

TEST REPORT

Report No.: **2021-90031-1**
FCC ID.....: **2A344BAB20164938688**
Applicant.....: **Shenzhen BAB smart technology Co., LTD**
Address.....: Room 502, Building 2, Fufengda Industrial Building, Fuyong Street, Baoan, Shenzhen.
Manufacturer.....: Shenzhen BAB smart technology Co., LTD
Address.....: Room 502, Building 2, Fufengda Industrial Building, Fuyong Street, Baoan, Shenzhen.
Product Name.....: **Smart Thermostat**
Trade Mark.....: N/A
Model/Type reference.....: GB
Listed Model(s): GA, GC
Standard.....: **FCC 15.247**
Date of receipt of test sample...: November 22, 2021
Date of testing.....: November 22, 2021~January 21, 2022
Date of issue.....: January 21, 2022
Test Result.....: **PASS**

Compiled by:
 (Printed name + Signature) Chen Zhijun

chen zhijun

Supervised by:
 (Printed name + Signature) Liu Canhui

Liu Canhui

Approved by:
 (Printed name + Signature) Wang Weixiong

Wang Weixiong

Testing Laboratory Name.....: **KSIGN Testing Co., Ltd.**

Address.....: Building 5, No. 316, Jianghong South Road Binjiang District, Hangzhou 310052, China

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1.TEST SUMMARY

1.1. Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

KDB 558074 D01 15.247 Meas Guidance v05r02 : The measurement guidance provided herein is applicable only to Digital Transmission System (DTS) devices operating in the 902-928 MHz. 2400-2483.5 MHz and/or 5725-5850 MHz bands under §15.247 of the FCC rules (Title 47 of the Code of Federal Regulations).

1.2. Report version

Revised No.	Date of issue	Description
01	January 21, 2022	Original

1.3. Test Description

FCC Part 15 Subpart C(15.247)			
Test Item	Standard Section	Result	Test Engineer
	FCC		
Antenna Requirement	15.203	Pass	Chen Zhijun
Conducted Emission	15.207	Pass	Chen Zhijun
6dB&99% Bandwidth	15.247(a)(2)	Pass	Chen Zhijun
Peak Output Power	15.247(b)	Pass	Chen Zhijun
Power Spectral Density	15.247(e)	Pass	Chen Zhijun
Restricted Band	15.247(d)/15.205	Pass	Chen Zhijun
Band Edge and Spurious Emission(Conducted)	15.247(d)	Pass	Chen Zhijun
Spurious Emission(Radiated)	15.247(d)&15.209	Pass	Chen Zhijun

Note: The measurement uncertainty is not included in the test result.

1.4. Test Facility

Address of the report laboratory

KSIGN Testing Co., Ltd.

Building 5, No. 316, Jianghong South Road Binjiang District, Hangzhou 310052, China

Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L0461

KSIGN Testing Co., Ltd. Has been assessed and proved to be in Compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2017 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No.: 4749.01

KSIGN Testing Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence In the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

IC Registration No.: CN0036

The 3m alternate test site of KSIGN Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: CN0036

FCC-Registration No.: CN1254

KSIGN Testing Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

1.5. Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2" and is documented in the KSIGN(Guangdong) Testing Co., Ltd. system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device. Below is the best measurement capability for KSIGN(Guangdong) Testing Co., Ltd.

Test Items	Measurement Uncertainty	Notes
Transmitter power conducted	0.42 dB	(1)
Transmitter power Radiated	2.14 dB	(1)
Conducted spurious emissions 9kHz~40GHz	1.60 dB	(1)
Radiated spurious emissions 9kHz~40GHz	2.20 dB	(1)
Conducted Emissions 9kHz~30MHz	3.20 dB	(1)
Radiated Emissions 30~1000MHz	4.70 dB	(1)
Radiated Emissions 1~18GHz	5.00 dB	(1)
Radiated Emissions 18~40GHz	5.54 dB	(1)
Occupied Bandwidth	2.80 dB	(1)

Note (1): This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=1.96$.

1.6. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15~35°C
Relative Humidity:	30~60 %
Air Pressure:	950~1050mba

2. GENERAL INFORMATION

2.1. General Description of EUT

Test Sample Number:	1-1-1(Normal Sample),1-1-2(Engineering Sample)
Product Name:	Smart Thermostat
Trade Mark:	N/A
Model/Type reference:	GB
Listed Model(s):	GA, GC
Model Different:	All models have the same circuit and RF module, except the appearance color are different, and the model name is different.
Power supply(Adapter):	INPUT: AC 95-240V, 50/60Hz
Power supply(Battery):	N/A
Hardware version:	101
Software version:	V1.0.3
2.4GHz WIFI	
Modulation:	802.11b: DSSS(CCK, DQPSK, DBPSK) 802.11g/n: OFDM(BPSK,QPSK,16QAM,64QAM)
Operation frequency:	802.11b/g/n(HT20): 2412MHz~2462MHz 802.11n(HT40): 2422MHz~2452MHz
Max Peak Output Power:	802.11b: 10.93dBm 802.11g: 10.84dBm 802.11n (HT20): 10.87dBm 802.11n (HT40): 10.90dBm
Channel number:	802.11b/g/n(HT20):11 channels 802.11n(HT40):7 channels
Test frequency:	CH01/03: 2412MHz/2422MHz; CH06: 2437MHz; CH09/11: 2452MHz/2462MHz
Channel separation:	5MHz
Antenna type:	PCB Antenna
Antenna gain:	1.5dBi

2.2. Operation State

Operation Frequency List: The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing.

Operation Frequency List:

Channel	Frequency (MHz)
01	2412
02	2417
03	2422
04	2427
05	2432
06	2437
07	2442
08	2447
09	2452
10	2457
11	2462

Note:

- 1.CH 01~CH 11 for 802.11b/g/n(HT20), CH03~CH09 for 802.11n(HT40).
- 2.The display in grey were the channel selected for testing.

Test mode

For RF test items
The engineering test program was provided and enabled to make EUT continuous transmit (duty cycle>98%).
For AC power line conducted emissions:
The EUT was set to connect with the WLAN AP under large package sizes transmission.
For Radiated spurious emissions test item:
The engineering test program was provided and enabled to make EUT continuous transmit(duty cycle>98%). The EUT in each of three orthogonal axis emissions had been tested ,but only the worst case (X axis) data Recorded in the report.

2.3. Measurement Instruments List

Tonscend JS0806-2 Test system					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
1	Spectrum Analyzer	R&S	FSV40-N	101798	03/22/2022
2	Vector Signal Generator	Agilent	N5182A	MY50142520	03/18/2022
3	Analog Signal Generator	HP	83752A	3344A00337	03/18/2022
4	Power Sensor	Agilent	E9304A	MY50390009	03/18/2022
5	Power Sensor	Agilent	E9300A	MY41498315	03/18/2022
6	Wideband Radio Communication Tester	R&S	CMW500	157282	03/18/2022
7	Climate Chamber	Angul	AGNH80L	1903042120	03/18/2022
8	Dual Output DC Power Supply	Agilent	E3646A	MY40009992	03/18/2022
9	RF Control Unit	Tonscend	JS0806-2	/	03/18/2022

Transmitter spurious emissions & Receiver spurious emissions					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Until
1	EMI Test Receiver	R&S	ESR	102525	03/18/2022
2	High Pass Filter	Chengdu E-Microwave	OHF-3-18-S	0E01901038	03/22/2022
3	High Pass Filter	Chengdu E-Microwave	OHF-6.5-18-S	0E01901039	03/22/2022
4	Spectrum Analyzer	HP	8593E	3831U02087	03/22/2022
5	Ultra-Broadband logarithmic period Antenna	Schwarzbeck	VULB 9163	01230	03/29/2023
6	Loop Antenna	Beijin ZHINAN	ZN30900C	18050	03/27/2022
7	Spectrum Analyzer	R&S	FSV40-N	101798	03/22/2022
8	Horn Antenna	Schwarzbeck	BBHA 9120 D	2023	03/29/2023
9	Horn Antenna	Schwarzbeck	BBHA 9170	00943	03/29/2023
10	Pre-Amplifier	Schwarzbeck	BBV 9745	9745#129	03/22/2022
11	Pre-Amplifier	EMCI	EMC051835S E	980662	03/22/2022
12	Pre-Amplifier	Schwarzbeck	BBV-9721	57	04/06/2022
13	Horn Antenna	Schwarzbeck	BBHA 9170	00939	03/28/2022

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
1	LISN	R&S	ENV432	1326.6105.02	03/18/2022
2	EMI Test Receiver	R&S	ESR	102524	03/18/2022
3	Manual RF Switch	JS TOYO	/	MSW-01/002	03/18/2022

Note:

1)The Cal. Interval was one year.

2)The cable loss has calculated in test result which connection between each test instruments.

TRF No. FCC Part 15.247_R1

Add : Building 5, No. 316, Jianghong South Road Binjiang District, Hangzhou 310052, China

Tel : +(86) 0571-8836 6861 Fax: +(86) 0571-8836 6821 E-mail : server@ksign.cn Web: www.ksign.cn

2.5. Test Software

Software name	Model	Version
Conducted emission Measurement Software	EZ-EMC	EMC-Con 3A1.1
Radiated emission Measurement Software	EZ-EMC	FA-03A.2.RE
Bluetooth and WIFI Test System	JS1120-3	2.5.77.0418

3. TEST ITEM AND RESULTS

3.1. Antenna requirement

Requirement

FCC CFR Title 47 Part 15 Subpart C Section 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, 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.

FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(i) Systems operating in the 2400~2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

Test Result

The directional gain of the antenna less than 6dBi, please refer to the EUT internal photographs antenna photo.

Note: The antenna is permanently fixed to the EUT

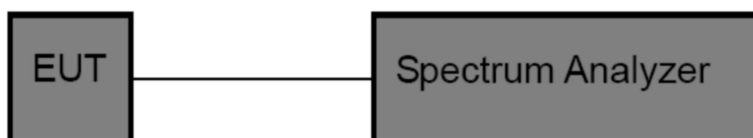
3.2. Peak Output Power

Limit

Test Item	Limit	Frequency Range(MHz)
Peak Output Power	1 Watt or 30 dBm	2400~2483.5

Test Configuration

Test



Procedure

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator.
2. The measurement is according to ANSI C63.10 (2013) for compliance to FCC 47CFR 15.247 requirements.
3. Spectrum Setting:
Set analyser center frequency to DTS channel center frequency.
Set the RBW to: 1MHz
Set the VBW to: 3MHz
Detector: peak
Sweep time: auto
Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.
4. The power sensor video bandwidth is greater than or equal to the DTS bandwidth of the equipment.

