

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1400
Project Number: ISL-D2450-cal-5639

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-2450-S-2

Frequency: 2450 MHz

Serial No: 2450-220-00753

Customer: ISL

Calibrated: 25th January 2012
Released on: 25th January, 2012

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

Released By: _____



Art Brennan, Quality Manager

NCL CALIBRATION LABORATORIES

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Conditions


Dipole 2450-220-00753 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: 51.5 mm
Height: 30.4 mm

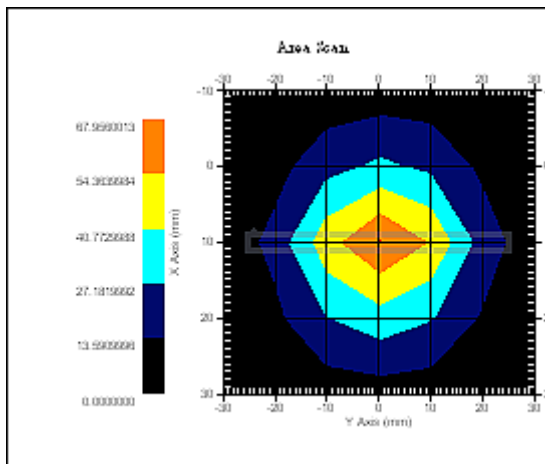
Electrical Specification

S11 R/L	-16.32 dB
SWR	1.37 U
Impedance	10.33 Ω

System Validation Results

Calibrated @ 100mW

Frequency	1 Gram	10 Gram	Peak
2450 MHz	55.57	25.80	112.98



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.

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

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
51.5 mm	30.4 mm	52.1 mm	31.0 mm

Tissue Validation

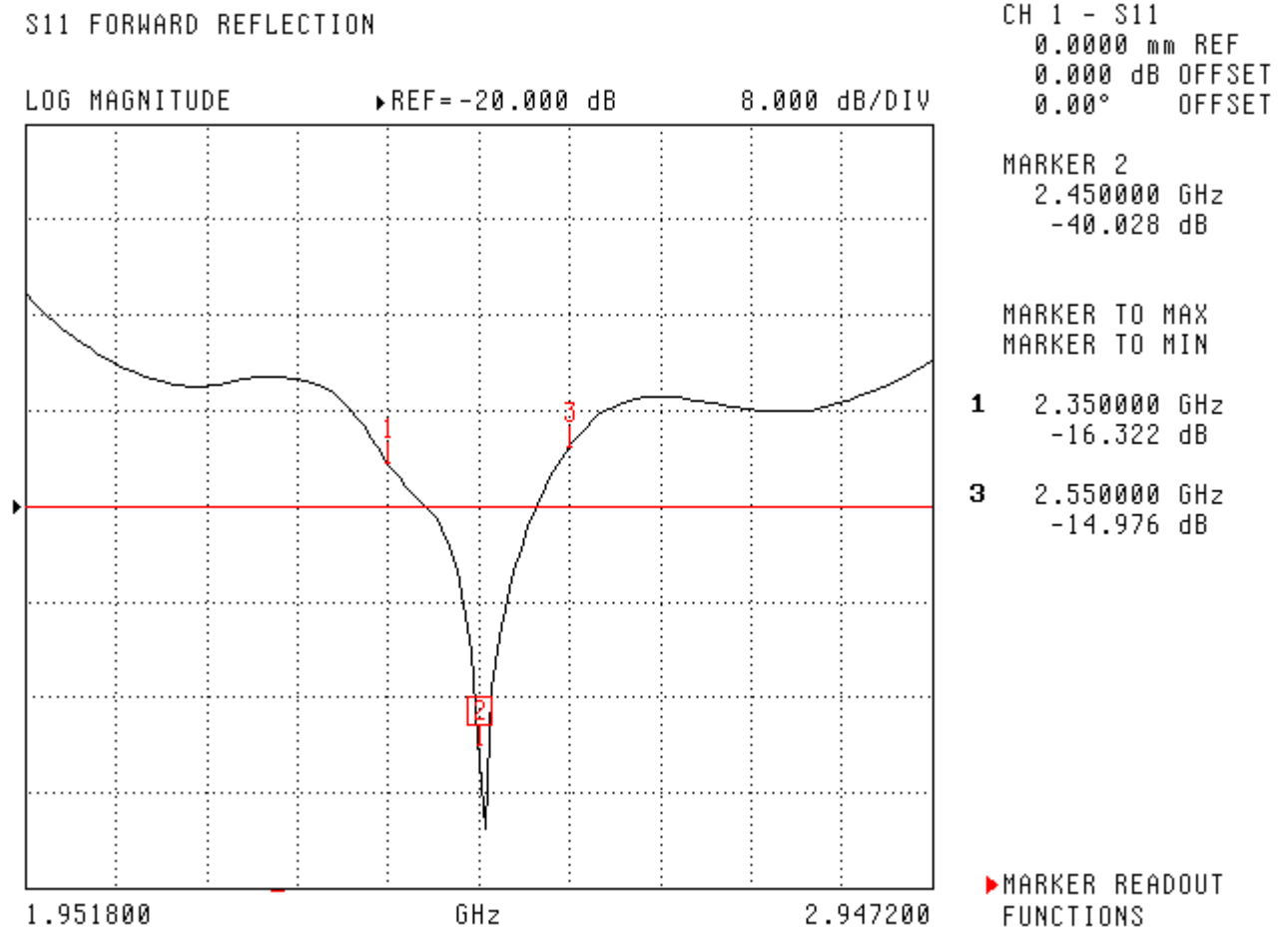
Body Tissue 2450 MHz	Measured
Dielectric constant, ϵ_r	51.2
Conductivity, σ [S/m]	2.16

