Report On

Specific Absorption Rate Testing of the
Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) and GPS

COMMERCIAL-IN-CONFIDENCE

FCC ID: APYHRO00200

Document 75924762 Report 13 Issue 2 **February 2014**

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuv-sud.co.uk

REPORT ON

Specific Absorption Rate Testing of the
Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) and GPS.

Document 75924762 Report 13 Issue 2

February 2014

PREPARED FOR

Sharp Communication Compliance Ltd
Azure House
Bagshot Road
Bracknell
Berkshire
RG12 7QY

PREPARED BY

Nigel Grigsby
Senior Engineer

APPROVED BY

Mark Jenkins
Authorised Signatory

DATED 07 February 2014

This report has been up-issued to Issue 2 to correct typographical errors.

Product Service

CONTENTS

SECTION 1

REPORT SUMMARY

Specific Absorption Rate Testing of the
Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) and GPS

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Specific Absorption Rate Testing of the SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) and GPS to the requirements of KDB 447498 – D01 v05 General RF Exposure Guidance.

Objective	To perform Specific Absorption Rate Testing to determine the Equipment Under Test's (EUT's) compliance with the requirements specified of KDB 447498 – D01 v05 General RF Exposure Guidance, for the series of tests carried out.
Applicant	Sharp Communication Compliance Ltd
Manufacturer	Sharp Corporation
Manufacturing Description	Tablet
Model Number	SHT22
Serial/IMEI Number(s)	004401115013464
Number of Samples Tested	1
Hardware Version	PP1
Software Version	AB280
Battery Cell Manufacturer	Sharp Corporation
Battery Model Number	Integral Battery; Non Removable
Battery Type	Lithium Ion; UBATIA236AFN1; DC 3.75V, 4080mAh
Test Specification/Issue/Date	KDB 447498 – D01 v05 General RF Exposure Guidance
Start of Test	14 January 2014
Finish of Test	16 January 2014
Related Document(s)	FCC 47CFR 2.1093: 2012 KDB 248227 - v01r02 (Rev 1.2) KDB 865664 – D01 v01 KDB 865664 – D02 v01 KDB 648474 – D04 v01 KDB 648574 – D04 V01r02 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 KDB 865664 – D01 v05.

The maximum 1g volume averaged stand-alone SAR found during this Assessment

Max 1g SAR (W/kg) Body	0.24 (Measured)	0.33 (Scaled/Reported)
Max 10g SAR (W/kg) Extremity	0.49 (Measured)	0.68 (Scaled/Reported)
Max 1g SAR (W/kg) Head	0.04 (Measured)	0.04 (Scaled/Reported)
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.		

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 KDB 865664 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
14/01/2014	2450	2450	53.83	-4.18%
15/01/2014	2450	2450	51.88	-1.34%
15/01/2014	5000	5200	73.57	4.30%
16/01/2014	5000	5200	86.61	3.48%
15/01/2014	5000	5500	78.30	3.02%
16/01/2013	5000	5500	78.40	-3.36%

*Normalised to a forward power of 1W

1.3.2 Results Summary Tables

WLAN 2450MHz Head Specific Absorption Rate (Maximum SAR) 1g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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	2412.0	16.97	17.00	0.03	0.03	Figure 06
Left 15°	1	2412.0	16.97	17.00	0.02	0.02	Figure 07
Right Cheek	1	2412.0	16.97	17.00	0.03	0.03	Figure 08
Right 15°	1	2412.0	16.97	17.00	0.04	**0.04**	Figure 09
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 Specific Absorption Rate (Maximum SAR) 1g Results for the the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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	16.97	17.00	0.14	0.14	Figure 10
10mm	Rear Face	1	2412.0	16.97	17.00	0.09	0.09	Figure 11
10mm	Right Edge	1	2412.0	16.97	17.00	0.07	0.07	Figure 12
10mm	Bottom Edge	1	2412.0	16.97	17.00	0.07	0.07	Figure 13
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 Extremity Configuration Specific Absorption Rate (Maximum SAR) 10g Results for the the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) and GPS.

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 10g SAR (W/kg)	Scaled 10g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
0mm	Front Face	1	2412.0	16.97	17.00	0.67	0.67	Figure 14
0mm	Rear Face	1	2412.0	16.97	17.00	0.27	0.27	Figure 15
0mm	Right Edge	1	2412.0	16.97	17.00	0.15	0.15	Figure 16
0mm	Bottom Edge	1	2412.0	16.97	17.00	0.21	0.21	Figure 17

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 0mm separation distance with a reported 10g SAR to meet the requirements of KDB 648474 D04

WLAN 5220MHz Head Specific Absorption Rate (Maximum SAR) 1g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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	44	5220.0	12.06	13.5	-	-	**
Left 15°	44	5220.0	12.06	13.5	-	-	**
Right Cheek	44	5220.0	12.06	13.5	-	-	**
Right 15°	44	5220.0	12.06	13.5	-	-	**

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 44 instead of the default test channel as this was the channel with the maximum output power.

** No data was recorded for this position due to SAR levels being below the SAR measurement system capability and the location of the WLAN antenna on the device.

*(NUA) Not UKAS Accredited

WLAN 5220MHz Body Specific Absorption Rate (Maximum SAR) 1g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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	44	5220.0	12.06	13.5	0.16	0.22	Figure 18
10mm	Rear Face	44	5220.0	12.06	13.5	0.12	0.17	Figure 19
10mm	Right Edge	44	5220.0	12.06	13.5	0.08	0.11	Figure 20
10mm	Bottom Edge	44	5220.0	12.06	13.5	0.23	0.32	Figure 21

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 44 instead of the default test channel as this was the channel with the maximum output power.

*(NUA) Not UKAS Accredited

WLAN 5220MHz Extremity Configuration Specific Absorption Rate (Maximum SAR) 10g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) and GPS. (NUA)*

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 10g SAR (W/kg)	Scaled 10g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
0mm	Front Face	44	5220.0	12.06	13.5	0.42	0.59	Figure 22
0mm	Rear Face	44	5220.0	12.06	13.5	0.19	0.26	Figure 23
0mm	Right Edge	44	5220.0	12.06	13.5	0.11	0.15	Figure 24
0mm	Bottom Edge	44	5220.0	12.06	13.5	0.49	**0.68**	Figure 25

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 44 instead of the default test channel as this was the channel with the maximum output power.

*(NUA) Not UKAS Accredited

Testing was carried out with a 0mm separation distance with a reported 10g SAR to meet the requirements of KDB 648474 D04

WLAN 5300MHz Head Specific Absorption Rate (Maximum SAR) 1g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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	60	5300.0	12.12	13.5	-	-	**
Left 15°	60	5300.0	12.12	13.5	-	-	**
Right Cheek	60	5300.0	12.12	13.5	-	-	**
Right 15°	60	5300.0	12.12	13.5	-	-	**

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 60 instead of the default test channel as this was the channel with the maximum output power.

** No data was recorded for this position due to SAR levels being below the SAR measurement system capability and the location of the WLAN antenna on the device.

*(NUA) Not UKAS Accredited

WLAN 5300MHz Body Specific Absorption Rate (Maximum SAR) 1g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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	60	5300.0	12.12	13.5	0.17	0.23	Figure 26
10mm	Rear Face	60	5300.0	12.12	13.5	0.14	0.19	Figure 27
10mm	Right Edge	60	5300.0	12.12	13.5	0.08	0.11	Figure 28
10mm	Bottom Edge	60	5300.0	12.12	13.5	0.24	**0.33**	Figure 29

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 60 instead of the default test channel as this was the channel with the maximum output power.

*(NUA) Not UKAS Accredited

WLAN 5300MHz Extremity Configuration Specific Absorption Rate (Maximum SAR) 10g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) and GPS. (NUA)*

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 10g SAR (W/kg)	Scaled 10g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
0mm	Front Face	60	5300.0	12.12	13.5	0.36	0.49	Figure 30
0mm	Rear Face	60	5300.0	12.12	13.5	0.18	0.25	Figure 31
0mm	Right Edge	60	5300.0	12.12	13.5	0.10	0.14	Figure 32
0mm	Bottom Edge	60	5300.0	12.12	13.5	0.42	0.58	Figure 33

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 60 instead of the default test channel as this was the channel with the maximum output power.

*(NUA) Not UKAS Accredited

Testing was carried out with a 0mm separation distance with a reported 10g SAR to meet the requirements of KDB 648474 D04

WLAN 5600MHz Head Specific Absorption Rate (Maximum SAR) 1g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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	120	5600.0	12.99	13.5	-	-	**
Left 15°	120	5600.0	12.99	13.5	-	-	**
Right Cheek	120	5600.0	12.99	13.5	-	-	**
Right 15°	120	5600.0	12.99	13.5	-	-	**

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 120 instead of the default test channel as this was the channel with the maximum output power.

** No data was recorded for this position due to SAR levels being below the SAR measurement system capability and the location of the WLAN antenna on the device.

*(NUA) Not UKAS Accredited

WLAN 5600MHz Body Specific Absorption Rate (Maximum SAR) 1g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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	120	5600.0	12.99	13.5	0.09	0.10	Figure 34
10mm	Rear Face	120	5600.0	12.99	13.5	0.09	0.10	Figure 35
10mm	Right Edge	120	5600.0	12.99	13.5	0.07	0.08	Figure 36
10mm	Bottom Edge	120	5600.0	12.99	13.5	0.15	0.17	Figure 37

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 120 instead of the default test channel as this was the channel with the maximum output power.

*(NUA) Not UKAS Accredited

WLAN 5600MHz Extremity Configuration Specific Absorption Rate (Maximum SAR) 10g Results for the Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) and GPS. (NUA)*

Position		Channel Number	Frequency (MHz)	Measured Conducted Power (dBm)	Tune Up limit (dBm)	Measured 10g SAR (W/kg)	Scaled 10g SAR (W/kg)	Area scan (Figure number)
Spacing	Position							
0mm	Front Face	120	5600.0	12.99	13.5	0.23	0.26	Figure 38
0mm	Rear Face	120	5600.0	12.99	13.5	0.11	0.12	Figure 39
0mm	Right Edge	120	5600.0	12.99	13.5	0.09	0.10	Figure 40
0mm	Bottom Edge	120	5600.0	12.99	13.5	0.32	0.36	Figure 41

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 120 instead of the default test channel as this was the channel with the maximum output power.

*(NUA) Not UKAS Accredited

Testing was carried out with a 0mm separation distance with a reported 10g SAR to meet the requirements of KDB 648474 D04

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The equipment under test (EUT) was a Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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 2.4GHz and 5GHz WLAN frequency bands at maximum power. The device was placed against a Specific Anthropomorphic Mannequin (SAM) phantom. 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 KDB 865665. Testing was performed at both the left and right ear of the phantom at both handset positions stated in the applied specification. No WLAN 5GHz Head SAR data was recorded due to SAR levels being below the SAR measurement system capability.

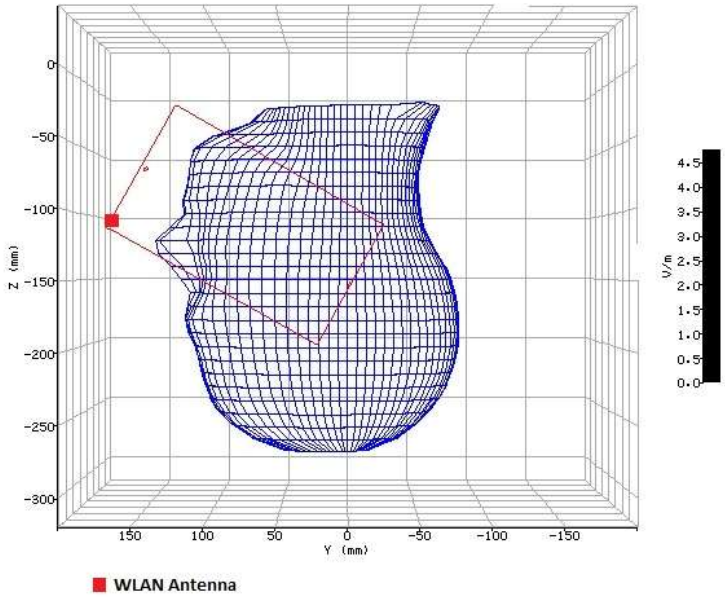
For body SAR assessment, testing was performed for 2.4GHz and 5GHz WLAN frequency bands at maximum power. The device was placed at a distance of 10mm & 0mm from the bottom of the flat phantom for all body testing. The Flat Phantom dimensions were 245mm x 195mm x 200mm with a sidewall thickness of 2.00mm. 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 KDB 865665. Testing was also carried out with a 0mm separation distance with a reported 10g SAR to meet the requirements of KDB 648474 D04 for extremity testing.

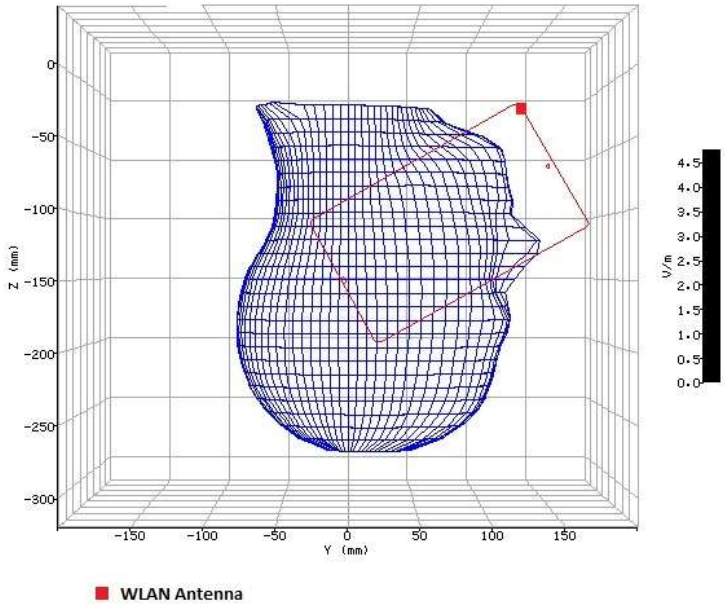
Testing was performed in each position at the frequency that gave the highest output power for each band. No SAR levels were found to be >0.80 W/kg (KDB 447498 D01) and therefore no additional testing was required at the remaining frequencies / channels of the bands. 2.4GHz WLAN testing was achieved using the devices internal software and settings supplied by the customer. The worse case data rate for 2.4GHz testing was obtained from data provided by TUV. 5GHz WLAN testing was achieved using the devices internal 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 6Mbps for 802.11a. SAR testing for 802.11g/n and 802.11n/ac channels was not required to be carried out based on the measured maximum average output power being less than ¼ dB higher than that measured on the corresponding 802.11b and 802.11a channels respectively.

The WLAN and Bluetooth do not simultaneously transmit.

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

In some of the test positions no data was recorded due to SAR levels being below the SAR measurement system capability. A combination of low SAR levels and the position of the WLAN antenna on the device with reference to the SAM phantom also contributed.





1.5 FCC POWER MEASUREMENTS

1.5.1 Method

Conducted power measurements were made using a power meter.

1.5.2 Conducted Power Measurements

WLAN

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
802.11(b) - 2.4 GHz – 1 Mbps	2412	20.13	**16.97**
	2437	19.87	16.59
	2462	19.18	15.88
802.11(g) - 2.4 GHz - 6 Mbps	2412	22.40	13.47
	2437	22.56	13.25
	2462	22.50	12.61
802.11 (n) - 2.4 GHz – MCS0	2412	22.37	13.21
	2437	22.34	13.22
	2462	22.68	12.62
802.11a - 5GHz - 6Mbps	5180	22.05	11.94
	5200	22.20	11.65
	5220	22.57	**12.06**
	5240	21.74	11.53
	5260	22.56	12.02
	5280	21.93	11.86
	5300	22.63	**12.12**
	5320	22.80	12.09
802.11a - 5GHz - 6Mbps	5500	23.18	12.78
	5520	23.81	12.75
	5540	23.00	12.46
	5560	23.16	12.54
	5580	23.47	12.77
	5600	23.64	**12.99**
	5620	23.58	12.83
	5640	23.51	12.79
	5660	22.78	12.40
	5680	22.75	12.62
	5700	22.99	12.66

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
802.11n20 - 5GHz – MCS0	5180	21.72	11.19
	5200	21.66	11.39
	5220	21.89	11.12
	5240	22.13	11.2
	5260	22.44	11.04
	5280	21.66	11.36
	5300	21.88	11.62
	5320	21.86	11.49
	5500	22.30	11.74
	5520	22.59	12.07
	5540	22.70	11.85
	5560	22.64	11.67
	5580	22.64	11.89
	5600	23.38	12.20
	5620	22.69	11.93
	5640	22.83	11.99
	5660	22.32	11.62
	5680	22.23	11.54
	5700	21.66	11.68
802.11n40 - 5GHz – MCS0	5190	22.53	11.04
	5230	22.01	10.84
	5270	22.00	11.04
	5310	22.42	11.60
	5510	22.85	12.00
	5550	22.86	11.85
	5590	23.40	12.08
	5630	23.37	11.98
	5670	23.10	11.62

Modulation	Frequency (MHz)	Conducted Carrier Power (dBm)	
		Peak	Average
802.11ac20 - 5GHz – MCS1	5180	21.22	10.86
	5200	21.42	11.16
	5220	21.23	10.93
	5240	21.29	10.91
	5260	21.19	11.02
	5280	21.44	11.2
	5300	21.68	11.45
	5320	21.56	11.31
	5500	21.89	11.76
	5520	22.27	12.01
	5540	22.28	11.93
	5560	21.86	11.64
	5580	21.88	11.71
	5600	22.32	12.14
	5620	21.94	11.77
	5640	22.16	11.97
	5660	21.74	11.42
	5680	21.81	11.68
	5700	22.19	11.86
802.11ac40 - 5GHz – MCS0	5190	21.2	10.95
	5230	21.12	10.93
	5270	21.3	11.06
	5310	21.69	11.59
	5510	22.36	12.01
	5550	21.85	11.68
	5590	22.23	12.02
	5630	22.17	11.95
	5670	21.77	11.55
802.11ac80 - 5GHz – MCS0	5210	21.69	10.99
	5290	21.85	11.19
	5530	22.75	11.91

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		Test Position	Distance (mm)	Threshold	Test Exclusion
		(dBm)	(mW)				
Bluetooth	2480.0	4.0	2.51	Head	< 5	0.79	Yes
Bluetooth	2480.0	4.0	2.51	Body	10	0.40	Yes
WLAN 2.4 GHz	2412.0	17.0	50.1	Head	< 5	15.6	No
				Body	10	7.8	No
WLAN 5GHz	5220.0	13.5	22.4	Head	< 5	10.2	No
				Body	10	5.1	No
WLAN 5GHz	5300.0	13.5	22.4	Head	< 5	10.3	No
				Body	10	5.2	No
WLAN 5GHz	5600.0	13.5	22.4	Head	< 5	10.6	No
				Body	10	5.3	No

Product Service

SECTION 2

TEST DETAILS

Specific Absorption Rate Testing of the
Sharp SHT22 Dual-band CDMA (BC0, BC6), Tri-band LTE (B1, B11, B18), Dual mode Tablet PC with Bluetooth, WLAN, SRD(NFC) 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.

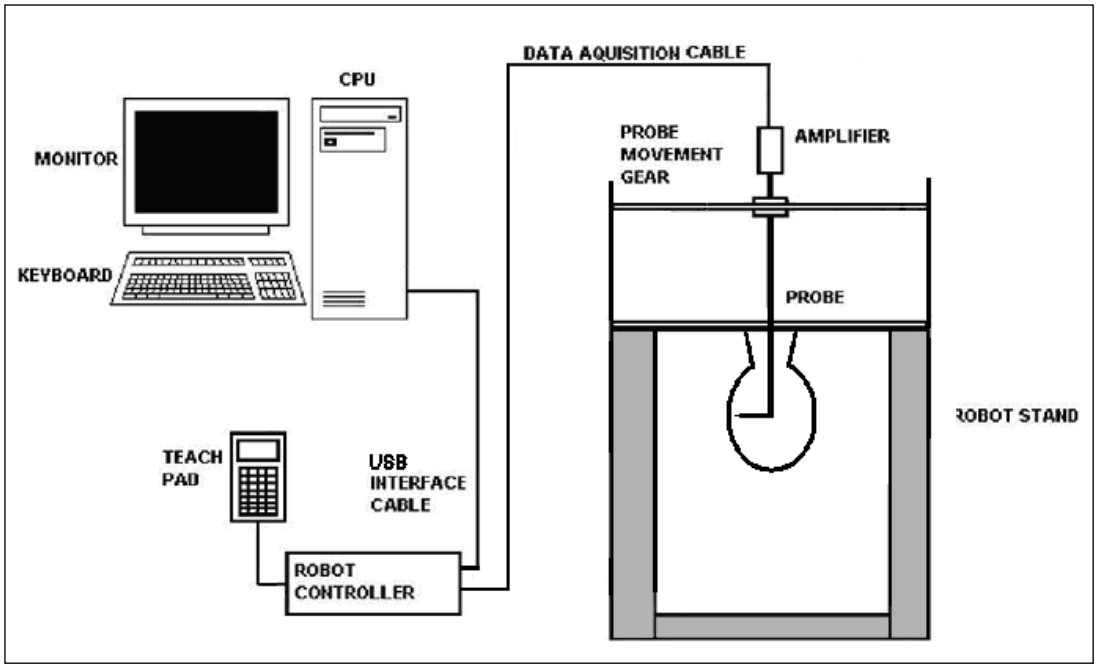


Figure 1 Schematic diagram of the SARA-C measurement system showing the L-probe and upside-down SAM phantom

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.

IFA-020 Fast Amplifier

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

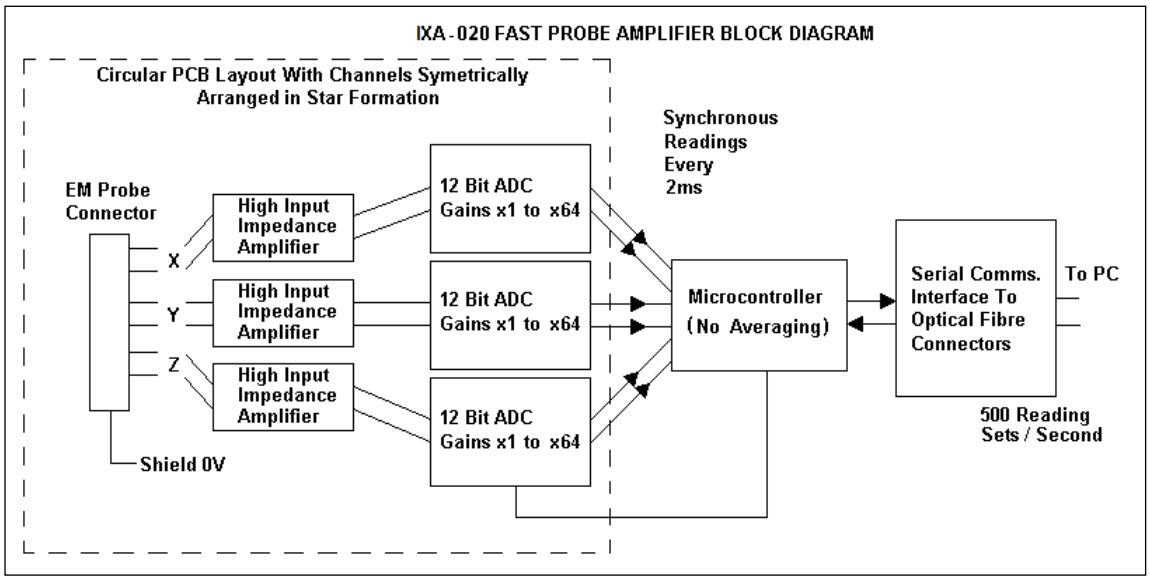


Figure 2 Schematic diagram of the fast amplifier

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.

Product Service

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.

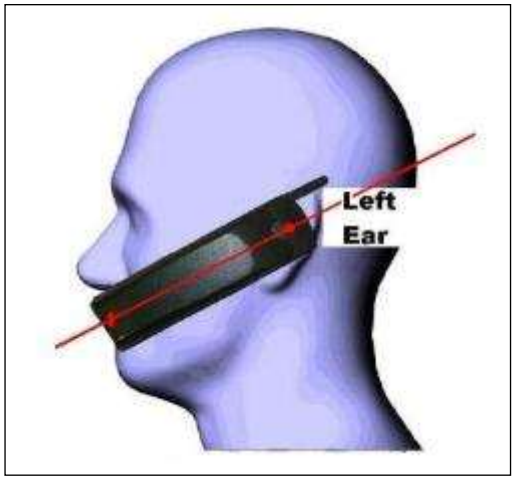


Figure 3 Side view of mobile next to head showing alignment

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°.

