

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: 24th May 2005
Released on: 24th May 2005

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

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

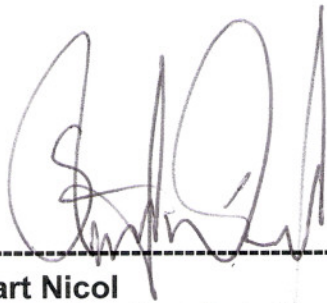
Conditions

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

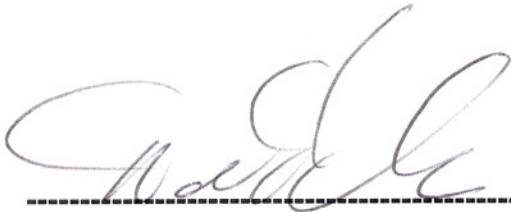
Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

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.



Stuart Nicol
Director Product Development



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

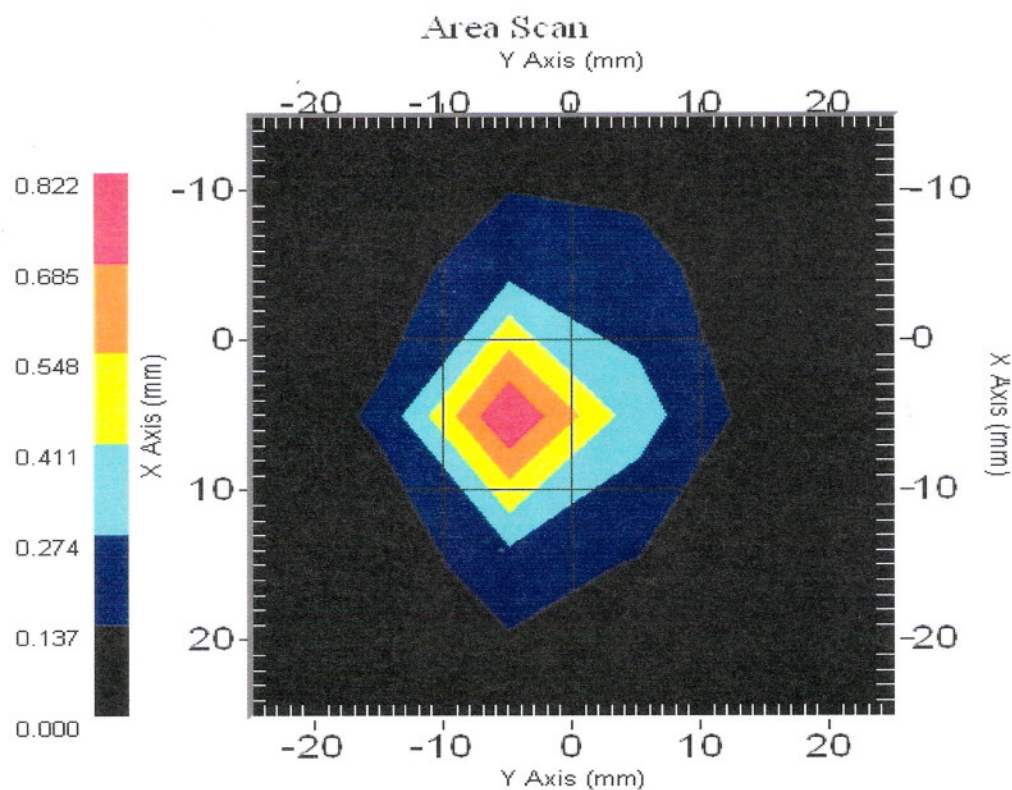
Length: 23.3 mm
