



TESTING LABORATORY  
CERTIFICATE#4323.01



## FCC PART 15.247 TEST REPORT

For

**Pycom Ltd**

High Point 9 Sydenham Road, Guildford Surrey GU1 3RX, Surrey, United Kingdom

**FCC ID: 2AJMTFIPY01R**

<b>Report Type:</b> Original Report	<b>Product Type:</b> FiPy Module
<b>Test Engineer:</b> Max Min	<i>Max Min</i>
<b>Report Number:</b> RSHA180108012-00D	
<b>Report Date:</b> 2018-07-25	
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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

Applicant	Pycom Ltd
Tested Model	Fipy 1.0
Product Type	FiPy Module
Dimension	55mm (L)* 20 mm (W)*3.5 mm(H)
Power Supply	DC 3.4-5.5V

*\*All measurement and test data in this report was gathered from production sample serial number: 20180108012.  
(Assigned by the BACL. The EUT supplied by the applicant was received on 2018-01-08)*

### Objective

This test report is prepared on behalf of Pycom 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)

FCC Part 15.247 DTS, Part 15.247 DSS, Part 15.249 DXX and Part 27 TNB submissions with FCC ID: 2AJMTFIPY01R.

### 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 and Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

**Measurement Uncertainty**

Item		Uncertainty
AC Power Lines Conducted Emissions		3.19 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	6.11dB
	1GHz~6GHz	4.45dB
	6GHz~18GHz	5.23dB
	18GHz~40GHz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0°C
Humidity		6%

**Test Facility**

The test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

Channel List for Sigfox mode:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	902.216	34	903.041	67	903.866
2	902.241	35	903.066	68	903.891
3	902.266	36	903.091	69	903.916
4	902.291	37	903.116	70	903.941
5	902.316	38	903.141	71	903.966
6	902.341	39	903.166	72	903.991
7	902.366	40	903.191	73	904.016
8	902.391	41	903.216	74	904.041
9	902.416	42	903.241	75	904.066
10	902.441	43	903.266	76	904.091
11	902.466	44	903.291	77	904.116
12	902.491	45	903.316	78	904.141
13	902.516	46	903.341	79	904.166
14	902.541	47	903.366	80	904.191
15	902.566	48	903.391	81	904.216
16	902.591	49	903.416	82	904.241
17	902.616	50	903.441	83	904.266
18	902.641	51	903.466	84	904.291
19	902.666	52	903.491	85	904.316
20	902.691	53	903.516	86	904.341
21	902.716	54	903.541	87	904.366
22	902.741	55	903.566	88	904.391
23	902.766	56	903.591	89	904.416
24	902.791	57	903.616	90	904.441
25	902.816	58	903.641	91	904.466
26	902.841	59	903.666	92	904.491
27	902.866	60	903.691	93	904.516
28	902.891	61	903.716	94	904.541
29	902.916	62	903.741	95	904.566
30	902.941	63	903.766	96	904.591
31	902.966	64	903.791	97	904.616
32	902.991	65	903.816	98	904.641
33	903.016	66	903.841	99	904.666

EUT was tested with Channel 1, 50 and 99.

**EUT Exercise Software**

RF test tool: putty.

Power lever 20

**Special Accessories**

No special accessory.

**Equipment Modifications**

No modification was made to the EUT tested.

**Support Equipment List and Details**

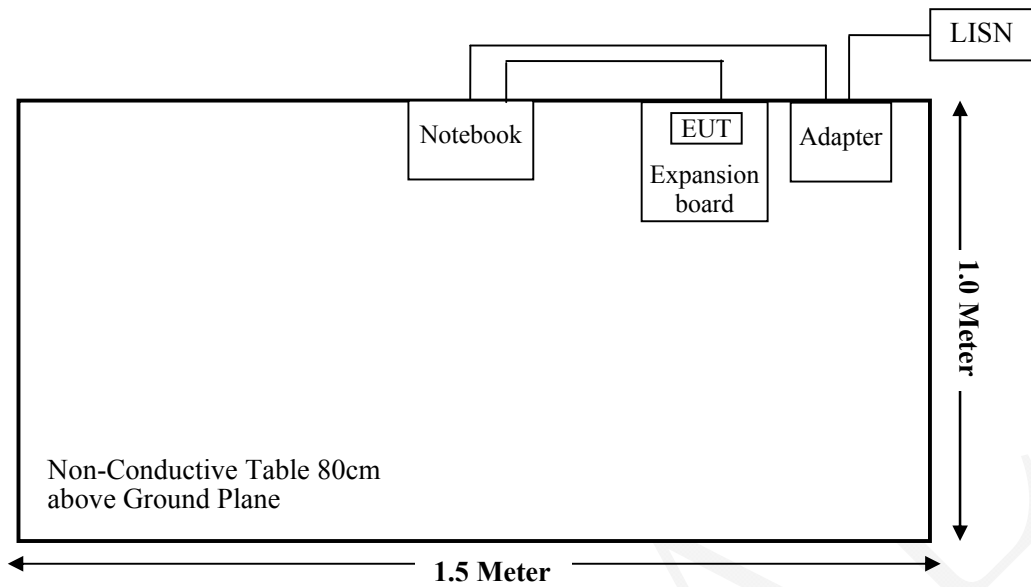
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
DELL	Adapter	LA65NS0-00	DF263
Pycom Ltd	Expansion board	V2.1A	1630000932

**External I/O Cable**

Cable Description	Length (m)	From Port	To
USB Cable	0.8	Expansion board	Notebook

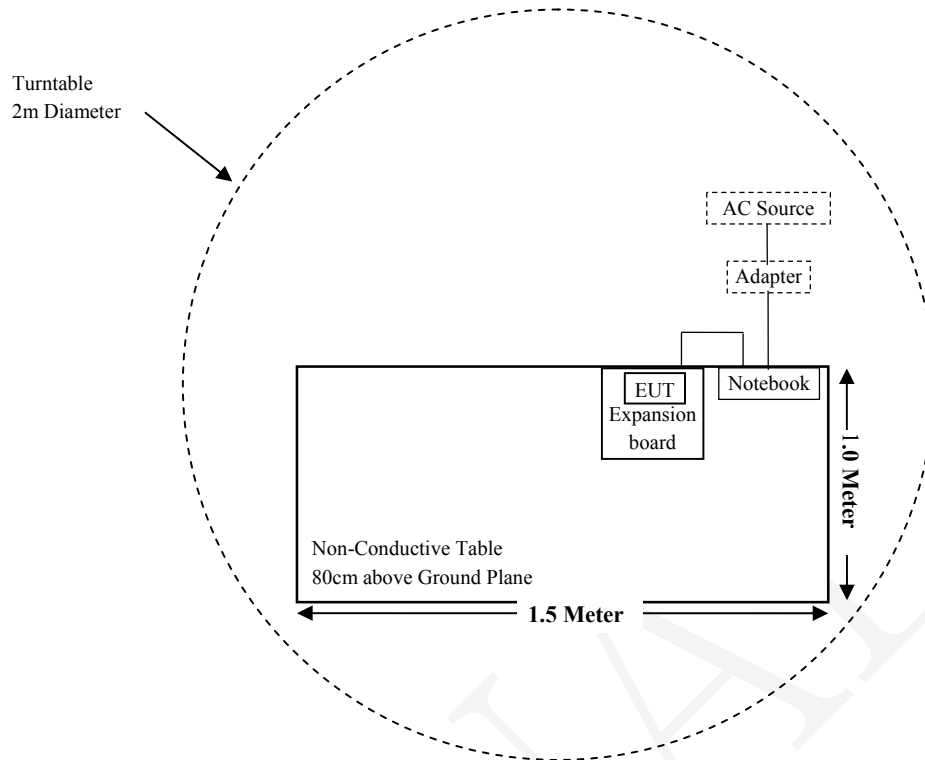
**Block Diagram of Test Setup**

For Conducted Emissions:

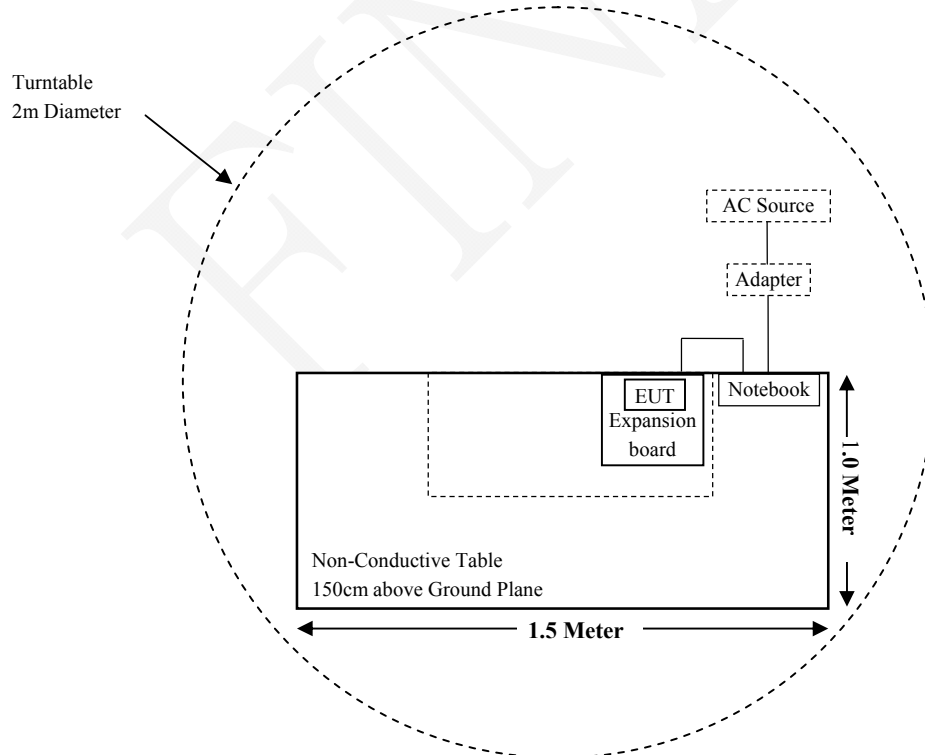




For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



**SUMMARY OF TEST RESULTS**

FCC Rules	Description of Test	Result
§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) (i)	20 dB Emission Bandwidth	Compliance
§15.247(a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(i)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(i)	Quantity of hopping channel Test	Compliance
§15.247(b)(2)	Peak Output Power Measurement	Compliance
§15.247(d)	Band edges	Compliance

