



Audix Technology Corporation

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Statement of Due Date for Dipole Calibration

We have defined that the calibration interval of following dipole which use for SAR system is 3 years.

SPEAG	D1750V2	1065
SPEAG	D900V2	1d133
SPEAG	D750V3	1056
SPEAG	D835V2	4d136
SPEAG	D1900V2	5d156
SPEAG	D2000V2	1061
SPEAG	D2450V2	888
SPEAG	D2600V2	1048
SPEAG	D5GHzV2	1124
SPEAG	CD2450V3	1161
SPEAG	CD1880V3	1173
SPEAG	CD835V3	1187

Please note that the Cal Interval may be other than 1 year, e.g. 2 years or 3 years.

Also we have determined that the original calibration result of these instruments are not significantly affected before the first-time use of them, when they are stored in good condition.

According to the above reasons, the dipole calibration Due Date described as below:

Example:

Date tested at SPEAG: May 9, 2012

Example Calibration Interval: 3 Years

First-Time Use of Instrument: September 13, 2012

First-Time Use + Selected Interval = Date for Next Calibration

September 13, 2012 + 3 Years = September 12, 2015

Leon Liu / Quality Manager

Dipole Verified Data

Model Name: D2450V2

SN:888

Pursuant to KDB 865664 D01 V01r01 section 3.2.2 that the reference dipole calibration can be extended to 3 years if Lab. does a confirmation on return loss and impedance annually, and compliance with following conditions,

1. Return loss deviates by less than 20% from the previous measurement and have 20 dB minimum return-loss requirement
2. The real or imaginary parts of the impedance, measured at least annually, deviates by less than 5 Ω from the previous measurement.

