Electromagnetic Compatibility Test Report

Tests Performed on a Trilithic

Seeker MCA III with Wifi Transciever, Model 2011690000

Radiometrics Document RP-7560D

ACCREDITED
TESTING CERT #1495.01

Product Detail:
FCC ID: P4V-MCAIII
IC: 7020A-MCAIII
Equipment type: 2412-2462 MHz and 5745-5825 MHz DTS Transmitter for 15.247

Test Standards:
US CFR Title 47, Chapter I, FCC Part 15 Subpart C
FCC Part 15 CFR Title 47: 2013
Industry Canada RSS-210, Issue 8: 2010 as required for Category I Equipment

This report concerns: Original Grant for Certification
FCC Part 15.247

Tests Performed For:	*Test Facility:*
Trilithic 9710 Park Davis Dr. Indianpolis, IN 46235	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 (815) 293-0772

Test Date(s): (Month-Day-Year)
May 8 to July 13, 2013 & May 15, 2014

Document RP-7560D Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	May 2, 2014		
1	May 27, 2014	10.5 & 10.7	Joseph Strzelecki

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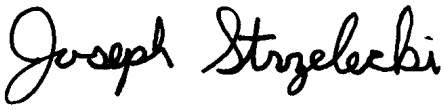
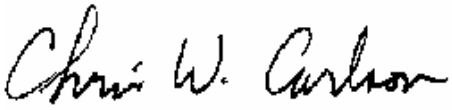
1 ADMINISTRATIVE DATA

Equipment Under Test: A Trilithic, Seeker MCA III with Wifi Model: 2011690000 Serial Number: 281195 This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) May 8, 2013	*Test Date(s): (Month-Day-Year)* May 8 to July 13, 2013 & May 15, 2014
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* The tests were not witnessed by Trilithic Trilithic
Radiometrics' Personnel Responsible for Test:  5/27/2014 Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  5/27/2014 Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Seeker MCA III Cable Installer Meter with Wifi, Model 2011690000, manufactured by Trilithic. The detailed test results are presented in a separate section. The following is a summary of the test results.

Spread Spectrum Transmitter Requirements

Environmental Phenomena	Frequency Range	FCC Section	RSS- Section	Test Result
RF AC Mains Conducted Emissions	0.15 - 30 MHz	15.207	GEN; 7.2.2	Not Required
RF Radiated Emissions	30-40,000 MHz	15.209 15.205 15.407 (b)	GEN; 7.2.5	Pass
6 & 20 dB Bandwidth Test	2400 to 2483.5 MHz 5725 to 5850 MHz	15.247 a	210; A8.1 (4)	Pass
Peak Output Power	2400 to 2483.5 MHz 5725 to 5850 MHz	15.247 b	210; A8.1 (1)	Pass
Band-edge Compliance of RF Conducted Emissions	2400 to 2483.5 MHz 5725 to 5850 MHz	15.247 d	210; A8.4 (2)	Pass
Spurious Radiated Emissions	30 MHz to 40 GHz	15.247 d	210; A8.5	Pass
Power Spectral Density	2400 to 2483.5 MHz 5725 to 5850 MHz	15.247 e	210; A8.2 (1)	Pass

Note: The RSS-210 specification is not currently covered in Radiometrics' Scope of Accreditation. This is technically very similar to FCC, CFR 47 Part 15 which is on Radiometrics scope.

Since the EUT is used exclusively in vehicles, AC power line conducted emissions are not required.

2.1 RF Exposure Compliance Requirements

Since the peak power output is 190 mW and the EUT is not handheld, the EUT meets the FCC requirement for RF exposure and is exempt from RSS-102. There are no user power level adjustments. The detailed calculations for RF Exposure are presented in a separate document.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Seeker MCA III Cable Installer Meter with Wifi, Model 2011690000, manufactured by Trilithic. The EUT was in good working condition during the tests, with no known defects. The antenna uses a reverse polarity connector. It is a Dual Band Low Profile Antenna (2.4GHz & 5Ghz) 3dBi & 4dBi (Trilithic PN: 2071677004).

For all Radiated emissions tests, the following antenna was used:

1. Low Profile Mag mount (Trilithic PN: 2071677004)

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna uses a reverse polarity SMA connector for the WIFI antenna. The product is only professionally installed; this keeps the user from installing a different SMA antenna. Therefore, it meets the 15.203 Requirements.

3.2 Related Submittals

Trilithic is not submitting any other products simultaneously for equipment authorization related to the EUT.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. Power was supplied from a 12 Volt battery, since this is an automotive installation.

The identification for all equipment, plus descriptions of all cables used in the tested system, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	Seeker MCA III with Wifi	E	Trilithic	2011690000	281195
2	Router	P	Dynex	DX-GB8PRT	10K22B16124

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

List of System Cables

QTY	Length (m)	Cable Description	Shielded?
1	2.5	DC Cord to external power supply	No
1	10	Ethernet cable	No
1	1.0	75 Ohm coaxial Cable	No

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2013	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-2009	2009	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2009	2009	American National Standard for Testing Unlicensed Wireless Devices
IC RSS-210 Issue 8	2010	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 3	2010	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)

The test procedures used are in accordance with the Industry Canada RSS-GEN and ANSI document C63.10. Radiated testing was performed at an antenna to EUT distance of 3 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC8727A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	01/15/13
AMP-20	Avantek	Pre-amplifier	SF8-0652	15221	8-18GHz	12 Mo	01/15/13
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	01/10/13
AMP-29	HP / Agilent	Amplifier	11975A	2304A00158	2-8 GHz	12 Mo.	11/06/12
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	12/05/12
ANT-44	Impossible Machine	Super Log Antenna	SL-20M2G	1002	20-2000MHz	24 Mo.	12/14/11
ANT-48	RMC	Std Gain Horn	HW2020	1001	18-26.5 GHz	12 Mo.	04/05/13
ANT-61	RMC	Std Gain Horn	HW2030	1001	26-40 GHz	12 Mo.	04/05/13
MXR-02	HP / Agilent	Harmonic Mixer	11970K	2332A00489	18-26.5GHz	12 Mo.	11/06/12
MXR-03	HP / Agilent	Harmonic Mixer	11971A	2332A00390	26.5-40GHz	12 Mo.	11/06/12
REC-01	Hewlett Packard	Spectrum Analyzer	8566A	2106A02115, 2209A01349	30Hz-22GHz	24 Mo.	11/21/12
REC-03	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	04/08/13
REC-08	Hewlett Packard	Spectrum Analyzer	8566B	2648A13481 2209A01436	30Hz-22GHz	24 Mo.	10/28/11
REC-10	HP / Agilent	EMI Receiver	8546A	3842A00521 3704A00484	30Hz-6GHz	24 Mo.	01/09/12
REC-12	Agilent	Spectrum Analyzer	AT/N9030A-550;C	MY53310115	3Hz-50 GHz	12 Mo.	3/25/14
THM-03	Fluke	Temp/Humid Meter	971	95850465	N/A	12 Mo.	04/26/13

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

10.1 Occupied Bandwidth

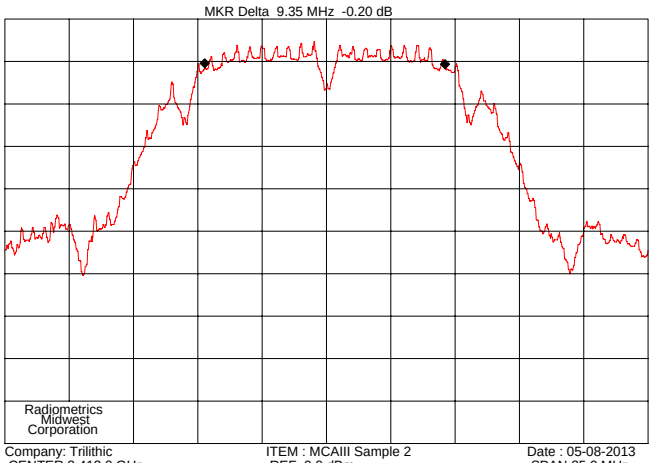
The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 6 or 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the bandwidth of the emission.

Occupied Bandwidth			802		BW		BW		BW	
Type	Channels Tested	Mbps	Mode	MHz	MHz	MHz	MHz	MHz	MHz	RBW
6 dB	1, 6, 11	1	b	2412	9.35	2437	9.7	2462	9.98	100 kHz
6 dB	1, 6, 11	6	g	2412	16.63	2437	16.78	2462	16.73	100 kHz
6 dB	1, 6, 11	6.5	N	2412	17.83	2437	18.03	2462	18.08	100 kHz
20 dB	1, 6, 11	1	b	2412	13.83	2437	13.73	2462	13.75	300 kHz
20 dB	1, 6, 11	6	g	2412	19.85	2437	19.83	2462	19.8	300 kHz
20 dB	1, 6, 11	6.5	N	2412	20.1	2437	20.1	2462	20	300 kHz
6 dB	149, 157, 165	6	a	5745	18.05	5785	16.63	5825	16.53	100 kHz
6 dB	149, 157, 165	6.5	N	5745	18.08	5785	17.8	5825	17.88	100 kHz
20 dB	149, 157, 165	6	a	5745	19.63	5785	19.63	5825	19.55	300 kHz
20 dB	149, 157, 165	6.5	N	5745	20.35	5785	20.2	5825	20.13	300 kHz

The highlighted cells are the bandwidths in MHz.

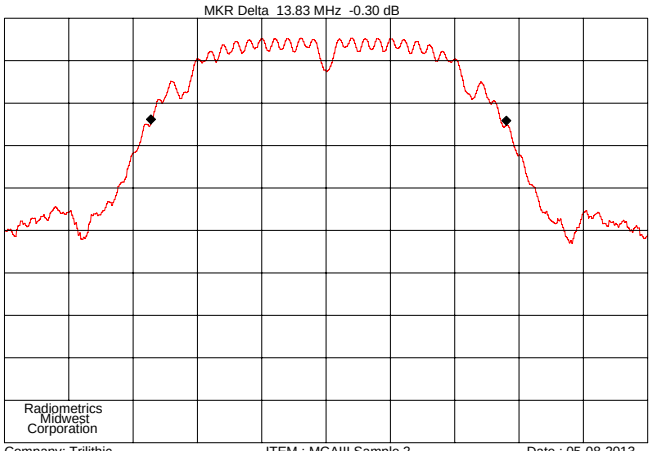
2.4 GHz Range Mode B Bandwidth Plots Follow:



Company: Trilithic
CENTER 2.412 0 GHz
RES BW 100 kHz
10 dB/
Notes: EUT Ch 001 Mode B, 6 dB Bandwidth Test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 300 kHz
Time: 11:22

