FCC PART 15.247
TEST REPORT

For

Hexing Electrical Co., Ltd

1418-5 Moganshan Road, Shangcheng Industrial Zone, Hangzhou, China

FCC ID: 2AIUZ-MJN956

Report Type:	**Product Type:**
Original Report	AMI Meter HexNet
Test Engineer:	Ada Yu
Report Number:	RSHA171204001-00A
Report Date:	2017-12-28
Reviewed By:	Oscar Ye RF Leader
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Kunshan) No.248 Chenghu Road,Kunshan,Jiangsu province,China Tel: +86-0512-86175000 Fax: +86-0512-88934268 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Hexing Electrical Co., Ltd
Tested Model	MJN956
Product Type	AMI Meter HexNet
Dimension	102.6 mm(L)×35.5 mm(W)×61.1 mm(H)
Power Supply	DC 5-15.5V

**All measurement and test data in this report was gathered from production sample serial number: 20171204001. (Assigned by BACL, Kunshan). The EUT was received on 2017-12-04.*

Objective

This test report is prepared on behalf of Hexing Electrical 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)

No submittal(s)/grant(s)

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 radiated and conducted emissions measurement was performed at Bay Area Compliance Lab 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		3.19dB
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~40Hz	5.65dB
Occupied Bandwidth		0.5kHz
Temperature		1.0℃
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

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	916.25	28	921.65
2	916.45	29	921.85
3	916.65	30	922.05
4	916.85	31	922.25
5	917.05	32	922.45
6	917.25	33	922.65
7	917.45	34	922.85
8	917.65	35	923.05
9	917.85	36	923.25
10	918.05	37	923.45
11	918.25	38	923.65
12	918.45	39	923.85
13	918.65	40	924.05
14	918.85	41	924.25
15	919.05	42	924.45
16	919.25	43	924.65
17	919.45	44	924.85
18	919.65	45	925.05
19	919.85	46	925.25
20	920.05	47	925.45
21	920.25	48	925.65
22	920.45	49	925.85
23	920.65	50	926.05
24	920.85	51	926.25
25	921.05	52	926.45
26	921.25	53	926.65
27	921.45		

EUT was tested with Channel 1, 27 and 53.

EUT Exercise Software

RF test tool : HxZBee_BZ
Power level setting: 3

Support Equipment List and Details

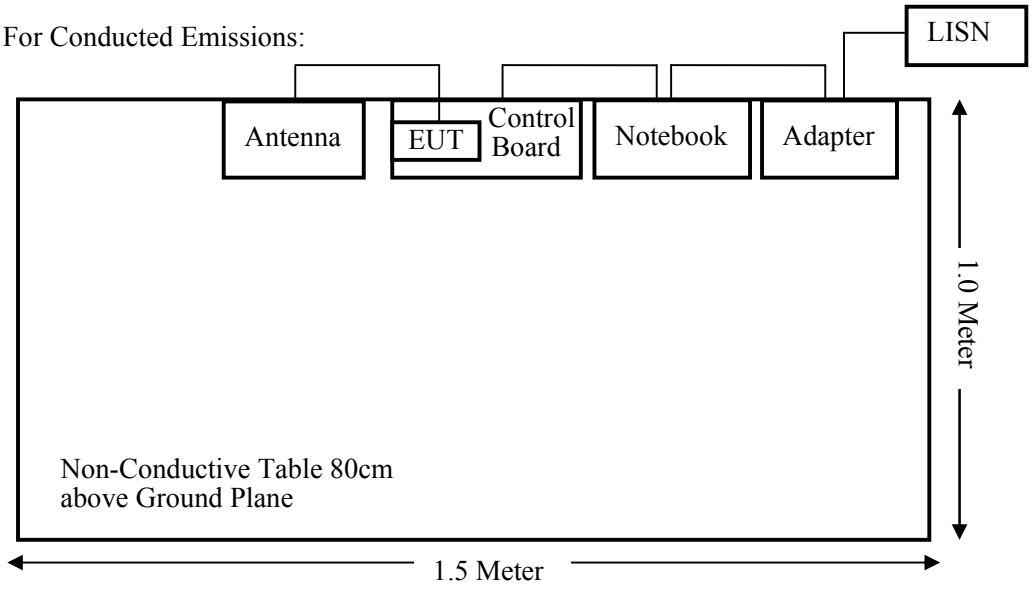
Manufacturer	Description	Model	Serial Number
DELL	Notebook	GX620	D65874152
DELL	Adapter	LA65NS0-00	DF263
Hexing	Control Board	HXRF-L	PB-00470-0V04

External I/O Cable

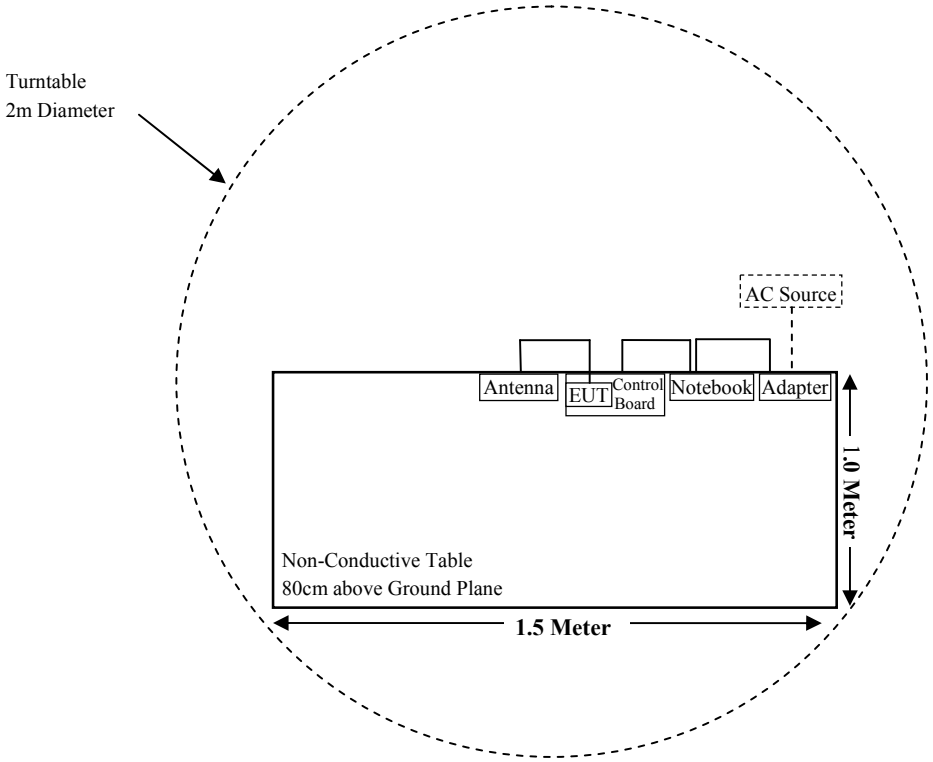
Cable Description	Shielding Type	Length (m)	From Port	To
USB Cable	Unshielding	1.0	Control Board	Notebook

Block Diagram of Test Setup

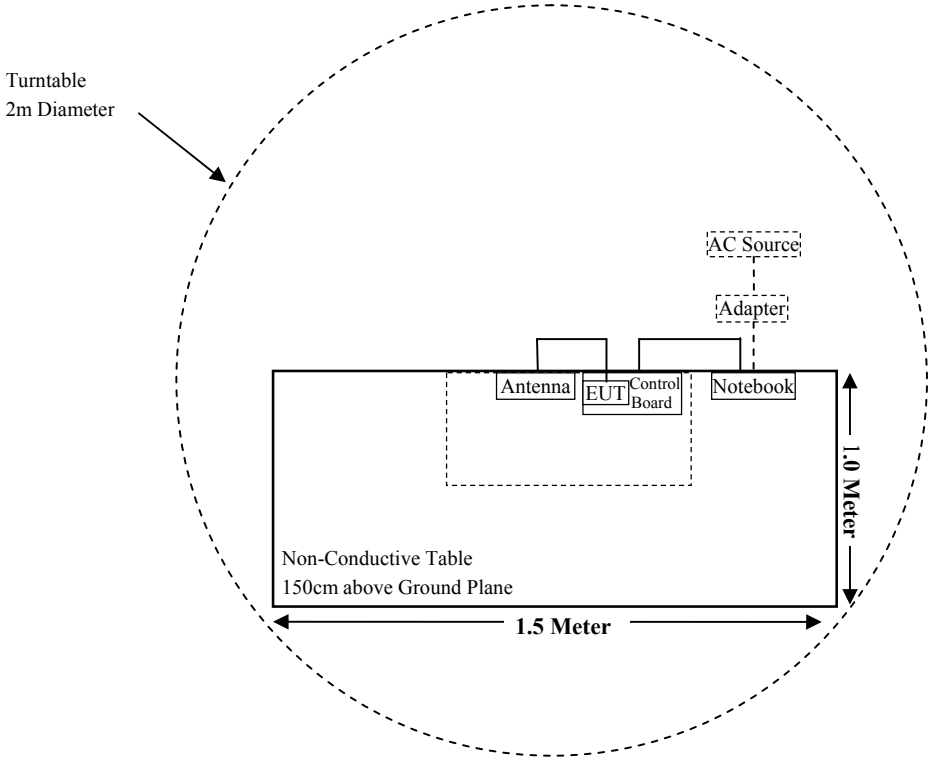
For Conducted Emissions:



For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1310 & §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)(i)	20 dB Emission Bandwidth	Compliance
§15.247(a)(1)(i)	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
Radiated Emission Test（Chamber 1#）					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2017-11-25	2018-11-24
Sunol Sciences	Broadband Antenna	JB3	A040914-2	2016-01-09	2019-01-08
Sonoma Instrunent	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
Radiated Emission Test（Chamber 2#）					
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
MICRO-TRONICS	Band Reject Filter	BRC50722	G013	2017-08-05	2018-08-04
Narda	Pre-amplifier	AFS42-00101800	2001270	2017-12-12	2018-12-11
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
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSV40	101116	2017-07-22	2018-07-21
Picosecond	DC Block	5500A-110	131047	2017-09-23	2018-09-22
Hexing	RF Cable	N/A	N/A	/	/
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2017-11-25	2018-11-24
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2017-11-12	2018-11-11
Rohde & Schwarz	LISN	ENV216	3560655016	2017-11-12	2018-11-11
BACL	BACL-EMC	V1.0	CE001	/	/
Narda	Attenuator/6dB	10690812-2	26850-6	2017-01-10	2018-01-09
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).

