

Hearing Aid Compatibility (HAC) Test Report

Applicant : SeniorTech LLC
Address : 100 Cherokee Blvd,Suite 216,Chattanooga,
TN 37045
Equipment : GSM Mobile Phone
Model name : EZ TWO
FCC ID : ZXL-EZTWOB



Date of Receipt : April 10,2013
Date of Test : April 16,2013
Report No. : 130416001HAC2-FCC

The test results relate only to the samples tested.

The test report shall not be reproduced except in full without the written approval of IAC Compliance Laboratory.

Test Report Certification

Test Date : April 16,2013

Report No.: 130416001HAC2-FCC

Product Name : **GSM Mobile Phone**

Applicant : **SeniorTech LLC**

Address : **100 Cherokee Blvd,Suite 216,Chattanooga,**
TN 37045

Manufacturer : **ENJOY GROUP(HK) CO,LIMITED**

Model No. : **EZ TWO**

Trade Name : **Snapfon**

Measurement Standard : **ANSI C63.19-2007 (8 June,2007)**

T category : **T3**

Test Result : **Complied**

The test results relate only to the samples tested.

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Documented By : 

Tested By : 

Approved By : 

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1. GENERAL INFORMATION

1.1. EUT Description

Product Name : GSM Mobile Phone
Trade Name : Snapfon
Model No. : EZ TWO
TX Frequency : GSM850: 824MHz~849MHz
GSM1900: 1850MHz~1910MHz
RX Frequency : GSM850: 869MHz~894MHz
GSM1900: 1930MHz~1990MHz
Antenna Type : Internal
Device Category : Portable
Hardware version : W57_-MB-_REV1.1
Max. Output Power : GSM850: 32.72dBm
(Conducted) GSM1900:29.80dBm

1.2. Test Environment

Ambient conditions in the laboratory:

Items	Required	Actual
Temperature(°C)	15~30	21.4
Humidity(%RH)	30~70	46

2 Test Conditions

2.1 Test Conditions Description

Test frequency: GSM 850MHz PCS 1900MHz

Operation mode: Call established

Power Level: GSM 850 MHz Maximum output power(level 5)

PCS 1900 MHz Maximum output power(level 0)

During test, EUT is in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up with a System Simulator (SS) by air link, and a call is established. The Absolute Radio Frequency Channel Number (ARFCN) is allocated to 128, 190 and 251 respectively in the case of GSM 850 MHz, or to 512, 661 and 810 respectively in the case of PCS 1900 MHz, The EUT is commanded to operate at maximum transmitting power.

2.2 Test Opertaion Description

On July 10,2003,the Federal Communications Commission (FCC) adopted new rules requiring wireless manufacturers and service providers to provide digital wireless phones that are compatible with hearing aids. The FCC has modified the exemption for wireless phones under the Hearing Aid Compatibility Act of 1998 (HAC Act) in WT Docket 01-309 RM-8658 to extend the benefits of wireless telecommunications to individuals with hearing disabilities. These benefits encompass business, social and emergency communications, which increase the value of the wireless network for everyone. An estimated more than 10% of the population in the United States show signs of hearing impairment and of that fraction, almost 80% use hearing aids. Approximately 500 million people worldwide suffer from hearing loss.

Compatibility Tests involved:

The standard calls for wireless communications devices to be measured for:

- RF Electric-field emissions.
- RF Magnetic- field emissions.
- T-coil mode, magnetic-signal strength in the audio band.
- T-coil mode, magnetic-signal frequency response through the audio band.
- T-coil mode, magnetic-signal and noise articulation index.

The hearing aid must be measured for:

- RF immunity in microphone mode
 - RF immunity in T-coil mode
- In the following tests and results, this report includes the evaluation for a wireless communications device

2.3 ANSI/IEEE PC 63.19 Performance Categories

2.3.1. T-coil

The table below provides the signal quality requirement for the intended audio magnetic signal from a wireless device. Only the RF immunity of the hearing aid is measured in T-coil mode. It is assumed that a hearing aid can have no immunity to an interference signal in the audio band, which is the intended reception band for this mode. The only criterion that can be measured is the RF immunity in T-coil mode. This is measured using the same procedure as the audio coupling mode at the same levels. The signal quality of the axial and radial components of the magnetic field was used to determine the T-coil mode category.

Category	Telephone RF Parameter
	Wireless Device Signal Quality (Signal+Noise-to-noise ratio in dB)
T1	0-10 dB
T2	10-20 dB
T3	20-30 dB
T4	>30 dB
Magnetic Coupling Parameters	

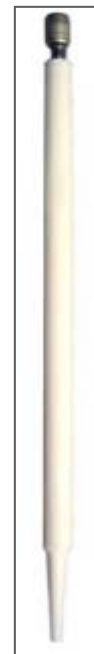
2.3.2. Articulation Weighing Factor (AWF)

Standard	Technology	AWF
T1/T1P1/3GPP	UMTS(WCDMA)	0
IS-95	CDMA	0
iden	GSM(22 and 11Hz)	0
J-STD-007	GSM (217Hz)	-5

Note: AWF has been developed from information presented to the committee regarding the interference potential of the various modulation types according to ANSI PC 63.19

2.4 E-Field Probe Specification

Compliant Standards	ANSI C63.19 200x
Construction	3 Dipoles utilizing high impedance lines diode mounted and arranged for X, Y, Z measurements
Frequency Range	700MHz to 3GHz
Sensitivity Air	Better than $0.65 \mu\text{V}/(\text{V}/\text{m})^2$
Dynamic Range	2mV to 200mV typical (non amplified)
Isotropic Response Axial	Typically $\pm 0.1\text{dB}$
Linearity	$\pm 0.2 \text{ dB}$ or better
Probe Tip Radius	5 mm
Sensor Offset	1.56 ($\pm 0.02 \text{ mm}$)
Probe Length	290 mm
Connector	6 Pin Bayonet
Material	Ertalyte™



2.5 H-Field Probe Specification

Compliant Standards	ANSI C63.19 200x
Construction	3 Dipoles utilizing high impedance lines diode mounted and arranged for X, Y, Z measurements
Frequency Range	700MHz to 3GHz
Sensitivity Air	$33.0\text{mV}/(\text{A}/\text{m})^2$
Dynamic Range	5 mA/m to 2 A/m
Linearity	$\pm 0.2 \text{ dB}$ or better
Probe Tip Radius	User selectable all $< 7 \text{ mm}$
Sensor Offset	3.5 ($\pm 0.02 \text{ mm}$)
Probe Length	300 mm
Connector	6 Pin Bayonet
Material	Ertalyte™



2.6 Axis Articulated Robot

ALSAS-10U utilizes a six articulated robot, which is controlled using a Pentium based real-time movement controller. The movement kinematics engine utilizes proprietary (Thermo CRS) interpolation and extrapolation algorithms, which allow full freedom of movement for each of the six joints within the working envelop. Utilization of joint 6 allows for full probe rotation with a tolerance better than 0.05mm around the central axis.



Robot/Controller Manufacturer	Thermo CRS
Number of Axis	Six independently controlled axis
Positioning Repeatability	0.05mm
Controller Type	Single phase Pentium based C500C
Robot Reach	710mm
Communication	RS232 and LAN compatible

2.7 Universal Device Positioner

The universal device positioner allows complete freedom of movement of the EUT. Developed to hold a EUT in a free-space scenario any additional loading attributable to the material used in the construction of the positioner has been eliminated. Repeatability has been enhanced through the linear scales which form the design used to indicate positioning for any given test scenario in all major axes.



2.8 T-Coil Probe



Serial Number:	SN 37/55 TCP11
Dimensions:	6.55mm length*2.29mm diameter
DC resistance:	860.6Ω
Wire size:	51 AWG
Inductance:	132.1 mH at 1kHz
Sensitivity:	-60.22 dB (V/A/m) at 1kHz

2.8.1 System Hardware

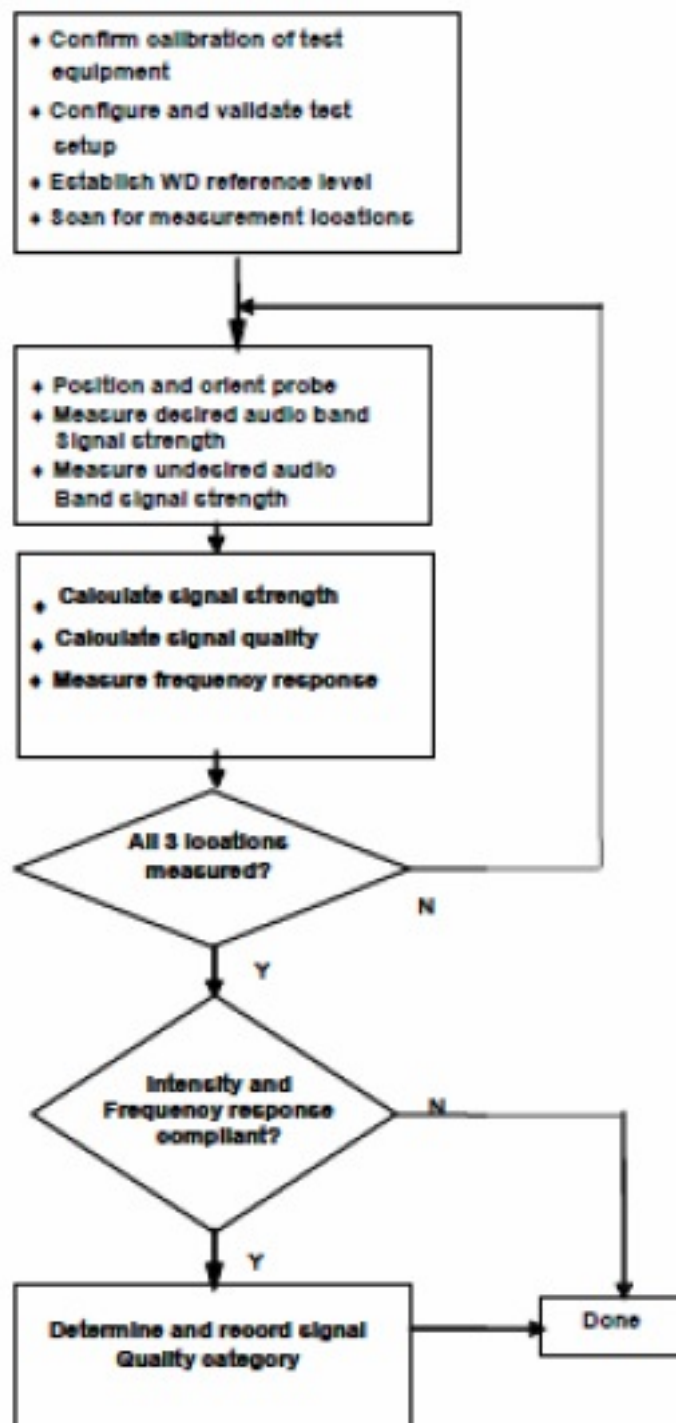
The HAC positioning ruler is used to position the phone properly with the regard to the position of the probe during a measurement. The positioning system is made of a dedicated frame that can be fixed on the table. The tip of the probe is positioned on a reference point located on the top of the positioning ruler. The distance between this reference point and the cross located on the ruler being known, the speaker of the phone is positioned on this cross in order to make sure both probe and phone are positioned properly.

During the measurement, the HAC ruler has to be removed so that it does not interfere with the measurement.

2.8.2 Test Procedure

2.8.2.1 T-coil Test Flow

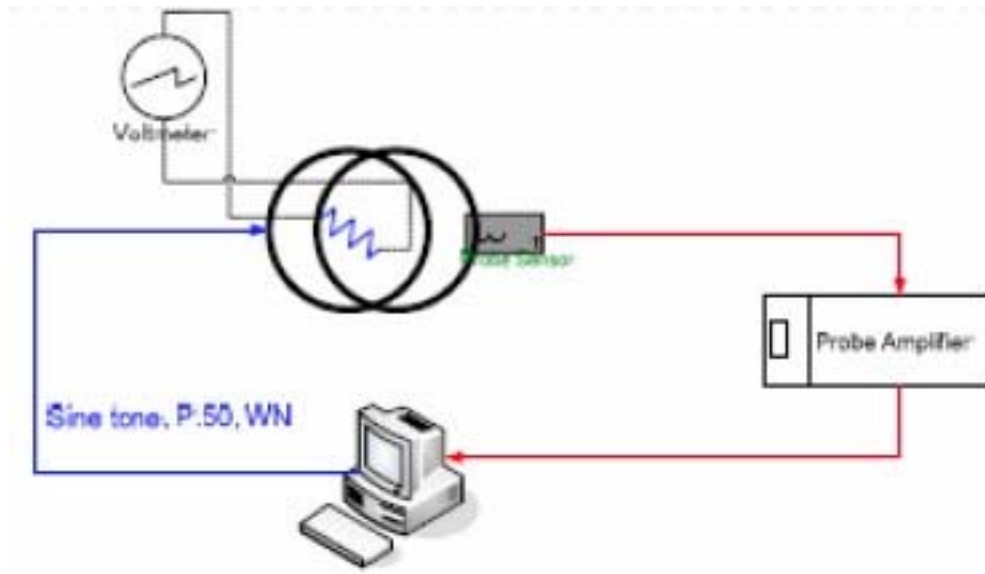
The flow diagram below was followed:



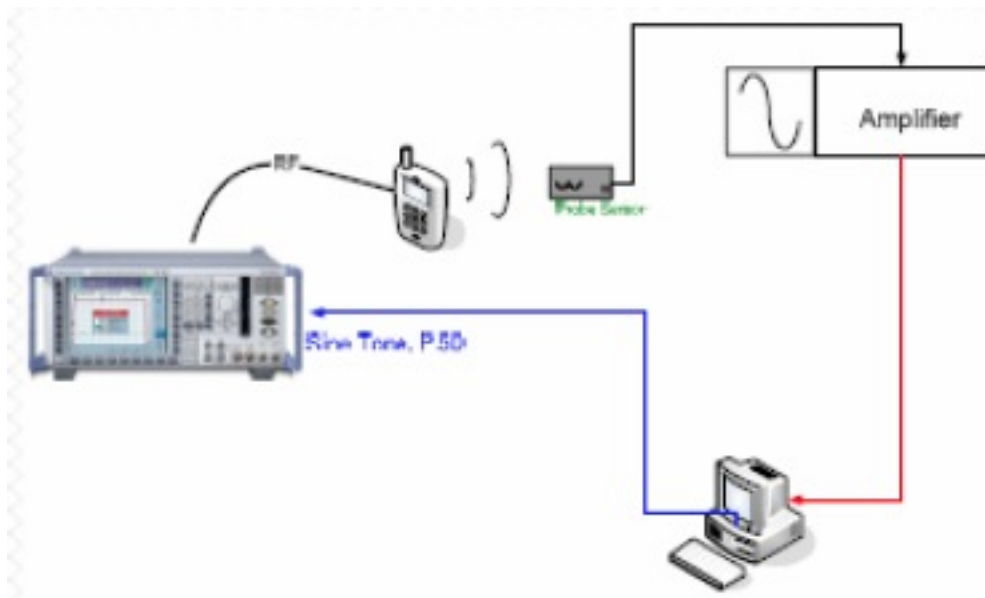
T-Coil Signal Test Process

2.8.2.2 Test Setup

The equipment was connected as shown in an acoustic/RF hemi-anechoic chamber:



