



Test report No. : 4789166774-US-R0-V0
Page : 1 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765

RADIO TEST REPORT

Product : DSL Router

Model Name : Vigor2765Vac

Series Model : Vigor2765ac, Vigor2766ac, Vigor2766Vac, Vigor2135ac, Vigor2135Vac, Vigor2135Fac, Vigor2135FVac, Vigor2125ac, Vigor2125Vac, Vigor2125Fac, Vigor2125FVac

FCC ID : VGY2765

Test Regulation : FCC 47 CFR Part 15 Subpart C (Section 15.247)

Received Date : Sep. 11, 2019

Test Date : Sep. 27, 2019 ~ Feb 14, 2020

Issued Date : Apr. 8, 2020

Applicant : DrayTek Corp.
No.26 Fu Shing Rd., HuKou County, Hsin-Chu Industrial Park,
Hsin-Chu, Taiwan 303 R.O.C

Issued By : Underwriters Laboratories Taiwan Co., Ltd.
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd.,
Zhudong Township, Hsinchu County, Taiwan



The results reported herein have been performed in accordance with the laboratory's terms of accreditation. This report shall not be reproduced except in full without the written approval of the Laboratory. The results in this report are responsible of the test sample(s) provided by the client only and are not to be used to indicate applicability to other similar products.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789166774-US-R0-V0
Page : 2 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765

REVISION HISTORY

Original Test Report No.: 4789166774-US-R0-V0

[illegible]

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Table Of Contents

1. Attestation of Test Results	4
2. Summary of Test Results	5
3. Test Methodology and Reference Procedures.....	6
4. Facilities and Accreditation	6
5. Measurement Uncertainty	7
6. Equipment under Test	8
6.1. Description of EUT	8
6.2. Channel List	11
6.3. Test Condition.....	12
6.4. Description Of Available Antennas	12
6.5. Test Mode Applicability and Tested Channel Detail.....	13
6.6. Duty cycle	14
7. Test Equipment.....	15
8. Description of Test Setup.....	17
9. Test Results.....	19
9.1. 6dB Bandwidth	19
9.2. Conducted output power	22
9.3. Power Spectral Density	25
9.4. Conducted Out of Band Emission.....	29
9.5. Radiated Spurious Emission	46
9.6. AC Power Line Conducted Emission	69
Appendix I Radiated Band Edge Measurement	75
Appendix II Radiated Spurious Emission Measurement	83



Test report No. : 4789166774-US-R0-V0
Page : 4 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765

1. Attestation of Test Results

APPLICANT: DrayTek Corp.
No.26 Fu Shing Rd., HuKou County, Hsin-Chu Industrial Park, Hsin-Chu, Taiwan 303 R.O.C

MANUFACTURER DrayTek Corp.
No.26 Fu Shing Rd., HuKou County, Hsin-Chu Industrial Park, Hsin-Chu, Taiwan 303 R.O.C

EUT DESCRIPTION: DSL Router

BRAND: DrayTek

MODEL: Vigor2765Vac

SERIES MODEL: Vigor2765ac, Vigor2766ac, Vigor2766Vac, Vigor2135ac, Vigor2135Vac, Vigor2135Fac, Vigor2135FVac, Vigor2125ac, Vigor2125Vac, Vigor2125Fac, Vigor2125FVac

SAMPLE STAGE: Engineering sample

DATE of TESTED: Sep. 27, 2019 ~ Feb 14, 2020

APPLICABLE STANDARDS

STANDARD	Test Results
FCC 47 CFR PART 15 Subpart C (Section 15.247)	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Cindy Hsin

Cindy Hsin
Project Handler

Date : Apr. 8, 2020

Approved and Authorized By:

Howard Kao

Howard Kao Date : Apr. 8, 2020
Project Engineer

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



2. Summary of Test Results

Summary of Test Results		
FCC Clause	Test Items	Result
15.247(a)(2)	6dB Bandwidth	PASS
15.247(b)	Conducted Output Power	PASS
15.247(e)	Power Spectral Density	PASS
15.247(d)	Antenna Port Emission	PASS
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS
15.207	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	PASS

Note:

1. For the Radiated Band Edge test plots were recorded in Appendix I, the Radiated Emissions test plots were recorded in Appendix II.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789166774-US-R0-V0
Page : 6 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765