**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Radiated Emission Test (Chamber 1#)</b>					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2017-11-12	2018-11-11
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Sonoma Instrument	Pre-amplifier	310N	171205	2017-08-15	2018-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-8	008	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2017-08-15	2018-08-14
<b>Radiated Emission Test (Chamber 2#)</b>					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2017-08-27	2018-08-26
ETS-LINDGREN	Horn Antenna	3115	6229	2016-01-11	2019-01-10
ETS-LINDGREN	Horn Antenna	3116	00084159	2016-10-18	2019-10-17
Mini-Circuits	Amplifier	ZVA-183W-S+	220701818	2018-05-20	2019-05-19
MICRO-TRONICS	Notch Filter	BRC50722	G013	2017-08-05	2018-08-04
Narda	Attenuator/10dB	10dB	/	2017-08-15	2018-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-11	011	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2017-08-15	2018-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2017-08-15	2018-08-14
<b>RF Conducted Test</b>					
Rohde & Schwarz	Signal Analyzer	FSV40	101116	2017-07-22	2018-07-21
Rohde & Schwarz	Signal Analyzer	FSIQ26	836131/009	2017-09-21	2018-09-20
Agilent	Power Meter	N1912A	MY5000492	2017-11-18	2018-11-17
Agilent	Power Sensor	N1921A	MY54210024	2017-11-18	2018-11-17
Narda	Attenuator/6dB	10690812-2	26850-6	2018-01-10	2019-01-09
Pycom Ltd	RF Cable	/	/	Each Time	/
<b>Conducted Emission Test</b>					
Rohde & Schwarz	EMI Test Receiver	ESCS30	834115/007	2017-11-12	2018-11-11
Rohde & Schwarz	LISN	ENV216	3560655016	2017-11-15	2018-11-14
BACL	Auto test Software	BACL-EMC	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2018-01-10	2019-01-09
MICRO-COAX	Coaxial Cable	Cable-15	015	2017-08-15	2018-08-14

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

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**FCC §15.203 – ANTENNA REQUIREMENT**

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**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 Information**

The EUT has an antenna for Sigfox, which is with a unique connector, and the antenna gain is 0.87 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

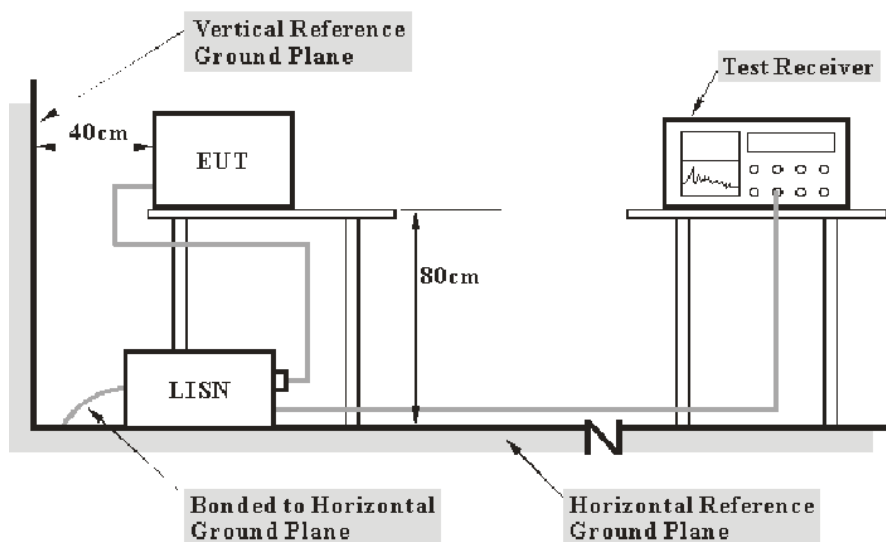
**Result:** Compliance.

## 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.

### 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:

$$\text{Corrected Factor (dB)} = \text{LISN VDF (dB)} + \text{Cable Loss (dB)} + \text{Transient Limiter Attenuation (dB)}$$

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:

$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V)} - \text{Corrected Amplitude (dB}\mu\text{V)}$$

## Test Results Summary

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

### Test Data

#### Environmental Conditions

Temperature:	23.4 °C
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

*The testing was performed by Max Min on 2018-06-13.*

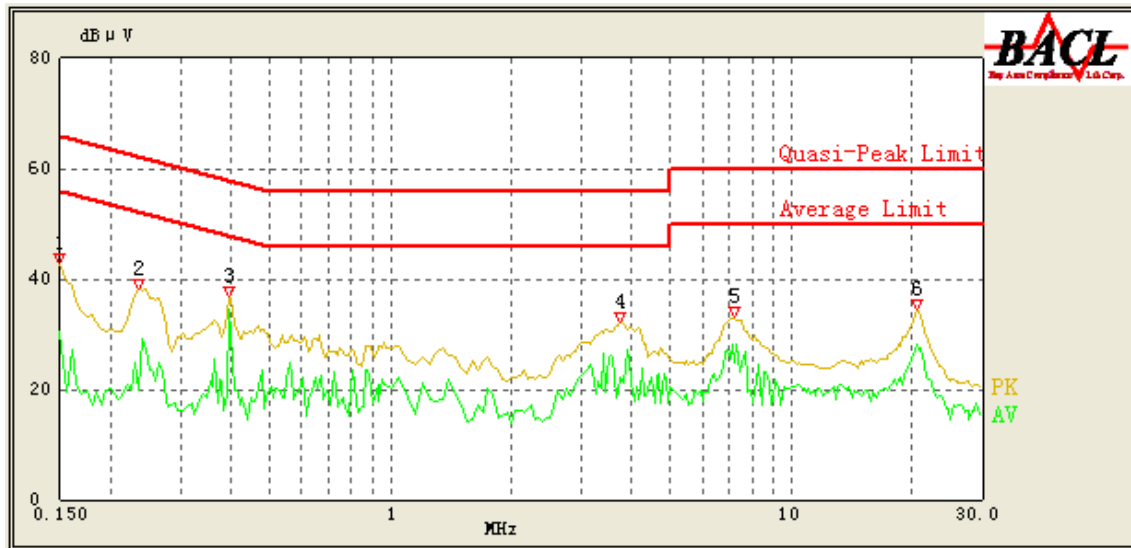
*EUT operation mode: Transmitting in low channel (worst case)*

## AC 120V/60 Hz, Line



Frequency (MHz)	Corrected Amplitude (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBμV)	Margin (dB)	Comment
0.150	45.29	QP	9.000	L1	16.06	66.00	20.71	Compliance
0.150	28.05	AV	9.000	L1	16.06	56.00	27.95	Compliance
0.235	39.49	QP	9.000	L1	16.06	63.57	24.08	Compliance
0.235	27.94	AV	9.000	L1	16.06	53.57	25.63	Compliance
0.400	34.39	QP	9.000	L1	16.09	58.86	24.47	Compliance
0.405	28.33	AV	9.000	L1	16.09	48.71	20.38	Compliance
3.950	33.69	QP	9.000	L1	15.88	56.00	22.31	Compliance
3.950	27.89	AV	9.000	L1	15.88	46.00	18.11	Compliance
7.550	33.01	QP	9.000	L1	15.93	60.00	26.99	Compliance
7.500	27.26	AV	9.000	L1	15.93	50.00	22.74	Compliance
20.700	33.99	QP	9.000	L1	16.17	60.00	26.01	Compliance
20.600	27.15	AV	9.000	L1	16.17	50.00	22.85	Compliance

## AC 120V/60 Hz, Neutral



Frequency (MHz)	Corrected Amplitude (dBμV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBμV)	Margin (dB)	Comment
0.150	42.87	QP	9.000	N	16.06	66.00	23.13	Compliance
0.150	30.65	AV	9.000	N	16.06	56.00	25.35	Compliance
0.235	38.23	QP	9.000	N	16.06	63.57	25.34	Compliance
0.235	19.71	AV	9.000	N	16.06	53.57	33.86	Compliance
0.395	36.89	QP	9.000	N	16.09	59.00	22.11	Compliance
0.395	34.52	AV	9.000	N	16.09	49.00	14.48	Compliance
3.750	32.19	QP	9.000	N	15.89	56.00	23.81	Compliance
3.750	22.09	AV	9.000	N	15.89	46.00	23.91	Compliance
7.250	33.22	QP	9.000	N	15.93	60.00	26.78	Compliance
7.200	24.68	AV	9.000	N	15.92	50.00	25.32	Compliance
20.550	34.39	QP	9.000	N	16.17	60.00	25.61	Compliance
20.700	28.10	AV	9.000	N	16.17	50.00	21.90	Compliance

