FCC Part 15.247

TEST REPORT

For

AEI Communications Corp

1001 Broadway 2D Millbrae, CA 94030 USA

FCC ID: O4EMIP-300

Report Type:	**Product Type:**
Original Report	WiFi Phone

Report Producer : **Shan Tsai** Shan Tsai

Report Number : **RXZ190626001-00A**

Report Date : **2019-08-21**

Reviewed By: **Jerry Chang** Jerry Chang

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
1.0	RXZ190626001	RXZ190626001-00A	2019-08-21	Original Report	Shan Tsai

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	AEI Communications Corp
	1001 Broadway 2D Millbrae, CA 94030 USA
Manufacturer	AEI COMMUNICATIONS INTERNATIONAL SDN.BHD
	2493 Mukim 1, Lorong Perusahaan 8, Kawasan, Perindustrian Perai,13600 Perai, Penang, Malaysia
Brand(Trade) Name	AEI
Product (Equipment)	WiFi Phone
Main Model Name	MIP-300
Series Model Name	N/A
Model Discrepancy	N/A
Frequency Range	IEEE 802.11b/g / IEEE 802.11n HT20 Mode: 2412 ~ 2462 MHz IEEE 802.11n HT40 Mode: 2422 ~ 2452 MHz
Transmit Power	IEEE 802.11b Mode: 17.53 dBm (0.0566W) IEEE 802.11g Mode: 17.64 dBm (0.0581W) IEEE 802.11n HT20 Mode: 17.6 dBm (0.0575W) IEEE 802.11n HT40 Mode: 16.53 dBm (0.0450W)
Modulation Technique	IEEE 802.11b Mode: DSSS IEEE 802.11g Mode: OFDM IEEE 802.11n HT20 Mode Mode: OFDM IEEE 802.11n HT40 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 HT 20 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 IEEE 802.11n HT 40 Mode: 13.5, 15,27, 30, 40.5, 45, 54, 60, 81, 90, 108, 120, 121.5, 135, 150, 162, 180, 216, 240, 243, 270, 300 Mbps
Number of Channels	IEEE 802.11b/g / IEEE 802.11n HT20 Mode: 11 Channels IEEE 802.11n HT40 Mode: 7 Channels
Antenna Specification	PCB Antenna / 2 dBi

Power Operation (Voltage Range)	☒ AC 120V/60Hz ☒ Adapter I/P: 100-240Vac,50/60Hz, 150mA O/P: 5.0Vdc, 500mA ☐ By AC Power Cord ☐ PoE
	☒ DC Type ☒ Battery: 3.7Vdc, 900mAh ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System
Received Date	Jun 26, 2019
Date of Test	Jul 09, 2019 ~ Jul 12, 2019

**All measurement and test data in this report was gathered from production sample serial number: 190626001 (Assigned by BACL, Taiwan).*

1.2 Objective

This report is prepared on behalf of *AEI Communications Corp* 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)

N/A

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 558074 D01 DTS Meas Guidance v05r02

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.

For 802.11n40 Mode were tested with channel 3, 6 and 9.

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

The software was used “SecureCRT”.

Test Frequency		Low	Mid	High
Power Level Setting	B Mode	17	17	17
	G Mode	15	15	15
	N20 Mode	15	15	15
	N40 Mode	12	12	12

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

802.11n ht40: MCS0

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number	BSMI	FCC ID	S/N
NB	DELL	E6410	N/A	PD98260NGU	10912240367
Adapter	I.T.E	S003ATU0500050	N/A	N/A	N/A
DOCK	AEI	N/A	N/A	N/A	N/A

2.5 External Cable List and Details

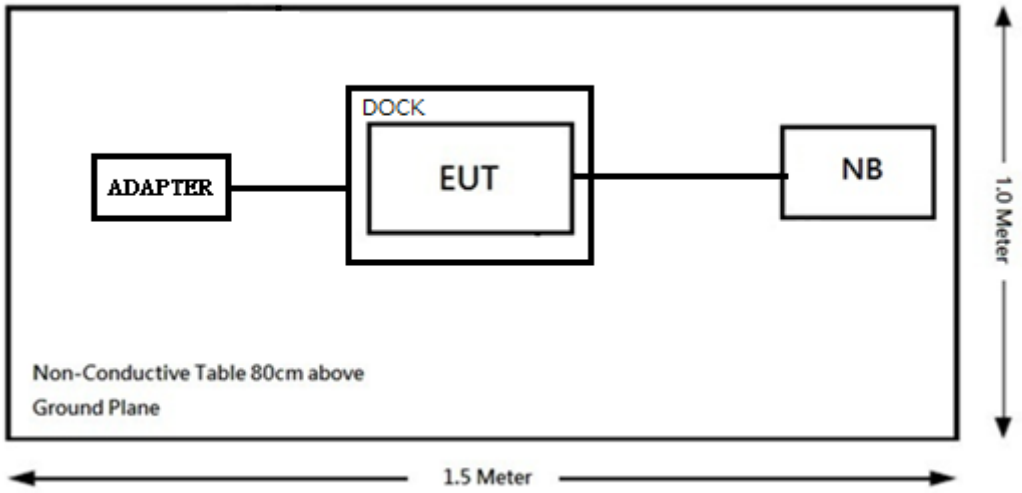
Cable Description	Length (m)	From	To
USB Cable	1	NB	EUT

2.6 Block Diagram of Test Setup

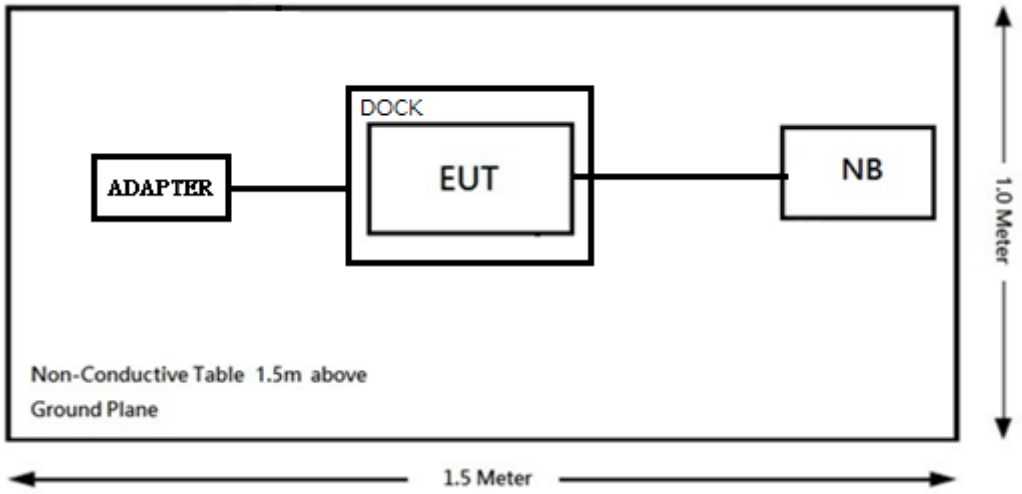
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

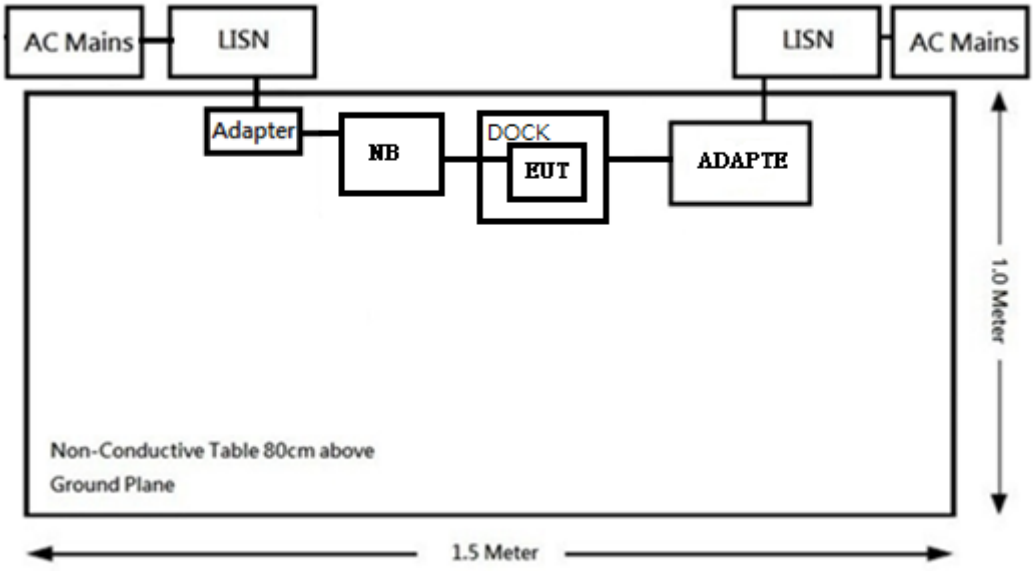
Below 1GHz:



Above 1GHz:



Conduction:



2.7 Duty Cycle

According to KDB 558074 D01 15.247 Meas Guidance v05r02 section 6.0:

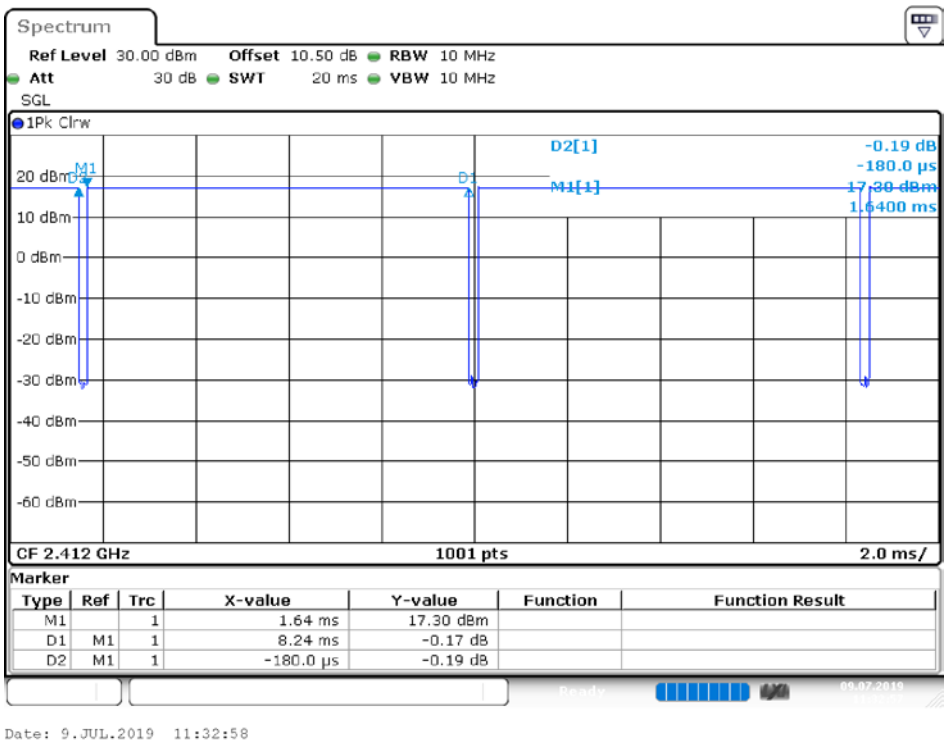
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximumpower transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	8.24	8.42	98	0.09
802.11g	1.365	1.565	87	0.60
802.11n20	1.28	1.475	87	0.60
802.11n40	0.336	0.536	63	2.01

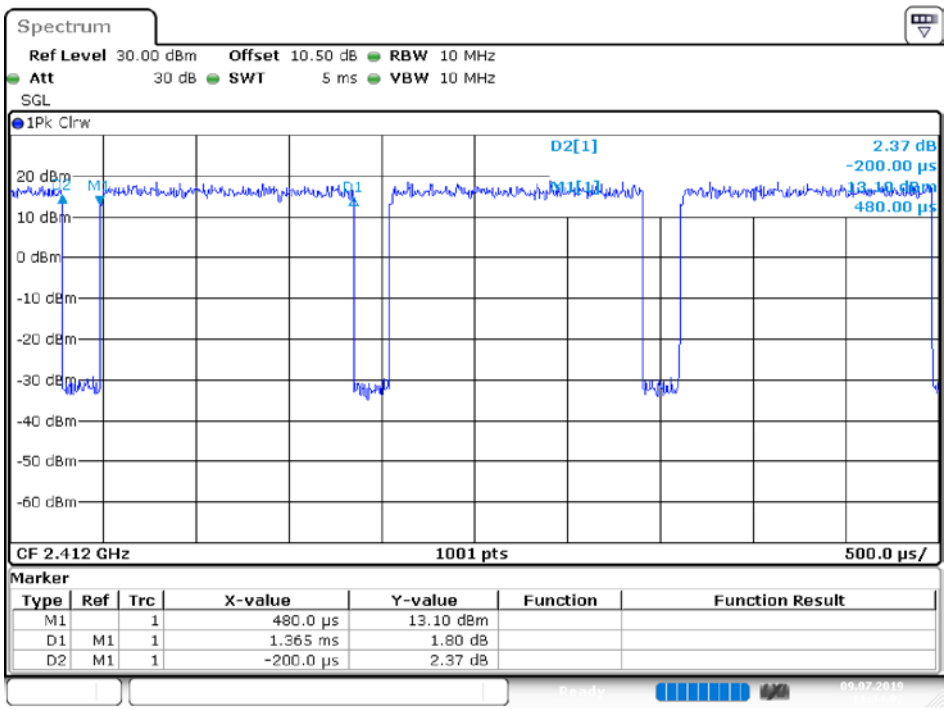
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

B Mode



G Mode



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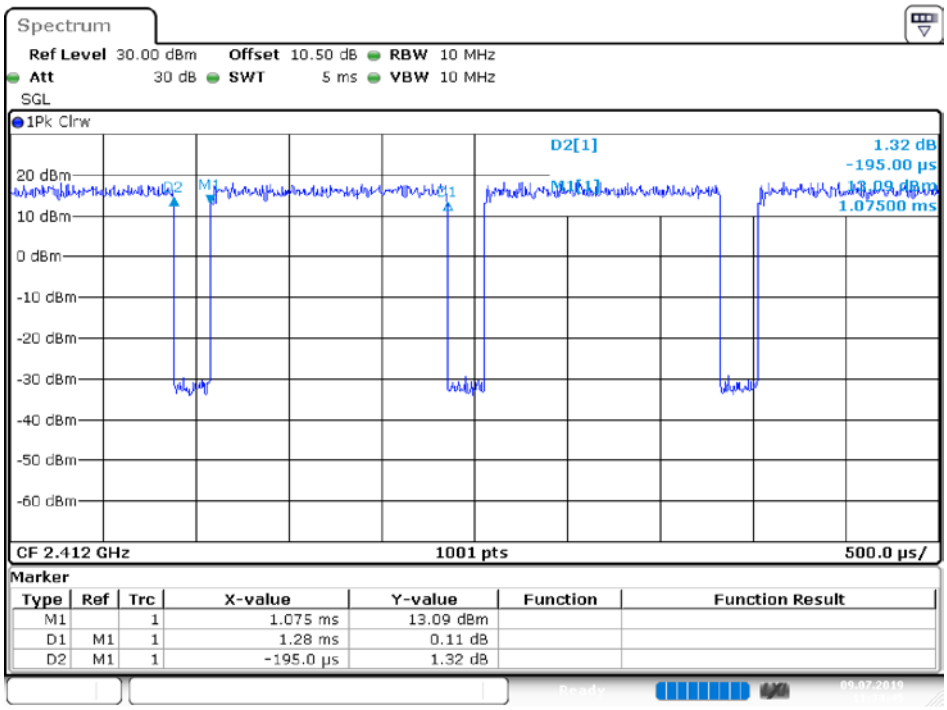
N20 Mode



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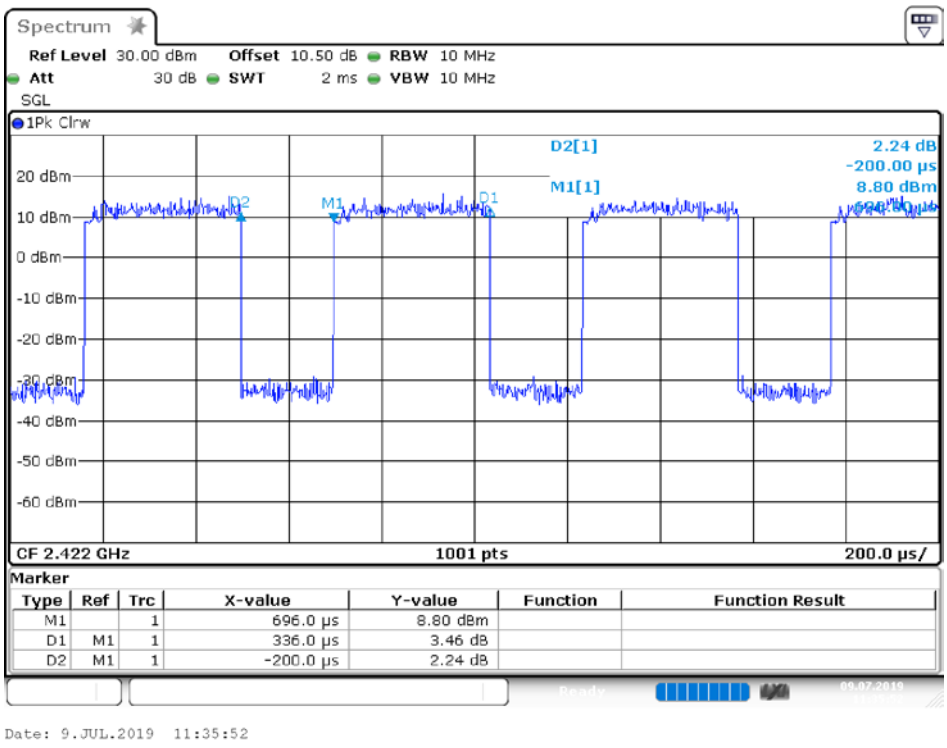
N40 Mode



Date: 9.JUL.2019 11:35:52

3 Summary of Test Results

FCC Rules	Description of Test	Results
FCC §15.247(i), § 2.1093	RF Exposure	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
LISN	Rohde & Schwarz	ENV216	101248	2019/06/26	2020/06/25
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	2019/07/01	2020/06/30
Software	AUDIX	E3	V9.150826k	N.C.R	N.C.R
Radiated Room (966-A)					
Active Loop Antenna	ETS-Lindgren	6502	00035796	2019/03/12	2020/03/11
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	2019/06/26	2020/06/25
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	2018/11/16	2019/11/15
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

NSA	BACL	966-A	N/A	2019/07/08	2020/07/07
VSWR	BACL	966-A	N/A	2018/07/16	2019/07/15
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSV40	101140	2018/11/22	2019/11/21
Cable	WOKEN	SFL402	S02-160323-07	2019/02/11	2020/02/10
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2019/03/07	2020/03/07
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2019/03/06	2020/03/05

***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), § 2.1093 - RF Exposure

5.1 Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance v06

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] ·

[$\sqrt{}$f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

5.2 RF Exposure Evaluation Result

For Wi-Fi:

Please refer to the SAR report, report No.: RXZ190626001-23A.

