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Report On

Specific Absorption Rate Testing of the
Sharp CDMA SHI14 Dual Band CDMA (800 MHz, BC0 and 1900 MHz, BC6) Cellular Phone with Bluetooth, WLAN, FeliCa and GPS

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REPORT ON	Specific Absorption Rate Testing of the Sharp CDMA SHI14 Dual Band CDMA (800 MHz, BC0 and 1900 MHz, BC6) Cellular Phone with Bluetooth, WLAN, FeliCa and GPS Document 75915808 Report 05 Issue 1 December 2011
PREPARED FOR	Sharp Communication Compliance Ltd Azure House Bagshot Road Bracknell Berkshire RG12 7QY
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DATED	08 December 2011

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SECTION 1

REPORT SUMMARY

Specific Absorption Rate Testing of the
Sharp CDMA SHI14 Dual Band CDMA (800 MHz, BC0 and 1900 MHz, BC6) 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 CDMA SHI14 Dual Band CDMA (800 MHz, BC0 and 1900 MHz, BC6) Cellular Phone with Bluetooth, WLAN, FeliCa and GPS to the requirements of OET65 C:2001.

Objective	To perform Specific Absorption Rate Testing to determine the Equipment Under Test's (EUT's) compliance with the requirements specified of EN 50360: 2001, for the series of tests carried out.
Applicant	Sharp Communication Compliance Ltd
Manufacturer	Sharp Corporation
Manufacturing Description	Dual Band CDMA (800 MHz, BC0 and 1900 MHz, BC6) Cellular Phone with Bluetooth, WLAN, FeliCa and GPS
Model Number	CDMA SHI14
Hardware Version	ES
Software Version	AA060
Battery Cell Manufacturer	Sharp
Battery Model Number	SHI11UAA
Test Specification/Issue/Date	OET Bulletin 65 Supplement C Edition 01-01
Start of Test	18 November 2011
Finish of Test	21 November 2011
Related Document(s)	FCC 47CFR 2.1093 KDB 248227 – v01r02 (Rev 1.2) KDB 450824 – D01 v01r01(Rev 1.1) KDB 450824 – D02 v01 KDB 648474 – D01 v01r05 KDB 941225 – D01 v02 KDB 941225 – D03 v01 IEEE 1528-2003
Name of Engineer(s)	Nigel Grigsby

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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)	0.578
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	Max 10g SAR (W/kg)*	Percentage Drift on Reference
21/11/2011	850	844.4	9.36	-1.48%	6.22	0.36%
18/11/2011	2450	2450	47.75	-8.87%	22.61	-5.80%

*Normalised to a forward power of 1W

1.3.2 Results Summary Tables

CDMA 2000 Head Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp CDMA SHI14.

Position		Channel Number	Frequency (MHz)	Max Spot SAR (W/kg)	Max 1g SAR (W/kg)	Max 10g SAR (W/kg)	SAR Drift (%)	Area scan (Figure number)
Ear	Head							
Left	Cheek	1013	824.7	0.470	0.450	0.356	-1.650	Figure 8
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) & 2.0 W/kg (10g)								

CDMA 2000 Body Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp CDMA SHI14.

Position		Channel Number	Frequency (MHz)	Max Spot SAR (W/kg)	Max 1g SAR (W/kg)	Max 10g SAR (W/kg)	SAR Drift (%)	Area scan (Figure number)
Spacing	Direction							
15mm	Rear Facing	1013	824.7	0.490	0.578	0.410	0.410	Figure 9
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) & 2.0 W/kg (10g)								

WLAN 2450MHz Head Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp CDMA SHI14.

Position		Channel Number	Frequency (MHz)	Max Spot SAR (W/kg)	Max 1g SAR (W/kg)	Max 10g SAR (W/kg)	SAR Drift (%)	Area scan (Figure number)
Ear	Head							
Right	Cheek	6	2437.0	0.130	0.114	0.058	2.040	Figure 10
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) & 2.0 W/kg (10g)								

WLAN 2450MHz Body Specific Absorption Rate (Maximum SAR) 1g & 10g Results for the Sharp CDMA SHI14.

Position		Channel Number	Frequency (MHz)	Max Spot SAR (W/kg)	Max 1g SAR (W/kg)	Max 10g SAR (W/kg)	SAR Drift (%)	Area scan (Figure number)
Spacing	Direction							
15mm	Rear Facing	6	2437.0	0.040	0.056	0.035	2.440	Figure 11
Limit for General Population (Uncontrolled Exposure) 1.6 W/kg (1g) & 2.0 W/kg (10g)								

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The equipment under test (EUT) was a CDMA SHI14 Dual Band CDMA (800 MHz, BC0 and 1900 MHz, BC6) Cellular Phone with Bluetooth, WLAN, FeliCa 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 standard batteries supplied and manufactured by Sharp Corporation. Each 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 CDMA 2000, 800MHz and WLAN 2450MHz frequency bands at maximum power. The device was placed against a Specific Anthropomorphic Mannequin (SAM) phantom as specified in the OET Bulletin 65 (Edition 97-01). 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 in OET Bulletin 65 (Edition 97-01).

For body SAR assessment, the device was tested for typical body-worn operation in accordance with the requirements of OET65(c) with the exception of SAR limits applied, these were obtained from ICNIRP (1998). Flat phantom dimensions were 210mmx210mmx210mm and with a sidewall thickness of 2.0mm. The phantom was filled to a 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). SAR testing was performed with the body of the device placed at 15.0mm separation from the phantom.

Testing was performed in each position / configuration that yielded worst case SAR from the testing of the Sharp CDMA SHI11 (TUV Job Number 75913699).

Conducted power measurements were carried out for CDMA 2000 on the device in Voice and Data modes. This was to ensure that the SHI14 conformed with the worst case configuration that yielded the highest SAR during the testing of the Sharp CDMA SHI11 (TUV Job Number 75913699).

Due to the inability to make conducted power measurements on the WLAN SAR sample the following technique was used to make power measurements and ascertain what testing was required and which channel yielded the highest power. Due to limiting factors of the radiated test setup the radiated measurements were made in maximum peak only as maximum average measurements could not be made. Measurements were made on the conducted sample in maximum peak and maximum average. On a channel by channel basis the ratio between maximum peak and maximum average was worked out, this ratio was then applied to the radiated maximum peak measurements that were taken on the radiated sample.

Testing is not required on 802.11g/n when the maximum average output power is less than 0.25dB higher than that measured on the corresponding 802.11b channels.

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HEAD SAR CDMA2000:

SAR for the head exposure configurations is measured in RC3 with the EUT configured to transmit at full rate using Loopback Service Option SO55.
SAR for RC1 is not required when the maximum average output of each channel is less than 0.25dB higher than that measured in RC3. If SAR for RC1 is required, then SAR is measured on the maximum output channel in RC1 using the exposure configuration that results in the highest SAR for that channel in RC3.

