

RADIO TEST REPORT

Product : 11AX/AC/A/B/G/N (WIFI 6) 2T2R Dual Band Simultaneous full size MPCIE wireless card

Model Name : WM-1431

FCC ID : 2AWKZ-WM1431

Test Regulation : FCC 47 CFR Part 15 Subpart E (Section 15.407)

Received Date : 2023/2/15

Test Date : 2023/3/13 ~ 2023/7/6

Issued Date : 2023/7/12

Applicant : Enli Incorporation
4F., No. 42, Aly. 5, Ln. 12, Sec. 3, Bade Rd., Songshan Dist.
Taipei 10559, 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



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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

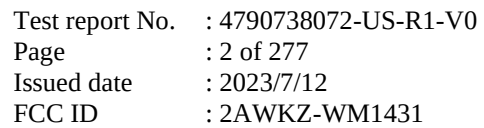


Table of Contents

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	14
6.4. Description of Available Antennas.....	15
6.5. Test Mode Applicability and Tested Channel Detail	16
6.6. Duty cycle.....	19
7. Test Equipment.....	21
8. Description of Test Setup.....	23
9. Test Results	25
9.1. 6dB Bandwidth	25
9.2. 26dB Bandwidth	35
9.3. Occupied Bandwidth	55
9.4. Conducted output power.....	78
9.5. Power Spectral Density	89
9.6. Frequency Stability	109
9.7. Radiated Spurious Emission.....	111
9.8. AC Power Line Conducted Emission.....	274

1. Attestation of Test Results

APPLICANT: Enli Incorporation
4F., No. 42, Aly. 5, Ln. 12, Sec. 3, Bade Rd., Songshan Dist. Taipei
10559, Taiwan

MANUFACTURER: Edimax Technology Co., Ltd.
Niu Shan Foreign Economic Industrial Park, Dong Cheng District,
Dongguan, Guangdong, China

EUT DESCRIPTION: 11AX/AC/A/B/G/N (WIFI 6) 2T2R Dual Band Simultaneous full size
MPCIE wireless card

BRAND: Comtrend

MODEL: WM-1431

SAMPLE STAGE: Engineering Verification Test sample

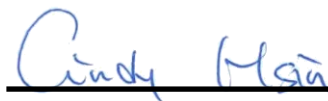
DATE of TESTED: 2023/3/13 ~ 2023/7/6

APPLICABLE STANDARDS	
STANDARD	Test Results
FCC 47 CFR PART 15 Subpart E (Section 15.407)	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 : 2023/7/12

Approved and Authorized By:



Eric Lee
Senior Laboratory Engineer

Date : 2023/7/12

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

2. Summary of Test Results

Summary of Test Results		
FCC Clause	Test Items	Result
15.407(e)	6dB Bandwidth	PASS
15.403(i)	26dB Bandwidth	PASS
2.1049	Occupied Bandwidth	See Note 1
15.407(a)(1/2/3)	Conducted Output Power	PASS
15.407(a)(1/2/3)	Power Spectral Density	PASS
15.407(g)	Frequency Stability	PASS
15.407(b) (1/2/3/4(i/ii)/9)	Radiated Emissions and Band Edge Measurement	PASS
15.407(b)(9)	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	PASS
15.407(h)	Dynamic Frequency Selection & Transmit power control	See Note 2

Note:

1. The Occupied Bandwidth was reference only.
2. The “Dynamic Frequency Selection & Transmit power control measurement” was recorded in Report No.: 4790738072-US-R2-V0

3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB 789033 D02 General UNII Test Procedure New Rules v02r01, 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.

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

5. Measurement Uncertainty

For statement of conformity, accuracy method (Section 4.3.4 of ISO Guide 115) 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 $k=2$.

Determining compliance based on the results of the compliance measurement, not considering measurement instrumentation uncertainty.

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

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

6. Equipment under Test

6.1. Description of EUT

Product	11AX/AC/A/B/G/N (WIFI 6) 2T2R Dual Band Simultaneous full size MPCIE wireless card	
Brand Name	Comtrend	
Model Name	WM-1431	
Operating Frequency	5180 ~ 5240 MHz, 5260 ~ 5320 MHz, 5500 ~ 5720 MHz, 5745 ~ 5825 MHz	
Modulation	1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK	
Transfer Rate	802.11a: up to 54 Mbps 802.11n: up to MCS15 802.11ac: up to MCS9 802.11ax: up to MCS11	
Number of Channel	5180 ~ 5240 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)
	5260 ~ 5320 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)
		1 for 802.11ac (VHT160), 802.11ax (HE160)
	5500 ~ 5720 MHz	12 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		6 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
		3 for 802.11ac (VHT80), 802.11ax (HE80)
		1 for 802.11ac (VHT160), 802.11ax (HE160)
	5745 ~ 5825 MHz	5 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

Maximum Output Power	Non-Beamforming mode: 5180 ~ 5240 MHz: 22.87 dBm 5260 ~ 5320 MHz: 23.96 dBm 5500 ~ 5720 MHz: 23.30 dBm 5745 ~ 5825 MHz: 24.71 dBm Beamforming mode: 5180 ~ 5240 MHz: 21.65 dBm 5260 ~ 5320 MHz: 21.44 dBm 5500 ~ 5720 MHz: 21.48 dBm 5745 ~ 5825 MHz: 24.56 dBm
Normal Voltage	3.3Vdc
Sample ID	5790214

Note:

1. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx,Rx Function
802.11a	2TX,2RX
802.11n (HT20)	2TX,2RX
802.11n (HT40)	2TX,2RX
802.11ac (VHT20)	2TX,2RX
802.11ac (VHT40)	2TX,2RX
802.11ac (VHT80)	2TX,2RX
802.11ac (VHT160)	2TX,2RX
802.11ax (HE20)	2TX,2RX
802.11ax (HE40)	2TX,2RX
802.11ax (HE80)	2TX,2RX
802.11ax (HE160)	2TX,2RX

* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ac mode for VHT20 / VHT40 / VHT80 / VHT160 and 802.11ax mode for HE20 / HE40 / HE80 / HE160, therefore investigated worst case to representative mode in test report.

2. The EUT contains following accessory devices.

Product	Brand	Model	Description
Antenna 1	LYNwave	ALX18P-222AA1-00	-
Antenna 2	LYNwave	ALX18P-222AA1-01	-
Antenna 3	KINSUN	6603303081	-
Antenna 4	WIESON	ARY121-0348-008-00	-
Antenna 5	ARISTOTLE	RFA-25-C2M2-M10-1	-
Antenna 6	ARISTOTLE	RFA-25-C2M2-U-M70	-
Antenna 7	WANSIH	WSS038	-

3. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual, the laboratory shall not be held responsible.

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

6.2. Channel List

FOR 5180 ~ 5240MHz

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

Channel	Frequency	Channel	Frequency
36	5180 MHz	44	5220 MHz
40	5200 MHz	48	5240 MHz

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
42	5210MHz

FOR 5260 ~ 5320MHz

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

Channel	Frequency	Channel	Frequency
52	5260 MHz	60	5300 MHz
56	5280 MHz	64	5320 MHz

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
54	5270 MHz	62	5310 MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
58	5290MHz

1 channel is provided for 802.11ac (VHT160), 802.11ax (HE160):

Channel	Frequency
50	5250MHz

FOR 5500 ~ 5720MHz

12 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

Channel	Frequency	Channel	Frequency
100	5500 MHz	124	5620 MHz
104	5520 MHz	128	5640 MHz
108	5540 MHz	132	5660 MHz
112	5560 MHz	136	5680 MHz
116	5580 MHz	140	5700 MHz
120	5600 MHz	144	5720 MHz

6 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
102	5510 MHz	126	5630 MHz
110	5550 MHz	134	5670 MHz
118	5590 MHz	142	5710 MHz

3 channels are provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency	Channel	Frequency
106	5530MHz	138	5690MHz
122	5610MHz	-	-

1 channel is provided for 802.11ac (VHT160), 802.11ax (HE160):

Channel	Frequency
114	5570MHz

FOR 5745 ~ 5825MHz:

5 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

Channel	Frequency	Channel	Frequency
149	5745MHz	161	5805MHz
153	5765MHz	165	5825MHz
157	5785MHz	-	-

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
151	5755MHz	159	5795MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
155	5775MHz

6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	20~26°C/ 51~69%RH	3.3Vdc	2023/03/20~ 2023/06/21	Rex Chen
Radiated Spurious Emission (Below 1GHz)	966-2	22~26°C/ 54~69%RH	3.3Vdc	2023/03/13~ 2023/06/06	Rex Chen
Radiated Spurious Emission (Above 1GHz)	966-2	21~26°C/ 51~69%RH	3.3Vdc	2023/03/13~ 2023/07/06	Rex Chen
AC power Line Conducted Emission	SR1	21~26°C/ 51~69%RH	3.3Vdc	2023/03/17~ 2023/03/24	Rex Chen

FCC Test Firm Registration Number: 498077

Sample Calculation:

Antenna Port Conducted Measurement:

- Where relevant, the follow sample calculation is provided:
 $\text{Result Value (dBm)} = \text{Reading Value (dBm)} + \text{Attenuator Factor (dB)} + \text{Cable Loss (dB)}.$
 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:
 $\text{Result Value (dBuV/m)} = \text{Reading Value (dBuV)} + \text{Correction Factor (dB/m)}.$
 $\text{Correction Factor (dB/m)} = \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Preamp Factor (dB)}.$
 Example: Result Value (34.5dBuV/m) = Reading Value (40.1dBuV) + 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:
 $\text{Result Value (dBuV)} = \text{Reading Value (dBuV)} + \text{Correction Factor (dB)}.$
 $\text{Correction Factor (dB)} = \text{Insertion loss(dB)} + \text{Cable loss(dB)}.$
 Example: Result Value (53.7dBuV) = Reading Value (35.1dBuV) + Insertion loss(18.1dB) + Cable loss(0.5dB).

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

6.4. Description of Available Antennas

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Maximum Gain (dBi)	Remark
1	Chain (0)+(1)	LYNwave	ALX18P-222AA1-00	Panel	2.4GHz: 6.4 5GHz: 4.2	I-PEX
2	Chain (0)+(1)	LYNwave	ALX18P-222AA1-01	Panel	2.4GHz: 2.6 5GHz: 5.2	I-PEX
3	Chain (0)+(1)	KINSUN	6603303081	Dipole	2.4GHz: 2.18 5GHz: 3.58	RP-SMA
4	Chain (0)+(1)	WIESON	ARY121-0348-008-00	Dipole	2.4GHz: 1.75 5GHz: 1.9	RP-SMA
5	Chain (0)+(1)	ARISTOTLE	RFA-25-C2M2-M10-1	Dipole	2.4GHz: 2.56 5GHz: 1.81	RP-SMA
6	Chain (0)+(1)	ARISTOTLE	RFA-25-C2M2-U-M70	Dipole	2.4GHz: 2.56 5GHz: 1.81	RP-SMA
7	Chain (0)+(1)	WANSIH	WSS038	Dipole	2.4GHz: 4.1 5GHz: 5.23	RP-SMA

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, the laboratory shall not be held responsible.

6.5. Test Mode Applicability and Tested Channel Detail

- Since the Panel Antenna No.2(Model: ALX18P-222AA1-01) and Dipole Antenna No.7(Model: WSS038) with the highest antenna gain for the operation band in 5GHz.
So, the fundamental was investigated in three orthogonal axes X-Y/Y-Z/X-Z. It was determined that the X-Z axis was the worst case for Panel Antenna No.2(Model: ALX18P-222AA1-01), and Y-Z axis was the worst case for Dipole Antenna No.7(Model: WSS038)
Therefore, all final radiated emission was by these conditions for 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).

