

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 C (Section 15.247)

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.

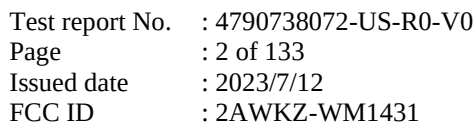
Underwriters Laboratories Taiwan Co., Ltd.

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-004737 (DCS:17-EM-F0876) / 6.1



Original Test Report No.: 4790738072-US-R0-V0

[illegible]

Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 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.....	10
6.3. Test Condition	11
6.4. Description of Available Antennas.....	12
6.5. Test Mode Applicability and Tested Channel Detail	13
6.6. Duty cycle.....	15
7. Test Equipment.....	16
8. Description of Test Setup.....	18
9. Test Results	20
9.1. 6dB Bandwidth.....	20
9.2. Conducted Output Power.....	30
9.3. Power Spectral Density	35
9.4. Conducted Out of Band Emission	40
9.5. Radiated Spurious Emission.....	66
9.6. AC Power Line Conducted Emission.....	130

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 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 : 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-004737 (DCS:17-EM-F0876) / 6.1

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

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-004737 (DCS:17-EM-F0876) / 6.1

3. Test Methodology and Reference Procedures

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

4. Facilities and Accreditation

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

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-004737 (DCS:17-EM-F0876) / 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

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	2412MHz ~ 2462MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA
Transfer Rate	802.11b: up to 11 Mbps 802.11g: up to 54 Mbps 802.11n: up to MCS15 802.11ax: up to MCS11
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20), 802.11ax (HE20) 7 for 802.11n (HT40), 802.11ax (HE40)
Maximum Output Power	Non-Beamforming mode: 802.11b: 21.79 dBm 802.11g: 24.63 dBm 802.11ax (HE20): 23.98 dBm 802.11ax (HE40): 23.44 dBm Beamforming mode: 802.11ax (HE20): 23.61 dBm 802.11ax (HE40): 23.26 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
802.11b	1TX,1RX
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.

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-004737 (DCS:17-EM-F0876) / 6.1

6.2. Channel List

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20), 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), 802.11ax (HE40):

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

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~ 2023/06/29	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:
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 (40.1dBuV) + 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:
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 (35.1dBuV) + 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-004737 (DCS:17-EM-F0876) / 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

- 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.
- Since the Panel Antenna No.1(Model: ALX18P-222AA1-00) and Dipole Antenna No.7(Model: WSS038) with the highest antenna gain for the operation band in 2.4GHz. So, the fundamental was investigated in three orthogonal axes X-Y/Y-Z/X-Z, and it was determined that the Y-Z axis was worst-case. Therefore, all final radiated testing was performed Y-Z plane.
- 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)	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,2,6,11	6 Mbps
	802.11ax20	OFDMA	BPSK	1 to 11	1,2,6,11	MCS0 Nss1
	802.11ax40	OFDMA	BPSK	3 to 9	3,6,9	MCS0 Nss1
Radiated Emissions (Below 1GHz)	802.11g	OFDM	BPSK	1 to 11	6	6 Mbps
AC Power Line Conducted Emission	802.11g	OFDM	BPSK	1 to 11	6	6 Mbps
*Antenna Port Conducted Measurement	802.11b	DSSS	DBPSK	1 to 11	1,6,11	1 Mbps
	802.11g	OFDM	BPSK	1 to 11	1,2,6,11	6 Mbps
	802.11ax20	OFDMA	BPSK	1 to 11	1,2,6,11	MCS0 Nss1
	802.11ax40	OFDMA	BPSK	3 to 9	3,6,9	MCS0 Nss1

*Note: For Antenna Port Conducted Measurement item, Inner channels only test Power and Conducted Out of Band Emission.

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-004737 (DCS:17-EM-F0876) / 6.1

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	1,2,6,11	MCS0 Nss1
	802.11ax40	OFDMA	BPSK	3 to 9	3,6,9	MCS0 Nss1

*Note : For Antenna Port Conducted Measurement item, Inner channels only test Power and Conducted Out of Band Emission.

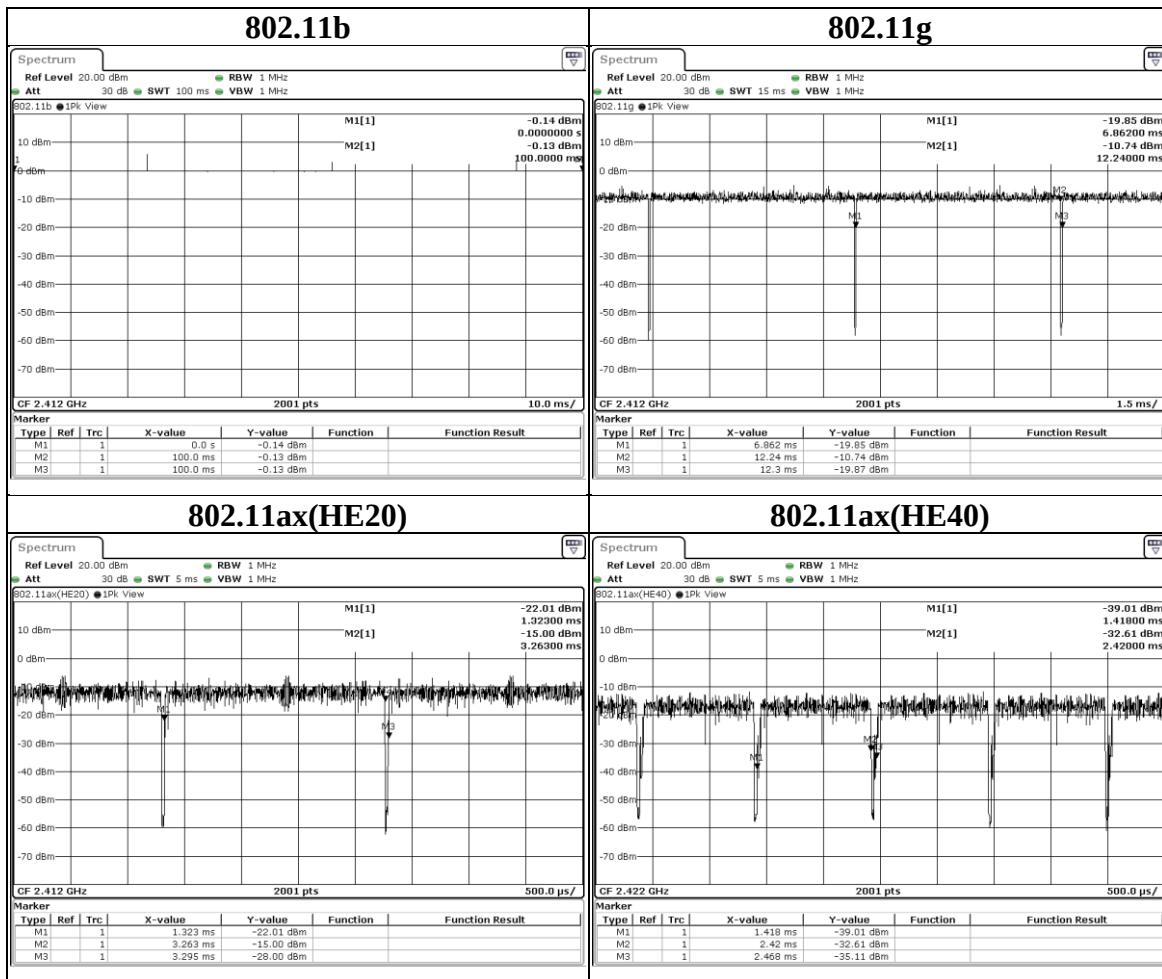
*Note : The worse spurious emissions test and the maximum output power were found in the Non-Beamforming mode. Therefore Beamforming mode only the test data of the RF output power were recorded in this report

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)
802.11b	100.000	100.000	1.0000	N/A	10Hz
802.11g	5.377	5.437	0.9890	N/A	10Hz
802.11ax(HE20)	1.940	1.973	0.9835	N/A	10Hz
802.11ax(HE40)	1.003	1.050	0.9548	0.20	1kHz



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	EMC330ES	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-004737 (DCS:17-EM-F0876) / 6.1

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2022/9/12	2023/9/11
Attenuator	EMCI	EMC-40ATK2W10	17002	2022/12/9	2023/12/8
Pulse Power Sensor	Anritsu	MA2411B	1531202	2023/1/4	2024/1/3
Power Meter	Anritsu	ML2495A	1645002	2023/1/4	2024/1/3
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 15247	ver 1.0
AC power Line Conducted Emission	EZ EMC	UL-3A1.2

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

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

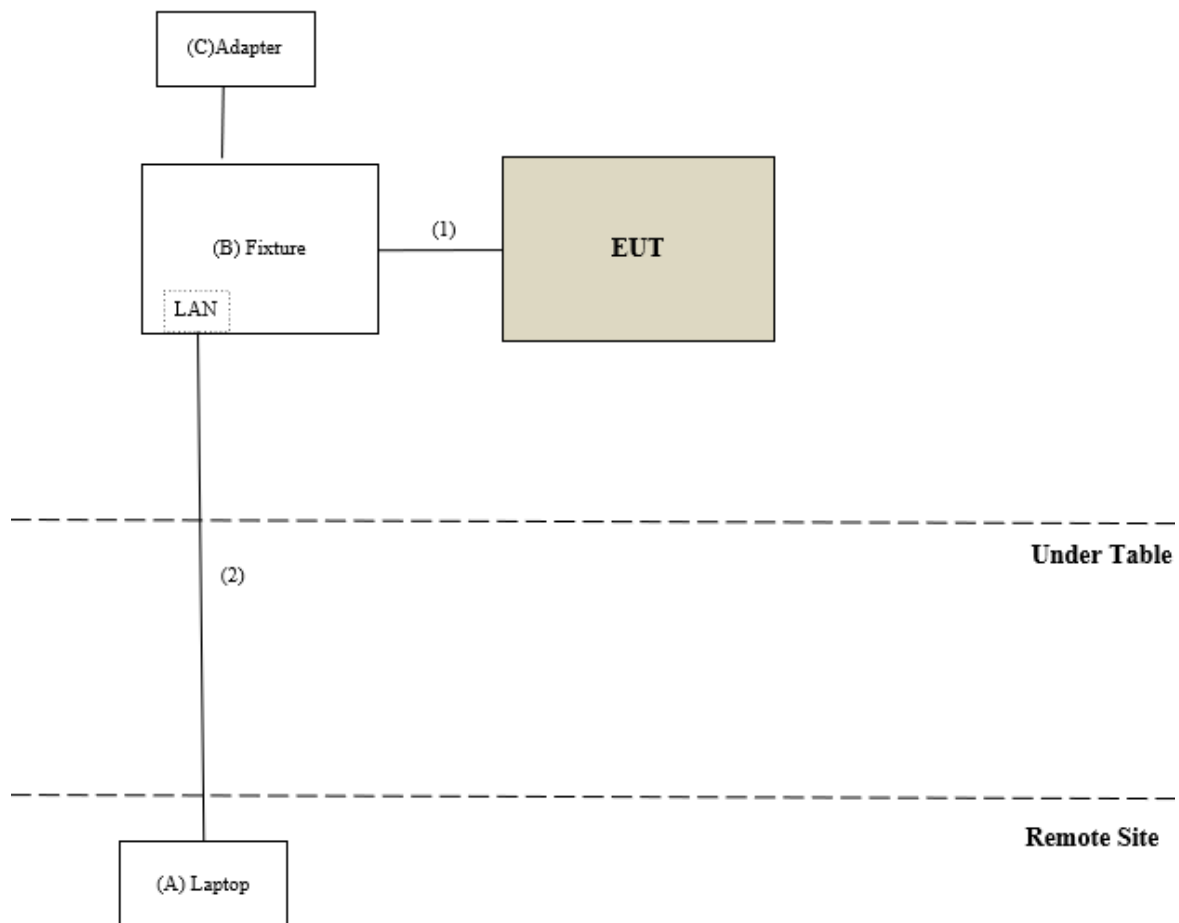
Facsimile (FAX) : +886-3-583-7948

Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1

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-004737 (DCS:17-EM-F0876) / 6.1

9. Test Results

9.1. 6dB Bandwidth

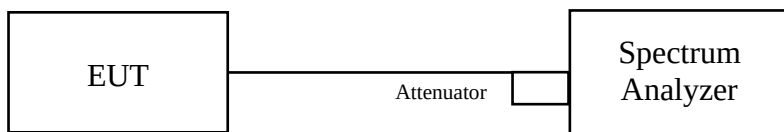
Requirements

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

Test procedure

- Set resolution bandwidth (RBW) = 100kHz.
- Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$, 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.