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
ESPRESSIF SYSTEMS (SHANGHAI) PTE LTD	PCB Antenna	2 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

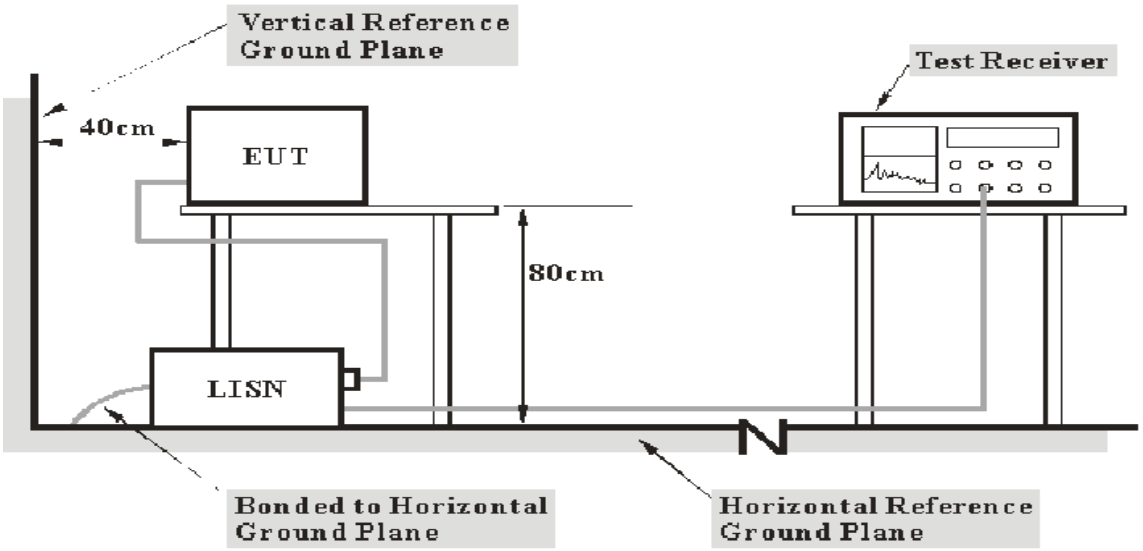
7.2 Measurement Uncertainty

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	2.71 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

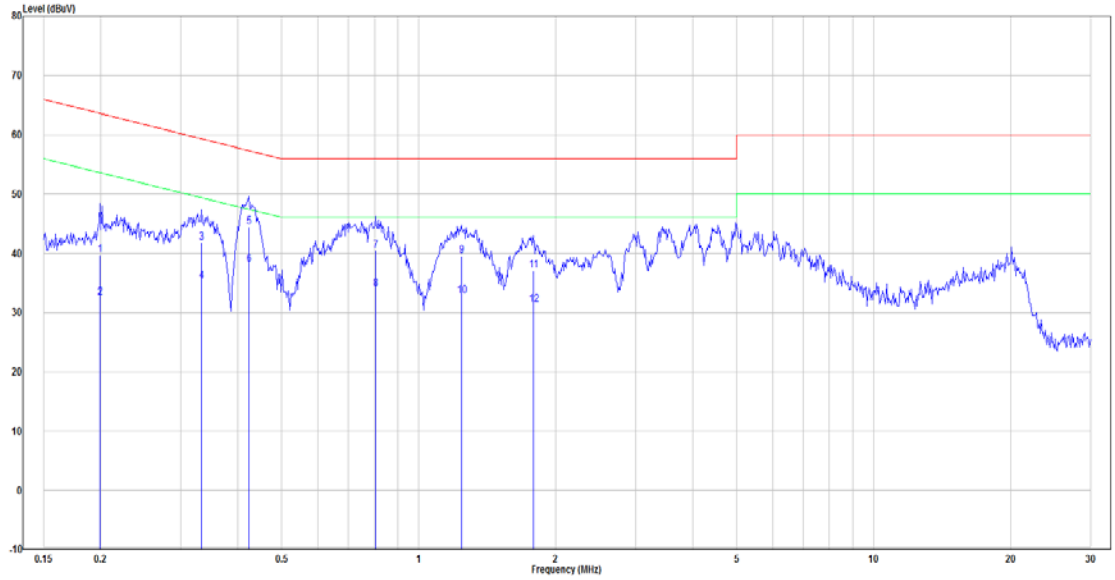
Temperature:	25 ℃
Relative Humidity:	60 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-07-12.

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	0.199	20.25	19.45	39.70	63.64	-23.94	QP
2	0.199	13.03	19.45	32.48	53.64	-21.16	Average
3	0.333	22.32	19.46	41.78	59.38	-17.60	QP
4	0.333	15.81	19.46	35.27	49.38	-14.11	Average
5	0.423	25.00	19.46	44.46	57.39	-12.93	QP
6	0.423	18.71	19.46	38.17	47.39	-9.22	Average
7	0.805	20.91	19.49	40.40	56.00	-15.60	QP
8	0.805	14.51	19.49	34.00	46.00	-12.00	Average
9	1.241	20.06	19.51	39.57	56.00	-16.43	QP
10	1.241	13.33	19.51	32.84	46.00	-13.16	Average
11	1.786	17.60	19.53	37.13	56.00	-18.87	QP
12	1.786	11.71	19.53	31.24	46.00	-14.76	Average

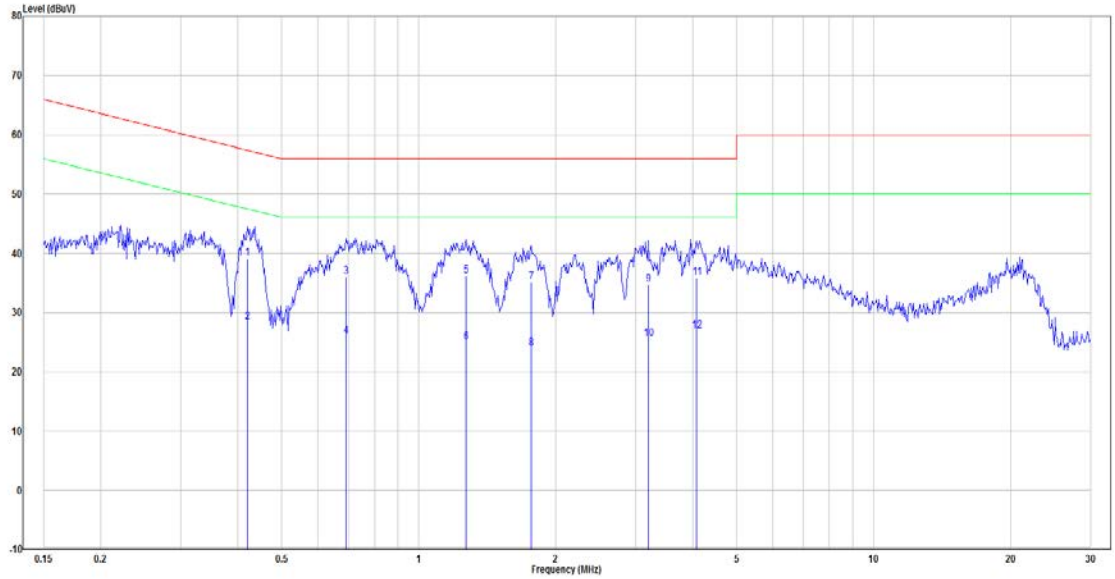
Note:

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	0.421	19.64	19.46	39.10	57.43	-18.33	QP
2	0.421	8.84	19.46	28.30	47.43	-19.13	Average
3	0.693	16.60	19.48	36.08	56.00	-19.92	QP
4	0.693	6.57	19.48	26.05	46.00	-19.95	Average
5	1.273	16.71	19.50	36.21	56.00	-19.79	QP
6	1.273	5.52	19.50	25.02	46.00	-20.98	Average
7	1.768	15.69	19.52	35.21	56.00	-20.79	QP
8	1.768	4.48	19.52	24.00	46.00	-22.00	Average
9	3.200	15.14	19.57	34.71	56.00	-21.29	QP
10	3.200	5.96	19.57	25.53	46.00	-20.47	Average
11	4.086	16.23	19.60	35.83	56.00	-20.17	QP
12	4.086	7.30	19.60	26.90	46.00	-19.10	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

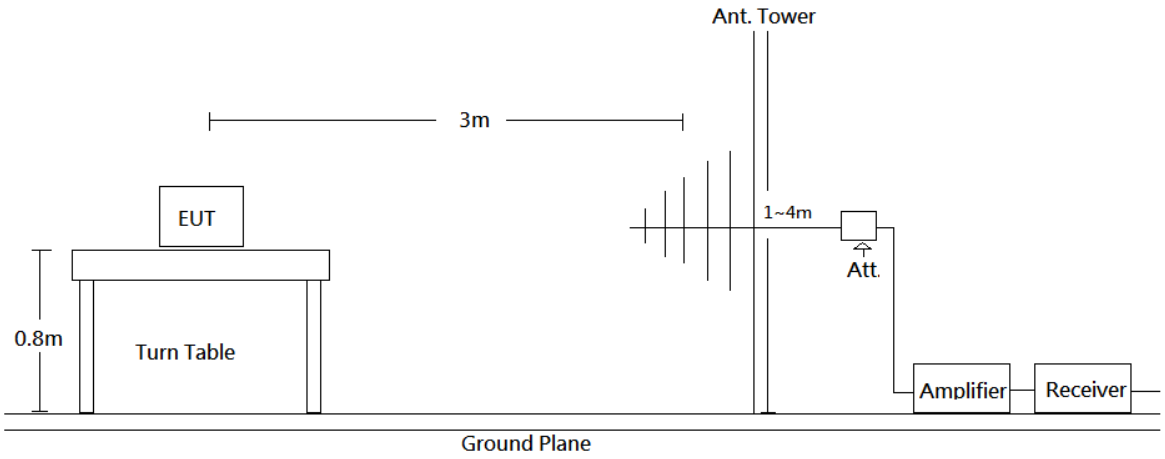
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency 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.

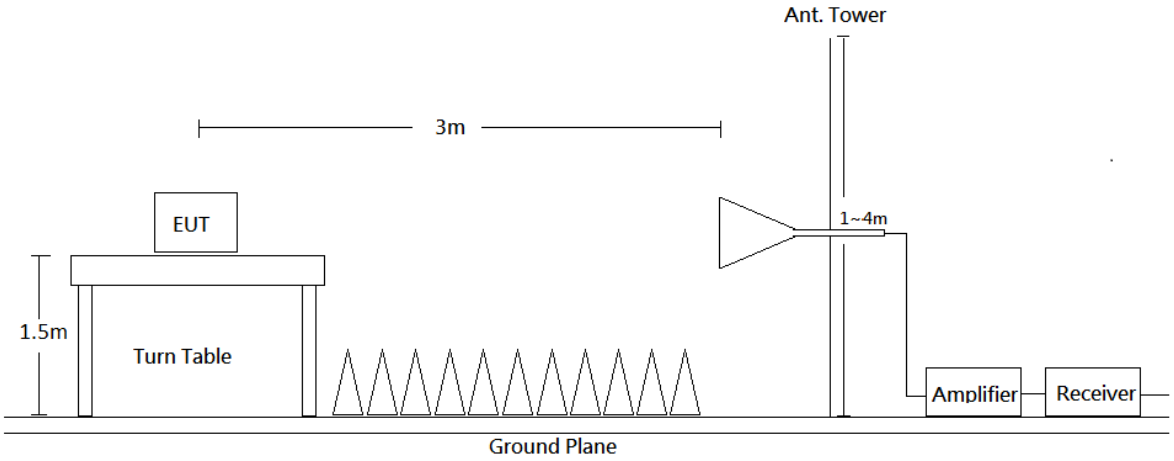
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.75 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.21 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.83 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.18 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.55 dB (k=2, 95% level of confidence)
26 GHz~40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

8.8 Environmental Conditions

Radiation		Conducted	
Temperature:	25 ℃	**Temperature:**	25.3 ℃
Relative Humidity:	59 %	**Relative Humidity:**	42 %
ATM Pressure:	1010 hPa	**ATM Pressure:**	1010 hPa

The Radiation Spurious Emissions testing was performed by Woods Chen on 2019-07-09 ~ 2019-07-11.

The Conducted Spurious Emissions testing was performed by David Hsu on 2019-07-09.

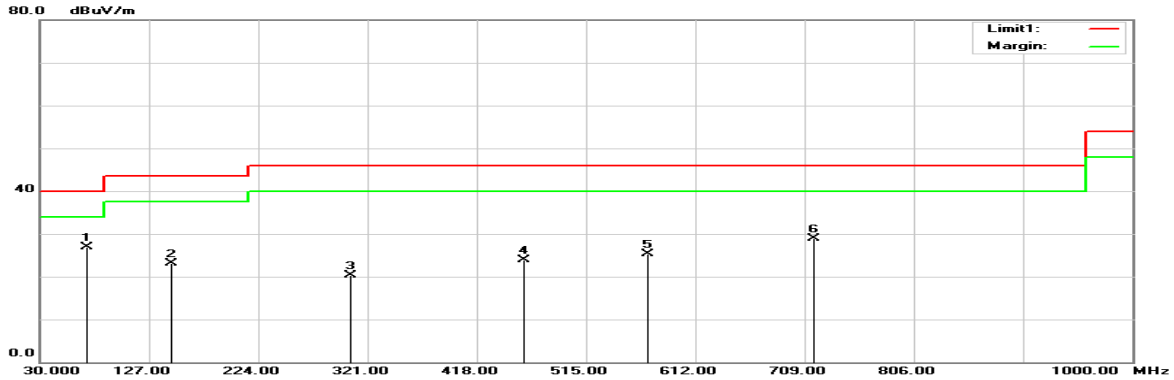
8.9 Test Results

Test Mode: Transmitting

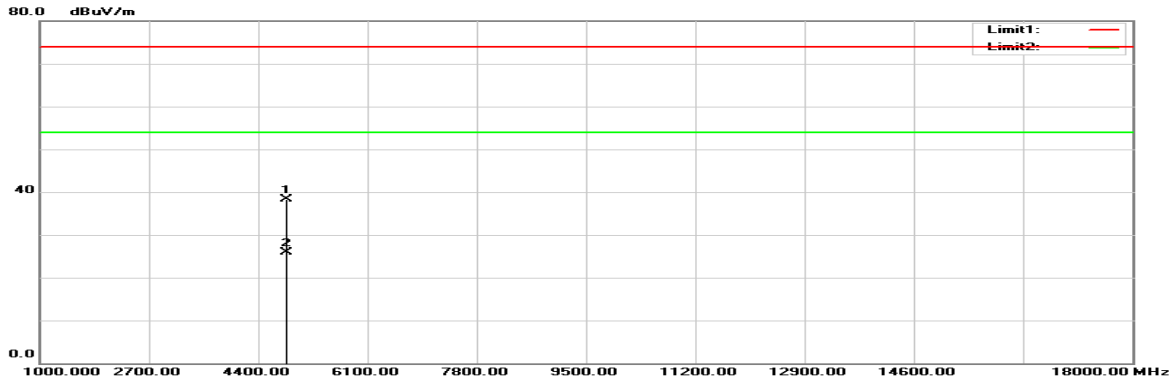
WIFI Mode *(Pre-scan with three orthogonal axis, and worse case as Z axis.)*

Horizontal (*worst case is Wi-Fi N40 mode low channel*)

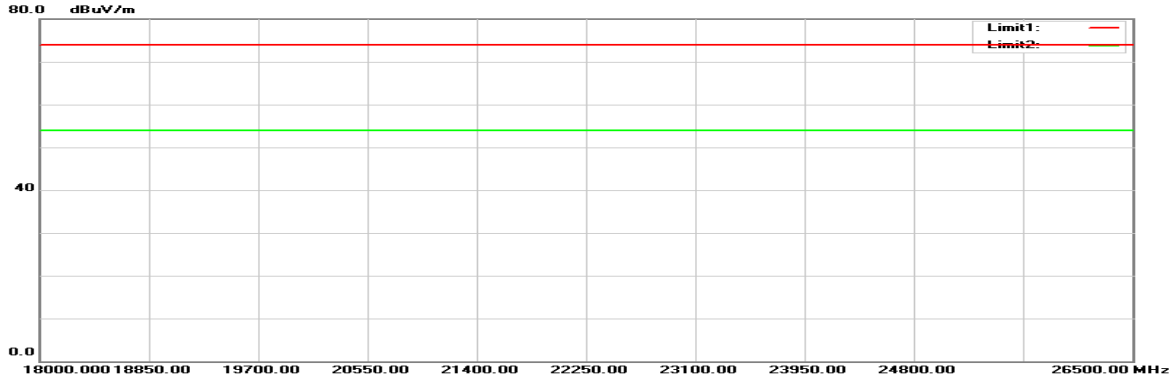
30MHz-1GHz:



1GHz-18GHz:

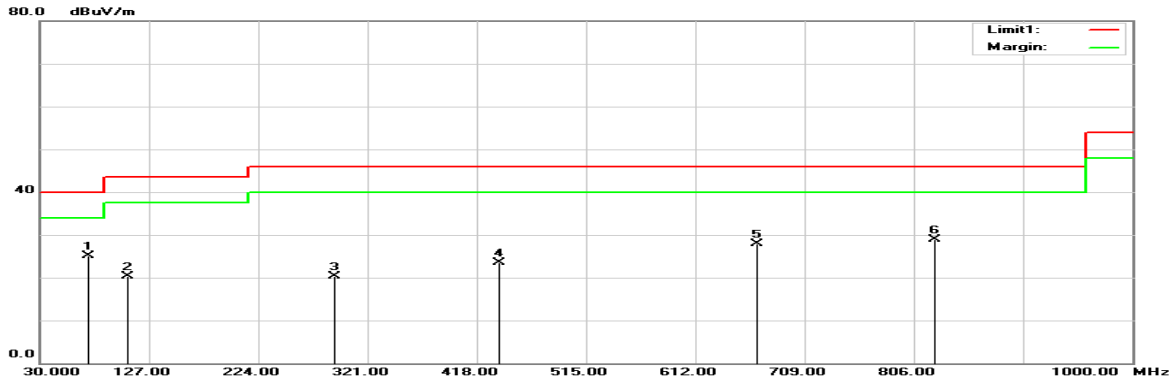


18GHz-26.5GHz:

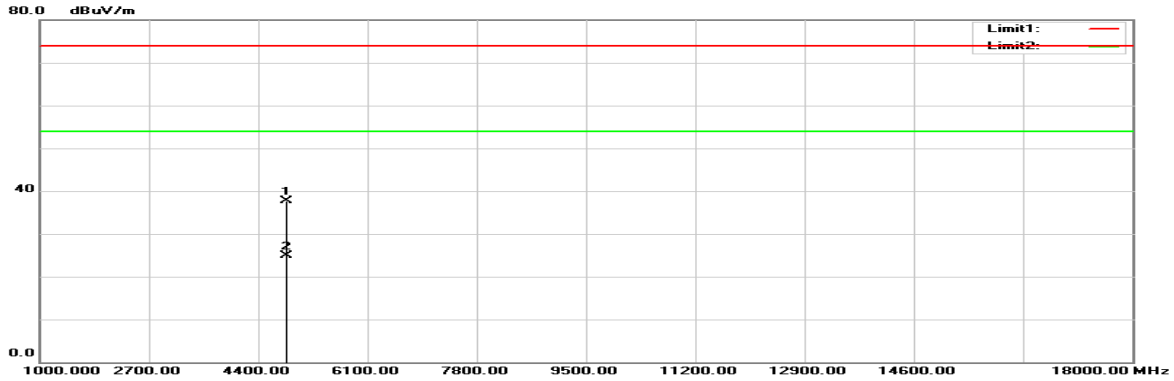


Vertical (*worst case is Wi-Fi N40 mode low channel*)

