



시험 성적서

TEST REPORT

페이지(page) : (1) / (총(Total) 108)

성적서 번호 Report No.		ICRT-TR-E222081-0A	
신청자 Client	기관명 Name	PITTASOFT CO.,LTD.	
	주 소 Address	A4th floor, ABN Tower, 331, Pangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea	
시험대상품목 Sample description		Car Dashcam	
모델명 Type designation		DR970X LTE	
정 격 Ratings		DC 12.0 V / DC 24.0 V	
시험장소 Place of test		☒ 고정시험(Inside test) ☐ 현장시험(Field test) 주소지(Address): 112, 113 Hwanggeum 3-ro 7beon-gil, Hagun-ri, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea	
시험기간 Date of test		31.May. 2022 ~ 08. Aug. 2022	
시험방법/항목 Test Method/Item		FCC Part 15 Subpart C §15.247	
시험결과 Test Results		Refer to 3. Test Summary	
확 인 Affirmation	작성자 Tested by	기술책임자 Technical Manager	
	성 명 Name	성 명 Name	
	Yeong-Hwan, Hong (서명)	Min-Gi, Son (서명)	
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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
ICRT-TR-E222081-0A	10-Aug-2022	Initial Issue	All



1. Applicant & Manufacturer & Test Laboratory Information

1.1 Applicant information

Applicant	PITTASOFT CO.,LTD.
Address	A4th floor, ABN Tower, 331, Pangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
Contact Person	MINHO SHIN
Telephone No.	+82-31-8039-7789
Fax No.	+82-31-8039-5260
E-mail	shinmh@pittasoft.com

1.2 Manufacturer Information

Manufacturer	PITTASOFT CO.,LTD.
Address	A4th floor, ABN Tower, 331, Pangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea

1.3 Test Laboratory Information

Conducted tests were performed at	
Laboratory	ICR Co., Ltd.
Address	112, Hwanggeum 3-ro 7beon-gil, Hagun-ri, Yangchon-eup, Gimpo-si, Gyeonggi-do, Korea
Telephone No.	+82-2-6351-9002
Fax No.	+82-2-6351-9007
RRA No.	KR0165
KOLAS No.	KT652
Test Firm Registration Number	490614



2. Equipment under Test(EUT) Information

2.1 General Information

Product Name	Car Dashcam
Brand Name	-
Model Name	DR970X LTE
Additional Model Name	DR970X-1CH LTE, DR970X-2CH LTE, DR970X-2CH IR LTE, DR970X-2CH DMS LTE, DR970X-2CH Truck LTE, DR970X-2CH ELD LTE
FCC ID	YCK-DR970XLTE
Power Supply	DC 12.0 V / DC 24.0 V

2.2 Additional Information

Equipment Class	DTS-Digital Transmission System	
Device Type	Stand-alone	
Operating Frequency	802.11b/g/n(HT20)	2 412 MHz ~ 2 462 MHz
	802.11n(HT40)	2 422 MHz ~ 2 452 MHz
	Bluetooth LE	2 402 MHz ~ 2 480
RF Output Power	802.11b	13.40 dBm
	802.11g	17.49 dBm
	802.11n(HT20)	16.53 dBm
	802.11n(HT40)	16.33 dBm
	Bluetooth LE	8.22 dBm
Number of Channel	802.11b/g/n(HT20)	11
	802.11n(HT40)	7
	Bluetooth LE	40
Modulation Type	CCK / OFDM / GFSK	
Antenna Type	Chip Antenna	
Antenna Gain	1.88 dBi	
Antenna Operating Mode	Single Antenna Equipment with only one antenna	



2.3 Mode of operation during the test

- The EUT is continuous transmission mode during the test with set to each of the Low Channel, Middle Channel, and High Channel at the worst case data rate. The worst case data rate for each modulation is determined 1 Mbps for IEEE 802.11b, 6 Mbps for IEEE 802.11g, 6.5 Mbps for HT20, 65 Mbps for HT40.

2.4 Modifications of EUT

- None

2.5 Reason of Additional Model Name

NO	Family Model Name	Difference
1	DR970X-1CH LTE	The basic model and electrical specifications, structure, and circuit are the same, but a simple derivative model name added due to a different seller
2	DR970X-2CH LTE	
3	DR970X-2CH IR LTE	
4	DR970X-2CH DMS LTE	
5	DR970X-2CH Truck LTE	
6	DR970X-2CH ELD LTE	



3. Test Summary

3.1 Test standards and results

FCC Part 15 Subpart C			
Clause	Test items	Applied	Results
§15.247 (a) (2)	6 dB Bandwidth	☒	PASS
§15.247 (b) (3)	Maximum Conducted (Average) Output Power	☒	PASS
§15.247 (e)	Power Spectral Density	☒	PASS
§15.247 (d)	Conducted Spurious Emission	☒	PASS
§15.247 (d) & §15.209 & §15.205	Radiated Spurious Emission	☒	PASS(Note1)
§15.207	Power Line Conducted Emission	☒	PASS
§15.203	Antenna Requirement	☒	PASS

- Note1: Data at DC 12 V of Radiated Emissions data are only those of Worst Case.

3.2 Purpose of the test

- To determine whether the equipment under test fulfills the requirements of the standards stated in FCC Part 15 Subpart C Section 15.247.

3.3 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013.

Radiated testing was performed at a distance of 3 m from EUT to the antenna.

3.4 Configuration of Test System

3.4.1 Radiated emission test

Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m Semi Anechoic Chamber. The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.



3.4.2 AC power line conducted emission test

The EUT was connected to LISN. All supporting equipment were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

3.5 Antenna requirement

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section.

The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.5.1 Result: Pass

The transmitter has a **Chip Antenna**. The directional gain of the antenna is **1.88 dBi**.



4. Used equipment on test

	Description	Model Name	Serial Number	Manufacturer	Next Cal. (cycle)
☒	Spectrum analyzer	FSV40	101455	R&S	2023. 03. 02 (1Y)
☒	Signal Generator	SMB100A	180607	R&S	2023. 03. 03 (1Y)
☒	Wideband Power Sensor	NRP-Z81	102999	R&S	2023. 03. 03 (1Y)
☒	DC Power Supply	XDL 35-5P	J00385373	Sorensen	2023. 03. 03 (1Y)
☒	Spectrum Analyzer	N9020A	US47360812	Agilent Technologies	2023. 06. 24 (1Y)
☒	DC Power Supply	DPR-303D	2090097	DIGITAL	2023. 06. 24 (1Y)
☒	Multimeter	17B+	36390701WS	FLUKE	2022. 12. 16 (1Y)
☒	Signal Generator	SMBV100A	255571	Rohde Schwarz	2022. 12. 16 (1Y)
☒	Signal Generator	MG3695C	173501	ANRITSU	2022. 12. 16 (1Y)
☒	Thermohygrometer	BJ5478	120612-2	BODYCOM	2022. 12. 16 (1Y)
☒	Loop Antenna	6502	00226186	ETS-Lindgren	2023. 06. 24 (1Y)
☒	Hybrid Antenna	VULB 9160	3362	Schwarzbeck	2022. 12. 16 (1Y)
☒	Horn Antenna	3117	00140394	ETS-Lindgren	2022. 12. 16 (1Y)
☒	Horn Antenna	SAS-574	155	A.H.Systems Inc.	2023. 06. 24 (1Y)
☒	PreAmplifier	8449B	3008A02108	Agilent Technologies	2023. 06. 24 (1Y)
☒	PreAmplifier	MLA-1840-J02-45	16966-10728	tsj	2023. 06. 24 (1Y)
☒	PreAmplifier	8447D	2944A07774	H.P	2022. 12. 16 (1Y)
☒	High Pass Filter	WHKX12-935-1000-15000-40SS	7	Wainwright Instruments	2023. 06. 24 (1Y)
☒	High Pass Filter	WHKX10-2838-3300-18000-60SS	2	Wainwright Instruments	2023. 06. 24 (1Y)
☒	High Pass Filter	WHKX6-6320-8000-26500-40CC	2	Wainwright Instruments	2023. 06. 24 (1Y)

※ All test equipment used is calibration on a regular basis.



5. 6 dB Bandwidth

5.1 Operating environment

Temperature : 25 °C

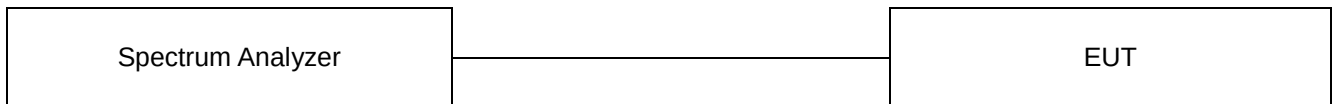
Relative humidity : 46 %

5.2 Measurement method

Standard : §15.247 (a) (2)

5.3 Test setup

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.





5.4 Test data

Operating mode : Transmit mode

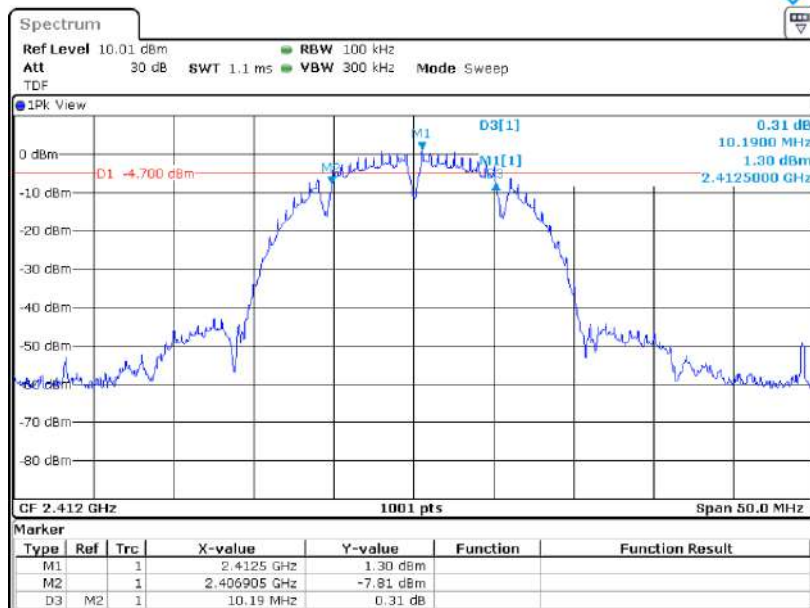
Test Result : Pass

5.4.1 Measured Results for DC 12 V

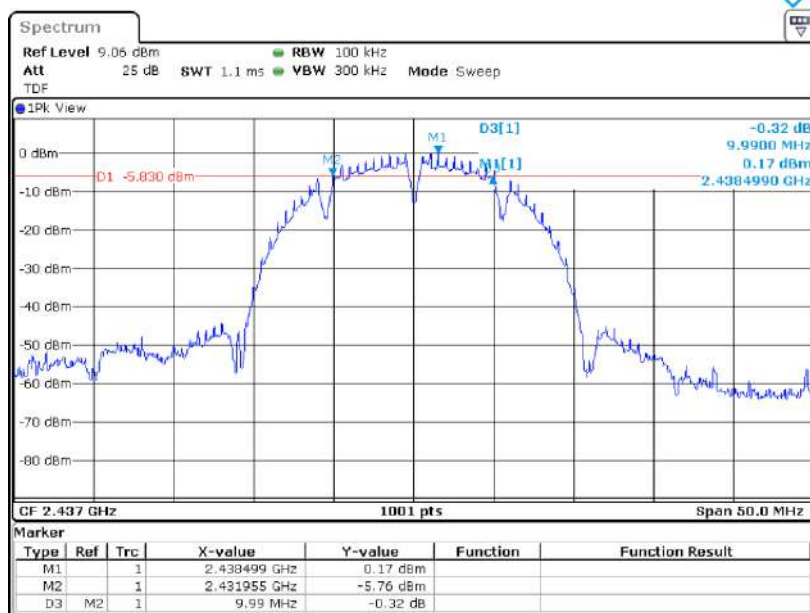
Modulation Type	Channel (Frequency)	Measured Value (MHz)	Limit (kHz)
802.11b	0 (2 412 MHz)	10.19	at least 500
	6 (2 437 MHz)	9.99	
	11 (2 462 MHz)	10.04	
802.11g	0 (2 412 MHz)	16.13	
	6 (2 437 MHz)	16.23	
	11 (2 462 MHz)	16.08	
802.11n(HT20)	0 (2 412 MHz)	17.48	
	6 (2 437 MHz)	16.98	
	11 (2 462 MHz)	17.03	
802.11n(HT40)	3 (2 422 MHz)	35.66	
	6 (2 437 MHz)	35.46	
	9 (2 452 MHz)	35.56	
Bluetooth LE	0 (2 402 MHz)	0.70	
	19 (2 440 MHz)	0.73	
	39 (2 480 MHz)	0.74	



5.4.1.1 Measured Graph for 802.11b_DC 12V



Low CH



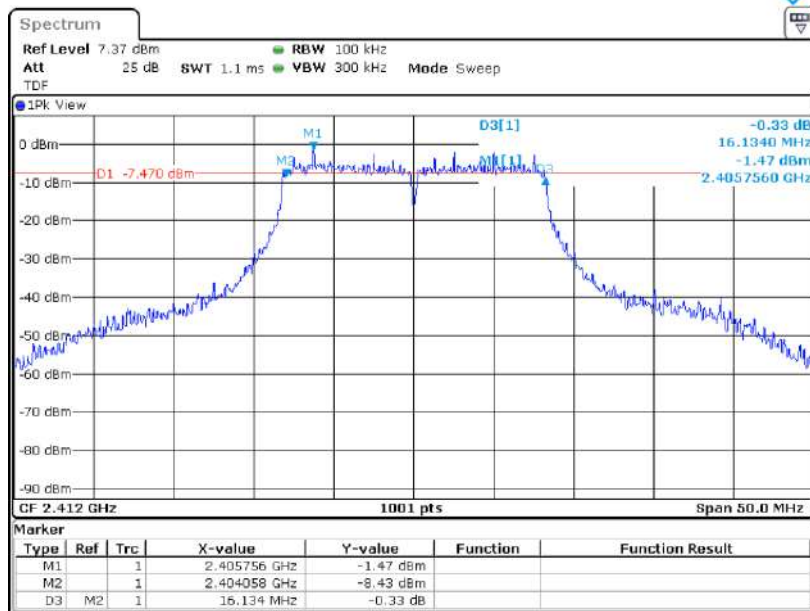
Mid CH



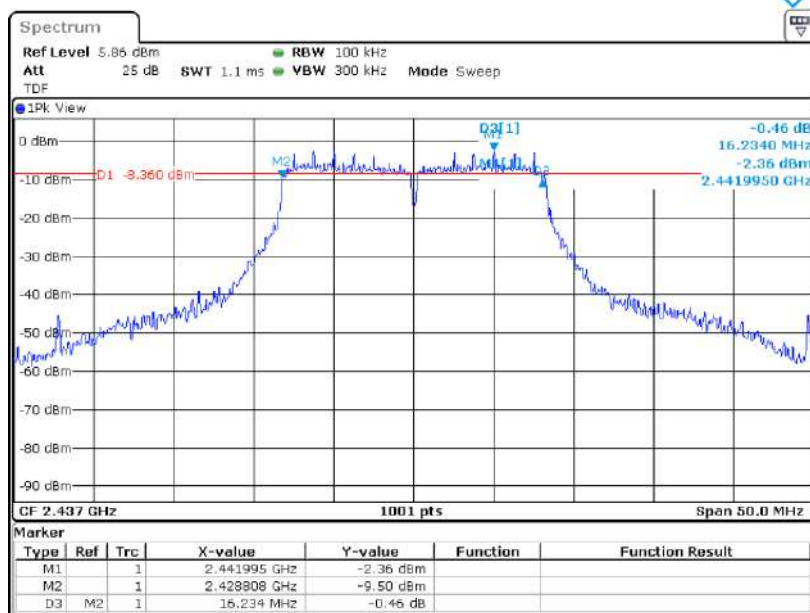
High CH



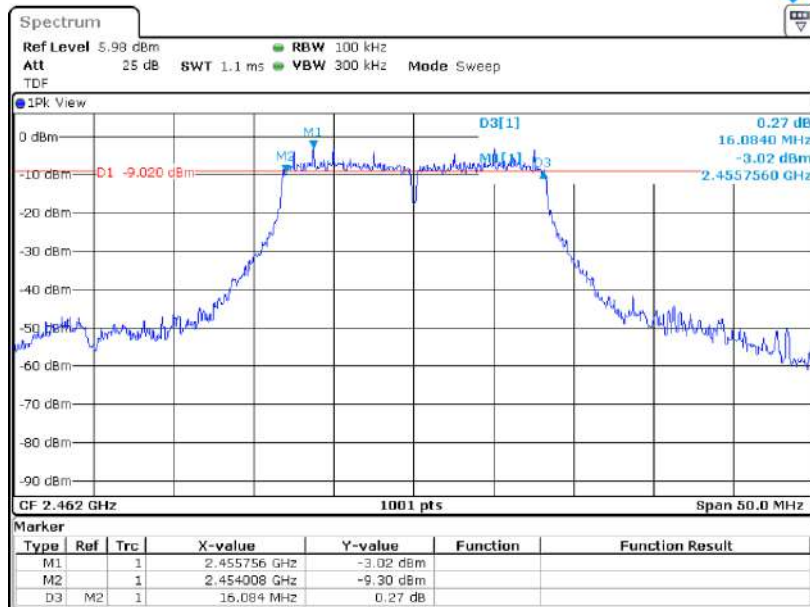
5.4.1.2 Measured Graph for 802.11g_DC 12 V



Low CH



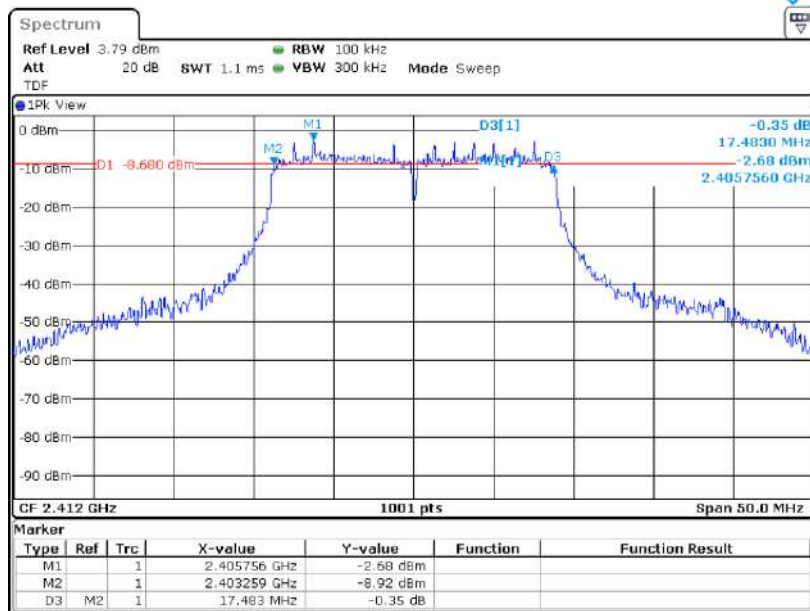
Mid CH



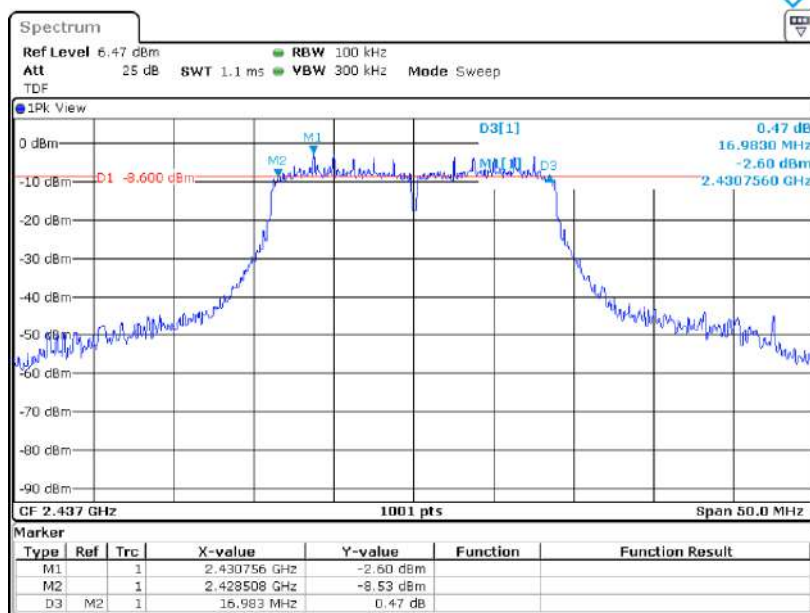
High CH



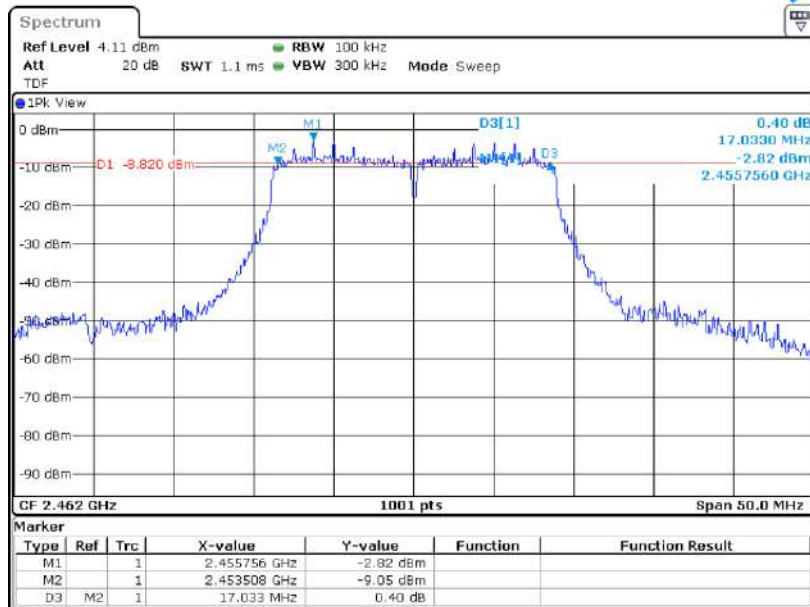
5.4.1.3 Measured Graph for 802.11n(HT20)_DC 12 V



Low CH



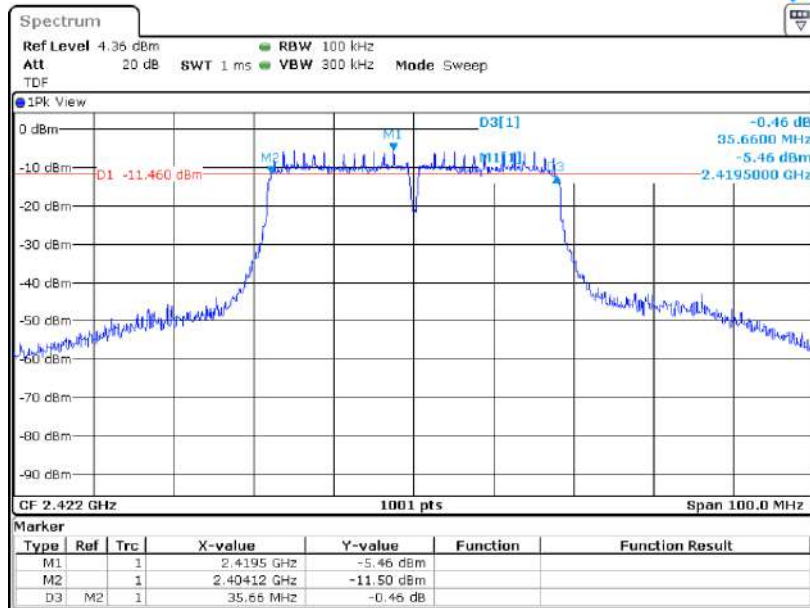
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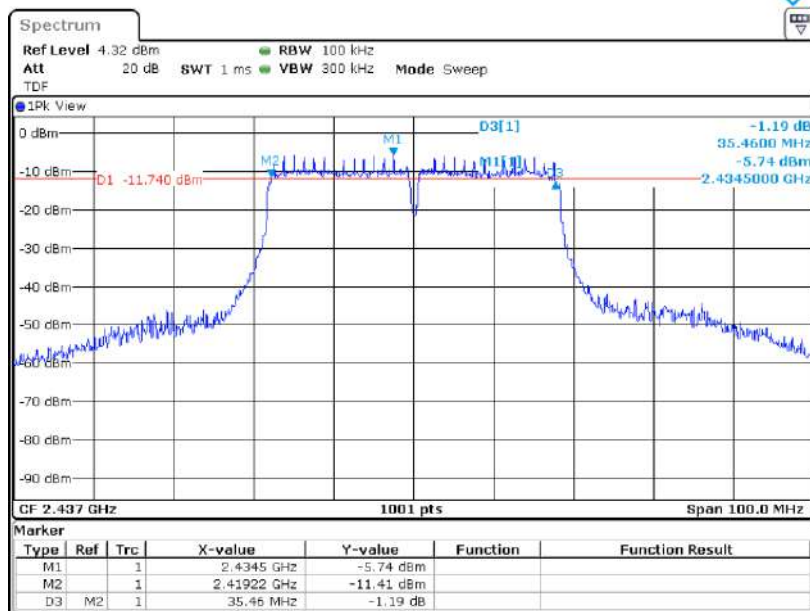
High CH



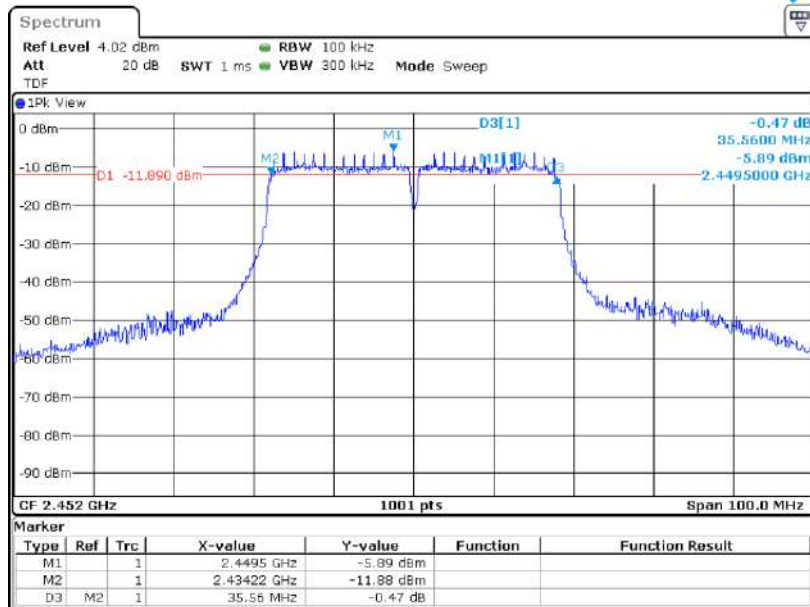
5.4.1.4 Measured Graph for 802.11n(HT40)_DC 12 V



Low CH



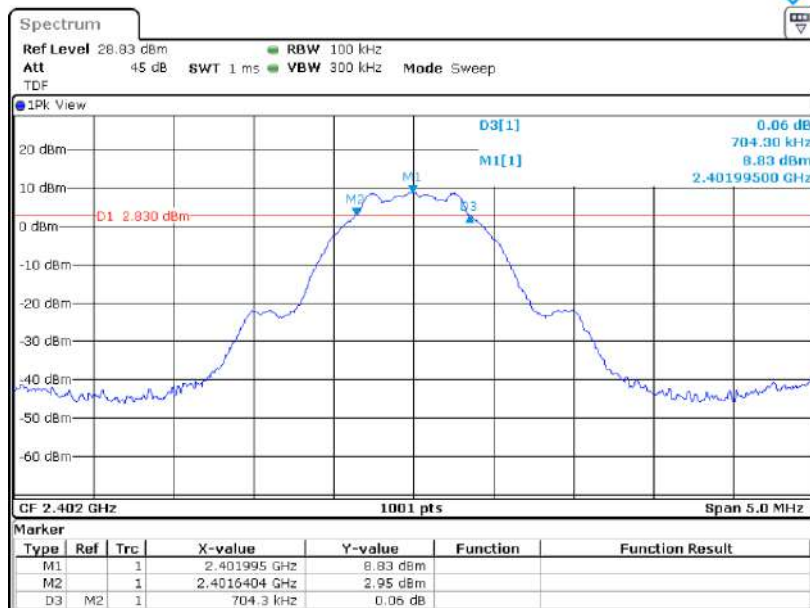
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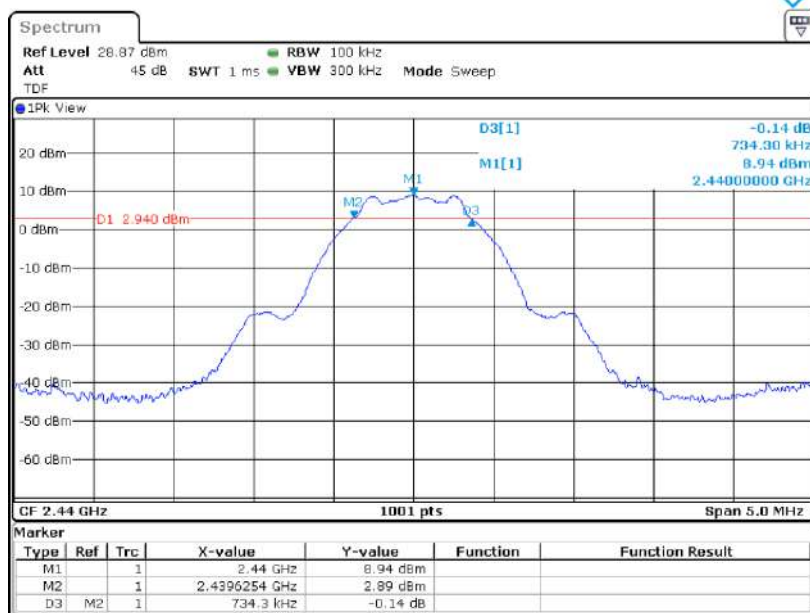
High CH



