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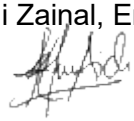
TEST REPORT # 315181 A
LSR Job #: C-2278

Compliance Testing of:
TiWi-BLE

Test Date(s):
8/27/15 – 9/29/15

Prepared For:
Attention: Hiroshi Inaba
Topcon Corporation
75-1, Hasunuma-cho, Itabashi-ku,
Tokyo, 174-8580 Japan.

This Test Report is issued under the Authority of:
Khairul Aidi Zainal, Engineering Manager-EMC test services.

Signature:  Date: 10/9/15

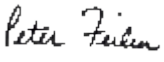
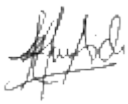
Test Report Reviewed by:	Project Engineer:
Peter Feilen, EMC Engineer	Khairul Aidi Zainal, Engineering Manager-EMC test services.
Signature:  Date: 10/9/15	Signature:  Date: 10/7/15

TABLE OF CONTENTS

EXHIBIT 1. INTRODUCTION

1.1 - Scope

References:	FCC Part 15, Subpart C, Section 15.247 RSS GEN issue 4 and RSS 247 issue 1
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	FCC KDB 558074 D01 DTS Measurement Guidance v03r03 ANSI C63.10

1.2 – Normative References

Publication	Year	Title
FCC CFR Parts 0-15	2015	Code of Federal Regulations – Telecommunications
ANSI C63.4	2014	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-247 Issue 1	2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
FCC KDB 558074 D01 DTS Measurement Guidance v03r03	2015	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

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. Accreditation status can be verified at A2LA’s web site: www.a2la2.net.

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:

Semi-Anechoic Chamber

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:	Topcon Corporation
Address:	75-1, Hasunam-cho, Itabashi-ku, Tokyo, 174-8580 Japan
Contact Name:	Hiroshi Inaba
E-mail:	h.inaba@topcon.jp

2.2 - Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	TiWi-BLE
Model Number:	TiWi-BLE
Serial Number:	3-01625

2.3 - Associated Antenna Description

The antennas associated with the EUT are:

1. Mitsubishi materials AM03DP-ST01 with a peak gain of 2.15dBi (0 dBd)
2. HOKO Electronics 1029-C17586 with a peak gain of 1.9dBi
3. LSR 2.4GHz dipole antenna with a peak gain of 2.0dBi
4. Ethertronics Prestta 1000423 2.4GHz antenna with a peak gain of -0.6dBi (at 2.4GHz)
5. LSR 2.4GHz waterproof Dipole Antenna, part 001-0010, with a peak gain of 2.0dBi.

2.4 - EUT'S Technical Specifications

EUT Frequency Range (in MHz)	2412MHz – 2462MHz (WLAN)
RF Power in Watts (Conducted measurement)	
Minimum:	2.4GHz WLAN 802.11 b: 0.0447watts 802.11 g: 0.0141watts 802.11 n (HT20): 0.0074watts
Maximum:	2.4GHz WLAN 802.11 b: 0.0525watts 802.11 g: 0.0257watts 802.11 n (HT20): 0.0251watts
Conducted Output Power, average (in dBm)	2.4GHz WLAN 802.11 b: Maximum = 17.2 dBm Minimum = 16.5 dBm 802.11 g: Maximum = 14.1 dBm Minimum = 11.5 dBm 802.11 n (HT20): Maximum = 14.0 dBm Minimum = 8.7 dBm
Field Strength at 3 meters (Maximum)	Not Applicable
99% Bandwidth	2.4GHz WLAN: 802.11 b: 14.4MHz 802.11 g: 16.8MHz 802.11 n (HT20): 17.9MHz
Type of Modulation	OFDM (WLAN), DSSS(WLAN)
DTS Bandwidth (6dB BW)	2.4GHz WLAN: 802.11 b: 9.9MHz 802.11 g: 16.4MHz 802.11 n (HT20):17.3MHz
Transmitter Spurious (worst case) at 3 meters	48.5dBµV/m at 4824MHz
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Antenna Information	
Detachable/non-detachable	detachable
Type	Sleeved dipole and SMD
Gain	Peak Gain in 2.4GHz band = 2.15dBi
EUT will be operated under FCC Rule Part(s)	Title 47 part 15.247
E]UT will be operated under RSS Rule Part(s)	RSS 247
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 (MPE)

Note: Refer to MPE exhibit.

2.5 - Product Description

The TiWi-BLE module is a module with support for WLAN (802.11 b/g/n)

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

FCC and IC Paragraph	Test Requirements	Compliance (Yes/No)
FCC : 15.207 IC : RSS GEN sect. 7.2.2	Power Line Conducted Emissions Measurements	Yes
FCC : 15.247 (a)(1) IC : RSS 210 A8.1 (a)	20 dB Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 247 5.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(d) IC : RSS 247 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC:15.247 (a)(2) IC: RSS 247 5.2	6 dB Bandwidth of a Digital Modulation System	Yes
FCC:15.247 (d) IC: RSS 247 5.2	Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS GEN	Transmitter Radiated Emissions	Yes

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 15.247, and Industry Canada RSS-247, Issue 1.

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. UNWANTED EMISSIONS INTO THE RESTRICTED FREQUENCY BANDS.

5.1 - Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.10-2013. The EUT was placed on an 80cm high non-conductive pedestal below 1 GHz and 150cm non-conductive pedestal above 1 GHz, centered on a flush mounted turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous transmit mode for final testing using power as provided by a bench DC power supply. The unit has the capability to operate on 3 channels, controllable via LSR WLAN tool V2.1.1.

The applicable limits apply at a 3 meter distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels to comply with FCC Part 15.31(m).

5.2 - Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 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 200 MHz, and a Log Periodic Antenna was used to measure emissions from 200 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 25 GHz range. The maximum radiated RF emissions between 30MHz to 25 GHz were found by raising and lowering the sense antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

The radiated RF measurements of the EUT were **cabinet radiation** measurements which are measurements of radiated emissions while the antenna port of the EUT properly terminated. According to the procedure of **KDB 558074 D01 DTS Meas Guidance v03r03 section 12.2**, antenna port conducted measurements shall supplement cabinet radiation measurements and is included in this section.

The EUT was positioned in 3 orthogonal orientations.

5.3 - Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at a calibration laboratory accredited to ISO 17025, and are traceable to the SI standard. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (video bandwidth of 1 MHz).

5.4 - Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 and Canada RSS-247, Issue 1, for a DTS transmitter. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 - 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), radiated emissions that fall within the restricted band described in 15.205(c), 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	-
960-40,000	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)

Per KDB 558074 section 10, an EIRP measurement can be converted to field strength using this relationship:
EIRP = E (electric field strength in dBμV/m) + 20log(d)-104.8
E = EIRP – 20log(d) + 104.8
Sample conversion:
For EIRP = -56.6 dBm,
E (dBμV/m) = -56.6 – 20log(3m) +104.8 = 38.7 dBμV/m
For EIRP = -60.9 dBm,
E (dBμV/m) = -60.9 – 20log(3m) + 104.8 = 34.4 dBμV/m

Above 1 GHz Peak and average limit for RF conducted measurements
Peak limit : EIRP = 74.0 dBuV/m + 20log(3m) – 104.8 = -21.2dBm
Average limit : EIRP = 54.0 dBuV/m + 20log(3m) – 104.8 = -41.2dBm

5.6 - Data:

Manufacturer:	Topcon corporation					
Date(s) of Test:	9/1/15-9/15/15					
Project Engineer(s):	Khairul Aidi Zainal					
Test Engineer(s):	Adam Alger, Khairul Aidi Zainal, Peter Feilen					
Voltage:	3.3VDC (Via bench DC supply)					
Operation Mode:	continuous transmit, modulated					
Environmental Conditions in the Lab:	Temperature: 70° F Relative Humidity: 32%					
EUT Power:	X	Single Phase 120VAC		3 Phase ___VAC		
		Battery		Other: Bench DC Supply		
EUT Placement:	X	80cm non-conductive pedestal	X	150cm non-conductive pedestal		
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

5.6.1 Cabinet radiation:

Emissions below 1GHz

Frequency (MHz)	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degrees)	Q. Peak Reading (dBµV/m)	Q. Peak limit(dBµV/m)	Q. Peak Margin (dB)	Notes
50.0	Vertical	Horizontal	100.0	0	11.2	40.0	28.8	1.0
100.0	Vertical	Horizontal	100.0	0	10.6	43.0	32.4	1.0
80.0	Vertical	Vertical	100.0	0	10.1	40.0	29.9	1.0
394.0	Vertical	Horizontal	100.0	271	29.3	46.0	16.7	
401.3	Vertical	Vertical	160.8	290	26.1	47.0	20.9	

Notes:
1. Measurement of system noise floor.
2. H: Horizontal, V: Vertical, S: Side, F: Flat.
3. Refer to exhibit 5.5 on explanation of how data is reported.

Emissions above 1GHz

Frequency (MHz)	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degrees)	Peak Reading (dBµV/m)	Average Reading (dBµV/m)	Peak Margin (dB)	Average Margin (dB)
4824	Vertical	Vertical	197.0	197	48.3	45.0	25.7	9.0
		Horizontal	170.0	263	48.0	44.2	26.0	9.8
	Horizontal	Vertical	197.0	252	47.7	43.0	26.3	11.0
		Horizontal	189.0	178	51.0	48.5	23.0	5.5
	Flat	Vertical	214.0	138	49.6	46.4	24.4	7.6
		Horizontal	215.0	273	47.8	43.9	26.2	10.1
4874	Vertical	Vertical	115.0	186	49.2	45.5	24.8	8.6
		Horizontal	118.0	261	48.7	44.4	25.3	9.6
	Horizontal	Vertical	178.0	279	45.8	40.4	28.2	13.6
		Horizontal	170.0	247	50.0	46.9	24.0	7.1
	Flat	Vertical	192.0	152	50.9	47.5	23.1	6.6
		Horizontal	235.0	265	48.7	45.1	25.3	8.9
4924	Vertical	Vertical	100.0	185	48.9	44.6	25.1	9.4
		Horizontal	152.0	255	48.2	43.6	25.9	10.4
	Horizontal	Vertical	158.0	263	45.3	38.8	28.7	15.2
		Horizontal	196.0	180	48.8	45.1	25.2	8.9
	Flat	Vertical	230.0	216	50.0	46.4	24.0	7.7
		Horizontal	219.0	272	47.3	42.7	26.7	11.3

Notes:
1. Measurement of system noise floor.
2. H: Horizontal, V: Vertical, S: Side, F: Flat.
3. Refer to exhibit 5.5 on explanation of how data is reported.

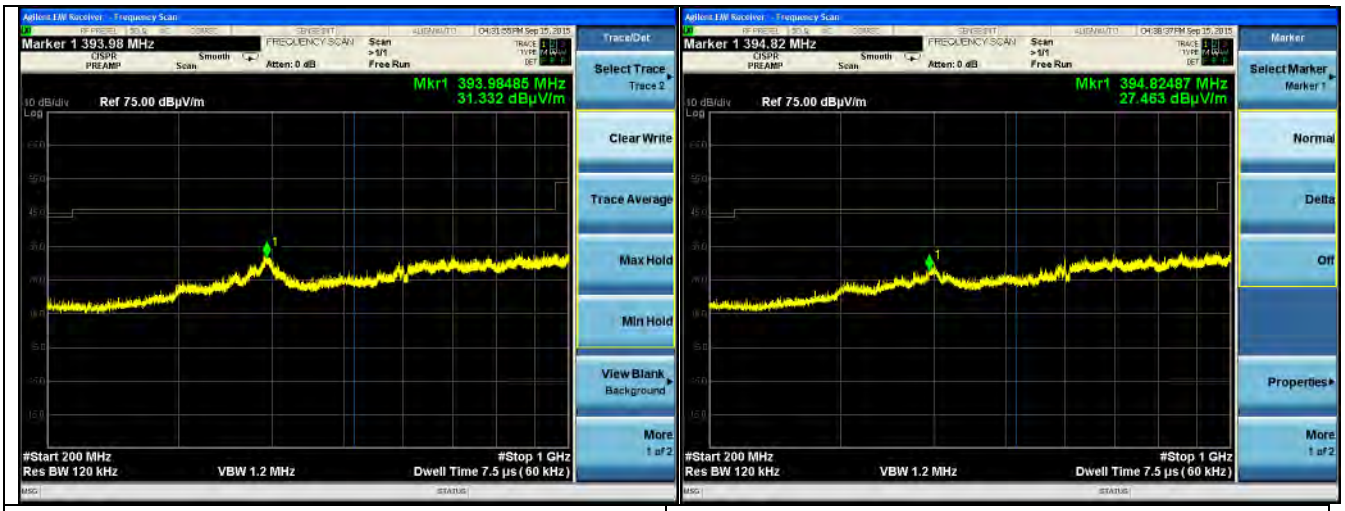
Screen Captures.

The screen captures below are those using the Peak detector of the analyzer. In addition, the screen captures presented are those which were deemed to be an appropriate representation of the spectrum scan. In addition, the plots shown below are not plots of peaked emissions.

30 to 300 MHz, 3m distance.

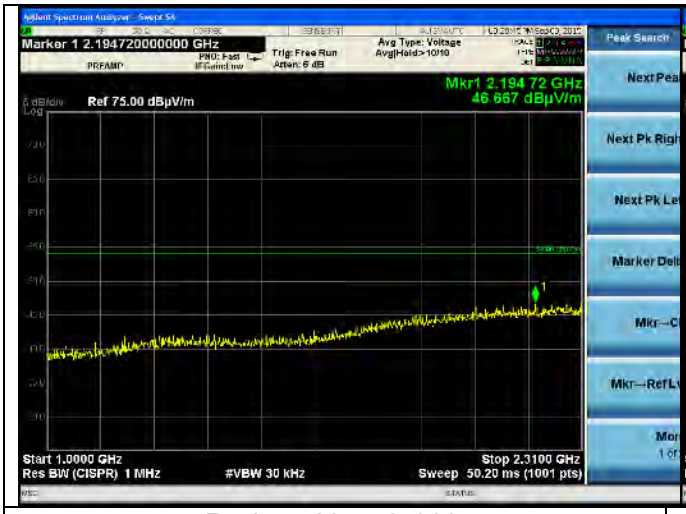
Horizontal	Vertical

200 to 1000 MHz, 3m distance.