FCC§15.247 (i), §1.1310& §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) 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;
According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary:
Predication of MPE limit at a given distance
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
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);

Measurement Result

Modulation	**Frequency Range**	**Antenna Gain**		**Target Output Power**		**Evaluation Distance**	**Power Density**	**MPE Limit**
	(MHz)	**(dBi)**	**(numeric)**	**(dBm)**	**(mW)**	**(cm)**	**(mW/cm^2)**	**(mW/cm^2)**
LoRa	916.25-926.65	3.0	2.00	26.50	446.68	20	0.1773	0.6108

Note: The target out putpower was declared by the manufacturer.

Result: The device meet FCC MPE at 20 cm distance.

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 Information

The EUT has a RP-SMA connector to attach an external antenna arrangement, which the antenna gain is 3.0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

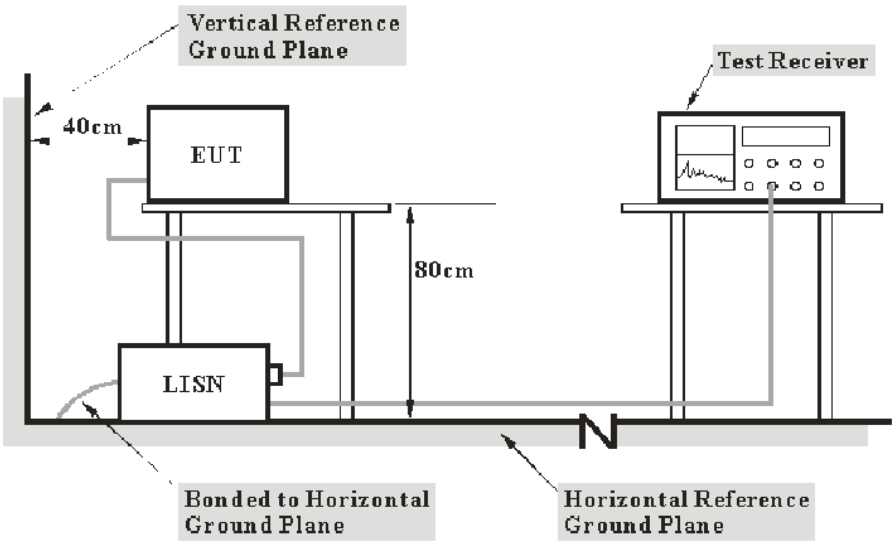
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

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 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:

Corrected 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 – Reading

Test Results Summary

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

Test Data

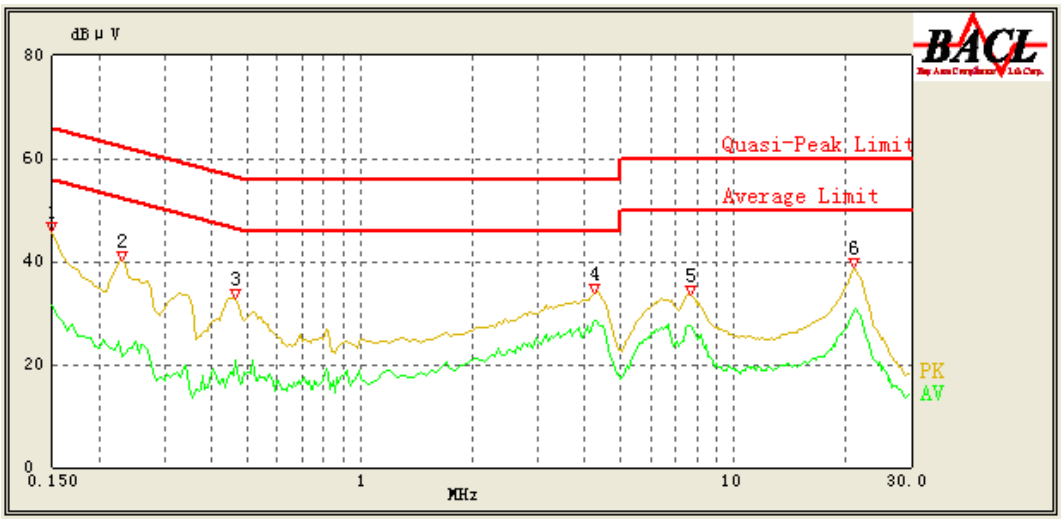
Environmental Conditions

Temperature:	22.7°C
Relative Humidity:	50 %
ATM Pressure:	101.3 kPa

The testing was performed by Ada Yu on 2017-12-08.

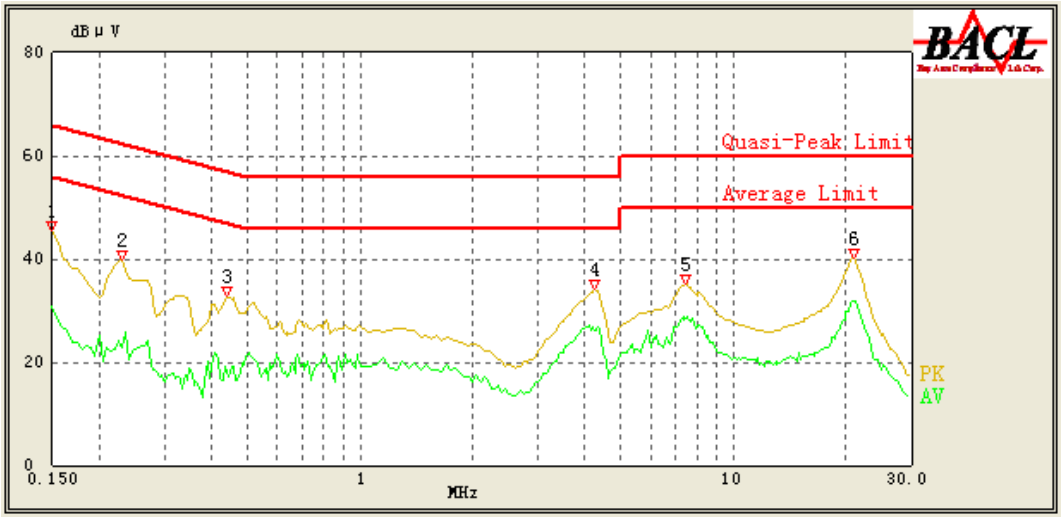
EUT operation mode: Transmitting in low channel.(worst case)

AC 120V/60 Hz, Line



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	45.92	QP	9.000	L1	16.06	66.00	20.08	Compliance
0.150	31.39	AV	9.000	L1	16.06	56.00	24.61	Compliance
0.230	40.15	QP	9.000	L1	16.02	63.71	23.56	Compliance
0.230	21.49	AV	9.000	L1	16.02	53.71	32.22	Compliance
0.465	32.87	QP	9.000	L1	16.07	57.00	24.13	Compliance
0.465	20.83	AV	9.000	L1	16.07	47.00	26.17	Compliance
4.250	33.79	QP	9.000	L1	15.85	56.00	22.21	Compliance
4.250	28.66	AV	9.000	L1	15.85	46.00	17.34	Compliance
7.650	33.63	QP	9.000	L1	16.00	60.00	26.37	Compliance
7.650	27.60	AV	9.000	L1	16.00	50.00	22.40	Compliance
21.100	38.73	QP	9.000	L1	16.44	60.00	21.27	Compliance
21.250	30.70	AV	9.000	L1	16.44	50.00	19.30	Compliance

AC 120V/60 Hz, Neutral



Frequency (MHz)	Reading (dBµV)	Detector (PK/AV/QP)	Bandwidth (kHz)	Line	Corrected Factor (dB)	Limit (dBµV)	Margin (dB)	Comment
0.150	45.55	QP	9.000	N	16.06	66.00	20.45	Compliance
0.150	30.76	AV	9.000	N	16.06	56.00	25.24	Compliance
0.230	39.79	QP	9.000	N	16.06	63.71	23.92	Compliance
0.230	22.69	AV	9.000	N	16.06	53.71	31.02	Compliance
0.440	32.72	QP	9.000	N	16.10	57.71	24.99	Compliance
0.440	18.44	AV	9.000	N	16.10	47.71	29.27	Compliance
4.250	34.14	QP	9.000	N	15.88	56.00	21.86	Compliance
4.250	26.05	AV	9.000	N	15.88	46.00	19.95	Compliance
7.450	35.23	QP	9.000	N	15.93	60.00	24.77	Compliance
7.400	28.17	AV	9.000	N	15.93	50.00	21.83	Compliance
20.950	40.17	QP	9.000	N	16.18	60.00	19.83	Compliance
20.900	31.93	AV	9.000	N	16.17	50.00	18.07	Compliance

