TESTING LABORATORY
CERTIFICATE#4323.01

FCC PART 15.247

TEST REPORT

For

LEHE Information Technology Co., Ltd

1418 moganshan Road, shangcheng Industrial Zone, Hangzhou, Zhejiang 310011 China

FCC ID: 2AWSFMJN53R410

Report Type:	**Product Type:**
Original Report	Meter Module

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Report Number:	RSHA201202001-00A
Report Date:	2021-01-15
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant:	LEHE Information Technology Co.,Ltd
Tested Model:	MJN53.R410
Product Type:	Meter Module
Power Supply:	DC 8V
RF Function:	SRD
Operating Band/Frequency:	902.2~927.8MHz(50 kbps), 902.4~927.6(150 kbps)
Channel Number:	129(50 kbps), 64(150 kbps)
Channel Separation:	0.2 MHz(50 kbps), 0.4 MHz (150 kbps)
Antenna Type:	Rod Antenna

All measurement and test data in this report was gathered from production sample serial number: RSHA201202001-1. (Assigned by the BACL. The EUT supplied by the applicant was received on 2020-12-02)

Objective

This report is prepared on behalf of *LEHE Information Technology Co.,Ltd* in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission rules.

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

Related Submittal(s)/Grant(s)

No related submittal(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 and FCC KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at 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℃
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 and CAB identifier CN0004 under the ISED requirement. 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

Available Channel List for 50kbps:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	902.20	33	908.60	65	915.00	117	925.40
2	902.40	34	908.80	66	915.20	118	925.60
3	902.60	35	909.00	67	915.40	119	925.80
4	902.80	36	909.20	68	915.60	120	926.00
5	903.00	37	909.40	69	915.80	121	926.20
6	903.20	38	909.60	70	916.00	122	926.40
7	903.40	39	909.80	71	916.20	123	926.60
8	903.60	40	910.00	72	916.40	124	926.80
9	903.80	41	910.20	73	916.60	125	927.00
10	904.00	42	910.40	74	916.80	126	927.20
11	904.20	43	910.60	75	917.00	127	927.40
12	904.40	44	910.80	76	917.20	128	927.60
.....	.....	.....	.....	.....	.....	129	927.80

EUT was tested with channel 1, 65, 129.

Available Channel List for 150kbps:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	902.40	17	908.80	33	915.20	49	921.60
2	902.80	18	909.20	34	915.60	50	922.00
3	903.20	19	909.60	35	916.00	51	922.40
4	903.60	20	910.00	36	916.40	52	922.80
5	904.00	21	910.40	37	916.80	53	923.20
6	904.40	22	910.80	38	917.20	54	923.60
7	904.80	23	911.20	39	917.60	55	924.00
8	905.20	24	911.60	40	918.00	56	924.40
9	905.60	25	912.00	41	918.40	57	924.80
10	906.00	26	912.40	42	918.80	58	925.20
11	906.40	27	912.80	43	919.20	59	925.60
12	906.80	28	913.20	44	919.60	60	926.00
13	907.20	29	913.60	45	920.00	61	926.40
14	907.60	30	914.00	46	920.40	62	926.80
15	908.00	31	914.40	47	920.80	63	927.20
16	908.40	32	914.80	48	921.20	64	927.60

EUT was tested with channel 1, 33, 64.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

RF test tool: VC_700X_User_Tool

Pre-scan with 50kbps data rate, the worst case was performed as below:

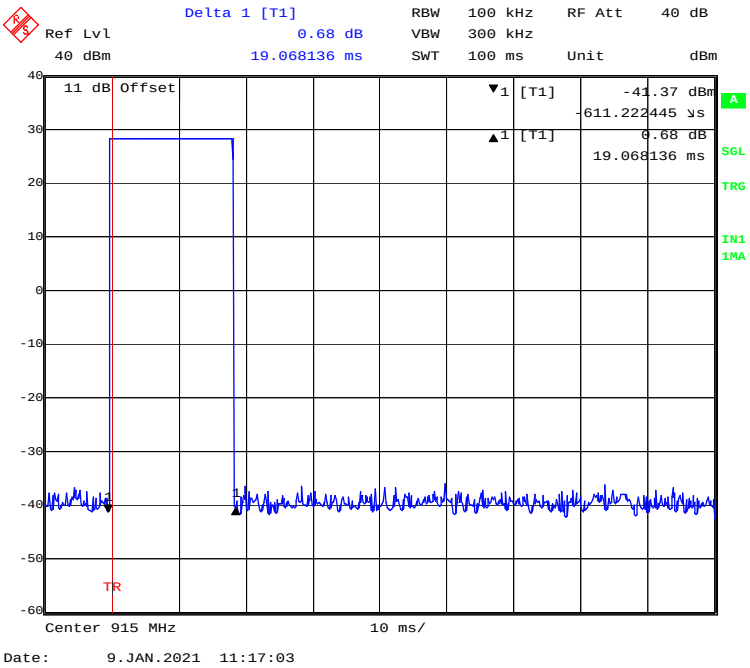
Frequency(MHz)	Power Setting
902.2	Default
915.0	Default
927.8	Default

Pre-scan with 150kbps data rate, the worst case was performed as below:

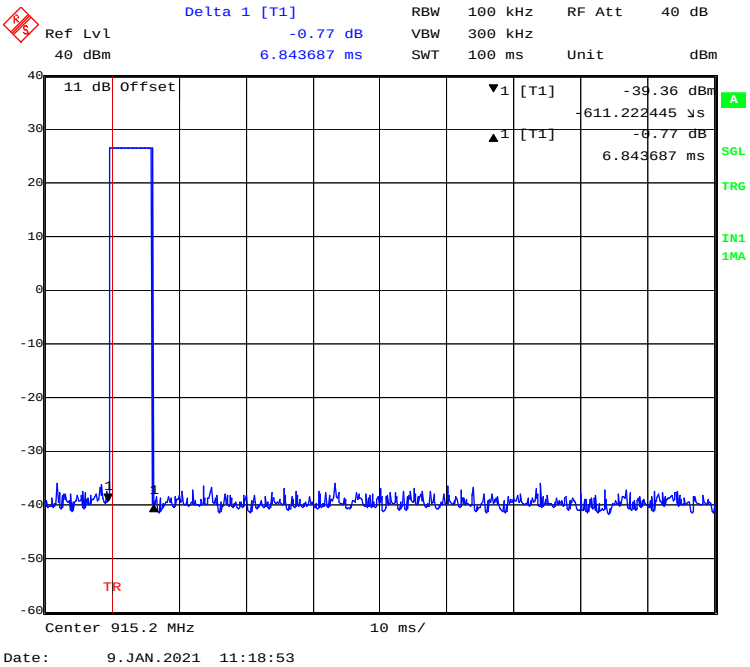
Frequency(MHz)	Power Setting
902.4	Default
915.2	Default
927.6	Default

Duty Cycle:

Middle Channel: 915MHz



Middle Channel:915.2MHz



1) 915MHz:

Max Duty cycle = 19.06ms/100ms=0.1906

Duty Cycle Correction Factor = 20*lg (duty cycle) = -14.40

2) 915.2MHz:

Max Duty cycle = 6.84ms/100ms=0.0684

Duty Cycle Correction Factor = 20*lg (duty cycle) = -23.30

Support Equipment List and Details

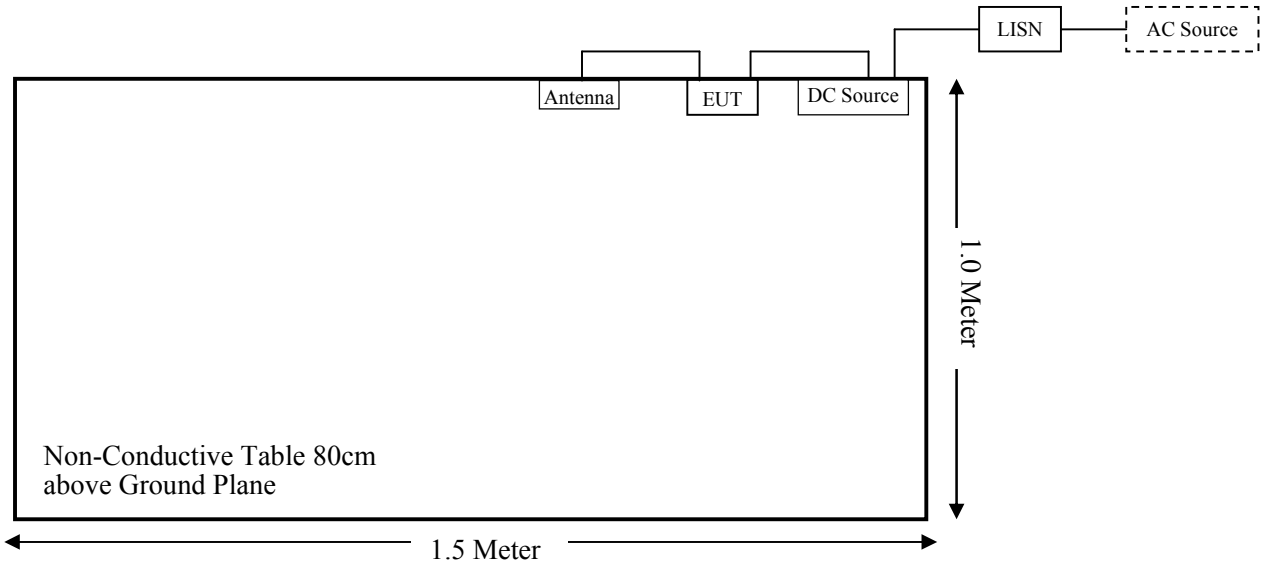
Manufacturer	Description	Model	Serial Number
MCH	DC Source	MCH-303D-II	14070562

External I/O Cable

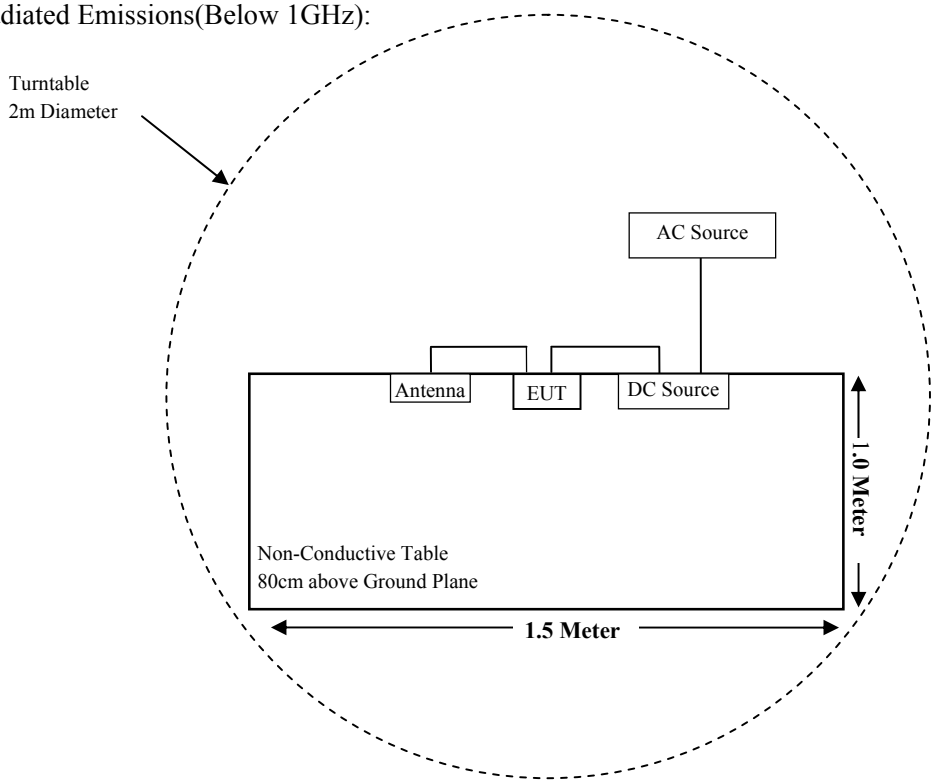
Cable Description	Length(m)	From Port	To
Power cable	1.0	EUT	DC Source
Power cable	1.0	DC Source	LISN

Block Diagram of Test Setup

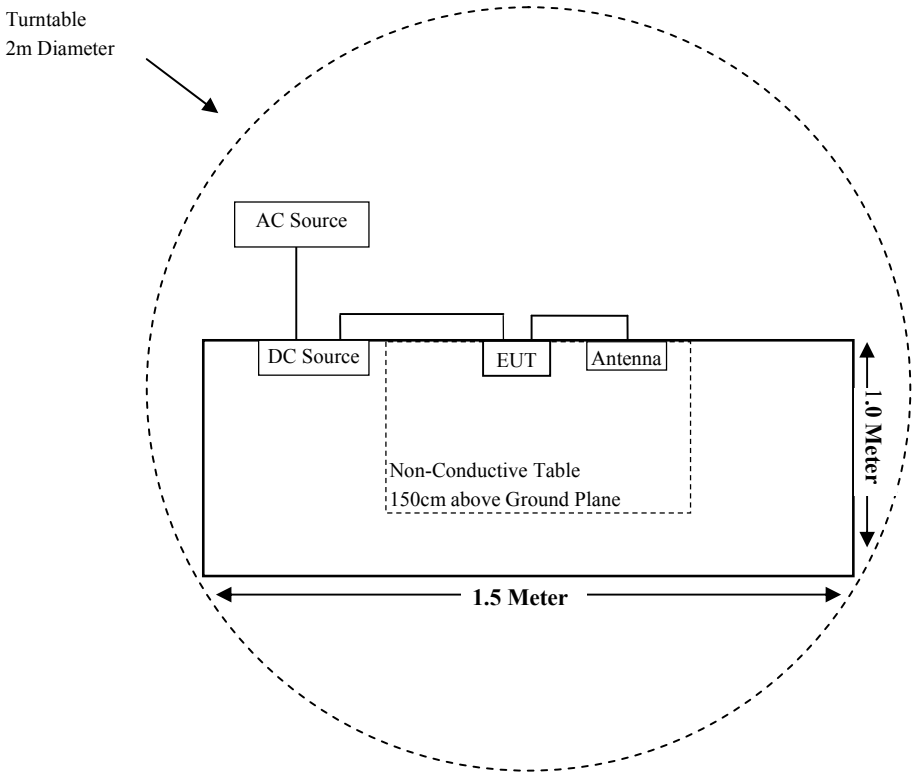
For Conducted Emissions:



For Radiated Emissions(Below 1GHz):



