



Appendix E. Dipole Calibration Data

Validation Dipole 835MHz

P/N: ALS-D-835-S-2

S/N: QTK-315

NCL CALIBRATION LABORATORIES

Calibration File No: DC-405-1
Project Number: QTKB-Dipole Cal-5226

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.

Quietek Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-835-S-2

Frequency: 835 MHz

Serial No: QTK-315

Customer: Quietek

Calibrated: 15 June 2006
Released on: 15 June 2006

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

Calibration Results Summary

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

Mechanical Dimensions

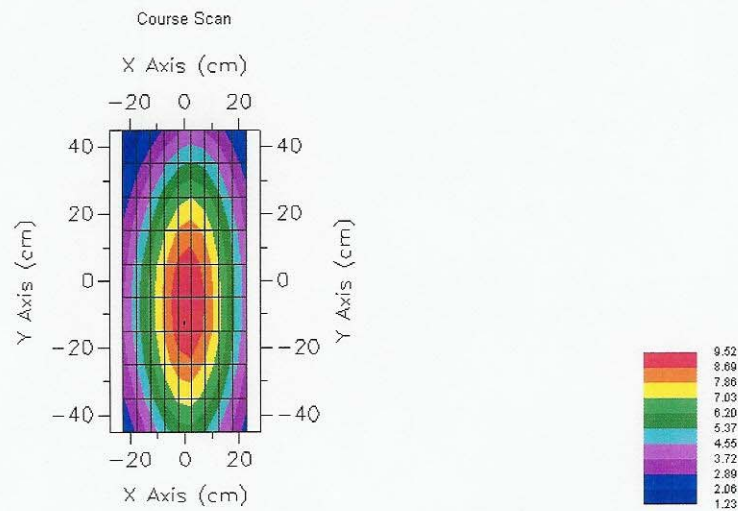
Length: 165.0 mm
Height: 90.0 mm

Electrical Specification

SWR: 1.05 U
Return Loss: -31.5 dB
Impedance: 47.6 Ω

System Validation Results

| Frequency | 1 Gram | 10 Gram | Peak |
|-----------|--------|---------|------|
| 835 MHz | 9.33 | 6.42 | 15.0 |



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 QTK-315. 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/APREL 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 QTK 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 QTK-315 was received for calibration.

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

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

Dipole Calibration Results

Mechanical Verification

| IEEE Length | IEEE Height | Measured Length | Measured Height |
|-------------|-------------|-----------------|-----------------|
| 161.0 mm | 89.8 mm | 165.0 mm | 90.0 mm |

Tissue Validation

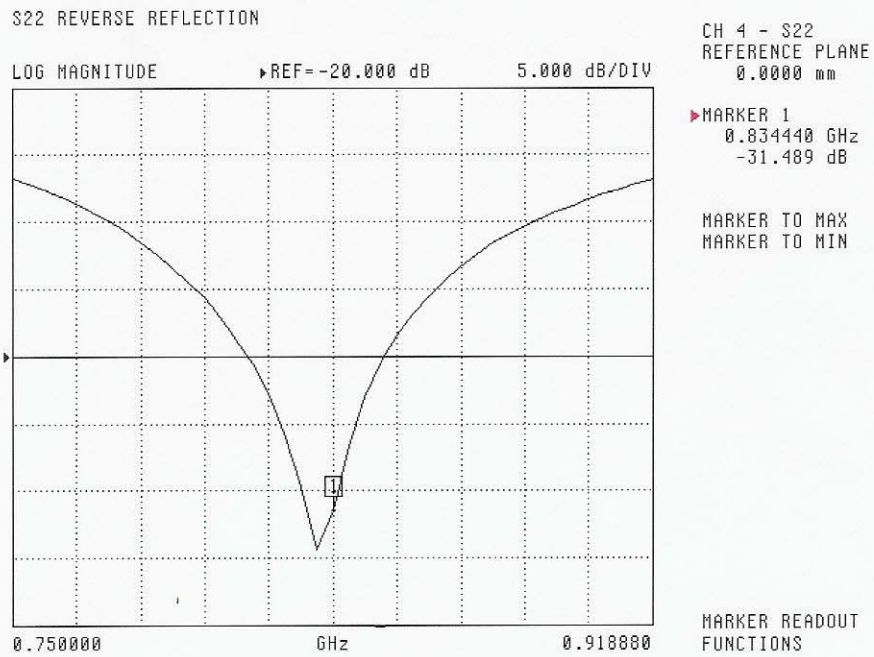
| Head Tissue 835 MHz | Measured |
|-----------------------------------|----------|
| Dielectric constant, ϵ_r | 42.54 |
| Conductivity, σ [S/m] | 0.91 |