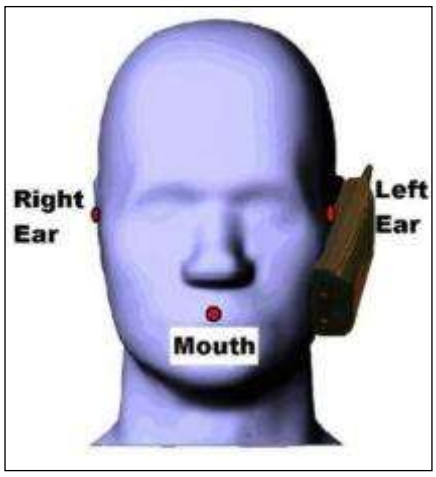


Figure 4 Cheek position

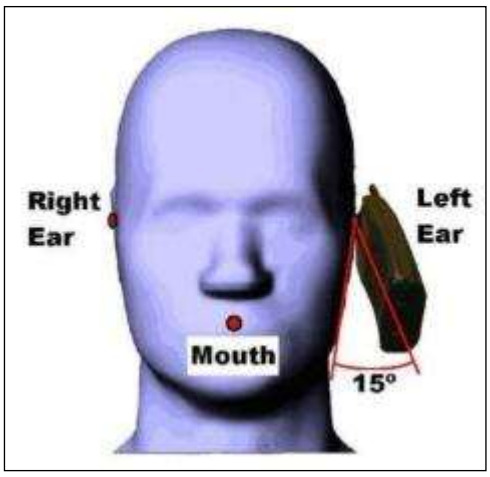


Figure 5 15º Tilt Position

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

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	14/01/2014-15:26:18	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.50°C	**LIQUID SIMULANT:**	2450Head
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	39.30
RELATIVE HUMIDITY:	32.50%	**CONDUCTIVITY:**	1.789
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	23.20°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	54.400mm
DUT POSITION:	Left-Cheek	**MAX SAR Z-AXIS LOCATION:**	-96.700mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	3.724
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	0.030 W/kg
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.026 W/kg
INPUT POWER LEVEL:	17.dBm	**SAR END:**	0.025 W/kg
PROBE BATTERY LAST CHANGED:	14/01/2014	**SAR DRIFT DURING SCAN:**	-3.800 %

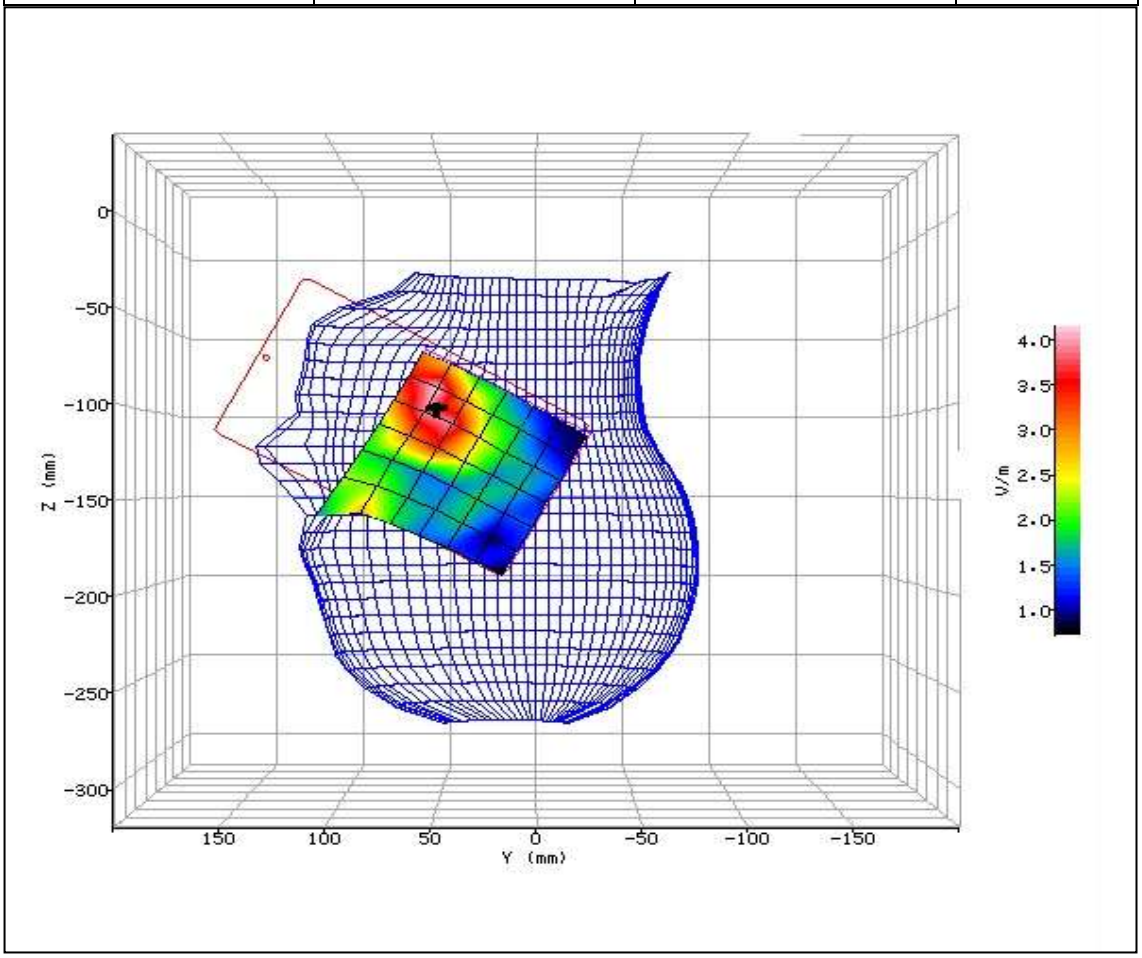


Figure 06: SAR Head Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	14/01/2014-15:45:22	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.50°C	**LIQUID SIMULANT:**	2450Head
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	39.30
RELATIVE HUMIDITY:	32.50%	**CONDUCTIVITY:**	1.789
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	23.20°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	13.000mm
DUT POSITION:	Left-15°	**MAX SAR Z-AXIS LOCATION:**	-125.300mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	2.918
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	0.023 W/kg
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.019 W/kg
INPUT POWER LEVEL:	17.dBm	**SAR END:**	0.020 W/kg
PROBE BATTERY LAST CHANGED:	14/01/2014	**SAR DRIFT DURING SCAN:**	5.300 %

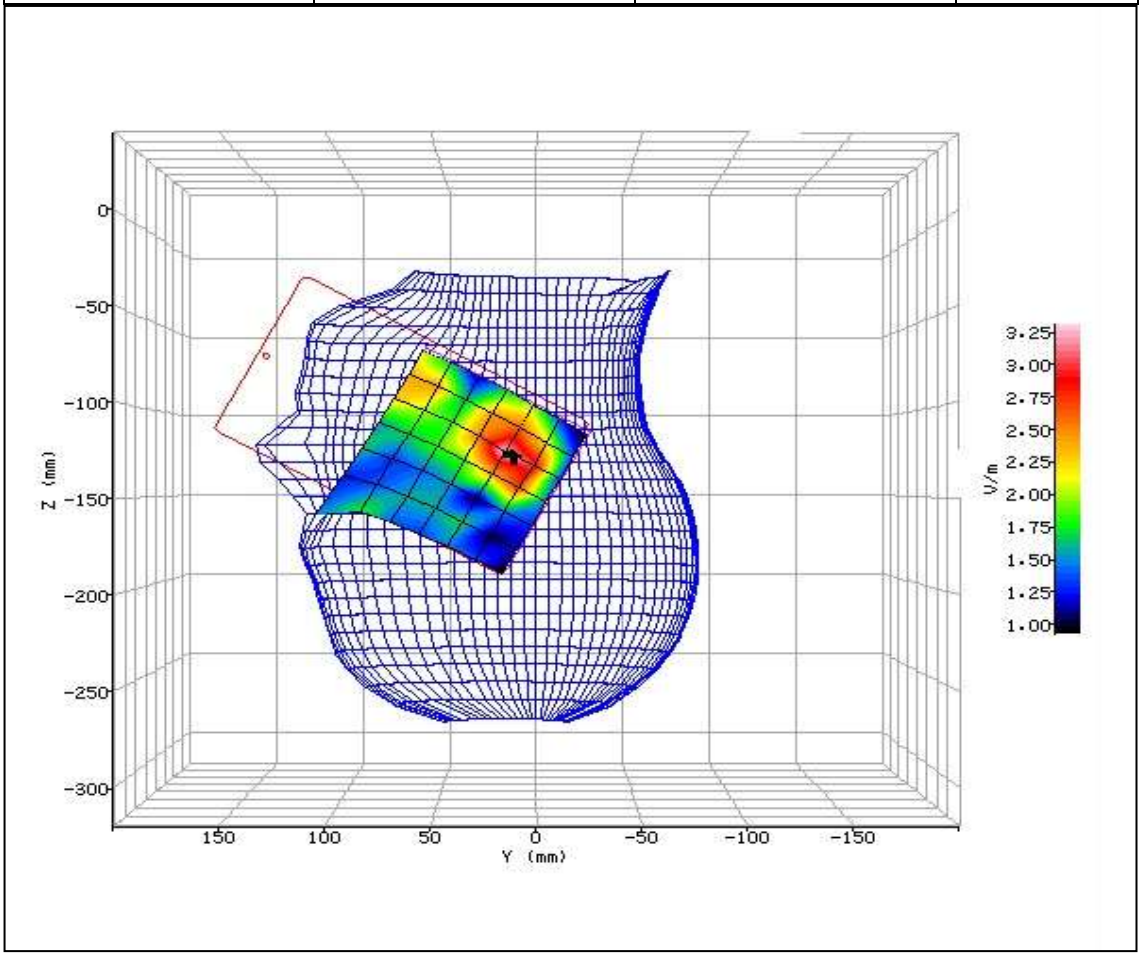


Figure 07: SAR Head Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	14/01/2014-16:26:33	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.50°C	**LIQUID SIMULANT:**	2450Head
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	39.30
RELATIVE HUMIDITY:	32.50%	**CONDUCTIVITY:**	1.789
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	23.20°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	51.600mm
DUT POSITION:	Right-Cheek	**MAX SAR Z-AXIS LOCATION:**	-153.400mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.035
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	0.030 W/kg
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.030 W/kg
INPUT POWER LEVEL:	17.dBm	**SAR END:**	0.028 W/kg
PROBE BATTERY LAST CHANGED:	14/01/2014	**SAR DRIFT DURING SCAN:**	-6.700 %

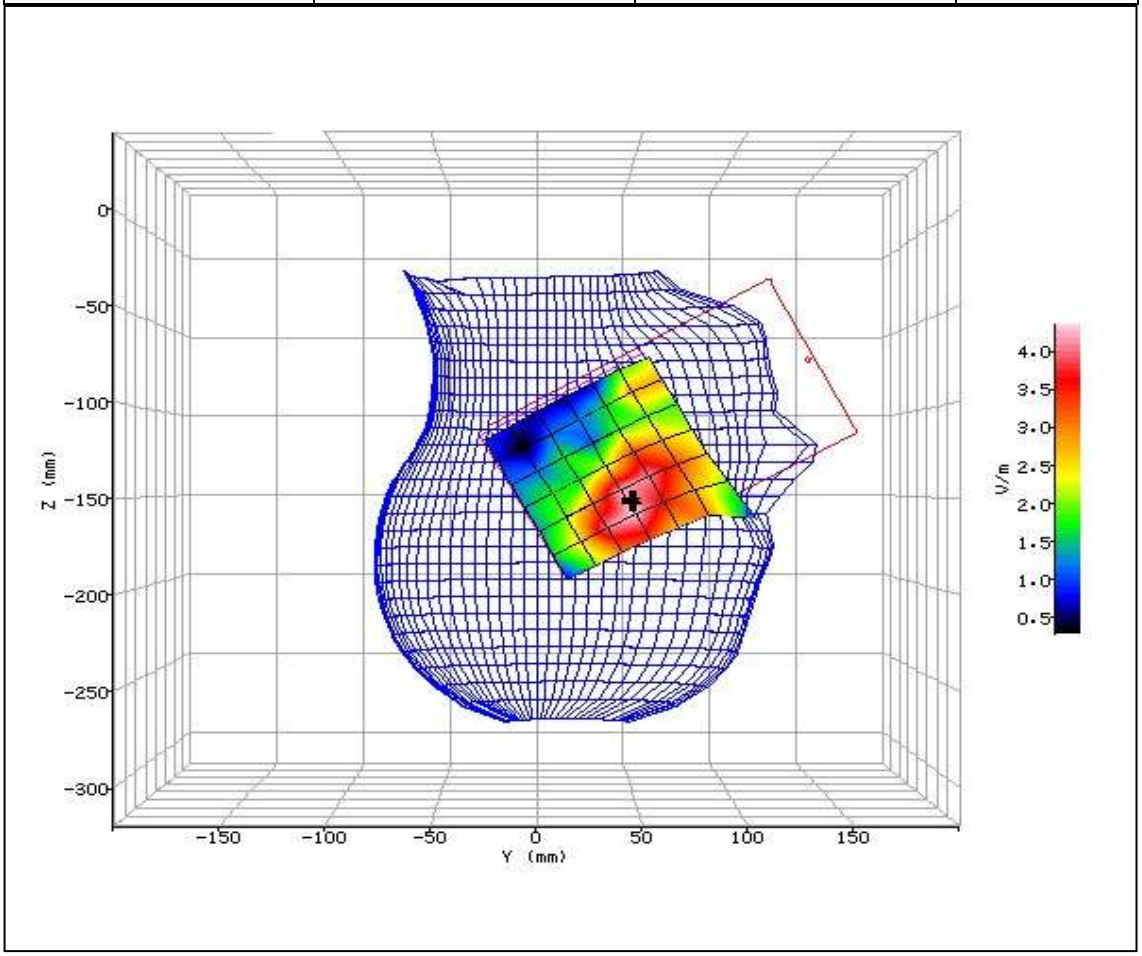


Figure 08: SAR Head Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	14/01/2014-16:43:49	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.50°C	**LIQUID SIMULANT:**	2450Head
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	39.30
RELATIVE HUMIDITY:	32.50%	**CONDUCTIVITY:**	1.789
PHANTOM S/NO:	IBX-040	**LIQUID TEMPERATURE:**	23.20°C
PHANTOM ROTATION:	N/A	**MAX SAR Y-AXIS LOCATION:**	38.400mm
DUT POSITION:	Right-15°	**MAX SAR Z-AXIS LOCATION:**	-167.900mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.059
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	0.037 W/kg
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.037 W/kg
INPUT POWER LEVEL:	17.dBm	**SAR END:**	0.036 W/kg
PROBE BATTERY LAST CHANGED:	14/01/2014	**SAR DRIFT DURING SCAN:**	-2.700 %

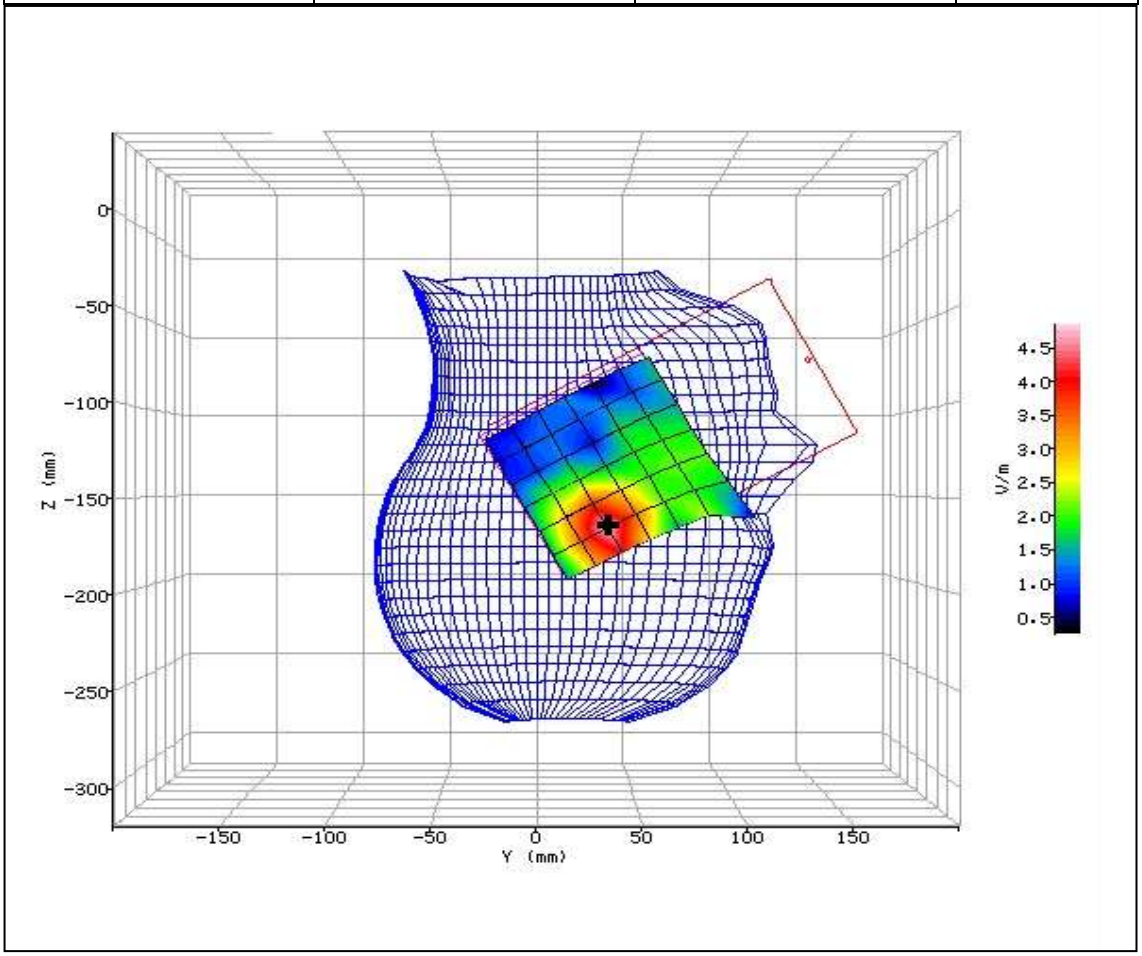


Figure 09: SAR Head Testing Results for the SHT22 Tablet at 2412.0MHz.

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

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-08:07:30	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.40°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	51.26
RELATIVE HUMIDITY:	33.10%	**CONDUCTIVITY:**	1.972
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.10°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	71.600mm
DUT POSITION:	10mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	-39.600mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	8.120
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	0.141 W/kg
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.141 W/kg
INPUT POWER LEVEL:	17dBm	**SAR END:**	0.143 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	1.600 %

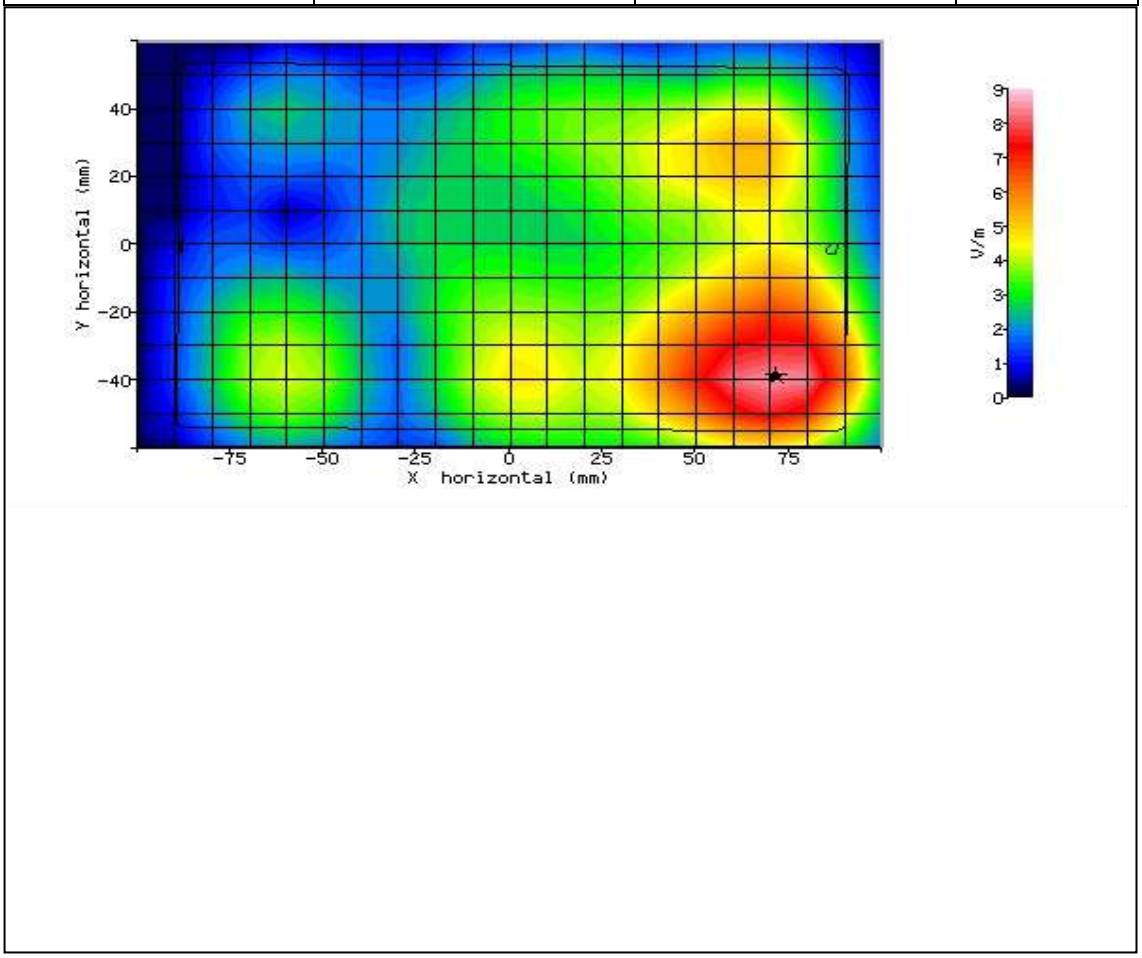


Figure 10: SAR Body Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-09:15:27	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.40°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	51.26
RELATIVE HUMIDITY:	33.10%	**CONDUCTIVITY:**	1.972
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.10°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	70.600mm
DUT POSITION:	10mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	39.800mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	6.405
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	0.089 W/kg
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.088 W/kg
INPUT POWER LEVEL:	17dBm	**SAR END:**	0.089 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	1.500 %

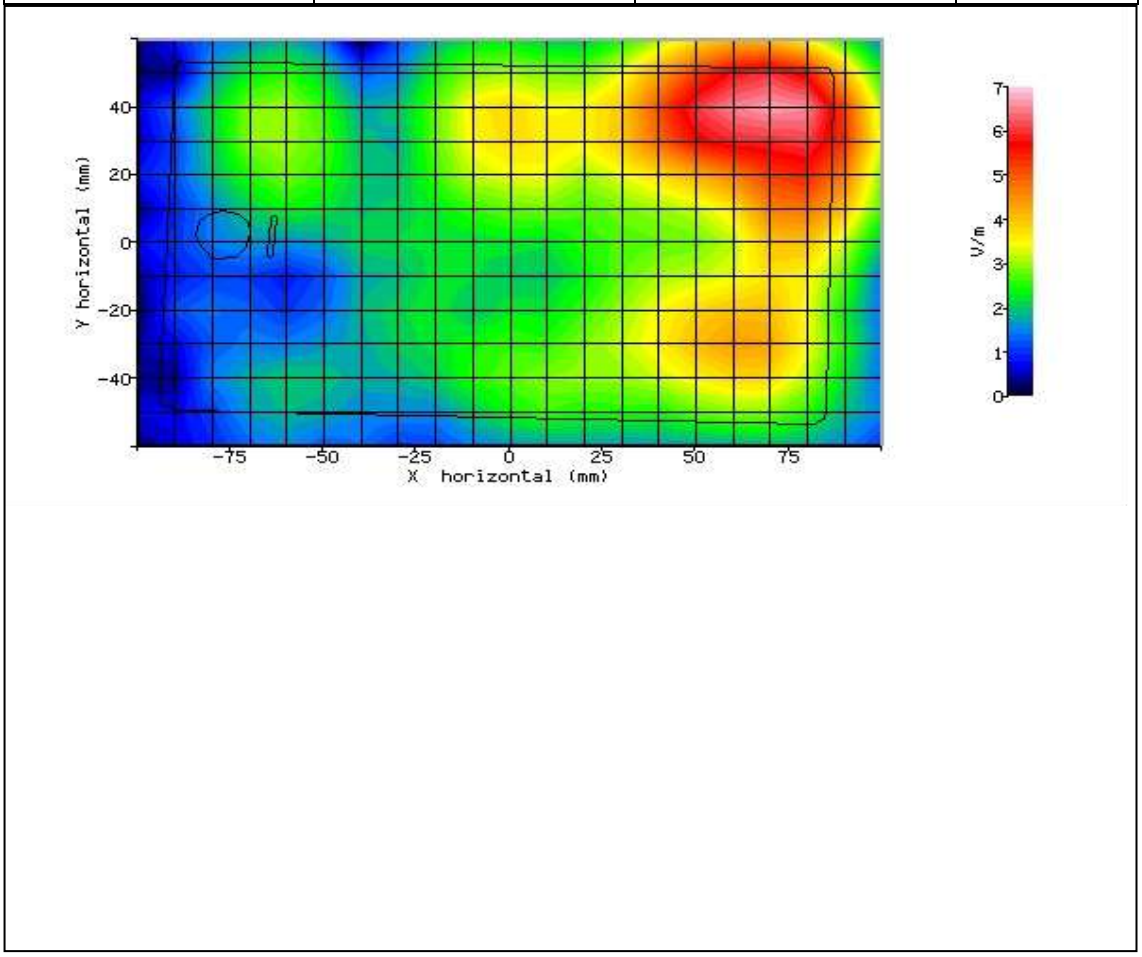


Figure 11: SAR Body Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-10:22:14	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.40°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	51.26
RELATIVE HUMIDITY:	33.10%	**CONDUCTIVITY:**	1.972
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.10°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	55.400mm
DUT POSITION:	10mm-RightEdge	**MAX SAR Y-AXIS LOCATION:**	3.300mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.706
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	0.072 W/kg
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.074 W/kg
INPUT POWER LEVEL:	17dBm	**SAR END:**	0.074 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	0.000 %