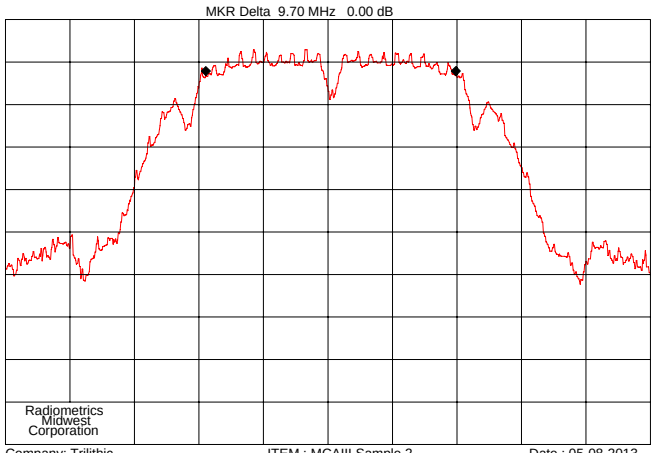
Date : 05-08-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW001B6



Company: Trilithic
CENTER 2.412 0 GHz
RES BW 300 kHz
10 dB/
Notes: EUT Ch 001 Mode B, 20 dB Bandwidth Test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 1 MHz
Time: 11:36

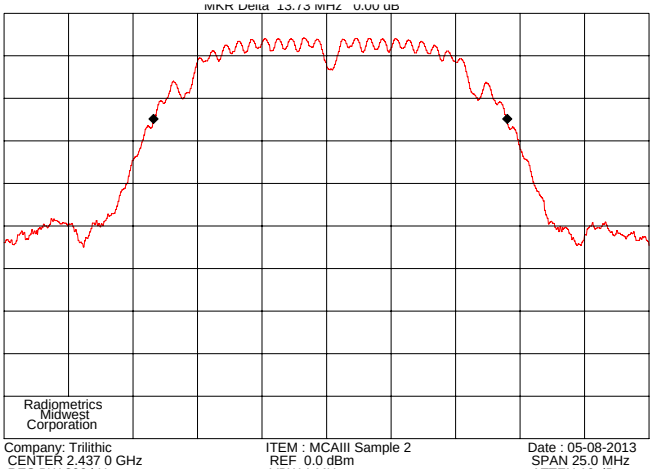
Date : 05-08-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW001B20



Company: Trilithic
CENTER 2.437 0 GHz
RES BW 100 kHz
10 dB/
Notes: EUT Ch 006 Mode B, 6 dB Bandwidth Test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 300 kHz
Time: 11:24

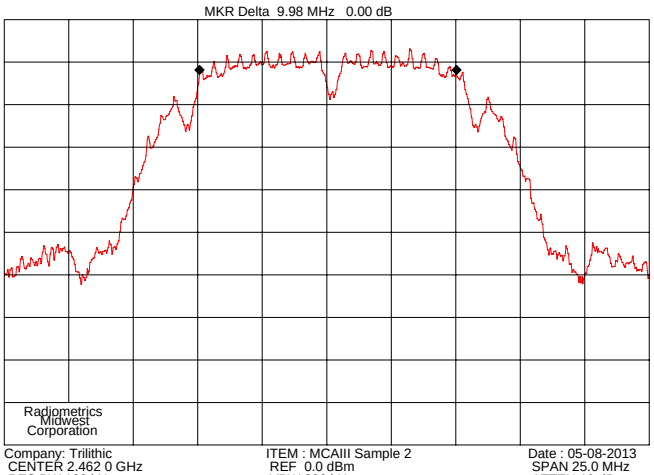
Date : 05-08-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW006B6



Company: Trilithic
CENTER 2.437 0 GHz
RES BW 300 kHz
10 dB/
Notes: EUT Ch 006 Mode B, 20 dB Bandwidth Test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 1 MHz
Time: 11:33

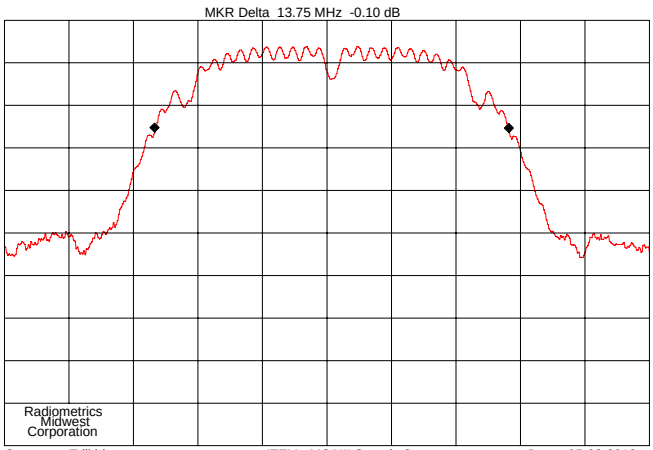
Date : 05-08-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW006B20



Company: Trilithic
CENTER 2.462 0 GHz
RES BW 100 kHz
10 dB/
Notes: EUT Ch 011 Mode B, 6 dB Bandwidth Test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 300 kHz
Time: 11:43

Date : 05-08-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW011B6

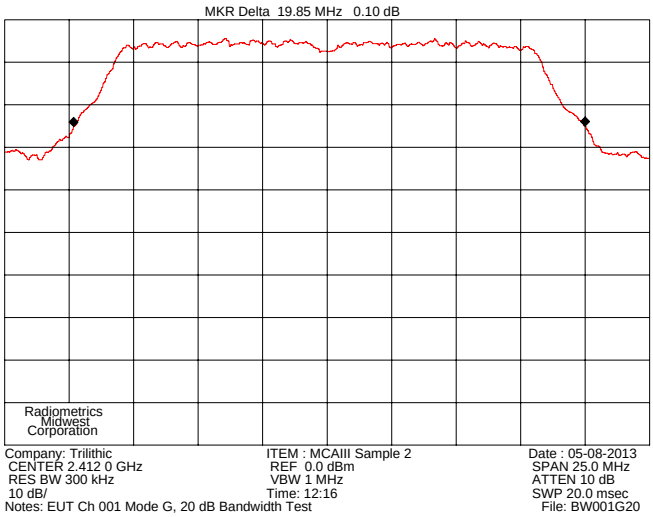


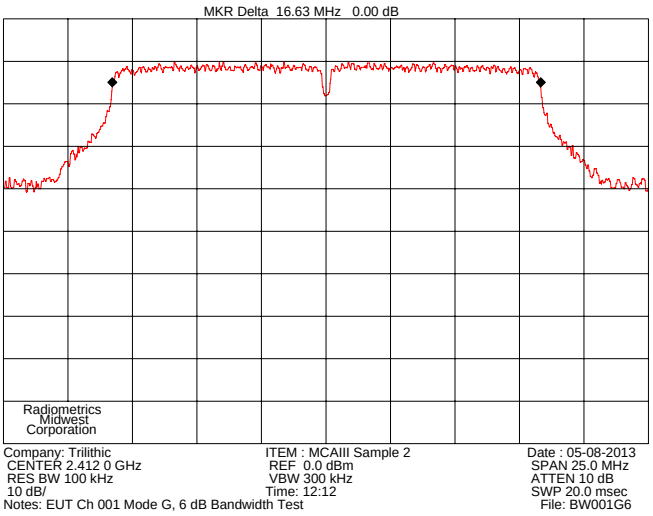
Company: Trilithic
CENTER 2.462 0 GHz
RES BW 300 kHz
10 dB/
Notes: EUT Ch 011 Mode B, 20 dB Bandwidth Test

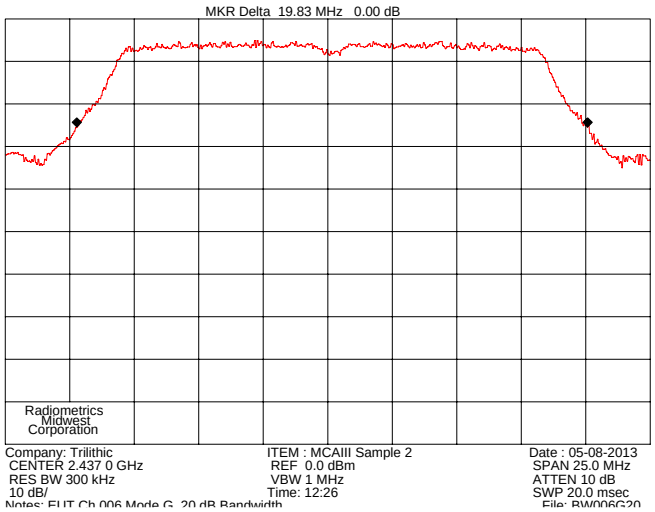
ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 1 MHz
Time: 11:40

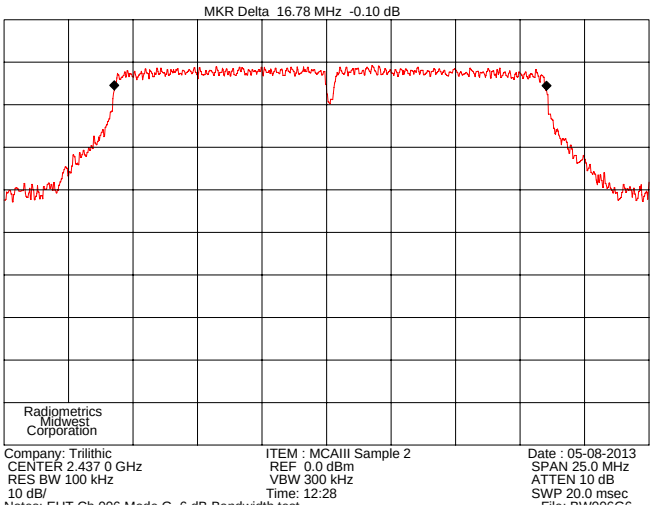
Date : 05-08-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW011B20

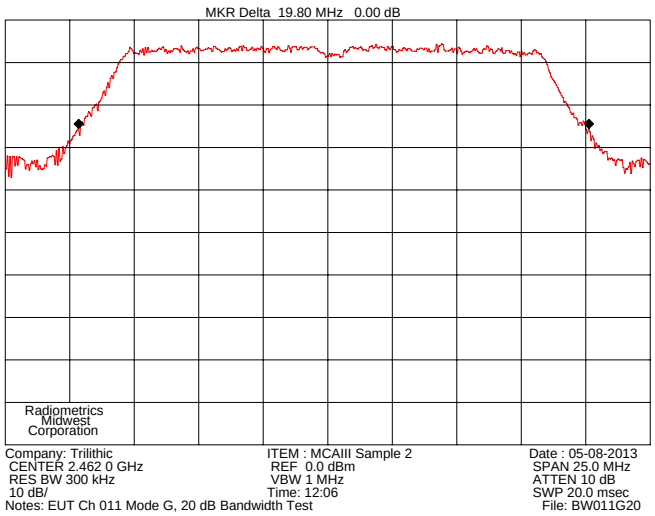
2.4 GHz Range Mode G Bandwidth Plots Follow:

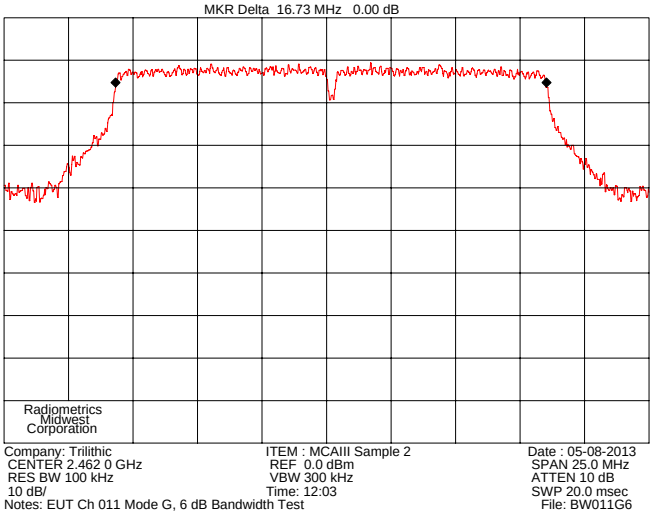




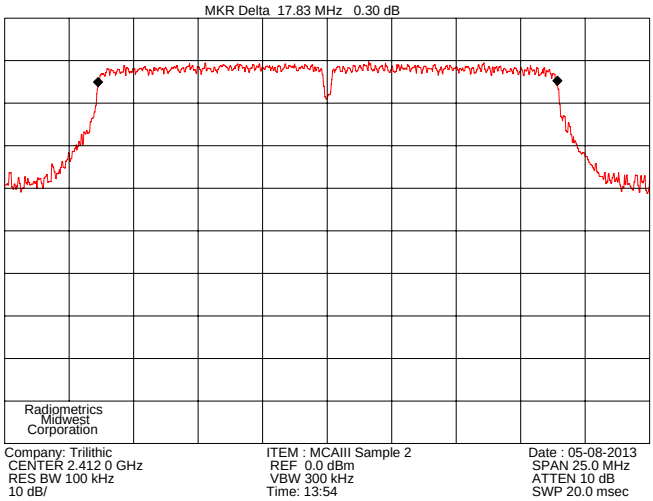


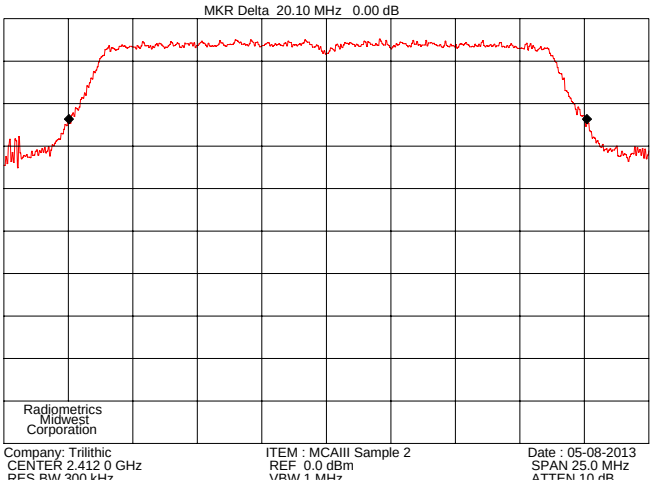


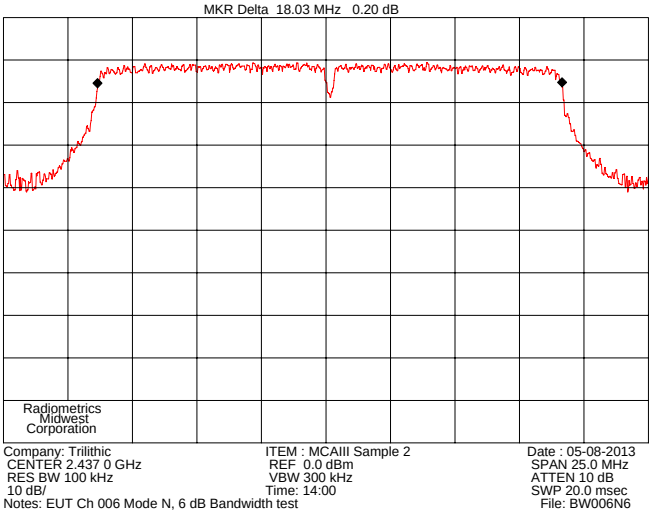


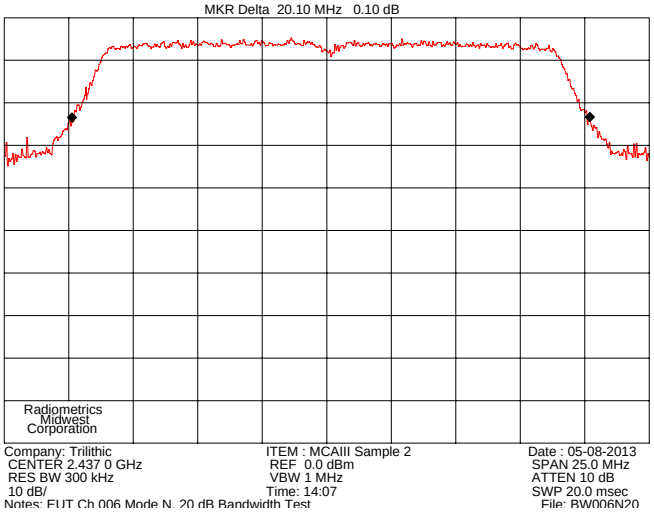


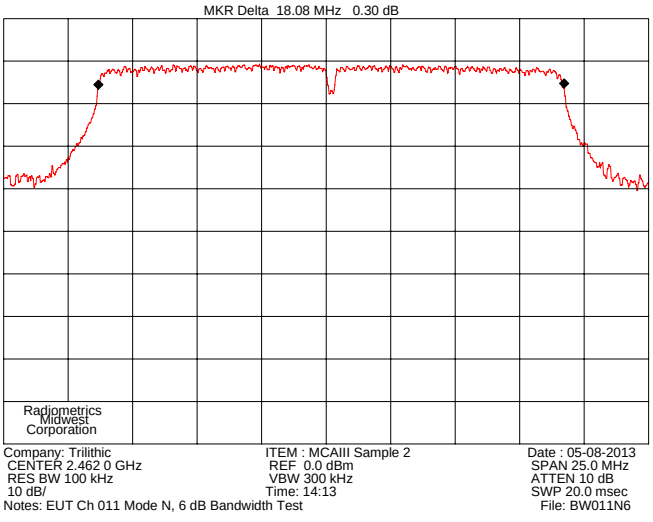
2.4 GHZ Range Mode N Bandwidth Plots Follow:

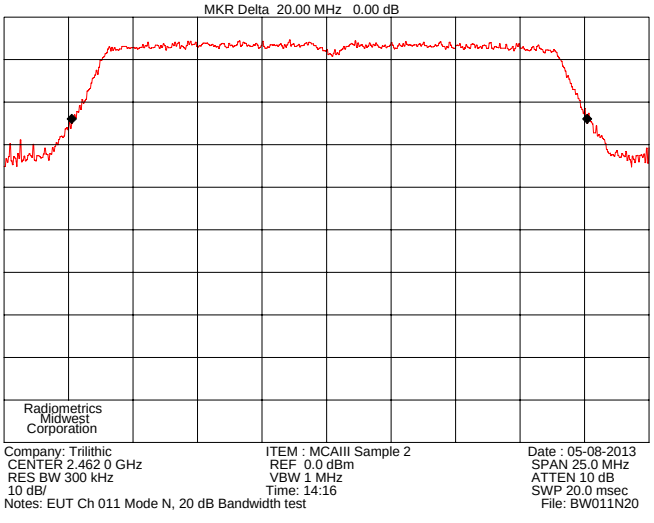




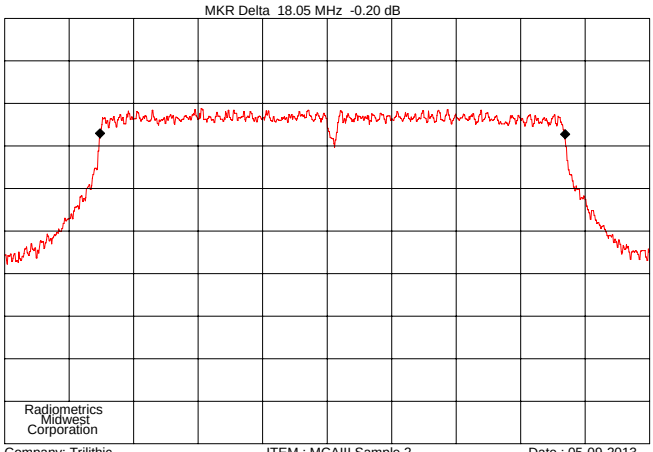








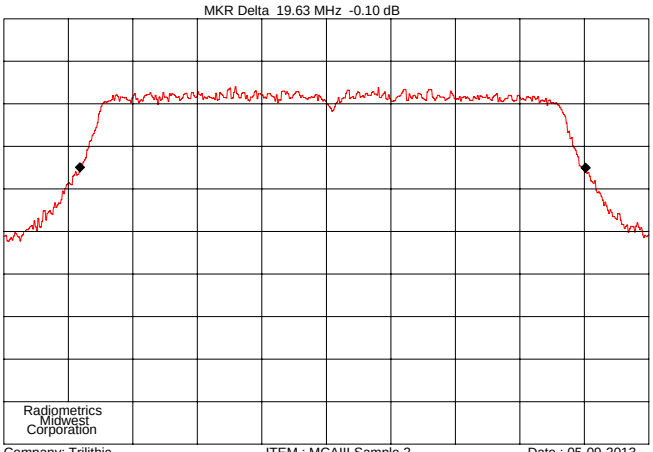
5.0 GHZ Range Mode A Bandwidth Plots Follow:



Company: Trilithic
CENTER 5.745 0 GHz
RES BW 100 kHz
10 dB/
Notes: EUT CH 149 Mode A, 6 dB Bandwidth Test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 300 kHz
Time: 07:48

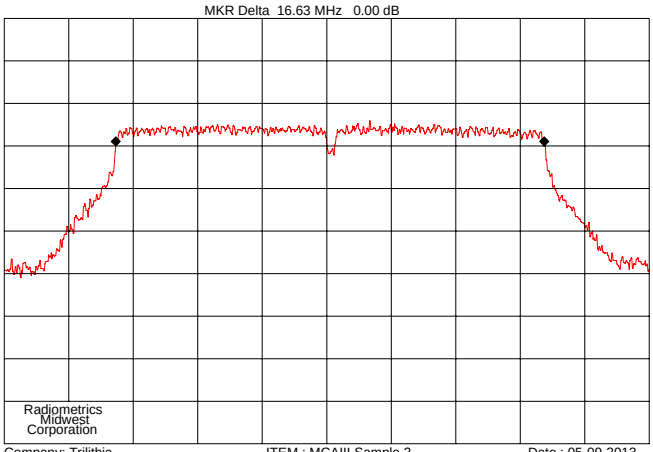
Date : 05-09-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW149A6



Company: Trilithic
CENTER 5.745 0 GHz
RES BW 300 kHz
10 dB/
Notes: EUT CH 149 Mode A, 20 dB Bandwidth test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 1 MHz
Time: 07:50

