Probe Calibration Data

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-555

Client: QUIETEK

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.

Equipment: Miniature Isotropic RF Probe 1900 MHz

Manufacturer: APREL Laboratories
Model No.: ALS-E-020
Serial No.: 265

HEAD Calibration

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: QTKB-ALS-E-020 Probe Cal-5091

Calibrated: 23rd March 2005
Released on: 23rd March 2005

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By:

NCL CALIBRATION LABORATORIES

61 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

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

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 265.

References

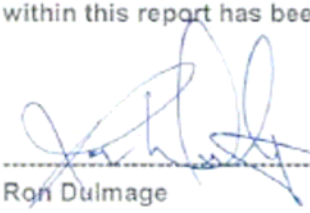
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"
SSI-TP-011 Tissue Calibration Procedure

Conditions

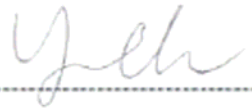
Probe 265 was a new probe taken from stock prior to calibration.

Ambient Temperature of the Laboratory:	22 °C +/- 0.5°C
Temperature of the Tissue:	21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



Ron Dulmage



Y. Chen

NCL Calibration Laboratories
Division of APREL Laboratories.

Calibration Results Summary

Probe Type:	E-Field Probe E-020
Serial Number:	265
Frequency:	1900 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	1.2 $\mu V/(V/m)^2$
Channel Y:	1.2 $\mu V/(V/m)^2$
Channel Z:	1.2 $\mu V/(V/m)^2$
Diode Compression Point:	95 mV

Page 3 of 10
This page has been reviewed for content and attested to on Page 2 of this document.

Sensitivity in Head Tissue

Frequency: 1900 MHz

Epsilon: 40.0 (+/-5%) **Sigma:** 1.40 S/m (+/-5%)

ConvF

Channel X: 4.9

Channel Y: 4.9

Channel Z: 4.9

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq.

Boundary Effect:

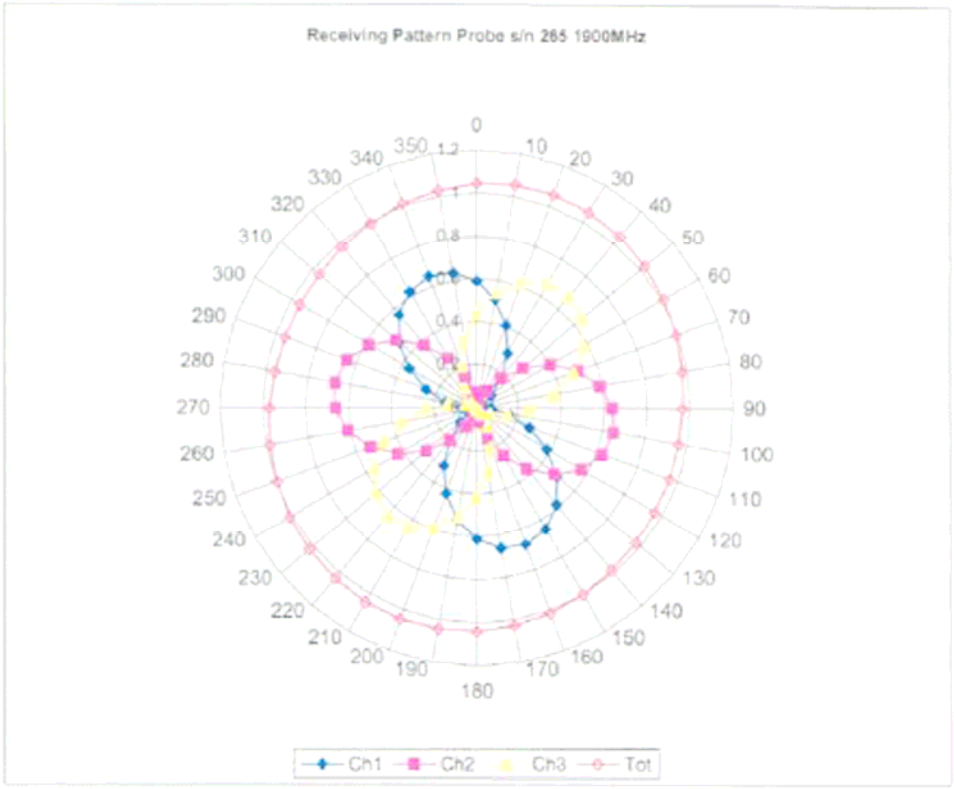
Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.44mm.

Spatial Resolution:

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

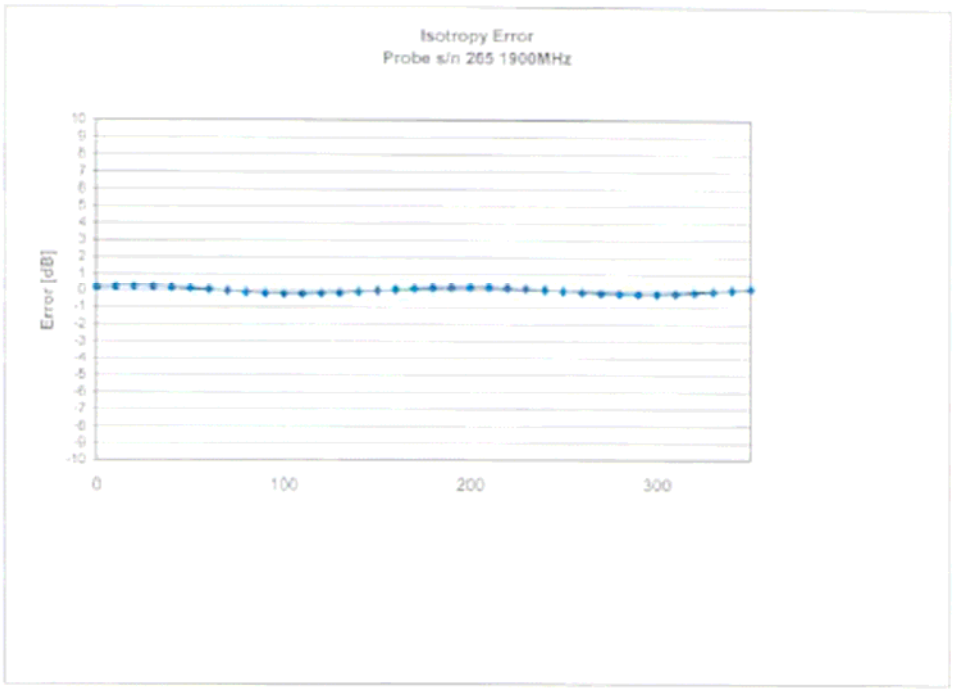
NCL Calibration Laboratories
Division of APREL Laboratories.

