

# NCL CALIBRATION LABORATORIES

Calibration File No: DC-591  
Project Number: RFEL-CAL-D-5258-5163

## 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.

RFEL Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-5258-S-2

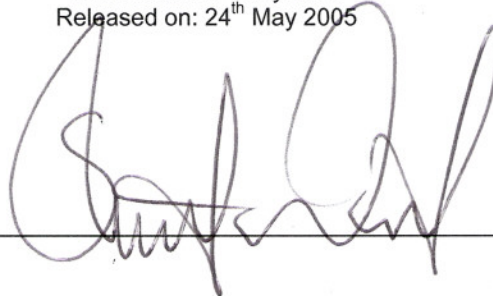
Frequency: 5.2GHz to 5.8GHz

Serial No: 5258-235-00801

Customer: RFEL

Calibrated: 24<sup>th</sup> May 2005  
Released on: 24<sup>th</sup> May 2005

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

A handwritten signature in dark ink, appearing to be a stylized name, is written over a horizontal line that extends from the 'Released By:' label to the right.

### **NCL** CALIBRATION LABORATORIES

51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA K2R 1E6

Division of APREL Lab.  
TEL: (613) 820-4988  
FAX: (613) 820-4162

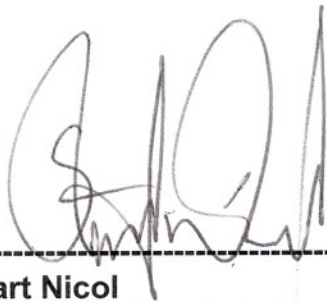
## Conditions

Dipole 5258-235-00801 was new and taken from stock prior to calibration.

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

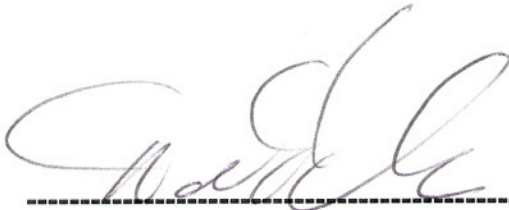
**Temperature of the Tissue:** 21 °C +/- 0.5°C

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



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**Stuart Nicol**  
**Director Product Development**



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**D. Brooks**  
**Member of Engineering Staff**  
**(Calibration Engineer)**

## Calibration Results Summary

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

### Mechanical Dimensions

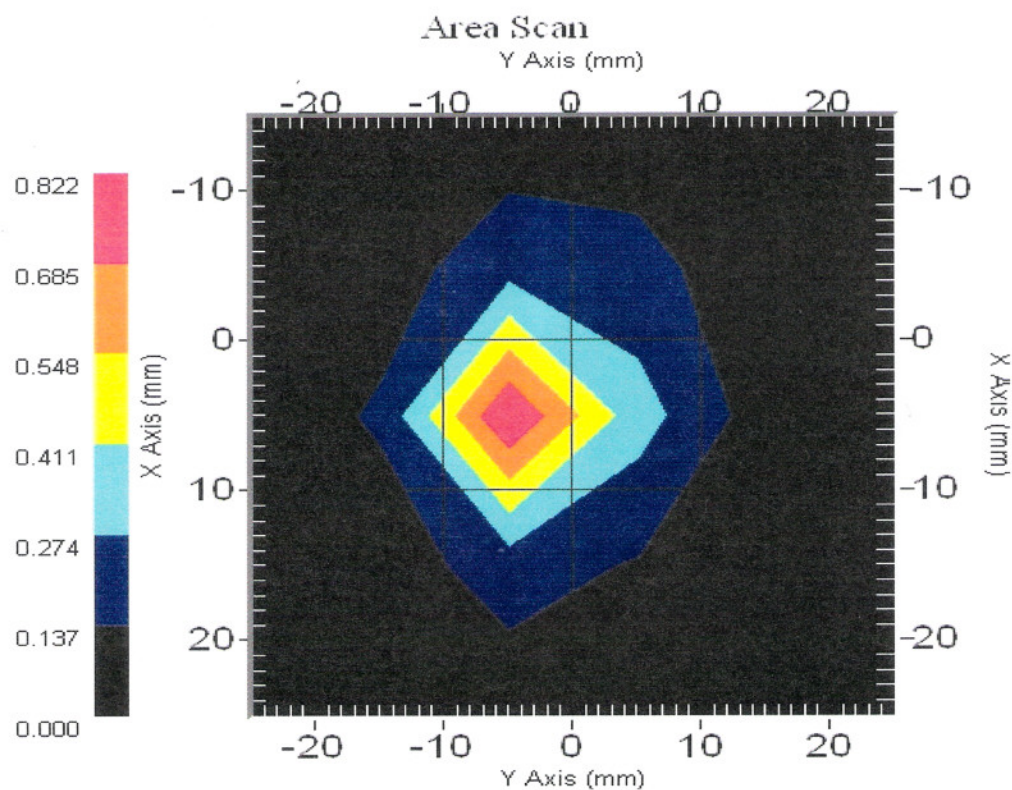
**Length:** 23.3 mm  
**Height:** 20.3 mm