Non-Beamforming mode:

Test Item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions (Above 1GHz)	802.11a	5180-5240	OFDM	36 to 48	36, 44, 48	6Mbps
	802.11ax20		OFDM/OFDMA	36 to 48	36, 44, 48	MCS0 Nss1
	802.11ax40			38 to 46	38, 46	MCS0 Nss1
	802.11ax80			42	42	MCS0 Nss1
	802.11a	5260-5320	OFDM	52 to 64	52, 60, 64	6Mbps
	802.11ax20		OFDM/OFDMA	52 to 64	52, 60, 64	MCS0 Nss1
	802.11ax40			54 to 62	54, 62	MCS0 Nss1
	802.11ax80			58	58	MCS0 Nss1
	802.11ax160			50	50	MCS0 Nss1
	802.11a	5500-5720	OFDM	100 to 144	100, 116, 140, 144	6Mbps
	802.11ax20		OFDM/OFDMA	100 to 144	100, 116, 140, 144	MCS0 Nss1
	802.11ax40			102 to 142	102, 110, 134, 142	MCS0 Nss1
	802.11ax80			106, 122, 138	106, 122, 138	MCS0 Nss1
	802.11ax160			114	114	MCS0 Nss1
	802.11a	5745-5825	OFDM	149 to 165	149, 157, 165	6Mbps
	802.11ax20		OFDM/OFDMA	149 to 165	149, 157, 165	MCS0 Nss1
	802.11ax40			151 to 159	151, 159	MCS0 Nss1
	802.11ax80			155	155	MCS0 Nss1

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

Test Item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions (Below 1GHz)	802.11ax40	5745-5825	OFDM/OFDMA	151 to 159	159	MCS0 Nss1
AC Power Line Conducted Emission	802.11ax40	5745-5825	OFDM/OFDMA	151 to 159	159	MCS0 Nss1
Antenna Port Conducted Measurement	802.11a	5180-5240	OFDM	36 to 48	36, 44, 48	6Mbps
	802.11ax20		OFDM/OFDMA	36 to 48	36, 44, 48	MCS0 Nss1
	802.11ax40			38 to 46	38, 46	MCS0 Nss1
	802.11ax80			42	42	MCS0 Nss1
	802.11a	5260-5320	OFDM	52 to 64	52, 60, 64	6Mbps
	802.11ax20		OFDM/OFDMA	52 to 64	52, 60, 64	MCS0 Nss1
	802.11ax40			54 to 62	54, 62	MCS0 Nss1
	802.11ax80			58	58	MCS0 Nss1
	802.11ax160			50	50	MCS0 Nss1
	802.11a	5500-5720	OFDM	100 to 144	100, 116, 140, 144	6Mbps
	802.11ax20		OFDM/OFDMA	100 to 144	100, 116, 140, 144	MCS0 Nss1
	802.11ax40			102 to 142	102, 110, 134, 142	MCS0 Nss1
	802.11ax80			106, 122, 138	106, 122, 138	MCS0 Nss1
	802.11ax160			114	114	MCS0 Nss1
	802.11a	5745-5825	OFDM	149 to 165	149, 157, 165	6Mbps
	802.11ax20		OFDM/OFDMA	149 to 165	149, 157, 165	MCS0 Nss1
	802.11ax40			151 to 159	151, 159	MCS0 Nss1
	802.11ax80			155	155	MCS0 Nss1

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

Beamforming mode:

Test Item	Mode	Modulation Technology	Modulation Type	Available Channel	Test Channel	Data Rate
Antenna Port Conducted Measurement	802.11ax20	5180-5240	OFDM/OFDMA	36 to 48	36, 44, 48	MCS0 Nss1
	802.11ax40			38 to 46	38, 46	MCS0 Nss1
	802.11ax80			42	42	MCS0 Nss1
	802.11ax20	5260-5320	OFDM/OFDMA	52 to 64	52, 60, 64	MCS0 Nss1
	802.11ax40			54 to 62	54, 62	MCS0 Nss1
	802.11ax80			58	58	MCS0 Nss1
	802.11ax160			50	50	MCS0 Nss1
	802.11ax20	5500-5720	OFDM/OFDMA	100 to 144	100, 116, 140, 144	MCS0 Nss1
	802.11ax40			102 to 142	102, 110, 134, 142	MCS0 Nss1
	802.11ax80			106, 122, 138	106, 122, 138	MCS0 Nss1
	802.11ax160			114	114	MCS0 Nss1
	802.11ax20	5745-5825	OFDM/OFDMA	149 to 165	149, 157, 165	MCS0 Nss1
	802.11ax40			151 to 159	151, 159	MCS0 Nss1
	802.11ax80			155	155	MCS0 Nss1

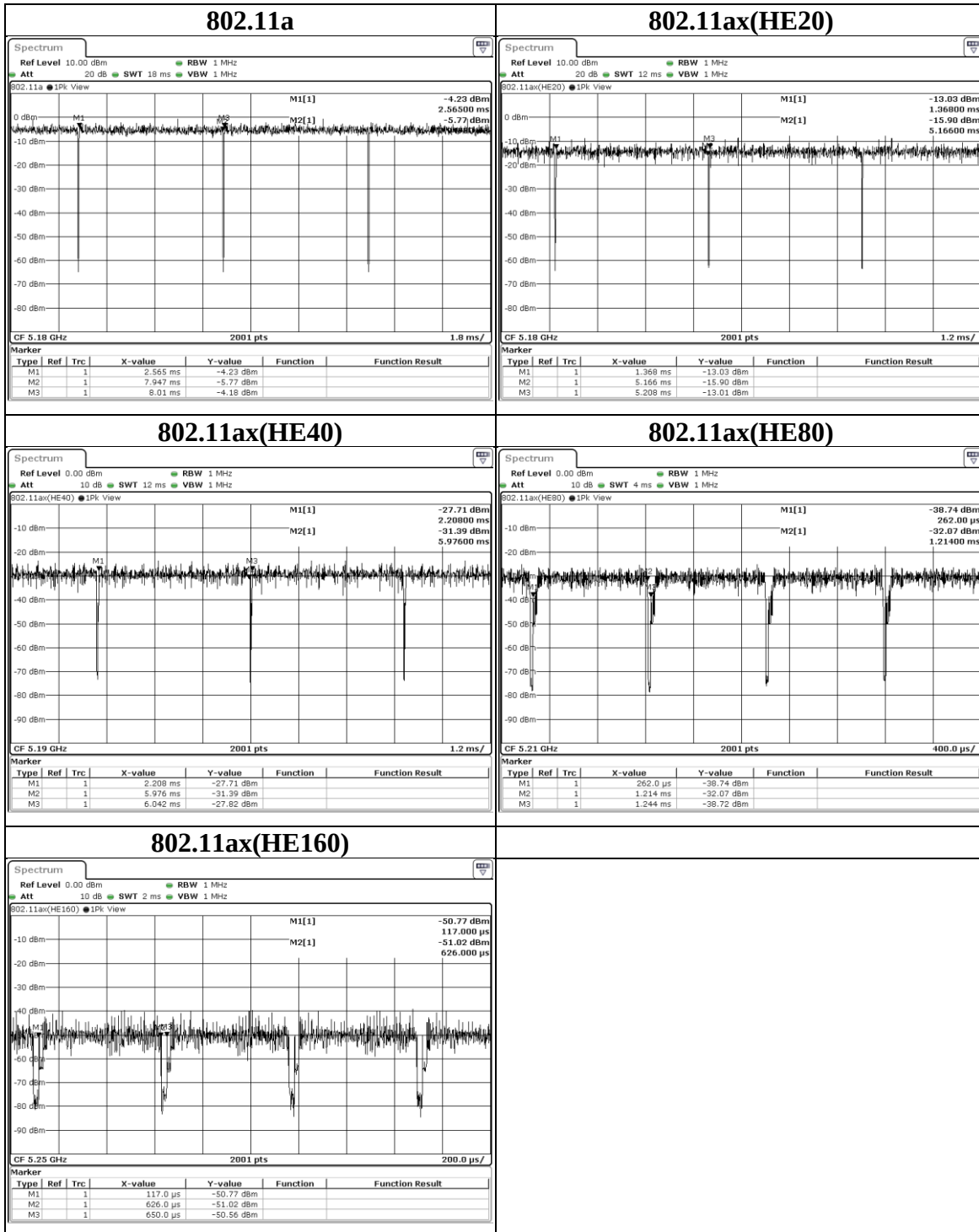
*Note : The worse spurious emissions test and maximum output power was found in Non-Beamforming mode. Therefore Beamforming mode only the test data of the RF output power were recorded in this report.

Simultaneously transmission condition:

Condition	Technology	
1	WLAN (2.4GHz)	WLAN (5GHz)
Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.		

6.6. Duty cycle

Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle	Duty Factor (dB)	VBW Set (above 1GHz)
802.11a	5.382	5.445	0.9884	N/A	10Hz
802.11ax(HE20)	3.798	3.840	0.9891	N/A	10Hz
802.11ax(HE40)	3.768	3.834	0.9828	N/A	10Hz
802.11ax(HE80)	0.952	0.982	0.9695	0.13	2kHz
802.11ax(HE160)	0.509	0.533	0.9550	0.20	2kHz



7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2022/10/24	2023/10/23
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	2022/12/13	2023/12/12
Loop Antenna	ETS lindgren	6502	00213440	2023/1/4	2024/1/3
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	2023/2/13	2024/2/12
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	2022/12/21	2023/12/20
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	2022/12/30	2023/12/29
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	2022/6/7	2023/6/6
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	2023/2/17	2024/2/16
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	2022/5/17	2023/5/16
				2023/5/9	2024/5/8
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	2022/12/1	2023/11/30
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	2022/12/1	2023/11/30

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2022/10/24	2023/10/23
Attenuator	EMCI	EMC-40ATK2W10	17002	2022/12/9	2023/12/8
USB Power Sensor	Anritsu	MA24408A	12031	2022/6/22	2023/6/21
Temperature & Humidity Test Chamber	GIANT FORCE	GTH-150-40-CP-AR	MAA1701-010	2023/3/8	2024/3/7
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	2022/11/10	2023/11/9
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2022/8/29	2023/8/28
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2022/8/30	2023/8/29
Cables	TITAN	CFD200	T0732ACFD200 20A300-2	2022/4/9	2023/4/8

UL Software		
Description	Name	Version
Radiated measurement	e3	6.191211 (V6)
Conducted measurement	RF-Conducted-FCC 15407	ver 1.1
AC power Line Conducted Emission	EZ_EMG	UL-3A1.2

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

8. Description of Test Setup

Support Equipment

ID	Equipment	Brand Name	Model Name	S/N	Remark
A	Laptop	DELL	Latitude E5470	CXSKWF2	Provided by Lab
B	Fixture	N/A	N/A	N/A	Provided by Client
C	Adapter	SAGE	SSP30180SK-D160-VI	SK-0122C-06788	Provided by Client

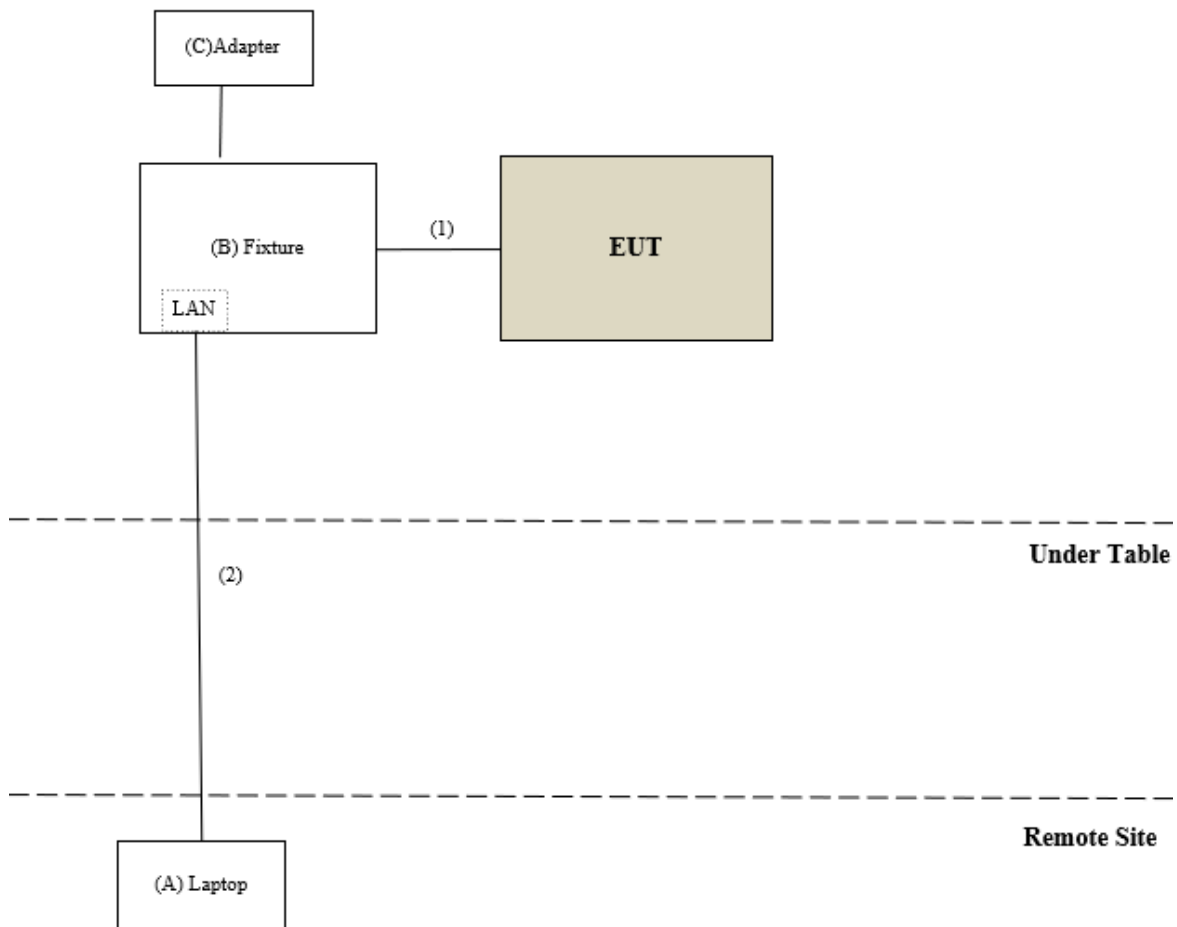
I/O Cables

ID	Equipment	Brand Name	Model Name	Length (m)	Remark
1	Flex Cable	N/A	N/A	0.3	Provided by Client
2	RJ-45 Cable	Fastlink	FL-61STU-04	10	Provide by lab

Test Setup

Controlled using a bespoke application (Intel DUT version 610.36) 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



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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

9. Test Results

9.1. 6dB Bandwidth

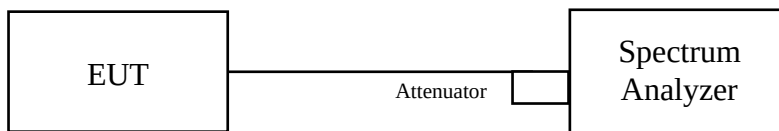
Requirements

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.

