FCC Part 15.247

TEST REPORT

For

3Egreen Technology, INC.

5F, No. 283 Songjiang Road, Zhongshan District, Taipei, Taiwan

FCC ID: 2AMHJGW08000000

Report Type:	**Product Type:**
Original Report	Tiny WIFI to Sub-1G Gateway

Report Producer : Kaylee Chiang

Report Number : RXZ190226005-00A

Report Date : 2019-06-06

Reviewed By: Jerry Chang

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
1.0	RXZ190226005	RXZ190226005-00A	2019-06-06	Original Report	Kaylee Chiang

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	3Egreen Technology, INC.
	5F, No. 283 Songjiang Road, Zhongshan District, Taipei, Taiwan
Manufacturer	3Egreen Technology, INC.
	5F, No. 283 Songjiang Road, Zhongshan District, Taipei, Taiwan
Brand(Trade) Name	3Egreen
Product (Equipment)	Tiny WIFI to Sub-1G Gateway
Main Model Name	GW08 Series
Series Model Name	N/A
Frequency Range	IEEE 802.11b/g / IEEE 802.11n HT20 Mode: 2412 ~ 2462 MHz
Transmit Power	IEEE 802.11b Mode: 14.56 dBm (0.029W) IEEE 802.11g Mode: 15.87 dBm (0.039W) IEEE 802.11n HT20 Mode: 14.53 dBm (0.028W)
Modulation Technique	IEEE 802.11b: DSSS IEEE 802.11g: OFDM IEEE 802.11n HT20 Mode: OFDM
Transmit Data Rate	IEEE 802.11b Mode: 11, 5.5, 2, 1 Mbps IEEE 802.11g Mode: 54, 48, 36, 24, 18, 12, 11 , 9, 6Mbps IEEE 802.11n HT20 Mode: 6.5, 7.2, 13, 14.4, 14.44, 19.5, 21.7, 26, 28.89, 28.9, 39, 43.3, 43.33 52, 57.78, 57.8, 58.5, 65.0, 72.2, 78, 86.67, 104, 115.56, 117, 130, 144.44 Mbps
Number of Channels	IEEE 802.11b/g / IEEE 802.11n HT20 Mode: 11 Channels
Antenna Specification	PCB Antenna / 3.3 dBi
Power Operation (Voltage Range)	☐ AC 120V/60Hz ☐ Adapter I/P: 100-240Vac,1.2A ; O/P: 12Vdc, 3A ☐ By AC Power Cord ☐ PoE
	☒ DC Type ☐ Battery ☐ DC Power Supply ☒ External from USB Cable: 5Vdc ☐ External DC Adapter
	☐ Host System
Received Date	Feb 26, 2019
Date of Test	Apr 03, 2019 ~ May 31, 2019

**All measurement and test data in this report was gathered from production sample serial number: 190226005 (Assigned by BACL, Taiwan).*

1.2 Objective

This report is prepared on behalf of *3Egreen Technology, INC.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.
The objective is to determine compliance with FCC Part 15.247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

1.3 Related Submittal(s)/Grant(s)

FCC Part 15.249 DXX submission with FCC ID: 2AMHJGW08000000.

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 662911 D01 Multiple Transmitter Output v02r01
KDB 558074 D01 DTS 15.247 Meas Guidance v05

1.5 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Taiwan) to collect test data is located on
☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.
☐68-3, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (Taiwan) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3180) and the FCC designation No.TW3180 under the Mutual Recognition Agreement (MRA) in FCC Test. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.10.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 974454. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

2 System Test Configuration

2.1 Description of Test Configuration

For WIFI mode, there are totally 11 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

For 802.11 b/g/n20 Modes were tested with channel 1, 6 and 11.

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

Used "SmartRF_Studio_7-2.6.1" software.

Test Frequency		Low	Mid	High
Power Level Setting	B Mode	0	0	0
	G Mode	0	0	0
	N20 Mode	0	0	0

The EUT was configured for testing in an engineering mode which was provided by the manufacturer.

The worst-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rates bandwidths, and modulations.

802.11b: 1Mbps

802.11g: 6Mbps

802.11n ht20: MCS0

2.4 Test Mode

Pre-Scan

Mode 1: Full System (model: GW08 Series) for all test item.

Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available.

Final Test

Mode 1: Full System (model: GW08 Series) for all test item.

2.5 Support Equipment List and Details

Description	Manufacturer	Model Number	BSMI	FCC ID	S/N
NB	DELL	E6410	N/A	PD98260NGU	10912240367
FIX	N/A	N/A	N/A	N/A	N/A

2.6 External Cable List and Details

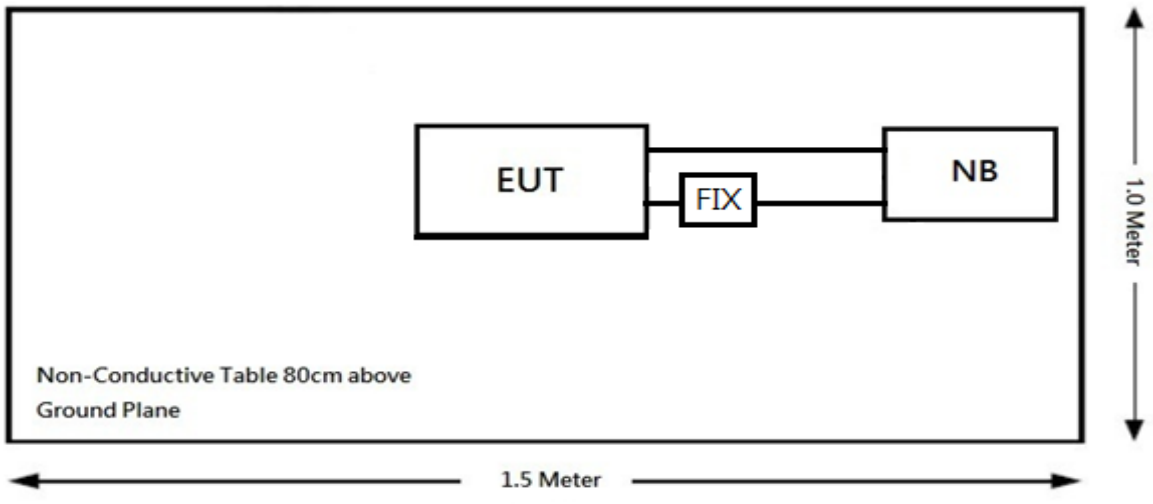
Cable Description	Length (m)	From	To
Micro USB Cable	1.5	NB	EUT
Micro USB Cable	1.5	NB	FIX
Control Cable	0.5	FIX	EUT

2.7 Block Diagram of Test Setup

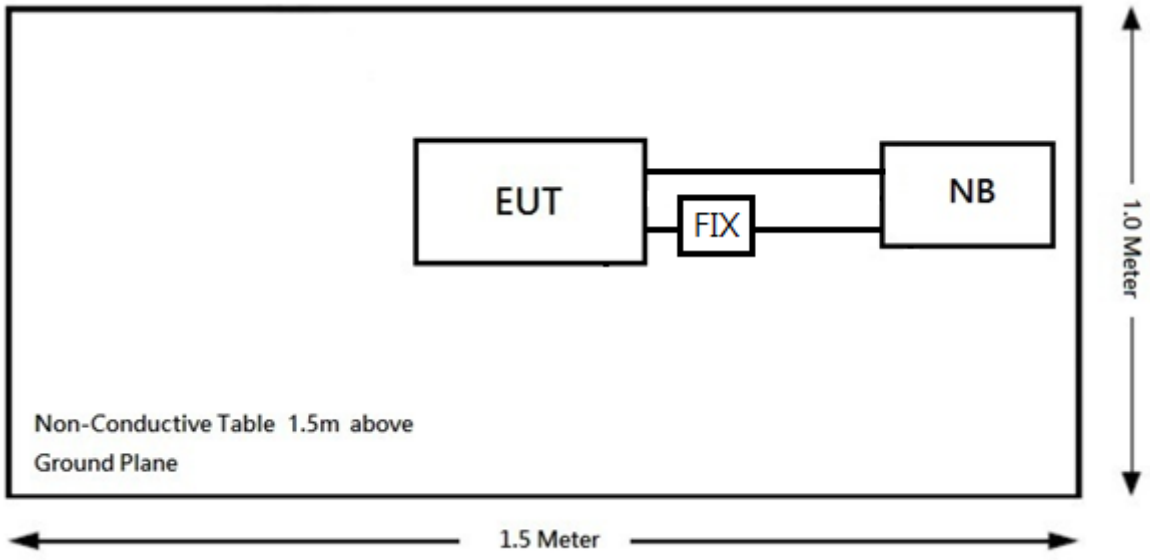
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

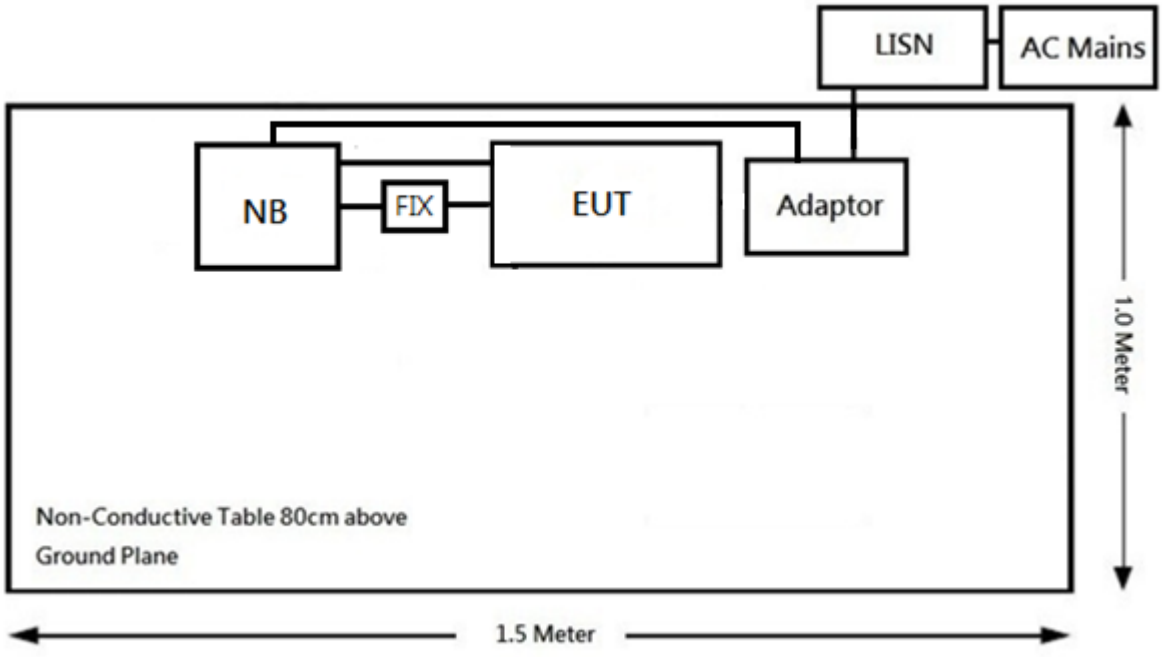
Below 1GHz:



Above 1GHz:



Conduction:



2.8 Duty Cycle

According to KDB 558074 D01 15.247 Meas Guidance v05 section 6.0:

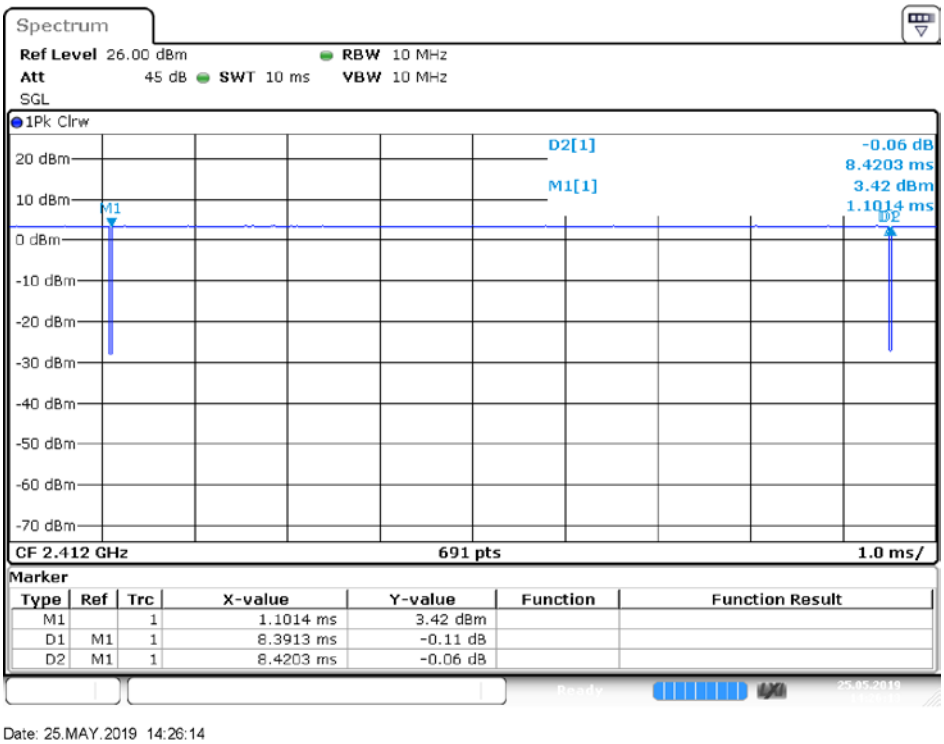
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximumpower transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	8.391	8.420	1	0.00
802.11g	1.376	1.427	0.96	0.18
802.11n20	1.304	1.355	0.96	0.18

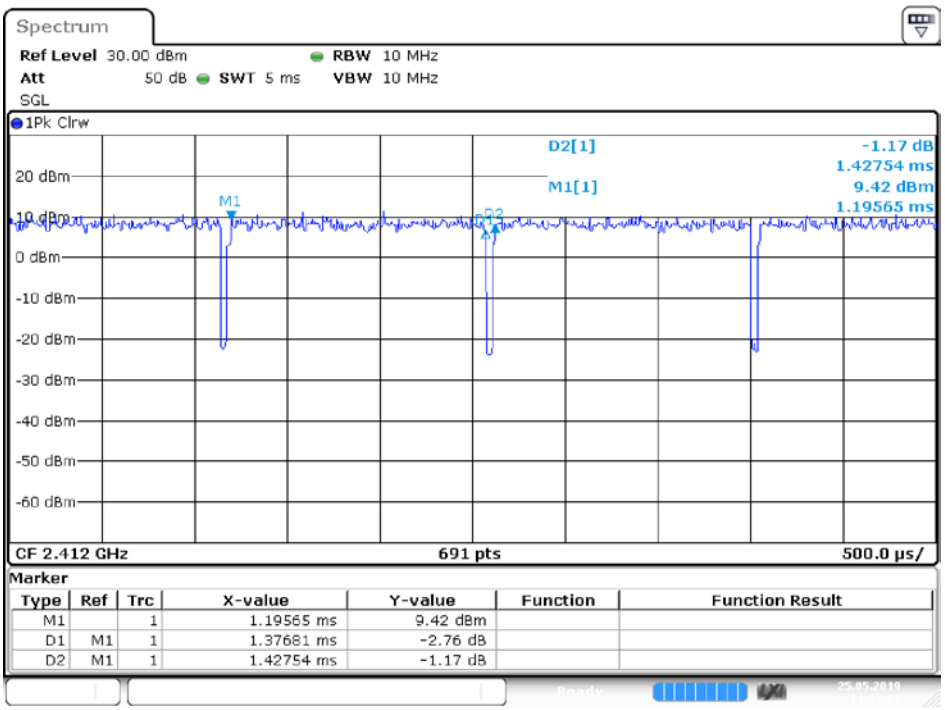
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

B Mode

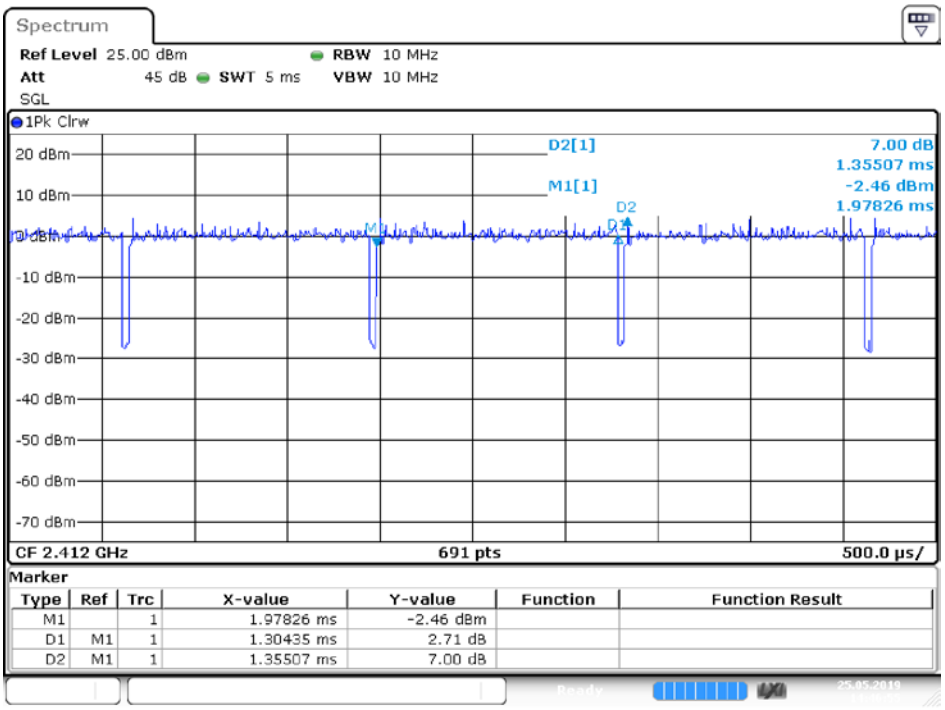


G Mode



Date: 25.MAY.2019 14:33:07

N20 Mode



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3 Summary of Test Results

FCC Rules	Description of Test	Results
§15.247(i), §1.1310, §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

