

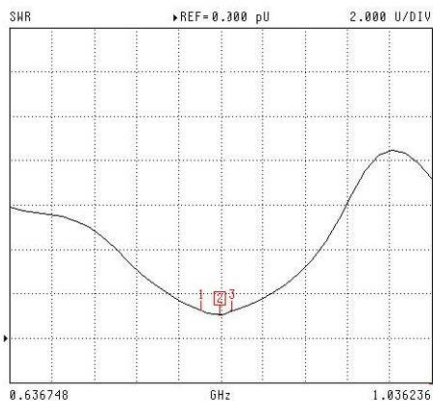
NCL Calibration Laboratories

Division of APREL Laboratories.

SWR

Head

S11 FORWARD REFLECTION



CH 1 - S11
5.0504 mm REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
0.835000 GHz
1.066 U

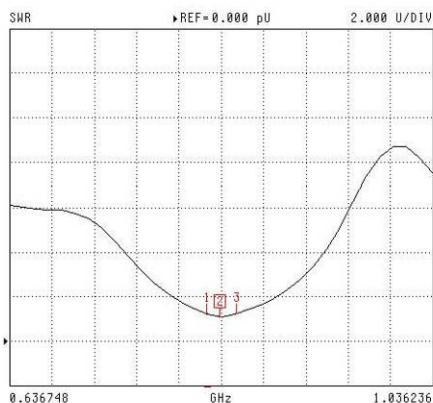
MARKER TO MAX
MARKER TO MIN

1 0.817593 GHz
1.251 U
3 0.840056 GHz
1.235 U

MARKER READOUT
FUNCTIONS

Body

S11 FORWARD REFLECTION



CH 1 - S11
5.0504 mm REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
0.835000 GHz
1.009 U

MARKER TO MAX
MARKER TO MIN

1 0.823279 GHz
1.226 U
3 0.851477 GHz
1.234 U

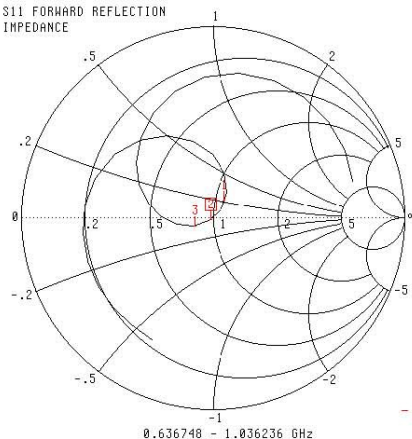
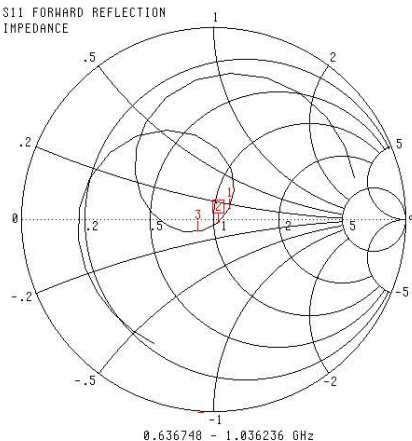
MARKER READOUT
FUNCTIONS

This page has been reviewed for content and attested to by signature within this document.

7

NCL Calibration Laboratories

Division of APREL Laboratories.

Smith Chart Dipole Impedance**Head**S11 FORWARD REFLECTION
IMPEDANCECH 1 - S11
5.0504 mm REF
0.000 dB OFFSET
0.00° OFFSET▶ MARKER 2
0.835000 GHz
49.001 Ω
-1.317 j Ω MARKER TO MAX
MARKER TO MIN1 0.817593 GHz
55.620 Ω
10.003 j Ω
3 0.848056 GHz
41.274 Ω
-3.871 j Ω MARKER READOUT
FUNCTIONS**Body**S11 FORWARD REFLECTION
IMPEDANCECH 1 - S11
5.0504 mm REF
0.000 dB OFFSET
0.00° OFFSET▶ MARKER 2
0.835000 GHz
53.117 Ω
-1.024 j Ω MARKER TO MAX
MARKER TO MIN1 0.823279 GHz
59.000 Ω
6.263 j Ω
3 0.851477 GHz
42.412 Ω
-5.581 j Ω MARKER READOUT
FUNCTIONS

This page has been reviewed for content and attested to by signature within this document.

8

NCL Calibration Laboratories

Division of APREL Laboratories.

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 2014.

This page has been reviewed for content and attested to by signature within this document.

9

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1531
Project Number: BACL-5745

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.