Electrical Calibration

Test	Result
S11 R/L	-16.32 dB
SWR	1.37 U
Impedance	10.33 Ω

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

S11 Parameter Return Loss



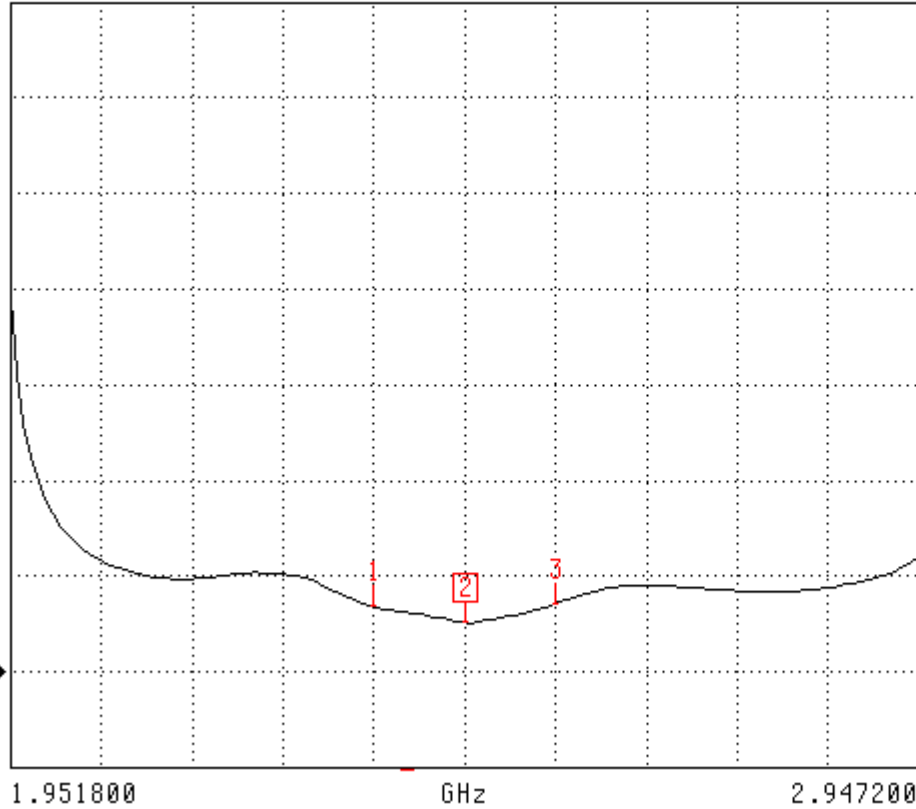
SWR

S11 FORWARD REFLECTION

SWR

REF=0.000 pU

2.000 U/DIV



CH 1 - S11

0.0000 mm REF

0.000 dB OFFSET

0.00° OFFSET

MARKER 2

2.450000 GHz

1.021 U

MARKER TO MAX

MARKER TO MIN

1 2.350000 GHz

