FCC Part 15.247

TEST REPORT

For

M2communication Inc.

17F.-3, No. 32, Gaotie 2nd Rd., Zhubei City, Hsinchu County ,Taiwan (R.O.C.)

FCC ID: 2AFXU-ES27-S2

Report Type:	**Product Type:**
Original Report	Electronic Shelf Label

Report Producer : Coco Lin

Report Number : RLK241015040RF01

Report Date : 2025-01-10

Reviewed By: Rory Cheng

Prepared By:

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Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RLK241015040	RLK241015040RF01	2025-01-10	Original Report	Coco Lin

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1 General Information

1.1 Product Description for Equipment under Test (EUT)

Applicant	M2communication Inc.
	17F.-3, No. 32, Gaotie 2nd Rd., Zhubei City, Hsinchu County ,Taiwan (R.O.C.)
Manufacturer	M2communication Inc.
	17F.-3, No. 32, Gaotie 2nd Rd., Zhubei City, Hsinchu County ,Taiwan (R.O.C.)
Brand(Trade) Name	M2COMM
Product (Equipment)	Electronic Shelf Label
Main Model Name	ES27-S2
Frequency Range	LORA Mode: 903 ~ 927MHz
Transmit Power	LORA Mode: 11.24 dBm
Modulation Technique	LORA Mode: 500kHz, 2GFSK
	☒ DC Type ☒ Battery: 3Vdc from Battery ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System
Received Date	10/18/2024
Date of Test	10/23 ~ 01/09/2025

*All measurement and test data in this report was gathered from production sample serial number: RLK241015040-1 & -2. Assigned by BACL, Linkou Laboratory.

1.2 Objective

This report is prepared on behalf of M2communication Inc. in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC Part 15.247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions.

1.3 Related Submittal(s)/Grant(s)

N/A.

1.4 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.

KDB 558074 D01 Meas Guidance v05r02

1.5 Statement of Compliance

Decision Rule: No, (The test results do not include MU judgment)

The measurement results in this report were performed at Bay Area Compliance Laboratories Corp. (Linkou Laboratory)

Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification. Bay Area Compliance Laboratories Corp. (Linkou Laboratory) is not responsible for the authenticity of the information provided by the applicant that affects the test results.

1.6 Measurement Uncertainty

Parameter		Uncertainty
AC Mains		±4.67 (dB)
RF output power, conducted		±3.73 (dB)
Power Spectral Density, conducted		±0.65 (dBm)
Occupied Bandwidth		±0.09 (%)
Unwanted Emissions, conducted		±1.02 (dB)
Emissions, radiated	30 MHz~1GHz	±3.13 (dB)
	1 GHz~18 GHz	±5.21 (dB)
	18 GHz~40 GHz	±4.72 (dB)
Temperature		±0.04 (%)
Humidity		±0.78 (℃)

1.7 Environmental Conditions

Test Site	Test Data	Temperature (℃)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
Radiation Spurious Emissions	2024/10/23	21.4	53	1010	Bruce Chen
Conducted Spurious Emissions	2025/01/09	21.2	50	1010	Hank Tsai
6 dB Emission Bandwidth	2025/01/09	21.2	50	1010	Hank Tsai
Maximum Output Power	2025/01/09	21.2	50	1010	Hank Tsai
100 kHz Bandwidth of Frequency Band Edge	2025/01/09	21.2	50	1010	Hank Tsai
Power Spectral Density	2025/01/09	21.2	50	1010	Hank Tsai

1.8 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Linkou Laboratory) to collect test data is located on

☒ No.6, Wende 2Rd., Guishan Dist., Taoyuan City 33382, Taiwan (R.O.C.).

Bay Area Compliance Laboratories Corp. (Linkou Laboratory) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3546) by Mutual Recognition Agreement (MRA). The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database. The FCC Registration No.: 0027578244. Designation No.: TW1119. The Test Firm Registration No.: 311381.

2 System Test Configuration

2.1 Description of Test Configuration

For LoRa mode, 97 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	903	21	908	41	913	61	918	81	923
2	903.25	22	908.25	42	913.25	62	918.25	82	923.25
3	903.5	23	908.5	43	913.5	63	918.5	83	923.5
4	903.75	24	908.75	44	913.75	64	918.75	84	923.75
5	904	25	909	45	914	65	919	85	924
6	904.25	26	909.25	46	914.25	66	919.25	86	924.25
7	904.5	27	909.5	47	914.5	67	919.5	87	924.5
8	904.75	28	909.75	48	914.75	68	919.75	88	924.75
9	905	29	910	49	915	69	920	89	925
10	905.25	30	910.25	50	915.25	70	920.25	90	925.25
11	905.5	31	910.5	51	915.5	71	920.5	91	925.5
12	905.75	32	910.75	52	915.75	72	920.75	92	925.75
13	906	33	911	53	916	73	921	93	926
14	906.25	34	911.25	54	916.25	74	921.25	94	926.25
15	906.5	35	911.5	55	916.5	75	921.5	95	926.5
16	906.75	36	911.75	56	916.75	76	921.75	96	926.75
17	907	37	912	57	917	77	922	97	927
18	907.25	38	912.25	58	917.25	78	922.25	/	/
19	907.5	39	912.5	59	917.5	79	922.5	/	/
20	907.75	40	912.75	60	917.75	80	922.75	/	/

Were tested with channel 1, 49 and 97.

The system was configured for testing in engineering mode, which was provided by manufacturer.

2.2 Equipment Modifications

No modification was made to the EUT.

2.3 EUT Exercise Software

The test software was used “TeraTerm-4.94.exe”

Test Frequency		Low	Mid	High
Power Level Setting	LORA	15	15	15

2.4 Support Equipment List and Details

Description	Manufacturer	Model Number	S/N
Notebook	Lenovo	Y520	PF9XB8523001
Battery	Panasonic	CR2450	N/A
Fixture	M2communication INC.	0C1-0001-02	N/A

2.5 External Cable List and Details

N/A

2.6 Test Mode

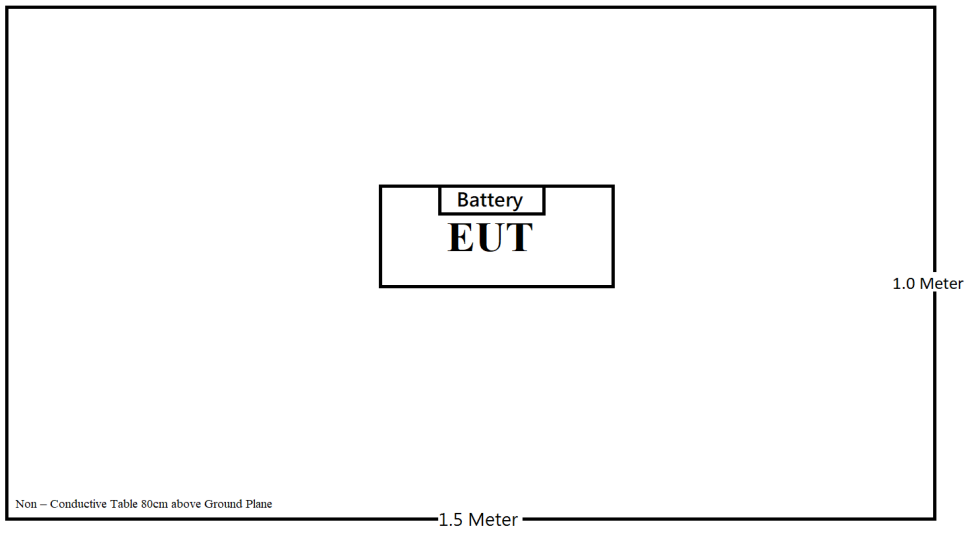
Full System (model: ES27-S2) for all test item.