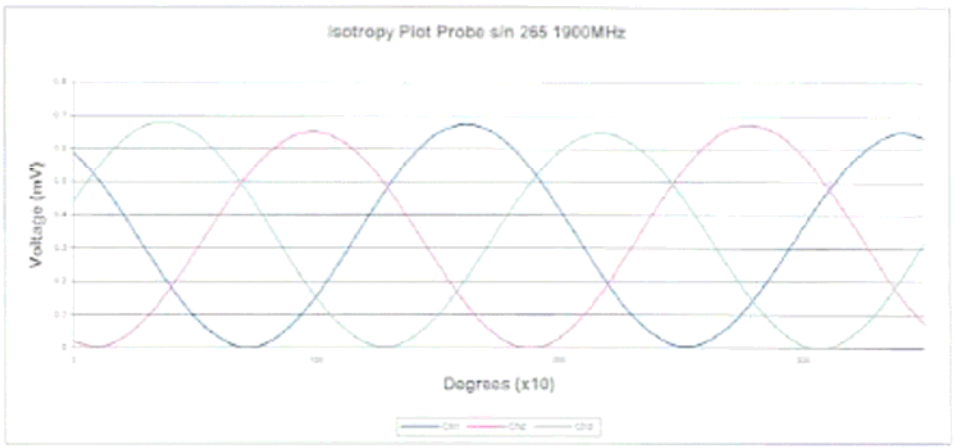
Receiving Pattern 1900 MHz (Air)



NCL Calibration Laboratories
Division of APREL Laboratories

Isotropy Error 1900 MHz (Air)





Isotropicity in Tissue: 0.10 dB

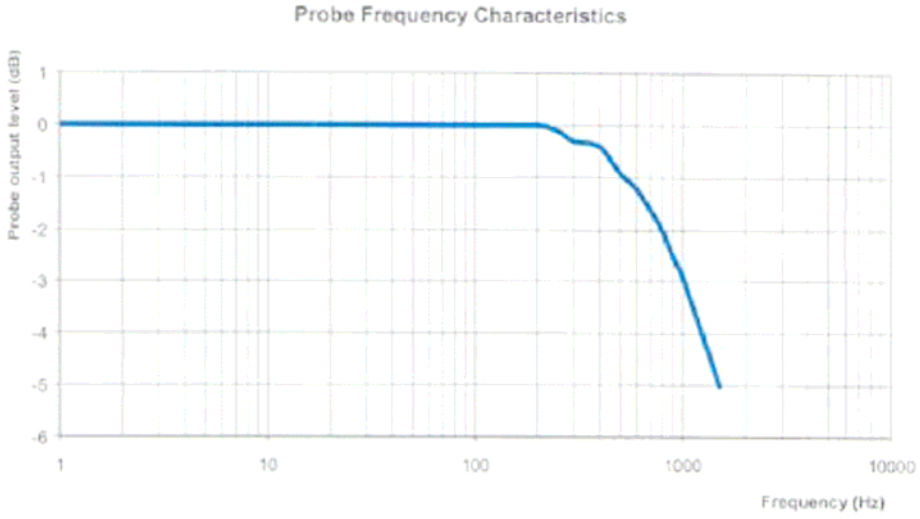
NCL Calibration Laboratories
Division of APREL Laboratories.

Dynamic Range

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

NCL Calibration Laboratories
Division of APREL Laboratories.

Video Bandwidth



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

NCL Calibration Laboratories
Division of APREL Laboratories.

Conversion Factor Uncertainty Assessment

Frequency:		1900MHz	
Epsilon:	40.0 (+/-5%)	**Sigma:**	1.40 S/m (+/-5%)
ConvF			
Channel X:	4.9	7%(K=2)	
Channel Y:	4.9	7%(K=2)	
Channel Z:	4.9	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%.

NCL Calibration Laboratories
Division of APREL Laboratories.

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 2004.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-556

Client: QUIETEK

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.

Equipment: Miniature Isotropic RF Probe 1900 MHz

Manufacturer: APREL Laboratories
Model No.: ALS-E-020
Serial No.: 265

BODY Calibration

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: QTKB-ALS-E-020 Probe Cal-5091

Calibrated: 23rd March 2005
Released on: 23rd March 2005

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

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

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 265.

References

SSI/DRB-TP-D01-032-E020-V2 E-Field Probe 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"
SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 265 was a new probe taken from stock prior to calibration.

Ambient Temperature of the Laboratory:	22 °C +/- 0.5°C
Temperature of the Tissue:	21 °C +/- 0.5°C

We the undersigned attest that to the best of our knowledge the calibration of this probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Ron Dulmage

Y. Chen

NCL Calibration Laboratories
Division of APREL Laboratories

Calibration Results Summary

Probe Type:	E-Field Probe E-020
Serial Number:	265
Frequency:	1900 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	1.2 $\mu V/(V/m)^2$
Channel Y:	1.2 $\mu V/(V/m)^2$
Channel Z:	1.2 $\mu V/(V/m)^2$
Diode Compression Point:	95 mV

Page 3 of 10
This page has been reviewed for content and attested to on Page 2 of this document.

Sensitivity in Body Tissue

Frequency: 1900 MHz

Epsilon: 53.3 (+/-5%) **Sigma:** 1.52 S/m (+/-5%)

ConvF

Channel X: 5.1

Channel Y: 5.1

Channel Z: 5.1

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq.

Boundary Effect:

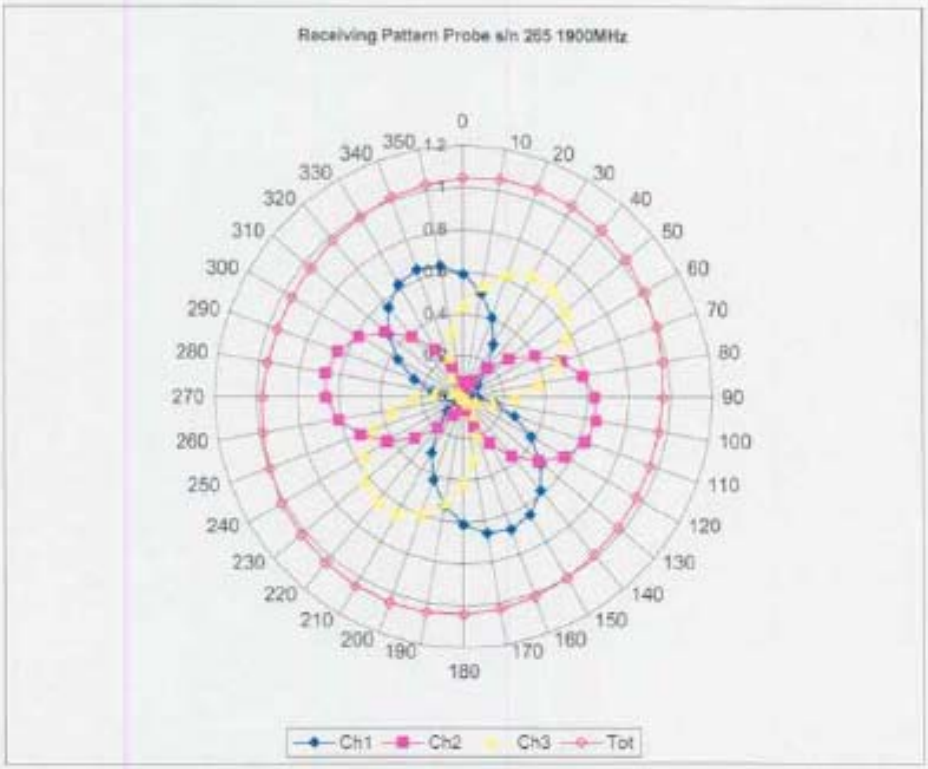
Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.44mm.