### Electrical Specification

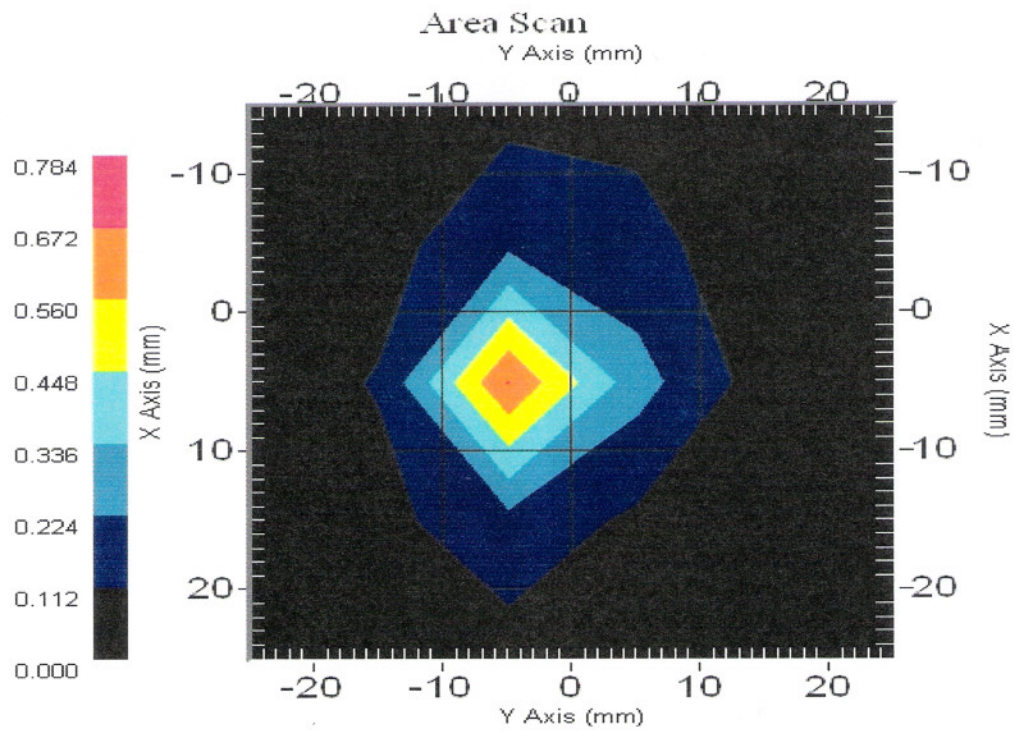
**SWR:** 1.22 U  
**Return Loss:** -20.0 dB  
**Impedance:** 50.0  $\Omega$

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
5200 MHz	62.9	17.9	223.1



Frequency	1 Gram	10 Gram	Peak
5800 MHz	58.3	18	207.1



## **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 5258-235-00801. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the 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 APREL 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 5258-235-00801 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

### Tissue Validation

Head Tissue 5200 MHz	Measured
Dielectric constant, $\epsilon_r$	35.3
Conductivity, $\sigma$ [S/m]	5.30

Head Tissue 5800 MHz	Measured
Dielectric constant, $\epsilon_r$	35.3
Conductivity, $\sigma$ [S/m]	5.30