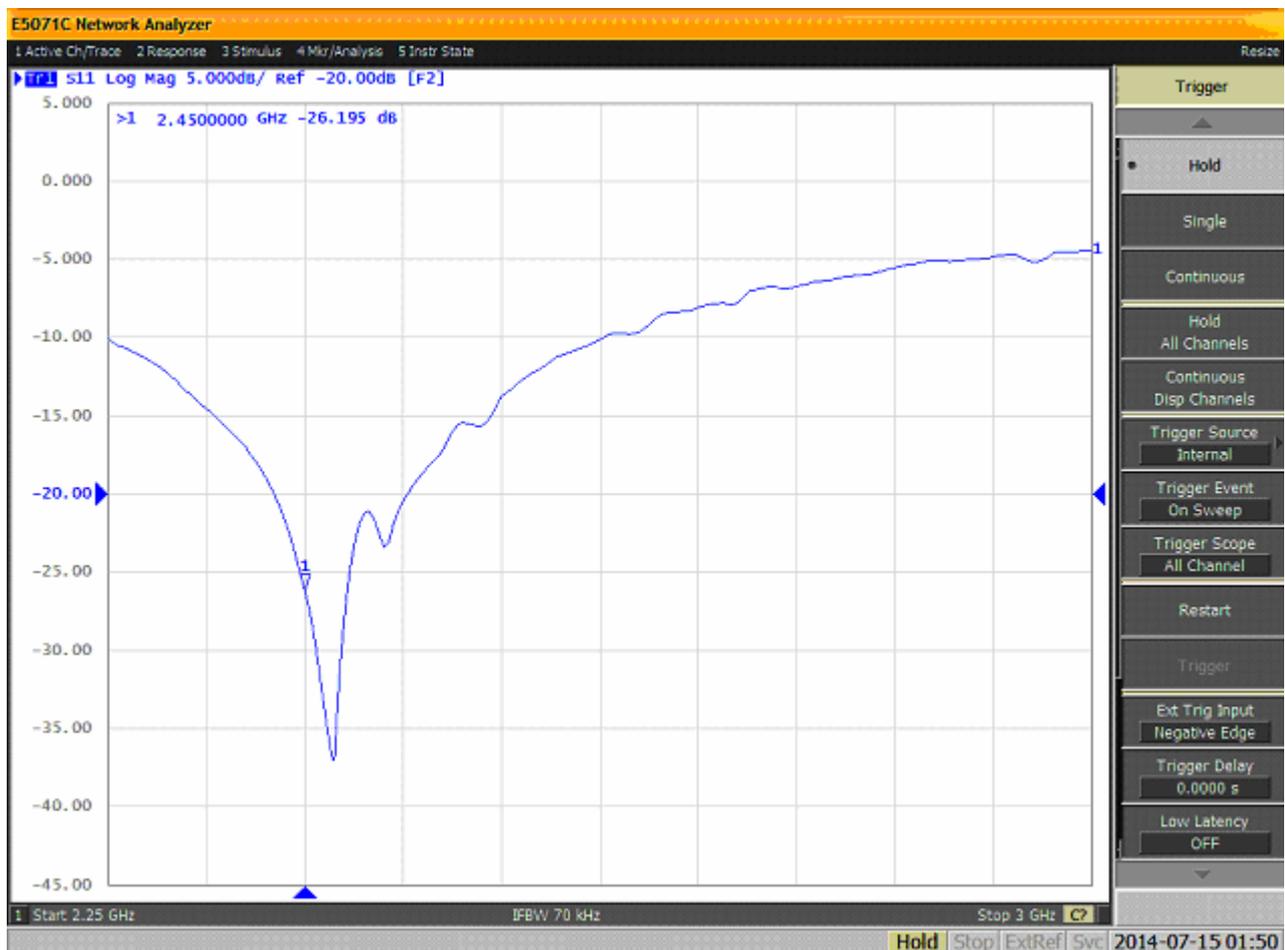
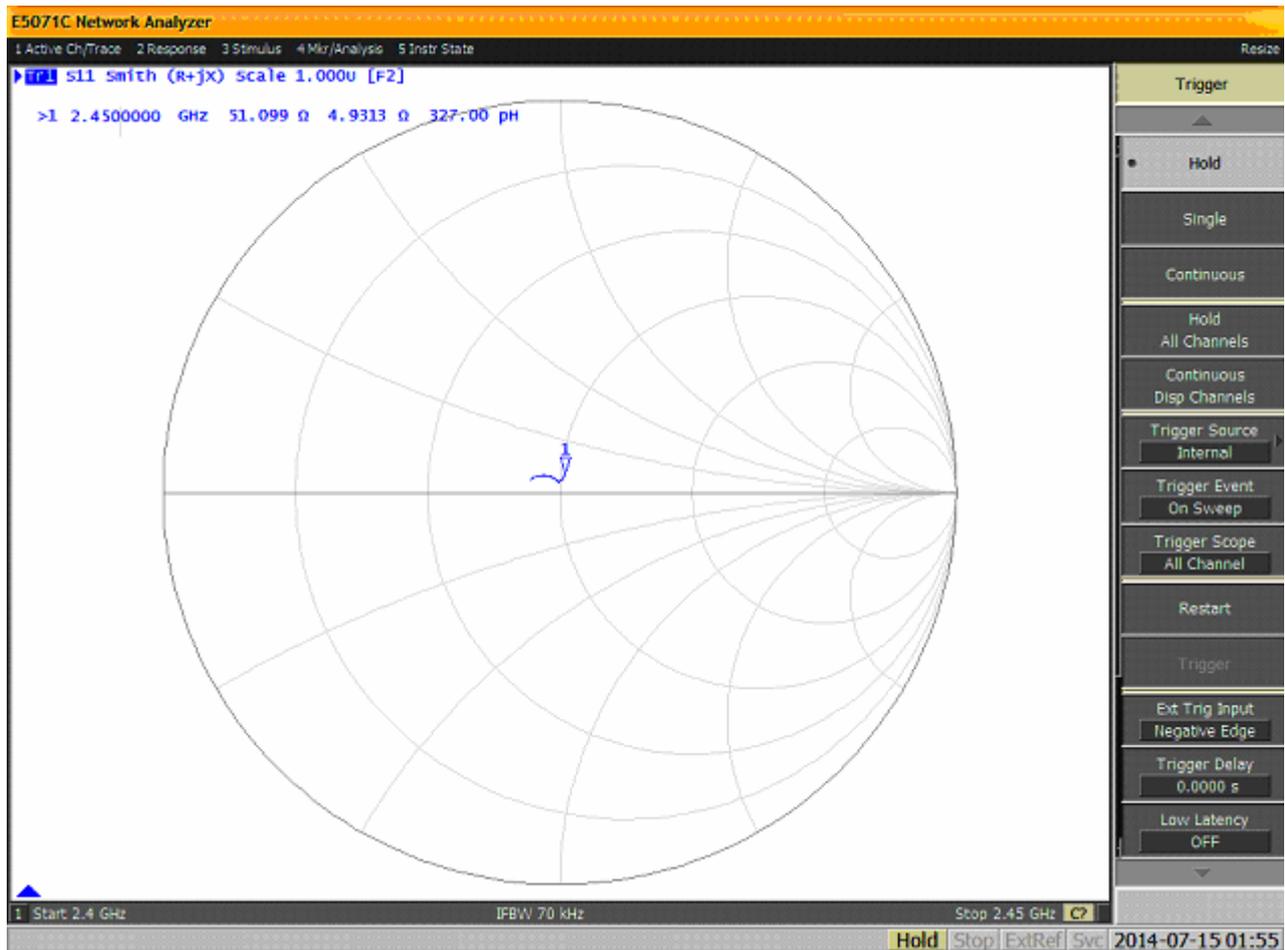
Antenna Parameters with Head Tissue

Item	Verified on 7/15, 2014	Original Cal. Result	Deviation
Impedance, transformed to feed point	51.099 +4.93j	53.8 +3.3j	< 5
Return Loss	-26.19 dB	-26.3 dB	0.42%

Antenna Parameters with Body Tissue

Item	Verified on 7/15, 2014	Original Cal. Result	Deviation
Impedance, transformed to feed point	49.527 +3.87j	50.2 +4.7j	< 5
Return Loss	-23.31 dB	-26.6 dB	12.37%

