ACCREDITED
TESTING LABORATORY
CERTIFICATE # 4821.01

BACL
Bay Area Compliance Labs Corp.

FCC PART 15.247
TEST REPORT

For

GDU-Tech Co., Ltd

11th floor, Tower 1, Novel Park, 4078 Dong Bin Road, Nanshan District, Shenzhen, China

FCC ID: 2AKIE-PD-RC01-0302

Report Type:	**Product Type:**
Original Report	GDU Remote controller

Report Number:	RSZ181016811-00B
Report Date:	2019-01-04
Reviewed By:	Rocky Kang RF Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

Note: This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA* or any agency of the Federal Government. * 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)

The *GDU-Tech Co., Ltd's* product, model number: *CME01-SAGA (FCC ID: 2AKIE-PD-RC01-0302)* or the "EUT" in this report was a *GDU Remote controller,* which was measured approximately: 244 mm (L) * 174 mm (W) * 85 mm (H), rated with input voltage: DC 7.4V from battery.

**All measurement and test data in this report was gathered from production sample serial number: 181016811 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2018-10-16.*

Objective

This test report is prepared on behalf of *GDU-Tech Co., Ltd* 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.

Related Submittal(s)/Grant(s)

Submissions with the plane unit of a system with FCC ID: 2AKIE-PD-SAGA-0302 and FCC Part 15.407 NII submissions with FCC ID: 2AKIE-PD-RC01-0302.

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.

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		±0.5dB
RF conducted test with spectrum		±1.5dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±3℃
Humidity		±6%
Supply voltages		±0.4%

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

For 2405-2473MHz, 18 channels are provided to testing

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2405	10	2441
2	2409	11	2445
3	2413	12	2449
4	2417	13	2453
5	2421	14	2457
6	2425	15	2461
7	2429	16	2465
8	2433	17	2469
9	2437	18	2473

Channel 1, 9, 18 were chosen for testing.

EUT Exercise Software

“Artosyn8020PCTool-v4.4.2.exe” software was used during test, the power level is 10.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

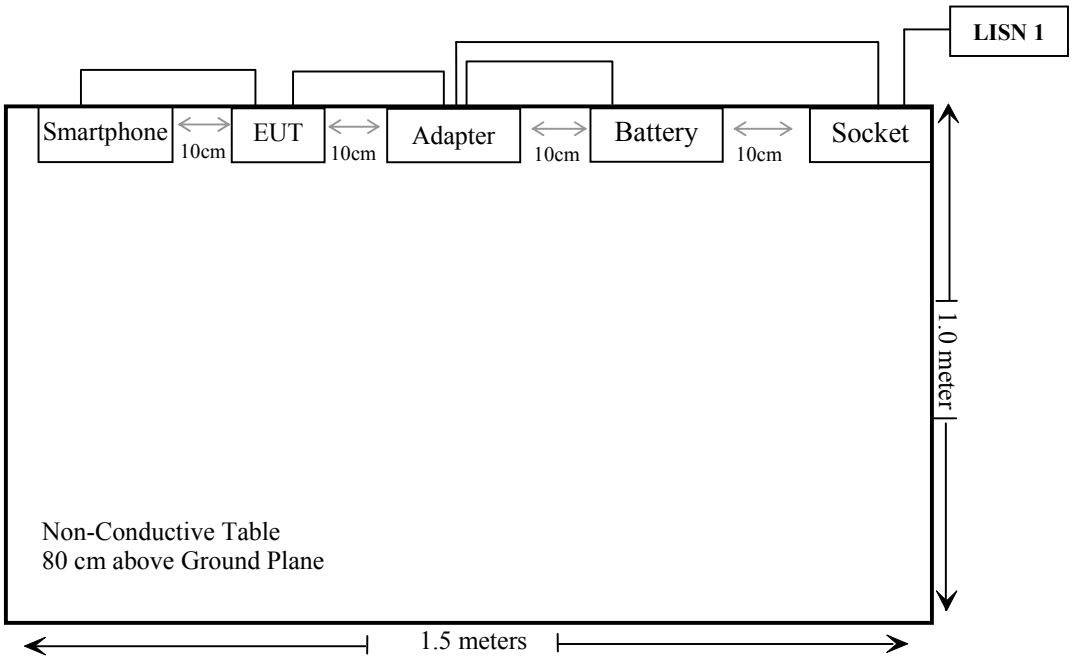
Manufacturer	Description	Model	Serial Number
BULL	Socket	GN-415K	5503290068073
Huawei	Mobile Phone	/	Unknown
GDU-Tech	Adapter	CPD-BC01	Unknown
Prodrone	Battery	PD1-12000mAh-4S	Unknown

External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-Shielding Detachable USB Cable	0.5	Mobile Phone	EUT
Un-Shielding Un-detachable USB Cable	1.0	Adapter	Battery
Un-Shielding Un-detachable USB Cable	1.0	EUT	Adapter
Unshielded Detachable AC Cable	1.2	Mains	Socket

Block Diagram of Test Setup

For Conducted emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§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)	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	ESCS30	100176	2018-07-11	2019-07-11
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2017-12-21	2018-12-21
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2018-05-12	2018-11-21
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Un-known	Conducted Emission Cable	78652	UF A210B-1-0720-504504	2018-05-12	2018-11-12
Radiated Emission Test					
A.H. System	Horn Antenna	SAS-200/571	135	2018-09-01	2021-08-31
Rohde & Schwarz	Signal Analyzer	FSEM	845987/005	2018-06-23	2019-06-23
COM-POWER	Pre-amplifier	PA-122	181919	2018-05-22	2018-11-22
COM-POWER	Pre-amplifier	PA-122	181919	2018-11-22	2019-05-22
Sonoma instrument	Amplifier	310N	186238	2018-05-12	2018-11-12
Sonoma instrument	Amplifier	310N	186238	2018-11-12	2019-05-12
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017-12-22	2020-12-21
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2018-01-11	2019-01-11
Ducommun technologies	RF Cable	UFA147A-2362-100100	MFR64639 231029-003	2018-08-01	2019-02-01
Ducommun technologies	RF Cable	104PEA	218124002	2018-05-21	2018-11-21
Ducommun technologies	RF Cable	104PEA	218124002	2018-11-21	2019-05-21
Ducommun technologies	RF Cable	RG-214	1	2018-05-21	2018-11-19
Ducommun technologies	RF Cable	RG-214	1	2018-11-21	2019-05-19
Ducommun technologies	RF Cable	RG-214	2	2018-05-22	2018-11-22
Ducommun technologies	RF Cable	RG-214	2	2018-11-22	2019-05-22
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-04	2017-12-29	2020-12-28
Heatsink Required	Amplifier	QLW-18405536-J0	15964001002	2018-08-01	2019-02-01
Sinoscite	Band Reject Filter	BSF2402-2480MN-0898-001	99632	2018-05-21	2018-11-21
Sinoscite	Band Reject Filter	BSF2402-2480MN-0898-001	99632	2018-11-21	2019-05-21
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Agilent	USB windebond power meter	U2021XA	MY54250003	2018-06-23	2019-06-23
WEINSCHEL	10dB Attenuator	5324	AU 3842	Each Time	
Rohde & Schwarz	Spectrum Analyzer	FSU26	200120	2017-12-24	2018-12-24
Rohde & Schwarz	Spectrum Analyzer	FSU26	200120	2018-12-24	2019-12-24
Ducommun technologies	RF Cable	RG-214	3	Each Time	

*** 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), §1.1307 (b) (1) & §2.1093 – RF EXPOSURE

Applicable Standard

FCC§1.1310 and §2.1093.

Measurement Result

Please refer to SAR test report: RSZ181016812-SA.