Validation Setup with Helmholtz Coil



T-Coil Test Setup

2.8.2.3 Test Procedure

Frequency Response Validation The frequency response through the Helmholtz Coil was verified to be within 0.5 dB relative to 1 kHz, between 300 – 3000 Hz using the ITU-P.50 artificial speech signal as shown below:



Measurement Validation WD noise measurements are filtered with A-weighting and Half-Band Integration over a frequency range of 100Hz – 10kHz to process ABM2 measurements. Below is the verification of the system processing A-weighting and Half-Band integration between system input to output within 0.5 dB of the theoretical result:

f(Hz)	HBI, A- Measured (dB re 1kHz)	HBI, A- Theoretical (dB re 1kHz)	dB Var.
100	-16.150	-16.170	0.012
125	-13.241	-13.250	0.008
160	-10.333	-10.340	0.007
200	-8.005	-8.010	0.006
250	-5.915	-5.920	0.005
315	-4.035	-4.040	0.005
400	-2.395	-2.400	0.004
500	-1.207	-1.210	0.003
630	-0.347	-0.350	0.003
800	0.068	0.070	0.002
1000	0.001	0.000	0.001
1250	-0.501	-0.500	-0.001
1600	-1.511	-1.510	-0.001
2000	-2.783	-2.780	-0.003
2500	-4.323	-4.320	-0.003
3150	-6.175	-6.170	-0.005
4000	-8.338	-8.330	-0.008
5000	-10.599	-10.590	-0.009
6300	-13.212	-13.200	-0.010
8000	-16.284	-16.270	-0.011
10000	-19.539	-19.520	-0.015

2.8.2.4 Uncertainty Estimation Table

a	b	c	d	e= f(d,k)	f	g	h= c*f/e	i= c*g/e	k
Uncertainty Component	Sec.	Tol (+ %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+%)	10g Ui (+%)	V i
Measurement System									
Probe calibration	E.2.1	7.0	N	1	1	1	7.00	7.00	
Axial Isotropy	E.2.2	2.5	R				1.02	1.02	
Hemispherical Isotropy	E.2.2	4.0	R				1.63	1.63	
Boundary effect	E.2.3	1.0	R		1	1	0.58	0.58	
Linearity	E.2.4	5.0	R		1	1	2.89	2.89	
System detection limits	E.2.5	1.0	R		1	1	0.58	0.58	
Readout Electronics	E.2.6	0.02	N	1	1	1	0.02	0.02	
Reponse Time	E.2.7	3.0	R		1	1	1.73	1.73	
Integration Time	E.2.8	2.0	R		1	1	1.15	1.15	
RF ambient Conditions	E.6.1	3.0	R		1	1	1.73	1.73	
Probe positioner Mechanical Tolerance	E.6.2	2.0	R		1	1	1.15	1.15	
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R		1	1	0.03	0.03	
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	E.5.2	5.0	R		1	1	2.89	2.89	
Test sample Related									
Test sample positioning	E.4.2.1	0.03	N	1	1	1	0.03	0.03	N - 1
Device Holder Uncertainty	E.4.1.1	5.00	N	1	1	1	5.00	5.00	
Output power Variation - SAR drift measurement	6.6.2	5.78	R		1	1	3.34	3.34	

2.9 Test Equipment List

Instrument	Manufacture	Model No.	Serial No.	Last Calibration
Universal Work Station	Aprel	ALS-UWS	100-00154	NCR
Data Acquisition Package	Aprel	ALS-DAQ-PAQ-3	110-00215	NCR
Probe Mounting Device and Boundary Detection Sensor System	Aprel	ALS-PMDPS-3	120-00265	NCR
E-Field Probe	Aprel	E-020-H	274	Oct.4,2012
H-Field Probe	Aprel	H-030	400-00102	Oct.4,2012
Reference Validation Dipole 900MHz	Aprel	ALS-D-900-S-2-HAC	190-00607	June 28,2012
Reference Validation Dipole 1900MHz	Aprel	ALS-D-1900-S-2-HAC	210-00708	June 28,2012
Dielectric Probe Kit	Aprel	ALS-PR-DIEL	260-00955	NCR
Device Holder 2.0	Aprel	ALS-H-E-SET-2	170-00506	NCR
SAR software	Aprel	ALS-SAR-AL-10	Ver.2.3.8.90	NCR
CRS C500C Controller	Thermo	ALS-C500	RCF0504291	NCR
CRS F3 Robot	Aprel	ALS-F3-SW	N/A	NCR
Power Amplifier	Mini-Circuit	SN0974	040306	Jul.17,2012
Directional Coupler	Agilent	778D-012	N/A	Jul.17,2012
Universal Radio Communication Tester	Agilent	E5515C	104845	Mar.1,2013
Spectrum Analyzer	R&S	FSP7	100614	Jul.19,2012
Signal Generator	Agilent	E8257D	N/A	Dec.10,2012
Power Meter	R&S	NRP	N/A	Dec.10,2012

Note: All equipment upon which need to be calibrated are with calibration period of 1 year.

3 OVERALL MEASUREMENT SUMMARY

3.1 Conducted Power(Unit:dBm)

Band	GSM850			GSM1900		
Channel	128	190	251	512	661	810
Frequency(MHz)	824.2	836.6	848.8	1850.2	1880.0	1909.8
GSM	32.64	32.72	32.68	29.80	29.70	29.72

3.2 T-coil for GSM:

T-Coil Test Result

Mode	Channel	Antenna	Result	High Value (dBA/m)
GSM850	Middle	Axial	T4	33.51
		Radial H	T3	27.80
		Radial V	T3	28.08
PCS1900	Middle	Axial	T3	27.47
		Radial H	T3	25.49
		Radial V	T4	31.64

4 Test Data

Frequency	PARAMETERS
GSM850	Measurement 1: T-coil Middle Channel on Axial
	Measurement 2: T-coil Middle Channel on Radial H
	Measurement 3: T-coil Middle Channel on Radial V
PCS1900	Measurement 4: T-coil Middle Channel on Axial
	Measurement 5: T-coil Middle Channel on Radial H
	Measurement 6: T-coil Middle Channel on Radial V

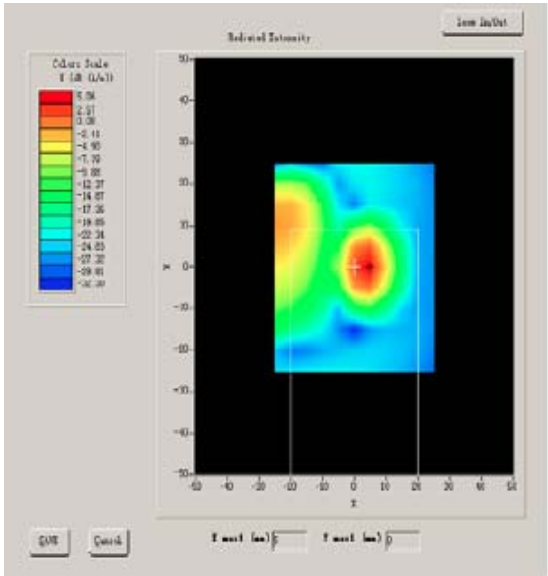
GSM850- Middle Channel on Axial

A. Experimental conditions.

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Scanning Height (mm)	10.0
Band	GSM850

B. HAC Measurement Results

Frequency (MHz): 836.400000

AXIAL ABM1	AXIAL ABM2
	NOT AVAILABLE

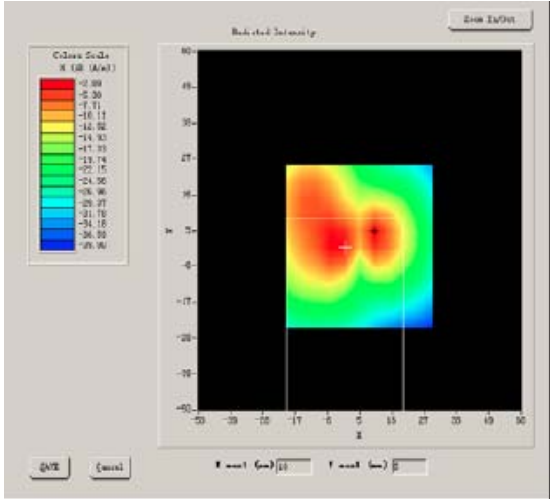
GSM850- Middle Channel on Radial H

A. Experimental conditions.

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Scanning Height (mm)	10.0
Band	GSM850

B. HAC Measurement Results

Frequency (MHz): 836.400000

RADIAL H ABM1	Radial H ABM2 NOT AVAILABLE
	

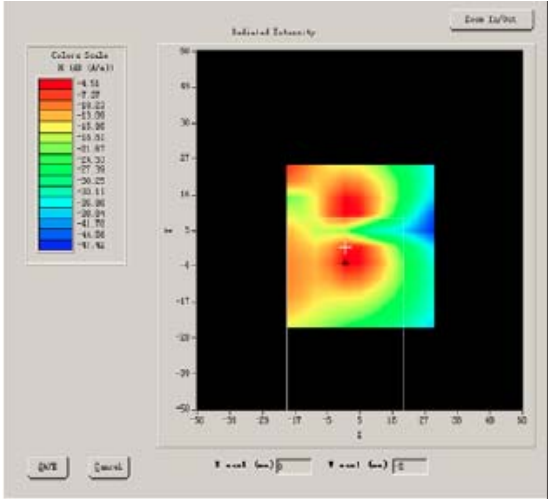
GSM850- Middle Channel on Radial V

A. Experimental conditions.

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Scanning Height (mm)	10.0
Band	GSM850

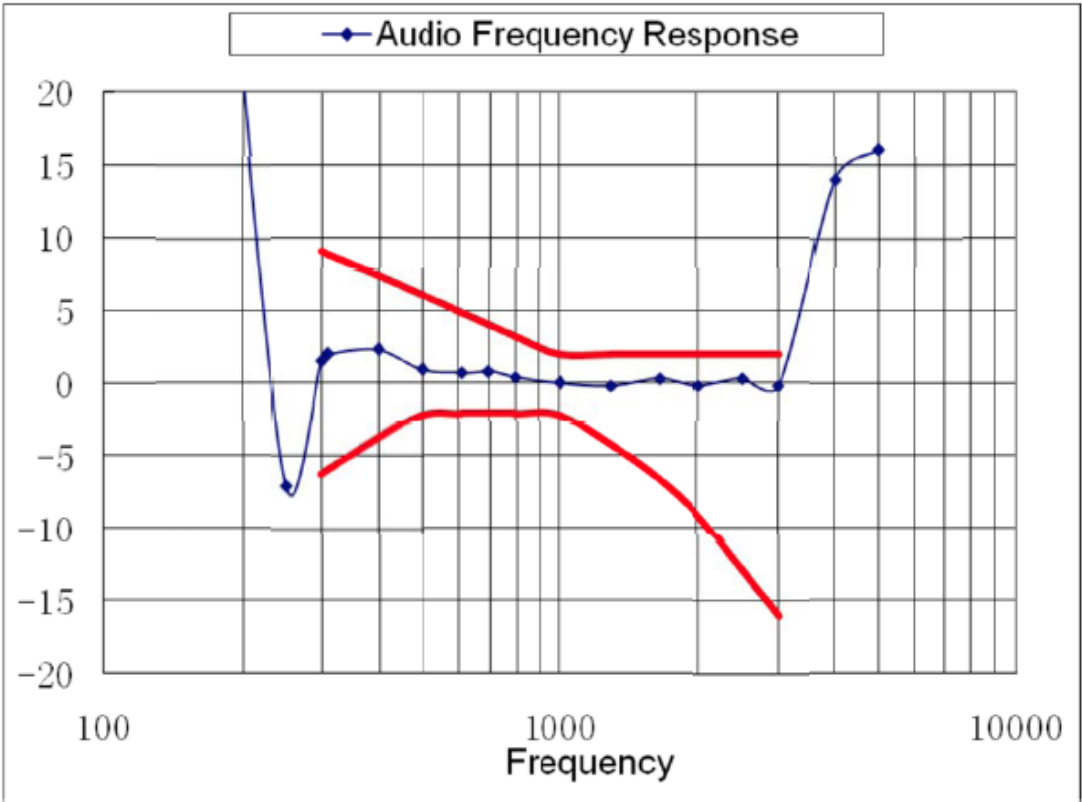
B. HAC Measurement Results

Frequency (MHz): 836.400000

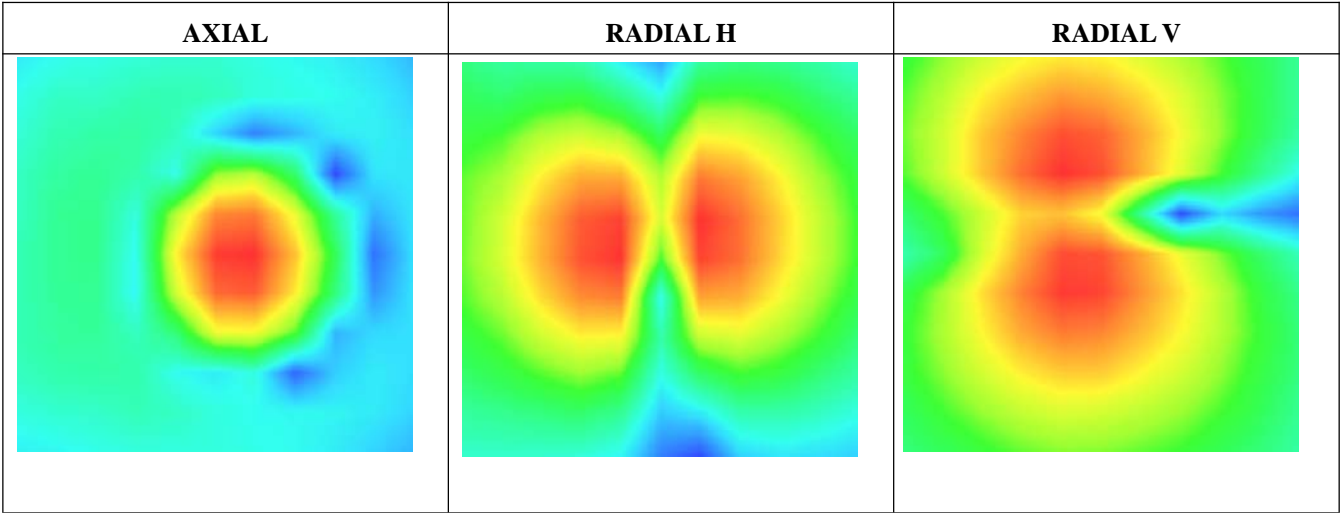
RADIAL V ABM1	RADIAL V ABM2
	NOT AVAILABLE

Test Summary

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBa/m	-	dBa/m	-	Pass/Fail
7.3.1.1	GSM	GSM850	Intensity, Axial	-18	Max	13.16	-	PASS
7.3.1.2			Intensity, RadialH	-18	Max	7.25	-	PASS
				-	-	-	-	-
7.3.1.2			Intensity, RadialV	-18	Max	5.87	-	PASS
				-	-	-	-	-
7.3.3			Signal to noise/noise, Axial	5	Max	33.51	T4	PASS
7.3.3			Signal to noise/noise, RadialH	5	Max	27.80	T3	PASS
				-	-	-	-	-
7.3.3			Signal to noise/noise, RadialV	5	Max	28.08	T3	PASS
				-	-	-	-	-
7.3.2	Frequency reponse, Axial	-	-	-	-	-		