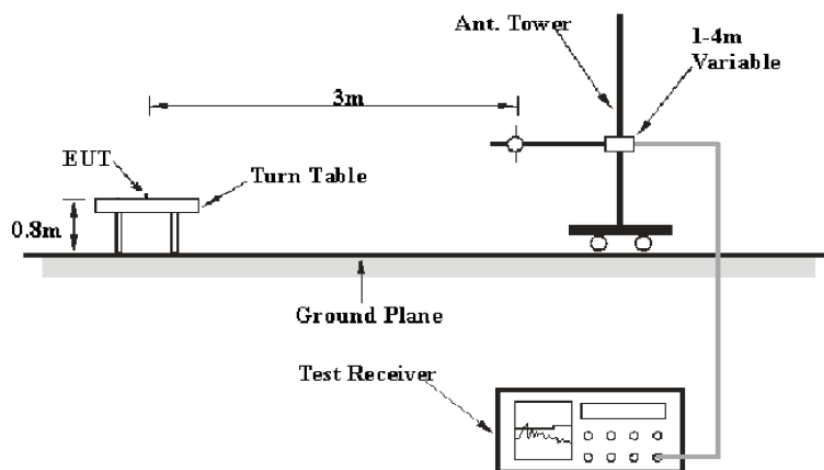
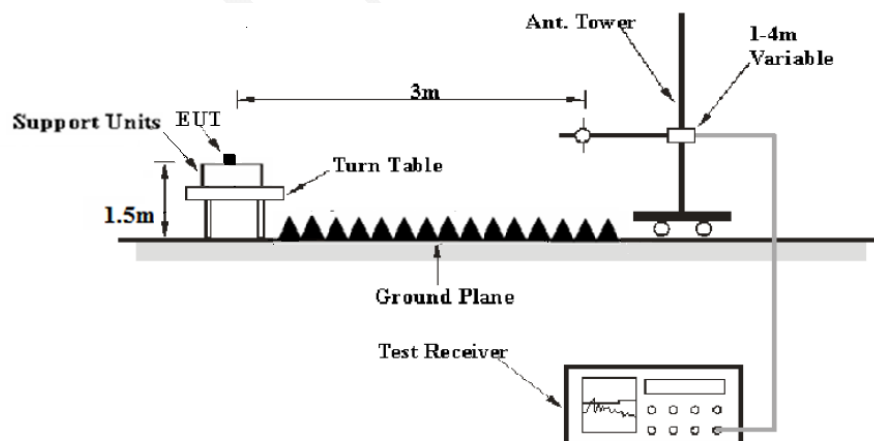
**Note:**

- 1) Corrected Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)
- 2) Margin (dB) = Limit (dBμV) – Corrected Amplitude (dBμV)



**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 Setup

The system was investigated from 30 MHz to 10 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1GHz	1MHz	3 MHz	/	PK
	1MHz	3 MHz	/	Ave.

## 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:

$$\text{Corrected Amplitude (dB}\mu\text{V /m)} = \text{Meter Reading (dB}\mu\text{V)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Amplifier Gain (dB)}$$

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:

$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V/m)} - \text{Corrected Amplitude (dB}\mu\text{V /m)}$$

## 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.

## Test Data

### Environmental Conditions

Temperature:	23.4 °C
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Max Min on 2018-03-08.

EUT operation mode: Transmitting

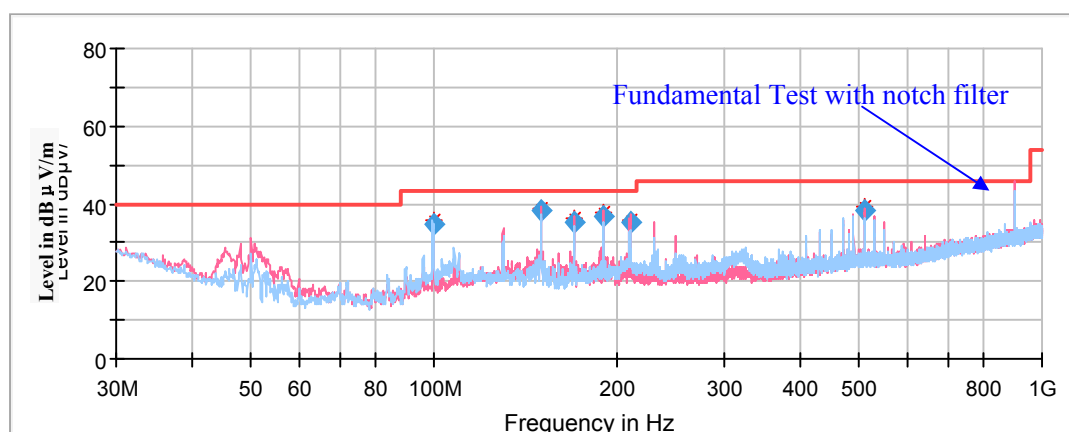
### Spurious Emission Test:

#### 30MHz-1GHz:

(Pre-scan with low, middle and high channels of operation in the X,Y and Z axes of orientation, the worst case **low channel of operation in X-axis of orientation** was recorded)

Note:

1. This test was performed with the 902-928MHz notch filter.



Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	Quasi-peak (dBμV/m)	Height (cm)	Polar (H/V)				
99.568950	34.72	198.0	H	358.0	-15.5	43.50	8.78
149.922000	38.13	101.0	V	330.0	-12.8	43.50	5.37
169.964250	35.35	101.0	V	266.0	-13.6	43.50	8.15
189.833350	36.89	101.0	V	153.0	-13.4	43.50	6.61
209.971950	35.14	101.0	V	95.0	-12.7	43.50	8.36
509.921900	38.25	101.0	V	49.0	-6.0	46.00	7.75

**1GHz-18GHz:**

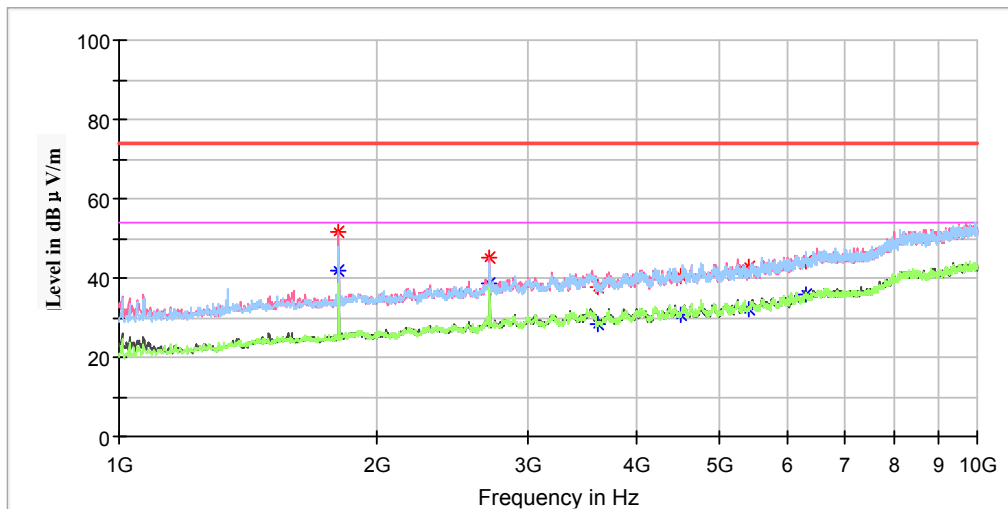
*Pre-Scan in the X,Y and Z axes of orientation,, the worst case **X-axis of orientation** was recorded*

Note:

1. The test was performed with a 10dB Attenuator.
2. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB) + Attenuator(dB)  
 Corrected Amplitude (dB $\mu$ V /m) = Corrected Factor (dB/m) + Reading (dB $\mu$ V)  
 Margin (dB) = Limit (dB $\mu$ V/m) – Corrected Amplitude (dB $\mu$ V /m)