Plot for Antenna Parameters with Head Tissue



Plot for Antenna Parameters with Body Tissue

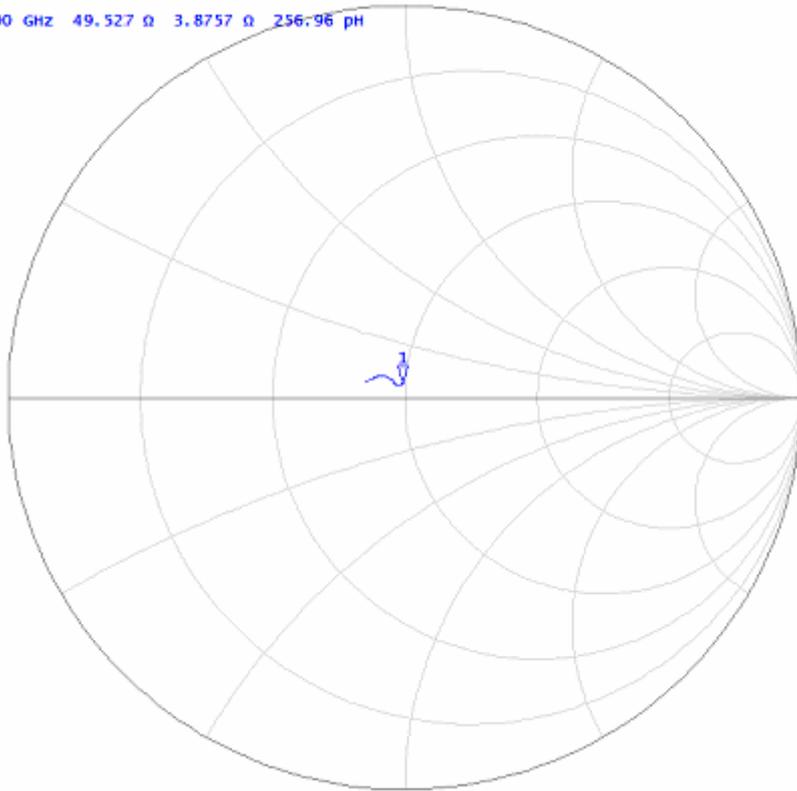
E5071C Network Analyzer

1 Active Ch/Trace 2 Response 3 Stimulus 4 Mix/Analysis 5 Instr State

Resize

▶ [F2] S11 Smith (R+jX) scale 1.000u [F2]

>1 2.4500000 GHz 49.527 Ω 3.8757 Ω 256.96 pF



Start 2.4 GHz

IFBW 70 kHz

Stop 2.45 GHz

Hold Stop ExtRef Svc 2014-07-15 23:36

Trigger

- Hold
- Single
- Continuous
- Hold All Channels
- Continuous Disp Channels
- Trigger Source Internal
- Trigger Event On Sweep
- Trigger Scope All Channel
- Restart
- Trigger
- Ext Trig Input Negative Edge
- Trigger Delay 0.0000 s
- Low Latency OFF

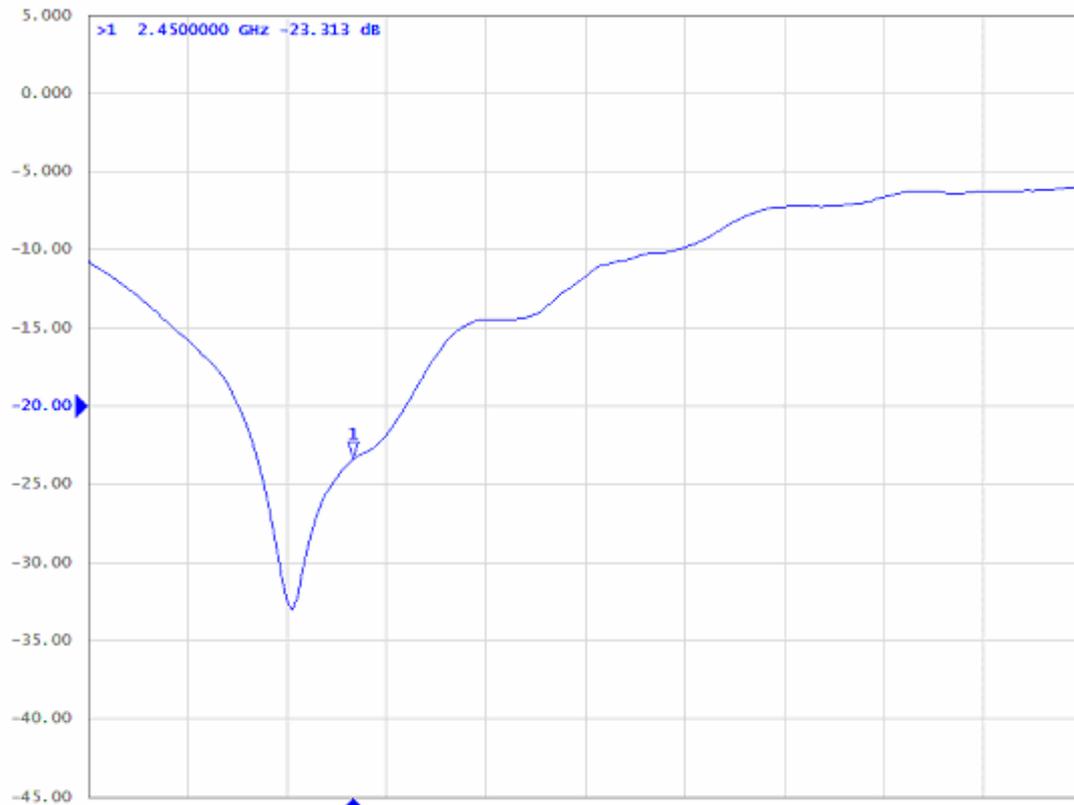
E5071C Network Analyzer

1 Active Ch/Trace 2 Response 3 Stimulus 4 Mix/Analysis 5 Instr State

Resize

▶ [F2] S11 Log Mag 5.000dB/ Ref -20.00dB [F2]