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

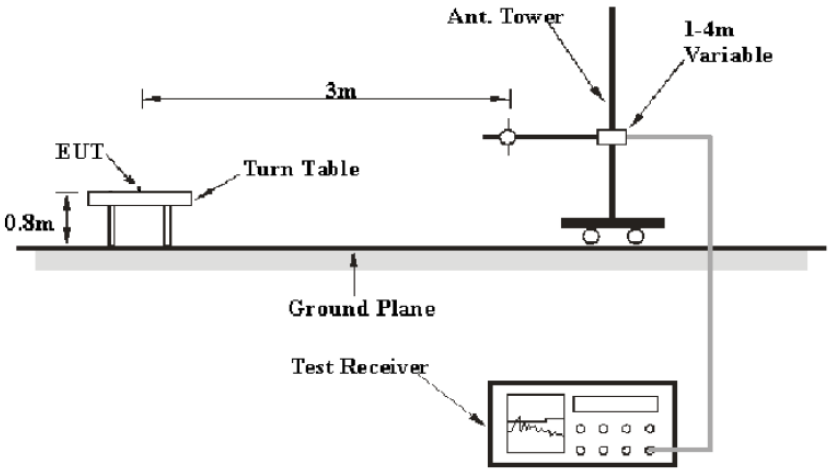
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

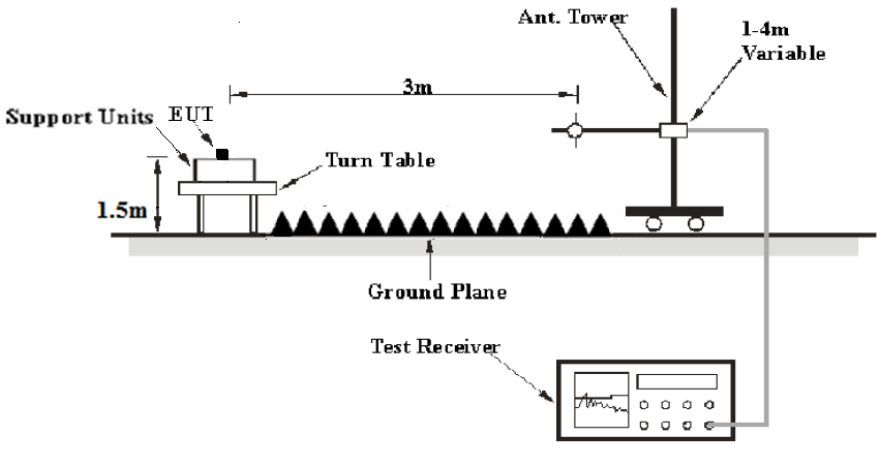
FCC §15.205; §15.209; §15.247(d)

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:

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.

Test Data

Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	49 %
ATM Pressure:	101.1 kPa

The testing was performed by Ada Yu from 2017-12-18 to 2017-12-21.

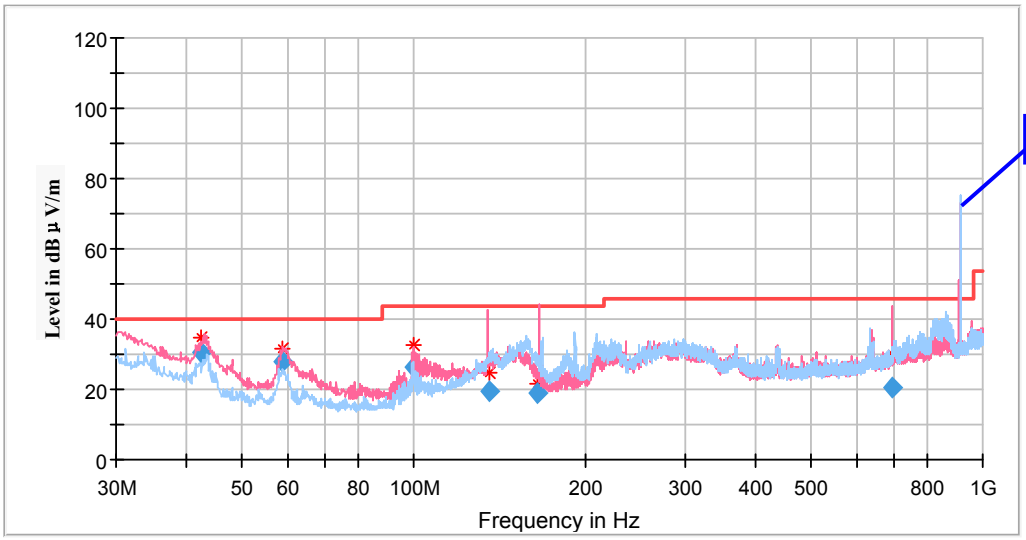
EUT operation mode: Transmitting

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 in X-axis of orientation** was recorded)*

Note:
1. This test was performed with the 902-928MHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
   Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude



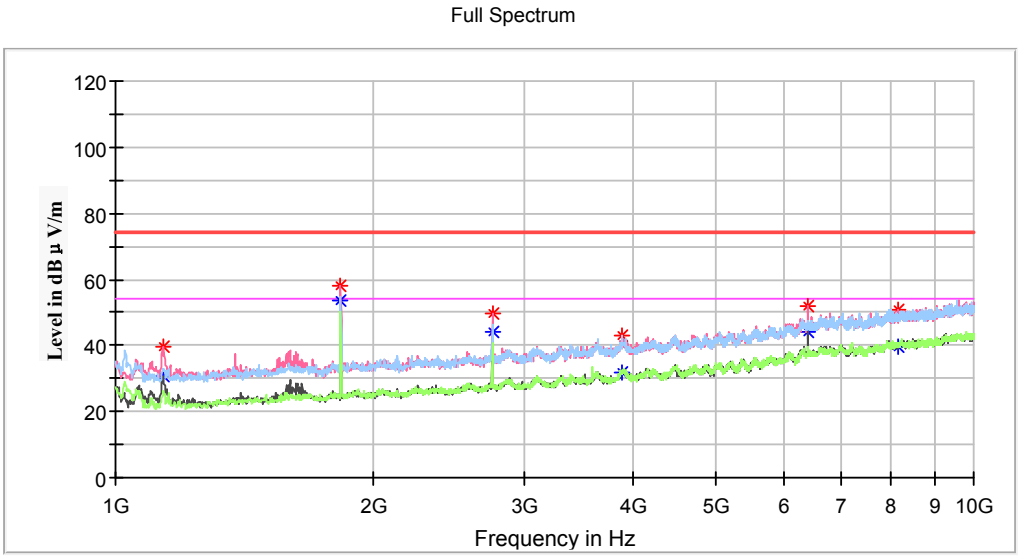
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
42.203060	34.59	100.0	V	63.0	-13.1	40.00	5.41
58.785990	31.47	100.0	V	99.0	-18.3	40.00	8.53
99.786870	32.53	100.0	V	228.0	-15.4	43.50	10.97
136.118420	24.70	200.0	V	210.0	-12.2	43.50	18.80
164.704540	21.69	200.0	V	142.0	-13.5	43.50	21.81
694.468390	29.84	200.0	V	229.0	-3.2	46.00	16.16

1GHz-10GHz:

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

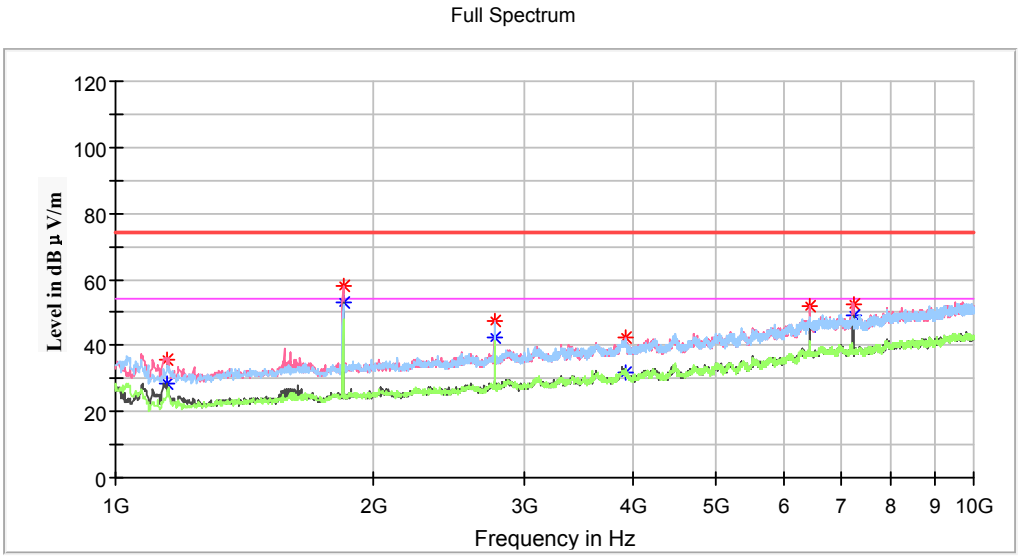
Note:
1. This test was performed with the 902-928MHz band reject filter.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
   Corrected Amplitude = Corrected Factor + Reading
   Margin = Limit - Corrected. Amplitude

