190_1TX.da53:0

Ambient Temp : 23.1 ℃ Tissue Temp : 22.2 ℃

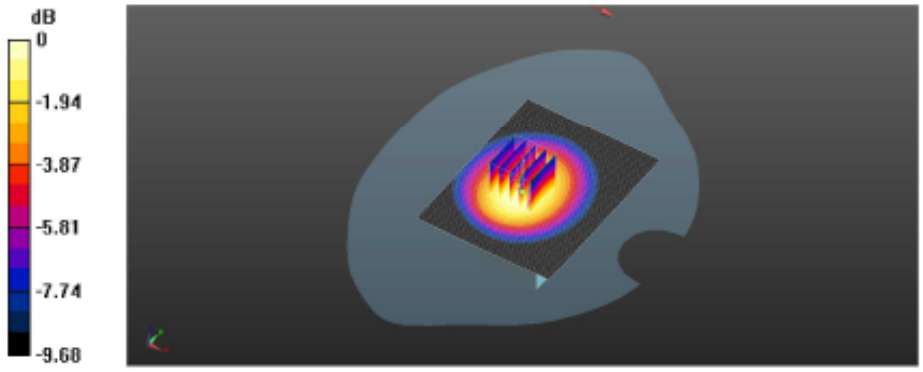
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS850 1TX; Frequency: 836.6 MHz;Duty Cycle: 1:8.30042
Medium parameters used: f = 837 MHz; σ = 0.966 mho/m; ε_r = 55.855; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(9.37, 9.37, 9.37); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS850/GPRS850_Front_CH190_1TX/Area Scan (71x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.323 W/kg

GPRS850/GPRS850_Front_CH190_1TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.373 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.363 mW/g
SAR(1 g) = 0.273 mW/g; SAR(10 g) = 0.196 mW/g
Maximum value of SAR (measured) = 0.323 W/kg



0 dB = 0.323 W/kg = -9.82 dB W/kg

Date: 2012-11-15

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS850_Rear_CH190_1TX.da53:0

Ambient Temp : 23.1 ℃ Tissue Temp : 22.2 ℃

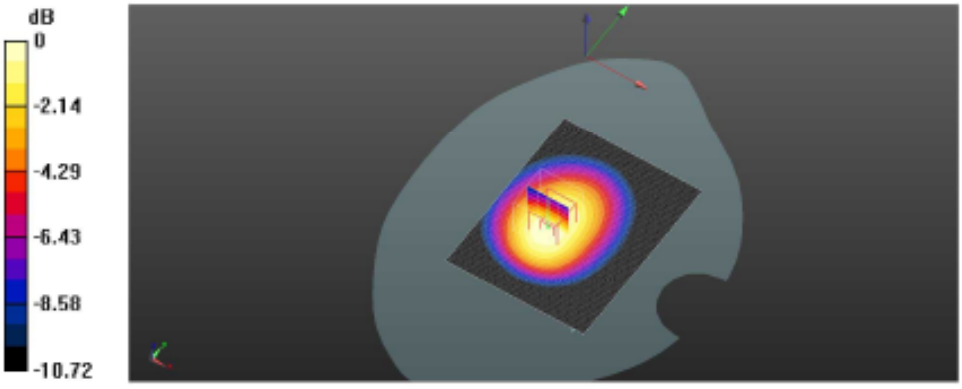
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS850 1TX; Frequency: 836.6 MHz;Duty Cycle: 1:8.30042
Medium parameters used: f = 837 MHz; σ = 0.966 mho/m; ε_r = 55.855; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(9.37, 9.37, 9.37); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS850/GPRS850_Rear_CH190_1TX/Area Scan (71x91x1): Interpolated grid:
dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.361 W/kg

GPRS850/GPRS850_Rear_CH190_1TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid:
dx=8mm, dy=8mm, dz=5mm
Reference Value = 18.373 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.408 mW/g
SAR(1 g) = 0.302 mW/g; SAR(10 g) = 0.213 mW/g
Maximum value of SAR (measured) = 0.360 W/kg



0 dB = 0.360 W/kg = -8.87 dB W/kg

Date: 2012-11-15

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS850_Rear_CH190_2TX.da53:0

Ambient Temp : 23.1 ℃ Tissue Temp : 22.2 ℃

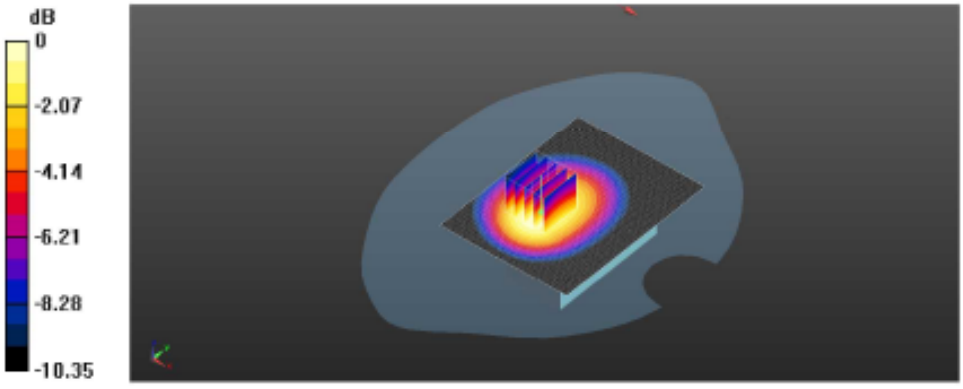
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS850 2TX; Frequency: 836.6 MHz;Duty Cycle: 1:4.14954
Medium parameters used: f = 837 MHz; σ = 0.966 mho/m; ε_r = 55.855; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(9.37, 9.37, 9.37); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP v5.0; Type: QD000P40CD; Serial: TP:1721
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