Spatial Resolution:

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

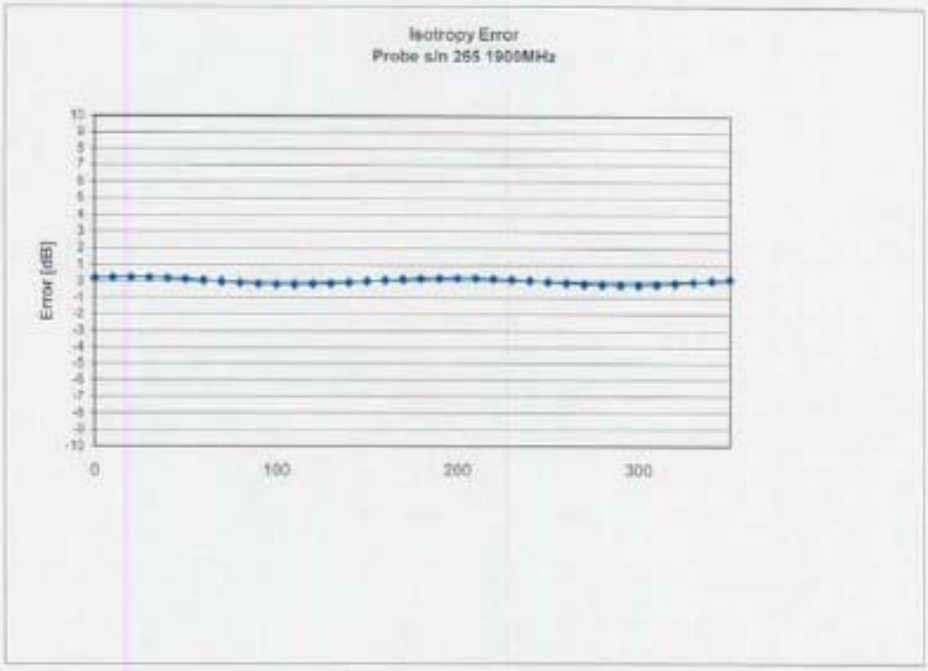
NCL Calibration Laboratories
Division of APREL Laboratories.

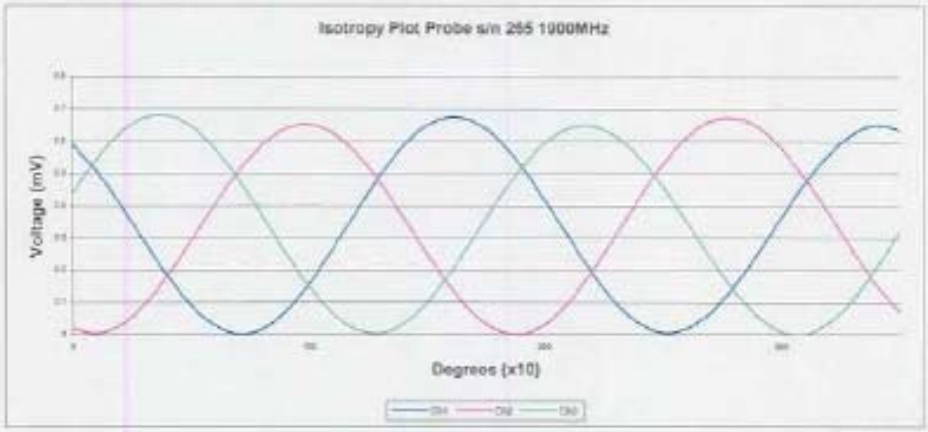
Receiving Pattern 1900 MHz (Air)



NCL Calibration Laboratories
Division of APREL Laboratories

Isotropy Error 1900 MHz (Air)



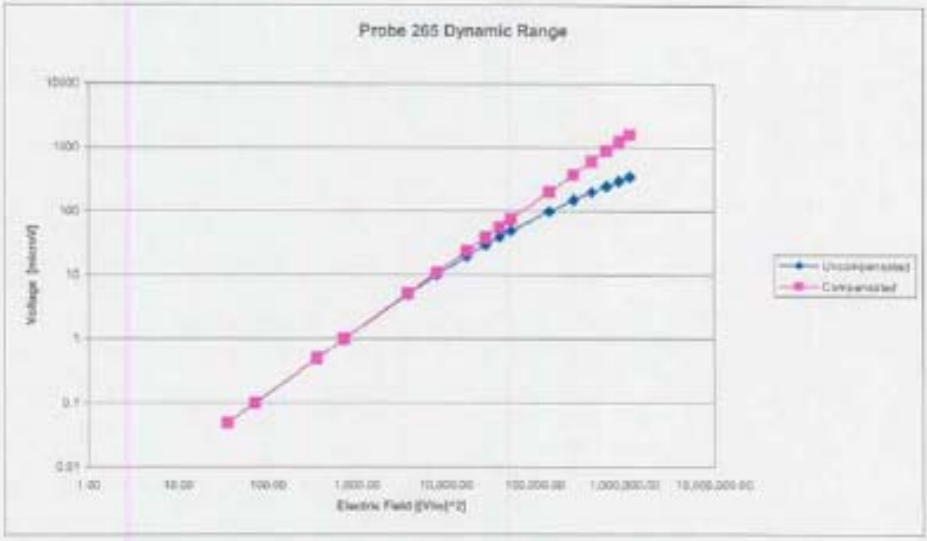


Isotropicity in Tissue: 0.10 dB

Page 6 of 10
This page has been reviewed for content and attested to on Page 2 of this document.