3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB558074 D01 Meas Guidance v05r02, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013 and KDB 662911 D01 Multiple Transmitter Output v02r01.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398. The full scope of accreditation can be viewed at http://accreditation.taftw.org.tw/taf/public/basic/viewApplyItems.action?unitNo=3398

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



5. Measurement Uncertainty

For statement of conformity, accuracy method (Section 8.2.4 and 8.2.5 of ISO Guide 98-4) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Test Item	Measurement Frequency Range	K	U(dB)
Conducted disturbance at mains terminals ports	0.15MHz ~ 30MHz	2	1.7
RF Conducted	9 kHz - 40GHz	2	1.0
Radiated disturbance below 30MHz	9 kHz - 30 MHz	2	2.2
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	2	5.3
Radiated disturbance above 1GHz	1GHz ~ 40GHz	2	4.8

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



6. Equipment under Test

6.1. Description of EUT

Product	DSL Router
Brand Name	DrayTek
Model Name	Vigor2765Vac
Series Model	Vigor2765ac, Vigor2766ac, Vigor2766Vac, Vigor2135ac, Vigor2135Vac, Vigor2135Fac, Vigor2135FVac, Vigor2125ac, Vigor2125Vac, Vigor2125Fac, Vigor2125FVac
S/N	191001DAA185F58
Operating Frequency	2412MHz ~ 2462MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Transfer Rate	802.11b: up to 11 Mbps 802.11g: up to 54 Mbps 802.11n: up to MCS15
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
Maximum Output Power	802.11b: 26.55 dBm 802.11g: 27.89 dBm 802.11n (HT20): 27.57 dBm 802.11n (HT40): 25.34 dBm
Normal Voltage	12Vdc from adapter

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Note:

1. The models difference table as below:

Main Model	Function				
	DSL	gfast	FXS	Eth-RJ45 WAN	Eth-SFP WAN
Vigor2765Vac	V	-	V	-	-
Series Model	Function difference				
	DSL	gfast	FXS	Eth-RJ45 WAN	Eth-SFP WAN
Vigor2765ac	V	-	-	-	-
Vigor2766ac	V	V	-	-	-
Vigor2766Vac	V	V	V	-	-
Vigor2135ac	-	-	-	V	-
Vigor2135Vac	-	-	V	V	-
Vigor2135Fac	-	-	-	-	V
Vigor2135FVac	-	-	V	-	V
Vigor2125ac	-	-	-	V	-
Vigor2125Vac	-	-	V	V	-
Vigor2125Fac	-	-	-	-	V
Vigor2125FVac	-	-	V	-	V

- The above models are declared for market purpose by the manufacturer, the difference between the main model and the series model is the combination of hardware design and appearance, there are no changes in RF-related parts, which will not affect RF characteristic.
2. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx,Rx Function
802.11b	2TX,2RX
802.11g	2TX,2RX
802.11n (HT20)	2TX,2RX
802.11n (HT40)	2TX,2RX

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



3. The EUT contains following accessory devices

Product	Brand	Model	Description
AC Adapter	Channel Well Technology	2ABL024F US	Input: 100-240Vac, 0.8A, Output: 12Vdc, 2A Length: 1.5 m, non-shielded cable w/o ferrite core
RJ-45 Cable	Tung-Li	5U422-20	Length: 3 m, non-shielded cable
RJ-11 Cable	N/A	N/A	Length: 1.8 m, non-shielded cable, 6P4C
RJ-11 to RJ-45 Cable	N/A	N/A	Length: 2.2 m, non-shielded cable, 6P4C
RJ-45 to RJ-45 Cable	N/A	N/A	Length: 2.2 m, non-shielded cable, 6P4C

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



6.2. Channel List

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency	Channel	Frequency
1	2412MHz	7	2442MHz
2	2417MHz	8	2447MHz
3	2422MHz	9	2452MHz
4	2427MHz	10	2457MHz
5	2432MHz	11	2462MHz
6	2437MHz	-	-

7 channels are provided for 802.11n (HT40):

Channel	Frequency	Channel	Frequency
3	2422MHz	7	2442MHz
4	2427MHz	8	2447MHz
5	2432MHz	9	2452MHz
6	2437MHz	-	-

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789166774-US-R0-V0
Page : 12 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765

6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	23~26°C / 62~66%RH	120Vac / 60 Hz	Oct. 3, 2019 ~ Feb. 14, 2020	WaterNil Guan / Wayne Chen
Radiated Spurious Emission	966-2	23~27°C / 60~69%RH	120Vac / 60 Hz	Sep. 27, 2019 ~ Feb. 7, 2020	WaterNil Guan / Wayne Chen
AC power Line Conducted Emission	SR1	24~26°C / 63~66%RH	120Vac / 60 Hz	Oct. 15, 2019 ~ Nov. 8, 2019	Wayne Chen