Test Mode

Please refer to the clause 2.2

Test Result

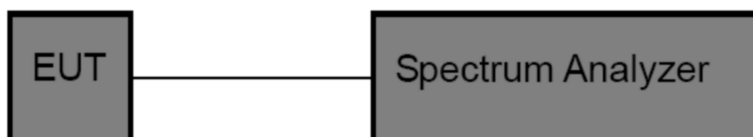
Mode	Channel frequency (MHz)	Test Result (dBm)	Limit (dBm)	Result
802.11b	2412	10.62	30	PASS
	2437	10.93	30	PASS
	2462	10.07	30	PASS
802.11g	2412	10.24	30	PASS
	2437	10.84	30	PASS
	2462	10.05	30	PASS
802.11n (HT20)	2412	9.87	30	PASS
	2437	10.87	30	PASS
	2462	9.56	30	PASS
802.11n (HT40)	2422	10.90	30	PASS
	2437	10.45	30	PASS
	2452	10.69	30	PASS

3.3. Power Spectral Density

Limit

FCC Part 15 Subpart C(15.247)		
Test Item	Limit	Frequency Range(MHz)
Power Spectral Density	8dBm(in any 3 kHz)	2400~2483.5

Test Configuration



Test Procedure

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator.
2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to ANSI C63.10 (2013) for compliance to FCC 47CFR 15.247 requirements.
3. Spectrum Setting:
 Set analyser center frequency to DTS channel center frequency.
 Set the span to 1.5 times the DTS bandwidth.
 Set the RBW to: 10 kHz
 Set the VBW to: 30 kHz
 Detector: peak
 Sweep time: auto
 Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

Test Mode

Please refer to the clause 2.2

Test Result

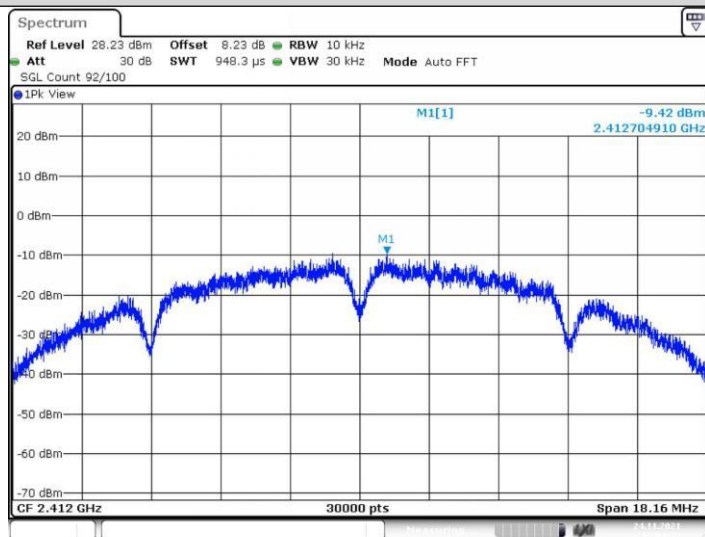
Note:

Power Density(dBm/3kHz)=Power Density(dBm/10kHz)-10*Log(10/3)

Mode	Frequency	Power Density (dBm/10kHz)	Power Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
802.11b	2412 MHz	-9.42	-14.65	8	Pass
	2437 MHz	-10.06	-15.29	8	Pass
	2462 MHz	-9.6	-14.83	8	Pass
802.11g	2412 MHz	-14.42	-19.65	8	Pass
	2437 MHz	-14.42	-19.65	8	Pass
	2462 MHz	-15.42	-20.65	8	Pass
802.11n(HT20)	2412 MHz	-15.43	-20.66	8	Pass
	2437 MHz	-15.89	-21.12	8	Pass
	2462 MHz	-16.34	-21.57	8	Pass
802.11n(HT40)	2422 MHz	-18.24	-23.47	8	Pass
	2437 MHz	-16.34	-21.57	8	Pass
	2452 MHz	-17.2	-22.43	8	Pass

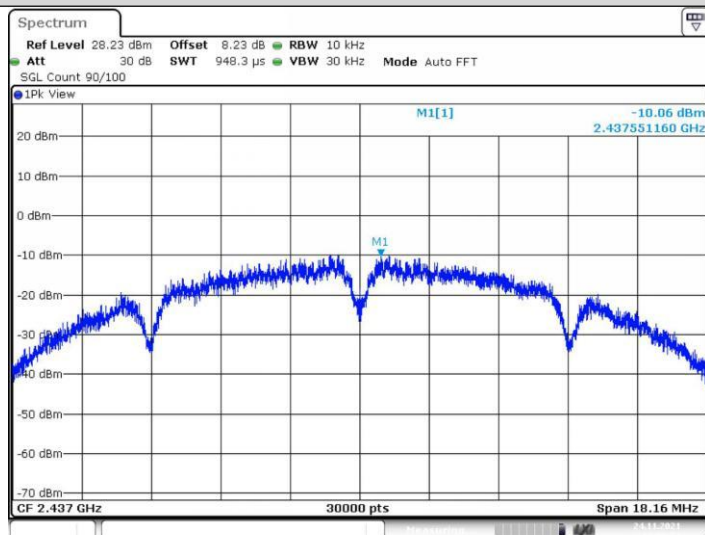
802.11b

2412 MHz



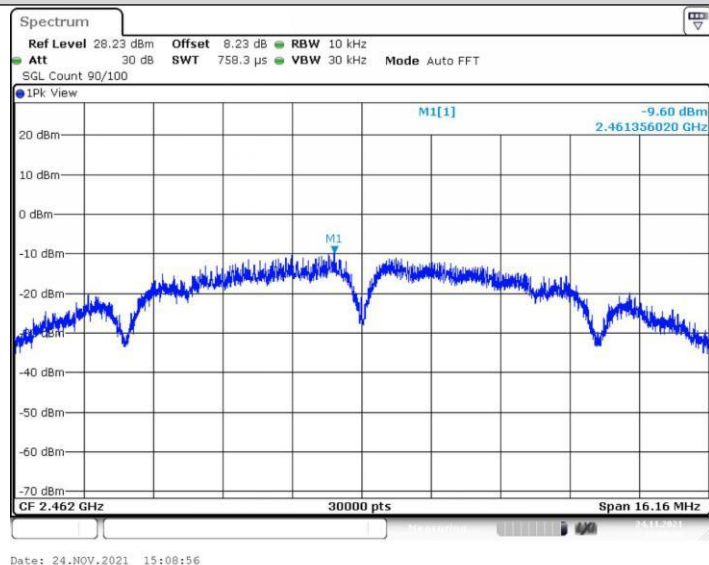
Date: 24.NOV.2021 15:03:33

2437 MHz



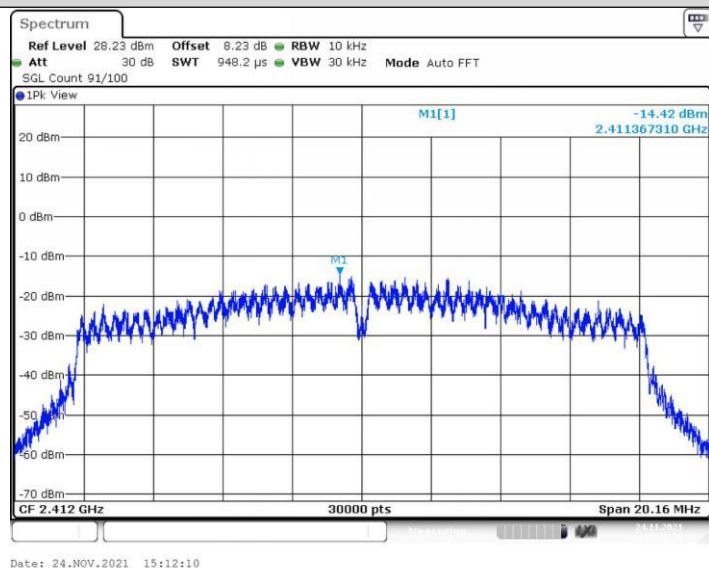
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2462 MHz

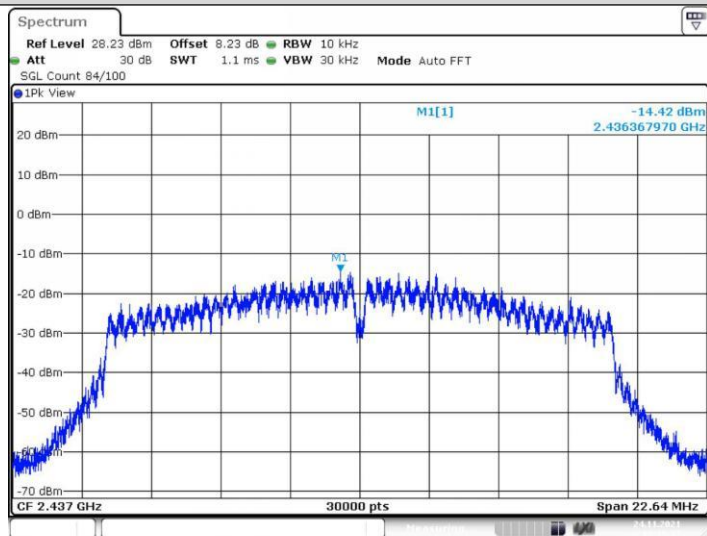


802.11g

2412 MHz

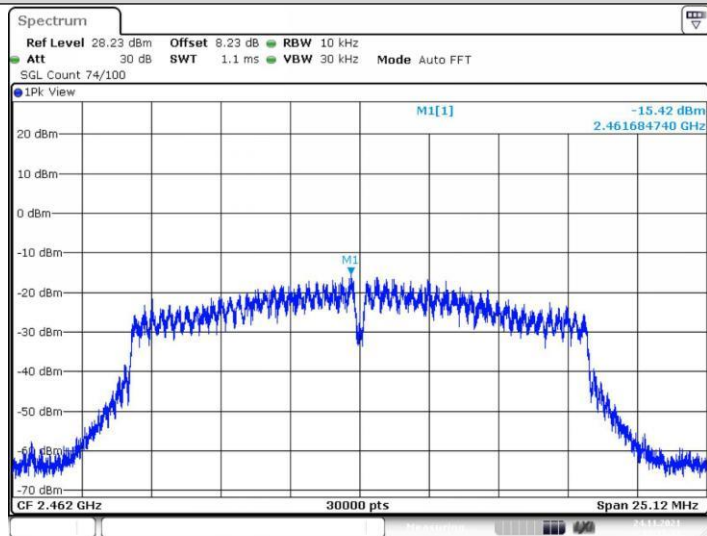


2437 MHz



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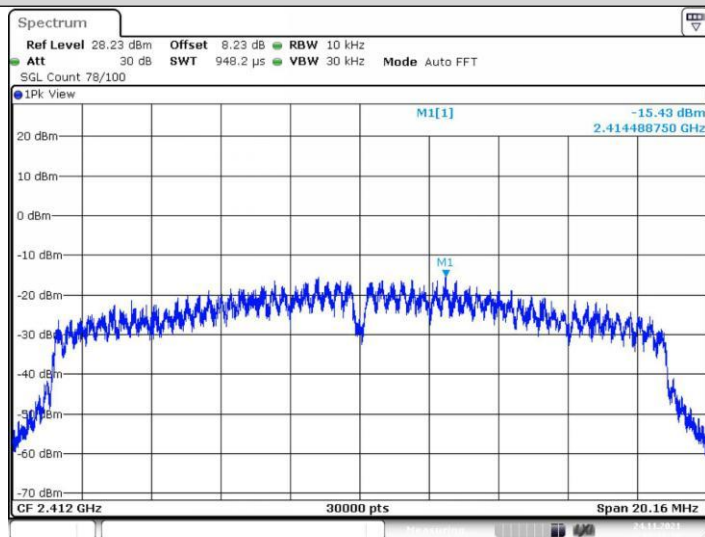
2462 MHz



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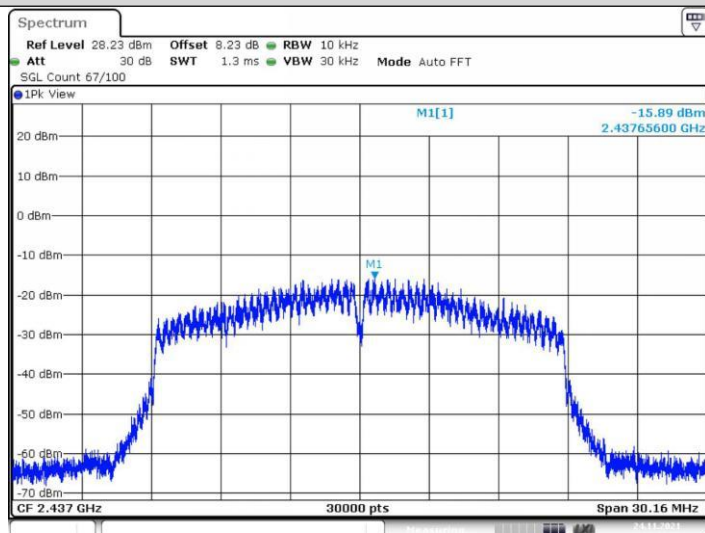
802.11n(HT20)