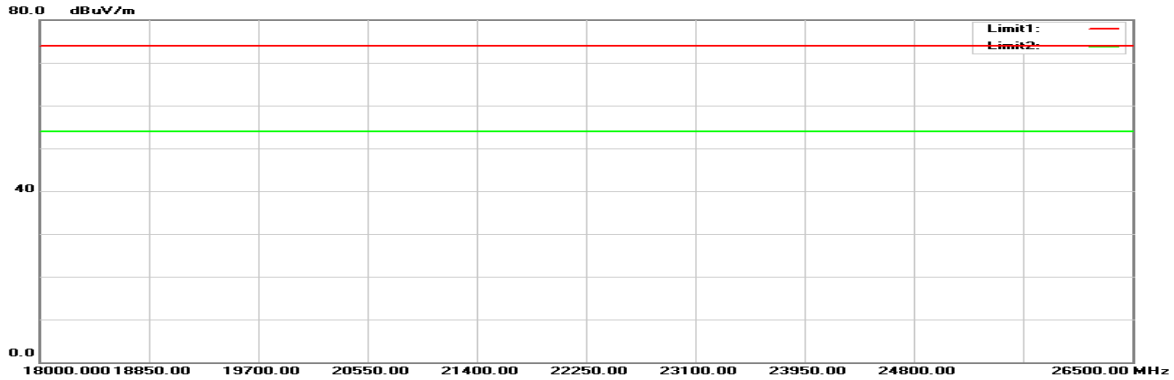
30MHz-1GHz:



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								
71.7100	42.38	-15.77	26.61	40.00	-13.39	100	133	QP
108.5700	35.09	-10.96	24.13	43.50	-19.37	100	28	QP
143.4900	32.95	-9.60	23.35	43.50	-20.15	100	358	QP
400.5400	28.86	-6.02	22.84	46.00	-23.16	100	166	QP
424.7900	29.21	-5.60	23.61	46.00	-22.39	100	272	QP
603.2700	29.19	-3.47	25.72	46.00	-20.28	100	318	QP
G Mode								
71.7100	42.44	-15.77	26.67	40.00	-13.33	100	360	QP
143.4900	32.69	-9.60	23.09	43.50	-20.41	100	350	QP
317.1200	29.57	-7.62	21.95	46.00	-24.05	100	45	QP
398.6000	28.90	-6.05	22.85	46.00	-23.15	100	57	QP
485.9000	29.16	-4.67	24.49	46.00	-21.51	100	155	QP
595.5100	29.51	-3.56	25.95	46.00	-20.05	100	327	QP
N20 Mode								
70.7400	42.74	-15.79	26.95	40.00	-13.05	100	131	QP
108.5700	34.27	-10.96	23.31	43.50	-20.19	100	18	QP
143.4900	32.62	-9.60	23.02	43.50	-20.48	100	9	QP
376.2900	28.23	-6.46	21.77	46.00	-24.23	100	356	QP
471.3500	29.53	-4.87	24.66	46.00	-21.34	100	243	QP
617.8200	29.35	-3.30	26.05	46.00	-19.95	100	11	QP
N40 Mode								
71.7100	42.74	-15.77	26.97	40.00	-13.03	100	360	QP
147.3700	32.81	-9.67	23.14	43.50	-20.36	100	356	QP
306.4500	28.22	-7.84	20.38	46.00	-25.62	100	174	QP
459.7100	28.86	-5.04	23.82	46.00	-22.18	100	52	QP
569.3200	29.19	-3.85	25.34	46.00	-20.66	100	235	QP
716.7600	31.07	-2.18	28.89	46.00	-17.11	100	251	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								
74.6200	40.72	-15.73	24.99	40.00	-15.01	100	110	QP
143.4900	29.99	-9.60	20.39	43.50	-23.11	100	312	QP
256.0100	29.52	-9.84	19.68	46.00	-26.32	100	54	QP
387.9300	28.58	-6.25	22.33	46.00	-23.67	100	129	QP
631.4000	29.29	-3.13	26.16	46.00	-19.84	100	296	QP
810.8500	28.78	-0.35	28.43	46.00	-17.57	100	81	QP
G Mode								
73.6500	40.89	-15.74	25.15	40.00	-14.85	100	85	QP
138.6400	31.17	-9.51	21.66	43.50	-21.84	100	1	QP
302.5700	28.16	-7.91	20.25	46.00	-25.75	100	295	QP
424.7900	29.70	-5.60	24.10	46.00	-21.90	100	7	QP
582.9000	29.39	-3.69	25.70	46.00	-20.30	100	323	QP
691.5400	29.56	-2.42	27.14	46.00	-18.86	100	292	QP
N20 Mode								
74.6200	39.85	-15.73	24.12	40.00	-15.88	100	91	QP
138.6400	29.66	-9.51	20.15	43.50	-23.35	100	358	QP
327.7900	29.55	-7.40	22.15	46.00	-23.85	100	188	QP
386.9600	29.45	-6.26	23.19	46.00	-22.81	100	316	QP
484.9300	29.10	-4.68	24.42	46.00	-21.58	100	1	QP
631.4000	30.40	-3.13	27.27	46.00	-18.73	100	1	QP
N40 Mode								
73.6500	40.84	-15.74	25.10	40.00	-14.90	100	126	QP
108.5700	31.34	-10.96	20.38	43.50	-23.12	100	36	QP
291.9000	28.40	-8.09	20.31	46.00	-25.69	100	202	QP
437.4000	28.93	-5.39	23.54	46.00	-22.46	100	257	QP
667.2900	30.53	-2.71	27.82	46.00	-18.18	100	346	QP
824.4300	29.11	-0.20	28.91	46.00	-17.09	100	175	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	52.37	-3.87	48.50	74.00	-25.50	100	174	peak
2390.000	39.35	-3.87	35.48	54.00	-18.52	100	174	AVG
2412.000	92.60	-3.66	88.94	N/A	N/A	100	177	peak
2412.000	86.94	-3.66	83.28	N/A	N/A	100	177	AVG
4824.000	35.54	2.04	37.58	74.00	-36.42	100	292	peak
4824.000	23.14	2.04	25.18	54.00	-28.82	100	292	AVG
B Mode, Middle channel								
2437.000	95.32	-3.39	91.93	N/A	N/A	100	212	peak
2437.000	89.90	-3.39	86.51	N/A	N/A	100	212	AVG
4874.000	35.73	2.59	38.32	74.00	-35.68	100	133	peak
4874.000	22.81	2.59	25.40	54.00	-28.60	100	133	AVG
B Mode, High channel								
2462.000	93.13	-3.12	90.01	N/A	N/A	100	175	peak
2462.000	87.37	-3.12	84.25	N/A	N/A	100	175	AVG
2483.500	52.45	-2.88	49.57	74.00	-24.43	100	8	peak
2483.500	39.39	-2.88	36.51	54.00	-17.49	100	8	AVG
4924.000	35.24	2.81	38.05	74.00	-35.95	100	31	peak
4924.000	23.54	2.81	26.35	54.00	-27.65	100	31	AVG

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	52.06	-3.87	48.19	74.00	-25.81	300	222	peak
2390.000	39.09	-3.87	35.22	54.00	-18.78	300	222	AVG
2412.000	84.11	-3.66	80.45	N/A	N/A	300	332	peak
2412.000	78.63	-3.66	74.97	N/A	N/A	300	332	AVG
4824.000	35.81	2.04	37.85	74.00	-36.15	100	178	peak
4824.000	23.25	2.04	25.29	54.00	-28.71	100	178	AVG
B Mode, Middle channel								
2437.000	88.40	-3.39	85.01	N/A	N/A	300	323	peak
2437.000	79.39	-3.39	76.00	N/A	N/A	300	323	AVG
4874.000	35.71	2.59	38.30	74.00	-35.70	100	1	peak
4874.000	22.94	2.59	25.53	54.00	-28.47	100	1	AVG
B Mode, High channel								
2462.000	84.45	-3.12	81.33	N/A	N/A	300	331	peak
2462.000	78.88	-3.12	75.76	N/A	N/A	300	331	AVG
2483.500	52.78	-2.88	49.90	74.00	-24.10	300	272	peak
2483.500	39.29	-2.88	36.41	54.00	-17.59	300	272	AVG
4924.000	35.34	2.81	38.15	74.00	-35.85	100	318	peak
4924.000	22.98	2.81	25.79	54.00	-28.21	100	318	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	54.93	-3.87	51.06	74.00	-22.94	100	222	peak
2390.000	40.32	-3.87	36.45	54.00	-17.55	100	222	AVG
2412.000	91.01	-3.66	87.35	N/A	N/A	100	172	peak
2412.000	79.09	-3.66	75.43	N/A	N/A	100	172	AVG
4824.000	35.95	2.04	37.99	74.00	-36.01	100	170	peak
4824.000	23.41	2.04	25.45	54.00	-28.55	100	170	AVG
G Mode, Middle channel								
2437.000	93.40	-3.39	90.01	N/A	N/A	100	214	peak
2437.000	81.76	-3.39	78.37	N/A	N/A	100	214	AVG
4874.000	36.59	2.59	39.18	74.00	-34.82	100	89	peak
4874.000	23.11	2.59	25.70	54.00	-28.30	100	89	AVG
G Mode, High channel								
2462.000	90.98	-3.12	87.86	N/A	N/A	100	189	peak
2462.000	79.76	-3.12	76.64	N/A	N/A	100	189	AVG
2483.500	53.01	-2.88	50.13	74.00	-23.87	100	214	peak
2483.500	39.90	-2.88	37.02	54.00	-16.98	100	214	AVG
4924.000	36.59	2.81	39.40	74.00	-34.60	100	82	peak
4924.000	23.22	2.81	26.03	54.00	-27.97	100	82	AVG

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	53.14	-3.87	49.27	74.00	-24.73	300	64	peak
2390.000	39.75	-3.87	35.88	54.00	-18.12	300	64	AVG
2412.000	81.75	-3.66	78.09	N/A	N/A	300	326	peak
2412.000	70.13	-3.66	66.47	N/A	N/A	300	326	AVG
4824.000	36.73	2.04	38.77	74.00	-35.23	100	327	peak
4824.000	22.45	2.04	24.49	54.00	-29.51	100	327	AVG
G Mode, Middle channel								
2437.000	85.77	-3.39	82.38	N/A	N/A	300	328	peak
2437.000	72.18	-3.39	68.79	N/A	N/A	300	328	AVG
4874.000	36.64	2.59	39.23	74.00	-34.77	100	104	peak
4874.000	22.52	2.59	25.11	54.00	-28.89	100	104	AVG
G Mode, High channel								
2462.000	82.99	-3.12	79.87	N/A	N/A	300	335	peak
2462.000	71.67	-3.12	68.55	N/A	N/A	300	335	AVG
2483.500	52.80	-2.88	49.92	74.00	-24.08	300	158	peak
2483.500	39.93	-2.88	37.05	54.00	-16.95	300	158	AVG
4924.000	35.65	2.81	38.46	74.00	-35.54	100	89	peak
4924.000	22.15	2.81	24.96	54.00	-29.04	100	89	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	54.86	-3.87	50.99	74.00	-23.01	100	202	peak
2390.000	40.22	-3.87	36.35	54.00	-17.65	100	202	AVG
2412.000	90.25	-3.66	86.59	N/A	N/A	100	196	peak
2412.000	73.12	-3.66	69.46	N/A	N/A	100	196	AVG
4824.000	35.49	2.04	37.53	74.00	-36.47	100	297	peak
4824.000	23.56	2.04	25.60	54.00	-28.40	100	297	AVG
N20 Mode, Middle channel								
2437.000	92.80	-3.39	89.41	N/A	N/A	100	206	peak
2437.000	75.81	-3.39	72.42	N/A	N/A	100	206	AVG
4874.000	35.35	2.59	37.94	74.00	-36.06	100	355	peak
4874.000	23.63	2.59	26.22	54.00	-27.78	100	355	AVG
N20 Mode, High channel								
2462.000	90.66	-3.12	87.54	N/A	N/A	100	173	peak
2462.000	73.88	-3.12	70.76	N/A	N/A	100	173	AVG
2483.500	51.70	-2.88	48.82	74.00	-25.18	100	290	peak
2483.500	39.29	-2.88	36.41	54.00	-17.59	100	290	AVG
4924.000	36.18	2.81	38.99	74.00	-35.01	100	186	peak
4924.000	23.40	2.81	26.21	54.00	-27.79	100	186	AVG

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	52.77	-3.87	48.90	74.00	-25.10	300	65	peak
2390.000	39.08	-3.87	35.21	54.00	-18.79	300	65	AVG
2412.000	81.74	-3.66	78.08	N/A	N/A	300	92	peak
2412.000	65.94	-3.66	62.28	N/A	N/A	300	92	AVG
4824.000	35.95	2.04	37.99	74.00	-36.01	100	65	peak
4824.000	22.57	2.04	24.61	54.00	-29.39	100	65	AVG
N20 Mode, Middle channel								
2437.000	86.11	-3.39	82.72	N/A	N/A	300	324	peak
2437.000	68.73	-3.39	65.34	N/A	N/A	300	324	AVG
4874.000	35.74	2.59	38.33	74.00	-35.67	100	119	peak
4874.000	22.78	2.59	25.37	54.00	-28.63	100	119	AVG
N20 Mode, High channel								
2462.000	82.31	-3.12	79.19	N/A	N/A	300	329	peak
2462.000	66.64	-3.12	63.52	N/A	N/A	300	329	AVG
2483.500	52.03	-2.88	49.15	74.00	-24.85	300	156	peak
2483.500	39.24	-2.88	36.36	54.00	-17.64	300	156	AVG
4924.000	35.30	2.81	38.11	74.00	-35.89	100	329	peak
4924.000	22.74	2.81	25.55	54.00	-28.45	100	329	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
N40 Mode, Low channel								
2390.000	70.72	-3.87	66.85	74.00	-7.15	100	223	peak
2390.000	47.97	-3.87	44.10	54.00	-9.90	100	223	AVG
2422.000	95.14	-3.55	91.59	N/A	N/A	100	201	peak
2422.000	74.27	-3.55	70.72	N/A	N/A	100	201	AVG
4844.000	35.99	2.25	38.24	74.00	-35.76	100	303	peak
4844.000	23.67	2.25	25.92	54.00	-28.08	100	303	AVG
N40 Mode, Middle channel								
2437.000	94.26	-3.39	90.87	N/A	N/A	100	173	peak
2437.000	73.95	-3.39	70.56	N/A	N/A	100	173	AVG
4874.000	36.03	2.59	38.62	74.00	-35.38	100	188	peak
4874.000	23.61	2.59	26.20	54.00	-27.80	100	188	AVG
N40 Mode, High channel								
2452.000	93.62	-3.22	90.40	N/A	N/A	100	221	peak
2452.000	72.50	-3.22	69.28	N/A	N/A	100	221	AVG
2483.500	67.88	-2.88	65.00	74.00	-9.00	100	172	peak
2483.500	46.28	-2.88	43.40	54.00	-10.60	100	172	AVG
4904.000	35.86	2.87	38.73	74.00	-35.27	100	152	peak
4904.000	23.69	2.87	26.56	54.00	-27.44	100	152	AVG

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
N40 Mode, Low channel								
2390.000	66.66	-3.87	62.79	74.00	-11.21	300	66	peak
2390.000	46.71	-3.87	42.84	54.00	-11.16	300	66	AVG
2422.000	87.81	-3.55	84.26	N/A	N/A	300	324	peak
2422.000	67.46	-3.55	63.91	N/A	N/A	300	324	AVG
4844.000	35.48	2.25	37.73	74.00	-36.27	100	299	peak
4844.000	22.59	2.25	24.84	54.00	-29.16	100	299	AVG
N40 Mode, Middle channel								
2437.000	86.65	-3.39	83.26	N/A	N/A	300	318	peak
2437.000	68.44	-3.39	65.05	N/A	N/A	300	318	AVG
4874.000	36.33	2.59	38.92	74.00	-35.08	100	259	peak
4874.000	22.87	2.59	25.46	54.00	-28.54	100	259	AVG
N40 Mode, High channel								
2452.000	86.21	-3.22	82.99	N/A	N/A	300	320	peak
2452.000	67.57	-3.22	64.35	N/A	N/A	300	320	AVG
2483.500	57.23	-2.88	54.35	74.00	-19.65	300	344	peak
2483.500	44.83	-2.88	41.95	54.00	-12.05	300	344	AVG
4904.000	37.03	2.87	39.90	74.00	-34.10	100	247	peak
4904.000	22.98	2.87	25.85	54.00	-28.15	100	247	AVG

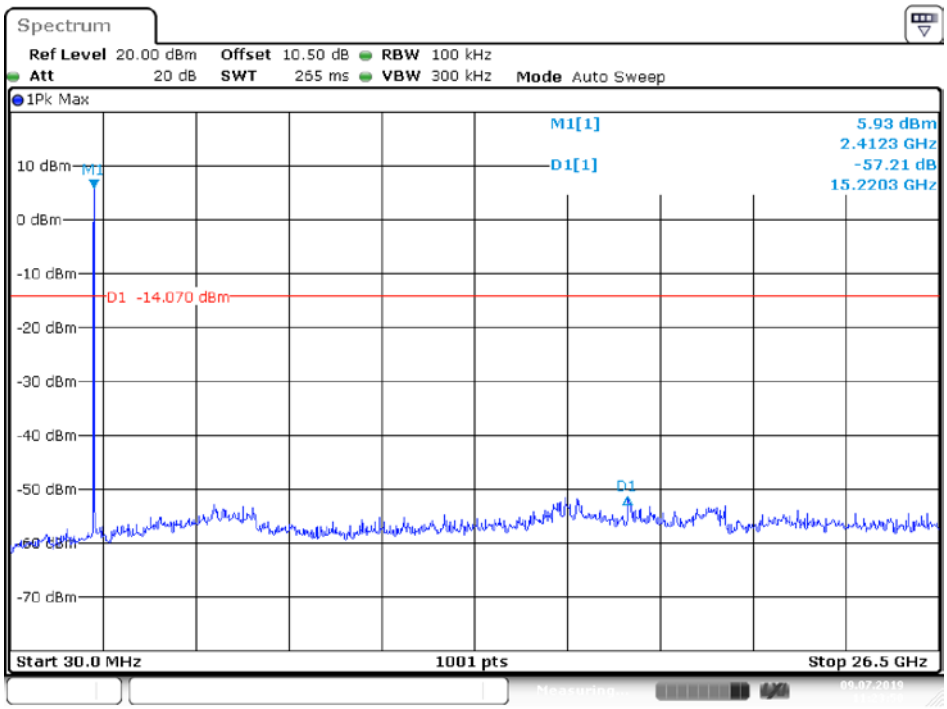
Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
B Mode				
Low	2412	57.21	≥ 20	PASS
Mid	2437	54.67	≥ 20	PASS
High	2462	56.20	≥ 20	PASS
G Mode				
Low	2412	47.45	≥ 20	PASS
Mid	2437	47.69	≥ 20	PASS
High	2462	46.58	≥ 20	PASS
N20 Mode				
Low	2412	46.40	≥ 20	PASS
Mid	2437	47.15	≥ 20	PASS
High	2462	48.32	≥ 20	PASS
N40 Mode				
Low	2422	47.70	≥ 20	PASS
Mid	2437	46.30	≥ 20	PASS
High	2452	44.57	≥ 20	PASS

