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Report On

Specific Absorption Rate Testing of the
Sharp 205SH AXGP & Quad-band WCDMA (FDD I/FDD V/FDD VIII/FDD XI) Dual-mode Cellular Phone with Bluetooth, WLAN, Felica and GPS

FCC ID: APYHRO00193

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REPORT ON

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May 2013

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SECTION 1

REPORT SUMMARY

Specific Absorption Rate Testing of the
Sharp 204SH AXGP & Quad-band WCDMA (FDD I/FDD V/FDD VIII/FDD XI) Dual-mode
Cellular Phone with Bluetooth, WLAN, Felica and GPS

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Specific Absorption Rate Testing of the Sharp 205SH AXGP & Quad-band WCDMA (FDD I/FDD V/FDD VIII/FDD XI) Dual-mode Cellular Phone with Bluetooth, WLAN, Felica and GPSto the requirements of OET Bulletin 65 Supplement C Edition 01-01.

Objective	To perform Specific Absorption Rate Testing to determine the Equipment Under Test's (EUT's) compliance with the requirements specified of OET Bulletin 65 Supplement C Edition 01-01, for the series of tests carried out.
Applicant	Sharp Communication Compliance Ltd
Manufacturer	Sharp Corporation
Manufacturing Description	Mobile Handset
Model Number	205SH
Power Class	WCDMA FDDV Class 3
Serial/IMEI Number(s)	004401114778976 004401114778950
Number of Samples Tested	2
Hardware Version	PP1
Software Version	A4040 / F3282
Battery Cell Manufacturer	Sharp Corporation
Battery Model Number	Integral Battery; Non Removable
Test Specification/Issue/Date	OET Bulletin 65 Supplement C Edition 01-01
Start of Test	17 April 2013
Finish of Test	30 April 2013
Related Document(s)	FCC 47CFR 2.1093: 2012 KDB 447498 – D01 v05 KDB 248227 - v01r02 (Rev 1.2) KDB 865664 – D01 v01 KDB 865664 – D02 v01 KDB 648474 – D04 v01 KDB 941225 - D01 v02 KDB 941225 – D06 v01 KDB 941225 – D02 v02r01 IEEE 1528-2003
Name of Engineer(s)	Nigel Grigsby Michael Mawby

1.2 BRIEF SUMMARY OF RESULTS

The measurements shown in this report were made in accordance with the procedures specified OET 65(C) – 2001.

The maximum 1g volume averaged SAR found during this Assessment

Max 1g SAR (W/kg) Body	0.346 (Measured)	0.384 (Scaled)
Max 1g SAR (W/kg) Head	0.381 (Measured)	0.486 (Scaled)
The maximum 1g volume averaged SAR level measured for all the tests performed did not exceed the limits for General Population/Uncontrolled Exposure (W/kg) Partial Body of 1.6 W/kg. Level defined in Supplement C (Edition 01-01) to OET Bulletin 65 (97-01).		

1.3 TEST RESULTS SUMMARY

1.3.1 System Performance / Validation Check Results

Prior to formal testing being performed a System Check was performed in accordance with OET 65(C) – 2001 and the results were compared against published data in Standard IEEE 1528-2003. The following results were obtained: -

System performance / Validation results

Date	Dipole Used	Frequency (MHz)	Max 1g SAR (W/kg)*	Percentage Drift on Reference
18/04/2013	835	835	9.88	3.31%
22/04/2013	835	835	9.74	1.86%
17/04/2013	2450	2450	50.34	-3.92%
22/04/2013	2450	2450	50.67	-3.29%
29/04/2013	5200	5200	88.12	0.00%
29/04/2013	5500	5500	95.99	0.00%

*Normalised to a forward power of 1W

1.3.2 Results Summary Tables

WCDMA FDDV Head Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH Corporation Sharp Quad-band WCDMA (FDD I / FDD V / FDD VIII / FDD XI) Cellular Phone with Bluetooth, WLAN and GPS.

Test Position	Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Left Cheek	4133	826.6	23.75	24.2	0.236	0.262	Figure 8
Left 15°	4133	826.6	23.75	24.2	0.183	0.203	Figure 9
Right Cheek	4133	826.6	23.75	24.2	0.289	0.321	Figure 10
Right 15°	4133	826.6	23.75	24.2	0.204	0.224	Figure 11
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is: ≤ 0.8W/kg when the transmission band is ≤ 100MHz ≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz ≤ 0.4W/kg when the transmission band is ≥ 200MHz							

WCDMA FDDV Body & Hotspot Configuration Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH Quad-band WCDMA (FDD I / FDD V / FDD VIII / FDD XI) Cellular Phone with Bluetooth, WLAN and GPS.

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
10mm	Front Facing	4133	826.6	23.75	24.2	0.255	0.283	Figure 12
10mm	Rear Facing	4133	826.6	23.75	24.2	0.346	0.384	Figure 13
10mm	Right Edge	4133	826.6	23.75	24.2	0.157	0.174	Figure 14
10mm	Left Edge	4133	826.6	23.75	24.2	0.155	0.172	Figure 15
10mm	Bottom Edge	4133	826.6	23.75	24.2	0.022	0.024	Figure 16
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is: ≤ 0.8W/kg when the transmission band is ≤ 100MHz ≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz ≤ 0.4W/kg when the transmission band is ≥ 200MHz Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06 KDB – 648474 D04 - When the reported SAR for body-worn accessory, measured without a headset connected to the handset, is >1.2W/kg, the highest reported SAR configuration for that wireless mode and frequency band is repeated for that body worn accessory with a headset attached to the handset.								

WLAN 2450MHz Head Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH Quad-band WCDMA (FDD I / FDD V / FDD VIII / FDD XI) Cellular Phone with Bluetooth, WLAN and GPS

Test Position	Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Left Cheek	1	2412	13.73	15.3	0.161	0.231	Figure 17
Left 15°	1	2412	13.73	15.3	0.194	0.278	Figure 18
Right Cheek	1	2412	13.73	15.3	0.203	0.291	Figure 19
Right 15°	1	2412	13.73	15.3	0.184	0.264	Figure 20
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is: ≤ 0.8W/kg when the transmission band is ≤ 100MHz ≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz ≤ 0.4W/kg when the transmission band is ≥ 200MHz							

WLAN 2450MHz Body & Hotspot Configuration Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH Quad-band WCDMA (FDD I / FDD V / FDD VIII / FDD XI) Cellular Phone with Bluetooth, WLAN and GPS.

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
10mm	Front Face	1	2412.0	13.73	15.3	0.054	0.078	Figure 21
10mm	Rear Face	1	2412.0	13.73	15.3	0.170	0.244	Figure 22
10mm	Right Edge	1	2412.0	13.73	15.3	0.147	0.211	Figure 23
10mm	Top Edge	1	2412.0	13.73	15.3	0.118	0.169	Figure 24
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is: ≤ 0.8W/kg when the transmission band is ≤ 100MHz ≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz ≤ 0.4W/kg when the transmission band is ≥ 200MHz Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06 KDB – 648474 D04 - When the reported SAR for body-worn accessory, measured without a headset connected to the handset, is >1.2W/kg, the highest reported SAR configuration for that wireless mode and frequency band is repeated for that body worn accessory with a headset attached to the handset.								

WLAN 5000MHz Head Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH AXGP & Quad-band WCDMA (FDD I/FDD V/FDD VIII/FDD XI) Dual-mode Cellular Phone with Bluetooth, WLAN, Felica and GPS(NUA)*

Test Position	Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Left Cheek	48	5240.0	13.44	14.5	0.042	0.054	Figure 25
Left 15°	48	5240.0	13.44	14.5	0.020	0.026	Figure 26
Right Cheek	48	5240.0	13.44	14.5	0.108	0.138	Figure 27
Right 15°	48	5240.0	13.44	14.5	0.050	0.064	Figure 28
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is: ≤ 0.8W/kg when the transmission band is ≤ 100MHz ≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz ≤ 0.4W/kg when the transmission band is ≥ 200MHz *(NUA) Not UKAS Accredited							

WLAN 5000MHz Body & Hotspot Configuration Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH Quad-band WCDMA (FDD I / FDD V / FDD VIII / FDD XI) Cellular Phone with Bluetooth, WLAN and GPS. (NUA)*

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
10mm	Front Face	48	5240.0	13.44	14.5	0.022	0.028	Figure 37
10mm	Rear Face	48	5240.0	13.44	14.5	0.061	0.078	Figure 38
10mm	Right Edge	48	5240.0	13.44	14.5	0.080	0.102	Figure 39
10mm	Top Edge	48	5240.0	13.44	14.5	0.016	0.020	Figure 40
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is: ≤ 0.8W/kg when the transmission band is ≤ 100MHz ≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz ≤ 0.4W/kg when the transmission band is ≥ 200MHz Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06 KDB – 648474 D04 - When the reported SAR for body-worn accessory, measured without a headset connected to the handset, is >1.2W/kg, the highest reported SAR configuration for that wireless mode and frequency band is repeated for that body worn accessory with a headset attached to the handset. *(NUA) Not UKAS Accredited								

WLAN 5000MHz Head Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH AXGP & Quad-band WCDMA (FDD I/FDD V/FDD VIII/FDD XI) Dual-mode Cellular Phone with Bluetooth, WLAN, Felica and GPS(NUA)*

Test Position	Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Left Cheek	56	5280.0	13.96	14.5	0.027	0.034	Figure 29
Left 15°	56	5280.0	13.96	14.5	0.019	0.024	Figure 30
Right Cheek	56	5280.0	13.96	14.5	0.381	0.486	Figure 31
Right 15°	56	5280.0	13.96	14.5	0.095	0.121	Figure 32

Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g)

KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is:

≤ 0.8W/kg when the transmission band is ≤ 100MHz
≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz
≤ 0.4W/kg when the transmission band is ≥ 200MHz

KDB 248227 - v01r02 (Rev 1.2) – Testing was carried out on Channel 56 instead of the default test channel as this was the channel with the maximum output power.
*(NUA) Not UKAS Accredited

WLAN 5000MHz Body & Hotspot Configuration Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH Quad-band WCDMA (FDD I / FDD V / FDD VIII / FDD XI) Cellular Phone with Bluetooth, WLAN and GPS. (NUA)*

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
10mm	Front Face	56	5280.0	13.96	14.5	0.021	0.027	Figure 41
10mm	Rear Face	56	5280.0	13.96	14.5	0.060	0.077	Figure 42
10mm	Right Edge	56	5280.0	13.96	14.5	0.072	0.092	Figure 43
10mm	Top Edge	56	5280.0	13.96	14.5	0.019	0.024	Figure 44

Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g)

KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is:

≤ 0.8W/kg when the transmission band is ≤ 100MHz
≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz
≤ 0.4W/kg when the transmission band is ≥ 200MHz

Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06

KDB – 648474 D04 - When the reported SAR for body-worn accessory, measured without a headset connected to the handset, is >1.2W/kg, the highest reported SAR configuration for that wireless mode and frequency band is repeated for that body worn accessory with a headset attached to the handset.

KDB 248227 - v01r02 (Rev 1.2) – Testing was carried out on Channel 56 instead of the default test channel as this was the channel with the maximum output power.

*(NUA) Not UKAS Accredited

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WLAN 5000MHz Head Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH AXGP & Quad-band WCDMA (FDD I/FDD V/FDD VIII/FDD XI) Dual-mode Cellular Phone with Bluetooth, WLAN, Felica and GPS(NUA)*

Test Position	Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Left Cheek	124	5620.0	14.35	14.5	0.031	0.039	Figure 33
Left 15°	124	5620.0	14.35	14.5	0.047	0.061	Figure 34
Right Cheek	124	5620.0	14.35	14.5	0.356	0.454	Figure 35
Right 15°	124	5620.0	14.35	14.5	0.110	0.140	Figure 36
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is: ≤ 0.8W/kg when the transmission band is ≤ 100MHz ≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz ≤ 0.4W/kg when the transmission band is ≥ 200MHz *(NUA) Not UKAS Accredited							

WLAN 5000MHz Body & Hotspot Configuration Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp 205SH Quad-band WCDMA (FDD I / FDD V / FDD VIII / FDD XI) Cellular Phone with Bluetooth, WLAN and GPS. (NUA)*

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 1g SAR (W/kg)	Scaled 1g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
10mm	Front Face	124	5620.0	14.35	14.5	0.031	0.040	Figure 45
10mm	Rear Face	124	5620.0	14.35	14.5	0.161	0.205	Figure 46
10mm	Right Edge	124	5620.0	14.35	14.5	0.125	0.160	Figure 47
10mm	Top Edge	124	5620.0	14.35	14.5	0.010	0.013	Figure 48
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) KDB 447498 D01 - Testing of other required channels within the operation mode of a frequency band is not required when the reported 1g SAR for mid-band or highest output power channel is: ≤ 0.8W/kg when the transmission band is ≤ 100MHz ≤ 0.6W/kg when the transmission band is between 100MHz and 200MHz ≤ 0.4W/kg when the transmission band is ≥ 200MHz Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06 KDB – 648474 D04 - When the reported SAR for body-worn accessory, measured without a headset connected to the handset, is >1.2W/kg, the highest reported SAR configuration for that wireless mode and frequency band is repeated for that body worn accessory with a headset attached to the handset. *(NUA) Not UKAS Accredited								

1.3.3 Simultaneous Transmission

Position / Head	WCDMA FDDV 1g SAR (W/kg) CH 4133 (Scaled SAR values)	WLAN 2.4GHz 1g SAR (W/kg) CH 2412 (Scaled SAR values)	∑ 1g SAR (W/kg)
Left Cheek	0.262	0.231	0.493
Left 15°	0.203	0.278	0.481
Right Cheek	0.321	0.291	0.612
Right 15°	0.224	0.264	0.488
Simultaneous Transmission KDB 447498 D01			

Simultaneous SAR measurements were not required as the sum of the 1g SAR measurements did not exceed 1.6 W/kg.

Position / Body	WCDMA FDDV 1g SAR (W/kg) CH 4133 (Scaled SAR values)	WLAN 2.4GHz 1g SAR (W/kg) CH 2412 (Scaled SAR values)	∑ 1g SAR (W/kg)
Front	0.283	0.078	0.361
Rear	0.384	0.244	0.628
Top Edge	N/A	0.169	N/A
Bottom Edge	0.024	N/A	N/A
Left edge	0.172	N/A	N/A
Right Edge	0.174	0.211	0.385
Simultaneous Transmission KDB 447498 D01 Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06			

Simultaneous SAR measurements were not required as the sum of the 1g SAR measurements did not exceed 1.6 W/kg.

Position / Head	WCDMA FDDV 1g SAR (W/kg) Ch4133 (Scaled SAR values)	WLAN 5GHz 1g SAR (W/kg) CH 48 (Scaled SAR values)	∑ 1g SAR (W/kg)
Left Cheek	0.262	0.054	0.316
Left 15°	0.203	0.026	0.229
Right Cheek	0.321	0.138	0.459
Right 15°	0.224	0.064	0.288
Simultaneous Transmission KDB 447498 D01			

Simultaneous SAR measurements were not required as the sum of the 1g SAR measurements did not exceed 1.6 W/kg.

Position Body	WCDMA FDDV 1g SAR (W/kg) Ch4133 (Scaled SAR values)	WLAN 5GHz 1g SAR (W/kg) CH 48 (Scaled SAR values)	∑ 1g SAR (W/kg)
Front	0.283	0.028	0.311
Rear	0.384	0.078	0.462
Top Edge	N/A	0.020	N/A
Bottom Edge	0.024	N/A	N/A
Left edge	0.172	N/A	N/A
Right Edge	0.174	0.102	0.276
Simultaneous Transmission KDB 447498 D01 Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06			

Simultaneous SAR measurements were not required as the sum of the 1g SAR measurements did not exceed 1.6 W/kg.

Position Head	WCDMA FDDV 1g SAR (W/kg) Ch4133 (Scaled SAR values)	WLAN 5GHz 1g SAR (W/kg) CH 56 (Scaled SAR values)	∑ 1g SAR (W/kg)
Left Cheek	0.262	0.034	0.296
Left 15°	0.203	0.024	0.227
Right Cheek	0.321	0.486	0.807
Right 15°	0.224	0.121	0.345
Simultaneous Transmission KDB 447498 D01			

Simultaneous SAR measurements were not required as the sum of the 1g SAR measurements did not exceed 1.6 W/kg.

Position Body	WCDMA FDDV 1g SAR (W/kg) Ch4133 (Scaled SAR values)	WLAN 5GHz 1g SAR (W/kg) CH 56 (Scaled SAR values)	∑ 1g SAR (W/kg)
Front	0.283	0.027	0.31
Rear	0.384	0.077	0.461
Top Edge	N/A	0.024	N/A
Bottom Edge	0.024	N/A	N/A
Left edge	0.172	N/A	N/A
Right Edge	0.174	0.092	0.266
Simultaneous Transmission KDB 447498 D01 Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06			

Simultaneous SAR measurements were not required as the sum of the 1g SAR measurements did not exceed 1.6 W/kg.

Position Head	WCDMA FDDV 1g SAR (W/kg) Ch4133 (Scaled SAR values)	WLAN 5GHz 1g SAR (W/kg) CH 124 (Scaled SAR values)	∑ 1g SAR (W/kg)
Left Cheek	0.262	0.039	0.301
Left 15°	0.203	0.061	0.264
Right Cheek	0.321	0.454	0.775
Right 15°	0.224	0.140	0.364
Simultaneous Transmission KDB 447498 D01			

Simultaneous SAR measurements were not required as the sum of the 1g SAR measurements did not exceed 1.6 W/kg.

Position Body	WCDMA FDDV 1g SAR (W/kg) Ch4133 (Scaled SAR values)	WLAN 5GHz 1g SAR (W/kg) CH 124 (Scaled SAR values)	∑ 1g SAR (W/kg)
Front	0.283	0.040	0.323
Rear	0.384	0.205	0.589
Top Edge	N/A	0.013	N/A
Bottom Edge	0.024	N/A	N/A
Left edge	0.172	N/A	N/A
Right Edge	0.174	0.160	0.334
Simultaneous Transmission KDB 447498 D01 Testing was carried out with a 10mm separation distance to meet the requirements of KDB 941225 D06			

Simultaneous SAR measurements were not required as the sum of the 1g SAR measurements did not exceed 1.6 W/kg.

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The equipment under test (EUT) was a Sharp 205SH Quad-band WCDMA (FDD I / FDD V / FDD VIII / FDD XI) Cellular Phone with Bluetooth, WLAN and GPS. A full technical description can be found in the manufacturer's documentation.

1.4.2 Test Configuration and Modes of Operation

The testing was performed with an integral battery supplied and manufactured by Sharp Corporation. The battery was fully charged before each measurement and there were no external connections.

For head SAR assessment, testing was performed with the device in the declared normal position of operation for WCDMA FDDV and WLAN 2.4GHz frequency bands at maximum power. The device was placed against a Specific Anthropomorphic Mannequin (SAM) phantom as specified in OET 65(C) - 2001. The phantom was filled with simulant liquid appropriate to the frequency band. The dielectric properties were measured and found to be in accordance with the requirements for the dielectric properties specified OET 65(C) - 2001. Testing was performed at both the left and right ear of the phantom at both handset positions stated in the applied specification.

For body SAR assessment, testing was performed for WCDMA FDDV and 2.4GHz WLAN frequency bands at maximum power. SAR assessment was performed with a Headset accessory attached during testing on the Body. The device was placed at a distance of 10 mm from the bottom of the flat phantom for all body testing. The Flat Phantom dimensions were 245mm x 195mm x 200mm with a sidewall thickness of 2.00mm. The phantom was filled to a minimum depth of 150mm with the appropriate Body simulant liquid. The dielectric properties were in accordance with the requirements specified in Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01).
As the device is capable of hotspot configuration a 10mm separation distance was used to meet the requirements of KDB 941225 D06 Hotspot.

Testing was performed in each position at the frequency that gave the highest output power for each band. No SAR levels were found to be >0.80 W/kg (KDB 447498 D01) and therefore no additional testing was required at the remaining frequencies / channels of the bands. WLAN testing was achieved using the devices internal software, customer supplied software and settings supplied by the customer. The worse case data rate for 5GHz testing was obtained from data provided by TUV. The worst case was deemed as the data rate which produced the highest level of conducted average power. For 2.4GHz WLAN this was 1Mbps for 802.11b. For 5GHz WLAN this was 9Mbps for 802.11a.

Included in this report are descriptions of the test method; the equipment used and an analysis of the test uncertainties applicable and diagrams indicating the locations of maximum SAR for each test position along with photographs indicating the positioning of the handset against the body as appropriate

1.5 FCC POWER MEASUREMENTS

1.5.1 Method

Conducted power measurements were made using a power meter.

1.5.2 Conducted Power Measurements

WCDMA FDD V

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
WCDMA - 12.2kbps RMC	826.6	27.21	23.75
	835.0	27.02	23.66
	826.4	26.58	23.15
WCDMA - 12.2kbps AMR with 3.4kbps SRB	826.6	27.24	23.72
	835.0	27.00	23.65
	826.4	26.55	23.13
WCDMA - HSDPA (Subtest #1)	826.6	26.72	22.69
	835.0	26.33	22.64
	826.4	26.04	22.18
WCDMA - HSDPA (Subtest #2)	826.6	27.42	22.25
	835.0	27.25	22.16
	826.4	26.84	21.65
WCDMA - HSDPA (Subtest #3)	826.6	27.34	21.68
	835.0	27.16	21.60
	826.4	26.68	21.04
WCDMA - HSDPA (Subtest #4)	826.6	27.36	21.69
	835.0	27.22	21.58
	826.4	26.72	21.03
WCDMA - HSUPA (Subtest #1)	826.6	27.59	22.38
	835.0	27.45	22.30
	826.4	27.07	21.77
WCDMA - HSUPA (Subtest #2)	826.6	27.47	22.03
	835.0	27.21	21.93
	826.4	26.82	21.50

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
WCDMA - 12.2kbps RMCWCDMA - HSUPA (Subtest #3)	826.6	27.40	22.35
	835.0	27.28	22.34
	826.4	26.92	21.78
WCDMA - HSUPA (Subtest #4)	826.6	27.11	22.72
	835.0	26.84	22.70
	826.4	26.41	22.19
WCDMA - HSUPA (Subtest #5)	826.6	27.56	22.34
	835.0	27.42	22.30
	826.4	26.99	21.77

WLAN

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
802.11(b) - 2.4 GHz - 1 Mbps	2412	17.56	13.73
	2437	16.67	13.34
	2462	17.27	13.72
802.11(g) - 2.4 GHz - 6 Mbps	2412	21.67	11.91
	2437	21.23	11.76
	2462	21.79	12.15
802.11(n20) - 2.4 GHz - 19.5 Mbps	2412	21.35	10.86
	2437	20.64	10.39
	2462	21.41	11.01
802.11a - 5GHz - 9Mbps	5180	24.77	13.43
	5200	24.05	12.81
	5220	24.55	13.33
	5240	24.49	13.44
	5260	24.34	13.27
	5280	24.64	13.96
	5300	24.37	13.47
	5320	23.50	12.65

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
802.11a - 5GHz - 9Mbps	5500	23.93	13.54
	5520	23.46	13.78
	5540	23.42	13.63
	5560	23.34	13.61
	5580	23.67	13.74
	5600	23.55	13.75
	5620	24.22	14.35
	5640	23.23	13.21
	5660	23.98	13.87
	5680	22.85	13.08
	5700	24.23	14.28
802.11n20 - 5GHz - 6.5Mbps	5180	23.64	12.25
	5200	23.44	11.77
	5220	23.38	12.19
	5240	23.23	11.80
	5260	23.35	12.13
	5280	24.26	12.94
	5300	23.64	12.44
	5320	23.02	11.66
	5500	23.39	12.76
	5520	23.12	12.73
	5540	23.40	12.68
	5560	22.74	12.49
	5580	23.31	13.07
	5600	23.35	12.79
	5620	23.92	13.38
	5640	23.05	12.53
	5660	22.94	12.74
	5680	22.96	12.47
	5700	23.74	13.24

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
802.11n40 - 5GHz - 27Mbps	5190	24.36	12.93
	5230	24.69	13.38
	5270	23.91	12.86
	5310	23.29	12.06
	5510	23.33	12.70
	5550	22.95	13.02
	5590	23.84	13.24
	5630	23.17	12.86
	5670	22.85	12.55

Bluetooth

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
DH5	2402	0.89	-1.69
	2441	0.94	-1.96
	2480	1.60	-0.97

1.5.3 Standalone SAR Test Exclusion Considerations (KDB 447498 D01)

The 1g SAR Test exclusion thresholds for 100 MHz to 6 GHz *test separation distances* ≤ 50 mm are determined by:

[(*max power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] [√f ($_{GHz}$)]* ≤ 3.0, where

- f ($_{GHz}$) is the RF channel transmit frequency in GHz.
- Power and distance are rounded to the nearest mW and mm before calculation.
- The result is rounded to one decimal place for comparison.
- When the maximum test separation distance is < 5 mm, a distance of 5 mm is applied.

Band	Frequency (MHz)	Max Power (dBm)	Max Power (mW)	Test Position	Distance (mm)	Threshold	Test Exclusion
FDD V	826.6	24.2	263.0	Head	< 5	47.8	No
				Body	10	22.8	No
WLAN 2.4 GHz	2412.0	15.3	33.88	Head	< 5	10.5	No
				Body	10	5.3	No
WLAN 5GHz	5240.0	14.5	28.13	Head	< 5	12.9	No
				Body	10	6.5	No
WLAN 5GHz	5280.0	14.5	28.13	Head	< 5	13.0	No
				Body	10	6.5	No
WLAN 5GHz	5620.0	14.5	28.13	Head	< 5	13.4	No
				Body	10	6.7	No
Bluetooth	2480.0	0	1	Head	< 5	0.3	Yes
				Body	10	0.2	Yes

COMMERCIAL-IN-CONFIDENCE

Product Service

SECTION 2

TEST DETAILS

Specific Absorption Rate Testing of the
Sharp 205SH AXGP & Quad-band WCDMA (FDD I/FDD V/FDD VIII/FDD XI) Dual-mode
Cellular Phone with Bluetooth, WLAN, Felica and GPS

2.1 SARA-C SAR MEASUREMENT SYSTEM

2.1.1 Robot System Specification

The SAR measurement system being used is the IndexSAR SARA-C system, which consists of a cartestian 6-axis robot jig, a dedicated robot controller, a straight IndexSAR probe, an L-shaped Indexsar probe, a fast amplifier, and two phantoms: an upside-down SAM phantom, and a rectangular box phantom,

Figure 1. The L-probe is used in connection with measurements on DUTs held against the SAM phantom, while the straight probe is used exclusively in the box phantom. The robot is used to articulate the probe to programmed positions inside the phantom head to obtain SAR readings from the DUT.

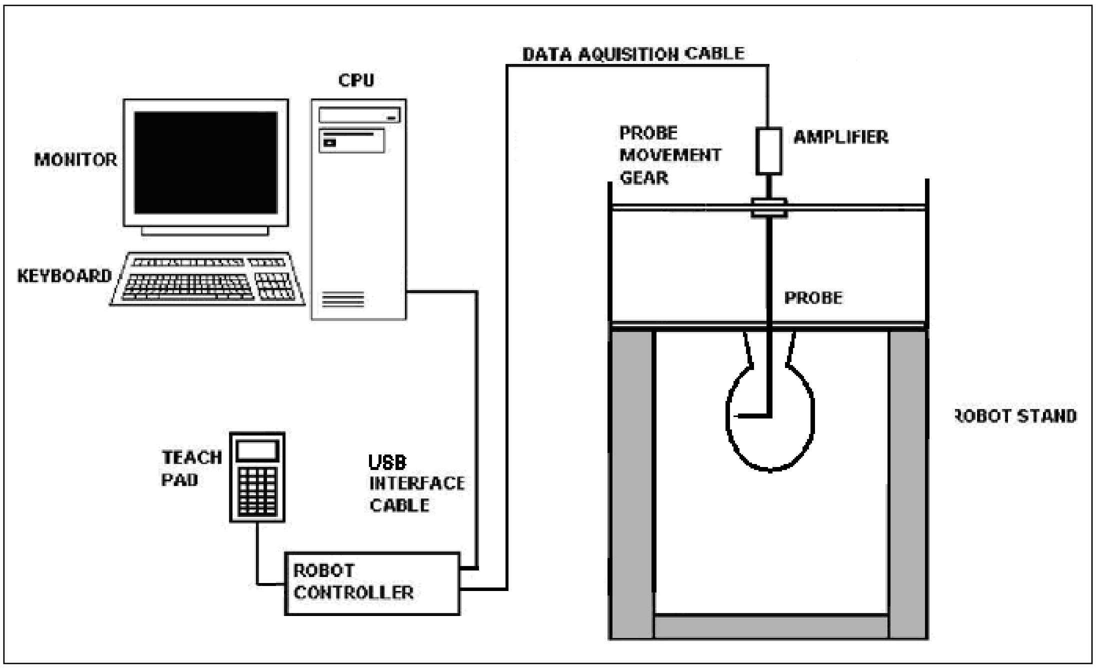


Figure 1 Schematic diagram of the SARA-C measurement system showing the L-probe and upside-down SAM phantom

The system is controlled remotely from a PC, which contains the software to drive the robot and data acquisition equipment. The software also displays the data obtained from test scans.

The position and digitised shape of the phantom heads are made available to the software for accurate positioning of the probe and reduction of set-up time. The SAM phantom heads are individually digitised using a Mitutoyo CMM machine to a precision of 0.001mm. The data is then converted into a shape format for the software, providing an accurate description of the phantom shell. Even with this accuracy, registration errors and deformation of the phantom when filled with 7 litres of fluid, can lead to probe placement errors of 1mm or more. For this reason, the L-probes house a 2-axis strain gauge unit, which allow the actual phantom wall position to be sensed to an accuracy of 0.3mm during probe movements.

In operation, the system first does an area (2D) scan within the liquid following the curve of the phantom wall at a fixed distance. When the maximum SAR point has been found, the system will then carry out a 3D scan centred at that point to determine volume averaged SAR level.

2.1.2 Probe and Amplifier Specification

IndexSAR isotropic immersible straight SAR probes

Straight probes are constructed using three orthogonal dipole sensors arranged on an interlocking, triangular prism core. The probes have built-in shielding against static charges and are contained within a PEEK cylindrical enclosure material at the tip. The tips come in either 5mm (typically for use up to 3GHz) or 2.5mm (above 3GHz) versions, model types IXP-050 and IXP-025 respectively.

Straight probes are calibrated by NPL in the UK.

Straight probes are used exclusively in the box phantom, to measure SAR from DUTs placed against the phantom base. In SARA2, straight probes were also used in the SAM phantom, but this is forbidden in SARA-C, where L-probes are demanded. NB the reverse is not true: L-probes can be used in the box phantom.

IndexSAR L-probes

The L-shaped probe is so designed to ensure the probe tip can remain perpendicular to the SAM phantom wall during scans. To allow for greater probe articulation freedom, the SAM phantom head has been turned upside down and the probe is inserted through the throat aperture, rather than through a small hole at the top of the head in the old SARA2 SAR measurement system.

Like the straight probes, L-probes also come in the same two tip sizes: IXP-020 (5mm) and IXP-021 (2.5mm).

L-probes are calibrated to national standards in-house by IndexSAR.

L-probes can be used either in the SAM head, or against the side wall of the box phantom.

Product Service

IFA-020 Fast Amplifier

A block diagram of the fast probe amplifier electronics is shown below.

