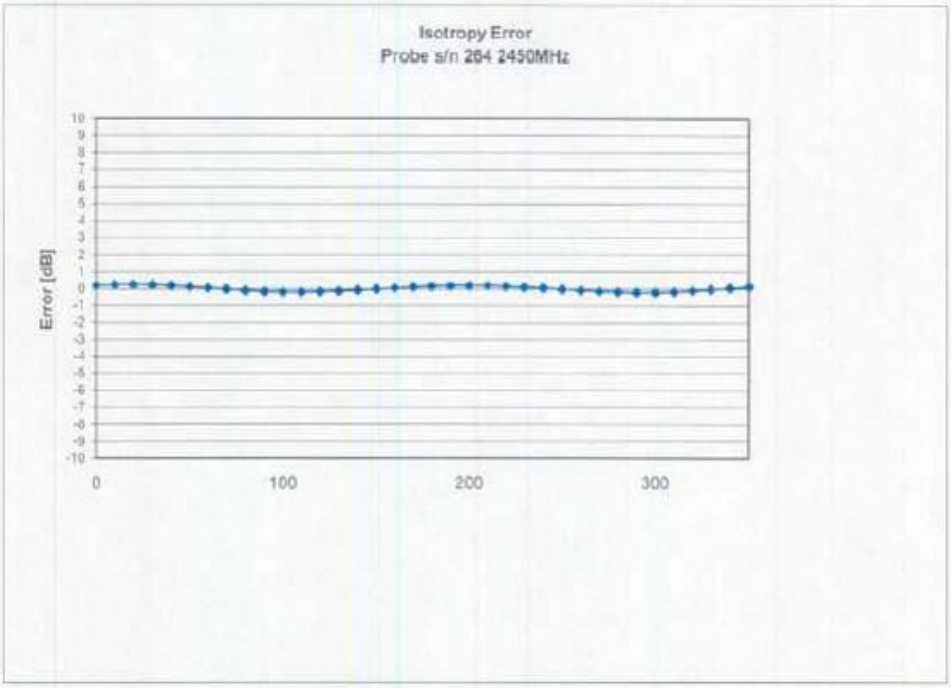
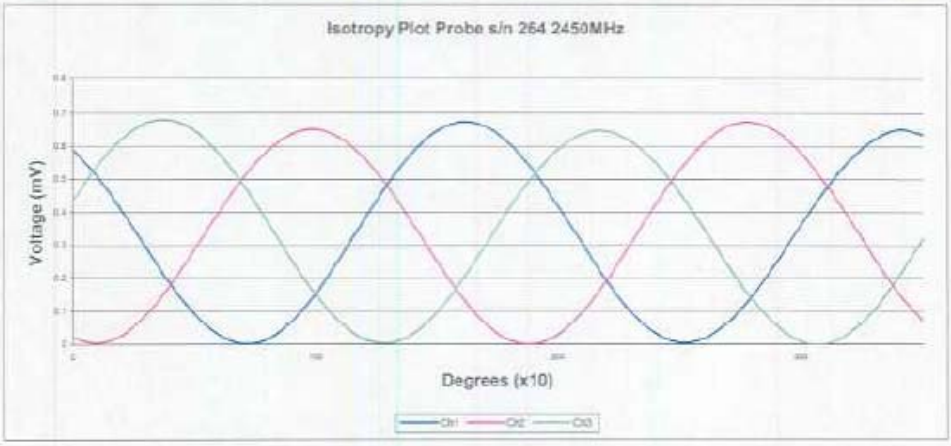
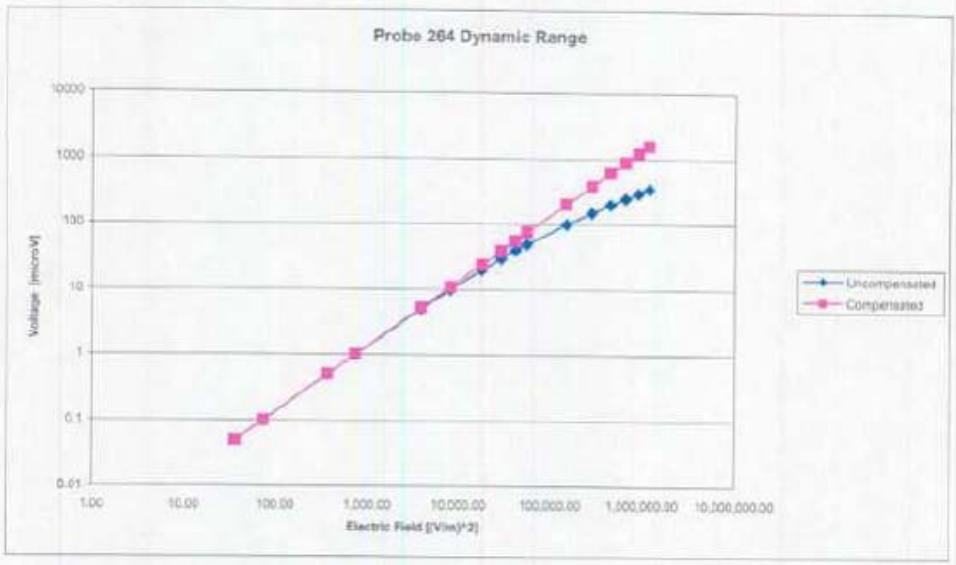
Isotropy Error 2450 MHz (Air)