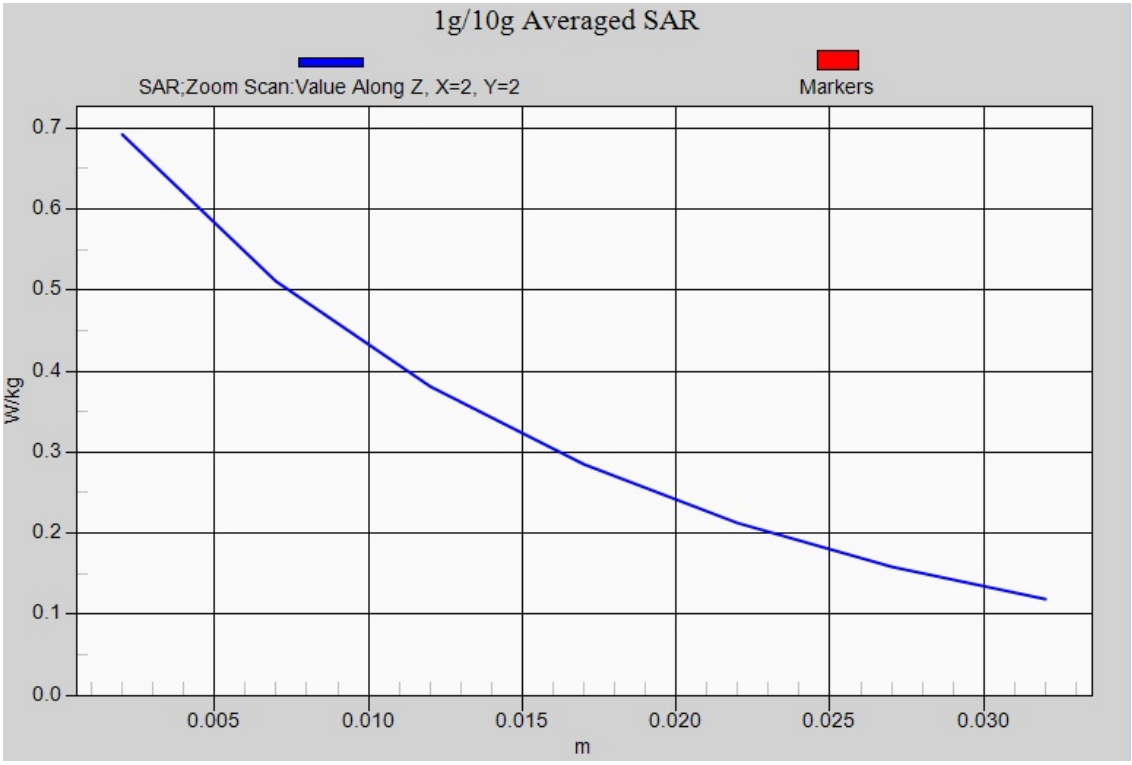
GPRS850/GPRS850_Rear_CH190_2TX/Area Scan (71x91x1): Interpolated grid:
dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.703 W/kg

GPRS850/GPRS850_Rear_CH190_2TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid:
dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.381 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.783 mW/g
SAR(1 g) = 0.580 mW/g; SAR(10 g) = 0.411 mW/g
Maximum value of SAR (measured) = 0.693 W/kg



0 dB = 0.693 W/kg = -3.19 dB W/kg

Z Scan


1g/10g Averaged SAR
SAR;Zoom Scan:Value Along Z, X=2, Y=2
Markers
W/kg
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.005
0.010
0.015
0.020
0.025
0.030
m

GSM1900 Body SAR Test

Date: 2012-11-16

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS1900_Front_CH661_1TX.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 22.3 ℃

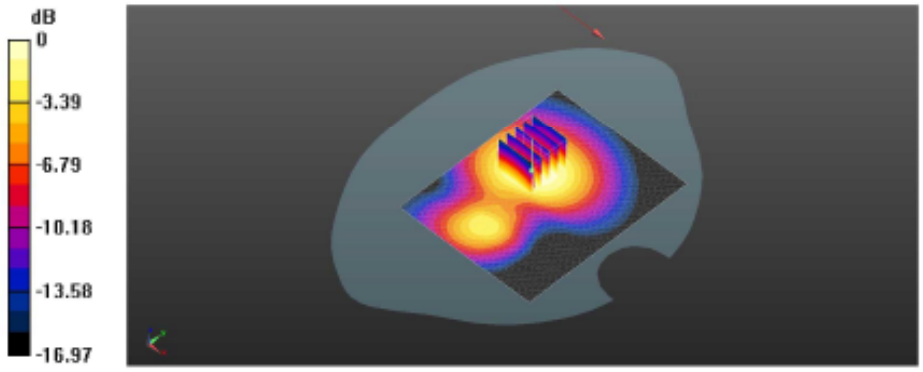
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS1900 1TX; Frequency: 1880 MHz;Duty Cycle: 1:8.30042
Medium parameters used: f = 1880 MHz; σ = 1.494 mho/m; ε_r = 51.358; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.9, 7.9, 7.9); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1720
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS1900/GPRS1900_Front_CH661_1TX/Area Scan (81x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.482 W/kg

GPRS1900/GPRS1900_Front_CH661_1TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.366 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.563 mW/g
SAR(1 g) = 0.358 mW/g; SAR(10 g) = 0.218 mW/g
Maximum value of SAR (measured) = 0.466 W/kg



0 dB = 0.466 W/kg = -6.63 dB W/kg

Date: 2012-11-16

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS1900_Rear_CH661_1TX.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 22.3 ℃

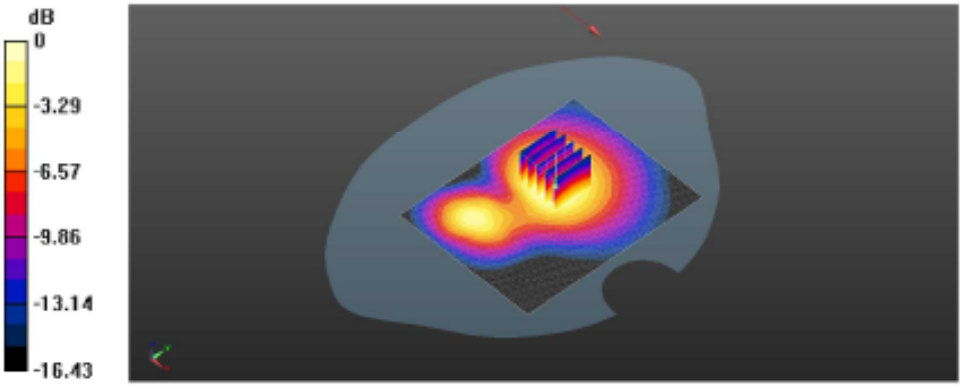
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS1900 1TX; Frequency: 1880 MHz;Duty Cycle: 1:8.30042
Medium parameters used: f = 1880 MHz; σ = 1.494 mho/m; ε_r = 51.358; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.9, 7.9, 7.9); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1720
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS1900/GPRS1900_Rear_CH661_1TX/Area Scan (81x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.542 W/kg

GPRS1900/GPRS1900_Rear_CH661_1TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.573 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.645 mW/g
SAR(1 g) = 0.414 mW/g; SAR(10 g) = 0.253 mW/g
Maximum value of SAR (measured) = 0.535 W/kg



0 dB = 0.535 W/kg = -5.43 dB W/kg

Date: 2012-11-16

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS1900_Rear_CH661_2TX.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 22.3 ℃