NCL Calibration Laboratories
Division of APREL Laboratories

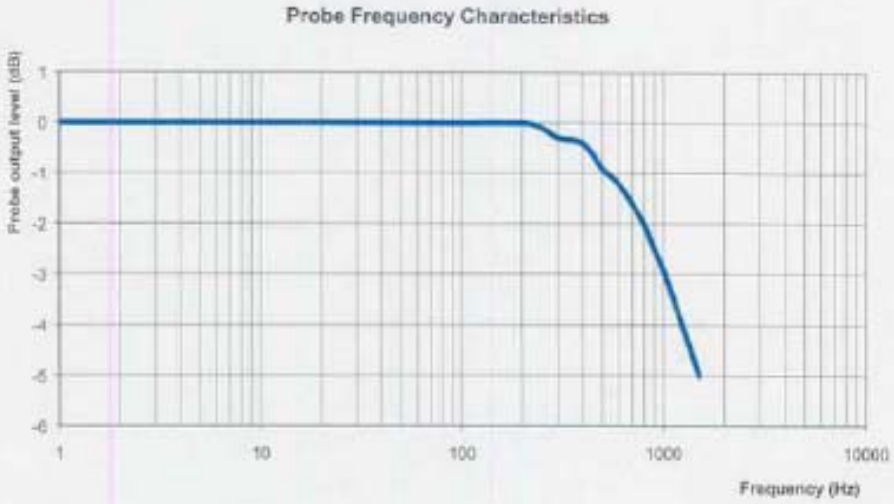
Dynamic Range



Page 7 of 10
This page has been reviewed for content and attested to on Page 2 of this document.

NCL Calibration Laboratories
Division of APREL Laboratories.

Video Bandwidth



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

NCL Calibration Laboratories
Division of APREL Laboratories

Conversion Factor Uncertainty Assessment

Frequency:		1900MHz	
Epsilon:	53.3 (+/-5%)	**Sigma:**	1.52 S/m (+/-5%)
ConvF			
Channel X:	5.1	7%(K=2)	
Channel Y:	5.1	7%(K=2)	
Channel Z:	5.1	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 May 2004.

Dipole Calibration Data

NCL CALIBRATION LABORATORIES

Calibration File No: DC-408
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-1900-S-2
Frequency: 1.9 GHz
Serial No: QTK-318

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

NCL Calibration Laboratories
Division of APREL Laboratories.

Calibration Results Summary

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

Mechanical Dimensions

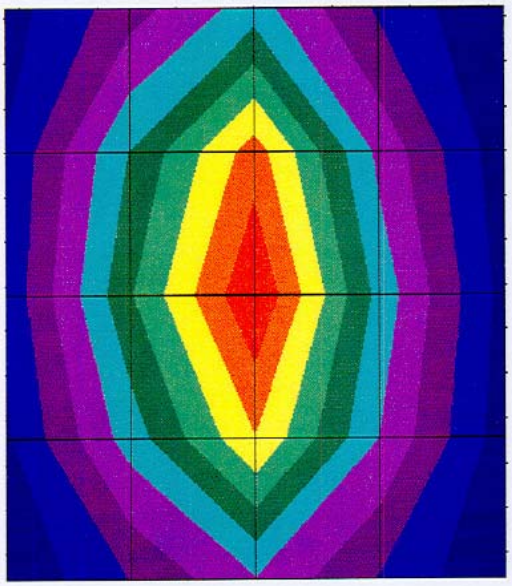
Length: 70.0 mm
Height: 39.5 mm

Electrical Specification

SWR: 1.1 U
Return Loss: -25.8 dB
Impedance: 47.8 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
1.9 GHz	36.0	20.78	67.7



Page 2 of 9 Calibrated by: Approved by:

NCL Calibration Laboratories
Division of APREL Laboratories.

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-318. 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-318 was new taken from stock.

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

Page 3 of 9 Calibrated by: Approved by:

NCL Calibration Laboratories
Division of APREL Laboratories.

Dipole Calibration Results

Mechanical Verification

IEEE Length	IEEE Height	Measured Length	Measured Height
68.0 mm	39.5 mm	70.0 mm	39.5 mm

Tissue Validation

Head Tissue 1900 MHz	Measured
Dielectric constant, ε_r	39.9
Conductivity, σ [S/m]	1.42

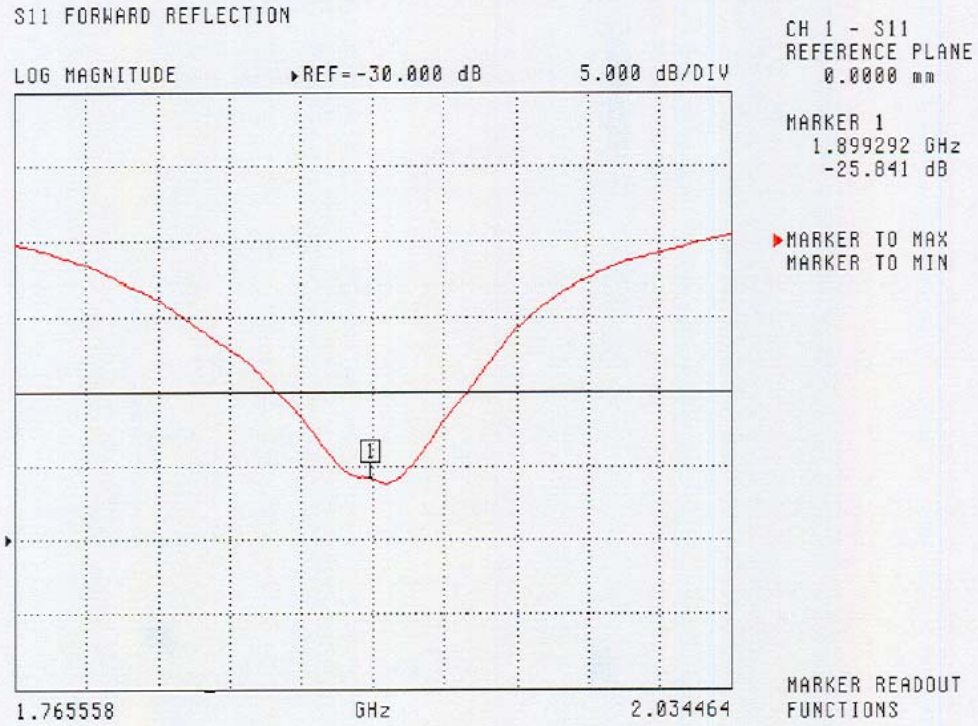
NCL Calibration Laboratories
Division of APREL Laboratories.