T.Coil Scan Overlay Magnetic Field Distributions



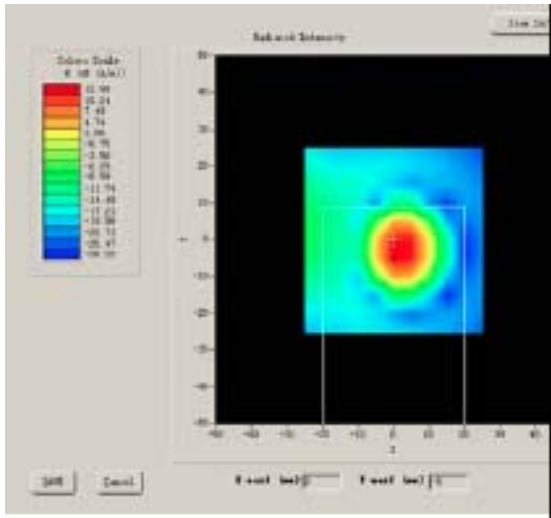
GSM1900- Middle Channel on Axial

A. Experimental conditions.

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Scanning Height (mm)	10.0
Band	GSM1900

B. HAC Measurement Results

Frequency (MHz): 1880.000000

AXIAL ABM1	AXIAL ABM2
	NOT AVAILABLE

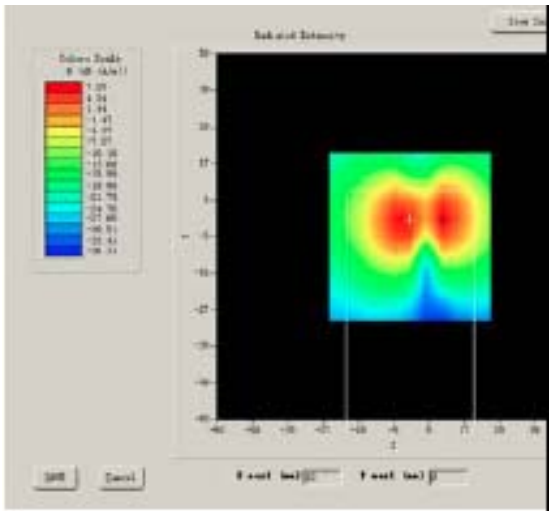
GSM1900- Middle Channel on Radial H

A. Experimental conditions.

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Scanning Height (mm)	10.0
Band	GSM1900

B. HAC Measurement Results

Frequency (MHz): 1880.000000

RADIAL H ABM1	RADIAL H ABM2
	NOT AVAILABLE

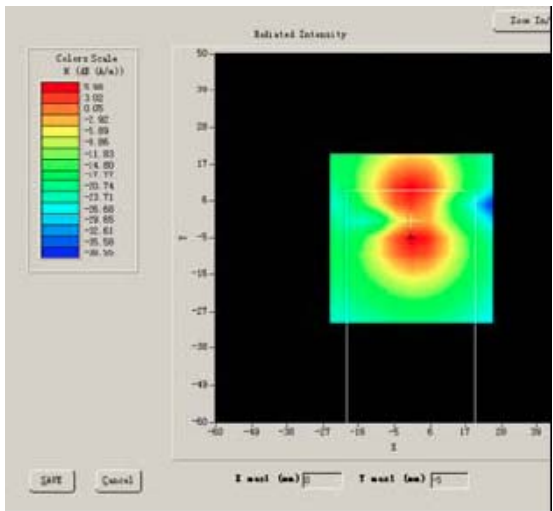
GSM1900- Middle Channel on Radial V

A. Experimental conditions.

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Scanning Height (mm)	10.0
Band	GSM1900

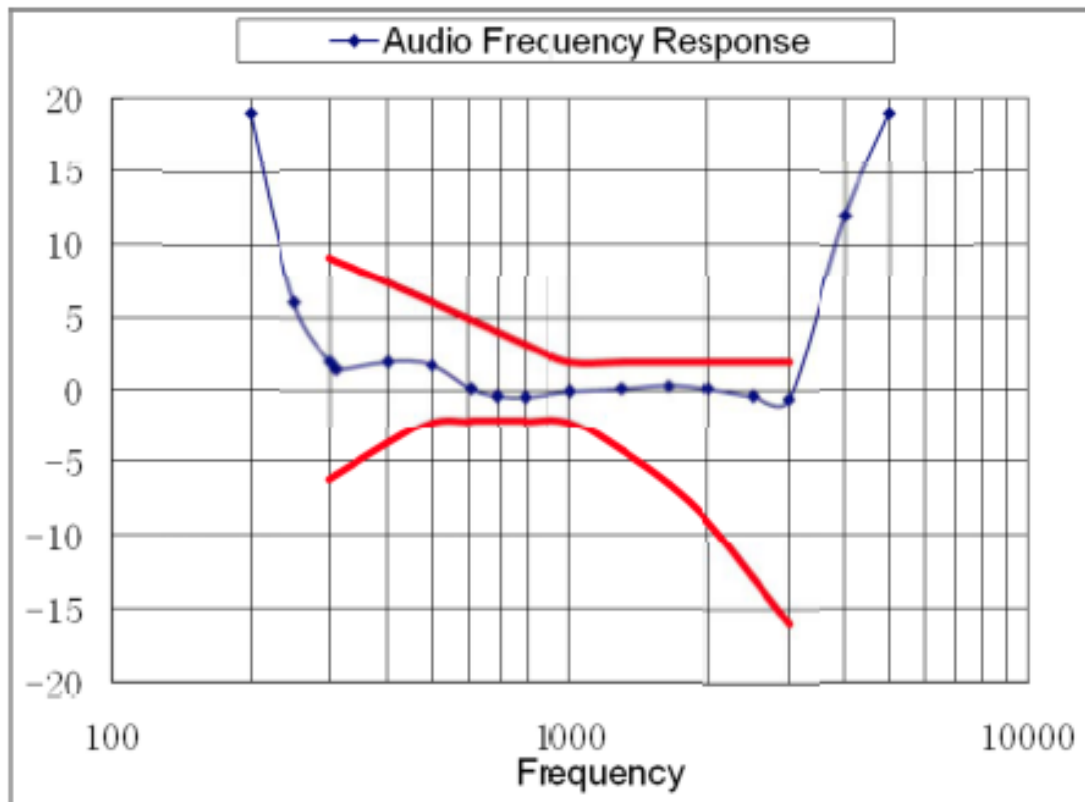
B. HAC Measurement Results

Frequency (MHz): 1880.000000

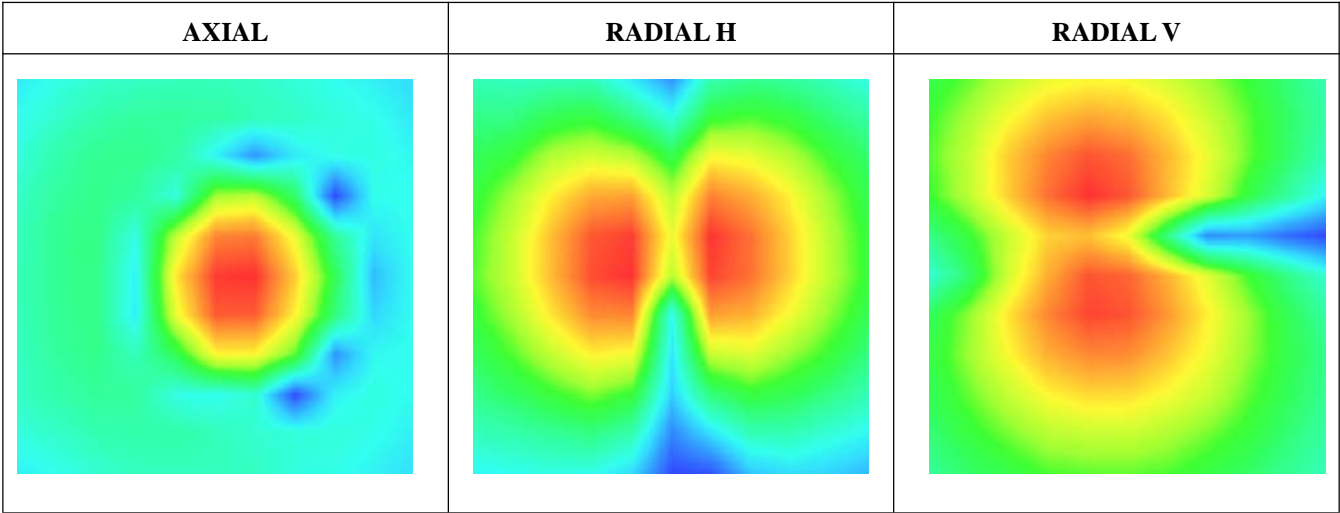
RADIAL V ABM1	RADIAL V ABM2
	NOT AVAILABLE

Test Summary

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measure d	Category	Verdict
				dBa/m	-	dBa/m	-	Pass/Fail
7.3.1.1	GSM	GSM1900	Intensity, Axial	-18	Max	13.53	-	PASS
7.3.1.2			Intensity, RadialH	-18	Max	7.63	-	PASS
				-	-	-	-	-
7.3.1.2			Intensity, RadialV	-18	Max	4.84	-	PASS
				-	-	-	-	-
7.3.3			Signal to noise/noise, Axial	5	Max	27.47	T3	PASS
7.3.3			Signal to noise/noise, RadialH	5	Max	25.49	T3	PASS
				-	-	-	-	-
7.3.3			Signal to noise/noise, RadialV	5	Max	31.64	T4	PASS
				-	-	-	-	-
7.3.2	Frequency reponse, Axial	-	-	-	-	-		



T.Coil Scan Overlay Magnetic Field Distributions



--END--

7 Probe calibration report

NCL CALIBRATION LABORATORIES

A Division of APREL Inc

Calibration File No.: CP-1433

Client: IAC

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.

Equipment: Miniature Isotropic RF Probe 835 MHz

Manufacturer: APREL Laboratories

Model No.: E-020-H

Serial No.: 420-00274

E-Field Hearing Aid Compatibility Certification Report

Calibration Procedure: SSI/DRB-TP-D01-038-E

Project No: IAC-HAC e-probe-cal-5696

Calibrated: 4th October 2012

Released on: 5th October 2012

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

Released By:



Art Brennan, Quality Manager

NCL CALIBRATION LABORATORIES

303 Terry Fox Drive, Suite 102
Kanata, Ontario
CANADA K2K 3J1

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FAX: (613) 435-8306

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-038-E E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 420-00274.

References

SSI/DRB-TP-D01-038-E E-Field HAC Probe Calibration Procedure
IEEE Std 1309-2006 "Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40GHz".
IEEE Std C63.19-2007 American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids

Conditions

Probe 420-00274 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



Dan Brooks, Test Engineer

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Calibration Results Summary

Probe Type:	E-Field Probe E-020-H
Serial Number:	420-00274
Frequency:	835 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

Spatial Resolution:

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Sensitivity in Air

Normalized for HAC testing.

Frequency:	835 MHz
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Sensitivity Factors

Channel 1:	1.48
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Channel 2:	1.48
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Channel 3:	1.48
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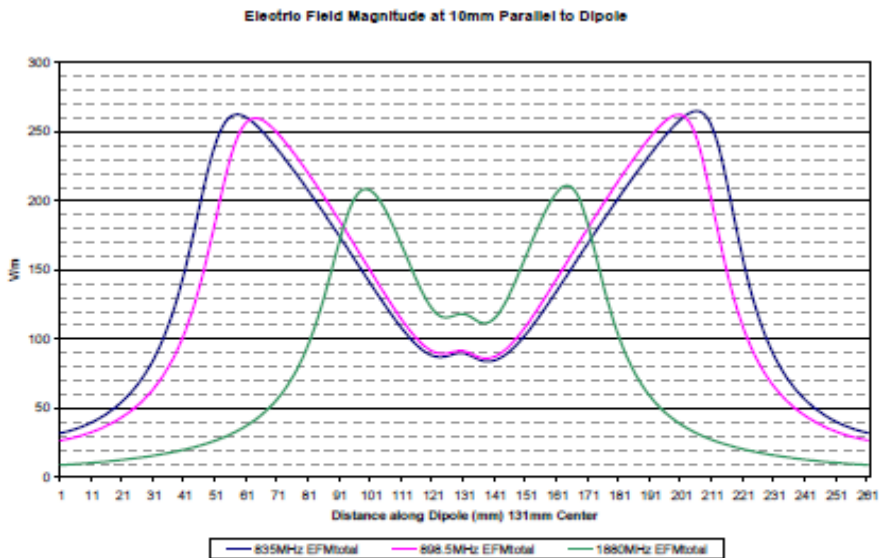
Diode Compression Point:	95 mV
---------------------------------	-------

NCL Calibration Laboratories
Division of APREL Laboratories.

Target E-Field Measured 835 MHz:

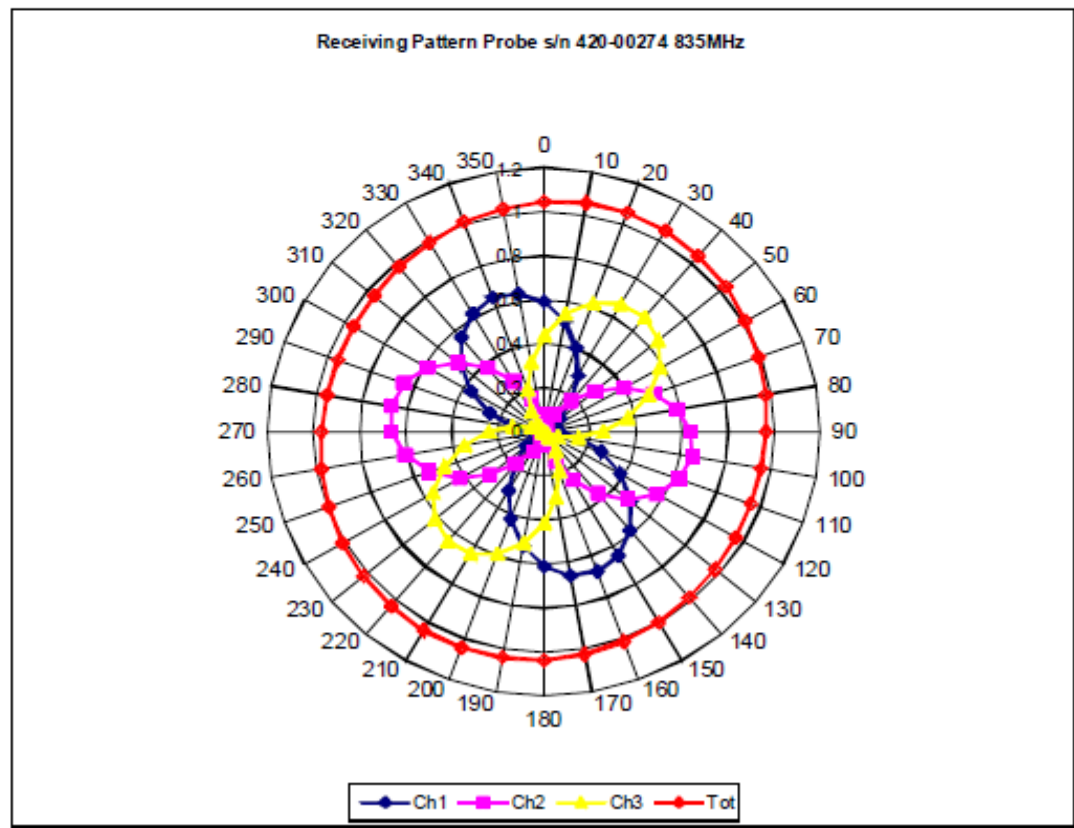
The E-Filed measured with probe Serial Number: E-020-H-420-00274 has been normalized to meet the target values to within 10%.