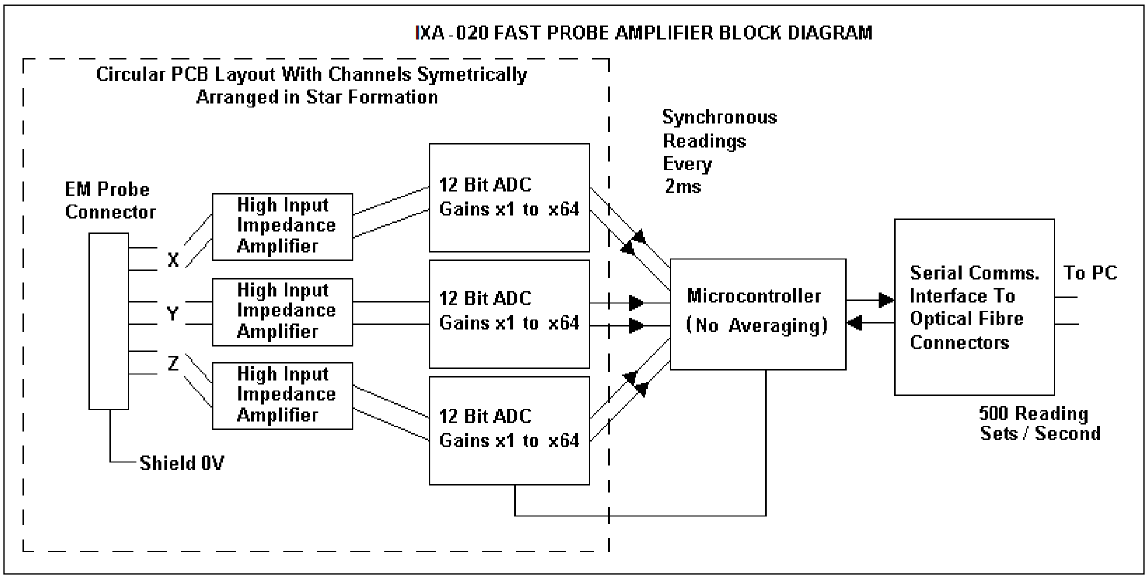


Figure 2 Schematic diagram of the fast amplifier

This amplifier has a time constant of approx. 50µs, which is much faster than the SAR probe response time. The overall system time constant is therefore that of the probe (<1ms) and a reading containing data for all three channels is returned to the PC every 2ms. The conversion period is approx. 1 µs at the start of each 2ms period. This enables the probe to follow pulse modulated signals of periods >>2ms. The PC software applies the linearisation procedure separately to each reading, so no linearisation corrections for the averaging of modulated signals are needed in this case.

The fast amplifier sampling rate can be adjusted via the SARA-C user interface from 1.7ms to 2.3ms. When not measuring CW signals, it is important to ensure that this probe reading rate and the modulated signal's pulse repetition rate are not unintentionally synchronised since this can lead to aliasing and a gross reduction in accuracy. For GSM signals, the default amplifier sampling rate of 2ms is entirely satisfactory, whereas changing it to 2.3ms (almost exactly half the GSM frame rate) could mean GSM bursts are always missed.

When aggregating 2ms samples to reduce the stochastic noise, it is equally important to match the number of samples with the longer-term timing structure of the modulation scheme. Taking GSM as an example again, since 120ms is the precise length of a GSM traffic channel multiframe, best practice would dictate that aggregated samples should cover exact multiples of this timescale. In this case, setting the number of samples to be aggregated to 120 (2 multiframes), or 240 samples (4 multiframes) should be ideal. Other signalling protocols would require changing these numbers as appropriate.

Phantoms

The Flat phantom used is a rectangular Perspex Box IndexSAR item IXB-2HF, dimensions 240 x 190 x 195mm (w x d x h). The base and one side wall are made of FR4 material which has specific dielectric properties and a tightly-controlled thickness. The base is used in tandem with straight probes, measuring either a DUT or a validation dipole, while the side wall is for performing validations with the L-probe. It is also feasible to perform measurements on body-worn devices with the L-probe against the side window, but only if the L-probe is suitably calibrated (ie if the measurement standard demands body and head fluids have the same dielectric properties).

The Specific Anthropomorphic Mannequin (SAM) Upright Phantom is fabricated using moulds generated from the CAD files as specified by CENELEC EN 62209-1: 2006.

2.1.3 SAR Measurement Procedure

Detailed measurement procedures for SARA-C are set out in a separate IndexSAR technical document ("SARA-C Operational Procedures"

A test set and dipole antenna control the handset via an air link and a low-mass phone holder can position the phone at either ear. Graduated scales are provided to set the phone in the 15 degree position. The upright phantom head holds approx. 7 litres of simulant liquid. The phantom is filled and emptied through the 110mm diameter penetration hole in the neck.

An area scan is performed inside the head at a fixed distance of 5mm from the curved surface on the source side. An algorithm presents the user with the location of any local hotspots and allows one to be selected for a follow-up 3D scan, looking at how the signal absorption varies with depth. A comparison between the start and end readings at a fixed distance from the DUT also enables the power drift during measurement to be assessed.

SARA-C Interpolation and Extrapolation schemes

SARA-C software contains support for both 2D cubic B-spline interpolation as well as 3D cubic B-spline interpolation. In addition, for extrapolation purposes, a proprietary curve-fitting routine is implemented as a weighted average of 3 different polynomial fits. The polynomial fitting procedures have been extensively tested by comparing the fitting coefficients generated by the SARA-C procedures with those obtained using the polynomial fit functions of Microsoft Excel when applied to the same test input data.

Interpolation of 2D area scan

The 2D cubic B-spline interpolation is used after the initial area scan at fixed distance from the phantom shell wall. The initial scan data are collected with approx. 115mm spatial resolution and spline interpolation is used to find the location of the local maximum to within a 1mm resolution for positioning the subsequent 3D scanning.

Extrapolation of 3D scan

For the 3D scan, data are collected on a spatially regular, but conformal, 3D grid having (by default) 6.4 mm steps in the lateral dimensions and 3.5 mm steps in the depth direction (away from the source). SARA-C enables full control over the selection of alternative step sizes in all directions.

The overall accuracy of the 1g and 10g SAR volume average depends largely on the accuracy with which the probe can be re-positioned in the head. Although the digitised shape of the head is available to the SARA-C software, a better positioning solution is to use strain gauges attached to the L-probe to feel for the actual surface and to base all movements relative to this positive detection. An even more precise, but time-consuming, method is to place the probe tip in positive contact against the phantom wall, then step backwards 0.01mm at a time while monitoring the recorded SAR reading. At the exact moment that the probe detaches from contact, the SAR reading will suddenly fall.

After the data collection, the data are extrapolated up to the shell wall in the depth direction to assign values to points in the 3D array which cannot be measured in practice because of the finite size of the sensor tip. For automated measurements inside the head, the distance of the closest plane from the wall cannot be less than 2.7mm (for 5mm probes) and 1.39mm (for 2.5mm probes), this being the distance of the probe sensors behind the front edge of the probe tip.

Interpolation of 3D scan and volume averaging

The procedure used in SARA-C for defining the volumes used in SAR averaging follow the method of adapting the surface of the ‘cube’ to conform with the curved inner surface of the phantom (see Appendix C.2.2.1 in EN 62209-1: 2006). This is called, here, the conformal scheme.

For each row of data in the depth direction, the data are extrapolated to the phantom wall, and interpolated to less than 1mm spacing and average values are calculated from the phantom surface for the row of data over distances corresponding to the requisite depth for 10g and 1g cubes. This results in two 2D arrays of data, one for 1g and the other for 10g masses, which are then cubic B-spline interpolated to sub mm lateral resolution. A search routine then moves an averaging square around through the 2D array and records the maximum value of the corresponding 1g and 10g volume averages.

The default step size is 3.5mm, but this is under user-control. The compromise is with time of scan, so it is not practical to make it much smaller or scan times become long and power-drop influences become larger.
The robot positioning system specification for the repeatability of the positioning (**dss** in EN 62209-1: 2006) is +/- 0.04mm.

2.1.4 Head Test Positions

This recommended practice specifies exactly two test positions for the handset against the head phantom, the “Cheek” position and the “tilted” position. The handset should be tested in both positions on the left and right sides of the SAM phantom. In each test position the centre of the earpiece of the device is placed directly at the entrance of the auditory canal. The angles mentioned in the test positions used are referenced to the line connecting both auditory canal openings. The plane this line is on is known as the reference plane. Testing is performed on the right and left-hand sides of the generic phantom head.

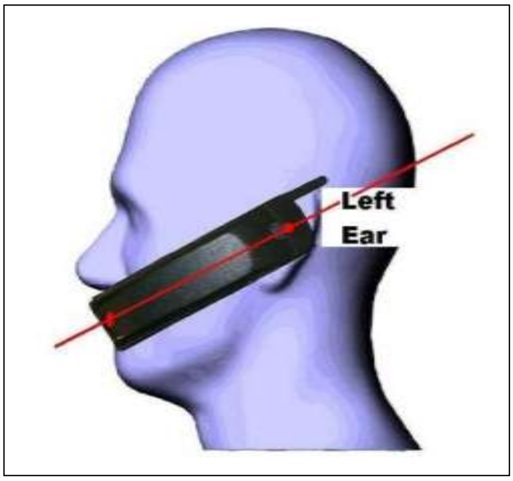


Figure 3 Side view of mobile next to head showing alignment

The Cheek Position

The Cheek Position is where the mobile is in the reference plane and the line between the mobile and the line connecting both auditory canal openings is reduced until any part of the mobile touches any part of the generic twin phantom head.

The 15° Position

The 15° Position is where the mobile is in the reference Cheek position and the phone is kept in contact with the auditory canal at the earpiece; the bottom of the phone is then tilted away from the phantom mouth by 15°.

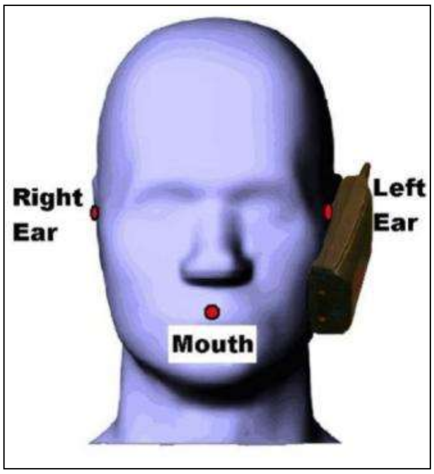


Figure 4 Cheek position

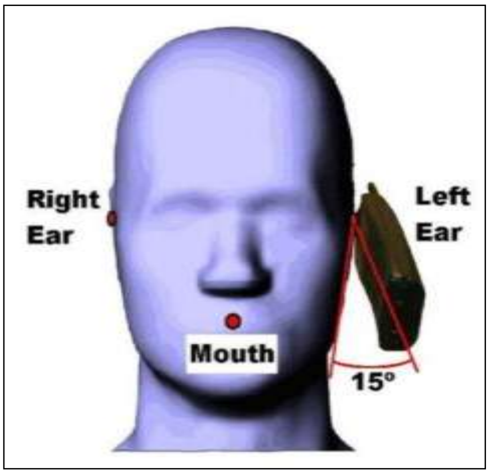


Figure 5 15º Tilt Position

2.2 WCDMA FDDV HEAD SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	18/04/2013-16:02:59	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.60°C	**LIQUID SIMULANT:**	835Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	39.91
RELATIVE HUMIDITY:	33.60%	**CONDUCTIVITY:**	0.877
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.60°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	58.80mm
DUT POSITION:	Left-Cheek	**MAX SAR Z-AXIS LOCATION:**	-119.40mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	15.513
TEST FREQUENCY:	826.6MHz	**SAR 1g:**	0.236 W/kg
TYPE OF MODULATION:	QPSK (RMC Mode)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.248 W/kg
INPUT POWER LEVEL:	24dBm	**SAR END:**	0.248 W/kg
PROBE BATTERY LAST CHANGED:	18/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

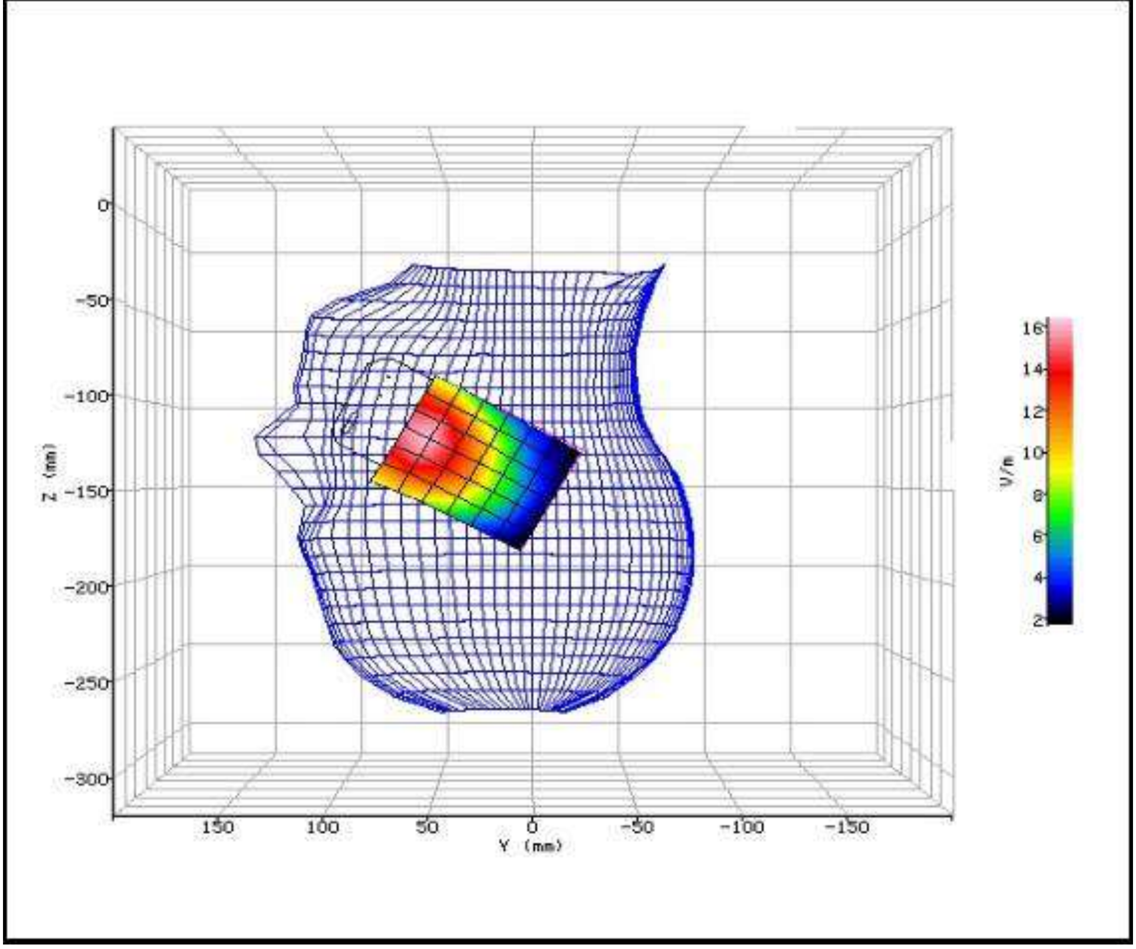


Figure 8: SAR Head Testing Results for the 205SH Mobile Handset at 826.6MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	18/04/2013-16:21:28	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.60°C	**LIQUID SIMULANT:**	835Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	39.91
RELATIVE HUMIDITY:	33.60%	**CONDUCTIVITY:**	0.877
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.60°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	44.00mm
DUT POSITION:	Left-15°	**MAX SAR Z-AXIS LOCATION:**	-131.90mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	13.161
TEST FREQUENCY:	826.6MHz	**SAR 1g:**	0.183 W/kg
TYPE OF MODULATION:	QPSK (RMC Mode)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.174 W/kg
INPUT POWER LEVEL:	24dBm	**SAR END:**	0.179 W/kg
PROBE BATTERY LAST CHANGED:	18/04/2013	**SAR DRIFT DURING SCAN:**	2.900 %

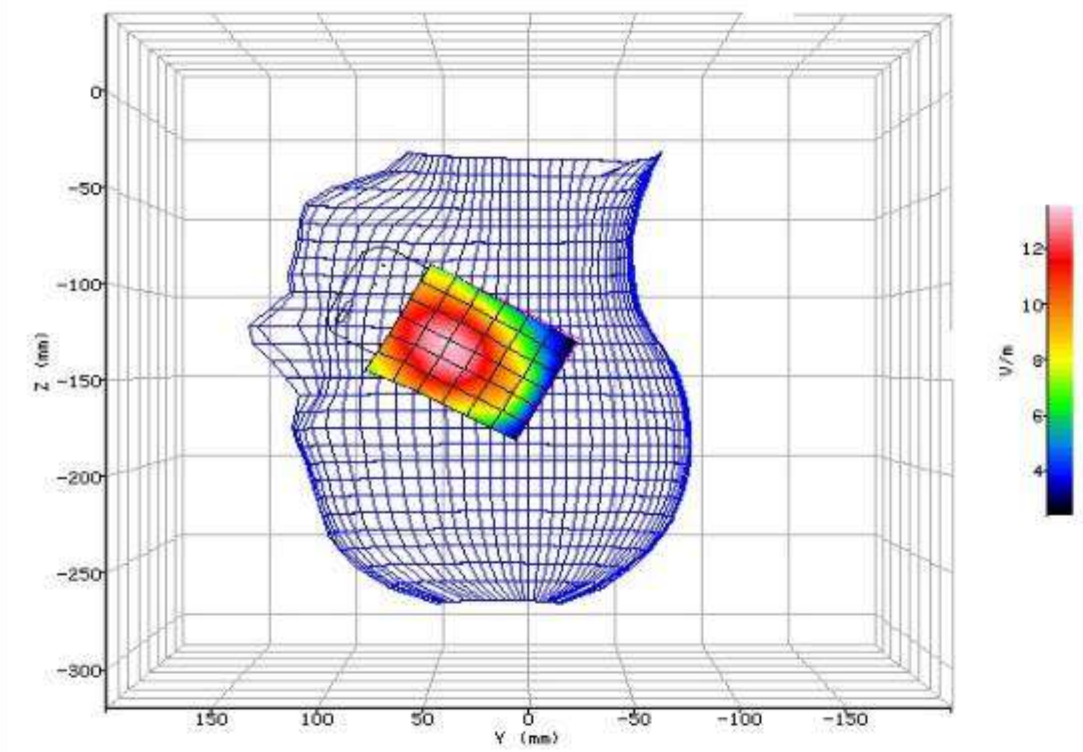


Figure 9: SAR Head Testing Results for the 205SH Mobile Handset at 826.6MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	18/04/2013-16:42:16	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.60°C	**LIQUID SIMULANT:**	835Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	39.91
RELATIVE HUMIDITY:	33.60%	**CONDUCTIVITY:**	0.877
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.60°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	57.40mm
DUT POSITION:	Right-Cheek	**MAX SAR Z-AXIS LOCATION:**	-115.20mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	15.822
TEST FREQUENCY:	826.6MHz	**SAR 1g:**	0.289 W/kg
TYPE OF MODULATION:	QPSK (RMC Mode)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.264 W/kg
INPUT POWER LEVEL:	24dBm	**SAR END:**	0.262 W/kg
PROBE BATTERY LAST CHANGED:	18/04/2013	**SAR DRIFT DURING SCAN:**	-0.800 %

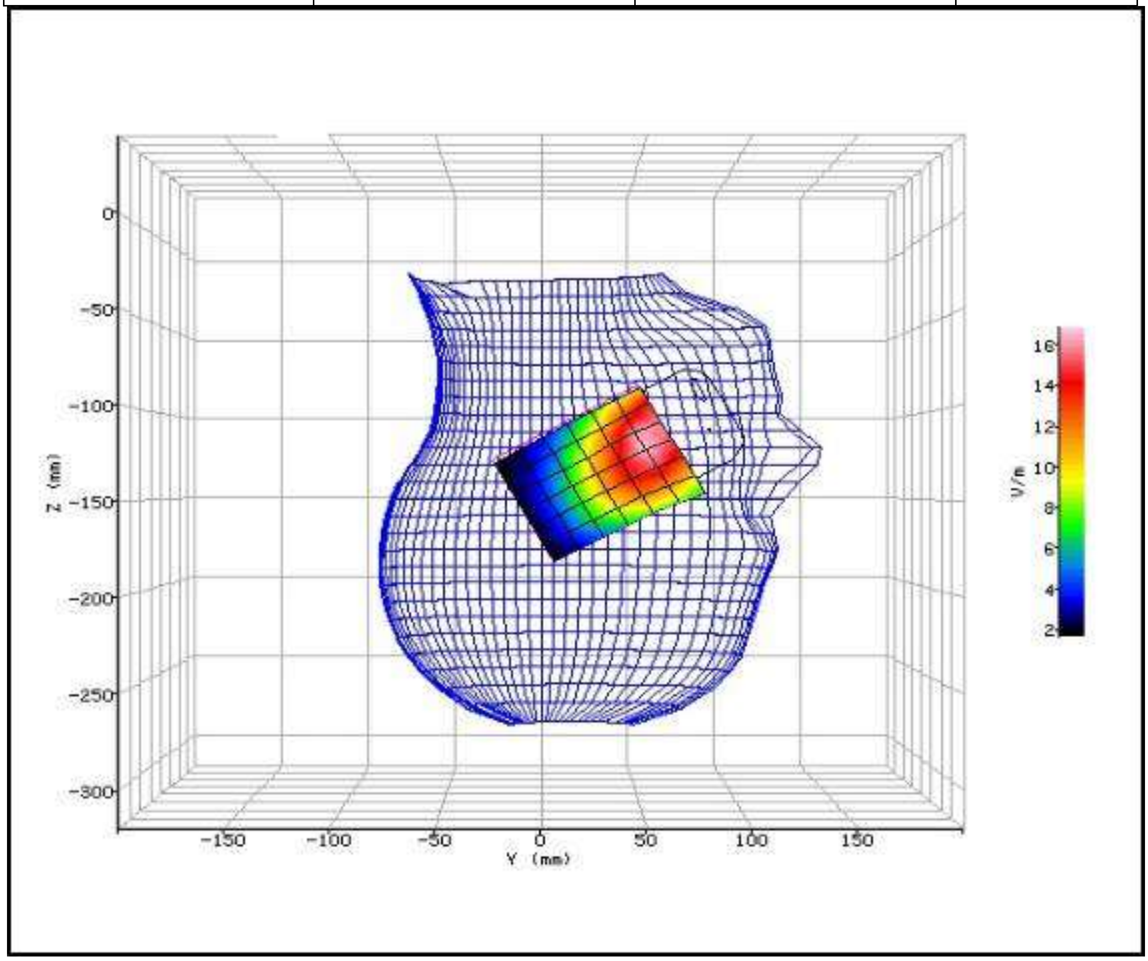


Figure 10: SAR Head Testing Results for the 205SH Mobile Handset at 826.6MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	18/04/2013-17:00:04	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.60°C	**LIQUID SIMULANT:**	835Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	39.91
RELATIVE HUMIDITY:	33.60%	**CONDUCTIVITY:**	0.877
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.60°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	46.60mm
DUT POSITION:	Right-15°	**MAX SAR Z-AXIS LOCATION:**	-128.70mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	13.688
TEST FREQUENCY:	826.6MHz	**SAR 1g:**	0.204 W/kg
TYPE OF MODULATION:	QPSK (RMC Mode)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.189 W/kg
INPUT POWER LEVEL:	24dBm	**SAR END:**	0.194 W/kg
PROBE BATTERY LAST CHANGED:	18/04/2013	**SAR DRIFT DURING SCAN:**	2.600 %

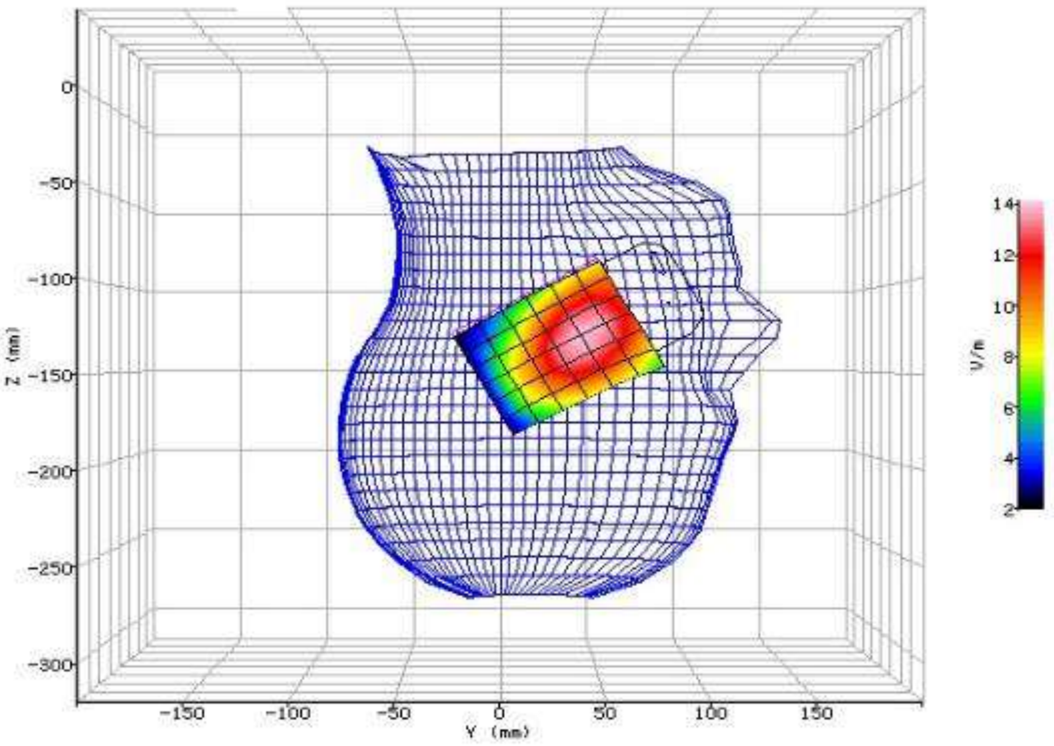


Figure 11: SAR Head Testing Results for the 205SH Mobile Handset at 826.6MHz.

Product Service

2.3 WCDMA FDDV BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	22/04/2013-13:21:20	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.90°C	**LIQUID SIMULANT:**	835Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	57.18
RELATIVE HUMIDITY:	32.80%	**CONDUCTIVITY:**	1.018
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-13.00mm
DUT POSITION:	10mm-Front Facing	**MAX SAR Y-AXIS LOCATION:**	-1.40mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	16.038
TEST FREQUENCY:	826.6MHz	**SAR 1g:**	0.255 W/kg
TYPE OF MODULATION:	QPSK (RMC Mode)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.269 W/kg
INPUT POWER LEVEL:	24dBm	**SAR END:**	0.266 W/kg
PROBE BATTERY LAST CHANGED:	22/04/2013	**SAR DRIFT DURING SCAN:**	-1.100 %

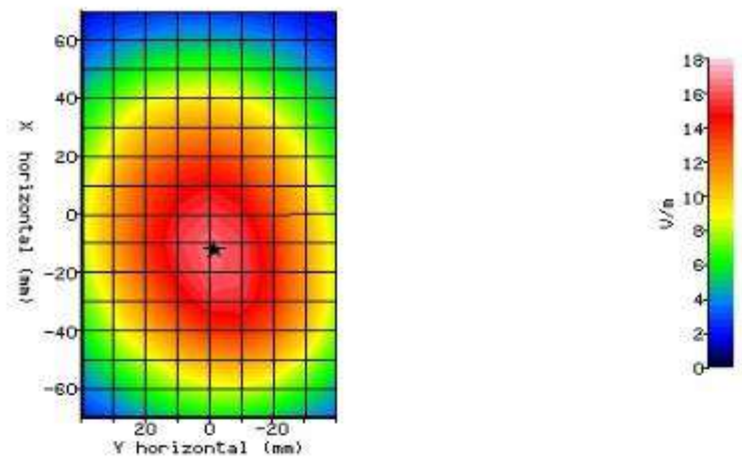


Figure 12: SAR Body Testing Results for the 205SH Mobile Handset at 826.6MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	INPUT POWER DRIFT:	0 dB
DATE / TIME:	22/04/2013-13:36:16	DUT BATTERY MODEL/NO:	N/A
AMBIENT TEMPERATURE:	22.90°C	LIQUID SIMULANT:	835Body
DEVICE UNDER TEST:	205SH	RELATIVE PERMITTIVITY:	57.18
RELATIVE HUMIDITY:	32.80%	CONDUCTIVITY:	1.018
PHANTOM S/NO:	IXB-2HF	LIQUID TEMPERATURE:	22.70°C
PHANTOM ROTATION:	N/A	MAX SAR X-AXIS LOCATION:	-28.10mm
DUT POSITION:	10mm-Rear Facing	MAX SAR Y-AXIS LOCATION:	15.20mm
ANTENNA CONFIGURATION:	N/A	MAX E FIELD:	18.322
TEST FREQUENCY:	826.6MHz	SAR 1g:	N/A
TYPE OF MODULATION:	QPSK (RMC Mode)	SAR 10g:	1.000 W/kg
MODN. DUTY CYCLE:	100%	SAR START:	0.364 W/kg
INPUT POWER LEVEL:	24dBm	SAR END:	0.361 W/kg
PROBE BATTERY LAST CHANGED:	22/04/2013	SAR DRIFT DURING SCAN:	-0.700 %

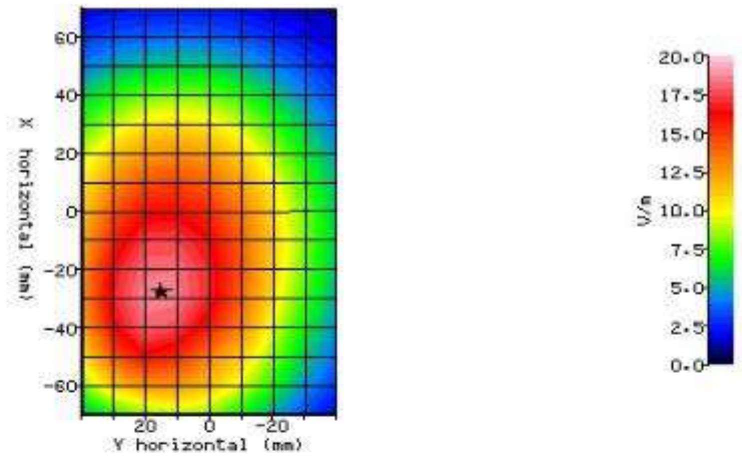


Figure 13: SAR Body Testing Results for the 205SH Mobile Handset at 826.6MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	22/04/2013-14:06:46	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.90°C	**LIQUID SIMULANT:**	835Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	57.18
RELATIVE HUMIDITY:	32.80%	**CONDUCTIVITY:**	1.018
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-1.30mm
DUT POSITION:	10mm-Right Edge	**MAX SAR Y-AXIS LOCATION:**	2.10mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	12.406
TEST FREQUENCY:	826.6MHz	**SAR 1g:**	0.157 W/kg
TYPE OF MODULATION:	QPSK (RMC Mode)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.165 W/kg
INPUT POWER LEVEL:	24dBm	**SAR END:**	0.169 W/kg
PROBE BATTERY LAST CHANGED:	22/04/2013	**SAR DRIFT DURING SCAN:**	2.100 %

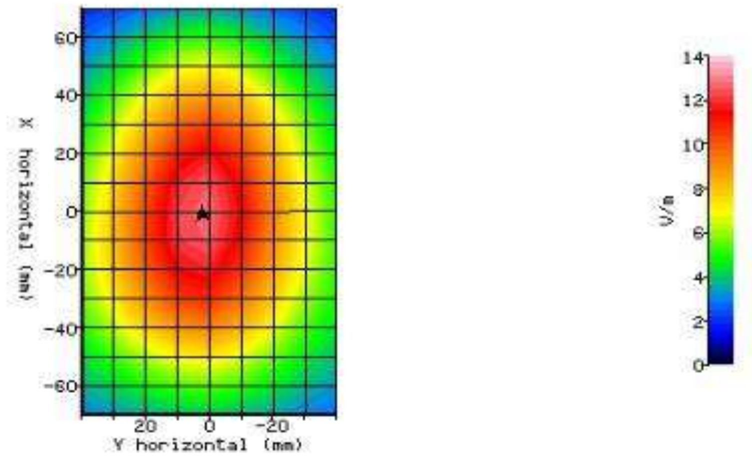


Figure 14: SAR Body Testing Results for the 205SH Mobile Handset at 826.6MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	22/04/2013-13:51:05	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.90°C	**LIQUID SIMULANT:**	835Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	57.18
RELATIVE HUMIDITY:	32.80%	**CONDUCTIVITY:**	1.018
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	6.50mm
DUT POSITION:	10mm-Left Edge	**MAX SAR Y-AXIS LOCATION:**	0.30mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	12.295
TEST FREQUENCY:	826.6MHz	**SAR 1g:**	0.155 W/kg
TYPE OF MODULATION:	QPSK (RMC Mode)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.164 W/kg
INPUT POWER LEVEL:	24dBm	**SAR END:**	0.168 W/kg
PROBE BATTERY LAST CHANGED:	22/04/2013	**SAR DRIFT DURING SCAN:**	2.500 %

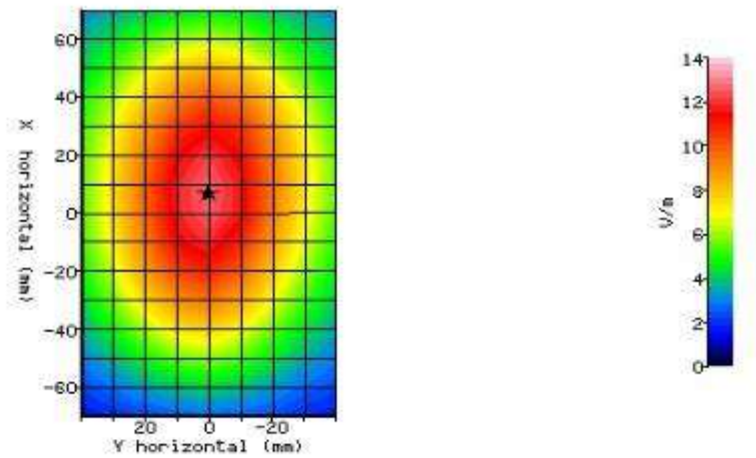


Figure 15: SAR Body Testing Results for the 205SH Mobile Handset at 826.6MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	INPUT POWER DRIFT:	0 dB
DATE / TIME:	22/04/2013-14:22:37	DUT BATTERY MODEL/NO:	N/A
AMBIENT TEMPERATURE:	22.90°C	LIQUID SIMULANT:	835Body
DEVICE UNDER TEST:	205SH	RELATIVE PERMITTIVITY:	57.18
RELATIVE HUMIDITY:	32.80%	CONDUCTIVITY:	1.018
PHANTOM S/NO:	IXB-2HF	LIQUID TEMPERATURE:	22.70°C
PHANTOM ROTATION:	N/A	MAX SAR X-AXIS LOCATION:	13.30mm
DUT POSITION:	10mm-Bottom Edge	MAX SAR Y-AXIS LOCATION:	12.20mm
ANTENNA CONFIGURATION:	N/A	MAX E FIELD:	4.489
TEST FREQUENCY:	826.6MHz	SAR 1g:	0.022 W/kg
TYPE OF MODULATION:	QPSK (RMC Mode)	SAR 10g:	N/A
MODN. DUTY CYCLE:	100%	SAR START:	0.023 W/kg
INPUT POWER LEVEL:	24dBm	SAR END:	0.023 W/kg
PROBE BATTERY LAST CHANGED:	22/04/2013	SAR DRIFT DURING SCAN:	-1.200 %

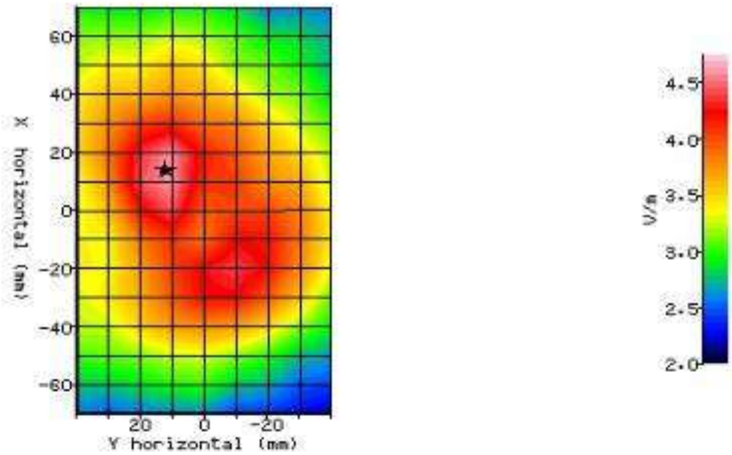


Figure 16: SAR Body Testing Results for the 205SH Mobile Handset at 826.6MHz.

