TCC
Nokia

FINAS
Finnish Accreditation Service
T117 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	FCC_RM-963_01	**Date of report:**	2013-07-25
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Tested device:	RM-963		
FCC ID:	QTLRM-963	**IC:**	-
Supplement reports:	SAR_Photo_RM-963_04		

Testing has been carried out in accordance with:

47CFR §2.1093
Radiofrequency Radiation Exposure Evaluation: Portable Devices

FCC OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01)
Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

RSS-102
Evaluation Procedure for Mobile and Portable Radio Transmitters with Respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields

IEEE 1528 - 2003
IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Technique

Documentation: The documentation of the testing performed on the tested devices is archived for 15 years at TCC Nokia.

Test results: **The tested device complies with the requirements in respect of all parameters subject to the test.** The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.

Date and signatures:

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	2013-07-15 to 2013-07-16
SN, HW and SW numbers of tested device	SN: 004402/47/464054/1, HW: 0102, SW: 01.90, DUT: 17571 SN: 004402/47/464081/4, HW: 0102, SW: 01.90, DUT: 17572
Batteries used in testing	BL-5CB, DUT: 17566, 17567, 17568
Headsets used in testing	WH-108, DUT: 17569, 17570
Other accessories used in testing	-
State of sample	Prototype unit
Notes	-

1.2 Maximum Results

The maximum measured SAR values for Head configuration and Body Worn configuration are given in section 1.2.1 and 1.2.2 respectively. The device conforms to the requirements of the standard(s) when the maximum measured SAR value is less than or equal to the limit.

1.2.1 Head Configuration

Mode	Ch / *f*(MHz)	Conducted power	Position	Measured SAR value (1g avg)	Reported* SAR value (1g avg)	SAR limit (1g avg)	Result	Plot #
GSM850	190 / 836.6	32.05 dBm	Left, Cheek	0.958 W/kg	**0.98 W/kg**	1.6 W/kg	PASSED	1
GSM1900	810 / 1909.8	30.75 dBm	Left, Cheek	1.05 W/kg	**1.07 W/kg**	1.6 W/kg	PASSED	2

1.2.2 Body Worn Configuration

Mode	Ch / *f*(MHz)	Conducted power	Separation distance	Measured SAR value (1g avg)	Reported* SAR value (1g avg)	SAR limit (1g avg)	Result	Plot #
GSM850	190 / 836.6	32.05 dBm	1.5 cm	0.518 W/kg	**0.53 W/kg**	1.6 W/kg	PASSED	3
GSM1900	661 / 1880.0	30.80 dBm	1.5 cm	0.430 W/kg	**0.44 W/kg**	1.6 W/kg	PASSED	4

* Reported SAR values are scaled to, or measured at, upper limit of power tuning tolerance.

Summary SAR data

	FCC-defined SAR values for the Grants of Equipment Authorization		
	PCE	DTS	NII
Maximum Head SAR values	1.07 W/kg	-	-
{Max + Max} Simultaneous Head SAR value	-		
Maximum Body SAR values	0.53 W/kg	-	-
{Max + Max} Simultaneous Body SAR value	-		
Maximum Product Specific (Wireless Router) SAR values	-	-	-
{Max + Max} Simultaneous Product Specific SAR value	-		
Maximum Simultaneous SAR value -	-		

Note:

PCE contains the highest results between all cellular modes (cellular, AWS and PCS bands)
DTS contains the highest results between WLAN 2.4GHz + RLAN 5725-5850MHz
NII contains the highest results between RLAN 5150-5250, 5250-5350 and 5470-5725

1.2.3 Maximum Drift

Maximum drift covered by 5% measurement uncertainty	Maximum drift during measurements
0.2dB	0.13 dB

1.2.4 Measurement Uncertainty

Expanded Uncertainty (k=2) 95%	± 27.1%

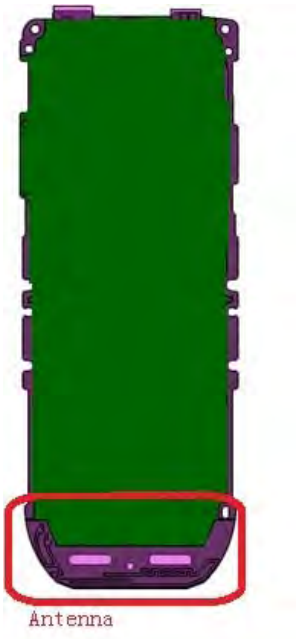
2. DESCRIPTION OF THE DEVICE UNDER TEST

Device category	Portable
Exposure environment	General population / uncontrolled

Modes of Operation	Bands	Modulation Mode	Duty Cycle	Transmitter Frequency Range (MHz)	Power Tuning Target (dBm)	Upper Limit of Power Tuning Tolerance (dBm)
					1-slot	1-slot
GSM	850	GMSK	1/8	824 – 849	31.8	32.15
	1900			1850 – 1910	30.5	30.85

2.1 Description of the Antenna

The device has an internal antenna for cellular use. The cellular antenna is located at the bottom underneath the back cover.



3. TEST CONDITIONS

3.1 Temperature and Humidity

Ambient temperature (°C):	20.5 – 22.5
Ambient humidity (RH %):	35 - 55

3.2 Test Signal, Frequencies and Output Power

The device was put into operation by using a call tester. Communication between the device and the call tester was established by air link.

The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence.

In all operating bands the measurements were performed on lowest, middle and highest channels.

The conducted output power of the device was measured by a separate test laboratory on the same unit(s) as used for SAR testing. The results are given in the appendix D.

Motorola Fast SAR algorithm is used in this testing.

Here is a summary list of the KDB documents used in the reported testing:
KDB 648474 D04 Handset SAR v01r01
KDB 447498 D01 General RF Exposure Guidance v05r01
KDB 690783 D01 SAR Listings on Grants
KDB 865664 D01 SAR Measurement 100MHz to 6GHz v01r01
KDB 865664 D02 RF Exposure Reporting v01r01

3.3 Test Cases and Test Minimisation

This chapter is informative only and explains some of the basic test reduction principles. Procedures laid out in KDBs mentioned in previous Chapter are fully followed.

The tested device examined in this report may not incorporate all of the features described in the text that follows, but its SAR evaluation will have been subjected to the same considerations and test logic described below.

Whilst it's possible to identify the maximum SAR test cases from inspection of the conducted power levels given in the Results tables (Section 7), different modes in the same band and

multi-slot transmit GSM/GPRS modes can create some difficulties. Therefore the sequence of the SAR tests made in evaluating this device has used test logic that is based on measured SAR values. Comparison of measured SAR values in this way, can also allow some test minimization (i.e. test elimination) to be made.

For example, when SAR testing multi-slot GSM/GPRS/EGPRS modes, it is an inefficient use of test resources to fully SAR test every test configuration in each of the different modes as these modes have a fixed power relationship between them that is the same, irrespective of the test configuration. In the case of multi-slot GSM/GPRS modes, a single comparative SAR test - using the same test channel and test configuration – is made in each of the n-slot modes; the mode with the highest measured SAR value is then subjected to full SAR testing in all test configurations. These comparative SAR tests (same frequency, same test configuration) are regarded as extremely accurate as they are relative tests in which the tested device changes neither its frequency nor its position between tests. For different modes that operate in the same band and use the same antenna e.g. GSM/GPRS850 and WCDMA850, full SAR testing is carried out in the GSM/GPRS850 mode but WCDMA850 testing is limited to 3 channel testing in the maximum SAR test configuration for GSM/GPRS850.

Multi-slot SAR testing against the Head is always performed whenever such a device offers Push to Talk over cellular with the internal earpiece active, Dual Transfer Mode (i.e. the ability to transmit voice and data simultaneously using the same transmitter) or has WLAN (which enables a Voice over IP call to take place whilst the device can simultaneously transmit data on a cellular band). Whenever a device has an intended multi-slot use against the head, it is also Head SAR tested in EGPRS mode. It should be noted that EGPRS transmit modes can have either GMSK or 8PSK modulation but, when tested, only 8PSK EGPRS will appear explicitly in the results tables, as GMSK EGPRS mode has identical time-averaged power to the reported GPRS mode.

Devices that have flips or slides are fully SAR tested in all device configurations consistent with their intended usage. For example, flip phones that can receive a call in closed mode are SAR tested against the head in both open and closed configurations. Similarly, slide phones are fully SAR tested in all slide configurations in which calls are intended to be made or received.

In the results tables in Section 7, the maximum SAR value for the ‘basic’ tests (i.e. left cheek, left tilt, right cheek and right tilt in Head SAR testing; with and without headset with the back &/or display side facing the flat phantom in Body SAR testing) is bolded for each band. In some cases, after full testing of the basic SAR test configurations has been completed, additional checking SAR tests are made. These checking tests are always based on the bolded result from the ‘basic’ testing. When the SAR value of a checking test exceeds the maximum value from the basic tests, it is also bolded and used as the basis for any further checking tests that might be needed.