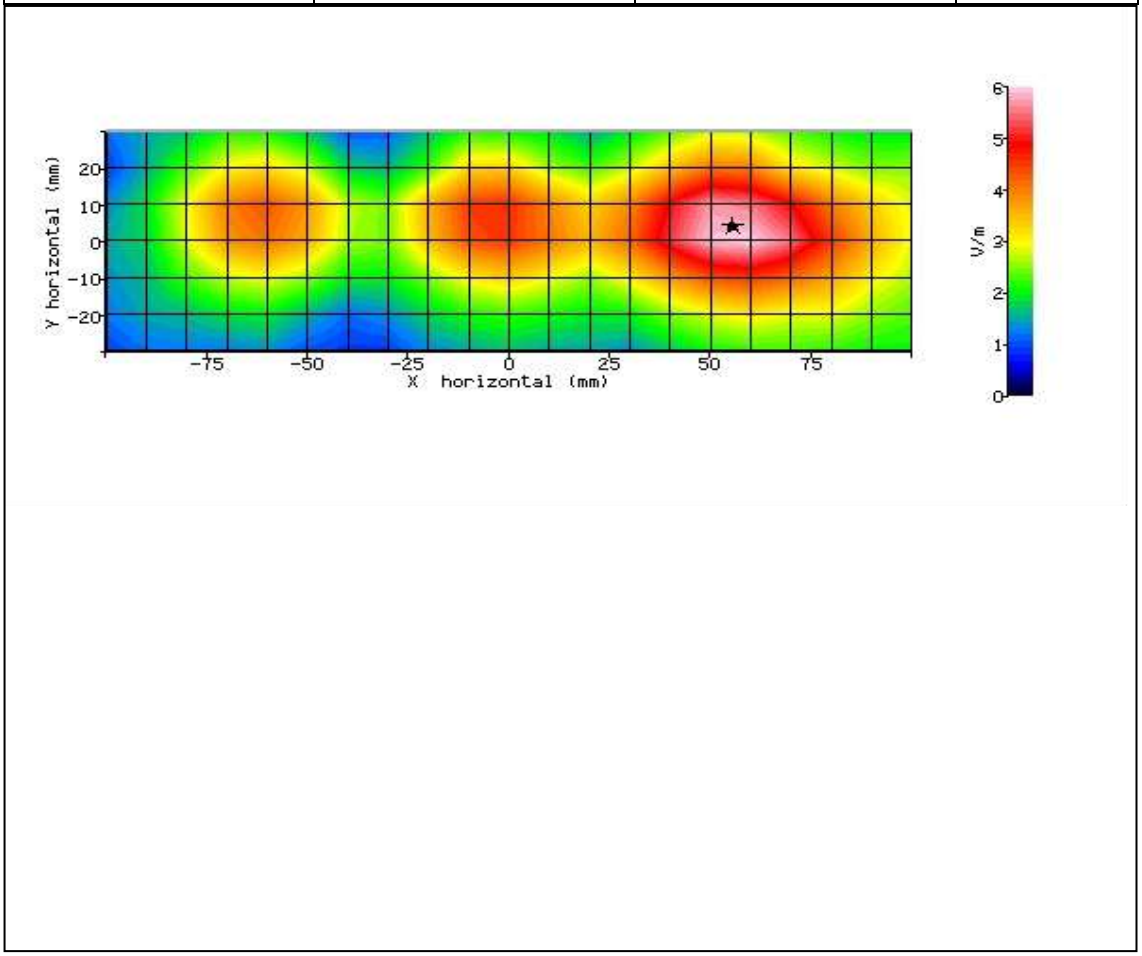


Figure 12: SAR Body Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-11:01:18	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.40°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	51.26
RELATIVE HUMIDITY:	33.10%	**CONDUCTIVITY:**	1.972
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.10°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-18.300mm
DUT POSITION:	10mm-Bottom Edge	**MAX SAR Y-AXIS LOCATION:**	4.900mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.731
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	0.071 W/kg
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.076 W/kg
INPUT POWER LEVEL:	17dBm	**SAR END:**	0.074 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	-1.600 %

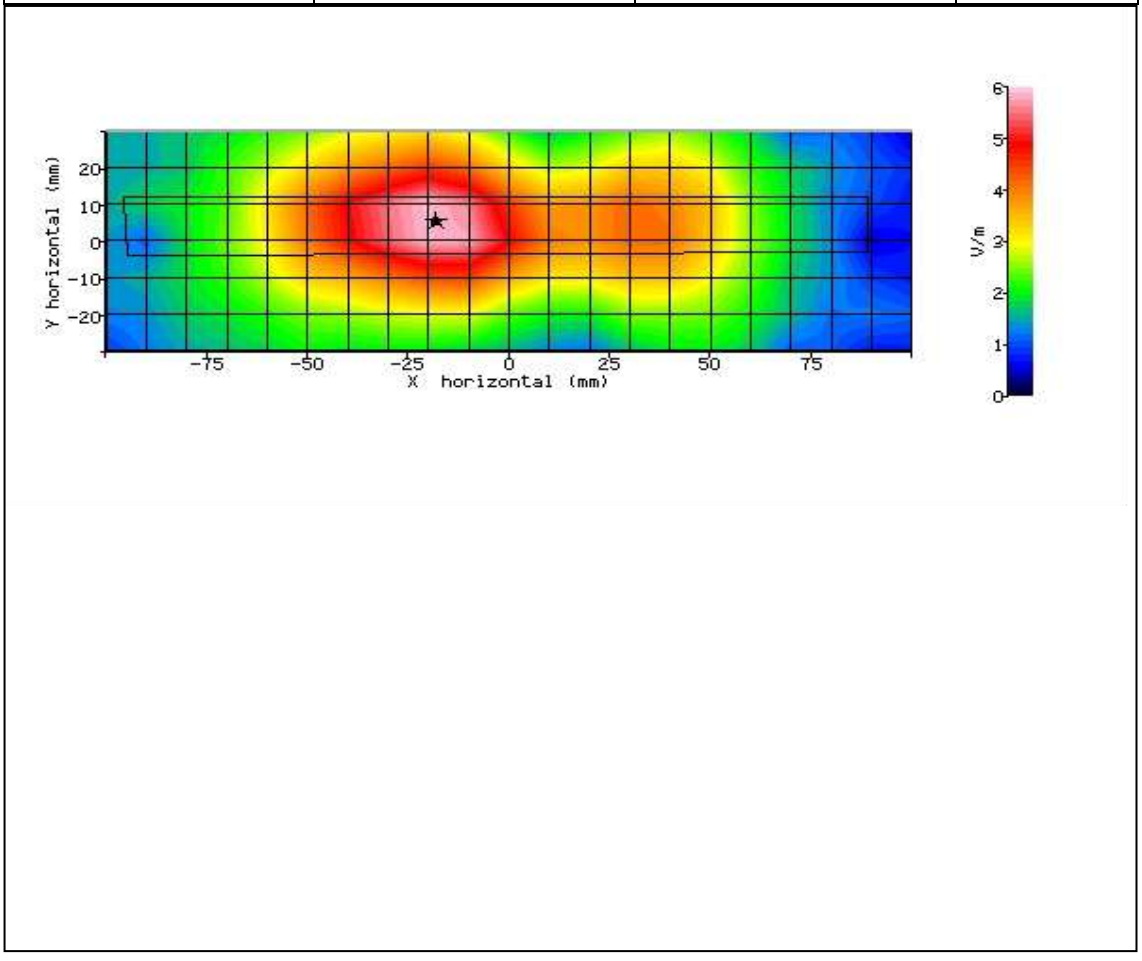


Figure 13: SAR Body Testing Results for the SHT22 Tablet at 2412.0MHz.

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

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-08:22:41	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.40°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	51.26
RELATIVE HUMIDITY:	33.10%	**CONDUCTIVITY:**	1.972
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.10°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	78.400mm
DUT POSITION:	0mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	-39.000mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	24.422
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	0.674 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	1.595 W/kg
INPUT POWER LEVEL:	17dBm	**SAR END:**	0.535 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	-3.700 %

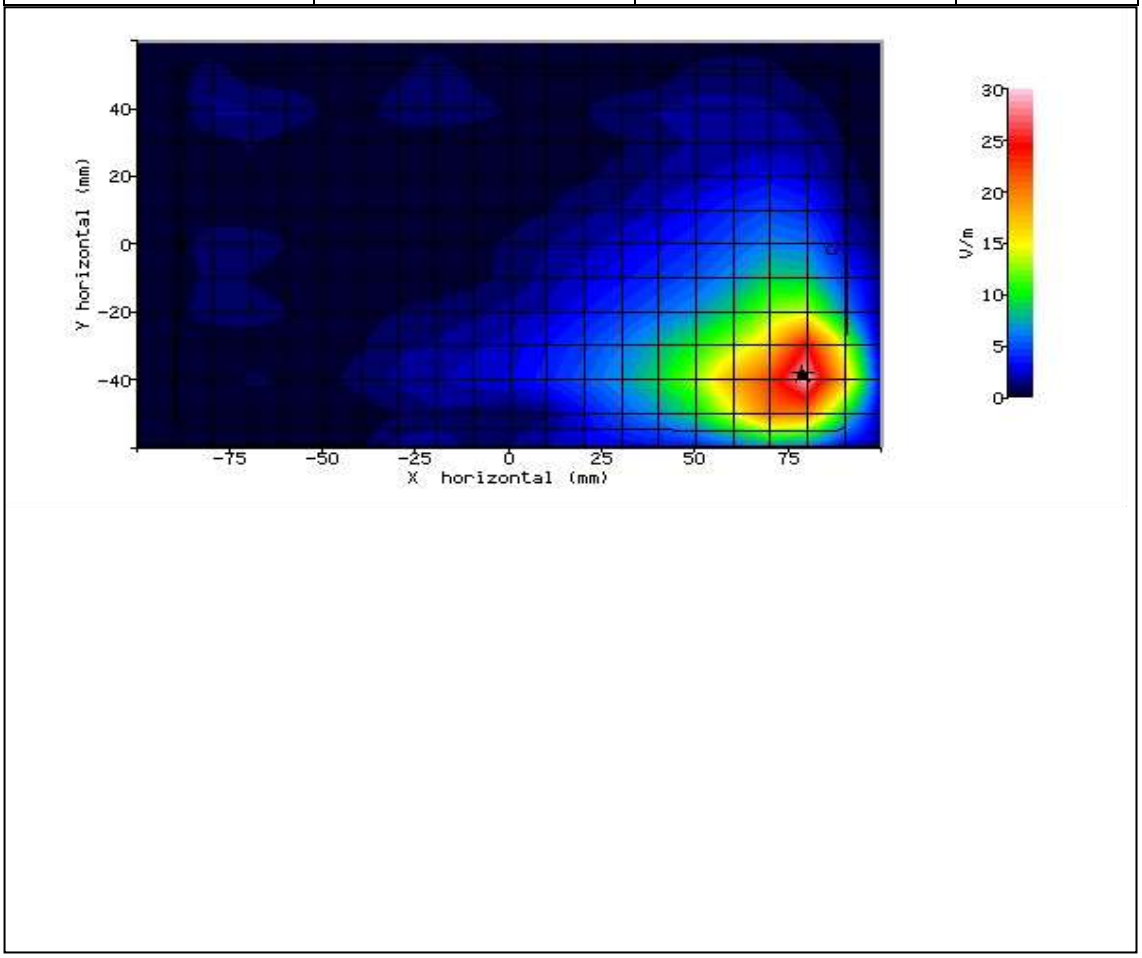


Figure 14: SAR Body Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-08:37:30	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.40°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	51.26
RELATIVE HUMIDITY:	33.10%	**CONDUCTIVITY:**	1.972
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.10°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	76.600mm
DUT POSITION:	0mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	38.100mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	15.529
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	0.274 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	0.666 W/kg
INPUT POWER LEVEL:	17dBm	**SAR END:**	0.665 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	-0.100 %

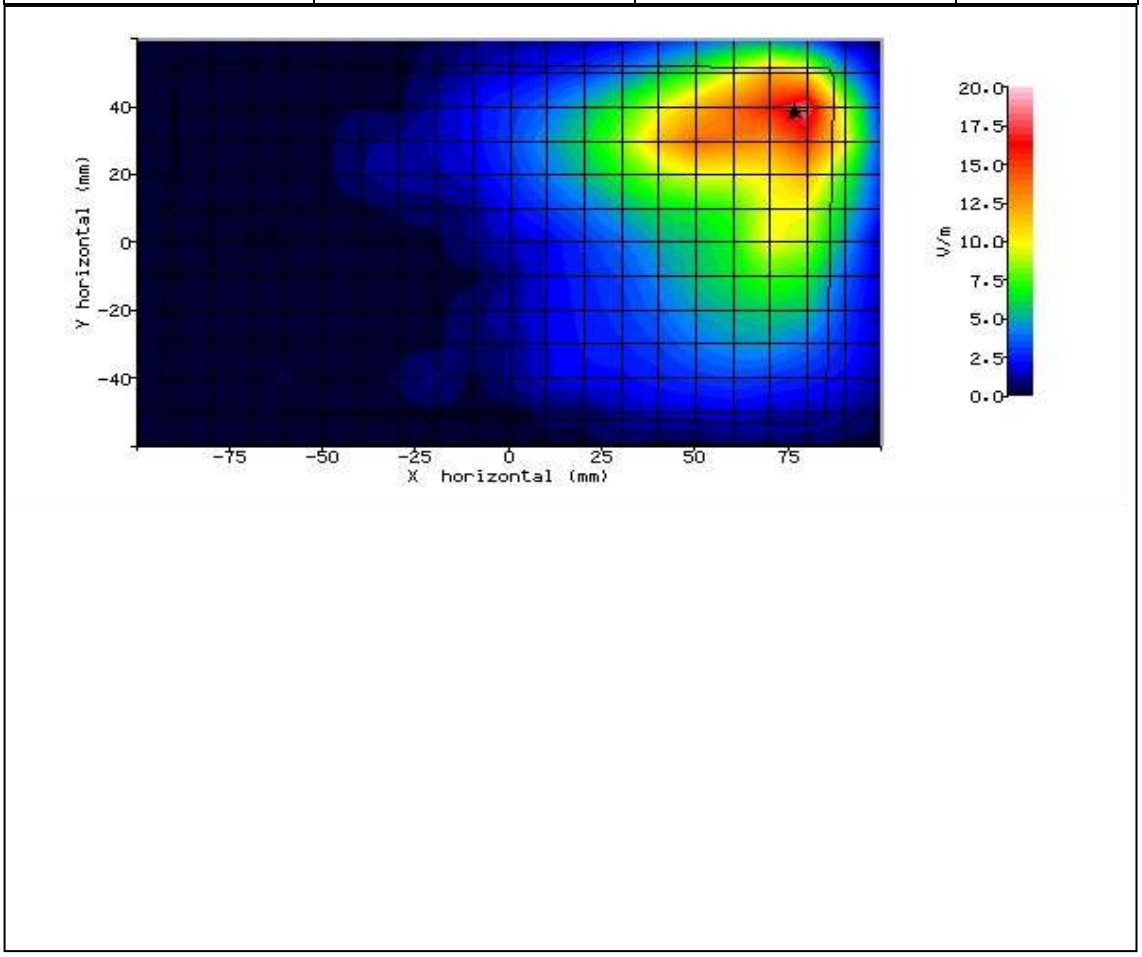


Figure 15: SAR Body Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-10:38:08	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.40°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	51.26
RELATIVE HUMIDITY:	33.10%	**CONDUCTIVITY:**	1.972
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.10°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	72.800mm
DUT POSITION:	0mm-RightEdge	**MAX SAR Y-AXIS LOCATION:**	0.600mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	11.661
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	0.153 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	0.383 W/kg
INPUT POWER LEVEL:	17dBm	**SAR END:**	0.379 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	-0.900 %

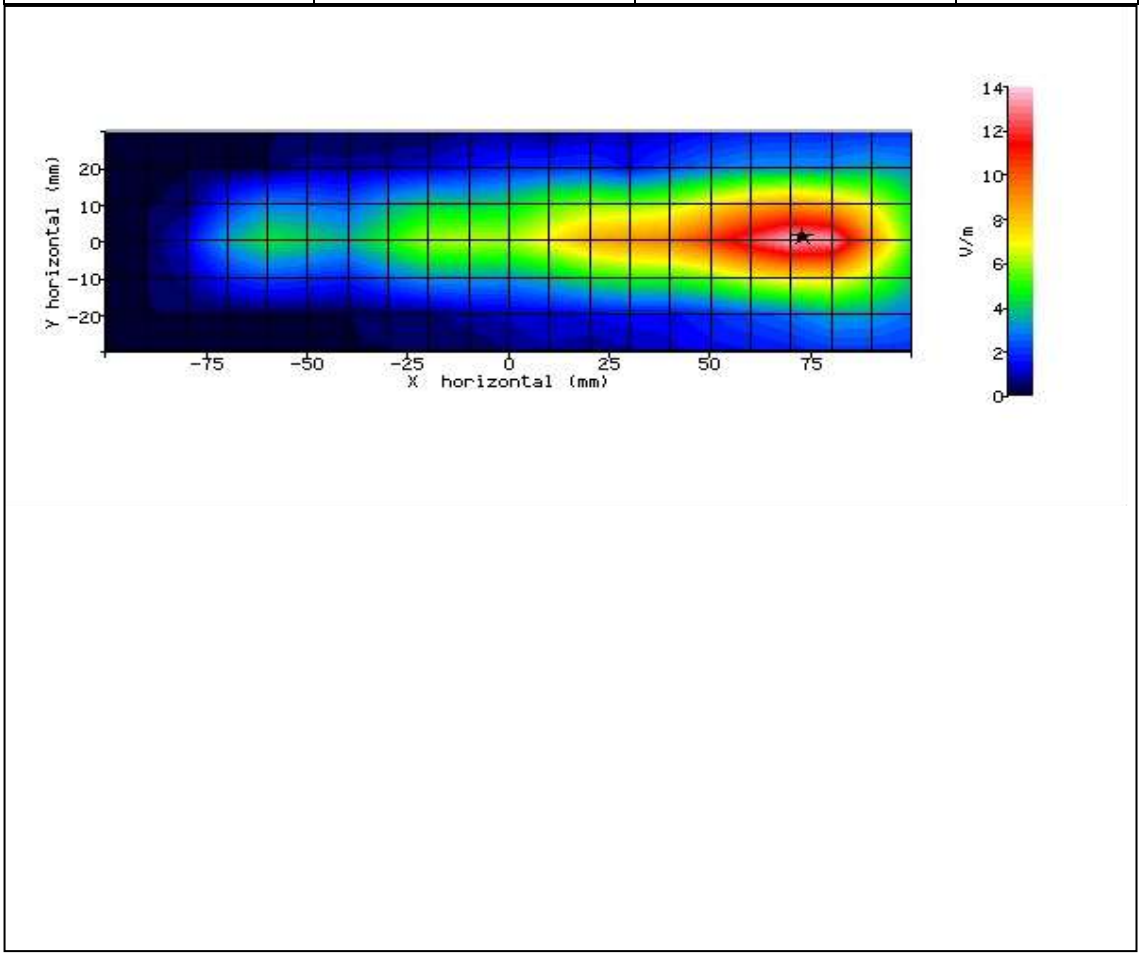


Figure 16: SAR Body Testing Results for the SHT22 Tablet at 2412.0MHz.

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-11:14:30	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.40°C	**LIQUID SIMULANT:**	2450Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	51.26
RELATIVE HUMIDITY:	33.10%	**CONDUCTIVITY:**	1.972
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.10°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-11.000mm
DUT POSITION:	0mm-Bottom Edge	**MAX SAR Y-AXIS LOCATION:**	8.300mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	13.383
TEST FREQUENCY:	2412.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	DSSS (WLAN)	**SAR 10g:**	0.208 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	0.489 W/kg
INPUT POWER LEVEL:	17dBm	**SAR END:**	0.502 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	0.988 %

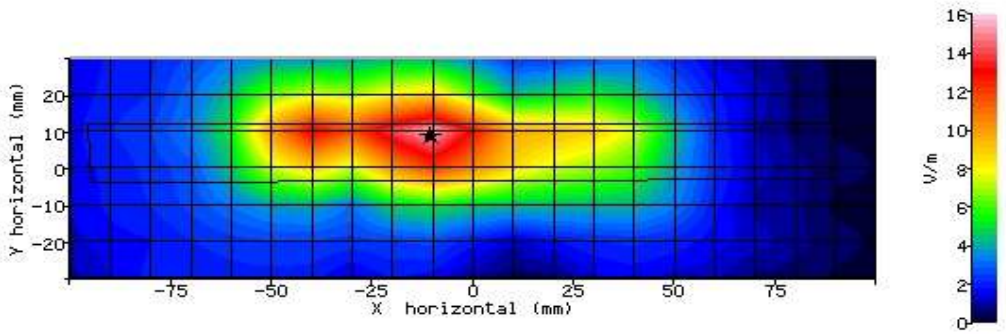


Figure 17: SAR Body Testing Results for the SHT22 Tablet at 2412.0MHz.

2.5 WLAN 5220MHz BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-08:10:56	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.00°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	38.90%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	84.400mm
DUT POSITION:	10mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	-38.000mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.704
TEST FREQUENCY:	5220.0MHz	**SAR 1g:**	0.162 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.226 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.226 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	0.100 %

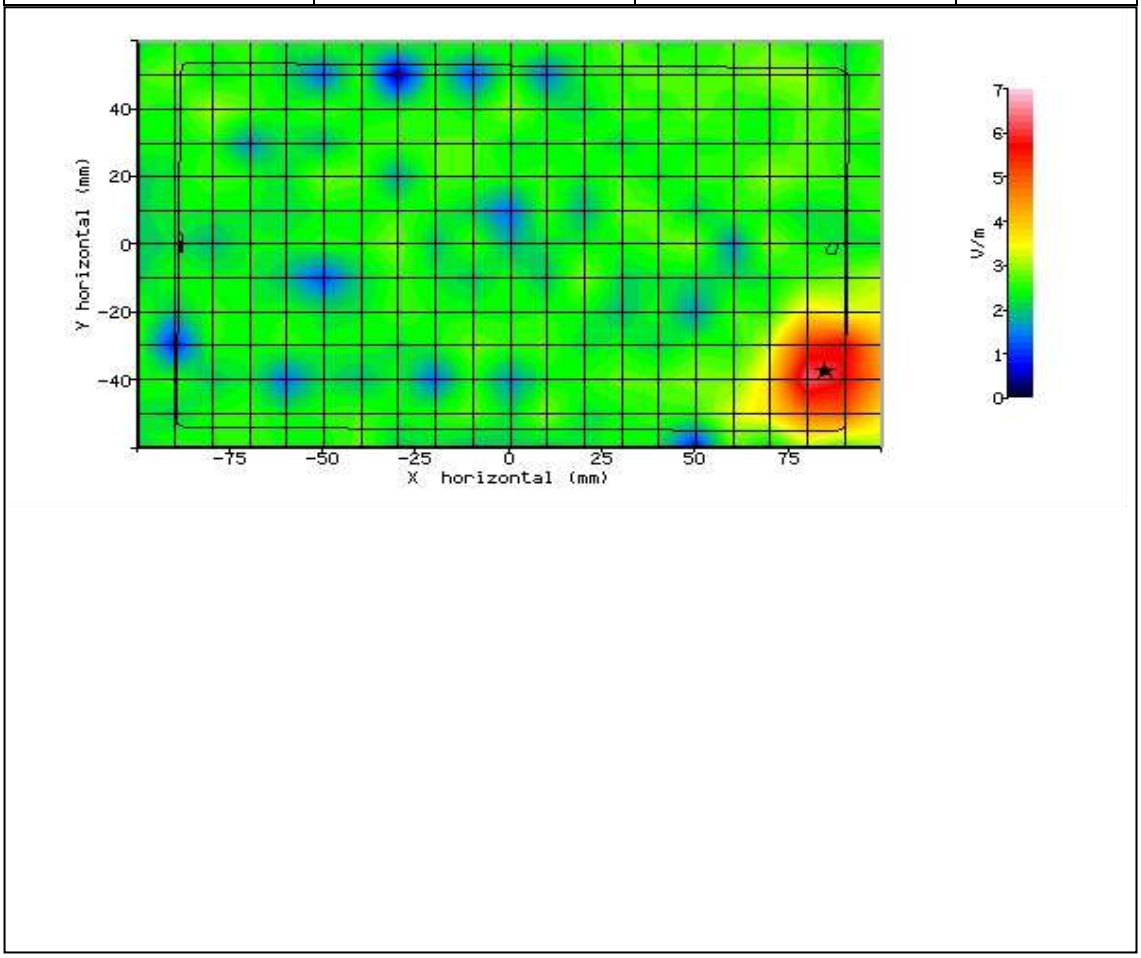


Figure 18: SAR Body Testing Results for the SHT22 Tablet at 5220.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-08:27:33	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.00°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	38.90%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	83.30mm
DUT POSITION:	10mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	39.90mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.101
TEST FREQUENCY:	5220.0MHz	**SAR 1g:**	0.118 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.159 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.161 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	1.400 %