4 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
LISN	Rohde & Schwarz	ENV216	101612	2019/02/21	2020/02/20
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2018/10/23	2019/10/22
Pulse Limiter	Rohde & Schwarz	ESH3Z2	TXZEM104	2018/08/03	2019/08/02
RF Cable	EMEC	EM-CB5D	001	2018/07/02	2019/07/01
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiated Room (966-A)					
Bilog Antenna with 6 dB Attenuator	SUNOL SCIENCES & MINI-CIRCUITS	JB6/UNAT-6+	A050115/15542_01	2018/12/11	2019/12/10
Horn Antenna	EMCO	SAS-571	1020	2019/04/17	2020/04/16
Horn Antenna	ETS-Lindgren	3116	62638	2018/08/29	2019/08/28
Preamplifier	Sonoma	310N	130602	2018/07/04	2019/07/03
Preamplifier	EM Electronics Corp.	EM01G18G	060657	2018/12/07	2019/12/06
Microware Preamplifier	EM Electronics Corporation	EM18G40G	060656	2019/01/11	2020/01/10
EMI Test Receiver	Rohde & Schwarz	ESR7	101419	2018/10/23	2019/10/22
Spectrum Analyzer	Rohde & Schwarz	FSV40	101435	2019/02/13	2020/02/12
Micro flex Cable	UTIFLEX	FSCM 64639 / (2M)	93D0127	2018/07/31	2019/07/30
Micro flex Cable	UTIFLEX	UFA210A-1-3149-300300	MFR64639 226389-001	2018/11/19	2019/11/18
Micro flex Cable	ROSNOL	K1K50-UP0264-K1K50-450CM	160309-1	2019/03/04	2020/03/03
Micro flex Cable	ROSNOL	K1K50-UP0264-K1K50-80CM	160309-2	2019/01/16	2020/01/15
Turn Table	Champro	TT-2000	060772-T	N.C.R	N.C.R
Antenna Tower	Champro	AM-BS-4500-B	060772-A	N.C.R	N.C.R
Controller	Champro	EM1000	60772	N.C.R	N.C.R
Software	Farad	EZ_EMC	BACL-03A1	N.C.R	N.C.R

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2018/11/14	2019/11/13
Cable	WOKEN	SFL402	S02-160323-07	2019/02/11	2020/02/10
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2019/03/06	2020/03/05
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2019/03/07	2020/03/06

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements*

5 FCC §15.247(i), §1.1310, § 2.1091 - Maximum Permissible Exposure (MPE)

5.1 Applicable Standard

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

5.2 RF Exposure Evaluation Result

MPE evaluation:

Mode	Frequency Range (MHz)	Antenna Gain		Target Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
WIFI 2.4G	2437	3.3	2.14	16	39.81	20	0.0169	1.0
Sub-1G	920.5-924.5	3	1.995	-4.4	0.363	20	0.0001	0.613

Sub-1G EIRP = 93.78 dBμV/m – 95.23 = -1.45dBm

Conducted Power = -1.45dBm -3dBi = -4.45dBm

MPE evaluation for simultaneous transmission:

WIFI 2.4G and Sub-1G can transmit at the same time, MPE evaluation is as below formula:

PD1/Limit1+PD2/Limit2+…… < 1, PD (Power Density)

MPE evaluation:

MPE of WIFI 2.4G/1 + MPE of Sub-1G/0.613

= 0.0169/1+0.0001/0.613 = 0.017063 < 1.0

Result: MPE evaluation of single and simultaneous transmission meet the requirement of standard.

6 FCC §15.203 – Antenna Requirements

6.1 Applicable Standard

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 user of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna does not exceed 6dBi.

6.2 Antenna Information

Manufacturer	Type	Antenna Gain	Result
Texas Instruments	PCB Antenna	3.3 dBi	Compliance

The EUT has one integral antenna arrangement, which was permanently attached; fulfill the requirement of this section.

7 FCC §15.207(a) – AC Line Conducted Emissions

7.1 Applicable Standard

According to §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

Note 2: A linear average detector is required

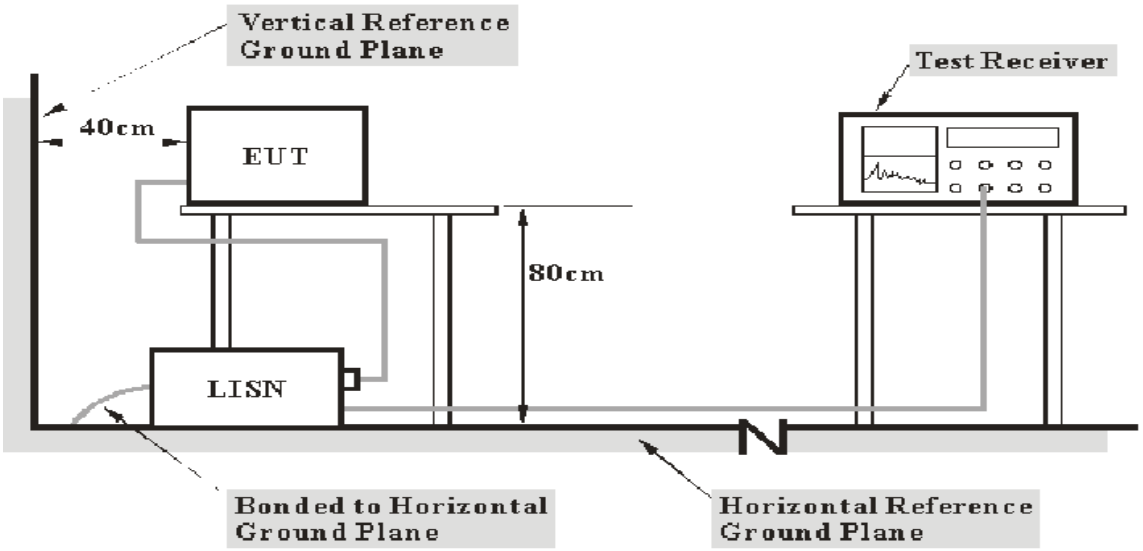
7.2 Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between LISN/ISN and receiver, LISN/ISN voltage division factor, LISN/ISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Taiwan) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report

Port	Expanded Measurement uncertainty
AC Mains	4.22 dB (k=2, 95% level of confidence)

7.3 EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

7.4 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150kHz to 30MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations

Frequency Range	IF B/W
150kHz – 30MHz	9kHz

7.5 Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

7.6 Corrected Factor & Margin Calculation

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "Over Limit" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

Over Limit = Level – Limit Line

7.7 Environmental Conditions

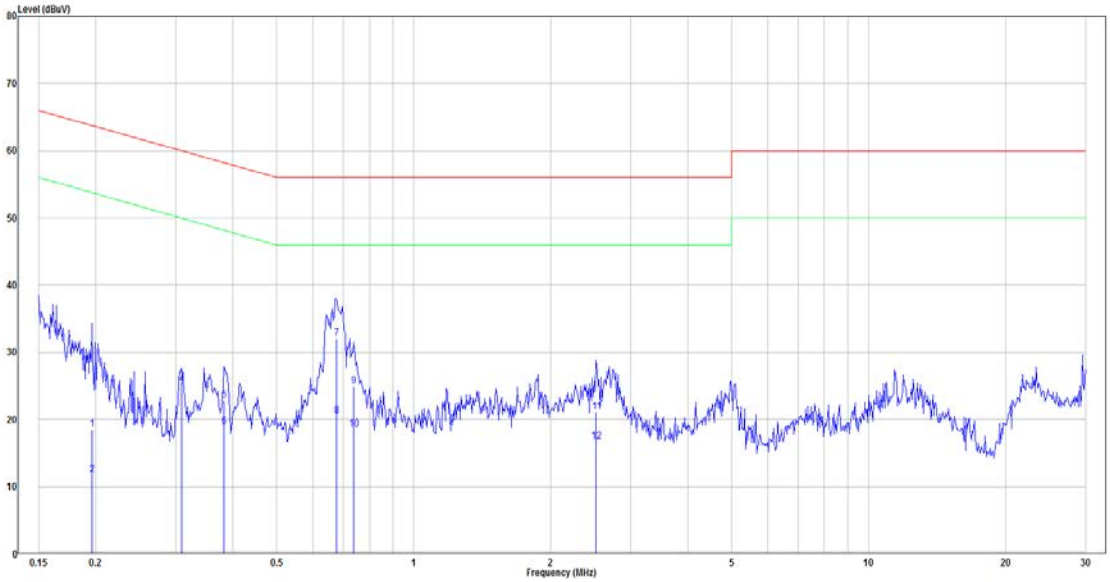
Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-05-31.

7.8 Test Results

Test Mode: Transmitting

Main: AC120 V, 60 Hz, Line



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBµV)	Factor(dB)	(dBµV)	(dBµV)	(dB)	
1	0.196	-0.87	19.46	18.59	63.76	-45.17	QP
2	0.196	-7.71	19.46	11.75	53.76	-42.02	Average
3	0.309	6.22	19.47	25.69	60.00	-34.31	QP
4	0.309	5.73	19.47	25.20	50.00	-24.80	Average
5	0.383	3.41	19.47	22.88	58.22	-35.34	QP
6	0.383	-0.54	19.47	18.92	48.22	-29.29	Average
7	0.676	12.63	19.48	32.11	56.00	-23.89	QP
8	0.676	1.06	19.48	20.55	46.00	-25.45	Average
9	0.739	5.45	19.49	24.93	56.00	-31.07	QP
10	0.739	-0.98	19.49	18.51	46.00	-27.49	Average
11	2.519	1.56	19.56	21.12	56.00	-34.88	QP
12	2.519	-2.82	19.56	16.74	46.00	-29.26	Average

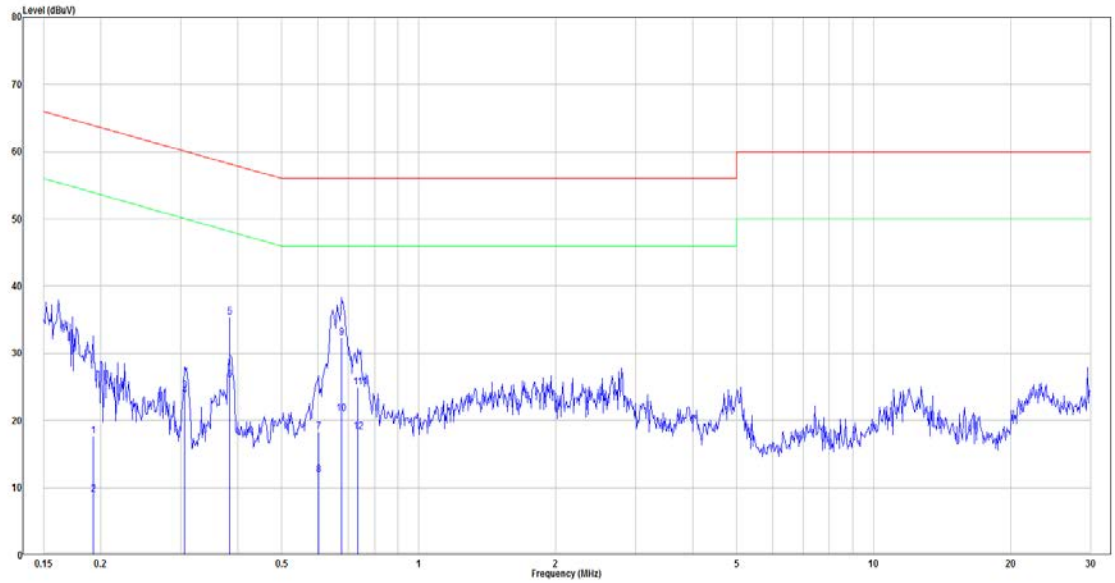
Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

Main: AC120 V, 60 Hz, Neutral



No.	Frequency	Reading	Correct	Result	Limit	Over limit	Remark
	(MHz)	(dBµV)	Factor(dB)	(dBµV)	(dBµV)	(dB)	
1	0.192	-1.72	19.46	17.73	63.93	-46.20	QP
2	0.192	-10.44	19.46	9.02	53.93	-44.91	Average
3	0.306	4.97	19.46	24.43	60.08	-35.65	QP
4	0.306	4.23	19.46	23.69	50.08	-26.39	Average
5	0.385	15.94	19.46	35.40	58.18	-22.78	QP
6	0.385	6.62	19.46	26.08	48.18	-22.10	Average
7	0.603	-1.22	19.47	18.25	56.00	-37.75	QP
8	0.603	-7.56	19.47	11.91	46.00	-34.09	Average
9	0.676	12.87	19.47	32.34	56.00	-23.66	QP
10	0.676	1.50	19.47	20.97	46.00	-25.03	Average
11	0.736	5.43	19.48	24.91	56.00	-31.09	QP
12	0.736	-1.23	19.48	18.25	46.00	-27.75	Average

Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

8 FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

8.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

8.2 Measurement Uncertainty

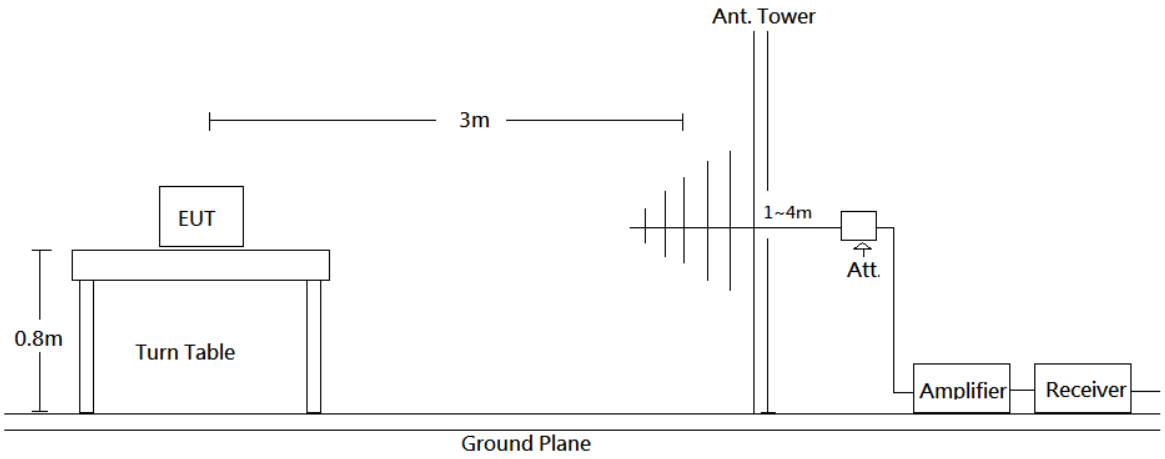
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Taiwan) is shown in below table. And the uncertainty will not be taken into consideration for the test data recorded in the report.

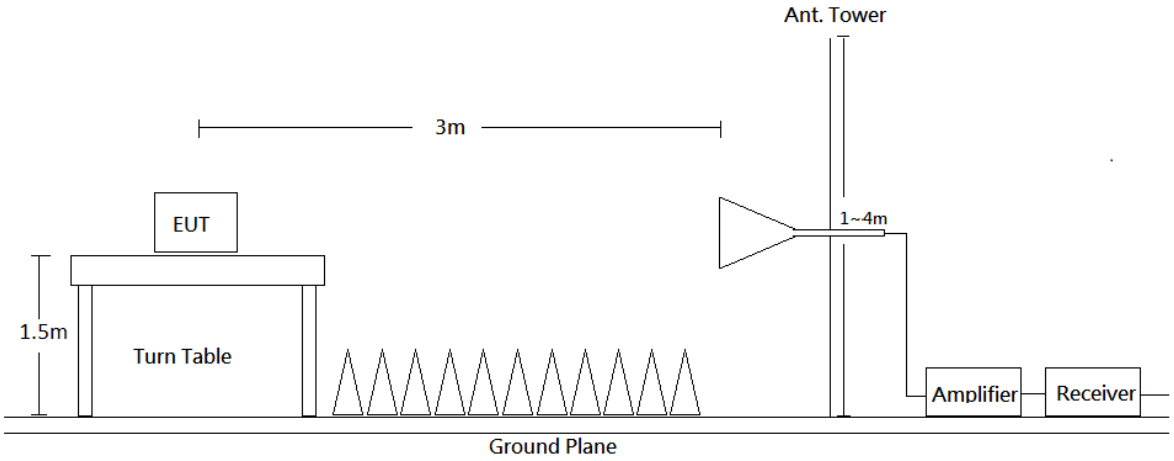
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.75 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.21 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.83 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.18 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.55 dB (k=2, 95% level of confidence)
26 GHz~40 GHz	4.67 dB (k=2, 95% level of confidence)

8.3 EUT Setup

Below 1 GHz:



Above 1 GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

8.4 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Detector	Duty cycle	Measurement method
30-1000 MHz	120 kHz	/	QP		QP
Above 1 GHz	1 MHz	3 MHz	PK		PK
	1 MHz	3 MHz	RMS	>98%	Ave
	1 MHz	1/T	PK	<98%	Ave

8.5 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

8.6 Corrected Factor & Margin Calculation

The Correct Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

The "Margin" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Result – Limit

8.7 Test Results Summary

According to the data in the following table, the EUT complied with the FCC §15.209 Limit. Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$Lm + U(Lm) \leq Llim + Ucispr$$

In BACL, U(Lm) is less than Ucispr, if Lm is less than Llim, it implies that the EUT complies with the limit.

