FCC Part 15.247

TEST REPORT

For

IEI Integration Corp.

No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)

FCC ID: RFHMODAT-550A

Report Type:	**Product Type:**
Original Report	PDA

Report Producer : **Jane Lee** Jane Lee

Report Number : **RLK181207001-00B**

Report Date : **2019-02-20**

Reviewed By: **Jerry Chang** Jerry J. Chang

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
1.0	RLK181207001	RLK181207001-00B	2019-02-20	Original Report	Jane Lee

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	IEI Integration Corp. No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)
Manufacturer	IEI Integration Corp. No. 29, Zhongxing Rd, Xizhi Dist., New Taipei City 221, Taiwan(R.O.C.)
Brand(Trade) Name	
Product (Equipment)	PDA
Main Model Name	MODAT-550A-OA53
Series Model Name	MODAT-550A-OA53-ET
Model Discrepancy	MODAT-550A-OA53 with Barcode Reader MODAT-550A-OA53-ET without Barcode Reader
Frequency Range	BLE 2402 ~ 2480 MHz IEEE 802.11b/g / IEEE 802.11n HT20 Mode: 2412 ~ 2462 MHz IEEE 802.11n HT40 Mode: 2422 ~ 2452 MHz
Transmit Power	BLE Mode: 0.62 dBm (0.001W) IEEE 802.11b Mode: 20.39 dBm (0.109W) IEEE 802.11g Mode: 23.07 dBm (0.203W) IEEE 802.11n HT20 Mode: 22.99 dBm (0.199W) IEEE 802.11n HT40 Mode: 22.86 dBm (0.193W)
Modulation Technique	BLE Mode: GFSK IEEE 802.11b: DSSS IEEE 802.11g: OFDM IEEE 802.11n HT20 Mode: OFDM IEEE 802.11n HT40 Mode: OFDM
Number of Channels	BLE Mode: 40 Channels IEEE 802.11b/g / IEEE 802.11n HT20 Mode: 11 Channels IEEE 802.11n HT40 Mode: 7 Channels
Antenna Specification	FPC Antenna / 0 dBi

Power Operation (Voltage Range)	☒ AC 120V/60Hz ☒ Adapter: *Brand Name: Asian Power Devices Inc* *Model: WA15IO5R* *I/P: 100-240V 50~60Hz 0.5A* *O/P: 5Vdc, 3A* ☐ By AC Power Cord ☐ PoE
	☐ DC Type ☒ Battery: *Rechargeable Li-polymer Battery* *Brand Name: QIAO XIN TECHOLOGY CO., LTD* *Model: IE-01S02A0* *3.7V ⎓ 4000mAh, 14.8W* ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System
Received Date	Dec 07, 2018
Date of Test	Dec 07, 2018 ~ Feb 19, 2019

**All measurement and test data in this report was gathered from production sample serial number: 181207001 (Assigned by BACL, Taiwan).*

1.2 Objective

This report is prepared on behalf of *IEI Integration 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)

FCC Part 15.407 NII submission with FCC ID: RFHMODAT-550A

FCC Part 15.225 DXX submission with FCC ID: RFHMODAT-550A

FCC Part 15.247 DSS submission with FCC ID: RFHMODAT-550A

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.

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 BT BLE mode, there are totally 40 channels.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402	21	2442
2	2404	--	--
3	2406	--	--
4	2408	38	2476
--	--	39	2478
20	2440	40	2480

For BLE Modes were tested with channel 1, 20 and 40.

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 used "EngineerMode".

Test Frequency		Low	Mid	High
Power Level Setting	BLE Mode	0	0	0
	B Mode	20.5	20.5	20.5
	G Mode	17.0	17.0	17.0
	N20 Mode	17.0	17.0	17.0
	N40 Mode	16.5	16.5	16.5

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 Test Mode

Full System (model: MODAT-550A-OA53) for all test item.

2.5 Support Equipment List and Details

Description	Manufacturer	Model Number	BSMI	FCC ID	S/N
Adapter	APD	WA-15105R	R43017	N/A	N/A
Base	iEi	iEi	N/A	N/A	N/A

2.6 External Cable List and Details

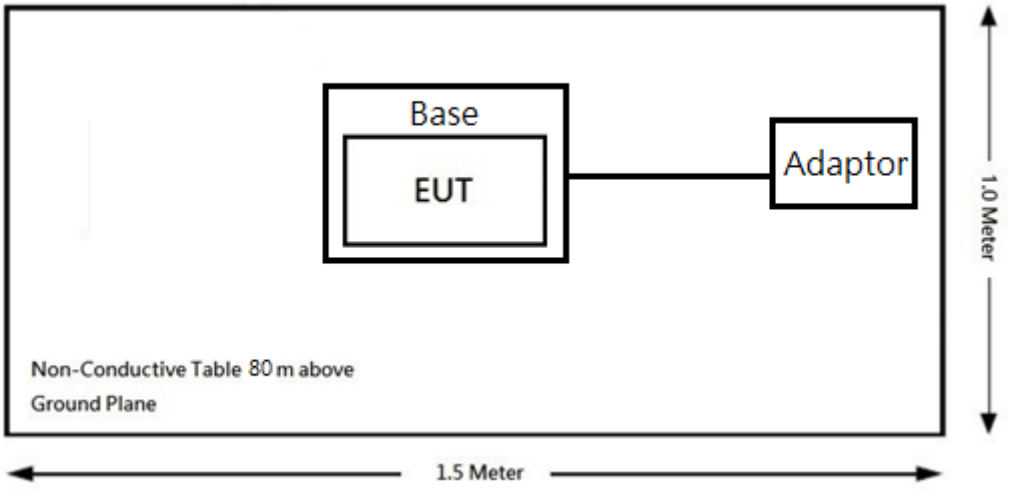
Cable Description	Length (m)	From	To
Micro USB Cable	1.5	Adapter	Base

2.7 Block Diagram of Test Setup

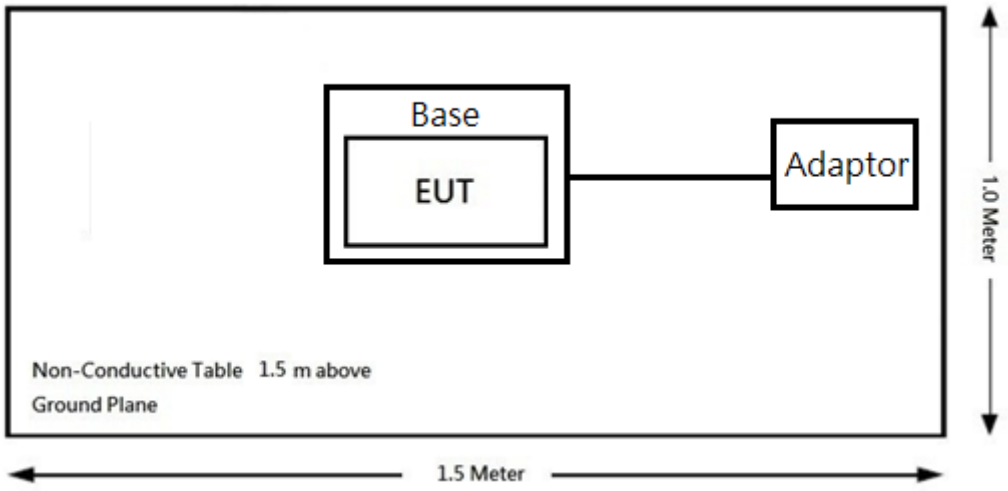
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

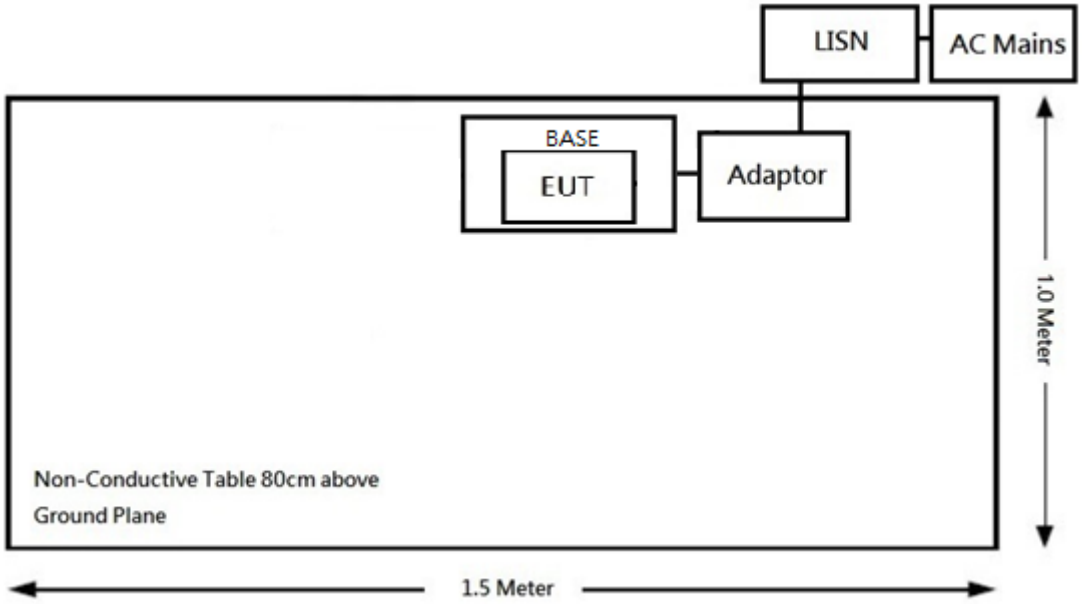
Below 1GHz:



Above 1GHz:



Conduction:


LISN
AC Mains
BASE
EUT
Adaptor
1.0 Meter
Non-Conductive Table 80cm above
Ground Plane
1.5 Meter

2.8 Duty Cycle

According to KDB 558074 D01 15.247 Meas Guidance v05 r01:

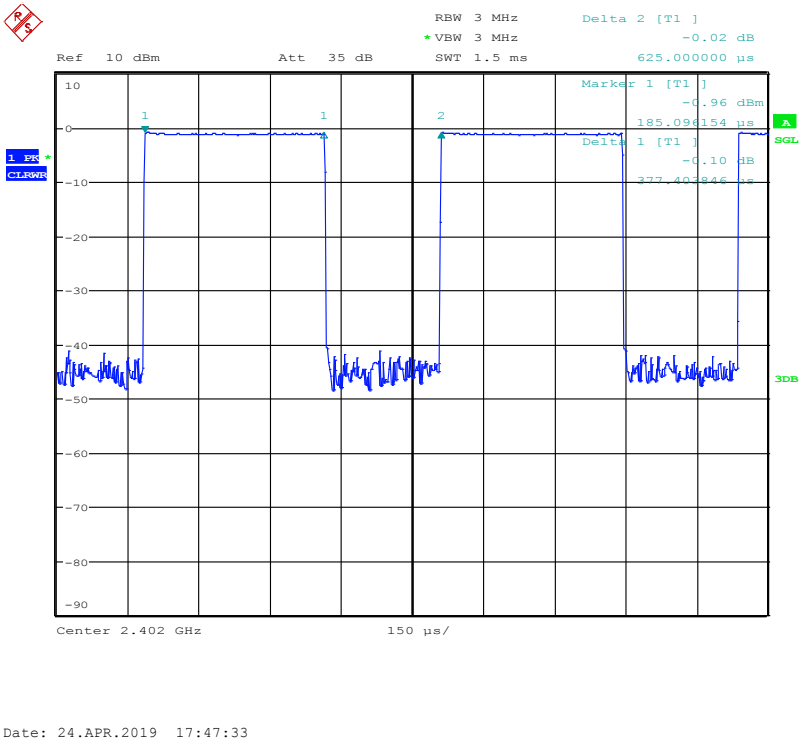
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximumpower transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
BLE	0.377	0.625	60	2.22
802.11b	20	20	100	0
802.11g	20	20	100	0
802.11n20	20	20	100	0
802.11n40	20	20	100	0

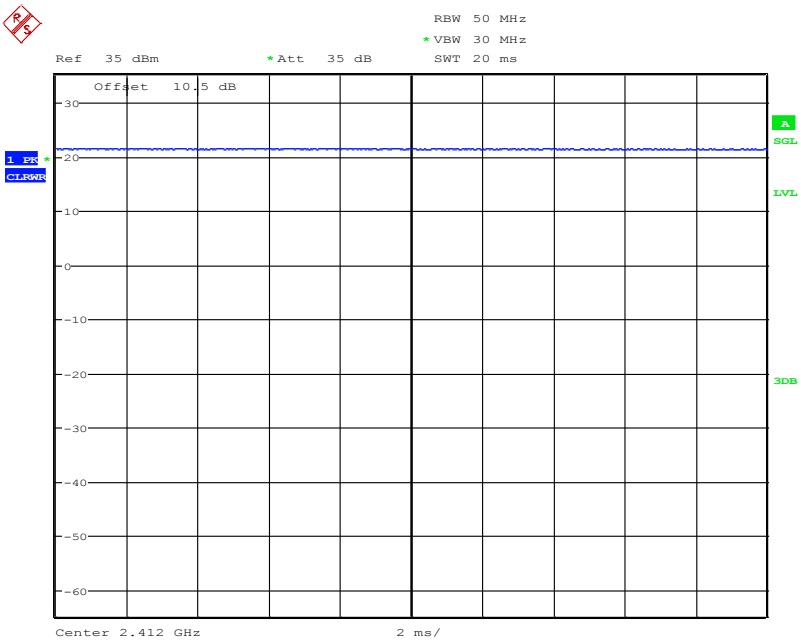
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

BLE Mode

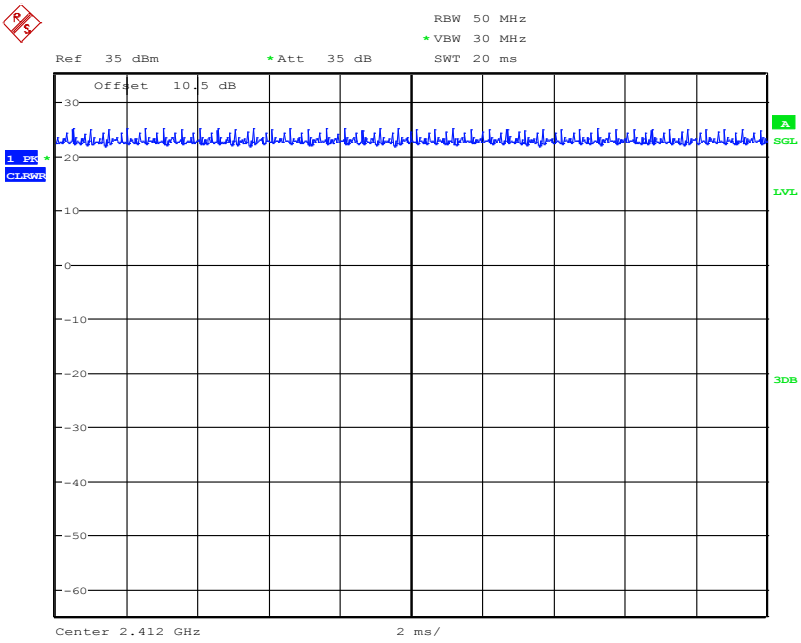


B Mode



Date: 9.JAN.2019 17:07:13

G Mode



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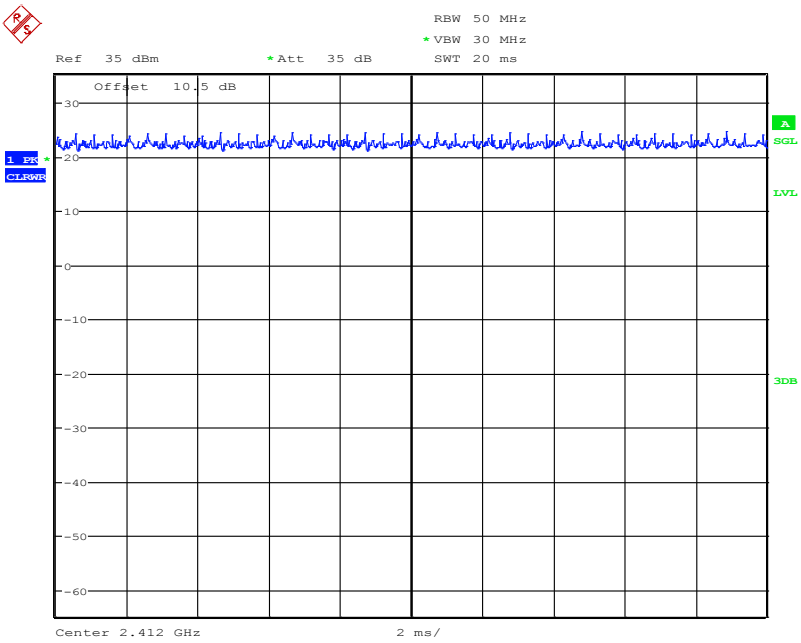
N20 Mode



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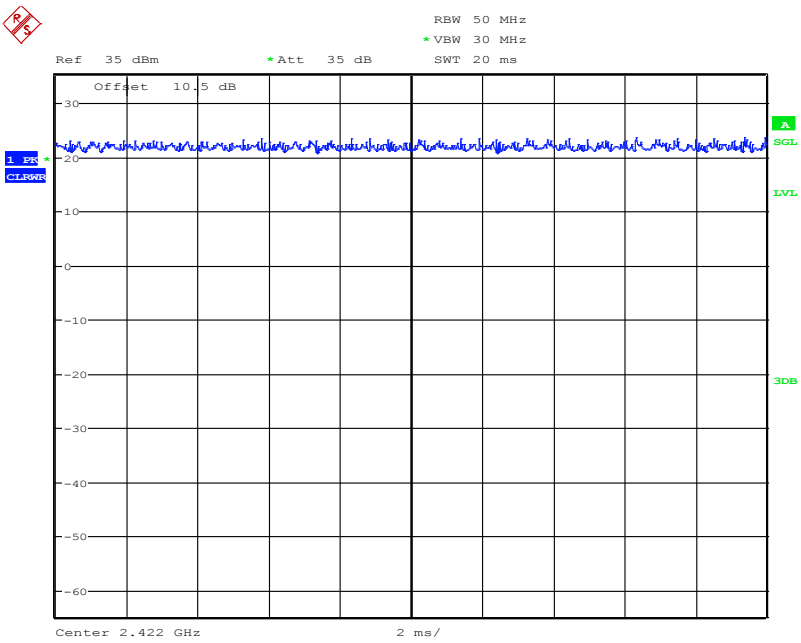
N40 Mode



Date: 9.JAN.2019 17:03:58

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	2018/02/22	2019/02/21
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)					
Active Loop Antenna	ETS-Lindgren	6502	00035796	2018/03/13	2019/03/12
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	3115	9311-4158	2018/04/20	2019/04/19
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	2018/02/13	2019/02/12
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	2018/03/05	2019/03/04
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	2018/07/09	2019/07/08

VSWR	BACL	966-A	N/A	2018/07/16	2019/07/15
Description	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due Date**
Conducted Room					
Spectrum Analyzer	Rohde & Schwarz	FSU26	200268	2018/05/04	2019/05/03
Cable	WOKEN	SFL402	S02-160323-07	2018/02/11	2019/02/10
Attenuator	MINI-CIRCUITS	BW-S10W5+	N/A	2018/03/08	2019/03/07
Power Sensor	KEYSIGHT	U2021XA	MY54080018	2018/03/07	2019/03/06

***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), § 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)] ·

[√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.: RLK181207001-23A

For BLE:

Frequency (MHz)	Tune-up Power		Evaluation Distance (mm)	SAR Exclusion Result	SAR Exclusion Limit
	(dBm)	(mW)			(1g SAR)
2402-2480	1	1.259	5	0.4007	3

Therefore, the stand-alone SAR evaluation for BLE is not necessary.