Checking tests are largely voluntary and can cover optional batteries, different camera slide positions, optional covers, etc. In the case of optional batteries, if the construction of the optional battery is significantly different to the battery used in the full testing e.g. if the outer can is floating electrically rather than grounded, then the maximum SAR test configuration in each band is tested with the optional battery in 3 channels. For camera slides, if the slide material is metal, then checking tests in 3 channels are again run for the maximum SAR test configuration in each band. For plastic camera slides, SAR checking is only carried out in the channel that provided the maximum SAR value for the original. Optional front and back covers are tested if their shape differs significantly from the original or if their metallic content varies by more than 15% from the original; in the former case, the testing depends on the extent of the physical differences, whereas in the latter case, 3 channel SAR testing is performed in every band in the max SAR test configuration.

4. DESCRIPTION OF THE TEST EQUIPMENT

4.1 Measurement System and Components

The measurements were performed using an automated DASY near-field scanning system manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements was the 'advanced extrapolation' algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Serial Number	Calibration date	Calibration expiry
DAE4	793	2013-06	2014-06
DAE4	1355	2013-01	2014-01
E-field Probe ES3DV3	3131	2013-06	2014-06
E-field Probe ES3DV3	3165	2013-01	2014-01
Dipole Validation Kit, D835V2	480	2012-12	2014-12
Dipole Validation Kit, D1900V2	5d013	2012-12	2014-12
DASY5 software	Version 5.2		

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration date	Calibration expiry
Signal Generator	E4438C	MY42080610	2012-08	2013-08
Signal Generator	SML03	101264	2012-08	2013-08
Amplifier	5S1G4M3	302338	-	-
Amplifier	ZHL-42-SMA	NO72095-5	-	-
Power Meter	NRVS	838624/032	2012-08	2013-08
Power Meter	NRVD	840023/028	2012-08	2013-08
Power Sensor	NRV-Z32	100067	2012-08	2013-08
Power Sensor	NRV-Z32	849745/018	2012-08	2013-08
Call Tester	CMU 200	103293	-	-
Call Tester	CMU 200	104983	-	-
Network Analyzer	ENA E5071C	MY46213166	2012-08	2013-08
Dielectric Probe Kit	DAK-3.5	1042	-	-

4.1.1 Isotropic E-field Probe Type ES3DV3

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., butyl diglycol)
Calibration	Calibration certificate in Appendix E
Frequency	10 MHz to 4 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in HSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm Tip length: 20 mm Body diameter: 12 mm Tip diameter: 3.9 mm Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms

4.2 Phantoms

The phantom used for all head SAR tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528 - 2003.

The phantom used for all Body SAR tests i.e. for both system checks and device testing, was a "Triple Flat Phantom", also manufactured by SPEAG; this phantom conform to the requirements of OET Bulletin 65, Supplement C.

The SPEAG device holder (see Section 5.1) was used to position the device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

4.3 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEEE 1528 - 2003 and FCC Supplement C to OET Bulletin 65. All tests were carried out using simulants whose dielectric parameters were within ± 5% of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters.

The depth of the tissue simulant was at least 15.0 cm measured from the ear reference point during system checking and device measurements.

4.3.1 Tissue Simulant Recipes

The following recipe(s) were used for Head and Body tissue simulant(s):

850MHz band

Ingredient	Head (% by weight)	Body (% by weight)
Deionised Water	51.50	69.25
Tween 20	47.35	30.00
Salt	1.15	0.75

1900MHz band

Ingredient	Head (% by weight)	Body (% by weight)
Deionised Water	54.50	70.25
Tween 20	45.23	29.41
Salt	0.27	0.34

4.4 System validation and System checking

4.4.1 System validation status

Probe Calibration Point f / MHz	Test System	DASY SW	Dipole Type / SN	Probe Type / SN	Calibrated signal type(s)	DAE unit Type / SN	Validation done	
							Head tissue simulant	Body tissue simulant
835	TCC Salo / SAR-3	V52.8	D835V2 / 480	ES3DV4 / 3165	CW	DAE4 / 1355	2013-05	2013-05
1900	TCC Salo / SAR-1	V52.8	D1900V2 / 5d013	ES3DV3 / 3131	CW	DAE4 / 793	2013-07	2013-07

4.4.2 System checking

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyser. A system check measurement was made following the determination of the dielectric parameters of the simulant, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom for head system checking, and under the flat phantom for body system checking. The system checking results (dielectric parameters and SAR values) are given in the table below.

System checking, head tissue simulant

f [MHz]	Description	SAR 1g [W/kg]	Estimated SAR 1g [W/kg]	Estimated SAR 1g Deviation	Dielectric Parameters		SAR 1g Deviation from target	Dielectric Parameters Deviation from target		Temp	Plot #
				dSAR [%]	ε_r	σ [S/m]	dSAR [%]	$d\varepsilon_r$ [%]	$d\sigma$ [%]	[°C]	
	Tolerances			±3%			±10 %	±5 %	±5 %		
835	IEEE1528 / IEC62209				41.5	0.90					
	Reference result SN:480	2.39	-		41.4	0.92	TCC Salo/SAR-3 ES3DV3 SN:3165 Head 835MHz				
	2013-07-15	2.22	2.19	-1.35	40.0	0.89	-7.11	-3.38	-3.26	21.6	1
	2013-07-16	2.26	2.24	-0.88	41.0	0.91	-5.44	-0.97	-1.09	21.7	-
1900	IEEE1528 / IEC62209				40.0	1.40					
	Reference result SN:5d013	10.10	-		39.5	1.38	TCC Salo/SAR-1 ES3DV3 SN:3131 Head 1900MHz				
	2013-07-15	10.20	10.40	1.96	38.4	1.36	0.99	-2.78	-2.17	22.0	2

System checking, body tissue simulant

f [MHz]	Description	SAR 1g [W/kg]	Estimated SAR 1g [W/kg]	Estimated SAR 1g Deviation	Dielectric Parameters		SAR 1g Deviation from target	Dielectric Parameters Deviation from target		Temp	Plot #
				dSAR [%]	ε_r	σ [S/m]	dSAR [%]	$d\varepsilon_r$ [%]	$d\sigma$ [%]	[°C]	
	Tolerances			±3%			±10 %	±5 %	±5 %		
	IEEE1528 / IEC62209				55.2	0.97					
	Reference result SN:480	2.42	-		54.5	0.99	TCC Salo/SAR-3 ES3DV3 SN:3165 Body 835MHz				
835	2013-07-16	2.28	2.22	-2.63	53.0	0.98	-5.79	-2.75	-1.01	22.0	3
	IEEE1528 / IEC62209				53.3	1.52					
	Reference result SN:5d013	10.30	-		52.2	1.52	TCC Salo/SAR-1 ES3DV3 SN:3131 Body 1900MHz				
1900	2013-07-16	9.44	9.49	0.53	51.0	1.49	-8.35	-2.30	-2.63	22.7	4

Plots of the system checking scans are given in Appendix A.

4.5 Tissue Simulants used in the Measurements

Head tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Dielectric Parameters Deviation from recommended value		Temp [°C]
		ε_r	σ [S/m]	$d\varepsilon_r$ [%]	$d\sigma$ [%]	
	Tolerances			±5 %	±5 %	
836	Recommended value	41.5	0.90			
	2013-07-15	40.0	0.89	-3.61	-1.11	21.6
	2013-07-16	41.0	0.91	-1.20	1.11	21.7
1880	Recommended value	40.0	1.40			
	2013-07-15	38.4	1.34	-4.00	-4.29	22.0

Body tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Dielectric Parameters Deviation from Recommended value		Temp [°C]
		ε_r	σ [S/m]	$d\varepsilon_r$ [%]	$d\sigma$ [%]	
	Tolerances			±5 %	±5 %	
836	Recommended value	55.2	0.97			
	2013-07-16	53.0	0.98	-3.99	1.03	22.0
1880	Recommended value	53.3	1.52			
	2013-07-16	51.1	1.47	-4.13	-3.29	22.7

Dielectric parameter data for the band edges is given in Appendix C.

5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy system.

Device holder supplied by SPEAG

A Nokia designed spacer (illustrated below) was used to position the device within the SPEAG holder. The spacer positions the device so that the holder has minimal effect on the test results but still holds the device securely. The spacer was removed before the tests.

Nokia spacer

5.2 Test Positions

5.2.1 Against Phantom Head

Measurements were made in “cheek” and “tilt” positions on both the left hand and right hand sides of the phantom.

The positions used in the measurements were according to IEEE 1528 - 2003 "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques".

5.2.2 Body Worn Configuration

The device was placed in the SPEAG holder using the Nokia spacer and placed below the flat section of the phantom. The distance between the device and the phantom was kept at the separation distance indicated in the photo below using a separate flat spacer that was removed before the start of the measurements. The device was oriented with both sides facing the phantom to find the highest results.

