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TESTING LABORATORY
CERTIFICATE # 4821.01

BACL
Bay Area Compliance Labs Corp.

FCC PART 15.247
TEST REPORT

For

Astera LED-Technology GmbH

Stahlgruberring 36, Munich, Germany 81829

FCC ID: X55FP5-E26

Report Type:	**Product Type:**
Original Report	NYX Bulb

Report Number: RSZ200701011-00

Report Date: 2020-09-08

Reviewed By: Jimmy Xiao RF Engineer

Jimmy Xiao

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Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★".

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	NYX Bulb
Model	FP5-E26
Frequency Range	917.0-922.2MHz
Maximum Conducted Peak Output Power	9.47dBm
Antenna Specification	-1.0dBi
Modulation Type	GFSK
Voltage Range	100-120V, 50/60Hz or DC 5-18V
Date of Test	2020-06-23 to 2020-08-27
Sample serial number	RSZ200701011-RF-S1 (Assigned by BACL, Shenzhen)
Received date	2020-06-22
Sample/EUT Status	Good condition

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

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.

For Radiated Emissions testing, please refer to DA 00-705 Released March 30, 2000, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

Frequency range: 917-922.2MHz, Channel spacing: 100 kHz, total channels: 53.

Low Channel: 917MHz (CH0); Middle Channel: 919.6MHz (CH26); High Channel: 922.2MHz (CH52) were selected to test.

EUT Exercise Software

Software "AsteraApp_9.96" was used and the power level is default.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

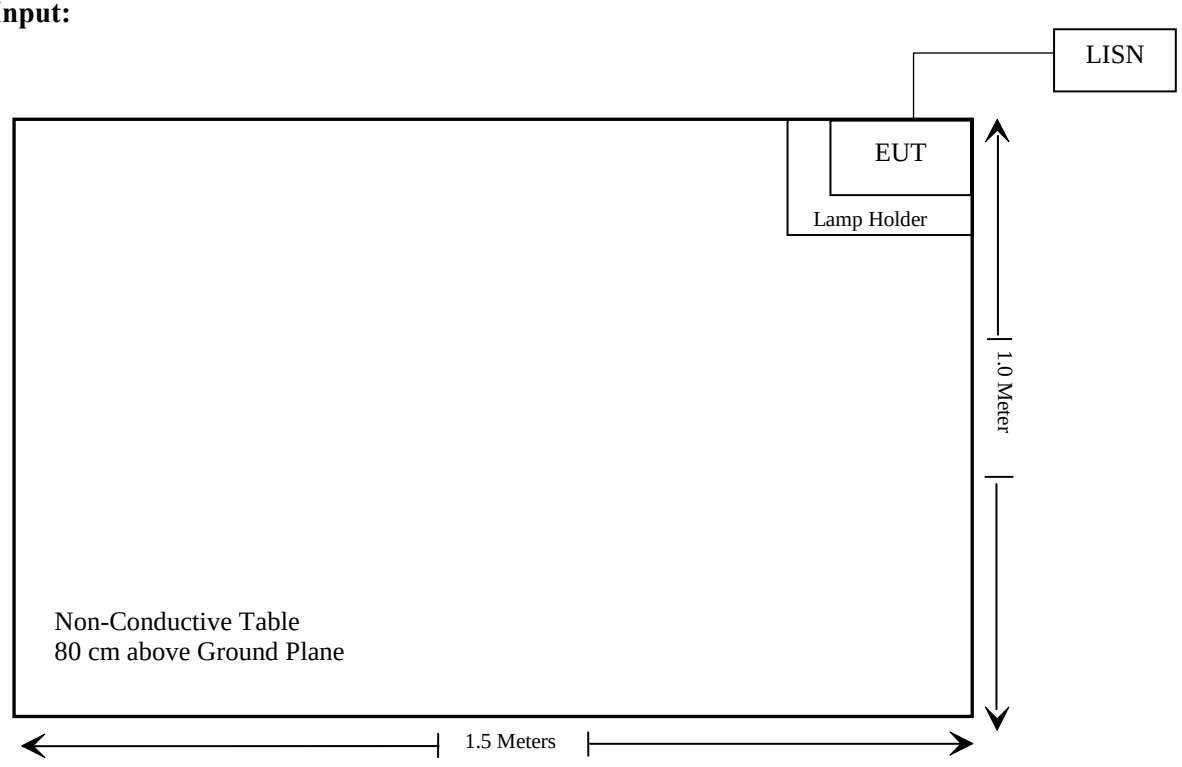
Manufacturer	Description	Model	Serial Number
Unknown	Lamp holder	Unknown	Unknown
Dongguan Aohai	Adapter	A8-501000	A1906034835

External I/O Cable

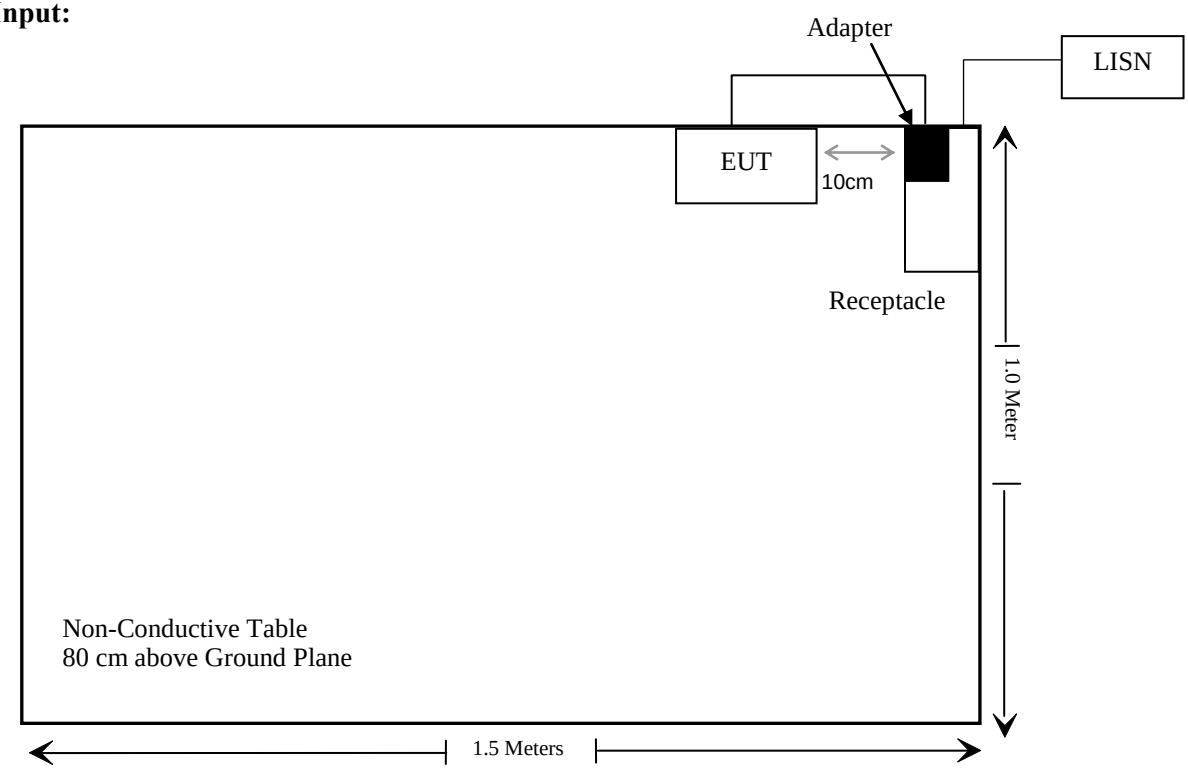
Cable Description	Length (m)	From Port	To
Un-shielded Un-detachable AC Cable	1.0	Lamp Holder	LISN
Un-shielding Detachable DC Power Cable	0.3	EUT	Adapter

Block Diagram of Test Setup

AC Input:



DC Input:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Peak Output Power Measurement	Compliance
§15.247(d)	Band edges	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2020/7/9	2021/7/8
Rohde & Schwarz	LISN	ENV216	101613	2020/1/22	2021/1/21
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2020/7/9	2021/7/8
Sonoma instrument	Pre-amplifier	310 N	186238	2020/4/20	2021/4/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019/7/22	2020/07/21
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
OuLiTong	Band Reject filter	902-928MHz	OE01902427	2020/04/20	2021/04/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2017/12/6	2020/12/5
RF Conducted Test					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2020/3/1	2021/3/1
WEINSCHEL	10dB Attenuator	5324	AU3842	2019/11/29	2020/11/28
Unknown	RF Cable	Unknown	2301 276	2019/11/29	2020/11/28

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

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

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

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm2)
P = power input to the antenna (in appropriate units, e.g., mW).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

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

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

Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBi)	(numeric)	(dBm)	(mW)			
917.0-922.2	-1.0	0.79	10.00	10.00	20	0.002	0.61
802.11b 2412-2462	3.4	2.19	27.00	501.19	20	0.2183	1.0
802.11g 2412-2462	3.4	2.19	26.00	398.11	20	0.1734	1.0
802.11n20 2412-2462	3.4	2.19	26.00	398.11	20	0.1734	1.0
802.11n40 2422-2452	3.4	2.19	27.00	501.19	20	0.2183	1.0
BLE 2402-2480	3.4	2.19	7.00	5.01	20	0.0022	1.0
BT 2402-2480	3.4	2.19	9.00	7.94	20	0.0035	1.0

Note: 1. The tune up conducted power was declared by the applicant
2. The BLE, Wi-Fi function can transmit at the same time with the 900M radio.
3. Please refer to the report of the FCC ID: 2AC7Z-ESP32WROVERE for the Bluetoothe and Wi-Fi output power.