2412 MHz



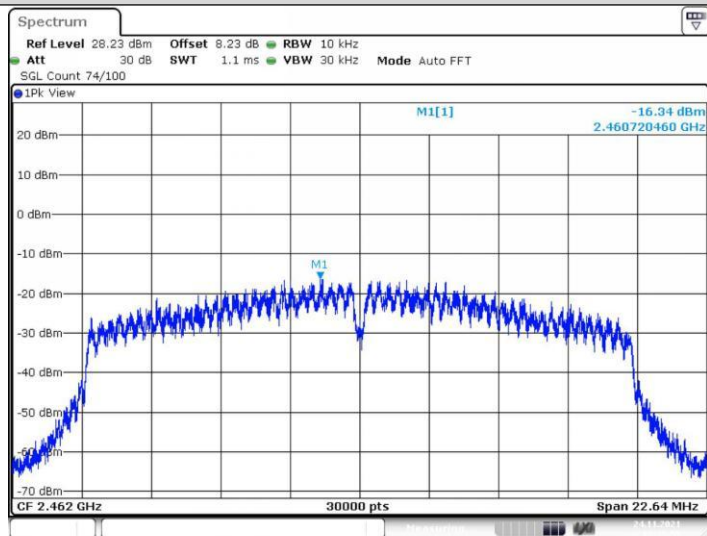
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2437 MHz



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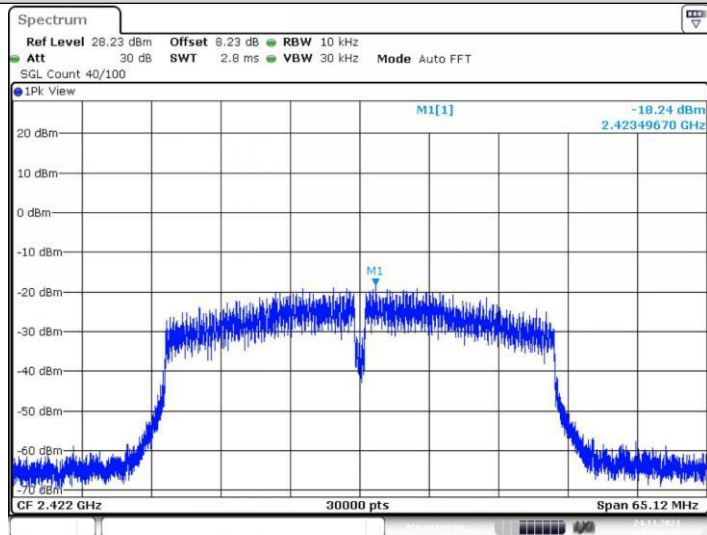
2462 MHz



Date: 24.NOV.2021 15:25:59

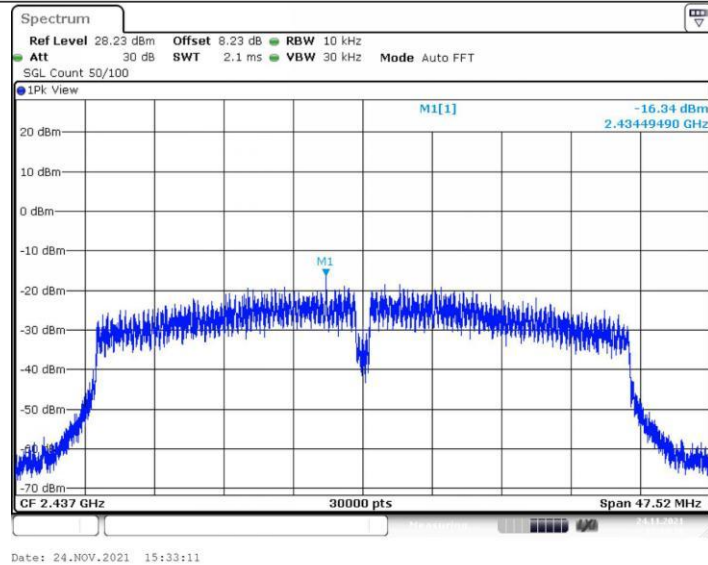
802.11n(HT40)

2422 MHz

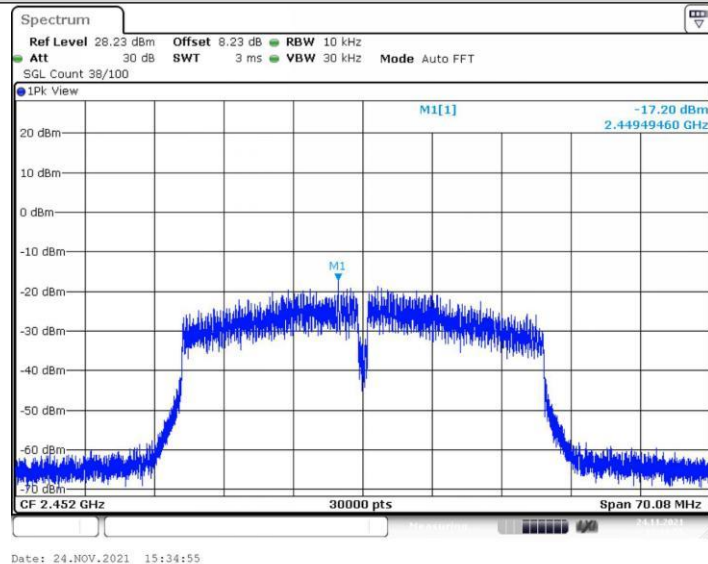


Date: 24.NOV.2021 15:30:18

2437 MHz



2452 MHz

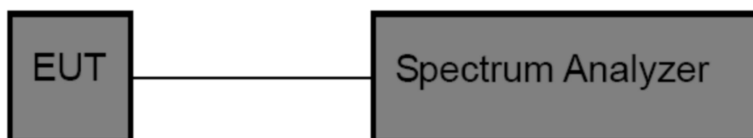


3.4. Bandwidth

Limit

Test Item	Limit	Frequency Range(MHz)
Bandwidth	≥ 500 KHz (6dB bandwidth)	2400~2483.5

Test Configuration



Test Procedure

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator:
6db Bandwidth
 - (1) Set RBW = 100 kHz.
 - (2) Set the video bandwidth (VBW) ≥ 3 RBW.
 - (3) Detector = Peak.
 - (4) Trace mode = Max hold.
 - (5) Sweep = Auto couple.

NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

Test Mode

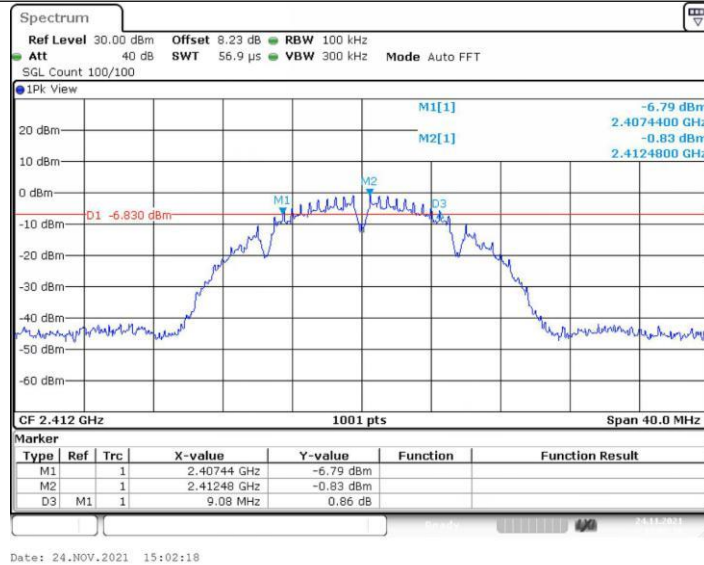
Please refer to the clause 2.2.

Test Results

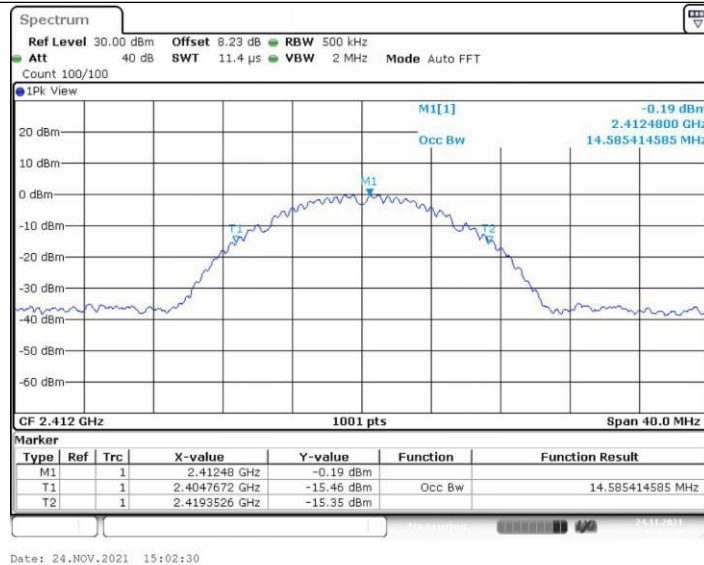
Mode	Frequency	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Result
802.11b	2412 MHz	9.08	14.585	≥ 0.5	Pass
	2437 MHz	9.08	14.505	≥ 0.5	Pass
	2462 MHz	8.08	14.625	≥ 0.5	Pass
802.11g	2412 MHz	10.08	16.104	≥ 0.5	Pass
	2437 MHz	11.32	16.064	≥ 0.5	Pass
	2462 MHz	12.56	16.144	≥ 0.5	Pass
802.11n(HT20)	2412 MHz	10.08	16.863	≥ 0.5	Pass
	2437 MHz	15.08	16.823	≥ 0.5	Pass
	2462 MHz	11.32	16.823	≥ 0.5	Pass
802.11n(HT40)	2422 MHz	32.56	35.485	≥ 0.5	Pass
	2437 MHz	23.76	35.485	≥ 0.5	Pass
	2452 MHz	35.04	35.405	≥ 0.5	Pass

802.11b_2412 MHz

6dB Bandwidth

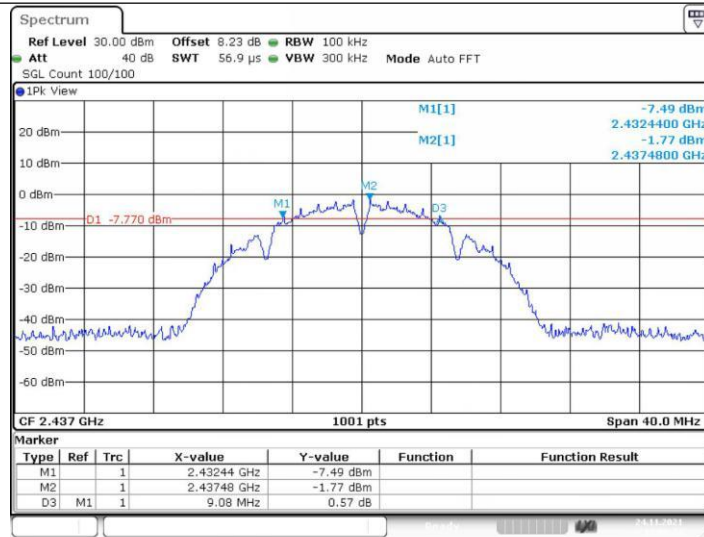


99% Bandwidth



802.11b_2437 MHz

6dB Bandwidth



Date: 24.NOV.2021 15:06:24

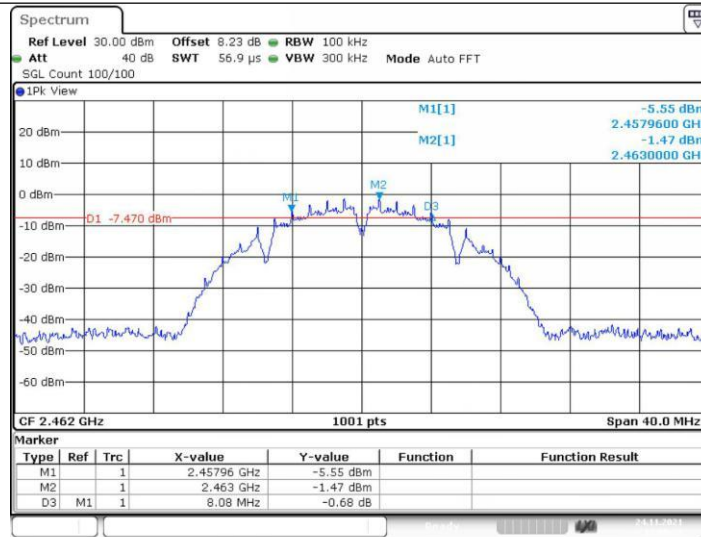
99% Bandwidth



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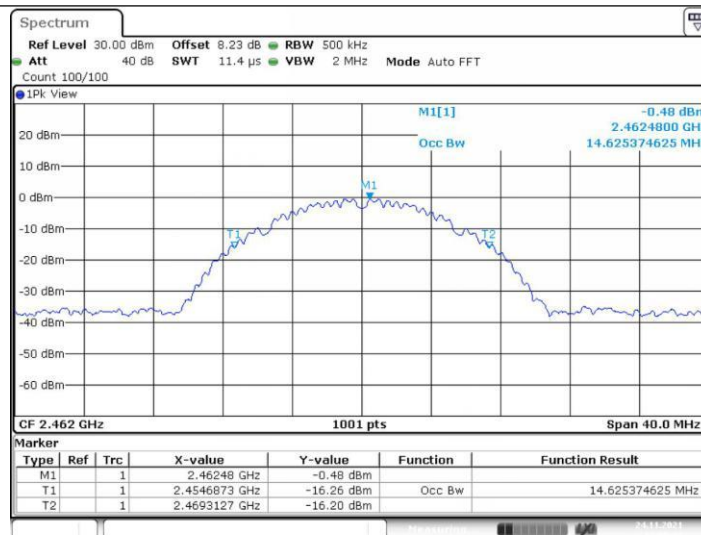
802.11b_2462 MHz