BACL Head & Body Validation Dipole

Manufacturer: APREL Laboratories

Part number: ALS-D-1750-S-2

Frequency: 1750 MHz

Serial No: 198-00304

Customer: ISL

Calibrated: 8th October, 2013
Released on: 8th October, 2013

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

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

Dipole 198-00304 was an original 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

This page has been reviewed for content and attested to by signature within this document.

2

NCL Calibration Laboratories

Division of APREL Laboratories.

Calibration Results Summary

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

Mechanical Dimensions

Length: 75 mm
Height: 42 mm

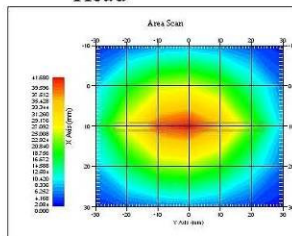
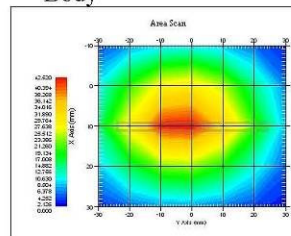
Electrical Calibration

Test	Result Head	Result Body
S11 R/L	-25.567	-20.548 dB
SWR	1.111U	1.207 U
Impedance	53.637 Ω	55.929 Ω

System Validation Results, 1750 MHz

	1g	10g
Head	37.02	18.99
Body	36.65	18.85

Type	Epsilon	Sigma
Head	38.51	1.36
Body	51.79	1.53

Head**Body**

This page has been reviewed for content and attested to by signature within this document.

3

NCL Calibration Laboratories

Division of APREL Laboratories.

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. 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 an original calibration taken from stock.

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)

This page has been reviewed for content and attested to by signature within this document.

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NCL Calibration Laboratories

Division of APREL Laboratories.

Dipole Calibration Results**Mechanical Verification**

Measured Length	Measured Height
75 mm	42 mm

Tissue Validation

Frequency	Permittivity ϵ	Conductivity σ
1750 Head	38.23	1.38
1750 Body	52.86	1.54

This page has been reviewed for content and attested to by signature within this document.

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NCL Calibration Laboratories

Division of APREL Laboratories.

Electrical Calibration

Test	Result Head	Result Body
S11 R/L	-25.567	-20.548 dB
SWR	1.111U	1.207 U
Impedance	53.637 Ω	55.929 Ω

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

S11 Parameter Return Loss**Head**

S11 FORWARD REFLECTION

LOG MAGNITUDE REF=-20.000 dB 5.000 dB/DIV

CH 1 - S11
5.0504 REF
0.000 dB OFFSET
0.00° OFFSETMARKER 2
1.750000 GHz
-25.567 dBMARKER TO MAX
MARKER TO MIN1 1.699041 GHz
-20.014 dB
3 1.799855 GHz
-20.001 dBMARKER READOUT
FUNCTIONS**Body**

S11 FORWARD REFLECTION

LOG MAGNITUDE REF=-20.000 dB 5.000 dB/DIV

CH 1 - S11
5.0504 REF
0.000 dB OFFSET
0.00° OFFSETMARKER 2
1.750000 GHz
-20.548 dBMARKER TO MAX
MARKER TO MINMARKER READOUT
FUNCTIONS

This page has been reviewed for content and attested to by signature within this document.

6

NCL Calibration Laboratories

Division of APREL Laboratories.

SWR

Head

S11 FORWARD REFLECTION



CH 1 - S11
5.0504 REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
1.750000 GHz
1.111 U

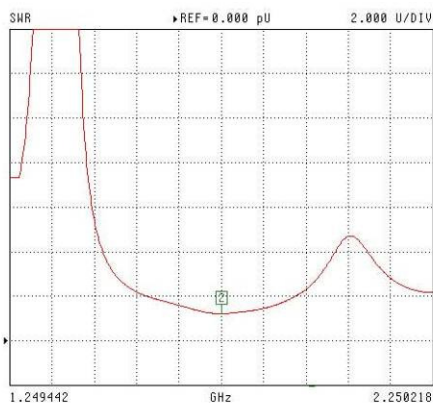
MARKER TO MAX
MARKER TO MIN

1 1.699041 GHz
1.225 U
3 1.799855 GHz
1.225 U

MARKER READOUT
FUNCTIONS

Body

S11 FORWARD REFLECTION



CH 1 - S11
5.0504 REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
1.750000 GHz
1.207 U

