

## NCL CALIBRATION LABORATORIES

Calibration File No: DC-0265  
Project Number: Internal

## C E R T I F I C A T E   O F   C A L I B R A T I O N

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.

APREL Validation Dipole

Manufacturer: APREL Laboratories

Part number: D-2450-S-1

Frequency: 2.45 GHz

Serial No: ALCD-10

Customer: APREL

Calibrated: 15 November 2002  
Released on: 14 November 2003

Released By: \_\_\_\_\_

### NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY  
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CANADA K2R 1E6

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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

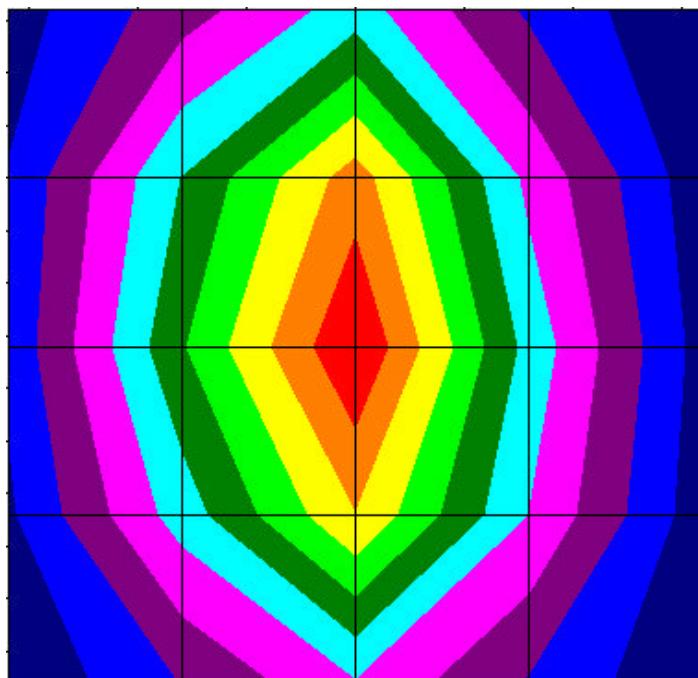
**Length:** 51.7 mm  
**Height:** 30.8 mm

### Electrical Specification

**SWR:** 1.181U  
**Return Loss:** -21.4 dB  
**Impedance:** 46.175

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
2.45 GHz	52.45	22.91	102.91



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### **Introduction**

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018. The results contained within this report are for Validation Dipole ALCD-10 at 2.45 GHz. 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 mechanical specification. 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 ALIDX-500, along with the APREL Reference E-010 130 MHz to 26 GHz E-Field Probe Serial Number 163.

### **References**

SSI-TP-018 Dipole Calibration Procedure

SSI-TP-016 Tissue Calibration Procedure

IEEE P1528 *DRAFT* “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 ALCD-10 was a new Dipole taken from stock prior to calibration.

**Ambient Temperature of the Laboratory:** 24 °C +/- 0.5°C

**Temperature of the Tissue:** 20 °C +/- 0.5°C

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### **Dipole Calibration Results**

#### **Mechanical Verification**

<b>IEEE Length</b>	<b>IEEE Height</b>	<b>Measured Length</b>	<b>Measured Height</b>
51.5 mm	30.4 mm	51.7 mm	30.8 mm

#### **Tissue Validation**

<b>Head Tissue 2450 MHz</b>	<b>Measured</b>
Dielectric constant, $\epsilon_r$	39.2
Conductivity, $s$ [S/m]	1.82
Tissue Conversion Factor,	4.61