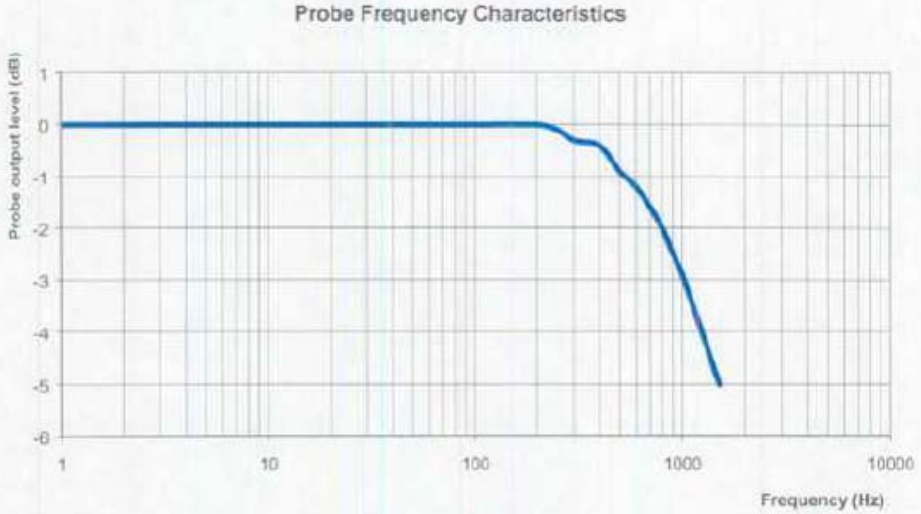
Isotropicity in Tissue: 0.10 dB

Dynamic Range



This page has been reviewed for content and attested to on Page 2 of this document.

Video Bandwidth



Video Bandwidth at 500 Hz	1 dB
Video Bandwidth at 1000 Hz	3 dB

Conversion Factor Uncertainty Assessment

Frequency:		2450MHz	
Epsilon:	52.7 (+/-5%)	**Sigma:**	1.95 S/m (+/-5%)
ConvF			
Channel X:	5.2	7%(K=2)	
Channel Y:	5.2	7%(K=2)	
Channel Z:	5.2	7%(K=2)	

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 MΩ.

Boundary Effect:

For a distance of 2.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List.

Appendix - Dipole Calibration

Validation Dipole 2450MHz
P/N: ALS-D-2450-S-2
S/N: QTK-319

NCL CALIBRATION LABORATORIES

Calibration File No: DC-409
Project Number: QTKB-ALSAS-10U-5050

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Quietek Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-2450-S-2
Frequency: 2.45 GHz
Serial No: QTK-319

Customer: Quietek

Calibrated: 23 June 2004
Released on: 23 June 2004

Released By: _____

NCL CALIBRATION LABORATORIES
51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4161

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

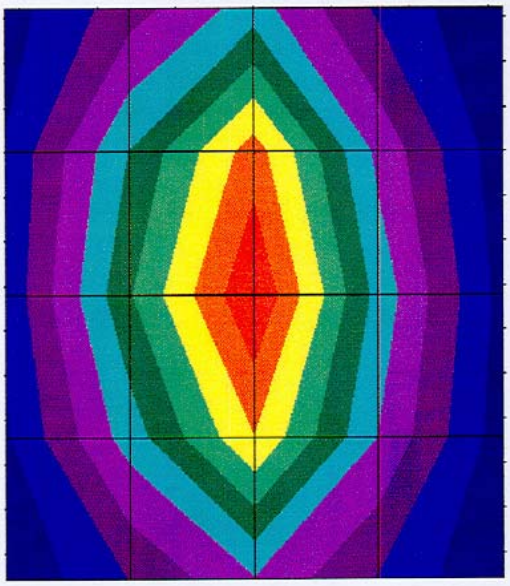
Length: 53.5 mm
Height: 30.4 mm

Electrical Specification

SWR: 1.19 U
Return Loss: -20.8 dB
Impedance: 49.4 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
2.45 GHz	48.07	25.65	95.6



Calibrated by:

Approved by:

Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole QTK-319. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the IEEE/APREL mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with QTK E-020 130 MHz to 26 GHz E-Field Probe Serial Number 212.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

Conditions

Dipole QTK-319 was new taken from stock.