Test Data

Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11a	144 (U-NII-2C)	5720	13.287	13.209	0.5	PASS
	144 (U-NII-2C+U-NII-3)	5720	16.539	16.373	0.5	PASS
	144 (U-NII-3)	5720	3.252	3.164	0.5	PASS
	149	5745	16.327	16.305	0.5	PASS
	157	5785	16.31	16.358	0.5	PASS
	165	5825	16.334	16.33	0.5	PASS

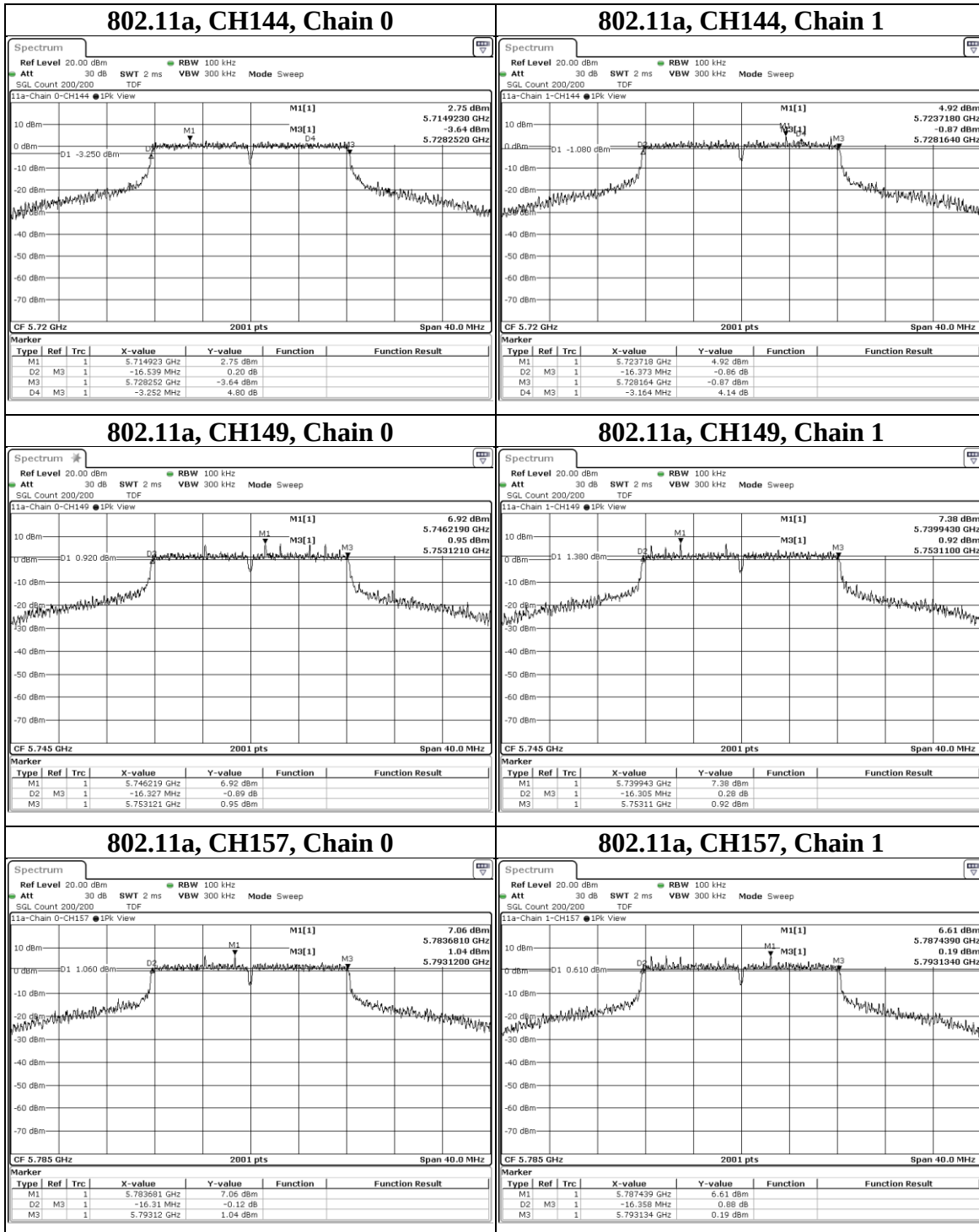
Underwriters Laboratories Taiwan Co., Ltd.

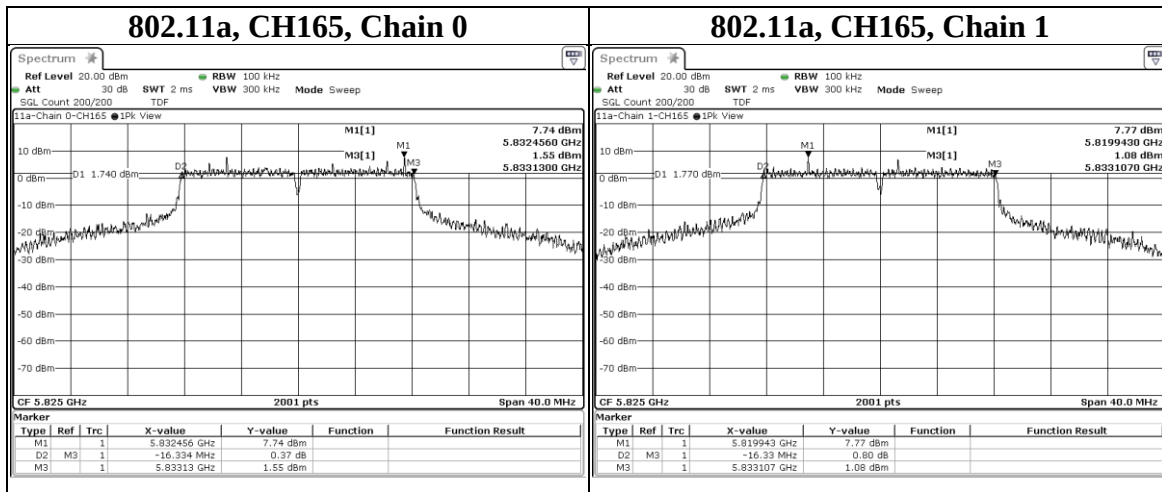
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

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

Doc No: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1





Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE20)	144 (U-NII-2C)	5720	14.453	14.51	0.5	PASS
	144 (U-NII-2C+U-NII-3)	5720	18.844	18.947	0.5	PASS
	144 (U-NII-3)	5720	4.391	4.437	0.5	PASS
	149	5745	18.897	18.774	0.5	PASS
	157	5785	18.277	18.849	0.5	PASS
	165	5825	18.246	18.704	0.5	PASS

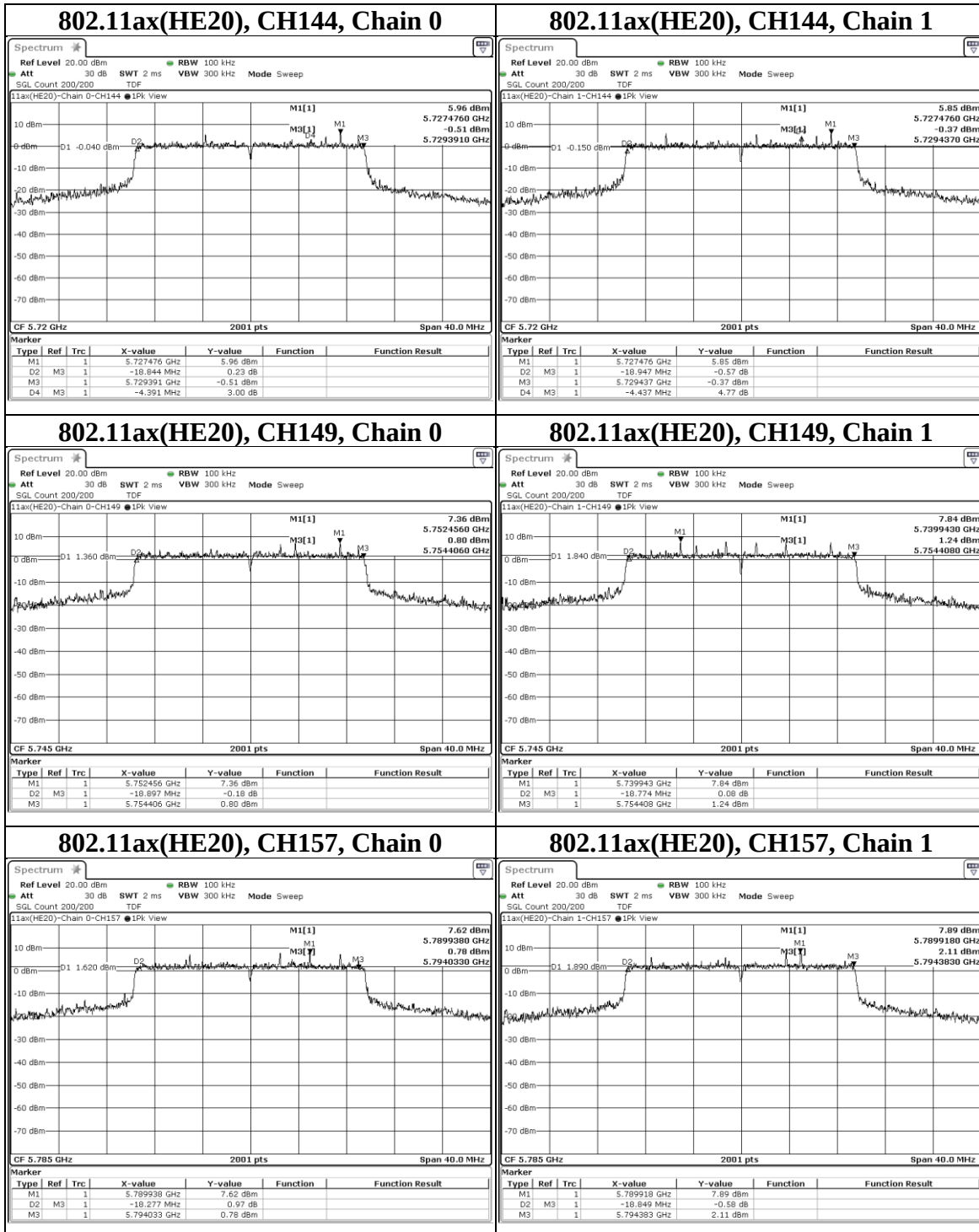
Underwriters Laboratories Taiwan Co., Ltd.