Electrical Calibration

| Test | Result |
|-----------|---------------|
| S11 R/L | -31.5 dB |
| SWR | 1.06 U |
| Impedance | 47.6 Ω |

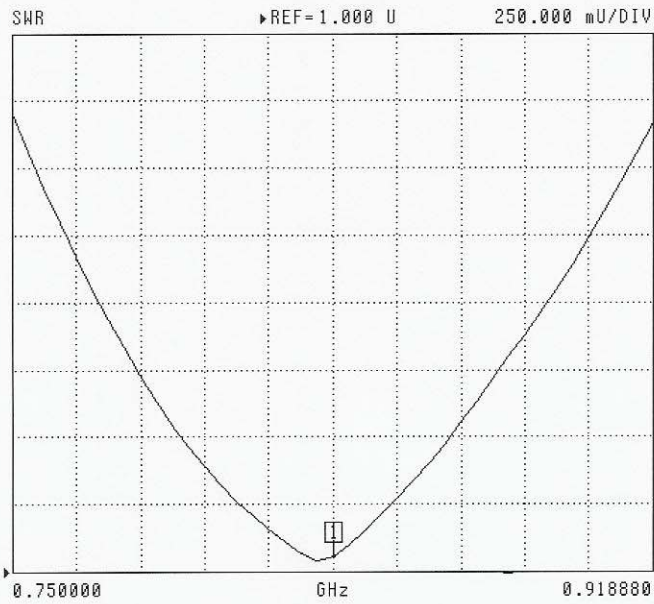
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss



SWR

S22 REVERSE REFLECTION



CH 4 - S22
REFERENCE PLANE
0.0000 mm

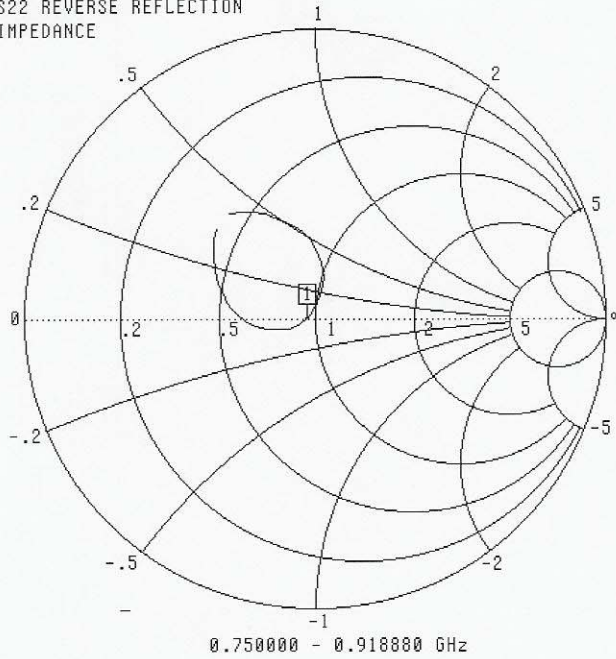
▶ MARKER 1
0.834440 GHz
1.055 U

MARKER TO MAX
MARKER TO MIN

MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance

S22 REVERSE REFLECTION
IMPEDANCE



CH 4 - S22
REFERENCE PLANE
0.0000 mm

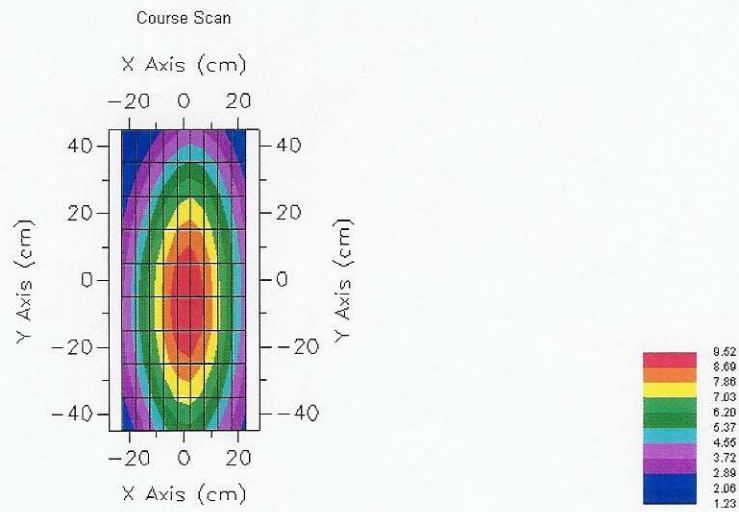
▶ MARKER 1
0.834440 GHz
47.585 Ω
34.845 $j\Omega$

MARKER TO MAX
MARKER TO MIN

MARKER READOUT
FUNCTIONS

System Validation Results Using the Electrically Calibrated Dipole

| Head Tissue Frequency | 1 Gram | 10 Gram | Peak Above Feed Point |
|-----------------------|--------|---------|-----------------------|
| 835 MHz | 9.33 | 6.42 | 15.0 |



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





Appendix E. Dipole Calibration

Validation Dipole 1900 MHz

M/N: ALS-D-1900-S-2

S/N: QTK-318

NCL CALIBRATION LABORATORIES

Calibration File No: DC-890

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.

