LS RESEARCH, LLC
WIRELESS PRODUCT DEVELOPMENT
ACCREDITED
Testing Cert. 1255.01
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www.lsr.com

TEST REPORT # TX 312142 C C-1489 FCCIC U-NII
LSR Job #: C-1489

Compliance Testing of:
Logic PD 37x Torpedo + Wireless SOM

Test Date(s):
February 27th to July 17th 2012

Prepared For:
Logic PD
411 Washington Ave N. Suite 400
Minneapolis, MN 55401

This Test Report is issued under the Authority of:
Khairul Aidi Zainal, Senior EMC Engineer.

Signature: Date: 8/3/12

Test Report Reviewed by: Tom Smith	Project Engineer: Khairul Aidi Zainal, Senior EMC Engineer.
Signature: Thomas T. Smith Date: 8/6/2012	Signature: Date:8/3/12

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EXHIBIT 1. INTRODUCTION

1.1 - Scope

References:	FCC Part 15, Subpart C, Section 15.407 RSS GEN issue 3 and RSS 210 issue 8 Annex 9 RSS 102 issue 4
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	OET KDB 789033 D01 General UNII Test Procedure
Environmental Classification:	Commercial, Industrial or Business Residential

1.2 – Normative References

Publication	Year	Title
FCC CFR Parts 0-15	2012	Code of Federal Regulations – Telecommunications
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
RSS-210 Annex 9	2010	Low-power License-exempt Radio communication Devices (All Frequency Bands): Category I Equipment
RSS-GEN Issue 3	2010	General Requirements and Information for the Certification of Radio Apparatus
RSS 102	2010	Radio Frequency (RF) Exposure Compliance of Radiocommunication apparatus.
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
FCC KDB 789033 D01	2012	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices- Part 15 Subpart E.

1.3 - LS Research, LLC Test Facility

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) as conforming to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

1.4 – Location of Testing

All testing was performed at the following location utilizing the facilities listed below, unless otherwise noted.

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA,

List of Facilities Located at LS Research, LLC:

Compact Chamber
Semi-Anechoic Chamber
Open Area Test Site (OATS)

1.5 – Test Equipment Utilized

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated by a calibration laboratory accredited to the requirements of ISO/IEC 17025, and traceable to the SI standard.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 – Client Information

Manufacturer Name:	Logic PD
Address:	411 Washington Ave N. Suite 4, Minneapolis, MN 55401
Contact Name:	Joe Charboneau

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	37x Torpedo + Wireless SOM
Model Number:	SOMDM3730-30-2780AKCR-B
Serial Number:	2012M00619/2012M01222 (Radiated) 2012M00625/2012M01201 (Radiated) 2411M00976/4511M01290 (Radiated) 4511M01221(Radiated) 2911M00065/4511M01156 (Conducted) 2012M00627/2012M01206 (Conducted) 2012M00626/2012M01208(Conducted)

2.3 - Associated Antenna Description

The antenna associated with the EUT is a dual band isolated Magnetic dipole (IMD) with gains:
1. 2.5dBi peak between 2.39 to 2.49 GHz.
2. 3.5dBi peak between 4.9 to 5.9 GHz.

2.4 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	5180 to 5240 MHz
RF Power in Watts (Conducted measurement)	
Minimum:	802.11a = 0.1148 802.11n HT20 = 0.0050
Maximum:	802.11a = 0.1288 802.11n HT20 = 0.0054
Max Conducted Output Power (in dBm)	802.11a = 11.1 802.11n HT20 = 7.1
Field Strength at 3 meters (Maximum)	Not Applicable
Occupied Bandwidth (99% BW)	
Type of Modulation	OFDM
Transmitter Spurious (worst case) at 3 meters	49.1dBµV/m at 13000MHz
Stepped (Y/N)	N
Step Value:	N/A
Frequency Tolerance %, Hz, ppm	Better than 1 PPM
Transceiver Model # (if applicable)	WL1283 (Texas Instrument)
Microprocessor #	DM3730 (Texas Instrument)
Antenna Information	
Detachable/non-detachable	Detachable
Type	Dual band isolated magnetic dipole.
Gain (From data sheet)	2.5dBi peak between 2.39 to 2.49 GHz. 3.5dBi peak between 4.9 to 5.9 GHz
EUT will be operated under FCC Rule Part(s)	Title 47 part 15.407
EUT will be operated under RSS Rule Part(s)	RSS 210 A9
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Mobile

RF Technical Information:

Type of Evaluation (check one)		SAR Evaluation: Device Used in the Vicinity of the Human Head
		SAR Evaluation: Body-worn Device
	X	RF Evaluation

If RF Evaluation checked above, test engineer to complete the following:

Evaluated against exposure limits: ☒ General Public Use ☐ Controlled Use
Duty Cycle used in evaluation: 100 %
Standard used for evaluation: OET 65
Measurement Distance: 20 cm
RF Value: **0.0574** ☐ ☐ V/m ☐ A/m ☒ W/m^2
☐ Measured ☐ Computed ☒ Calculated

2.5 - Product Description

The 37x Torpedo + wireless SOM is an ultra-compact off-the-shelf solution for applications in markets where network connectivity is required and space is a premium. The product is used by OEM integrators to gain access to 802.11 a/b/g/n, Bluetooth, and GPS capabilities.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 - Climate Test Conditions

Temperature:	70 -71° F
Humidity:	32-42%
Pressure:	728-741mmHg

3.2 - Applicability & Summary Of EMC Emission Test Results

3.2.1 Operation in the 5.15 – 5.25 GHz band

FCC Rule Part	RSS Rule Part	Test Description	Test Result
15.407 (a)(1)	210 A9.2 (1)	Power Limits	Pass
15.407 (a)(1)	210 A9.2 (1)	Peak Power Spectral Density	Pass
15.407 (a)(1)	210 A9.2 (1)	26dB Bandwidth	Pass
15.407 (a)(6)	N/A	Peak Excursion Ratio	Pass
15.407 (b)(1)	210 A9.2 (1)	Undesirable emissions Limit	Pass
15.407 (b)(6) & (7),	210 A9.2 (1) GEN	Spurious Emissions below 1GHz AC Mains emissions	Pass
15.407 (e)	210 A.9.2 (1)	Indoor Operation	Pass
15.407 (f)	102 (4)	RF Exposure requirements	Pass
15.407 (g)	N/A	Frequency Stability	Pass

3.3 - Modifications Incorporated In The EUT For Compliance Purposes

☒ None ☐ Yes (explain below)

3.4 - Deviations & Exclusions From Test Specifications

☒ None ☐ Yes (explain below)

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.407, and Industry Canada RSS-210, Issue 8 (2010), Annex 9.

Note: If some emissions are seen to be within 3 dB of their respective limits; as these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. General Procedures.

5.1 Radiated measurements

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 40000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz while a standard gain horn antenna was used in the 18 GHz to 40 GHz range. The maximum radiated RF emissions between 30MHz to 4 GHz were found by raising and lowering the sense antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities. Measurements above 4 GHz are performed at 1 meter separation distance.

The EUT was positioned in 3 orthogonal orientations.

5.2 Calculation of Radiated emissions limits and reported data.

Reported data:

For both fundamental and spurious emissions measurement, the data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBµV/m) + Antenna correction Factor + Cable factor (dB) + Miscellaneous factors when applicable (dB) – amplification factor when applicable (dB).

Generic example of reported data at 200 MHz:

Reported Measurement data = 18.2 (raw receiver measurement) + 15.8 (antenna factor) + 1.45 (cable factor) = 35.45 (dBµV/m).

As specified in 15.247 (d) and RSS 210 A8.5, radiated emissions that fall within the restricted band described in 15.205(c) for FCC and section 2.2 of RSS 210 for IC, must comply with the general emissions limit.

The following table depicts the general radiated emission limits above 30 MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands. The mentioned limits correspond to those limits listed in RSS GEN.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24,000	500	54.0	63.5

Sample conversion of field strength (μV/m to dBμV/m):
dBμV/m = 20 log $_{10}$ (100)= 40 dBμV/m (from 30-88 MHz)

Conversion of field strength measurements to EIRP (KDB 412172).

E[dBμV/m] = EIRP[dBm] – 20 log(d[meters]) + 104.77

E is the field strength
d is the measurements distance

Example:

1. Field strength to EIRP:

   E = 105.2 [dBμV/m], d = 3 [meters]
   EIRP = 105.2 – 95.2 = 10 dBm

2. EIRP to field strength:

   EIRP = -30.0 dBm, d = 3 [meters]
   E = -30.0 + 95.2 = 65.2 [dBμV/m]

EXHIBIT 6. EUT Duty Cycle

Test Engineer: Adam Alger

All measurements are to be performed with the EUT transmitting at greater than or equal to 98% percent duty cycle. If greater than or equal to 98 percent duty cycle is not available, the actual duty cycle needs to be measured so that power and peak spectral density measurements can be corrected upwards.

6.1 Test Procedure.

Per KDB 789033 D01 section B, a spectrum analyzer with zero span at the frequency of interest was used to measure the on and off times of the transmitted signal.

6.2 Data.

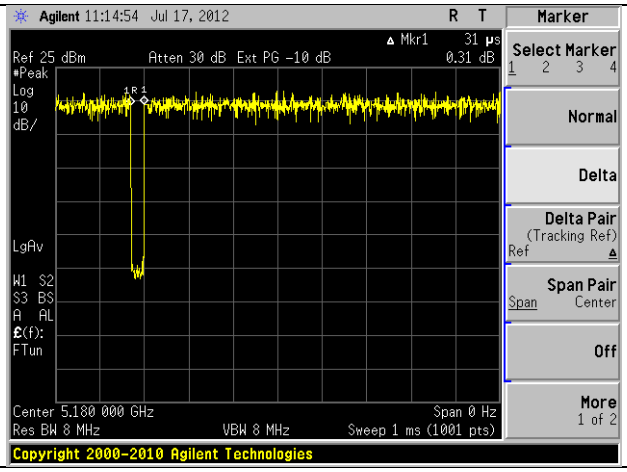
The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

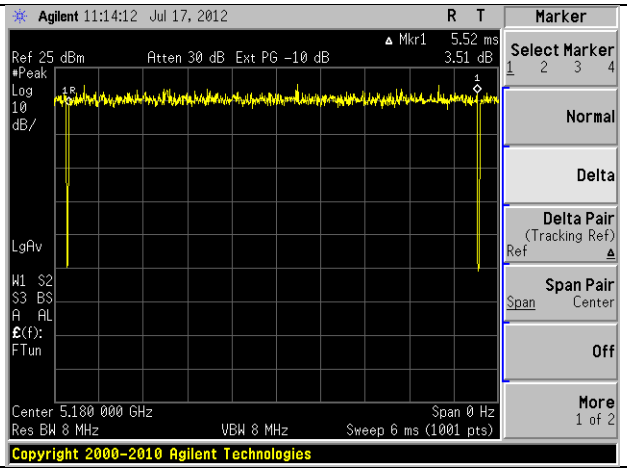
Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

6.2.1 6MBPS.