>1 2.4500000 GHz -23.313 dB



Start 2.25 GHz

IFBW 70 kHz

Stop 3 GHz

Meas Stop ExtRef Svc 2014-07-15 07:15

System

- Print
- Abort Printing
- Printer Setup...
- Invert Image ON
- Dump Screen Image...
- Multipoint Test Set Setup
- Misc Setup
- Backlight ON
- Firmware Revision
- Service Menu
- Help
- Return

Dipole Verified Data

Model Name: D2450V2

SN:888

Pursuant to KDB 865664 D01 V01r01 section 3.2.2 that the reference dipole calibration can be extended to 3 years if Lab. does a confirmation on return loss and impedance annually, and compliance with following conditions,

1. Return loss deviates by less than 20% from the previous measurement and have 20 dB minimum return-loss requirement
2. The real or imaginary parts of the impedance, measured at least annually, deviates by less than 5 Ω from the previous measurement.

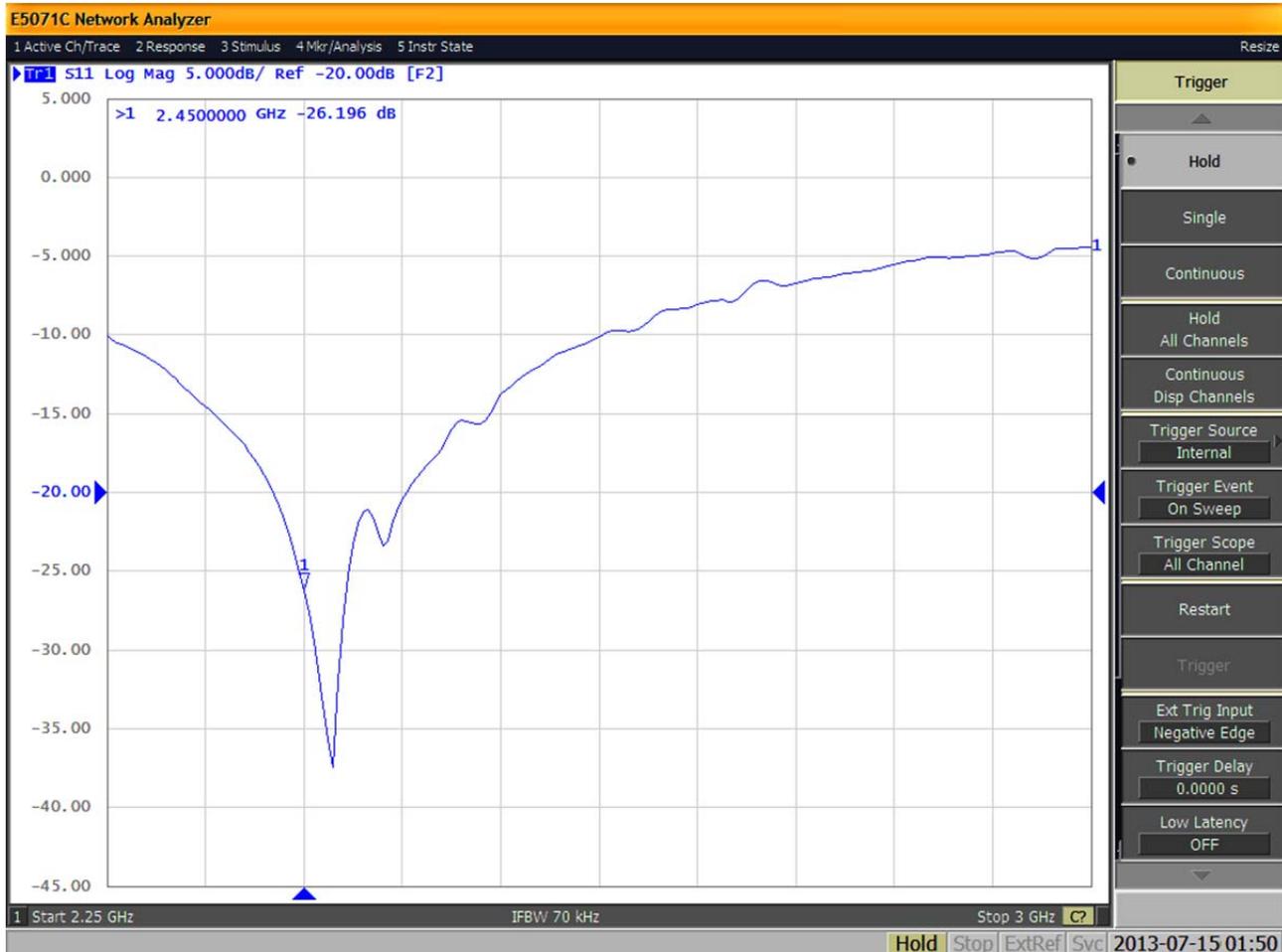
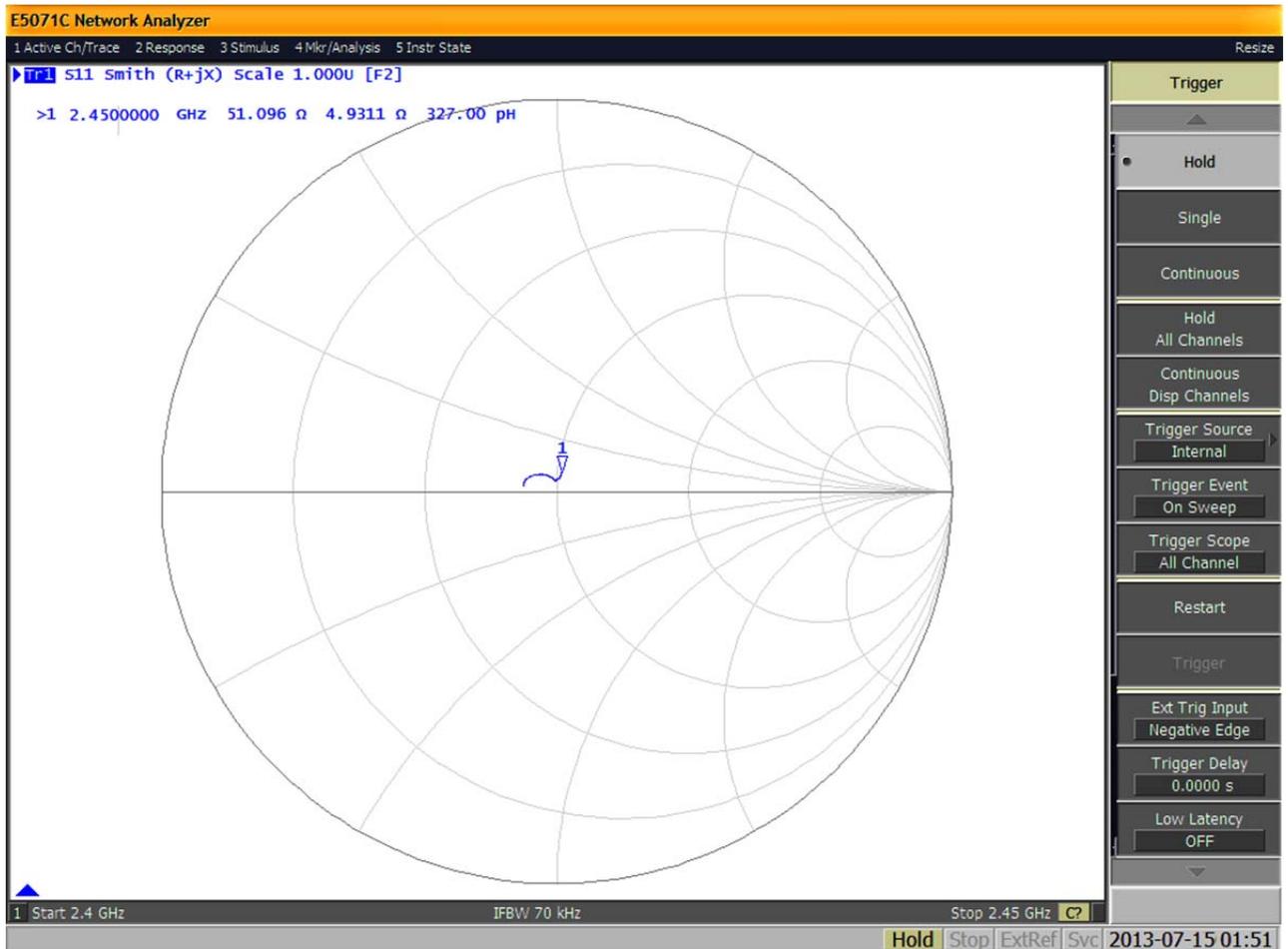
Antenna Parameters with Head Tissue