8.8 Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The Radiation Spurious Emissions testing was performed by Tom Hsu on 2019-04-03.

The Conducted Spurious Emissions testing was performed by Tom Hsu on 2019-05-25.

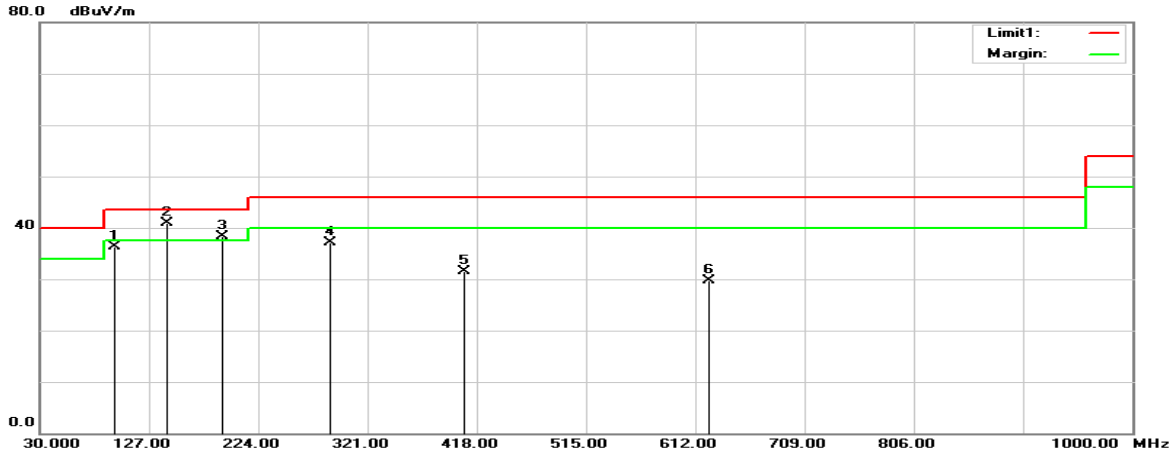
8.9 Test Results

Test Mode: Transmitting

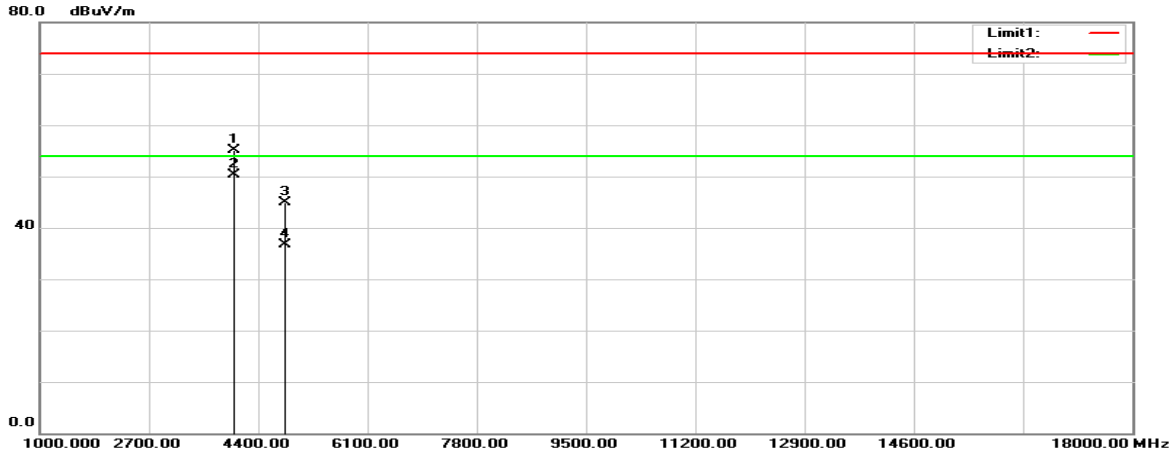
(Pre-scan with three orthogonal axis, and worse case as Y axis.)

Horizontal (*worst case is Wi-Fi B mode low channel*)

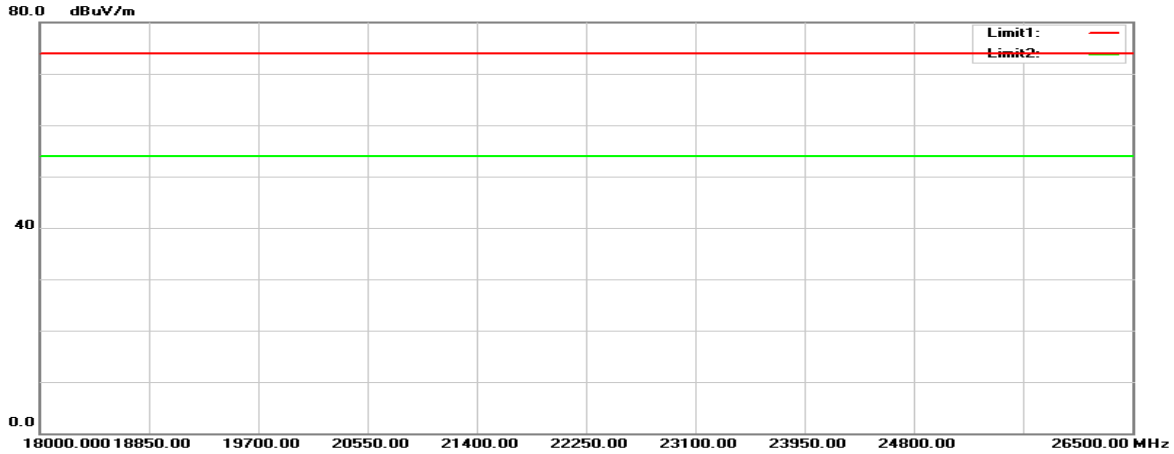
30MHz-1GHz:



1GHz-18GHz:

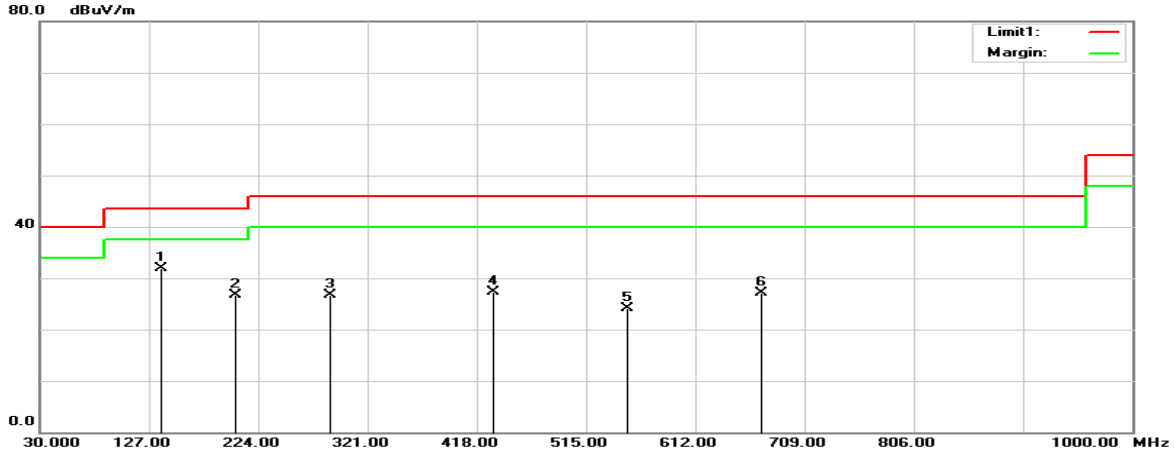


18GHz-26.5GHz:

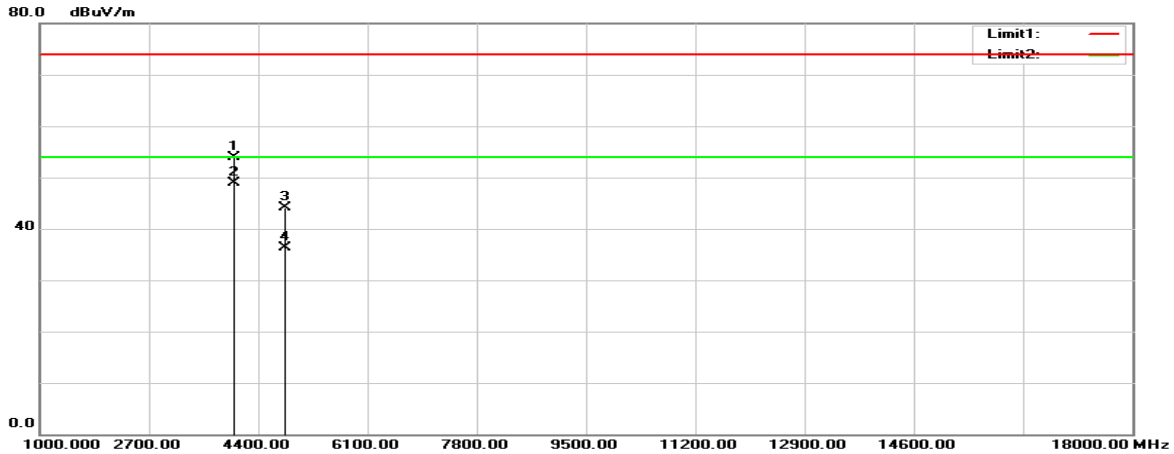


Vertical (*worst case is Wi-Fi B mode low channel*)

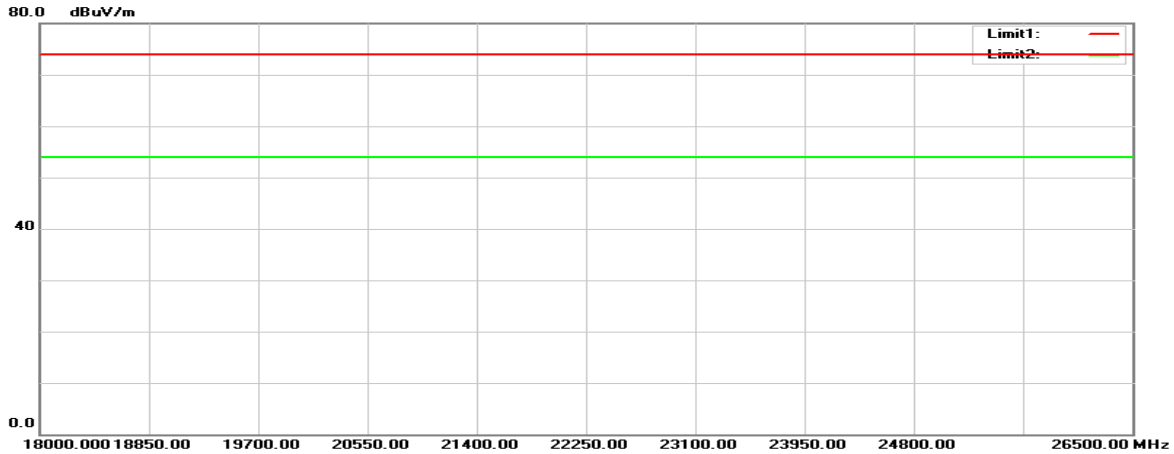
30MHz-1GHz:



1GHz-18GHz:



18GHz-26.5GHz:



Below 1GHz

Horizontal

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
B Mode								
95.9600	50.60	-14.33	36.27	43.50	-7.23	100	110	QP
143.4900	50.48	-9.60	40.88	43.50	-2.62	100	89	QP
191.9900	48.88	-10.56	38.32	43.50	-5.18	100	29	QP
288.0200	45.35	-8.17	37.18	46.00	-8.82	100	360	QP
407.3300	37.49	-5.90	31.59	46.00	-14.41	100	74	QP
623.6400	32.86	-3.23	29.63	46.00	-16.37	100	61	QP
G Mode								
137.6700	49.77	-9.47	40.30	43.50	-3.20	100	75	QP
191.0200	49.41	-10.79	38.62	43.50	-4.88	100	36	QP
288.0200	44.99	-8.17	36.82	46.00	-9.18	100	353	QP
407.3300	38.39	-5.90	32.49	46.00	-13.51	100	252	QP
431.5800	35.48	-5.49	29.99	46.00	-16.01	100	243	QP
551.8600	33.02	-4.04	28.98	46.00	-17.02	100	74	QP
N20 Mode								
143.4900	50.54	-9.60	40.94	43.50	-2.56	100	97	QP
191.0200	49.72	-10.79	38.93	43.50	-4.57	100	41	QP
288.0200	45.19	-8.17	37.02	46.00	-8.98	100	360	QP
407.3300	37.62	-5.90	31.72	46.00	-14.28	100	240	QP
551.8600	33.45	-4.04	29.41	46.00	-16.59	100	77	QP
623.6400	33.52	-3.23	30.29	46.00	-15.71	100	56	QP

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
B Mode								
137.6700	41.90	-9.98	31.92	43.50	-11.58	100	10	QP
203.6300	36.99	-10.22	26.77	43.50	-16.73	100	70	QP
288.0200	35.63	-8.87	26.76	46.00	-19.24	100	23	QP
432.5500	33.57	-6.29	27.28	46.00	-18.72	100	83	QP
551.8600	29.07	-4.98	24.09	46.00	-21.91	100	316	QP
670.2000	30.80	-3.63	27.17	46.00	-18.83	100	72	QP
G Mode								
133.7900	41.36	-9.86	31.50	43.50	-12.00	100	356	QP
191.9900	38.43	-11.18	27.25	43.50	-16.25	100	81	QP
288.0200	36.08	-8.87	27.21	46.00	-18.79	100	28	QP
439.3400	33.10	-6.18	26.92	46.00	-19.08	100	294	QP
623.6400	30.94	-4.16	26.78	46.00	-19.22	100	38	QP
687.6600	30.92	-3.43	27.49	46.00	-18.51	100	64	QP
N20 Mode								
137.6700	42.31	-9.98	32.33	43.50	-11.17	100	359	QP
263.7700	36.51	-9.82	26.69	46.00	-19.31	100	19	QP
288.0200	35.98	-8.87	27.11	46.00	-18.89	100	23	QP
438.3700	36.41	-6.20	30.21	46.00	-15.79	100	67	QP
623.6400	30.42	-4.16	26.26	46.00	-19.74	100	33	QP
674.0800	31.69	-3.58	28.11	46.00	-17.89	100	284	QP

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Above 1GHz

Horizontal

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
B Mode, Low channel								
2390.000	54.62	-3.83	50.79	74.00	-23.21	300	73	peak
2390.000	43.45	-3.83	39.62	54.00	-14.38	300	73	AVG
2412.000	98.35	-3.78	94.57	N/A	N/A	300	65	peak
2412.000	95.04	-3.78	91.26	N/A	N/A	300	65	AVG
4019.000	54.25	0.76	55.01	74.00	-18.99	267	165	peak
4019.000	49.60	0.76	50.36	54.00	-3.64	267	165	AVG
4824.000	43.08	1.74	44.82	74.00	-29.18	100	300	peak
4824.000	34.99	1.74	36.73	54.00	-17.27	100	300	AVG
B Mode, Middle channel								
2437.000	100.05	-3.76	96.29	N/A	N/A	300	64	peak
2437.000	96.77	-3.76	93.01	N/A	N/A	300	64	AVG
4060.000	54.42	0.65	55.07	74.00	-18.93	223	157	peak
4060.000	49.70	0.65	50.35	54.00	-3.65	223	157	AVG
4874.000	41.70	2.05	43.75	74.00	-30.25	112	255	peak
4874.000	33.88	2.05	35.93	54.00	-18.07	112	255	AVG
B Mode, High channel								
2462.000	100.03	-3.67	96.36	N/A	N/A	300	65	peak
2462.000	96.77	-3.67	93.10	N/A	N/A	300	65	AVG
2483.500	56.96	-3.52	53.44	74.00	-20.56	300	63	peak
2483.500	46.58	-3.52	43.06	54.00	-10.94	300	63	AVG
4133.000	51.22	0.61	51.83	74.00	-22.17	100	164	peak
4133.000	46.12	0.61	46.73	54.00	-7.27	100	164	AVG
4924.000	41.72	2.21	43.93	74.00	-30.07	145	259	peak
4924.000	33.35	2.21	35.56	54.00	-18.44	145	259	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
B Mode, Low channel								
2390.000	55.17	-3.83	51.34	74.00	-22.66	200	98	peak
2390.000	43.67	-3.83	39.84	54.00	-14.16	200	98	AVG
2412.000	99.63	-3.78	95.85	N/A	N/A	200	98	peak
2412.000	95.95	-3.78	92.17	N/A	N/A	200	98	AVG
4019.000	53.21	0.76	53.97	74.00	-20.03	205	287	peak
4019.000	48.22	0.76	48.98	54.00	-5.02	205	287	AVG
4824.000	42.42	1.74	44.16	74.00	-29.84	105	1	peak
4824.000	34.49	1.74	36.23	54.00	-17.77	105	1	AVG
B Mode, Middle channel								
2437.000	101.68	-3.76	97.92	N/A	N/A	200	96	peak
2437.000	98.36	-3.76	94.60	N/A	N/A	200	96	AVG
4060.000	51.35	0.65	52.00	74.00	-22.00	146	356	peak
4060.000	46.17	0.65	46.82	54.00	-7.18	146	356	AVG
4874.000	44.31	2.05	46.36	74.00	-27.64	100	313	peak
4874.000	38.38	2.05	40.43	54.00	-13.57	100	313	AVG
B Mode, High channel								
2462.000	102.25	-3.67	98.58	N/A	N/A	200	109	peak
2462.000	98.98	-3.67	95.31	N/A	N/A	200	109	AVG
2483.500	59.30	-3.52	55.78	74.00	-18.22	200	89	peak
2483.500	48.52	-3.52	45.00	54.00	-9.00	200	89	AVG
4094.000	49.72	0.67	50.39	74.00	-23.61	119	356	peak
4094.000	44.18	0.67	44.85	54.00	-9.15	119	356	AVG
4924.000	43.03	2.21	45.24	74.00	-28.76	115	305	peak
4924.000	35.53	2.21	37.74	54.00	-16.26	115	305	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Horizontal