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 two antennas arrangement for 2.4GHz, which was permanently attached, and one is internal antenna only used to transmit signals and one is external antenna only used to receive signals, and each antenna gain is 2 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

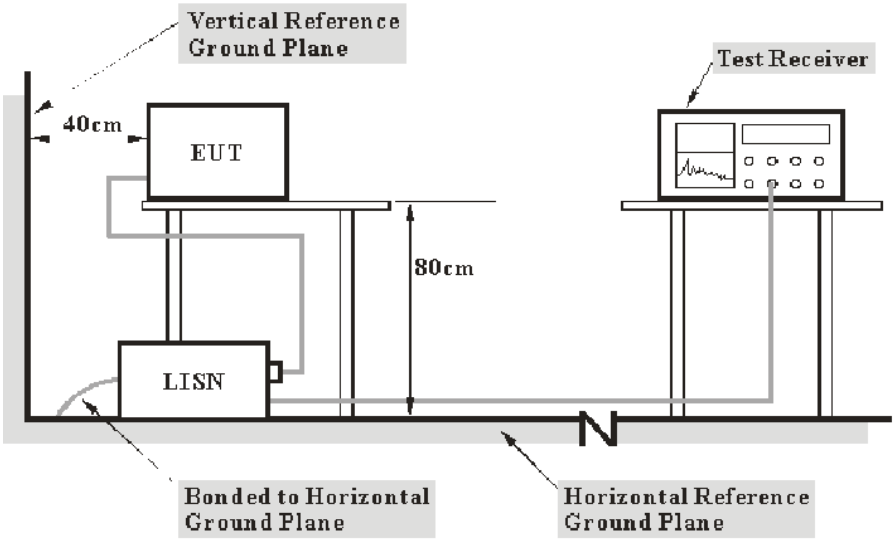
Result: Compliance.

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 Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207,

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

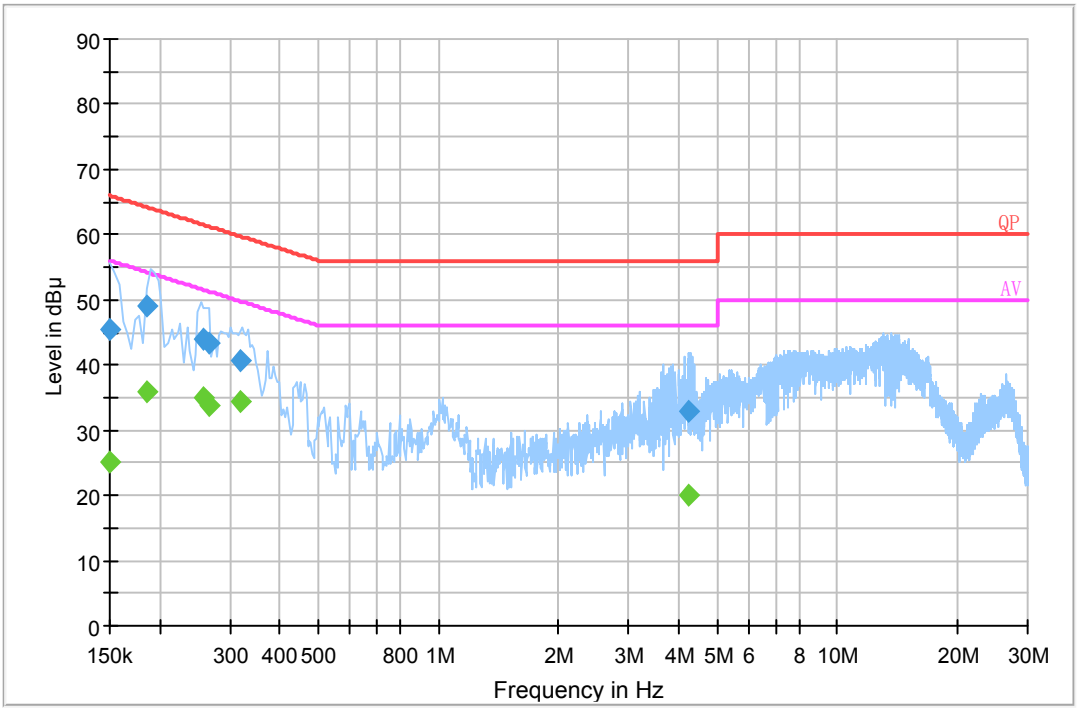
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2018-11-06.

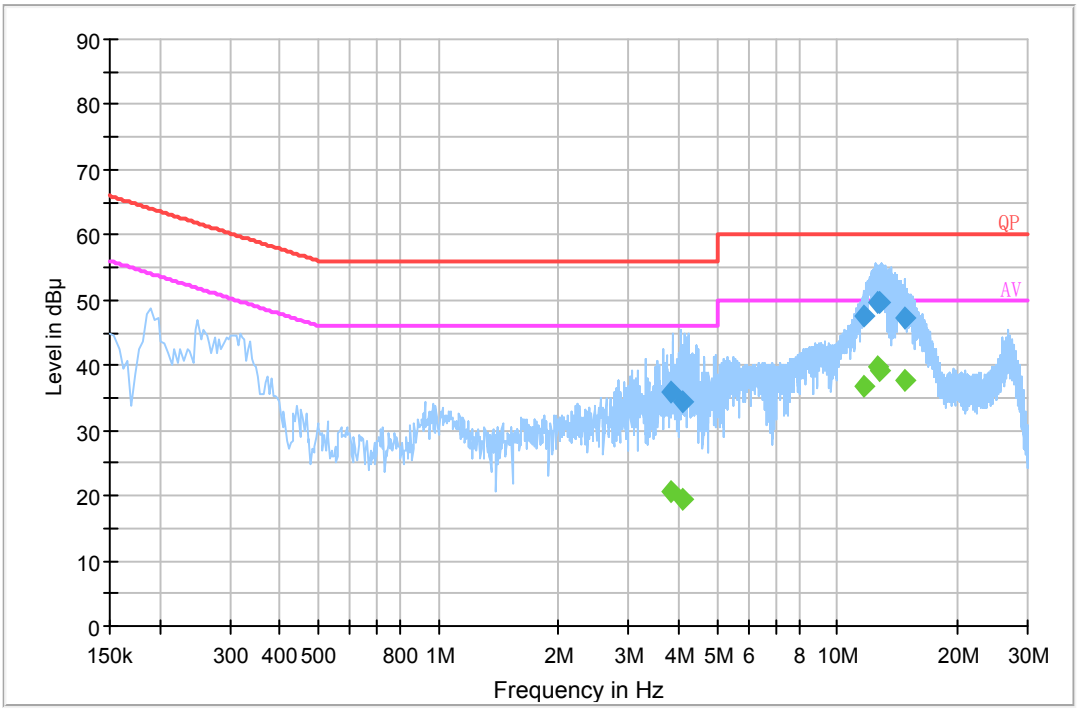
EUT operation mode: Charging (RF function no working while it's charging)

AC 120V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
0.150000	45.3	19.8	66.0	20.7	QP
0.185500	49.1	19.8	64.2	15.1	QP
0.257500	44.1	19.7	61.5	17.4	QP
0.265500	43.5	19.8	61.3	17.8	QP
0.317170	40.6	19.8	59.8	19.2	QP
4.249830	32.9	20.0	56.0	23.1	QP
0.150000	25.1	19.8	56.0	30.9	Ave.
0.185500	35.8	19.8	54.2	18.4	Ave.
0.257500	35.1	19.7	51.5	16.4	Ave.
0.265500	33.9	19.8	51.3	17.4	Ave.
0.317170	34.5	19.8	49.8	15.3	Ave.
4.249830	20.0	20.0	46.0	26	Ave.

AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
3.835950	36.0	19.9	56.0	20.0	QP
4.113010	34.3	20.0	56.0	21.7	QP
11.621890	47.5	20.2	60.0	12.5	QP
12.554110	49.7	20.2	60.0	10.3	QP
12.803390	49.7	20.2	60.0	10.3	QP
14.717110	47.4	20.2	60.0	12.6	QP
3.835950	20.5	19.9	46.0	25.5	Ave.
4.113010	19.4	20.0	46.0	26.6	Ave.
11.621890	36.6	20.2	50.0	13.4	Ave.
12.554110	39.9	20.2	50.0	10.1	Ave.
12.803390	39.2	20.2	50.0	10.8	Ave.
14.717110	37.6	20.2	50.0	12.4	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