Horizontal	Vertical

1000 to 2310 MHz, 3m distance.



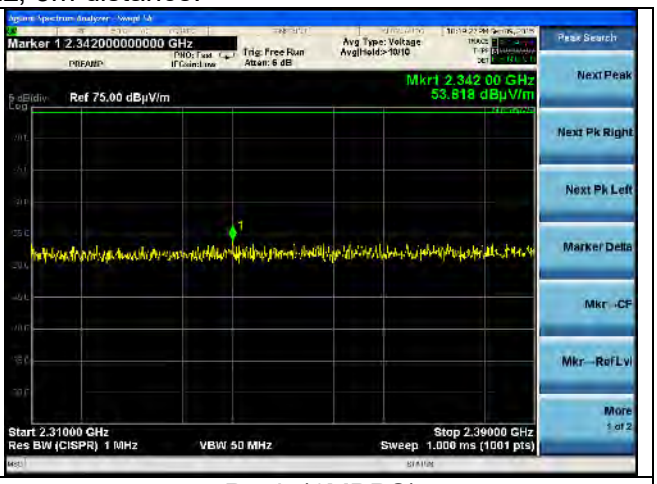
Reduced bandwidth

Peak

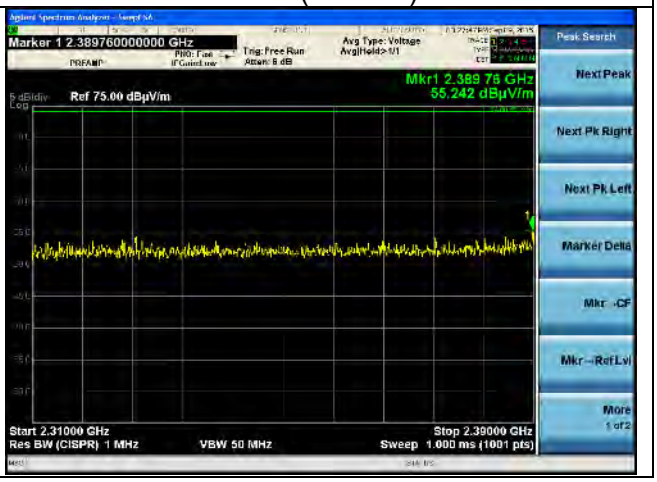
.

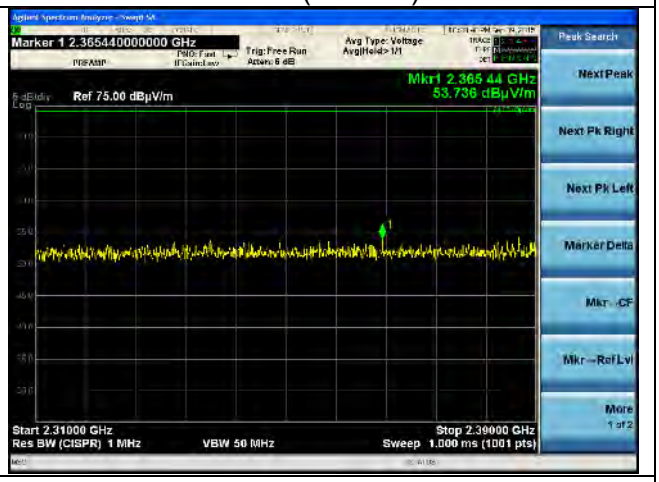
2310 to 2390 MHz, 3m distance.

Average (1MBPS)

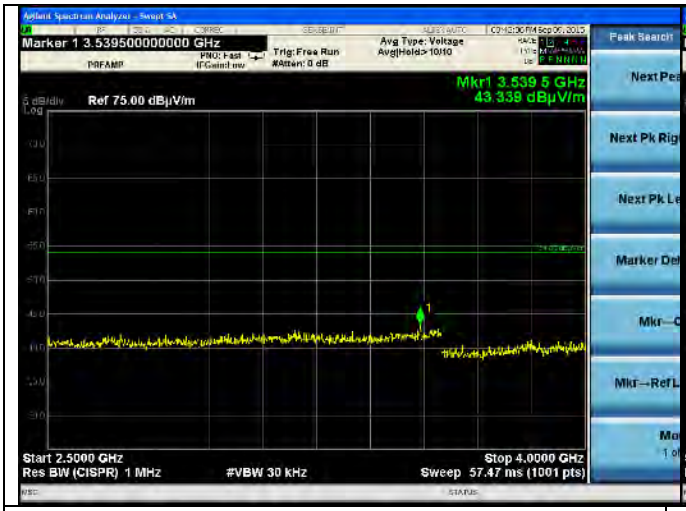
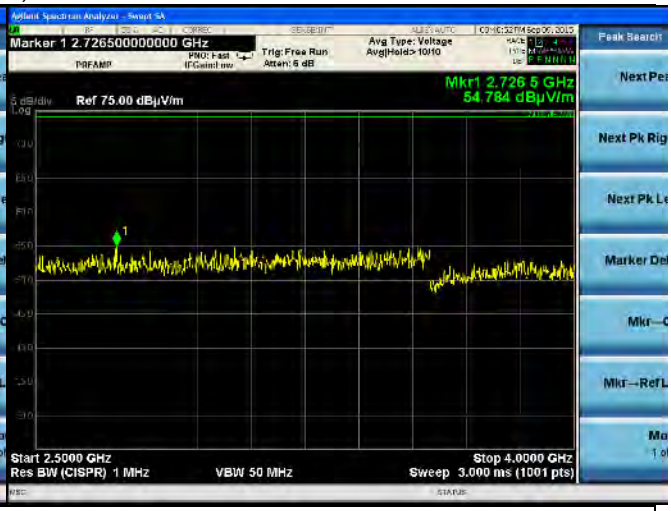


Peak (1MBPS)



Average (6MBPS)	Peak (6MBPS)
	
Average (MCS0)	Peak (MCS0)

2500 to 4000 MHz, 3m distance.

Reduced bandwidth	Peak
	

Note: The range 2483.5 to 2500 MHz is in section 8 of this report (Band-edges).

4000 to 25000 MHz, 3m distance.

4000 to 18000 MHz (reduced bandwidth)

18000 to 25000 MHz (reduced bandwidth)

5.6.2 Antenna port conducted measurements:

(Data to complement cabinet radiation measurements)

Restricted band emission frequency (MHz)	Peak (dBm)	Average (dBm)	Ground Reflection factor (dB)	antenna gain correction (dBi)	Final peak emission (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average emission (dBm)	Average Limit (dBm)	Average Margin (dB)
2813.5	-55.8	-60.8	0.0	2.2	-53.7	-21.2	32.4	-58.7	-41.2	17.4
2732.5	-52.4	-68.7	0.0	2.2	-50.3	-21.2	29.1	-66.5	-41.2	25.3
19294.0	-54.0	-64.7	0.0	2.2	-51.8	-21.2	30.6	-62.6	-41.2	21.4
2844.0	-56.1	-63.7	0.0	2.2	-54.0	-21.2	32.7	-61.6	-41.2	20.3
4868.0	-55.0	-66.0	0.0	2.2	-52.9	-21.2	31.7	-63.9	-41.2	22.6
2872.5	-60.0	-71.6	0.0	2.2	-57.8	-21.2	36.6	-69.4	-41.2	28.2
4928.0	-56.4	-74.1	0.0	2.2	-54.3	-21.2	33.1	-72.0	-41.2	30.7

Note:

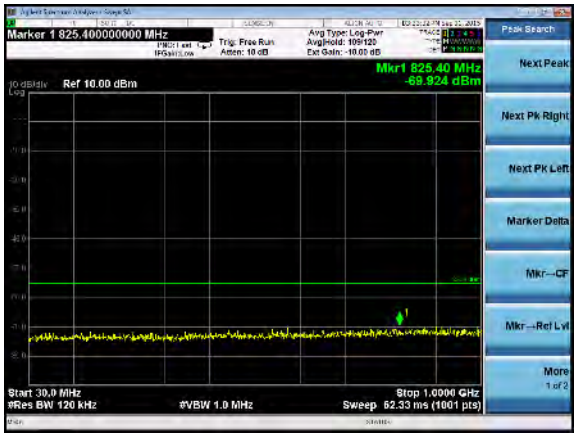
1. Example calculation:
   Measurement (dBm) + ground reflection factor + antenna correction (dBi)
   = -55.8 + 0 + 2.2 = -53.7 dBm (Peak data at 2813.5MHz)

2. Data above are those when the EUT was in 802.11 b mode with 1 MBPS since it was determined to have the worst case emissions.

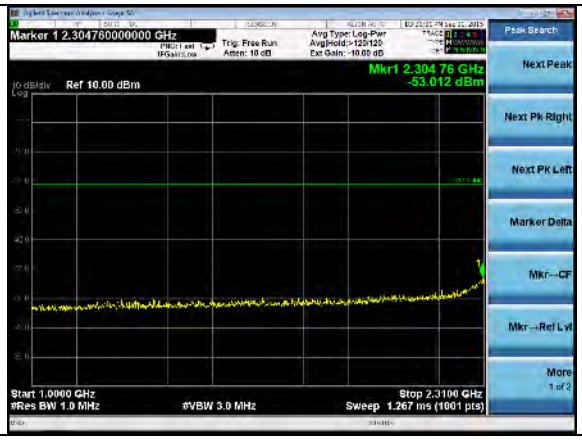
Screen Captures.

The screen captures presented are those which were deemed to be an appropriate representation of the spectrum scan.

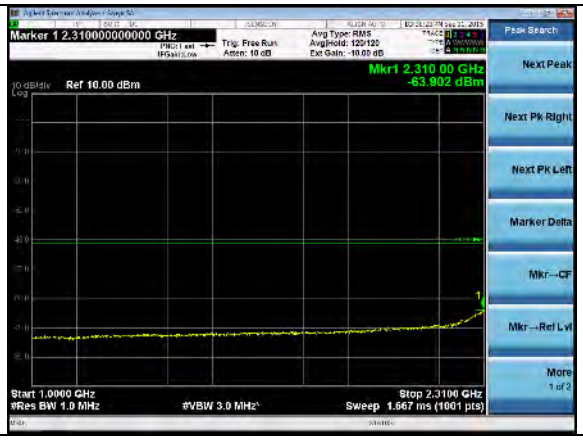
30 to 1000 MHz



1000 to 2310 MHz



Peak



Average

802.11 Standard	Data Rate (MBPS)	Peak data Frequency (MHz)	Restricted band emission: Peak (dBm)	Average data Frequency (MHz)	Restricted band emission: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak emission (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average emission (dBm)	Average Limit (dBm)	Average Margin (dB)
b	1	2383.8	-41.1	2386.2	-47.3	0.0	2.2	-38.9	-21.2	17.7	-45.1	-41.2	3.8
a,g	6	2387.4	-25.4	2389.8	-46.8	0.1	2.2	-23.2	-21.2	2.0	-44.5	-41.2	3.3
a,g	11	2386.6	-39.1	2387.3	-49.0	0.2	2.2	-36.9	-21.2	15.7	-46.6	-41.2	5.3
a,g	54	2389.4	-39.8	2389.8	-52.4	1.0	2.2	-37.6	-21.2	16.4	-49.2	-41.2	8.0
n	MCS0	2389.8	-25.6	2389.6	-45.8	0.1	2.2	-23.4	-21.2	2.2	-43.5	-41.2	2.2
n	MCS7	2389.6	-41.5	2389.9	-54.7	1.1	2.2	-39.3	-21.2	18.1	-51.4	-41.2	10.2

Note:

1. This table corresponds to the proceeding plots of the range 2310MHz to 2390MHz.

2310 MHz to 2390MHz

Peak (1MBPS)

Average (1MBPS)

Peak (6MBPS)

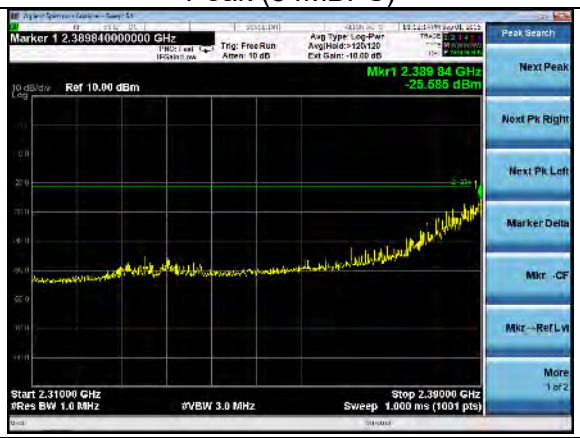
Average (6MBPS)

Peak (11MBPS)

Average (11MBPS)

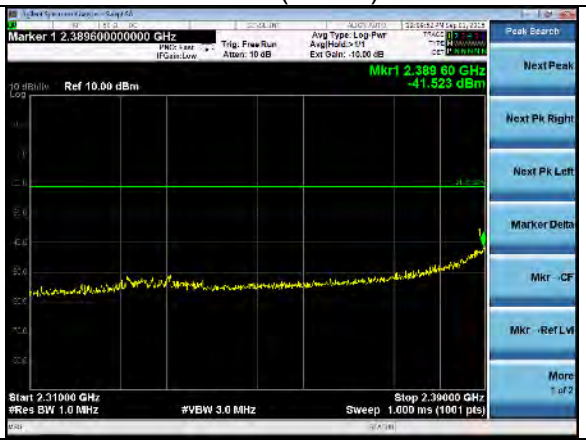
Peak (54MBPS)

Average (54MBPS)



Peak (MCS0)

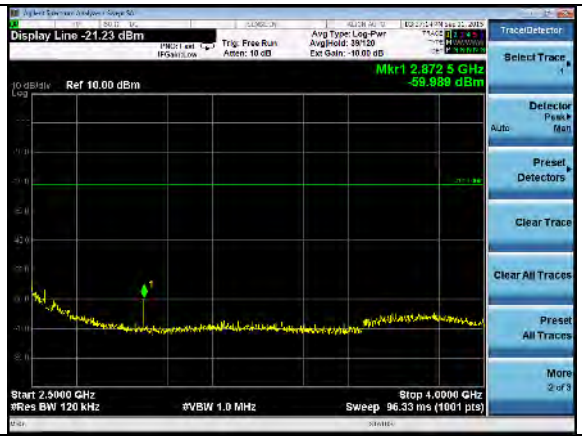
Average (MCS0)