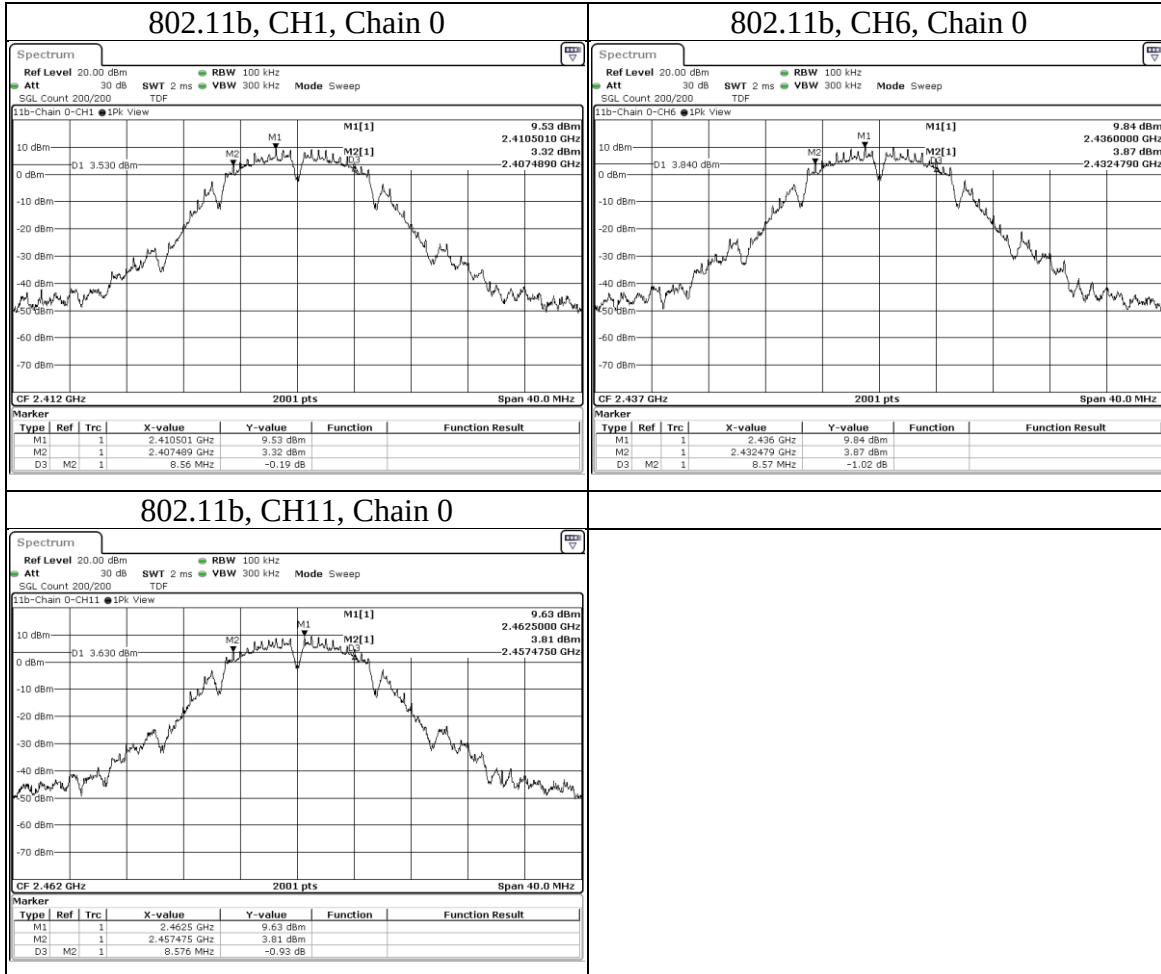
Test Setup



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		
802.11b	1	2412	8.560	0.5	PASS
	6	2437	8.570	0.5	PASS
	11	2462	8.576	0.5	PASS



Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11g	1	2412	16.581	16.512	0.5	PASS
	2	2417	16.570	16.544	0.5	PASS
	6	2437	16.346	16.341	0.5	PASS
	11	2462	16.581	16.545	0.5	PASS

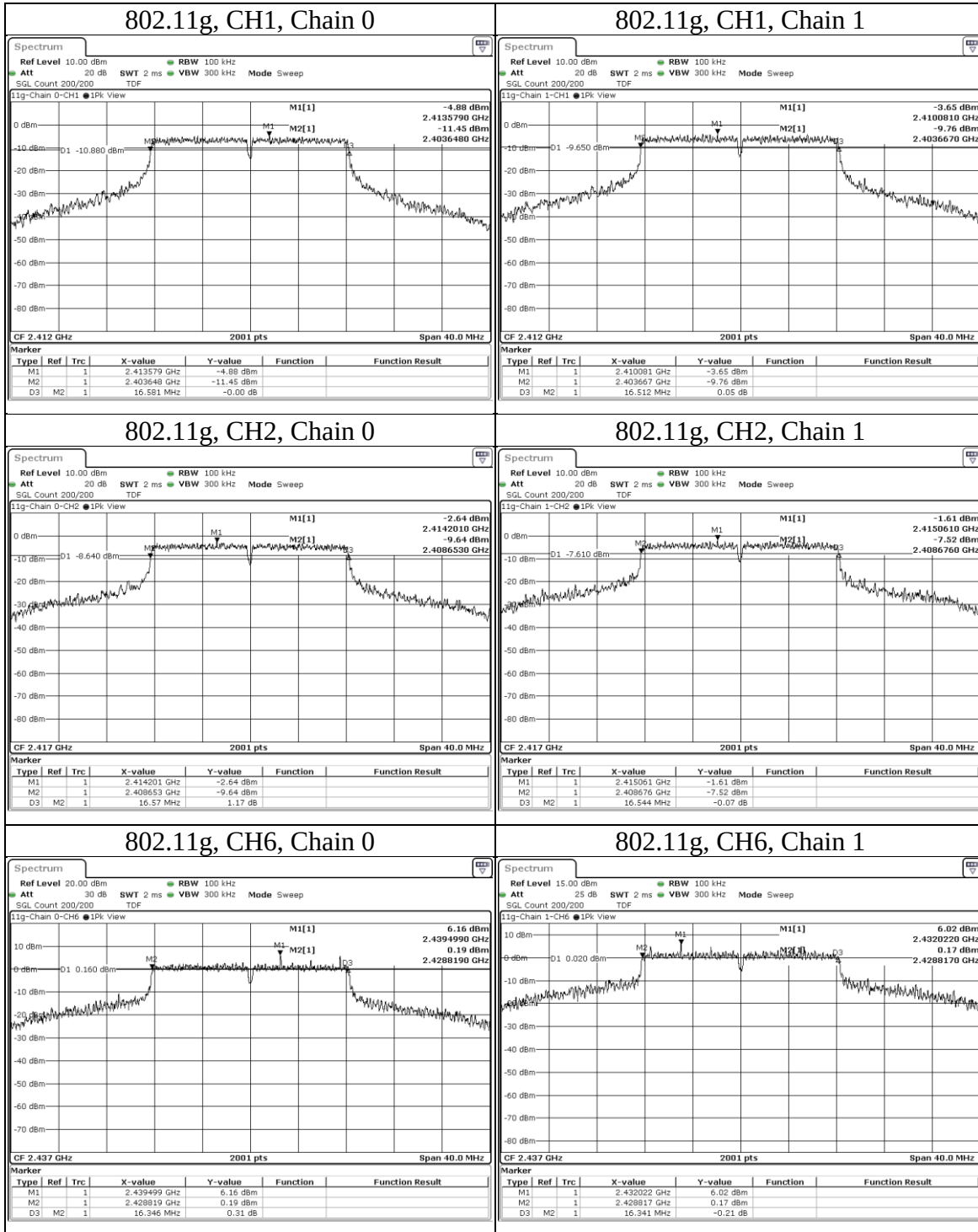
Underwriters Laboratories Taiwan Co., Ltd.

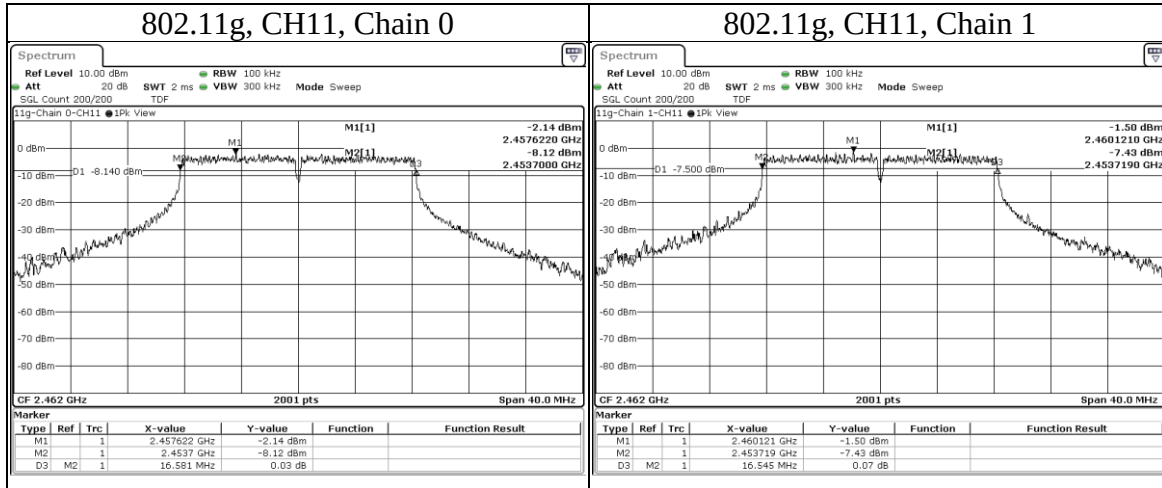
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

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

Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1





Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE20)	1	2412	19.101	19.120	0.5	PASS
	2	2417	19.135	19.159	0.5	PASS
	6	2437	18.796	18.997	0.5	PASS
	11	2462	19.155	18.989	0.5	PASS

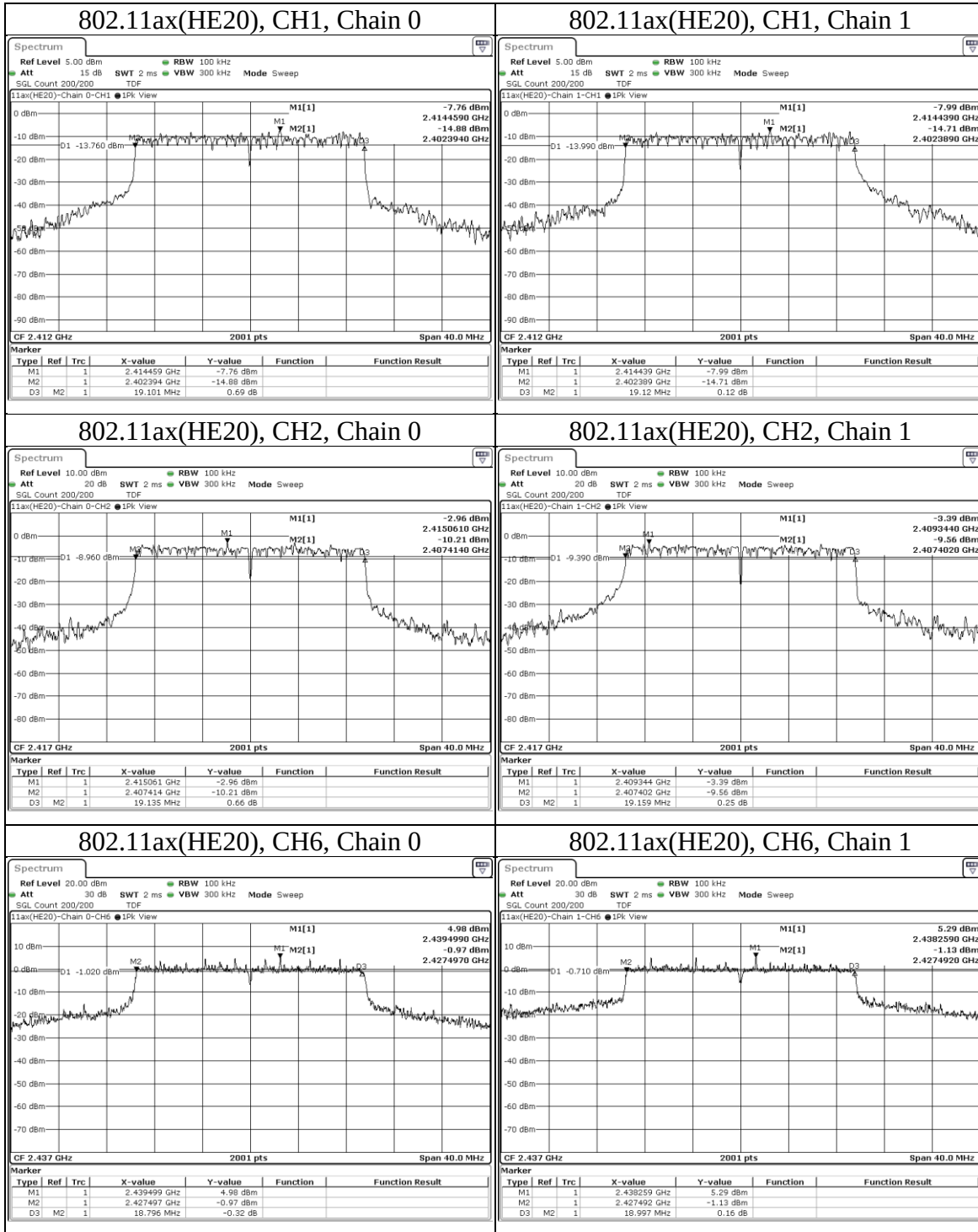
Underwriters Laboratories Taiwan Co., Ltd.