Quietek Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-1900-S-2

Frequency: 1.9 GHz

Serial No: QTK-318

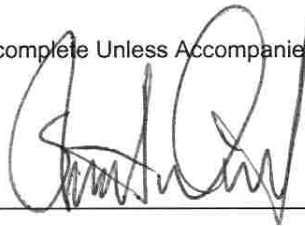
Customer: Quietek

Project Number: QTKB-Dipole-CAL-5336

Calibrated: 9th May 2008
Released on: 9th May 2008

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

Released By: _____



NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4161

Calibration Results Summary

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

Mechanical Dimensions

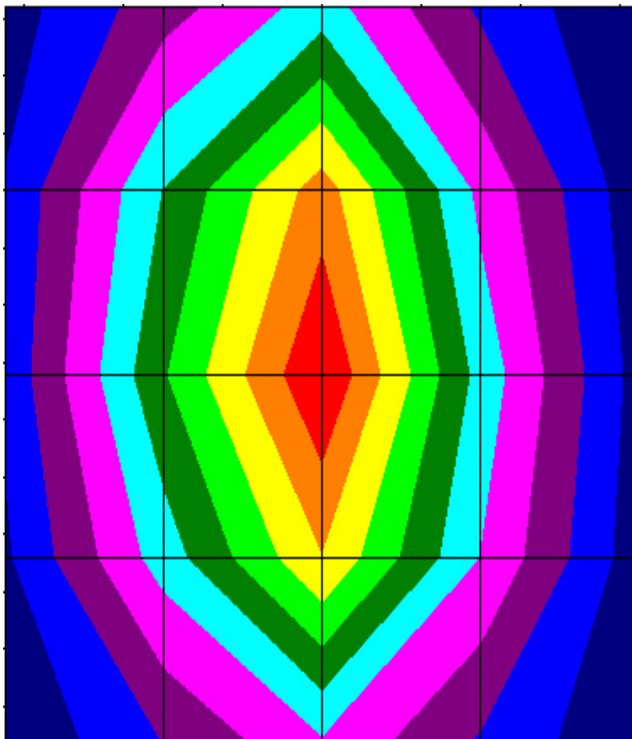
Length: 70.0 mm
Height: 39.5 mm

Electrical Specification

SWR: 1.1 U
Return Loss: -25.8 dB
Impedance: 47.8 Ω

System Validation Results

| Frequency | 1 Gram | 10 Gram | Peak |
|-----------|--------|---------|------|
| 1.9 GHz | 36.0 | 20.78 | 67.7 |



Conditions

Dipole 318 is a recalibration.

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

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

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 & Part 2: Procedure to determine the specific absorption rate (SAR) for mobile wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)

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



C. Teodorian

20 °C +/- 0.5°C

NCL Calibration Laboratories

Division of APREL Laboratories.

Dipole Calibration Results

Mechanical Verification

| IEEE Length | IEEE Height | Measured Length | Measured Height |
|--------------------|--------------------|------------------------|------------------------|
| 68.0 mm | 39.5 mm | 70.0 mm | 39.5 mm |

