



Test report No. : 4790371368-US-R0-V0  
Page : 1 of 96  
Issued date : 2022/11/9  
FCC ID : RYK-WPEQ268AXB

# RADIO TEST REPORT

**Product** : Wi-Fi 6E BT Half Min PCIe Module  
**Model Name** : WPEQ-268AXI(BT)  
**Series Model** : WPEQ-268AX(BT)  
**FCC ID** : RYK-WPEQ268AXB  
**Test Regulation** : FCC 47 CFR Part 15 Subpart C (Section 15.247)  
**Received Date** : 2022/4/18  
**Test Date** : 2022/4/29 ~ 2022/6/13  
**Issued Date** : 2022/11/9

**Applicant** : SparkLAN Communications, Inc.  
5F, No. 199, Ruihu St., Neihu Dist., Taipei City 114067,  
Taiwan

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



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Doc No: 17-EM-F0876 / 6.0





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## 1. Attestation of Test Results

**APPLICANT:** SparkLAN Communications, Inc.  
 5F, No. 199, Ruihu St., Neihu Dist., Taipei City 114067, Taiwan

**MANUFACTURER:** SparkLAN Communications, Inc.  
 5F, No. 199, Ruihu St., Neihu Dist., Taipei City 114067, Taiwan

**EUT DESCRIPTION:** Wi-Fi 6E BT Half Min PCIe Module

**BRAND:** SparkLAN

**MODEL:** WPEQ-268AXI(BT)

**SERIES MODEL:** WPEQ-268AX(BT)

**SAMPLE STAGE:** Engineering Verification Test sample

**DATE of TESTED:** 2022/4/29 ~ 2022/6/13

<b>APPLICABLE STANDARDS</b>	
<b>STANDARD</b>	<b>Test Results</b>
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  
 Project Handler

Date : 2022/11/9

Approved and Authorized By:

Kent Liu  
 Senior Laboratory Engineer

Date : 2022/11/9

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## 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

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### 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

<b>Test Location</b>	Underwriters Laboratories Taiwan Co., Ltd.
<b>Address</b>	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
<b>Accreditation Certificate</b>	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

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## 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  $k=2$ .

Measurement	Frequency	Uncertainty
Conducted disturbance at mains terminals ports	150kHz ~ 30MHz	$\pm 2.9$ dB
RF Conducted	9 kHz - 40GHz	$\pm 2.4$ dB
Radiated disturbance below 30MHz	9 kHz - 30 MHz	$\pm 1.9$ dB
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	$\pm 5.8$ dB
Radiated disturbance above 1 GHz	1GHz ~ 40GHz	$\pm 4.8$ dB

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## 6. Equipment under Test

### 6.1. Description of EUT

<b>Product</b>	Wi-Fi 6E BT Half Min PCIe Module
<b>Brand Name</b>	SparkLAN
<b>Model Name</b>	WPEQ-268AXI(BT)
<b>Series Model</b>	WPEQ-268AX(BT)
<b>Operating Frequency</b>	2412MHz ~ 2462MHz
<b>Modulation</b>	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA
<b>Transfer Rate</b>	802.11b: up to 11 Mbps 802.11g: up to 54 Mbps 802.11n: up to MCS15 802.11ax: up to MCS11
<b>Number of Channel</b>	11 for 802.11b, 802.11g, 802.11n (HT20), 802.11ax (HE20) 7 for 802.11n (HT40), 802.11ax (HE40)
<b>Maximum Output Power</b>	<b>Non-Beamforming mode:</b> 802.11b: 24.91 dBm 802.11g: 26.86 dBm 802.11ax (HE20): 26.97 dBm 802.11ax (HE40): 22.13 dBm <b>Beamforming mode:</b> 802.11ax (HE20): 26.74 dBm 802.11ax (HE40): 21.86 dBm
<b>Normal Voltage</b>	3.3 Vdc
<b>Sample ID</b>	4862912

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Note:

1. The models difference table as below:

Model	Difference
WPEQ-268AXI(BT)	Operating Temp -40~+75°C
WPEQ-268AX(BT)	Operating Temp -10~+65°C

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
802.11ax (HE20)	2TX,2RX
802.11ax (HE40)	2TX,2RX

\* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ax mode for HE20 / HE40, therefore investigated worst case to representative mode in test report.

3. The EUT contains following accessory devices:

Product	Brand	Model	Description
Antenna 1	SparkLAN	AD-506AX	-
Antenna 2	SparkLAN	AD-501AX	-
Antenna 3	SparkLAN	AD-312N	-
Antenna 4	SparkLAN	AD-509AX	-
Antenna 5	SparkLAN	AD-103AG	-
Antenna 6	SparkLAN	AD-302N	-
Antenna 7	SparkLAN	AD-303N	-
Antenna 8	SparkLAN	AD-315N	-
Antenna 9	SparkLAN	AD-507AX	-
Antenna 10	SparkLAN	AD-508AX	-
I-PEX Cable	SparkLAN	N/A	RP-SMA to I-PEX

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

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## 6.2. Channel List

11 channels are provided for 802.11b, 802.11g, 802.11n (HT20) and 802.11ax (HE20):

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

7 channels are provided for 802.11n (HT40) and 802.11ax (HE40):

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

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### 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/ 60~65%RH	3.3Vdc	2022/04/29~ 2022/06/13	Mike Cai
Radiated Spurious Emission	966-2	23~26°C/ 60~65%RH	3.3Vdc	2022/04/29~ 2022/05/24	Mike Cai
AC power Line Conducted Emission	SR1	23~26°C/ 60~65%RH	120Vac/60Hz	2022/05/24~ 2022/05/24	Mike Cai

FCC Test Firm Registration Number: 498077

#### Sample Calculation:

##### Antenna Port Conducted Measurement:

- Where relevant, the follow sample calculation is provided:  
Result Value (dBm) = Reading Value (dBm) + Attenuator Factor (dB) + Cable Loss (dB).  
Example: Result Value (10dBm) = Reading Value (-2dBm) + Attenuator Factor (10dB) + Cable Loss(2dB).  
\*Test plot only shown the “Result Value”.

##### Radiated Spurious Emission:

- Where relevant, the follow sample calculation is provided:  
Result Value (dBuV/m) = Reading Value (dBuV) + Correction Factor (dB/m).  
Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Loss (dB) - Preamp Factor (dB).  
Example: Result Value (34.5dBuV/m) = Reading Value (40.1dBm) + Antenna Factor (18.7dB/m) + Cable Loss (4.2dB) - Preamp Factor (28.5dB).

##### AC power Line Conducted Emission:

- Where relevant, the follow sample calculation is provided:  
Result Value (dBuV) = Reading Value (dBuV) + Correction Factor (dB).  
Correction Factor (dB) = Insertion loss(dB) + Cable loss(dB).  
Example: Result Value (53.7dBuV) = Reading Value (35.1dBm) + Insertion loss(18.1dB) + Cable loss(0.5dB).

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#### 6.4. Description of Available Antennas

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Frequency Band (MHz)	Maximum Gain (dBi)	Remark
1	Chain (0)+(1)	SparkLAN	AD-506AX	Dipole	2400~2483	2.65	I-PEX
					5150~5250	4.35	
					5250~5350	4.35	
					5470~5725	4.35	
					5725~5850	4.81	
					5925~6425	4.98	
					6425~6525	4.85	
					6875~7125	4.79	
2	Chain (0)+(1)	SparkLAN	AD-501AX	Dipole	2400~2483	3.7	RP-SMA
					5150~5850	5	
					5925~7125	5	
3	Chain (0)+(1)	SparkLAN	AD-312N	Dipole	2400~2483	2.65	I-PEX
					5150~5875	4.86	
4	Chain (0)+(1)	SparkLAN	AD-509AX	Dipole	2400~2483	3.7	I-PEX
					5150~5850	5	
					5925~7125	5	
5	Chain (0)+(1)	SparkLAN	AD-103AG	Dipole	2400~2483	2.02	RP-SMA
					5150~5875	2.03	
6	Chain (0)+(1)	SparkLAN	AD-302N	Dipole	2400~2483	3.14	RP-SMA
					5150~5875	2.87	
7	Chain (0)+(1)	SparkLAN	AD-303N	Dipole	2400~2483	3.14	RP-SMA
					5150~5875	3.45	
8	Chain (0)+(1)	SparkLAN	AD-315N	Dipole	2400~2483	3	I-PEX
					5150~5875	5	
9	Chain (0)+(1)	SparkLAN	AD-507AX	Dipole	2400~2483	2.67	I-PEX
					5150~5250	4.35	
					5250~5350	3.83	
					5470~5725	4.7	
					5725~5850	4.87	
					5925~6425	4.91	
					6425~6525	4.85	
					6875~7125	4.94	
10	Chain (0)+(1)	SparkLAN	AD-508AX	Dipole	2400~2483	2.67	I-PEX
					5150~5250	4.35	
					5250~5350	3.83	
					5470~5725	4.7	
					5725~5850	4.87	
					5925~6425	4.91	
					6425~6525	4.85	
					6875~7125	4.94	

- Note: 1. The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.  
2. For above antenna connector type: RP-SMA need to be combined with I-PEX cable.

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## 6.5. Test Mode Applicability and Tested Channel Detail

- The fundamental of the dipole antenna was investigated in two orthogonal (lay and stand), it was determined that stand mode was worst-case. Therefore, all final radiated testing was performed with the dipole antenna in stand mode.
- For AC power line conducted emissions, the pre-scan has been determined by AC power 120Vac/60Hz (worst case)
- The antennas AD-501AX has the highest gain, the following conducted tests are all carried out using this antenna.
- The antennas AD-501AX/ AD-509AX has the same type and same gain, therefore, the highest fundamental was determined antenna AD-501AX worst-case, the Antenna AD-501AX was selected for the final radiated testing.
- 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.
- 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 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.
- 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).

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**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 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6 Mbps
	802.11ax20	OFDMA	BPSK	1 to 11	1,6,11	HE0
	802.11ax40	OFDMA	BPSK	3 to 9	3,6,9	HE0
Radiated Emissions (Below 1GHz)	802.11ax20	OFDMA	BPSK	1 to 11	6	HE0
AC Power Line Conducted Emission	802.11ax20	OFDMA	BPSK	1 to 11	6	HE0
*Antenna Port Conducted Measurement	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6 Mbps
	802.11ax20	OFDMA	BPSK	1 to 11	1,6,11	HE0
	802.11ax40	OFDMA	BPSK	3 to 9	3,6,9	HE0
Conducted Emissions (Above 1GHz)	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,6,11	6 Mbps
	802.11ax20	OFDMA	BPSK	1 to 11	1,6,11	HE0
	802.11ax40	OFDMA	BPSK	3 to 9	3,6,9	HE0
Conducted Emissions (Below 1GHz)	802.11ax20	OFDMA	BPSK	1 to 11	6	HE0

**Beamforming mode:**

Test Item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
*Antenna Port Conducted Measurement	802.11ax20	OFDMA	BPSK	1 to 11	1,6,11	HE0
	802.11ax40	OFDMA	BPSK	3 to 9	3,6,9	HE0

\* Note: The worse spurious emissions test and maximum output power was found in Non-Beamforming mode. Therefore Beamforming mode only the test data of the RF output power were recorded in this report.

Simultaneously transmission condition:

Condition	Technology	
1	WLAN (2.4GHz)	WLAN (5GHz)
2	WLAN (2.4GHz)	WLAN (6GHz)

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

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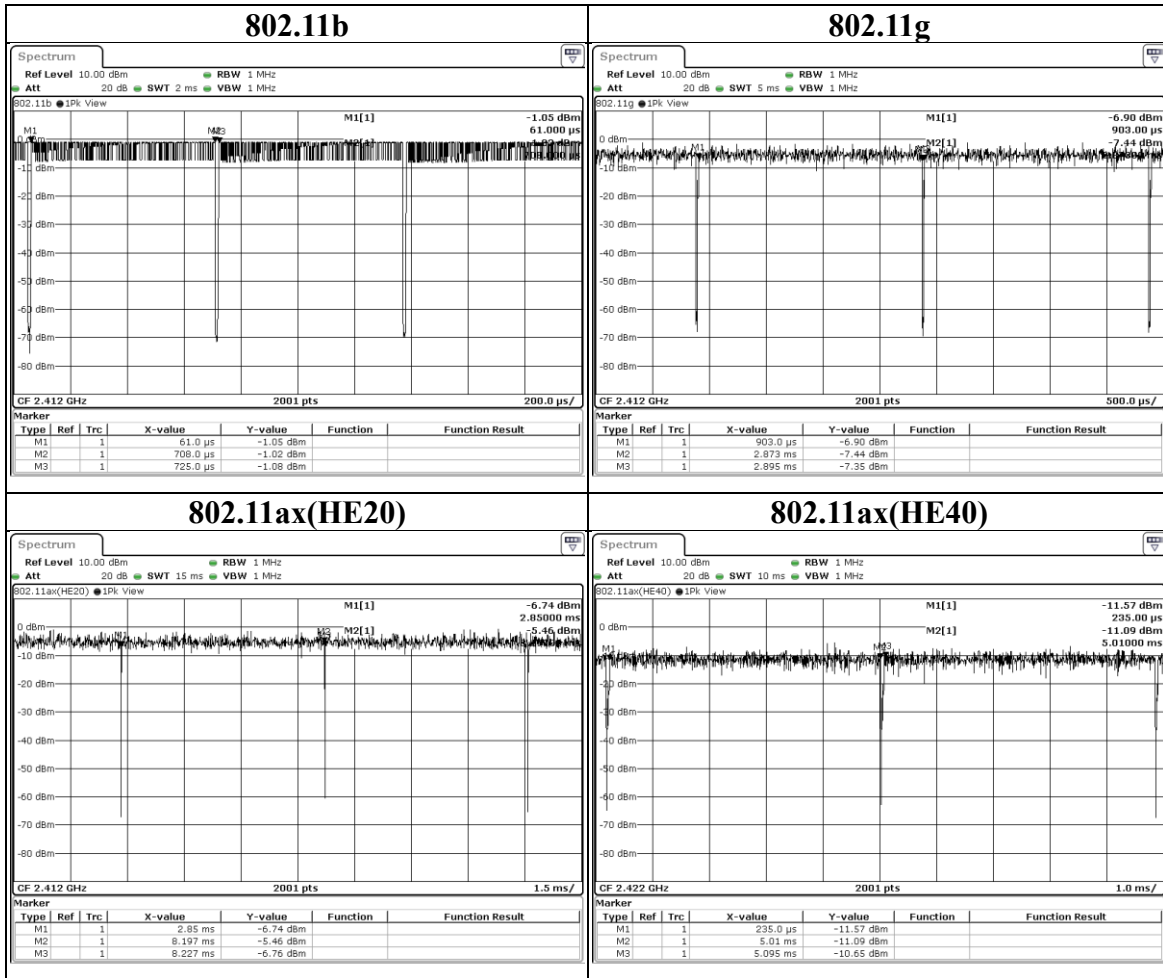
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### 6.6. Duty cycle

Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle	Duty Factor (dB)	VBW Set (above 1GHz)
802.11b	0.647	0.664	0.97	0.11	2kHz
802.11g	1.970	1.993	0.99	N/A	10Hz
802.11ax(HE20)	5.348	5.377	0.99	N/A	10Hz
802.11ax(HE40)	4.775	4.860	0.98	N/A	10Hz



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## 7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
<b>Radiated Spurious Emission</b>					
Spectrum Analyzer	Keysight	N9010A	MY56070827	2021/11/9	2022/11/8
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	2021/12/10	2022/12/9
Loop Antenna	ETS lindgren	6502	00213440	2021/12/23	2022/12/22
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	2022/2/8	2023/2/7
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	2021/12/13	2022/12/12
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	2021/12/17	2022/12/16
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	2021/6/8	2022/6/7
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	2022/2/16	2023/2/15
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	2021/5/19	2022/5/18
				2022/5/17	2023/5/16
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	2021/12/3	2022/12/2
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	2021/12/3	2022/12/2

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Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2021/10/29	2022/10/28
Attenuator	EMCI	EMC-40ATK2W10	17002	2021/12/13	2022/12/12
Pulse Power Sensor	Anritsu	MA2411B	1531202	2021/12/22	2022/12/21
Power Meter	Anritsu	ML2495A	1645002	2021/12/22	2022/12/21
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	2021/11/15	2022/11/14
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2021/8/30	2022/8/29
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2021/8/26	2022/8/25
Cables	TITAN	CFD200	T0732ACFD20 020A300-1	2022/3/16	2023/3/15

UL Software		
Description	Name	Version
Radiated measurement	e3	6.191211 (V6)
Conducted measurement	RF Conducted Test Tools	ver 2.4.0.620b
AC power Line Conducted Emission	EZ_EMCC	UL-3A1.2

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## 8. Description of Test Setup

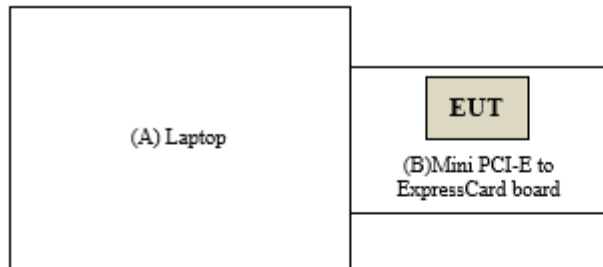
### Support Equipment

ID	Equipment	Brand Name	Model Name	S/N	Remark
A	Laptop	Dell	Latitude E6430	2MMN3X1	Provide by lab
B	Mini PCI-E to ExpressCard board	N/A	N/A	N/A	Provide by lab

### Test Setup

Controlled using a bespoke application (QSPR\_Version 5.0-00197) 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.

### Setup Diagram for Test



-----  
**Under Table**

-----  
**Remote Site**

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## 9. Test Results

### 9.1. 6dB Bandwidth

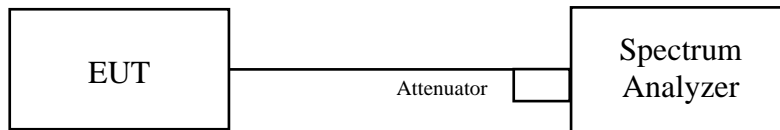
#### Requirements

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.

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**Test Data**

Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11b	1	2412	8.092	8.537	0.5	Pass
	6	2437	8.082	8.067	0.5	Pass
	11	2462	7.102	8.086	0.5	Pass

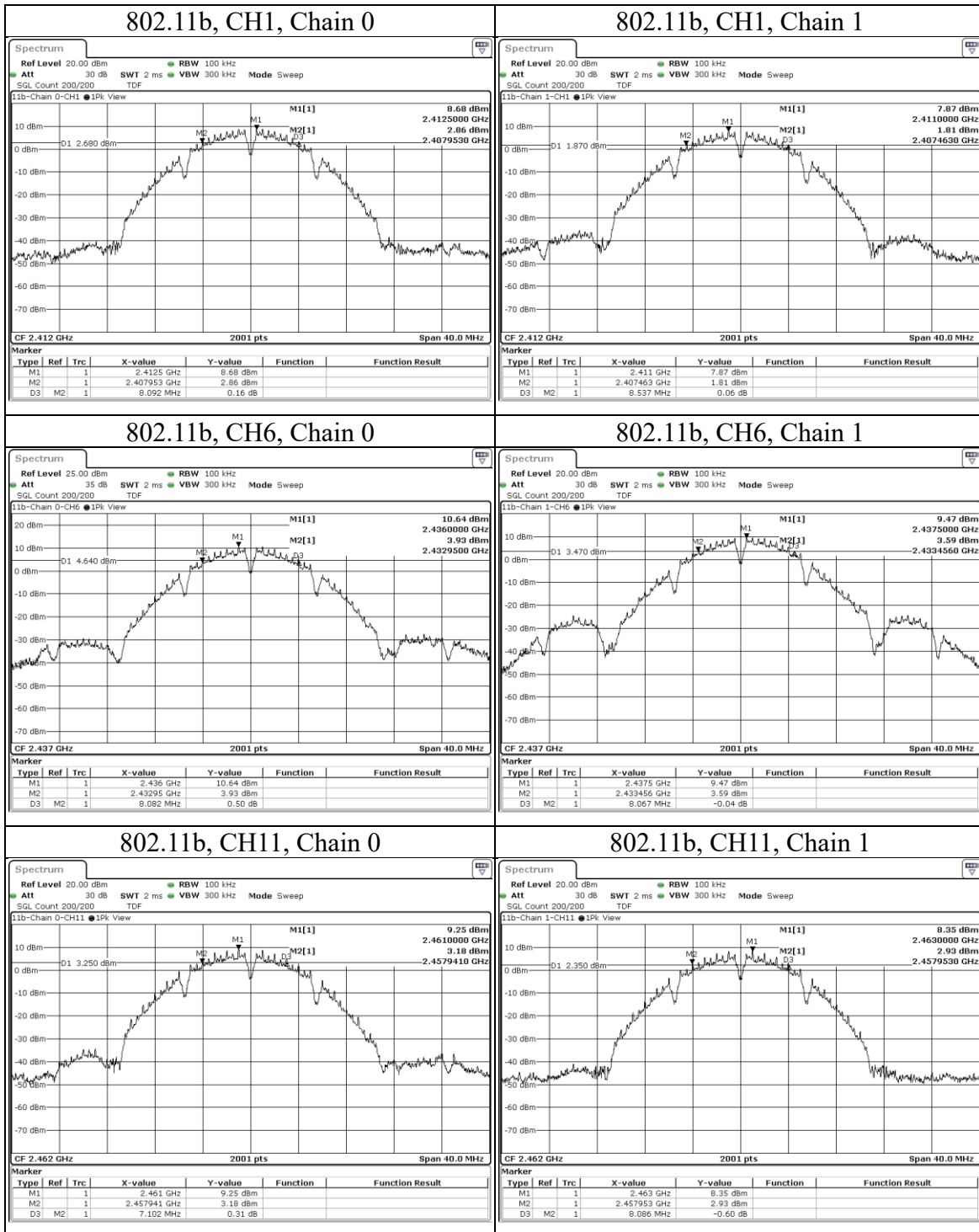
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Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11g	1	2412	14.513	15.940	0.5	Pass
	6	2437	13.833	14.439	0.5	Pass
	11	2462	15.680	15.119	0.5	Pass

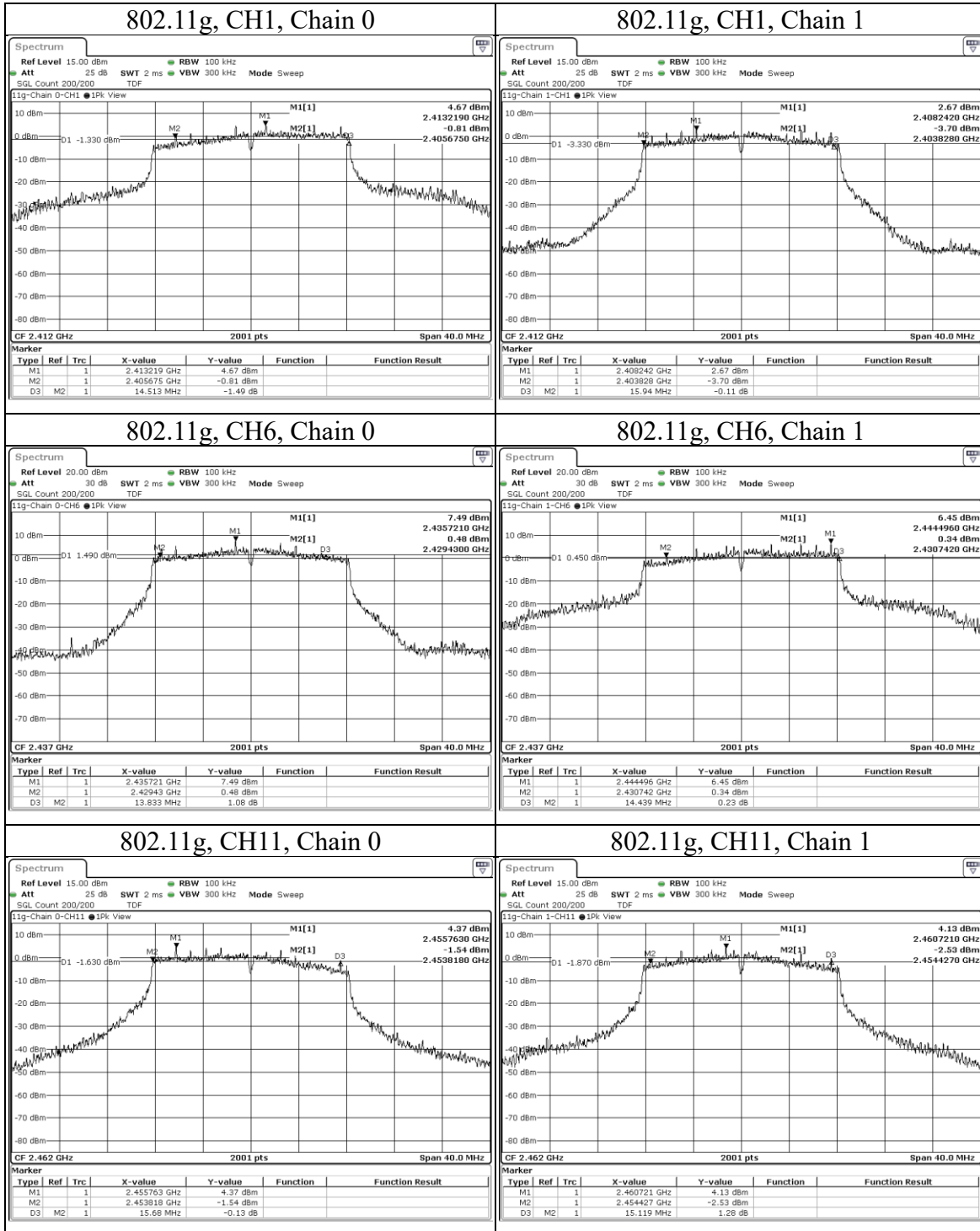
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Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE20)	1	2412	14.507	16.542	0.5	Pass
	6	2437	12.604	18.028	0.5	Pass
	11	2462	14.069	13.836	0.5	Pass

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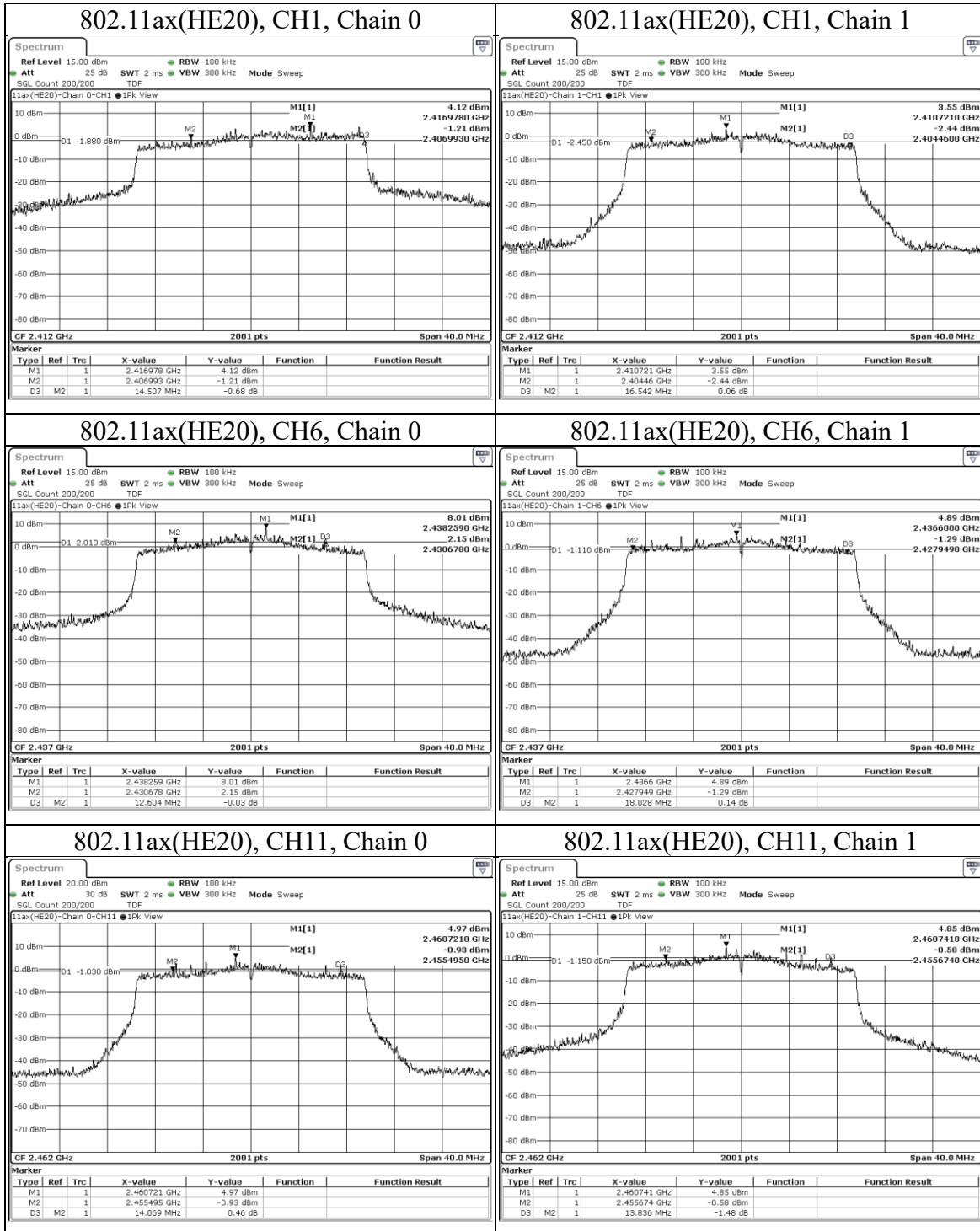
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Doc No: 17-EM-F0876 / 6.0







Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE40)	3	2422	36.848	36.673	0.5	Pass
	6	2437	17.200	36.325	0.5	Pass
	9	2452	23.629	37.286	0.5	Pass

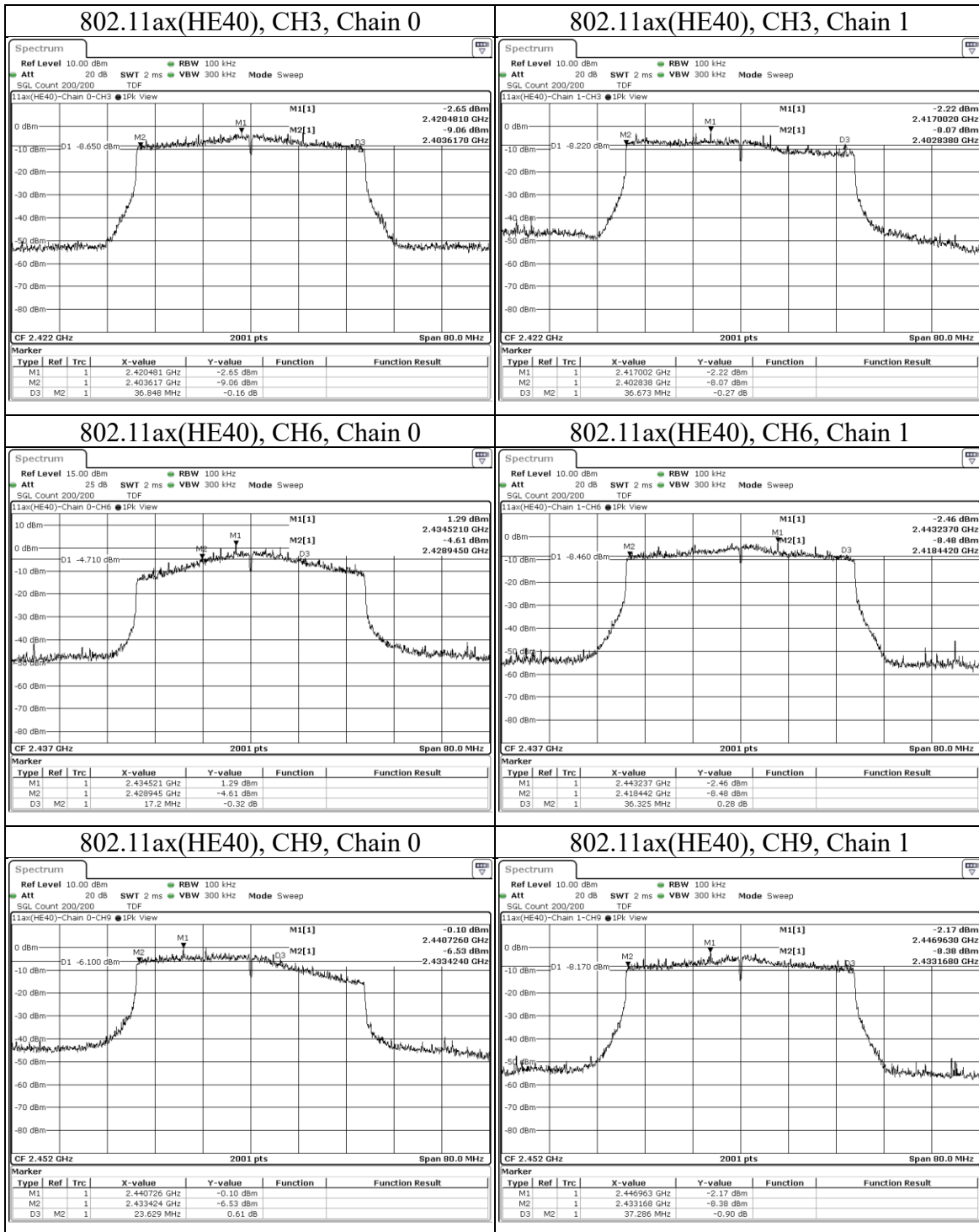
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## 9.2. Conducted Output Power

### Requirements

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

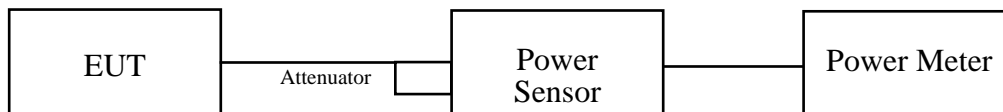
Note:

1.  $P_{Out}$  = maximum conducted output power in dBm,
2.  $G_{TX}$  = the maximum transmitting antenna directional gain in dBi.
3. Directional Gain =  $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{Gn/20})^2 / N_{ANT}]$  dBi.  
     $N_{ANT}$ : Number of Transmit Antennas  
     $G1, G2, \dots, Gn$ : Gain of Individual Antennas  
    Example: two antenna and gain 5 dBi / 3dBi, so if it was used for TxBF power measurement  
    Directional Gain =  $10 \log[(10^{5/20} + 10^{3/20})^2 / 2]$  dBi = 7.07 dBi
4. Per KDB 662911 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  $\geq 40$  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.  
    Example: Maximum antenna gain = 5 dBi and  $N_{ANT} \leq 4$ , so if it was used for CDD power measurement  
    Directional Gain = 5 dBi + Array Gain = 5 dBi + 0 dB = 5 dBi
5. For power measurement of KDB 662911 is used with multiple transmitter output. Total conducted power is the sum of the conducted power levels measured at the various output ports.

### 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.

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## Test Data

### Non-Beamforming mode

#### 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	20.44	19.63	202.302	23.06	30	PASS
6	2437	22.25	21.51	309.742	24.91	30	PASS
11	2462	19.59	19.00	170.608	22.32	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	21.11	20.80	249.459	23.97	30	PASS
6	2437	23.13	24.46	485.289	26.86	30	PASS
11	2462	21.04	20.79	247.172	23.93	30	PASS

##### 802.11ax (HE20)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	21.46	20.73	258.226	24.12	30	PASS
6	2437	23.36	24.48	497.737	26.97	30	PASS
11	2462	21.51	21.27	275.423	24.40	30	PASS

##### 802.11ax (HE40)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	18.31	17.83	128.529	21.09	30	PASS
6	2437	19.17	19.06	163.305	22.13	30	PASS
9	2452	18.72	18.42	143.88	21.58	30	PASS

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### Average Power (Reference Only)

#### 802.11b

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	17.98	17.13	114.551	20.59
6	2437	19.91	19.20	181.134	22.58
11	2462	16.98	16.54	95.06	19.78

#### 802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	15.01	14.48	59.704	17.76
6	2437	17.62	17.40	112.72	20.52
11	2462	14.73	14.64	58.884	17.70

#### 802.11ax (HE20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	14.60	13.99	53.951	17.32
6	2437	17.03	16.80	98.401	19.93
11	2462	14.65	14.49	57.28	17.58

#### 802.11ax (HE40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	12.09	11.20	29.376	14.68
6	2437	12.74	12.18	35.318	15.48
9	2452	12.70	12.21	35.237	15.47

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## Beamforming mode

### Peak Power

#### 802.11ax (HE20)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	21.29	20.45	245.471	23.90	30	PASS
6	2437	23.11	24.28	472.063	26.74	30	PASS
11	2462	21.33	21.13	265.461	24.24	30	PASS

#### 802.11ax (HE40)

Channel	Frequency (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	18.17	17.70	124.451	20.95	30	PASS
6	2437	18.90	18.79	153.462	21.86	30	PASS
9	2452	18.61	18.16	138.038	21.40	30	PASS

### Average Power (Reference Only)

#### 802.11ax (HE20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	14.45	13.75	51.523	17.12
6	2437	16.91	16.61	94.842	19.77
11	2462	14.44	14.37	55.208	17.42

#### 802.11ax (HE40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	11.86	10.91	27.669	14.42
6	2437	12.46	12.06	33.651	15.27
9	2452	12.41	12.09	33.574	15.26

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### 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  $PSD = 8 - (G_{TX} - 6)$ ).

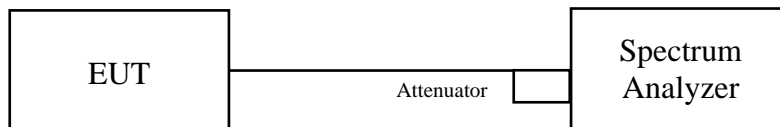
Note:

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 =  $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{Gn/20})^2 / Nant]$  dBi.  
Nant: Number of Transmit Antennas  
G1, G2,..., Gn: Gain of Individual Antennas  
Example: two antenna and gain 5 dBi / 3dBi, so if it was used for power density measurement  
Directional Gain =  $10 \log[(10^{5/20} + 10^{3/20})^2 / 2]$  dBi = 7.07 dBi
4. "PSD per chain" of the report shown is maximum value for each chain, at the "Total PSD" is summing entire spectra across corresponding frequency bins on the various outputs by computer, refer KDB 662911 Method a) for calculating total power density.
5. Method a) of power density measurement of KDB 662911 is used for calculating total power density with multiple transmitter output. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.

#### 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.

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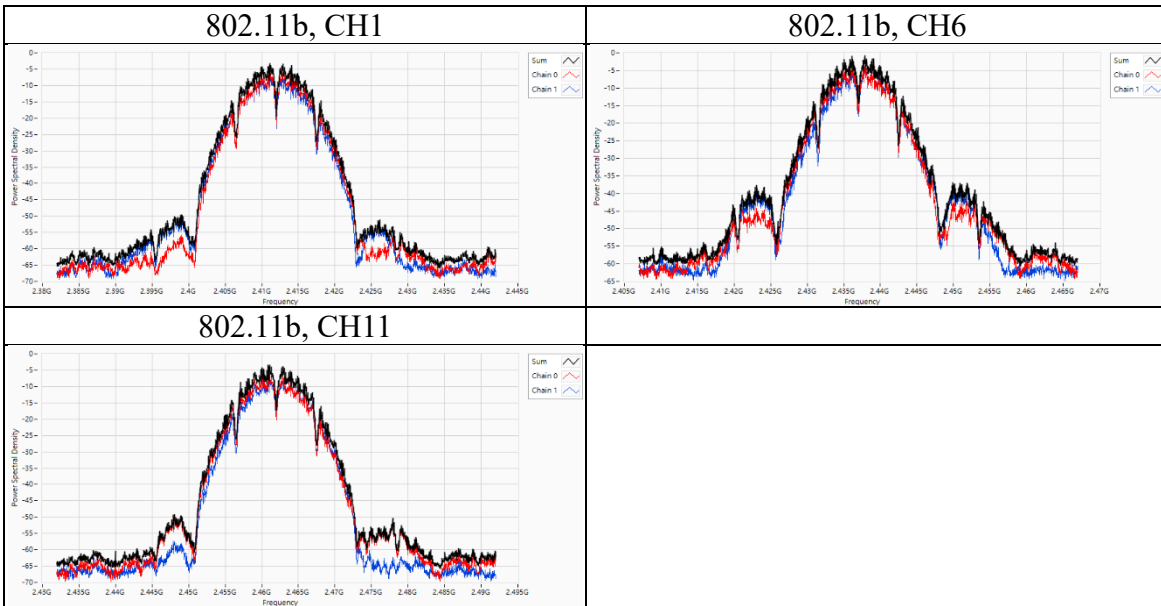




**Test Data**

Mode	CH	Freq (MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Directional Gain (dBi)	Result
802.11b	1	2412	-3.31	7.29	6.71	Pass
	6	2437	-0.7	7.29	6.71	Pass
	11	2462	-3.37	7.29	6.71	Pass

Mode	CH	Freq (MHz)	PSD per Chain (dBm/MHz)	
			Chain 0	Chain 1
802.11b	1	2412	-5.368	-6.805
	6	2437	-3.404	-3.852
	11	2462	-5.939	-6.131



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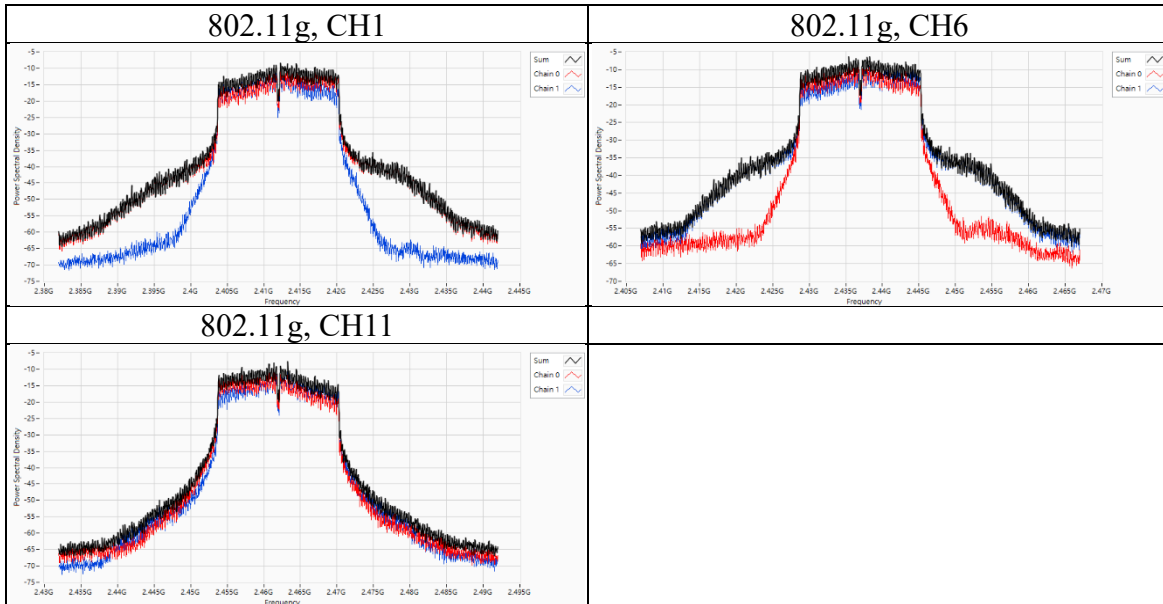
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Mode	CH	Freq (MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Directional Gain (dBi)	Result
802.11g	1	2412	-8.49	7.29	6.71	Pass
	6	2437	-6.24	7.29	6.71	Pass
	11	2462	-7.61	7.29	6.71	Pass

Mode	CH	Freq (MHz)	PSD per Chain (dBm/MHz)	
			Chain 0	Chain 1
802.11g	1	2412	-10.38	-11.682
	6	2437	-8.08	-9.149
	11	2462	-10.171	-9.632