## NCL Calibration Laboratories

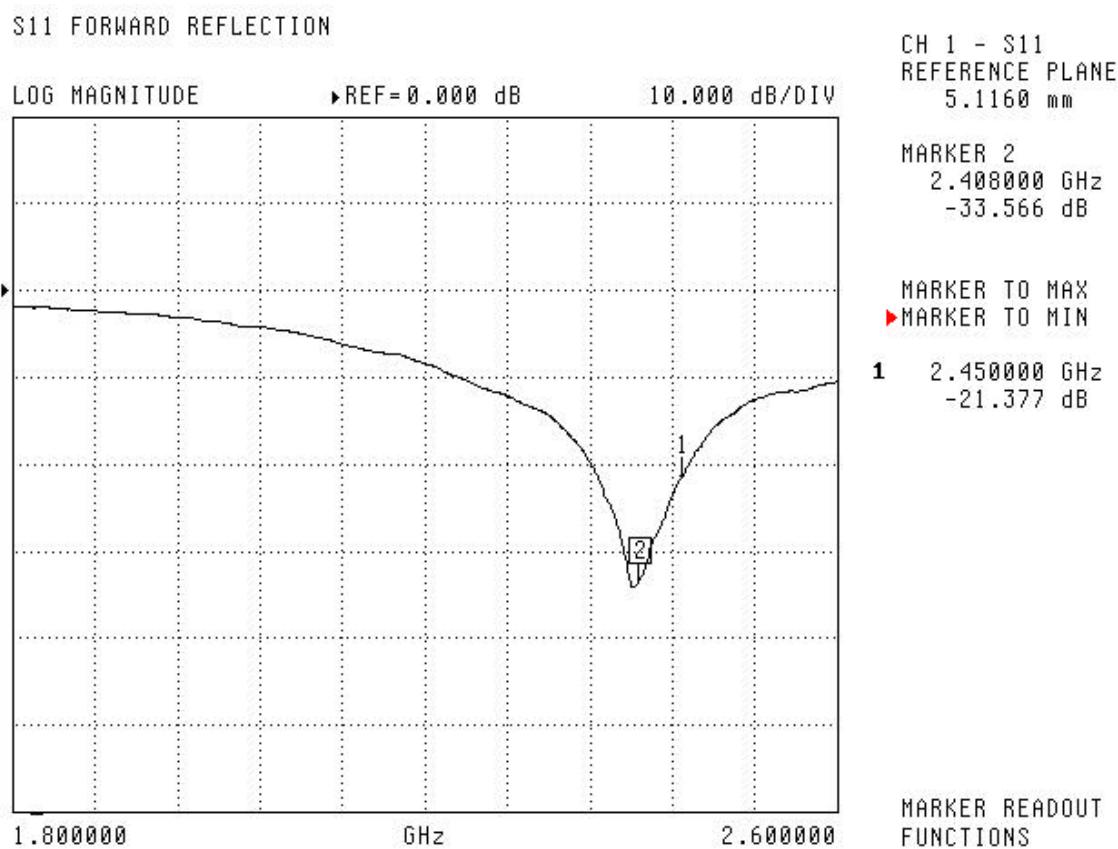
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### Electrical Calibration

Test	Result	IEEE Value
S11 R/L	-21.4	-21 dB
SWR	1.181U	-
Impedance	46.175 $\Omega$	

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

### S11 Parameter Return Loss



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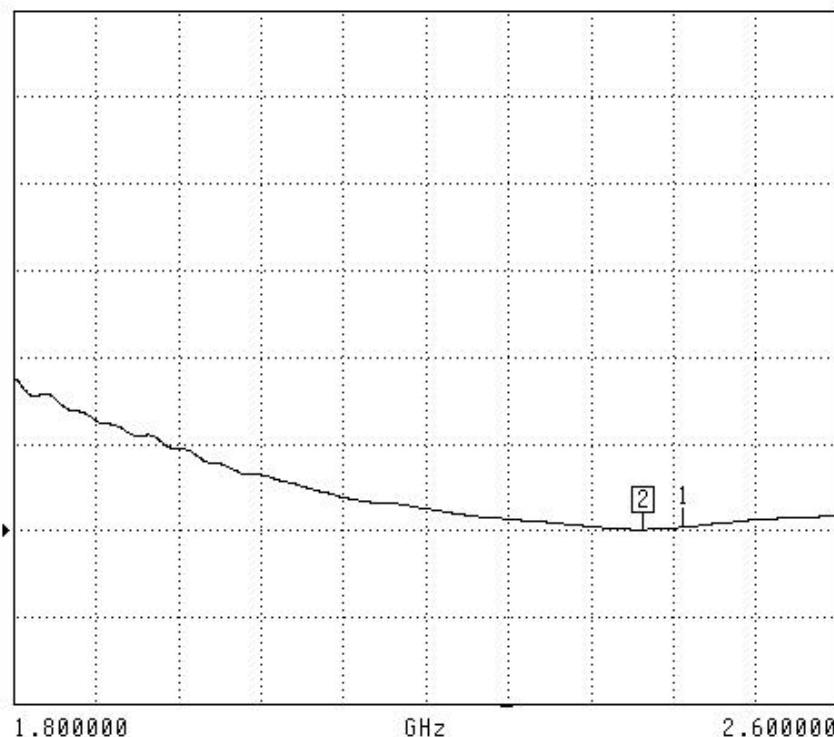
## SWR