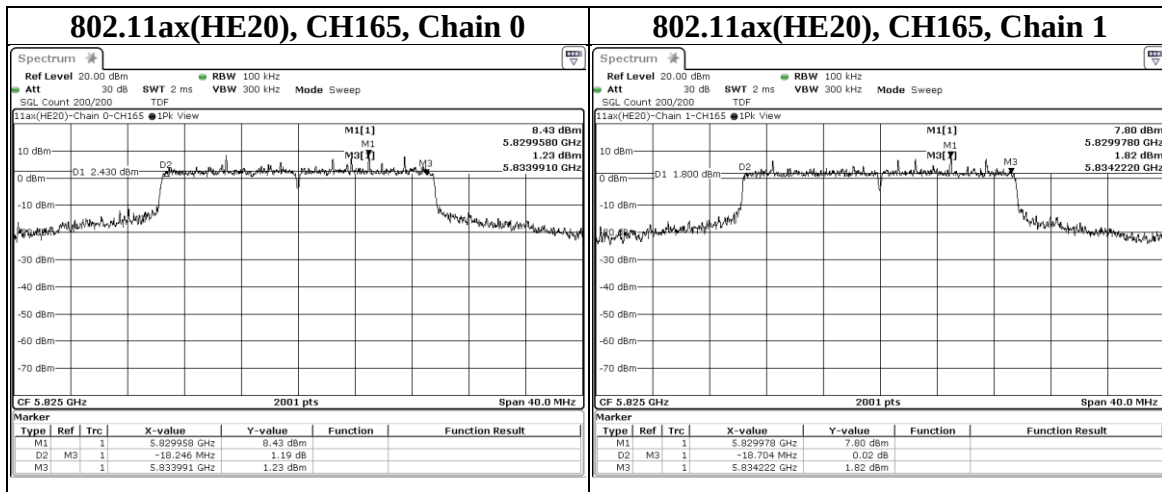
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

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

Doc No: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1





Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE40)	142 (U-NII-2C)	5710	33.87	33.572	0.5	PASS
	142 (U-NII-2C+U-NII-3)	5710	36.992	36.584	0.5	PASS
	142 (U-NII-3)	5710	3.122	3.012	0.5	PASS
	151	5755	37.788	37.058	0.5	PASS
	159	5795	37.044	36.808	0.5	PASS

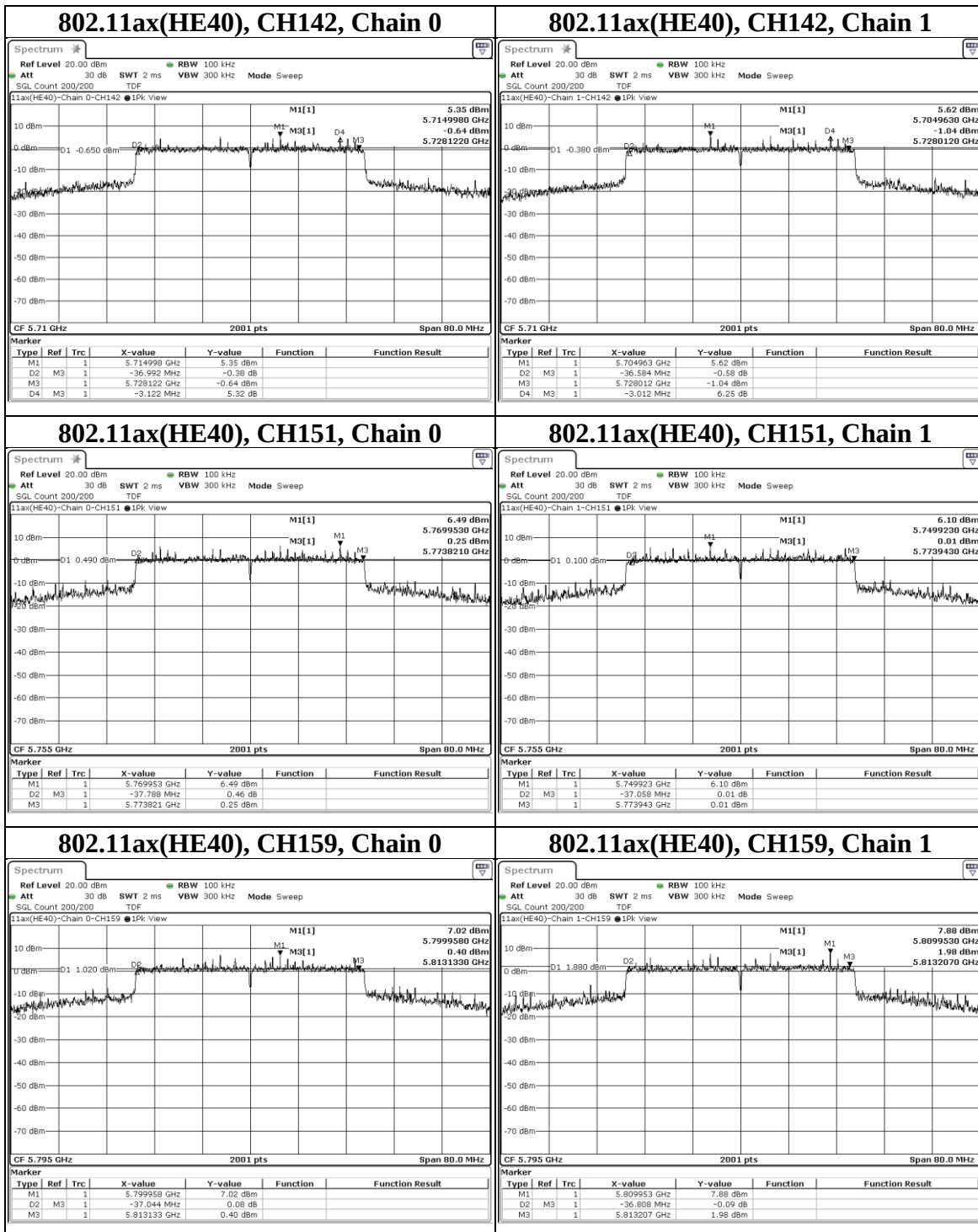
Underwriters Laboratories Taiwan Co., Ltd.

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

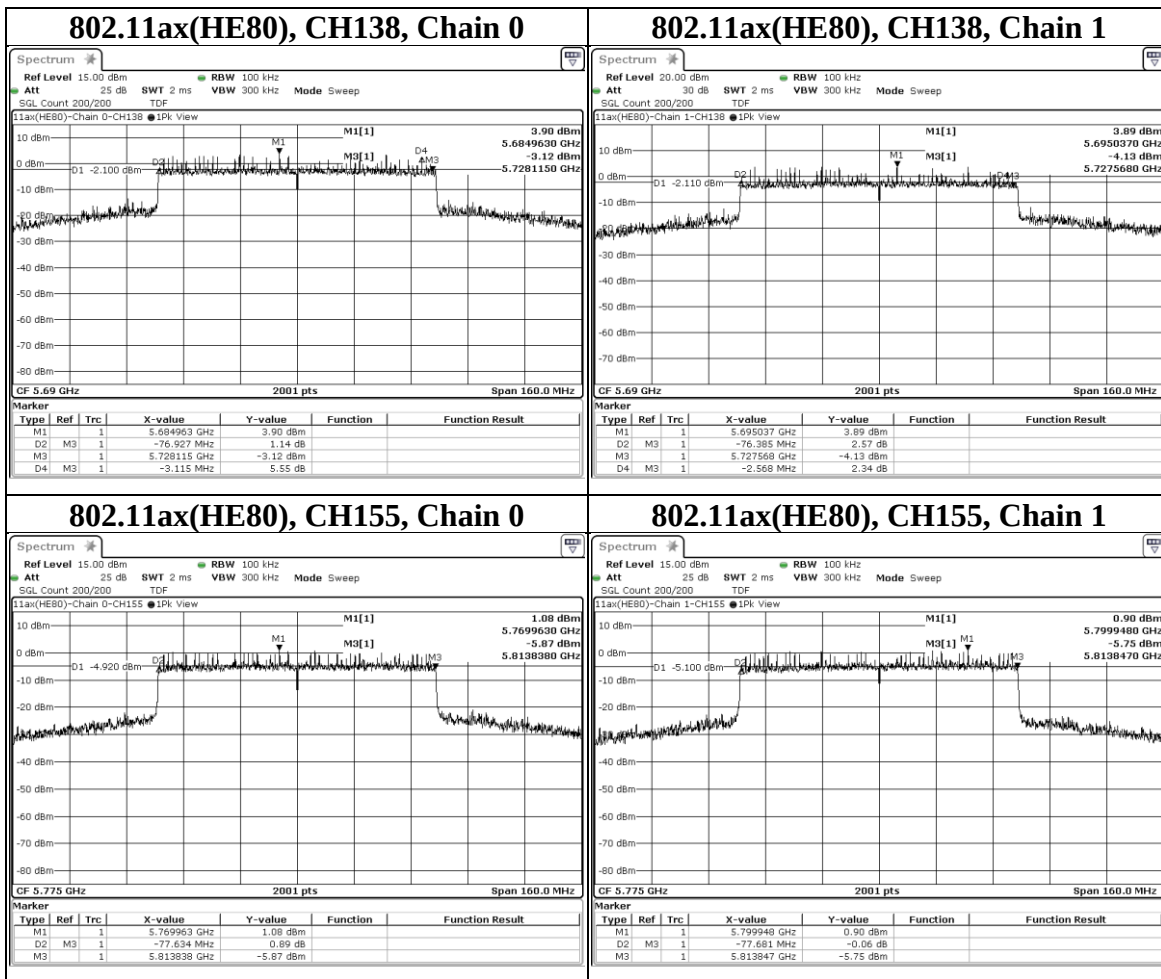
Telephone : +886-2-7737-3000

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

Doc No: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1



Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE80)	138 (U-NII-2C)	5690	73.812	73.817	0.5	PASS
	138 (U-NII-2C+U-NII-3)	5690	76.927	76.385	0.5	PASS
	138 (U-NII-3)	5690	3.115	2.568	0.5	PASS
	155	5775	77.634	77.681	0.5	PASS

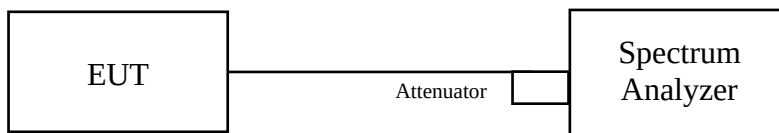


9.2. 26dB Bandwidth

Test procedure

- a. Set RBW = approximately 1% of the emission bandwidth.
- b. Set the VBW > RBW.
- c. Detector = Peak.
- d. Trace mode = max hold.
- e. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Test Setup



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

Test Data

Mode	CH	Freq (MHz)	26dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11a	36	5180	27.272	29.509	N/A	PASS
	44	5220	29.843	31.57	N/A	PASS
	48	5240	35.108	34.937	N/A	PASS
	52	5260	36.314	35.685	N/A	PASS
	60	5300	34.234	34.644	N/A	PASS
	64	5320	27.558	26.149	N/A	PASS
	100	5500	26.744	33.553	N/A	PASS
	116	5580	36.45	36.294	N/A	PASS
	140	5700	21.664	24.437	N/A	PASS
	144 (U-NII-2C)	5720	21.297	21.595	N/A	PASS
	144 (U-NII-2C+U-NII-3)	5720	33.767	34.333	N/A	PASS
	144 (U-NII-3)	5720	12.47	12.738	N/A	PASS

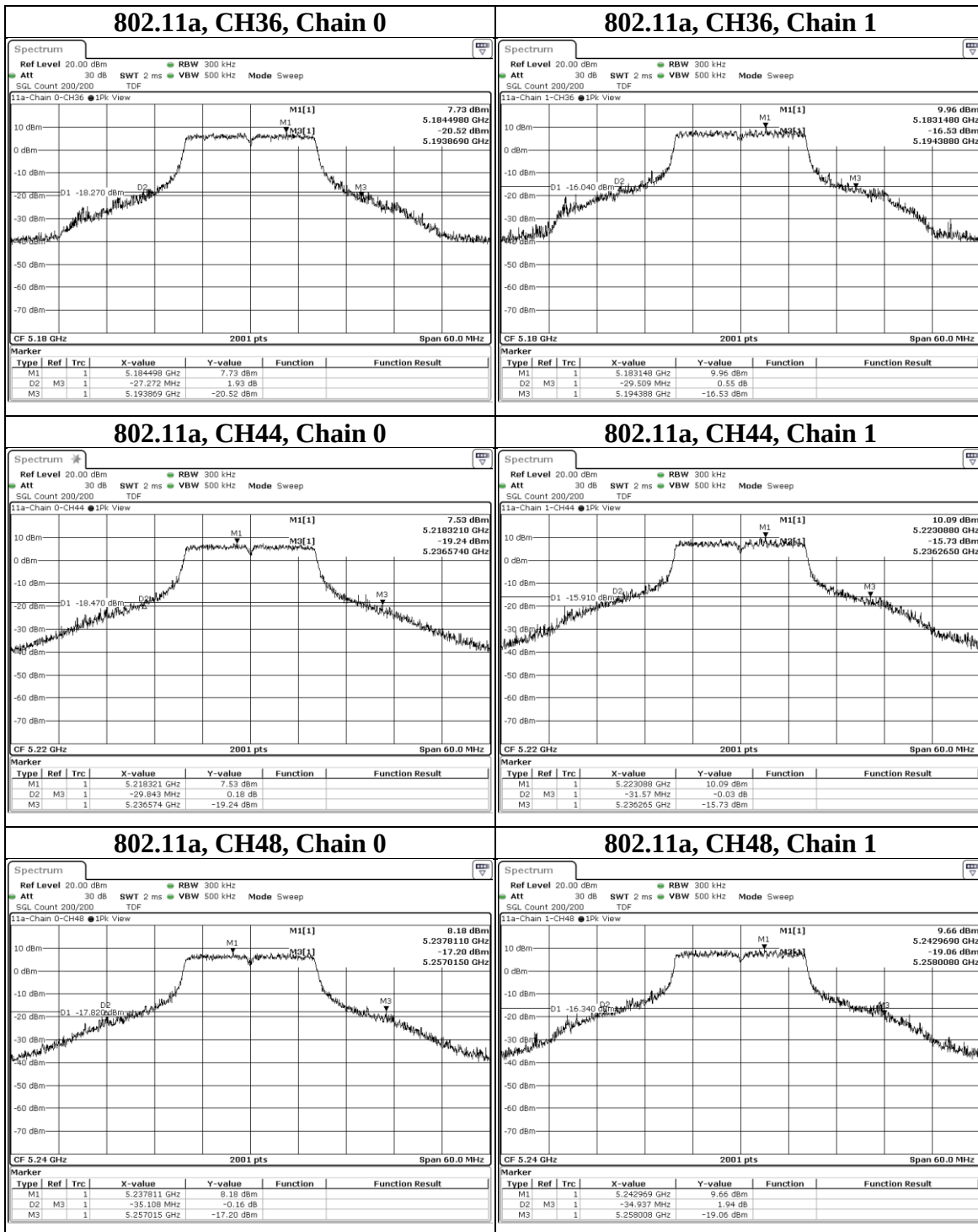
Underwriters Laboratories Taiwan Co., Ltd.