Ambient Temperature of the Laboratory:	22 °C +/- 0.5°C
Temperature of the Tissue:	20 °C +/- 0.5°C

Dipole Calibration Results

Mechanical Verification

IEEE Length	IEEE Height	Measured Length	Measured Height
51.5 mm	30.4 mm	53.5 mm	30.4 mm

Tissue Validation

Body Tissue 2450 MHz	Measured
Dielectric constant, ε_r	52.5
Conductivity, σ [S/m]	1.78

Calibrated by:

Approved by:

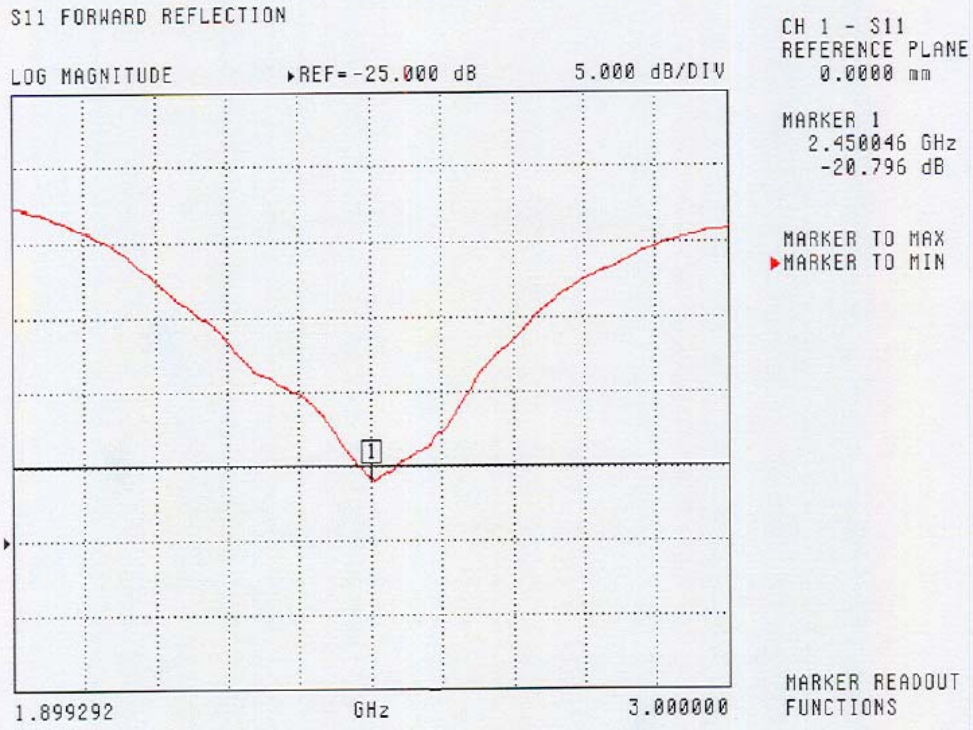
NCL Calibration Laboratories
Division of APREL Laboratories.

Electrical Calibration

Test	Result
S11 R/L	-20.8 dB
SWR	1.2 U
Impedance	49.4 Ω

The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss



Calibrated by
Approved by:

QuieTek

NCL Calibration Laboratories
Division of APREL Laboratories.

SWR

S11 FORWARD REFLECTION

CH 1 - S11
REFERENCE PLANE
0.0000 mm

MARKER 1
2.450046 GHz
1.199 U

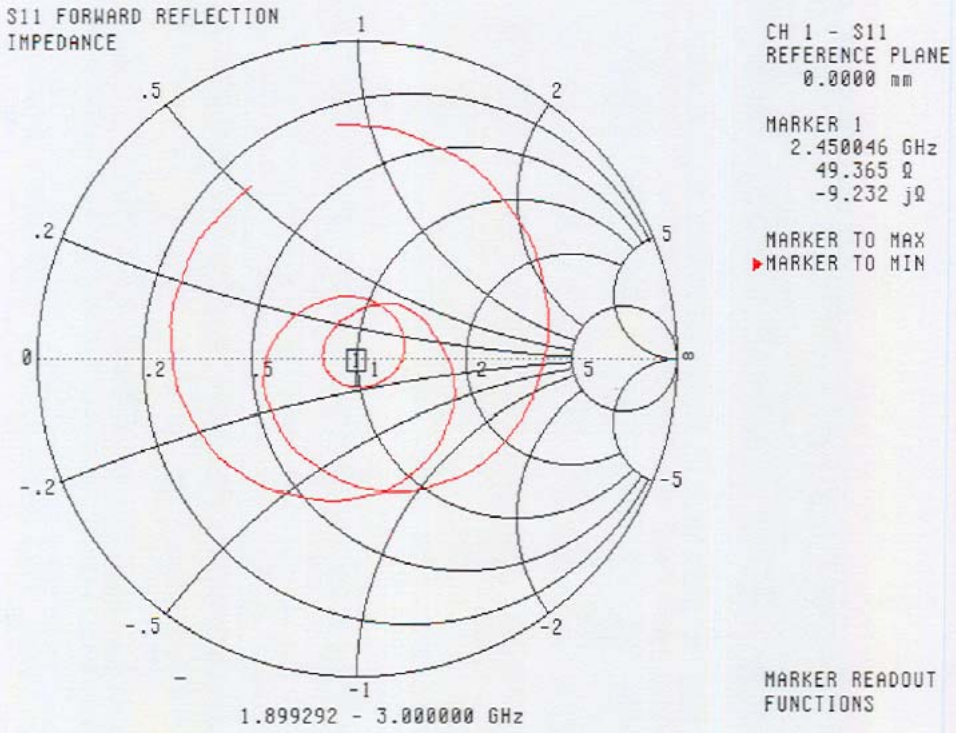
MARKER TO MAX
▸MARKER TO MIN

MARKER READOUT
FUNCTIONS

Page 6 of 9 Calibrated by Approved by:

NCL Calibration Laboratories
Division of APREL Laboratories.