**Low Channel: 902.216 MHz**

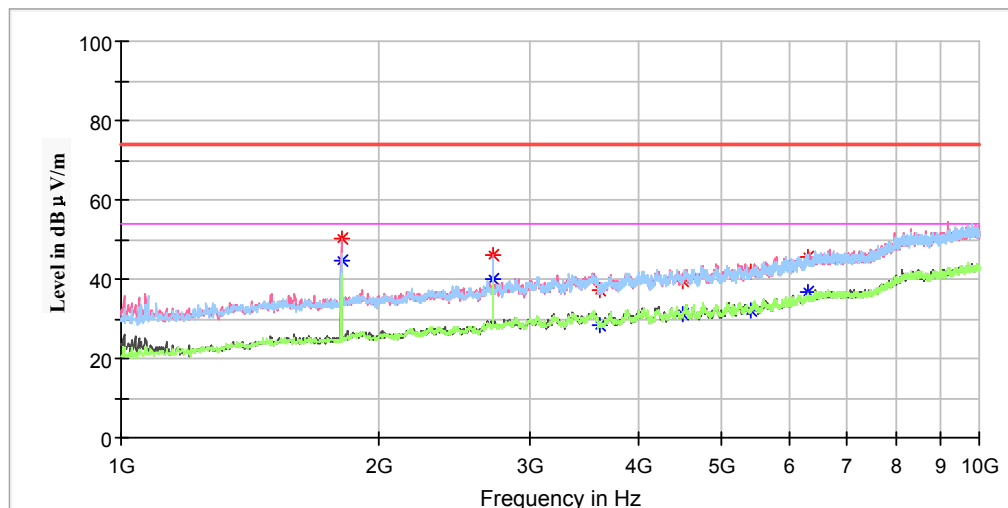
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dB $\mu$ V/m)	Margin (dB)
	MaxPeak (dB $\mu$ V /m)	Average (dB $\mu$ V /m)	Height (cm)	Polar (H/V)				
1804.450000	---	41.71	150.0	V	174.0	-6.8	54.00	12.29
1804.450000	51.52	---	150.0	V	174.0	-6.8	74.00	22.48
2706.675000	---	38.82	250.0	V	0.0	-3.5	54.00	15.18
2706.675000	45.03	---	250.0	V	0.0	-3.5	74.00	28.97
3610.000000	---	28.57	100.0	V	213.0	-0.5	54.00	25.43
3610.000000	37.54	---	100.0	V	213.0	-0.5	74.00	36.46
4510.000000	40.30	---	200.0	H	335.0	1.8	74.00	33.70
4510.000000	---	30.82	200.0	H	335.0	1.8	54.00	23.18
5413.600000	---	32.23	250.0	V	284.0	3.8	54.00	21.77
5413.600000	42.93	---	250.0	V	284.0	3.8	74.00	31.07
6315.400000	44.29	---	150.0	V	364.0	7.3	74.00	29.71
6315.400000	---	35.84	150.0	V	264.0	7.3	54.00	18.16

**Middle Channel: 903.441 MHz**

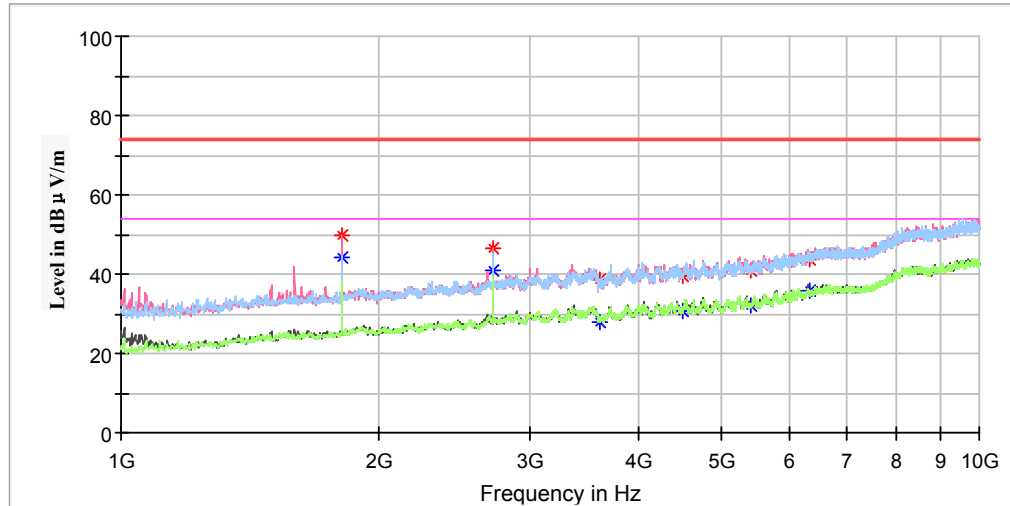
Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1806.900000	---	44.64	150.0	V	173.0	-6.8	54.00	9.36
1806.900000	50.29	---	150.0	V	173.0	-6.8	74.00	23.71
2710.350000	---	40.13	200.0	V	5.0	-3.5	54.00	13.87
2710.350000	45.99	---	200.0	V	5.0	-3.5	74.00	28.01
3613.600000	---	28.54	250.0	V	323.0	-0.5	54.00	25.46
3613.600000	37.04	---	250.0	V	323.0	-0.5	74.00	36.96
4517.200000	---	31.14	150.0	V	340.0	1.8	54.00	22.86
4517.200000	39.64	---	150.0	V	340.0	1.8	74.00	34.36
5420.800000	---	32.19	200.0	V	191.0	3.8	54.00	21.81
5420.800000	41.99	---	200.0	V	191.0	3.8	74.00	32.01
6324.400000	---	36.56	150.0	V	314.0	7.4	54.00	17.44
6324.400000	45.41	---	150.0	V	314.0	7.4	74.00	28.59

**High Channel: 904.666MHz**

Full Spectrum



Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
	MaxPeak (dBμV /m)	Average (dBμV /m)	Height (cm)	Polar (H/V)				
1809.350000	49.95	---	200.0	V	165.0	-6.7	74.00	24.05
1809.350000	---	44.09	200.0	V	165.0	-6.7	54.00	9.91
2714.025000	46.74	---	250.0	V	8.0	-3.5	74.00	27.26
2714.025000	---	40.71	250.0	V	8.0	-3.5	54.00	13.29
3617.200000	38.47	---	200.0	V	272.0	-0.5	74.00	35.53
3617.200000	---	27.96	200.0	V	272.0	-0.5	54.00	26.04
4522.600000	39.72	---	100.0	V	341.0	1.9	74.00	34.28
4522.600000	---	30.88	100.0	V	341.0	1.9	54.00	23.12
5428.000000	40.93	---	250.0	V	114.0	3.9	74.00	33.07
5428.000000	---	32.12	250.0	V	114.0	3.9	54.00	21.88
6331.600000	43.52	---	100.0	V	329.0	7.4	74.00	30.48
6331.600000	---	35.99	100.0	V	329.0	7.4	54.00	18.01

**Fundamental Test & Restricted Bands Emissions:**

*Pre-Scan in the X,Y and Z axes of orientation,, the worst case X-axis of orientation was recorded*

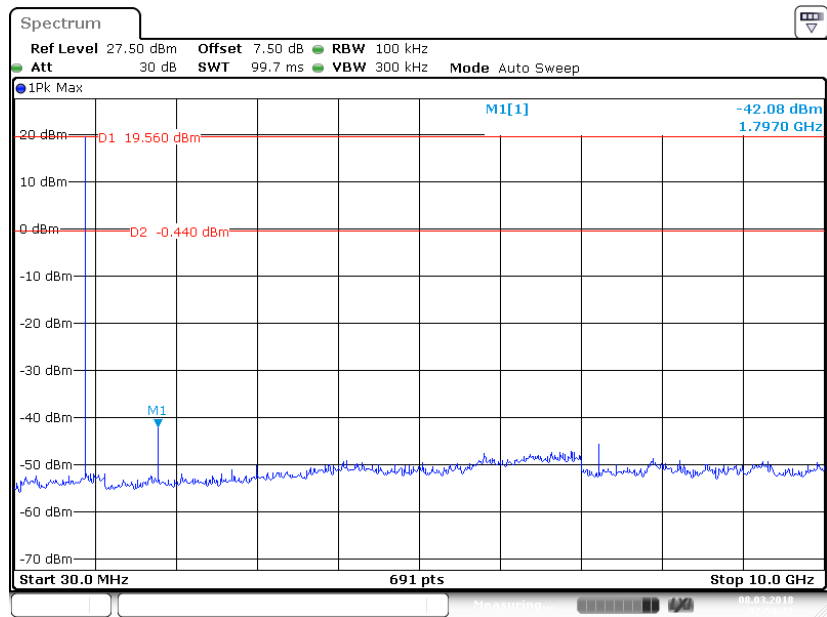
Note:

1. Corrected Factor (dB/m) = Antenna factor (RX) (dB/m) + Cable Loss (dB) – Amplifier Factor (dB)  
 Corrected Amplitude (dBμV /m) = Corrected Factor (dB/m) + Reading (dBμV)  
 Margin (dB) = Limit (dBμV/m) – Corrected Amplitude (dBμV /m)