Tissue Validation

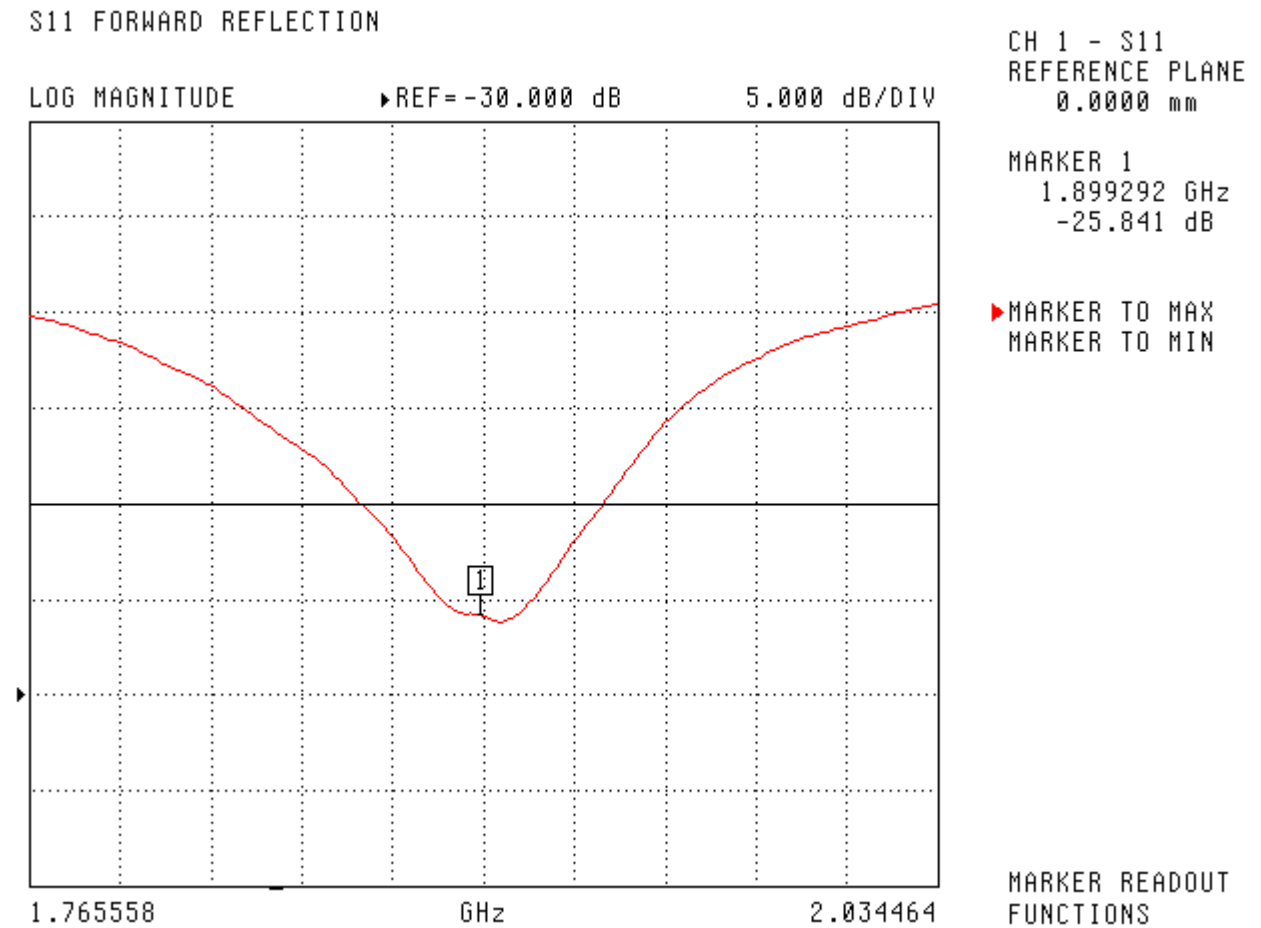
| Head Tissue 1900 MHz | Measured |
|---|-----------------|
| Dielectric constant, ϵ_r | 39.9 |
| Conductivity, σ [S/m] | 1.42 |

Electrical Calibration

| Test | Result |
|-----------|---------------|
| S11 R/L | -25.8 dB |
| SWR | 1.1 U |
| Impedance | 47.8 Ω |