2.4 WLAN 2450MHz HEAD SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	17/04/2013-16:34:41	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	42.10°C	**LIQUID SIMULANT:**	2450Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	38.40
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	1.814
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	42.10°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	2.10mm
DUT POSITION:	Left-Cheek	**MAX SAR Z-AXIS LOCATION:**	-155.50mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	7.069
TEST FREQUENCY:	2412MHz	**SAR 1g:**	0.161 W/kg
TYPE OF MODULATION:	WLAN (DSSS)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.144 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.149 W/kg
PROBE BATTERY LAST CHANGED:	17/04/2013	**SAR DRIFT DURING SCAN:**	3.500 %

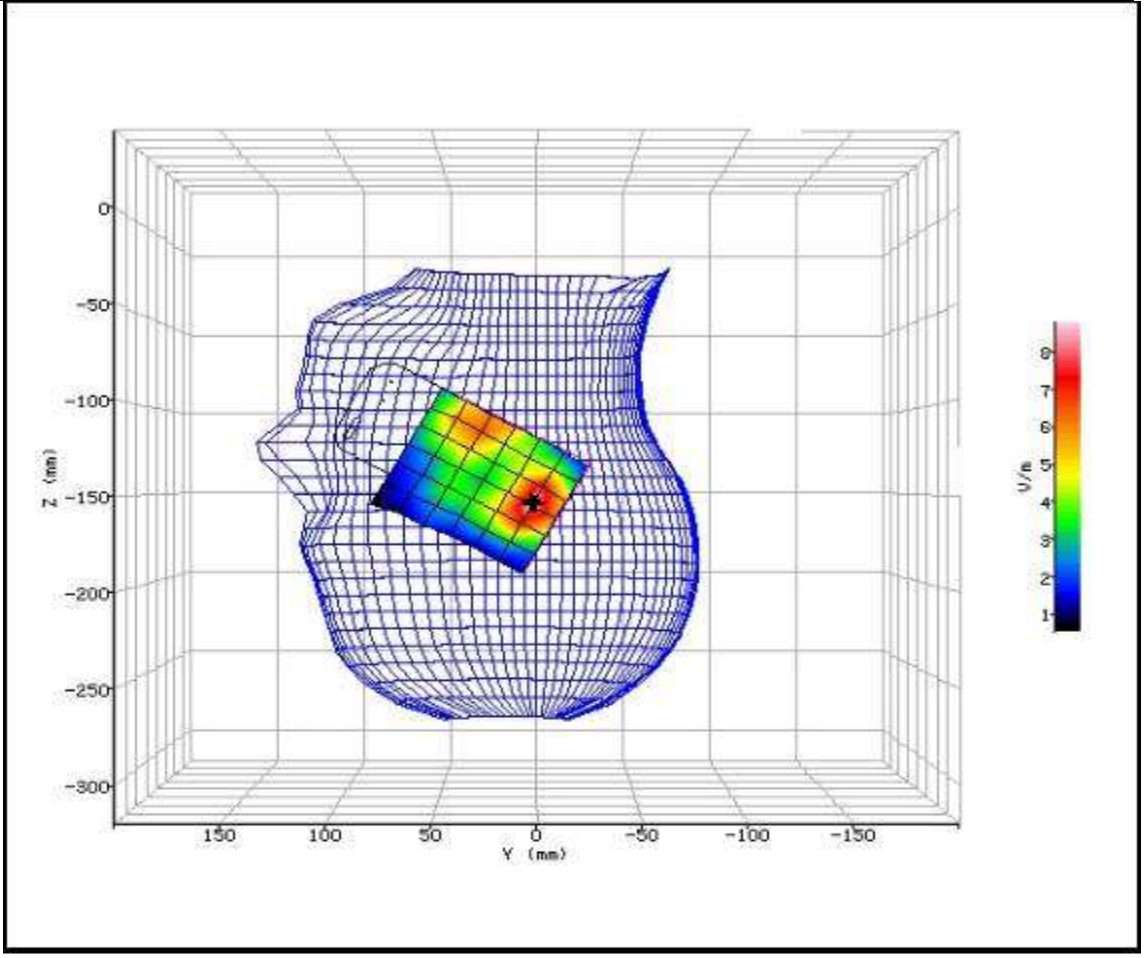


Figure 17: SAR Head Testing Results for the 205SH Mobile Handset at 2412MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	17/04/2013-16:52:44	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	42.10°C	**LIQUID SIMULANT:**	2450Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	38.40
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	1.814
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	42.10°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	0.70mm
DUT POSITION:	Left-15°	**MAX SAR Z-AXIS LOCATION:**	-157.70mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	7.536
TEST FREQUENCY:	2412MHz	**SAR 1g:**	0.194 W/kg
TYPE OF MODULATION:	WLAN (DSSS)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.175 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.173 W/kg
PROBE BATTERY LAST CHANGED:	17/04/2013	**SAR DRIFT DURING SCAN:**	-1.100 %

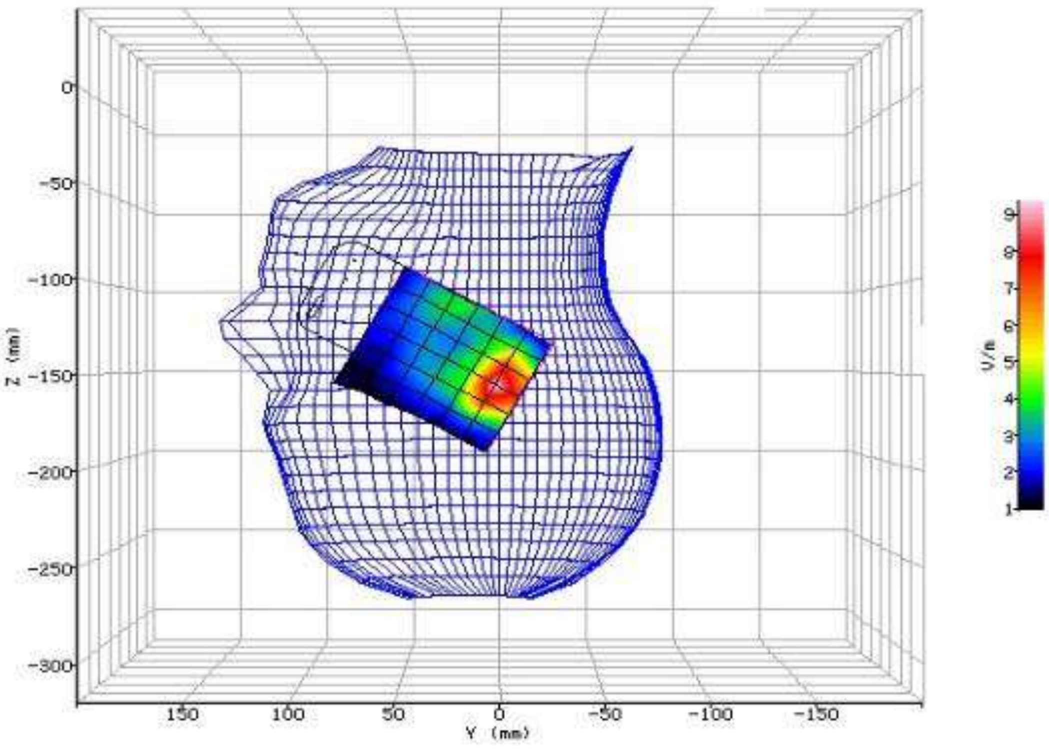


Figure 18: SAR Head Testing Results for the 205SH Mobile Handset at 2412MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	17/04/2013-15:52:03	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	42.10°C	**LIQUID SIMULANT:**	2450Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	38.40
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	1.814
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	42.10°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	47.10mm
DUT POSITION:	Right-Cheek	**MAX SAR Z-AXIS LOCATION:**	-160.90mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	9.601
TEST FREQUENCY:	2412MHz	**SAR 1g:**	0.203 W/kg
TYPE OF MODULATION:	WLAN (DSSS)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.263 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.266 W/kg
PROBE BATTERY LAST CHANGED:	17/04/2013	**SAR DRIFT DURING SCAN:**	1.100 %

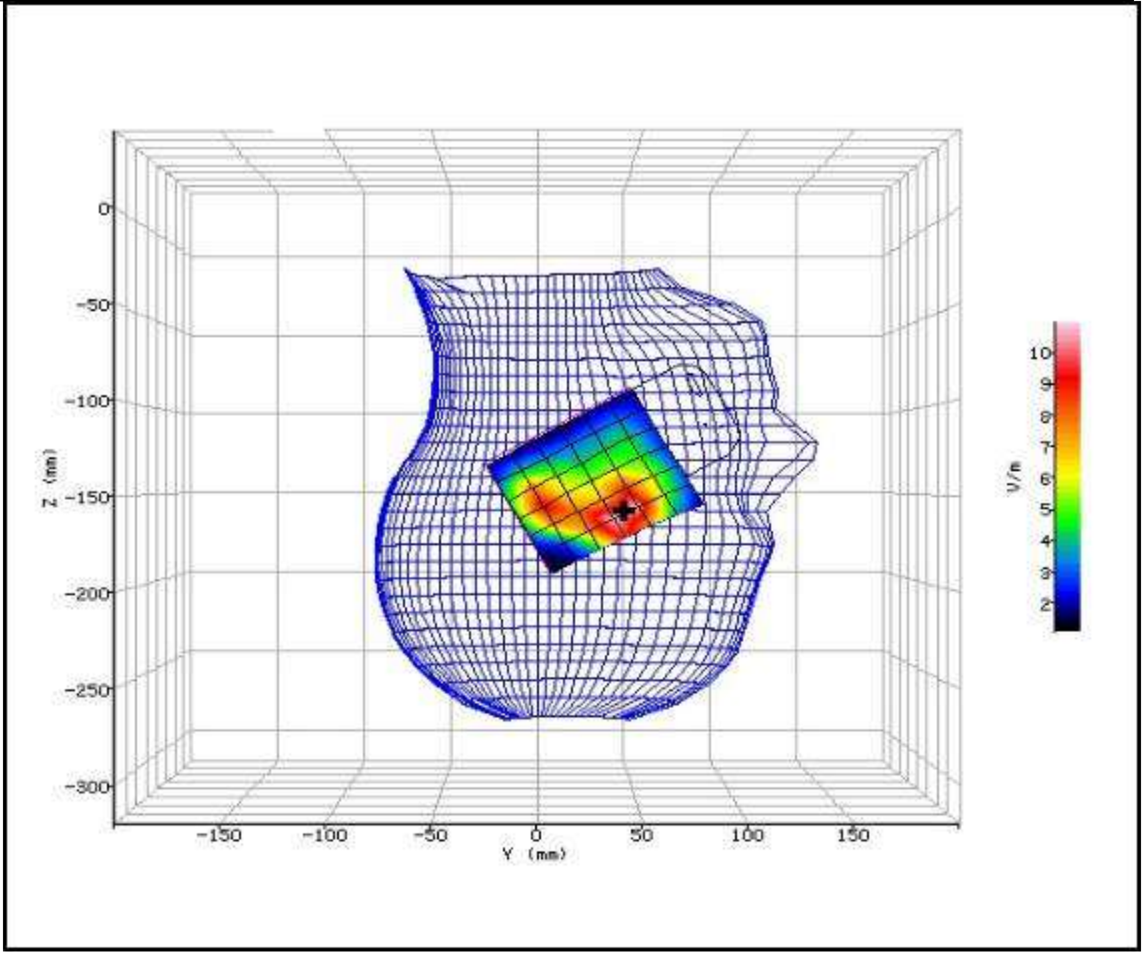


Figure 19: SAR Head Testing Results for the 205SH Mobile Handset at 2412MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	17/04/2013-16:11:43	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.20°C	**LIQUID SIMULANT:**	2450Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	38.40
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	1.814
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	4.20mm
DUT POSITION:	Right-15°	**MAX SAR Z-AXIS LOCATION:**	-154.40mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	8.358
TEST FREQUENCY:	2412MHz	**SAR 1g:**	0.184 W/kg
TYPE OF MODULATION:	WLAN (DSSS)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.204 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.195 W/kg
PROBE BATTERY LAST CHANGED:	17/04/2013	**SAR DRIFT DURING SCAN:**	-4.400 %

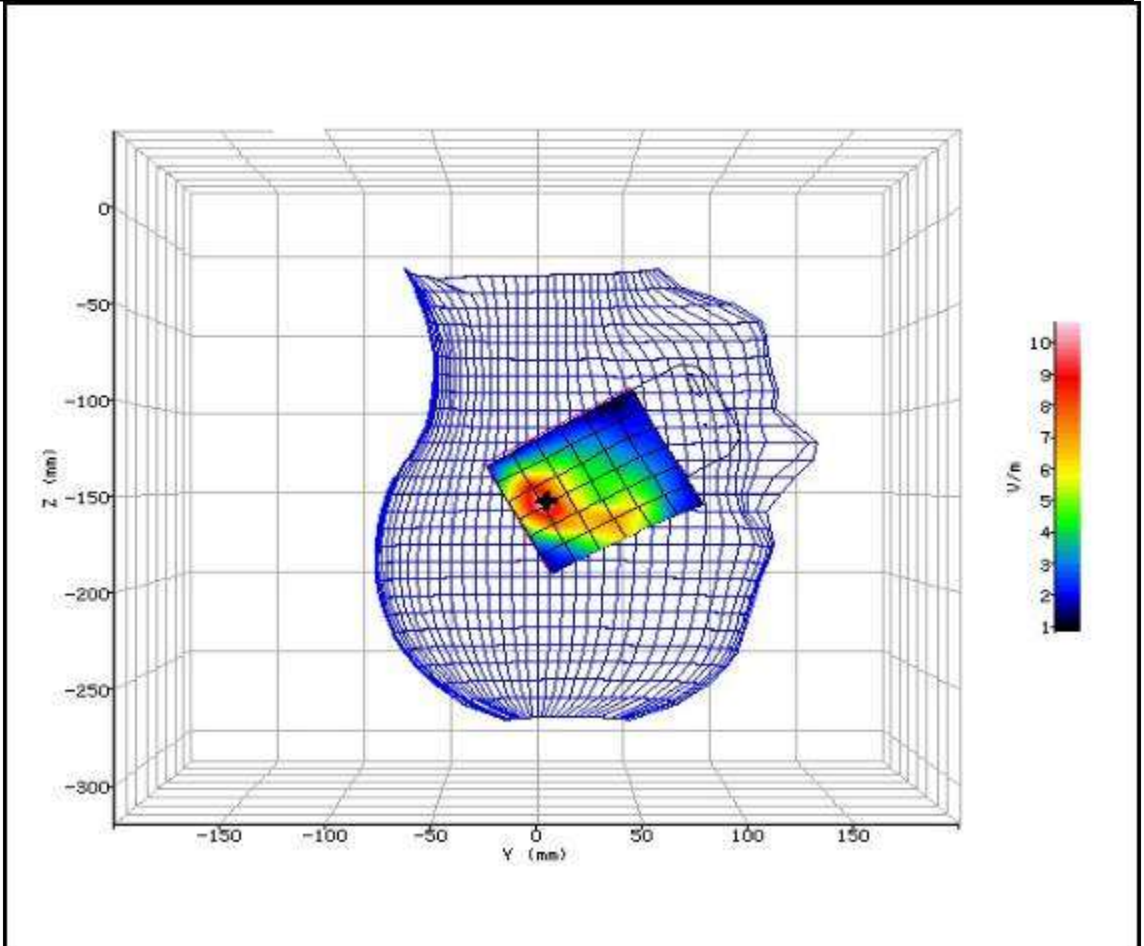


Figure 20: SAR Head Testing Results for the 205SH Mobile Handset at 2412MHz.

2.5 WLAN 2450MHz BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	23/04/2013-08:59:34	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	21.80°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	51.73
RELATIVE HUMIDITY:	41.60%	**CONDUCTIVITY:**	1.982
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.50°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	58.60mm
DUT POSITION:	10mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	1.60mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.844
TEST FREQUENCY:	2412MHz	**SAR 1g:**	0.054 W/kg
TYPE OF MODULATION:	WLAN(DSSS)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.056 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.059 W/kg
PROBE BATTERY LAST CHANGED:	23/04/2013	**SAR DRIFT DURING SCAN:**	4.300 %

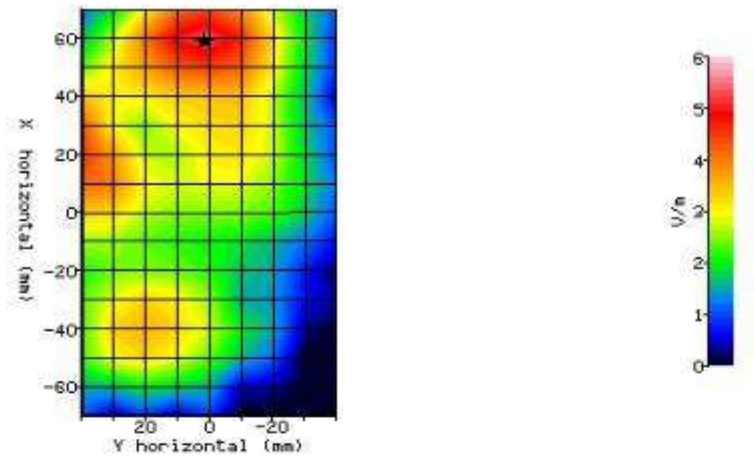


Figure 21: SAR Body Testing Results for the 205SH Mobile Handset at 2412MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	23/04/2013-08:47:44	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	21.80°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	51.73
RELATIVE HUMIDITY:	41.60%	**CONDUCTIVITY:**	1.982
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.50°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	23.00mm
DUT POSITION:	10mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	-28.80mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	8.089
TEST FREQUENCY:	2412MHz	**SAR 1g:**	0.170 W/kg
TYPE OF MODULATION:	WLAN(DSSS)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.204 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.214 W/kg
PROBE BATTERY LAST CHANGED:	23/04/2013	**SAR DRIFT DURING SCAN:**	4.700 %

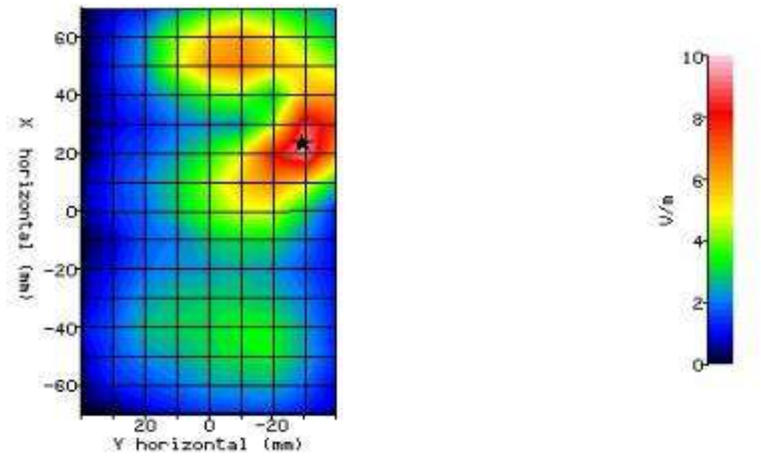


Figure 22: SAR Body Testing Results for the 205SH Mobile Handset at 2412MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	23/04/2013-09:12:46	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	21.80°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	51.73
RELATIVE HUMIDITY:	41.60%	**CONDUCTIVITY:**	1.982
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.50°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	29.10mm
DUT POSITION:	10mm-Right Edge	**MAX SAR Y-AXIS LOCATION:**	10.70mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	7.870
TEST FREQUENCY:	2412MHz	**SAR 1g:**	0.147 W/kg
TYPE OF MODULATION:	WLAN(DSSS)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.169 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.165 W/kg
PROBE BATTERY LAST CHANGED:	23/04/2013	**SAR DRIFT DURING SCAN:**	-2.200 %

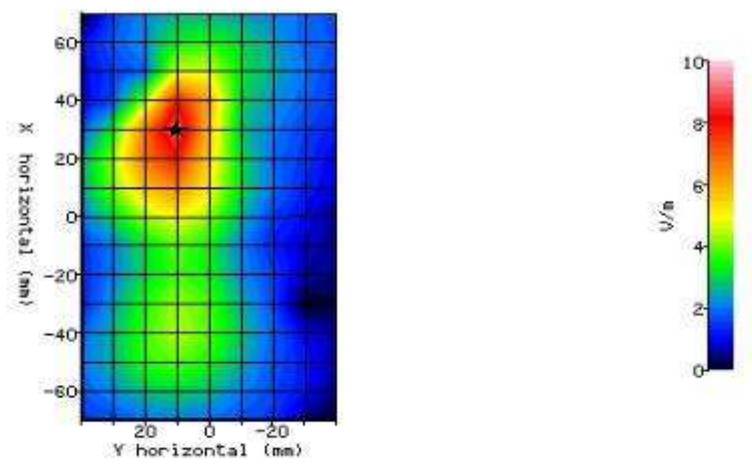


Figure 23: SAR Body Testing Results for the 205SH Mobile Handset at 2412MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.07.10	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	23/04/2013-09:26:52	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	21.80°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	51.73
RELATIVE HUMIDITY:	41.60%	**CONDUCTIVITY:**	1.982
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.50°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-1.00mm
DUT POSITION:	10mm-Top Edge	**MAX SAR Y-AXIS LOCATION:**	11.80mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	7.153
TEST FREQUENCY:	2412MHz	**SAR 1g:**	0.118 W/kg
TYPE OF MODULATION:	WLAN(DSSS)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.131 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.137 W/kg
PROBE BATTERY LAST CHANGED:	23/04/2013	**SAR DRIFT DURING SCAN:**	4.500 %

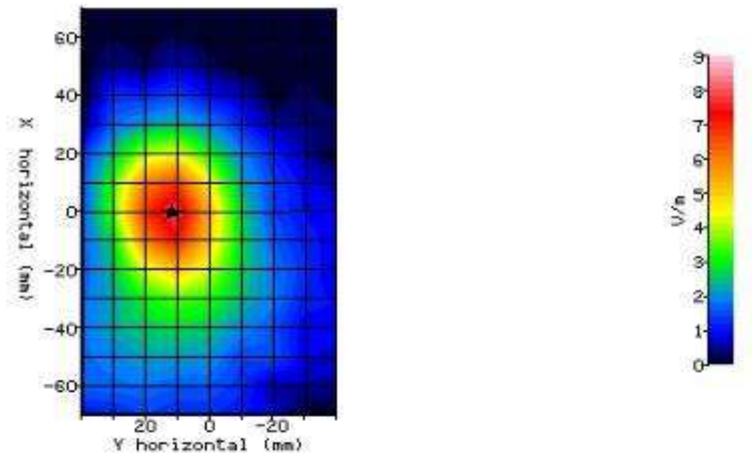


Figure 24: SAR Body Testing Results for the 205SH Mobile Handset at 2412MHz.

2.6 WLAN 5000MHz HEAD SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-11:42:59	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	12.80mm
DUT POSITION:	Left-Cheek	**MAX SAR Z-AXIS LOCATION:**	-112.10mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	3.058
TEST FREQUENCY:	5240.0MHz	**SAR 1g:**	0.042 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.019 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.019 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

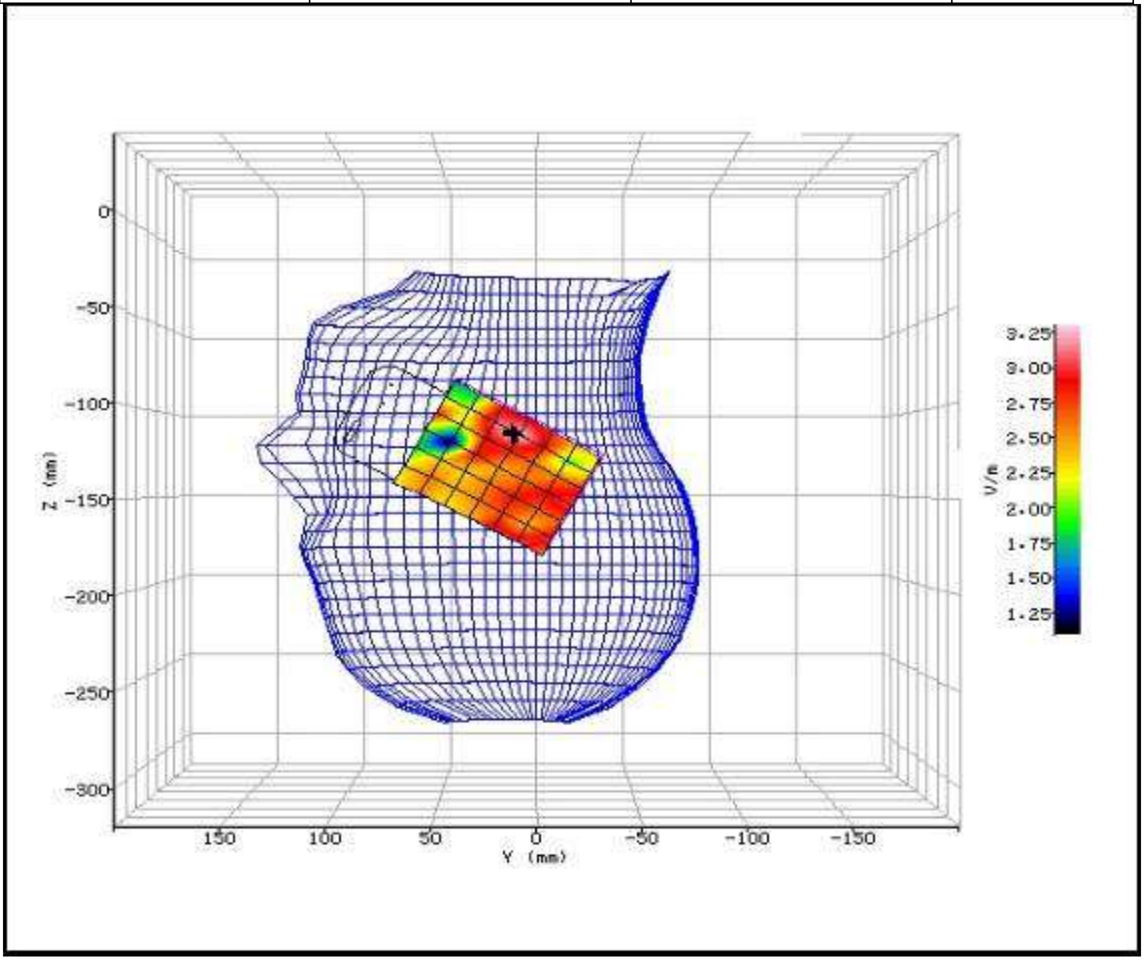


Figure 25: SAR Head Testing Results for the 205SH Mobile Handset at 5240.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-11:53:54	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	-7.20mm
DUT POSITION:	Left-15°	**MAX SAR Z-AXIS LOCATION:**	-147.80mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	1.816
TEST FREQUENCY:	5240.0MHz	**SAR 1g:**	0.020 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.019 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.019 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

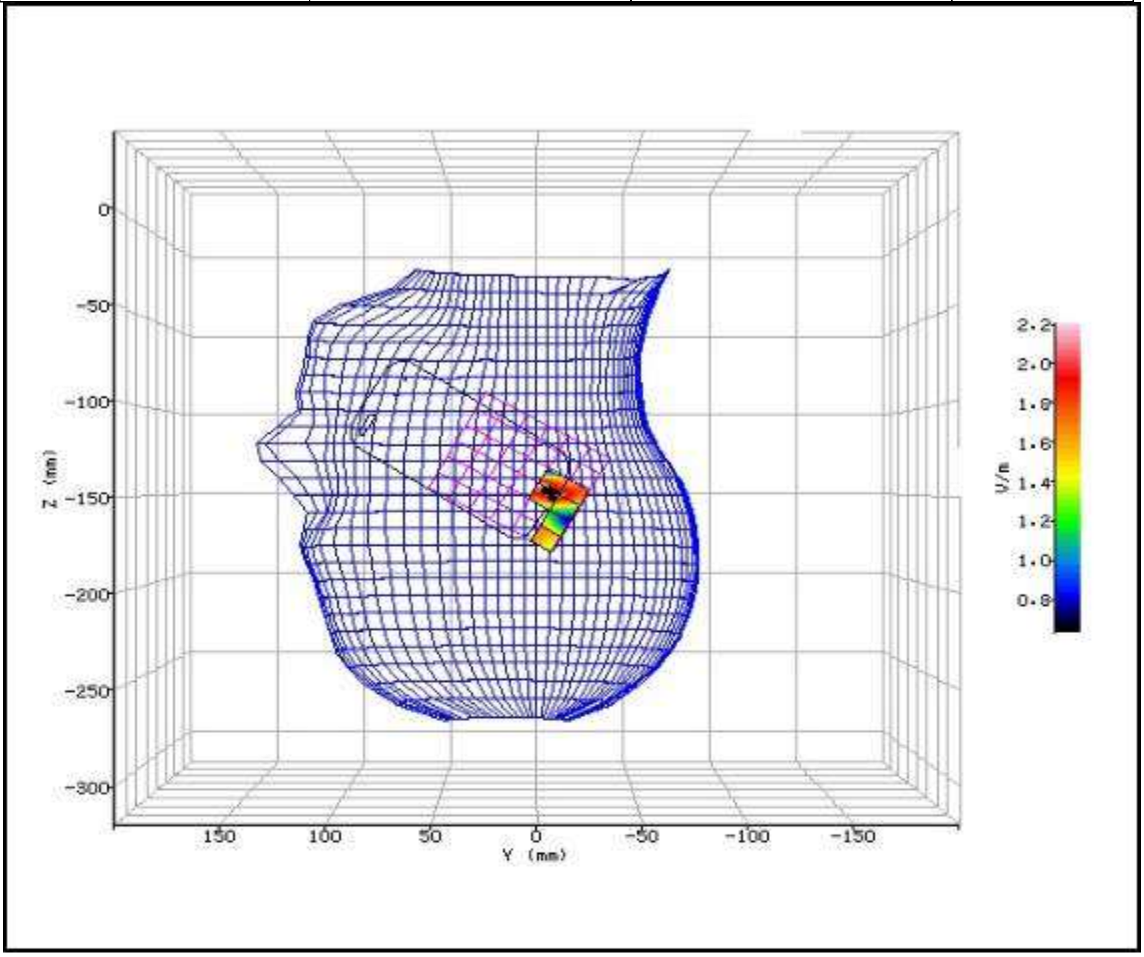


Figure 26: SAR Head Testing Results for the 205SH Mobile Handset at 5240.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-10:25:41	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	40.30mm
DUT POSITION:	Right-Cheek	**MAX SAR Z-AXIS LOCATION:**	-166.90mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.286
TEST FREQUENCY:	5240.0MHz	**SAR 1g:**	0.108 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.163 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.163 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