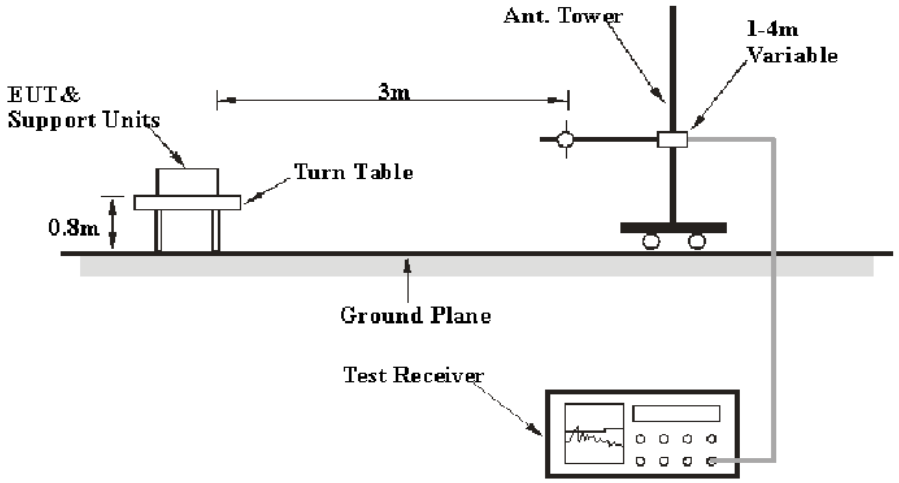
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

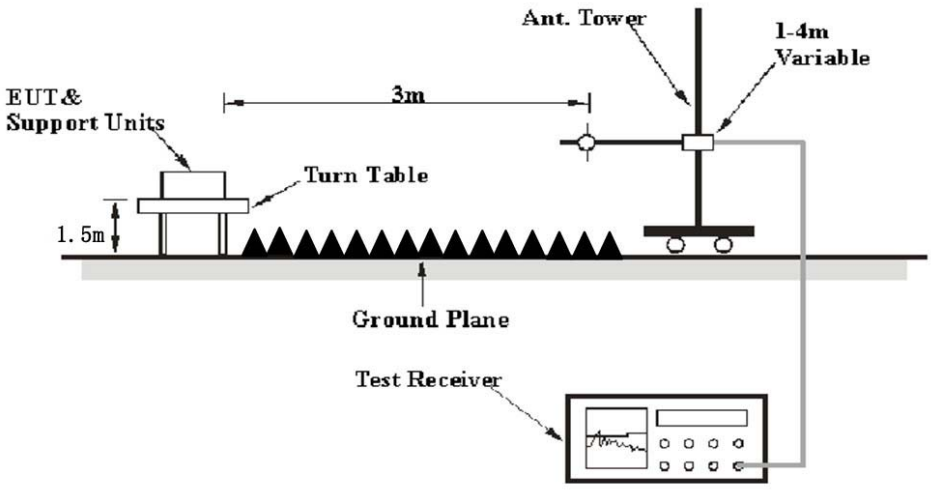
FCC §15.205; §15.209; §15.247(d)

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, 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 Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr}, if L_m is less than L_{lim}, it implies that the EUT complies with the limit.

Test Data

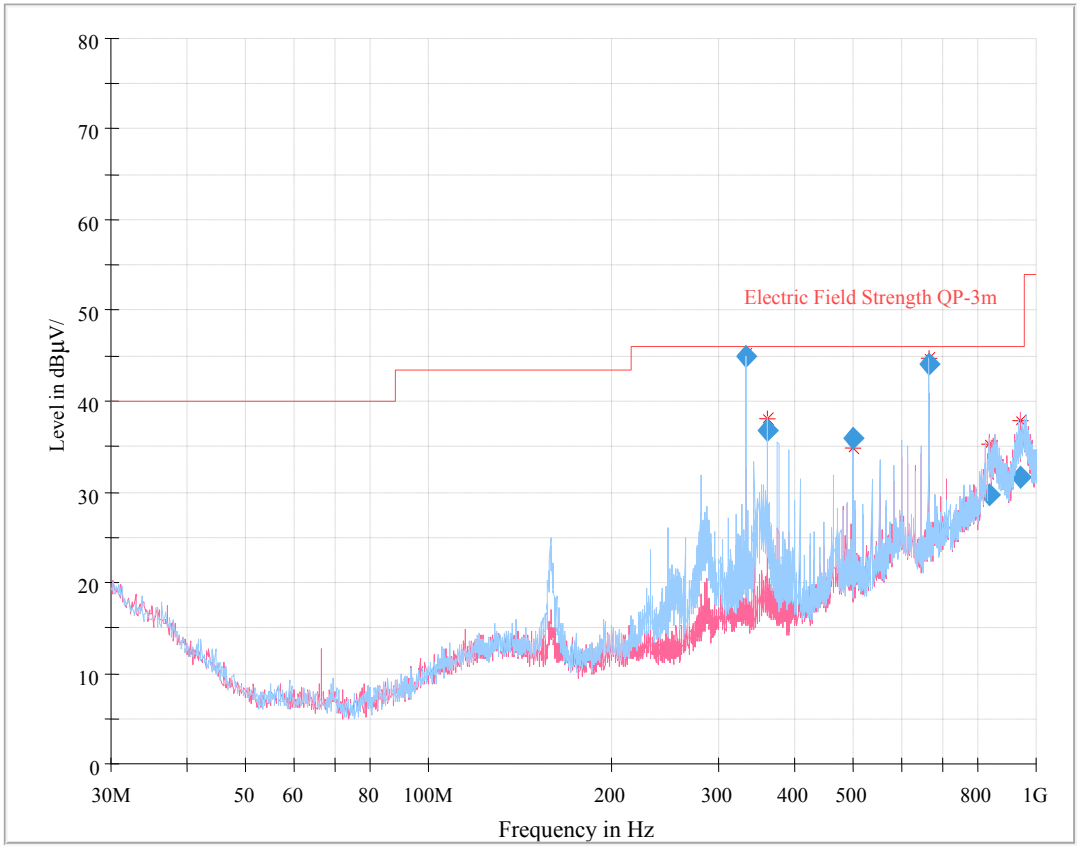
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Baston Chen and Yecar Lu on 2018-10-28 and 2019-01-03.

EUT operation mode: Transmitting

30 MHz~1 GHz: *(the worst case is High channel)*



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
332.007125	44.90	108.0	H	260.0	-10.8	46.00	1.10
359.983875	36.81	108.0	H	81.0	-10.7	46.00	9.19
497.984750	35.98	163.0	H	128.0	-7.2	46.00	10.02
663.992625	44.10	117.0	H	112.0	-2.9	46.00	1.90
837.579250	29.74	234.0	H	251.0	5.7	46.00	16.26
939.583750	31.57	116.0	V	59.0	8.7	46.00	14.43

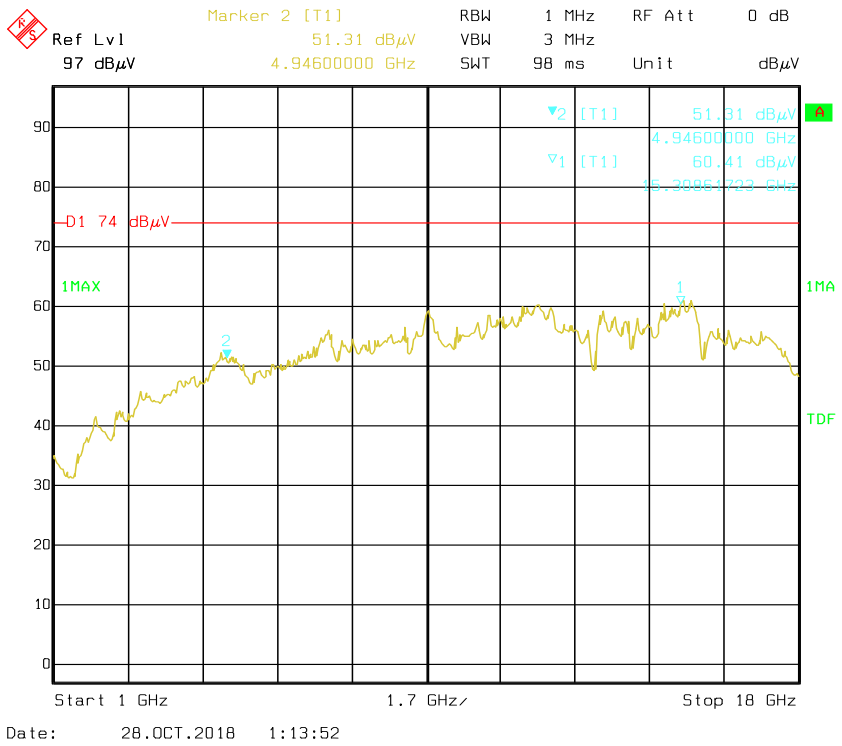
1 GHz - 25 GHz:

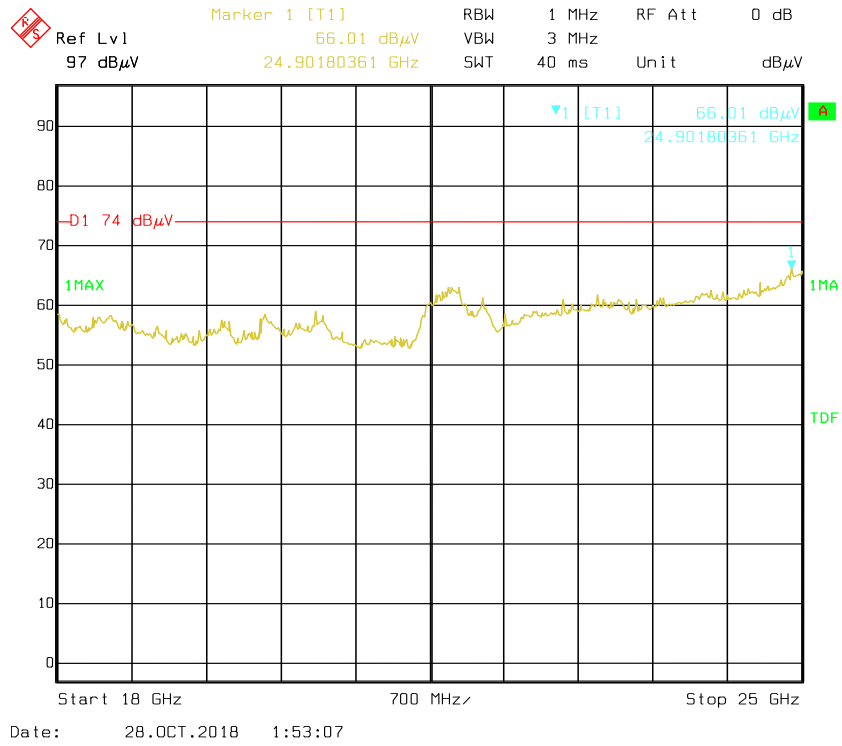
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	FCC Part 15.247/205/209	
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)			Limit (dBμV/m)	Margin (dB)
Low Channel (2405 MHz)									
2405.00	76.48	PK	354	1.2	H	33.00	109.48	/	/
2405.00	64.03	Ave.	354	1.2	H	33.00	97.03	/	/
2405.00	80.94	PK	131	1.8	V	33.00	113.94	/	/
2405.00	68.90	Ave.	131	1.8	V	33.00	101.90	/	/
2390.00	27.80	PK	267	1.2	V	33.00	60.80	74	13.20
2390.00	13.36	Ave.	267	1.2	V	33.00	46.36	54	7.64
2483.50	27.28	PK	253	1.6	V	33.20	60.48	74	13.52
2483.50	13.30	Ave.	253	1.6	V	33.20	46.50	54	7.50
4810.00	42.56	PK	297	2.3	V	7.88	50.44	74	23.56
4810.00	28.73	Ave.	297	2.3	V	7.88	36.61	54	17.39
Middle Channel (2437MHz)									
2437.00	76.20	PK	320	2.4	H	33.10	109.30	/	/
2437.00	63.42	Ave.	320	2.4	H	33.10	96.52	/	/
2437.00	79.89	PK	194	2.5	V	33.10	112.99	/	/
2437.00	67.05	Ave.	194	2.5	V	33.10	100.15	/	/
4874.00	41.72	PK	214	1.7	V	9.21	50.93	74	23.07
4874.00	27.83	Ave.	214	1.7	V	9.21	37.04	54	16.96
High Channel (2473 MHz)									
2473.00	73.30	PK	118	2.0	H	33.20	106.50	/	/
2473.00	61.50	Ave.	118	2.0	H	33.20	94.70	/	/
2473.00	77.90	PK	47	1.9	V	33.20	111.10	/	/
2473.00	65.30	Ave.	47	1.9	V	33.20	98.50	/	/
2390.00	27.46	PK	253	2.3	V	33.00	60.46	74	13.54
2390.00	13.35	Ave.	253	2.3	V	33.00	46.35	54	7.65
2483.50	27.48	PK	106	1.3	V	33.20	60.68	74	13.32
2483.50	13.33	Ave.	106	1.3	V	33.20	46.53	54	7.47
4946.00	42.49	PK	345	1.4	V	9.21	51.70	74	22.30
4946.00	28.11	Ave.	345	1.4	V	9.21	37.32	54	16.68

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.
And for the pre-scan is performed with the 2400-2483.5MHz band filter.