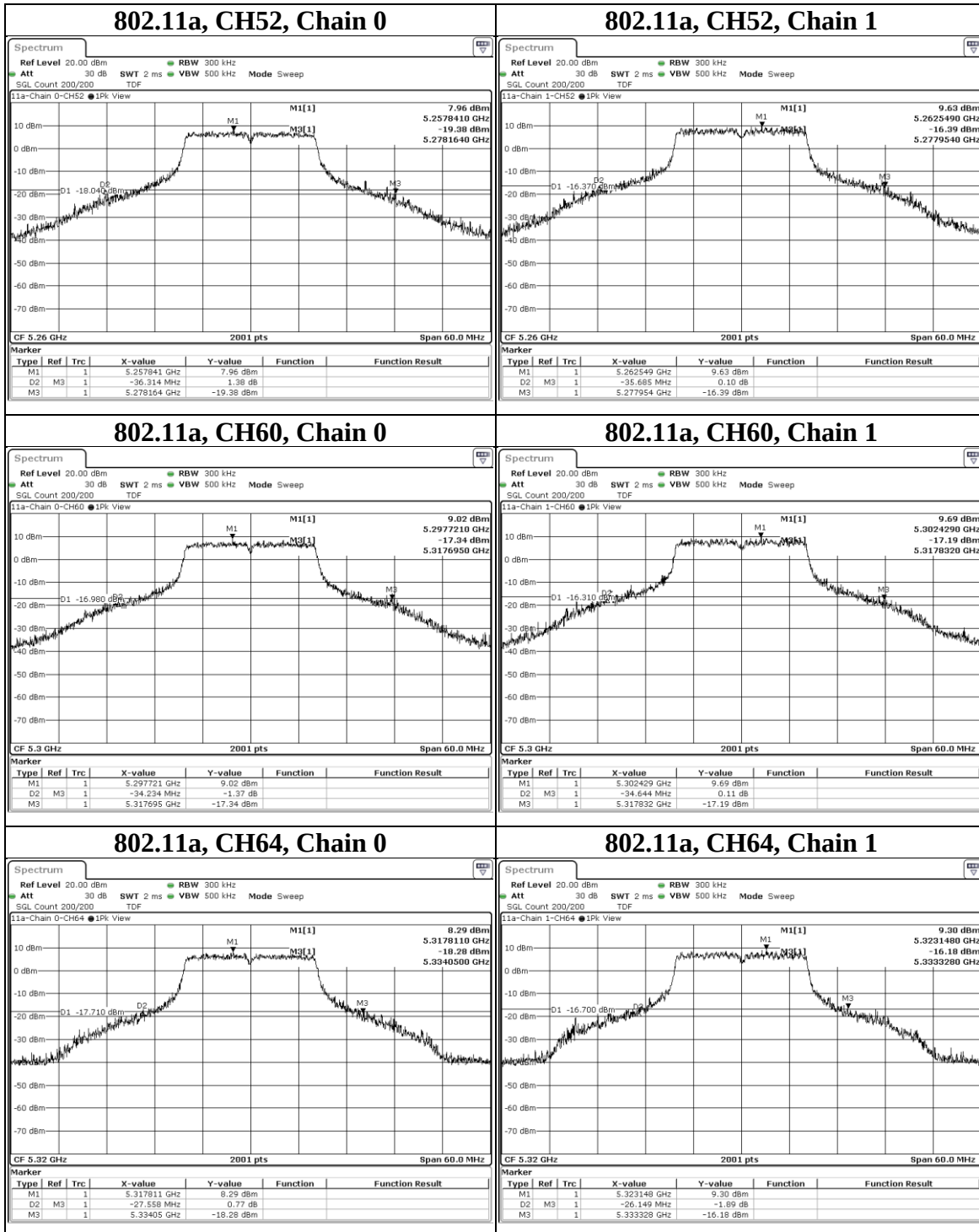
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

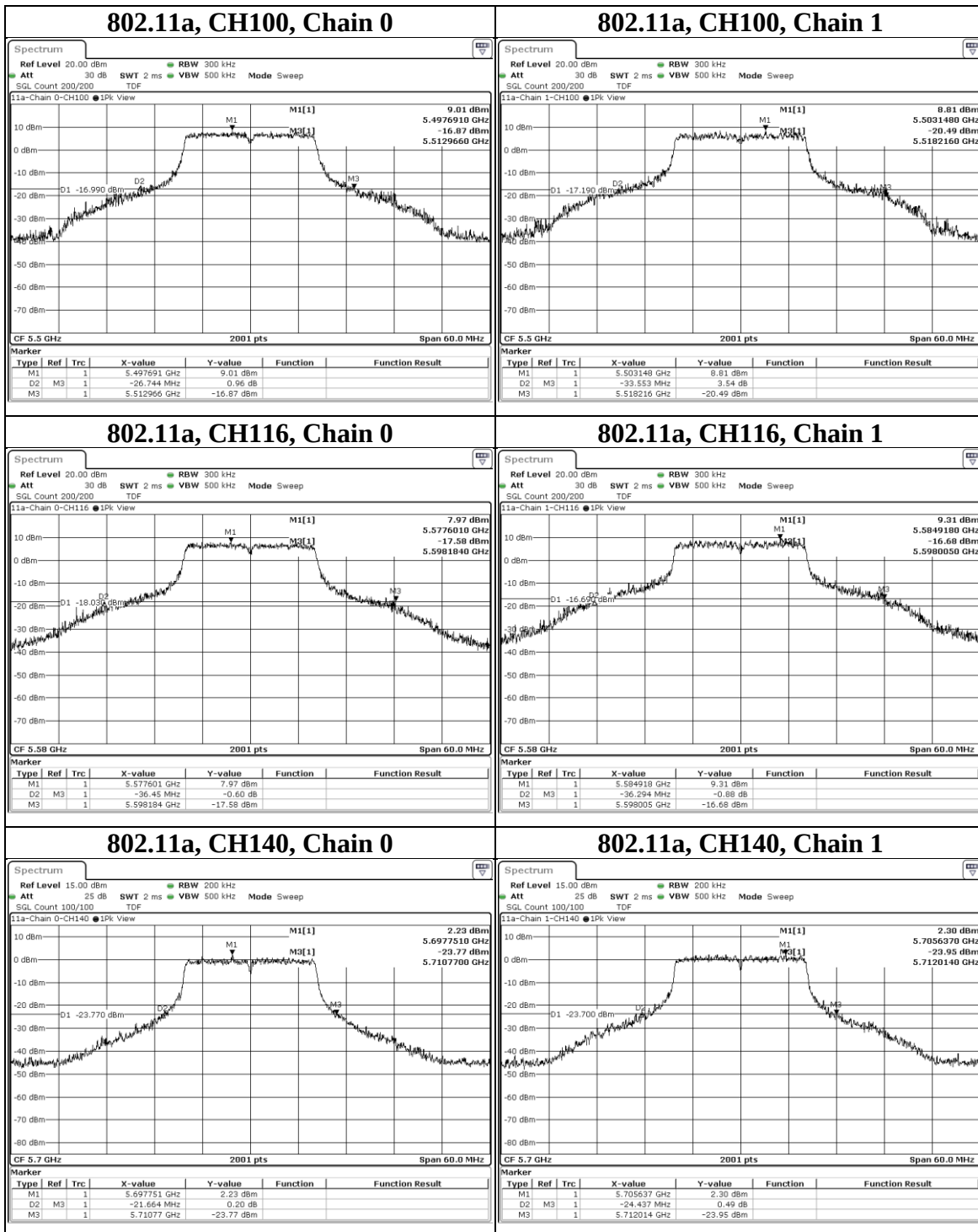
Telephone : +886-2-7737-3000

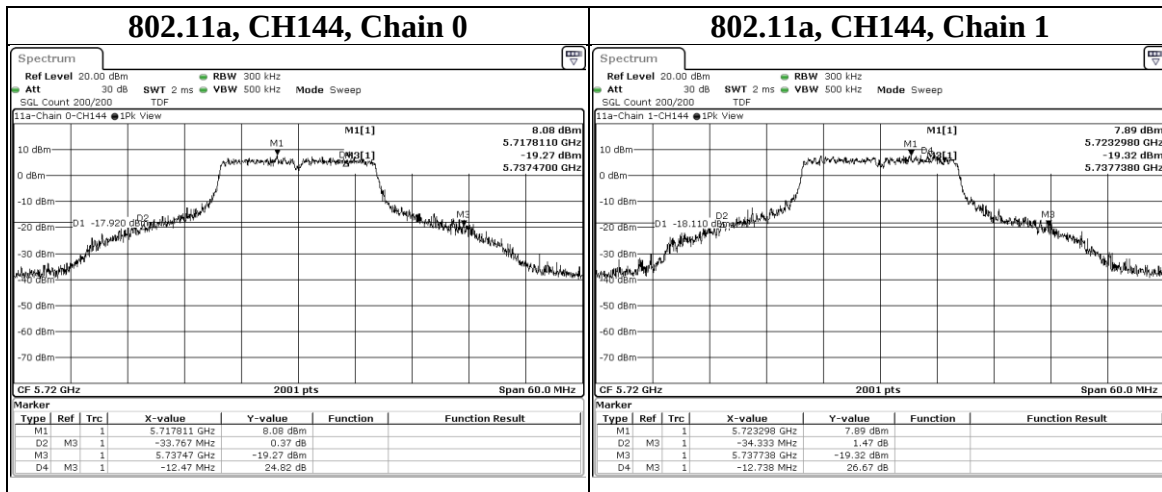
Facsimile (FAX) : +886-3-583-7948

Doc No: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1









Mode	CH	Freq (MHz)	26dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE20)	36	5180	22.901	21.116	N/A	PASS
	44	5220	27.867	37.819	N/A	PASS
	48	5240	28.201	34.9	N/A	PASS
	52	5260	35.718	37.814	N/A	PASS
	60	5300	37.667	37.387	N/A	PASS
	64	5320	22.467	21.363	N/A	PASS
	100	5500	22.454	29.452	N/A	PASS
	116	5580	37.013	43.203	N/A	PASS
	140	5700	21.881	23.105	N/A	PASS
	144 (U-NII-2C)	5720	25.069	25.025	N/A	PASS
	144 (U-NII-2C+U-NII-3)	5720	36.53	36.215	N/A	PASS
	144 (U-NII-3)	5720	11.461	11.19	N/A	PASS

