



MOTOROLA

Portable Cellular Phone Class II SAR Test Report v2

Tests Requested By: Motorola Mobile Devices
600 N. US Highway 45
Libertyville, IL 60048

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This laboratory is accredited to ISO/IEC 17025-2005 to perform the following tests:

Accreditation:



TESTING CERT #2518-02

Tests:

Electromagnetic Specific Absorption Rate

Procedures:

IEC 62209-1

RSS-102

IEEE 1528 - 2003

FCC OET Bulletin 65 (*including Supplement C*)

Australian Communications Authority Radio

Communications (Electromagnetic Radiation – Human Exposure) Standard 2003

CENELEC EN 50360

ARIB Std. T-56 (2002)

Statement of Compliance:

On the following products or types of products:

On the following products or types of products: Wireless Communications Devices (Examples): Two Way Radios; Portable Phones (including Cellular, Licensed Non-Broadcast and PCS); Low Frequency Readers; and Pagers

Motorola declares under its sole responsibility that the portable cellular telephone model to which this declaration relates, is in conformity with the appropriate General Population/Uncontrolled RF exposure standards, recommendations and guidelines (FCC 47 CFR §2.1093) as well as with CENELEC en50360:2001 and ANSI / IEEE C95.1. It also declares that the product was tested in accordance with IEEE 1528 / CENELEC EN62209-1 (2006), as well as other appropriate measurement standards, guidelines and recommended practices. Any deviations from these standards, guidelines and recommended practices are noted below:

(none)

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1. Introduction

The Motorola Mobile Devices Business Product Safety Laboratory has performed measurements of the maximum potential exposure to the user of the portable cellular phone covered by this test report. The Specific Absorption Rate (SAR) of this product was measured. The portable cellular phone was tested in accordance with [1], [4] and [5]. The SAR values measured for the portable cellular phone are below the maximum recommended levels of 1.6 W/kg in a 1g average set in [3] and 2.0W/kg in a 10g average set in [2].

For ANSI / IEEE C95.1 (1g), the final SAR reading for this phone is 0.62 W/kg for head adjacent use and 0.38 W/kg for body worn use. These measurements were performed using a Dasy4™ v4.7 system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich Switzerland.

2. Description of the Device Under Test

2.1 Antenna description

Type	Internal Antenna	
Location	Bottom of the Transceiver	
Dimensions	Length	6.66mm
	Width	56.22mm
Configuration	FICA	

2.2 Device description

Serial number	354636030004918 & TA007000EX					
Mode(s) of Operation	GSM 900	GSM 1800	GSM 1900	WCDMA 2100	Bluetooth	WLAN 802.11b/g
Modulation Mode(s)	GMSK	GMSK	GMSK	QPSK	GFSK	BPSK
Maximum Output Power Setting	33.00 dBm	30.00 dBm	30.00 dBm	25.00 dBm	10.00 dBm	23.00 dBm
Duty Cycle	1:8	1:8	1:8	1:1	1:1	1:1
Transmitting Frequency Rang(s)	880.2-914.8MHz	1710.2-1784.8MHz	1850.2-1909.8MHz	1922.4-1977.6 MHz	2402.0-2483.5MHz	2412.0-2462.5MHz
Production Unit or Identical Prototype (47 CFR §2.908)	Identical Prototype					
Device Category	Portable					
RF Exposure Limits	General Population / Uncontrolled					

Mode(s) of Operation	GPRS 900				GPRS 1800				GPRS 1900			
Modulation Mode(s)	GMSK				GMSK				GMSK			
Maximum Output Power Setting	33.00 dBm	31.00 dBm	29.00 dBm	27.00 dBm	30.00 dBm	28.00 dBm	26.00 dBm	24.00 dBm	30.00 dBm	28.00 dBm	26.00 dBm	24.00 dBm
Duty Cycle	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8
Transmitting Frequency Rang(s)	880.2-914.8MHz				1710.2-1784.8MHz				1850.2-1909.8MHz			

Note: Bolded entries indicate data mode configurations of highest time-average power output per band and data mode type.

3. Test Equipment Used

3.1 Dosimetric System

The Motorola Mobile Devices Business Product Safety & Compliance Laboratory utilizes a Dosimetric Assessment System (Dasy4™ v4.7) manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. All the SAR measurements are taken within a shielded enclosure. The overall 10g RSS uncertainty of the measurement system is $\pm 10.8\%$ (K=1) with an expanded uncertainty of $\pm 21.6\%$ (K=2). The overall 1g RSS uncertainty of the measurement system is $\pm 11.1\%$ (K=1) with an expanded uncertainty of $\pm 22.2\%$ (K=2). The measurement uncertainty budget is given in Appendix 5. Per IEEE 1528, this uncertainty budget is applicable to the SAR range of 0.4W/kg to 10W/kg.

The list of calibrated equipment used for the measurements is shown in the following table.

Description	Serial Number	Cal Due Date
DASY4™ DAE V1	365	21-Aug-2010
	650	31-Aug-2010
E-Field Probe ES3DV3	3191	07-Nov-2009
	3184	18-Sep-2010
S.A.M. Phantom used for 1800/1900/2450MHz	TP-1134	
	TP-1250	
Dipole Validation Kit, DV1800V2	272tr	01-Apr-2010
Dipole Validation Kit, DV2450V2	767	01-Apr-2010

3.2 Additional Equipment

Description	Serial Number	Cal Due Date
Signal Generator HP8648C	3847A04840	21-Jan-2010
Power Meter E4419B	GB39511085	21-Jan-2010
Power Sensor #1 - 8481A	MY41095450	21-Jan-2010
Power Sensor #2 - 8481A	2702A82671	21-Jan-2010
Network Analyzer HP8753ES	US39172714	22-Jan-2010
Dielectric Probe Kit HP85070C	US99360207	

Description	Serial Number	Cal Due Date
Signal Generator HP8648C	3847A04844	Jan-29-2010
Power Meter E4419B	GB39511086	Jun-12-2010
Power Sensor #1 - E9301A	US39210934	Apr-23-2010
Power Sensor #2 - E9301A	US39211006	Apr-22-2010
Network Analyzer HP8753ES	US39172529	Jun-11-2010
Dielectric Probe Kit HP85070C	US99360070	

4. Electrical parameters of the tissue simulating liquid

Prior to conducting SAR measurements, the relative permittivity, ϵ_r , and the conductivity, σ , of the tissue simulating liquids were measured with a HP85070 Dielectric Probe Kit. These values, along with the temperature of the simulated tissue are shown in the table below. The recommended limits for permittivity and conductivity are also shown. A mass density of $\rho=1\text{g/cm}^3$ was entered into the system in all the cases. It can be seen that the measured parameters are within tolerance of the recommended limits specified in [1] and [5].

f (MHz)	Tissue type	Limits / Measured	Dielectric Parameters		
			ϵ_r	σ (S/m)	Temp (°C)
1880	Head	Measured, 5-Jan-2009	38.5	1.44	21.0
		Measured, 5-Jan-2009	39.3	1.45	20.8
		Recommended Limits	40.0 $\pm 5\%$	1.40 $\pm 5\%$	18-25
	Body	Measured, 5-Jan-2009	52.7	1.59	21.0
		Recommended Limits	53.3 $\pm 5\%$	1.52 $\pm 5\%$	18-25
2450	Head	Measured, 8-Oct-2009	37.1	1.89	21.8
		Measured, 9-Oct-2009	37.1	1.89	21.6
		Measured, 21-Jan-2010	37.6	1.88	21.5
		Recommended Limits	39.2 $\pm 10\%$	1.80 $\pm 5\%$	18-25
	Body	Measured, 8-Oct-2009	50.2	2.04	21.9
		Measured, 9-Oct-2009	50.2	2.04	21.9
		Measured, 21-Jan-2010	50.9	1.92	21.5
		Recommended Limits	52.7 $\pm 10\%$	1.95 $\pm 5\%$	18-25

The list of ingredients and the percent composition used for the tissue simulates are indicated in the table below.

Ingredient	835MHz / 900 MHz Head	835MHz / 900 MHz Body	1800MHz / 1900 MHz Head	1800 MHz / 1900 MHz Body	2450MHz Head	2450 MHz Body
Sugar	57	44.9	--	--	--	--
DGBE	--	--	47	30.8	--	30
Diacetin	--	--	--	--	51	--
Water	40.45	53.06	52.62	68.8	48.75	70
Salt	1.45	0.94	0.38	0.4	0.15	--
HEC	1	1	--	--	--	--
Bact.	0.1	0.1	--	--	0.1	--

5. System Accuracy Verification

A system accuracy verification of the DASY4™ was performed using the measurement equipment listed in Section 3.1. The daily system accuracy verification occurs within the flat section of the SAM phantom.

A SAR measurement was performed to verify the measured SAR was within $\pm 10\%$ from the target SAR indicated in Appendix 6. These frequencies are within $\pm 10\%$ of the compliance test mid-band frequency as required in [1] and [5]. The test was conducted on the same days as the measurement of the DUT. Recommended limits for permittivity and conductivity, specified in [5], are shown in the table below. The obtained results from the system accuracy verification are also displayed in the table below. SAR values are normalized to 1W forward power delivered to the dipole. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values. The distributions of SAR compare well with those of the reference measurements (see Appendix 1). The tissue stimulant depth was verified to be 15.0cm ± 0.5 cm. Z-axis scans showing the SAR penetration are also included in Appendix 1.

f (MHz)	Description	SAR (W/kg), 1gram	Dielectric Parameters		Ambient Temp (°C)	Tissue Temp (°C)
			ϵ_r	σ (S/m)		
1800	Measured, 5-Jan-2010	36.68	39.6	1.36	20.6	19.5
	Recommended Limits	37.91	40.0 $\pm 5\%$	1.40 $\pm 5\%$	18-25	18-25
2450	Measured, 8-Oct-2009	54.75	37.1	1.89	22.2	21.9
	Measured, 9-Oct-2009	53.25	36.6	1.89	21.0	24.0
	Measured, 21-Jan-2010	53.75	37.6	1.88	20.2	19.9
	Recommended Limits	56.68	39.2 $\pm 10\%$	1.80 $\pm 5\%$	18-25	18-25

The following probe conversion factors were used on the E-Field probe(s) used for the system accuracy verification measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	SN3184	1810	5.14	8 of 9
		2450	4.44	8 of 9
	SN3191	2450	4.57	8 of 9

6. Test Results

The test sample was operated using an actual transmission through a base station simulator. The base station simulator was setup to the proper channel, transmitter power level and transmit mode of operation. The phone was tested in the configurations stipulated in [1], [4] and [5]. The phone was positioned into these configurations using the device holder supplied with the DASY4™ SAR measurement system. The measured dielectric constant of the material used for the device holder is less than 2.9 and the loss tangent is less than 0.02 ($\pm 30\%$) at 850MHz. The default settings for the “coarse” and “cube” scans were chosen and used for measurements. The grid spacing of the course scan was set to 15 mm as shown in the SAR plots included in Appendix 2 and 3. Please refer to the DASY4™ manual for additional information on SAR scanning procedures and algorithms used.

The Cellular Phone model covered by this report has the following battery options:
SNN5843A - 1390 mAH Battery

The battery with the highest capacity is the SNN5843A. This battery was used to do most of the SAR testing. The phone was placed in the SAR measurement system with a fully charged battery.

6.1 Head Adjacent Test Results

The SAR results shown in tables 1 through 4 are maximum SAR values averaged over 1 gram of phantom tissue, to demonstrate compliance to [3] and also over 10 grams of phantom tissue, to demonstrate compliance to the [6]. Also shown are the measured conducted output power levels, the temperature of the simulated tissue after the test, the measured drift and the extrapolated SAR. The exact method of extrapolation is $\text{New SAR} = \text{Old SAR} * 10^{(-\text{drift}/10)}$. The SAR reported at the end of the measurement process by the DASY4™ measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process. This is the most conservative SAR because it corresponds to the average output power at the beginning of the SAR test. This extrapolation has been done because when the DUT is operating properly it may exhibit a slump in radiated power and SAR over time. This is verified by measuring the SAR drift after the test.

The left head and right head SAR contour distributions are similar. Because of this similarity, the cheek/touch and 15° tilt test conditions with the highest SAR values in each band are indicated as bold numbers in the following tables and are included in Appendix 2. All other test conditions measured lower SAR values than those included in Appendix 2.

The guidelines provided in “SAR for Handsets with Multiple Transmitters” (KDB publication 648474 - D01 v01r03) were utilized for evaluation of the need for simultaneous transmission SAR testing. These guidelines direct that if the SAR-to-peak location separation ratio for the GSM antenna and the Wi-Fi antenna is < 0.3 then SAR evaluation for simultaneous transmission is not required. For GSM1900, the SAR-to-peak location separation ratio is 0.108. Thus, no testing was performed to determine the aggregate 1 g SAR. SAR plots with the Wi-Fi SAR overlaid upon the GSM SAR are provided in Appendix 2 to provide visual indication of the separation of the SAR hotspots for each modulation.

The SAR measurements were performed using the SAM phantoms listed in section 3.1. Since the same phantoms and simulated tissue were used for the system accuracy verification and the device SAR measurements, the Z-axis scans included in Appendix 1 are applicable for verification of simulated tissue depth to be 15.0cm ± 0.5 cm.

The following probe conversion factors were used on the E-Field probe(s) used for the head adjacent measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	SN3184	1810	5.14	8 of 9
		2450	4.44	8 of 9
	SN3191	2450	4.57	8 of 9

Left Head Cheek Position								
f (MHz)	Description	Conducted Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 1900	Channel 512	30.09						
	Channel 661	30.15	19.7	-0.0234	0.26	0.26	0.391	0.39
	Channel 810	29.89						
WLAN 802.11b/g	Channel 1	21.95	19.9	0.0935	0.176	0.18	0.338	0.34
	Channel 6	22.06	21.9	-0.038	0.242	0.24	0.477	0.48
	Channel 11	22.41	19.8	-0.00807	0.0855	0.09	0.17	0.17

Table 1: SAR measurement results at the highest possible output power, measured in a head cheek position against the ICNIRP and ANSI SAR Limit.

