MEASUREMENT REPORT
FCC PART 15.247 WLAN 802.11b/g/n

FCC ID:	TK4WLE600VX
APPLICANT:	Compex Systems Pte Ltd
Application Type:	Certification
Product:	802.11ac Dual Band Module
Model No.:	WLE600VX
Trademark:	COMPEX
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15.247
Test Procedure(s):	ANSI C63.10-2013, KDB 558074 D01v03r03, KDB 662911 D01v02r01
Test Date:	Mar. 16 ~ Jun. 17, 2015

Reviewed By : Robin Wu
(Robin Wu)

Approved By : Marlinchen
(Marlin Chen)

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 558074 D01v03r03. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date
1503RSU02901	Rev. 01	Initial report	06-17-2015
1503RSU02901	Rev. 02	Add some test descriptions and test plots	06-25-2015

CONTENTS

Description Page

§2.1033 General Information 5

1. INTRODUCTION 6

1.1. Scope 6
1.2. MRT Test Location 6

2. PRODUCT INFORMATION 7

2.1. Equipment Description 7
2.2. Applicable Standards 7
2.3. Operation Frequency / Channel List 8
2.4. Description of Available Antennas 9
2.5. Description of Antenna RF Port 9
2.6. Test Mode 10
2.7. Test Software 10
2.8. Device Capabilities 12
2.9. Test Configuration 13
2.10. EMI Suppression Device(s)/Modifications 13
2.11. Labeling Requirements 13

3. DESCRIPTION OF TEST 14

3.1. Evaluation Procedure 14
3.2. AC Line Conducted Emissions 14
3.3. Radiated Emissions 15

4. ANTENNA REQUIREMENTS 16

5. TEST EQUIPMENT CALIBRATION DATE 17

6. MEASUREMENT UNCERTAINTY 18

7. TEST RESULT 19

7.1. Summary 19
7.2. 6dB Bandwidth Measurement 20
7.2.1. Test Limit 20
7.2.2. Test Procedure used 20
7.2.3. Test Setting 20
7.2.4. Test Setup 20
7.2.5. Test Result 21
7.3. Output Power Measurement 25

7.3.1. Test Limit 25
7.3.2. Test Procedure Used 25
7.3.3. Test Setting 25
7.3.4. Test Setup 26
7.3.5. Test Result of Output Power 27
7.4. Power Spectral Density Measurement 29
7.4.1. Test Limit 29
7.4.2. Test Procedure Used 29
7.4.3. Test Setting 29
7.4.4. Test Setup 30
7.4.5. Test Result 31
7.5. Conducted Band Edge and Out-of-Band Emissions 42
7.5.1. Test Limit 42
7.5.2. Test Procedure Used 42
7.5.3. Test Settitng 42
7.5.4. Test Setup 43
7.5.5. Test Result 44
7.6. Radiated Spurious Emission Measurement 51
7.6.1. Test Limit 51
7.6.2. Test Procedure Used 51
7.6.3. Test Setting 51
7.6.4. Test Setup 53
7.6.5. Test Result 55
7.7. Radiated Restricted Band Edge Measurement 87
7.7.1. Test Result 87
7.8. AC Conducted Emissions Measurement 183
7.8.1. Test Limit 183
7.8.2. Test Setup 183
7.8.3. Test Result 184

8. CONCLUSION 186

§2.1033 General Information

Applicant:	Compex Systems Pte Ltd
Applicant Address:	135, Joo Seng Road, #08-01 Singapore 368363
Manufacturer:	Compex Systems Pte Ltd
Manufacturer Address:	135, Joo Seng Road, #08-01 Singapore 368363
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
MRT Registration No.:	809388
FCC Rule Part(s):	Part 15.247
Model No.:	WLE600VX
FCC ID:	TK4WLE600VX
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering
FCC Classification:	Digital Transmission System (DTS)

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- **MRT facility is a FCC registered (MRT Reg. No. 809388) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.**
- **MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.**
- **MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.**

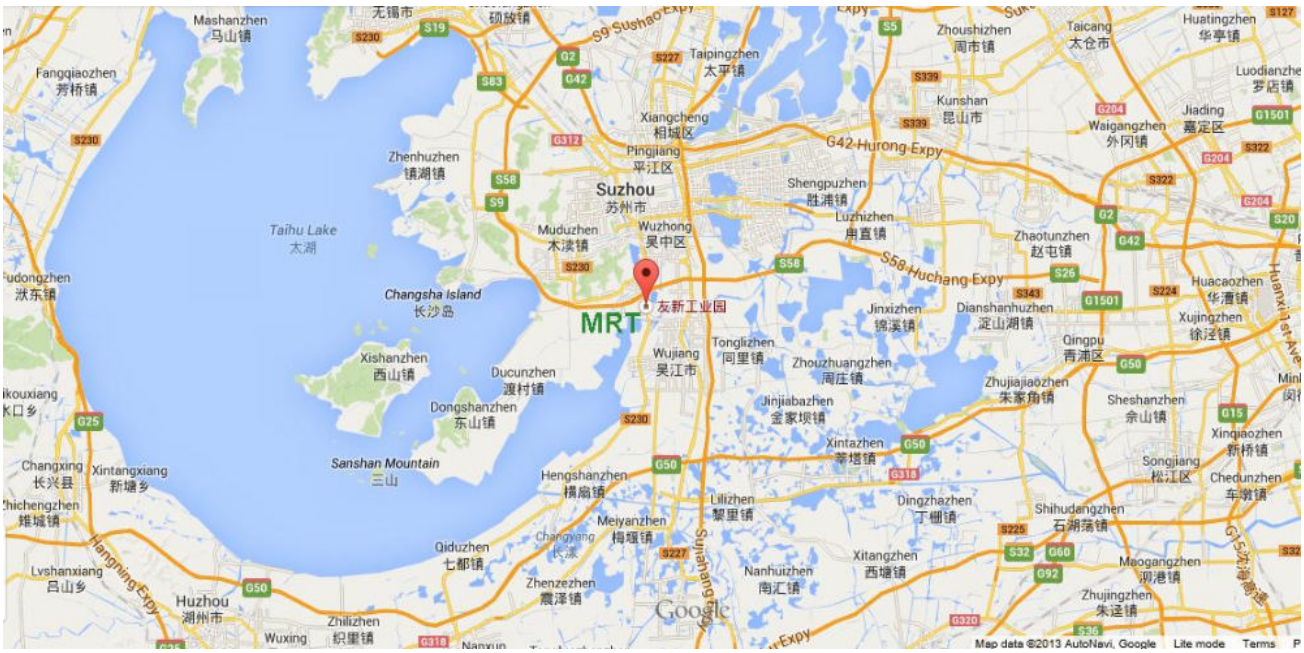
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	802.11ac Dual Band Module
Model No.	WLE600VX
Frequency Range	802.11b/g/n-HT20: 2412 ~ 2462 MHz 802.11n-HT40: 2422 ~ 2452 MHz
Maximum Output Power	802.11b: 22.42dBm 802.11g: 21.56dBm 802.11n-HT20: 24.22dBm 802.11n-HT40: 23.54dBm
Type of Modulation	802.11b: DSSS 802.11g/n: OFDM

2.2. Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r03
- ANSI C63.10-2013

Note:

1. All the test items were verified and recorded according to the standards and without any deviation during the test.
2. FCC permits the use of the 1.5 meter table as an alternative in ANSI C63.10-2013 through inquiry tracking number 198796.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B recorded in a separate report.

2.3. Operation Frequency / Channel List

802.11b/g/n-HT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
01	2412 MHz	02	2417 MHz	03	2422 MHz
04	2427 MHz	05	2432 MHz	06	2437 MHz
07	2442 MHz	08	2447 MHz	09	2452 MHz
10	2457 MHz	11	2462 MHz	N/A	N/A

802.11n-HT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
03	2422 MHz	04	2427 MHz	05	2432 MHz
06	2437 MHz	07	2442 MHz	08	2447 MHz
09	2452 MHz	N/A	N/A	N/A	N/A

2.4. Description of Available Antennas

Antenna Type	Manufacturer	Tx Paths	Max Directional Gain (dBi)
Panel Antenna 1#	Compex Systems Pte Ltd	2	2.4GHz: 11.0
Panel Antenna 2#	Kenbotong Communication LTD	2	2.4GHz: 10.0 5GHz: 10.0
Panel Antenna 3#	Smart Ant Inc	2	2.4GHz: 7.0 5GHz: 7.0
Panel Antenna 4#	TAOGLAS Inc	2	2.4GHz: 4.5 5GHz: 6.7
Panel Antenna 5#	Compex Systems Pte Ltd	2	2.4GHz: 5.0 5GHz: 5.0
Panel Antenna 6#	Compex Systems Pte Ltd	2	2.4GHz: 5.0 5GHz: 5.0
Dipole Antenna 1#	Kunshan Wavelink Electronic Co., Ltd.	2	2.4GHz: 2.0 5GHz: 2.0

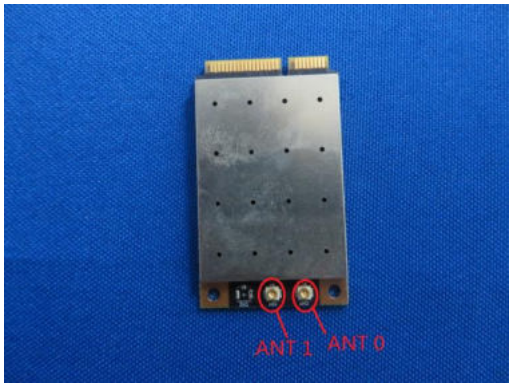
Note 1: The device didn't support transmit beam-forming mode and Cyclic Delay Diversity (CDD) mode, and the transmit signals are uncorrected, so no add array gain to the band power and band PSD.