2.7 Block Diagram of Test Setup

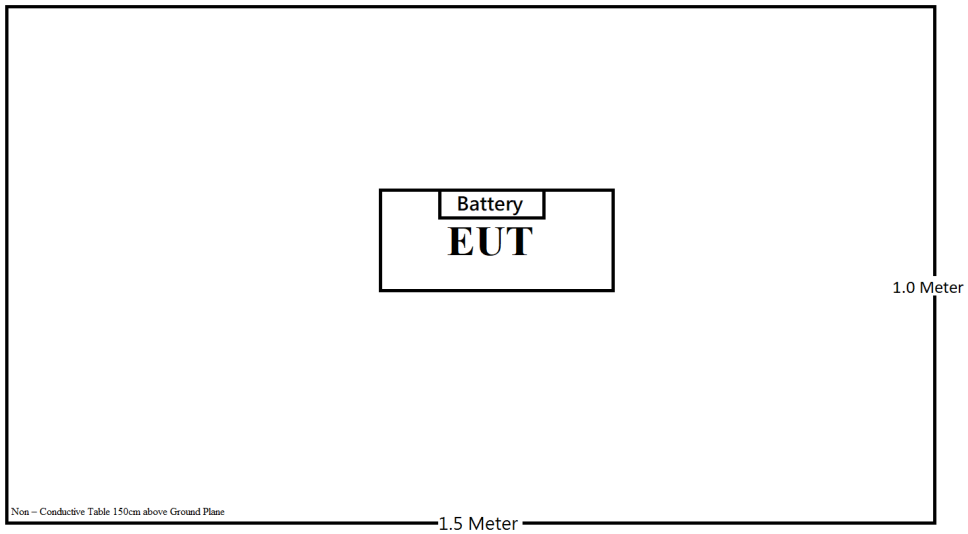
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

Radiation:

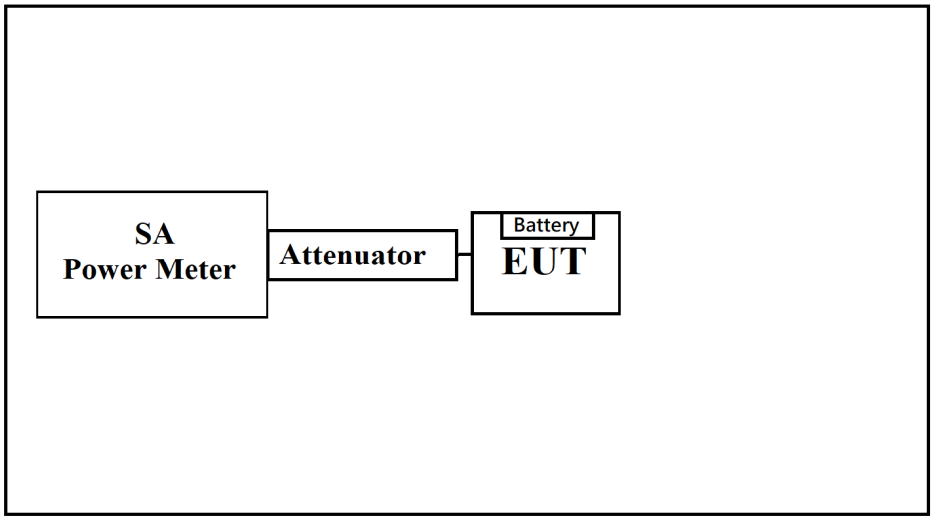
Below 1GHz:



Above 1GHz:



Conducted:



2.8 Duty Cycle

According to KDB 558074 D01 15.247 Meas Guidance v05r02 section 6.0:

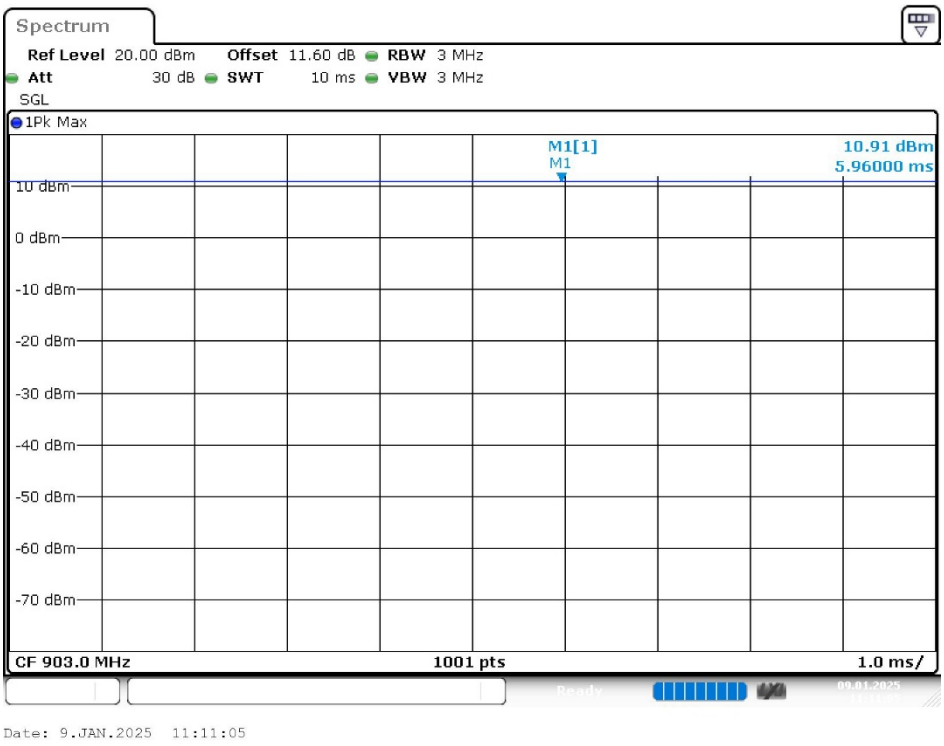
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximumpower transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T VBW setting (Hz)
Lora	10	10	100	0	10

Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

LORA Mode



3 Summary of Test Results

FCC Rules	Description of Test	Results
§FCC §15.247(i), §1.1307(b)(3)	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Not applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

Not applicable: Device use disposable battery.

4 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Room (966-A)					
Bilog Antenna & 6 dB Attenuator	SUNOL SCIENCES & EMCI	JB3 & N-6-06	A111513 & AT-N0668	2024/04/19	2025/04/19
Active Loop Antenna	ETS-Lindgren	6502	0001-3322	2024/03/27	2025/03/27
Horn Antenna	EMCO	3115	2058	2024/03/26	2025/03/26
Preamplifier with 1W input limiter	A.H. Systems	PAM-0118P	470	2024/03/26	2025/03/26
ESR EMI Test Receiver	Rohde & Schwarz	ESR3	102448	2024/09/19	2025/09/19
Spectrum Analyzer	Rohde & Schwarz	FSV40	1321.3008K40-101940-YY	2023/12/15	2024/12/15
Microflex Cable (1m)	MTJ	00000-MT26A-100	H0919	2024/08/01	2025/08/01
Microflex Cable (2m)	EMCI	EMCI06-SM-SM-2000	180515	2024/08/01	2025/08/01
Microflex Cable (8m)	UTIFLEX	UFA210A-1-3149-300300	MFR 64639 232490-001	2024/08/01	2025/08/01
Band Reject Filter	Guanggaoj	XBLBQ-DZA05	190329-1-09	2024/04/01	2025/04/01
Software	AUDIX	E3 V9	E3LK-01	N.C.R	N.C.R
Conducted Room					
Cable	MTJ	MT40S	620620-MT40S-100	2024/12/27	2025/12/26
Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	101938	2024/12/04	2025/12/03
USB Wideband Power Sensor	AGILENT	U2021XA	MY54080011	2024/08/28	2025/08/28
10dB Attenuator	MCL	BW-S10W5+	605	2024/03/22	2025/03/22

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements.

5 FCC §15.247(i), §1.1307(b)(3) – RF Exposure

5.1 Applicable Standard

ccording to subpart 15.247(i) and subpart §1.1307(b)(3), 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.

For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

5.2 RF Exposure Evaluation Result

Project info

Band	Freq (MHz)	Tune-up Power (dBm)	Ant Gain (dBi)	Distances (mm)	Duty (%)	Tune-up Power (mW)	ERP (dBm)	ERP (mW)
LoRa	903	11.5	-3.8	200	100%	14.13	5.55	3.59

§ 1.1307(b)(3)(i)(A)

Band	Freq (MHz)	Tune-up Power(mW)	Result
LoRa	903	14.13	not exempt

§ 1.1307(b)(3)(i)(C)

Band	Freq (MHz)	λ/2π (mm)	Distances applies	ERP Limit (mW)	Result
LoRa	903	52.88	apply	462.34	exempt

Result: The device compliant the MPE-Based Exemption at 20cm distances.

6 FCC §15.203 – Antenna Requirements

6.1 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.

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 does not exceed 6dBi.