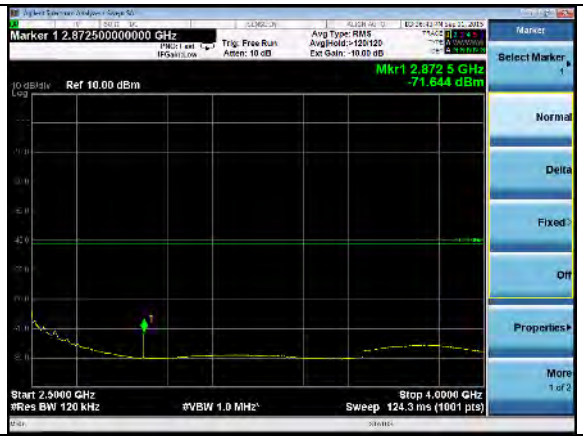
Peak (MCS7)

Average (MCS7)

2500 to 4000 MHz

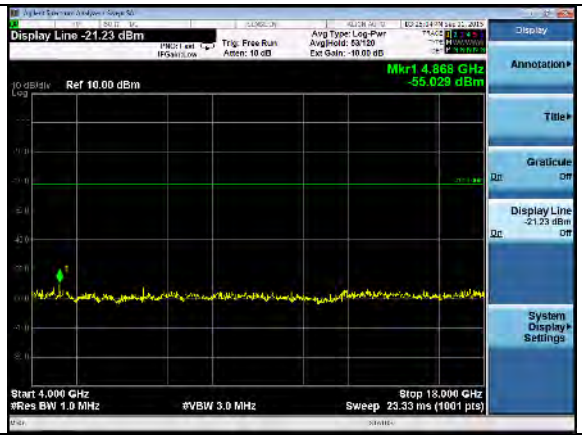


Peak

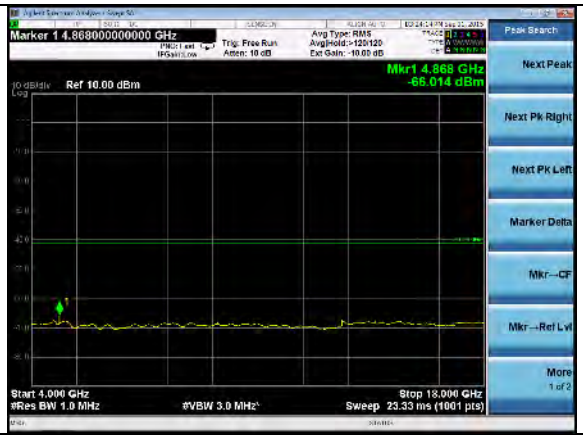


Average

4000 to 18000 MHz



Peak



Average

The range of 2483.5 to 2500 MHz is in exhibit 8 (band-edges)

18000 to 25000 MHz

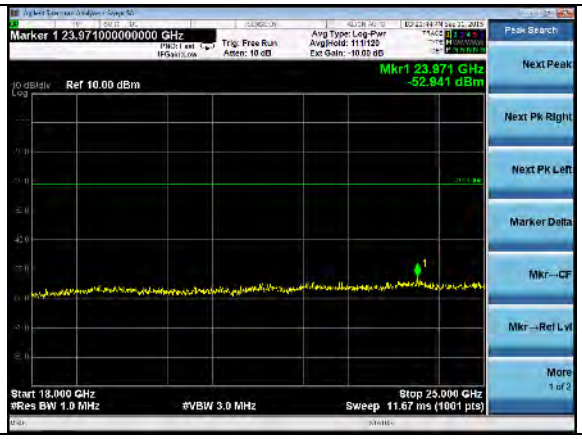
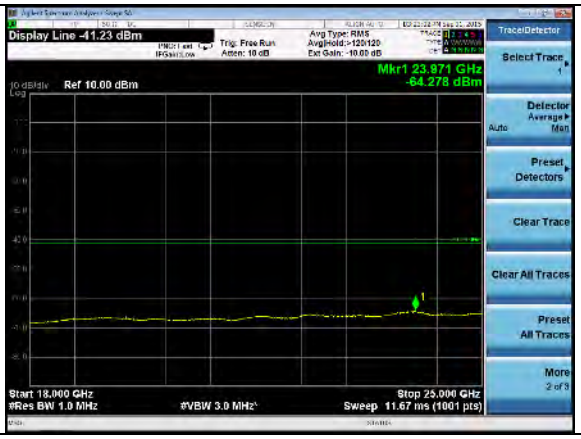
	
Peak	Average

EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE

6.1 Test Setup

The test area and setup are in accordance with ANSI C63.4 and with Title 47 CFR, FCC Part 15, Industry Canada RSS GEN. The EUT was placed on a non-conductive table, with a height of 80 cm above the reference ground plane. The power supply was then plugged into a 50Ω (ohm), 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 EMI receiver System. The LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

A generic AC/DC adapter was used to supply power to the module.

6.2 Test Procedure

The EUT was investigated in continuous modulated transmit 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.

6.3 Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter were performed at an IEC/ISO 17025 accredited calibration laboratory, traceable to the SI standard. All cables are calibrated and checked periodically for conformance. The emissions are measured on the EMI System, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

6.4 Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15.207 and RSS GEN 7.2.4 for Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

6.5 FCC 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.			

6.6 CONDUCTED EMISSIONS TEST DATA CHART

Frequency Range inspected: 150 KHz to 30 MHz

Manufacturer:	Topcon					
Date(s) of Test:	9/29/15					
Project Engineer:	Khairul Aidi Zainal					
Test Engineer:	Khairul Aidi Zainal					
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

120VAC, 60Hz

		Quasi-Peak			Average		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.154	2	28.4	65.8	37.4	21.2	55.8	34.6
0.604	2	28.9	56.0	27.1	22.6	46.0	23.4
1.293	2	23.3	56.0	32.7	16.3	46.0	29.7
11.169	2	18.9	60.0	41.1	11.6	50.0	38.4
0.150	1	42.8	66.0	23.2	32.4	56.0	23.6
0.608	1	29.4	56.0	26.6	23.0	46.0	23.0
1.180	1	22.0	56.0	34.0	15.1	46.0	30.9
12.029	1	18.9	60.0	41.1	11.6	50.0	38.4

Notes:

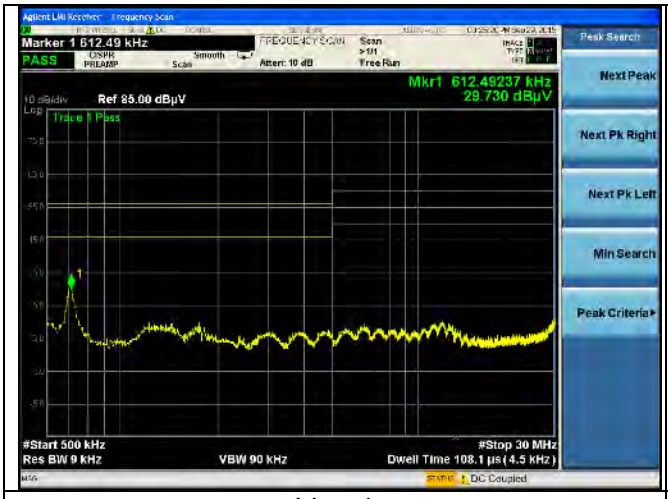
1) The emissions listed are characteristic of the power supply used and not that of the transmitter. Changing transmit channels did not change the emissions.

6.7 Test Setup Photo(s) – Conducted Emissions Test

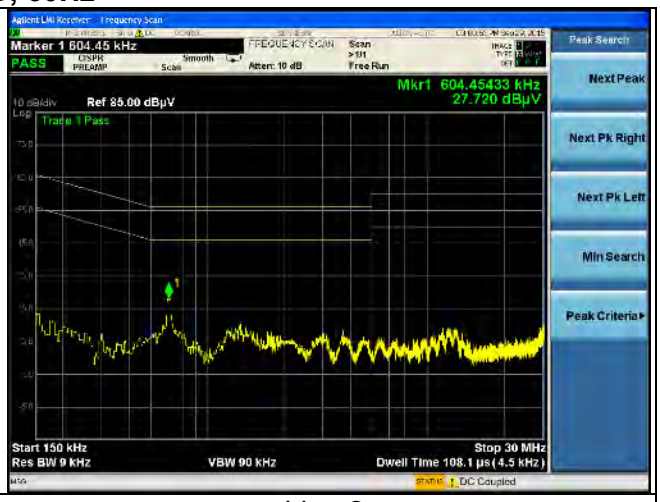
6.8 Screen Captures – Conducted Emissions Test

These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized.

120 VAC, 60Hz



Line 1



Line 2

EXHIBIT 7. OCCUPIED BANDWIDTH

Test Engineer(s): Khairul Aidi Zainal

7.1 - Limits

For a DTS system operating in the 2400 to 2483.5 MHz band, the 6dB emission bandwidth limit is 500 kHz.

7.2 - Method of Measurements

For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. A bandwidth measurement function that is built into the spectrum analyzer was used to measure the 20dB/emission bandwidth while the 6dB bandwidth was measured using **FCC OET KDB 558074 section 8 option2.**

Note:
The 20dB bandwidth was measured for use with the measurement method prescribed in FCC OET KDB 558074 for maximum conducted power.

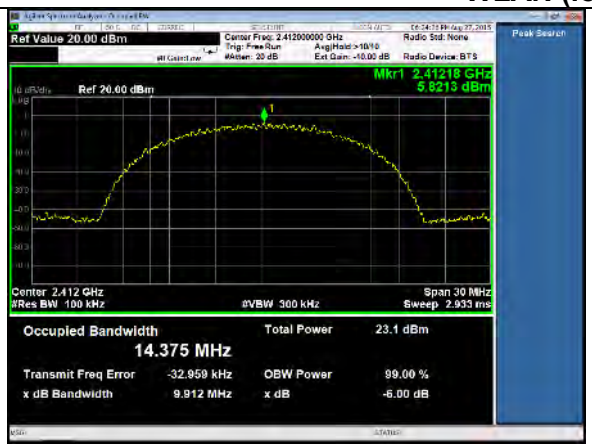
7.3 - Test Data

802.11 Standard	Data Rate (MBPS)	Channel	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	20dB Bandwidth (MHz)	6dB Bandwidth minimum limit (MHz)
b	1 (DBPSK)	1	9.1	13.9	16.2	0.5
		6	9.1	13.9	16.2	0.5
		11	9.1	13.9	16.2	0.5
g	6 (BPSK)	1	15.5	16.8	19.7	0.5
		6	15.7	16.8	19.3	0.5
		11	15.4	16.8	19.4	0.5
n	MCS0 (BPSK)	1	15.3	17.9	20.8	0.5
		6	15.2	17.9	20.7	0.5
		11	15.2	17.9	20.8	0.5
b	11 (8QPSK)	1	9.9	14.4	16.5	0.5
		6	9.7	14.4	16.6	0.5
		11	9.7	14.4	16.6	0.5
g	54 (64QAM)	1	16.4	16.7	18.6	0.5
		6	16.4	16.6	18.7	0.5
		11	16.4	16.6	18.6	0.5
n	MCS7 (64QAM)	1	16.9	17.8	19.7	0.5
		6	17.3	17.8	19.9	0.5
		11	17.0	17.8	20.1	0.5

7.4 – Screen Captures

Examples of bandwidth measurements:

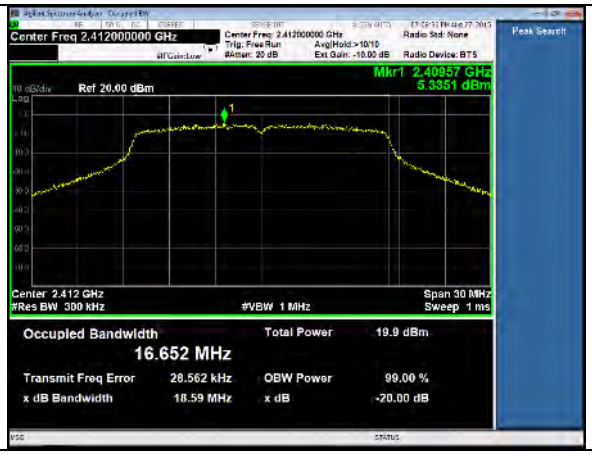
WLAN (lowest channel)



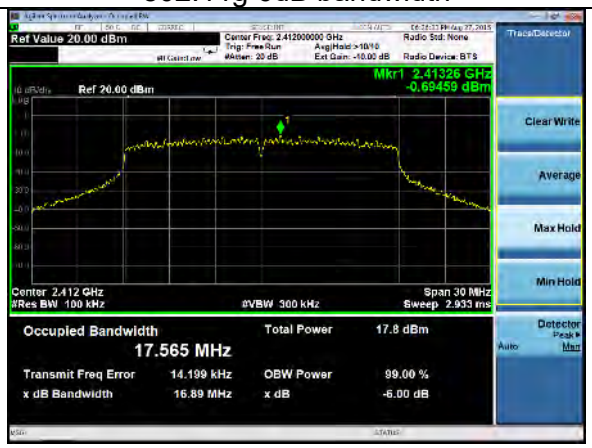
802.11b 6dB bandwidth

802.11b -20dB and 99% bandwidth

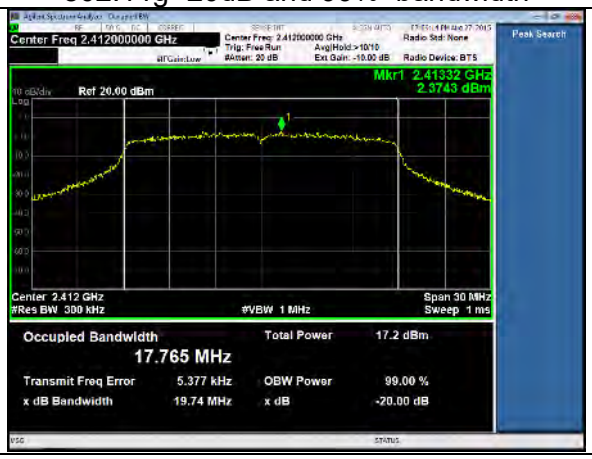
802.11g 6dB bandwidth



802.11g -20dB and 99% bandwidth



802.11n (HT20) 6dB bandwidth



802.11n (HT20) -20dB and 99% bandwidth

EXHIBIT 8. BAND EDGE MEASUREMENTS

Test Engineer(s): Aidi Zainal, Peter Feilen

8.1 - Method of Measurements

FCC 15.247 require a measurement of spurious emission levels at the restricted band to be compliant to the general emissions limit, in particular at the Band-Edges where the intentional radiator operates. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower Band-Edge, and at the highest channel for the investigation of the higher Band-Edge.