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 List and Details

Manufacturer	Type	Antenna Gain	Result
ICP Electronics Inc.	FPC Antenna	0 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

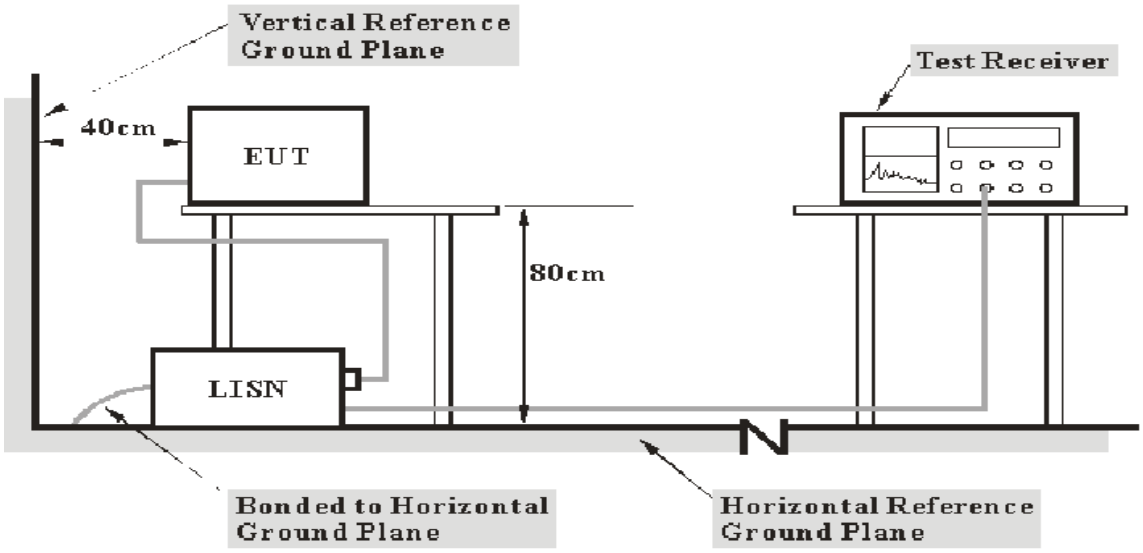
7.2 Measurement Uncertainty

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 Environmental Conditions

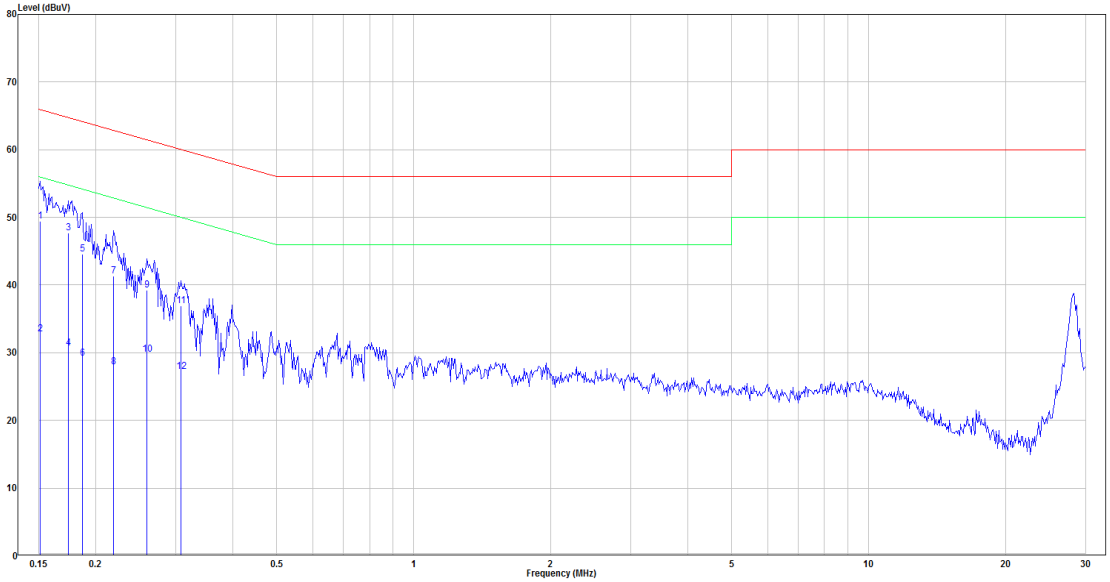
Temperature:	27.7 ℃
Relative Humidity:	68 %
ATM Pressure:	1009 hPa

The testing was performed by Tom Hsu on 2019-01-31.

7.7 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	0.151	29.97	19.45	49.42	65.96	-16.54	QP
2	0.151	13.28	19.45	32.73	55.96	-23.23	Average
3	0.174	28.21	19.46	47.67	64.76	-17.09	QP
4	0.174	11.26	19.46	30.72	54.76	-24.04	Average
5	0.187	25.07	19.46	44.53	64.18	-19.65	QP
6	0.187	9.77	19.46	29.23	54.18	-24.95	Average
7	0.219	21.88	19.46	41.34	62.85	-21.51	QP
8	0.219	8.42	19.46	27.88	52.85	-24.97	Average
9	0.260	19.73	19.46	39.19	61.45	-22.26	QP
10	0.260	10.25	19.46	29.71	51.45	-21.74	Average
11	0.307	17.44	19.47	36.91	60.04	-23.13	QP
12	0.307	7.73	19.47	27.20	50.04	-22.84	Average

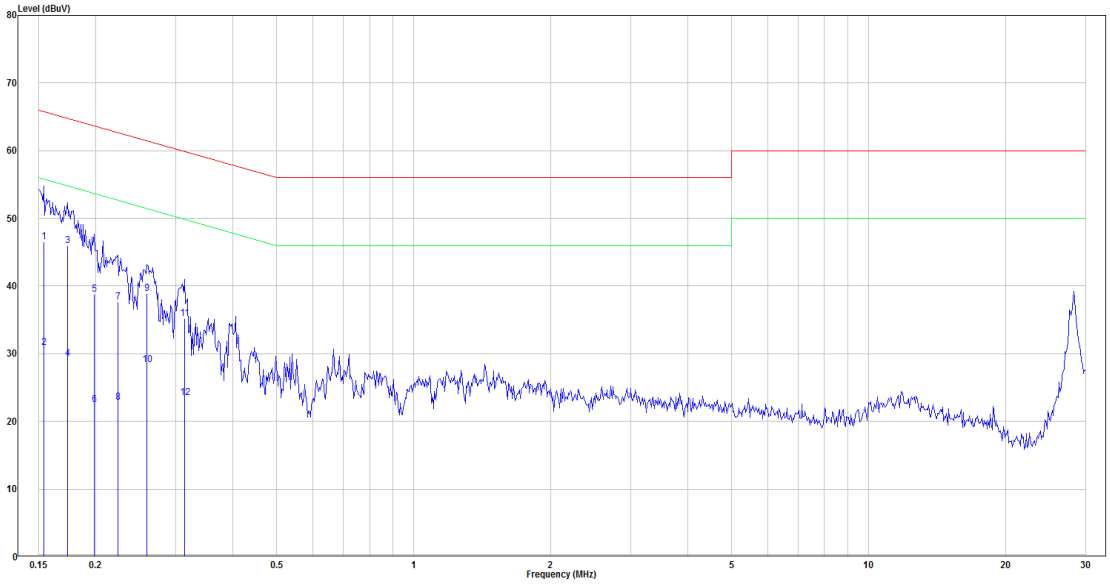
Note:

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	0.154	27.09	19.44	46.53	65.79	-19.26	QP
2	0.154	11.49	19.44	30.93	55.79	-24.86	Average
3	0.173	26.50	19.45	45.95	64.80	-18.85	QP
4	0.173	9.78	19.45	29.23	54.80	-25.57	Average
5	0.198	19.36	19.46	38.82	63.68	-24.86	QP
6	0.198	2.99	19.46	22.45	53.68	-31.23	Average
7	0.223	18.18	19.46	37.64	62.69	-25.05	QP
8	0.223	3.37	19.46	22.83	52.69	-29.86	Average
9	0.260	19.49	19.46	38.95	61.45	-22.50	QP
10	0.260	8.89	19.46	28.35	51.45	-23.10	Average
11	0.314	15.75	19.46	35.21	59.87	-24.66	QP
12	0.314	4.06	19.46	23.52	49.87	-26.35	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

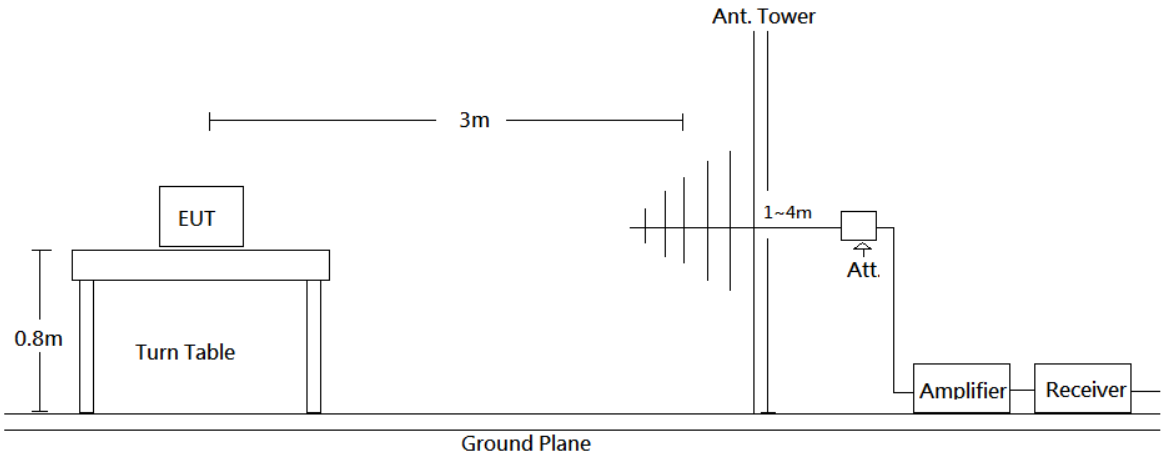
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency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

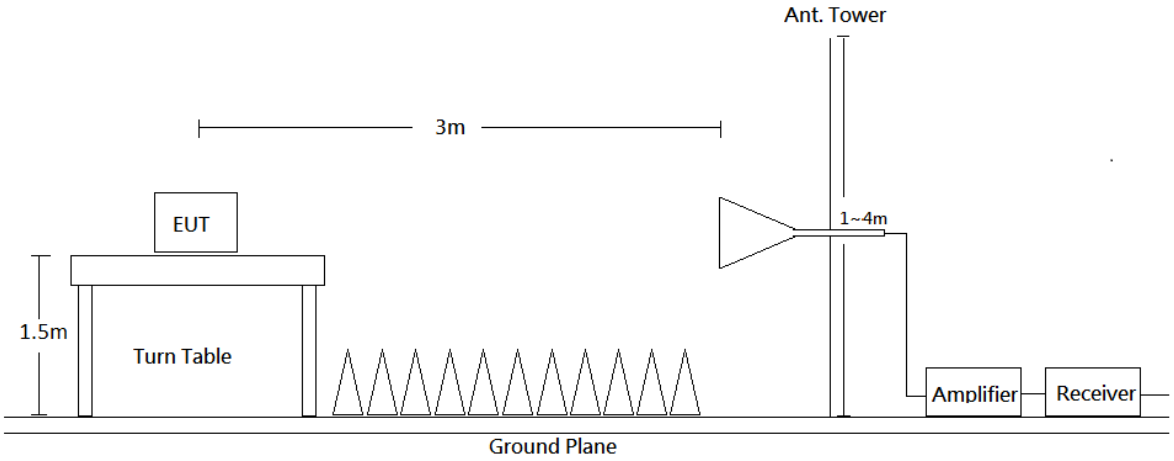
Frequency	Measurement uncertainty
30 MHz~200 MHz	3.75 dB (k=2, 95% level of confidence)
200 MHz~1 GHz	4.21 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	4.83 dB (k=2, 95% level of confidence)
6 GHz~18 GHz	5.18 dB (k=2, 95% level of confidence)
18 GHz~26 GHz	4.55 dB (k=2, 95% level of confidence)
26 GHz~40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

Radiation		Conducted	
Temperature:	25 ℃	**Temperature:**	26 ℃
Relative Humidity:	55 %	**Relative Humidity:**	59 %
ATM Pressure:	1010 hPa	**ATM Pressure:**	1010 hPa

The Radiation Spurious Emissions testing was performed by Tom Hsu on 2019-01-19.

The Conducted Spurious Emissions testing was performed by Tom Hsu on 2019-01-14.

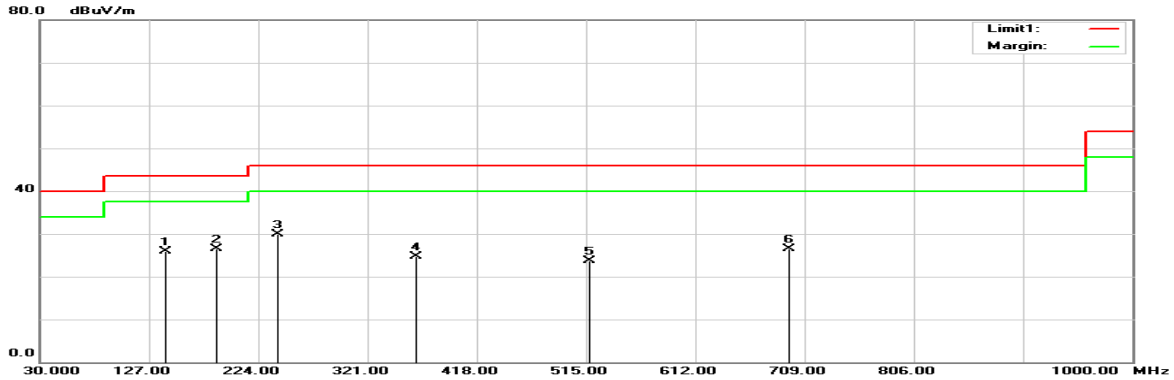
8.7 Test Results

Test Mode: Transmitting

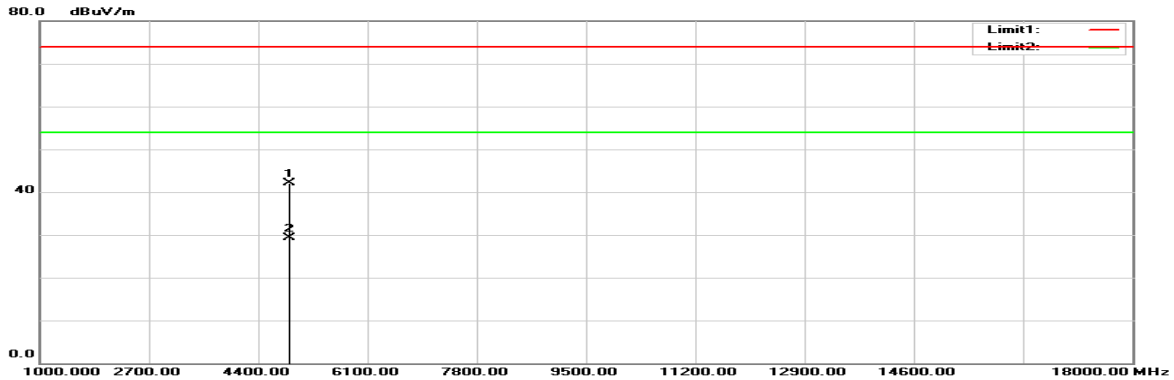
BLE Mode *(Pre-scan with three orthogonal axis, and worse case as Z axis.)*

Horizontal (*worst case is BLE mode Middle channel*)

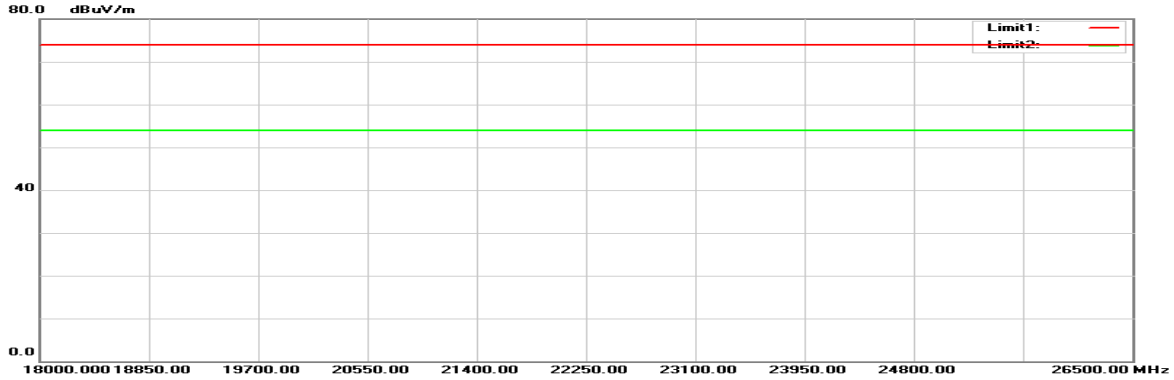
30MHz-1GHz:



1GHz-18GHz:

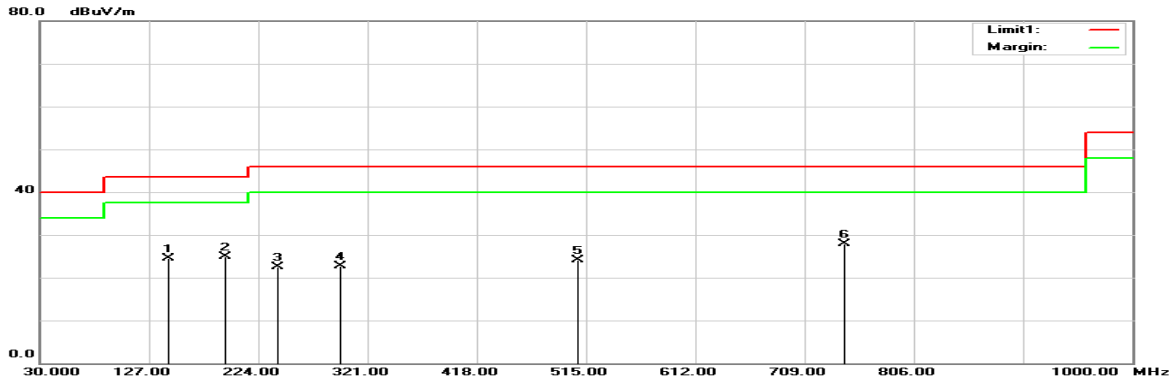


18GHz-26.5GHz:

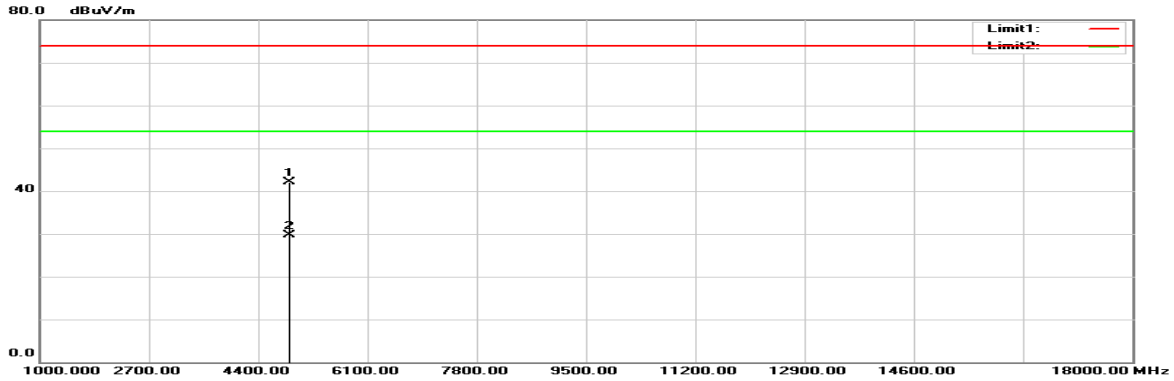


Vertical (*worst case is BLE mode Middle channel*)

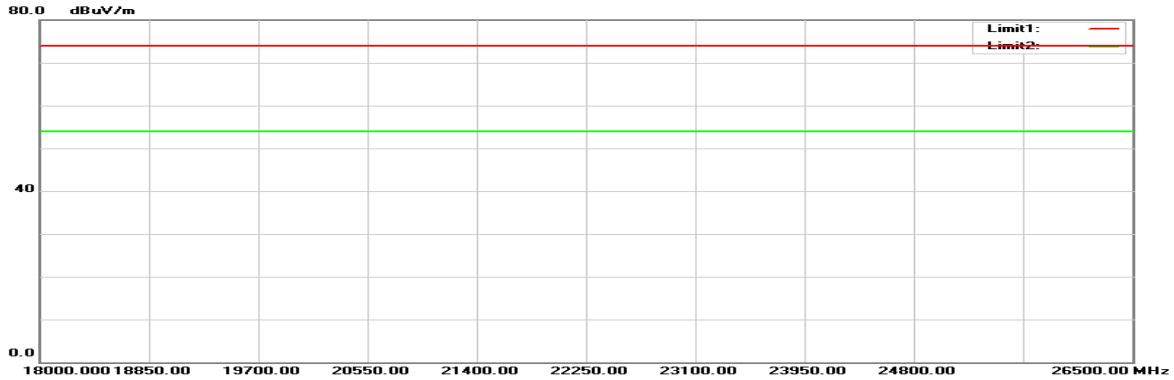
30MHz-1GHz:



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
141.5500	35.52	-9.58	25.94	43.50	-17.56	100	359	QP
187.1400	37.70	-11.16	26.54	43.50	-16.96	100	65	QP
241.4600	40.24	-10.36	29.88	46.00	-16.12	100	95	QP
363.6800	31.50	-6.70	24.80	46.00	-21.20	100	273	QP
517.9100	28.10	-4.33	23.77	46.00	-22.23	100	1	QP
695.4200	28.84	-2.38	26.46	46.00	-19.54	100	289	QP