Off time

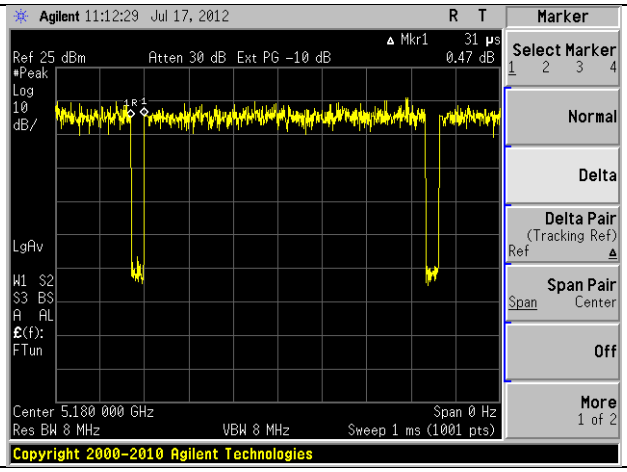


On time

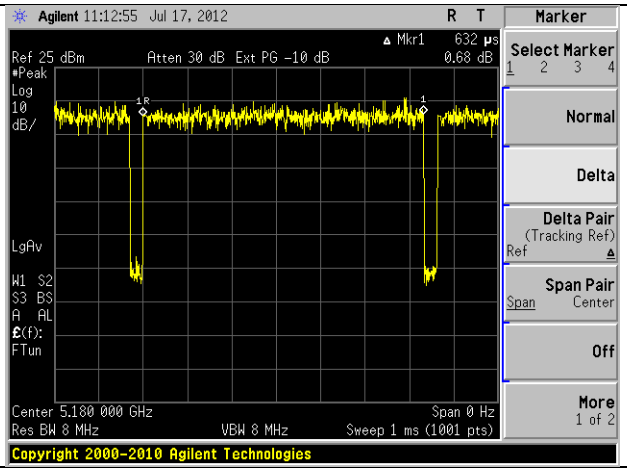
Duty Cycle = Tx On /(Tx On + TxOff)

Duty Cycle = 5.52ms / 5.56ms = .99

6.2.2 54MBPS



Off time



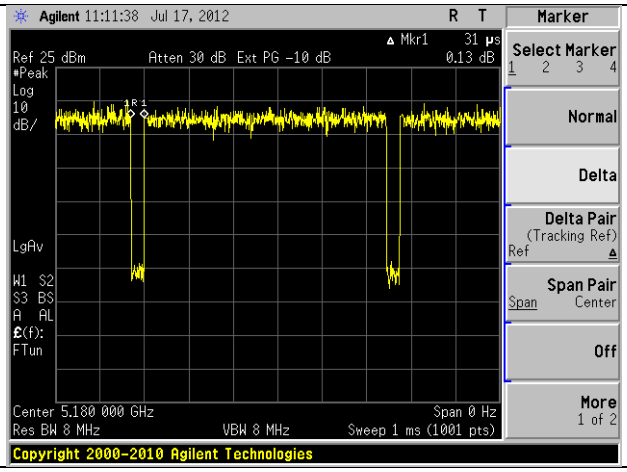
On time

Duty Cycle = Tx On /(Tx On + TxOff)

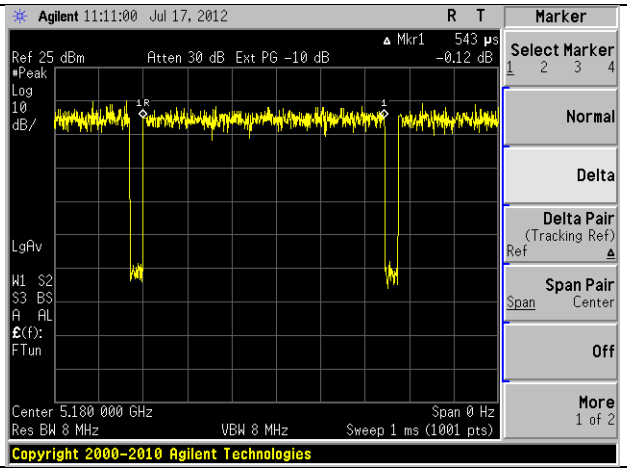
Duty Cycle = 632 µs / 663 µs = .953

Duty Cycle Correction = 10 log(1/.953) = **.208dB**

6.2.4 MCS7



Off time



On time

Duty Cycle = Tx On /(Tx On + TxOff)

Duty Cycle = 535 µs / 574 µs = .946

Duty Cycle Correction = 10 log(1/.946) = **.241dB**

EXHIBIT 7. Emission Bandwidth (EBW)

Test Engineer: Adam Alger

The emission bandwidth is the 26dB bandwidth in MHz. This bandwidth is used to determine the maximum conducted output power measurement and the appropriate limit.

7.1 Test procedure.

KDB 789033 D01 section D.

7.2 Test Data.

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

7.2.1 Operation in the 5.15 – 5.25 GHz band

7.2.1.1 6MBPS

Data Rate	Channel	Frequency (MHz)	EBW 26dB (MHz)
6 Mbps	36	5180	21.8
	40	5200	22.6
	48	5240	22.2

7.2.1.2 54MBPS

Data Rate	Channel	Frequency (MHz)	EBW 26dB (MHz)
54 Mbps	36	5180	23.3
	40	5200	22.5
	48	5240	22.4

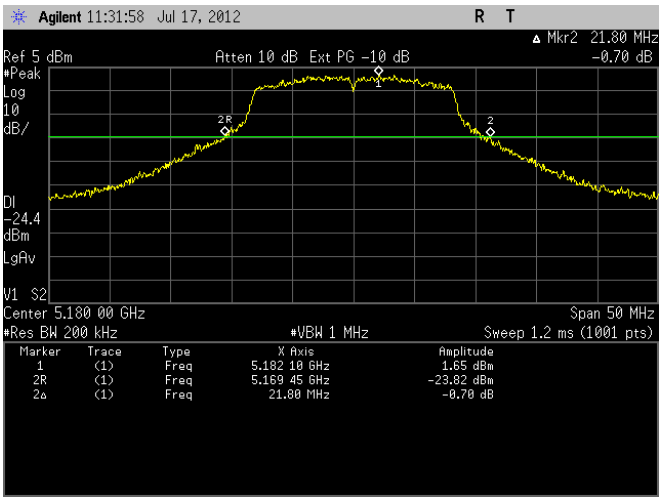
7.2.1.3 MCS7

Data Rate	Channel	Frequency (MHz)	EBW 26dB (MHz)
MCS 7 (65 Mbps)	36	5180	23.3
	40	5200	23.9
	48	5240	23.7

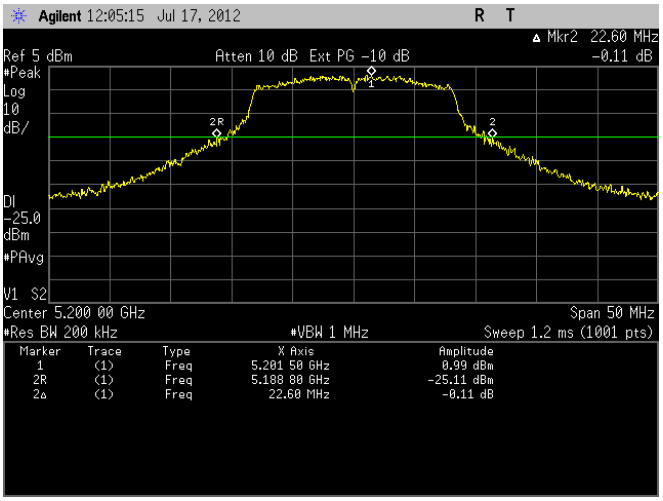
7.3 Screen Captures

7.3.1 Operation in the 5.15 – 5.25 GHz band

Channel 36



Channel 40



Channel 48

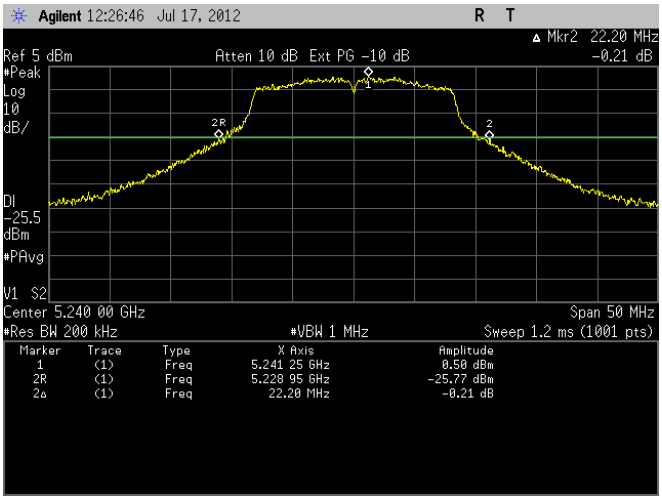

Agilent 12:26:46 Jul 17, 2012
R T
Mkr2 22.20 MHz
-0.21 dB
Ref 5 dBm
Atten 10 dB Ext PG -10 dB
#Peak
Log
10
dB/
DI
-25.5
dBm
#PAvg
V1 S2
Center 5.240 00 GHz
Span 50 MHz
#Res BW 200 kHz
#VBW 1 MHz
Sweep 1.2 ms (1001 pts)
Marker Trace Type X Axis Amplitude
1 (1) Freq 5.241 25 GHz 0.50 dBm
2R (1) Freq 5.228 95 GHz -25.77 dBm
2Δ (1) Freq 22.20 MHz -0.21 dB

EXHIBIT 8 Maximum Conducted Output Power And Peak Power Spectral Density

Test Engineer: Adam Alger

8.1 Test Procedure

KDB 789033 D01 section C (Maximum Conducted Output Power) and E (Peak Power Spectral Density)

8.2 Limits

8.2.1 Operation in the band 5.15 to 5.25 GHz

Maximum conducted output power = Lesser of 50mW or 4dBm + 10 log EBW

Peak Power Spectral Density = 4 dBm/MHz

8.2.2 Operation in the band 5.25 to 5.35 GHz

Maximum conducted output power = Lesser of 250mW or 11dBm + 10 log EBW

Peak Power Spectral Density = 11 dBm/MHz

8.2.3 Operation in the band 5.47 to 5.725 GHz

Maximum conducted output power = Lesser of 250mW or 11dBm + 10 log EBW

Peak Power Spectral Density = 11 dBm/MHz

8.2.4 Operation in the band 5.725 to 5.825 GHz

Maximum conducted output power = Lesser of 1W or 4dBm + 17 log EBW

Peak Power Spectral Density = 17 dBm/MHz

8.3 Test Data

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

8.3.1 Operation in the band 5.15 to 5.25 GHz

8.3.1.1 6MBPS

Data Rate	Channel	Frequency (MHz)	Power *SA2 (dBm)	Power Limit (dBm)	Power Margin (dB)	*PPSD (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
6 Mbps	36	5180	11.1	17	5.9	1.3	4	2.7
	40	5200	10.9	17	6.1	0.9	4	3.1
	48	5240	10.6	17	6.4	1.0	4	3.1