For Radiated Emissions(Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§1.1310& §2.1091	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.247(d)	Spurious Emissions at Antenna Port	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247(a)(1) (i)	20 dB Emission Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(i)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(i)	Quantity of hopping channel Test	Compliant
§15.247(b)(2)	Peak Output Power Measurement	Compliant
§15.247(d)	Band Edge	Compliant

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	2020-11-27	2021-11-26
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2020-08-05	2023-08-04
Sonoma Instrument	Amplifier	310N	171205	2020-08-14	2021-08-13
Rohde & Schwarz	Auto test Software	EMC32	100361	--	--
MICRO-TRONICS	Notch Filter	BRC50722	G013	2020-08-05	2021-08-04
Narda	Attenuator	10dB	010	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-8	008	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2020-08-15	2021-08-14
Radiated Emission Test（Chamber 2#）					
Rohde & Schwarz	EMI Test Receiver	ESU40	100207	2020-04-01	2021-03-31
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2020-07-15	2023-07-14
A.H.Systems,inc	Amplifier	PAM-0118P	512	2020-02-20	2021-02-19
MICRO-TRONICS	Band Reject Filter	BRM50702	G024	2020-08-05	2021-08-04
Narda	Attenuator	10dB	010	2020-08-15	2021-08-14
Rohde & Schwarz	Auto test Software	EMC32	100361	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2020-12-12	2021-12-11
MICRO-COAX	Coaxial Cable	Cable-11	011	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-12	012	2020-08-15	2021-08-14
MICRO-COAX	Coaxial Cable	Cable-13	013	2020-08-15	2021-08-14
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048/027	2020-11-27	2021-11-26
Narda	Attenuator	10dB	010	2020-08-15	2021-08-14
LEHE	RF Cable	LEHE C01	C01	Each Time	N/A
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2020-07-28	2021-07-27
Rohde & Schwarz	LISN	ENV216	101115	2020-11-27	2021-11-26
Audix	Test Software	e3	V9	/	/
Rohde & Schwarz	Pulse limiter	ESH3-Z2	100552	N/A	N/A
MICRO-COAX	Coaxial Cable	Cable-15	015	2020-08-15	2021-08-14

*** 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 §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1310, 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm²)**	**Averaging Time (minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f²)	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

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);

Calculated Data:

Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBi)	(numeric)	(dBm)	(mW)			
902-928	4.00	2.51	29.00	794.33	20	0.3969	0.6013

Note: The Tune-up power was declared by the manufacturer.

Conclusion: The device meets MPE at distance 20cm.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT test with Rod antenna and the antenna gain is 4dBi, the antenna was permanently attached, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna Type	Antenna Gain	Input impedance
Rod antenna	4dBi	50Ω

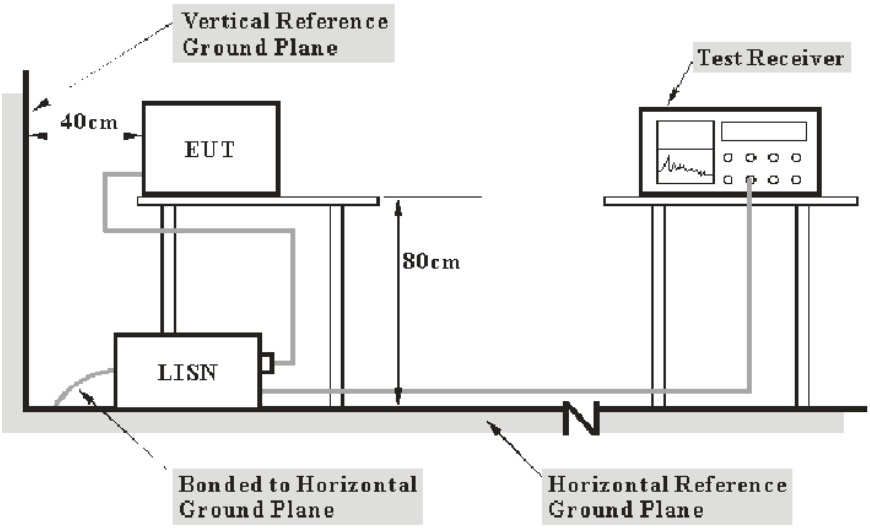
Result: Compliant.

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 DC Source 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.

Factor & Over Limit Calculation

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

Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)

The "**Over Limit**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit of 7 dB means the emission is 7 dB above the limit. The equation for Over Limit calculation is as follows:

Over Limit (dB) = Read level (dBμV) + Factor (dB) - Limit (dBμV)

Test Results Summary

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

Test Data

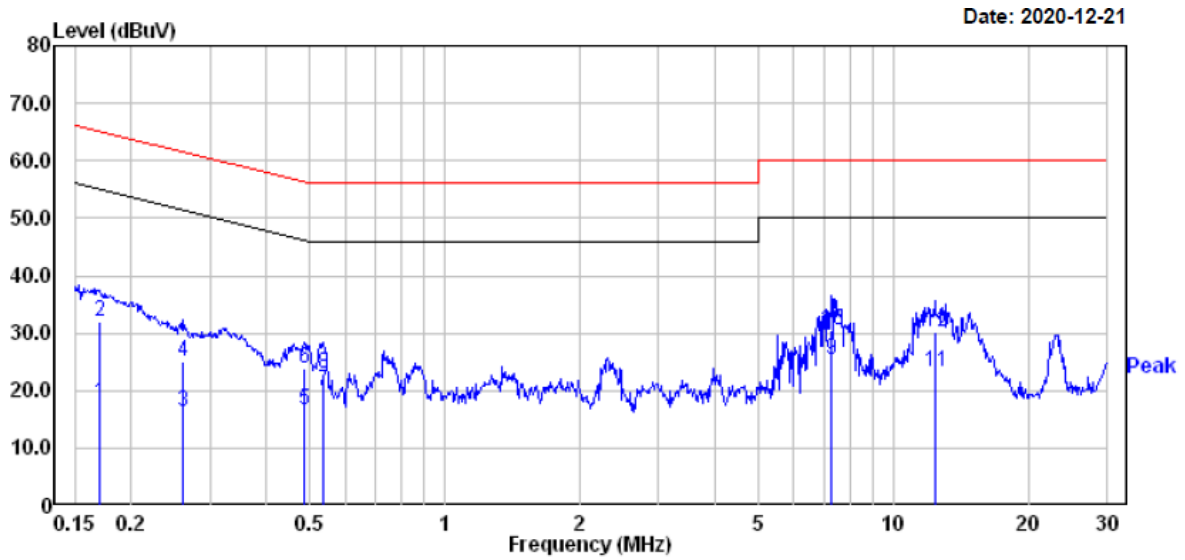
Environmental Conditions

Temperature:	23.5 ℃
Relative Humidity:	53 %
ATM Pressure:	101.1 kPa

The testing was performed by CK Huang on 2020-12-21.

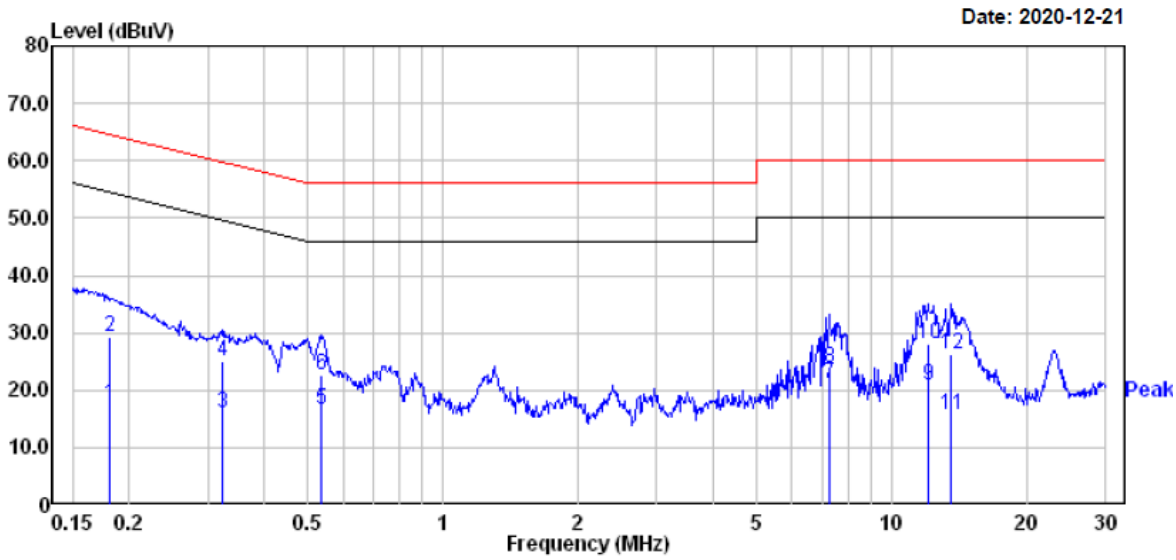
EUT operation mode: Charging

AC 120V/60 Hz, Line



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.170	-1.90	19.83	17.93	54.94	-37.01	Average
2	0.170	12.20	19.83	32.03	64.94	-32.91	QP
3	0.262	-3.50	19.82	16.32	51.38	-35.06	Average
4	0.262	5.10	19.82	24.92	61.38	-36.46	QP
5	0.486	-3.20	19.76	16.56	46.23	-29.67	Average
6	0.486	4.00	19.76	23.76	56.23	-32.47	QP
7	0.535	0.11	19.75	19.86	46.00	-26.14	Average
8	0.535	3.11	19.75	22.86	56.00	-33.14	QP
9	7.290	5.90	19.52	25.42	50.00	-24.58	Average
10	7.290	11.10	19.52	30.62	60.00	-29.38	QP
11	12.384	3.79	19.60	23.39	50.00	-26.61	Average
12	12.384	10.49	19.60	30.09	60.00	-29.91	QP

AC 120V/60 Hz, Neutral



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.182	-2.30	19.83	17.53	54.42	-36.89	Average
2	0.182	9.60	19.83	29.43	64.42	-34.99	QP
3	0.322	-3.80	19.82	16.02	49.66	-33.64	Average
4	0.322	5.20	19.82	25.02	59.66	-34.64	QP
5	0.535	-3.09	19.75	16.66	46.00	-29.34	Average
6	0.535	3.01	19.75	22.76	56.00	-33.24	QP
7	7.252	1.50	19.52	21.02	50.00	-28.98	Average
8	7.252	4.30	19.52	23.82	60.00	-36.18	QP
9	12.060	1.21	19.58	20.79	50.00	-29.21	Average
10	12.060	8.41	19.58	27.99	60.00	-32.01	QP
11	13.551	-3.80	19.61	15.81	50.00	-34.19	Average
12	13.551	6.60	19.61	26.21	60.00	-33.79	QP

Note:

1) Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Attenuator (dB)
2) Over Limit (dB) = Read level (dBµV) + Factor (dB) - Limit (dBµV)

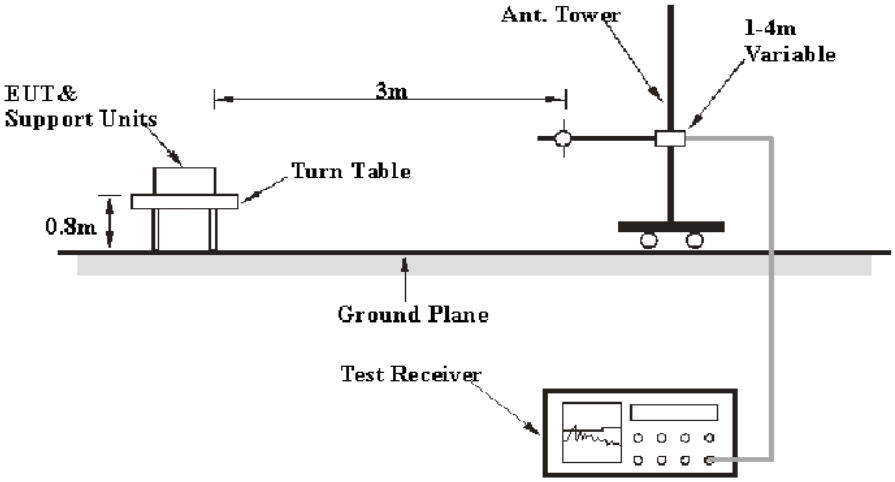
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

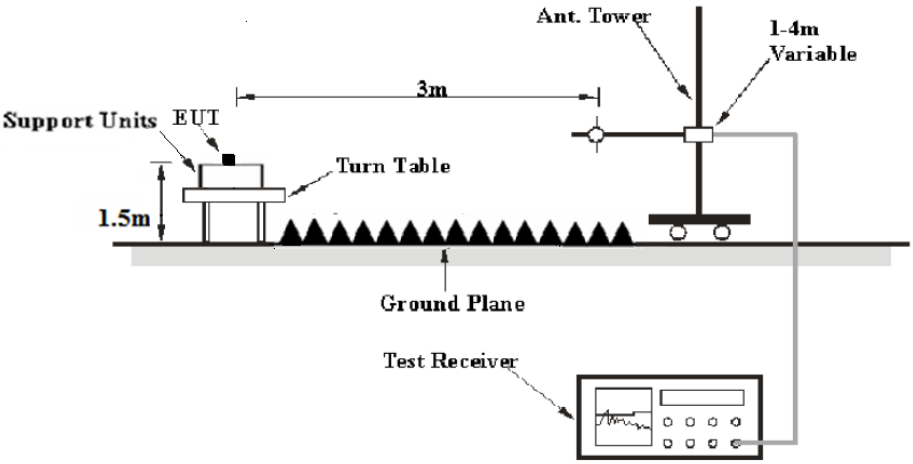
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters test site, 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

Test Procedure

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz - 1 GHz, 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 (dBμV/m) = Meter Reading (dBμV) + Antenna Factor (dB/m) + Cable Loss (dB) - 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:

Margin (dB) = Limit (dBμV/m) - Corrected Amplitude (dBμV/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℃
Relative Humidity:	53%
ATM Pressure:	101.2 kPa

The testing was performed by CK Huang on 2021-01-09.