FCC Test Firm Registration Number: 498077

6.4. Description Of Available Antennas

Antenna	Brand Name	Model Name	Antenna Type	Antenna Gain(dBi)
Chain(0)	Walsin	RFDPA131300SBLB805	Dipole	2.18
Chain(1)	Walsin	RFDPA131300SBLB805	Dipole	2.18

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



6.5. Test Mode Applicability and Tested Channel Detail

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- For below 1 GHz radiated emission and AC power line conducted emission have performed all modes of operation were investigated and the worst-case emissions are reported.
- For Antenna Port Conducted Measurement, this item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- The fundamental of the EUT was investigated in three orthogonal axes X/Y/Z, it was determined that X axis was worst-case. Therefore, all final radiated testing was performed with the EUT in X axis.
- For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.
- For AC power line conducted emissions, the pre-scan has been determined by AC power 120Vac/60Hz (worst case)
- Pre-scan radiation has been determined by the model Vigor2765Vac (the worst case). Therefore, only the model Vigor2765Vac tests was performed and recorded in this report.

Non-Beamforming Mode

Test item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions (Above 1GHz)	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1.0
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6.0
	802.11n(HT20)	OFDM	BPSK	1 to 11	1,6,11	MCS0
	802.11n(HT40)	OFDM	BPSK	3 to 9	3,6,9	MCS0
Radiated Emissions (Below 1GHz)	802.11n(HT20)	OFDM	BPSK	1 to 11	11	MCS0
AC Power Line Conducted Emission	802.11n(HT20)	OFDM	BPSK	1 to 11	11	MCS0
Antenna Port Conducted Measurement	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1.0
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6.0
	802.11n(HT20)	OFDM	BPSK	1 to 11	1,6,11	MCS0
	802.11n(HT40)	OFDM	BPSK	3 to 9	3,6,9	MCS0

Co-Location Mode

Test item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions	802.11b	DSSS	DBPSK	1 to 11	6+48	1.0
	802.11a	OFDM	BPSK	36 to 48		6.0
				149 to 165		