8.3.1.2 54MBPS

Data Rate	Channel	Frequency (MHz)	Power *SA2 (dBm)	Duty Cycle Correction (dB)	Power w/ D.C.C. (dBm)	Power Limit (dBm)	Power Margin (dB)	*PPSD (dBm)	Duty Cycle Correction (dB)	PPSD w/ D.C.C. (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
54 Mbps	36	5180	8.2	0.2	8.4	17	8.6	-2.6	0.2	-2.4	4	6.4
	40	5200	8.1	0.2	8.3	17	8.7	-2.6	0.2	-2.4	4	6.4
	48	5240	8.2	0.2	8.4	17	8.6	-2.6	0.2	-2.4	4	6.4

8.3.1.3 MCS7

Data Rate	Channel	Frequency (MHz)	Power *SA2 (dBm)	Duty Cycle Correction (dB)	Power w/ D.C.C. (dBm)	Power Limit (dBm)	Power Margin (dB)	*PPSD (dBm)	Duty Cycle Correction (dB)	PPSD w/ D.C.C. (dBm)	PKPSD Limit (dBm)	PKPSD Margin (dB)
MCS 7 (65 Mbps)	36	5180	7.1	0.2	7.3	17	9.7	-4.2	0.2	-4.0	4	8.0
	40	5200	7.0	0.2	7.2	17	9.8	-3.9	0.2	-3.7	4	7.7
	48	5240	7.3	0.2	7.5	17	9.5	-3.8	0.2	-3.6	4	7.6

8.3.2 Operation in the band 5.25 to 5.35 GHz

Not Applicable

8.3.3 Operation in the band 5.47 to 5.725 GHz

Not Applicable

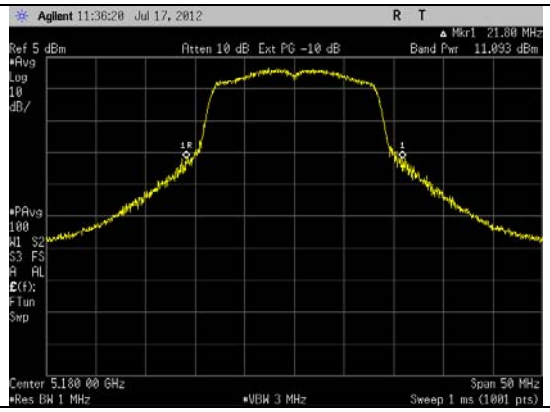
8.3.4 Operation in the band 5.725 to 5.825 GHz