Low Channel: 916.25MHz



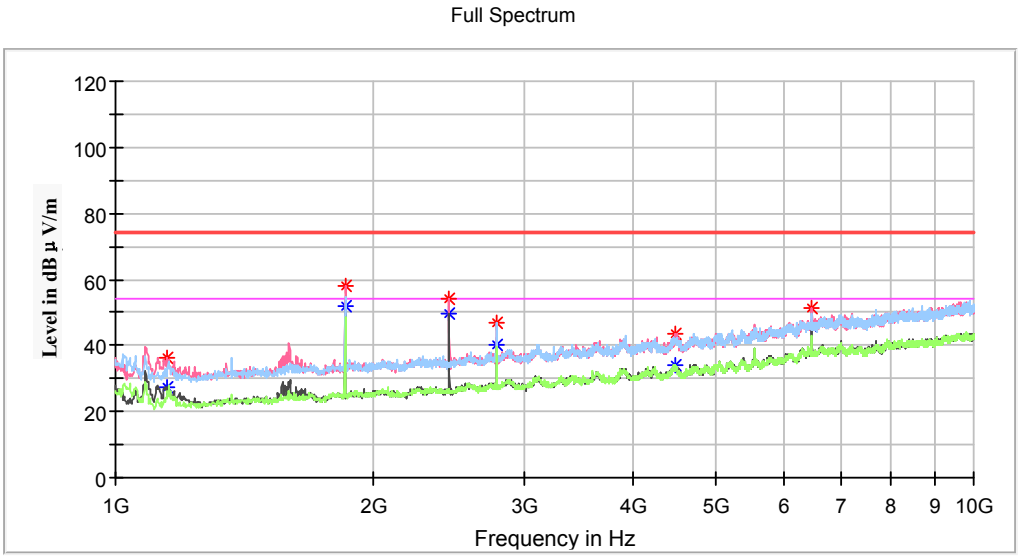
Frequency (MHz)	Corrected Amplitude		Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	MaxPeak (dBµV /m)	Average (dBµV /m)	Height (cm)	Polar (H/V)				
1135.000000	---	30.54	200.0	V	136.0	-10.6	54.00	23.46
1135.000000	39.67	---	200.0	V	136.0	-10.6	74.00	34.33
1832.500000	58.05	---	150.0	V	173.0	-6.7	74.00	15.95
1832.500000	---	53.74	150.0	V	173.0	-6.7	54.00	0.26
2748.750000	49.55	---	150.0	V	325.0	-3.3	74.00	24.45
2748.750000	---	44.17	150.0	V	325.0	-3.3	54.00	9.83
3898.000000	---	32.08	150.0	H	131.0	0.5	54.00	21.92
3898.000000	42.74	---	150.0	H	131.0	0.5	74.00	31.26
6414.400000	52.02	---	200.0	V	126.0	7.8	74.00	21.98
6414.400000	---	44.02	200.0	V	126.0	7.8	54.00	9.98
8162.200000	---	39.80	200.0	V	24.0	12.3	54.00	14.20
8162.200000	50.97	---	200.0	V	24.0	12.3	74.00	23.03

Middle Channel: 921.45MHz



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)				
1149.400000	35.49	---	150.0	V	20.0	-10.5	74.00	38.51
1149.400000	---	28.65	150.0	V	20.0	-10.5	54.00	25.35
1842.900000	57.98	---	200.0	V	193.0	-6.6	74.00	16.02
1842.900000	---	52.94	200.0	V	193.0	-6.6	54.00	1.06
2764.350000	47.17	---	200.0	V	24.0	-3.2	74.00	26.83
2764.350000	---	42.18	200.0	V	24.0	-3.2	54.00	11.82
3921.400000	---	31.77	200.0	H	121.0	0.5	54.00	22.23
3921.400000	42.32	---	200.0	H	121.0	0.5	74.00	31.68
6450.400000	---	45.64	200.0	V	142.0	8.0	54.00	8.36
6450.400000	52.08	---	200.0	V	142.0	8.0	74.00	21.92
7235.200000	52.67	---	150.0	V	286.0	9.8	74.00	21.33
7235.200000	---	48.98	150.0	V	286.0	9.8	54.00	5.02

High Channel: 926.65MHz



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)				
1149.400000	---	27.33	150.0	V	8.0	-10.5	54.00	26.67
1149.400000	36.14	---	150.0	V	8.0	-10.5	74.00	37.86
1853.500000	58.24	---	200.0	V	191.0	-6.6	74.00	15.76
1853.500000	---	51.81	200.0	V	191.0	-6.6	54.00	2.19
2447.200000	54.25	---	150.0	V	300.0	-4.8	74.00	19.75
2447.200000	---	49.47	150.0	V	300.0	-4.8	54.00	4.53
2779.950000	47.06	---	150.0	V	331.0	-3.1	74.00	26.94
2779.950000	---	40.18	150.0	V	331.0	-3.1	54.00	13.82
4493.800000	---	33.86	200.0	H	99.0	1.8	54.00	20.14
4493.800000	43.61	---	200.0	H	99.0	1.8	74.00	30.39
6486.400000	51.20	---	200.0	V	230.0	8.2	74.00	22.80
6486.400000	---	45.57	200.0	V	230.0	8.2	54.00	8.43

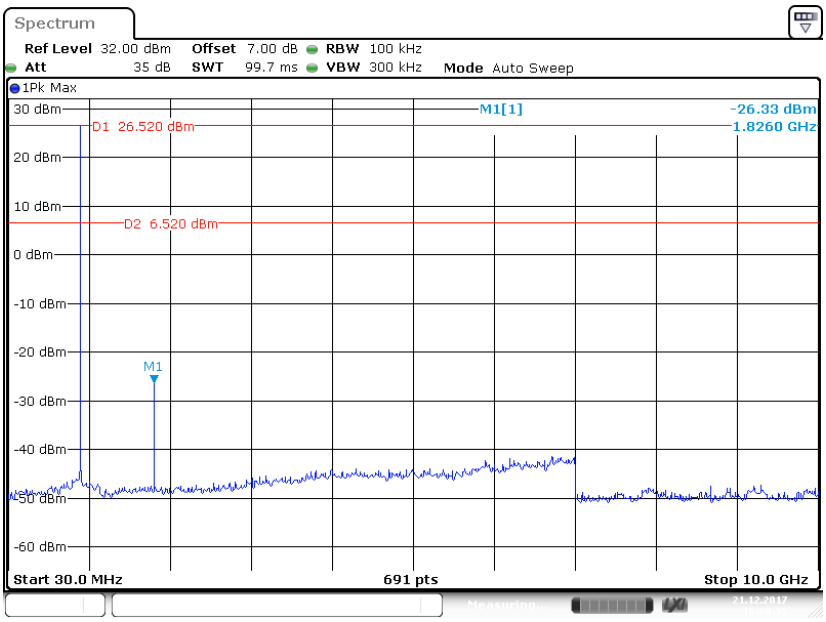
Radiation Spurious for Fundamental andBand Edge:

1. This test was performed with a 10dB Attenuator.
2. Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
   Corrected Amplitude = Corrected Factor + Reading
   Margin = Limit - Corrected. Amplitude

Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corr. (dB)	Limit	Margin (dB)
	QuasiPeak (dBμV/m)	Height (cm)	Polar (H/V)				
Low Channel 916.25MHz							
916.25	120.30	250.0	V	49.0	10.5	/	/
902.00	51.22	250.0	V	206.0	10.2	100.30	49.08
Middle Channel 921.45MHz							
921.45	120.56	185.0	V	92.0	10.7	/	/
High Channel: 926.65MHz							
926.65	121.14	200.0	H	164.0	10.7	/	/
928.00	60.57	200.0	H	164.0	10.8	101.14	40.57

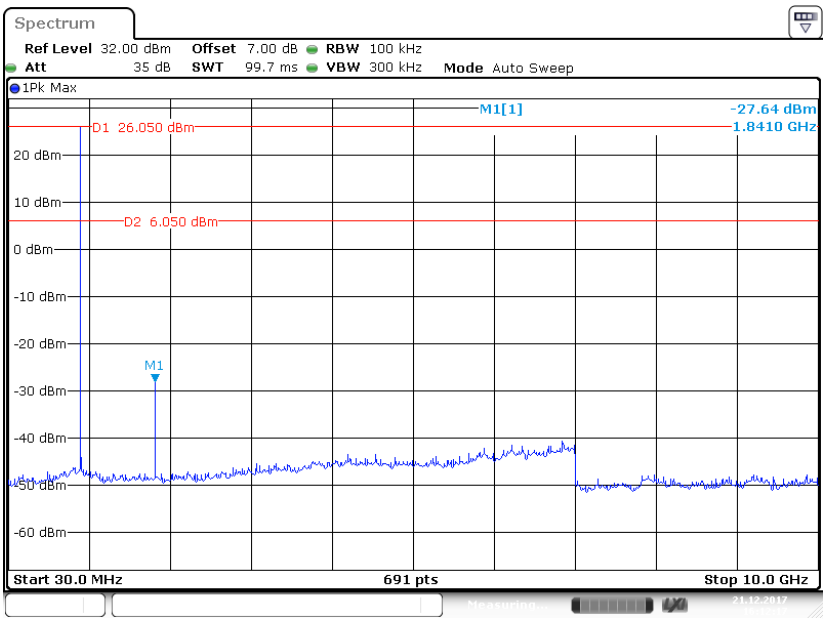
Conducted Spurious Emissions at Antenna Port

Low Channel



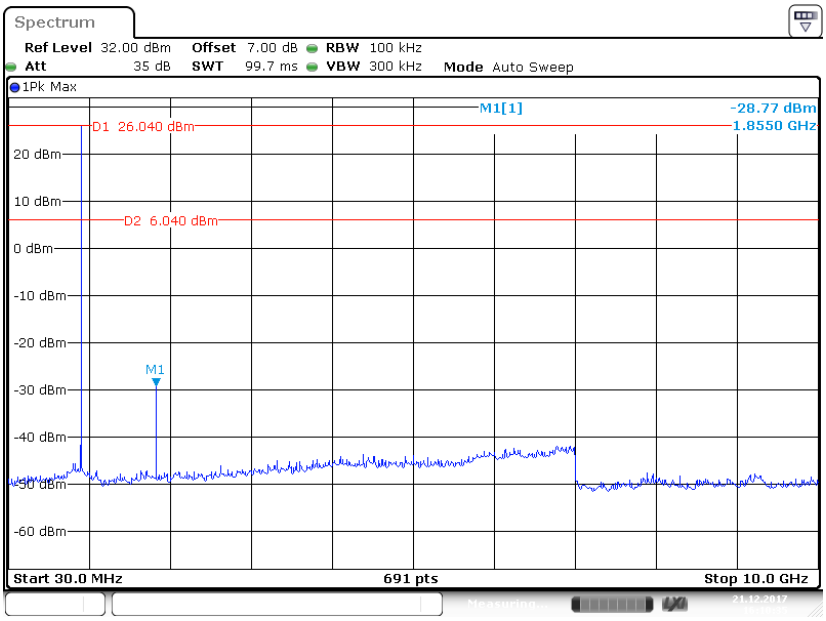
Date:21.DEC.2017 16:08:35

Middle Channel



Date:21.DEC.2017 16:12:17

High Channel



Date:21.DEC.2017 16:10:35

FCC §15.247(a) (1) (i)-CHANNEL SEPARATION 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. 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:	24.1 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