Height: 20.3 mm

Electrical Specification

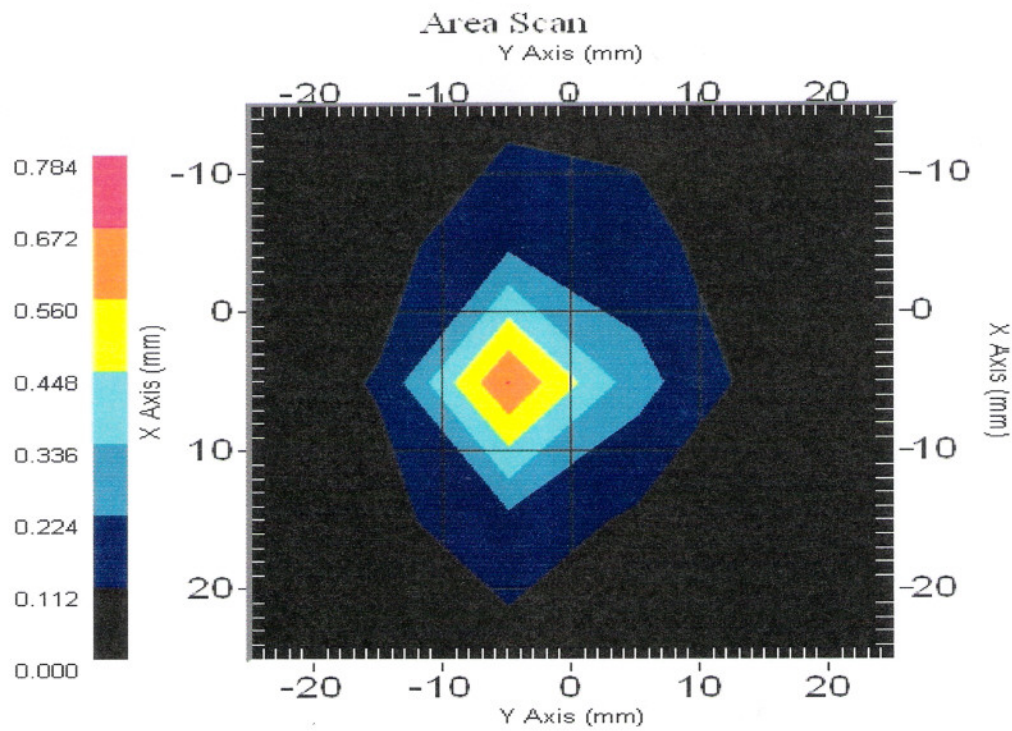
SWR: 1.22 U
Return Loss: -20.0 dB
Impedance: 50.0 Ω

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, ϵ_r | 35.3 |
| Conductivity, σ [S/m] | 5.30 |

| Head Tissue 5800 MHz | Measured |
|-----------------------------------|----------|
| Dielectric constant, ϵ_r | 35.3 |
| Conductivity, σ [S/m] | 5.30 |

Mechanical Verification

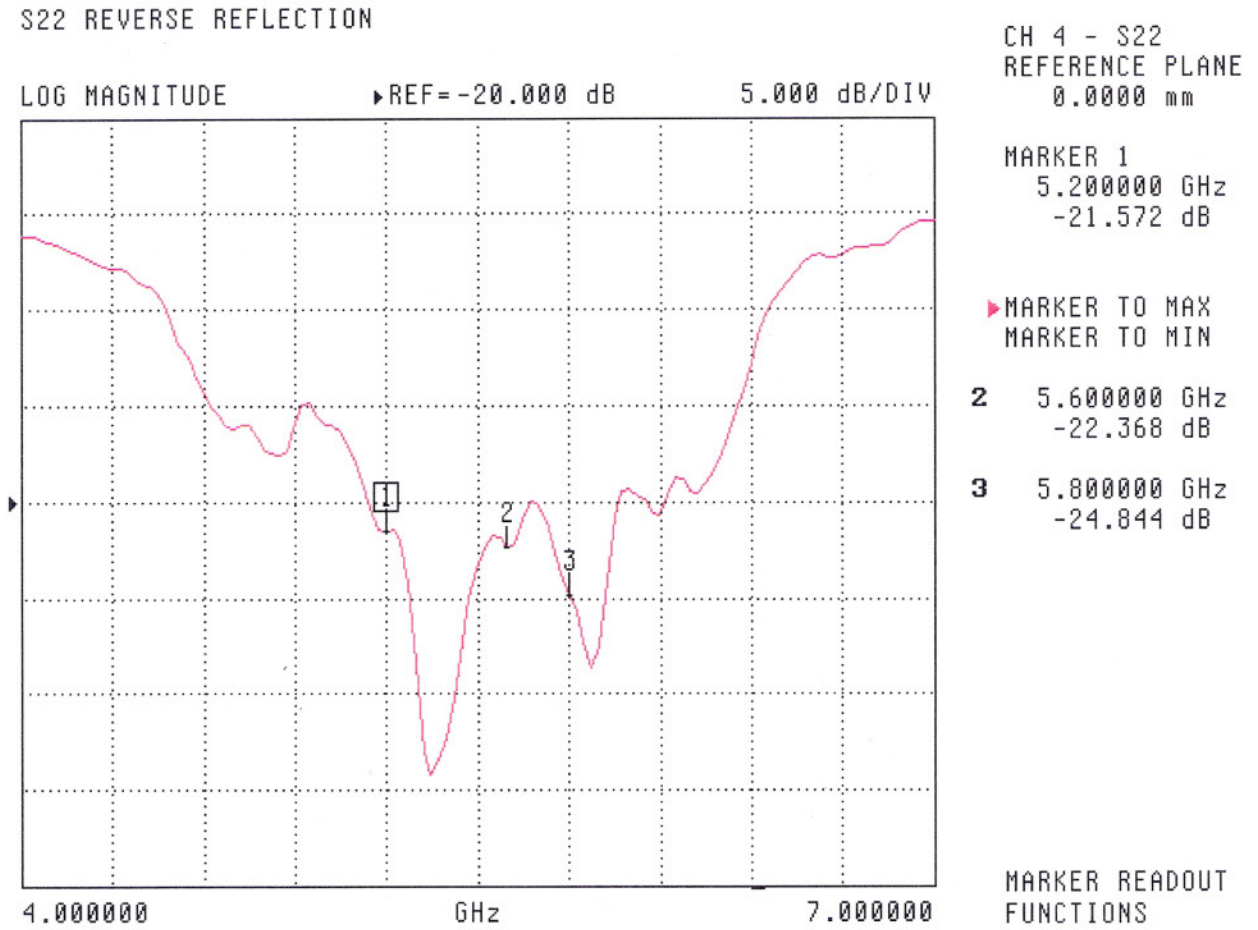
| APREL Length | APREL Height | Measured Length | Measured Height |
|--------------|--------------|-----------------|-----------------|
| 23.1 mm | 20.7 mm | 23.3 mm | 20.3 mm |