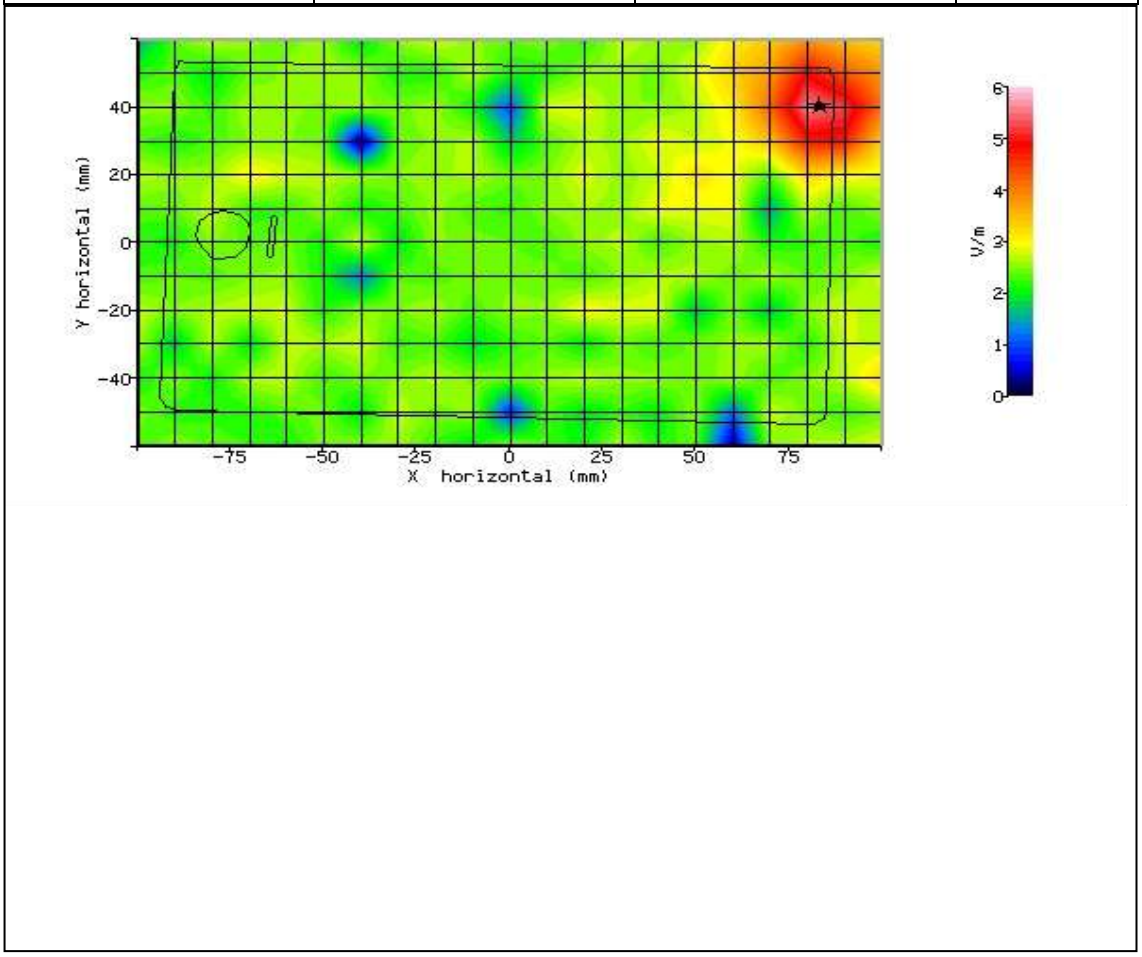


Figure 19: SAR Body Testing Results for the SHT22 Tablet at 5220.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-09:57:32	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.00°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	38.90%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	92.20mm
DUT POSITION:	10mm-RightEdge	**MAX SAR Y-AXIS LOCATION:**	5.10mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.399
TEST FREQUENCY:	5220.0MHz	**SAR 1g:**	0.084 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.094 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.103 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	9.100 %

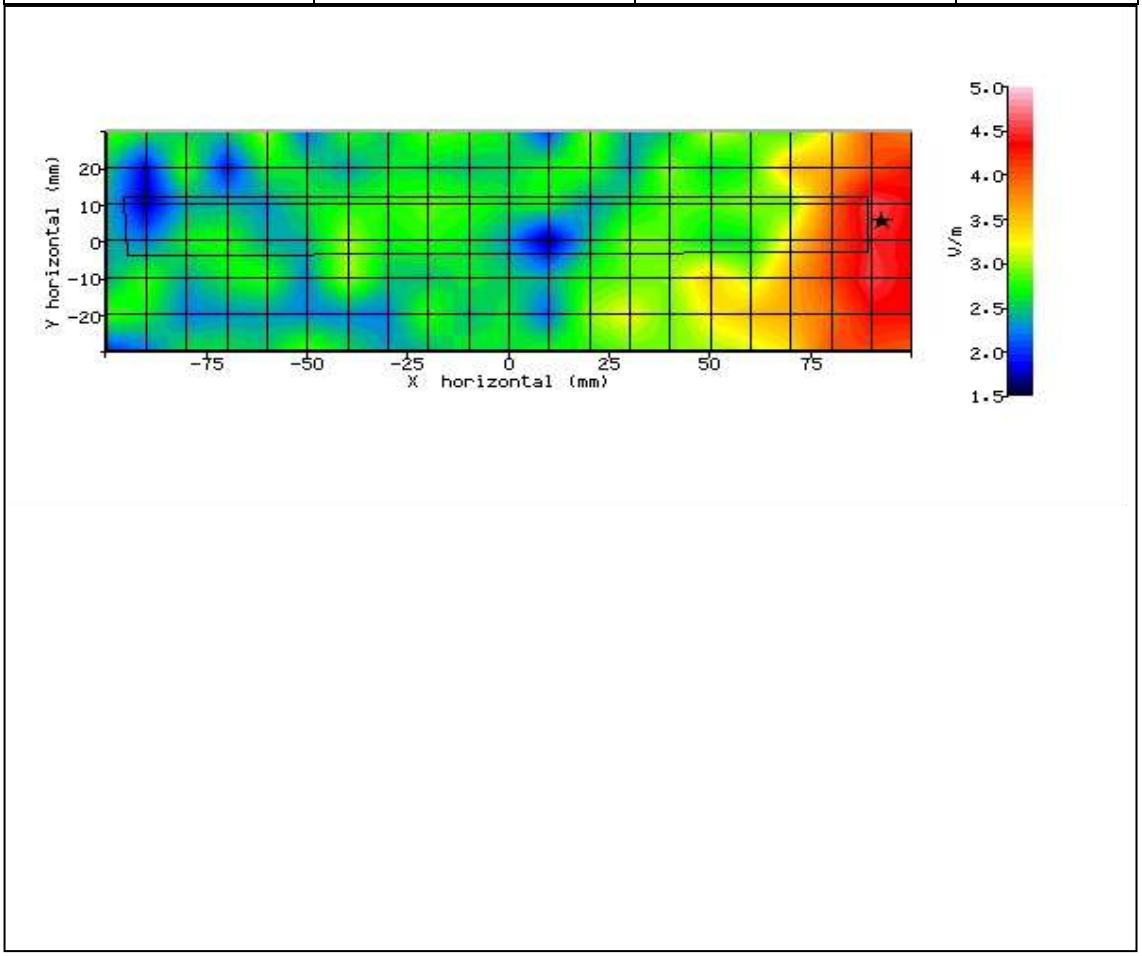


Figure 20: SAR Body Testing Results for the SHT22 Tablet at 5220.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-10:58:16	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.00°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	38.90%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-38.60mm
DUT POSITION:	10mm-Bottom Edge	**MAX SAR Y-AXIS LOCATION:**	0.90mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	6.852
TEST FREQUENCY:	5220.0MHz	**SAR 1g:**	0.227 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.306 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.301 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-1.500 %

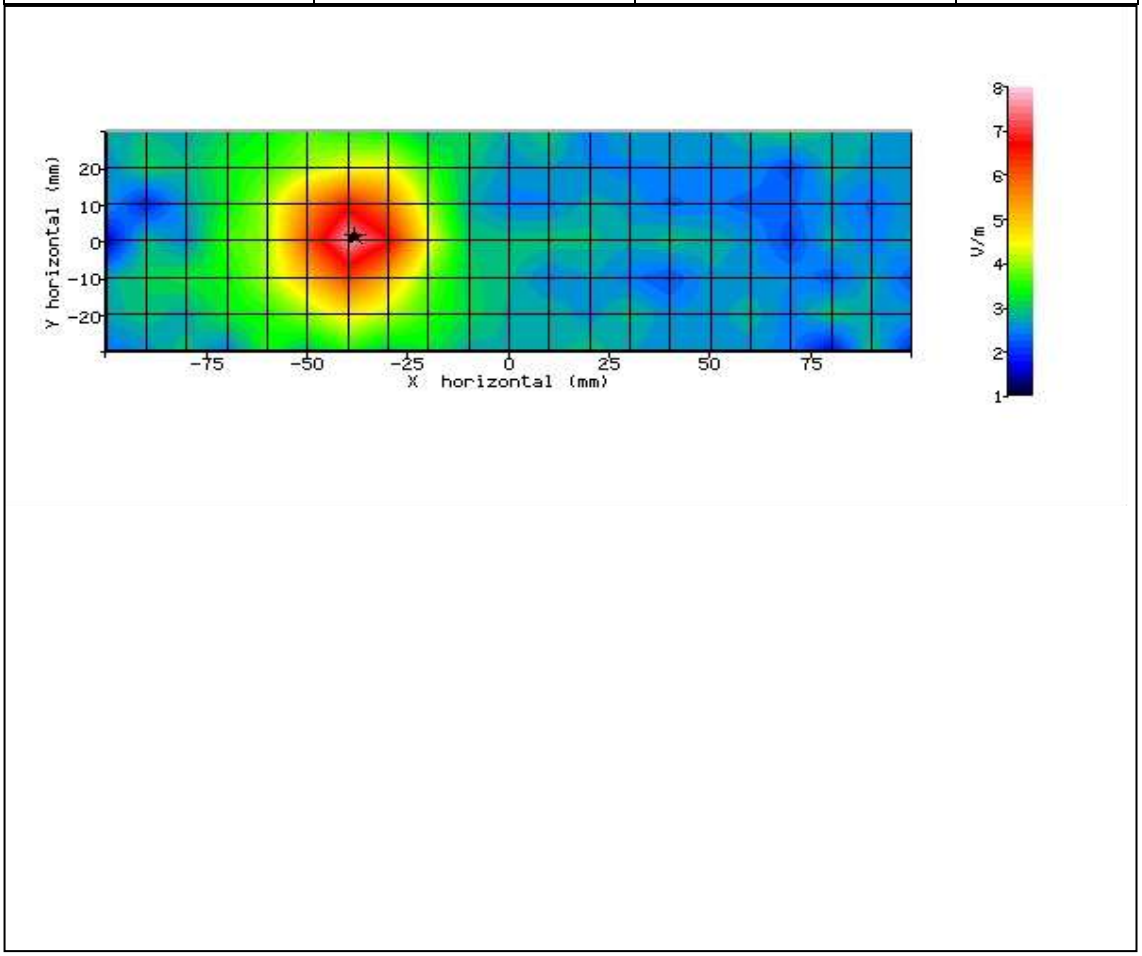


Figure 21: SAR Body Testing Results for the SHT22 Tablet at 5220.0MHz. (NUA)

2.6 WLAN 5220MHz EXTREMITY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-08:58:56	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.00°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	38.90%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	81.20mm
DUT POSITION:	0mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	-39.90mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	16.475
TEST FREQUENCY:	5220.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.422 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	3.424 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	3.485 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	1.800 %

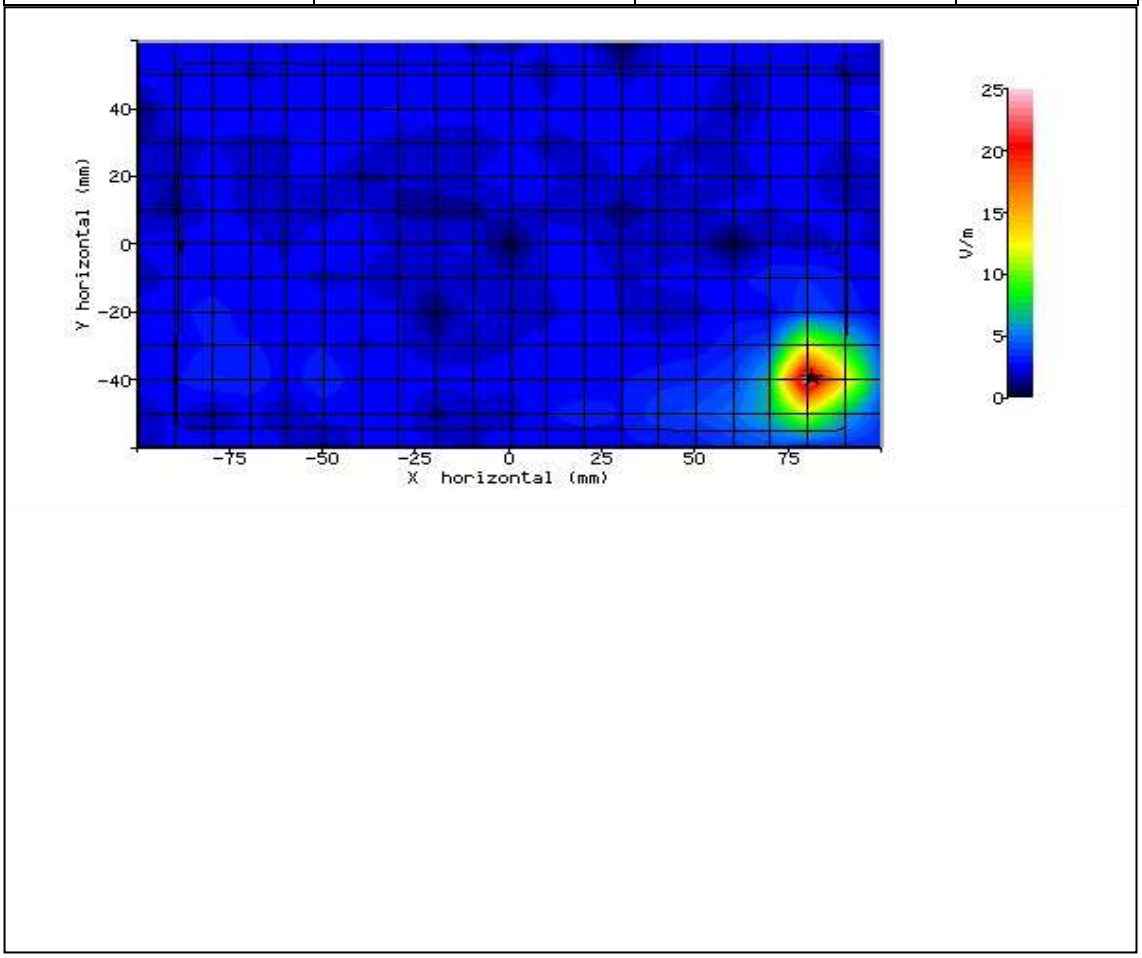


Figure 22: SAR Body Testing Results for the SHT22 Tablet at 5220.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-09:16:38	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.00°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	38.90%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	81.70mm
DUT POSITION:	0mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	39.00mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	10.151
TEST FREQUENCY:	5220.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.190 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	1.026 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	1.011 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-1.500 %

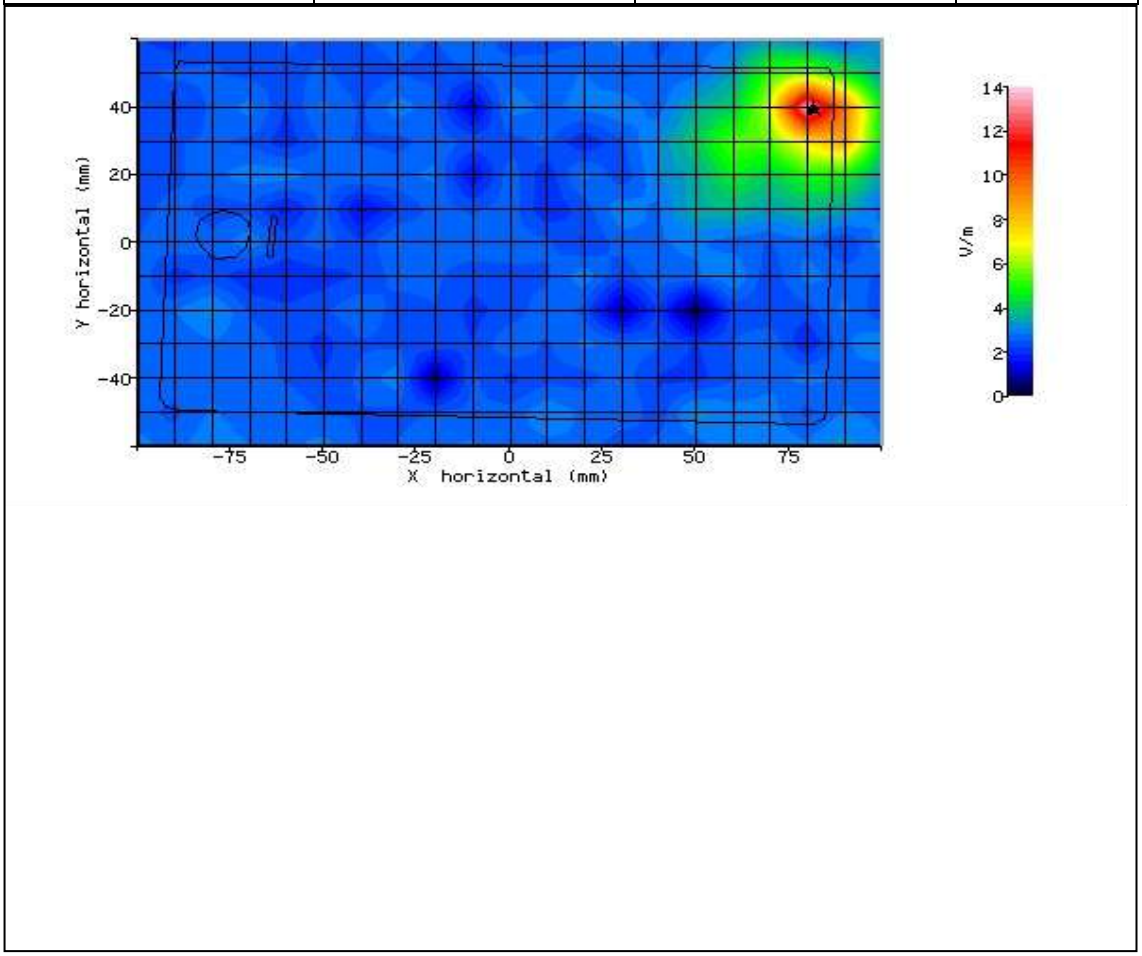


Figure 23: SAR Body Testing Results for the SHT22 Tablet at 5220.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-10:14:56	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.00°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	38.90%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	86.00mm
DUT POSITION:	0mm-RightEdge	**MAX SAR Y-AXIS LOCATION:**	0.00mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	6.701
TEST FREQUENCY:	5220.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.107 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	0.287 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.300 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	4.600 %

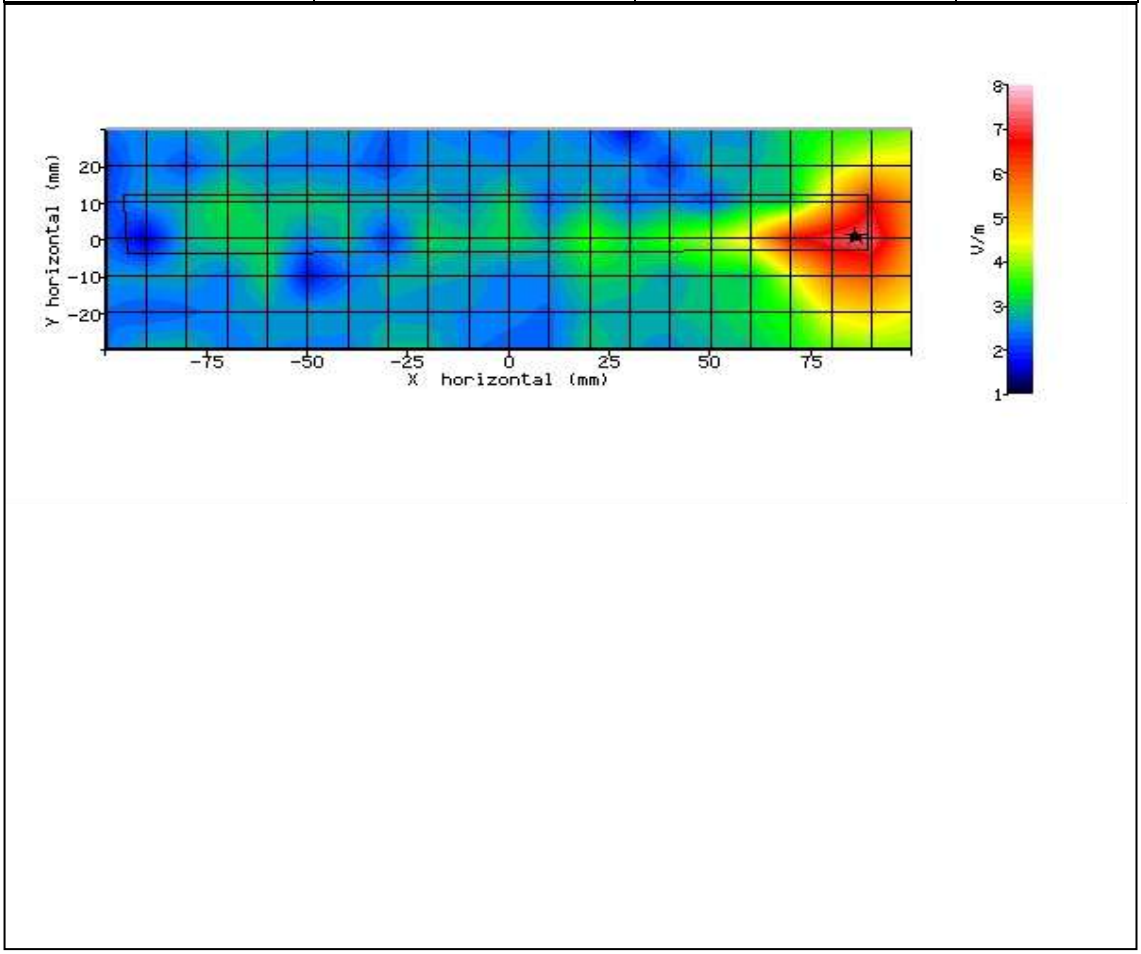


Figure 24: SAR Body Testing Results for the SHT22 Tablet at 5220.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-11:14:09	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.00°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	38.90%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.90°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-36.90mm
DUT POSITION:	0mm-Bottom Edge	**MAX SAR Y-AXIS LOCATION:**	0.10mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	16.949
TEST FREQUENCY:	5220.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.492 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	3.781 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	3.778 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-0.100 %

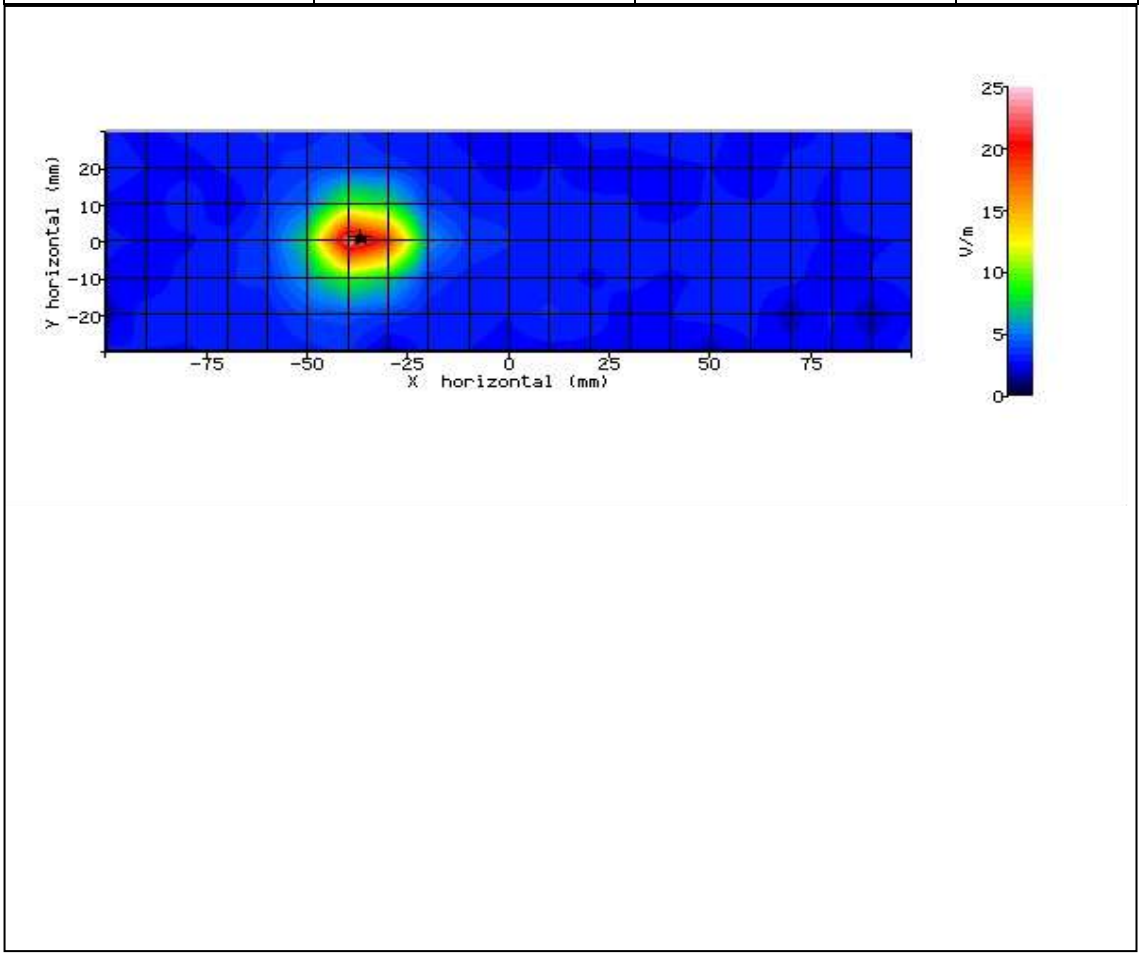


Figure 25: SAR Body Testing Results for the SHT22 Tablet at 5220.0MHz. (NUA)