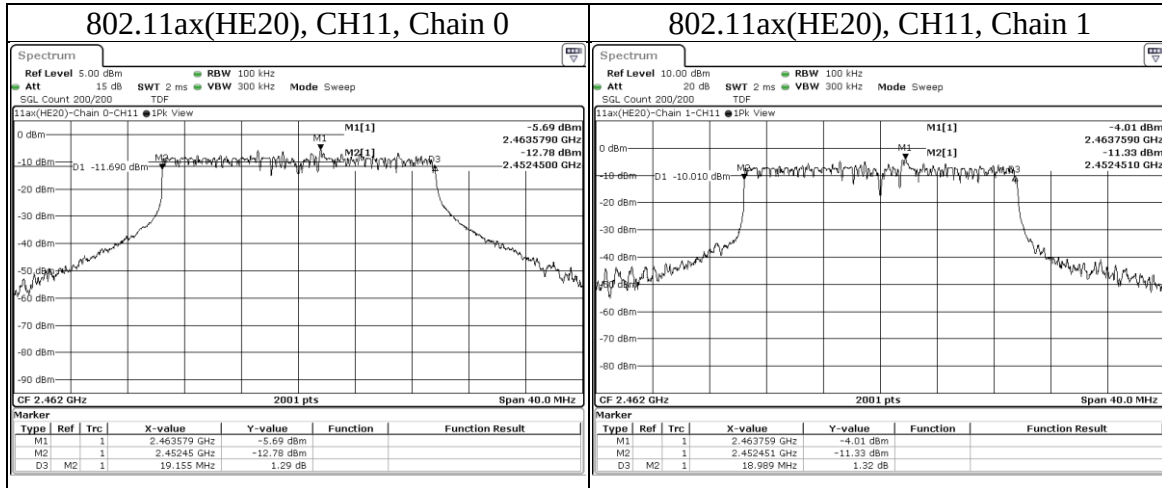
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

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

Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1





Mode	CH	Freq (MHz)	6dB BW (MHz)		Limit (MHz)	Result
			Chain 0	Chain 1		
802.11ax(HE40)	3	2422	38.199	38.212	0.5	PASS
	6	2437	37.915	37.772	0.5	PASS
	9	2452	38.088	38.049	0.5	PASS

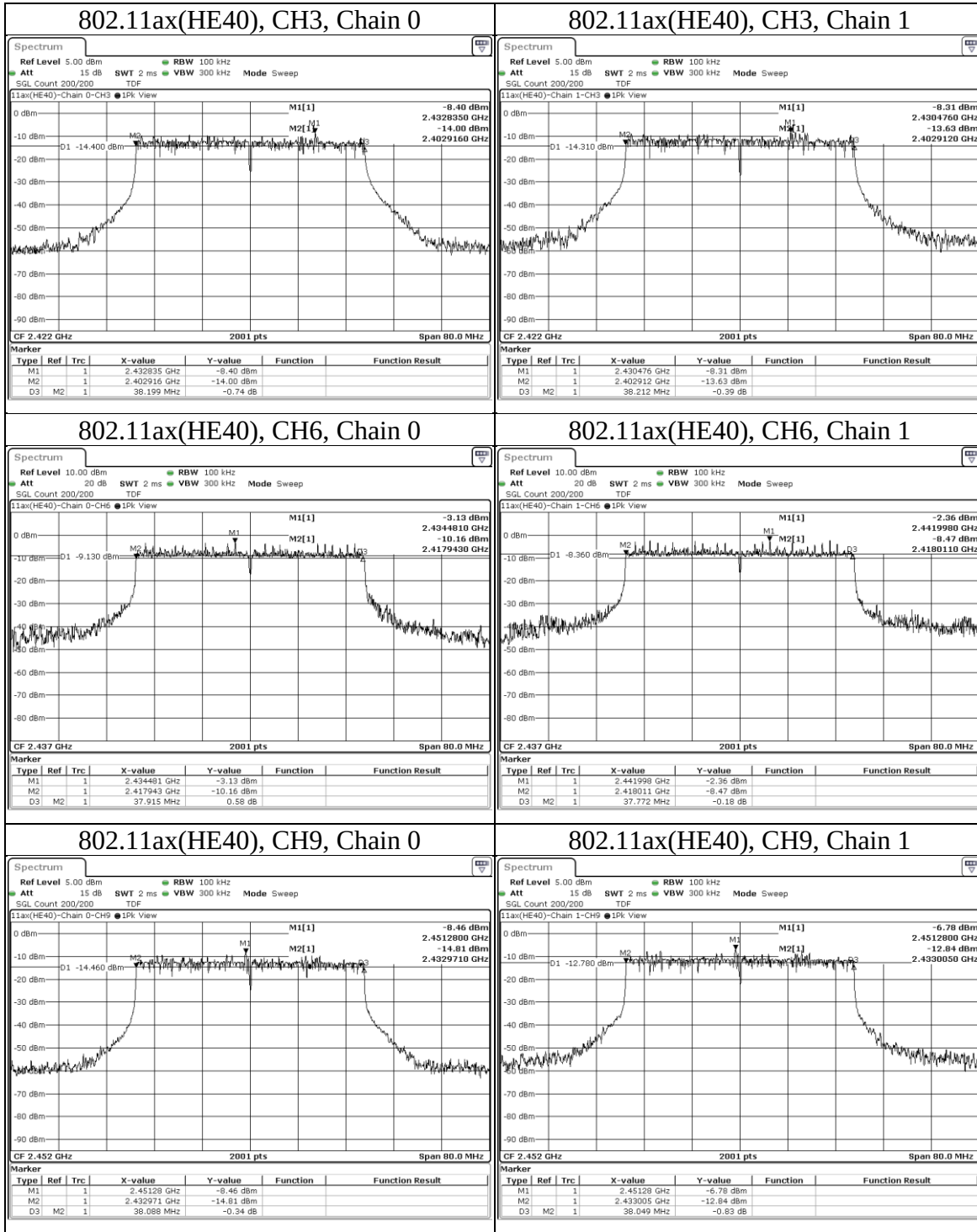
Underwriters Laboratories Taiwan Co., Ltd.

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-004737 (DCS:17-EM-F0876) / 6.1



9.2. Conducted Output Power

Requirements

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

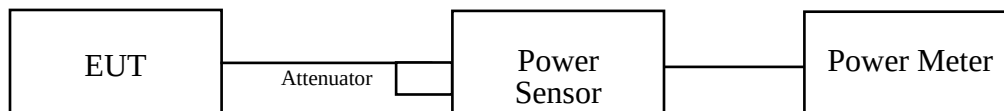
Note:

1. P_{Out} = maximum conducted output power in dBm, G_{TX} = the maximum transmitting antenna directional gain in dBi, B is the 26 dB emission bandwidth in megahertz
2. Directional Gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{Gn/20})^2 / N_{\text{ant}}]$ dBi.
Nant: Number of Transmit Antennas
G1, G2,..., Gn: Gain of Individual Antennas
Example: The maximum antenna gain of ALX18P-222AA1-00 is 6.4 dBi, so if it was used for TxBF power measurement, Directional Gain = $10 \log[(10^{6.4/20} + 10^{6.4/20})^2 / 2]$ dBi = 9.41 dBi
3. Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices, CDD
Array Gain = 0 dB (i.e., no array gain) for $N_{\text{ANT}} \leq 4$;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;
Array Gain = $5 \log(N_{\text{ANT}}/N_{\text{SS}})$ dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{\text{ANT}} \geq 5$.
Example: The maximum antenna gain of ALX18P-222AA1-00 is 6.4 dBi, and $N_{\text{ANT}} \leq 4$, so if it was used for CDD power measurement, Directional Gain = 6.4 dBi + Array Gain = 6.4 dBi + 0 dB = 6.4 dBi
4. 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.

Test Data

Non-Beamforming mode:

Peak Power

802.11b

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
1	2412	146.555	21.66	29.6	PASS
6	2437	151.008	21.79	29.6	PASS
11	2462	147.571	21.69	29.6	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	18.31	17.70	126.765	21.03	29.6	PASS
2	2417	18.33	17.84	128.825	21.10	29.6	PASS
6	2437	21.93	21.28	290.402	24.63	29.6	PASS
11	2462	20.54	20.03	213.796	23.30	29.6	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	16.75	16.88	96.161	19.83	29.6	PASS
2	2417	20.85	20.12	224.388	23.51	29.6	PASS
6	2437	21.58	20.25	250.035	23.98	29.6	PASS
11	2462	18.67	19.19	156.675	21.95	29.6	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-004737 (DCS:17-EM-F0876) / 6.1

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	17.51	17.87	117.49	20.70	29.6	PASS
6	2437	20.75	20.09	220.8	23.44	29.6	PASS
9	2452	19.31	19.59	176.198	22.46	29.6	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-004737 (DCS:17-EM-F0876) / 6.1

Average Power (Reference Only)

802.11b

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
1	2412	79.799	19.02
6	2437	86.696	19.38
11	2462	81.846	19.13

802.11g

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	11.64	12.15	30.974	14.91
2	2417	13.44	13.77	45.92	16.62
6	2437	17.64	17.65	116.413	20.66
11	2462	12.51	12.10	34.041	15.32

802.11ax (HE20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
1	2412	9.15	9.60	17.338	12.39
2	2417	13.74	14.01	48.865	16.89
6	2437	17.34	17.35	108.643	20.36
11	2462	10.84	11.71	26.977	14.31

802.11ax (HE40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	9.69	10.35	20.137	13.04
6	2437	12.16	12.64	34.834	15.42
9	2452	10.23	10.49	21.727	13.37

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-004737 (DCS:17-EM-F0876) / 6.1

Beamforming mode:

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	16.47	16.64	90.573	19.57	26.59	PASS
2	2417	20.59	19.93	212.814	23.28	26.59	PASS
6	2437	21.09	20.05	229.615	23.61	26.59	PASS
11	2462	18.49	18.93	148.936	21.73	26.59	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	17.34	17.60	111.686	20.48	26.59	PASS
6	2437	20.55	19.92	211.836	23.26	26.59	PASS
9	2452	19.01	19.38	166.341	22.21	26.59	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	8.90	9.34	16.368	12.14
2	2417	13.51	13.75	46.132	16.64
6	2437	17.08	17.08	102.094	20.09
11	2462	10.62	11.54	25.763	14.11

802.11ax (HE40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)
		Chain 0	Chain 1		
3	2422	9.52	10.14	19.275	12.85
6	2437	11.90	12.40	32.885	15.17
9	2452	9.93	10.29	20.512	13.12

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-004737 (DCS:17-EM-F0876) / 6.1

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: The maximum antenna gain of ALX18P-222AA1-00 is 6.4 dBi, so if it was used for power density measurement, Directional Gain = $10 \log[(10^{6.4/20} + 10^{6.4/20})^2 / 2]$ dBi = 9.41 dBi

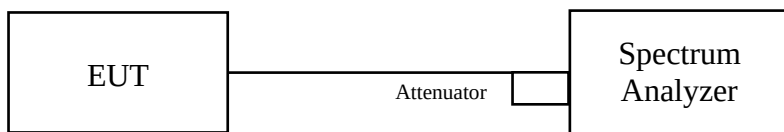
"PSD per chain" of the report shown is maximum value for each chain, at the "Total PSD" is summing entire spectra across corresponding frequency bins on the various outputs by computer, refer KDB 662911 Method a) for calculating total power density.

4. 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.

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

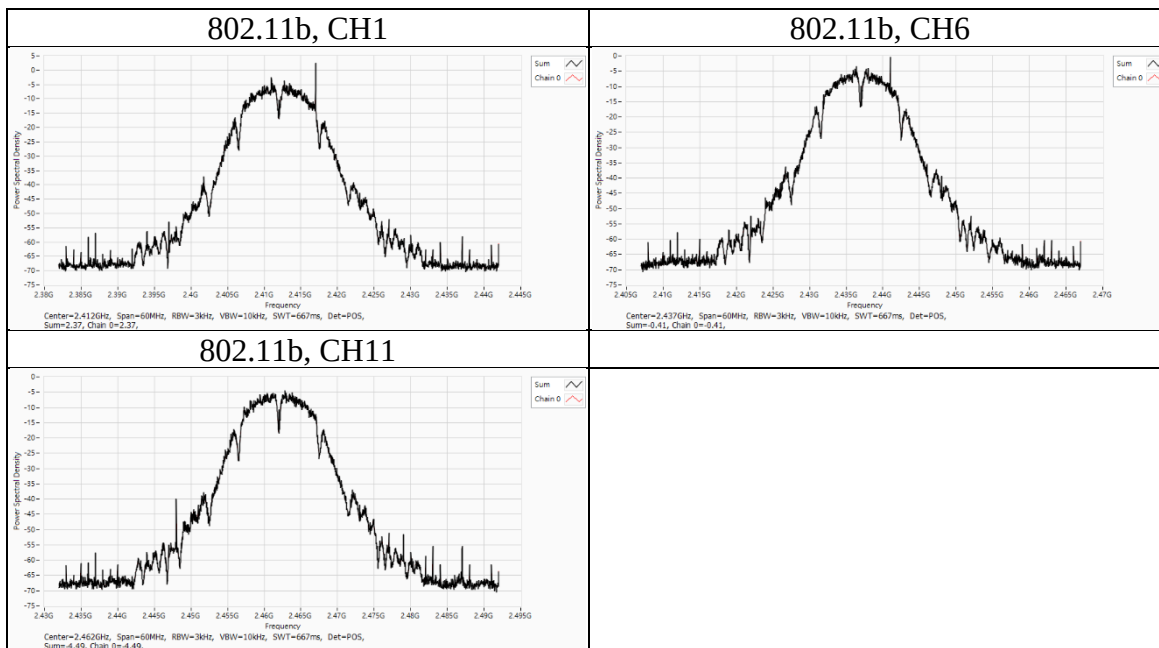
Facsimile (FAX) : +886-3-583-7948

Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1

Test Data

Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11b	1	2412	2.37	7.6	6.4	PASS
	6	2437	-0.41	7.6	6.4	PASS
	11	2462	-4.49	7.6	6.4	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)
			Chain 0
802.11b	1	2412	2.367
	6	2437	-0.408
	11	2462	-4.486



Underwriters Laboratories Taiwan Co., Ltd.