Item	Verified on 7/15, 2013	Original Cal. Result	Deviation
Impedance, transformed to feed point	51.096 Ω +4.93j Ω	53.8 Ω +3.3j Ω	< 5 Ω
Return Loss	-26.196 dB	-26.3 dB	0.39%

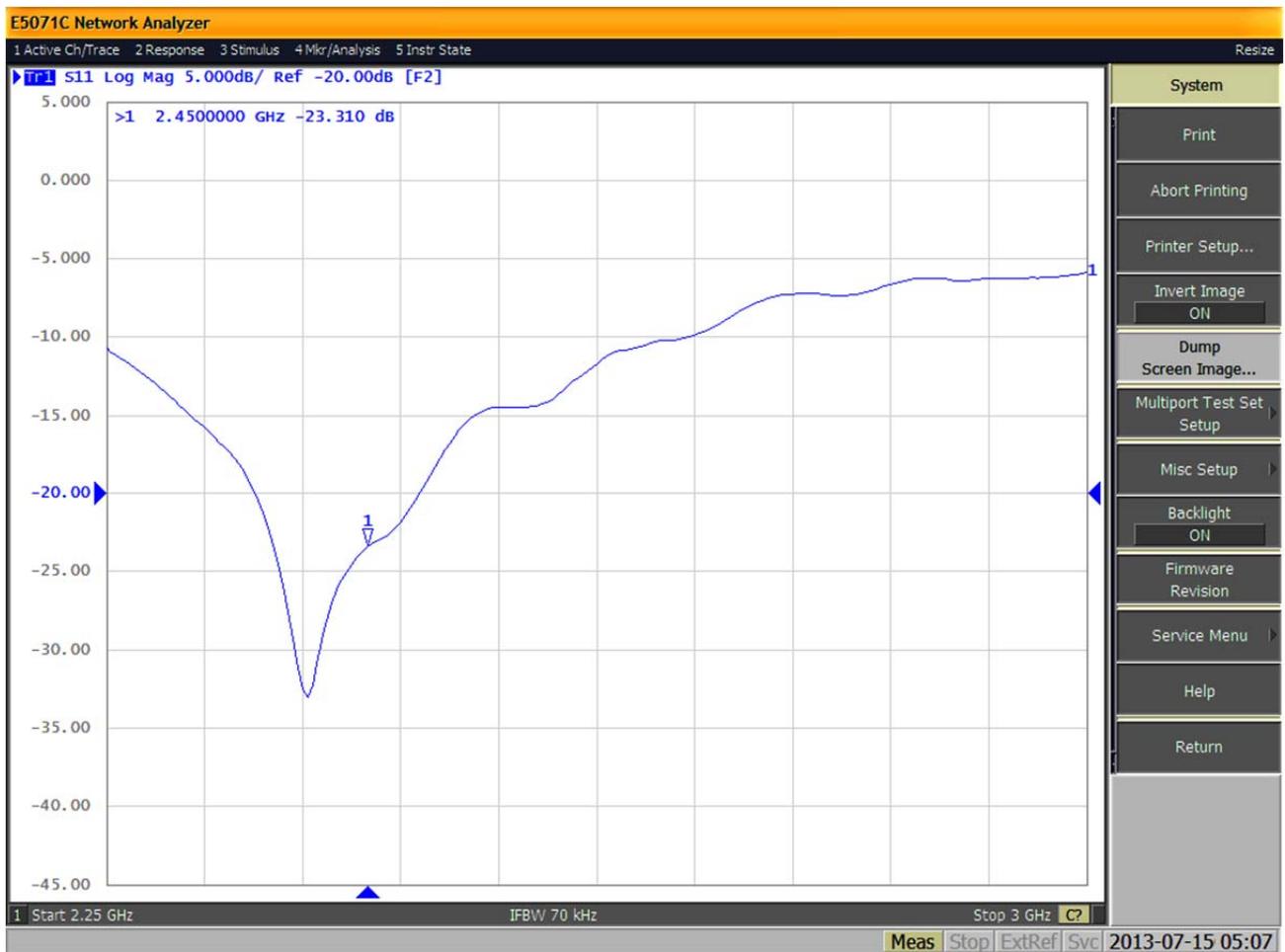
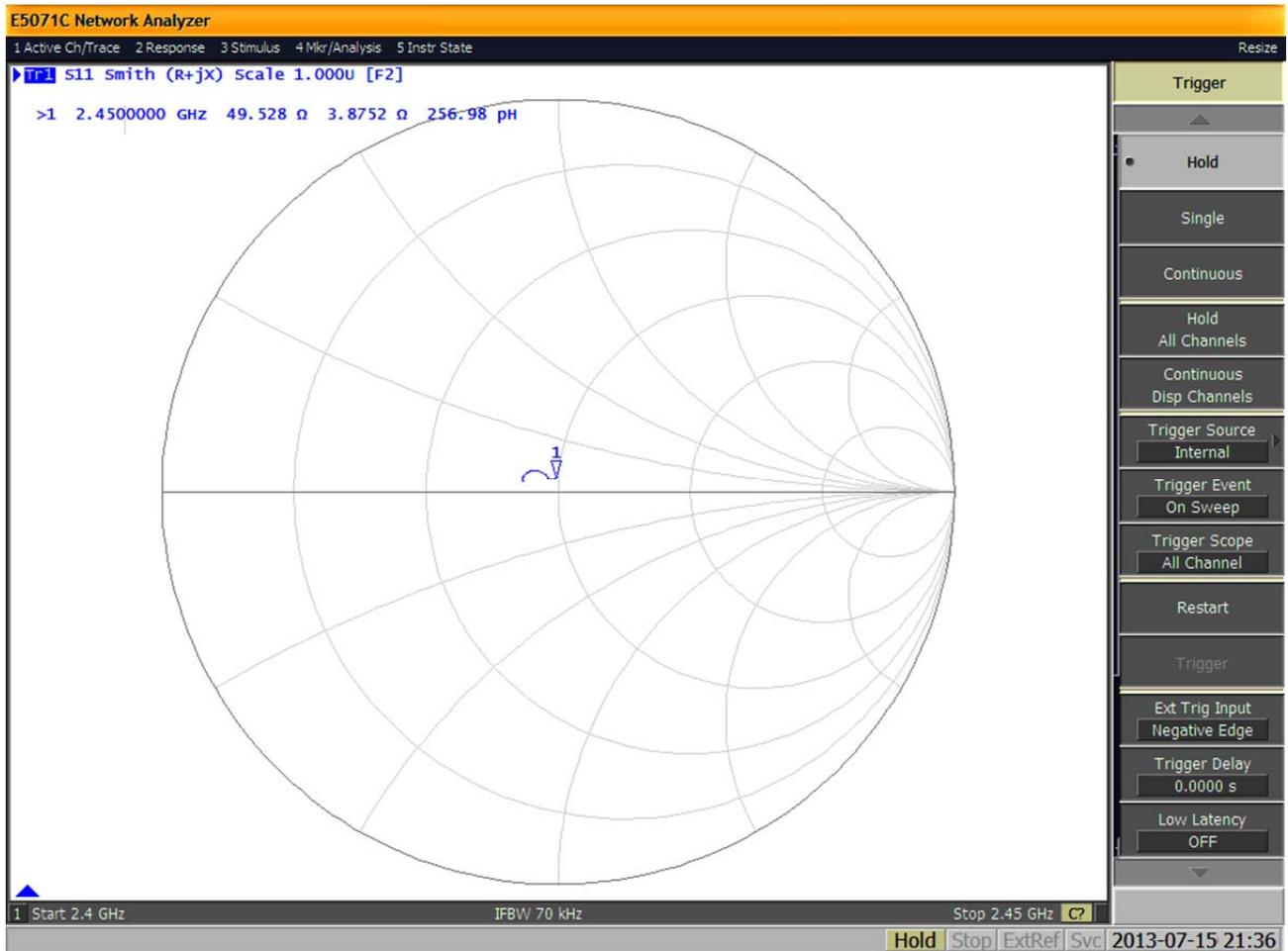
Antenna Parameters with Body Tissue

