



FCC RF Test Report

APPLICANT : Ring LLC
EQUIPMENT : Smart Controller
BRAND NAME : ring
MODEL NAME : 7PFYAB
FCC ID : 2AEUP-7PFYAB
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DSS) Spread Spectrum Transmitter
TEST DATE(S) : Nov. 04, 2025 ~ Dec. 03, 2025

We, Sporton International Inc. (ShenZhen), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (ShenZhen), the test report shall not be reproduced except in full.

Fly Liang

Approved by: Fly Liang



Sporton International Inc. (ShenZhen)

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People's Republic of China



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR5N0311C	Rev. 01	Initial issue of report	Nov. 28, 2025
FR5N0311C	Rev. 02	1. Added note for F1 on Page 24,25 2. Added Middle channel test data for RSE below 1GHz test and removed test data for Radiated Band Edges This report is an updated version, replacing the report issued on Nov. 28, 2025.	Dec. 11, 2025

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(1)(i)	Number of Channels	15.247(a)(1)(i)	Pass	-
3.2	15.247(a)(1)	Hopping Channel Separation	20dB Bandwidth	Pass	-
0	15.247(a)(1)(i)	Dwell Time of Each Channel	$\leq 0.4\text{sec}$	Pass	-
3.4	15.247(a)(1)(i)	20dB Bandwidth	$\leq 500\text{kHz}$	Pass	-
3.4	-	99% Bandwidth	-	Report Only	-
3.5	15.247(b)(2)	Peak Output Power	$\leq 1\text{W}$	Pass	-
3.6	15.247(d)	Conducted Band Edges	$\leq 20\text{dBc}$	Pass	-
3.7	15.247(d)	Conducted Spurious Emission	$\leq 20\text{dBc}$	Pass	-
3.8	15.247(d)	Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 8.28 dB at 2706.600 MHz
3.9	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 14.83 dB at 0.174750 MHz
3.10	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-

Conformity Assessment Condition:

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacture who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
- The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty"

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



1 General Description

1.1 Applicant

Ring LLC

12515 Cerise Ave, Hawthorne, CA 90250, USA

1.2 Product Feature of Equipment Under Test

Product Feature	
Equipment	Smart Controller
Brand Name	ring
Model Name	7PFYAB
FCC ID	2AEUP-7PFYAB
SN Code	N/A
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.3 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	902 MHz ~ 928 MHz
Number of Channels	128
Bandwidth / Spreading Factor	125kHz / 7, 8, 9
Maximum Output Power to Antenna	SF7 : 20.98 dBm (0.1253 W) SF8 : 20.79 dBm (0.1199 W) SF9 : 20.77 dBm (0.1194 W)
99% Occupied Bandwidth	SF7 : 0.128MHz
Antenna Type / Gain	Metal Monopole Antenna with gain 3.32 dBi
Type of Modulation	LoRa-FHSS

Note: For SF7/8/9 mode, the whole testing has assessed SF7 mode by referring to the higher conducted power.

1.4 Modification of EUT

No modifications are made to the EUT during all test items.

1.5 Testing Location

Sporton International Inc. (Shenzhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Test Firm	Sporton International Inc. (Shenzhen)		
Test Site Location	101, 1st Floor, Block B, Building 1, No. 2, Tengfeng 4th Road, Fenghuang Community, Fuyong Street, Baoan District, Shenzhen City, Guangdong Province 518103 People's Republic of China TEL: +86-755-86066985		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	TH01-SZ 03CH03-SZ CO02-SZ	CN1256	421272

1.6 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH03-SZ	AUDIX	E3	6.2009-8-24
2.	CO02-SZ	R&S	EMC32	10.60.20

1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2020

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902-928 MHz	1	902.2	44	910.8	87	919.4
	2	902.4	45	911	88	919.6
	3	902.6	46	911.2	89	919.8
	4	902.8	47	911.4	90	920
	5	903	48	911.6	91	920.2
	6	903.2	49	911.8	92	920.4
	7	903.4	50	912	93	920.6
	8	903.6	51	912.2	94	920.8
	9	903.8	52	912.4	95	921
	10	904	53	912.6	96	921.2
	11	904.2	54	912.8	97	921.4
	12	904.4	55	913	98	921.6
	13	904.6	56	913.2	99	921.8
	14	904.8	57	913.4	100	922
	15	905	58	913.6	101	922.2
	16	905.2	59	913.8	102	922.4
	17	905.4	60	914	103	922.6
	18	905.6	61	914.2	104	922.8
	19	905.8	62	914.4	105	923
	20	906	63	914.6	106	923.2
	21	906.2	64	914.8	107	923.4
	22	906.4	65	915	108	923.6
	23	906.6	66	915.2	109	923.8
	24	906.8	67	915.4	110	924
	25	907	68	915.6	111	924.2
	26	907.2	69	915.8	112	924.4
	27	907.4	70	916	113	924.6
	28	907.6	71	916.2	114	924.8
	29	907.8	72	916.4	115	925
	30	908	73	916.6	116	925.2
	31	908.2	74	916.8	117	925.4
	32	908.4	75	917	118	925.6
	33	908.6	76	917.2	119	925.8
	34	908.8	77	917.4	120	926
	35	909	78	917.6	121	926.2
	36	909.2	79	917.8	122	926.4
	37	909.4	80	918	123	926.6
	38	909.6	81	918.2	124	926.8
	39	909.8	82	918.4	125	927
	40	910	83	918.6	126	927.2
	41	910.2	84	918.8	127	927.4
	42	910.4	85	919	128	927.6
	43	910.6	86	919.2		