The Band-edge measurements were performed conducted (100kHz) and cabinet radiated (with the addition of antenna port conducted measurement). The measurement of radiated band-edge was performed to satisfy FCC 15.247(d).

Per FCC KDB 558074 D01 Measurement Guidance v03r03 section 11, conducted measurements were performed with 100 kHz bandwidth for all emissions outside of the band of operation. Emissions in the restricted band, a bandwidth of 120kHz (below 1000MHz) and 1MHz (above 1000MHz) were used in accordance with C63.4 and was performed radiated.

Since the radiated measurements were performed as a cabinet radiation measurement, antenna port conducted measurement per **FCC KDB 558074 D01 Measurement Guidance v03r03 section 12** was also performed.

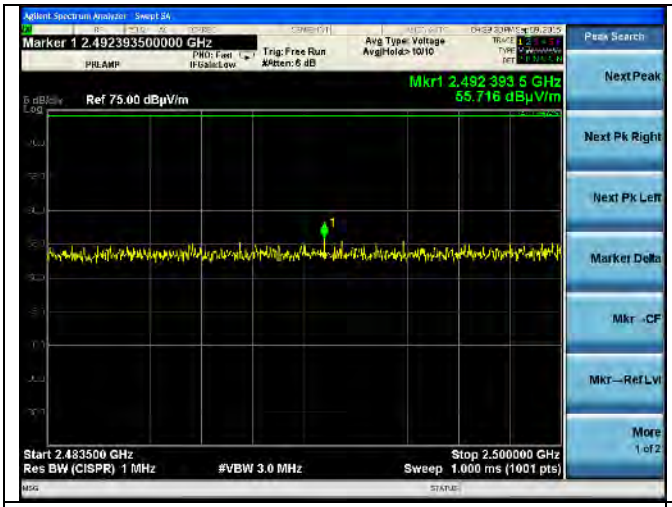
For both conducted and radiated measurements, correction factors and the cable loss factors were entered into the EMI Receiver database. **As a result, the plots taken from the EMI Receiver accounts for all applicable correction factor as well as cable loss, and can therefore be entered into the database as a corrected meter reading.**

8.2. Restricted band Band edge

The data presented below are samples selected from the various data rates and channels tested.

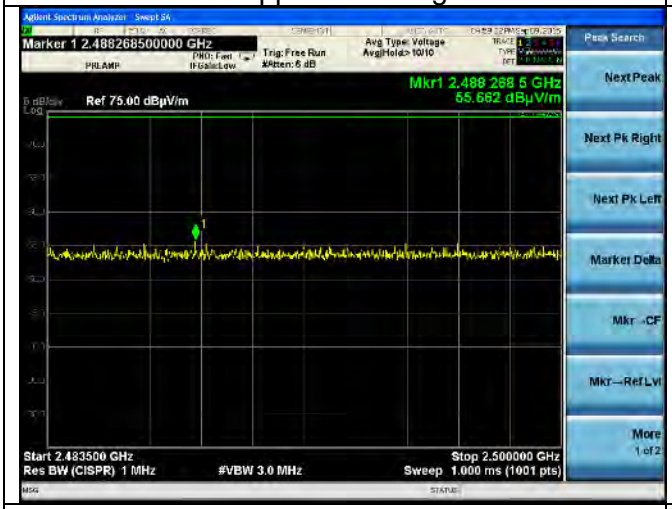
A. Cabinet radiation:

2483.5 to 2500 MHz Restricted band



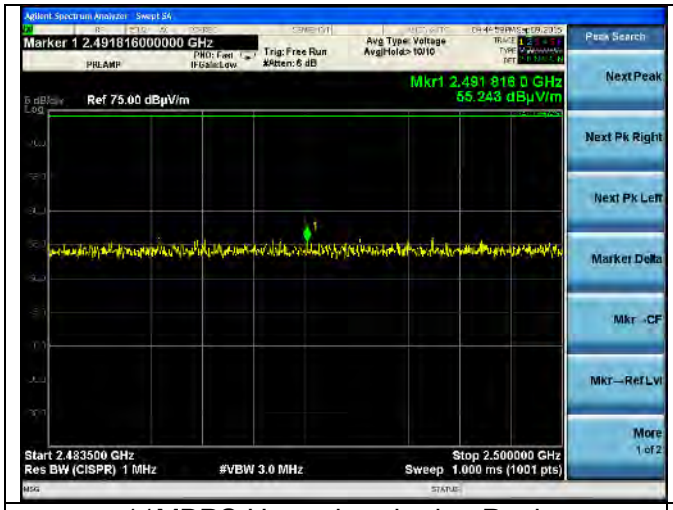
1MBPS Upper band edge Peak

1MBPS Upper band edge Average

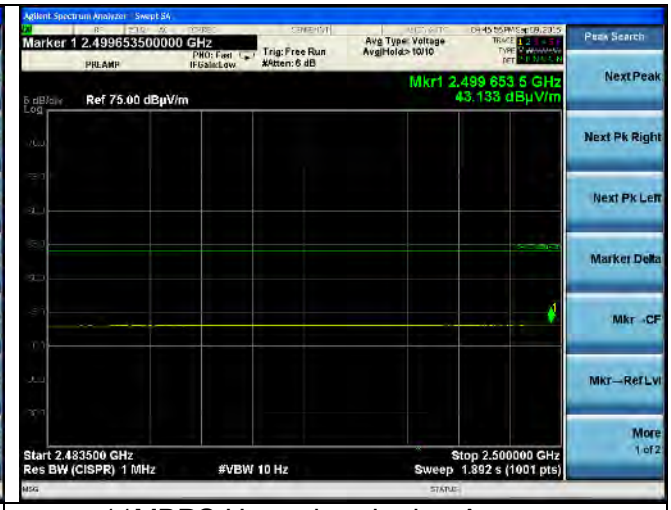


6MBPS Upper band edge Peak

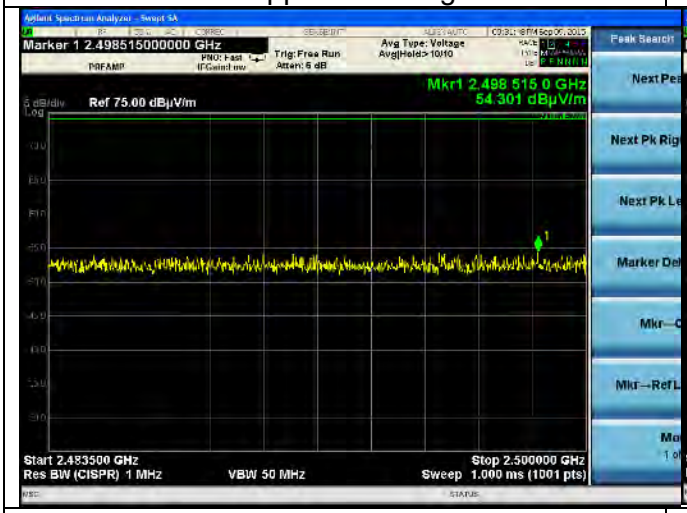
6MBPS Upper band edge Average



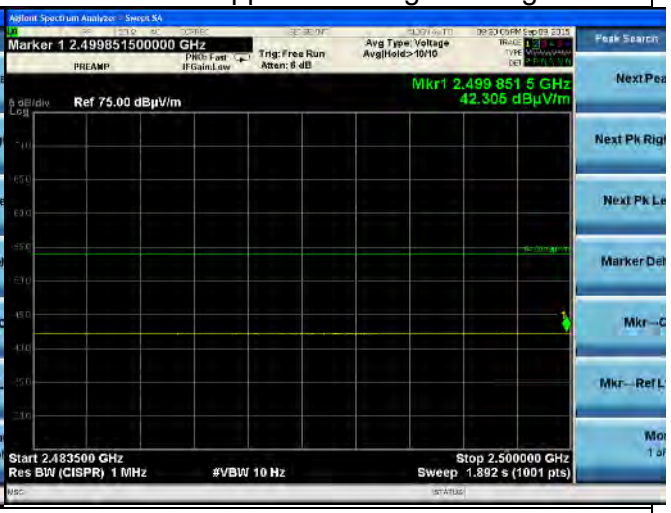
11MBPS Upper band edge Peak



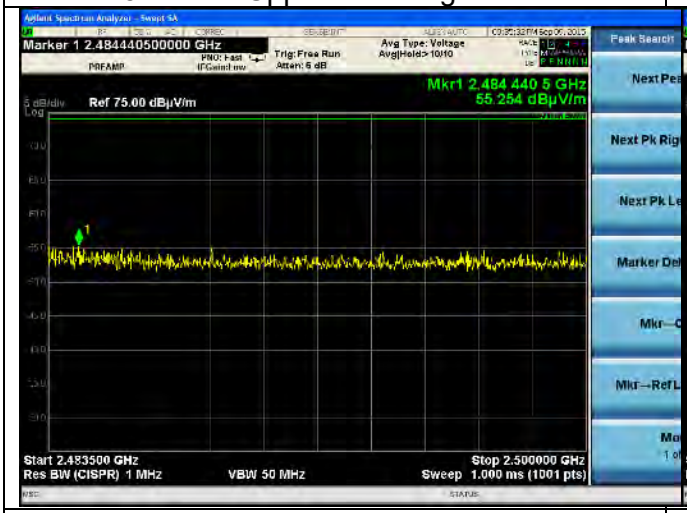
11MBPS Upper band edge Average



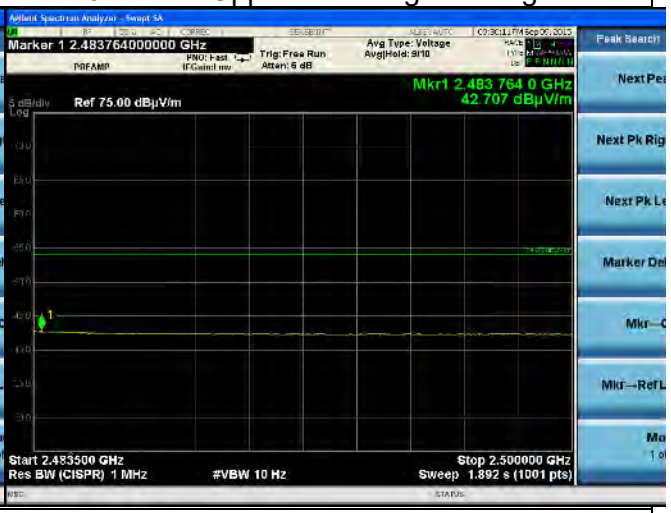
54MBPS Upper band edge Peak



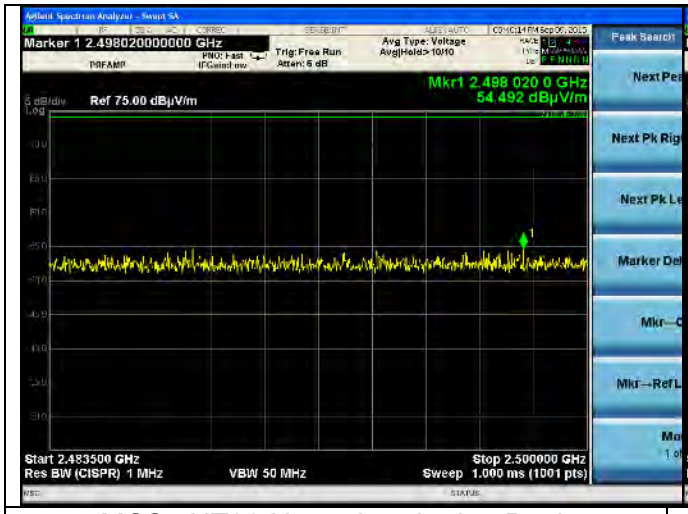
54MBPS Upper band edge Average



MCS0 HT20 Upper band edge Peak



MCS0 HT20 Upper band edge Average



MCS7 HT20 Upper band edge Peak

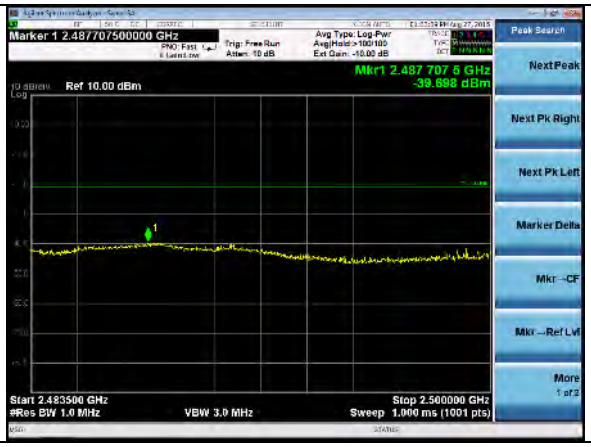
MCS7 HT20 Upper band edge Average

B. Antenna port conducted measurement:

Data Rate (MBPS)	Peak data Frequency (MHz)	Restricted band Band-edge: Peak (dBm)	Average data Frequency (MHz)	Restricted band Band-edge: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak Band-edge (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average Band-edge (dBm)	Average Limit (dBm)	Average Margin (dB)
1	2487.7	-39.7	2488.0	-47.2	0.0	2.2	-37.5	-21.2	16.3	-45.1	-41.2	3.9
11	2488.7	-38.6	2488.9	-48.2	0.2	2.2	-36.4	-21.2	15.2	-45.9	-41.2	4.7
6	2483.5	-25.4	2483.9	-45.6	0.1	2.2	-23.3	-21.2	2.1	-43.4	-41.2	2.1
54	2484.2	-39.4	2483.7	-52.9	1.0	2.2	-37.2	-21.2	16.0	-49.7	-41.2	8.5
MCS0	2483.7	-25.6	2483.7	-46.0	0.1	2.2	-23.4	-21.2	2.2	-43.8	-41.2	2.6
MCS7	2483.8	-39.4	2483.6	-54.7	1.1	2.2	-37.3	-21.2	16.1	-51.5	-41.2	10.2

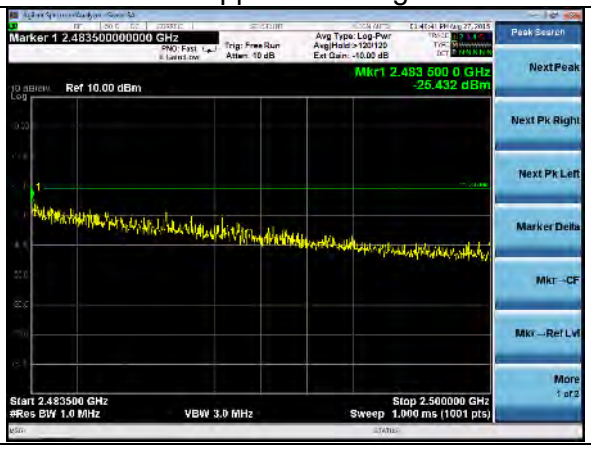
Note:
1. Section 12.2.5.2 of KDB 558074 v03r03 was used for average measurements while section 12.2.4 of KDB 558074 v03r03 was used for Peak measurements.