Target E-Field DSY @10mm:	185.90 V/m
Measured E-Field @ 10 mm:	184.05 V/m
Delta E-Field:	1. 85 V/m
Deviation from Target:	< 1%



NCL Calibration Laboratories
Division of APREL Laboratories.

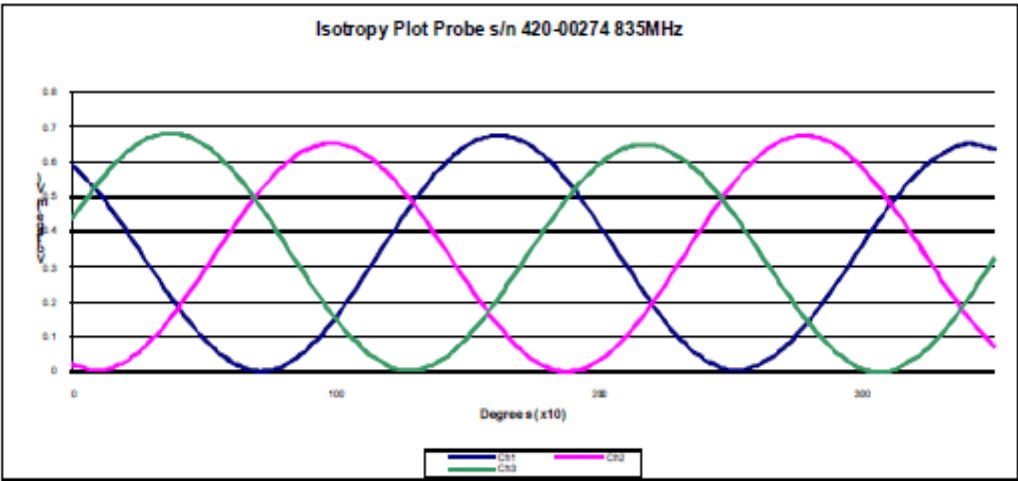
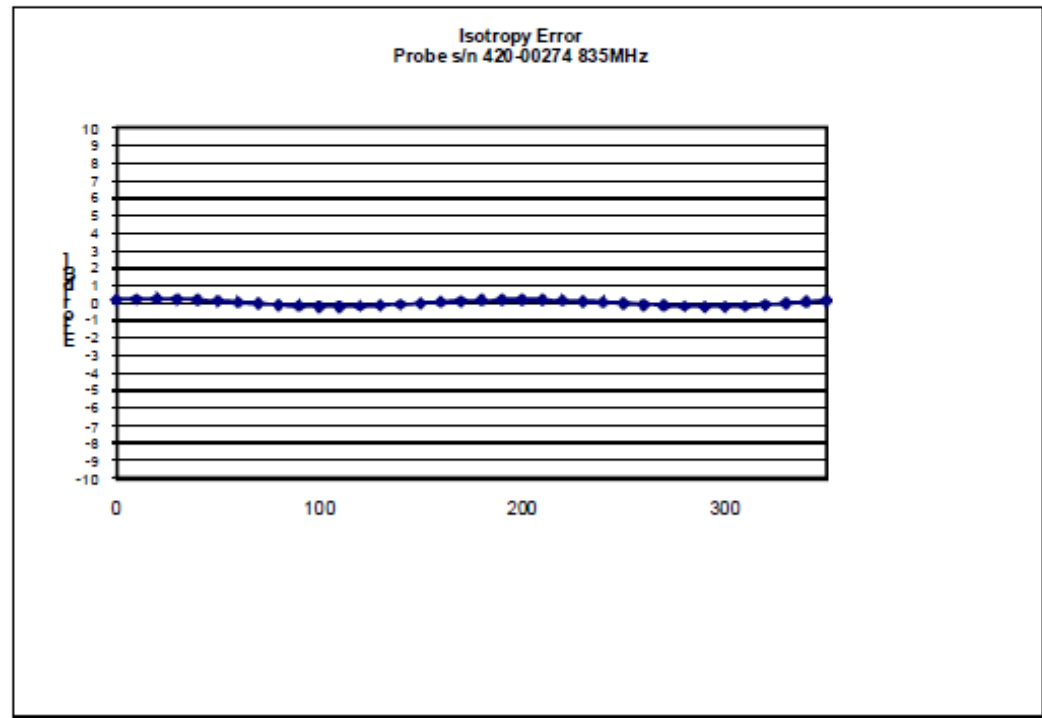
Receiving Pattern 835 MHz (Air)



Page 5 of 9
This page has been reviewed for content and attested to on Page 2 of this document.

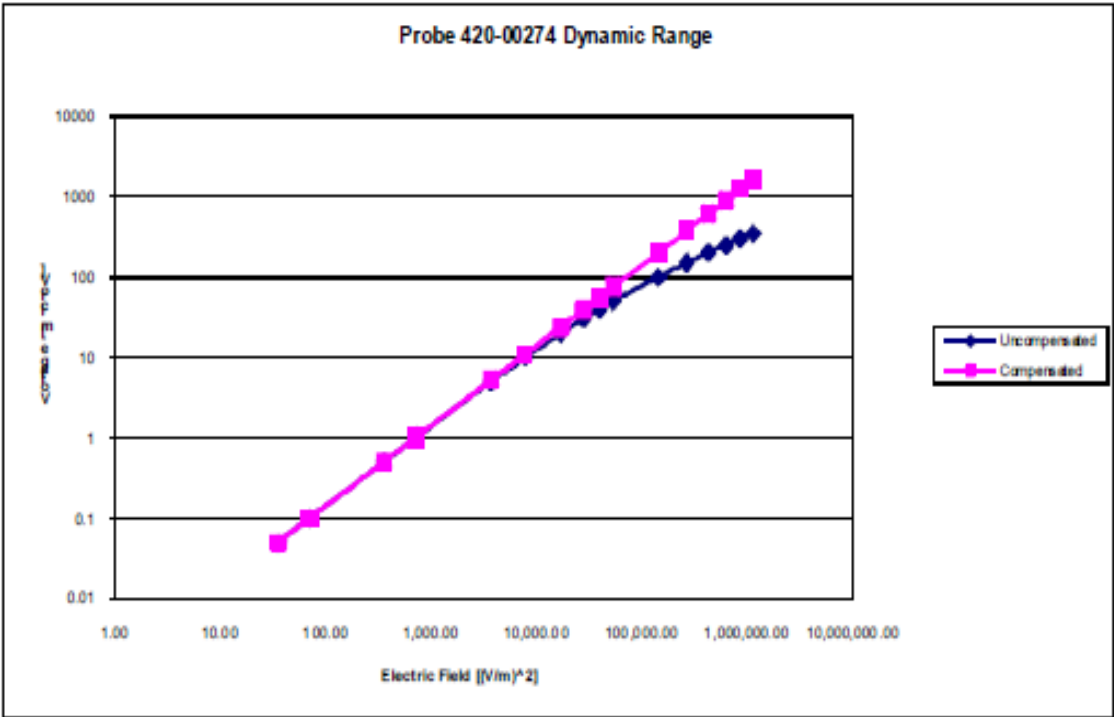
NCL Calibration Laboratories
Division of APREL Laboratories.

Isotropy Error 835 MHz (Air)

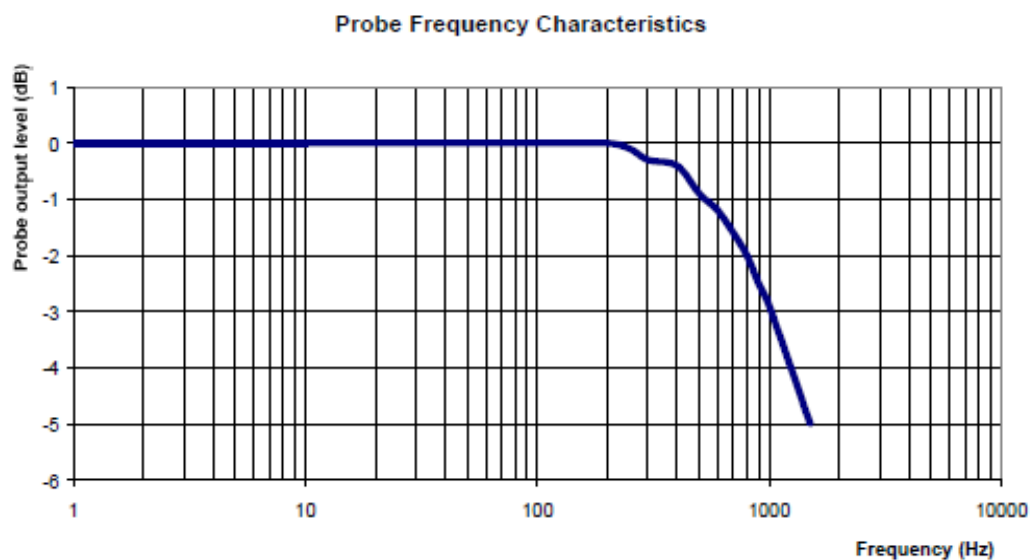


NCL Calibration Laboratories
Division of APREL Laboratories.

Dynamic Range



Division of APREL Laboratories.



Video Bandwidth at 500 Hz	1 dB
Video Bandwidth at 1.02 KHz:	3 dB

This page has been reviewed for content and attested to on Page 2 of this document.

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 2012.

NCL CALIBRATION LABORATORIES*A Division of APREL Inc*

Calibration File No.: CP-1434

Client: IAC

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.

Equipment: Miniature H-field RF Probe

Manufacturer: APREL Laboratories

Model No.: H-020

Serial No.: 400-00102

Calibration Type.: AIR Calibration

Calibration Frequency.: 835MHz

Calibration Procedure: SSI/DRB-TP-D01-038

Project No: IAC-HAC H-probe-cal-5697

Calibrated: 4th October 2012Released on: 5th October 2012

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

Released By: _____



Art Brennan, Quality Manager

NCL CALIBRATION LABORATORIES

303 Terry Fox Drive, Suite 102
Kanata, Ontario
CANADA K2K 3J1

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

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-038 H-Field Probe Calibration Procedure. The results contained within this report are for APREL H-Field Probe H-030 400-00102.

References

SSI/DRB-TP-D01-038 H-Field Probe Calibration Procedure

IEEE Std 1309-2005 "Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40GHz".

IEEE Std C63.19-2006 American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids

Conditions

Probe 400-00102 was a re- calibration.

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

Sensor offset

Each probe is comprised of magnetic sensors and positioned at 90 degree to each other. The electric center of the loop is the calibration field point of the probe and the reference for all subsequent sensitivities.

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



Dan Brooks, Test Engineer

Page 2 of 7

This page has been reviewed for content and attested to on Page 2 of this document.

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Mechanical H-Field Probe Properties

Probe Type:	H-Field Probe H-020
Serial Number:	400-00102
Sensor Offset:	3.5 mm
Sensor Diameter:	3.8 mm
Tip Enclosure:	Etalyle
Tip Diameter:	8.5 mm
Total Length:	>300 mm

Sensitivity in Air at 835MHz

All Channels :	112.0 mV/(A/m) ²
Diode Compression Point:	75 mV

NOTE:

Sensitivity as measured and recorded above has been calculated for each sensor when fully assembled and positioned spatially around the measurement space and has been normalized to reduce measurement uncertainty and enhance probe response for all three measurement locations and perceived vectors.

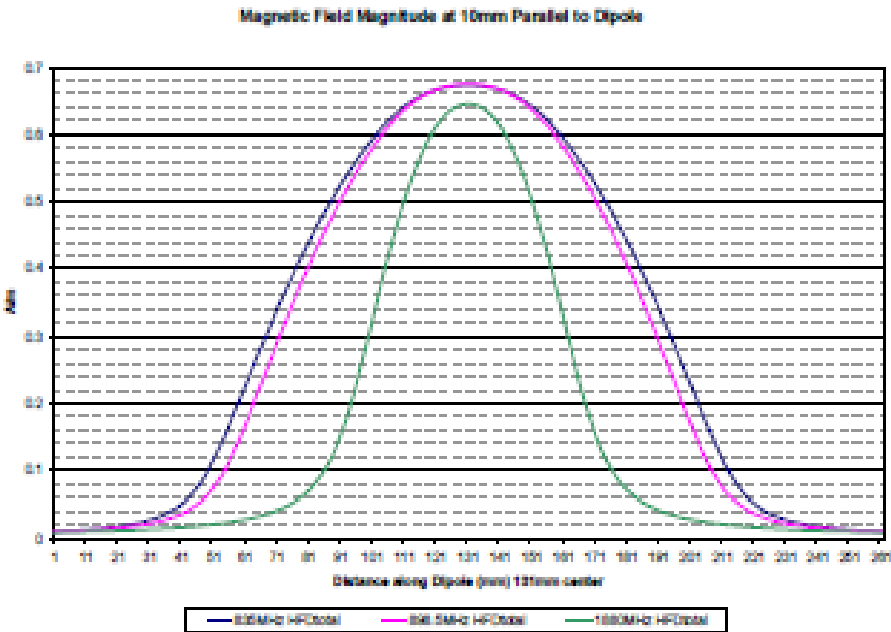
NCL Calibration Laboratories

Division of APREL Laboratories.

Target H-Field Measured:

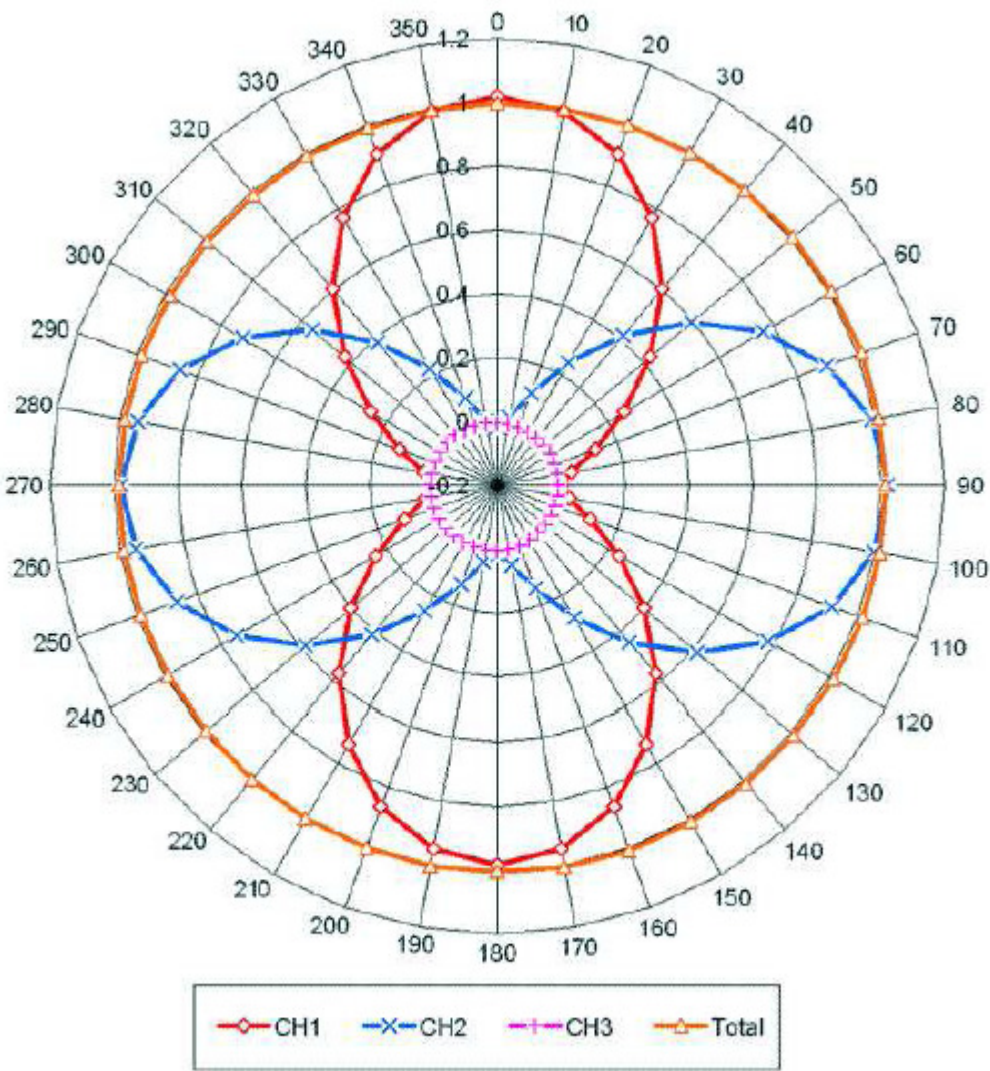
The H-Field measured with probe Serial Number: H-020-400-00102 has been normalized to meet the target values to within 10%.