Vertical

Frequency (MHz)	Reading (dBµV)	Correct Factor(dB/m)	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
144.4600	34.04	-9.62	24.42	43.50	-19.08	100	337	QP
194.9000	34.87	-9.91	24.96	43.50	-18.54	100	41	QP
241.4600	32.77	-10.36	22.41	46.00	-23.59	100	256	QP
296.7500	30.73	-8.02	22.71	46.00	-23.29	100	277	QP
507.2400	28.45	-4.41	24.04	46.00	-21.96	100	293	QP
744.8900	29.75	-1.94	27.81	46.00	-18.19	100	343	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
Low channel								
2390.000	60.23	-3.83	56.40	74.00	-17.60	100	59	peak
2390.000	47.54	-3.83	43.71	54.00	-10.29	100	59	AVG
2402.000	92.41	-3.79	88.62	N/A	N/A	100	266	peak
2402.000	91.54	-3.79	87.75	N/A	N/A	100	266	AVG
4804.000	39.36	1.59	40.95	74.00	-33.05	100	66	peak
4804.000	27.78	1.59	29.37	54.00	-24.63	100	66	AVG
Middle channel								
2440.000	94.66	-3.75	90.91	N/A	N/A	100	268	peak
2440.000	93.80	-3.75	90.05	N/A	N/A	100	268	AVG
4880.000	40.12	2.08	42.20	74.00	-31.80	100	142	peak
4880.000	27.32	2.08	29.40	54.00	-24.60	100	142	AVG
High channel								
2480.000	93.36	-3.54	89.82	N/A	N/A	100	270	peak
2480.000	92.67	-3.54	89.13	N/A	N/A	100	270	AVG
2483.500	59.41	-3.52	55.89	74.00	-18.11	100	331	peak
2483.500	47.09	-3.52	43.57	54.00	-10.43	100	331	AVG
4960.000	40.86	2.26	43.12	74.00	-30.88	100	128	peak
4960.000	27.11	2.26	29.37	54.00	-24.63	100	128	AVG

Vertical

Frequency (MHz)	Reading (dBμV)	Correct Factor(dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
Low channel								
2390.000	58.79	-3.83	54.96	74.00	-19.04	100	18	peak
2390.000	47.61	-3.83	43.78	54.00	-10.22	100	18	AVG
2402.000	87.72	-3.79	83.93	N/A	N/A	100	269	peak
2402.000	86.85	-3.79	83.06	N/A	N/A	100	269	AVG
4804.000	40.21	1.59	41.80	74.00	-32.20	100	346	peak
4804.000	27.90	1.59	29.49	54.00	-24.51	100	346	AVG
Middle channel								
2440.000	92.09	-3.75	88.34	N/A	N/A	100	275	peak
2440.000	91.40	-3.75	87.65	N/A	N/A	100	275	AVG
4880.000	40.01	2.08	42.09	74.00	-31.91	100	354	peak
4880.000	27.63	2.08	29.71	54.00	-24.29	100	354	AVG
High channel								
2480.000	91.59	-3.54	88.05	N/A	N/A	100	348	peak
2480.000	90.93	-3.54	87.39	N/A	N/A	100	348	AVG
2483.500	59.44	-3.52	55.92	74.00	-18.08	100	130	peak
2483.500	48.55	-3.52	45.03	54.00	-8.97	100	130	AVG
4960.000	38.73	2.26	40.99	74.00	-33.01	100	310	peak
4960.000	27.26	2.26	29.52	54.00	-24.48	100	310	AVG

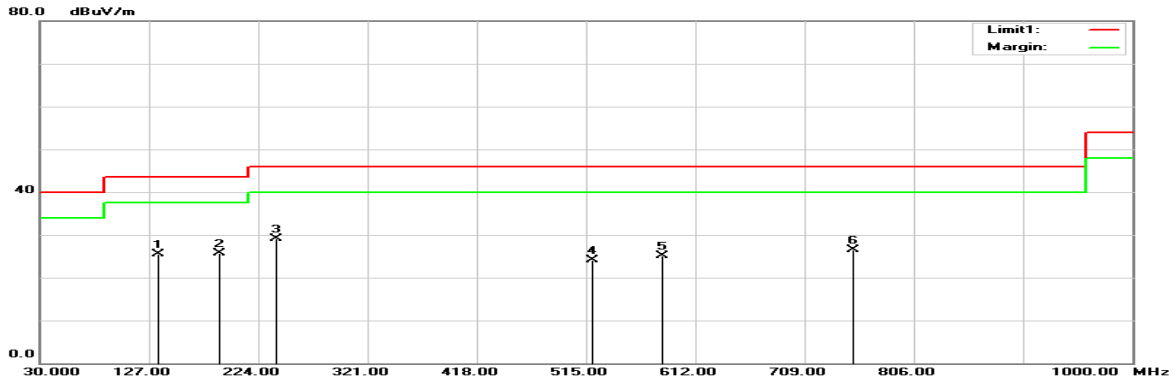
Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Test Mode: Transmitting

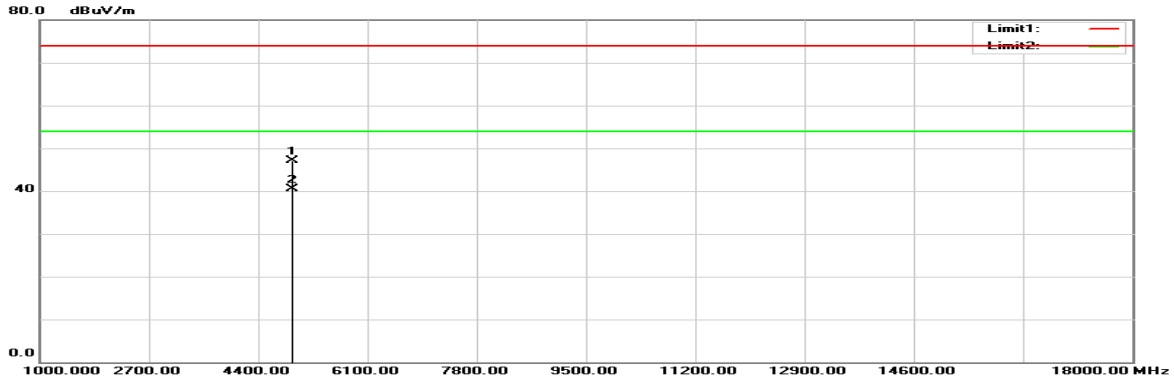
(Pre-scan with three orthogonal axis, and worse case as Z axis.)

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

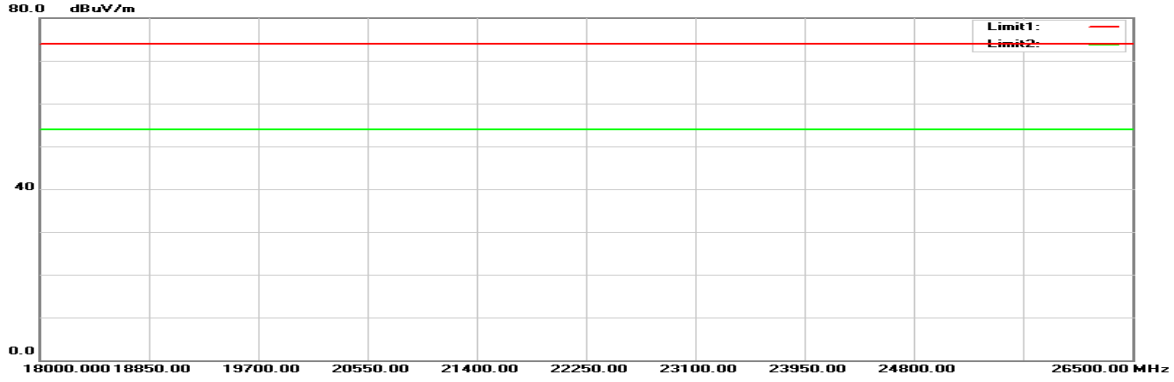
30MHz-1GHz:



1GHz-18GHz:

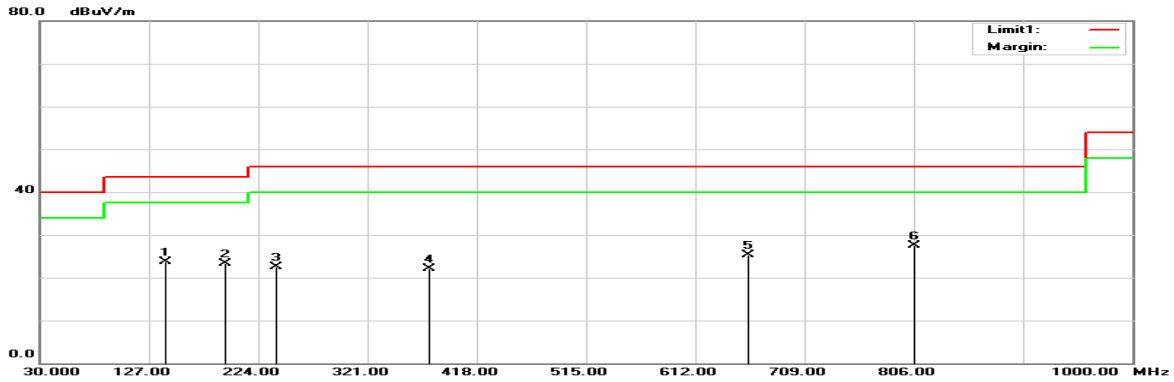


18GHz-26.5GHz:

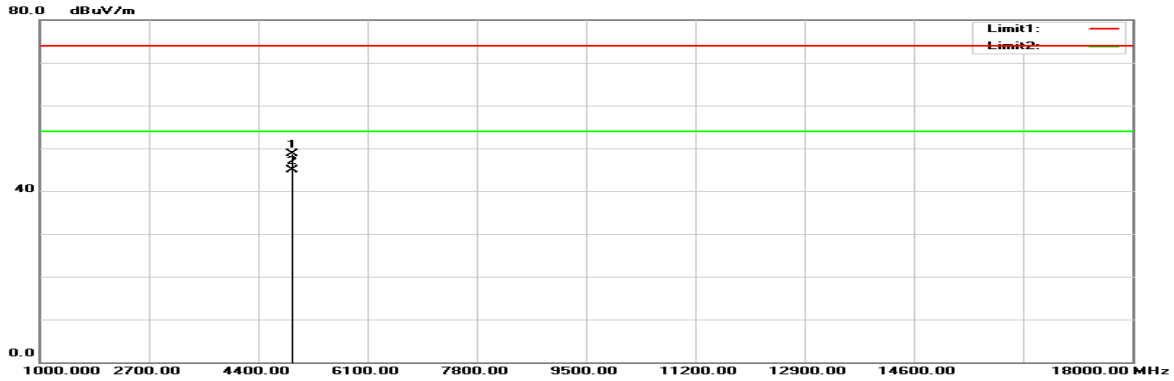


Vertical (*worst case is Wi-Fi B mode High channel*)

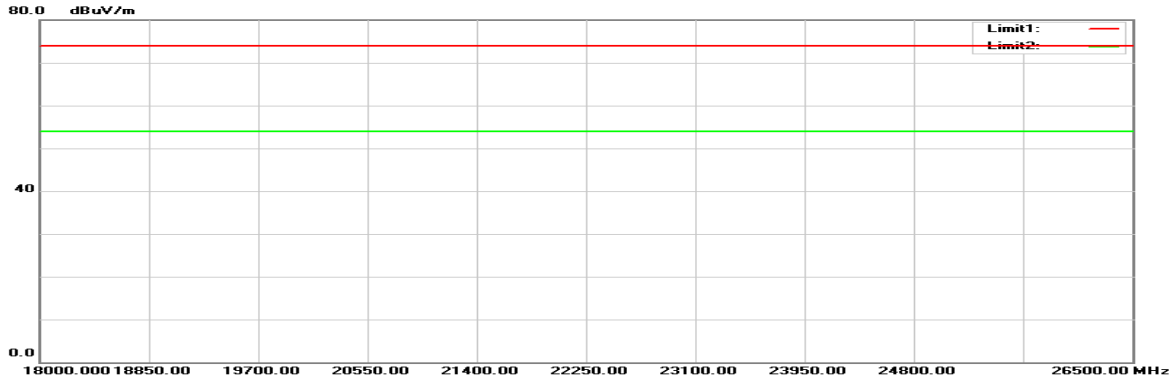
30MHz-1GHz:



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								
135.7300	34.83	-9.42	25.41	43.50	-18.09	100	129	QP
190.0500	36.64	-11.00	25.64	43.50	-17.86	100	65	QP
240.4900	39.51	-10.38	29.13	46.00	-16.87	100	112	QP
520.8200	28.40	-4.30	24.10	46.00	-21.90	100	193	QP
582.9000	28.88	-3.69	25.19	46.00	-20.81	100	359	QP
751.6800	28.30	-1.84	26.46	46.00	-19.54	100	357	QP
G Mode								
136.7000	34.59	-9.45	25.14	43.50	-18.36	100	1	QP
189.0800	36.79	-11.06	25.73	43.50	-17.77	100	57	QP
241.4600	41.01	-10.36	30.65	46.00	-15.35	100	94	QP
551.8600	28.12	-4.04	24.08	46.00	-21.92	100	219	QP
770.1100	28.02	-1.32	26.70	46.00	-19.30	100	153	QP
866.1400	27.97	0.25	28.22	46.00	-17.78	100	284	QP
N20 Mode								
120.2100	34.84	-9.31	25.53	43.50	-17.97	100	137	QP
192.9600	36.08	-10.34	25.74	43.50	-17.76	100	57	QP
241.4600	40.15	-10.36	29.79	46.00	-16.21	100	10	QP
374.3500	29.22	-6.49	22.73	46.00	-23.27	100	172	QP
575.1400	28.48	-3.79	24.69	46.00	-21.31	100	338	QP
760.4100	28.00	-1.59	26.41	46.00	-19.59	100	1	QP
N40 Mode								
138.6400	34.78	-9.51	25.27	43.50	-18.23	100	349	QP
191.9900	36.73	-10.56	26.17	43.50	-17.33	100	70	QP
242.4300	39.56	-10.35	29.21	46.00	-16.79	100	1	QP
358.8300	29.81	-6.77	23.04	46.00	-22.96	100	196	QP
552.8300	28.52	-4.02	24.50	46.00	-21.50	100	346	QP
666.3200	29.29	-2.72	26.57	46.00	-19.43	100	343	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								
141.5500	33.77	-10.08	23.69	43.50	-19.81	100	360	QP
194.9000	33.87	-10.52	23.35	43.50	-20.15	100	42	QP
239.5200	33.57	-11.02	22.55	46.00	-23.45	100	256	QP
376.2900	29.36	-7.18	22.18	46.00	-23.82	100	82	QP
659.5300	28.98	-3.76	25.22	46.00	-20.78	100	3	QP
806.0000	28.97	-1.42	27.55	46.00	-18.45	100	59	QP
G Mode								
141.5500	32.99	-10.08	22.91	43.50	-20.59	100	359	QP
199.7500	33.26	-9.41	23.85	43.50	-19.65	100	45	QP
231.7600	32.76	-11.19	21.57	46.00	-24.43	100	287	QP
313.2400	29.71	-8.41	21.30	46.00	-24.70	100	255	QP
477.1700	28.21	-5.68	22.53	46.00	-23.47	100	259	QP
740.0400	28.60	-2.92	25.68	46.00	-20.32	100	9	QP
N20 Mode								
141.5500	33.79	-10.08	23.71	43.50	-19.79	100	360	QP
195.8700	34.09	-10.30	23.79	43.50	-19.71	100	42	QP
235.6400	33.27	-11.11	22.16	46.00	-23.84	100	266	QP
309.3600	30.10	-8.49	21.61	46.00	-24.39	100	253	QP
538.2800	28.20	-5.09	23.11	46.00	-22.89	100	357	QP
744.8900	28.53	-2.88	25.65	46.00	-20.35	100	225	QP
N40 Mode								
139.6100	33.18	-10.04	23.14	43.50	-20.36	100	355	QP
198.7800	33.05	-9.64	23.41	43.50	-20.09	100	57	QP
230.7900	33.01	-11.22	21.79	46.00	-24.21	100	273	QP
312.2700	29.96	-8.43	21.53	46.00	-24.47	100	138	QP
353.0100	29.17	-7.61	21.56	46.00	-24.44	100	44	QP
724.5200	28.99	-3.07	25.92	46.00	-20.08	100	2	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	60.57	-3.83	56.74	74.00	-17.26	100	151	peak
2390.000	46.97	-3.83	43.14	54.00	-10.86	100	151	AVG
2412.000	106.27	-3.78	102.49	N/A	N/A	100	278	peak
2412.000	102.89	-3.78	99.11	N/A	N/A	100	278	AVG
4824.000	45.57	1.74	47.31	74.00	-26.69	100	95	peak
4824.000	37.61	1.74	39.35	54.00	-14.65	100	95	AVG
B Mode, Middle channel								
2437.000	107.21	-3.76	103.45	N/A	N/A	100	271	peak
2437.000	103.82	-3.76	100.06	N/A	N/A	100	271	AVG
4874.000	43.81	2.05	45.86	74.00	-28.14	100	320	peak
4874.000	36.11	2.05	38.16	54.00	-15.84	100	320	AVG
B Mode, High channel								
2462.000	106.98	-3.67	103.31	N/A	N/A	100	287	peak
2462.000	103.20	-3.67	99.53	N/A	N/A	100	287	AVG
2483.500	60.70	-3.52	57.18	74.00	-16.82	100	46	peak
2483.500	47.01	-3.52	43.49	54.00	-10.51	100	46	AVG
4924.000	44.96	2.21	47.17	74.00	-26.83	100	326	peak
4924.000	38.25	2.21	40.46	54.00	-13.54	100	326	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	60.36	-3.83	56.53	74.00	-17.47	100	344	peak
2390.000	46.59	-3.83	42.76	54.00	-11.24	100	344	AVG
2412.000	102.00	-3.78	98.22	N/A	N/A	100	322	peak
2412.000	98.65	-3.78	94.87	N/A	N/A	100	322	AVG
4824.000	47.31	1.74	49.05	74.00	-24.95	100	51	peak
4824.000	41.64	1.74	43.38	54.00	-10.62	100	51	AVG
B Mode, Middle channel								
2437.000	105.59	-3.76	101.83	N/A	N/A	100	285	peak
2437.000	101.79	-3.76	98.03	N/A	N/A	100	285	AVG
4874.000	45.83	2.05	47.88	74.00	-26.12	100	55	peak
4874.000	40.55	2.05	42.60	54.00	-11.40	100	55	AVG
B Mode, High channel								
2462.000	104.82	-3.67	101.15	N/A	N/A	100	325	peak
2462.000	101.05	-3.67	97.38	N/A	N/A	100	325	AVG
2483.500	60.93	-3.52	57.41	74.00	-16.59	100	23	peak
2483.500	46.93	-3.52	43.41	54.00	-10.59	100	23	AVG
4924.000	46.44	2.21	48.65	74.00	-25.35	100	51	peak
4924.000	42.78	2.21	44.99	54.00	-9.01	100	51	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	65.21	-3.83	61.38	74.00	-12.62	100	268	peak
2390.000	48.88	-3.83	45.05	54.00	-8.95	100	268	AVG
2412.000	105.97	-3.78	102.19	N/A	N/A	100	274	peak
2412.000	96.40	-3.78	92.62	N/A	N/A	100	274	AVG
4824.000	41.81	1.74	43.55	74.00	-30.45	100	323	peak
4824.000	28.29	1.74	30.03	54.00	-23.97	100	323	AVG
G Mode, Middle channel								
2437.000	106.26	-3.76	102.50	N/A	N/A	100	273	peak
2437.000	96.53	-3.76	92.77	N/A	N/A	100	273	AVG
4874.000	41.68	2.05	43.73	74.00	-30.27	100	360	peak
4874.000	27.64	2.05	29.69	54.00	-24.31	100	360	AVG
G Mode, High channel								
2462.000	105.81	-3.67	102.14	N/A	N/A	100	288	peak
2462.000	95.99	-3.67	92.32	N/A	N/A	100	288	AVG
2483.500	63.66	-3.52	60.14	74.00	-13.86	100	291	peak
2483.500	47.88	-3.52	44.36	54.00	-9.64	100	291	AVG
4924.000	40.38	2.21	42.59	74.00	-31.41	100	231	peak
4924.000	27.38	2.21	29.59	54.00	-24.41	100	231	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	61.87	-3.83	58.04	74.00	-15.96	100	247	peak
2390.000	47.36	-3.83	43.53	54.00	-10.47	100	247	AVG
2412.000	102.35	-3.78	98.57	N/A	N/A	100	322	peak
2412.000	92.80	-3.78	89.02	N/A	N/A	100	322	AVG
4824.000	43.71	1.74	45.45	74.00	-28.55	100	298	peak
4824.000	29.37	1.74	31.11	54.00	-22.89	100	298	AVG
G Mode, Middle channel								
2437.000	104.53	-3.76	100.77	N/A	N/A	100	283	peak
2437.000	95.06	-3.76	91.30	N/A	N/A	100	283	AVG
4874.000	43.29	2.05	45.34	74.00	-28.66	100	297	peak
4874.000	28.49	2.05	30.54	54.00	-23.46	100	297	AVG
G Mode, High channel								
2462.000	104.03	-3.67	100.36	N/A	N/A	100	275	peak
2462.000	94.21	-3.67	90.54	N/A	N/A	100	275	AVG
2483.500	64.02	-3.52	60.50	74.00	-13.50	100	273	peak
2483.500	47.26	-3.52	43.74	54.00	-10.26	100	273	AVG
4924.000	41.37	2.21	43.58	74.00	-30.42	100	121	peak
4924.000	27.78	2.21	29.99	54.00	-24.01	100	121	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	68.04	-3.83	64.21	74.00	-9.79	100	254	peak
2390.000	48.99	-3.83	45.16	54.00	-8.84	100	254	AVG
2412.000	104.84	-3.78	101.06	N/A	N/A	100	280	peak
2412.000	94.91	-3.78	91.13	N/A	N/A	100	280	AVG
4824.000	42.38	1.74	44.12	74.00	-29.88	100	74	peak
4824.000	27.82	1.74	29.56	54.00	-24.44	100	74	AVG
N20 Mode, Middle channel								
2437.000	106.02	-3.76	102.26	N/A	N/A	100	271	peak
2437.000	95.96	-3.76	92.20	N/A	N/A	100	271	AVG
4874.000	42.58	2.05	44.63	74.00	-29.37	100	101	peak
4874.000	27.62	2.05	29.67	54.00	-24.33	100	101	AVG
N20 Mode, High channel								
2462.000	105.53	-3.67	101.86	N/A	N/A	100	288	peak
2462.000	95.51	-3.67	91.84	N/A	N/A	100	288	AVG
2483.500	64.84	-3.52	61.32	74.00	-12.68	100	290	peak
2483.500	48.62	-3.52	45.10	54.00	-8.90	100	290	AVG
4924.000	41.08	2.21	43.29	74.00	-30.71	100	248	peak
4924.000	27.37	2.21	29.58	54.00	-24.42	100	248	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	64.49	-3.83	60.66	74.00	-13.34	100	207	peak
2390.000	47.55	-3.83	43.72	54.00	-10.28	100	207	AVG
2412.000	101.34	-3.78	97.56	N/A	N/A	100	323	peak
2412.000	91.36	-3.78	87.58	N/A	N/A	100	323	AVG
4824.000	44.02	1.74	45.76	74.00	-28.24	100	298	peak
4824.000	28.92	1.74	30.66	54.00	-23.34	100	298	AVG
N20 Mode, Middle channel								
2437.000	104.36	-3.76	100.60	N/A	N/A	100	283	peak
2437.000	94.44	-3.76	90.68	N/A	N/A	100	283	AVG
4874.000	44.29	2.05	46.34	74.00	-27.66	100	93	peak
4874.000	28.81	2.05	30.86	54.00	-23.14	100	93	AVG
N20 Mode, High channel								
2462.000	104.04	-3.67	100.37	N/A	N/A	100	274	peak
2462.000	93.97	-3.67	90.30	N/A	N/A	100	274	AVG
2483.500	65.27	-3.52	61.75	74.00	-12.25	100	289	peak
2483.500	48.51	-3.52	44.99	54.00	-9.01	100	289	AVG
4924.000	41.44	2.21	43.65	74.00	-30.35	100	228	peak
4924.000	28.40	2.21	30.61	54.00	-23.39	100	228	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	69.63	-3.83	65.80	74.00	-8.20	100	281	peak
2390.000	54.47	-3.83	50.64	54.00	-3.36	100	281	AVG
2422.000	102.17	-3.77	98.40	N/A	N/A	100	284	peak
2422.000	92.13	-3.77	88.36	N/A	N/A	100	284	AVG
4844.000	42.51	1.87	44.38	74.00	-29.62	100	300	peak
4844.000	28.04	1.87	29.91	54.00	-24.09	100	300	AVG
N40 Mode, Middle channel								
2437.000	103.57	-3.76	99.81	N/A	N/A	100	273	peak
2437.000	93.49	-3.76	89.73	N/A	N/A	100	273	AVG
4874.000	41.75	2.05	43.80	74.00	-30.20	100	90	peak
4874.000	27.95	2.05	30.00	54.00	-24.00	100	90	AVG
N40 Mode, High channel								
2452.000	102.21	-3.73	98.48	N/A	N/A	100	271	peak
2452.000	92.22	-3.73	88.49	N/A	N/A	100	271	AVG
2483.500	66.44	-3.52	62.92	74.00	-11.08	100	130	peak
2483.500	49.05	-3.52	45.53	54.00	-8.47	100	130	AVG
4904.000	41.51	2.19	43.70	74.00	-30.30	100	46	peak
4904.000	27.16	2.19	29.35	54.00	-24.65	100	46	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	67.99	-3.83	64.16	74.00	-9.84	100	269	peak
2390.000	53.11	-3.83	49.28	54.00	-4.72	100	269	AVG
2422.000	99.84	-3.77	96.07	N/A	N/A	100	283	peak
2422.000	90.62	-3.77	86.85	N/A	N/A	100	283	AVG
4844.000	43.28	1.87	45.15	74.00	-28.85	100	43	peak
4844.000	28.75	1.87	30.62	54.00	-23.38	100	43	AVG
N40 Mode, Middle channel								
2437.000	102.08	-3.76	98.32	N/A	N/A	100	285	peak
2437.000	92.08	-3.76	88.32	N/A	N/A	100	285	AVG
4874.000	42.21	2.05	44.26	74.00	-29.74	100	322	peak
4874.000	27.59	2.05	29.64	54.00	-24.36	100	322	AVG
N40 Mode, High channel								
2452.000	99.81	-3.73	96.08	N/A	N/A	100	283	peak
2452.000	90.38	-3.73	86.65	N/A	N/A	100	283	AVG
2483.500	66.18	-3.52	62.66	74.00	-11.34	100	326	peak
2483.500	49.17	-3.52	45.65	54.00	-8.35	100	326	AVG
4904.000	41.68	2.19	43.87	74.00	-30.13	100	100	peak
4904.000	27.83	2.19	30.02	54.00	-23.98	100	100	AVG