2.7 WLAN 5300MHz BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-12:01:43	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	83.00mm
DUT POSITION:	10mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	-39.00mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.866
TEST FREQUENCY:	5300.0MHz	**SAR 1g:**	0.166 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.233 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.236 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	1.400 %

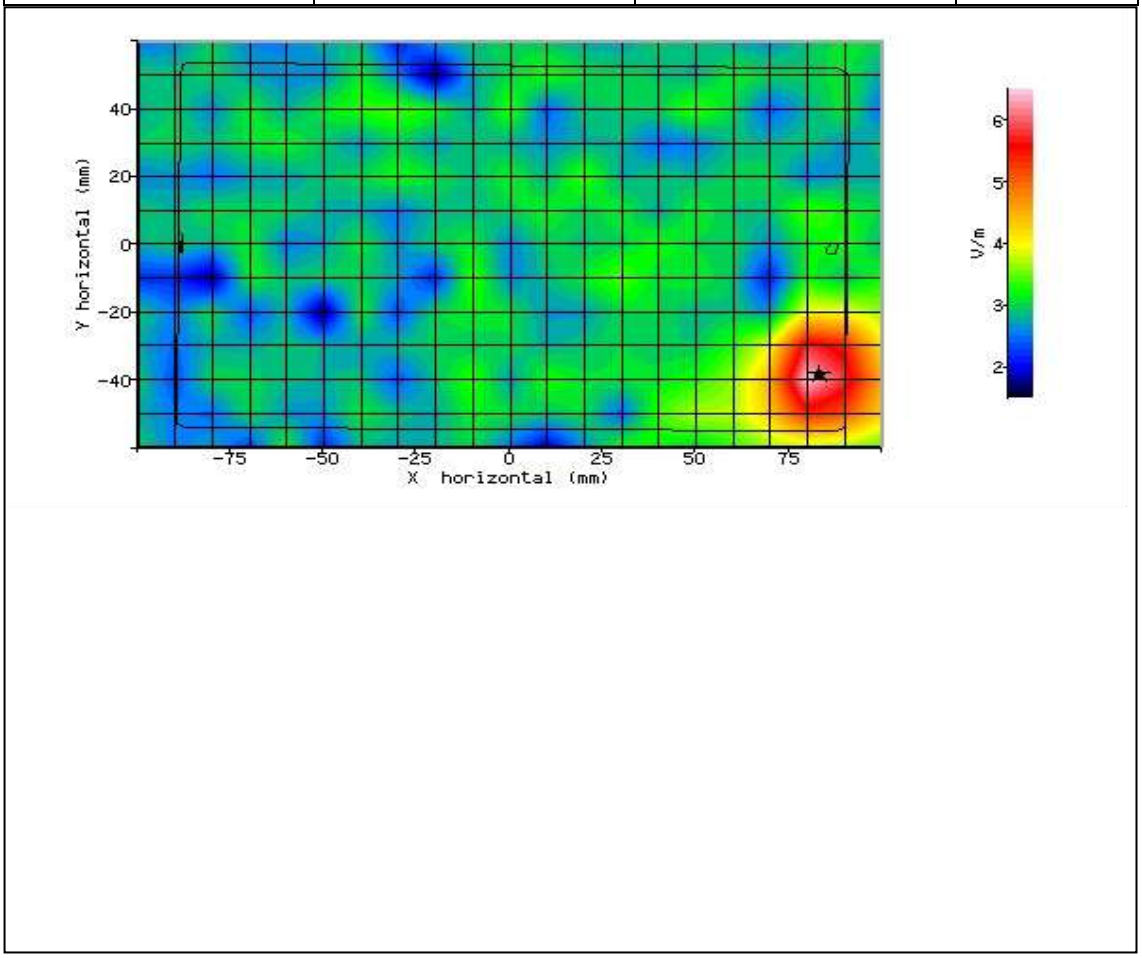


Figure 26: SAR Body Testing Results for the SHT22 Tablet at 5300.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-13:05:06	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	81.90mm
DUT POSITION:	10mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	40.00mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.646
TEST FREQUENCY:	5300.0MHz	**SAR 1g:**	0.140 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.183 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.187 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	2.200 %

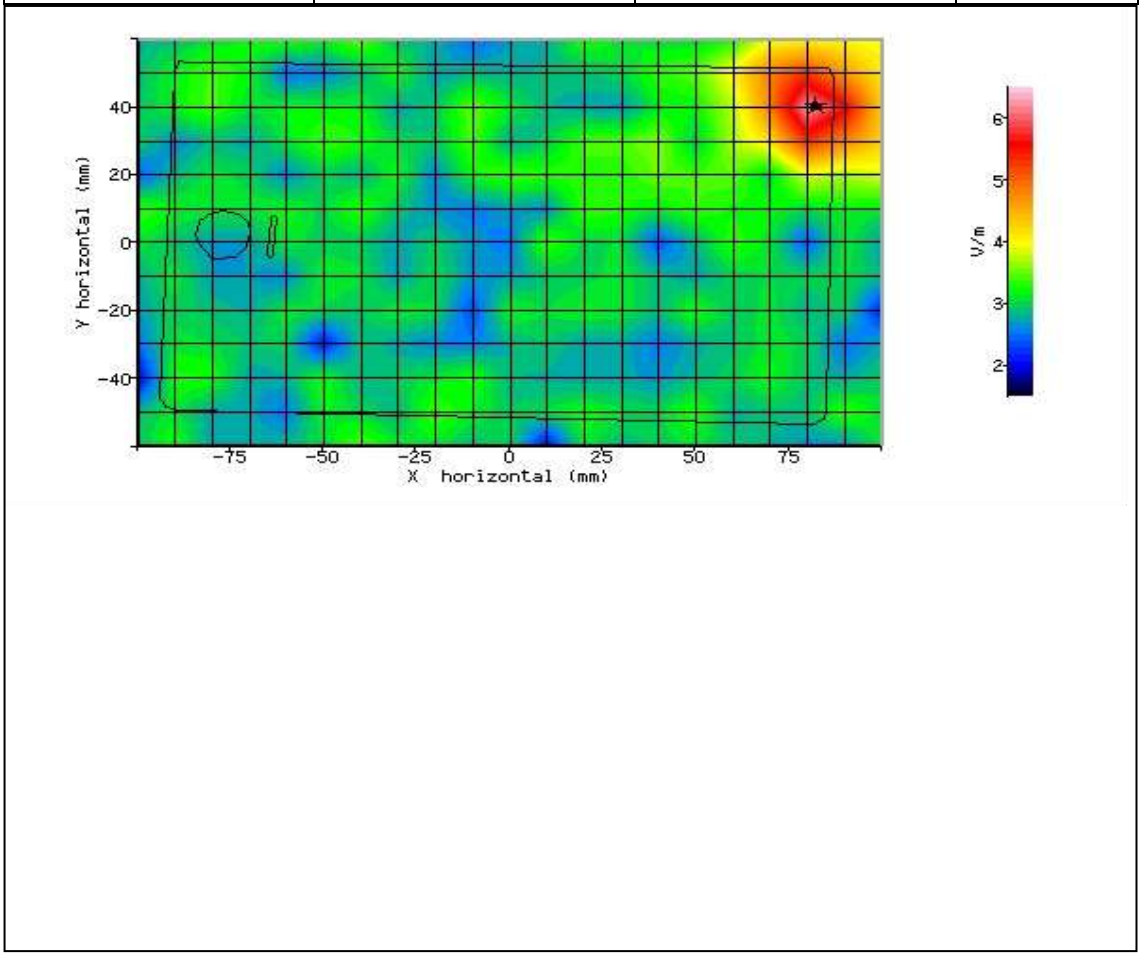


Figure 27: SAR Body Testing Results for the SHT22 Tablet at 5300.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-14:11:15	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	96.00mm
DUT POSITION:	10mm-RightEdge	**MAX SAR Y-AXIS LOCATION:**	-12.00mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.388
TEST FREQUENCY:	5300.0MHz	**SAR 1g:**	0.082 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.095 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.102 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	7.300 %

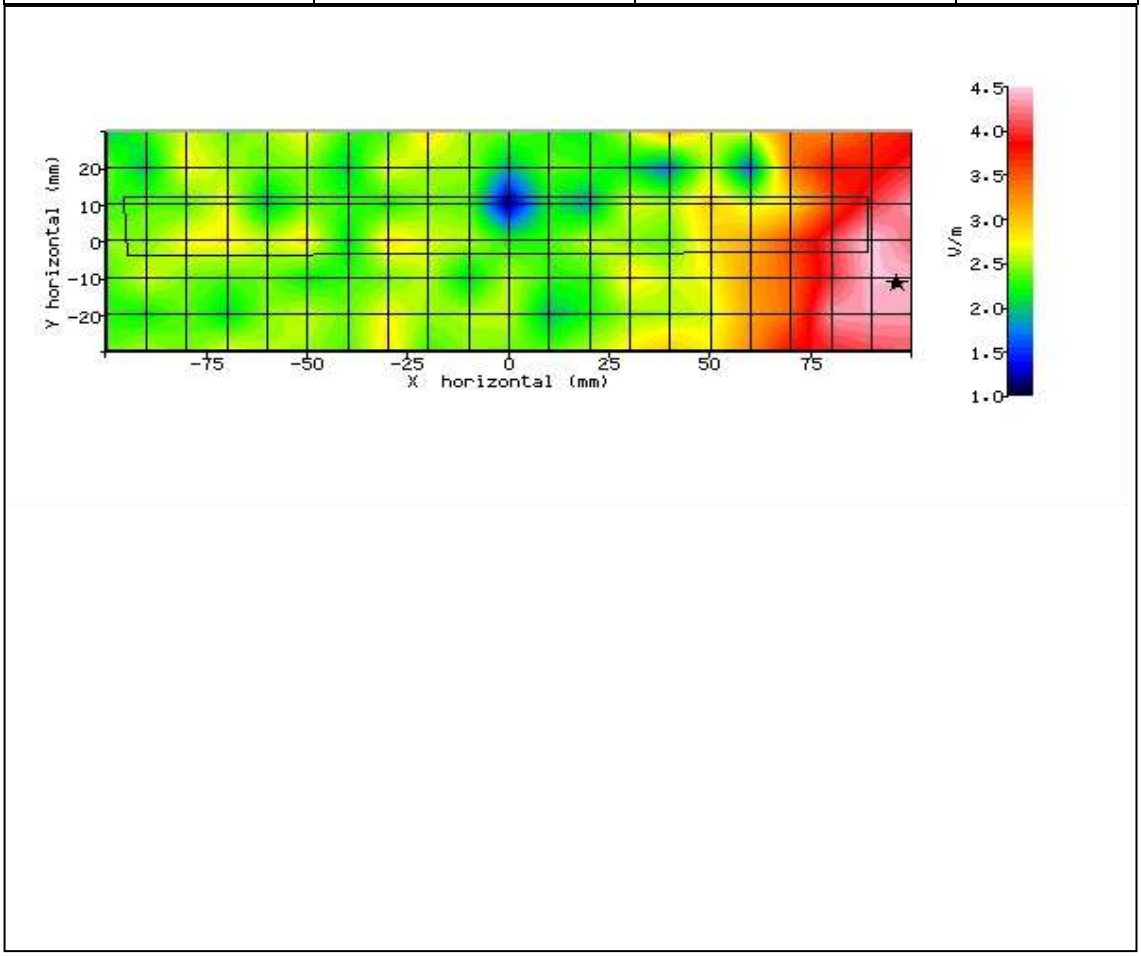


Figure 28: SAR Body Testing Results for the SHT22 Tablet at 5300.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-15:01:37	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-38.10mm
DUT POSITION:	10mm-Bottom Edge	**MAX SAR Y-AXIS LOCATION:**	5.90mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	7.162
TEST FREQUENCY:	5300.0MHz	**SAR 1g:**	0.236 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.311 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.326 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	4.700 %

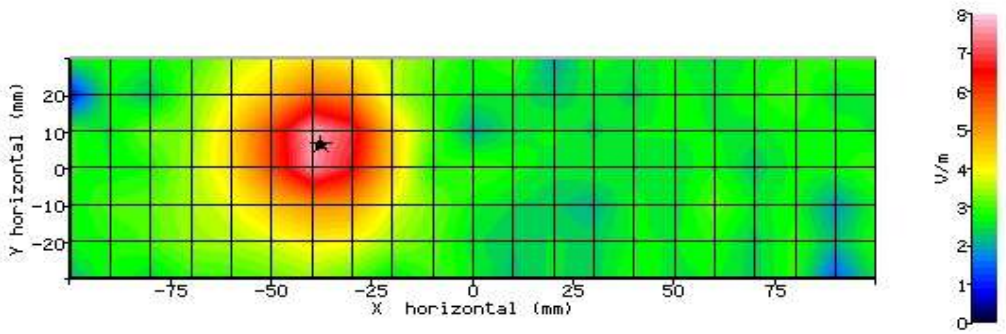


Figure 29: SAR Body Testing Results for the SHT22 Tablet at 5300.0MHz. (NUA)

2.8 WLAN 5300MHz EXTREMITY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-12:19:52	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	80.40mm
DUT POSITION:	0mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	-37.50mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	14.896
TEST FREQUENCY:	5300.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.361 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	2.706 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	2.685 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-0.800 %

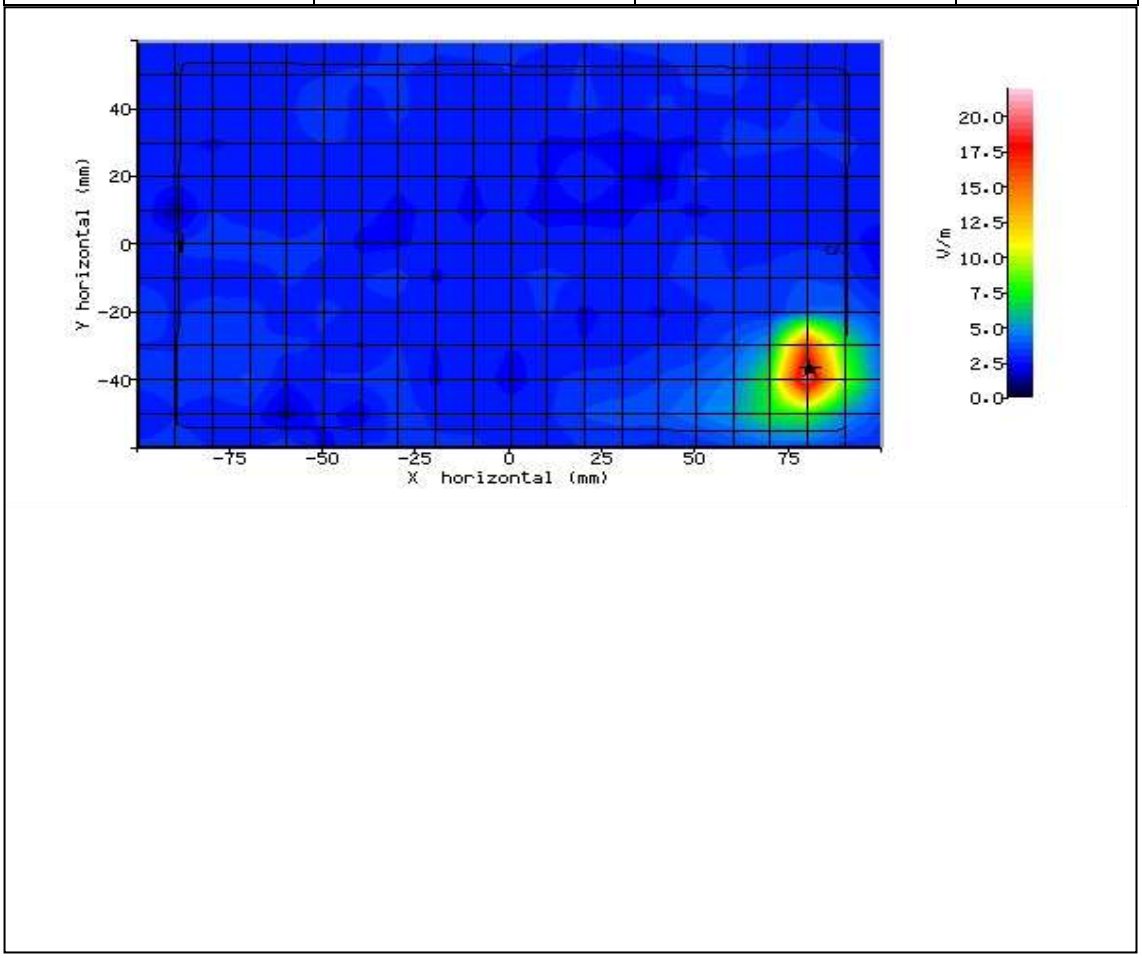


Figure 30: SAR Body Testing Results for the SHT22 Tablet at 5300.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-13:21:05	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	78.20mm
DUT POSITION:	0mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	39.30mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	9.741
TEST FREQUENCY:	5300.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.180 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	0.891 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.866 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-2.800 %

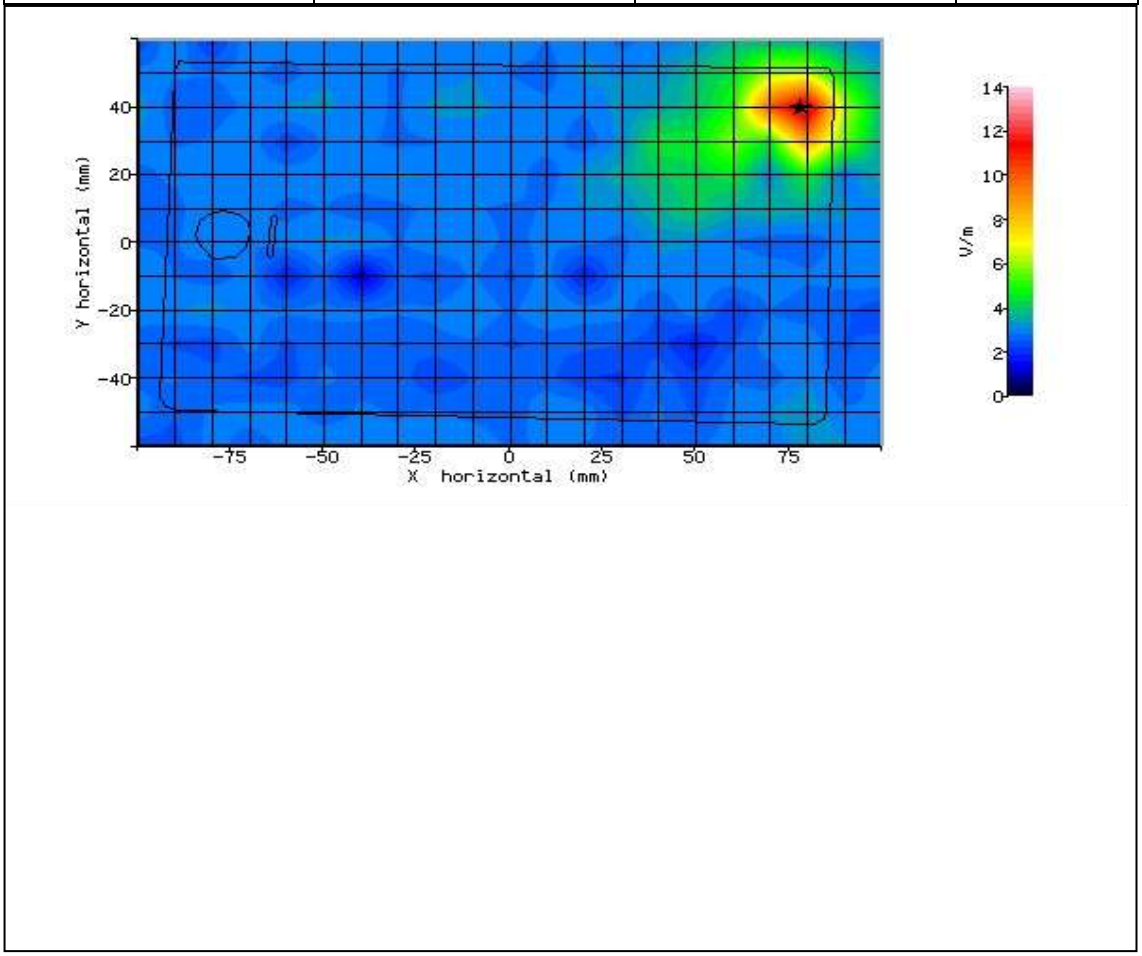


Figure 31: SAR Body Testing Results for the SHT22 Tablet at 5300.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-14:24:10	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	83.80mm
DUT POSITION:	0mm-RightEdge	**MAX SAR Y-AXIS LOCATION:**	2.30mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	6.871
TEST FREQUENCY:	5300.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.102 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	0.312 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.321 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	3.100 %

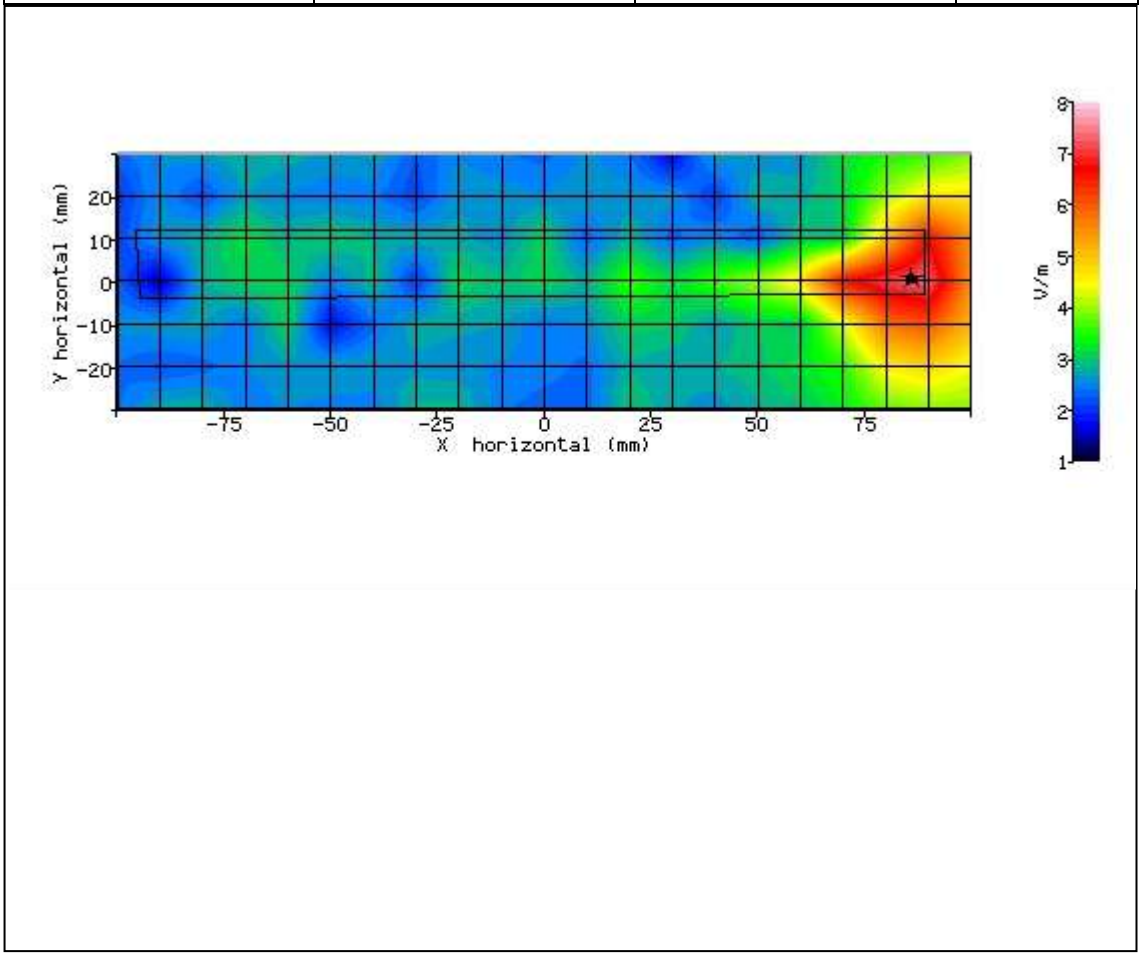


Figure 32: SAR Body Testing Results for the SHT22 Tablet at 5300.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-15:16:38	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	48.95
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.048
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-40.00mm
DUT POSITION:	0mm-Bottom Edge	**MAX SAR Y-AXIS LOCATION:**	0.50mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	16.400
TEST FREQUENCY:	5300.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.423 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	3.234 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	3.271 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	1.100 %