Target H-Field D&Y @ 10 mm:	0.325A/m
Measured H-Field @ 10 mm:	0.327 A/m
Delta H-Field:	0.002 A/m
Deviation from Target:	< 1%



NCL Calibration Laboratories
Division of APREL Laboratories.

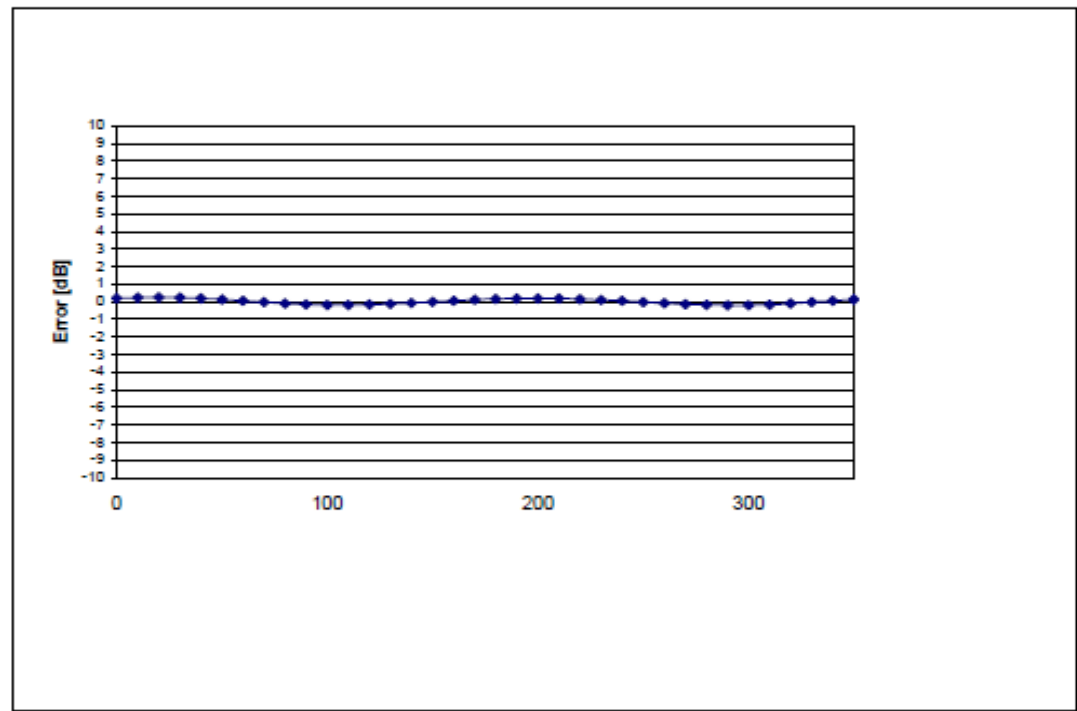
Measured Receiving Pattern at 835MHz
H-030-400-00102



Measured at 90° Θ

NCL Calibration Laboratories
Division of APREL Laboratories.

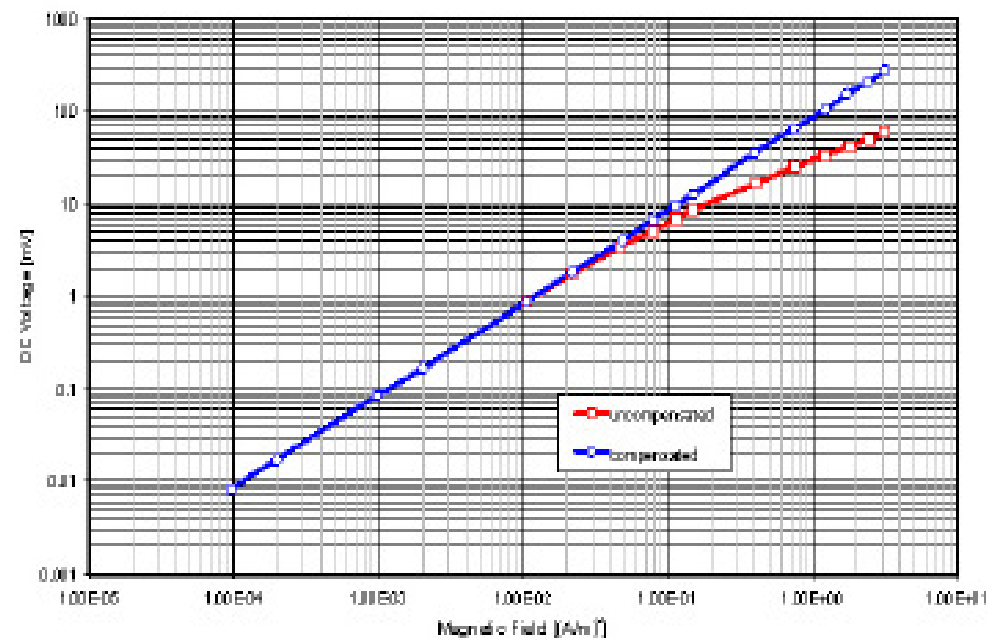
Loop Isotropy Error Normalized to Reference 835 MHz



Isotropy: 0.20 dB

NCL Calibration Laboratories
Division of APREL Laboratories.

Dynamic Range Normalized to Reference



Measured at 90° ϕ

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 2012.

NCL CALIBRATION LABORATORIES*A Division of APREL Inc*

Calibration File No.: CP-1433

Client: IAC

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.

Equipment: Miniature Isotropic RF Probe 835 MHz

Manufacturer: APREL Laboratories

Model No.: E-020-H

Serial No.: 420-00274

E-Field Hearing Aid Compatibility Certification Report

Calibration Procedure: SSI/DRB-TP-D01-038-E

Project No: IAC-HAC e-probe-cal-5686

Calibrated: 4th October 2012Released on: 5th October 2012

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

Released By: _____



Art Brennan, Quality Manager

NCL CALIBRATION LABORATORIES

303 Terry Fox Drive, Suite 102
Kanata, Ontario
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Division of APREL
TEL: (613) 438-8300
FAX: (613) 438-8308

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-038-E E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 420-00274.

References

SSI/DRB-TP-D01-038-E E-Field HAC Probe Calibration Procedure
IEEE Std 1309-2006 "Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40GHz".
IEEE Std C63.19-2007 American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids

Conditions

Probe 420-00274 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



Dan Brooks, Test Engineer

Page 2 of 9

This page has been reviewed for content and attested to on Page 2 of this document.

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Calibration Results Summary

Probe Type:	E-Field Probe E-020-H
Serial Number:	420-00274
Frequency:	1880 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

Spatial Resolution:

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Sensitivity in Air

Normalized for HAC testing.

Frequency:	1880 MHz
-------------------	----------

Sensitivity Factors

Channel 1: 1.72

Channel 2: 1.72

Channel 3: 1.72

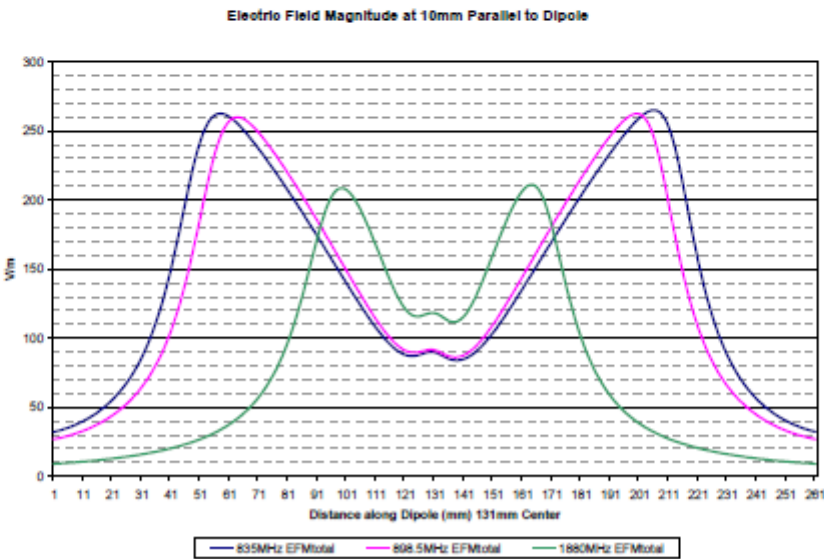
Diode Compression Point:	95 mV
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NCL Calibration Laboratories
Division of APREL Laboratories.

Target E-Field Measured 1880 MHz:

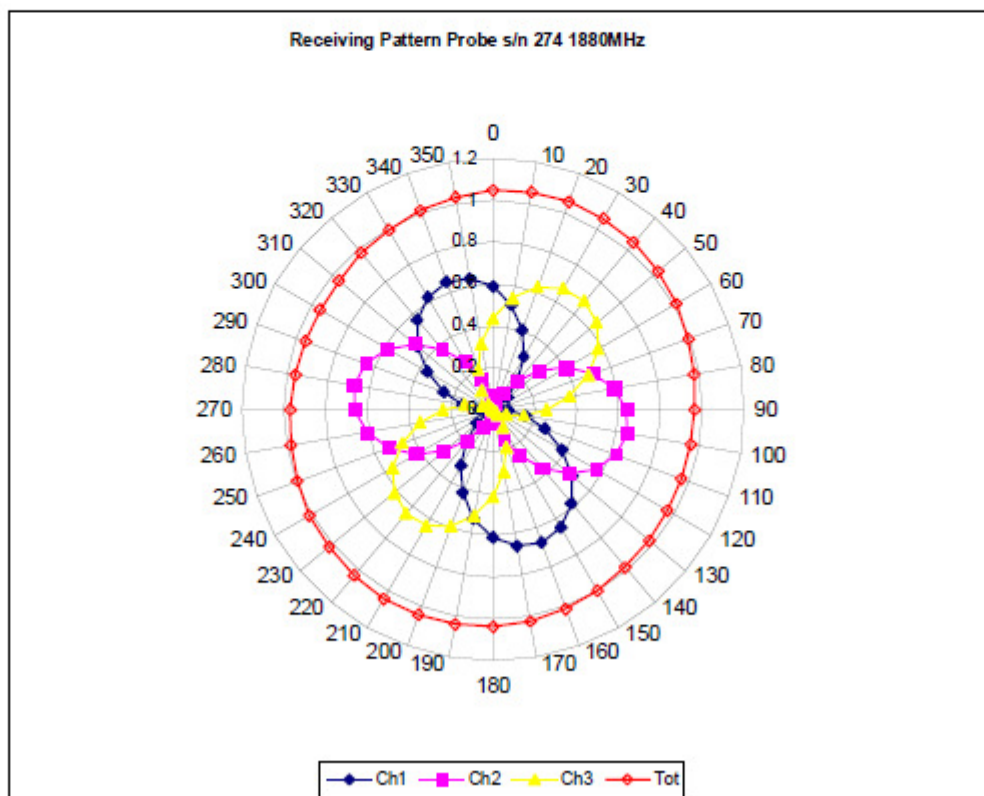
The E-Filed measured with probe Serial Number: E-020-H-420-00274 has been normalized to meet the target values to within 10%.

Target E-Field DSY@10mm:	156.0 V/m
Measured E-Field @ 10 mm:	156.74 V/m
Delta E-Field:	0.74 V/m
Deviation from Target:	< 1%



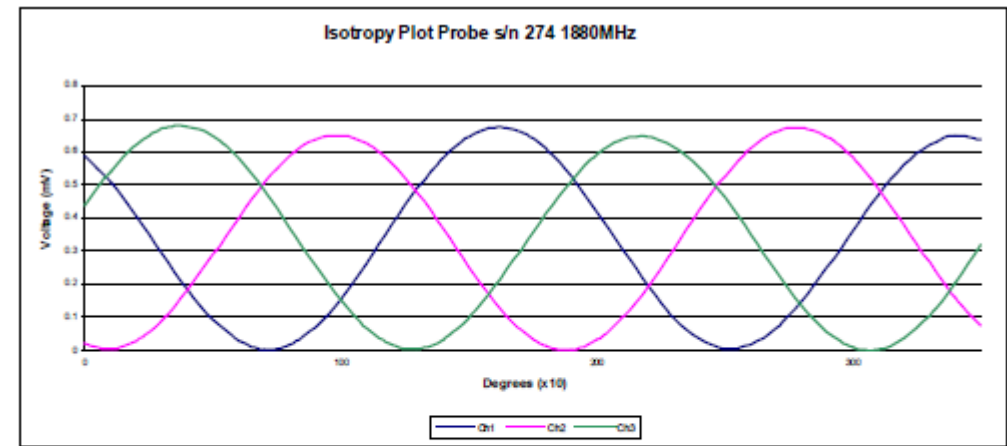
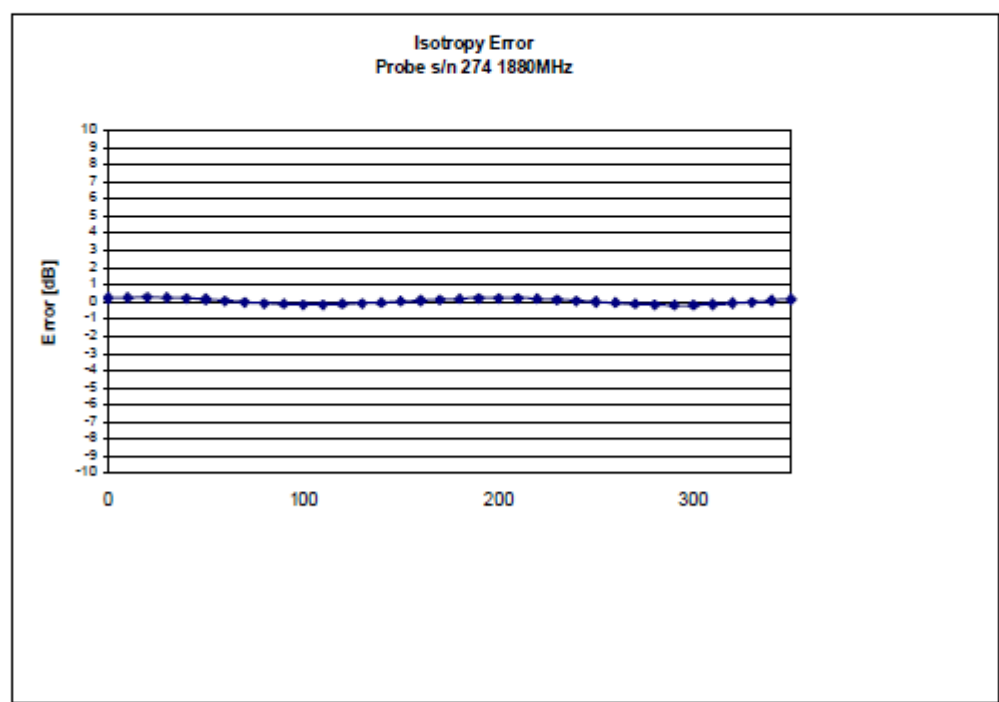
NCL Calibration Laboratories

Division of APREL Laboratories.