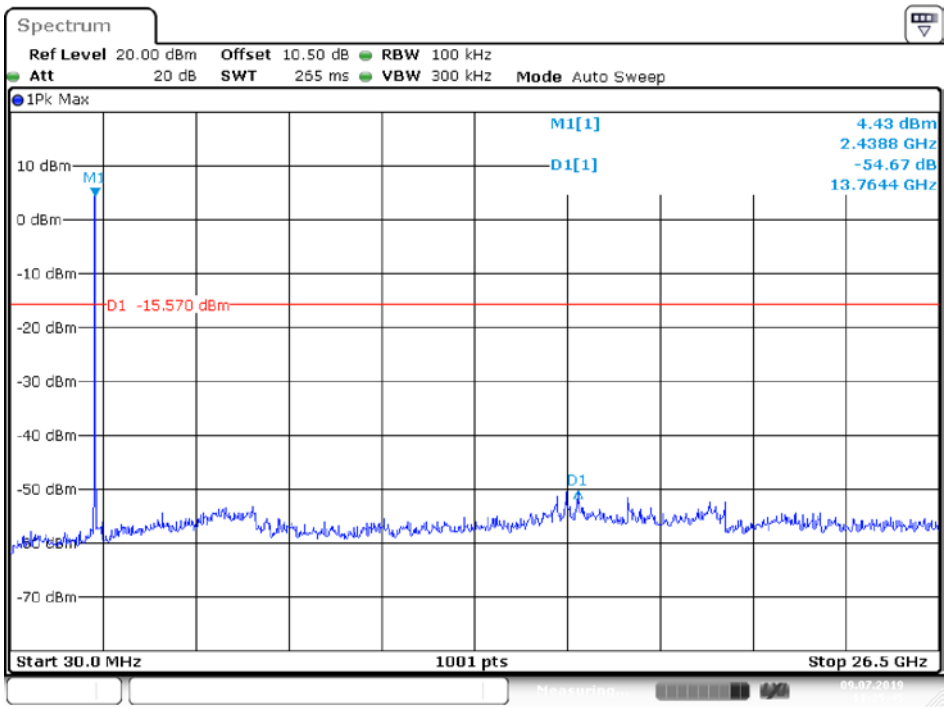
B Mode

Low Channel



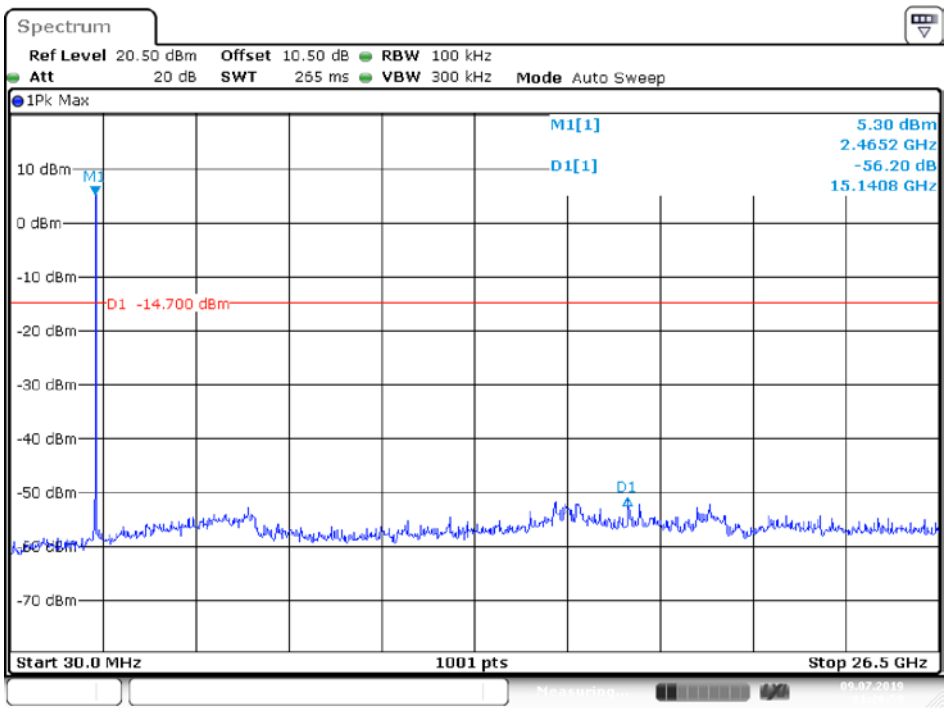
Date: 9.JUL.2019 11:23:50

Middle Channel



Date: 9.JUL.2019 11:25:45

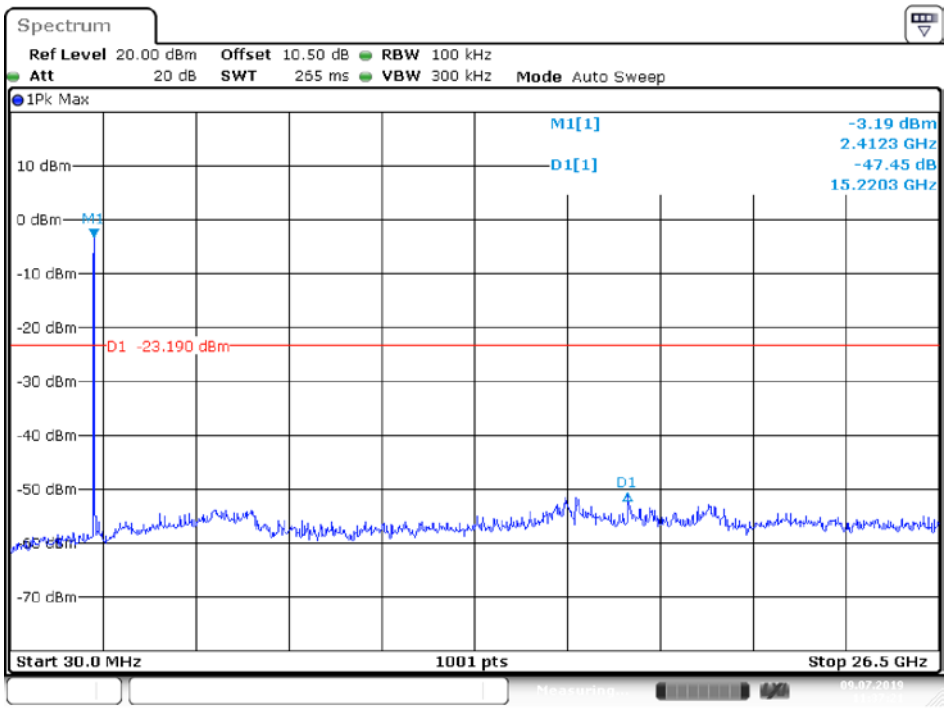
High Channel



Date: 9.JUL.2019 11:28:59

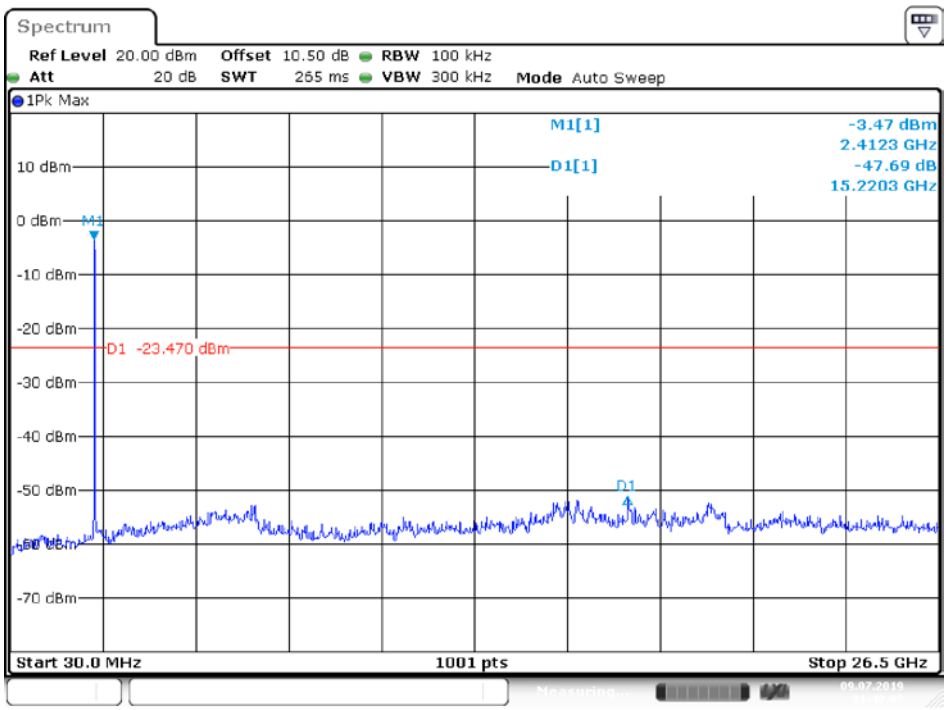
G Mode

Low Channel



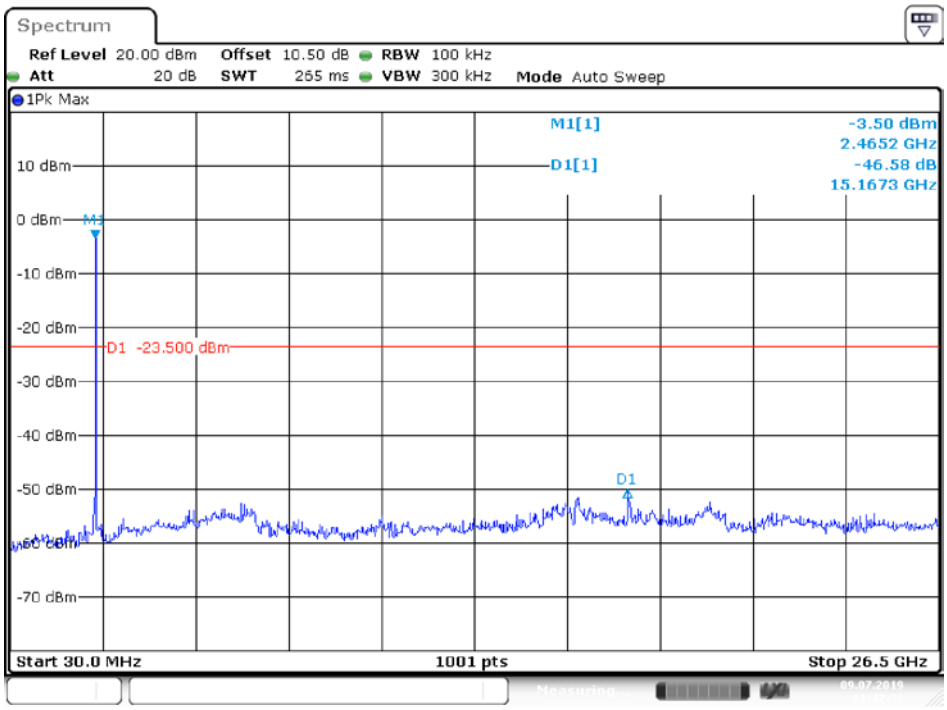
Date: 9.JUL.2019 11:37:22

Middle Channel



Date: 9.JUL.2019 11:40:10

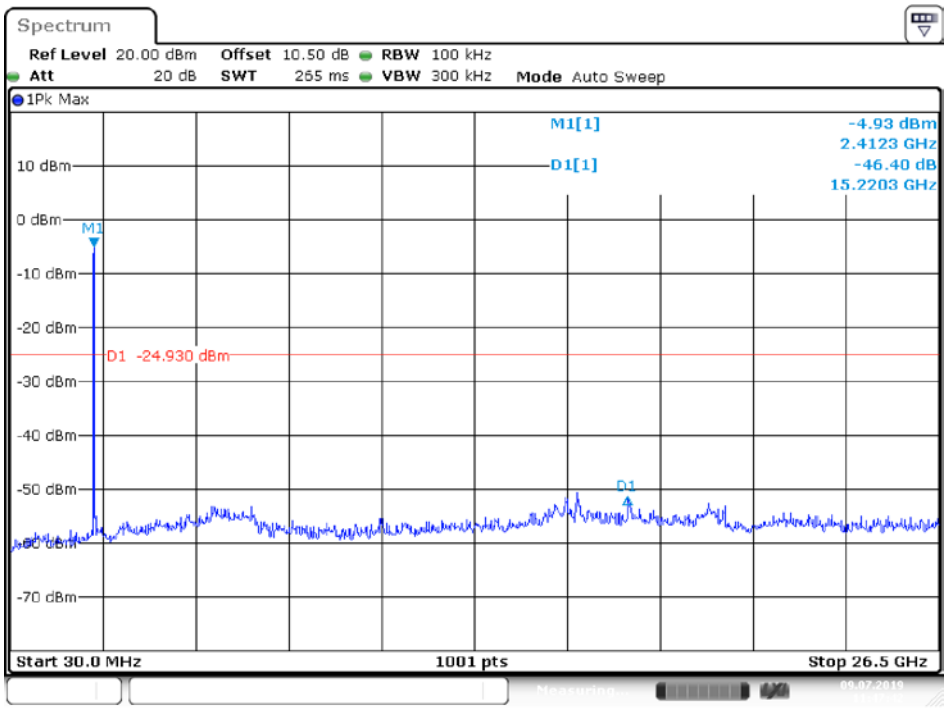
High Channel



Date: 9.JUL.2019 11:42:34

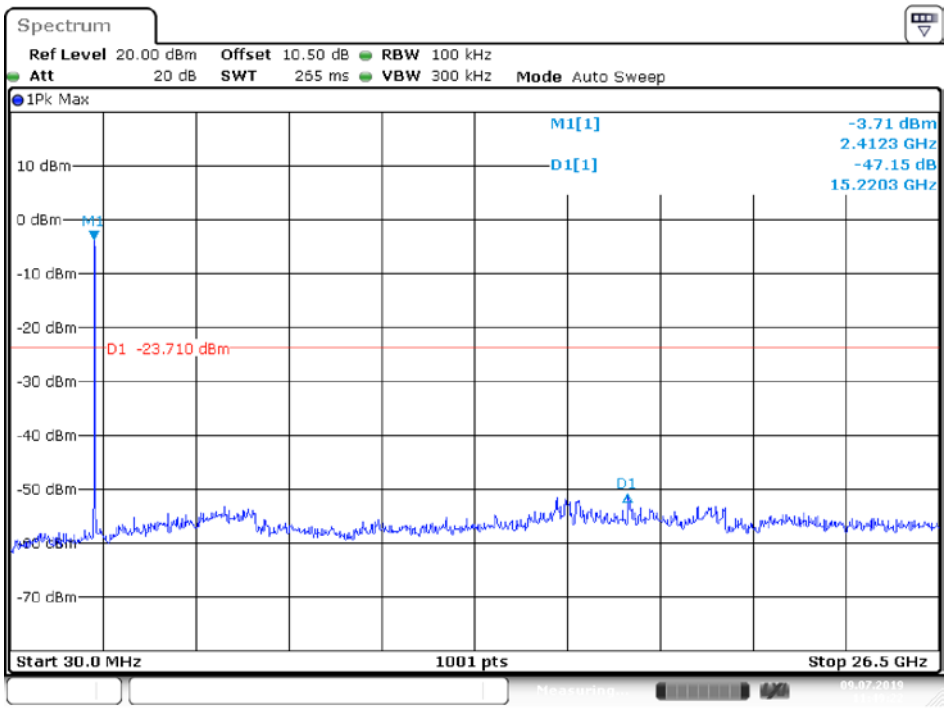
N20 Mode

Low Channel



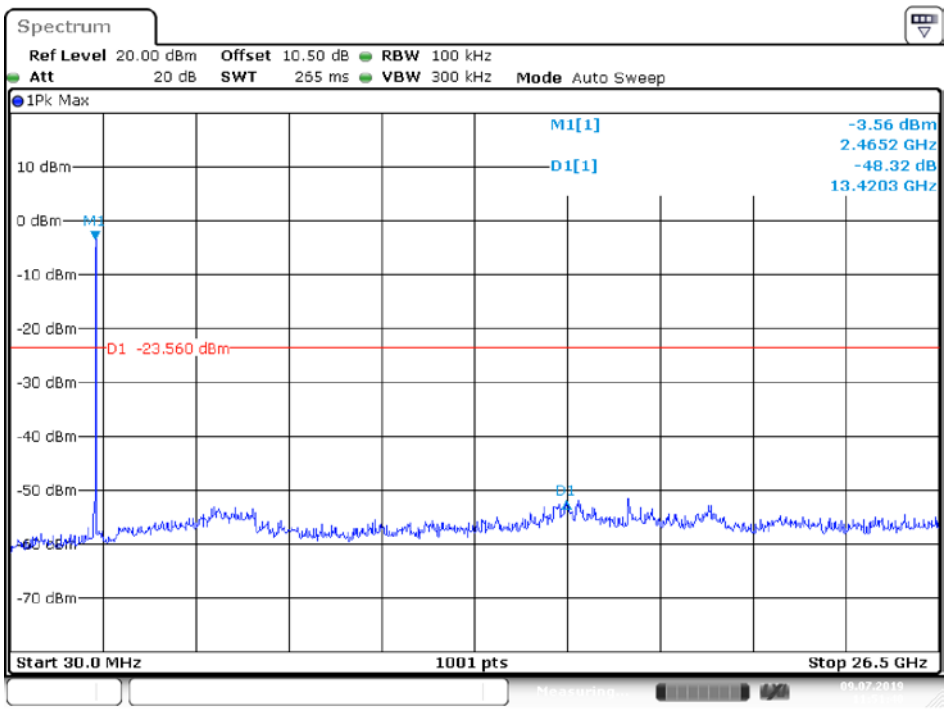
Date: 9.JUL.2019 11:47:43

Middle Channel



Date: 9.JUL.2019 11:49:22

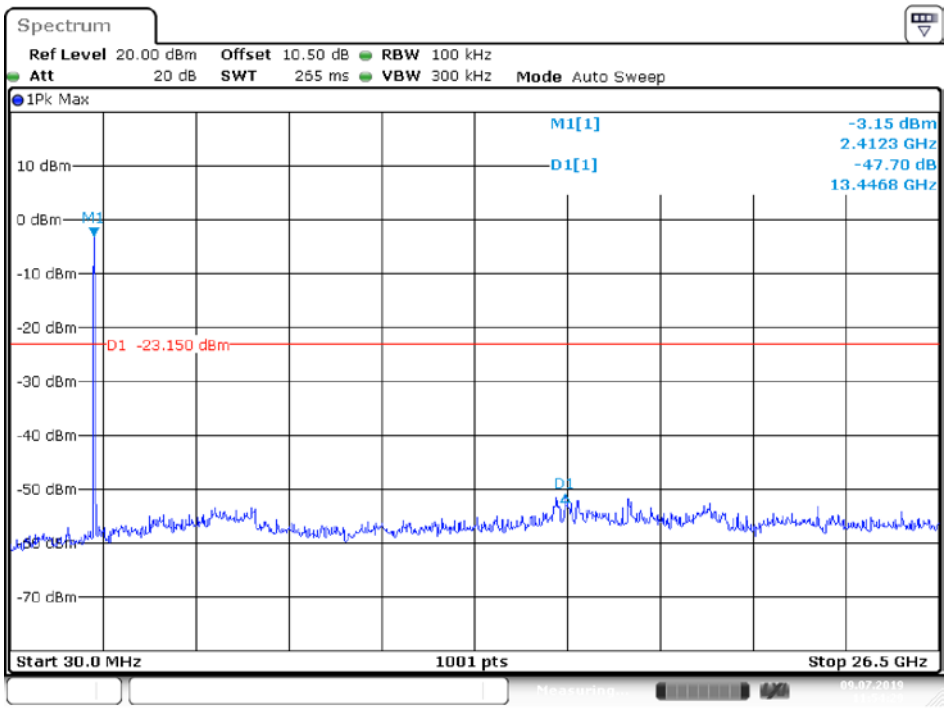
High Channel



Date: 9.JUL.2019 11:51:41

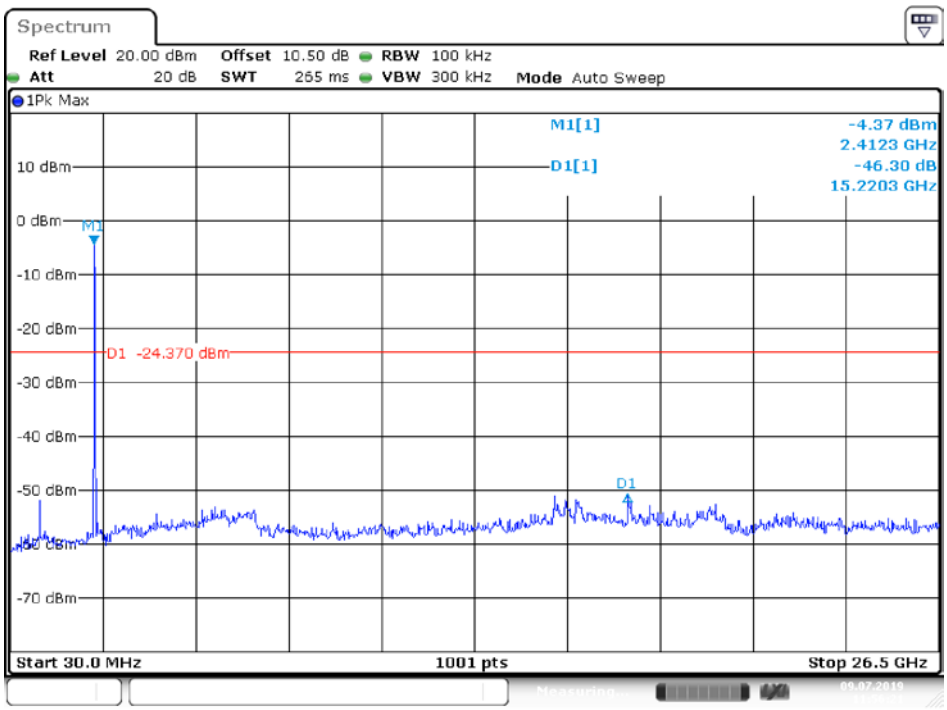
N40 Mode

Low Channel



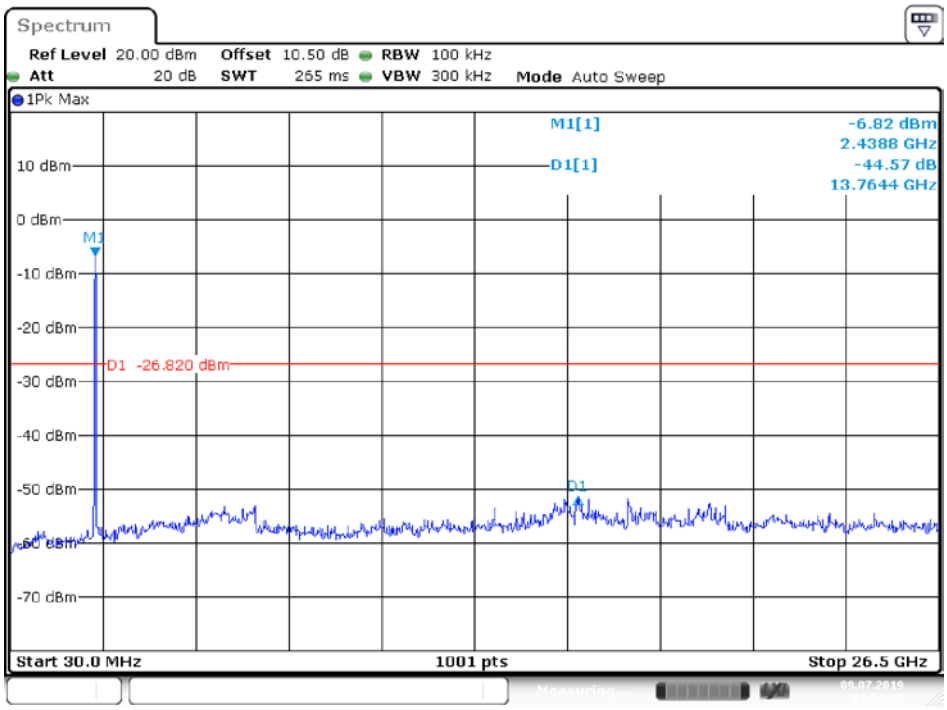
Date: 9.JUL.2019 11:54:29

Middle Channel



Date: 9.JUL.2019 11:56:22

High Channel



Date: 9.JUL.2019 11:58:31

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:	25.3 ℃
Relative Humidity:	42 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-07-09.

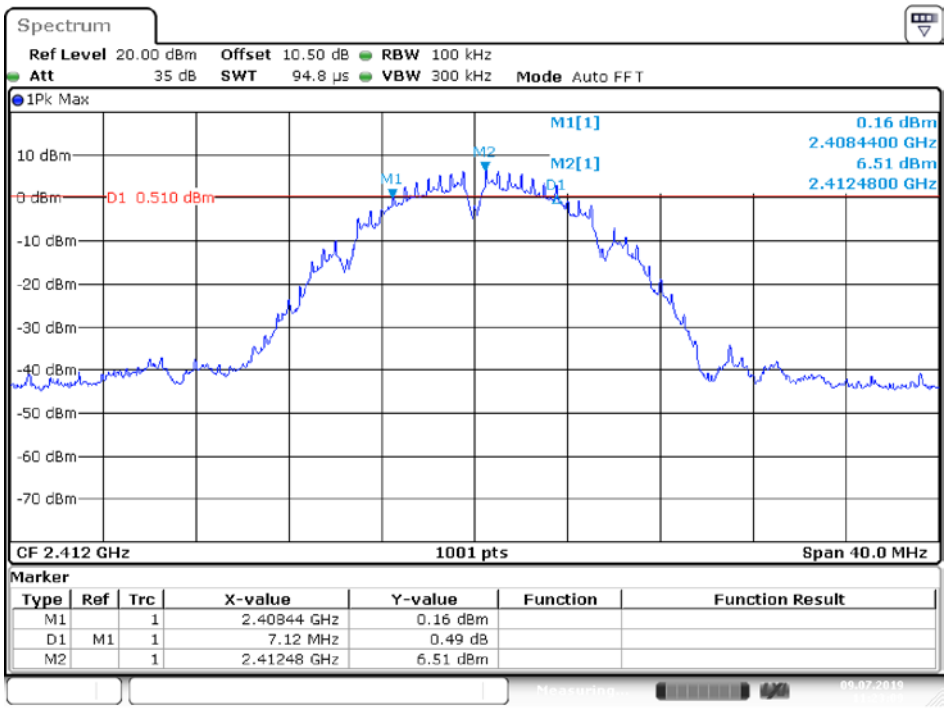
9.4 Test Results

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)	Result
B Mode				
Low	2412	7.12	> 500	PASS
Middle	2437	7.08	> 500	PASS
High	2462	7.12	> 500	PASS
G Mode				
Low	2412	16.12	> 500	PASS
Middle	2437	16.4	> 500	PASS
High	2462	16.4	> 500	PASS
N20 Mode				
Low	2412	16.68	> 500	PASS
Middle	2437	17.24	> 500	PASS
High	2462	17.32	> 500	PASS
N40 Mode				
Low	2422	35.12	> 500	PASS
Middle	2437	35.36	> 500	PASS
High	2452	36.32	> 500	PASS

