

# NCL CALIBRATION LABORATORIES

Calibration File No: DC-1397  
Project Number: ISL-D1800-cal-5636

## 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.

ISL Body Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-1800-S-2

Frequency: 1800 MHz

Serial No: 1800-200-00653

Customer: ISL

Calibrated: 25th January 2012  
Released on: 25<sup>th</sup> January 2012

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

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



Art Brennan, Quality Manager

**NCL** CALIBRATION LABORATORIES

Suite 102, 303 Terry Fox Dr,  
OTTAWA, ONTARIO  
CANADA K2K 3J1

Division of APREL Lab.  
TEL: (613) 435-8300  
FAX: (613) 435-8306

## Conditions

Dipole 1800-200-00653 was a re-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 subject has been accurately conducted and that all information contained within the results pages have been reviewed for accuracy.**



Art Brennan, Quality Manager



Constantin Teodorian, Test Engineer

## Calibration Results Summary

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

### Mechanical Dimensions

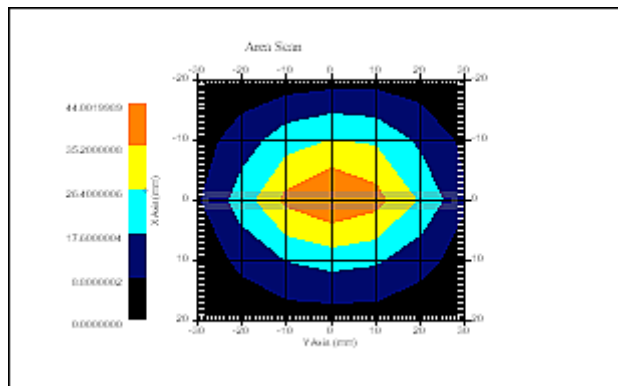
**Length:** 72.0 mm  
**Height:** 41.7 mm

### Electrical Specification

S11 R/L	-13.28 dB
SWR	1.554 U
Impedance	33.688 $\Omega$

### System Validation Results

Frequency	1 Gram	10 Gram	Peak
1800 MHz	37.96	19.60	70.06



## 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 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-030 130 MHz to 26 GHz E-Field Probe Serial Number 215.

## 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"

IEC-62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures"

Part 1: "Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 300 MHz to 3 GHz)"

IEC-62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures"

Part 2 *Draft*: "Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 30 MHz to 6 GHz)"

## Conditions

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

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

This was a recalibration.

## Dipole Calibration uncertainty

The calibration uncertainty for the dipole is made up of various parameters presented below.

<b>Mechanical</b>	1%
<b>Positioning Error</b>	1.22%
<b>Electrical</b>	1.7%
<b>Tissue</b>	2.2%
<b>Dipole Validation</b>	2.2%
<b>TOTAL</b>	<b>8.32% (16.64% K=2)</b>

## **Dipole Calibration Results**

### **Mechanical Verification**

<b>APREL Length</b>	<b>APREL Height</b>	<b>Measured Length</b>	<b>Measured Height</b>
72.0 mm	41.7 mm	72.9 mm	41.7 mm