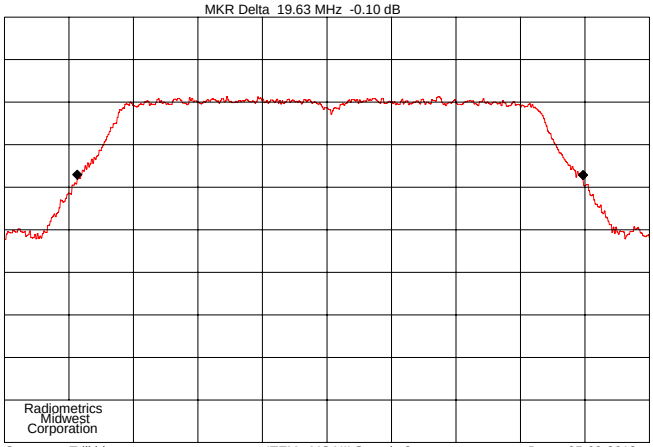
Date : 05-09-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW149A20



Company: Trilithic
CENTER 5.785 0 GHz
RES BW 100 kHz
10 dB/
Notes: EUT CH 157 Mode A, 6 dB Bandwidth test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 300 kHz
Time: 07:54

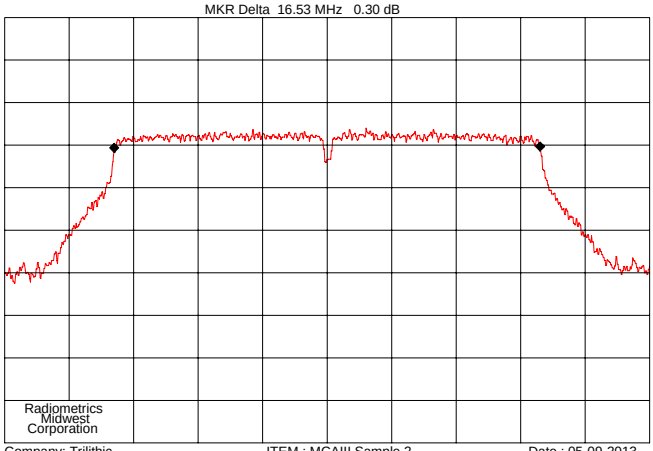
Date : 05-09-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW157A6



Company: Trilithic
CENTER 5.785 0 GHz
RES BW 300 kHz
10 dB/
Notes: EUT CH 157 Mode A, 20 dB Bandwidth test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 1 MHz
Time: 07:56

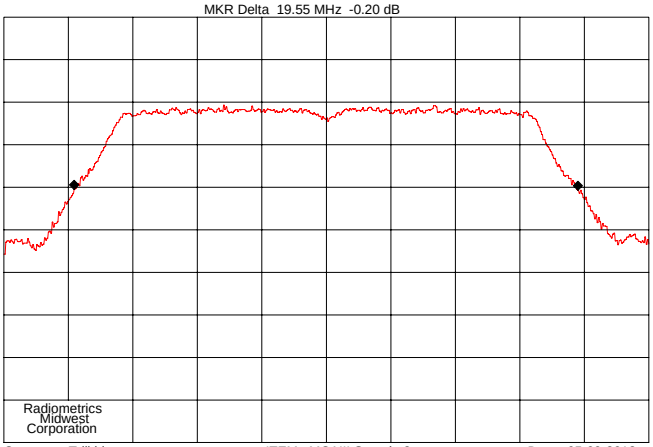
Date : 05-09-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW157A20



Company: Trilithic
CENTER 5.825 0 GHz
RES BW 100 kHz
10 dB/
Notes: EUT CH 165 Mode A, 6 dB Bandwidth test

ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 300 kHz
Time: 08:00

Date : 05-09-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW165A6

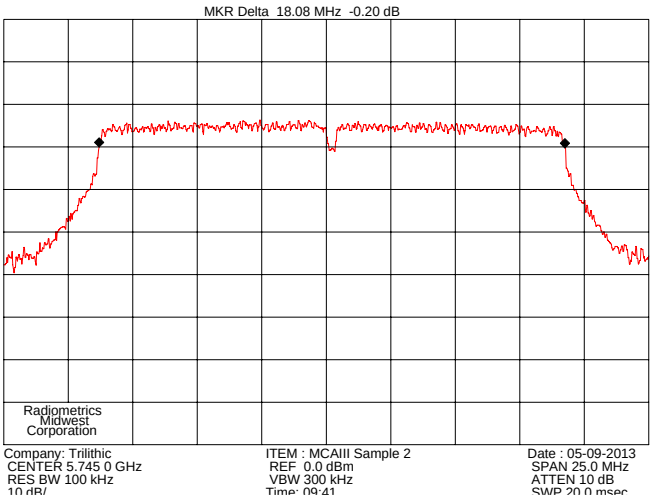


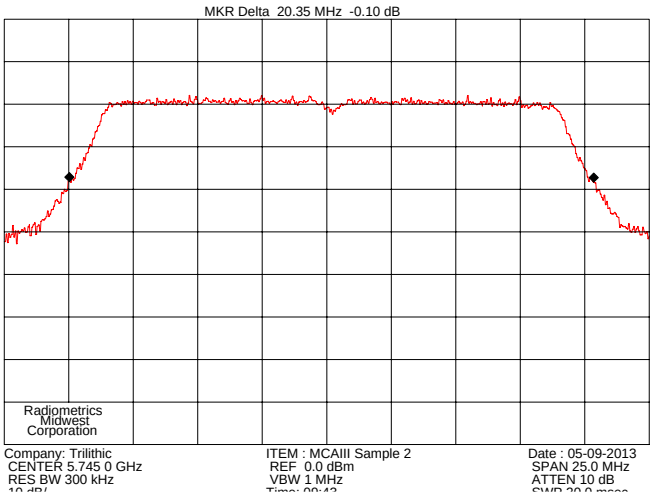
Company: Trilithic
CENTER 5.825 0 GHz
RES BW 300 kHz
10 dB/
Notes: EUT CH 165 Mode A, 20 dB Bandwidth test

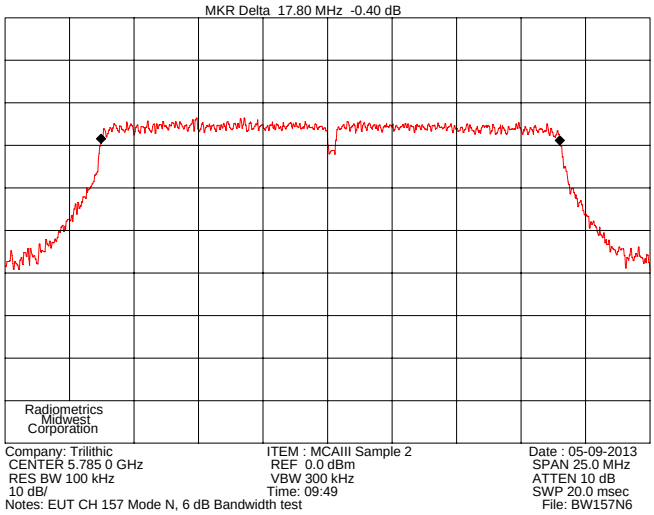
ITEM : MCAIII Sample 2
REF 0.0 dBm
VBW 1 MHz
Time: 08:13

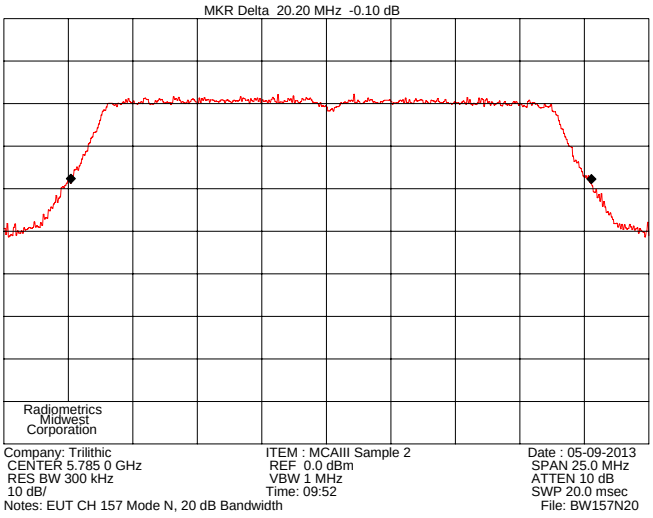
Date : 05-09-2013
SPAN 25.0 MHz
ATTEN 10 dB
SWP 20.0 msec
File: BW165A20

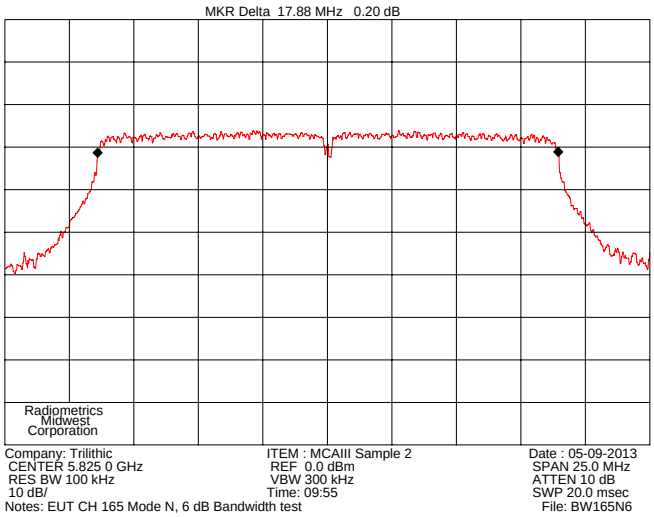
5.0 GHz Range Mode N Bandwidth Plots Follow:

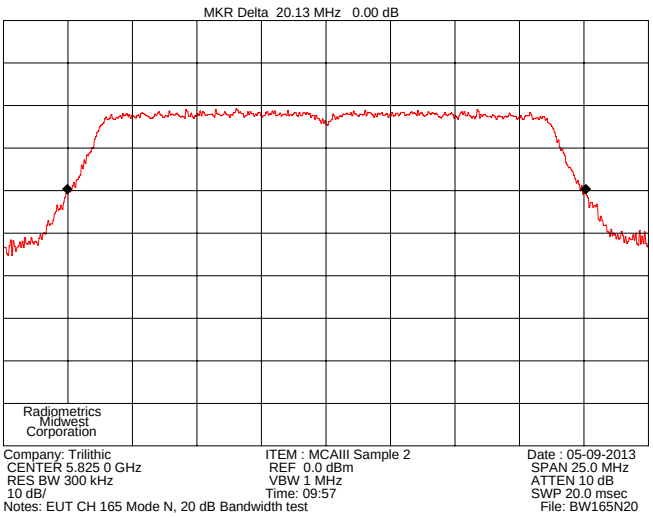












10.2 Peak Output Power

The EUT antenna port was connected to the Spectrum analyzer Via a low loss coaxial cable.

The power output test method from ANSI C63.10 section 6.10.2.1 c) was used for this test. The spectrum analyzer was set to the following settings:

Span = 25 MHz; RBW = 1 MHz; VBW = 3 MHz; Detector function = peak; Trace = max hold

The trace was allowed to stabilize. The marker-to-peak function was used to measure the peak of the emission. The indicated level is the peak output power. The BW correction factor is 10*Log(BW). Note 30 dBm = 1 watt. Since the gain of the antenna is always less than 6 dB, the limit is not reduced.