5.3 Scan Procedures

Fast SAR procedure is described in KDB 447498 D01 General RF Exposure Guidance v05r01. First, area scans were used for determination of the 1-g SAR estimation (Fast SAR) for all SAR measurements. Next, a zoom scan, a minimum of 5x5x7 points covering a volume of at least 30x30x30mm, was performed only for the highest Fast SAR among all the test positions / channels if 1-g Fast SAR <0.8 W/kg or for all test positions / channels if 1-g Fast SAR ≥ 1.2 W/kg. If 1-g Fast SAR is >0.8 W/kg but <1.2 W/kg, zoom scan is required for highest Fast SAR channel measured for that position and additional zoom scan is required for highest Fast SAR among other positions / channels which 1-g Fast SAR <0.8 W/kg. Zoom scan for all channels in the same position is required also if 1-g Fast SAR and 1-g Full SAR are not within 0.100 W/kg. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

5.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy4 are all based on the modified Quadratic Shepard's method (Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).

The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighbouring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

6. MEASUREMENT UNCERTAINTY

Table 6.1 Measurement uncertainty evaluation for Full SAR in 0.3-6 GHz range

Uncertainty Component	Section in IEEE 1528	Tol. (%)	Prob Dist	Div	c_i	$c_i . u_i$ (%)	v_i
Measurement System							
Probe Calibration	E2.1	±6.55	N	1	1	±6.55	∞
Axial Isotropy	E2.2	±4.7	R	√3	$(1-c_p)^{1/2}$	±1.9	∞
Hemispherical Isotropy	E2.2	±9.6	R	√3	$(c_p)^{1/2}$	±3.9	∞
Boundary Effect	E2.3	±1.0	R	√3	1	±0.6	∞
Linearity	E2.4	±4.7	R	√3	1	±2.7	∞
System Detection Limits	E2.5	±1.0	R	√3	1	±0.6	∞
Readout Electronics	E2.6	±1.0	N	1	1	±1.0	∞
Response Time	E2.7	±0.8	R	√3	1	±0.5	∞
Integration Time	E2.8	±2.6	R	√3	1	±1.5	∞
RF Ambient Conditions - Noise	E6.1	±3.0	R	√3	1	±1.7	∞
RF Ambient Conditions - Reflections	E6.1	±3.0	R	√3	1	±1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	±0.4	R	√3	1	±0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	±2.9	R	√3	1	±1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5	±3.9	R	√3	1	±2.3	∞
Test sample Related							
Test Sample Positioning	E4.2	±6.0	N	1	1	±6.0	11
Device Holder Uncertainty	E4.1	±5.0	N	1	1	±5.0	7
Output Power Variation - SAR drift measurement	6.6.3	±5.0	R	√3	1	±2.9	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	±4.0	R	√3	1	±2.3	∞
Conductivity Target - tolerance	E3.2	±5.0	R	√3	0.64	±1.8	∞
Conductivity - measurement uncertainty	E3.3	±5.5	N	1	0.64	±3.5	5
Permittivity Target - tolerance	E3.2	±5.0	R	√3	0.6	±1.7	∞
Permittivity - measurement uncertainty	E3.3	±2.9	N	1	0.6	±1.7	5
Combined Standard Uncertainty			RSS			**±13.5**	116
Coverage Factor for 95%			**k=2**				
Expanded Uncertainty						**±27.1**	

Table 6.2 – Measurement uncertainty evaluation for Fast SAR in 0.3-6GHz range

Relative DASY5 Uncertainty Budget for Fast SAR Tests
According to IEEE 1528/2011 and IEC 62209-1/2011
(0.3 - 3 GHz range)

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0%	N	1	0	0			
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Modulation Response	±2.4%	R	$\sqrt{3}$	1	1	±1.4%	±1.4%	∞
Readout Electronics	±0.3%	N	1	0	0			
Response Time	±0.8%	R	$\sqrt{3}$	0	0			
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	0	0			
Probe Positioner	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Spatial x-y-Resolution	±10.0%	R	$\sqrt{3}$	1	1	±5.8%	±5.8%	∞
Fast SAR z-Approximation	±7.0%	R	$\sqrt{3}$	1	1	±4.0%	±4.0%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Power Scaling	±0%	R	$\sqrt{3}$	0	0			
Phantom and Setup								
Phantom Uncertainty	±6.1%	R	$\sqrt{3}$	1	1	±3.5%	±3.5%	∞
SAR correction	±1.9%	R	$\sqrt{3}$	0	0			
Liquid Conductivity (mea.)	±2.5%	R	$\sqrt{3}$	0	0			
Liquid Permittivity (mea.)	±2.5%	R	$\sqrt{3}$	0	0			
Temp. unc. - Conductivity	±3.4%	R	$\sqrt{3}$	0	0			
Temp. unc. - Permittivity	±0.4%	R	$\sqrt{3}$	0	0			
Combined Std. Uncertainty						±11.4%	±11.4%	748
Expanded STD Uncertainty						**±22.7%**	**±22.7%**	

7. RESULTS

The measured Head SAR values for the test device are tabulated below:

850MHz Band Head SAR results

Mode	Device orientation	SAR measurement	Measured 1g SAR [W/kg]			Reported* 1g SAR [W/kg]			Max Deviation (Estimated SAR - Full SAR) [W/kg]	Plot #
			Ch 128 824.2 MHz	Ch 190 836.6 MHz	Ch 251 848.8 MHz	Ch 128 824.2 MHz	Ch 190 836.6 MHz	Ch 251 848.8 MHz		
GSM	Tuning Target + Tolerance [dBm]		32.15			Scaling factor*				
	Conducted Slot Average Power [dBm]		32.10	32.05	32.10	0.05	0.10	0.05	dB	
	Time-averaged power [dBm]		23.07	23.02	23.07	1.01	1.02	1.01	Lin	
	Left Cheek	Estimated SAR	0.909	0.936	0.910	0.920	0.958	0.921	0.02	1
		Full SAR	-	0.958	-	-	**0.980**	-		
	Left Tilt	Estimated SAR	-	0.423	-	-	0.433	-	-	-
		Full SAR	-	-	-	-	-	-		
	Right Cheek	Estimated SAR	0.899	0.919	0.900	0.909	0.940	0.910	0.01	-
		Full SAR	-	0.910	-	-	0.931	-		
	Right Tilt	Estimated SAR	-	0.438	-	-	0.448	-	0.00	-
		Full SAR	-	0.435	-	-	0.445	-		
	Worst case checking	Estimated SAR	-	-	-	-	-	-	-	-
		Full SAR	-	-	-	-	-	-		
	Repeated SAR Left Cheek	Estimated SAR	-	0.915	-	-	0.936	-	0.03	-
		Full SAR	-	0.943	-	-	0.965	-		

1900MHz Band Head SAR results

Mode	Device orientation	SAR measurement	Measured 1g SAR [W/kg]			Reported* 1g SAR [W/kg]			Max Deviation (Estimated SAR - Full SAR) [W/kg]	Plot #
			Ch 512 1850.2 MHz	Ch 661 1880.0 MHz	Ch 810 1909.8 MHz	Ch 512 1850.2 MHz	Ch 661 1880.0 MHz	Ch 810 1909.8 MHz		
GSM	Tuning Target + Tolerance [dBm]		30.85			Scaling factor*				
	Conducted Slot Average Power [dBm]		30.80	30.80	30.75	0.05	0.05	0.10	dB	
	Time-averaged power [dBm]		21.77	21.77	21.72	1,01	1.01	1.02	Lin	
	Left Cheek	Estimated SAR	0.843	0.979	1.02	0.853	0.990	1.04	0.00	-
		Full SAR	-	-	1.02	-	-	1.04		
	Left Tilt	Estimated SAR	-	0.407	-	-	0.412	-	-	-
		Full SAR	-	-	-	-	-	-		
	Right Cheek	Estimated SAR	0.744	0.853	0.943	0.753	0.863	0.965	0.00	-
		Full SAR	-	-	0.945	-	-	0.967		
	Right Tilt	Estimated SAR	-	0.449	-	-	0.454	-	0.02	-
		Full SAR	-	0.425	-	-	0.430	-		
	Worst case checking	Estimated SAR	-	-	-	-	-	-	-	-
		Full SAR	-	-	-	-	-	-		
	Repeated SAR Left Cheek	Estimated SAR	-	-	1.04	-	-	1.06	0.01	2
		Full SAR	-	-	1.05	-	-	**1.07**		

The measured Body SAR values for the test device are tabulated below:

850MHz Band Body SAR results

Mode	Device orientation		SAR measurement	Measured 1g SAR [W/kg]			Reported* 1g SAR [W/kg]			Max Deviation (Estimated SAR - Full SAR) [W/kg]	Plot #
				Ch 128	Ch 190	Ch 251	Ch 128	Ch 190	Ch 251		
				824.2 MHz	836.6 MHz	848.8 MHz	824.2 MHz	836.6 MHz	848.8 MHz		
GSM	Tuning Target + Tolerance [dBm]			32.15			Scaling factor*				
	Conducted Slot Average Power [dBm]			32.10	32.05	32.10	0.05	0.10	0,05	dB	
	Time-averaged power [dBm]			23.07	23.02	23.07	1.01	1.02	1,01	Lin	
	Back facing phantom	Without headset	Estimated SAR	-	0.481	-	-	0.492	-	-	-
			Full SAR	-	-	-	-	-	-		
		Headset WH-108	Estimated SAR	-	0.356	-	-	0.364	-	-	-
			Full SAR	-	-	-	-	-	-		
	Display facing phantom	Without headset	Estimated SAR	0.508	0.513	0.494	0.514	0.525	0.500	0.01	3
			Full SAR	-	0.518	-	-	**0.530**	-		
		Headset WH-108	Estimated SAR	-	0.240	-	-	0.246	-	-	-
			Full SAR	-	-	-	-	-	-		

1900MHz Band Body SAR results

Mode	Device orientation		SAR measurement	Measured 1g SAR [W/kg]			Reported* 1g SAR [W/kg]			Max Deviation (Estimated SAR - Full SAR) [W/kg]	Plot #
				Ch 512 1850.2 MHz	Ch 661 1880.0 MHz	Ch 810 1909.8 MHz	Ch 512 1850.2 MHz	Ch 661 1880.0 MHz	Ch 810 1909.8 MHz		
GSM	Tuning Target + Tolerance [dBm]			30.85			Scaling factor*				
	Conducted Slot Average Power [dBm]			30.80	30.80	30.75	0.05	0.05	0.10	dB	
	Time-averaged power [dBm]			21.77	21.77	21.72	1.01	1.01	1.02	Lin	
	Back facing phantom	Without headset	Estimated SAR	0.352	0.430	0.411	0.356	**0.435**	0.421	0.02	4
			Full SAR	-	0.414	-	-	0.419	-		
		Headset WH-108	Estimated SAR	-	0.350	-	-	0.354	-	-	-
			Full SAR	-	-	-	-	-	-		
	Display facing phantom	Without headset	Estimated SAR	-	0.359	-	-	0.363	-	-	-
			Full SAR	-	-	-	-	-	-		
		Headset WH-108	Estimated SAR	-	0.276	-	-	0.279	-	-	-
			Full SAR	-	-	-	-	-	-		

* Reported SAR values are scaled to, or measured at, upper limit of power tuning tolerance.

Plots of the Measurement scans are given in Appendix B.

APPENDIX A: SYSTEM CHECKING SCANS

Plot #1

Date/Time: 2013-07-15 09:26:43

Test Laboratory: TCC Nokia
Type: D835V2, Serial: D835V2 - SN:480

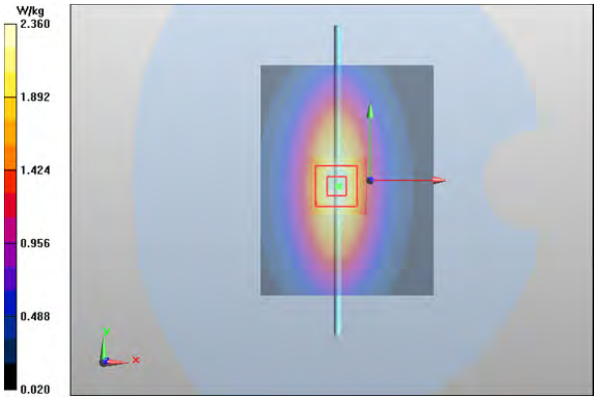
Communication System: CW835
Frequency: 835.0 MHz, Duty Cycle: 1:1.000
Medium: HSL850; Medium notes: t= 21,6 C
Medium Parameters used: f=835 MHz; σ = 0.8921 S/m; ε_r = 39.96; ρ = 1.000 g/cm^3;
Phantom section: Flat Section

DASY Configuration:
Probe: ES3DV3 - SN3165; ConvF(5.19,5.19,5.19); Calibrated: 2013-01-21;
Sensor-Surface: 4 mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1355; Calibrated: 2013-01-08
Phantom: SAM2; Type: SAM; Serial: TP-1570
Measurement SW: DASY52 52.8.6(1115); SEMCAD X Version 14.6.10 (7164)

d=15mm, Pin=250mW/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15 mm
Fast SAR: SAR(1g) = 2.19 W/kg; SAR(10g) = 1.49 W/kg
Maximum value of SAR (interpolated) = 2.36 W/kg

d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm
Reference Value = 52.846 V/m
Peak SAR (extrapolated) = 3.27 W/kg
Maximum value of SAR (measured) 2.40 W/kg

SAR(1g) = 2.22 W/kg;
SAR(10g) = 1.46 W/kg
Power Drift = -0.019 dB



Plot #2

Date/Time: 2013-07-15 08:42:51

Test Laboratory: TCC Nokia
Type: D1900V2, Serial: D1900V2 - SN:5d013

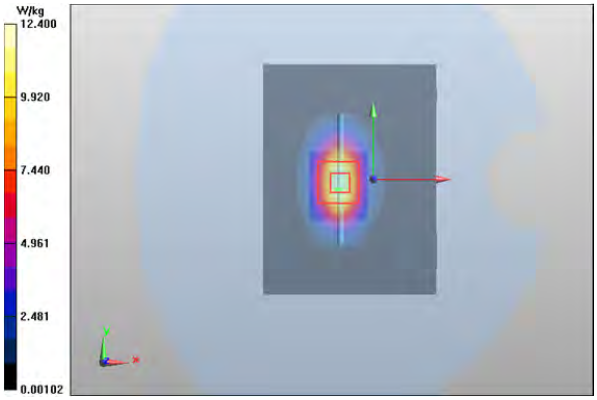
Communication System: CW1900
Frequency: 1900 MHz, Duty Cycle: 1:1.000
Medium: HSL1900; Medium notes: t= 22.0 C
Medium Parameters used: f=1900 MHz; σ = 1.356 S/m; ε_r = 38.36; ρ = 1.000 g/cm^3;
Phantom section: Flat Section

DASY Configuration:
Probe: ES3DV3 - SN3131; ConvF(5.17,5.17,5.17); Calibrated: 2013-06-18;
Sensor-Surface: 4 mm (Mechanical Surface Detection)
Electronics: DAE4 Sn793; Calibrated: 2013-06-10
Phantom: SAM 1; Type: Twin SAM 040 CA; Serial: TP-1449
Measurement SW: DASY52 52.8.6(1115); SEMCAD X Version 14.6.10 (7164)

d=10mm, Pin=250mW/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15 mm
Fast SAR: SAR(1g) = 10.4 W/kg; SAR(10g) = 5.48 W/kg
Maximum value of SAR (interpolated) = 12.4 W/kg

d=10mm, Pin=250mW/Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm
Reference Value = 93.050 V/m
Peak SAR (extrapolated) = 18.8 W/kg
Maximum value of SAR (measured) 11.5 W/kg

SAR(1g) = 10.2 W/kg;
SAR(10g) = 5.37 W/kg
Power Drift = 0.033 dB



Plot #3

Date/Time: 2013-07-16 14:25:50

Test Laboratory: TCC Nokia
Type: D835V2, Serial: D835V2 - SN:480

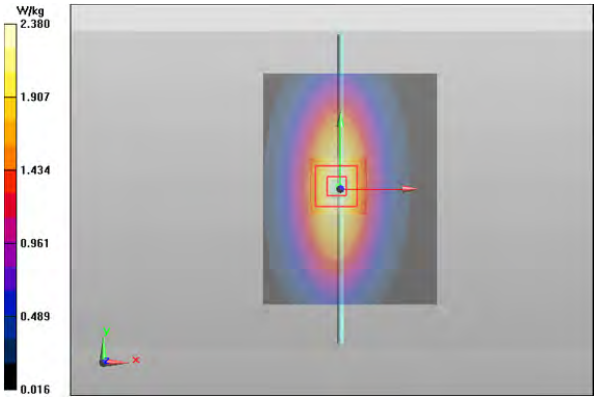
Communication System: CW835
Frequency: 835.0 MHz, Duty Cycle: 1:1.000
Medium: BSL850; Medium notes: t= 22,0 C
Medium Parameters used: f=835 MHz; σ = 0.9768 S/m; ε_r = 53.04; ρ = 1.000 g/cm^3;
Phantom section: Center Section

DASY Configuration:
Probe: ES3DV3 - SN3165; ConvF(5.19,5.19,5.19); Calibrated: 2013-01-21;
Sensor-Surface: 4 mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1355; Calibrated: 2013-01-08
Phantom: 1. Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
Measurement SW: DASY52 52.8.6(1115); SEMCAD X Version 14.6.10 (7164)

d=15mm, Pin=250mW/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15 mm
Fast SAR: SAR(1g) = 2.22 W/kg; SAR(10g) = 1.51 W/kg
Maximum value of SAR (interpolated) = 2.38 W/kg

d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm
Reference Value = 50.859 V/m
Peak SAR (extrapolated) = 3.33 W/kg
Maximum value of SAR (measured) 2.46 W/kg