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
G Mode, Low channel								
2390.000	59.34	-3.83	55.51	74.00	-18.49	300	89	peak
2390.000	42.03	-3.83	38.20	54.00	-15.80	300	89	AVG
2412.000	99.23	-3.78	95.45	N/A	N/A	308	97	peak
2412.000	88.75	-3.78	84.97	N/A	N/A	308	97	AVG
4009.000	53.59	0.80	54.39	74.00	-19.61	100	16	peak
4009.000	44.41	0.80	45.21	54.00	-8.79	100	16	AVG
4824.000	40.95	1.74	42.69	74.00	-31.31	100	281	peak
4824.000	26.52	1.74	28.26	54.00	-25.74	100	281	AVG
G Mode, Middle channel								
2437.000	102.63	-3.76	98.87	N/A	N/A	294	96	peak
2437.000	92.74	-3.76	88.98	N/A	N/A	294	96	AVG
4060.000	55.17	0.65	55.82	74.00	-18.18	100	165	peak
4060.000	45.30	0.65	45.95	54.00	-8.05	100	165	AVG
4876.000	45.12	2.06	47.18	74.00	-26.82	100	297	peak
4876.000	30.70	2.06	32.76	54.00	-21.24	100	297	AVG
6491.000	43.58	5.25	48.83	74.00	-25.17	100	10	peak
6491.000	38.42	5.25	43.67	54.00	-10.33	100	10	AVG
G Mode, High channel								
2462.000	101.16	-3.67	97.49	N/A	N/A	317	94	peak
2462.000	91.05	-3.67	87.38	N/A	N/A	317	94	AVG
2483.500	61.44	-3.52	57.92	74.00	-16.08	300	98	peak
2483.500	45.72	-3.52	42.20	54.00	-11.80	300	98	AVG
4094.000	51.82	0.67	52.49	74.00	-21.51	100	152	peak
4094.000	41.43	0.67	42.10	54.00	-11.90	100	152	AVG
4924.000	40.03	2.21	42.24	74.00	-31.76	100	274	peak
4924.000	26.42	2.21	28.63	54.00	-25.37	100	274	AVG
6559.000	42.11	5.37	47.48	74.00	-26.52	100	359	peak
6559.000	36.09	5.37	41.46	54.00	-12.54	100	359	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
G Mode, Low channel								
2390.000	61.54	-3.83	57.71	74.00	-16.29	200	127	peak
2390.000	43.28	-3.83	39.45	54.00	-14.55	200	127	AVG
2412.000	100.96	-3.78	97.18	N/A	N/A	210	208	peak
2412.000	90.80	-3.78	87.02	N/A	N/A	210	208	AVG
4009.000	50.50	0.80	51.30	74.00	-22.70	100	284	peak
4009.000	39.97	0.80	40.77	54.00	-13.23	100	284	AVG
4824.000	41.35	1.74	43.09	74.00	-30.91	100	312	peak
4824.000	26.31	1.74	28.05	54.00	-25.95	100	312	AVG
G Mode, Middle channel								
2437.000	103.83	-3.76	100.07	N/A	N/A	223	208	peak
2437.000	93.35	-3.76	89.59	N/A	N/A	223	208	AVG
4043.000	51.75	0.67	52.42	74.00	-21.58	100	156	peak
4043.000	40.93	0.67	41.60	54.00	-12.40	100	156	AVG
4874.000	46.02	2.05	48.07	74.00	-25.93	100	326	peak
4874.000	30.94	2.05	32.99	54.00	-21.01	100	326	AVG
G Mode, High channel								
2462.000	102.34	-3.67	98.67	N/A	N/A	210	123	peak
2462.000	92.31	-3.67	88.64	N/A	N/A	210	123	AVG
2483.500	62.17	-3.52	58.65	74.00	-15.35	200	120	peak
2483.500	46.20	-3.52	42.68	54.00	-11.32	200	120	AVG
4094.000	49.37	0.67	50.04	74.00	-23.96	100	153	peak
4094.000	38.08	0.67	38.75	54.00	-15.25	100	153	AVG
4924.000	40.08	2.21	42.29	74.00	-31.71	100	174	peak
4924.000	25.47	2.21	27.68	54.00	-26.32	100	174	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Horizontal

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
N20 Mode, Low channel								
2390.000	58.62	-3.83	54.79	74.00	-19.21	300	155	peak
2390.000	41.98	-3.83	38.15	54.00	-15.85	300	155	AVG
2412.000	98.25	-3.78	94.47	N/A	N/A	308	96	peak
2412.000	88.04	-3.78	84.26	N/A	N/A	308	96	AVG
4009.000	54.67	0.80	55.47	74.00	-18.53	100	153	peak
4009.000	44.13	0.80	44.93	54.00	-9.07	100	153	AVG
4824.000	39.70	1.74	41.44	74.00	-32.56	100	1	peak
4824.000	25.01	1.74	26.75	54.00	-27.25	100	1	AVG
N20 Mode, Middle channel								
2437.000	101.77	-3.76	98.01	N/A	N/A	295	95	peak
2437.000	91.52	-3.76	87.76	N/A	N/A	295	95	AVG
4060.000	55.82	0.65	56.47	74.00	-17.53	100	152	peak
4060.000	44.83	0.65	45.48	54.00	-8.52	100	152	AVG
4874.000	41.96	2.05	44.01	74.00	-29.99	100	308	peak
4874.000	27.99	2.05	30.04	54.00	-23.96	100	308	AVG
N20 Mode, High channel								
2462.000	100.60	-3.67	96.93	N/A	N/A	300	96	peak
2462.000	90.29	-3.67	86.62	N/A	N/A	300	96	AVG
2483.500	61.88	-3.52	58.36	74.00	-15.64	300	99	peak
2483.500	45.10	-3.52	41.58	54.00	-12.42	300	99	AVG
4094.000	50.80	0.67	51.47	74.00	-22.53	100	172	peak
4094.000	39.76	0.67	40.43	54.00	-13.57	100	172	AVG
4924.000	39.58	2.21	41.79	74.00	-32.21	100	335	peak
4924.000	25.90	2.21	28.11	54.00	-25.89	100	335	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
N20 Mode, Low channel								
2390.000	61.06	-3.83	57.23	74.00	-16.77	200	128	peak
2390.000	43.54	-3.83	39.71	54.00	-14.29	200	128	AVG
2412.000	100.52	-3.78	96.74	N/A	N/A	200	206	peak
2412.000	90.07	-3.78	86.29	N/A	N/A	200	206	AVG
4009.000	50.31	0.80	51.11	74.00	-22.89	100	103	peak
4009.000	39.69	0.80	40.49	54.00	-13.51	100	103	AVG
4824.000	39.07	1.74	40.81	74.00	-33.19	100	83	peak
4824.000	25.44	1.74	27.18	54.00	-26.82	100	83	AVG
N20 Mode, Middle channel								
2437.000	103.30	-3.76	99.54	N/A	N/A	245	112	peak
2437.000	92.89	-3.76	89.13	N/A	N/A	245	112	AVG
4060.000	51.09	0.65	51.74	74.00	-22.26	100	118	peak
4060.000	39.70	0.65	40.35	54.00	-13.65	100	118	AVG
4874.000	44.18	2.05	46.23	74.00	-27.77	100	321	peak
4874.000	28.92	2.05	30.97	54.00	-23.03	100	321	AVG
N20 Mode, High channel								
2462.000	101.50	-3.67	97.83	N/A	N/A	200	113	peak
2462.000	91.29	-3.67	87.62	N/A	N/A	200	113	AVG
2483.500	62.60	-3.52	59.08	74.00	-14.92	200	123	peak
2483.500	46.26	-3.52	42.74	54.00	-11.26	200	123	AVG
4094.000	49.89	0.67	50.56	74.00	-23.44	100	155	peak
4094.000	38.23	0.67	38.90	54.00	-15.10	100	155	AVG
4924.000	39.92	2.21	42.13	74.00	-31.87	100	155	peak
4924.000	26.07	2.21	28.28	54.00	-25.72	100	155	AVG

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Test Mode: simultaneous transmissions (WIFI 2.4G+Sub-1G)

Horizontal

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
191.9900	48.88	-10.56	38.32	43.50	-5.18	100	105	QP
239.5200	45.56	-10.39	35.17	46.00	-10.83	100	149	QP
288.0200	45.35	-8.17	37.18	46.00	-8.82	100	74	QP
311.3000	43.87	-7.74	36.13	46.00	-9.87	100	356	QP
359.8000	37.74	-6.76	30.98	46.00	-15.02	100	55	QP
407.3300	37.49	-5.90	31.59	46.00	-14.41	100	28	QP
1841.000	39.56	-5.22	34.34	74.00	-39.66	100	62	peak
1841.000	27.56	-5.22	22.34	54.00	-31.66	100	62	AVG
4824.000	38.20	1.74	39.94	74.00	-34.06	100	15	peak
4824.000	24.98	1.74	26.72	54.00	-27.28	100	15	AVG

Vertical

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
119.2400	38.73	-9.85	28.88	43.50	-14.62	100	316	QP
167.7400	35.06	-11.03	24.03	43.50	-19.47	100	58	QP
203.6300	36.30	-10.22	26.08	43.50	-17.42	100	47	QP
252.1300	33.20	-10.72	22.48	46.00	-23.52	100	279	QP
311.3000	32.34	-8.45	23.89	46.00	-22.11	100	280	QP
431.5800	34.08	-6.30	27.78	46.00	-18.22	100	115	QP
1841.000	39.07	-5.22	33.85	74.00	-40.15	100	66	peak
1841.000	28.93	-5.22	23.71	54.00	-30.29	100	66	AVG
4824.000	37.52	1.74	39.26	74.00	-34.74	100	81	peak
4824.000	24.93	1.74	26.67	54.00	-27.33	100	81	AVG

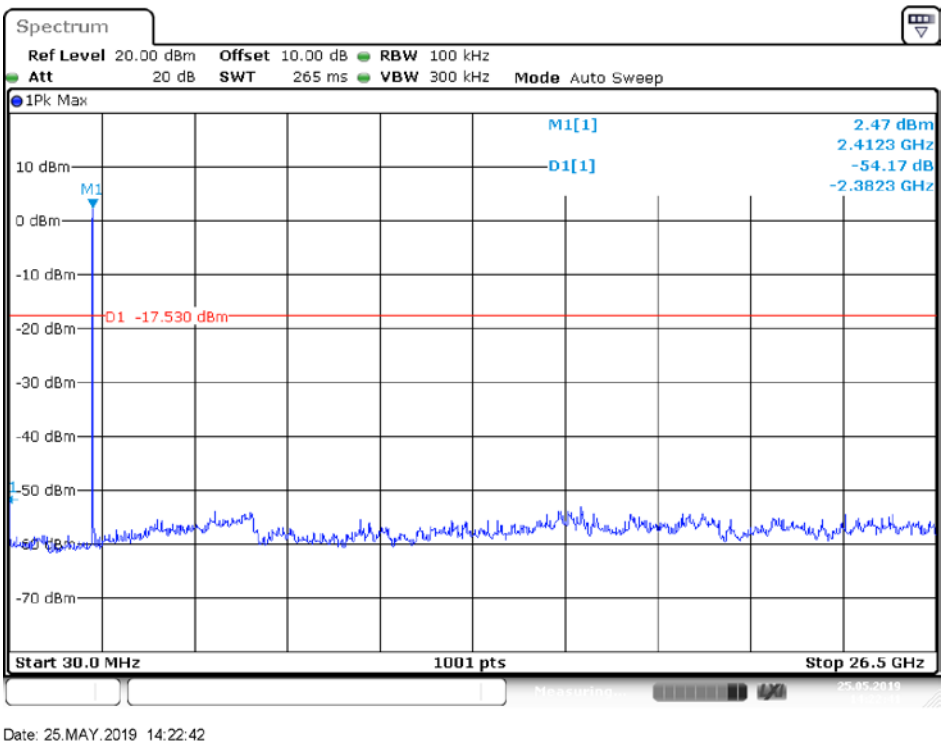
Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
B Mode				
Low	2412	54.17	≥ 20	PASS
Mid	2437	53.32	≥ 20	PASS
High	2462	53.50	≥ 20	PASS
G Mode				
Low	2412	48.12	≥ 20	PASS
Mid	2437	46.37	≥ 20	PASS
High	2462	45.67	≥ 20	PASS
N20 Mode				
Low	2412	45.32	≥ 20	PASS
Mid	2437	41.43	≥ 20	PASS
High	2462	43.09	≥ 20	PASS

