CIARS CENTRE FOR INTELLIGENT ANTENNA AND RADIO SYSTEMS

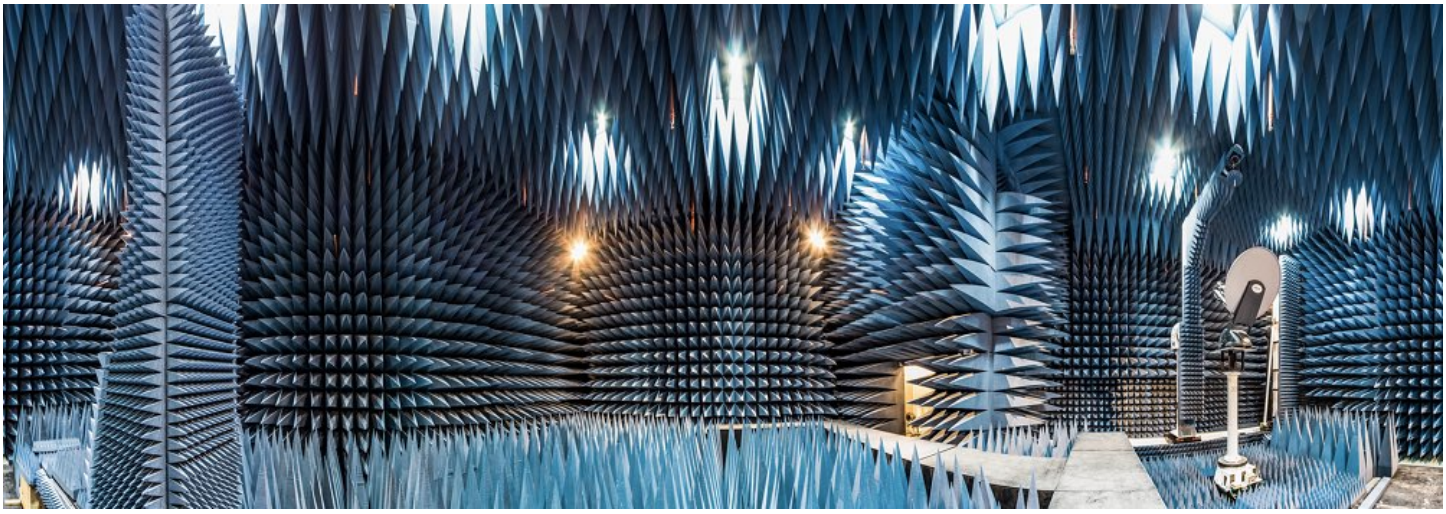
Test Document and Calibration Certificates