Item	Verified on 7/15, 2013	Original Cal. Result	Deviation
Impedance, transformed to feed point	49.528 Ω +3.87j Ω	50.2 Ω +4.7j Ω	< 5 Ω
Return Loss	-23.31 dB	-26.6 dB	12.37%

Plot for Antenna Parameters with Head Tissue



Plot for Antenna Parameters with Body Tissue





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

Accreditation No.: **SCS 108**

Client **Audix-TW (Auden)**

Certificate No: **D2450V2-888_May12**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 888**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **May 02, 2012**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: May 7, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	39.6 \pm 6 %	1.81 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.4 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.10 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.4 mW / g \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	52.4 \pm 6 %	1.98 mho/m \pm 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	51.2 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.02 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.0 mW / g \pm 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω + 3.3 j Ω
Return Loss	- 26.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.2 Ω + 4.7 j Ω
Return Loss	- 26.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.158 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2011

DASY5 Validation Report for Head TSL

Date: 02.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 888

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.81$ mho/m; $\epsilon_r = 39.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

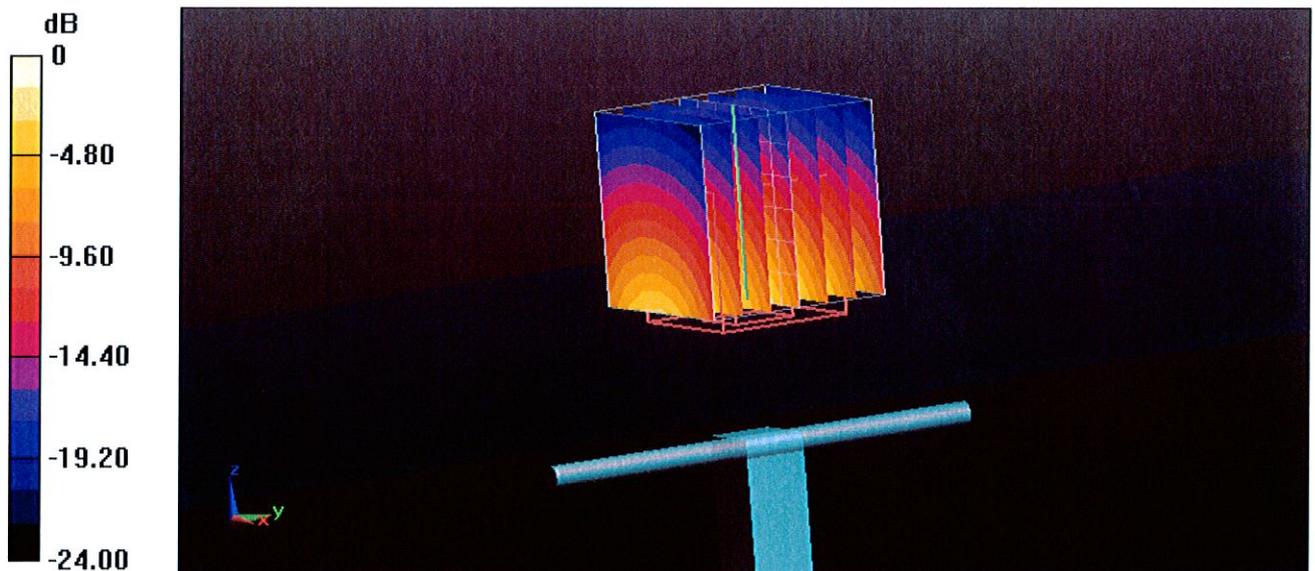
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.760 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 27.041 mW/g

SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.1 mW/g

Maximum value of SAR (measured) = 16.8 mW/g



0 dB = 16.8 mW/g = 24.51 dB mW/g

Impedance Measurement Plot for Head TSL

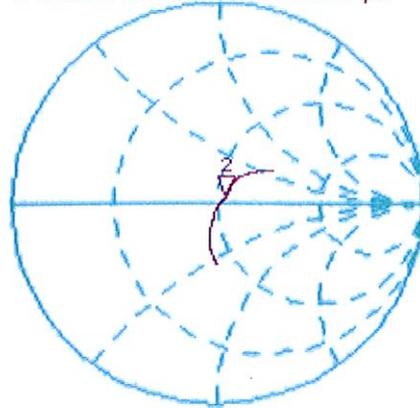
2 May 2012 09:58:18
[CH1] S11 1 U FS 2: 53.812 Ω 3.2676 Ω 212.27 μ H 2 450.000 000 MHz