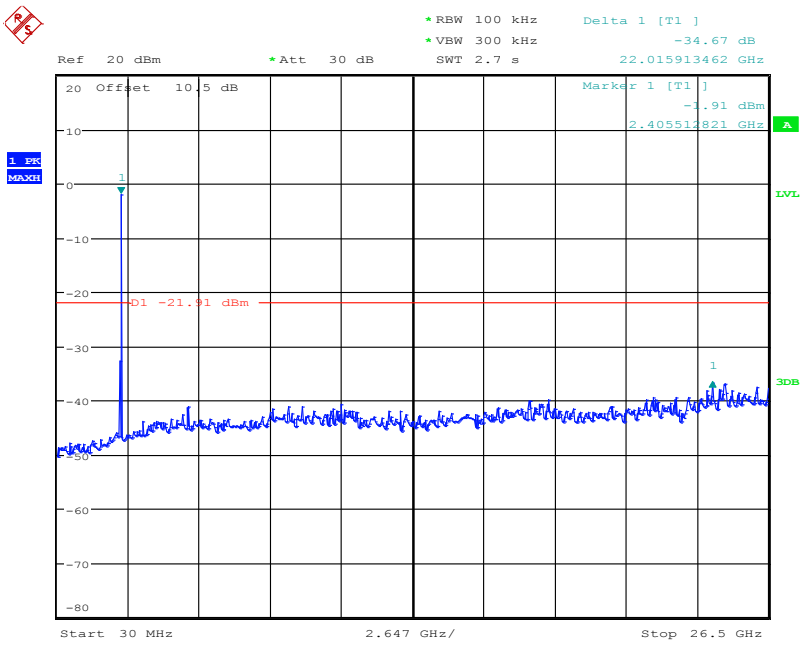
Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE				
Low	2402	34.67	≥ 20	PASS
Mid	2440	34.68	≥ 20	PASS
High	2480	34.83	≥ 20	PASS
B Mode				
Low	2412	37.45	≥ 20	PASS
Mid	2437	39.71	≥ 20	PASS
High	2462	40.11	≥ 20	PASS
G Mode				
Low	2412	32.11	≥ 20	PASS
Mid	2437	33.51	≥ 20	PASS
High	2462	31.87	≥ 20	PASS
N20 Mode				
Low	2412	30.86	≥ 20	PASS
Mid	2437	31.26	≥ 20	PASS
High	2462	31.75	≥ 20	PASS
N40 Mode				
Low	2422	27.11	≥ 20	PASS
Mid	2437	28.51	≥ 20	PASS
High	2452	29.97	≥ 20	PASS

BLE Mode

Low Channel



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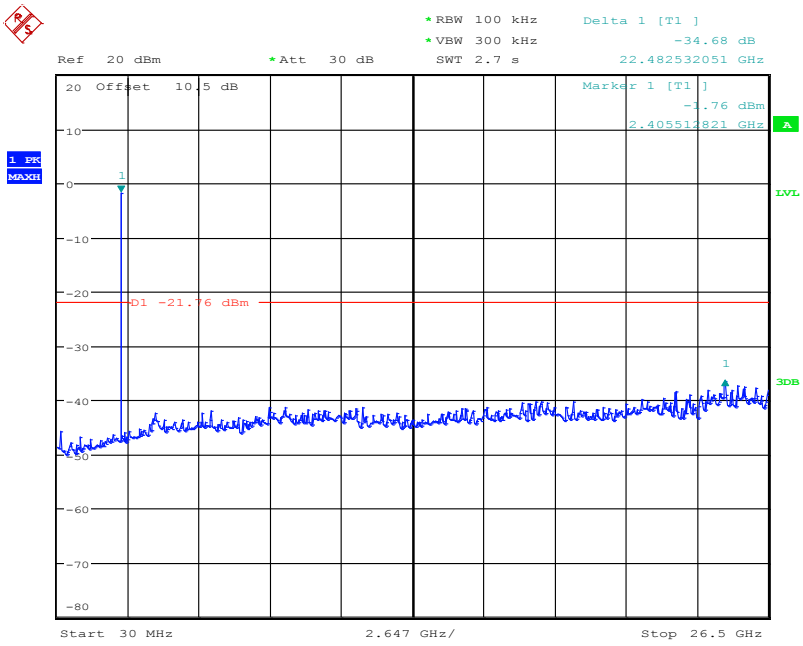
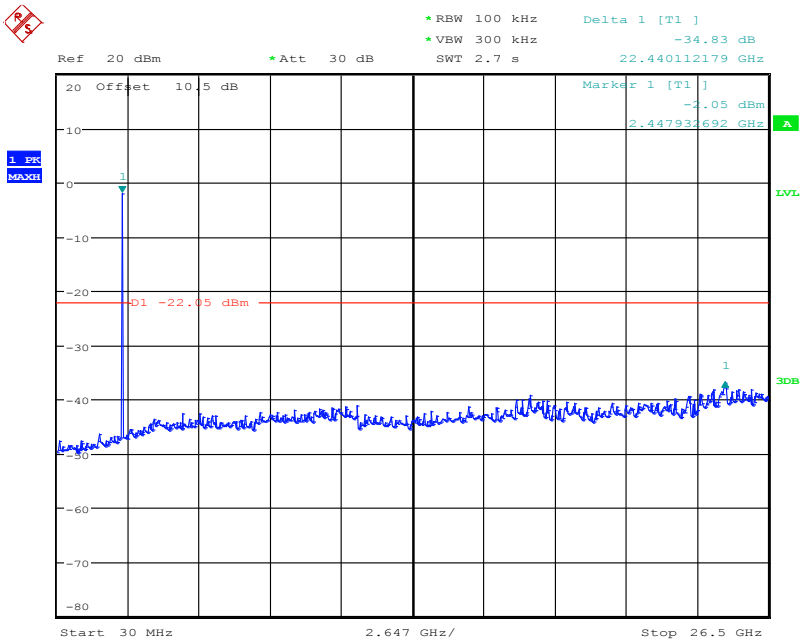
Middle Channel



Date: 14.JAN.2019 17:56:47

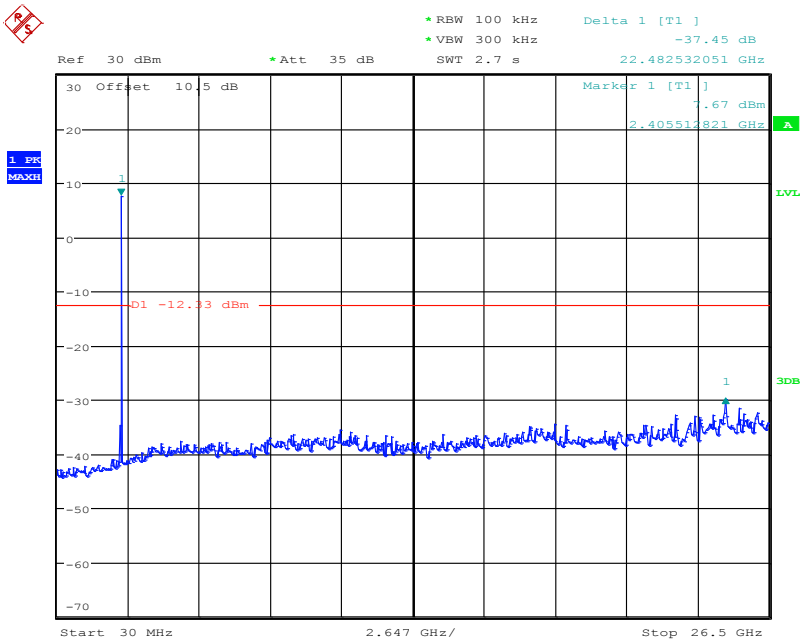
High Channel



Date: 14.JAN.2019 17:55:32

B Mode

Low Channel



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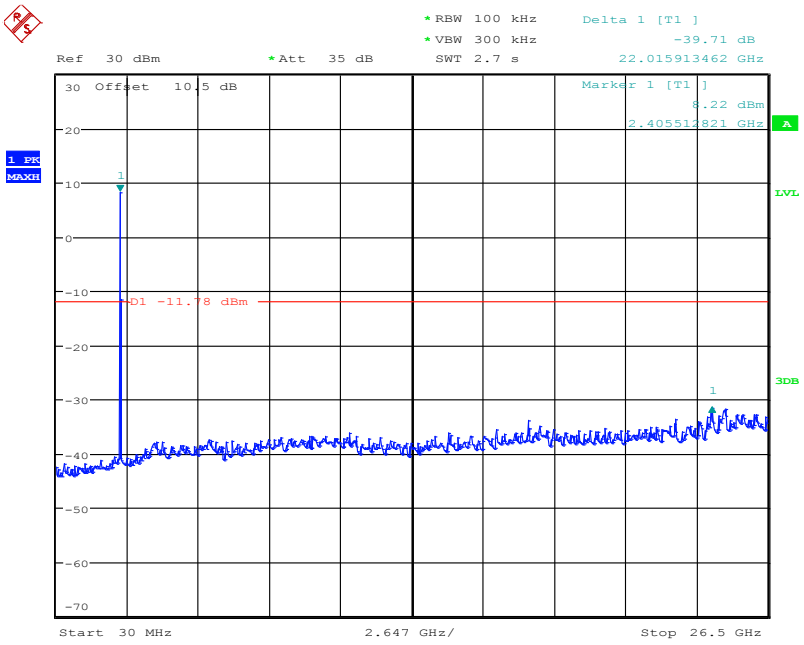
Middle Channel



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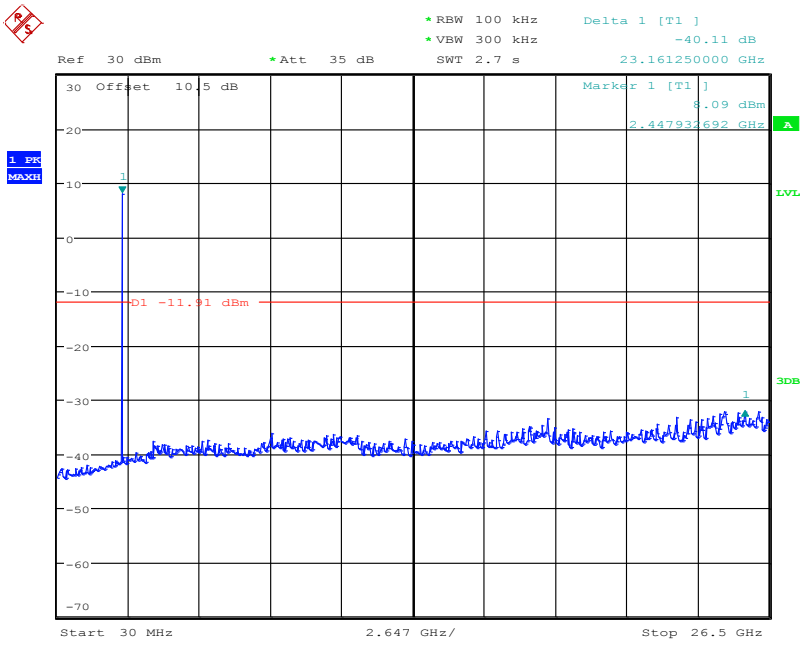
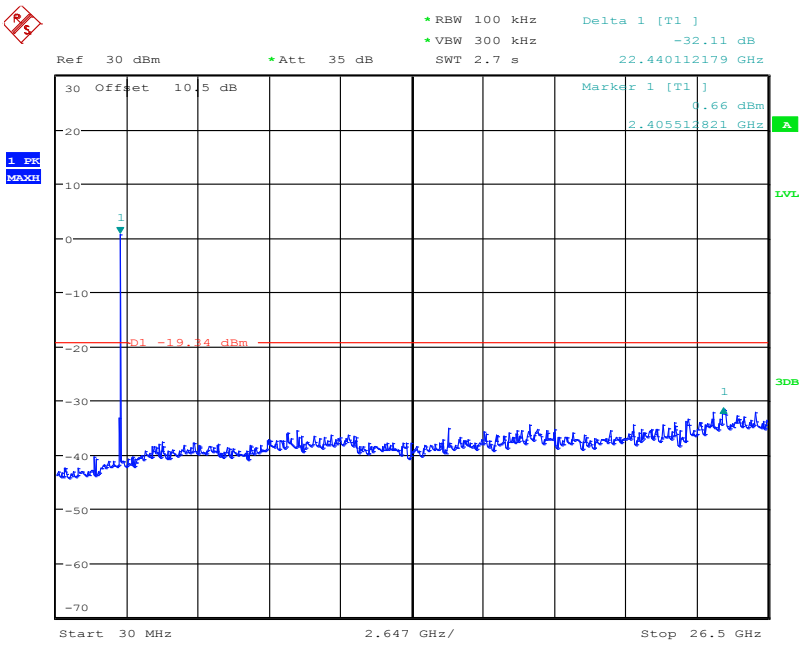
High Channel



Date: 14.JAN.2019 14:47:02

G Mode

Low Channel



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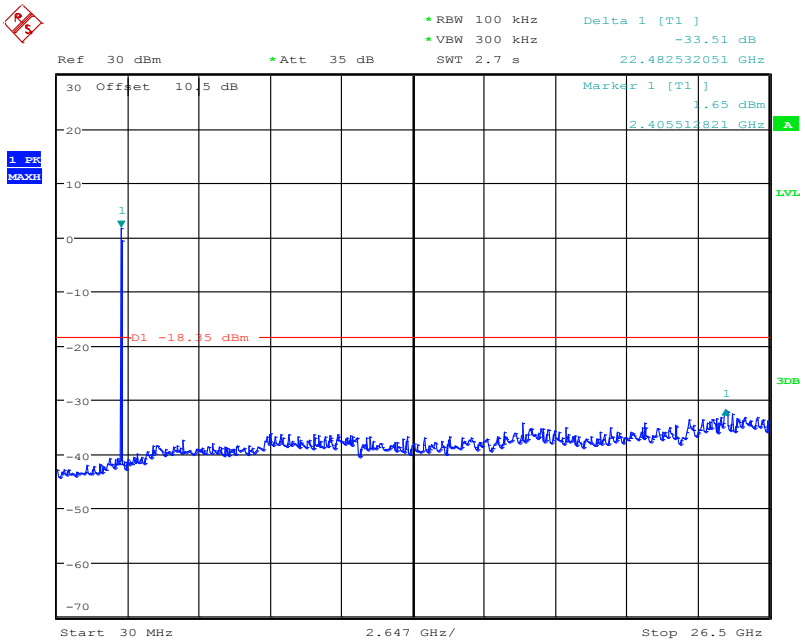
Middle Channel



