



## **Appendix E. 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) 820-4888  
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## 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

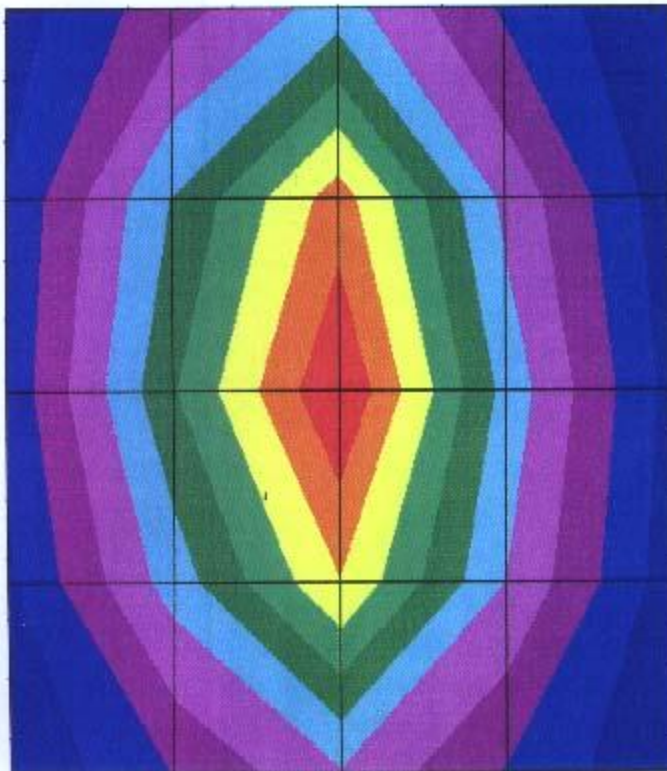
SWR: 1.21 U

Return Loss: -20.7 dB

Impedance: 47.7  $\Omega$

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
2.45 GHz	48.07	25.65	95.6



## 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

## 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, $\epsilon_r$	52.5
Conductivity, $\sigma$ [S/m]	1.78

Electrical Calibration

Test	Result
S11 R/L	-20.7 dB
SWR	1.21 U
Impedance	47.7 $\Omega$

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

S11 Parameter Return Loss

S22 REVERSE REFLECTION

LOG MAGNITUDE

REF = -20.000 dB

5.000 dB/DIV



CH 4 - S22  
REFERENCE PLANE  
0.0000 mm

MARKER 1  
2.451466 GHz  
-20.669 dB

MARKER TO MAX  
MARKER TO MIN

MARKER READOUT  
FUNCTIONS

SWR

S22 REVERSE REFLECTION

SWR REF=1.500 U 600.000 mU/DIV



CH 1 - S22  
REFERENCE PLANE  
0.0000 mm

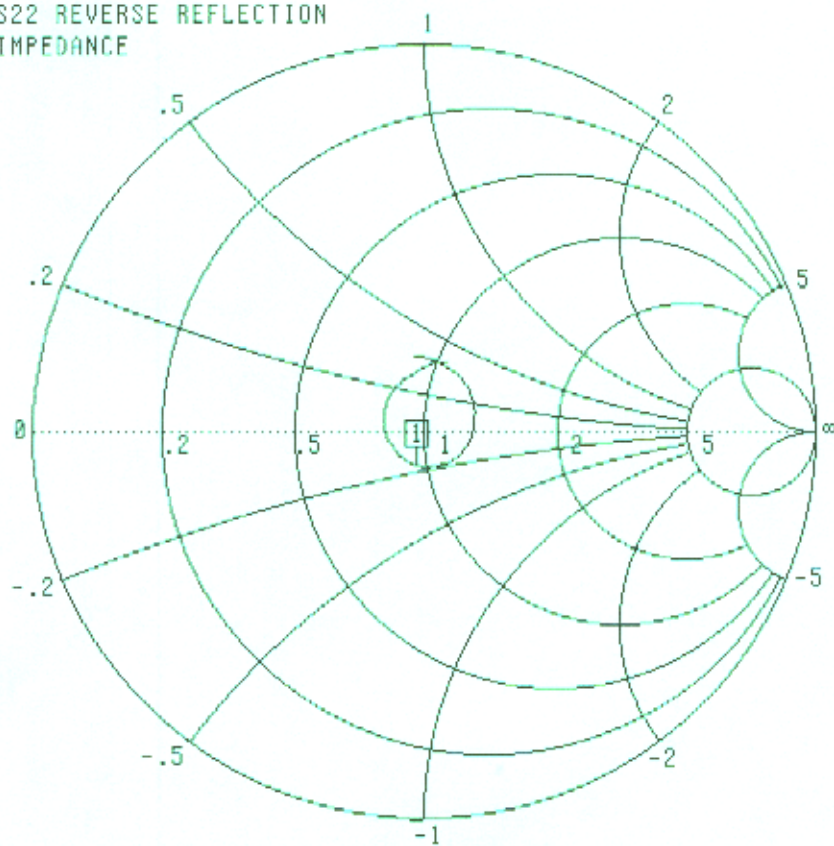
MARKER 1  
2.451466 GHz  
1.208 U

MARKER TO MAX  
MARKER TO MIN

MARKER READOUT  
FUNCTIONS

### Smith Chart Dipole Impedance

S22 REVERSE REFLECTION  
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

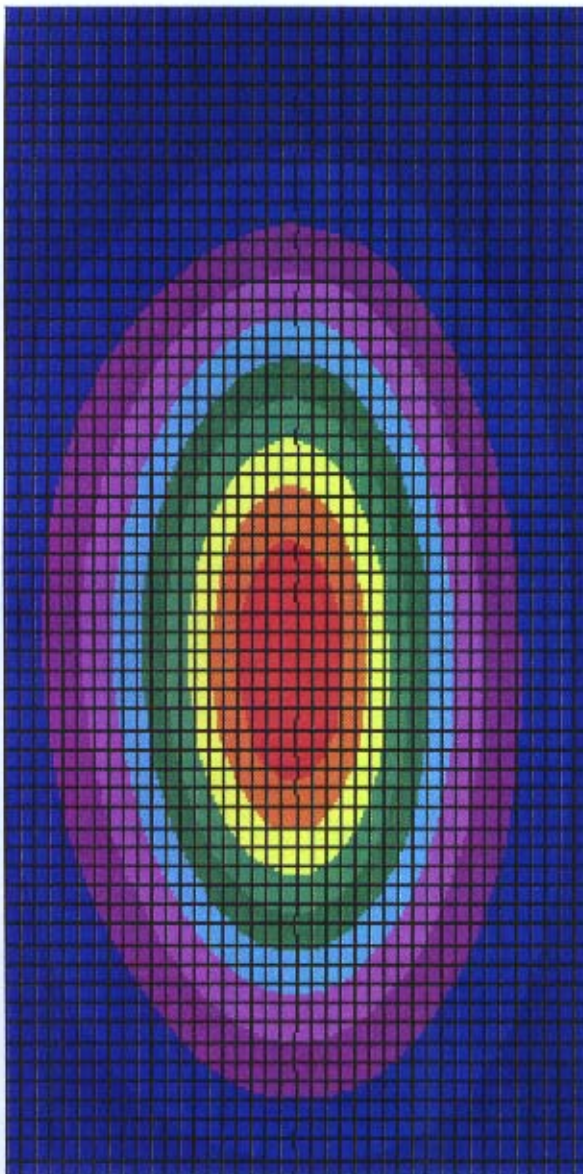
MARKER READOUT  
FUNCTIONS

2.299474 - 2.599236 GHz



**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



## **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