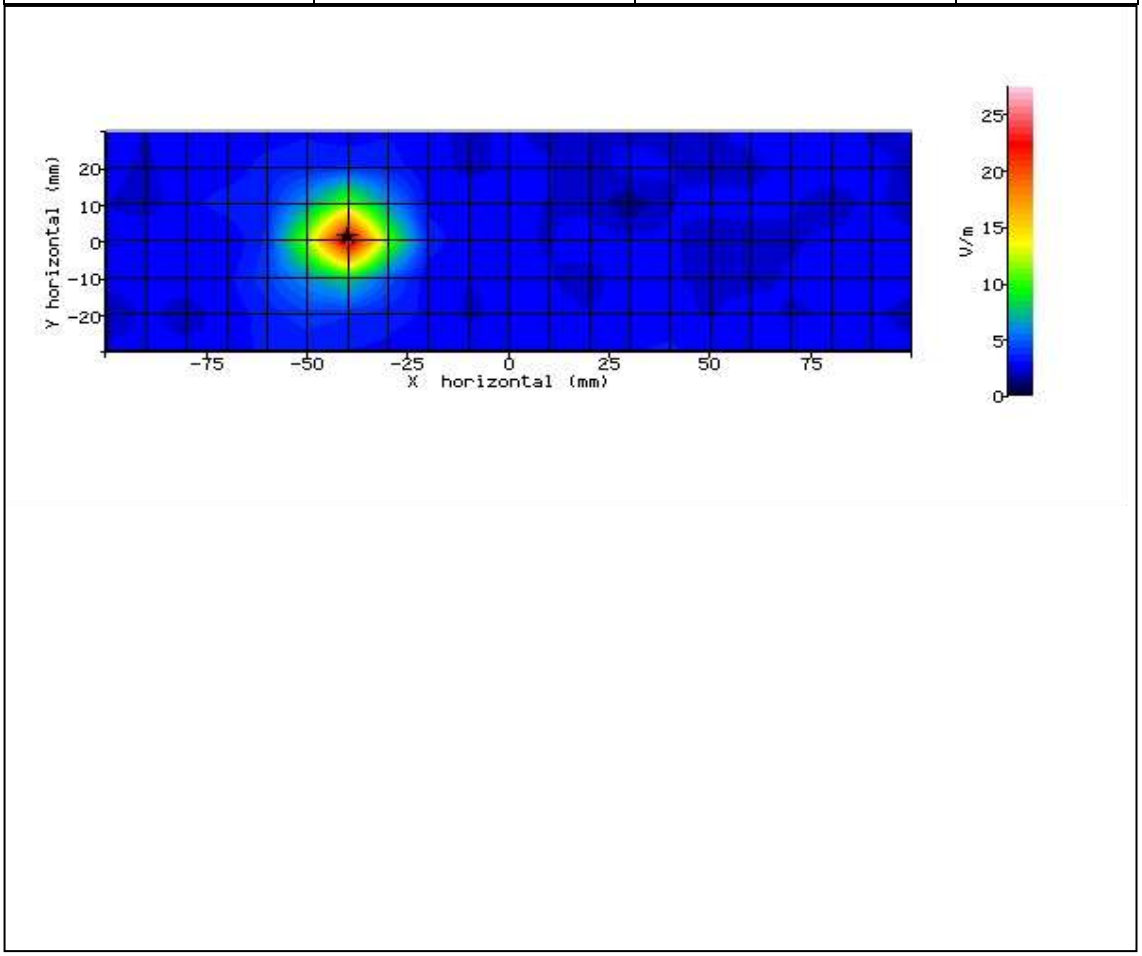


Figure 33: SAR Body Testing Results for the SHT22 Tablet at 5300.0MHz. (NUA)

2.9 WLAN 5600MHz BODY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-15:39:58	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	47.99
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.488
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	81.900mm
DUT POSITION:	10mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	-40.500mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.463
TEST FREQUENCY:	5600.0MHz	**SAR 1g:**	0.092 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.146 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.144 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-1.200 %

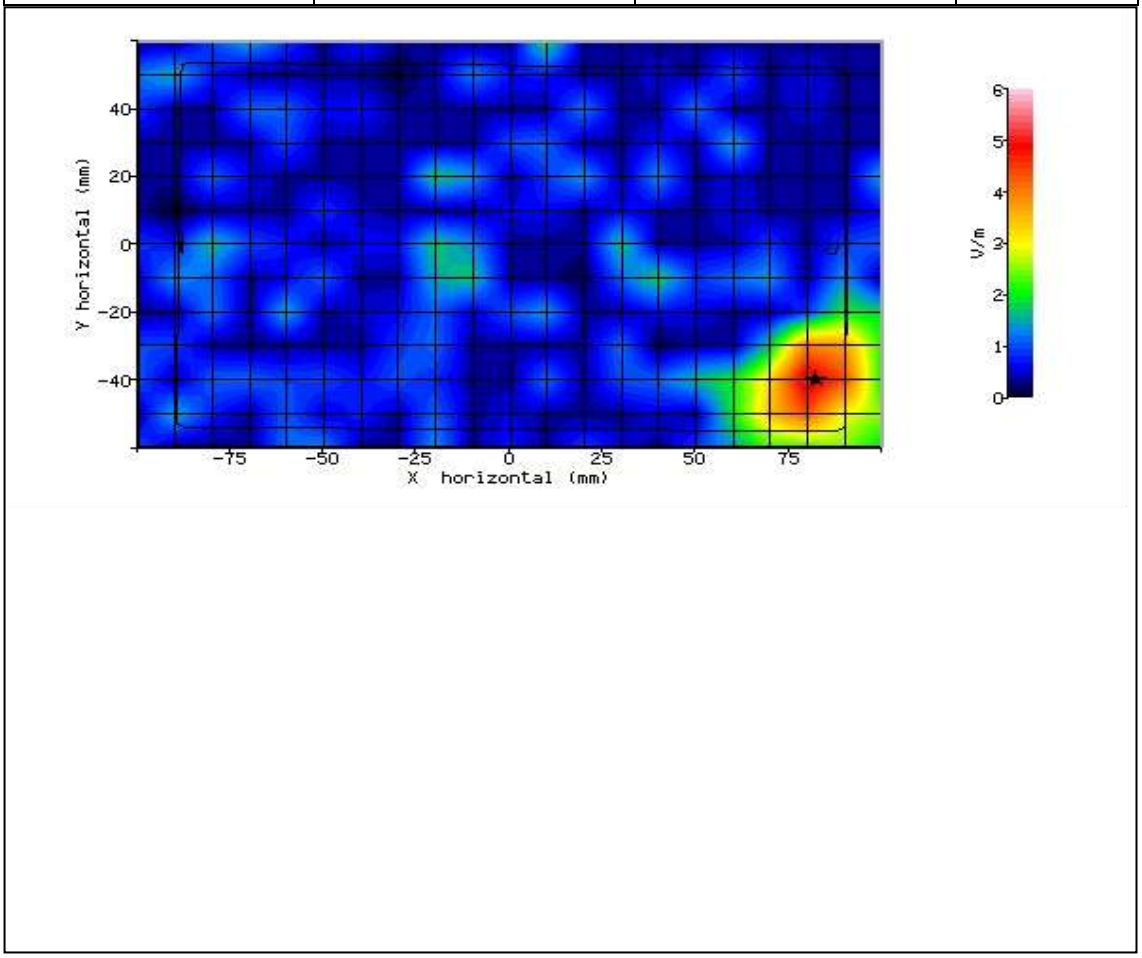


Figure 34: SAR Body Testing Results for the SHT22 Tablet at 5600.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-16:12:43	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	47.99
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.488
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	83.500mm
DUT POSITION:	10mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	34.800mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	4.017
TEST FREQUENCY:	5600.0MHz	**SAR 1g:**	0.085 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.121 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.114 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-6.000 %

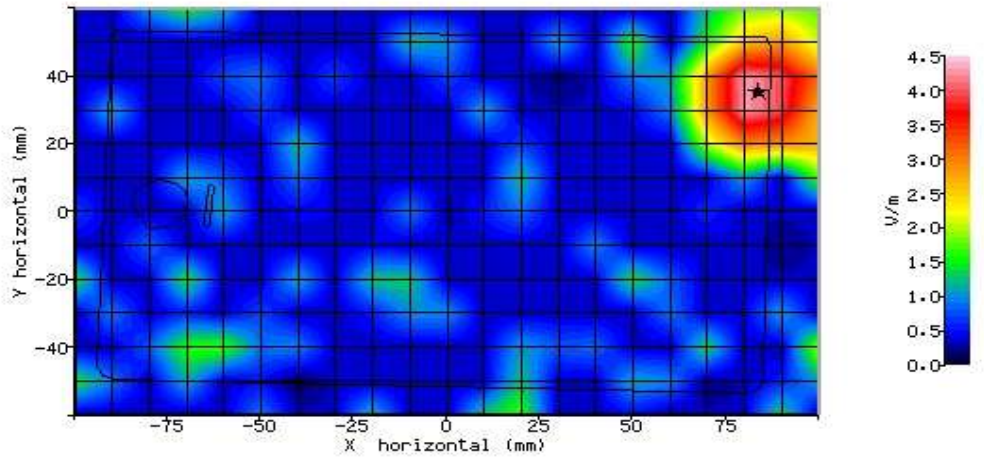


Figure 35: SAR Body Testing Results for the SHT22 Tablet at 5600.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-06:22:32	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.10°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	47.99
RELATIVE HUMIDITY:	30.90%	**CONDUCTIVITY:**	5.488
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.00°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	93.100mm
DUT POSITION:	10mm-RightEdge	**MAX SAR Y-AXIS LOCATION:**	-7.300mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	3.865
TEST FREQUENCY:	5600.0MHz	**SAR 1g:**	0.072 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.092 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.092 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	0.000 %

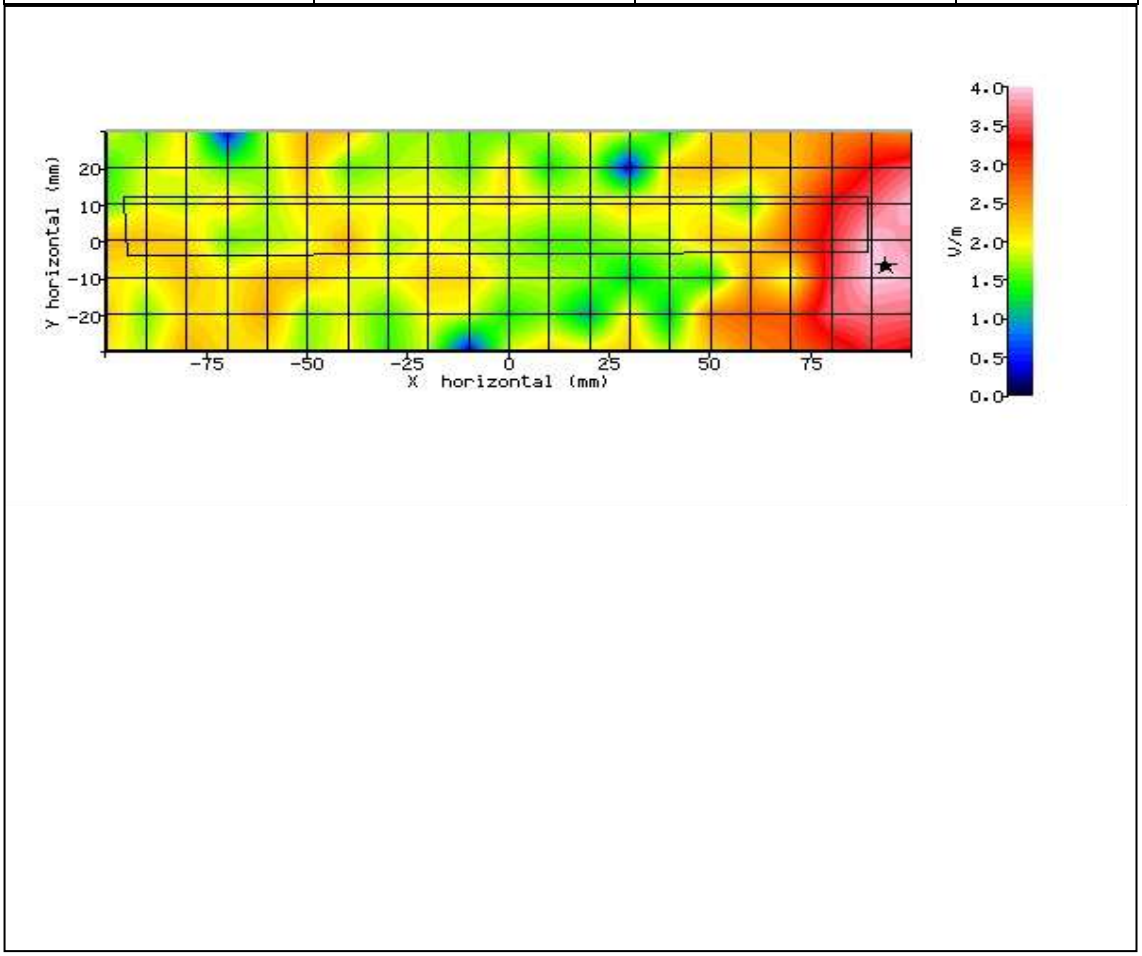


Figure 36: SAR Body Testing Results for the SHT22 Tablet at 5600.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-06:52:08	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.10°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	47.99
RELATIVE HUMIDITY:	30.90%	**CONDUCTIVITY:**	5.488
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.00°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-40.000mm
DUT POSITION:	10mm-Bottom Edge	**MAX SAR Y-AXIS LOCATION:**	-1.700mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	5.621
TEST FREQUENCY:	5600.0MHz	**SAR 1g:**	0.149 W/kg
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	N/A
MODN. DUTY CYCLE:	100%	**SAR START:**	0.222 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.221 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	-0.400 %

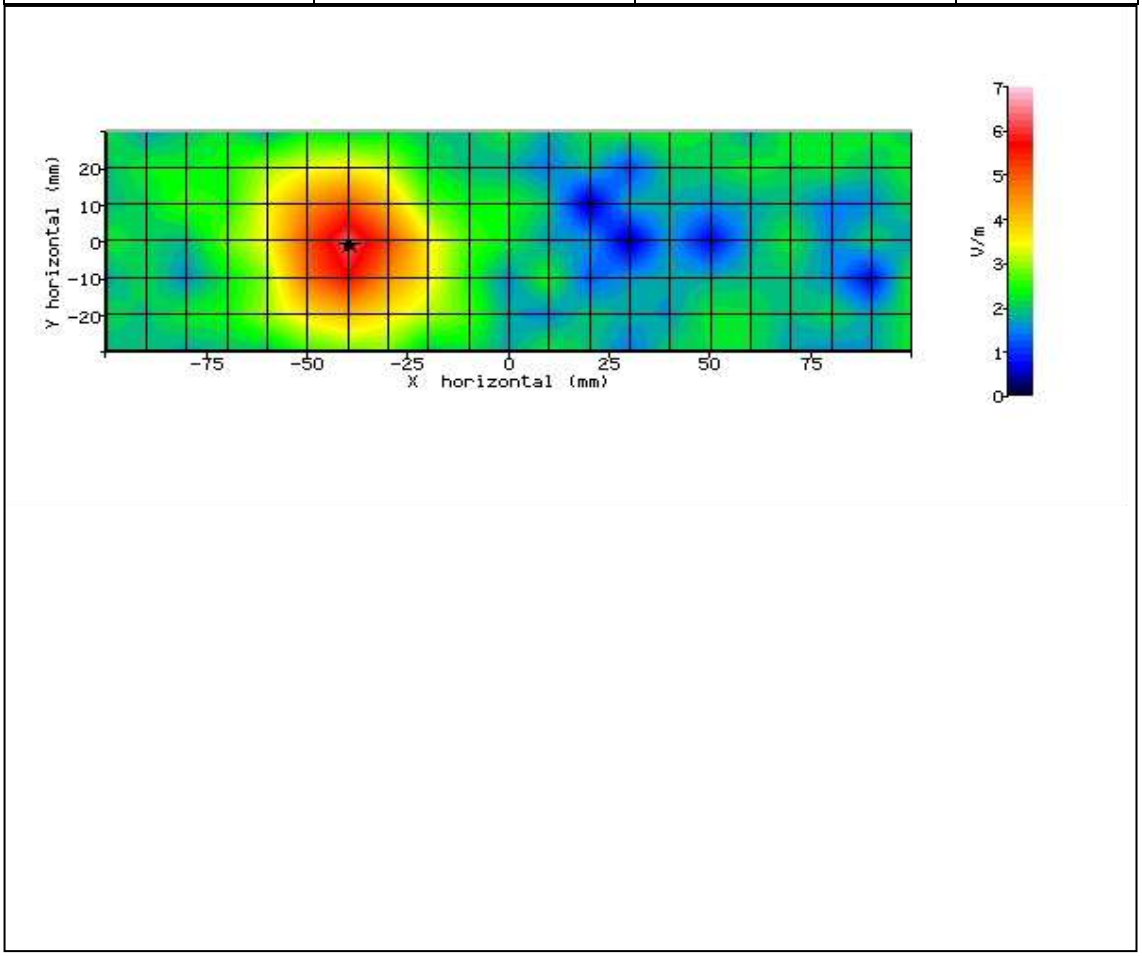


Figure 37: SAR Body Testing Results for the SHT22 Tablet at 5600.0MHz. (NUA)

2.10 WLAN 5600MHz EXTREMITY SAR TEST RESULTS AND COURSE AREA SCANS – 2D

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-15:55:57	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	47.99
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.488
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	81.400mm
DUT POSITION:	0mm-Front Face	**MAX SAR Y-AXIS LOCATION:**	-37.800mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	11.184
TEST FREQUENCY:	5600.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.232 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	1.726 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	1.706 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-1.100 %

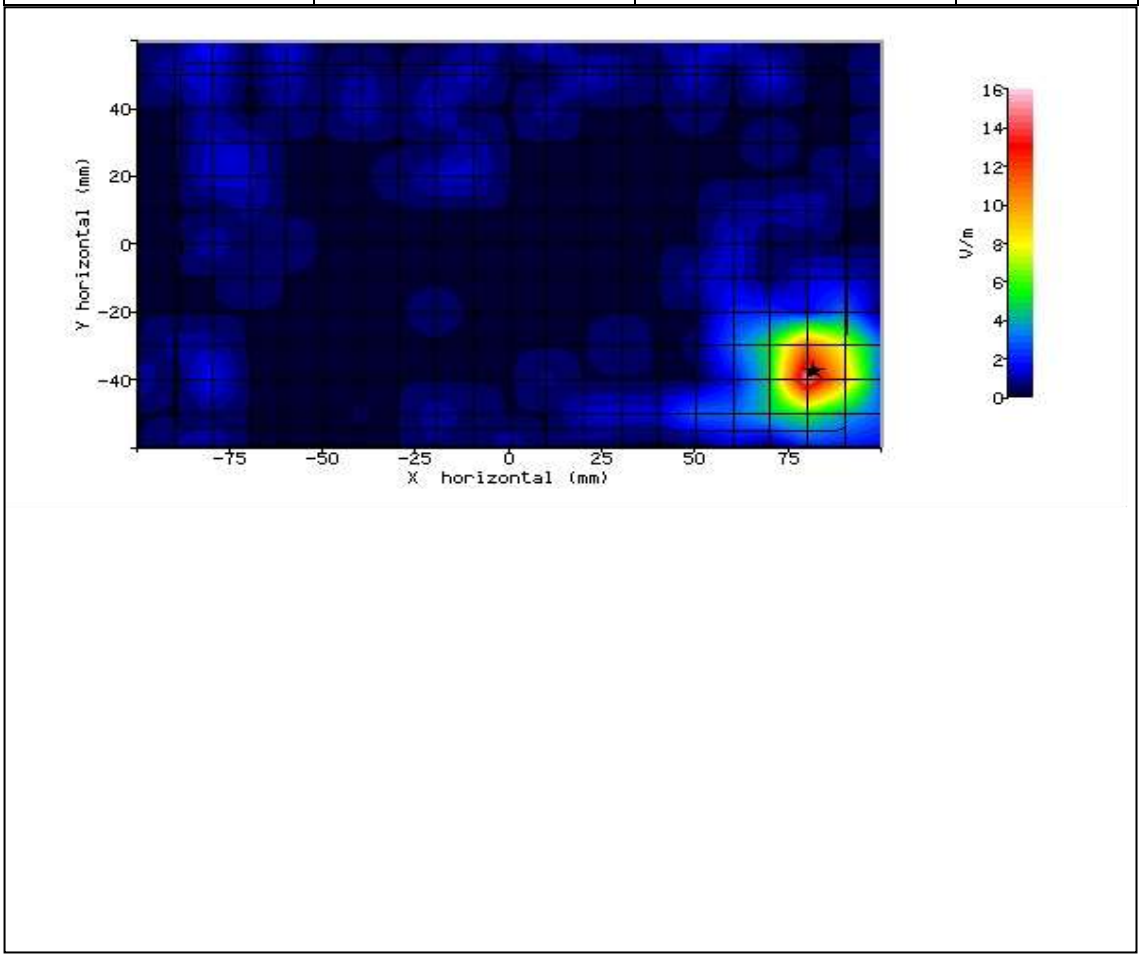


Figure 38: SAR Body Testing Results for the SHT22 Tablet at 5600.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	15/01/2014-16:28:47	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	22.80°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	47.99
RELATIVE HUMIDITY:	42.10%	**CONDUCTIVITY:**	5.488
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	22.80°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	79.100mm
DUT POSITION:	0mm-Rear Face	**MAX SAR Y-AXIS LOCATION:**	38.500mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	8.242
TEST FREQUENCY:	5600.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.112 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	0.715 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.709 W/kg
PROBE BATTERY LAST CHANGED:	15/01/2014	**SAR DRIFT DURING SCAN:**	-0.900 %

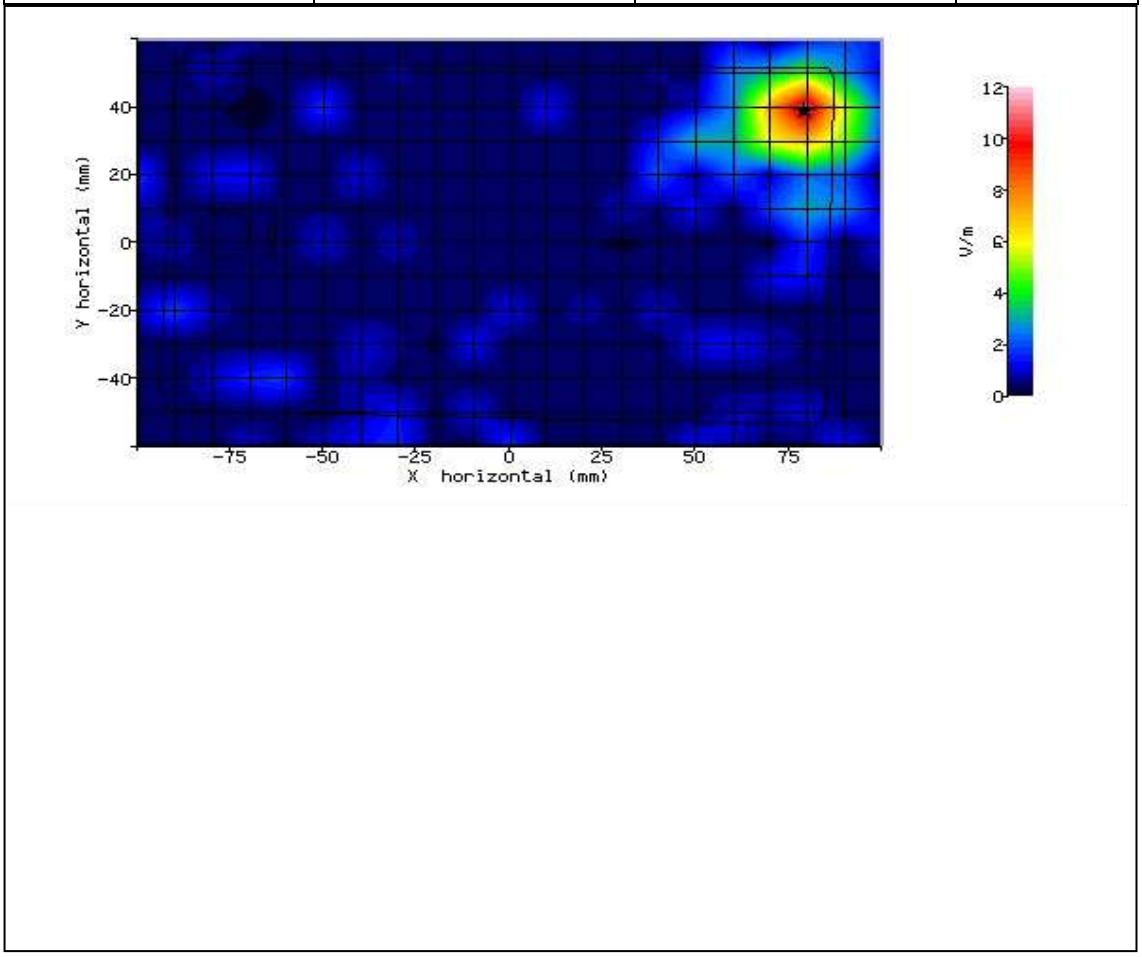


Figure 39: SAR Body Testing Results for the SHT22 Tablet at 5600.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-06:36:41	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.10°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	47.99
RELATIVE HUMIDITY:	30.90%	**CONDUCTIVITY:**	5.488
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.00°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	85.300mm
DUT POSITION:	0mm-RightEdge	**MAX SAR Y-AXIS LOCATION:**	-1.800mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	6.589
TEST FREQUENCY:	5600.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.092 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	0.328 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	0.326 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	-0.600 %