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



6.6. Duty cycle

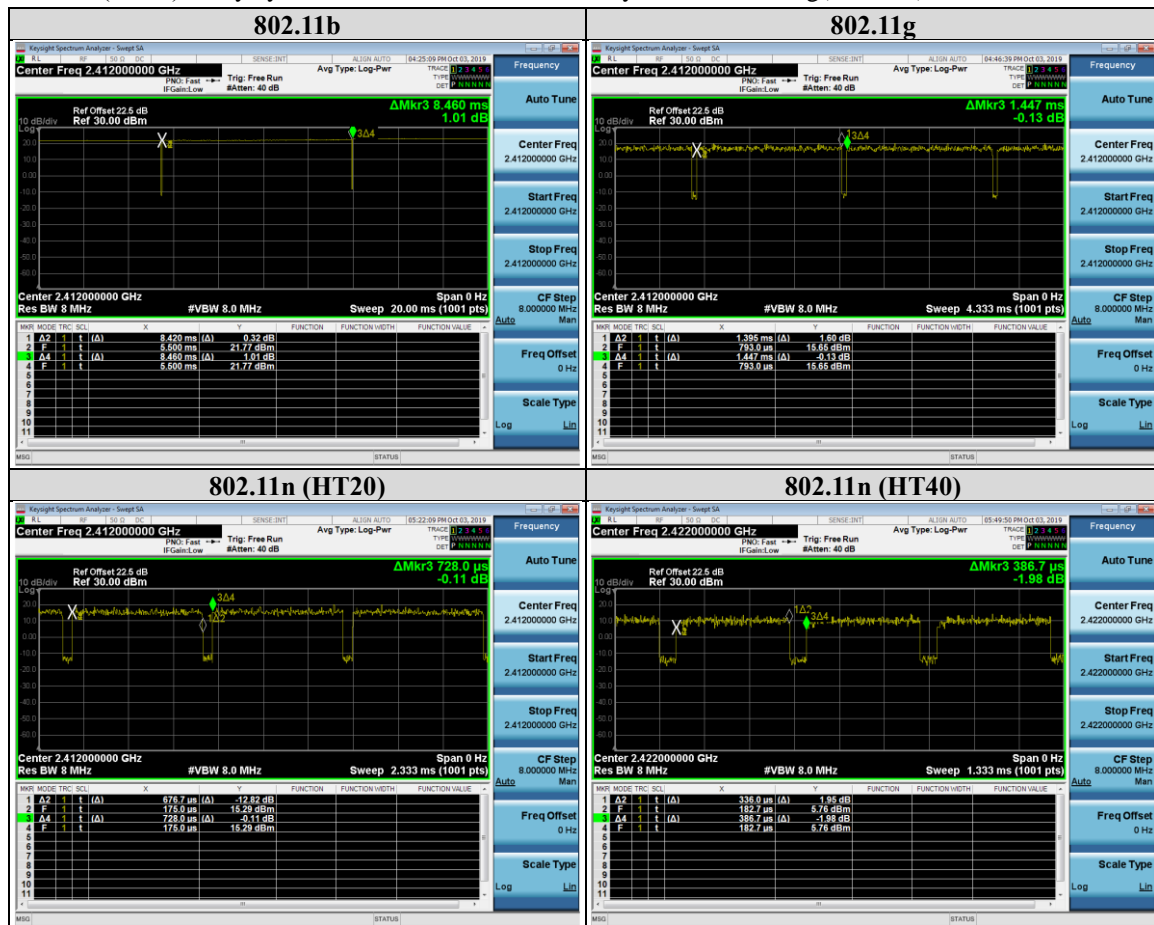
Non-Beamforming Mode

802.11b: Duty cycle = $8.42/8.46 = 0.995$, duty cycle of test signal is $\geq 98\%$, duty factor is not required.

802.11g: Duty cycle = $1.395/1.447 = 0.964$, Duty factor = $10 * \log(1/0.964) = 0.16$

802.11n (HT20): Duty cycle = $0.6767/0.728 = 0.93$, Duty factor = $10 * \log(1/0.93) = 0.32$

802.11n (HT40): Duty cycle = $0.336/0.3867 = 0.869$, Duty factor = $10 * \log(1/0.869) = 0.61$



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789166774-US-R0-V0
Page : 15 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765

7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	Nov. 8, 2018	1 year
				Nov. 13, 2019	
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	Nov. 8, 2018	1 year
				Dec. 4, 2019	
Loop Antenna	ETS lindgren	6502	00213440	Dec. 11, 2018	1 year
				Dec. 19, 2019	
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	Jan. 14, 2019	1 year
				Jan. 3, 2020	
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	Jan. 25, 2019	1 year
				Jan. 3, 2020	
Horn Antenna(18-40 GHz)	Schwarzbeck	BBHA 9170	781	Jan. 16, 2019	1 year
				Dec. 27, 2019	
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	Jan. 30, 2019	1 year
				Feb. 4, 2020	
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	Jan. 29, 2019	1 year
				Feb. 4, 2020	
Preamplifier (18-40GHz)	EMCI	EMC184040SE E	980426	May. 8, 2019	1 year
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	Jan. 29, 2019	1 year
				Jan. 8, 2020	
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	Jan. 29, 2019	1 year
				Jan. 8, 2020	

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789166774-US-R0-V0
Page : 16 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	Nov. 8, 2018	1 year
				Nov. 6, 2019	
Pulse Power Sensor	Anrisu	MA2411B	1531202	Dec. 17, 2018	1 year
				Dec. 23, 2019	
Power Meter	Anrisu	ML2495A	1645002	Dec. 17, 2018	1 year
				Dec. 23, 2019	
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	Nov. 14, 2018	1 year
				Nov. 19, 2019	
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	Aug. 8, 2019	1 year
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	Aug. 6, 2019	1 year
Cables	HARBOUR INDUSTRIES	LL142	170205-5000-1	Jan. 29, 2019	1 year
				Feb. 5, 2020	

UL Software		
Description	Name	Version
Radiated measurement	EZ_EMC	1.1.4.2
Conducted measurement	Keysight.TestSystem	1.0.0.0
AC power Line Conducted Emission	EZ_EMC	1.1.4.2

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



8. Description of Test Setup

Support Equipment

Equipment	Brand Name	Model Name	S/N	Remark
Notebook	DELL	Latitude E5470	3JFKWF2	N/A
Connector	N/A	N/A	N/A	RJ-45 to RJ-45
USB Device	SP Widget	TOUCH T03	N/A	8GB
USB Device	SP Widget	TOUCH T03	N/A	8GB