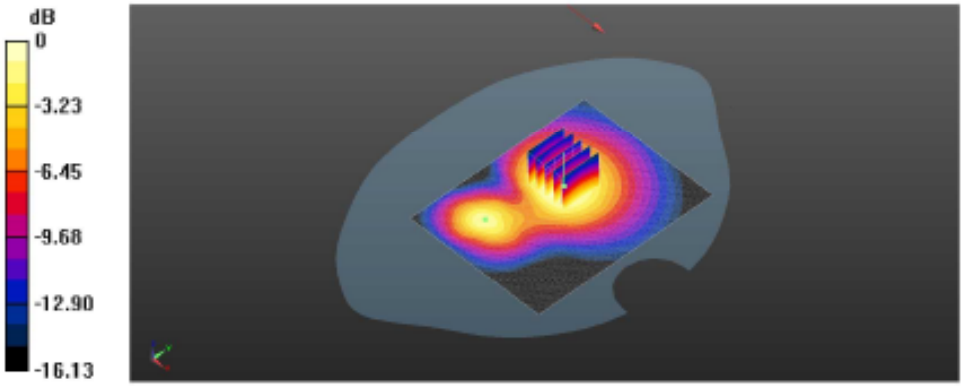
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS1900 2TX; Frequency: 1880 MHz;Duty Cycle: 1:4.14954
Medium parameters used: f = 1880 MHz; σ = 1.494 mho/m; ε_r = 51.358; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.9, 7.9, 7.9); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1720
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS1900/GPRS1900_Rear_CH661_2TX/Area Scan (81x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.07 W/kg

GPRS1900/GPRS1900_Rear_CH661_2TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.147 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.276 mW/g
SAR(1 g) = 0.817 mW/g; SAR(10 g) = 0.499 mW/g
Maximum value of SAR (measured) = 1.06 W/kg



0 dB = 1.06 W/kg = 0.51 dB W/kg

Date: 2012-11-16

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS1900_Rear_CH661_2TX.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 22.3 ℃

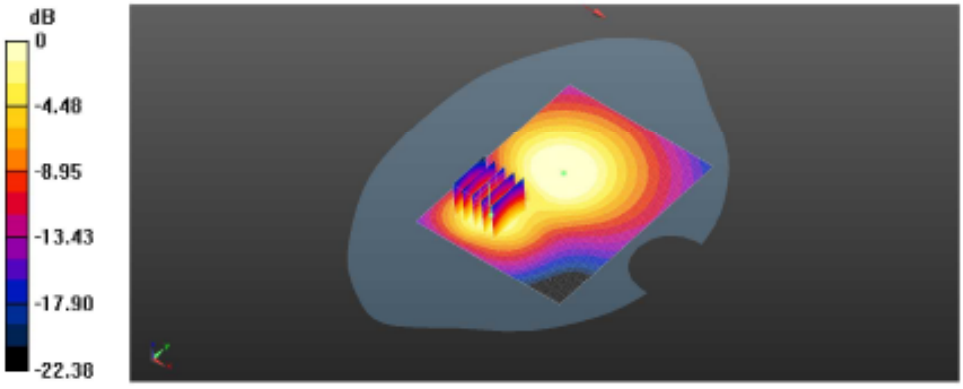
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS1900 2TX; Frequency: 1880 MHz;Duty Cycle: 1:4.14954
Medium parameters used: f = 1880 MHz; σ = 1.494 mho/m; ε_r = 51.358; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.9, 7.9, 7.9); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1720
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS1900/GPRS1900_Rear_CH661_2TX/Area Scan (81x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.07 W/kg

GPRS1900/GPRS1900_Rear_CH661_2TX/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.147 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.000 mW/g
SAR(1 g) = 0.567 mW/g; SAR(10 g) = 0.300 mW/g
Maximum value of SAR (measured) = 0.779 W/kg



0 dB = 0.779 W/kg = -2.17 dB W/kg

Date: 2012-11-16

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS1900_Rear_CH512_2TX.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 22.3 ℃

DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS1900 2TX; Frequency: 1850.2 MHz;Duty Cycle: 1:4.14954
Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.459 mho/m; ε_r = 51.491; ρ = 1000 kg/m^3
Phantom section: Flat Section

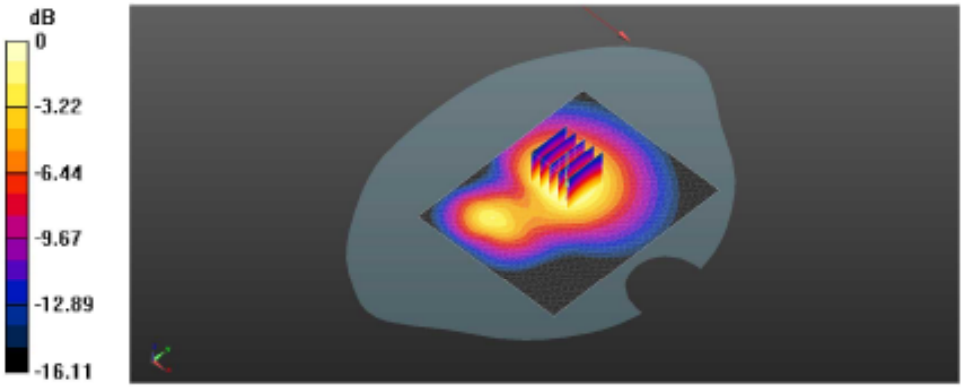
DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.9, 7.9, 7.9); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1720
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS1900/GPRS1900_Rear_CH512_2TX/Area Scan (81x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.06 W/kg