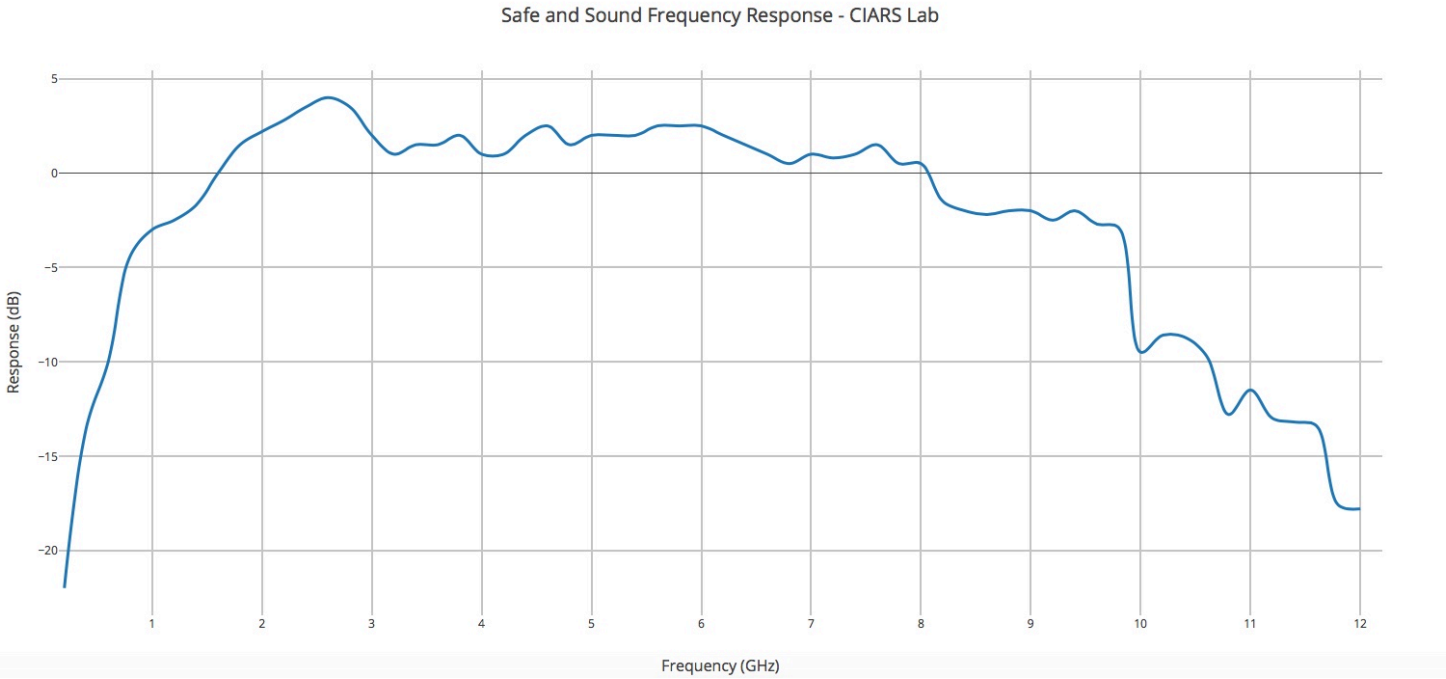
Calibration Device & Description:

Safe and Sound - made by Safe Living Technologies
Broadband RF Detector - frequency response test - 200 MHz to 12 GHz
October 3, 2018

Test Facility:

CIARS - ERL Lab Anechoic Chamber (100 MHz - 110 GHz capability)
(Acceptance test procedure & calibration certificates included in Appendix A)





Calibration Standard & Setup:

Agilent 8267D Signal generator fed into calibrated ultra wide-band antennas, d = 1.5 m
Temperature range: 21-23 C, Rel. H: 40-50%

Testing Procedure:

Device detector voltage changes measured across test range at power levels of 10, 15 and 20 dBm.

Ultra broadband antennas used: Ant 1: 200 MHz - 1 GHz, Ant. 2: 1-8 GHz, Ant. 3: 8-12 GHz.

The Safe and Sound detector was tested for relative frequency response, and calculations made for absolute frequency response. Correction Factor = Reference field strength/measured field strength.

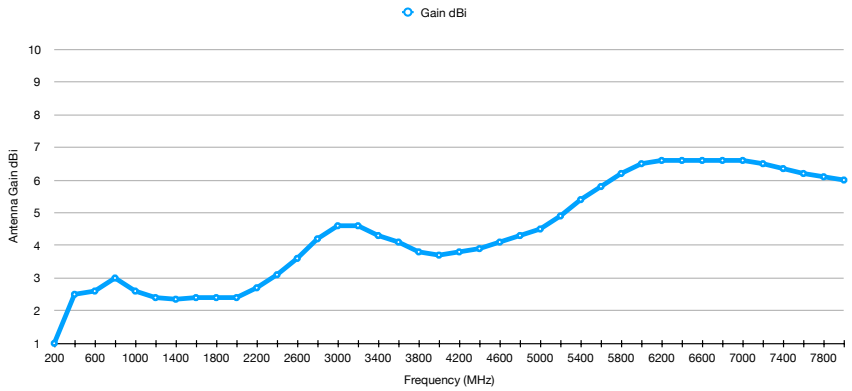
Testing Measurement Data
Ant. 1: 200 MHz - 1 GHz, Ant. 2: 1 GHz - 8 GHz, Ant. 3: 8 GHz - 12 GHz
Detector Gain results normalized for plot by -26dB