I/O Cables

Equipment	Brand Name	Model Name	S/N	Remark
RJ-45 cable	N/A	N/A	N/A	Length : 10m
RJ-45 cable	N/A	N/A	N/A	Length : 1.5m
RJ-45 cable	N/A	N/A	N/A	Length : 1.5m
RJ-45 cable	N/A	N/A	N/A	Length : 1.5m

Test Setup

Controlled using a bespoke application (MT7615D QAtool package_UIv1.84_DLLv3.81) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

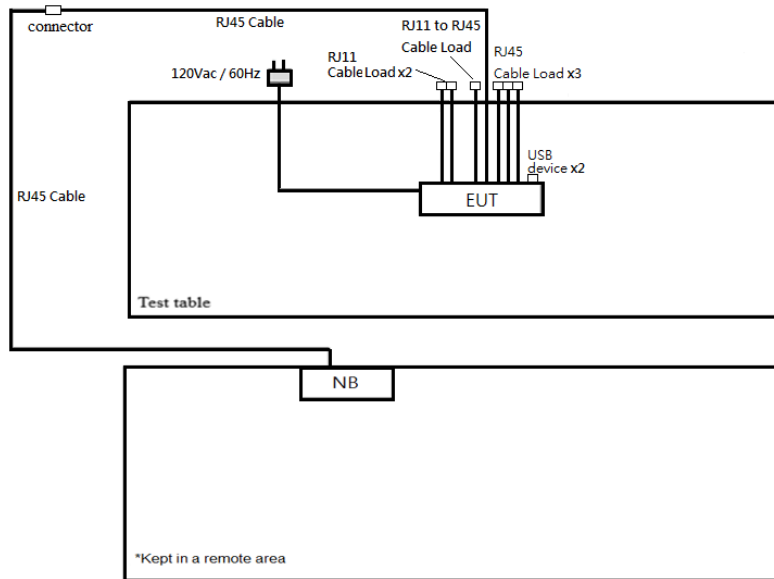
Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Setup Diagram for Test

Non-Beamforming Mode



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



9. Test Results

9.1. 6dB Bandwidth

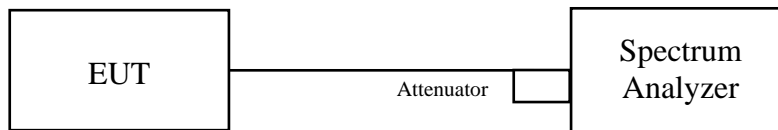
Requirements

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

Test procedure

- Set resolution bandwidth (RBW) = 100kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test Data

802.11b

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	9.09	9.0675	0.5	Pass
6	2437	10.07625	9.0975	0.5	Pass
11	2462	9.0975	9.07875	0.5	Pass

802.11g

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	15.0825	15.12	0.5	Pass
6	2437	15.1275	15.6975	0.5	Pass
11	2462	15.12	15.105	0.5	Pass

802.11n (HT20)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
1	2412	15.1275	15.6825	0.5	Pass
6	2437	15.1275	15.1275	0.5	Pass
11	2462	15.1275	15.69	0.5	Pass

802.11n (HT40)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Pass / Fail
		Chain 0	Chain 1		
3	2422	35.0925	35.085	0.5	Pass
6	2437	35.0925	35.0925	0.5	Pass
9	2452	35.0925	35.085	0.5	Pass