2483.5 to 2500 MHz Restricted band

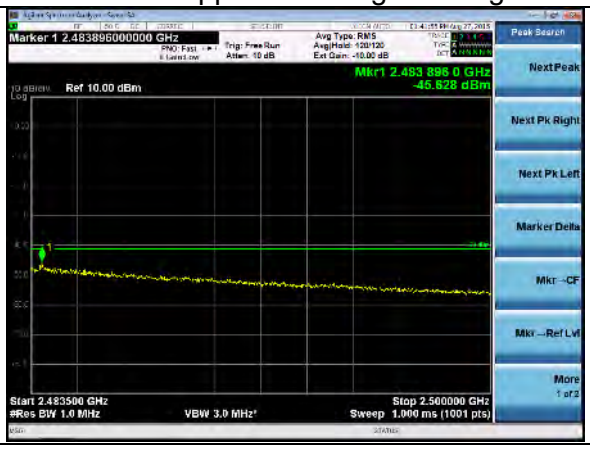


1MBPS Upper band edge Peak

1MBPS Upper band edge Average

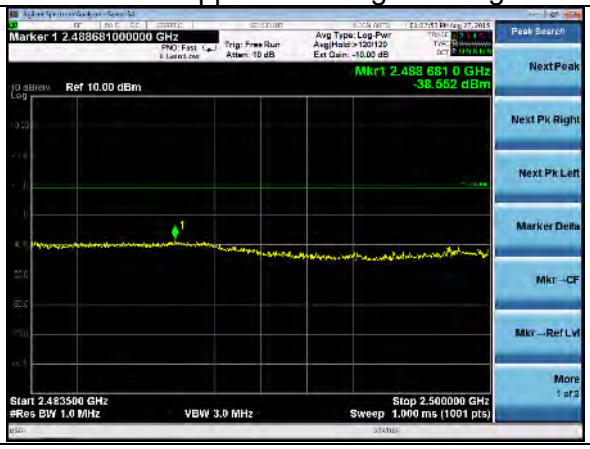


6MBPS Upper band edge Peak



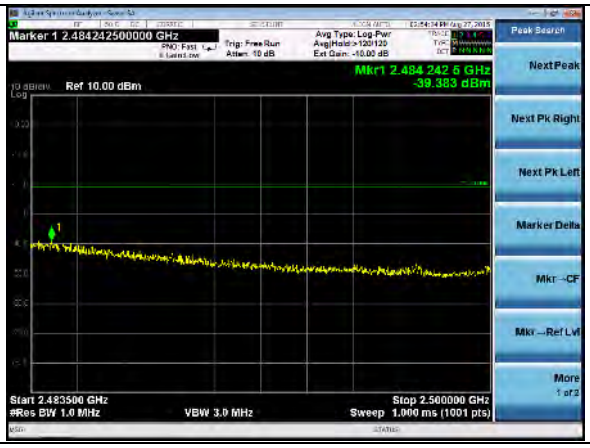
6MBPS Upper band edge Average

11MBPS Upper band edge Peak

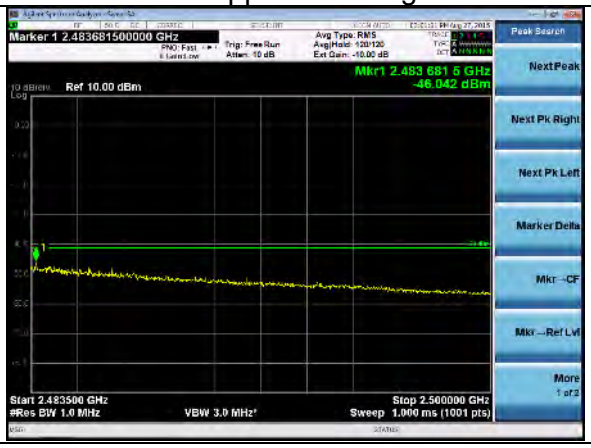


11MBPS Upper band edge Average

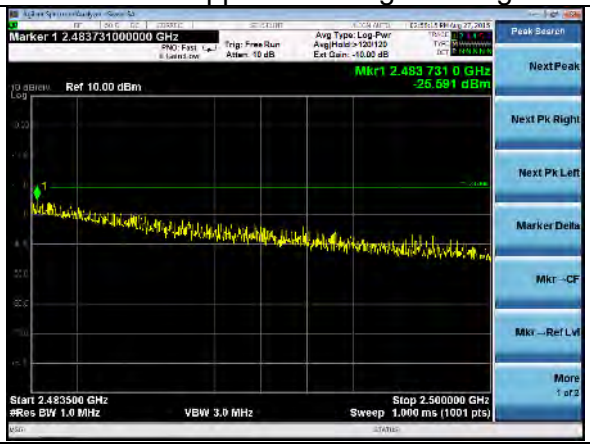
54MBPS Upper band edge Peak



54MBPS Upper band edge Average



MCS0 HT20 Upper band edge Peak



MCS0 HT20 Upper band edge Average

MCS7 HT20 Upper band edge Peak

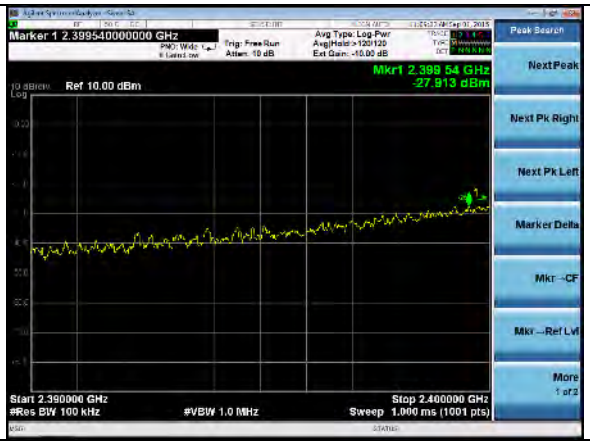
MCS7 HT20 Upper band edge Average

C. Band-edge in 100kHz bandwidth:

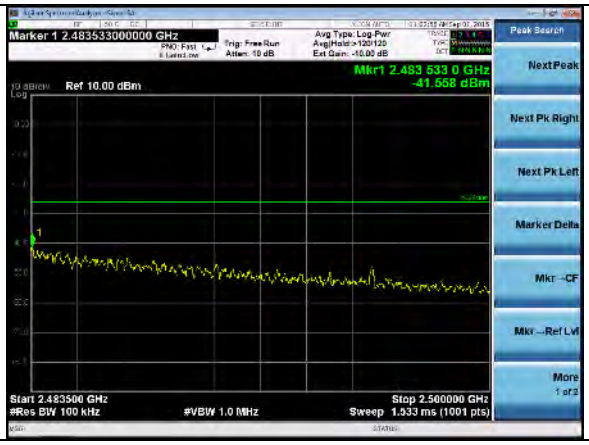
Note: The limits in the plots below are based on 30dB below the measured fundamental (using the procedure of FCC KDB 558074 D01 Measurement Guidance v03r03 section 11).

802.11b lower band-edge

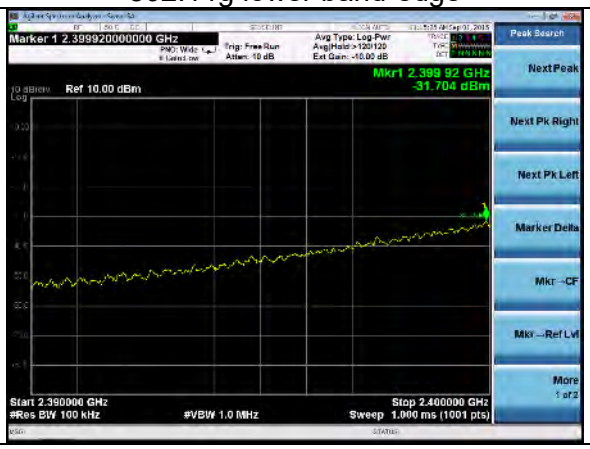
802.11b upper band-edge



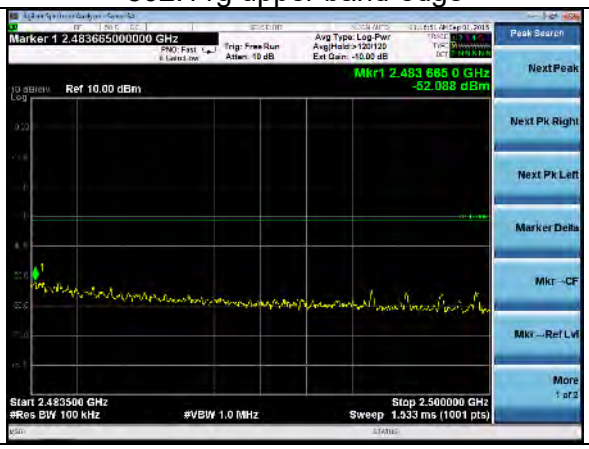
802.11g lower band-edge



802.11g upper band-edge



802.11n lower band-edge



802.11n upper band-edge

EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

Test Engineer(s): Peter Feilen

9.1 - Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

Measurement procedure used was FCC OET KDB 558074 D01 Measurement Guidance v03r03 section 9.2.2.4

9.2 - 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).

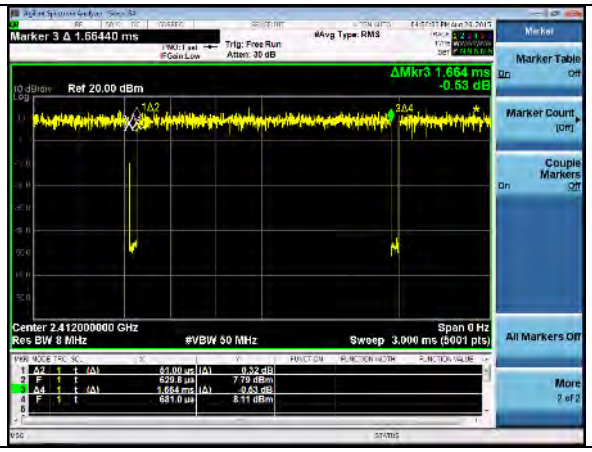
9.2.1. WLAN Maximum conducted average power:

9.2.1.1 Duty cycle:

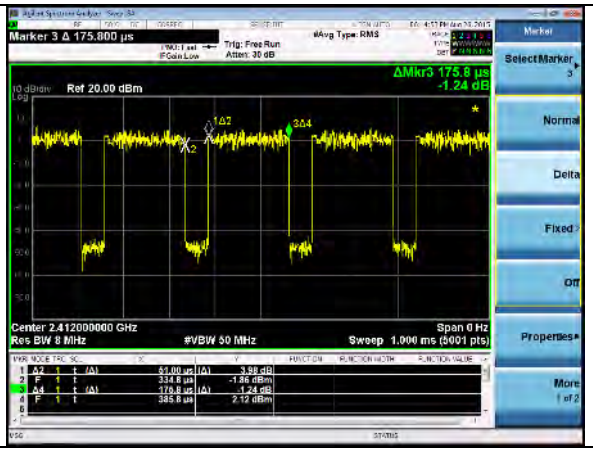
Measurement procedure: **FCC OET KDB 558074 D01 Measurement Guidance v03r03 section 6**

Data Rate (MBPS)	TX on time (ms)	TX off time (ms)	Duty Cycle	Duty cycle correction factor (dB)
1.0	10.010	0.046	1.00	0.0
6.0	1.664	0.051	0.97	0.1
11.0	1.085	0.046	0.96	0.2
54.0	0.203	0.051	0.80	1.0
MCS0	1.540	0.051	0.97	0.1
MCS7	0.176	0.051	0.78	1.1
MCS1	0.783	0.052	0.94	0.3
MCS5	0.216	0.052	0.81	0.9
MCS3	0.404	0.051	0.89	0.5

Example screen captures:



6MBPS



MCS7

9.2.1.2 WLAN Maximum conducted (average) output power:

802.11 Standard	Data Rate (MBPS)	Channel	Maximum Conducted Power (dBm)	D.C correction (dB)	Corrected Maximum Conducted Power (dBm)	Power Limit (dBm)	Power margin (dB)
b	1 (DBPSK)	1	17.2	0.0	17.2	30.0	12.8
		6	17.0	0.0	17.0	30.0	13.0
		11	16.5	0.0	16.5	30.0	13.5
g	6 (BPSK)	1	14.0	0.1	14.1	30.0	16.0
		6	13.8	0.1	13.9	30.0	16.2
		11	14.0	0.1	14.1	30.0	16.0
n (HT20)	MCS0 (BPSK)	1	13.9	0.1	14.0	30.0	16.1
		6	13.9	0.1	14.0	30.0	16.1
		11	13.9	0.1	14.0	30.0	16.1
b	11 (8QPSK)	1	16.8	0.2	17.0	30.0	13.2
		6	16.9	0.2	17.1	30.0	13.1
		11	16.8	0.2	17.0	30.0	13.2
g	54 (64QAM)	1	11.1	1.0	12.1	30.0	18.9
		6	10.6	1.0	11.6	30.0	19.4
		11	10.5	1.0	11.5	30.0	19.5
n (HT20)	MCS7 (64QAM)	1	7.8	1.1	8.9	30.0	22.2
		6	7.6	1.1	8.7	30.0	22.4
		11	7.8	1.1	8.9	30.0	22.2

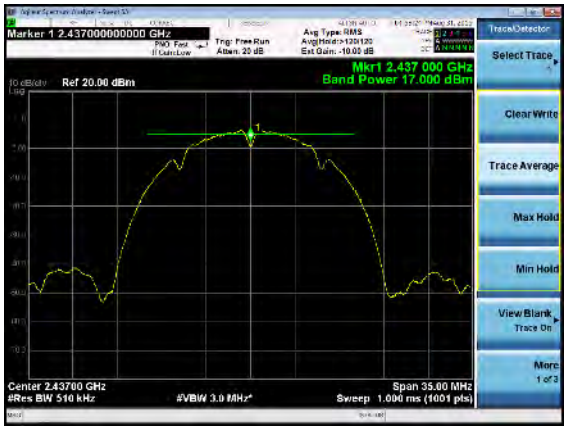
9.3 – Screen Captures.