6dB Bandwidth



Date: 24.NOV.2021 15:08:29

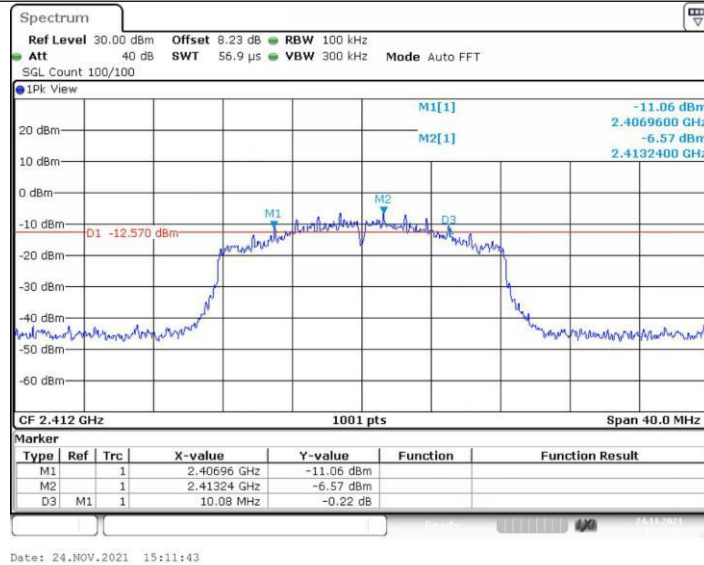
99% Bandwidth



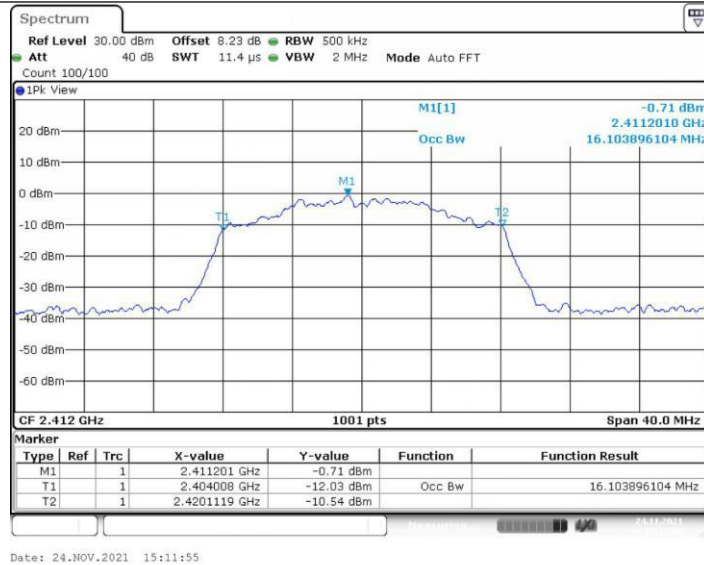
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802.11g_2412 MHz