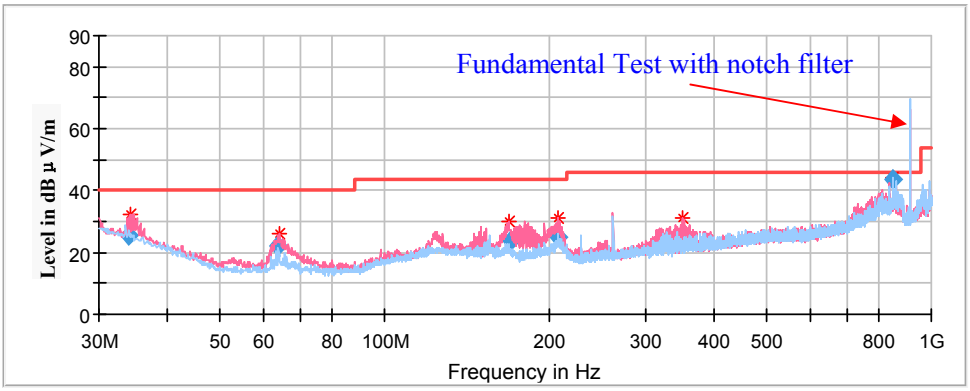
EUT operation mode: Transmitting

For 50kbps:

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.)*



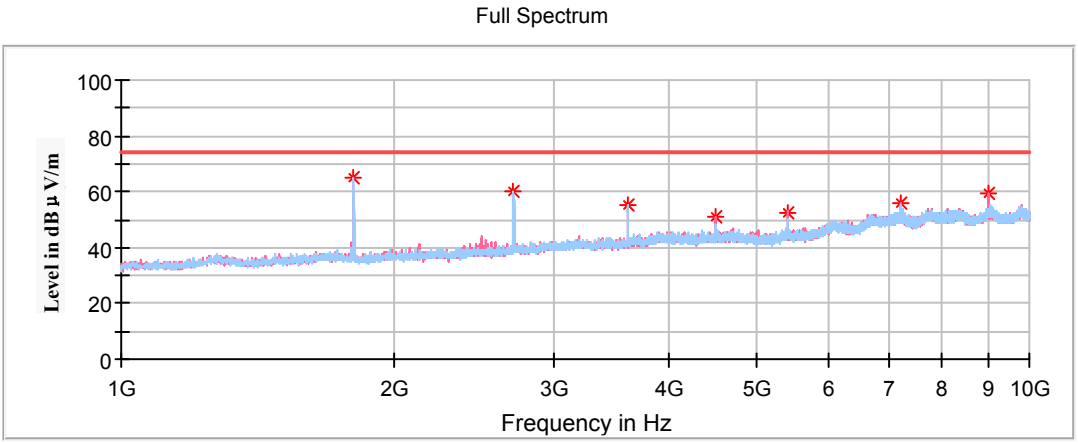
Frequency (MHz)	Corrected Amplitude QuasiPeak (dBµV/m)	Rx Antenna Height (cm)	Rx Antenna Polar (H/V)	Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
34.243750	32.51	100.0	V	21.0	-7.4	40.00	7.49
64.192500	25.84	100.0	V	136.0	-17.6	40.00	14.16
168.831250	29.79	100.0	V	124.0	-13.2	43.50	13.71
207.995000	31.22	100.0	V	0.0	-12.3	43.50	12.28
349.615000	31.10	100.0	V	21.0	-9.8	46.00	14.90
851.105000	42.99	200.0	H	247.0	-0.6	46.00	3.01

1GHz-10GHz:

*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 (dB/m) + Cable Loss (dB) – Amplifier Factor (dB) + Attenuator(dB)
   Corrected Amplitude (dBµV/m) = Corrected Factor (dB/m) + Reading (dBµV)
   Margin (dB) = Limit (dBµV/m) – Corrected Amplitude (dBµV/m)

Low Channel: 902.2MHz



Frequency (MHz)	Corrected Amplitude Max Peak (dBµV/m)	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polar (H/V)				
1803.700000	64.87	200.0	H	139.0	-8.3	74.00	9.13
2706.400000	60.10	150.0	H	83.0	-4.7	74.00	13.90
3609.100000	54.97	150.0	H	95.0	-1.3	74.00	19.03
4510.900000	50.87	150.0	V	96.0	0.9	74.00	23.13
5413.600000	52.77	200.0	V	94.0	1.9	74.00	21.23
7218.100000	56.01	150.0	V	109.0	9.0	74.00	17.99
9022.600000	59.79	200.0	V	145.0	10.8	74.00	14.21

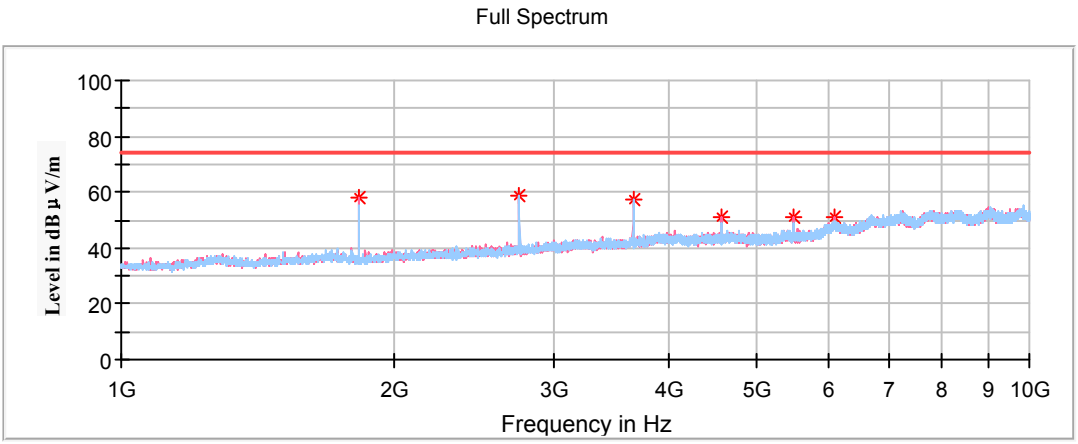
Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBµV/m)	Height (cm)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Corrected Ampitude (dBµV/m)	FCC Part 15.247/205/209	
						Limit (dBµV/m)	Margin (dB)
1803.70	63.59	200.00	H	-14.40	49.19	54	4.81
2706.40	59.79	150.00	H	-14.40	45.39	54	8.61
3609.10	54.79	150.00	H	-14.40	40.39	54	13.61
4510.90	50.46	150.00	V	-14.40	36.06	54	17.94
5413.60	52.44	200.00	V	-14.40	38.04	54	15.96
7218.10	55.89	150.00	V	-14.40	41.49	54	12.51
9022.60	59.22	200.00	V	-14.40	44.83	54	9.17

Note:

AV = PK + Duty Cycle Correction Factor

Middle Channel: 915MHz



Frequency (MHz)	Corrected Amplitude Max Peak (dBµV/m)	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polar (H/V)				
1828.900000	57.97	200.0	V	127.0	-8.3	74.00	16.03
2744.200000	58.53	200.0	V	127.0	-4.5	74.00	15.47
3659.500000	57.50	150.0	H	94.0	-1.1	74.00	16.50
4574.800000	50.93	150.0	V	106.0	0.9	74.00	23.07
5490.100000	51.20	200.0	V	101.0	2.0	74.00	22.80
6095.800000	51.08	150.0	V	0.0	5.4	74.00	22.92

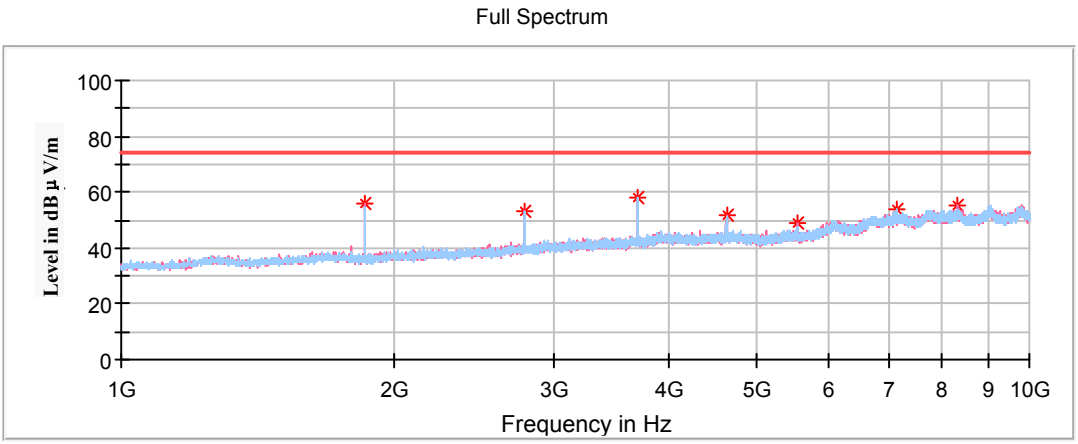
Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBµV/m)	Height (cm)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Corrected Ampitude (dBµV/m)	FCC Part 15.247/205/209	
						Limit (dBµV/m)	Margin (dB)
1828.90	57.66	200.0	V	-14.40	43.26	54	10.74
2744.20	58.46	200.0	V	-14.40	44.06	54	9.94
3659.50	57.44	150.0	H	-14.40	43.04	54	10.96
4574.80	50.44	150.0	V	-14.40	36.04	54	17.96
5490.10	51.01	200.0	V	-14.40	36.86	54	17.14
6095.80	50.76	150.0	V	-14.40	36.36	54	17.64

Note:

AV = PK + Duty Cycle Correction Factor

High Channel: 927.8MHz



Frequency (MHz)	Corrected Amplitude Max Peak (dBµV/m)	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polar (H/V)				
1855.900000	55.65	200.0	V	67.0	-8.2	74.00	18.35
2782.000000	53.34	200.0	V	131.0	-4.3	74.00	20.66
3710.800000	58.11	200.0	H	112.0	-0.9	74.00	15.89
4637.800000	51.62	150.0	V	112.0	1.0	74.00	22.38
5565.700000	49.20	200.0	V	285.0	2.4	74.00	24.80
7147.000000	53.76	200.0	H	266.0	9.0	74.00	20.24
8347.600000	55.51	150.0	V	164.0	10.8	74.00	18.49

Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBµV/m)	Height (cm)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Corrected Ampitude (dBµV/m)	FCC Part 15.247/205/209	
						Limit (dBµV/m)	Margin (dB)
1855.90	55.31	200.0	V	-14.40	40.91	54	13.09
2782.00	53.12	200.0	V	-14.40	38.72	54	15.28
3710.80	57.69	200.0	H	-14.40	43.29	54	10.71
4637.80	51.03	150.0	V	-14.40	36.63	54	17.37
5565.70	49.11	200.0	V	-14.40	34.71	54	19.29
7147.00	53.33	200.0	H	-14.40	38.93	54	15.07
8347.60	55.02	150.0	V	-14.40	40.62	54	13.38

Note:

AV = PK + Duty Cycle Correction Factor

Bandedge Emissions Test:

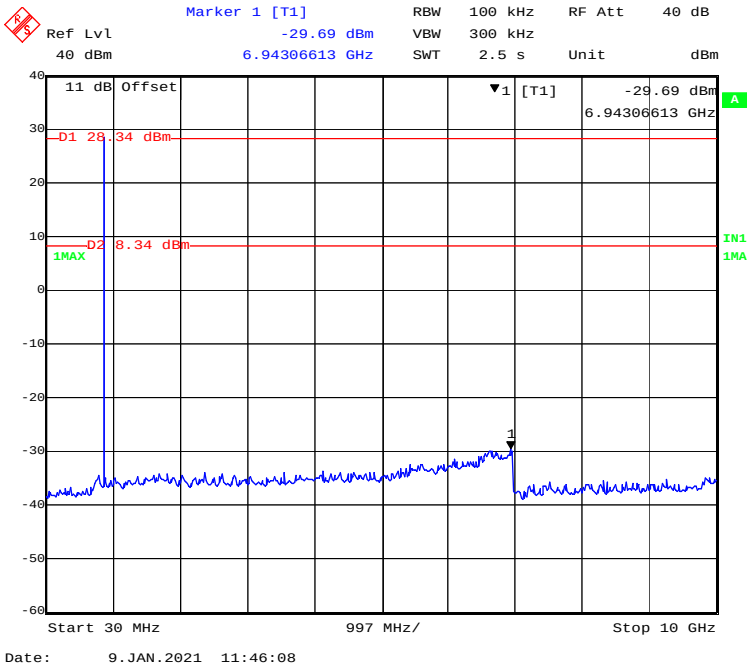
*(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.)*

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

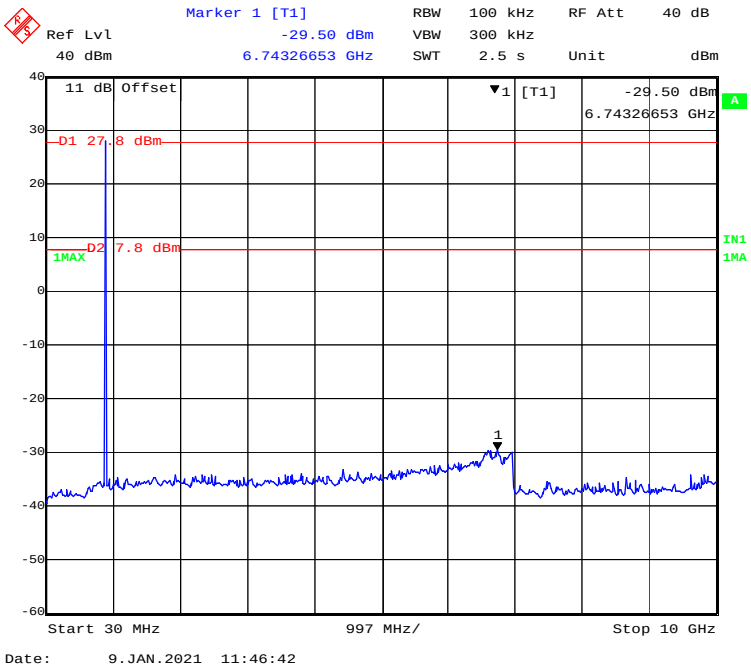
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
Low Channel: 902.2MHz							
902.20	126.35	150	H	78	1.02	/	/
902.20	127.99	200	V	116	1.02	/	/
901.55	46.00	200	H	190	1.02	106.35	60.35
901.55	44.14	200	V	126	1.02	107.99	63.85
High Channel: 927.8MHz							
927.80	127.46	150	H	219	1.67	/	/
927.80	127.70	150	V	102	1.67	/	/
928.00	45.37	150	H	125	1.68	106.81	61.44
928.00	46.27	200	V	114	1.68	107.05	60.78

Conducted Spurious Emissions at Antenna Port:

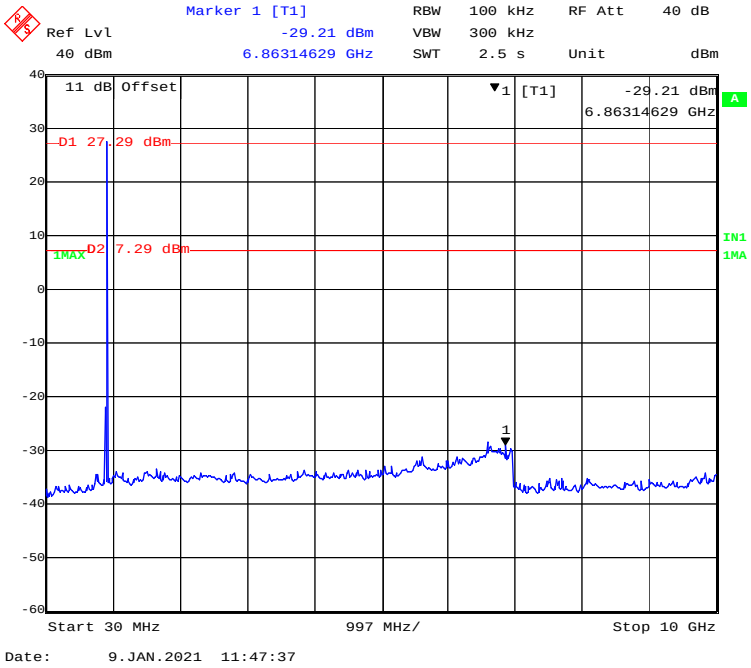
Low Channel



Middle Channel



High Channel

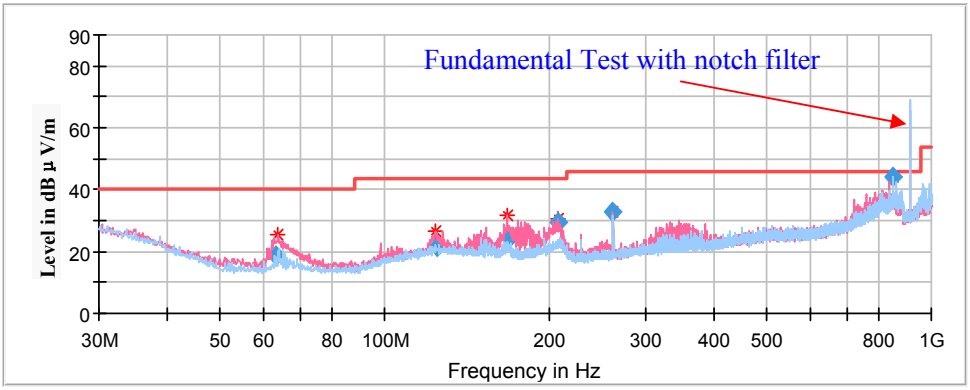


For 150kbps:

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.)*



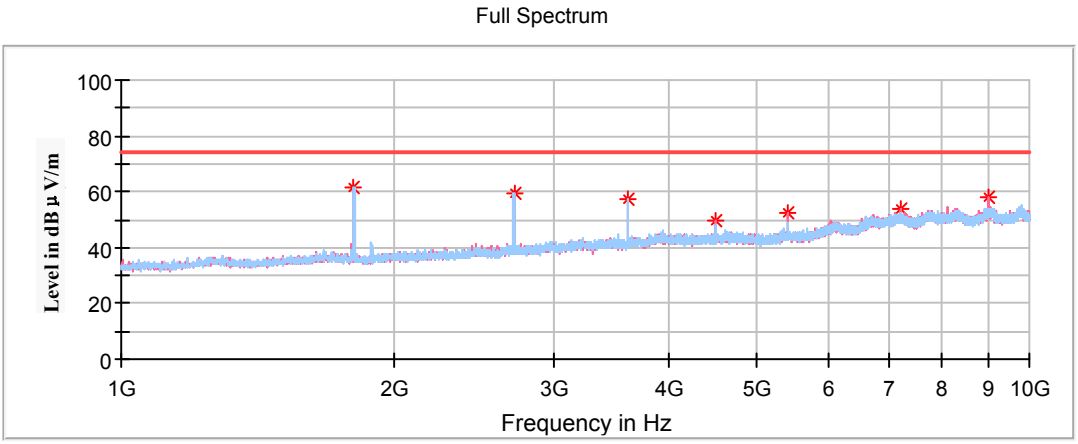
Frequency (MHz)	Corrected Amplitude QuasiPeak (dBµV/m)	Rx Antenna Height (cm)	Rx Antenna Polar (H/V)	Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
63.423450	18.43	100.0	V	145.0	-17.7	40.00	21.57
124.704700	21.65	100.0	V	264.0	-11.2	43.50	21.85
168.291700	24.58	100.0	V	157.0	-13.1	43.50	18.92
207.996500	29.33	100.0	V	117.0	-12.3	43.50	14.17
261.815000	33.00	100.0	V	271.0	-12.7	46.00	13.00
851.253900	42.31	200.0	H	245.0	-0.6	46.00	3.69

1GHz-10GHz:

*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 (dB/m) + Cable Loss (dB) – Amplifier Factor (dB) + Attenuator(dB)
   Corrected Amplitude (dBµV/m) = Corrected Factor (dB/m) + Reading (dBµV)
   Margin (dB) = Limit (dBµV/m) – Corrected Amplitude (dBµV/m)

Low Channel: 902.4MHz



Frequency (MHz)	Corrected Amplitude Max Peak (dBµV/m)	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polar (H/V)				
1803.700000	61.36	200.0	V	25.0	-8.3	74.00	12.64
2707.300000	59.75	150.0	V	135.0	-4.7	74.00	14.25
3610.000000	57.17	200.0	H	108.0	-1.3	74.00	16.83
4512.700000	49.52	150.0	V	289.0	0.9	74.00	24.48
5414.500000	52.53	150.0	V	104.0	1.9	74.00	21.47
7219.000000	53.91	150.0	V	27.0	9.0	74.00	20.09
9024.400000	57.93	200.0	V	138.0	10.8	74.00	16.07

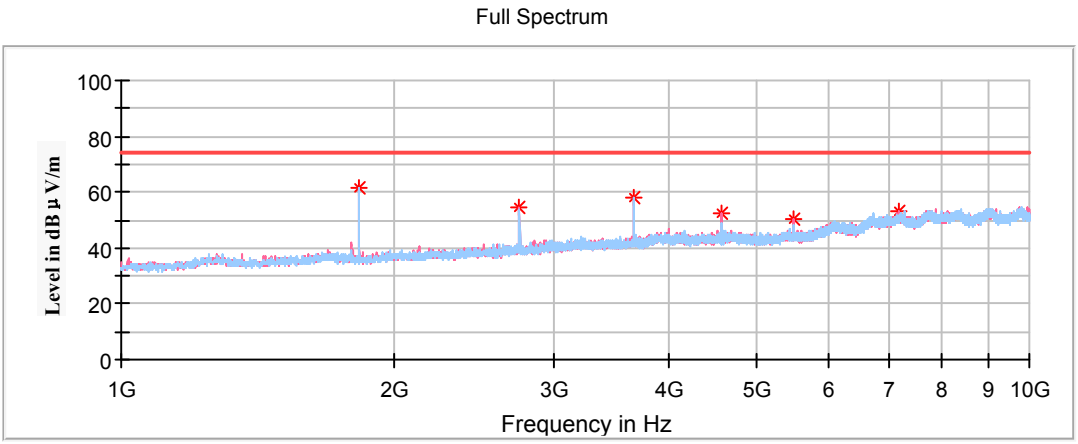
Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBµV/m)	Height (cm)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Corrected Ampitude (dBµV/m)	FCC Part 15.247/205/209	
						Limit (dBµV/m)	Margin (dB)
1803.70	61.23	200.0	V	-23.30	33.72	54	20.28
2707.30	58.44	150.0	V	-23.30	24.92	54	29.08
3610.00	57.02	200.0	H	-23.30	28.49	54	25.51
4512.70	48.22	150.0	V	-23.30	29.03	54	24.97
5414.50	51.79	150.0	V	-23.30	34.15	54	19.85
7219.00	52.33	150.0	V	-23.30	33.72	54	20.28
9024.40	57.45	200.0	V	-23.30	24.92	54	29.08

Note:

AV = PK + Duty Cycle Correction Factor

Middle Channel: 915.2MHz



Frequency (MHz)	Corrected Amplitude Max Peak (dBµV/m)	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polar (H/V)				
1829.800000	61.44	200.0	V	56.0	-8.3	74.00	12.56
2746.000000	54.85	150.0	V	138.0	-4.5	74.00	19.15
3660.400000	58.23	150.0	H	94.0	-1.1	74.00	15.77
4575.700000	52.12	150.0	V	112.0	0.9	74.00	21.88
5491.000000	50.54	200.0	V	94.0	2.0	74.00	23.46
7183.900000	53.30	150.0	V	74.0	9.0	74.00	20.70

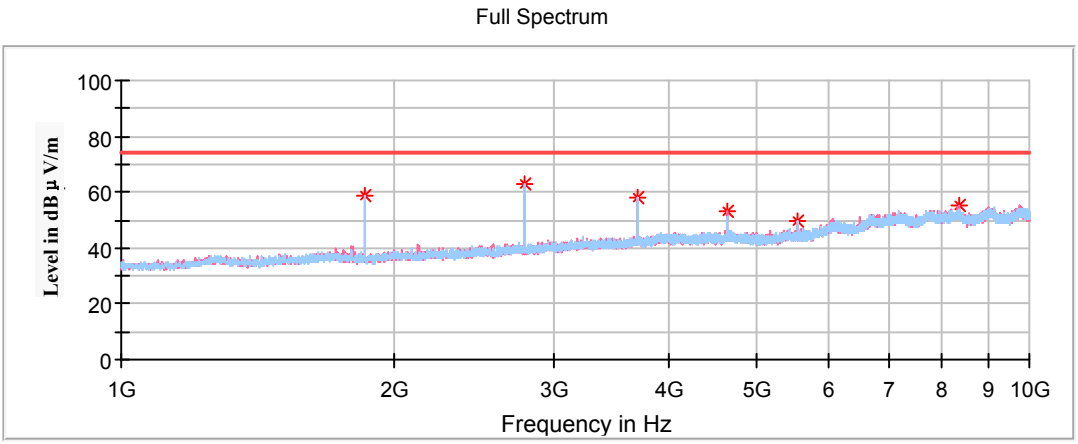
Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBµV/m)	Height (cm)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Corrected Ampitude (dBµV/m)	FCC Part 15.247/205/209	
						Limit (dBµV/m)	Margin (dB)
1829.80	61.21	200.0	V	-23.30	37.91	54	16.09
2746.00	54.02	150.0	V	-23.30	30.72	54	23.28
3660.40	58.01	150.0	H	-23.30	34.71	54	19.29
4575.70	51.22	150.0	V	-23.30	27.92	54	26.08
5491.00	50.12	200.0	V	-23.30	26.82	54	27.18
7183.90	53.23	150.0	V	-23.30	29.93	54	24.07

Note:

AV = PK + Duty Cycle Correction Factor

High Channel: 927.6MHz



Frequency (MHz)	Corrected Amplitude Max Peak (dBµV/m)	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polar (H/V)				
1855.000000	58.92	200.0	H	37.0	-8.2	74.00	15.08
2782.900000	62.81	200.0	H	100.0	-4.3	74.00	11.19
3710.800000	57.97	200.0	V	248.0	-0.9	74.00	16.03
4639.600000	52.99	150.0	V	114.0	1.0	74.00	21.01
5566.600000	49.94	200.0	V	94.0	2.4	74.00	24.06
8350.300000	55.37	200.0	V	158.0	10.8	74.00	18.63

Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBµV/m)	Height (cm)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Corrected Ampitude (dBµV/m)	FCC Part 15.247/205/209	
						Limit (dBµV/m)	Margin (dB)
1855.00	57.69	200.0	H	-23.30	34.39	54	19.61
2782.90	61.29	200.0	H	-23.30	37.99	54	16.01
3710.80	56.88	200.0	V	-23.30	33.58	54	20.42
4639.60	52.12	150.0	V	-23.30	28.82	54	25.18
5566.60	49.33	200.0	V	-23.30	26.03	54	27.97
8350.30	54.12	200.0	V	-23.30	30.82	54	23.18

Note:

AV = PK + Duty Cycle Correction Factor

Bandedge Emissions Test:

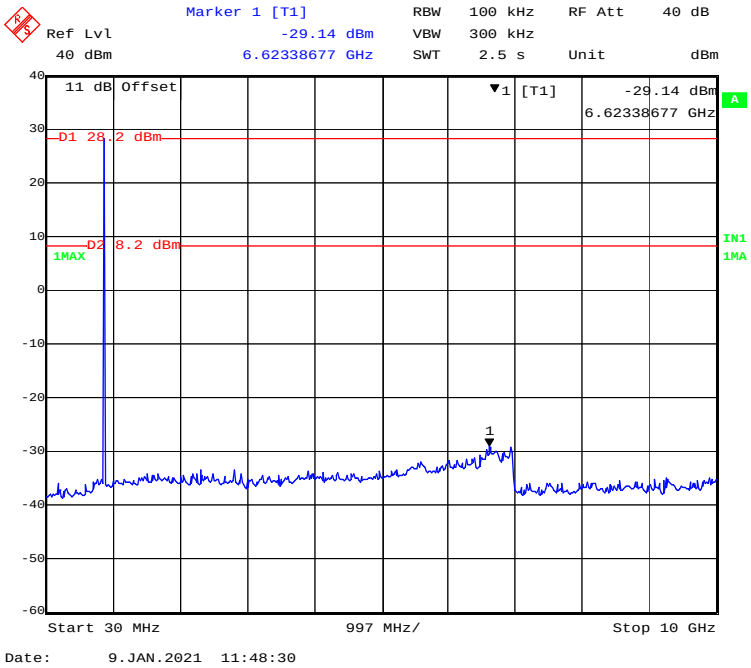
*(Pre-scan in the X,Y and Z axes of orientation, the worst case **X-axis of orientation** was recorded.)*