Note: The above EUT's information was declared by manufacturer.

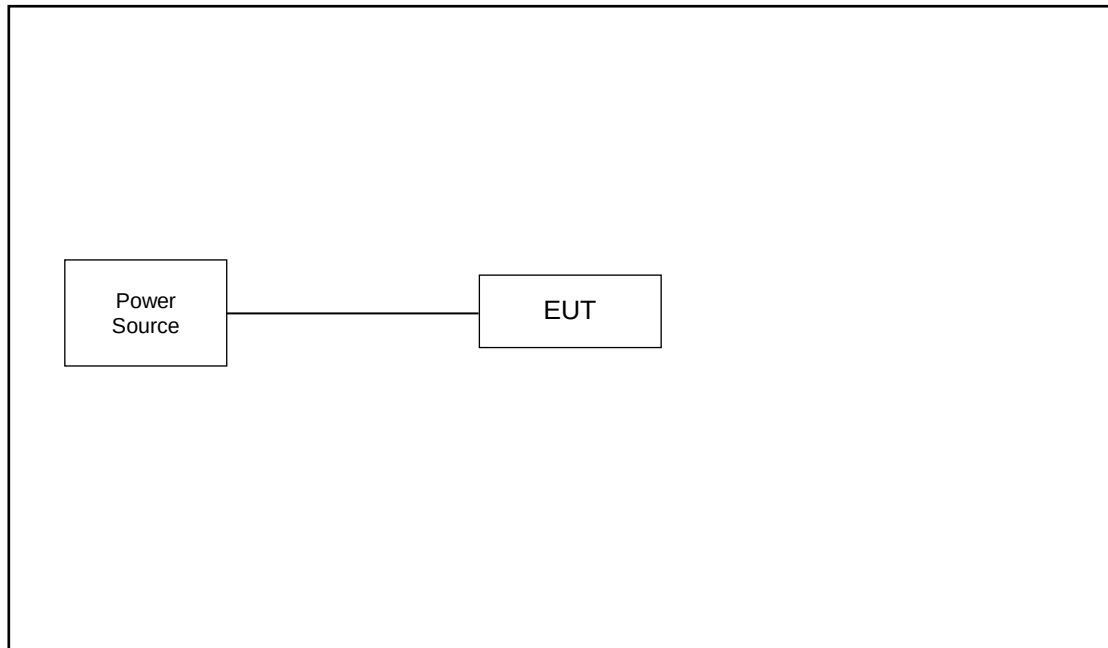
2.2 Test Mode

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

Summary table of Test Cases	
Test Item	Modulation / Spreading Factor
	LoRa FHSS / SF7
Conducted Test Cases	Mode 1: CH1_902.2 MHz Mode 2: CH65_915 MHz Mode 3: CH128_927.6 MHz
Radiated Test Cases	Mode 1: CH1_902.2 MHz Mode 2: CH65_915 MHz Mode 3: CH128_927.6 MHz
AC Conducted Emission	Mode 1: Lora Tx + AC Power Cable

2.3 Connection Diagram of Test System



2.4 EUT Operation Test Setup

For LoRa FHSS function, the engineering test program was provided and enabled to make EUT continuous transmit.

2.5 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 0.3 dB and 20dB attenuator.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 0.3 + 20 = 20.3 \text{ (dB)}\end{aligned}$$

3 Test Result

3.1 Number of Channel Measurement

3.1.1 Limits of Number of Hopping Frequency

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

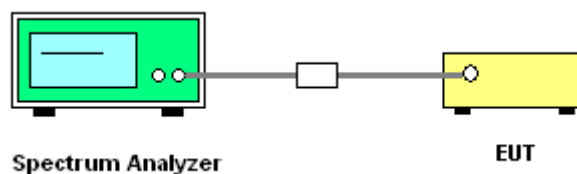
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedure

1. The testing follows ANSI C63.10-2020 clause 7.8.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation;
RBW = 50kHz; VBW = 200KHz; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

3.1.4 Test Setup



3.1.5 Test Result of Number of Hopping Frequency

Please refer to Appendix A.