BODY SAR CDMA2000:

SAR for the body exposure configuration is measured in RC3 with the EUT configured using TDSO / SO32, to transmit at full rate on FCH with all other code channels disabled.
SAR for multiple code channels (FCH + SCH) is not required when the maximum average output of each RF channel is less than 0.25dB higher than that measured with FCH only. If SAR for multiple code channels is required then SAR is measured on the maximum output channel (FCH + SCHn) with FCH at full rate and SCH0 enabled at 9600bps, using the exposure configuration that results in the highest SAR with FCH only for that channel. When multiple code channels are enabled, the DUT may shift by more than 0.5dB and lead to higher SAR drifts and SCH dropouts.

Body SAR in RC1 is not required when the maximum average output of each channel is less than 0.25dB higher than that measured in RC3. If SAR for RC1 is required, then SAR is measured on the maximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that results in the highest SAR that channel in RC3.

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.

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1.5 FCC POWER MEASUREMENTS

1.5.1 Method

Conducted power measurements were made using a power meter.

1.5.2 Conducted Power Measurements

Head

Serial No.	Mode	Modulation	Frequency	Conducted Carrier Power Average (dBm)
SSHFA002162	S055, RC1	64-RAY Orthogonal	824.70	21.12
			836.52	24.06
			848.27	24.09

Serial No.	Mode	Modulation	Frequency	Conducted Carrier Power Average (dBm)
SSHFA002162	S055, RC3	64-RAY Orthogonal	824.70	**24.19**
			836.52	24.03
			848.37	24.08

Body

Serial No.	Mode	Modulation	Frequency	Conducted Carrier Power Average (dBm)
SSHFA002162	TDS032, FCH RC3	BPSK	824.70	**24.18**
			836.52	24.02
			848.37	24.10

Serial No.	Mode	Modulation	Frequency	Conducted Carrier Power Average (dBm)
SSHFA002162	TDS032, FCH +SCH RC3	BPSK	824.70	24.17
			836.52	24.07
			848.37	24.01

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WLAN

Mode	Modulation	Frequency	Conducted Carrier Power (dBm) Serial No. SSHFL001008	Radiated Carrier Power(dBm) Serial No. SSHFA002158	Peak to Average Ratio (dB)	Corrected Radiated Carrier Power for SAR Report (dBm)
802.11b 11Mbps	CCK/PBCC	2412	18.37	19.1	3.61	15.49
		2437	18.67	20.1	3.69	16.41
		2462	19.33	18.8	3.86	14.94

Mode	Modulation	Frequency	Conducted Carrier Power (dBm) Serial No. SSHFL001008	Radiated Carrier Power(dBm) Serial No. SSHFA002158	Peak to Average Ratio (dB)	Corrected Radiated Carrier Power for SAR Report (dBm)
802.11g 12Mbps	QPSK	2412	20.26	19.9	9.68	10.22
		2437	20.86	19.8	9.88	9.92
		2462	21.40	19.9	10.04	9.86

Mode	Modulation	Frequency	Conducted Carrier Power (dBm) Serial No. SSHFL001008	Radiated Carrier Power(dBm) Serial No. SSHFA002158	Peak to Average Ratio (dB)	Corrected Radiated Carrier Power for SAR Report (dBm)
802.11n 52Mbps	OFDM/ 64QAM	2412	20.40	19.2	10.09	9.11
		2437	20.91	10.02	10.02	9.18
		2462	21.28	10.26	10.26	8.74

SECTION 2

TEST DETAILS

Specific Absorption Rate Testing of the
Sharp CDMA SHI14 Dual Band CDMA (800 MHz, BC0 and 1900 MHz, BC6) Cellular Phone
with Bluetooth, WLAN, FeliCa and GPS

2.1 SARA 2 SAR MEASUREMENT SYSTEM

2.1.1 Robot System Specification

The SAR measurement system being used is the IndexSAR SARA2 system, which consists of a Mitsubishi RV-E2 6-axis robot arm and controller, IndexSAR probe and amplifier and SAM phantom Head Shape. The robot is used to articulate the probe to programmed positions inside the phantom head to obtain the SAR readings from the DUT.

Schematic diagram of the SAR measurement system

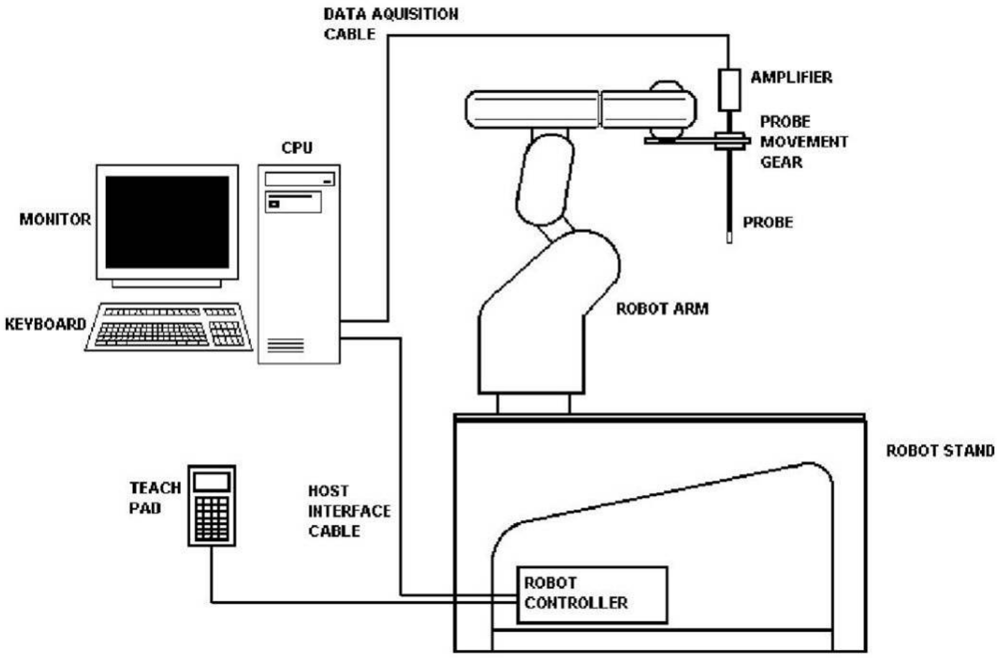

Figure 1

The system is controlled remotely from a PC, which contains the software to control 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.

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. 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

IXP-050 IndexSAR isotropic immersible SAR probe

The 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.
Probe calibration is described in the following section.

IFA-010 Fast Amplifier

Technical description of IndexSAR IFA-010 Fast probe amplifier
A block diagram of the fast probe amplifier electronics is shown below.