Not Applicable

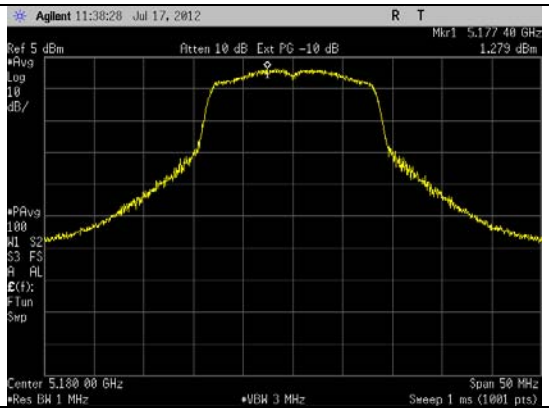
8.4 Screen Captures

8.4.1 Operation in the band 5.15 to 5.25 GHz

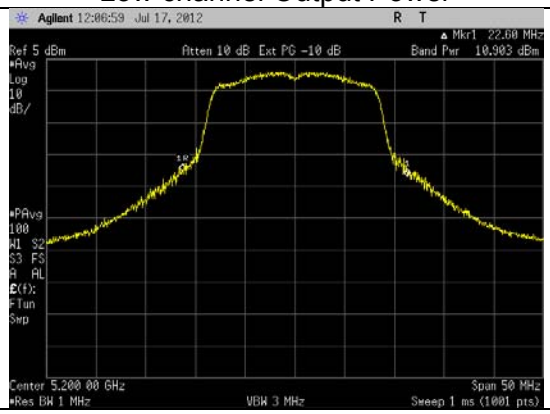
8.4.1.1 6MBPS



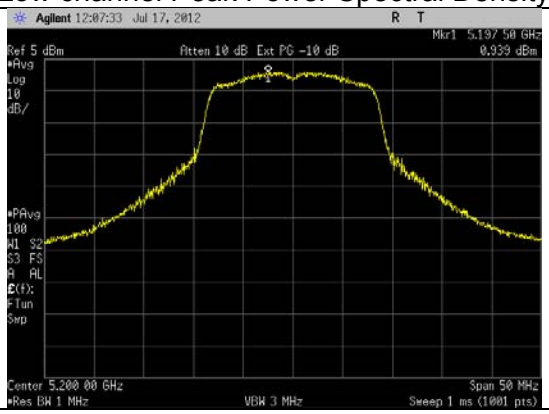
Low channel Output Power



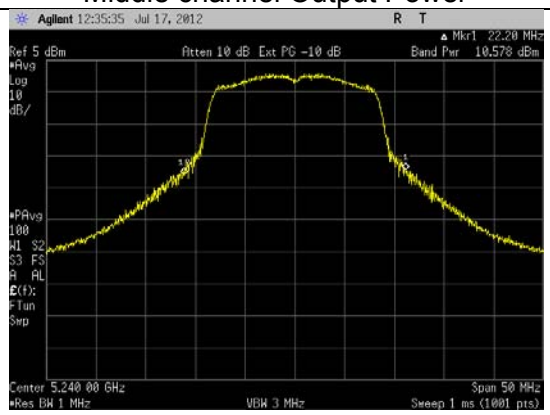
Low channel Peak Power Spectral Density



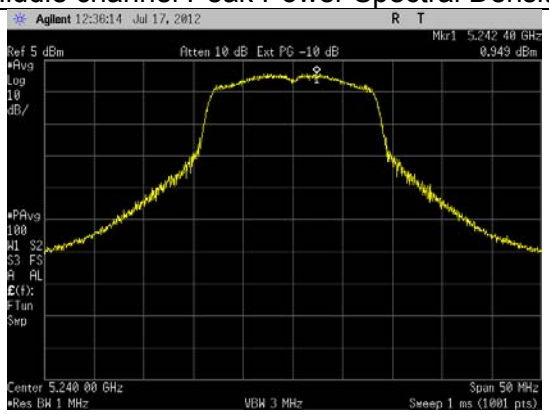
Middle channel Output Power



Middle channel Peak Power Spectral Density

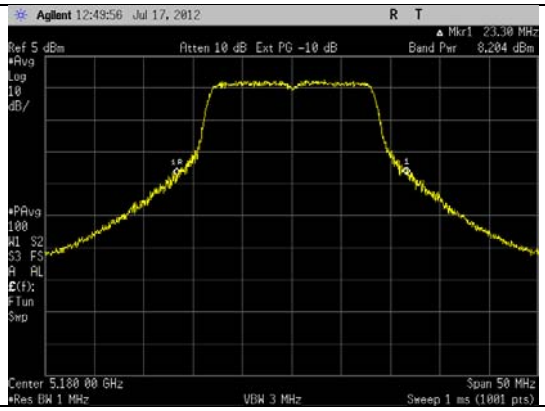


High channel Output Power

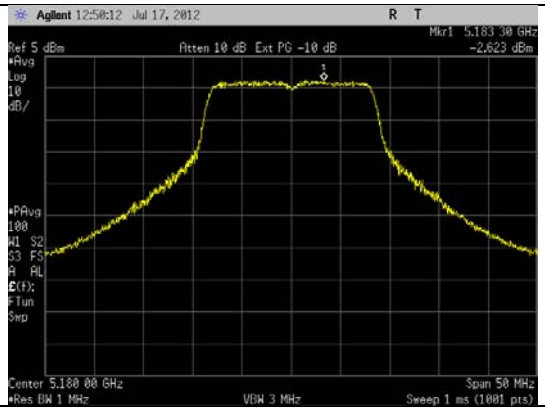


High channel Peak Power Spectral Density

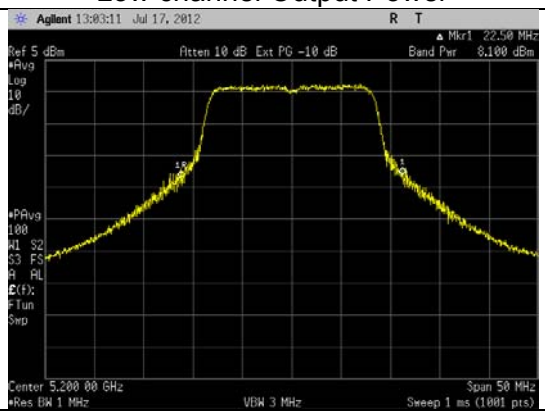
8.4.1.2 54MBPS



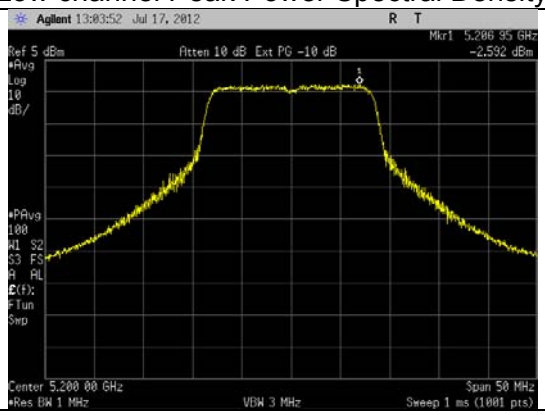
Low channel Output Power



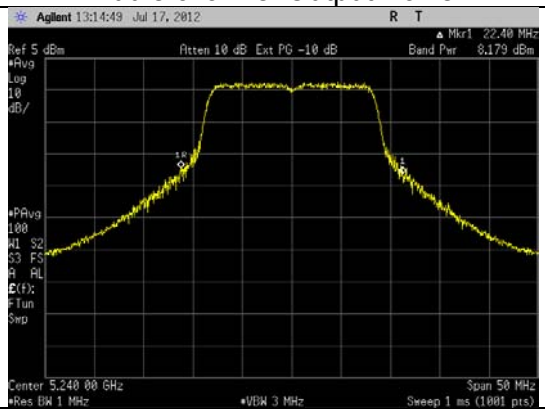
Low channel Peak Power Spectral Density



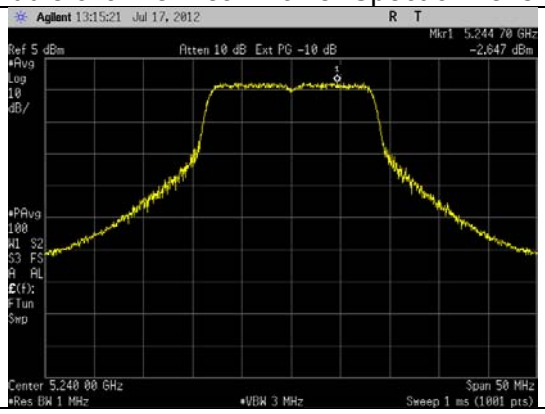
Middle channel Output Power



Middle channel Peak Power Spectral Density

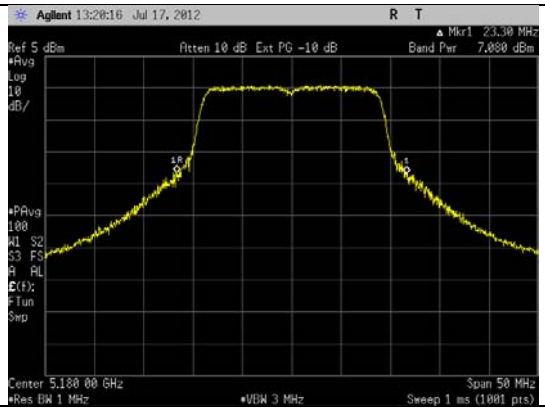


High channel Output Power

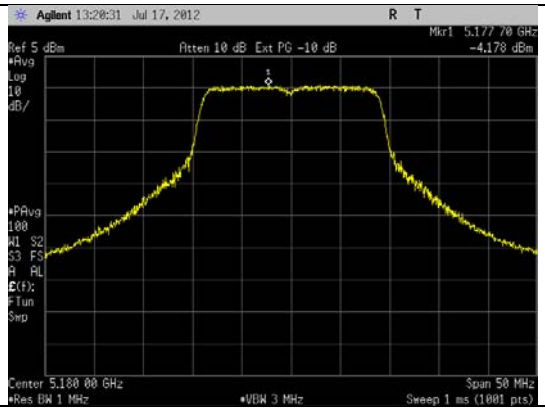


High channel Peak Power Spectral Density

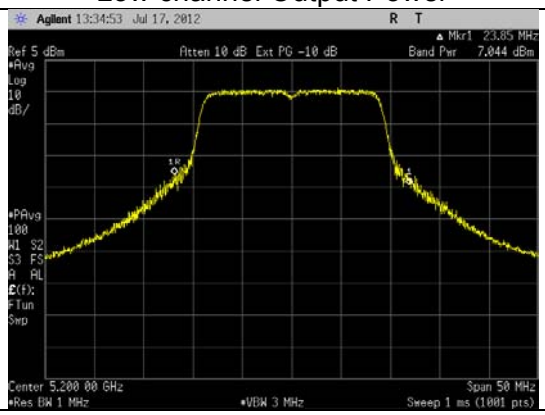
8.4.1.3 MCS7



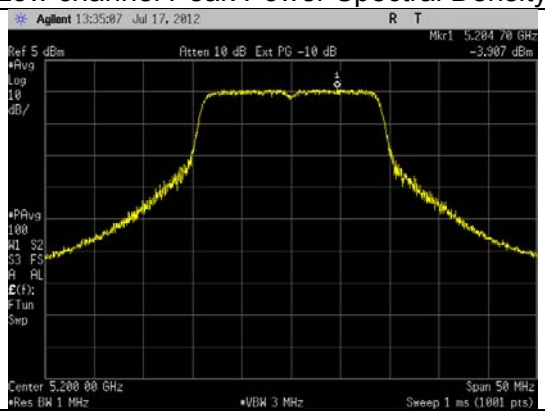
Low channel Output Power



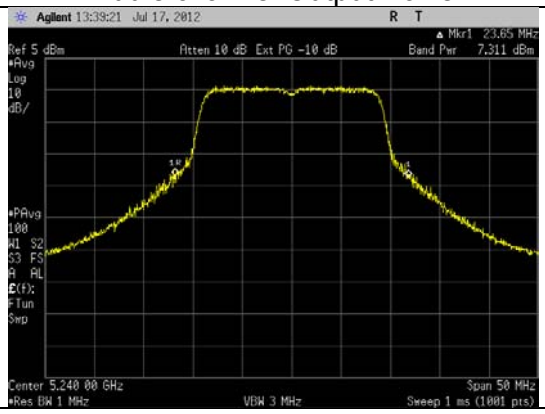
Low channel Peak Power Spectral Density



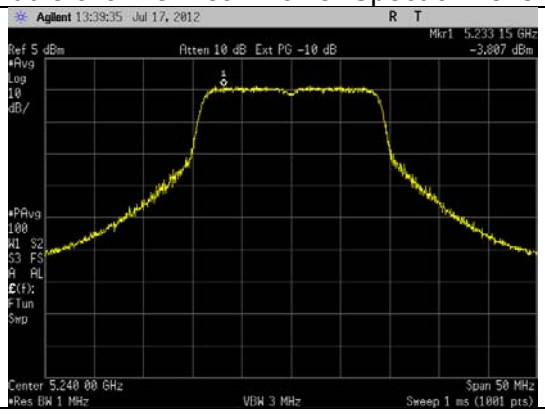
Middle channel Output Power



Middle channel Peak Power Spectral Density



High channel Output Power



High channel Peak Power Spectral Density

EXHIBIT 9. Peak Excursion Ratio

Test Engineer: Adam Alger

9.1 Test Procedure

KDB 789033 D01 section F

9.2 Limit

The ratio of the peak excursion of the modulation envelope to the maximum conducted output power shall not exceed 13dB across any 1 MHz bandwidth or the emission bandwidth, whichever is less.

9.3 Test Data

The data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBm) + Cable factor (dB) + Miscellaneous factors when applicable (dB).

Generic example of reported data at 2440 MHz:

Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

Sample calculation for peak excursion:

Peak Excursion (Channel 48/6MBPS) = 8.3 dBm (Peak Max Hold) – 1.0dBm(PPSD) = 7.3dBm

9.3.1 Operation in the 5.15 – 5.25 GHz band

9.3.1.1 6MBPS

Data Rate	Channel	Frequency (MHz)	*PPSD (dBm)	Peak Hold Value (dBm)	Peak Excursion (dB)	Peak Excursion Limit (dB)	Peak Excursion Margin (dB)
6 Mbps	36	5180	1.3	9.0	7.7	13	5.3
	40	5200	0.9	9.1	8.2	13	4.8
	48	5240	1.0	8.3	7.3	13	5.7

9.3.1.2 54MBPS

Data Rate	Channel	Frequency (MHz)	PPSD w/ D.C.C. (dBm)	Peak Hold Value (dBm)	Peak Excursion (dB)	Peak Excursion Limit (dB)	Peak Excursion Margin (dB)
54 Mbps	36	5180	-2.4	6.4	8.8	13	4.2
	40	5200	-2.4	6.3	8.7	13	4.3
	48	5240	-2.4	6.6	9.0	13	4.0

9.3.1.3 MCS7

Data Rate	Channel	Frequency (MHz)	PPSD w/ D.C.C. (dBm)	Peak Hold Value (dBm)	Peak Excursion (dB)	Peak Excursion Limit (dB)	Peak Excursion Margin (dB)
MCS 7 (65 Mbps)	36	5180	-4.0	4.5	8.5	13	4.5
	40	5200	-3.7	5.1	8.8	13	4.2
	48	5240	-3.6	5.2	8.8	13	4.2

Note:

1. D.C.C : Duty Cycle Correction

9.3.2 Operation in the 5.25 – 5.35 GHz band

Not Applicable

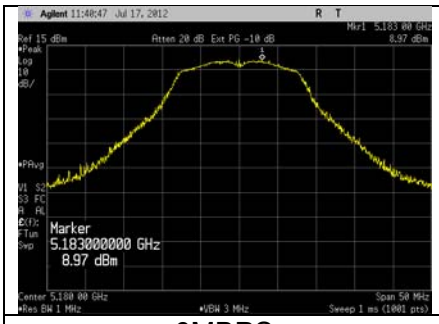
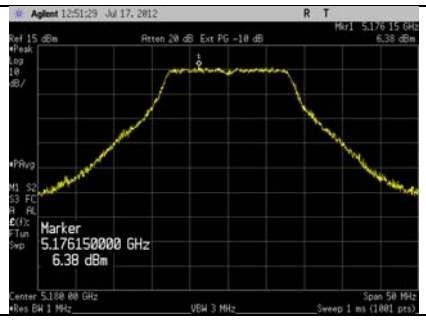
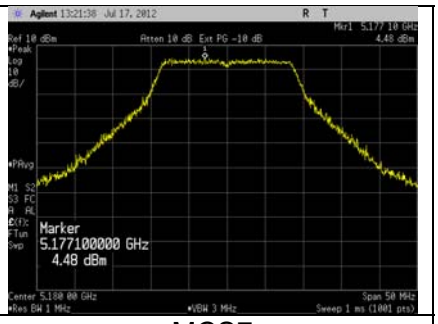
9.3.3 Operation in the 5.47 – 5.725 GHz band

Not Applicable

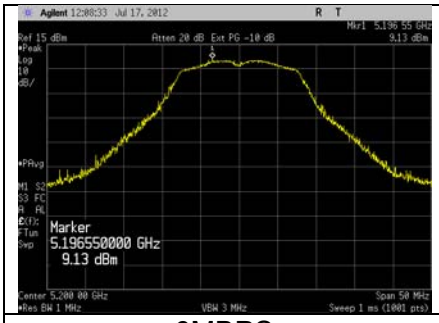
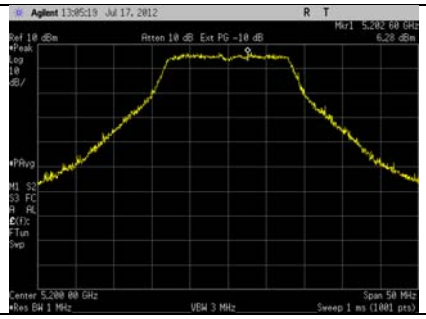
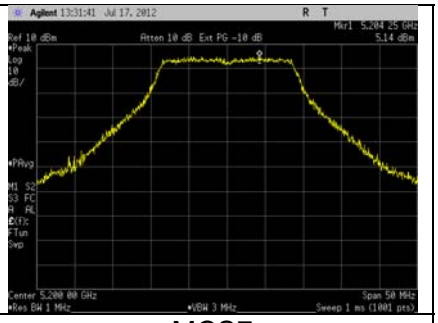
9.4 Screen Captures

9.4.3.1 Operation in the 5.15 – 5.25 GHz band

9.4.1.1 Channel 36

		
6MBPS	54MBPS	MCS7

9.4.1.2 Channel 40

		
6MBPS	54MBPS	MCS7

9.4.1.3 Channel 48

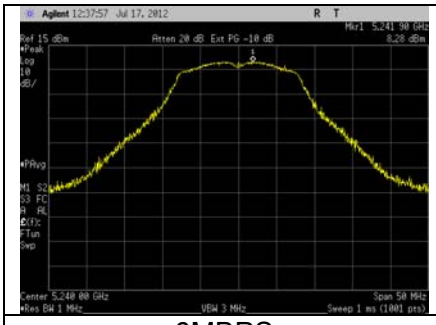
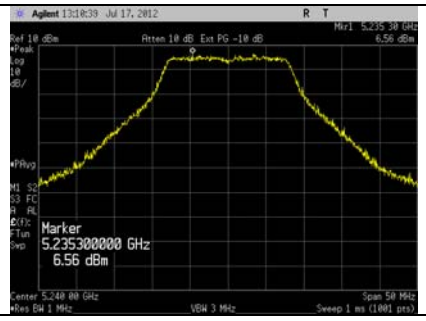
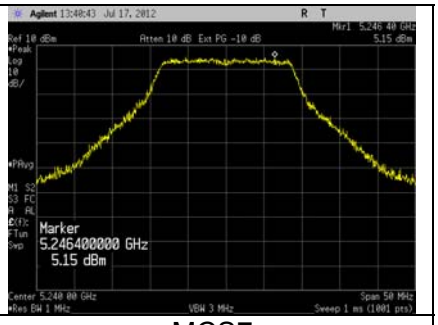
		
6MBPS	54MBPS	MCS7

EXHIBIT 10 Spurious Emissions

Test Engineers: Adam Alger, Khairul Aidi Zainal

10.1 Test Procedure

1. KDB 789033 D01 section G.
2. ANSI C63.4-2003

The unwanted emissions measurements both in the restricted and non-restricted bands were performed via antenna-port conducted measurements in conjunction with cabinet emissions test. In the cabinet emissions tests, the EUT antenna was replaced with a termination matching the nominal impedance of the antenna.