6dB Bandwidth

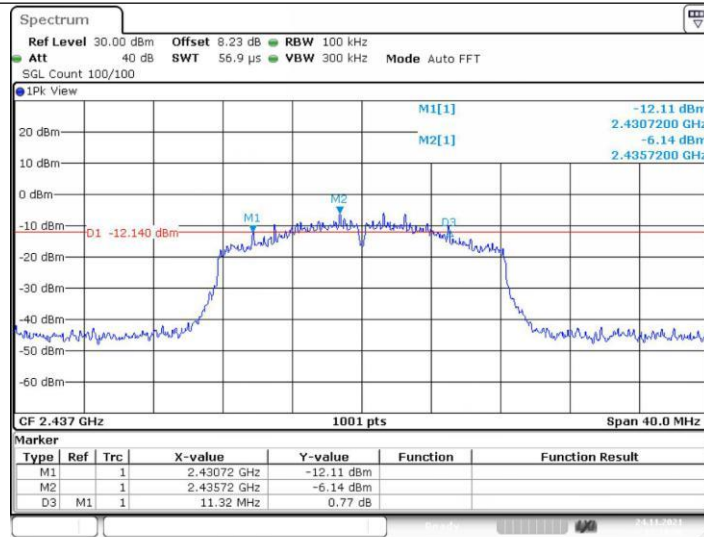


99% Bandwidth



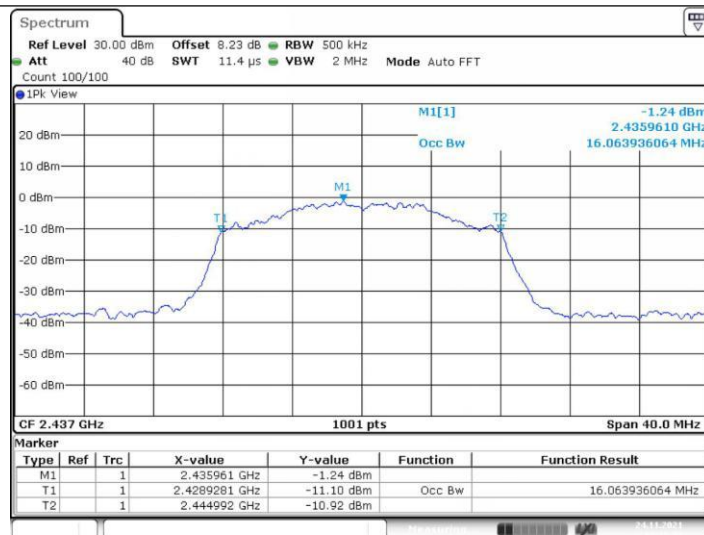
802.11g_2437 MHz

6dB Bandwidth



Date: 24.NOV.2021 15:14:51

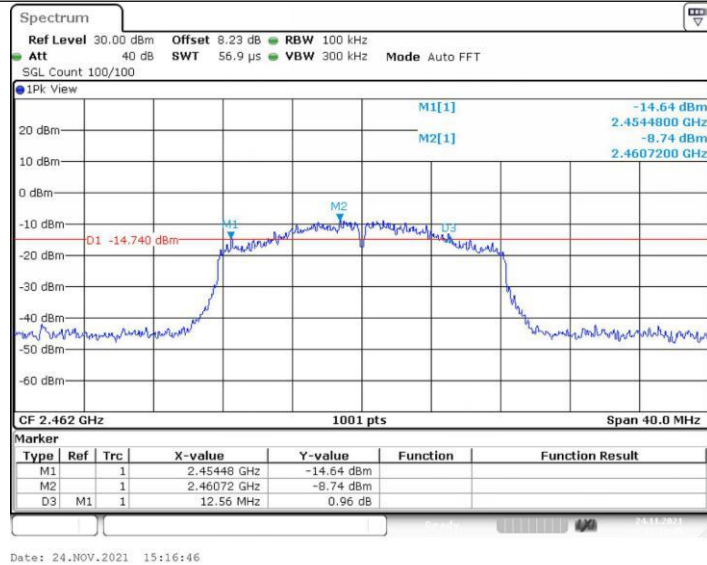
99% Bandwidth



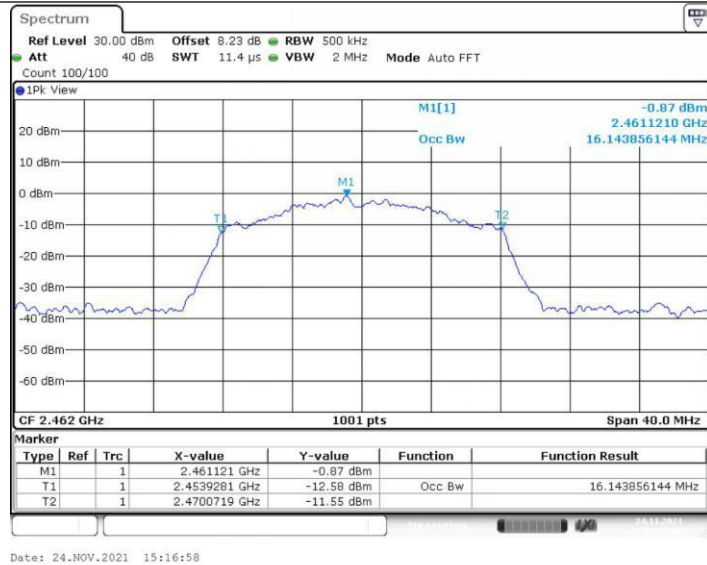
Date: 24.NOV.2021 15:15:02

802.11g_2462 MHz

6dB Bandwidth

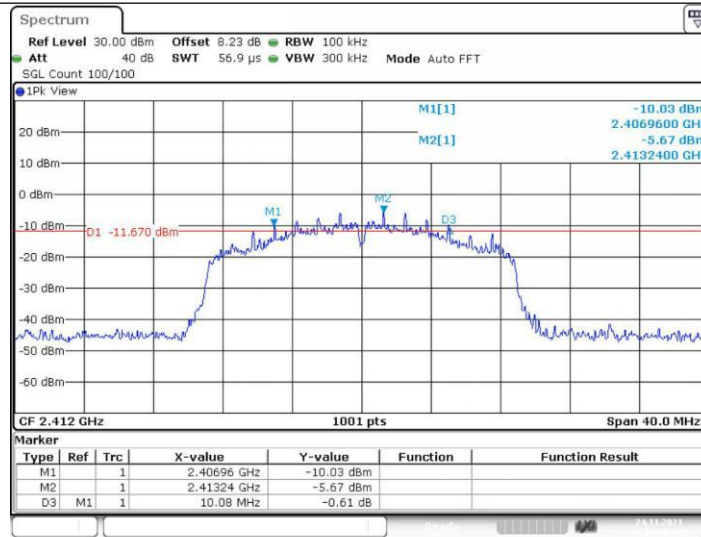


99% Bandwidth



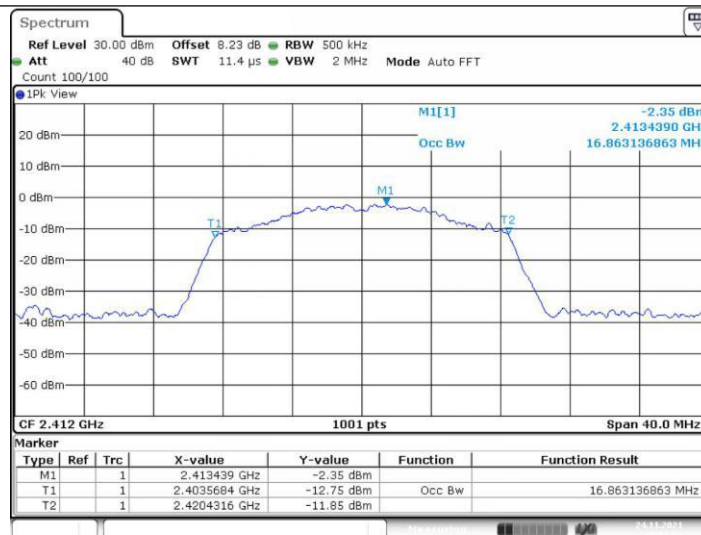
802.11n(HT20)_2412 MHz

6dB Bandwidth



Date: 24.NOV.2021 15:20:49

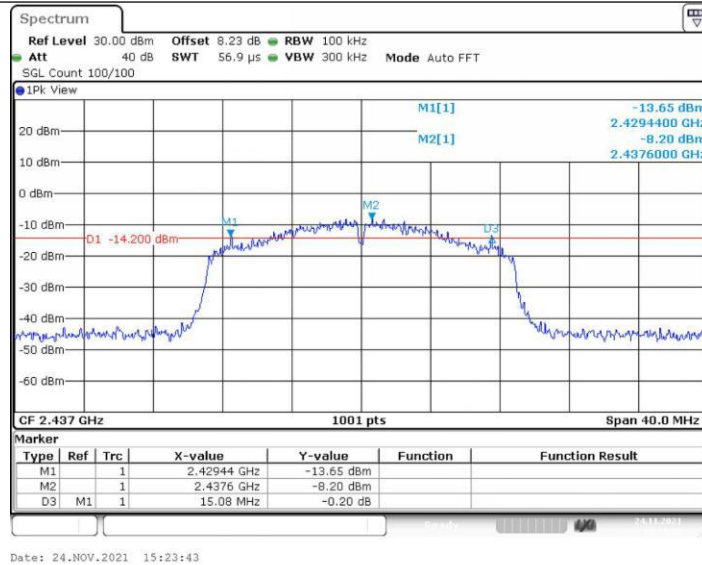
99% Bandwidth



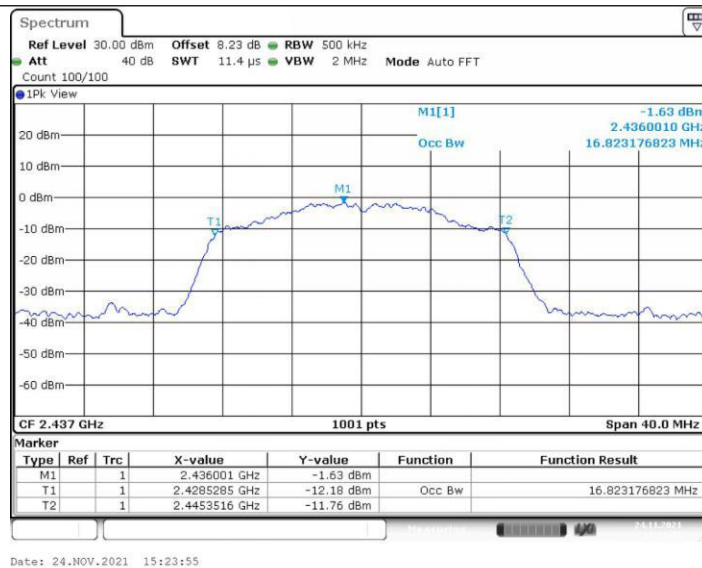
Date: 24.NOV.2021 15:21:01

802.11n(HT20)_2437 MHz

6dB Bandwidth

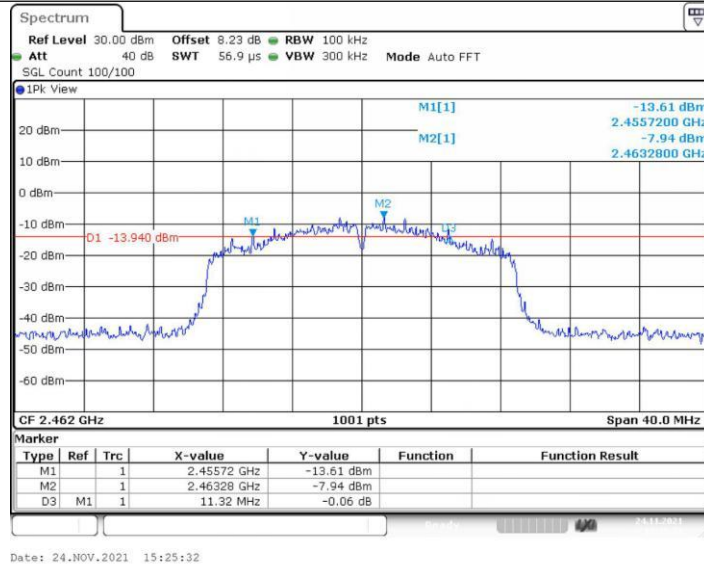


99% Bandwidth

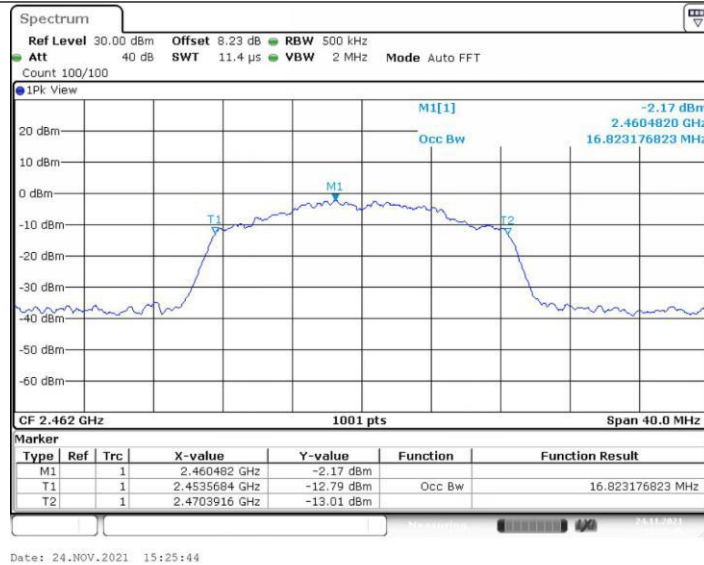


802.11n(HT20)_2462 MHz

6dB Bandwidth

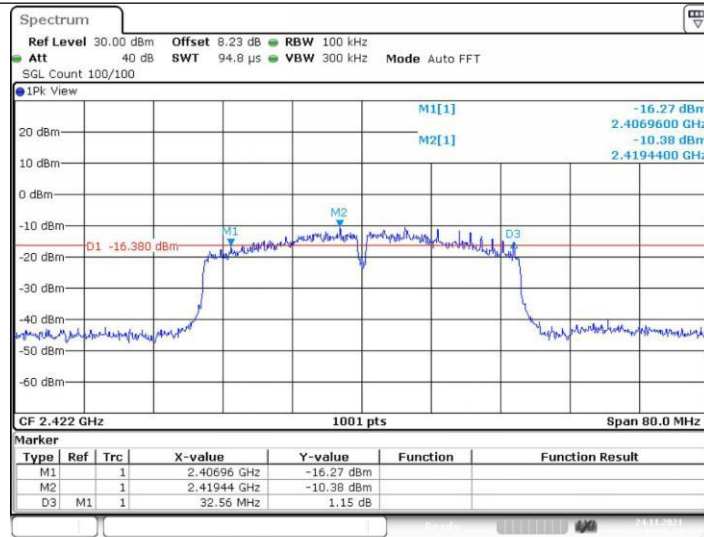


99% Bandwidth

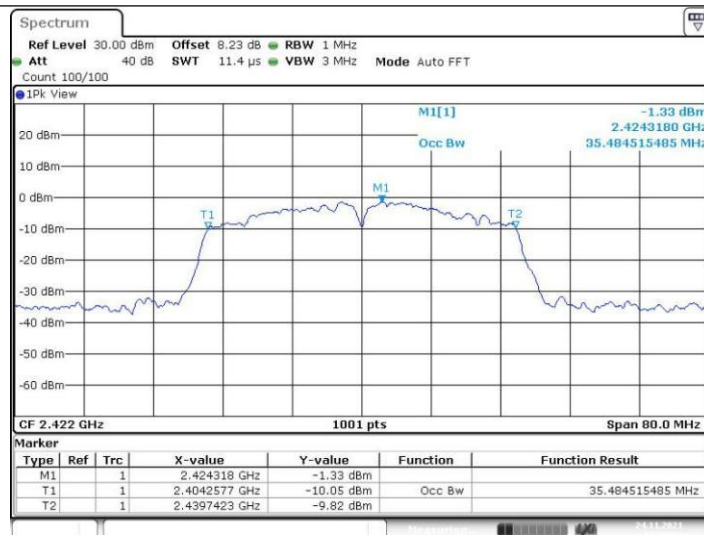


802.11n(HT40)_2422 MHz

6dB Bandwidth

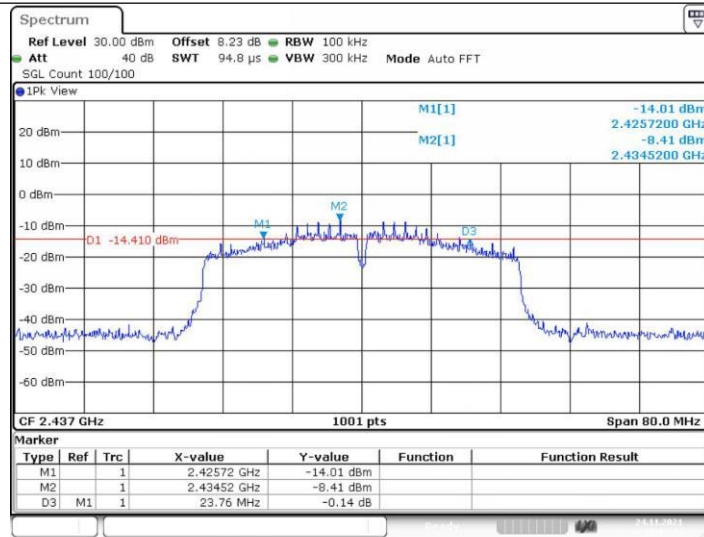


99% Bandwidth



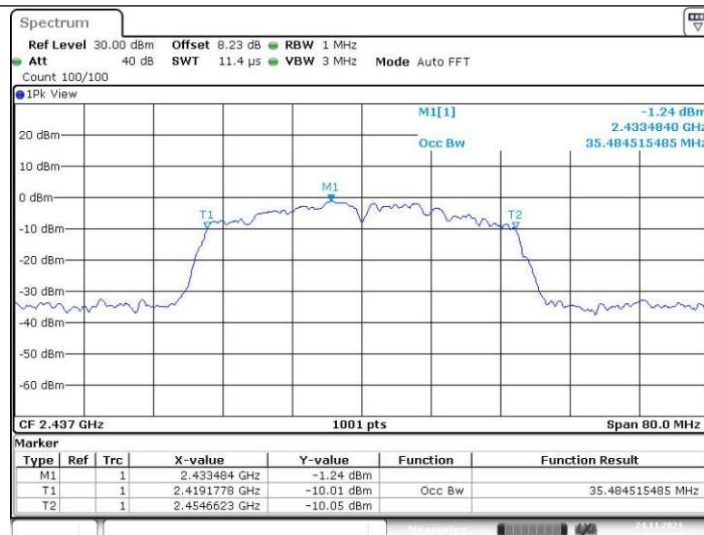
802.11n(HT40)_2437 MHz