So the worst simultaneous transmitting consideration:

The ratio=$MPE_{900MRadio}$/limit + $MPE_{Wi\text{-}Fi}$/limit=0.002/0.61+0.2183/1.0=0.2216＜1.0

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC §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 use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has one internal antenna arrangement which was permanently attached and the antenna gain is -1.0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

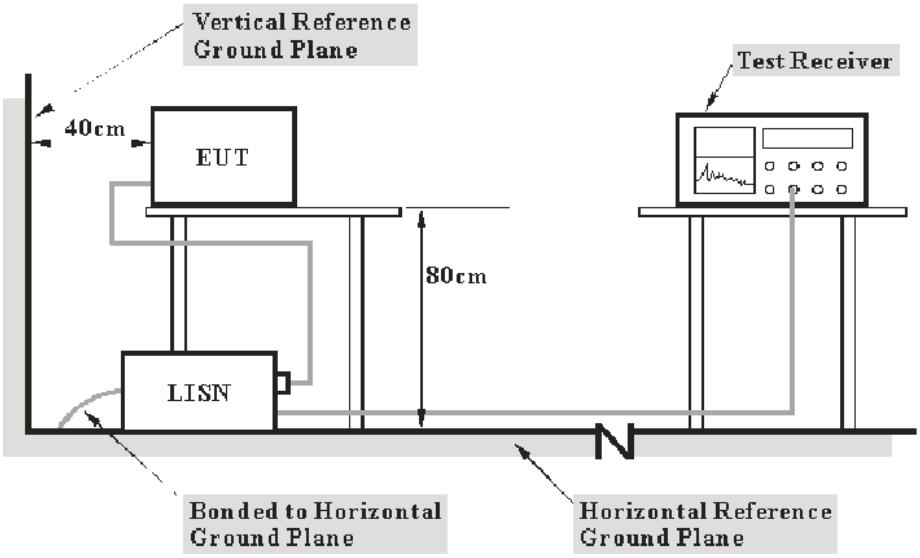
Result: Pass

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

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

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

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

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

Corrected Factor & Margin Calculation

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

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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 = Limit – Corrected Amplitude

Test Data

Environmental Conditions

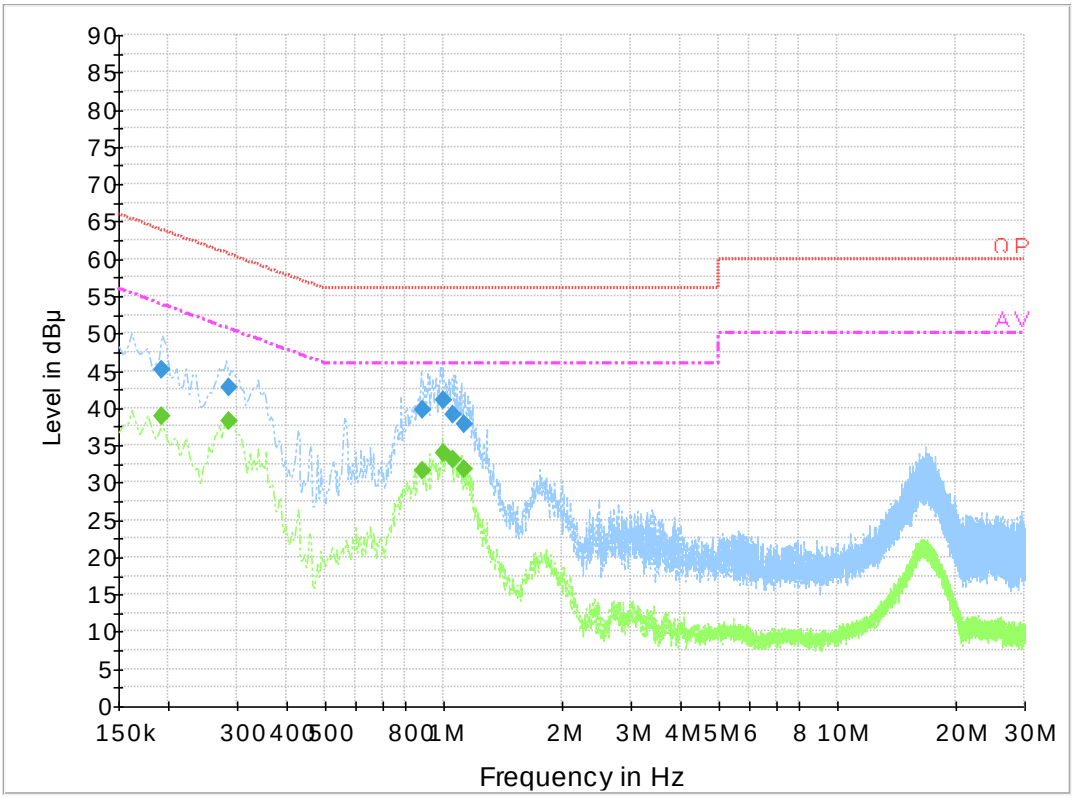
Temperature:	25 ℃
Relative Humidity:	65 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-07-22.

EUT operation mode: Transmitting & Lighting

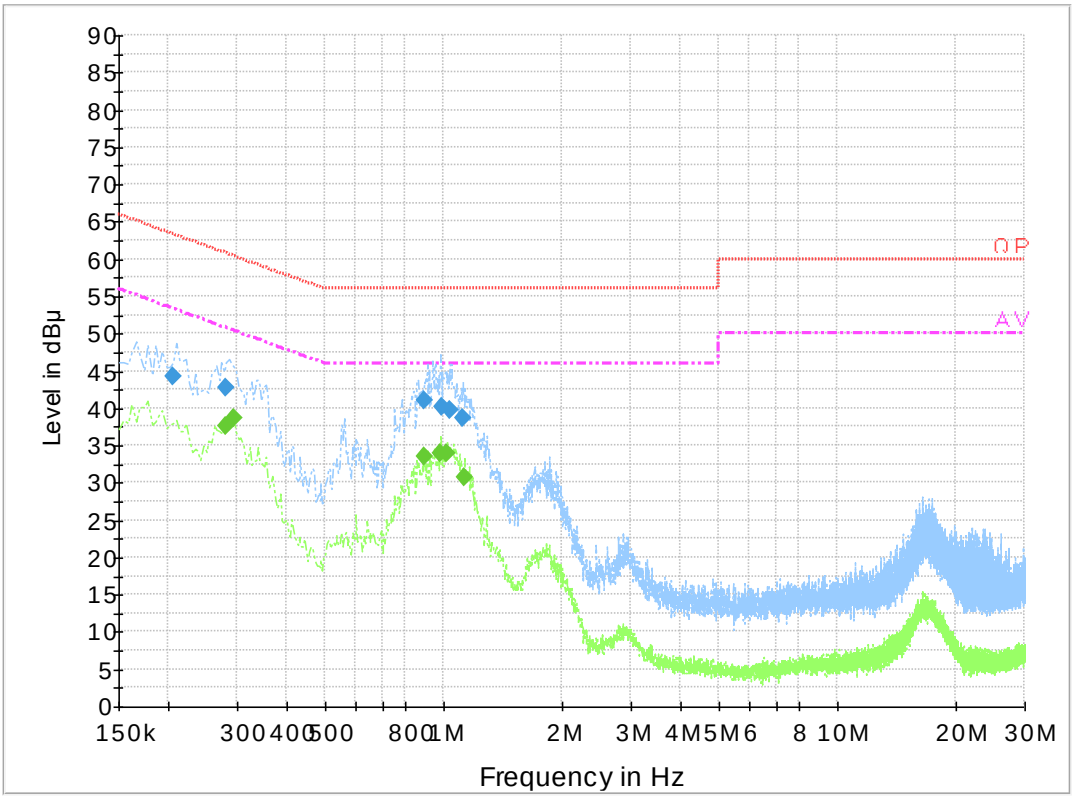
AC Input:

AC 120V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.193500	45.0	19.8	63.9	18.9	QP
0.286500	42.8	19.7	60.6	17.8	QP
0.891170	39.7	19.8	56.0	16.3	QP
1.000790	41.1	19.9	56.0	14.9	QP
1.057890	39.2	19.9	56.0	16.8	QP
1.128930	37.9	19.8	56.0	18.1	QP
0.193500	38.9	19.8	53.9	15.0	Ave.
0.286500	38.2	19.7	50.6	12.4	Ave.
0.891170	31.5	19.8	46.0	14.5	Ave.
1.000790	33.9	19.9	46.0	12.1	Ave.
1.057890	33.1	19.9	46.0	12.9	Ave.
1.128930	31.7	19.8	46.0	14.3	Ave.