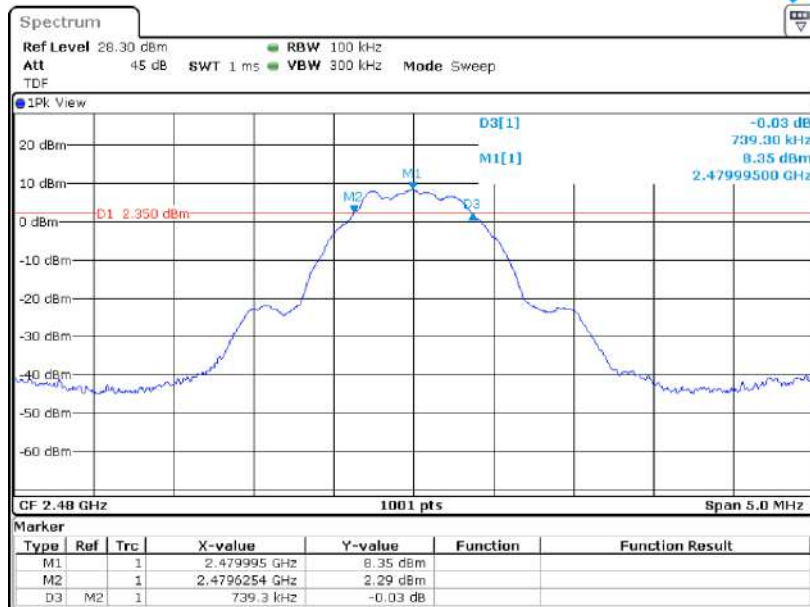
5.4.1.5 Measured Graph for Bluetooth LE_DC 12 V



Low CH



Mid CH



High CH

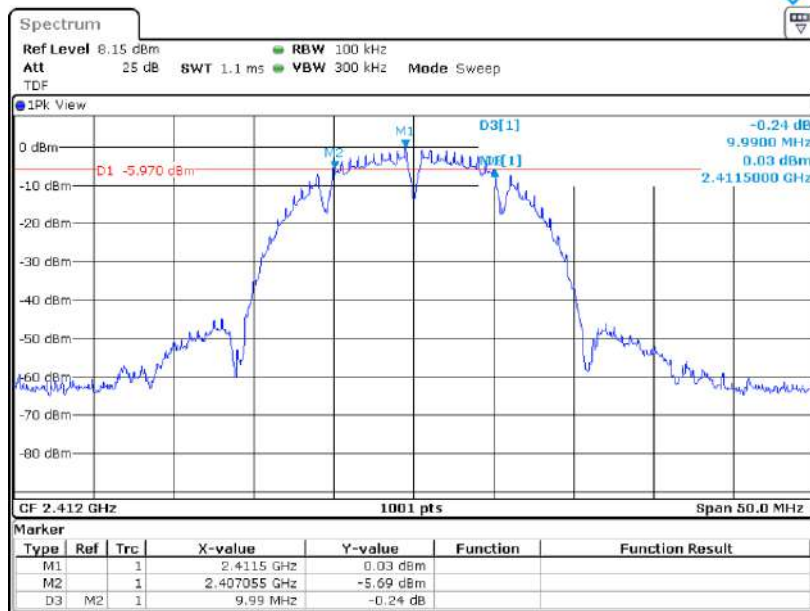


5.4.2 Measured Results for DC 24 V

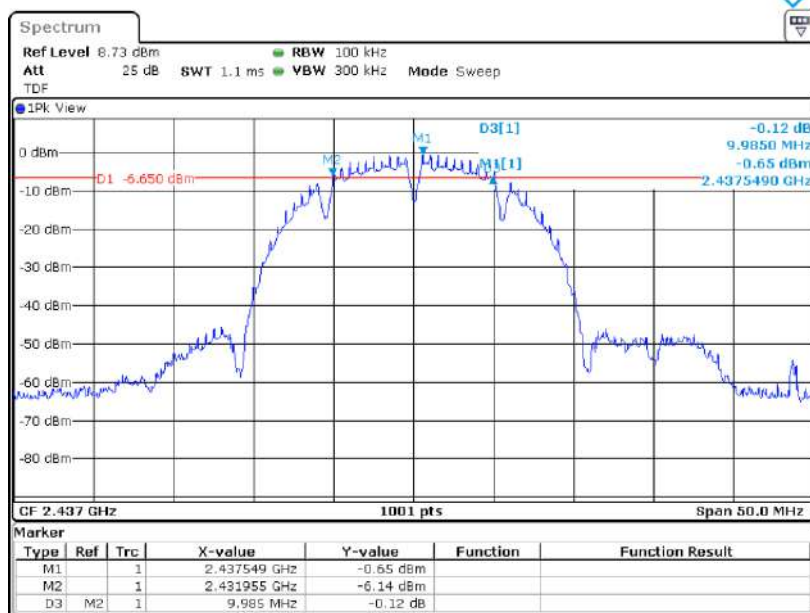
Modulation Type	Channel (Frequency)	Measured Value (MHz)	Limit (kHz)
802.11b	0 (2 412 MHz)	9.99	at least 500
	6 (2 437 MHz)	9.99	
	11 (2 462 MHz)	10.09	
802.11g	0 (2 412 MHz)	16.38	
	6 (2 437 MHz)	16.38	
	11 (2 462 MHz)	16.38	
802.11n(HT20)	0 (2 412 MHz)	16.73	
	6 (2 437 MHz)	16.88	
	11 (2 462 MHz)	17.13	
802.11n(HT40)	3 (2 422 MHz)	35.56	
	6 (2 437 MHz)	35.56	
	9 (2 452 MHz)	35.56	
Bluetooth LE	0 (2 402 MHz)	0.73	
	19 (2 440 MHz)	0.75	
	39 (2 480 MHz)	0.73	



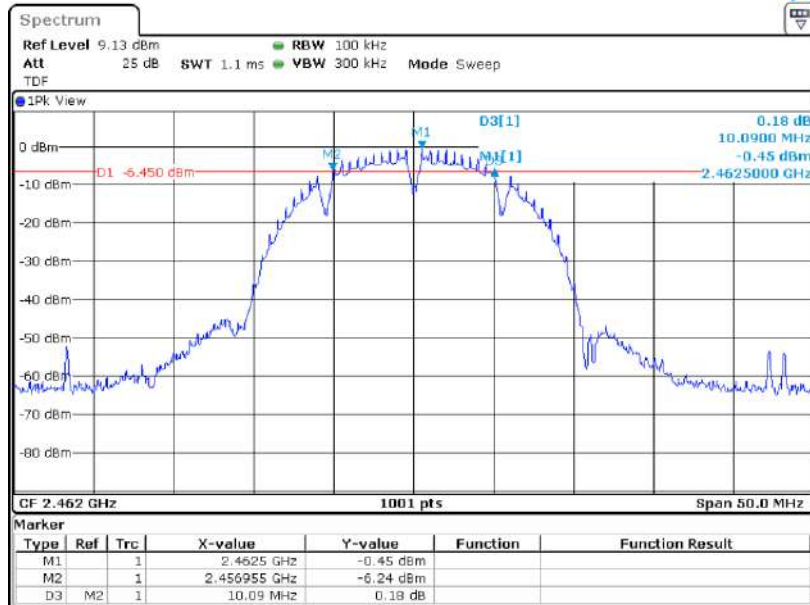
5.4.2.1 Measured Graph for 802.11b_DC 24V



Low CH



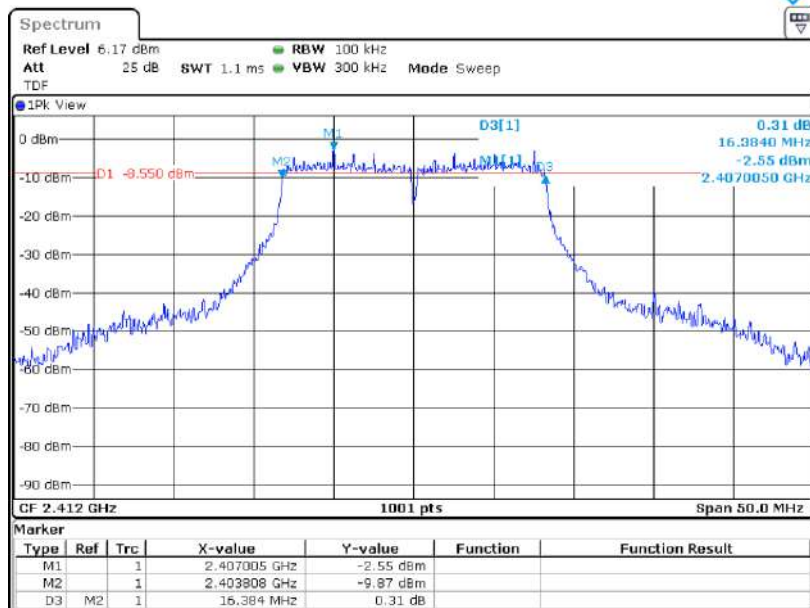
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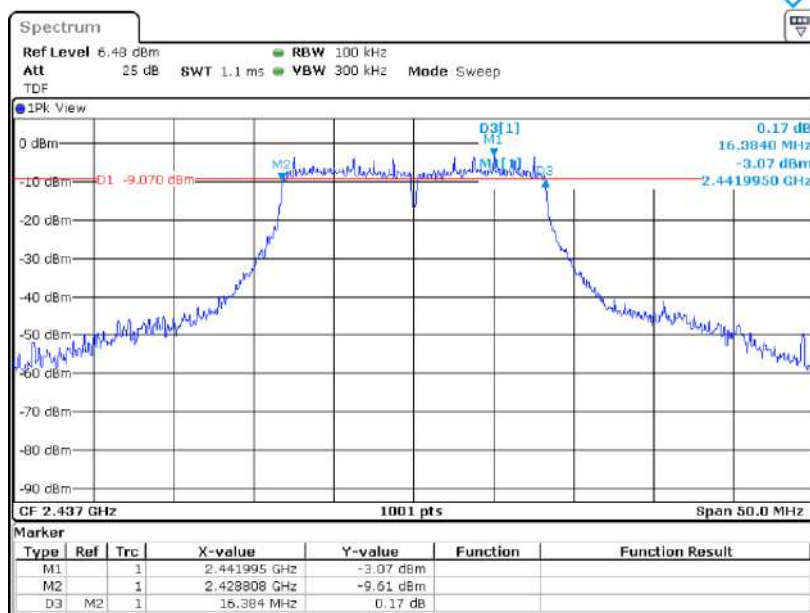
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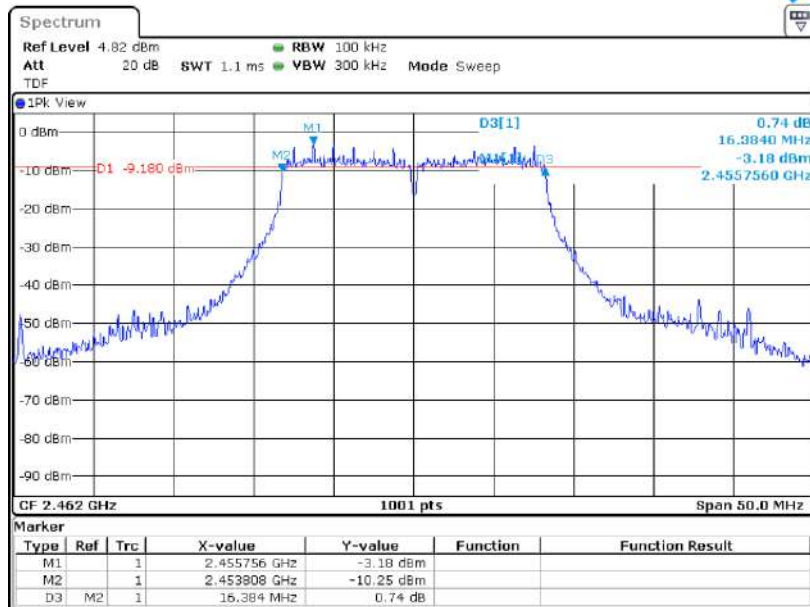
5.4.2.2 Measured Graph for 802.11g_DC 24 V



Low CH



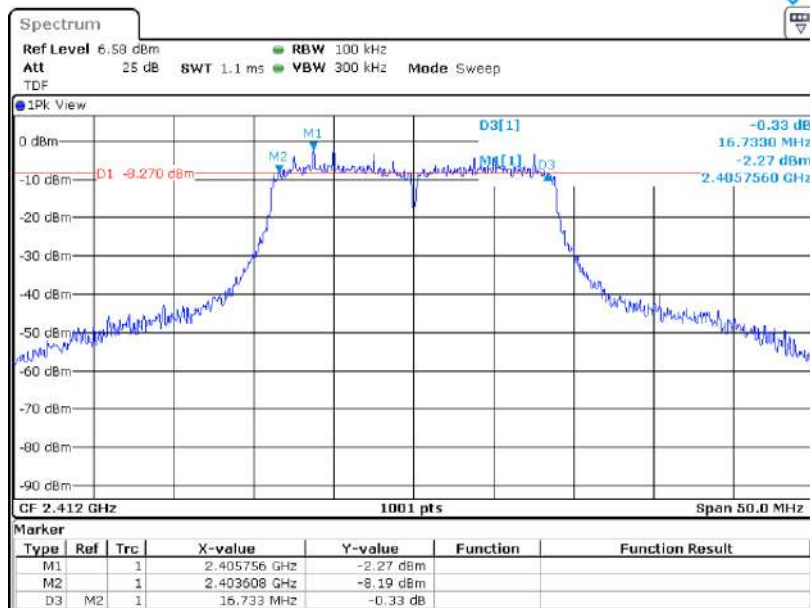
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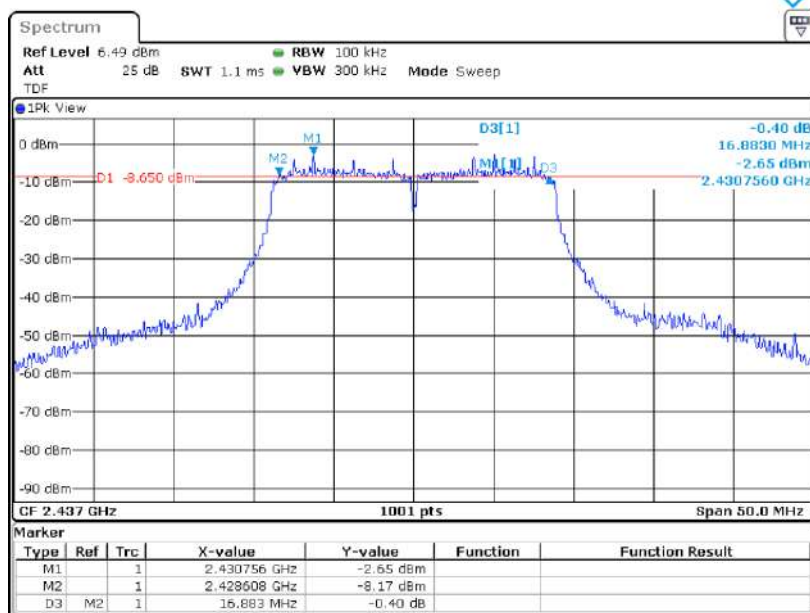
High CH



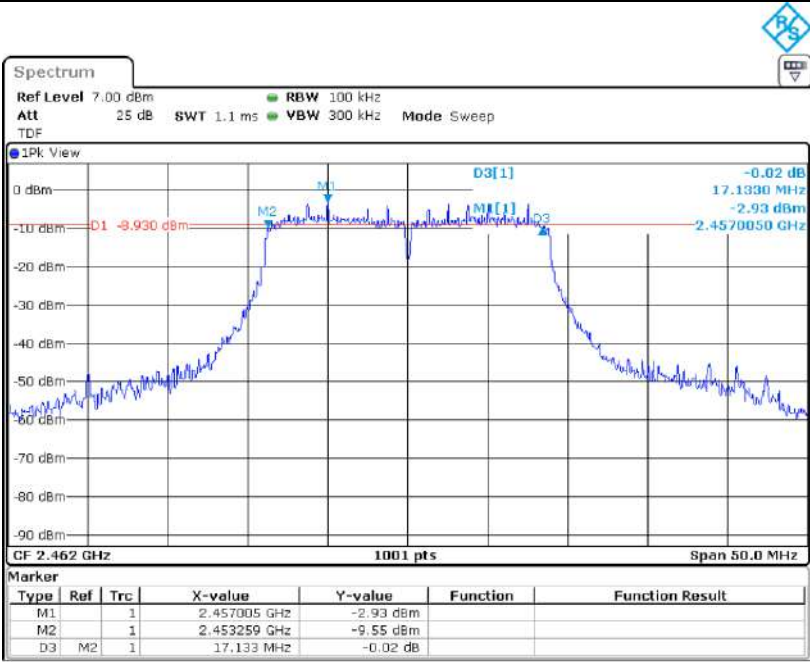
5.4.2.3 Measured Graph for 802.11n(HT20)_DC 24 V



Low CH



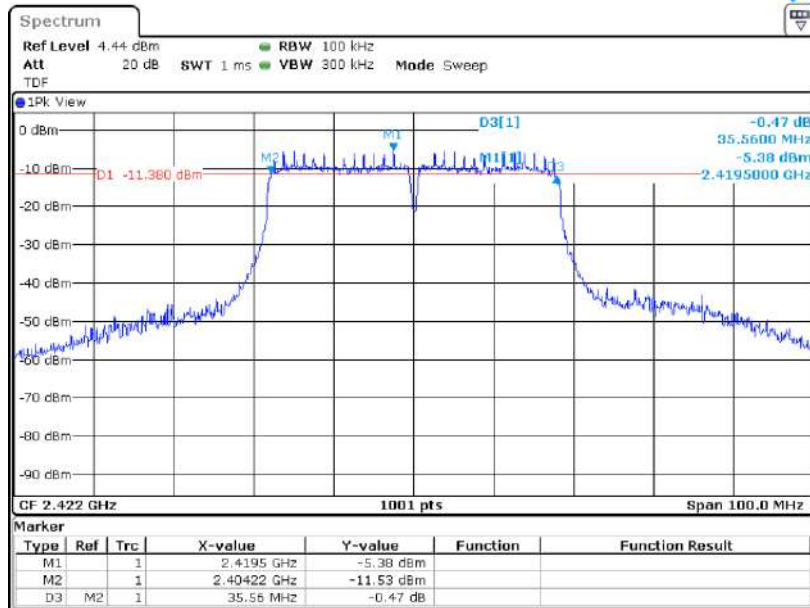
Mid CH



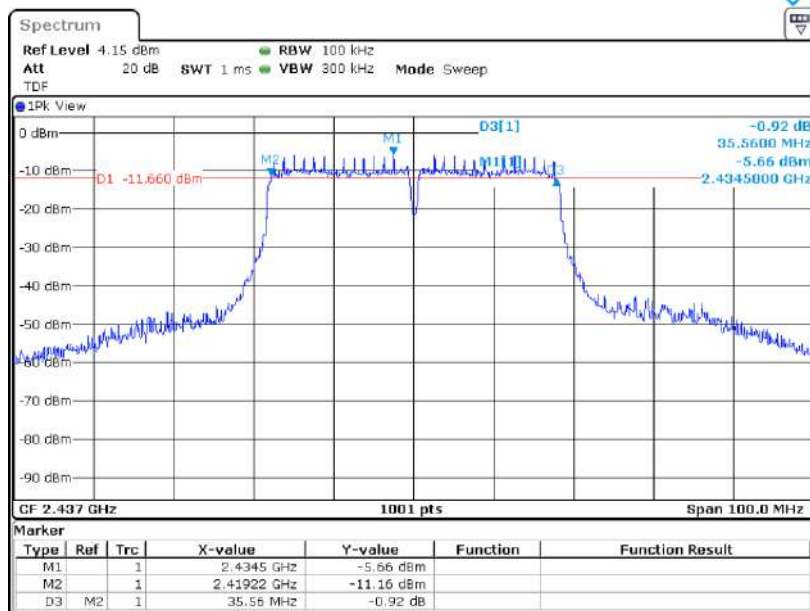
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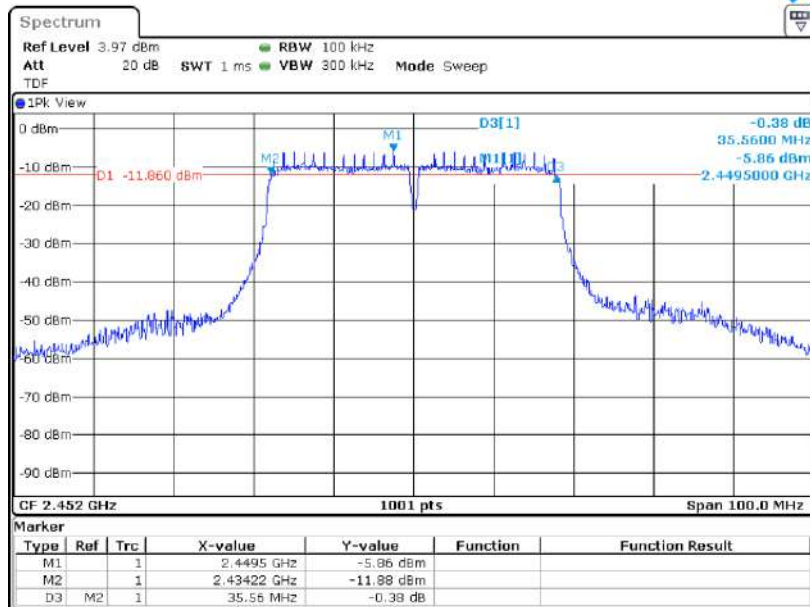
5.4.2.4 Measured Graph for 802.11n(HT40)_DC 24 V



Low CH



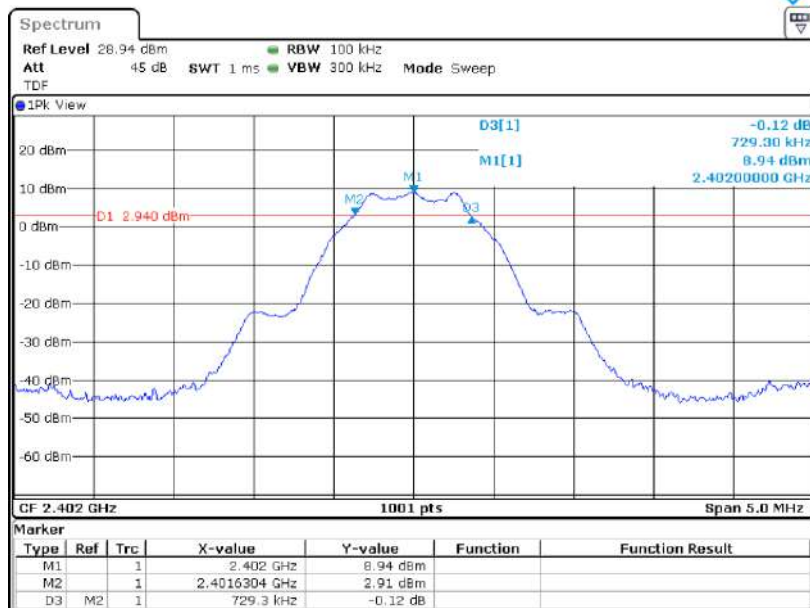
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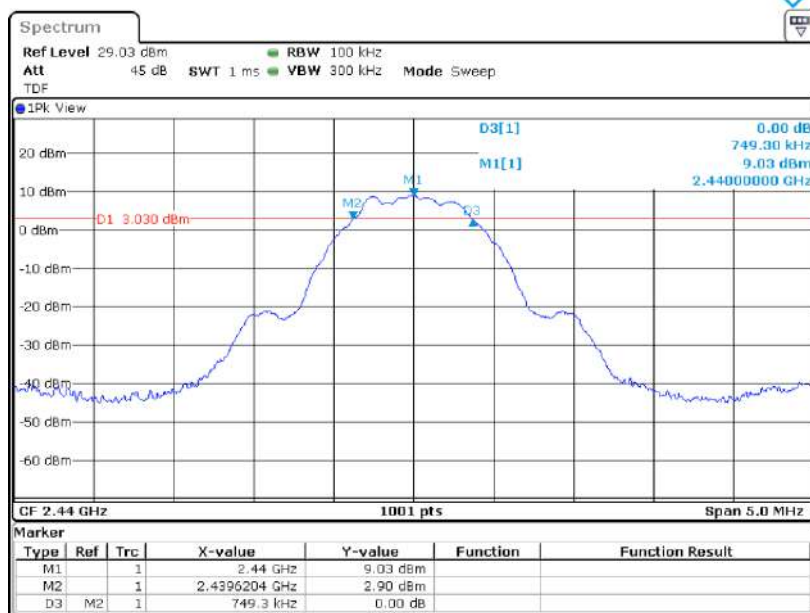
High CH



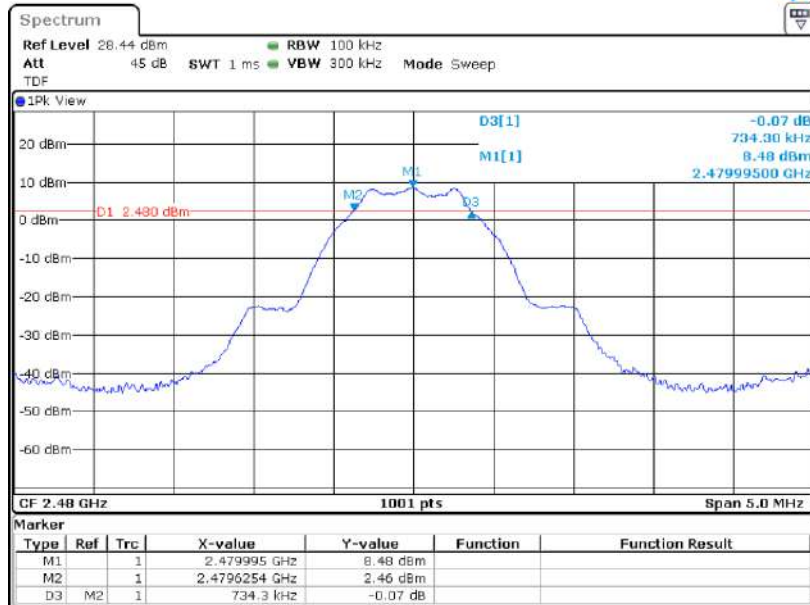
5.4.2.5 Measured Graph for Bluetooth LE_DC 24 V



Low CH



Mid CH



High CH



6. Maximum Conducted (Average) Output Power

6.1 Operating environment

Temperature : 25 °C

Relative humidity : 46 %

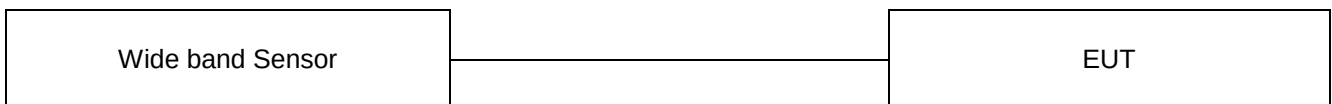
6.2 Measurement method

Standard : §15.247 (b) (3)

6.3 Test setup

The maximum peak output power was measured with the wide band sensor connected to the antenna output power of the EUT. The Wide Band Sensor is measured when the EUT is transmitting at the appropriate center frequency its maximum power control level as described in Section 8.3(558074 D01 15.247 Meas Guidance v05r02).

Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.





6.4 Test data

Operating mode : Transmit mode

Test Result : Pass

6.4.1 Measured Results for DC 12 V

Modulation Type	Channel (Frequency)	Measured Value (dBm)	Limit (dBm)
802.11b	1 (2 412 MHz)	13.40	30 (1 Watt)
	6 (2 437 MHz)	12.60	
	11 (2 462 MHz)	12.35	
802.11g	1 (2 412 MHz)	17.49	
	6 (2 437 MHz)	16.72	
	11 (2 462 MHz)	15.95	
802.11n(HT20)	1 (2 412 MHz)	16.53	
	6 (2 437 MHz)	16.12	
	11 (2 462 MHz)	15.84	
802.11n(HT40)	3 (2 422 MHz)	16.29	
	6 (2 437 MHz)	16.09	
	9 (2 452 MHz)	15.94	
Bluetooth LE	0 (2 402 MHz)	7.78	
	19 (2 440 MHz)	7.99	
	39 (2 480 MHz)	7.50	



6.4.2 Measured Results for DC 24 V

Modulation Type	Channel (Frequency)	Measured Value (dBm)	Limit (dBm)
802.11b	1 (2 412 MHz)	12.53	30 (1 Watt)
	6 (2 437 MHz)	12.16	
	11 (2 462 MHz)	11.93	
802.11g	1 (2 412 MHz)	16.61	
	6 (2 437 MHz)	16.26	
	11 (2 462 MHz)	16.03	
802.11n(HT20)	1 (2 412 MHz)	16.48	
	6 (2 437 MHz)	16.17	
	11 (2 462 MHz)	15.94	
802.11n(HT40)	3 (2 422 MHz)	16.33	
	6 (2 437 MHz)	16.13	
	9 (2 452 MHz)	16.00	
Bluetooth LE	0 (2 402 MHz)	8.06	
	19 (2 440 MHz)	8.22	
	39 (2 480 MHz)	7.56	



7. Power Spectral Density

7.1 Operating environment

Temperature : 25 °C

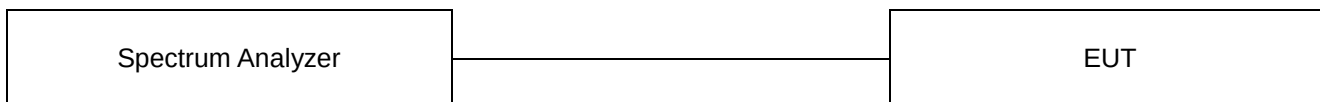
Relative humidity : 46 %

7.2 Measurement method

Standard : §15.247 (e)

7.3 Test setup

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 3 kHz, the video bandwidth is set to 3 times the resolution bandwidth.