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

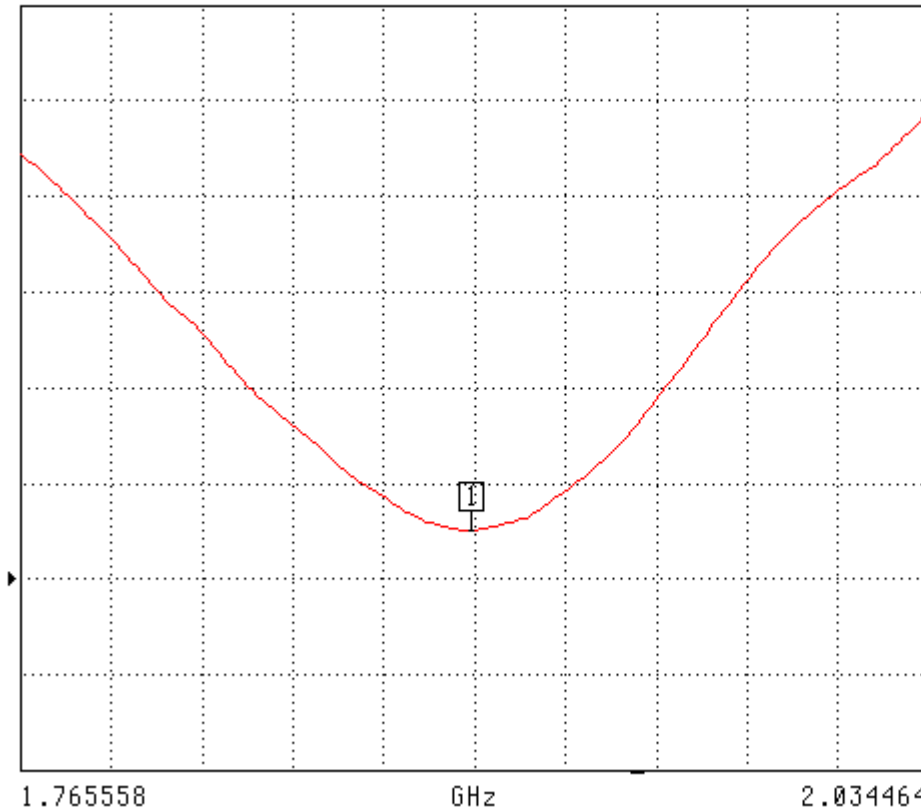
S11 Parameter Return Loss



SWR

S11 FORWARD REFLECTION

SWR REF=1.000 U 200.000 mU/DIV



CH 1 - S11
REFERENCE PLANE
0.0000 mm

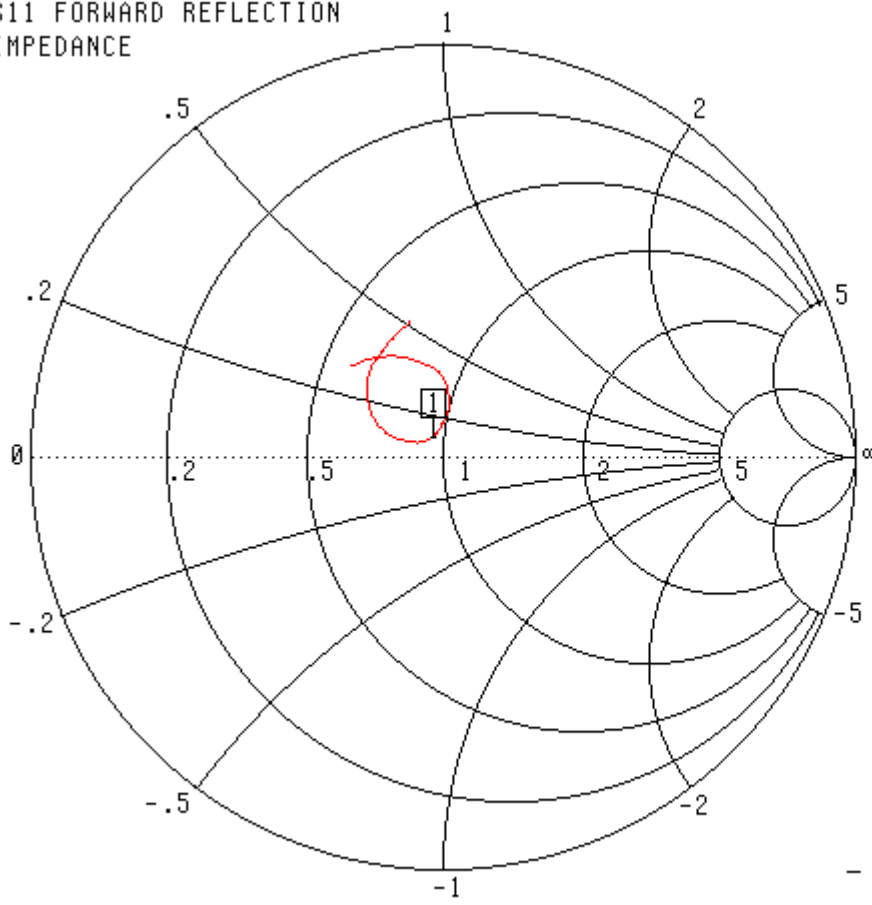
MARKER 1
1.899292 GHz
1.101 U

▶ MARKER TO MAX
MARKER TO MIN

MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



CH 1 - S11
REFERENCE PLANE
0.0000 mm

MARKER 1
1.899292 GHz
47.748 Ω
4.401 $j\Omega$

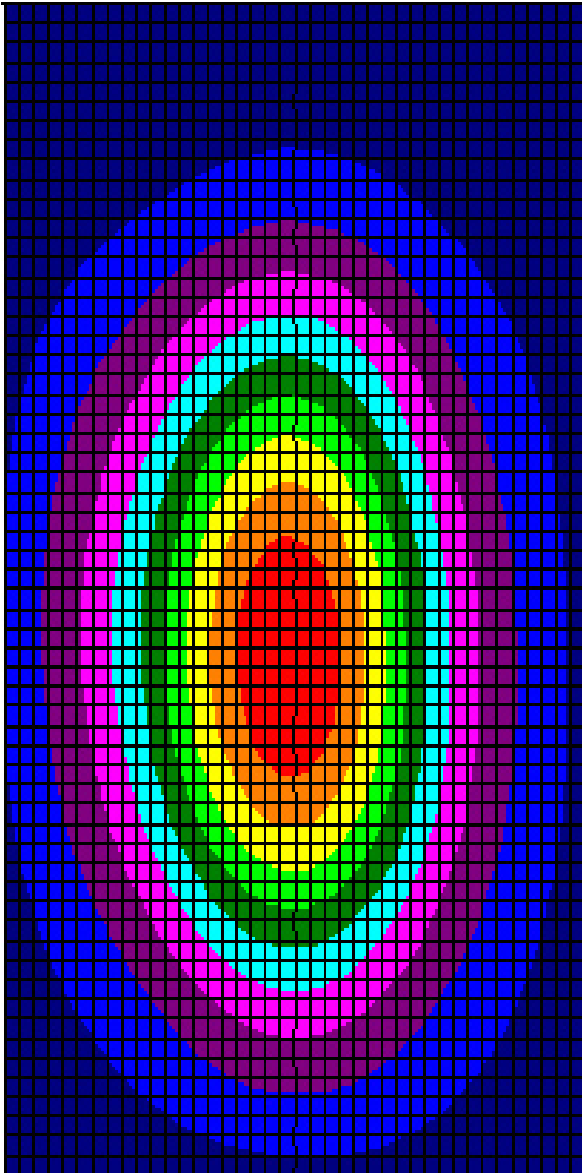
▶ MARKER TO MAX
MARKER TO MIN

- MARKER READOUT
FUNCTIONS

1.765558 - 2.034464 GHz

System Validation Results Using the Electrically Calibrated Dipole

| Frequency | 1 Gram | 10 Gram | Peak Above Feed Point |
|------------------|---------------|----------------|----------------------------------|
| 1.9 GHz | 36.0 | 20.78 | 67.7 |



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 2008.



Appendix E. Dipole Calibration

Validation Dipole 2450MHz

P/N: ALS-D-2450-S-2

S/N: QTK-319

NCL CALIBRATION LABORATORIES

Calibration File No: DC-409-1