Note 2: We selected the panel antenna 1# and dipole antenna 1# for all radiated emission testing.

2.5. Description of Antenna RF Port

--	2.4/5GHz Antenna RF Port	
	2.4/5GHz	2.4/5GHz
Software Control Port	Ant 0	Ant 1

Antenna RF Port Plot



2.6. Test Mode

Test Mode	Mode 1: Transmit by 802.11b
	Mode 2: Transmit by 802.11g
	Mode 3: Transmit by 802.11n-HT20
	Mode 4: Transmit by 802.11n-HT40

2.7. Test Software

The test utility software used during testing was “ART2-GUI Version: 2.3”.

Final Power Parameter Value of the test software.

Test Mode	Test Frequency (MHz)	Power Parameter Value		
		Ant 0	Ant 1	Ant 0 + 1
Dipole Antenna 1#				
802.11b	2412	20.0	20.0	Not Support
	2437	20.0	20.0	
	2462	20.0	20.0	
802.11g	2412	17.0	16.5	Not Support
	2437	20.0	20.0	
	2462	17.5	17.0	
802.11n-HT20	2412	17.0	17.0	15.0
	2437	20.0	20.0	20.0
	2462	17.5	17.0	15.5
802.11n-HT40	2422	17.0	17.0	14.0
	2437	20.0	20.0	20.0
	2452	16.5	15.5	14.5

Test Mode	Test Frequency (MHz)	Power Parameter Value		
		Ant 0	Ant 1	Ant 0 + 1
Panel Antenna 1#				
802.11b	2412	19.0	18.0	Not Support
	2437	20.0	20.0	
	2462	20.0	20.0	
802.11g	2412	13.5	14.0	Not Support
	2437	18.0	18.0	
	2462	16.0	15.0	
802.11n-HT20	2412	13.5	13.0	11.5
	2437	18.0	18.0	17.0
	2462	15.5	14.0	13.5
802.11n-HT40	2422	10.5	9.5	10.0
	2437	16.0	16.0	15.0
	2452	11.0	11.0	10.0

Note: We use the max power parameter value to test during the process of the Occupied Bandwidth & Output Power & Power Density testing.

2.8. Device Capabilities

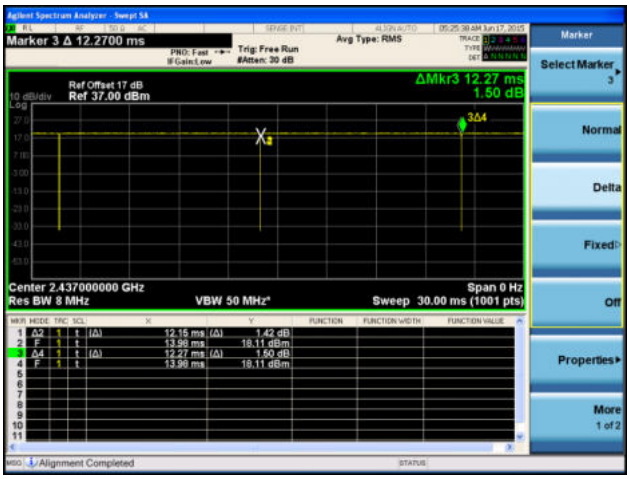
This device contains the following capabilities:

2.4GHz WLAN (DTS) and 5GHz WLAN (UNII)

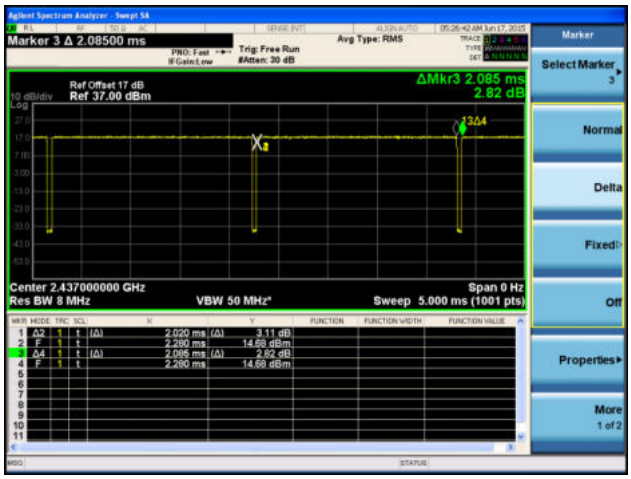
Note: 2.4GHz WLAN (DTS) operation is possible in 20MHz, and 40MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = Average per the guidance of Section 6.0 b) of KDB 558074 D01v03r03. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
802.11b	99.0%
802.11g	96.9%
802.11n-HT20	96.9%
802.11n-HT40	95.6%

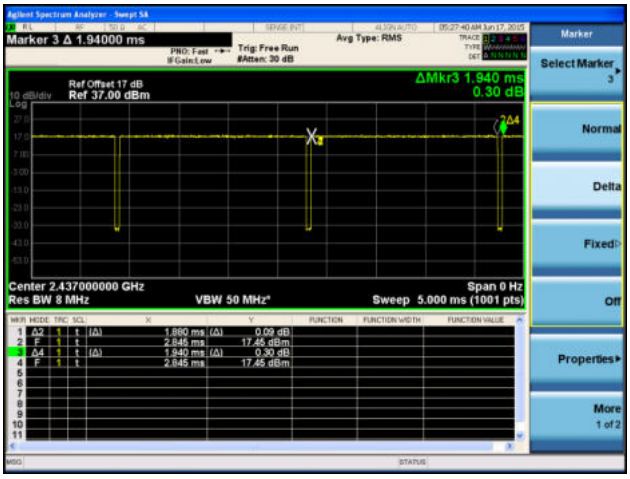
802.11 b – Duty Cycle



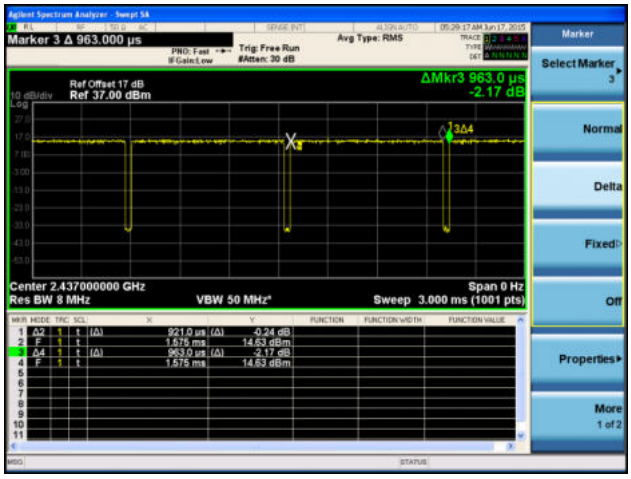
802.11 g – Duty Cycle



802.11 n-HT20 – Duty Cycle



802.11 n-HT40 – Duty Cycle



2.9. Test Configuration

The **802.11ac Dual Band Module FCC ID: TK4WLE600VX** was tested per the guidance of KDB 558074 D01v03r03. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.10. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.11. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the trade name and FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 558074 D01v03r03 were used in the measurement of the **802.11ac Dual Band Module FCC ID: TK4WLE600VX.**

Deviation from measurement procedure…….....None

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

Line conducted emissions test results are shown in Section 7.8.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-25GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna of the **802.11ac Dual Band Module** uses a unique connector.

Antenna Type	Antenna Connector Type
Panel Antenna 1#	IPEX connector
Panel Antenna 2#	Inverted connector
Panel Antenna 3#	Inverted connector
Panel Antenna 4#	IPEX connector
Panel Antenna 5#	IPEX connector
Panel Antenna 6#	IPEX connector
Dipole Antenna 1#	IPEX connector

Conclusion:

The **802.11ac Dual Band Module FCC ID: TK4WLE600VX** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2015/11/07
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2015/11/07
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2015/11/07
Temperature/ Meter Humidity	Anymetre	TH101B	MRTSUE06045	1 year	2015/11/14

Radiated Emission

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	E4447A	MRTSUE06028	1 year	2015/10/09
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2015/11/07
Preamplifier	Schwarzbeck	AP18G40	MRTSUE06121	1 year	2016/04/15
Preamplifier	Agilent	83017A	MRTSUE06019	1 year	2015/12/13
Loop Antenna	Schwarzbeck	FMZB1519	MRTSUE06025	1 year	2015/11/08
TRILOG Antenna	Schwarzbeck	VULB9162	MRTSUE06022	1 year	2015/11/08
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2015/11/08
Broadband Horn Antenna	Schwarzbeck	BBHA9170	MRTSUE06024	1 year	2016/01/05
Temperature/Humidity Meter	Anymetre	TH101B	MRTSUE06048	1 year	2015/11/14

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2016/04/23
USB Wideband Power Sensor	Boonton	55006	MRTSUE06109	1 year	2015/10/15
Temperature/Humidity Meter	Anymetre	TH101B	MRTSUE06046	1 year	2015/11/14