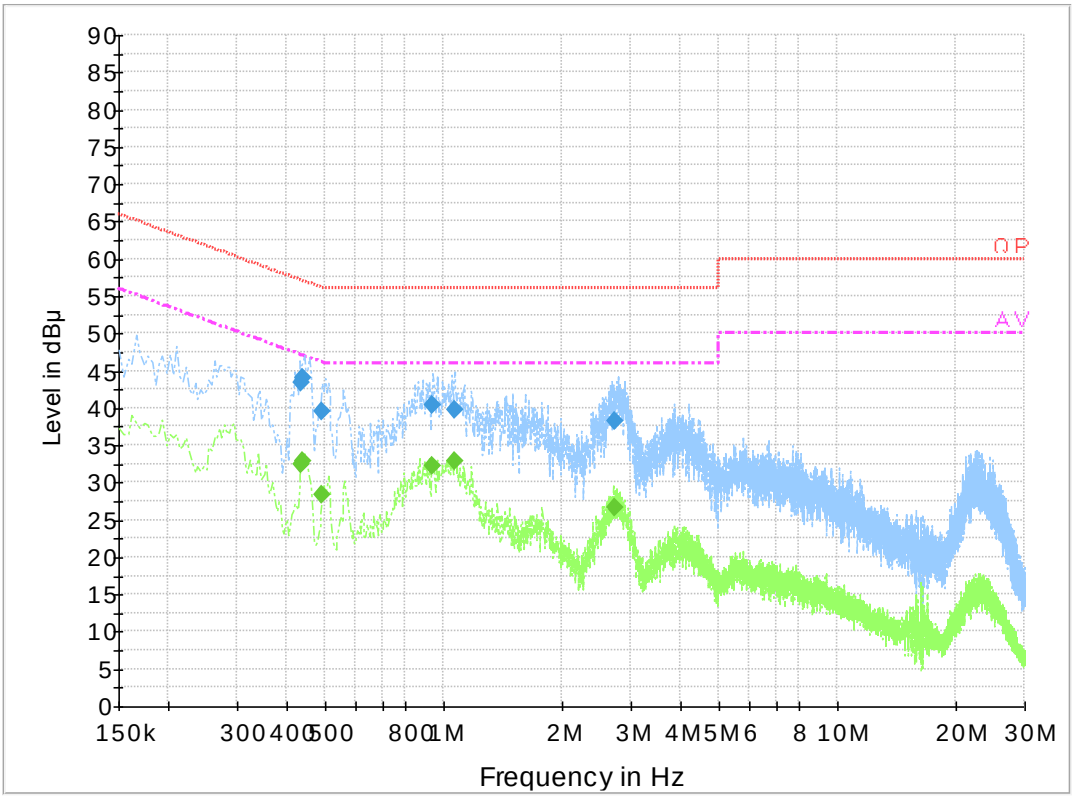
AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.205500	44.3	19.8	63.4	19.1	QP
0.281500	42.8	19.7	60.8	18.0	QP
0.892470	40.9	19.7	56.0	15.1	QP
0.995210	40.2	19.8	56.0	15.8	QP
1.038250	39.7	19.8	56.0	16.3	QP
1.124990	38.7	19.8	56.0	17.3	QP
0.282000	37.5	19.7	50.8	13.2	Ave.
0.294000	38.6	19.7	50.4	11.8	Ave.
0.894000	33.4	19.7	46.0	12.6	Ave.
0.986000	33.9	19.8	46.0	12.1	Ave.
1.026000	34.0	19.8	46.0	12.0	Ave.
1.134000	30.8	19.8	46.0	15.2	Ave.

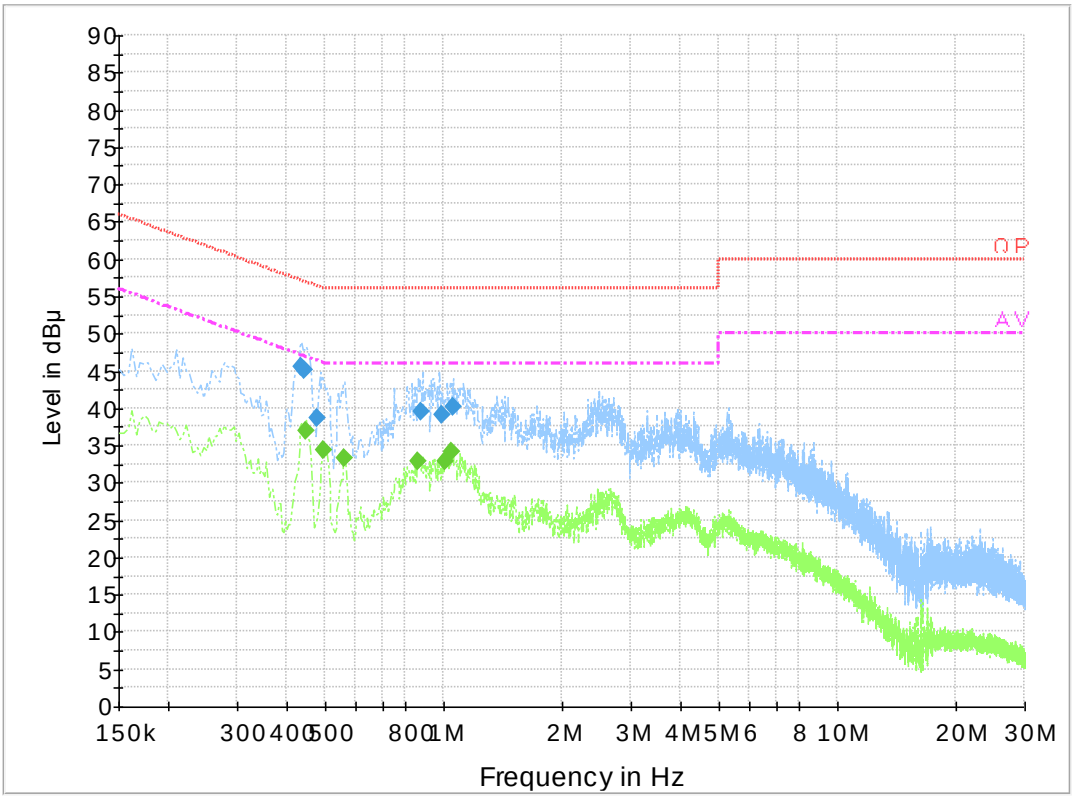
DC Input:

Adapter connected to AC 120V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.435550	43.3	19.8	57.1	13.8	QP
0.439310	44.1	19.8	57.1	13.0	QP
0.494470	39.6	19.8	56.1	16.5	QP
0.935870	40.3	19.8	56.0	15.7	QP
1.069950	39.8	19.9	56.0	16.2	QP
2.736390	38.2	19.9	56.0	17.8	QP
0.435550	32.5	19.8	47.1	14.6	Ave.
0.439310	33.0	19.8	47.1	14.1	Ave.
0.494470	28.4	19.8	46.1	17.7	Ave.
0.935870	32.3	19.8	46.0	13.7	Ave.
1.069950	32.9	19.9	46.0	13.1	Ave.
2.736390	26.7	19.9	46.0	19.3	Ave.

Adapter connected to AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.436450	45.5	19.8	57.1	11.6	QP
0.444570	45.0	19.8	57.0	11.9	QP
0.478710	38.6	19.8	56.4	17.7	QP
0.880710	39.4	19.7	56.0	16.6	QP
0.992670	39.0	19.8	56.0	17.0	QP
1.058130	40.3	19.8	56.0	15.7	QP
0.450000	37.0	19.8	46.9	9.8	Ave.
0.498000	34.5	19.8	46.0	11.6	Ave.
0.562000	33.3	19.8	46.0	12.7	Ave.
0.866000	32.9	19.8	46.0	13.1	Ave.
1.010000	32.9	19.8	46.0	13.1	Ave.
1.050000	34.1	19.8	46.0	11.9	Ave.

Note:
1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

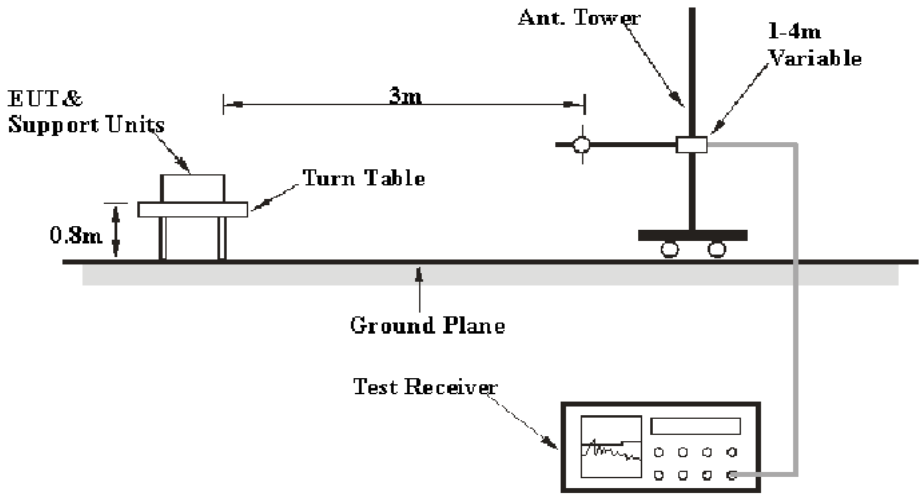
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

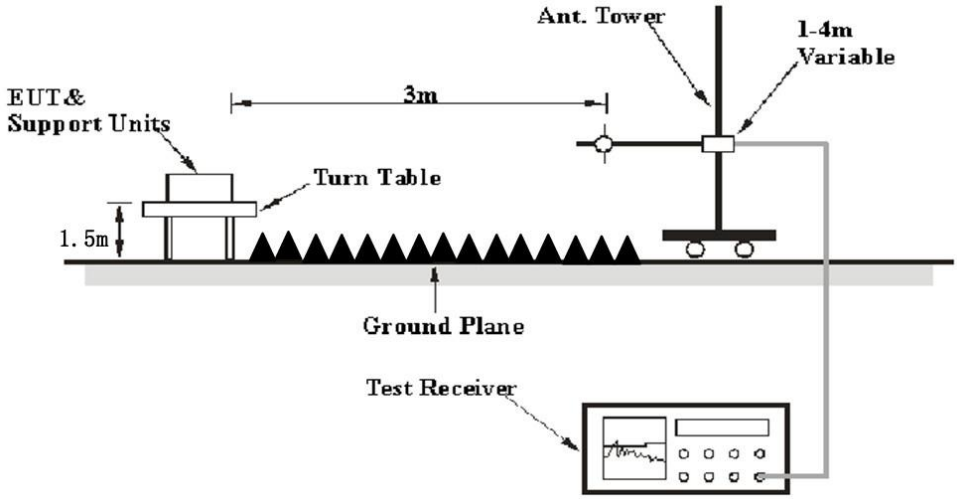
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, according to the DA 00-705 Released March 30, 2000, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Average

Test Procedure

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

All final data was recorded in Quasi-peak detection mode for frequency range of 30 MHz -1 GHz and peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude 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:

Corrected Amplitude = Meter Reading + 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 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Data