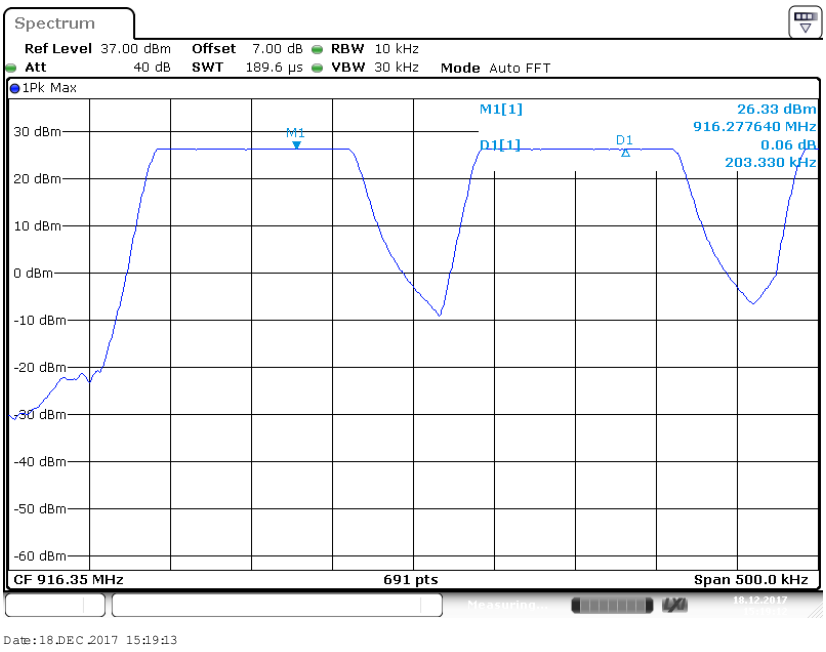
The testing was performed by Ada Yu on 2017-12-18.

EUT operation mode: Transmitting

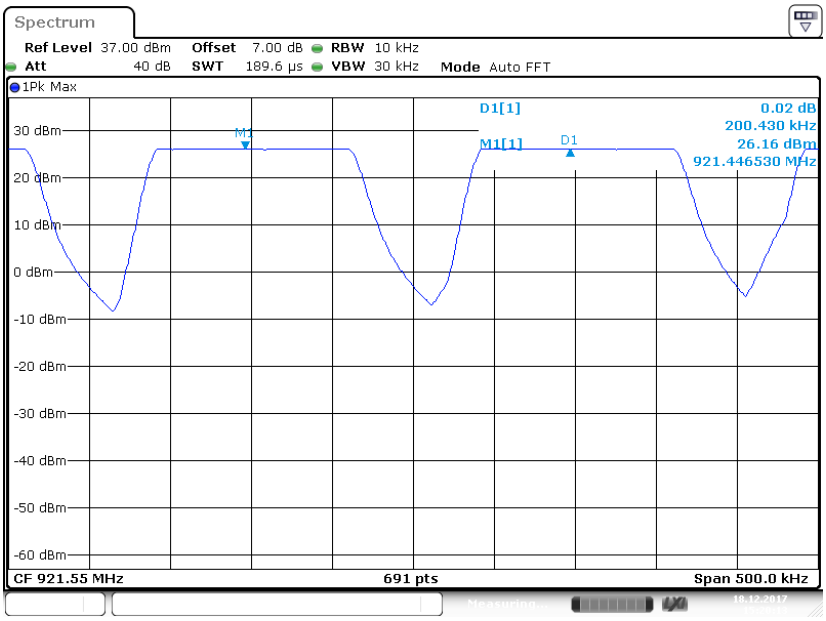
Modulation	Channel	Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
LoRa	Low	916.25	0.203	≥0.139	Pass
	Adjacent	916.45			
	Middle	921.45	0.200	≥0.139	Pass
	Adjacent	921.65			
	Adjacent	926.45	0.200	≥0.139	Pass
	High	926.65			

Note: Limit = 20 dB bandwidth

Low Channel

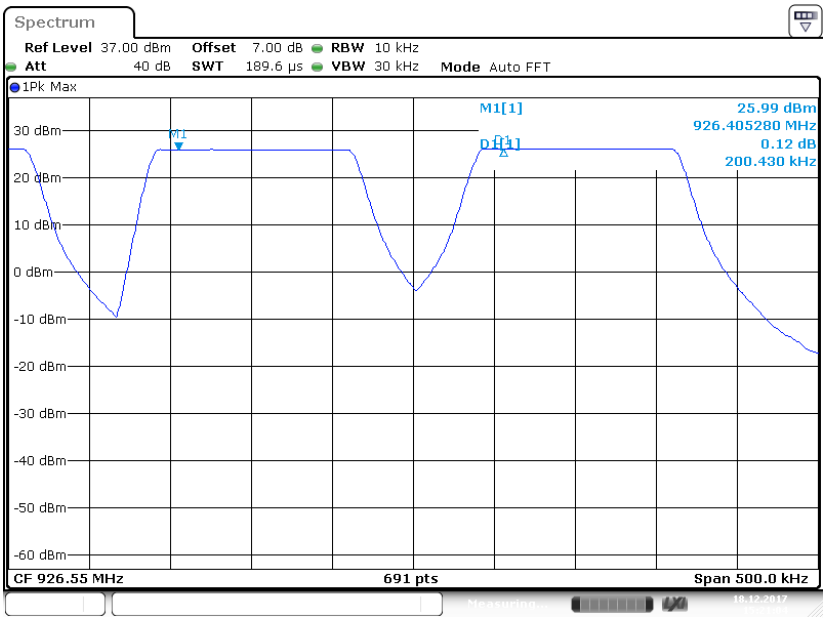


Middle Channel



Date: 18.DEC.2017 15:20:14

High Channel



Date: 18.DEC.2017 15:21:04

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

Temperature:	24.5 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

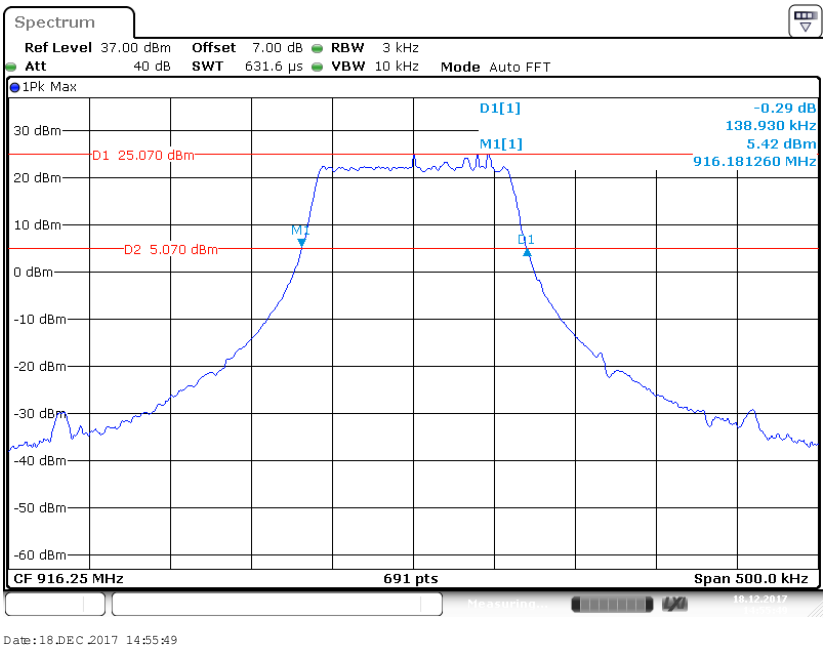
The testing was performed by Ada Yu on 2017-12-18 & 2017-12-28.

EUT operation mode: Transmitting

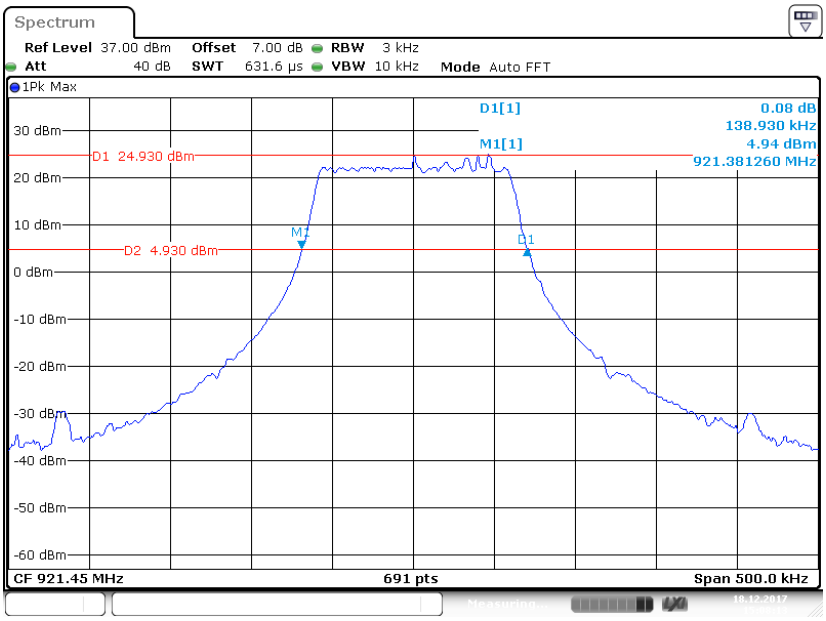
Test Result: Compliance.