6.2 Antenna Information

Manufacturer	Model	Type	Antenna Gain
Cirocomm Technology Corp.	ES27	PCB Antenna	-3.8 dBi

Result: Compliance

7 FCC §15.207(a) – AC Line Conducted Emissions

7.1 Applicable Standard

According to §15.207

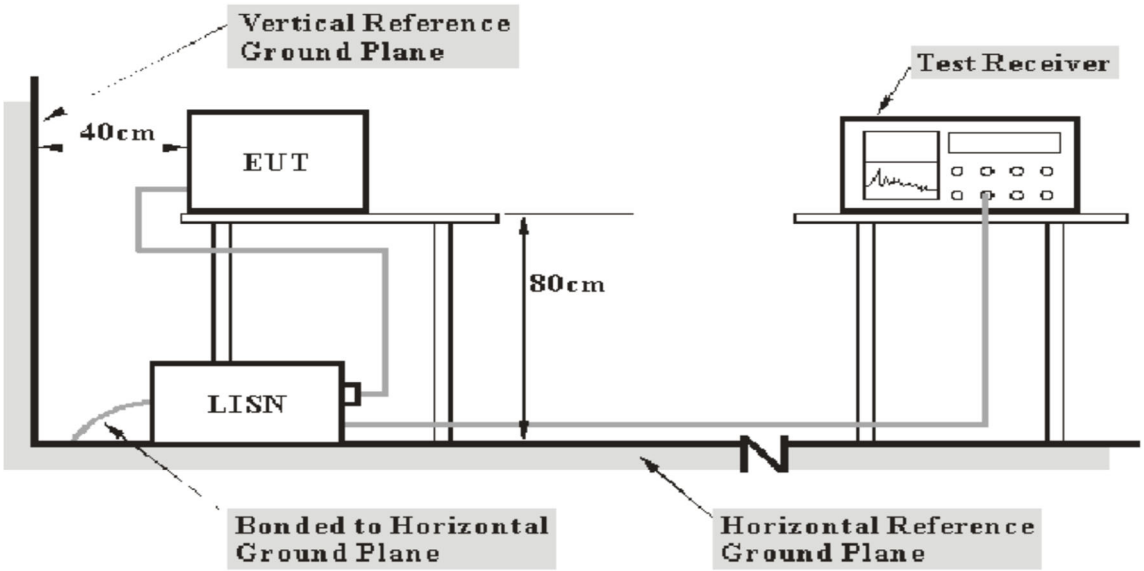
For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

Note 2: A linear average detector is required

7.2 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.

7.3 EMI Test Receiver Setup

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

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

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

7.4 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.

7.5 Corrected Factor & Margin Calculation

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

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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 below the limit. The equation for Over Limit calculation is as follows:

Over Limit = Level – Limit Line

7.6 Test Results

Not applicable

8 FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

8.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	608 – 614	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	5. 35 – 5. 46
2.1735 – 2.1905	16.80425 – 16.80475	1300 – 1427	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1435 – 1626.5	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1645.5 – 1646.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1660 – 1710	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1718.8 – 1722.2	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	2200 – 2300	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2310 – 2390	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2483.5 – 2500	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2690 – 2900	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	3260 – 3267	22.01 – 23.12
8.41425 – 8.41475	162.0125 –167.17	3.332 – 3.339	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3 3458 – 3 358	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3.600 – 4.400	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4		Above 38.6
13.36 – 13.41	399.9 – 410		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

According to ANSI C63.10-2013, section 5.3.3

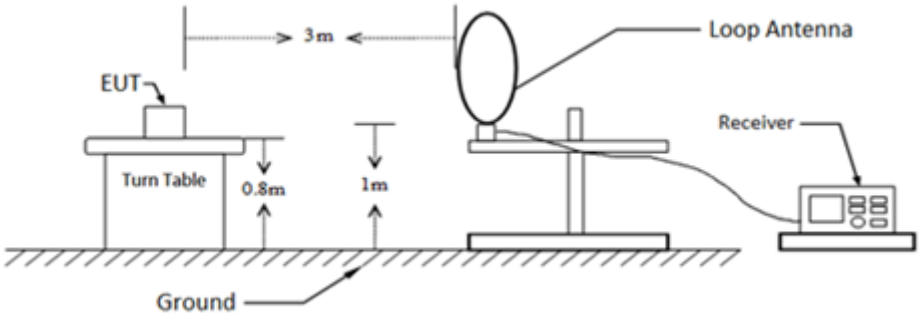
Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field, and the emissions to be measured can be detected by the measurement equipment (see 4.3.4).

Measurements shall not be performed at a distance greater than 30 m for frequencies above 30 MHz, unless it can be further demonstrated that measurements at a distance of 30 m or less are impractical. Measurements from 18 GHz to 40 GHz are typically made at distances significantly less than 3 m from the EUT. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade of distance (inverse of linear distance for field-strength measurements or inverse of linear distance-squared for power-density measurements).

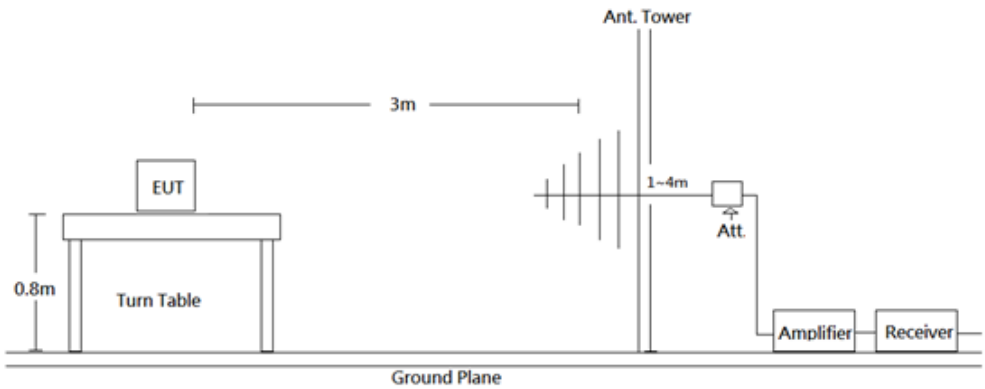
As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the 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).

8.2 EUT Setup

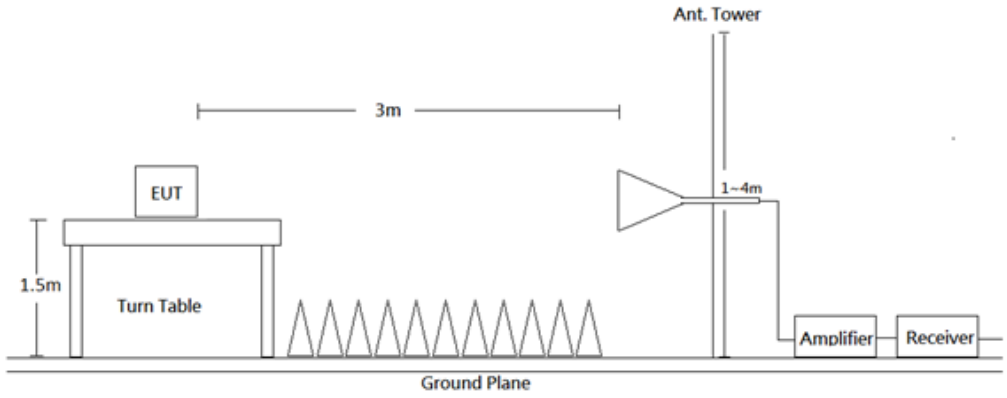
9kHz-30MHz:



30MHz-1GHz:



1-10 GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

8.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 kHz to 10 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Duty cycle	Measurement method
9 kHz - 150 kHz	300 Hz	1 kHz	/	QP/AV
150 kHz - 30 MHz	10 kHz	30 kHz	/	QP/AV
30-1000 MHz	100 kHz	300 kHz	/	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	1/T	<98%	Ave
	1 MHz	10Hz	>98%	Ave

Note: T is minimum transmission duration

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

8.4 Test Procedure

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

All data was recorded in Quasi-peak and average detector mode from 9 kHz to 30 MHz, Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

8.5 Corrected Factor & Margin Calculation

The Correct Factor 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:

Correct Factor = 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 -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Result – Limit

8.6 Test Results

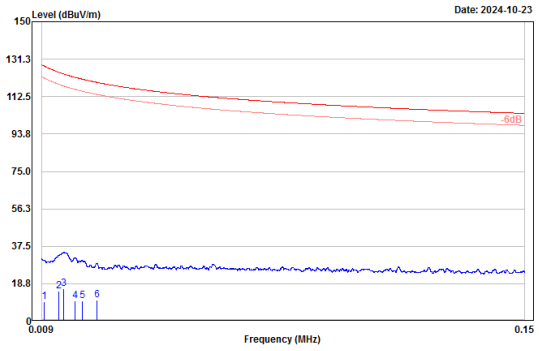
Test Mode: Transmitting

(Loop Ant pre-scan with three orthogonal axis, and worse case as perpendicular axis..)