Right Head Cheek Position								
f (MHz)	Description	Conducted Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 1900	Channel 512	30.09						
	Channel 661	30.15	19.6	0.0681	0.371	0.37	0.61	0.61
	Channel 810	29.89						
WLAN 802.11b/g	Channel 1	21.95	19.8	-0.00088	0.197	0.20	0.402	0.40
	Channel 6	22.06	21.7	-0.0456	0.294	0.30	0.614	0.62
	Channel 11	22.41	19.8	-0.0065	0.0939	0.09	0.197	0.20

Table 2: SAR measurement results at the highest possible output power, measured in a head cheek position against the ICNIRP and ANSI SAR Limit.

Left Head 15° Tilt Position								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 1900	Channel 512	30.09						
	Channel 661	30.15	19.5	0.0134	0.21	0.21	0.344	0.34
	Channel 810	29.89						
WLAN 802.11b/g	Channel 1	21.95	19.8	0.0111	0.194	0.19	0.401	0.40
	Channel 6	22.06	21.8	-0.0177	0.272	0.27	0.571	0.57
	Channel 11	22.41	19.8	-0.0212	0.0851	0.09	0.173	0.17

Table 3: SAR measurement results at the highest possible output power, measured in a head 15° Tilt position against the ICNIRP and ANSI SAR Limit.

Right Head 15° Tilt Position								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 1900	Channel 512	30.09						
	Channel 661	30.15	19.7	-0.0288	0.182	0.18	0.286	0.29
	Channel 810	29.89						
WLAN 802.11b/g	Channel 1	21.95	19.8	0.0263	0.156	0.16	0.304	0.30
	Channel 6	22.06	21.7	0.0273	0.251	0.25	0.501	0.50
	Channel 11	22.41	19.8	-0.0386	0.0714	0.07	0.141	0.14

Table 4: SAR measurement results at the highest possible output power, measured in a head 15° Tilt position against the ICNIRP and ANSI SAR Limit.

6.2 Body Worn Test Results

The SAR results shown in tables 5 through 7 are maximum SAR values averaged over 1 gram of phantom tissue, to demonstrate compliance to [3] and also over 10 grams of phantom tissue, to demonstrate compliance to the [6]. Also shown are the measured conducted output power levels, the temperature of the test facility during the test, the temperature of the tissue simulate after the test, the measured drift and the extrapolated SAR. The exact method of extrapolation is $\text{New SAR} = \text{Old SAR} * 10^{(-\text{drift}/10)}$. The SAR reported at the end of the measurement process by the DASY4™ measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process. This is the most conservative SAR because it corresponds to the average output power at the beginning of the SAR test. This extrapolation has been done because when the DUT is operating properly it may exhibit a slump in radiated power and SAR over time. This is verified by measuring the SAR drift after the test.

The test conditions that produced the highest SAR values in each band are indicated as bold numbers in the following tables and are included in Appendix 3. All other test conditions measured lower SAR values than those included in Appendix 3.

A “flat” phantom was for the body-worn tests. This “flat” phantom is made out of 1” thick natural High Density Polyethylene with a thickness at the bottom equal to 2.0mm. It measures 52.7cm(long) x 26.7cm(wide) x 21.2cm(tall). The measured dielectric constant of the material used is less than 2.3 and the loss tangent is less than 0.0046 all the way up to 2.184GHz.

The tissue stimulant depth was verified to be 15.0cm ±0.5cm. The same device holder described in section 6 was used for positioning the phone. The functional accessories were divided into two categories, the ones with metal components and the ones with non-metal components. For non-metallic component accessories, testing was performed on the accessory that displayed the closest proximity to the flat phantom. Each metallic component accessory, if any, was checked for uniqueness of metal component so that each is tested with the device. If multiple accessories shared an identical metal component, only the accessory that dictates the closest spacing to the body was tested. The cellular phone was tested with a headset connected to the device for all body-worn SAR measurements.

There are no Body-Worn Accessories available for this phone at the time of testing hence the device was tested per the supplement C testing guidelines for devices that do not have body worn accessories. A separation distance of 15mm between the device and the flat phantom was used for testing body-worn SAR. The device was tested with the front and back of the device facing the phantom.

In addition to accessory testing, the cellular phone was tested in data mode operations with the front and back of the phone facing the phantom. For these tests, a separation distance of 25mm between the device and the flat phantom was used. The device was tested with the front and back of the device facing the phantom.

The following probe conversion factors were used on the E-Field probe(s) used for the body worn measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	SN3184	1810	4.84	8 of 9
		2450	4.28	8 of 9
	SN3191	2450	4.08	8 of 9

BodyWorn Front part of the phone 15mm away from the flat phantom								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 1900	Channel 512	30.09						
	Channel 661	30.15	20.6	-0.0225	0.169	0.17	0.264	0.27
	Channel 810	29.89						
WLAN 802.11b/g	Channel 1	21.95	20.0	0.00751	0.05	0.05	0.0838	0.08
	Channel 6	22.06	21.9	-0.0665	0.0791	0.08	0.14	0.14
	Channel 11	22.41	20.2	0.0406	0.024	0.02	0.0411	0.04
Bluetooth 2450MHz	Channel 0	9.22						
	Channel 39	9.10	21.9	2.21	0.00000622	0.00	0.0000419	0.00
	Channel 78	9.35						
<i>GSM 1900 + WLAN + Bluetooth</i>						0.25		0.41

Table 5: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

BodyWorn Back part of the phone 15mm away from the flat phantom								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 1900	Channel 512	30.09						
	Channel 661	30.15	20.6	-0.0132	0.235	0.24	0.381	0.38
	Channel 810	29.89						
WLAN 802.11b/g	Channel 1	21.95	20.0	0.0981	0.0584	0.06	0.109	0.10
	Channel 6	22.06	21.8	0.0686	0.0739	0.07	0.13	0.13
	Channel 11	22.41	20.0	0.0343	0.0305	0.03	0.0519	0.05
Bluetooth 2450MHz	Channel 0	9.22						
	Channel 39	9.10	21.7	999	0.0000015	0.00	0.0000105	0.00
	Channel 78	9.35						
<i>GSM 1900 + WLAN + Bluetooth</i>						0.31		0.51

Table 6: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

Highest BodyWorn Phone 25mm away from the flat phantom								
<i>f</i> (MHz)	Description	Conducted Output Power (dBm)	Temp (°C)	Drift (dB)	<i>10g SAR value</i>		<i>1g SAR value</i>	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GPRS1900 <i>Class10</i> <i>Back</i>	Channel 512	28.21						
	Channel 661	28.17	20.2	-0.0202	0.0821	0.08	0.125	0.13
	Channel 810	28.21						
WLAN 802.11b/g <i>Back</i>	Channel 1	21.95	20.1	0.0305	0.0243	0.02	0.0405	0.04
	Channel 6	22.06	22.2	-0.027	0.0259	0.03	0.0447	0.04
	Channel 11	22.41	20.0	0.104	0.0113	0.01	0.019	0.02
<i>GPRS 1900</i> <i>Class 10 +</i> <i>WLAN</i>						<i>0.11</i>		<i>0.17</i>

Table 7: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

References

- [1] CENELEC, en62209-1:2006 “Human Exposure to Radio Frequency Fields From Hand - Held and Body - Mounted Wireless Communication Devices – Human Models, Instrumentation, and Procedures”
- [2] CENELEC, en50360:2001 “Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz – 3GHz)”.
- [3] ANSI / IEEE, C95.1 1999 Edition “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz”
- [4] FCC OET Bulletin 65 Supplement C 01-01
- [5] IEEE 1528 2003 Edition “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”
- [6] ICNIRP Guidelines “Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)”

Appendix 1

SAR distribution comparison for the system accuracy verification

Test Laboratory: Motorola 1009'2009_2450MHz_Good -6.1%

Procedure Notes: 2450 MHz System Performance Check / Dipole Sn# 767 PM1 Power = 200 mW

Sim.Temp@meas = 23.8C Sim.Temp@SPC = 24C Room Temp @ SPC = 21C

Communication System: CW - Dipole; Frequency: 2450 MHz; Channel Number: 11; Duty Cycle: 1:1

Medium: VALIDATION Only; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.89$ mho/m; $\epsilon_r = 36.6$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3191; ConvF(4.57, 4.57, 4.57); Calibrated: 11/7/2008
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn365; Calibrated: 8/21/2009
- Phantom: PCS-9 Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1134;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (4x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 8.35 mW/g

Daily SPC Check/0-Degree, 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 81.9 V/m; Power Drift = 0.038 dB

Peak SAR (extrapolated) = 23.6 W/kg

SAR(1 g) = 10.8 mW/g; SAR(10 g) = 4.89 mW/g

Maximum value of SAR (measured) = 12.1 mW/g

Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0:

Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 81.9 V/m; Power Drift = 0.038 dB

Peak SAR (extrapolated) = 23.1 W/kg

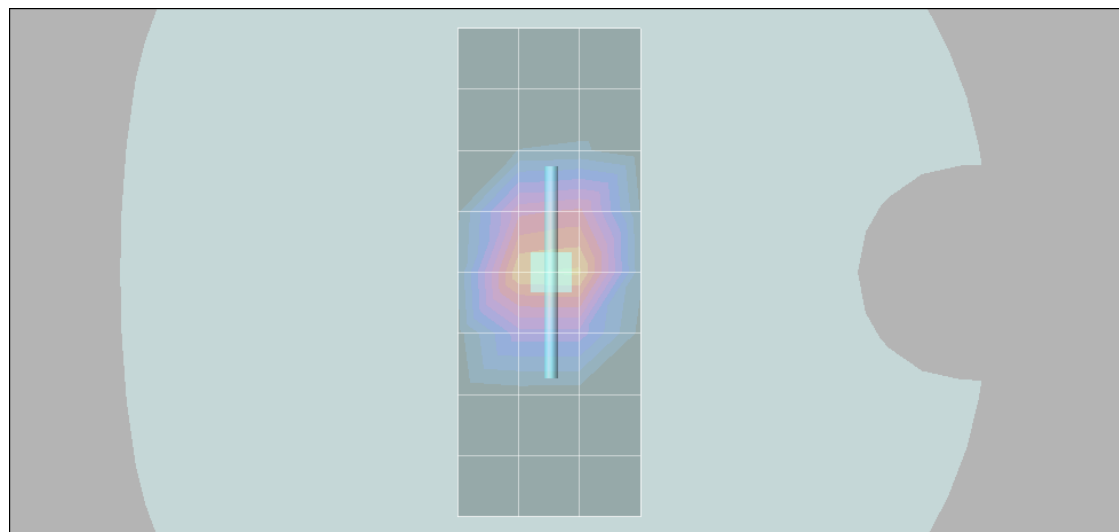
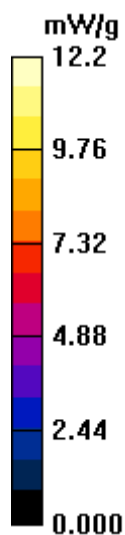
SAR(1 g) = 10.5 mW/g; SAR(10 g) = 4.72 mW/g

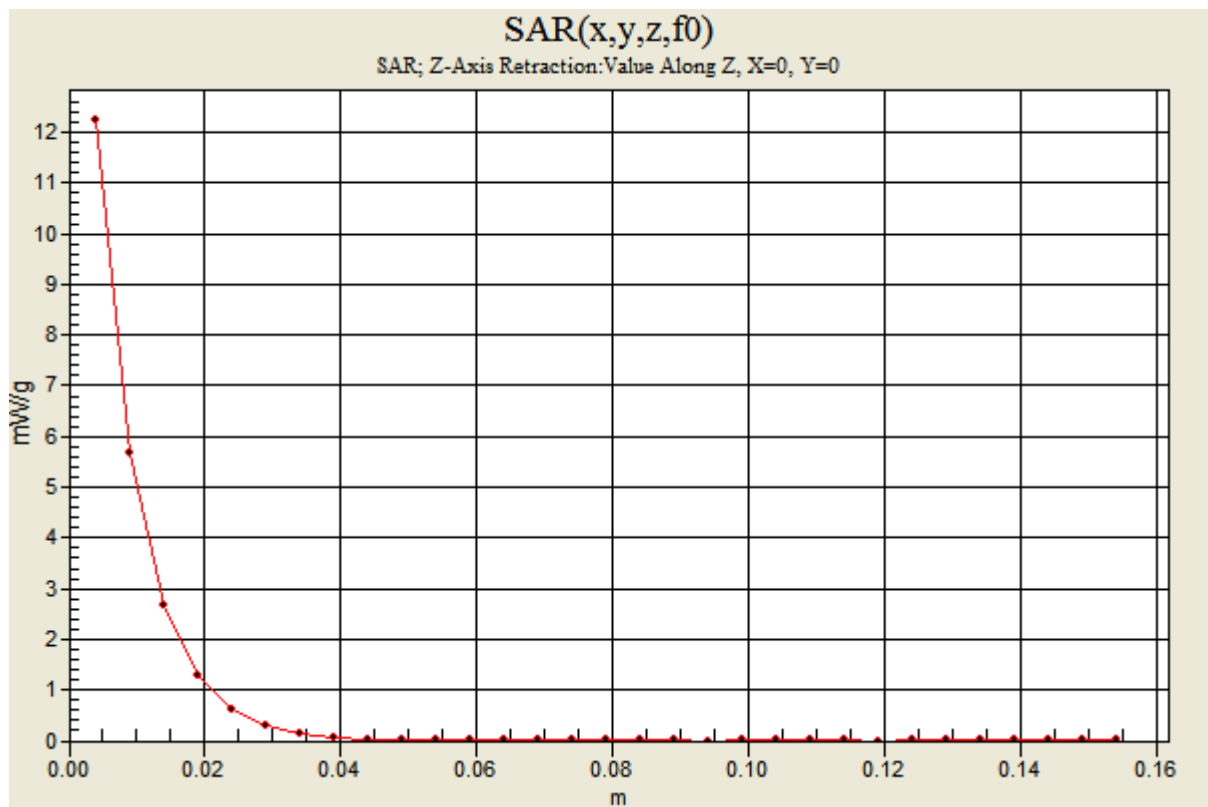
Maximum value of SAR (measured) = 11.6 mW/g