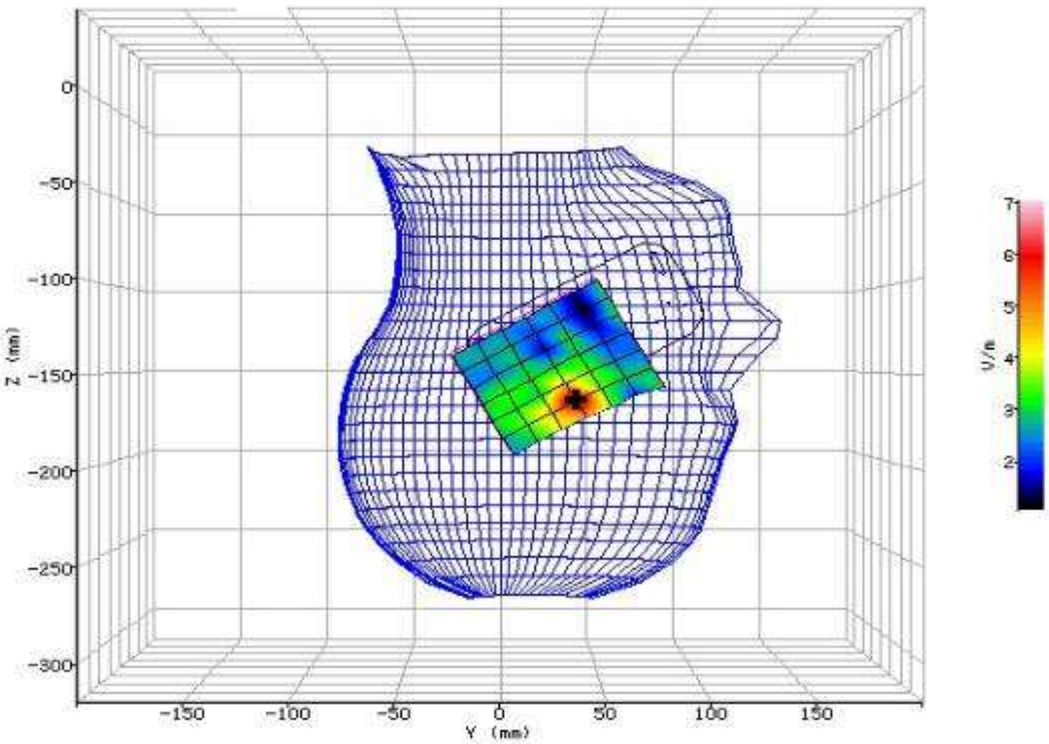


Figure 27: SAR Head Testing Results for the 205SH Mobile Handset at 5240.0MHz. (NUA)

Product Service

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-10:44:37	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	42.10mm
DUT POSITION:	Right-15°	**MAX SAR Z-AXIS LOCATION:**	-168.60mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	3.731
TEST FREQUENCY:	5240.0MHz	**SAR 1g:**	0.050 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.071 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.071 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

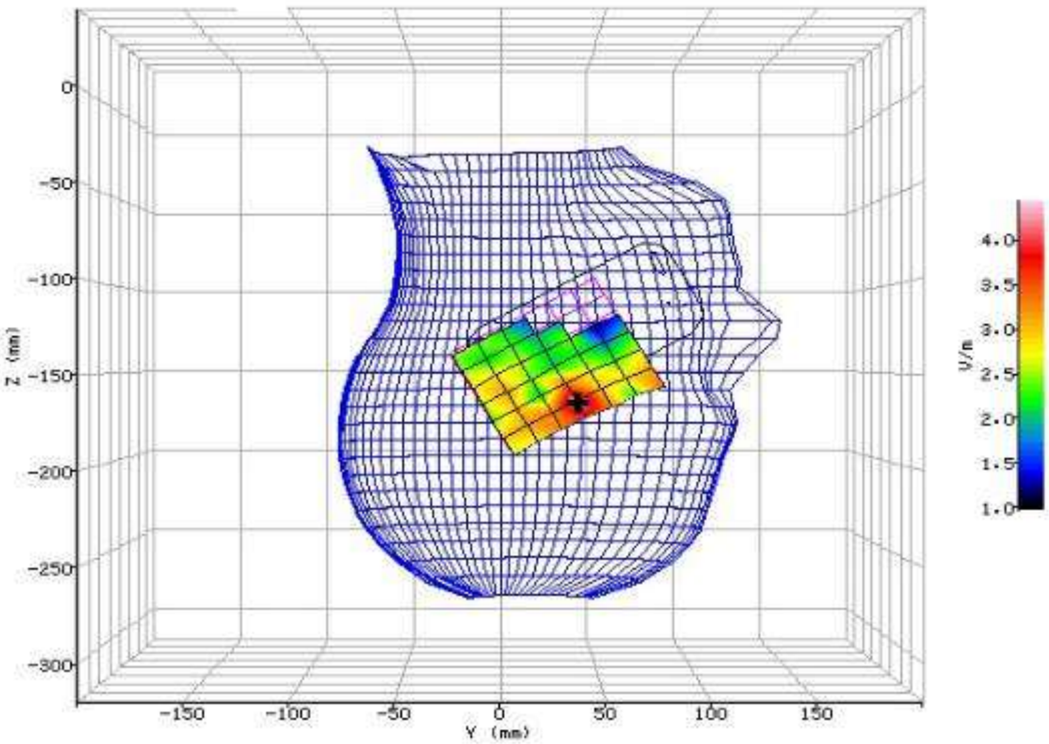


Figure 28: SAR Head Testing Results for the 205SH Mobile Handset at 5240.0MHz. (NUA)

2.7 WLAN 5000MHz HEAD SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-12:43:01	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	10.00mm
DUT POSITION:	Left-Cheek	**MAX SAR Z-AXIS LOCATION:**	-110.40mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	2.305
TEST FREQUENCY:	5280.0MHz	**SAR 1g:**	0.027 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.017 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.017 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

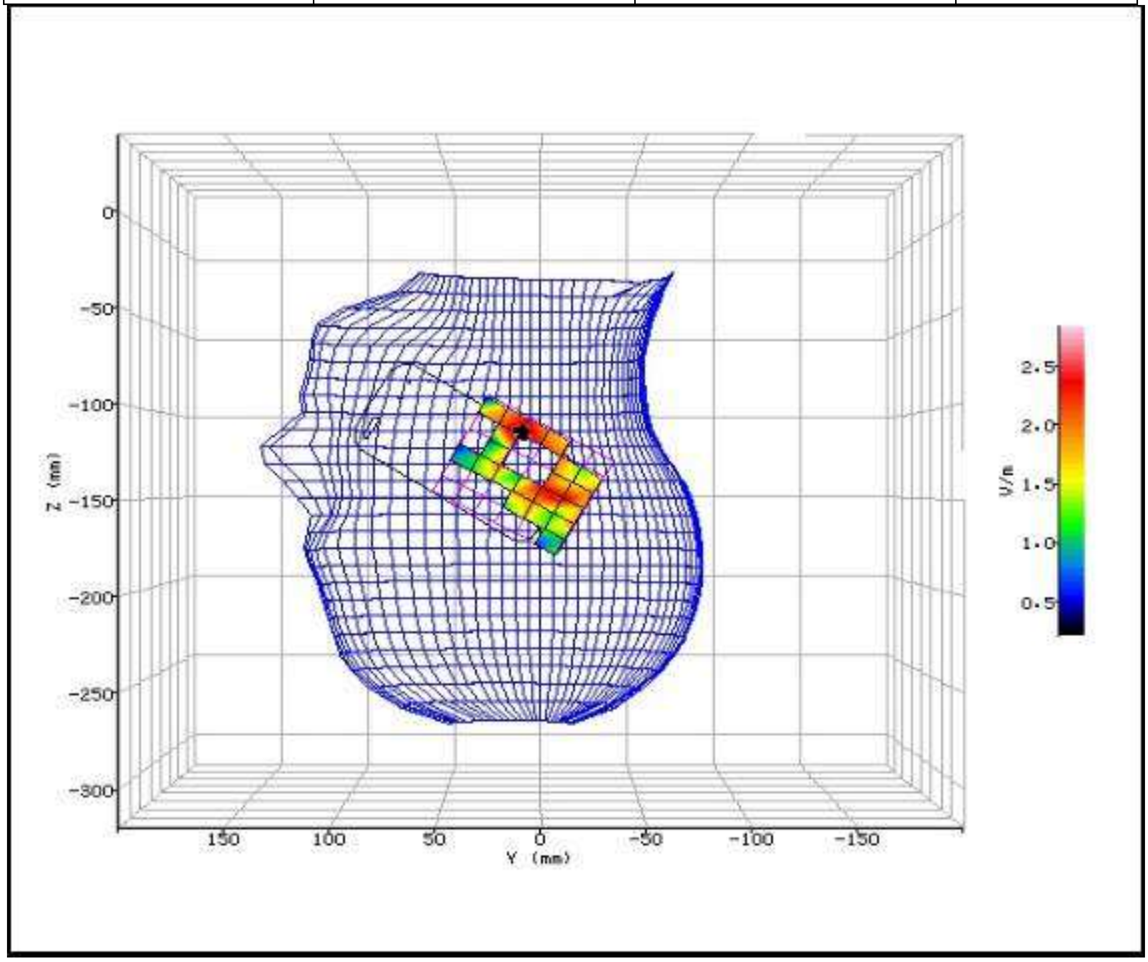


Figure 29: SAR Head Testing Results for the 205SH Mobile Handset at 5280.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-12:53:03	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	-6.60mm
DUT POSITION:	Left-15°	**MAX SAR Z-AXIS LOCATION:**	-147.50mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	1.974
TEST FREQUENCY:	5280.0MHz	**SAR 1g:**	0.019 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.022 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.022 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

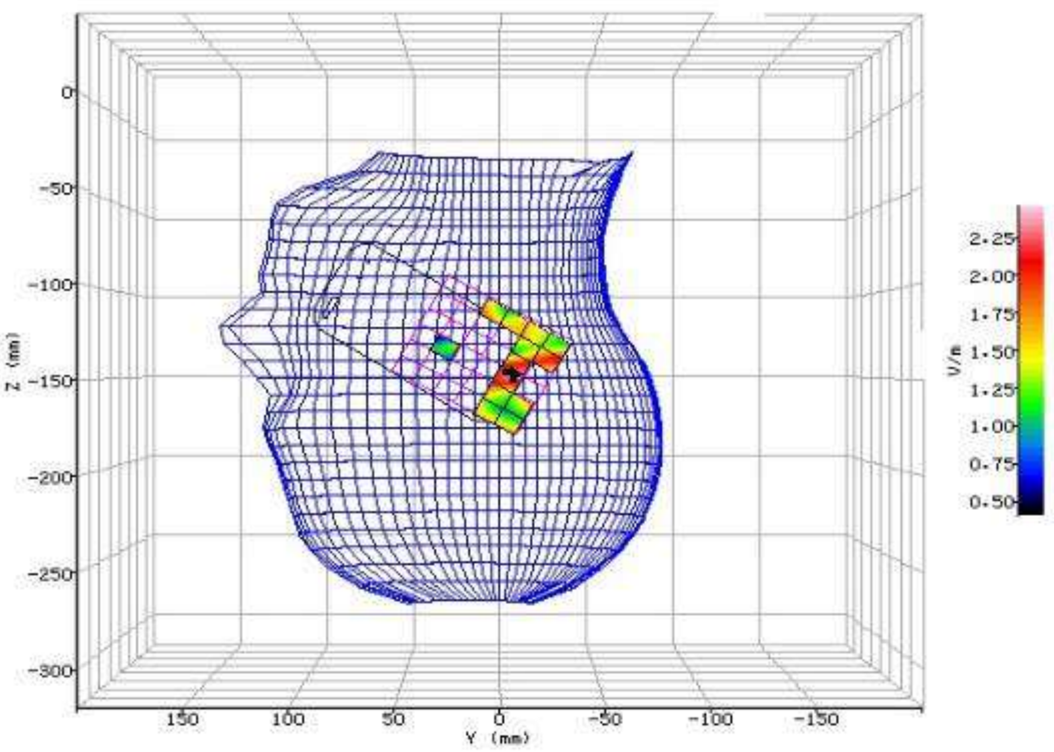


Figure 30: SAR Head Testing Results for the 205SH Mobile Handset at 5280.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-13:23:25	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	39.00mm
DUT POSITION:	Right-Cheek	**MAX SAR Z-AXIS LOCATION:**	-169.40mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.111
TEST FREQUENCY:	5280.0MHz	**SAR 1g:**	0.381 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.188 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.201 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	6.900 %

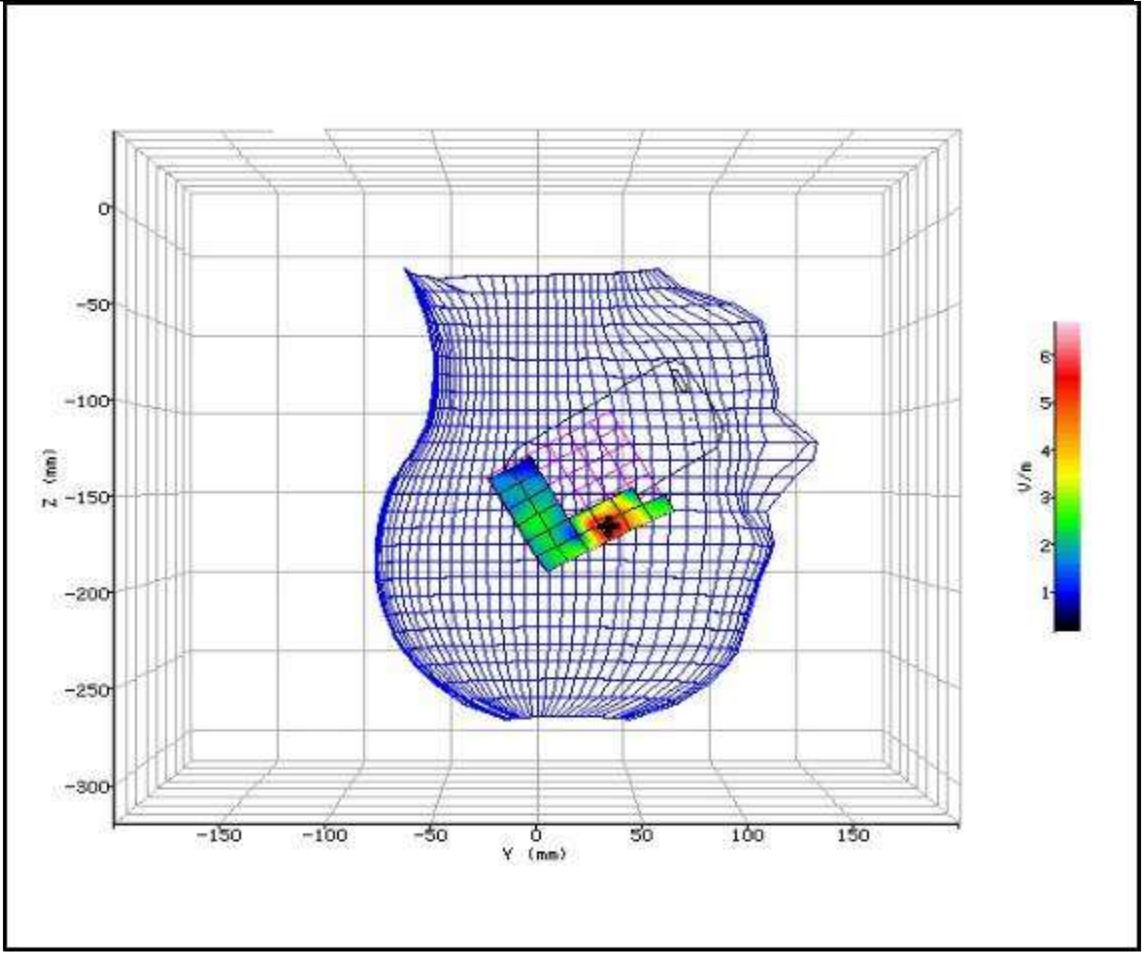


Figure 31: SAR Head Testing Results for the 205SH Mobile Handset at 5280.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	INPUT POWER DRIFT:	0 dB
DATE / TIME:	30/04/2013-13:47:06	DUT BATTERY MODEL/NO:	N/A
AMBIENT TEMPERATURE:	22.50°C	LIQUID SIMULANT:	5200Head
DEVICE UNDER TEST:	205SH	RELATIVE PERMITTIVITY:	34.34
RELATIVE HUMIDITY:	26.20%	CONDUCTIVITY:	4.561
PHANTOM S/NO:	IBX-040	LIQUID TEMPERATURE:	22.70°C
PHANTOM ROTATION:	N/A	MAX SAR Y-AXIS LOCATION:	43.60mm
DUT POSITION:	Right-15°	MAX SAR Z-AXIS LOCATION:	-171.20mm
ANTENNA CONFIGURATION:	N/A	MAX E FIELD:	3.685
TEST FREQUENCY:	5280.0MHz	SAR 1g:	0.095 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	SAR 10g:	N/A
MODN. DUTY CYCLE:	100%	SAR START:	0.080 W/kg
INPUT POWER LEVEL:	20dBm	SAR END:	0.084 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	SAR DRIFT DURING SCAN:	5.000 %

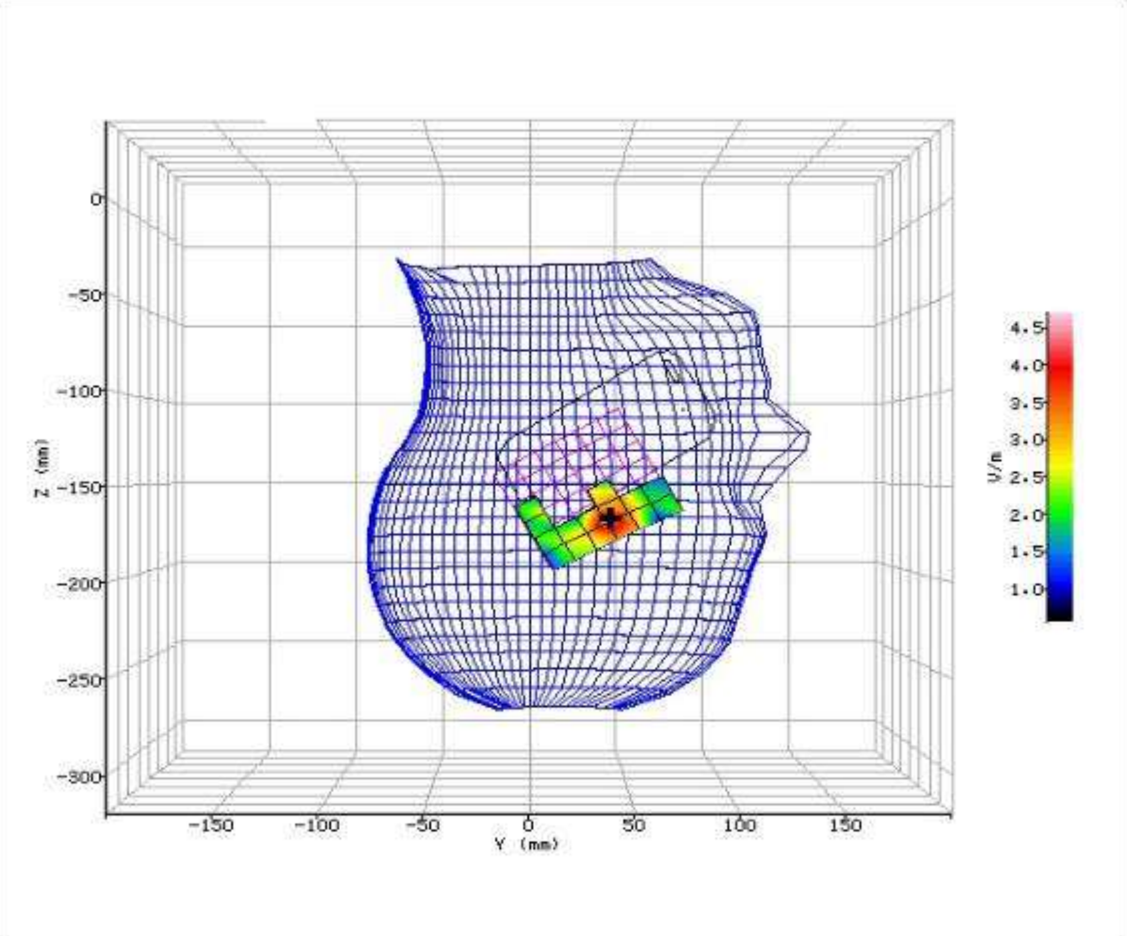


Figure 32: SAR Head Testing Results for the 205SH Mobile Handset at 5280.0MHz. (NUA)

2.8 WLAN 5000MHz HEAD SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-15:36:48	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	-7.80mm
DUT POSITION:	Left-Cheek	**MAX SAR Z-AXIS LOCATION:**	-151.10mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	3.261
TEST FREQUENCY:	5620.0MHz	**SAR 1g:**	0.031 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.049 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.048 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	-2.000 %

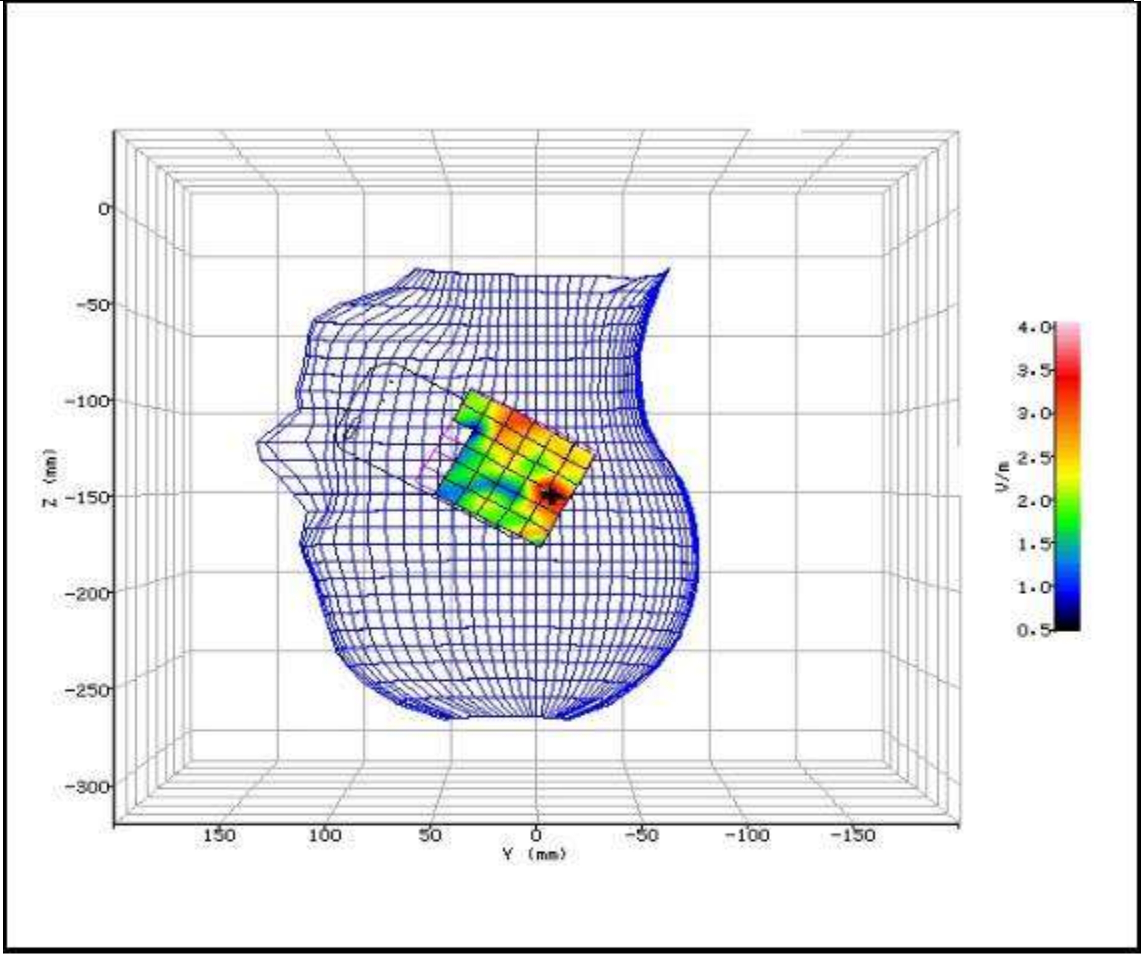


Figure 33: SAR Head Testing Results for the 205SH Mobile Handset at 5620.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-15:56:58	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	-5.00mm
DUT POSITION:	Left-15°	**MAX SAR Z-AXIS LOCATION:**	-149.50mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	2.991
TEST FREQUENCY:	5620.0MHz	**SAR 1g:**	0.047 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.048 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.048 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

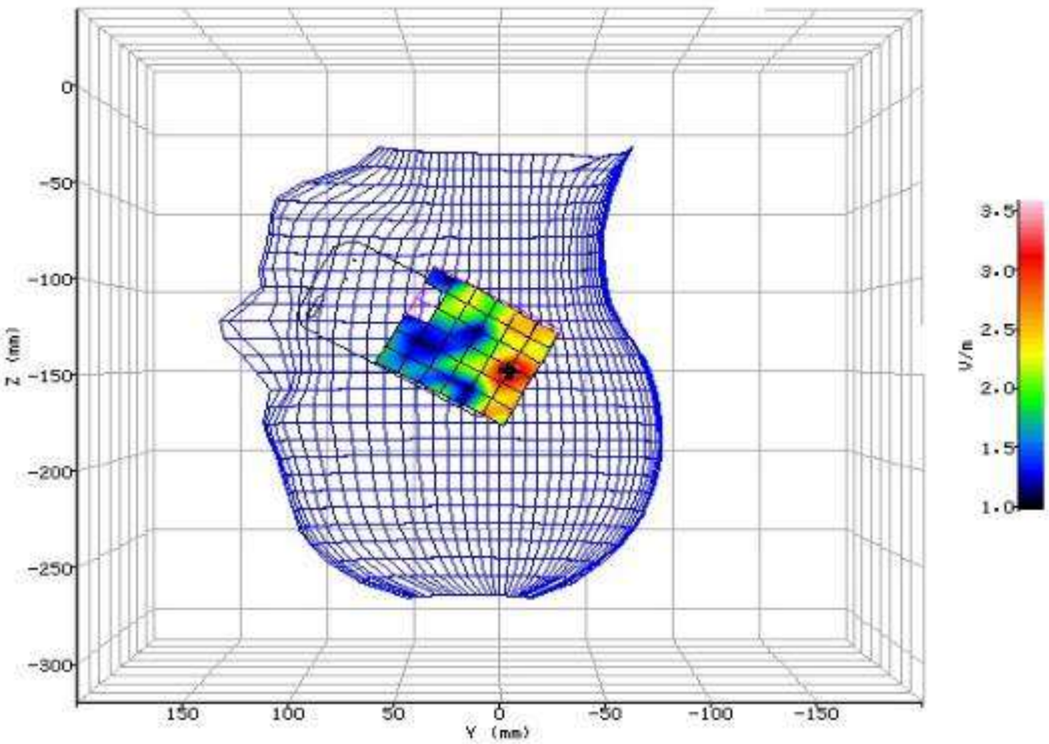


Figure 34: SAR Head Testing Results for the 205SH Mobile Handset at 5620.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-14:39:02	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	42.20mm
DUT POSITION:	Right-Cheek	**MAX SAR Z-AXIS LOCATION:**	-170.80mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	6.170
TEST FREQUENCY:	5620.0MHz	**SAR 1g:**	0.356 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.334 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.309 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	-7.500 %

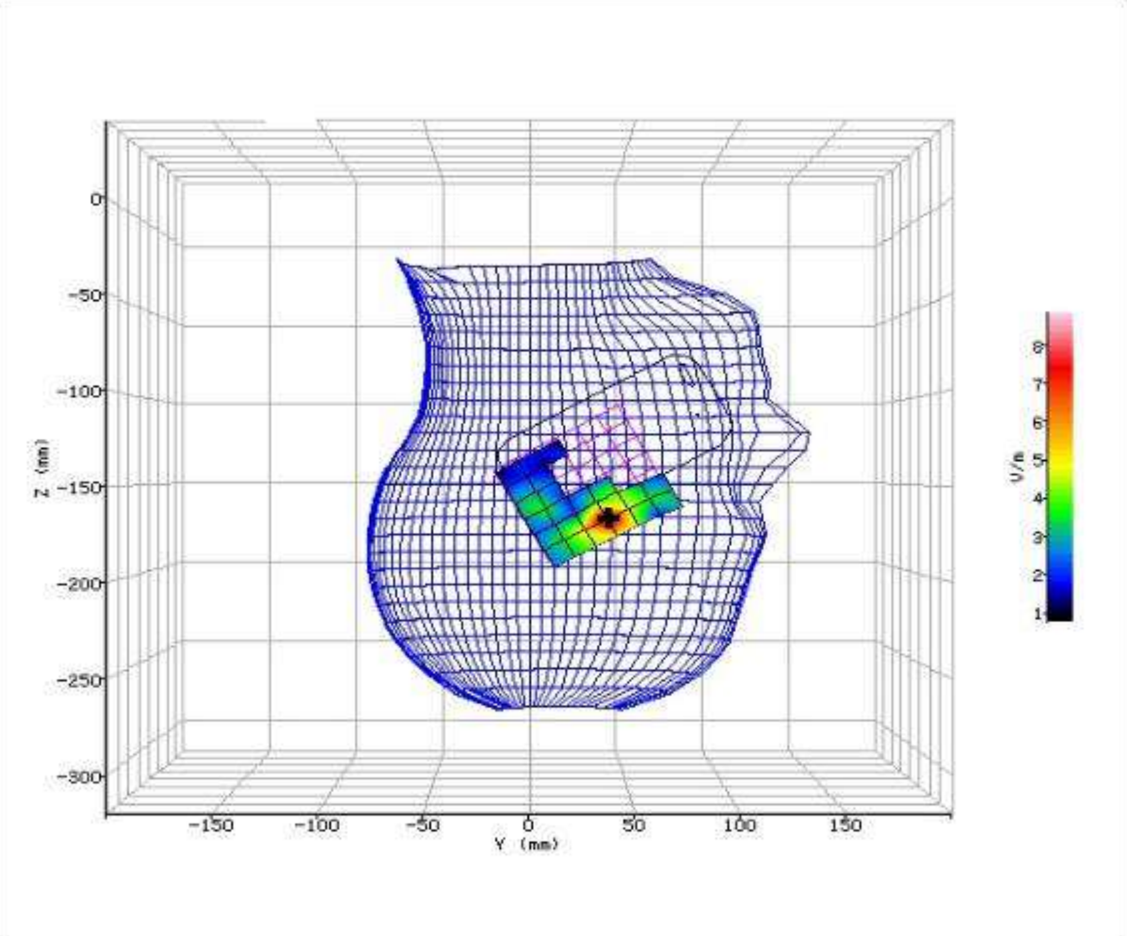


Figure 35: SAR Head Testing Results for the 205SH Mobile Handset at 5620.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.03	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	30/04/2013-14:58:12	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.50°C	**LIQUID SIMULANT:**	5200Head
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	34.34
RELATIVE HUMIDITY:	26.20%	**CONDUCTIVITY:**	4.561
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	43.10mm
DUT POSITION:	Right-15°	**MAX SAR Z-AXIS LOCATION:**	-171.00mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.488
TEST FREQUENCY:	5620.0MHz	**SAR 1g:**	0.110 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.132 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.132 W/kg
PROBE BATTERY LAST CHANGED:	30/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