Block diagram of the fast probe amplifier electronic

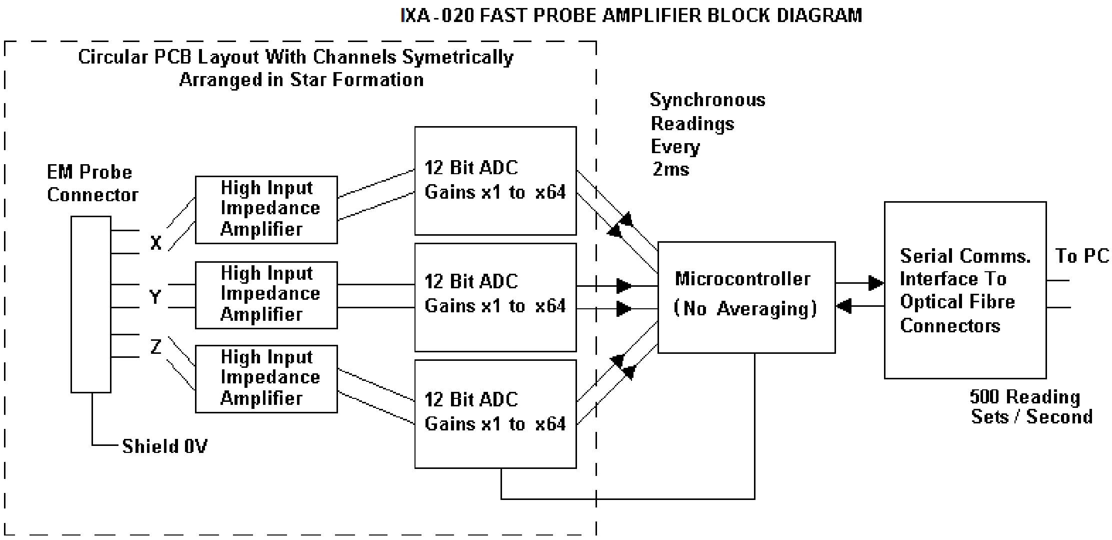

Figure 2

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 reading sets for all three channels (simultaneously) are returned every 2ms to the PC. 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. It is important to ensure that the probe reading frequency and the pulse period are not synchronised and the behaviour with pulses of short duration in comparison with the measurement interval need additional consideration.

Phantoms

The Flat phantom used is a rectangular Perspex Box IndexSAR item IXB-070. Dimensions 210w 210d 210h (mm). This phantom is used with IndexSAR side bench IXM-030.

The Specific Anthropomorphic Mannequin (SAM) Upright Phantom is fabricated using moulds generated from the CAD files as specified by CENELEC EN 62209-1: 2006. It is mounted via a rotation base to a supporting table, which also holds the robotic positioner. The phantom and robot alignment is assured by both mechanical and laser registration systems.

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2.1.3 SAR Measurement Procedure

Principal components of the SAR measurement test bench

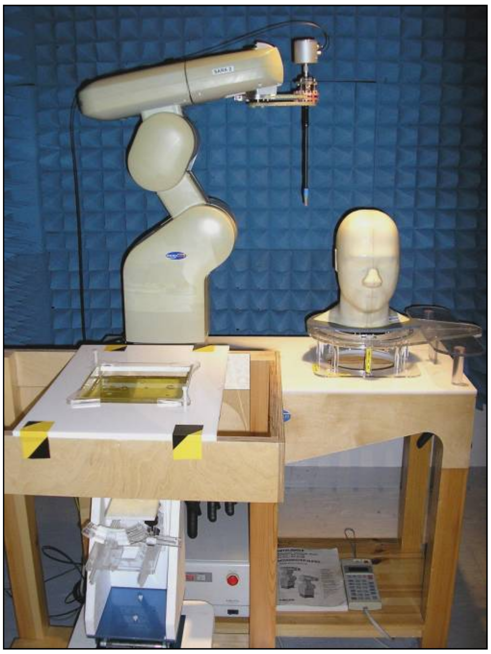

Figure 3

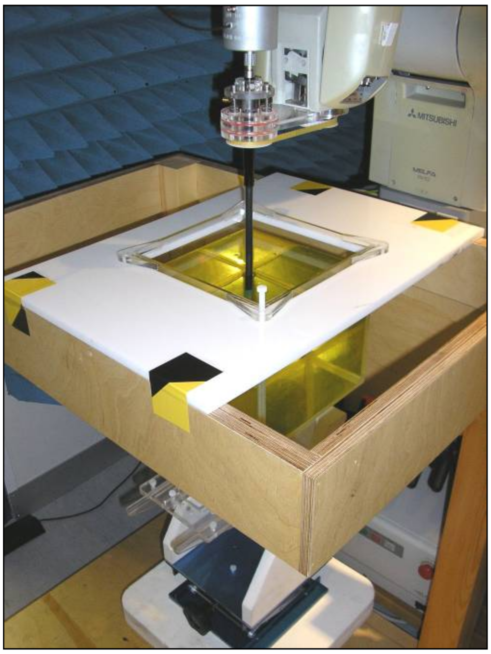

Figure 4

The major components of the test bench are shown in the pictures above. 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 a 45mm diameter penetration hole in the top of the head.

After an area scan has been done at a fixed distance of 8mm from the surface of the phantom on the source side, a 3D scan is set up around the location of the maximum spot SAR. First, a point within the scan area is visited by the probe and a SAR reading taken at the start of testing. At the end of testing, the probe is returned to the same point and a second reading is taken. Comparison between these start and end readings enables the power drift during measurement to be assessed.

SARA2 Interpolation and Extrapolation schemes

SARA2 software contains support for both 2D cubic B-spline interpolation as well as 3D cubic B-spline interpolation. In addition, for extrapolation purposes, a general n^{-th} order polynomial fitting routine is implemented following a singular value decomposition algorithm presented in [4]. A 4^{th} order polynomial fit is used by default for data extrapolation, but a linear-logarithmic fitting function can be selected as an option. The polynomial fitting procedures have been tested by comparing the fitting coefficients generated by the SARA2 procedures with those obtained using the polynomial fit functions of Microsoft Excel when applied to the same test input data.

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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 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). SARA2 enables full control over the selection of alternative step sizes in all directions.

The digitised shape of the head is available to the SARA2 software, which decides which points in the 3D array are sufficiently well within the shell wall to be 'visited' by the SAR probe. After the data collection, the data are extrapolated in the depth direction to assign values to points in the 3D array closer to the shell wall. A notional extrapolation value is also assigned to the first point outside the shell wall so that subsequent interpolation schemes will be applicable right up to the shell wall boundary.

Interpolation of 3D scan and volume averaging

The procedure used for defining the shape of the volumes used for SAR averaging in the SARA2 software 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 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, 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. For the definition of the surface in this procedure, the digitised position of the headshell surface is used for measurement in head-shaped phantoms. For measurements in rectangular, box phantoms, the distance between the phantom wall and the closest set of gridded data points is entered into the software.