SAR(1g) = 2.28 W/kg;
SAR(10g) = 1.51 W/kg
Power Drift = -0.047 dB



Plot #4

Date/Time: 2013-07-16 08:19:26

Test Laboratory: TCC Nokia
Type: D1900V2, Serial: D1900V2 - SN:5d013

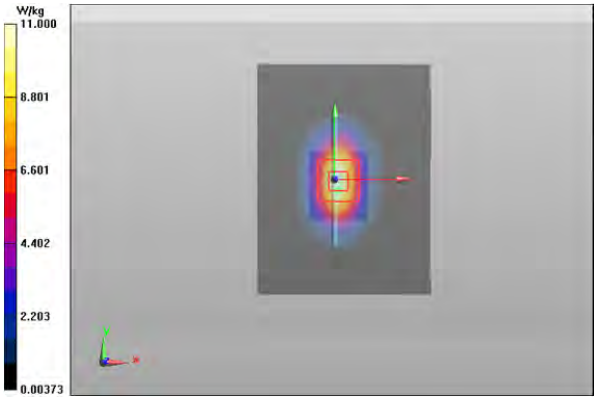
Communication System: CW1900
Frequency: 1900 MHz, Duty Cycle: 1:1.000
Medium: HSL1900; Medium notes: t= 22.7 C
Medium Parameters used: f=1900 MHz; σ = 1.485 S/m; ε_r = 51.04; ρ = 1.000 g/cm^3;
Phantom section: Center Section

DASY Configuration:
Probe: ES3DV3 - SN3131; ConvF(5.17,5.17,5.17); Calibrated: 2013-06-18;
Sensor-Surface: 4 mm (Mechanical Surface Detection)
Electronics: DAE4 Sn793; Calibrated: 2013-06-10
Phantom: SAM 3 Triple Phantom 5.1C; Type: QD 000 P51 CA; Serial:
Measurement SW: DASY52 52.8.6(1115); SEMCAD X Version 14.6.10 (7164)

d=10mm, Pin=250mW/Area Scan (61x81x1): Measurement grid: dx=15mm, dy=15 mm
Fast SAR: SAR(1g) = 9.49 W/kg; SAR(10g) = 4.89 W/kg
Maximum value of SAR (interpolated) = 11.0 W/kg

d=10mm, Pin=250mW/Zoom Scan (7x8x7)/Cube 0: Measurement grid: dx=5 mm, dy=5 mm, dz=5 mm
Reference Value = 86.651 V/m
Peak SAR (extrapolated) = 16.0 W/kg
Maximum value of SAR (measured) 10.7 W/kg

SAR(1g) = 9.44 W/kg;
SAR(10g) = 5.03 W/kg
Power Drift = -0.047 dB



APPENDIX B: MEASUREMENT SCANS

Plot #1

Date/Time: 2013-07-15 11:13:35

Test Laboratory: TCC Nokia
Type: RM-963, Serial: 004402/47/464081/4

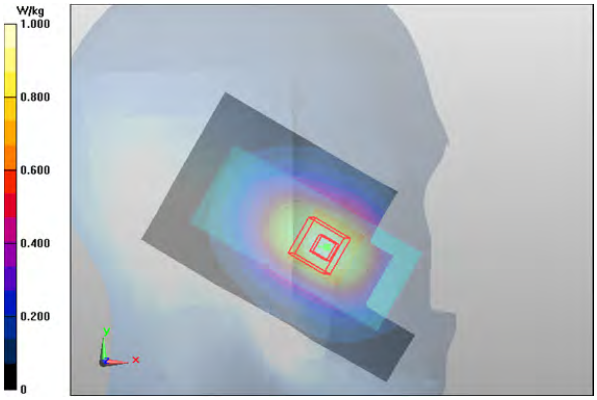
Communication System: GSM850
Frequency: 836.6 MHz, Duty Cycle: 1:8.300
Medium: HSL850; Medium notes: t= 21,6 C
Medium Parameters used: f=837 MHz; σ = 0.8934 S/m; ε_r = 39.95; ρ = 1.000 g/cm^3;
Phantom section: Left Section

DASY Configuration:
Probe: ES3DV3 - SN3165; ConvF(5.19,5.19,5.19); Calibrated: 2013-01-21;
Sensor-Surface: 4 mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1355; Calibrated: 2013-01-08
Phantom: SAM2; Type: SAM; Serial: TP-1570
Measurement SW: DASY52 52.8.6(1115); SEMCAD X Version 14.6.10 (7164)

GSM850/Cheek - Middle/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15 mm
Fast SAR: SAR(1g) = 0.936 W/kg; SAR(10g) = 0.644 W/kg
Maximum value of SAR (interpolated) = 1.00 W/kg

GSM850/Cheek - Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5 mm, dy=7.5 mm, dz=5 mm
Reference Value = 33.991 V/m
Peak SAR (extrapolated) = 1.25 W/kg
Maximum value of SAR (measured) 1.02 W/kg

SAR(1g) = 0.958 W/kg;
SAR(10g) = 0.682 W/kg
Power Drift = 0.051 dB



Plot #2

Date/Time: 2013-07-15 13:48:32

Test Laboratory: TCC Nokia
Type: RM-963, Serial: 004402/47/464054/1

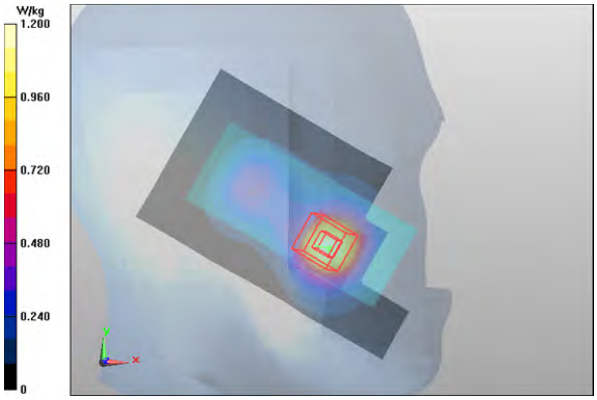
Communication System: GSM1900
Frequency: 1910 MHz, Duty Cycle: 1:8.300
Medium: HSL1900; Medium notes: t= 21.3 C
Medium Parameters used: f=1910 MHz; σ = 1.409 S/m; ε_r = 39.17; ρ = 1.000 g/cm^3;
Phantom section: Left Section

DASY Configuration:
Probe: ES3DV3 - SN3131; ConvF(5.17,5.17,5.17); Calibrated: 2013-06-18;
Sensor-Surface: 4 mm (Mechanical Surface Detection (Locations From Previous Scan Used))
Electronics: DAE4 Sn793; Calibrated: 2013-06-10
Phantom: SAM 1; Type: Twin SAM 040 CA; Serial: TP-1449
Measurement SW: DASY52 52.8.6(1115); SEMCAD X Version 14.6.10 (7164)

GSM1900/Cheek - High - Repeated/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15 mm
Fast SAR: SAR(1g) = 1.04 W/kg; SAR(10g) = 0.586 W/kg
Maximum value of SAR (interpolated) = 1.20 W/kg

GSM1900/Cheek - High - Repeated/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5 mm, dy=7.5 mm, dz=5 mm
Reference Value = 29.108 V/m
Peak SAR (extrapolated) = 1.54 W/kg
Maximum value of SAR (measured) 1.13 W/kg

SAR(1g) = 1.05 W/kg;
SAR(10g) = 0.643 W/kg
Power Drift = -0.044 dB



Plot #3

Date/Time: 2013-07-17 08:39:04

Test Laboratory: TCC Nokia
Type: RM-963, Serial: 004402/47/464081/4

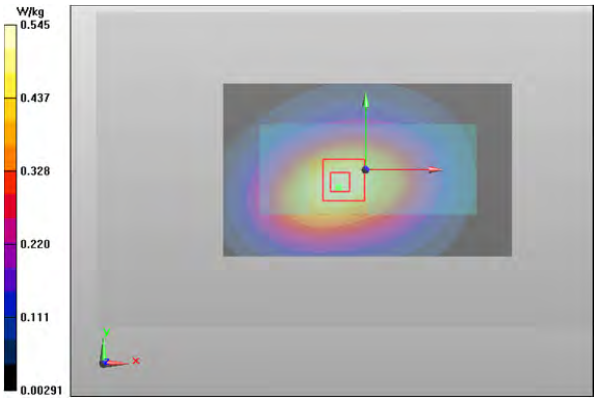
Communication System: GSM850
Frequency: 836.6 MHz, Duty Cycle: 1:8.300
Medium: BSL850; Medium notes: t= 22,0 C
Medium Parameters used: f=837 MHz; σ = 0.9779 S/m; ε_r = 53.04; ρ = 1.000 g/cm^3;
Phantom section: Center Section