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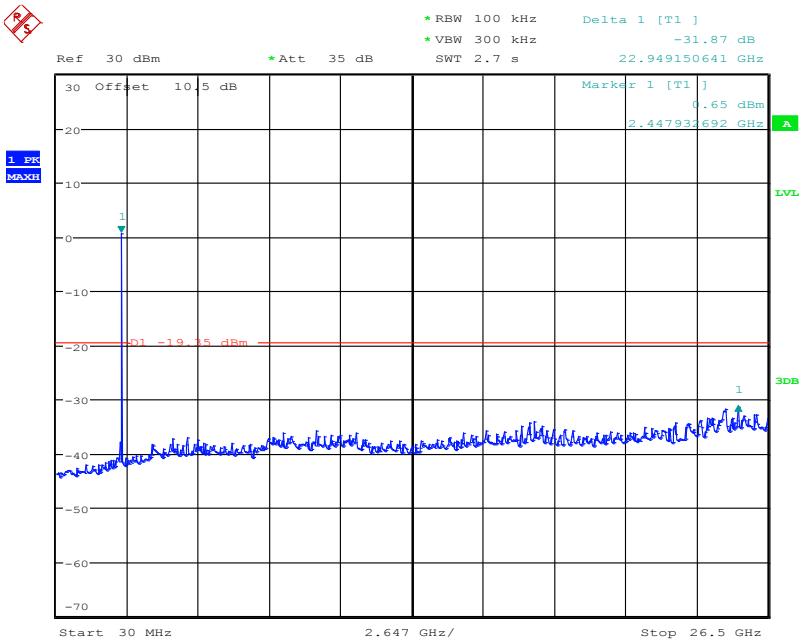
High Channel



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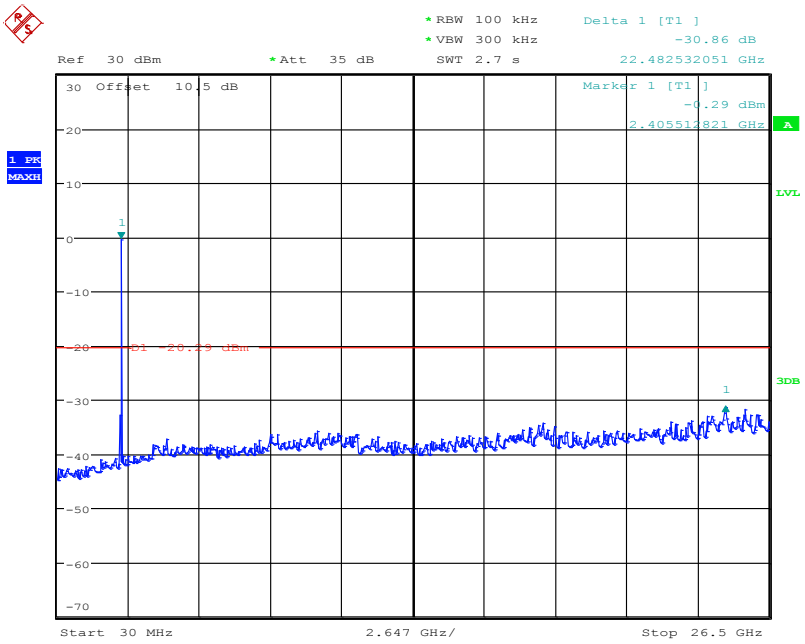
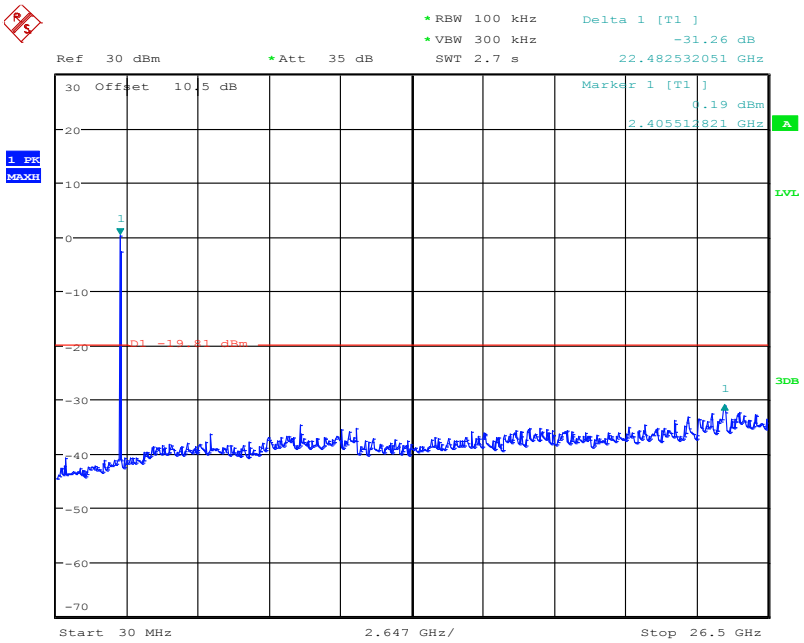
N20 Mode

Low Channel



Date: 14.JAN.2019 15:00:28

Middle Channel



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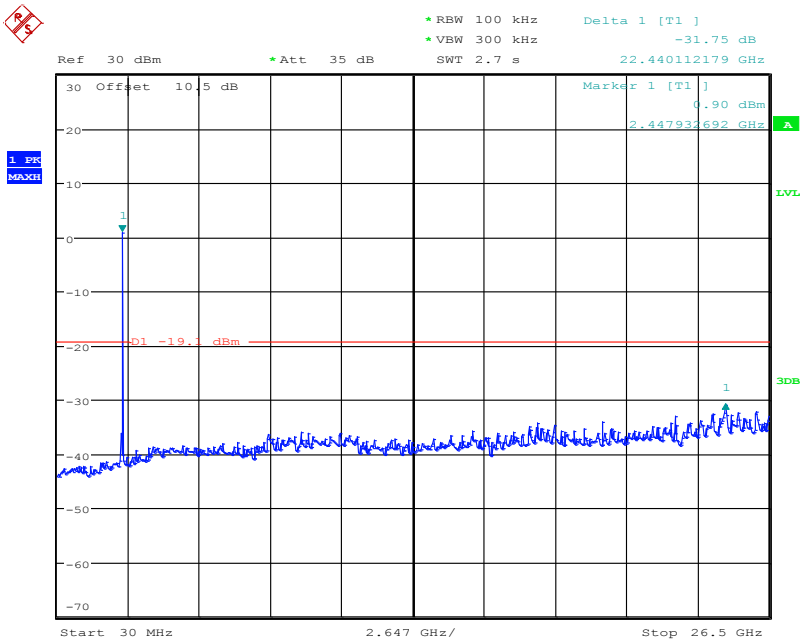
High Channel



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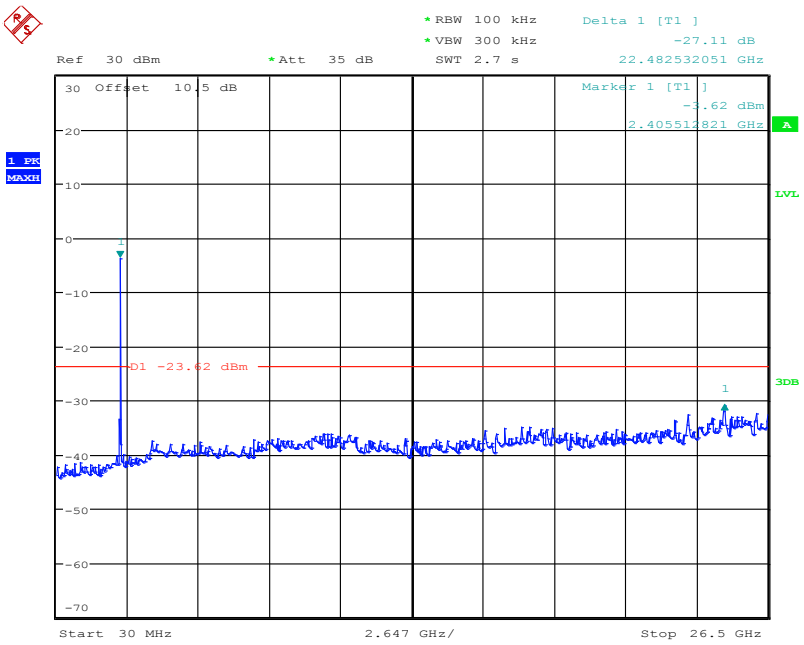
N40 Mode

Low Channel



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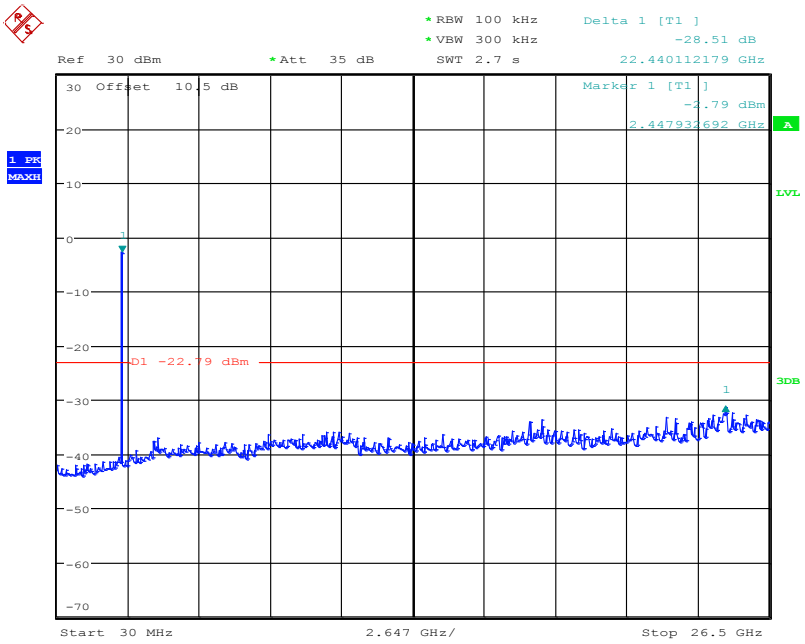
Middle Channel



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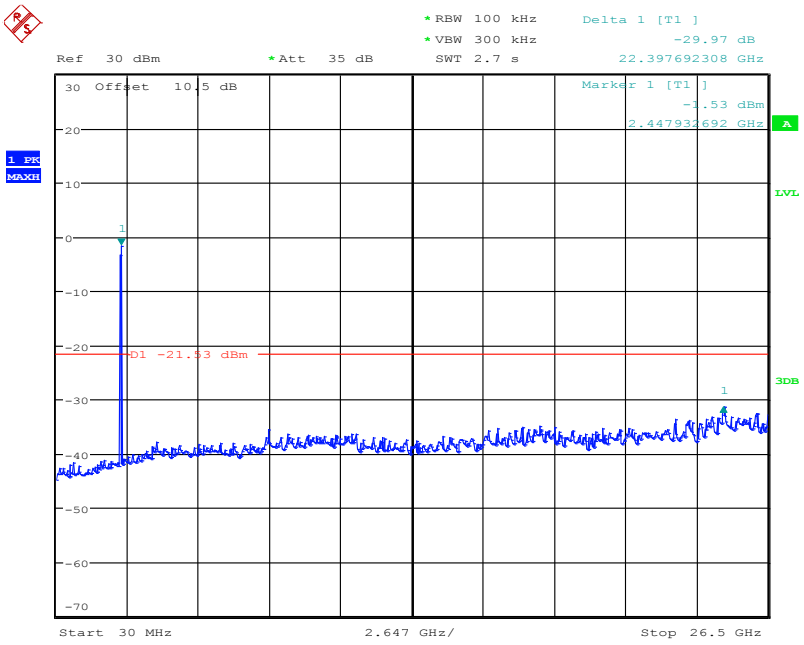
High Channel



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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 2019-01-14.

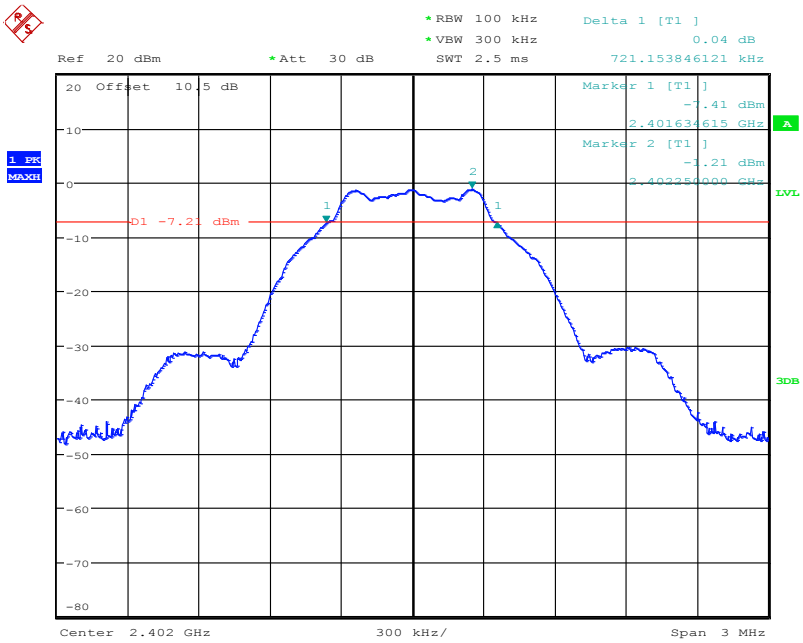
9.4 Test Results

Channel	Frequency (MHz)	6 dB Emission Bandwidth (kHz)	Limit (kHz)	Result
BLE				
Low	2402	0.72	> 500	PASS
Middle	2440	0.72	> 500	PASS
High	2480	0.74	> 500	PASS
B Mode				
Low	2412	9.55	> 500	PASS
Middle	2437	9.55	> 500	PASS
High	2462	9.62	> 500	PASS
G Mode				
Low	2412	16.47	> 500	PASS
Middle	2437	16.41	> 500	PASS
High	2462	16.47	> 500	PASS
N20 Mode				
Low	2412	17.63	> 500	PASS
Middle	2437	17.69	> 500	PASS
High	2462	17.63	> 500	PASS
N40 Mode				
Low	2422	36.41	> 500	PASS
Middle	2437	36.03	> 500	PASS
High	2452	35.13	> 500	PASS

Please refer to the following plots

BLE Mode

Low Channel



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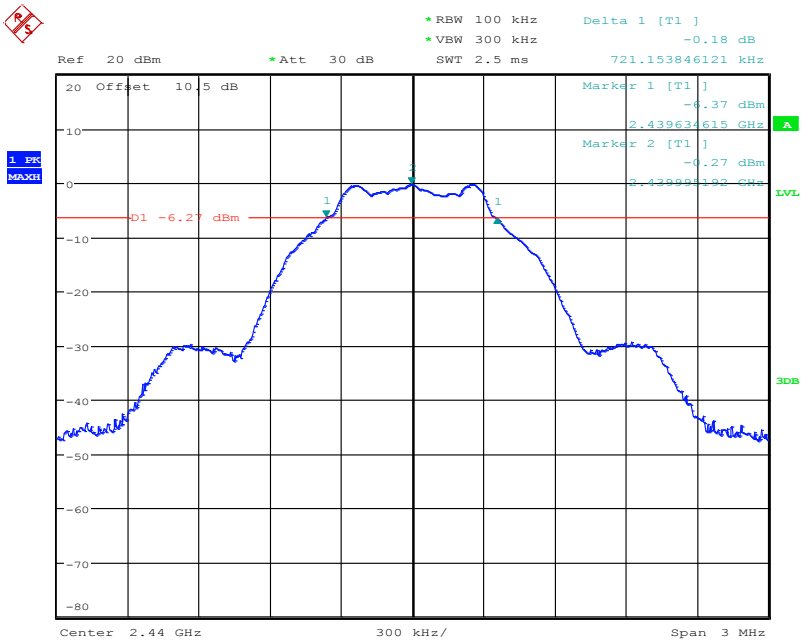
Middle Channel



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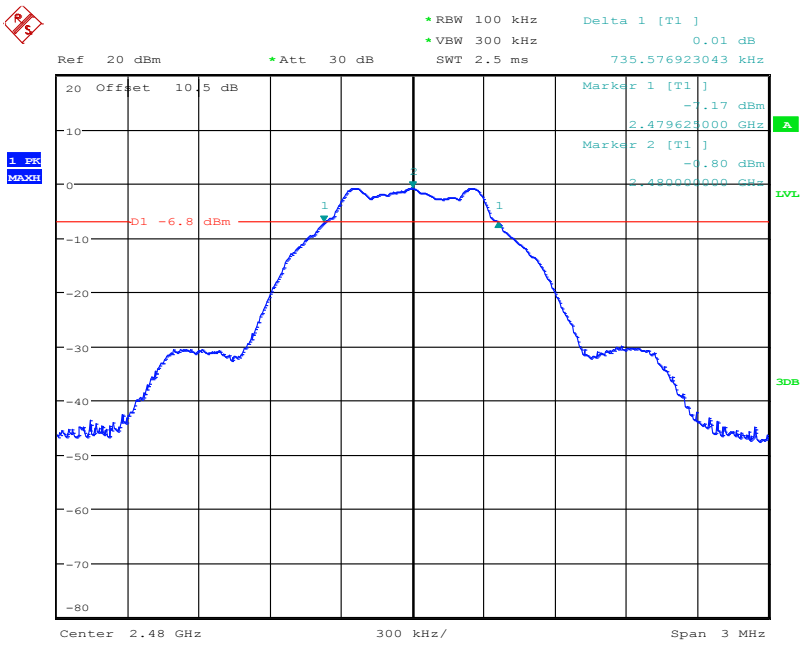
High Channel



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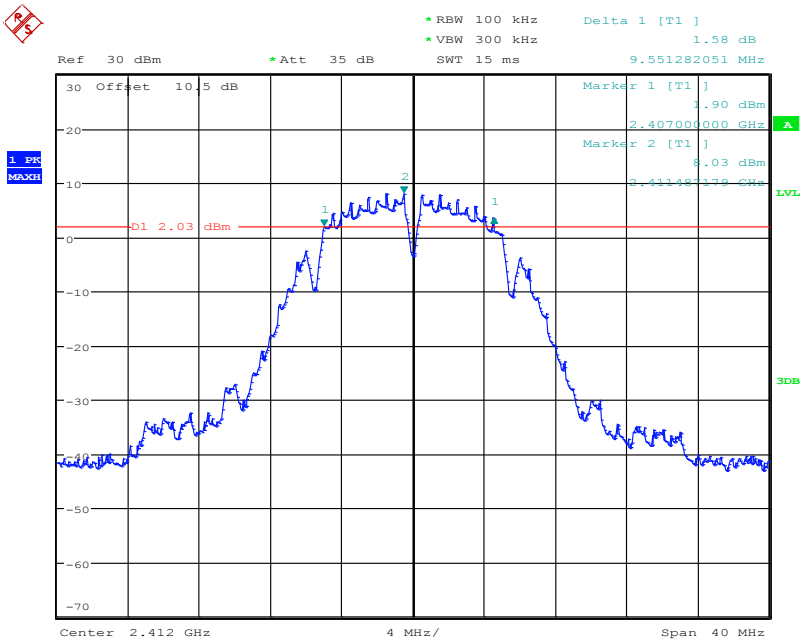
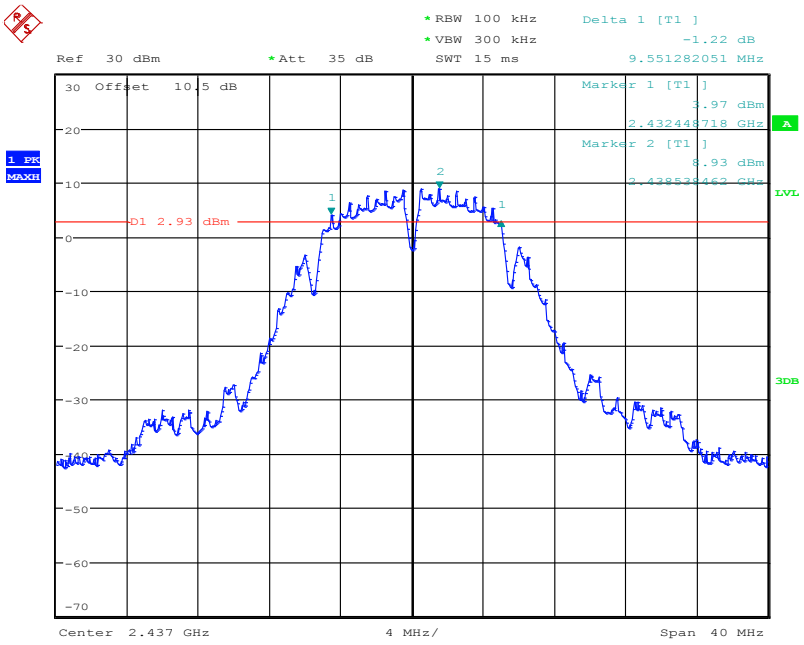
B Mode