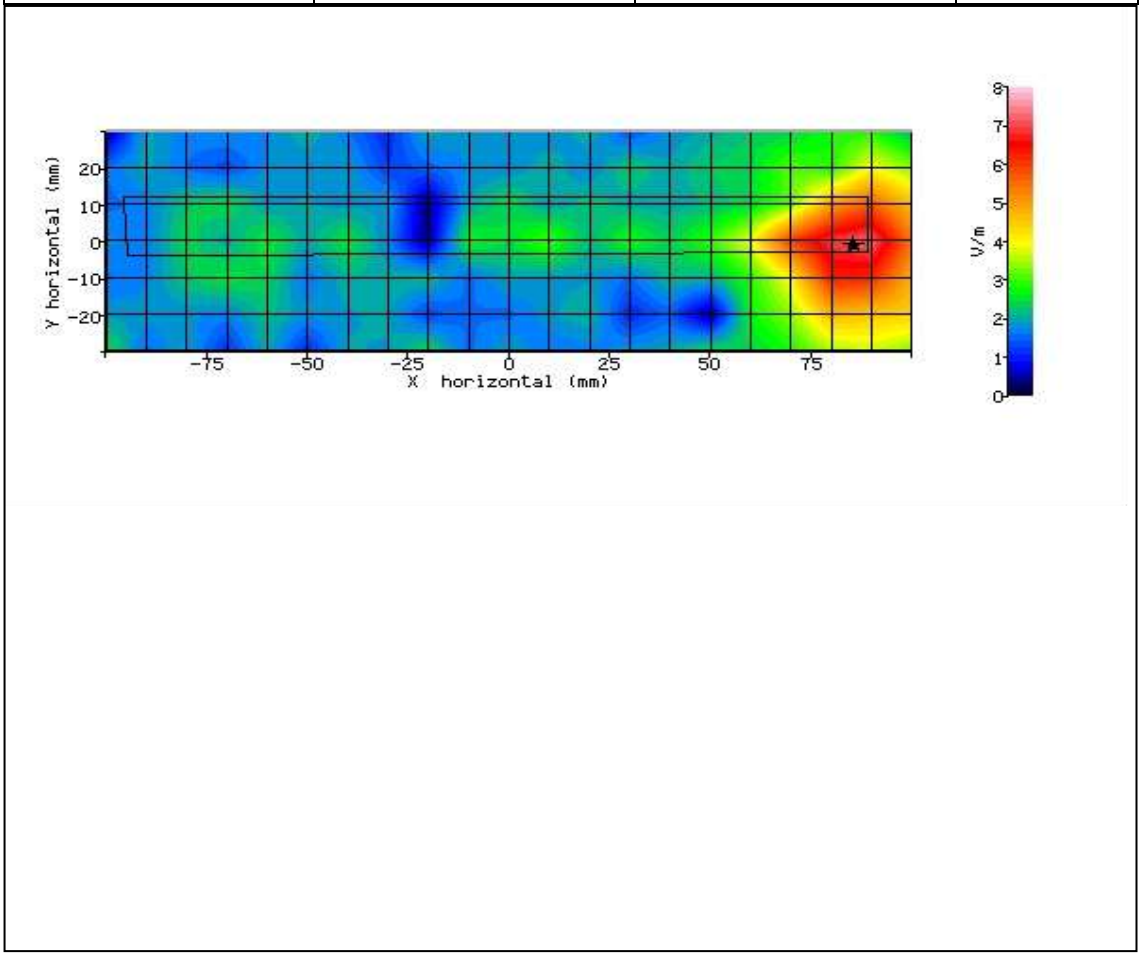


Figure 40: SAR Body Testing Results for the SHT22 Tablet at 5600.0MHz. (NUA)

SYSTEM / SOFTWARE:	SARA-C / v6.08.11	**INPUT POWER DRIFT:**	0 dB
DATE / TIME:	16/01/2014-07:06:25	**DUT BATTERY MODEL/NO:**	N/A
AMBIENT TEMPERATURE:	23.10°C	**LIQUID SIMULANT:**	5000 Body
DEVICE UNDER TEST:	SHT22	**RELATIVE PERMITTIVITY:**	47.99
RELATIVE HUMIDITY:	30.90%	**CONDUCTIVITY:**	5.488
PHANTOM S/NO:	IXB-2HF	**LIQUID TEMPERATURE:**	23.00°C
PHANTOM ROTATION:	N/A	**MAX SAR X-AXIS LOCATION:**	-39.900mm
DUT POSITION:	0mm-Bottom Edge	**MAX SAR Y-AXIS LOCATION:**	-4.800mm
ANTENNA CONFIGURATION:	N/A	**MAX E FIELD:**	12.906
TEST FREQUENCY:	5600.0MHz	**SAR 1g:**	N/A
TYPE OF MODULATION:	OFDM (WLAN)	**SAR 10g:**	0.316 W/kg
MODN. DUTY CYCLE:	100%	**SAR START:**	2.543 W/kg
INPUT POWER LEVEL:	13.5dBm	**SAR END:**	2.542 W/kg
PROBE BATTERY LAST CHANGED:	16/01/2014	**SAR DRIFT DURING SCAN:**	0.000 %

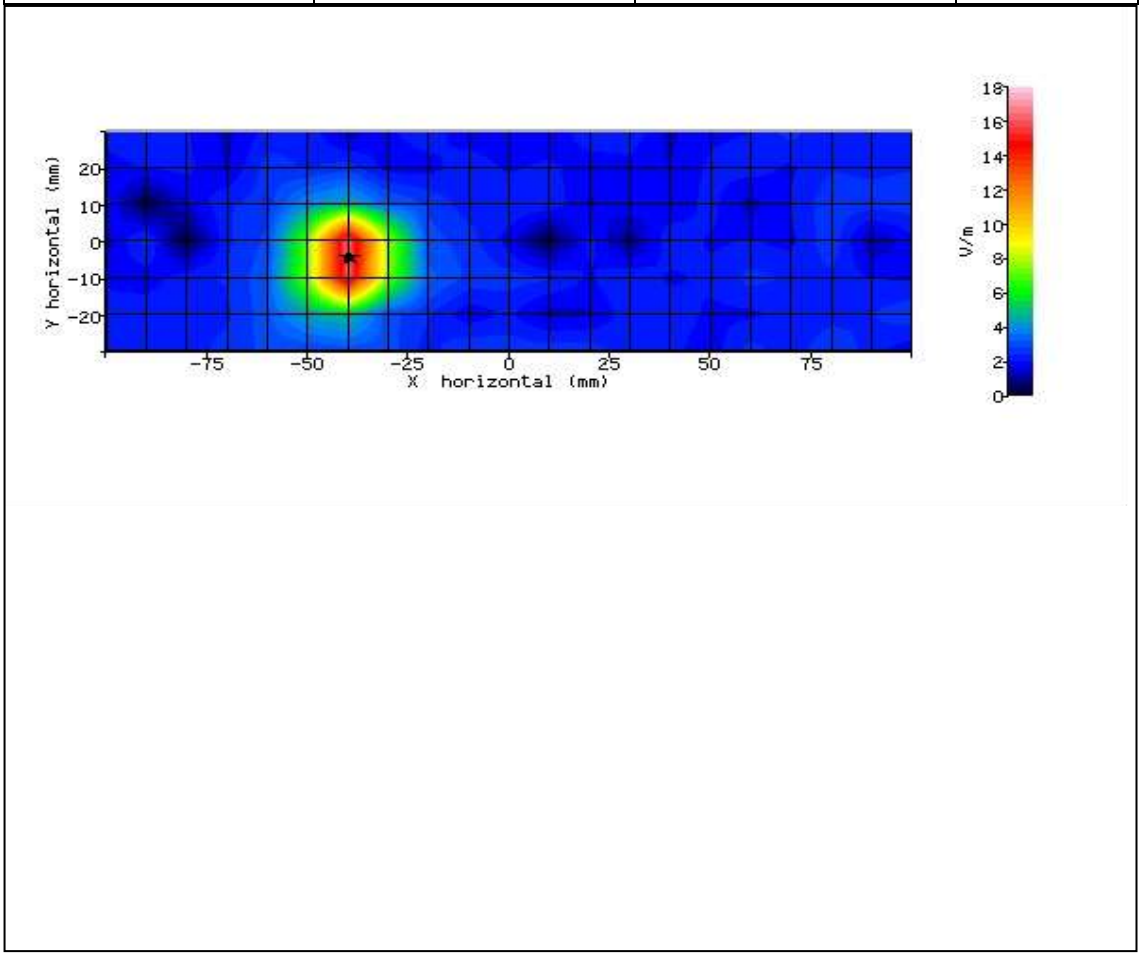


Figure 41: SAR Body Testing Results for the SHT22 Tablet at 5600.0MHz. (NUA)

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
Signal Generator	Hewlett Packard	ESG4000A	38	12	23-May-2014
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	06-Dec-2014
10MHz - 2.5GHz, 3W, Amplifier	Vectawave Technology	VTL5400	51	-	TU
Directional Coupler	Krytar	1850	58	-	TU
Power Sensor	Rohde & Schwarz	NRV-Z1	60	12	14-Jun-2014
Thermometer	Digitron	T208	64	12	16-Jan-2014
Amplifier (5GHz)	IndexSar Ltd	5GHz	157	-	TU
Power Sensor	Rohde & Schwarz	NRV-Z1	178	12	23-May-2014
Communications Tester	Rohde & Schwarz	CMU 200	442	12	08-Nov-2014
Directional Coupler	Hewlett Packard	11692D	452	-	TU
Attenuator (20dB, 10W)	Weinschel	37-20-34	482	12	17-Oct-2014
Attenuator (20dB, 20W)	Narda	766F-20	483	12	13-Jun-2014
Spectrum Analyser	Agilent Technologies	E4407B	1154	12	13-Aug-2014
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	03-Apr-2014
Antenna (Omnidirectional)	Katherin Scala Division	OG-890/1990/DC	2905	-	TU
Antenna (Omnidirectional)	Katherin Scala Division	OG-890/1990/DC	2906	-	TU
Power Meter	Rohde & Schwarz	NRVD	2979	12	25-May-2014
Radio Communications Test Set	Rohde & Schwarz	CMU 200	3035	12	25-Oct-2014
Dual Channel Power Meter	Rohde & Schwarz	NRVD	3259	12	14-Jun-2014
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	01-Feb-2014
Power Sensor	Rohde & Schwarz	NRV-Z1	3563	12	23-May-2014
Meter & T/C	R.S Components	Meter 615-8206 & Type K T/C	3612	12	08-Jul-2014
Part of SARAC System	IndexSar Ltd	Robot Controller	4076	-	TU
Part of SARAC System	IndexSar Ltd	White Benchtop	4080	-	TU
Part of SARAC System	IndexSar Ltd	Wooden Bench	4081	-	TU
Fast Probe Amplifier (3 Channels)	IndexSar Ltd	IXA-020 (5GHz)	4094	-	TU
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	4144	12	17-Jul-2014
Flat Phantom	IndexSar Ltd	IXB-2HF 800-6000MHz	4255	-	TU
Spacer used to raise body phantom	IndexSar Ltd	Body Phantom Spacer	4259	-	TU
hold handsets against SAM Phantom	IndexSar Ltd	Handset Holder	4263	-	TU

Instrument Description	Manufacturer	Model Type	TE Number	Cal Period (months)	Calibration Due Date
hold handsets against SAM Phantom	IndexSar Ltd	Handset Holder	4264	-	TU
Part of SARAC System	IndexSar Ltd	Wooden Bench	4266	-	TU
Part of SARAC System	IndexSar Ltd	Robot Controller	4267	-	TU
Part of SARAC System	IndexSar Ltd	Cartesian Leg Extension	4268	-	TU
Cartesian 4-axis Robot	IndexSar Ltd	SARAC	4269	-	TU
Part of SARAC System	IndexSar Ltd	White Benchtop	4270	-	TU
Digital thermo Hygrometer	Radio Spares	1260	4300	12	22-Mar-2014
SAR 5GHz Di-pole	Speag	D2450GHzV2	3875	-	TU
SAR 5GHz Di-pole	Speag	D5GHzV2	4309	-	TU
Immersible SAR Probe	IndexSar Ltd	IXP-021	4311	24	25-Oct-2014
Immersible SAR Probe	IndexSar Ltd	IPX-020	4317	24	24-Apr-2015
Immersible SAR Probe	IndexSar Ltd	IXP-050	4313	24	07-Mar-2015
Immersible SAR Probe	IndexSar Ltd	IXP-025	4310	24	07-Apr-2014
2450MHz Head Fluid	IndexSar Ltd	Batch 11	N/A	1	31-Jan-2014
2450MHz Head Fluid	IndexSar Ltd	Batch 7	N/A	1	31-Jan-2014
5000MHz Head Fluid	IndexSar Ltd	Batch 4	N/A	1	31-Jan-2014
5000MHz Head Fluid	IndexSar Ltd	Batch 3	N/A	1	31-Jan-2014

TU – Traceability Unscheduled

3.2 TEST SOFTWARE

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

Instrument	Version Number	Date
SARA-C system	v.6.08.11	06 June 2013
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 KDB 865665.

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
2450 MHz Head	39.2	39.30	1.80	1.789
2450MHz Body	52.7	51.26	1.95	1.972
5200MHz Head	36.0	34.92	4.66	4.539
5200MHz Body	49.0	48.95	5.30	5.048
5500MHz Head	35.6	34.09	4.96	4.872
5500MHz Body	48.6	47.99	5.65	5.488

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 23.4°C to 23.5°C.
The actual humidity during the testing ranged from 32.5% to 23.4% RH.

3.4.2 Test Fluid Temperature Range

Frequency	Body / Head Fluid	Min Temperature °C	Max Temperature °C
2450MHz	Head	23.2	23.2
2450MHz	Body	23.1	23.1
5200MHz	Head	22.7	22.7
5200MHz	Body	22.8	22.9
5500MHz	Head	22.8	22.8
5500MHz	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 5.3% (0.950 dB) for head and 9.1% (1.916 dB) for body. 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	5.3	R	1.73	1	3.06	∞
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			10.67	
Expanded uncertainty (95% confidence interval)			K=2			21.34	

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	9.1	R	1.73	1	5.25	∞
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			11.28	
Expanded uncertainty (95% confidence interval)			K=2			23.47	

Product Service

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

Product Service

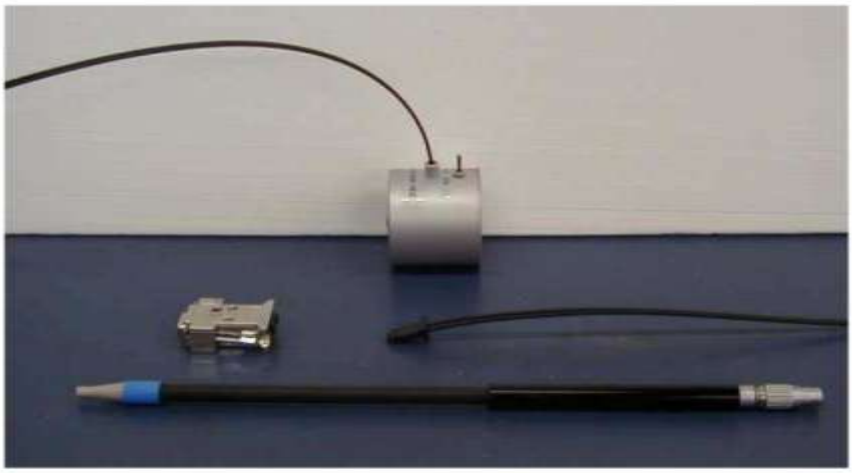
IMMERSIBLE SAR PROBE

CALIBRATION REPORT

Part Number: IXP – 050

S/N 0204

April 2013



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

Product Service

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

Calibration Certificate 1304/0204
Date of Issue: 23rd April 2013
Immersible SAR Probe

Type:	IXP-050
Manufacturer:	IndexSAR, UK
Serial Number:	0204
Place of Calibration:	IndexSAR, UK
Date of Receipt of Probe:	N/A
Calibration Dates:	14th January – 7th March 2013
Customer:	TUV Sud

IndexSAR Ltd hereby declares that the IXP-050 Probe named above has been calibrated for conformity to the current versions of IEEE 1528, IEC 62209-1, IEC 62209-2, and FCC OET65 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:		**Director**

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

Product Service

INTRODUCTION

Straight probes can work on either SARA-C (to measure SAR values in flat phantoms containing Body tissue simulant fluid) or on SARA2 (where they can measure either in a flat phantom with Body fluid, or in a SAM phantom containing Head fluid).

This Report presents measured calibration data for a particular Indexsar SAR probe (S/N 0204) for use on SARA-C only. **The calibration factors do not apply to, and will not give correct readings on, the IndexSAR SARA2 system.**

Indexsar probes are characterised using procedures that, where applicable, follow the recommendations of IEC 62209-1 [Ref 1], IEEE 1528 [Ref 2], IEC 62209-2 [Ref 3] and FCC OET65 [Ref 4] 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 the following stages

1) Determination of the channel sensitivity factors which optimise the probe's overall axial isotropy in 900MHz brain fluid

2) Measure the incidental spherical isotropy using these derived channel sensitivity factors.

3) Since isotropy and channel sensitivity factors are frequency independent, these channel sensitivity factors can be applied to model the exponential decay of SAR in a waveguide fluid cell at each frequency of interest, 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] - [4]. 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.

Product Service

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.

For this value of DCP, the typical linearity response of IXP-050 probes to CW and to GSM modulation is shown in Figure 7, along with departures of this same dataset from linearity.

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

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

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

Within SARA-C, an L-probe's predominant mode of operation is with the tip pointing directly towards the source of radiation. Consequently, optimising the probe's response to boresight signals ("axial isotropy") is far more important than optimising its spherical isotropy (where the direction, as well as the polarisation angle, of the incoming radiation must be taken into account).

The setup for measuring the probe's axial isotropy is shown in **Error! Reference source not found.**. Since isotropy is frequency-independent, measurements are normally made at a frequency of 900MHz as lower frequencies are more tolerant of positional inaccuracies.

A 900MHz waveguide containing head-fluid simulant is selected. Like all waveguides used during probe calibration, this particular waveguide contains two distinct sections: an air-filled launcher section, and a liquid cell section, separated by a dielectric matching window designed to minimise reflections at the air-liquid interface.

The waveguide stands in an upright position and the liquid cell section is filled with 900MHz brain fluid to within 10 mm of the open end. The depth of liquid ensures there is negligible radiation from the waveguide open top and that the probe calibration is not influenced by reflections from nearby objects.

During the measurement, a TE_{21} mode is launched into the waveguide by means of an N-type-to-waveguide adapter. The probe is then lowered vertically into the liquid until the tip is exactly 10mm above the centre of the dielectric window. This particular separation ensures that the probe is operating in a part of the waveguide where boundary corrections are not necessary.

Care must also be taken that the probe tip is centred while rotating.

Product Service

The exact power applied to the input of the waveguide during this stage of the probe calibration is immaterial since only relative values are of interest while the probe rotates. However, the power must be sufficiently above the noise floor and free from drift.

The dedicated Indexsar calibration software rotates the probe in 10 degree steps about its axis, and 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 data have been collected from a full probe rotation, the Air Factors are adjusted using a special Excel Solver routine to equalise the output from each channel and hence minimise the axial isotropy. This automated approach to optimisation removes the effect of human bias.

Figure 2 represents the output from each diode sensor as a function of probe rotation angle.

4. Measurement of Spherical Isotropy

As mentioned earlier, in SARA-C a straight probe is always positioned so as to be end-on to the incoming signal source. The probe's axial isotropy response is therefore far more important than its spherical isotropy, which is included here for completeness only.

The setup for assessing the probe's spherical isotropy is shown in Figure 1.

A box phantom containing 900MHz head fluid is irradiated by a tuned dipole, mounted to the side of the phantom on the SARA2 robot's seventh axis. During calibration, the spherical response is generated by rotating the probe about its axis in 15 degree steps and changing the dipole polarisation in 10 degree steps.

The relative channel sensitivities are fixed by the earlier measurement of, and optimisation for, axial isotropy. The effect on spherical isotropy is shown in Figure 3.

5. 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 height above 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

Product Service

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.

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

Different waveguides are used for 700MHz, 835/900MHz, 1450MHz, 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.

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.

During calibration, the probe is lowered carefully until it 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 vertically

Product Service

upwards. This cycle is repeated 150 times. The vertical 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.

For calibrations at 450MHz, where waveguide calibrations become unfeasible, a full 3D SAR scan over a tuned dipole is performed, and the conversion factor adjusted to make the measured 1g and 10g volume-averaged SAR values agree with published targets.

CALIBRATION FACTORS MEASURED FOR PROBE S/N 0204

The probe was calibrated at 450, 835, 900, 1800, 2100, 2450 and 2600MHz in liquid samples representing brain and body liquid at these frequencies.

The calibration was for CW signals only, 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 axial isotropy of the probe was measured by rotating the probe about its axis in 10 degree steps through 360 degrees in this orientation.

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 8).

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 20 indicates the calibration status of all test equipment used during probe calibration.

Product Service

MEASUREMENT UNCERTAINTIES

A complete measurement uncertainty analysis for the SARA-C measurement system has been published in Reference [6]. 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%

Product Service

SUMMARY OF CAL FACTORS FOR PROBE IXP-020 S/N 0204

	Relative Channel Sensitivities (to optimise Axial Isotropy)			
	X	Y	Z	
Air Factors	91.78	66.90	81.32	$(V/m)^2/mV$
DCPs	100	100	100	mV

Measured Isotropy	(+/-) dB
Axial Isotropy	0.02
Spherical Isotropy	0.66

Additional Information	
Sensor offset (mm)	2.7
Elbow – Tip dimension (mm)	0.0

Product Service

SAR Conversion Factors/ Boundary Corrections							
	Head Fluid			Body Fluid			
Frequency* (MHz)	SAR Conv Factor	Boundary Correction f(0)	Boundary Correction d(mm)	SAR Conv Factor	Boundary Correction f(0)	Boundary Correction d(mm)	Notes
450	0.317	0	1	0.317	0	1	3
700	-	-	-	-	-	-	-
835	0.310	1.69	1.08	0.327	0.59	1.91	1,2
900	0.313	0.80	1.52	0.327	1.17	1.31	1,2
1450	-	-	-	-	-	-	-
1800	0.357	0.77	1.68	0.381	0.64	2.07	1,2
1900	0.366	0.71	1.83	0.388	0.64	2.12	1,2
2100	0.397	0.70	1.96	0.413	0.78	1.86	1,2
2450	0.397	1.09	1.44	0.440	1.09	1.51	1,2
2600	0.394	1.26	1.35	0.449	1.17	1.46	1,2
Notes							
1)	Calibrations done at 22°C +/-2°C						
2)	Waveguide calibration						
3)	By validation						

The valid frequency of SARA-C probe calibrations are ±100MHz (F<300MHz) and ±200MHz (F>300MHz)

Page 10 of 23

Product Service

PROBE SPECIFICATIONS

Indexsar probe 0204, 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 0204	BSEN [1]	IEEE [2]
Overall length (mm)	350		
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		

Typical Dynamic range	S/N 0204	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 0204	BSEN [1]	IEEE [2]
Axial rotation with probe normal to source (+/- dB)	0.02	0.5	0.25
Spherical isotropy covering all orientations to source (+/- dB)	0.66	N/A	N/A

NB Isotropy is frequency independent

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. No adhesives are used in the immersed section. Outer case materials are PEEK and heat-shrink sleeving.
Chemical resistance	Tested to be resistant to TWEEN20 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

References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

For a specific reference, subsequent revisions do not apply.

For a non-specific reference, the latest version applies.