Environmental Conditions

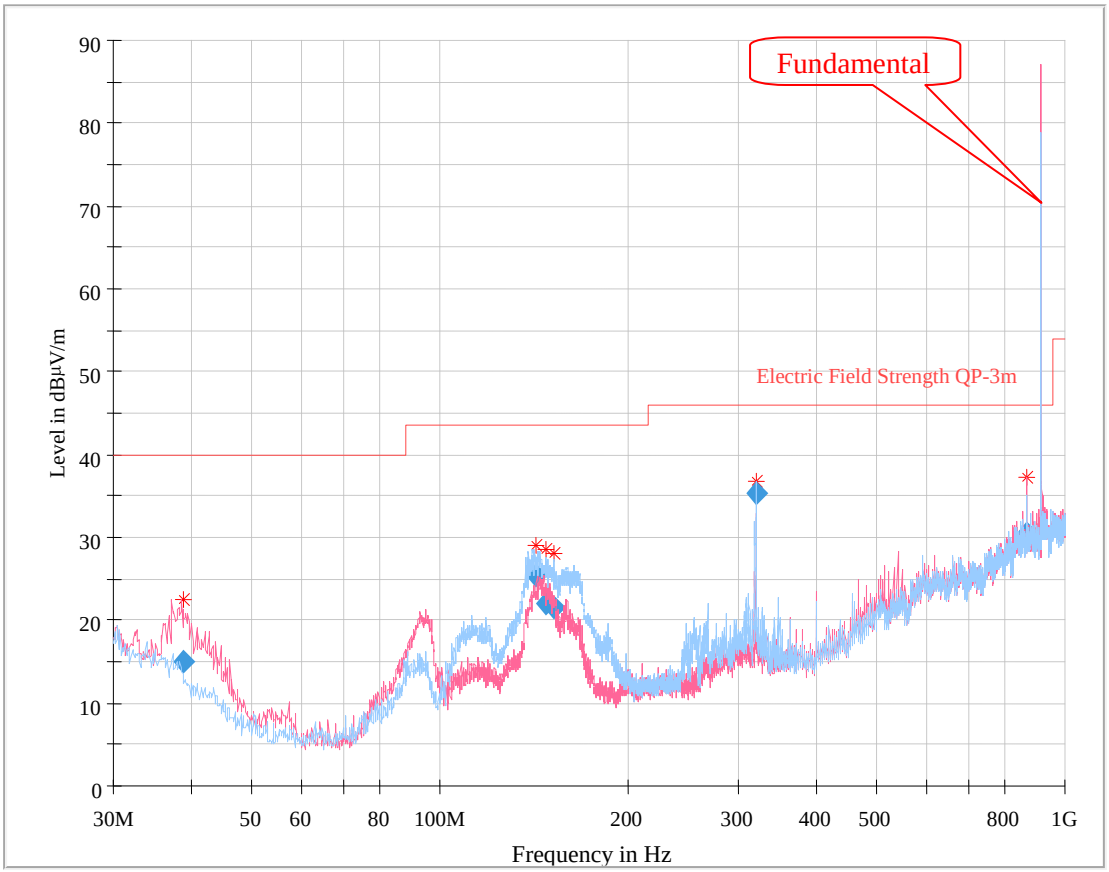
Temperature:	23~28 ℃
Relative Humidity:	55~58 %
ATM Pressure:	101.0 kPa

The testing was performed by Harris He on 2020-07-13 for below 1GHz and Leo Huang on 2020-06-25 for Above 1GHz.

EUT operation mode: Transmitting & Lighting

AC Input:

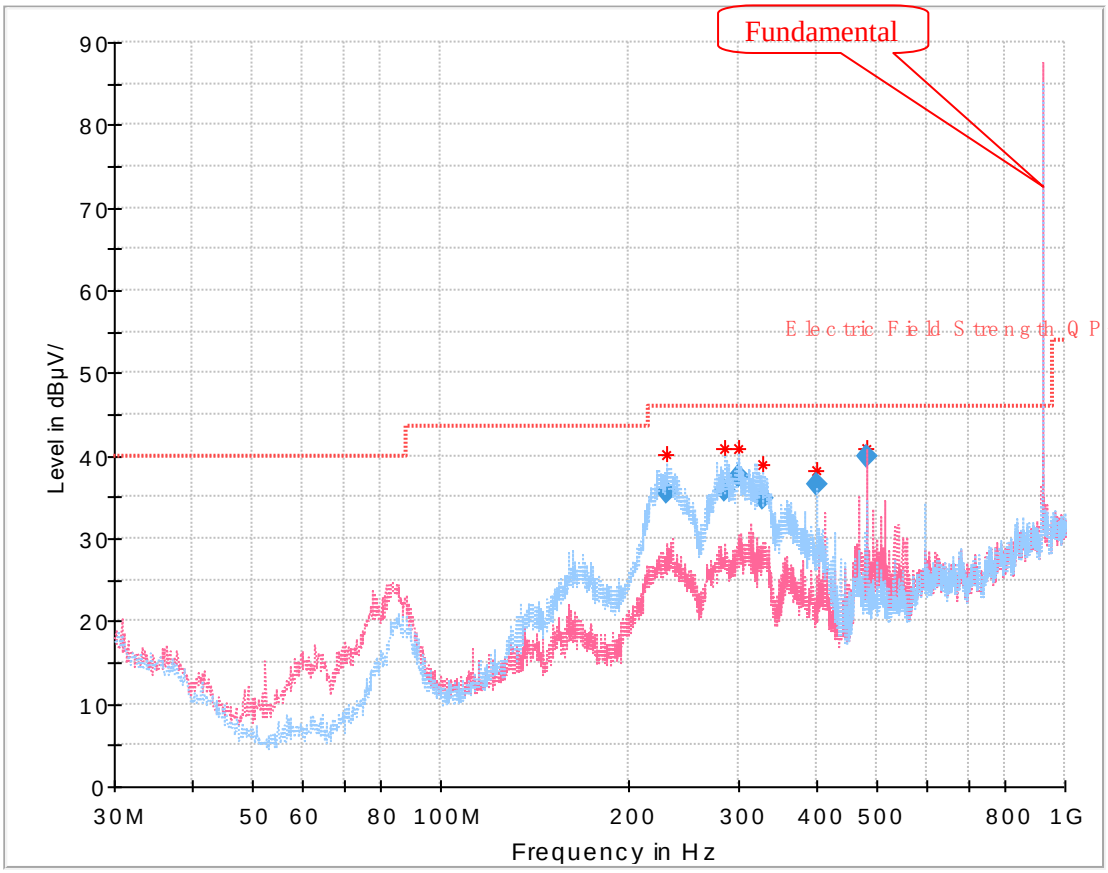
30 MHz~1 GHz (Low channel was worst case):



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
38.762500	15.11	108.0	V	144.0	-13.0	40.00	24.89
142.033500	25.33	203.0	H	257.0	-14.2	43.50	18.17
147.748375	22.02	211.0	H	250.0	-14.2	43.50	21.48
152.239000	21.45	188.0	H	26.0	-14.2	43.50	22.05
320.044625	35.32	109.0	H	134.0	-10.7	46.00	10.68
869.006500	30.40	153.0	V	108.0	3.5	46.00	15.60

DC Input:

30 MHz~1 GHz (Low channel was worst case):



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
230.439125	35.55	146.0	H	101.0	-14.0	46.00	10.45
285.846500	35.72	110.0	H	209.0	-11.6	46.00	10.28
300.010125	37.56	102.0	H	204.0	-10.6	46.00	8.44
328.025250	34.83	109.0	H	195.0	-10.7	46.00	11.17
399.997750	36.50	102.0	H	180.0	-10.3	46.00	9.50
479.980250	39.80	103.0	V	58.0	-6.4	46.00	6.20

1 GHz - 10 GHz:

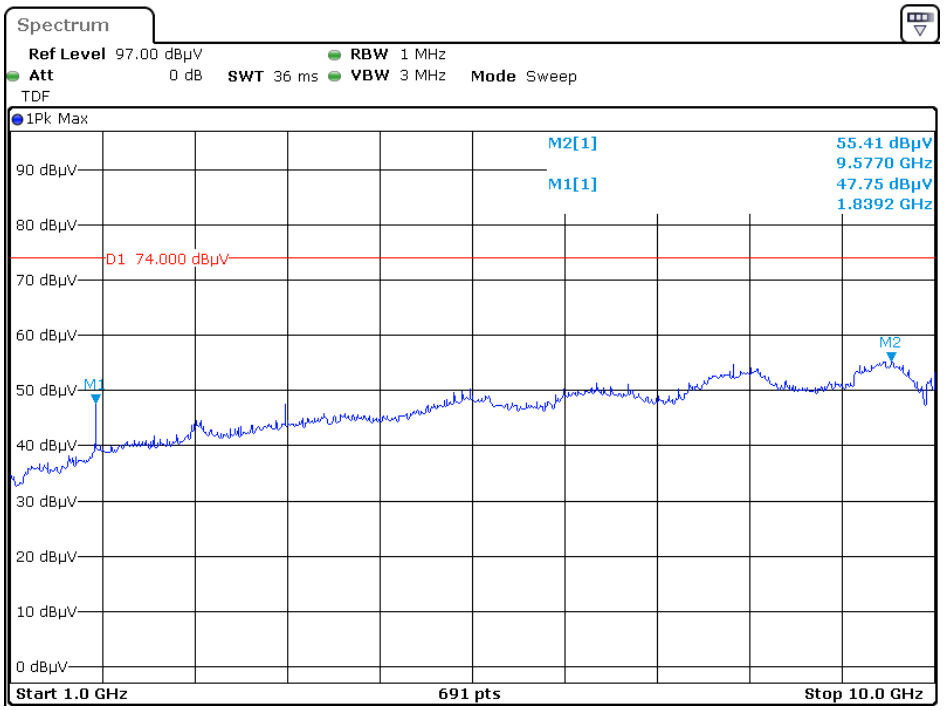
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (917.0MHz)									
1834.00	50.14	PK	24	1.6	H	-1.55	48.59	74	25.41
1834.00	46.48	Ave.	24	1.6	H	-1.55	44.93	54	9.07
1834.00	47.93	PK	138	1.5	V	-1.55	46.38	74	27.62
1834.00	43.06	Ave.	138	1.5	V	-1.55	41.51	54	12.49
Middle Channel(919.6MHz)									
1839.20	50.71	PK	188	1.5	H	-1.55	49.16	74	24.84
1839.20	47.50	Ave.	188	1.5	H	-1.55	45.59	54	8.41
1839.20	47.09	PK	56	2.4	V	-1.55	45.54	74	28.46
1839.20	42.01	Ave.	56	2.4	V	-1.55	40.42	54	13.58
High Channel(922.2MHz)									
1844.40	47.22	PK	222	1.3	H	-1.55	45.67	74	28.33
1844.40	42.57	Ave.	222	1.3	H	-1.55	41.02	54	12.98
1844.40	46.09	PK	145	1.3	V	-1.55	44.54	74	29.46
1844.40	39.50	Ave.	145	1.3	V	-1.55	37.95	54	16.05