S11 FORWARD REFLECTION

SWR

► REF=1.000 U

5.000 U/DIV



CH 1 - S11  
REFERENCE PLANE  
5.1160 mm

MARKER 2  
2.411000 GHz  
1.049 U

► MARKER TO MAX  
► MARKER TO MIN

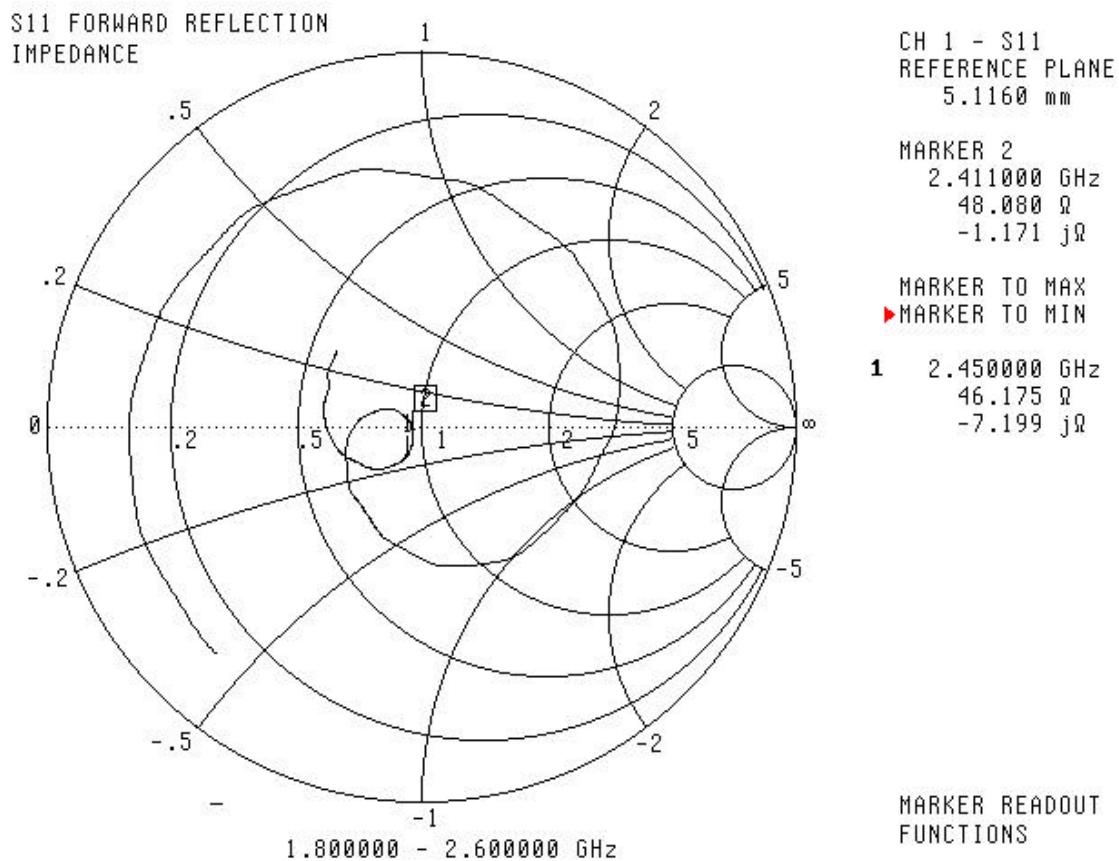
1 2.450000 GHz  
1.181 U

► MARKER READOUT  
FUNCTIONS

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## Smith Chart Dipole Impedance



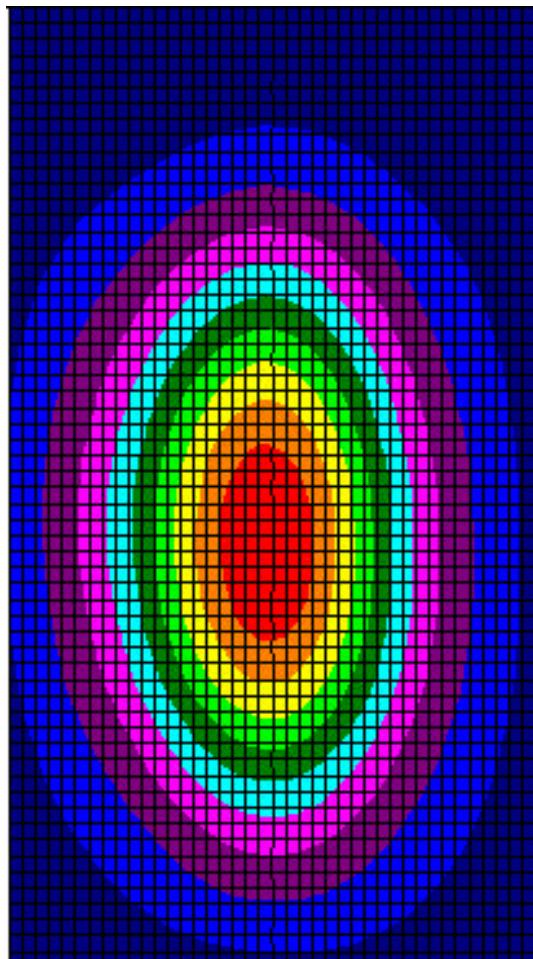
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### System Validation Results Using the Electrically Calibrated Dipole

Frequency	1 Gram	10 Gram	Peak Above Feed Point
2.45 GHz	52.45	22.91	102.91

The following Graphic Plot is the splined measurement result for the course scan.



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### **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 2002