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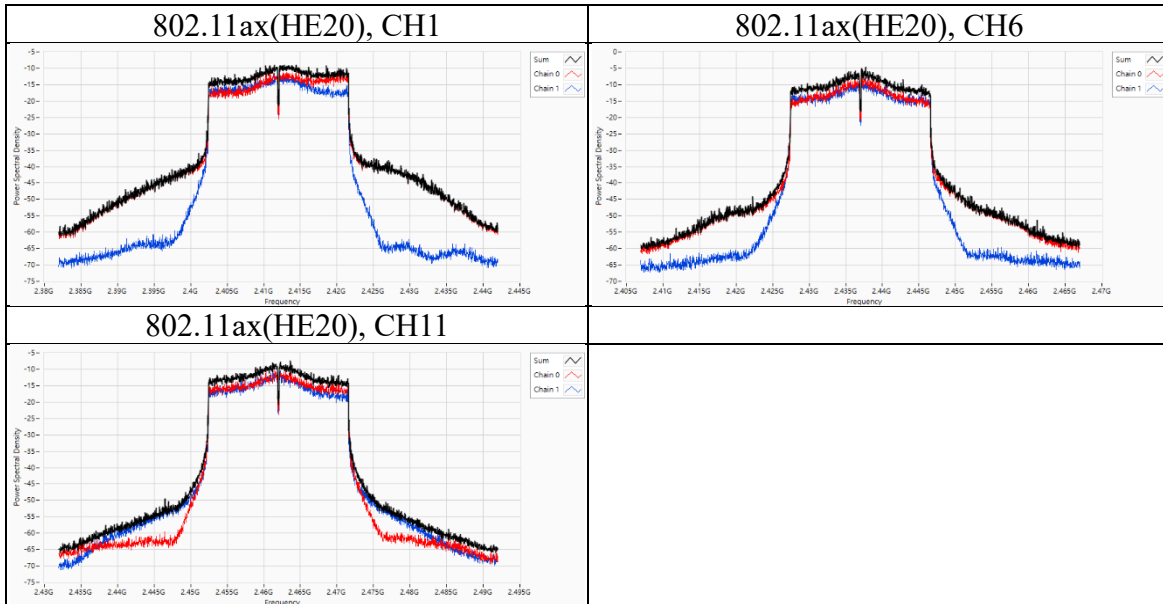
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Mode	CH	Freq (MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Directional Gain (dBi)	Result
802.11ax(HE20)	1	2412	-8.97	7.29	6.71	Pass
	6	2437	-4.65	7.29	6.71	Pass
	11	2462	-7.34	7.29	6.71	Pass

Mode	CH	Freq (MHz)	PSD per Chain (dBm/MHz)	
			Chain 0	Chain 1
802.11ax(HE20)	1	2412	-9.78	-11.454
	6	2437	-6.817	-6.748
	11	2462	-8.506	-9.582



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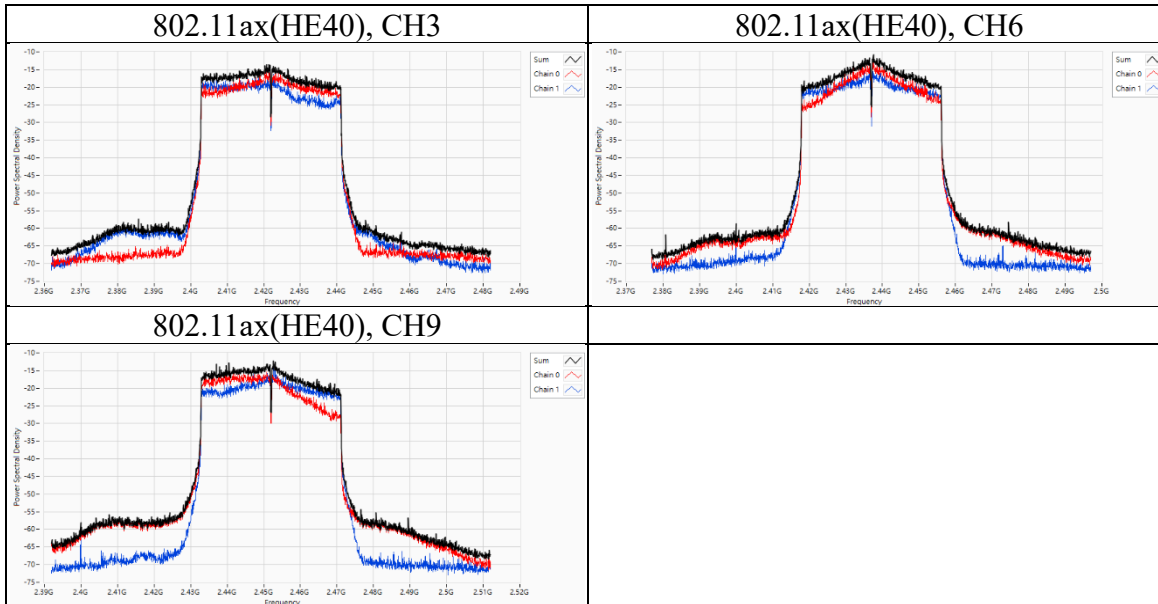
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Mode	CH	Freq (MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Directional Gain (dBi)	Result
802.11ax(HE40)	3	2422	-13.56	7.29	6.71	Pass
	6	2437	-10.71	7.29	6.71	Pass
	9	2452	-12.29	7.29	6.71	Pass

Mode	CH	Freq (MHz)	PSD per Chain (dBm/MHz)	
			Chain 0	Chain 1
802.11ax(HE40)	3	2422	-15.05	-16.306
	6	2437	-12.048	-15.332
	9	2452	-13.712	-13.769



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## 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

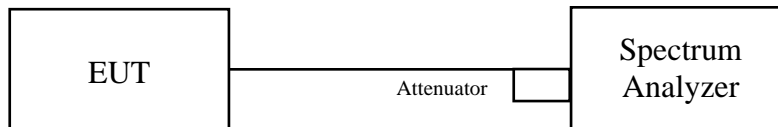
Measurement Procedure REF

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

Measurement Procedure OOBE

1. Set RBW = 100 kHz.
2. Set VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

### Test Setup



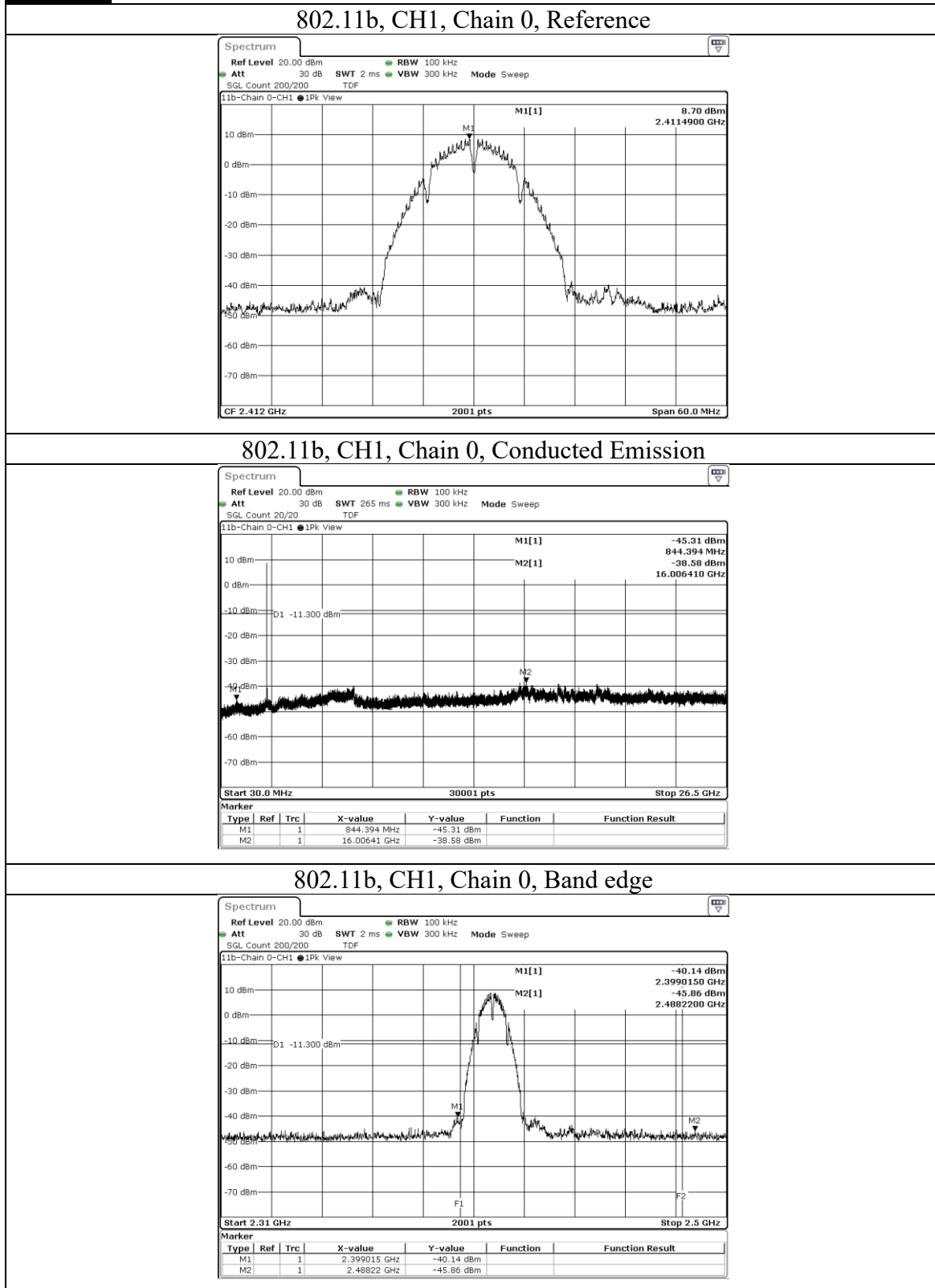
The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

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**Test Data**



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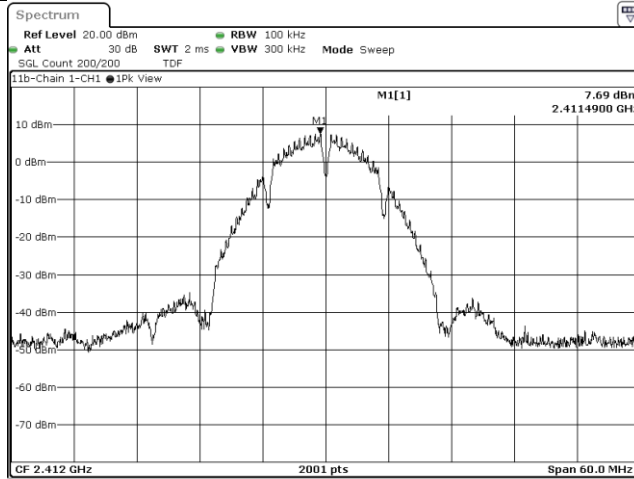
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

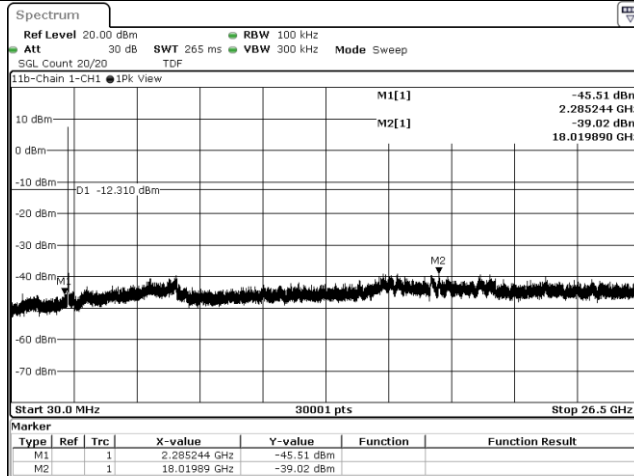
Facsimile (FAX) : +886-3-583-7948



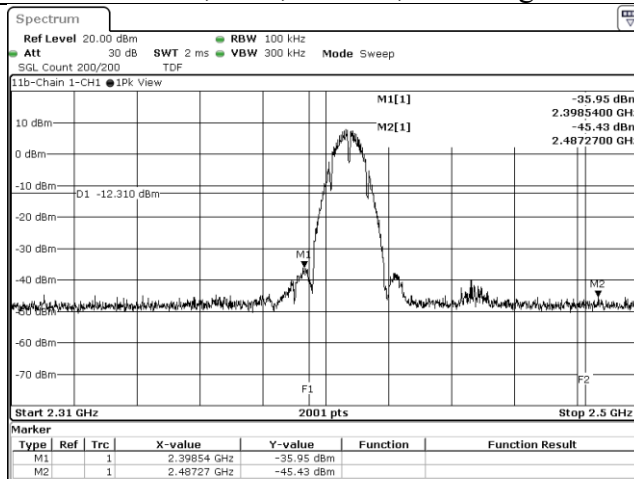
### 802.11b, CH1, Chain 1, Reference



### 802.11b, CH1, Chain 1, Conducted Emission



### 802.11b, CH1, Chain 1, Band edge



## Underwriters Laboratories Taiwan Co., Ltd.

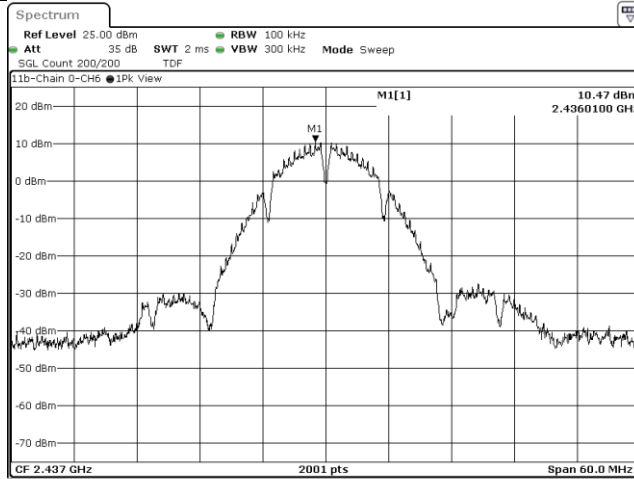
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