For measurements in box-shaped phantoms, this distance is under the control of the user. The effective distance must be greater than 2.5mm as this is the tip-sensor distance and to avoid interface proximity effects, it should be at least 5mm. A value of 6 or 8mm is recommended. This distance is called **dbe** in EN 62209-1: 2006.

For automated measurements inside the head, the distance cannot be less than 2.5mm, which is the radius of the probe tip and to avoid interface proximity effects, a minimum clearance distance of x mm is retained. The actual value of dbe will vary from point to point depending upon how the spatially-regular 3D grid points fit within the shell. The greatest separation is when a grid point is just not visited due to the probe tip dimensions. In this case the distance could be as large as the step-size plus the minimum clearance distance (i.e with x=5 and a step size of 3.5, **dbe** will be between 3.5 and 8.5mm).

The default step size (**dstep** in EN 62209-1: 2006) used 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.

The phantom shell is made by an industrial moulding process from the CAD files of the SAM shape, with both internal and external moulds. For the upright phantoms, the external shape is subsequently digitised on a Mitutoyo CMM machine (Euro C574) to a precision of 0.001mm. Wall thickness measurements made non-destructively with an ultrasonic sensor indicate that the shell thickness (**dph**) away from the ear is 2.0 +/- 0.1mm. The ultrasonic measurements were calibrated using additional mechanical measurements on available cut surfaces of the phantom shells.

For the upright phantom, the alignment is based upon registration of the rotation axis of the phantom on its 253mm-diameter baseplate bearing and the position of the probe axis when commanded to go to the axial position. A laser alignment tool is provided (procedure detailed elsewhere). This enables the registration of the phantom tip (**dmis**) to be assured to within approx. 0.2mm. This alignment is done with reference to the actual probe tip after installation and probe alignment. The rotational positioning of the phantom is variable – offering advantages for special studies, but locating pins ensure accurate repositioning at the principal positions (LH and RH ears).

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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. These two test positions are defined in the following sub-clauses. 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.

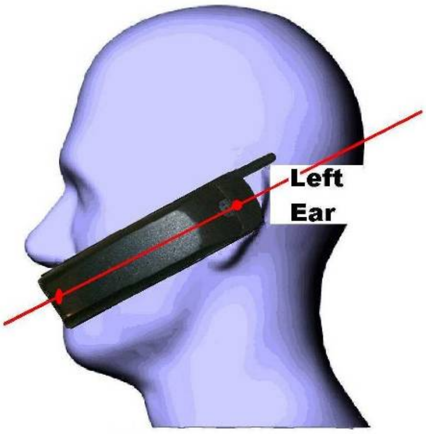

Figure 5. – Side View of Mobile next to head showing alignment.

<u>The Cheek Position</u>
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.

<u>The 15° Position</u>
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°.

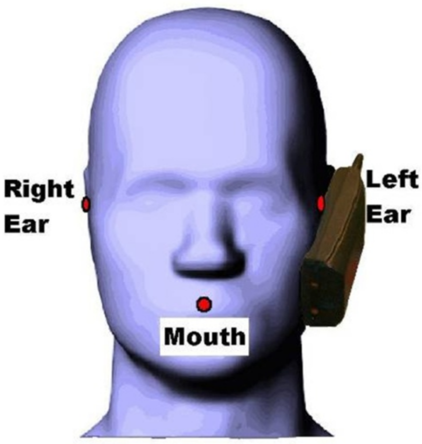

Figure 6. – Cheek Position.

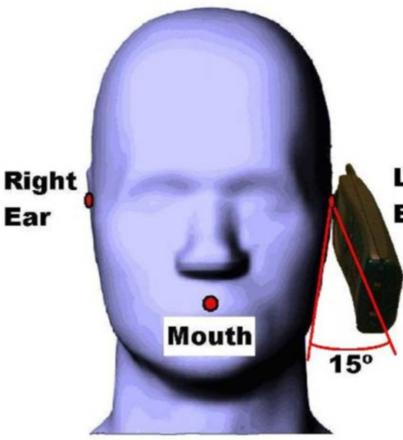

Figure 7. – 15º Tilt Position.

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2.2 CDMA 2000 HEAD SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA2 / 2.53 VPM	INPUT POWER DRIFT:	0 dB
DATE / TIME:	21/11/2011 14:05:03	DUT BATTERY MODEL/NO:	SHI11UAA
FILENAME:	01.txt	PROBE SERIAL NUMBER:	190
AMBIENT TEMPERATURE:	22.80°C	LIQUID SIMULANT:	835Head
DEVICE UNDER TEST:	CDMA SHI14	RELATIVE PERMITTIVITY:	40.86
RELATIVE HUMIDITY:	42.20%	CONDUCTIVITY:	0.877
PHANTOM S/NO:	Head_04_35.csv	LIQUID TEMPERATURE:	23.10°C
PHANTOM ROTATION:	0°	MAX SAR Y-AXIS LOCATION:	-49.40mm
DUT POSITION:	Left-Cheek	MAX SAR Z-AXIS LOCATION:	-159.75mm
ANTENNA CONFIGURATION:	N/A	MAX E FIELD:	20.780
TEST FREQUENCY:	824.7MHz	SAR 1g:	0.450 W/kg
AIR FACTORS:	519.61 / 671.10 / 632.34	SAR 10g:	0.356 W/kg
CONVERSION FACTORS:	0.230 / 0.199 / 0.232	SAR START:	0.288 W/kg
TYPE OF MODULATION:	64-RAY Orthogonal	SAR END:	0.283 W/kg
MODN. DUTY CYCLE:	100%	SAR DRIFT DURING SCAN:	-1.650 %
DIODE COMPRESSION FACTORS (V*200):	20 / 20 / 20	PROBE BATTERY LAST CHANGED:	21/11/2011
INPUT POWER LEVEL:	23dBm	EXTRAPOLATION:	poly4