Daily SPC Check/Z-Axis Retraction (1x1x31):

Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 12.2 mW/g





Test Laboratory: Motorola 1008'2009_2450MHz_Good -3.4%

Procedure Notes: 2450 MHz System Performance Check / Dipole Sn# 767 PM1 Power = 200 mW

Sim.Temp@meas = 23.2C Sim.Temp@SPC = 21.9C Room Temp @ SPC = 22.2C

Communication System: CW - Dipole; Frequency: 2450 MHz; Channel Number: 11; Duty Cycle: 1:1

Medium: VALIDATION Only; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.89$ mho/m; $\epsilon_r = 37.1$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3191; ConvF(4.57, 4.57, 4.57); Calibrated: 11/7/2008
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn365; Calibrated: 8/21/2009
- Phantom: PCS-9_Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1134;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (4x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 8.53 mW/g

Daily SPC Check/0-Degree, 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 82.6 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 24.1 W/kg

SAR(1 g) = 11.1 mW/g; SAR(10 g) = 5.05 mW/g

Maximum value of SAR (measured) = 12.5 mW/g

Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0:

Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 82.6 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 23.6 W/kg

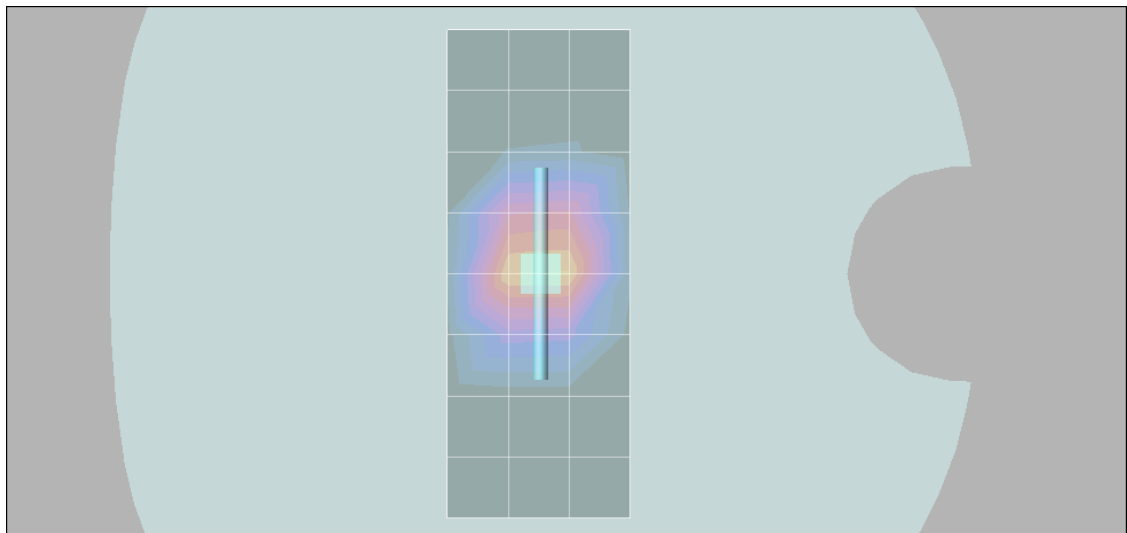
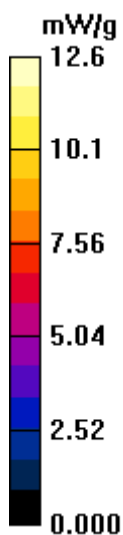
SAR(1 g) = 10.8 mW/g; SAR(10 g) = 4.88 mW/g

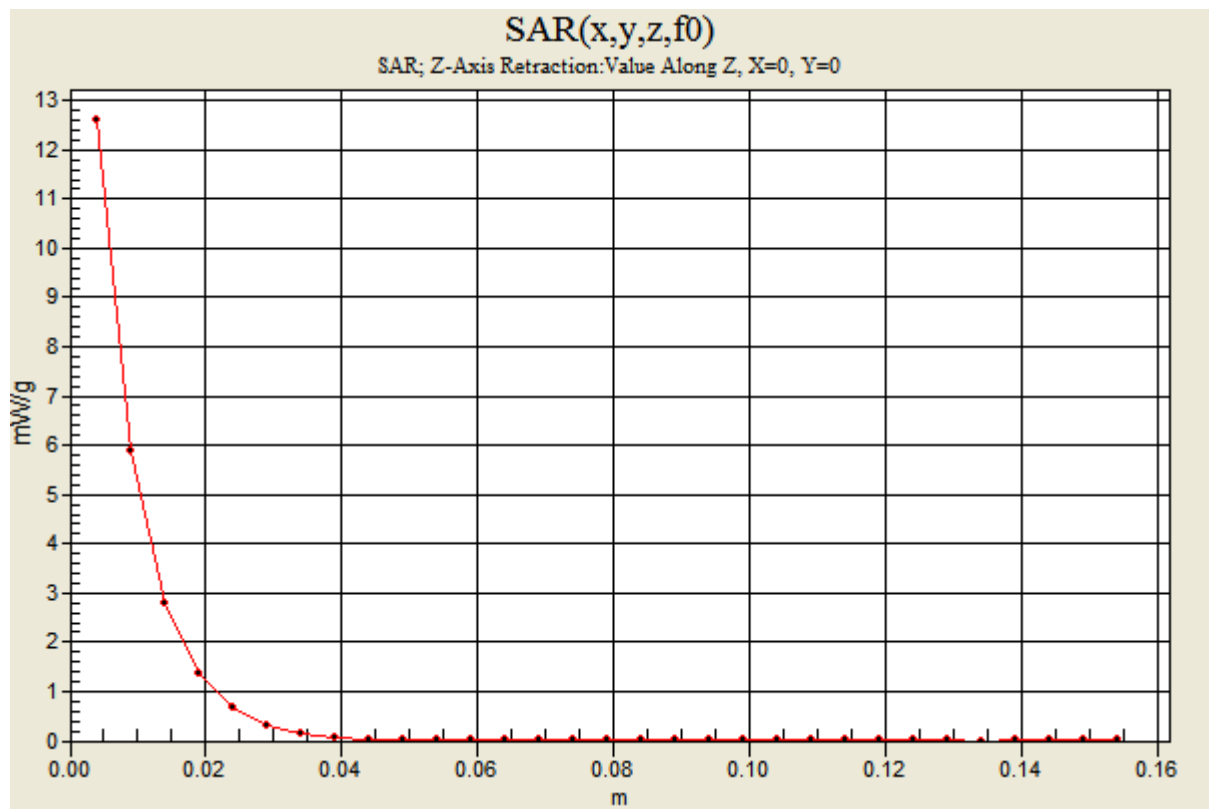
Maximum value of SAR (measured) = 11.9 mW/g

Daily SPC Check/Z-Axis Retraction (1x1x31):

Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 12.6 mW/g





Test Laboratory: Motorola

1800 MHz System Performance Check

Procedure Notes: 1800 MHz System Performance Check / Dipole Sn# 272TR PM1 Power = 200 mW

[Sim.Temp@meas](#) = 19.5°C Sim.Temp@SPC = 19.5°C Room Temp @ SPC = 20.6°C

Communication System: CW - Dipole; Frequency: 1800 MHz; Communication System Channel Number: 8; Duty Cycle: 1:1

Medium: VALIDATION Only; Medium parameters used: $f = 1800$ MHz; $\sigma = 1.36$ mho/m; $\epsilon_r = 39.6$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(5.14, 5.14, 5.14); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn650; Calibrated: 8/21/2009
- Phantom: R4 : Sect.1, Amy Twin; Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (9x4x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 6.44 mW/g

Daily SPC Check/0-Degree 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 80.0 V/m; Power Drift = -0.026 dB

Peak SAR (extrapolated) = 12.5 W/kg

SAR(1 g) = 7.29 mW/g; SAR(10 g) = 3.9 mW/g

Maximum value of SAR (measured) = 8.17 mW/g

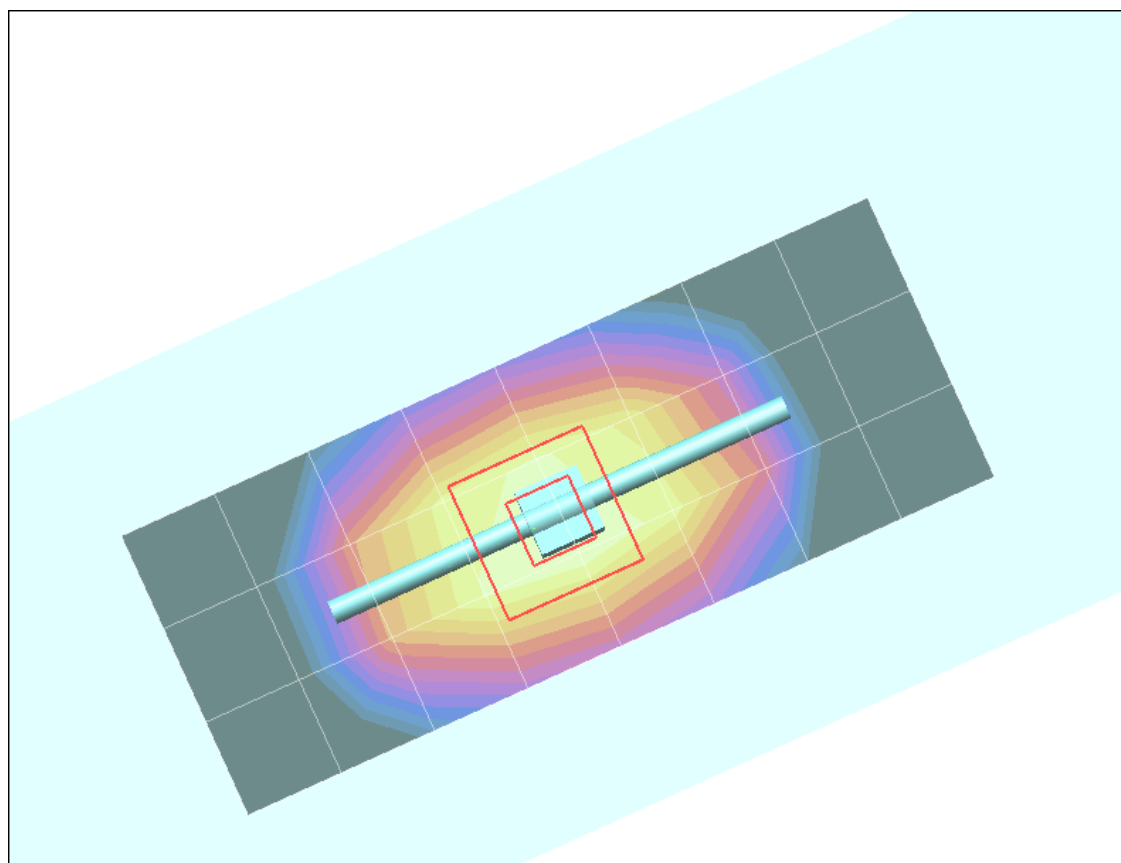
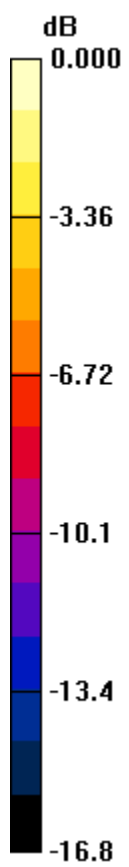
Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 80.0 V/m; Power Drift = -0.026 dB

Peak SAR (extrapolated) = 12.6 W/kg

SAR(1 g) = 7.38 mW/g; SAR(10 g) = 3.96 mW/g

Maximum value of SAR (measured) = 8.30 mW/g



0 dB = 8.30mW/g

Test Laboratory: Motorola 2450 Performance Check

Procedure Notes: 2450 MHz System Performance Check / Dipole Sn# 740 PM1 Power = 200 mW [Sim.Temp@meas](#) = 19.7C Sim.Temp@SPC = 19.9C Room Temp @ SPC = 20.2C
Communication System: CW - Dipole; Frequency: 2450 MHz; Communication System Channel Number: 11; Duty Cycle: 1:1
Medium: VALIDATION Only; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.88$ mho/m; $\epsilon_r = 37.6$; $\rho = 1000$ kg/m³