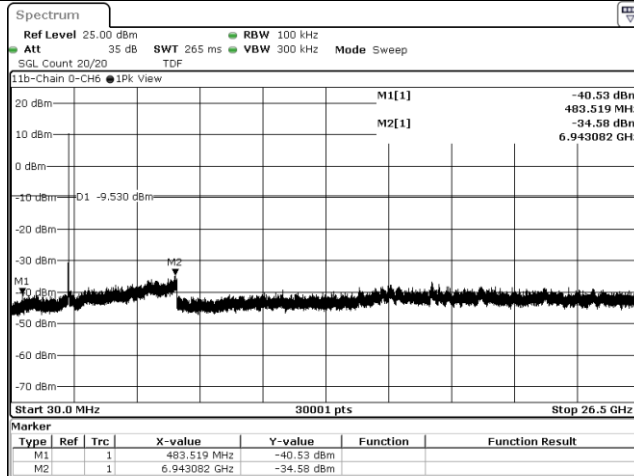
Facsimile (FAX) : +886-3-583-7948



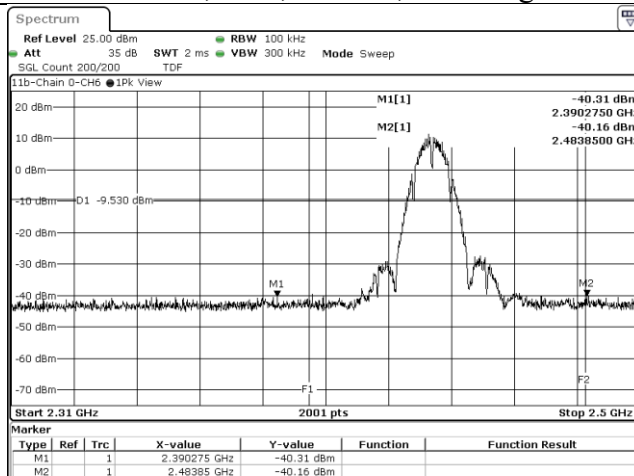
### 802.11b, CH6, Chain 0, Reference



### 802.11b, CH6, Chain 0, Conducted Emission



### 802.11b, CH6, Chain 0, Band edge



## Underwriters Laboratories Taiwan Co., Ltd.

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

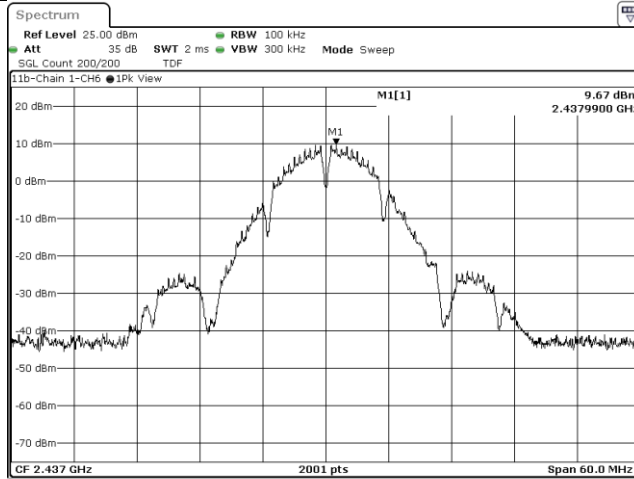
Telephone : +886-2-7737-3000

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

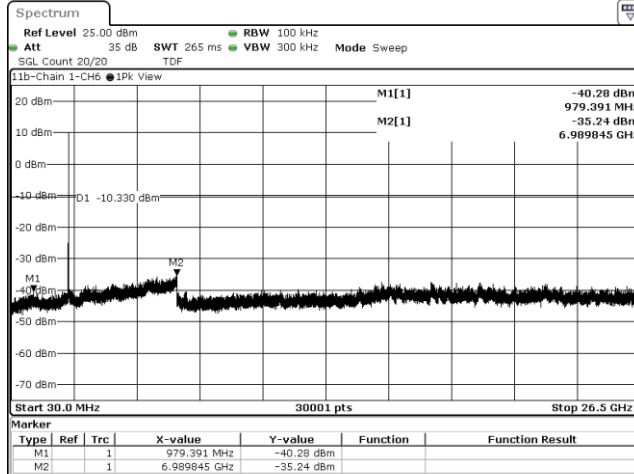




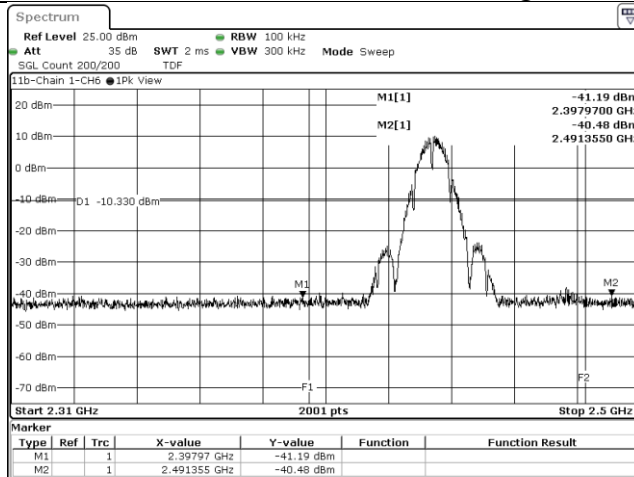
### 802.11b, CH6, Chain 1, Reference



### 802.11b, CH6, Chain 1, Conducted Emission



### 802.11b, CH6, Chain 1, Band edge



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

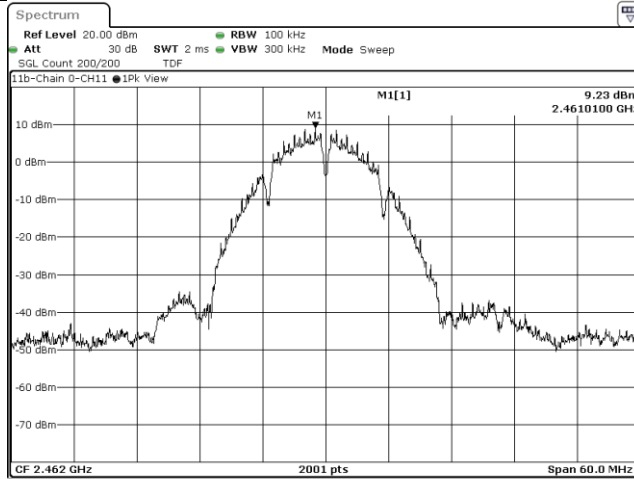
Telephone : +886-2-7737-3000

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

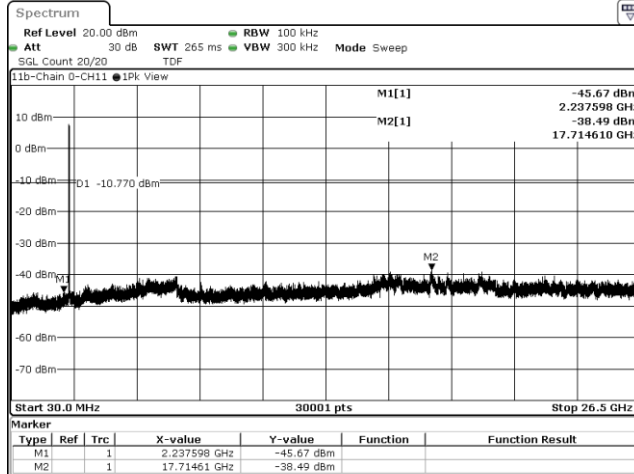
Doc No: 17-EM-F0876 / 6.0



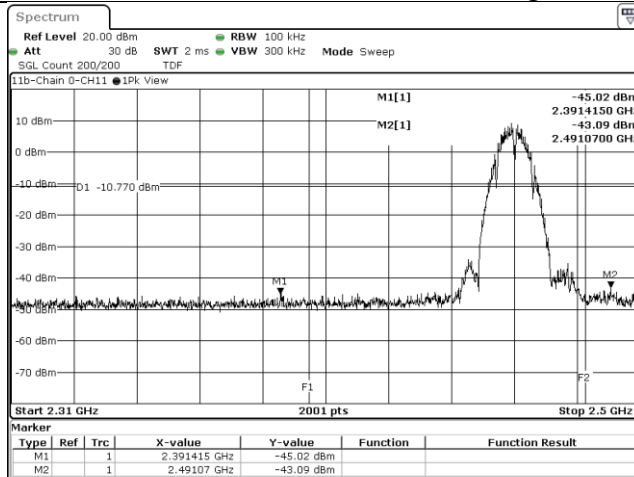
### 802.11b, CH11, Chain 0, Reference



### 802.11b, CH11, Chain 0, Conducted Emission



### 802.11b, CH11, Chain 0, Band edge



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

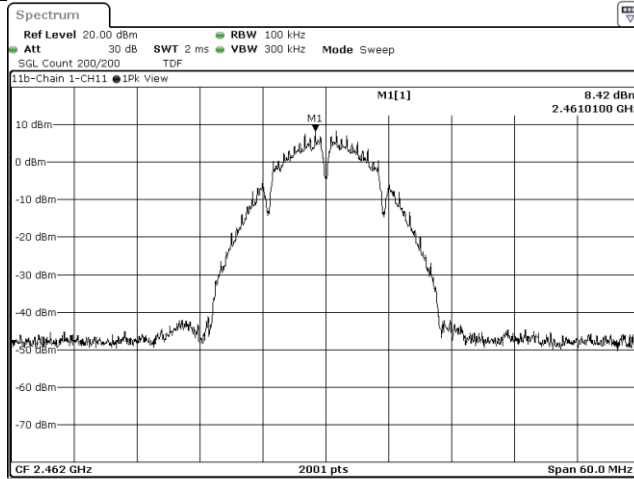
Telephone : +886-2-7737-3000

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

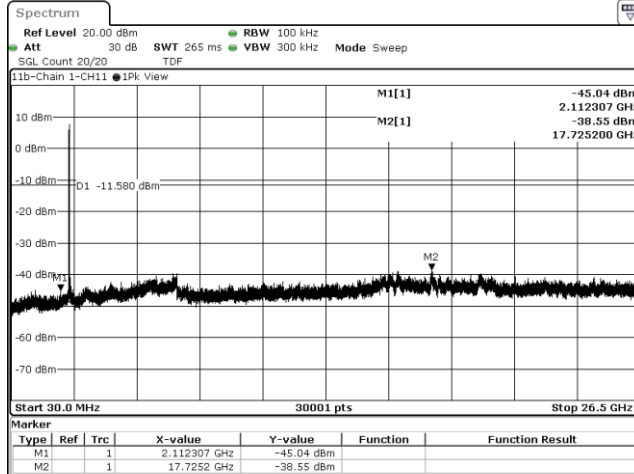
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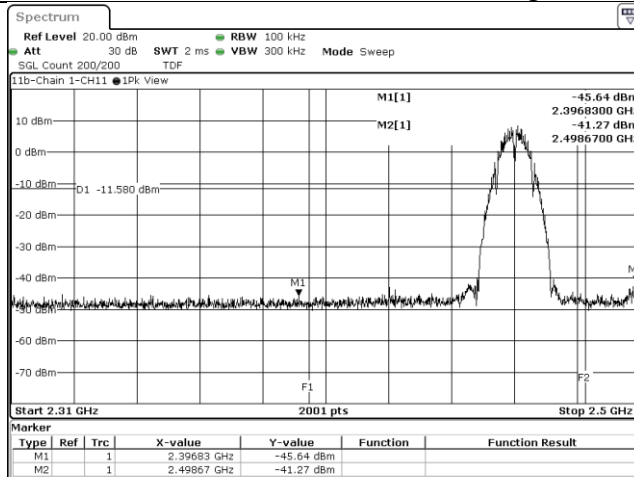
### 802.11b, CH11, Chain 1, Reference



### 802.11b, CH11, Chain 1, Conducted Emission



### 802.11b, CH11, Chain 1, Band edge



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

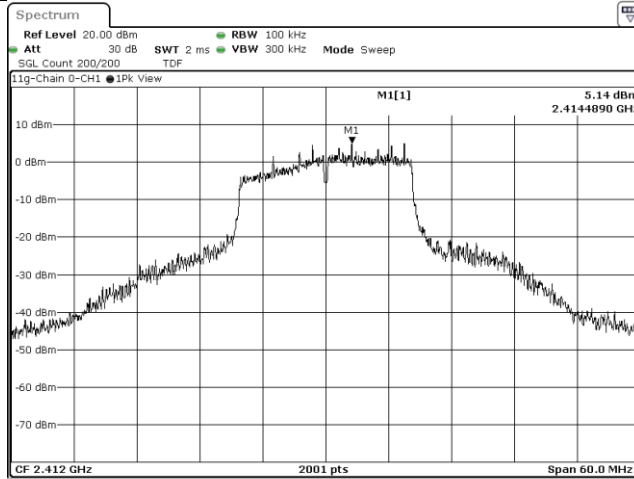
Telephone :+886-2-7737-3000

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

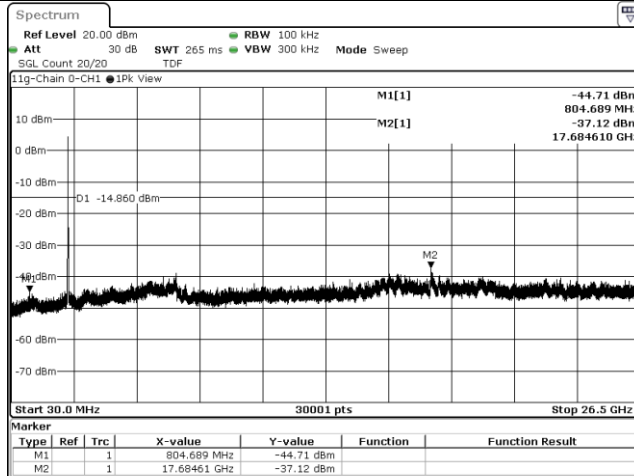
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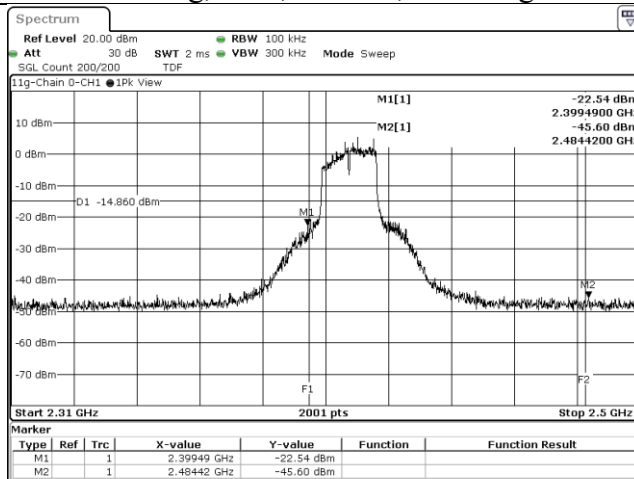
### 802.11g, CH1, Chain 0, Reference



### 802.11g, CH1, Chain 0, Conducted Emission



### 802.11g, CH1, Chain 0, Band edge



## Underwriters Laboratories Taiwan Co., Ltd.

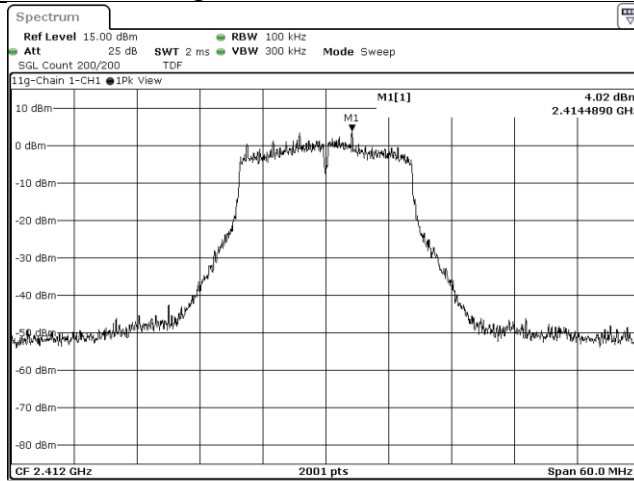
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