7.4 Test data

Operating mode : Transmit mode

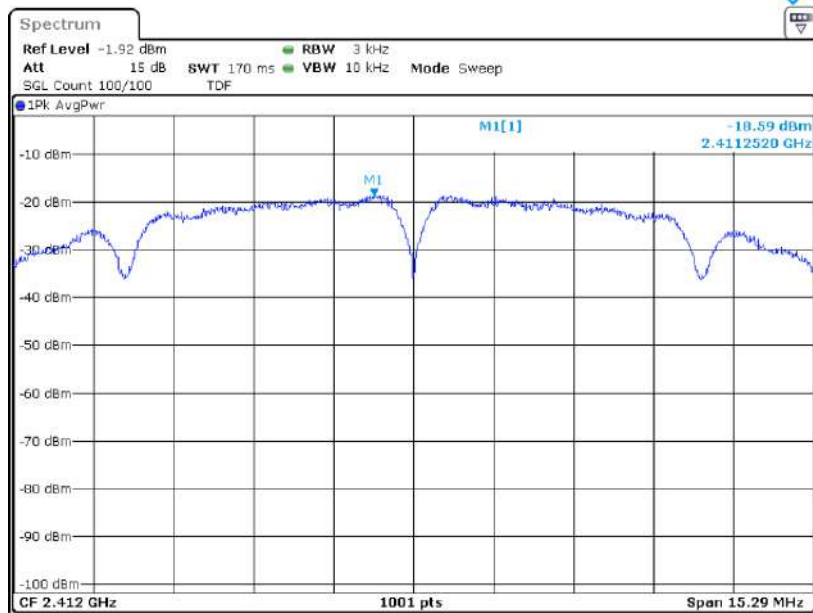
Test Result : Pass

7.4.1 Measured Results for DC 12 V

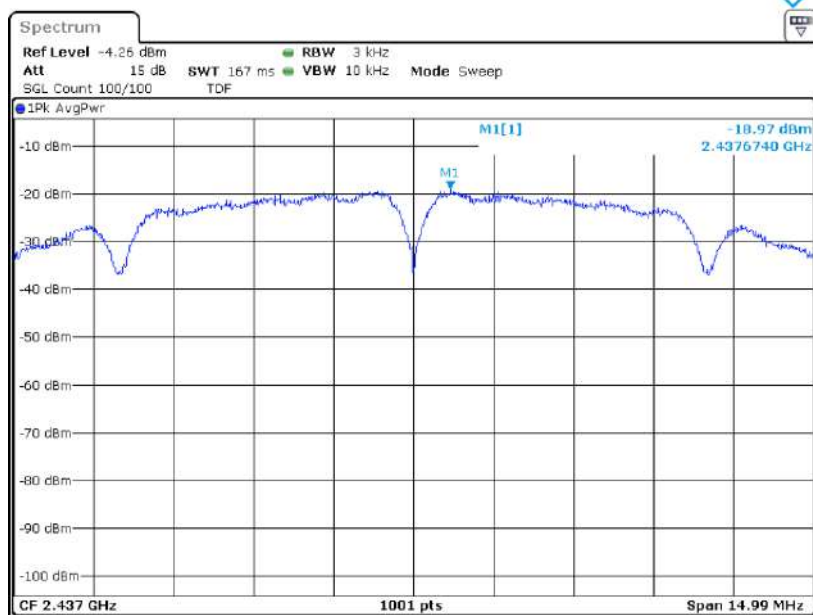
Modulation Type	Channel (Frequency)	Highest signal level (dBm)	Limit (dBm/3kHz)
802.11b	1 (2 412 MHz)	-18.59	8
	6 (2 437 MHz)	-18.97	
	11 (2 462 MHz)	-19.12	
802.11g	1 (2 412 MHz)	-22.06	
	6 (2 437 MHz)	-22.48	
	11 (2 462 MHz)	-23.23	
802.11n(HT20)	1 (2 412 MHz)	-23.16	
	6 (2 437 MHz)	-23.36	
	11 (2 462 MHz)	-23.88	
802.11n(HT40)	3 (2 422 MHz)	-26.04	
	6 (2 437 MHz)	-26.07	
	9 (2 452 MHz)	-26.93	
Bluetooth LE	0 (2 402 MHz)	-5.33	
	19 (2 440 MHz)	-4.82	
	39 (2 480 MHz)	-4.29	



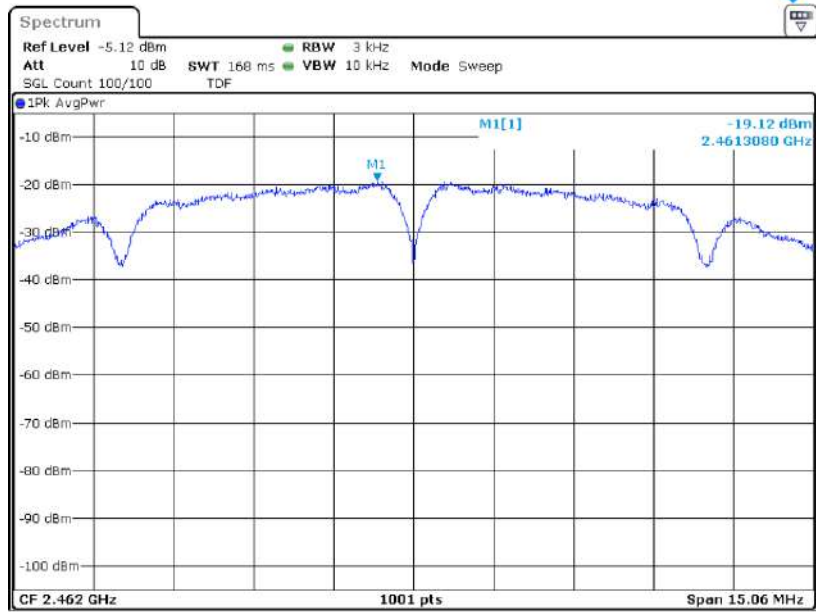
7.4.1.1 Measured Graph for 802.11b_DC 12 V



Low CH



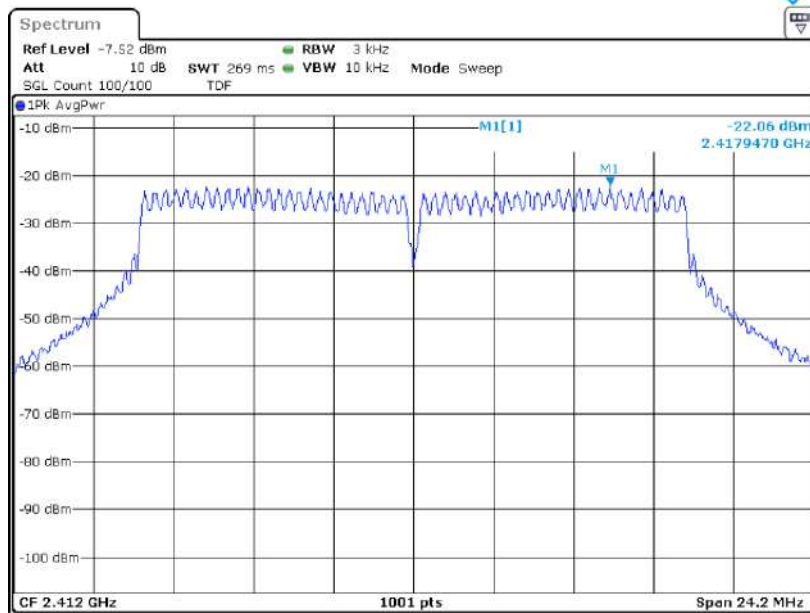
Mid CH



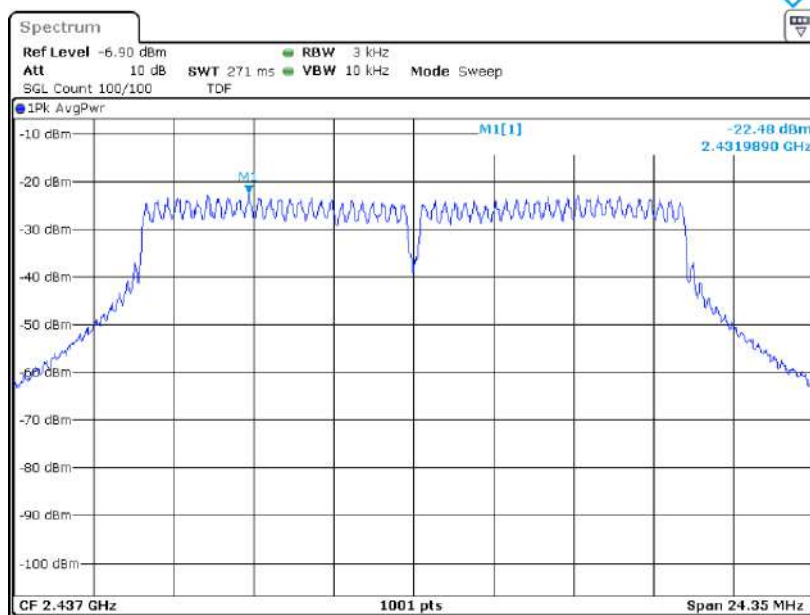
High CH



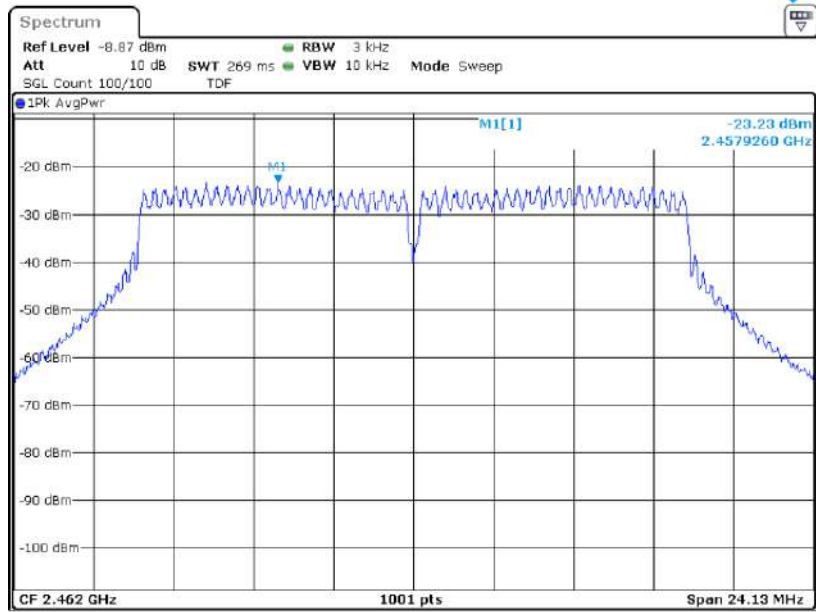
7.4.1.2 Measured Graph for 802.11g_DC 12 V



Low CH



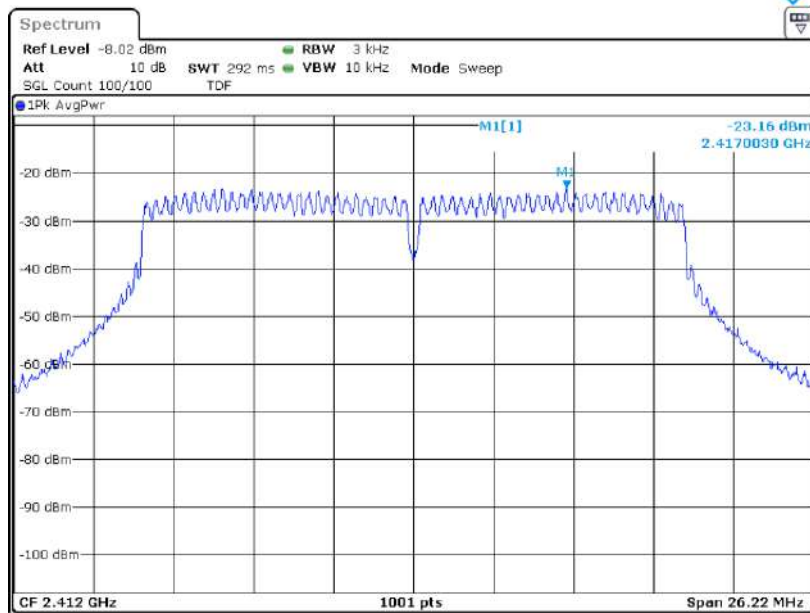
Mid CH



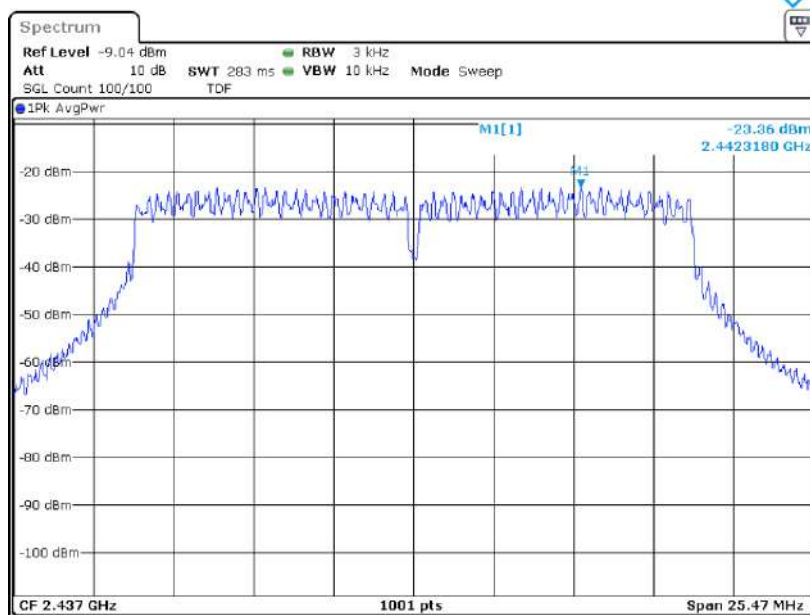
High CH



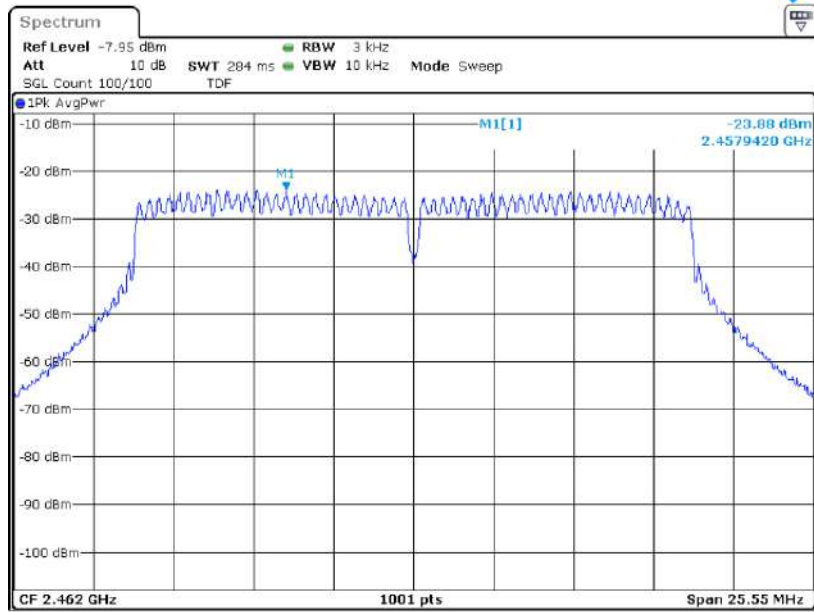
7.4.1.3 Measured Graph for 802.11n(HT20)_DC 12 V



Low CH



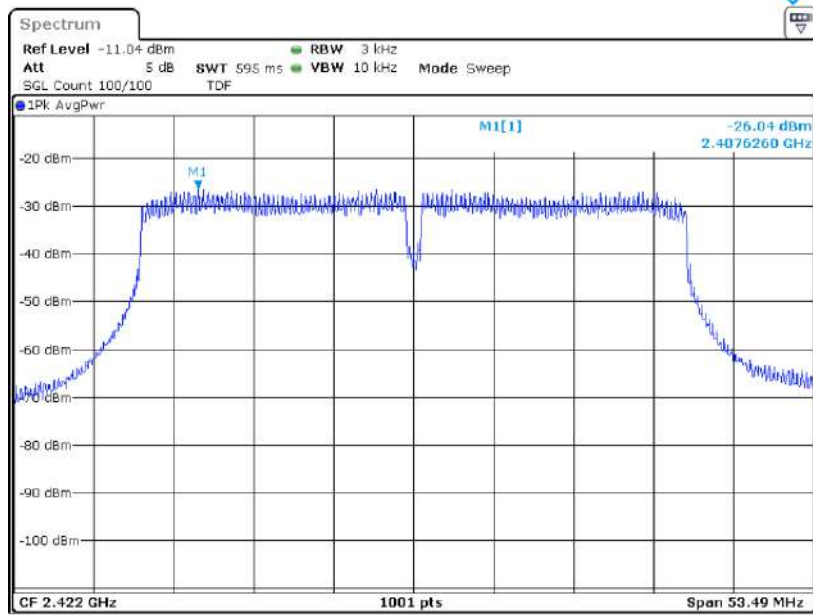
Mid CH



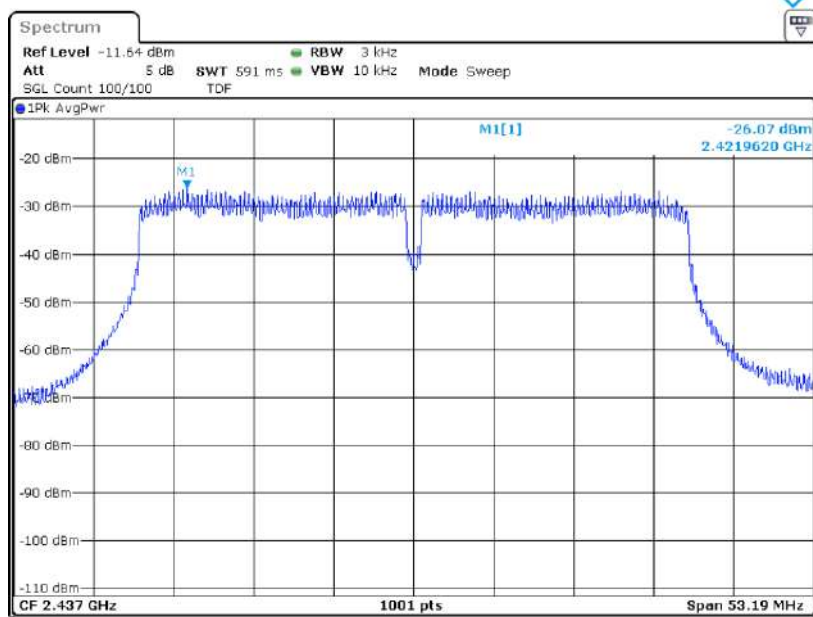
High CH



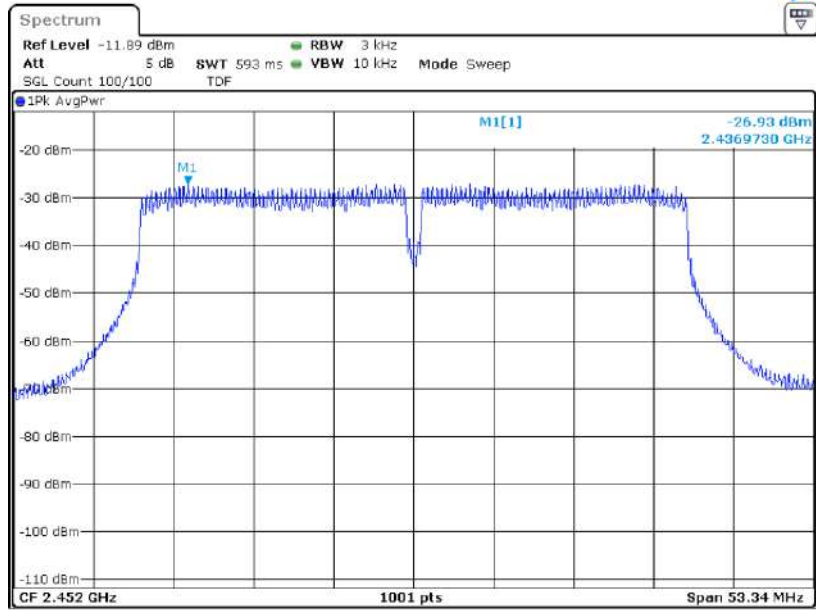
7.4.1.4 Measured Graph for 802.11n(HT40)_DC 12 V



Low CH



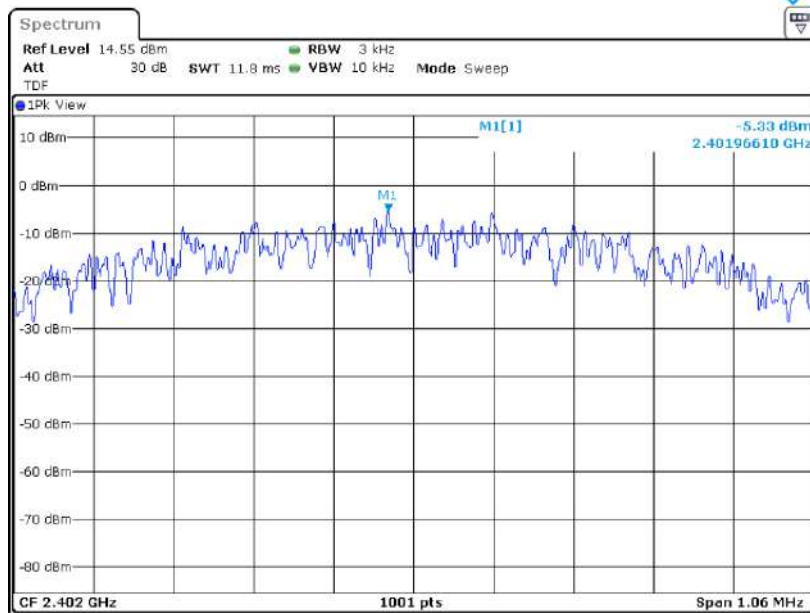
Mid CH



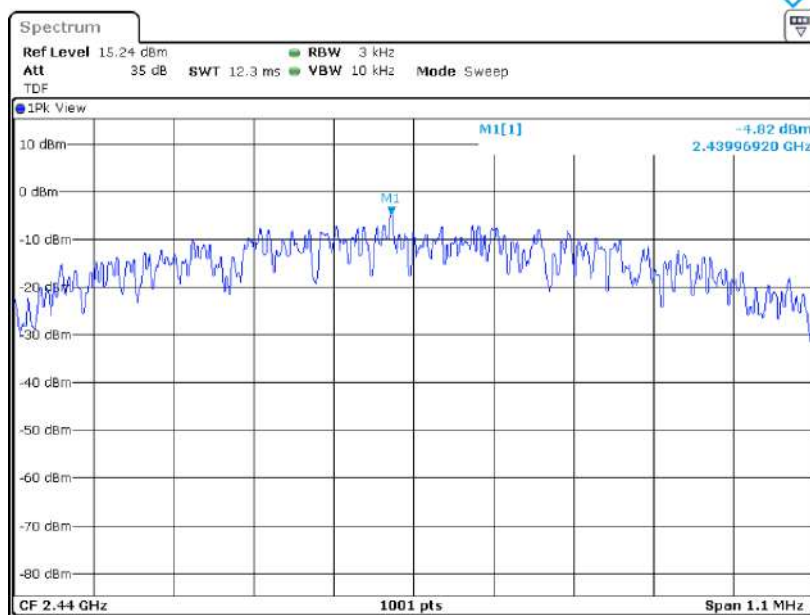
High CH



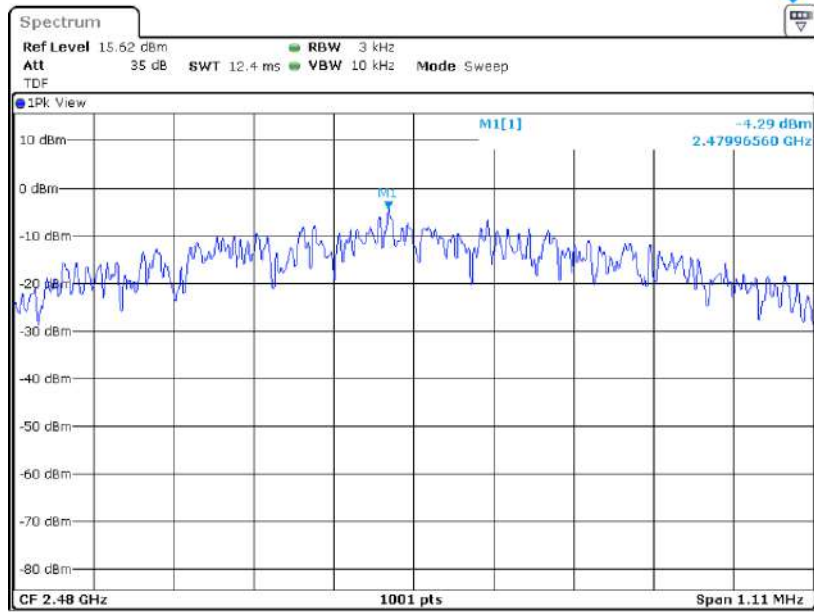
7.4.1.5 Measured Graph for Bluetooth LE_DC 12 V



Low CH



Mid CH



High CH

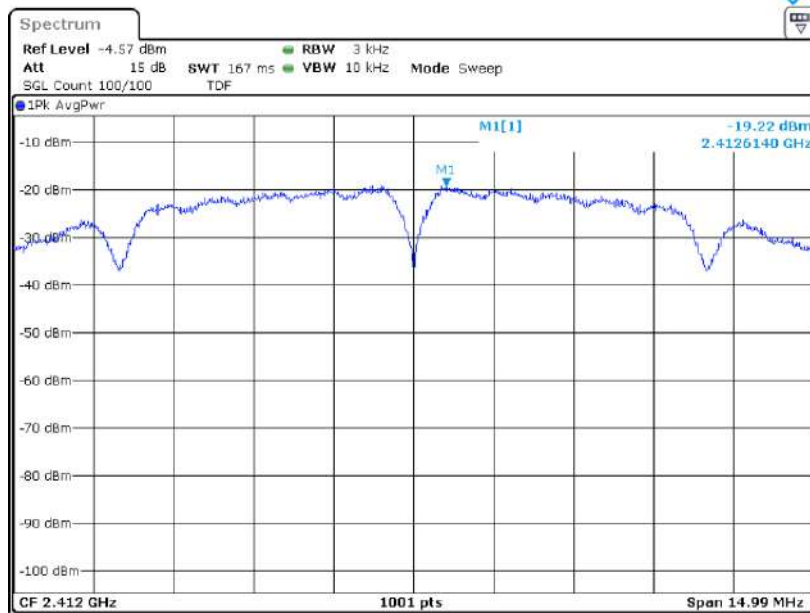


7.4.2 Measured Results for DC 24 V

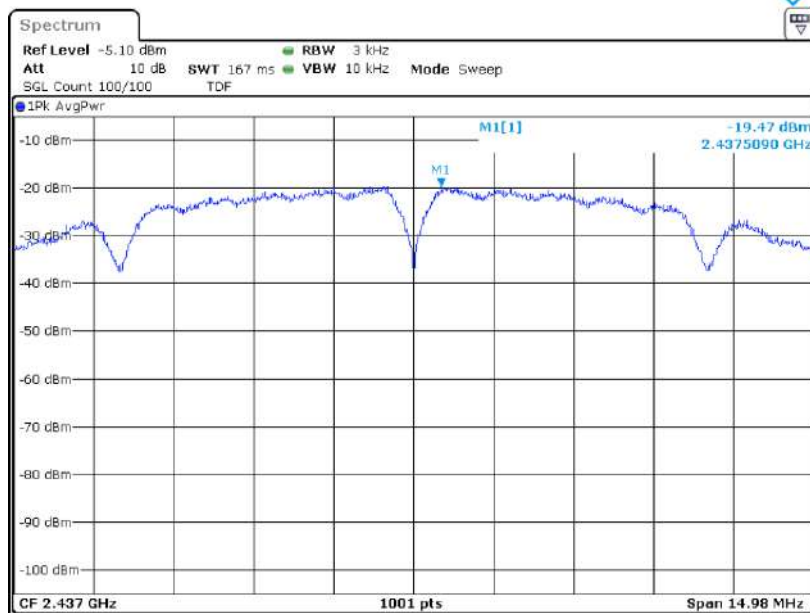
Modulation Type	Channel (Frequency)	Highest signal level (dBm)	Limit (dBm/3kHz)
802.11b	1 (2 412 MHz)	-19.22	8
	6 (2 437 MHz)	-19.47	
	11 (2 462 MHz)	-19.47	
802.11g	1 (2 412 MHz)	-22.08	
	6 (2 437 MHz)	-23.18	
	11 (2 462 MHz)	-22.49	
802.11n(HT20)	1 (2 412 MHz)	-23.24	
	6 (2 437 MHz)	-23.40	
	11 (2 462 MHz)	-23.84	
802.11n(HT40)	3 (2 422 MHz)	-26.24	
	6 (2 437 MHz)	-26.19	
	9 (2 452 MHz)	-26.50	
Bluetooth LE	0 (2 402 MHz)	-6.47	
	19 (2 440 MHz)	-4.21	
	39 (2 480 MHz)	-6.31	