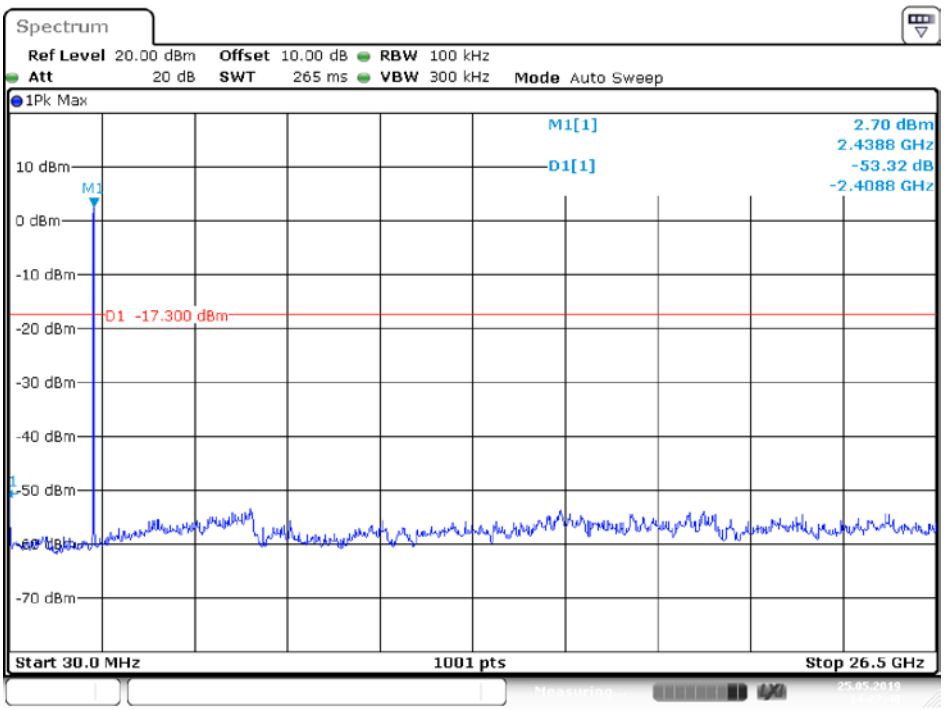
B Mode

Low Channel



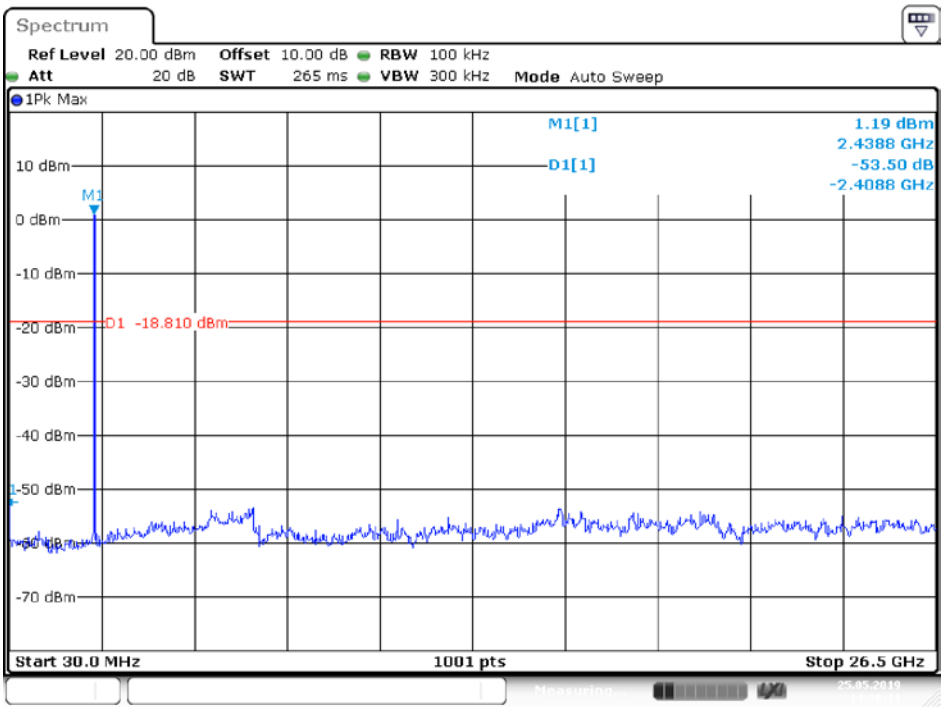
Date: 25.MAY.2019 14:22:42

Middle Channel



Date: 25.MAY.2019 14:27:50

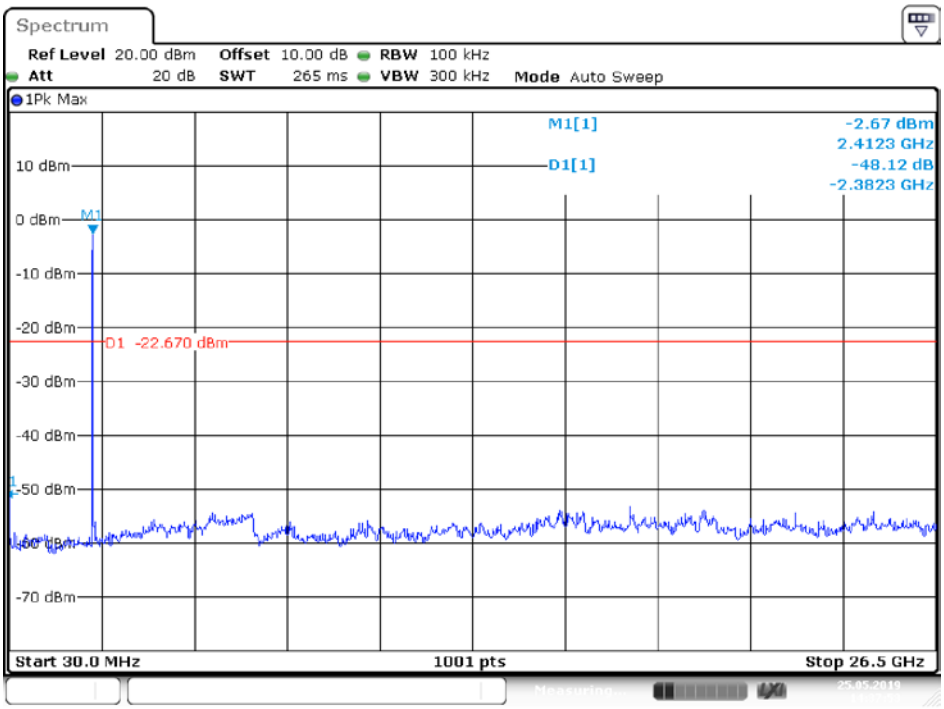
High Channel



Date: 25.MAY.2019 14:30:11

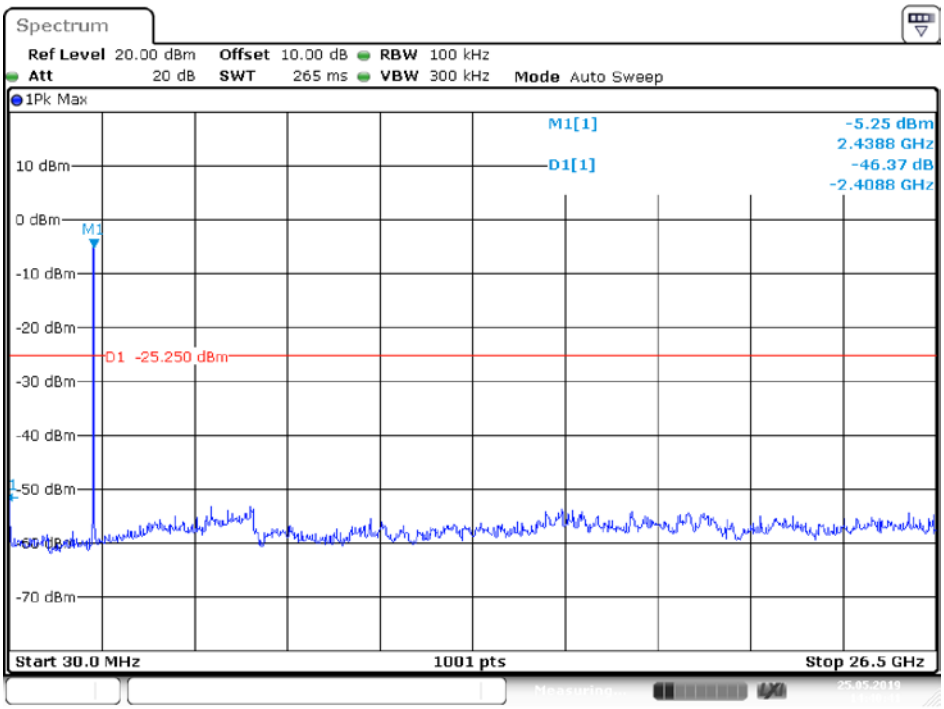
G Mode

Low Channel



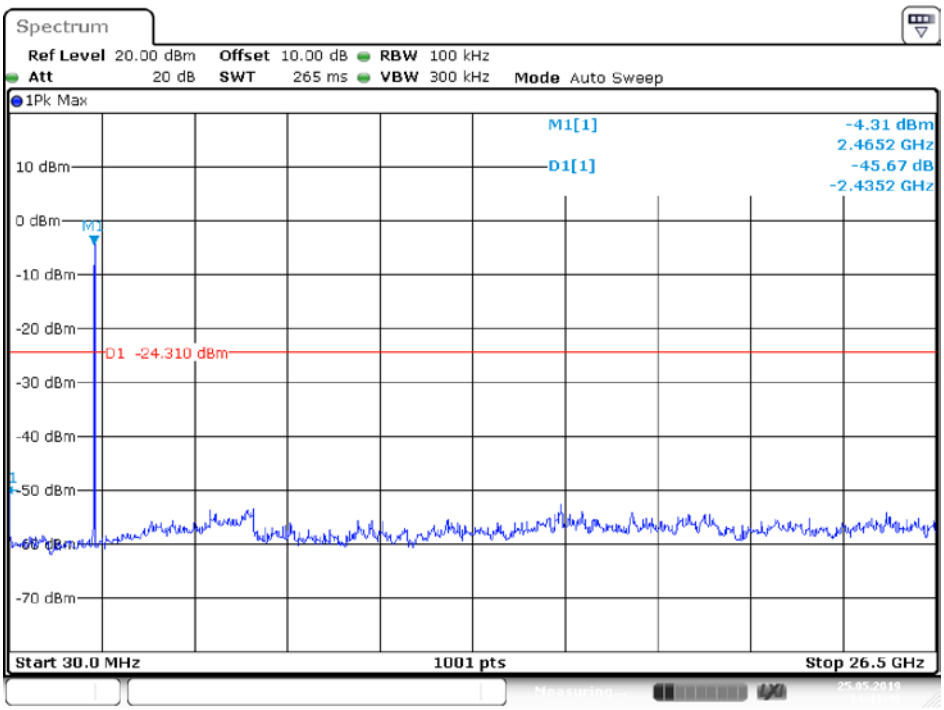
Date: 25.MAY.2019 14:37:53

Middle Channel



Date: 25.MAY.2019 14:40:42

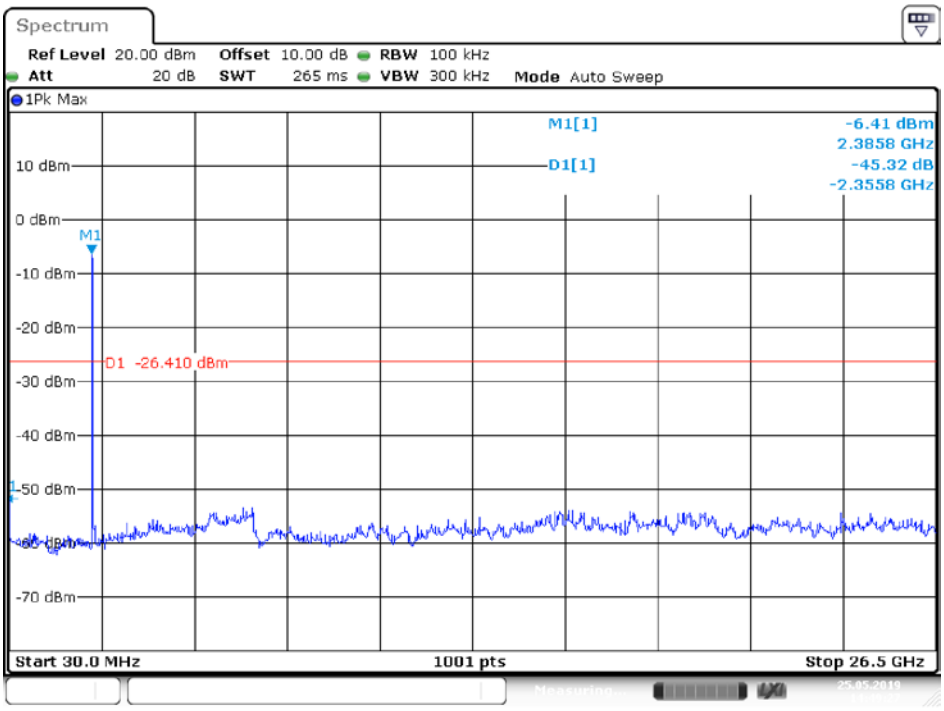
High Channel



Date: 25.MAY.2019 14:43:49

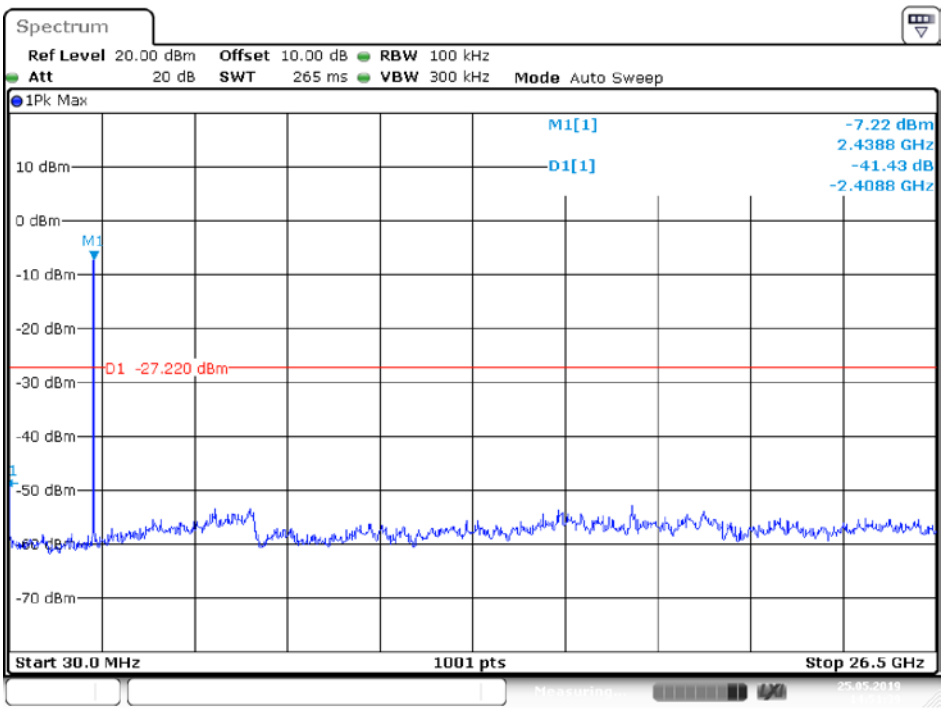
N20 Mode

Low Channel



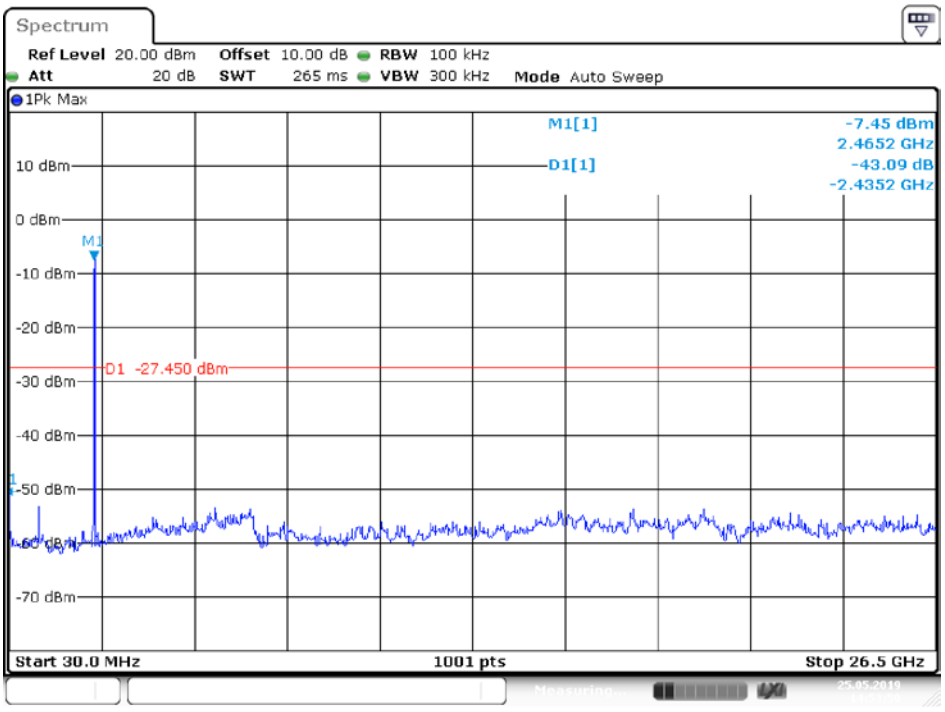
Date: 25.MAY.2019 14:49:27

Middle Channel



Date: 25.MAY.2019 14:51:39

High Channel



Date: 25.MAY.2019 14:53:51

9 FCC §15.247(a)(2) – 6 dB Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2).

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 Test Procedure

The steps for the first option are as follows:

a) Set RBW = 100 kHz.

b) Set the VBW ≥ [3 × RBW].

c) Detector = peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

9.3 Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-05-25.

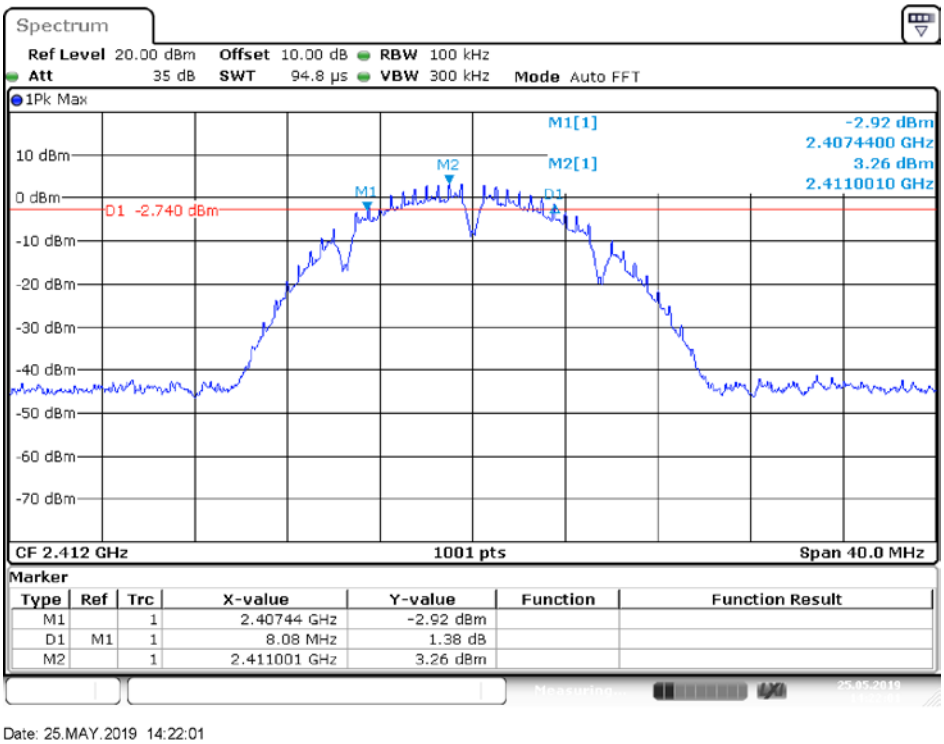
9.4 Test Results

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)	Result
B Mode				
Low	2412	8.08	> 500	PASS
Middle	2437	8.04	> 500	PASS
High	2462	8.52	> 500	PASS
G Mode				
Low	2412	15.56	> 500	PASS
Middle	2437	14.04	> 500	PASS
High	2462	13.16	> 500	PASS
N20 Mode				
Low	2412	15.44	> 500	PASS
Middle	2437	13.84	> 500	PASS
High	2462	14.40	> 500	PASS