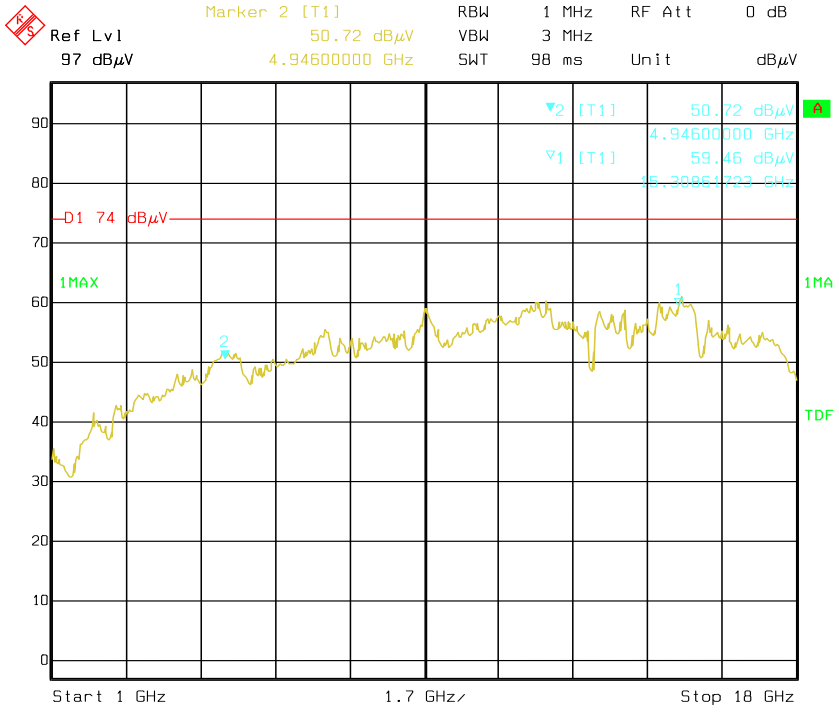
Pre-scan with High Channel Peak

Horizontal





Vertical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RBW 1 MHz
RF Att 0 dB
Ref Lvl
50.72 dBµV
VBW 3 MHz
97 dBµV
4.94600000 GHz
SWT 98 ms
Unit dBµV
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4.94600000 GHz
▽1 [T1] 59.46 dBµV
D1 74 dBµV
1MAX
1MA
TDF
Start 1 GHz
1.7 GHz/
Stop 18 GHz
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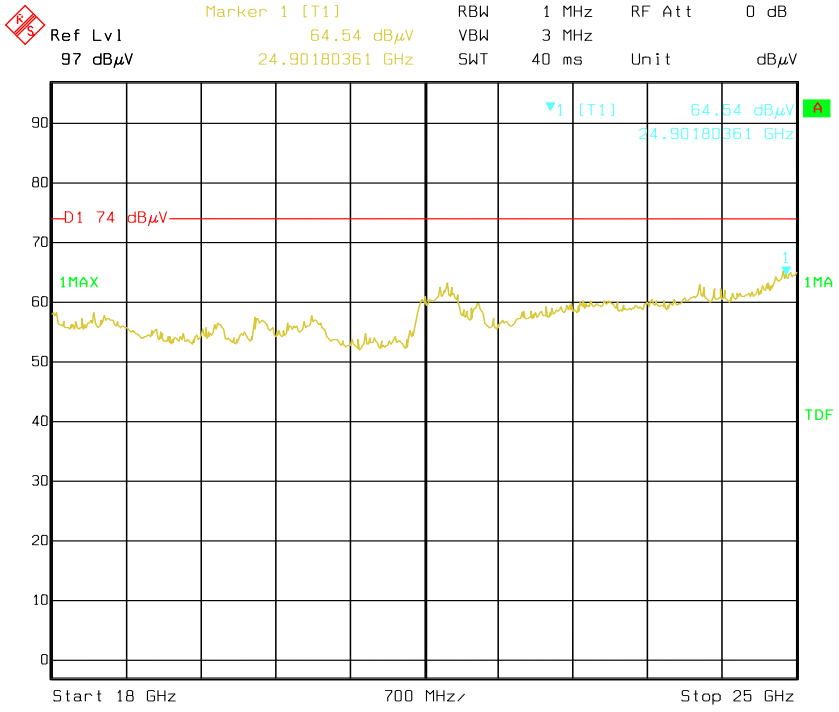
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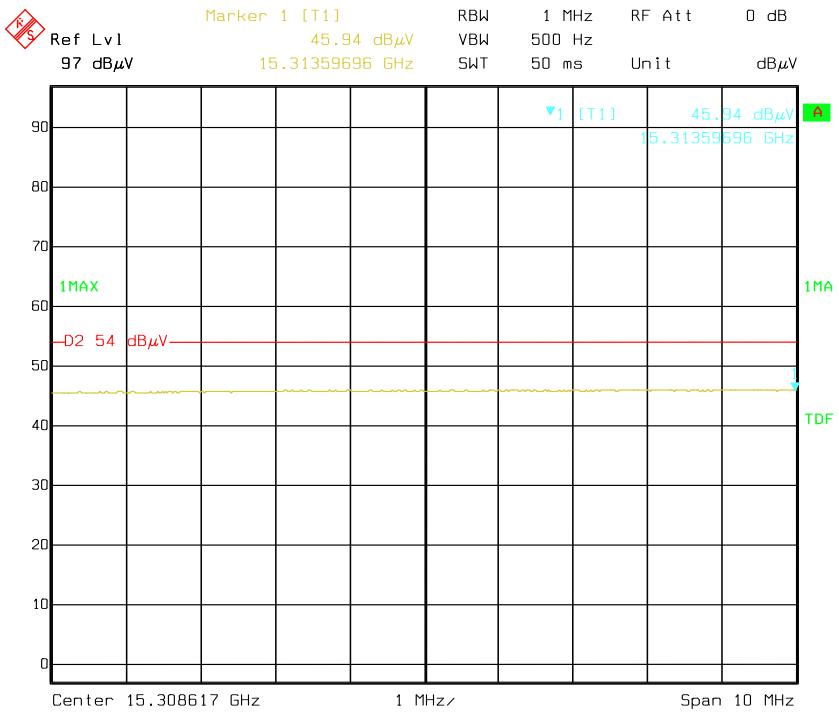
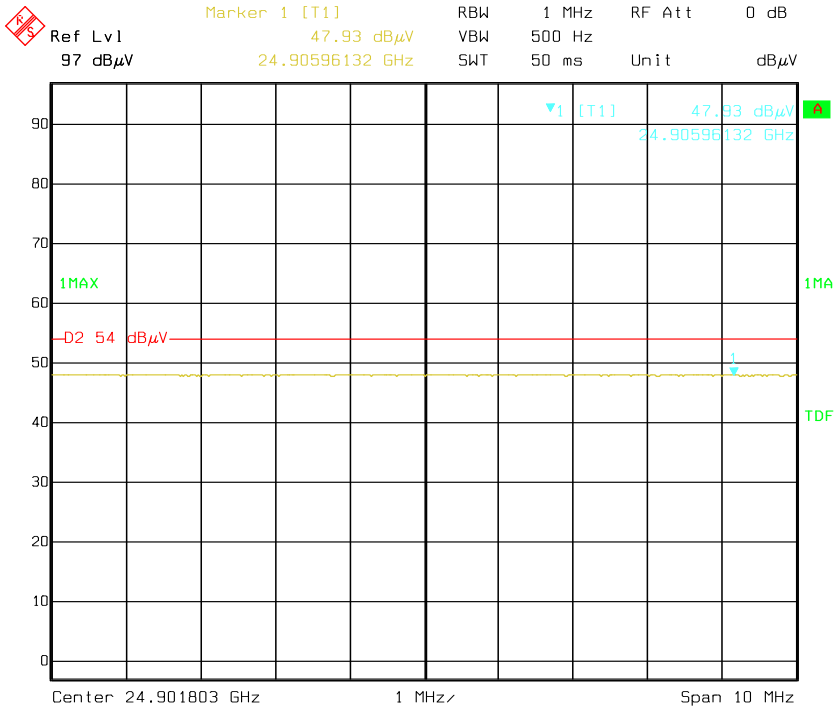
RBW 1 MHz
RF Att 0 dB
Ref Lvl
64.54 dBµV
VBW 3 MHz
97 dBµV
24.90180361 GHz
SWT 40 ms
Unit dBµV
▼1 [T1] 64.54 dBµV
24.90180361 GHz
D1 74 dBµV
1MAX
1MA
TDF
Start 18 GHz
700 MHz/
Stop 25 GHz
Date: 28.OCT.2018 1:55:07

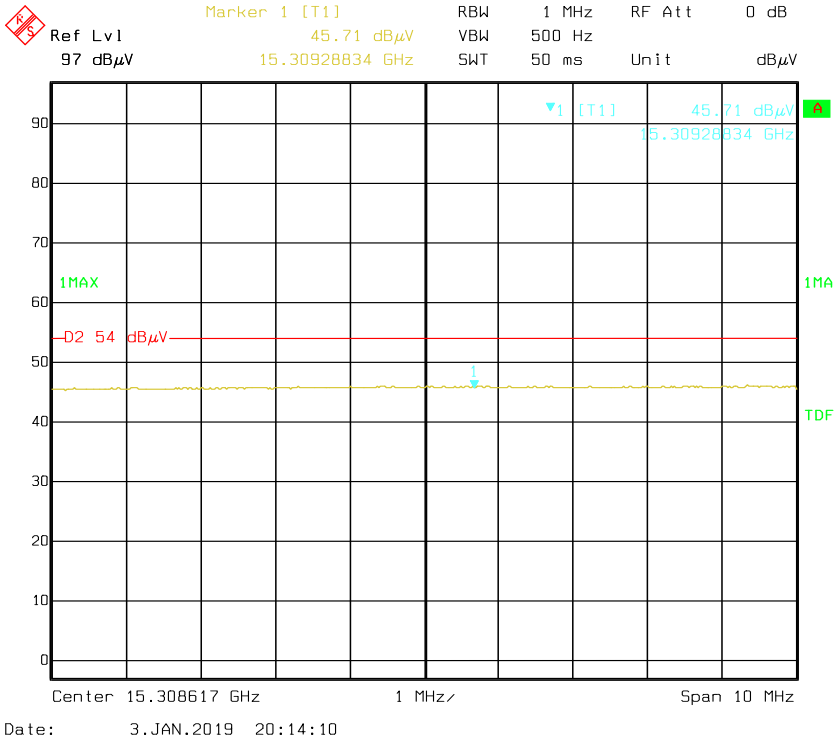
For Average

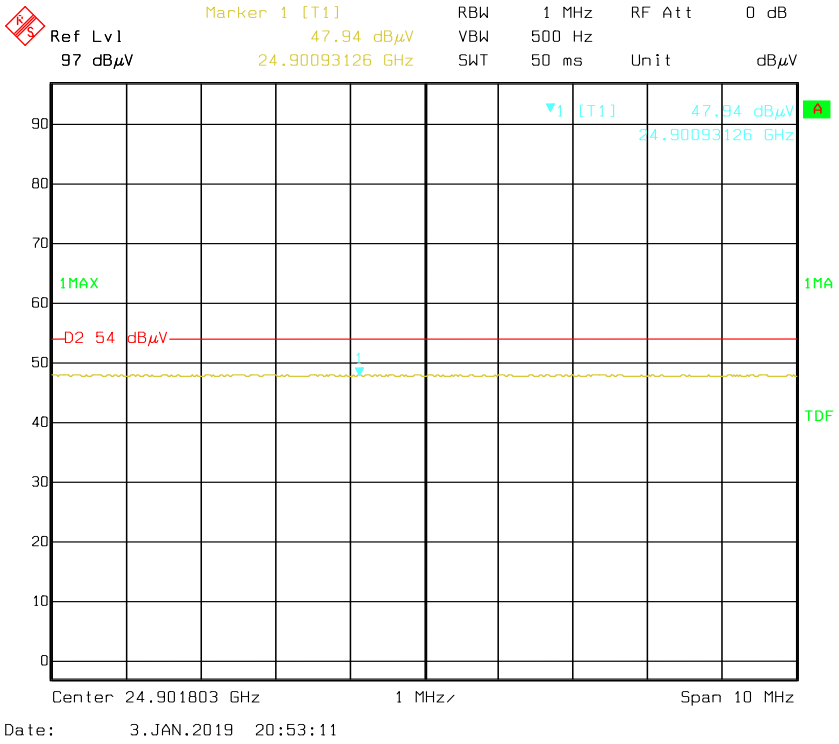
Horizontal





Vertical


Marker 1 [T1]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
45.71 dBµV
VBW 500 Hz
97 dBµV
15.30928834 GHz
SWT 50 ms
Unit dBµV
1 [T1] 45.71 dBµV
15.30928834 GHz
1MAX
1MA
D2 54 dBµV
TDF
Center 15.308617 GHz
1 MHz/
Span 10 MHz
Date: 3.JAN.2019 20:14:10