9.3.1 WLAN:

1MBPS

Low Channel

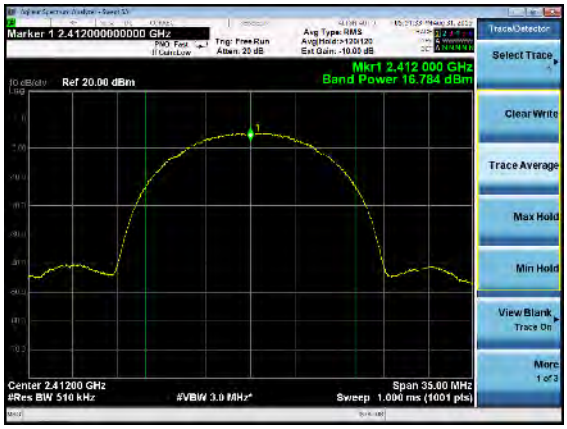
Middle Channel



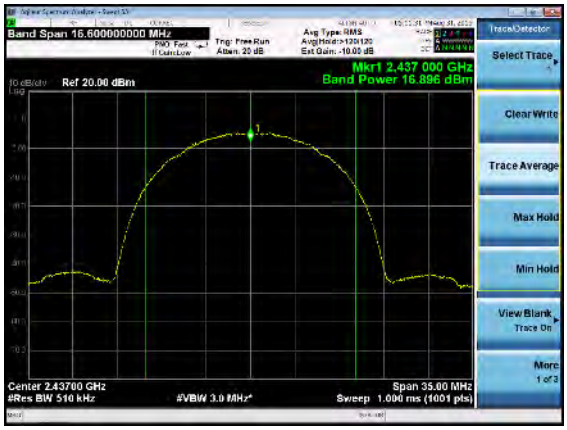
High Channel

11MBPS

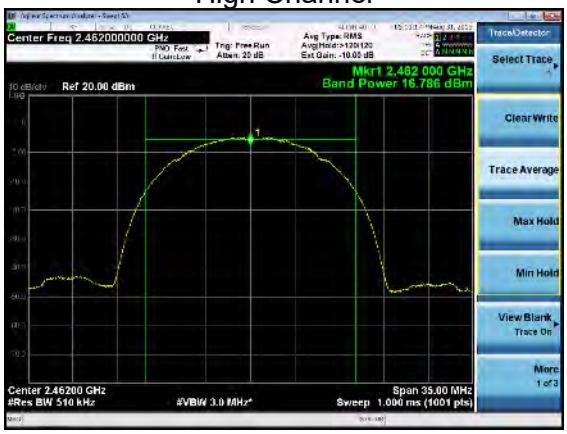
Low Channel



Middle Channel



High Channel



6MBPS

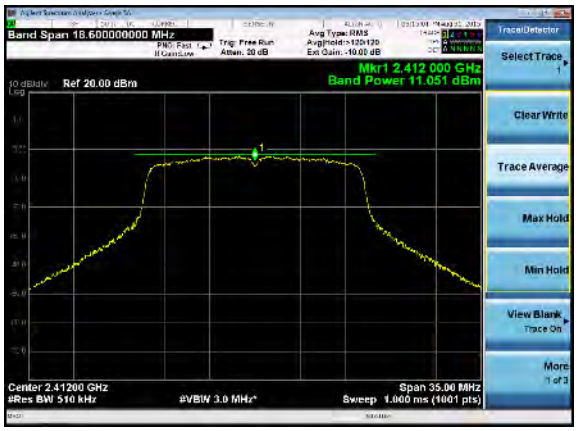
Low Channel

Middle Channel

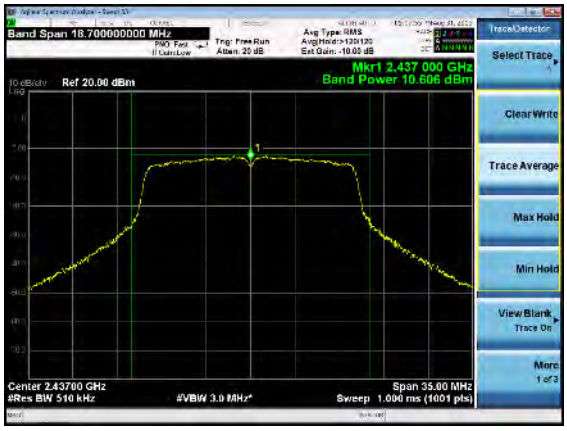
High Channel

54MBPS

Low Channel



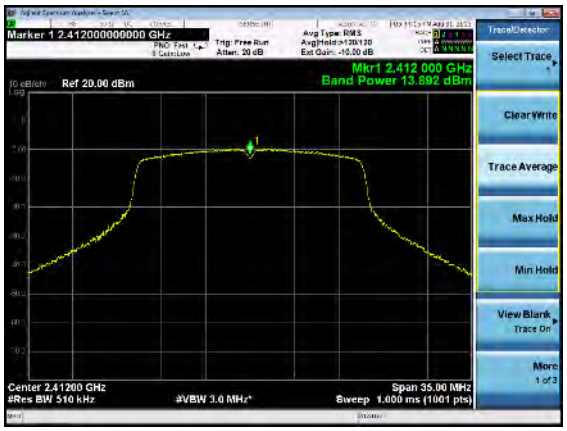
Middle Channel



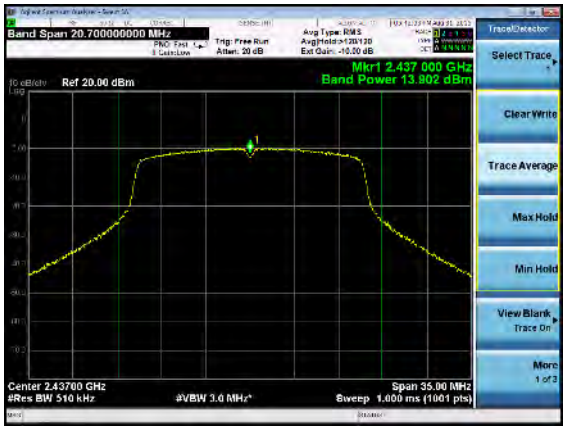
High Channel

MCS0 HT20

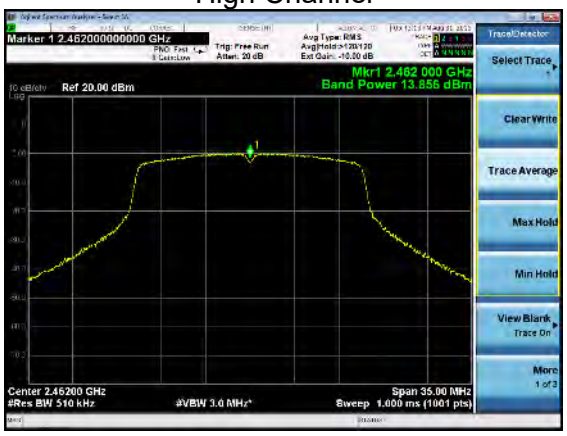
Low Channel



Middle Channel

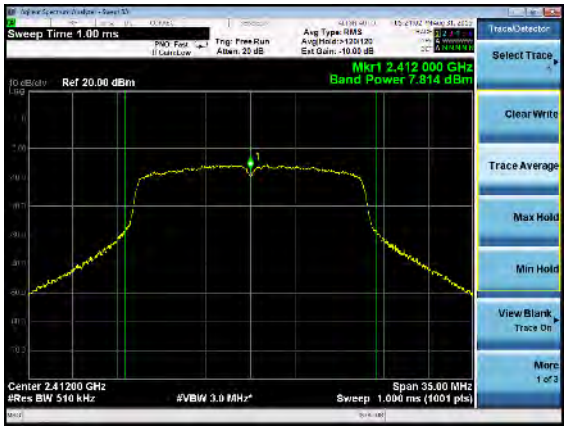


High Channel



MCS7 HT20

Low Channel



Middle Channel

High Channel

EXHIBIT 10. CONDUCTED SPURIOUS EMISSIONS: 15.247(d)

Test Engineer(s): Peter Feilen

10.1 - Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 db below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

10.2 – Conducted Harmonic And Spurious RF Measurements

FCC Part 15.247(d) and IC RSS 210 A8.5 both require a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct readings of the measurements made without the need for any further corrections. A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

Measurement procedure used was FCC OET KDB 558074 D01 Measurement Guidance v03r03 section 11.

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:

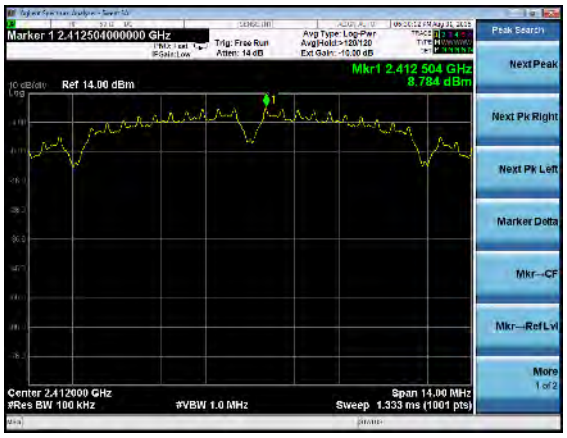
Reported Measurement data = 8.55 (raw receiver measurement in dBm) + 0.85 (cable factor in dB) = 9.4 (dBm).

10.3 - Test Data

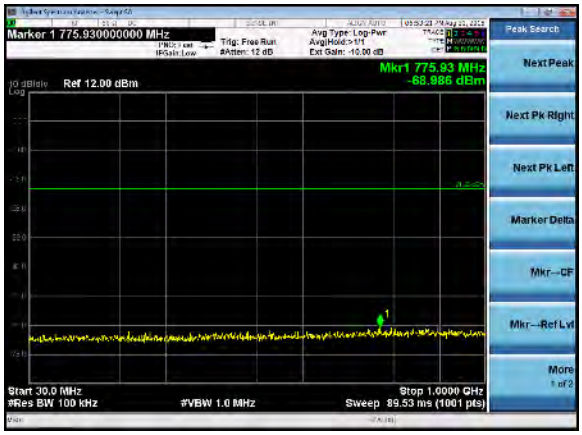
The data presented below are samples selected from the various data rates and channels tested.

10.3.1 2.4GHz WLAN

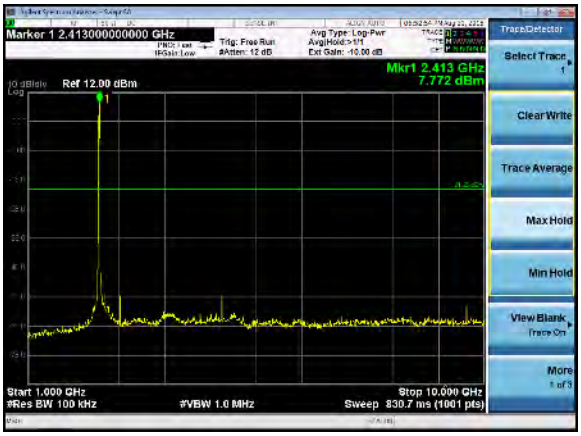
Low Channel fundamental in 100 kHz:



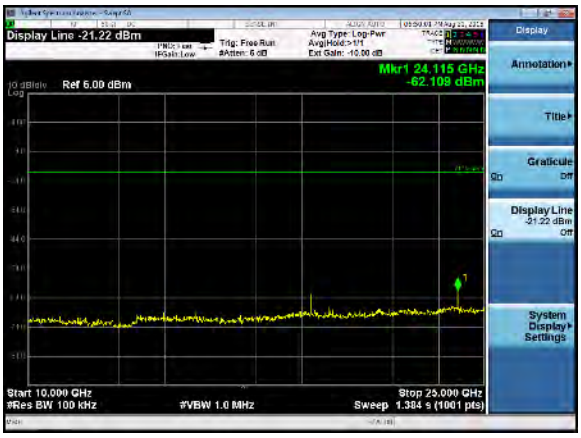
30MHz to 1000MHz



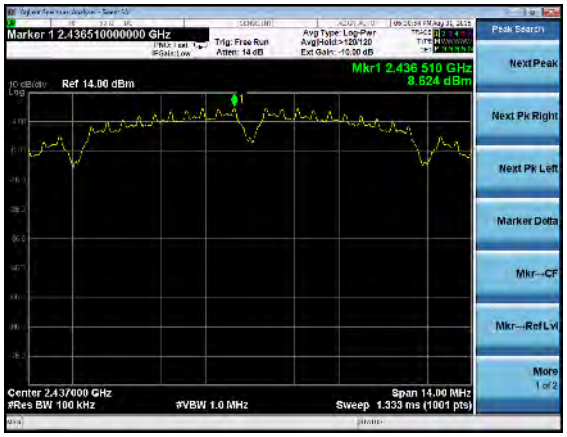
1000MHz to 10000MHz



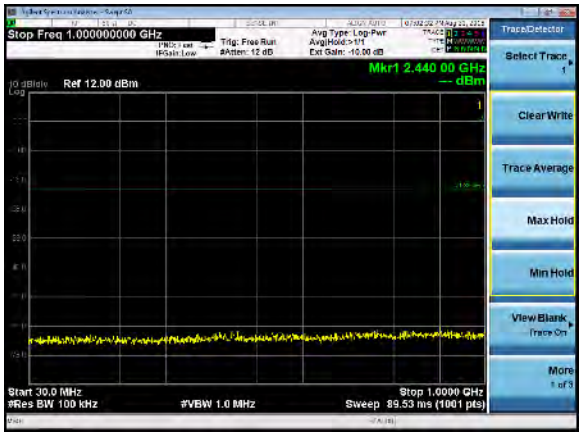
10000 to 25000MHz



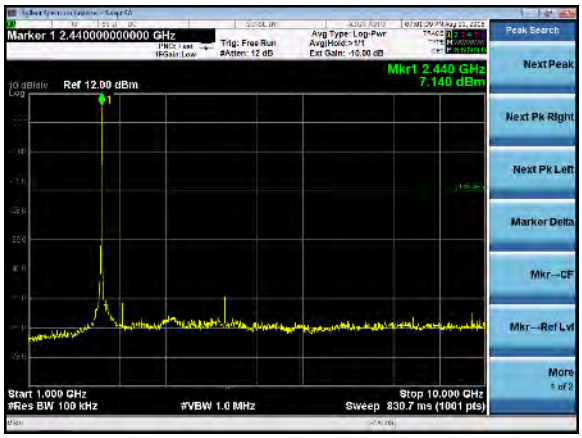
Middle Channel fundamental in 100 kHz:



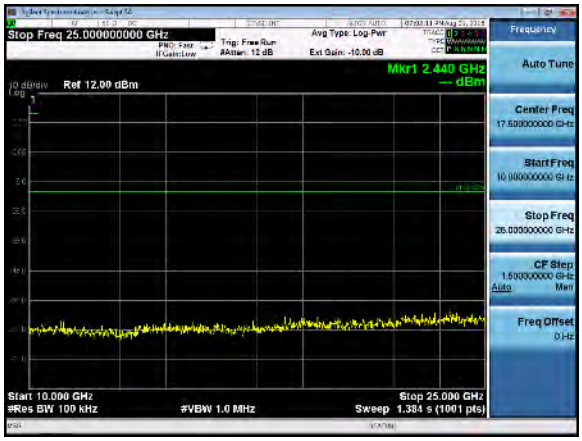
30MHz to 1000MHz



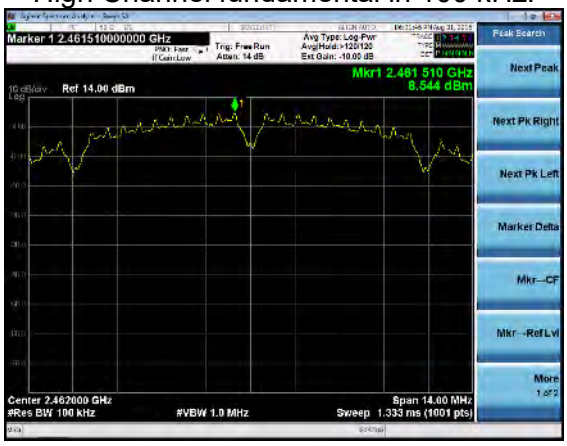
1000MHz to 10000MHz



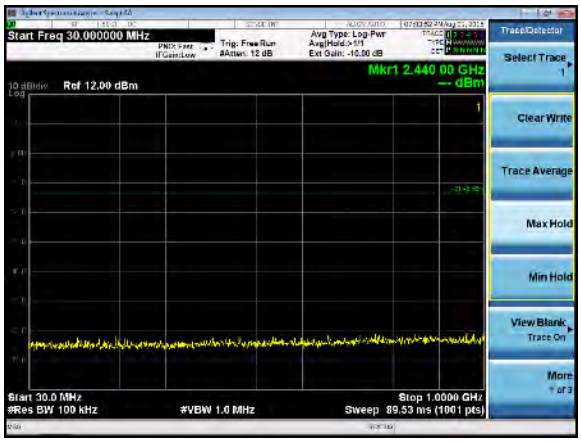
10000MHz to 25000MHz



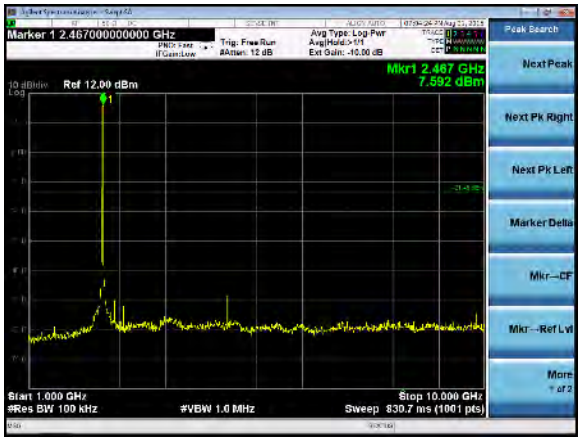
High Channel fundamental in 100 kHz:



30MHz to 1000MHz



1000MHz to 10000MHz



10000MHz to 25000MHz

EXHIBIT 11. POWER SPECTRAL DENSITIES: 15.247(e)

11.1 Limits

For digitally modulate systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

In accordance with FCC Part 15.247(e) and RSS 210 A8.2(b), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in previous sections. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a power density measurement was performed.

Measurement procedure used was FCC OET KDB 558074 D01 Measurement Guidance v03r03 section 10.2 for WLAN.

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).

11.2 Test Data

802.11 Standard	Data Rate (MBPS)	Channel	Peak PSD (dBm)	PSD in 3kHz limit(dBm)	PSD margin (dBm)
b	1 (DBPSK)	1	4.7	8.0	3.3
		6	5.2	8.0	2.8
		11	5.1	8.0	2.9
g	6 (BPSK)	1	3.9	8.0	4.1
		6	3.7	8.0	4.3
		11	3.7	8.0	4.3
n (HT20)	MCS0 (BPSK)	1	3.8	8.0	4.2
		6	3.9	8.0	4.1
		11	3.9	8.0	4.1
b	11 (8QPSK)	1	3.3	8.0	4.7
		6	3.2	8.0	4.8
		11	3.2	8.0	4.8
g	54 (64QAM)	1	1.4	8.0	6.6
		6	1.3	8.0	6.7
		11	1.2	8.0	6.8
n (HT20)	MCS7 (64QAM)	1	-1.1	8.0	9.1
		6	-1.3	8.0	9.3
		11	-1.5	8.0	9.5

11.3 Screen Captures – Power Spectral Density

11.3.1 2.4GHz WLAN

11.3.1.1 1MBPS

Low Channel

Middle Channel

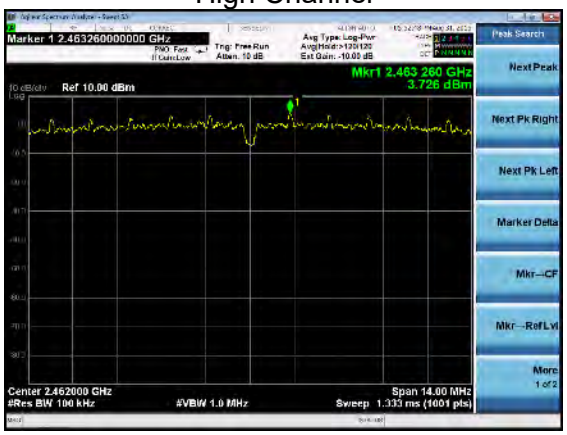
High Channel

11.3.1.2 6MBPS

Low Channel

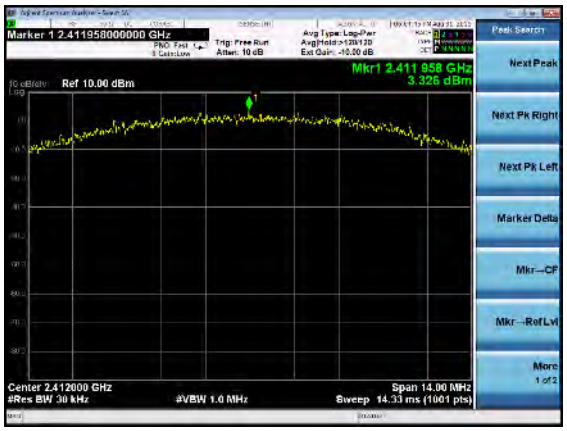
Middle Channel

High Channel



11.3.1.3 11MBPS

Low Channel

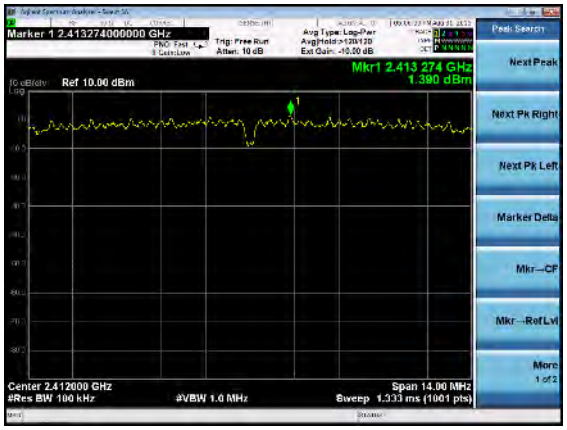


Middle Channel

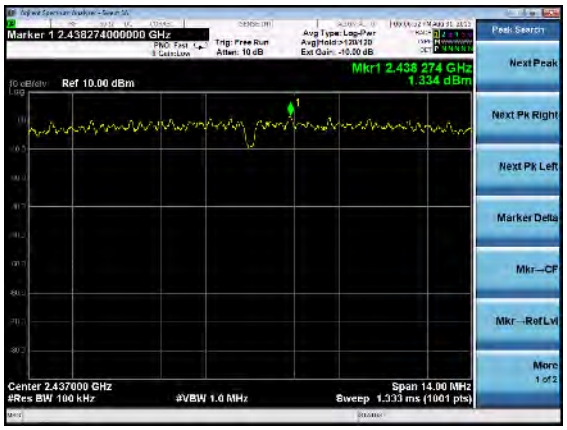
High Channel

11.3.1.4 54MBPS

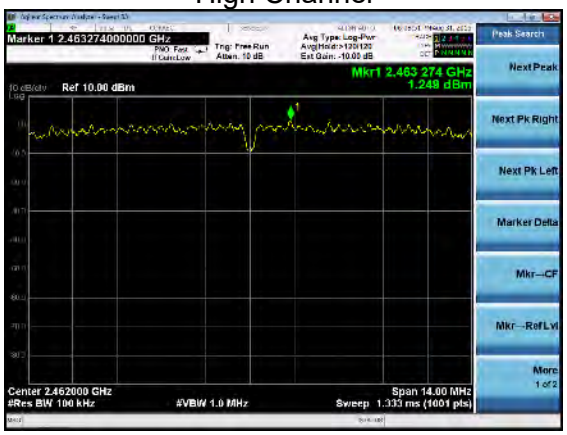
Low Channel



Middle Channel

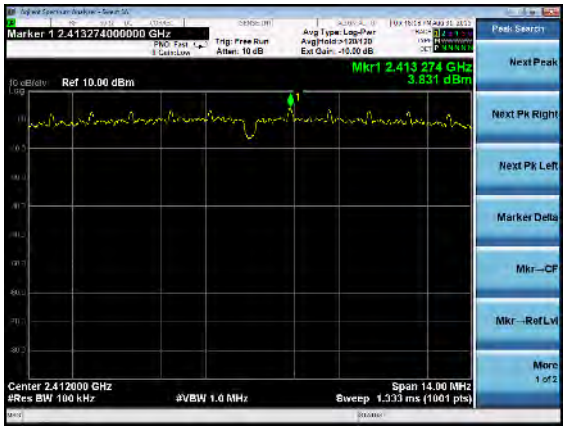


High Channel

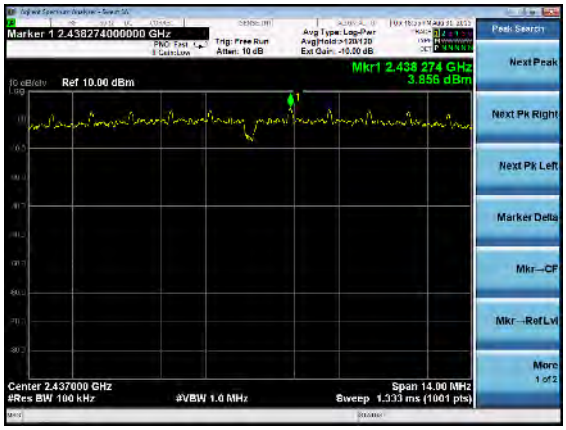


11.3.1.5 MCS0 HT20

Low Channel



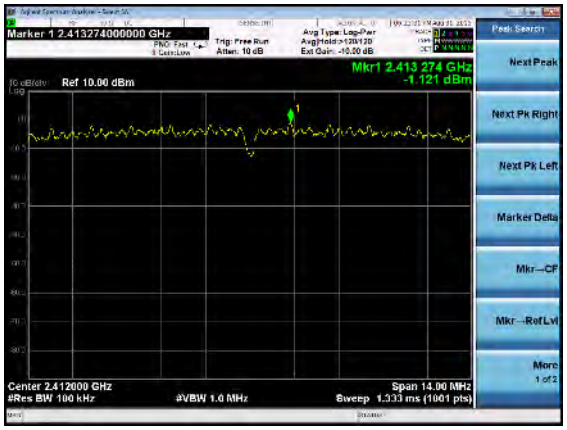
Middle Channel



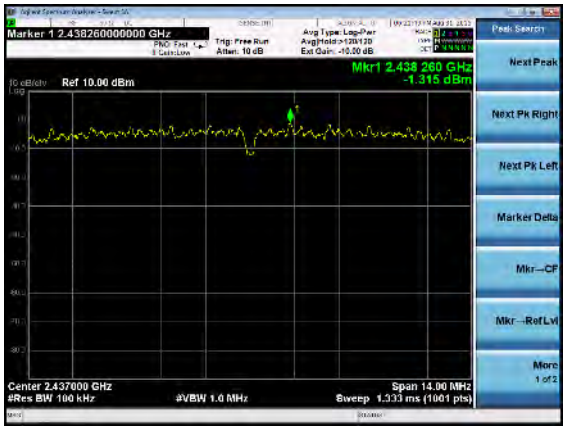
High Channel

11.3.1.6 MCS7 HT20

Low Channel



Middle Channel



High Channel

EXHIBIT 12. FREQUENCY STABILITY OVER VOLTAGE VARIATIONS

Test Engineer(s): Khairul Aidi Zainal

The frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by an external bench-type DC power supply and was varied ±10% from the nominal.