Co-location Transmitting (802.11b mode 2437MHz + SRD 919.6MHz)

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
320.04	47.94	QP	152	1.9	H	-10.7	37.24	46	8.76
320.04	43.87	QP	299	2.2	V	-10.7	33.17	46	12.83
1839.20	49.82	PK	93	1.2	H	-1.55	48.27	74	25.73
1839.20	46.79	Ave.	93	1.2	H	-1.55	45.24	54	8.76
4874.00	46.36	PK	233	1.7	H	6.76	53.12	74	20.88
4874.00	29.85	Ave.	233	1.7	H	6.76	36.61	54	17.39

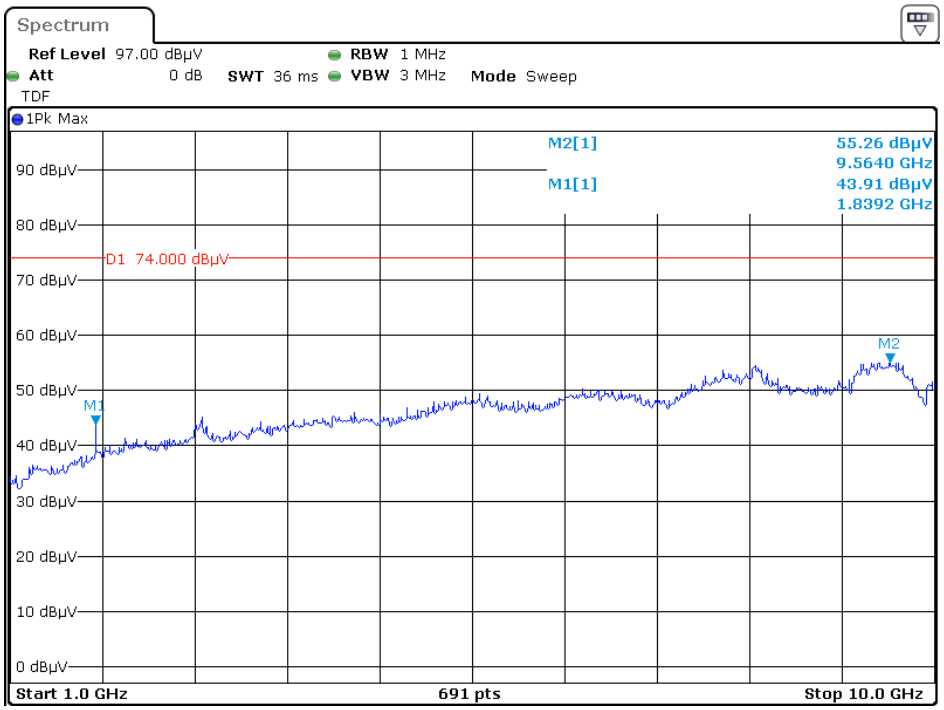
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.

Pre-scan with Middle channel Peak
Horizontal



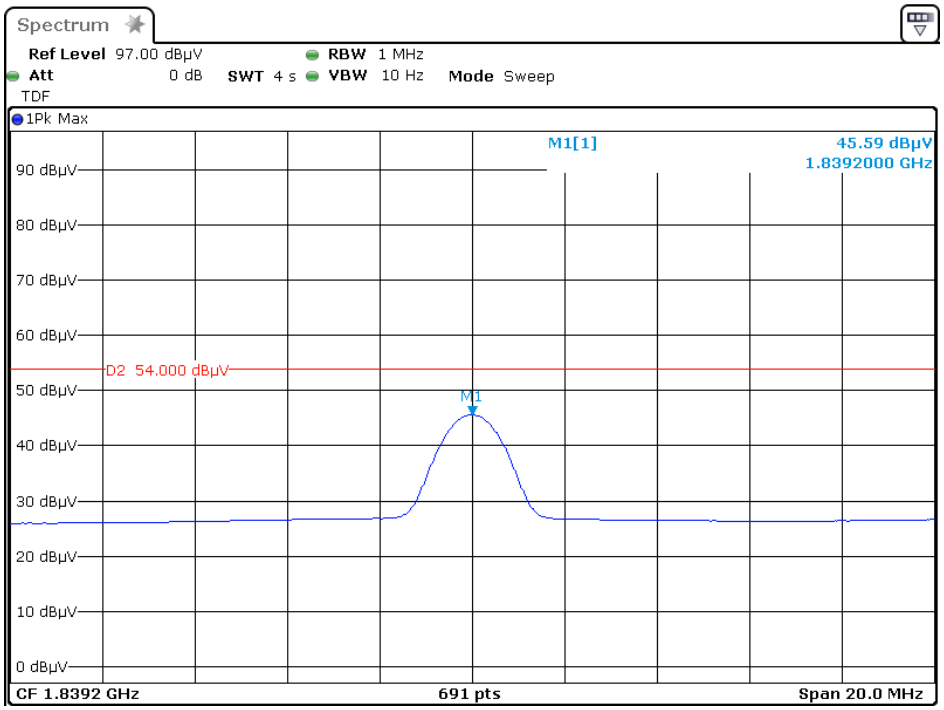
Date: 25.JUN.2020 13:30:37

Vertical



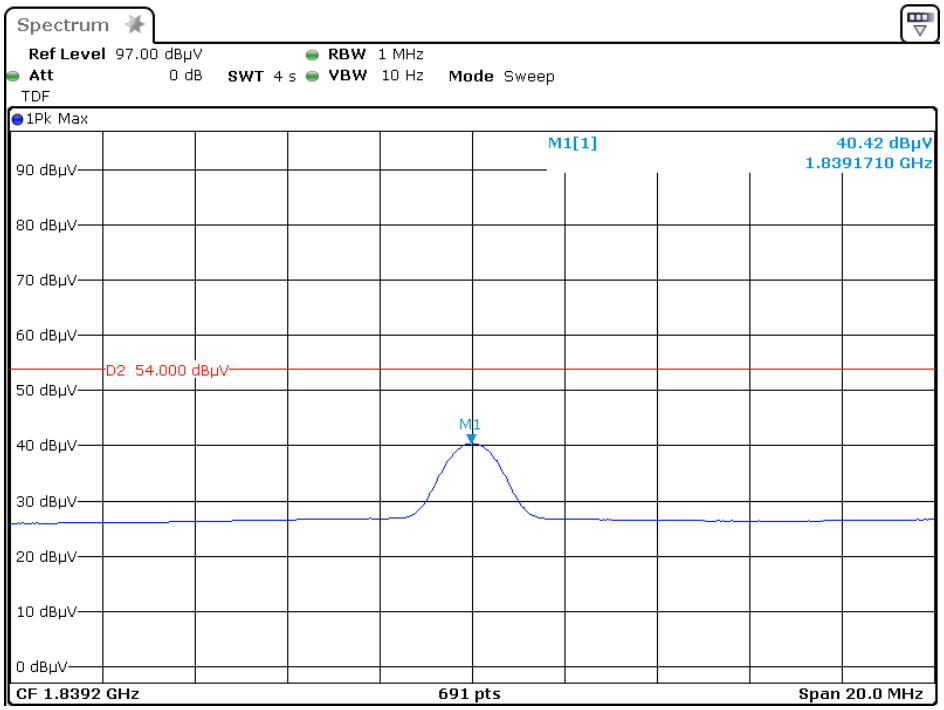
Date: 25.JUN.2020 13:36:48

Average
Horizontal



Date: 25.JUN.2020 13:33:20

Vertical



Date: 25.JUN.2020 13:40:47

FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

Applicable Standard

Frequency hopping systems shall have hoping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-08-27.

EUT operation mode: Transmitting

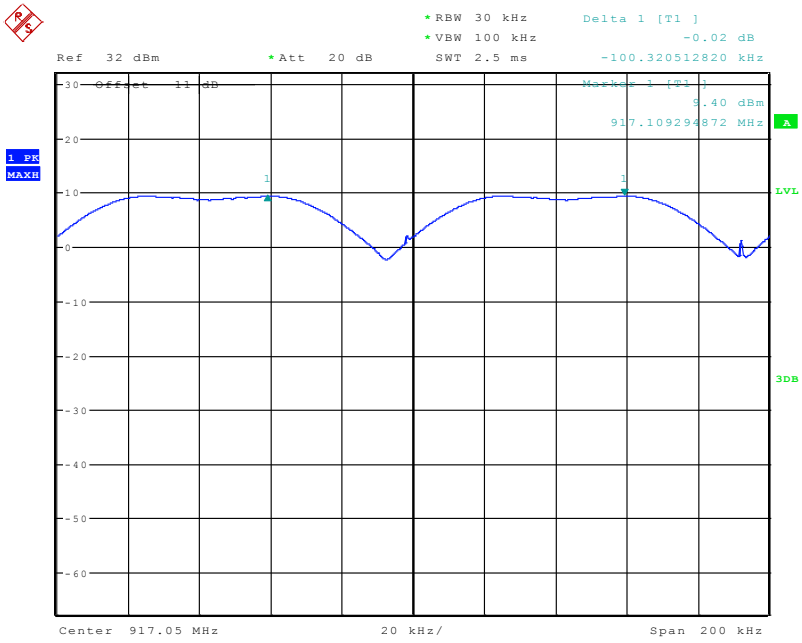
Test Result: Pass

Please refer to following table and plots.