Marker 1 [T1]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
47.94 dBµV
VBW 500 Hz
97 dBµV
24.90093126 GHz
SWT 50 ms
Unit dBµV
1 [T1] 47.94 dBµV
24.90093126 GHz
1MAX
1MA
D2 54 dBµV
TDF
Center 24.901803 GHz
1 MHz/
Span 10 MHz
Date: 3.JAN.2019 20:53:11

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:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

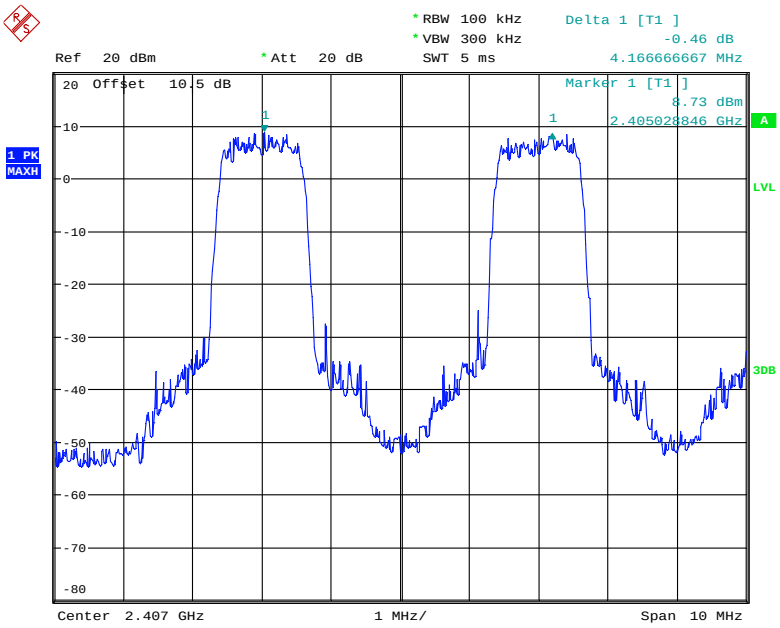
The testing was performed by Shawn Xiao on 2019-01-03.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

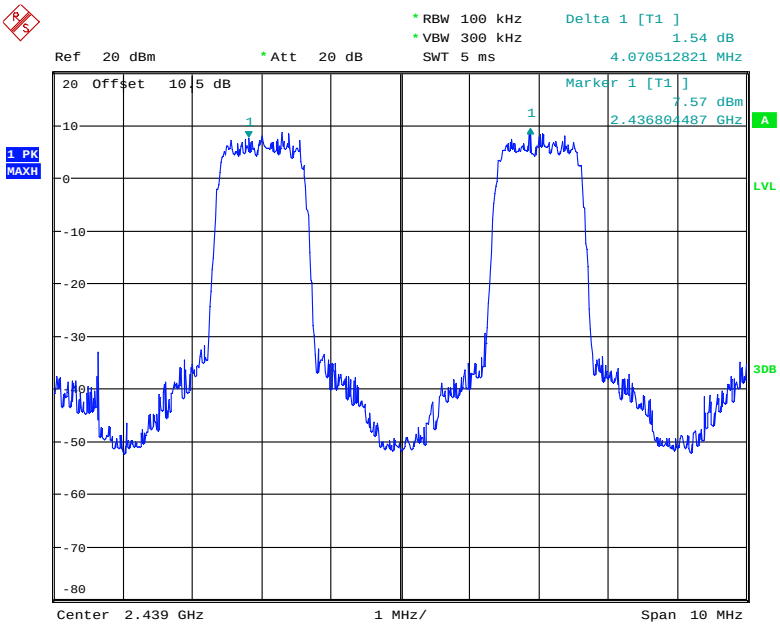
Channel	Channel Frequency (MHz)	Channel Separation (MHz)	20 dBc BW (MHz)	Channel Separation Limit	Result
Low Channel	2405	4.167	1.303	≥Two-thrids of the 20 dB bandwidth	Compliance
Adjacency Channel	2409				
Middle	2437	4.071	1.293	≥Two-thrids of the 20 dB bandwidth	Compliance
Adjacency Channel	2441				
High	2473	4.006	1.298	≥Two-thrids of the 20 dB bandwidth	Compliance
Adjacency Channel	2469				

Low Channel



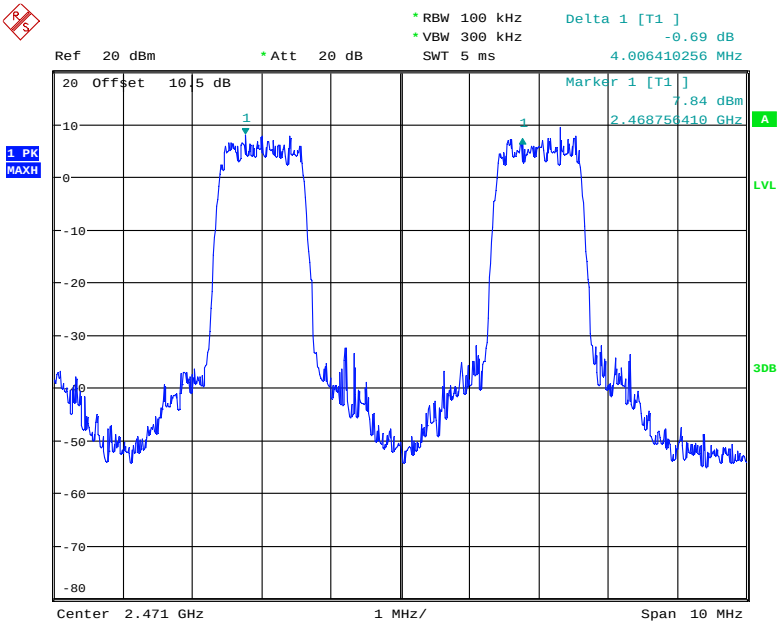
Date: 3.JAN.2019 20:33:28

Middle Channel



Date: 3.JAN.2019 20:30:34

High Channel



Date: 3.JAN.2019 20:28:53

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.

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:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

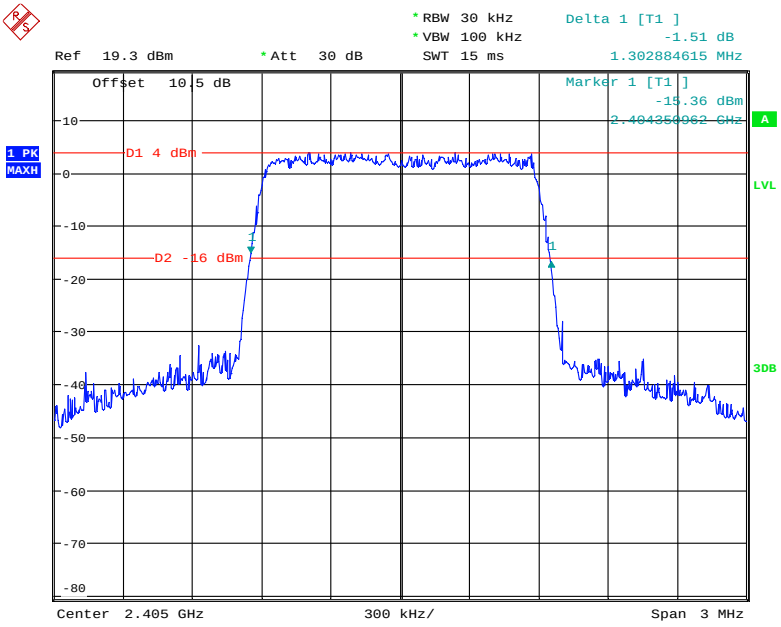
The testing was performed by Shawn Xiao on 2019-01-03.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