6dB Bandwidth



Date: 24.NOV.2021 15:32:44

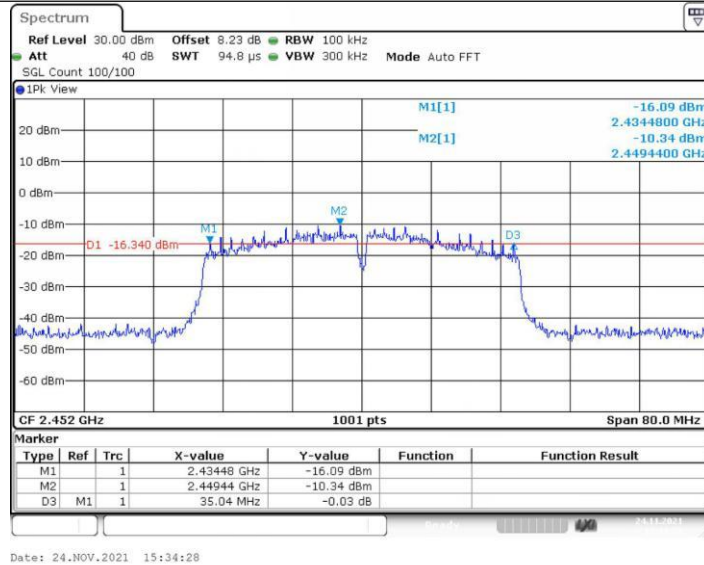
99% Bandwidth



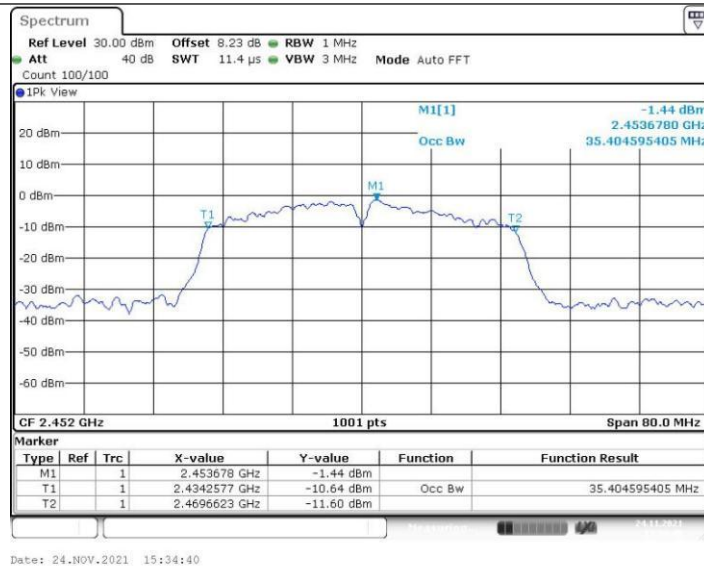
Date: 24.NOV.2021 15:32:56

802.11n(HT40)_2452 MHz

6dB Bandwidth



99% Bandwidth



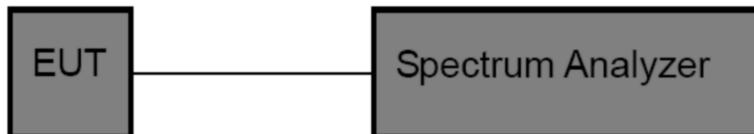
3.5. Band edge and Spurious Emission (Conducted)

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.

Test Configuration



Test Procedure

1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator.
2. Spectrum Setting:
 - RBW=100KHz
 - VBW=300KHz.
 - Detector function: Peak.
 - Trace: Max hold.
 - Sweep = Auto couple.

Allow the trace to stabilize.

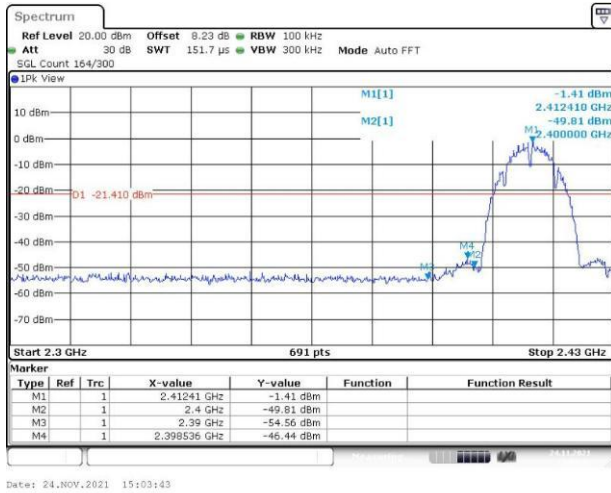
Test Mode

Please refer to the clause 2.2.

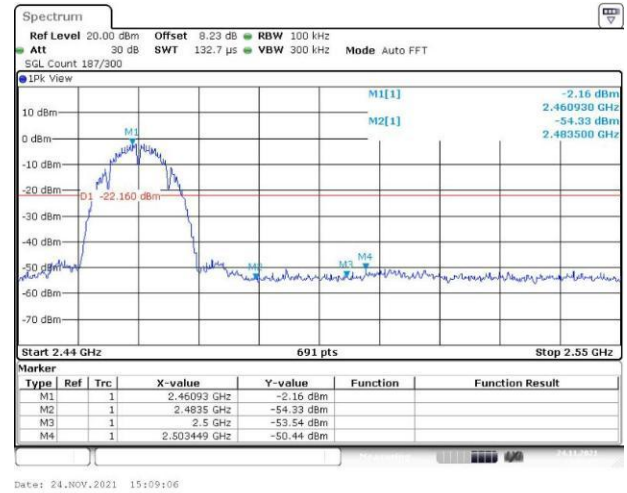
Test Results

802.11b

CH01-Bandedge

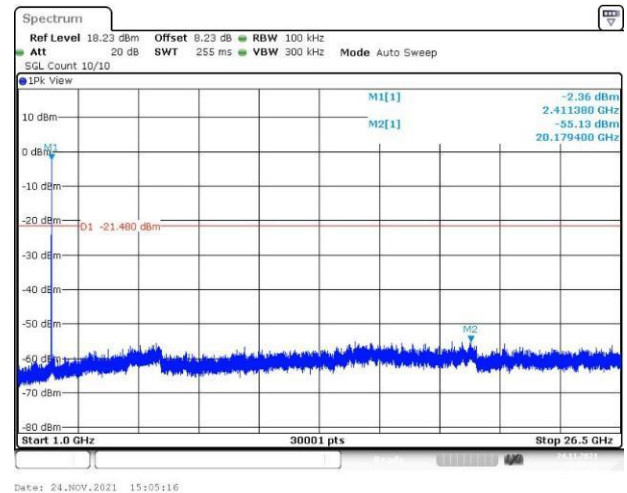
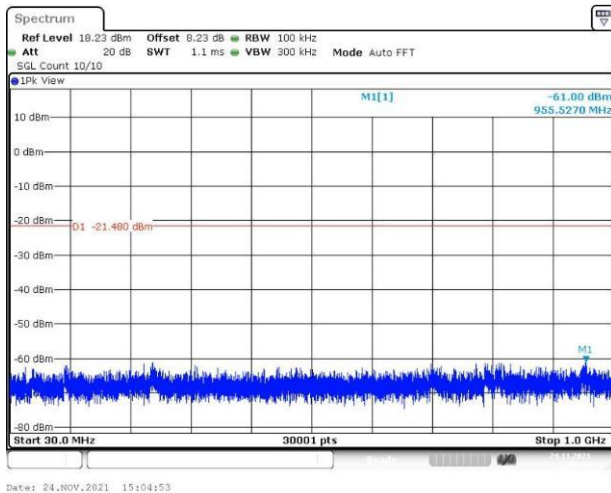


CH11-Bandedge

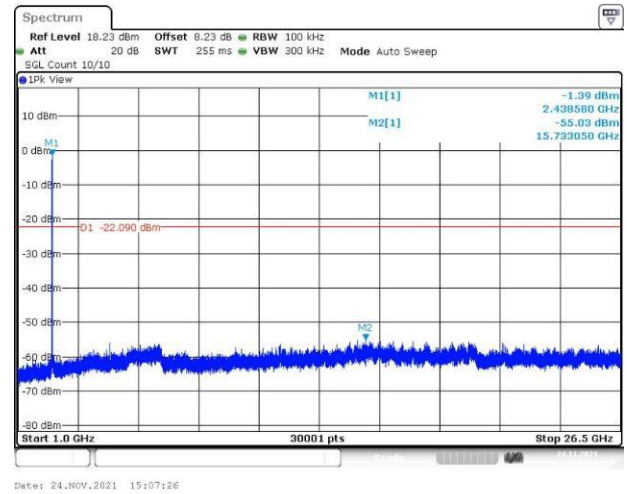
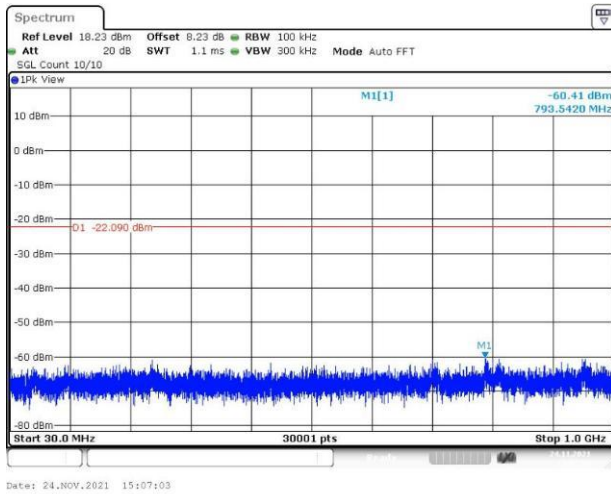


802.11b

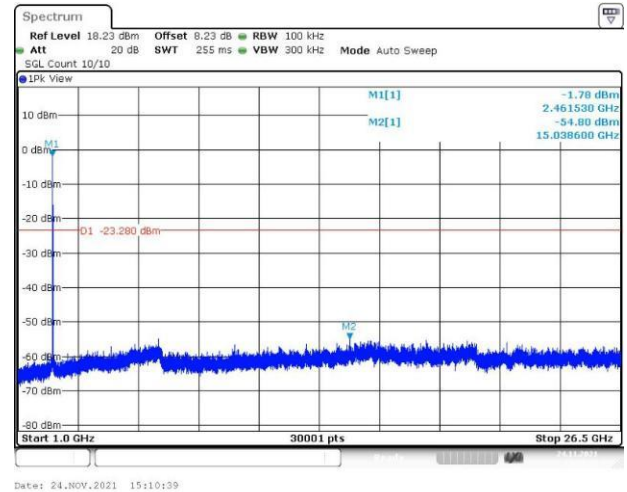
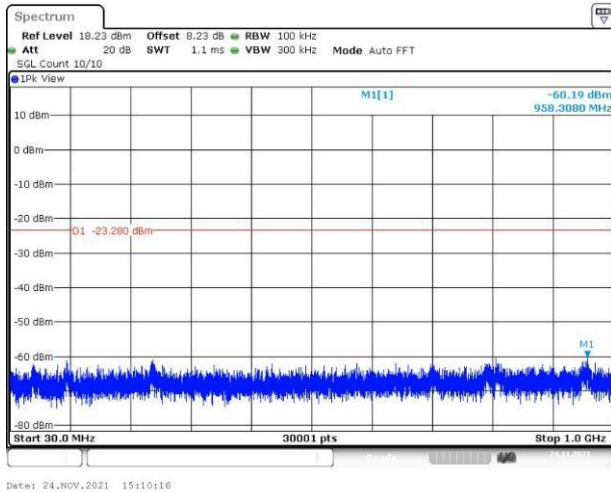
CH01-SE