Software	Version	Function
e3	V8.3.5	EMI Test Software

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

AC Conducted Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB

7. TEST RESULT

7.1. Summary

Company Name: **Compex Systems Pte Ltd**
FCC ID: **TK4WLE600VX**
FCC Classification: **Digital Transmission System (DTS)**
Data Rate(s) Tested: **1Mbps ~ 11Mbps (b);**
6Mbps ~ 54Mbps (g);
6.5/7.2Mbps ~ 195/216.7Mbps (n-HT20);
13.5/15Mbps ~ 405/450Mbps (n-HT40)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	6dB Bandwidth	≥ 500kHz	Conducted	Pass	Section 7.2
15.247(b)(3)	Output Power	≤ 30dBm		Pass	Section 7.3
15.247(e)	Power Spectral Density	≤ 8dBm/3kHz		Pass	Section 7.4
15.247(d)	Band Edge / Out-of-Band Emissions	≥ 30dBc(Average)		Pass	Section 7.5
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 7.6 & 7.7
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.8

Notes:

1) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

7.2. 6dB Bandwidth Measurement

7.2.1. Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

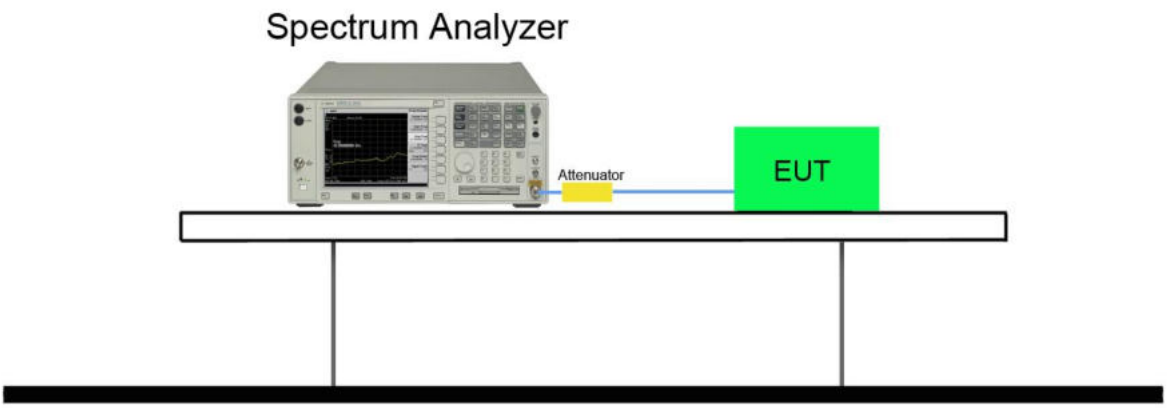
7.2.2. Test Procedure used

KDB 558074 D01v03r02 – Section 8.2 Option 2

7.2.3. Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

7.2.4. Test Setup



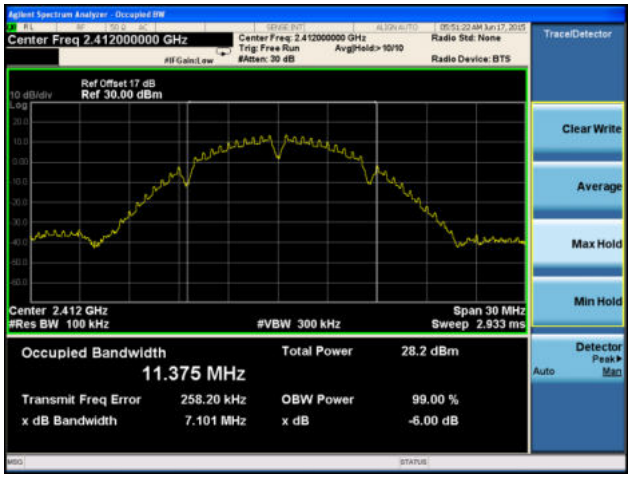
7.2.5. Test Result

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
802.11b	1	01	2412	7.10	≥0.5	Pass
802.11b	1	06	2437	7.10	≥0.5	Pass
802.11b	1	11	2462	7.10	≥0.5	Pass
802.11g	6	01	2412	16.34	≥0.5	Pass
802.11g	6	06	2437	16.36	≥0.5	Pass
802.11g	6	11	2462	16.34	≥0.5	Pass
802.11n-HT20	6.5	01	2412	17.34	≥0.5	Pass
802.11n-HT20	6.5	06	2437	17.29	≥0.5	Pass
802.11n-HT20	6.5	11	2462	17.58	≥0.5	Pass
802.11n-HT40	13.5	03	2422	35.72	≥0.5	Pass
802.11n-HT40	13.5	06	2437	35.50	≥0.5	Pass
802.11n-HT40	13.5	09	2452	35.75	≥0.5	Pass

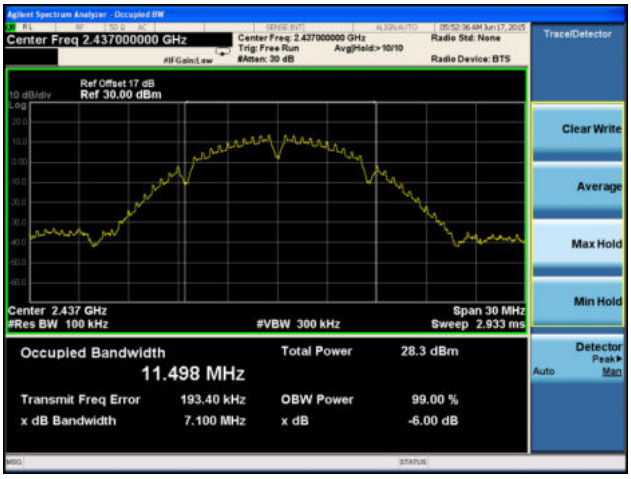
Note: 6dB Bandwidth is measured at ant 0 port.

802.11b 6dB Bandwidth

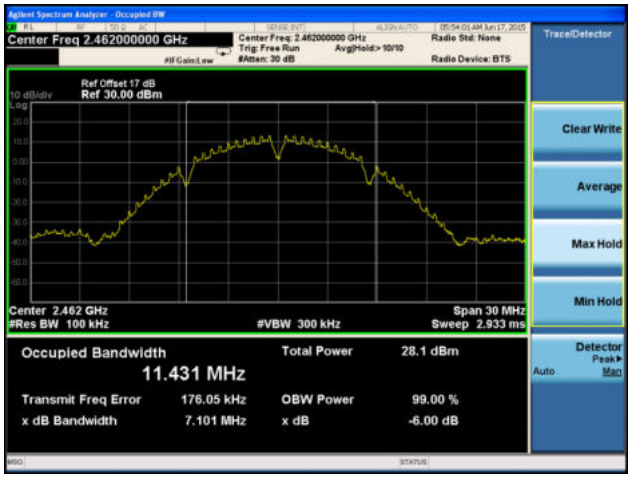
Channel 01 (2412MHz)



Channel 06 (2437MHz)

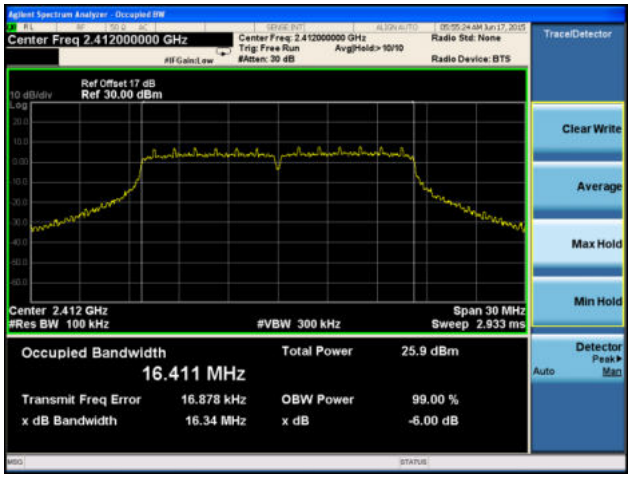


Channel 11 (2462MHz)