MARKER TO MAX
MARKER TO MIN

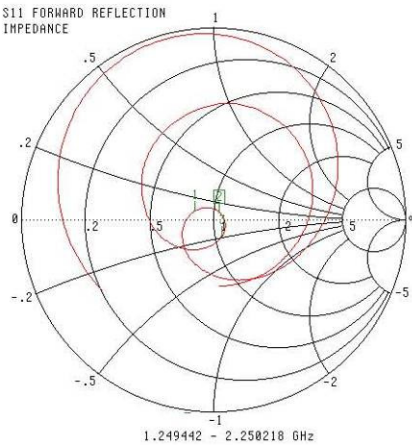
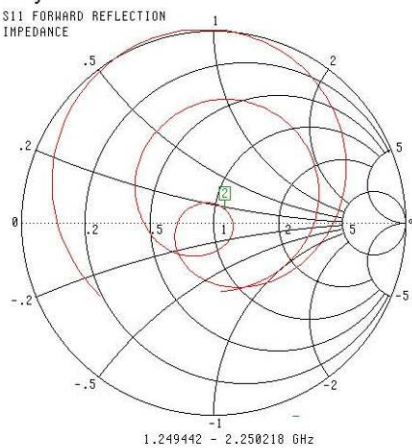
MARKER READOUT
FUNCTIONS

This page has been reviewed for content and attested to by signature within this document.

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NCL Calibration Laboratories

Division of APREL Laboratories.

Smith Chart Dipole Impedance**Head**S11 FORWARD REFLECTION
IMPEDANCECH 1 - S11
5.0504 dB REF
0.000 dB OFFSET
0.00° OFFSET▶ MARKER 2
1.750000 GHz
53.637 Ω
3.752 jΩMARKER TO MAX
MARKER TO MIN1 1.699041 GHz
41.539 Ω
3.495 jΩ
3 1.799855 GHz
54.266 Ω
-9.681 jΩMARKER READOUT
FUNCTIONS**Body**S11 FORWARD REFLECTION
IMPEDANCECH 1 - S11
5.0504 dB REF
0.000 dB OFFSET
0.00° OFFSET▶ MARKER 2
1.750000 GHz
55.929 Ω
7.816 jΩMARKER TO MAX
MARKER TO MINMARKER READOUT
FUNCTIONS

This page has been reviewed for content and attested to by signature within this document.

8

NCL Calibration Laboratories

Division of APREL Laboratories.

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 2013

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This page has been reviewed for content and attested to by signature within this document.

9

NCL CALIBRATION LABORATORIES

Calibration File No: DC-1601
Project Number: BAC-dipole –cal-5779

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.

Validation Dipole (Head & Body)

Manufacturer: APREL Laboratories

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

Frequency: 1900 MHz

Serial No: 210-00710

Customer: Bay Area Compliance Laboratory (China)

Calibrated: 9th October, 2014
Released on: 9th October, 2014

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.
Kanata, ONTARIO
CANADA K2K 3J1

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

NCL Calibration Laboratories

Division of APREL Laboratories.

Conditions

Dipole 210-00710 was received in good condition and was a re-calibration.

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

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

Attestation

The below named signatories have conducted the calibration and review of the data which is presented in this calibration report.

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



Maryna Nesterova Calibration Engineer

Primary Measurement Standards**Instrument**

Tektronix USB Power Meter
Network Analyzer Anritsu 37347C

Serial Number

11C940
002106

Cal due date

May 14, 2015
Feb. 20, 2015

This page has been reviewed for content and attested to by signature within this document.

NCL Calibration Laboratories

Division of APREL Laboratories.

Calibration Results Summary

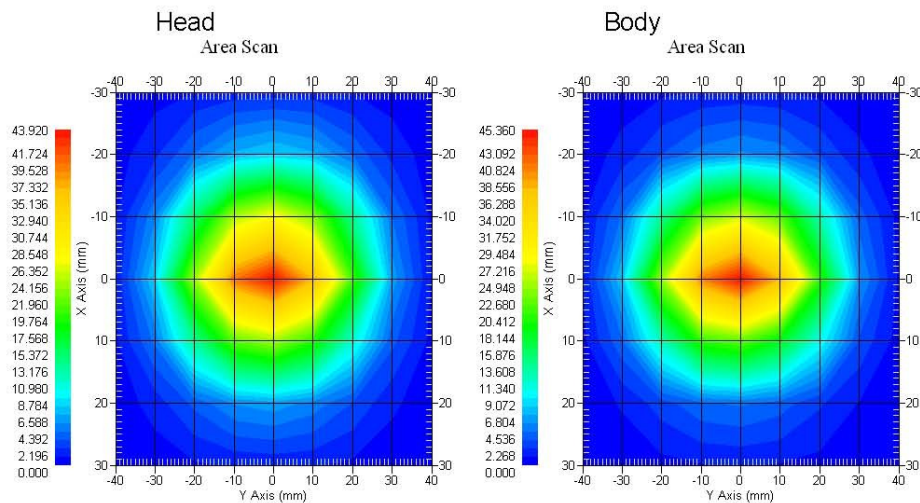
The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

Mechanical Dimensions**Length:** 67.1 mm**Height:** 38.9 mm**Electrical Specification**

Tissue	Frequency	SWR:	Return Loss	Impedance
Head	1900MHz	1.084 U	-27.92 dB	52.247 Ω
Body	1900MHz	1.128 U	-24.40 dB	52.618 Ω

System Validation Results

Tissue	Frequency	1 Gram	10 Gram	Peak
Head	1900 MHz	39.481	20.44	73.364
Body	1900 MHz	39.715	20.552	73.565



NCL Calibration Laboratories

Division of APREL Laboratories.