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

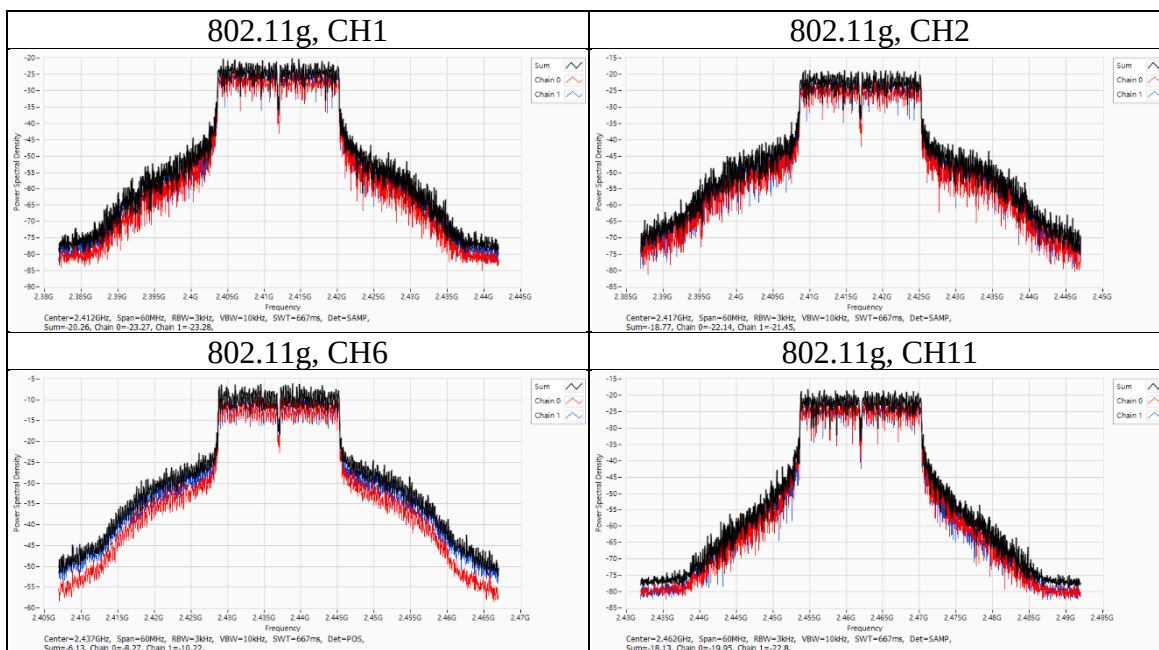
Telephone : +886-2-7737-3000

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

Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1

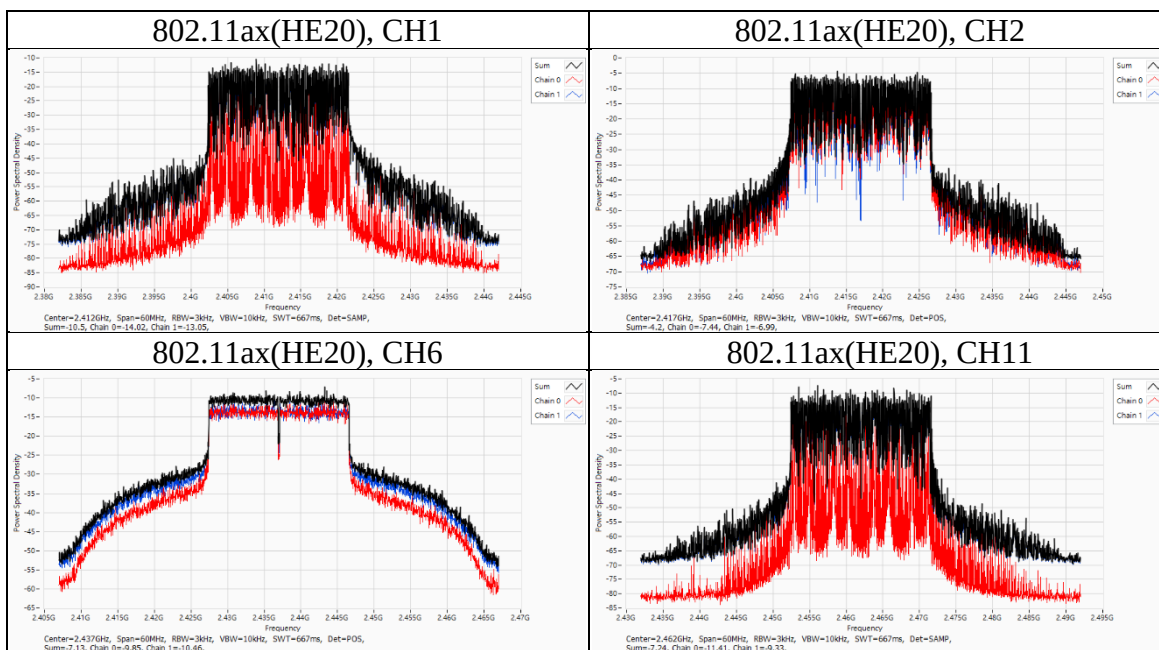
Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11g	1	2412	-20.26	4.59	9.41	PASS
	2	2417	-18.77	4.59	9.41	PASS
	6	2437	-6.13	4.59	9.41	PASS
	11	2462	-18.13	4.59	9.41	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11g	1	2412	-22.911	-22.687
	2	2417	-20.87	-20.974
	6	2437	-8.271	-8.891
	11	2462	-19.946	-20.774



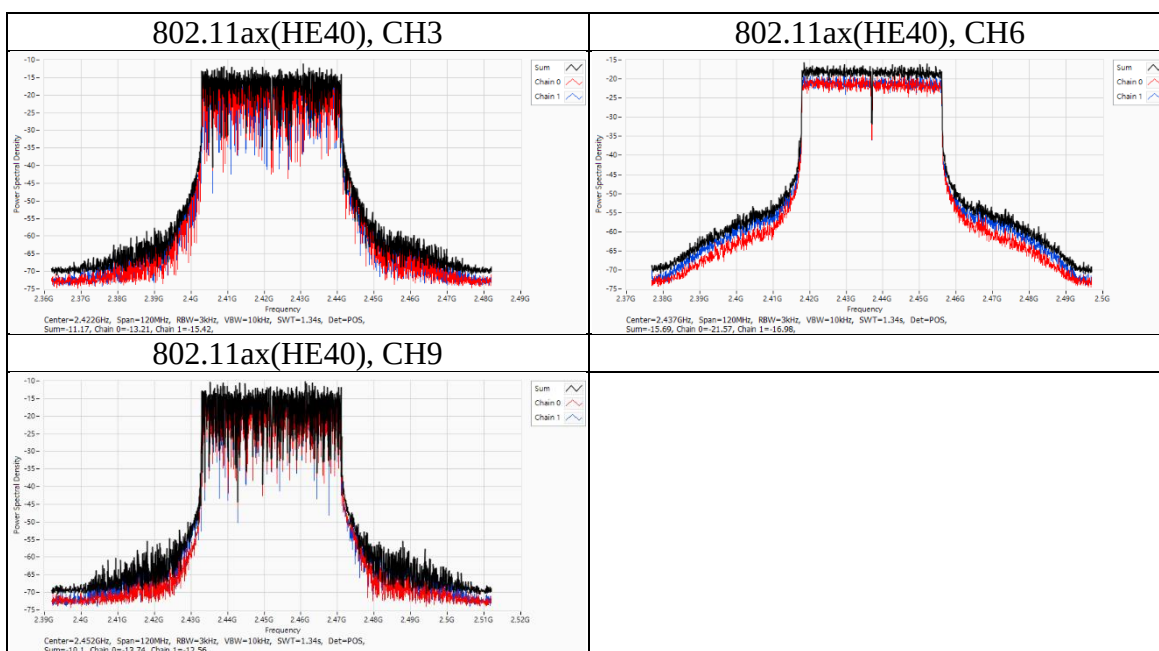
Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11ax(HE20)	1	2412	-10.5	4.59	9.41	PASS
	2	2417	-4.2	4.59	9.41	PASS
	6	2437	-7.13	4.59	9.41	PASS
	11	2462	-7.24	4.59	9.41	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11ax(HE20)	1	2412	-14.015	-11.95
	2	2417	-7.441	-6.988
	6	2437	-9.85	-10.215
	11	2462	-11.408	-8.607



Mode	CH	Freq (MHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Directional Gain (dBi)	Result
802.11ax(HE40)	3	2422	-11.17	4.59	9.41	PASS
	6	2437	-15.69	4.59	9.41	PASS
	9	2452	-10.1	4.59	9.41	PASS

Mode	CH	Freq (MHz)	PSD per Chain (dBm/3kHz)	
			Chain 0	Chain 1
802.11ax(HE40)	3	2422	-13.214	-13.256
	6	2437	-18.156	-16.981
	9	2452	-13.736	-12.524



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

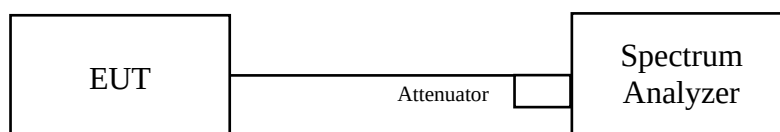
Measurement Procedure REF

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.

Underwriters Laboratories Taiwan Co., Ltd.

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

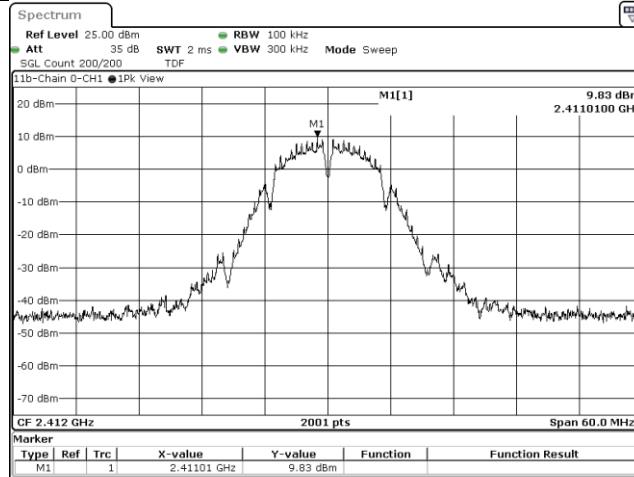
Telephone : +886-2-7737-3000

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

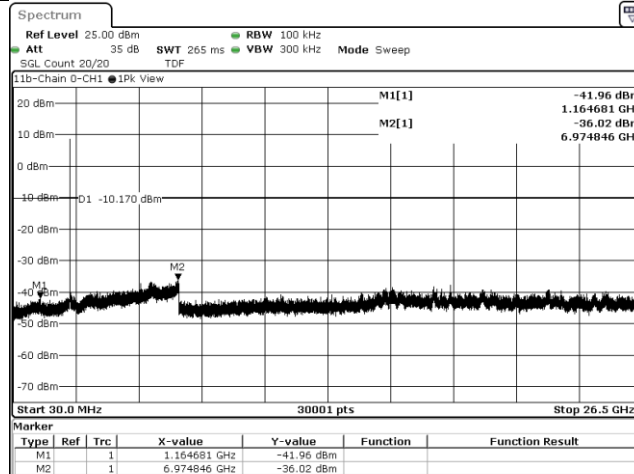
Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1

Test Data

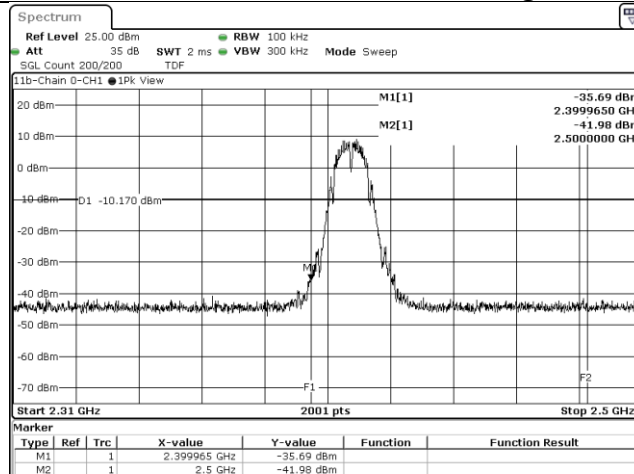
802.11b, CH1, Chain 0, Reference



802.11b, CH1, Chain 0, Conducted Emission



802.11b, CH1, Chain 0, Band edge



802.11b, CH6, Chain 0, Reference

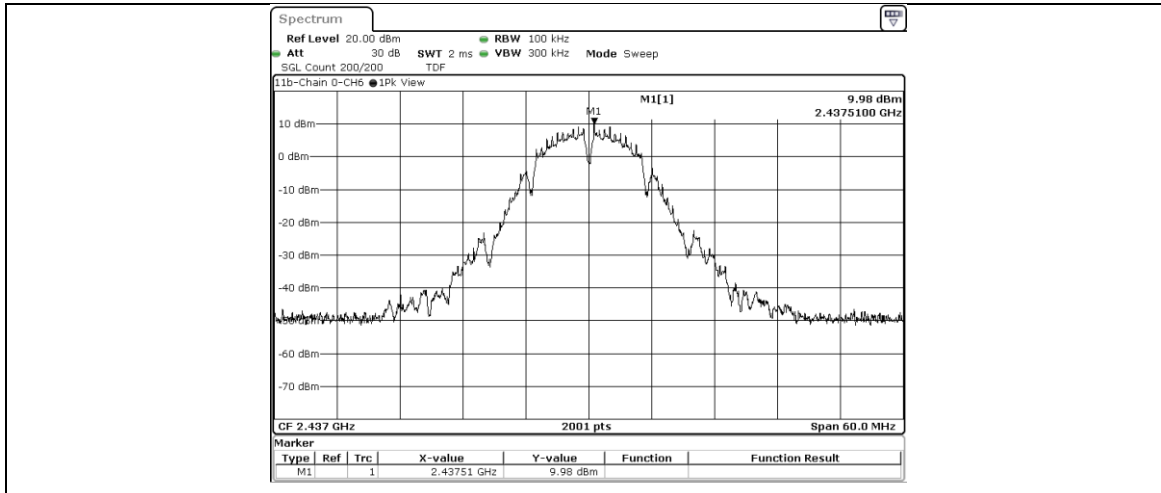
Underwriters Laboratories Taiwan Co., Ltd.