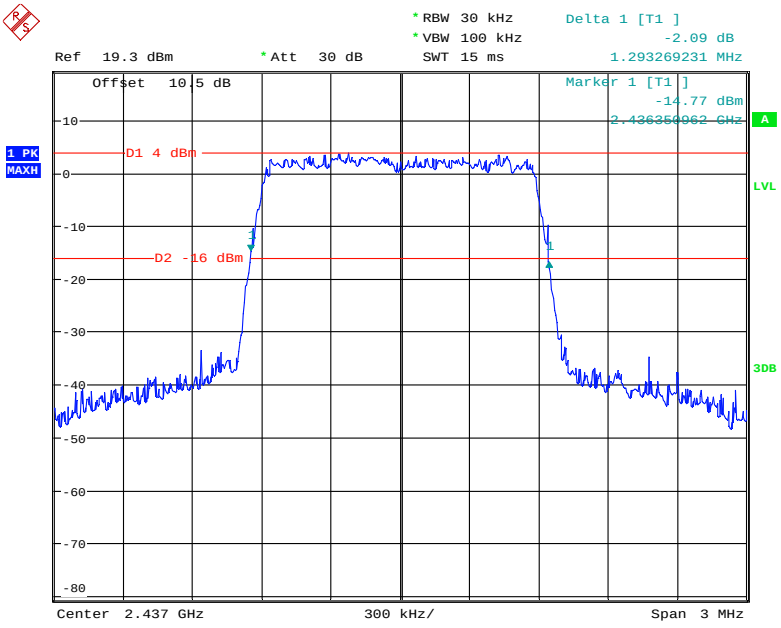
Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)
Low	2405	1.303
Middle	2437	1.293
High	2473	1.298

Low Channel



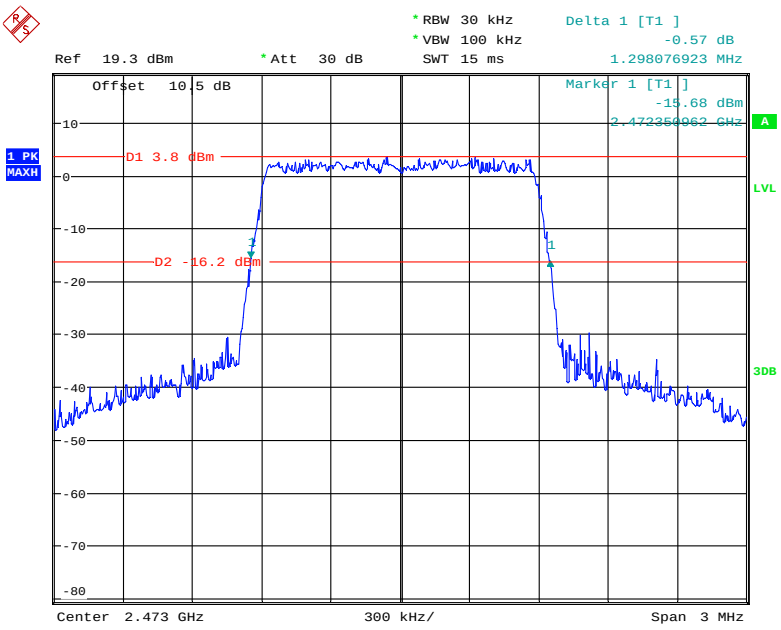
Date: 3.JAN.2019 20:07:29

Middle Channel



Date: 3.JAN.2019 20:09:50

High Channel



Date: 3.JAN.2019 20:12:00

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.

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:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

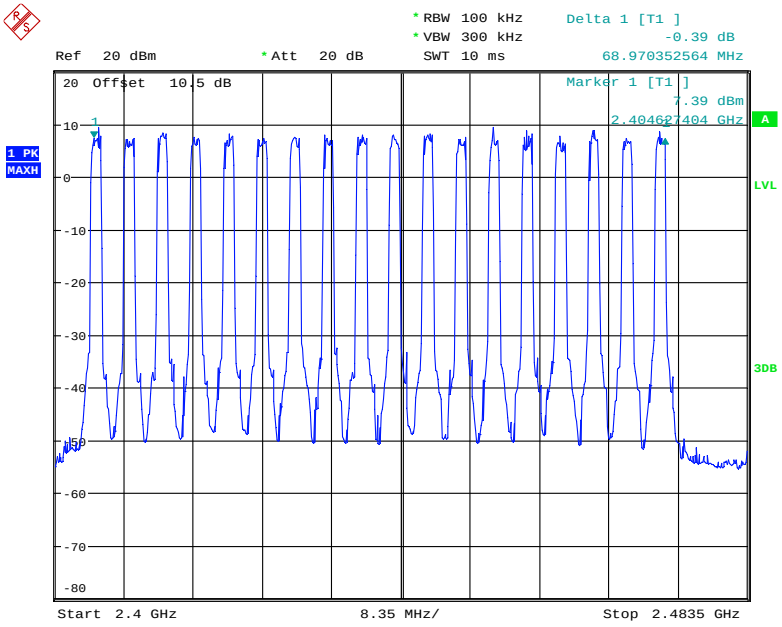
The testing was performed by Shawn Xiao on 2019-01-03.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots.

Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
2400-2483.5	18	≥15

Number of Hopping Channels



Date: 3.JAN.2019 20:36:23

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.

Test Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
d) Detector function: Peak.
e) Trace: Max hold.
Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test or each variation in transmit time.
Repeat the measurement using a longer sweep time to determine the number of hops over the period pecified in the requirements. The sweep time shall be equal to, or less than, the period specified in the equirements. Determine the number of hops over the sweep time and calculate the total number of hops in he period specified in the requirements, using the following equation:
(Number of hops in the period specified in the requirements) =
(number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)
The average time of occupancy is calculated from the transmit time per hop multiplied by the number of ops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.
The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

Test Data

Environmental Conditions

Temperature:	24~25 ℃
Relative Humidity:	55~56 %
ATM Pressure:	101.0~101.3 kPa

The testing was performed by Shawn Xiao from 2019-01-03 to 2019-01-04.

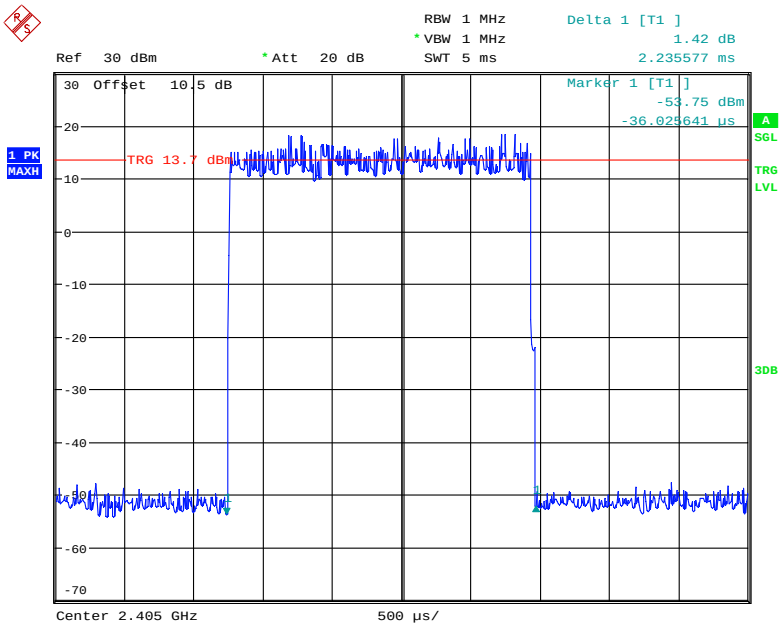
EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table and plots

