

DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

TEST REPORT

SCOPE OF WORK

FCC TESTING—ECH-REFL01-5G, ECH-REFL02-5G

REPORT NUMBER

190926001SZN-001

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DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Application
For
Certification

FCC ID: 2ATAP-ECHELON

Echelon Reflect, Echelon Reflect Touch

Model: ECH-REFL01-5G, ECH-REFL02-5G

2.4GHz Wi-Fi Transceiver

Report No.: 190926001SZN-001

We hereby certify that the sample of the above item is considered to comply with the
requirements of FCC Part 15, Subpart C for Intentional Radiator,
mention 47 CFR [10-1-18]

Prepared and Checked by:

Approved by:

Jeff Liang
Engineer

Kidd Yang
Technical Supervisor
Date: October 17, 2019

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Intertek Testing Services Shenzhen Ltd. Longhua Branch

101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, Shenzhen, P.R. China.

Tel: (86 755) 8601 6288

Fax: (86 755) 8601 6751

MEASUREMENT/TECHNICAL REPORT

This report concerns (check one) Original Grant ☒ Class II Change ☐

Equipment Type: DTS - Part 15 Digital Transmission Systems (Wi-Fi transmitter portion)

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes ☐ No ☒

If yes, defer until : _____
date

Company Name agrees to notify the Commission by: _____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes ☐ No ☒

If no, assumed Part 15, Subpart C for intentional radiator - the new 47 CFR [10-01-18] Edition] provision.

Report prepared by:

Jeff Liang
Intertek Testing Services Shenzhen Ltd. Longhua Branch
101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community,
GuanHu Subdistrict, LongHua District, Shenzhen, P.R. China.
Tel: (86 755) 8601 6288 Fax: (86 755) 8601 6751

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1.0 Summary of Test results

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Applicant Address: ROOM 203, NO. 48 OF CHUANGYE 1ST RD., MULUN AREA, CHANGPING TOWN

DONGGUAN Guangdong China

Manufacturer: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Manufacturer Address: ROOM 203, NO. 48 OF CHUANGYE 1ST RD., MULUN AREA, CHANGPING

TOWN DONGGUAN Guangdong China

Model: ECH-REFL01-5G, ECH-REFL02-5G

FCC ID: 2ATAP-ECHELON

TEST ITEM	REFERENCE	RESULTS
Max. Output power	15.247(b)(3)	Pass
6 dB Bandwidth	15.247(a)(2)	Pass
Max. Power Density	15.247(e)	Pass
Out of Band Antenna Conducted Emission	15.247(d)	Pass
Radiated Emission in Restricted Bands	15.247(d)	Pass
Conducted Emission	15.209	Pass
Antenna Requirement	15.203	Pass (See Notes)

Notes: The EUT uses an Integral Antenna which in accordance to Section 15.203 is considered sufficient to comply with the provisions of this section.

2.0 General Description

2.1 Product Description

The Equipment Under Test (EUT) is an Echelon Reflect with BT5.0 (dual-mode) operating in 2402-2480MHz, 2.4G Wi-Fi function operating in 2412-2462MHz and 5G Wi-Fi function operating in 5180-5240&5745-5825MHz. The EUT is powered by A.C. 120V, 60Hz. Bluetooth and WIFI transmitters are share one antenna and can transmit simultaneously, but 2.4G WIFI and 5G WIFI cannot transmit simultaneously. User cannot access USB/LAN/SD card ports in normal use. For more detailed features description, please refer to the user's manual.

Type of Modulation: CCK, BPSK, QPSK, 16QAM, 64QAM, DQPSK, DBPSK

Antenna Type: Internal Antenna

Antenna Gain: 3dBi

The model: ECH-REFL02-5G is the same as the model: ECH-REFL01-5G in hardware aspect. Their difference in product name, model number and with/without support touch screen function for marketing purpose. Details as below:

Product name	Model Number	Description
Echelon Reflect	ECH-REFL01-5G	Not support touch screen function
Echelon Reflect Touch	ECH-REFL02-5G	Support touch screen function

Partial tests are required to both designing schemes after evaluation, but only worst-case is reflected in the report.

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

2.2 Related Submittal(s) Grants

This is an application for certification of:

DTS- Part 15 Digital Transmission Systems (2.4GHz Wi-Fi transmitter portion).

Remaining functions are subjected to the following documents:

For the 5G Wi-Fi function was tested and demonstrated in report 190926001SZN-002.

For the BT 5.0 EDR function was tested and demonstrated in report 190926001SZN-003.

For the BT 5.0 BLE function was tested and demonstrated in report 190926001SZN-004.

For other functions were reported in the SDoC report: 190926001SZN-005.

2.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013) and KDB 558074 D01 v05r02. Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Justification Section" of this Application.

2.4 Test Facility

The Semi-anechoic chamber and shielded room used to collect the radiated data and conducted data are **Intertek Testing Services Shenzhen Ltd. Longhua Branch** and located at 101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community, GuanHu Subdistrict, LongHua District, Shenzhen, P.R. China. This test facility and site measurement data have been fully placed on file with File Number: CN1188.

3.0 System Test Configuration

3.1 Justification

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables were manipulated to produce worst case emissions. The EUT was powered by A.C. 120V, 60Hz during the test. Both designing schemes have been considered, only the worst data was reported in this report.

On 802.11b/g/n-HT20 mode, only one antenna is used, and all data rate were tested and only the worst case data is shown in the report.

For maximizing emissions, the EUT was rotated through 360°, the EUT was placed on the styrene turntable with 0.8m up to 1GHz and 1.5 m above 1GHz. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

The rear of unit shall be flushed with the rear of the table.

Radiated emission measurement were performed the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

3.2 EUT Exercising Software

The EUT exercise program (provided by client) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The worst case configuration is used in all specified testing.

Test Software: Ampak RFTTestTool, VER: 5.6

The parameters of test software setting:

During the test, Channel and power controlling software provided by the applicant was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the application and is going to be fixed on the firmware of the end product.

3.3 Special Accessories

N/A.

3.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

3.5 Equipment Modification

Any modifications installed previous to testing by DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Longhua Branch.

3.6 Support Equipment List and Description

Description	Manufacturer	Model No.
Portable computer (Provided by Intertek)	DELL	Latitude 3480

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 15, 2019

Model: ECH-REFL01-5G

4.0 Measurement Results

4.1 Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b)(3):

The antenna power of the EUT was connected to the input of a broadband peak RF power meter. The power meter have a video bandwidth that is greater than DTS bandwidth and utilize a fast-responding diode detector. Power was read directly at the EUT antenna terminals with cable loss added.

For antennas with gains of 6 dBi or less, maximum allowed Transmitter output is 1 watt (+30 dBm).

4.1.1 Test Result

Operating Mode: Standalone transmission (2.4G WIFI)

IEEE 802.11b (Antenna Gain = 3dBi) (CCK, 1Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	17.2	52.48
Middle Channel: 2437	17.3	53.70
High Channel: 2462	17.0	50.12

IEEE 802.11g (Antenna Gain = 3dBi) (16QAM, 6Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	20.5	112.20
Middle Channel: 2437	20.3	107.15
High Channel: 2462	20.2	104.71

IEEE 802.11n-HT20 (Antenna Gain = 3dBi) (64QAM, 6Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	20.6	114.82
Middle Channel: 2437	20.6	114.82
High Channel: 2462	20.4	109.65

Operating Mode: Simultaneous transmission (BT+2.4G WIFI)

IEEE 802.11b (Antenna Gain = 3dBi) (CCK, 1Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	17.6	57.54
Middle Channel: 2437	17.5	56.23
High Channel: 2462	17.3	53.70

IEEE 802.11g (Antenna Gain = 3dBi) (16QAM, 6Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	20.6	114.82
Middle Channel: 2437	20.5	112.20
High Channel: 2462	20.3	107.15

IEEE 802.11n-HT20 (Antenna Gain = 3dBi) (64QAM, 6Mbps)		
Frequency (MHz)	Output in dBm (Peak Reading)	Output in mWatt
Low Channel: 2412	20.9	123.03
Middle Channel: 2437	20.8	120.23
High Channel: 2462	20.6	114.82

Cable loss: 2.5 dB External Attenuation: 0 dB

Cable loss, external attenuation has been included in OFFSET function

EUT max. output level = 20.9dBm

EUT max. E.I.R.P = 20.9dBm + 3dBi = 23.9dBm = 245.5mW

For RF Exposure, the information is saved with filename: RF exposure.pdf.

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 15, 2019

Model: ECH-REFL01-5G

4.2 Minimum 6 dB RF Bandwidth, FCC Rule 15.247(a) (2):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RES BW was set to 100 KHz according to FCC KDB 558074 D01 v05r02. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

Limit: The 6 dB Bandwidth is at least 500 kHz.

4.2.1 Test Result

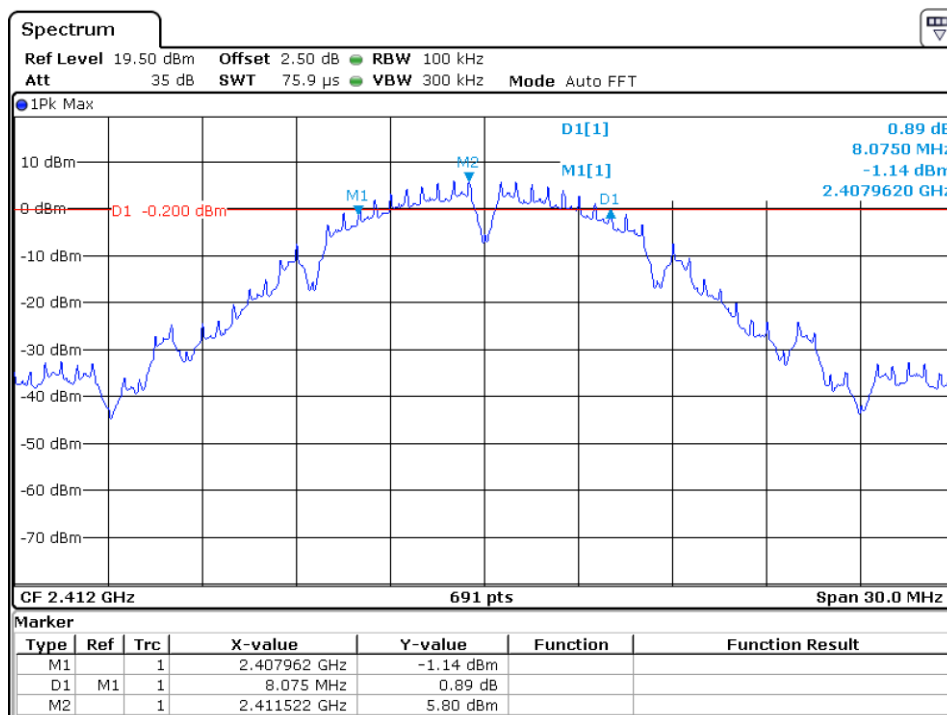
IEEE 802.11b (CCK, 1Mbps)	
Frequency (MHz)	6 dB Bandwidth (MHz)
2412	8.075
2437	8.075
2462	8.075

IEEE 802.11g (16QAM, 6Mbps)	
Frequency (MHz)	6 dB Bandwidth (MHz)
2412	15.716
2437	15.716
2462	15.716

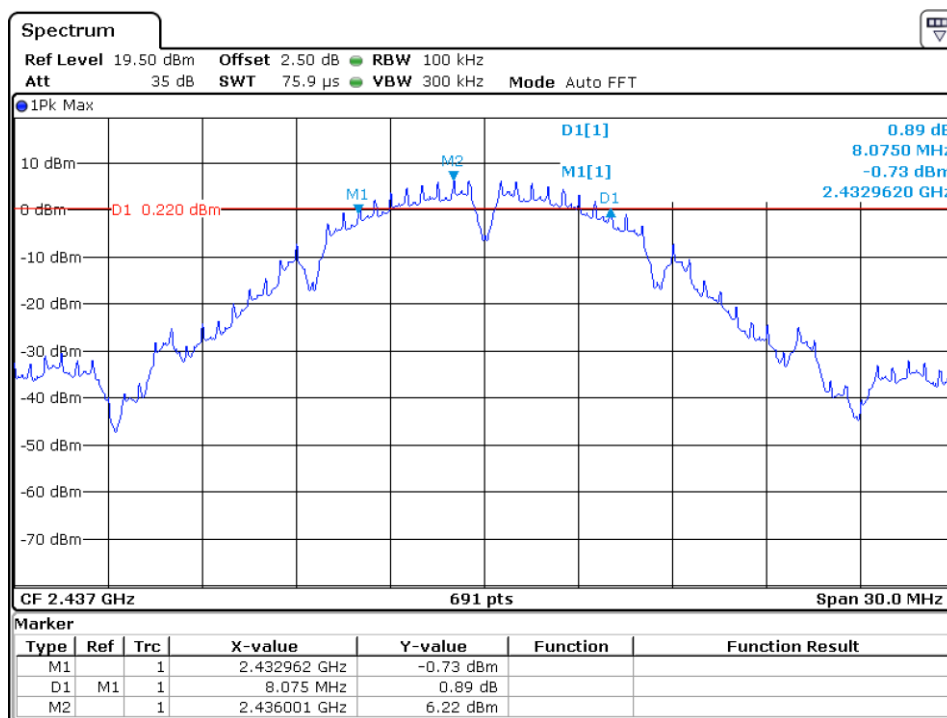
IEEE 802.11n-HT20 (64QAM, 6Mbps)	
Frequency (MHz)	6 dB Bandwidth (MHz)
2412	16.368
2437	16.889
2462	16.324

The test plots are attached as below.

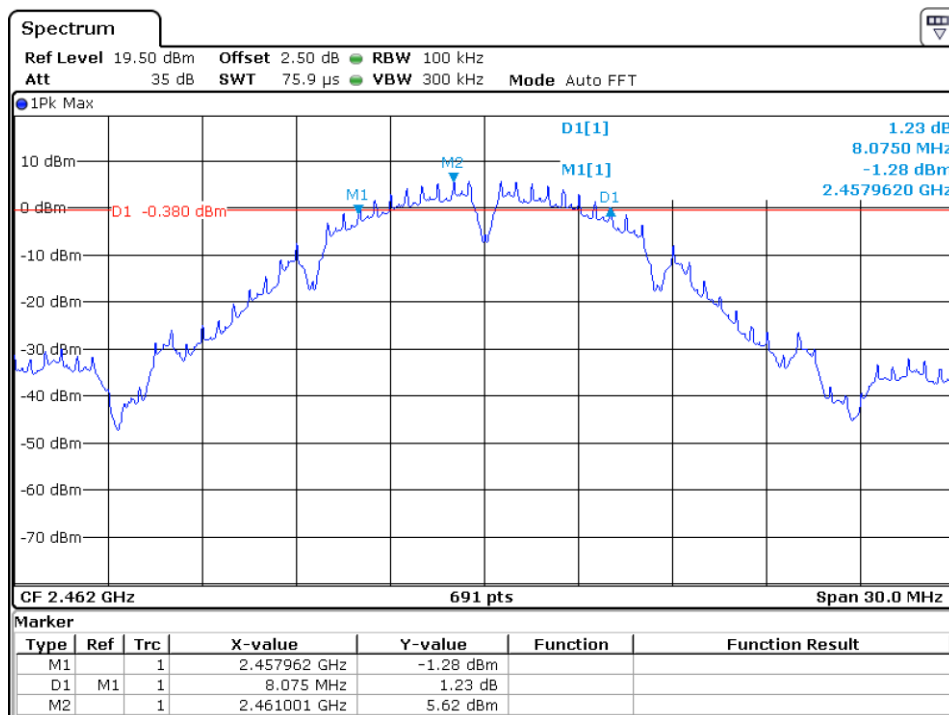
802.11b



Date: 15.OCT.2019 13:46:37

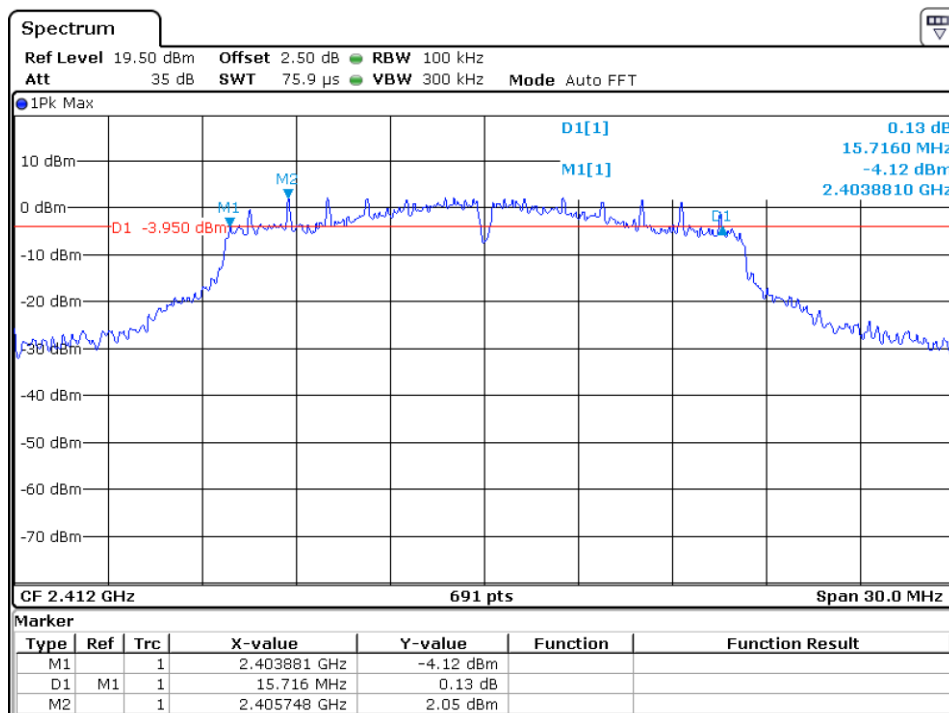


Date: 15.OCT.2019 13:53:04

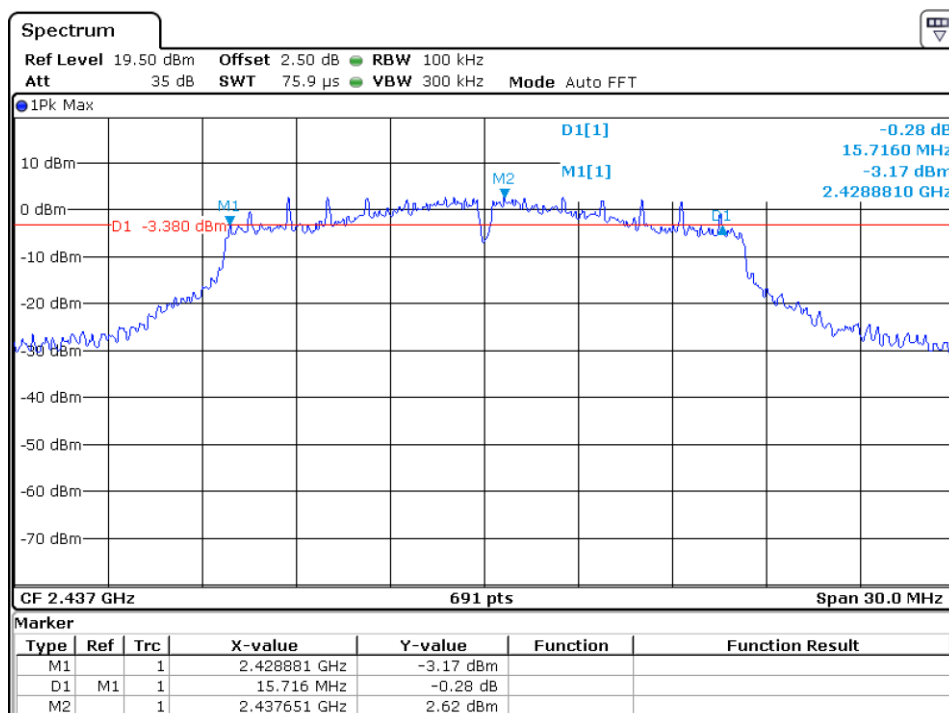


Date: 15.OCT.2019 13:57:54

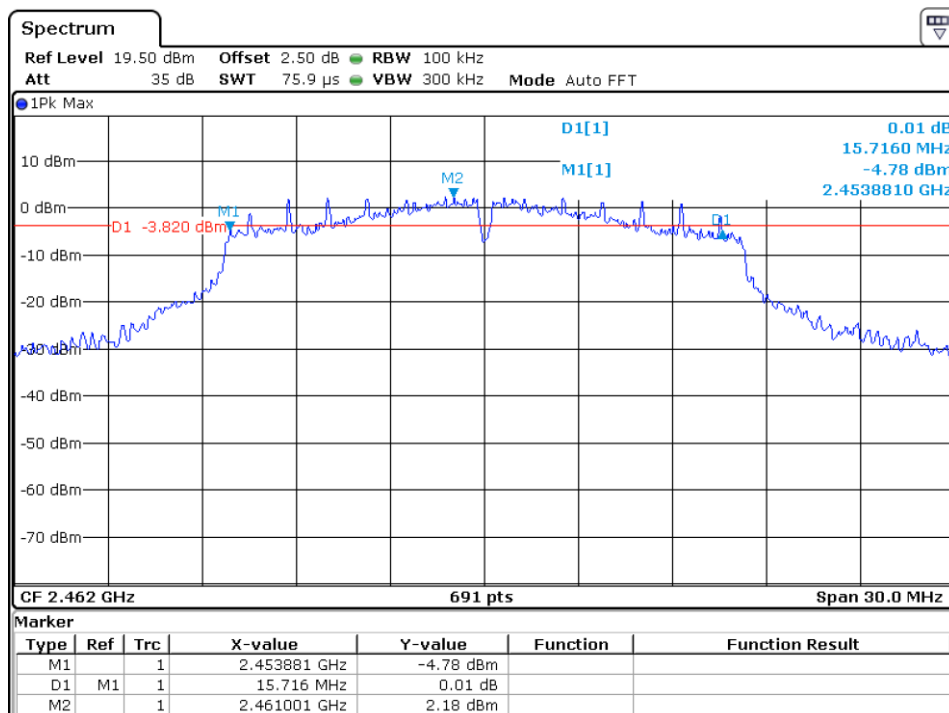
802.11g



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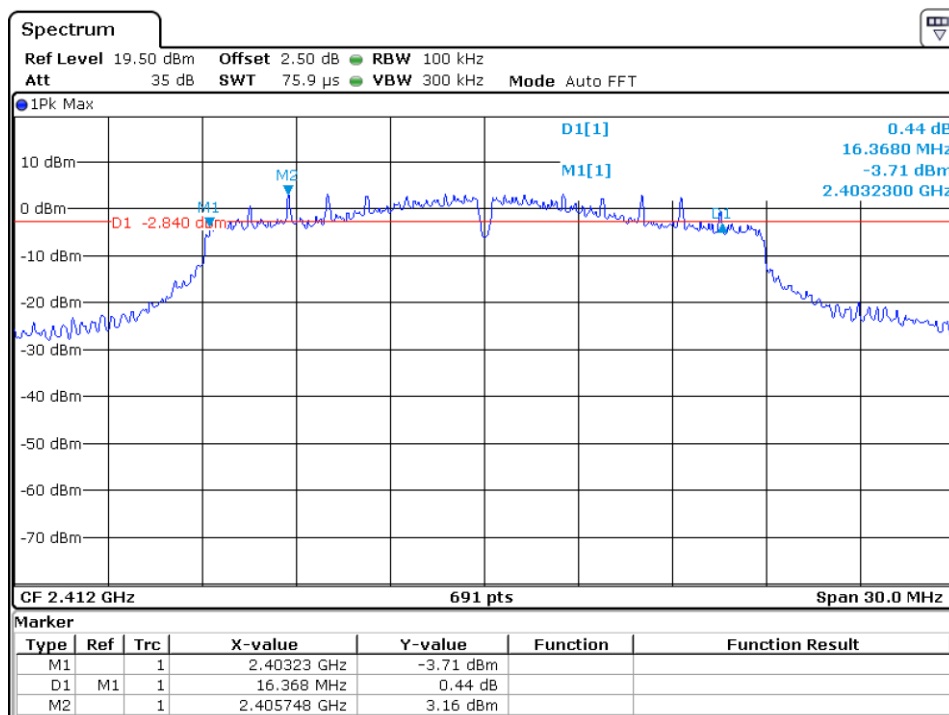


Date: 15.OCT.2019 14:10:45

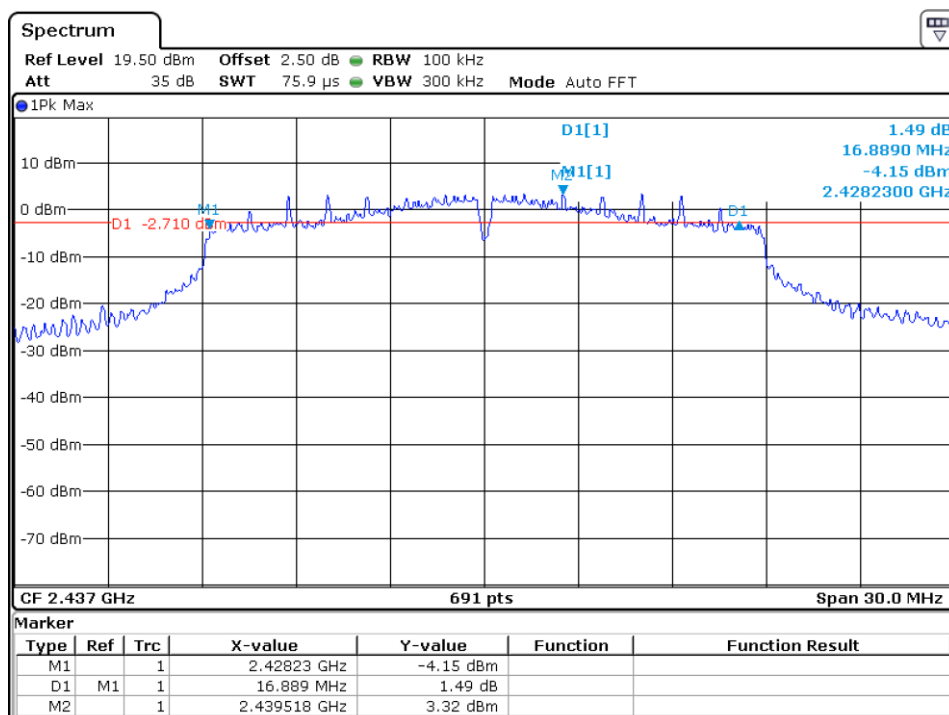


Date: 15.OCT.2019 14:19:24

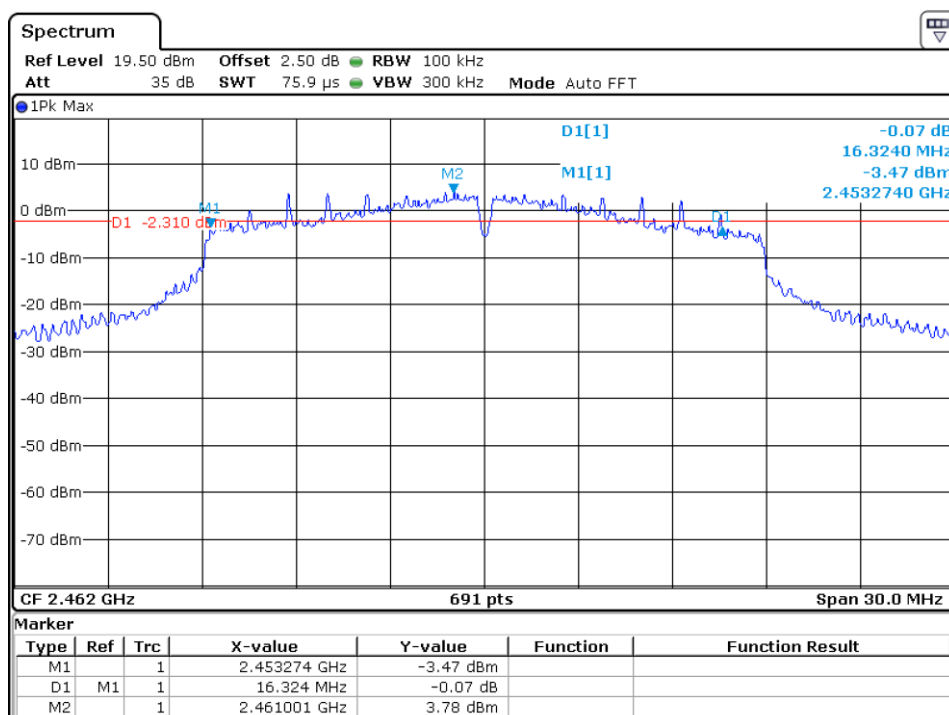
802.11n-HT20



Date: 15.OCT.2019 14:35:09



Date: 15.OCT.2019 14:50:58



Date: 15.OCT.2019 14:56:54

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 15, 2019

Model: ECH-REFL01-5G

4.3 Maximum Power Density Reading, FCC Rule 15.247(e):

The Measurement Procedure PKPSD was set according to the FCC KDB 558074 D01 v05r02.

Antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

Limit: The Power Density does not exceed 8dBm/100 kHz.

4.3.1 Test Result

Operating Mode: Standalone transmission (2.4G WIFI)

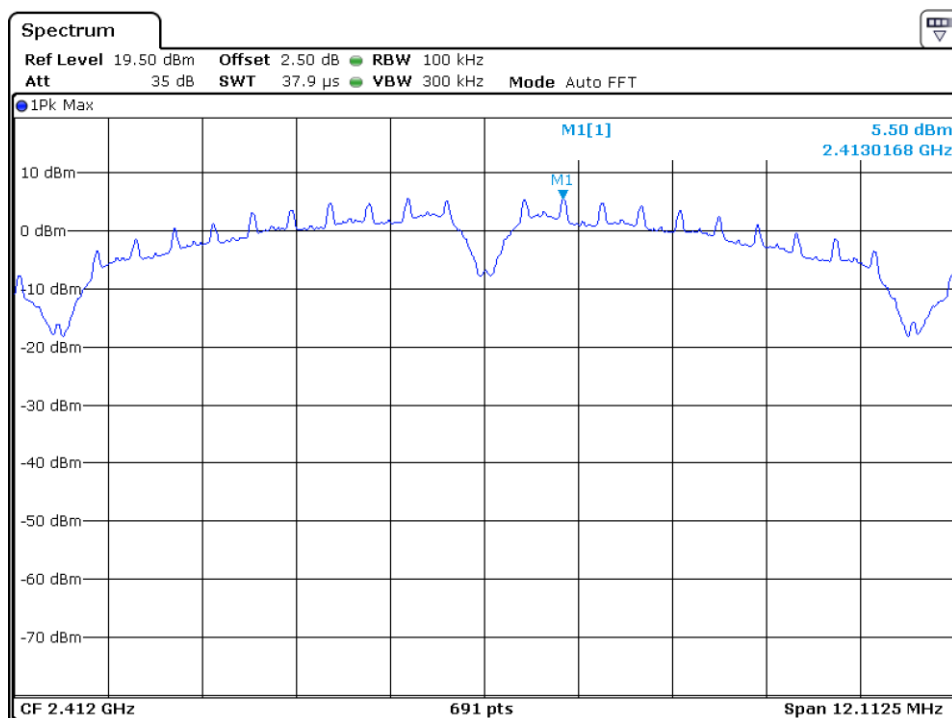
IEEE 802.11b (CCK, 1Mbps)	
Frequency (MHz)	Power Density with RBW 100KHz
2412	5.50
2437	6.26
2462	5.52

IEEE 802.11g (16QAM, 6Mbps)	
Frequency (MHz)	Power Density with RBW 100KHz
2412	2.06
2437	2.61
2462	2.15

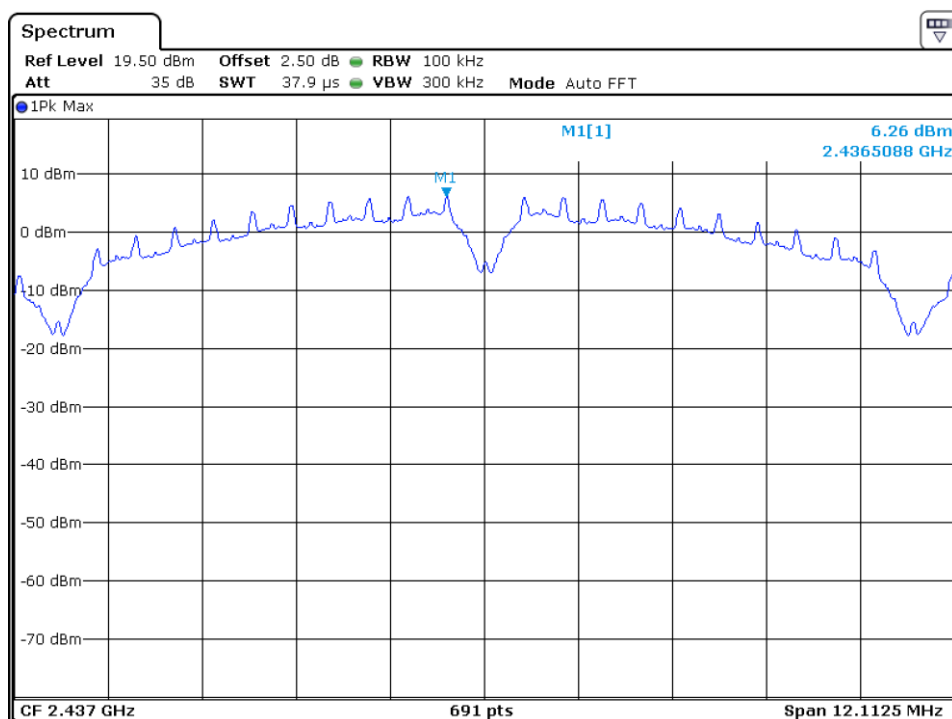
IEEE 802.11n-HT20 (64QAM, 6Mbps)	
Frequency (MHz)	Power Density with RBW 100KHz
2412	3.11
2437	3.21
2462	3.87

The test plots are attached as below.

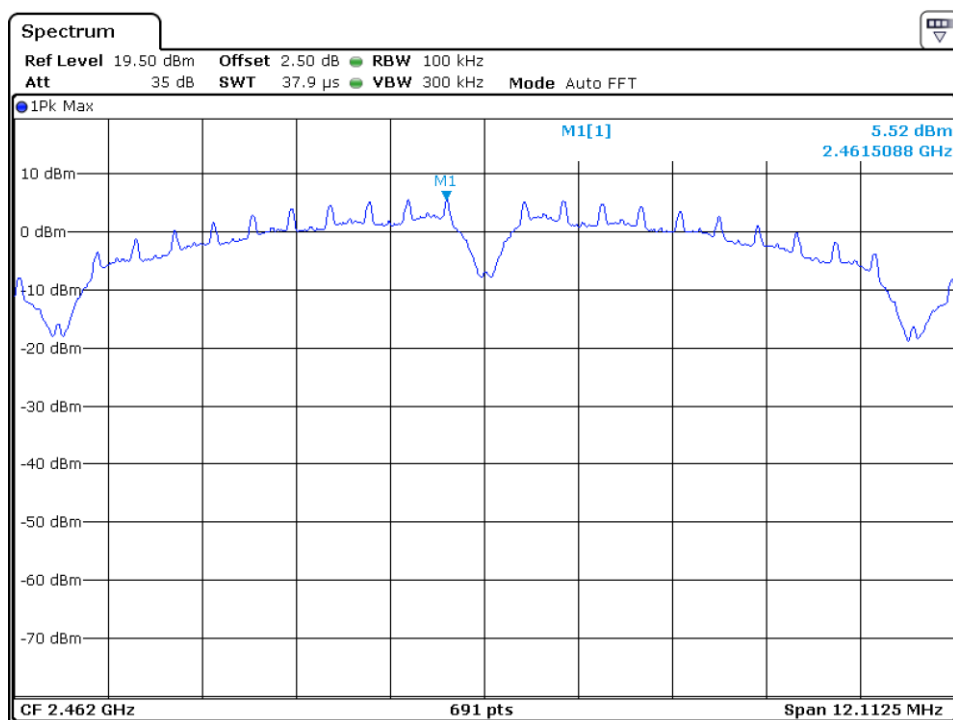
802.11b



Date: 15.OCT.2019 13:48:29

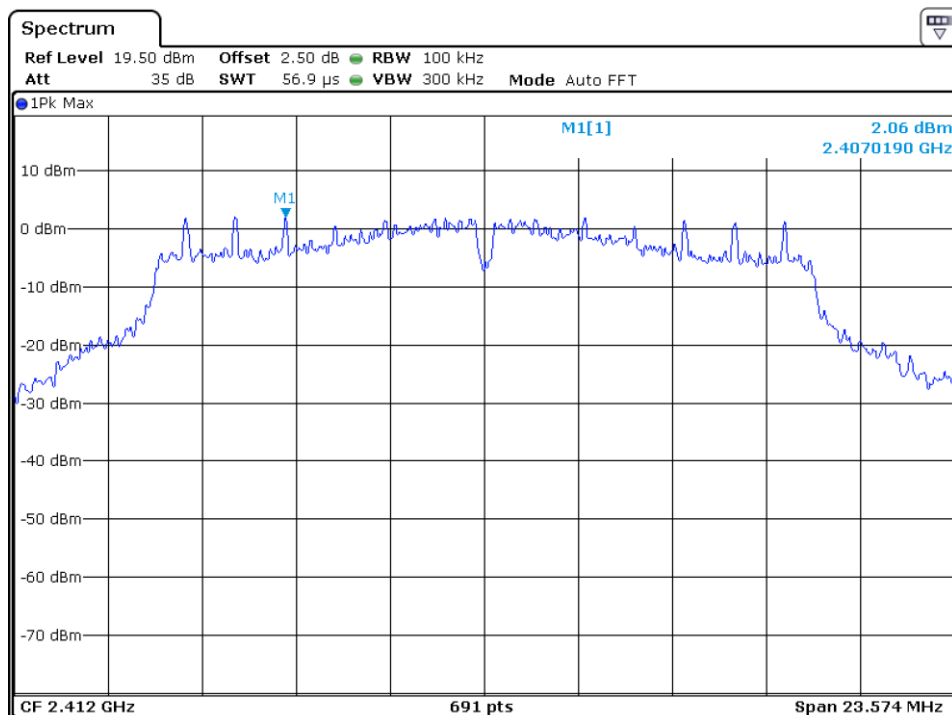


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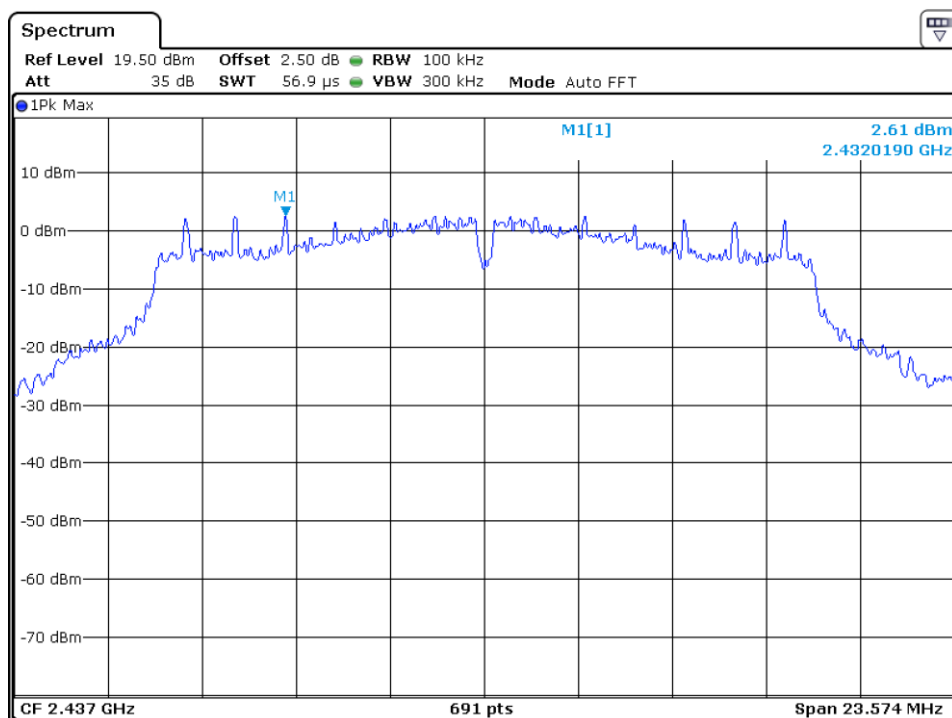


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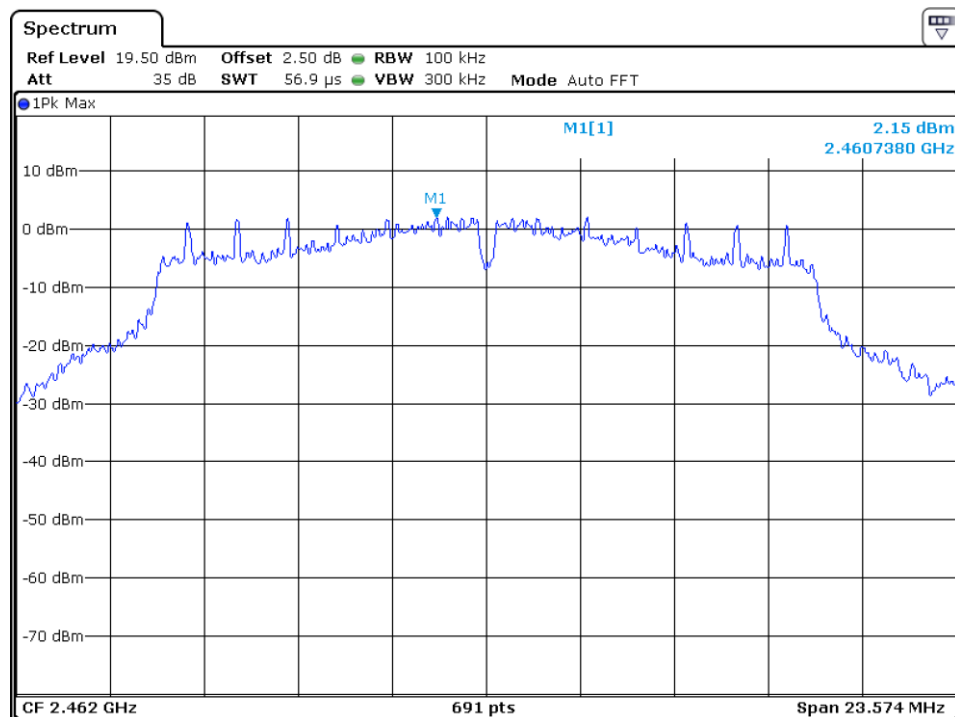
802.11g



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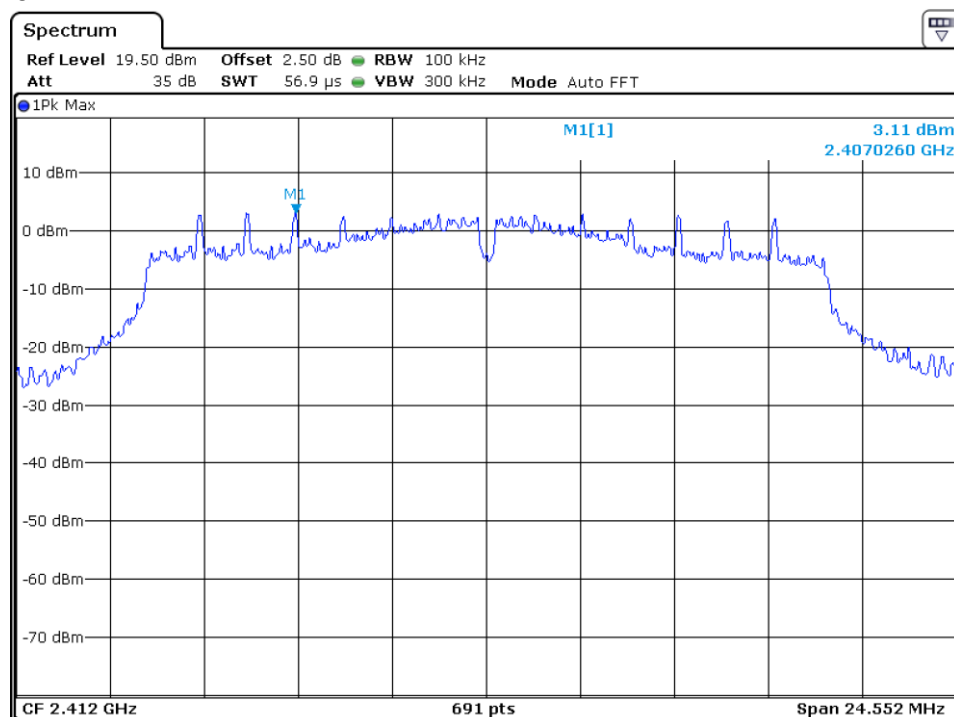


Date: 15.OCT.2019 14:13:07

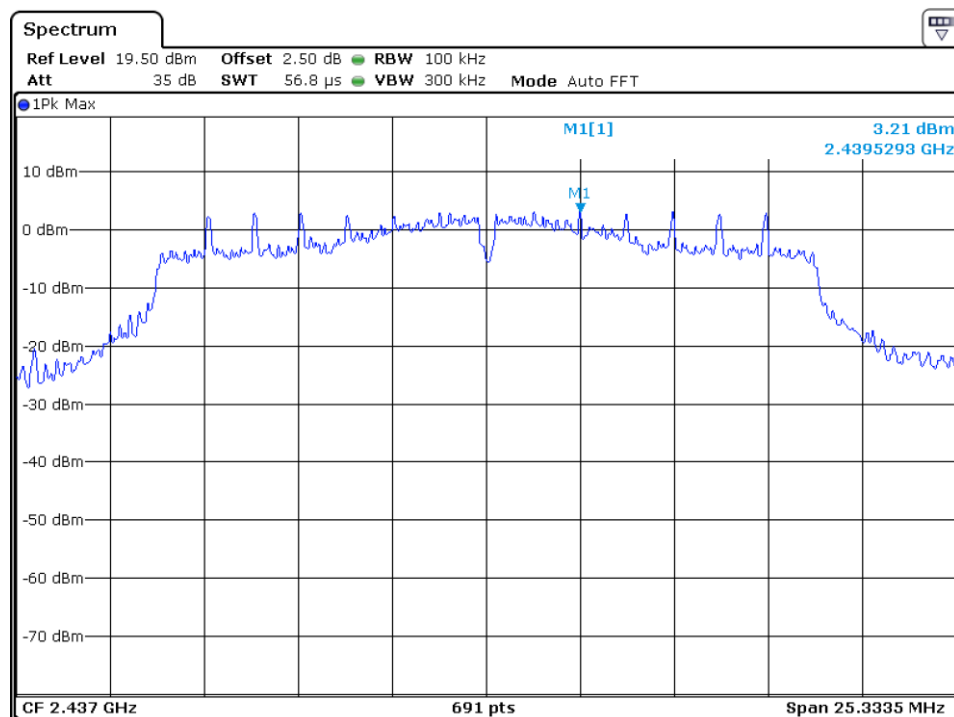


Date: 15.OCT.2019 14:20:17

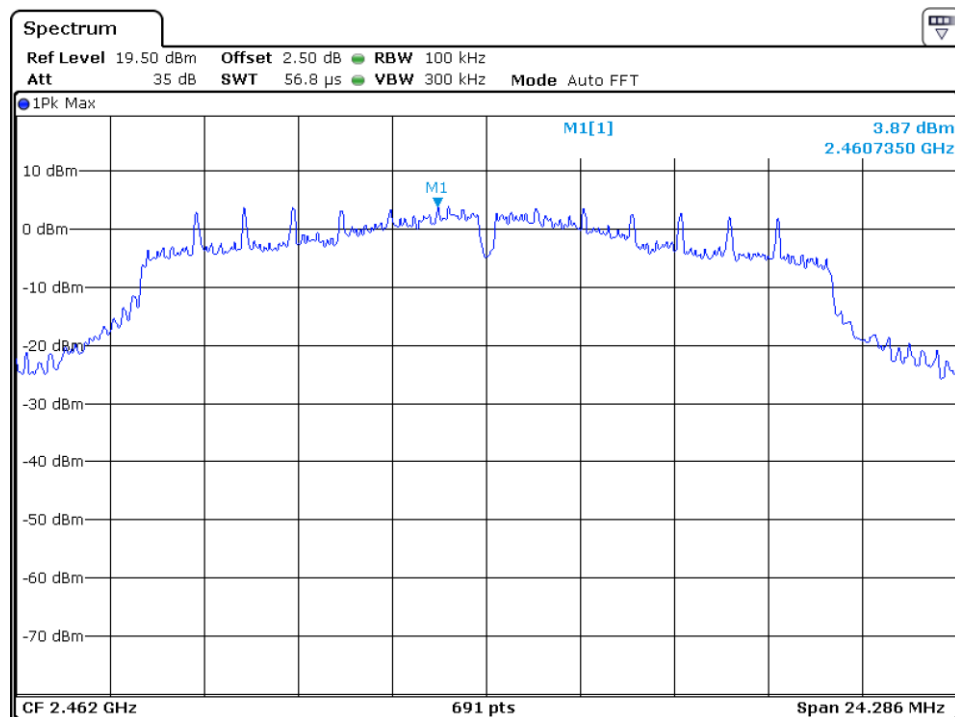
802.11n-HT20



Date: 15.OCT.2019 14:36:24



Date: 15.OCT.2019 14:51:48



Date: 15.OCT.2019 14:57:53

Operating Mode: Simultaneous transmission (BT+2.4G WIFI)