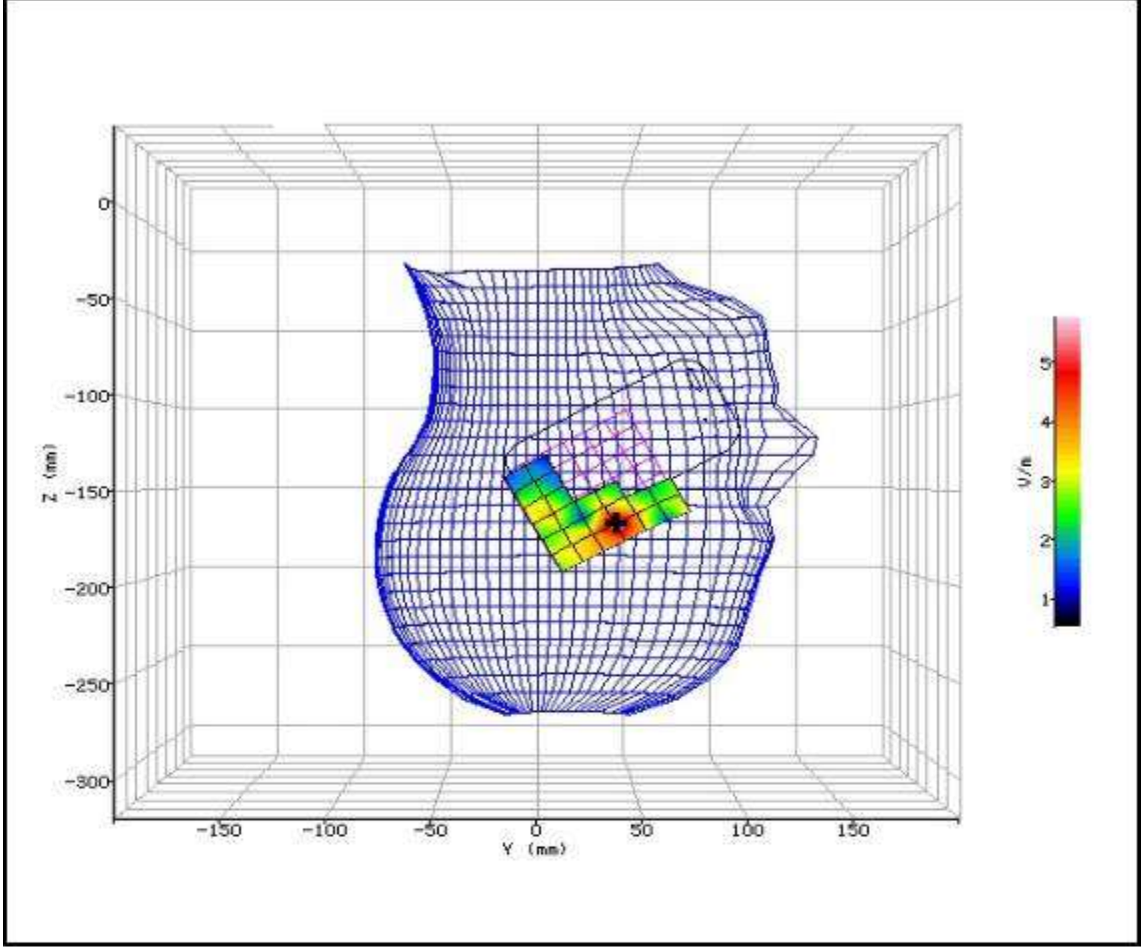


Figure 36: SAR Head Testing Results for the 205SH Mobile Handset at 5620.0MHz. (NUA)

2.9 WLAN 5000MHz BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-08:51:04	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.90°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	41.80%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	39.000mm
DUT POSITION:	10mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	39.100mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	2.001
TEST FREQUENCY:	5240.0MHz	**SAR 1g:**	0.022 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.036 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.036 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

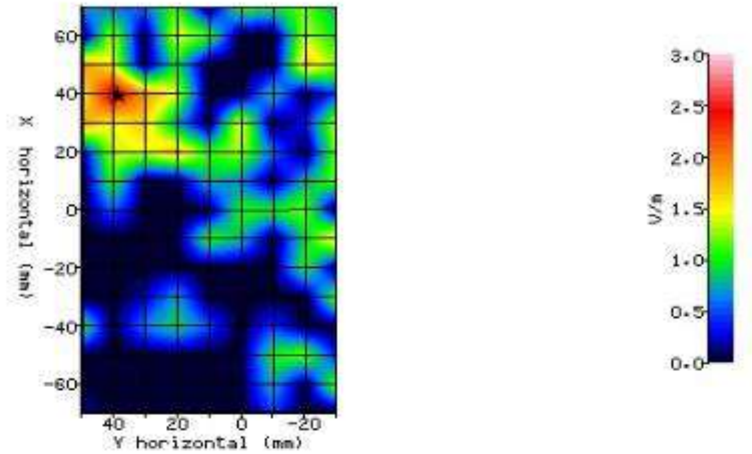


Figure 37: SAR Body Testing Results for the 205SH Mobile Handset at 5240.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-09:07:33	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.90°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	41.80%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	21.200mm
DUT POSITION:	10mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	-18.800mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	3.670
TEST FREQUENCY:	5240.0MHz	**SAR 1g:**	0.061 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.093 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.093 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

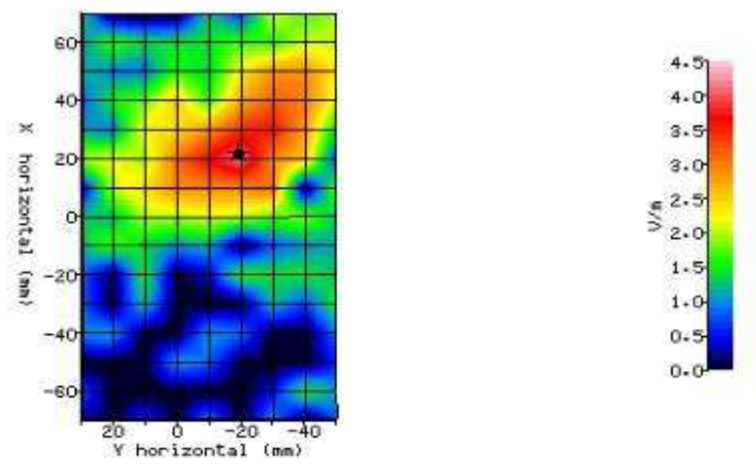


Figure 38: SAR Body Testing Results for the 205SH Mobile Handset at 5240.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-09:21:52	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.90°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	41.80%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	39.500mm
DUT POSITION:	10mm-Right Edge	**MAX SAR Y-AXIS LOCATION:**	8.800mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.188
TEST FREQUENCY:	5240.0MHz	**SAR 1g:**	0.080 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.125 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.128 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	2.000 %

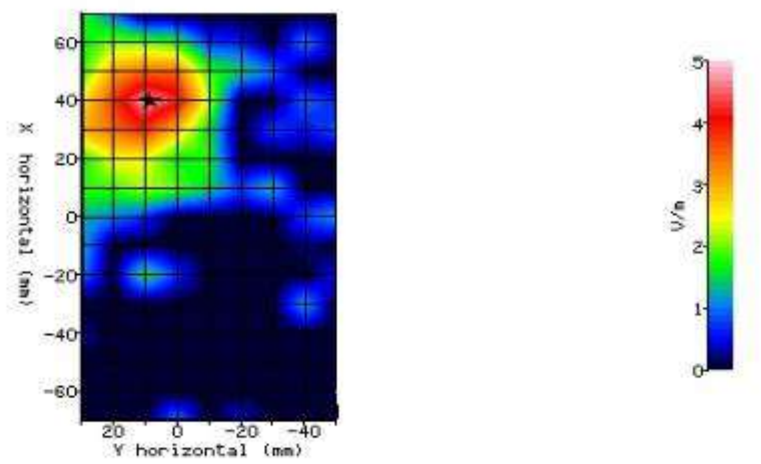


Figure 39: SAR Body Testing Results for the 205SH Mobile Handset at 5240.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-09:58:46	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.90°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	41.80%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.70°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-18.800mm
DUT POSITION:	10mm-Top Edge	**MAX SAR Y-AXIS LOCATION:**	31.200mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	1.484
TEST FREQUENCY:	5240.0MHz	**SAR 1g:**	0.016 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.008 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.008 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

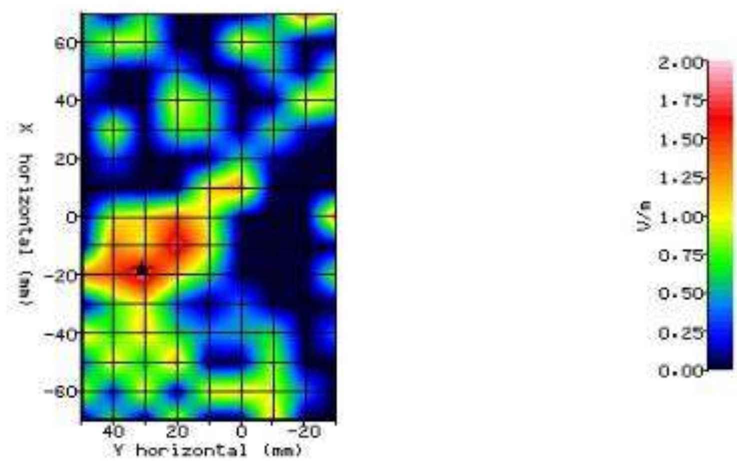


Figure 40: SAR Body Testing Results for the 205SH Mobile Handset at 5240.0MHz. (NUA)

Product Service

2.10 WLAN 5000MHz BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-10:57:18	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.60°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	35.50%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.60°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	33.400mm
DUT POSITION:	10mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	41.000mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	2.160
TEST FREQUENCY:	5280.0MHz	**SAR 1g:**	0.021 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.027 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.030 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	8.700 %

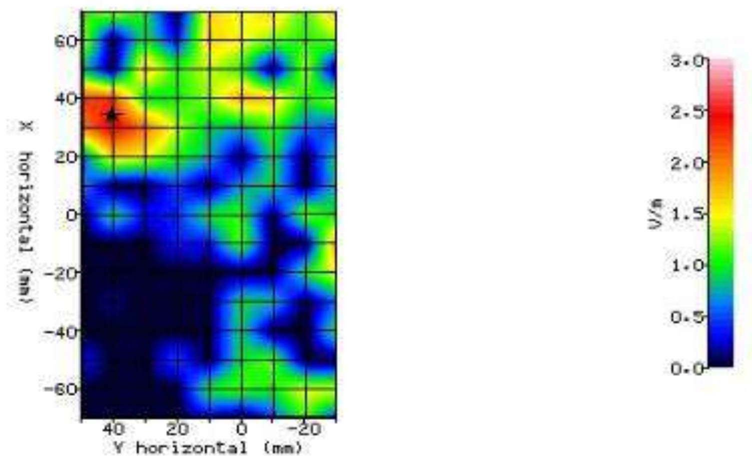


Figure 41: SAR Body Testing Results for the 205SH Mobile Handset at 5280.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-11:11:14	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.60°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	35.50%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.60°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	14.000mm
DUT POSITION:	10mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	-21.900mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	3.664
TEST FREQUENCY:	5280.0MHz	**SAR 1g:**	0.060 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.093 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.099 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	5.900 %

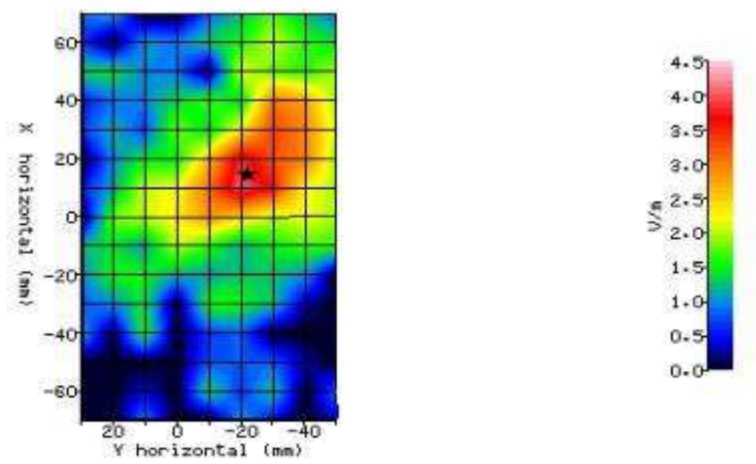


Figure 42: SAR Body Testing Results for the 205SH Mobile Handset at 5280.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-11:24:35	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.60°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	35.50%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.60°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	42.800mm
DUT POSITION:	10mm-Right Edge	**MAX SAR Y-AXIS LOCATION:**	11.500mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	3.986
TEST FREQUENCY:	5280.0MHz	**SAR 1g:**	0.072 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.105 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.108 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	3.600 %

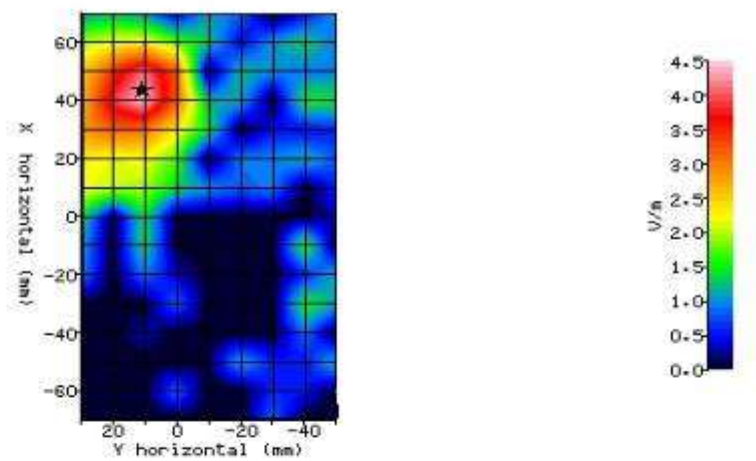


Figure 43: SAR Body Testing Results for the 205SH Mobile Handset at 5280.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-11:41:02	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.60°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	35.50%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.60°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-16.600mm
DUT POSITION:	10mm-Top Edge	**MAX SAR Y-AXIS LOCATION:**	24.400mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	1.636
TEST FREQUENCY:	5280.0MHz	**SAR 1g:**	0.019 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.025 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.025 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

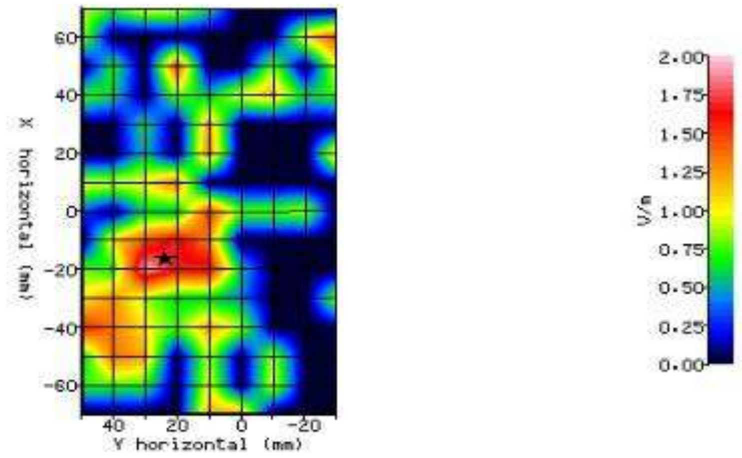


Figure 44: SAR Body Testing Results for the 205SH Mobile Handset at 5280.0MHz. (NUA)

2.11 WLAN 5000MHz BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-13:04:20	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	21.80°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	38.20%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.40°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	29.600mm
DUT POSITION:	10mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	38.300mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	1.659
TEST FREQUENCY:	5620.0MHz	**SAR 1g:**	0.031 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.026 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.026 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

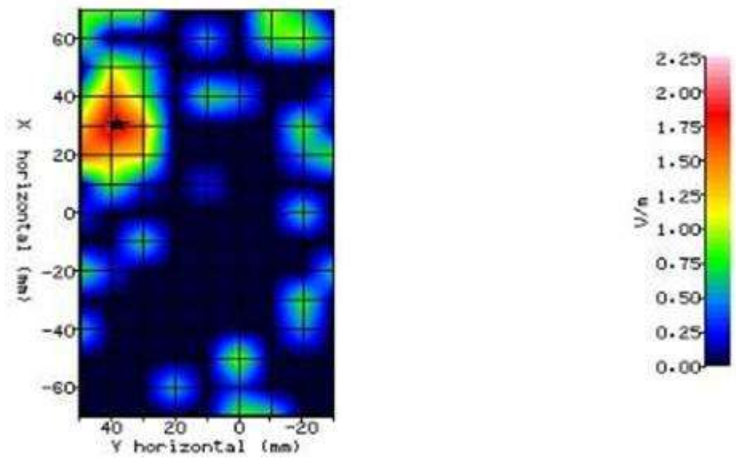
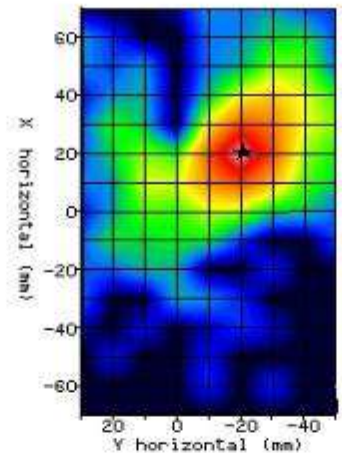


Figure 45: SAR Body Testing Results for the 205SH Mobile Handset at 5620.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-13:17:47	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	21.80°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	38.20%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.40°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	20.000mm
DUT POSITION:	10mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	-20.400mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.711
TEST FREQUENCY:	5620.0MHz	**SAR 1g:**	0.161 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.263 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.267 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	1.700 %



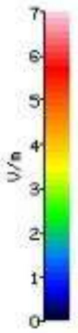


Figure 46: SAR Body Testing Results for the 205SH Mobile Handset at 5620.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-13:35:05	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	21.80°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	38.20%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.40°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	40.600mm
DUT POSITION:	10mm-Right Edge	**MAX SAR Y-AXIS LOCATION:**	10.500mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.042
TEST FREQUENCY:	5620.0MHz	**SAR 1g:**	0.125 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.178 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.168 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	-5.800 %

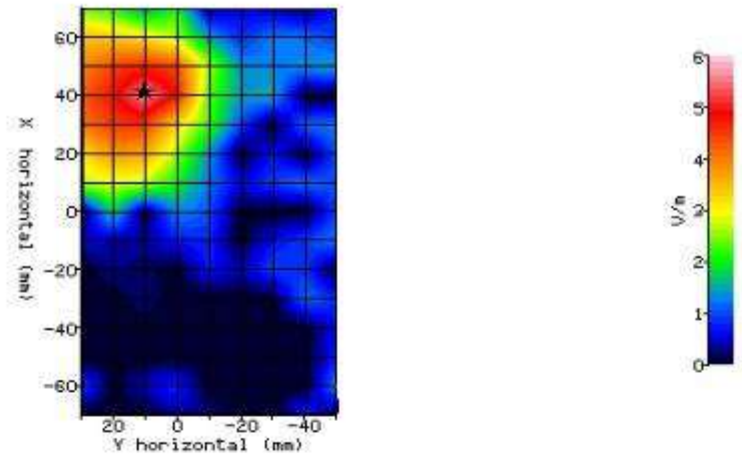


Figure 47: SAR Body Testing Results for the 205SH Mobile Handset at 5620.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.07.14	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	24/04/2013-14:19:06	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	21.80°C	**LIQUID SIMULANT:**	5200Body
DEVICE UNDER TEST:	205SH	**RELATIVE PERMITTIVITY:**	47.93
RELATIVE HUMIDITY:	38.20%	**CONDUCTIVITY:**	5.124
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.40°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-40.800mm
DUT POSITION:	10mm-Top Edge	**MAX SAR Y-AXIS LOCATION:**	29.100mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	1.393
TEST FREQUENCY:	5620.0MHz	**SAR 1g:**	0.010 W/kg
TYPE OF MODULATION:	WLAN (OFDM)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.018 W/kg
INPUT POWER LEVEL:	20dBm	**SAR END:**	0.018 W/kg
PROBE BATTERY LAST CHANGED:	24/04/2013	**SAR DRIFT DURING SCAN:**	0.000 %

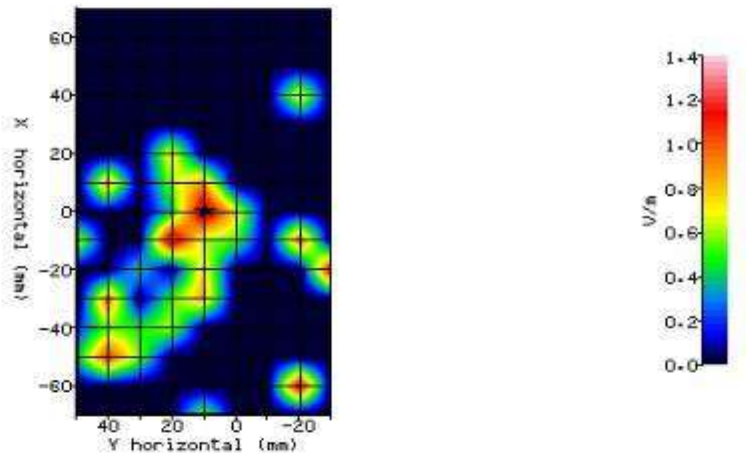


Figure 48: SAR Body Testing Results for the 205SH Mobile Handset at 5620.0MHz. (NUA)

Product Service

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

The following test equipment was used at TÜV SÜD Product Service:

Instrument Description	Manufacturer	Model Type	TE Number	Cal Period (months)	Calibration Due Date
10MHz - 2.5GHz, 3W, Amplifier	Vectawave Technology	VTL5400	51	-	TU
Power Sensor	Rohde & Schwarz	NRV-Z1	60	12	12-Jun-2013
Signal Generator	Hewlett Packard	ESG4000A	61	12	23-May-2013
Thermometer	Digitron	T208	64	12	16-Jan-2014
Amplifier (5GHz)	IndexSar Ltd	5GHz	157	-	TU
Communications Tester	Rohde & Schwarz	CMU 200	442	12	1-Nov-2013
Directional Coupler	Hewlett Packard	11692D	452	-	TU
Attenuator (20dB, 10W)	Weinschel	37-20-34	482	12	11-Oct-2013
Spectrum Analyser	Hewlett Packard	8562A	1001	12	15-Nov-2013
Dipole Positioner/Support (plastic)	IndexSar Ltd	IXH-020	1584	-	TU
Bi-directional Coupler	IndexSar Ltd	7401 (VDC0830-20)	2414	-	TU
Hygromer	Rotronic	I-1000	2784	12	3-Apr-2014
Power Sensor	Rohde & Schwarz	NRV- Z5	2878	12	12-Jun-2013
Dual Channel Power Meter	Rohde & Schwarz	NRVD	3259	12	12-Jun-2013
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	1-Feb-2014
SAR 900 MHz dipole	Speag	D900V2	3856	-	O/P Mon
SAR 835 MHz dipole	Speag	D835V2	3857	-	O/P Mon
SAR 1900 MHz dipole	Speag	D1900V2	3876	-	O/P Mon
SAR 2450 MHz dipole	Speag	D2450V2	3875	-	O/P Mon
Immersible SAR Probe	IndexSar Ltd	IPX-020	4077	12	17-May-2013
Immersible SAR Probe	IndexSar Ltd	IPX-050	4077	12	28-Feb-2014
Part of SARAC System	IndexSar Ltd	Cartesian Leg Extension	4078	-	TU
Cartesian 4-axis Robot	IndexSar Ltd	SARAC	4079	-	TU
Part of SARAC System	IndexSar Ltd	Wooden Bench	4081	-	TU
Flat Phantom	IndexSar Ltd	IXB-2HF 800-6000MHz	4255	-	TU
835MHz Head Fluid	TUV SUD Product Service	Batch 19	N/A	1	31-May-2013
835MHz Body Fluid	TUV SUD Product Service	Batch 13	N/A	1	31-May-2013
2450MHz Head Fluid	TUV SUD Product Service	Batch 10	N/A	1	31-May-2013
2450MHz Body Fluid	TUV SUD Product Service	Batch 7	N/A	1	31-May-2013
5200MHz Head Fluid	TUV SUD Product Service	Batch 3	N/A	1	31-May-2013
5200MHz Body Fluid	TUV SUD Product Service	Batch 2	N/A	1	31-May-2013
5500MHz Head Fluid	TUV SUD Product Service	Batch 3	N/A	1	31-May-2013
5500MHz Body Fluid	TUV SUD Product Service	Batch 2	N/A	1	31-May-2013

TU – Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment.

3.2 TEST SOFTWARE

The following software was used to control the TÜV SÜD Product Service SARA2 System.

Instrument	Version Number	Date
SARA-C system	v.6.07.10	28 February 2010
IFA-10 Probe amplifier	Version 2	-

3.3 DIELECTRIC PROPERTIES OF SIMULANT LIQUIDS

The fluid properties of the simulant fluids used during routine SAR evaluation meet the dielectric properties required by OET 65(C) – 2001.

IEEE 1528 Recipes

Frequency (MHz)	300	450		835	900			1450	1800				1900		1950	2000	2100		2450		3000
Recipe#	1	1	3	1	1	2	3	1	1	2	2	3	1	2	4	1	1	2	2	3	2
Ingredients (% by weight)																					
1, 2-Pro-panediol						64.81															
Bactericide	0.19	0.19	0.50	0.10	0.10		0.50													0.50	
Diacetin			48.90				49.20													49.45	
DGBE								45.41	47.00	13.84	44.92		44.94	13.84	45.00	50.00	50.00	7.99	7.99		7.99
HEC	0.98	0.96		1.00	1.00																
NaCl	5.95	3.95	1.70	1.45	1.48	0.79	1.10	0.67	0.36	0.35	0.18	0.64	0.18	0.35				0.16	0.16		0.16
Sucrose	55.32	56.32		57.00	56.50																
Triton X-100										30.45				30.45				19.97	19.97		19.97
Water	37.56	38.56	48.90	40.45	40.92	34.40	49.20	53.80	52.64	55.36	54.90	49.43	54.90	55.36	55.00	50.00	50.00	71.88	71.88	49.75	71.88
Measured dielectric parameters																					
ε'_r	46.00	43.40	44.30	41.60	41.20	41.80	42.70	40.9	39.3	41.00	40.40	39.20	39.90	41.00	40.10	37.00	36.80	41.10	40.30	39.20	37.90
σ (S/m)	0.86	0.85	0.90	0.90	0.98	0.97	0.99	1.21	1.39	1.38	1.40	1.40	1.42	1.38	1.41	1.40	1.51	1.55	1.88	1.82	2.46
Temp (ºC)	22	22	20	22	22	22	20	22	22	21	22	20	21	21	20	22	22	20	20	20	20
Target dielectric parameters (Table 2)																					
ε'_r	45.30	43.50		41.5	41.50			40.50	40.00								39.80		39.20		38.50
σ (S/m)	0.87	0.87		0.9	0.97			1.20	1.40								1.49		1.80		2.40

NOTE – Multiple columns for any single frequency are optional recipe #, reference: 1 (Kanda et al. [B185]), 2 (Vigneras [B143]), 3 (Peyman and Gabriel [B119]), 4 (Fukunaga et al [B50])

The dielectric properties of the tissue simulant liquids used for the SAR testing at TÜV SÜD Product Service are as follows:-

Fluid Type and Frequency	Relative Permittivity εR (ε') Target	Relative Permittivity εR (ε') Measured	Conductivity σ Target	Conductivity σ Measured
835 MHz Head	41.5	39.91	0.90	0.877
835 MHz Body	55.0	57.18	0.97	1.018
2450 MHz Head	39.2	38.40	1.8	1.814
2450 MHz Body	52.7	51.73	1.95	1.982
5200 MHz Head	36.0	34.34	4.66	4.561
5200 MHz Body	49.0	47.93	5.30	5.124
5500 MHz Head	35.6	33.82	4.96	4.901
5500 MHz Body	48.6	47.15	5.65	5.614

3.4 TEST CONDITIONS

3.4.1 Test Laboratory Conditions

Ambient temperature: Within +15°C to +35°C.
The actual temperature during the testing ranged from 21.8°C to 42.1°C.
The actual humidity during the testing ranged from 26.2% to 42.1% RH.
.

3.4.2 Test Fluid Temperature Range

Frequency	Body / Head Fluid	Min Temperature °C	Max Temperature °C
835 MHz	Head	22.6	22.6
835 MHz	Body	22.7	22.7
2450 MHz	Head	22.9	42.1
2450 MHz	Body	22.5	22.5
5000 MHz	Head	22.7	22.7
5000 MHz	Body	22.4	22.7

3.4.3 SAR Drift

The SAR Drift was within acceptable limits during scans. The maximum SAR Drift, drift due to the handset electronics, was recorded as 8.7% (0.920 dB) for all of the testing. The measurement uncertainty budget for this assessment includes the maximum SAR Drift figures for Head and/or Body as applicable.

3.5 MEASUREMENT UNCERTAINTY

Head SAR Measurements.

Source of Uncertainty	Description	Tolerance / Uncertainty ± %	Probability distribution	Div	c_i (1g)	Standard Uncertainty ± % (1g)	v_i or v_{eff}
Measurement System							
Probe calibration	7.2.1	8.73	N	1	1	8.73	∞
Isotropy	7.2.1.2	3.18	R	1.73	1	1.84	∞
Probe angle >30deg	additional	12.00	R	1.73	1	6.93	∞
Boundary effect	7.2.1.5	0.49	R	1.73	1	0.28	∞
Linearity	7.2.1.3	1.00	R	1.73	1	0.58	∞
Detection limits	7.2.1.4	0.00	R	1.73	1	0.00	∞
Readout electronics	7.2.1.6	0.30	N	1	1	0.30	∞
Response time	7.2.1.7	0.00	R	1.73	1	0.00	∞
Integration time (equiv.)	7.2.1.8	1.38	R	1.73	1	0.80	∞
RF ambient conditions	7.2.3.6	3.00	R	1.73	1	1.73	∞
Probe positioner mech. restrictions	7.2.2.1	5.35	R	1.73	1	3.09	∞
Probe positioning with respect to phantom shell	7.2.2.3	5.00	R	1.73	1	2.89	∞
Post-processing	7.2.4	7.00	R	1.73	1	4.04	∞
Test sample related							
Test sample positioning	7.2.2.4	1.50	R	1.73	1	0.87	∞
Device holder uncertainty	7.2.2.4.2	1.73	R	1.73	1	1.00	∞
Drift of output power	7.2.3.4	-7.5	R	1.73	1	-4.33	∞
Phantom and set-up							
Phantom uncertainty (shape and thickness tolerances)	7.2.2.2	2.01	R	1.73	1	1.16	∞
Liquid conductivity (target)	7.2.3.3	5.00	R	1.73	0.64	1.85	∞
Liquid conductivity (meas.)	7.2.3.3	5.00	N	1	0.64	3.20	∞
Liquid permittivity (target)	7.2.3.4	5.00	R	1.73	0.6	1.73	∞
Liquid permittivity (meas.)	7.2.3.4	3.00	N	1	0.6	1.80	∞
Combined standard uncertainty			RSS			14.41	
Expanded uncertainty (95% confidence interval)			K=2			28.82	

Body SAR Measurements.