Chan	Freq MHz	Mode	Mbps	Spec An dBm	Loss dB	BW MHz	Peak power dBm	Limit dBm	Margin
1	2412	802.11b	1	6.4	0.8	13.8	18.6	30.0	11.4
1	2412	802.11g	6	8.3	0.8	19.9	22.1	30.0	7.9
1	2412	802.11N	MSC0	8.0	0.8	20.1	21.8	30.0	8.2
6	2437	802.11b	1	6.1	0.8	13.7	18.3	30.0	11.7
6	2437	802.11g	6	9.0	0.8	19.8	22.8	30.0	7.2
6	2437	802.11N	MSC0	8.6	0.8	20.1	22.4	30.0	7.6
11	2462	802.11b	1	6.4	0.8	13.7	18.6	30.0	11.4
11	2462	802.11g	6	8.5	0.8	19.8	22.3	30.0	7.7
11	2462	802.11N	MSC0	7.1	0.8	20.0	20.9	30.0	9.1
149	5745	802.11a	6	-3.5	1.2	19.6	10.6	30.0	19.4
149	5745	802.11N	MSC0	-3.1	1.2	20.3	11.2	30.0	18.8
157	5785	802.11a	6	-3.3	1.2	19.6	10.8	30.0	19.2
157	5785	802.11N	MSC0	-3.0	1.2	20.2	11.3	30.0	18.7
165	5825	802.11a	6	-3.1	1.2	19.6	11.0	30.0	19.0
165	5825	802.11N	MSC0	-3.3	1.2	20.1	10.9	30.0	19.1

10.3 Power Spectral Density

The PSD test method from ANSI C63.10 section 6.11.2.3 was used for this test. The spectrum analyzer was set to the following settings:

Span = 20 MHz; RBW = 3 kHz; VBW = 10 kHz
Detector function = Peak

Chan	Mbps	Mode	MHz	dBm	Loss	Pk pwr	Limit	Margin
1	1	802.11b	2412	-9.2	0.8	-8.4	8.0	16.4
1	6	802.11g	2412	-12.9	0.8	-12.1	8.0	20.1
1	MSC0	802.11N	2412	-12.2	0.8	-11.4	8.0	19.4
6	1	802.11b	2437	-7.6	0.8	-6.8	8.0	14.8
6	6	802.11g	2437	-13.0	0.8	-12.2	8.0	20.2
6	MSC0	802.11N	2437	-13.6	0.8	-12.8	8.0	20.8
11	1	802.11b	2462	-9.9	0.8	-9.1	8.0	17.1
11	6	802.11g	2462	-13.6	0.8	-12.8	8.0	20.8
11	MSC0	802.11N	2462	-12.5	0.8	-11.7	8.0	19.7
149	6	802.11a	5745	-20.4	1.2	-19.2	8.0	27.2
149	MSC0	802.11N	5745	-20.7	1.2	-19.5	8.0	27.5
157	6	802.11a	5785	-19.4	1.2	-18.2	8.0	26.2
157	MSC0	802.11N	5785	-20.6	1.2	-19.4	8.0	27.4
165	6	802.11a	5825	-19.3	1.2	-18.1	8.0	26.1
165	MSC0	802.11N	5825	-19.5	1.2	-18.3	8.0	26.3

10.4 Band-edge Compliance of RF Conducted Emissions

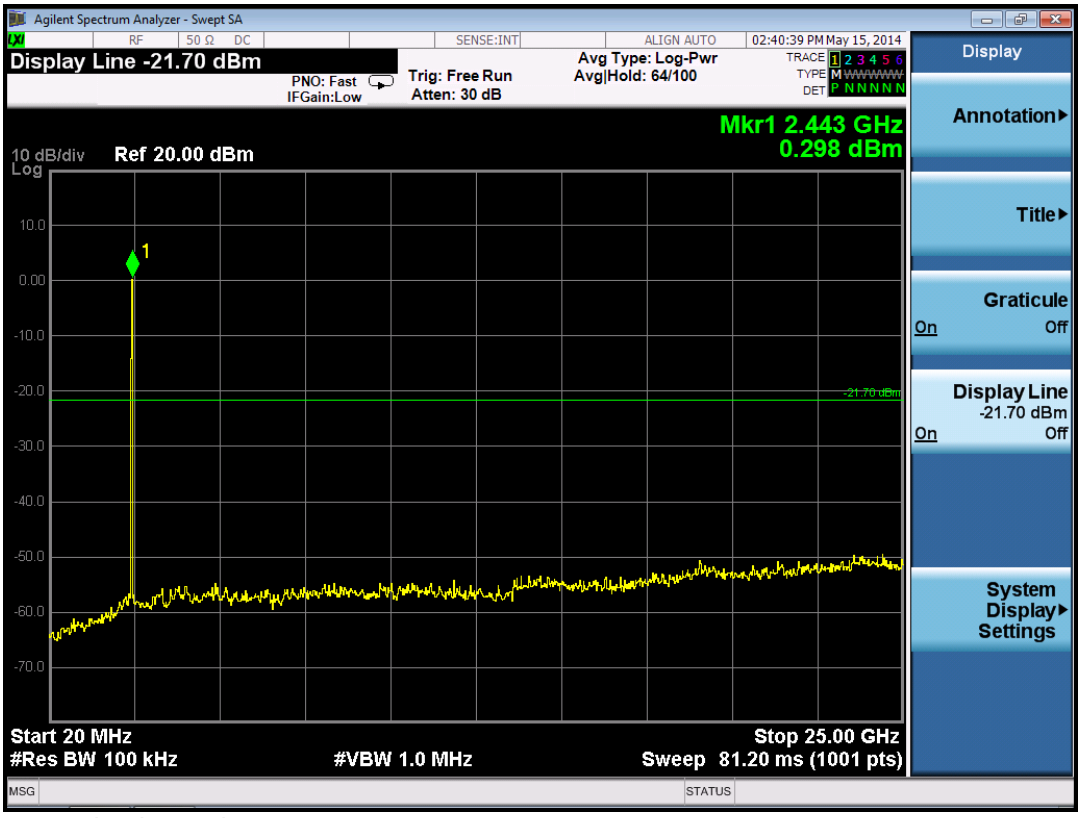
The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation at the band-edge, with the EUT set to the lowest frequency. The trace was allowed to stabilize.

				Delta	Limit	Margin	Band edge
Chan	Frequency	**Mode**	**Mbps**	dB	dB	dB	Freq
1	2412	802.11b	1	43.9	20.0	23.9	2400.0
1	2412	802.11g	6	25.8	20.0	5.8	2400.0
1	2412	802.11N	MSC0	34.6	20.0	14.6	2400.0
11	2462	802.11b	1	43.7	20.0	23.7	2483.5
11	2462	802.11g	6	38.2	20.0	18.2	2483.5
11	2462	802.11N	MSC0	34.7	20.0	14.7	2483.5
149	5745	802.11a	6	41.8	20.0	21.8	5725.0
149	5745	802.11N	MSC0	39.4	20.0	19.4	5725.0
165	5825	802.11a	6	45.2	20.0	25.2	5875.0
165	5825	802.11N	MSC0	46.2	20.0	26.2	5875.0