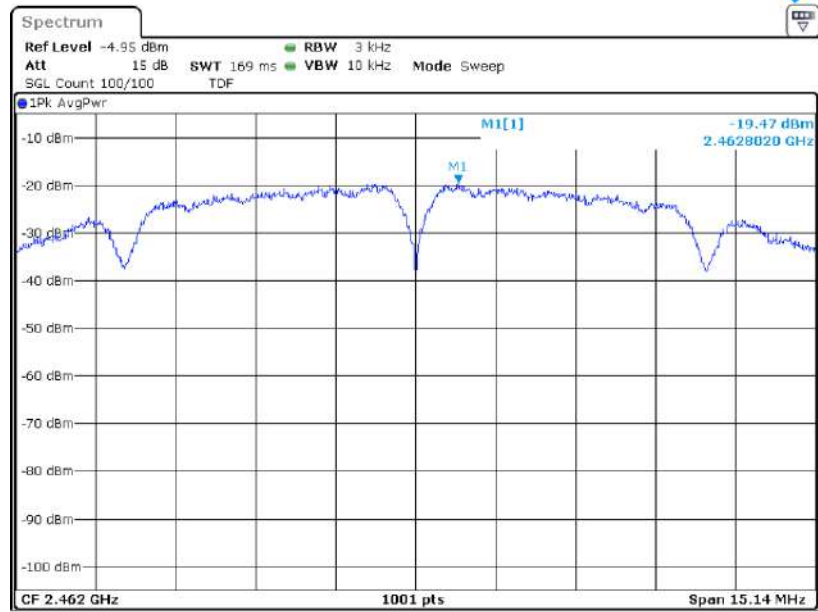
7.4.2.1 Measured Graph for 802.11b_DC 24 V



Low CH



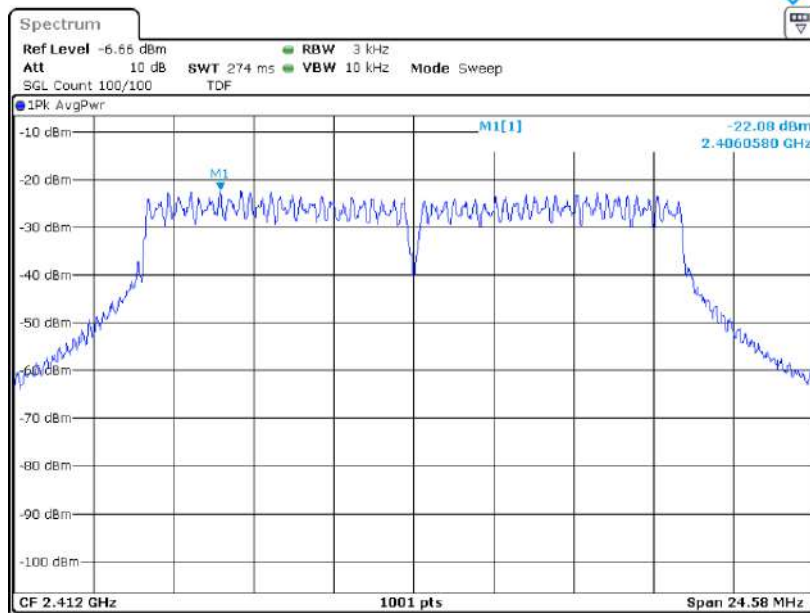
Mid CH



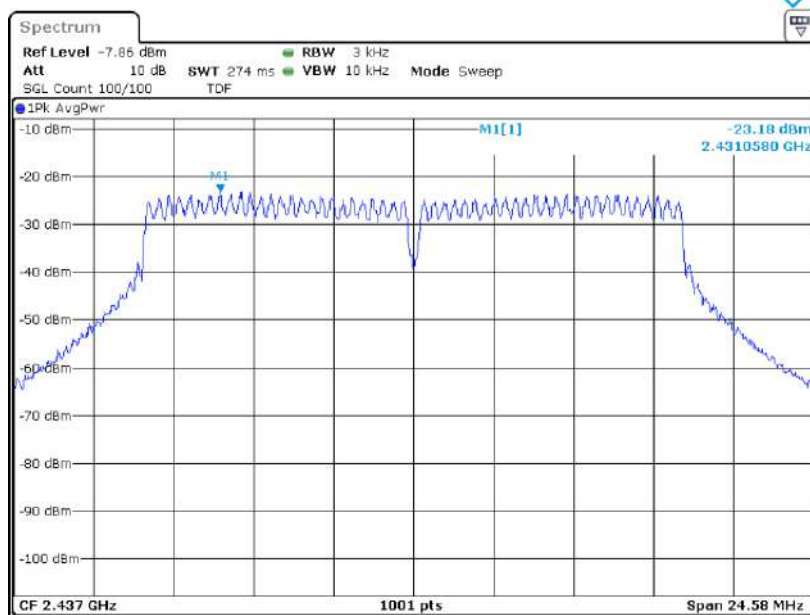
High CH



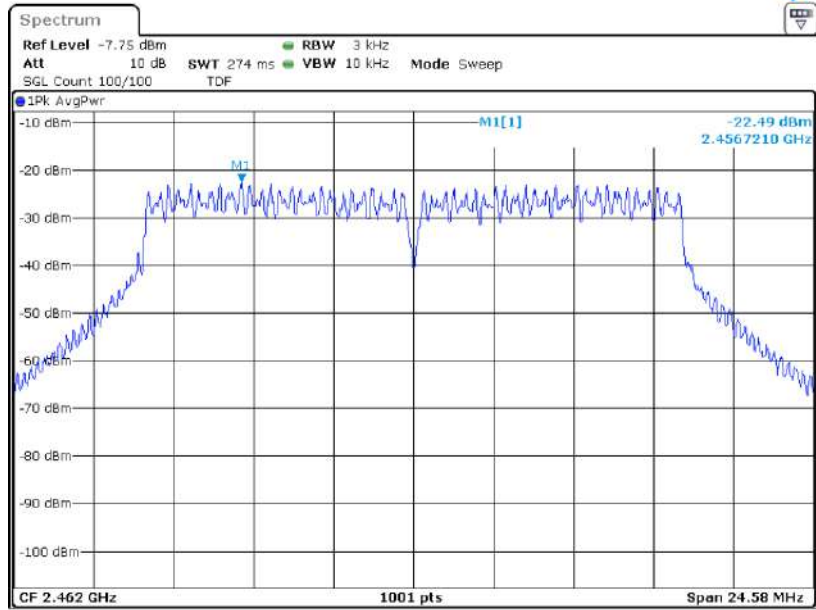
7.4.2.2 Measured Graph for 802.11g_DC 24 V



Low CH



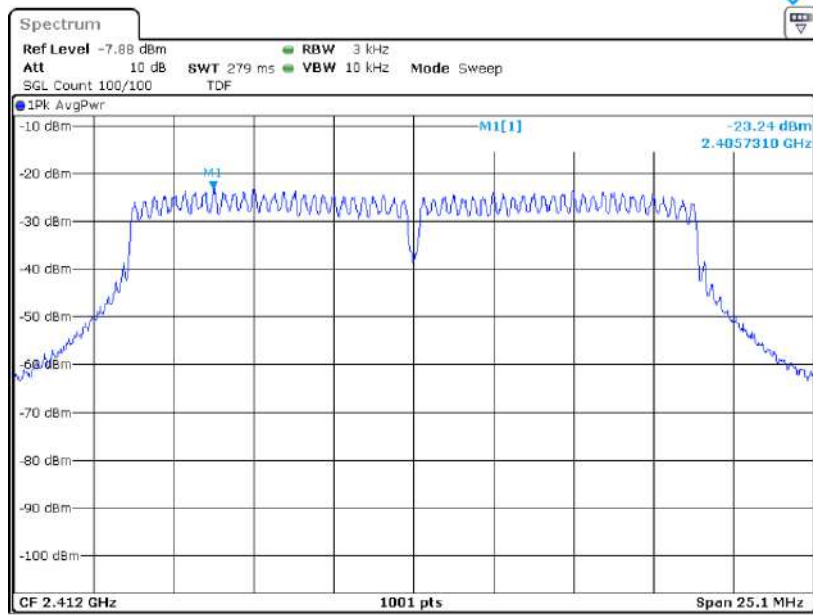
Mid CH



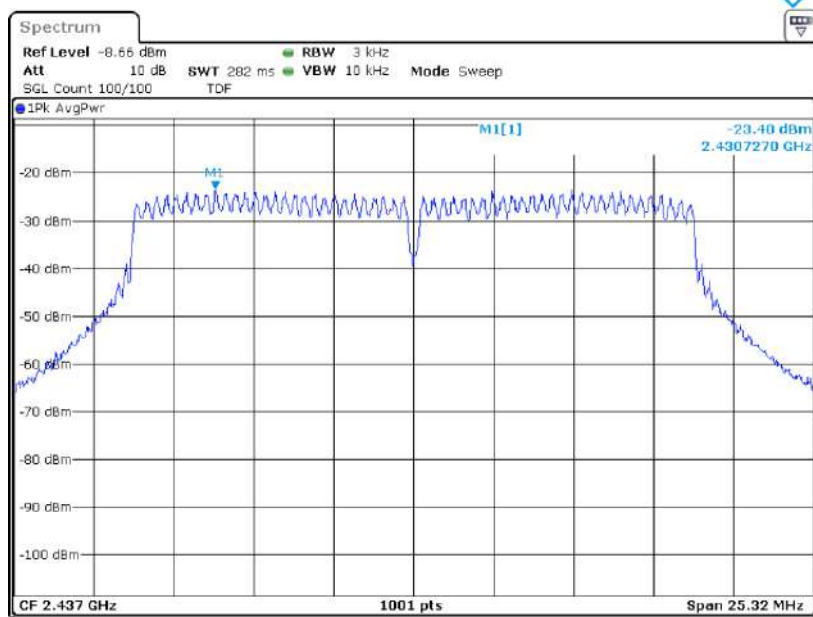
High CH



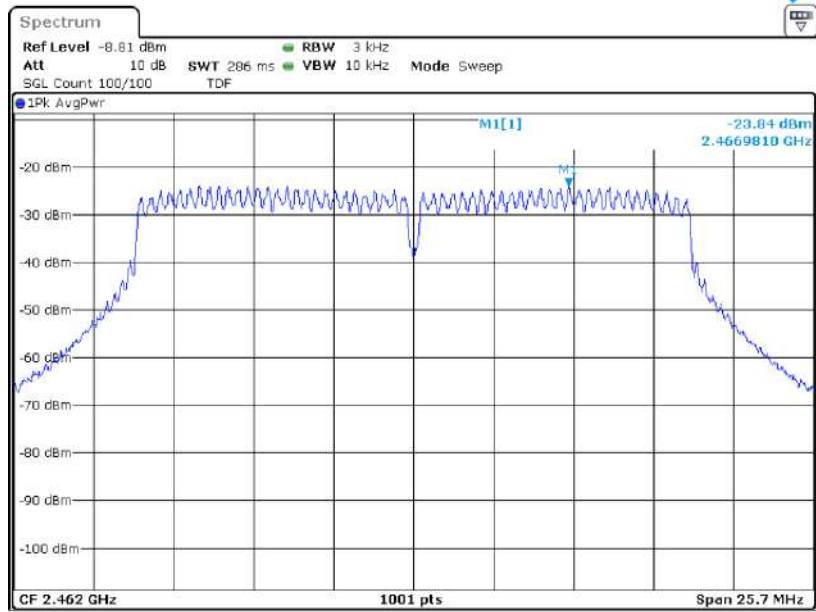
7.4.2.3 Measured Graph for 802.11n(HT20)_DC 24 V



Low CH



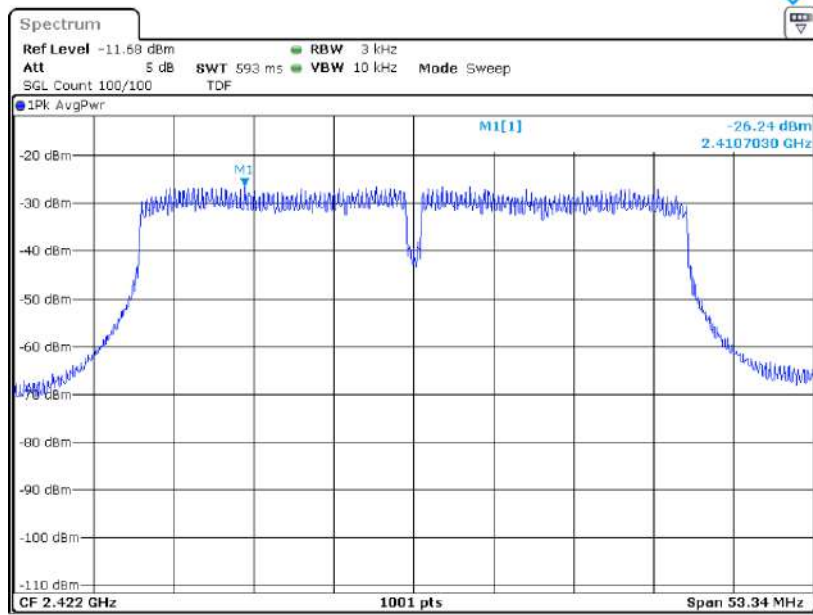
Mid CH



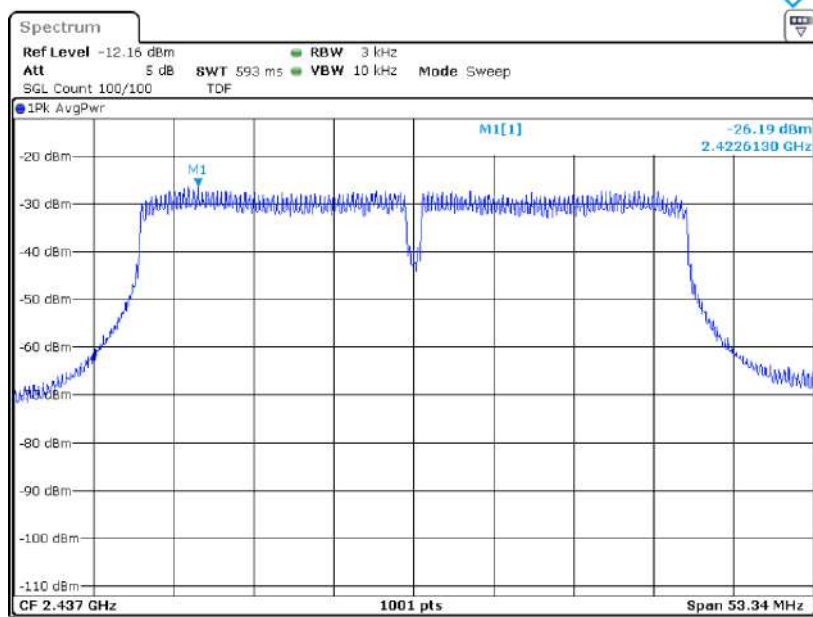
High CH



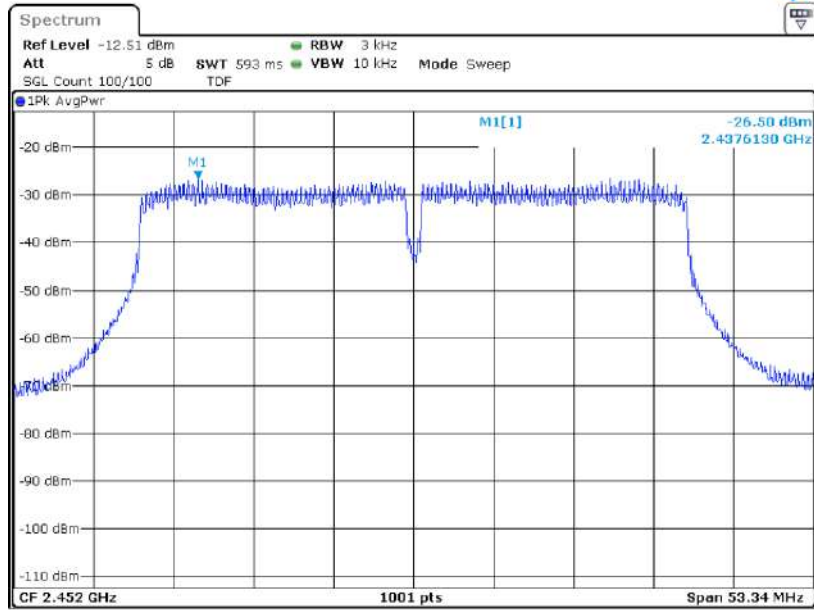
7.4.2.4 Measured Graph for 802.11n(HT40)_DC 24 V



Low CH



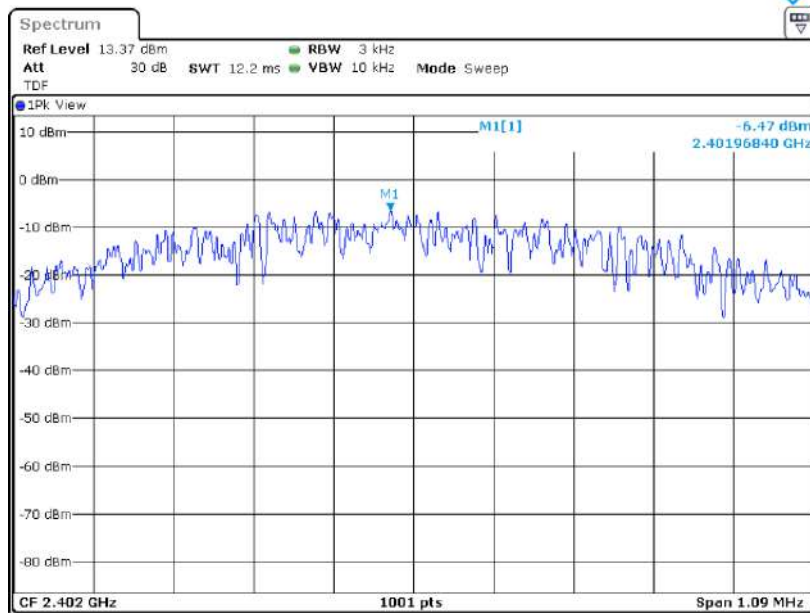
Mid CH



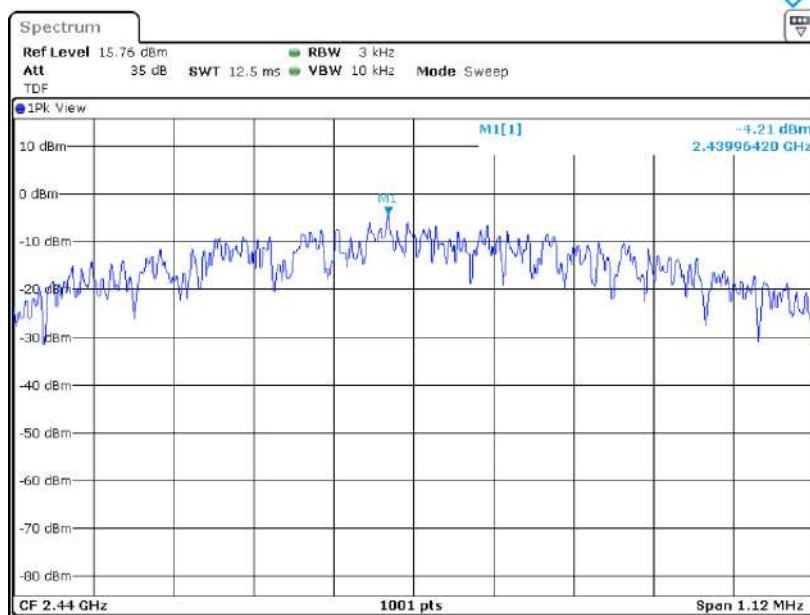
High CH



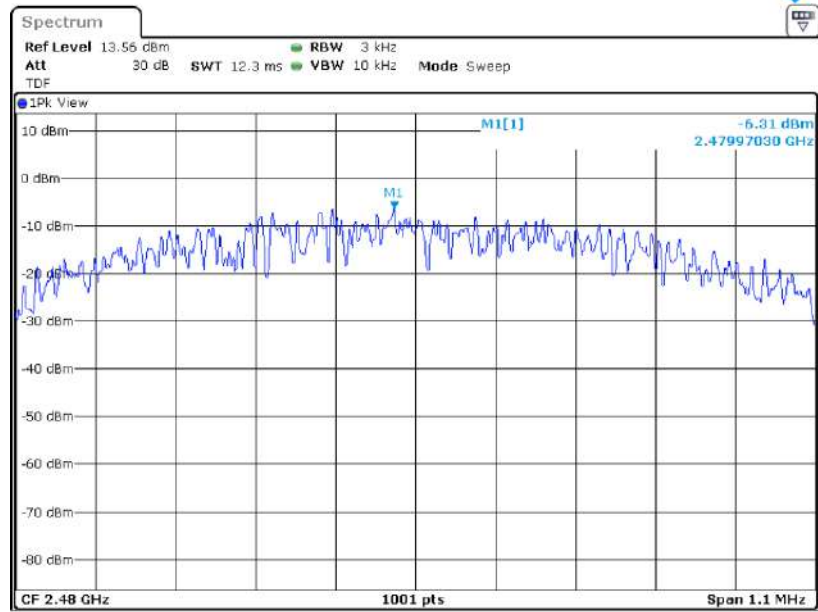
7.4.2.5 Measured Graph for Bluetooth LE_DC 24 V



Low CH



Mid CH



High CH



8. Conducted Spurious Emission

8.1 Operating environment

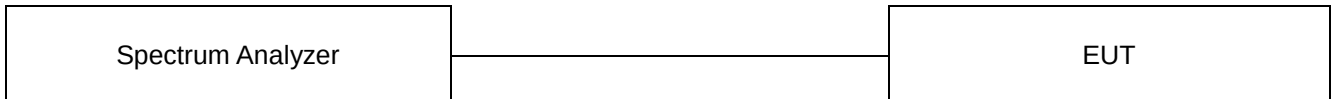
Temperature : 25 °C
Relative humidity : 46 %

8.2 Measurement method

Standard : §15.247 (d)

8.3 Test setup

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.





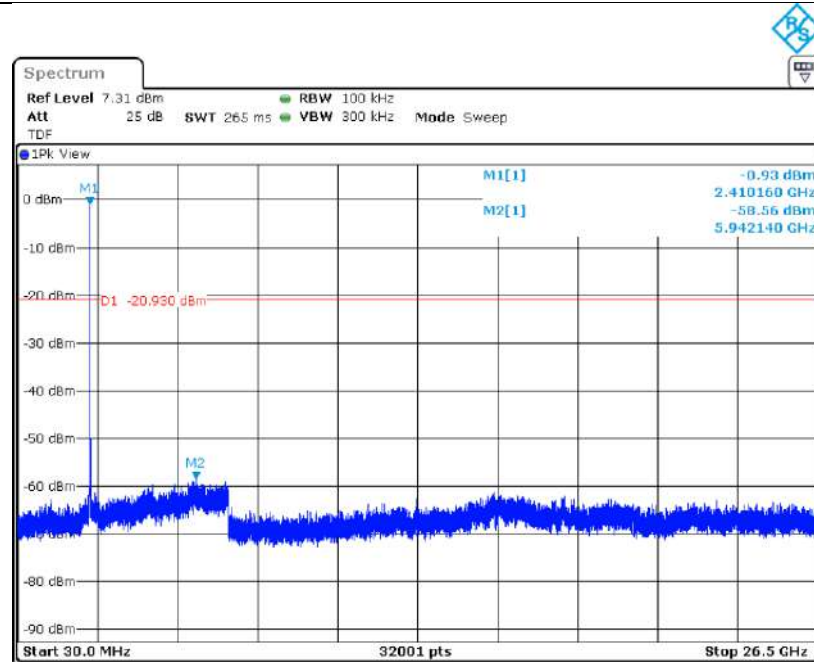
8.4 Test data

Operating mode : Transmit mode

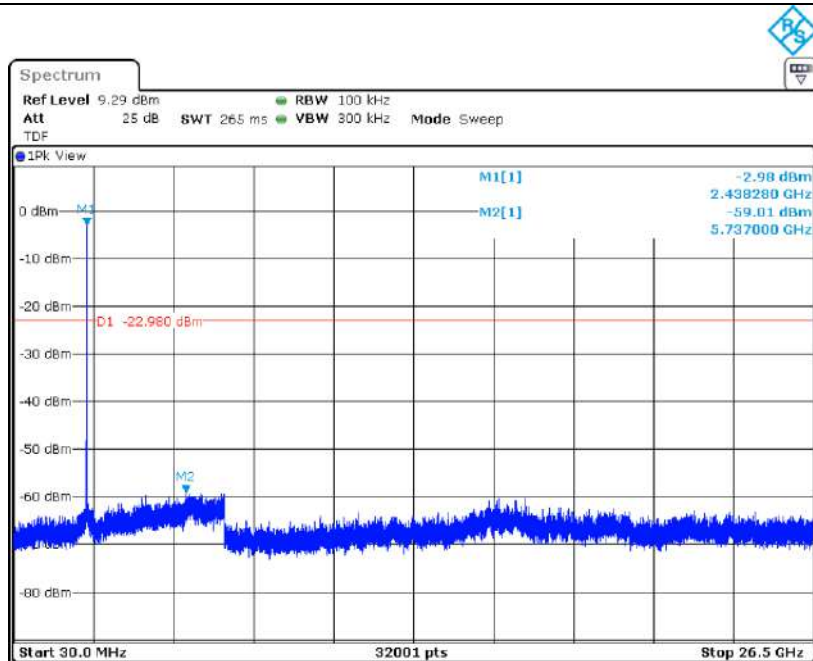
Test Result : Pass

8.4.1 Measured Results

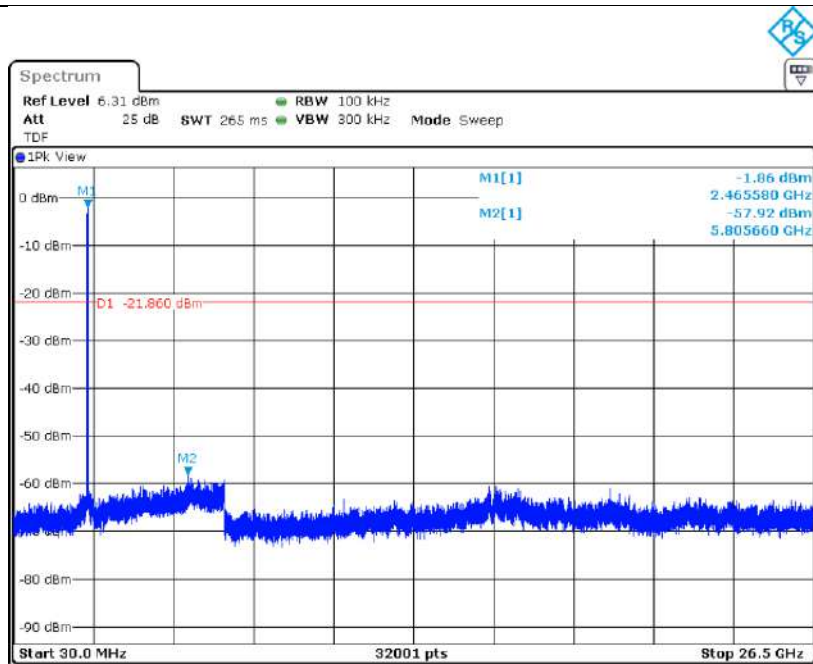
8.4.1.1 Unwanted Emissions In Non-Restricted Frequency Bands for 802.11b_DC 12 V