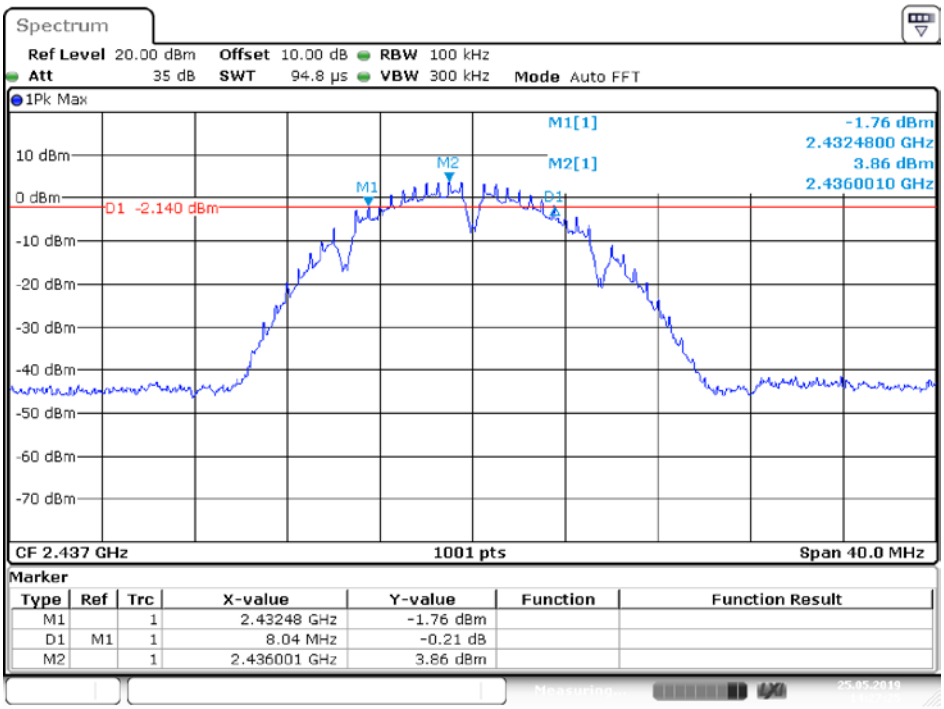
Please refer to the following plots

B Mode

Low Channel

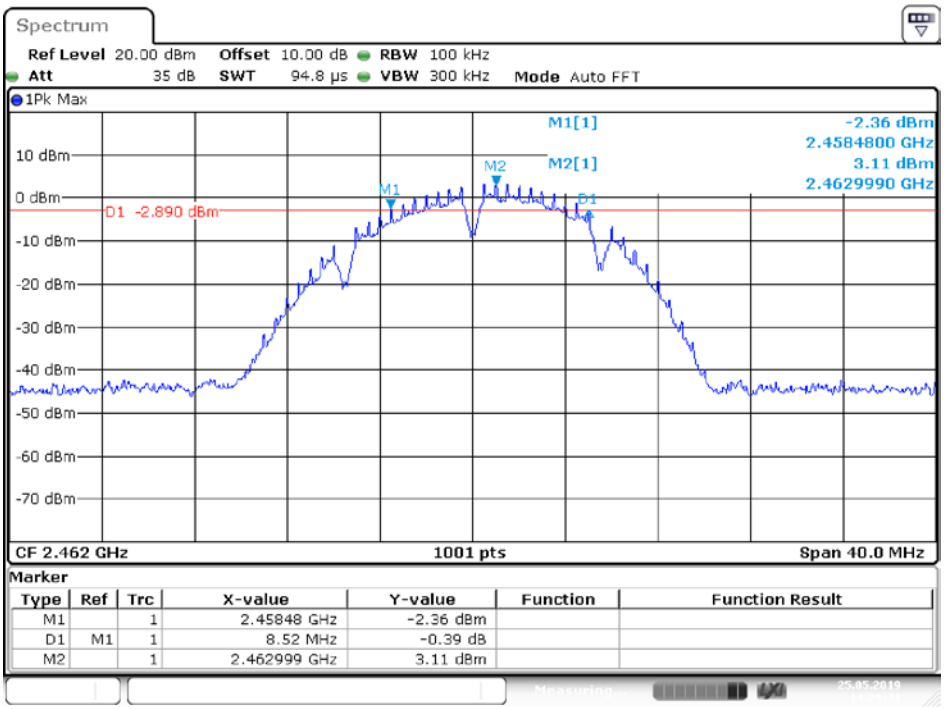


Middle Channel



Date: 25.MAY.2019 14:27:26

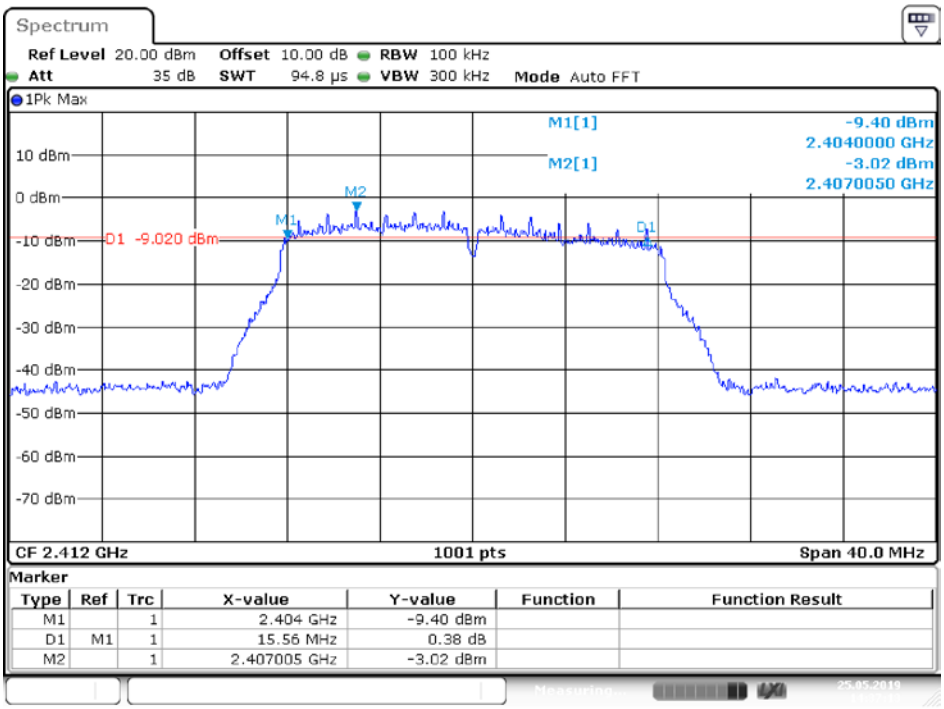
High Channel



Date: 25.MAY.2019 14:29:31

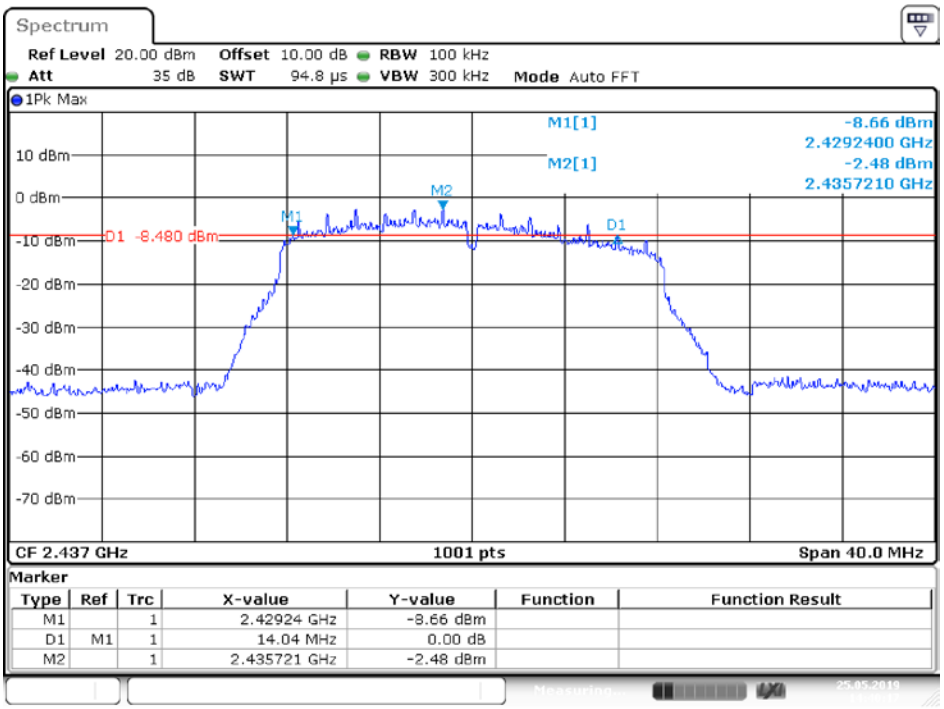
G Mode

Low Channel



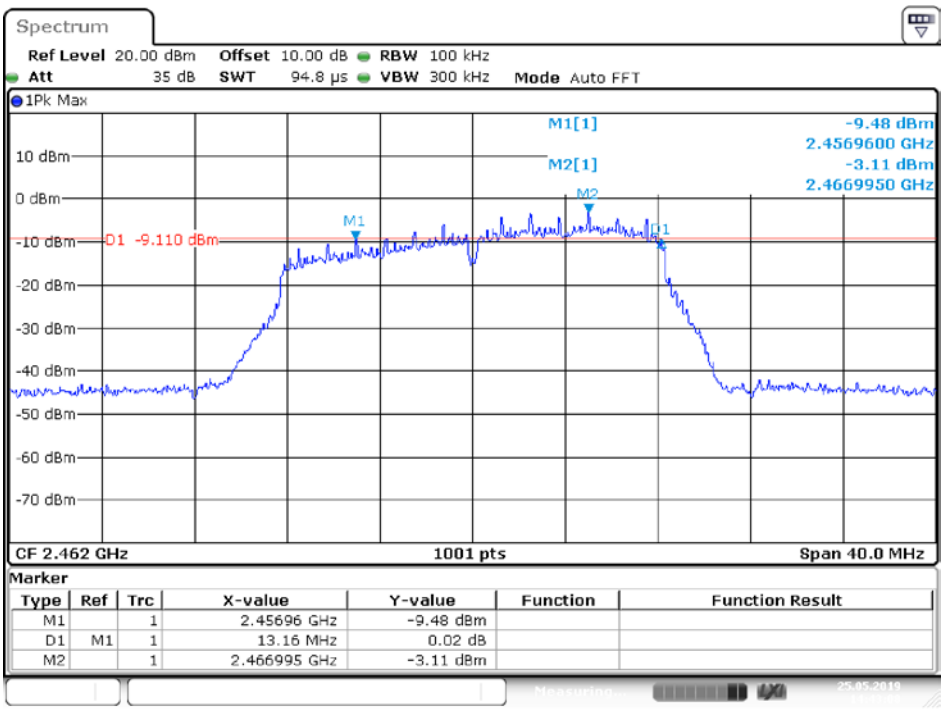
Date: 25.MAY.2019 14:37:13

Middle Channel



Date: 25.MAY.2019 14:40:17

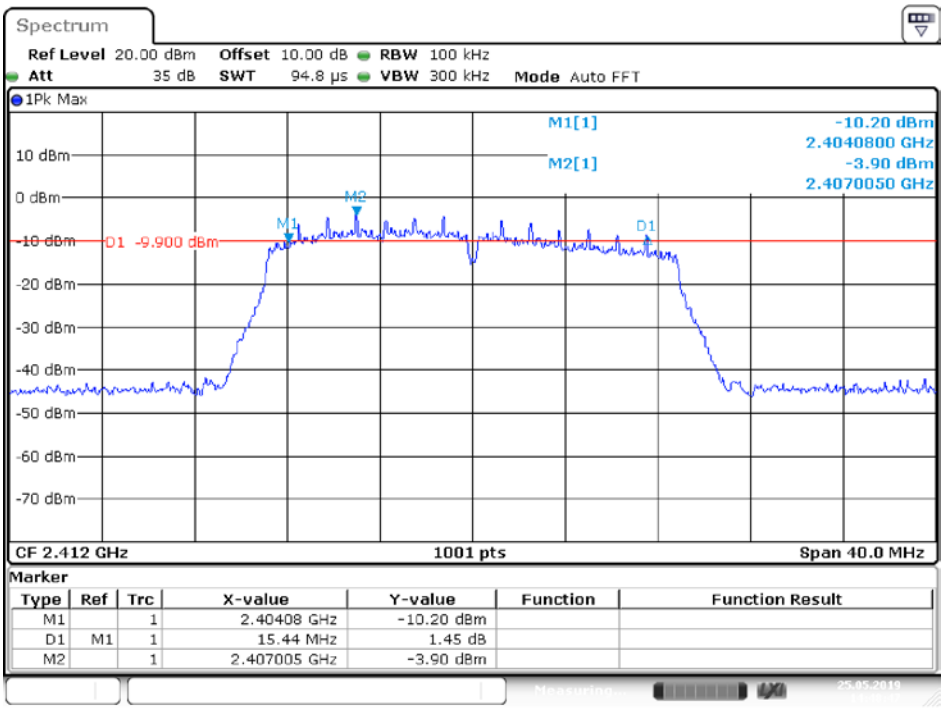
High Channel



Date: 25.MAY.2019 14:43:09

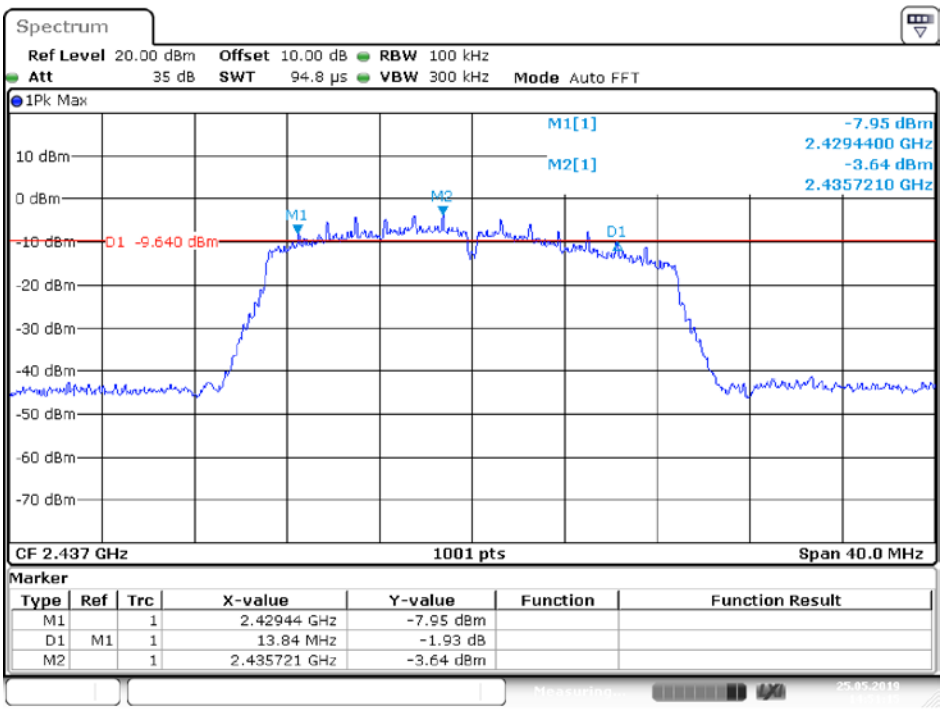
N20 Mode

Low Channel



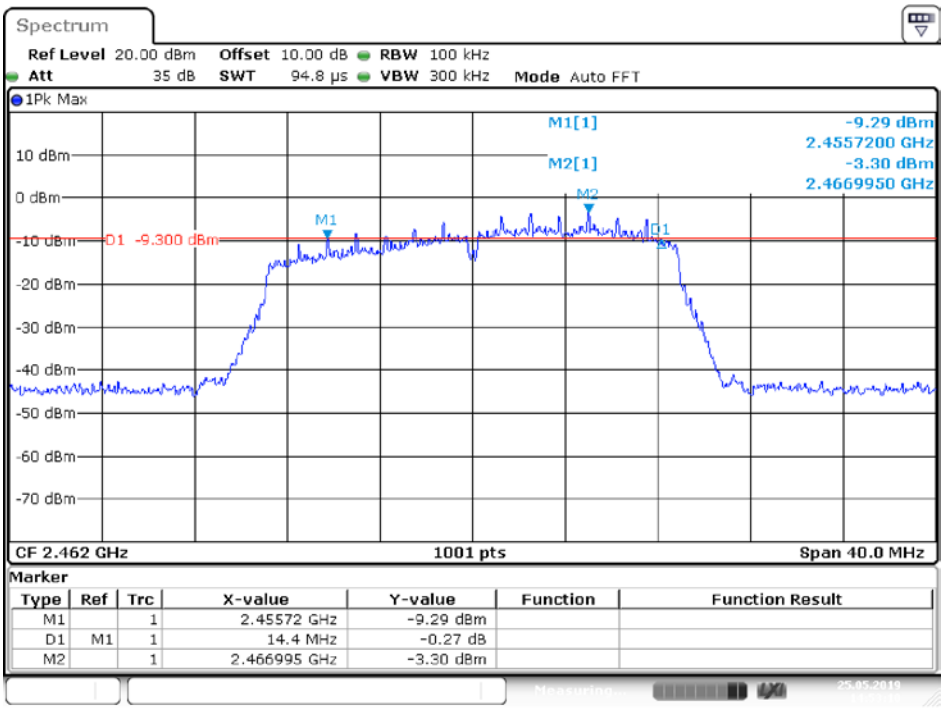
Date: 25.MAY.2019 14:48:47

Middle Channel



Date: 25.MAY.2019 14:51:15

High Channel



Date: 25.MAY.2019 14:53:10

10 FCC §15.247(b)(3) – Maximum Output Power

10.1 Applicable Standard

According to FCC §15.247(b) (3).

Systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

10.2 Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.

10.3 Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-05-25.

10.4 Test Results

Conducted Peak Output Power

Channel	Frequency (MHz)	Power (dBm)	Power (W)	Limit (W)	Result
B Mode					
Low	2412	14.24	0.027	1	PASS
Middle	2437	14.56	0.029	1	PASS
High	2462	14.23	0.026	1	PASS
G Mode					
Low	2412	15.62	0.036	1	PASS
Middle	2437	15.87	0.039	1	PASS
High	2462	15.03	0.032	1	PASS
N20 Mode					
Low	2412	14.18	0.026	1	PASS
Middle	2437	14.53	0.028	1	PASS
High	2462	14.25	0.027	1	PASS

Conducted Average Output Power

Channel	Frequency (MHz)	Power (dBm)	Duty Factor (dB)	Power With Duty Factor (dBm)	Limit (dBm)	Result
B Mode						
Low	2412	10.28	0	10.28	30	PASS
Middle	2437	11.14	0	11.14	30	PASS
High	2462	10.80	0	10.80	30	PASS
G Mode						
Low	2412	6.69	0.18	6.87	30	PASS
Middle	2437	6.91	0.18	7.09	30	PASS
High	2462	6.12	0.18	6.30	30	PASS
N20 Mode						
Low	2412	5.23	0.18	5.41	30	PASS
Middle	2437	5.56	0.18	5.74	30	PASS
High	2462	5.27	0.18	5.45	30	PASS

11 FCC§15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

11.1 Applicable Standard

According to FCC §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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

11.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.