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

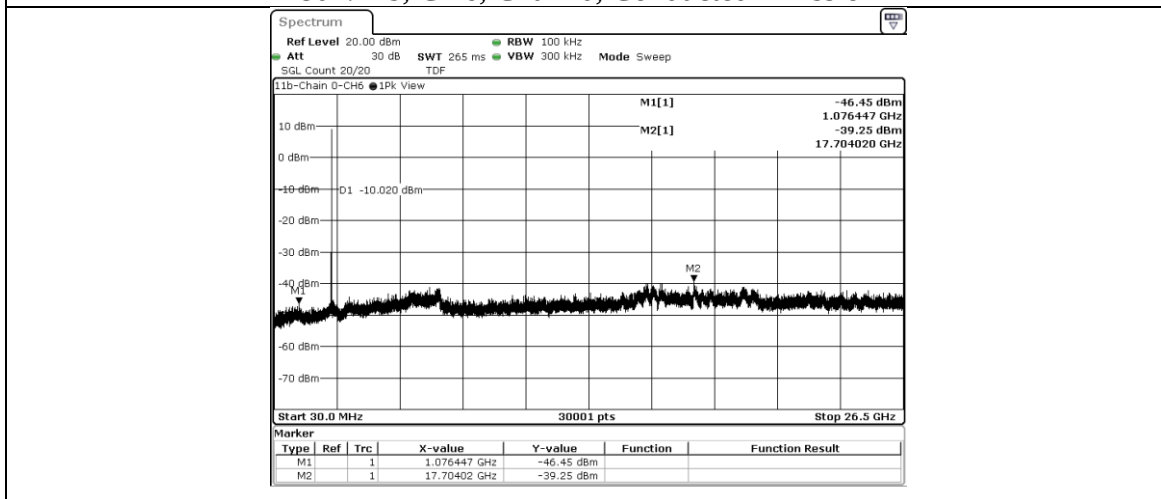
Telephone : +886-2-7737-3000

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

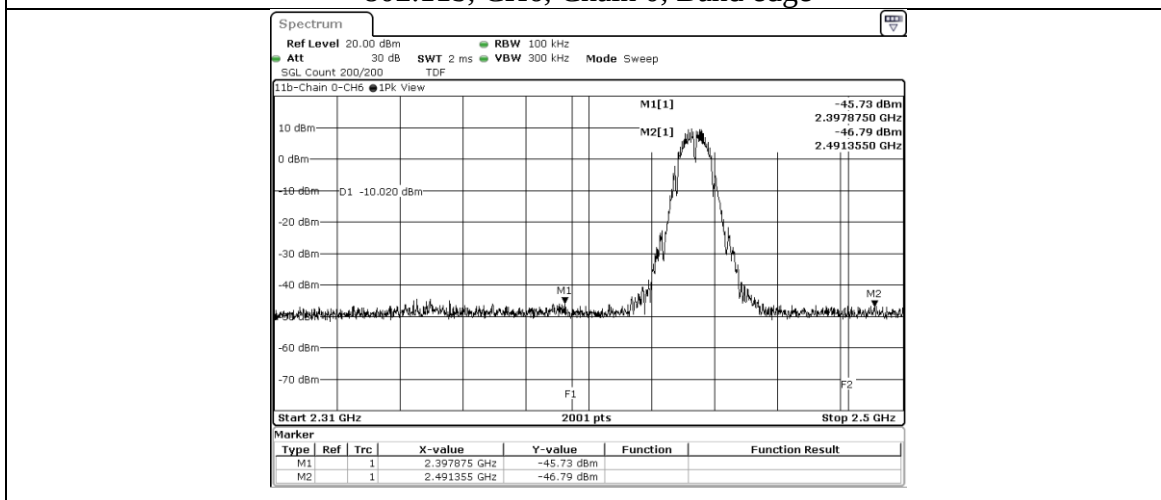
Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1



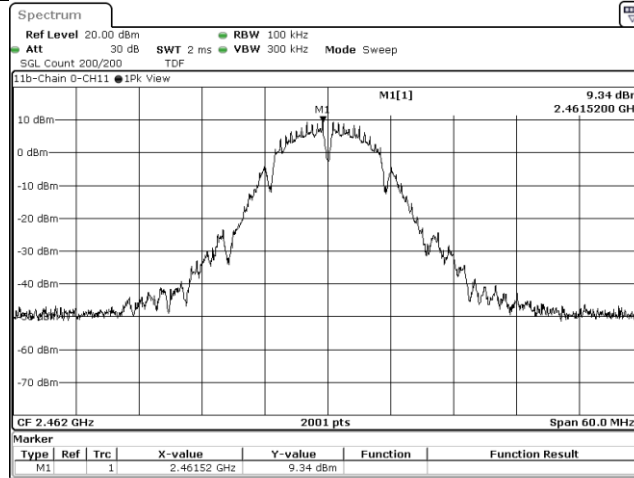
802.11b, CH6, Chain 0, Conducted Emission



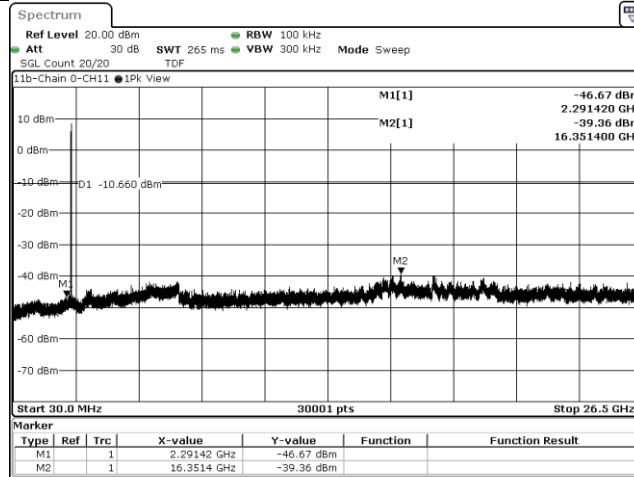
802.11b, CH6, Chain 0, Band edge



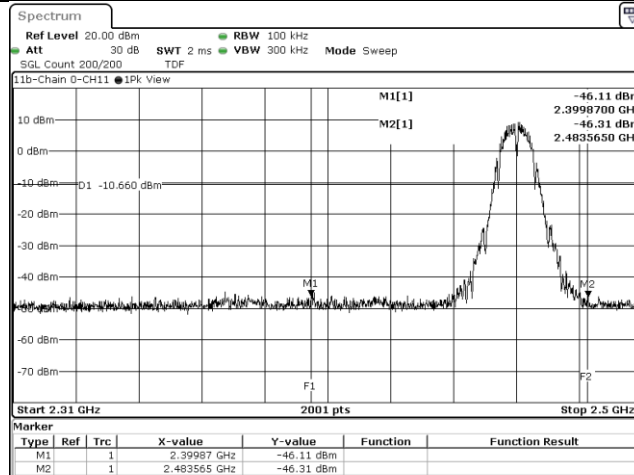
802.11b, CH11, Chain 0, Reference



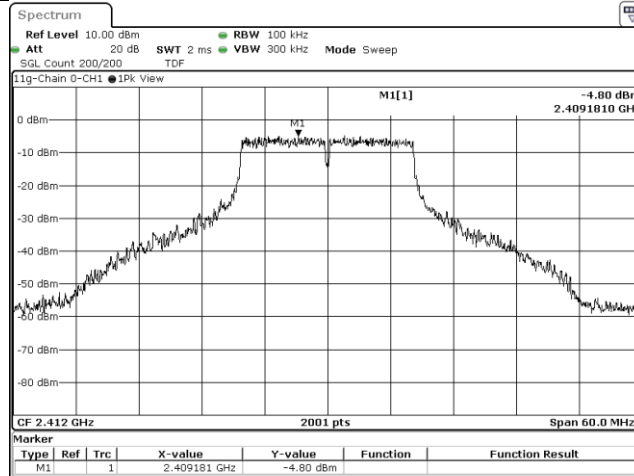
802.11b, CH11, Chain 0, Conducted Emission



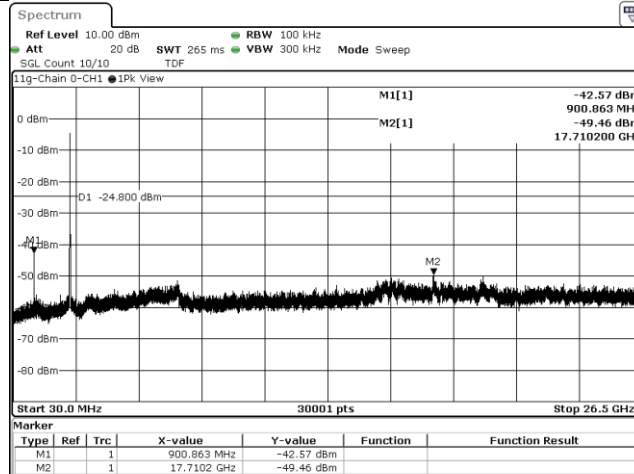
802.11b, CH11, Chain 0, Band edge



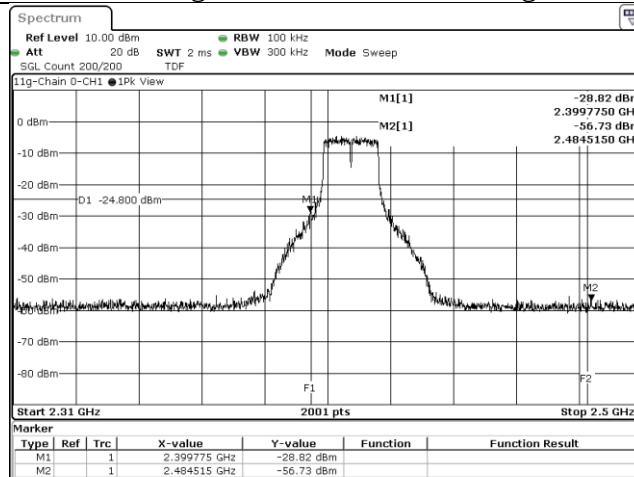
802.11g, CH1, Chain 0, Reference



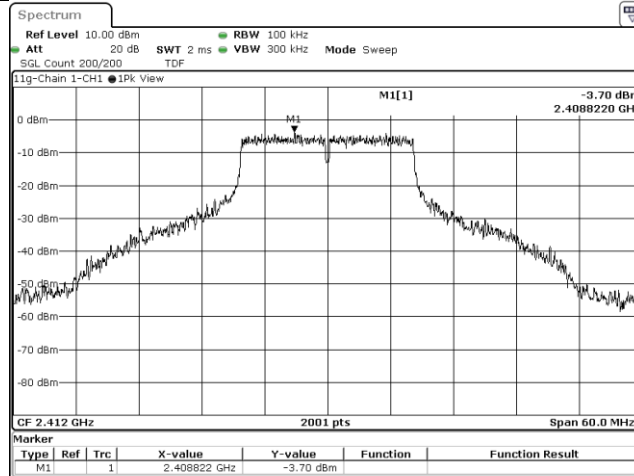
802.11g, CH1, Chain 0, Conducted Emission



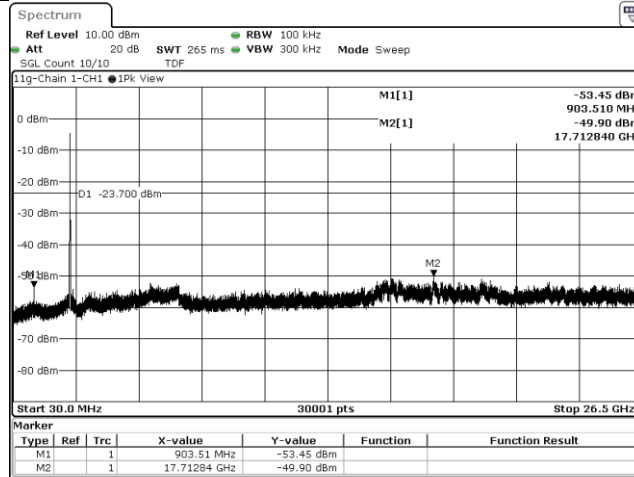
802.11g, CH1, Chain 0, Band edge



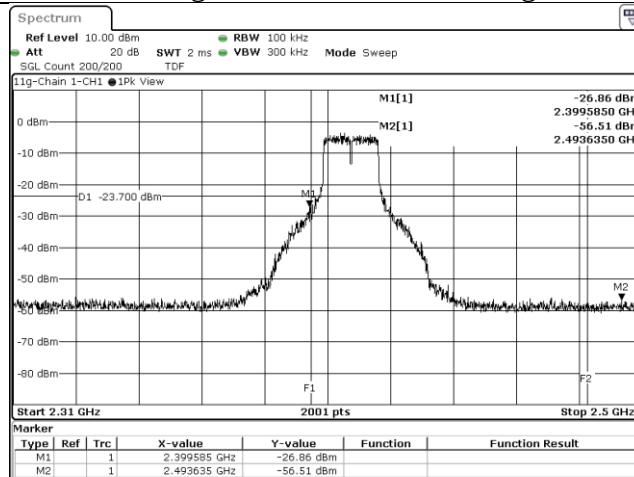
802.11g, CH1, Chain 1, Reference



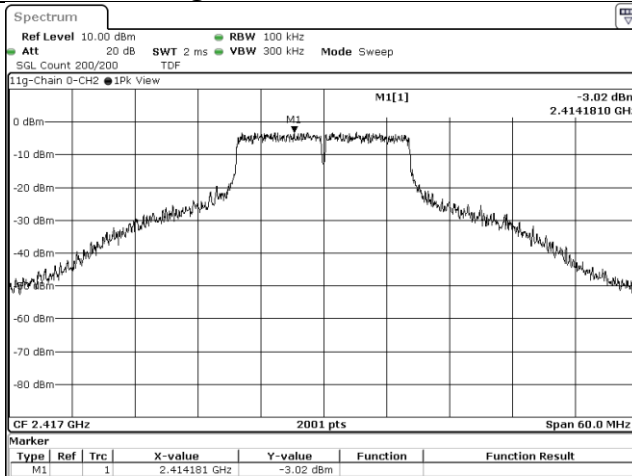
802.11g, CH1, Chain 1, Conducted Emission