Source of Uncertainty	Description	Tolerance / Uncertainty ± %	Probability distribution	Div	c_i (1g)	Standard Uncertainty ± % (1g)	v_i or v_{eff}
Measurement System							
Probe calibration	7.2.1	8.73	N	1	1	8.73	∞
Isotropy	7.2.1.2	3.18	R	1.73	1	1.84	∞
Boundary effect	7.2.1.5	0.49	R	1.73	1	0.28	∞
Linearity	7.2.1.3	1.00	R	1.73	1	0.58	∞
Detection limits	7.2.1.4	0.00	R	1.73	1	0.00	∞
Readout electronics	7.2.1.6	0.30	N	1	1	0.30	∞
Response time	7.2.1.7	0.00	R	1.73	1	0.00	∞
Integration time (equiv.)	7.2.1.8	1.38	R	1.73	1	0.80	∞
RF ambient conditions	7.2.3.6	3.00	R	1.73	1	1.73	∞
Probe positioner mech. restrictions	7.2.2.1	0.60	R	1.73	1	0.35	∞
Probe positioning with respect to phantom shell	7.2.2.3	2.00	R	1.73	1	1.15	∞
Post-processing	7.2.4	7.00	R	1.73	1	4.04	∞
Test sample related							
Test sample positioning	7.2.2.4	1.50	R	1.73	1	0.87	∞
Device holder uncertainty	7.2.2.4.2	1.73	R	1.73	1	1.00	∞
Drift of output power	7.2.3.4	8.7	R	1.73	1	2.89	∞
Phantom and set-up							
Phantom uncertainty (shape and thickness tolerances)	7.2.2.2	2.01	R	1.73	1	1.16	∞
Liquid conductivity (target)	7.2.3.3	5.00	R	1.73	0.64	1.85	∞
Liquid conductivity (meas.)	7.2.3.3	5.00	N	1	0.64	3.20	∞
Liquid permittivity (target)	7.2.3.4	5.00	R	1.73	0.6	1.73	∞
Liquid permittivity (meas.)	7.2.3.4	3.00	N	1	0.6	1.80	∞
Combined standard uncertainty			RSS			11.52	
Expanded uncertainty (95% confidence interval)			K=2			23.05	

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

ANNEX A

PROBE CALIBRATION REPORT

TÜV SÜD Product Service

NATIONAL PHYSICAL LABORATORY

Teddington Middlesex UK TW11 0LW Telephone +44 20 8977 3222

Certificate of Calibration

SAR PROBE
IndexSAR

Model: IXP-050

Serial number: 0170

FOR: Indexsar Ltd.
Oakfield House
Cudworth Lane
Newdigate
Surrey
RH5 5BG

DESCRIPTION: An IndexSAR isotropic electric field probe for determining specific absorption rates (SAR) in dielectric liquids. The probe has three orthogonal sensors, and the output voltage of the sensors is converted to an optical signal by a meter unit containing an analogue to digital (AD) converter. Probe readings are obtained using software via the RS232 port. The probe was calibrated with IndexSAR amplifier model IXA-010 S/N 036 belonging to NPL.

IDENTIFICATION: The probe is marked with the manufacturer's serial number 0170

MEASUREMENTS COMPLETED ON: 1 March 2012

The reported uncertainty is based on a coverage factor $k = 2$, providing a level of confidence of approximately 95%

Reference : 2012020074-1

Date of Issue : 1 March 2012

Checked by : BGL

Page 1 of 7

Signed : B Loader **(Authorised Signatory)**

Name : Mr B G Loader **on behalf of NPLML**

Product Service

NATIONAL PHYSICAL LABORATORY

Continuation Sheet

MEASUREMENT PROCEDURE

For frequencies at or above 835 MHz, the calibration method is based on establishing a calculable specific absorption rate (SAR) using a matched waveguide cell [1]. The cell has a feed-section and a liquid-filled section separated by a matching window that is designed to minimise reflections at the interface. A TE_{01} mode is launched into the waveguide by means of a N-type-to-waveguide adapter. The power delivered to the liquid is calculated from the forward power and reflection coefficient measured at the input to the cell. At the centre of the cross-section of the waveguide cell, the volume specific absorption rate (SAR^V) in the liquid as a function of distance from the window is given by

$$SAR^V = \frac{4(P_w)}{ab\delta} e^{-2Z/\delta} \qquad (1)$$

where

a = the larger cross-sectional dimension of the waveguide.
b = the smaller cross-sectional dimension of the waveguide.
δ = the skin depth for the liquid in the waveguide.
Z = the distance of the probe's sensors from the liquid to matching window boundary.
P_w = the power delivered to the liquid.

For frequencies below 835 MHz, the SAR in the liquid is established by measuring the rate of temperature rise in the liquid at the calibration point. In this case the SAR in the liquid is related to the temperature rise by

$$SAR = c\frac{dT}{dt} \qquad (2)$$

where c is the specific heat of the liquid.

Liquids having the properties specified by SAR measurement standards [2, 3, 4] were used for the calibration. The value of δ for the liquid was obtained by measuring the electric field (E) at a number of distances from the matching window. The calibration was for continuous wave (CW) signals, and the axis of the probe was parallel to the direction of propagation of the incident field i.e. end-on to the incident radiation. The probe was rotated about its axis in 15-degree steps, and the ratio of the calibration factors for the three probe sensors X, Y, & Z were optimized to give the best axial isotropy.

Reference : 2012020074-1 **Page 2 of 7**

Date of Issue : 1 March 2012

Checked by : BCL

Product Service

NATIONAL PHYSICAL LABORATORY

Continuation Sheet

The probe was calibrated with the linearisation and air-correction factors enabled. Comparing the measured values of E^2 in the liquid to those calculated for the waveguide cell allows the ratio, *ConvF*, of sensitivity for $(E^2_{LIQUID}) / (E^2_{AIR})$ to be determined, as required by the probe software.

The linear response of the probe to continuous wave signals was tested at 1800 MHz over the range 0.12 W/kg to 100 W/kg in accordance with [3].

The spherical isotropy of the probe was tested in head liquid at 900 MHz, in accordance with [3, 5, 6], for probe axial rotation (θ) through 360° and source polarisation (φ) rotation through 90 ° in 15° increments.

ENVIRONMENT

Measurements were made in a temperature-controlled laboratory at 22 ± 1°C. The temperature of the liquid used was measured at the beginning and end of each measurement.

UNCERTAINTIES

The estimated uncertainty in calibration for SAR (W kg^{-1}) is ± 10 %. The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

This uncertainty is valid when the probe is used in a liquid with the same dielectric properties as those used for the calibration. No estimate is made for the long-term stability of the device calibrated or of the fluids used in the calibration.

When using the probe for SAR testing, additional uncertainties should be added to account for the spherical isotropy of the probe, proximity effects, linearity, and response to pulsed fields. There will be additional uncertainty if the probe is used in liquids having significantly different electrical properties to those used for the calibration. The electrical properties of the liquids will be related to temperature.

RESULTS

Tables 1 and 2 give the results for calibration in liquid.

These calibration factors are only correct when the values for sensitivity in free-space, diode compression and sensor offset from the tip of the probe, as set in the probe software, are the same as those given in Table 1 and 2.

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Table 3 contains the values of the boundary correction factors *f(0)* and *d*.

Table 4 gives the probe linearity and spherical isotropy.

REFERENCES:

[1] Pokovic, KT, T.Schmid and N.Kuster, "Robust set-up for Precise Calibration of E-field probes in Tissue Simulating Liquids at Mobile Phone Frequencies", Proceedings ICECOM 1997, pp 120 – 124, Dubrovnik, Croatia Oct 12-17, 1997.

[2] British Standard BS EN 503361:2001. "Basic standard for the measurement of specific absorption rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)".

[3] IEEE Standard 1528-2003 "Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques".

[4] Federal Communications Commission, FCC OET Bulletin 65, Supplement C, June 2001, "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", David L. Means, Kwok W. Chan.

[5] IEC Standard 62209-1 Ed 1. (2005), "Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices - Human models, Instrumentation, and Procedures – - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)".

[6] IEC Standard 62209-2 Ed 1. (2010), "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)".

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Table 1
Sensitivity in Head Simulating Liquids.
SAR probe: IXP-050
S/N 0170

Probe settings for calibration		
Sensitivity in free-space[1]	**Diode Compression[2]**	**Sensor offset from tip of probe[2]**
Lin X =524.99 $(V/m)^2/(V*200)$ Lin Y = 453.82 $(V/m)^2/(V*200)$ Lin Z = 484.81 $(V/m)^2/(V*200)$	DCP_X = 20 (V*200) DCP_Y = 20 (V*200) DCP_Z= 20 (V*200)	2.7 mm

Sensitivity in Head Simulating Liquid.						
Calibration frequency	Liquid Phantom[3]		Calibration Factors for E^2_{Liquid} / E^2_{Air}			Axial Isotropy
(MHz)	ε' [3]	σ [3] (Sm^{-1})	$ConvF_X$	$ConvF_Y$	$ConvF_Z$	(dB)
450	41.8	0.88	**0.180**	**0.177**	**0.187**	±0.01
835	40.2	0.93	**0.240**	**0.215**	**0.228**	±0.01
900	39.8	0.97	**0.242**	**0.217**	**0.228**	±0.01
1800	40.0	1.41	**0.277**	**0.299**	**0.295**	±0.05
1900	39.2	1.39	**0.308**	**0.335**	**0.292**	±0.01
2100	40.5	1.46	**0.319**	**0.350**	**0.331**	±0.02
2450	39.1	1.80	**0.308**	**0.342**	**0.325**	±0.02
2600	38.6	1.95	**0.323**	**0.360**	**0.344**	±0.02

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Checked by : BCL

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Table 2
Sensitivity in Body Simulating Liquids.
SAR probe: IXP-050
S/N 0170

Probe settings for calibration		
Sensitivity in free-space(1)	**Diode Compression**(2)	**Sensor offset from tip of probe**(2)
Lin X =524.99 $(V/m)^2/(V*200)$ Lin Y = 453.82 $(V/m)^2/(V*200)$ Lin Z = 484.81 $(V/m)^2/(V*200)$	DCP_X = 20 (V*200) DCP_Y = 20 (V*200) DCP_Z = 20 (V*200)	2.7 mm

Sensitivity in Body Simulating Liquid.

Calibration frequency	Liquid Phantom(3)		Calibration Factors for E^2_{Liquid} / E^2_{Air}			Axial Isotropy
(MHz)	ε' (3)	σ (3) (Sm^{-1})	$ConvF_X$	$ConvF_Y$	$ConvF_Z$	(dB)
450	55.6	0.98	**0.194**	**0.187**	**0.200**	±0.03
835	56.1	1.02	**0.225**	**0.231**	**0.233**	±0.01
900	55.8	1.05	**0.234**	**0.242**	**0.243**	±0.01
1800	52.3	1.51	**0.305**	**0.320**	**0.321**	±0.02
1900	52.0	1.59	**0.319**	**0.337**	**0.338**	±0.03
2100	51.5	1.63	**0.341**	**0.375**	**0.365**	±0.01
2450	50.5	1.96	**0.342**	**0.383**	**0.367**	±0.02
2600	50.2	2.12	**0.355**	**0.399**	**0.382**	±0.02

Notes.
(1) Measured at 900 MHz
(2) The manufacturer supplied these figures.
(3) Measured at a temperature of 22 ± 1 ^{0}C.

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Table 3
Boundary Correction Factors
SAR probe: IXP-050
S/N 0170

Frequency	Head Simulating Liquid		Body Simulating Liquid	
(MHz)	*f(0)*	*d*	*f(0)*	*d*
450	4.99	0.77	1.17	1.27
835	0.49	2.51	2.71	0.92
900	1.14	1.24	0.98	1.47
1800	0.64	1.73	0.59	1.90
1900	0.76	1.55	0.63	1.80
2100	0.71	1.71	0.69	1.72
2450	1.10	1.30	0.99	1.39
2600	0.77	1.50	0.78	1.55

Table 4
Linearity and Spherical Isotropy
SAR probe: IXP-050
S/N 0170

Parameter	Frequency	Range	Maximum deviation
Linearity	1800 MHz	0.12 – 100 W/kg	± 0.10 dB
Spherical isotropy in head liquid	900 MHz	θ = 0 to 360°, φ = 0 to 90 °	± 0.9 dB

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Teddington Middlesex UK TW11 0LW Telephone +44 20 8977 3222

Certificate of Calibration

SAR PROBE

IndexSAR

Model: IXP-025

Serial number: G0006

FOR: Indexsar Ltd.
Oakfield House
Cudworth Lane
Newdigate
Surrey
RH5 5BG

DESCRIPTION: An IndexSAR isotropic electric field probe for determining specific absorption rates (SAR) in dielectric liquids. The probe has three orthogonal sensors, and the output voltage of the sensors is converted to an optical signal by a meter unit containing an analogue to digital (AD) converter. Probe readings are obtained using software via the RS232 port. The probe was calibrated with IndexSAR amplifier model IXA-010 S/N 036 belonging to NPL.

IDENTIFICATION: The probe is marked with the manufacturer's serial number G0006

MEASUREMENTS COMPLETED ON: 28 November 2011

The reported uncertainty is based on a coverage factor $k = 2$, providing a level of confidence of approximately 95%

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Date of Issue : 6 December 2011 **Signed :** B Loader **(Authorised Signatory)**

Checked by : BGL **Name : Mr B G Loader** **on behalf of NPLML**

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MEASUREMENT PROCEDURE

For frequencies at or above 835 MHz, the calibration method is based on establishing a calculable specific absorption rate (SAR) using a matched waveguide cell [1]. The cell has a feed-section and a liquid-filled section separated by a matching window that is designed to minimise reflections at the interface. A TE_{01} mode is launched into the waveguide by means of a N-type-to-waveguide adapter. The power delivered to the liquid is calculated from the forward power and reflection coefficient measured at the input to the cell. At the centre of the cross-section of the waveguide cell, the volume specific absorption rate (SAR^V) in the liquid as a function of distance from the window is given by

$$SAR^V = \frac{4(P_w)}{ab\delta} e^{-2Z/\delta} \tag{1}$$

where

a = the larger cross-sectional dimension of the waveguide.
b = the smaller cross-sectional dimension of the waveguide.
δ = the skin depth for the liquid in the waveguide.
Z = the distance of the probe's sensors from the liquid to matching window boundary.
P_w = the power delivered to the liquid.

For frequencies below 835 MHz, the SAR in the liquid is established by measuring the rate of temperature rise in the liquid at the calibration point. In this case the SAR in the liquid is related to the temperature rise by

$$SAR = c\frac{dT}{dt} \tag{2}$$

where c is the specific heat of the liquid.

Liquids having the properties specified by SAR measurement standards [2, 3, 4] were used for the calibration. The value of δ for the liquid was obtained by measuring the electric field (E) at a number of distances from the matching window. The calibration was for continuous wave (CW) signals, and the axis of the probe was parallel to the direction of propagation of the incident field i.e. end-on to the incident radiation. The probe was rotated about its axis in 15-degree steps, and the ratio of the calibration factors for the three probe sensors X, Y, & Z were optimized to give the best axial isotropy.

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The probe was calibrated with the linearisation and air-correction factors enabled. Comparing the measured values of E^2 in the liquid to those calculated for the waveguide cell allows the ratio, *ConvF*, of sensitivity for $(E^2_{LIQUID}) / (E^2_{AIR})$ to be determined, as required by the probe software.

ENVIRONMENT

Measurements were made in a temperature-controlled laboratory at 22 ± 1°C. The temperature of the liquid used was measured at the beginning and end of each measurement.

UNCERTAINTIES

The estimated uncertainty in calibration for SAR (W kg^{-1}) is ± 10 %. The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

This uncertainty is valid when the probe is used in a liquid with the same dielectric properties as those used for the calibration. No estimate is made for the long-term stability of the device calibrated or of the fluids used in the calibration.

When using the probe for SAR testing, additional uncertainties should be added to account for the spherical isotropy of the probe, proximity effects, linearity, and response to pulsed fields. There will be additional uncertainty if the probe is used in liquids having significantly different electrical properties to those used for the calibration. The electrical properties of the liquids will be related to temperature.

RESULTS

Tables 1 and 2 give the results for calibration in liquid.

These calibration factors are only correct when the values for sensitivity in free-space, diode compression and sensor offset from the tip of the probe, as set in the probe software, are the same as those given in Table 1 and 2.

Table 3 contains the values of the boundary correction factors *f(0)* and *d*.

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REFERENCES:

[1] Pokovic, KT, T.Schmid and N.Kuster, "Robust set-up for Precise Calibration of E-field probes in Tissue Simulating Liquids at Mobile Phone Frequencies", Proceedings ICECOM 1997, pp 120 – 124, Dubrovnik, Croatia Oct 12-17, 1997.

[2] British Standard BS EN 503361:2001. "Basic standard for the measurement of specific absorption rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz)".

[3] IEEE Standard 1528-2003 "Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques".

[4] Federal Communications Commission, FCC OET Bulletin 65, Supplement C, June 2001, "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", David L. Means, Kwok W. Chan.

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Table 1
Sensitivity in Head Simulating Liquids.
SAR probe: IXP-025
S/N G0006

Probe settings for calibration		
Sensitivity in free-space[1]	**Diode Compression[2]**	**Sensor offset from tip of probe[2]**
Lin X = 4181.03 $(V/m)^2/(V*200)$ Lin Y = 4634.25 $(V/m)^2/(V*200)$ Lin Z = 3860.61 $(V/m)^2/(V*200)$	DCP_X = 20 (V*200) DCP_Y = 20 (V*200) DCP_Z = 20 (V*200)	1.39 mm

Sensitivity in Head Simulating Liquid.						
Calibration frequency	Liquid Phantom[3]		Calibration Factors for E^2_{Liquid} / E^2_{Air}			Axial Isotropy
(MHz)	ε' [3]	σ [3] (Sm^{-1})	*ConvF*$_X$	*ConvF*$_Y$	*ConvF*$_Z$	(dB)
5200	35.16	4.89	**0.343**	**0.335**	**0.162**	±0.09
5800	33.78	5.57	**0.405**	**0.413**	**0.200**	±0.07

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Table 2

Sensitivity in Body Simulating Liquids.

SAR probe: IXP-025

S/N G0006

Probe settings for calibration		
Sensitivity in free-space[1]	**Diode Compression**[2]	**Sensor offset from tip of probe**[2]
Lin X = 4181.03 $(V/m)^2/(V*200)$ Lin Y = 4634.25 $(V/m)^2/(V*200)$ Lin Z = 3860.61 $(V/m)^2/(V*200)$	DCP_X = 20 (V*200) DCP_Y = 20 (V*200) DCP_Z = 20 (V*200)	1.39 mm

Sensitivity in Body Simulating Liquid.						
Calibration frequency	Liquid Phantom[3]		Calibration Factors for E^2_{Liquid} / E^2_{Air}			Axial Isotropy
(MHz)	ε' [3]	σ [3] (Sm^{-1})	$ConvF_X$	$ConvF_Y$	$ConvF_Z$	(dB)
5200	50.52	5.38	**0.439**	**0.436**	**0.214**	±0.04
5800	48.91	6.24	**0.473**	**0.494**	**0.235**	±0.06

Notes.

[1] Measured at 900 MHz

[2] The manufacturer supplied these figures.

[3] Measured at a temperature of 22 ± 1 ^{0}C.

Table 3

Boundary Correction Factors

SAR probe: IXP-025

S/N G0006

Frequency	Head Simulating Liquid		Body Simulating Liquid	
(MHz)	*f(0)*	*d*	*f(0)*	*d*
5200	0.247	1.332	0.281	1.630
5800	0.627	0.992	0.235	2.036

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Date of Issue : 6 December 2011

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IMMERSIBLE SAR PROBE

CALIBRATION REPORT

Part Number: IXP–020

S/N L0011

October 2011

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e-mail: enquiries@indexsar.com

Calibration Certificate 1110/L0011
Date of Issue: 11th October 2011
Immersible SAR Probe

Type:	IXP-020
Manufacturer:	IndexSAR, UK
Serial Number:	L0011
Place of Calibration:	IndexSAR, UK
Date of Receipt of Probe:	N/A
Calibration Dates:	7th April — 18th May 2011
Customer:	TUV

IndexSAR Ltd hereby declares that the IXP-020 Probe named above has been calibrated for conformity to the IEEE 1528 and BSEN 62209-1 standards using the methods described in this calibration document. Where applicable, the standards used in the calibration process are traceable to the UK's National Physical Laboratory.

Calibrated by:	A. Brinklow	**Technical Manager**
Approved by:	[signature]	**Director**

Please keep this certificate with the calibration document. When the probe is sent for a calibration check, please include the calibration document.

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INTRODUCTION

This Report presents measured calibration data for a particular Indexsar SAR probe (S/N L0011) only and describes the procedures used for characterisation and calibration.

Indexsar probes are characterised using procedures that, where applicable, follow the recommendations of BSEN 622009-1 [Ref 1] & IEEE [Ref 2] standards. The procedures incorporate techniques for probe linearisation, isotropy assessment and determination of liquid factors (conversion factors). Calibrations are determined by comparing probe readings with analytical computations in canonical test geometries (waveguides) using normalised power inputs.

Each step of the calibration procedure and the equipment used is described in the sections below.

CALIBRATION PROCEDURE

1. Objectives

The calibration process comprises two stages:-

1) Determination of the channel sensitivity factors which optimise the probe's overall spherical isotropy in 900MHz brain fluid
2) At each frequency of interest, application of these channel sensitivity factors to model the exponential decay of SAR in a waveguide fluid cell, and hence derive the liquid conversion factors at that frequency

2. Probe output

The probe channel output signals are linearised in the manner set out in Refs [1] and [2]. The following equation is utilized for each channel:

$$U_{lin} = U_{o/p} + U_{o/p}{}^{2} / DCP \qquad (1)$$

where U_{lin} is the linearised signal, $U_{o/p}$ is the raw output signal in mV and DCP is the diode compression potential, also in mV.

DCP is determined from fitting equation (1) to measurements of U_{lin} versus source feed power over the full dynamic range of the probe. The DCP is a characteristic of the Schottky diodes used as the sensors. For the IXP-020 probes with CW signals the DCP values are typically 100mV.

In turn, measurements of E-field are determined using the following equation:

$$\begin{aligned} E_{liq}{}^{2}\ (V/m) = \ & U_{linx} * \text{Air Factor}_x * \text{Liq Factor}_x \\ & + U_{liny} * \text{Air Factor}_y * \text{Liq Factor}_y \\ & + U_{linz} * \text{Air Factor}_z * \text{Liq Factor}_z \end{aligned} \qquad (3)$$

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Here, "Air Factor" represents each channel's sensitivity, while "Liq Factor" represents the enhancement in signal level when the probe is immersed in tissue-simulant liquids at each frequency of interest.

3. Selecting channel sensitivity factors to optimise isotropic response

After manufacture, the first stage of the calibration process is to balance the three channels' Air Factor values, thereby optimising the probe's overall response to incoming signals of any polarisation position angle ("spherical isotropy"). The setup for measuring the probe's spherical isotropy is shown in Figure 1.

A box phantom containing 900MHz head fluid is irradiated by a vertically-polarised, tuned dipole, mounted at the side of the phantom on the robot's seventh axis. The dipole is connected to a signal generator and amplifier via a directional coupler and power meter. The absolute power level is not important as long as it is stable, with stability being monitored using the coupler and power meter.

During calibration, the spherical response is generated by changing the orientation of the probe sensors with respect to the dipole, keeping the long shaft of the probe vertical and the probe sensors at the same position in space.

Initially, the short shaft of the probe is positioned parallel to the phantom wall with its sensors at the same vertical height as the centre of the source dipole and the line joining sensors to dipole perpendicular to the phantom wall (see Figure 1). In this position, the probe is said to be at a position angle of -90 degrees. During the scan, the probe is rotated from -90 to +90 degrees in 10 degree steps, and at each position angle, the dipole polarisation changes from 0 to 360 degrees in 20 degree steps. The short shaft of the probe thereby starts moving increasingly end-on to the dipole, and after perpendicularity, it carries on until facing in the opposite direction from its starting position, all the time with the centroid of the sensors occupying the same position in space.

At each position, an Indexsar 'Fast' amplifier samples the probe channels 500 times per second for 0.4 s. The raw $U_{o/p}$ data from each sample are packed into 10 bytes and transmitted back to the PC controller via an optical cable. U_{linx}, U_{liny} and U_{linz} are derived from the raw $U_{o/p}$ values and written to an Excel template.

Once a full set of data has been collected, the Air Factors are adjusted using a special Excel Solver routine to equalise the output from each channel and hence minimise the spherical isotropy. This automated approach to optimisation removes the effect of human bias.

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4. Determination of Conversion ("Liquid") Factors at each frequency of interest

A lookup table of conversion factors for a probe allows a SAR value to be derived at the measured frequencies, and for either brain or body fluid-simulant.

The method by which the conversion factors are assessed is based on the comparison between measured and analytical rates of decay of SAR with perpendicular distance from a dielectric window. This way, not only can the conversion factors for that frequency/fluid combination be determined, but an allowance can also be made for the scale and range of boundary layer effects.

The theoretical relationship between the SAR at the cross-sectional centre of the lossy waveguide as a function of the longitudinal distance (z) from the dielectric separator is given by Equation 4:

$$SAR(z) = \frac{4\left(P_f - P_b\right)}{\rho ab\delta} e^{-2z/\delta} \qquad (4)$$

Here, the density ρ is conventionally assumed to be 1000 kg/m^3, *ab* is the cross-sectional area of the waveguide, and P_f and P_b are the forward and reflected power inside the lossless section of the waveguide, respectively. The penetration depth δ (which is the reciprocal of the waveguide-mode attenuation coefficient) is a property of the lossy liquid and is given by Equation (5).

$$\delta = \left[\mathrm{Re}\left\{\sqrt{(\pi / a)^2 + j\omega\mu_o\left(\sigma + j\omega\varepsilon_o\varepsilon_r\right)}\right\}\right]^{-1} \qquad (5)$$

where σ is the conductivity of the tissue-simulant liquid in S/m, ε_r is its relative permittivity, and ω is the radial frequency (rad/s). Values for σ and ε_r are obtained prior to each waveguide test using an Indexsar DiLine measurement kit, which uses the TEM method as recommended in [2]. σ and ε_r are both temperature- and fluid-dependent, so are best measured using a sample of the tissue-simulant fluid immediately prior to the actual calibration.

Wherever possible, all DiLine and calibration measurements should be made in the open laboratory at 22 $\pm$ 2.0°C; if this is not possible, the values of σ and ε_r should reflect the actual temperature. Values employed for calibration are listed in the tables below.

Dedicated waveguides have been designed to accommodate the geometry of an L-shaped probe as it traces out the decay profile. Traditional straight probes measure the decay rate of a vertical-travelling signal above a horizontal dielectric window; for the L-shaped probes, the geometry has had to be changed, and the waveguide now lies horizontally and instead of being open at the end, is capped with a metal plate (see Figure 4). A slot is cut in

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the top ("b") face through which tissue simulant fluid can be poured, and through which the probe can enter the guide and be offered up to the now vertical waveguide window.

During calibration, the probe is moved carefully until the flat face of the tip is just touching the cross-sectional centre of the dielectric window. 200 samples are then taken and written to an Excel template file before moving the probe into the liquid away from the waveguide window. This cycle is repeated 150 times. The spatial separation between readings is determined from practical considerations of the expected SAR decay rate, and range from 0.2mm steps at low frequency, through 0.1mm at 2450MHz, down to 0.05mm at 5GHz.

Once the data collection is complete, a Solver routine is run which optimises the measured-theoretical fit by varying the conversion factor, and the boundary correction size and range.

By ensuring the waveguide cap is at least three penetration depths, reflections are negligible. The power absorbed in the liquid is therefore determined solely from the waveguide forward and reflected power.

Different waveguides are used for 835/900MHz, 1800/1900MHz, 2100/2450/2600MHz and 5200/5800MHz measurements. Table A.1 of [1] can be used for designing calibration waveguides with a return loss greater than 20 dB at the most important frequencies used for personal wireless communications, and better than 15dB for frequencies greater than 5GHz. Values for the penetration depth for these specific fixtures and tissue-simulating mixtures are also listed in Table A.1.

For 450 MHz calibrations, a slightly different technique must be used — the equatorial response of the probe-under-test is compared with the equivalent response of a probe whose 450MHz characteristics have already been determined by NPL. The conversion factor of the probe-under-test can then be deduced.

According to [1], this calibration technique provides excellent accuracy, with standard uncertainty of less than 3.6% depending on the frequency and medium. The calibration itself is reduced to power measurements traceable to a standard calibration procedure. The practical limitation to the frequency band of 800 to 5800 MHz because of the waveguide size is not severe in the context of compliance testing.

CALIBRATION FACTORS MEASURED FOR PROBE S/N L0011

The probe was calibrated at 835, 900, 1800, 1900, 2100 and 2450 MHz in liquid samples representing brain liquid at these frequencies.

The calibration was for CW signals only, and the horizontal axis of the probe was parallel to the direction of propagation of the incident field i.e. end-on to the incident radiation.

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The reference point for the calibration is in the centre of the probe's cross-section at a distance of 2.7 mm from the probe tip in the direction of the probe amplifier. A value of 2.7 mm should be used for the tip to sensor offset distance in the software. The distance of 2.7mm for assembled probes has been confirmed by taking X-ray images of the probe tips (see Figure 9).

It is important that the diode compression point and air factors used in the software are the same as those quoted in the results tables, as these are used to convert the diode output voltages to a SAR value.

CALIBRATION EQUIPMENT

The Table on page 16 indicates the calibration status of all test equipment used during probe calibration.

MEASUREMENT UNCERTAINTIES

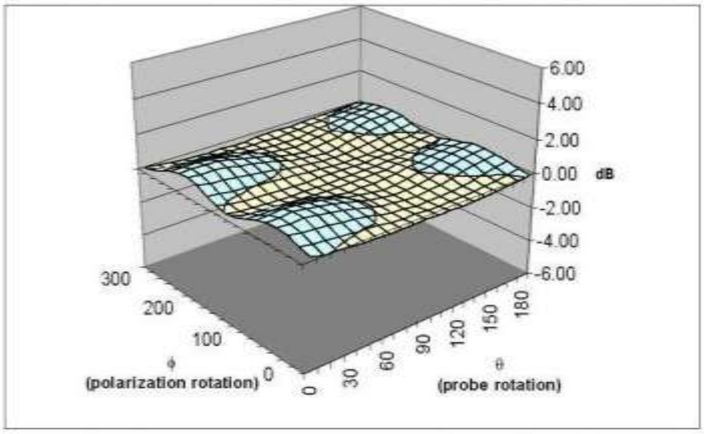
A complete measurement uncertainty analysis for the SARA2 measurement system has been published in Reference [3]. Table 10 from that document is re-created below, and lists the uncertainty factors associated just with the calibration of probes.

Source of uncertainty	Uncertainty value ± %	Probability distribution	Divisor	c_i	Standard uncertainty ui ± %	v_i or v_{eff}
Incident or forward power	5.743	N	1.00	1	5.743	∞
Refelected power	5.773	N	1.00	1	5.773	∞
Liquid conductivity	1.120	N	1.00	1	1.120	∞
Liquid permittivity	1.085	N	1.00	1	1.085	∞
Field homgeneity	0.002	R	1.73	1	0.001	∞
Probe positioning: +/-0.05mm	0.55	R	1.73	1	0.318	
Influence on Probe pos: 11%/mm						
Field probe linearity	4.7	R	1.73	1	2.714	∞
Combined standard uncertainty		**RSS**			**8.729**	

At the 95% confidence level, therefore, the expanded uncertainty is 17.1%

Product Service

SUMMARY OF CAL FACTORS FOR PROBE IXP-020 S/N L0011



Surface Isotropy diagram of IXP-020 Probe S/N L0011 at 900MHz (axial isotropy +/-0.03dB, spherical isotropy +/-0.58dB, other subsets listed below)

Measured Isotropy at 900MHz	Probe orientation range relative to dipole	(+/-) dB
Spherical Isotropy	±90°	0.58
	±60°	0.54
	±30°	0.32
	±20°	0.22
Axial Isotropy	0°	0.03

Channel Sensitivities				
	X	Y	Z	
Air Factors	69.36	84.92	85.72	$(V/m)^2/mV$
CW DCPs	100	100	100	mV

SAR Conversion Factors/ Boundary Corrections				
Freq (MHz)	SAR Conv Factor	Boundary Correction f(0)	Boundary Correction d(mm)	Notes
835	0.265	1.9	1.1	1,2
900	0.273	2.0	1.0	1,2
1800	0.327	1.3	1.3	1,2
1900	0.331	0.9	1.5	1,2
2100	0.350	1.0	1.5	1,2
2450	0.359	0.8	1.6	1,2
Notes				
1)	Calibrations done at 22°C +/-2°C			
2)	Waveguide calibration			

Probe tip radius	0 mm
X Ch. Angle to red dot	0°

Product Service

PROBE SPECIFICATIONS

Indexsar probe L0011, along with its calibration, is compared with BSEN 62209-1 and IEEE standards recommendations (Refs [1] and [2]) in the Tables below. A listing of relevant specifications is contained in the tables below:

Dimensions	S/N L0011	BSEN [1]	IEEE [2]
Vertical shaft (mm)	510		
Horizontal shaft (mm)	90		
Tip length (mm)	10		
Body diameter (mm)	12		
Tip diameter (mm)	5.2	8	8
Distance from probe tip to dipole centers (mm)	2.7		

Dynamic range	S/N L0011	BSEN [1]	IEEE [2]
Minimum (W/kg)	0.01	<0.02	0.01
Maximum (W/kg) N.B. only measured to > 100 W/kg on representative probes	>100	>100	100

Isotropy (measured at 900MHz)		S/N L0011	BSEN [1]	IEEE [2]
Spherical	Probe at ±90°	0.58	1.0	0.50
	Probe at ±60°	0.54		
	Probe at ±30°	0.32		
	Probe at ±20°	0.22		
Axial	Probe at 0°	0.03	0.5	0.25

Construction	Each probe contains three orthogonal dipole sensors arranged on a triangular prism core, protected against static charges by built-in shielding, and covered at the tip by PEEK cylindrical enclosure material. Outer case materials are PEEK and heat-shrink sleeving.
Chemical resistance	Tested to be resistant to TWEEN and sugar/salt-based simulant liquids but probes should be removed, cleaned and dried when not in use. NOT recommended for use with glycol or soluble oil-based liquids.