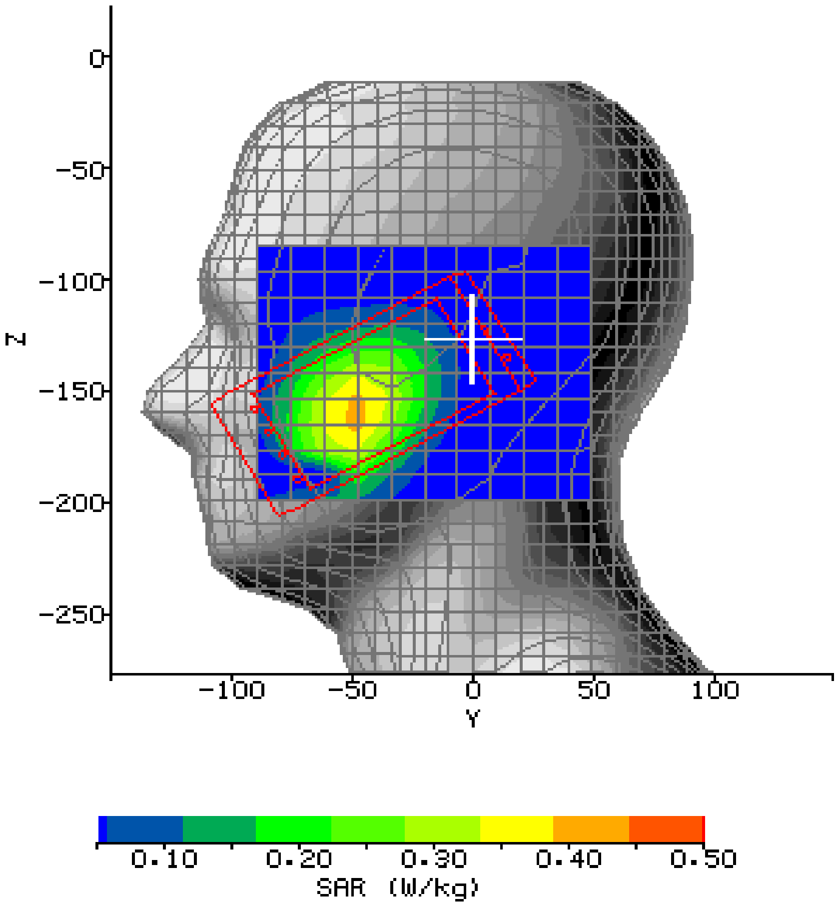

Figure 8: SAR Head Testing Results for the Sharp CDMA SHI14 Mobile Handset at 824.7MHz.

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2.3 CDMA 2000 BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA2 / 2.53 VPM	INPUT POWER DRIFT:	0 dB
DATE / TIME:	21/11/2011 14:42:33	DUT BATTERY MODEL/NO:	SHI11UAA
FILENAME:	02.txt	PROBE SERIAL NUMBER:	190
AMBIENT TEMPERATURE:	23.00°C	LIQUID SIMULANT:	835Body
DEVICE UNDER TEST:	CDMA SHI14	RELATIVE PERMITTIVITY:	55.32
RELATIVE HUMIDITY:	41.80%	CONDUCTIVITY:	1.018
PHANTOM S/NO:	HeadBox02.csv	LIQUID TEMPERATURE:	23.00°C
PHANTOM ROTATION:	N/A	MAX SAR X-AXIS LOCATION:	17.00mm
DUT POSITION:	15mm-Rear Facing	MAX SAR Y-AXIS LOCATION:	-5.00mm
ANTENNA CONFIGURATION:	N/A	MAX E FIELD:	21.470
TEST FREQUENCY:	824.7MHz	SAR 1g:	0.578 W/kg
AIR FACTORS:	519.61 / 671.10 / 632.34	SAR 10g:	0.410 W/kg
CONVERSION FACTORS:	0.233 / 0.201 / 0.235	SAR START:	0.177 W/kg
TYPE OF MODULATION:	BPSK	SAR END:	0.178 W/kg
MODN. DUTY CYCLE:	100%	SAR DRIFT DURING SCAN:	0.410 %
DIODE COMPRESSION FACTORS (V*200):	20 / 20 / 20	PROBE BATTERY LAST CHANGED:	21/11/2011
INPUT POWER LEVEL:	23dBm	EXTRAPOLATION:	poly4

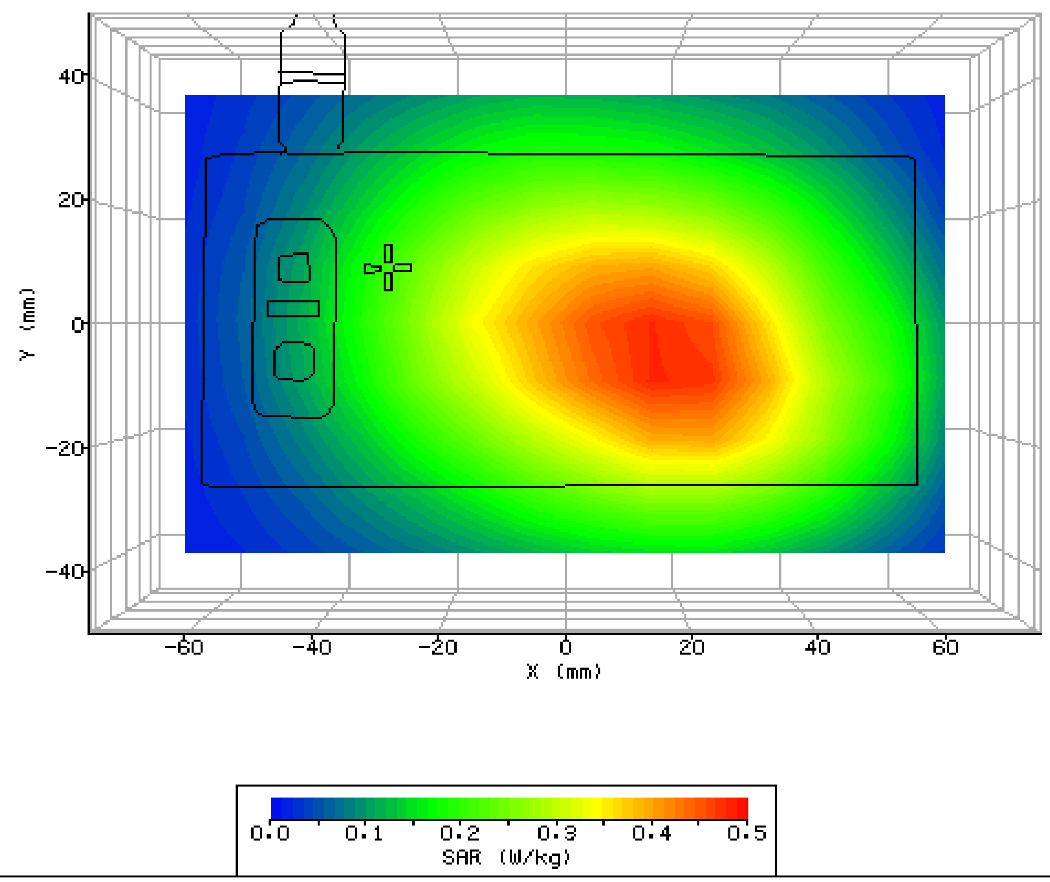

Figure 9: SAR Body Testing Results for the Sharp CDMA SHI14 Mobile Handset at 824.7MHz.