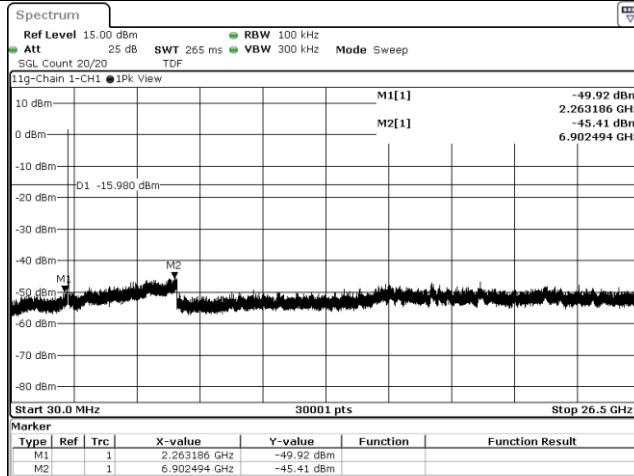
Facsimile (FAX) : +886-3-583-7948



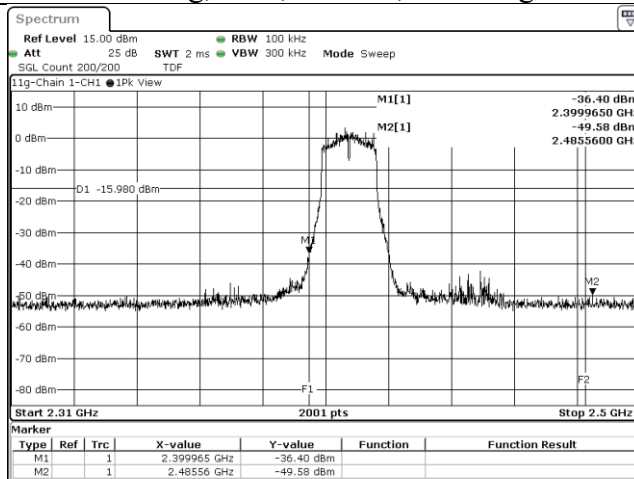
### 802.11g, CH1, Chain 1, Reference



### 802.11g, CH1, Chain 1, Conducted Emission



### 802.11g, CH1, Chain 1, Band edge



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

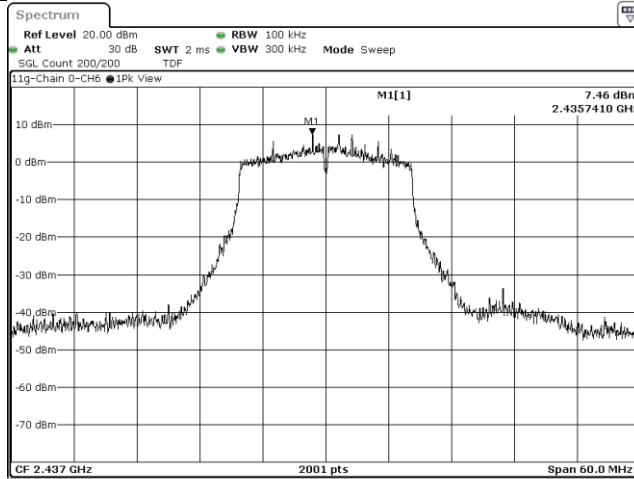
Telephone : +886-2-7737-3000

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

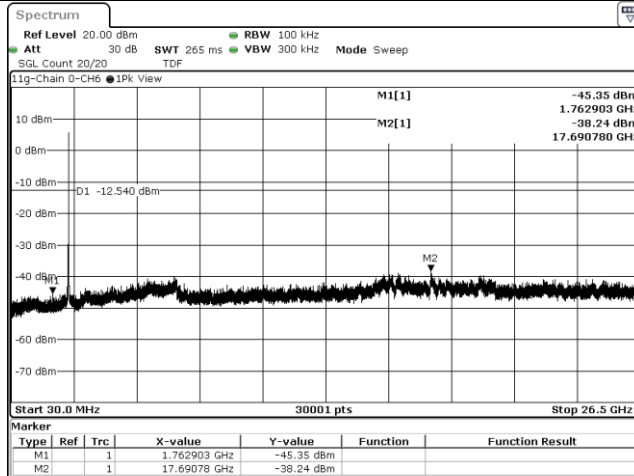
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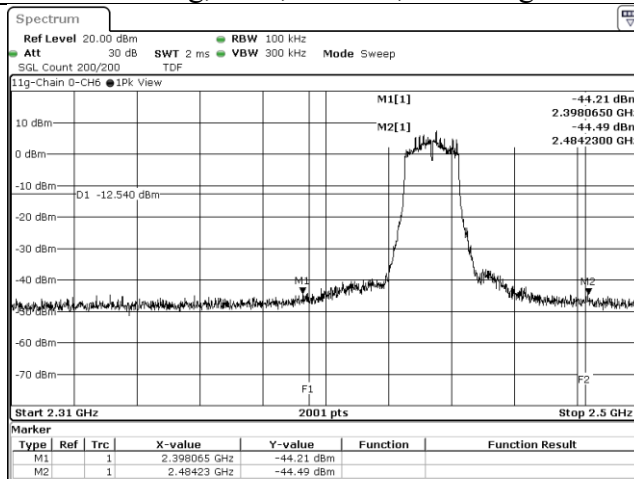
### 802.11g, CH6, Chain 0, Reference



### 802.11g, CH6, Chain 0, Conducted Emission



### 802.11g, CH6, Chain 0, Band edge



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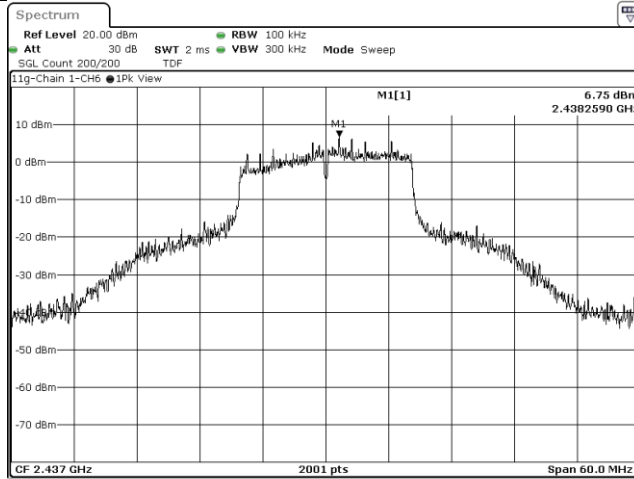
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

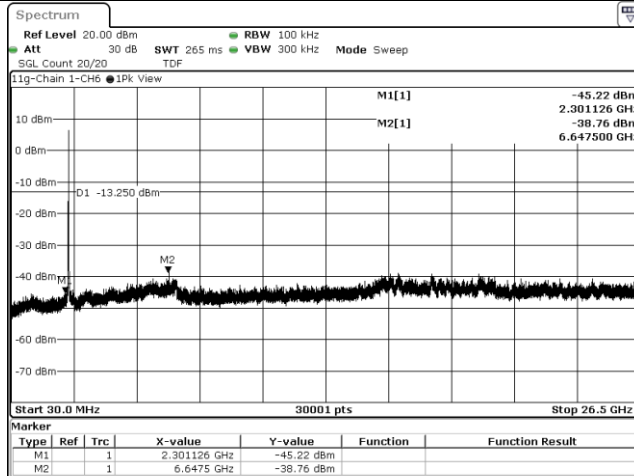
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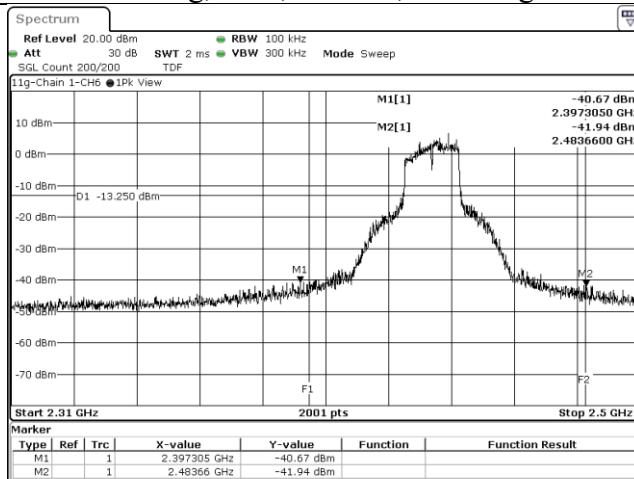
### 802.11g, CH6, Chain 1, Reference



### 802.11g, CH6, Chain 1, Conducted Emission



### 802.11g, CH6, Chain 1, Band edge



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

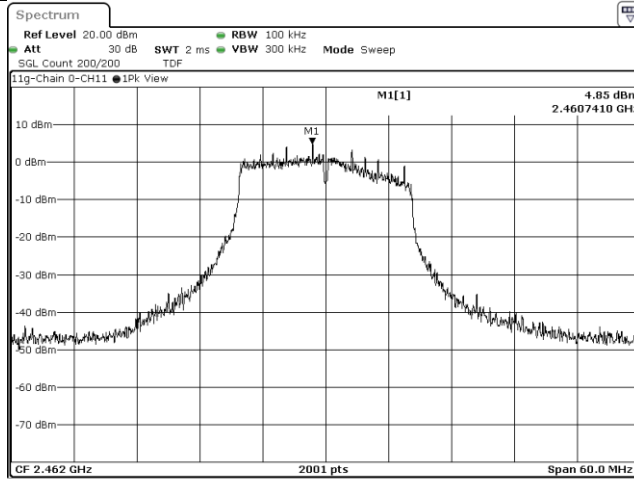
Telephone : +886-2-7737-3000

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

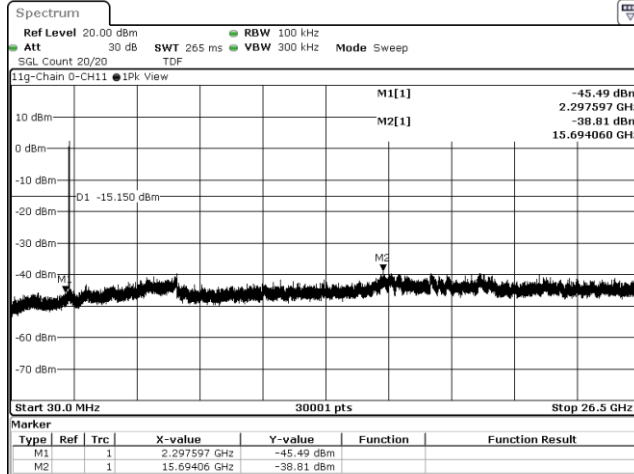
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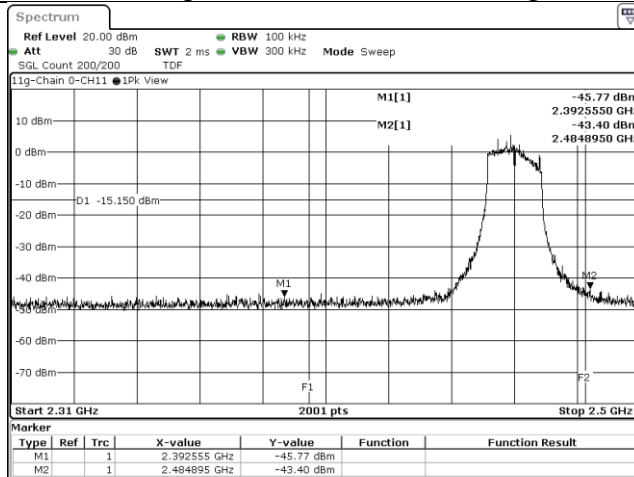
### 802.11g, CH11, Chain 0, Reference



### 802.11g, CH11, Chain 0, Conducted Emission



### 802.11g, CH11, Chain 0, Band edge



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

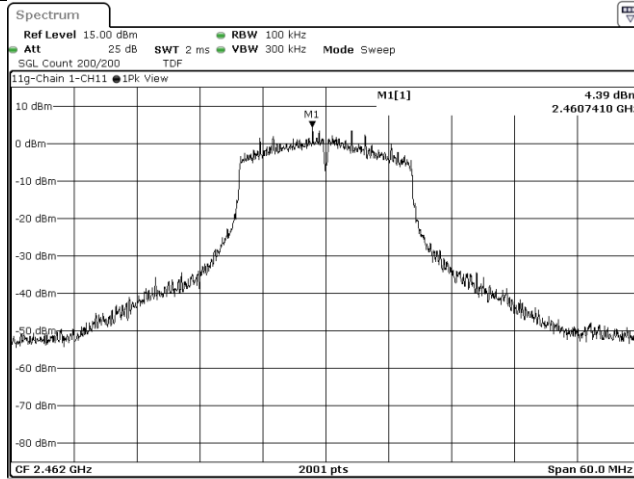
Telephone :+886-2-7737-3000

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

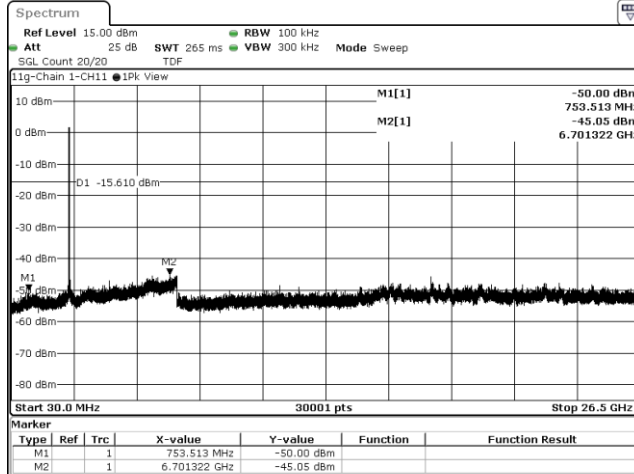




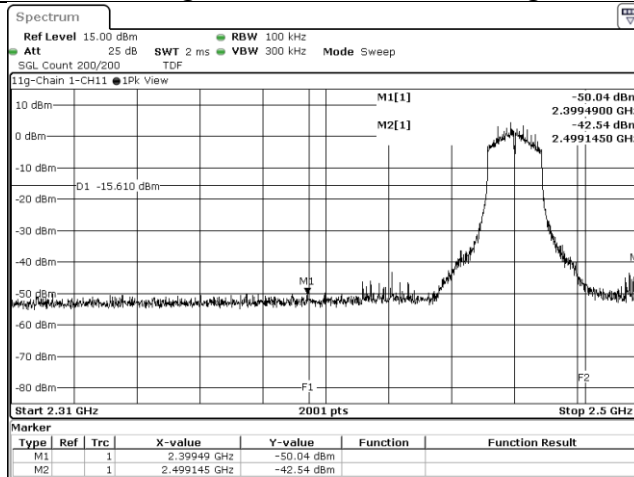
### 802.11g, CH11, Chain 1, Reference



### 802.11g, CH11, Chain 1, Conducted Emission



### 802.11g, CH11, Chain 1, Band edge



## Underwriters Laboratories Taiwan Co., Ltd.

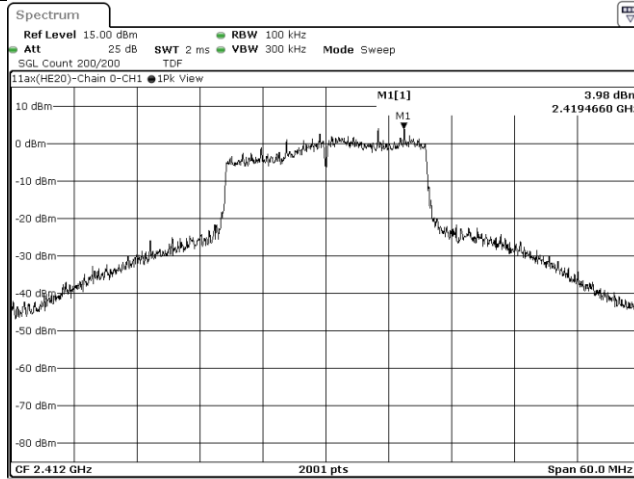
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