### Mechanical Verification

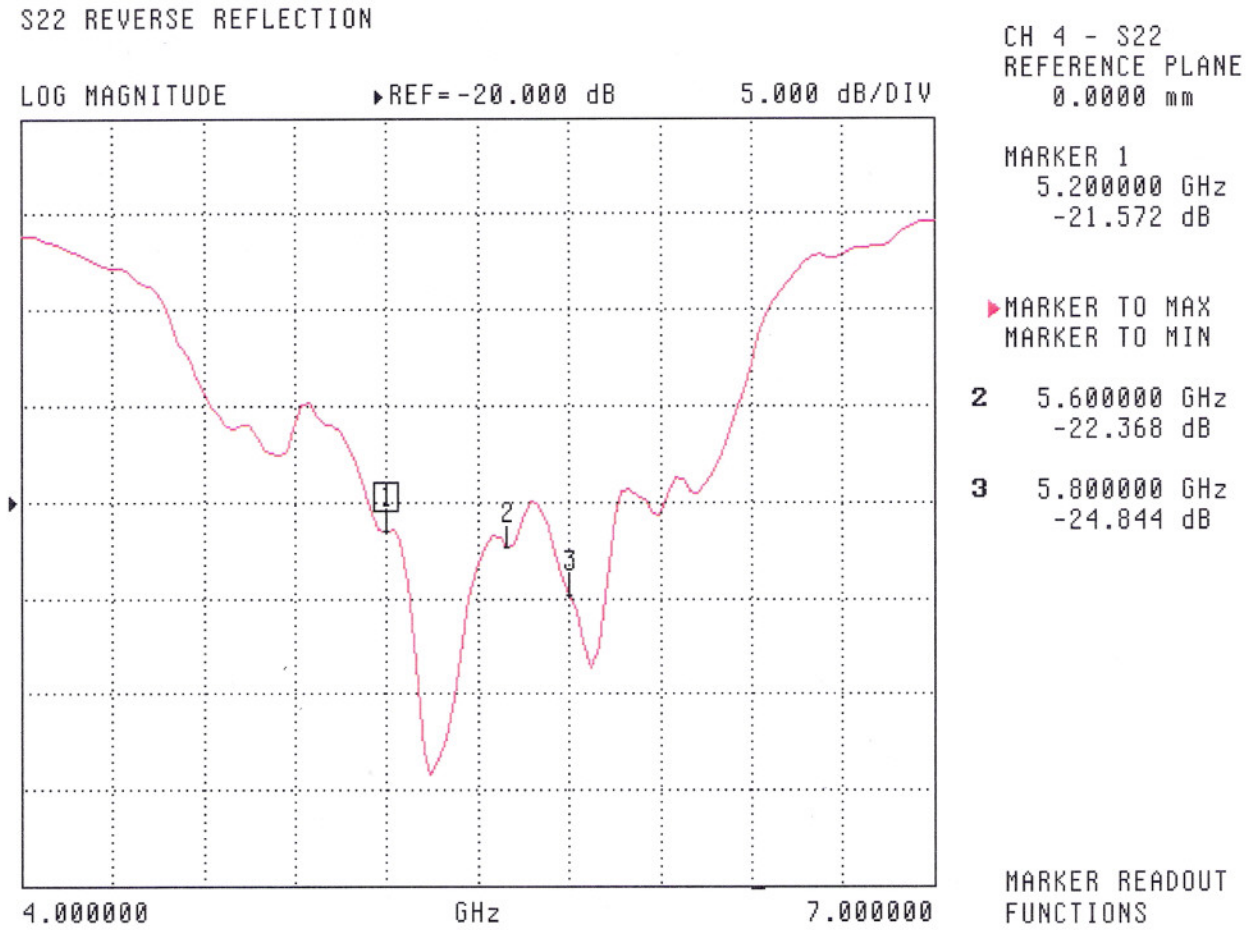
APREL Length	APREL Height	Measured Length	Measured Height
23.1 mm	20.7 mm	23.3 mm	20.3 mm