DASY Configuration:
Probe: ES3DV3 - SN3165; ConvF(5.19,5.19,5.19); Calibrated: 2013-01-21;
Sensor-Surface: 4 mm (Mechanical Surface Detection (Locations From Previous Scan Used))
Electronics: DAE4 Sn1355; Calibrated: 2013-01-08
Phantom: 1. Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: xxxx
Measurement SW: DASY52 52.8.6(1115); SEMCAD X Version 14.6.10 (7164)

GSM850/Body - Middle - Spacer 15mm - No Headset - Display Facing Phantom/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15 mm
Fast SAR: SAR(1g) = 0.513 W/kg; SAR(10g) = 0.358 W/kg
Maximum value of SAR (interpolated) = 0.545 W/kg

GSM850/Body - Middle - Spacer 15mm - No Headset - Display Facing Phantom/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5 mm, dy=7.5 mm, dz=5 mm
Reference Value = 22.954 V/m
Peak SAR (extrapolated) = 0.678 W/kg
Maximum value of SAR (measured) 0.546 W/kg

SAR(1g) = 0.518 W/kg;
SAR(10g) = 0.372 W/kg
Power Drift = -0.00539 dB



Plot #4

Date/Time: 2013-07-16 09:05:34

Test Laboratory: TCC Nokia
Type: RM-963, Serial: 004402/47/464054/1

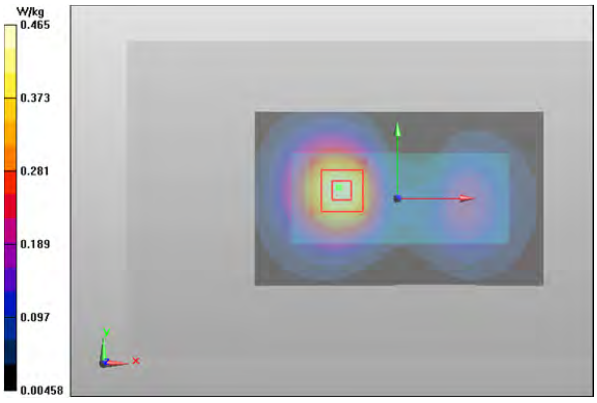
Communication System: GSM1900
Frequency: 1880 MHz, Duty Cycle: 1:8.300
Medium: HSL1900; Medium notes: t= 22.7 C
Medium Parameters used: f=1880 MHz; σ = 1.473 S/m; ε_r = 51.10; ρ = 1.000 g/cm^3;
Phantom section: Center Section

DASY Configuration:
Probe: ES3DV3 - SN3131; ConvF(5.17,5.17,5.17); Calibrated: 2013-06-18;
Sensor-Surface: 4 mm (Mechanical Surface Detection)
Electronics: DAE4 Sn793; Calibrated: 2013-06-10
Phantom: SAM 3 Triple Phantom 5.1C; Type: QD 000 P51 CA; Serial:
Measurement SW: DASY52 52.8.6(1115); SEMCAD X Version 14.6.10 (7164)

GSM1900/Body - Middle - Spacer 15mm - No Headset - Back Facing Phantom/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15 mm
Fast SAR: SAR(1g) = 0.430 W/kg; SAR(10g) = 0.256 W/kg
Maximum value of SAR (interpolated) = 0.465 W/kg

GSM1900/Body - Middle - Spacer 15mm - No Headset - Back Facing Phantom/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5 mm, dy=7.5 mm, dz=5 mm
Reference Value = 17.811 V/m
Peak SAR (extrapolated) = 0.600 W/kg
Maximum value of SAR (measured) 0.446 W/kg

SAR(1g) = 0.414 W/kg;
SAR(10g) = 0.262 W/kg
Power Drift = -0.000347 dB



APPENDIX C: DIELECTRIC PARAMETERS OF THE TISSUE SIMULANTS

Head tissue simulant dielectric parameters used in the measurements:

f (MHz)	Date	Dielectric Parameters					
		824.2MHz		837.0MHz		849.0MHz	
		ε_r	σ [S/m]	ε_r	σ [S/m]	ε_r	σ [S/m]
836	2013-07-15	40.0	0.88	40.0	0.89	39.9	0.90
	2013-07-16	41.1	0.90	41.0	0.91	41.0	0.92
f (MHz)	Date	Dielectric Parameters					
		1850.0MHz		1880.0MHz		1910.0MHz	
		ε_r	σ [S/m]	ε_r	σ [S/m]	ε_r	σ [S/m]
1880	2013-07-15	38.5	1.32	38.4	1.34	38.3	1.36

Body tissue simulant dielectric parameters used in the measurements:

f (MHz)	Date	Dielectric Parameters					
		824.2MHz		837.0MHz		849.0MHz	
		ε_r	σ [S/m]	ε_r	σ [S/m]	ε_r	σ [S/m]
836	2013-07-16	53.1	0.97	53.0	0.98	53.0	0.98
f (MHz)	Date	Dielectric Parameters					
		1850.0MHz		1880.0MHz		1910.0MHz	
		ε_r	σ [S/m]	ε_r	σ [S/m]	ε_r	σ [S/m]
1880	2013-07-16	51.2	1.46	51.1	1.47	51.0	1.49

APPENDIX D: CONDUCTED AVERAGE POWER MEASUREMENTS FOR GSM

D.1 Power Tuning Targets

GSM 850 Head and Body-worn			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	31.8	31.8	31.8

GSM 1900 Head and Body-worn			
Slot configuration	Low channel	Mid channel	High channel
GSM 1-slot	30.5	30.5	30.5

D.2 Conducted Power from the Samples used in the Testing

Type: RM-963; Serial number: 004402/47/464081/4 used for
- GSM850 Head and Body-worn SAR measurements

GSM 850 Head and Body-worn			
Slot configuration	CH 128 824.2 MHz	CH 190 836.6 MHz	CH 251 848.8 MHz
GSM 1-slot	32.10	32.05	32.10

Type: RM-963; Serial number: 004402/47/464054/1 used for
- GSM1900 Head and Body-worn SAR measurements

GSM 1900 Head and Body-worn			
Slot configuration	CH 512 1850.2 MHz	CH 661 1880.0 MHz	CH 810 1909.8 MHz
GSM 1-slot	30.80	30.80	30.75

APPENDIX E: RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)

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

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Accreditation No.: SCS 108

Client Nokia Salo TCC

Certificate No: ES3-3131_Jun13

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3131

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

Calibration date: June 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	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:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 18, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3131

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.23	6.23	6.23	0.31	1.83	± 12.0 %
835	41.5	0.90	5.96	5.96	5.96	0.26	1.99	± 12.0 %
1750	40.1	1.37	5.17	5.17	5.17	0.49	1.47	± 12.0 %
1900	40.0	1.40	4.98	4.98	4.98	0.67	1.27	± 12.0 %
2450	39.2	1.80	4.33	4.33	4.33	0.80	1.14	± 12.0 %
2600	39.0	1.96	4.21	4.21	4.21	0.80	1.09	± 12.0 %

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3131

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.10	6.10	6.10	0.30	1.90	± 12.0 %
835	55.2	0.97	6.03	6.03	6.03	0.39	1.68	± 12.0 %
1750	53.4	1.49	4.87	4.87	4.87	0.31	2.53	± 12.0 %
1900	53.3	1.52	4.62	4.62	4.62	0.28	2.70	± 12.0 %
2450	52.7	1.95	4.27	4.27	4.27	0.68	1.20	± 12.0 %
2600	52.5	2.16	4.17	4.17	4.17	0.50	1.10	± 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.

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Accreditation No.: SCS 108

Client Nokia Salo TCC

Certificate No: ES3-3165_Jan13

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3165**

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

Calibration date: **January 21, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
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	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
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-12)	In house check: Oct-13

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

Issued: January 21, 2013

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3165

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.46	6.46	6.46	0.23	2.34	± 12.0 %
835	41.5	0.90	6.20	6.20	6.20	0.33	1.65	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.67	1.25	± 12.0 %
1900	40.0	1.40	5.02	5.02	5.02	0.43	1.47	± 12.0 %
2450	39.2	1.80	4.45	4.45	4.45	0.60	1.41	± 12.0 %
2600	39.0	1.96	4.28	4.28	4.28	0.70	1.34	± 12.0 %

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3165

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.10	6.10	6.10	0.31	1.92	± 12.0 %
835	55.2	0.97	6.04	6.04	6.04	0.71	1.22	± 12.0 %
1750	53.4	1.49	4.86	4.86	4.86	0.54	1.49	± 12.0 %
1900	53.3	1.52	4.60	4.60	4.60	0.46	1.72	± 12.0 %
2450	52.7	1.95	4.18	4.18	4.18	0.64	1.17	± 12.0 %
2600	52.5	2.16	3.98	3.98	3.98	0.80	1.00	± 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.