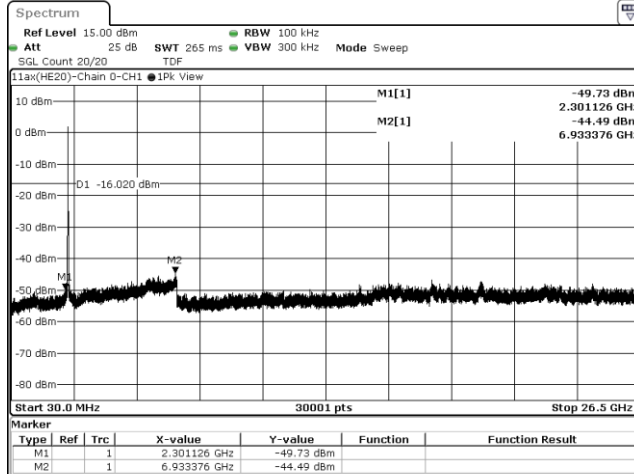
Facsimile (FAX) :+886-3-583-7948



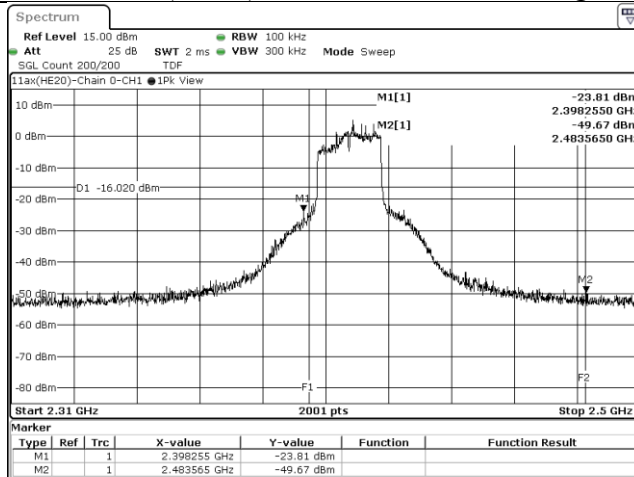
### 802.11ax(HE20), CH1, Chain 0, Reference



### 802.11ax(HE20), CH1, Chain 0, Conducted Emission



### 802.11ax(HE20), CH1, Chain 0, Band edge



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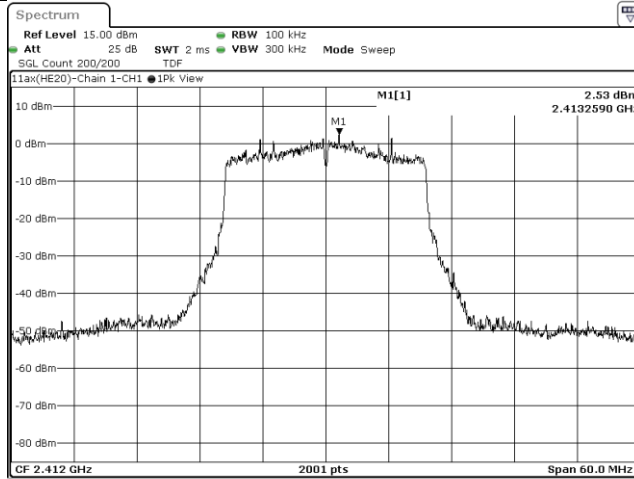
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

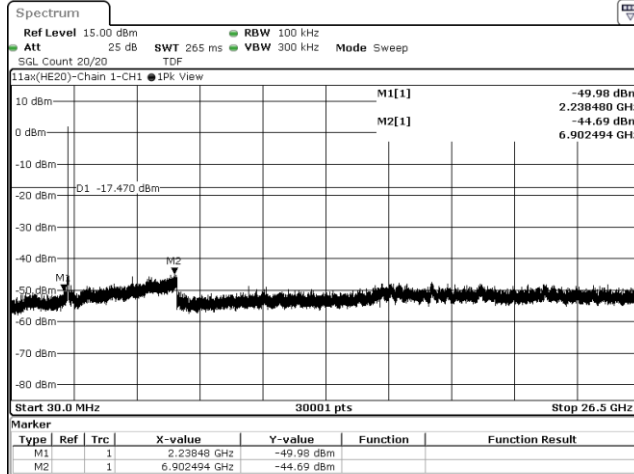
Facsimile (FAX) : +886-3-583-7948



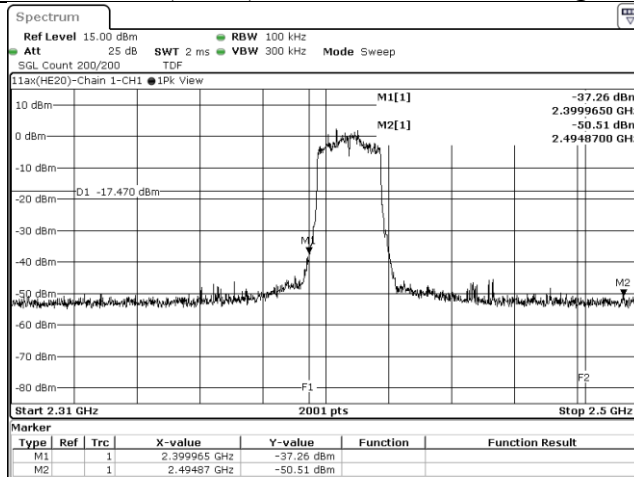
### 802.11ax(HE20), CH1, Chain 1, Reference



### 802.11ax(HE20), CH1, Chain 1, Conducted Emission



### 802.11ax(HE20), CH1, Chain 1, Band edge



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

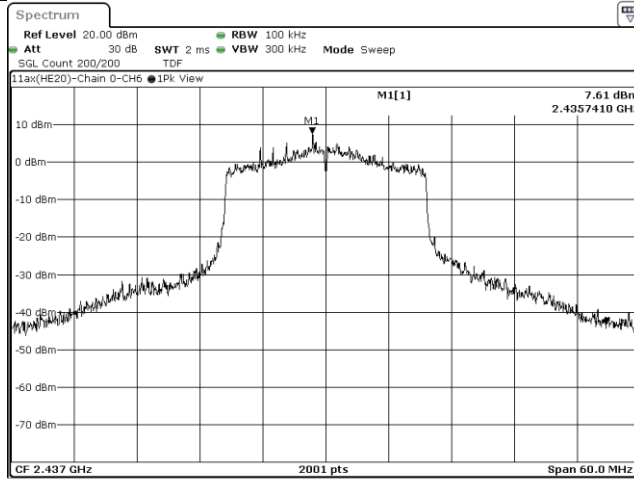
Telephone : +886-2-7737-3000

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

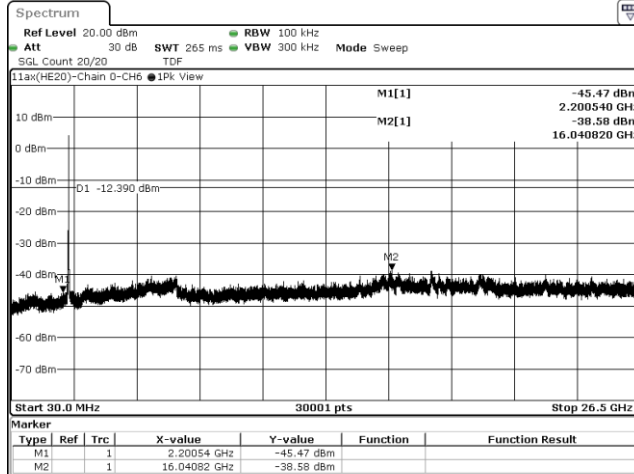
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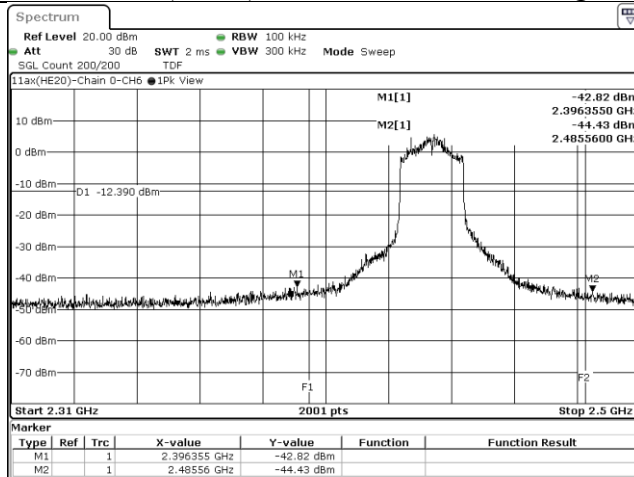
### 802.11ax(HE20), CH6, Chain 0, Reference



### 802.11ax(HE20), CH6, Chain 0, Conducted Emission



### 802.11ax(HE20), CH6, Chain 0, Band edge



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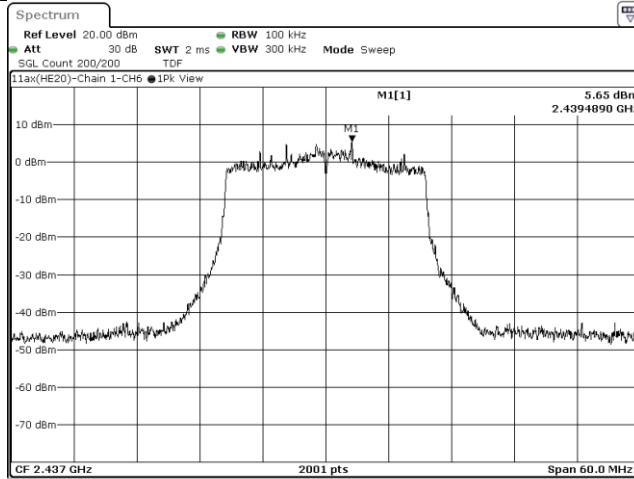
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

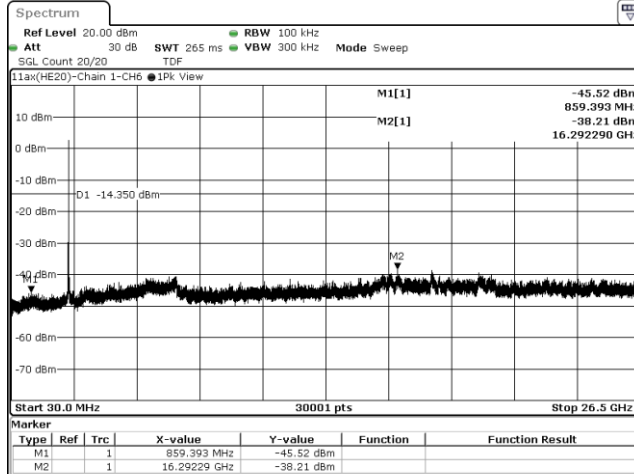
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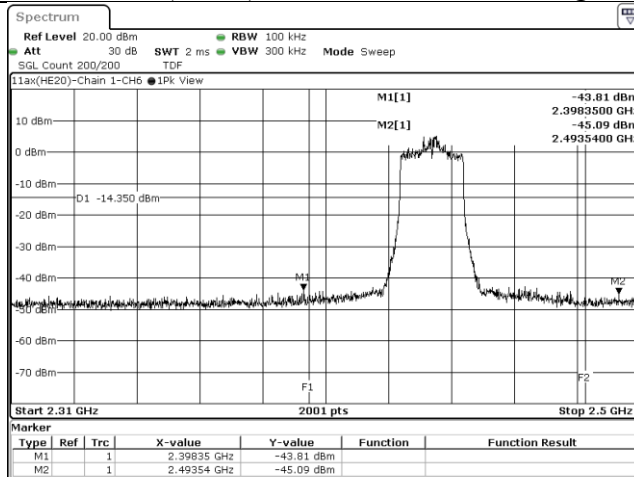
### 802.11ax(HE20), CH6, Chain 1, Reference



### 802.11ax(HE20), CH6, Chain 1, Conducted Emission



### 802.11ax(HE20), CH6, Chain 1, Band edge



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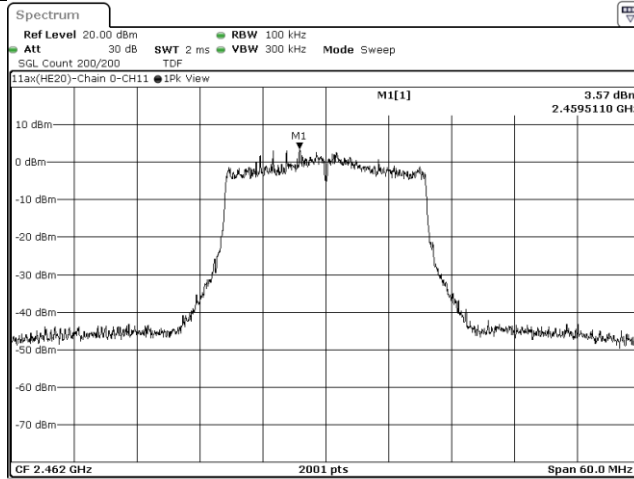
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