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

SYSTEM / SOFTWARE:	SARA2 / 2.53 VPM	INPUT POWER DRIFT:	0 dB
DATE / TIME:	18/11/2011 12:08:52	DUT BATTERY MODEL/NO:	SHI11UAA
FILENAME:	03.txt	PROBE SERIAL NUMBER:	190
AMBIENT TEMPERATURE:	22.80°C	LIQUID SIMULANT:	2450Head
DEVICE UNDER TEST:	CDMA SHI14	RELATIVE PERMITTIVITY:	38.15
RELATIVE HUMIDITY:	42.10%	CONDUCTIVITY:	1.732
PHANTOM S/NO:	Head_04_35.csv	LIQUID TEMPERATURE:	22.40°C
PHANTOM ROTATION:	180°	MAX SAR Y-AXIS LOCATION:	11.60mm
DUT POSITION:	Right-Cheek	MAX SAR Z-AXIS LOCATION:	-112.60mm
ANTENNA CONFIGURATION:	N/A	MAX E FIELD:	5.910
TEST FREQUENCY:	2437.0MHz	SAR 1g:	0.114 W/kg
AIR FACTORS:	519.61 / 671.10 / 632.34	SAR 10g:	0.058 W/kg
CONVERSION FACTORS:	0.305 / 0.249 / 0.307	SAR START:	0.025 W/kg
TYPE OF MODULATION:	CCK/PBCC (WLAN)	SAR END:	0.025 W/kg
MODN. DUTY CYCLE:	100%	SAR DRIFT DURING SCAN:	2.040 %
DIODE COMPRESSION FACTORS (V*200):	20 / 20 / 20	PROBE BATTERY LAST CHANGED:	18/11/2011
INPUT POWER LEVEL:	20dBm	EXTRAPOLATION:	poly4

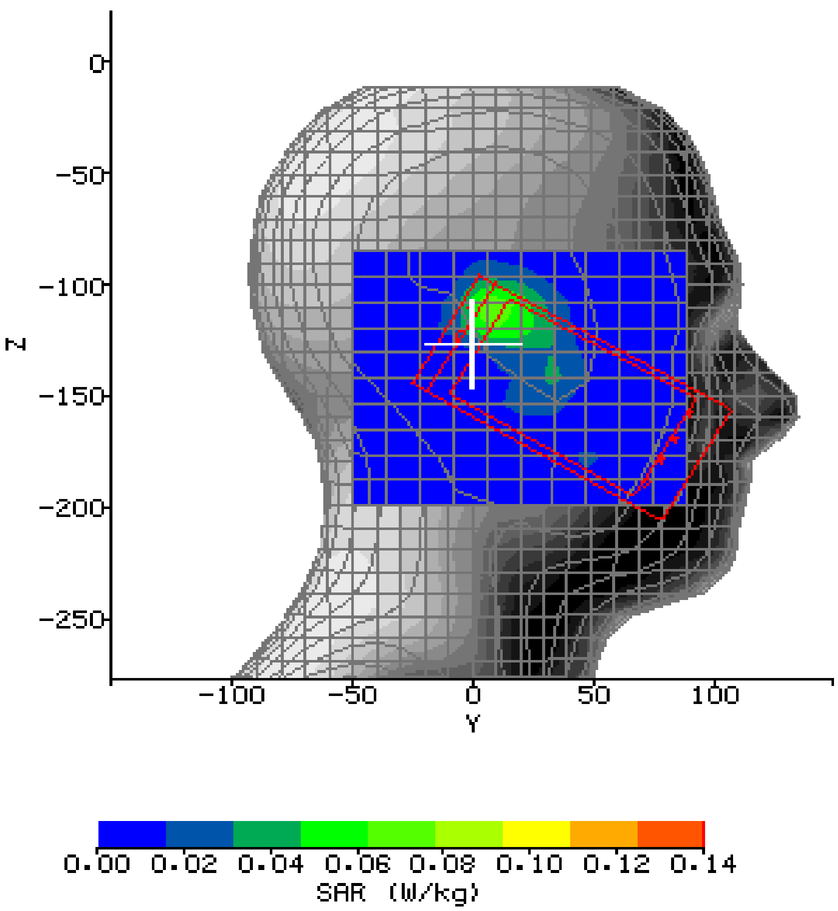

Figure 10: SAR Head Testing Results for the Sharp CDMA SHI14 Mobile Handset at 2437.0MHz.

Product Service

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

SYSTEM / SOFTWARE:	SARA2 / 2.53 VPM	INPUT POWER DRIFT:	0 dB
DATE / TIME:	18/11/2011 15:38:29	DUT BATTERY MODEL/NO:	SHI11UAA
FILENAME:	04.txt	PROBE SERIAL NUMBER:	190
AMBIENT TEMPERATURE:	23.10°C	LIQUID SIMULANT:	2450Body
DEVICE UNDER TEST:	CDMA SHI14	RELATIVE PERMITTIVITY:	52.35
RELATIVE HUMIDITY:	43.20%	CONDUCTIVITY:	1.951
PHANTOM S/NO:	HeadBox02.csv	LIQUID TEMPERATURE:	23.00°C
PHANTOM ROTATION:	N/A	MAX SAR X-AXIS LOCATION:	-40.00mm
DUT POSITION:	15mm-Rear Facing	MAX SAR Y-AXIS LOCATION:	18.00mm
ANTENNA CONFIGURATION:	N/A	MAX E FIELD:	4.16
TEST FREQUENCY:	2437.0MHz	SAR 1g:	0.056 W/kg
AIR FACTORS:	519.61 / 671.10 / 632.34	SAR 10g:	0.035 W/kg
CONVERSION FACTORS:	0.376 / 0.302 / 0.384	SAR START:	0.005 W/kg
TYPE OF MODULATION:	CCK/PBCC (WLAN)	SAR END:	0.005 W/kg
MODN. DUTY CYCLE:	100%	SAR DRIFT DURING SCAN:	2.440 %
DIODE COMPRESSION FACTORS (V*200):	20 / 20 / 20	PROBE BATTERY LAST CHANGED:	18/11/2011
INPUT POWER LEVEL:	20dBm	EXTRAPOLATION:	poly4