APPENDIX F: RELEVANT PAGES FROM DIPOLE VALIDATION KIT REPORT(S)

Calibration Laboratory of
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Accreditation No.: SCS 108

Client **Nokia Salo TCC**

Certificate No: D835V2-480_Dec12

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 480
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	December 03, 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	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	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-12)	In house check: Oct-13

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

Issued: December 3, 2012

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Engineering AG
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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "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	V52.8.3
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	41.4 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.40 W/kg ± 17.0 % (k=2)**

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

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.5 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.51 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.27 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω - 3.3 jΩ
Return Loss	- 29.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.7 Ω - 4.9 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 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	January 28, 2003

DASY5 Validation Report for Head TSL

Date: 03.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 480

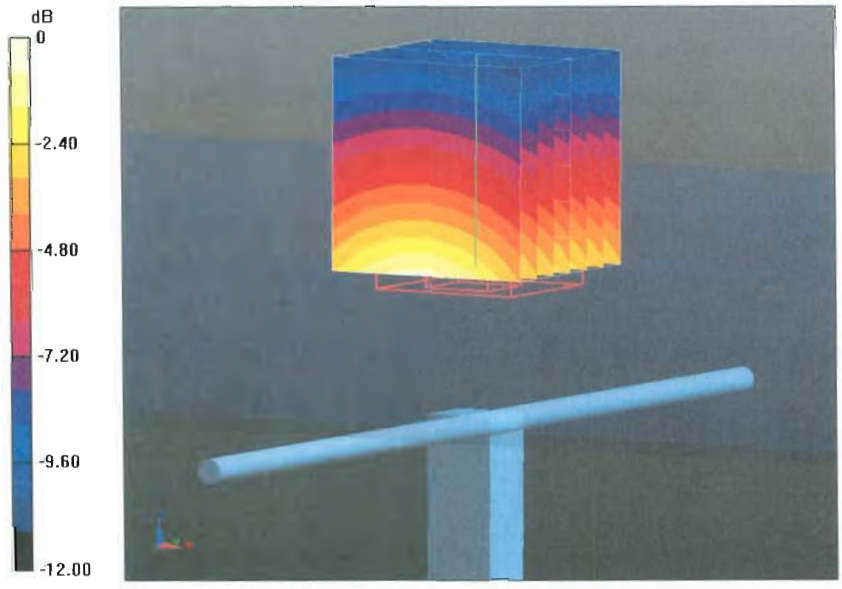
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.92 mho/m; ε_r = 41.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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 52.8.3(988); SEMCAD X 14.6.7(6848)

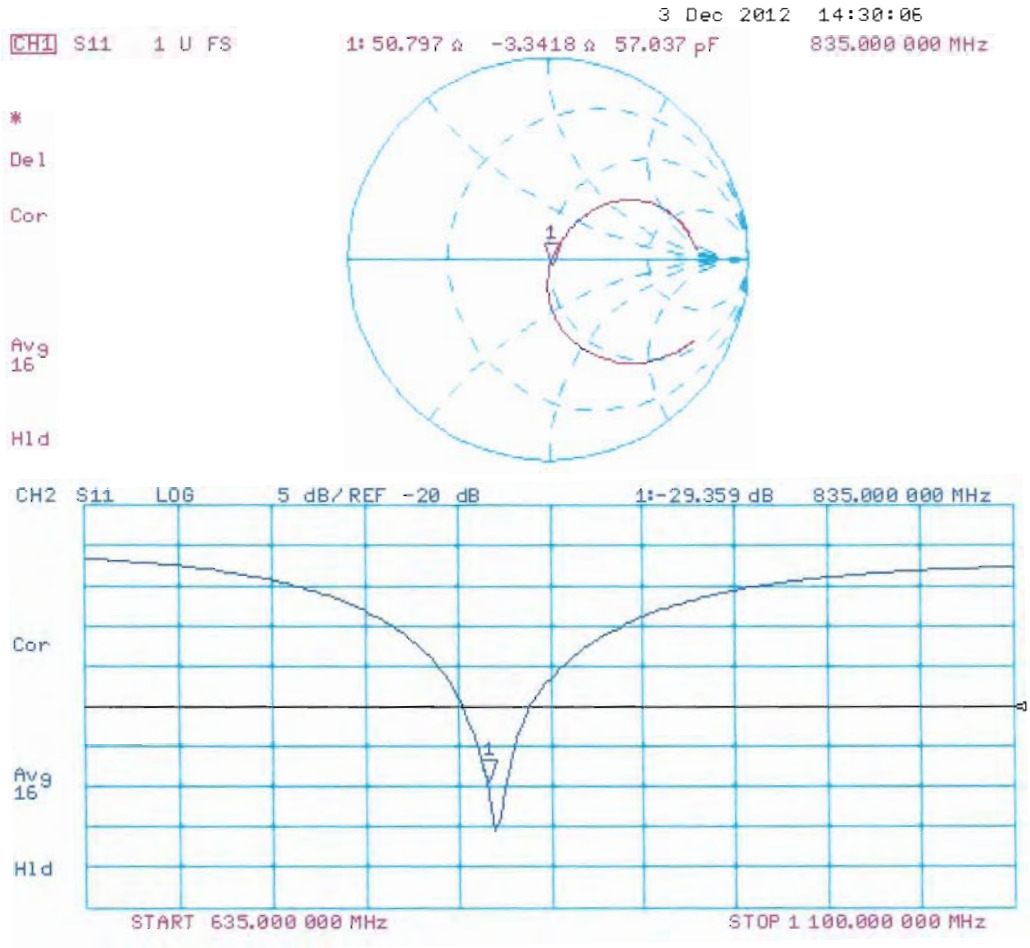
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.814 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.60 W/kg
SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.56 W/kg
Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 03.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 480

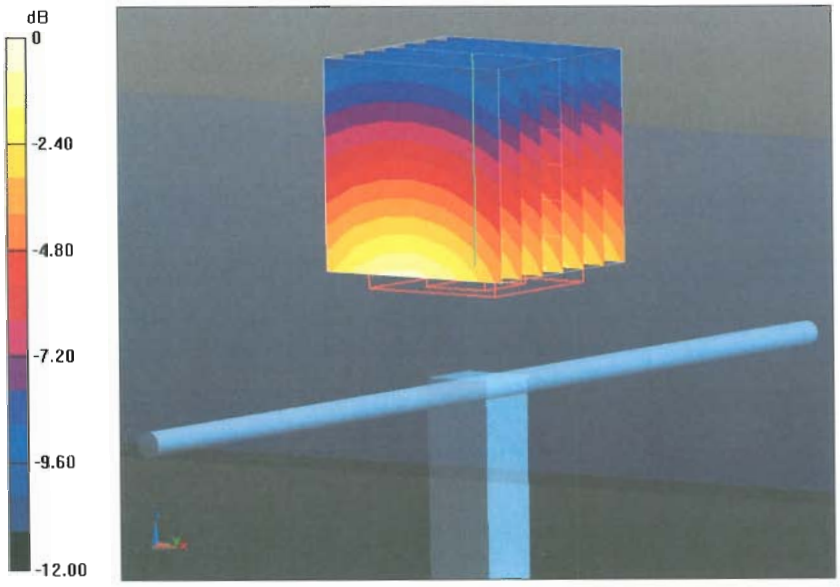
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.99 mho/m; ε_r = 54.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 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 52.8.3(988); SEMCAD X 14.6.7(6848)