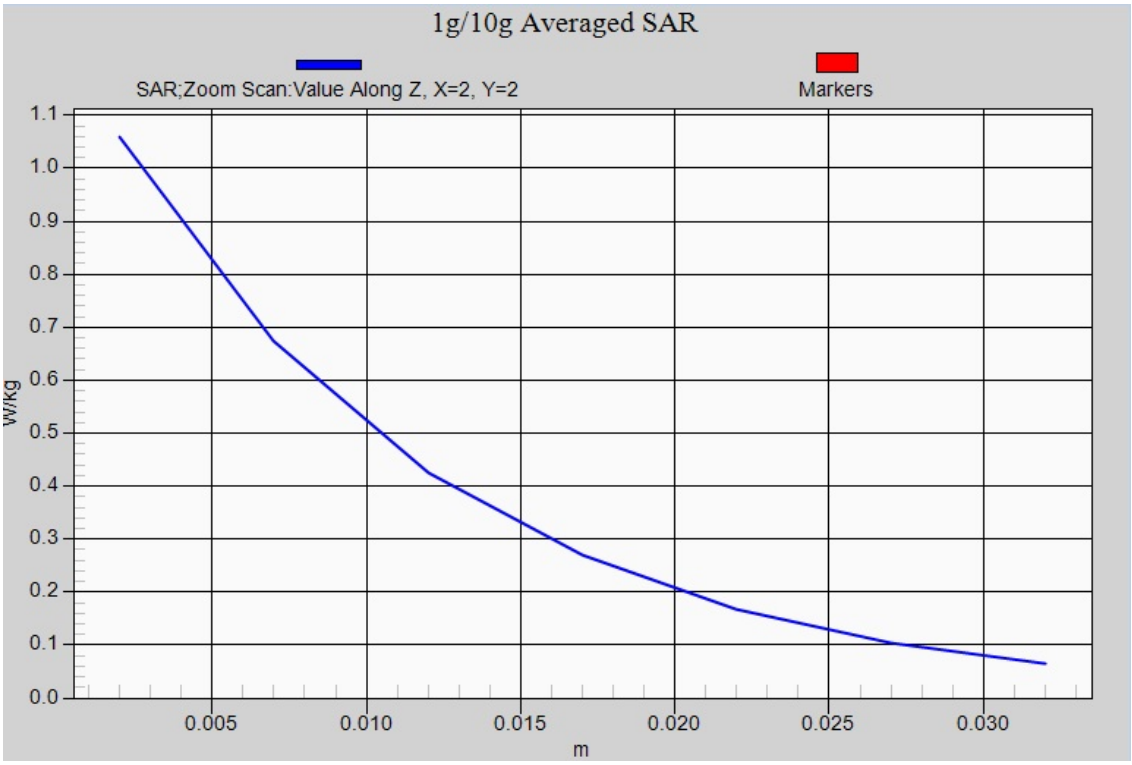
GPRS1900/GPRS1900_Rear_CH512_2TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.079 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 1.270 mW/g
SAR(1 g) = 0.818 mW/g; SAR(10 g) = 0.503 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.06 W/kg



0 dB = 1.06 W/kg = 0.51 dB W/kg

Z Scan


1g/10g Averaged SAR
SAR;Zoom Scan:Value Along Z, X=2, Y=2
Markers
W/Kg
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.005
0.010
0.015
0.020
0.025
0.030
m

Date: 2012-11-16

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS1900_Rear_CH810_2TX.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 22.3 ℃

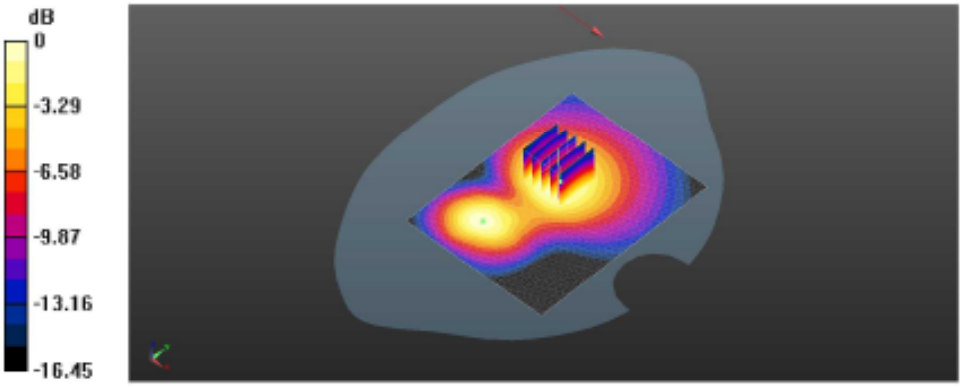
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS1900 2TX; Frequency: 1909.8 MHz;Duty Cycle: 1:4.14954
Medium parameters used: f = 1910 MHz; σ = 1.53 mho/m; ε_r = 51.245; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.9, 7.9, 7.9); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1720
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS1900/GPRS1900_Rear_CH810_2TX/Area Scan (81x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.993 W/kg

GPRS1900/GPRS1900_Rear_CH810_2TX/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.482 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 1.183 mW/g
SAR(1 g) = 0.748 mW/g; SAR(10 g) = 0.453 mW/g
Maximum value of SAR (measured) = 0.975 W/kg



0 dB = 0.975 W/kg = -0.22 dB W/kg

Date: 2012-11-16

Test Laboratory : SGS Korea (Gunpo Laboratory)
File Name: GPRS1900_Rear_CH810_2TX.da53:0

Ambient Temp : 23.3 ℃ Tissue Temp : 22.3 ℃

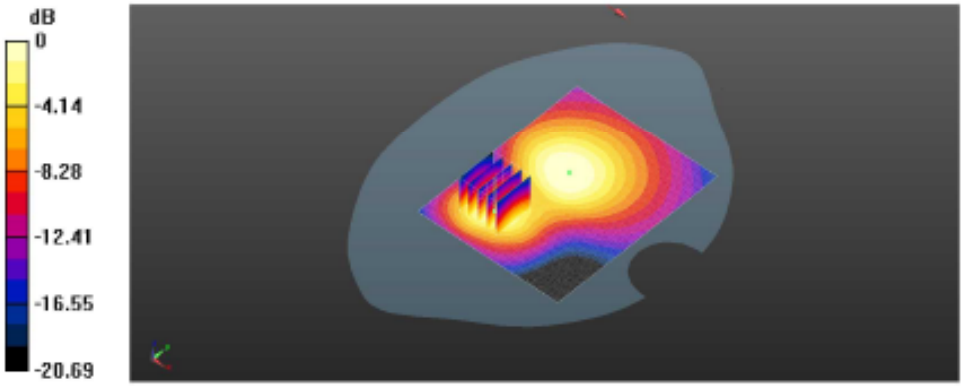
DUT: GM505YAA; Type: AUTO-CHEKT; Serial: N/A

Communication System: GPRS1900 2TX; Frequency: 1909.8 MHz;Duty Cycle: 1:4.14954
Medium parameters used: f = 1910 MHz; σ = 1.53 mho/m; ε_r = 51.245; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY52 Configuration:
- Probe: EX3DV4 - SN3862; ConvF(7.9, 7.9, 7.9); Calibrated: 19.07.2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1340; Calibrated: 10.07.2012
- Phantom: SAM with CRP; Type: SAM; Serial: TP-1720
- DASY52 52.8.2(969)SEMCAD X 14.6.6(6824)

GPRS1900/GPRS1900_Rear_CH810_2TX/Area Scan (81x101x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.993 W/kg

GPRS1900/GPRS1900_Rear_CH810_2TX/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.482 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 1.150 mW/g
SAR(1 g) = 0.653 mW/g; SAR(10 g) = 0.349 mW/g
Maximum value of SAR (measured) = 0.906 W/kg