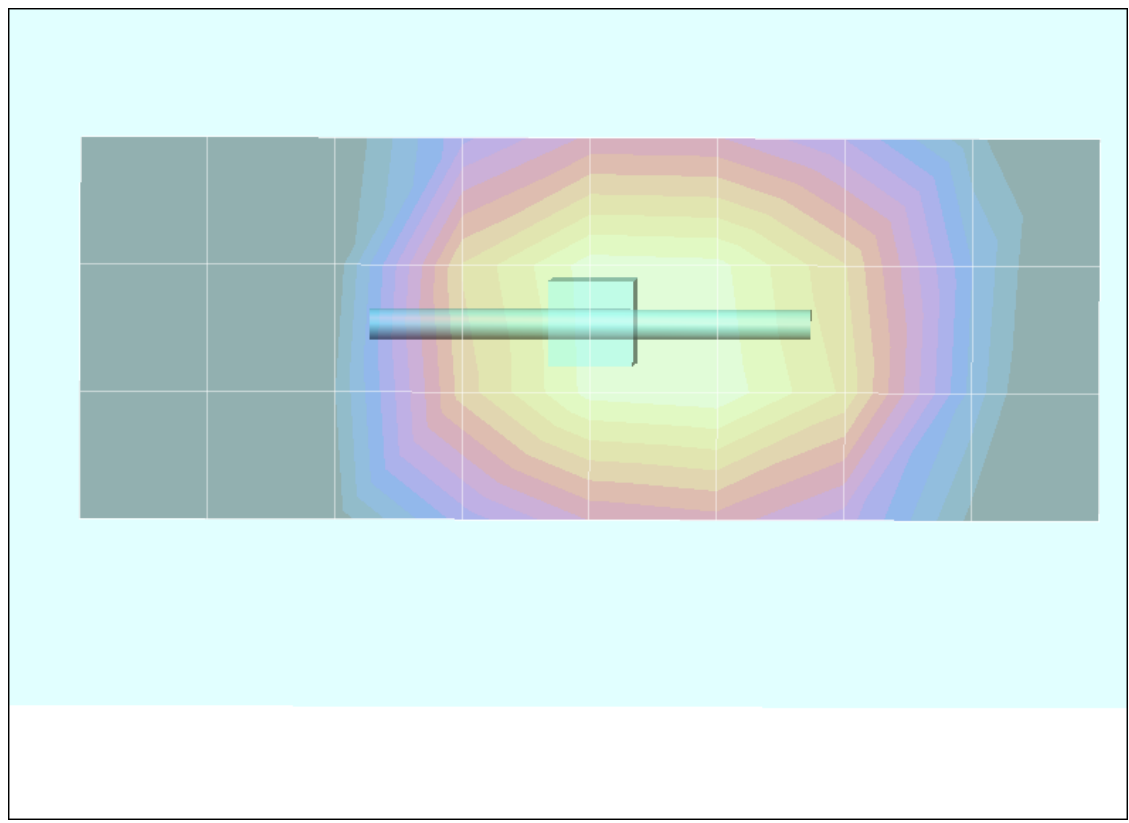
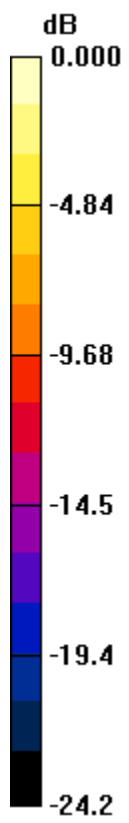
DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(4.44, 4.44, 4.44); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn650; Calibrated: 8/21/2009
- Phantom: R4 : Sect.1, Amy Twin; Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (9x4x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 7.75 mW/g

Daily SPC Check/0-Degree 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 76.9 V/m; Power Drift = -0.002 dB
Peak SAR (extrapolated) = 22.8 W/kg
SAR(1 g) = 10.7 mW/g; SAR(10 g) = 4.82 mW/g
Maximum value of SAR (measured) = 12.2 mW/g

Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 76.9 V/m; Power Drift = -0.002 dB
Peak SAR (extrapolated) = 22.9 W/kg
SAR(1 g) = 10.8 mW/g; SAR(10 g) = 4.9 mW/g
Maximum value of SAR (measured) = 12.3 mW/g

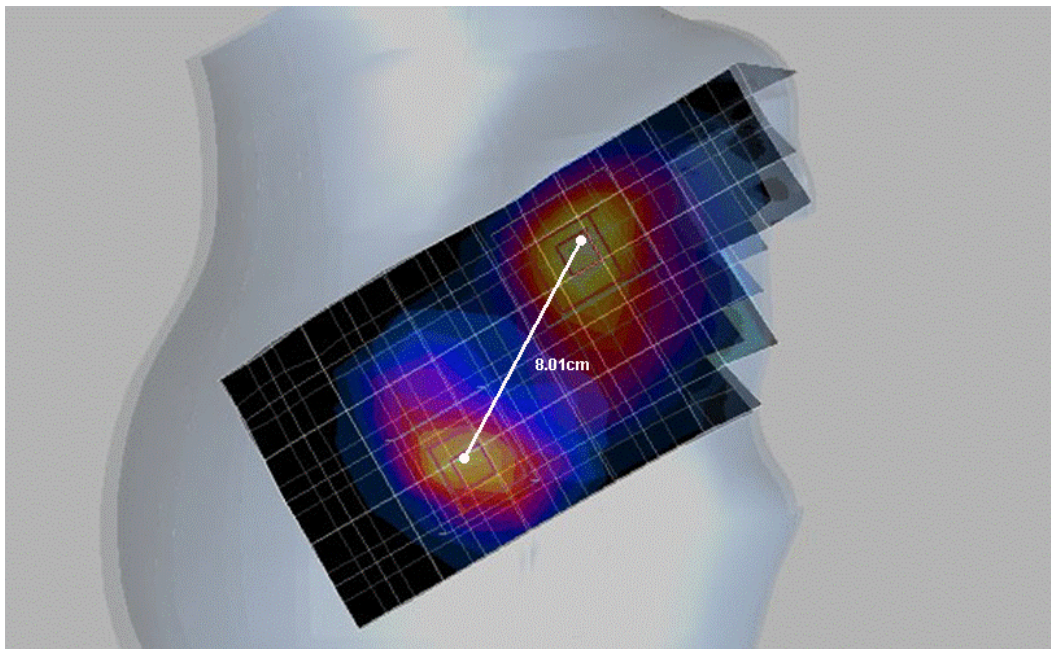


0 dB = 12.3mW/g

Appendix 2

SAR distribution plots for Phantom Head Adjacent Use

The guidelines provided in “SAR for Handsets with Multiple Transmitters” (KDB publication 648474 - D01 v01r03) were utilized for evaluation of the need for simultaneous transmission SAR testing. These guidelines direct that if the SAR-to-peak location separation ratio for the GSM/WCDMA antenna and the Wi-Fi antenna is < 0.3 then SAR evaluation for simultaneous transmission is not required. For GSM1900, the SAR-to-peak location separation ratio is 0.108. And for WCDMA2100, the SAR-to-peak location separation ratio is 0.269. Thus, no testing was performed to determine the aggregate 1 g SAR. SAR plots with the Wi-Fi SAR overlaid upon the GSM/WCDMA SAR are provided below. These summation plots provide visual indication of the separation of the SAR hotspots for each modulation.



GSM 1900 Right Head Cheek SAR overlaid with Wi-Fi Right Head Cheek SAR

Test Laboratory: Motorola GSM 1900 Cheek Touch

Serial: TA007000EX; Procedure Notes: Pwr Step: 00 Antenna Position: INTERNAL Battery Model #: SN5843A DEVICE POSITION: Cheek

Communication System: GSM 1900; Frequency: 1880 MHz; Communication System Channel Number: 661; Duty Cycle: 1:8

Medium: Regular Glycol Head 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.45$ mho/m; $\epsilon_r = 39.3$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(5.14, 5.14, 5.14); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn650; Calibrated: 8/21/2009
- Phantom: R#4 Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1250;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Right Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.623 mW/g

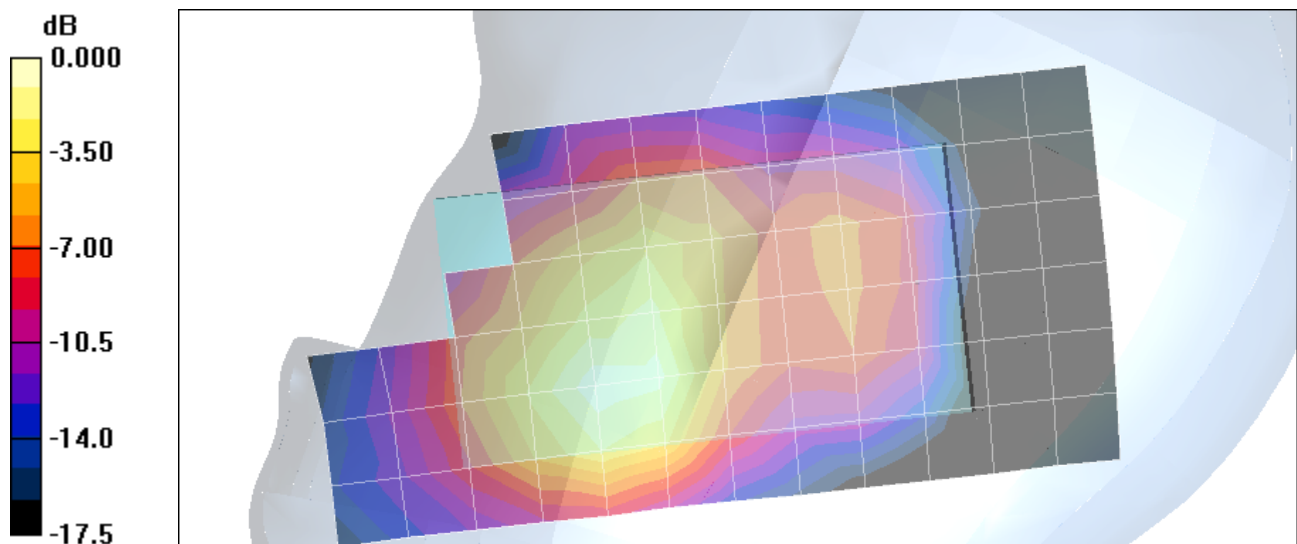
Right Head Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 20.8 V/m; Power Drift = 0.068 dB

Peak SAR (extrapolated) = 0.872 W/kg

SAR(1 g) = 0.610 mW/g; SAR(10 g) = 0.371 mW/g

Maximum value of SAR (measured) = 0.668 mW/g



0 dB = 0.668mW/g%20Ch...

Test Laboratory: Motorola GSM 1900 Tilt

Serial: TA007000EX; Procedure Notes: Pwr Step: 00 Antenna Position: INTERNAL Battery Model #: SN5843A DEVICE POSITION: TILTED

Communication System: GSM 1900; Frequency: 1880 MHz; Communication System Channel Number: 661; Duty Cycle: 1:8

Medium: Regular Glycol Head 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.44$ mho/m; $\epsilon_r = 38.5$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(5.14, 5.14, 5.14); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn650; Calibrated: 8/21/2009
- Phantom: R#4 Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1250;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Left Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.372 mW/g

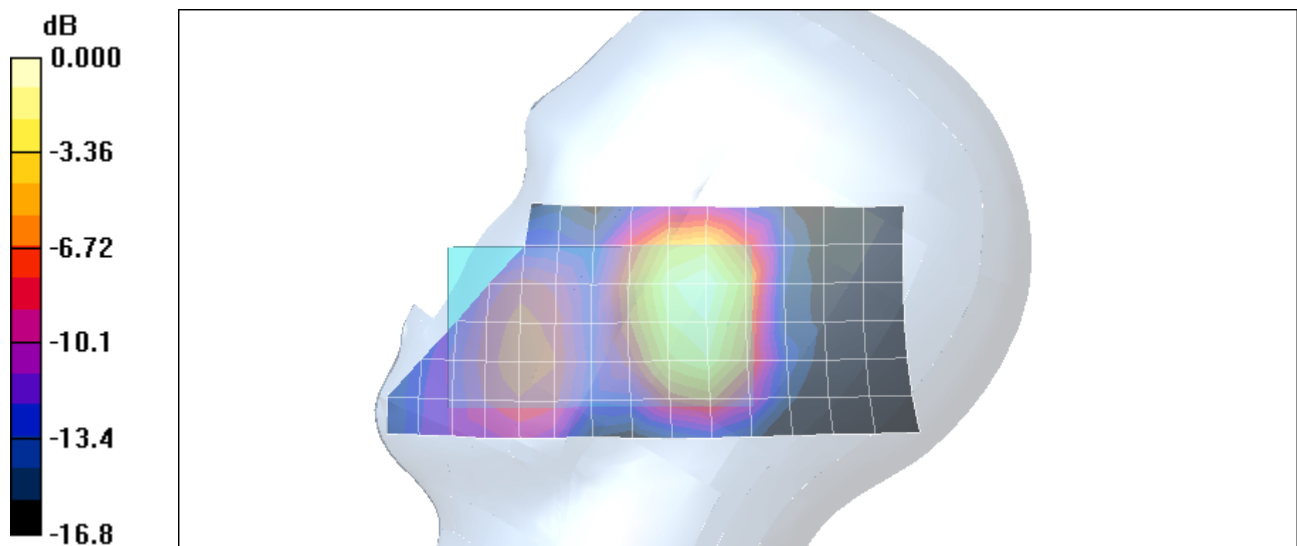
Left Head Template/5x5x7 Zoom Scan (≤ 3 GHz) (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 15.3 V/m; Power Drift = 0.013 dB

Peak SAR (extrapolated) = 0.495 W/kg

SAR(1 g) = 0.344 mW/g; SAR(10 g) = 0.210 mW/g

Maximum value of SAR (measured) = 0.367 mW/g



0 dB = 0.367mW/g.htm

Test Laboratory: Motorola WiFi Cheek

354636030004918;

Procedure Notes: Pwr Step: Test Mode(20dBm)_1Mbps Antenna Position: Internal Accessory Model #:

N/A Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Cheek

Communication System: Wi-Fi 2450; Frequency: 2437 MHz; Communication System Channel Number: 6;
Duty Cycle: 1:1

Medium: 2450 Glycol Head; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.89$ mho/m; $\epsilon_r = 37.1$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3191; ConvF(4.57, 4.57, 4.57); Calibrated: 11/7/2008
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn365; Calibrated: 8/21/2009
- Phantom: PCS-9_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1134;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Right Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.527 mW/g