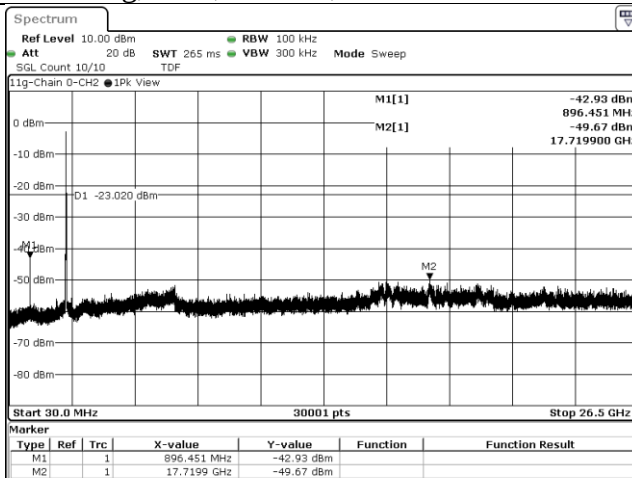
802.11g, CH1, Chain 1, Band edge



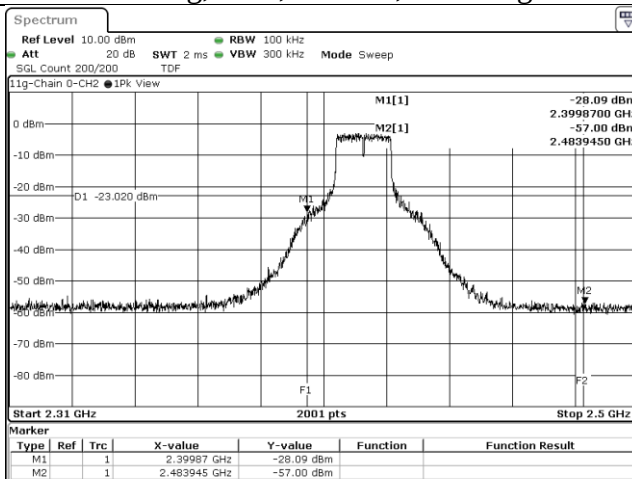
802.11g, CH2, Chain 0, Reference



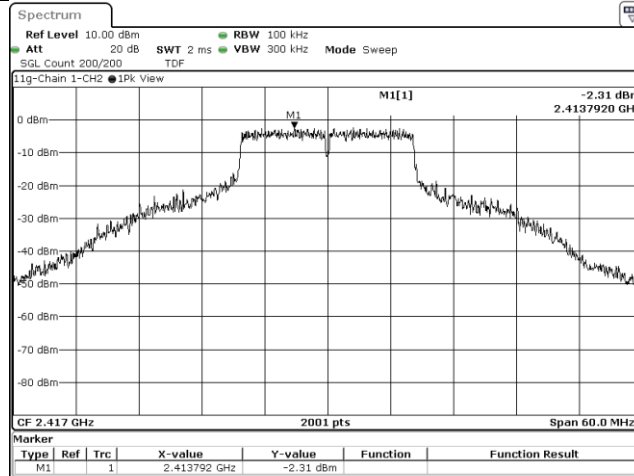
802.11g, CH2, Chain 0, Conducted Emission



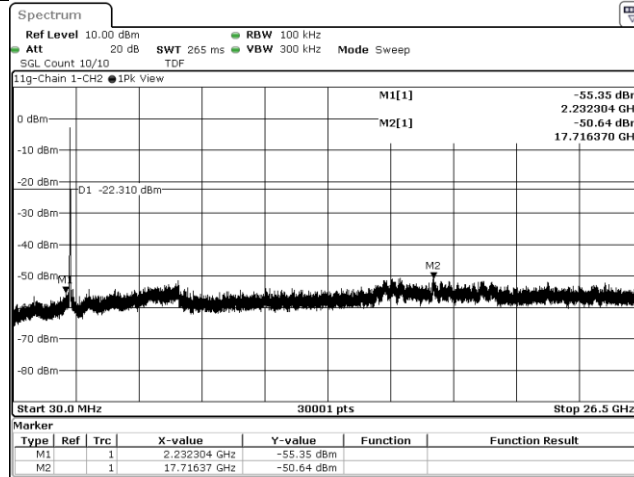
802.11g, CH2, Chain 0, Band edge



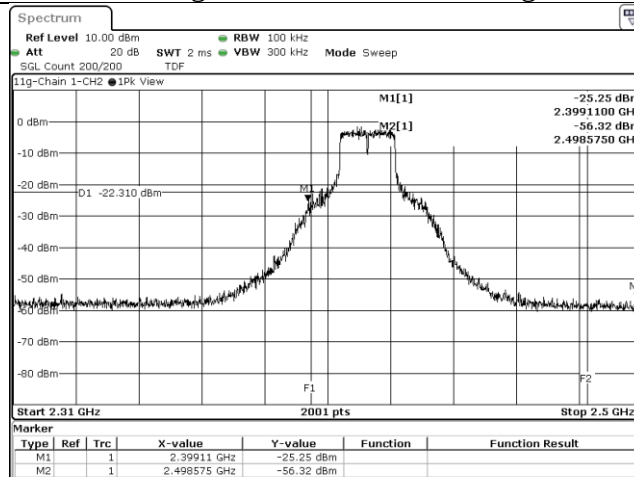
802.11g, CH2, Chain 1, Reference



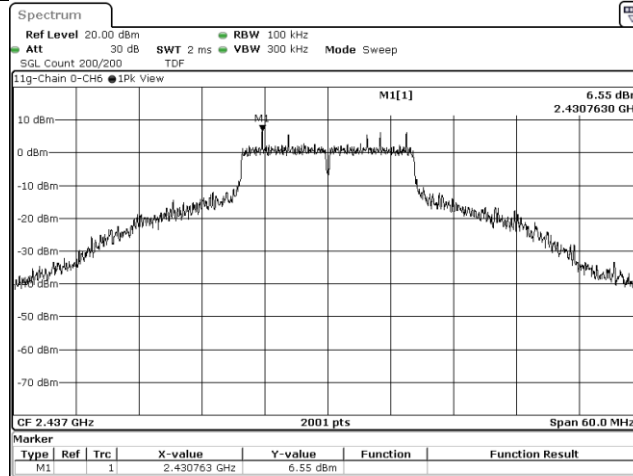
802.11g, CH2, Chain 1, Conducted Emission



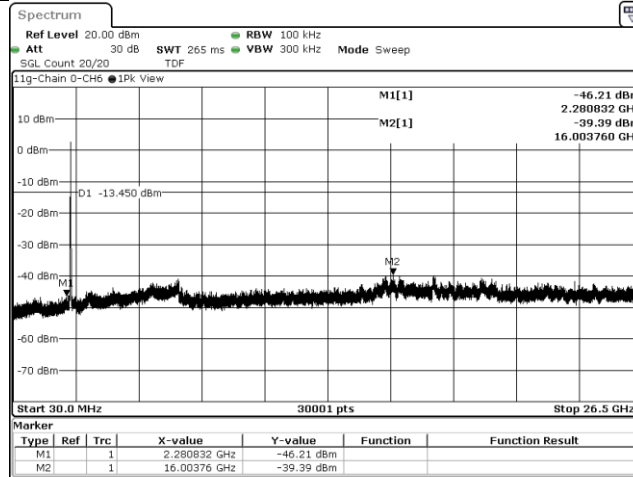
802.11g, CH2, Chain 1, Band edge



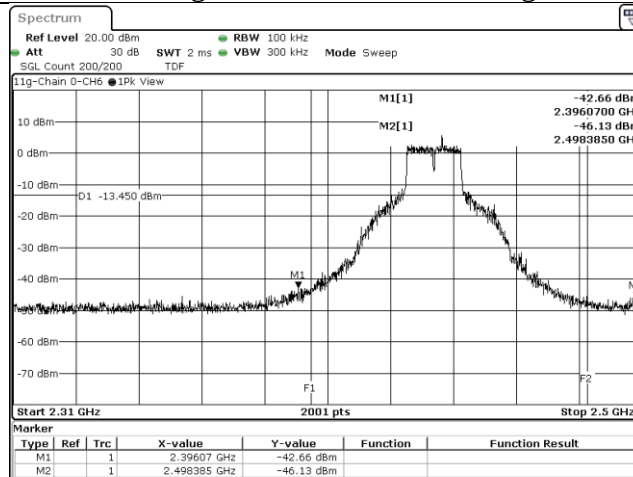
802.11g, CH6, Chain 0, Reference



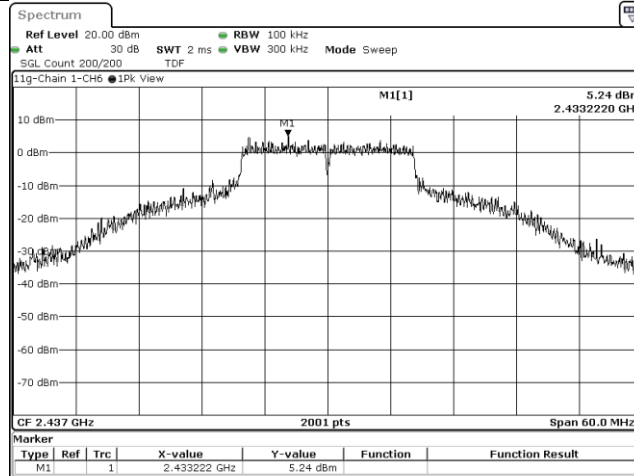
802.11g, CH6, Chain 0, Conducted Emission



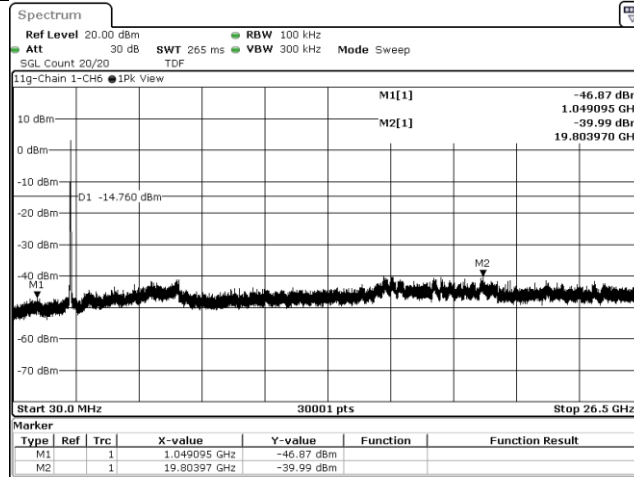
802.11g, CH6, Chain 0, Band edge



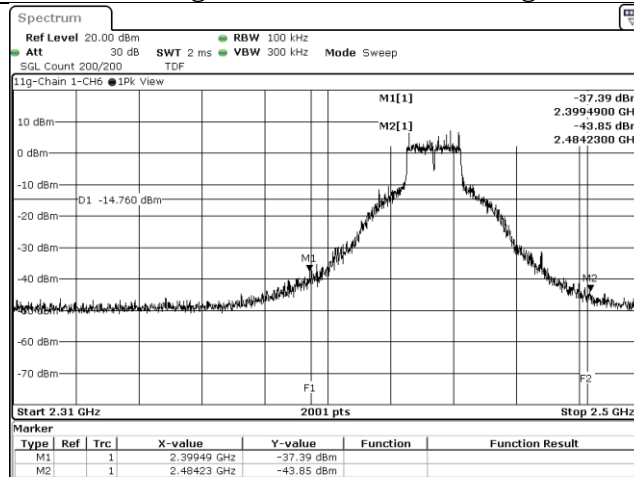
802.11g, CH6, Chain 1, Reference



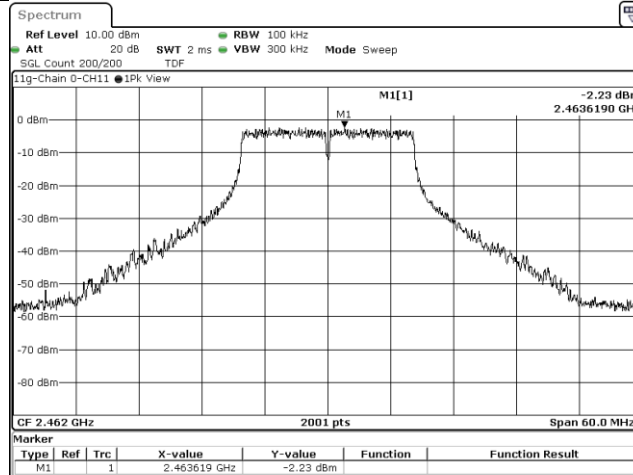
802.11g, CH6, Chain 1, Conducted Emission



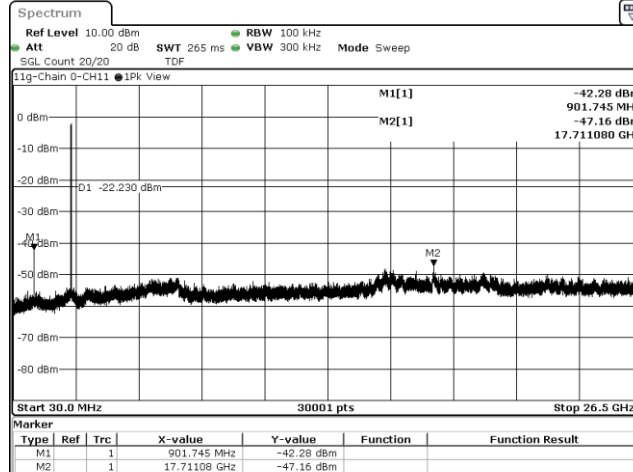
802.11g, CH6, Chain 1, Band edge



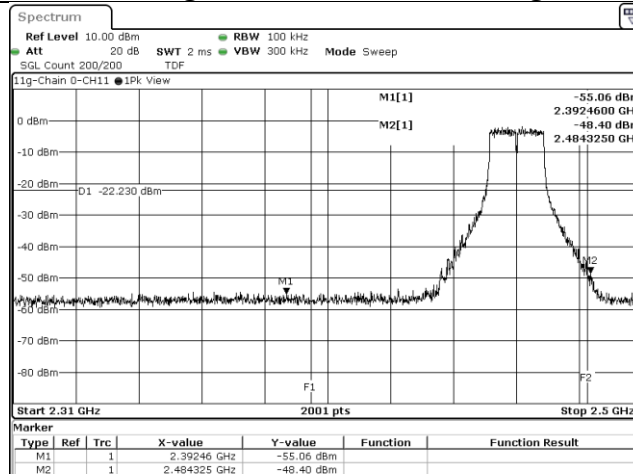
802.11g, CH11, Chain 0, Reference



802.11g, CH11, Chain 0, Conducted Emission



802.11g, CH11, Chain 0, Band edge



802.11g, CH11, Chain 1, Reference

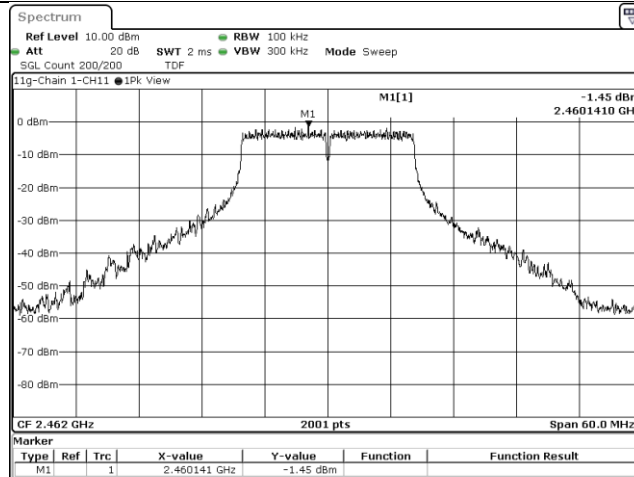
Underwriters Laboratories Taiwan Co., Ltd.