Please refer to the following plots

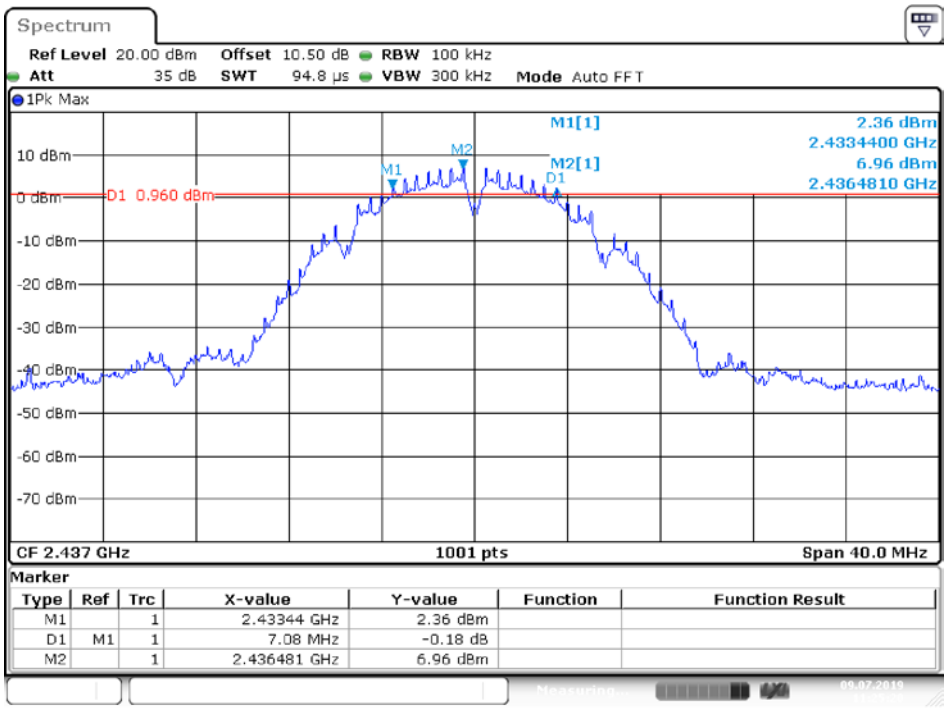
B Mode

Low Channel



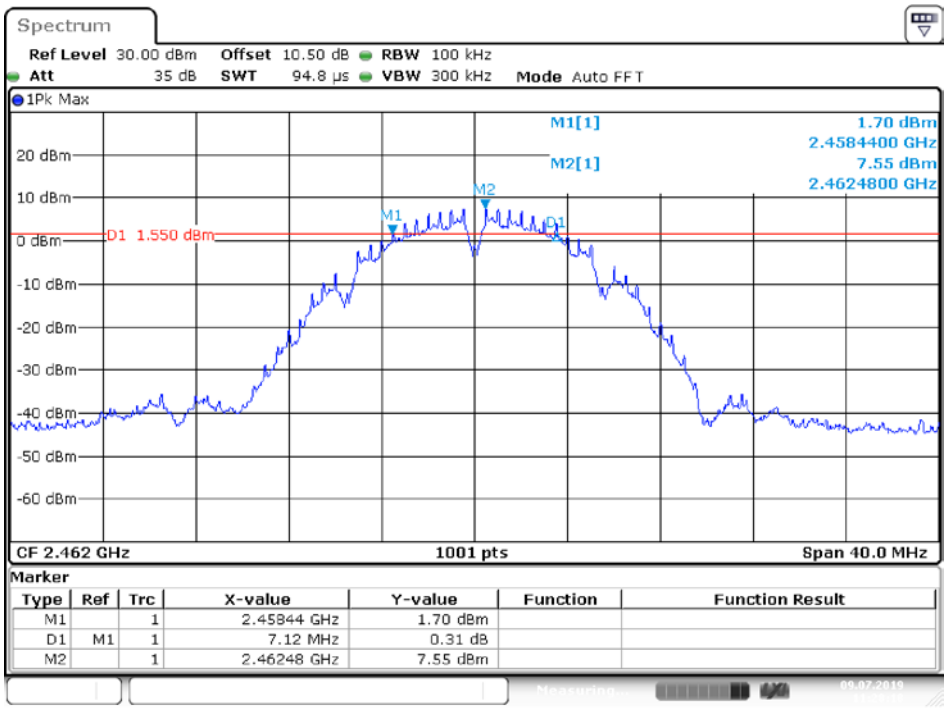
Date: 9.JUL.2019 11:23:09

Middle Channel



Date: 9.JUL.2019 11:25:20

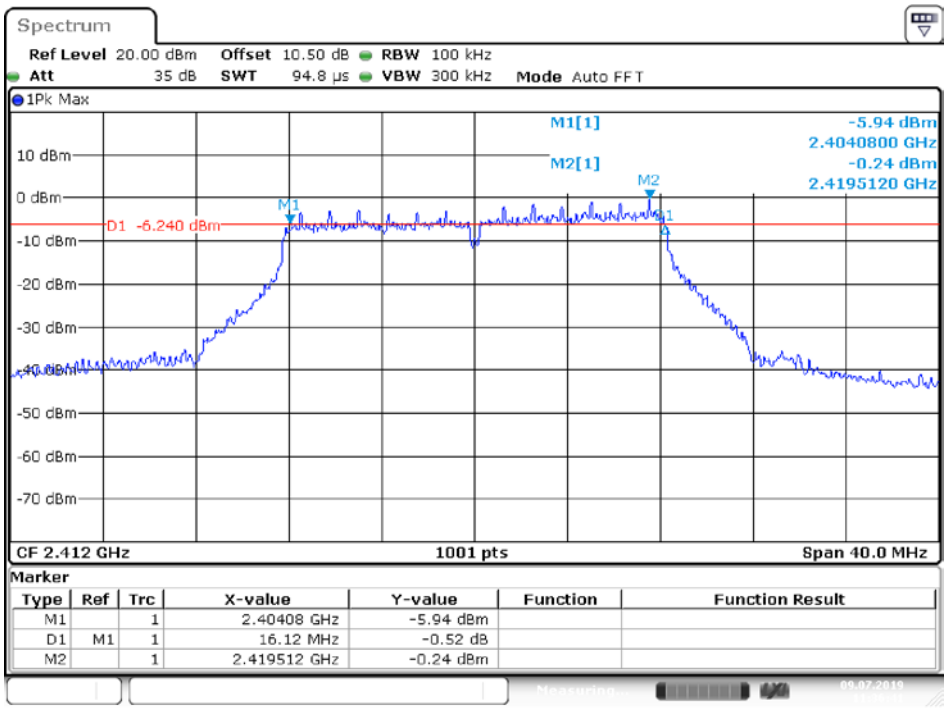
High Channel



Date: 9.JUL.2019 11:28:19

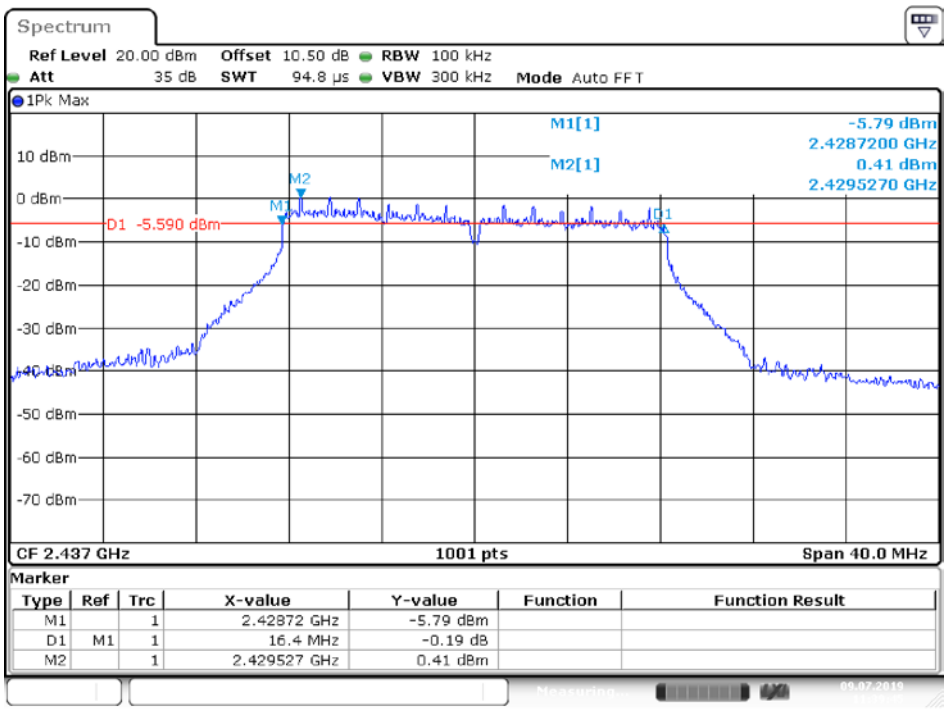
G Mode

Low Channel



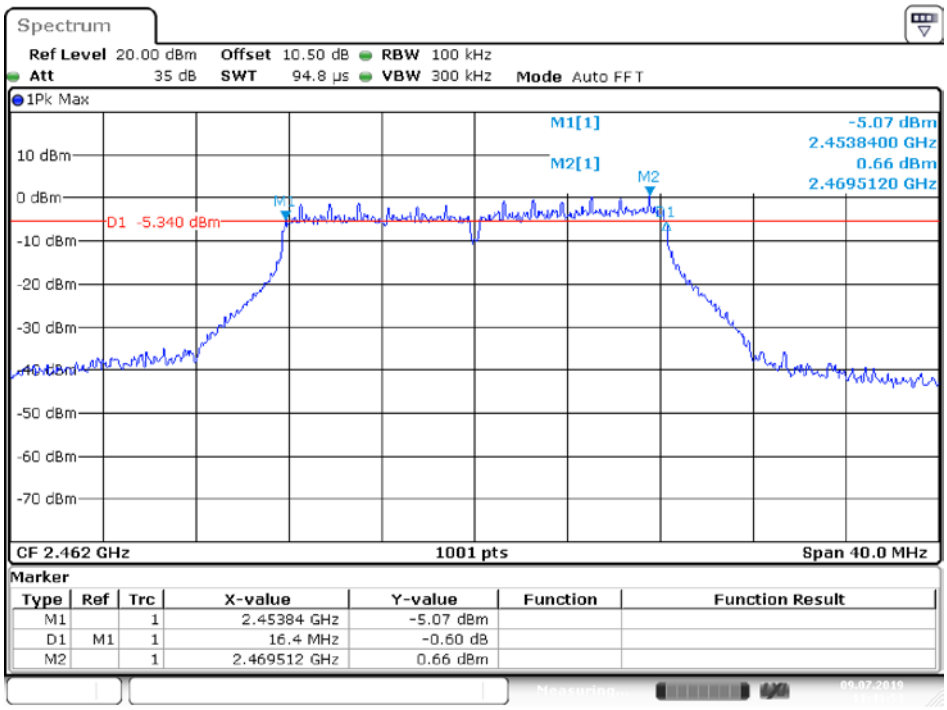
Date: 9.JUL.2019 11:36:41

Middle Channel



Date: 9.JUL.2019 11:39:45

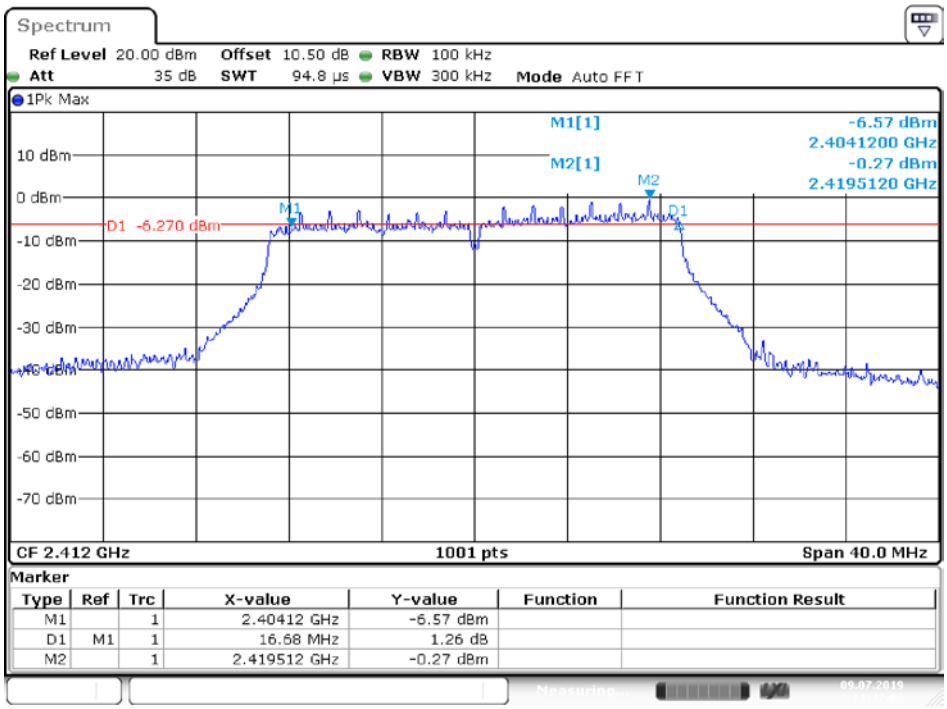
High Channel



Date: 9.JUL.2019 11:41:53

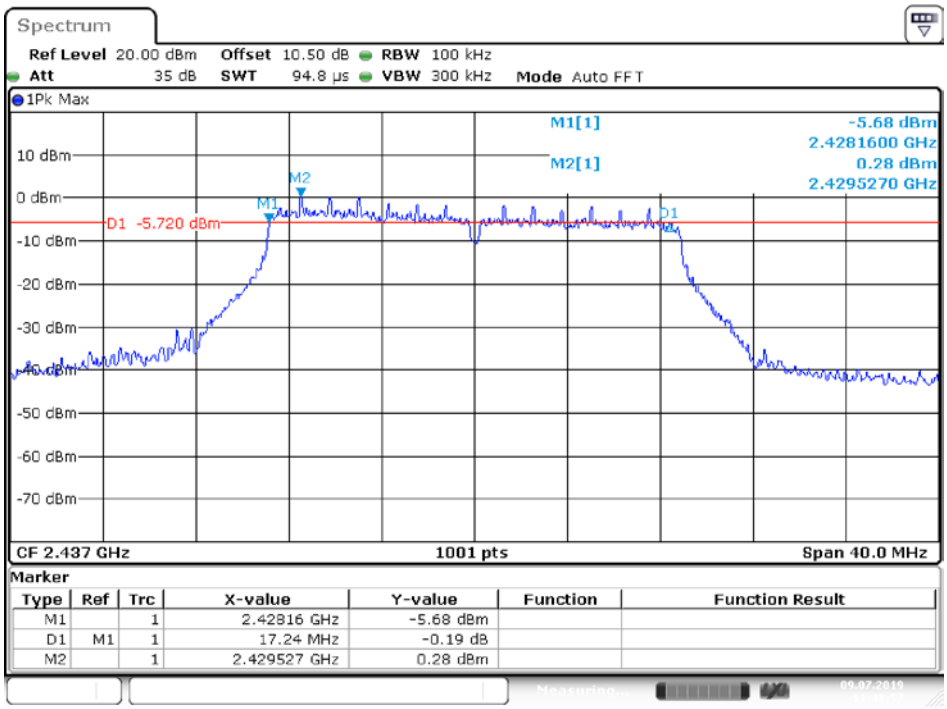
N20 Mode

Low Channel



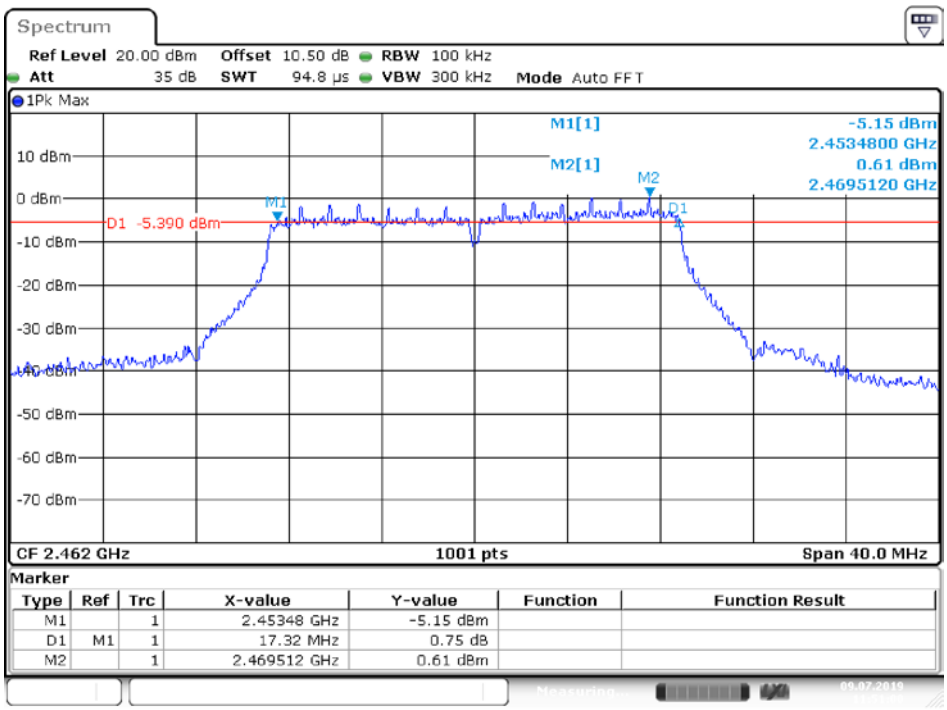
Date: 9.JUL.2019 11:47:02

Middle Channel



Date: 9.JUL.2019 11:48:57

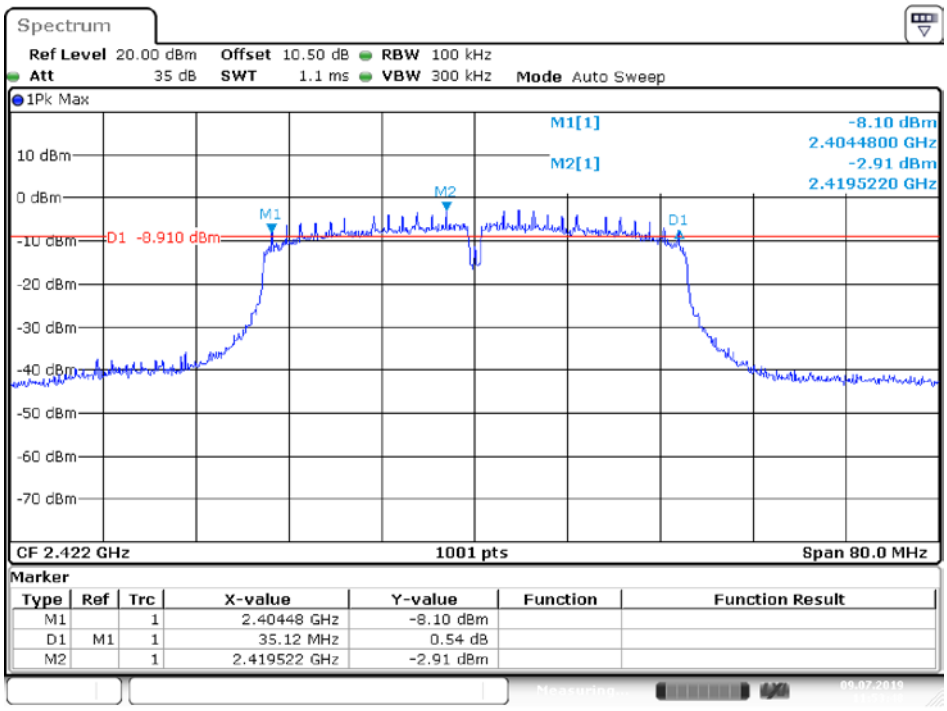
High Channel



Date: 9.JUL.2019 11:51:00

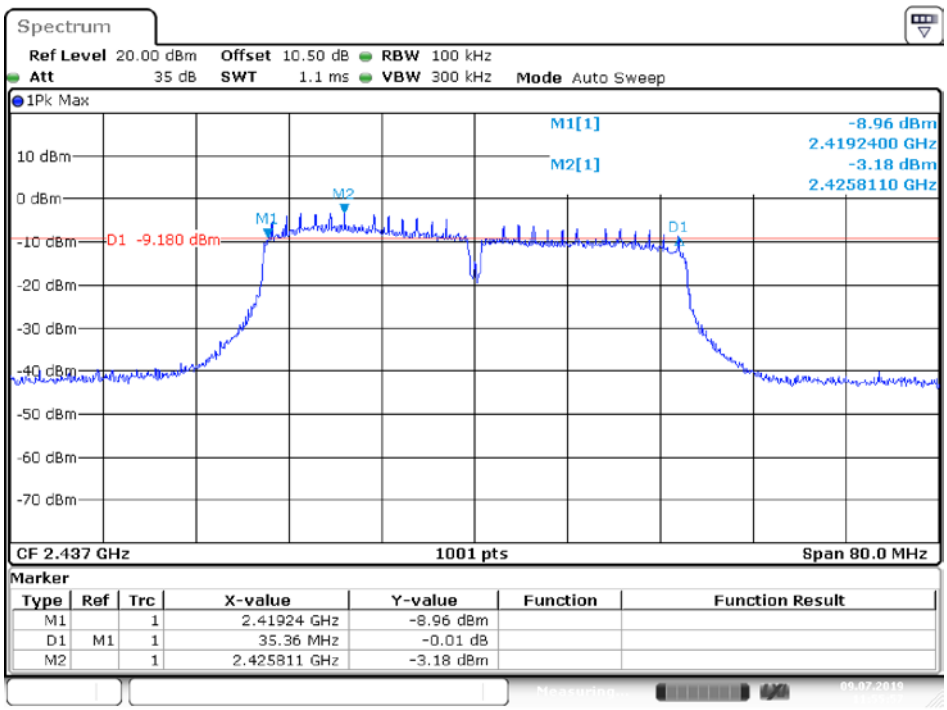
N40 Mode

Low Channel



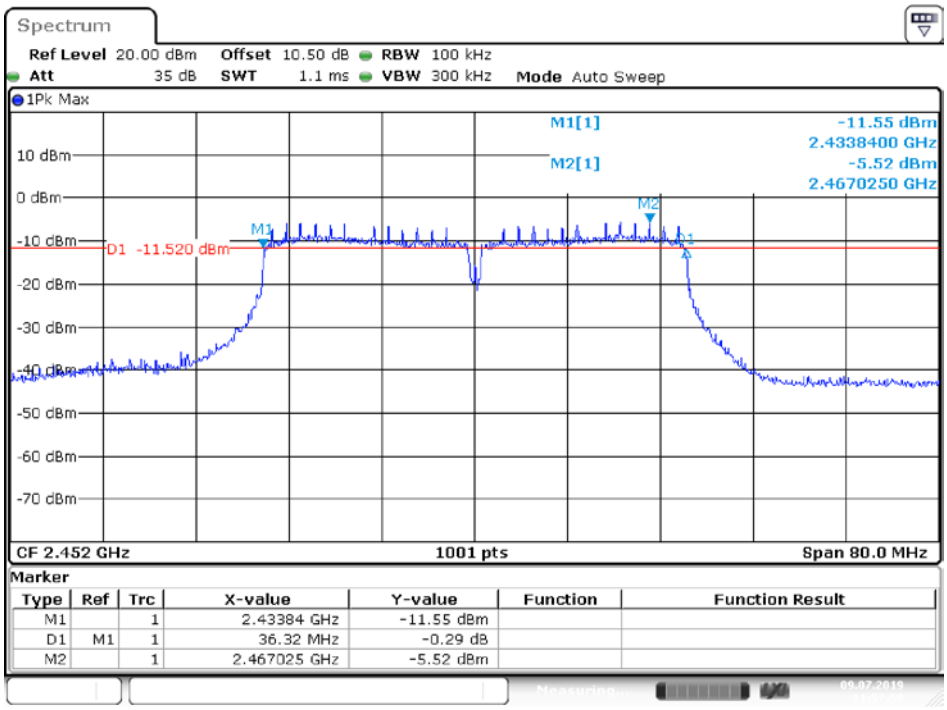
Date: 9.JUL.2019 11:53:49

Middle Channel



Date: 9.JUL.2019 11:55:57

High Channel



Date: 9.JUL.2019 11:57:50

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:	25.3 ℃
Relative Humidity:	42 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-07-09.

10.4 Test Results

Conducted Peak Output Power

Channel	Frequency	Maximum peak Conducted Output Power		Limit	Result
	(MHz)	(dBm)	(W)	(W)	
B Mode					
Low	2412	16.16	0.0413	1	PASS
Middle	2437	16.92	0.0492	1	PASS
High	2462	17.53	0.0566	1	PASS
G Mode					
Low	2412	16.36	0.0433	1	PASS
Middle	2437	17.18	0.0522	1	PASS
High	2462	17.64	0.0581	1	PASS
N20 Mode					