10.2 Limits

10.2.1 Operation in the 5150 to 5250 MHz band

All emissions outside of the 5150 to 5350 MHz band shall not exceed an EIRP of -27dBm.

10.2.2 Operation in the 5250 to 5350 MHz band

All emissions outside of the 5150 to 5350 MHz band shall not exceed an EIRP of -27dBm.
Devices operating in the 5250 to 5350 MHz band that generate emissions in the 5150 to 5250 MHz band must meet all applicable technical requirements for operation in the 5150 to 5250 MHz band (including indoor use) or alternatively meet an out of band emission EIRP limit of -27dBm/MHz in the 5150 to 5250 MHz band.

10.2.3 Operation in the 5470 to 5725 MHz band

All emissions outside of the 5150 to 5350 MHz band shall not exceed an EIRP of -27dBm

10.2.4 Operation in the 5725 MHz to 5825 MHz band

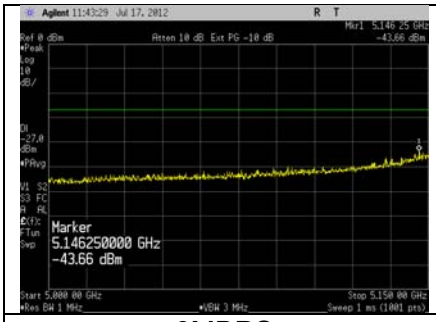
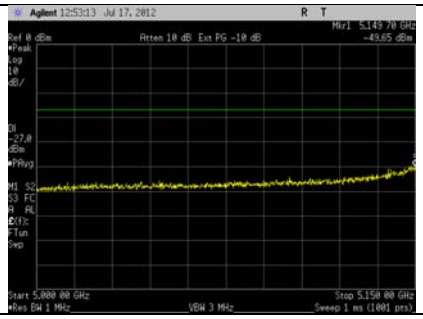
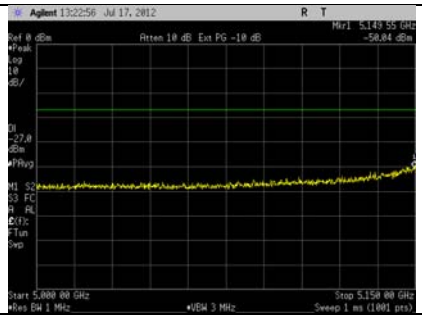
All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17dBm/MHz.

For frequencies 10 MH or greater above or below the band edge, emissions shall not exceed an EIRP of -27dBm/MHz.

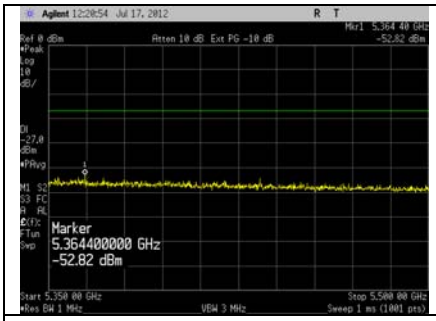
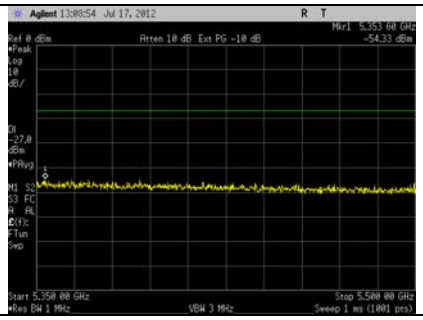
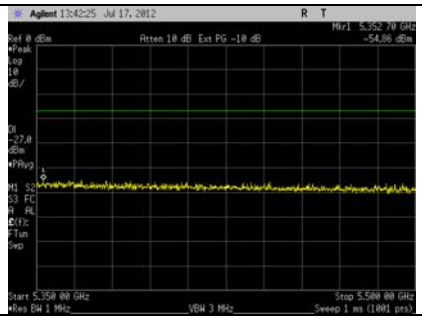
10.3 Test Data

10.3.1 Antenna port conducted measurements.

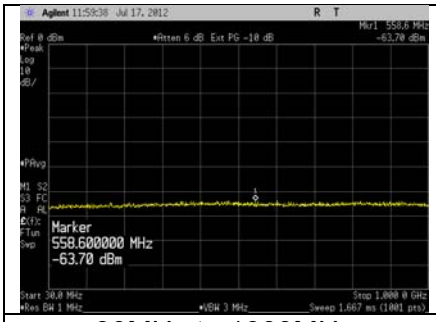
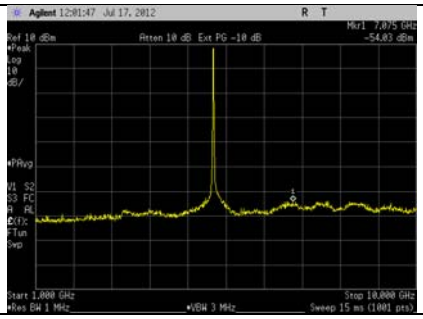
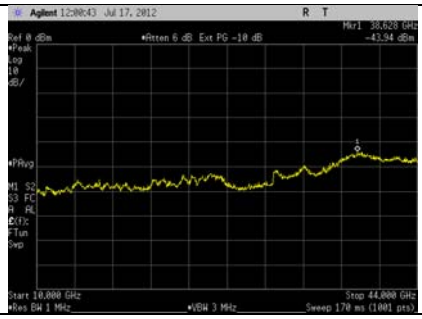
10.3.1.1 Operation in the 5150 to 5250 MHz band
10.3.1.1.1 Lower Band edge screen captures

		
6MBPS	54MBPS	MCS7

10.3.1.1.2 Upper Band edge screen captures

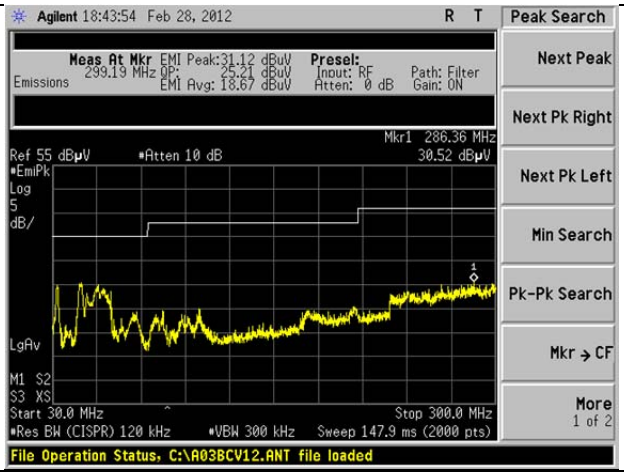
		
6MBPS	54MBPS	MCS7

10.3.1.1.3 Unwanted Emissions
The plots below are from the 6MBPS data rate which is representative of the other data rates.

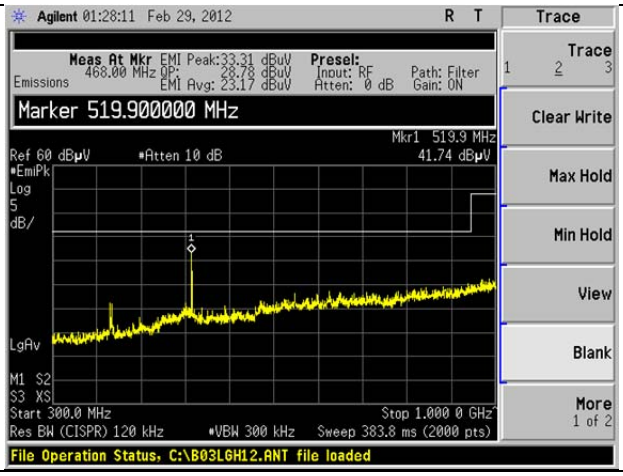
		
30MHz to 1000MHz	1000MHz to 10000MHz	10000MHZ to 44000MHz

10.3.2 Cabinet radiation measurements.

10.3.2.1 Emissions below 1000 MHz



30 to 300 MHz



300 to 1000 MHz

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
185.3	1.00	3	28.9	43.5	14.6	H	S
209.6	1.52	0	27.7	43.5	15.8	H	S
296.6	1.00	0	27.0	46.0	19.0	V	S
299.2	1.00	0	25.2	46.0	20.8	H	V
46.7	1.00	101	24.9	40.0	15.1	V	V
32.9	1.00	0	25.9	40.0	14.1	V	V
100.5	1.00	76	26.4	43.5	17.1	V	F
184.0	1.00	255	30.8	43.5	12.7	H	F
520.0	1.00	238	41.6	46.0	4.4	V	S
468.0	1.00	0	28.8	46.0	17.2	H	S
520.0	1.65	198	42.8	46.0	3.2	H	V
520.0	1.00	74	37.2	46.0	8.8	V	V
380.8	1.00	212	26.3	46.0	19.7	H	F

Note:
1. The emissions seen were not a function of the EUT.
2. H: Horizontal; V: Vertical; F:Flat

10.3.2.2 Emissions above 1000 MHz

For the following data, measurements were performed at a separation **distance of 1 meter**. The field strength was then converted to EIRP per KDB 789033:

EIRP [dBm] = E[dBuV/m] +20 log(d[meters])-104.77

EIRP is the equivalent isotropically radiated power in Watts
E is the field strength
D is the measurement distance

Examples:

1. Above 960MHz Restricted band limit conversion to EIRP:

   EIRP = 54[dBuV/m]+9.54-104.77= **-41.27dBm**

2. Spurious emission at **10360MHz (table 10.3.2.2.1.1, Channel 36):**

   EIRP = 52.9dBµV/m + 20 log (1 meter) – 104.77 = -51.8dBm

10.3.2.2.1 Operation in the 5150 to 5250 MHz band

10.3.2.2.1.1 Significant emissions data table

Channel 36

FREQ (MHz)	ANT	EUT	HEIGHT (cm)	AZIMUTH (°)	PEAK (dBµV/m)	QP (dBµV/m)	AVG (dBµV/m)	EIRP (dBm/MHz)	LIMIT (dBm/MHz)	MARGIN (dB)
10360.00	V	S	100.0	118	52.9	N/A	N/A	-51.8	-27.0	24.8
15540.00	H	F	100.0	153	55.3	N/A	46.7	-58.1	-41.2	16.8
12950.00	H	F	103.8	149	56.8	N/A	52.5	-48.0	-27.0	21.0
20720.00	H	S	100.0	103	57.7	N/A	53.9	-47.1	-27.0	20.1
18130.00	V	S	100.0	97	55.6	N/A	51.0	-53.8	-41.2	12.5

Channel 40

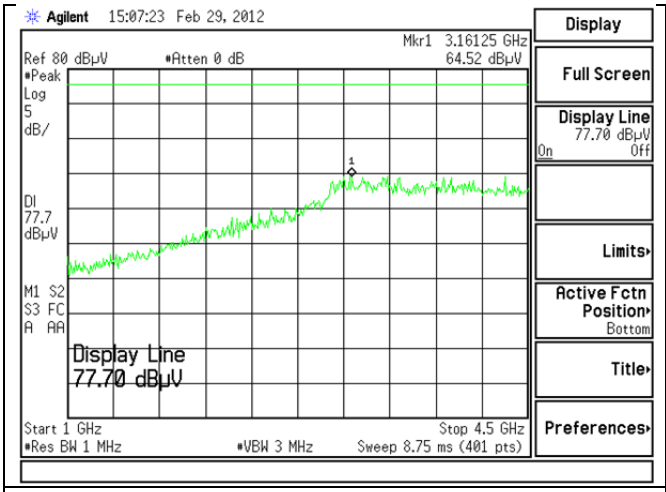
FREQ (MHz)	ANT	EUT	HEIGHT (cm)	AZIMUTH (°)	PEAK (dBµV/m)	QP (dBµV/m)	AVG (dBµV/m)	EIRP dBm/MHz	LIMIT dBm/MHz	MARGIN (dB)
10400.00	H	S	100.0	145	52.3	N/A	N/A	-52.5	-27.0	25.5
15600.00	H	F	100.0	148	57.2	N/A	47.1	-57.7	-41.2	16.4
13000.00	H	F	105.2	146	58.6	N/A	54.6	-46.2	-27.0	19.2
20800.00	H	S	100.0	74	55.8	N/A	51.0	-49.0	-27.0	22.0
18200.00	V	S	100.0	98	55.2	N/A	50.3	-54.5	-41.2	13.2

Channel 48

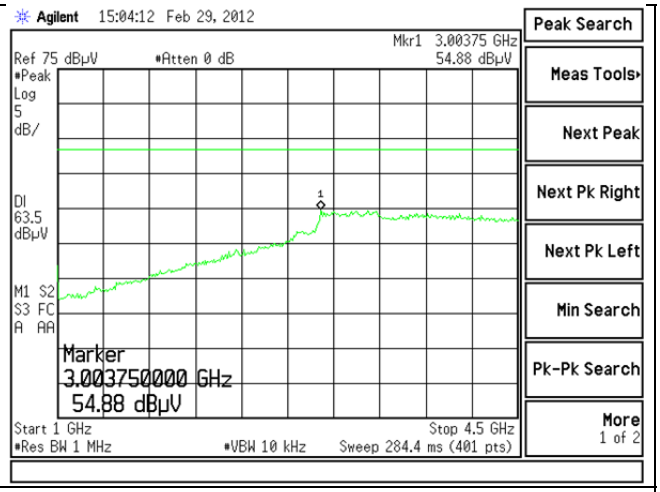
FREQ (MHz)	ANT	EUT	HEIGHT (cm)	AZIMUTH (°)	PEAK (dBµV/m)	QP (dBµV/m)	AVG (dBµV/m)	EIRP dBm/MHz	LIMIT dBm/MHz	MARGIN (dB)
10480.00	H	S	100.0	136	52.6	N/A	N/A	-52.2	-27.0	25.2
15720.00	H	F	100.0	149	59.2	N/A	48.8	-56.0	-41.2	14.7
13100.00	H	F	104.3	148	61.5	N/A	57.1	-43.3	-27.0	16.3
20960.00	V	S	100.6	71	56.8	N/A	49.9	-48.0	-27.0	21.0
18340.00	V	S	100.0	97	56.0	N/A	51.6	-53.2	-41.2	11.9

10.3.2.2.1.2 Emissions between 1000 to 8000 MHz

1000 to 4500 MHz

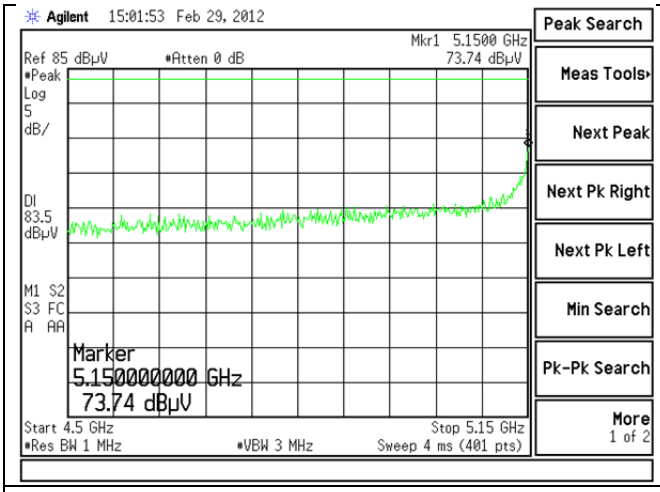


Peak Scan

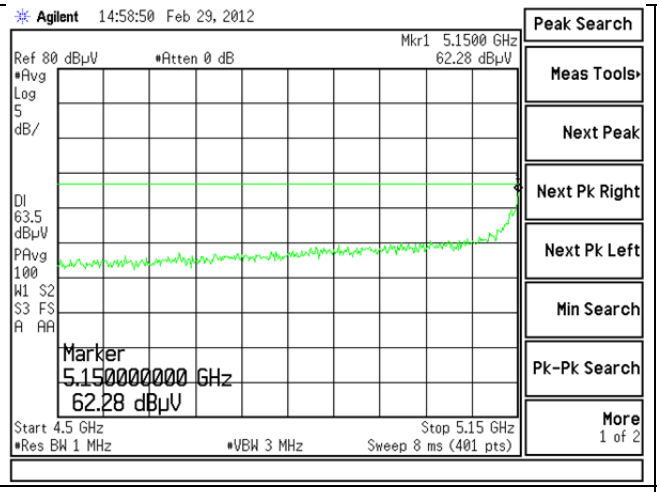


Reduced Bandwidth

4500 to 5150 MHz

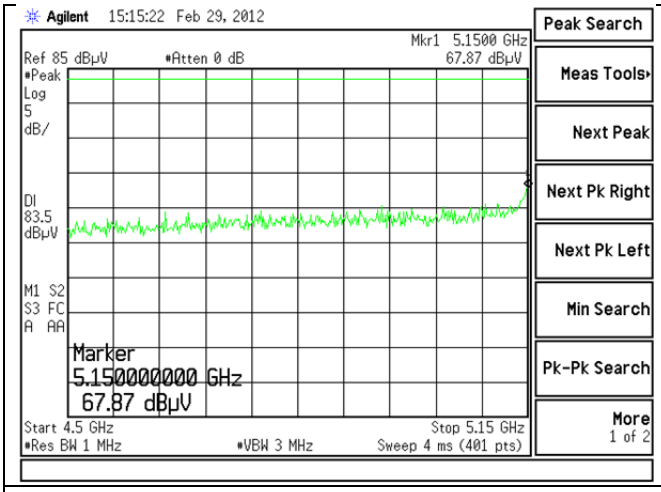


6MBPS Peak

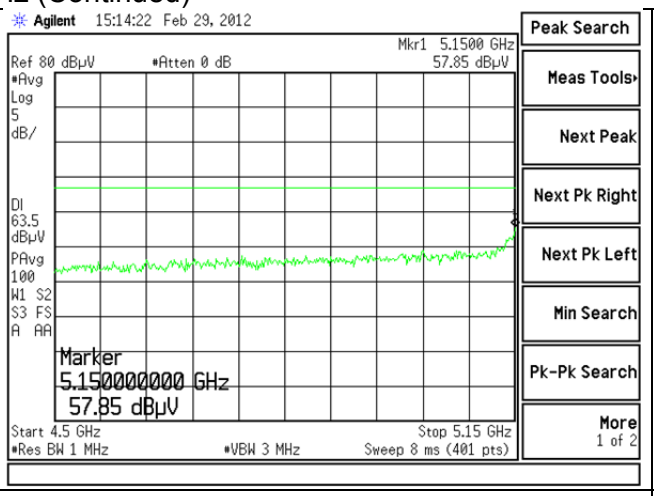


6MBPS Average

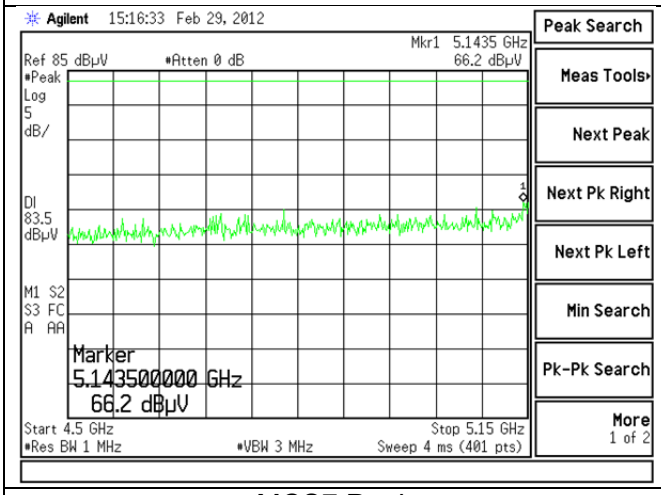
4500 to 5150 MHz (Continued)