*
De1

CA

Avg
16

H1 d

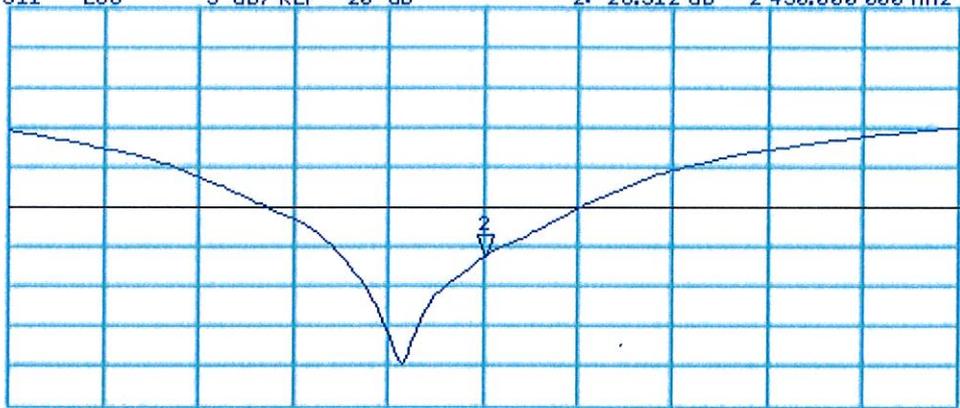


CH2 S11 LOG 5 dB/REF -20 dB 2:-26.312 dB 2 450.000 000 MHz

CA

Avg
16

H1 d



DASY5 Validation Report for Body TSL

Date: 02.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 888

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.98$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

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

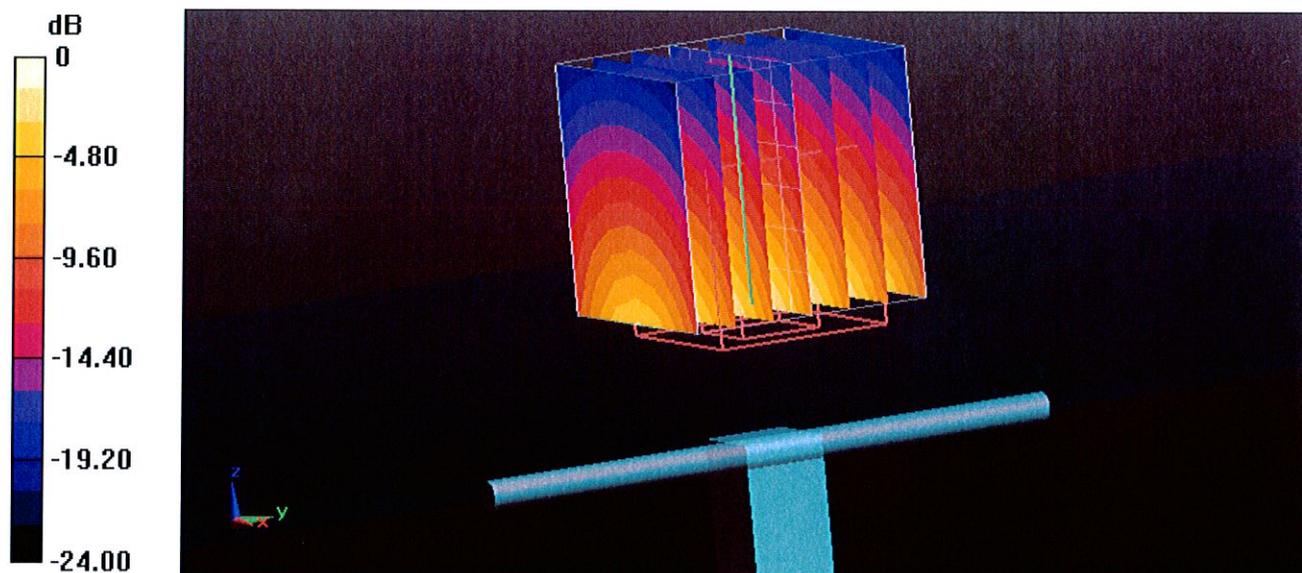
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.994 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 26.345 mW/g

SAR(1 g) = 12.9 mW/g; SAR(10 g) = 6.02 mW/g

Maximum value of SAR (measured) = 17.0 mW/g

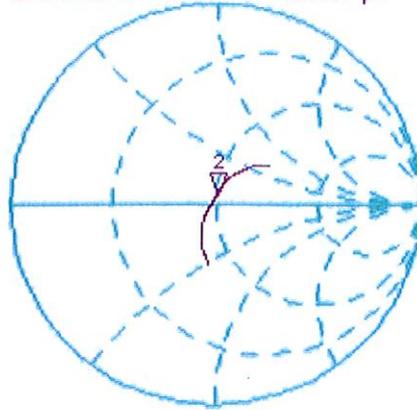


0 dB = 17.0 mW/g = 24.61 dB mW/g

Impedance Measurement Plot for Body TSL

2 May 2012 09:57:08
[CH1] S11 1 U FS 2: 50.221 Ω 4.6992 Ω 305.27 μ H 2 450.000 000 MHz

*
Del
CA
Avg
16
H1 d



CH2 S11 LOG 5 dB/REF -20 dB 2:-26.573 dB 2 450.000 000 MHz

CA
Avg
16
H1 d