0 dB = 0.906 W/kg = -0.86 dB W/kg

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	0.5	R	1.73	0.71	0.20	∞
hemispherical isotropy	E.2.2	2.6	R	1.73	0.71	1.06	∞
Boundary effect	E.2.3	0.8	R	1.73	1	0.46	∞
Linearity	E.2.4	0.6	R	1.73	1	0.35	∞
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	R	1.73	1	0.00	∞
Integration time	E.2.8	2.6	R	1.73	1	1.50	∞
RF ambient Condition –Noise	E.6.1	3	R	1.73	1	1.73	∞
RF ambient Condition – reflections	E.6.1	3	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	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	R	1.73	1	2.89	∞
Phantom uncertainty (shape and thickness tolerances)	E.3.1	4	R	1.73	1	2.31	∞
Liquid conductivity – deviation from target values	E.3.2	5	R	1.73	0.64	1.85	∞
Liquid conductivity – measurement uncertainty	E.3.2	0.7	N	1	0.64	0.45	5
Liquid permittivity – deviation from target values	E.3.3	5	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		10.83	∞
Expanded uncertainty (95% CONFIDENCE INTERVAL)				K=2		21.65	

Appendix C

Calibration Certificate

- **PROBE**
- **DAE**
- **835 ㎒ DIPOLE**
- **1900 ㎒ DIPOLE**

- PROBE Calibration Certificate

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Accreditation No.: **SCS 108**

Client **SGS (Dymstec)** Certificate No: **EX3-3862_Jul12**

CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3862

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

Calibration date: July 19, 2012

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	MY41498087	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	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
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-11)	In house check: Oct-12

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

Issued: July 23, 2012

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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe EX3DV4

SN:3862

Manufactured: February 2, 2012
Calibrated: July 19, 2012

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3862

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.42	0.43	0.37	± 10.1 %
DCP (mV)[B]	106.7	94.8	101.9	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[F] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	149.3	±3.8 %
			Y	0.00	0.00	1.00	146.9	
			Z	0.00	0.00	1.00	196.2	

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3862

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	9.34	9.34	9.34	0.21	1.30	± 12.0 %
900	41.5	0.97	9.27	9.27	9.27	0.21	1.22	± 12.0 %
1750	40.1	1.37	8.35	8.35	8.35	0.29	1.00	± 12.0 %
1810	40.0	1.40	8.02	8.02	8.02	0.33	0.83	± 12.0 %
1900	40.0	1.40	7.93	7.93	7.93	0.39	0.86	± 12.0 %
2450	39.2	1.80	7.09	7.09	7.09	0.34	0.90	± 12.0 %

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3862

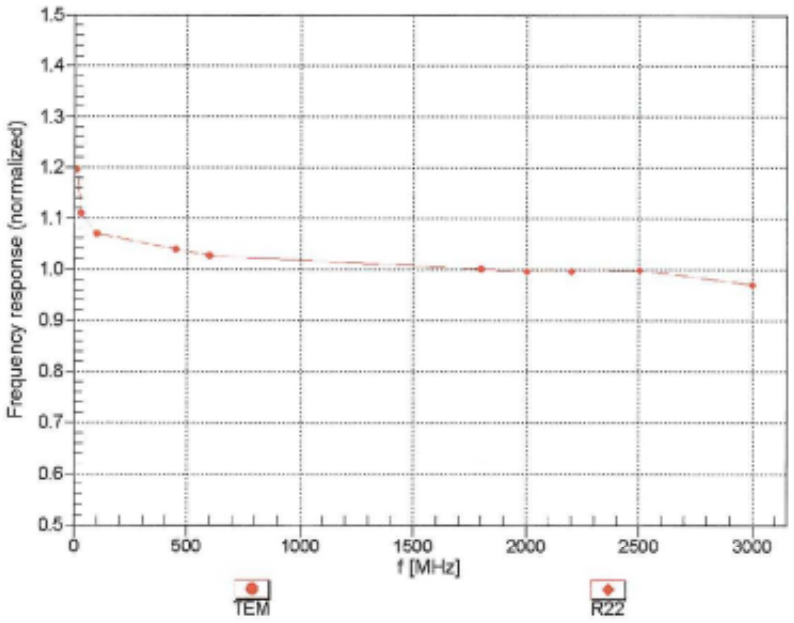
Calibration Parameter Determined in Body Tissue Simulating Media

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	9.37	9.37	9.37	0.30	1.00	± 12.0 %
1750	53.4	1.49	8.38	8.38	8.38	0.46	0.87	± 12.0 %
1900	53.3	1.52	7.90	7.90	7.90	0.31	0.98	± 12.0 %
2450	52.7	1.95	7.32	7.32	7.32	0.80	0.57	± 12.0 %

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

EX3DV4– SN:3862 July 19, 2012

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

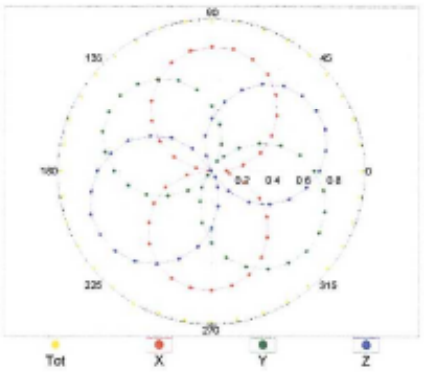


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

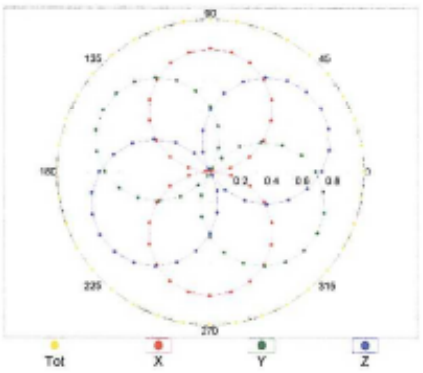
EX3DV4– SN:3862 July 19, 2012

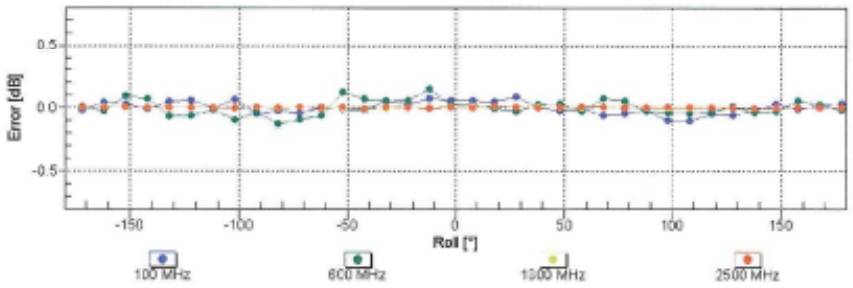
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