Low Channel



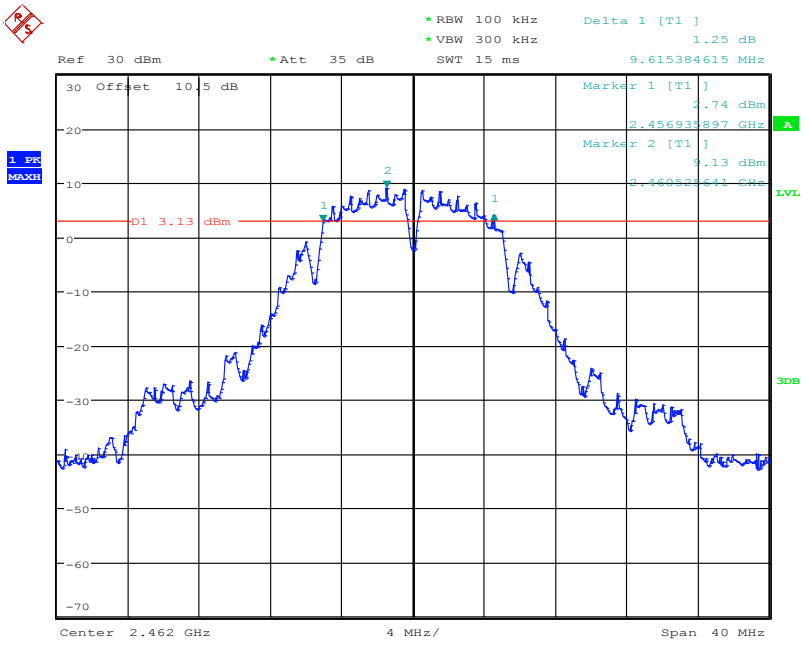
Date: 14.JAN.2019 14:42:41

Middle Channel



Date: 14.JAN.2019 14:44:37

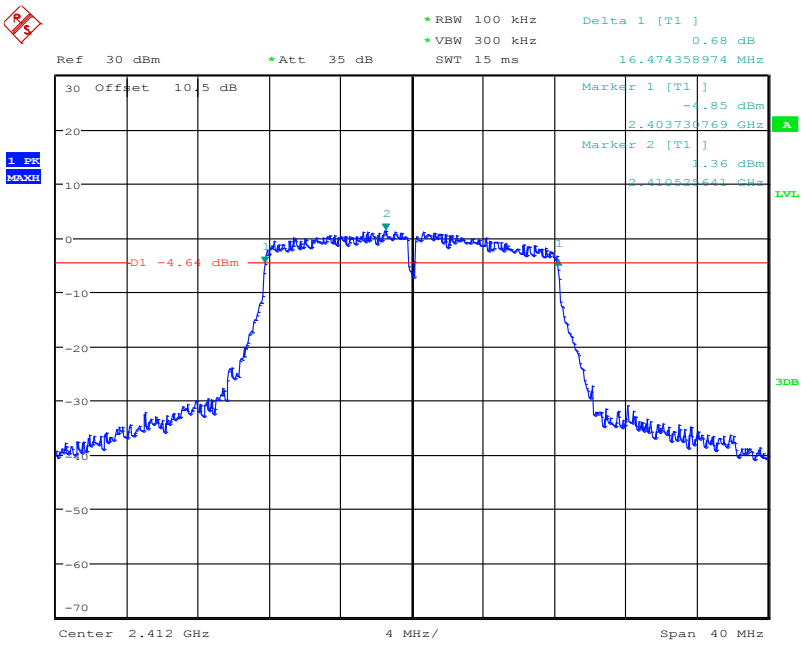
High Channel



Date: 14.JAN.2019 14:46:16

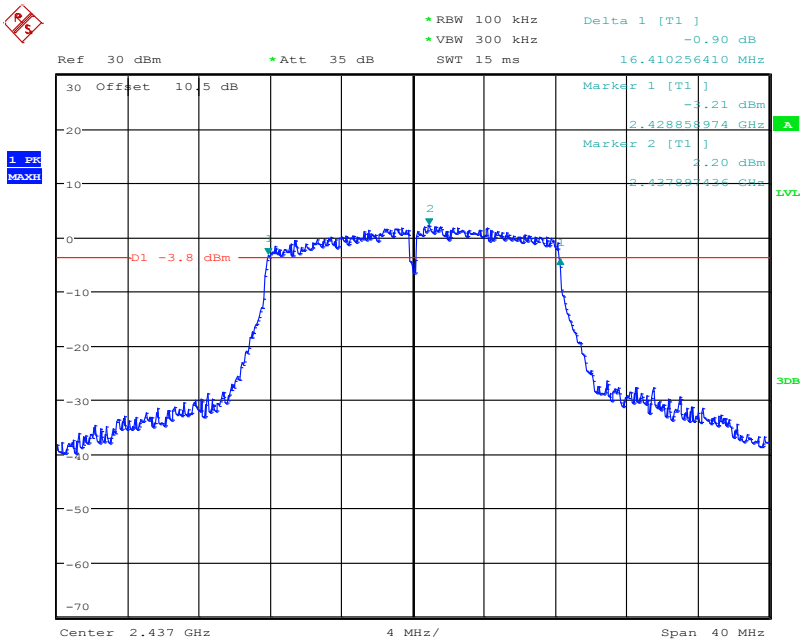
G Mode

Low Channel



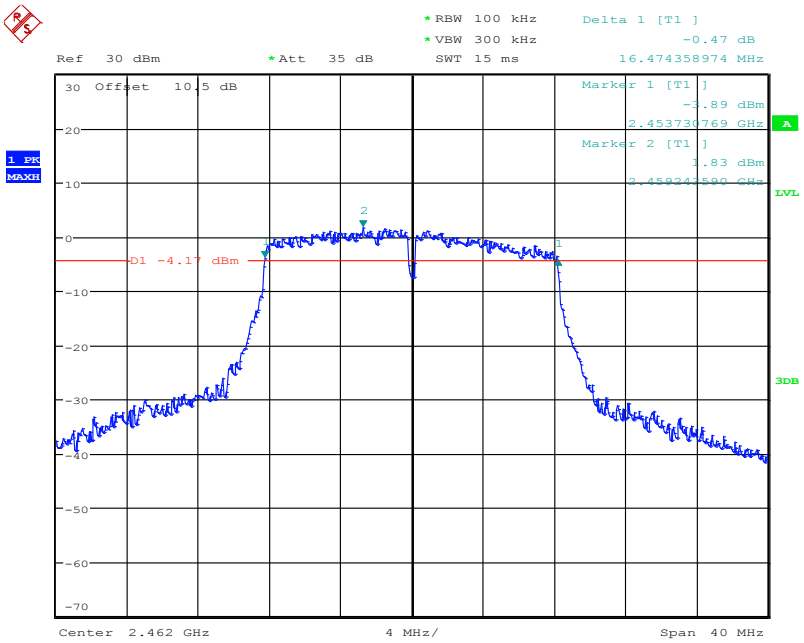
Date: 14.JAN.2019 14:48:45

Middle Channel



Date: 14.JAN.2019 14:54:43

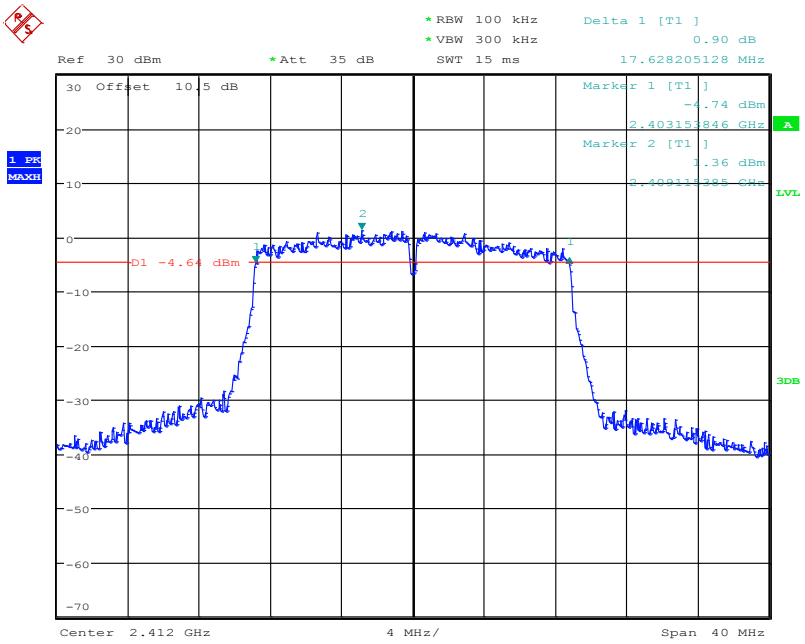
High Channel



Date: 14.JAN.2019 14:56:39

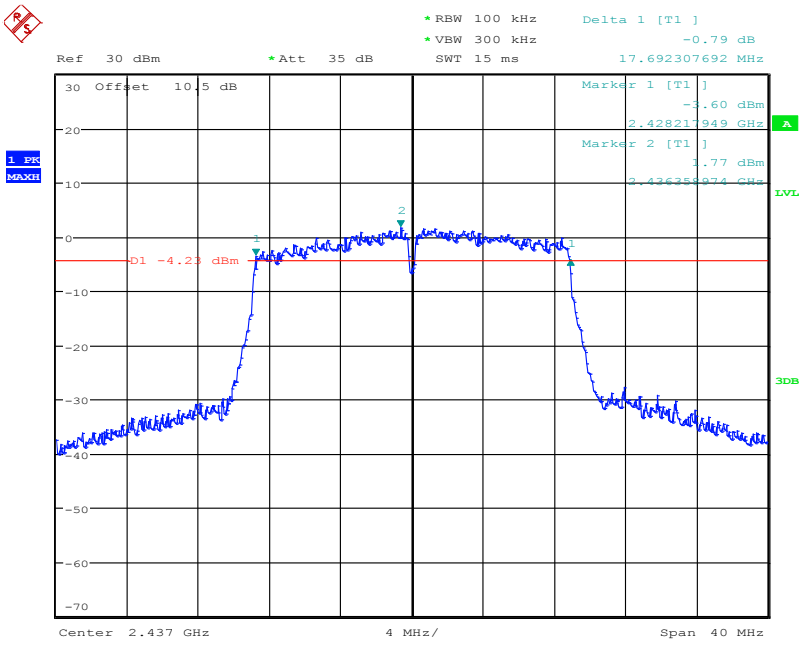
N20 Mode

Low Channel



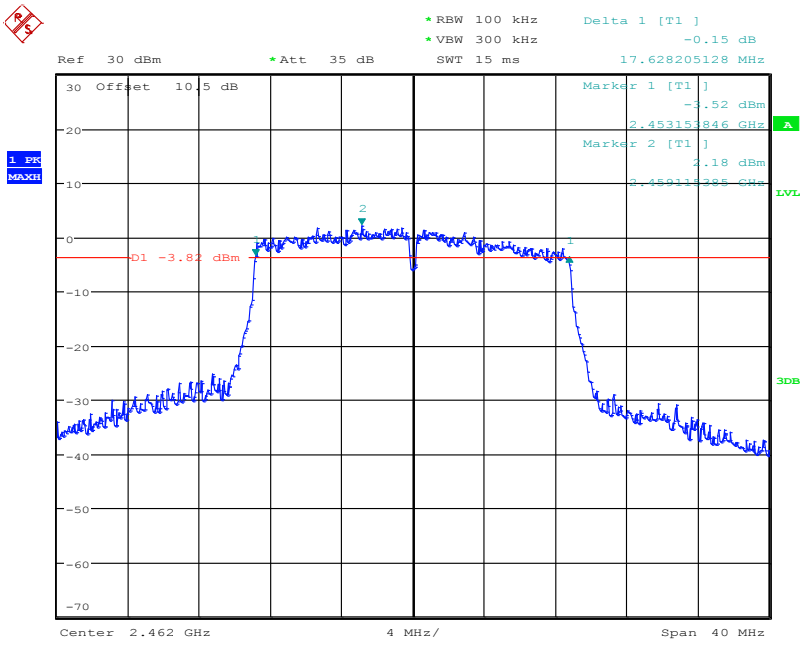
Date: 14.JAN.2019 14:58:39

Middle Channel



Date: 14.JAN.2019 15:02:54

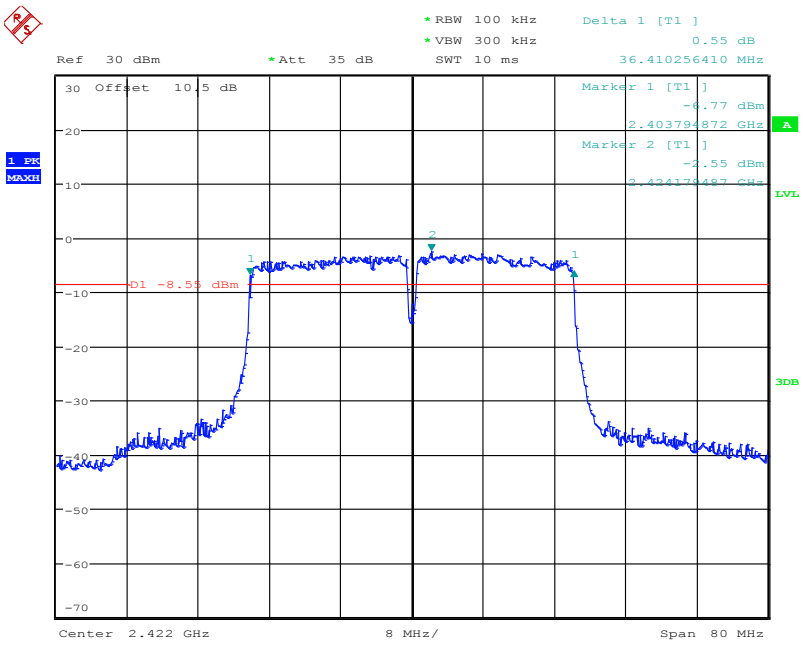
High Channel



Date: 14.JAN.2019 15:04:28

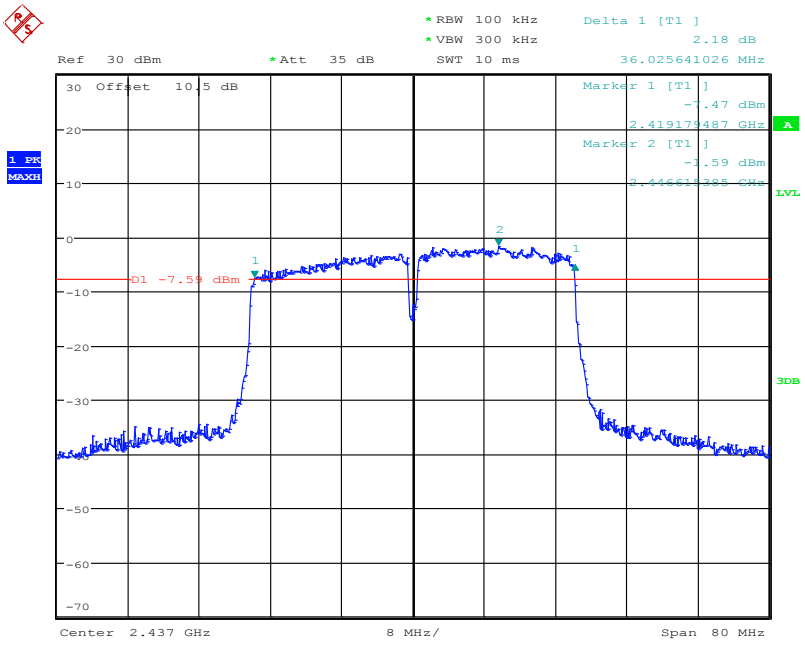
N40 Mode

Low Channel



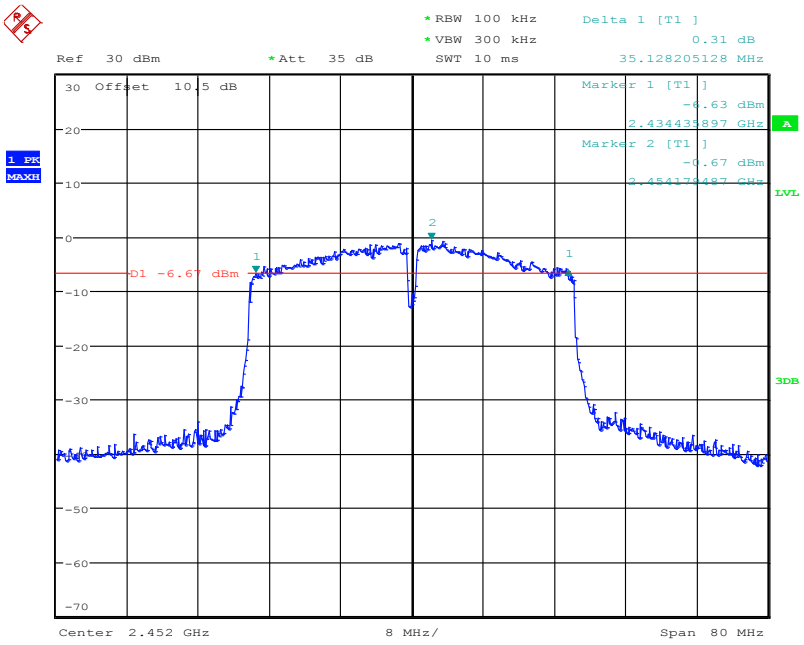
Date: 14.JAN.2019 15:06:34

Middle Channel



Date: 14.JAN.2019 15:08:17

High Channel



Date: 14.JAN.2019 15:09:48

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 2019-01-14.

10.4 Test Results

Channel	Frequency	Maximum peak Conducted Output Power		Limit	Result
	(MHz)	(dBm)	(W)	(W)	
BLE Mode					
Low	2402	0.29	0.0011	1	PASS
Middle	2440	0.62	0.0012	1	PASS
High	2480	0.38	0.0011	1	PASS
B Mode					
Low	2412	20.24	0.106	1	PASS
Middle	2437	20.39	0.109	1	PASS
High	2462	20.37	0.109	1	PASS
G Mode					
Low	2412	23.07	0.203	1	PASS
Middle	2437	22.91	0.195	1	PASS
High	2462	23.06	0.202	1	PASS
N20 Mode					
Low	2412	22.46	0.176	1	PASS
Middle	2437	22.51	0.178	1	PASS
High	2462	22.99	0.199	1	PASS
N40 Mode					
Low	2422	21.87	0.154	1	PASS
Middle	2437	22.86	0.193	1	PASS
High	2452	22.61	0.182	1	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 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 ℃
Relative Humidity:	55 %
ATM Pressure:	1010 hPa

The testing was performed by Tom Hsu on 2019-01-14.