[1] IEC 62209-1.
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
Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

[3] IEC 62209-2
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)

[4] FCC OET65
Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

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

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

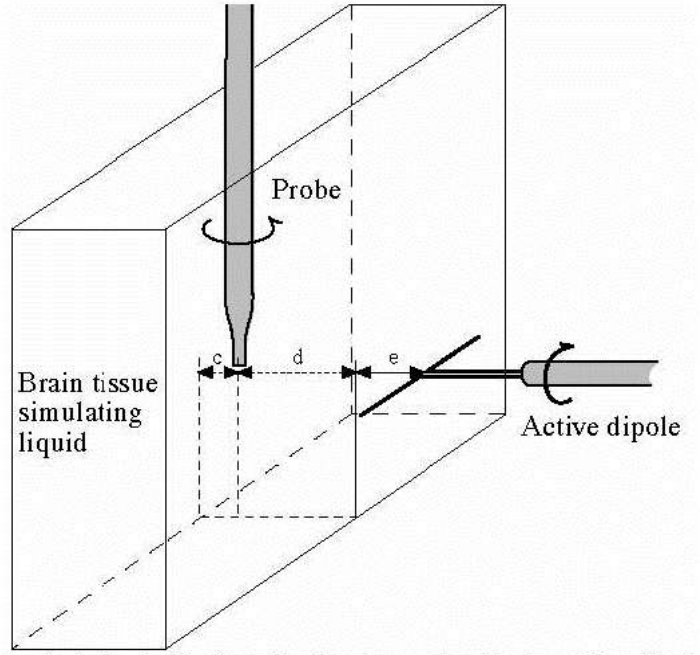


Figure 1. Spherical isotropy jig showing probe, dipole and box filled with simulated brain liquid (see Ref [2], Section A.5.2.1)

Product Service

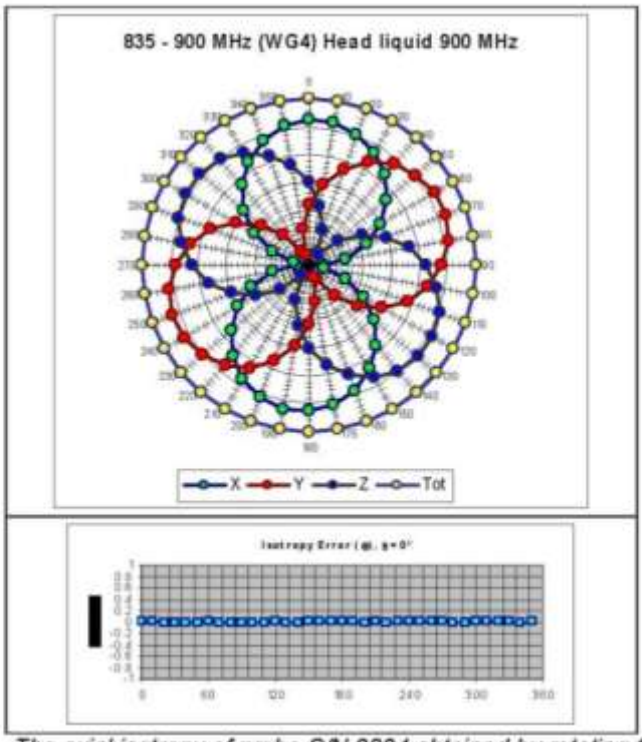


Figure 2. The axial isotropy of probe S/N 0204 obtained by rotating the probe in a liquid-filled waveguide at 900 MHz. (NB Axial Isotropy is frequency independent)

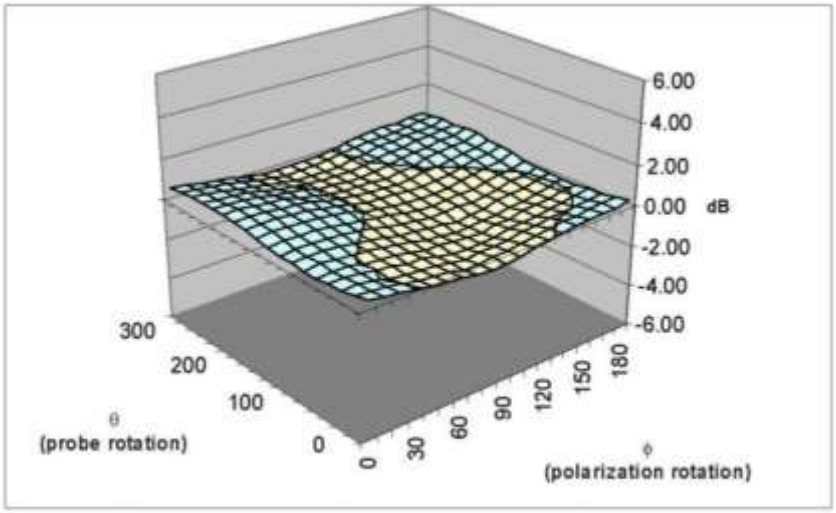


Figure 3 Spherical isotropy diagram after optimisation of relative channel sensitivities for axial isotropy

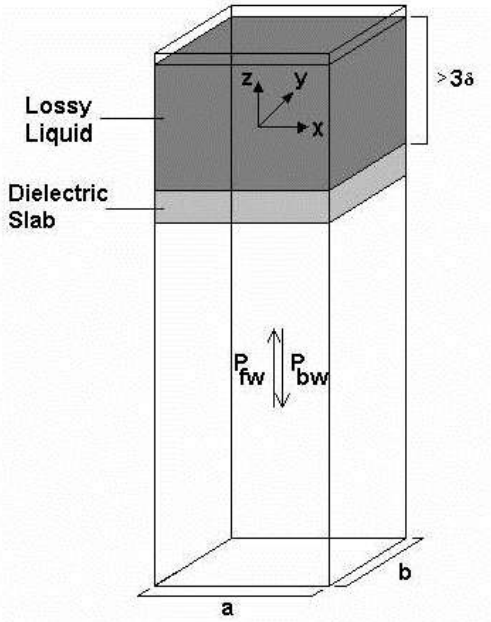


Figure 4. Geometry used for waveguide calibration (after Ref [2]. Section A.3.2.2)

Product Service

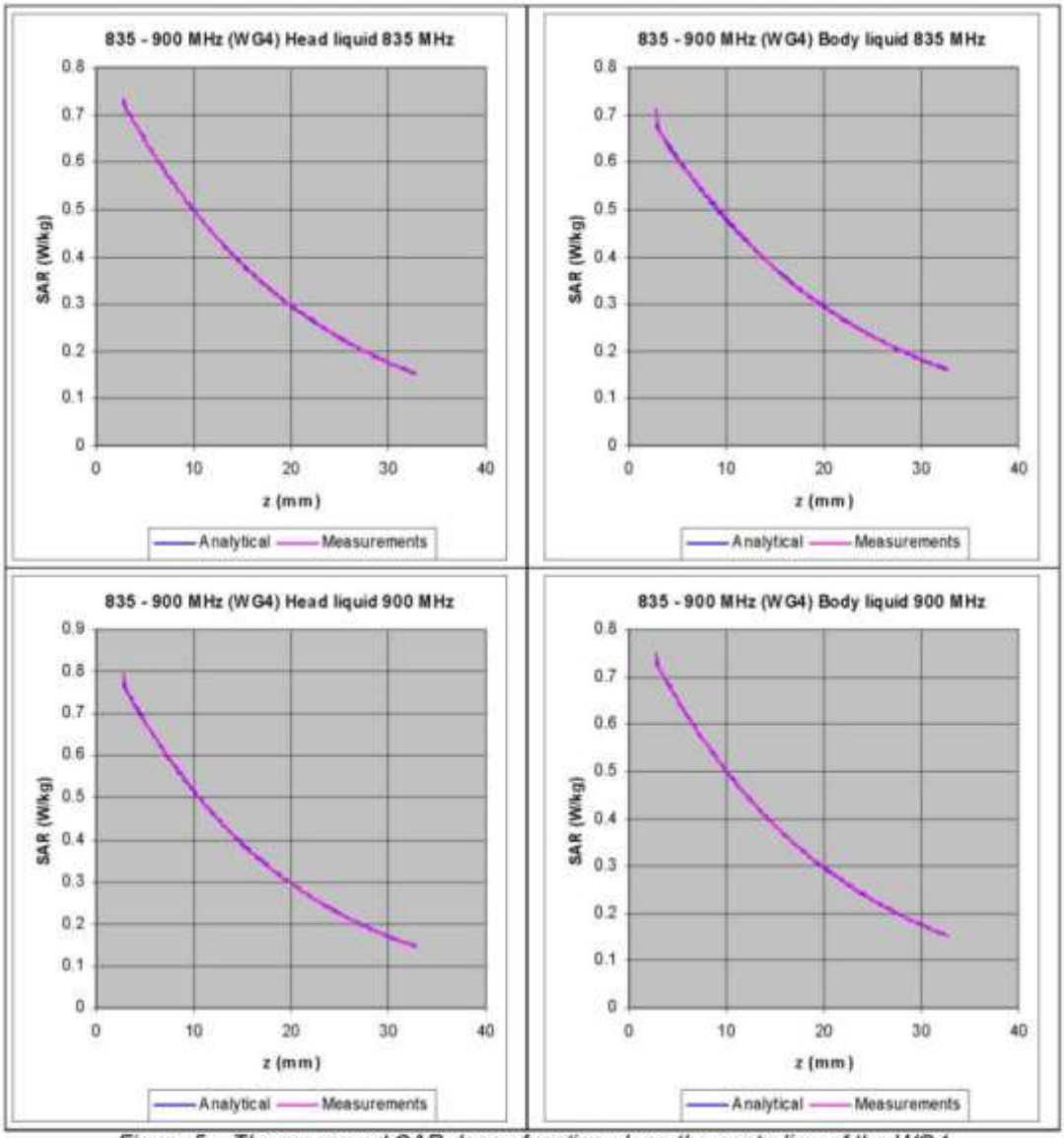
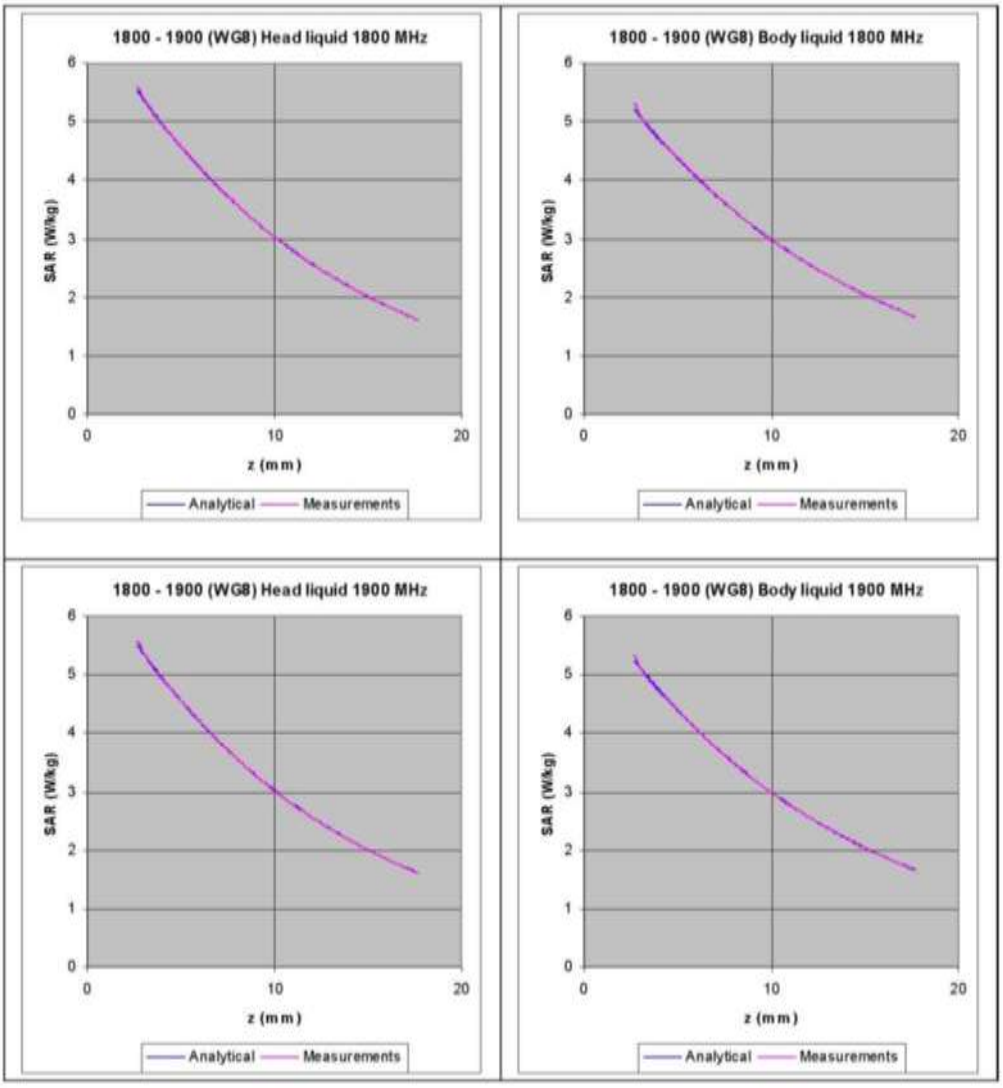
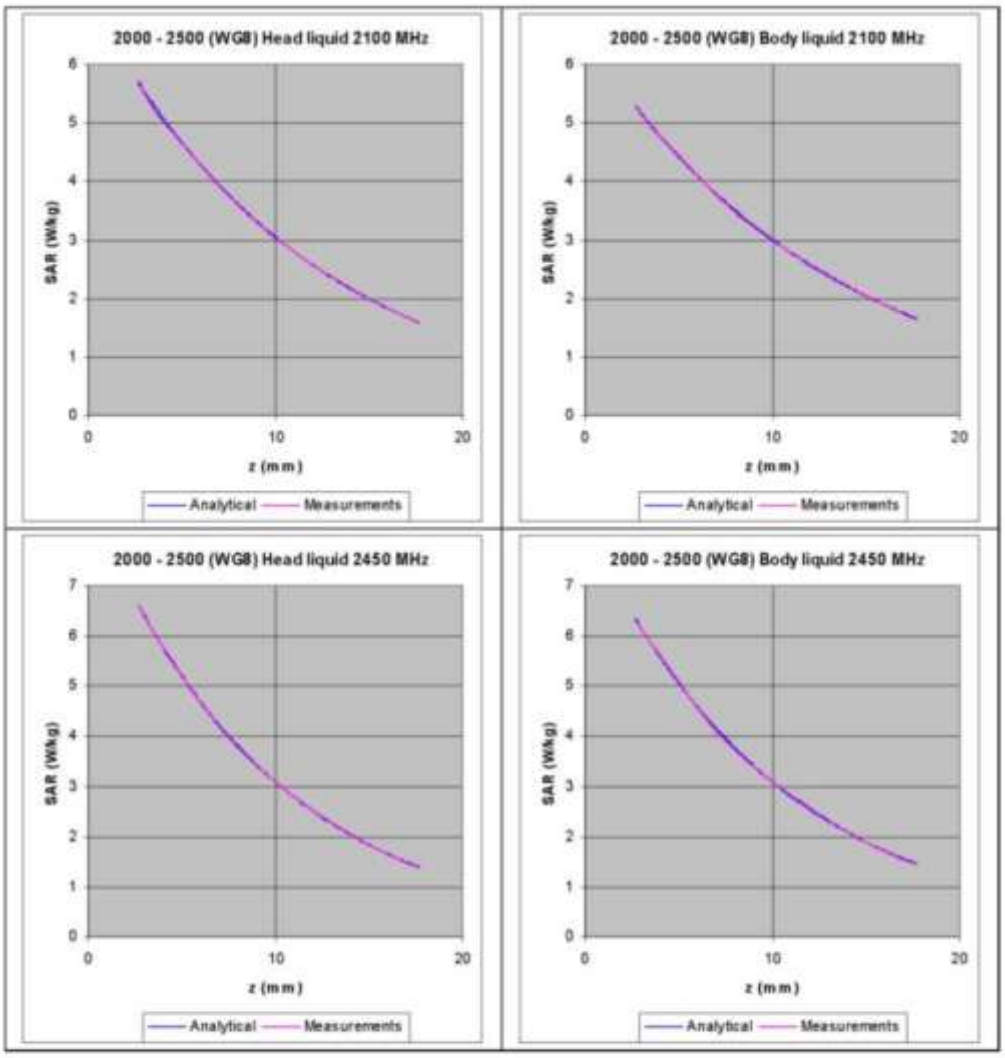


Figure 5 . The measured SAR decay function along the centreline of the WG4 waveguide with conversion factors adjusted to fit to the theoretical function for the particular dimension, frequency, power and liquid properties employed.

Product Service



Product Service



Product Service

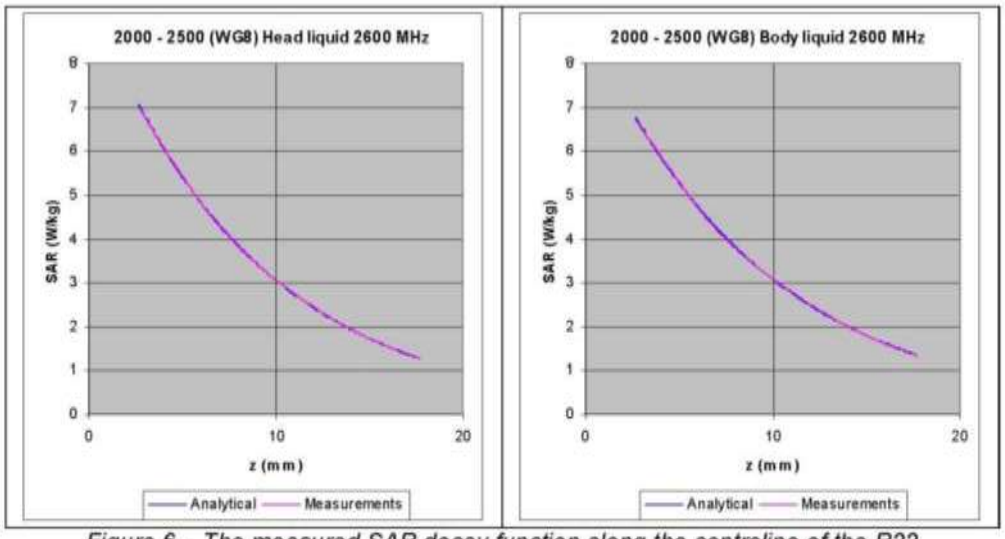


Figure 6 . The measured SAR decay function along the centreline of the R22 waveguide with conversion factors adjusted to fit to the theoretical function for the particular dimension, frequency, power and liquid properties employed.

Product Service

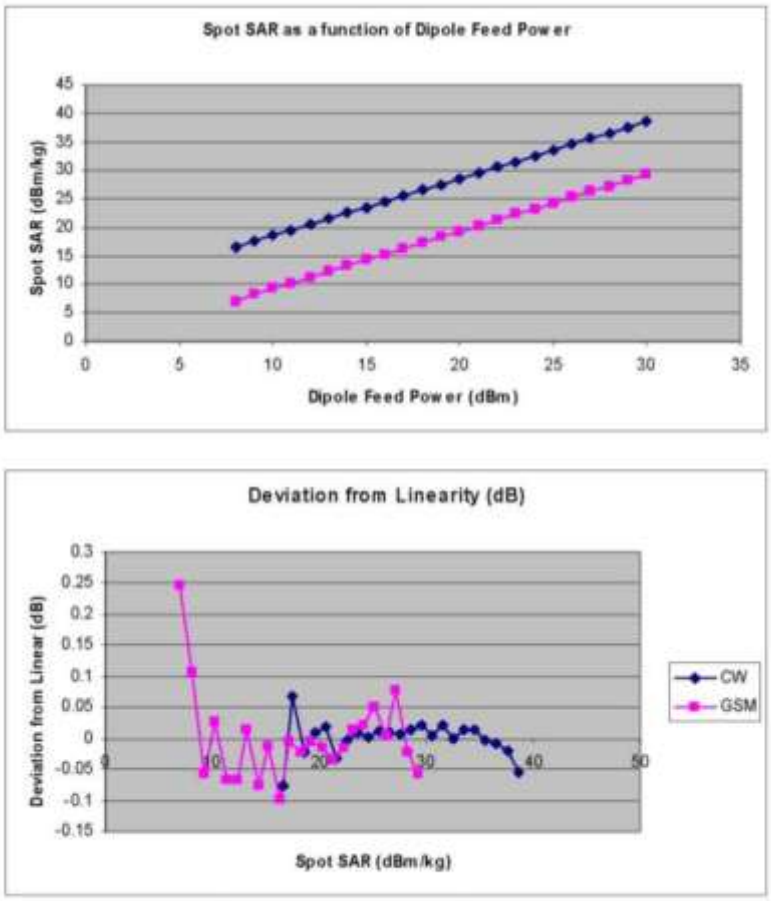


Figure 7 : The typical linearity response of IXP-050 probes to both CW (blue) and GSM (pink) modulation in close proximity to a source dipole. The top diagram shows the SAR reading as a function of dipole feed power, with GSM modulation being approx a factor of 8 (ie 9dB) lower than CW. The lower diagram shows the departure from linearity of the same two datasets.

Product Service

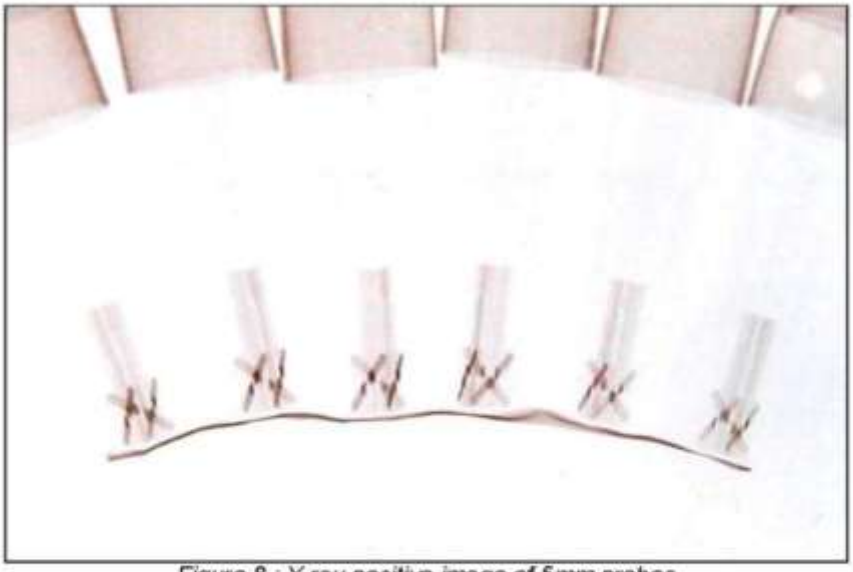


Figure 8 : X-ray positive image of 5mm probes

Product Service

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

Frequency (MHz)	Fluid Type	Relative Permittivity	Conductivity (S/m)	Relative Permittivity	Conductivity (S/m)	Relative Permittivity	Conductivity	Relative Permittivity	Conductivity
450	Head	44.33	0.835	43.5	0.87	1.9	-4.0	Pass	Pass
835		42.25	0.900	41.5	0.90	1.8	0.0	Pass	Pass
900		41.46	0.962	41.5	0.97	-0.1	-0.8	Pass	Pass
1800		39.92	1.396	40.0	1.40	-0.2	-0.4	Pass	Pass
1900		39.67	1.400	40.0	1.40	-0.8	0.0	Pass	Pass
2100		40.96	1.500	39.8	1.49	2.9	0.7	Pass	Pass
2450		39.81	1.821	39.2	1.80	1.6	1.2	Pass	Pass
2600		39.30	1.971	39.0	1.96	0.8	0.6	Pass	Pass
450	Body	57.53	0.902	56.7	0.94	1.5	-3.7	Pass	Pass
835		55.14	0.958	55.2	0.97	-0.1	-1.2	Pass	Pass
900		54.53	1.023	55	1.05	-0.9	-2.6	Pass	Pass
1800		53.07	1.521	53.3	1.52	-0.4	0.1	Pass	Pass
1900		52.85	1.533	53.3	1.52	-0.8	0.9	Pass	Pass
2100		53.92	1.568	53.2	1.62	1.4	-3.2	Pass	Pass
2450		52.90	1.957	52.7	1.95	0.4	0.4	Pass	Pass
2600		52.47	2.132	52.5	2.16	-0.1	-1.3	Pass	Pass

Product Service

IMMERSIBLE SAR PROBE

CALIBRATION REPORT

Part Number: IXP–020

S/N L0006

April 2013

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

Product Service

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

Calibration Certificate 1304/L0006
Date of Issue: 24 April 2013
Immersible SAR Probe

Type:	IXP-020
Manufacturer:	IndexSAR, UK
Serial Number:	L0006
Place of Calibration:	IndexSAR, UK
Date of Receipt of Probe:	N/A
Calibration Dates:	15 March – 23 April 2013
Customer:	TUV Sud

IndexSAR Ltd hereby declares that the IXP-050 Probe named above has been calibrated for conformity to the current versions of IEEE 1528, IEC 62209-1, IEC 62209-2, and FCC OET65 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:		**Director**

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

Product Service

INTRODUCTION

L-shaped probes are designed solely for use on the SARA-C SAR-measuring system. They are not designed to work on SARA2.

This Report presents measured calibration data for a particular Indexsar SAR probe (S/N L0006) only and describes the procedures used for characterisation and calibration.

Indexsar probes are characterised using procedures that, where applicable, follow the recommendations of IEC 62209-1 [Ref 1], IEEE 1528 [Ref 2], IEC 62209-2 [Ref 3] and FCC OET65 [Ref 4] 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 the following stages:-

1) Determination of the relative channel sensitivity factors which optimise the probe's overall axial isotropy in 900MHz brain fluid.

2) Measure the incidental spherical isotropy using these derived channel sensitivity factors.

3) Since isotropy and channel sensitivity factors are frequency independent, these channel sensitivity factors can be applied to model the exponential decay of SAR in a waveguide fluid cell at each frequency of interest, 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] - [4]. 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

Product Service

characteristic of the Schottky diodes used as the sensors. For the IXP-020 probes with CW signals the DCP values are typically 100mV.

For this value of DCP, the typical linearity response of IXP-050 probes to CW and to GSM modulation is shown in Figure 7, along with departures of this same dataset from linearity.

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

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

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

Within SARA-C, an L-probe's predominant mode of operation is with the tip pointing directly towards the source of radiation. Consequently, optimising the probe's response to boresight signals ("axial isotropy") is far more important than optimising its spherical isotropy (where the direction, as well as the polarisation angle, of the incoming radiation must be taken into account).

The setup for measuring the probe's axial isotropy is shown in Figure 1, and this allows spherical isotropy to be measured at the same time. Moreover, since isotropy is frequency-independent, measurements are normally made at a frequency of 900MHz as lower frequencies are more tolerant of positional inaccuracies.

A box phantom containing 900MHz head fluid is irradiated by a tuned dipole, mounted at the side of the phantom on the SARA2 robot's seventh axis. Note: although the probe is used on SARA-C, it is actually calibrated on SARA2. 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 isotropy response is measured by changing the orientation of the probe sensors with respect to the dipole, while keeping the long shaft of the probe vertical and the probe sensors at precisely the same position in space. Correctly aligning the probe sensors in this way is essential to an accurate measurement of isotropy.

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

Product Service

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).

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

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^{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 2). 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.

During calibration, the probe tip is moved carefully towards the dielectric window until the flat face of the tip is just touching the exact centre of the face. 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 at each separation. 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.

Product Service

Different waveguides are used for 700MHz, 835/900MHz, 1450MHz, 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.

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.

For calibrations at 450MHz, where waveguide calibrations become unfeasible, a full 3D SAR scan over a tuned dipole is performed, and the conversion factor adjusted to make the measured 1g and 10g volume-averaged SAR values agree with published targets.

CALIBRATION FACTORS MEASURED FOR PROBE S/N L0006

The probe was calibrated at 450, 835, 900, 1800, 1900, 2100, 2450 and 2600 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.

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 21 indicates the calibration status of all test equipment used during probe calibration.