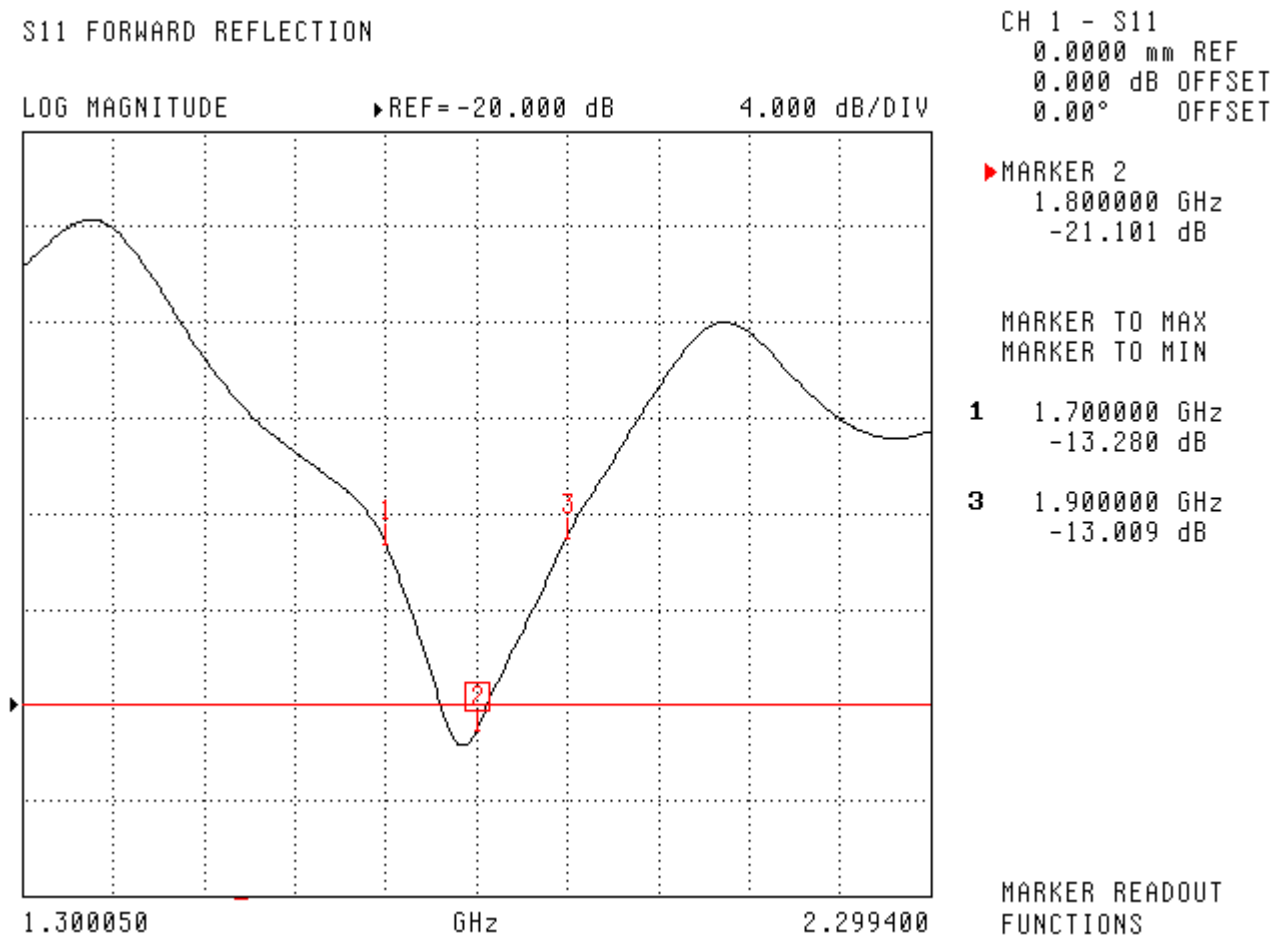
### **Tissue Validation**

<b>Body Tissue 1800 MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	52.38
<b>Conductivity, <math>\sigma</math> [S/m]</b>	1.5