Electrical Calibration

Test	Result
S11 R/L	-25.8 dB
SWR	1.1 U
Impedance	47.8 Ω

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

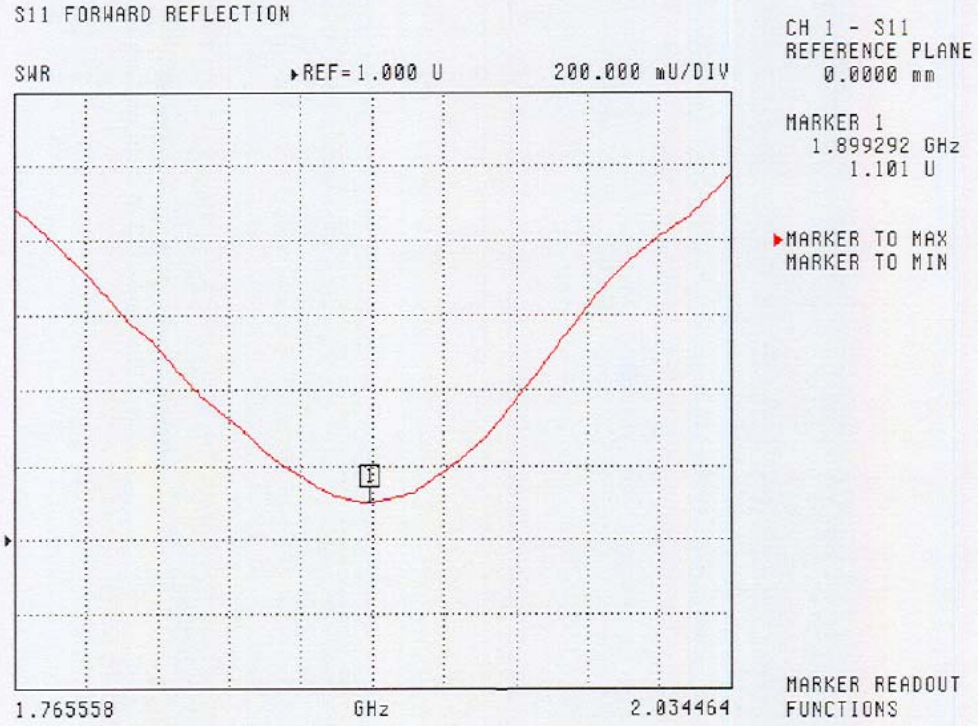
S11 Parameter Return Loss



Page 5 of 9 Calibrated by: Approved by:

NCL Calibration Laboratories
Division of APREL Laboratories.

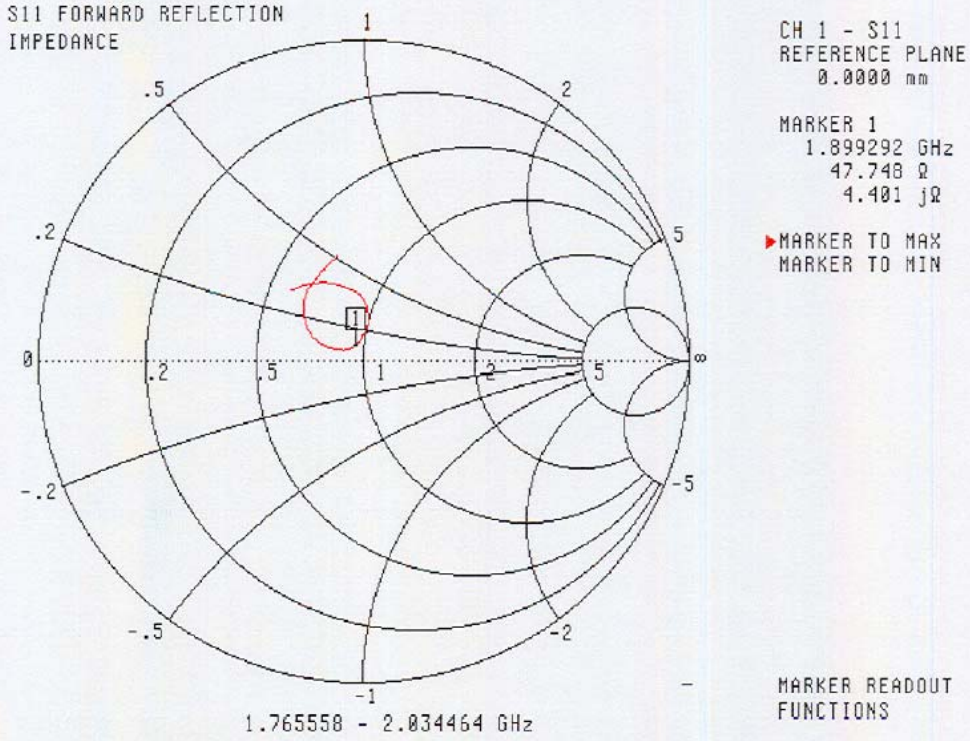
SWR



Page 6 of 9 Calibrated by Approved by:

NCL Calibration Laboratories
Division of APREL Laboratories.

Smith Chart Dipole Impedance

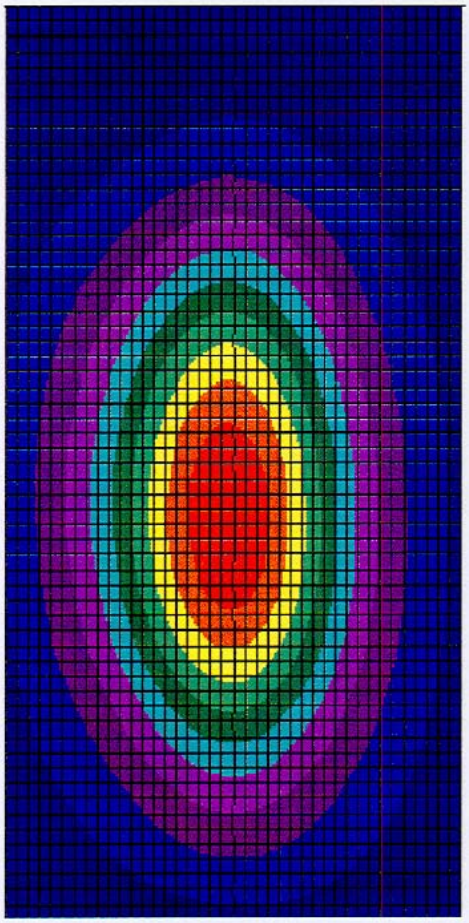


Page 7 of 9 Calibrated by: Approved by:

NCL Calibration Laboratories
Division of APREL Laboratories.

System Validation Results Using the Electrically Calibrated Dipole

Frequency	1 Gram	10 Gram	Peak Above Feed Point
1.9 GHz	36.0	20.78	67.7



Page 8 of 9 Calibrated by Approved by:

NCL Calibration Laboratories
Division of APREL Laboratories.

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 10.057W/Kg and 9.938 W/Kg, is very close.