Receiving Pattern 1880 MHz (Air)

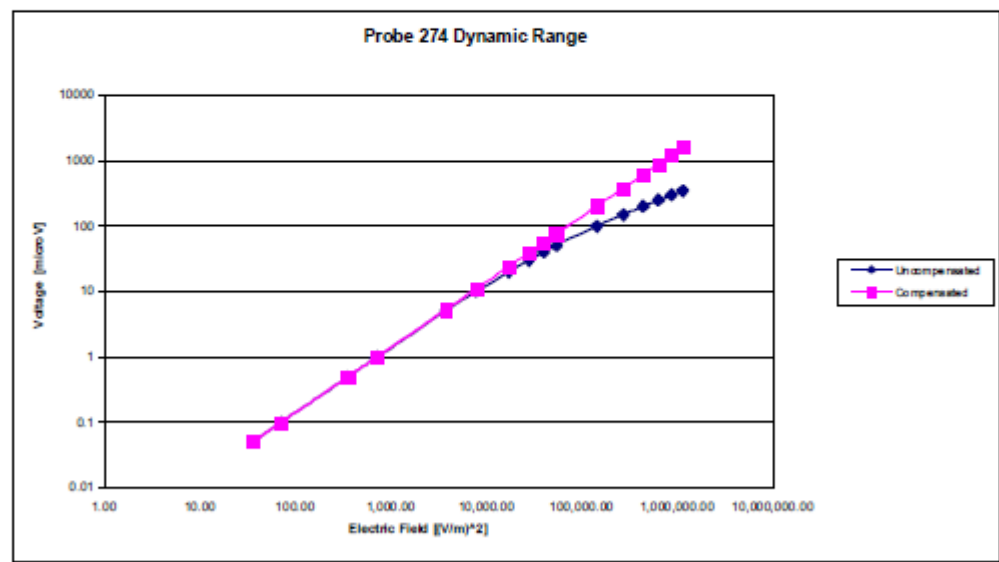
NCL Calibration Laboratories
Division of APREL Laboratories.

Isotropy Error 1880 MHz (Air)



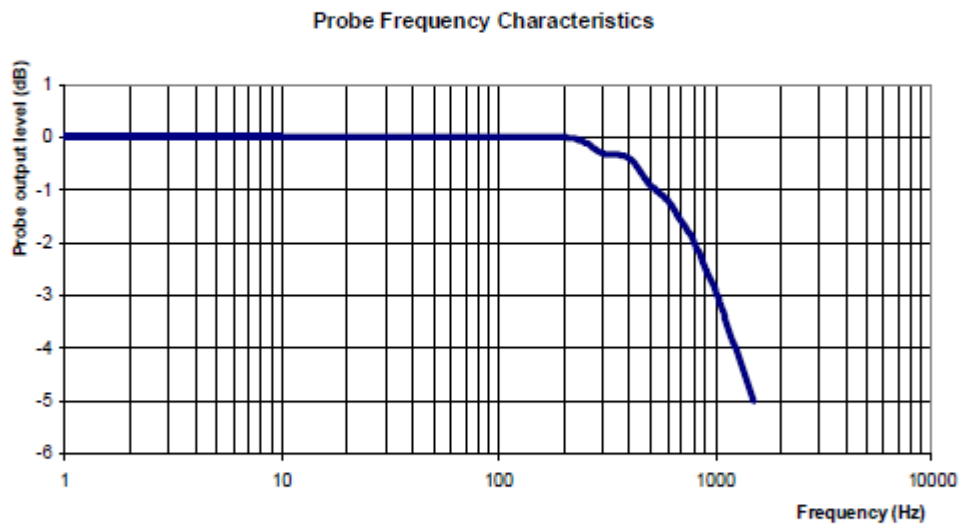
NCL Calibration Laboratories
Division of APREL Laboratories.

Dynamic Range



NCL Calibration Laboratories
Division of APREL Laboratories.

Video Bandwidth



Video Bandwidth at 500 Hz	1 dB
Video Bandwidth at 1.02 KHz:	3 dB

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 2012.

Page 9 of 9

This page has been reviewed for content and attested to on Page 2 of this document.

NCL CALIBRATION LABORATORIES*A Division of APREL Inc*

Calibration File No.: CP-1434

Client: IAC

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.

Equipment: Miniature H-field RF Probe

Manufacturer: APREL Laboratories

Model No.: H-020

Serial No.: 400-00102

Calibration Type.: AIR Calibration

Calibration Frequency.: 1880MHz

Calibration Procedure: SSIDRB-TP-D01-038

Project No: IAC-HAC H-probe-cal-5597

Calibrated: 4th October 2012Released on: 4th October 2012

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

Released By: _____



Art Brennan, Quality Manager

NCL CALIBRATION LABORATORIES303 Terry Fox Drive, Suite 102
Kensington, Ontario
CANADA K2K 3J1Division of APREL
TEL: (613) 435-8300
FAX: (613) 435-8306

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-038 H-Field Probe Calibration Procedure. The results contained within this report are for APREL H-Field Probe H-030 400-00102.

References

SSI/DRB-TP-D01-038 H-Field Probe Calibration Procedure

IEEE Std 1309-2005 "Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 kHz to 40GHz".

IEEE Std C63.19-2006 American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids

Conditions

Probe 400-00102 was a re- calibration.

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

Sensor offset

Each probe is comprised of magnetic sensors and positioned at 90 degree to each other. The electric center of the loop is the calibration field point of the probe and the reference for all subsequent sensitivities.

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



Dan Brooks, Test Engineer

Page 2 of 7

This page has been reviewed for content and attested to on Page 2 of this document.

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Mechanical H-Field Probe Properties

Probe Type:	H-Field Probe H-020
Serial Number:	400-00102
Sensor Offset:	3.5 mm
Sensor Diameter:	3.8 mm
Tip Enclosure:	Etralyte
Tip Diameter:	8.5 mm
Total Length:	>300 mm

Sensitivity In Air at 1880MHz

All Channels :	1356 mV/(A/m) ²
Diode Compression Point:	75 mV

NOTE:

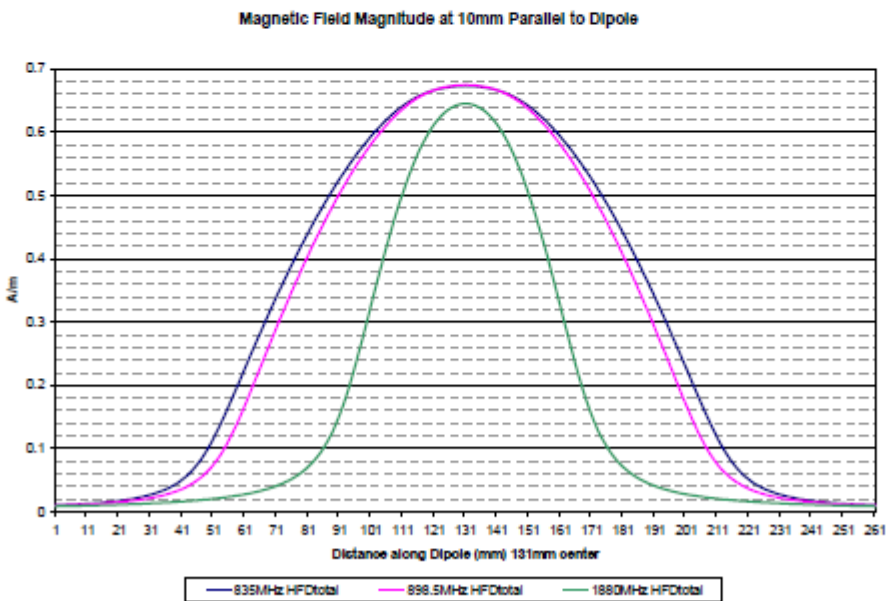
Sensitivity as measured and recorded above has been calculated for each sensor when fully assembled and positioned spatially around the measurement space and has been normalized to reduce measurement uncertainty and enhance probe response for all three measurement locations and perceived vectors.

NCL Calibration Laboratories
Division of APREL Laboratories.

Target H-Field Measured:

The H-Filed measured with probe Serial Number: H-030-400-00102 has been normalized to meet the target values to within 10%.

Target H-Field DSY @ 10 mm:	0.443 A/m
Measured H-Field @ 10 mm:	0.447 A/m
Delta H-Field:	0.004 A/m
Deviation from Target:	< 1%



NCL Calibration Laboratories

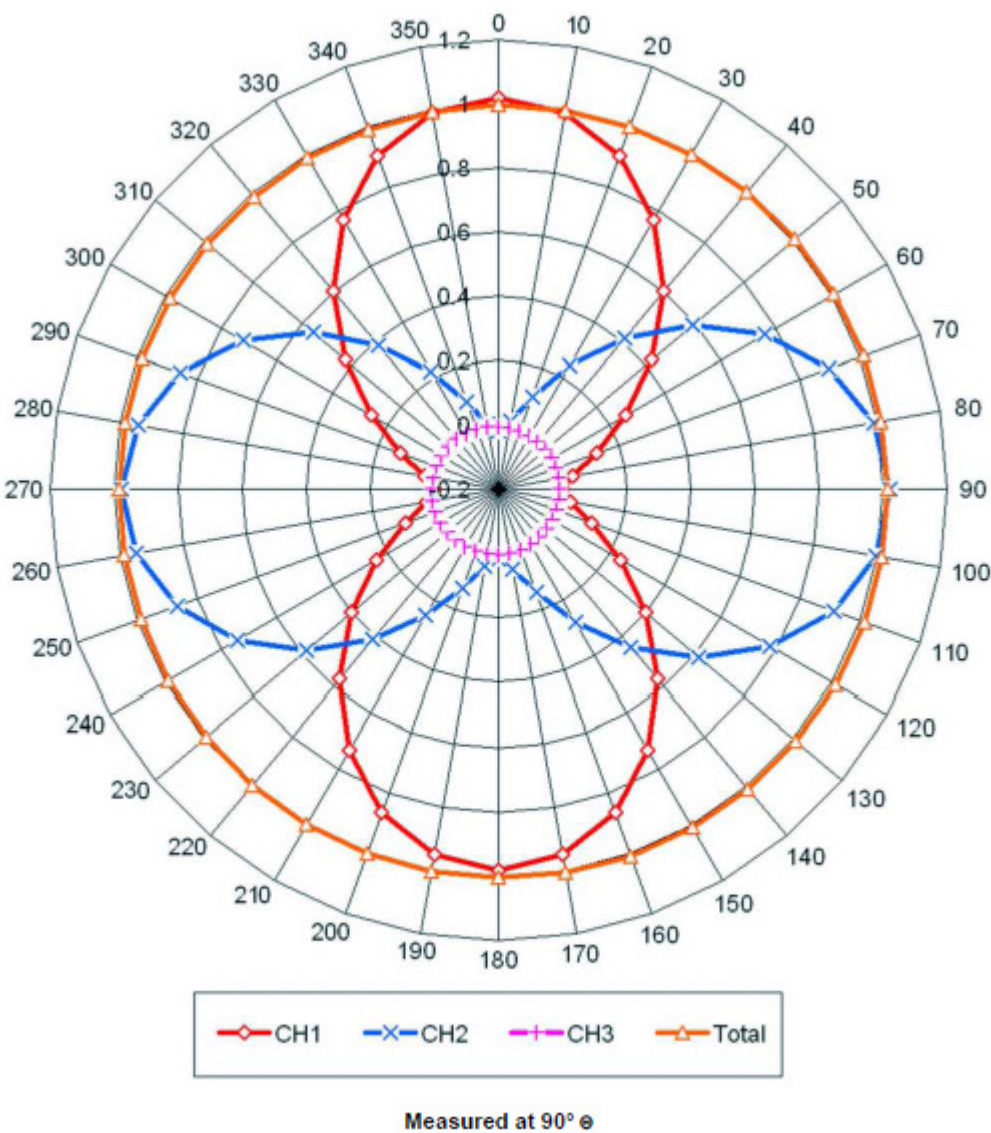
Division of APREL Laboratories.

Spatial Resolution:

The measured probe tip diameter is 8.5 mm (+/- 0.1 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

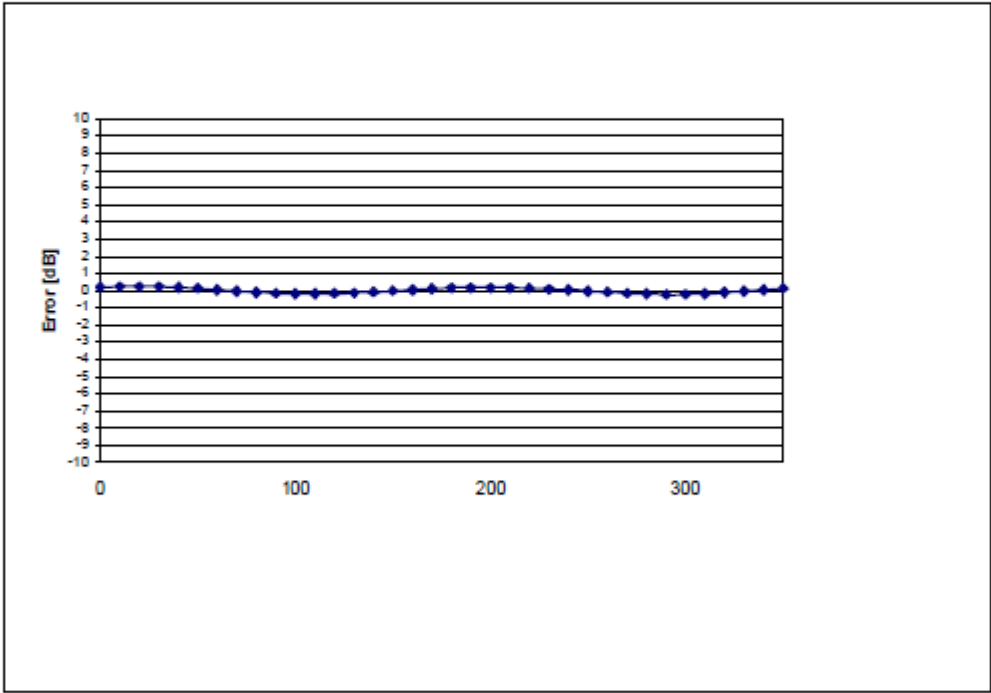
Measured Receiving Pattern at 1880MHz

H-030-400-00102



NCL Calibration Laboratories
Division of APREL Laboratories.