9kHz-30MHz:

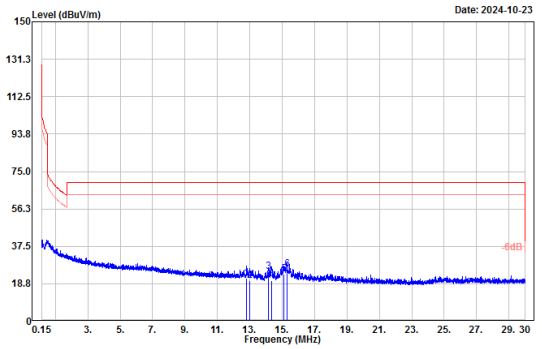
(worst case is middle channel)

9kHz-150kHz	150kHz-30MHz



Site : LK-966A
Condition: 3m
Mode : Lora TX-915MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	0.010	-3.98	13.69	9.71	127.78	-118.07	QP
2	0.014	1.45	13.59	15.04	124.71	-109.67	QP
3	0.016	2.75	13.65	16.40	123.79	-107.39	QP
4	0.019	-3.60	13.78	10.18	122.19	-112.01	QP
5	0.021	-3.65	13.77	10.12	121.25	-111.13	QP
6	0.025	-3.01	13.47	10.46	119.62	-109.16	QP



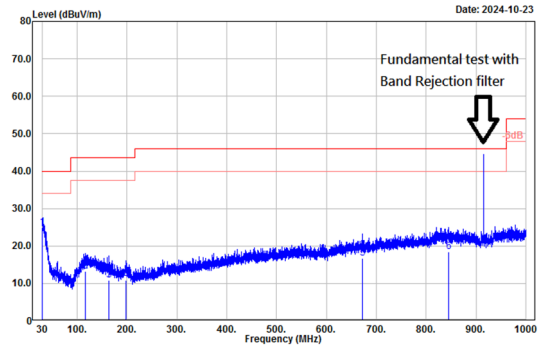
Site : LK-966A
Condition: 3m
Mode : Lora TX-915MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	12.809	9.79	11.85	21.64	69.54	-47.90	QP
2	12.988	8.56	11.77	20.33	69.54	-49.21	QP
3	14.144	13.22	11.68	24.90	69.54	-44.64	QP
4	14.335	8.53	11.68	20.21	69.54	-49.33	QP
5	15.108	11.98	11.71	23.69	69.54	-45.85	QP
6	15.317	14.42	11.75	26.17	69.54	-43.37	QP

30MHz-1GHz:

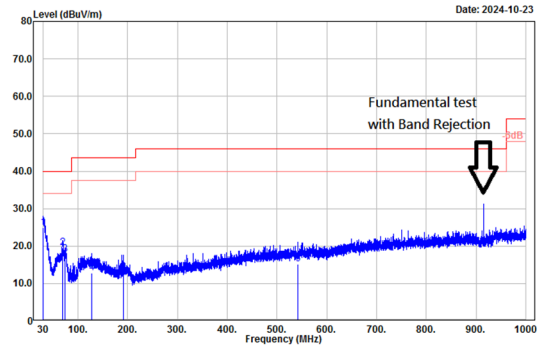
(worst case is middle channel)

Middle channel	
Horizontal	**Vertical**



Site : LK-966A
Condition: 3m horizontal
Mode : Lora TX-915MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	30.291	33.73	-8.85	24.88	40.00	-15.12	QP
2	116.427	32.13	-18.82	13.31	43.50	-30.19	QP
3	164.248	31.38	-20.49	10.89	43.50	-32.61	QP
4	197.810	31.16	-20.40	10.76	43.50	-32.74	QP
5	671.558	29.56	-12.84	16.72	46.00	-29.28	QP
6	844.606	29.33	-10.84	18.49	46.00	-27.51	QP



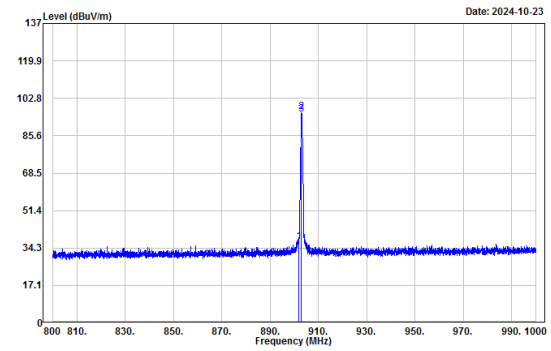
Site : LK-966A
Condition: 3m vertical
Mode : Lora TX-915MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	30.097	33.64	-8.70	24.94	40.00	-15.06	QP
2	68.606	43.03	-23.46	19.57	40.00	-20.43	QP
3	74.523	41.67	-23.87	17.80	40.00	-22.20	QP
4	127.679	31.28	-18.46	12.82	43.50	-30.68	QP
5	190.826	33.28	-21.24	12.04	43.50	-31.46	QP
6	541.384	29.99	-14.88	15.11	46.00	-30.89	QP

Band-Edge:

Low channel

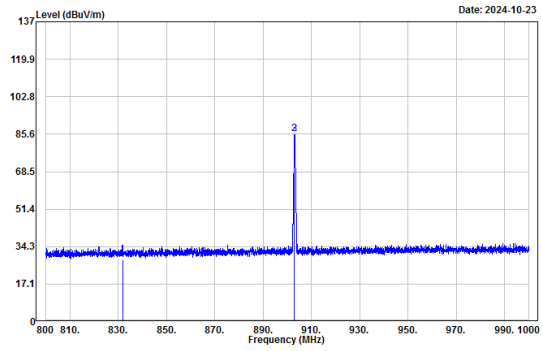
Horizontal



Site : LK-966A
Condition: 3m horizontal
Mode : Lora TX-903MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	902.000	47.22	-10.11	37.11	75.31	-38.20	QP
2	903.000	106.71	-10.10	96.61	------	------	Peak
3	903.000	105.41	-10.10	95.31	------	------	QP

Vertical

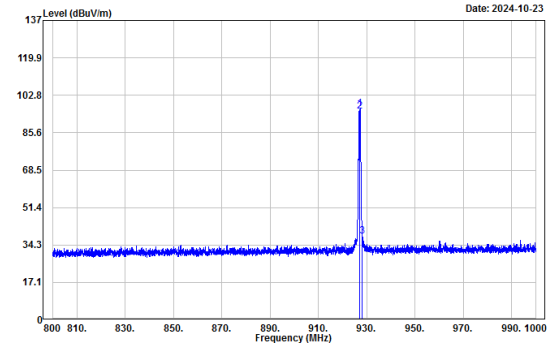


Site : LK-966A
Condition: 3m vertical
Mode : Lora TX-903MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	831.800	39.34	-10.97	28.37	65.92	-37.55	QP
2	903.000	96.05	-10.10	85.95	------	------	Peak
3	903.000	96.02	-10.10	85.92	------	------	QP

High channel

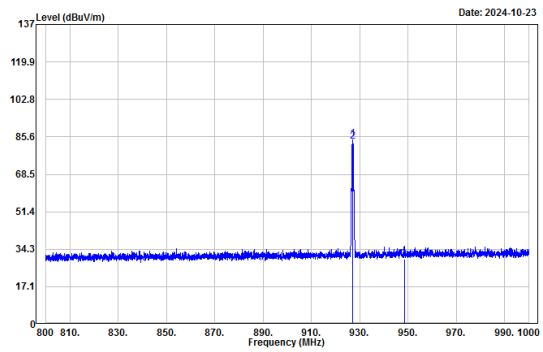
Horizontal



Site : LK-966A
Condition: 3m horizontal
Mode : Lora TX-927MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	927.000	106.33	-9.74	96.59	------	------	Peak
2	927.000	105.20	-9.74	95.46	------	------	QP
3	928.080	48.06	-9.73	38.33	75.46	-37.13	QP

Vertical



Site : LK-966A
Condition: 3m vertical
Mode : Lora TX-927MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	927.000	94.43	-9.74	84.69	------	------	Peak
2	927.000	93.27	-9.74	83.53	------	------	QP
3	948.400	39.15	-9.43	29.72	63.53	-33.81	QP

Note:

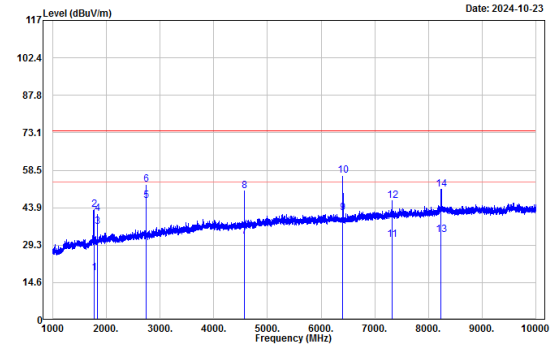
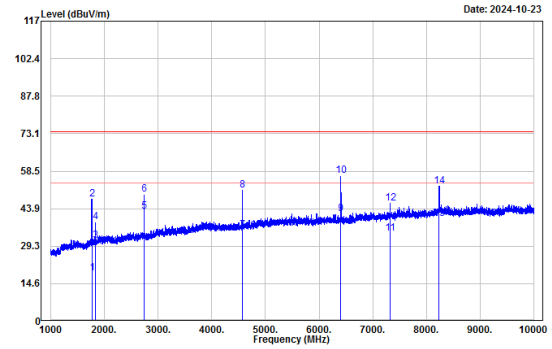
Level = Read Level + Factor

Over Limit = Level– Limit Line

Factor = Antenna Factor + Cable Loss – Amplifier Gain

1GHz-10GHz:

(worst case is middle channel)

Horizontal	Vertical
	

Site : LK-966A
Condition: 3m horizontal
Mode : Lora TX-915MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1765.900	28.93	-10.39	18.54	54.00	-35.46	Average
2	1765.900	53.54	-10.39	43.15	74.00	-30.85	Peak
3	1830.000	46.59	-10.28	36.31	54.00	-17.69	Average
4	1830.000	51.67	-10.28	41.39	74.00	-32.61	Peak
5	2745.000	54.13	-7.53	46.60	54.00	-7.40	Average
6	2745.000	60.48	-7.53	52.95	74.00	-21.05	Peak
7	4575.000	35.11	-2.47	32.64	54.00	-21.36	Average
8	4575.000	52.84	-2.47	50.37	74.00	-23.63	Peak
9	6405.000	40.73	1.06	41.79	54.00	-12.21	Average
10	6405.000	55.44	1.06	56.50	74.00	-17.50	Peak
11	7320.000	26.89	4.53	31.42	54.00	-22.58	Average
12	7320.000	42.11	4.53	46.64	74.00	-27.36	Peak
13	8235.000	27.15	6.20	33.35	54.00	-20.65	Average
14	8235.000	44.91	6.20	51.11	74.00	-22.89	Peak

Site : LK-966A
Condition: 3m vertical
Mode : Lora TX-915MHz
Note : Temp/RH:21.4°C/53%
Tester: Bruce

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1769.500	29.21	-10.43	18.78	54.00	-35.22	Average
2	1769.500	58.03	-10.43	47.60	74.00	-26.40	Peak
3	1830.000	41.66	-10.28	31.38	54.00	-22.62	Average
4	1830.000	49.02	-10.28	38.74	74.00	-35.26	Peak
5	2745.000	50.33	-7.53	42.80	54.00	-11.20	Average
6	2745.000	57.03	-7.53	49.50	74.00	-24.50	Peak
7	4575.000	37.86	-2.47	35.39	54.00	-18.61	Average
8	4575.000	53.47	-2.47	51.00	74.00	-23.00	Peak
9	6405.000	40.92	1.06	41.98	54.00	-12.02	Average
10	6405.000	55.55	1.06	56.61	74.00	-17.39	Peak
11	7320.000	29.57	4.53	34.10	54.00	-19.90	Average
12	7320.000	41.59	4.53	46.12	74.00	-27.88	Peak
13	8235.000	33.84	6.20	40.04	54.00	-13.96	Average
14	8235.000	46.46	6.20	52.66	74.00	-21.34	Peak

Note:

Level = Read Level + Factor

Over Limit = Level– Limit Line

Factor = Antenna Factor + Cable Loss – Amplifier Gain

For 18-26.5GHz Convert the test distance limit of 3 meters to a limit of 1 meter:

Conversion factor = 20 log (1m/3m) = 9.5 dB,

Average Limit = 54+9.5 = 63.50 dBuV/m , Peak Limit = 63.50+20 = 83.50 dBuV/m @ 1m

Above 1GHz

Low channel

Horizontal

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1806.000	49.70	-10.67	39.03	54.00	-14.97	Average
2	1806.000	54.11	-10.67	43.44	74.00	-30.56	Peak
3	2709.000	52.41	-7.42	44.99	54.00	-9.01	Average
4	2709.000	59.00	-7.42	51.58	74.00	-22.42	Peak
5	6321.000	40.07	1.26	41.33	54.00	-12.67	Average
6	6321.000	54.63	1.26	55.89	74.00	-18.11	Peak

Vertical

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1806.000	44.53	-10.67	33.86	54.00	-20.14	Average
2	1806.000	50.28	-10.67	39.61	74.00	-34.39	Peak
3	2709.000	49.74	-7.42	42.32	54.00	-11.68	Average
4	2709.000	56.91	-7.42	49.49	74.00	-24.51	Peak
5	8127.000	36.31	5.77	42.08	54.00	-11.92	Average
6	8127.000	50.74	5.77	56.51	74.00	-17.49	Peak

Middle channel

Horizontal

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1830.000	46.59	-10.28	36.31	54.00	-17.69	Average
2	1830.000	51.67	-10.28	41.39	74.00	-32.61	Peak
3	2745.000	54.13	-7.53	46.60	54.00	-7.40	Average
4	2745.000	60.48	-7.53	52.95	74.00	-21.05	Peak
5	6405.000	40.73	1.06	41.79	54.00	-12.21	Average
6	6405.000	55.44	1.06	56.50	74.00	-17.50	Peak

Vertical

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1830.000	41.66	-10.28	31.38	54.00	-22.62	Average
2	1830.000	49.02	-10.28	38.74	74.00	-35.26	Peak
3	2745.000	50.33	-7.53	42.80	54.00	-11.20	Average
4	2745.000	57.03	-7.53	49.50	74.00	-24.50	Peak
5	6405.000	40.92	1.06	41.98	54.00	-12.02	Average
6	6405.000	55.55	1.06	56.61	74.00	-17.39	Peak

High channel

Horizontal

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1854.000	41.84	-9.92	31.92	54.00	-22.08	Average
2	1854.000	48.18	-9.92	38.26	74.00	-35.74	Peak
3	2781.000	52.60	-7.47	45.13	54.00	-8.87	Average
4	2781.000	59.02	-7.47	51.55	74.00	-22.45	Peak
5	6489.000	39.02	1.12	40.14	54.00	-13.86	Average
6	6489.000	53.34	1.12	54.46	74.00	-19.54	Peak

Vertical

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	
1	1854.000	35.06	-9.92	25.14	54.00	-28.86	Average
2	1854.000	44.40	-9.92	34.48	74.00	-39.52	Peak
3	2781.000	48.91	-7.47	41.44	54.00	-12.56	Average
4	2781.000	56.01	-7.47	48.54	74.00	-25.46	Peak
5	6489.000	42.20	1.12	43.32	54.00	-10.68	Average
6	6489.000	57.71	1.12	58.83	74.00	-15.17	Peak

Note:

Level = Read Level + Factor

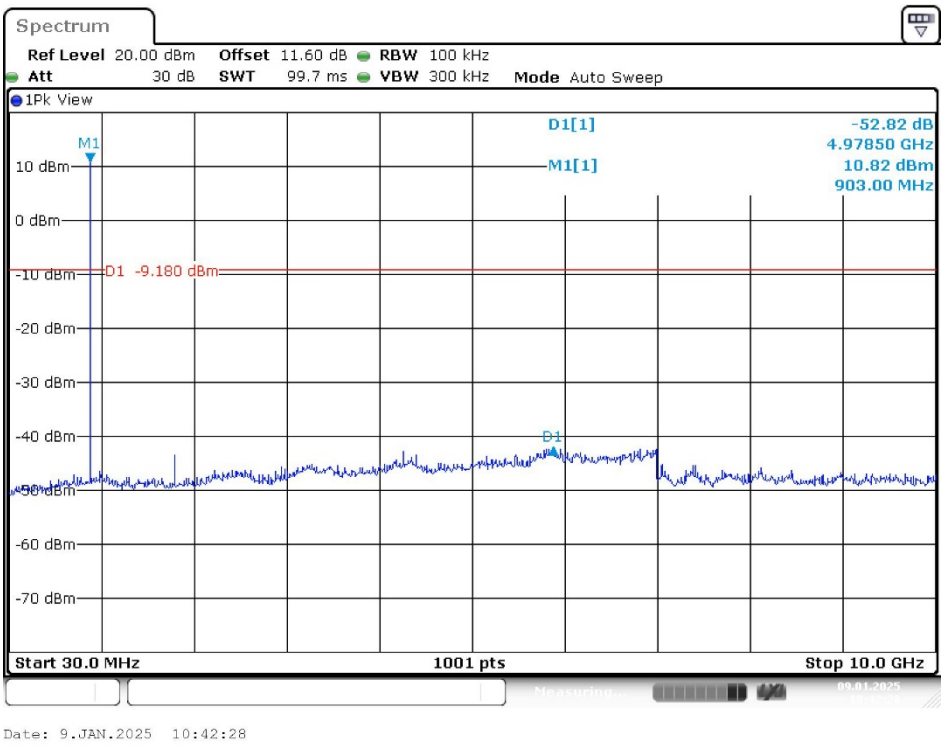
Over Limit = Level– Limit Line

Factor = Antenna Factor + Cable Loss – Amplifier Gain

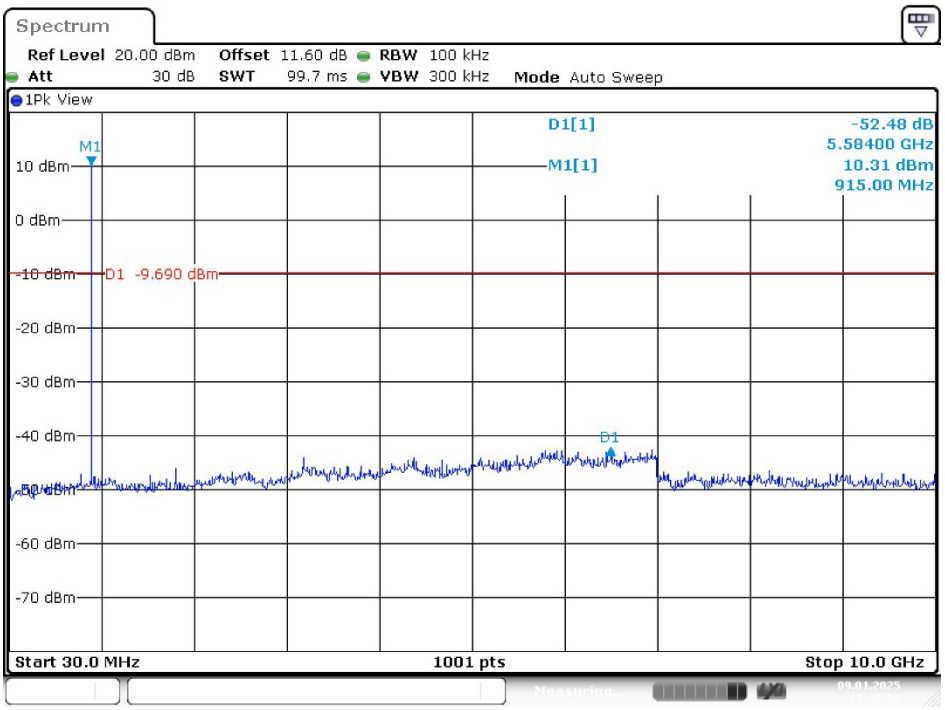
Conducted Spurious Emissions:

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
Low	903	52.82	≥ 20	PASS
Mid	915	52.48	≥ 20	PASS
High	927	52.45	≥ 20	PASS

Low Channel

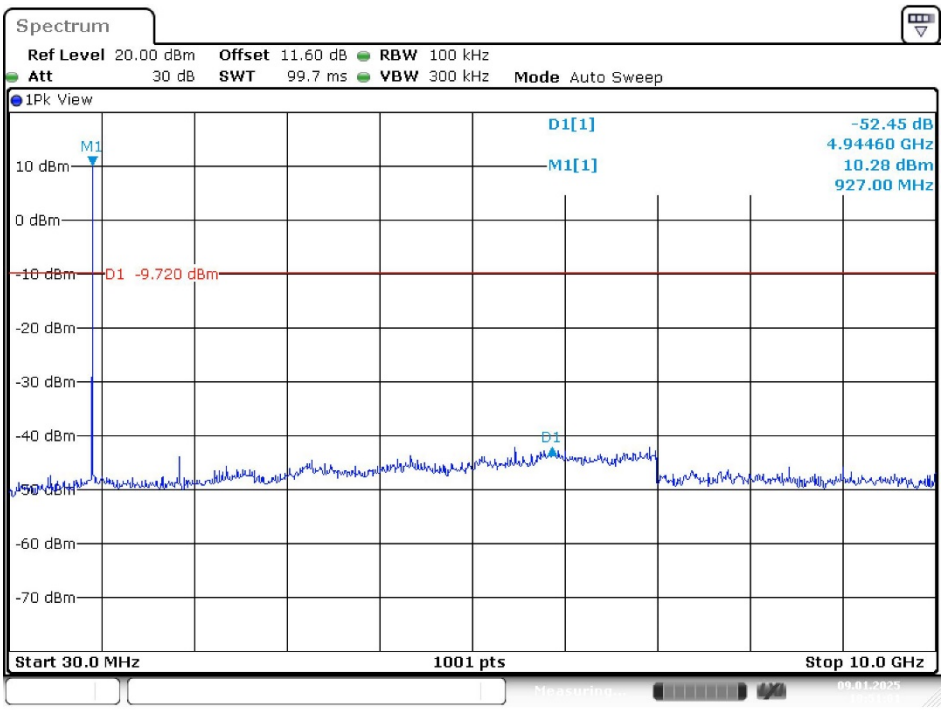


Middle Channel



Date: 9.JAN.2025 10:46:08

High Channel



Date: 9.JAN.2025 10:51:01

9 FCC §15.247(a)(2) – 6 dB Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2).

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 Test Procedure

The steps for the first option are as follows:

a) Set RBW = 100 kHz.

b) Set the VBW ≥ [3 × RBW].

c) Detector = peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

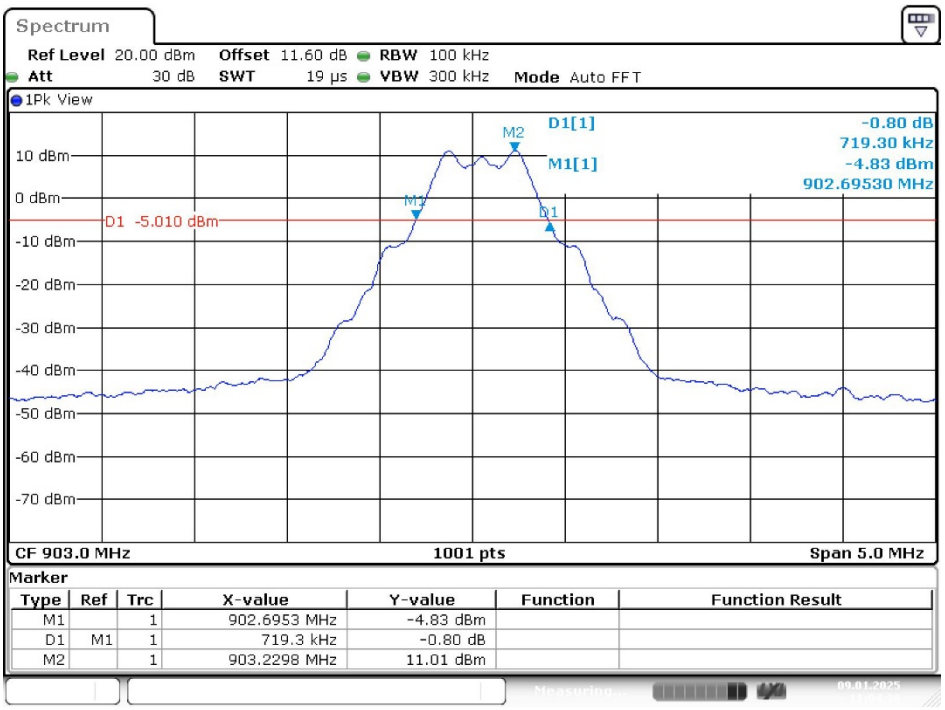
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

9.3 Test Results

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)	Result
Low	903	0.72	> 500	Compliance
Middle	915	0.71	> 500	Compliance
High	927	0.70	> 500	Compliance