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

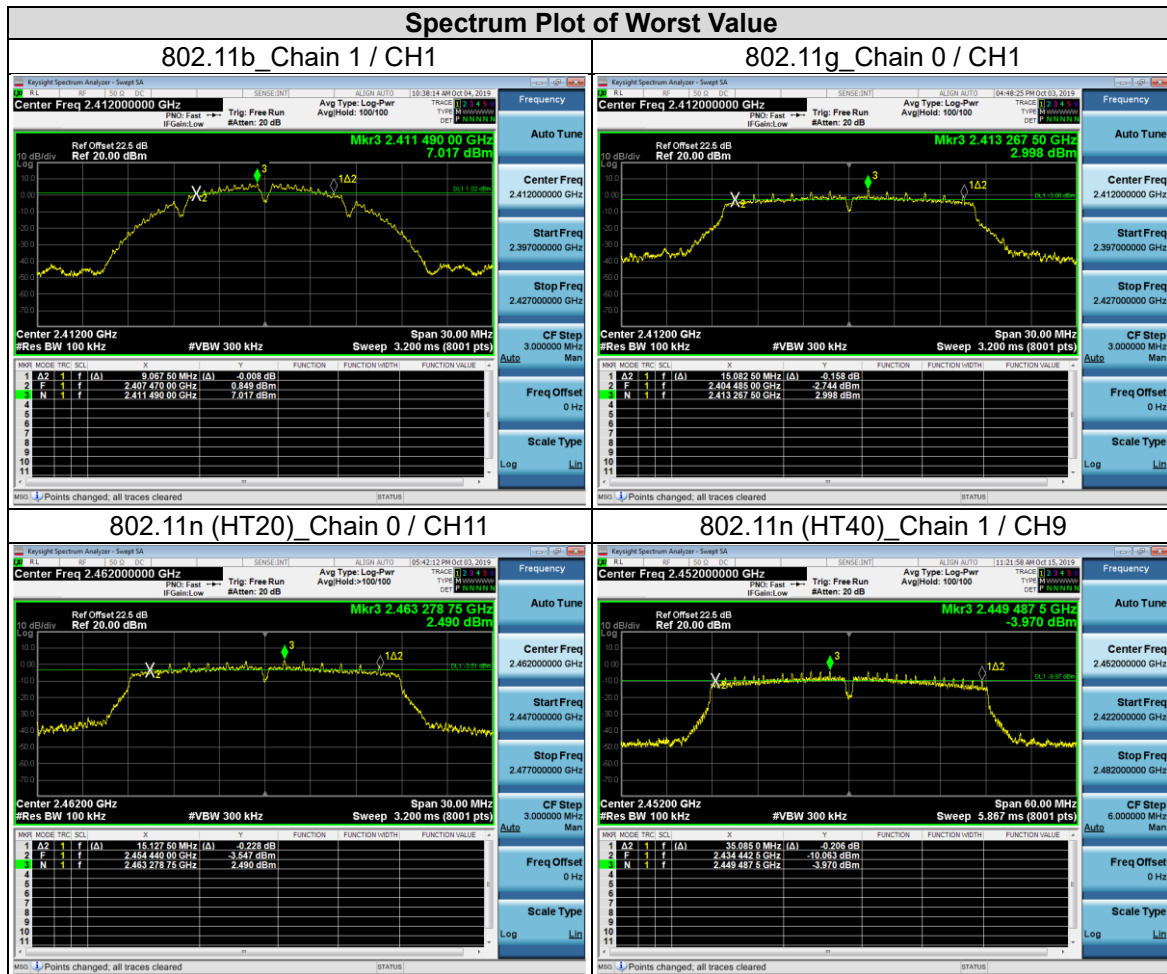
Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789166774-US-R0-V0
Page : 21 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



9.2. Conducted output power

Requirements

For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;

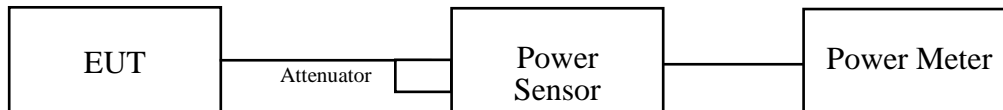
Array Gain = $5 \log(N_{ANT}/N_{SS})$ dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.

For power measurements on all other devices: Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB.

Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

Test Setup



The loss between RF output port of the EUT and the input port of the Power Meter has been taken into consideration.



Test Data

Peak Power

802.11b

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.73	18.93	196.467	22.93	30	Pass
6	2437	23.93	23.12	452.288	26.55	30	Pass
11	2462	21.59	19.87	241.263	23.82	30	Pass

802.11g

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	22.07	21.22	293.499	24.68	30	Pass
6	2437	24.33	25.36	614.577	27.89	30	Pass
11	2462	21.78	20.63	266.272	24.25	30	Pass

802.11n (HT20)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	20.63	19.69	208.722	23.20	30	Pass
6	2437	24.07	25.00	571.498	27.57	30	Pass
11	2462	20.62	19.38	202.041	23.05	30	Pass

802.11n (HT40)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	19.00	17.48	135.409	21.32	30	Pass
6	2437	22.64	22.00	342.143	25.34	30	Pass
9	2452	20.41	18.16	175.365	22.44	30	Pass

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Average Power (Reference Only)