Product Service

REFERENCES

[1] BSEN 62209-1:2006. Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices — Human models, instrumentation, and procedures — Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)

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

[3] Indexsar Report IXS-0300, October 2007. Measurement uncertainties for the SARA2 system assessed against the recommendations of BS EN 62209-1:2006

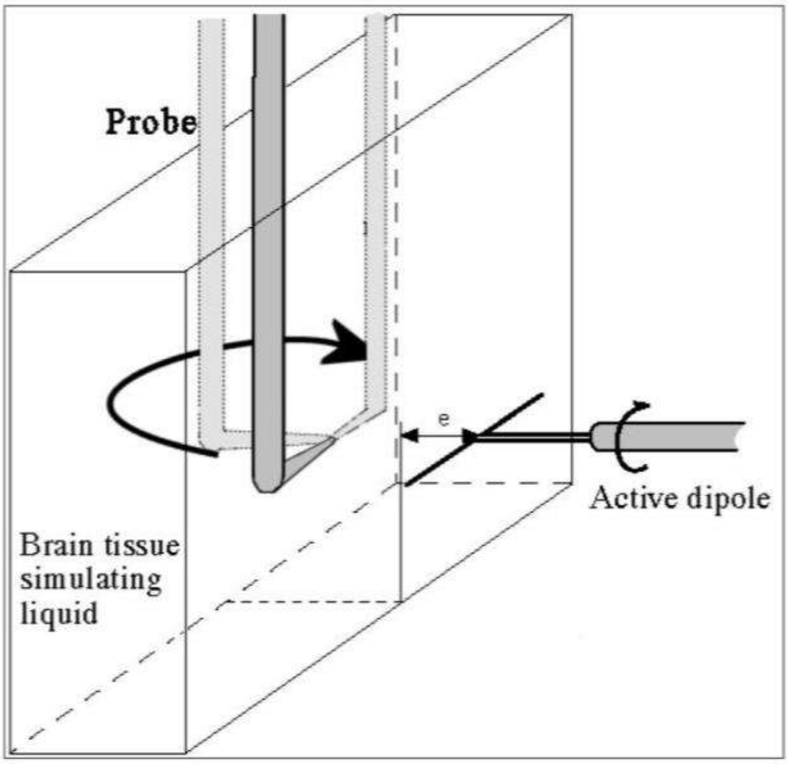


Figure 1. Spherical isotropy jig showing probe, dipole and box filled with simulated brain liquid (see Ref [2], Section A.5.2.1)

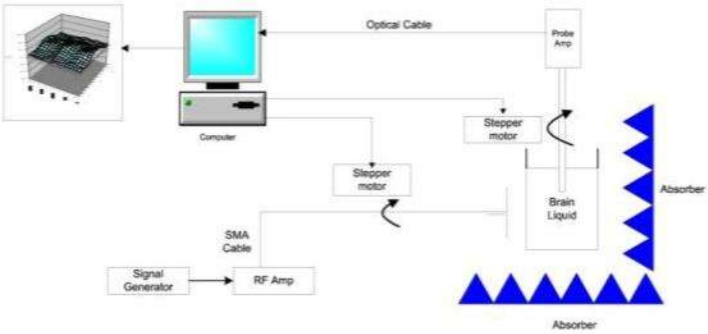


Figure 2. Schematic diagram of the test geometry used for isotropy determination

Figure 4. Schematic showing the innovative design of slot in the waveguide termination

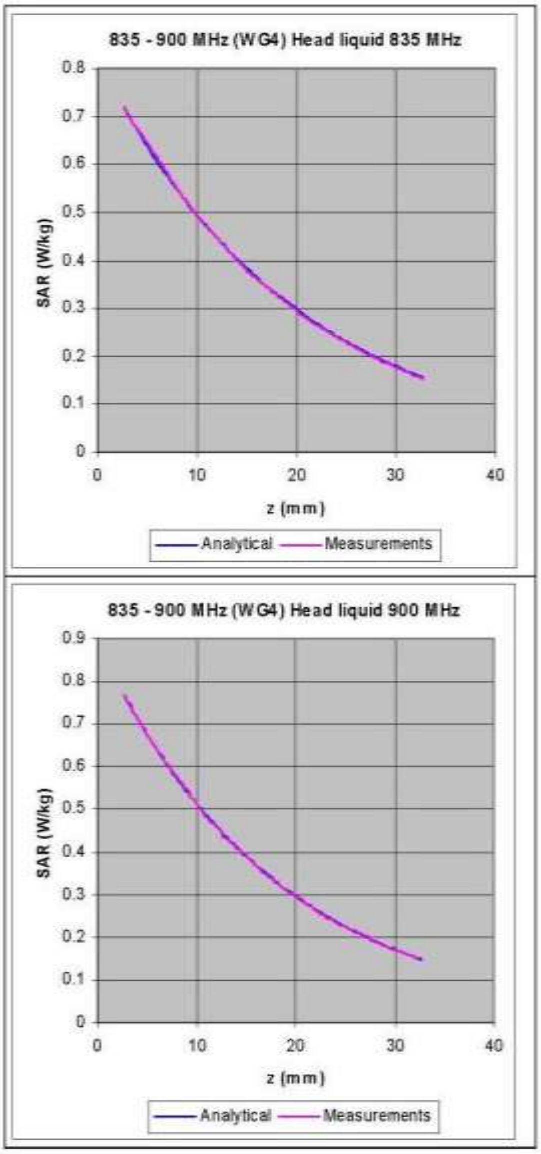
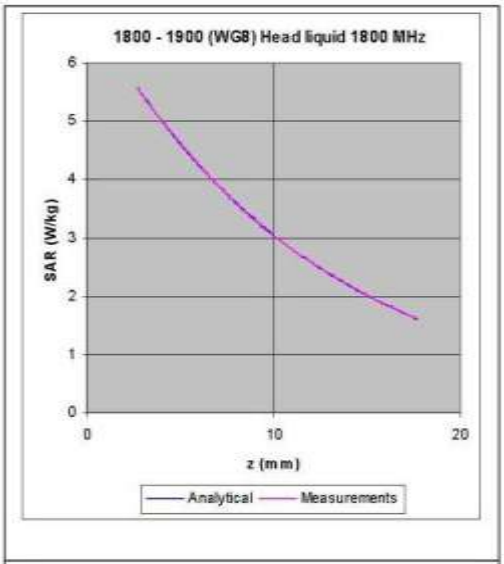
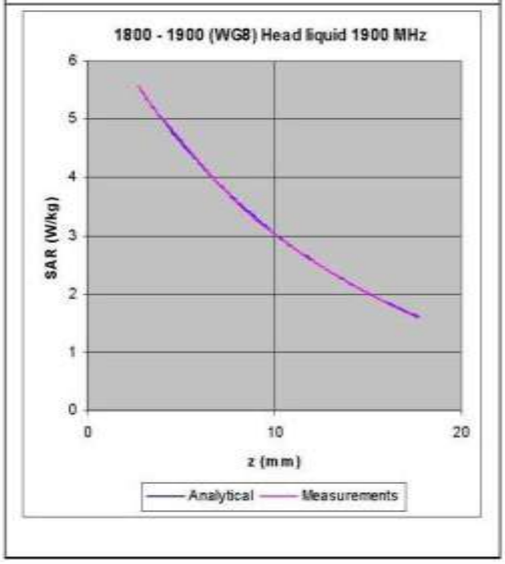


Figure 6. The measured SAR decay function along the centreline of the WG4 waveguide with conversion factors adjusted to fit to the theoretical function for the particular dimension, frequency, power and liquid properties employed.


1800 - 1900 (WG8) Head liquid 1800 MHz
SAR (W/kg)
z (mm)
Analytical
Measurements


1800 - 1900 (WG8) Head liquid 1900 MHz
SAR (W/kg)
z (mm)
Analytical
Measurements

Product Service

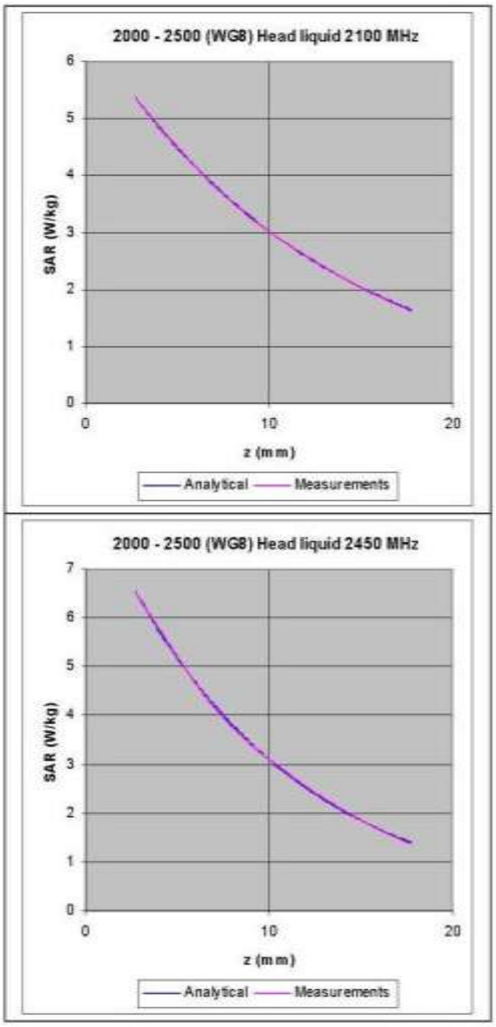


Figure 7. The measured SAR decay function along the centreline of the R22 waveguide with conversion factors adjusted to fit to the theoretical function for the particular dimension, frequency, power and liquid properties employed.

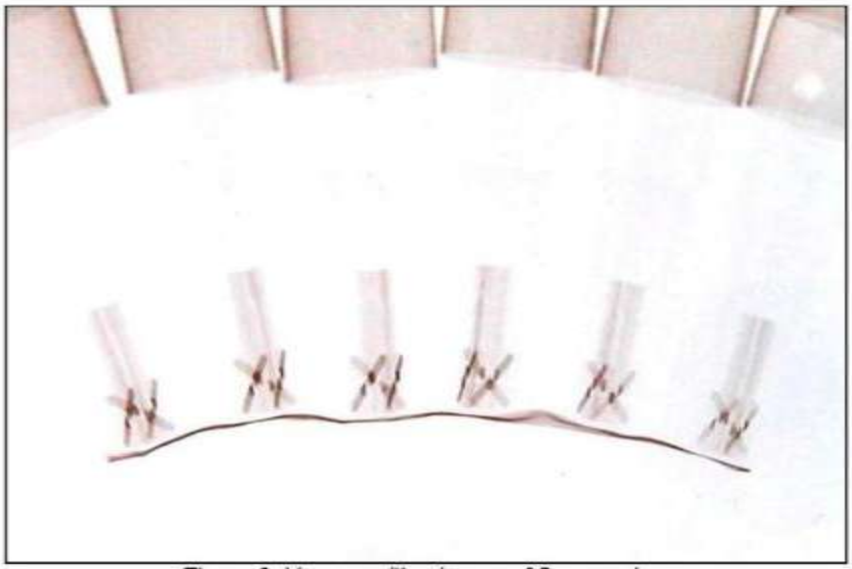


Figure 9: X-ray positive image of 5mm probes

Table indicating the dielectric parameters of the liquids used for calibrations at each frequency

Liquid used	Relative permittivity (measured)	Conductivity (S/m) (measured)
835 MHz BRAIN	42.80	0.91
900 MHz BRAIN	40.47	0.95
1800 MHz BRAIN	40.01	1.42
1900 MHz BRAIN	40.08	1.42
2100 MHz BRAIN	41.98	1.38
2450 MHz BRAIN	40.68	1.77

Table of test equipment calibration status

Instrument description	Supplier / Manufacturer	Model	Serial No.	Last calibration date	Calibration due date
Power sensor	Rohde & Schwarz	NRP-Z23	100169	14/09/2010	14/9/2012
Dielectric property measurement	Indexsar	DiLine (sensor lengths: 160mm, 80mm and 60mm)	N/A	(absolute) – checked against NPL values using reference liquids	N/A
Vector network analyser	Anritsu	MS6423B	003102	17/01/2011	17/01/2012
SMA autocalibration module	Anritsu	36581KKF/1	001902	17/01/2011	17/01/2012

Product Service

IMMERSIBLE SAR PROBE

CALIBRATION REPORT

Part Number: IXP–021

S/N LG0018

October 2012

Indexsar Limited
Oakfield House
Cudworth Lane
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Surrey RH5 5BG
Tel: +44 (0) 1306 632 870
Fax: +44 (0) 1306 631 834
e-mail: enquiries@indexsar.com

Product Service

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Fax: +44 (0) 1306 631 834
e-mail: enquiries@indexsar.com

Calibration Certificate 1210/LG0018
Date of Issue: 24th October 2012
Immersible SAR Probe

Type:	IXP-021
Manufacturer:	IndexSAR, UK
Serial Number:	LG0018
Place of Calibration:	IndexSAR, UK
Date of Receipt of Probe:	N/A
Customer:	TUV Sud

IndexSAR Ltd hereby declares that the IXP-021 Probe named above has been calibrated for conformity to the IEEE 1528 and BSEN 62209-1 standards using the methods described in this calibration document. Where applicable, the standards used in the calibration process are traceable to the UK's National Physical Laboratory.

Calibrated by:	A. Brinklow	**Technical Manager**
Approved by:	[signature]	**Director**

Please keep this certificate with the calibration document. When the probe is sent for a calibration check, please include the calibration document.

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INTRODUCTION

This Report presents measured calibration data for a particular Indexsar SAR probe (S/N LG0018) only and describes the procedures used for characterisation and calibration.

Indexsar probes are characterised using procedures that, where applicable, follow the recommendations of BSEN 622009-1 [Ref 1] & IEEE [Ref 2] standards. The procedures incorporate techniques for probe linearisation, isotropy assessment and determination of liquid factors (conversion factors). Calibrations are determined by comparing probe readings with analytical computations in canonical test geometries (waveguides) using normalised power inputs.

Each step of the calibration procedure and the equipment used is described in the sections below.

CALIBRATION PROCEDURE

1. Objectives

The calibration process comprises two stages:-

1) Determination of the channel sensitivity factors which optimise the probe's overall rotational isotropy in brain fluid
2) At each frequency of interest, application of these channel sensitivity factors to model the exponential decay of SAR in a waveguide fluid cell, and hence derive the liquid conversion factors at that frequency

2. Probe output

The probe channel output signals are linearised in the manner set out in Refs [1] and [2]. The following equation is utilized for each channel:

$$U_{lin} = U_{o/p} + U_{o/p}{}^{2} / DCP \qquad (1)$$

where U_{lin} is the linearised signal, $U_{o/p}$ is the raw output signal in mV and DCP is the diode compression potential, also in mV.

DCP is determined from fitting equation (1) to measurements of U_{lin} versus source feed power over the full dynamic range of the probe. The DCP is a characteristic of the Schottky diodes used as the sensors. For the IXP-021 probes with CW signals the DCP values are typically 100mV.

In turn, measurements of E-field are determined using the following equation:

$$\begin{aligned} E_{liq}{}^{2}\ (V/m) = \ & U_{linx} * \text{Air Factor}_x * \text{Liq Factor}_x \\ & + U_{liny} * \text{Air Factor}_y * \text{Liq Factor}_y \\ & + U_{linz} * \text{Air Factor}_z * \text{Liq Factor}_z \qquad (3) \end{aligned}$$

COMMERCIAL-IN-CONFIDENCE

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Here, "Air Factor" represents each channel's sensitivity, while "Liq Factor" represents the enhancement in signal level when the probe is immersed in tissue-simulant liquids at each frequency of interest.

3. Selecting channel sensitivity factors to optimise isotropic response

After manufacture, the first stage of the calibration process is to balance the three channels' Air Factor values, thereby optimising the probe's overall response to incoming signals of any polarisation position angle ("rotational isotropy"). The setup for measuring the probe's rotational isotropy for frequencies below 3GHz is shown in Figure 1, while above 3GHz, the probe is clamped with the short shaft hanging down vertically in the mouth of a waveguide mounted on a turntable, Figure 2.

A box phantom containing head fluid is irradiated by a vertically-polarised, tuned dipole, mounted at the side of the phantom on the robot's seventh axis. The dipole is connected to a signal generator and amplifier via a directional coupler and power meter. The absolute power level is not important as long as it is stable, with stability being monitored using the coupler and power meter.

During calibration, the spherical response is generated by changing the orientation of the probe sensors with respect to the dipole, keeping the long shaft of the probe vertical and the probe sensors at the same position in space.

Initially, the short shaft of the probe is positioned parallel to the phantom wall with its sensors at the same vertical height as the centre of the source dipole and the line joining sensors to dipole perpendicular to the phantom wall (see Figure 1). In this position, the probe is said to be at a position angle of -90 degrees. During the scan, the probe is rotated from -90 to +90 degrees in 10 degree steps, and at each position angle, the dipole polarisation changes from 0 to 360 degrees in 20 degree steps. The short shaft of the probe thereby starts moving increasingly end-on to the dipole, and after perpendicularity, it carries on until facing in the opposite direction from its starting position, all the time with the centroid of the sensors occupying the same position in space. When the short shaft is exactly end-on to the dipole, rotating the dipole generates the rotational isotropy figure.

At each position, an Indexsar 'Fast' amplifier samples the probe channels 500 times per second for 0.4 s. The raw $U_{o/p}$ data from each sample are packed into 10 bytes and transmitted back to the PC controller via an optical cable. U_{linx}, U_{liny} and U_{linz} are derived from the raw $U_{o/p}$ values and written to an Excel template.

Once a full set of data has been collected, the Air Factors are adjusted using a special Excel Solver routine to equalise the output from each channel and hence minimise the rotational isotropy. This automated approach to optimisation removes the effect of human bias.

The process is repeated for each frequency of interest.

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4. Determination of Conversion ("Liquid") Factors at each frequency of interest

A lookup table of conversion factors for a probe allows a SAR value to be derived at the measured frequencies, and for either brain or body fluid-simulant.

The method by which the conversion factors are assessed is based on the comparison between measured and analytical rates of decay of SAR with perpendicular distance from a dielectric window. This way, not only can the conversion factors for that frequency/fluid combination be determined, but an allowance can also be made for the scale and range of boundary layer effects.

The theoretical relationship between the SAR at the cross-sectional centre of the lossy waveguide as a function of the longitudinal distance (z) from the dielectric separator is given by Equation 4:

$$SAR(z) = \frac{4\left(P_f - P_b\right)}{\rho ab\delta} e^{-2z/\delta} \quad (4)$$

Here, the density ρ is conventionally assumed to be 1000 kg/m^3, ab is the cross-sectional area of the waveguide, and P_f and P_b are the forward and reflected power inside the lossless section of the waveguide, respectively. The penetration depth δ (which is the reciprocal of the waveguide-mode attenuation coefficient) is a property of the lossy liquid and is given by Equation (5).

$$\delta = \left[\mathrm{Re}\left\{\sqrt{(\pi / a)^2 + j\omega\mu_o\left(\sigma + j\omega\varepsilon_o\varepsilon_r\right)}\right\}\right]^{-1} \quad (5)$$

where σ is the conductivity of the tissue-simulant liquid in S/m, ε_r is its relative permittivity, and ω is the radial frequency (rad/s). Values for σ and ε_r are obtained prior to each waveguide test using an Indexsar DiLine measurement kit, which uses the TEM method as recommended in [2]. σ and ε_r are both temperature- and fluid-dependent, so are best measured using a sample of the tissue-simulant fluid immediately prior to the actual calibration.

Wherever possible, all DiLine and calibration measurements should be made in the open laboratory at 22 $\pm$ 2.0°C; if this is not possible, the values of σ and ε_r should reflect the actual temperature. Values employed for calibration are listed in the tables below.

Dedicated waveguides have been designed to accommodate the geometry of an L-shaped probe as it traces out the decay profile. Traditional straight probes measure the decay rate of a vertical-travelling signal above a horizontal dielectric window; for the L-shaped probes below 3GHz, the geometry has had to be changed, and the waveguide now lies horizontally and instead of being open at the end, is capped with a metal plate (see Figure 4). A slot is cut in the top ("b") face through which tissue simulant fluid can be poured, and through which the probe can enter the guide and be offered up to the now vertical waveguide window. Above 3GHz, where the short shaft is longer than the height of the fluid-filled waveguide cell, the probe is oriented as shown in Figure 2.

During calibration, the probe is moved carefully until the flat face of the tip is just touching the cross-sectional centre of the dielectric window. 200 samples are then taken and written to an Excel template file before moving the probe into the liquid away from the waveguide window. This cycle is repeated 150 times. The spatial separation between readings is determined from practical considerations of the expected SAR decay rate, and range from 0.2mm steps at low frequency, through 0.1mm at 2450MHz, down to 0.05mm at 5GHz.

Once the data collection is complete, a Solver routine is run which optimises the measured-theoretical fit by varying the conversion factor, and the boundary correction size and range.

By ensuring the waveguide cap is at least three penetration depths, reflections are negligible. The power absorbed in the liquid is therefore determined solely from the waveguide forward and reflected power.

Different waveguides are used for 835/900MHz, 1800/1900MHz, 2100/2450/2600MHz and 5200/5800MHz measurements. Table A.1 of [1] can be used for designing calibration waveguides with a return loss greater than 20 dB at the most important frequencies used for personal wireless communications, and better than 15dB for frequencies greater than 5GHz. Values for the penetration depth for these specific fixtures and tissue-simulating mixtures are also listed in Table A.1.

For 450 MHz calibrations, a slightly different technique must be used — the equatorial response of the probe-under-test is compared with the equivalent response of a probe whose 450MHz characteristics have already been determined by NPL. The conversion factor of the probe-under-test can then be deduced.

According to [1], this calibration technique provides excellent accuracy, with standard uncertainty of less than 3.6% depending on the frequency and medium. The calibration itself is reduced to power measurements traceable to a standard calibration procedure. The practical limitation to the frequency band of 800 to 5800 MHz because of the waveguide size is not severe in the context of compliance testing.

CALIBRATION FACTORS MEASURED FOR PROBE S/N LG0018

The probe was calibrated at 5200 and 5800 MHz in liquid samples representing brain and muscle tissue at these frequencies.

Product Service

The calibration was for CW signals only, and the horizontal axis of the probe was parallel to the direction of propagation of the incident field i.e. end-on to the incident radiation.

The reference point for the calibration is in the centre of the probe's cross-section at a distance of 2.7 mm from the probe tip in the direction of the probe amplifier. A value of 2.7 mm should be used for the tip to sensor offset distance in the software. The distance of 2.7mm for assembled probes has been confirmed by taking X-ray images of the probe tips (see Figure 9).

It is important that the diode compression point and air factors used in the software are the same as those quoted in the results tables, as these are used to convert the diode output voltages to a SAR value.

CALIBRATION EQUIPMENT

The Table on page 16 indicates the calibration status of all test equipment used during probe calibration.

MEASUREMENT UNCERTAINTIES

A complete measurement uncertainty analysis for the SARA-C measurement system has been published in Reference [3]. Table 17 from that document is re-created below, and lists the uncertainty factors associated just with the calibration of probes.

Source of uncertainty	Uncertainty value ± %	Probability distribution	Divisor	c_i	Standard uncertainty ui ± %	v_i or v_{eff}
Forward power	3.92	N	1.00	1	3.92	∞
Reflected power	4.09	N	1.00	1	4.09	∞
Liquid conductivity	1.308	N	1.00	1	1.31	∞
Liquid permittivity	1.271	N	1.00	1	1.27	∞
Field homgeneity	3.0	R	1.73	1	1.73	∞
Probe positioning	0.22	R	1.73	1	0.13	∞
Field probe linearity	0.2	R	1.73	1	0.12	∞
Combined standard uncertainty		RSS			6.20	

At the 95% confidence level, therefore, the expanded uncertainty is ±12.4%

SUMMARY OF CAL FACTORS FOR PROBE IXP-021 S/N LG0018

SAR Calibration Factors / Boundary Corrections*								
Freq (MHz)	Tissue Type	Air Factor X ((V/m)²/mV)	Air Factor Y ((V/m)²/mV)	Air Factor Z ((V/m)²/mV)	Rotational Isotropy (± dB)	SAR Conv Factor	Boundary Correction f(0)	Boundary Correction d(mm)
5200	Head	285.66	352.95	321.39	0.07	0.784	0.675	0.891
5500		287.11	350.55	322.34	-	0.851	0.635	1.084
5800		288.55	348.15	323.30	0.04	0.919	0.594	1.277
5200	Body	287.52	347.12	325.35	0.02	1.029	0.541	1.790
5500		286.25	347.27	326.48	-	1.039	0.515	1.705
5800		284.98	347.41	327.61	0.02	1.049	0.489	1.619

* Data for 5500MHz are interpolated from measured data at 5200 and 5800MHz

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PROBE SPECIFICATIONS

Indexsar probe LG0018, along with its calibration, is compared with BSEN 62209-1 and IEEE standards recommendations (Refs [1] and [2]) in the Tables below. A listing of relevant specifications is contained in the tables below:

Dimensions	S/N LG0018	BSEN [1]	IEEE [2]
Vertical shaft (mm)	510		
Horizontal shaft (mm)	90		
Tip length (mm)	10		
Body diameter (mm)	12		
Tip diameter (mm)	5.2	8	8
Distance from probe tip to dipole centers (mm)	2.7		

Dynamic range	S/N LG0018	BSEN [1]	IEEE [2]
Minimum (W/kg)	0.01	<0.02	0.01
Maximum (W/kg) N.B. only measured to > 100 W/kg on representative probes	>100	>100	100

Rotational Isotropy	S/N LG0018	BSEN [1]	IEEE [2]
5200 Head	0.07	0.5	0.25
5800 Head	0.04		
5200 Body	0.02		
5800 Body	0.02		

Construction	Each probe contains three orthogonal dipole sensors arranged on a triangular prism core, protected against static charges by built-in shielding, and covered at the tip by PEEK cylindrical enclosure material. Outer case materials are PEEK and heat-shrink sleeving.
Chemical resistance	Tested to be resistant to TWEEN and sugar/salt-based simulant liquids but probes should be removed, cleaned and dried when not in use. NOT recommended for use with glycol or soluble oil-based liquids.

Product Service

REFERENCES

[1] BSEN 62209-1:2006. Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices — Human models, instrumentation, and procedures — Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)

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

[3] SARA-C SAR Testing System: Measurement Uncertainty, v1.0.3. 13 October 2011.

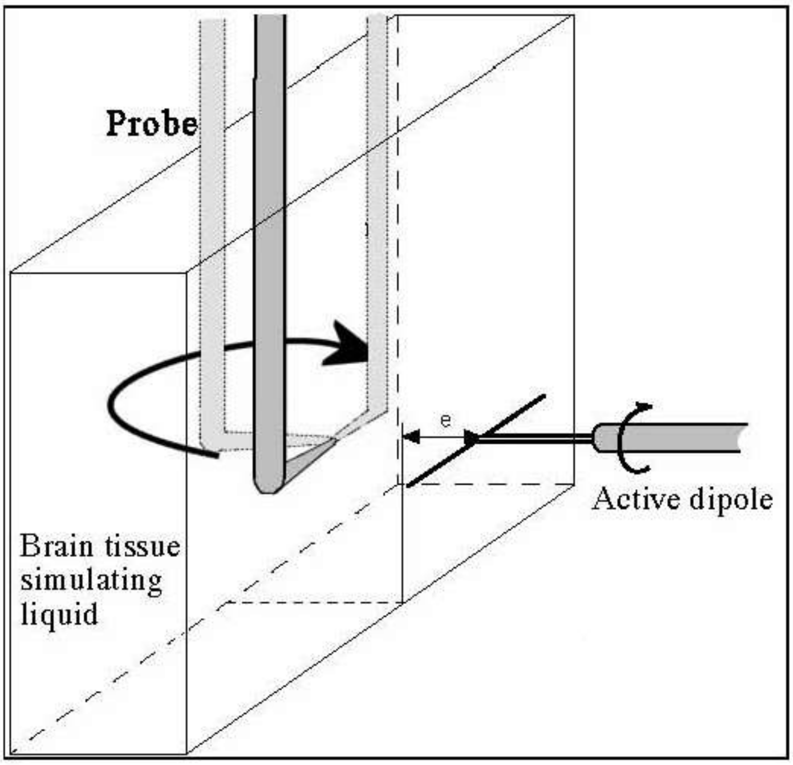

Figure 1. Spherical isotropy jig showing probe, dipole and box filled with simulated brain liquid (see Ref [2], Section A.5.2.1)

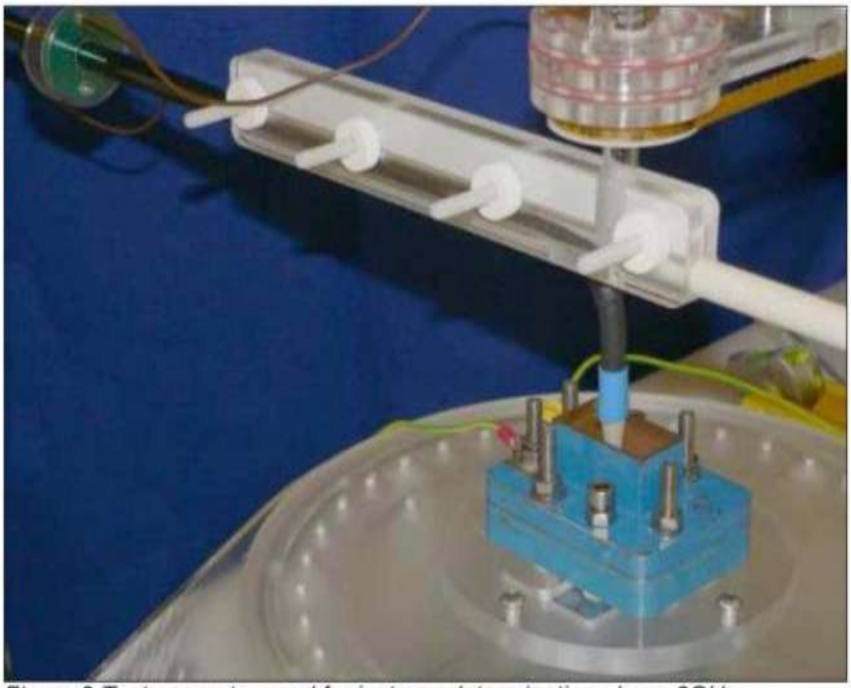

Figure 2 Test geometry used for isotropy determination above 3GHz

Figure 4. Schematic showing the innovative design of slot in the waveguide termination

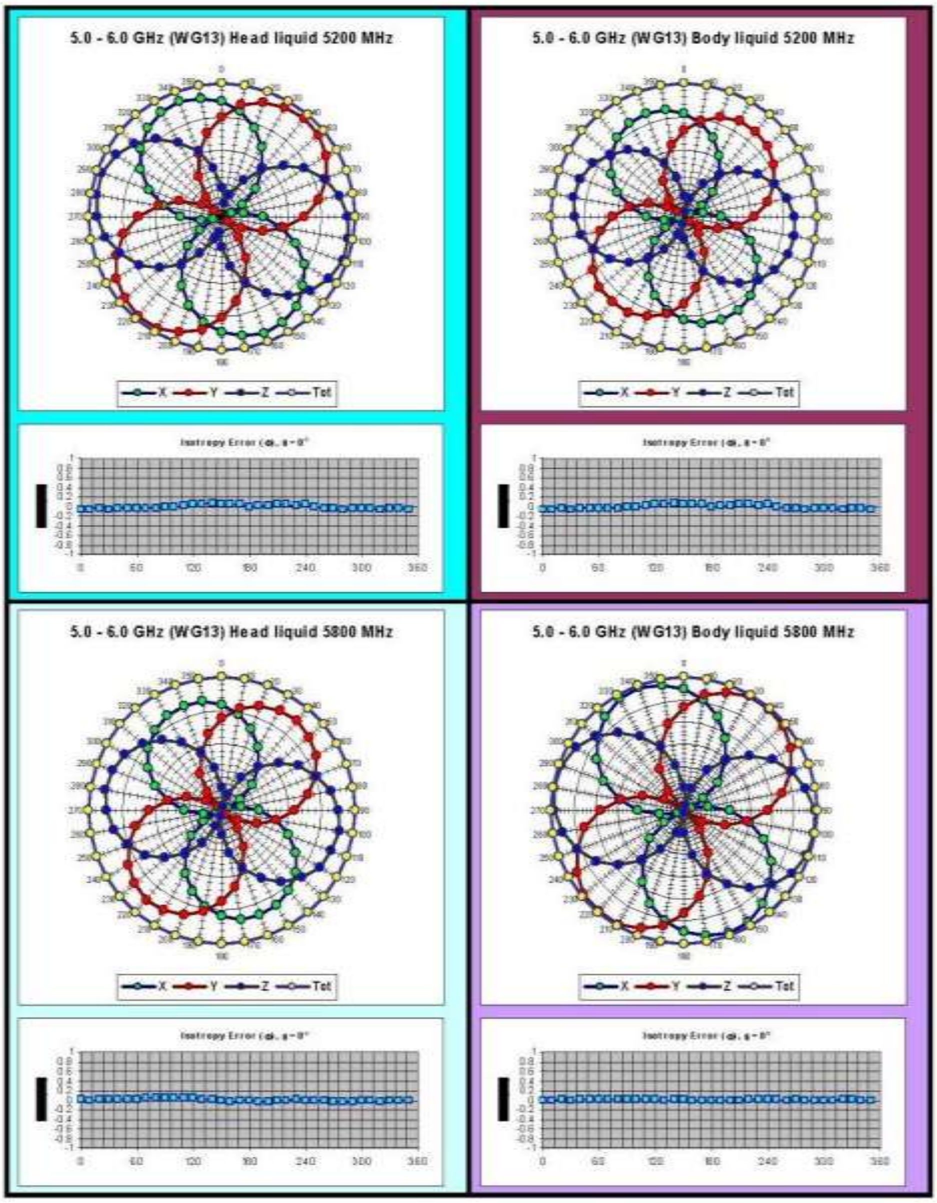

Figure 6. Rotational isotropy measurements inside a WG13 waveguide.