Modulation	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)	Limit for Channel Number≥50 (MHz)
LoRa	Low	916.25	0.139	<0.25
	Middle	921.45	0.139	<0.25
	High	926.65	0.140	<0.25

Low Channel

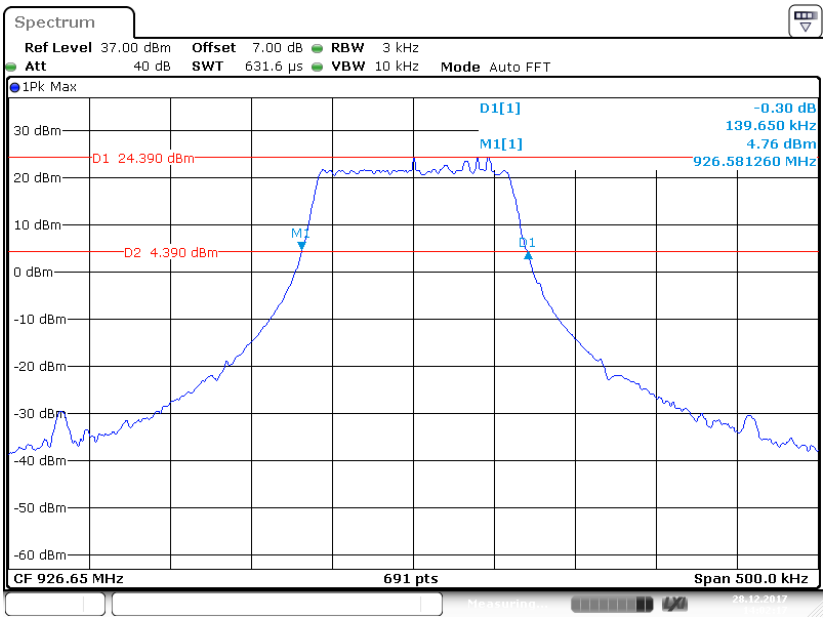


Middle Channel



Date:18.DEC.2017 15:08:14

High Channel



Date:28.DEC.2017 14:02:17

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

Temperature:	24 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

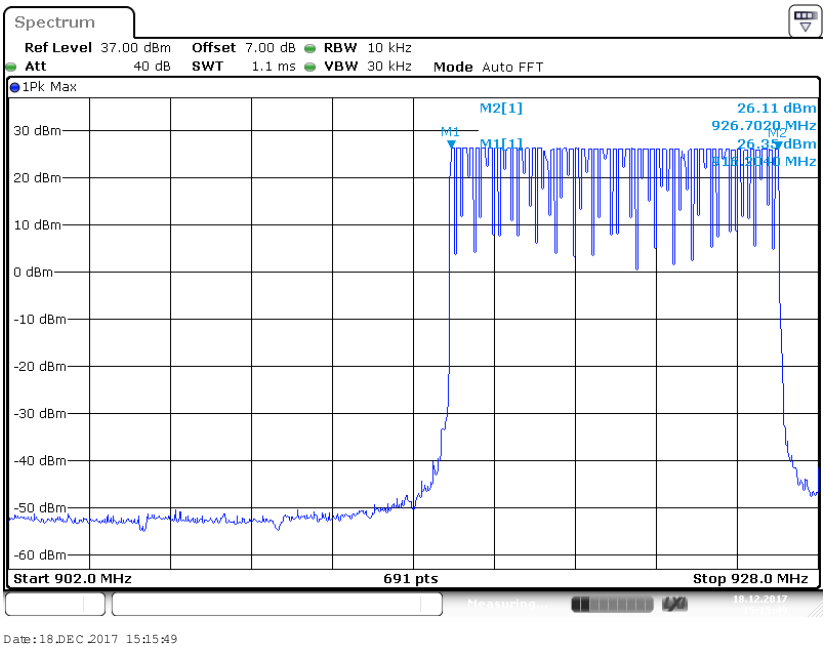
The testing was performed by Ada Yu on 2017-12-18.

EUT operation mode: Hopping

Test Result: Compliance.

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

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

1 Span: Zero span, centered on a hopping channel.
2 RBW shall be ⩽ channel spacing and where possible RBW should be set ⩾ 1 / T, where T is the expected dwell time per channel.
3 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.
4 Detector function: Peak.
5 Trace: Max hold.

Test Data

Environmental Conditions

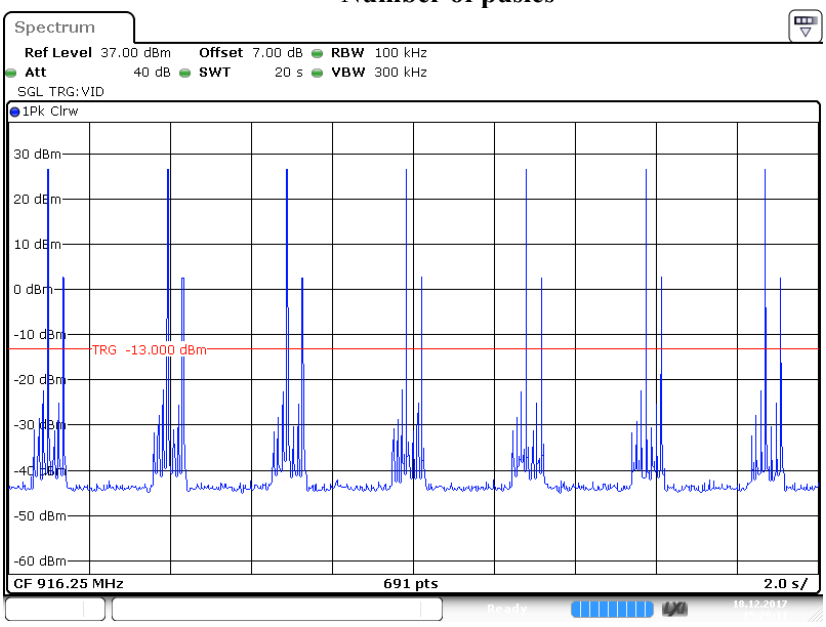
Temperature:	24.2 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Ada Yu on 2017-12-18 & 2017-12-28.

EUT operation mode: Transmitting

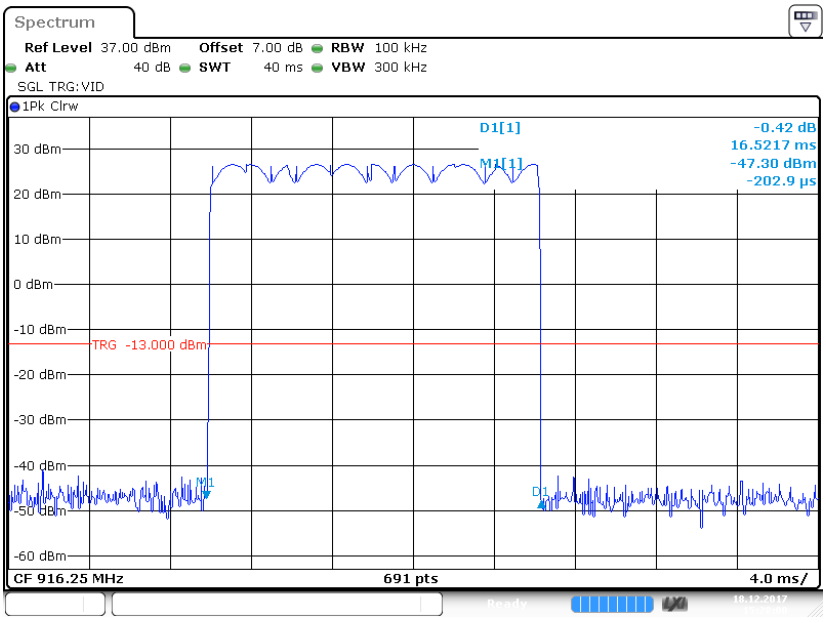
Modulation	Channel	Pulse Width (ms)	Pulse Number	Dwell Time (S)	Limit (S)	Result
LoRa	Low	16.52	7	0.12	≤0.4	Pass
	Middle	16.58	7	0.12	≤0.4	Pass
	High	16.61	7	0.12	≤0.4	Pass
	Note:Dwell time = Pulse time*N					