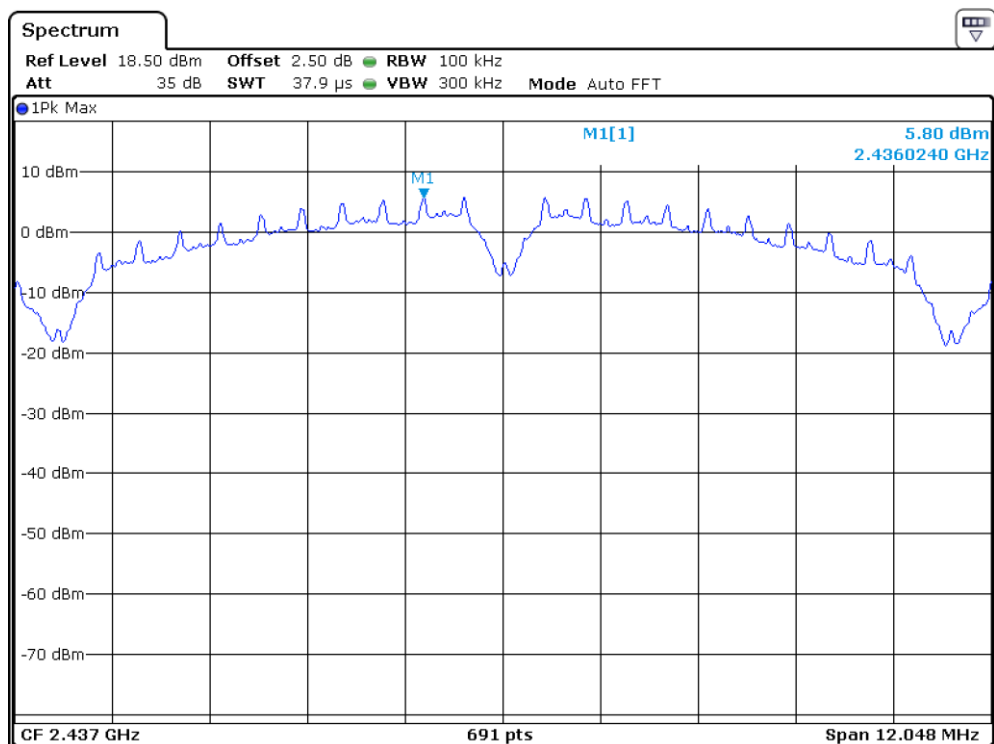
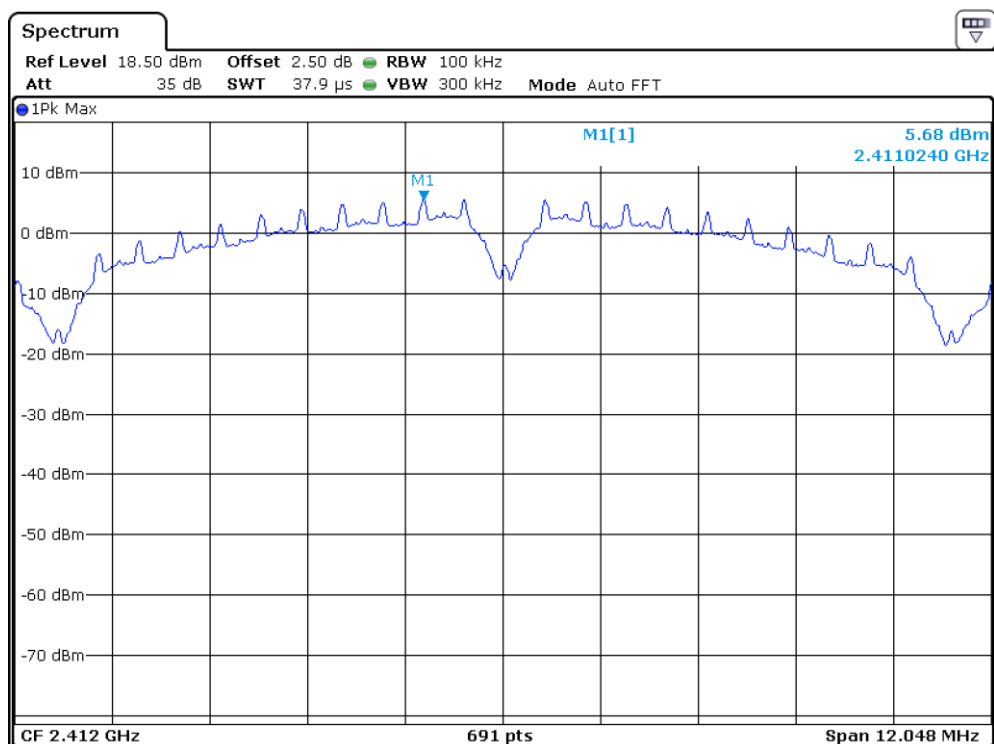
IEEE 802.11b (CCK, 1Mbps)	
Frequency (MHz)	Power Density with RBW 100KHz
2412	5.68
2437	5.80
2462	5.45

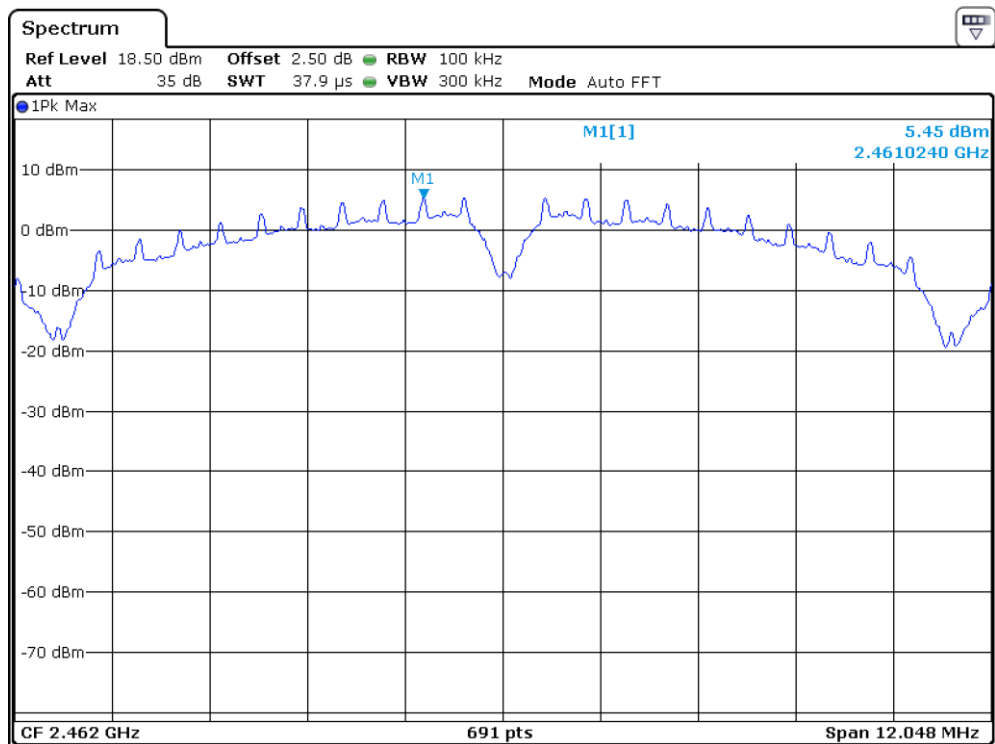
IEEE 802.11g (16QAM, 6Mbps)	
Frequency (MHz)	Power Density with RBW 100KHz
2412	1.95
2437	2.44
2462	2.57

IEEE 802.11n-HT20 (64QAM, 6Mbps)	
Frequency (MHz)	Power Density with RBW 100KHz
2412	3.29
2437	3.38
2462	3.11

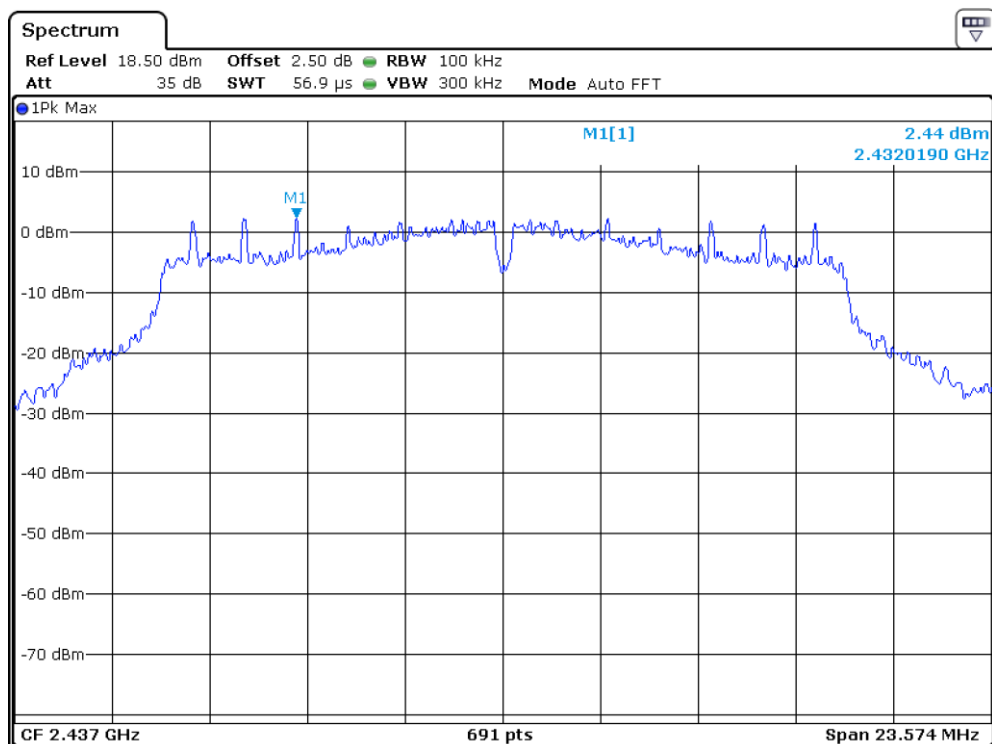
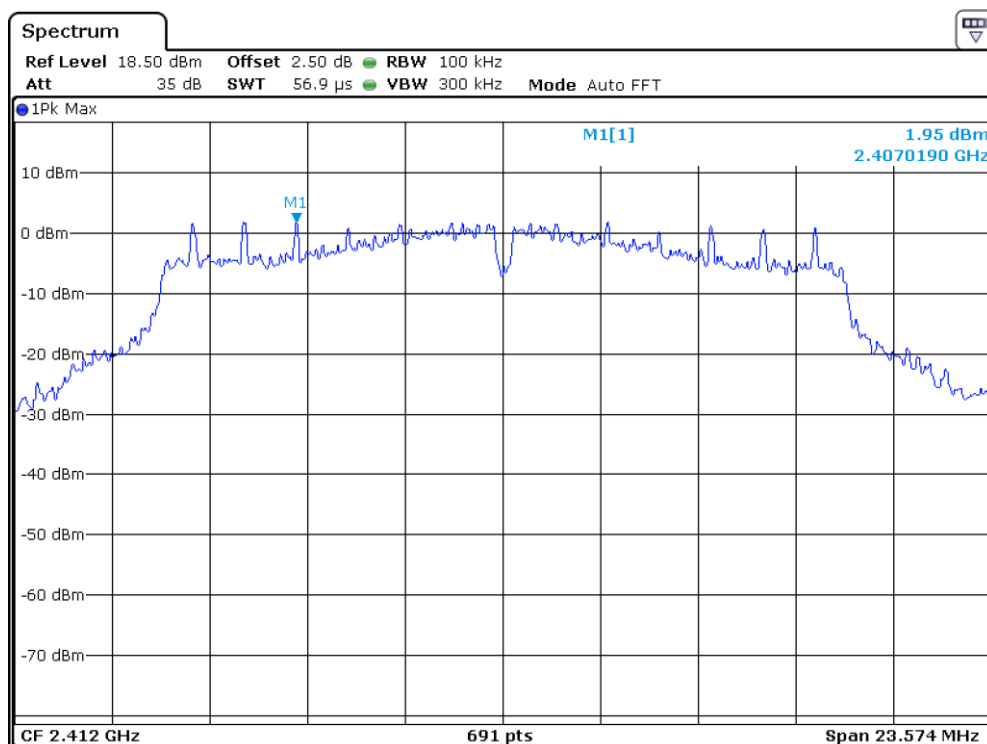
The test plots are attached as below.

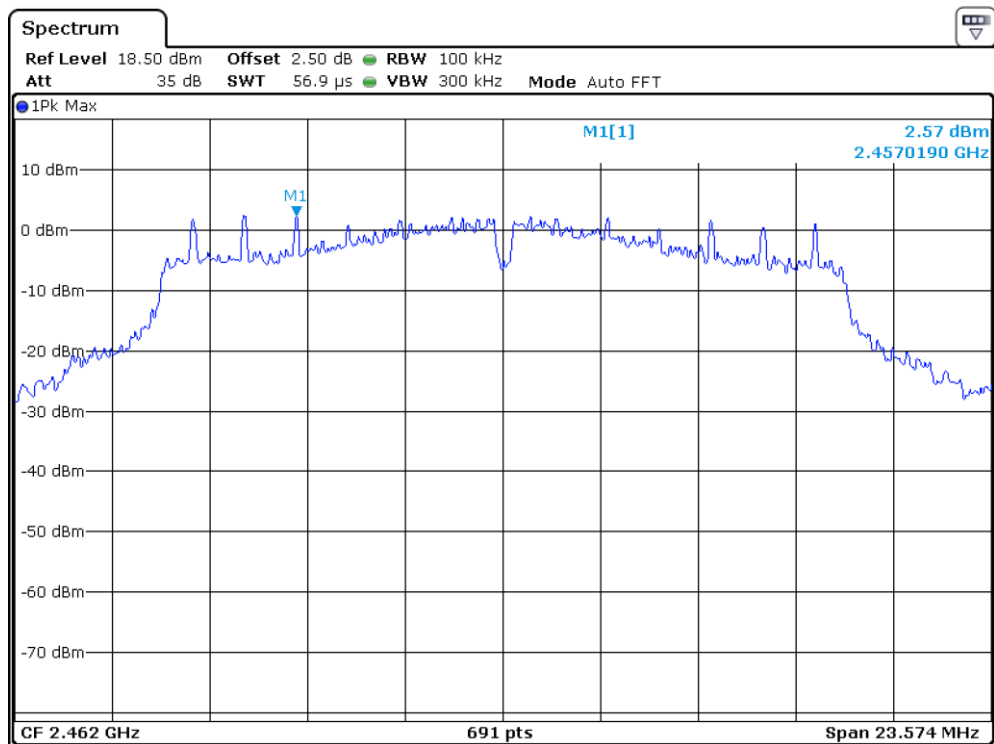
802.11b



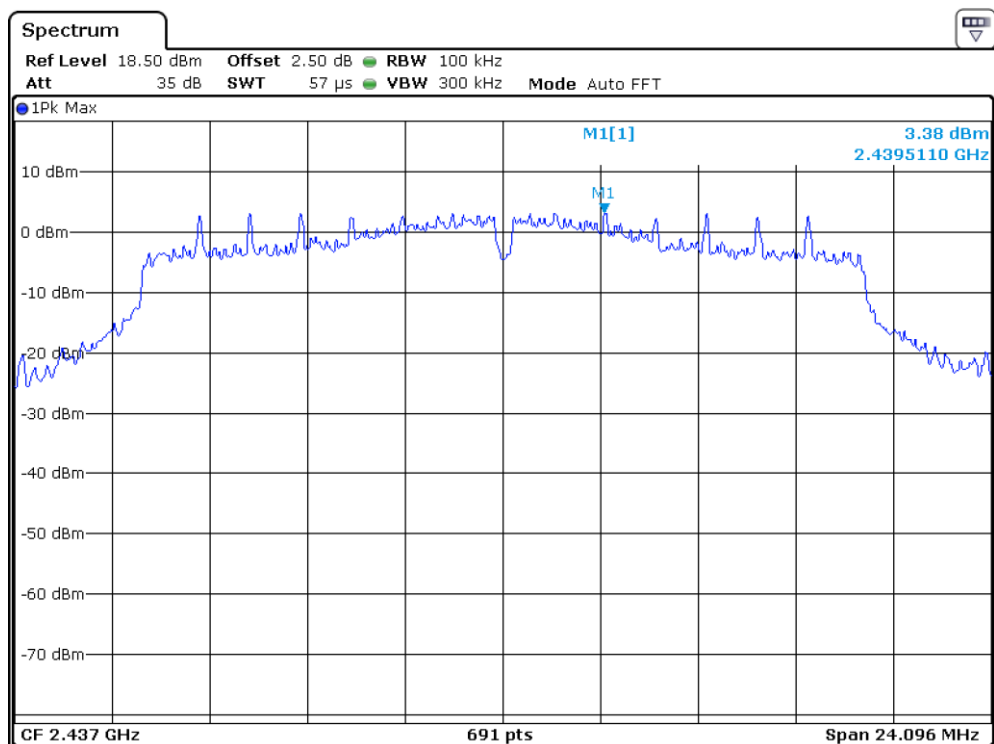
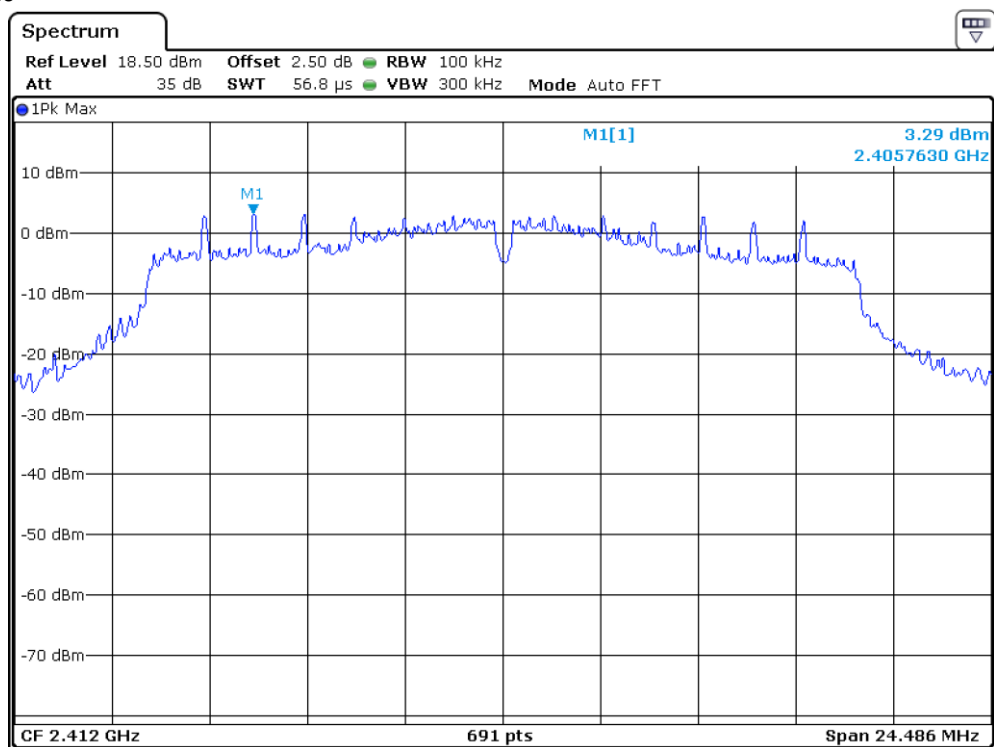


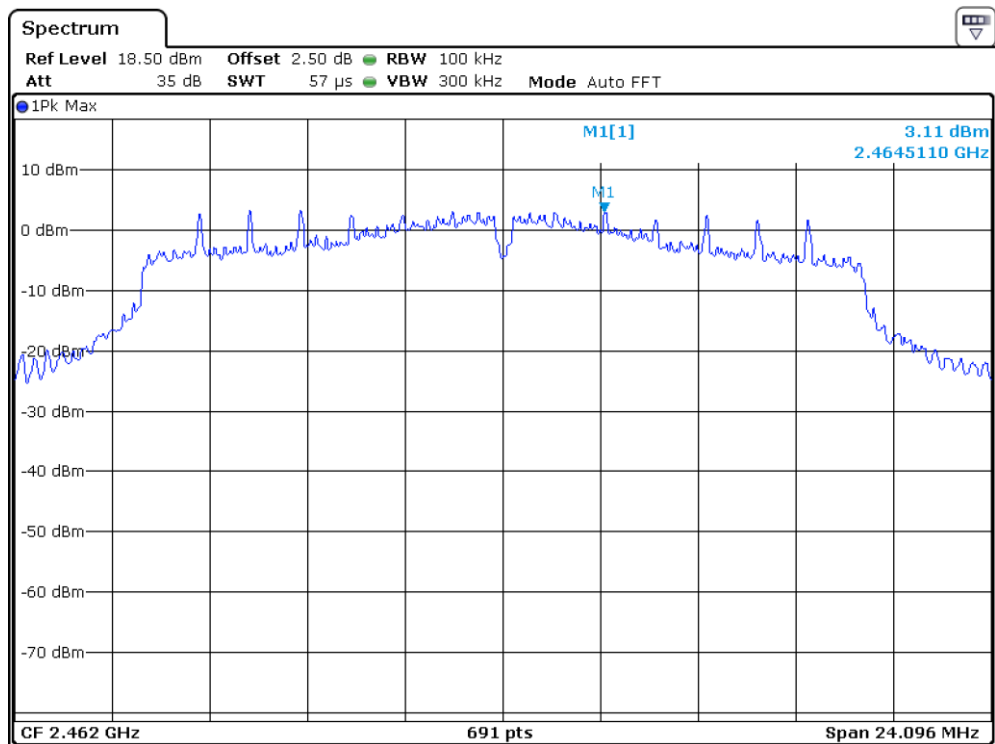
802.11g





802.11n-HT20





Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 15, 2019

Model: ECH-REFL01-5G

4.4 Out of Band Conducted Emissions, FCC Rule 15.247(d)

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. The Measurement Procedure was set according to the FCC KDB 558074 D01 v05r02.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the passband.

Refer to the attached test plots for out of band conducted emissions data with rate of 1Mbps for 802.11b and 6Mbps for 802.11g and 6Mbps for 802.11n-HT20.

The test plots showed all spurious emission up to the tenth harmonic were measured and they were found to be at least 20 dB below the highest level of the desired power in the passband.

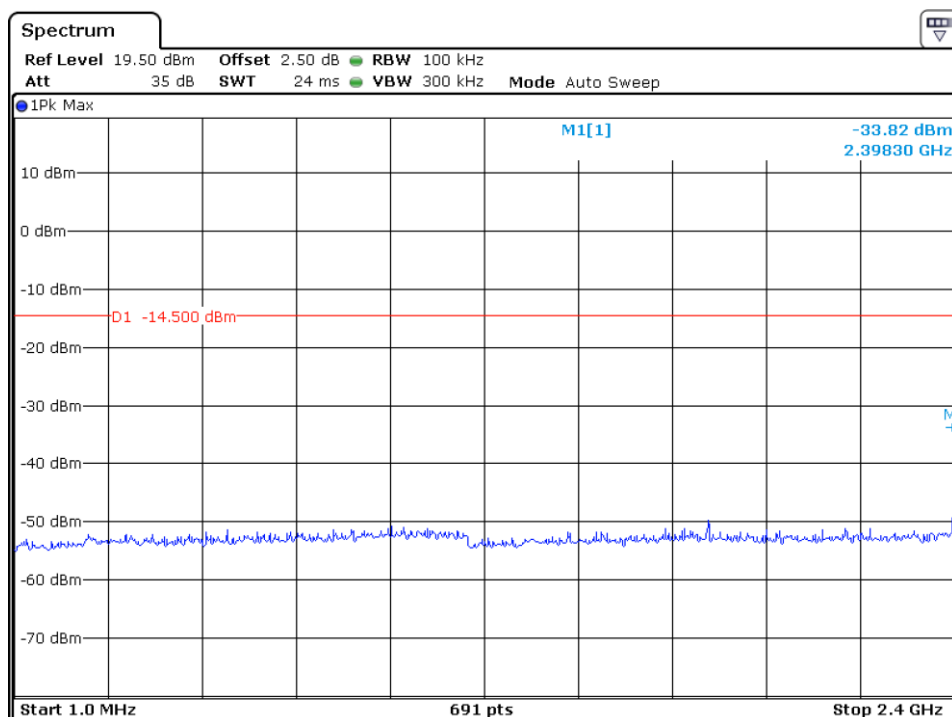
The test plots are attached as below.