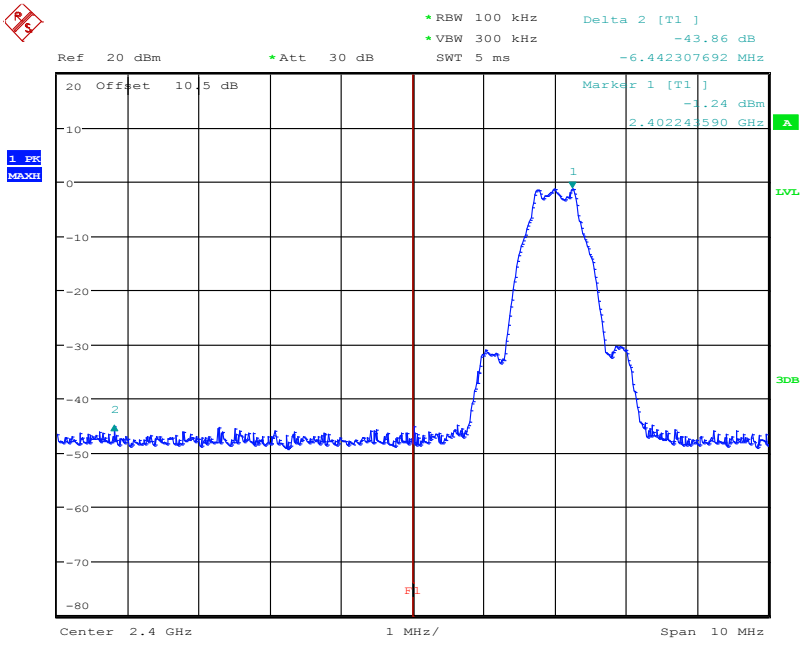
11.4 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BLE				
Low	2402	43.86	≥ 20	PASS
High	2480	44.32	≥ 20	PASS
B Mode				
Low	2412	40.88	≥ 20	PASS
High	2462	48.53	≥ 20	PASS
G Mode				
Low	2412	31.50	≥ 20	PASS
High	2462	41.28	≥ 20	PASS
N20 Mode				
Low	2412	31.79	≥ 20	PASS
High	2462	41.62	≥ 20	PASS
N40 Mode				
Low	2422	31.59	≥ 20	PASS
High	2452	36.81	≥ 20	PASS

Please refer to the following plots

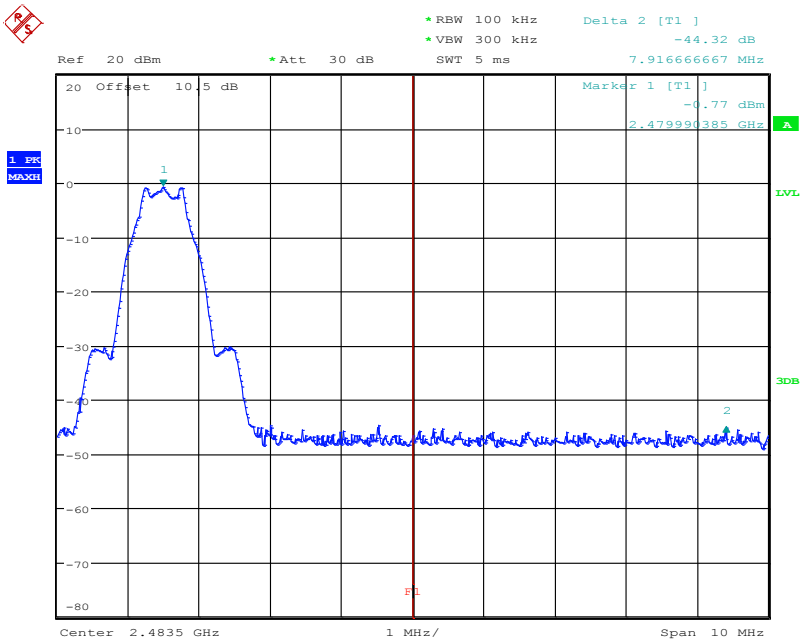
BLE Mode

Band Edge, Left Side



Date: 14.JAN.2019 17:52:19

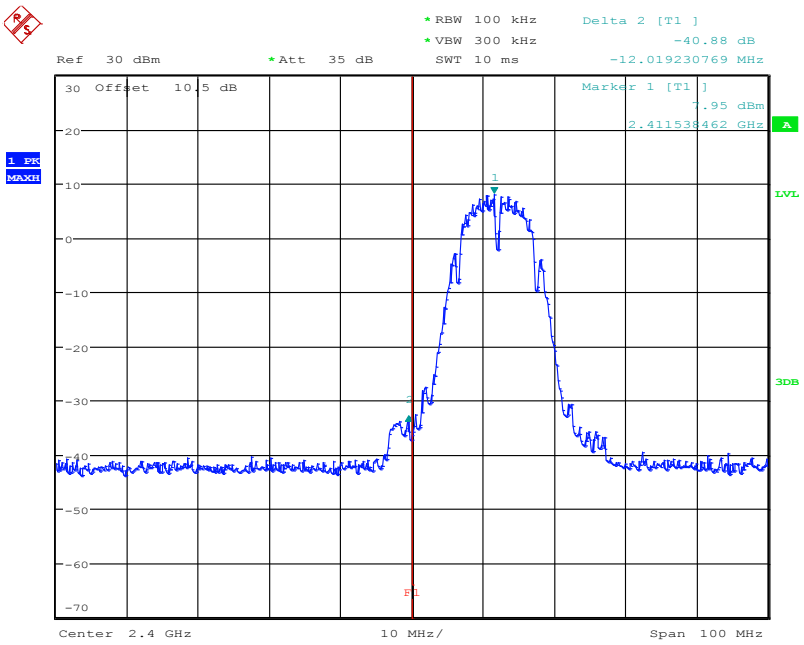
Band Edge, Right Side



Date: 14.JAN.2019 17:55:14

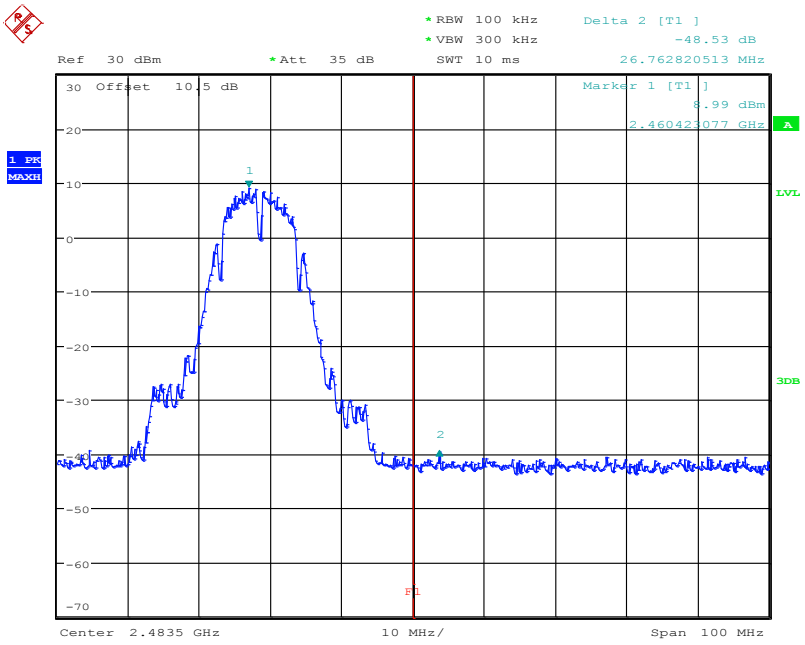
B Mode

Band Edge, Left Side



Date: 14.JAN.2019 14:43:09

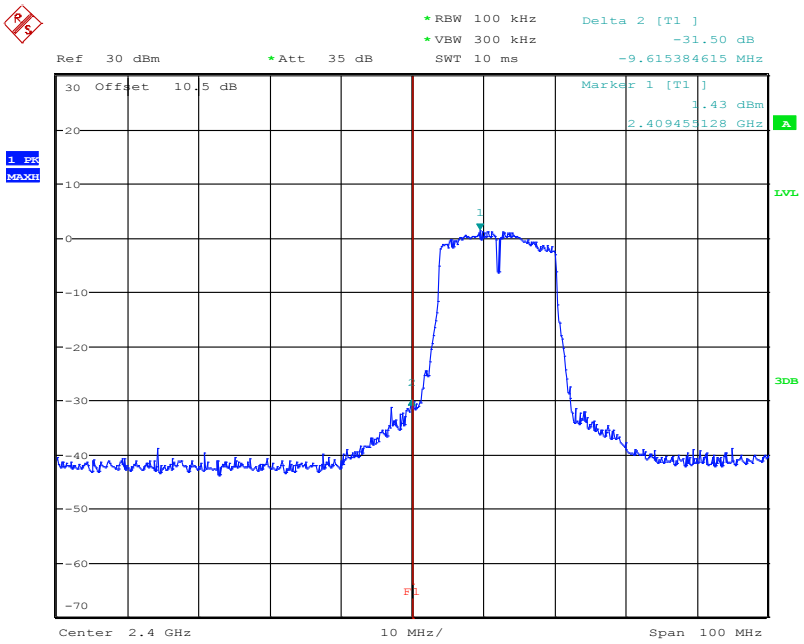
Band Edge, Right Side



Date: 14.JAN.2019 14:46:44

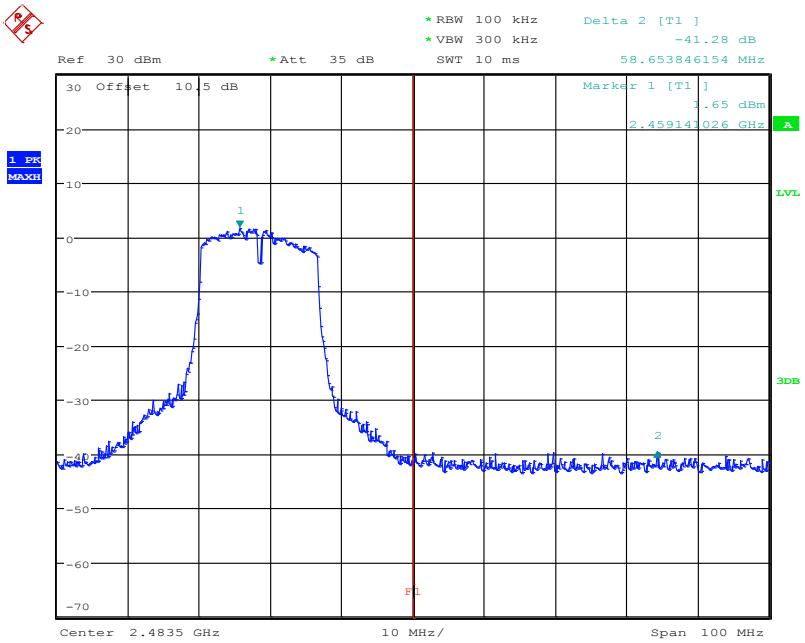
G Mode

Band Edge, Left Side



Date: 14.JAN.2019 14:51:56

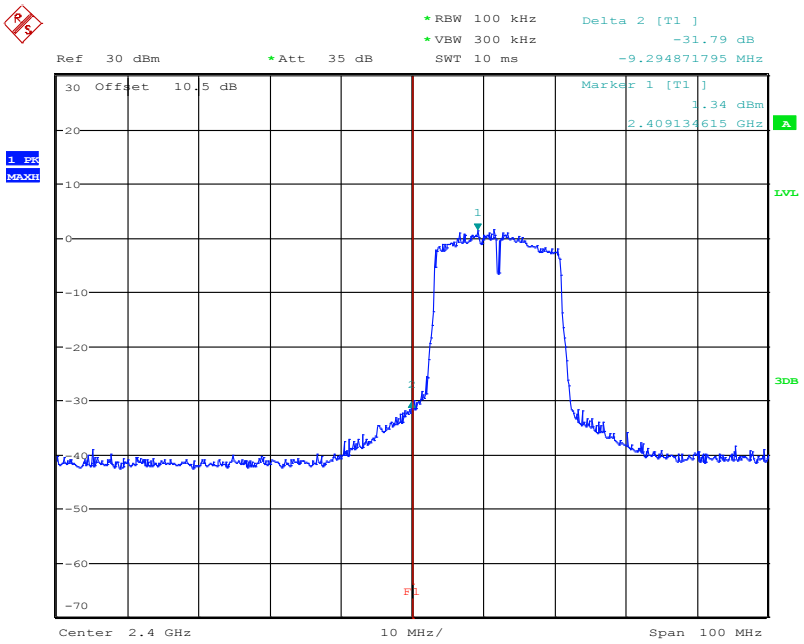
Band Edge, Right Side



Date: 14.JAN.2019 14:57:07

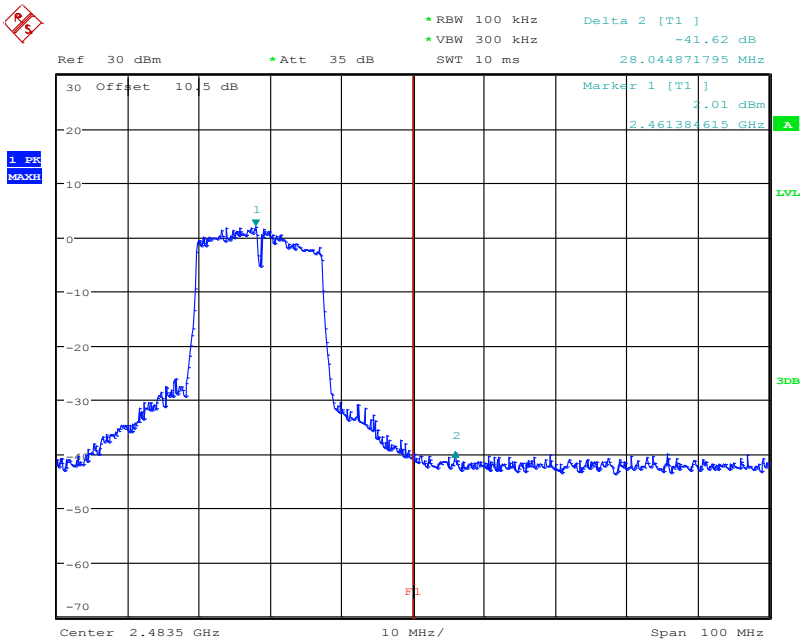
N20 Mode

Band Edge, Left Side



Date: 14.JAN.2019 15:02:06

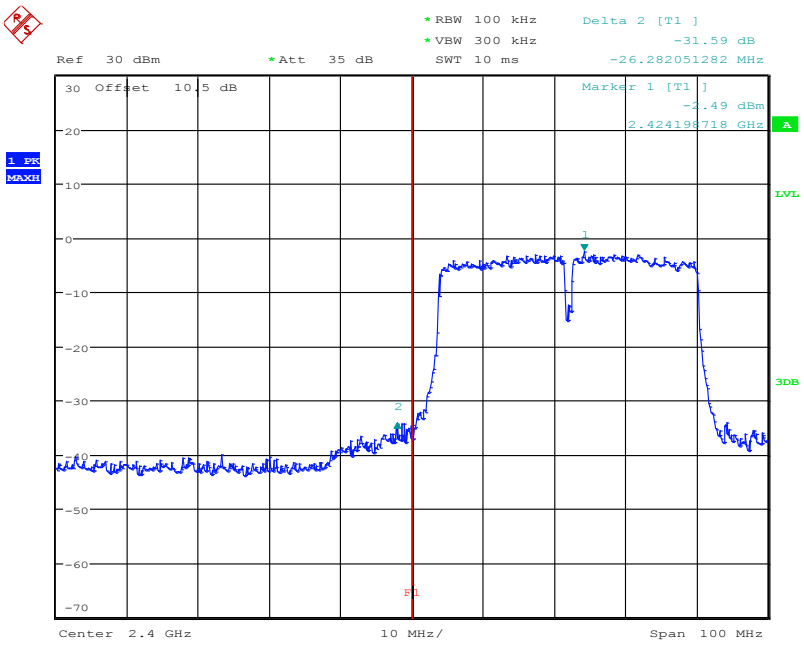
Band Edge, Right Side



Date: 14.JAN.2019 15:04:56

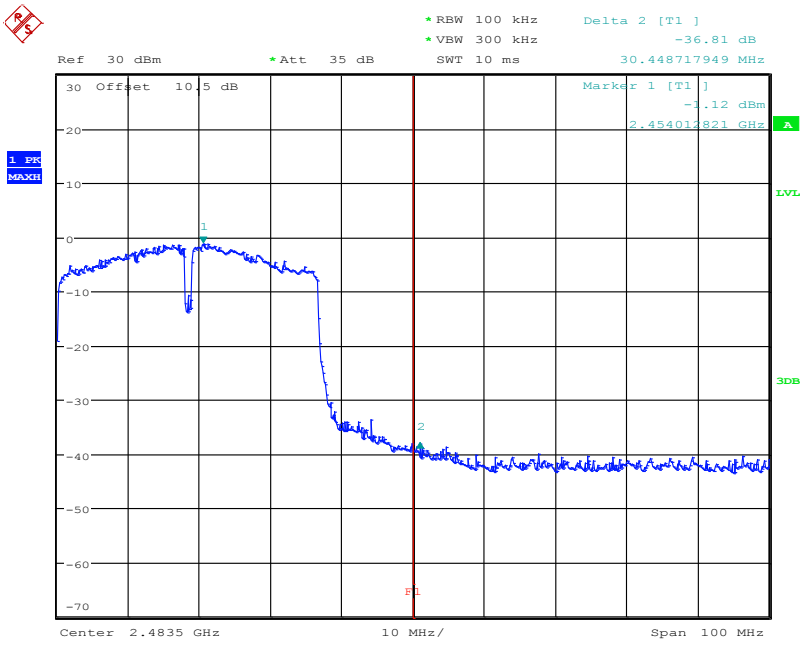
N40 Mode

Band Edge, Left Side



Date: 14.JAN.2019 15:07:02

Band Edge, Right Side



Date: 14.JAN.2019 15:10:16

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 2019-01-14.

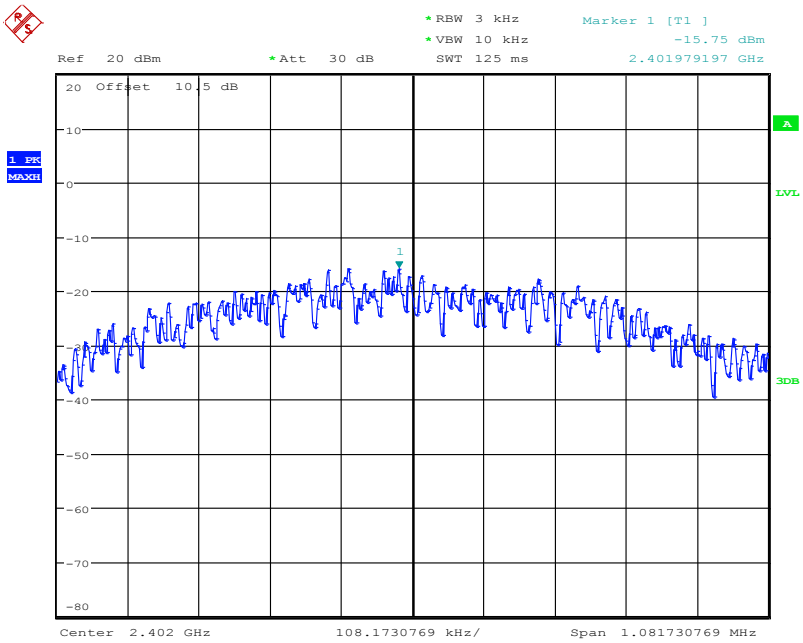
12.4 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
BLE				
Low	2402	-15.75	8	PASS
Middle	2440	-14.75	8	PASS
High	2480	-15.32	8	PASS
B Mode				
Low	2412	-10.29	8	PASS
Middle	2437	-9.36	8	PASS
High	2462	-9.30	8	PASS
G Mode				
Low	2412	-12.79	8	PASS
Middle	2437	-11.53	8	PASS
High	2462	-12.44	8	PASS
N20 Mode				
Low	2412	-12.77	8	PASS
Middle	2437	-12.15	8	PASS
High	2462	-12.01	8	PASS
N40 Mode				
Low	2422	-15.91	8	PASS
Middle	2437	-15.52	8	PASS
High	2452	-15.06	8	PASS