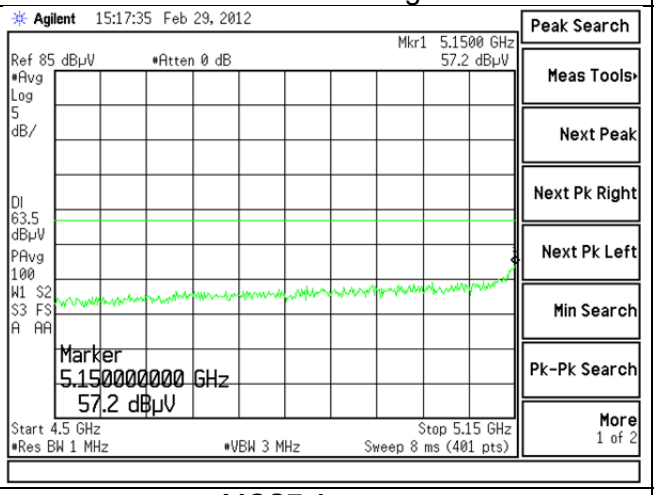
54MBPS Peak



54MBPS Average

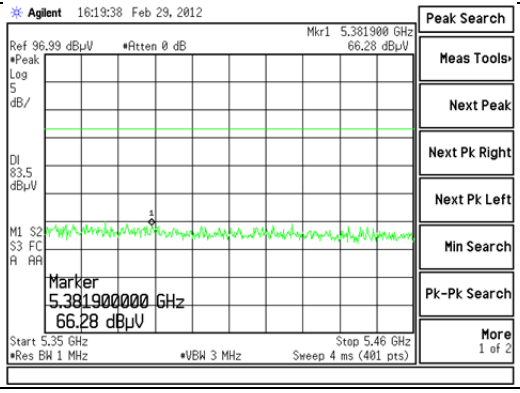


MCS7 Peak

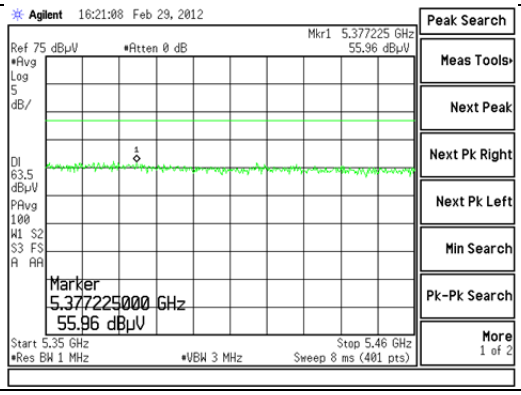


MCS7 Average

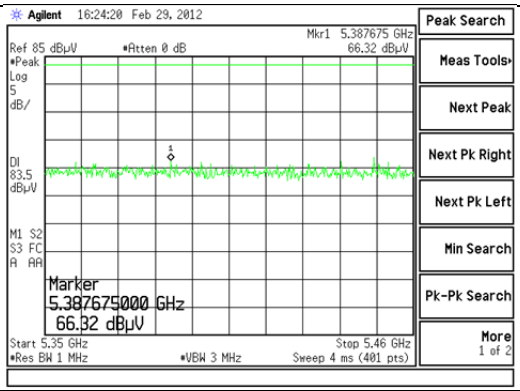
5350 to 5460 MHz



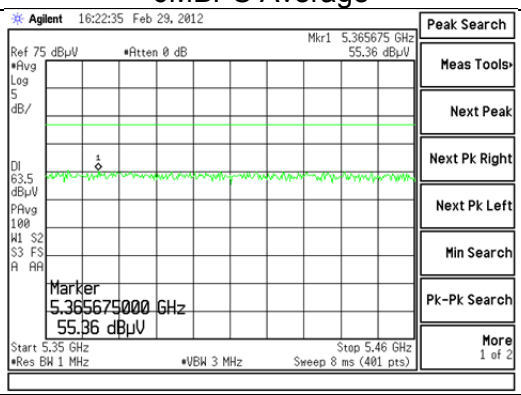
6MBPS Peak



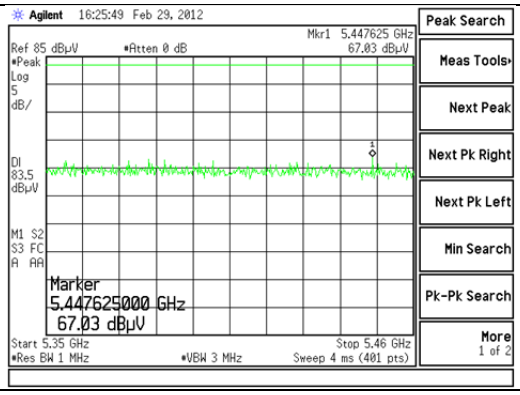
6MBPS Average



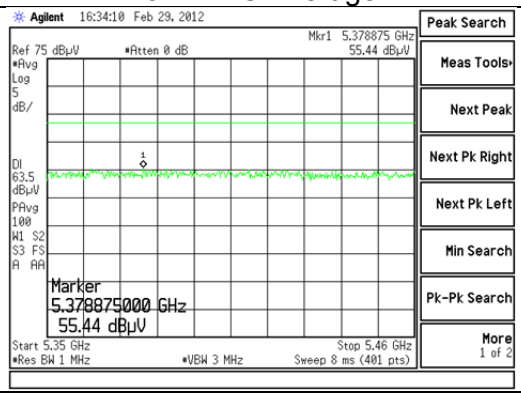
54MBPS Peak



54MBPS Average

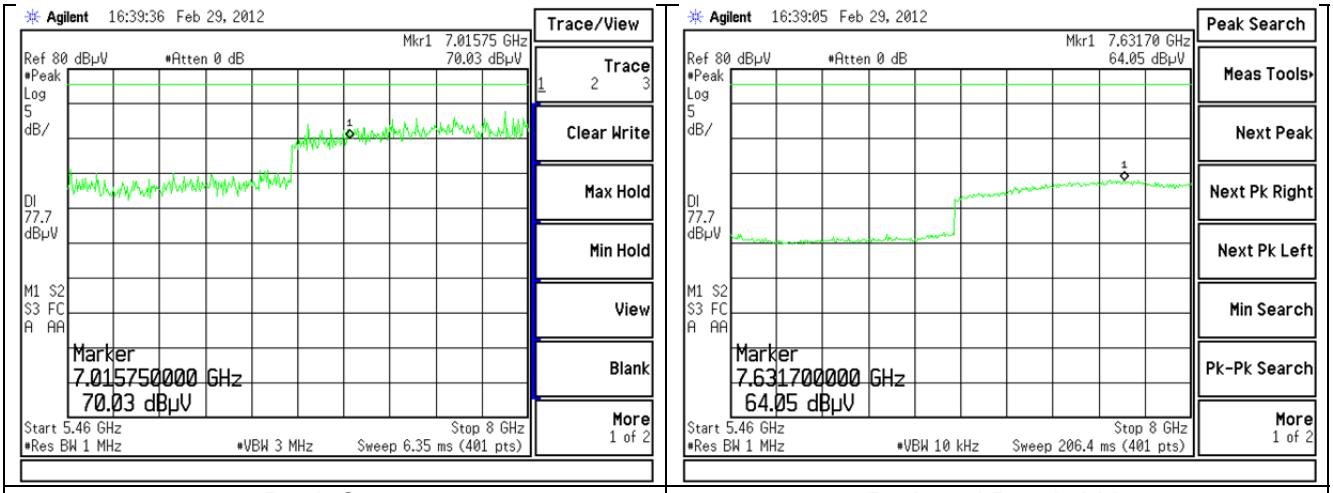


MCS7 Peak



MCS7 Average

5460 to 8000 MHz

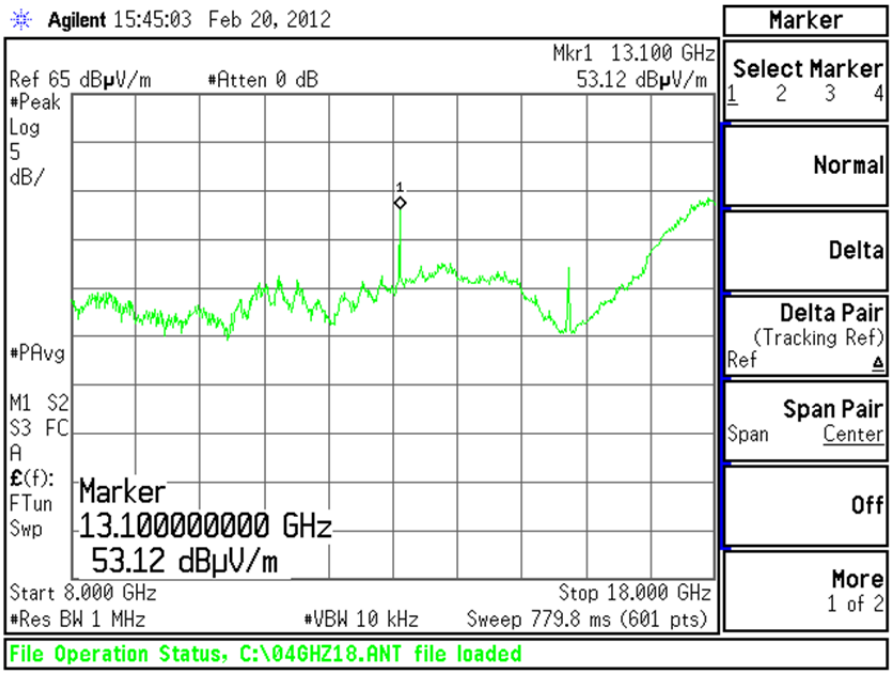


Peak Scan	Reduced Bandwidth

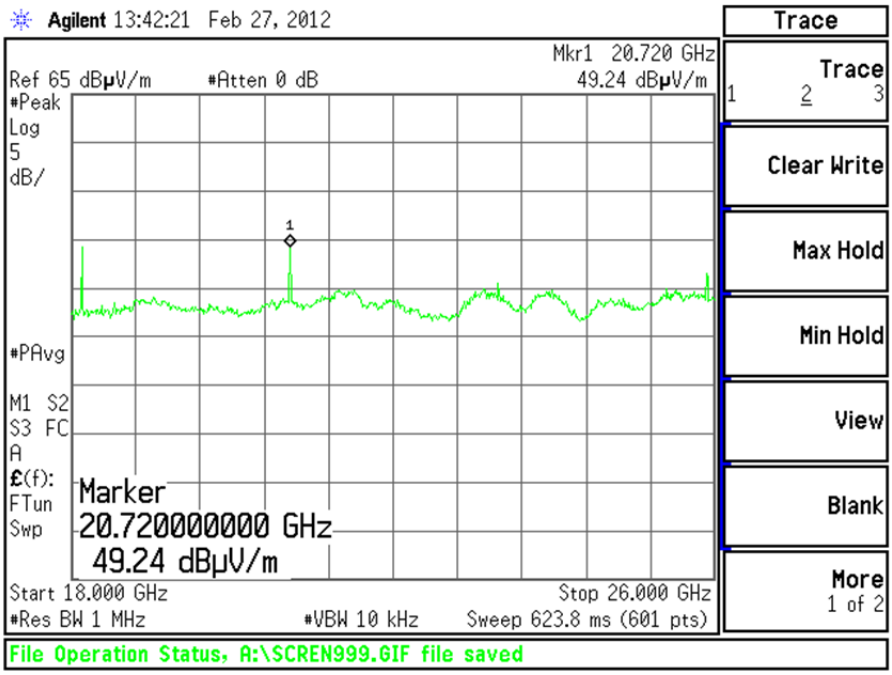
10.3.2.2.1.3 Emissions between 8000MHz to 40000MHz

The plots shown below are those of 6MBPS which is representative of the other data rates.