3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.

4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.

5. Repeat above procedures until all measured frequencies were complete.

11.3 Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-05-25.

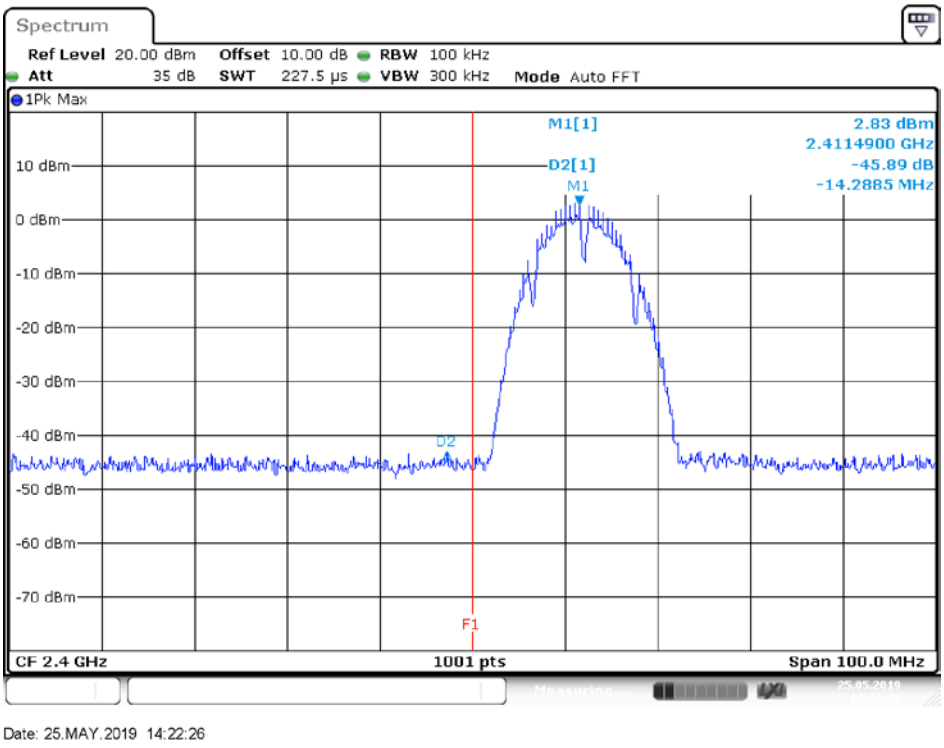
11.4 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
B Mode				
Low	2412	45.89	≥ 20	PASS
High	2462	44.78	≥ 20	PASS
G Mode				
Low	2412	39.44	≥ 20	PASS
High	2462	39.32	≥ 20	PASS
N20 Mode				
Low	2412	38.74	≥ 20	PASS
High	2462	39.12	≥ 20	PASS

Please refer to the following plots.

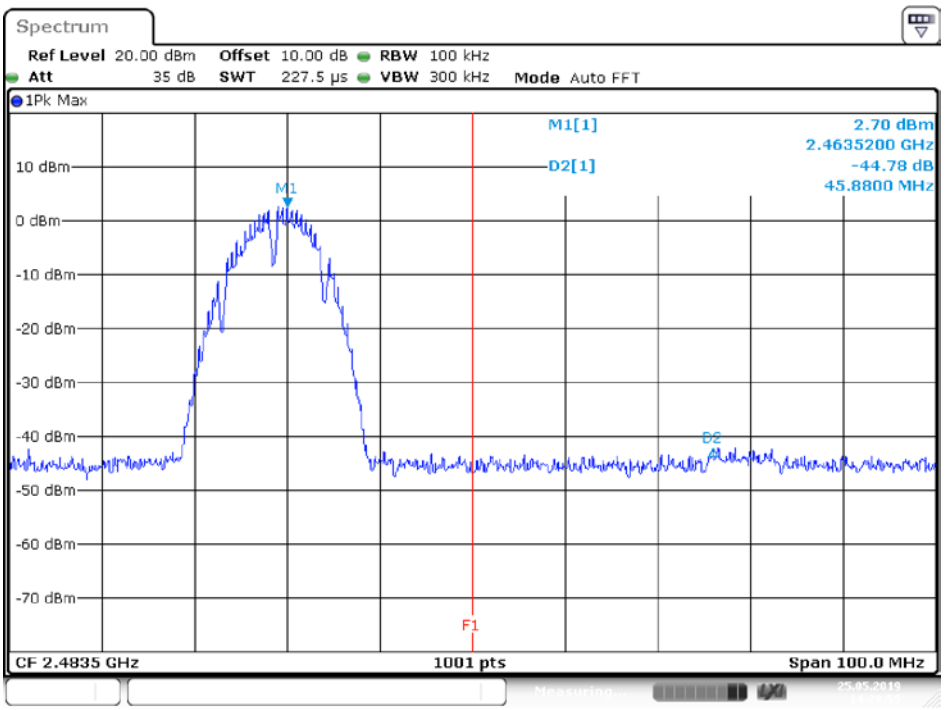
B Mode

Band Edge, Left Side



Date: 25.MAY.2019 14:22:26

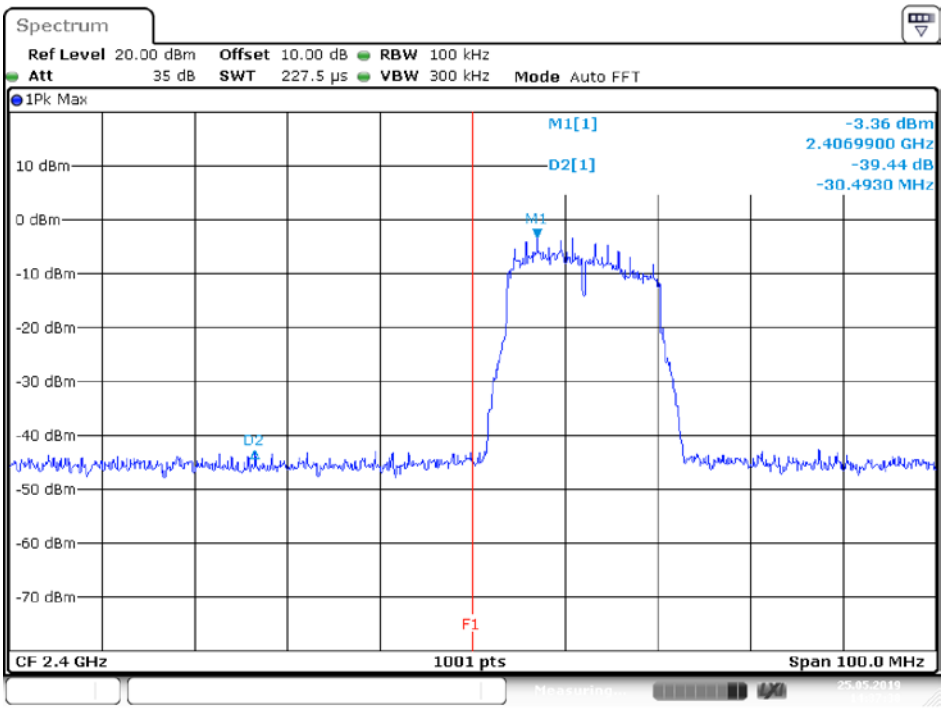
Band Edge, Right Side



Date: 25.MAY.2019 14:29:56

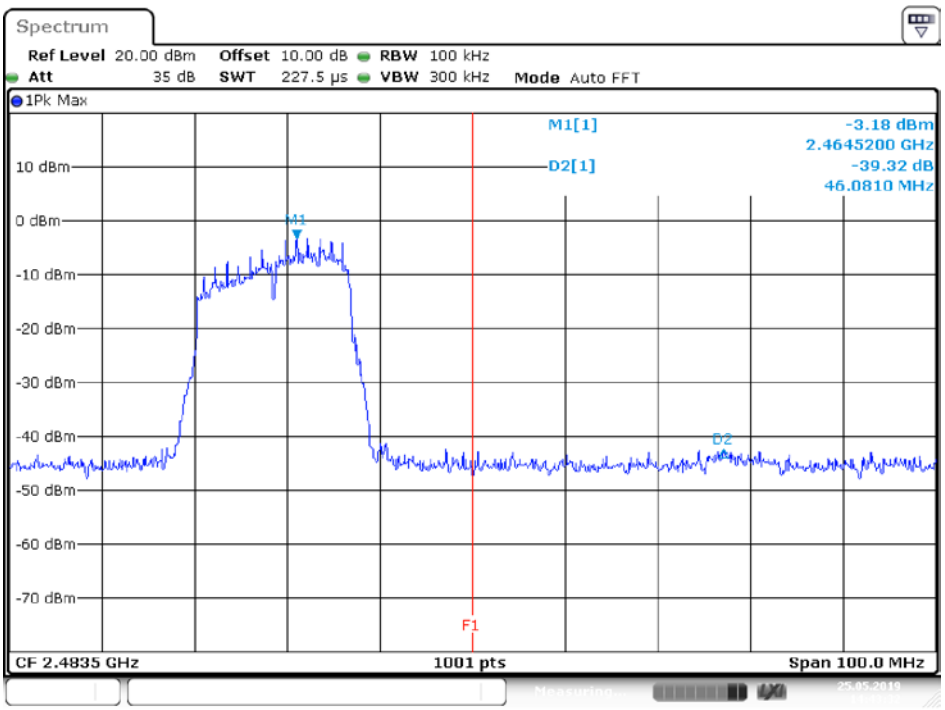
G Mode

Band Edge, Left Side



Date: 25.MAY.2019 14:37:38

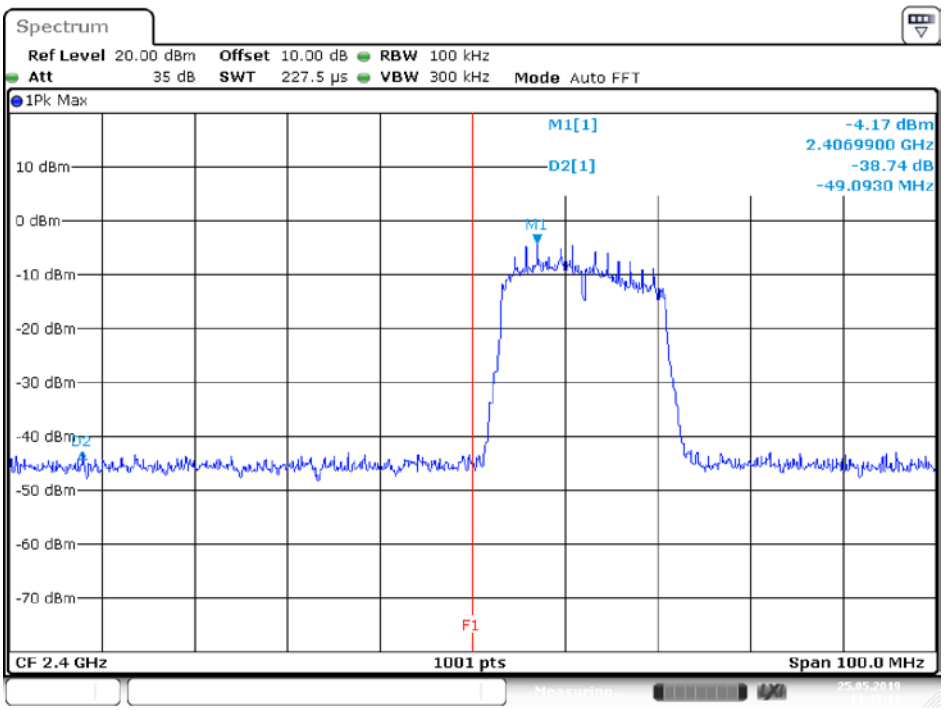
Band Edge, Right Side



Date: 25.MAY.2019 14:43:33

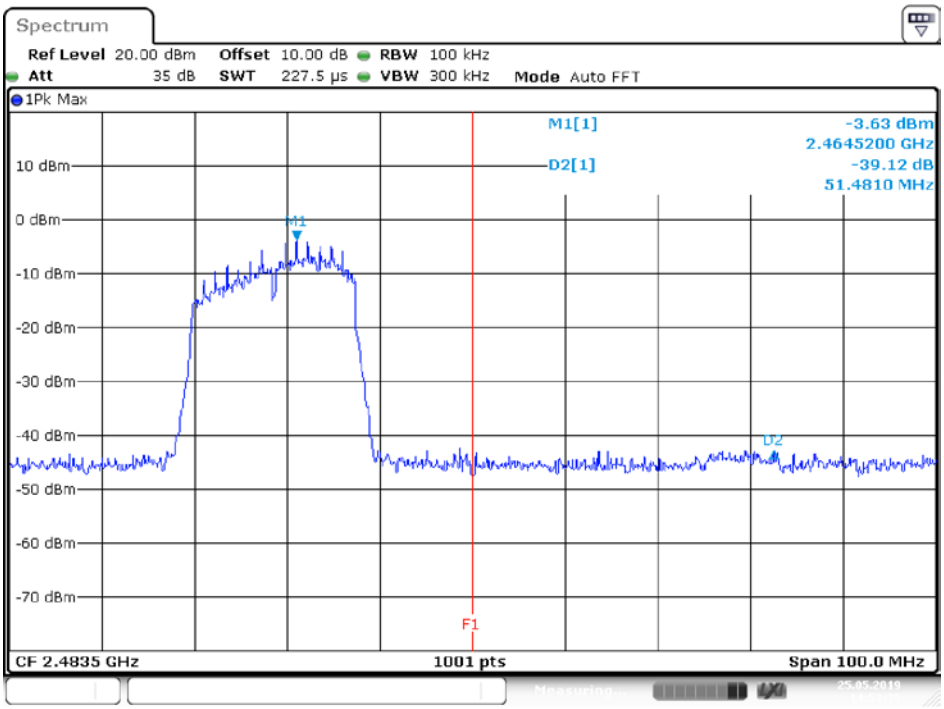
N20 Mode

Band Edge, Left Side



Date: 25.MAY.2019 14:49:12

Band Edge, Right Side



Date: 25.MAY.2019 14:53:35

12 FCC §15.247(e) – Power Spectral Density

12.1 Applicable Standard

According to FCC §15.247(e).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

12.2 Test Procedure

According to ANSI C63.10-2013

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × RBW].

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat

12.3 Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-05-25.

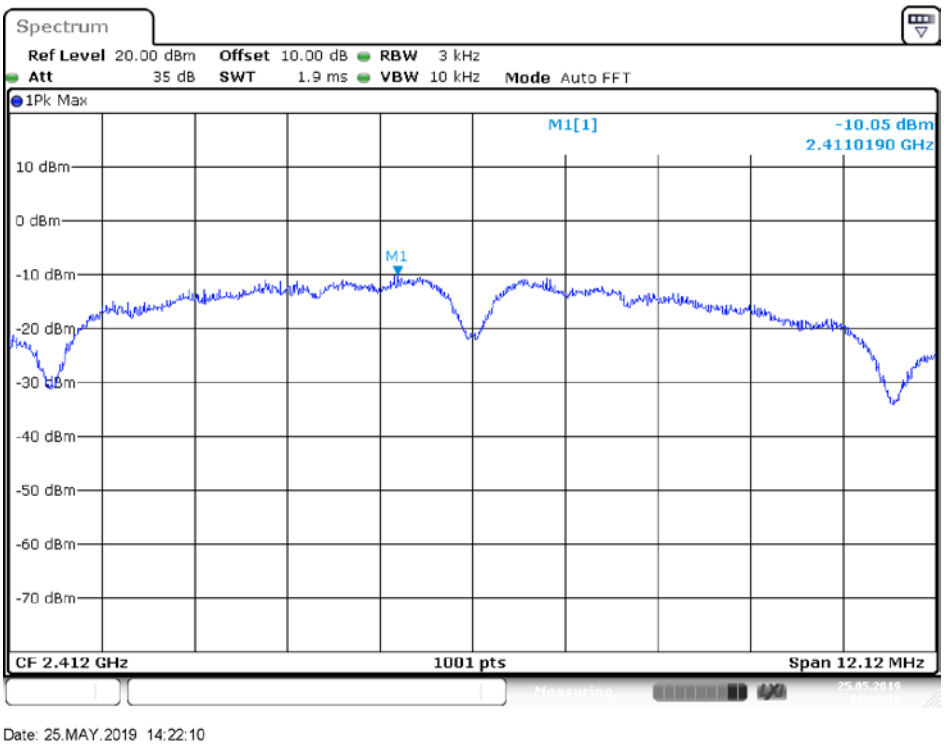
12.4 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
B Mode				
Low	2412	-10.05	8	PASS
Middle	2437	-9.48	8	PASS
High	2462	-9.56	8	PASS
G Mode				
Low	2412	-14.49	8	PASS
Middle	2437	-14.46	8	PASS
High	2462	-15.79	8	PASS
N20 Mode				
Low	2412	-17.38	8	PASS
Middle	2437	-16.70	8	PASS
High	2462	-16.67	8	PASS