Smith Chart Dipole Impedance

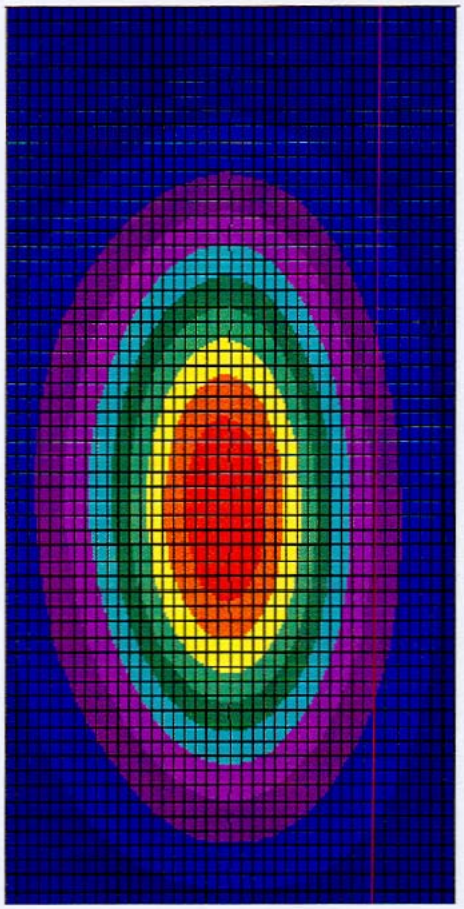


Calibrated by:
Approved by:

NCL Calibration Laboratories
Division of APREL Laboratories.

System Validation Results Using the Electrically Calibrated Dipole

Frequency	1 Gram	10 Gram	Peak Above Feed Point
2.45 GHz	48.07	25.65	95.6



Calibrated by:

Approved by:

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2003

Please see the following SAR System Validation Data tested by the probe and validation dipole, which are calibrated from original manufacturer APREL on June 15, 2006.

Quietek has compared them with previous SAR system validation data and confirmed that the difference between two tested results, which are 12.829W/Kg and 13.221 W/Kg, is very close.

There is only 2.9% difference between two results, which is within 5% tolerance.