4.4.1 Test Result

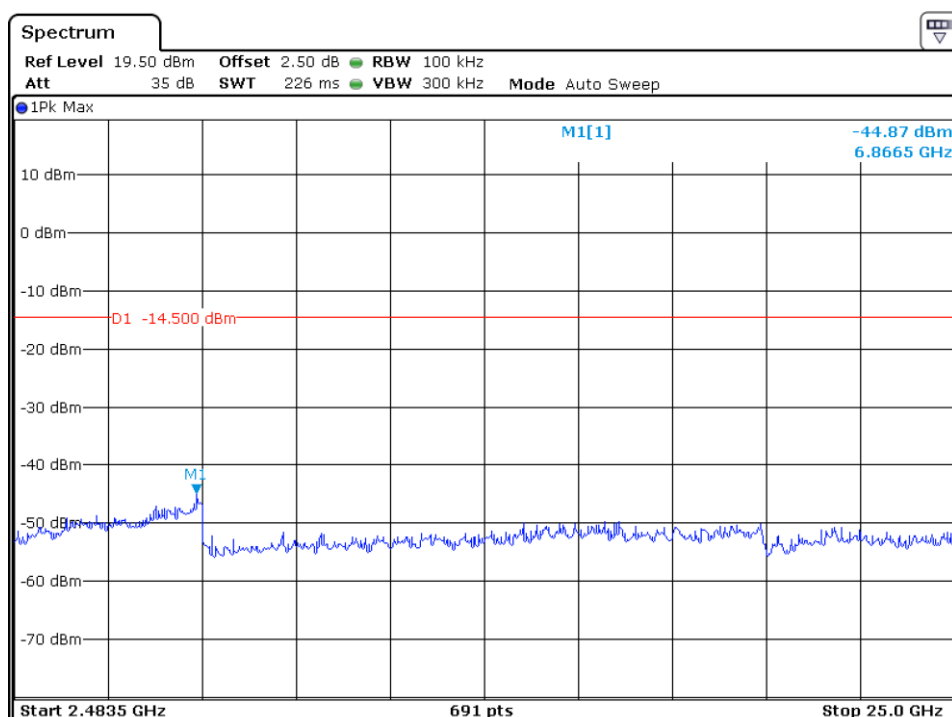
Operating Mode: Standalone transmission (2.4G WIFI)

802.11b

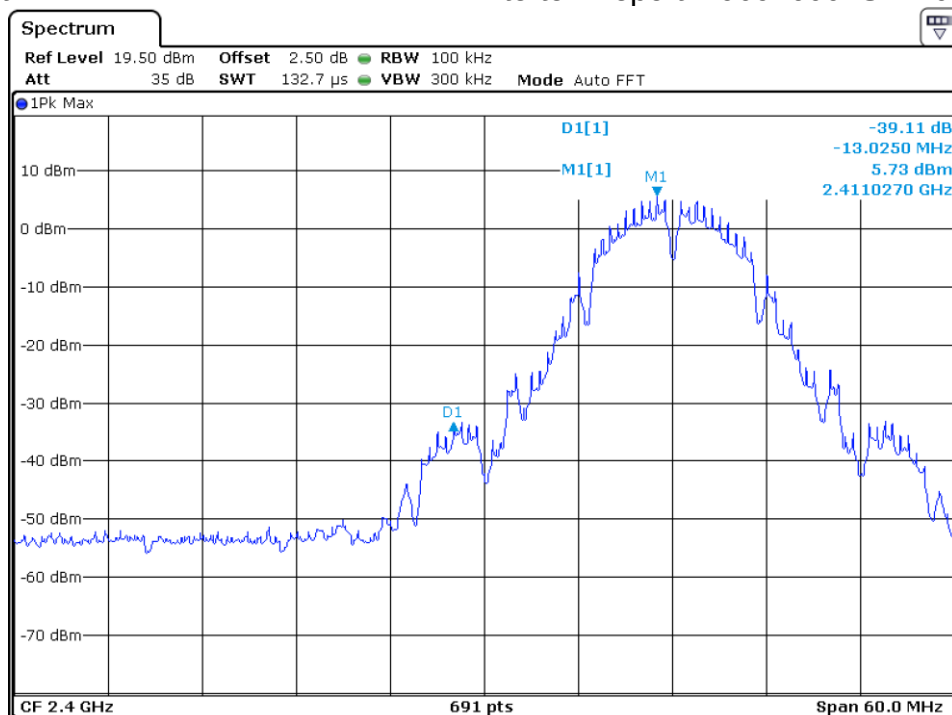
Channel 01 (2412MHz) Reference Level: 5.5dBm



Date: 15.OCT.2019 13:49:46

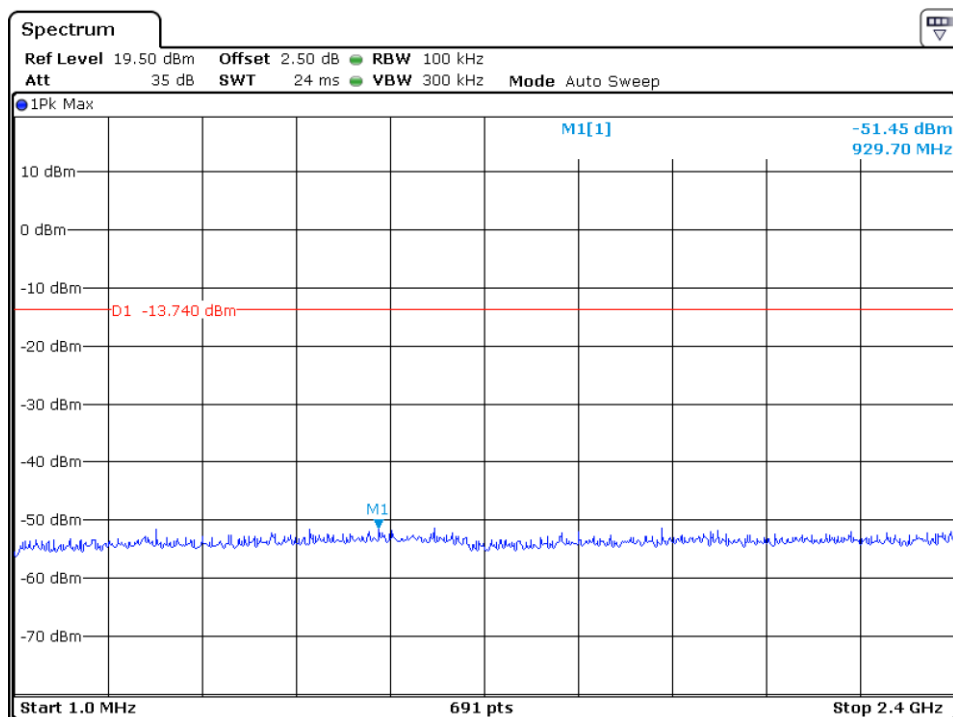


Date: 15.OCT.2019 13:50:23

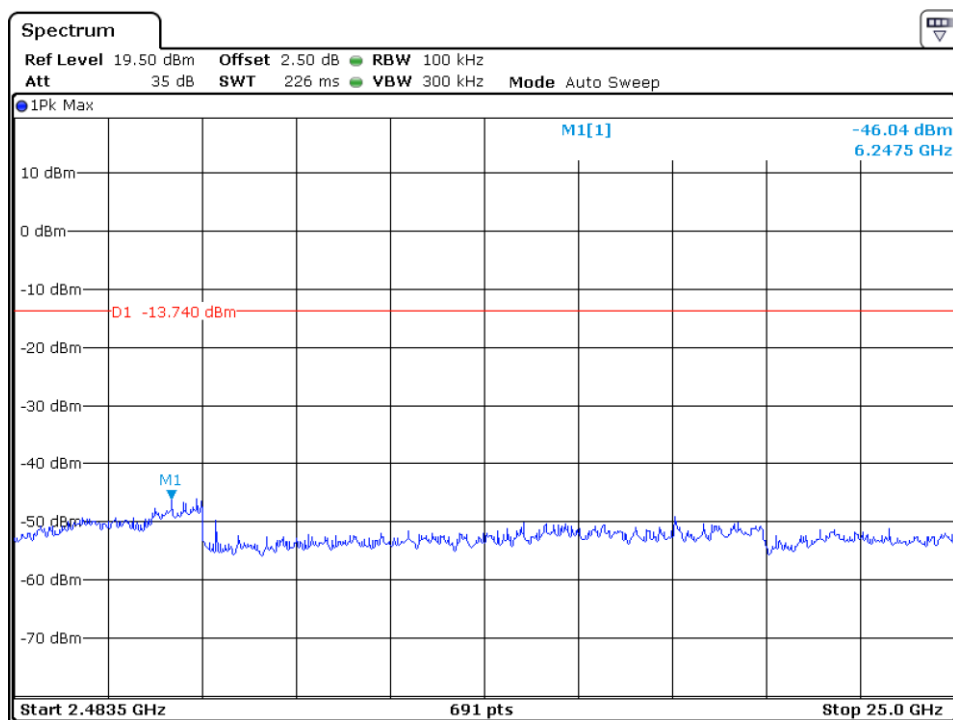


Date: 15.OCT.2019 13:50:54

Channel 06 (2437MHz) Reference Level: 6.26dBm

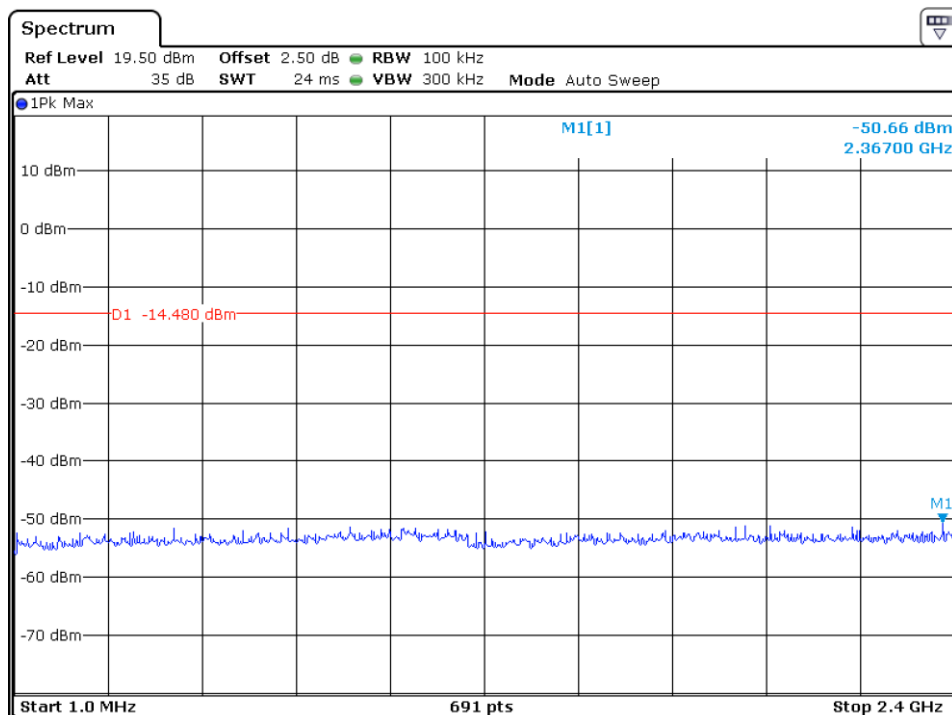


Date: 15.OCT.2019 13:55:30

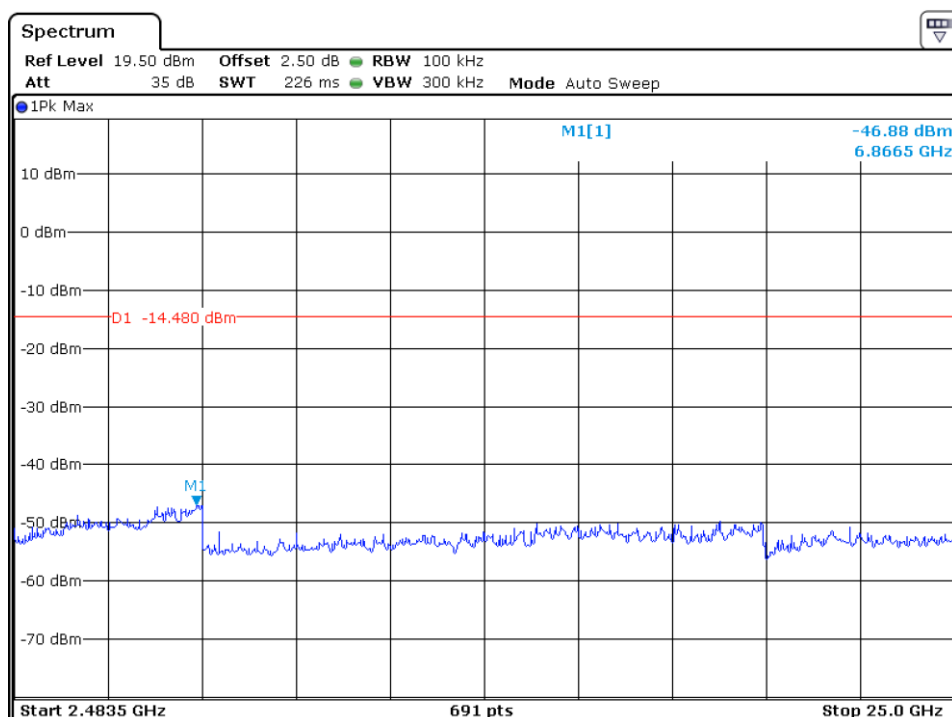


Date: 15.OCT.2019 13:55:56

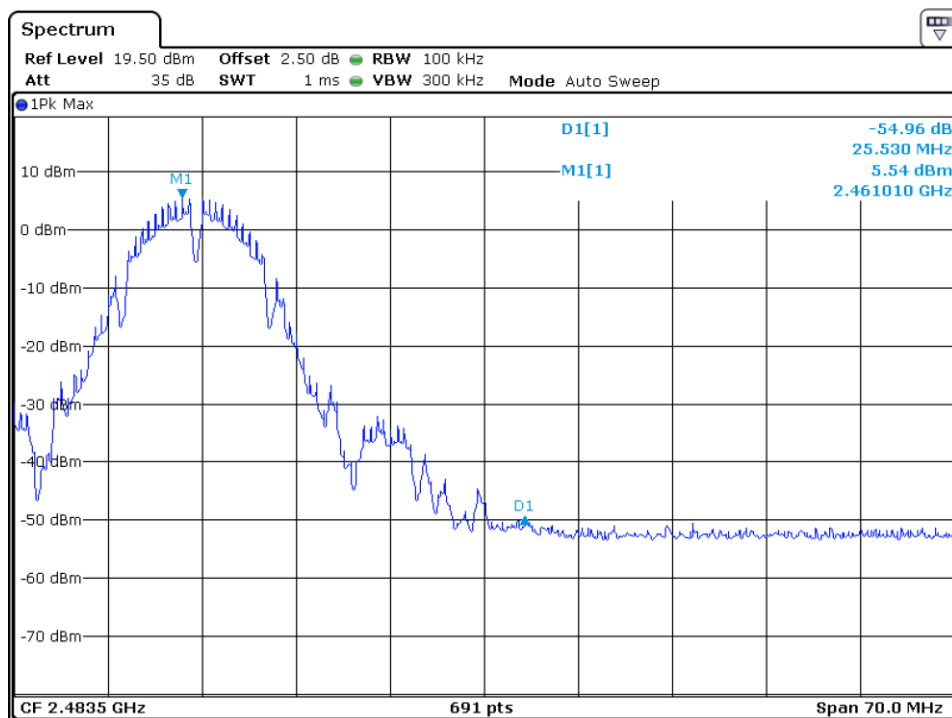
Channel 11 (2462MHz) Reference Level: 5.52dBm



Date: 15.OCT.2019 13:59:27



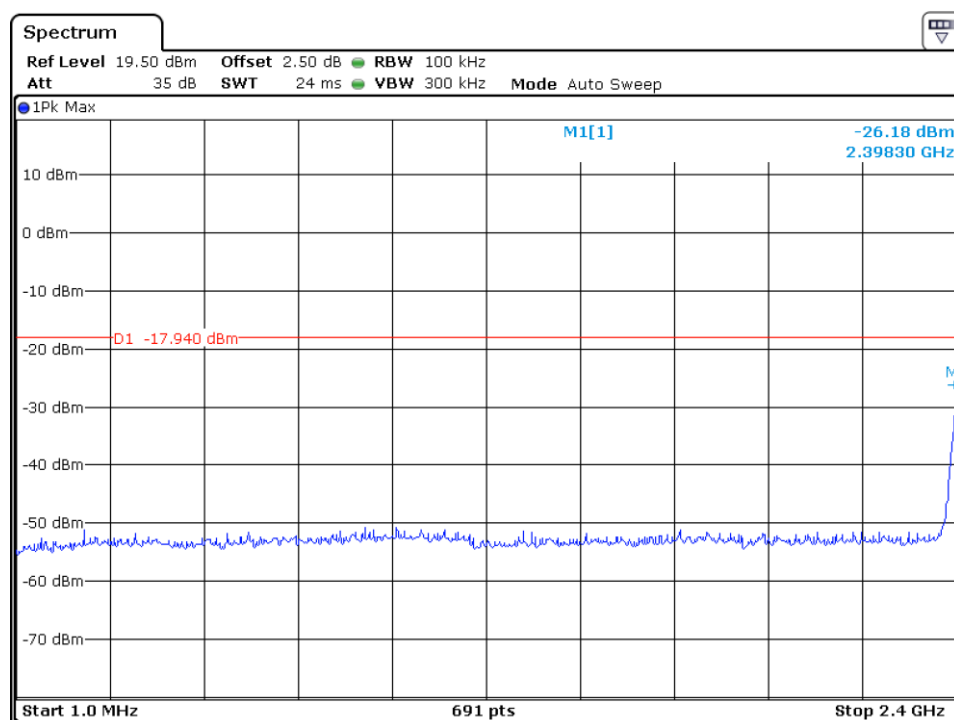
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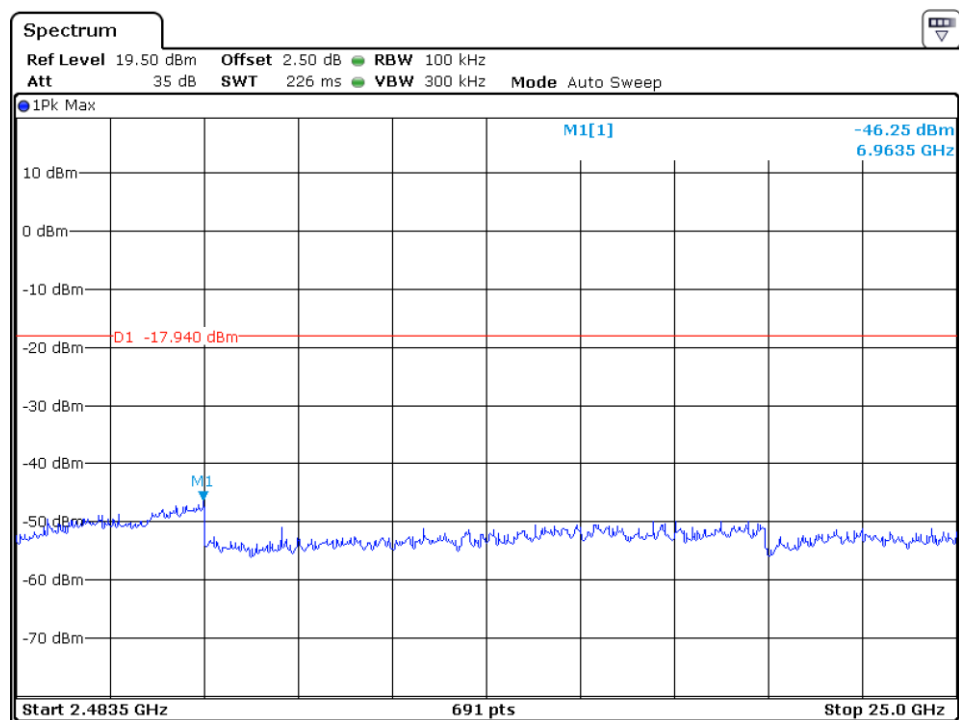
Date: 15.OCT.2019 14:00:31

802.11g

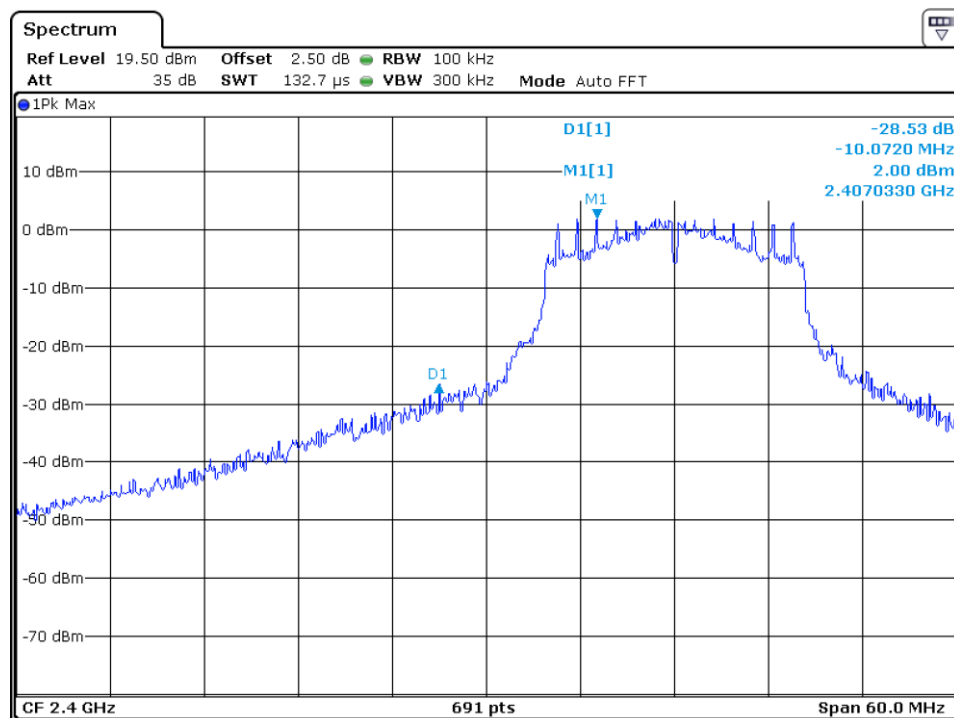
Channel 01 (2412MHz) Reference Level: 2.06dBm