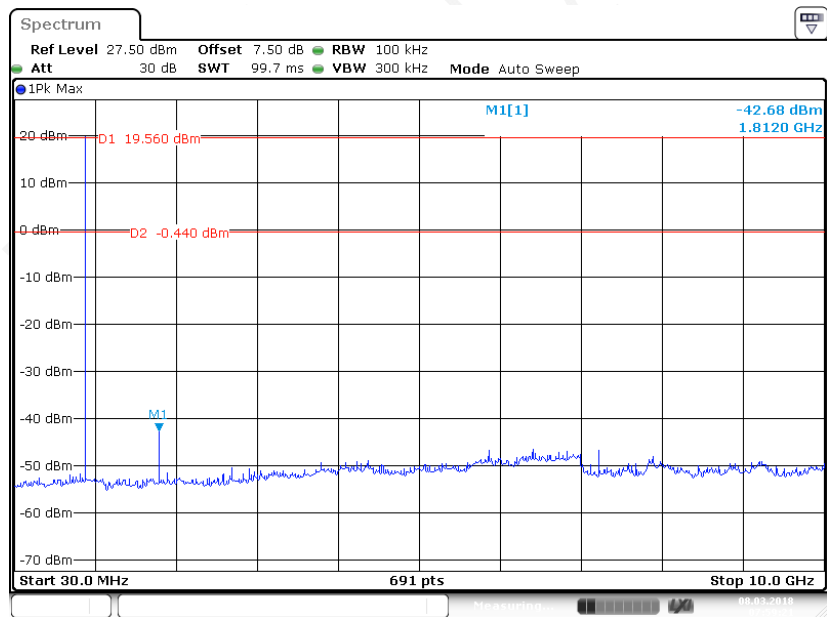
Frequency (MHz)	Corrected Amplitude (dBμV /m)	Detector (PK/QP/Ave.)	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBμV/m)	Margin (dB)
			Height (cm)	Polar (H/V)				
902.216MHz								
902.216	115.13	PK	100	V	106	0.21	/	/
902.216	113.26	PK	100	H	106	0.21	/	/
902.000	36.59	QP	100	V	261	0.20	46	9.41
902.000	30.72	QP	100	H	261	0.20	46	15.28
903.441MHz								
903.441	115.16	PK	100	V	317	0.23	/	/
903.441	113.29	PK	100	H	317	0.23	/	/
904.666MHz								
904.666	115.11	PK	100	V	193	0.26	/	/
904.666	113.08	PK	100	H	193	0.26	/	/
928.000	33.39	QP	200	V	252	0.75	46	12.61
928.000	27.92	QP	200	H	252	0.75	46	18.08

Spurious Emissions at Antenna Port:

Low Channel

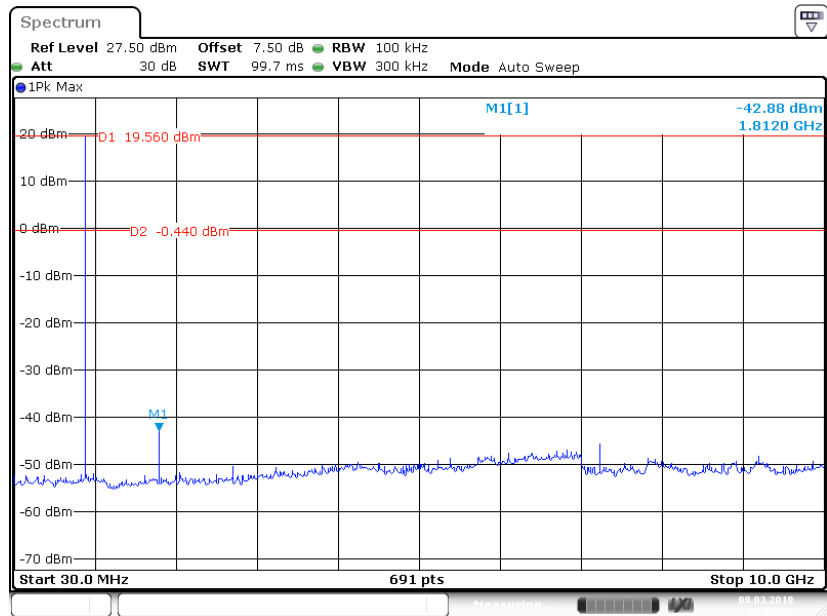


Middle Channel





# High Channel



**FCC §15.247(a) (1)-CHANNEL SEPARATION TEST****Applicable Standard**

(1) Frequency hopping systems shall have hopping 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**

<b>Temperature:</b>	24.1 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101.0 kPa

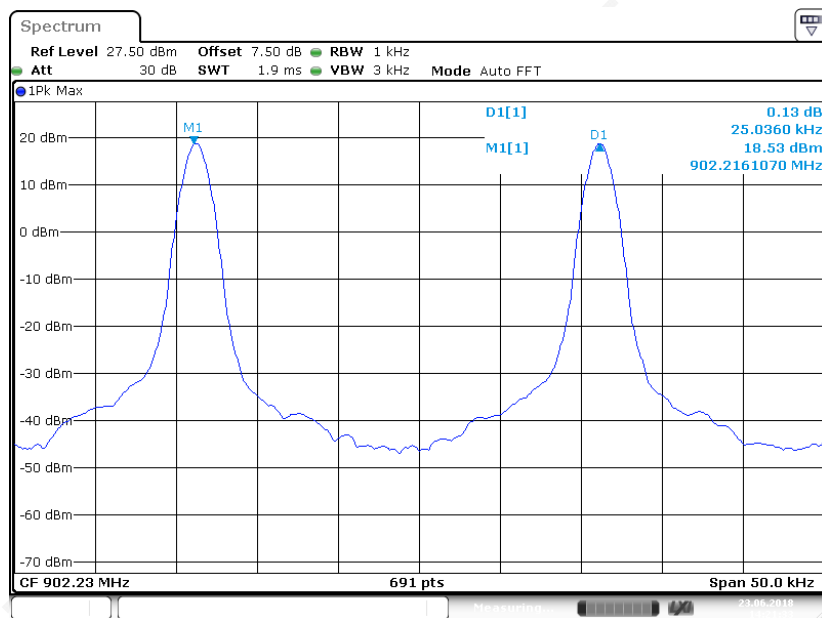
*The testing was performed by Max Min on 2018-06-23.*

*EUT operation mode: Transmitting*

*Test Result: Compliance.*

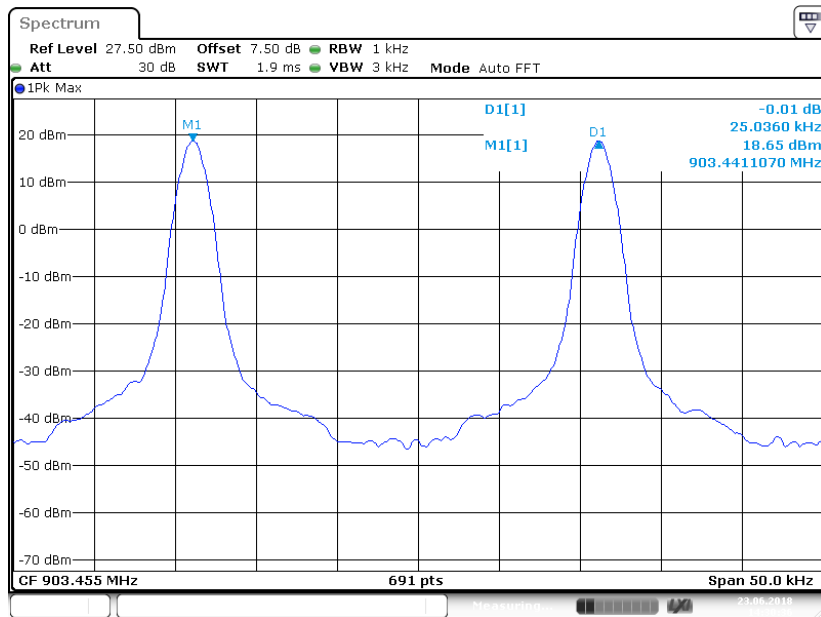
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit (kHz)	Result
Low	902.216	25.036	$\geq 25$	Pass
Adjacent	902.241			
Middle	903.441	25.036	$\geq 25$	Pass
Adjacent	903.466			
High	904.641	25.036	$\geq 25$	Pass
Adjacent	904.666			

### Low Channel

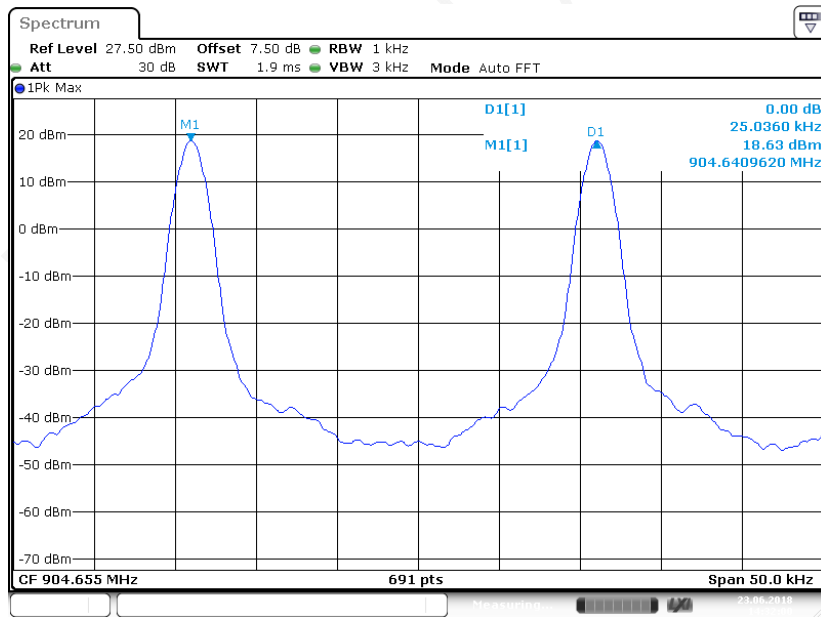


Date: 23 JUN 2018 14:21:33

### Middle Channel



### High Channel



**FCC §15.247(a) (1) (i)– 20 dB EMISSION BANDWIDTH****Applicable Standard**

(i) 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**

<b>Temperature:</b>	24.5 °C
<b>Relative Humidity:</b>	56 %
<b>ATM Pressure:</b>	101.0 kPa