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

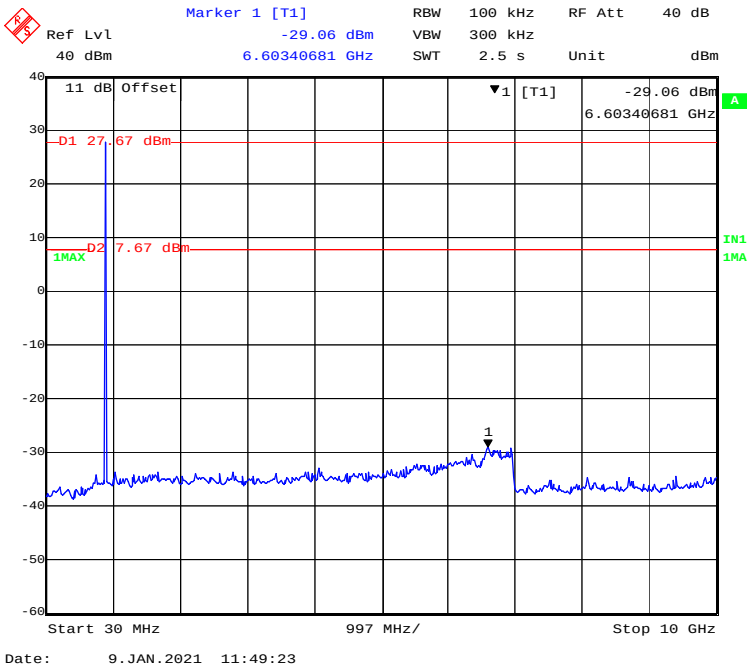
Frequency (MHz)	Corrected Amplitude	Rx Antenna		Turntable Degree	Corrected Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
	QuasiPeak (dBµV/m)	Height (cm)	Polar (H/V)				
Low Channel: 902.4MHz							
902.40	125.99	200	H	199	1.03	/	/
902.40	127.91	150	V	296	1.03	/	/
902.00	46.04	150	H	225	1.02	105.99	59.95
902.00	47.34	150	V	157	1.02	107.91	60.57
High 926.7MHz							
927.60	126.69	200	H	228	1.67	/	/
927.60	126.33	150	V	106	1.67	/	/
928.00	47.91	150	H	315	1.68	106.69	58.78
928.00	47.64	150	V	180	1.68	106.33	58.69

Conducted Spurious Emissions at Antenna Port:

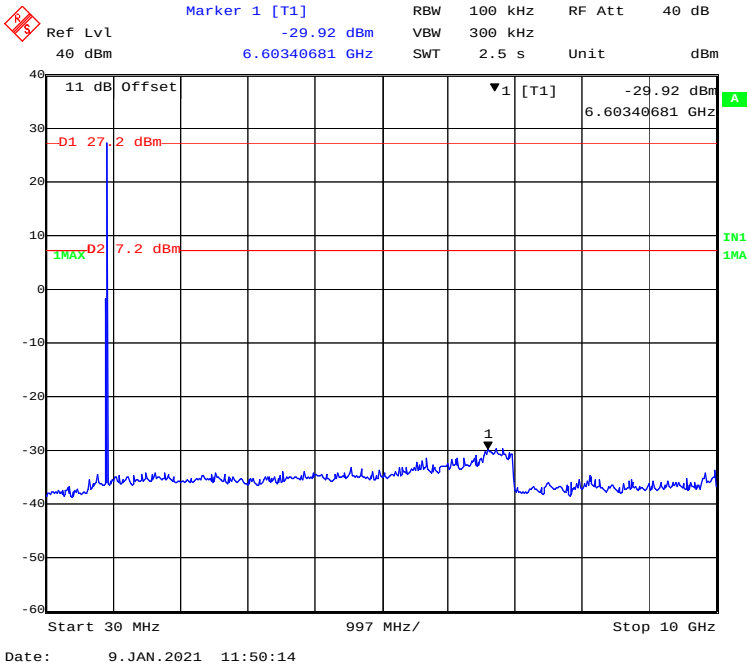
Low Channel



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

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a. Span: Wide enough to capture the peaks of two adjacent channels.
b. RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
c. Video (or average) bandwidth (VBW) ≥ RBW.
d. Sweep: Auto.
e. Detector function: Peak.
f. Trace: Max hold.
g. Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Test Data

Environmental Conditions

Temperature:	23.4℃
Relative Humidity:	53 %
ATM Pressure:	101.2 kPa

The testing was performed by CK Huang on 2021-01-09.

EUT operation mode: Transmitting

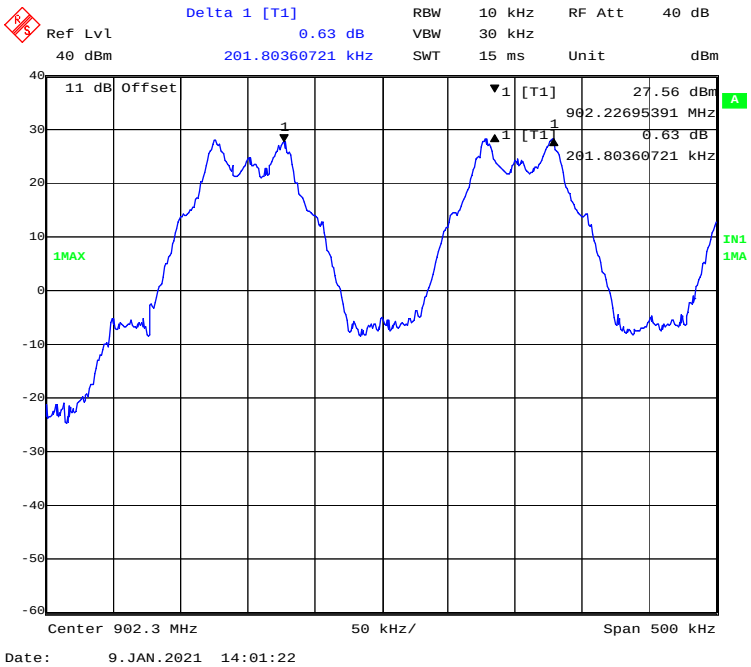
Test Result: Compliant.

For 50kbps:

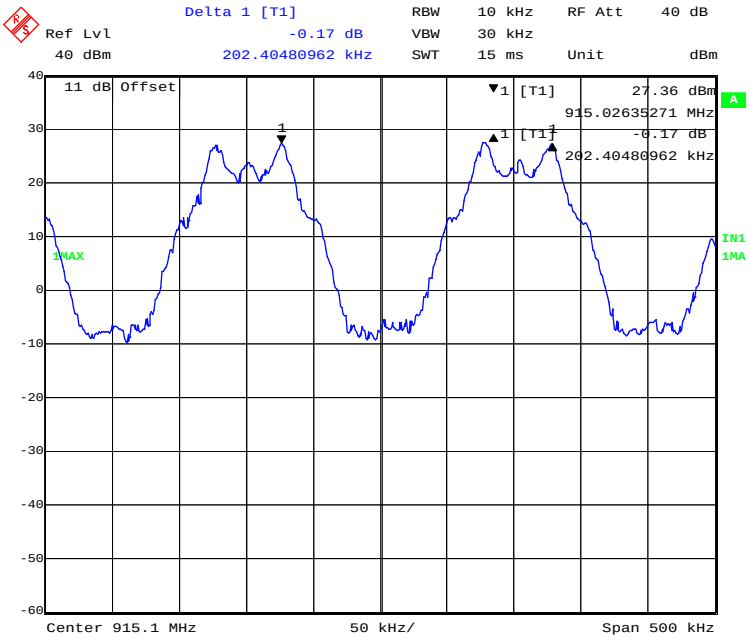
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit (MHz)	Result
Low	902.2	201.804	≥107.615	Pass
Adjacent	902.4			
Middle	915.0	202.405	≥108.818	Pass
Adjacent	915.2			
High	927.8	200.401	≥108.216	Pass
Adjacent	927.6			

The limit = 20dB Bandwidth

Low Channel

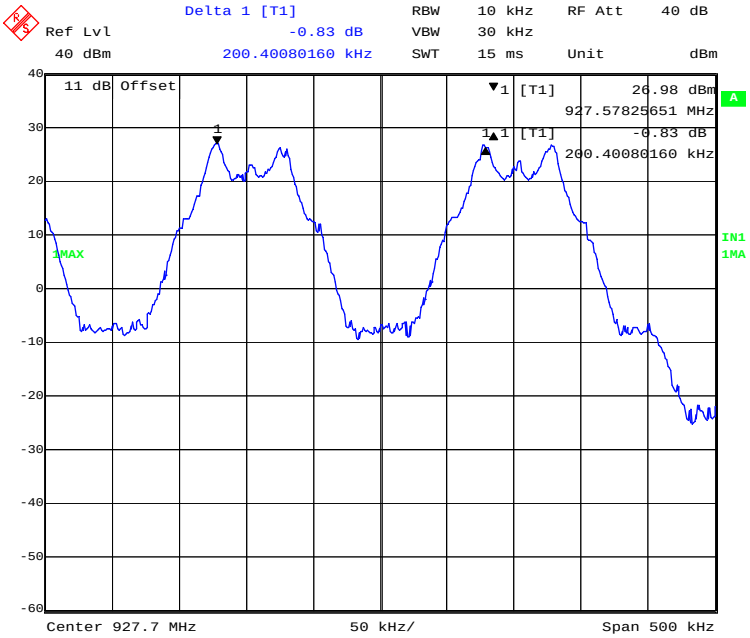


Middle Channel



Date: 9.JAN.2021 14:03:32

High Channel



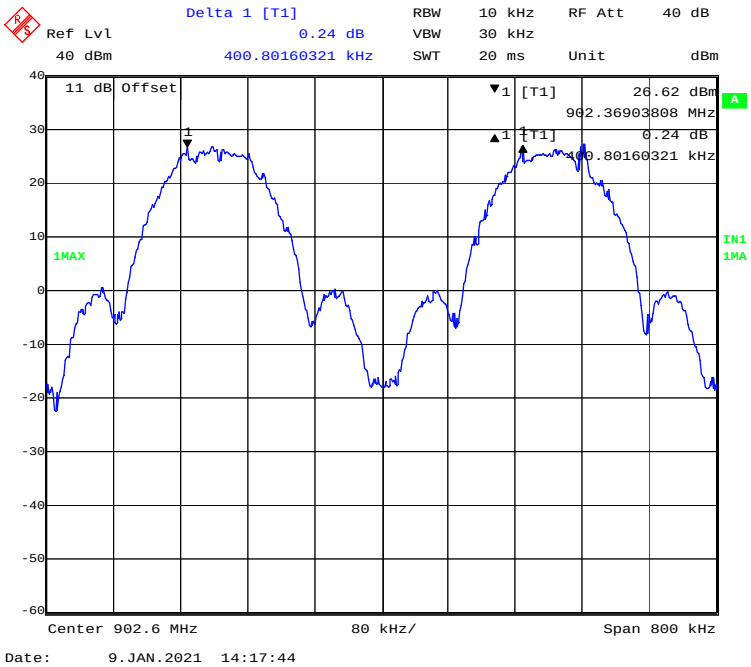
Date: 9.JAN.2021 14:06:26

For 150kbps:

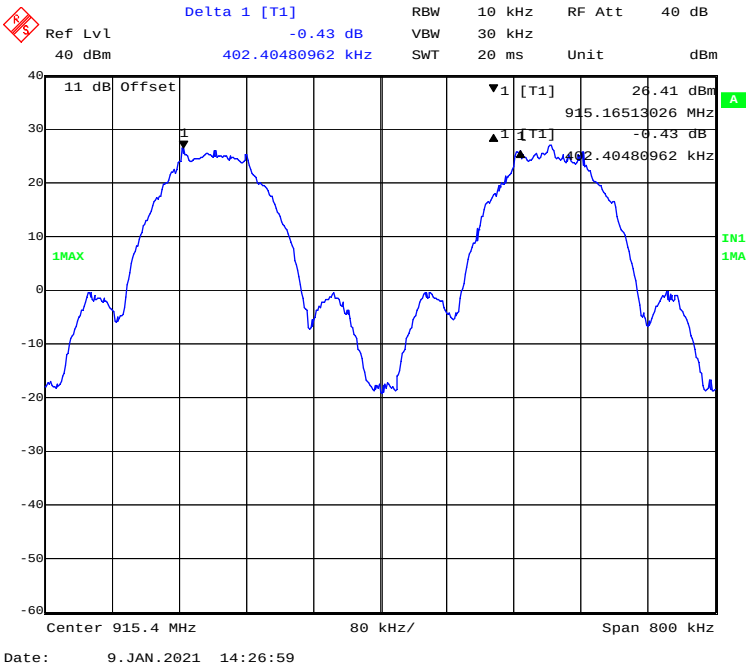
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit (MHz)	Result
Low	902.4	400.802	≥330.661	Pass
Adjacent	902.8			
Middle	915.2	402.405	≥326.653	Pass
Adjacent	915.6			
High	927.6	400.802	≥326.653	Pass
Adjacent	927.2			

The limit = 20dB Bandwidth

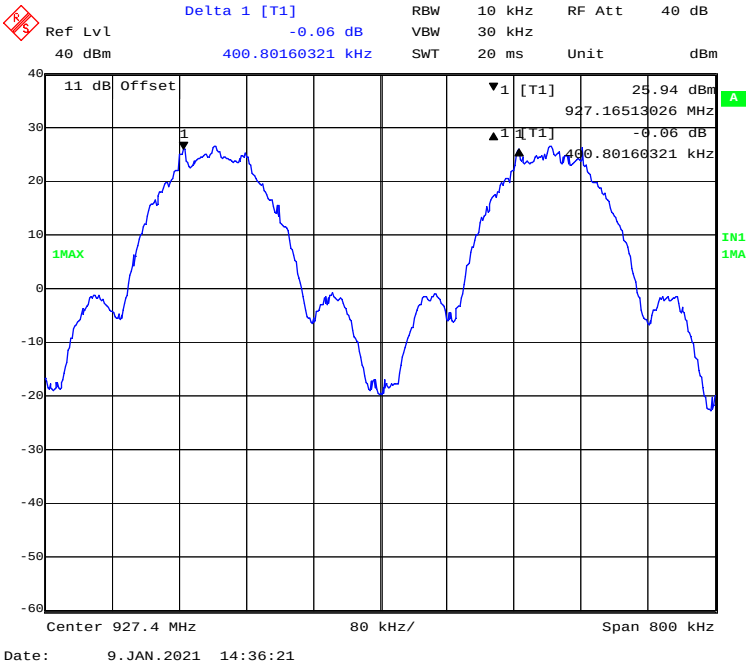
Low Channel



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

Temperature:	25℃
Relative Humidity:	50 %
ATM Pressure:	101.2 kPa

The testing was performed by CK Huang on 2021-01-09.

EUT operation mode: Transmitting

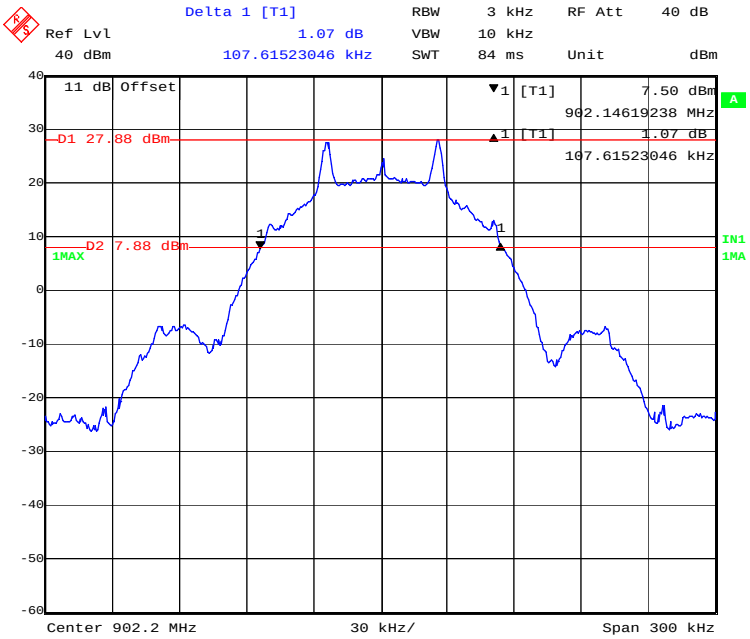
Test Result: Compliant.