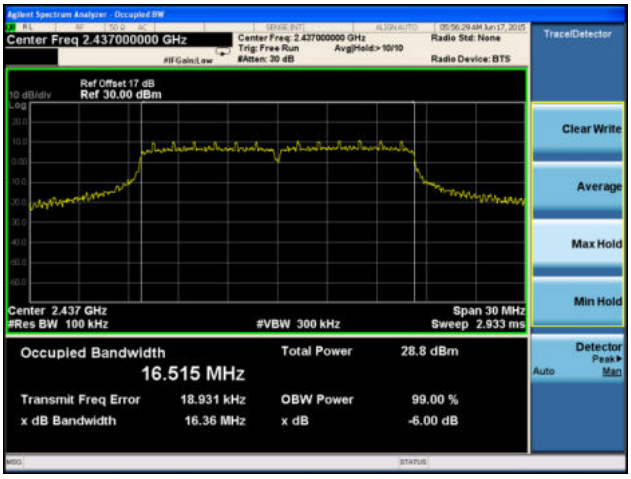


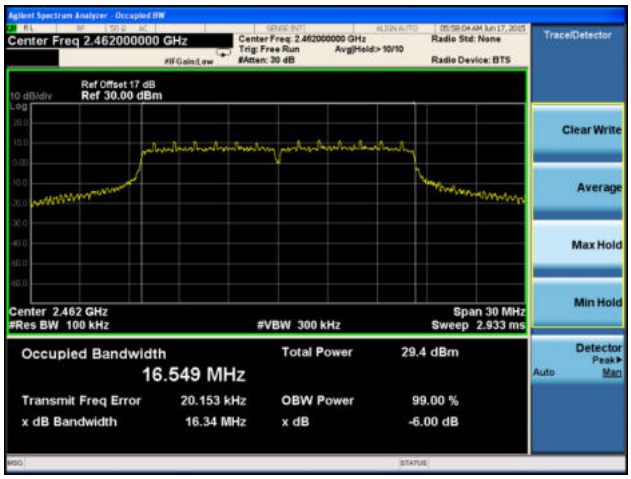
802.11g 6dB Bandwidth

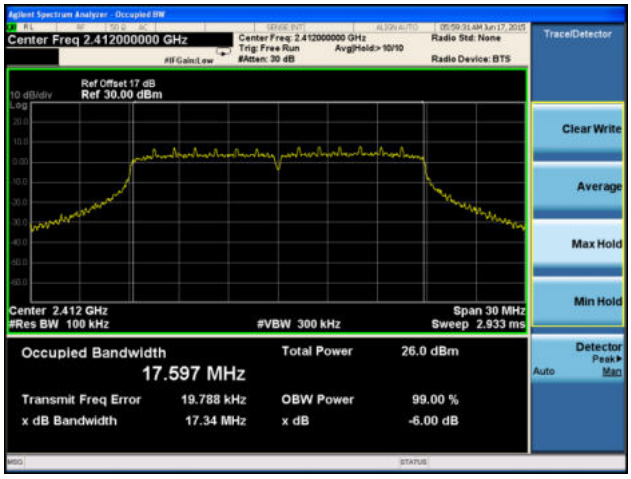
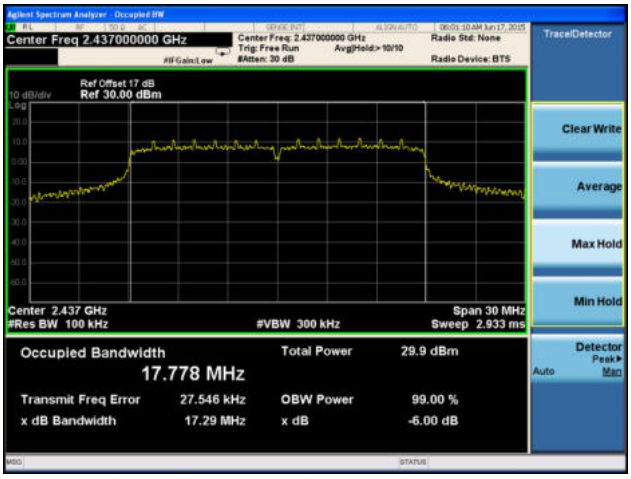
Channel 01 (2412MHz)

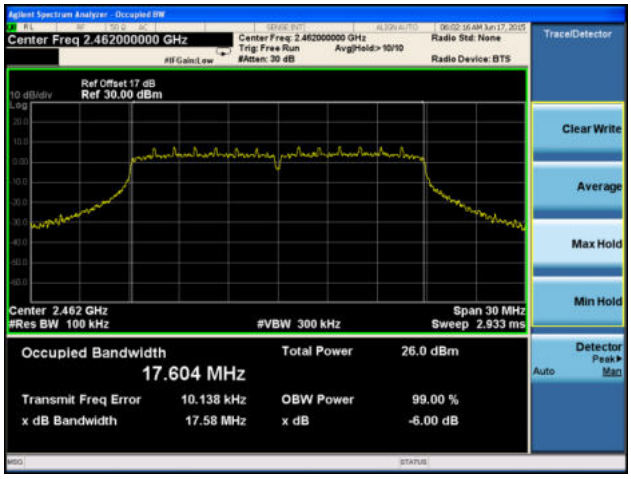


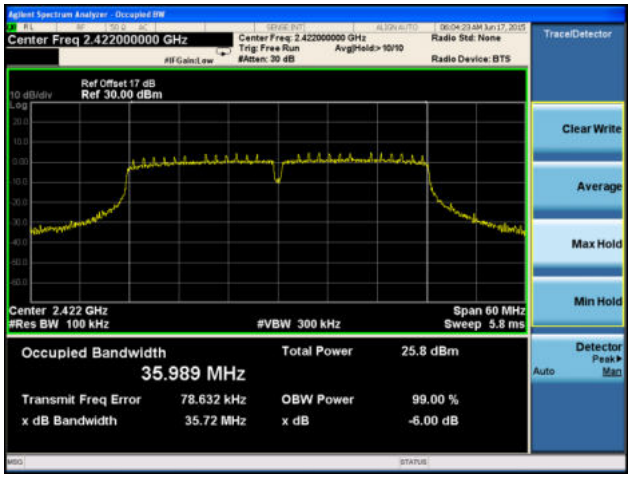
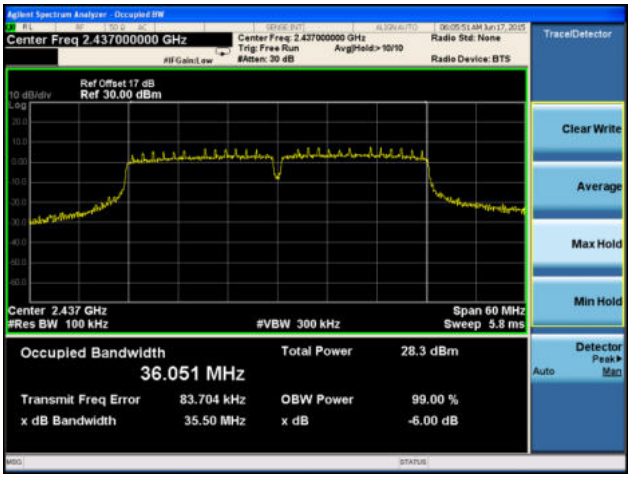
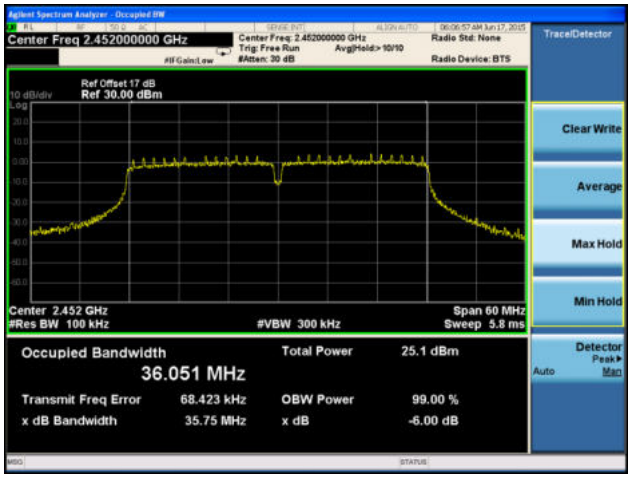
Channel 06 (2437MHz)



Channel 11 (2462MHz)	
	

802.11n-HT20 6dB Bandwidth	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	

Channel 11 (2462MHz)	
	

802.11n-HT40 6dB Bandwidth	
Channel 03 (2422MHz)	**Channel 06 (2437MHz)**
	
Channel 09 (2452MHz)	
	

7.3. Output Power Measurement

7.3.1. Test Limit

The maximum output power shall be less 1 Watt (30dBm).

The conducted output power limit is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For fixed point-to-point operation, systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Dipole Antenna 1#: Power Limit = 30dBm;

Panel Antenna 1#: Power Limit = 30dBm – (11dBi – 6dBi)/3 = 28.33dBm;

7.3.2. Test Procedure Used

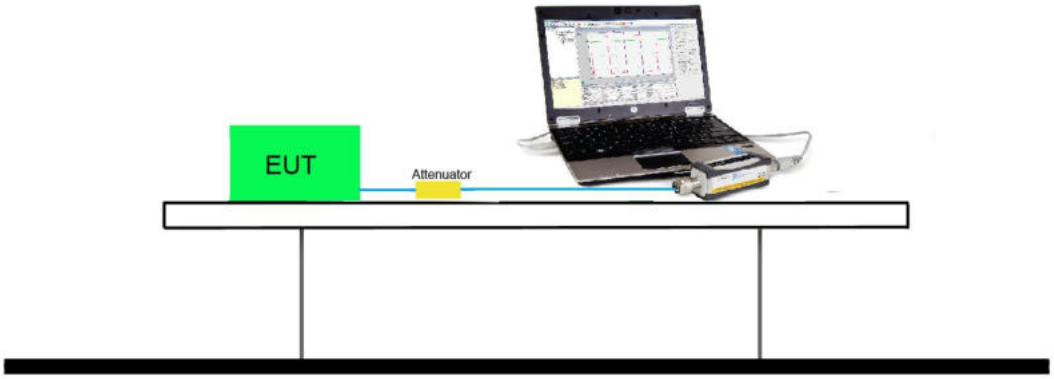
KDB 558074 D01v03r02 - Section 9.2.3.2 AVGPM-G Average Power Method

7.3.3. Test Setting

Average Power Measurement

Average power measurements were perform only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

7.3.4. Test Setup



7.3.5. Test Result of Output Power

Output power at various data rates for Ant 0 / Ant 0 + 1:

Test Mode	Bandwidth (MHz)	Channel No.	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)
802.11b	20	6	2437	1	22.20
				5.5	21.74
				11	21.28
802.11g	20	6	2437	6	21.42
				24	21.11
				54	20.66
802.11n	20	6	2437	13	21.39
				14.4	21.13
				19.5	20.82
				52	20.69
				57.8	20.51
				156	20.33
				130	20.14
				144	19.85
				195	19.71
802.11n	40	6	2437	27	20.25
				30	20.06
				40.5	19.72
				108	19.52
				120	19.43
				324	19.20
				270	19.05
				300	18.85
				405	18.61

Test Result of Average Output Power

1Tx

Test Mode	N_{Tx}	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Limit (dBm)	Result
11b	1	1	1	2412	22.42	22.26	≤ 28.33	Pass
11b	1	1	6	2437	22.20	22.04	≤ 28.33	Pass
11b	1	1	11	2462	21.81	21.69	≤ 28.33	Pass
11g	1	6	1	2412	19.26	18.75	≤ 28.33	Pass
11g	1	6	6	2437	21.42	21.56	≤ 28.33	Pass
11g	1	6	11	2462	18.51	18.41	≤ 28.33	Pass
11n-HT20	1	6.5	1	2412	19.03	18.89	≤ 28.33	Pass
11n-HT20	1	6.5	6	2437	21.39	21.30	≤ 28.33	Pass
11n-HT20	1	6.5	11	2462	18.34	18.29	≤ 28.33	Pass
11n-HT40	1	13.5	3	2422	17.71	17.52	≤ 28.33	Pass
11n-HT40	1	13.5	6	2437	20.25	20.13	≤ 28.33	Pass
11n-HT40	1	13.5	9	2452	16.78	16.31	≤ 28.33	Pass

2Tx

Test Mode	N_{Tx}	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Total Average Power (dBm)	Limit (dBm)	Result
11n-HT20	2	13	1	2412	16.92	16.78	19.86	≤ 28.33	Pass
11n-HT20	2	13	6	2437	21.29	21.12	24.22	≤ 28.33	Pass
11n-HT20	2	13	11	2462	16.78	16.56	19.68	≤ 28.33	Pass
11n-HT40	2	27	3	2422	15.30	15.13	18.23	≤ 28.33	Pass
11n-HT40	2	27	6	2437	20.58	20.47	23.54	≤ 28.33	Pass
11n-HT40	2	27	9	2452	15.71	15.85	18.79	≤ 28.33	Pass

Note: Total Average Power (dBm) = $10*\log\{10^{(\text{Ant 0 Average Power }/10)}+10^{(\text{Ant 1 Average Power }/10)}\}$ (dBm).

7.4. Power Spectral Density Measurement

7.4.1. Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

For 2.412~2.462GHz Band:

Dipole Antenna 1#: Limit (dBm) = 8dBm/3kHz;

Panel Antenna 1#: Limit (dBm) = 8dBm/3kHz – (11dBi – 6dBi)/3 = 6.33dBm/3kHz;

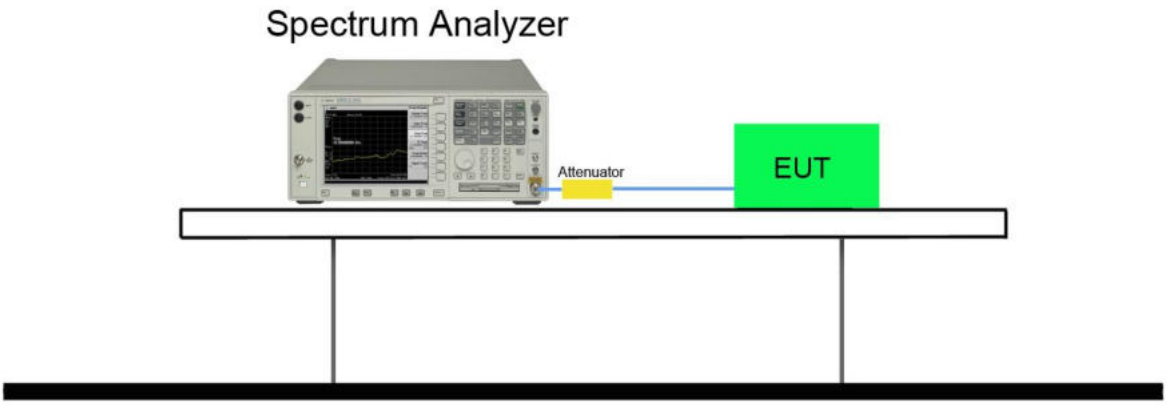
7.4.2. Test Procedure Used

KDB 558074 D01v03r02 - Section 10.5 Method PSD

7.4.3. Test Setting

1. Measure the duty cycle (x) of the transmitter output signal
2. Set instrument center frequency to DTS channel center frequency.
3. Set span to at least 1.5 times the OBW.
4. RBW = 10kHz
5. VBW = 30kHz
6. Detector = RMS
7. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
8. Sweep time = auto couple
9. Don't use sweep triggering. Allow sweep to "free run".
10. Employ trace averaging (RMS) mode over a minimum of 100 traces.
11. Use the peak marker function to determine the maximum amplitude level.
12. Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time.
13. Add Constant Factor = 10*log(3kHz / 10kHz) = -5.23

7.4.4. Test Setup



7.4.5. Test Result

1Tx

Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 PSD (dBm / 10kHz)	Ant 1 PSD (dBm / 10kHz)	Duty Cycle (%)	Constant Factor	Max PSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
11b	1	1	2412	-4.00	-4.31	99.0	-5.23	-9.23	≤ 6.33	Pass
11b	1	6	2437	-4.03	-3.95	99.0	-5.23	-9.18	≤ 6.33	Pass
11b	1	11	2462	-3.93	-3.94	99.0	-5.23	-9.16	≤ 6.33	Pass
11g	6	1	2412	-10.90	-12.01	96.9	-5.23	-15.99	≤ 6.33	Pass
11g	6	6	2437	-8.27	-7.58	96.9	-5.23	-12.67	≤ 6.33	Pass
11g	6	11	2462	-10.77	-11.19	96.9	-5.23	-15.86	≤ 6.33	Pass
11n-HT20	6.5	1	2412	-11.21	-11.46	96.9	-5.23	-16.30	≤ 6.33	Pass
11n-HT20	6.5	6	2437	-8.55	-8.23	96.9	-5.23	-13.32	≤ 6.33	Pass
11n-HT20	6.5	11	2462	-11.33	-11.81	96.9	-5.23	-16.42	≤ 6.33	Pass
11n-HT40	13.5	3	2422	-14.27	-14.40	95.6	-5.23	-19.30	≤ 6.33	Pass
11n-HT40	13.5	6	2437	-11.91	-11.81	95.6	-5.23	-16.84	≤ 6.33	Pass
11n-HT40	13.5	9	2452	-15.11	-15.75	95.6	-5.23	-20.14	≤ 6.33	Pass

Note: When EUT duty cycle < 98%, the max PSD = the PSD + 10*log(1/duty cycle) + Constant Factor.

2Tx

Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 PSD (dBm / 10kHz)	Ant 1 PSD (dBm / 10kHz)	Duty Cycle (%)	Constant Factor	Total PSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
11n-HT20	13	1	2412	-12.13	-12.17	96.9	-5.23	-14.23	≤ 6.33	Pass
11n-HT20	13	6	2437	-8.12	-7.97	96.9	-5.23	-10.13	≤ 6.33	Pass
11n-HT20	13	11	2462	-10.64	-12.07	96.9	-5.23	-13.38	≤ 6.33	Pass
11n-HT40	27	3	2422	-16.28	-16.03	95.6	-5.23	-18.18	≤ 6.33	Pass
11n-HT40	27	6	2437	-11.63	-11.54	95.6	-5.23	-13.61	≤ 6.33	Pass
11n-HT40	27	9	2452	-16.64	-15.82	95.6	-5.23	-18.23	≤ 6.33	Pass

Note: When EUT duty cycle < 98%, the total PSD = $10*\log\{10^{(\text{Ant 0 PSD}/10)}+10^{(\text{Ant 1 PSD}/10)}\}$ + 10*log(1/duty cycle) + Constant Factor.