Low CH

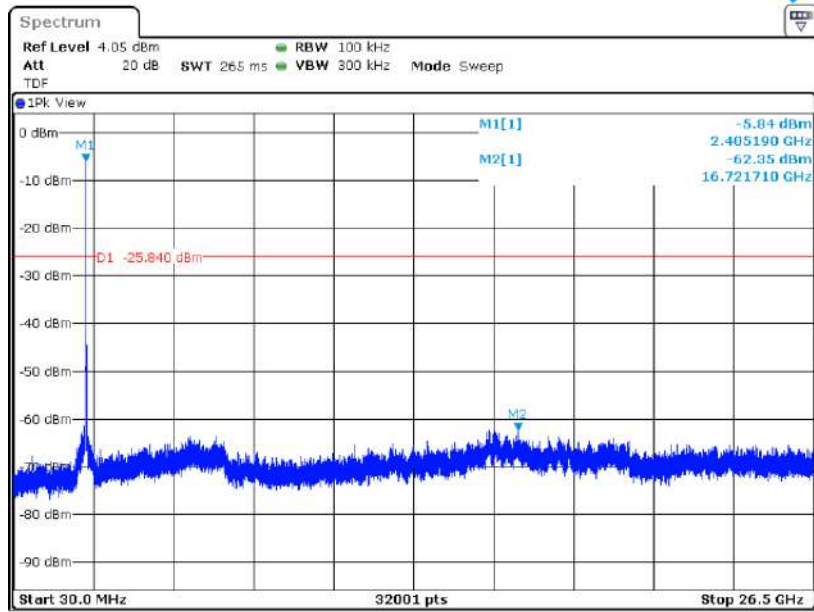


Mid CH

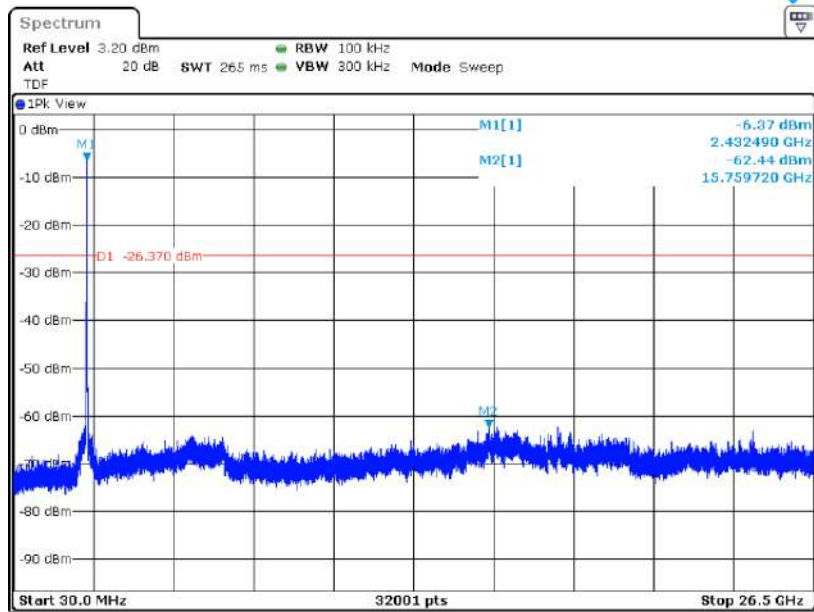


High CH

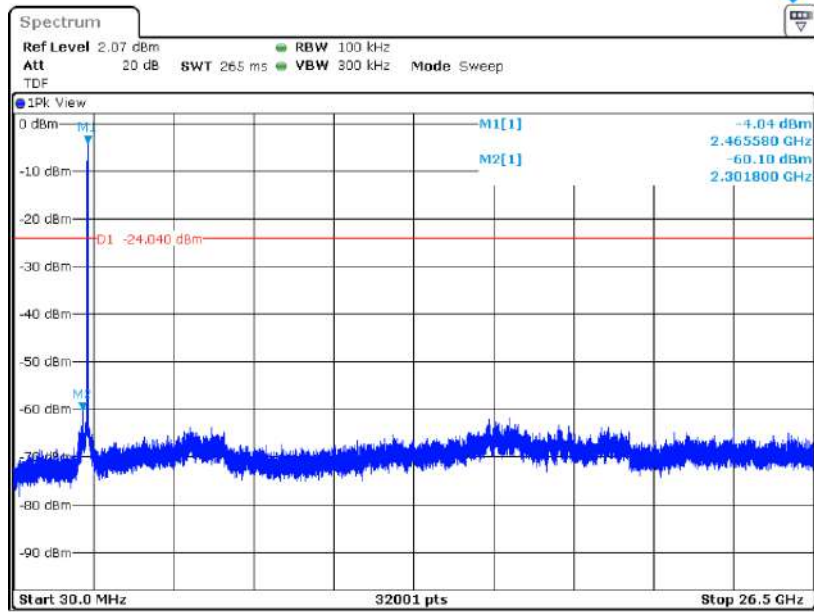
8.4.1.2 Unwanted Emissions In Non-Restricted Frequency Bands for 802.11g_DC 12 V



Low CH



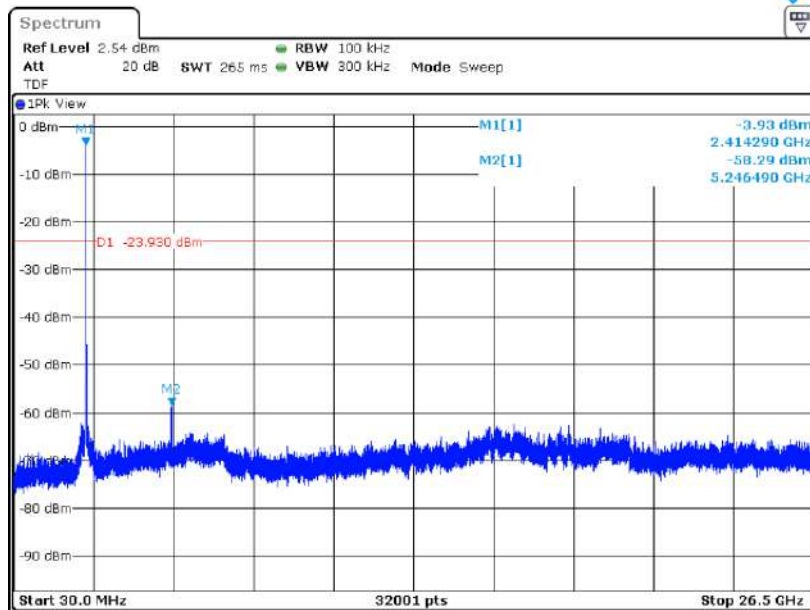
Mid CH



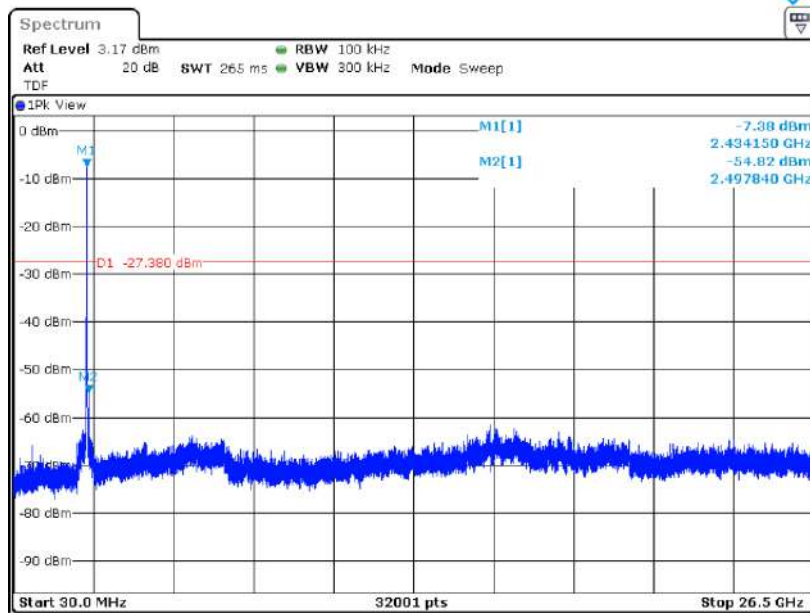
High CH



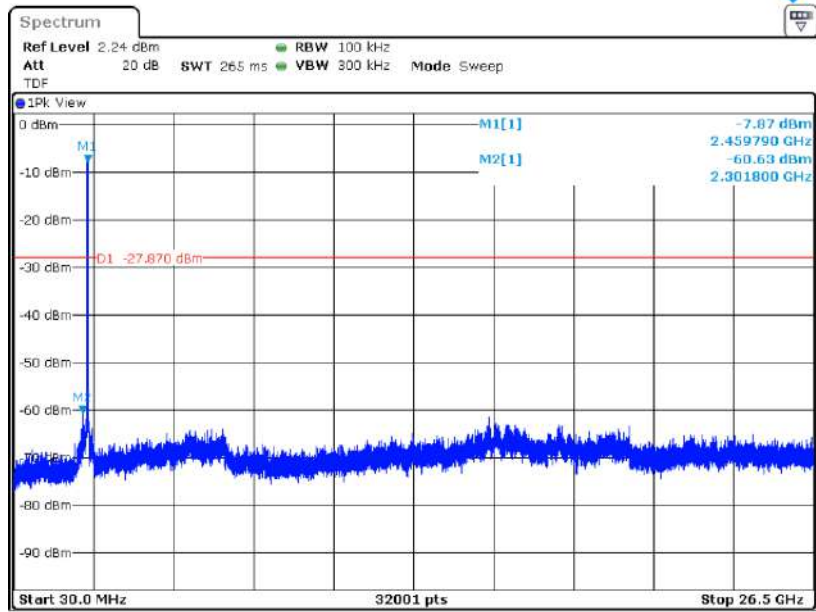
8.4.1.3 Unwanted Emissions In Non-Restricted Frequency Bands for 802.11n(HT20)_DC 12 V



Low CH



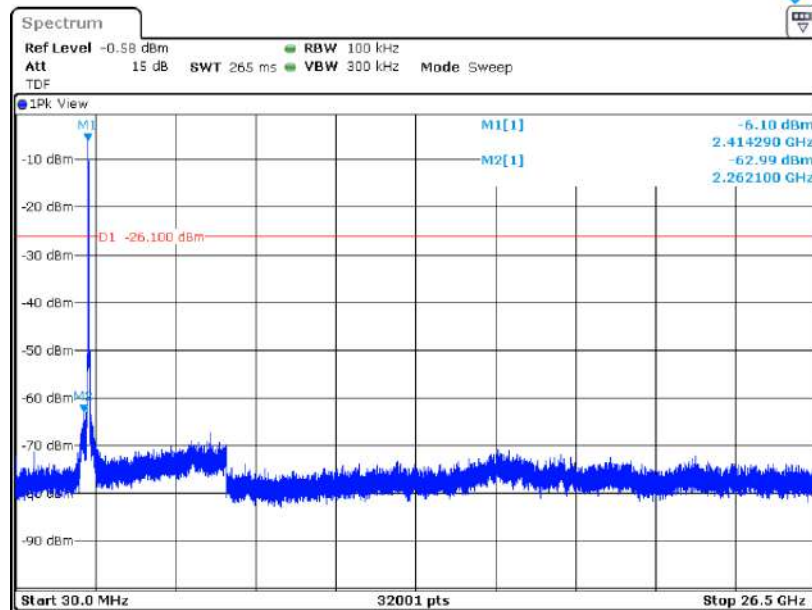
Mid CH



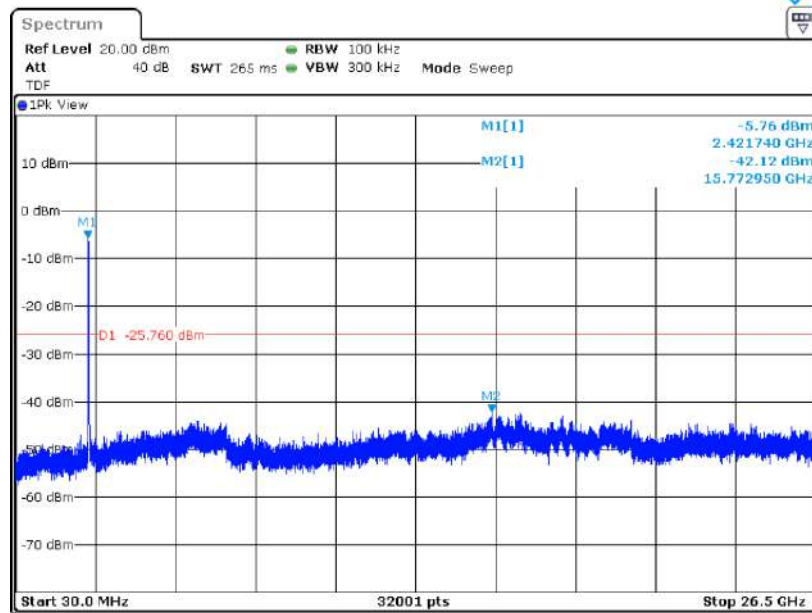
High CH



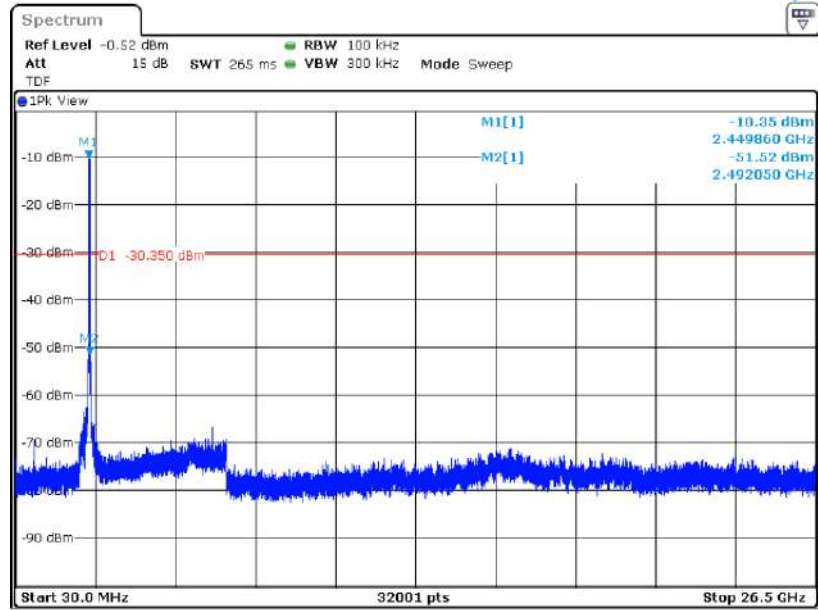
8.4.1.4 Unwanted Emissions In Non-Restricted Frequency Bands for 802.11n(HT40)_DC 12 V



Low CH



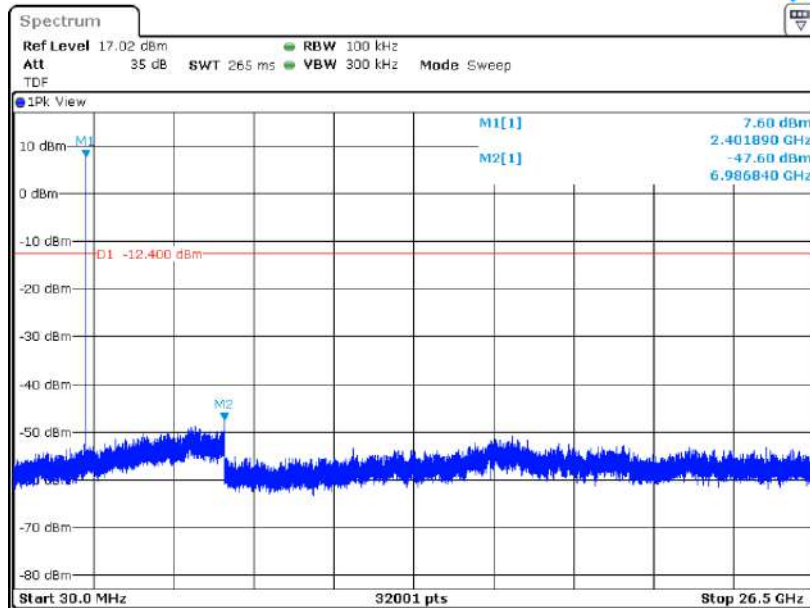
Mid CH



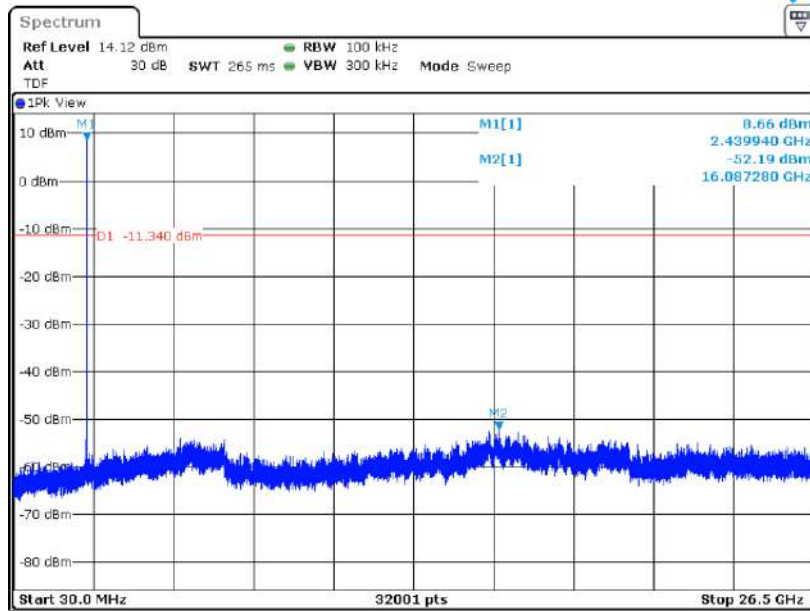
High CH



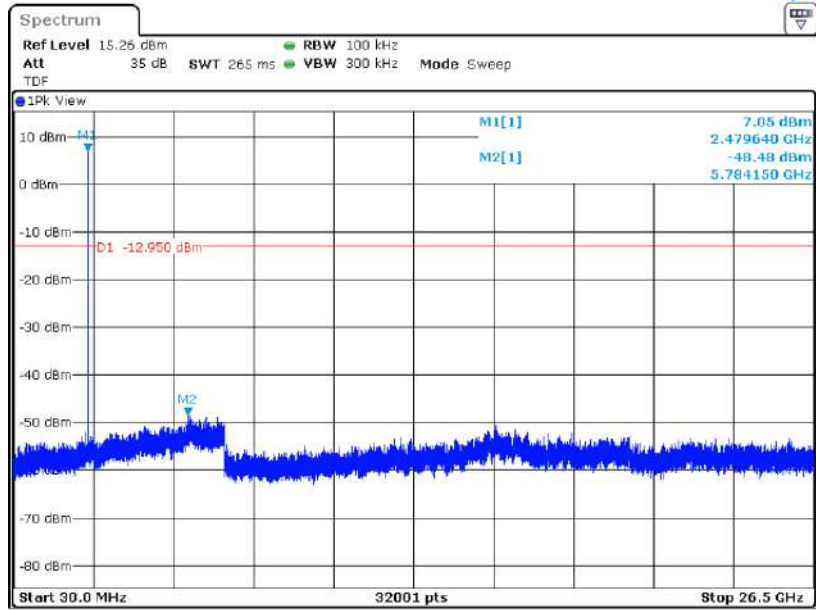
8.4.1.5 Unwanted Emissions In Non-Restricted Frequency Bands for Bluetooth LE_DC 12 V