EUT operation mode: Transmitting

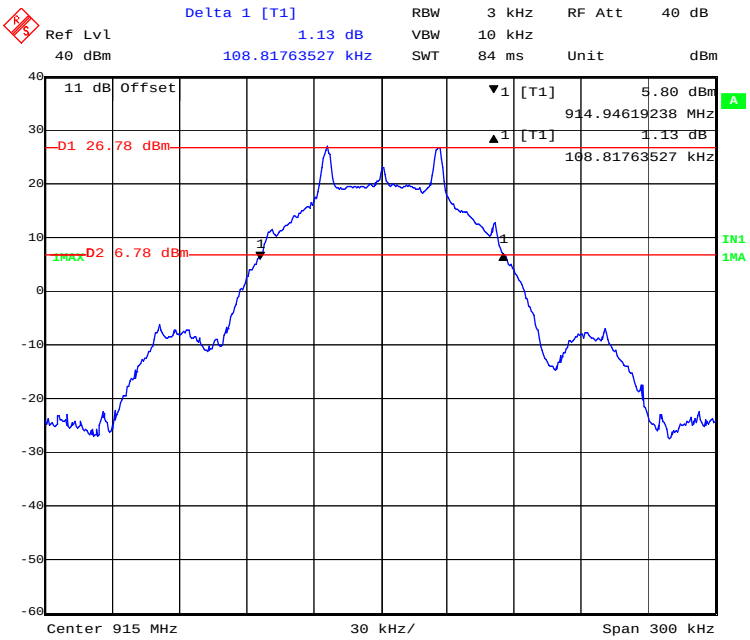
For 50kbps:

Channel	Frequency (MHz)	20 dB Emission Bandwidth (kHz)	Limit (kHz)
Low	902.2	107.615	≤250
Middle	915.0	108.818	≤250
High	927.8	108.216	≤250

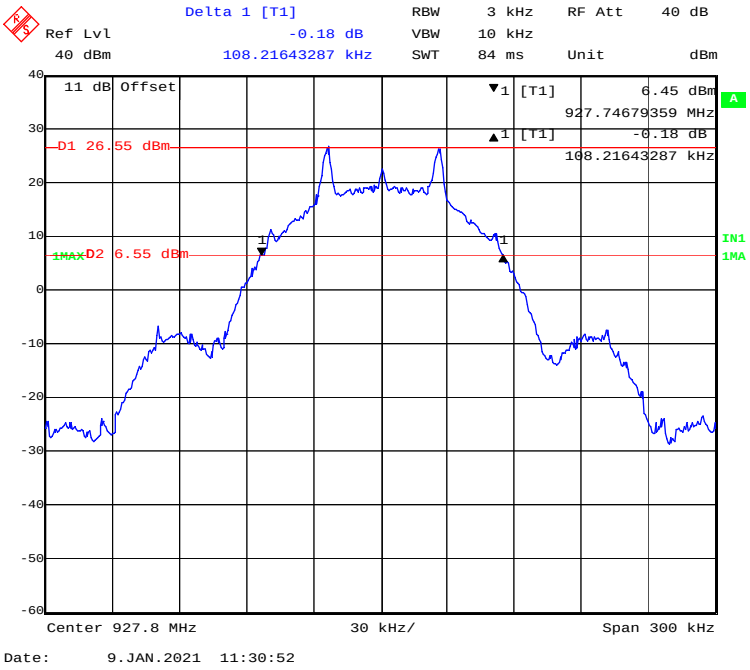
Low Channel



Middle Channel



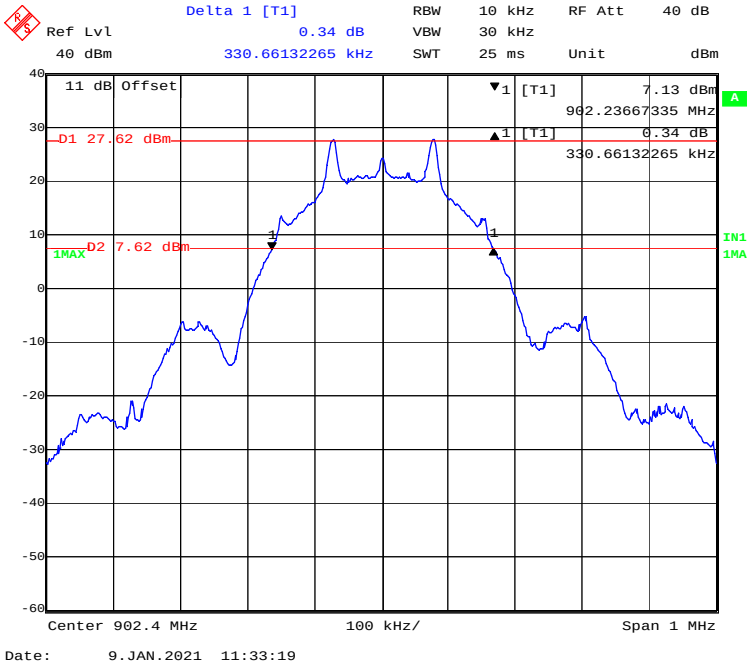
High Channel



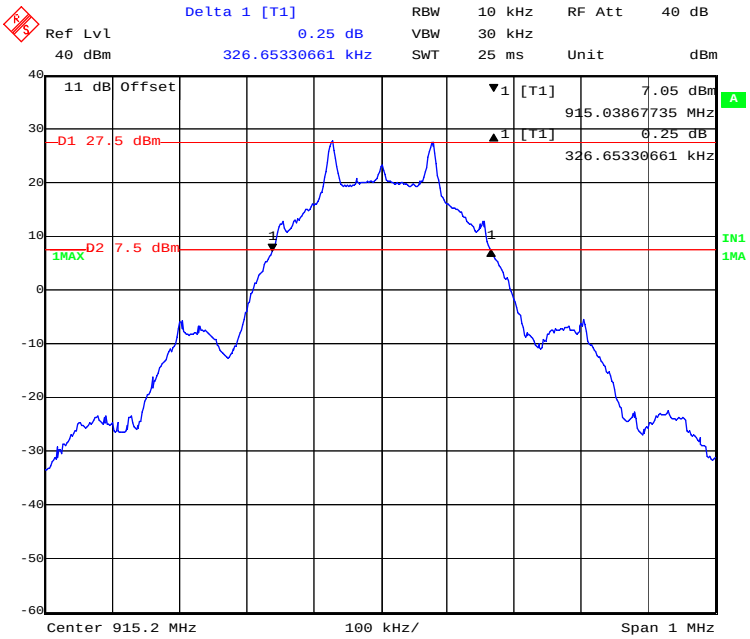
For 150kbps:

Channel	Frequency (MHz)	20 dB Emission Bandwidth (kHz)	Limit (kHz)
Low	902.4	330.661	≤500
Middle	915.2	326.653	≤500
High	927.6	326.653	≤500

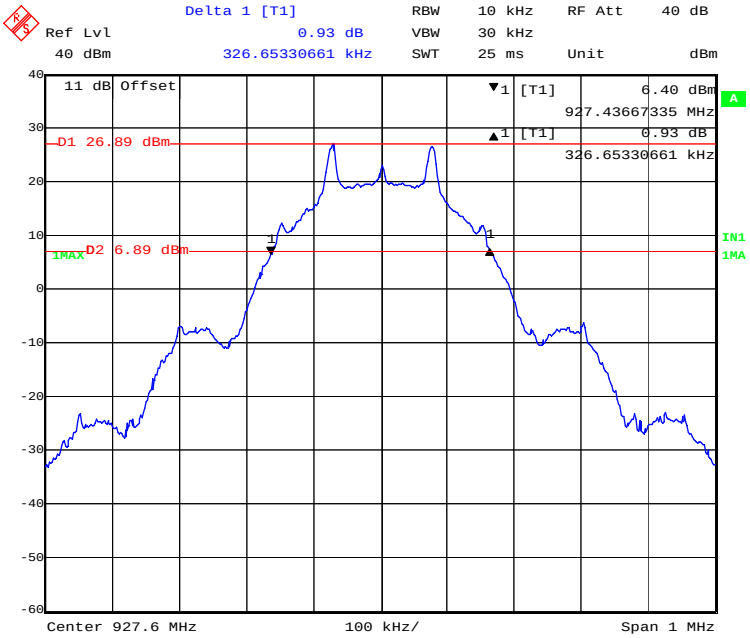
Low Channel



Middle Channel



High Channel



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:	23.4℃
Relative Humidity:	53 %
ATM Pressure:	101.2 kPa

The testing was performed by CK Huang on 2021-01-09.

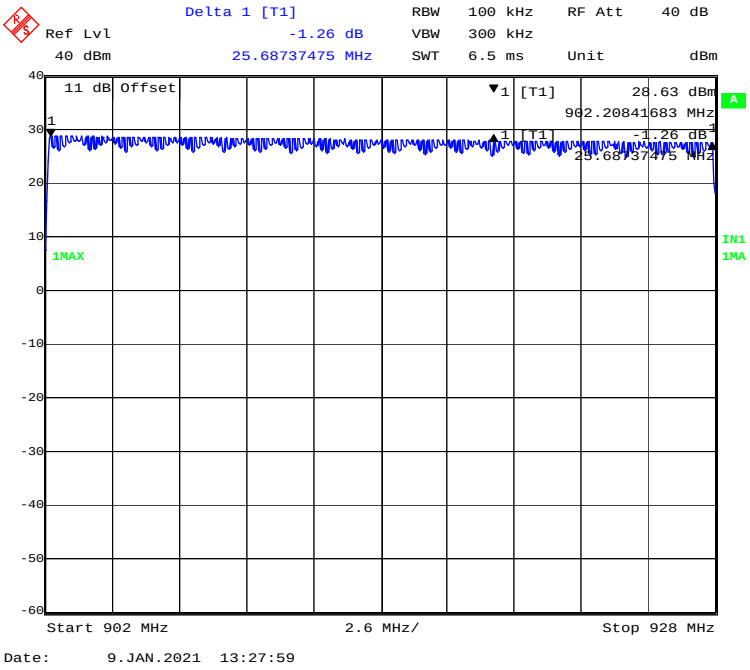
EUT operation mode: Transmitting

Test Result: Compliant.

For 50kbps:

Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
902~928	129	≥50

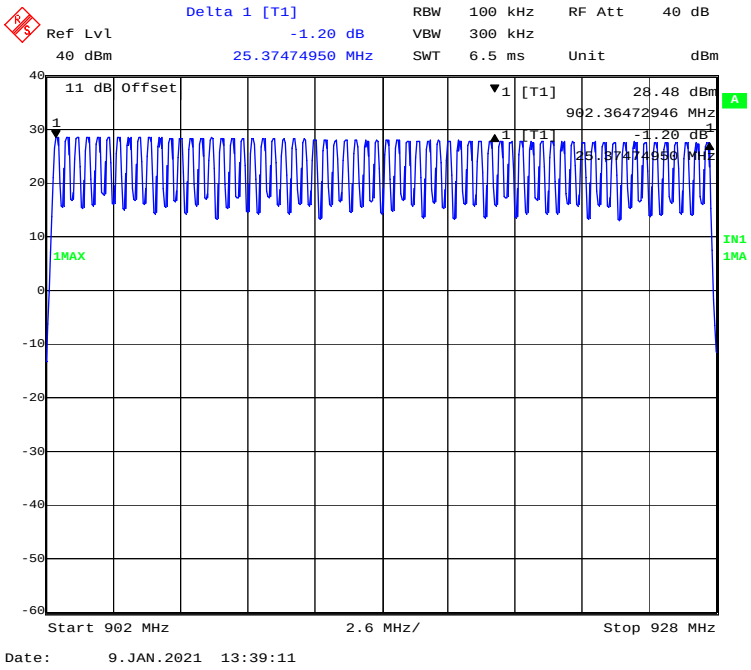
Number of Hopping Channels



For 150kbps:

Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
902~928	64	≥25

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 20 (s), the quantity of pulse was get from single sweep. In addition, the time of single pulses was tested.

Test Data

Environmental Conditions

Temperature:	23.5 ℃
Relative Humidity:	51 %
ATM Pressure:	101.3 kPa

The testing was performed by CK Huang on 2021-01-14.

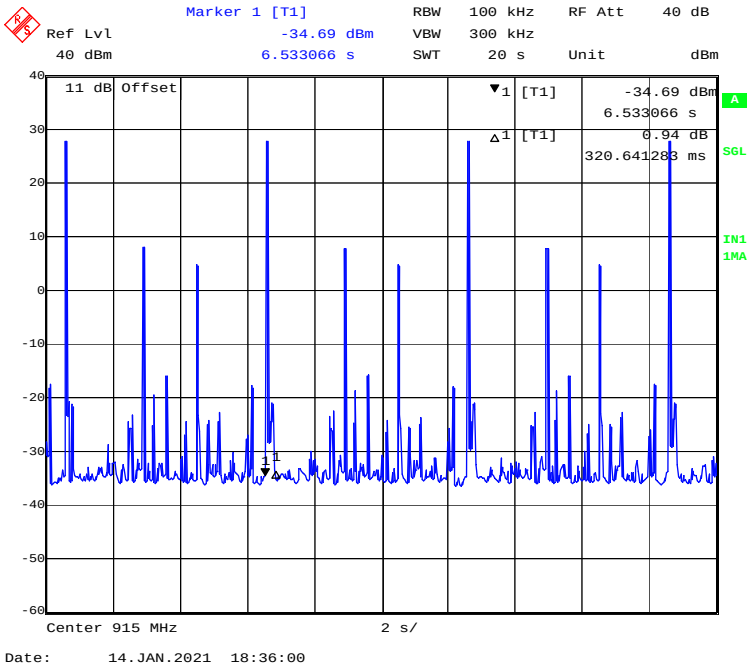
EUT operation mode: Transmitting

Test Result: Compliant.