SAR System Validation Data

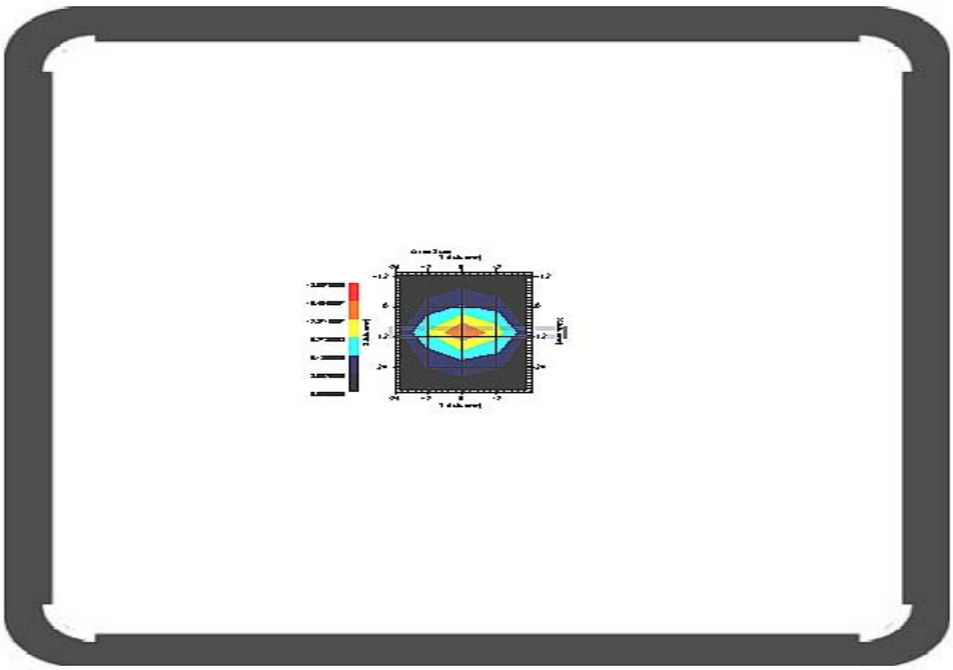
ALSAS-10U VER 2.3.0 APREL Laboratories

SAR Test Report

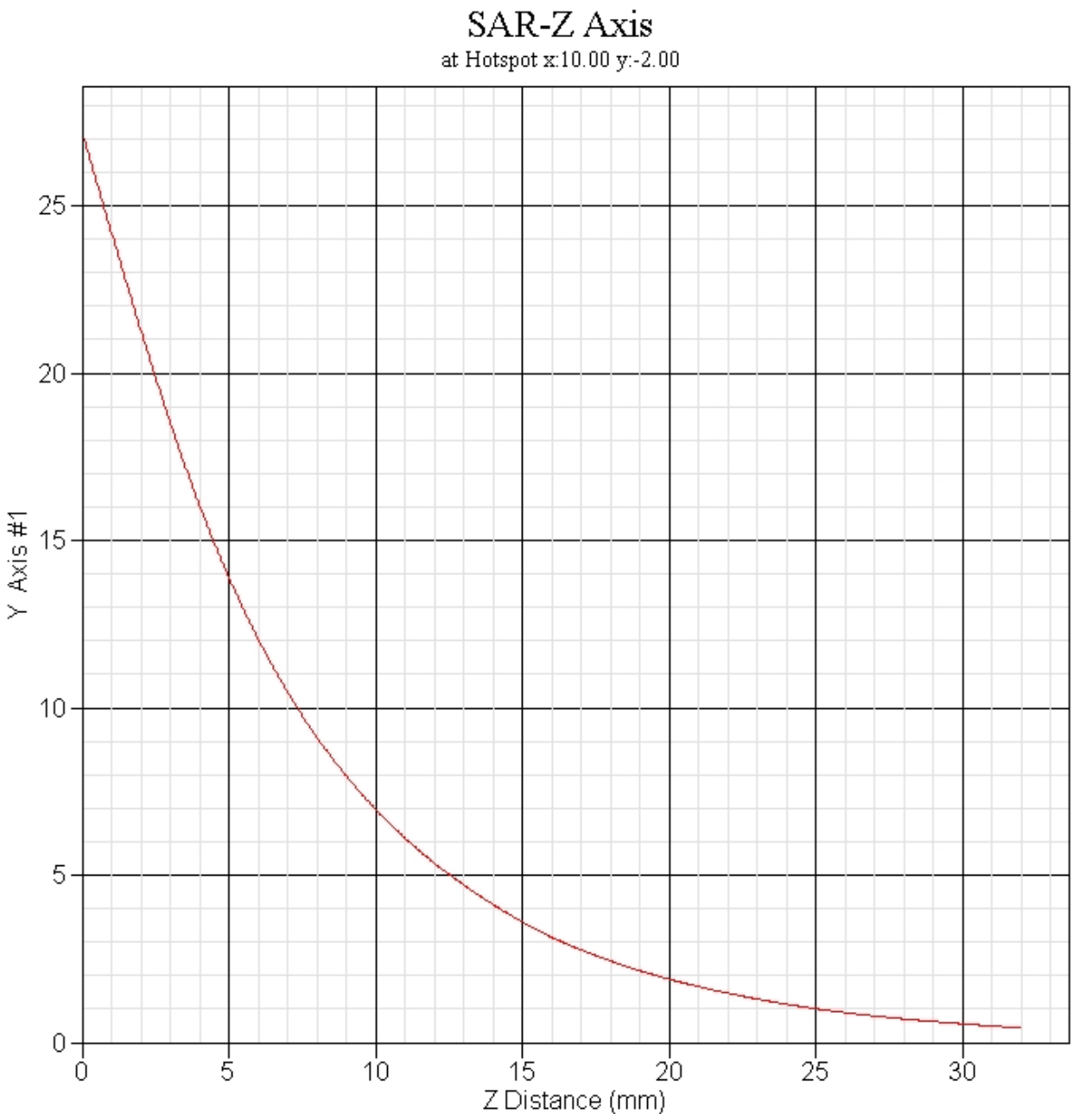
```
Validation Date   : 26-Jun-2006
Measurement Date  : 26-Jun-2006

Product Data
Device Name      : Dipole-2450
Type            : Dipole
Model           : Standard
Frequency       : 2450.00 MHz
Max. Transmit Pwr : 0.25 W
Drift Time      : 0 min(s)
Length          : 51.5 mm
Width           : 3.6 mm
Depth           : 30.4 mm
Power Drift-Start : 6.579 W/kg
Power Drift-Finish: 6.796 W/kg
Power Drift (%)   : 3.288

Phantom Data
Type           : Uni-Phantom
Size (mm)       : 280 x 280 x 200
Location        : Center

Tissue Data
Type           : HEAD
Serial No.      : 325-H
Frequency       : 2450.00 MHz
Last Calib. Date : 26-Jun-2006
Temperature     : 21.80 °C
Ambient Temp.    : 22.20 °C
Humidity        : 55.00 RH%
Epsilon         : 38.24 F/m
Sigma          : 1.845 S/m
Density         : 1000.00 kg/cu. m
```

Probe Data
Name : Probe 264
Model : E020
Type : E-Field Triangle
Serial No. : 264
Last Calib. Date : 21-Mar-2006
Frequency : 2450.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5
Probe Sensitivity: 1.20 1.20 1.20 $\mu V/(V/m)^2$
Compression Point: 95.00 mV
Offset : 1.56 mm

Measurement Data
Crest Factor : 1
Tissue Temp. : 21.80 °C
Ambient Temp. : 22.20 °C
Area Scan : 5x5x1 : Measurement x=12mm, y=12mm, z=4mm
Zoom Scan : 5x5x8 : Measurement x=8mm, y=8mm, z=4mm
DUT Position : Touch
Channel : 2450



1 gram SAR value : 13.221 W/kg
10 gram SAR value : 5.961 W/kg
Area Scan Peak SAR : 15.466 W/kg
Zoom Scan Peak SAR : 27.223 W/kg


SAR-Z Axis
at Hotspot x:10.00 y:-2.00
Y Axis #1
Z Distance (mm)
0
5
10
15
20
25
30