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 210-00710. 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 30 MHz to 6 GHz E-Field Probe Serial Number 225.

References

- IEC-62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures"
- Part 2: "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)"
- TP-D01-032-E020-V2 E-Field probe calibration procedure
- D22-012-Tissue dielectric tissue calibration procedure
- D28-002-Dipole procedure for validation of SAR system using a dipole
- IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

Conditions

Dipole 210-00710 was a recalibration.

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

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

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)

This page has been reviewed for content and attested to by signature within this document.

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NCL Calibration Laboratories

Division of APREL Laboratories.

Dipole Calibration Results**Mechanical Verification**

APREL Length	APREL Height	Measured Length	Measured Height
68.0 mm	39.5 mm	67.1 mm	38.9 mm

Electrical Validation

Tissue	Frequency	SWR:	Return Loss	Impedance
Head	1900MHz	1.084 U	-27.92 dB	52.247 Ω
Body	1900MHz	1.128 U	-24.40 dB	52.618 Ω

Tissue Validation

	Dielectric constant, ϵ_r	Conductivity, σ [S/m]
Head Tissue 1900MHz	40.20	1.38
Body Tissue 1900MHz	52.63	1.46

This page has been reviewed for content and attested to by signature within this document.

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NCL Calibration Laboratories

Division of APREL Laboratories.

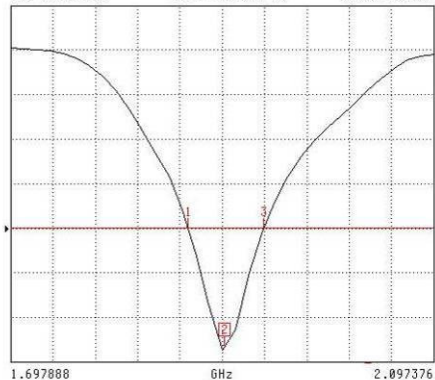
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss

Head: Frequency Range 1.865 to 1.937 GHz

S11 FORWARD REFLECTION

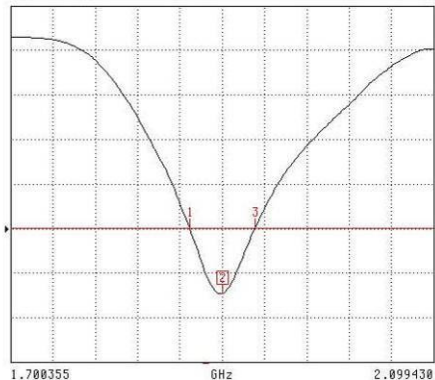
LOG MAGNITUDE REF=-20.000 dB 3.000 dB/DIV

CH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSETMARKER 2
1.900000 GHz
-27.924 dBMARKER TO MAX
MARKER TO MIN1 1.865442 GHz
-20.007 dB
3 1.937220 GHz
-20.003 dBMARKER READOUT
FUNCTIONS

Body: Frequency Range 1.869 to 1.931 MHz

S11 FORWARD REFLECTION

LOG MAGNITUDE REF=-20.000 dB 3.000 dB/DIV

CH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSETMARKER 2
1.900000 GHz
-24.397 dBMARKER TO MAX
MARKER TO MIN1 1.869475 GHz
-20.005 dB
3 1.931189 GHz
-20.005 dBMARKER READOUT
FUNCTIONS

This page has been reviewed for content and attested to by signature within this document.

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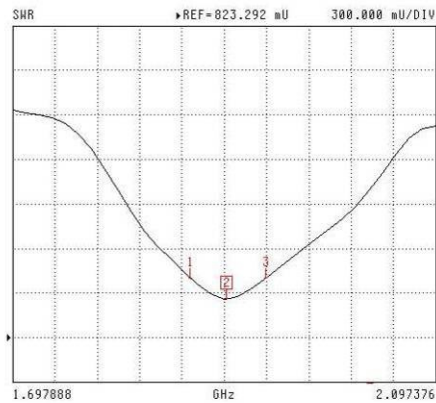
NCL Calibration Laboratories

Division of APREL Laboratories.