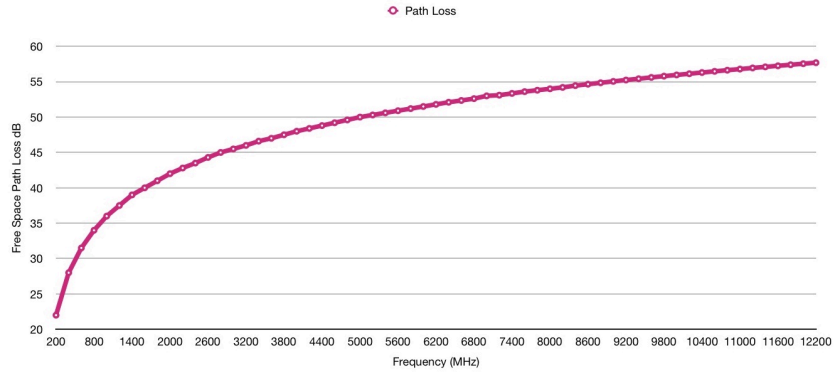
Frequency (GHz)	Difference (volt)	Path Loss (dB)	Detector Gain (dB)
0.2	0.12	22	4
0.4	0.52	28	12.5
0.6	0.52	31.5	16
0.8	0.86	34	21.6
1.0	0.8	36	23
1.2	0.8	37.5	23.5
1.4	0.85	38.9	24.3
1.6	0.98	40	26
1.8	1.08	41	27.5
2	1.04	42	28.2
2.2	1.17	42.8	28.8
2.4	1.06	43.6	29.5
2.6	1.1	44.3	30
2.8	1.1	44.9	29.5
3	0.9	45.5	28
3.2	0.7	46.1	27
3.4	0.8	46.5	27.5
3.6	0.86	47.1	27.5

Frequency (GHz)	Difference (volt)	Path Loss (dB)	Detector Gain (dB)
3.8	0.7	47.6	28
4	0.7	48	27
4.2	0.94	48.4	27
4.4	0.95	48.8	28
4.6	0.7	49.2	28.5
4.8	0.85	49.6	27.5
5	0.9	50	28
5.2	0.9	50.3	28
5.4	0.92	50.6	28
5.6	0.85	50.9	28.5
5.8	0.7	51.2	28.5
6	0.7	51.5	28.5
6.2	0.6	51.8	28
6.4	0.55	52	27.5
6.6	0.48	52.35	27
6.8	0.4	52.6	26.5
7.0	0.5	52.85	27
7.2	0.5	53.1	26.8
7.4	0.5	53.35	27
7.6	0.45	53.6	27.5
7.8	0.43	53.8	26.5
8.0	0.42	54	26.5
8.2	0.28	54.25	24.5
8.4	0.21	54.45	24
8.6	0.21	54.65	23.8
8.8	0.22	54.85	24
9.0	0.2	55.05	24
9.2	0.2	55.24	23.5
9.4	0.22	55.42	24

Frequency (GHz)	Difference (volt)	Path Loss (dB)	Detector Gain (dB)
9.6	0.2	55.61	23.3
9.8	0.2	55.8	23.1
10	0.08	55.96	16.5
10.2	0.1	56.13	17.4
10.4	0.1	56.3	17.3
10.6	0.08	56.47	16.3
10.8	0.06	56.63	13.2
11	0.07	56.74	14.5
11.2	0.06	56.95	13
11.4	0.06	57.1	12.8
11.6	0.06	57.25	12.6
11.8	0.04	57.4	8.4
12.0	0.04	57.55	8.2

Constants:
UWB Antenna Gains, Free space path loss applied to calculate correction factors & plot results
(0.2 - 8 GHz TX antennas shown)





Appendix A - CIARS Lab Calibration Standard Certificates & RF Acceptance Procedure:

Agilent Technologies

Agilent Technologies
1400 Fountaingrove Parkway
Santa Rosa, California 95403-1799
USA

5962-0476

Certificate Of Calibration

Certificate No: 444268-531551-1

Manufacturer: Agilent Technologies
Description: RF Signal Generator
Model No: E8267D
Serial No: US48050004
Options Installed With Specifications: 544 602 UNT UNU UNX

Date of Calibration: 25 OCT 2008
Temperature: (23 +/- 5) deg. C
Humidity: (5 to 70)% RH
Procedure: TEST PROC. E8267D

This certifies that the above product was calibrated in compliance with a quality system registered to ISO 9001:2000, using applicable Agilent Technologies' procedures.

As Received: Factory tested. No incoming data available.