Date: 15.OCT.2019 14:06:48

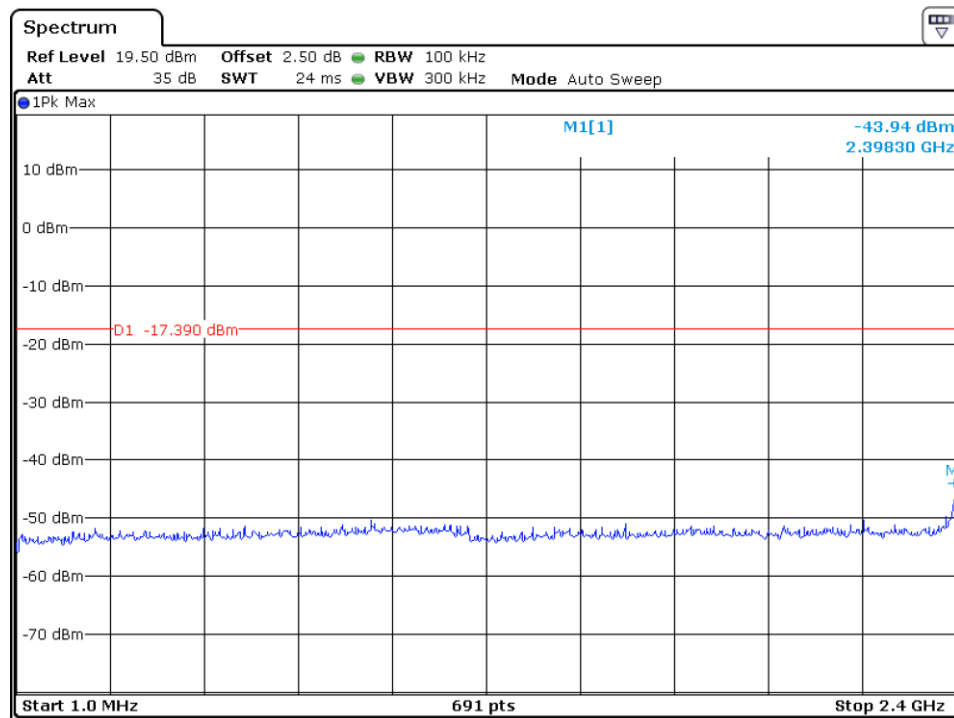


Date: 15.OCT.2019 14:07:17

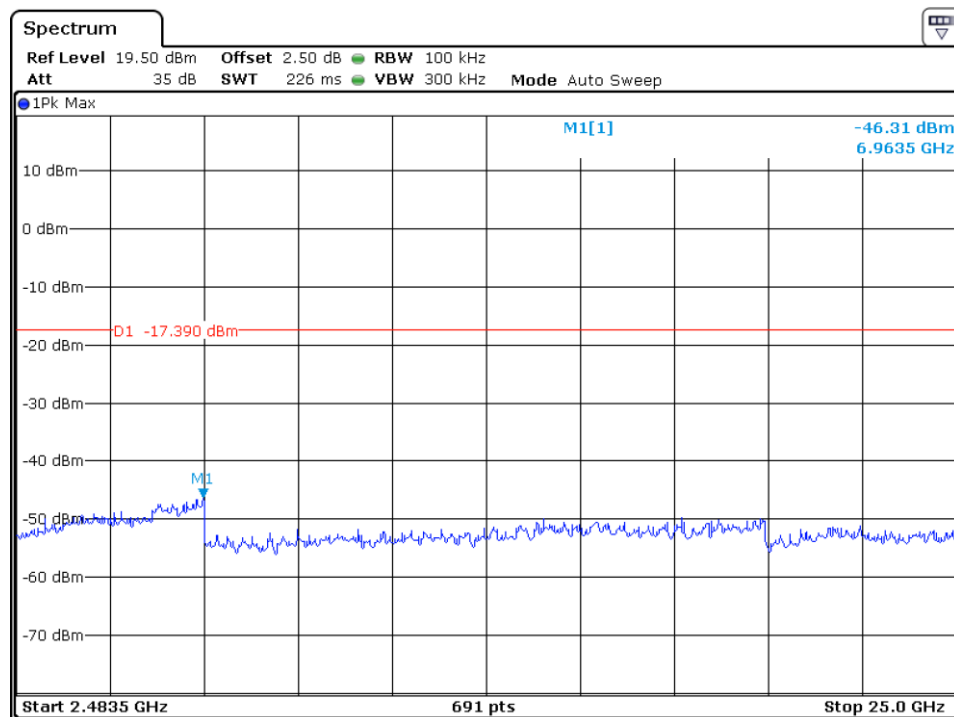


Date: 15.OCT.2019 14:08:09

Channel 06 (2437MHz) Reference Level: 2.61dBm

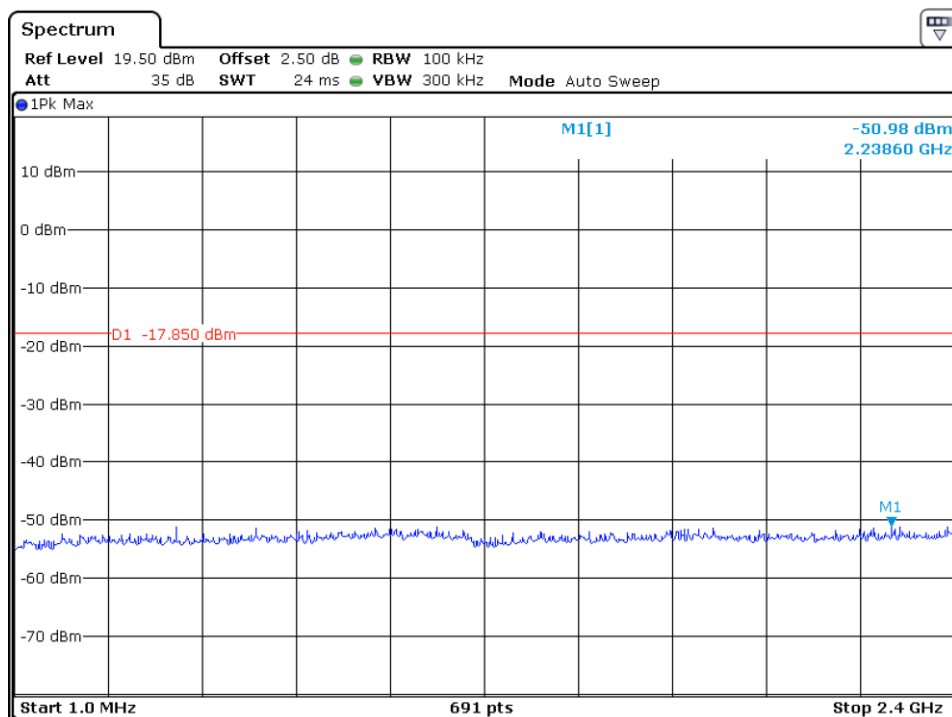


Date: 15.OCT.2019 14:15:15

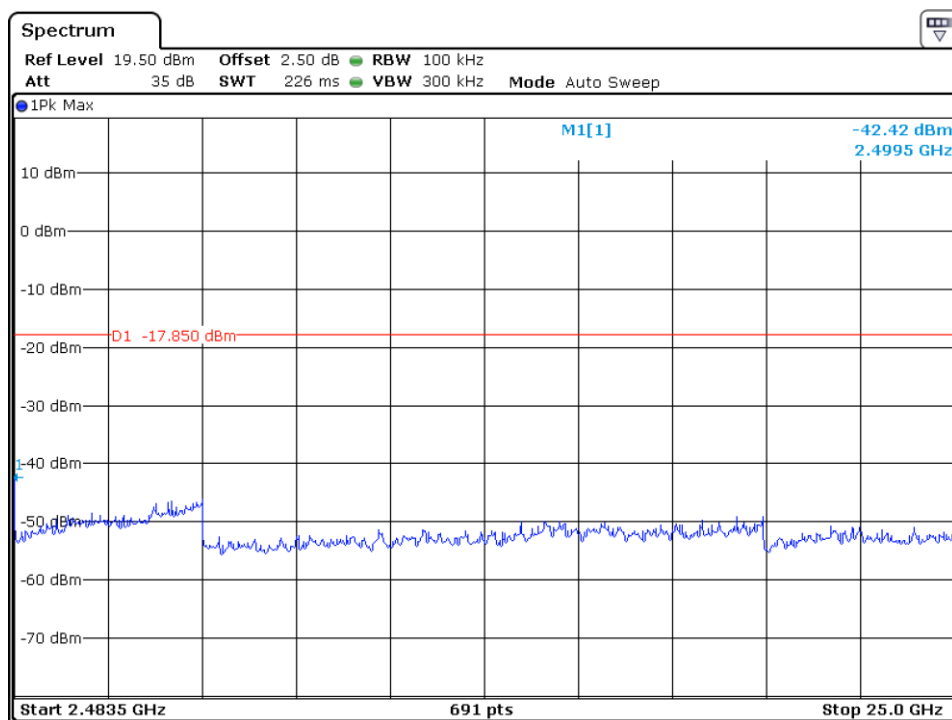


Date: 15.OCT.2019 14:15:42

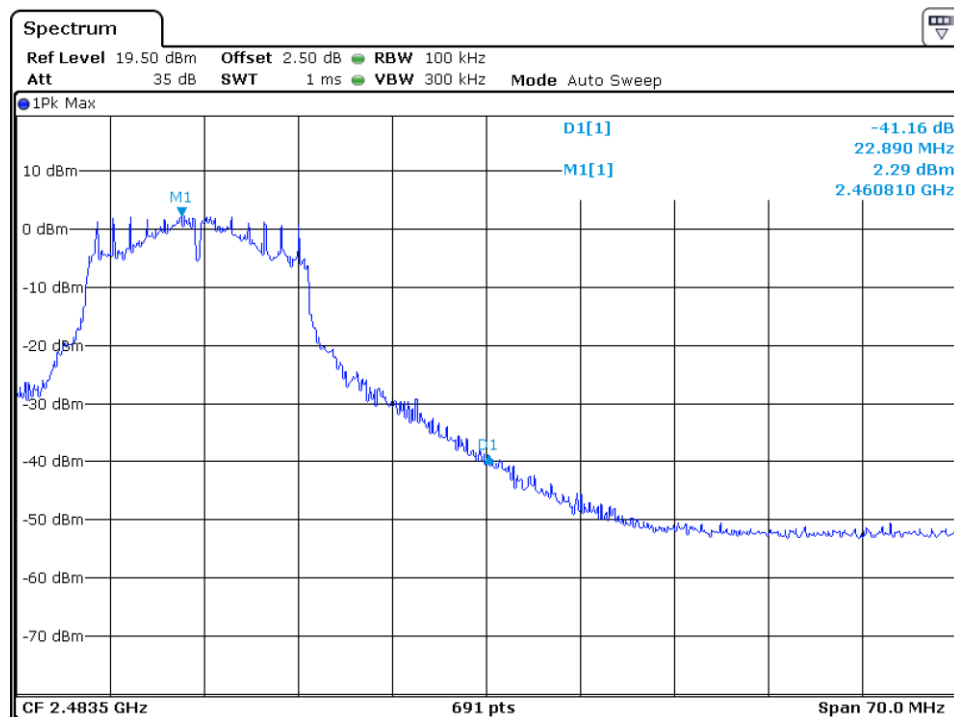
Channel 11 (2462MHz) Reference Level: 2.15dBm



Date: 15.OCT.2019 14:21:23



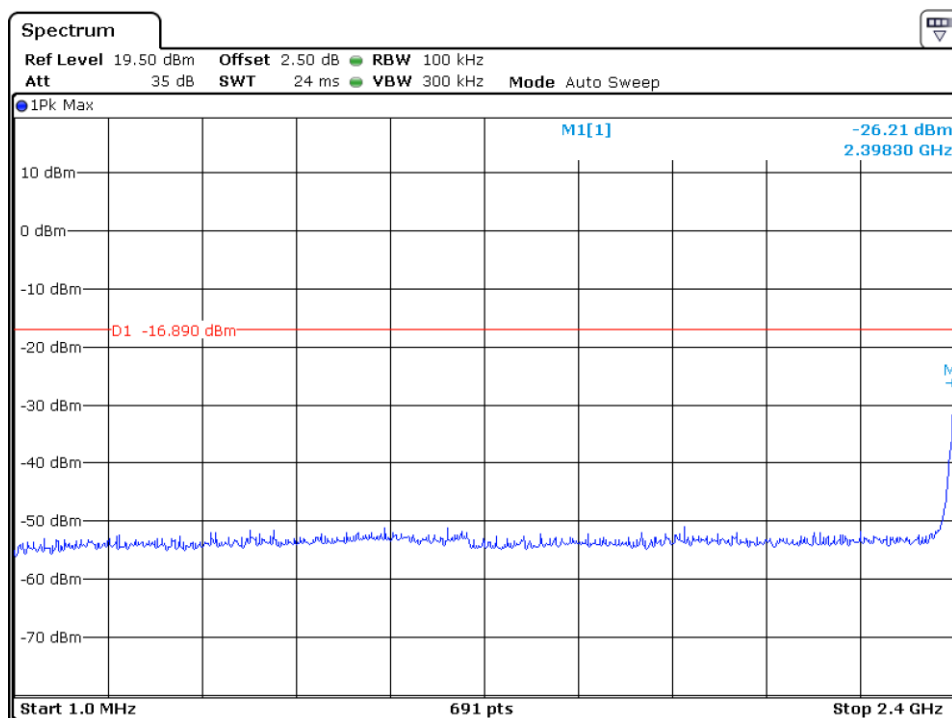
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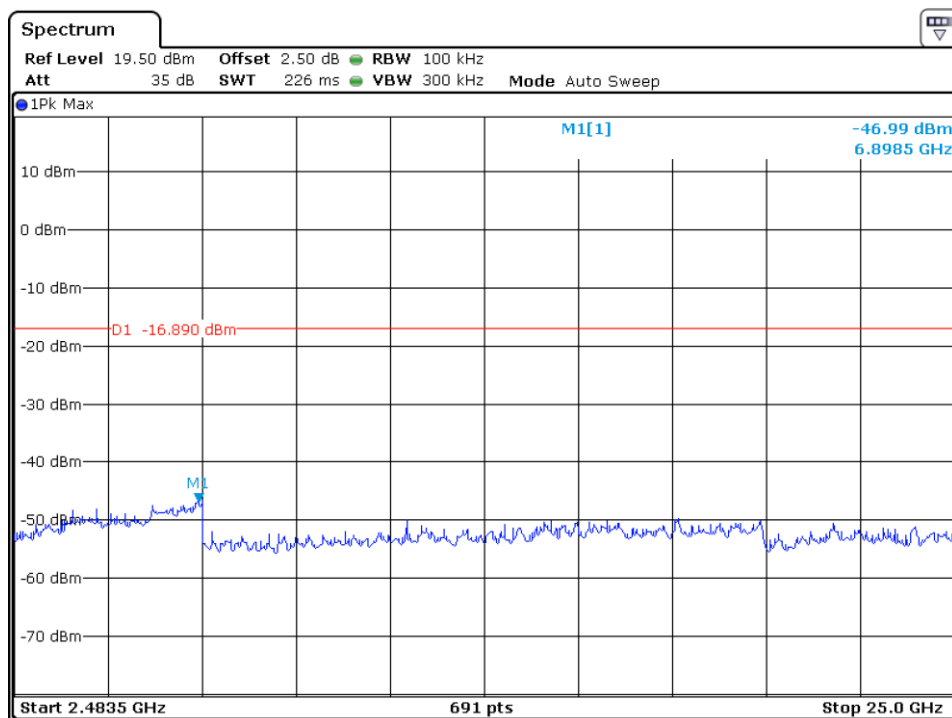
Date: 15.OCT.2019 14:17:01

802.11n-HT20

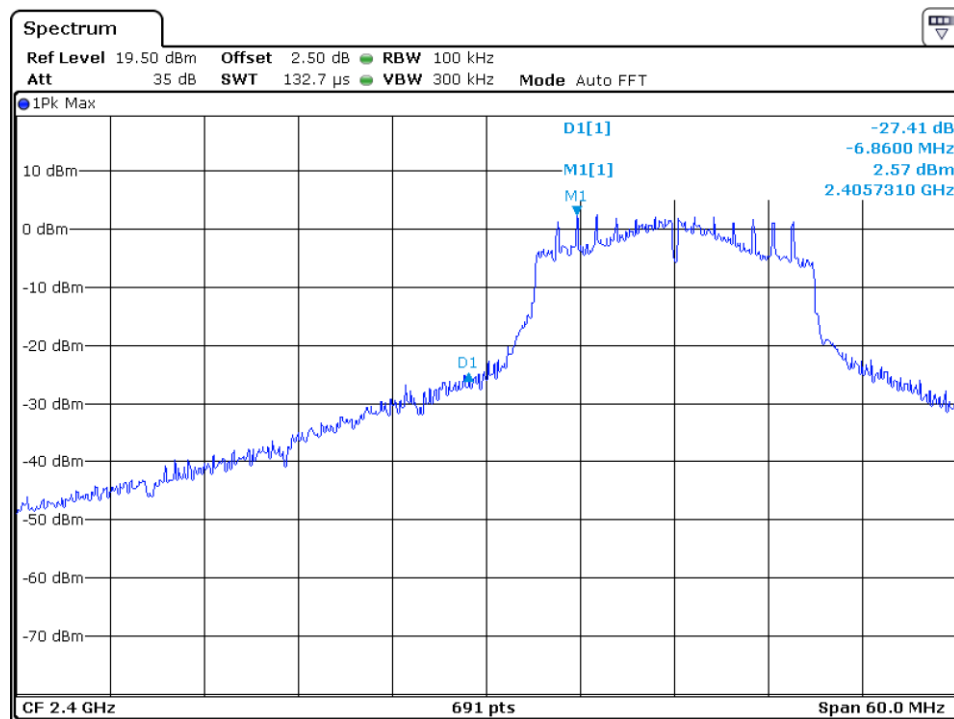
Channel 01 (2412MHz) Reference Level: 3.11dBm



Date: 15.OCT.2019 14:37:48

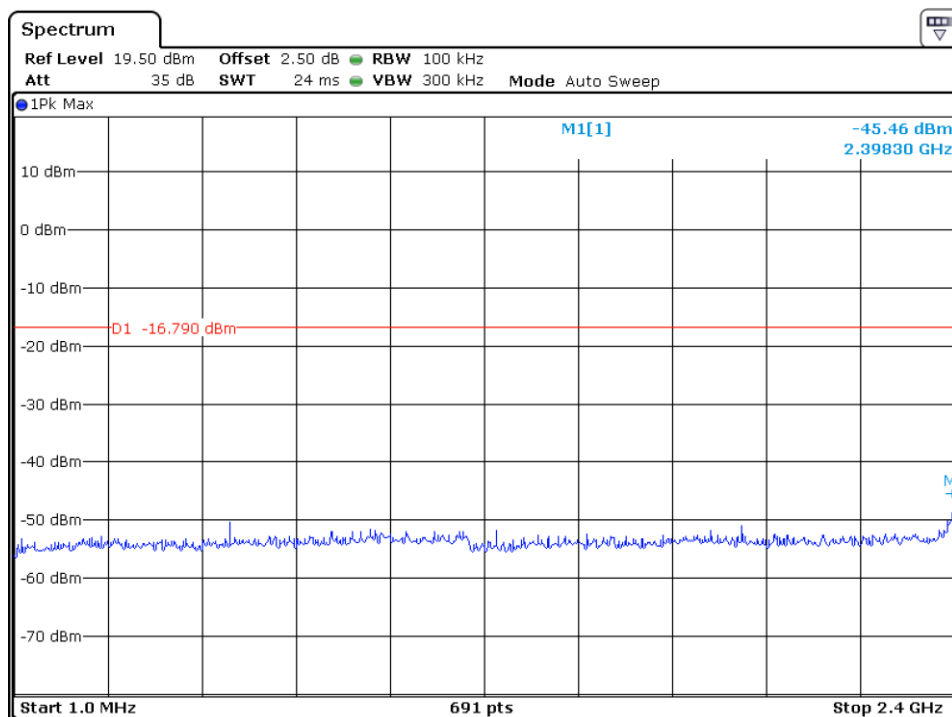


Date: 15.OCT.2019 14:38:21

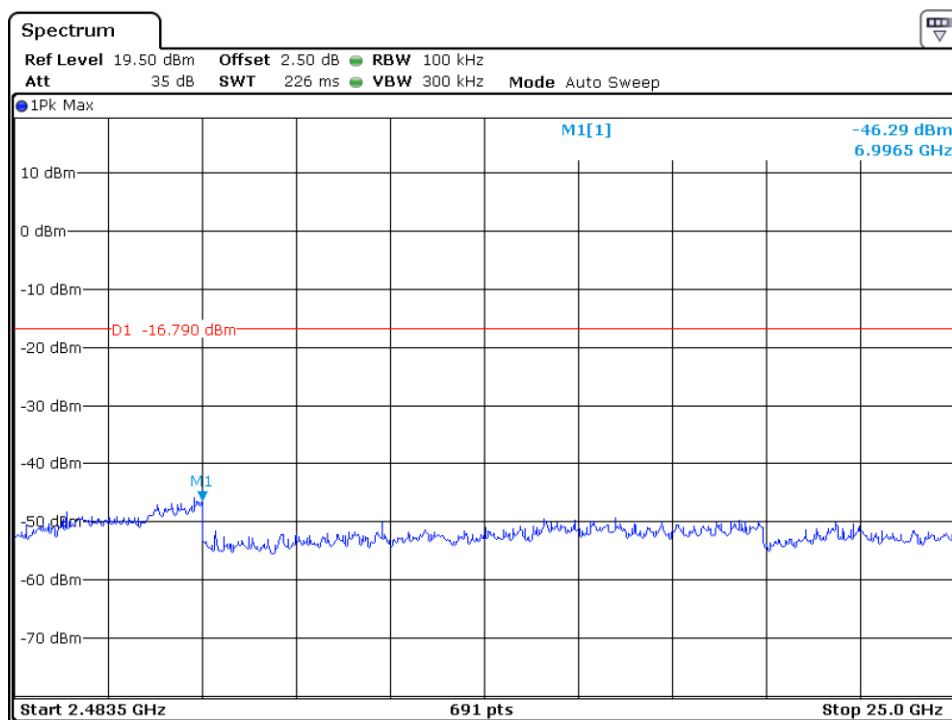


Date: 15.OCT.2019 14:42:05

Channel 06 (2437MHz) Reference Level: 3.21dBm

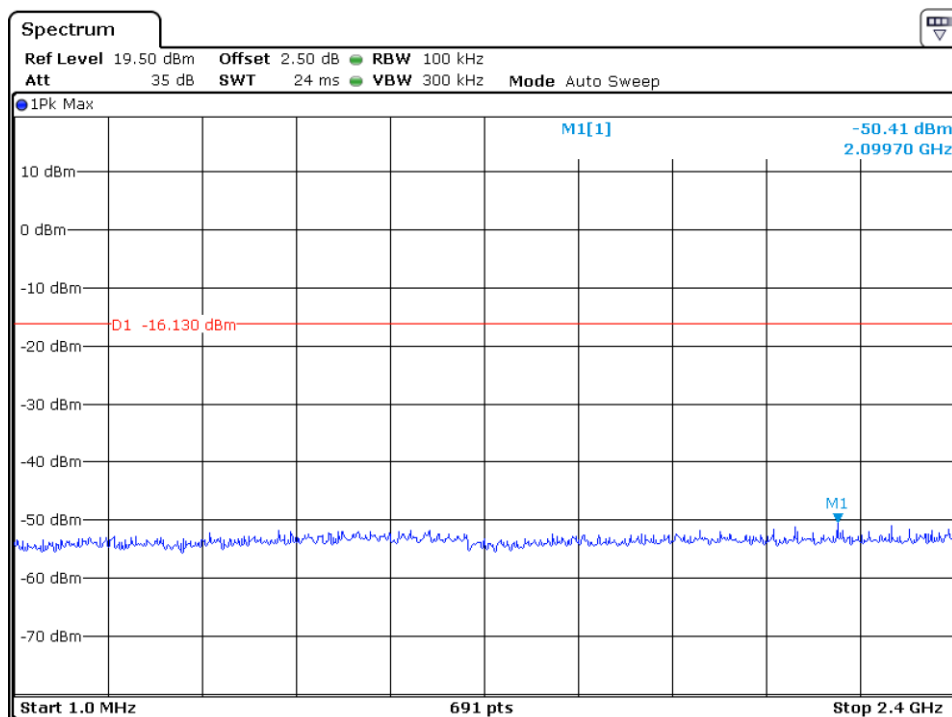


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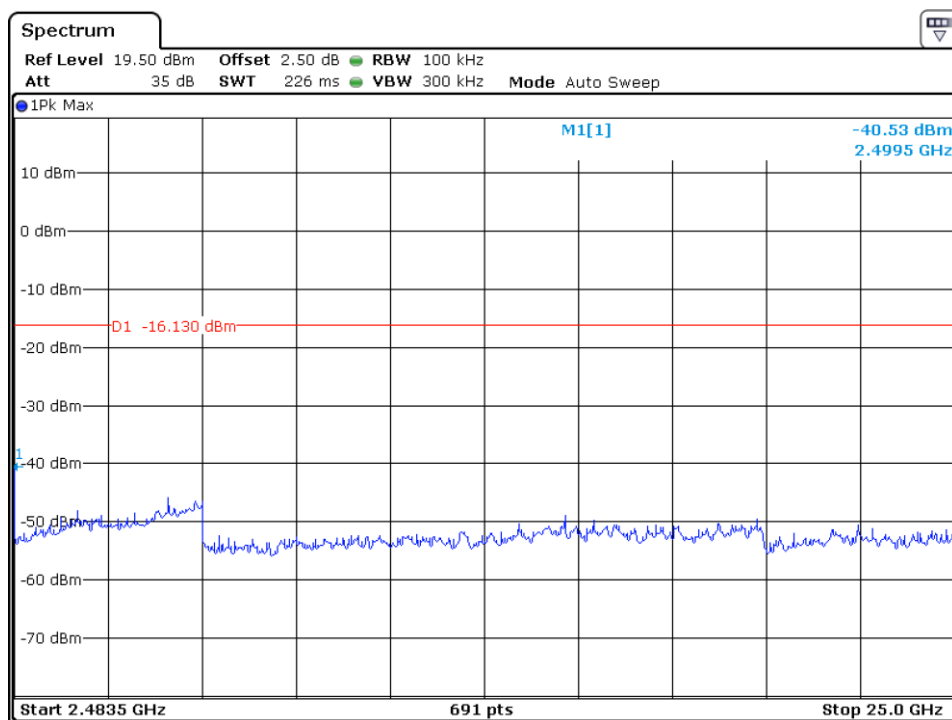


Date: 15.OCT.2019 14:53:25

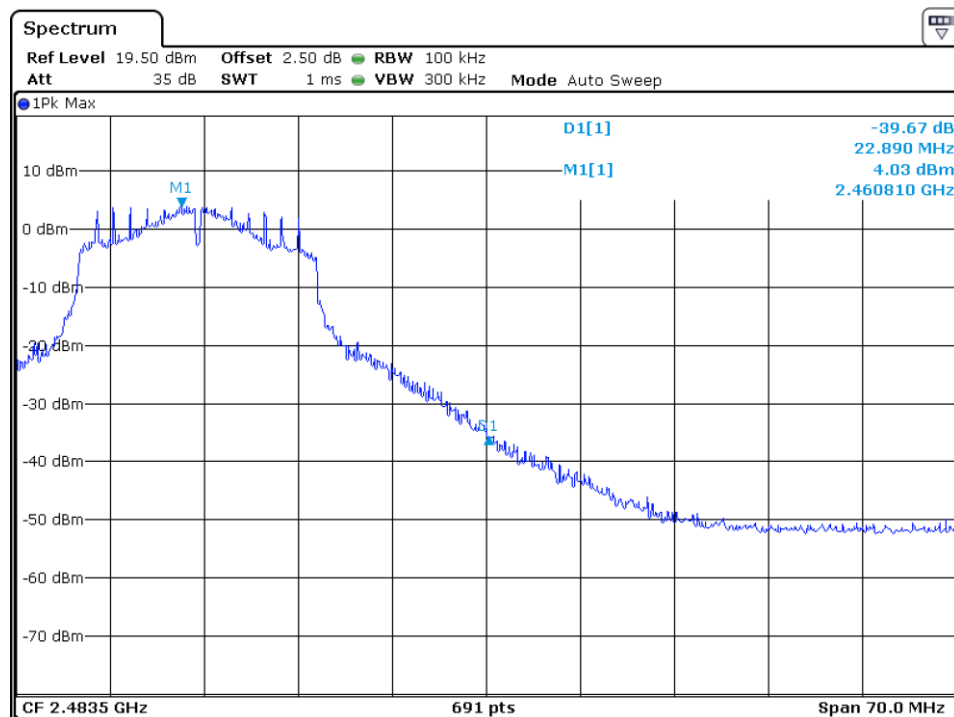
Channel 11 (2462MHz) Reference Level: 3.87dBm