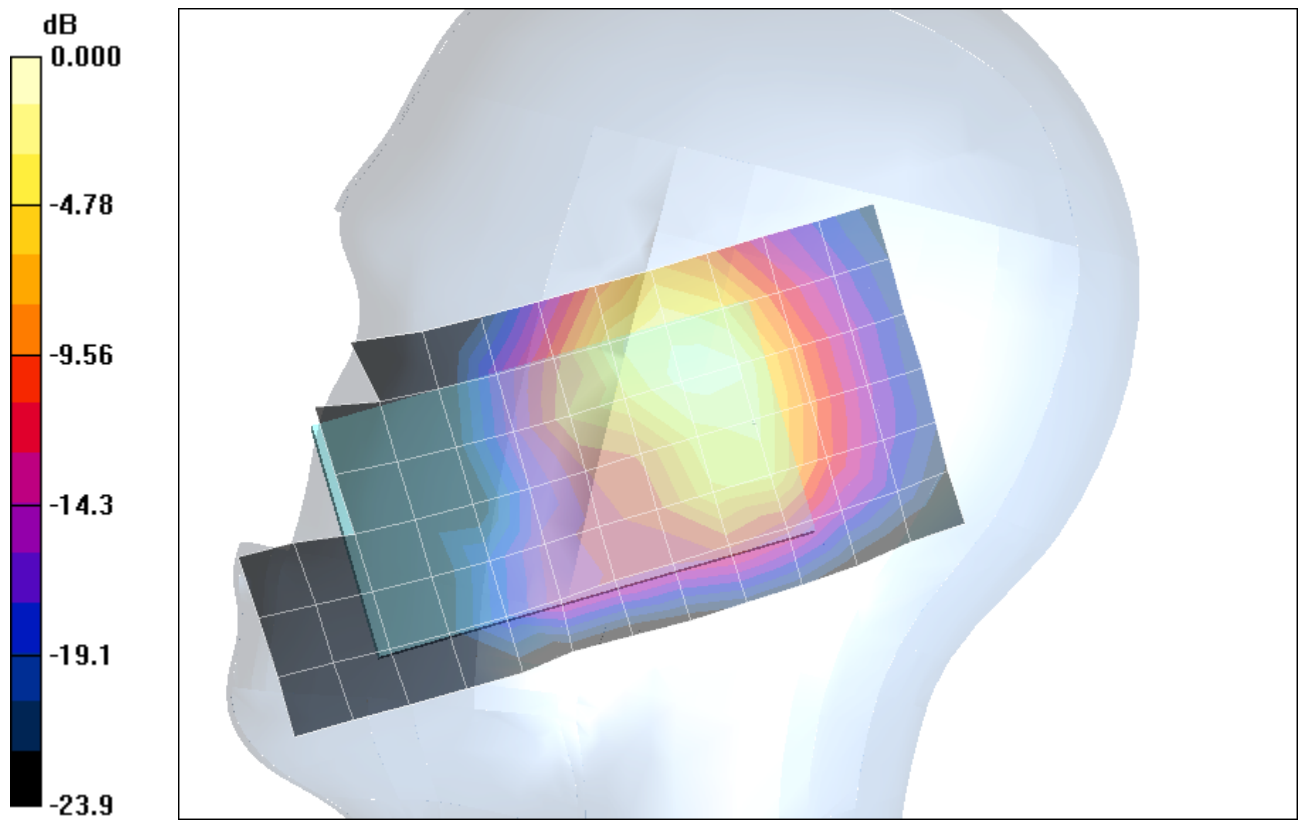
Right Head Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.0 V/m; Power Drift = -0.046 dB

Peak SAR (extrapolated) = 1.27 W/kg

SAR(1 g) = 0.614 mW/g; SAR(10 g) = 0.294 mW/g

Maximum value of SAR (measured) = 0.675 mW/g



0 dB = 0.675mW/g

Test Laboratory: Motorola WiFi Tilted

354636030004918;

Procedure Notes: Pwr Step: Test Mode(20dBm); Antenna Position: Internal

Battery Model #: SNN5843A; DEVICE POSITION (cheek or rotated): Rotated

Communication System: Wi-Fi 2450; Frequency: 2437 MHz; Channel Number: 6; Duty Cycle: 1:1

Medium: 2450 Glycol Head; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.89$ mho/m; $\epsilon_r = 37.1$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3191; ConvF(4.57, 4.57, 4.57); Calibrated: 11/7/2008
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn365; Calibrated: 8/21/2009
- Phantom: PCS-9_Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1134;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Left Head Template/Area Scan - Normal (15mm) (7x17x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.493 mW/g

Left Head Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

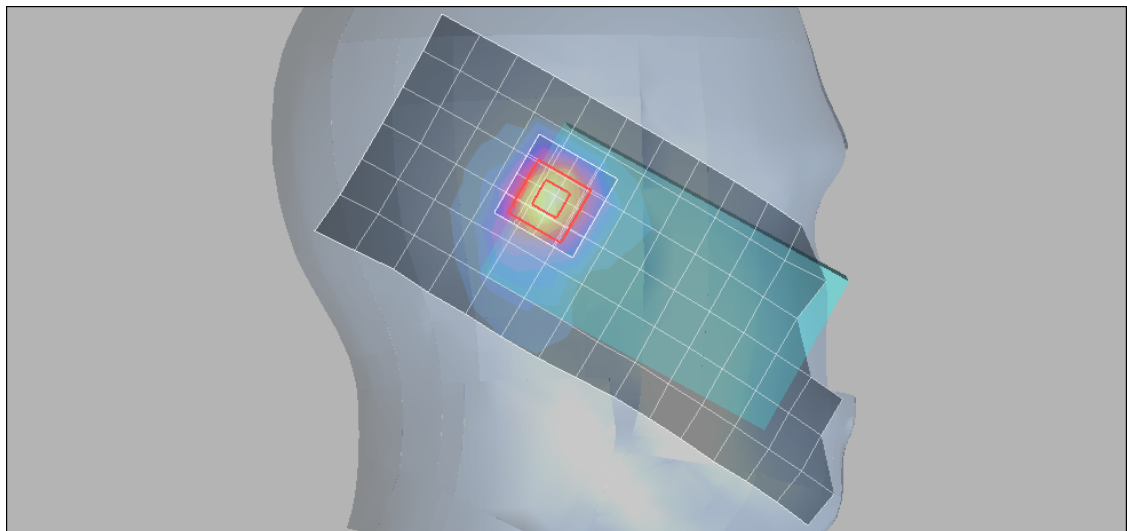
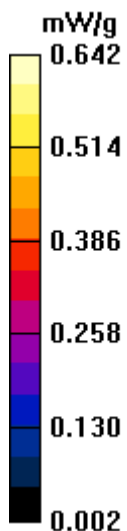
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 18.5 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 1.14 W/kg

SAR(1 g) = 0.571 mW/g; SAR(10 g) = 0.272 mW/g

Maximum value of SAR (measured) = 0.642 mW/g



Appendix 3

SAR distribution plots for Body Worn Configuration

Test Laboratory: Motorola GSM 1900 Body Worn

Serial: TA007000EX; Procedure Notes: Pwr Step: 0 Antenna Position: Internal Battery Model #: SNN5843A Back of Phone 15mm from Flat Phantom Simulate Temp when Measured:

20.4C Simulate Temp after Test: 20.6C

Communication System: GSM 1900; Frequency: 1880 MHz; Communication System

Channel Number: 661; Duty Cycle: 1:8

Medium: Regular Glycol Body 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.59$ mho/m; $\epsilon_r = 52.7$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(4.84, 4.84, 4.84); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn650; Calibrated: 8/21/2009
- Phantom: R4 : Sect.1, Amy Twin; Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Extended Body (15mm) (16x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.373 mW/g

Amy Twin Phone Template/5x5x7 Zoom Scan (≤ 3 GHz) (5x5x7)/Cube 0: Measurement grid:

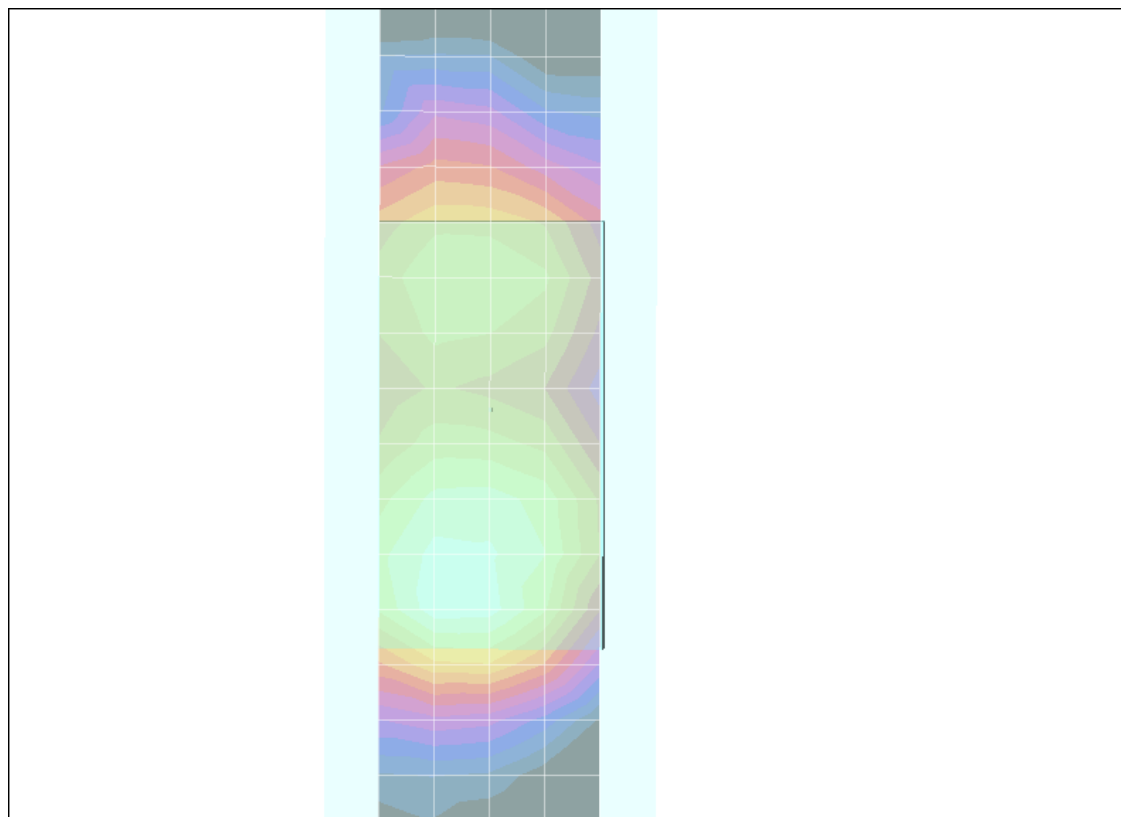
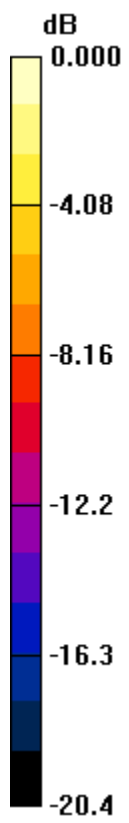
dx=8mm, dy=8mm, dz=5mm

Reference Value = 15.6 V/m; Power Drift = -0.013 dB

Peak SAR (extrapolated) = 0.584 W/kg

SAR(1 g) = 0.381 mW/g; SAR(10 g) = 0.235 mW/g

Maximum value of SAR (measured) = 0.418 mW/g..



0 dB = 0.418mW/g...

Test Laboratory: Motorola Bluetooth2450 BodyWorn

354636030004918;

Procedure Notes: Pwr Step: Test Mode(OTA) Antenna Position: Internal

Battery Model #: SNN5843A; Device Position: Front part of phone 15mm away from the flat phantom

Communication System: Bluetooth; Frequency: 2441 MHz; Channel Number: 39; Duty Cycle: 1:1

Medium: 2450 Glycol Body; Medium parameters used: $f = 2450$ MHz; $\sigma = 2.04$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3191; ConvF(4.08, 4.08, 4.08); Calibrated: 11/7/2008
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn365; Calibrated: 8/21/2009
- Phantom: R#9_Section 2, Amy Twin, Rev2 (23-June-04); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Body (15mm) (13x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.000 mW/g

Amy Twin Phone Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

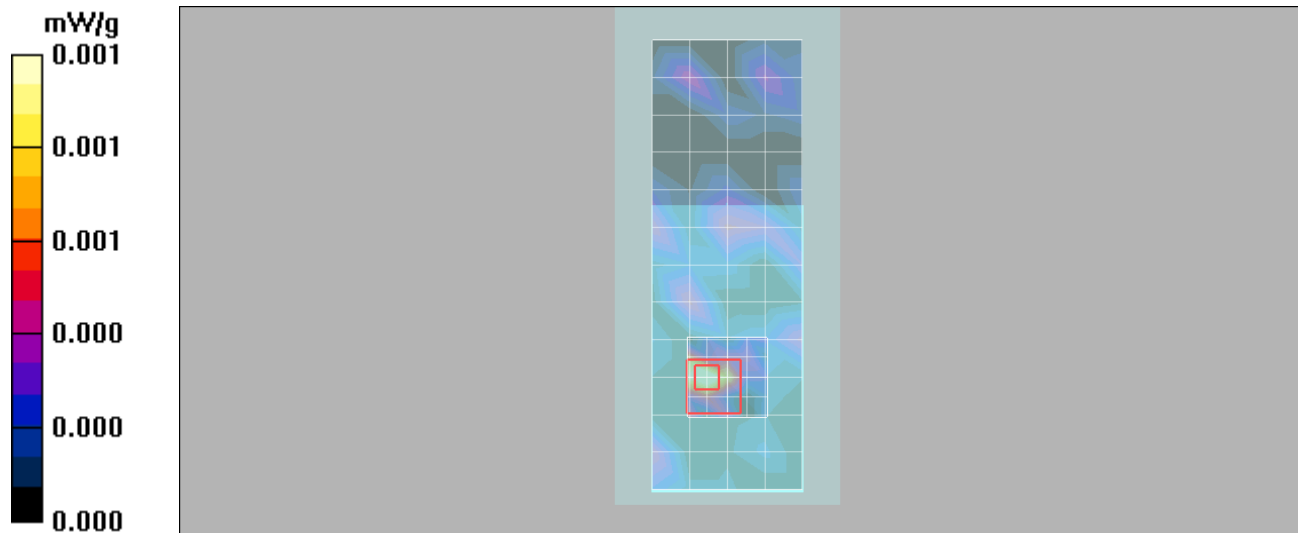
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 0.342 V/m; Power Drift = 2.21 dB

Peak SAR (extrapolated) = 0.001 W/kg

SAR(1 g) = 4.19e-005 mW/g; SAR(10 g) = 6.22e-006 mW/g

Maximum value of SAR (measured) = 0.001 mW/g



Test Laboratory: Motorola WiFi BodyWorn

354636030004918;

Procedure Notes: Pwr Step: 20dBm; Antenna Position: Internal

Battery Model #: SNN5843A; Device Position: Front of phone 15mm away from the flat phantom

Communication System: Wi-Fi 2450; Frequency: 2437 MHz; Channel Number: 6; Duty Cycle: 1:1