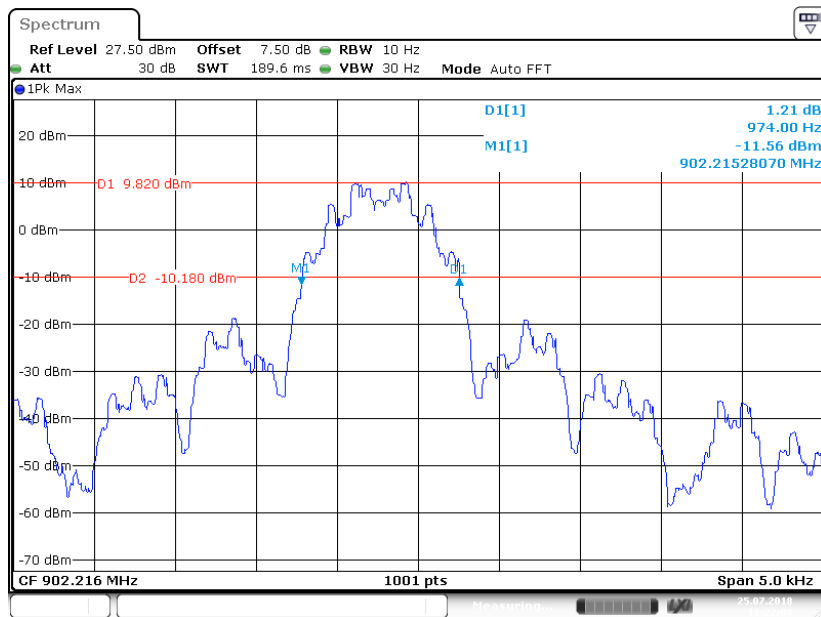
*The testing was performed by Max Min on 2018-07-25.*

*EUT operation mode: Transmitting*

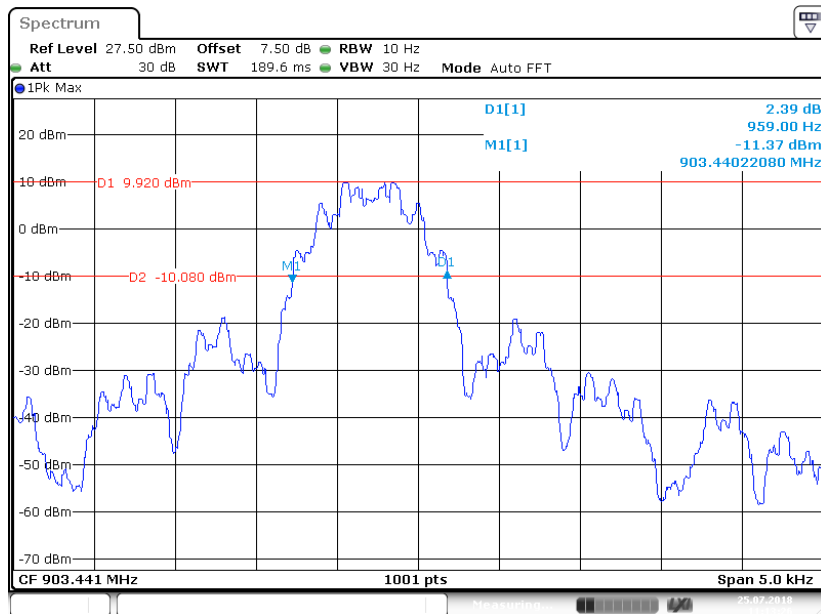
*Test Result: Compliance.*

Channel	Frequency (MHz)	20 dB Emission Bandwidth (kHz)	Limit (kHz)
Low	902.216	0.974	≤500
Middle	903.441	0.959	≤500
High	904.666	0.954	≤500

### Low Channel

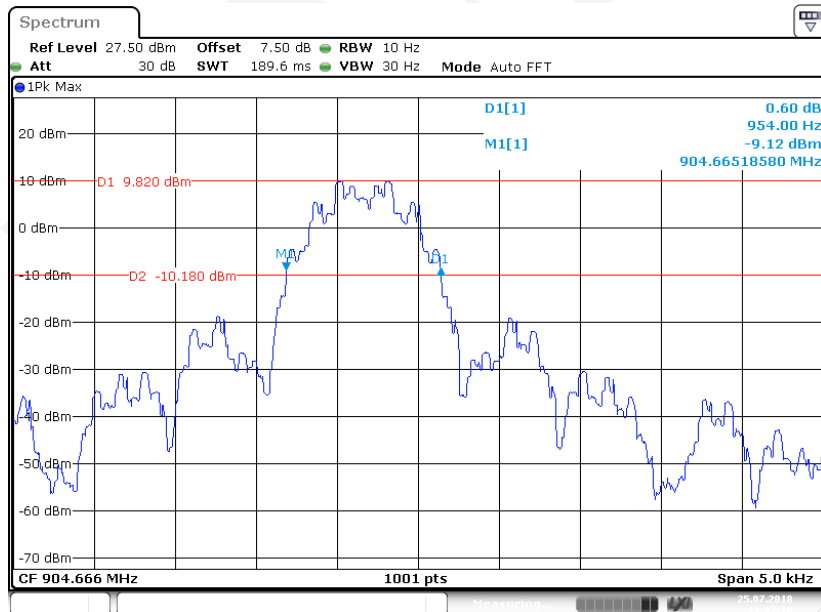


### Middle Channel



Date: 25 JUL 2018 11:13:26

### High Channel



Date: 25 JUL 2018 11:17:20

**FCC §15.247(a) (1) (i)-QUANTITY OF HOPPING CHANNEL TEST****Applicable Standard**

(i) 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**

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Max Min on 2018-06-23.*

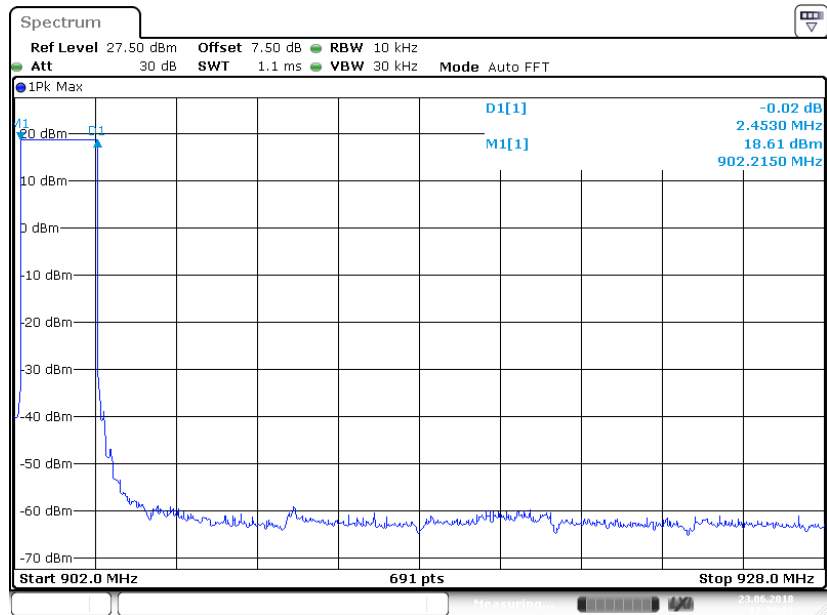
*EUT operation mode: Transmitting*

*Test Result: Compliance.*



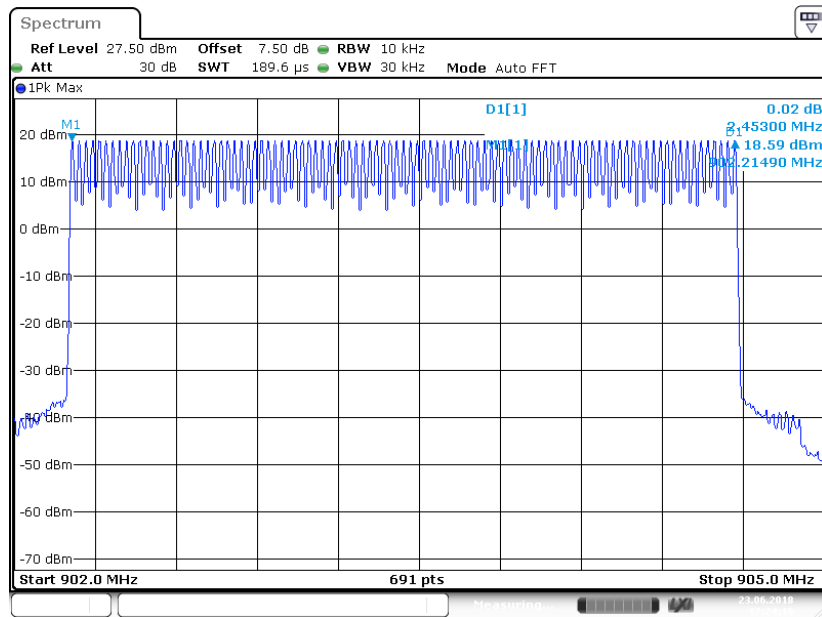
Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
902~928	99	≥50

### Number of Hopping Channels



Date: 23 JUN 2018 17:30:33

# Number of Hopping Channels



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

### Applicable Standard

(i) 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

The EUT was worked in channel hopping; Spectrum SPAN was set as 0. Sweep was set as 0.4 X channel no. (s), the quantity of pulse was get from single sweep. In addition, the time of single pulses was tested.