Date: 15.OCT.2019 14:58:48



Date: 15.OCT.2019 14:59:15

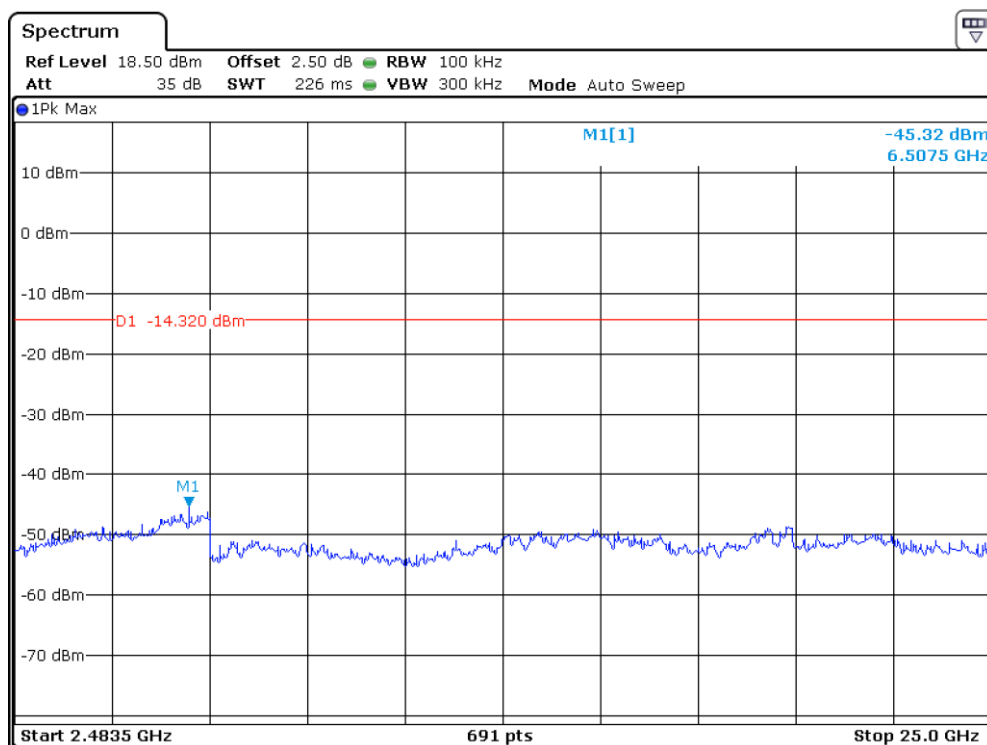
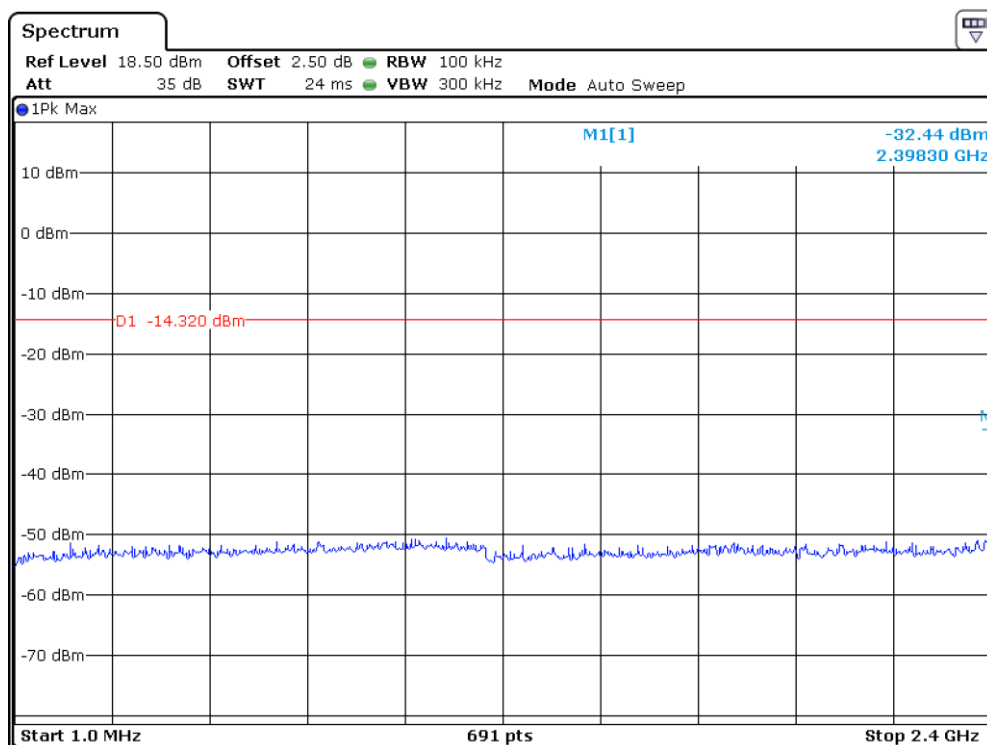


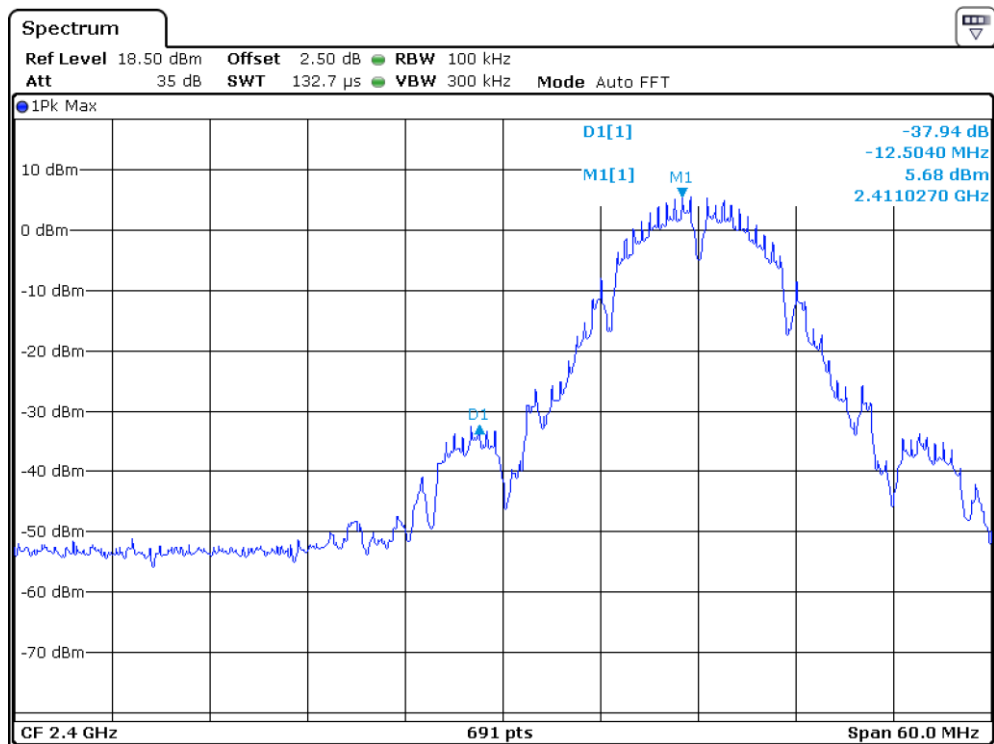
Date: 15.OCT.2019 15:00:55

Operating Mode: Simultaneously transmission (BT+2.4G WIFI)

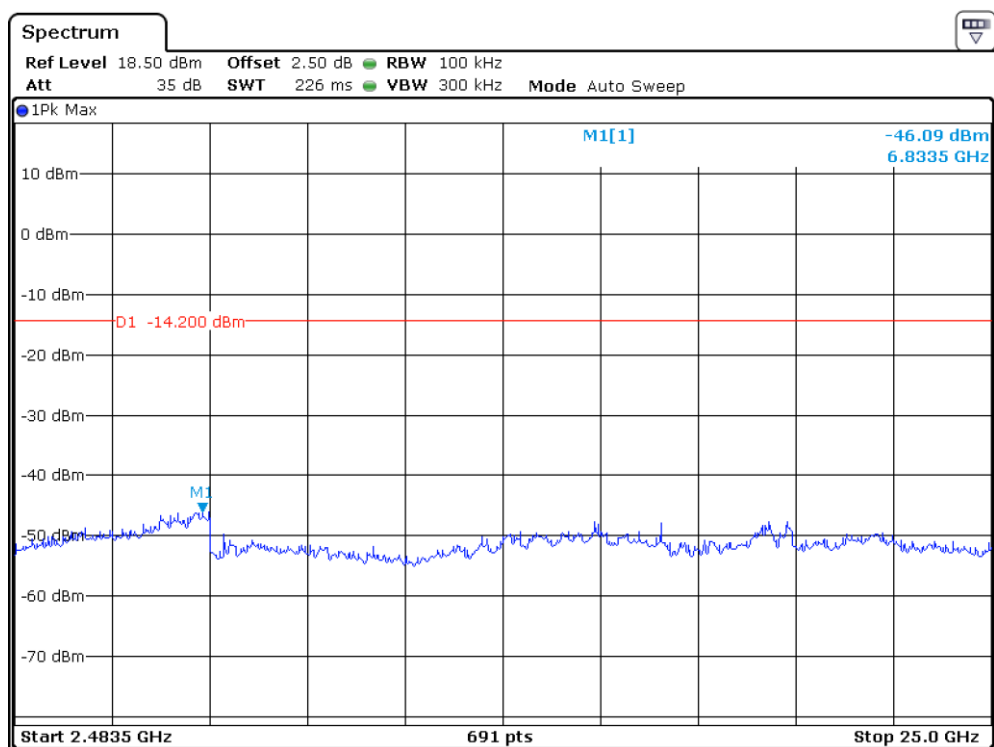
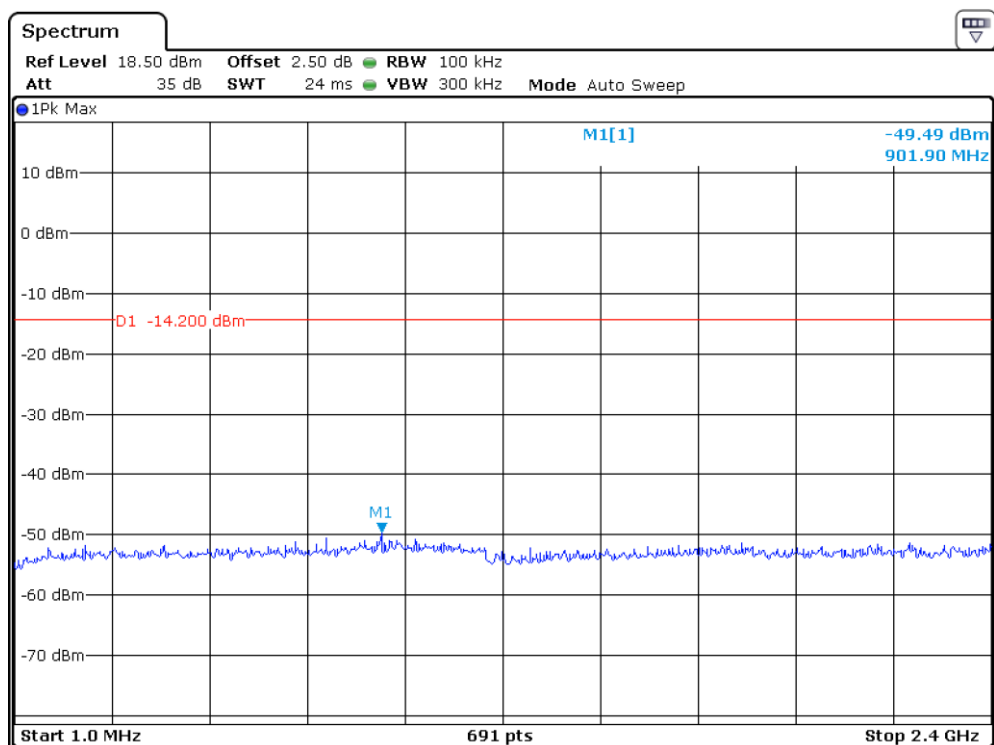
802.11b

Channel 01 (2412MHz) Reference Level: 5.68dBm

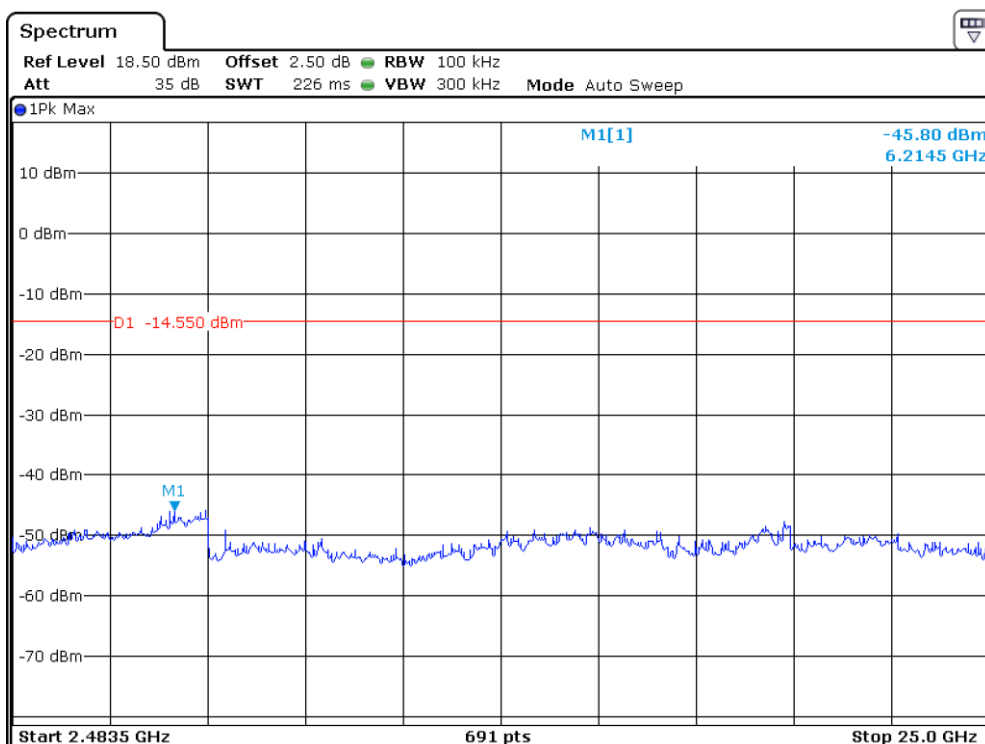
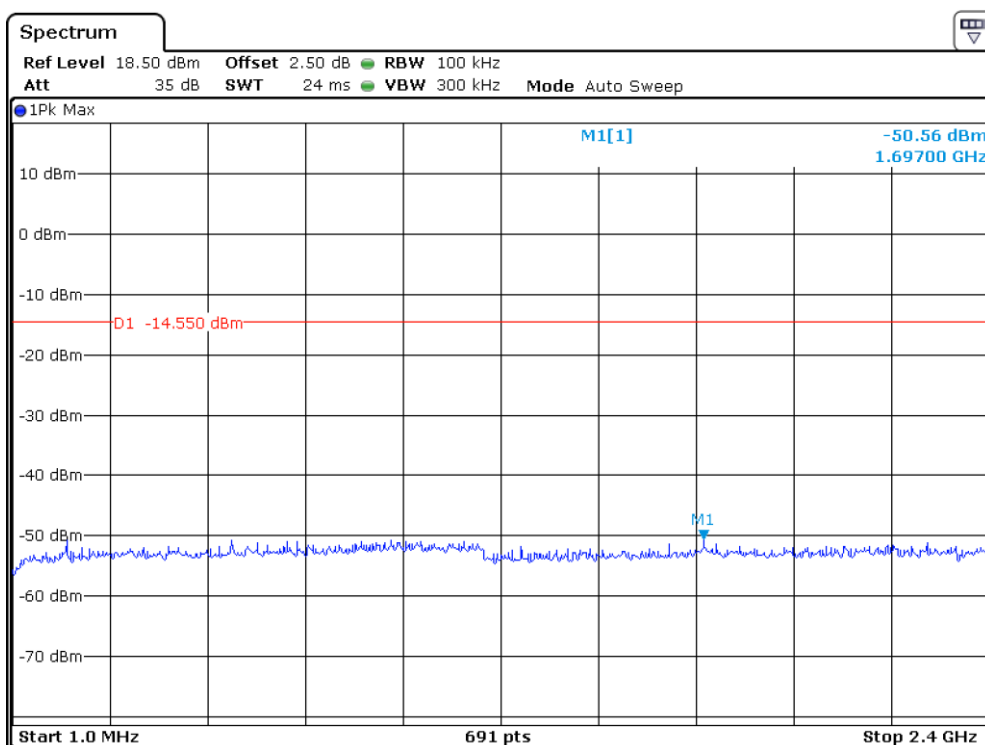


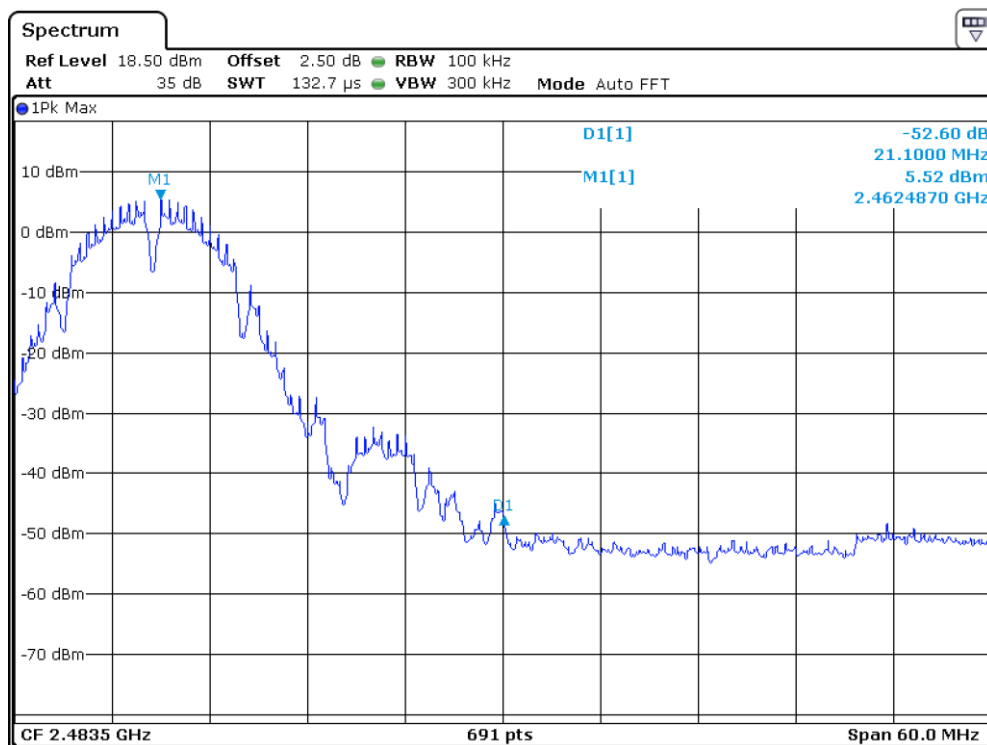


Channel 06 (2437MHz) Reference Level: 5.8dBm



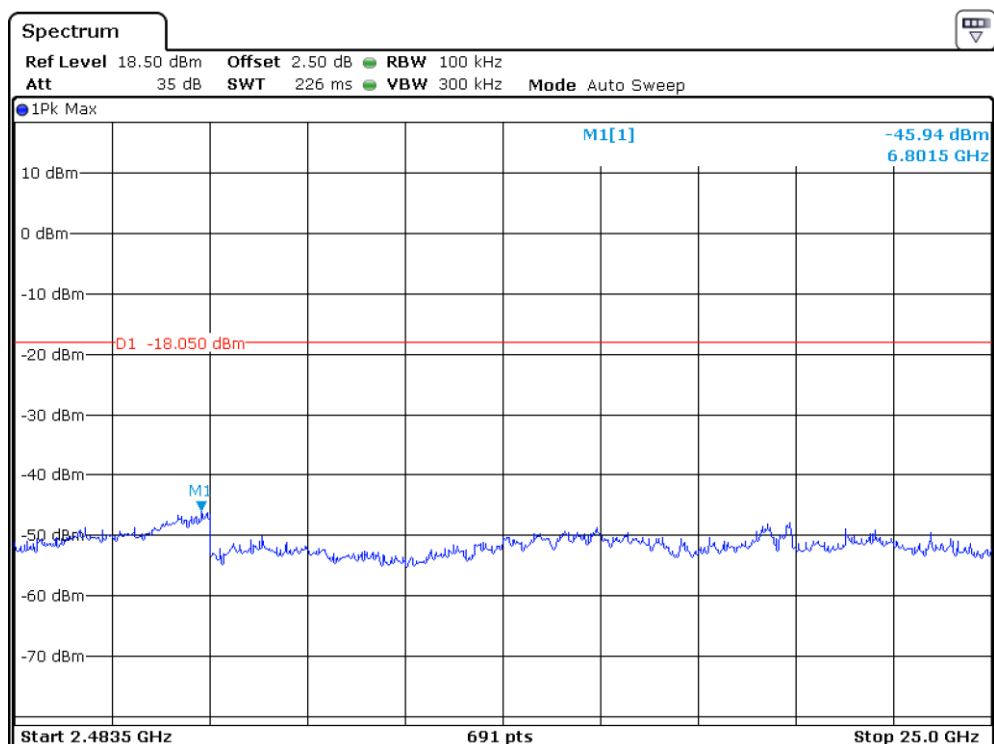
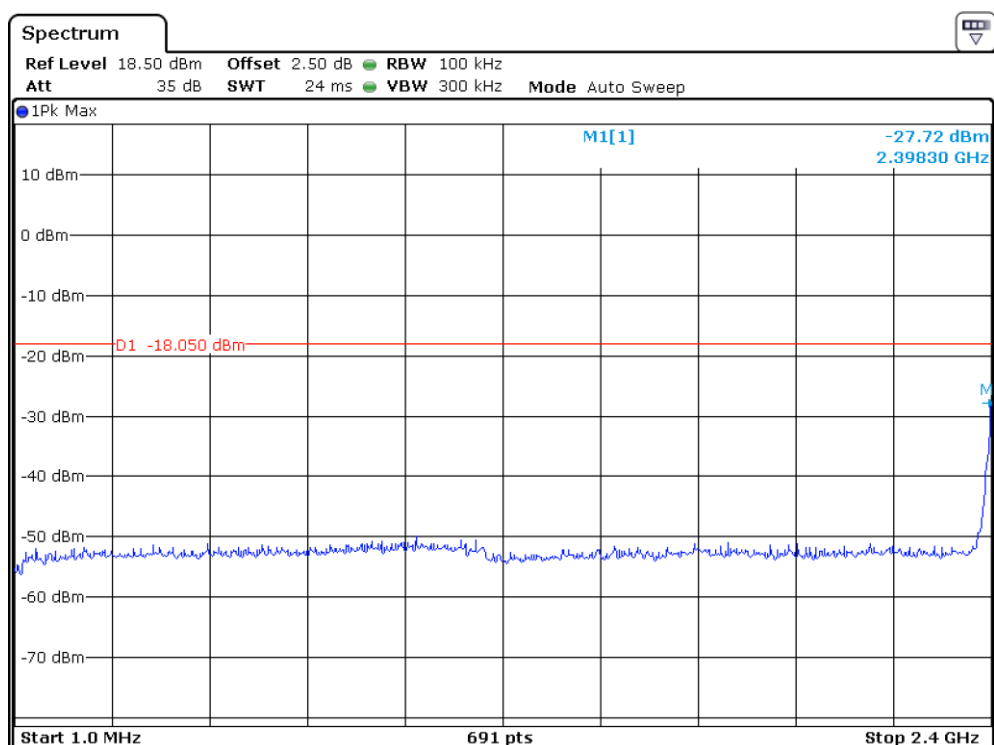
Channel 11 (2462MHz) Reference Level: 5.45dBm

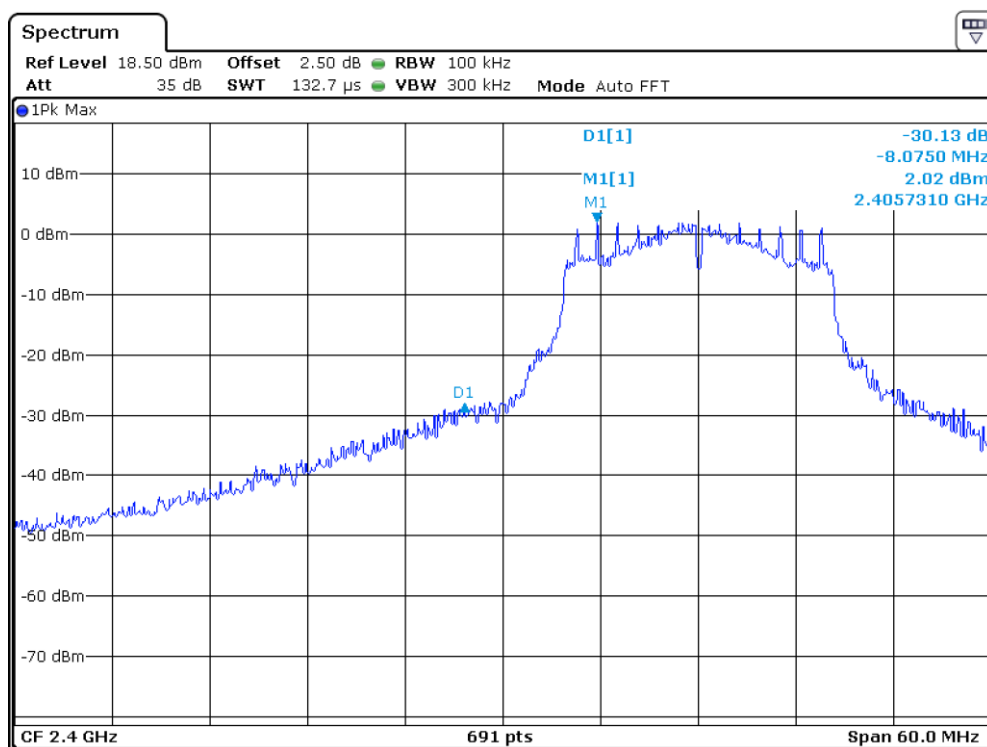




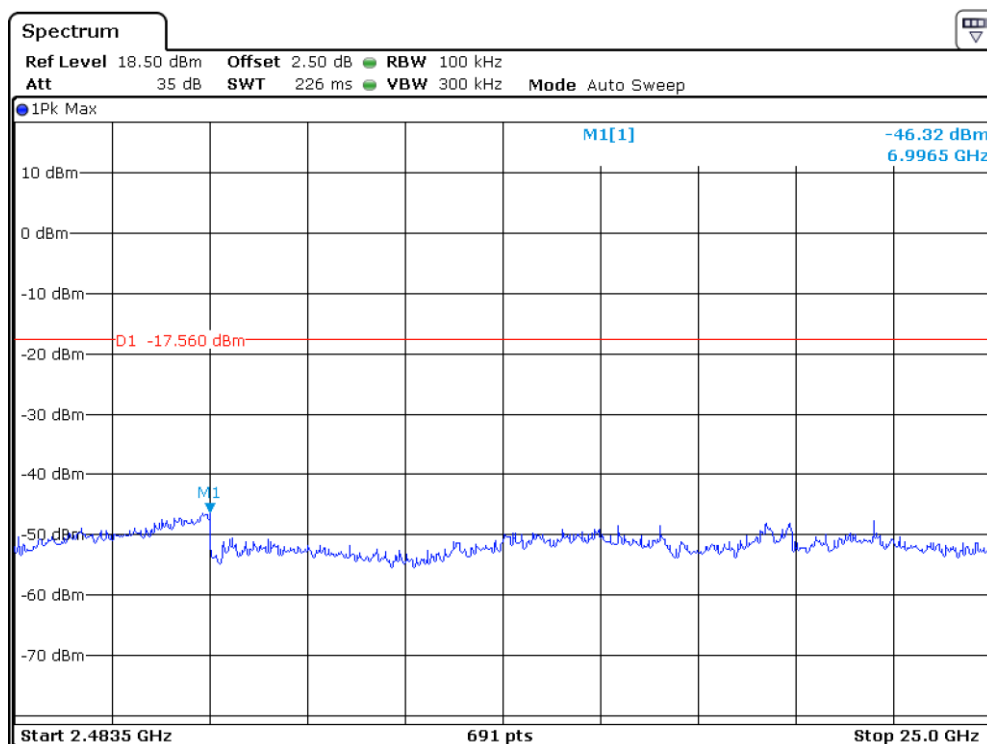
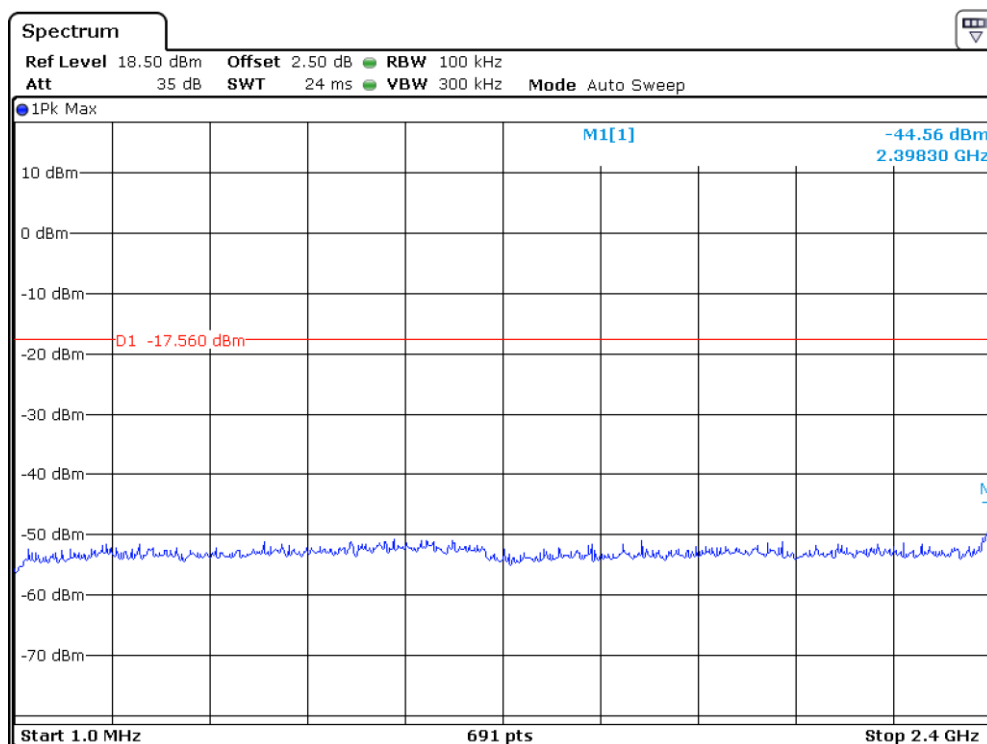
802.11g