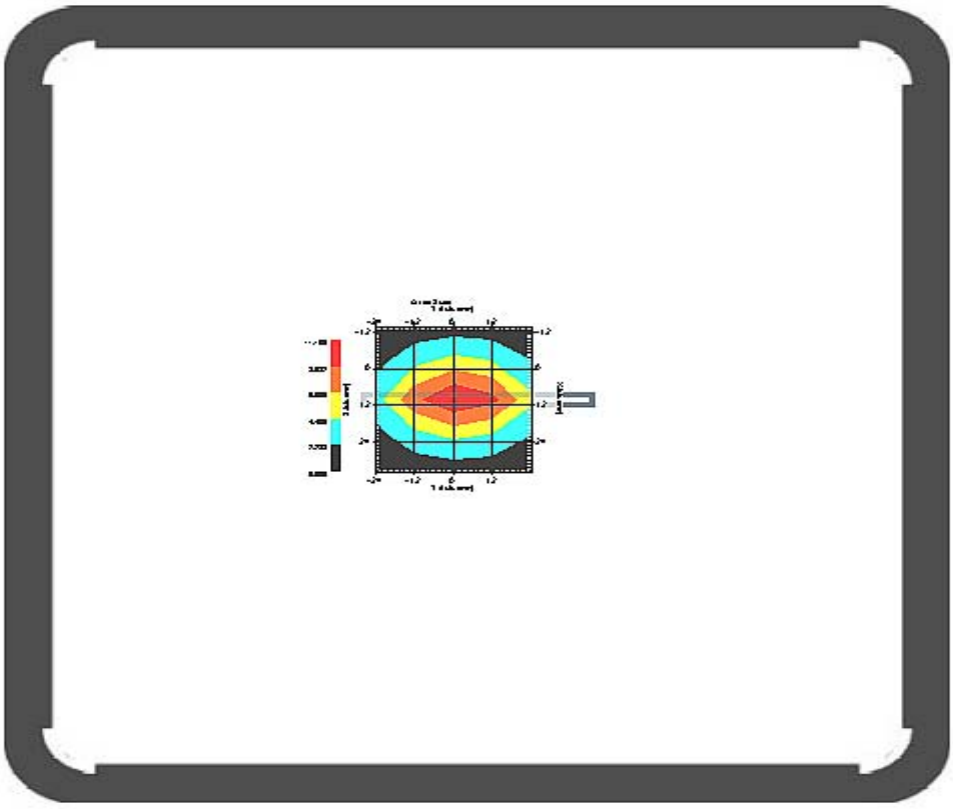
It has only 1.2% difference between two results, which is within 5% tolerance.

SAR System Validation Data

```
ALSAS-10U VER 2.3.0APREL Laboratories

SAR Test Report


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

Product Data
Device Name      : Dipole-1900
Type            : Dipole
Model           : Standard
Frequency        : 1900.00 MHz
Max. Transmit Pwr : 0.25 W
Drift Time       : 0 min(s)
Length          : 68 mm
Width           : 3.6 mm
Depth           : 39.5 mm
Power Drift-Start : 6.849 W/kg
Power Drift-Finish: 6.647 W/kg
Power Drift (%)   : -2.946

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

Tissue Data
Type           : HEAD
Serial No.      : 324-H
Frequency       : 1900.00 MHz
Last Calib. Date : 26-Jun-2006
Temperature     : 21.80 °C
Ambient Temp.    : 22.20 °C
Humidity        : 55.00 RH%
Epsilon         : 38.82 F/m
Sigma           : 1.441 S/m
Density         : 1000.00 kg/cu. m

Probe Data
Name           : Probe 264
Model          : E020
Type           : E-Field Triangle
Serial No.      : 264
```

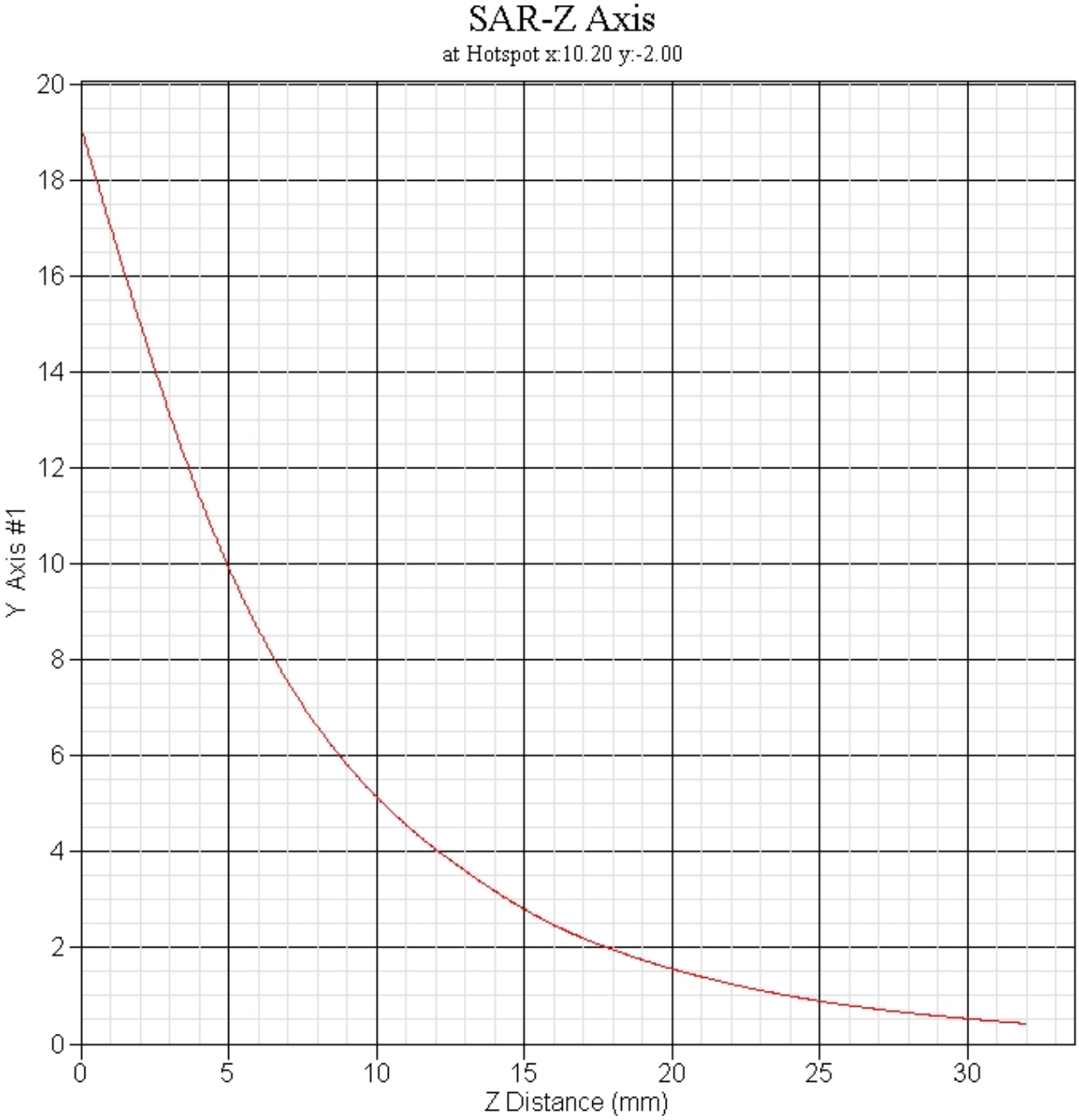
Last Calib. Date : 21-Mar-2006
Frequency : 1900.00 MHz
Duty Cycle Factor: 1
Conversion Factor: 5.5
Probe Sensitivity: 1.20 1.20 1.20 μV/(V/m)^2
Compression Point: 95.00 mV
Offset : 1.56 mm