SWR

Head

S11 FORWARD REFLECTION



CH 1 - S11
5.0584 m REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
1.900000 GHz
1.084 U

MARKER TO MAX

MARKER TO MIN

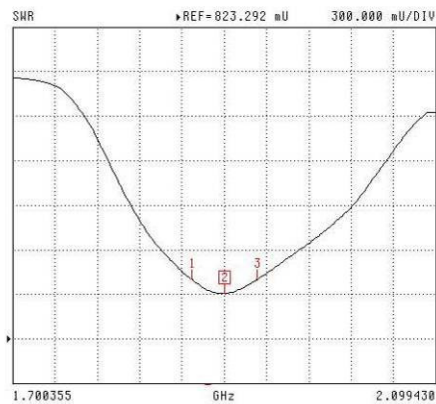
1 1.865442 GHz
1.226 U

3 1.937220 GHz
1.224 U

MARKER READOUT
FUNCTIONS

Body

S11 FORWARD REFLECTION



CH 1 - S11
5.0584 m REF
0.000 dB OFFSET
0.00° OFFSET

MARKER 2
1.900000 GHz
1.128 U

MARKER TO MAX

MARKER TO MIN

1 1.869475 GHz
1.223 U

3 1.931189 GHz
1.223 U

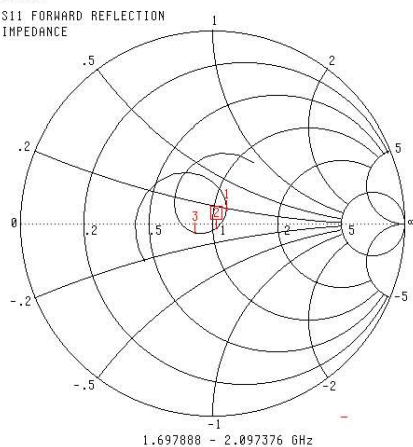
MARKER READOUT
FUNCTIONS

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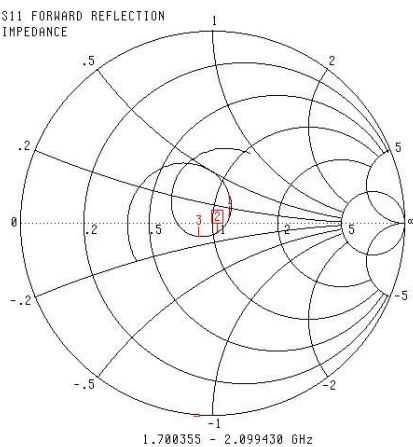
7

NCL Calibration Laboratories

Division of APREL Laboratories.

Smith Chart Dipole Impedance**Head**S11 FORWARD REFLECTION
IMPEDANCECH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSET▶ MARKER 2
1.900000 GHz
52.247 Ω
-3.103 jΩMARKER TO MAX
MARKER TO MIN

Marker	Frequency (GHz)	Resistance (Ω)	Reactance (jΩ)
1	1.865442	57.627	7.644
2	1.900000	52.247	-3.103
3	1.937220	41.868	-4.273

MARKER READOUT
FUNCTIONS**Body**S11 FORWARD REFLECTION
IMPEDANCECH 1 - S11
5.0584 mm REF
0.000 dB OFFSET
0.00° OFFSET▶ MARKER 2
1.900000 GHz
52.618 Ω
-5.535 jΩMARKER TO MAX
MARKER TO MIN

Marker	Frequency (GHz)	Resistance (Ω)	Reactance (jΩ)
1	1.869475	60.277	4.049
2	1.900000	52.618	-5.535
3	1.931189	43.257	-6.479

MARKER READOUT
FUNCTIONS

This page has been reviewed for content and attested to by signature within this document.

8

NCL Calibration Laboratories

Division of APREL Laboratories.

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 2014

This page has been reviewed for content and attested to by signature within this document.