CH06-SE



CH11-SE

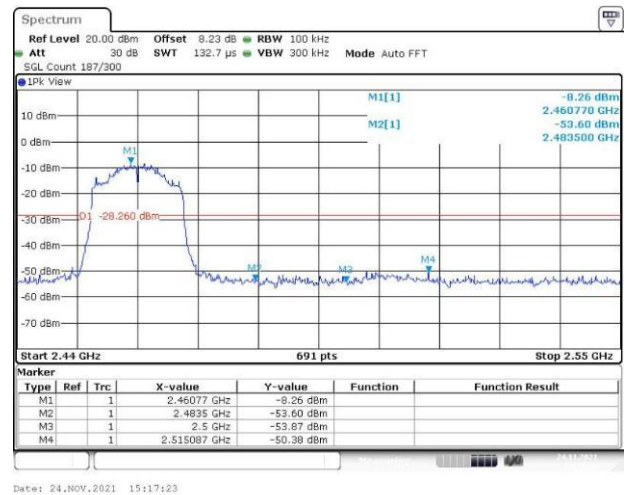


802.11g

CH01-Bandedge

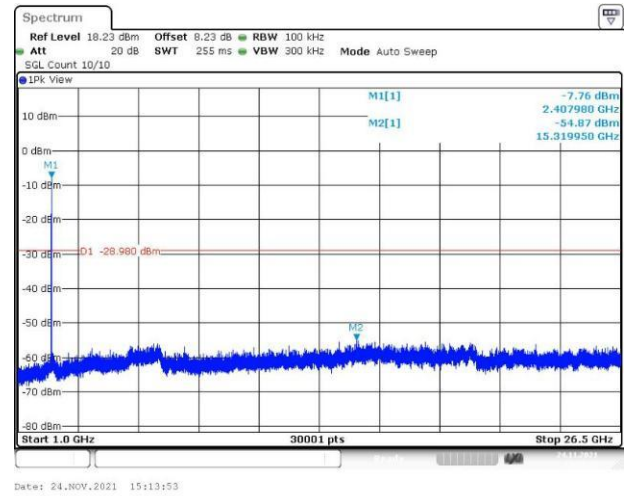
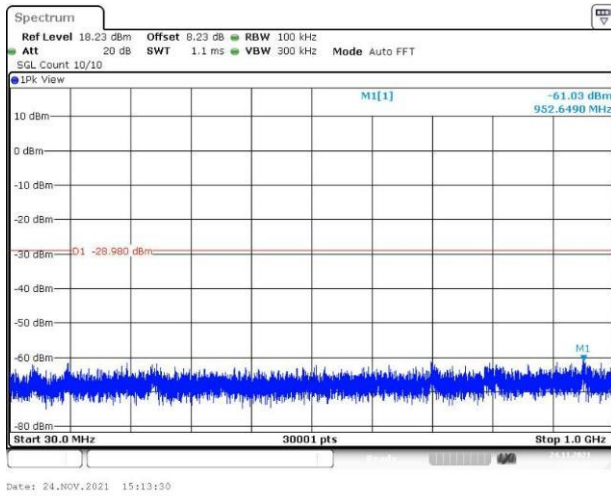


CH11-Bandedge

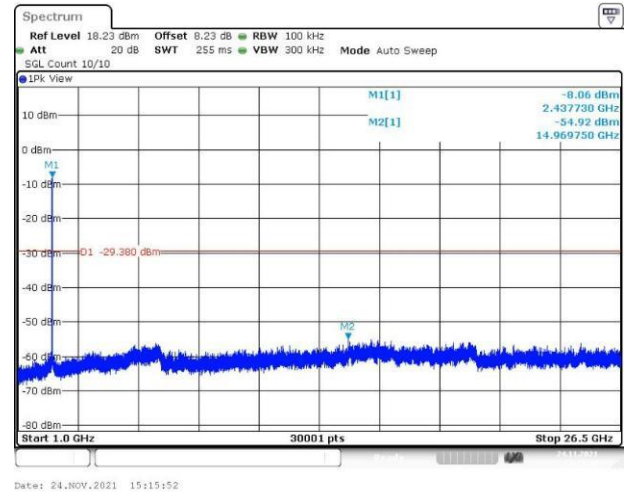
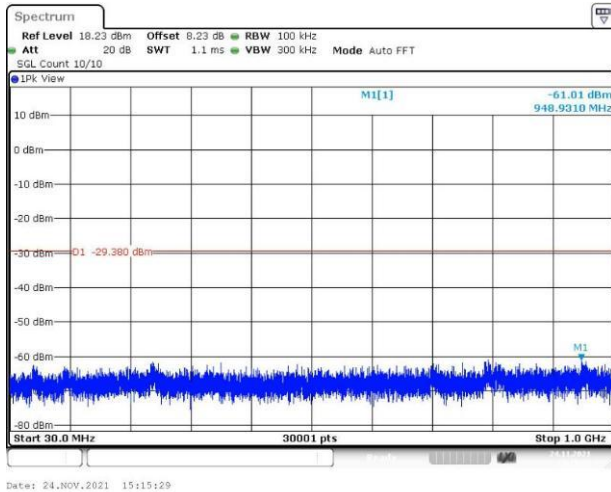


802.11g

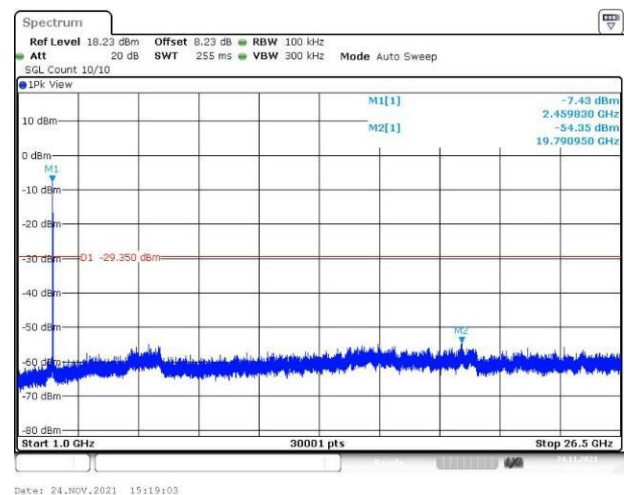
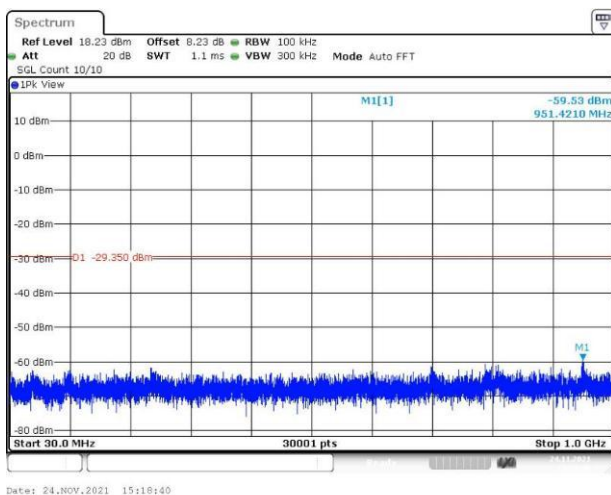
CH01-SE



CH06-SE

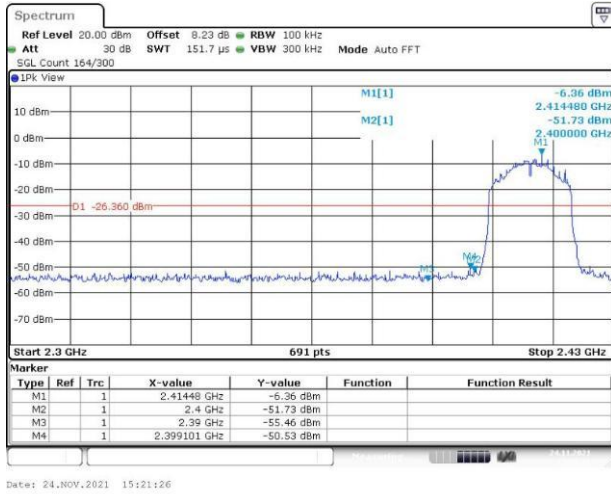


CH11-SE

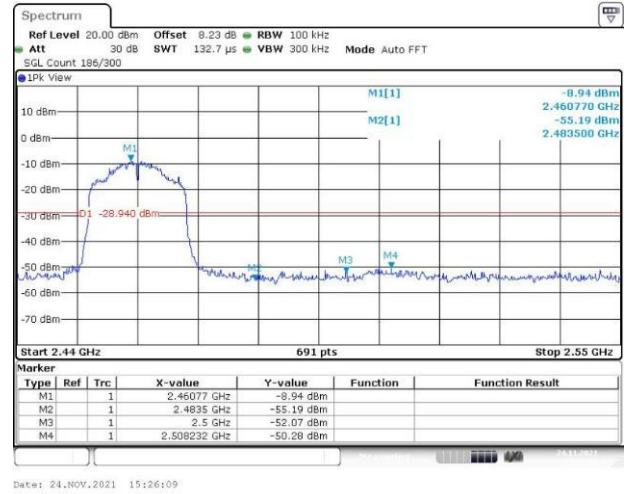


802.11n(HT20)

CH01-Bandedge

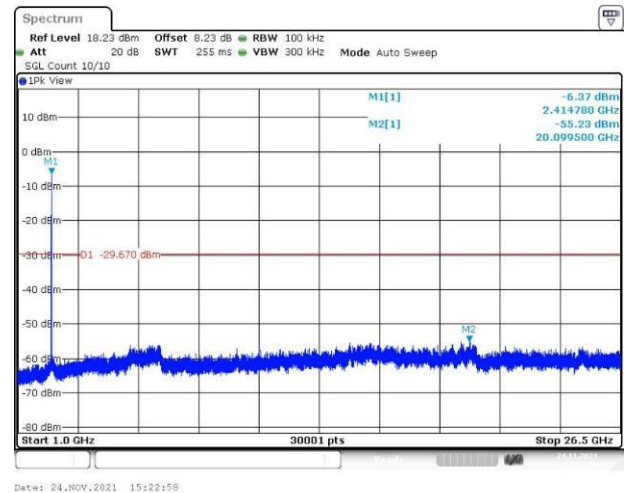
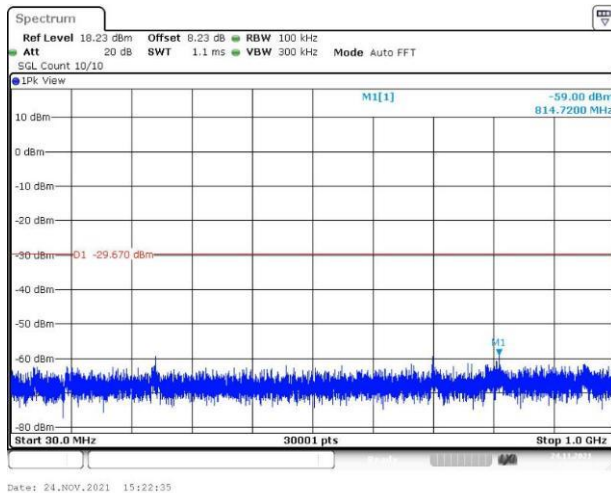


CH11-Bandedge

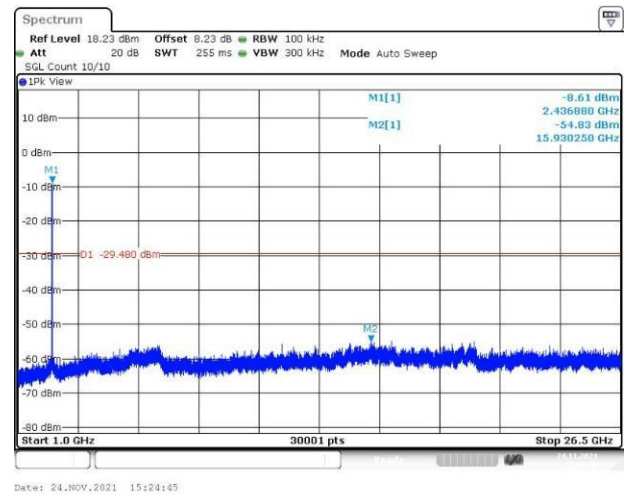
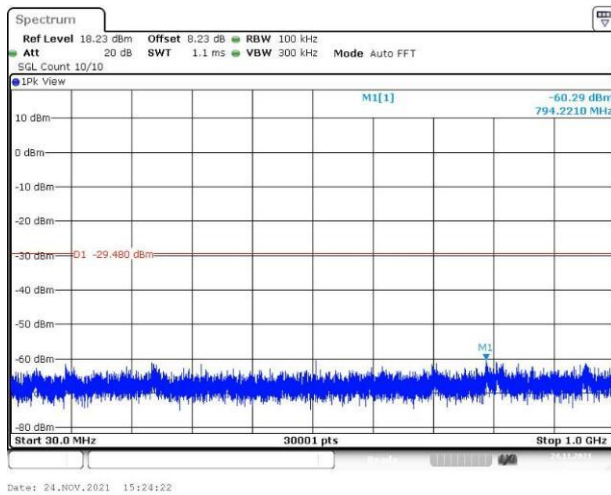