Medium: 2450 Glycol Body; Medium parameters used: $f = 2450$ MHz; $\sigma = 2.04$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3191; ConvF(4.08, 4.08, 4.08); Calibrated: 11/7/2008
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn365; Calibrated: 8/21/2009
- Phantom: R#9_Section 2, Amy Twin, Rev2 (23-June-04); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Body (15mm) (13x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.133 mW/g

Amy Twin Phone Template/5x5x7 Zoom Scan (≤ 3 GHz) (5x5x7)/Cube 0:

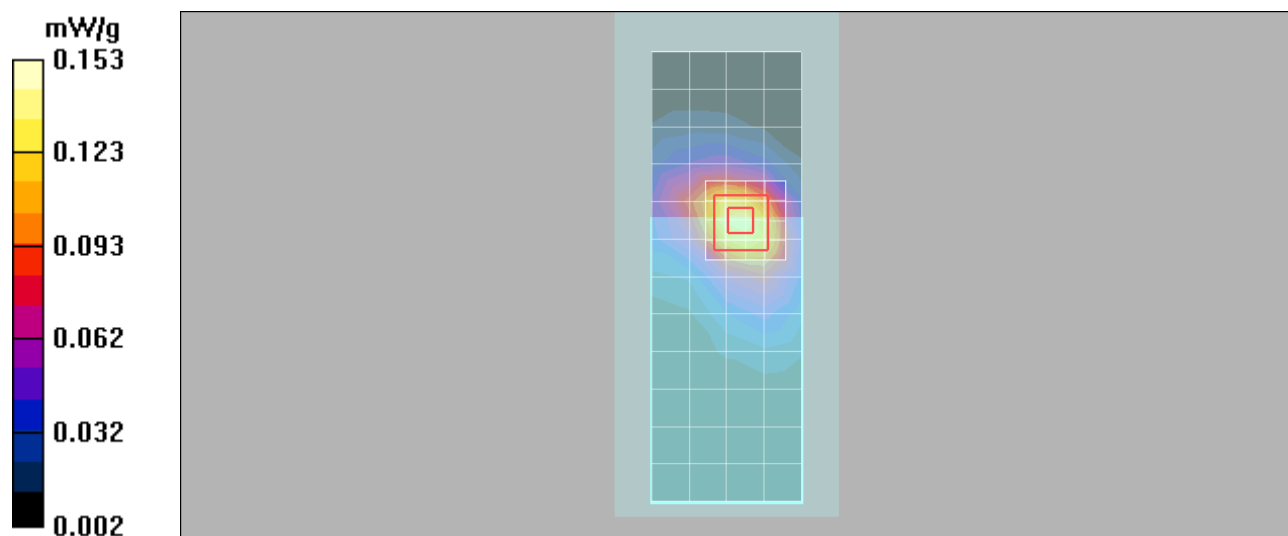
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.58 V/m; Power Drift = -0.067 dB

Peak SAR (extrapolated) = 0.244 W/kg

SAR(1 g) = 0.140 mW/g; SAR(10 g) = 0.079 mW/g

Maximum value of SAR (measured) = 0.153 mW/g



Appendix 4
Probe Calibration Certificate



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Client **Motorola MDB**

Certificate No: **ES3-3184_Sep09**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3184**

Calibration procedure(s) **QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25.v2
 Calibration procedure for dosimetric E-field probes**

Calibration date: **September 18, 2009**

Condition of the calibrated item **In Tolerance**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator	SN: S5129 (30b)	31-Mar-09 (No. 217-01027)	Mar-10
Reference Probe ES3DV2	SN: 3013	2-Jan-09 (No. ES3-3013_Jan09)	Jan-10
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

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

Issued: September 21, 2009

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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3184

Manufactured:	August 19, 2008
Last calibrated:	September 22, 2008
Recalibrated:	September 18, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV3 SN:3184

Sensitivity in Free Space^A

NormX	1.28 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.36 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.27 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression^B

DCP X	91 mV
DCP Y	92 mV
DCP Z	95 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL **835 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SAR _{be} [%]	Without Correction Algorithm	11.1	7.3
SAR _{be} [%]	With Correction Algorithm	0.8	0.5

TSL **1810 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SAR _{be} [%]	Without Correction Algorithm	12.1	8.3
SAR _{be} [%]	With Correction Algorithm	0.8	0.4

Sensor Offset

Probe Tip to Sensor Center **2.0 mm**

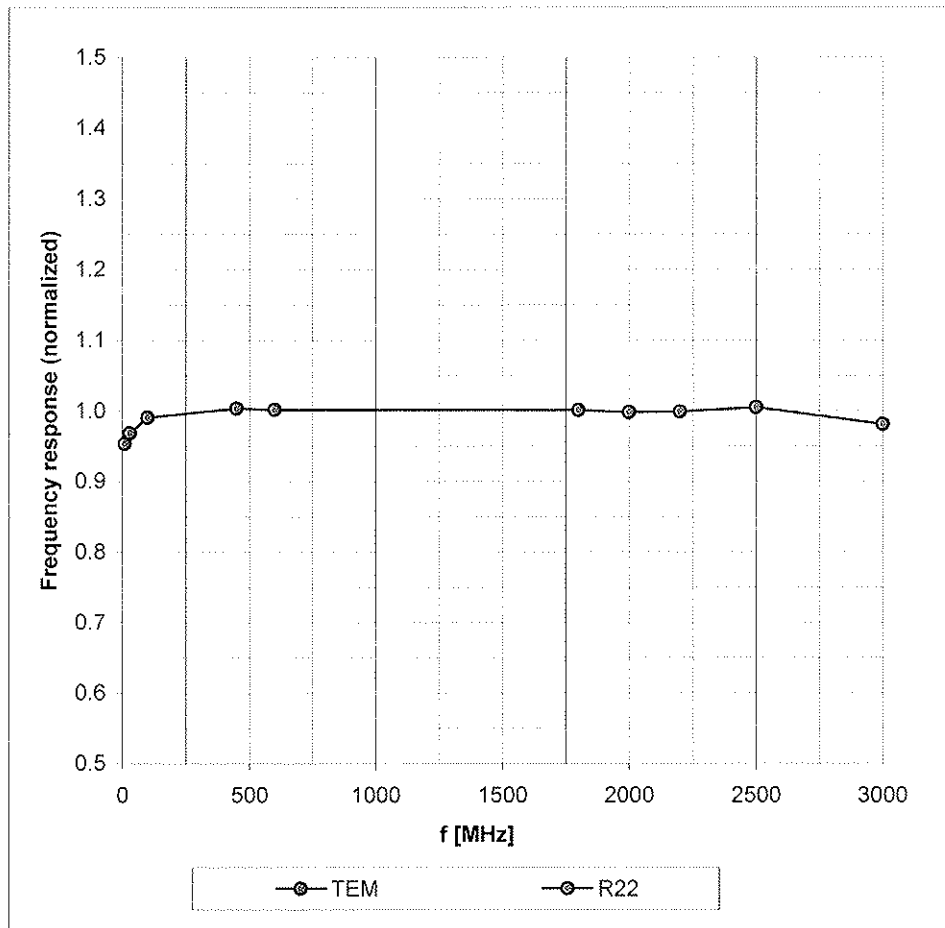
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

^B Numerical linearization parameter: uncertainty not required.

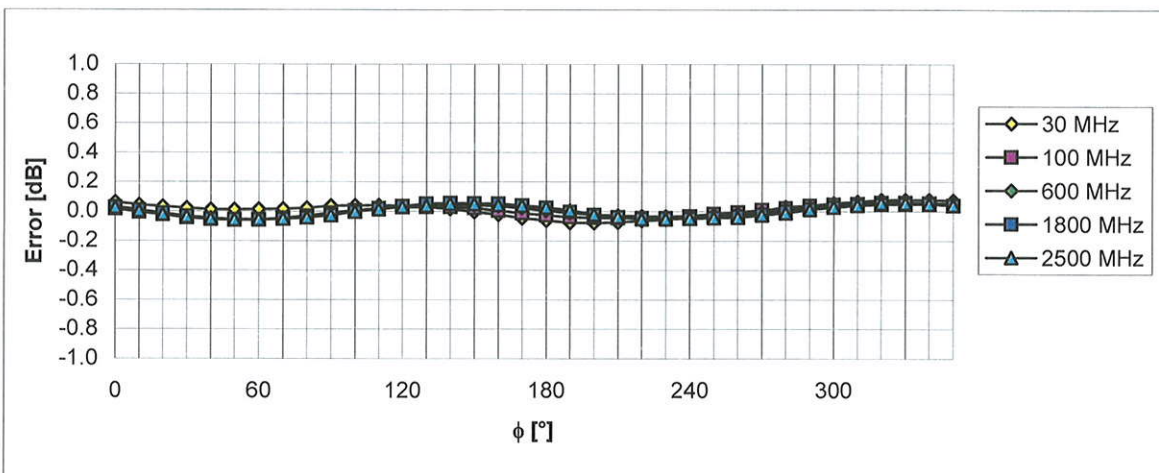
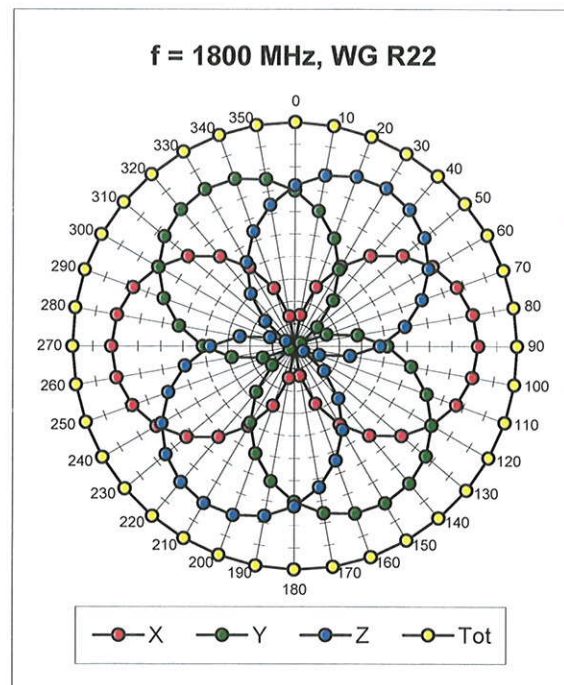
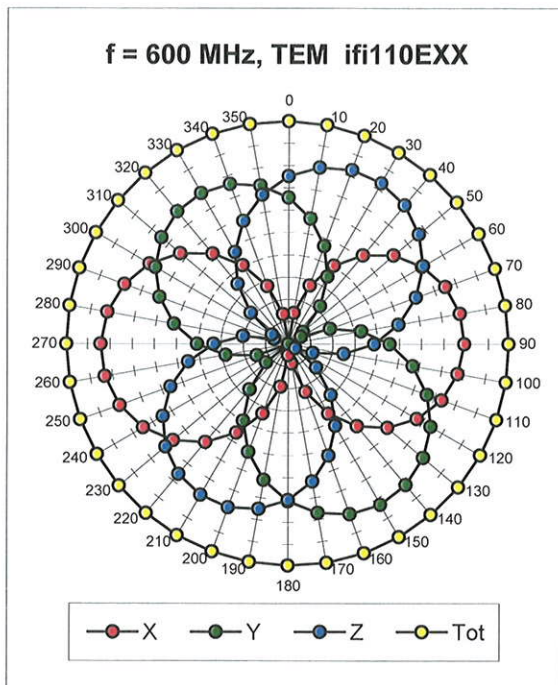
Frequency Response of E-Field

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



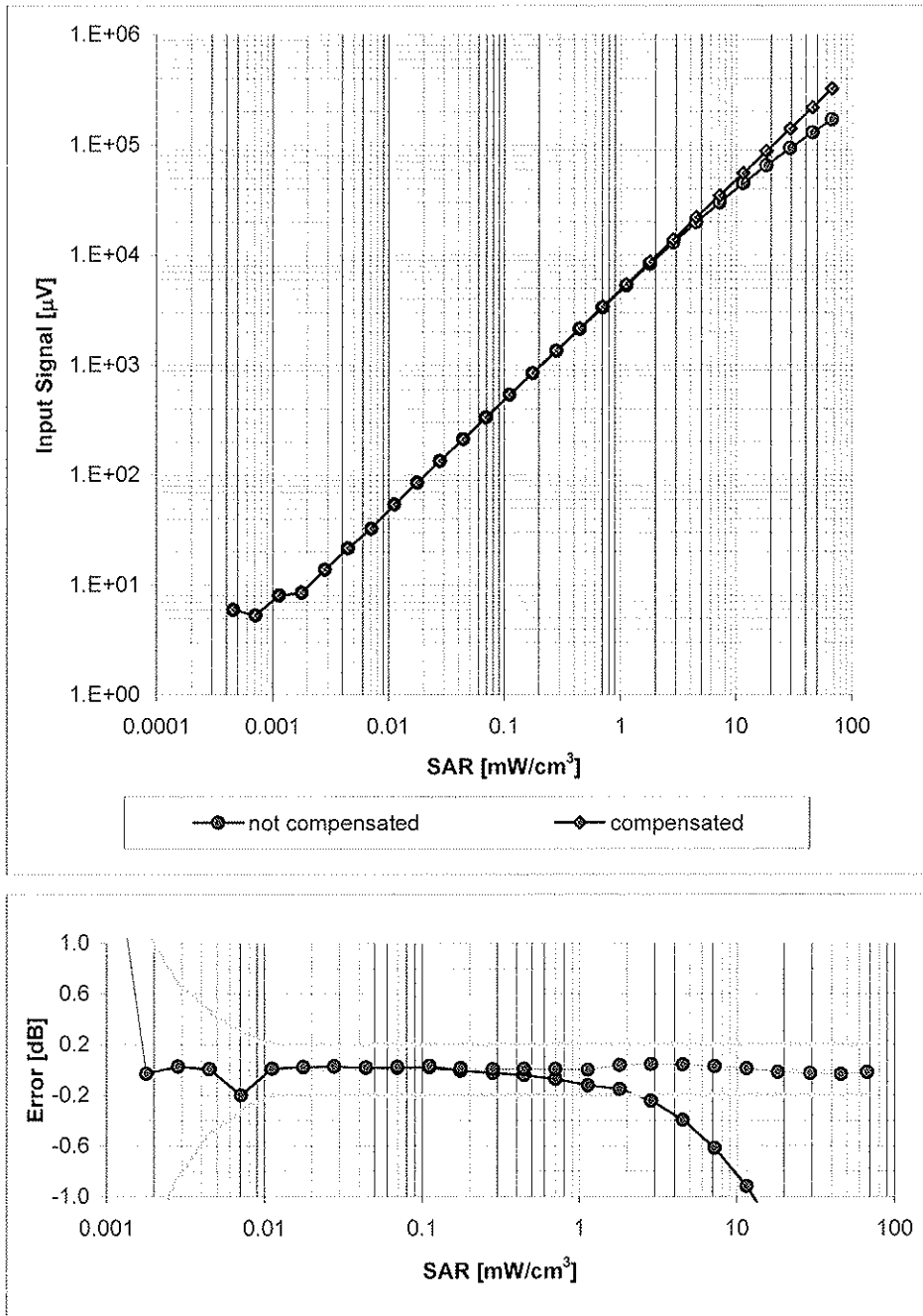
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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