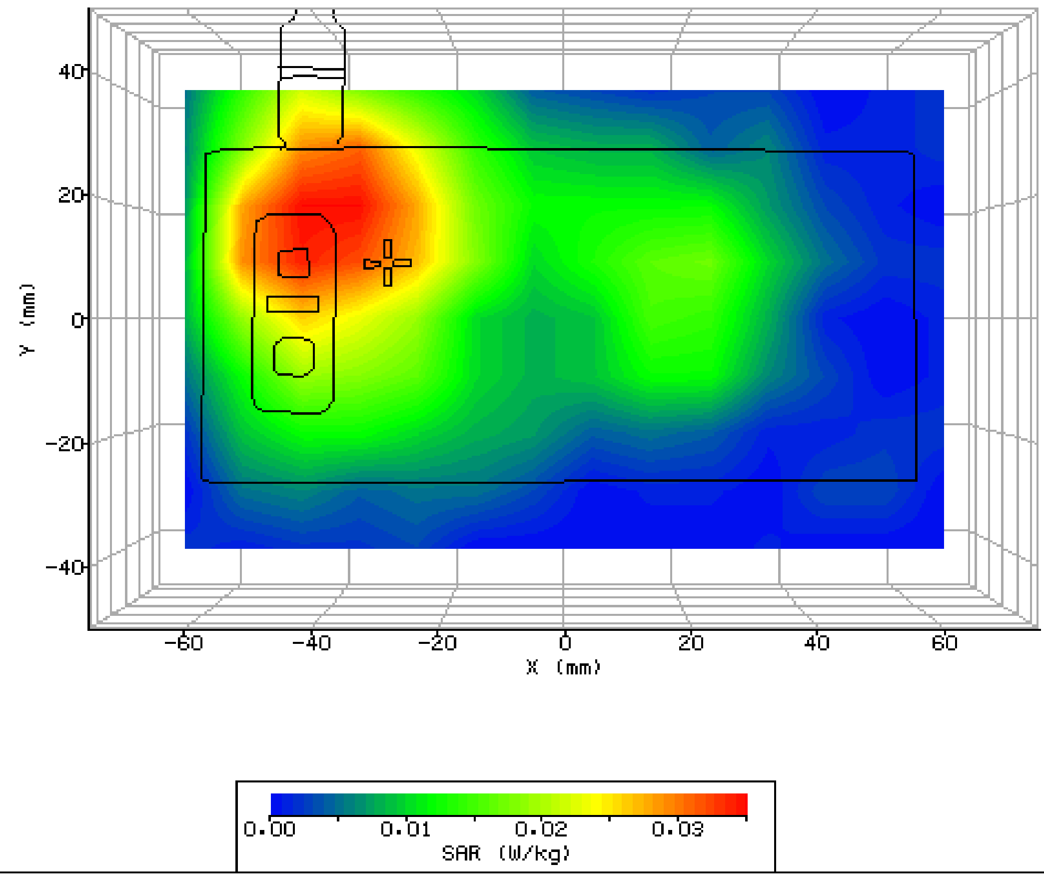

Figure 11: SAR Body Testing Results for the Sharp CDMA SHI14 Mobile Handset at 2437.0MHz.

SECTION 3

TEST EQUIPMENT USED

Product Service

3.1 TEST EQUIPMENT USED

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

Instrument Description	Manufacturer	Model Type	TE Number	Cal Period (months)	Calibration Due Date
Signal Generator	Hewlett Packard	ESG4000A	38	12	18-May-12
Power Sensor	Rohde & Schwarz	NRV-Z1	60	12	06-Jun-12
Industrial Robot	Mitsubishi	RV-E2/CR-E116	63	-	TU
Thermometer	Digitron	T208	64	12	03-May-12
Thermocouple (Type K)	TUV	TYPE K	65	12	03-May-12
Attenuator (20dB, 20W)	Narda	766F-20	483	12	09-Jun-12
Fast Probe Amplifier (3 channels)	IndexSar Ltd	IFA-010	1558	-	TU
SAM Head Phantom	Antennessa	Head_04_35.csv	1561	-	TU
Upright Bench 2 Chamber 2	IndexSar Ltd	SARA2-B2	1569	-	TU
Side Bench 2 Chamber 2	IndexSar Ltd	IXM-030	1571	-	TU
Bi-directional Coupler	IndexSar Ltd	7401 (VDC0830-20)	2414	-	TU
Validation Amplifier (10MHz - 2.5GHz)	IndexSar Ltd	VBM2500-3	2415	-	TU
Hygromer	Rotronic	I-1000	2784	12	22-Dec-11
Power Sensor	Rohde & Schwarz	NRV- Z5	2878	12	06-Jun-12
Dual Channel Power Meter	Rohde & Schwarz	NRVD	3259	12	06-Jun-12
Immersible SAR Probe	IndexSar Ltd	IXP-050	3893	12	23-Feb-12
835 MHz Head Fluid	TUV SUD Product Service	Batch 18	N/A	1	28-Nov-11
835 MHz Body Fluid	TUV SUD Product Service	Batch 11	N/A	1	28-Nov-11
2450 MHz Head Fluid	TUV SUD Product Service	Batch 9	N/A	1	28-Nov-11
2450 MHz Body Fluid	TUV SUD Product Service	Batch 7	N/A	1	28-Nov-11

TU – Traceability Unscheduled

3.2 TEST SOFTWARE

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

Instrument	Version Number	Date
SARA2 system	v.2.5.3 VPM	28 November 2006
Mitsubishi robot controller firmware revision	RV-E2 Version C9a	-
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.

The fluids were calibrated in our Laboratory and re-checked prior to any measurements being made against reference fluids stated in IEEE 1528-2003 of 0.9% NaCl (Salt Solution) at 23ºC and also for Dimethylsulphoxide (DMS) at 21ºC.

<u>IEEE 1528 Recipes</u>

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 Ltd are as follows:-

Fluid Type and Frequency	Relative Permittivity εR (ε') Target	Relative Permittivity εR (ε') Measured	Conductivity σ Target	Conductivity σ Measured
835MHz Head	41.5	40.86	0.90	0.877
835MHz Body	55.0	55.32	0.97	1.018
2450MHz Head	39.2	38.15	1.80	1.732
2450MHz Body	52.7	52.35	1.95	1.951

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 22.8°C to 23.1°C.
The actual humidity during the testing ranged from 41.8% to 43.2% RH.

Product Service

3.4.2 Test Fluid Temperature Range

Frequency	Body / Head Fluid	Min Temperature °C	Max Temperature °C
835 MHz	Head	23.1	23.1
835 MHz	Body	23.0	23.0
2450 MHz	Head	22.4	22.4
2450 MHz	Body	23.0	23.0

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 2.44% (0.1 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	2.04	R	1.73	1	1.18	∞
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			13.79	
Expanded uncertainty (95% confidence interval)			K=2			27.59	

Product Service

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	2.44	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