Channel	Channel Separation (MHz)	Limit (MHz)	Result
Low	0.100	0.069	Compliance
Middle	0.100	0.069	Compliance
High	0.101	0.066	Compliance

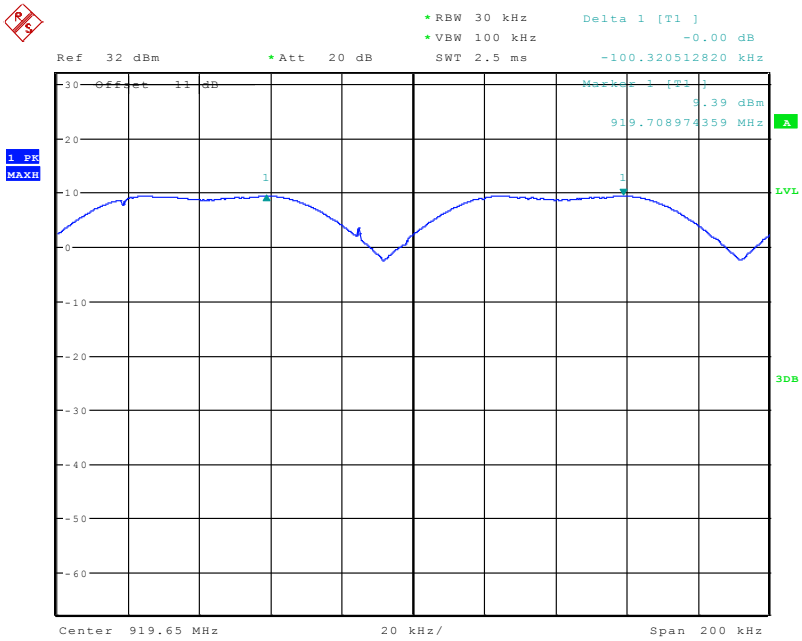
Please refer to the following plots.

Low Channel



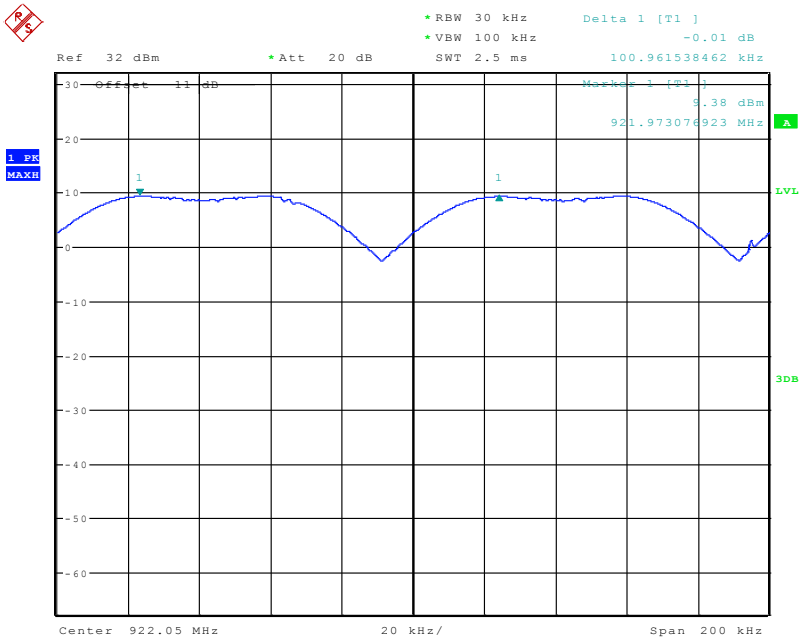
Date: 27.AUG.2020 17:08:21

Middle Channel



Date: 27.AUG.2020 17:09:15

High Channel



Date: 27.AUG.2020 17:06:42

FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH

Applicable Standard

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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 it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-08-27.

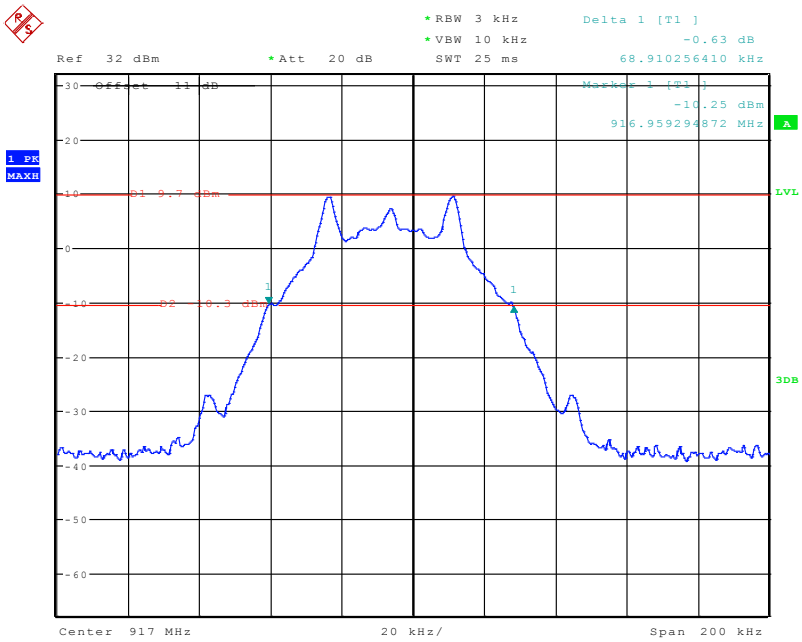
EUT operation mode: Transmitting

Test Result: Pass

Please refer to following table and plots.

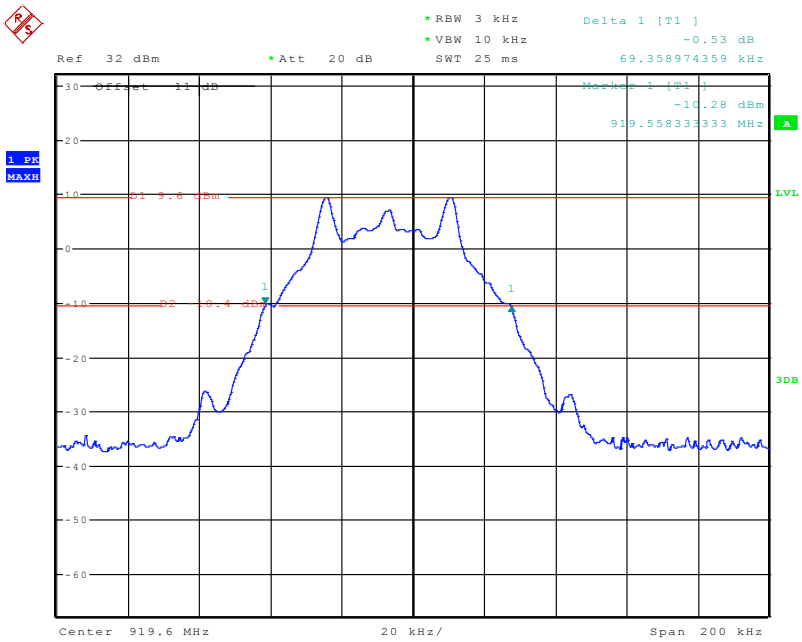
Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
Low	917.0	0.069
Middle	919.6	0.069
High	922.2	0.066

Low Channel



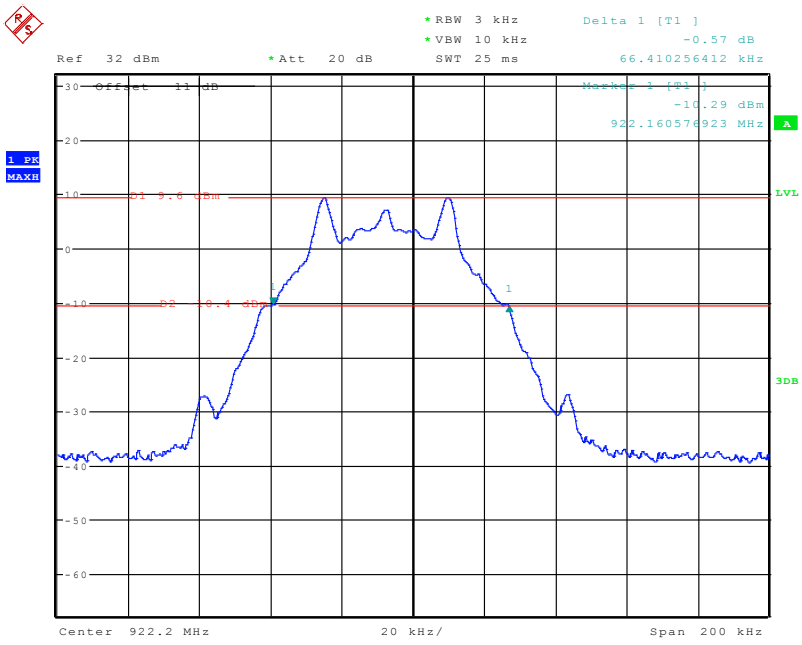
Date: 27.AUG.2020 16:42:05

Middle Channel



Date: 27.AUG.2020 16:57:54

High Channel



Date: 27.AUG.2020 17:01:22

FCC §15.247(a) (1) (iii)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure

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

2. Set the EUT in hopping mode from first channel to last.

3. By using the max-hold function record the quantity of the channel.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-08-27.