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

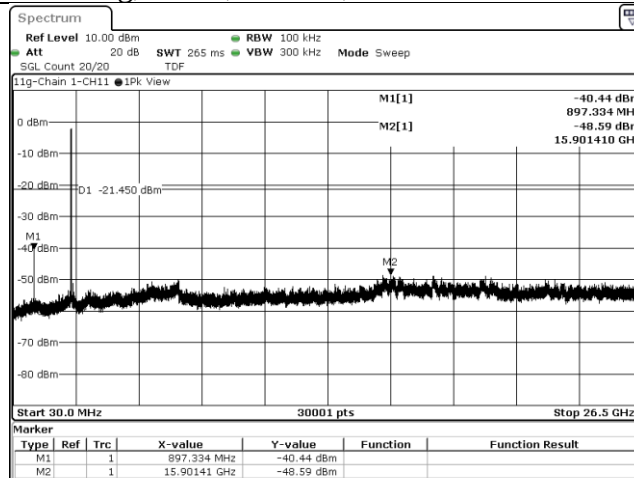
Telephone : +886-2-7737-3000

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

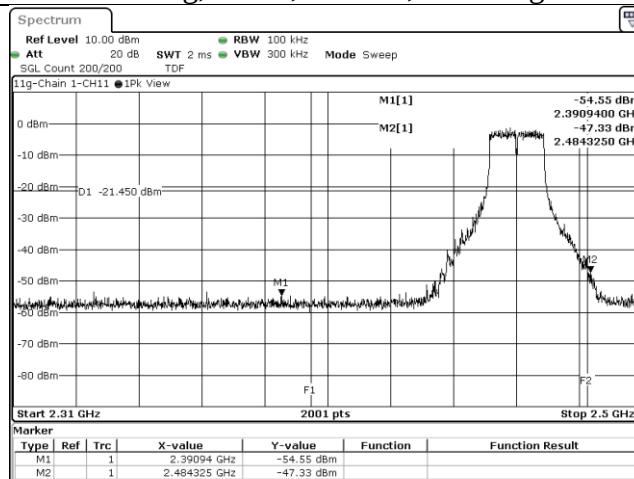
Doc No: Form-ULID-004737 (DCS:17-EM-F0876) / 6.1



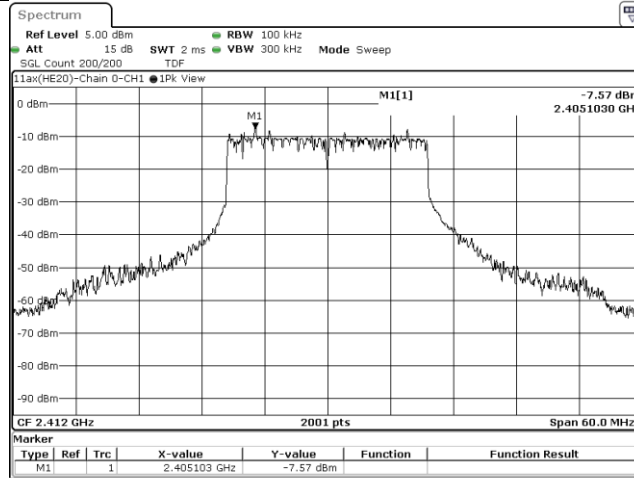
802.11g, CH11, Chain 1, Conducted Emission



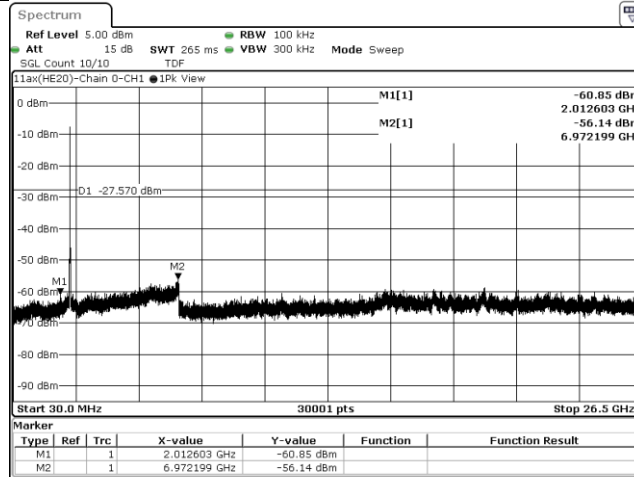
802.11g, CH11, Chain 1, Band edge



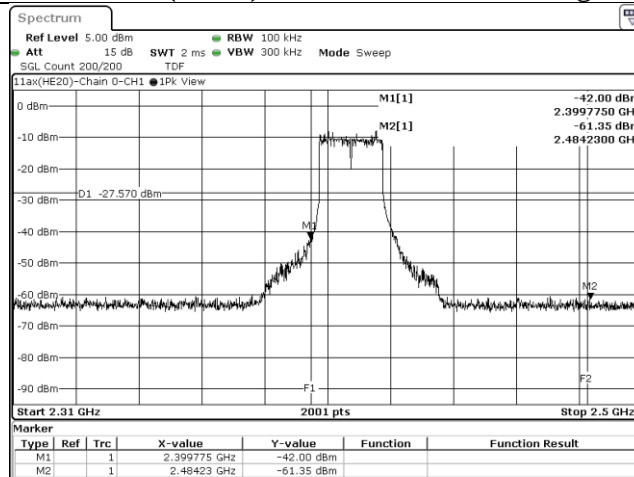
802.11ax(HE20), CH1, Chain 0, Reference



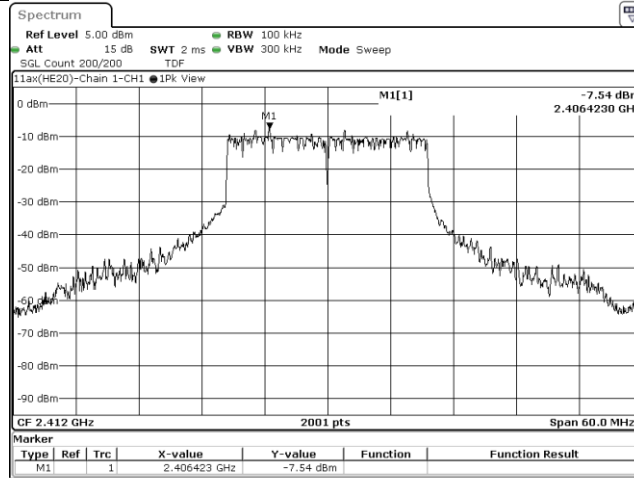
802.11ax(HE20), CH1, Chain 0, Conducted Emission



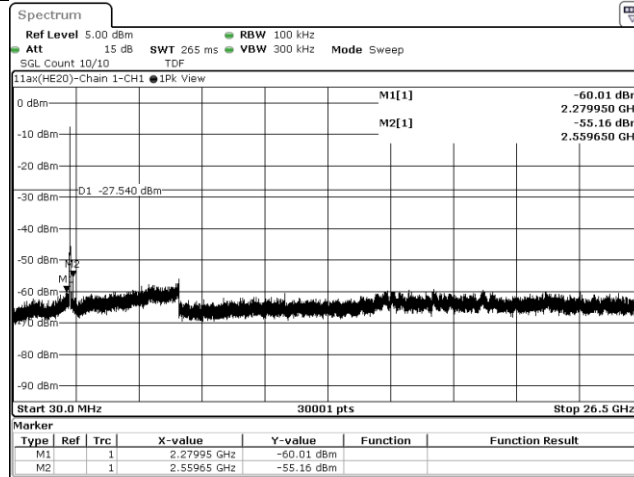
802.11ax(HE20), CH1, Chain 0, Band edge



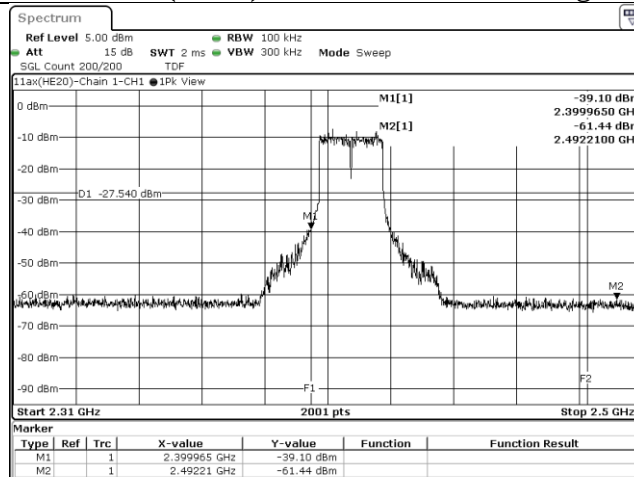
802.11ax(HE20), CH1, Chain 1, Reference



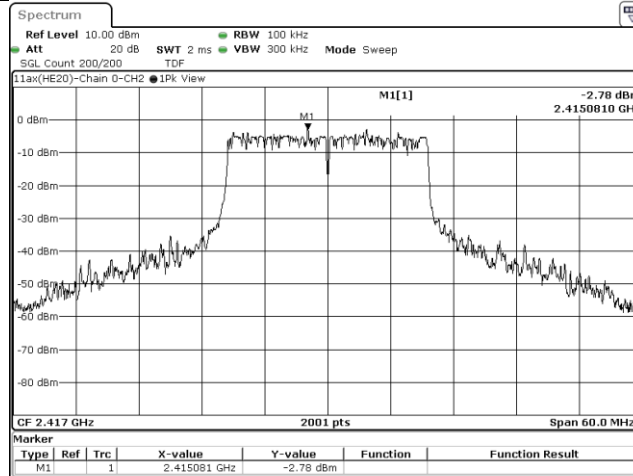
802.11ax(HE20), CH1, Chain 1, Conducted Emission



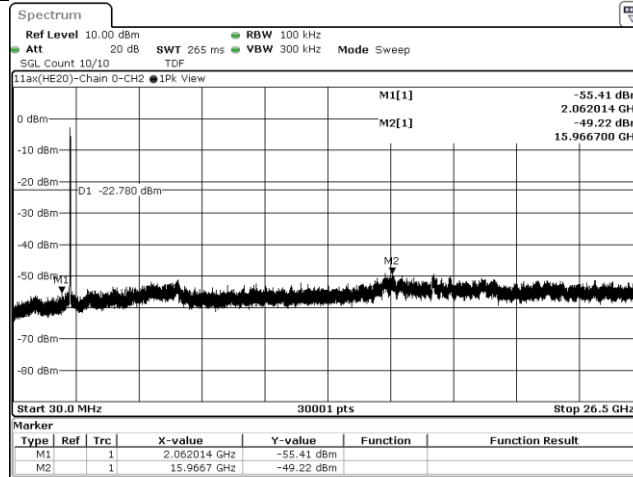
802.11ax(HE20), CH1, Chain 1, Band edge



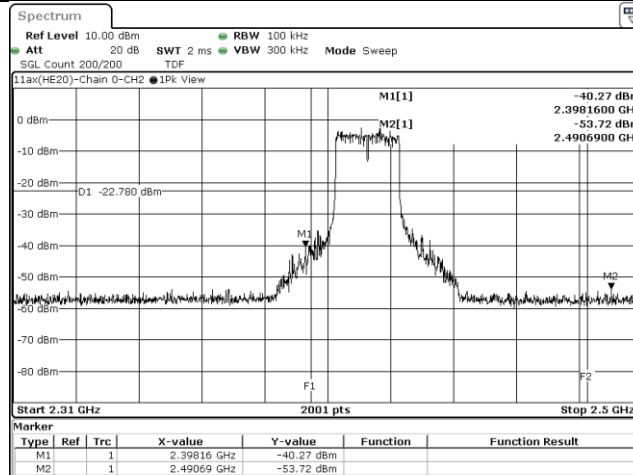
802.11ax(HE20), CH2, Chain 0, Reference



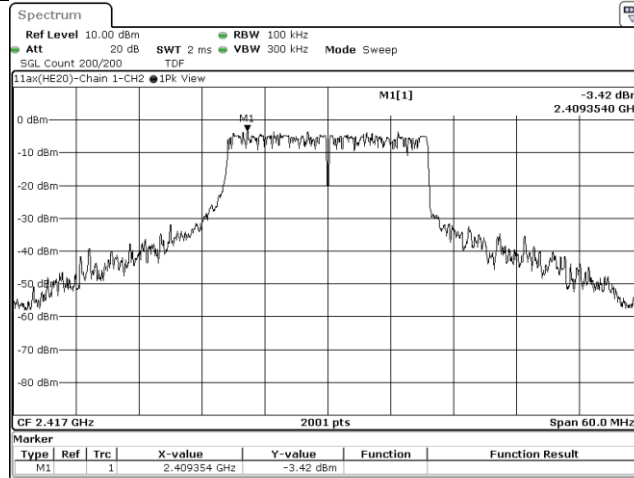
802.11ax(HE20), CH2, Chain 0, Conducted Emission