Please refer to the following plots

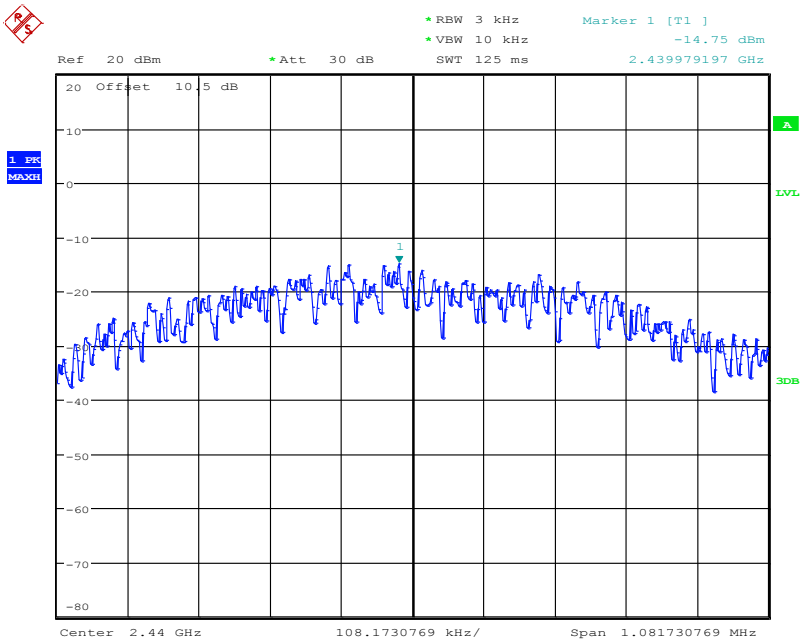
BLE Mode

Low Channel



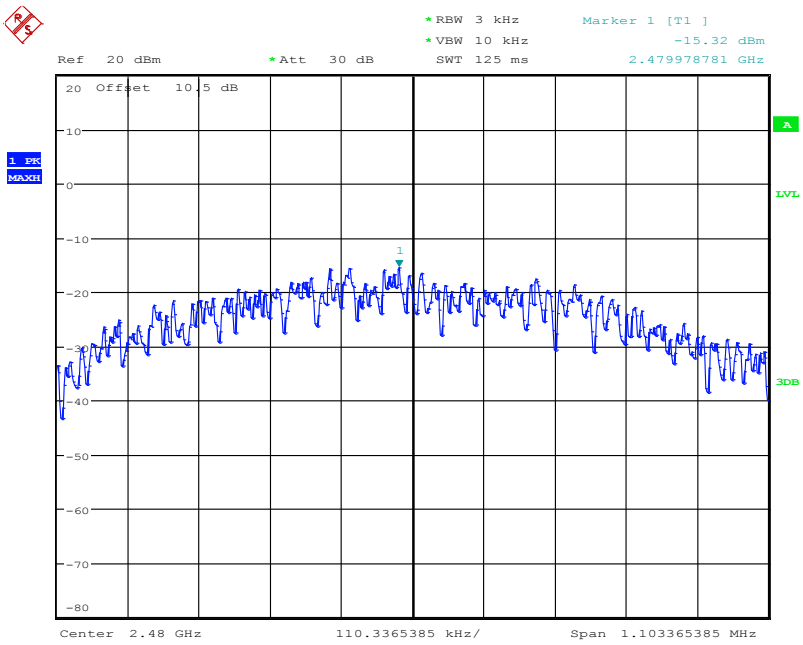
Date: 14.JAN.2019 17:51:43

Middle Channel



Date: 14.JAN.2019 17:53:21

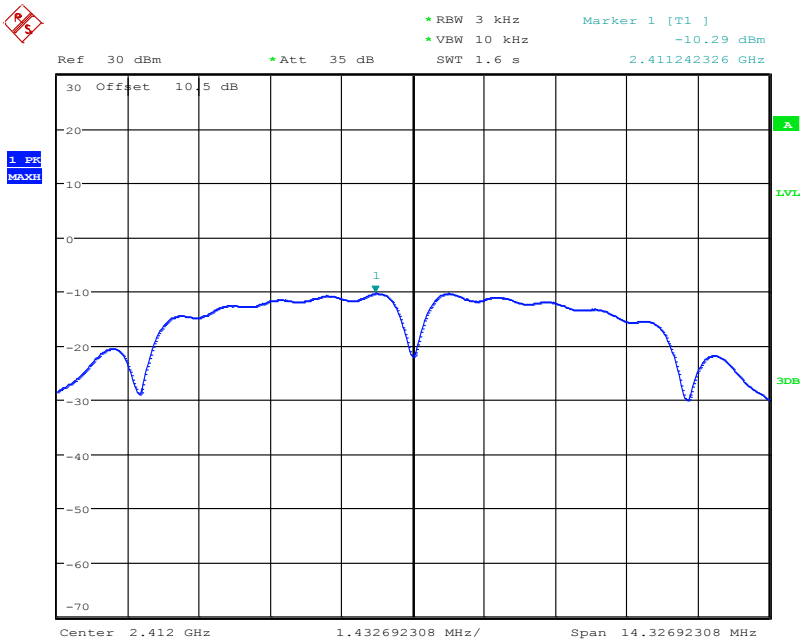
High Channel



Date: 14.JAN.2019 17:54:38

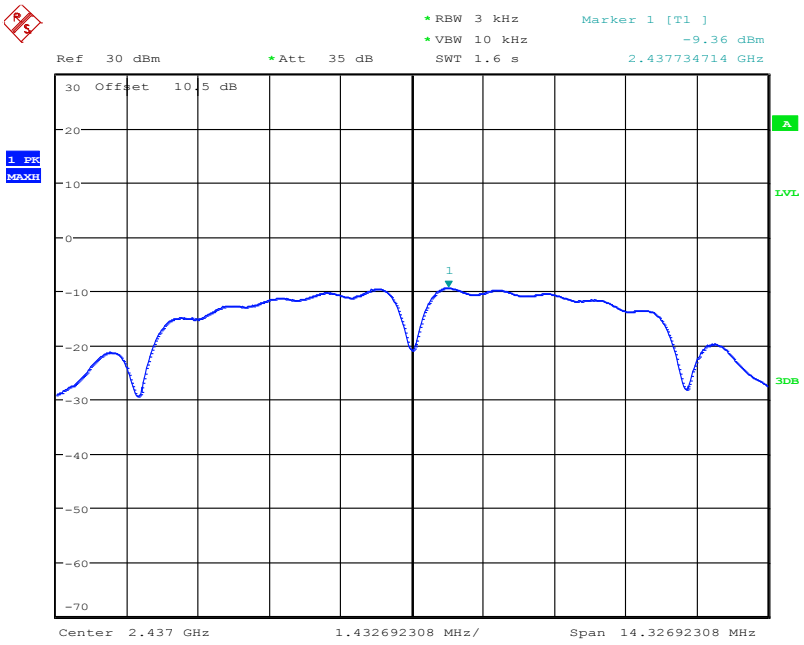
B Mode

Low Channel



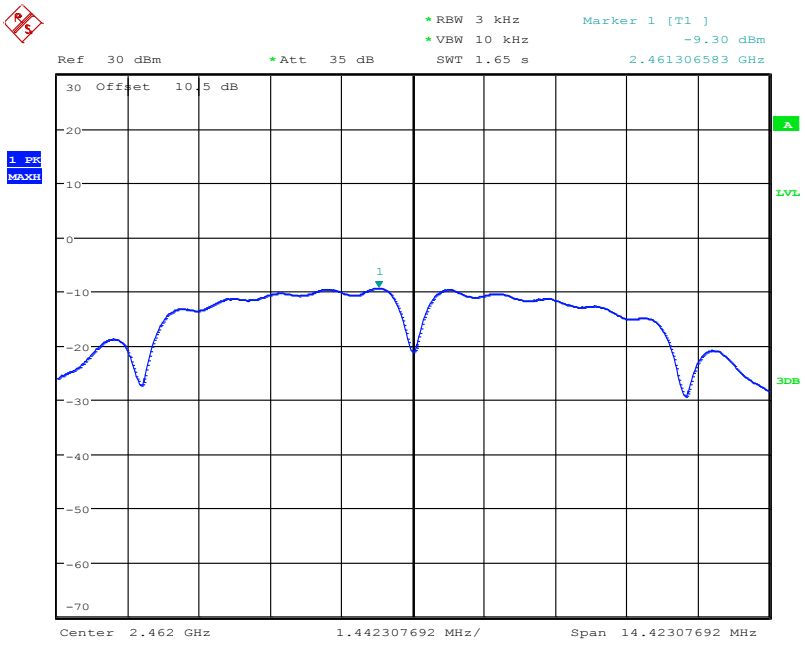
Date: 14.JAN.2019 14:42:50

Middle Channel



Date: 14.JAN.2019 14:44:46

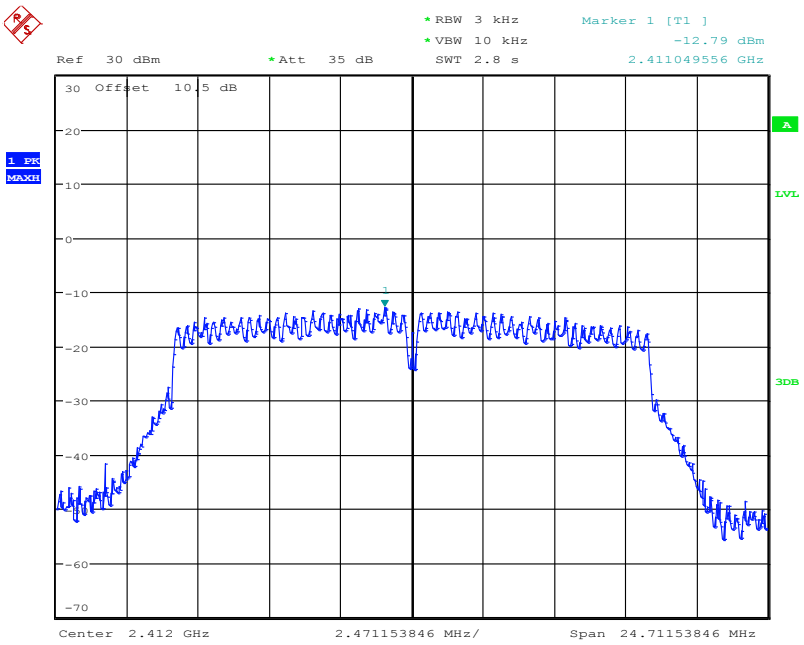
High Channel



Date: 14.JAN.2019 14:46:26

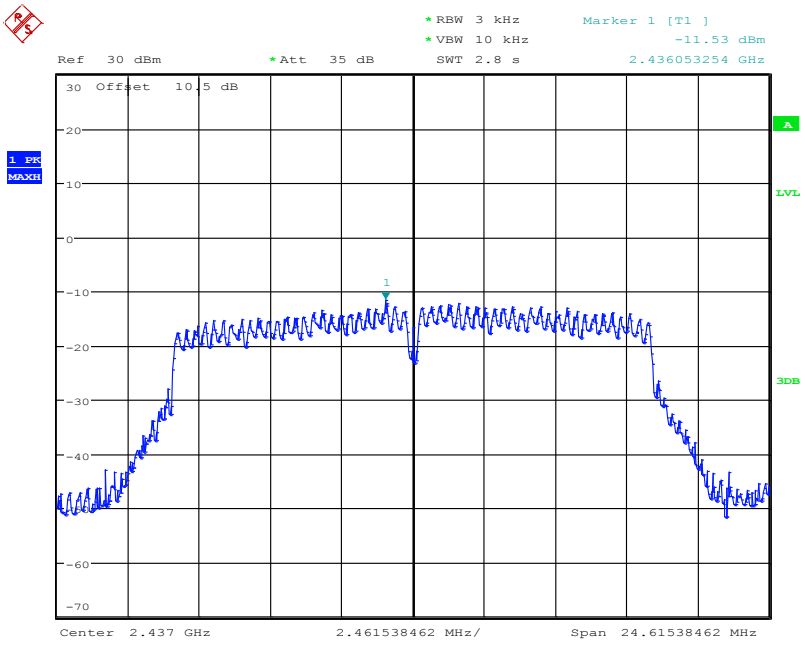
G Mode

Low Channel



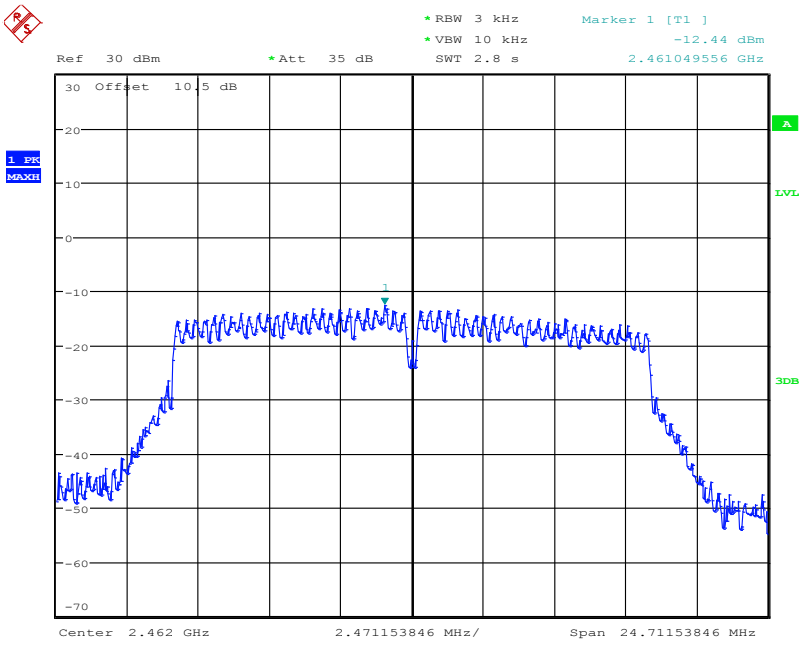
Date: 14.JAN.2019 14:48:55

Middle Channel



Date: 14.JAN.2019 14:54:53

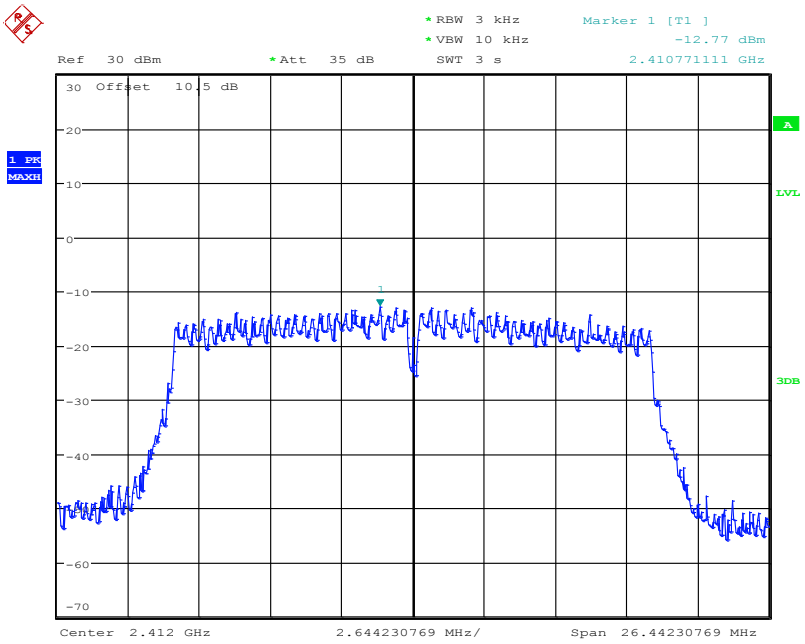
High Channel



Date: 14.JAN.2019 14:56:49

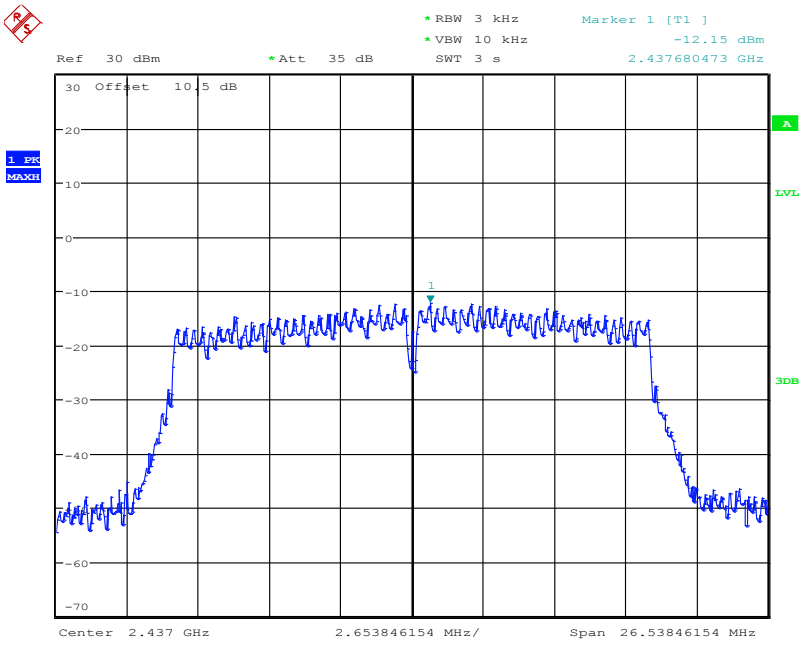
N20 Mode

Low Channel



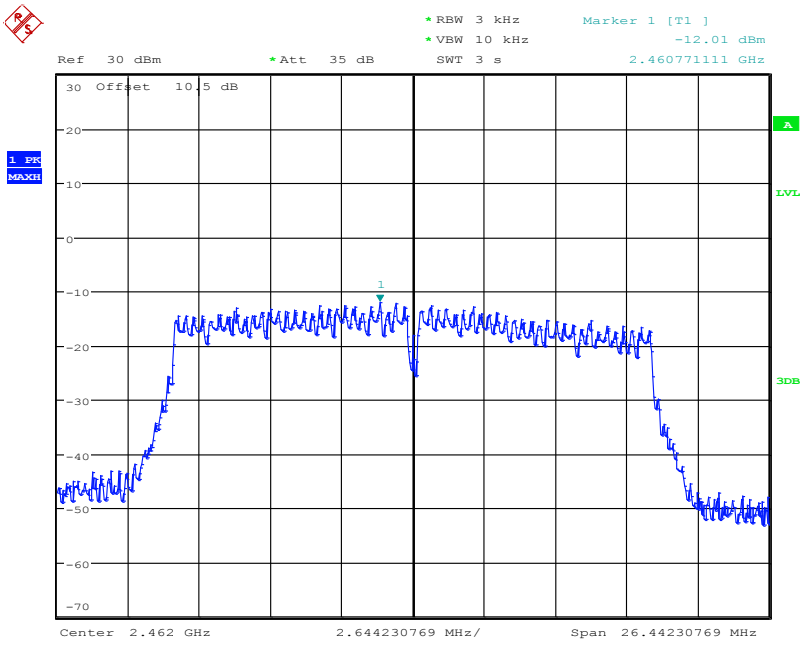
Date: 14.JAN.2019 14:58:48

Middle Channel



Date: 14.JAN.2019 15:03:04

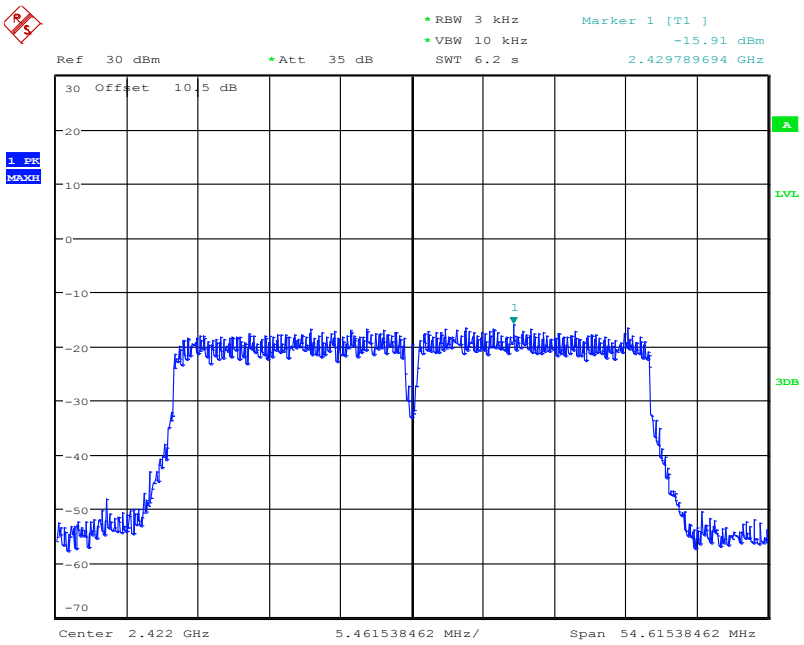
High Channel



Date: 14.JAN.2019 15:04:37

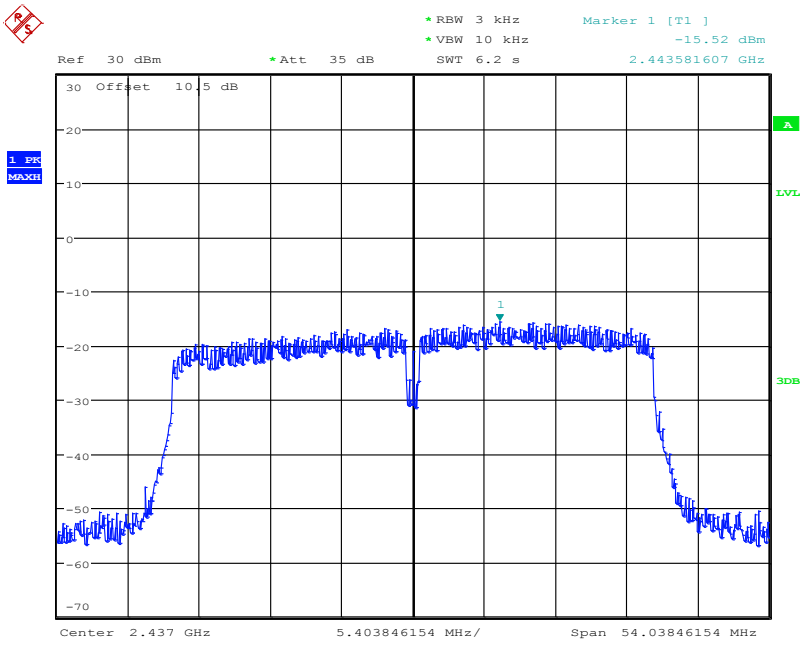
N40 Mode

Low Channel



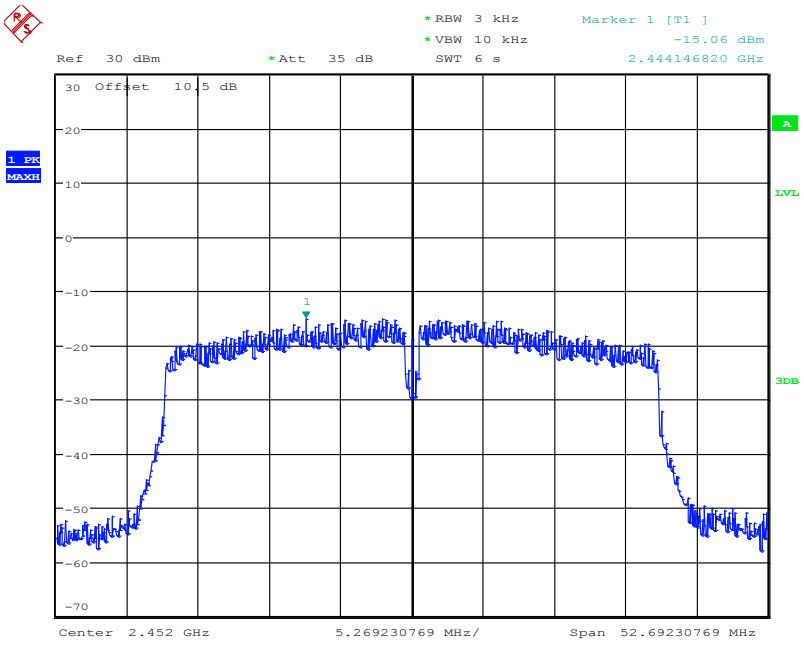
Date: 14.JAN.2019 15:06:43

Middle Channel



Date: 14.JAN.2019 15:08:27

High Channel



Date: 14.JAN.2019 15:09:57

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