Low CH



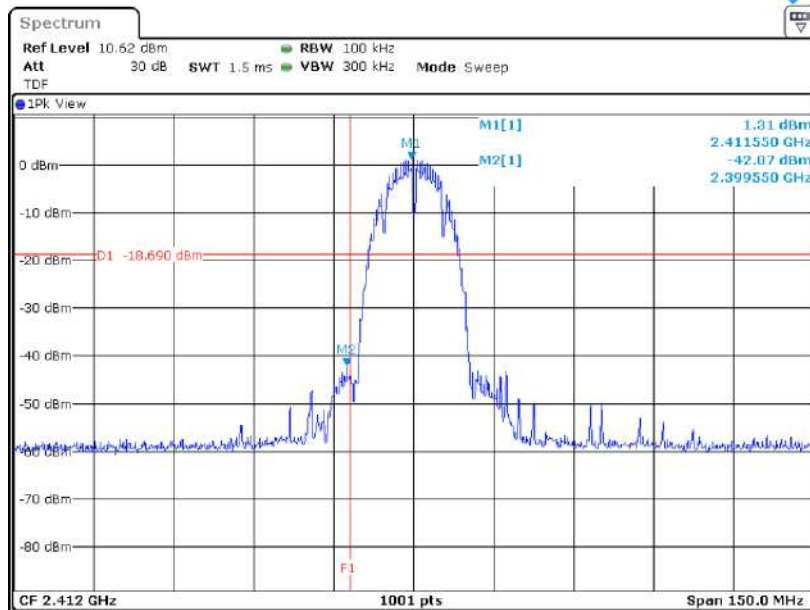
Mid CH



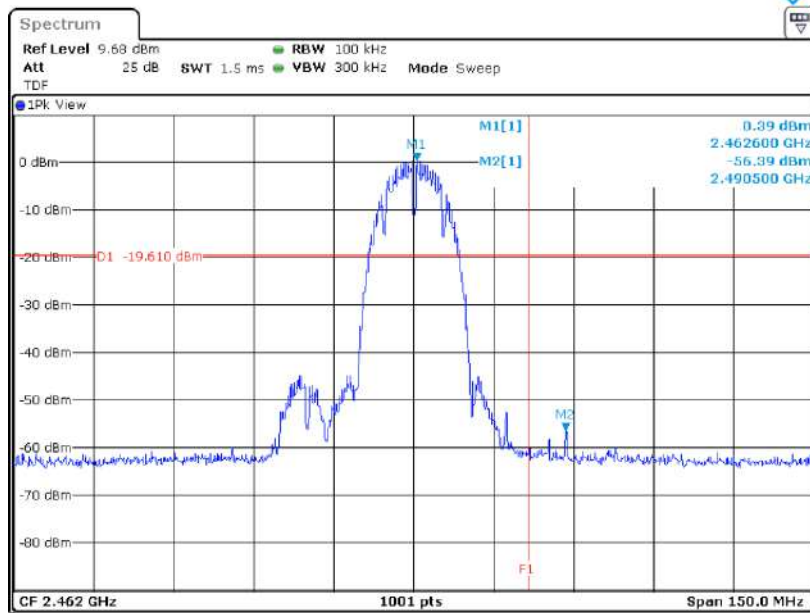
High CH



8.4.1.6 Band Edge for 802.11b_DC 12 V



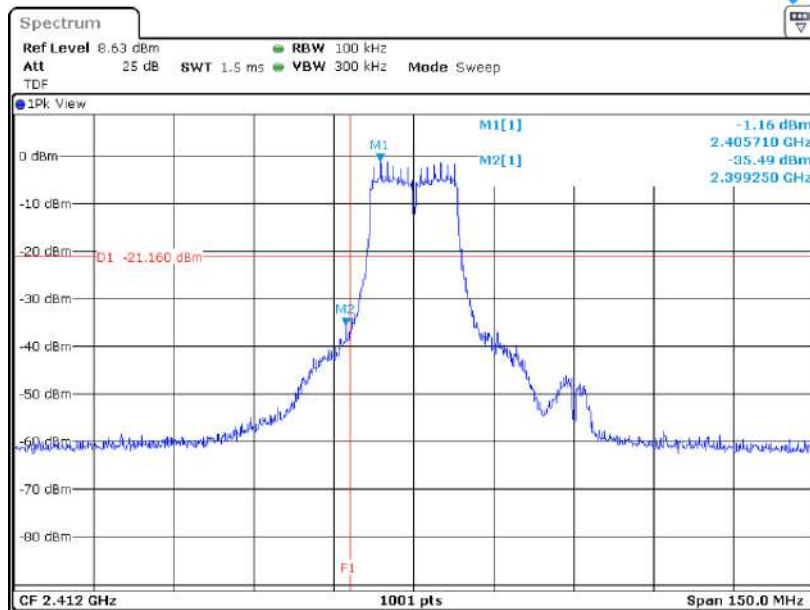
Low CH



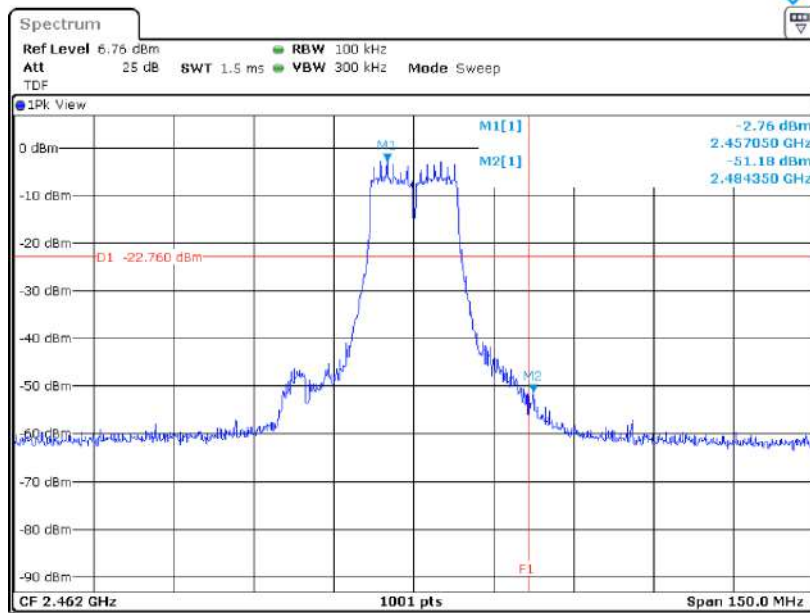
High CH



8.4.1.7 Band Edge for 802.11g_DC 12 V



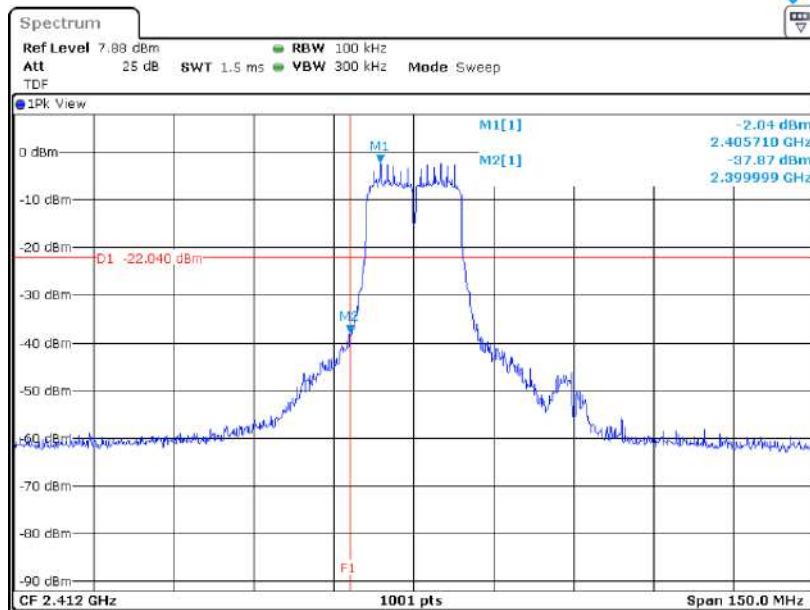
Low CH



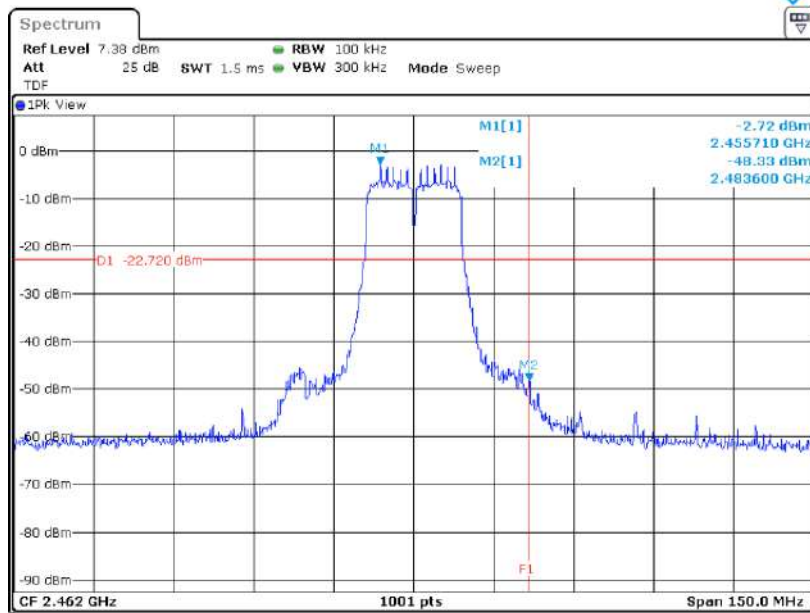
High CH



8.4.1.8 Band Edge for 802.11n(HT20)_DC 12 V



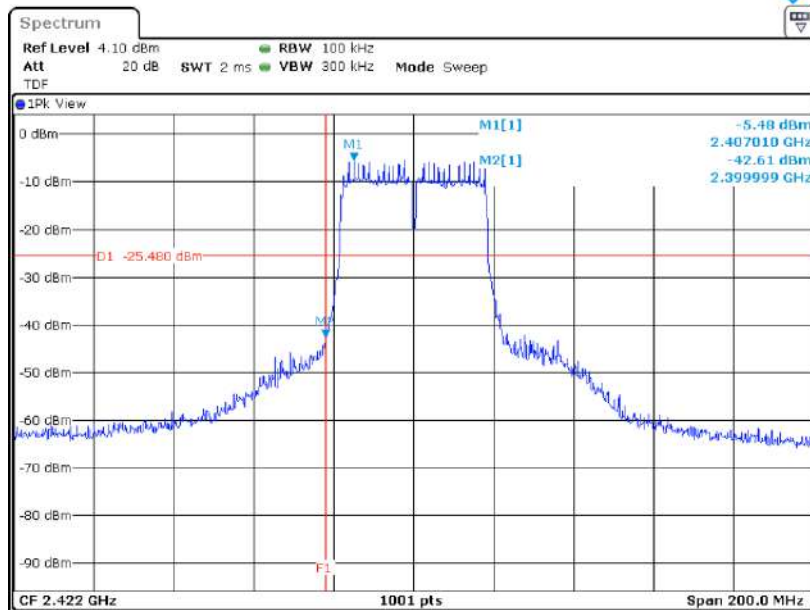
Low CH



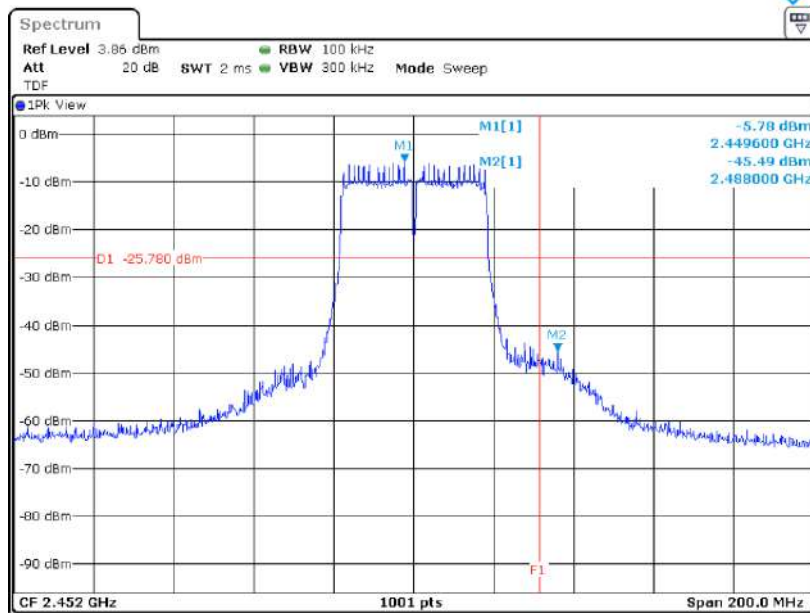
High CH



8.4.1.9 Band Edge for 802.11n(HT40)_DC 12 V



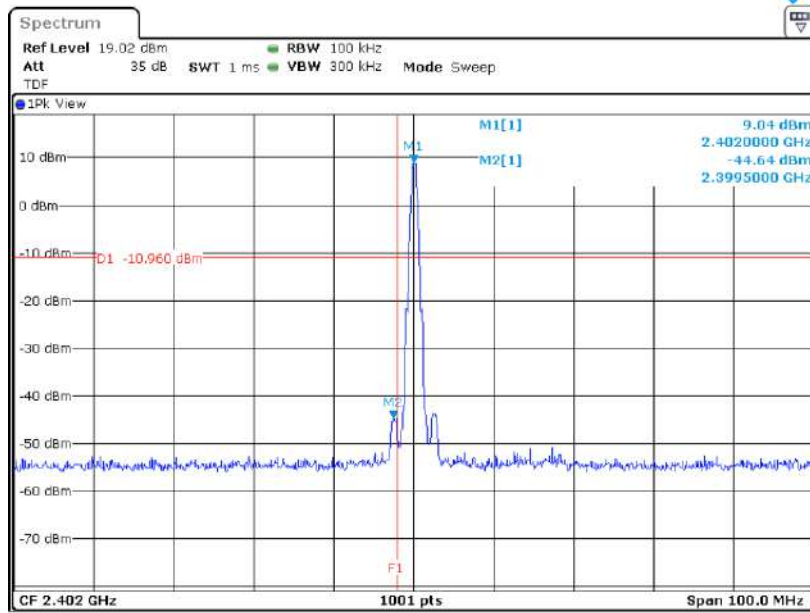
Low CH



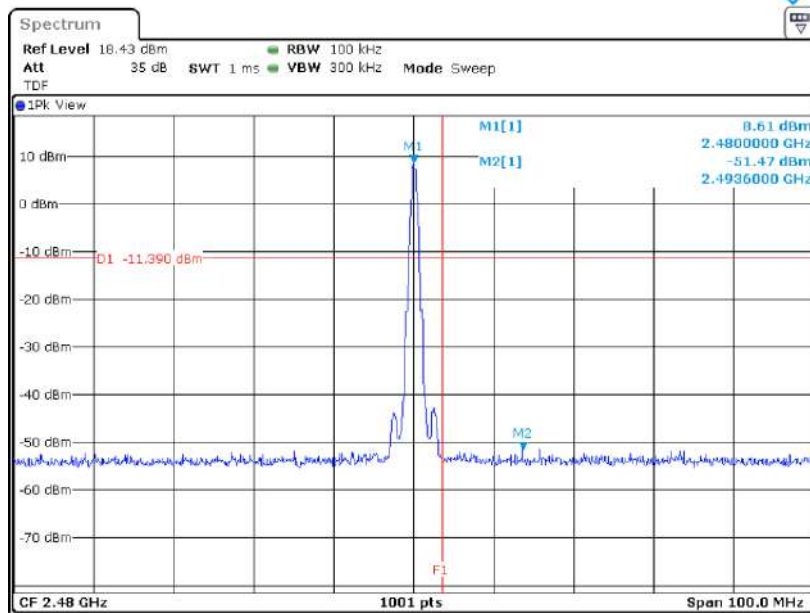
High CH



8.4.1.10 Band Edge for Bluetooth LE_DC 12 V



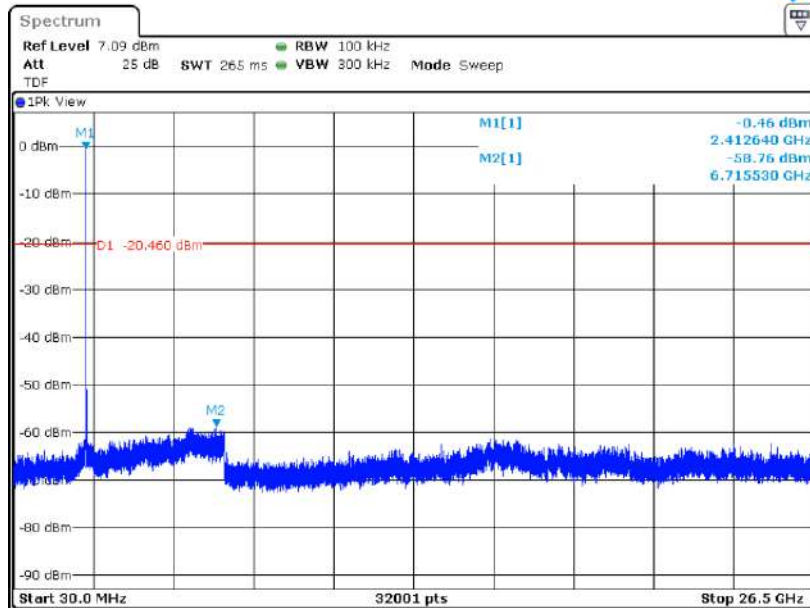
Low CH



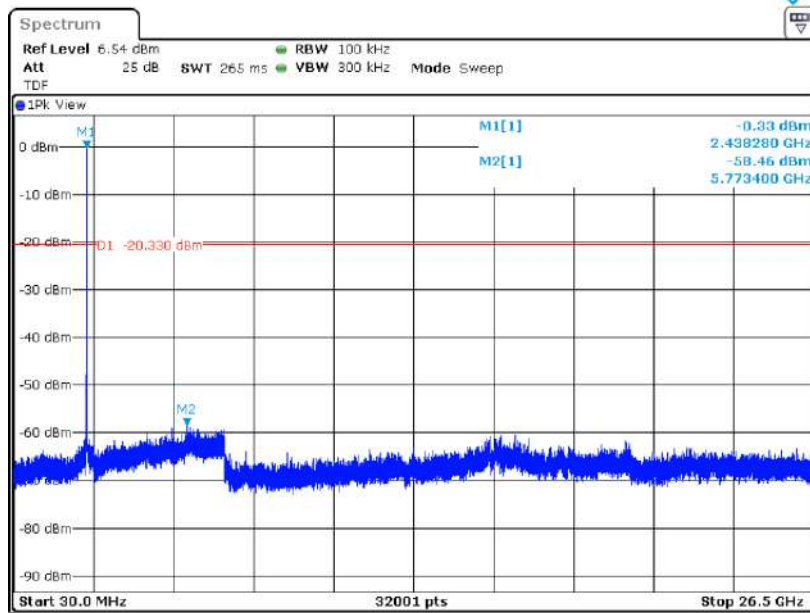
High CH



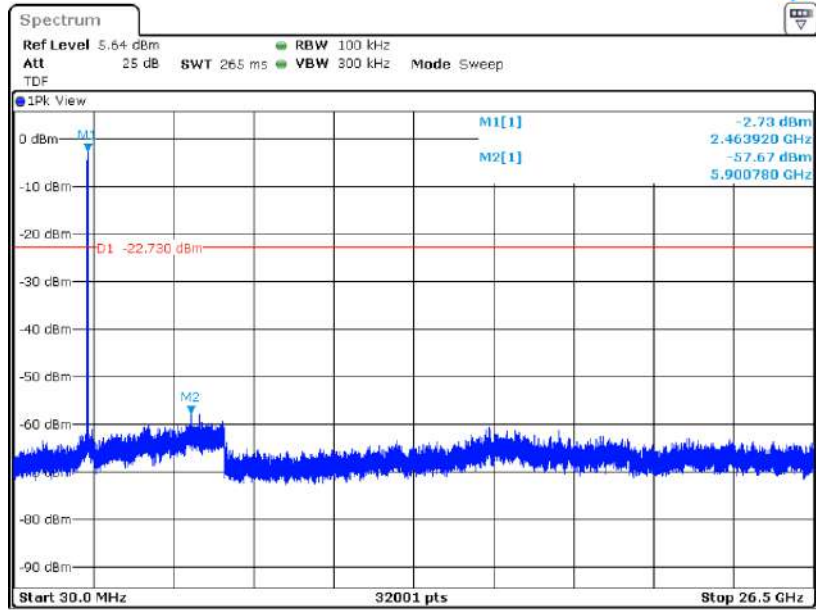
8.4.1.11 Unwanted Emissions In Non-Restricted Frequency Bands for 802.11b DC 24 V



Low CH



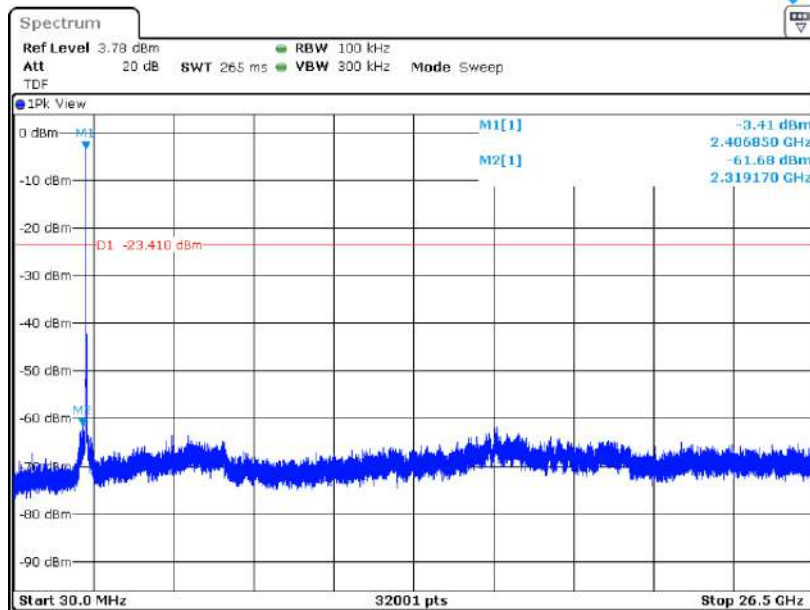
Mid CH



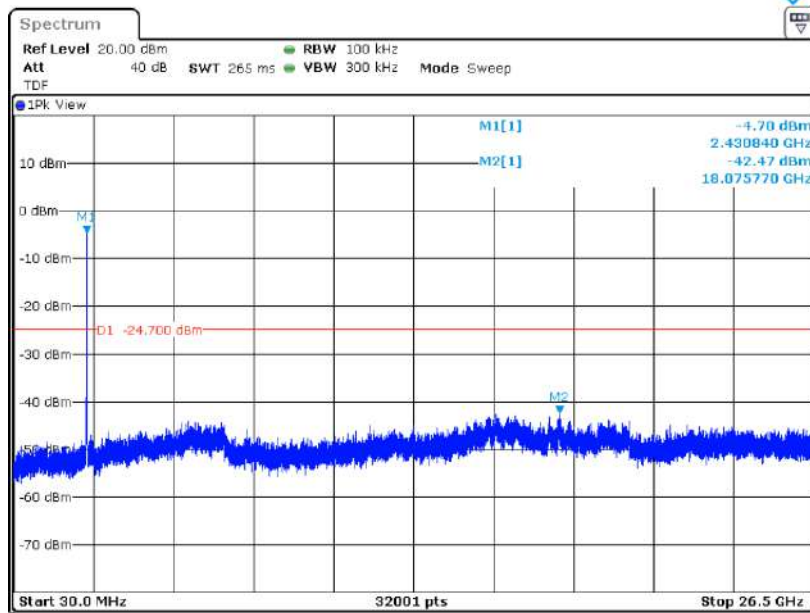
High CH



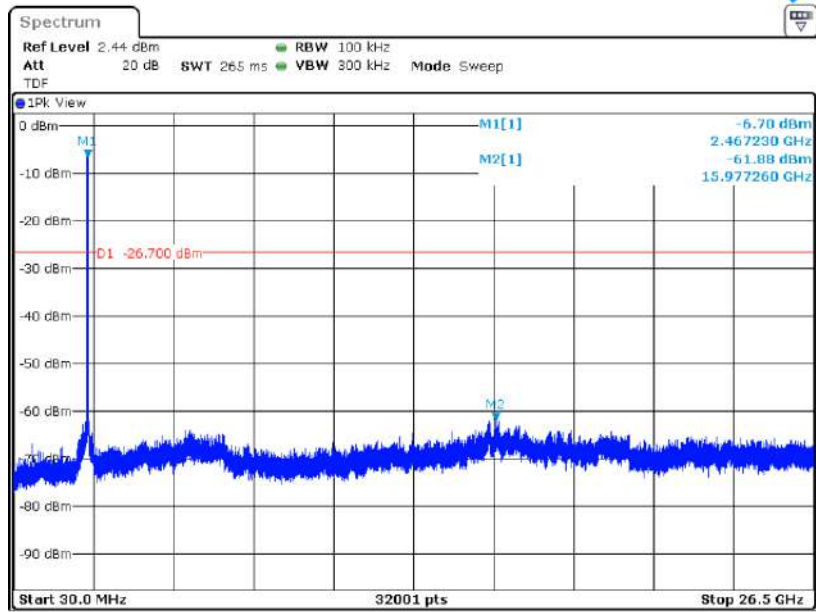
8.4.1.12 Unwanted Emissions In Non-Restricted Frequency Bands for 802.11g_DC 24 V



Low CH



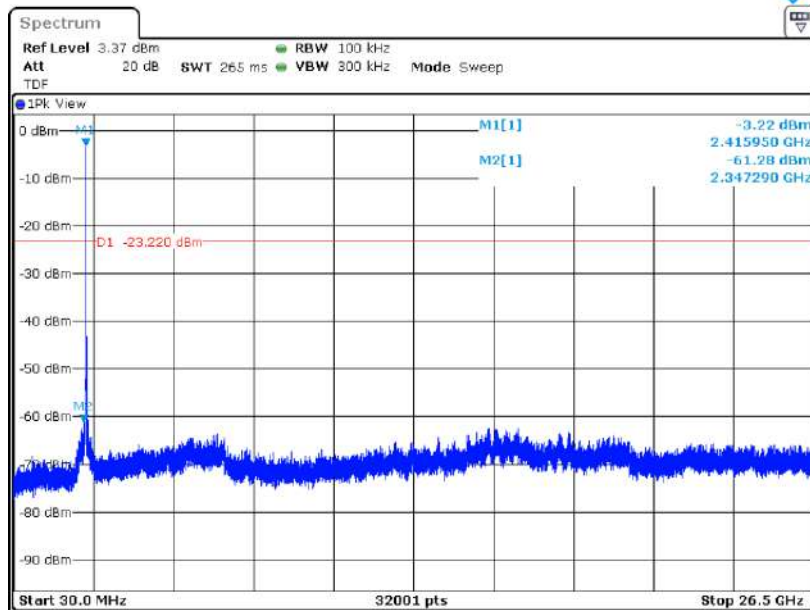
Mid CH



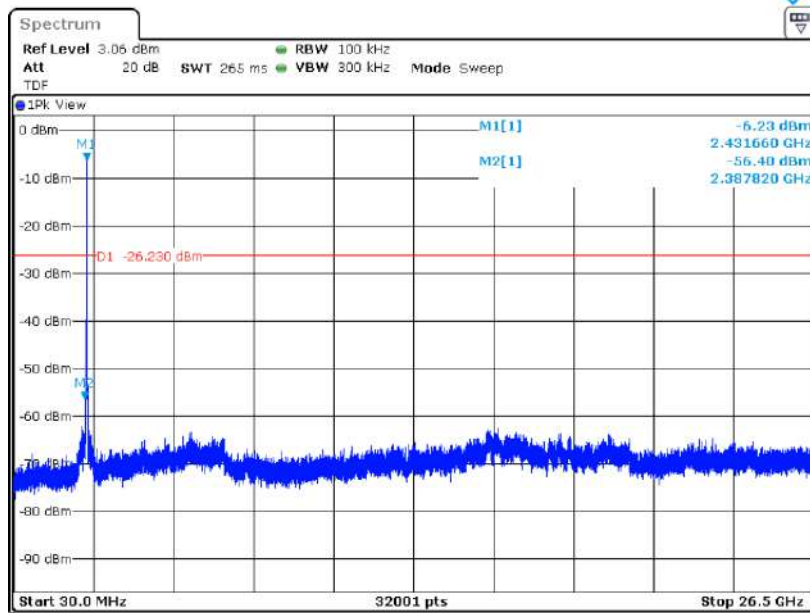
High CH



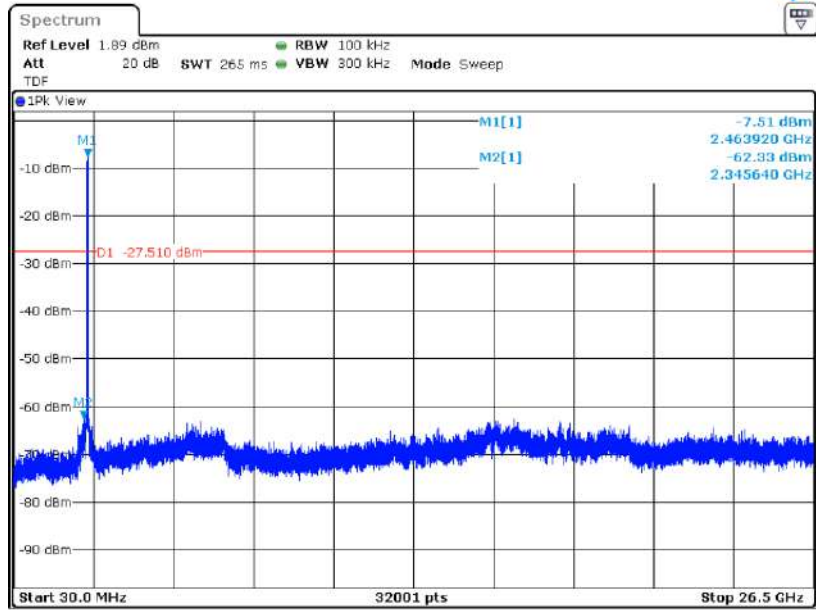
8.4.1.13 Unwanted Emissions In Non-Restricted Frequency Bands for 802.11n(HT20)_DC 24 V



Low CH



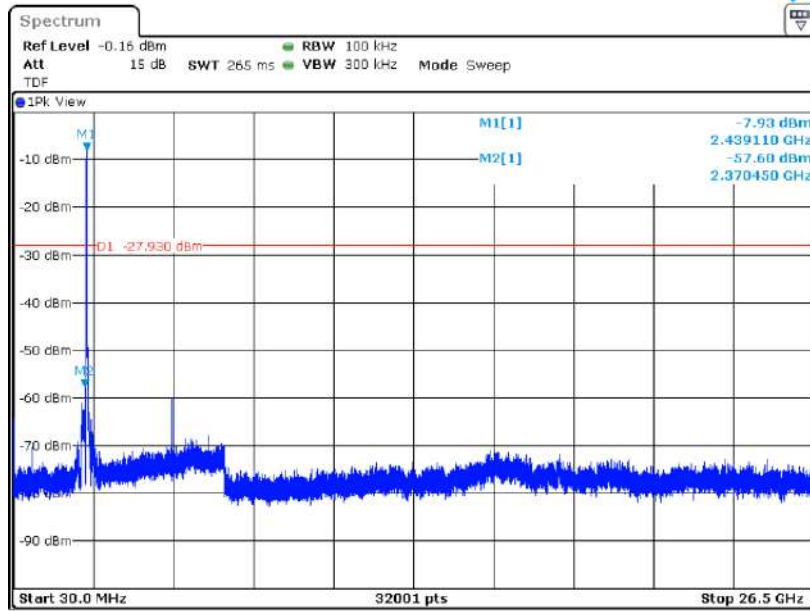
Mid CH



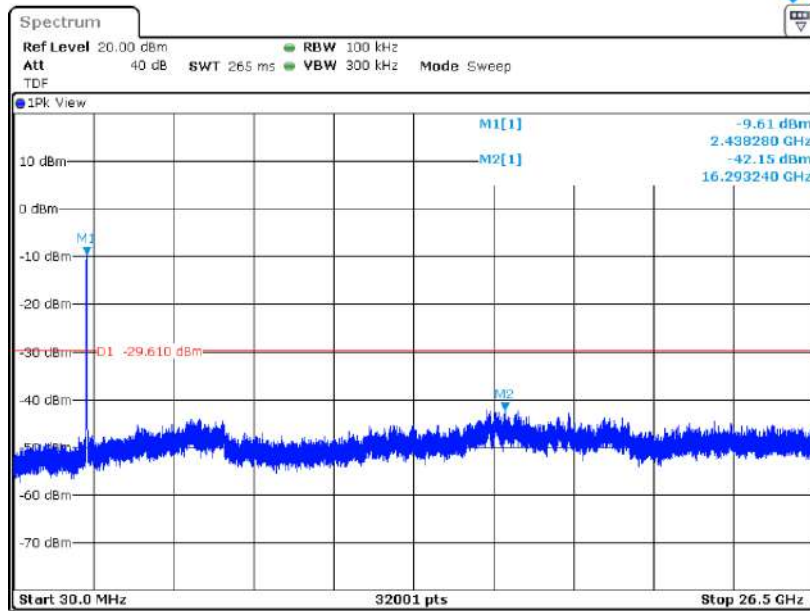
High CH



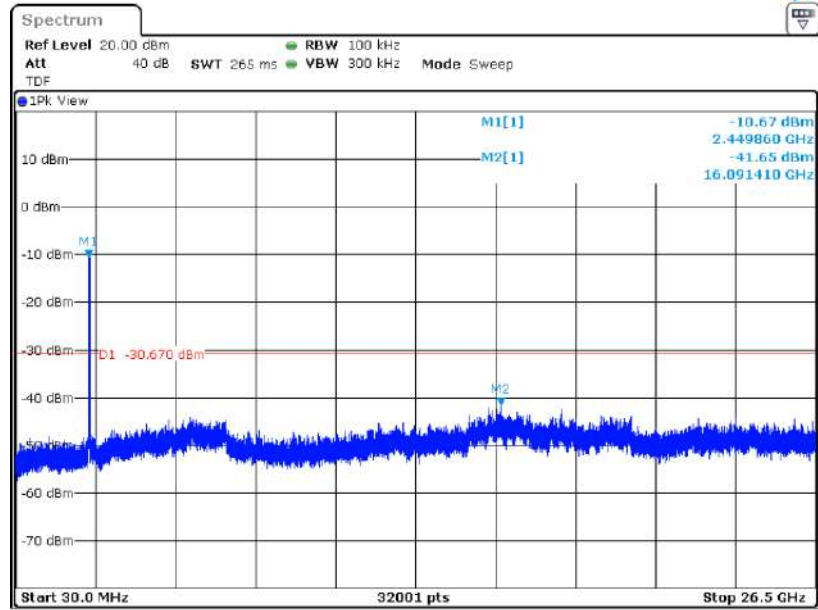
8.4.1.14 Unwanted Emissions In Non-Restricted Frequency Bands for 802.11n(HT40)_DC 24 V



Low CH



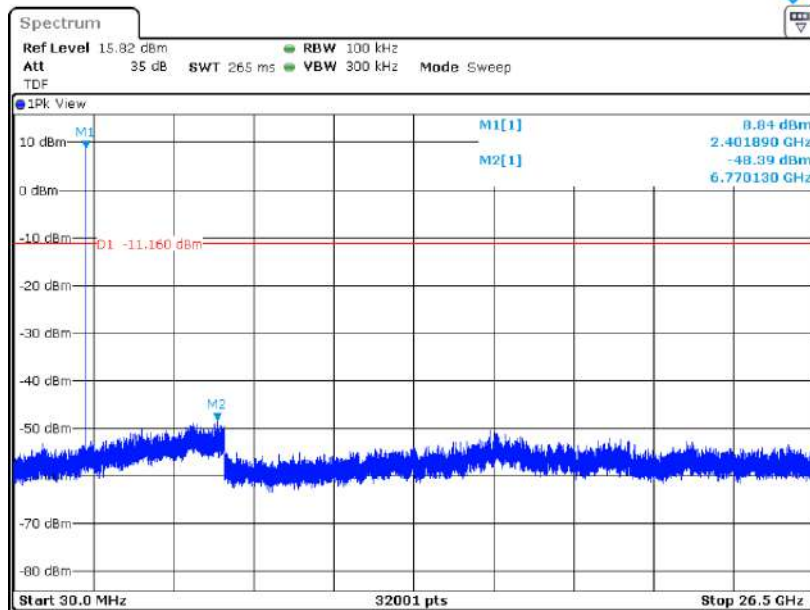
Mid CH



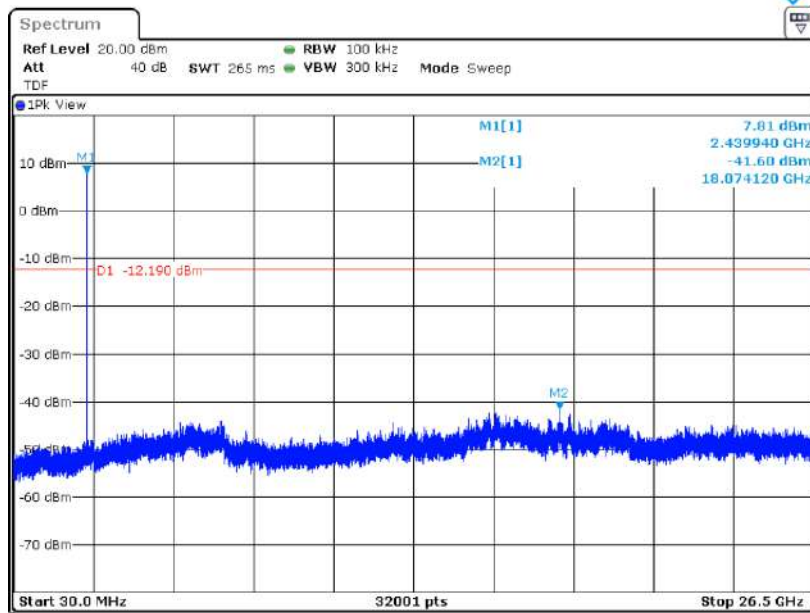
High CH



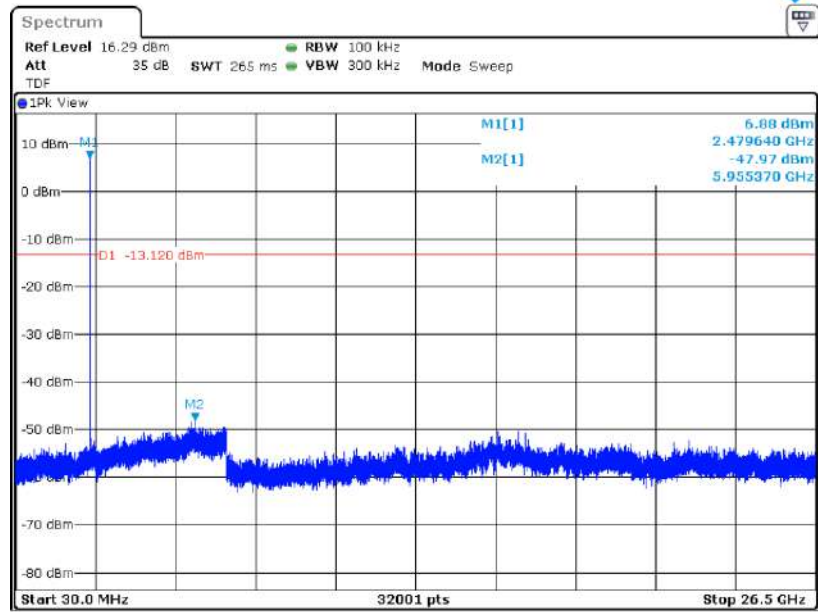
8.4.1.15 Unwanted Emissions In Non-Restricted Frequency Bands for Bluetooth LE_DC 24 V