Low Channel
Number of pusles



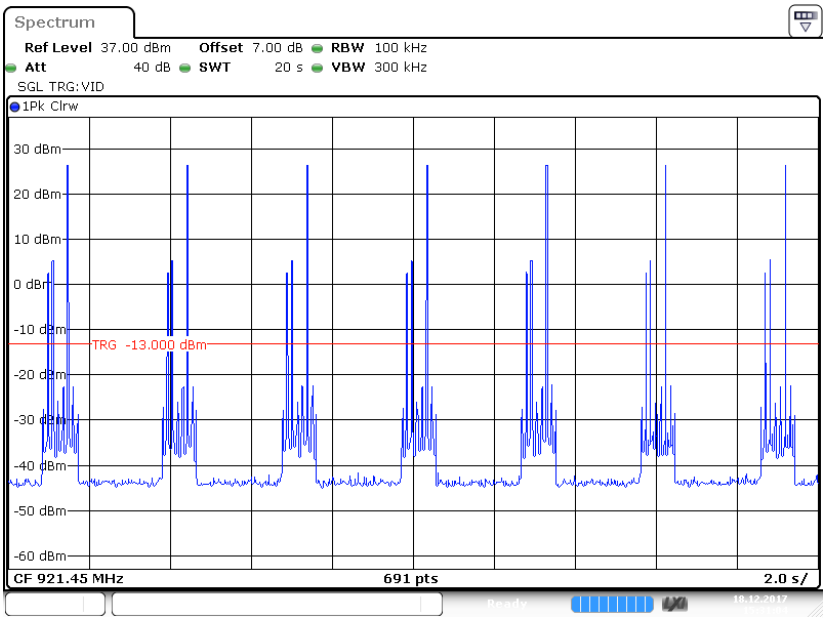
Date: 18.DEC.2017 15:29:11

Single Pusle



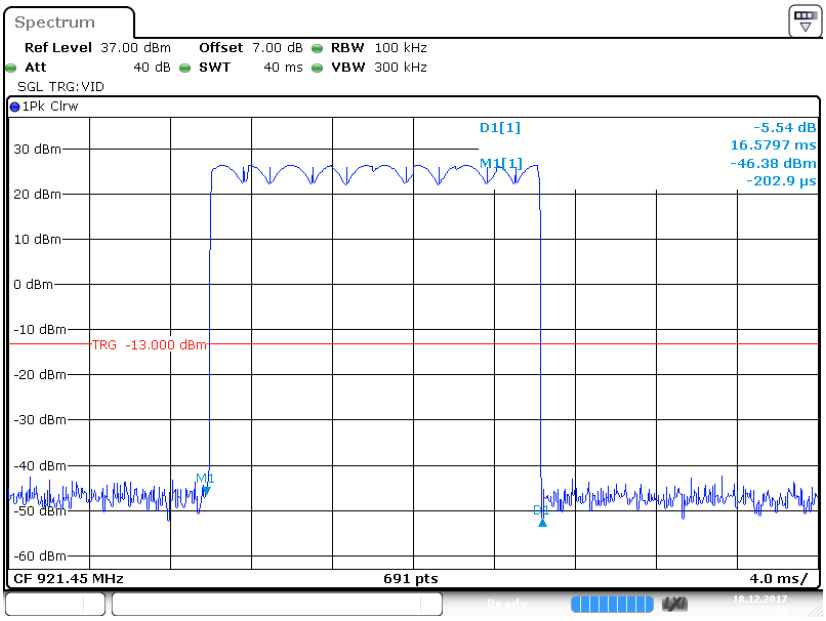
Date: 18.DEC.2017 15:28:00

Middle Channel
Number of pusles



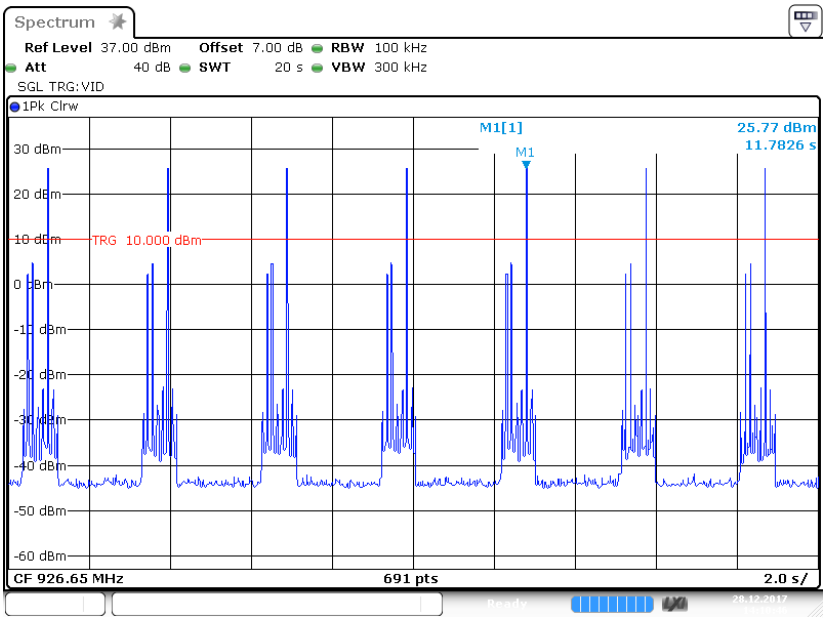
Date:18.DEC.2017 15:31:04

Single Pusle



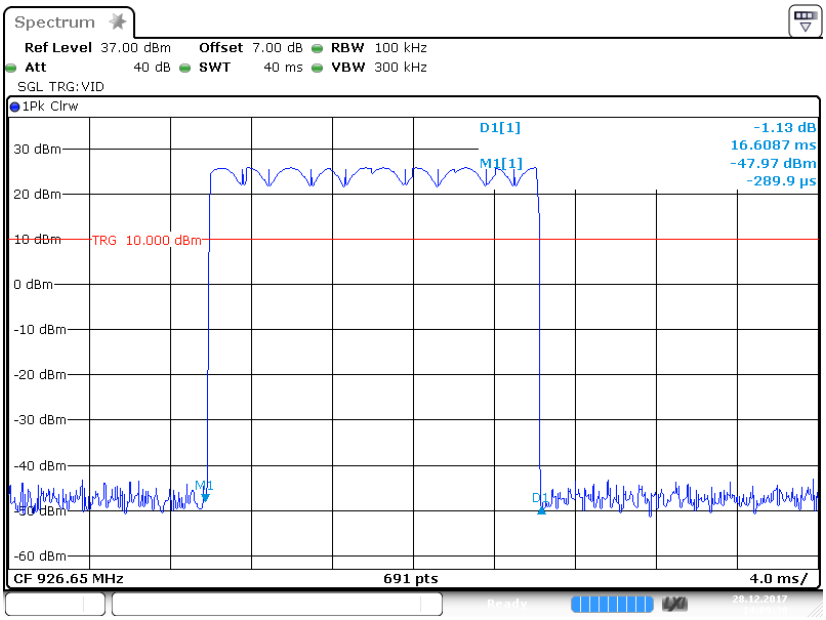
Date:18.DEC.2017 15:31:39

High Channel
Number of pusles



Date: 28.DEC.2017 14:10:46

Single Pusle



Date: 28.DEC.2017 14:09:38

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

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

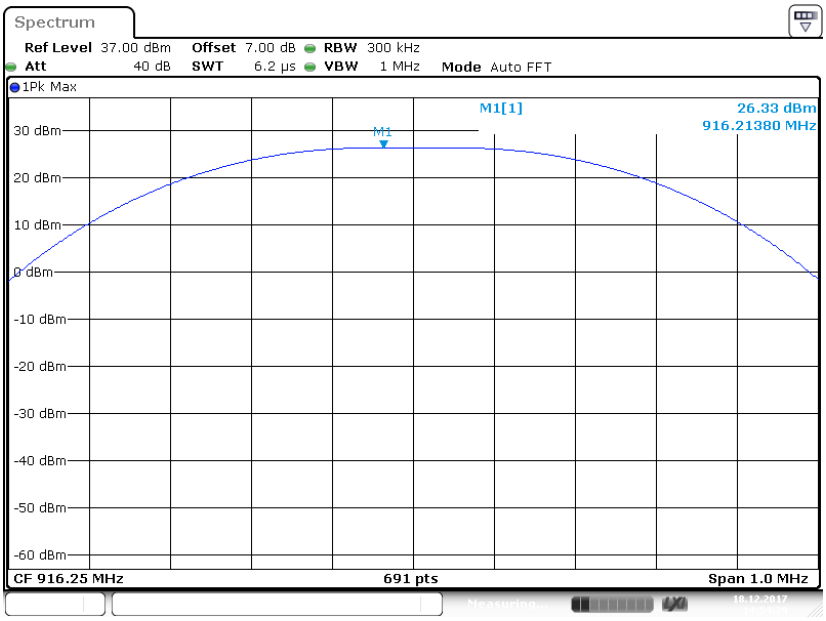
The testing was performed by Ada Yu on 2017-12-18.

EUT operation mode: Transmitting

Test Result: Compliance.

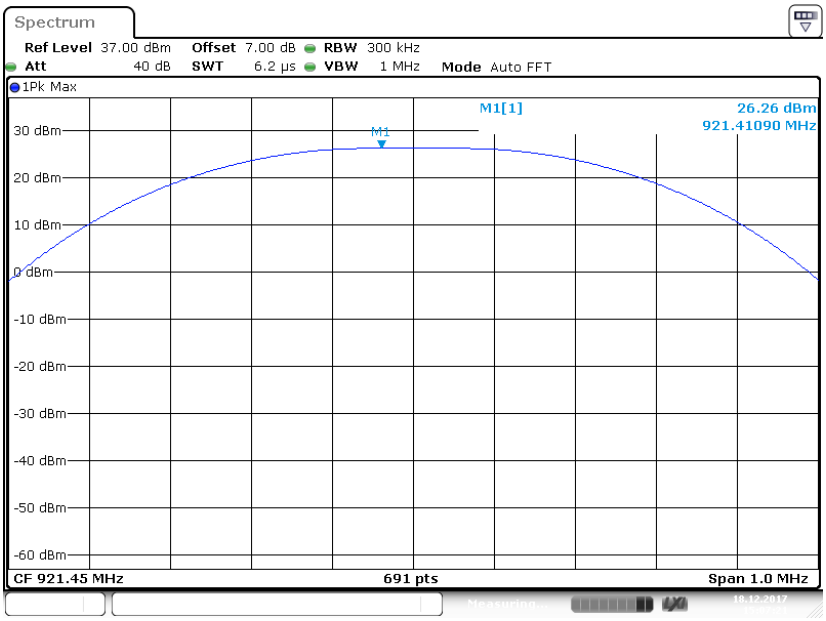
Modulation	Channel	Frequency (MHz)	Output Power		Limit (mW)
			(dBm)	(mW)	
LoRa	Low	916.25	26.33	429.54	≤1000
	Middle	921.45	26.26	422.67	≤1000
	High	926.65	26.06	403.65	≤1000