Project Number: QTKB-Dipole Cal-5228

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.

Quietek Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-2450-S-2

Frequency: 2.45 GHz

Serial No: QTK-319

Customer: Quietek

Calibrated: 15 June 2006
Released on: 15 June 2006

Released By: _____



NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4888
FAX: (613) 820-4161

Calibration Results Summary

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

Mechanical Dimensions

Length: 53.5 mm

Height: 30.4 mm

Electrical Specification

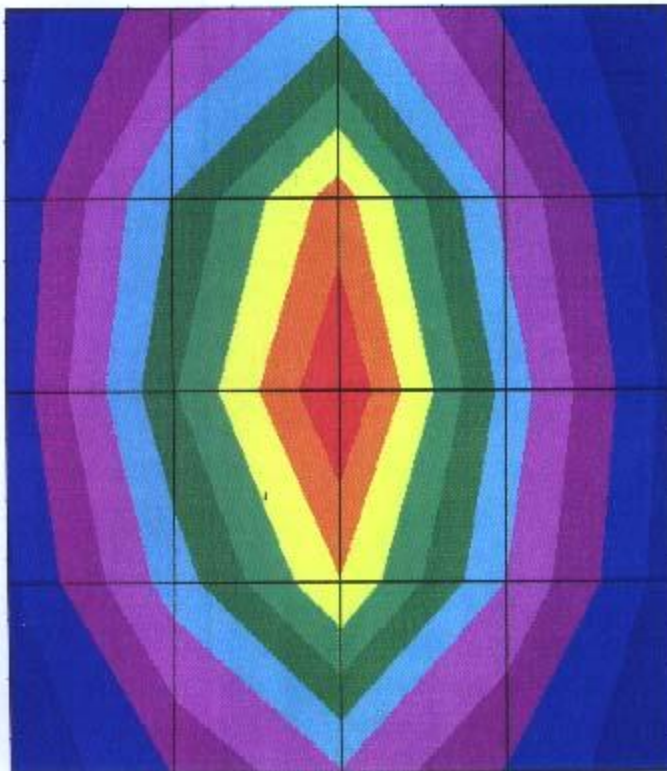
SWR: 1.21 U

Return Loss: -20.7 dB

Impedance: 47.7 Ω

System Validation Results

| Frequency | 1 Gram | 10 Gram | Peak |
|-----------|--------|---------|------|
| 2.45 GHz | 48.07 | 25.65 | 95.6 |



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 QTK-319. 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/APREL 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 QTK 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 QTK-319 was received for calibration.