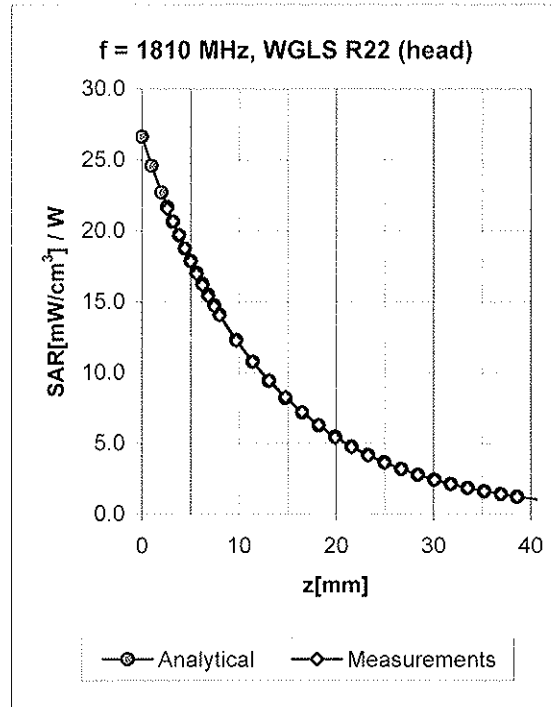
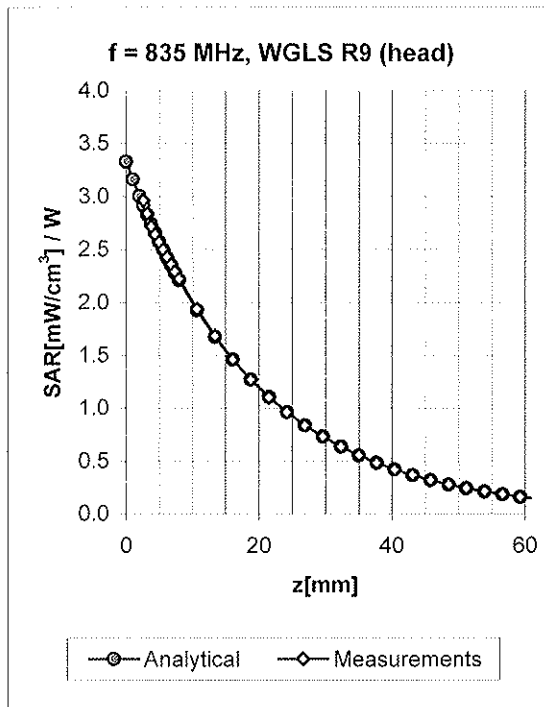
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (Waveguide R22, $f = 1800 \text{ MHz}$)



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

Conversion Factor Assessment

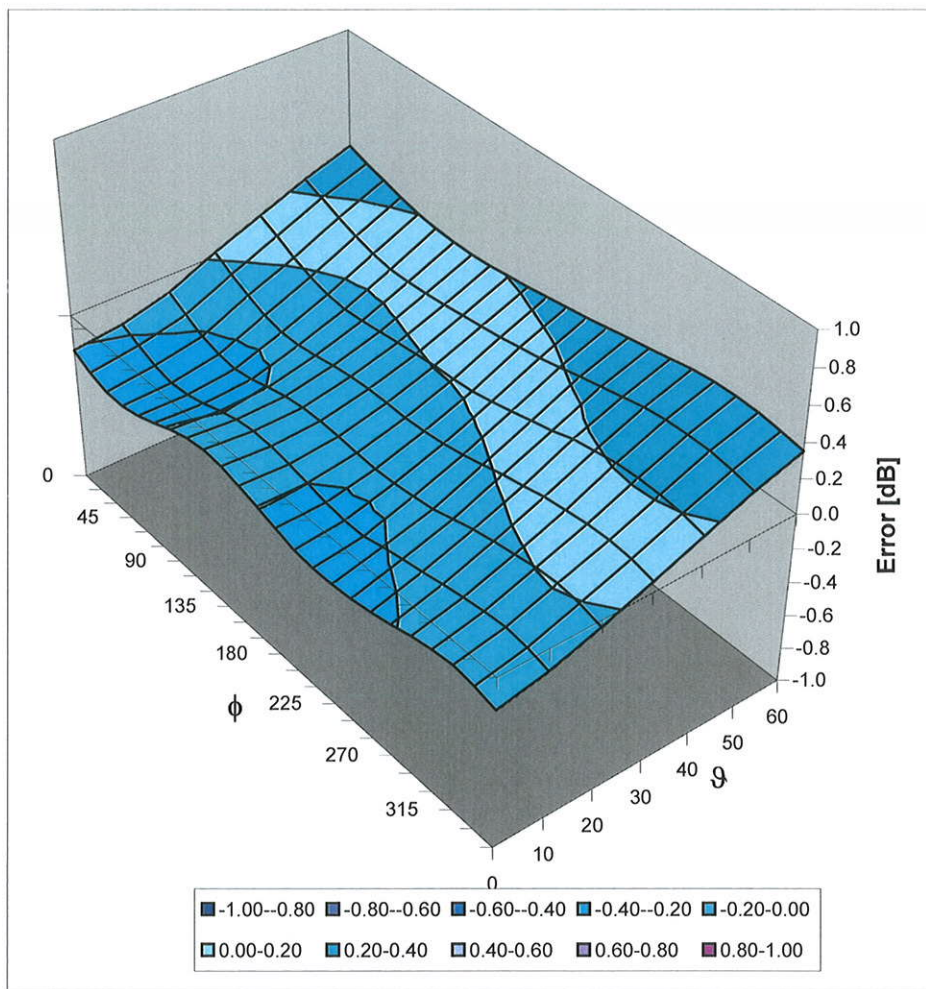


f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	0.27	2.21	6.26 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.26	2.94	5.14 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.23	3.55	4.94 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.34	2.33	4.44 ± 11.0% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.32	1.92	6.08 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.37	2.02	4.84 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.30	2.95	4.81 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.99	1.20	4.28 ± 11.0% (k=2)

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (ϕ , ϑ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client

Motorola Korea

Certificate No.: **ES3-3191-Nov08**

CALIBRATION CERTIFICATE

Object

ES3DV3 - SN:3191

Calibration procedure(s)

**QA CAL-01.v6 and QA CAL-23.v3
Calibration procedure for dosimetric E-field probes**

Calibration date:

November 7, 2008

Condition of the calibrated item

In Tolerance

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-08 (No. 217-00788)	Apr-09
Power sensor E4412A	MY41495277	1-Apr-08 (No. 217-00788)	Apr-09
Power sensor E4412A	MY41498087	1-Apr-08 (No. 217-00788)	Apr-09
Reference 3 dB Attenuator	SN: S5054 (3c)	1-Jul-08 (No. 217-00865)	Jul-09
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-08 (No. 217-00787)	Apr-09
Reference 30 dB Attenuator	SN: S5129 (30b)	1-Jul-08 (No. 217-00866)	Jul-09
Reference Probe ES3DV2	SN: 3013	2-Jan-08 (No. ES3-3013_Jan08)	Jan-09
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: November 11, 2008

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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}:** Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}:** DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters:** Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy):** in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset:** The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3191

Manufactured:	June 16, 2008
Calibrated:	November 7, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV3 SN:3191

Sensitivity in Free Space^A

Diode Compression^B

NormX	1.25 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	83 mV
NormY	1.34 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	84 mV
NormZ	1.32 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	81 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SAR _{be} [%]	Without Correction Algorithm	12.0	7.5
SAR _{be} [%]	With Correction Algorithm	0.7	0.3

TSL **1810 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SAR _{be} [%]	Without Correction Algorithm	9.4	6.0
SAR _{be} [%]	With Correction Algorithm	0.8	0.3

Sensor Offset

Probe Tip to Sensor Center **2.0 mm**

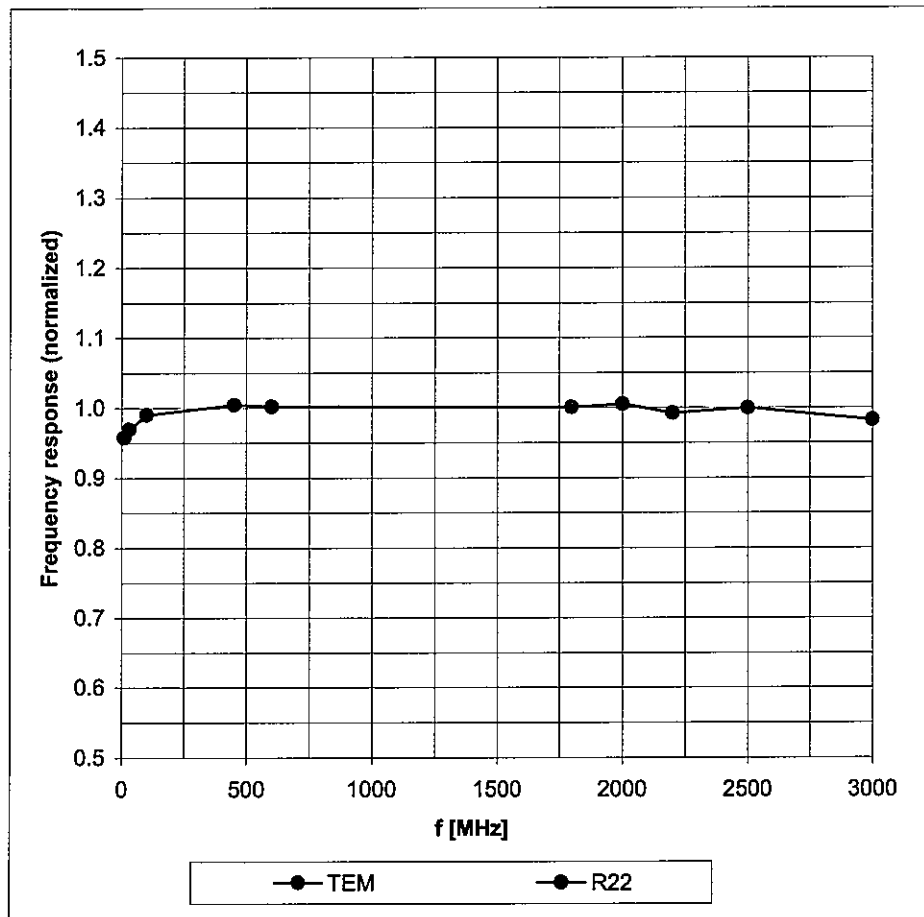
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

^B Numerical linearization parameter: uncertainty not required.

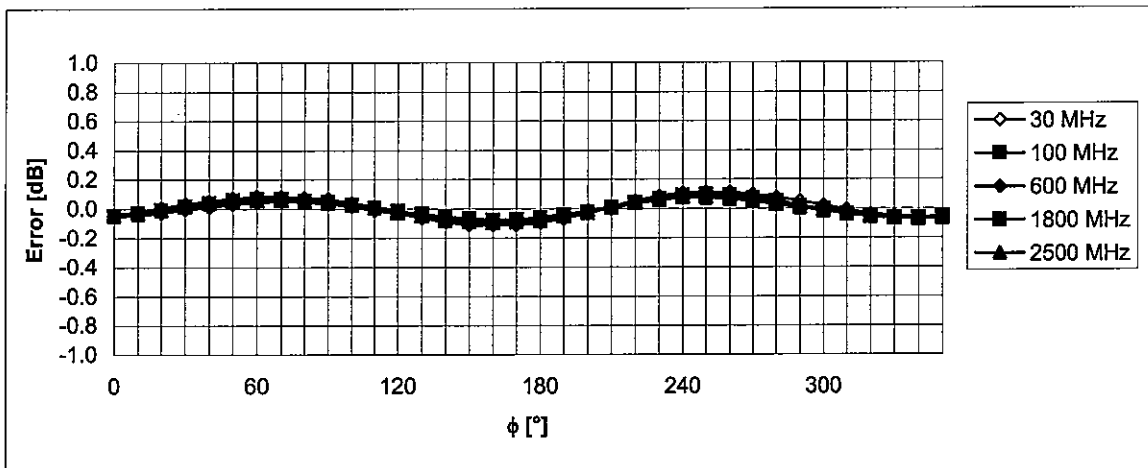
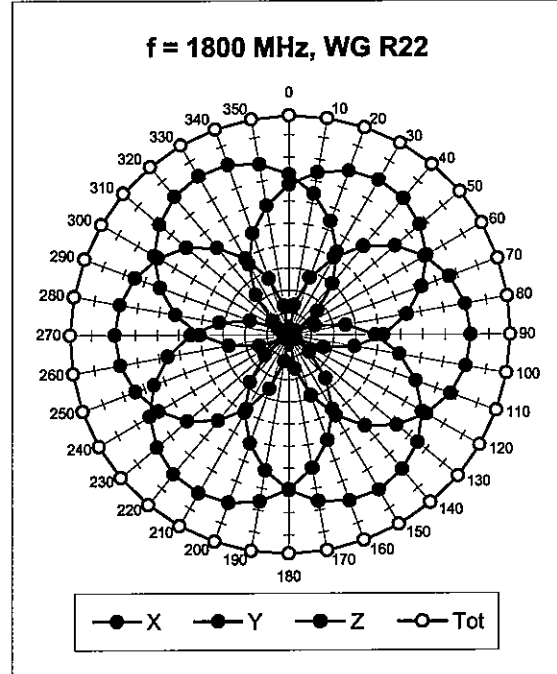
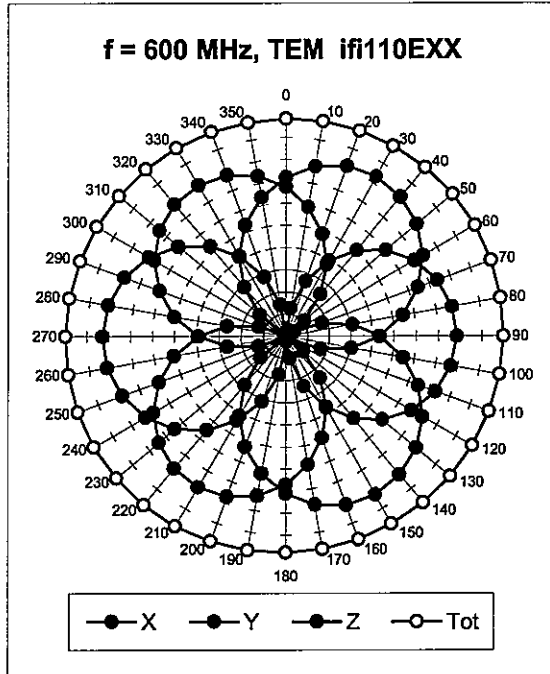
Frequency Response of E-Field