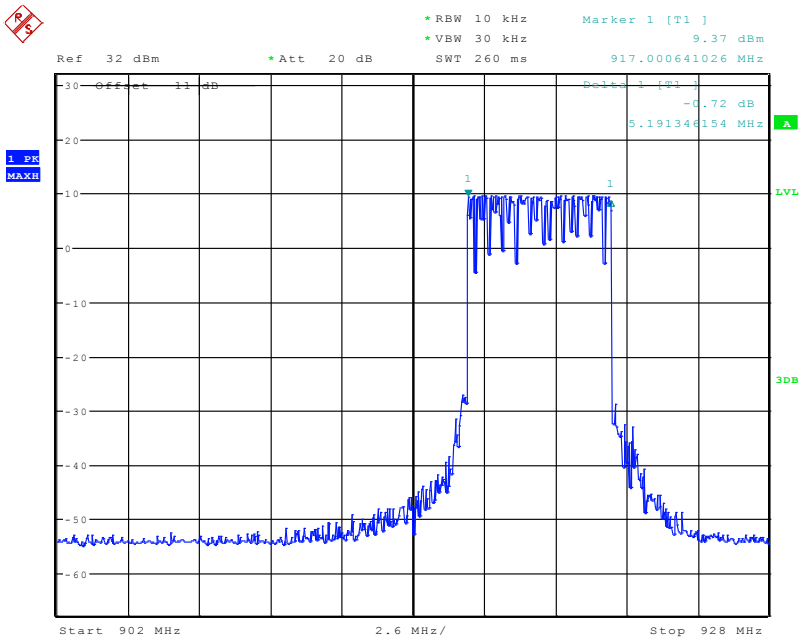
EUT operation mode: Transmitting

Test Result: Pass

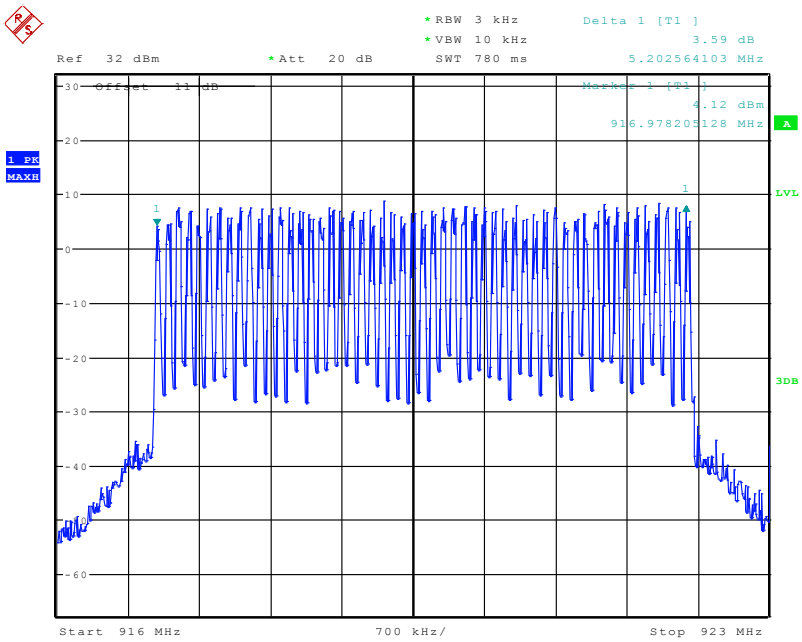
Please refer to following table and plots.

Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
902-928	53	≥50

Number of Hopping Channels



Date: 27.AUG.2020 17:25:08



Date: 27.AUG.2020 17:54:52

FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure

1. The EUT was worked in channel hopping.
2. Set the RBW≤ channel spacing
3. Set the VBW ≥ 3×RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

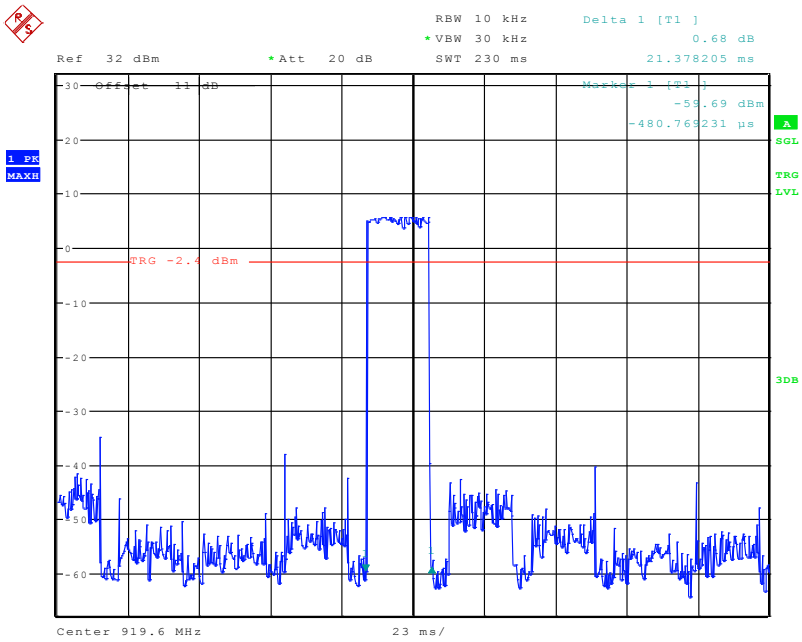
The testing was performed by Gavin Guo on 2020-08-27.

EUT operation mode: Transmitting

Please refer to following table and plots

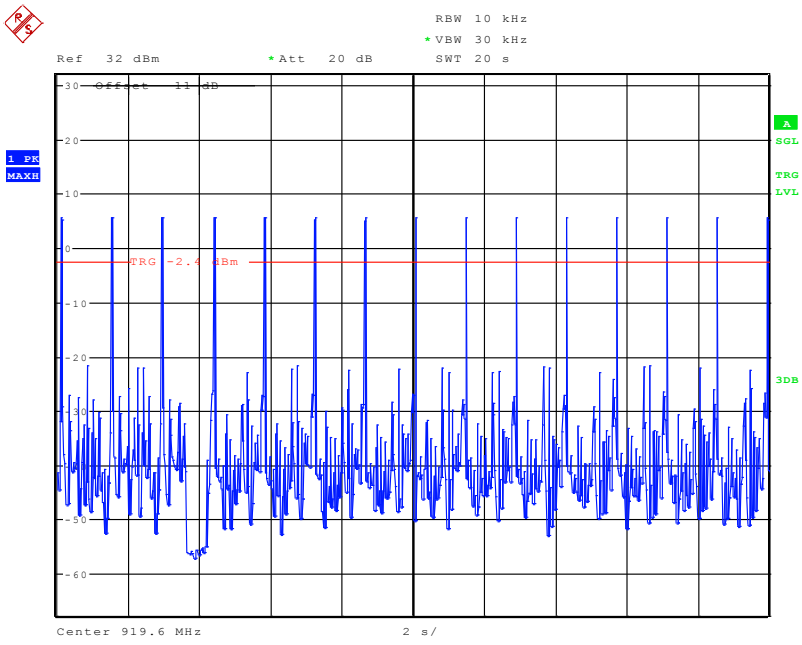
Frequency (MHz)	Pulse Time (ms)	Hopping Number	Period Time (s)	Total of Dwell (ms)	Limit (ms)	Result
919.6	21.378	15	20	320.67	<400	Pass

Pulse time



Date: 27.AUG.2020 19:00:32

Hopping Number in 20s



Date: 27.AUG.2020 19:03:37

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Test Procedure

1. Place the EUT on a bench and set in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-08-27.

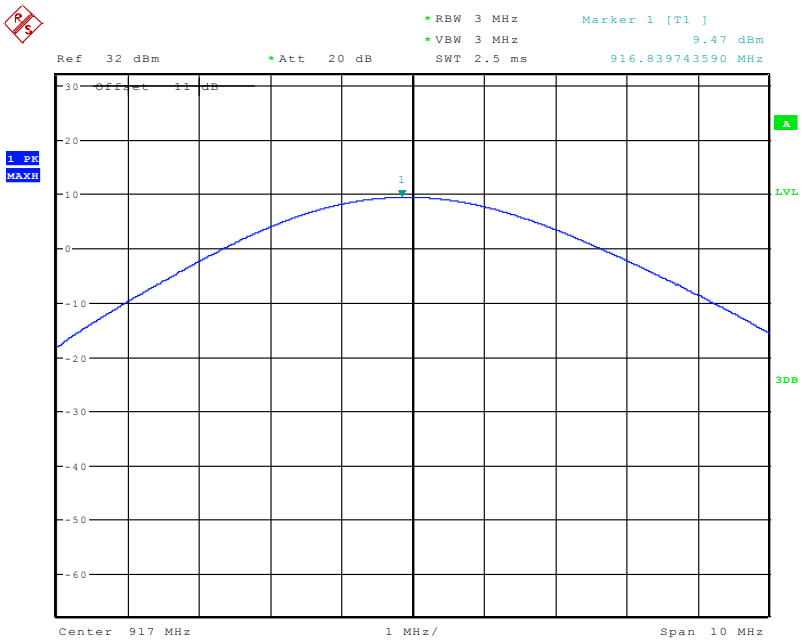
EUT operation mode: Transmitting

Test Result: Pass

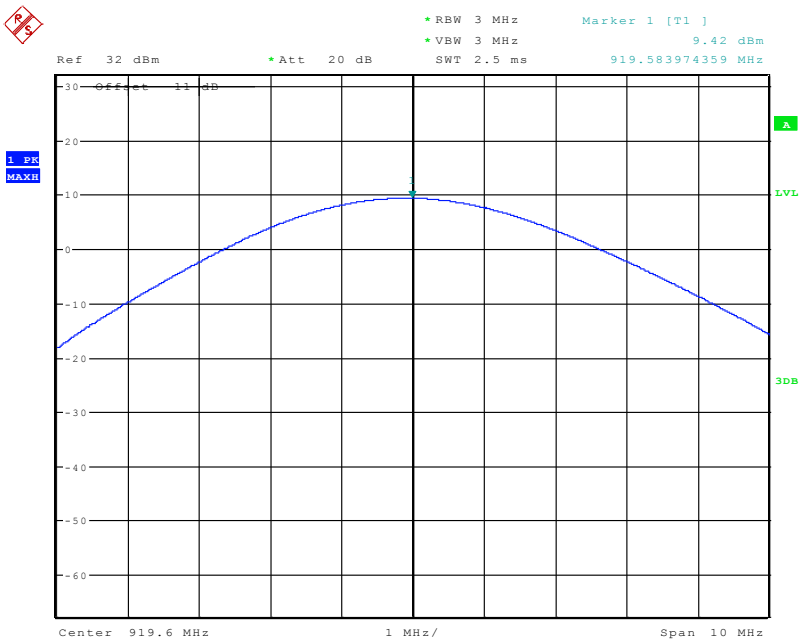
Please refer to following table.