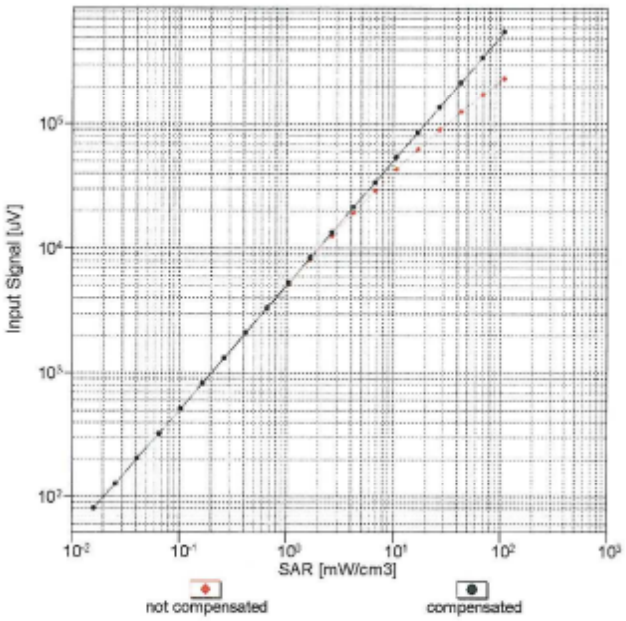
f=1800 MHz,R22

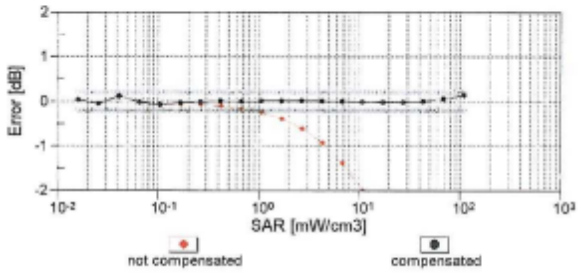




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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



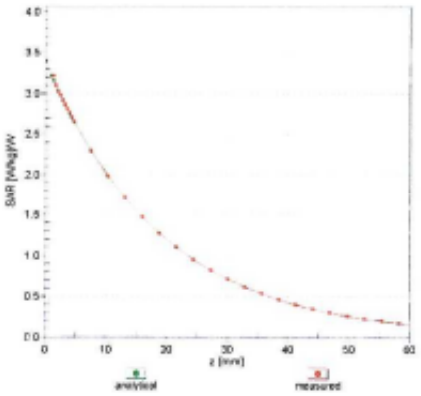


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

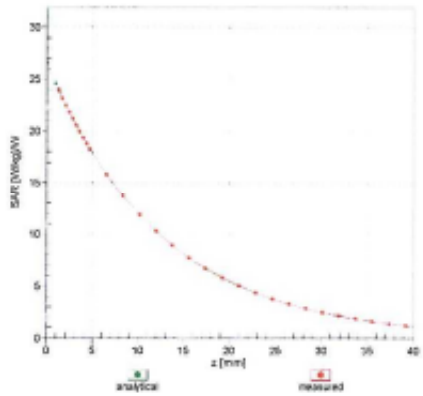
EX3DV4– SN:3862 July 19, 2012

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

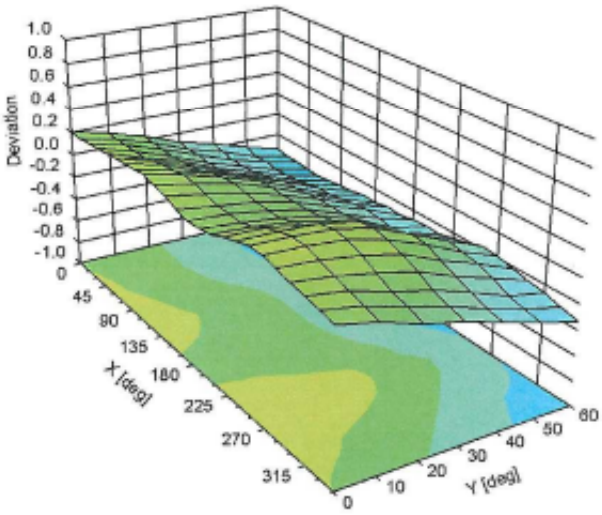


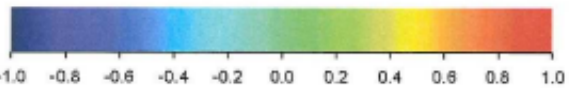
f = 1810 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3862

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	107.9
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

-DAE Calibration Certificate

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Accreditation No.: **SCS 108**

Client **SGS (Dymstec)**

Certificate No: **DAE4-1340_Jul12**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BJ - SN: 1340
Calibration procedure(s)	QA CAL-06.v24 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	July 10, 2012

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V2.1	SE UWS 053 AA 1001	06-Jan-12 (in house check)	In house check: Jan-13

	Name	Function	Signature
Calibrated by:	Eric Hainfeld	Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: July 10, 2012

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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 = 6.1μV , full range = -100...+300 mV
Low Range: 1LSB = 61nV , full range = -1.....+3mV

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

Calibration Factors	X	Y	Z
High Range	404.816 ± 0.1% (k=2)	404.267 ± 0.1% (k=2)	404.287 ± 0.1% (k=2)
Low Range	3.98926 ± 0.7% (k=2)	3.98671 ± 0.7% (k=2)	3.98083 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	256 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199990.77	-5.51	-0.00
Channel X	+ Input	20000.35	0.37	0.00
Channel X	- Input	-19997.05	3.35	-0.02
Channel Y	+ Input	199991.21	-4.81	-0.00
Channel Y	+ Input	19997.26	-2.76	-0.01
Channel Y	- Input	-20001.32	-0.88	0.00
Channel Z	+ Input	199990.17	-5.61	-0.00
Channel Z	+ Input	19999.03	-0.92	-0.00
Channel Z	- Input	-20002.23	-1.65	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.07	0.18	0.01
Channel X	+ Input	201.34	0.01	0.01
Channel X	- Input	-198.70	-0.08	0.04
Channel Y	+ Input	2000.62	-0.31	-0.02
Channel Y	+ Input	200.89	-0.39	-0.19
Channel Y	- Input	-198.48	0.21	-0.10
Channel Z	+ Input	2000.53	-0.29	-0.01
Channel Z	+ Input	200.08	-1.16	-0.58
Channel Z	- Input	-200.30	-1.59	0.80

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-6.54	-6.70
	- 200	9.80	8.18
Channel Y	200	-1.45	-1.57
	- 200	0.92	0.43
Channel Z	200	2.74	2.22
	- 200	-4.71	-4.88

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	-	0.17	-3.54
Channel Y	200	5.87	-	-0.07
Channel Z	200	9.54	4.08	-