Judgement: Pass by 5.8 dB

10.5 Spurious RF Conducted Emissions from the Antenna Port

802.11b Channel 1



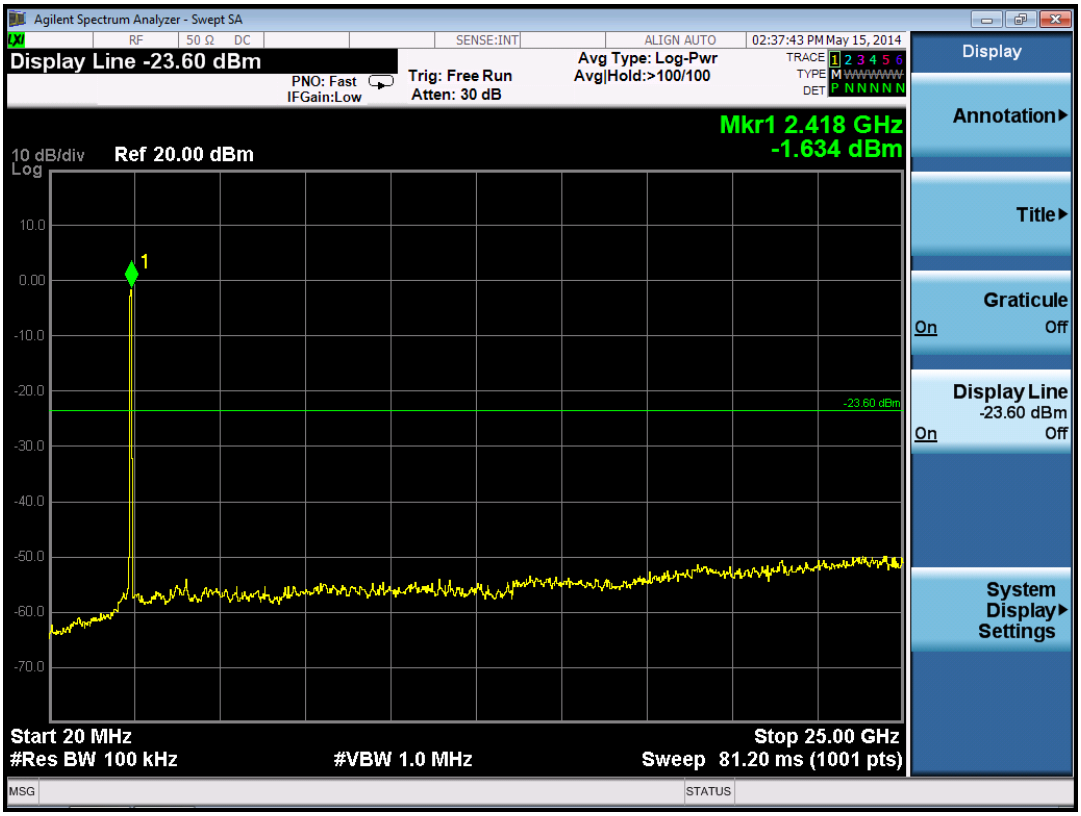
802.11b Channel 6

802.11b Channel 11

802.11g Channel 1

802.11g Channel 6

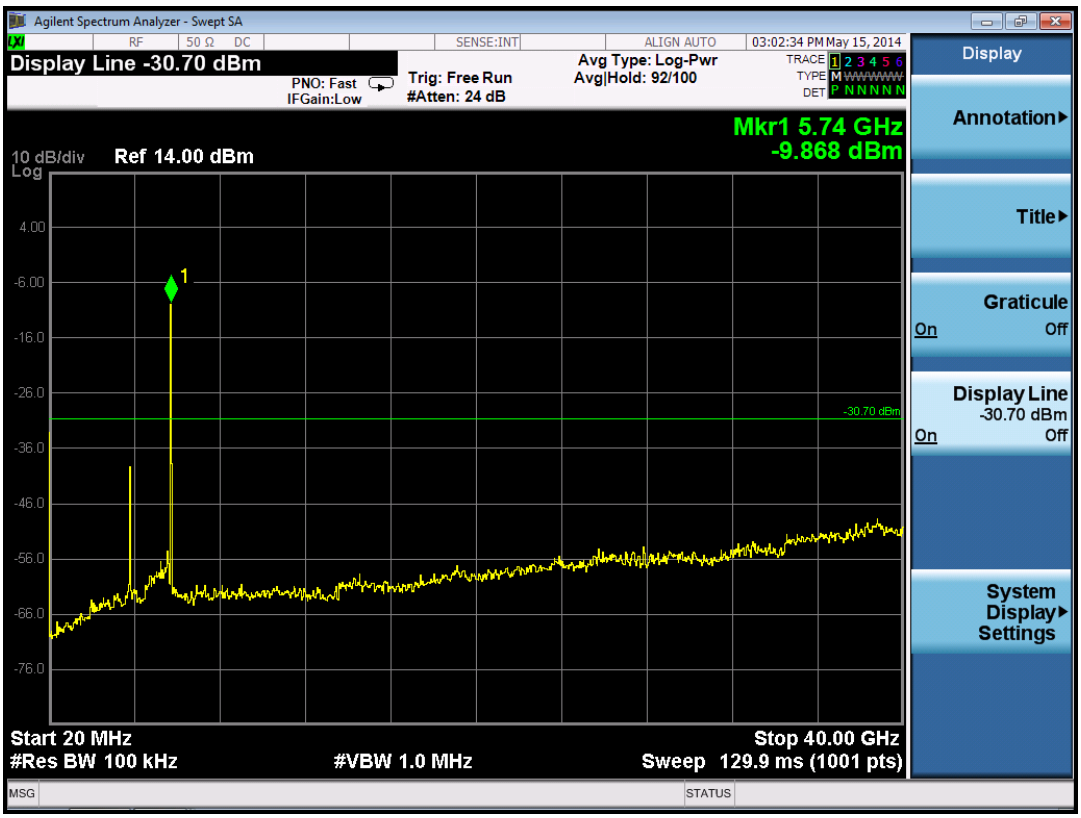
802.11g Channel 11



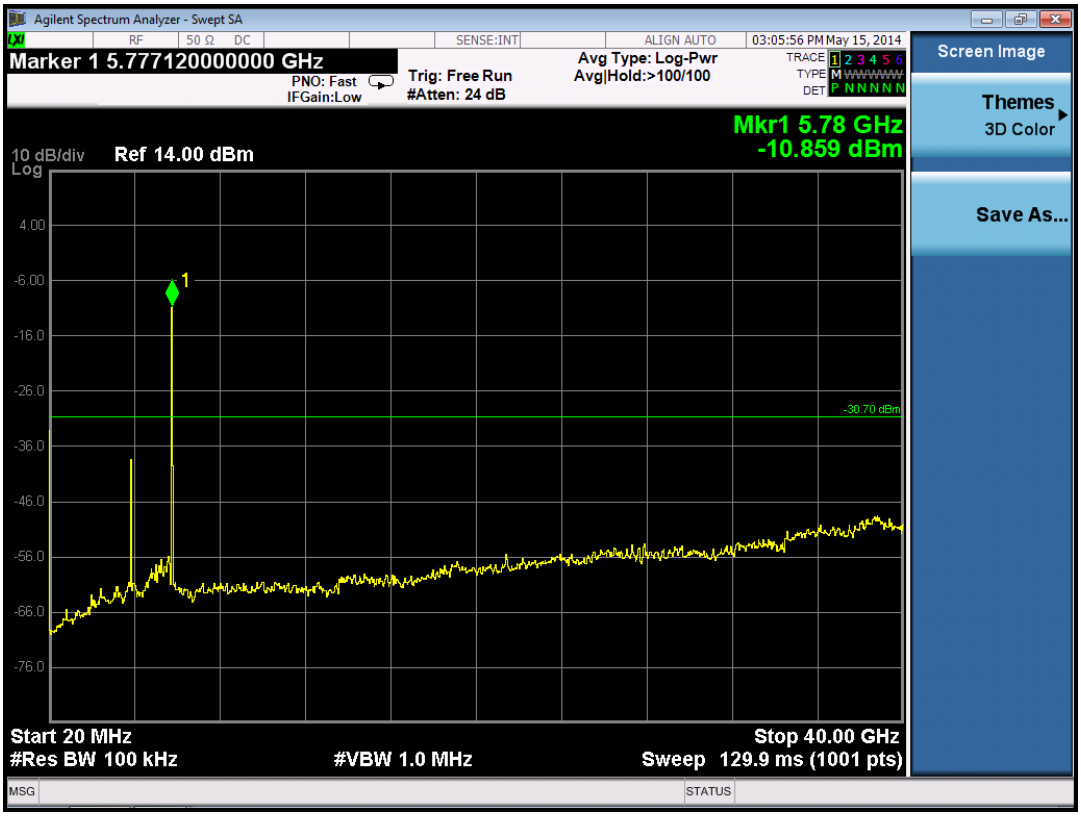
802.11N Channel 1

802.11N Channel 6

802.11N Channel 11

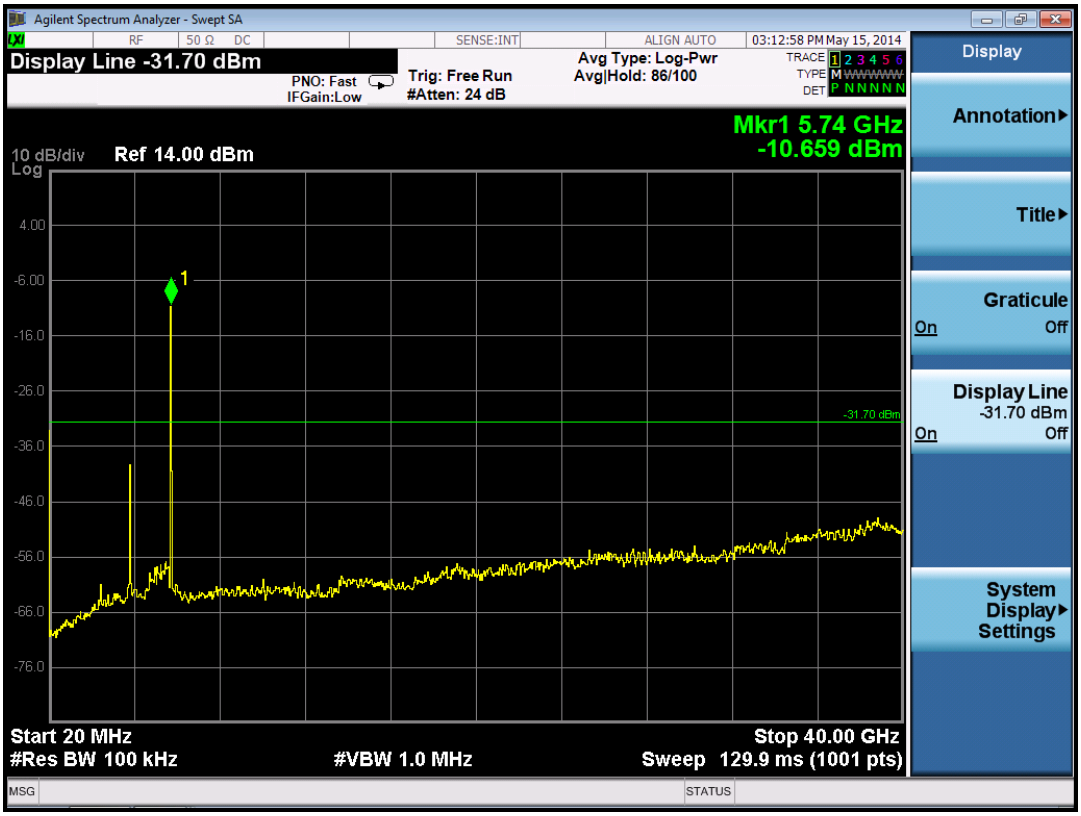


802.11g Channel 149



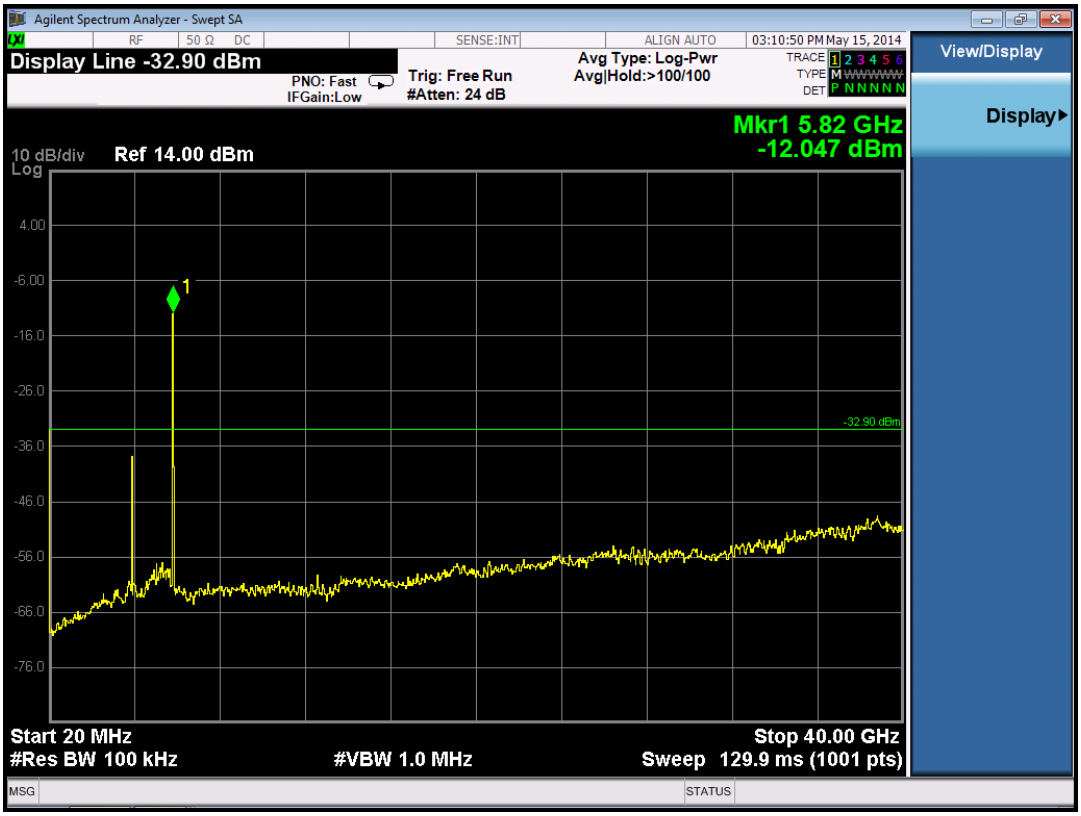
802.11g Channel 157

802.11g Channel 165



802.11N Channel 149

802.11N Channel 157



802.11N Channel 165

10.6 Spurious Radiated Emissions (Restricted Band)

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu spectrum analyzer was used. For tests from 1 to 40 GHz, an HP 8566 spectrum analyzer was used. For tests from 1 to 10 GHz, a high pass filter was used to reduce the fundamental emission. A harmonic mixers were used from 18 to 40 GHz. Figure 4 herein lists the details of the test equipment used during radiated emissions tests. In addition, a high pass filter was used to reduce the fundamental emission.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 40,000 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