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	24.2 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101.0 kPa

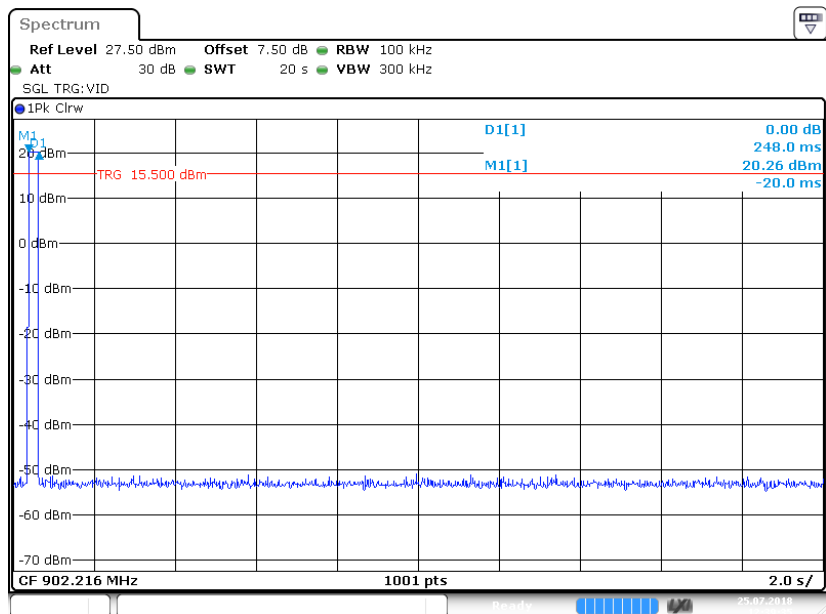
The testing was performed by Max Min on 2018-07-25.

EUT operation mode: Transmitting

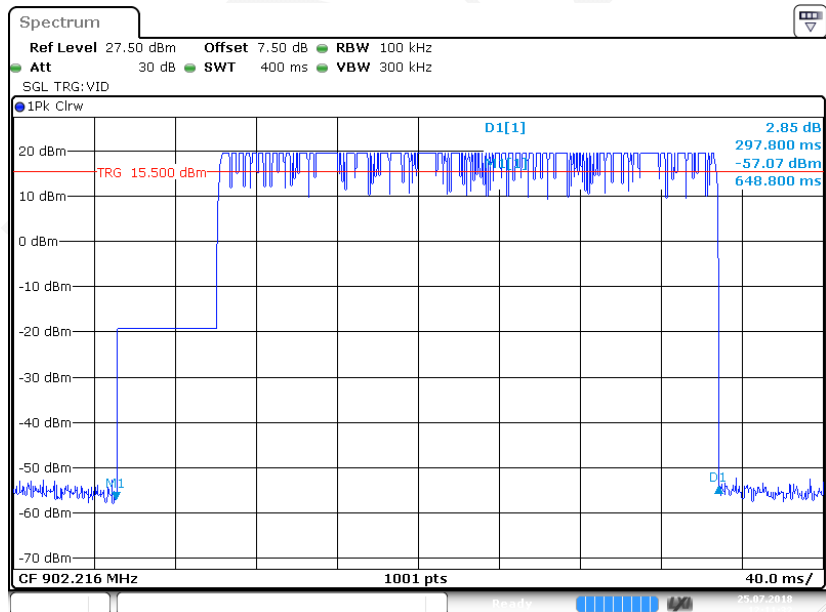
Test Result: Compliance.

Channel	Pulse Width	Pulse Number	Dwell Time	Limit	Result
	(ms)		(s)	(s)	
Low	297.8	1	0.2978	≤0.4	Pass
Middle	297.8	1	0.2978	≤0.4	Pass
High	297.8	1	0.2978	≤0.4	Pass
Note: Dwell time = Pulse time * N					

### Low Channel

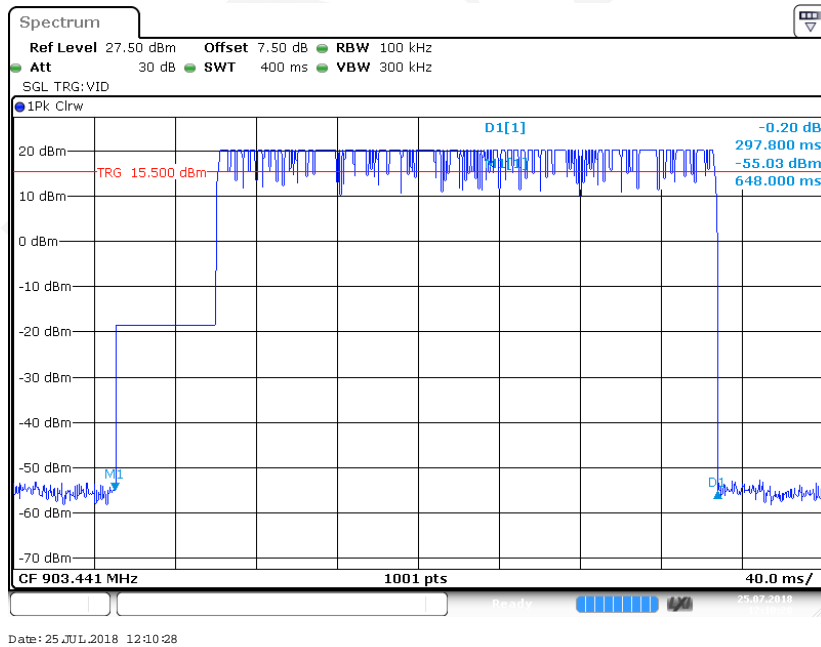
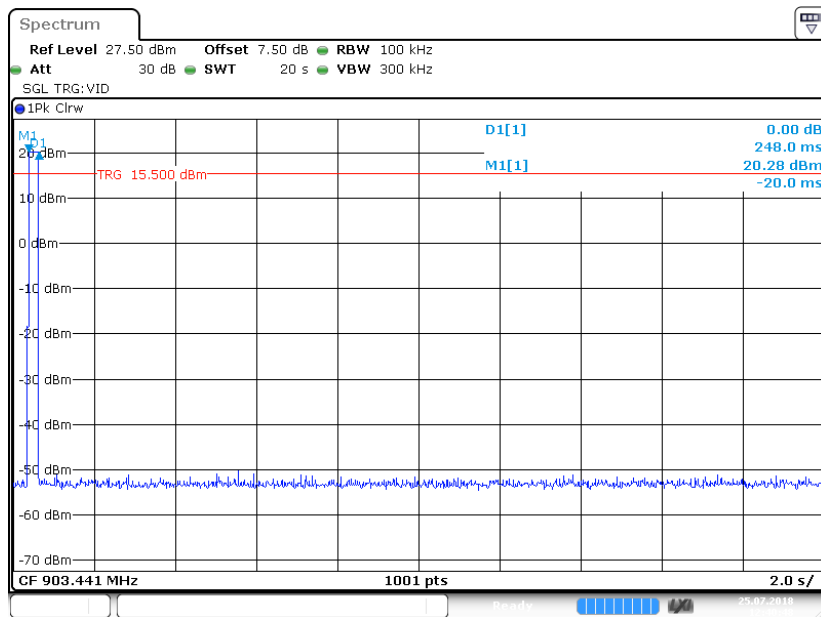