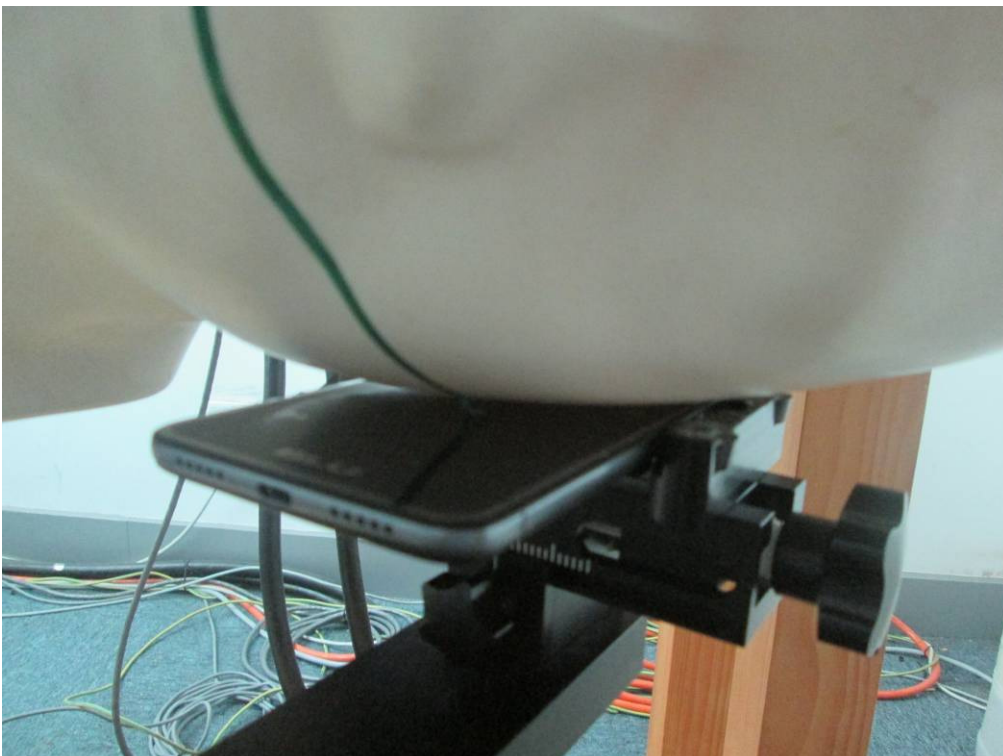
9

APPENDIX D EUT TEST POSITION PHOTOS

Liquid depth $\geq 15\text{cm}$



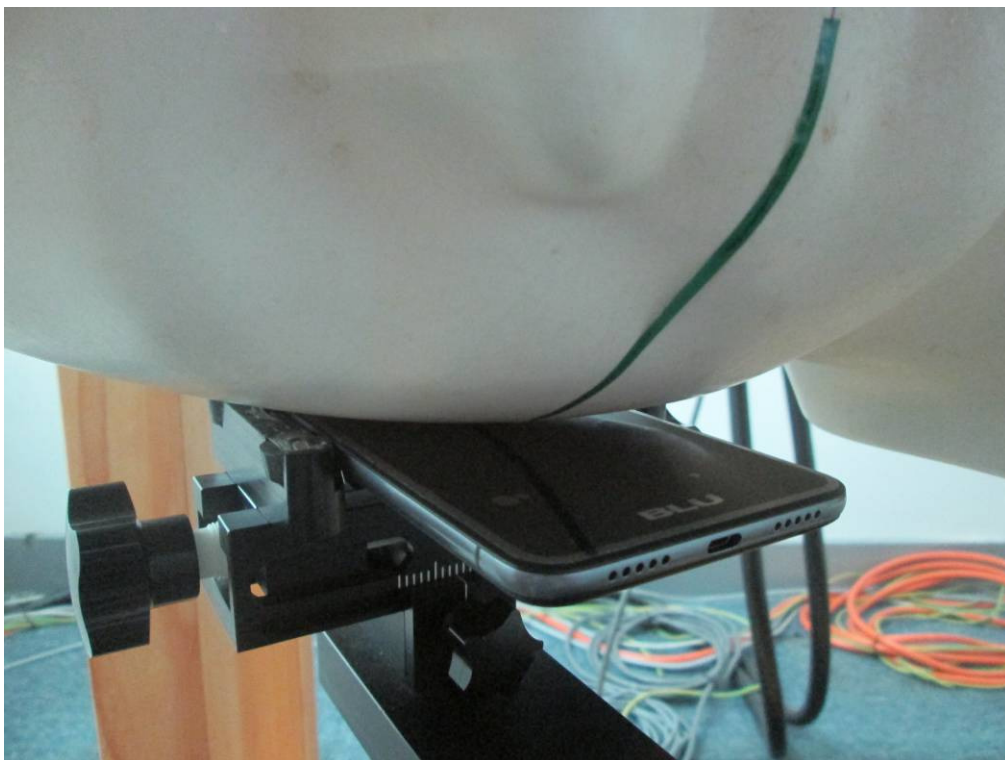
Left Head Touch Setup Photo



Left Head Tilt Setup Photo



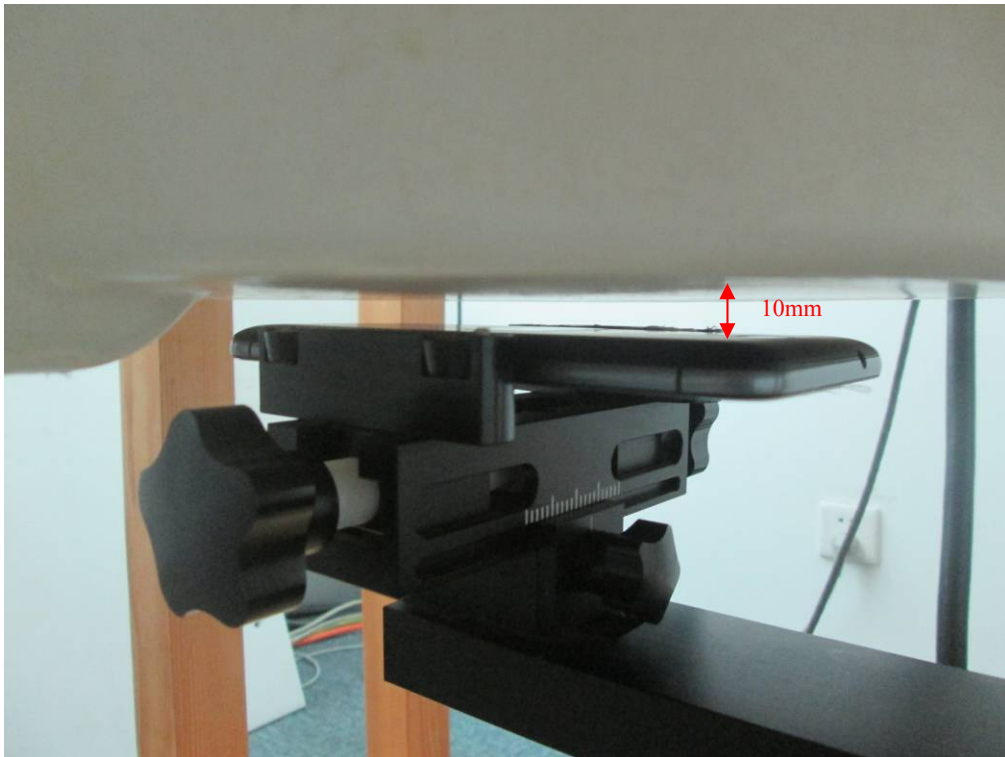
Right Head Touch Setup Photo



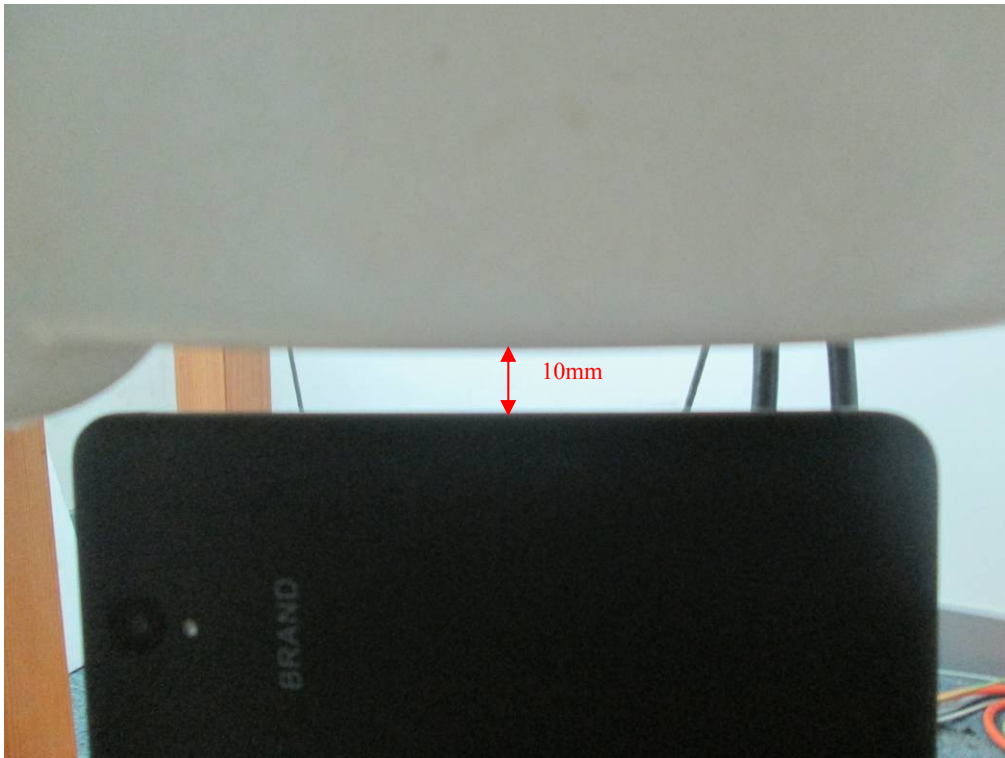
Right Head Tilt Setup Photo



Body-worn Back Setup Photo



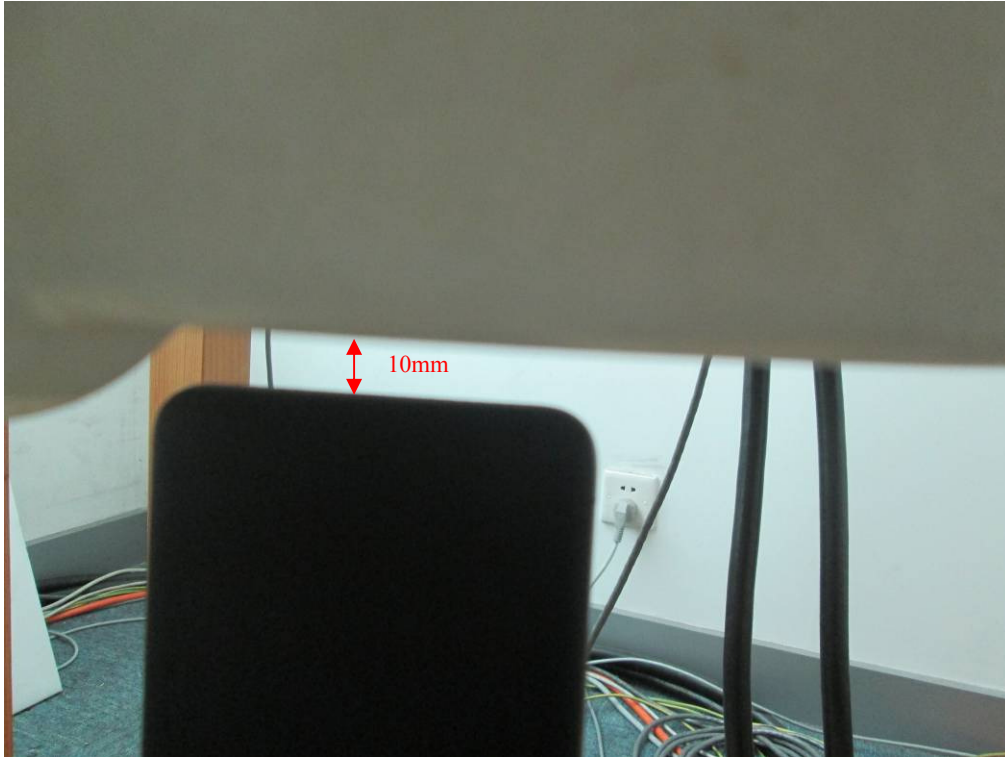
Body-worn Left Setup Photo



Body-worn Right Setup Photo



Body-worn Bottom Setup Photo



APPENDIX F INFORMATIVE REFERENCES

- [1] Federal Communications Commission, "Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.
- [2] David L. Means Kwok Chan, Robert F. Cleveland, "Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commission, Office of Engineering & Technology, Washington, DC, 1997.
- [3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105-113, Jan. 1996.