1.368 U

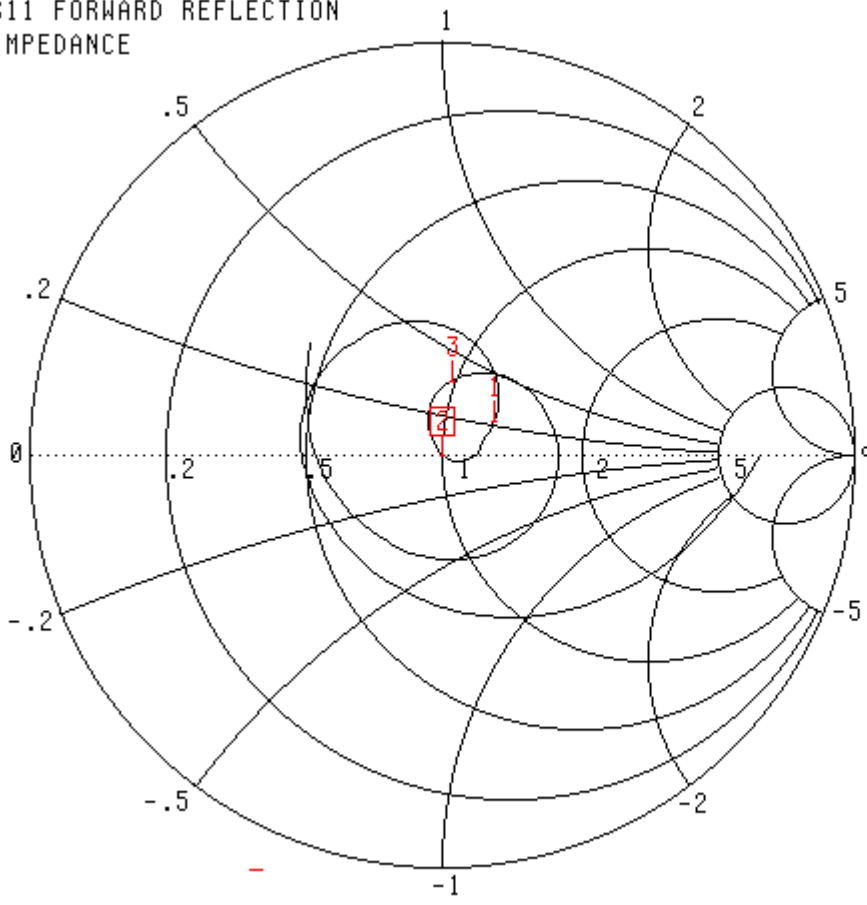
3 2.550000 GHz

1.430 U

MARKER READOUT FUNCTIONS

Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



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

MARKER 2
2.450000 GHz
50.713 Ω
-649.365 jΩ

MARKER TO MAX
MARKER TO MIN

1 2.350000 GHz
64.146 Ω
10.325 jΩ
3 2.550000 GHz
49.559 Ω
18.033 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.