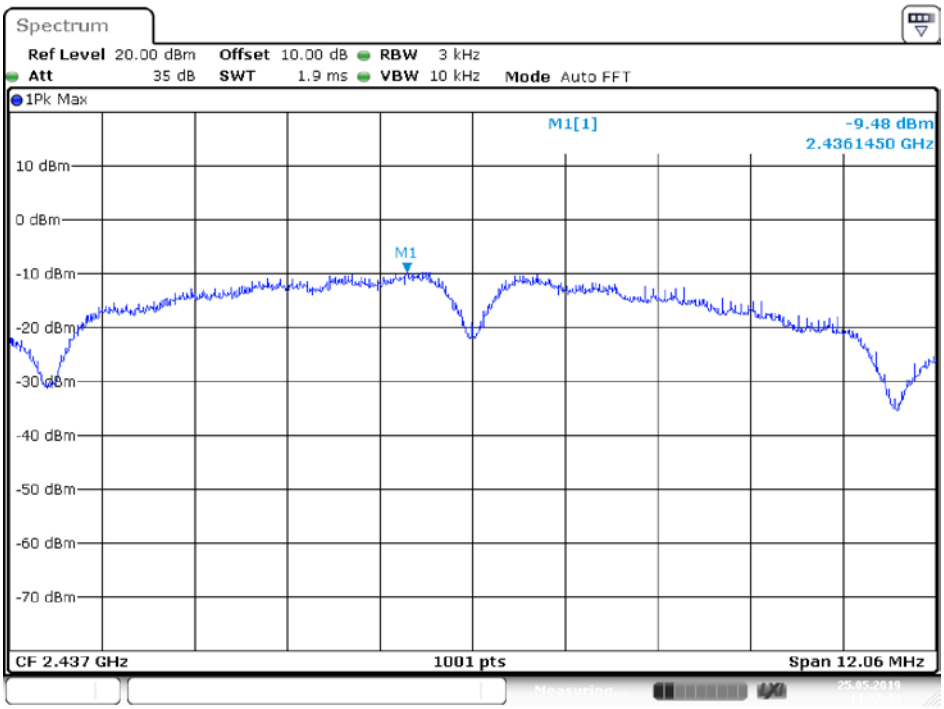
Please refer to the following plots

B Mode

Low Channel

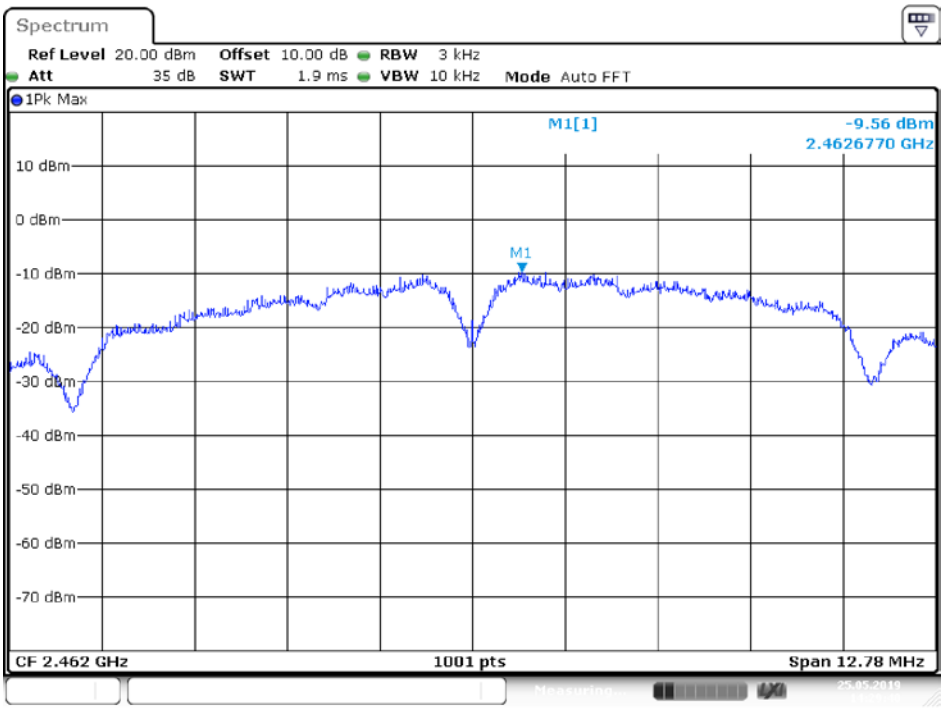


Middle Channel



Date: 25.MAY.2019 14:27:34

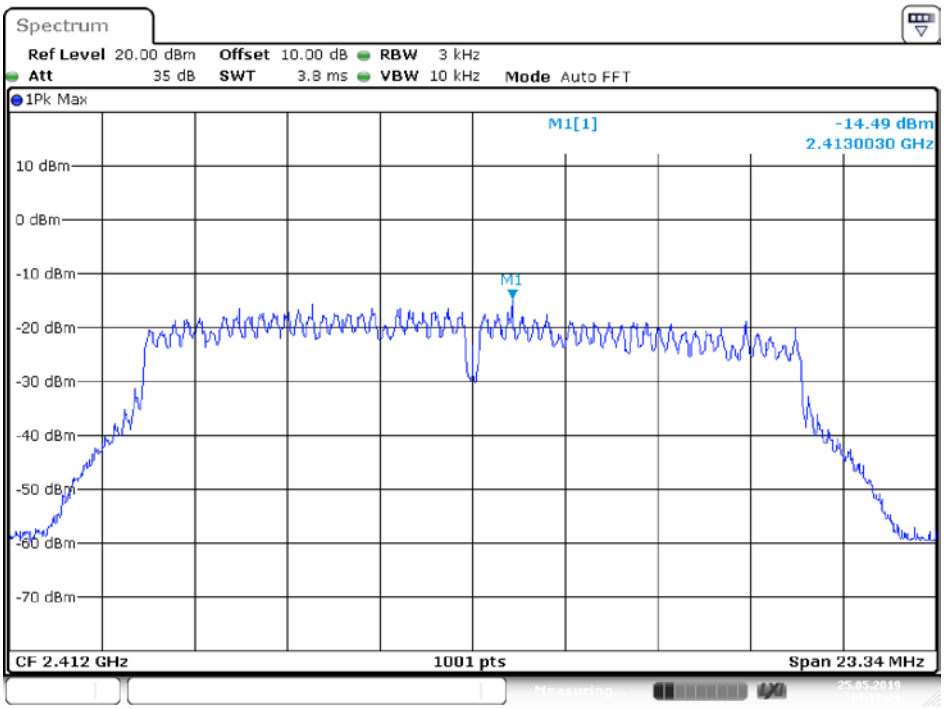
High Channel



Date: 25.MAY.2019 14:29:40

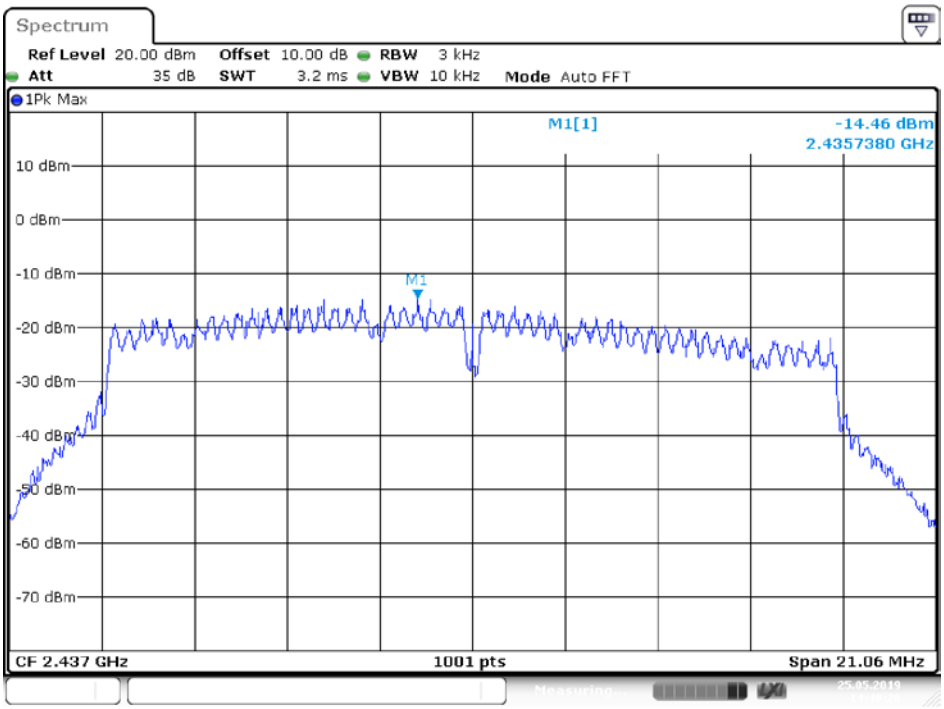
G Mode

Low Channel



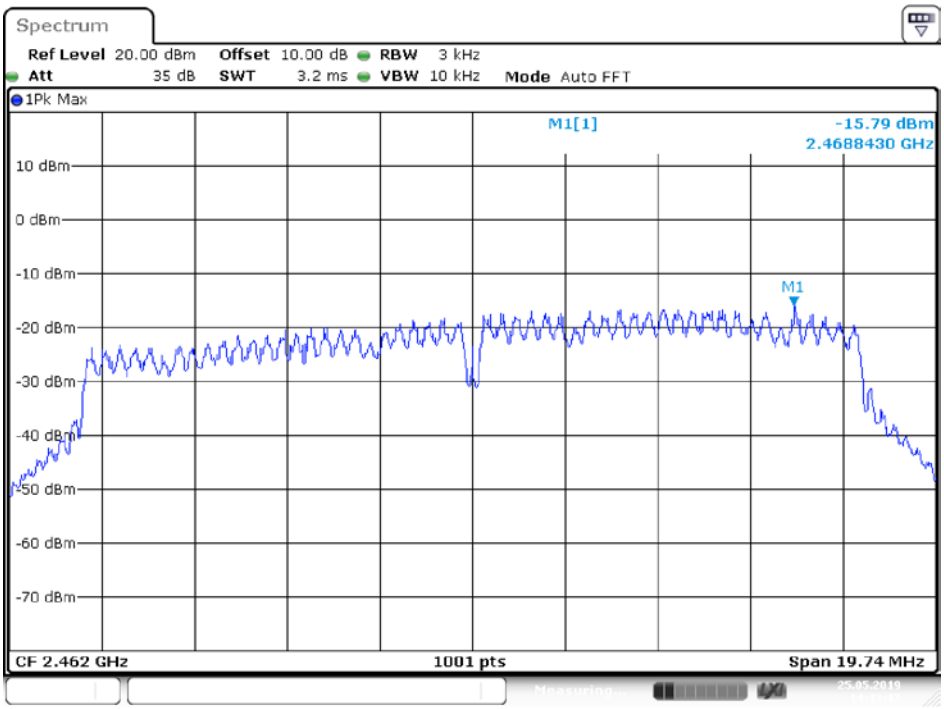
Date: 25.MAY.2019 14:37:22

Middle Channel



Date: 25.MAY.2019 14:40:26

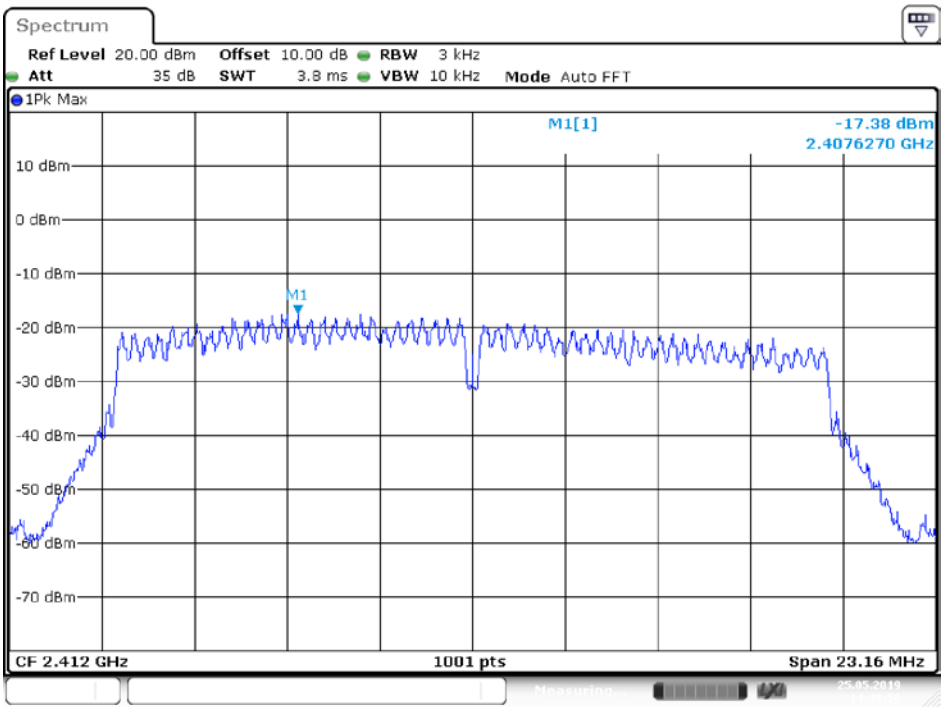
High Channel



Date: 25.MAY.2019 14:43:18

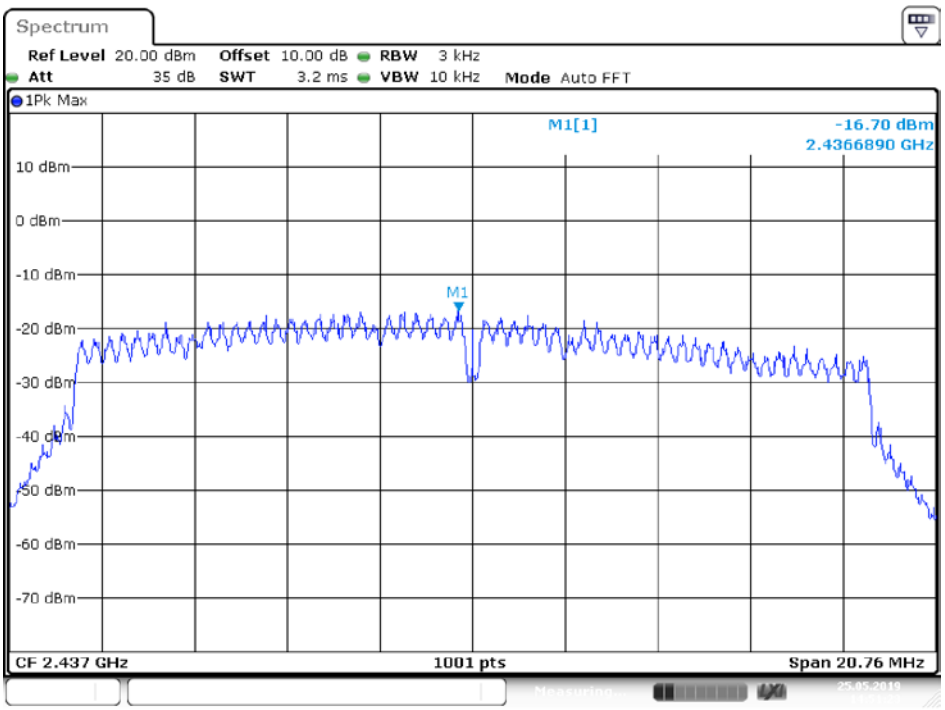
N20 Mode

Low Channel



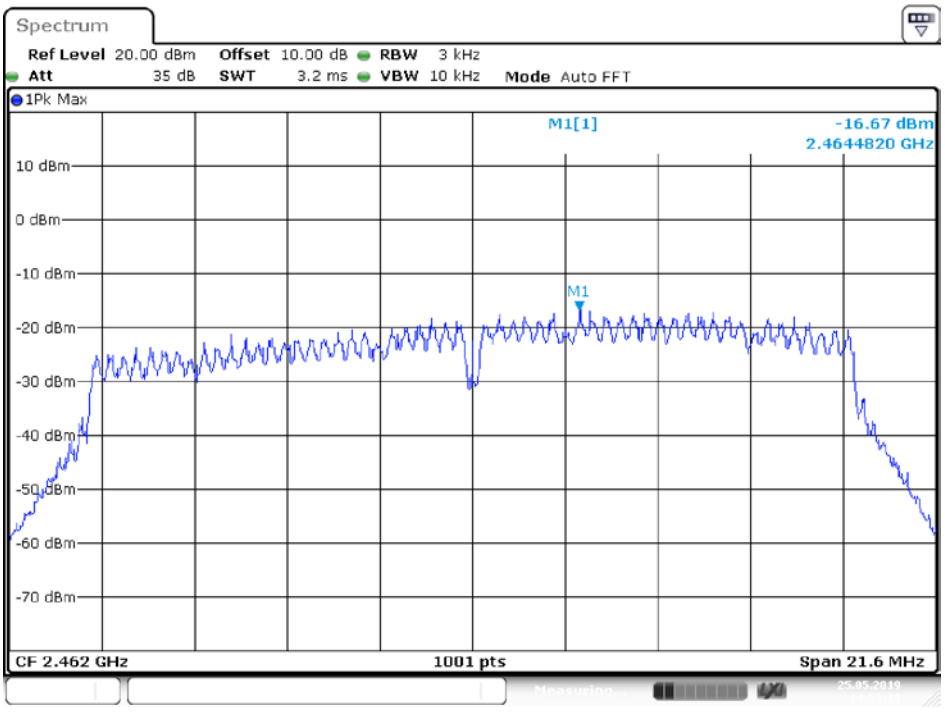
Date: 25.MAY.2019 14:46:56

Middle Channel



Date: 25.MAY.2019 14:51:24

High Channel



Date: 25.MAY.2019 14:53:19

******* END OF REPORT *******