Channel 01 (2412MHz) Reference Level: 1.95dBm

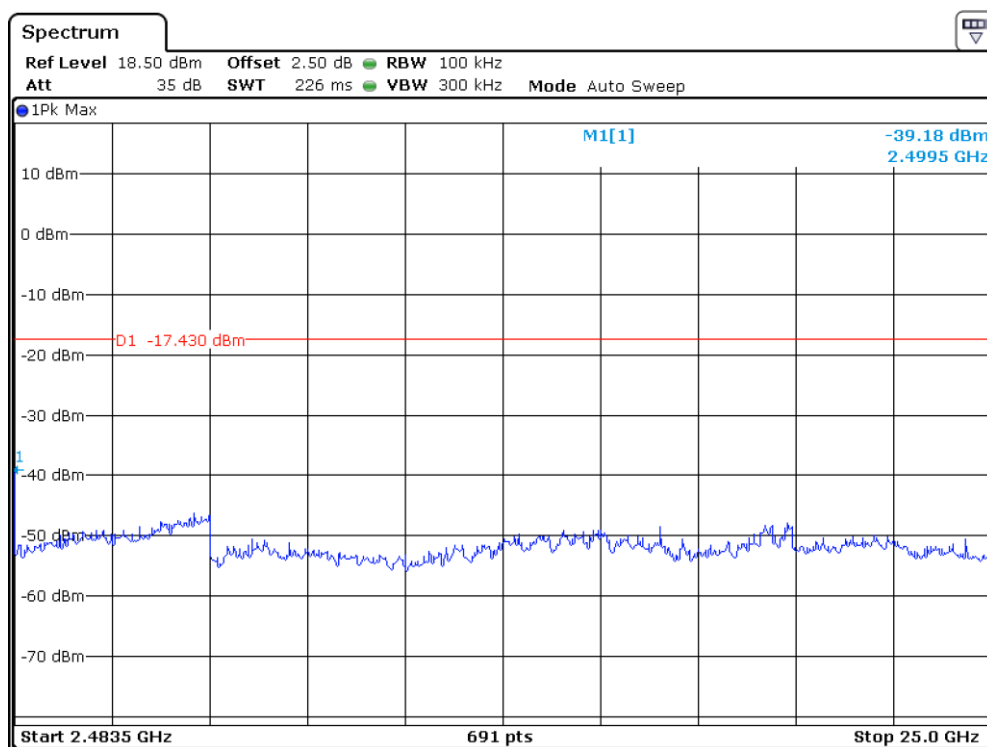
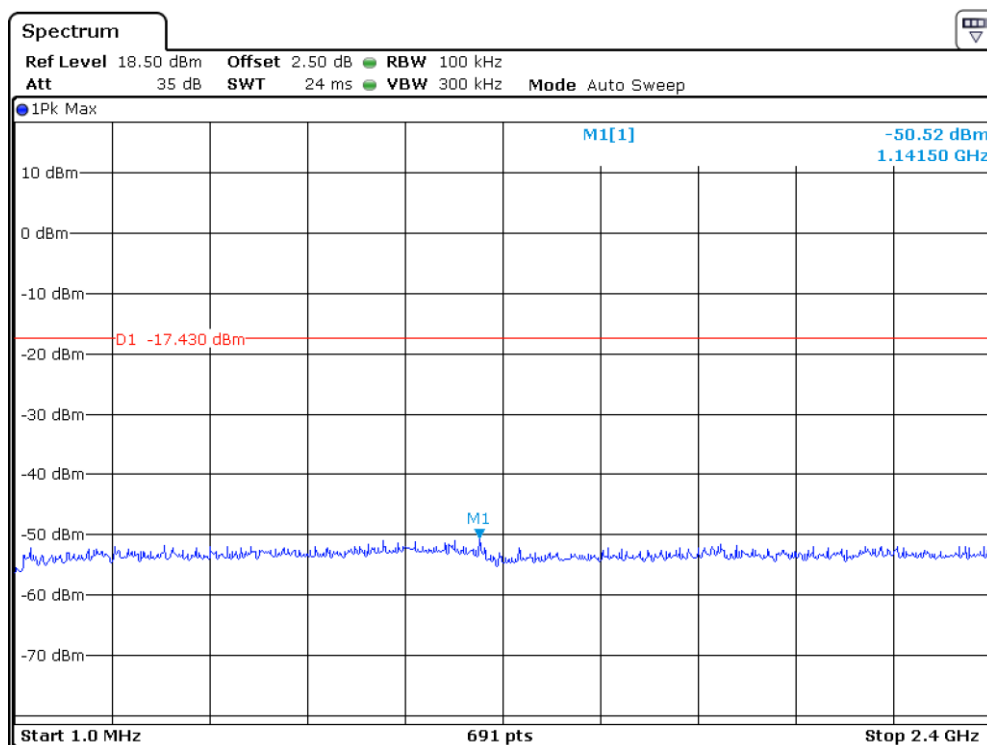


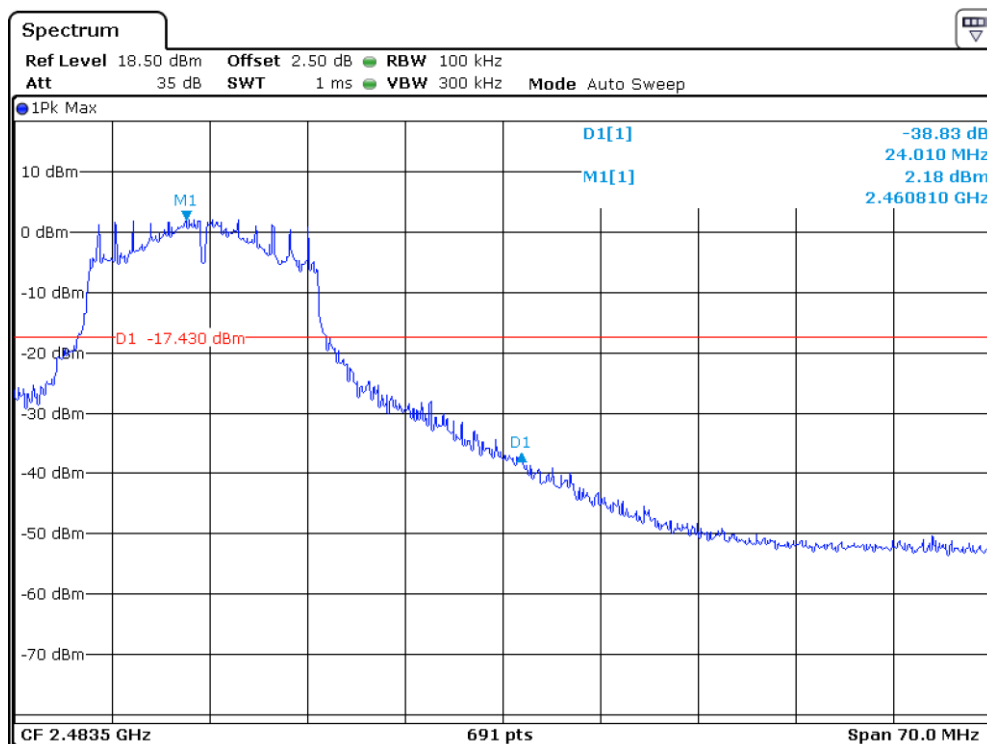


Channel 06 (2437MHz) Reference Level: 2.44dBm



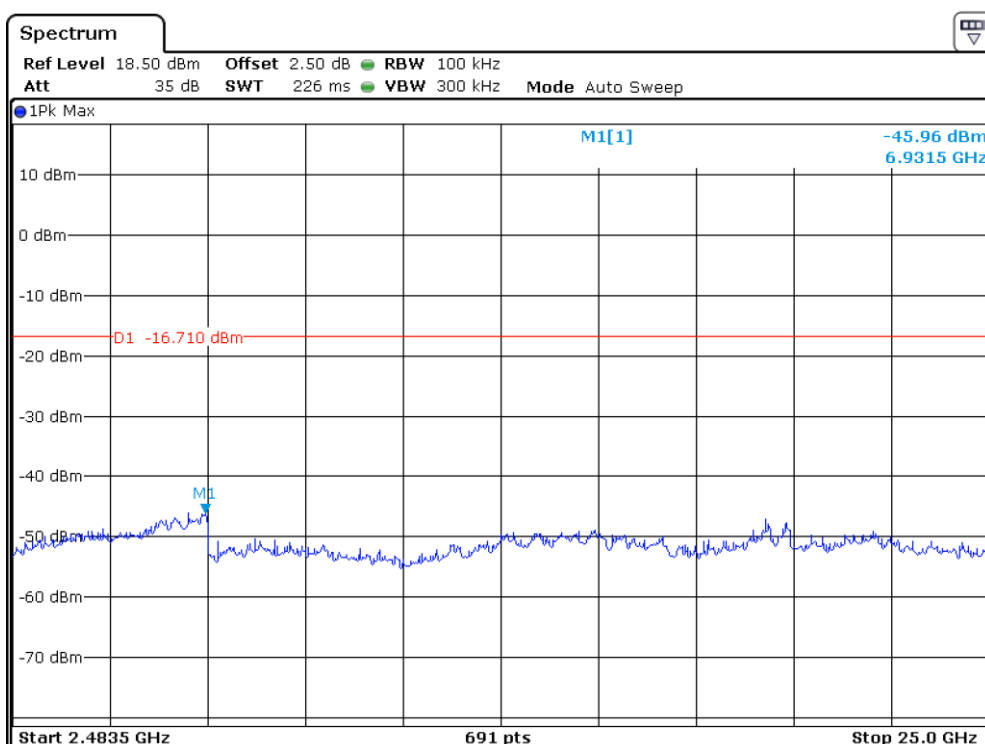
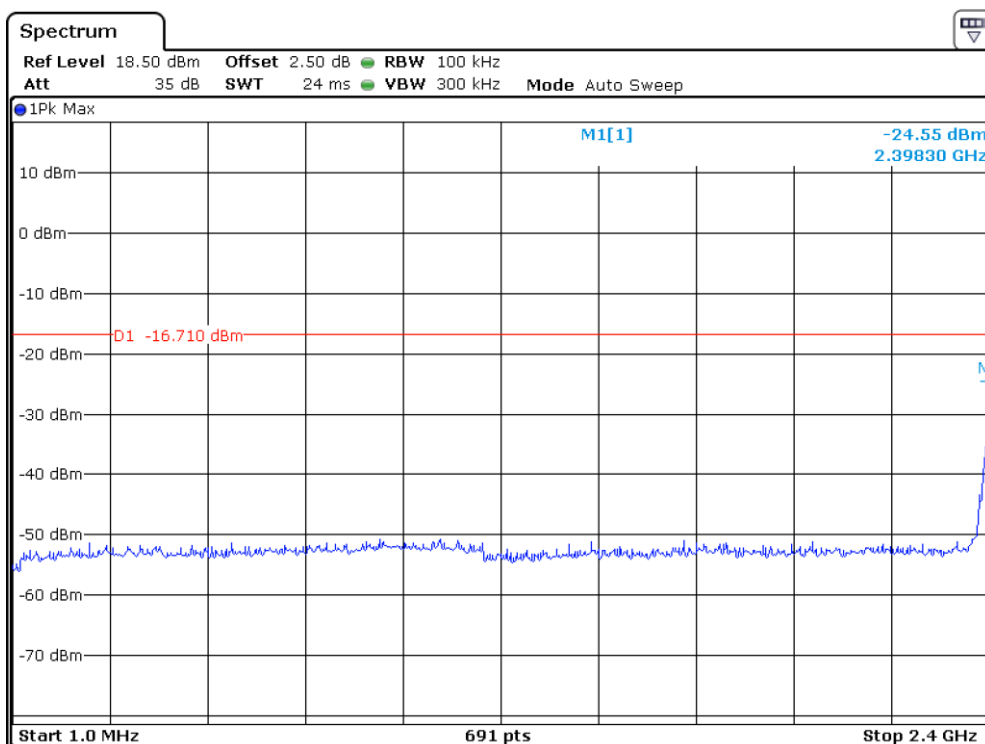
Channel 11 (2462MHz) Reference Level: 2.57dBm

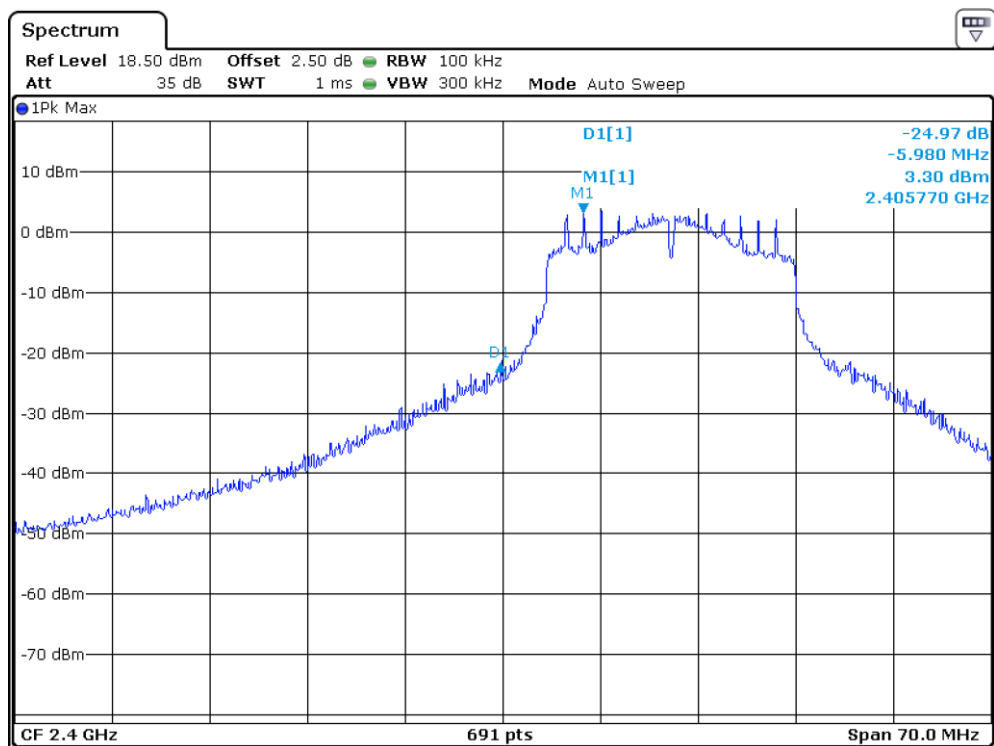




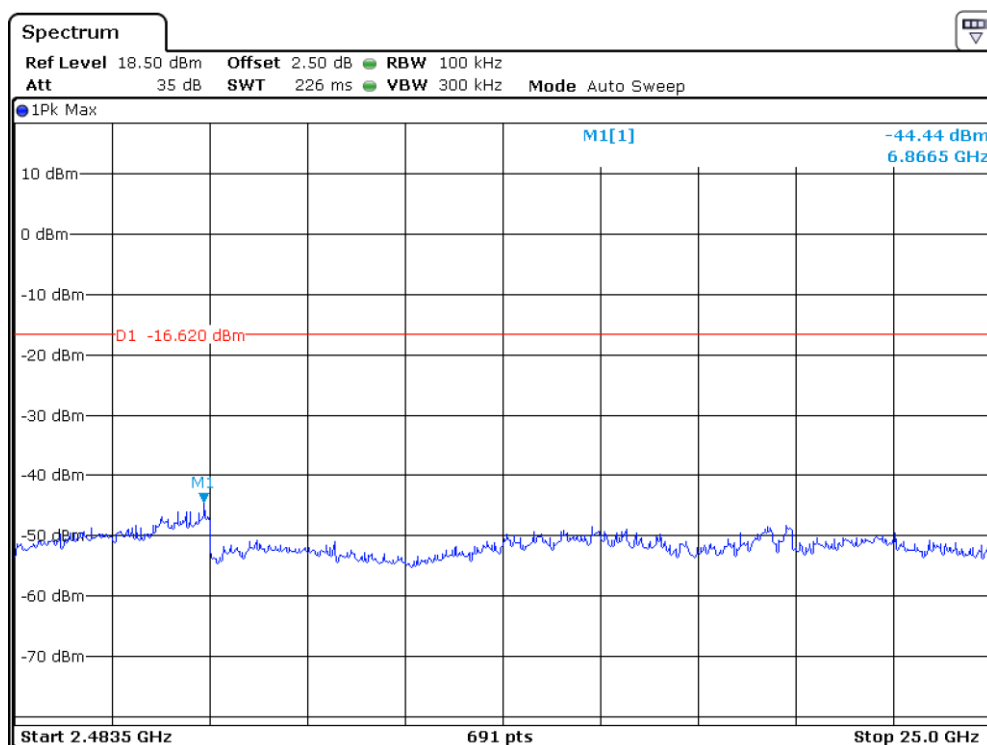
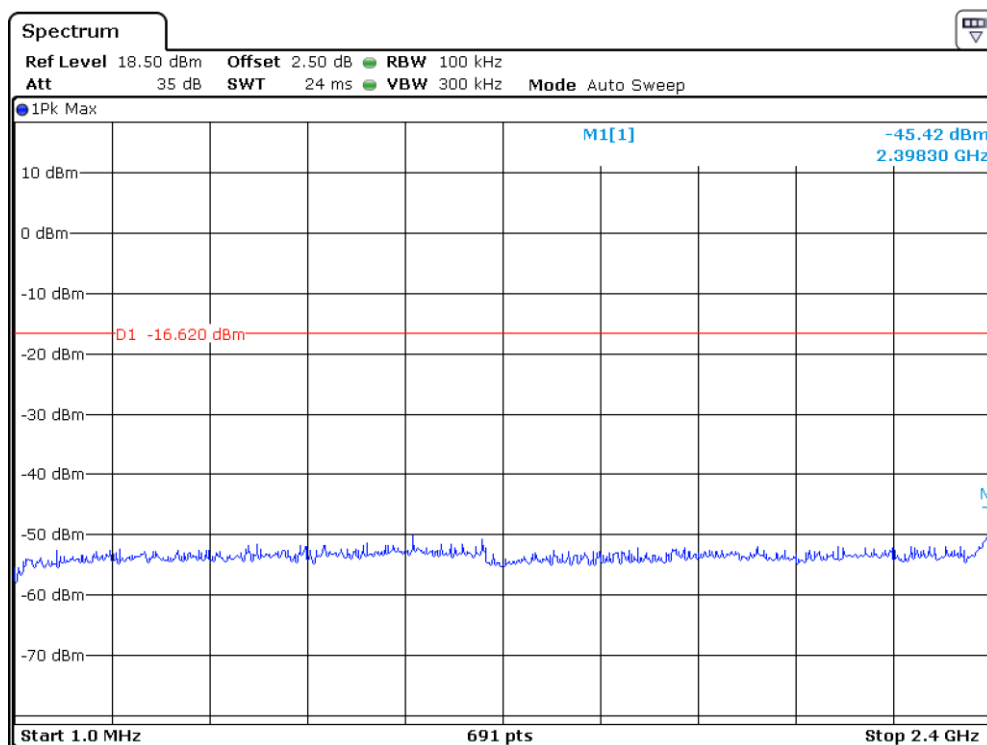
802.11n-HT20

Channel 01 (2412MHz) Reference Level: 3.29dBm

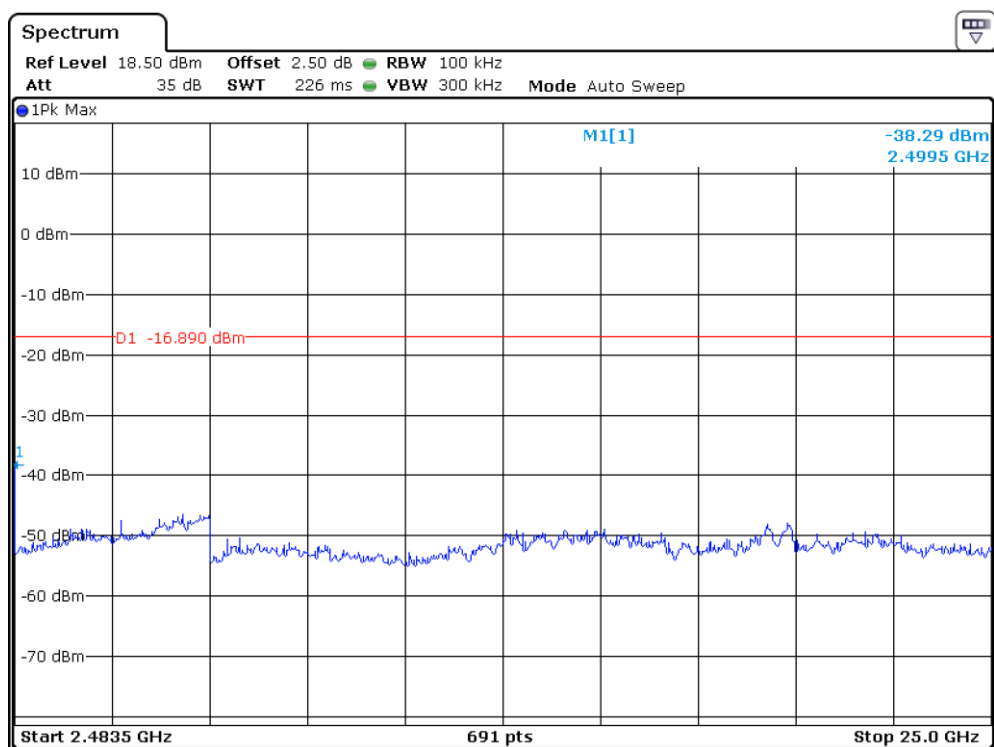
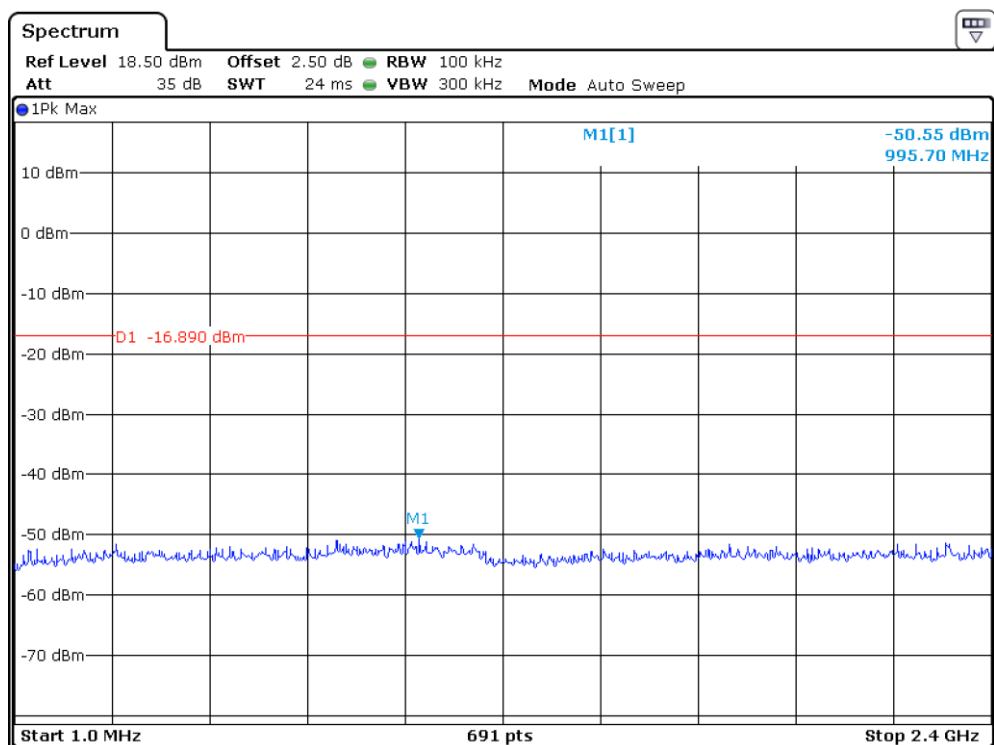