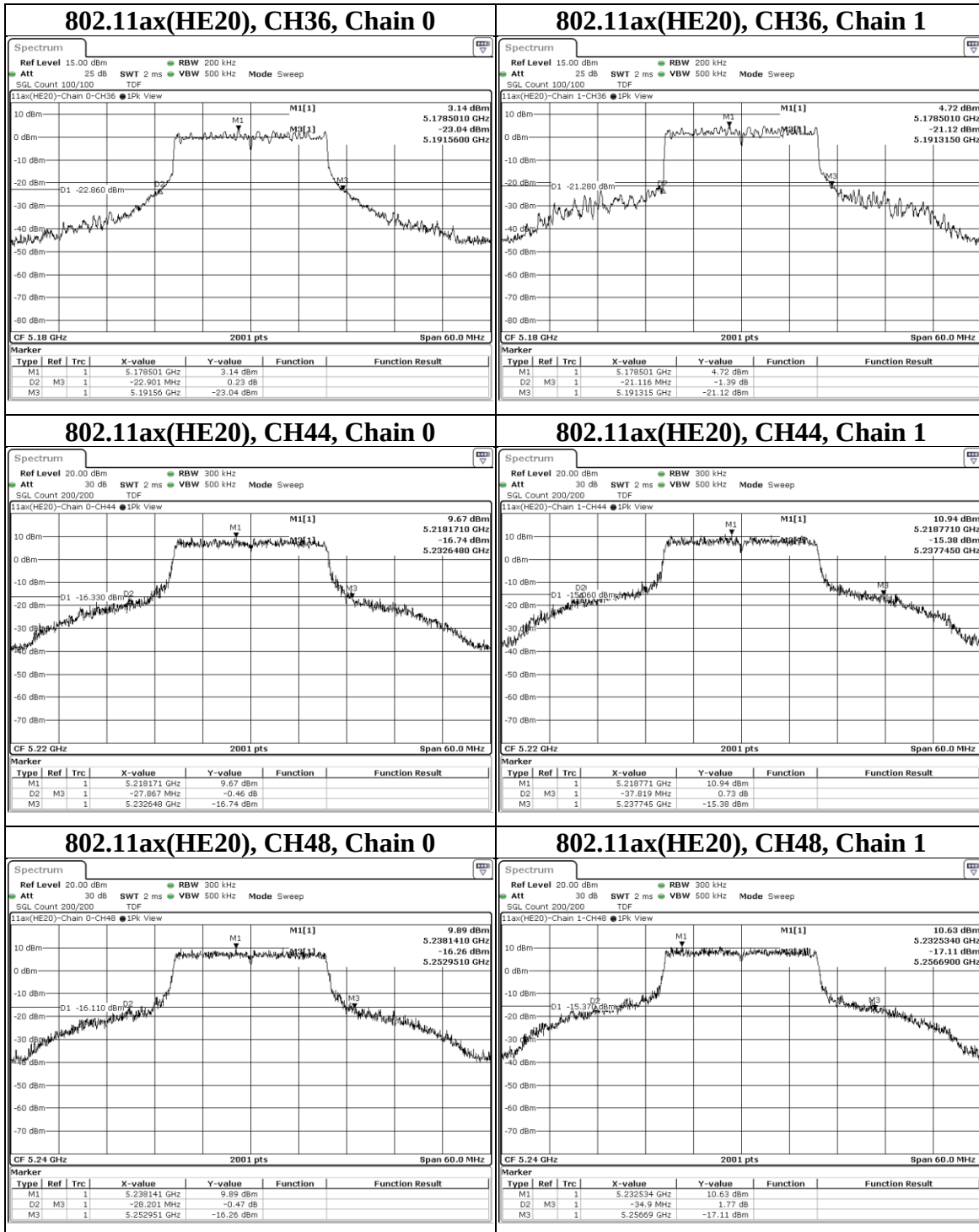
Underwriters Laboratories Taiwan Co., Ltd.

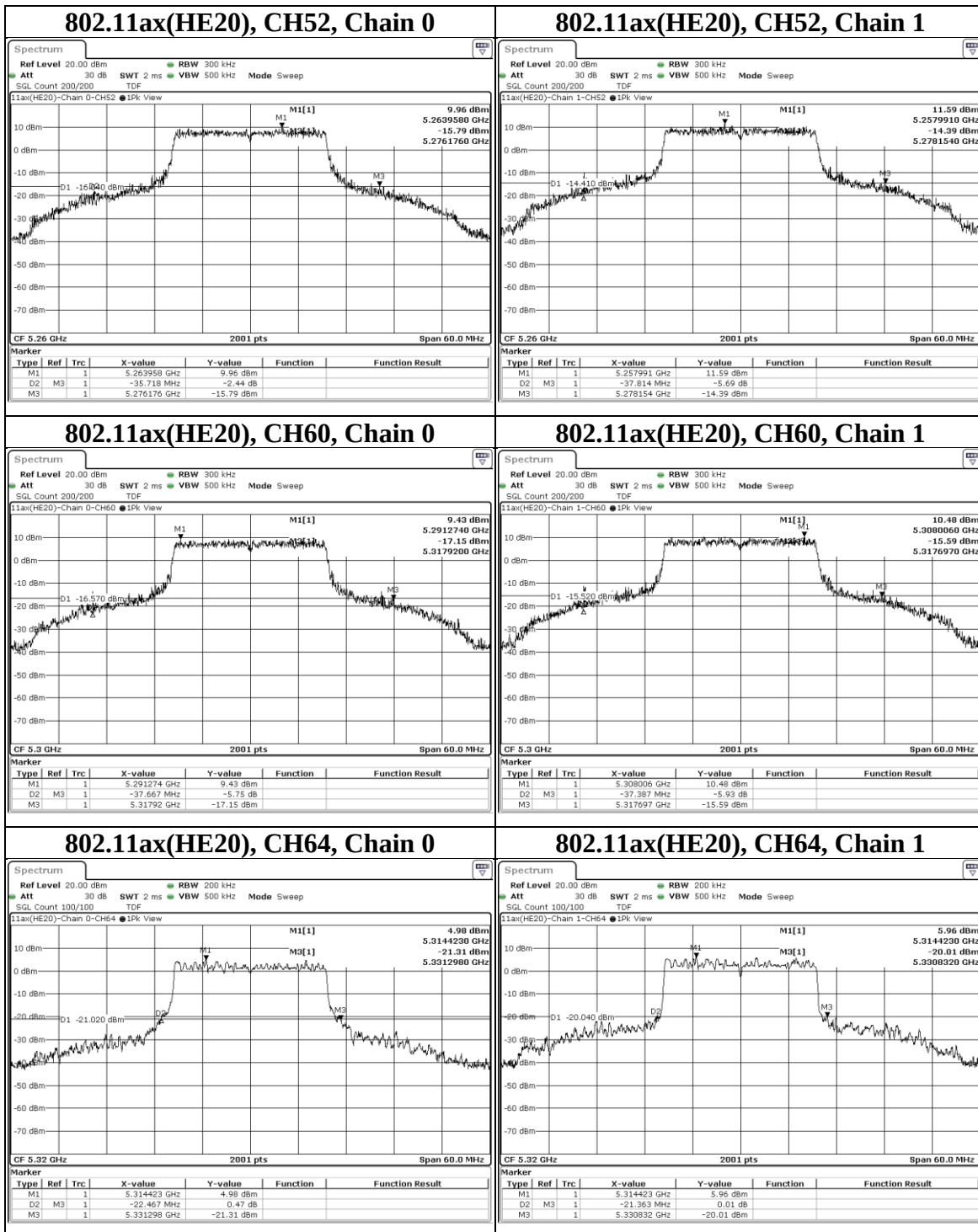
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

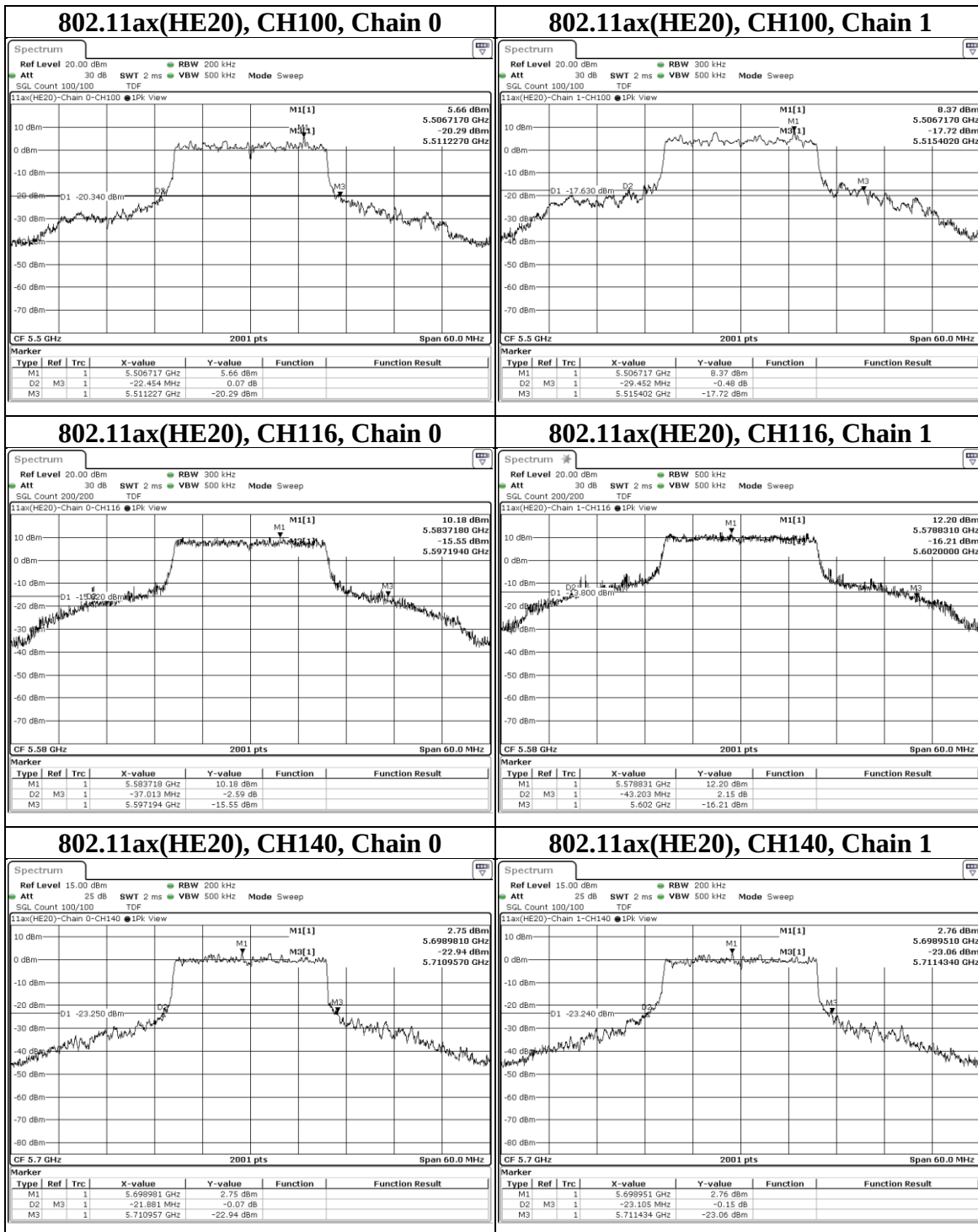
Telephone : +886-2-7737-3000

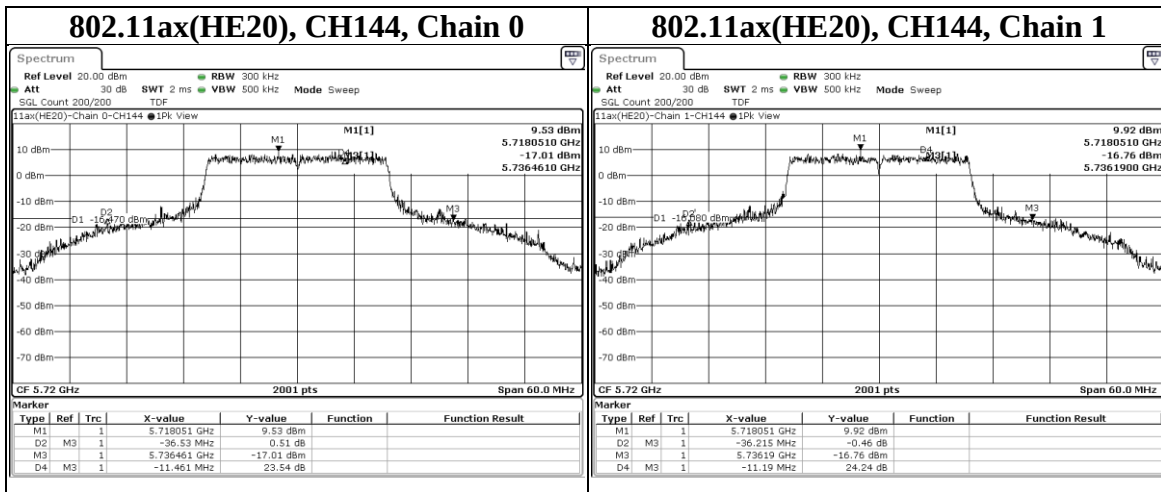
Facsimile (FAX) : +886-3-583-7948

Doc No: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1









Mode	CH	Freq (MHz)	26dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE40)	38	5190	42.784	41.876	N/A	PASS
	46	5230	65.525	62.988	N/A	PASS
	54	5270	80.132	85.572	N/A	PASS
	62	5310	44.87	43.403	N/A	PASS
	102	5510	42.666	42.26	N/A	PASS
	110	5550	84.697	96.635	N/A	PASS
	134	5670	43.733	77.144	N/A	PASS
	142 (U-NII-2C)	5710	58.925	62.767	N/A	PASS
	142 (U-NII-2C+U-NII-3)	5710	92.635	96.991	N/A	PASS
	142 (U-NII-3)	5710	33.71	34.224	N/A	PASS