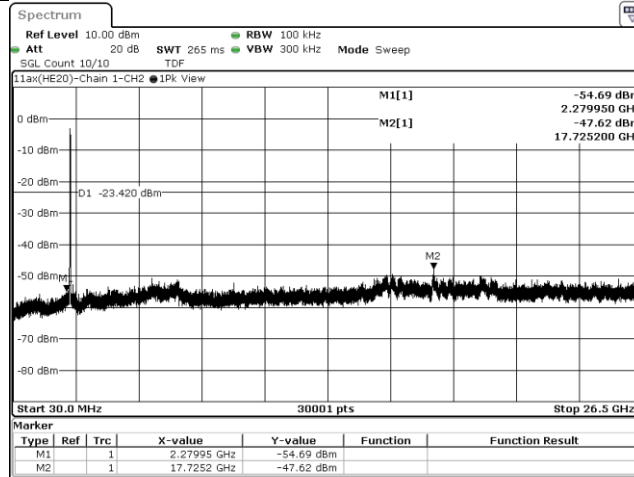
802.11ax(HE20), CH2, Chain 0, Band edge



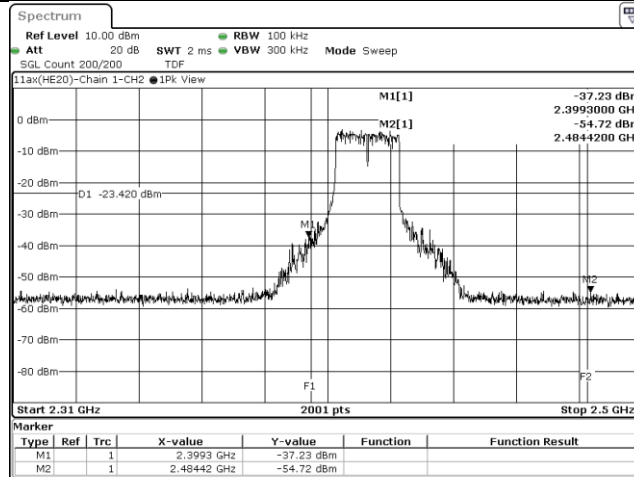
802.11ax(HE20), CH2, Chain 1, Reference



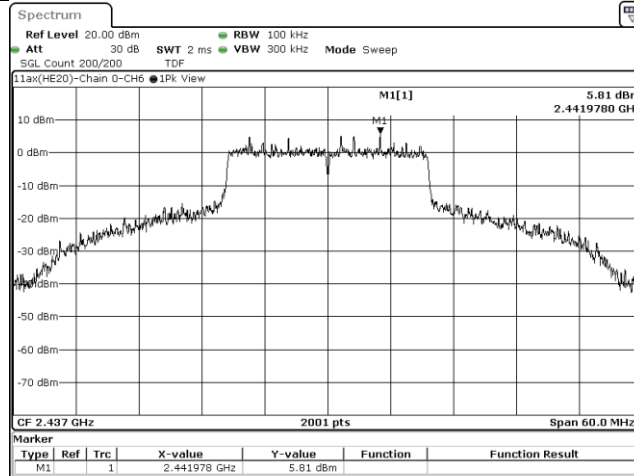
802.11ax(HE20), CH2, Chain 1, Conducted Emission



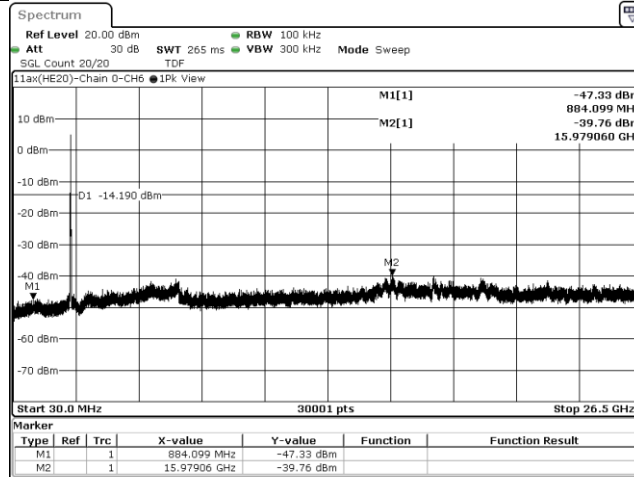
802.11ax(HE20), CH2, Chain 1, Band edge



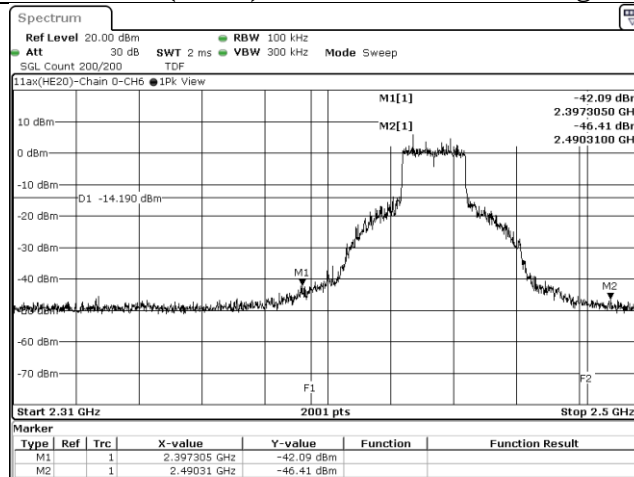
802.11ax(HE20), CH6, Chain 0, Reference



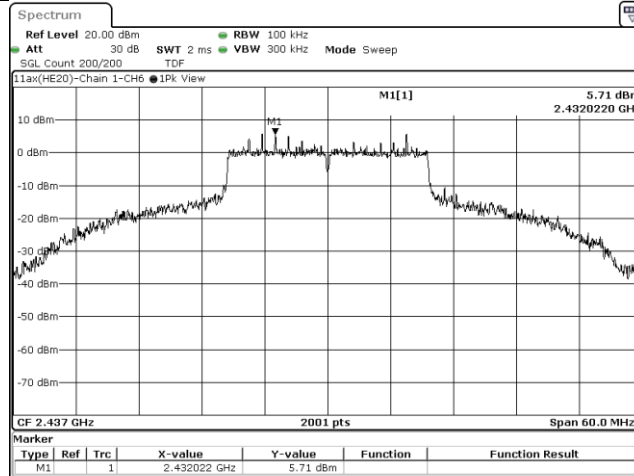
802.11ax(HE20), CH6, Chain 0, Conducted Emission



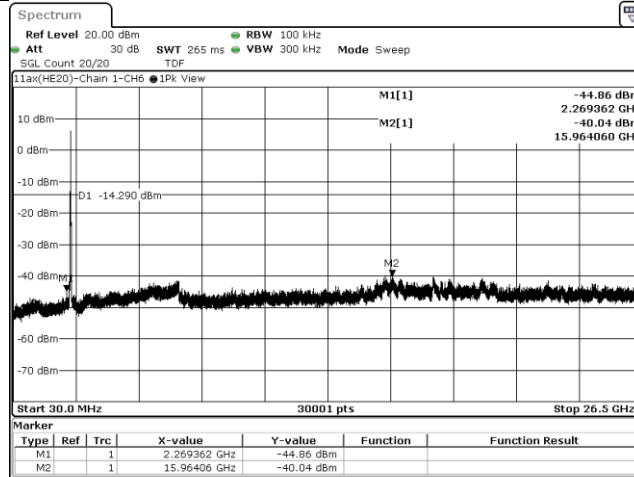
802.11ax(HE20), CH6, Chain 0, Band edge



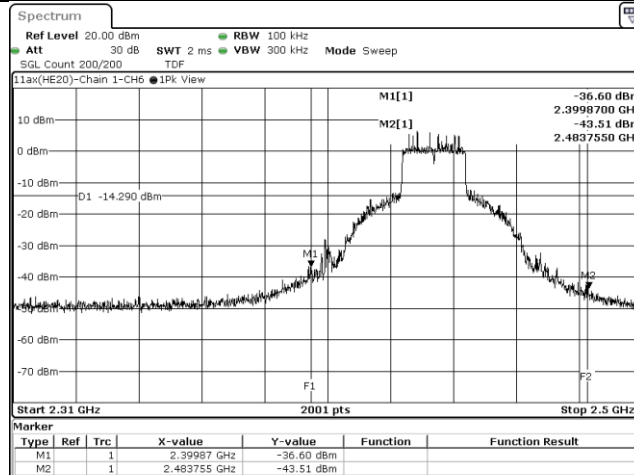
802.11ax(HE20), CH6, Chain 1, Reference



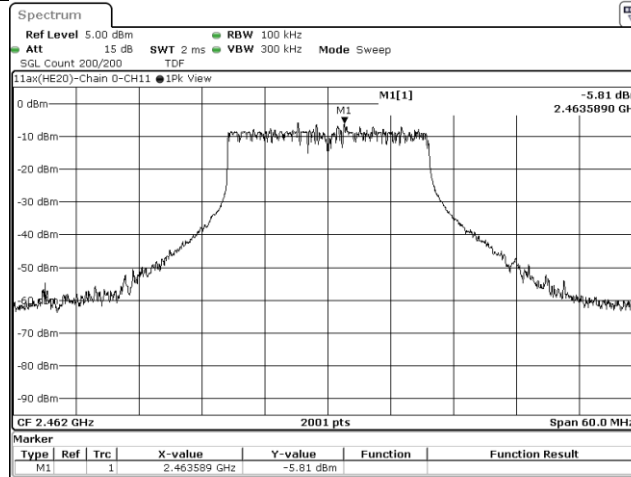
802.11ax(HE20), CH6, Chain 1, Conducted Emission



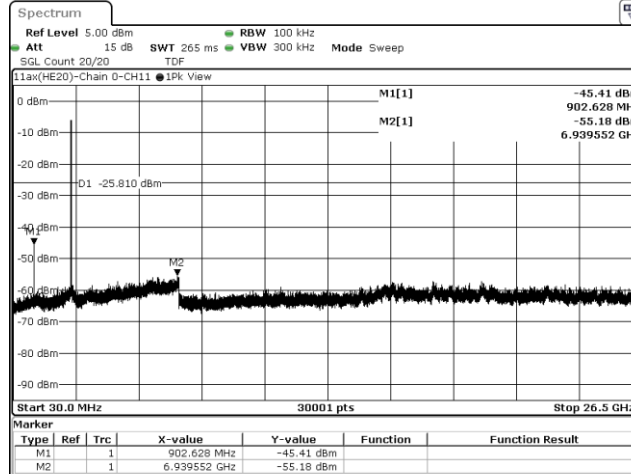
802.11ax(HE20), CH6, Chain 1, Band edge



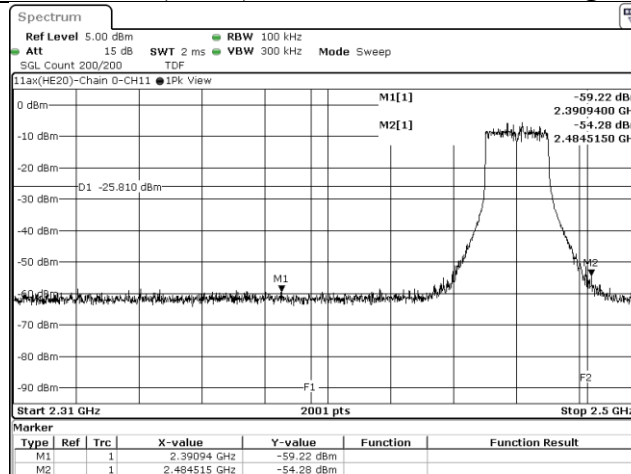
802.11ax(HE20), CH11, Chain 0, Reference



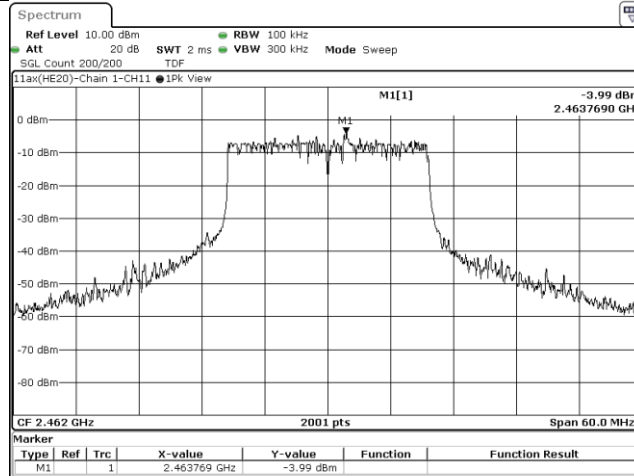
802.11ax(HE20), CH11, Chain 0, Conducted Emission



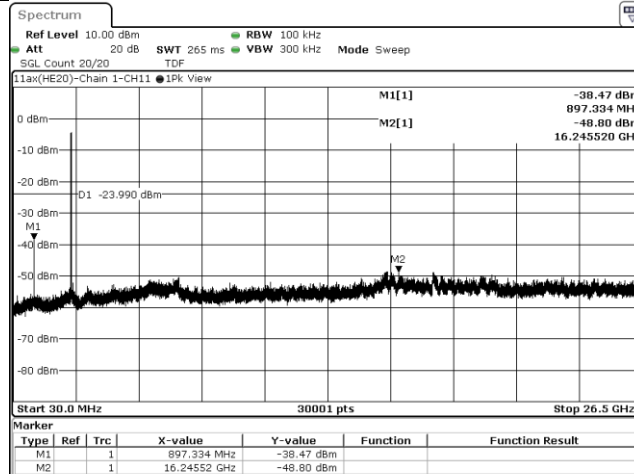
802.11ax(HE20), CH11, Chain 0, Band edge



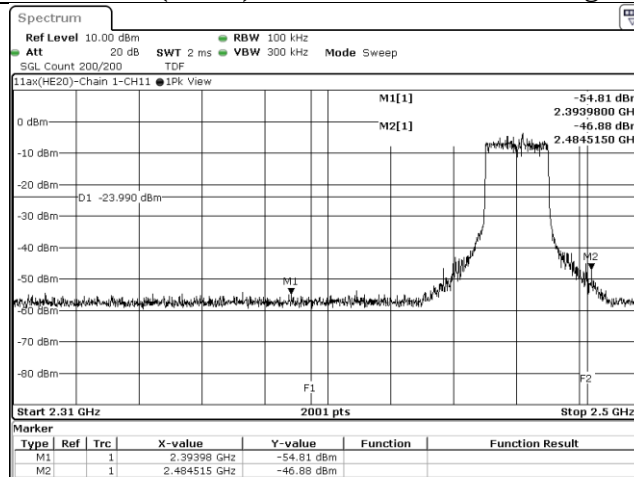
802.11ax(HE20), CH11, Chain 1, Reference



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



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



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

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-004737 (DCS:17-EM-F0876) / 6.1