Appendix - Dipole Calibration

Validation Dipole 2450MHz
P/N: ALS-D-2450-S-2
S/N: QTK-319

NCL CALIBRATION LABORATORIES

Calibration File No: DC-409-1
Project Number: QTKB-Dipole Cal-5228

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Quietek Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-2450-S-2
Frequency: 2.45 GHz
Serial No: QTK-319

Customer: Quietek

Calibrated: 15 June 2006
Released on: 15 June 2006

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4161

Calibration Results Summary

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions

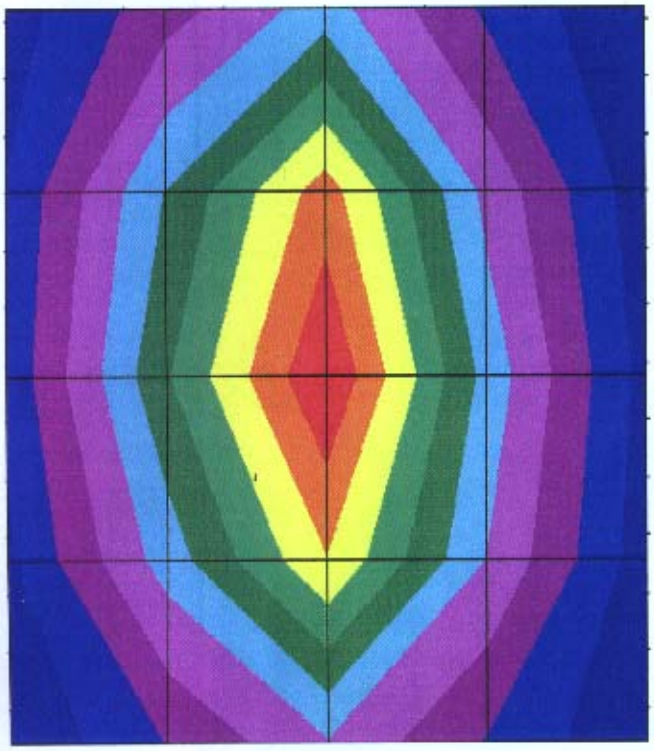
Length: 53.5 mm
Height: 30.4 mm

Electrical Specification

SWR: 1.21 U
Return Loss: -20.7 dB
Impedance: 47.7 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
2.45 GHz	48.07	25.65	95.6



Calibrated by

Approved by:

Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole QTK-319. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the IEEE/APREL mechanical specifications. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALSAS-10U, along with QTK E-020 130 MHz to 26 GHz E-Field Probe Serial Number 212.

References

SSI-TP-018-ALSAS Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

Conditions

Dipole QTK-319 was received for calibration.

Ambient Temperature of the Laboratory:	22 °C +/- 0.5°C
Temperature of the Tissue:	20 °C +/- 0.5°C

Calibrated by 
Approved by: 

Dipole Calibration Results

Mechanical Verification

IEEE Length	IEEE Height	Measured Length	Measured Height
51.5 mm	30.4 mm	53.5 mm	30.4 mm

Tissue Validation

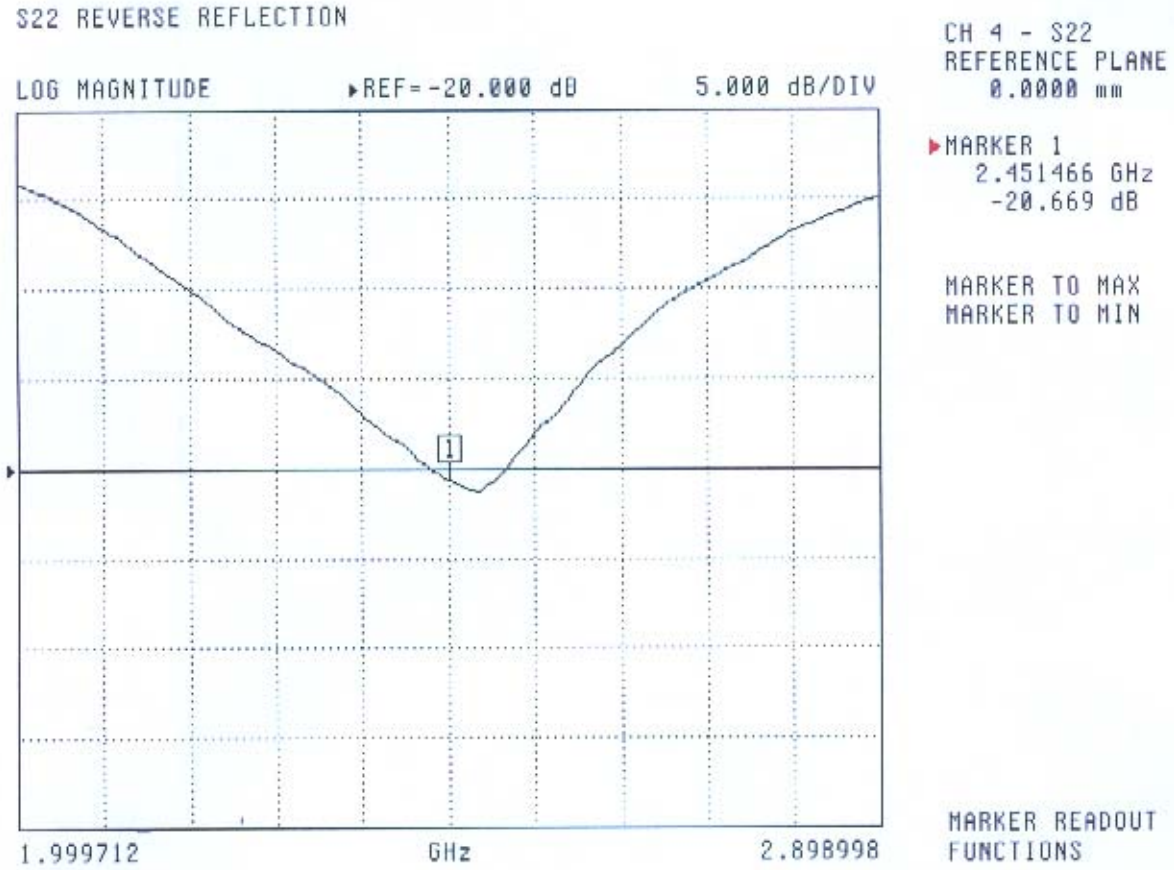
Body Tissue 2450 MHz	Measured
Dielectric constant, ε_r	52.5
Conductivity, σ [S/m]	1.78