Low	2412	16.31	0.0428	1	PASS
Middle	2437	17.14	0.0518	1	PASS
High	2462	17.6	0.0575	1	PASS
N40 Mode					
Low	2422	16.53	0.0450	1	PASS
Middle	2437	15.63	0.0366	1	PASS
High	2452	14.42	0.0277	1	PASS

Conducted Average Output Power

Channel	Frequency (MHz)	Power (dBm)	Duty Factor (dB)	Power With Duty Factor (dBm)	Power With Duty Factor (W)	Limit (W)	Result
	B Mode						
Low	2412	13.64	0.09	13.73	0.0236	1	Compliance
Middle	2437	14.36	0.09	14.45	0.0278	1	Compliance
High	2462	15	0.09	15.09	0.0322	1	Compliance
	G Mode						
Low	2412	9.17	0.6	9.77	0.0094	1	Compliance
Middle	2437	10.05	0.6	10.65	0.0116	1	Compliance
High	2462	10.45	0.6	11.05	0.0127	1	Compliance
	N20 Mode						
Low	2412	9.18	0.6	9.78	0.0095	1	Compliance
Middle	2437	10.05	0.6	10.65	0.0116	1	Compliance
High	2462	10.44	0.6	11.04	0.0127	1	Compliance
	N40 Mode						
Low	2422	9.38	2.01	11.39	0.0137	1	Compliance
Middle	2437	8.49	2.01	10.5	0.0112	1	Compliance
High	2452	7.28	2.01	9.29	0.0084	1	Compliance

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 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)).

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:	25.3 ℃
Relative Humidity:	42 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-07-09.

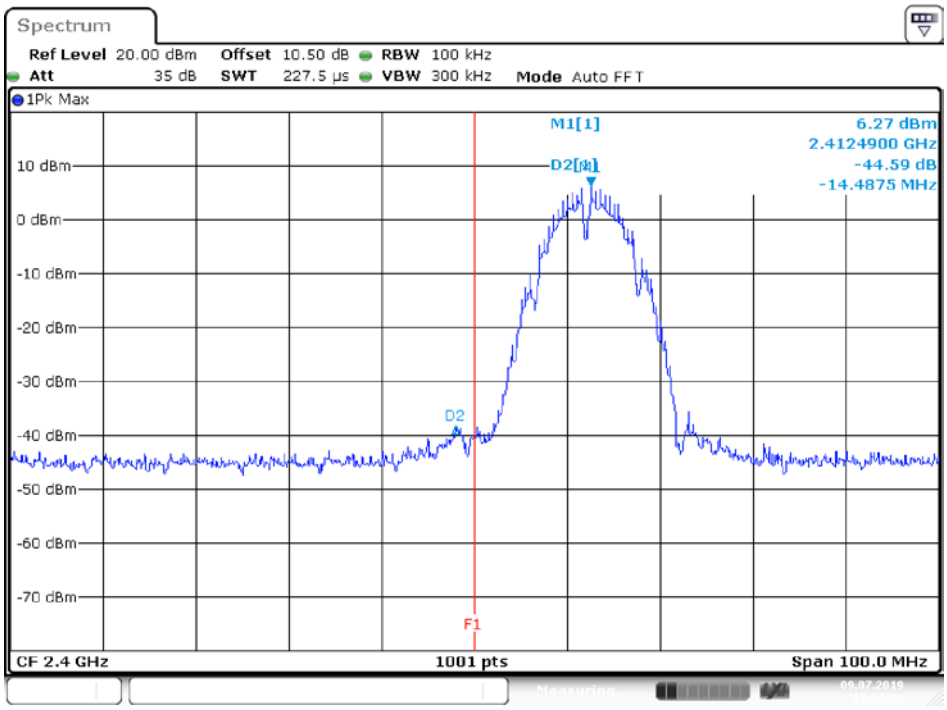
11.4 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
B Mode				
Low	2412	44.59	≥ 20	PASS
High	2462	48.61	≥ 20	PASS
G Mode				
Low	2412	36.29	≥ 20	PASS
High	2462	41.96	≥ 20	PASS
N20 Mode				
Low	2412	35.86	≥ 20	PASS
High	2462	42.44	≥ 20	PASS
N40 Mode				
Low	2422	33.56	≥ 20	PASS
High	2452	35.12	≥ 20	PASS