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

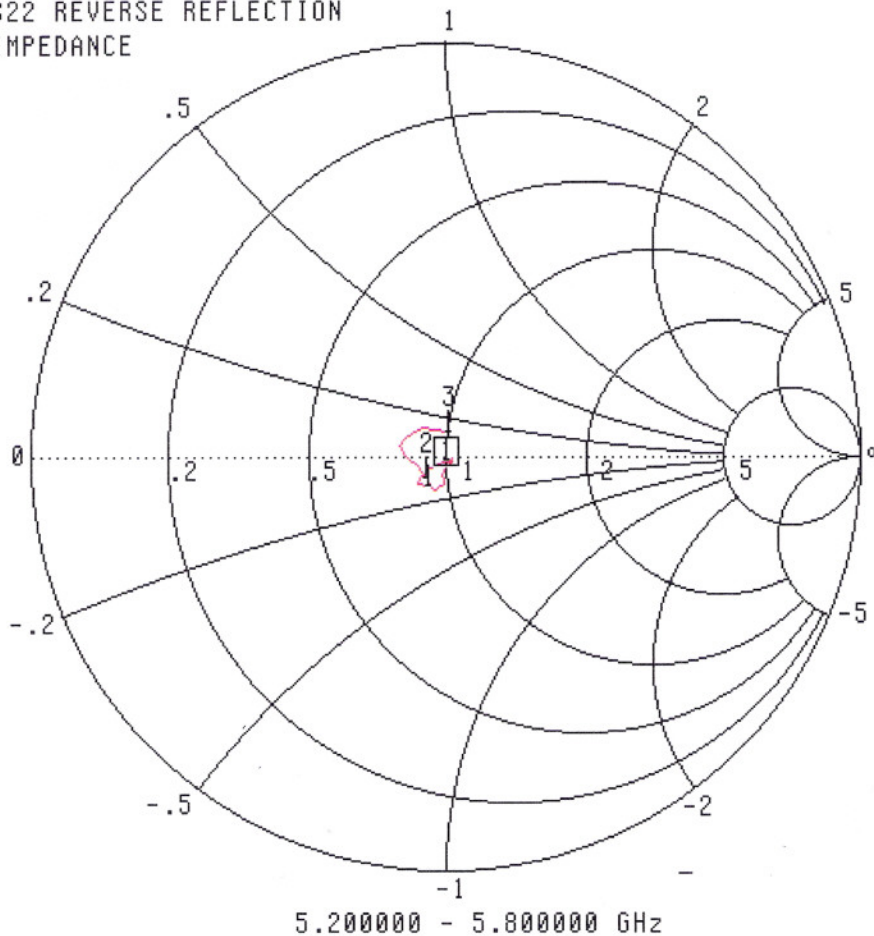
2 5.600000 GHz
1.153 U

3 5.800000 GHz
1.124 U

MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance

S22 REVERSE REFLECTION
IMPEDANCE



CH 4 - S22
REFERENCE PLANE
0.0000 mm

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

▶ MARKER TO MAX
MARKER TO MIN

2 5.600000 GHz
45.348 Ω
-4.725 $j\Omega$
3 5.800000 GHz
50.691 Ω
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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Division of APREL Lab.
TEL: (613) 820-4988
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