### Electrical Calibration

S11	5200MHz	5800MHz
RL (dB)	-21.6	-24.8
SWR	1.19	1.12
Impedance (ohms)	45.6	50.7

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

**S11 Parameter Return Loss**



**SWR**

S22 REVERSE REFLECTION

SWR                      ▶ REF=2.500 U                      500.000 mU/DIV



CH 4 - S22  
REFERENCE PLANE  
0.0000 mm

MARKER 1  
5.200000 GHz  
1.189 U

▶ MARKER TO MAX  
MARKER TO MIN

2 5.600000 GHz  
1.153 U

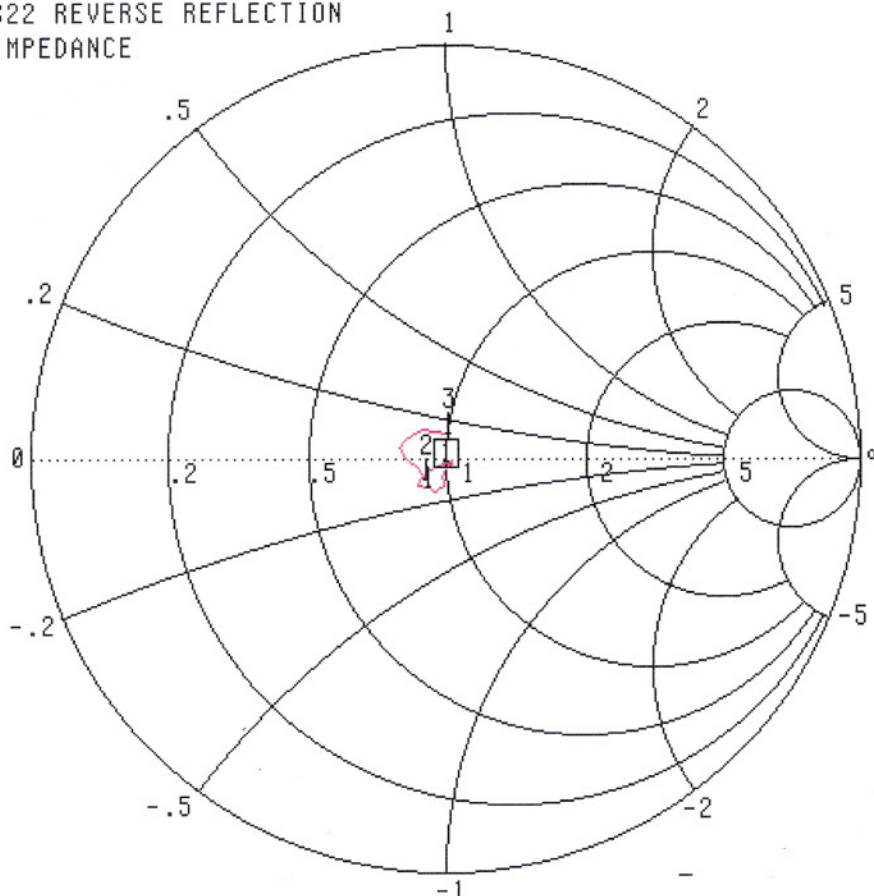
3 5.800000 GHz  
1.124 U

MARKER READOUT  
FUNCTIONS



### Smith Chart Dipole Impedance

S22 REVERSE REFLECTION  
IMPEDANCE



5.200000 - 5.800000 GHz

CH 4 - S22  
REFERENCE PLANE  
0.0000 mm

MARKER 1  
5.200000 GHz  
45.566  $\Omega$   
-6.839  $j\Omega$

▶ MARKER TO MAX  
MARKER TO MIN

2 5.600000 GHz  
45.348  $\Omega$   
-4.725  $j\Omega$   
3 5.800000 GHz  
50.691  $\Omega$   
5.736  $j\Omega$

MARKER READOUT  
FUNCTIONS

## **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

## Appendix F – Phantom Calibration Data Sheets

## NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-273

# 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 National Standards.

Thickness of the UniPhantom is 2 mm  $\pm$  10%  
Pinna thickness is 6 mm  $\pm$  10%

Resolution:	0.01 mm	Calibrated to:	0.0 mm
Stability:	OK	Accuracy:	< 0.1 mm

Calibrated By: Karen K. Feb 17/04.

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