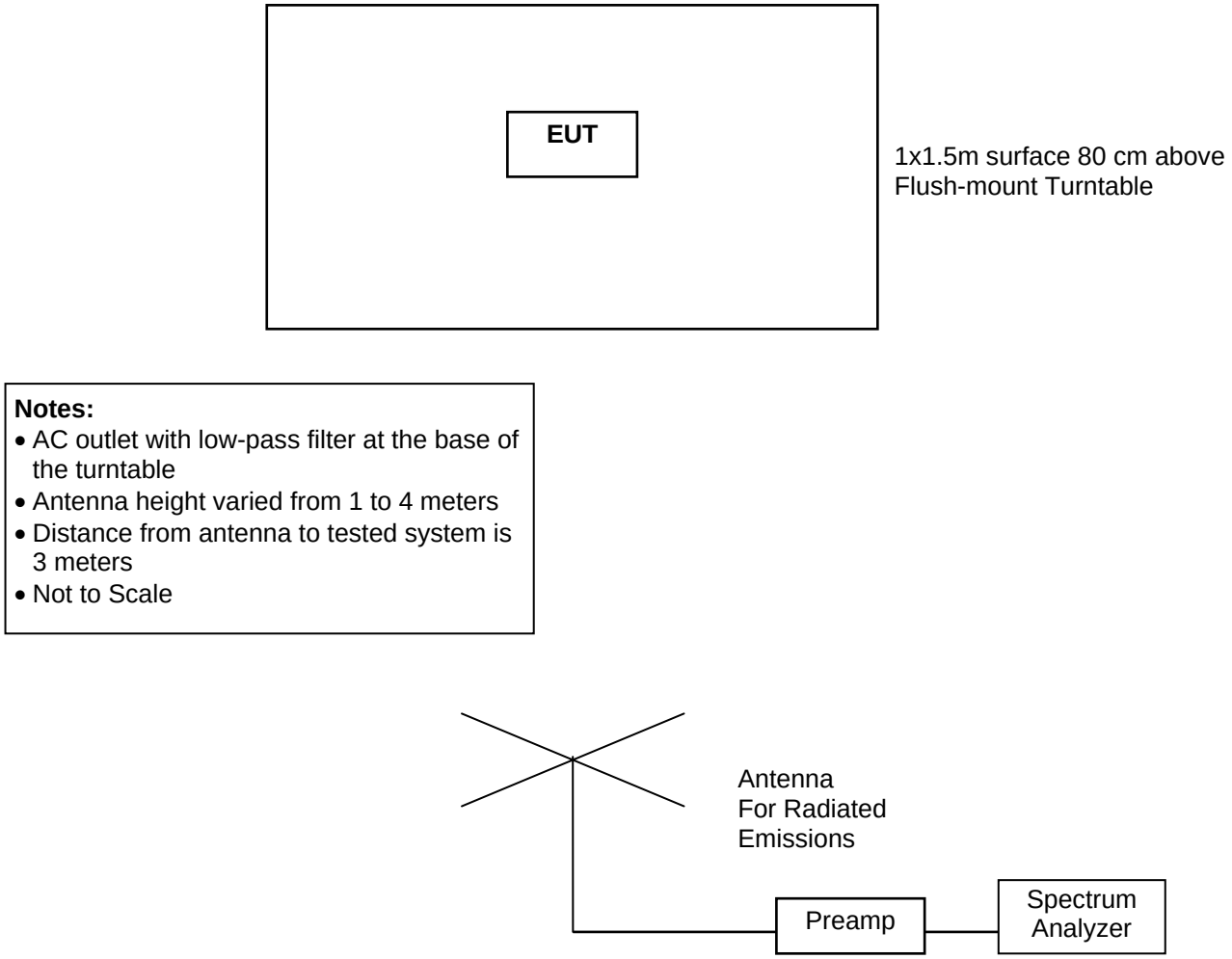
10.6.1 Radiated Emissions Field Strength Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
HPF = High pass Filter Loss

Figure 1. Drawing of Radiated Emissions Setup



10.7 Restricted Band Radiated Emissions Test Results

The following spectrum analyzer settings were used.
Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold
A Video Bandwidth of 10 Hz was used for Average measurements above 1 GHz.

Manufacturer	Trilithic	Specification	FCC Part 15 Subpart C & RSS-210
Model	2011690000	Test Date	July 10-13, 2013
Serial Number	281195	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain – Duty Cycle Factor + HP Filter Loss		

Restricted band Emissions below 1 GHz

Freq. MHz	Meter Reading dBuV	Det. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
124.8	37.3	P	14.6	H/44	-27.2	24.7	43.5	18.8
149.6	39.6	P	9.7	H/44	-26.9	22.4	43.5	21.1
250.2	55.5	P	12.7	H/44	-27.4	40.8	46.0	5.2
275.4	44.5	P	13.1	H/44	-27.3	30.3	46.0	15.7
399.7	41.0	P	15.5	H/44	-27.2	29.3	46.0	16.7
1000.0	37.1	P	22.5	H/44	-24.0	35.6	54.0	18.4
75.2	47.6	P	7.0	V/44	-27.7	26.9	40.0	13.1
124.8	42.4	P	14.6	V/44	-27.2	29.8	43.5	13.7
149.6	43.1	P	9.7	V/44	-26.9	25.9	43.5	17.6
250.2	52.8	P	12.7	V/44	-27.4	38.1	46.0	7.9
275.4	47.0	P	13.1	V/44	-27.3	32.8	46.0	13.2
1000.0	36.2	P	22.5	V/44	-24.0	34.7	54.0	19.3

Non Harmonic, Restricted band Emissions above 1 GHz:

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Pol.	Antenna ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
1348.0	40.4	P	H	13.0	-3.1	37.3	74.0	36.7
1605.0	38.8	P	H	13.0	-3.2	35.6	74.0	38.4
2299.0	39.4	P	H	13.0	-0.1	39.3	74.0	34.7
3629.0	43.0	P	H	13.0	5.1	48.1	74.0	25.9
3829.7	22.5	A	H	13.0	10.5	33.0	54.0	21.0
3829.9	37.3	P	H	13.0	10.5	47.8	74.0	26.2
3843.4	40.3	P	H	13.0	10.6	50.9	74.0	23.1
3843.4	35.2	A	H	13.0	10.6	45.8	54.0	8.2
3869.9	39.5	P	H	13.0	10.6	50.1	74.0	23.9
3870.1	34.6	A	H	13.0	10.6	45.2	54.0	8.8
1398.0	39.4	P	V	13.0	-3.6	35.8	74.0	38.2
1604.0	43.6	P	V	13.0	-3.2	40.4	74.0	33.6
2842.0	37.6	P	V	13.0	2.3	39.9	74.0	34.1
3830.0	41.9	P	V	13.0	10.5	52.4	74.0	21.6
3830.1	38.3	A	V	13.0	10.5	48.8	54.0	5.2
3843.4	41.8	A	V	13.0	10.6	52.4	54.0	1.6
3843.4	45.1	P	V	13.0	10.6	55.7	74.0	18.3
3870.1	42.9	P	V	13.0	10.6	53.5	74.0	20.5
3870.1	39.2	A	V	13.0	10.6	49.8	54.0	4.2

Judgement: Pass by 1.6 dB

10.7.1 Radiated emissions (Fundamental, Band edge and Harmonics)

802.11b Radiated emissions (Fundamental, Band edge and Harmonics)

		Spectrum Analyzer Readings					EUT	Peak	Ave	Peak	Ave	Margin
hrm	Tx					Corr.	Emission	Tot. FS		Limit		Under
		Vertical		Horizontal			Freq					
#	Freq	Peak	Ave	Peak	Ave	Fact.	MHz	dBuV/m		dBuV/m		Limit
1	2412	101.9	98.8	98.2	95.1	2.3	2412.0	104.2	101.1	125	115	13.9
BE	2412	45.2	42.1	41.5	38.4	2.3	2390.0	47.5	44.4	74	54	9.6
2	2412	34.0	30.9	32.6	29.5	11.0	4824.0	45.0	41.9	74	54	12.1
3	2412	39.6	36.5	39.4	36.3	11.6	7236.0	51.2	48.1	74	54	5.9
1	2437	97.0	93.9	95.1	92.0	2.5	2437.0	99.5	96.4	125	115	18.6
2	2437	33.2	30.1	33.4	30.3	10.6	4874.0	44.0	40.9	74	54	13.1
3	2437	39.8	36.7	40.1	37.0	11.9	7311.0	52.0	48.9	74	54	5.1
1	2462	96.0	92.9	93.6	90.5	2.5	2462.0	98.5	95.4	125	115	19.6
BE	2462	43.3	40.2	40.9	37.8	0.0	2483.5	43.3	40.2	74	54	13.8
2	2462	34.9	31.8	34.2	31.1	10.6	4924.0	45.5	42.4	74	54	11.6
3	2462	39.4	36.3	39.5	36.4	11.9	7386.0	51.4	48.3	74	54	5.7
Column numbers (see below for explanations)												
1	2	3	4	5	6	7	8	9	10	11	12	13

Judgment: Passed by 5.1 dB
No other emissions were detected from 2 to 25 GHz.

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #4. Average Reading based on peak reading reduced by the Duty cycle correction
Column #5. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #6. Average Reading based on peak reading reduced by the Duty cycle correction
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.
Column #11. Peak Limit.
Column #12. Average Limit.
Column #13. The margin (last column) is the worst case margin under the peak or average limits for that row.

802.11g Radiated emissions

		Spectrum Analyzer Readings					EUT	Peak	Ave	Peak	Ave	Margin
hrm	Tx					Corr.	Emission	Tot. FS		Limit		Under
		Vertical		Horizontal			Freq					
#	Freq	Peak	Ave	Peak	Ave	Fact.	MHz	dBuV/m		dBuV/m		Limit
1	2412	103.8	95.1	97.5	88.8	2.3	2412.0	106.1	97.4	125	115	17.6
BE	2412	66.8	50.1	56.8	48.1	2.3	2390.0	69.1	52.4	74	54	1.6
2	2412	32.8	24.1	33.5	24.8	11.0	4824.0	44.5	35.8	74	54	18.2
3	2412	39.6	30.9	40.0	31.3	11.6	7236.0	51.6	42.9	74	54	11.1
1	2437	96.8	88.1	96.7	88.0	2.5	2437.0	99.3	90.6	125	115	24.4
2	2437	34.1	25.4	33.4	24.7	10.6	4874.0	44.7	36.0	74	54	18.0
3	2437	39.8	31.1	39.5	30.8	11.9	7311.0	51.7	43.0	74	54	11.0
1	2462	98.1	89.4	96.9	88.2	2.5	2462.0	100.6	91.9	125	115	23.1
BE	2462	56.7	48.0	55.5	46.8	0.0	2483.5	56.7	48.0	74	54	6.0
2	2462	34.5	25.8	34.2	25.5	10.6	4924.0	45.1	36.4	74	54	17.6
3	2462	39.4	30.7	39.8	31.1	11.9	7386.0	51.7	43.0	74	54	11.0
Column numbers (see below for explanations)												
1	2	3	4	5	6	7	8	9	10	11	12	13

Judgment: Passed by 1.6 dB

No other emissions were detected from 2 to 25 GHz.