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	16036	14867
Channel Y	15954	14621
Channel Z	15767	15486

5. Input Offset Measurement

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

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-1.35	-2.24	-0.14	0.35
Channel Y	-1.50	-2.38	0.09	0.43
Channel Z	-3.63	-4.85	-2.65	0.42

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

- 835 ㎒ Dipole Calibration Certificate

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Accreditation No.: SCS 108

Client SGS (Dymstec)

Certificate No: D835V2-4d138_Jul12

CALIBRATION CERTIFICATE

Object D835V2 - SN: 4d138

Calibration procedure(s) QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: July 10, 2012

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
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-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 11, 2012

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Certificate No: D835V2-4d138_Jul12 Page 1 of 8

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

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

Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.5 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.31 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**9.27 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.51 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**6.06 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.3 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.43 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**9.50 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.60 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**6.29 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 3.7 jΩ
Return Loss	- 28.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.5 Ω - 5.1 jΩ
Return Loss	- 24.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.398 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: 10.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

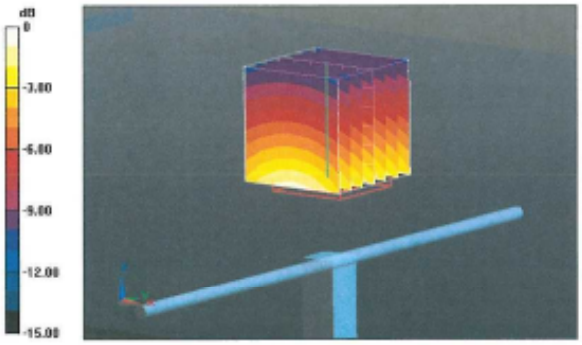
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d138

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.89 mho/m; ε_r = 40.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

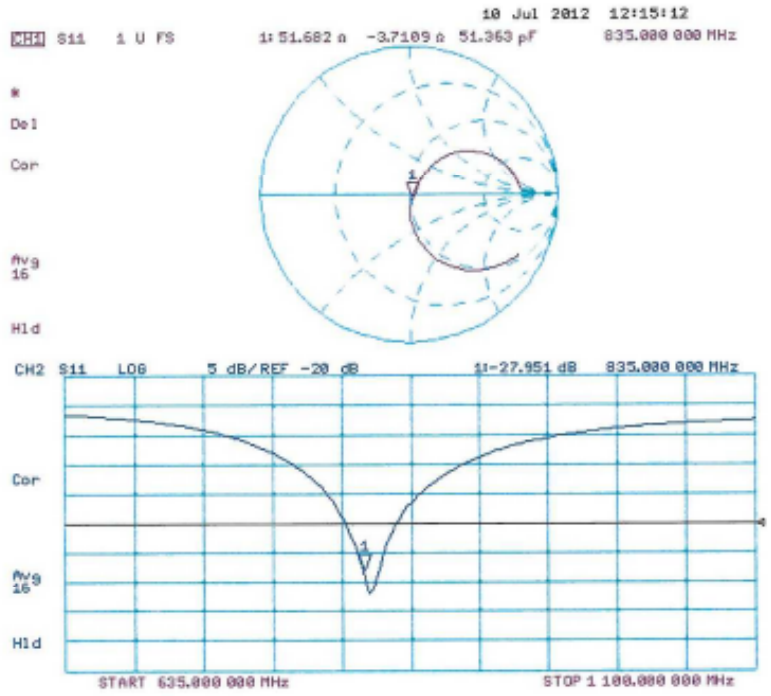
- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.222 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.408 mW/g
SAR(1 g) = 2.31 mW/g; SAR(10 g) = 1.51 mW/g
Maximum value of SAR (measured) = 2.70 mW/g



0 dB = 2.70 mW/g = 8.63 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 10.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

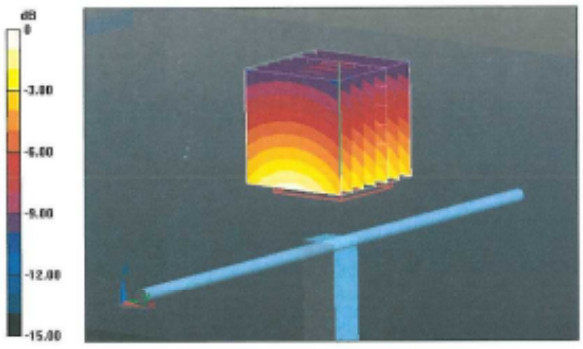
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d138

Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.99 mho/m; ε_r = 53.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

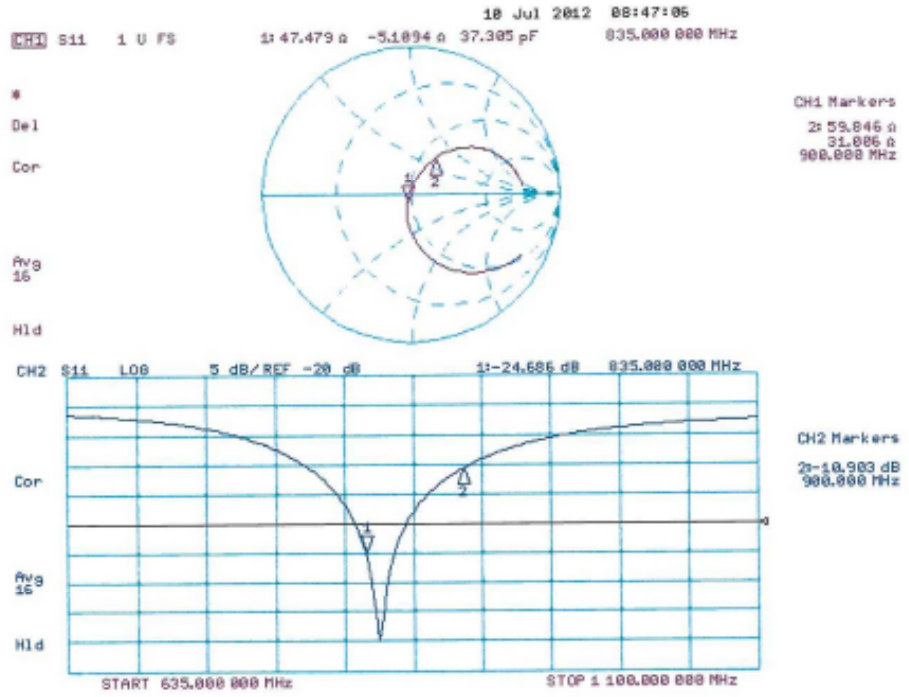
- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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 = 55.568 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.546 mW/g
SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.6 mW/g
Maximum value of SAR (measured) = 2.83 mW/g