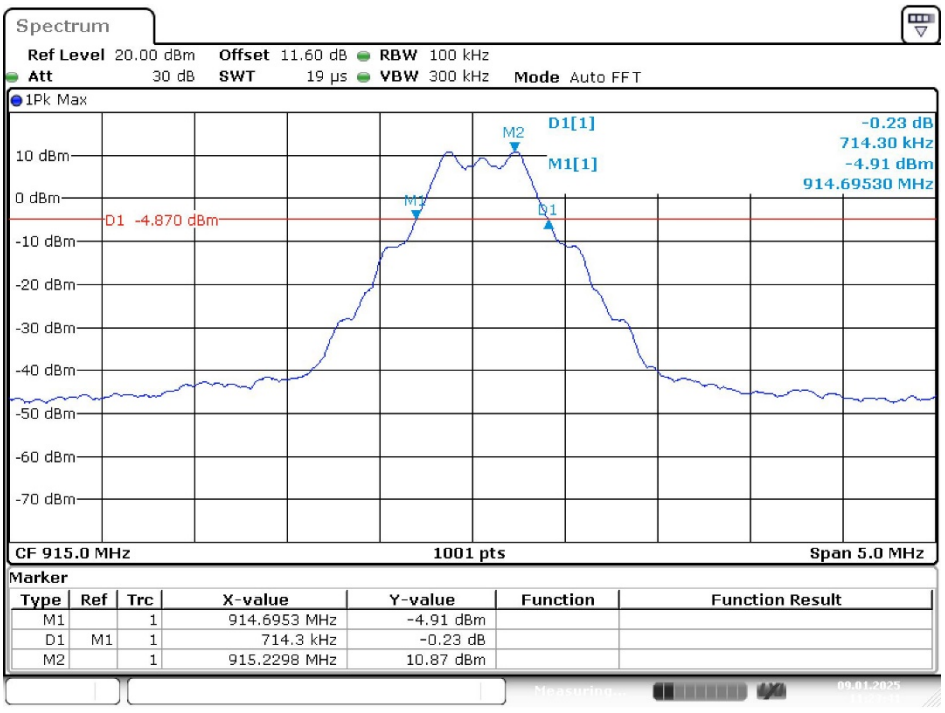
Please refer to the following plots

Low Channel



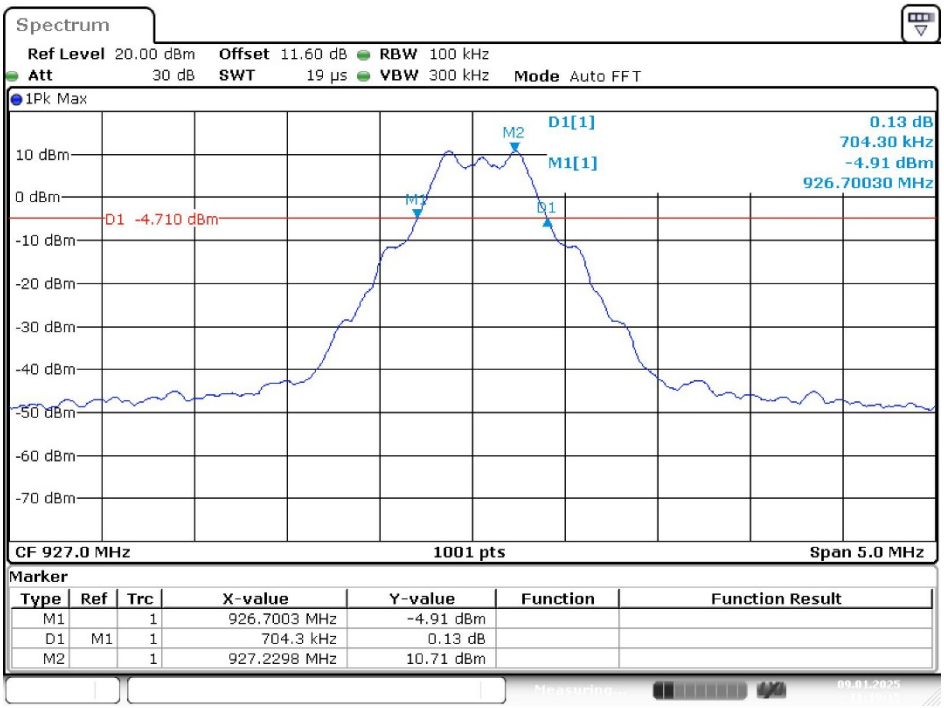
Date: 9.JAN.2025 11:04:30

Middle Channel



Date: 9.JAN.2025 11:23:41

High Channel



Date: 9.JAN.2025 11:19:15

10 FCC §15.247(b)(3) – Maximum Output Power

10.1 Applicable Standard

According to FCC §15.247(b) (3).

Systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

10.2 Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.

10.3 Test Results

Conducted Peak Output Power

Channel	Frequency (MHz)	Power (dBm)	Power (W)	Limit (W)	Result
Lora Mode					
Low	903	11.24	0.01330	1	PASS
Middle	915	11.11	0.01291	1	PASS
High	927	10.94	0.01242	1	PASS

11 FCC§15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

11.1 Applicable Standard

According to FCC §15.247(d).

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)).

11.2 Test Procedure

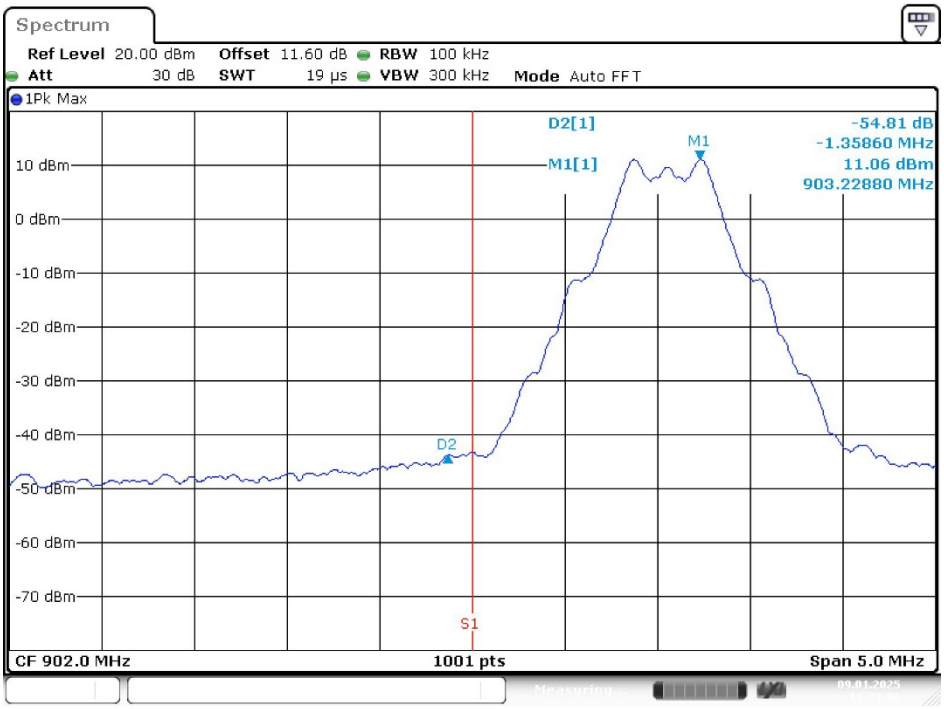
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then 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 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.