802.11b PSD - Ant 0

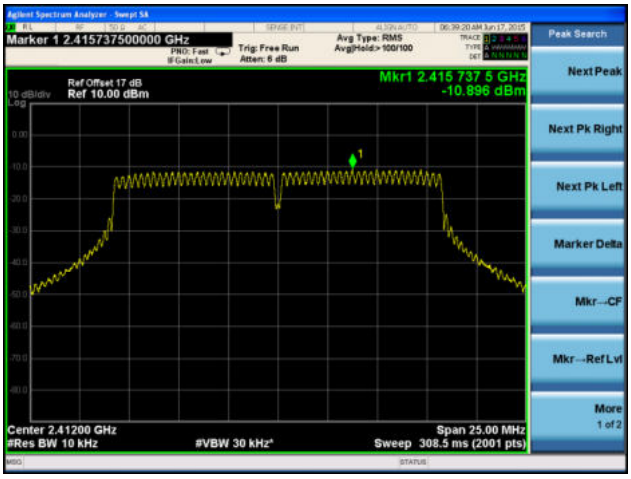
Channel 01 (2412MHz)

Channel 06 (2437MHz)

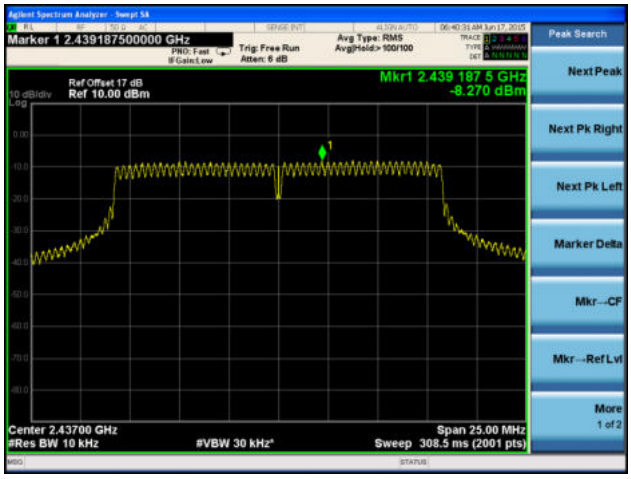
Channel 11 (2462MHz)

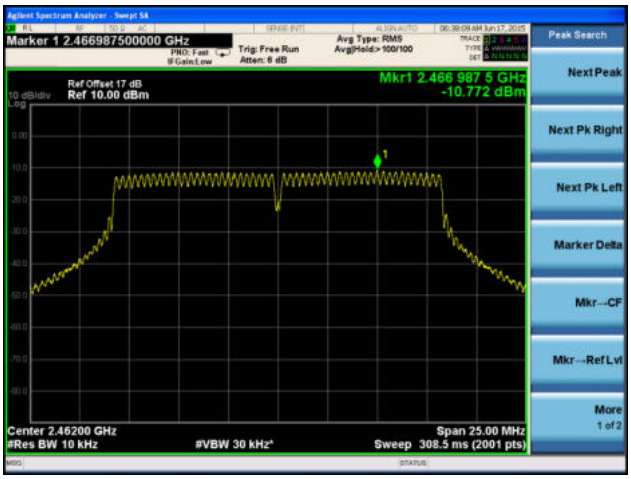
802.11g PSD - Ant 0

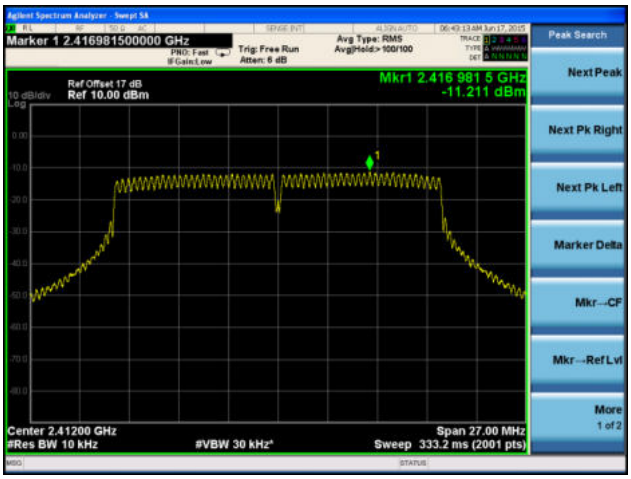
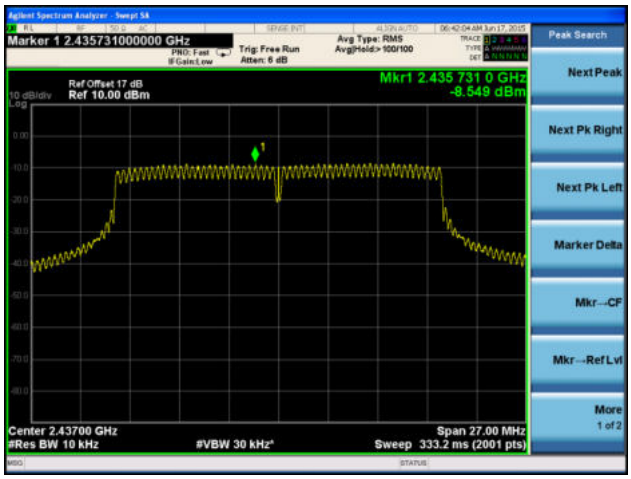
Channel 01 (2412MHz)

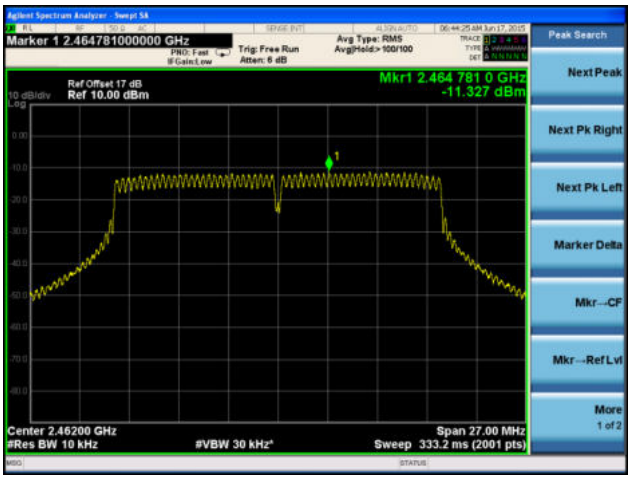


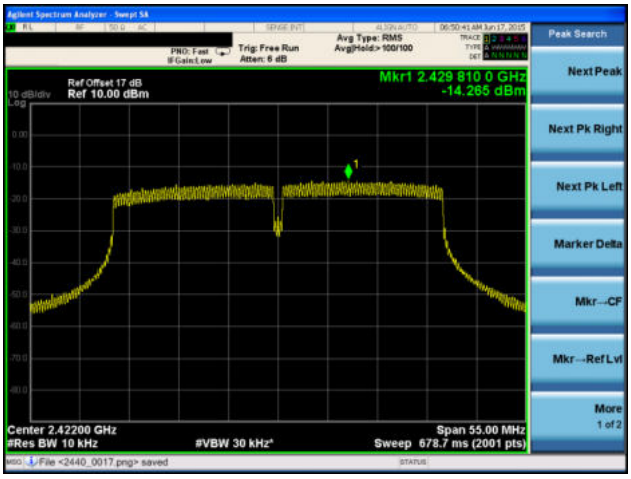
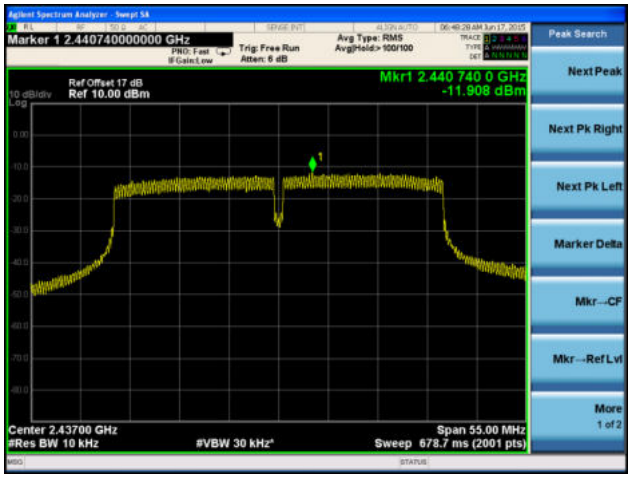
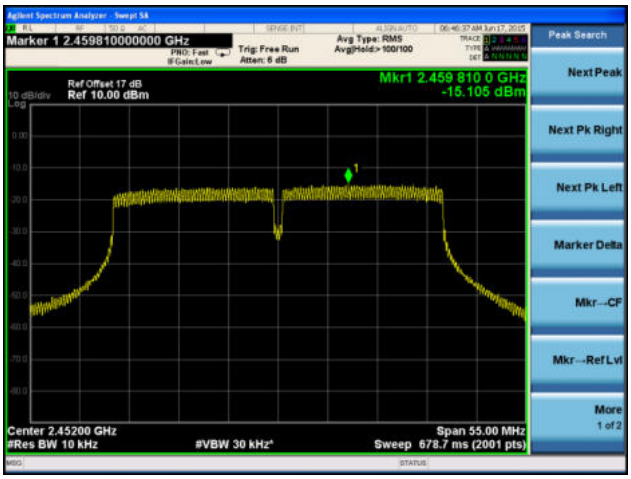
Channel 06 (2437MHz)



Channel 11 (2462MHz)	
	

802.11n-HT20 PSD - Ant 0	
Channel 01 (2412MHz)	**Channel 06 (2437MHz)**
	

Channel 11 (2462MHz)	
	

802.11n-HT40 PSD - Ant 0	
Channel 03 (2422MHz)	**Channel 06 (2437MHz)**
	
Channel 09 (2452MHz)	
	

802.11b PSD - Ant 1

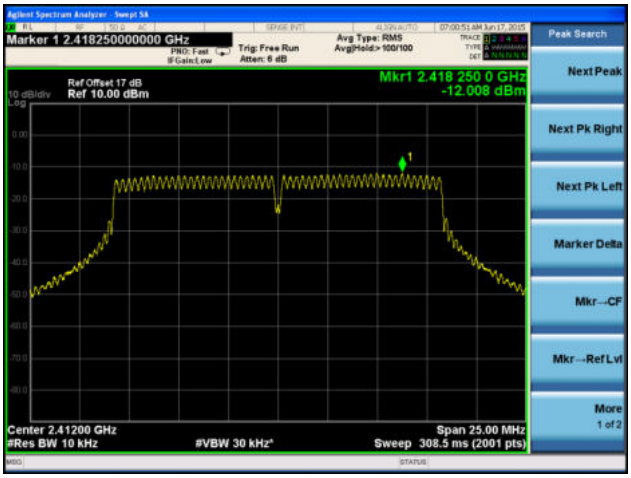
Channel 01 (2412MHz)