802.11n(HT20)

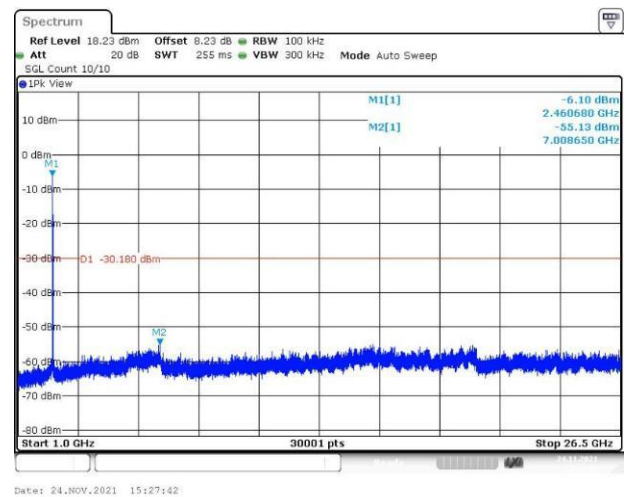
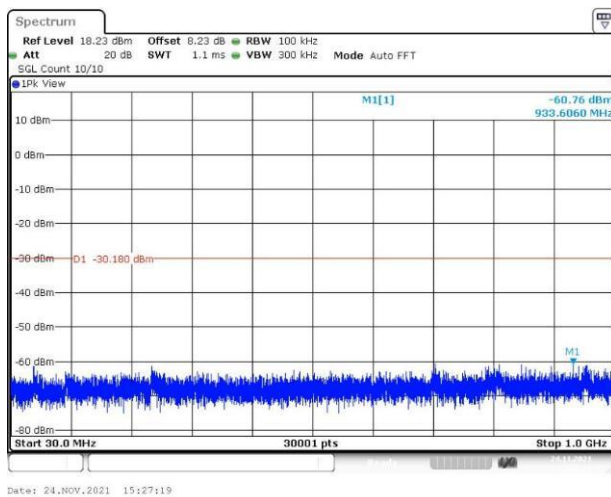
CH01-SE



CH06-SE

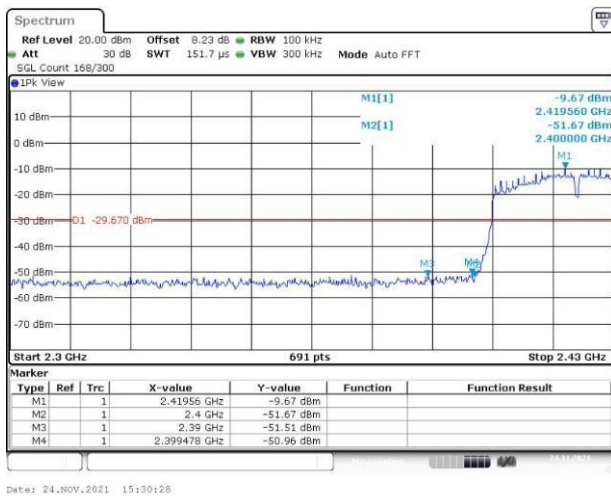


CH11-SE



802.11n(HT40)

CH03-Bandedge

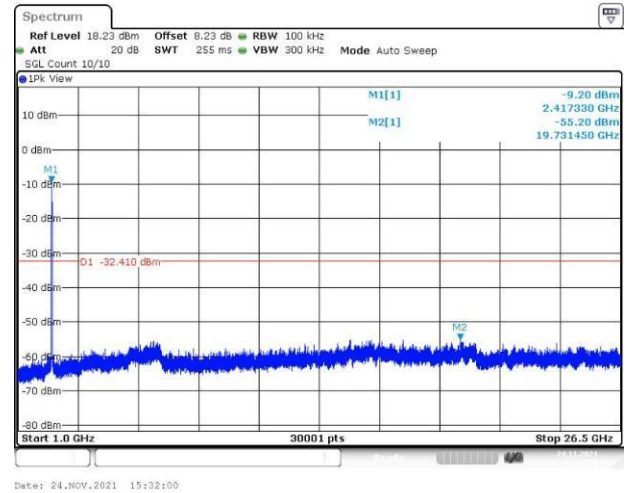
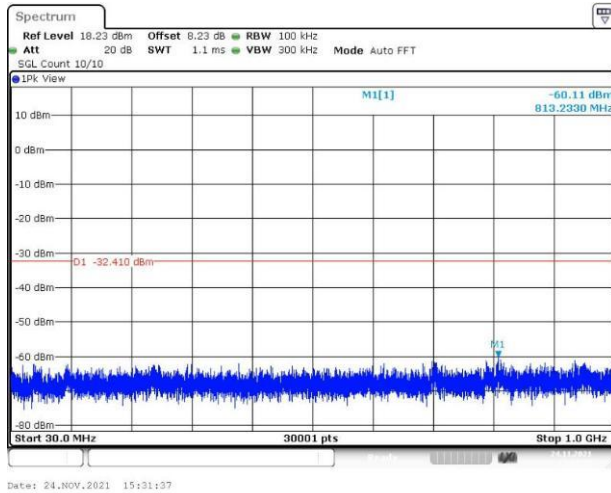


CH09-Bandedge

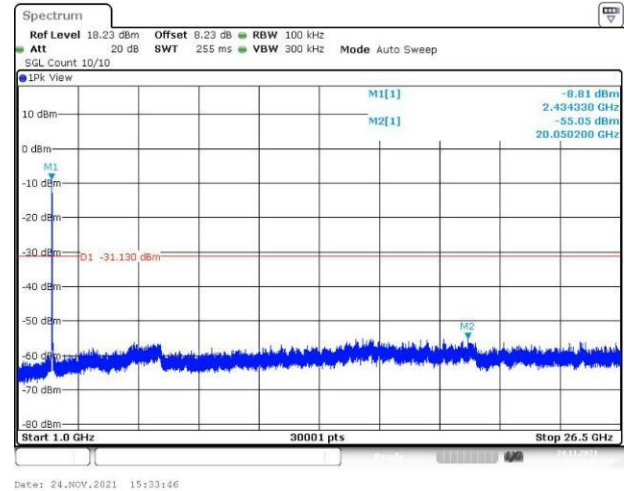
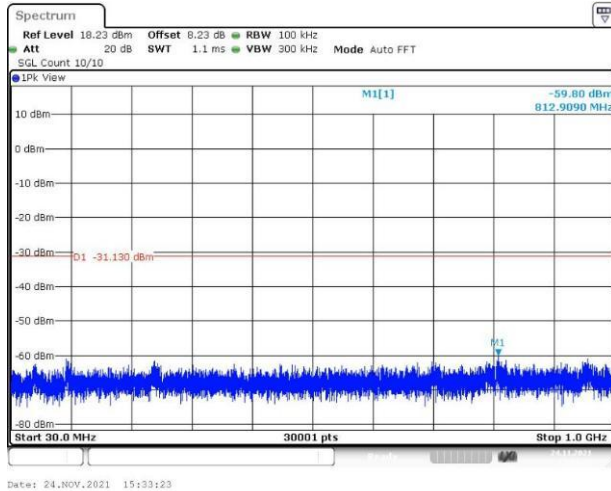


802.11n(HT40)

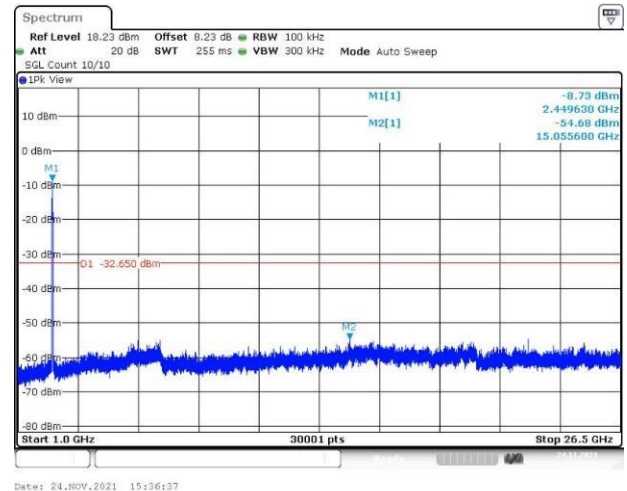
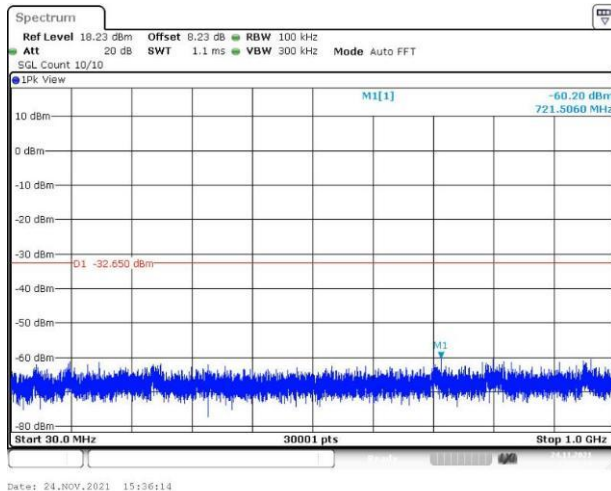
CH03-SE



CH06-SE



CH09-SE



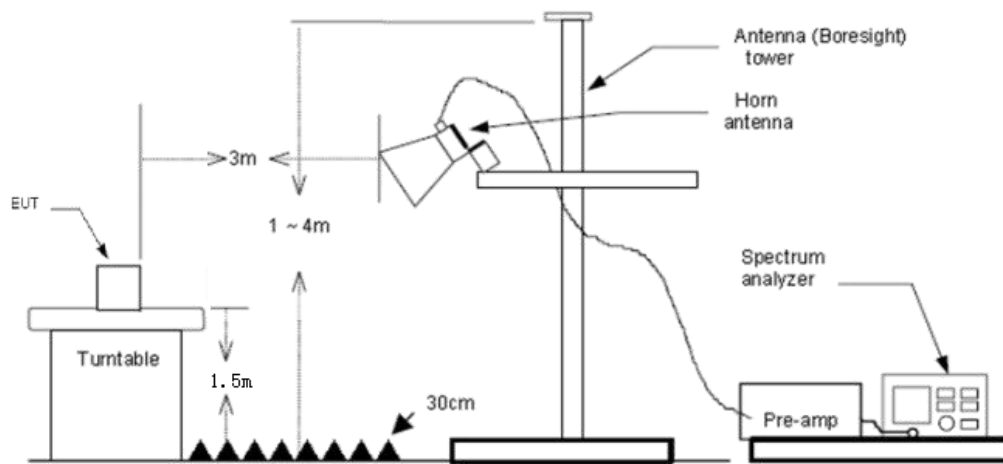
3.6. Band Edge Emissions(Radiated)

Limit

Restricted Frequency Band (MHz)	(dBuV/m)(at 3m)	
	Peak	Average
2310 ~2390	74	54
2483.5 ~2500	74	54

Note: All restriction bands have been tested, only the worst case is reported.

Test Configuration



Test Procedure

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:
RBW=1MHz, VBW=3MHz PEAK detector for Peak value.
RBW=1MHz, VBW=10Hz with PEAK detector for Average Value.

Test Mode

Please refer to the clause 2.2.

Test Results

Note:

1. Measurement = Reading level + Correct Factor
Correct Factor=Antenna Factor + Cable Loss -Preamplifier Factor
2. Pre-scan 802.11b, 802.11g, 802.11n(HT20) and 802.11n(HT40) mode, and found the 802.11n20 mode which it is worse case, so only show the test data for worse case.

TRF No. FCC Part 15.247_R1

Add : Building 5, No. 316, Jianghong South Road Binjiang District, Hangzhou 310052, China

Tel : +(86) 0571-8836 6861 Fax: +(86) 0571-8836 6821 E-mail : server@ksign.cn Web: www.ksign.cn