Please refer to the following plots

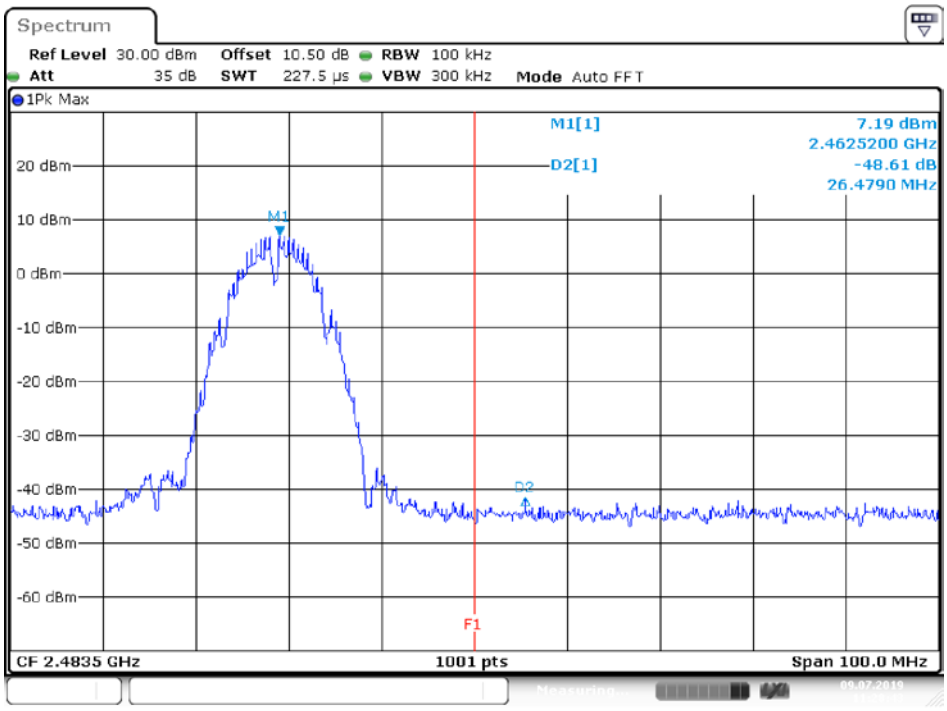
B Mode

Band Edge, Left Side



Date: 9.JUL.2019 11:23:35

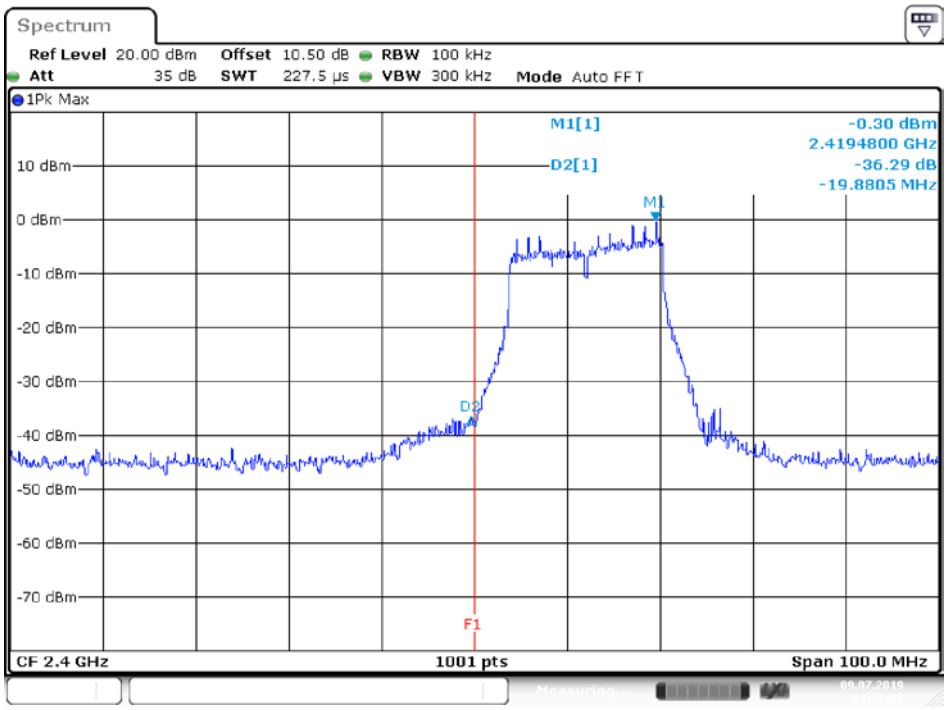
Band Edge, Right Side



Date: 9.JUL.2019 11:28:44

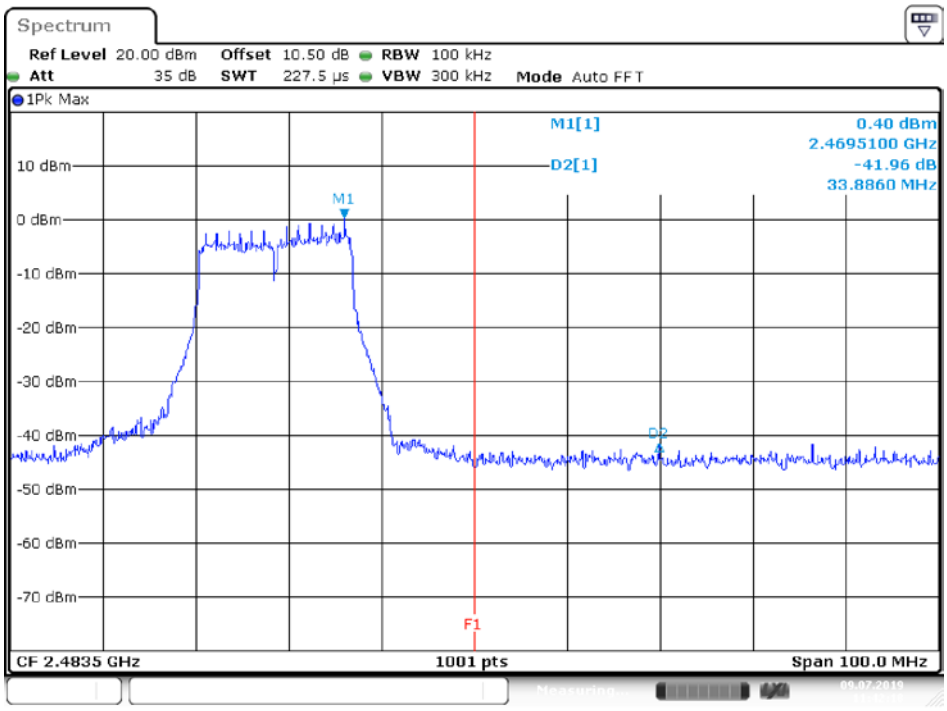
G Mode

Band Edge, Left Side



Date: 9.JUL.2019 11:37:06

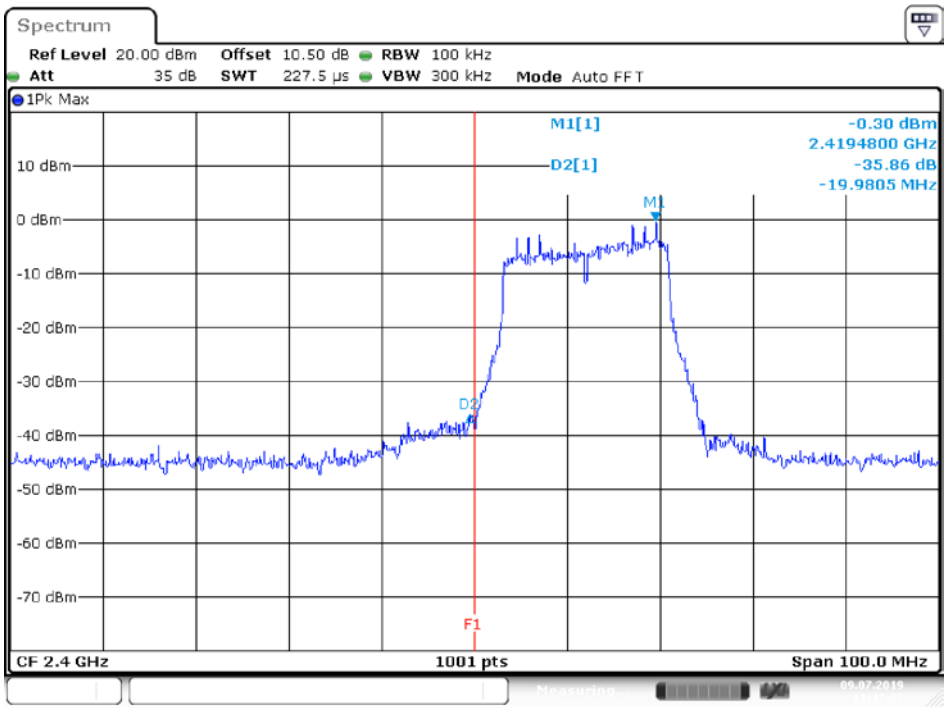
Band Edge, Right Side



Date: 9.JUL.2019 11:42:18

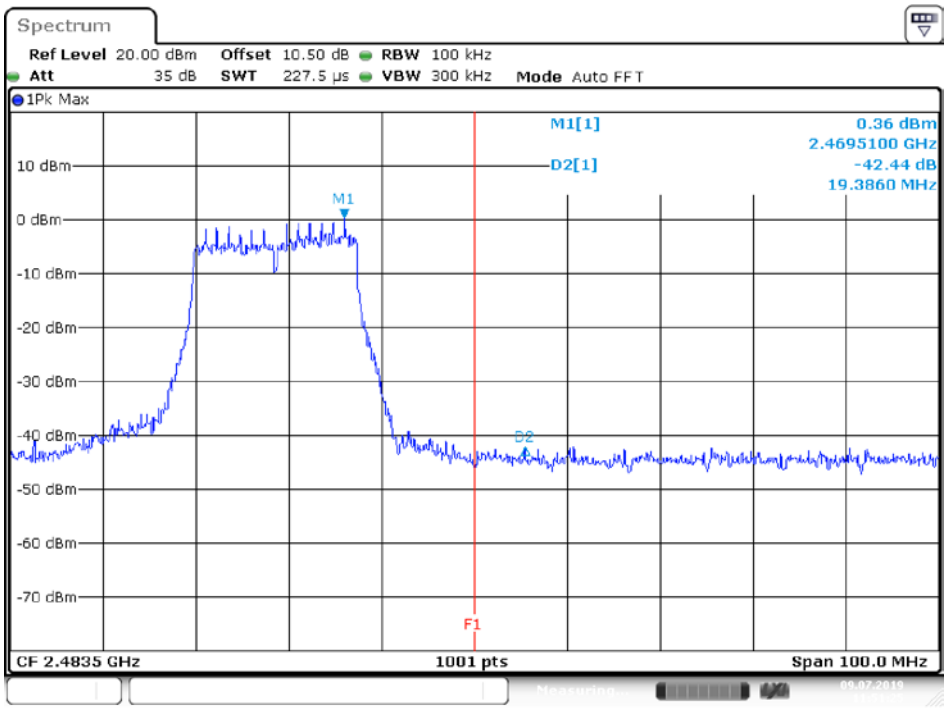
N20 Mode

Band Edge, Left Side



Date: 9.JUL.2019 11:47:27

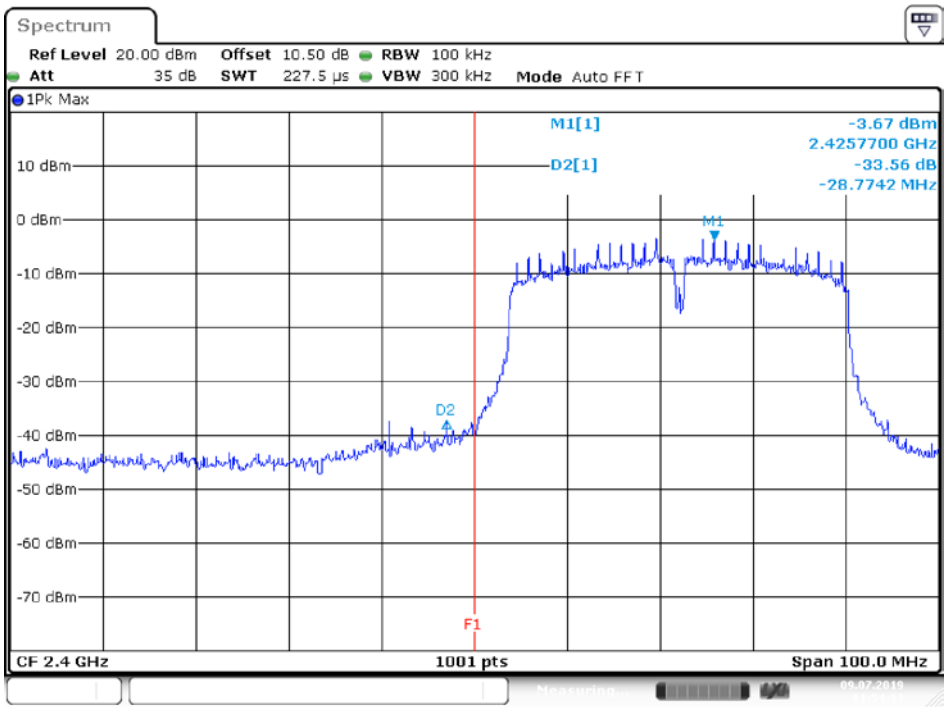
Band Edge, Right Side



Date: 9.JUL.2019 11:51:25

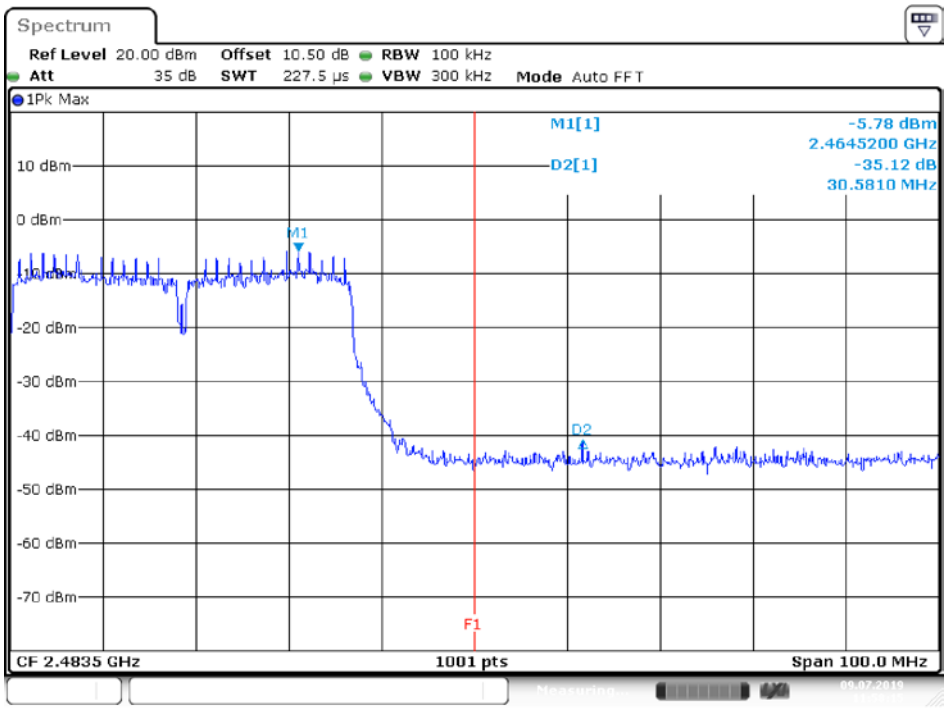
N40 Mode

Band Edge, Left Side



Date: 9.JUL.2019 11:54:14

Band Edge, Right Side



Date: 9.JUL.2019 11:58:15

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:	25.3 ℃
Relative Humidity:	42 %
ATM Pressure:	1010 hPa

The testing was performed by David Hsu on 2019-07-09.

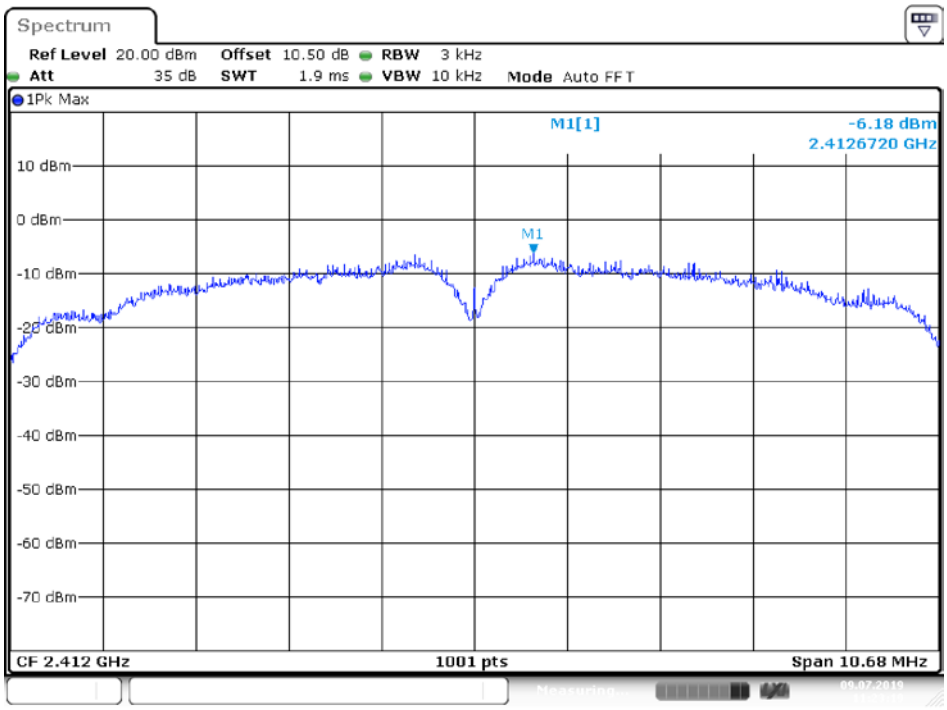
12.4 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
B Mode				
Low	2412	-6.18	8	PASS
Middle	2437	-5.33	8	PASS
High	2462	-5.21	8	PASS
G Mode				
Low	2412	-13.89	8	PASS
Middle	2437	-13.08	8	PASS
High	2462	-12.71	8	PASS
N20 Mode				
Low	2412	-13.28	8	PASS
Middle	2437	-13.01	8	PASS
High	2462	-12.8	8	PASS
N40 Mode				
Low	2422	-16.03	8	PASS
Middle	2437	-16.4	8	PASS
High	2452	-19.42	8	PASS