11.3 Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
Low	903	54.81	≥ 20	PASS
High	927	43.20	≥ 20	PASS

Please refer to the following plots

Band Edge, Left Side



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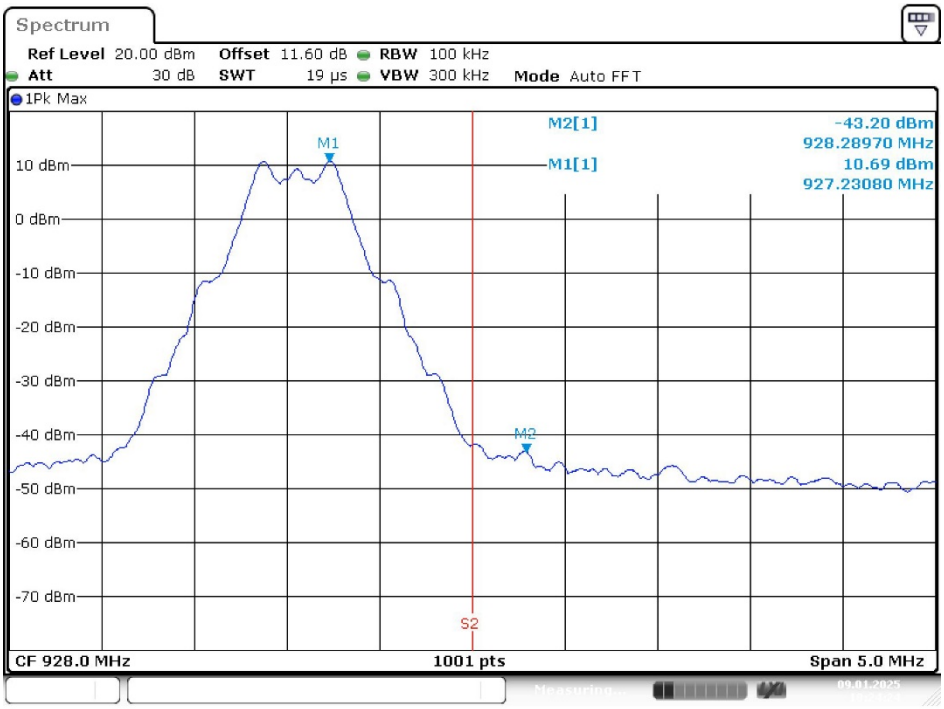
Band Edge, Right Side



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12 FCC §15.247(e) – Power Spectral Density

12.1 Applicable Standard

According to FCC §15.247(e).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

12.2 Test Procedure

According to ANSI C63.10-2013

a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 times the DTS bandwidth.

c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × RBW].

e) Detector = peak.

f) Sweep time = auto couple.

g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

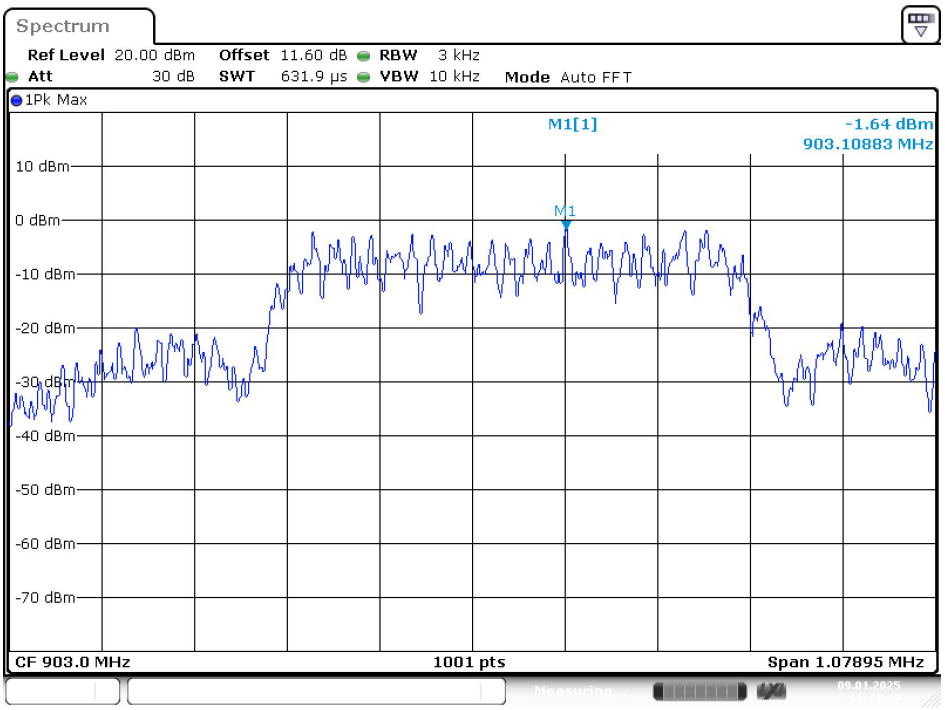
j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat

12.3 Test Results

Channel	Frequency (MHz)	Power Spectral Density (dBm/3 kHz)	Limit (dBm/3 kHz)	Result
Low	903	-1.64	8	Compliance
Middle	915	-1.70	8	Compliance
High	927	-1.87	8	Compliance

Please refer to the following plots

Low Channel



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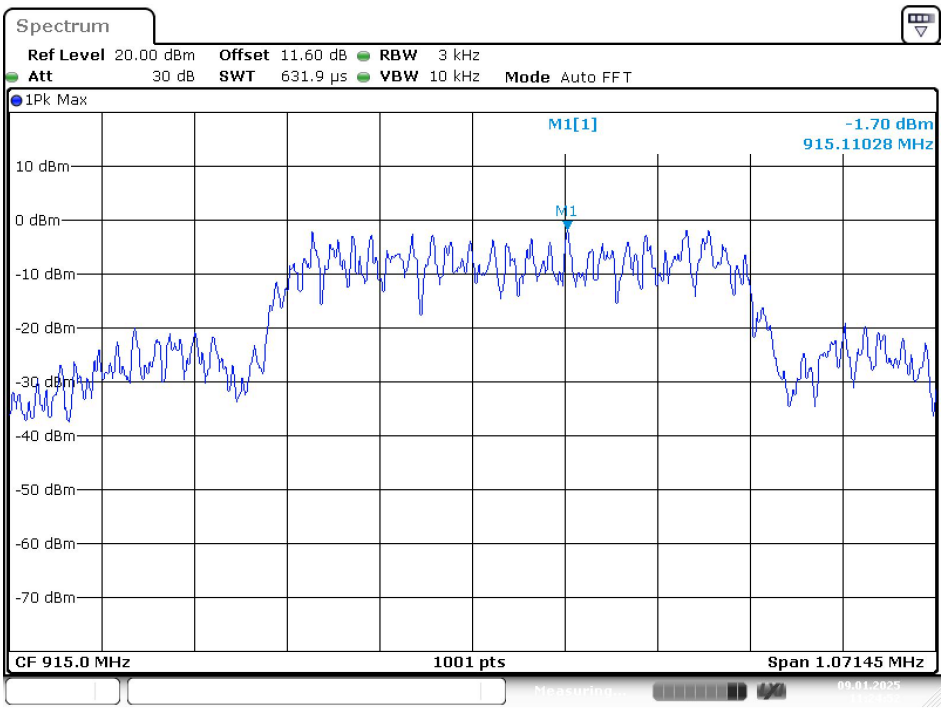
Middle Channel



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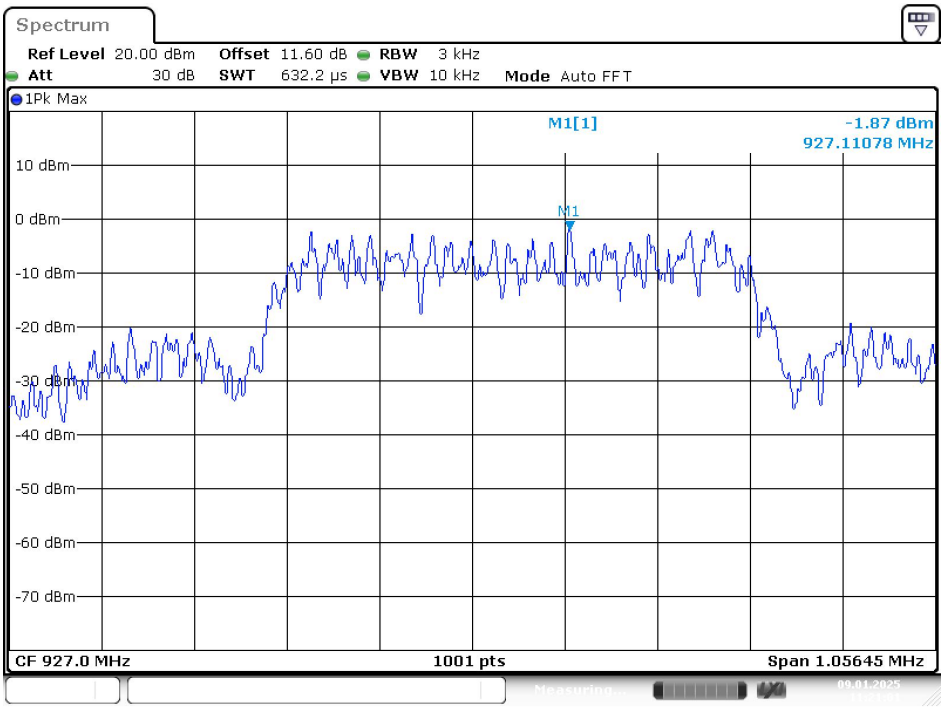
High Channel



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