0 dB = 2.83 mW/g = 9.04 dB mW/g

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
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Accreditation No.: SCS 108

Client SGS (Dymstec)

Certificate No: D1900V2-5d158_Jul12

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d158
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 11, 2012

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	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
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-11)	In house check: Oct-12

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

Issued: July 11, 2012

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

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.70 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**39.1 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.13 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.6 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.6 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**40.3 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.34 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.3 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.0 Ω + 5.4 jΩ
Return Loss	- 24.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.0 Ω + 5.9 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 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: 11.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

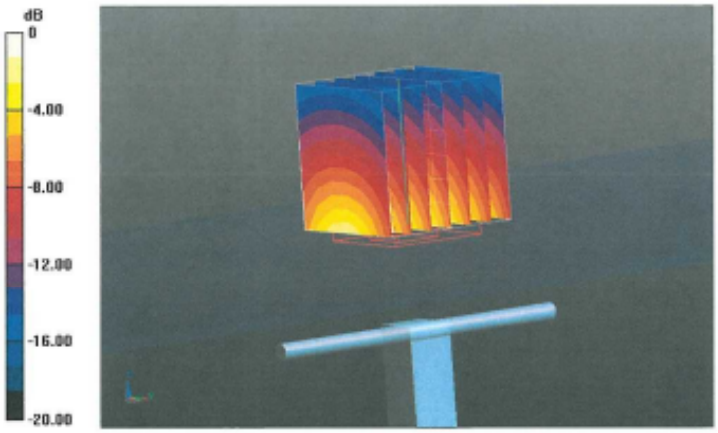
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d158

Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 mho/m; ε_r = 39.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

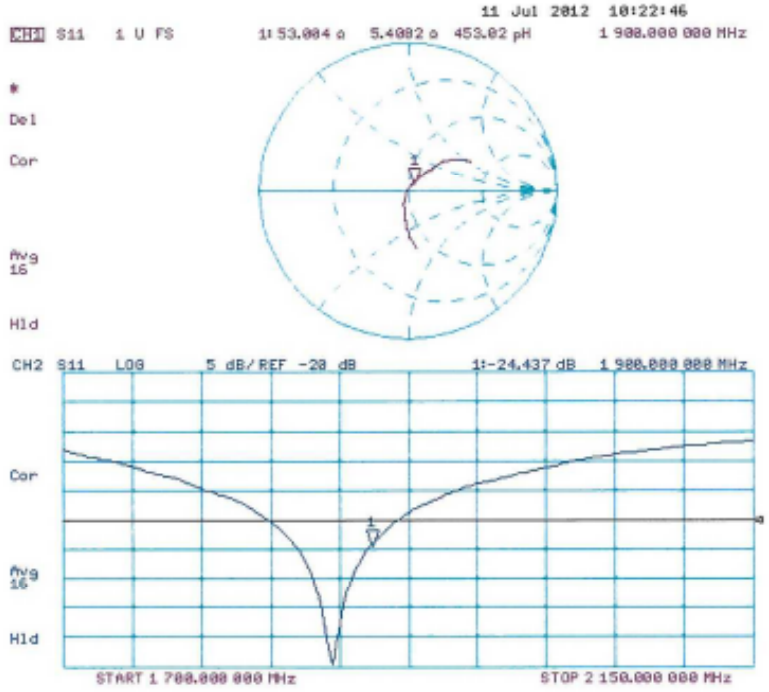
- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.671 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 17.315 mW/g
SAR(1 g) = 9.7 mW/g; SAR(10 g) = 5.13 mW/g
Maximum value of SAR (measured) = 12.0 mW/g



0 dB = 12.0 mW/g = 21.58 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

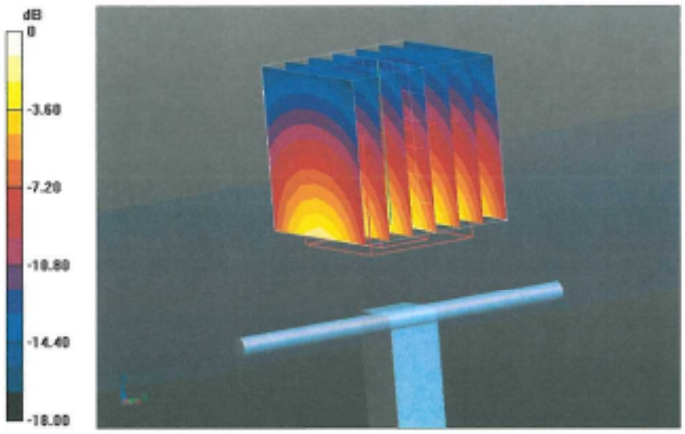
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d158

Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.52 mho/m; ε_r = 52.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

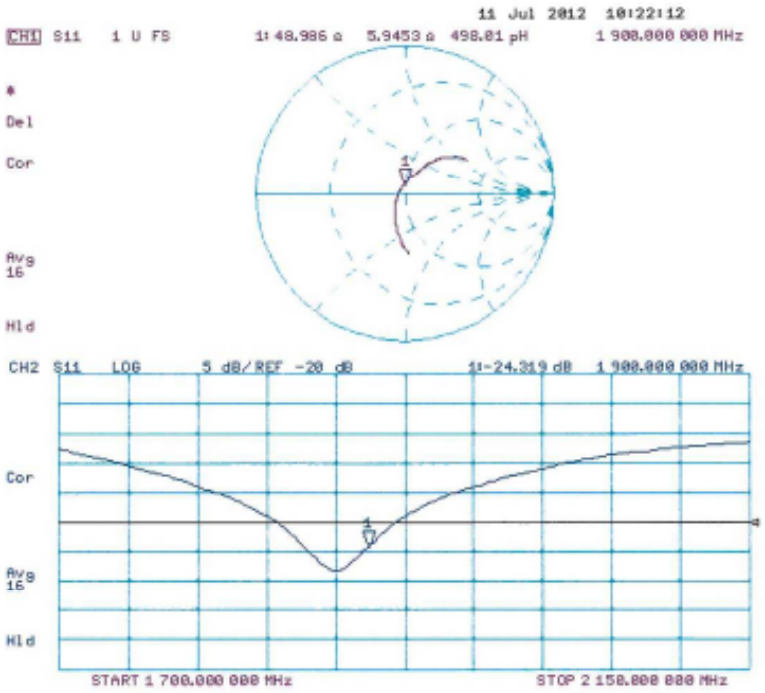
- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.435 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 17.558 mW/g
SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.34 mW/g
Maximum value of SAR (measured) = 12.7 mW/g



0 dB = 12.7 mW/g = 22.08 dB mW/g

Impedance Measurement Plot for Body TSL



-THE END-