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 : 1900



1 gram SAR value : 9.938 W/kg
10 gram SAR value : 4.949 W/kg
Area Scan Peak SAR : 11.164 W/kg
Zoom Scan Peak SAR : 19.116 W/kg

SAR System 1900MHz Validation Z-Axis plot



NCL CALIBRATION LABORATORIES

Calibration File No: DC-408-1
Project Number: QTKB-Dipole Cal-5230

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-1900-S-2
Frequency: 1.9 GHz
Serial No: QTK-318

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

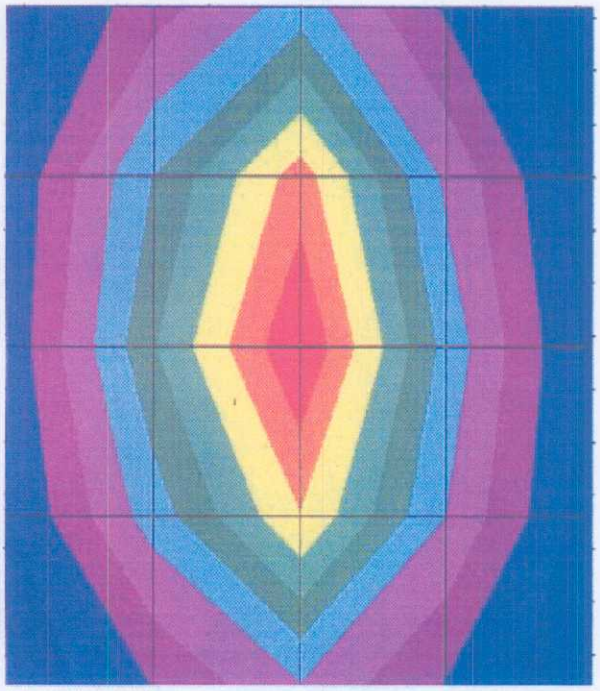
Length: 70.0 mm
Height: 39.5 mm

Electrical Specification

SWR: 1.1 U
Return Loss: -25.7 dB
Impedance: 46.8 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
1.9 GHz	36.0	20.78	67.7



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-318. 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-318 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
68.0 mm	39.5 mm	70.0 mm	39.5 mm

Tissue Validation

Head Tissue 1900 MHz	Measured
Dielectric constant, ε_r	39.9
Conductivity, σ [S/m]	1.42

Calibrated by

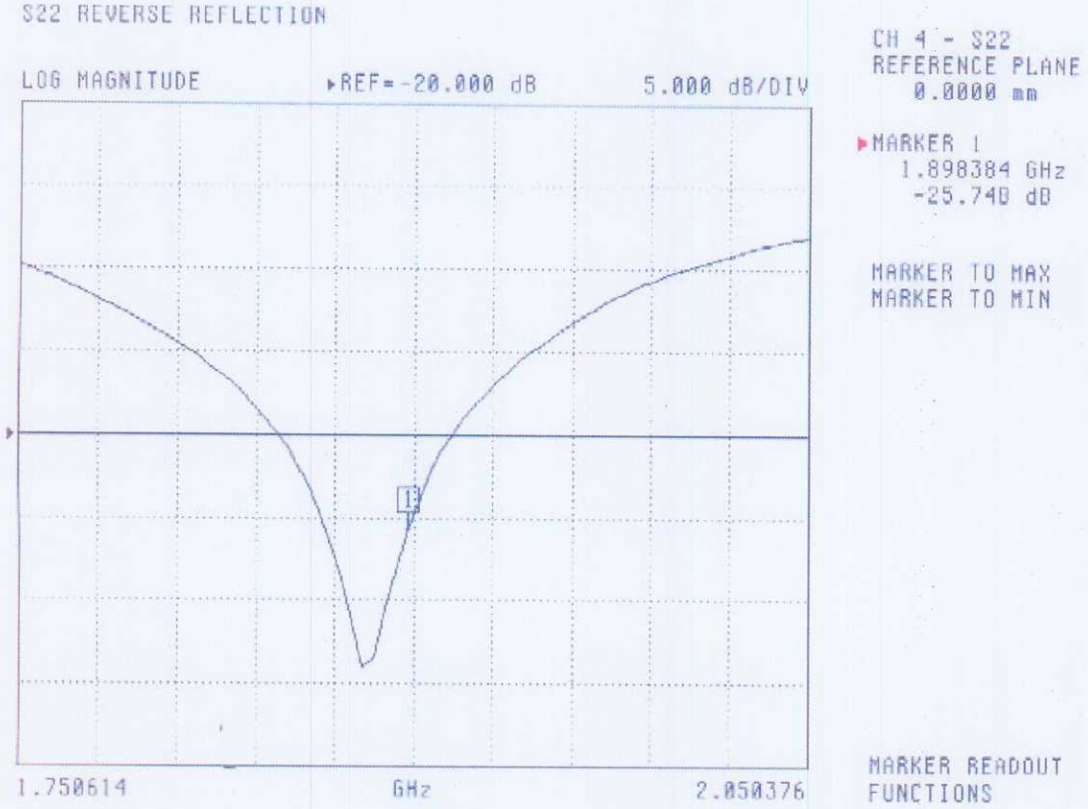
Approved by:

Electrical Calibration

Test	Result
S11 R/L	-25.7 dB
SWR	1.1 U
Impedance	46.8 Ω

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

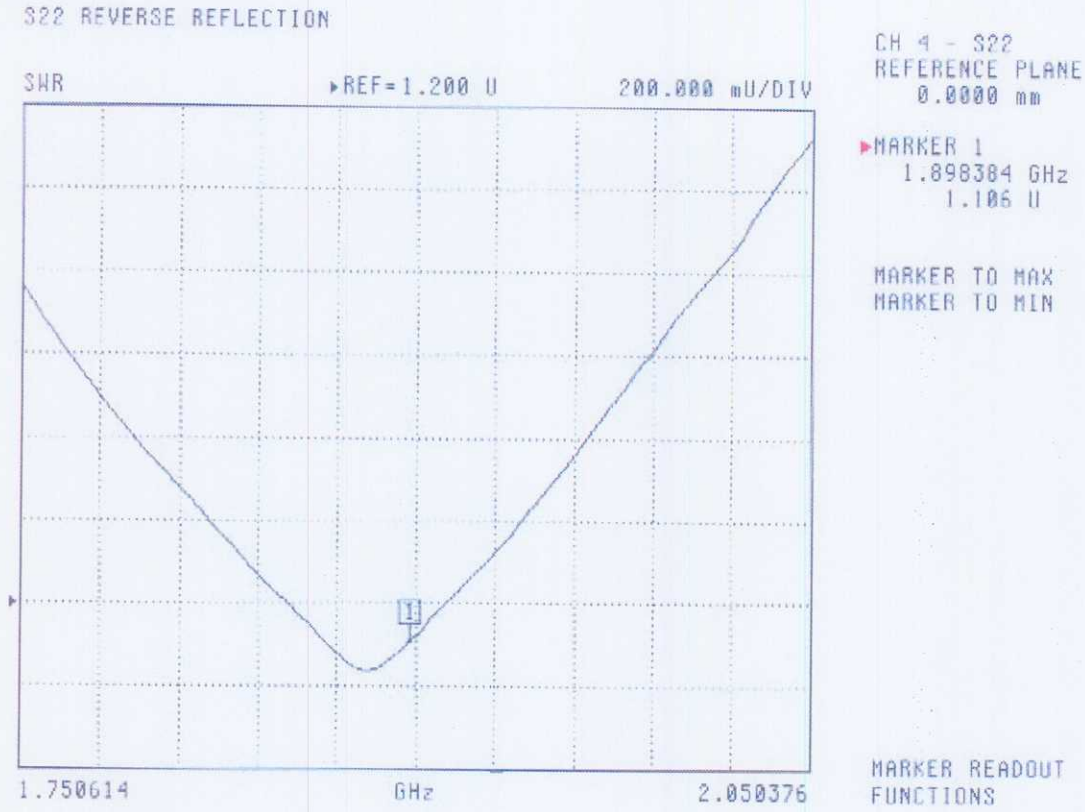
S11 Parameter Return Loss



Calibrated by

Approved by:

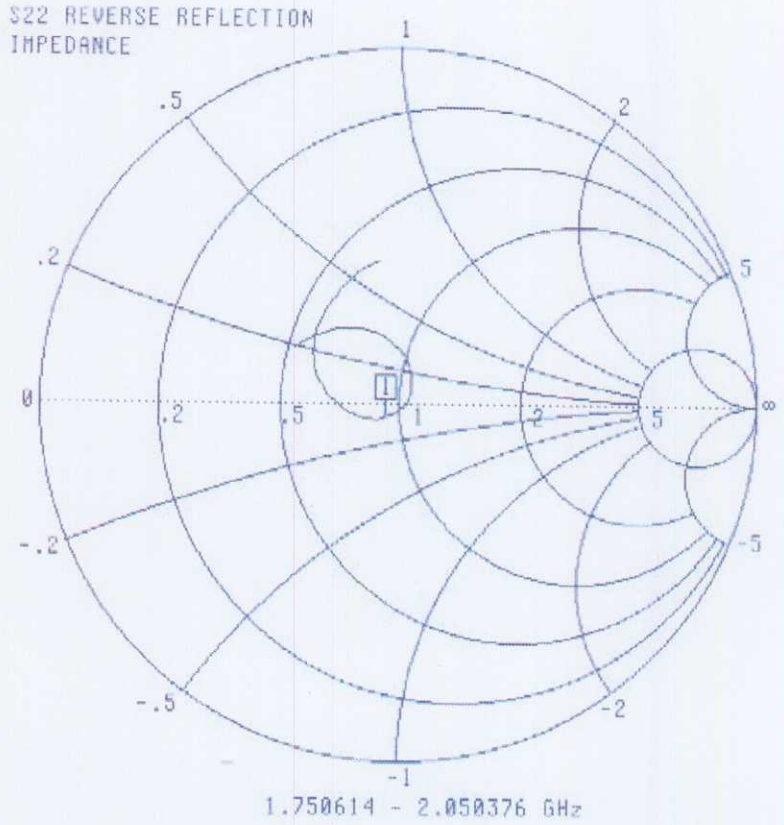
SWR



Calibrated by

Approved by:

Smith Chart Dipole Impedance



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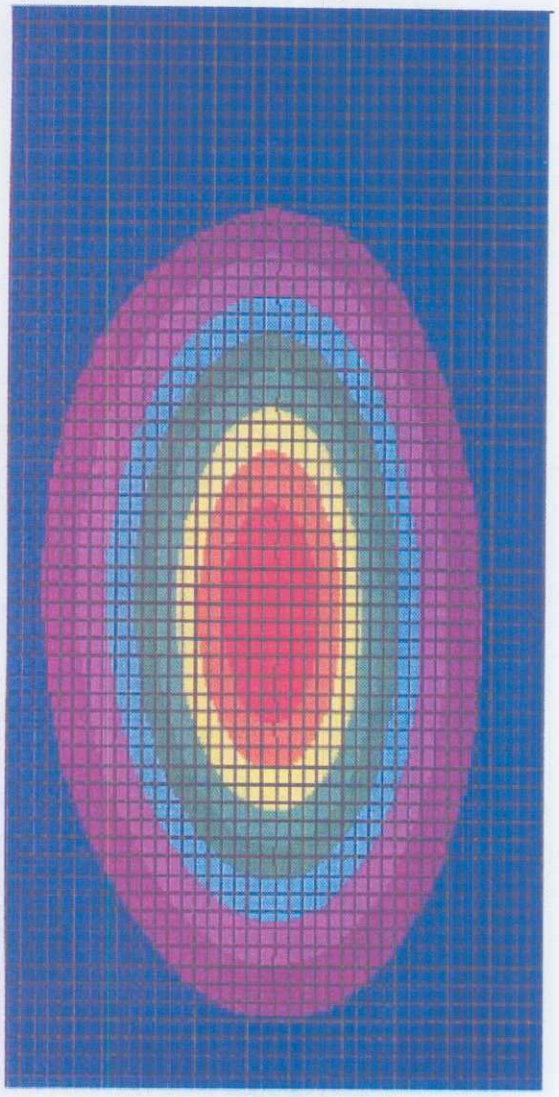
System Validation Results Using the Electrically Calibrated Dipole

Frequency	1 Gram	10 Gram	Peak Above Feed Point
1.9 GHz	36.0	20.78	67.7



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