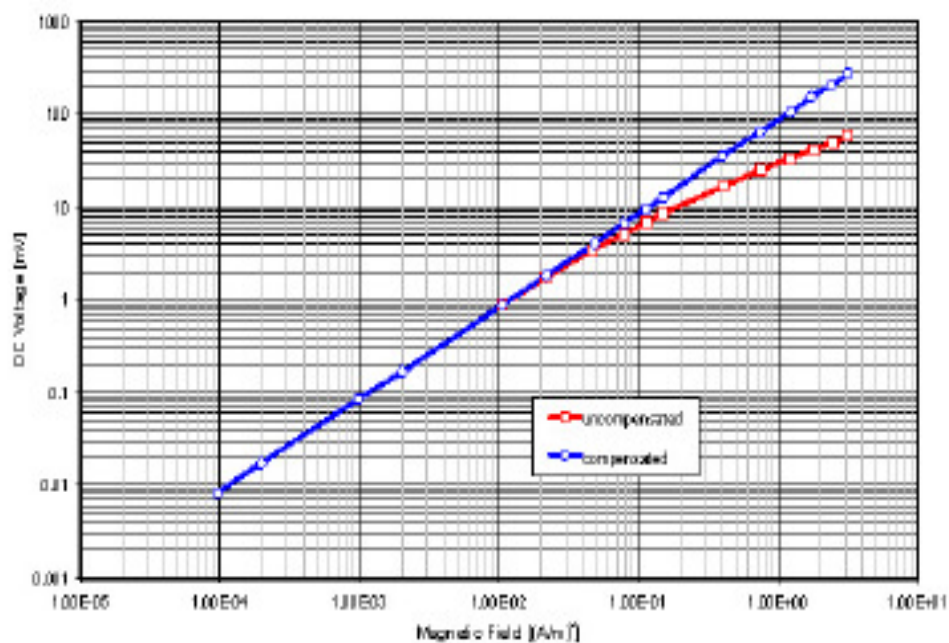
Loop Isotropy Error Normalized to Reference 1880 MHz



Isotropy: 0.20 dB

NCL Calibration Laboratories

Division of APREL Laboratories.

Dynamic Range Normalized to ReferenceMeasured at 90° ϕ **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 2012

10 Dipole calibration report**NCL CALIBRATION LABORATORIES**

Calibration File No: HAC-DC-1417
Project Number: INKB-HAC-835 dipole-5665

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.

HAC Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-835-S-2-HAC
Frequency: 835 MHz
Serial No: 185-00578

Customer: Inventec Appliance (Pudong) Corporation

Calibrated: June 9th, 2012
Released on June 9th, 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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CANADA, K2K 3J1

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FAX: (613) 435-8306

NCL Calibration Laboratories
Division of APREL Laboratories.

Conditions

Dipole 185-00578 client original calibration following modification.

Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C
Temperature of the Tissue: 21 °C +/- 0.5°C

Calibration Results Summary

This dipole has been found to comply with the calibration requirements detailed in the "Experimental Investigation into the Frequency Response for the APREL Laboratories IEEE C63.19 Hearing Aid Compatibility Validation Dipole Tuned for Air [2005 version]". When used correctly this dipole has been found to be capable of generating fields as required in the document "ATIS Incubator Solutions Program-4 Hearing Aid Compatibility AISP.4-Hearing Aid Compatibility "Test Plan & Technical Specification for Wireless Phone Compliance Baseline" [2005 Version]" for HAC system validation.

Electrical Results

Frequency: 835MHz

SWR: 1.46 U
Return Loss: -14.54 dB
Impedance: 39.73 Ω

Dipole Complies: 808 to 875MHz

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.

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Introduction

The results contained within this calibration report are for HAC Validation Dipole 185-00578. The calibration routine consisted of a two step process. Step 1 involves a mechanical verification and inspection to ensure that the dipole meets the manufacturing tolerances. Step 2 involves a complete electrical calibration of the HAC validation dipole conducted within an ambient controlled environment, where the SWR, Impedance, and Return Loss are fully assessed.

References

Experimental Investigation into the Frequency Response for the APREL Laboratories IEEE C63.19 Hearing Aid Compatibility Validation Dipole Tuned for Air [2006 version]

C63.19 American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids 2007/8

Conditions

Dipole 185-00578 was an original calibration following modification.

Ambient Temperature of the Laboratory: 22 °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.

3

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Dipole Calibration Results**Electrical Calibration**

Test	Result
S11 R/L	-14.54 dB
SWR	1.46 U
Impedance	39.73 Ω

Calibration Summary

This dipole has been found to comply with the calibration requirements detailed in the "Experimental Investigation into the Frequency Response for the APREL Laboratories IEEE C63.19 Hearing Aid Compatibility Validation Dipole Tuned for Air [2007/8 version]".

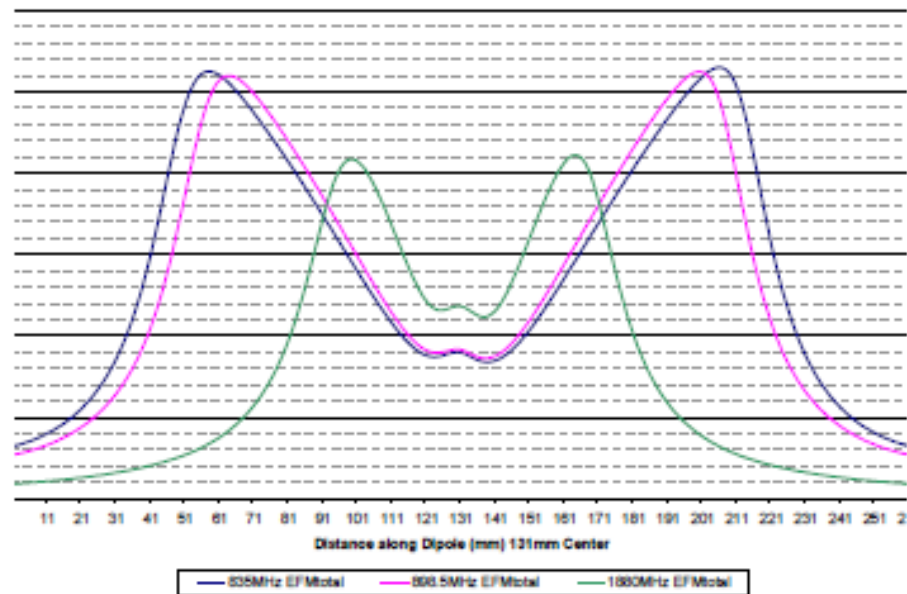
This page has been reviewed for content and attested to by signature within this document.

4

NCL Calibration Laboratories
Division of APREL Laboratories.

Target E-Field Measured:

The E-Field measured with probe Serial Number: E-020-H-420-00101 has been normalized to meet the target values within the standard C63.19 2007/8 to within 10%.



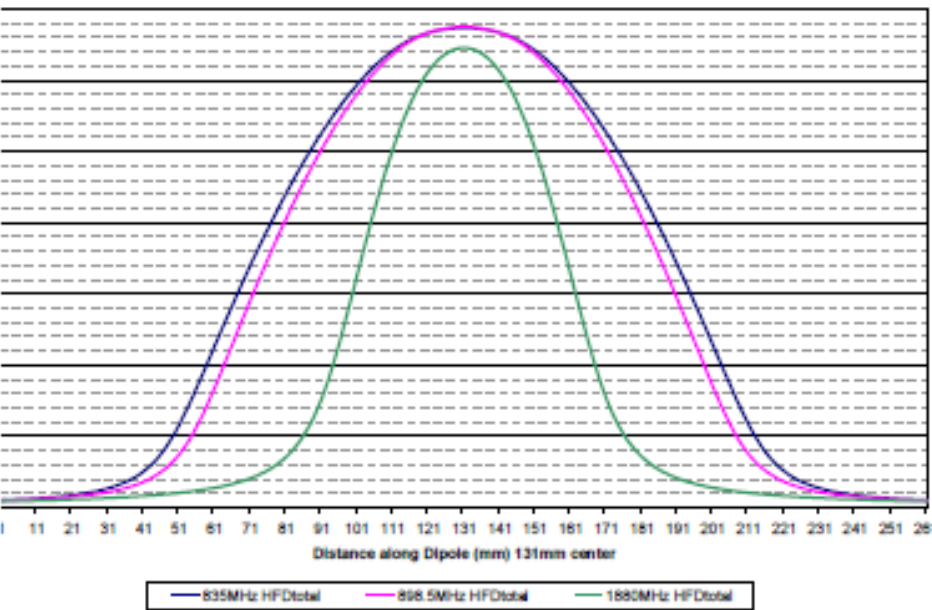
Target E-Field DSY @ 10mm:	185.9 V/m
Measured E-Field @ 10mm:	183.3 V/m
Delta E-Field:	2.5 V/m
Deviation from Target:	1.3%

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

NCL Calibration Laboratories
Division of APREL Laboratories.

Target H-Field Measured:

The H-Field measured with probe Serial Number: H-030-400-00110 has been normalized to meet the target values within the standard C63.19 2006 to within 10%.



Target H-Field DSY @ 10mm:	0.469 A/m
Measured H-Field @ 10mm:	0.474 A/m
Delta H-Field:	0.005 A/m
Deviation from Target:	<1%

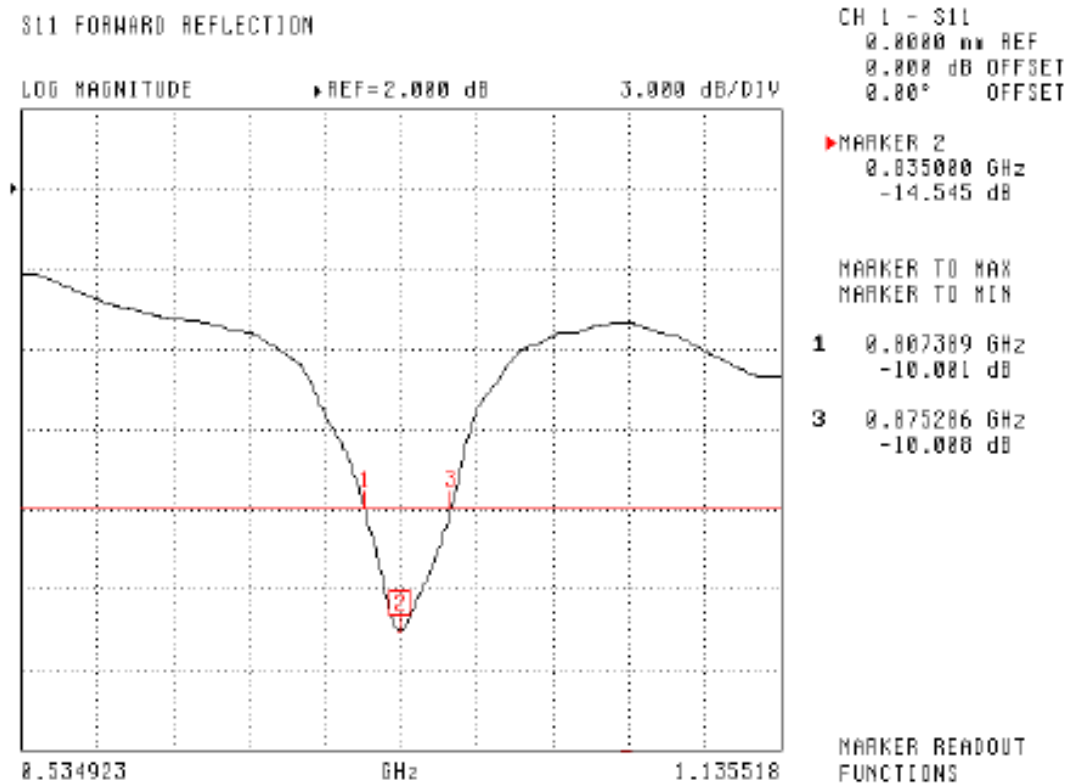
This page has been reviewed for content and attested to by signature within this document.

NCL Calibration Laboratories
Division of APREL Laboratories.

Results (Graphical Plots)

The following graphs and plots are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss



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

7

NCL Calibration Laboratories
Division of APREL Laboratories.

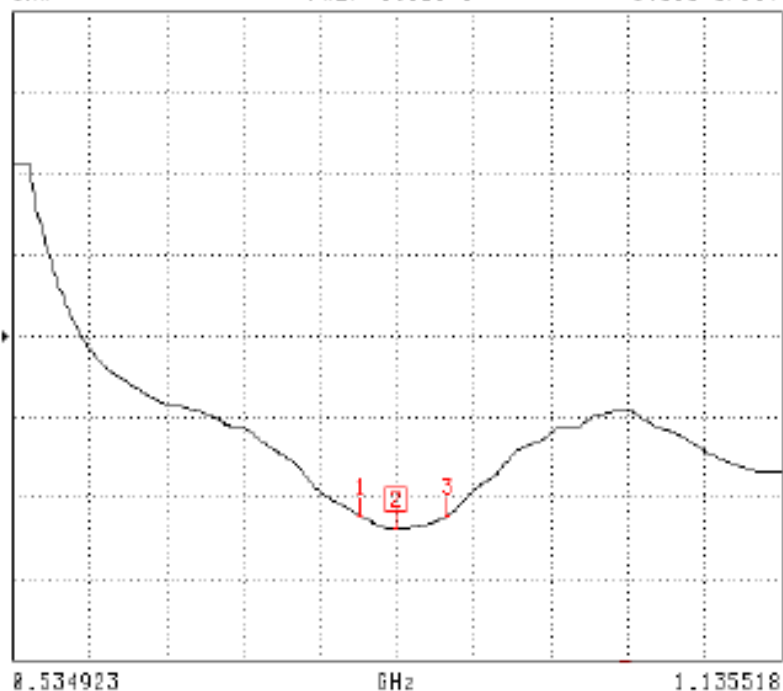
Standing Wave Ratio

S11 FORWARD REFLECTION

SWR

REF=0.623 U

3.000 U/DIV



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

MARKER 2
0.835000 GHz
1.463 U

MARKER TO MAX
MARKER TO MIN

1 0.807389 GHz
1.943 U

3 0.875286 GHz
1.944 U

MARKER READOUT
FUNCTIONS

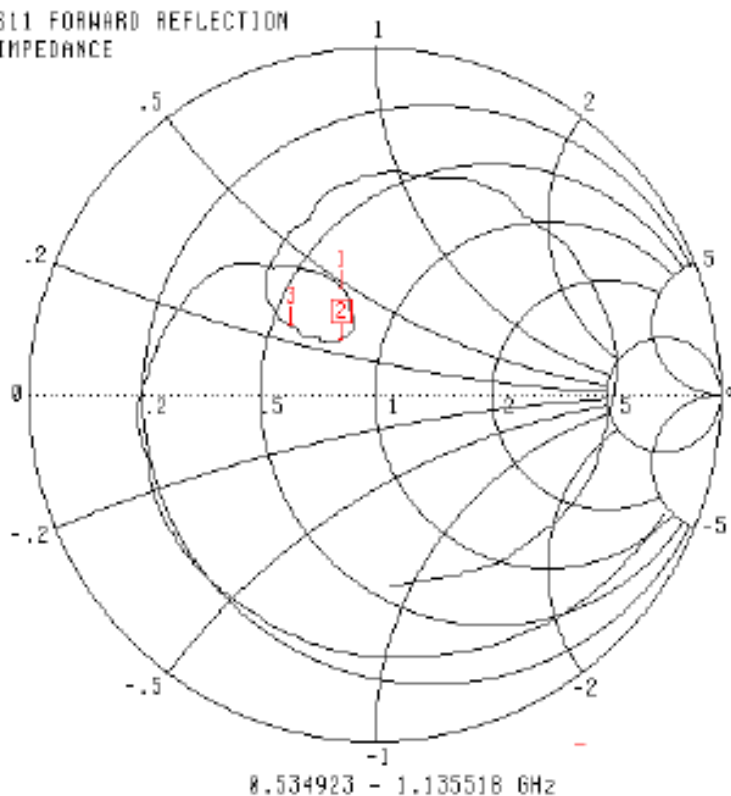
This page has been reviewed for content and attested to by signature within this document.