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

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



Dipole Calibration Results

Mechanical Verification

| IEEE Length | IEEE Height | Measured Length | Measured Height |
|-------------|-------------|-----------------|-----------------|
| 51.5 mm | 30.4 mm | 53.5 mm | 30.4 mm |

Tissue Validation

| Body Tissue 2450 MHz | Measured |
|-----------------------------------|----------|
| Dielectric constant, ϵ_r | 52.5 |
| Conductivity, σ [S/m] | 1.78 |

Electrical Calibration

| Test | Result |
|-----------|---------------|
| S11 R/L | -20.7 dB |
| SWR | 1.21 U |
| Impedance | 47.7 Ω |

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

S11 Parameter Return Loss

S22 REVERSE REFLECTION

LOG MAGNITUDE

REF = -20.000 dB

5.000 dB/DIV



CH 4 - S22
REFERENCE PLANE
0.0000 mm

MARKER 1
2.451466 GHz
-20.669 dB

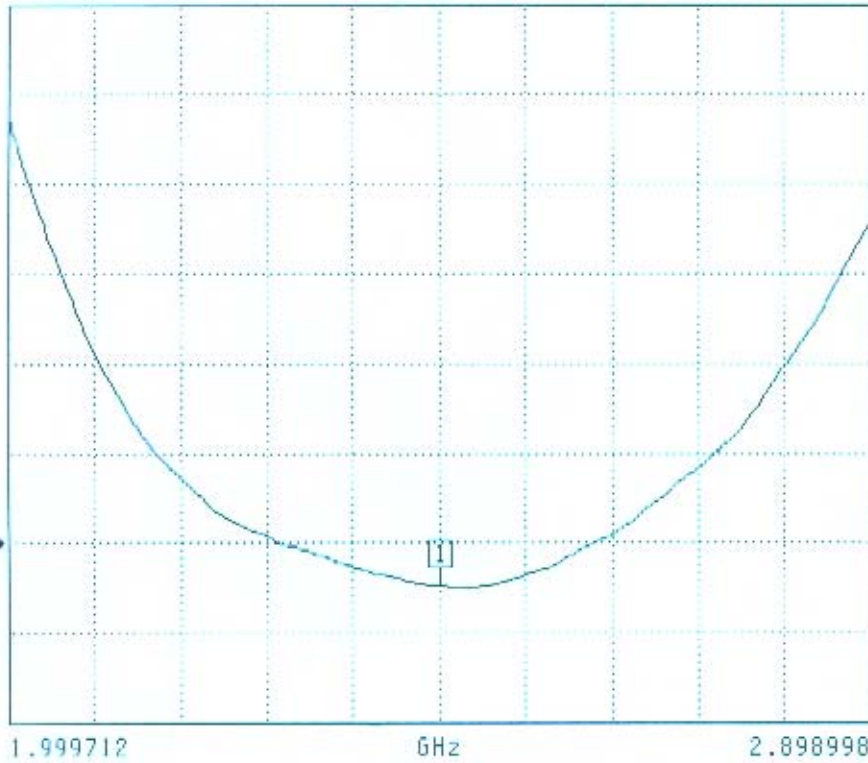
MARKER TO MAX
MARKER TO MIN

MARKER READOUT
FUNCTIONS

SWR

S22 REVERSE REFLECTION

SWR REF=1.500 U 600.000 mU/DIV



CH 1 - S22
REFERENCE PLANE
0.0000 mm

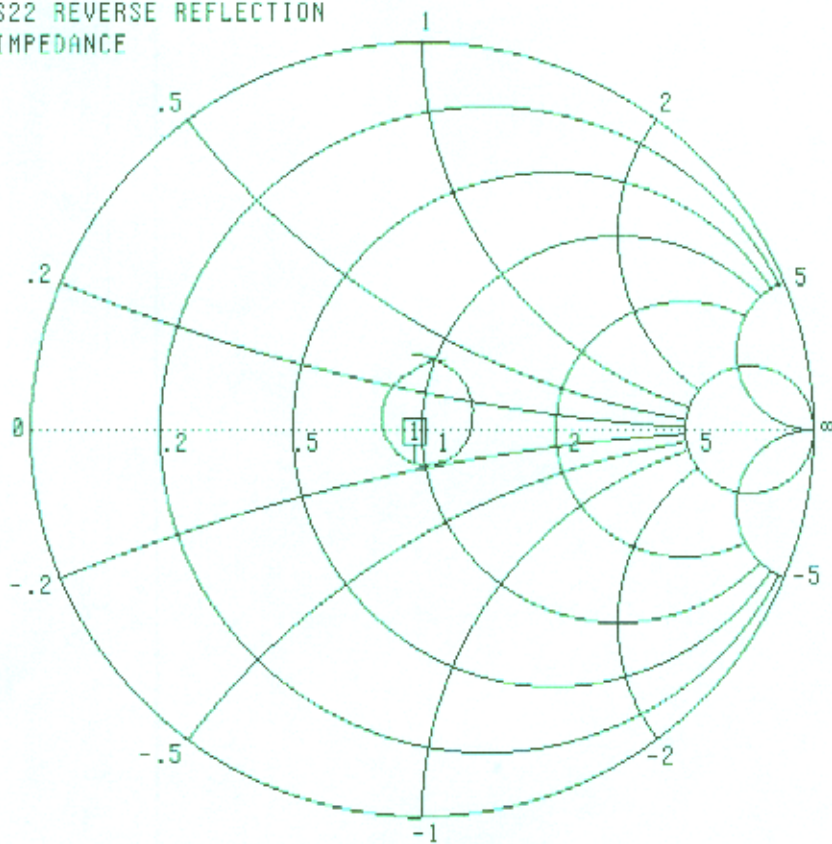
MARKER 1
2.451466 GHz
1.208 U

MARKER TO MAX
MARKER TO MIN

MARKER READOUT
FUNCTIONS

Smith Chart Dipole Impedance

S22 REVERSE REFLECTION
IMPEDANCE



CH 4 - S22
REFERENCE PLANE
0.0000 mm

▶ MARKER 1
2.451466 GHz
47.685 Ω
-8.809 jΩ

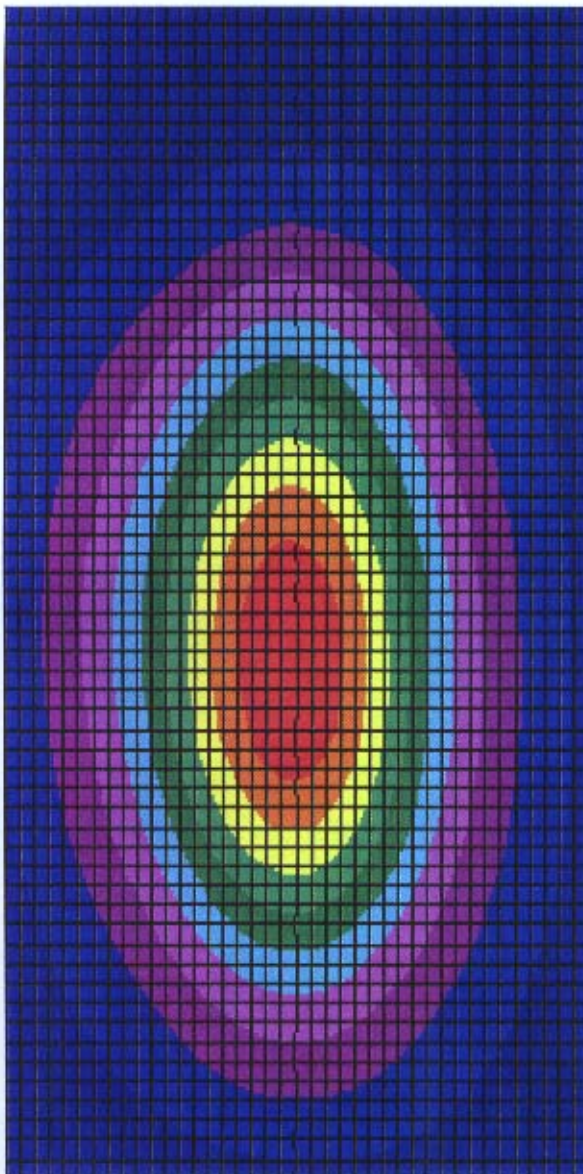
MARKER TO MAX
MARKER TO MIN

MARKER READOUT
FUNCTIONS

2.299474 - 2.599236 GHz

System Validation Results Using the Electrically Calibrated Dipole

| Frequency | 1 Gram | 10 Gram | Peak Above Feed Point |
|-----------|--------|---------|-----------------------|
| 2.45 GHz | 48.07 | 25.65 | 95.6 |



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