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #4. Average Reading based on peak reading reduced by the Duty cycle correction
Column #5. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #6. Average Reading based on peak reading reduced by the Duty cycle correction
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.
Column #11. Peak Limit.
Column #12. Average Limit. Note that the limit at the fundamental is for reference only.
Column #13. The margin (last column) is the worst case margin under the peak or average limits for that row.

802.11N Radiated emissions (Fundamental, Band edge and Harmonics)

		Spectrum Analyzer Readings					EUT	Peak	Ave	Peak	Ave	Margin
hrm	Tx					Corr.	Emission	Tot. FS		Limit		Under
		Vertical		Horizontal			Freq					
#	Freq	Peak	Ave	Peak	Ave	Fact.	MHz	dBuV/m		dBuV/m		Limit
1	2412	97.9	89.0	97.3	88.6	2.3	2412.0	100.2	91.3	125	115	23.7
BE	2412	58.2	49.5	55.8	47.1	2.3	2390.0	60.5	51.8	74	54	2.2
2	2412	34.7	26.0	33.5	24.8	11.0	4824.0	45.7	37.0	74	54	17.0
3	2412	39.3	30.6	39.4	30.7	11.6	7236.0	51.0	42.3	74	54	11.7
1	2437	97.3	88.6	96.2	87.5	2.5	2437.0	99.8	91.1	125	115	23.9
2	2437	33.3	24.6	33.9	25.2	10.6	4874.0	44.5	35.8	74	54	18.2
3	2437	40.2	31.5	39.2	30.5	11.9	7311.0	52.1	43.4	74	54	10.6
1	2462	97.4	88.7	96.4	87.7	2.5	2462.0	99.9	91.2	125	115	23.8
BE	2462	57.9	49.2	54.6	45.9	2.5	2483.5	60.4	51.7	74	54	2.3
2	2462	34.3	25.6	33.7	25.0	10.6	4924.0	44.9	36.2	74	54	17.8
3	2462	39.3	30.6	39.1	30.4	11.9	7386.0	51.2	42.5	74	54	11.5
Column numbers (see below for explanations)												
1	2	3	4	5	6	7	8	9	10	11	12	13

Judgment: Passed by 2.2 dB
No other emissions were detected from 2 to 25 GHz.

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #4. Average Reading based on peak reading reduced by the Duty cycle correction
Column #5. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #6. Average Reading based on peak reading reduced by the Duty cycle correction
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.
Column #11. Peak Limit.
Column #12. Average Limit. Note that the limit at the fundamental is for reference only.
Column #13. The margin (last column) is the worst case margin under the peak or average limits for that row.

802.11A; FCC 15.247 Radiated emissions (Fundamental, Band edge and Harmonics)

5745, 5785 and 5825 MHz

		Spectrum Analyzer Readings					EUT	Peak	Ave	Peak	Ave	Margin
hrm	Tx					Corr.	Emission	Tot. FS		Limit		Under
		Vertical		Horizontal			Freq					
#	Freq	Peak	Ave	Peak	Ave	Fact.	MHz	dBuV/m		dBuV/m		Limit
1	5745	80.1	71.4	74.3	65.6	11.8	5745.0	91.9	83.2	125	115	31.8
2	5745	43.0	34.3	42.9	34.2	4.4	11490.0	47.4	38.7	74	54	15.3
3	5745	44.6	35.9	44.4	35.7	8.6	17235.0	53.2	44.5	74	54	9.5
1	5785	80.0	71.3	74.1	65.4	11.8	5785.0	91.8	83.1	125	115	31.9
2	5785	43.2	34.5	43.2	34.5	4.4	11570.0	47.6	38.9	74	54	15.1
3	5785	44.2	35.5	44.3	35.6	9.3	17355.0	53.6	44.9	74	54	9.1
1	5825	78.2	69.5	72.0	63.3	11.9	5825.0	90.1	81.4	125	115	33.6
2	5825	43.0	34.3	42.6	33.9	4.5	11650.0	47.5	38.8	74	54	15.2
3	5825	45.8	37.1	44.3	35.6	9.7	17475.0	55.5	46.8	74	54	7.2
Column numbers (see below for explanations)												
1	2	3	4	5	6	7	8	9	10	11	12	13

Judgment: Passed by 7.2 dB
No other emissions were detected from 2 to 40 GHz.

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #4. Average Reading based on peak reading reduced by the Duty cycle correction
Column #5. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #6. Average Reading based on peak reading reduced by the Duty cycle correction
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.
Column #11. Peak Limit.
Column #12. Average Limit. Note that the limit at the fundamental is for reference only.
Column #13. The margin (last column) is the worst case margin under the peak or average limits for that row.

802.11N; FCC 15.247 Radiated emissions (Fundamental, Band edge and Harmonics)

5745, 5785 and 5825 MHz

		Spectrum Analyzer Readings					EUT	Peak	Ave	Peak	Ave	Margin
hrm	Tx					Corr.	Emission	Tot. FS		Limit		Under
		Vertical		Horizontal			Freq					
#	Freq	Peak	Ave	Peak	Ave	Fact.	MHz	dBuV/m		dBuV/m		Limit
1	5745	73.0	71.4	70.6	63.9	11.8	5745.0	91.9	83.2	125	115	31.8
2	5745	43.2	34.5	42.7	34.4	4.4	11490.0	47.6	38.9	74	54	15.1
3	5745	44.3	35.6	44.2	35.6	8.6	17235.0	52.9	44.2	74	54	9.8
1	5785	73.0	70.7	72.0	65.6	11.8	5785.0	91.2	82.5	125	115	32.5
2	5785	43.2	34.6	43.0	34.3	4.4	11570.0	47.7	39.0	74	54	15.0
3	5785	44.8	36.1	44.7	36.0	9.3	17355.0	54.1	45.4	74	54	8.6
1	5825	74.3	69.7	71.5	64.2	11.9	5825.0	90.3	81.6	125	115	33.4
2	5825	42.9	35.2	42.7	34.7	4.5	11650.0	48.4	39.7	74	54	14.3
3	5825	44.6	35.9	44.3	35.6	9.7	17475.0	54.3	45.6	74	54	8.4
Column numbers (see below for explanations)												
1	2	3	4	5	6	7	8	9	10	11	12	13

Judgment: Passed by 8.6 dB
No other emissions were detected from 2 to 40 GHz.

Column #1. hrm = Harmonic; BE = Band Edge emissions
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #4. Average Reading based on peak reading reduced by the Duty cycle correction
Column #5. Uncorrected readings from the spectrum analyzer with First Axis Rotation.
Column #6. Average Reading based on peak reading reduced by the Duty cycle correction
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.
Column #11. Peak Limit.
Column #12. Average Limit. Note that the limit at the fundamental is for reference only.
Column #13. The margin (last column) is the worst case margin under the peak or average limits for that row.

10.8 Unintentional Emissions (Receive Mode)

Manufacturer	Trilithic	Specification	FCC Part 15.247 & RSS-210
Model	2011690000	Test Date	07-09-13
Serial Number	281195	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain		
Configuration	Receive mode		

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna Factor dB	Antenna Pol/ ID#	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
36.0	32.9	P	16.2	H/44	-28.4	20.6	40.0	19.4
62.4	35.0	P	9.8	H/44	-28.0	16.7	40.0	23.3
103.2	42.2	P	10.5	H/44	-27.6	25.2	43.5	18.3
104.8	39.8	P	12.0	H/44	-27.5	24.2	43.5	19.3
151.6	39.4	P	9.6	H/44	-27.0	22.0	43.5	21.5
174.4	47.3	P	9.2	H/44	-26.7	29.8	43.5	13.7
199.2	51.0	P	9.8	H/44	-26.5	34.4	43.5	9.1
224.0	55.0	P	11.6	H/44	-26.2	40.4	46.0	5.6
225.0	51.1	Q	11.7	H/44	-26.2	36.5	46.0	9.5
225.6	55.2	P	11.7	H/44	-26.2	40.7	46.0	5.3
250.0	58.6	Q	12.7	H/44	-27.6	43.7	46.0	2.3
300.6	48.3	P	12.9	H/44	-27.5	33.7	46.0	12.3
349.9	48.1	P	14.6	H/44	-27.5	35.2	46.0	10.8
375.1	44.7	P	15.3	H/44	-27.4	32.6	46.0	13.4
399.7	47.1	P	15.5	H/44	-27.4	35.2	46.0	10.8
424.4	43.1	P	16.4	H/44	-27.4	32.1	46.0	13.9
450.0	52.5	P	16.4	H/44	-27.1	41.9	46.0	4.1
474.2	46.0	P	17.5	H/44	-27.0	36.5	46.0	9.5
499.4	50.2	P	17.5	H/44	-26.8	40.8	46.0	5.2
500.0	49.8	Q	17.5	H/44	-26.8	40.4	46.0	5.6
36.4	43.1	P	16.1	V/44	-28.4	30.8	40.0	9.2
75.2	42.6	P	7.0	V/44	-27.9	21.7	40.0	18.3
103.6	46.4	P	10.8	V/44	-27.6	29.7	43.5	13.8
149.6	40.5	P	9.7	V/44	-27.0	23.2	43.5	20.3
167.2	48.8	P	9.7	V/44	-26.8	31.7	43.5	11.8
199.2	48.0	P	9.8	V/44	-26.5	31.4	43.5	12.1
224.0	49.6	P	11.6	V/44	-26.2	34.9	46.0	11.1
225.6	49.9	P	11.7	V/44	-26.2	35.4	46.0	10.6
250.2	54.9	P	12.7	V/44	-27.6	40.0	46.0	6.0
275.4	43.2	P	13.1	V/44	-27.5	28.8	46.0	17.2
300.0	48.0	P	12.8	V/44	-27.5	33.3	46.0	12.7
349.9	49.3	P	14.6	V/44	-27.5	36.4	46.0	9.6
375.1	45.7	P	15.3	V/44	-27.4	33.6	46.0	12.4
399.7	46.4	P	15.5	V/44	-27.4	34.5	46.0	11.5
474.2	42.9	P	17.5	V/44	-27.0	33.4	46.0	12.6
499.4	48.9	P	17.5	V/44	-26.8	39.5	46.0	6.5
500.0	49.1	Q	17.5	V/44	-26.8	39.8	46.0	6.2
550.0	50.9	P	19.1	V/44	-26.5	43.4	46.0	2.6

Judgement: Pass by 2.3 dB