8

NCL Calibration Laboratories
Division of APREL Laboratories.

Smith Chart Dipole Impedance

S11 FORWARD REFLECTION
IMPEDANCE



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

▶ MARKER 2
0.835000 GHz
39.737 Ω
12.682 j Ω

MARKER TO MAX
MARKER TO MIN

1 0.807389 GHz
34.963 Ω
23.910 j Ω
3 0.875286 GHz
28.771 Ω
12.489 j Ω

MARKER READOUT
FUNCTIONS

9

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

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.

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

10

NCL CALIBRATION LABORATORIES

Calibration File No: HAC-DC-1416
Project Number: INKB-HAC-1880 dipole-5664

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.

HAC Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-1900-S-2-HAC
Frequency: 1880 MHz
Serial No: 210-00708

Customer: Inventec Appliance (Pudong) Corporation

Calibrated: June 8th, 2012
Released on June 8th, 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

NCL Calibration LaboratoriesDivision of APREL Laboratories.

Conditions

Dipole 210-00708 client re-calibration.

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

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

Calibration Results Summary

This dipole has been found to comply with the calibration requirements detailed in the "Experimental Investigation into the Frequency Response for the APREL Laboratories IEEE C63.19 Hearing Aid Compatibility Validation Dipole Tuned for Air [2005 version]". When used correctly this dipole has been found to be capable of generating fields as required in the document "ATIS Incubator Solutions Program-4 Hearing Aid Compatibility AISP.4-Hearing Aid Compatibility "Test Plan & Technical Specification for Wireless Phone Compliance Baseline" [2005 Version]" for HAC system validation.

Electrical Results

Frequency: 1855MHz

SWR: 1.42 U

Return Loss: -15.29 dB

Impedance: 37.01 Ω

Dipole Complies: 1677 to 1979MHz

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.

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Introduction

The results contained within this calibration report are for HAC Validation Dipole 210-00708. The calibration routine consisted of a two step process. Step 1 involves a mechanical verification and inspection to ensure that the dipole meets the manufacturing tolerances. Step 2 involves a complete electrical calibration of the HAC validation dipole conducted within an ambient controlled environment, where the SWR, Impedance, and Return Loss are fully assessed.

References

Experimental Investigation into the Frequency Response for the APREL Laboratories IEEE C63.19 Hearing Aid Compatibility Validation Dipole Tuned for Air [2006 version]

C63.19 American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids 2007/8

Conditions

Dipole 210-00708 was a re-calibration.

Ambient Temperature of the Laboratory: 22 °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)

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Dipole Calibration Results**Electrical Calibration**

Test	Result
S11 R/L	-15.28 dB
SWR	1.42 U
Impedance	37.01 Ω

Calibration Summary

This dipole has been found to comply with the calibration requirements detailed in the "Experimental Investigation into the Frequency Response for the APREL Laboratories IEEE C63.19 Hearing Aid Compatibility Validation Dipole Tuned for Air [2007/8 version]".

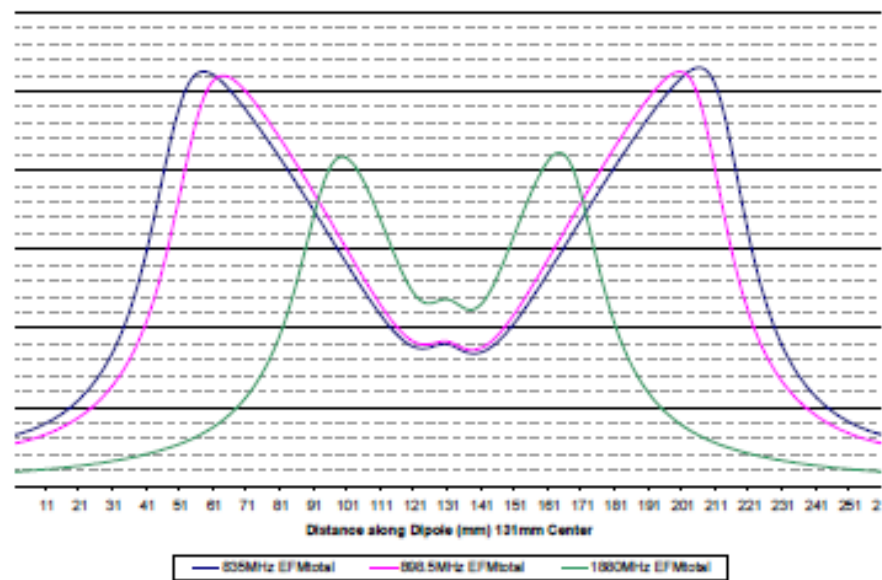
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Target E-Field Measured:

The E-Field measured with probe Serial Number: E-020-H-420-00101 has been normalized to meet the target values within the standard C63.19 2007/8 to within 10%.



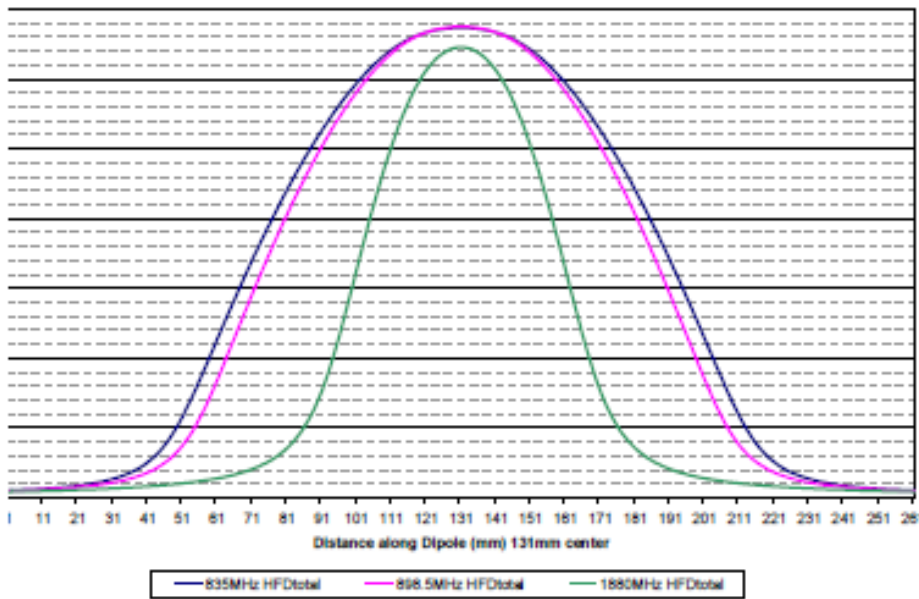
Target E-Field DSY @ 10mm:	185.9 V/m
Measured E-Field @ 10mm:	183.3 V/m
Delta E-Field:	2.5 V/m
Deviation from Target:	1.3%

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Target H-Field Measured:

The H-Field measured with probe Serial Number: H-030-400-00110 has been normalized to meet the target values within the standard C63.19 2006 to within 10%.



Target H-Field DSY @ 10mm:	0.469 A/m
Measured H-Field @ 10mm:	0.474 A/m
Delta H-Field:	0.005 A/m
Deviation from Target:	<1%

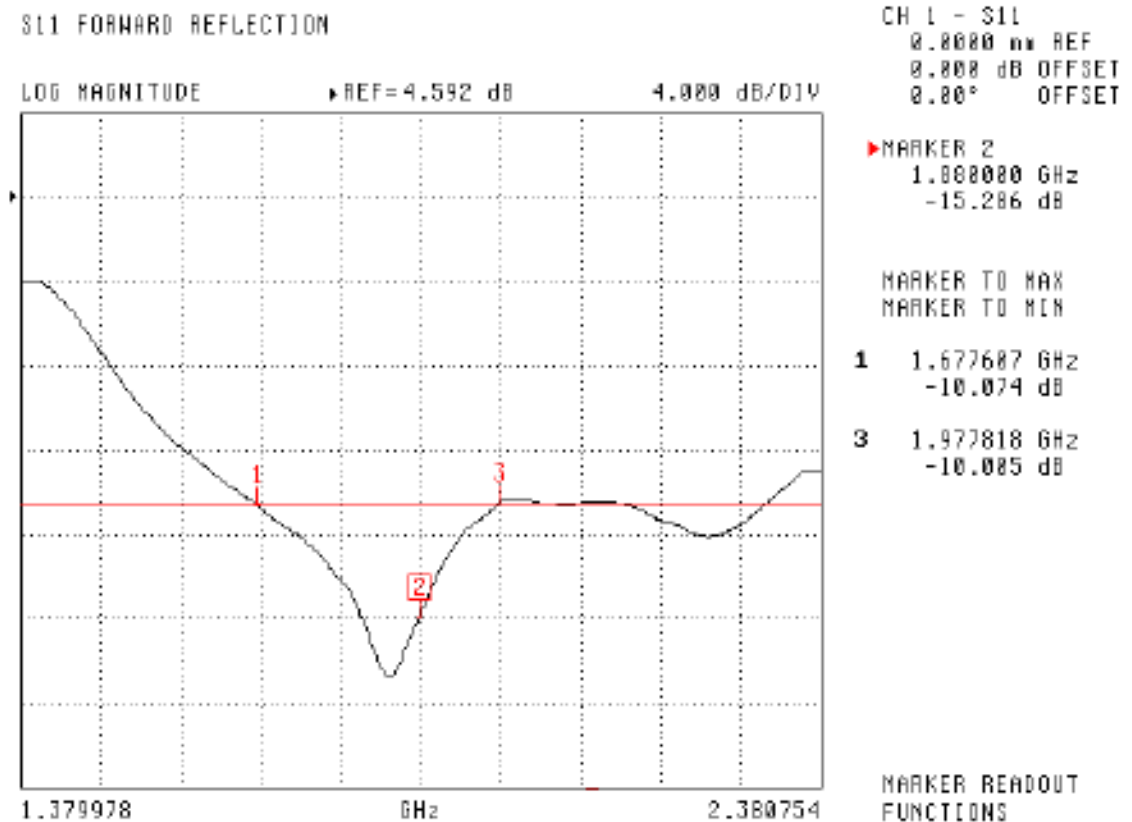
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Results (Graphical Plots)

The following graphs and plots are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss



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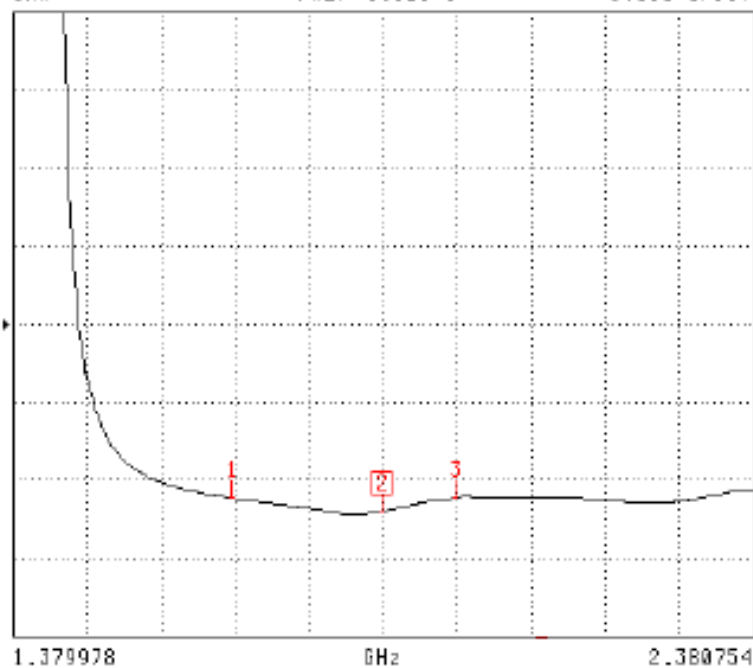
Standing Wave Ratio

S11 FORWARD REFLECTION

SWR

REF=0.623 U

3.000 U/DIV

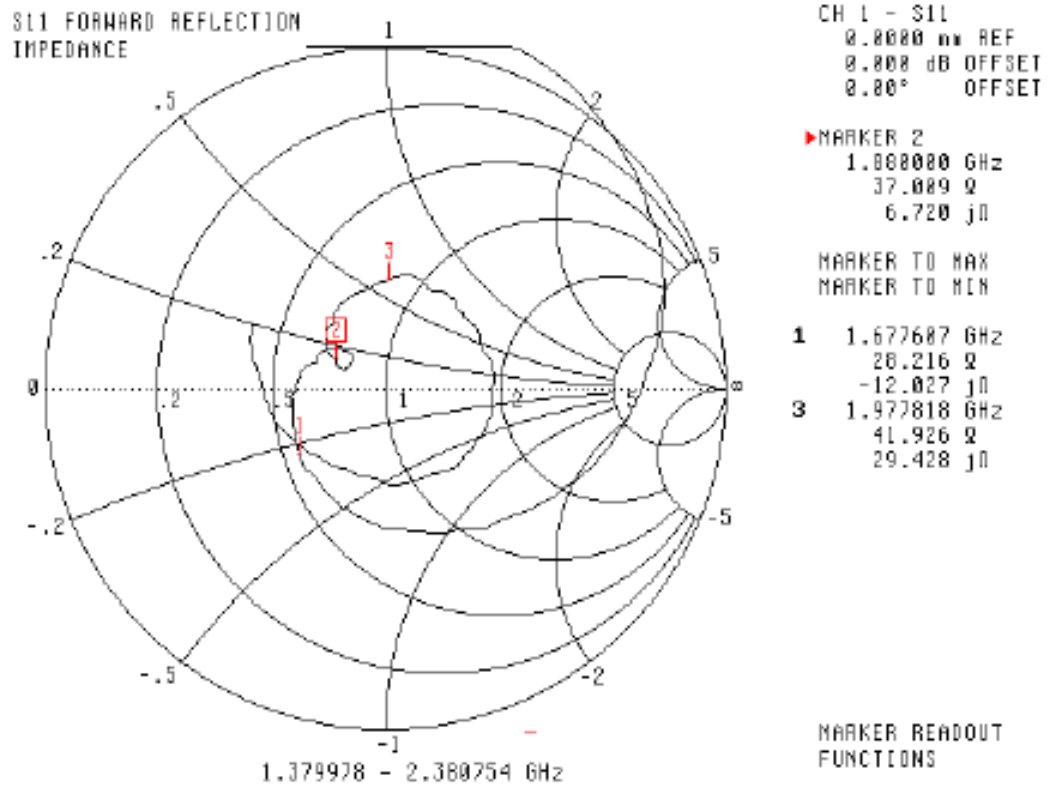


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Smith Chart Dipole Impedance



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