PHOTOGRAPHS

Product Service

4.1 TEST POSITIONAL PHOTOGRAPHS

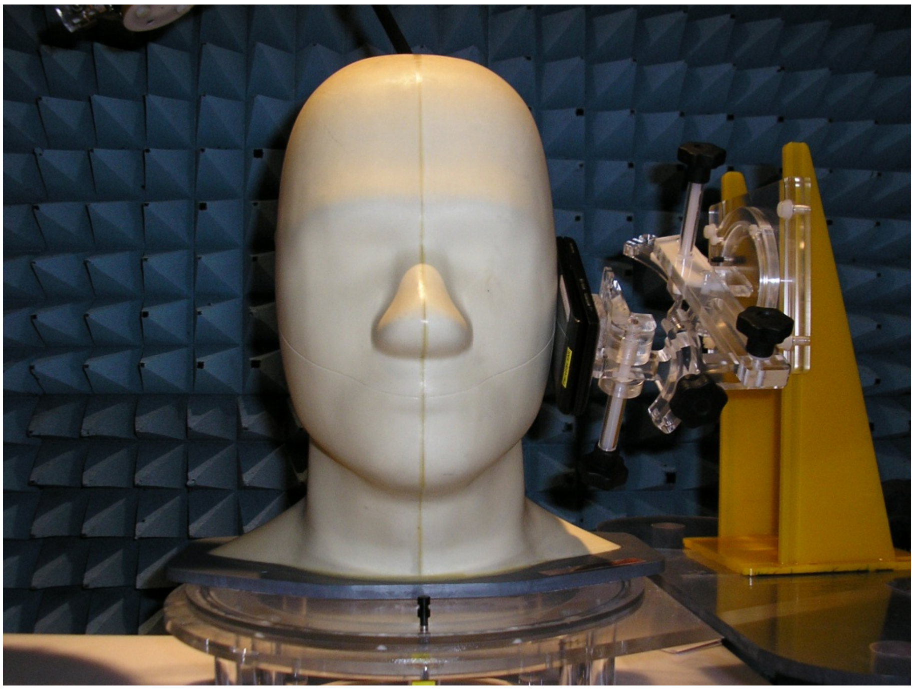

Figure 12
LH Cheek

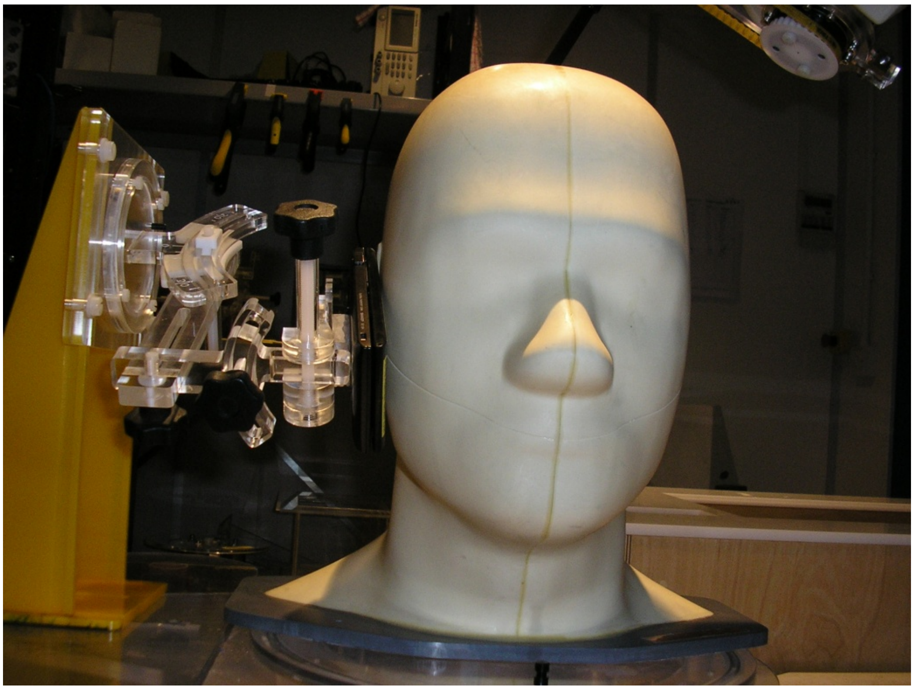

Figure 13
RH Cheek

Figure 14
Rear

4.2 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

Figure 15
Front View

Figure 16
Front Slider Open View

Figure 17
Rear View

Figure 18
Rear View Battery Removed

Figure 19
Headset

Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

Product Service

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

UKAS
TESTING
0141

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

NATIONAL PHYSICAL LABORATORY

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

Certificate of Calibration

SAR PROBE

IndexSAR

Model: IXP-050

Serial number: 0190

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 0190

MEASUREMENTS COMPLETED ON: 23rd February 2011

PREVIOUS NPL CERTIFICATE: None

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

Reference : 2011020183-2

Date of Issue : 3rd March 2011

Checked by : [signature]

Signed : [signature]

Name : Mr B G Loader

(Authorised Signatory)

on behalf of NPLML

NPLC01-05/07

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.

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*. These values were supplied by the manufacturer.

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.

Table 1
Sensitivity in Head Simulating Liquids.
SAR probe: IXP-050
S/N 0190

Probe settings for calibration		
Sensitivity in free-space(1)	**Diode Compression**(2)	**Sensor offset from tip of probe**(2)
Lin X = 519.61 $(V/m)^2/(V*200)$ Lin Y = 671.10 $(V/m)^2/(V*200)$ Lin Z = 632.34 $(V/m)^2/(V*200)$	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	42.2	0.83	**0.198**	**0.174**	**0.202**	±0.01
835	40.8	0.91	**0.230**	**0.199**	**0.232**	±0.01
900	40.4	0.95	**0.240**	**0.207**	**0.243**	±0.01
1800	39.6	1.41	**0.287**	**0.239**	**0.288**	±0.02
1900	39.6	1.43	**0.285**	**0.236**	**0.288**	±0.02
2100	39.0	1.48	**0.319**	**0.263**	**0.320**	±0.03
2450	37.7	1.84	**0.305**	**0.249**	**0.307**	±0.04
2600	37.1	2.00	**0.324**	**0.267**	**0.333**	±0.02

Table 2
Sensitivity in Body Simulating Liquids.
SAR probe: IXP-050
S/N 0190

Probe settings for calibration		
Sensitivity in free-space(1)	**Diode Compression**(2)	**Sensor offset from tip of probe**(2)
Lin X = 519.61 $(V/m)^2/(V*200)$ Lin Y = 671.10 $(V/m)^2/(V*200)$ Lin Z = 632.34 $(V/m)^2/(V*200)$	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	55.0	0.92	**0.202**	**0.177**	**0.205**	±0.02
835	56.5	0.99	**0.233**	**0.201**	**0.235**	±0.01
900	56.2	1.03	**0.244**	**0.209**	**0.245**	±0.01
1800	53.4	1.49	**0.308**	**0.254**	**0.314**	±0.02
1900	53.1	1.58	**0.318**	**0.261**	**0.325**	±0.03
2100	52.7	1.70	**0.348**	**0.270**	**0.347**	±0.02
2450	54.2	2.04	**0.376**	**0.302**	**0.384**	±0.03
2600	51.3	2.22	**0.386**	**0.308**	**0.390**	±0.03

Notes.
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
Manufacturer's boundary correction factors for
IXP-050 probes

Frequency	Head Simulating Liquid		Body Simulating Liquid	
(MHz)	*f(0)*	*d*	*f(0)*	*d*
835	1.35	1.30	1.45	1.30
900	1.20	1.30	1.45	1.30
1800	1.15	1.40	1.10	1.40
1900	1.10	1.40	1.10	1.50
2100	0.90	1.60	0.90	1.70
2450	0.85	1.60	0.85	1.80