As Shipped Conditions: At the completion of the calibration, measured values were IN SPECIFICATION at the points tested.

These calibration procedures and test points are those recommended in a procedure developed by Agilent.

Remarks or special requirements:

Traceability information: Traceability is to national standards administered by the U.S.NIST, NRC Canada, Euromet members (NPL, PTB, BNM, etc.) or other recognized standard laboratories. Some measurements are traceable to natural physical constants, consensus standards or ratio type measurements. Supporting documentation relative to traceability is available for review by appointment. This report shall not be reproduced, except in full, without prior written approval of the calibration facility.

Calibration Equipment Used: *Date used: Date equipment used in this calibration.*

Model Number	Model Description	Trace Number	Date Used	Cal Due Date
E8241A	Signal Generator	55170	24-OCT-2008	14-MAR-2010
89441A	Vector Signal Analyzer	22705	24-OCT-2008	20-JUN-2009
89431A	2.65GHz Downconverter	414091	24-OCT-2008	20-JUN-2009
E4433B	Signal Generator	259587	24-OCT-2008	09-MAY-2010
3458A	Multimeter	23234	24-OCT-2008	28-JAN-2009
89410A	DC to 10MHz Vector Signal Analyzer	259492	25-OCT-2008	05-NOV-2008
E8257D	RF Signal Generator	427709	25-OCT-2008	21-DEC-2008
70420A	Test Set	24332	25-OCT-2008	30-NOV-2008
70427A	Down Converter	54103	25-OCT-2008	30-NOV-2008
53181A	Frequency Counter	22600	25-OCT-2008	20-MAY-2009
81110A	330 MHz Pulse / Pattern Generator	24228	24-OCT-2008	28-FEB-2009

Print Date: 27-OCT-2008

Agilent Technologies
DD MM YY BY
CAL 25 10 08 SC
DUE

Pat Harper
Order Fulfillment Manager

KEYSIGHT TECHNOLOGIES

Bayan Lepas Free Industrial Zone
11900 Penang,
Malaysia

5962-0476

Certificate Of Calibration

Certificate No: DSOS204AMY58150141

Manufacturer: Keysight Technologies
Description: S-Series, 2GHz 4CH DSO
Model No: DSOS204A
Serial No: MY58150141
Options Installed With Specifications: N/A

Date of Calibration: 29-JUL-2018
Temperature: (23 ± 5)°C
Humidity: 20% - 75% RH
Procedure: ATM-09-B0415, ATM-09-B0419

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures in compliance with a quality management system registered to ISO 9001:2015.

As Received Conditions: Factory tested - No incoming data available.

As Shipped Conditions: At the completion of the calibration, measured values were IN-SPECIFICATION at the points tested.

Remarks or special requirements:

Notes:
1) This calibration report shall not be reproduced, except in full.

Traceability Information: Measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Calibration Equipment Used: *Date Used: Date equipment used in this Calibration.*

Model Number	Model Description	Trace Number	Date Used	Cal Due Date
33250A	FUNC/ARB WAVEFORM GENERATOR	PA6777	29-JUL-2018	22-MAR-2019
34411A	DIGITAL MULTIMETER/DIGITIZER, 6.5 DIGIT	P6834	29-JUL-2018	22-MAY-2019
81134A	2-CHANNEL PULSE/ PATTERN GENERATOR	PB6258	29-JUL-2018	10-MAR-2019
910R	GPS CONTROLLED FREQUENCY STD	PS0090	29-JUL-2018	13-JUN-2019
E3640A	DC POWER SUPPLY	PB6735	29-JUL-2018	09-FEB-2019
E8257D	PSG ANALOG SIGNAL GENERATOR	PB6416	29-JUL-2018	28-MAY-2019
E9304A	E-SERIES AVERAGE POWER SENSOR	P6741	29-JUL-2018	25-APR-2019
N1914A	EPM SERIES POWER METER	PB6765	29-JUL-2018	23-APR-2019
N6746B	DC POWER MODULE	PB6899	29-JUL-2018	09-FEB-2019
N6784A	SOURCE/MEASURE UNIT	PB6895	29-JUL-2018	12-SEP-2018

Print Date: 01-AUG-2018

Tay Eng Su
Quality Manager

Keysight Technologies
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KEYSIGHT TECHNOLOGIES