For 50kbps:

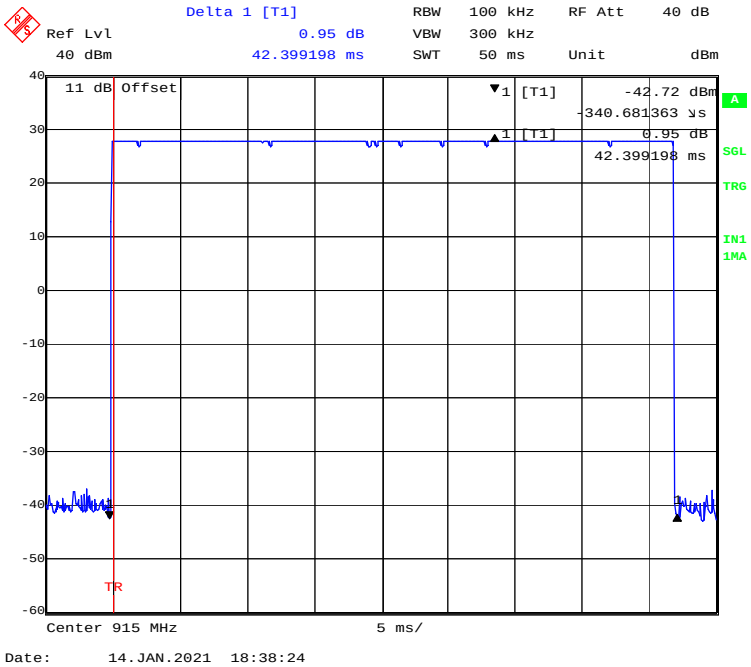
Pulse Width	Pulse Number	Dwell Time	Limit	Result
(ms)		(s)	(s)	
42.399	4	0.170	≤0.4	Pass
Note: Dwell time = Pulse time*N Observed time = 20 s				

Number of Pulses



Date: 14.JAN.2021 18:36:00

Single Pulse

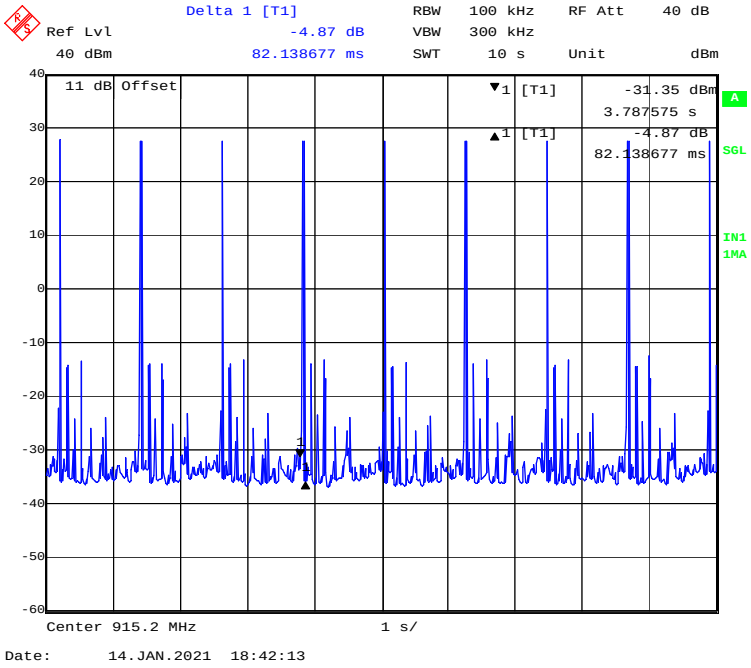


Date: 14.JAN.2021 18:38:24

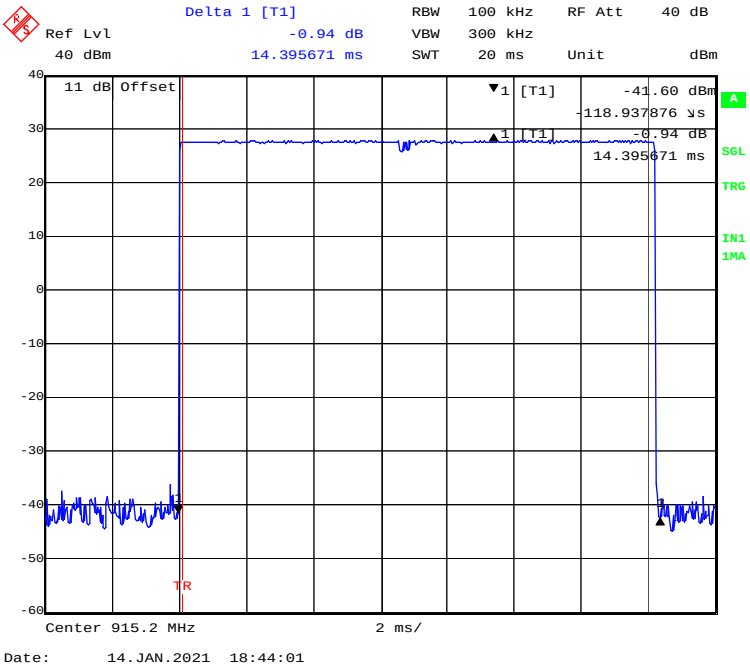
For 150kbps:

Pulse Width	Pulse Number	Dwell Time	Limit	Result
(ms)		(s)	(s)	
14.396	9	0.130	≤0.4	Pass
Note: Dwell time = Pulse time*N Observed time = 10 s				

Number of Pulses



Single Pulse



FCC §15.247(b) (2) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

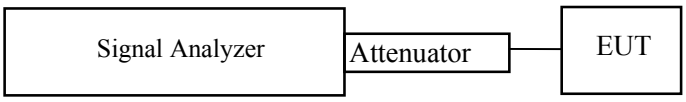
For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Test Procedure

a. Use the following spectrum analyzer settings:

1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
2) RBW > 20 dB bandwidth of the emission being measured.
3) VBW ≥ RBW.
4) Sweep: Auto.
5) Detector function: Peak.
6) Trace: Max hold.

b. Allow trace to stabilize.
c. Use the marker-to-peak function to set the marker to the peak of the emission.
d. The indicated level is the peak output power, after any corrections for external attenuators and cables.
e. A plot of the test results and setup description shall be included in the test report.



Test Data

Environmental Conditions

Temperature:	23.4 ℃
Relative Humidity:	53 %
ATM Pressure:	101.2 kPa

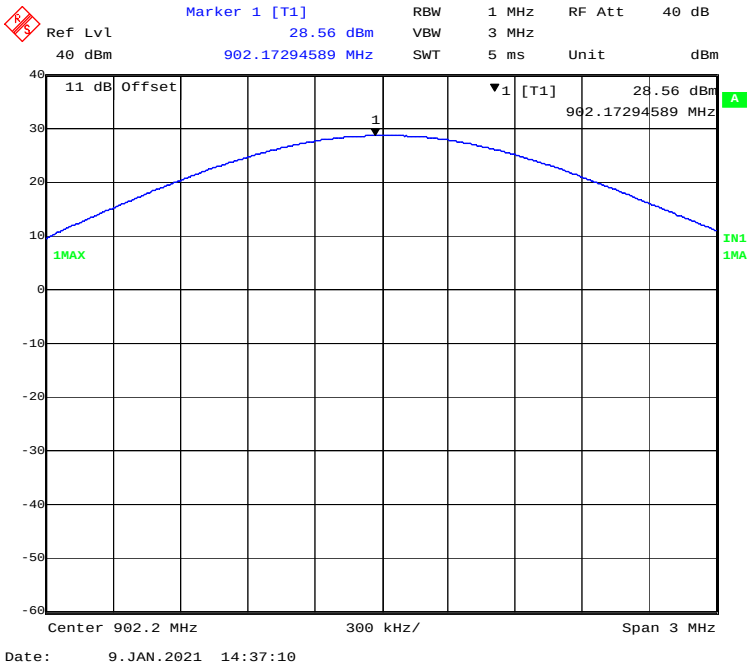
The testing was performed by CK Huang on 2021-01-09.

EUT operation mode: Transmitting

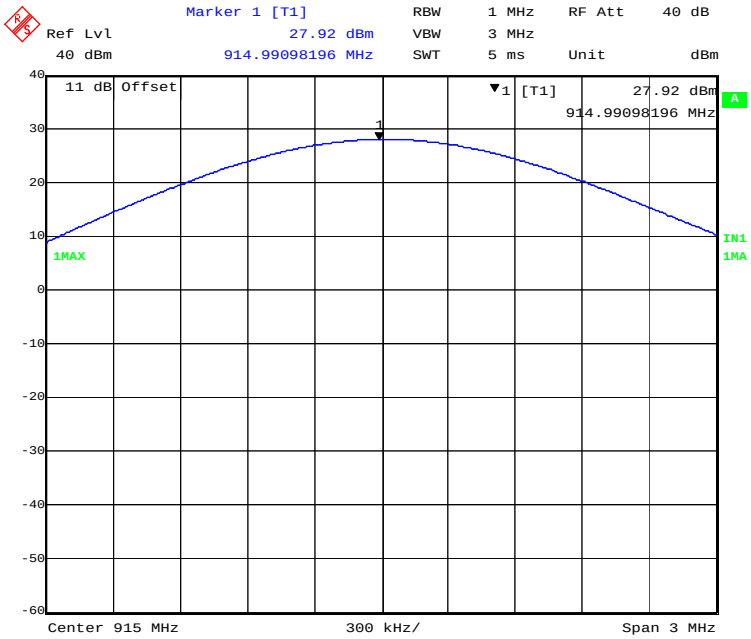
For 50kbps:

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
Low	902.2	28.56	30	Pass
Middle	915.0	27.92	30	Pass
High	927.8	27.36	30	Pass

Low Channel

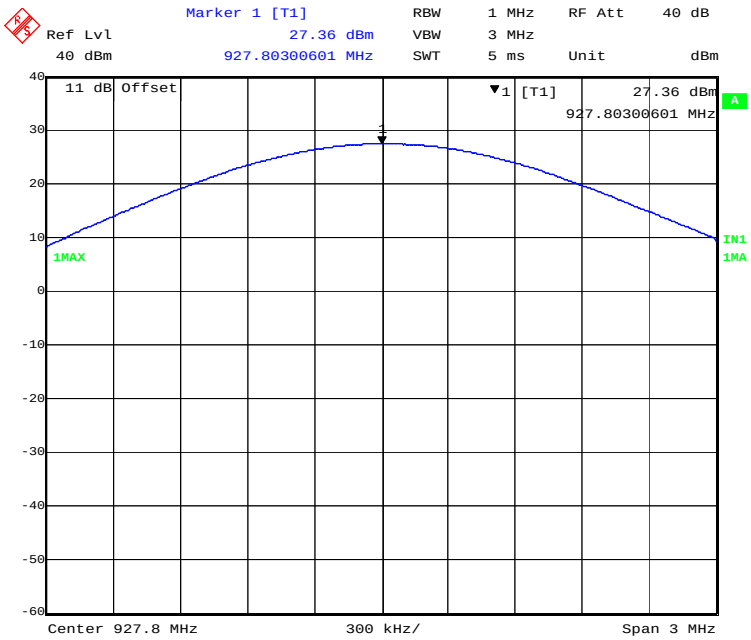


Middle Channel



Date: 9.JAN.2021 14:38:02

High Channel

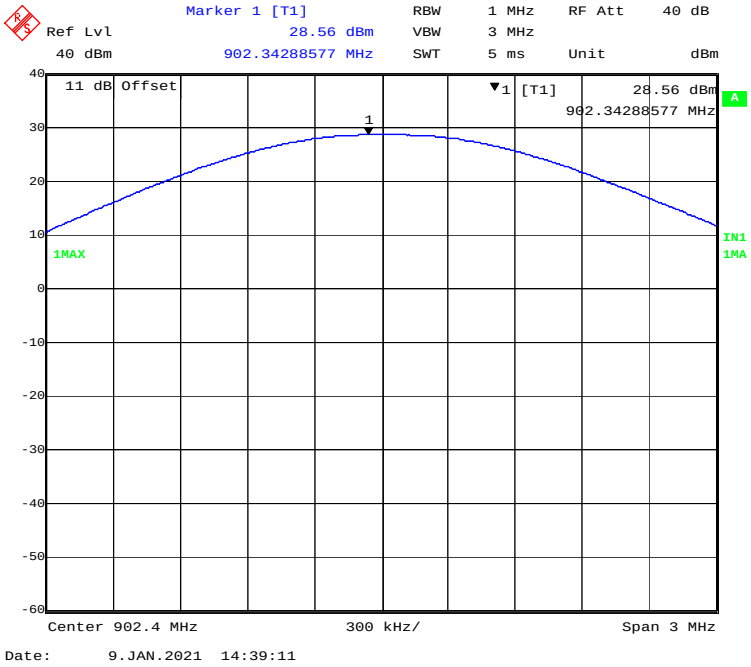


Date: 9.JAN.2021 14:38:42

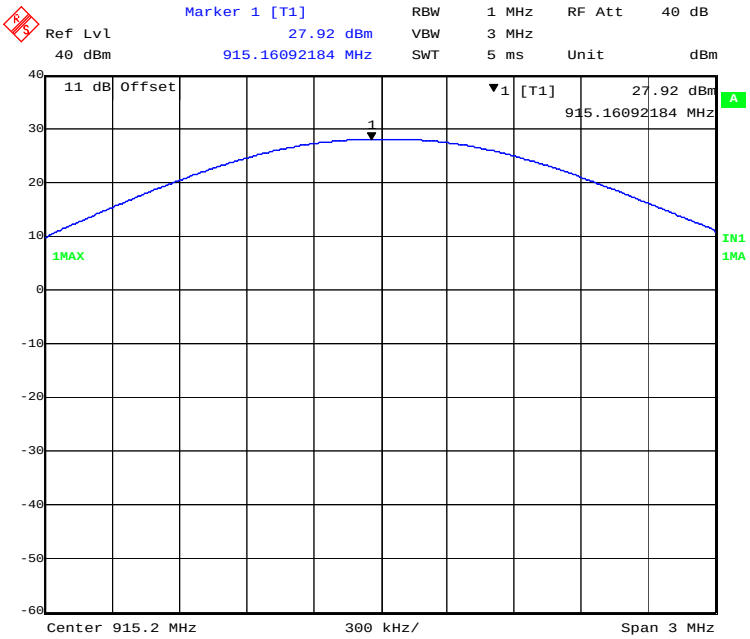
For 150kbps:

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Limit (dBm)	Result
Low	902.4	28.56	30	Pass
Middle	915.2	27.92	30	Pass
High	927.6	27.35	30	Pass