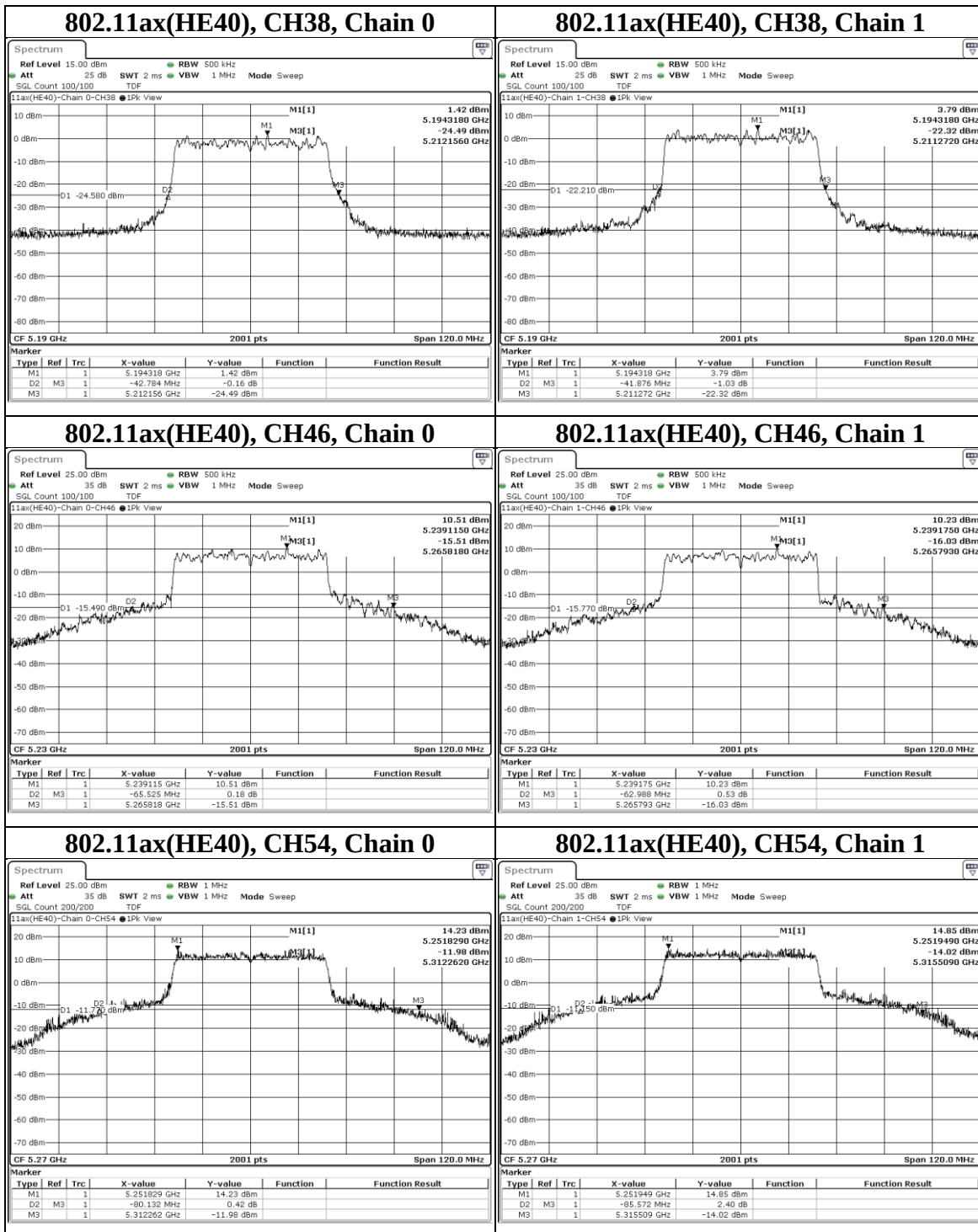
Underwriters Laboratories Taiwan Co., Ltd.

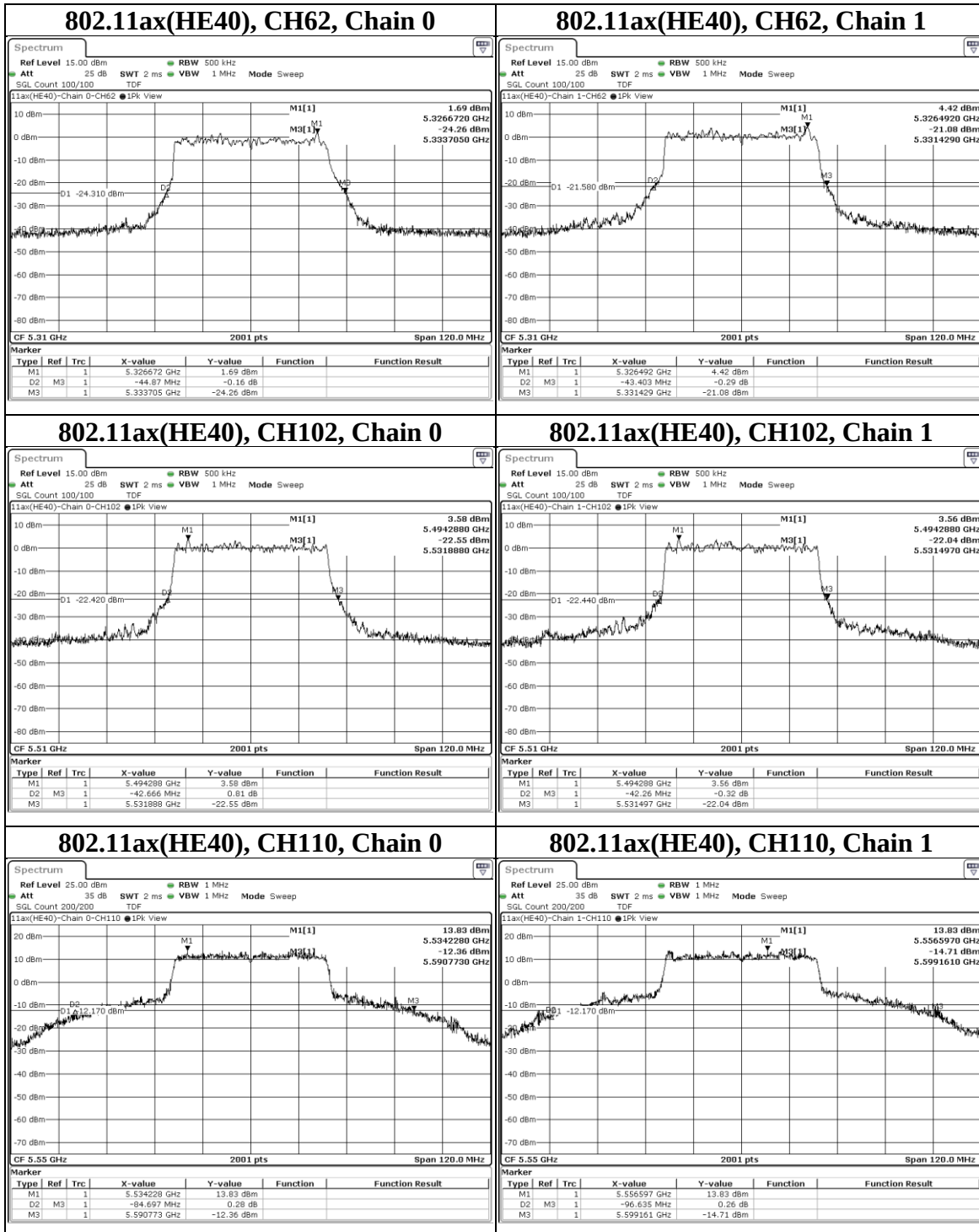
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

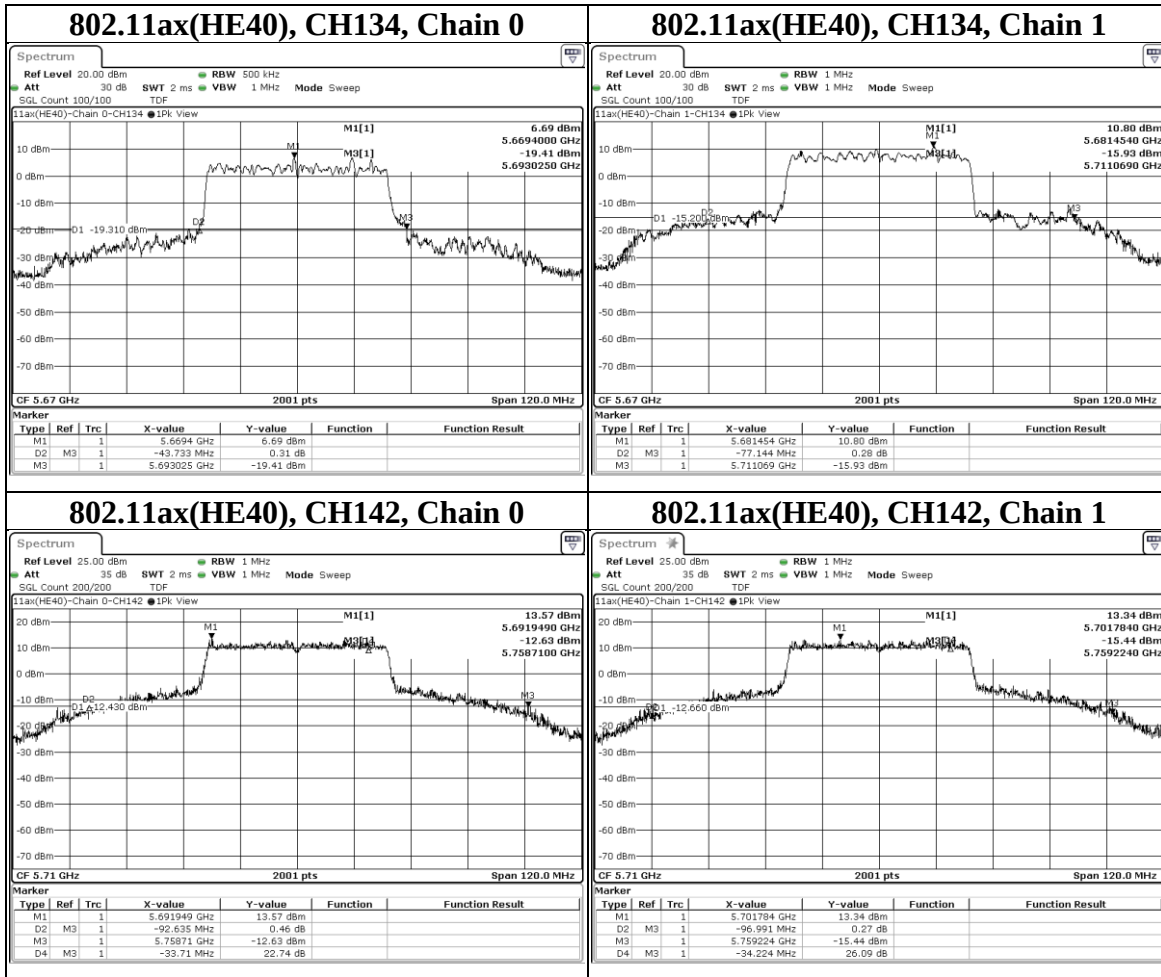
Telephone : +886-2-7737-3000

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

Doc No: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1







Mode	CH	Freq (MHz)	26dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE80)	42	5210	82.447	81.885	N/A	PASS
	58	5290	84.754	84.194	N/A	PASS
	106	5530	83.626	82.409	N/A	PASS
	122	5610	98.306	147.104	N/A	PASS
	138 (U-NII-2C)	5690	132.364	136.649	N/A	PASS
	138 (U-NII-2C+U-NII-3)	5690	194.647	206.786	N/A	PASS
	138 (U-NII-3)	5690	62.283	70.137	N/A	PASS