Low CH



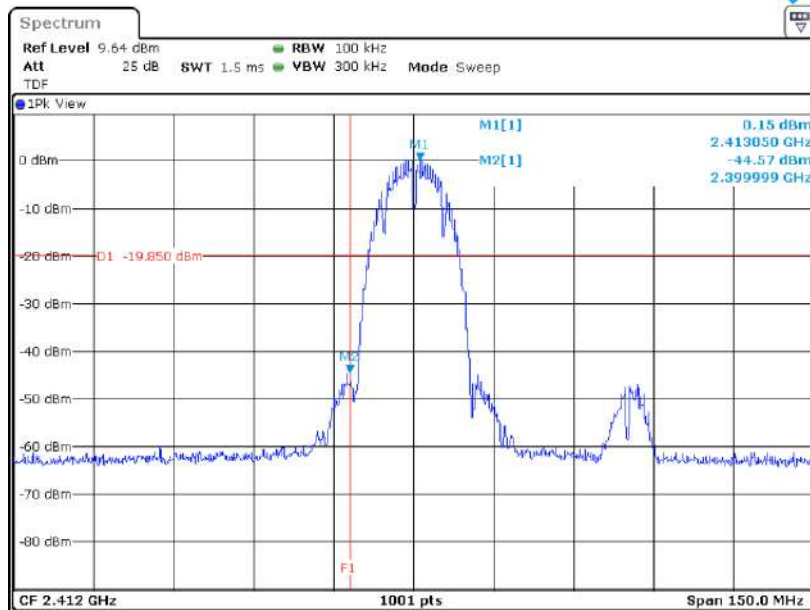
Mid CH



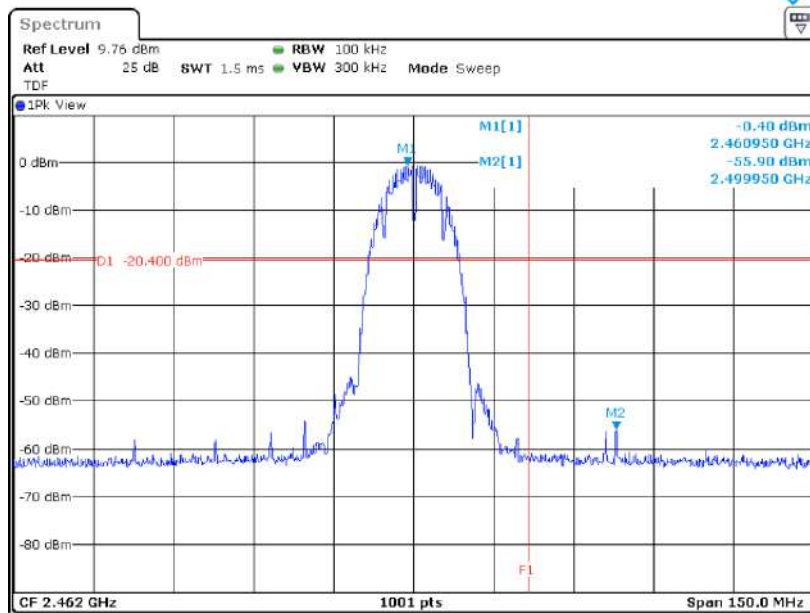
High CH



8.4.1.16 Band Edge for 802.11b_DC 24 V



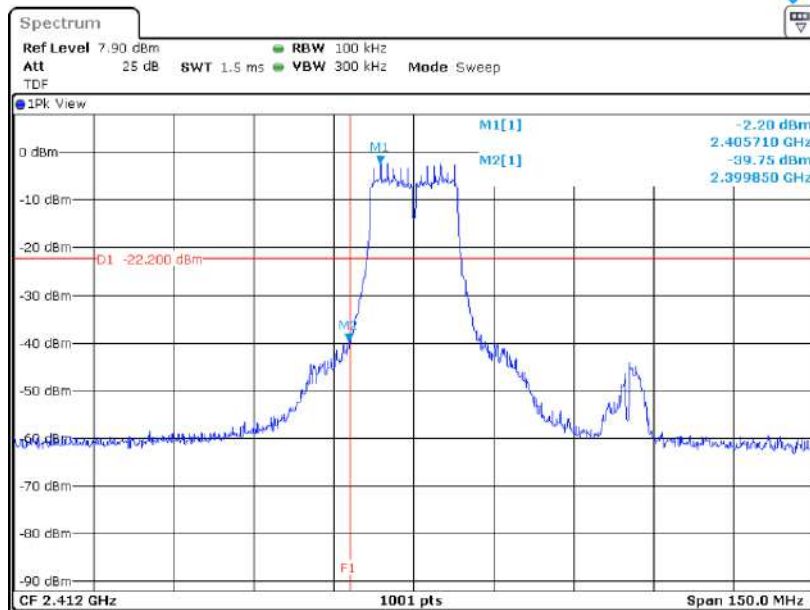
Low CH



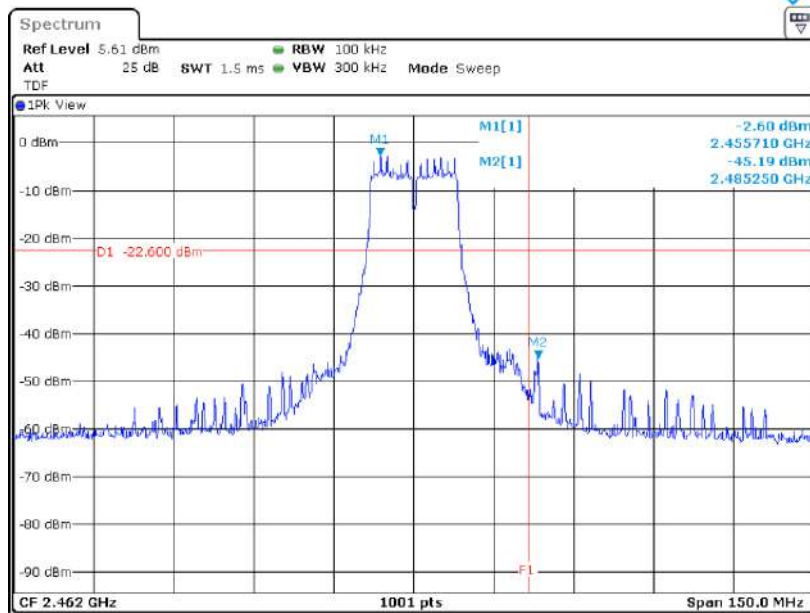
High CH



8.4.1.17 Band Edge for 802.11g_DC 24 V



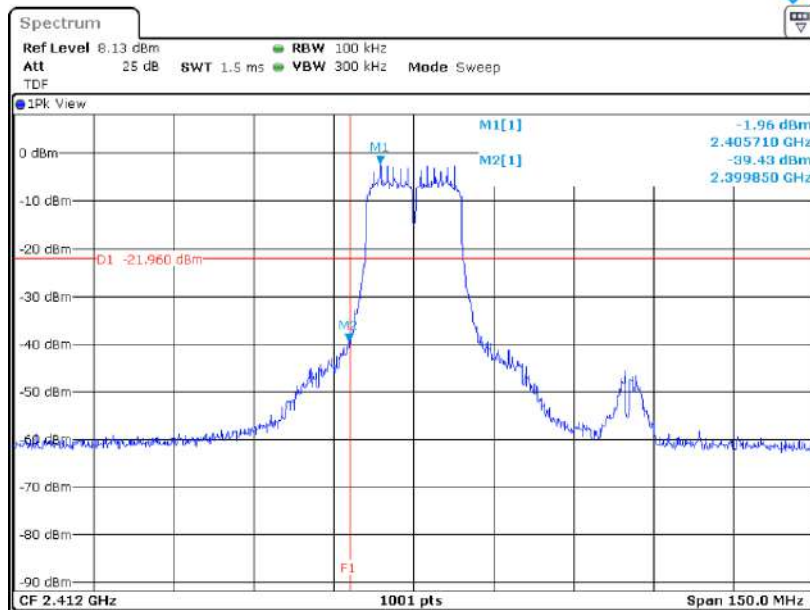
Low CH



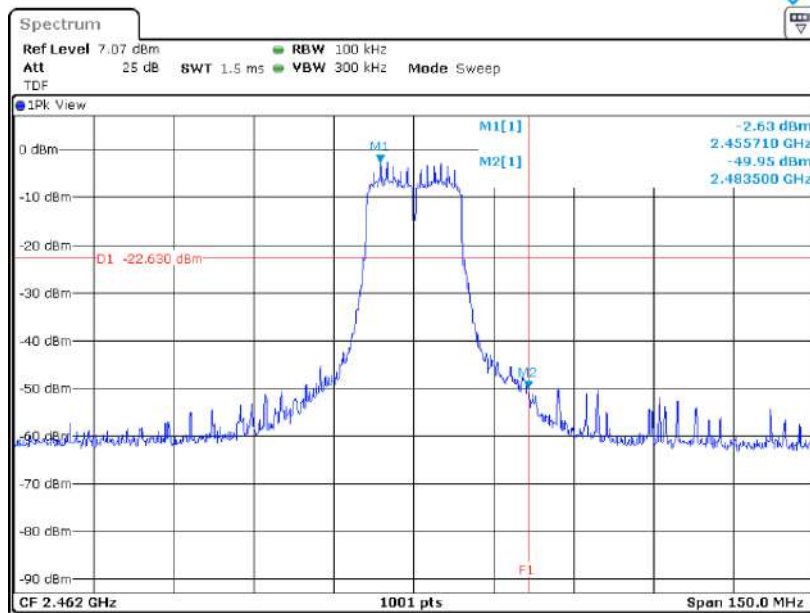
High CH



8.4.1.18 Band Edge for 802.11n(HT20)_DC 24 V



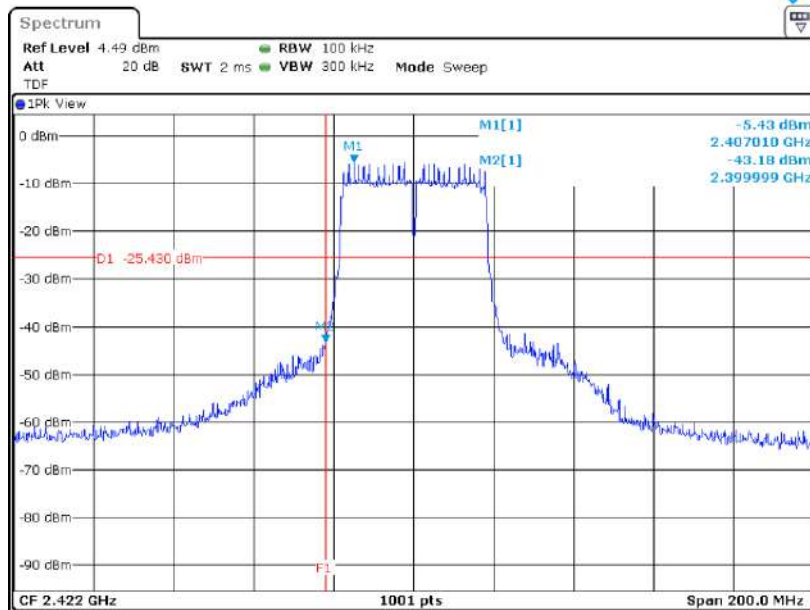
Low CH



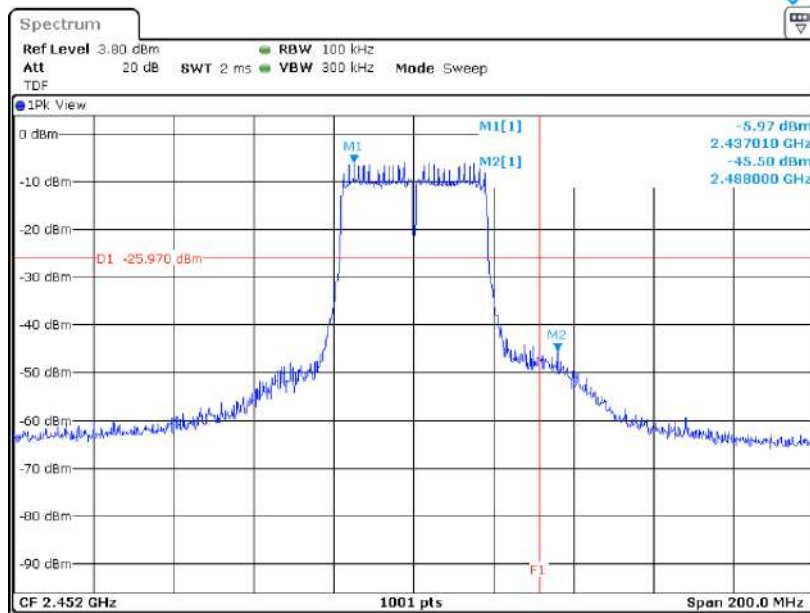
High CH



8.4.1.19 Band Edge for 802.11n(HT40)_DC 24 V



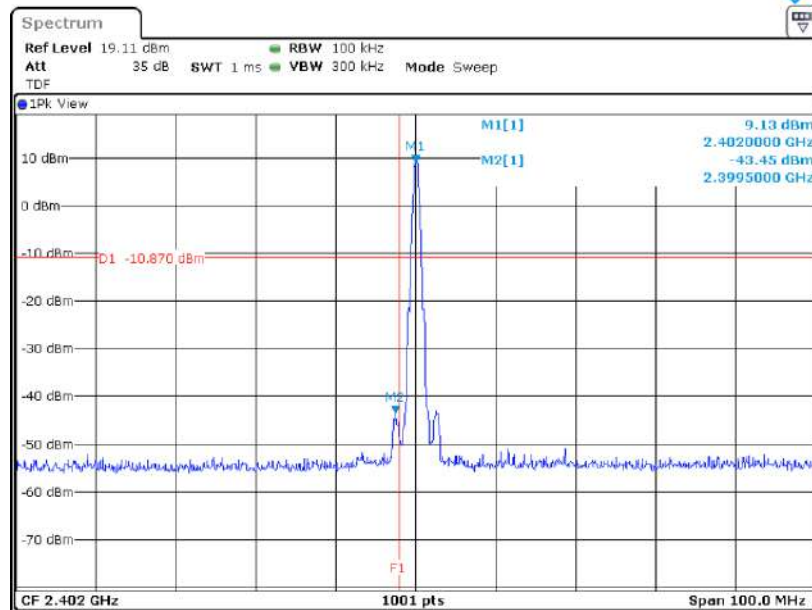
Low CH



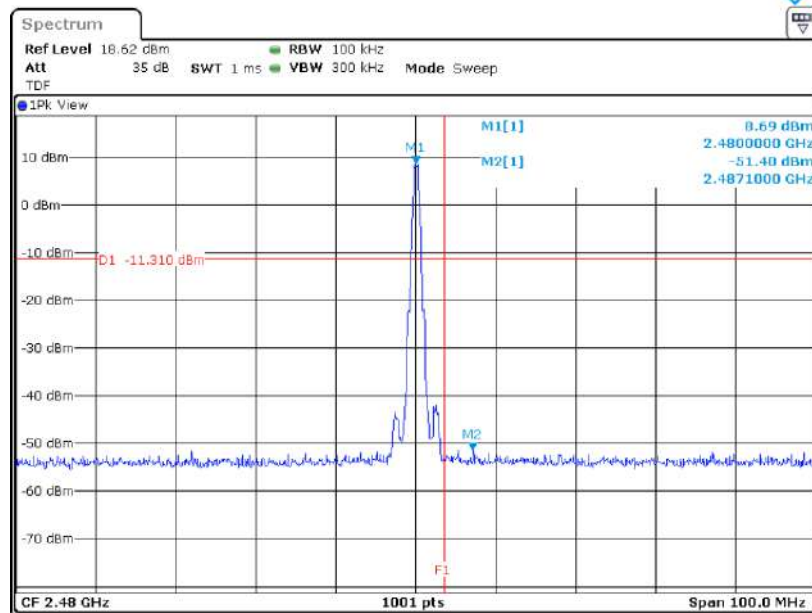
High CH



8.4.1.20 Band Edge for Bluetooth LE_DC 24 V



Low CH



High CH

9. Radiated Spurious Emission

9.1 Operating environment

Temperature : 24 °C

Relative humidity : 45 %

9.2 Measurement method

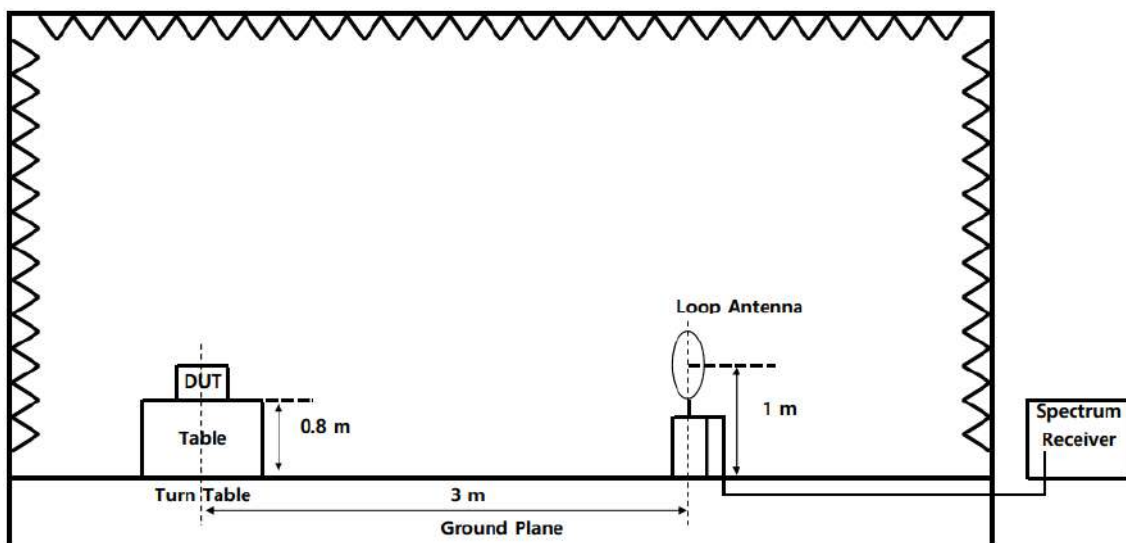
Standard : §15.247 (d), §15.209, §15.205

9.3 Test setup

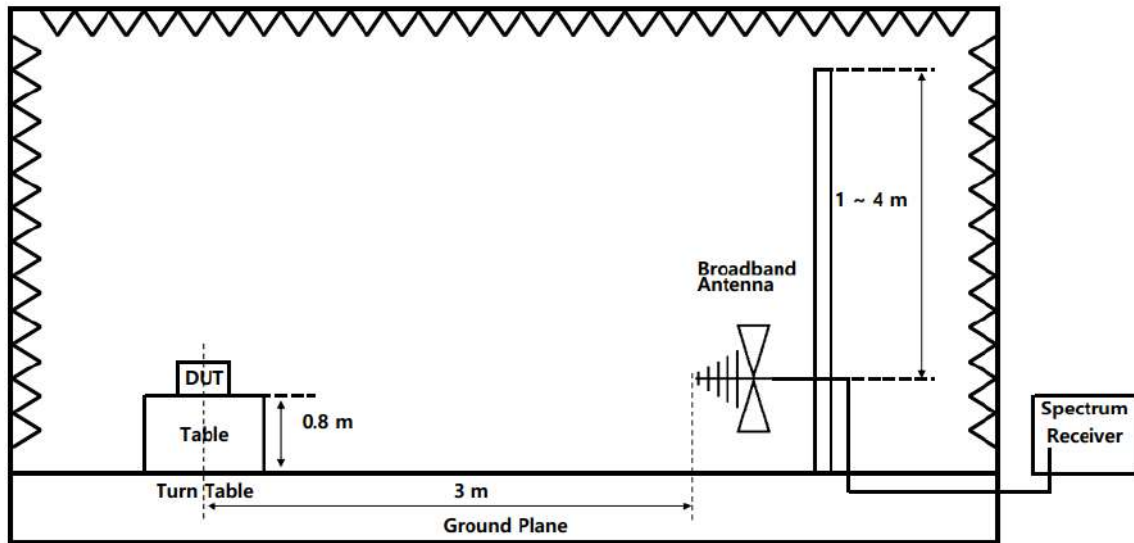
The radiated emissions measurements were performed on the 3 m, Semi-Anechoic Chamber. The EUT was placed on a non-conductive turntable above the ground plane.

The frequency spectrum from 9 kHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

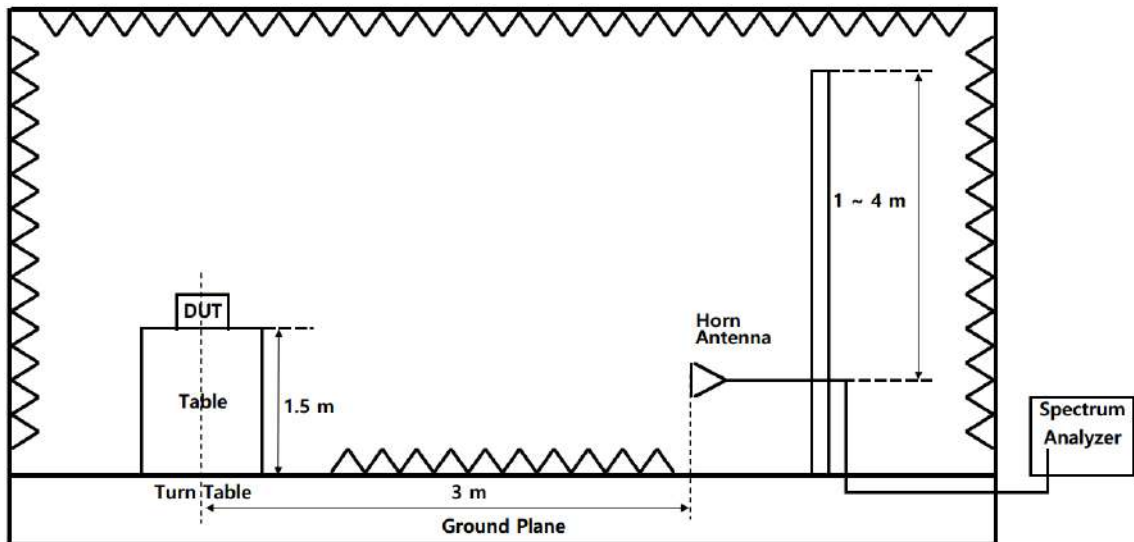
9.3.1 Below 30 MHz



9.3.2 30 MHz to 1 GHz



9.3.3 Above 1 GHz





9.4 Test data

Operating mode : Transmit mode

Test Result : Pass

9.4.1 Radiated Emissions data for DC 24 V (WLAN 2.4 GHz)

9.4.1.1 Radiated Emissions data (9 kHz ~ 1 GHz)_ 802.11b

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detect or Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 412	36.03	V	X	QP	47.70	-9.3	N/A	N/A	38.40	40.00	1.60
	42.45	V	X	QP	45.10	-8.6	N/A	N/A	36.50	40.00	3.50
	71.44	V	X	QP	42.40	-10.4	N/A	N/A	32.00	40.00	8.00
	72.02	H	X	QP	41.90	-10.5	N/A	N/A	31.40	40.00	8.60
	144.05	H	X	QP	33.90	-6.8	N/A	N/A	27.20	43.50	16.30
	196.53	H	X	QP	38.40	-9.2	N/A	N/A	29.20	43.50	14.30
	240.00	H	X	QP	49.50	-6.9	N/A	N/A	42.60	46.00	3.40
	240.00	V	X	QP	43.10	-6.9	N/A	N/A	36.20	46.00	9.80

9.4.1.2 Radiated Emissions data (9 kHz ~ 1 GHz) : 802.11b

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detect or Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 412	36.03	V	X	QP	47.70	-9.3	N/A	N/A	38.40	40.00	1.60
	42.45	V	X	QP	45.10	-8.6	N/A	N/A	36.50	40.00	3.50
	71.44	V	X	QP	42.40	-10.4	N/A	N/A	32.00	40.00	8.00
	72.02	H	X	QP	41.90	-10.5	N/A	N/A	31.40	40.00	8.60
	144.05	H	X	QP	33.90	-6.8	N/A	N/A	27.20	43.50	16.30
	196.53	H	X	QP	38.40	-9.2	N/A	N/A	29.20	43.50	14.30
	240.00	H	X	QP	49.50	-6.9	N/A	N/A	42.60	46.00	3.40
	240.00	V	X	QP	43.10	-6.9	N/A	N/A	36.20	46.00	9.80



9.4.1.3 Radiated Emissions data (1 GHz ~ 25 GHz) : 802.11b

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector or Mode	Reading (dBuV)	TF (dB/m)	DCC F (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 412	2 389.48	H	X	PK	44.28	5.71	N/A	N/A	49.99	74.00	24.01
	2 389.02	H	X	AV	34.29	5.71	0.50	N/A	40.50	54.00	13.50
	4 824.18	H	X	PK	41.19	10.34	N/A	N/A	51.53	74.00	22.47
	4 824.08	H	X	AV	30.95	10.34	0.50	N/A	41.79	54.00	12.21
2 437	4 873.37	H	X	PK	40.44	10.35	N/A	N/A	50.79	74.00	23.21
	4 873.88	H	X	AV	30.69	10.35	0.50	N/A	41.54	54.00	12.46
2 462	2 487.25	H	X	PK	44.48	6.02	N/A	N/A	50.50	74.00	23.50
	2 486.43	H	X	AV	33.60	6.02	0.50	N/A	40.12	54.00	13.88
	4 923.36	H	X	PK	40.80	10.40	N/A	N/A	51.20	74.00	22.80
	4 923.68	H	X	AV	30.88	10.40	0.50	N/A	41.78	54.00	12.22

9.4.1.4 Radiated Emissions data (1 GHz ~ 25 GHz) : 802.11g

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector or Mode		Reading (dBuV)	TF (dB/m)	DCC F (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 412	2 389.01	H	X	PK		45.13	5.71	N/A	N/A	50.84	74.00	23.16
	2 389.05	H	X	AV		34.62	5.71	2.40	N/A	42.73	54.00	11.27
	4 823.83	H	X	PK		40.90	10.34	N/A	N/A	51.24	74.00	22.76
	4 823.82	H	X	AV		30.98	10.34	2.40	N/A	43.72	54.00	10.28
2 437	4 873.61	H	X	PK		40.77	10.35	N/A	N/A	51.12	74.00	22.88
	4 873.72	H	X	AV		30.77	10.35	2.40	N/A	43.52	54.00	10.48
2 462	2 484.06	H	X	PK		44.33	6.01	N/A	N/A	50.34	74.00	23.66
	2 484.82	H	X	AV		34.02	6.01	2.40	N/A	42.43	54.00	11.57
	4 924.19	H	X	PK		40.61	10.40	N/A	N/A	51.01	74.00	22.99
	4 924.35	H	X	AV		31.15	10.40	2.40	N/A	43.95	54.00	10.05



9.4.1.5 Radiated Emissions data (1 GHz ~ 25 GHz) : 802.11n(HT20)

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detect or Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 412	2 389.72	H	X	PK	46.25	5.71	N/A	N/A	51.96	74.00	22.04
	2 389.78	H	X	AV	34.33	5.71	2.53	N/A	42.57	54.00	11.43
	4 823.57	H	X	PK	40.52	10.34	N/A	N/A	50.86	74.00	23.14
	4 823.76	H	X	AV	30.60	10.34	2.53	N/A	43.47	54.00	10.53
2 437	4 873.90	H	X	PK	41.10	10.35	N/A	N/A	51.45	74.00	22.55
	4 874.22	H	X	AV	30.40	10.35	2.53	N/A	43.28	54.00	10.72
2 462	2 484.62	H	X	PK	44.37	6.01	N/A	N/A	50.38	74.00	23.62
	2 484.26	H	X	AV	33.95	6.01	2.53	N/A	42.49	54.00	11.51
	4 924.09	H	X	PK	40.69	10.40	N/A	N/A	51.09	74.00	22.91
	4 924.22	H	X	AV	30.38	10.40	2.53	N/A	43.31	54.00	10.69

9.4.1.6 Radiated Emissions data (1 GHz ~ 25 GHz) : 802.11n(HT40)

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detect or Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 422	2 387.06	H	X	PK	51.57	5.71	N/A	N/A	57.28	74.00	16.72
	2 387.91	H	X	AV	35.28	5.71	4.13	N/A	45.12	54.00	8.88
	4 843.68	H	X	PK	40.90	10.37	N/A	N/A	51.27	74.00	22.73
	4 843.52	H	X	AV	31.14	10.36	4.13	N/A	45.63	54.00	8.37
2 437	4 873.34	H	X	PK	41.02	10.35	N/A	N/A	51.37	74.00	22.63
	4 873.49	H	X	AV	30.48	10.35	4.13	N/A	44.96	54.00	9.04
2 452	2 484.13	H	X	PK	47.76	6.01	N/A	N/A	53.77	74.00	20.23
	2 484.20	H	X	AV	33.64	6.01	4.13	N/A	43.78	54.00	10.22
	4 903.69	H	X	PK	40.68	10.34	N/A	N/A	51.02	74.00	22.98
	4 903.68	H	X	AV	30.43	10.34	4.13	N/A	44.90	54.00	9.10



9.4.2 Radiated Emissions data for DC 12 V (WLAN 2.4 GHz)

9.4.2.1 Worst case data : 802.11n(HT40)

Tested Frequency (MHz)	Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detect or Mode	Reading (dBuV)	TF (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2 422	2 389.62	H	X	PK	51.00	5.71	N/A	N/A	56.71	74.00	17.29
	2 388.67	H	X	AV	35.37	5.71	4.13	N/A	45.21	54.00	8.79
	4 844.65	H	X	PK	41.09	10.37	N/A	N/A	51.46	74.00	22.54
	4 844.61	H	X	AV	31.00	10.37	4.13	N/A	45.50	54.00	8.50

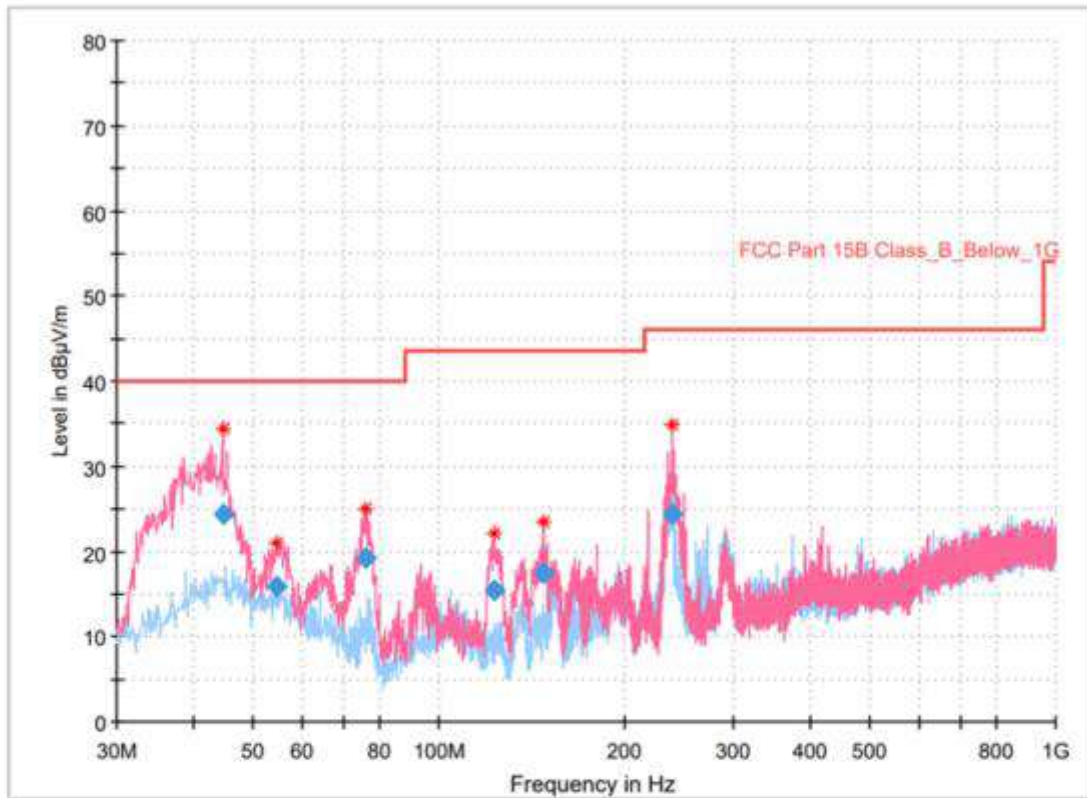


9.4.3 Test data for Spurious & Harmonic for Bluetooth LE DC 12 V

9.4.3.1 Measurement Results for Below 30 MHz

Frequency (MHz)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low CH							
It was not found any emissions peaks found from the EUT.							
Mid CH							
It was not found any emissions peaks found from the EUT.							
High CH							
It was not found any emissions peaks found from the EUT.							