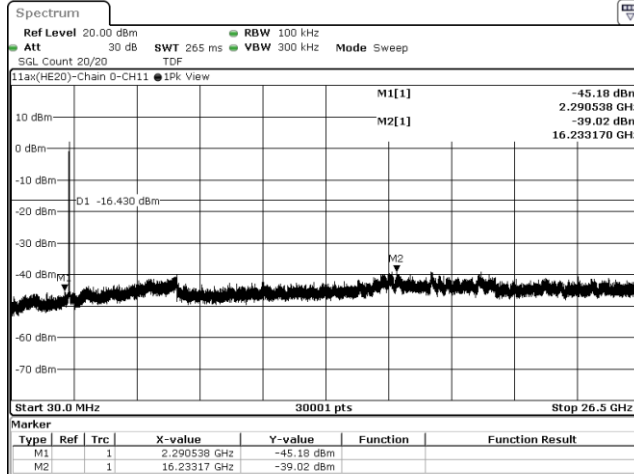
Facsimile (FAX ) :+886-3-583-7948



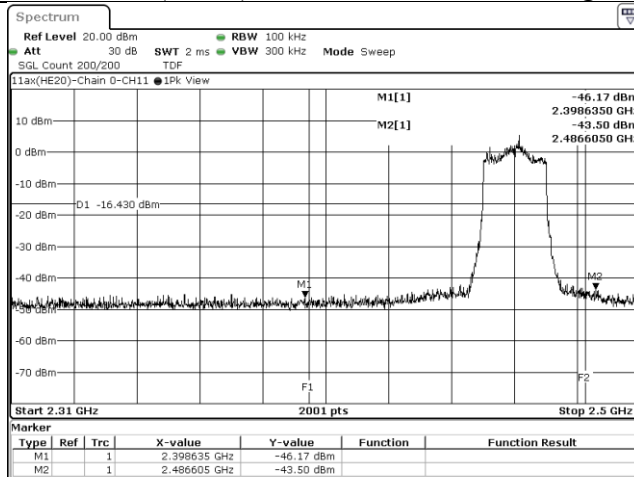
### 802.11ax(HE20), CH11, Chain 0, Reference



### 802.11ax(HE20), CH11, Chain 0, Conducted Emission



### 802.11ax(HE20), CH11, Chain 0, Band edge



## Underwriters Laboratories Taiwan Co., Ltd.

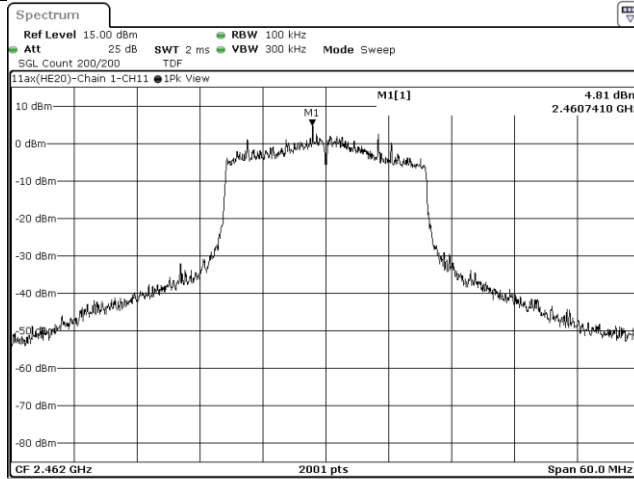
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

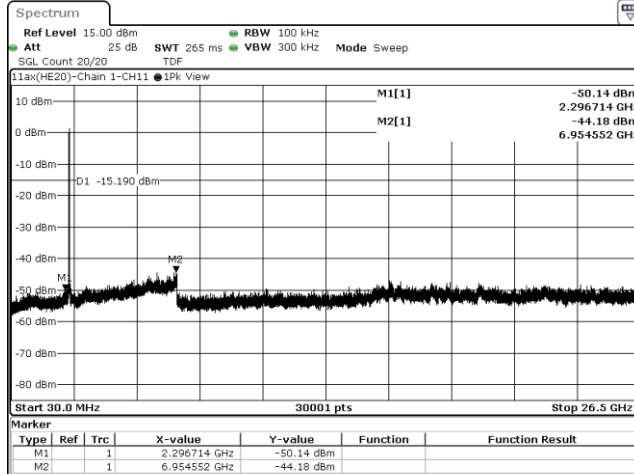
Facsimile (FAX) : +886-3-583-7948



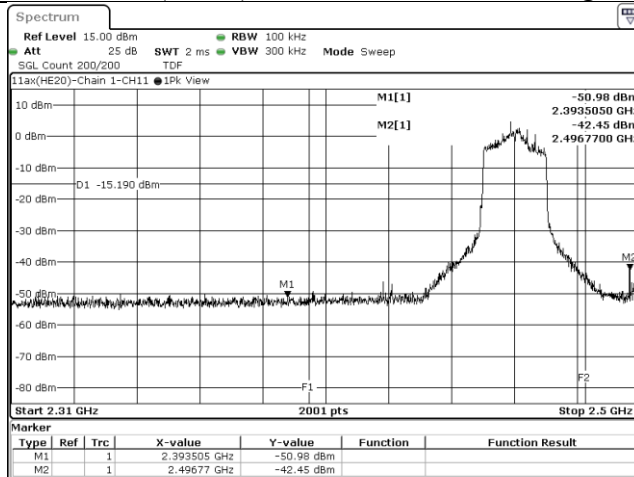
### 802.11ax(HE20), CH11, Chain 1, Reference



### 802.11ax(HE20), CH11, Chain 1, Conducted Emission



### 802.11ax(HE20), CH11, Chain 1, Band edge



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

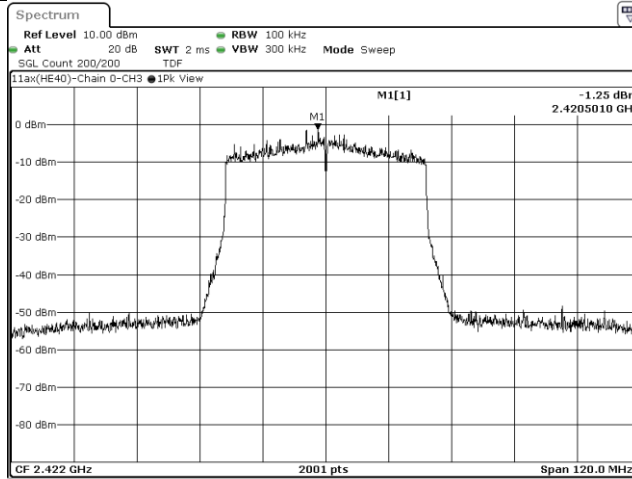
Telephone : +886-2-7737-3000

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

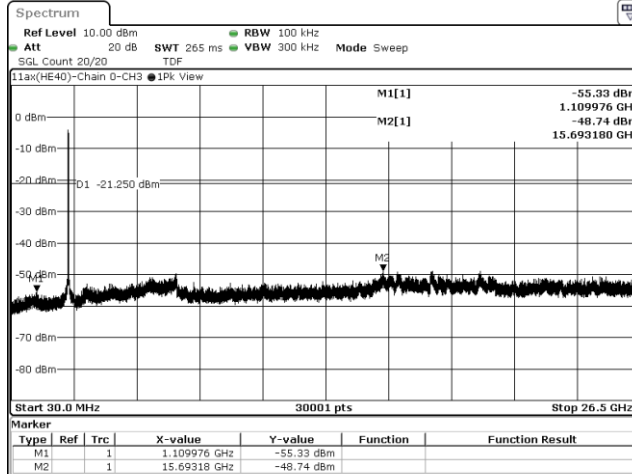
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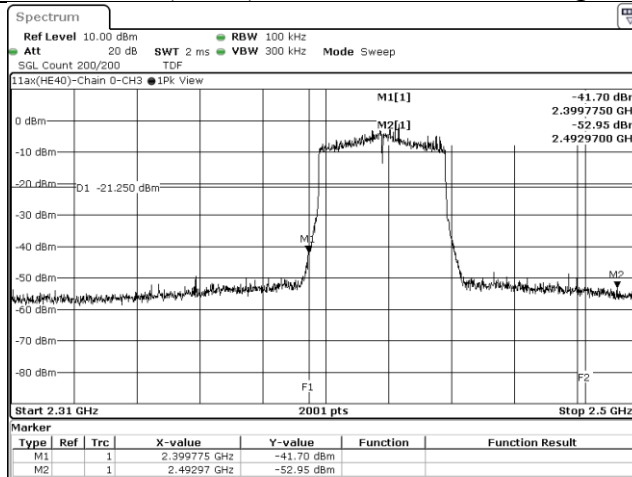
### 802.11ax(HE40), CH3, Chain 0, Reference



### 802.11ax(HE40), CH3, Chain 0, Conducted Emission



### 802.11ax(HE40), CH3, Chain 0, Band edge



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

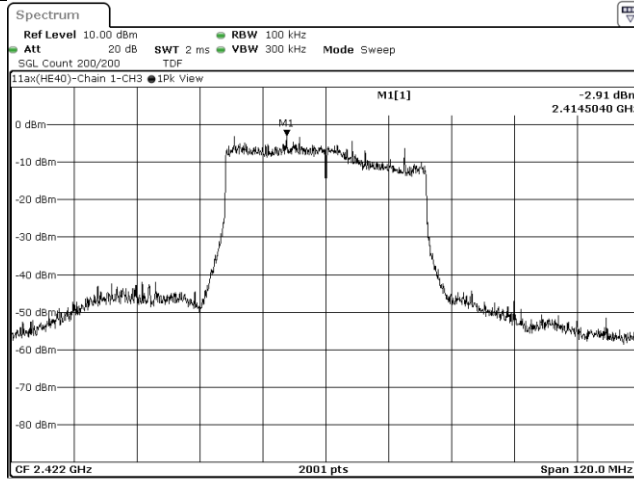
Telephone : +886-2-7737-3000

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

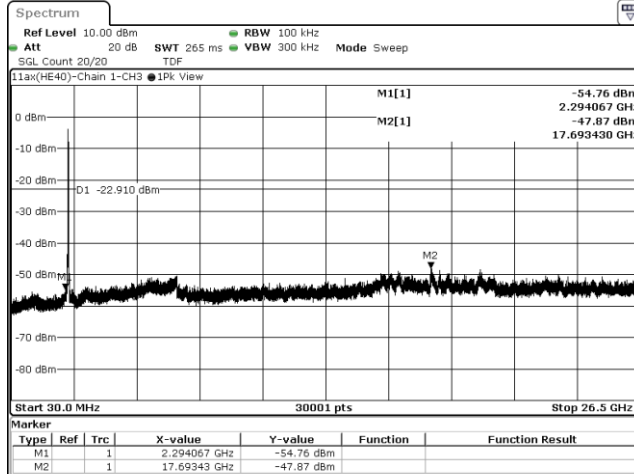




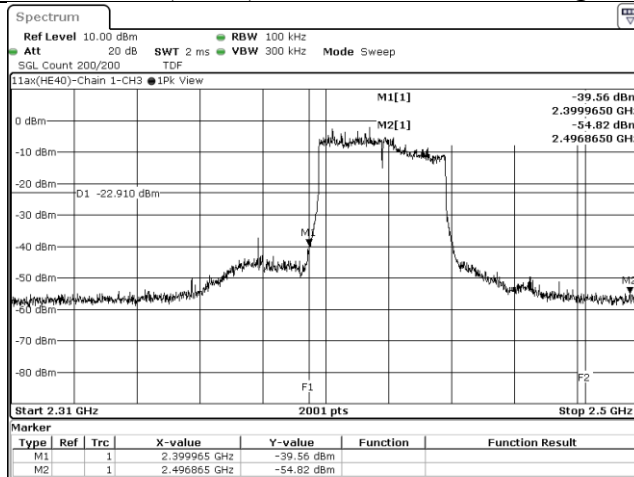
### 802.11ax(HE40), CH3, Chain 1, Reference



### 802.11ax(HE40), CH3, Chain 1, Conducted Emission



### 802.11ax(HE40), CH3, Chain 1, Band edge



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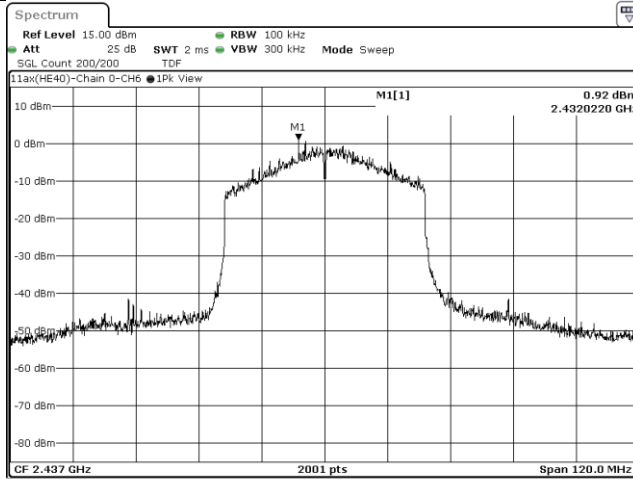
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

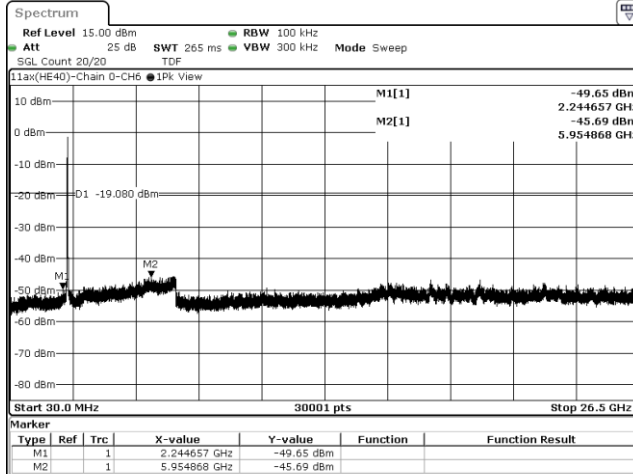
Facsimile (FAX) : +886-3-583-7948



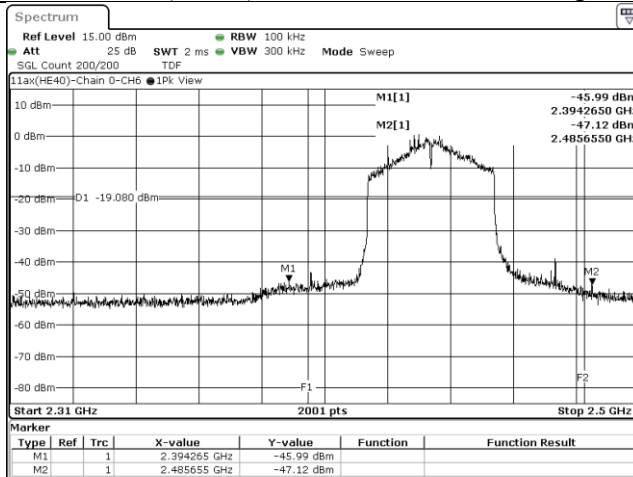
### 802.11ax(HE40), CH6, Chain 0, Reference



### 802.11ax(HE40), CH6, Chain 0, Conducted Emission



### 802.11ax(HE40), CH6, Chain 0, Band edge



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