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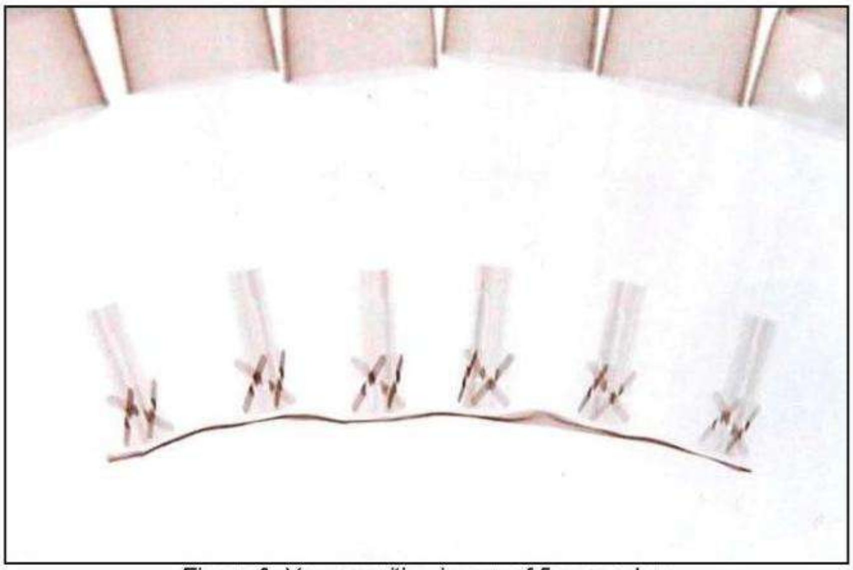

Figure 9: X-ray positive image of 5mm probes

Table indicating the dielectric parameters of the liquids used for calibrations at each frequency

Liquid used	Relative permittivity (measured)	Conductivity (S/m) (measured)
5200 MHz HEAD	36.24	4.53
5800 MHz HEAD	35.17	4.99
5200 MHz BODY	50.89	4.93
5800 MHz BODY	48.67	6.02

Table of test equipment calibration status as at time of probe calibration

Instrument description	Supplier / Manufacturer	Model	Serial No.	Calibration due date
Power sensor	Rohde & Schwarz	NRP-Z23	100063	08/09/2014
Dielectric property measurement	Indexsar	DiLine (sensor lengths: 160mm, 80mm and 60mm)	N/A	N/A
Vector network analyser	Anritsu	MS6423B	003102	16/01/2013
SMA autocalibration module	Anritsu	36581KKF/1	001902	16/01/2013

ANNEX B

DIPOLE CALIBRATION REPORTS

Product Service

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

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

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

Accreditation No.: **SCS 108**

Client **TÜV Product Service Ltd**

Certificate No: **D1900V2-546_Mar11**

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 546
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits
Calibration date:	March 21, 2011

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	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: March 21, 2011

Product Service

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

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

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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Product Service

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
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	39.3 ± 6 %	1.40 mho/m ± 6 %
Head TSL temperature during test	(21.5 ± 0.2) °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 mW / g
SAR normalized	normalized to 1W	40.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**41.3 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.25 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**21.0 mW /g ± 16.5 % (k=2)**

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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	52.1 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.96 mW / g
SAR normalized	normalized to 1W	39.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**39.8 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.20 mW / g
SAR normalized	normalized to 1W	20.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 mW / g ± 16.5 % (k=2)**

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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 Ω + 3.9 jΩ
Return Loss	- 28.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.8 Ω + 4.1 jΩ
Return Loss	- 24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 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.
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	November 15, 2001

Product Service

DASY5 Validation Report for Head TSL

Date/Time: 21.03.2011 15:38:43

Test Laboratory: SPEAG, Zurich, Switzerland

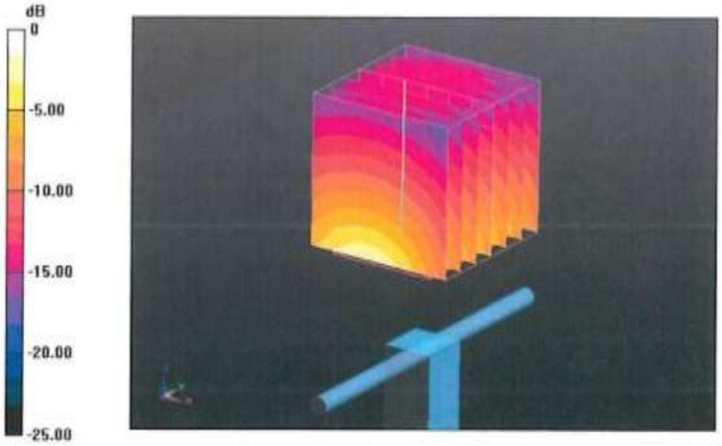
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:546

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL U12 BB
Medium parameters used: f = 1900 MHz; σ = 1.4 mho/m; ε_r = 39.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.09, 5.09, 5.09); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2829)

Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.820 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 18.710 W/kg
SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.25 mW/g
Maximum value of SAR (measured) = 12.512 mW/g

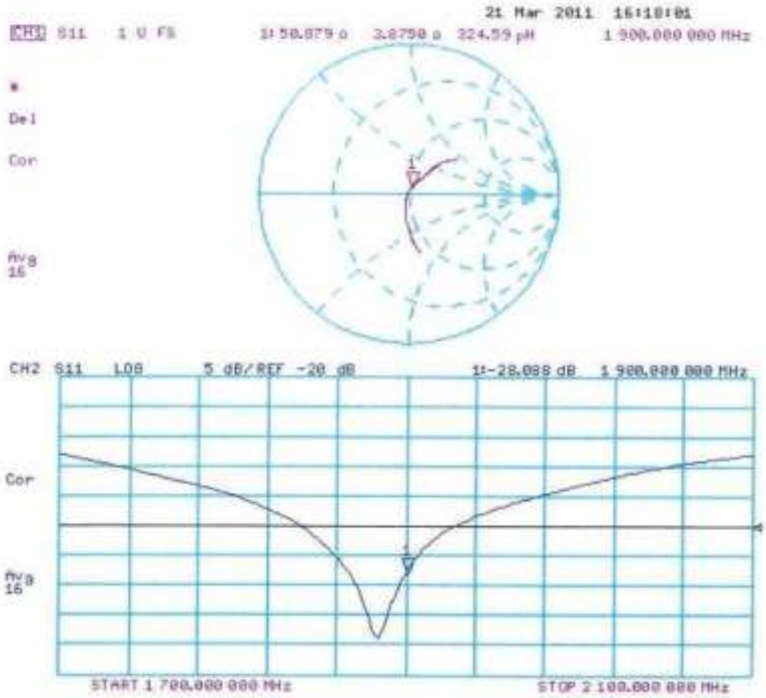


0 dB = 12.510mW/g

Certificate No: D1900V2-546_Mar11 Page 6 of 9

Product Service

Impedance Measurement Plot for Head TSL



Product Service

DASY5 Validation Report for Body TSL

Date/Time: 21.03.2011 13:11:15

Test Laboratory: SPEAG, Zurich, Switzerland

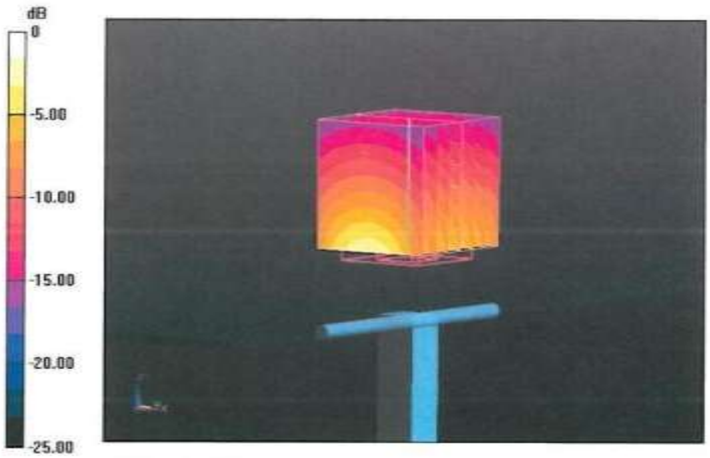
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:546

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: MSL U12 BB
Medium parameters used: f = 1900 MHz; σ = 1.51 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.59, 4.59, 4.59); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2829)

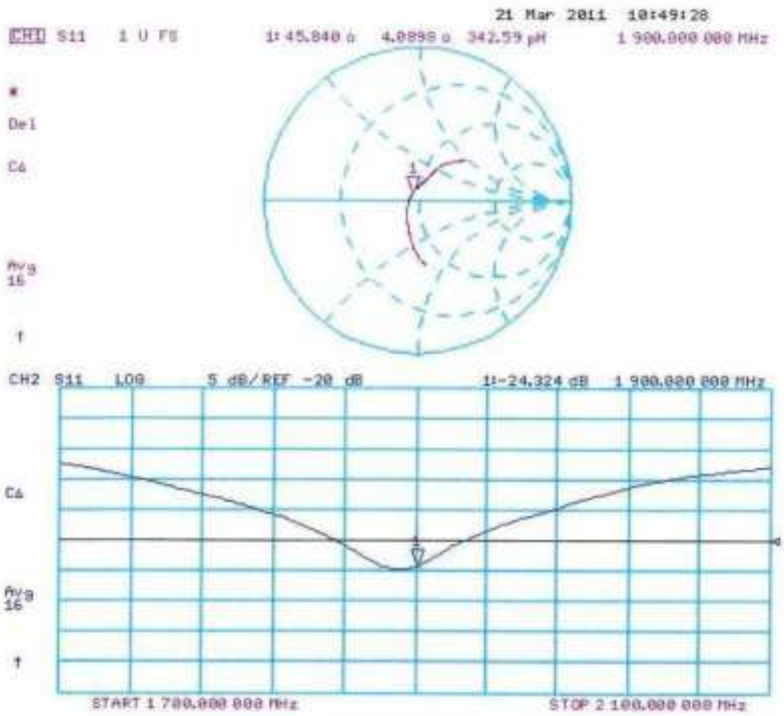
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.768 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 17.207 W/kg
SAR(1 g) = 9.96 mW/g; SAR(10 g) = 5.2 mW/g
Maximum value of SAR (measured) = 12.620 mW/g



0 dB = 12.620mW/g

Product Service

Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-546_Mar11 Page 9 of 9

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Accreditation No.: **SCS 108**

Client **TÜV Product Service Ltd**

Certificate No: **D2450V2-715_Mar11**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 715
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits
Calibration date:	March 22, 2011

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	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: March 22, 2011

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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.

Product Service

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.7 ± 6 %	1.72 mho/m ± 6 %
Head TSL temperature during test	(21.3 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.0 mW / g
SAR normalized	normalized to 1W	52.0 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**52.9 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.09 mW / g
SAR normalized	normalized to 1W	24.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 mW /g ± 16.5 % (k=2)**

Product Service

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.5 ± 6 %	1.92 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 mW / g
SAR normalized	normalized to 1W	51.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**51.3 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.95 mW / g
SAR normalized	normalized to 1W	23.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**23.8 mW / g ± 16.5 % (k=2)**

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Product Service

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.4 Ω - 0.4 jΩ
Return Loss	- 29.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.2 Ω + 1.4 jΩ
Return Loss	- 35.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 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.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 05, 2002

DASY5 Validation Report for Head TSL

Date/Time: 22.03.2011 13:23:3

Test Laboratory: SPEAG, Zurich, Switzerland

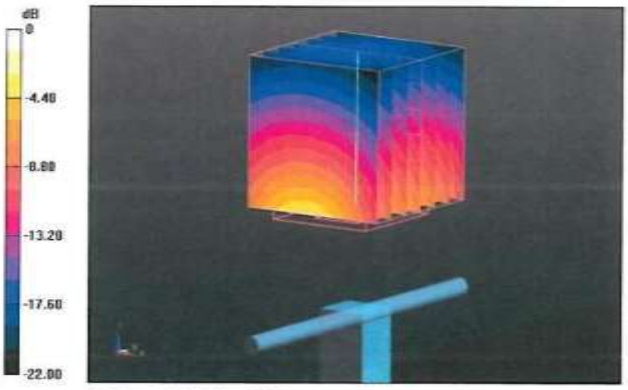
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:715

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL U12 BB
Medium parameters used: f = 2450 MHz; σ = 1.72 mho/m; ε_r = 38.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

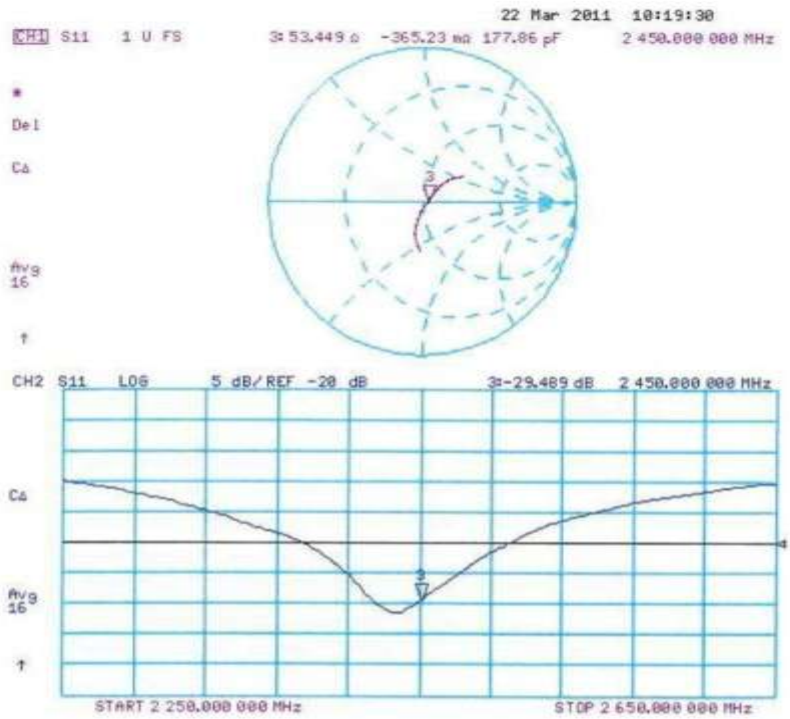
- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.1 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 26.631 W/kg
SAR(1 g) = 13 mW/g; SAR(10 g) = 6.09 mW/g
Maximum value of SAR (measured) = 16.606 mW/g



0 dB = 16.610mW/g

Impedance Measurement Plot for Head TSL



Product Service

DASY5 Validation Report for Body TSL

Date/Time: 21.03.2011 13:50:01

Test Laboratory: SPEAG, Zurich, Switzerland

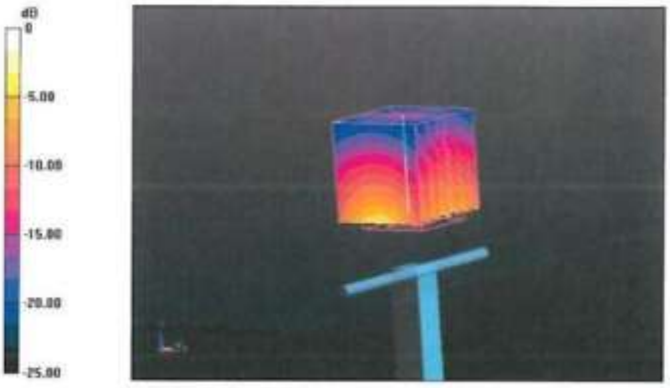
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:715

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL U12 BB
Medium parameters used: f = 2450 MHz; σ = 1.92 mho/m; ε_r = 51.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.265 V/m; Power Drift = 0.0074 dB
Peak SAR (extrapolated) = 26.996 W/kg
SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.95 mW/g
Maximum value of SAR (measured) = 16.835 mW/g



0 dB = 16.840mW/g

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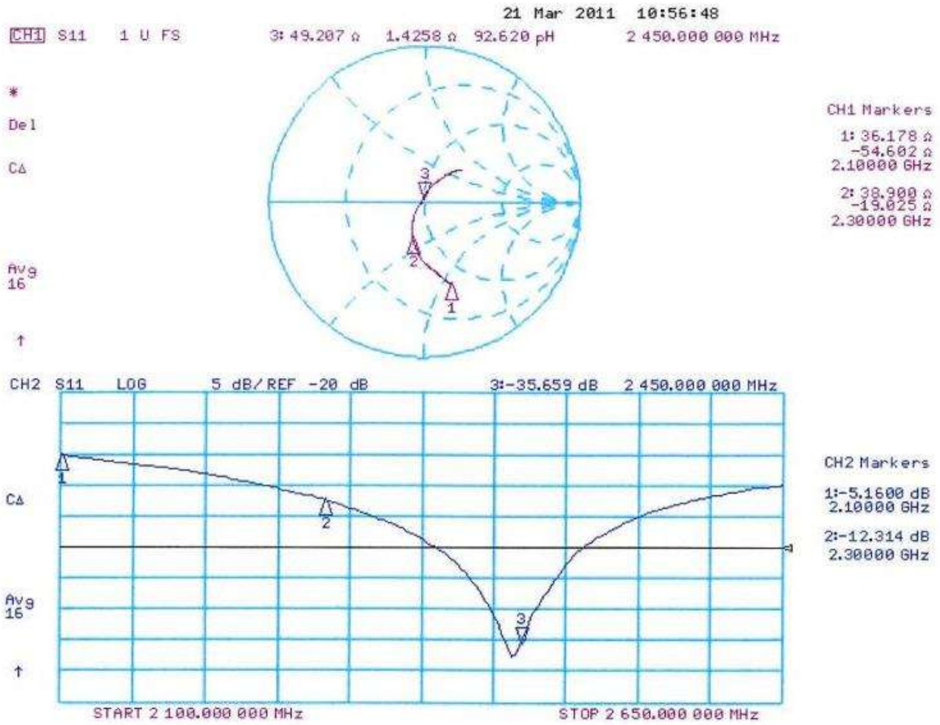
Impedance Measurement Plot for Body TSL



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Accreditation No.: **SCS 108**

Client **TÜV Product Service Ltd**

Certificate No: **D5GHzV2-1100_Mar11**

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1100
Calibration procedure(s)	QA CAL-22.v1 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	March 14, 2011

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	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe EX3DV4	SN: 3503	04-Mar-11 (No. EX3-3503_Mar11)	Mar-12
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: March 16, 2011

Product Service

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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) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
b) 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:

c) 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.

Product Service

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Area Scan resolution	dx, dy = 10 mm	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	
Frequency	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.4 ± 6 %	4.51 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.31 mW / g
SAR normalized	normalized to 1W	83.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**83.2 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 mW / g
SAR normalized	normalized to 1W	23.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.6 mW / g ± 19.5 % (k=2)**

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Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.9 ± 6 %	4.80 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.98 mW / g
SAR normalized	normalized to 1W	89.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**89.8 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.54 mW / g
SAR normalized	normalized to 1W	25.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**25.4 mW / g ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.10 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.39 mW / g
SAR normalized	normalized to 1W	83.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**83.9 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.37 mW / g
SAR normalized	normalized to 1W	23.7 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.7 mW / g ± 19.5 % (k=2)**

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Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.48 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.70 mW / g
SAR normalized	normalized to 1W	77.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**76.8 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.14 mW / g
SAR normalized	normalized to 1W	21.4 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.4 mW / g ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.8 ± 6 %	5.85 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	condition	
SAR measured	100 mW input power	8.22 mW / g
SAR normalized	normalized to 1W	82.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**82.0 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.27 mW / g
SAR normalized	normalized to 1W	22.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**22.7 mW / g ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	6.22 mho/m ± 6 %
Body TSL temperature during test	(21.0 ± 0.2) °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.61 mW / g
SAR normalized	normalized to 1W	76.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**75.8 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.9 mW / g ± 19.5 % (k=2)**

Product Service

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.5 Ω - 7.5 jΩ
Return Loss	-22.3 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	48.9 Ω - 1.7 jΩ
Return Loss	-33.8 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	51.7 Ω + 4.3 jΩ
Return Loss	-26.9 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	53.0 Ω - 6.6 jΩ
Return Loss	-23.1 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	49.4 Ω - 1.4 jΩ
Return Loss	-36.4 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	52.2 Ω + 3.8 jΩ
Return Loss	-27.3 dB

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General Antenna Parameters and Design

Electrical Delay (one direction)	1.207 ns

After long term use with 40 W 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.
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	September 24, 2010

Product Service

DASY5 Validation Report for Head TSL

Date/Time: 11.03.2011 14:54:17

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1100

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: HSL 5000
Medium parameters used: f = 5200 MHz; σ = 4.51 mho/m; ε_r = 36.4; ρ = 1000 kg/m^3 .
Medium parameters used: f = 5500 MHz; σ = 4.8 mho/m; ε_r = 35.9; ρ = 1000 kg/m^3 .
Medium parameters used: f = 5800 MHz; σ = 5.1 mho/m; ε_r = 35.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

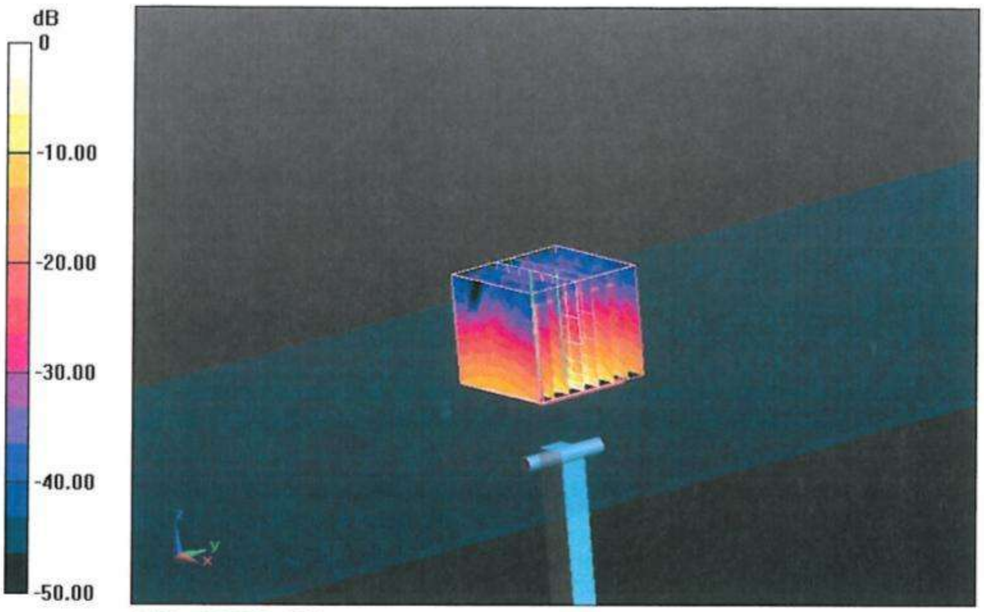
DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41), ConvF(4.91, 4.91, 4.91), ConvF(4.81, 4.81, 4.81); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Pin=100mW, f=5200 MHz/Zoom Scan (4x4x1.4mm), dist=1.4mm (8x8x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.701 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.049 W/kg
SAR(1 g) = 8.31 mW/g; SAR(10 g) = 2.36 mW/g
Maximum value of SAR (measured) = 18.802 mW/g

Pin=100mW, f=5500 MHz/Zoom Scan (4x4x1.4mm), dist=1.4mm (8x8x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.450 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 35.828 W/kg
SAR(1 g) = 8.98 mW/g; SAR(10 g) = 2.54 mW/g
Maximum value of SAR (measured) = 21.257 mW/g

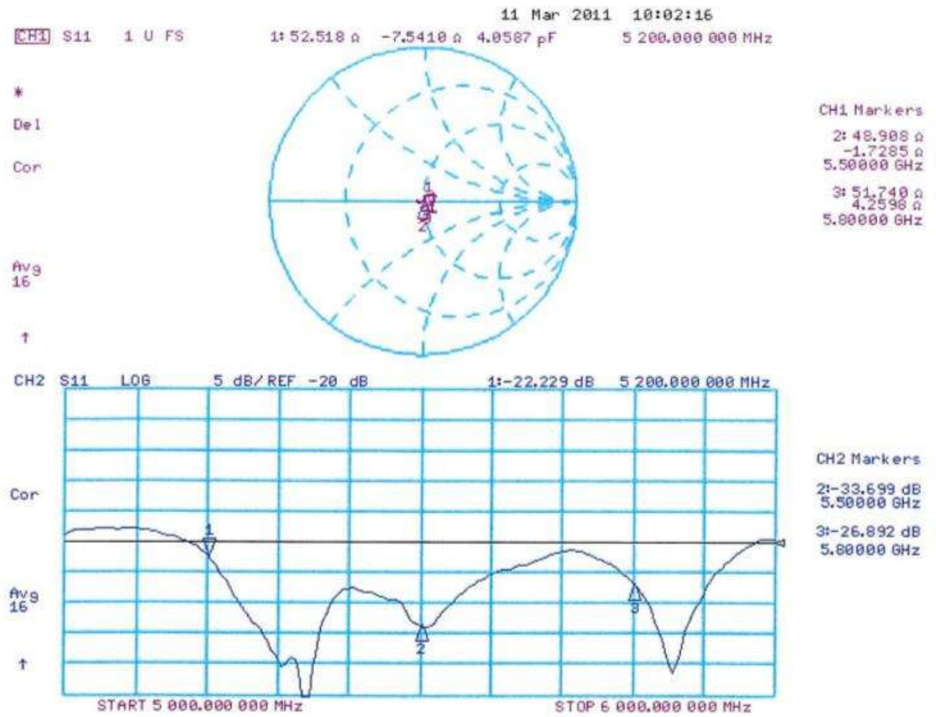
Pin=100mW, f=5800 MHz/Zoom Scan (4x4x1.4mm), dist=1.4mm (8x8x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 57.226 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 35.431 W/kg
SAR(1 g) = 8.39 mW/g; SAR(10 g) = 2.37 mW/g
Maximum value of SAR (measured) = 20.329 mW/g



0 dB = 20.330mW/g

Product Service

Impedance Measurement Plot for Head TSL



Product Service

DASY5 Validation Report for Body TSL

Date/Time: 14.03.2011 15:25:41

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1100

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: MSL 5000 MHz
Medium parameters used: f = 5200 MHz; σ = 5.54 mho/m; ε_r = 48.3; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5500 MHz; σ = 5.92 mho/m; ε_r = 47.7; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 6.3 mho/m; ε_r = 47; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

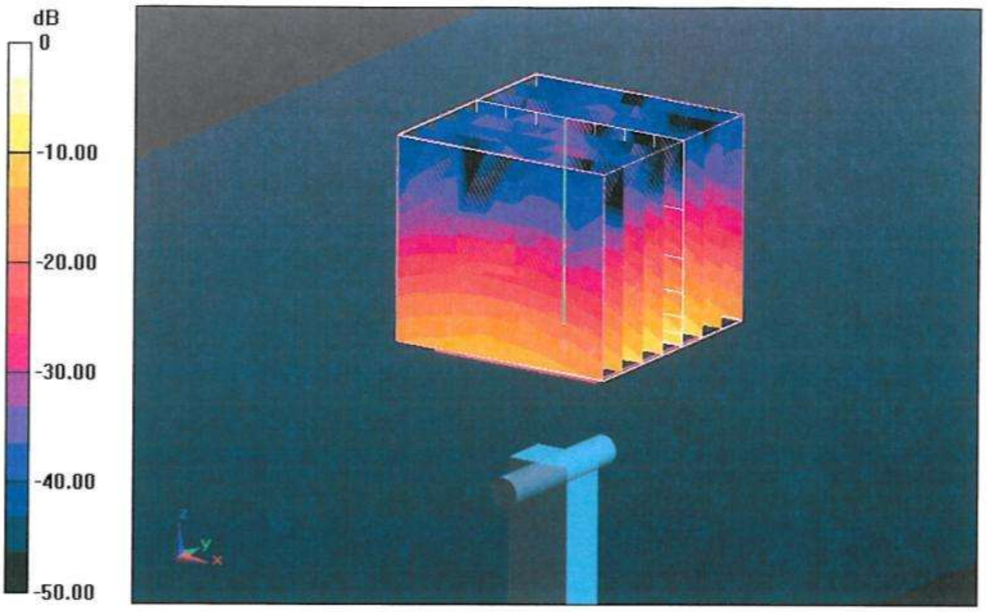
DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91), ConvF(4.43, 4.43, 4.43), ConvF(4.38, 4.38, 4.38); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Pin=100mW, f=5200 MHz/Zoom Scan (4x4x1.4mm), dist=1.4mm (8x8x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.462 V/m; Power Drift = -0.0014 dB
Peak SAR (extrapolated) = 30.321 W/kg
SAR(1 g) = 7.7 mW/g; SAR(10 g) = 2.14 mW/g
Maximum value of SAR (measured) = 17.819 mW/g

Pin=100mW, f=5500 MHz/Zoom Scan (4x4x1.4mm), dist=1.4mm (8x8x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.851 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 35.000 W/kg
SAR(1 g) = 8.22 mW/g; SAR(10 g) = 2.27 mW/g
Maximum value of SAR (measured) = 19.554 mW/g

Pin=100mW, f=5800 MHz/Zoom Scan (4x4x1.4mm), dist=1.4mm (8x8x7)/Cube 0:
Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.021 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 35.337 W/kg
SAR(1 g) = 7.61 mW/g; SAR(10 g) = 2.1 mW/g
Maximum value of SAR (measured) = 18.772 mW/g



0 dB = 18.770mW/g

Product Service

Impedance Measurement Plot for Body TSL