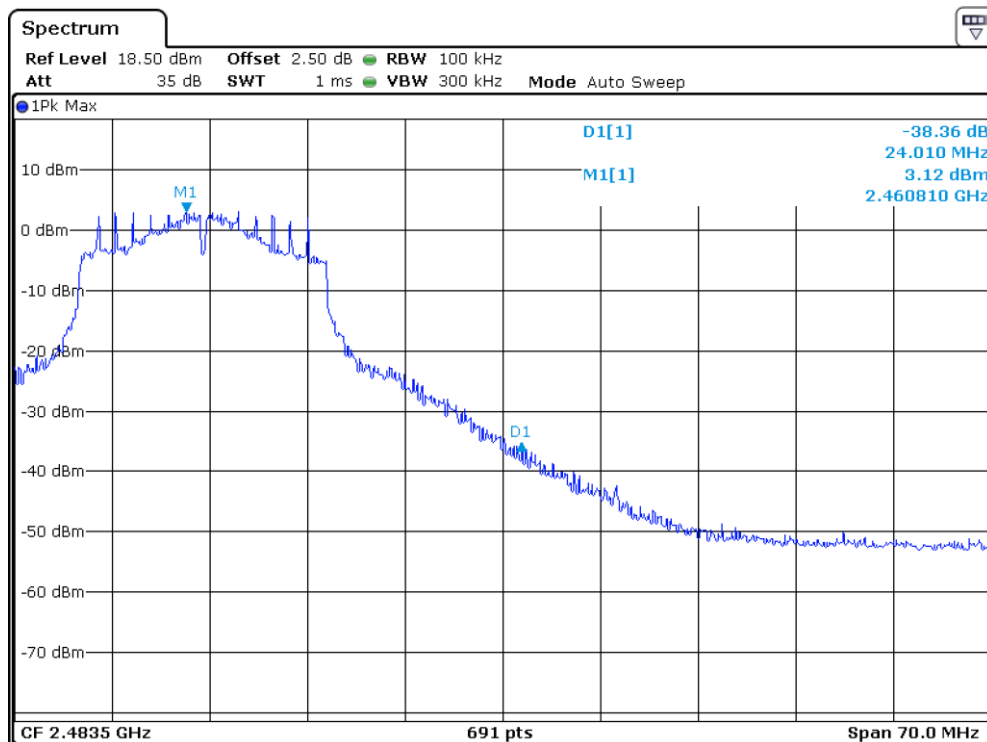


Channel 06 (2437MHz) Reference Level: 3.38dBm



Channel 11 (2462MHz) Reference Level: 3.11dBm





Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 15, 2019

Model: ECH-REFL01-5G

4.5 Out of Band Radiated Emissions (for emissions in 4.4 above that are less than 20dB below carrier),
FCC Rule 15.247(d):

For out of band emissions that are close to or that exceed the 20dB attenuation requirement described in the specification, radiated measurements were performed at a 3m separation distance to determine whether these emissions complied with the general radiated emission requirement.

☒ Not required, since all emissions are more than 20dB below fundamental.

☐ See attached data sheet.

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 14, 2019

Model: ECH-REFL01-5G

4.6 Transmitter Radiated Emissions in Restricted Bands, FCC Rule 15.35(b) (c):

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included. All measurements were performed with peak detection unless otherwise specified.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 14, 2019

Model: ECH-REFL01-5G

4.7 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

$$FS = RA + AF + CF - AG + PD$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB
- PD = Pulse Desensitization in dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

$$FS = RA + AF + CF - AG + PD$$

Example

Assume a receiver reading of 62.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB. The net field strength for comparison to the appropriate emission limit is 42 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$PD = 0 \text{ dB}$$

$$FS = 62 + 7.4 + 1.6 - 29 + 0 = 42 \text{ dB}\mu\text{V/m}$$

$$\text{Level in mV/m} = \text{Common Antilogarithm} [(42 \text{ dB}\mu\text{V/m})/20] = 125.9 \mu\text{V/m}$$

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 14, 2019

Model: ECH-REFL01-5G

4.8 Radiated Spurious Emission

Worst Case Radiated Spurious Emission
at 891.03576MHz
is passed by 2.2dB margin.

For the electronic filing, the worst case radiated emission configuration photographs are saved with filename: radiated photos.pdf. Simultaneous transmission was considered during the test.

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

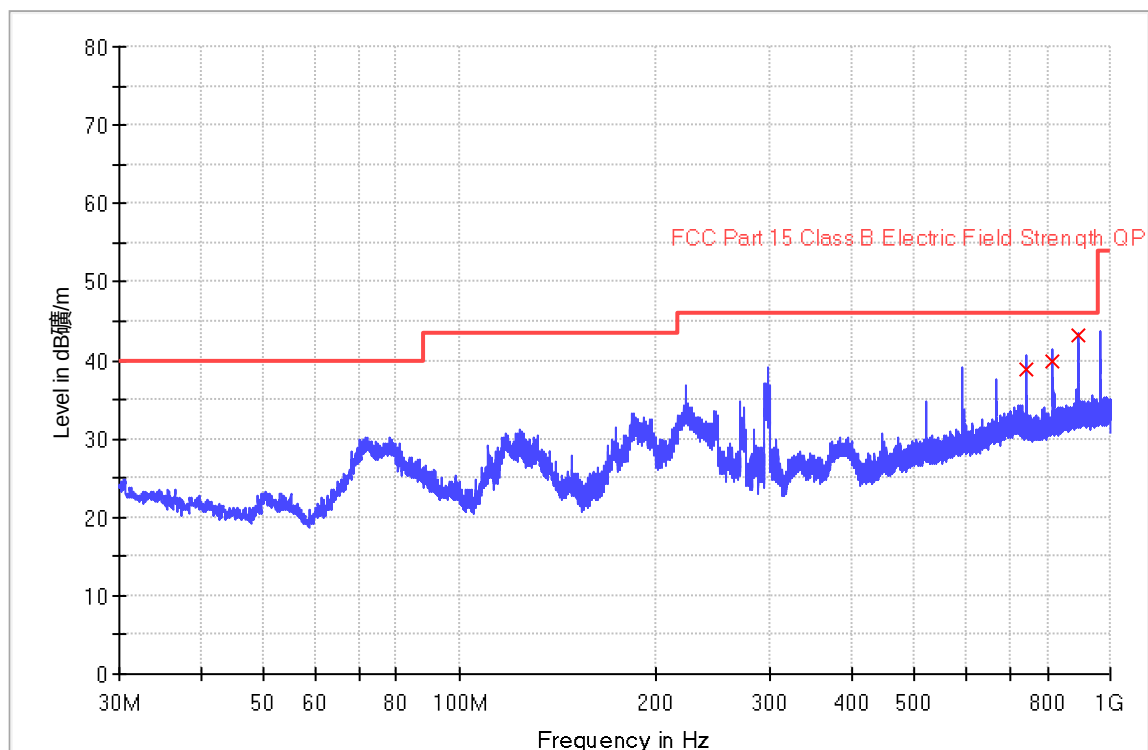
Date of Test: October 14, 2019

Model: ECH-REFL01-5G

Worst Case Operating Mode: Simultaneous transmission (BT+2.4G WIFI)

ANT Polarity: Horizontal

FCC Part 15



Frequency (MHz)	Quasi Peak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
742.497333	38.9	1000.0	120.000	H	27.0	7.1	46.0
816.784520	40.0	1000.0	120.000	H	27.4	6.0	46.0
891.010160	43.3	1000.0	120.000	H	28.3	2.7	46.0

Remark:

1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m)= Corr. (dB/m)+ Read Level (dBμV)
3. Margin (dB) = Limit Line(dBμV/m) – Level (dBμV/m)

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

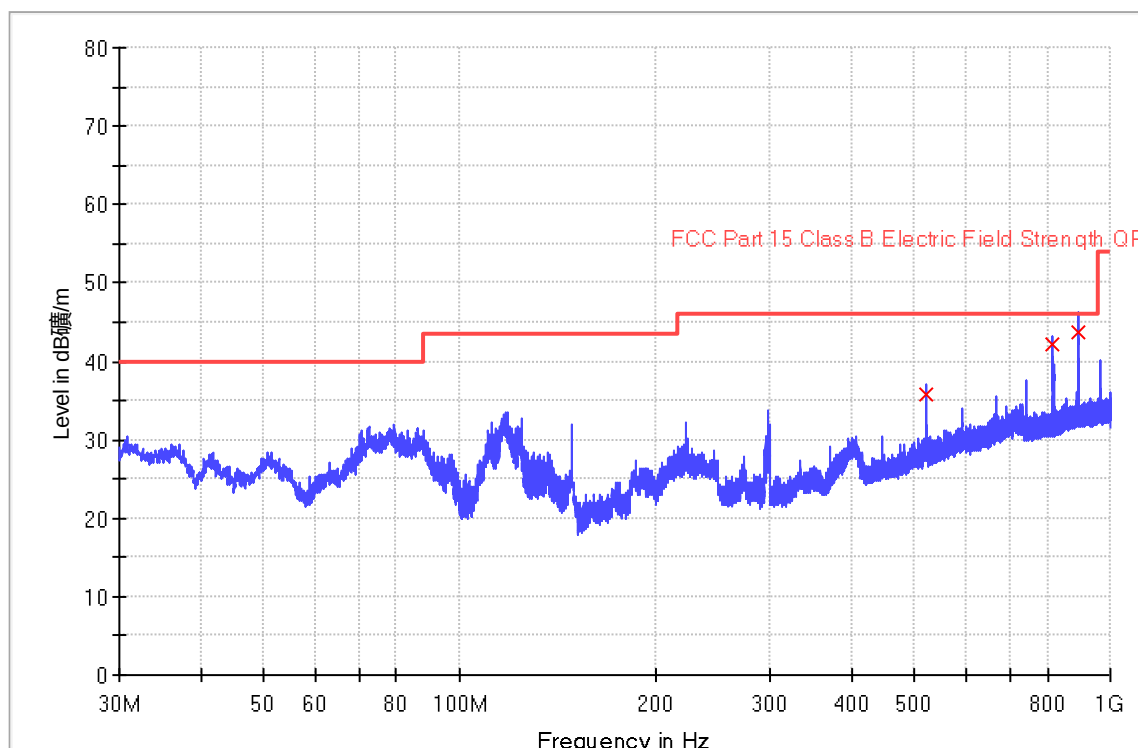
Date of Test: October 14, 2019

Model: ECH-REFL01-5G

Worst Case Operating Mode: Simultaneous transmission (BT+2.4G WIFI)

ANT Polarity: Vertical

FCC Part 15



Frequency (MHz)	Quasi Peak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV/m)
519.753000	35.7	1000.0	120.000	V	23.4	10.3	46.0
816.734667	42.1	1000.0	120.000	V	27.4	3.9	46.0
891.035760	43.8	1000.0	120.000	V	28.3	2.2	46.0

Remark:

1. Corr. = Antenna Factor (dB/m) + Cable Loss (dB)
2. QuasiPeak (dBμV/m) = Corr. (dB/m) + Read Level (dBμV)
3. Margin (dB) = Limit Line (dBμV/m) – Level (dBμV/m)

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 14, 2019

Model: ECH-REFL01-5G

Worst Case Operating Mode: Transmitting (802.11b)

Radiated Emissions

(802.11b-Channel 01)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	49.6	36.8	33.5	46.3	74.0	-27.7
Horizontal	*2390.000	47.4	36.4	29.1	40.1	74.0	-33.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4824.000	41.3	36.8	33.5	38.0	54.0	-16.0
Horizontal	*2390.000	37.6	36.4	29.1	30.3	54.0	-23.7

- NOTES:
1. Peak detector is used, RBW=1MHz/VBW=3MHz for peak value and RBW=1MHz/VBW=10Hz for average value.
 2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
 3. Negative value in the margin column shows emission below limit.
 4. Horn antenna used for the emission over 1000MHz.
- * Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 14, 2019

Model: ECH-REFL01-5G

Worst Case Operating Mode: Transmitting (802.11b)

Radiated Emissions

(802.11b-Channel 06)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	51.8	36.7	33.4	48.5	74.0	-25.5
Horizontal	*7311.000	57.1	36.6	35.8	56.3	74.0	-17.7

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4874.000	42.2	36.7	33.4	38.9	54.0	-15.1
Horizontal	*7311.000	46.2	36.6	35.8	45.4	54.0	-8.6

- NOTES:
1. Peak detector is used, RBW=1MHz/VBW=3MHz for peak value and RBW=1MHz / VBW=10Hz for average value.
 2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
 3. Negative value in the margin column shows emission below limit.
 4. Horn antenna used for the emission over 1000MHz.
- * Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 14, 2019

Model: ECH-REFL01-5G

Worst Case Operating Mode: Transmitting (802.11b)

Radiated Emissions

(802.11b-Channel 11)

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Peak Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	51.5	36.8	33.3	48.0	74.0	-26.0
Horizontal	*2484.50	48.3	36.5	29.3	41.1	74.0	-32.9

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
Horizontal	*4924.000	42.9	36.8	33.3	39.4	54.0	-14.6
Horizontal	*2484.500	38.6	36.5	29.3	31.4	54.0	-22.6

- NOTES:
1. Peak detector is used, RBW=1MHz/VBW=3MHz for peak value and RBW=1MHz / VBW=10Hz for average value.
 2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
 3. Negative value in the margin column shows emission below limit.
 4. Horn antenna used for the emission over 1000MHz.
- * Emission within the restricted band meets the requirement of section 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.



Total Quality. Assured.

Test Report

Intertek Report: 190926001SZN-001_updated

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 16, 2019

Model: ECH-REFL02-5G

4.9 Conducted Emission

Worst Case Conducted Emission (WIFI Link)
at 13.398MHz
is passed by 7.3dB margin.

For the electronic filing, the worst case radiated emission configuration photographs are saved with filename: conducted photos.pdf.

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 16, 2019

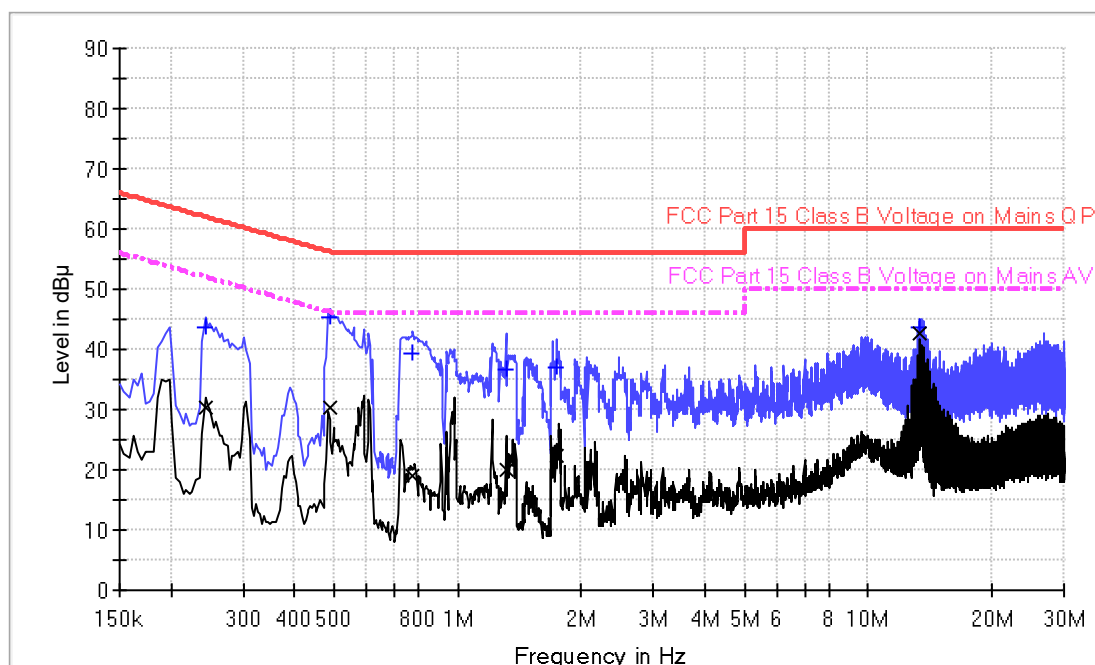
Model: ECH-REFL02-5G

Worst Case Operating Mode: Simultaneous transmission (BT+2.4G WIFI)

Phase: Live

Graphic / Data Table

Conducted Emissions Pursuant to FCC 15.207: Emissions Requirement



Result Table QP

Frequency (MHz)	Quasi Peak (dBμV)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.242000	43.7	L1	9.7	18.3	62.0
0.486000	45.2	L1	9.7	11.0	56.2
0.778000	39.4	L1	9.7	16.6	56.0
1.310000	36.5	L1	9.7	19.5	56.0
1.742000	37.0	L1	9.7	19.0	56.0
13.398000	43.8	L1	10.1	16.2	60.0

Result Table AV

Frequency (MHz)	Average (dBμV)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.242000	30.5	L1	9.7	21.5	52.0
0.486000	30.3	L1	9.7	15.9	46.2
0.778000	19.0	L1	9.7	27.0	46.0
1.310000	19.9	L1	9.7	26.1	46.0
1.742000	22.4	L1	9.7	23.6	46.0
13.398000	42.7	L1	10.1	7.3	50.0

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)

2. Margin (dB) = Limit (dBμV) – Level (dBμV)

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 16, 2019

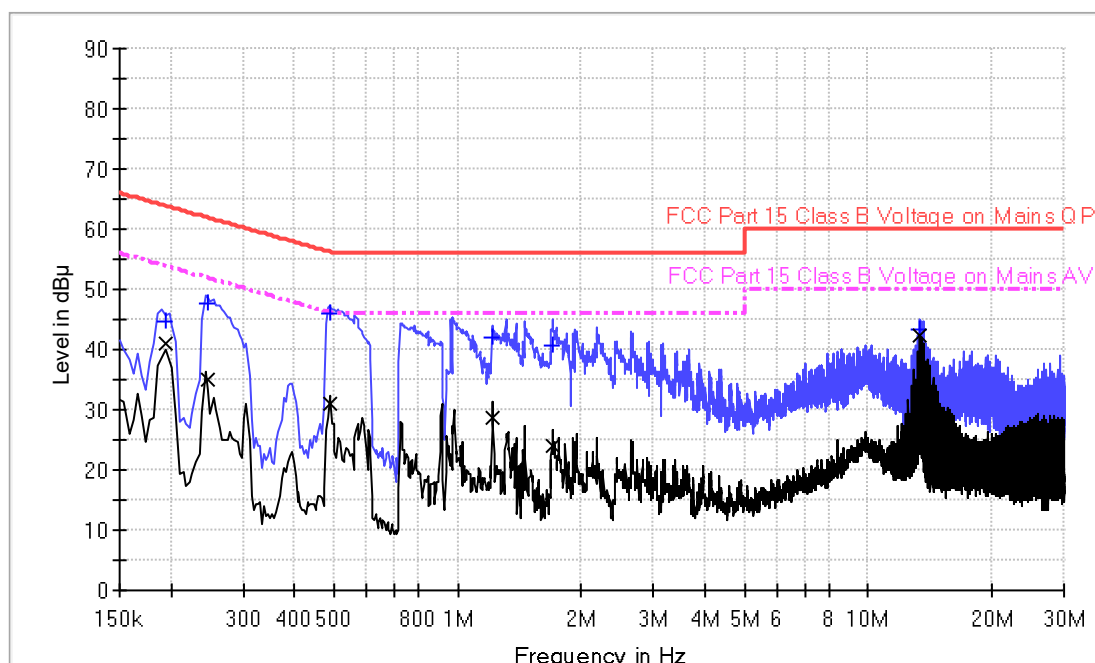
Model: ECH-REFL02-5G

Worst Case Operating Mode: Simultaneous transmission (BT+2.4G WIFI)

Phase: Neutral

Graphic / Data Table

Conducted Emissions Pursuant to FCC 15.207: Emissions Requirement



Result Table QP

Frequency (MHz)	QuasiPeak (dBμV)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.194000	44.5	N	9.7	19.4	63.9
0.246000	47.7	N	9.7	14.2	61.9
0.486000	46.1	N	9.7	10.1	56.2
1.214000	42.1	N	9.7	13.9	56.0
1.706000	40.8	N	9.7	15.2	56.0
13.398000	43.4	N	10.1	16.6	60.0

Result Table AV

Frequency (MHz)	Average (dBμV)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.194000	41.1	N	9.7	12.8	53.9
0.246000	34.9	N	9.7	17.0	51.9
0.486000	31.1	N	9.7	15.1	46.2
1.214000	28.6	N	9.7	17.4	46.0
1.706000	23.9	N	9.7	22.1	46.0
13.398000	42.2	N	10.1	7.8	50.0

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Limit (dBuV) – Level (dBuV)



Total Quality. Assured.

Test Report

Intertek Report: 190926001SZN-001_updated

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 16, 2019

Model: ECH-REFL01-5G

4.10 Radiated Emissions from Digital Section of Transceiver, FCC Ref: 15.109

☐ Not required - No digital part

☐ Test results are attached

☒ Included in the separated report.

Applicant: DONGGUAN TYSTART GLASS TECHNOLOGY CO., LTD

Date of Test: October 16, 2019

Model: ECH-REFL01-5G

4.11 Transmitter Duty Cycle Calculation and Measurements, FCC Rule 15.35(b), (c)

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEP function on the analyzer was set to ZERO SPAN. The Transmitter ON time was determined from the resultant time-amplitude display:

	See attached spectrum analyzer chart (s) for Transmitter timing
	See Transmitter timing diagram provided by manufacturer
x	Not applicable, duty cycle was not used.

5.0 Equipment Photographs

For electronic filing, the photographs are saved with filename: external photos.pdf & internal photos.pdf.

6.0 Product Labeling

For electronic filing, the FCC ID label artwork and location is saved with filename: label.pdf.

7.0 Technical Specifications

For electronic filing, the block diagram and circuit diagram are saved with filename: block.pdf and circuit.pdf respectively.

8.0 Instruction Manual

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

9.0 Confidentiality Request

For electronic filing, the confidentiality request of the tested EUT is saved with filename: request.pdf.

10.0 Discussion of Pulse Desensitization

The determination of pulse desensitivity was made in accordance with Hewlett Packard Application Note 150-2, *Spectrum Analysis ... Pulsed RF*.

Pulse desensitivity is not applicable for this device since the transmitter transmits the RF signal continuously.

11.0 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ182-02	RF Power Meter	Anritsu	ML2496A	1302005	28-May-2019	28-May-2020
SZ182-02-01	Power Sensor	Anritsu	MA2411B	1207429	28-May-2019	28-May-2020
SZ061-12	BiConiLog Antenna	ETS	3142E	00166158	14-Sep-2018	14-Sep-2020
SZ185-01	EMI Receiver	R&S	ESCI	100547	04-Jan-2019	04-Jan-2020
SZ061-08	Horn Antenna	ETS	3115	00092346	7-Sep-2019	7-Sep-2021
SZ061-07	Pyramidal Horn Antenna	ETS	3160-09	00083067	10-Mar-2019	10-Mar-2020
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	28-May-2019	28-May-2020
SZ056-06	Signal Analyzer	R&S	FSV 40	101101	28-May-2019	28-May-2020
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	15-Jan-2019	15-Jan-2020
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	15-Dec-2018	15-Dec-2020
SZ062-02	RF Cable	RADIAL	RG 213U	--	19-Jun-2019	19-Dec-2019
SZ062-05	RF Cable	RADIAL	0.04-26.5GHz	--	14-Aug-2019	14-Feb-2020
SZ062-12	RF Cable	RADIAL	0.04-26.5GHz	--	14-Aug-2019	14-Feb-2020
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	28-May-2019	28-May-2020
SZ185-02	EMI Test Receiver	R&S	ESCI	100692	26-Oct-2018	26-Oct-2019
SZ187-01	Two-Line V-Network	R&S	ENV216	100072	26-Oct-2018	26-Oct-2019
SZ188-03	Shielding Room	ETS	RFD-100	4100	16-Jan-2017	16-Jan-2020
SZ062-16	RF Cable	HUBER+SUHNER	CBL2-BN-1m	110127-2231000	29-Oct-2018	29-Oct-2019

***** End of Report*****