- [4] Niels Kuster, Ralph K. Kastele, and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with known precision", IEEE Transactions on Communications, vol. E80-B, no. 5, pp. 645-652, May 1997.
- [5] CENELEC, "Considerations for evaluating of human exposure to electromagnetic fields (EMFs) from mobile telecommunication equipment (MTE) in the frequency range 30MHz - 6GHz", Tech. Rep., CENELEC, European Committee for Electrotechnical Standardization, Brussels, 1997.
- [6] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.
- [7] Katja Pokovic, Thomas Schmid, and Niels Kuster, "Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM '97, Dubrovnik, October 15-17, 1997, pp. 120-24.
- [8] Katja Pokovic, Thomas Schmid, and Niels Kuster, "E-field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23-25 June, 1996, pp. 172-175.
- [9] Volker Hombach, Klaus Meier, Michael Burkhardt, Eberhard K. Uhn, and Niels Kuster, "The dependence of EM energy absorption upon human head modeling at 900 MHz", IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 10, pp. 1865-1873, Oct. 1996.
- [10] Klaus Meier, Ralf Kastele, Volker Hombach, Roger Tay, and Niels Kuster, "The dependence of EM energy absorption upon human head modeling at 1800 MHz", IEEE Transactions on Microwave Theory and Techniques, Oct. 1997, in press.
- [11] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.
- [12] W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery, Numerical Recipes in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992. Dosimetric Evaluation of Sample device, month 1998 9
- [13] NIS81 NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddington, Middlesex, England, 1994.
- [14] Barry N. Taylor and Christ E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994. Dosimetric Evaluation of Sample device, month 1998 10.

***** END OF REPORT *****