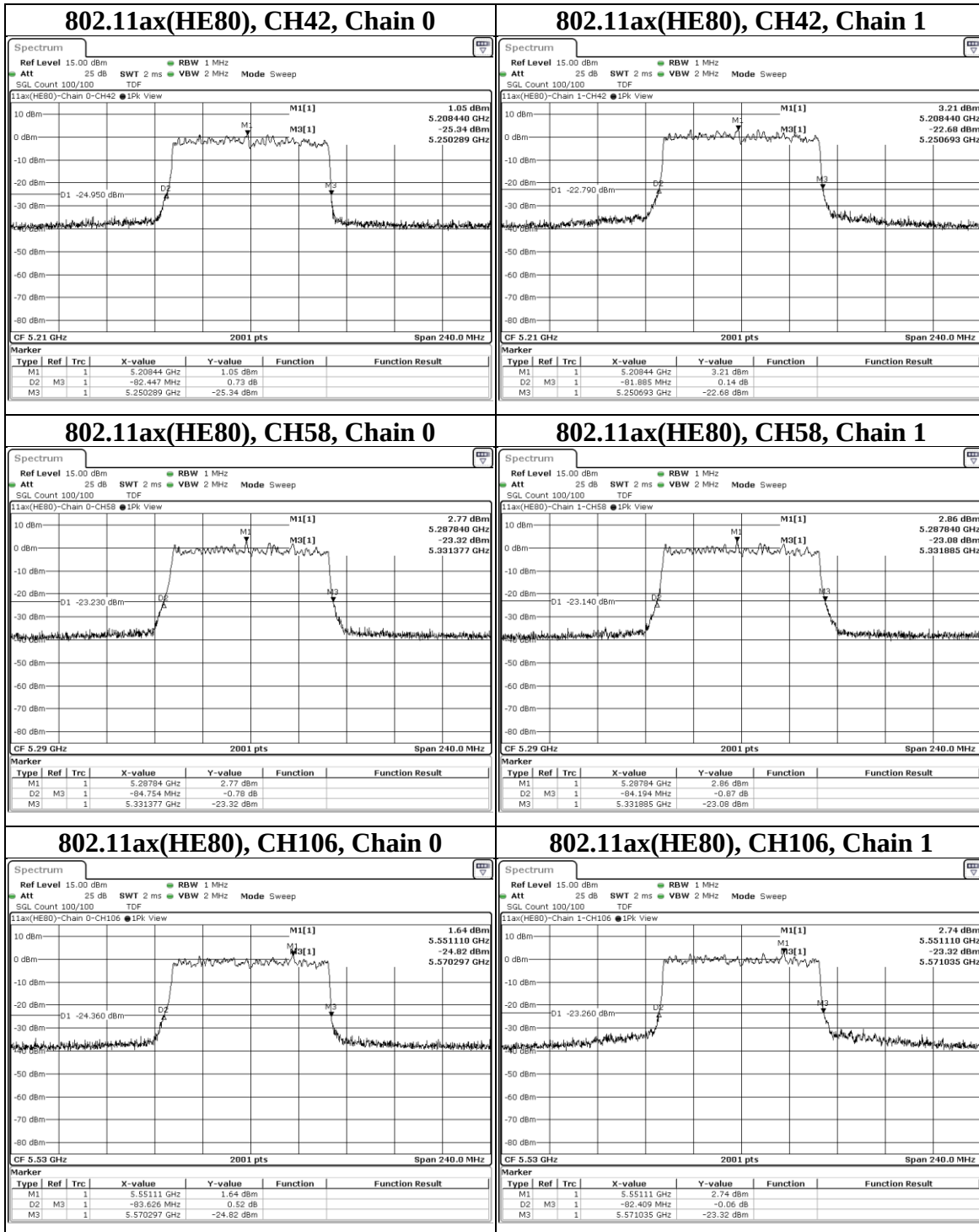
Underwriters Laboratories Taiwan Co., Ltd.

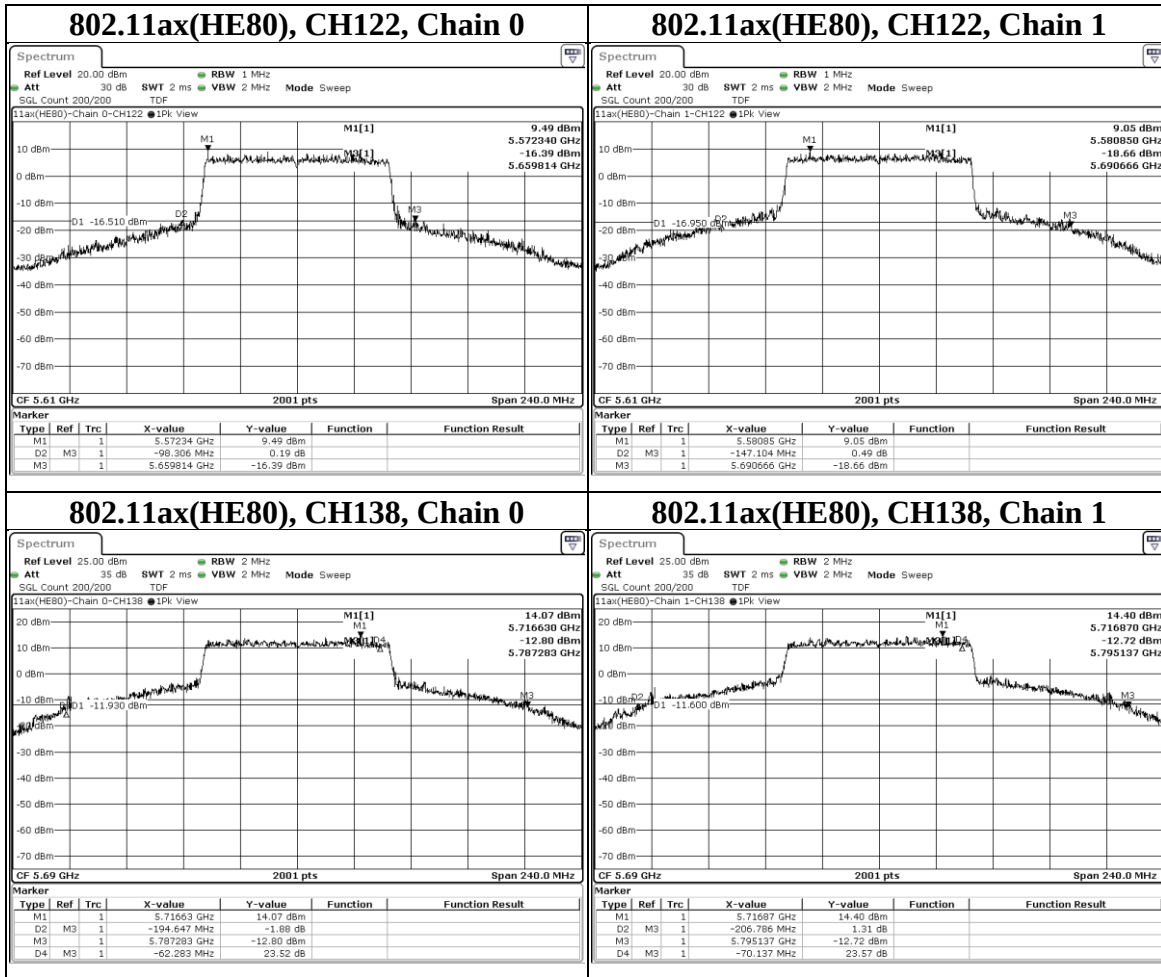
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

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

Doc No: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1





Mode	CH	Freq (MHz)	26dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE160)	50 (U-NII-1)	5250	166.513	163.236	N/A	PASS
	114	5570	167.424	165.843	N/A	PASS

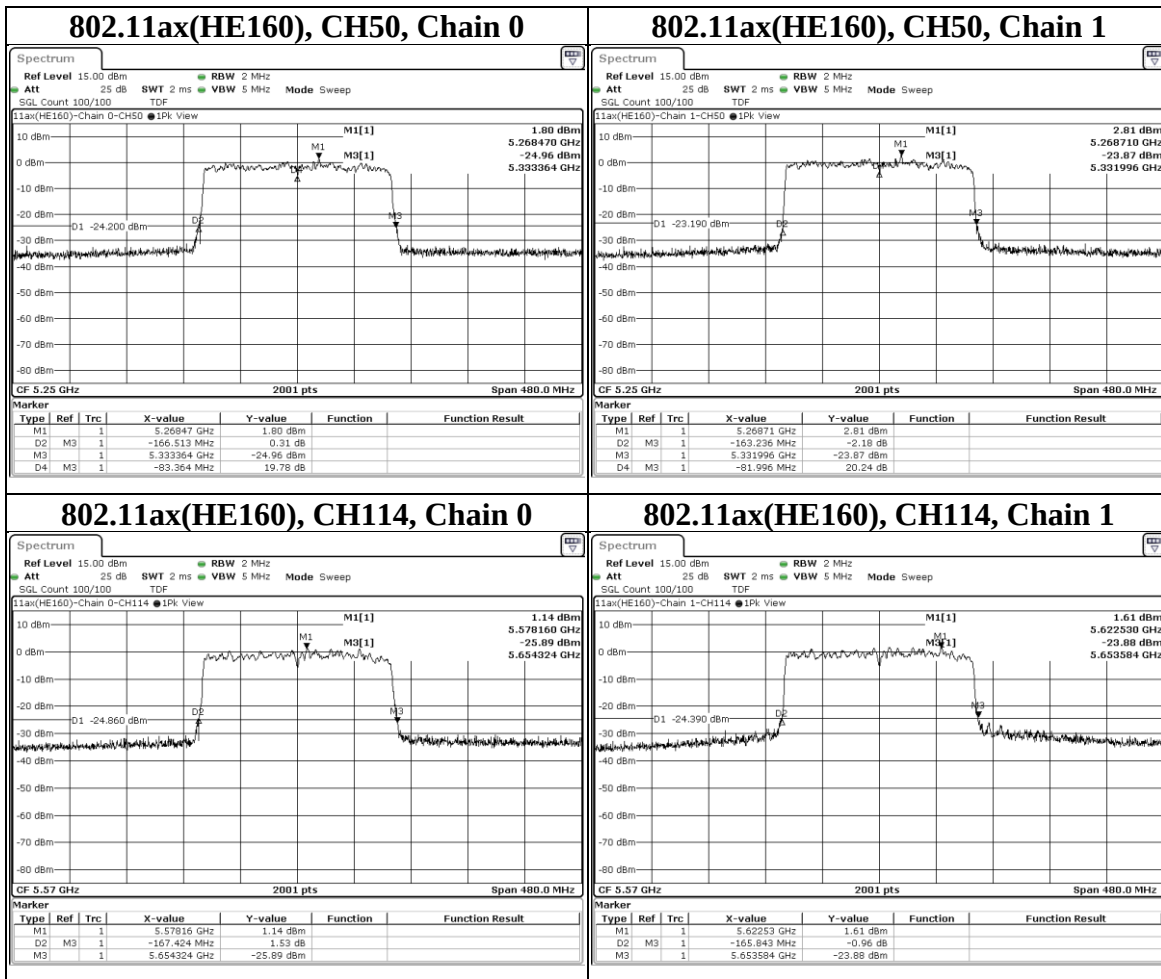
Underwriters Laboratories Taiwan Co., Ltd.

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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

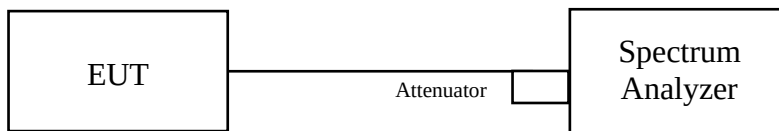


9.3. Occupied Bandwidth

Test procedure

- a. Set center frequency to the nominal EUT channel center frequency.
- b. Set span = 1.5 times to 5.0 times the OBW.
- c. Set RBW = 1% to 5% of the OBW
- d. Set VBW $\geq 3 \times$ RBW
- e. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f. Use the 99% power bandwidth function of the instrument (if available).
- g. If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

Test Setup



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

Test Data

Mode	CH	Freq (MHz)	OBW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11a	36	5180	17.992	17.969	N/A	PASS
	44	5220	18.831	19.039	N/A	PASS
	48	5240	20.526	18.87	N/A	PASS
	52	5260	20.447	21.002	N/A	PASS
	60	5300	20.955	19.125	N/A	PASS
	64	5320	17.969	17.676	N/A	PASS
	100	5500	18.185	18.975	N/A	PASS
	116	5580	21.082	22.736	N/A	PASS
	140	5700	17.932	17.375	N/A	PASS
	144 (U-NII-2C)	5720	14.327	14.248	N/A	PASS
	144 (U-NII-2C+U-NII-3)	5720	18.795	18.566	N/A	PASS
	144 (U-NII-3)	5720	4.468	4.318	N/A	PASS
	149	5745	22.232	20.447	N/A	PASS
	157	5785	24.324	22.37	N/A	PASS
	165	5825	20.662	19.235	N/A	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: Form-ULID-004739 (DCS:17-EM-F0878) / 6.1