Keysight Technologies Malaysia Sdn Bhd (463532-M)
Bayan Lepas Free Industrial Zone
11900 Penang, Malaysia

5962-0476

Certificate of Calibration

Certificate No: PENANG4291815-5212153-1

Manufacturer: Keysight Technologies
Description: EXA Signal Analyzer
Model No: N9010B
Serial No: MY55460109
Options Installed With Specifications: 544, B25, B40, CR3, DP2, EP5, EXM, FS1, FS2, MPB, MTU, P44, PC7, RTL, SSD, W7X

Date of Calibration: 07-AUG-2018
Temperature: (23 ± 2) °C
Humidity: (30 to 70)% RH
Procedure: N7814A.A1.N819

This certifies that the equipment has been calibrated using applicable Keysight Technologies procedures in compliance with a quality management system registered to ISO 9001:2015.

As Received Conditions: Factory tested. No incoming data available.

As Shipped Conditions: At the completion of the calibration, measured values were IN SPECIFICATION at the points tested.

Remarks or special requirements:
This calibration includes an attached measurement report with report number 2888A38095-YF3G.

Notes:
1) This calibration report shall not be reproduced, except in full.

Traceability Information: Measurements are traceable to the International System of Units (SI) via national metrology institutes (www.keysight.com/find/NMI) that are signatories to the CIPM Mutual Recognition Arrangement.

Print Date: 07-AUG-2018

Keysight Technologies
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Quality Manager

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NSI NEARFIELD SYSTEMS, INC.

©2012 Nearfield Systems, Inc.
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Tel: 310-525-7000 Fax: 310-525-7100
www.nearfield.com

University of Waterloo 13x13 PCSF - RF System

RF Acceptance Test Procedure

ATP-310

Author: Scott Caslow

Approved by: Bert Schlüper

Released by: Bruce Williams

23 July 2012

Revision Log

Rev. No.	Date	DCN No.	Changes
Initial	07/20/12	N/A	-

5.8 **Stability Test (Factory, Site)**

The stability test is performed for the following configurations:

Frequency band	1 – 20 GHz	20-40 GHz	33-50 GHz	50-75 GHz	75-110 GHz
Test Frequency	20 GHz	40 GHz	50 GHz	75 GHz	110 GHz

1) Connect the probe cable through an adapter to the AUT cable. Add attenuation to avoid saturating the receiver. For mm-wave, use probe and AUT.
2) Generate a beam table with a single beam. Set the frequency per the table above and set the receiver IF bandwidth to 100 Hz or lower to achieve a SNR of at least 60 dB (50 dB min for mm-wave).
3) Run a stability test for a period of 20 minutes, recording both amplitude and phase stability.
4) Record the reported peak-to-peak variation and the drift of both amplitude and phase on the data sheet.
5) Attach a copy of the plot to the test data sheet.

5.9 **Noise Test (Factory, Site)**

The following test measures the noise level on the test channel. It is performed for the following configurations:

Frequency band	0.1-1 GHz	1 – 18 GHz	6-20 GHz	20-40 GHz	33-50 GHz	mm-wave
Test Frequencies	0.1 – 1 GHz, 0.01 GHz step (91 freqs)	1 – 18 GHz, 0.02 GHz step (851 freqs)	6-20 GHz, 0.02 GHz step (701 freqs)	20-40 GHz, 0.025 GHz step (801 freqs)	33 – 50 GHz, 0.02 GHz step (851 freqs)	50-75 GHz, 0.05 GHz step (501 freqs) 75-110 GHz, 0.05 GHz step (701 freqs)

1) Disconnect the cable from the receiving antenna (or probe) and place a 50 ohm termination at the end of the cable. In mm-wave mode, insert a piece of Cu tape in between the waveguide flanges on the receive module, covering the waveguide opening.
2) Set the receiver to an IF bandwidth of 1 kHz.
3) Set up a beam table per the table above, using suggested dwell times.
4) Run the script ***PNA ILT Freq Sweep*** again. When prompted, choose 50 as the number of "ILT sweeps to average" and record the amplitude responses (ratioed and unratioed amplitude). Attach to the data sheet.

Tests completed by:

Reza Z. Rafi, PhD

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