Electrical Calibration

Test	Result
S11 R/L	-20.7 dB
SWR	1.21 U
Impedance	47.7 Ω

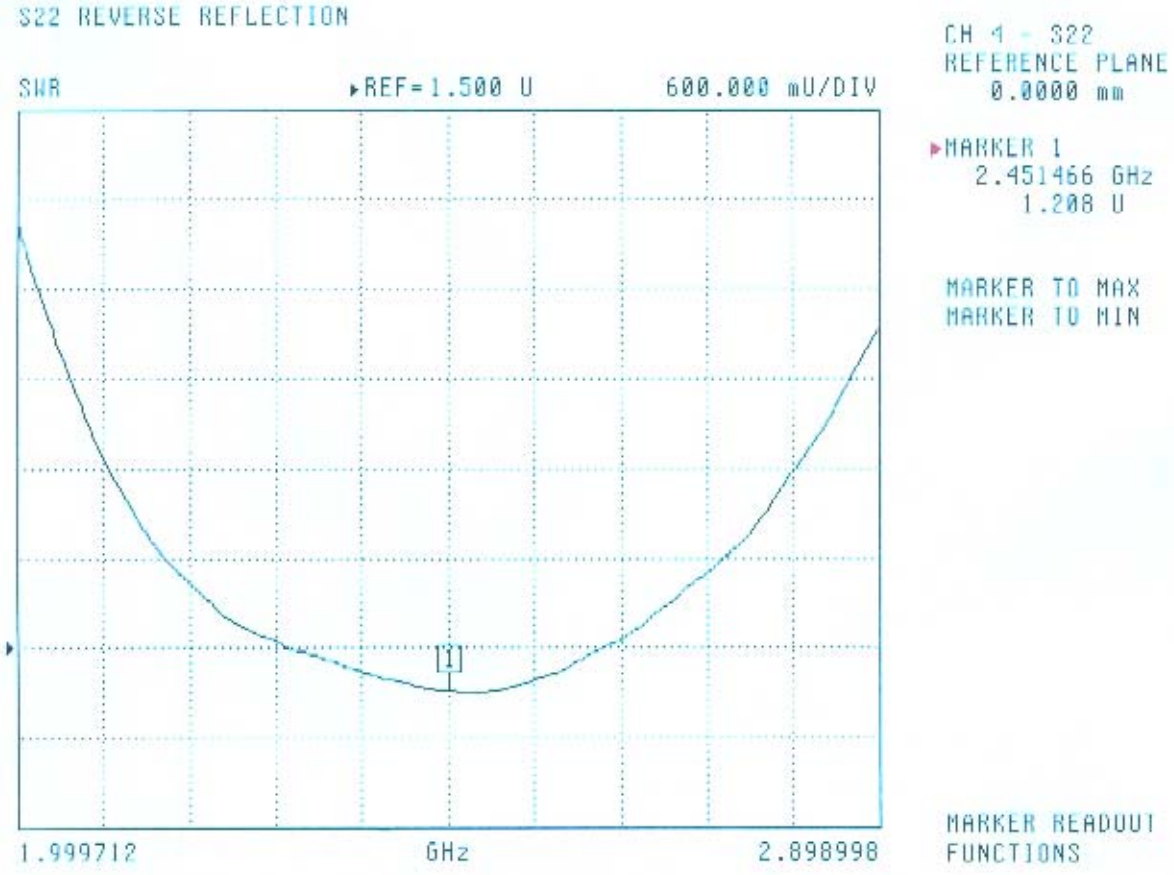
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss



Calibrated by
Approved by:

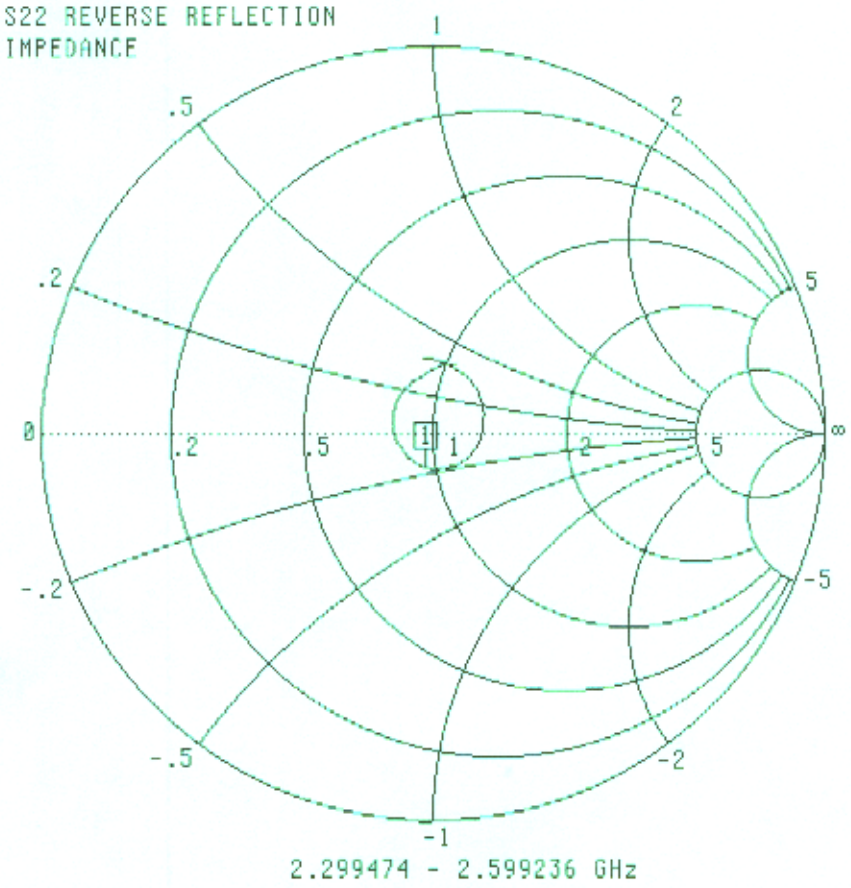
SWR



Calibrated by

Approved by:

Smith Chart Dipole Impedance



CH 4 - S22
REFERENCE PLANE
0.0000 mm

▸MARKER 1
2.451466 GHz
47.685 Ω
-8.809 jΩ

MARKER TO MAX
MARKER TO MIN

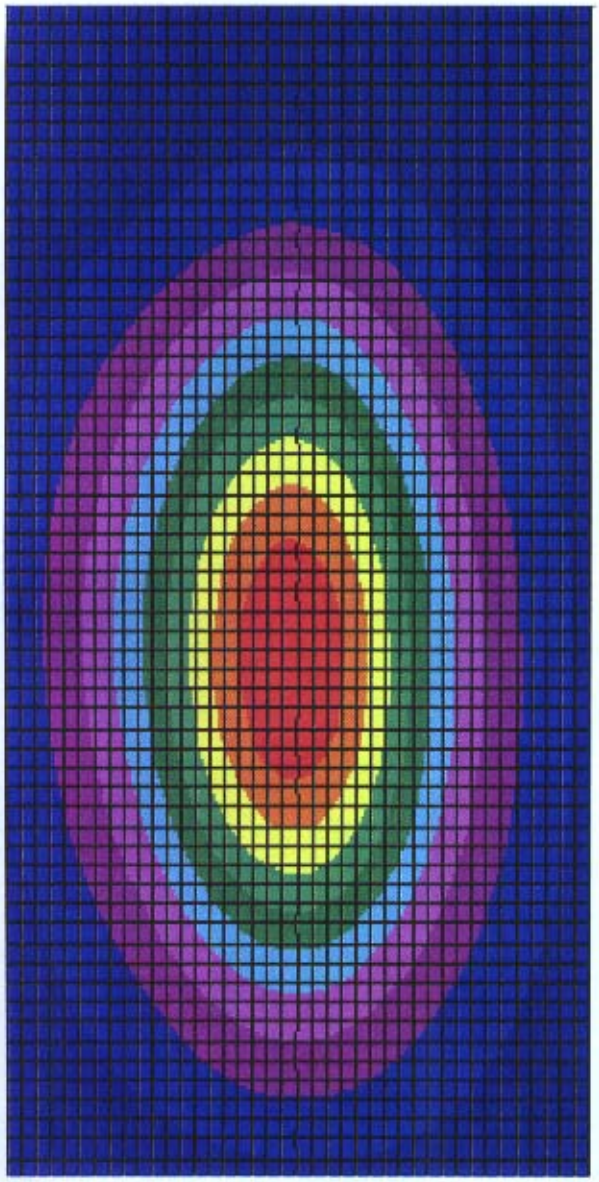
MARKER READOUT
FUNCTIONS

Calibrated by

Approved by:

System Validation Results Using the Electrically Calibrated Dipole

Frequency	1 Gram	10 Gram	Peak Above Feed Point
2.45 GHz	48.07	25.65	95.6



Calibrated by

Approved by:

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List