Please refer to the following plots

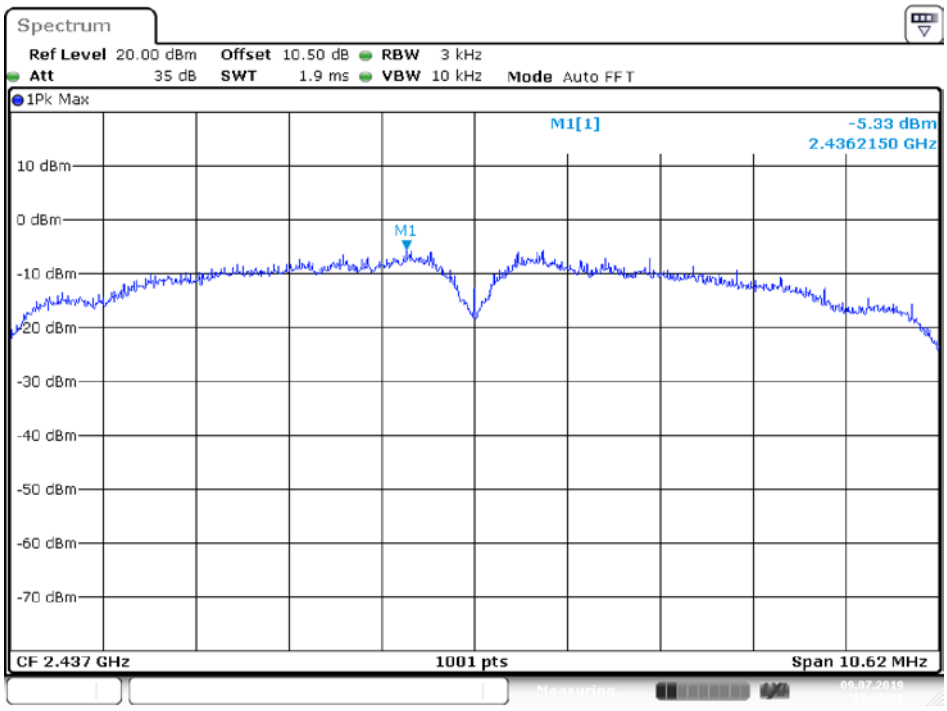
B Mode

Low Channel



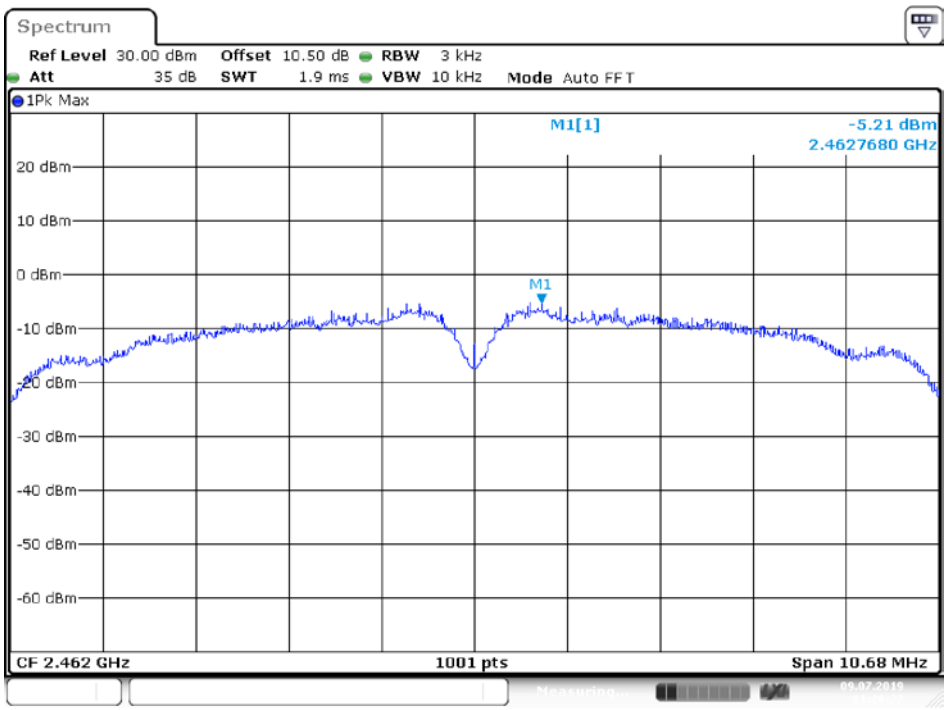
Date: 9.JUL.2019 11:23:19

Middle Channel



Date: 9.JUL.2019 11:25:29

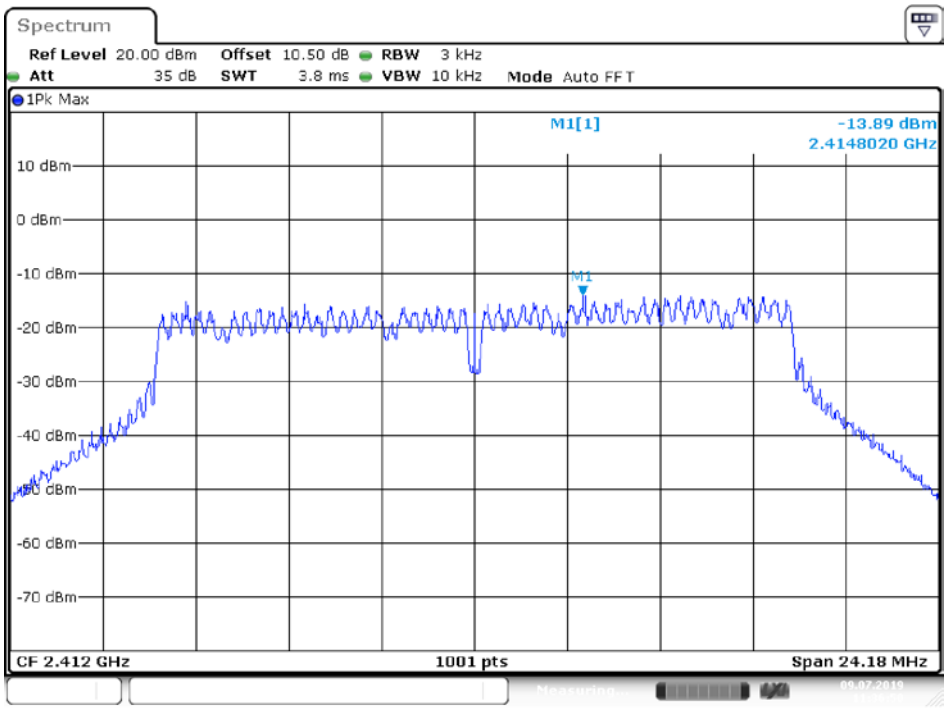
High Channel



Date: 9.JUL.2019 11:28:28

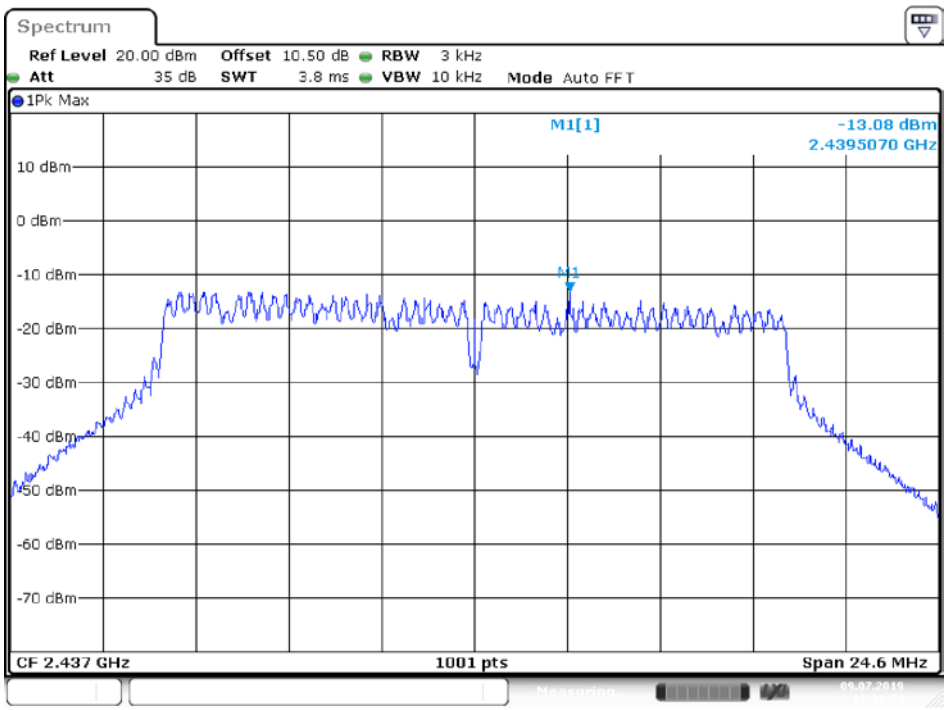
G Mode

Low Channel



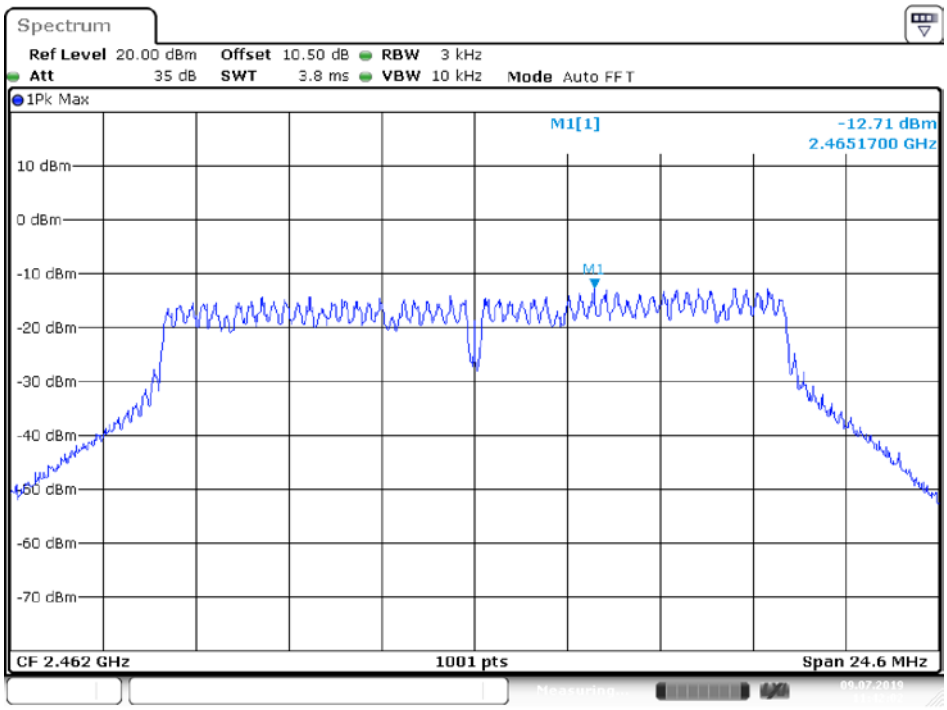
Date: 9.JUL.2019 11:36:50

Middle Channel



Date: 9.JUL.2019 11:39:54

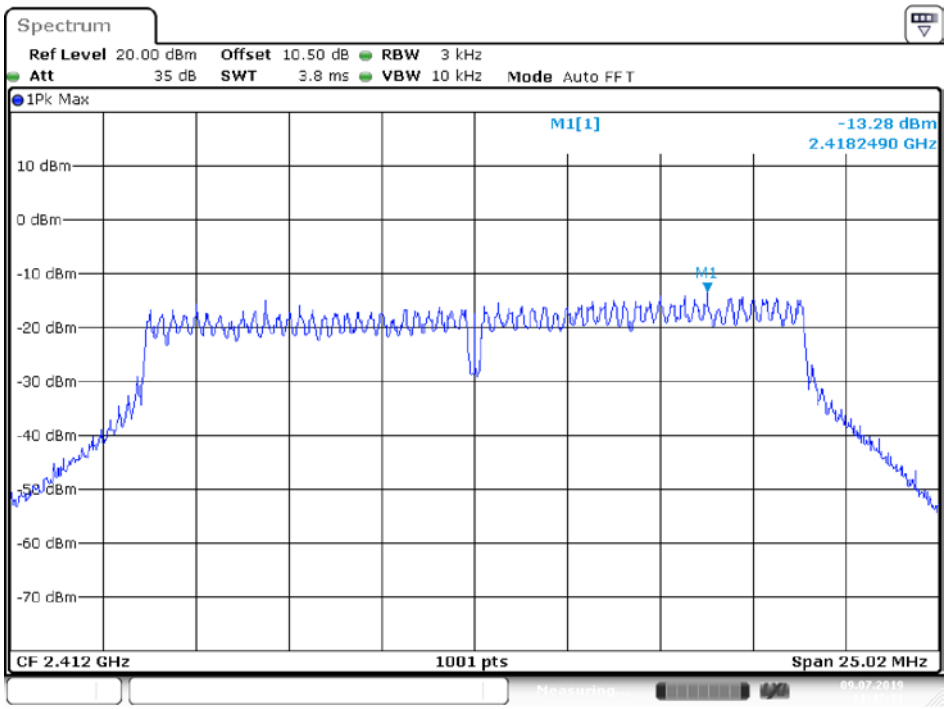
High Channel



Date: 9.JUL.2019 11:42:02

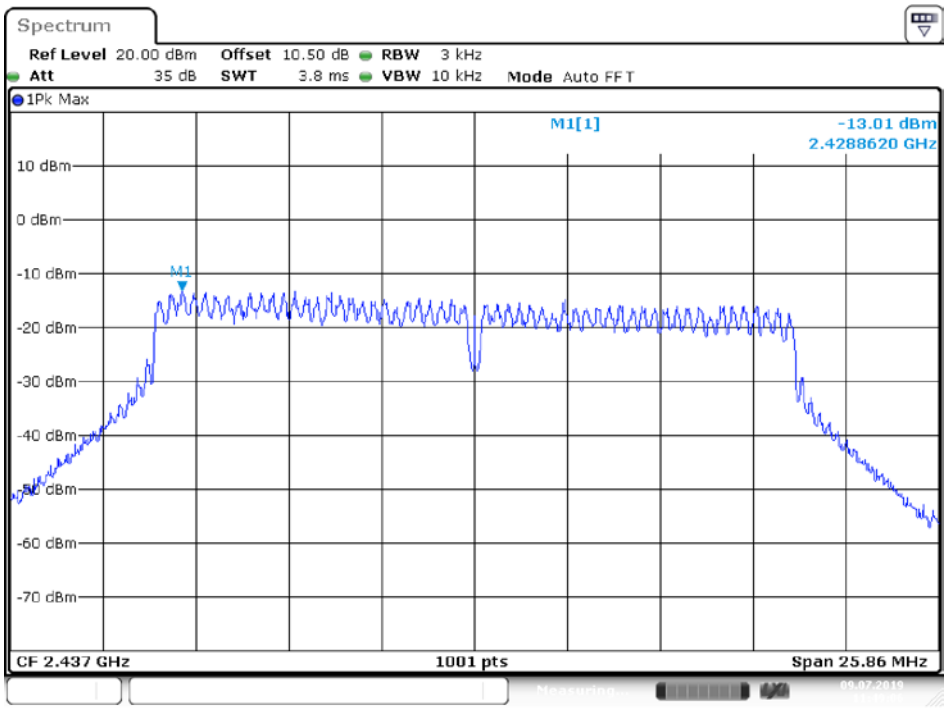
N20 Mode

Low Channel



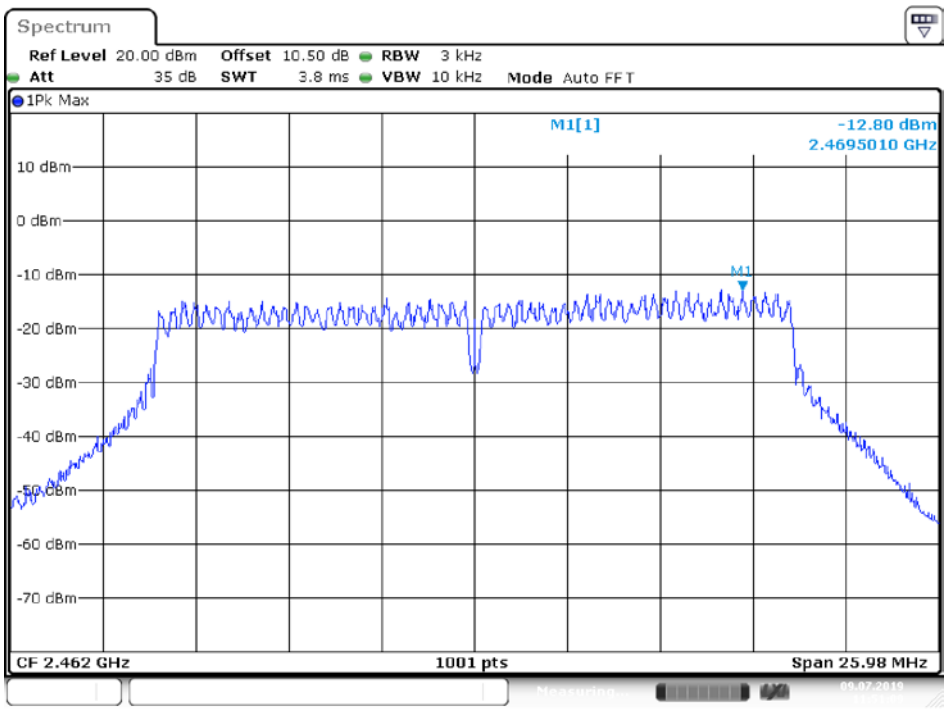
Date: 9.JUL.2019 11:47:11

Middle Channel



Date: 9.JUL.2019 11:49:06

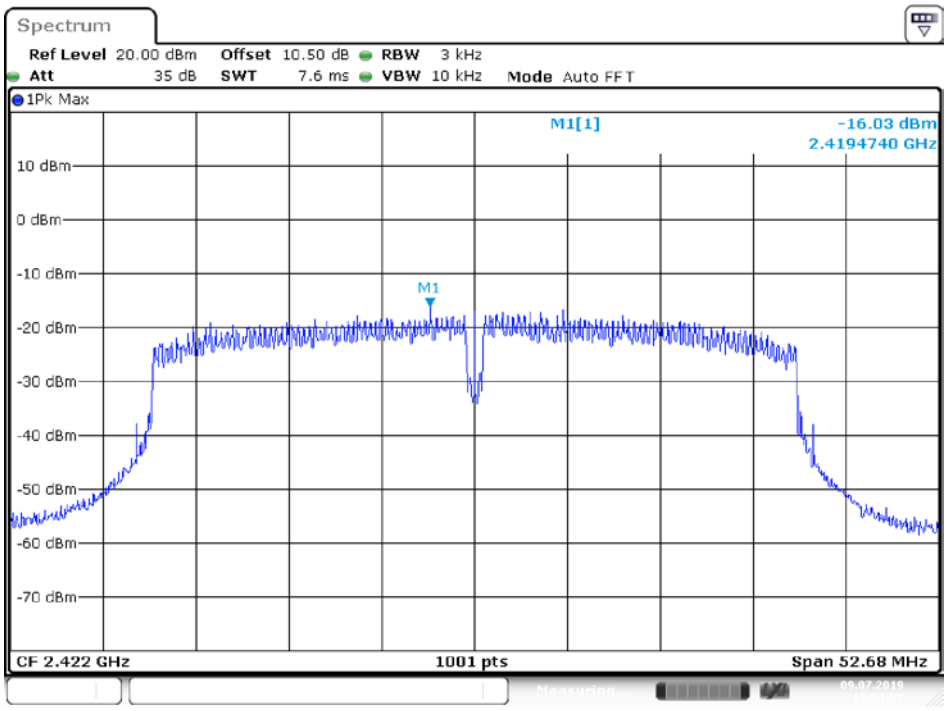
High Channel



Date: 9.JUL.2019 11:51:09

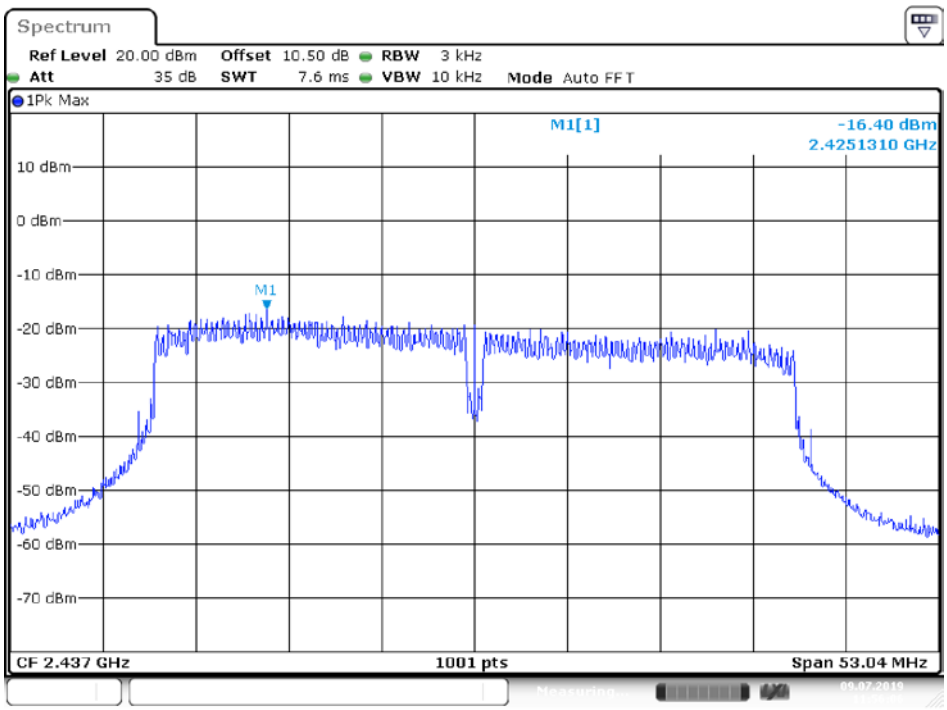
N40 Mode

Low Channel



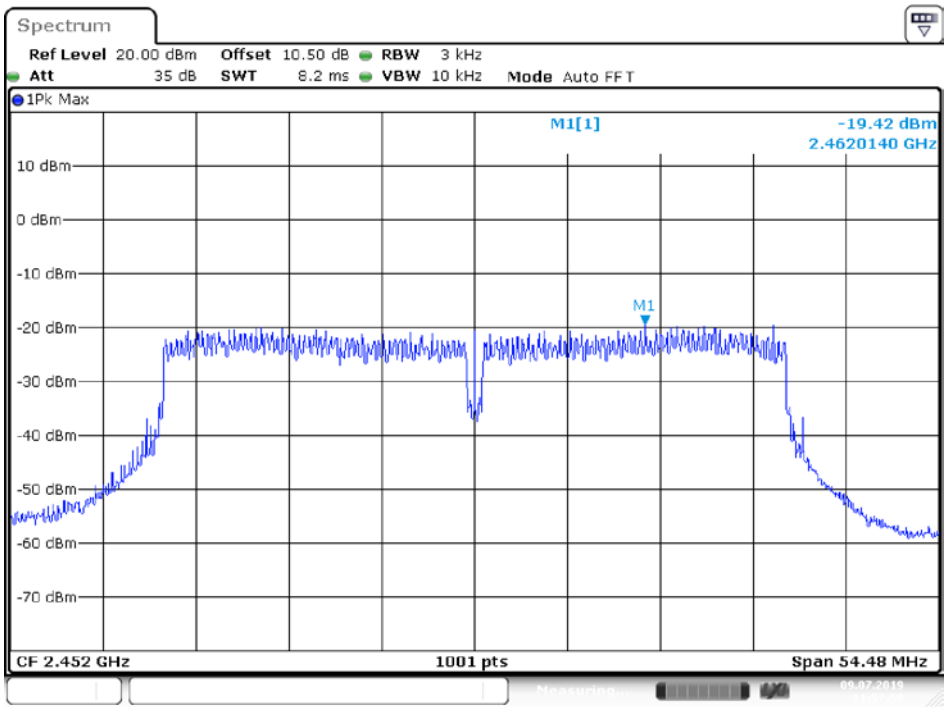
Date: 9.JUL.2019 11:53:58

Middle Channel



Date: 9.JUL.2019 11:56:06

High Channel



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