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle.

WLAN 2.4 GHZ

	13.5VDC	15.0VDC	16.5VDC	
	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	2412000969	2412000990	2412000990	21
MID CHANNEL	2437000920	2437000940	2437000960	40
HIGH CHANNEL	2462000939	2462000960	2462000960	21

EXHIBIT 13. COMPLIANCE TO KDB 594280 D01

In this exhibit, data is presented showing WLAN channel 12 and 13 compliance to the technical requirements for DTS operations in the band 2400 to 2483.5MHz.

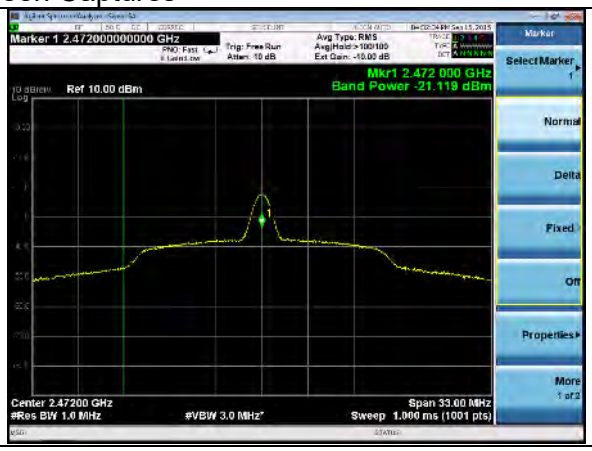
Measurements were performed conducted at the antenna port using measurement methods presented in KDB 558074

A. Maximum Conducted Power
(FCC OET KDB 558074 v03r02 section 9.2.2.4)

802.11 Standard	Data Rate (MBPS)	Channel	Maximum Conducted (average) Power (dBm)	Duty Cycle correction for average measurement (dB)	Corrected Maximum Conducted Power (dBm)	Power Limit (dBm)
b	1	12	-21.8	0.0	-21.8	30.0
		13	-21.7	0.0	-21.7	30.0
g	6	12	-21.1	0.1	-21.0	30.0
		13	-21.1	0.1	-21.0	30.0
n	MCS0	12	-21.2	0.1	-21.1	30.0
		13	-21.1	0.1	-21.0	30.0

Sample Screen Captures

Channel 12 (6MBPS)



Channel 13 (MCS0)

B. Restricted band Band-edge
(FCC OET KDB 558074 v03r03 section 12)

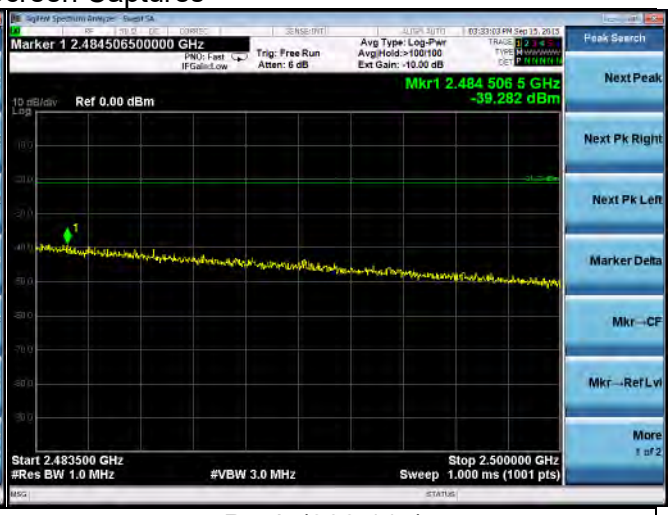
1. Channel 12

802.11 Standard	Data Rate (MBPS)	Peak data Frequency (MHz)	Restricted band Band-edge: Peak (dBm)	Average data Frequency (MHz)	Restricted band Band-edge: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak Band-edge (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average Band-edge (dBm)	Average Limit (dBm)	Average Margin (dB)
b	1	2484.8	-51.4	2484.4	-57.0	0.0	2.2	-49.2	-21.2	28.0	-54.8	-41.2	13.6
a,g	6	2484.5	-39.3	2483.6	-50.7	0.1	2.2	-37.1	-21.2	15.9	-48.4	-41.2	7.2
n	MCS0	2484.0	-39.4	2483.6	-50.8	0.1	2.2	-37.2	-21.2	16.0	-48.5	-41.2	7.3

Note:
a. Final Peak band-edge = Peak data + antenna gain
b. Final Average band-edge = Average data + DC correction + antenna gain
c. Peak data and average data includes all applicable equipment factors (i.e. cable factor)
d. Peak and average limit was converted from field strength to dBm using equation from C63.10

Sample Screen Captures

Average (802.11g)



Peak (802.11g)

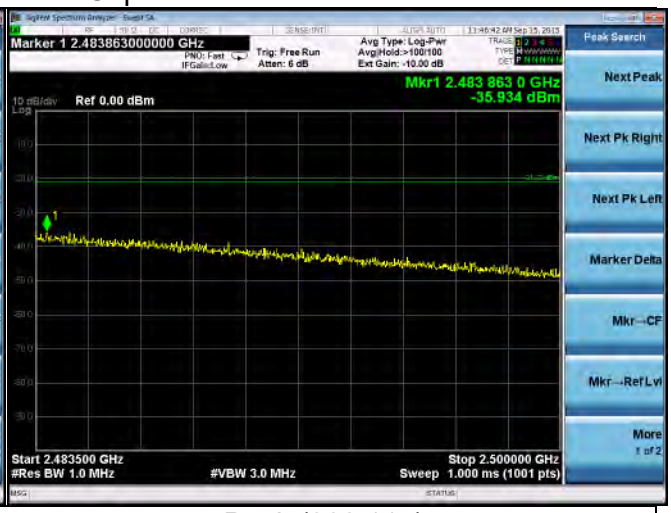
2. Channel 13

802.11 Standard	Data Rate (MBPS)	Peak data Frequency (MHz)	Restricted band Band-edge: Peak (dBm)	Average data Frequency (MHz)	Restricted band Band-edge: Avg (dBm)	Duty Cycle correction for average measurement (dB)	Antenna gain (dBi)	Final peak Band-edge (dBm)	Peak Limit (dBm)	Peak Margin (dB)	Final average Band-edge (dBm)	Average Limit (dBm)	Average Margin (dB)
b	1	2483.6	-49.6	2489.4	-57.0	0.0	2.2	-47.4	-21.2	26.1	-54.8	-41.2	13.5
a,g	6	2483.5	-35.3	2483.5	-47.2	0.1	2.2	-33.1	-21.2	11.9	-44.9	-41.2	3.7
n	MCS0	2483.9	-35.9	2483.5	-47.5	0.1	2.2	-33.7	-21.2	12.5	-45.2	-41.2	3.9

Note:
a. Final Peak band-edge = Peak data + antenna gain
b. Final Average band-edge = Average data + DC correction + antenna gain
c. Peak data and average data includes all applicable equipment factors (i.e. cable factor)
d. Peak and average limit was converted from field strength to dBm using equation from C63.10

Sample Screen Captures

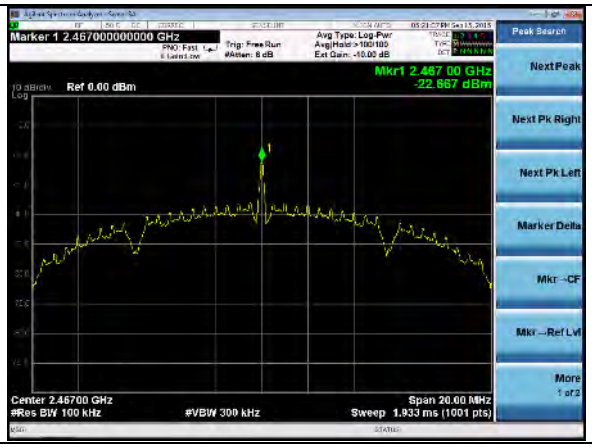
Average (802.11n)



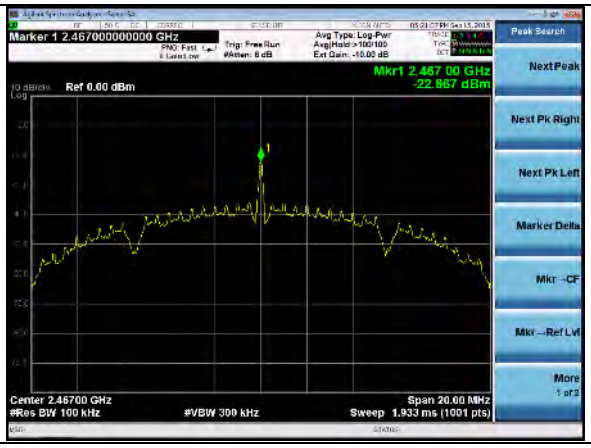
Peak (802.11n)

C. Transmitter spurious emissions (100 kHz bandwidth)
(FCC OET KDB 558074 v03r02 section 11)

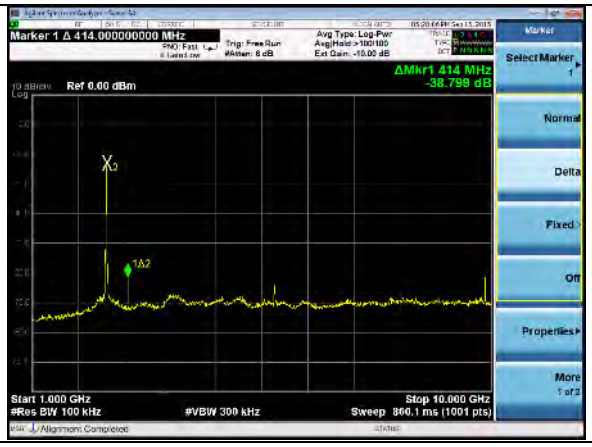
Channel 12



Fundamental



30 to 1000 MHz



1000 to 10000 MHz

10000 to 25000 MHz

Channel 13

Fundamental

30 to 1000 MHz

1000 to 10000 MHz

10000 to 25000 MHz

The EUT does NOT have the ability to operate at different power levels. The power levels are set via firmware. This firmware is installed onto the radio module at the factory. The user has no access to any power level control.

In addition, the module EEPROM will be programmed at the factory to only operate and actively scan on these specific channels:

Channels 1 – 11, 2412-2462 MHz 802.11b mode
Channels 1 – 11, 2412-2462 MHz 802.11g mode
Channels 1 – 11, 2412-2462 MHz 802.11n mode (20 MHz channel)

The following channels will be programmed at the factory to passively scan and will only listen and cannot send a probe request to initiate communication on these specific channels. Ad-hoc mode is always disabled on these passive channels.

Channels 12 & 13, 2467 & 2472 MHz 802.11b mode
Channels 12 & 13, 2467 & 2472 MHz 802.11g mode
Channels 12 & 13, 2467 & 2472 MHz 802.11n mode (20MHz channel)

APPENDIX A – Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 27-Aug-2015 Type Test : TX and RX AC mains Job # : C-2278

Prepared By: Aidi Customer : Topcon Positioning Systems Quote #: 315181

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/6/2015	5/6/2016	Active Calibration
2	EE 960162	LISN - 15A	COM-POWER	LI-215A	191969	7/24/2015	7/24/2016	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 27-Aug-2015 Type Test : Conducted measurements Job # : C-2278

Prepared By: Aidi Customer : Topcon Positioning Systems Quote #: 315181

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY53400296	12/11/2014	12/11/2015	Active Calibration
2	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	Verification	Verification	System

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 27-Aug-2015 Type Test : Radiated measurements Job # : C-2278

Prepared By: Aidi Customer : Topcon Positioning Systems Quote #: 315181

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/6/2015	5/6/2016	Active Calibration
2	EE 960125	SMA Cable	MegaPhase	NC19-S1S1-236	1GVT4 14032106 001	3/6/2015	3/6/2016	Active Verification
3	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	740411007	7/9/2015	7/9/2016	Active Calibration
4	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	7/9/2015	7/9/2016	Active Calibration
5	AA 960154	2.4GHz High Pass Filter	KWM	HPF-L-14186	7272-02	8/4/2015	8/4/2016	Active Calibration
6	EE 960088	8GHz MXE Spectrum Analyzer	Agilent	N9038A	MY51210138	1/9/2015	1/9/2016	Active Calibration
7	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY53400296	12/11/2014	12/11/2015	Active Calibration
8	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	8/6/2015	8/6/2016	Active Calibration
9	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	1/19/2015	1/19/2016	Active Calibration
10	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro / EMCO	WLA622-4 / 3160-09	123001	8/19/2015	8/19/2016	Active Calibration

APPENDIX B – Test Standards: CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2014		
ANSI C63.10	2013		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2015		
RSS GEN	2014		
RSS 247	2015		

APPENDIX C - Uncertainty Statement

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

Measurement Type	*Particular Configuration*	*Uncertainty Values*
Radiated Emissions	*3 – Meter chamber, Biconical Antenna*	*4.82 dB*
Radiated Emissions	*3-Meter Chamber, Log Periodic Antenna*	*4.88 dB*
Radiated Emissions	*3-Meter Chamber, Horn Antenna*	*4.85 dB*
Radiated Emissions	*10-Meter OATS, Biconical Antenna*	*4.32 dB*
Radiated Emissions	*10-Meter OATS, Log Periodic Antenna*	*3.63 dB*
Absolute Conducted Emissions	*Agilent PSA/ESA Series*	*1.38 dB*
AC Line Conducted Emissions	*Shielded Room/EMCO LISN*	*3.20 dB*
Radiated Immunity	*3 Volts/Meter in 3-Meter Chamber*	*2.05 Volts/Meter*
Conducted Immunity	*3 Volts level*	*2.33 V*
EFT Burst, Surge, VDI	*230 VAC*	*54.4 V*
ESD Immunity	*Discharge at 15kV*	*3200 V*
Temperature/Humidity	*Thermo-hygrometer*	*0.64° / 2.88 %RH*