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



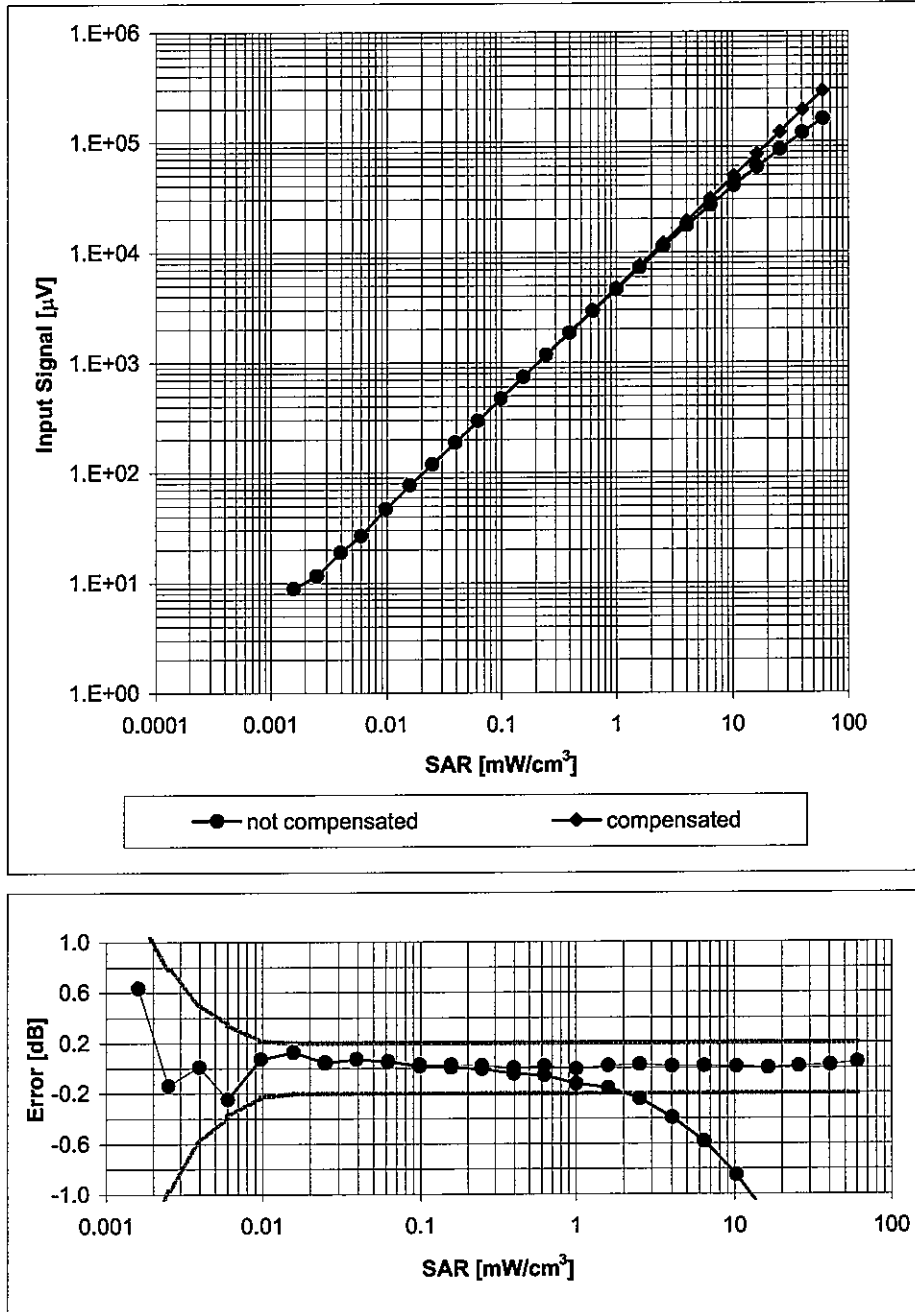
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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



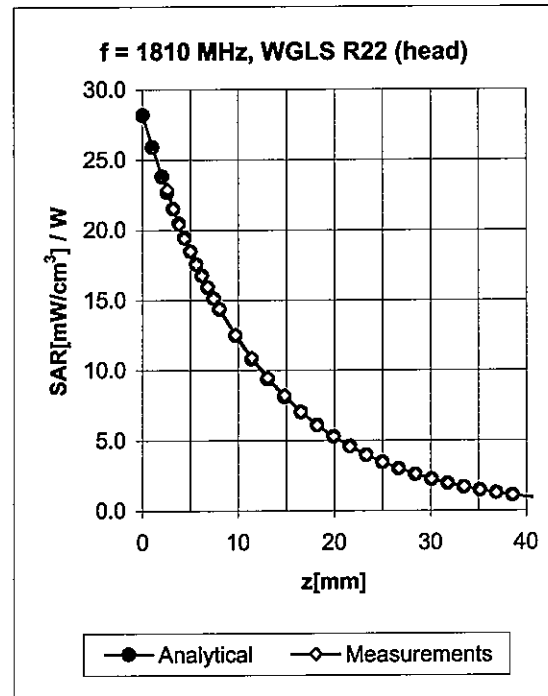
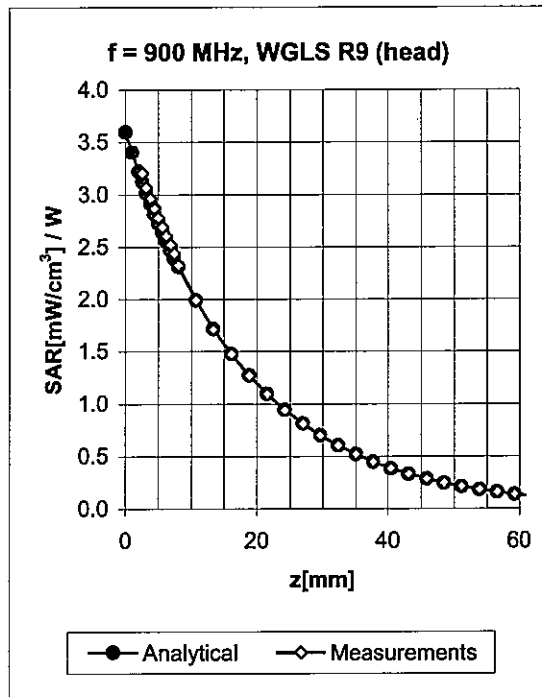
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range $f(\text{SAR}_{\text{head}})$
(Waveguide R22, $f = 1800 \text{ MHz}$)



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

Conversion Factor Assessment

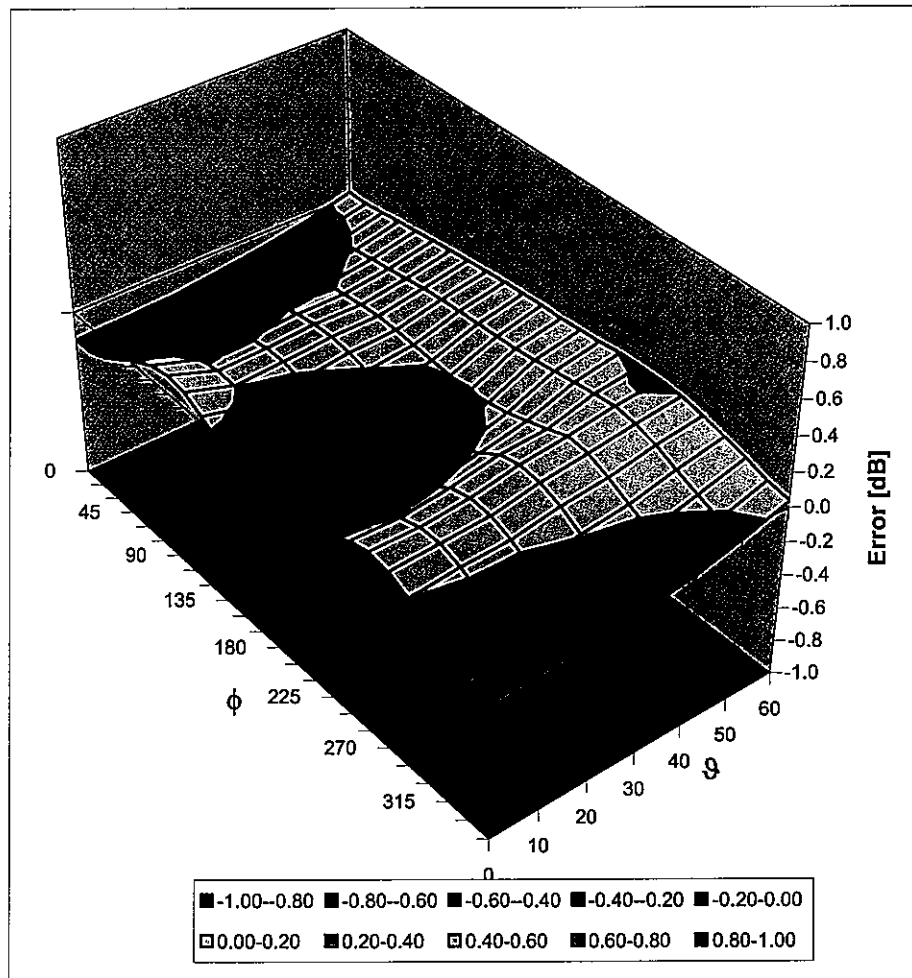


f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.46	1.50	6.03 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.70	1.33	5.19 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.63	1.43	4.97 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.61	1.55	4.57 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.88	1.25	6.01 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.32	2.12	4.85 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.30	2.41	4.77 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.49	1.66	4.08 ± 11.0% (k=2)

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (ϕ , ϑ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

Appendix 5
Measurement Uncertainty Budget

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h = c x f / e</i>	<i>i = c x g / e</i>	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob Dist	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>u_i</i> (±%)	10 g <i>u_i</i> (±%)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	5.9	N	1.00	1	1	5.9	5.9	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11.1	10.8	411
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				22.2	21.6	

Appendix 6

Dipole Characterization Certificate

Certification of System Performance Check Targets

FCD-1806, rev-1

-Historical Data-

	1800 MHz	
Reference Target:	38.4	(W/kg)
Measurement Uncertainty (k=1):	9.0%	
Measurement Period:	15April08 - 26March09	
# of tests performed:	929	
Grand Average:	37.91	(W/kg)
% Delta (Average - Reference Target)	-1.3%	
Is % Delta <= Expanded Measurement Uncertainty (k=2)?	Yes	
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT	
	<u>Applies to Dipole SN's:</u> 246tr, 250tr, 251tr, 259tr, 263tr, 271tr, 272tr, 276tr, 277tr, 279tr, 280tr, 281tr, 283tr, 284tr, 2d128, 2d129	

-New System Performance Check Targets- per WI-0396

(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity Target +/- %	Conductivity (S/m) Target +/- %
1800 MHz	37.91	40.0 +/- 5%	1.40 +/- 5%

-Approvals-

Submitted by:

Marge Kaunas

Date:

1-Apr-09

Signed:

Marge Kaunas

Comments:

Data file available upon request.

Approved by:

Steve Hauswirth

Date:

1-Apr-09

Signed:

Steve Hauswirth

Comments:

=====

Certification of System Performance Check Targets

FCD-1806, rev-1

-Historical Data-

	2450 MHz	
Reference Target:	52.4	(W/kg)
Measurement Uncertainty (k=1):	9.0%	
Measurement Period:	15April08 - 26March09	
# of tests performed:	150	
Grand Average:	56.68	(W/kg)
% Delta (Average - Reference Target)	8.2%	
Is % Delta <= Expanded Measurement Uncertainty (k=2)?	Yes	
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT	
	Applies to Dipole SN's:	
	740, 766, 767, 788, 789	

-New System Performance Check Targets- per WI-0396

(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity Target +/- %	Conductivity (S/m) Target +/- %
2450 MHz	56.68	39.2 +/- 10%	1.80 +/- 5%

-Approvals-

Submitted by: Marge Kaunas Date: 1-Apr-09

Signed: Marge Kaunas

Comments: Data file available upon request.

Approved by: Steve Hauswirth Date: 1-Apr-09

Signed: Steve Hauswirth

Comments:

END OF REPORT