802.11b

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	18.64	16.7	119.888	20.79
6	2437	22.46	21.15	306.515	24.86
11	2462	19.61	17.66	149.756	21.75

802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	13.27	11.44	35.164	15.46
6	2437	19.94	21.31	233.835	23.69
11	2462	12.87	10.9	31.667	15.01

802.11n (HT20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	12.61	10.90	30.542	14.85
6	2437	20.00	20.60	214.815	23.32
11	2462	12.65	10.58	29.837	14.75

802.11n (HT40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	10.11	8.53	17.386	12.40
6	2437	15.24	13.48	55.704	17.46
9	2452	11.63	9.10	22.683	13.56

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



9.3. Power Spectral Density

Requirements

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz (If $G_{TX} > 6$ dBi, then $PSD = 8 - (G_{TX} - 6)$).

Note:

1. PSD = power spectral density that he same method as used to determine the conducted output power shall be used to determine the power spectral density. And power spectral density in dBm/MHz.
2. G_{TX} = the maximum transmitting antenna directional gain in dBi.
3. Directional Gain = $G_{ant} + 10 \log (N_{ant})$ dBi.

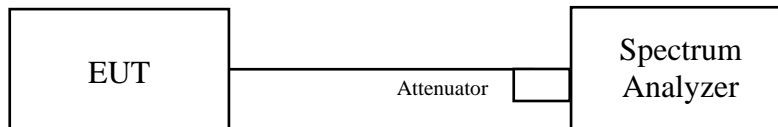
N_{ant} : Number of Transmit Antennas

G_1, G_2, \dots, G_n : Gain of Individual Antennas (Same for Each Antenna)

Test procedure

- a. Set analyzer center frequency to DTS channel center frequency.
- b. Set the span to 1.5 times the DTS bandwidth.
- c. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d. Set the VBW $\geq 3 \times \text{RBW}$.
- e. Detector = peak.
- f. Sweep time = auto couple.
- g. Trace mode = max hold.
- h. Allow trace to fully stabilize.
- i. Use the peak marker function to determine the maximum amplitude level within the RBW.

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test Data

802.11b

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-7.18	3.01	-4.17	8	Pass
	6	2437	-4.16	3.01	-1.14	8	Pass
	11	2462	-6.11	3.01	-3.10	8	Pass
1	1	2412	-8.67	3.01	-5.66	8	Pass
	6	2437	-4.51	3.01	-1.50	8	Pass
	11	2462	-8.00	3.01	-4.99	8	Pass

NOTE: Directional gain = 5.19 dBi < 6 dBi, so the limit no need to reduced.

802.11g

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-12.76	3.01	-9.75	8	Pass
	6	2437	-6.90	3.01	-3.89	8	Pass
	11	2462	-13.54	3.01	-10.52	8	Pass
1	1	2412	-14.90	3.01	-11.89	8	Pass
	6	2437	-5.30	3.01	-2.29	8	Pass
	11	2462	-15.03	3.01	-12.02	8	Pass

NOTE: Directional gain = 5.19 dBi < 6 dBi, so the limit no need to reduced.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



802.11n (HT20)

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	1	2412	-13.53	3.01	-10.52	8	Pass
	6	2437	-6.73	3.01	-3.71	8	Pass
	11	2462	-13.51	3.01	-10.50	8	Pass
1	1	2412	-14.51	3.01	-11.50	8	Pass
	6	2437	-5.06	3.01	-2.05	8	Pass
	11	2462	-15.74	3.01	-12.72	8	Pass

NOTE: Directional gain = 5.19 dBi < 6 dBi, so the limit no need to reduced.

802.11n (HT40)

TX Chain	Channel	Freq. (MHz)	PSD (dBm/3 kHz)	10 log (N=2) dB	Total PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Pass / Fail
0	3	2422	-18.08	3.01	-15.07	8	Pass
	6	2437	-13.29	3.01	-10.28	8	Pass
	9	2452	-17.94	3.01	-14.93	8	Pass
1	3	2422	-18.98	3.01	-15.97	8	Pass
	6	2437	-15.16	3.01	-12.15	8	Pass
	9	2452	-19.92	3.01	-16.91	8	Pass

NOTE: Directional gain = 5.19 dBi < 6 dBi, so the limit no need to reduced.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