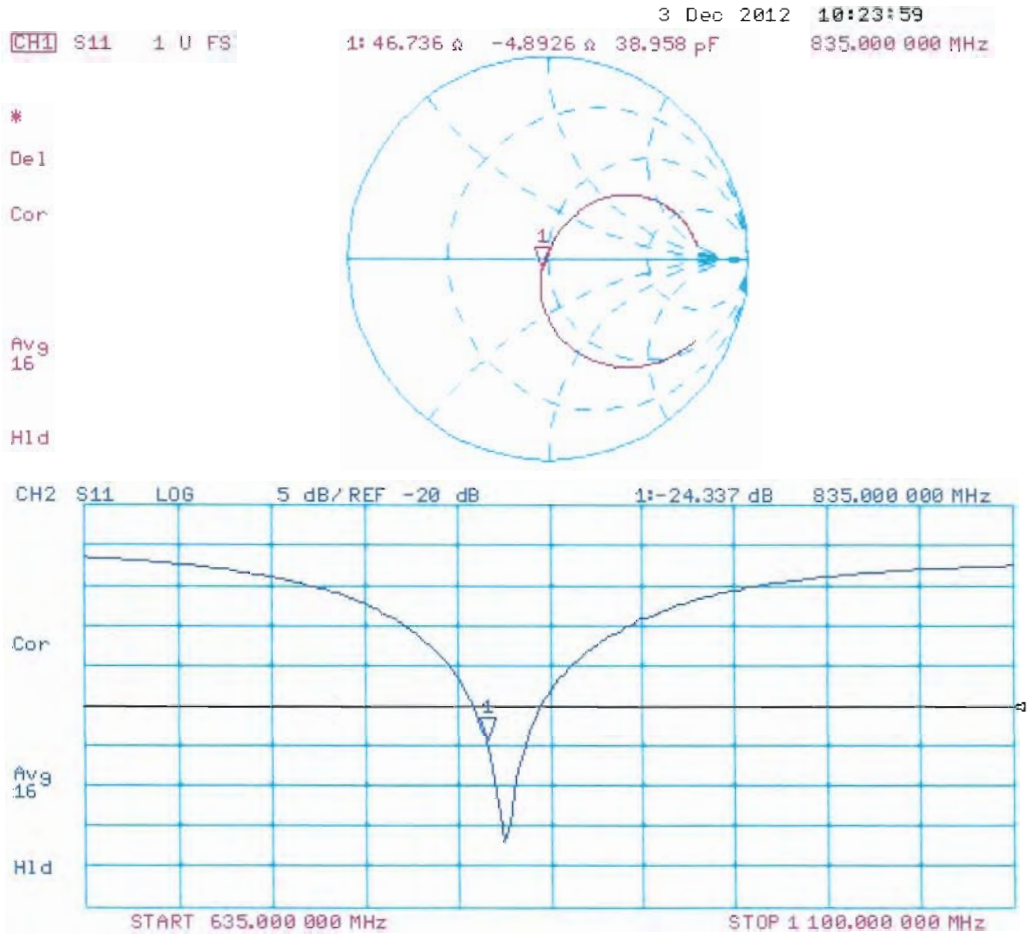
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.301 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.53 W/kg
SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client Nokia Salo TCC

Certificate No: D1900V2-5d013_Dec12

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d013
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	December 06, 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	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	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-12)	In house check: Oct-13

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

Issued: December 6, 2012

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	V52.8.3
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	39.5 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.6 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.2 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.2 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.3 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**41.0 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.6 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.3 Ω + 6.2 jΩ
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.4 Ω + 5.9 jΩ
Return Loss	- 24.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.194 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	April 30, 2002

Date: 06.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d013

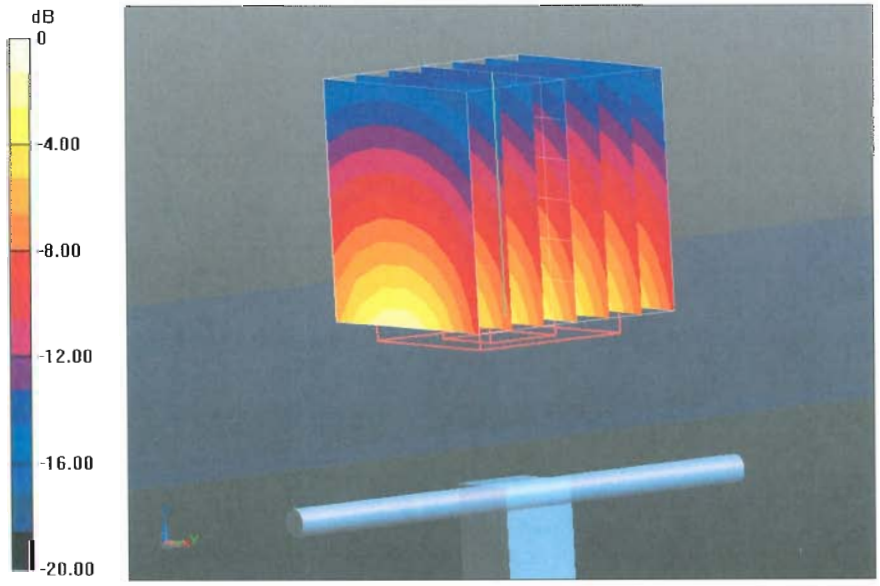
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 mho/m; ε_r = 39.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(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 52.8.3(988); SEMCAD X 14.6.7(6848)

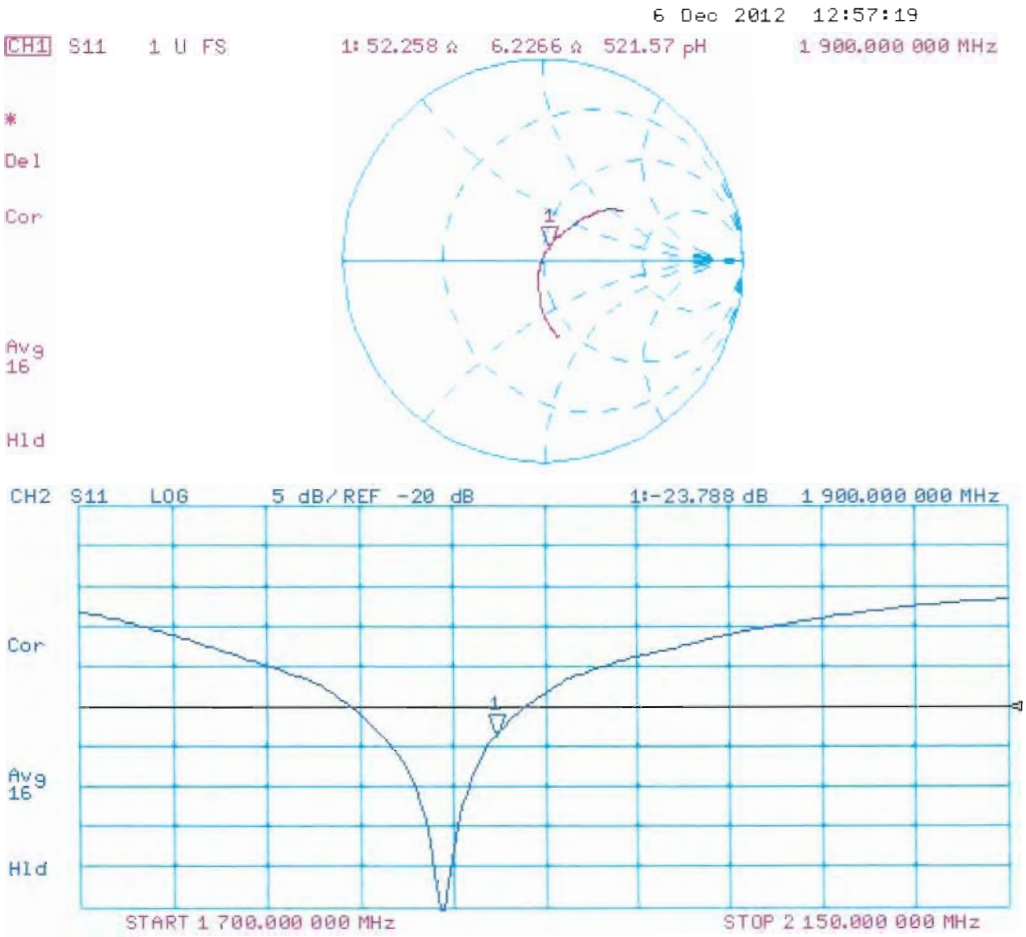
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.748 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.0 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.28 W/kg
Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 06.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d013

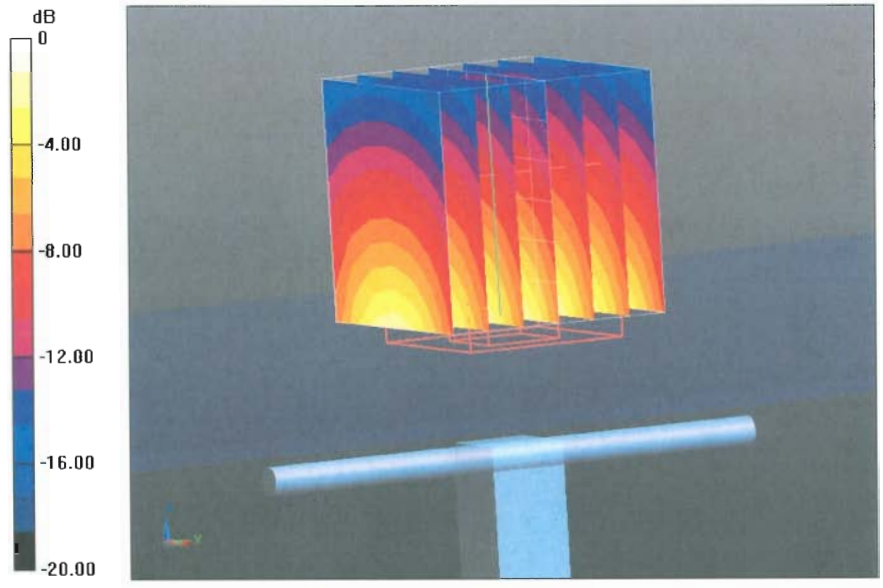
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.52 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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 52.8.3(988); SEMCAD X 14.6.7(6848)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.039 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.0 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.41 W/kg
Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Body TSL