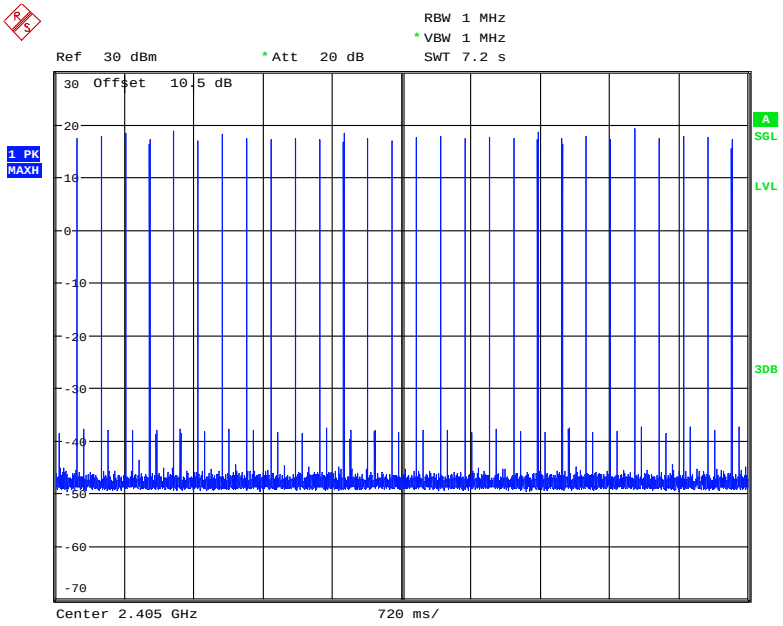
Mode	Pulse Time (ms)	Hopping Number	Period Time (s)	Total of Dwell (ms)	Limit (ms)	Result
Hopping	2.236	28	7.2	62.608	400	Pass

Note: A period time=0.4*18=7.2 (s), Total of Dwell=Pluse Time*Hopping Number

Pulse time



Hopping number in 7.2s



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.

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:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Shawn Xiao on 2019-01-03.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to following table.

Channel	Frequency (MHz)	Peak Output Power		Limit (mW)
		(dBm)	(mW)	
Low	2405	20.41	109.90	125
Middle	2437	20.18	104.23	125
High	2473	19.72	93.76	125

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

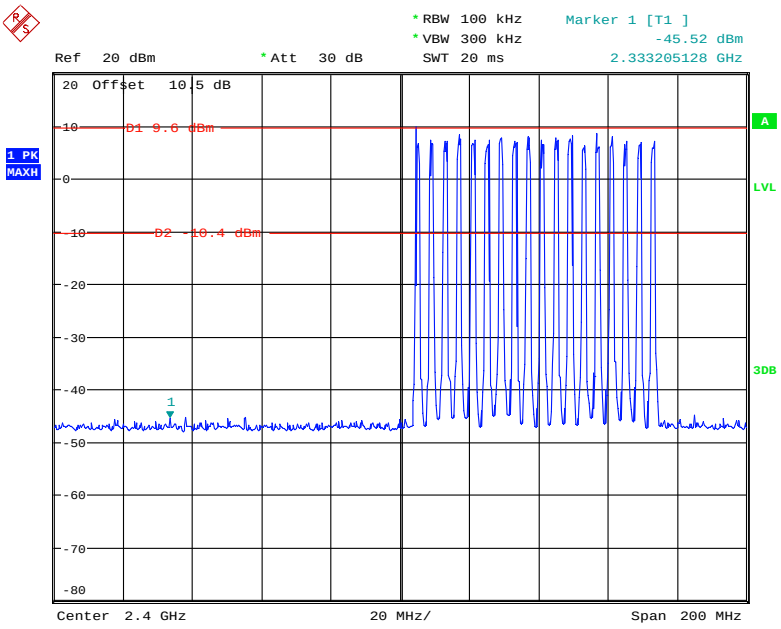
Temperature:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Shawn Xiao on 2019-01-03.

EUT operation mode: Transmitting

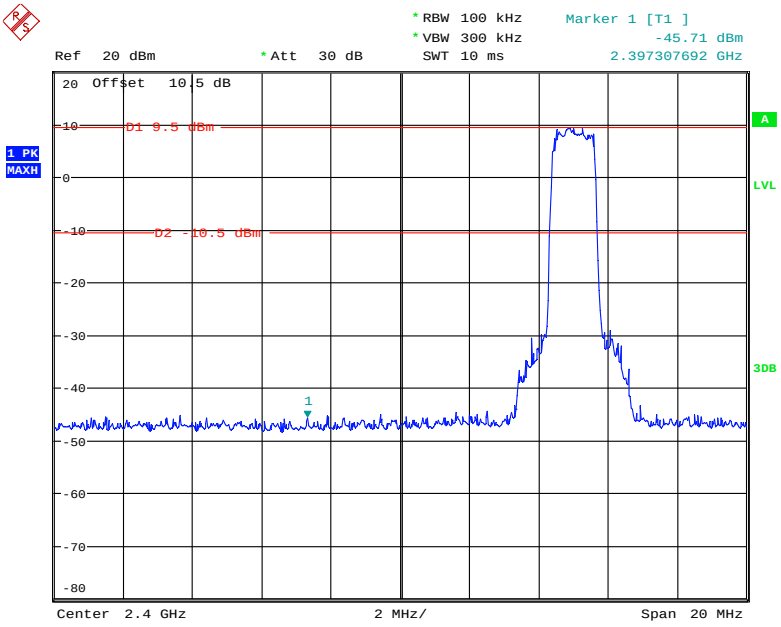
Test Result: Compliance. Please refer to following plots.

Band Edge-Left Side
Hopping



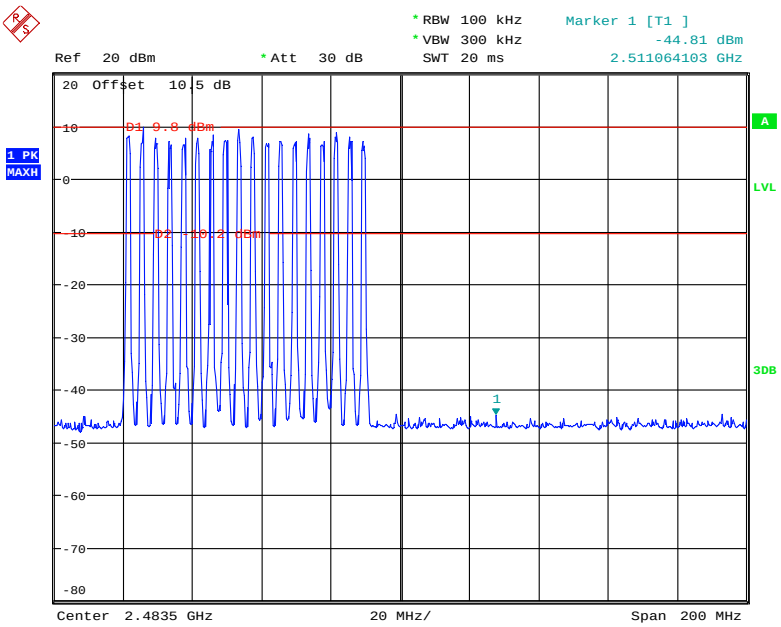
Date: 3.JAN.2019 20:22:14

Single



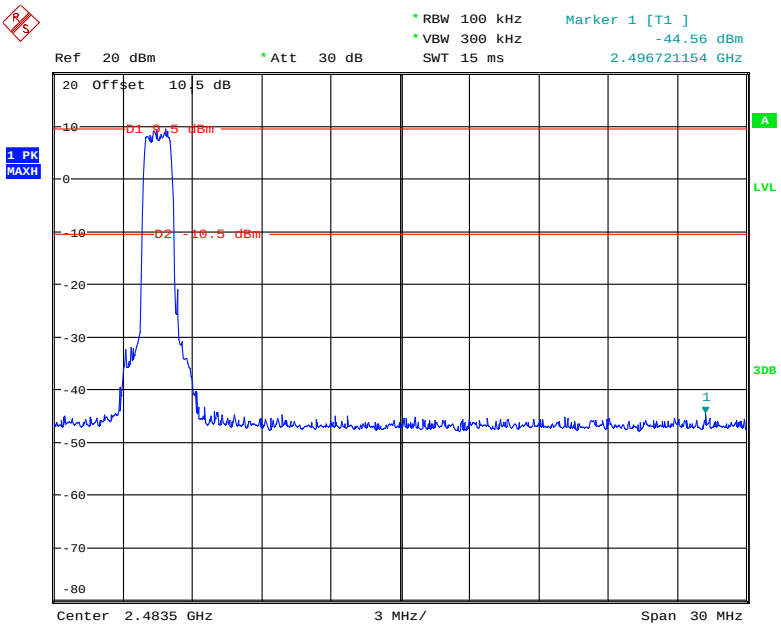
Date: 3.JAN.2019 20:19:57

Band Edge-Right Side
Hopping



Date: 3.JAN.2019 20:24:24

Single



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