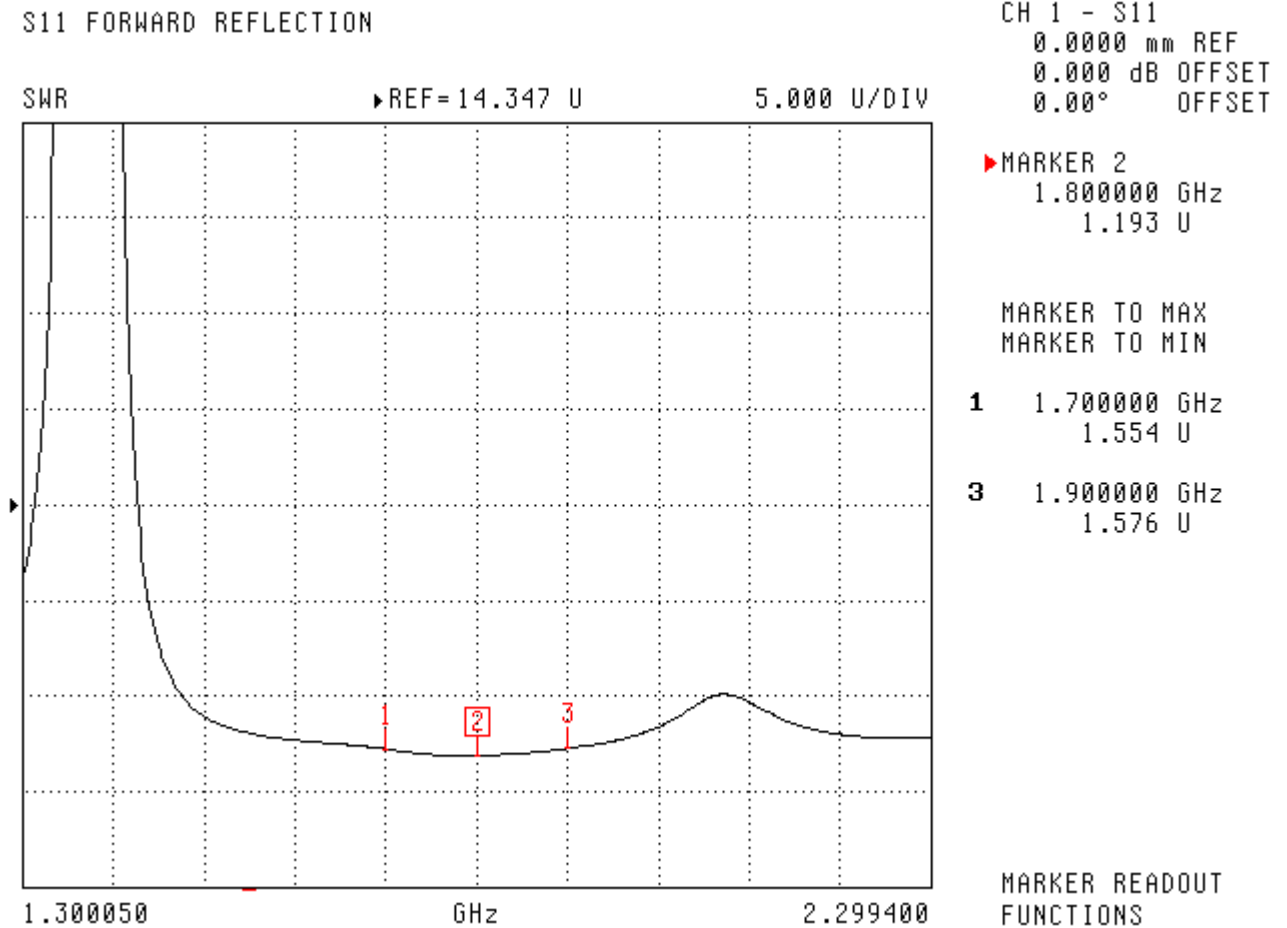
**Electrical Calibration**

Test	Result
S11 R/L	-13.28 dB
SWR	1.554 U
Impedance	33.688 $\Omega$

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

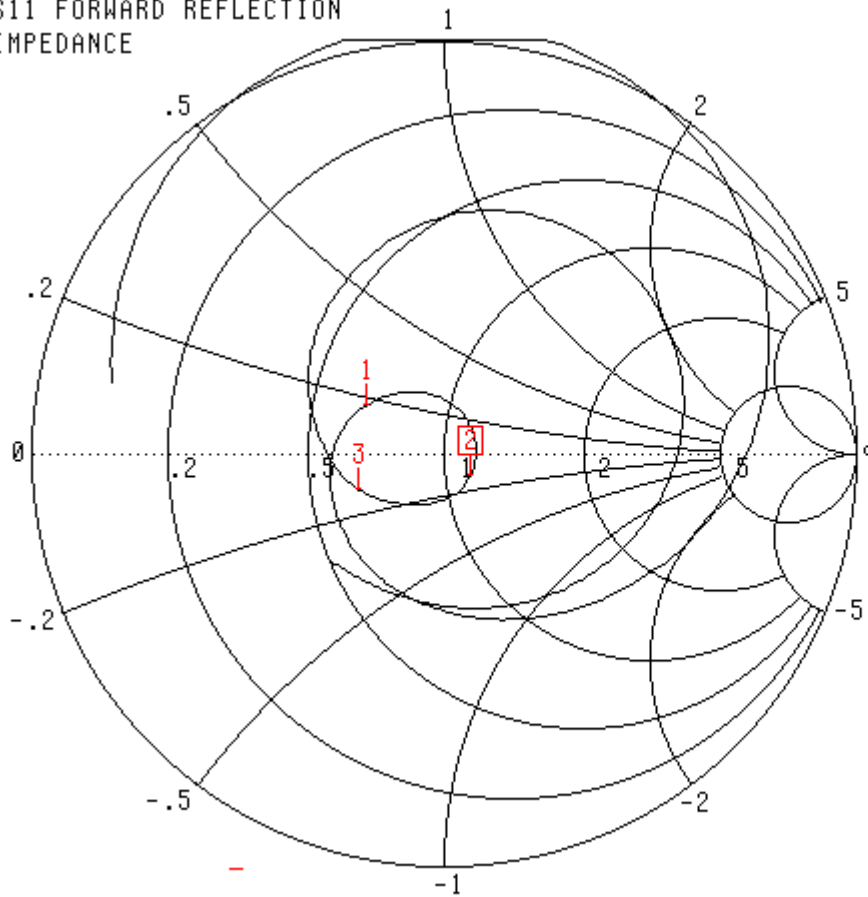
**S11 Parameter Return Loss**

## SWR



## Smith Chart Dipole Impedance

S11 FORWARD REFLECTION  
IMPEDANCE



CH 1 - S11  
0.0000 mm REF  
0.000 dB OFFSET  
0.00° OFFSET

▶ MARKER 2  
1.800000 GHz  
57.109 Ω  
-6.217 jΩ

MARKER TO MAX  
MARKER TO MIN

**1** 1.700000 GHz  
33.688 Ω  
8.137 jΩ  
**3** 1.900000 GHz  
32.495 Ω  
-5.973 jΩ

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 2011.