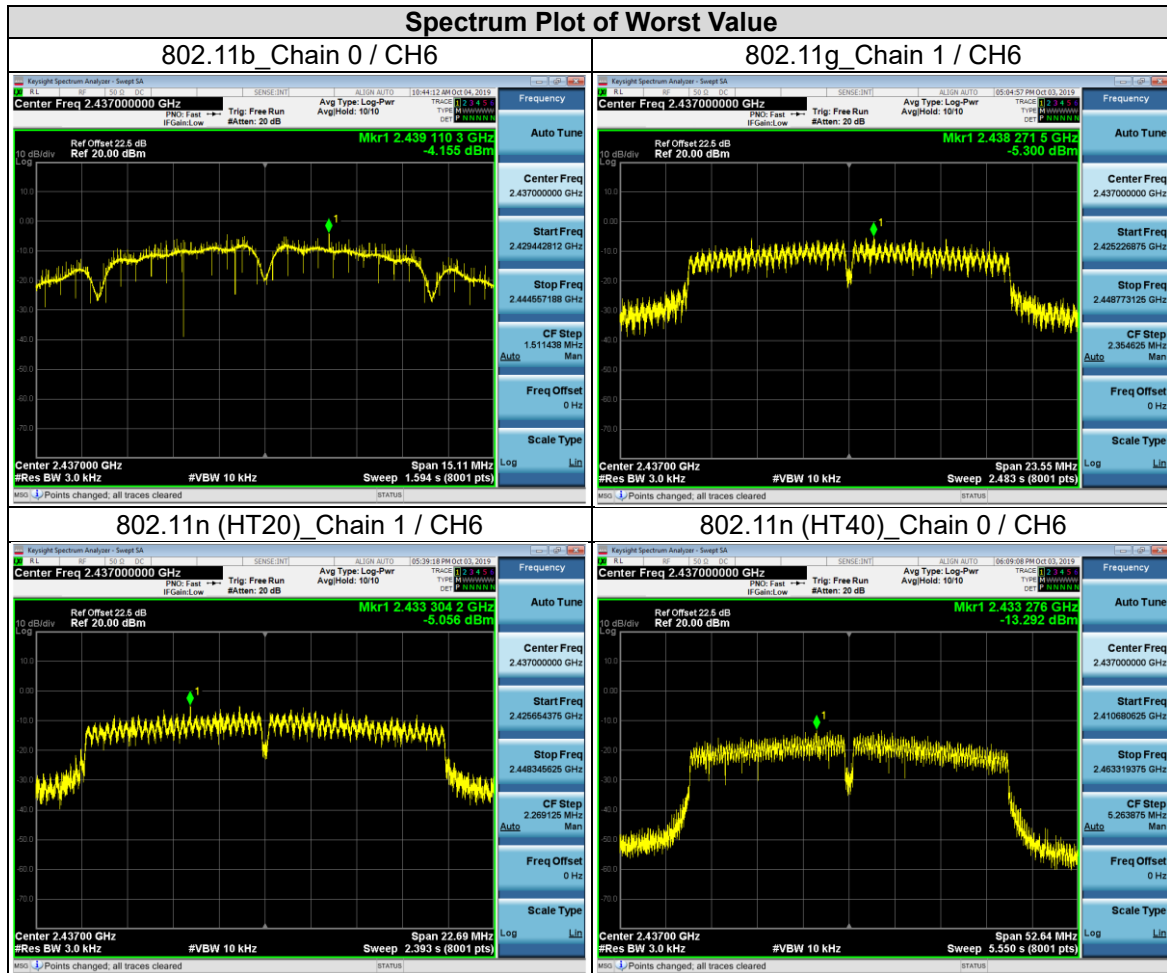
Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789166774-US-R0-V0
Page : 28 of 87
Issued date : Apr. 8, 2020
FCC ID : VGY2765



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



9.4. Conducted Out of Band Emission

Requirements

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b) (3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209 (a) is not required.

Test procedure

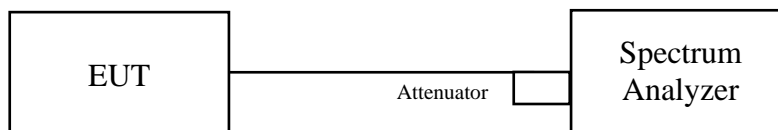
Measurement Procedure REF

- Set the RBW = 100 kHz.
- Set the VBW \geq 300 kHz.
- Set the span to 1.5 times the DTS bandwidth.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement Procedure OOB

- Set RBW = 100 kHz.
- Set VBW \geq 300 kHz.
- Detector = peak.
- Sweep = auto couple.
- Trace Mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0