Channel 06 (2437MHz)

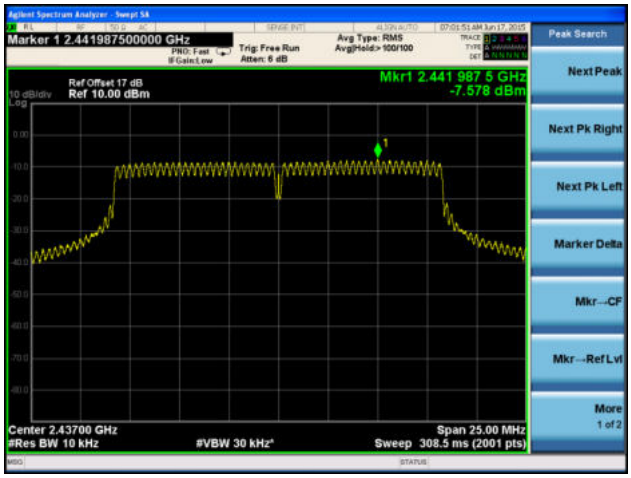
Channel 11 (2462MHz)

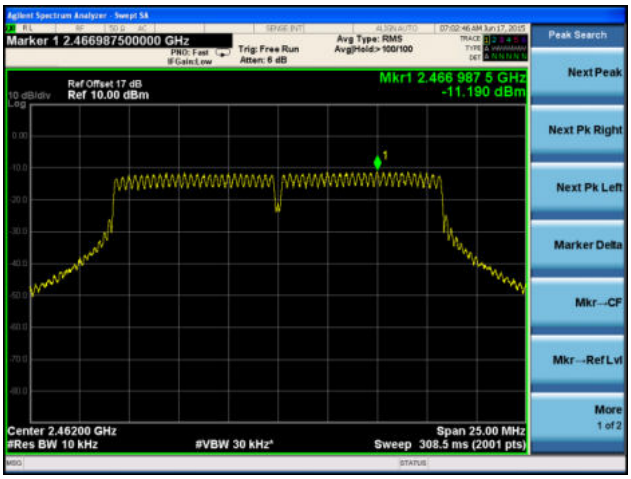
802.11g PSD - Ant 1

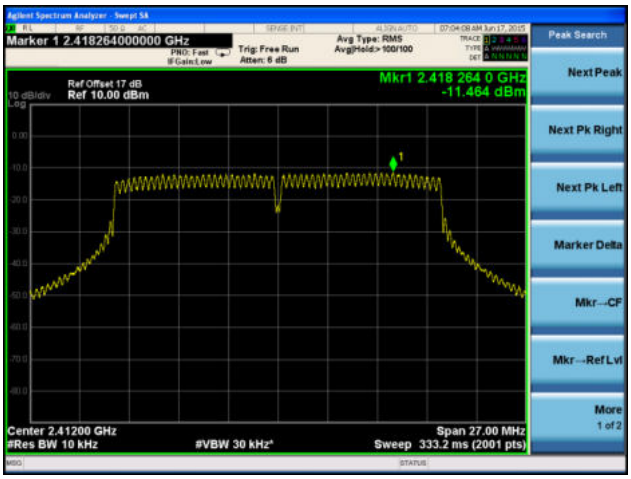
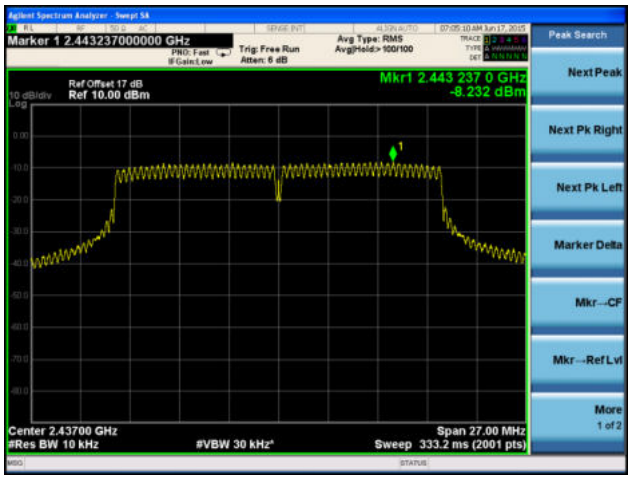
Channel 01 (2412MHz)

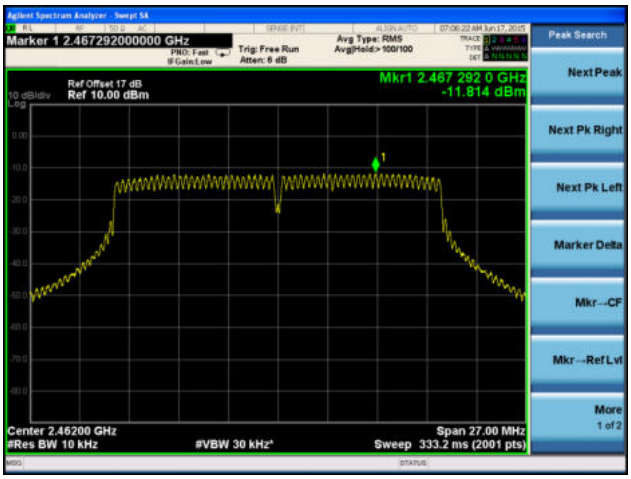


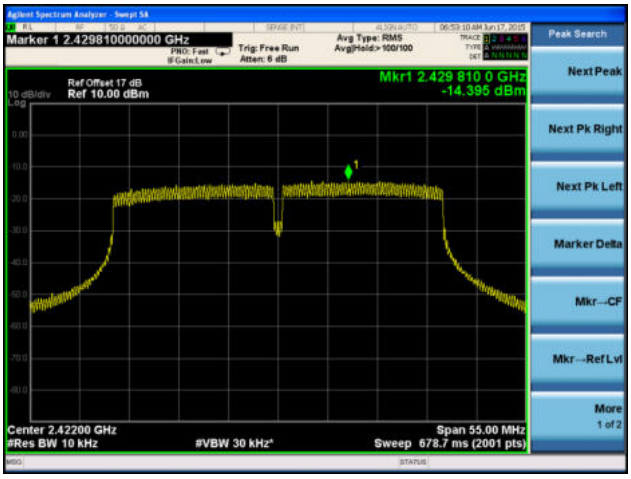
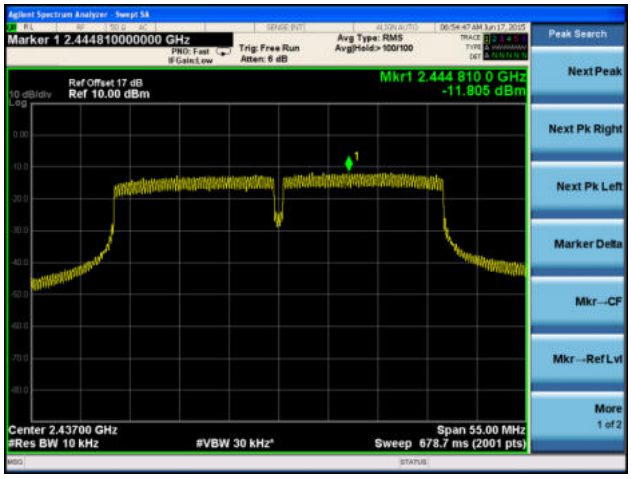
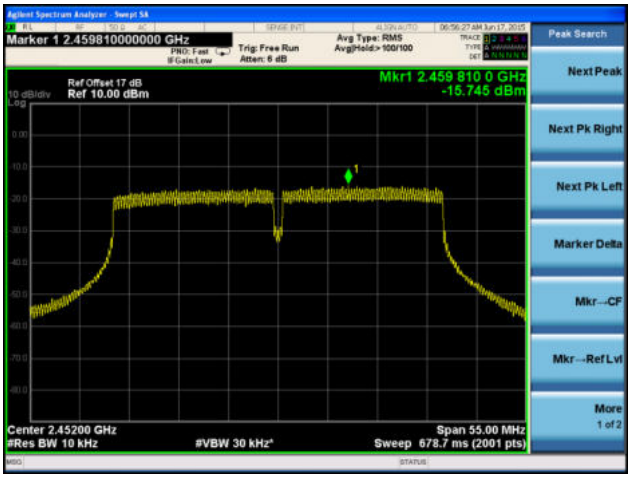
Channel 06 (2437MHz)



Channel 11 (2462MHz)	
	

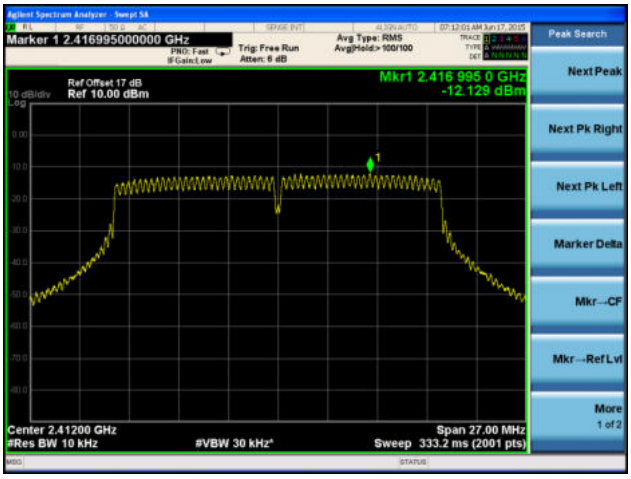
802.11n-HT20 PSD - Ant 1	
Channel 01 (2412MHz)	**Channel 06 (2437MHz)**
	