Low Channel



Middle Channel



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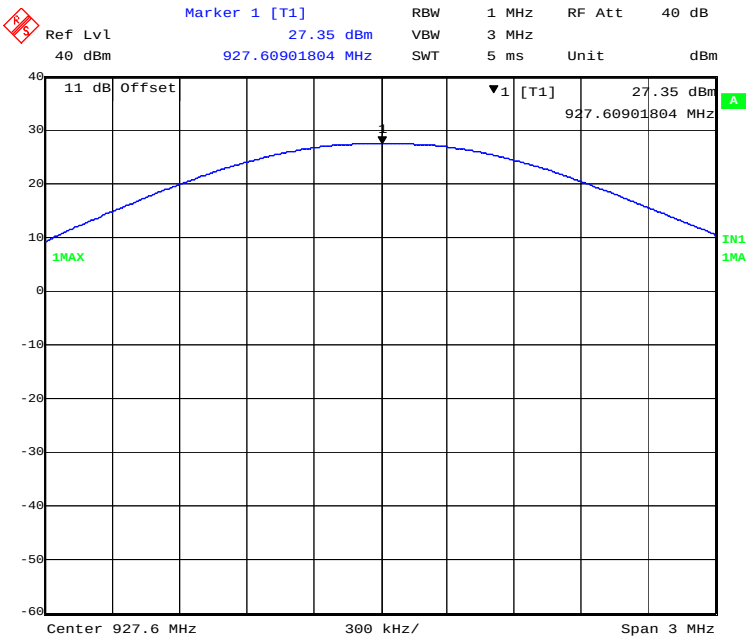
High Channel



Date: 9.JAN.2021 14:40:13

FCC §15.247(d) - BAND EDGE

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

According to ANSI C63.10-2013 sub-clause 6.10.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the middleest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the middleest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

Temperature:	23.4℃
Relative Humidity:	53 %
ATM Pressure:	101.2 kPa

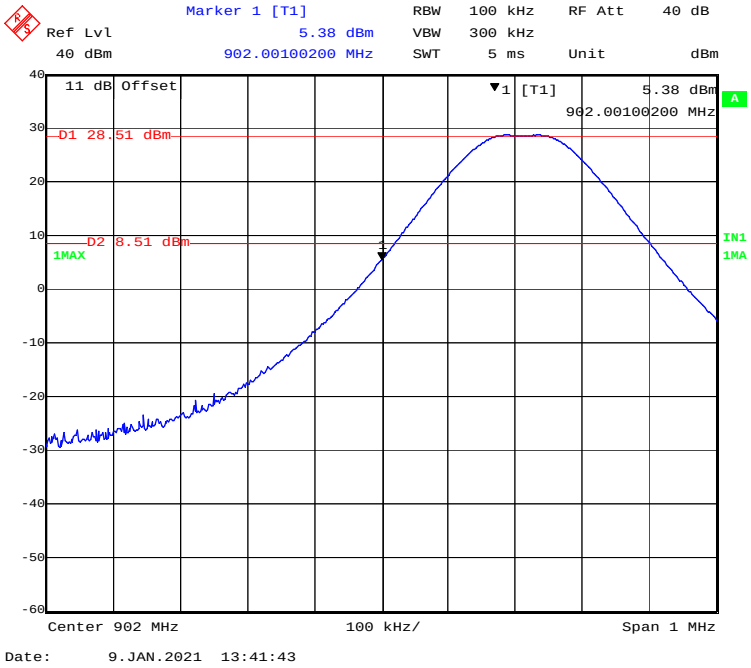
The testing was performed by CK Huang on 2021-01-09.

EUT operation mode: Transmitting

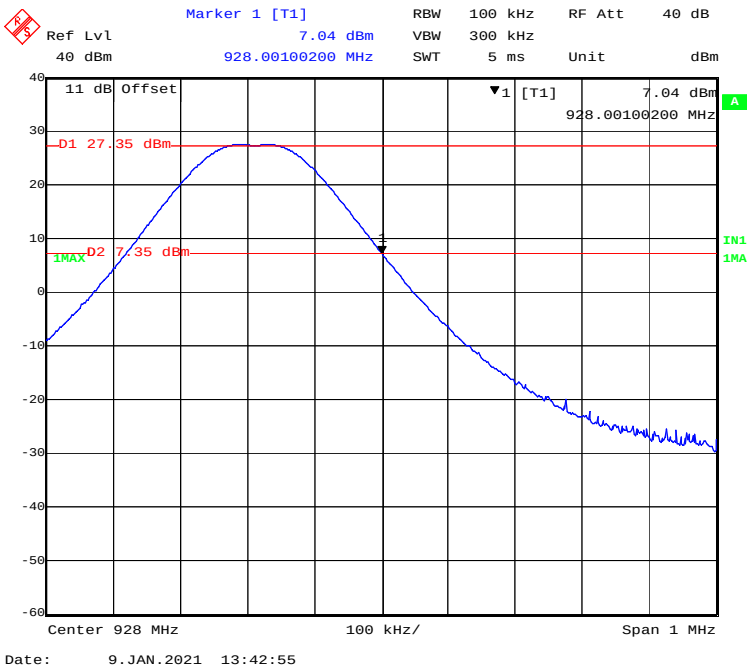
Test Result: Compliant.

For 50kbps:

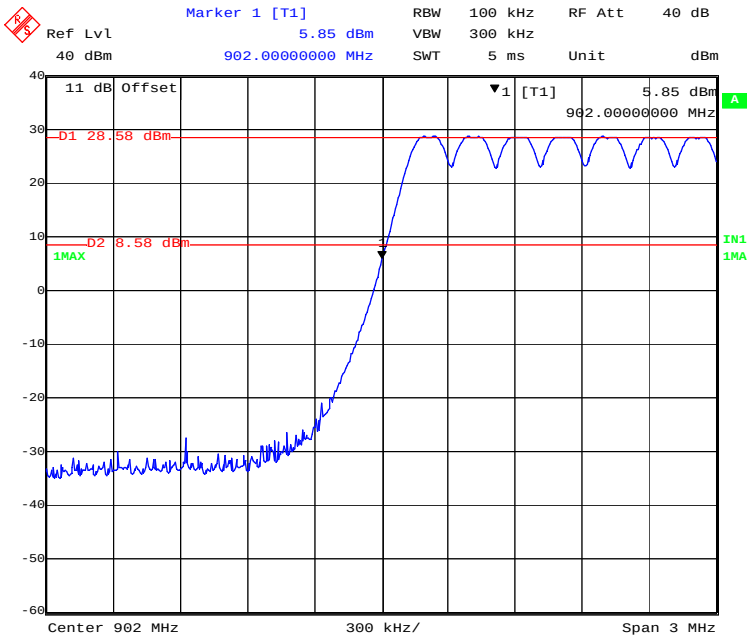
Left Side



Right Side

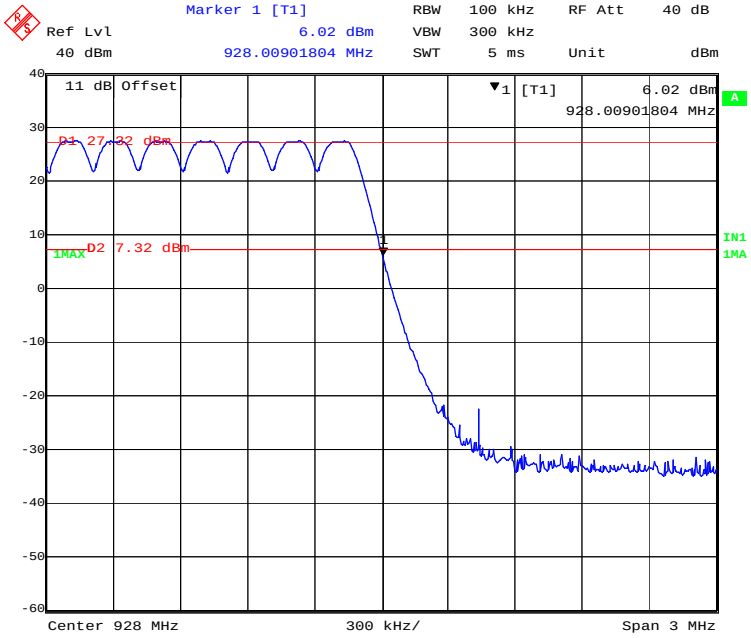


Left Side-Hopping



Date: 9.JAN.2021 13:52:48

Right Side-Hopping



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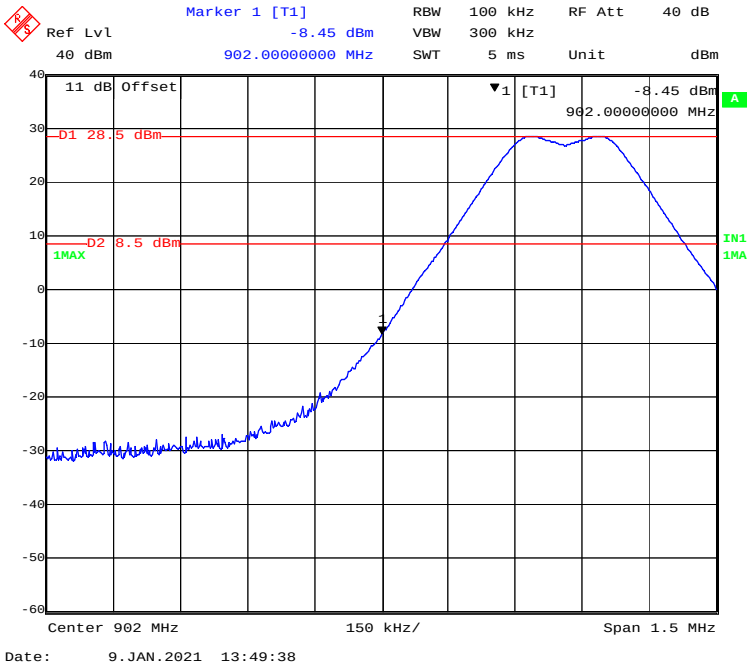
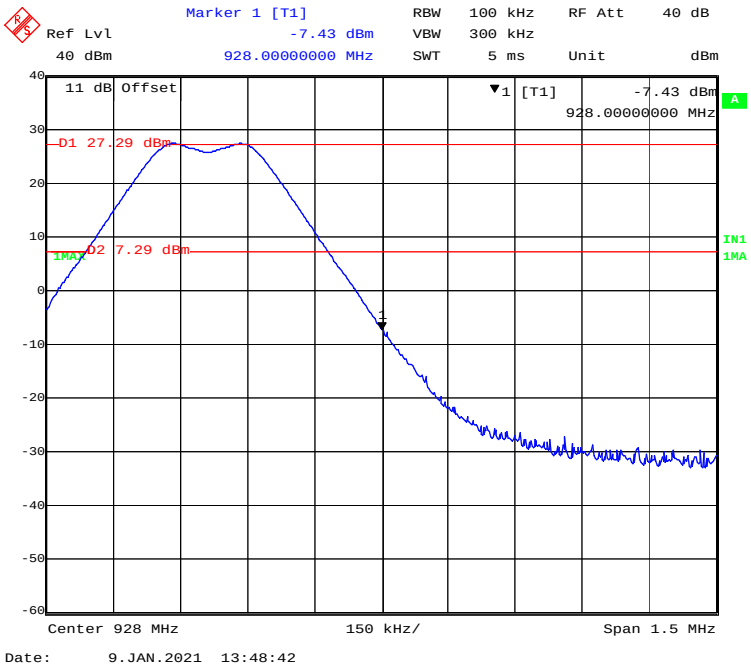
For 150kbps:

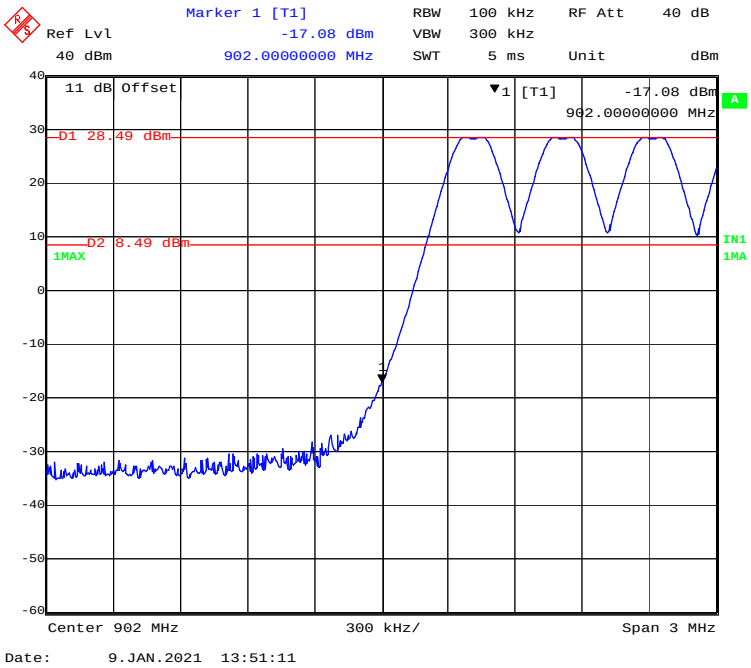
Left Side



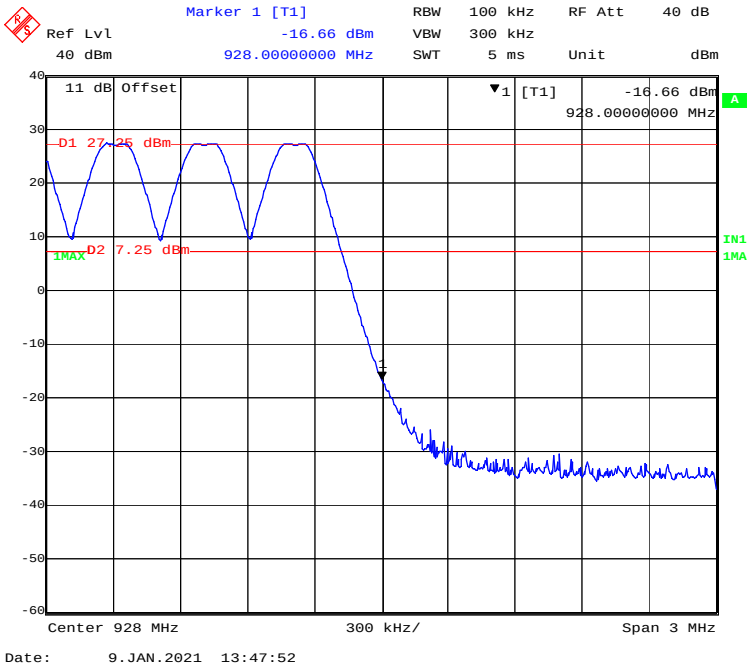
Right Side



Left Side-Hopping



Right Side-Hopping



Declarations

1: BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.

2: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

3: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

4: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

5: This report cannot be reproduced except in full, without prior written approval of the Company.

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