Date: 25 JUL 2018 12:39:35

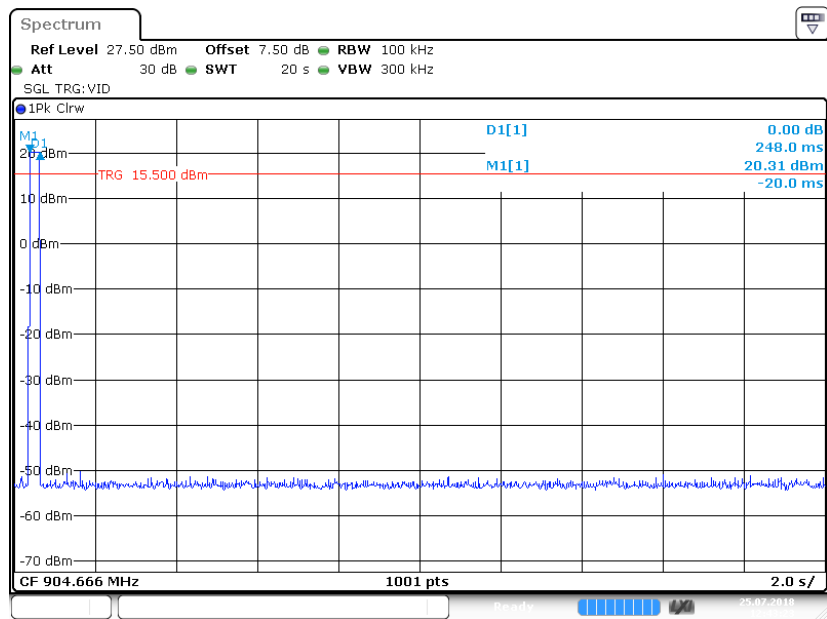


Date: 25 JUL 2018 12:11:32

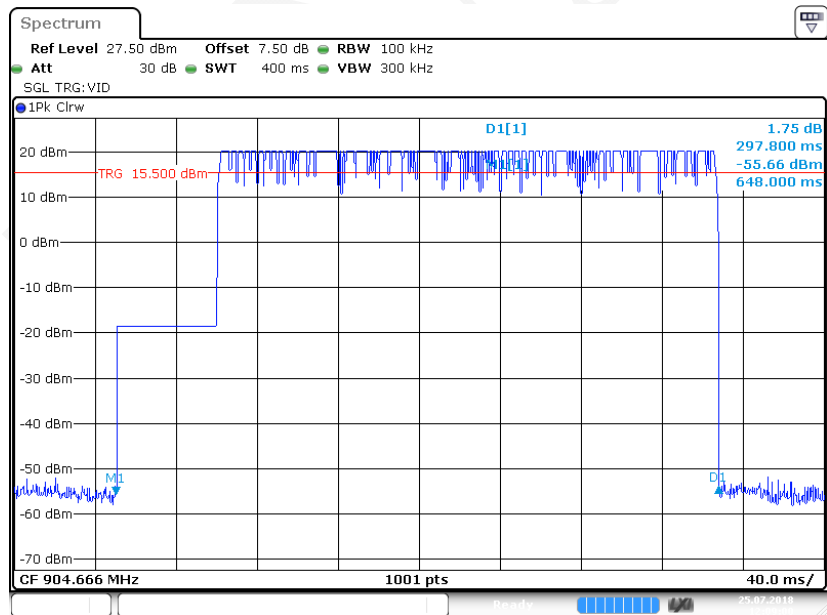
# Middle Channel



# High Channel



Date: 25 JUL 2018 12:43:23



Date: 25 JUL 2018 12:09:01

## FCC §15.247(b) (2) - PEAK OUTPUT POWER MEASUREMENT

### Applicable Standard

According to §15.247(b) (2), 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

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Max Min on 2018-03-08.

EUT operation mode: Transmitting

Test Result: Compliance.

Channel	Peak Conducted Output Power		Limit (mW)
	(dBm)	(mW)	
Low	19.58	90.78	≤1000
Middle	19.58	90.78	≤1000
High	19.58	90.78	≤1000

## 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:	24 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

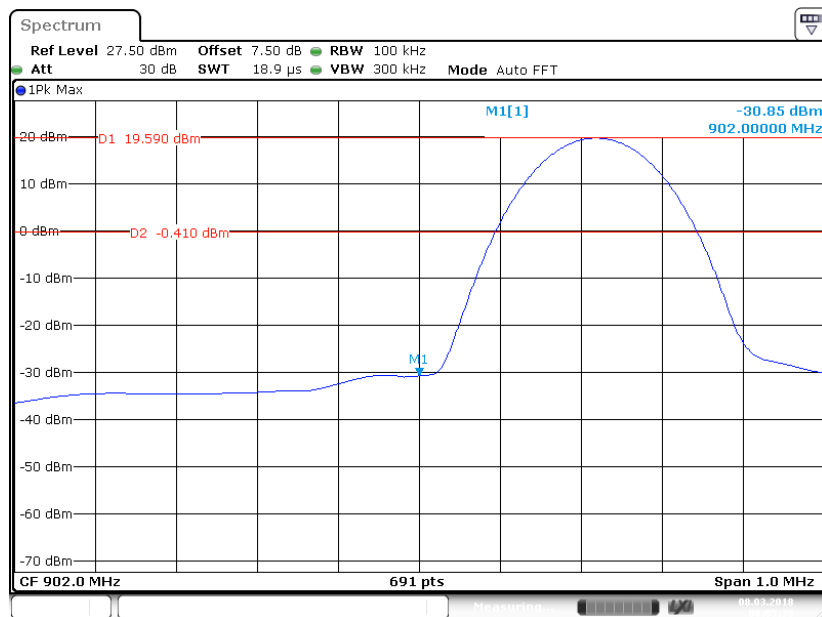
*The testing was performed by Max Min on 2018-03-08.*

*EUT operation mode: Transmitting*

*Test Result: Compliance.*

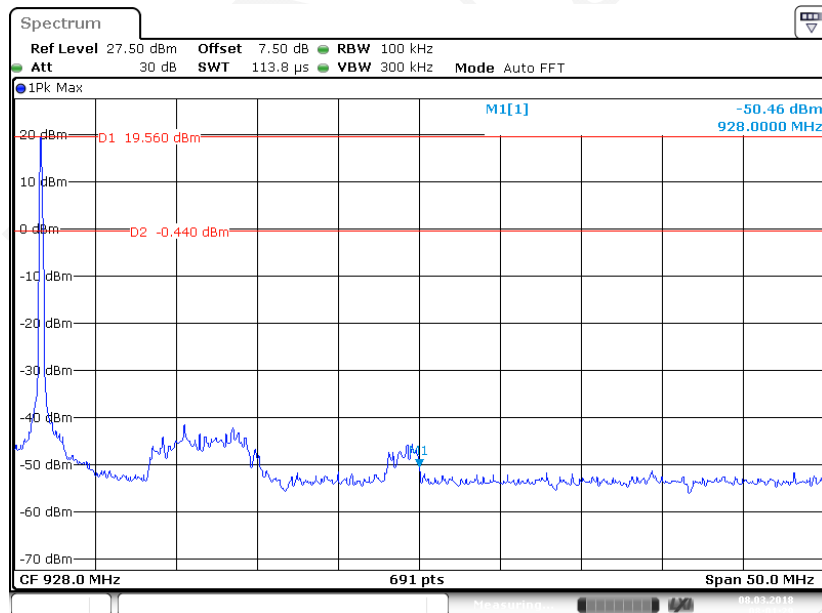


### Band Edge-Left Side

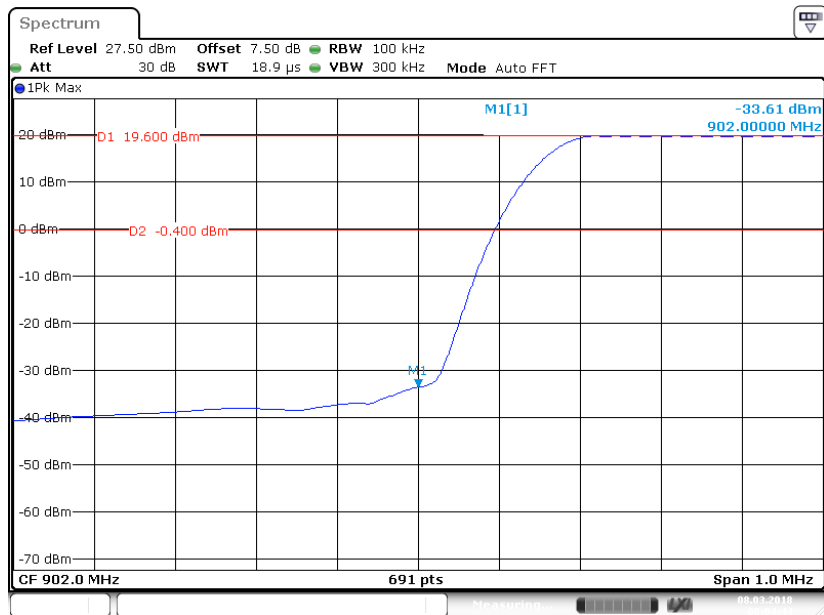
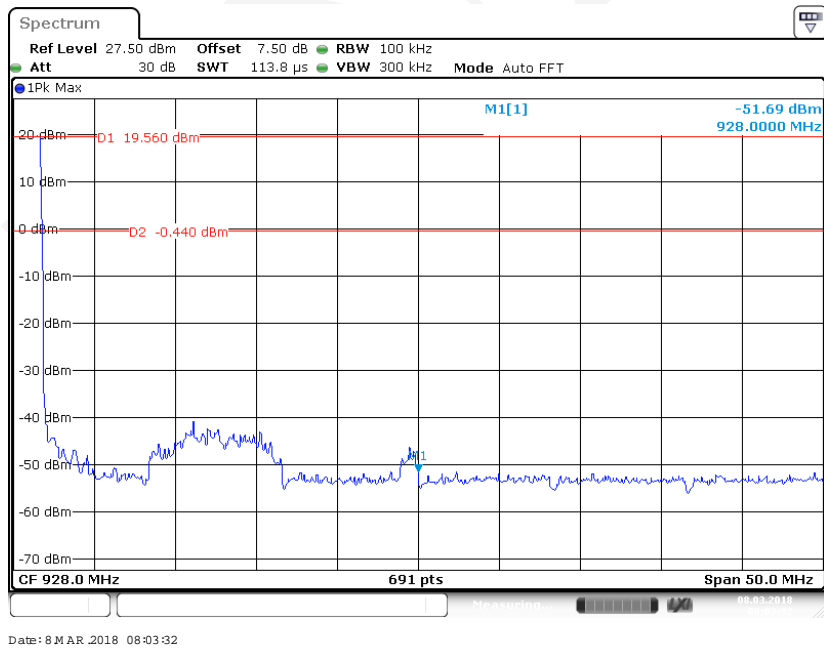


Date: 8 MAR 2018 08:05:39

### Band Edge-Right Side



Date: 8 MAR 2018 08:01:29

**Band Edge-Left Side (Hopping)****Band Edge-Right Side (Hopping)****\*\*\*\*\* END OF REPORT \*\*\*\*\***