Channel 11 (2462MHz)	
	

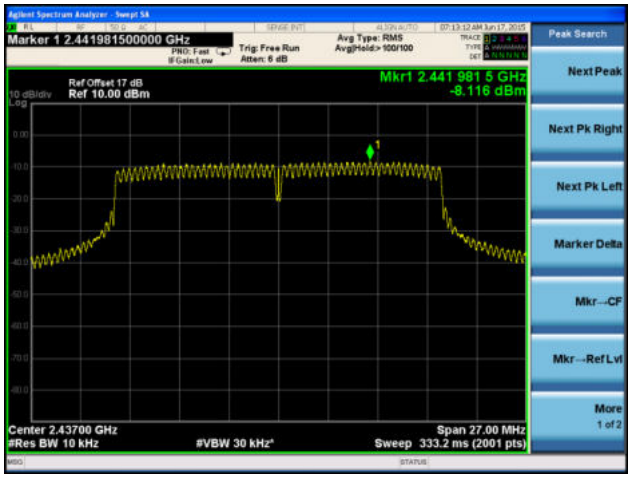
802.11n-HT40 PSD - Ant 1	
Channel 03 (2422MHz)	**Channel 06 (2437MHz)**
	
Channel 09 (2452MHz)	
	

802.11n-HT20 PSD - Ant 0 / Ant 0 + 1

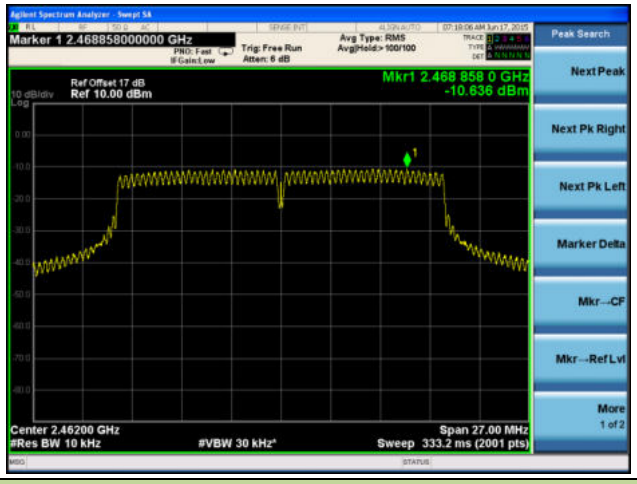
Channel 01 (2412MHz)



Channel 06 (2437MHz)

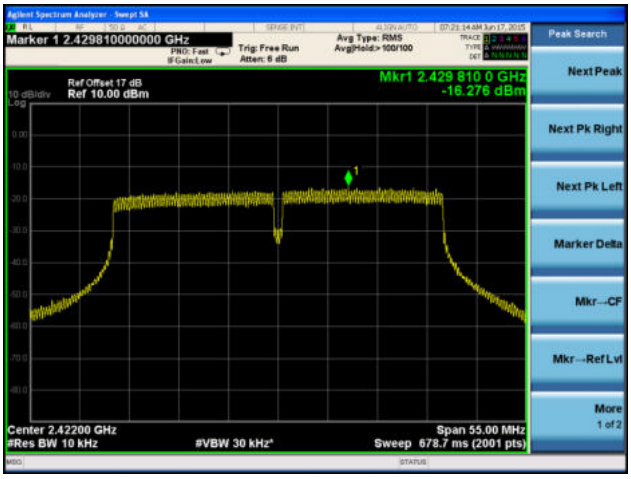


Channel 11 (2462MHz)

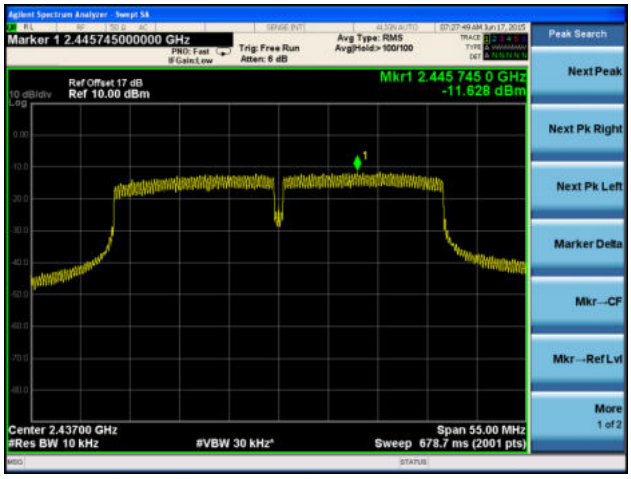


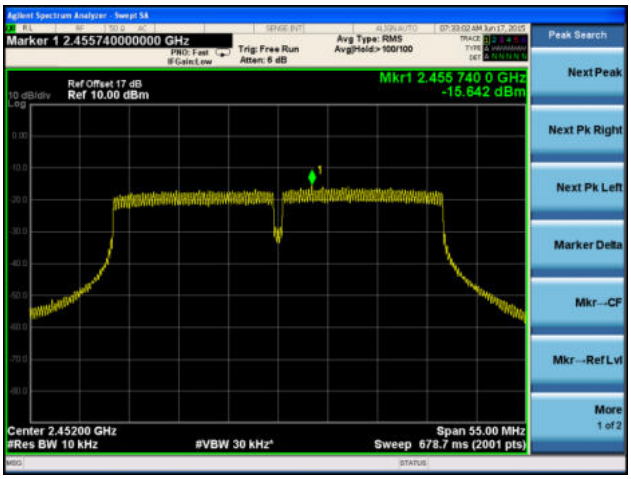
802.11n-HT40 PSD - Ant 0 / Ant 0 + 1

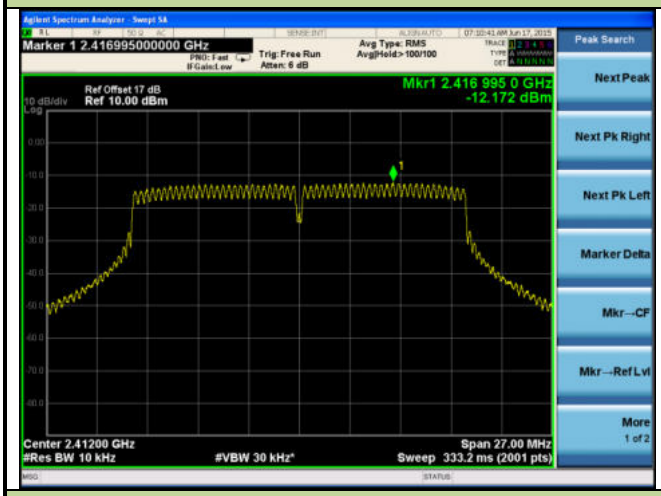
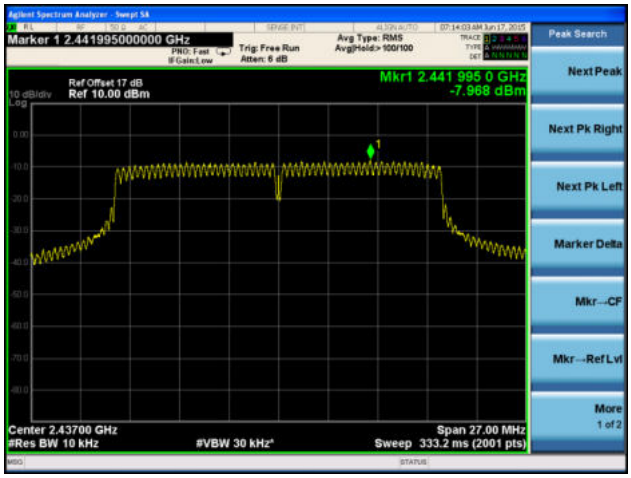
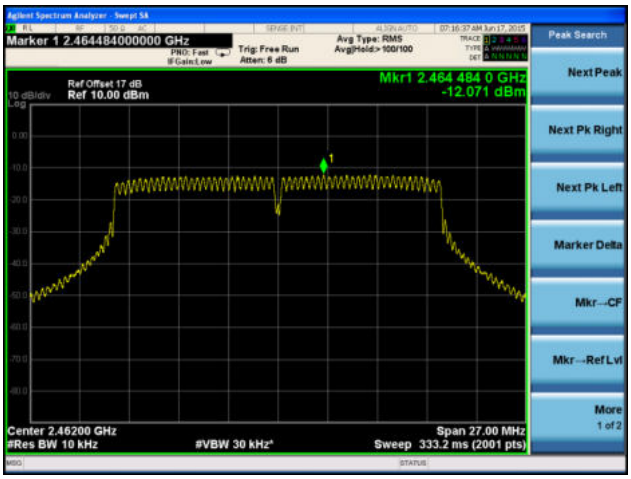
Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)	
	

802.11n-HT20 PSD - Ant 1 / Ant 0 + 1	
Channel 01 (2412MHz)	Channel 06 (2437MHz)
	

Channel 11 (2462MHz)