Low Channel



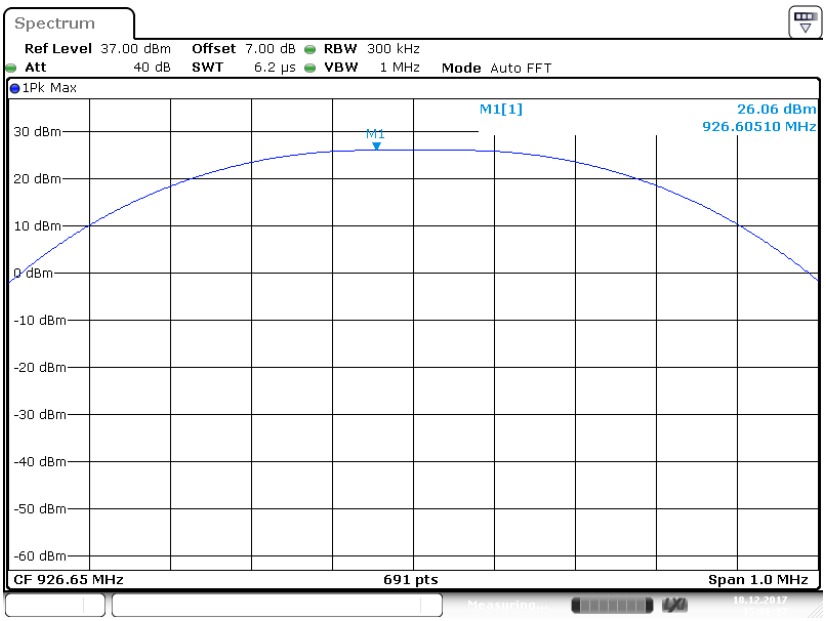
Date: 18.DEC.2017 14:54:29

Middle Channel



Date: 18.DEC.2017 15:07:20

High Channel



Date:18.DEC.2017 15:06:37

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

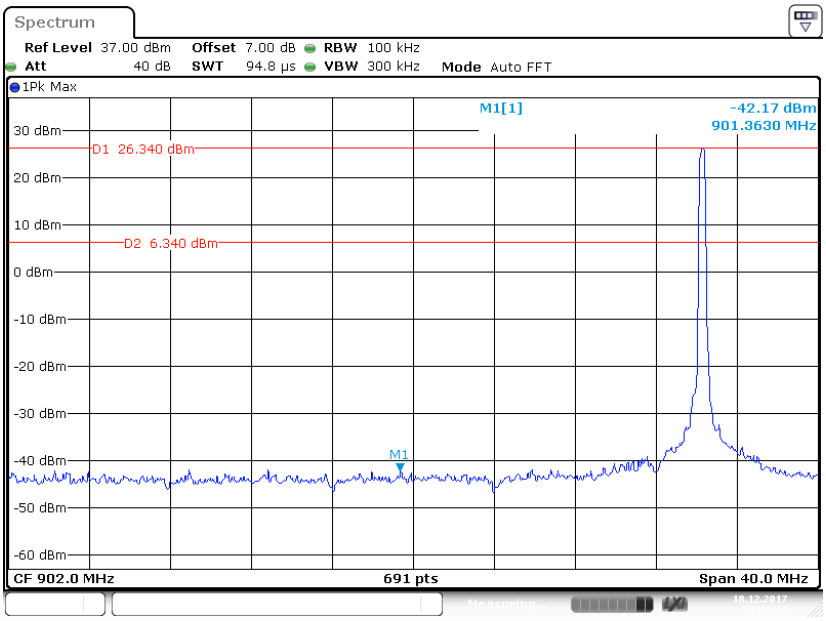
Temperature:	24.2 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Ada Yu on 2017-12-18.

EUT operation mode: Transmitting&Hopping

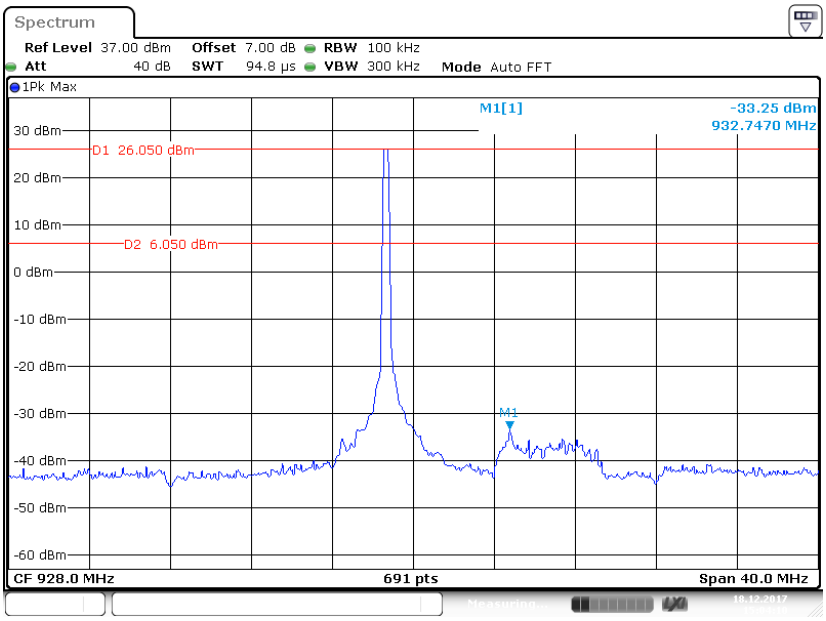
Operation Mode	Left Band Edge Value (dBm)	Right Band Edge Value (dBm)	Limit	Result
Transmitting	-42.17	-33.25	At least 20 dB below the highest level of the desired power	Compliance
Hopping	-41.85	-35.66		Compliance

Band Edge-Left Side



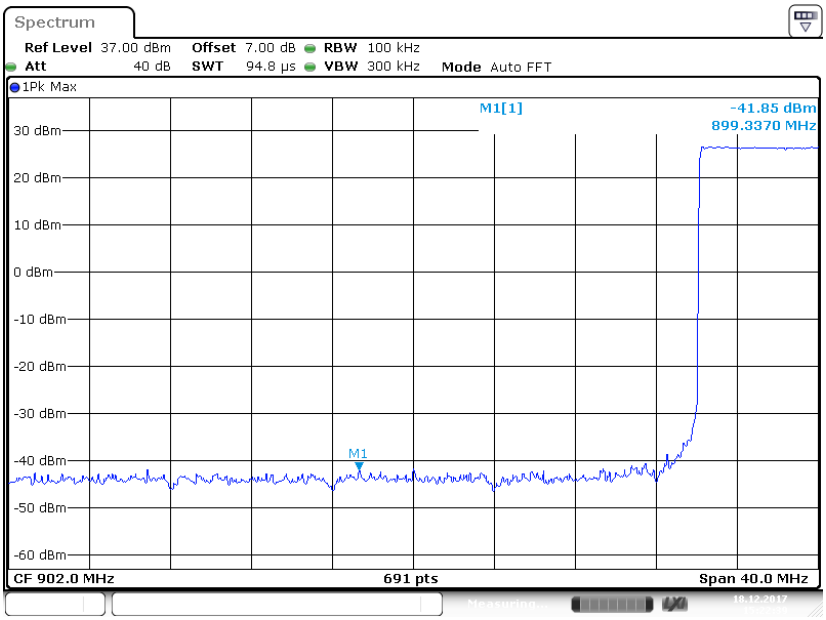
Date:18.DEC.2017 14:57:36

Band Edge-Right Side



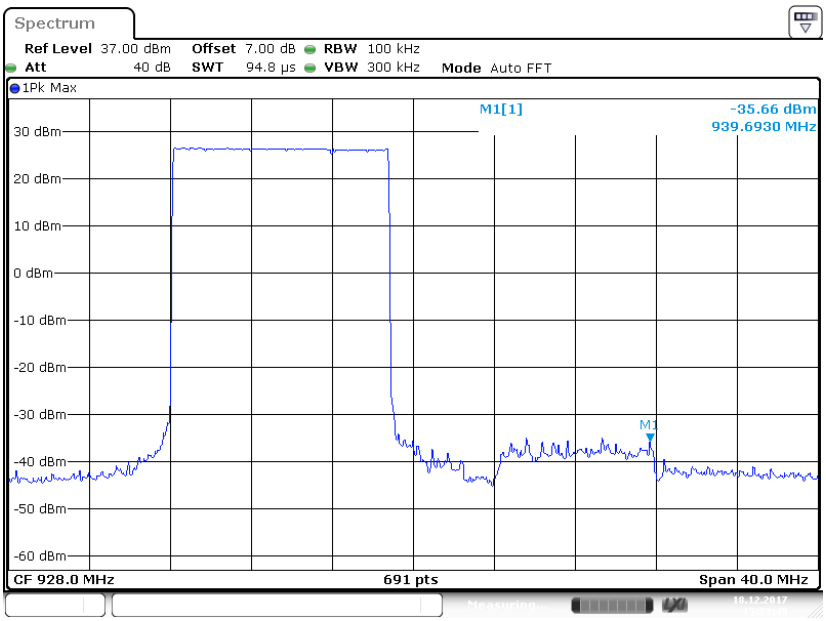
Date:18.DEC.2017 15:04:10

Band Edge-Left Side (Hopping)



Date:18.DEC.2017 15:22:40

Band Edge-Right Side (Hopping)



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