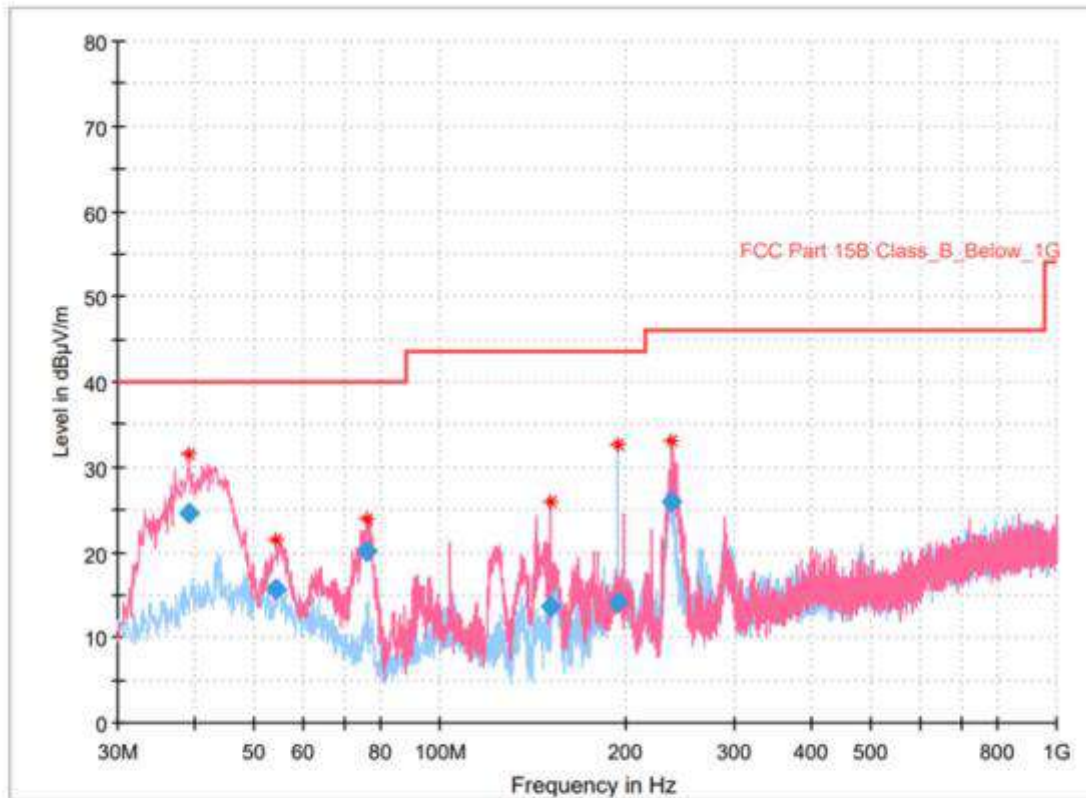
9.4.3.2 Measurement Results for Below 1 GHz



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
44.550000	24.41	40.00	15.59	1000.0	120.000	100.1	V	29.0	-20.8
54.638000	15.86	40.00	24.14	1000.0	120.000	100.1	V	56.0	-20.5
76.269000	19.27	40.00	20.73	1000.0	120.000	100.1	V	224.0	-27.1
123.120000	15.51	43.50	27.99	1000.0	120.000	100.1	V	313.0	-25.2
148.049000	17.47	43.50	26.03	1000.0	120.000	100.1	V	0.0	-26.4
239.520000	24.25	46.00	21.75	1000.0	120.000	100.1	V	0.0	-22.3

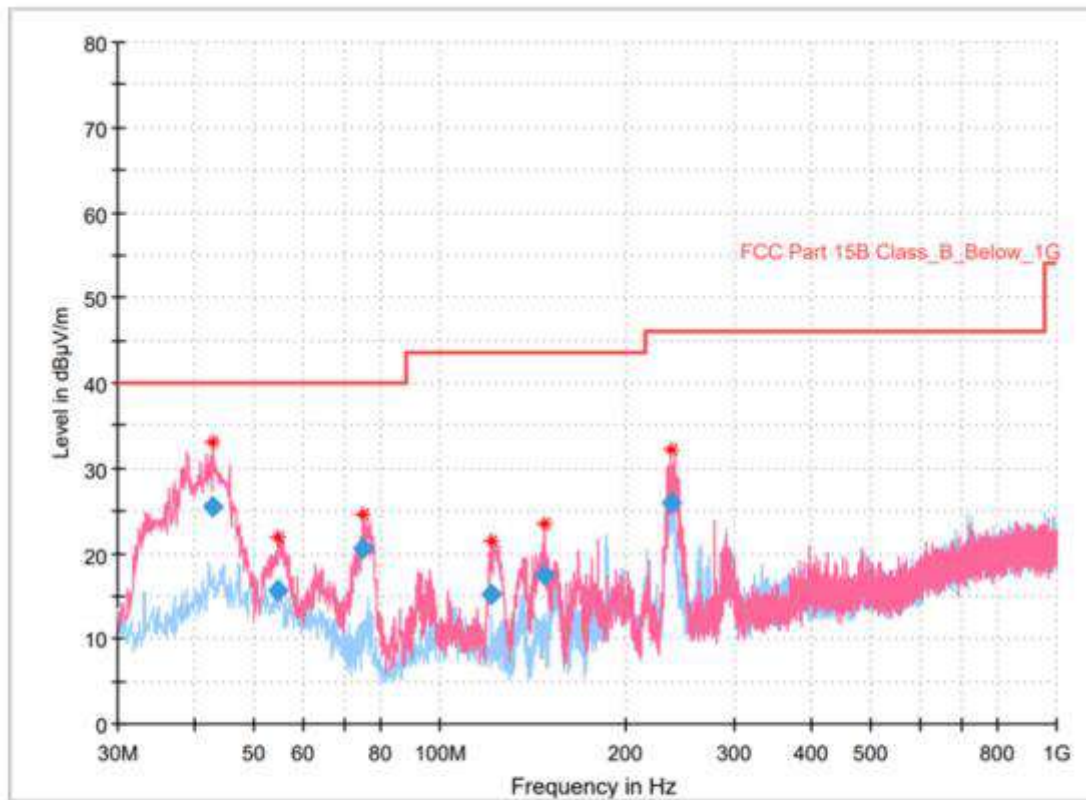
Low



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
39.118000	24.54	40.00	15.46	1000.0	120.000	100.1	V	217.0	-22.6
54.250000	15.62	40.00	24.38	1000.0	120.000	100.1	V	32.0	-20.5
76.269000	20.08	40.00	19.92	1000.0	120.000	100.1	V	301.0	-27.1
150.862000	13.53	43.50	29.97	1000.0	120.000	100.1	V	287.0	-26.5
194.124000	14.06	43.50	29.44	1000.0	120.000	100.1	H	339.0	-23.5
237.871000	25.94	46.00	20.06	1000.0	120.000	100.1	V	247.0	-22.4

Mid



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.804000	25.47	40.00	14.53	1000.0	120.000	100.1	V	228.0	-21.2
54.541000	15.64	40.00	24.36	1000.0	120.000	100.1	V	269.0	-20.5
75.105000	20.46	40.00	19.54	1000.0	120.000	100.1	V	269.0	-26.7
121.471000	15.17	43.50	28.33	1000.0	120.000	100.1	V	200.0	-25.0
147.661000	17.53	43.50	25.97	1000.0	120.000	100.1	V	39.0	-26.5
237.580000	25.88	46.00	20.12	1000.0	120.000	100.1	V	255.0	-22.4

High



9.4.3.3 Measurement Results for Above 1 GHz

Frequency (MHz)	Detector	Ant. Pol. (H/V)	Reading (dBμV)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low CH							
4 804.60	Peak	H	37.09	-4.30	41.39	73.98	32.59
	Average	H	23.69		27.99	53.98	25.99
Mid CH							
4 881.10	Peak	V	36.85	-3.80	40.65	73.98	33.33
	Average	V	23.06		26.86	53.98	27.12
High CH							
4 961.00	Peak	V	38.99	-3.60	42.59	73.98	31.39
	Average	V	25.55		29.15	53.98	24.83

- ※ Ant. Pol. : Antenna Polarization
- ※ Corr. Factor. : Antenna Factor + Cable Loss - Amplifier Gain
- ※ Result = Reading + Corr. Factor
- ※ Margin = Limit - Result

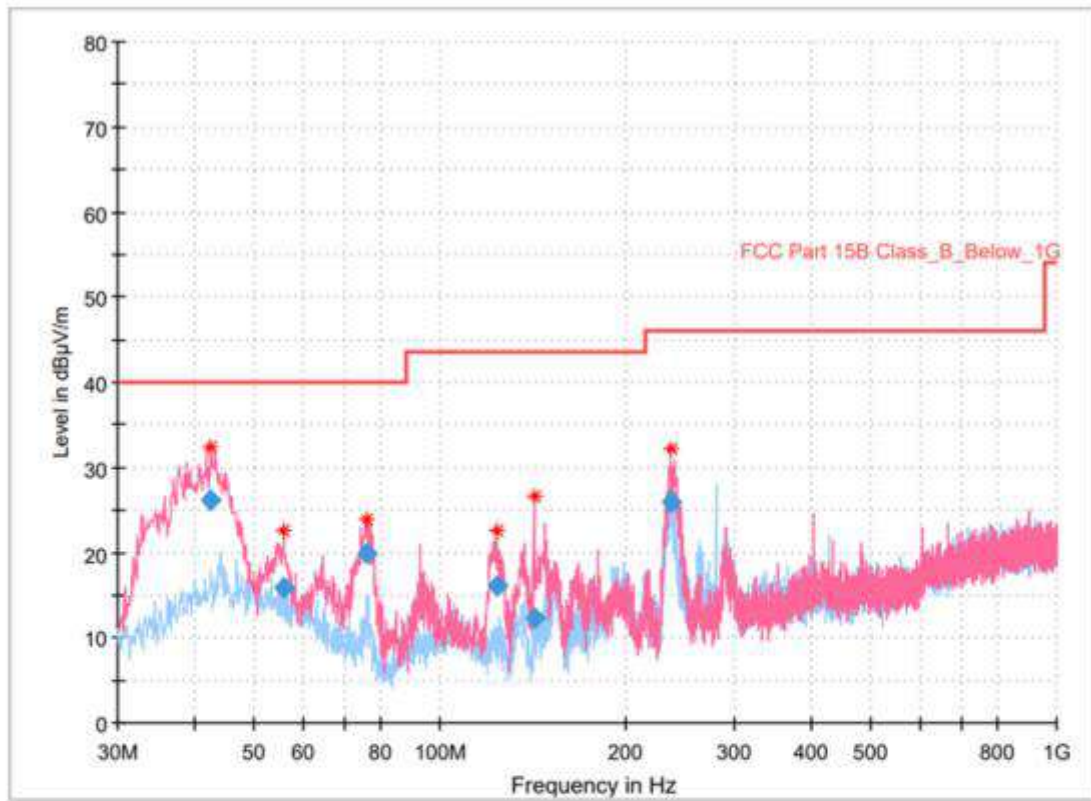


9.4.4 Test data for Spurious & Harmonic for Bluetooth LE DC 24 V

9.4.4.1 Measurement Results for Below 30 MHz

Frequency (MHz)	Reading (dBμV)	Detector	Ant. Pol. (H/V)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low CH							
It was not found any emissions peaks found from the EUT.							
Mid CH							
It was not found any emissions peaks found from the EUT.							
High CH							
It was not found any emissions peaks found from the EUT.							

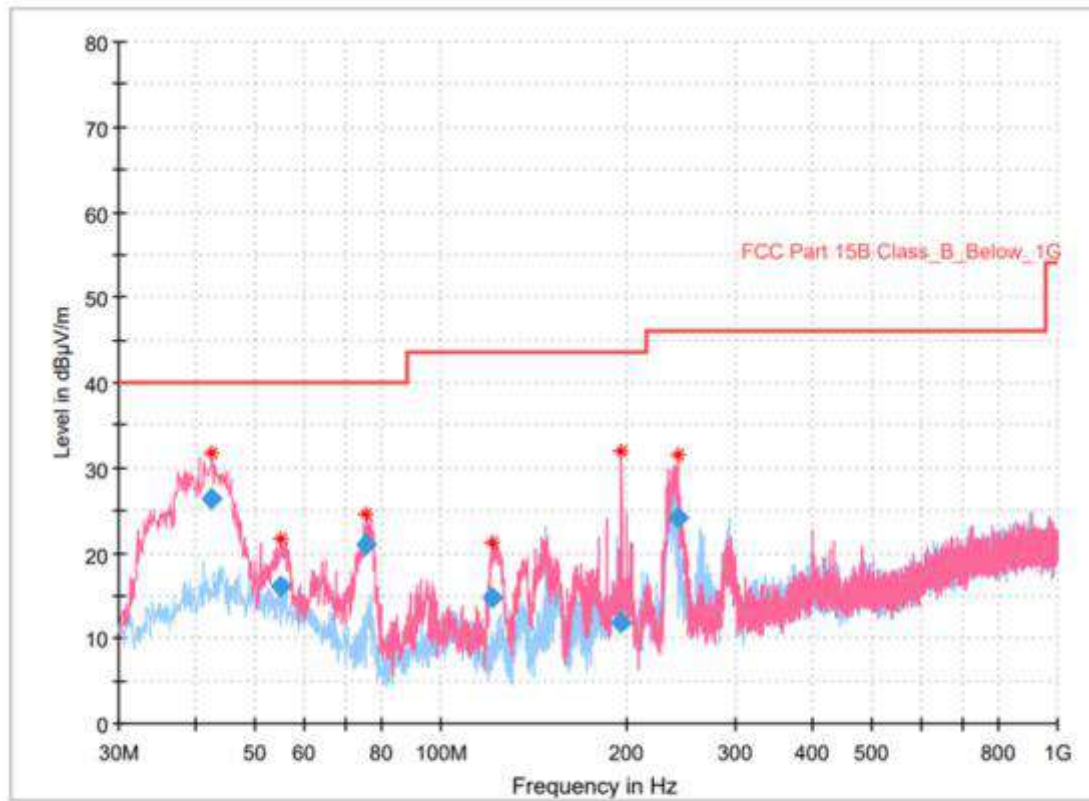
9.4.4.2 Measurement Results for Below 1 GHz



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.513000	26.15	40.00	13.85	1000.0	120.000	100.1	V	247.0	-21.3
55.705000	15.86	40.00	24.14	1000.0	120.000	100.1	V	35.0	-20.7
76.269000	19.81	40.00	20.19	1000.0	120.000	100.1	V	260.0	-27.1
123.508000	16.07	43.50	27.43	1000.0	120.000	100.1	V	260.0	-25.2
141.938000	12.29	43.50	31.21	1000.0	120.000	100.1	V	137.0	-26.5
237.483000	25.97	46.00	20.03	1000.0	120.000	100.1	V	234.0	-22.4

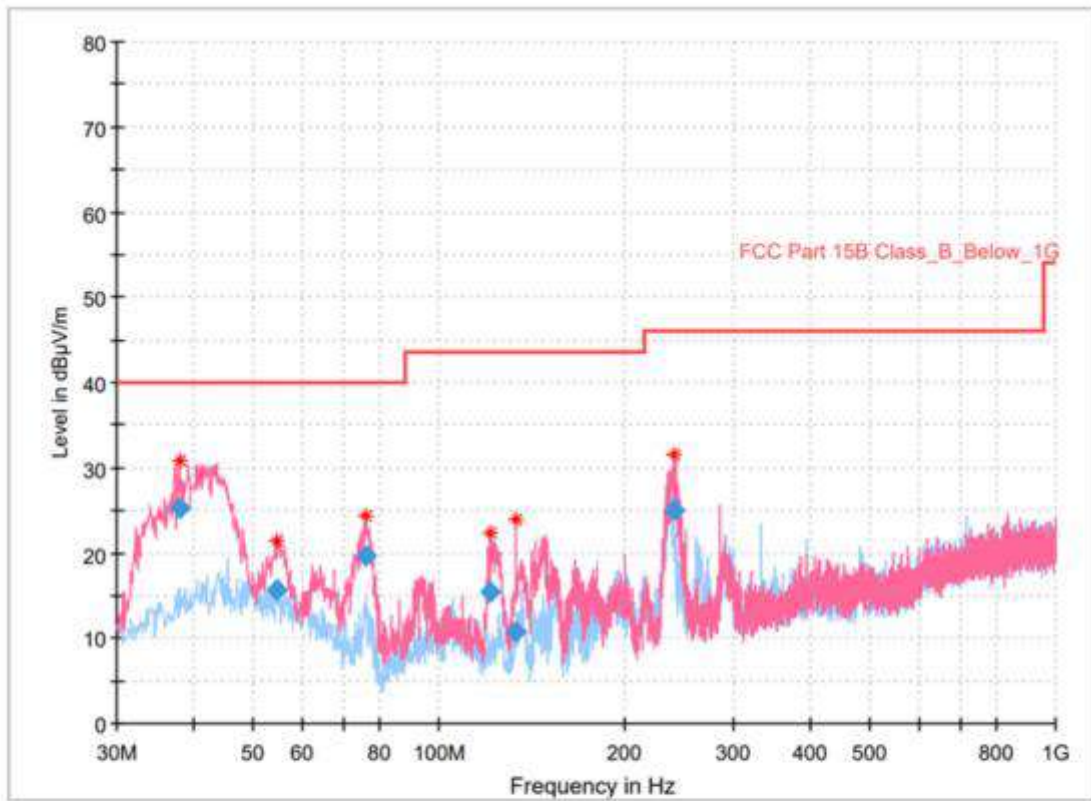
Low



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
42.513000	26.46	40.00	13.54	1000.0	120.000	100.1	V	7.0	-21.3
54.929000	16.07	40.00	23.93	1000.0	120.000	100.1	V	99.0	-20.6
75.687000	21.06	40.00	18.94	1000.0	120.000	100.1	V	316.0	-26.9
120.792000	14.77	43.50	28.73	1000.0	120.000	100.1	V	44.0	-24.9
196.355000	11.78	43.50	31.72	1000.0	120.000	100.1	V	0.0	-23.0
242.042000	24.22	46.00	21.78	1000.0	120.000	100.1	V	247.0	-22.2

Mid



Final Result

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.857000	25.23	40.00	14.77	1000.0	120.000	100.1	V	230.0	-22.8
54.444000	15.60	40.00	24.40	1000.0	120.000	100.1	V	135.0	-20.5
76.269000	19.74	40.00	20.26	1000.0	120.000	100.1	V	258.0	-27.1
121.180000	15.44	43.50	28.06	1000.0	120.000	100.1	V	190.0	-25.0
133.499000	10.63	43.50	32.87	1000.0	120.000	100.1	V	0.0	-26.1
239.908000	25.02	46.00	20.98	1000.0	120.000	100.1	V	0.0	-22.3

High



9.4.4.3 Measurement Results for Above 1 GHz

Frequency (MHz)	Detector	Ant. Pol. (H/V)	Reading (dBμV)	Corr. Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Low CH							
4 802.90	Peak	V	34.40	-4.40	38.80	73.98	35.18
	Average	V	20.39		24.79	53.98	29.19
4 804.60	Peak	V	40.21	-3.50	43.71	73.98	30.27
	Average	V	21.85		25.35	53.98	28.63
Mid CH							
4 879.40	Peak	V	38.20	-3.80	42.00	73.98	31.98
	Average	V	24.48		28.28	53.98	25.70
High CH							
4 961.00	Peak	H	38.01	-3.60	41.61	73.98	32.37
	Average	H	23.94		27.54	53.98	26.44

- ※ Ant. Pol. : Antenna Polarization
- ※ Corr. Factor. : Antenna Factor + Cable Loss - Amplifier Gain
- ※ Result = Reading + Corr. Factor
- ※ Margin = Limit - Result



10. Power Line Conducted Emission

10.1 Operating environment

Temperature : 24 °C

Relative humidity : 44 %

10.2 Measurement method

Standard : §15.207

10.3 Test setup

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.



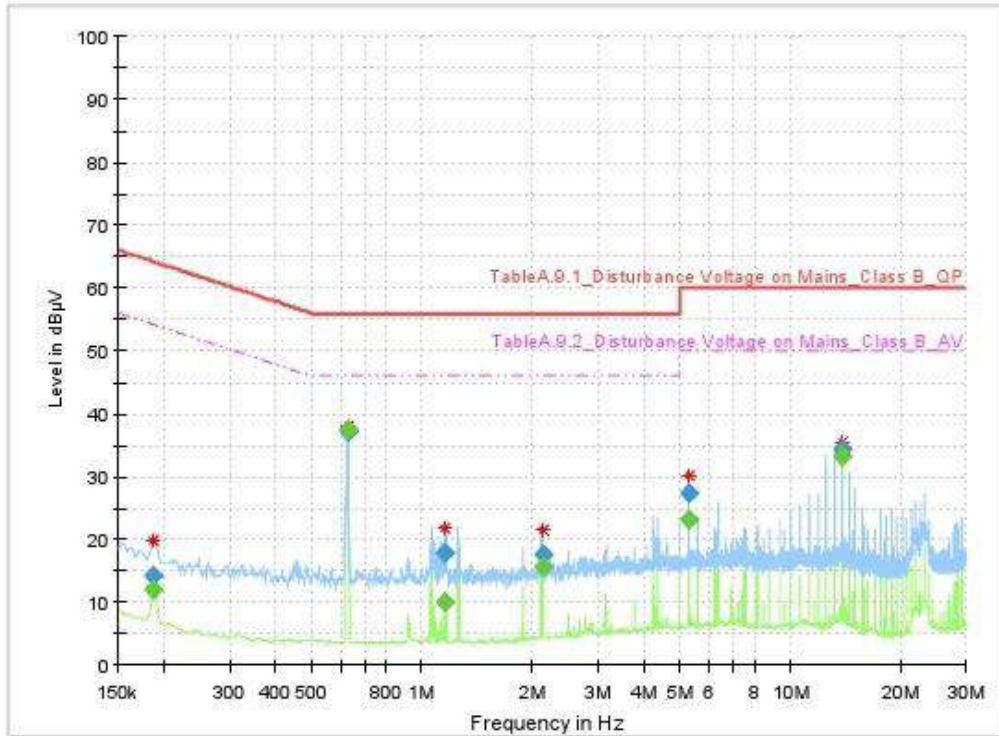


10.4 Test data

Operating mode : Transmit mode

Test Result : Pass

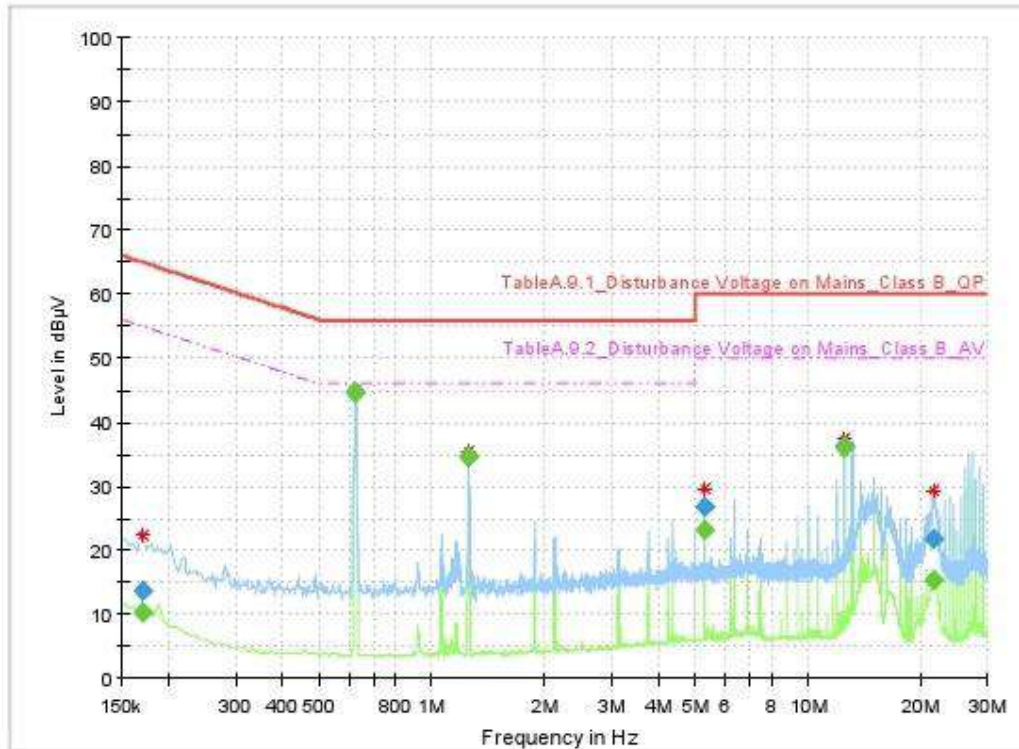
10.4.1 Measured Results & Graph



Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.186	---	12.11	54.21	42.11	1000.0	9.000	N	FLO	10.51
0.186	14.19	---	64.21	50.03	1000.0	9.000	N	FLO	10.51
0.627	---	37.32	46.00	8.68	1000.0	9.000	N	FLO	10.39
0.627	37.23	---	56.00	18.77	1000.0	9.000	N	FLO	10.39
1.158	---	9.99	46.00	36.01	1000.0	9.000	N	FLO	10.38
1.158	17.75	---	56.00	38.25	1000.0	9.000	N	FLO	10.38
2.123	---	15.76	46.00	30.24	1000.0	9.000	N	FLO	10.37
2.123	17.67	---	56.00	38.33	1000.0	9.000	N	FLO	10.37
5.307	---	23.31	50.00	26.69	1000.0	9.000	N	FLO	10.42
5.307	27.24	---	60.00	32.76	1000.0	9.000	N	FLO	10.42
13.776	---	33.35	50.00	16.65	1000.0	9.000	N	FLO	10.47
13.776	34.34	---	60.00	25.66	1000.0	9.000	N	FLO	10.47

Live line



Final Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.170	---	10.41	54.95	44.54	1000.0	9.000	N	FLO	10.54
0.170	13.79	---	64.95	51.16	1000.0	9.000	N	FLO	10.54
0.625	---	44.69	46.00	1.31	1000.0	9.000	N	FLO	10.39
0.625	44.62	---	56.00	11.38	1000.0	9.000	N	FLO	10.39
1.253	---	34.54	46.00	11.46	1000.0	9.000	N	FLO	10.38
1.253	34.53	---	56.00	21.47	1000.0	9.000	N	FLO	10.38
5.307	---	23.14	50.00	26.86	1000.0	9.000	N	FLO	10.42
5.307	26.92	---	60.00	33.08	1000.0	9.000	N	FLO	10.42
12.514	---	35.90	50.00	14.10	1000.0	9.000	N	FLO	10.50
12.514	36.34	---	60.00	23.66	1000.0	9.000	N	FLO	10.50
21.437	---	15.46	50.00	34.54	1000.0	9.000	N	FLO	10.66
21.437	21.92	---	60.00	38.08	1000.0	9.000	N	FLO	10.66

Neutral line

- END -