800MHz to 18000MHz



18000MHz to 26000MHz



26000MHz to 40000MHz

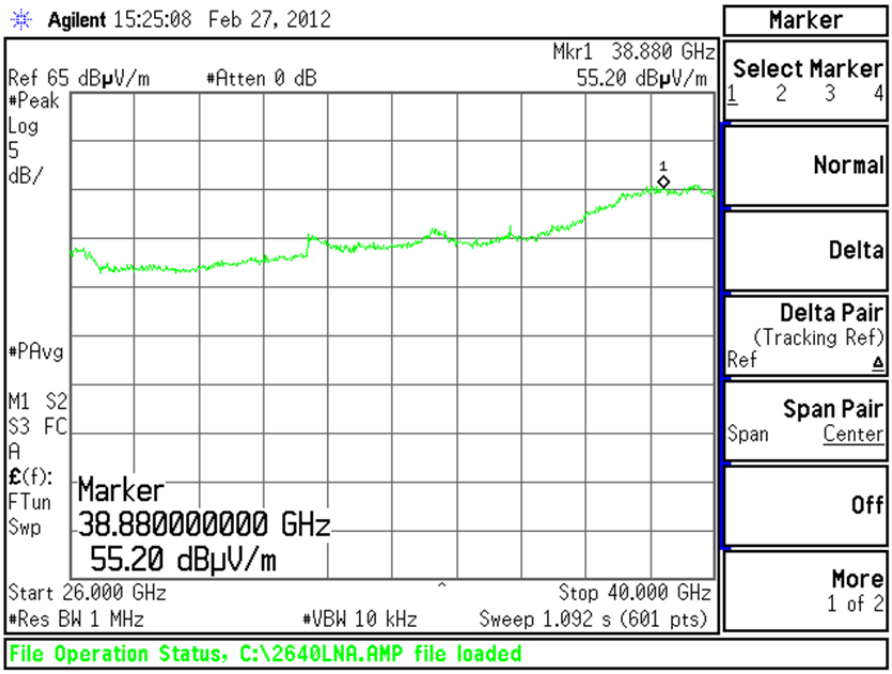


EXHIBIT 11 Frequency Stability

Test Engineer: Khairul Aidi Zainal

11.1 Test Procedure

For this test, the EUT was placed inside an environmental chamber. Antenna port conducted measurements were performed at the operating temperature ranges specified by the manufacturer owner's manual. In addition, the supply voltage was varied per the operating ranges specified in the owner's manual.

11.2 Limit

Manufacturer of U-NII devices are responsible for insuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

11.3 Test Data

4.25		5.0		5.75		
Power(dBm)	Frequency (Hz)	Power(dBm)	Frequency (Hz)	Power(dBm)	Frequency (Hz)	Channel
3.8	5745002200	**3.9**	5745002300	**3.9**	5745002340	149
4.5	5785002280	**4.5**	5785002360	**4.5**	5785002280	157
4.6	5825002160	**4.5**	5825002220	**4.5**	5825002320	165

Channel	max	min	freq drift (Hz)
149	5745002340	5745002200	140
157	5785002360	5785002280	80
165	5825002320	5825002160	160

The data collected shows that the frequency stability of the EUT is better than 1PPM and hence will result in the EUT will remain within the bands of operation.

EXHIBIT 12 Conducted Emissions Test, AC Power Line

Test Engineer: Michael Hintzke

12.1 Test Setup

The test area and setup are in accordance with ANSI C63.4-2003 and with Title 47 CFR, FCC Part 15, Industry Canada RSS-210 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

12.2 Test Procedure

The EUT was investigated in continuous modulated transmit mode and continuous receive mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1, Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

An off-the-shelf DC power supply was used during the test to supply the EUT with the appropriate DC voltage.

12.3 Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	**Class B Limits (dBμV)**		**Measuring Bandwidth**
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

12.4 Test Data

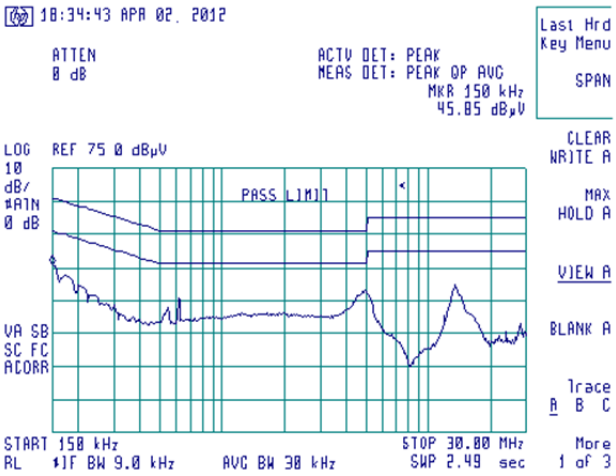
Manufacturer:	LS Research					
Date(s) of Test:	April 2nd 2012					
Project Engineer:	Khairul Aidi Zainal					
Test Engineer:	Mike Hintzke					
Voltage:	120 VAC					
Operation Mode:	Continuous transmit, modulated					
Environmental Conditions in the Lab:	Temperature: 71° F Relative Humidity: 40%					
Test Location:	X	AC Mains Test area				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:		Peak	X	Quasi-Peak	X	Average

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµ V)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµ V)	Average Margin (dB)
0.150	L1	42.2	66.0	23.8	25.4	56.0	30.6
0.621	L1	29.3	56.0	26.7	24.0	46.0	22.0
4.897	L1	34.3	56.0	21.7	28.6	46.0	17.4
13.520	L1	32.6	60.0	27.4	22.4	50.0	27.6
0.150	L2	41.7	66.0	24.3	26.8	56.0	29.2
4.905	L2	33.9	56.0	22.1	28.3	46.0	17.7
13.510	L2	35.3	60.0	24.7	26.2	50.0	23.8

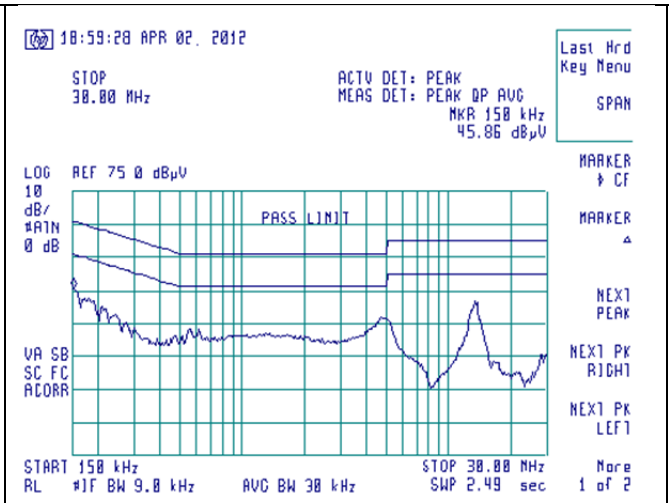
Notes:

1) The emissions listed are characteristic of the power supply used, and did not change by the EUT.

These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207 and RSS GEN 7.2.2 (Table 2).



Line 1



Line 2

6.5 Test Setup Photo(s)

APPENDIX A – Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 12-Dec-2011 Type Test: AC mains Job #: C-1333 and C-1489

Prepared By: Aidi Customer: Logic PD Quote #: 311310

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	11/22/2011	11/22/2012	Active Calibration
2	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	11/22/2011	11/22/2012	Active Calibration
3	AA 960072	Transient Limiter	HP	11947A	3107A02515	11/2/2011	11/2/2012	Active Calibration
4	AA 960075	LISN	EMCO	3810/2NM	9612-1710	9/19/2011	9/19/2012	Active Calibration

Project Engineer: Aidi Zainal Quality Assurance: Mike Hintzke

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 12-Dec-2011 Type Test: Conducted measurements Job #: C-1333

Prepared By: Aidi Customer: Logic PD Quote #: 311310

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/1/2011	6/1/2012	Active Calibration
2	EE 960073	SpectrumAnalyzer	Agilent	E4446A	US45300564	4/252011	4/252012	Active Calibration
3	CC 000221C	SpectrumAnalyzer	HP	E4407B	US39160256	5/4/2011	5/4/2012	Active Calibration

Project Engineer: Aidi Quality Assurance: Peter

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 21-Jun-2012 Type Test: Cond Measurements Job #: C-1489

Prepared By: Aidi Customer: Logic PD Quote #: 312142

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/1/2011	6/1/2013	Active Calibration
2	EE 960073	SpectrumAnalyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration
3	CC 000221C	SpectrumAnalyzer	HP	E4407B	US39160256	6/5/2012	6/5/2013	Active Calibration

Project Engineer: Aidi Zainal Quality Assurance: Mike Hintzke

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 21-Jun-2012 Type Test : Rad Band-Edge Job # : C-1333 and C-1489

Prepared By : Aidi Customer : Logic PD Quote # : 312142

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960157	3Hz-13.2GHz SpectrumAnalyzer	Agilent	E4445A	MY48250225	6/29/2012	6/29/2013	Active Calibration
2	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/29/2012	6/29/2013	Active Calibration
3	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	11/22/2011	11/22/2012	Active Calibration
4	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	11/22/2011	11/22/2012	Active Calibration
5	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	1/6/2012	1/6/2013	Active Calibration
6	EE 960161	26.5-40GHz LNA	Ducommun Techn	ALN-33144030	1103717-01	10/4/2011	10/4/2012	Active Calibration
7	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro	WLA622-4	123001	11/3/2011	11/3/2012	Active Calibration
8	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/1/2011	6/1/2013	Active Calibration
9	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	6/26/2012	6/26/2013	Active Calibration
10	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	11/15/2011	11/15/2012	Active Calibration
11	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	1/6/2012	1/6/2013	Active Calibration
12	AA 960137	Standard Gain Horn Ant	EMCO	3160-10	69259	10/4/2011	10/4/2014	Active Calibration
13	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	5/16/2012	5/16/2013	Active Calibration
14	AA 960150	Bicon Antenna	ETS	3110B	0003-3346	11/15/2011	11/15/2012	Active Calibration

Project Engineer: Aidi Quality Assurance: Shane

APPENDIX B – Test Standards: CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003		
ANSI C63.10	2009		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2012		
RSS GEN	2010		
RSS 210	2010		
RSS 102	2010		

APPENDIX C - Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB

	PARAMETER	LSR ± Uncertainty
1	Radio Frequency, from F0	$\pm 1.3 \times 10^{-7}$
2	Total RF conducted Power	±1.38 dB
3	RF conducted power density	±1.38 dB
4	Conducted spurious emissions	±1.38 dB
5	Radiated emissions	±4.87 dB
6	Temperature	±0.64° C
7	Humidity	±2.9 %
8	DC voltage	±0.03 %
9	Low frequency voltage	±0.1 %