Channel	Frequency (MHz)	Condcuted Peak Ouput Power (dBm)	Limit (dBm)
Low	917.0	9.47	30
Middle	919.6	9.42	30
High	922.2	9.38	30

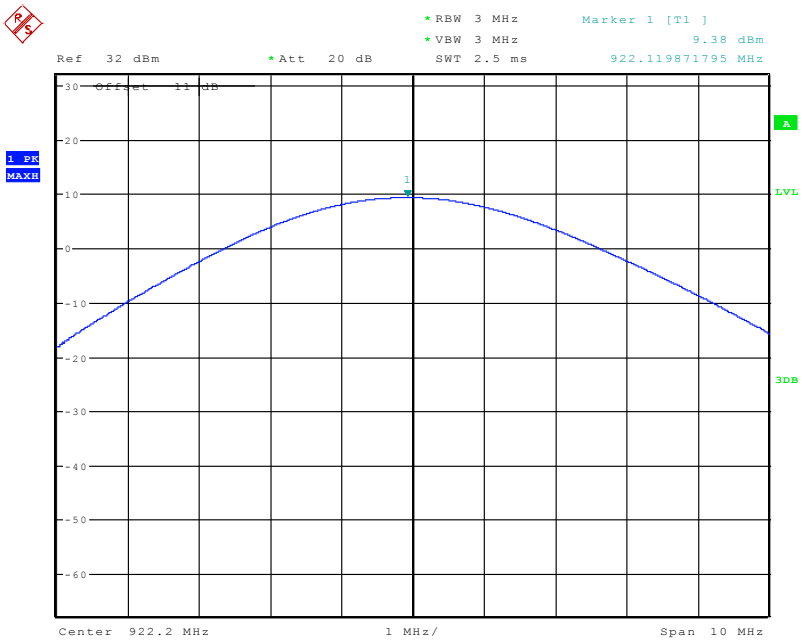
Low Channel



Middle Channel



High Channel



Date: 27.AUG.2020 17:01:51

FCC §15.247(d) - BAND EDGES TESTING

Applicable Standard

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)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 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.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Gavin Guo on 2020-08-27.

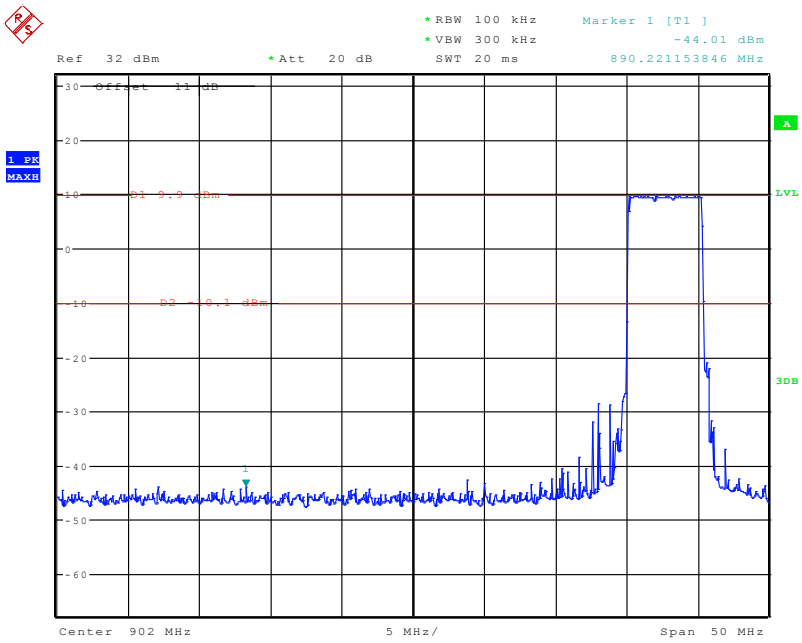
EUT operation mode: Transmitting

Test Result: Pass

Please refer to following plots.

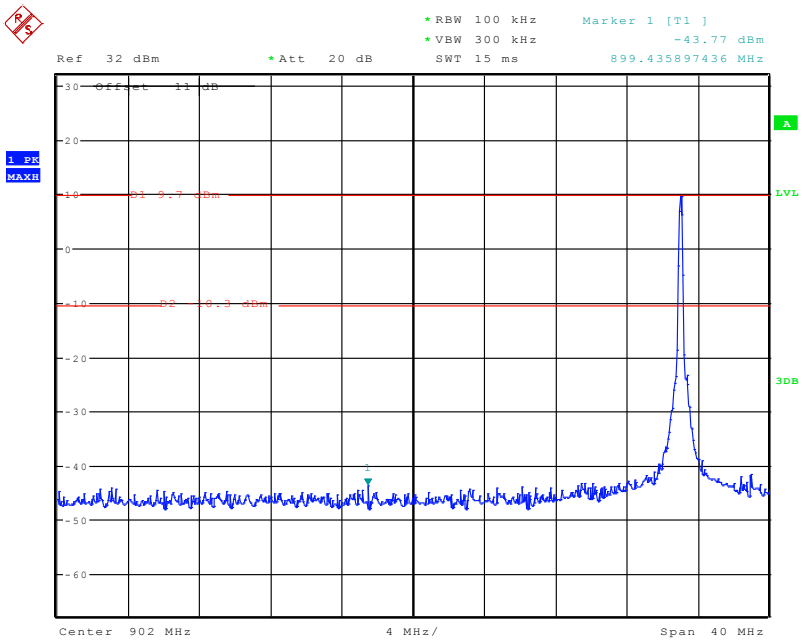
Band Edge-Left Side

Hopping



Date: 27.AUG.2020 17:05:43

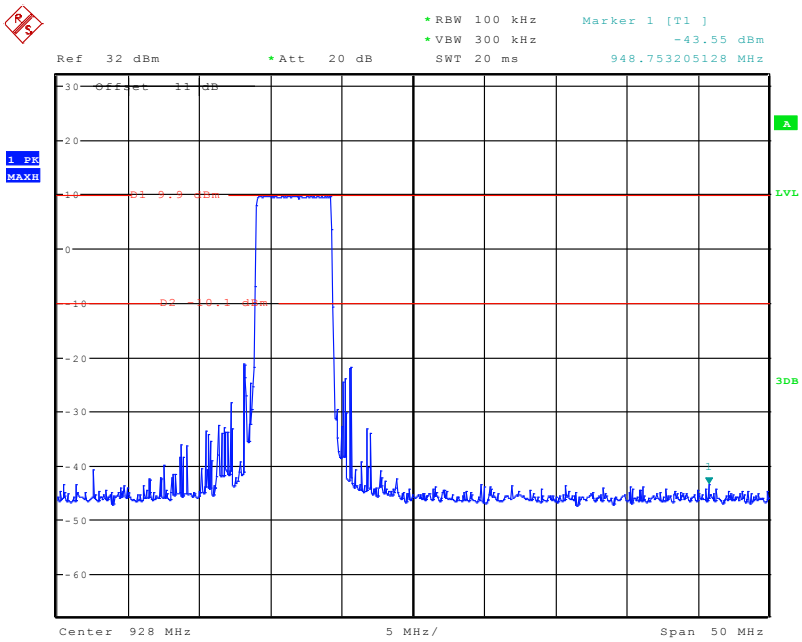
Single



Date: 27.AUG.2020 16:43:33

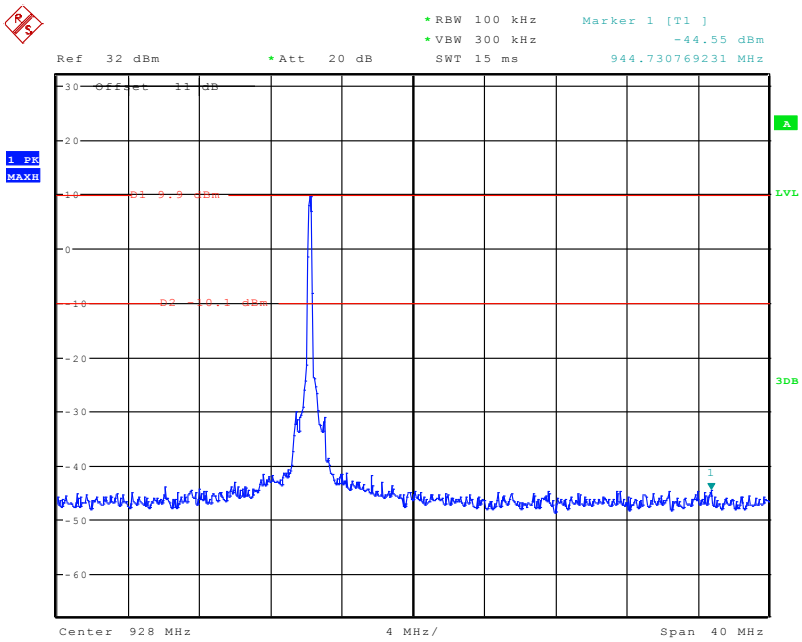
Band Edge-Right Side

Hopping



Date: 27.AUG.2020 17:04:53

Single



Date: 27.AUG.2020 17:02:46

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