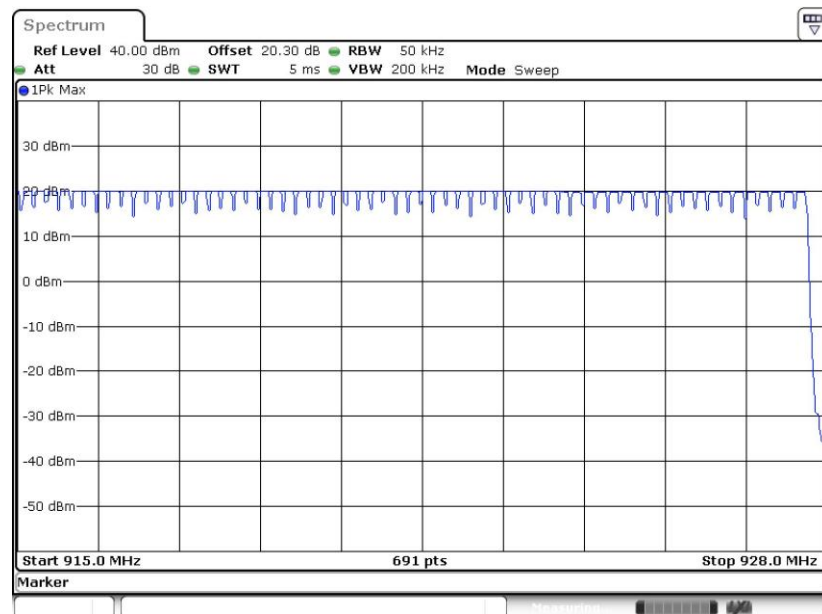


SF7:

Number of Hopping Channel Plot on Channel 1 - 128



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3.2 Hopping Channel Separation Measurement

3.2.1 Limit of Hopping Channel Separation

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.

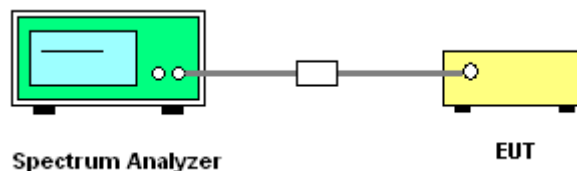
3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

1. The testing follows ANSI C63.10-2020 clause 7.8.2.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels;
RBW = 50kHz; VBW = 200KHz; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.2.4 Test Setup

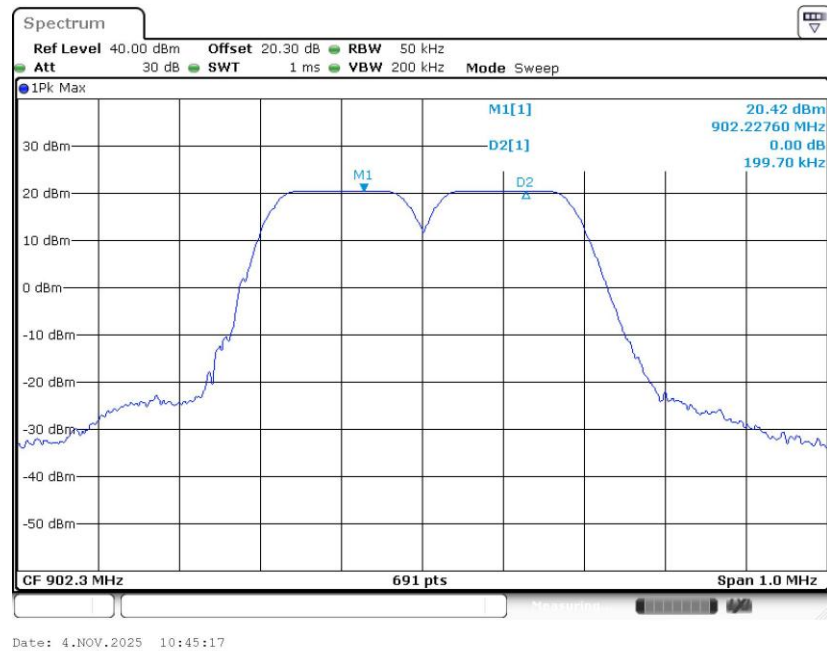


3.2.5 Test Result of Hopping Channel Separation

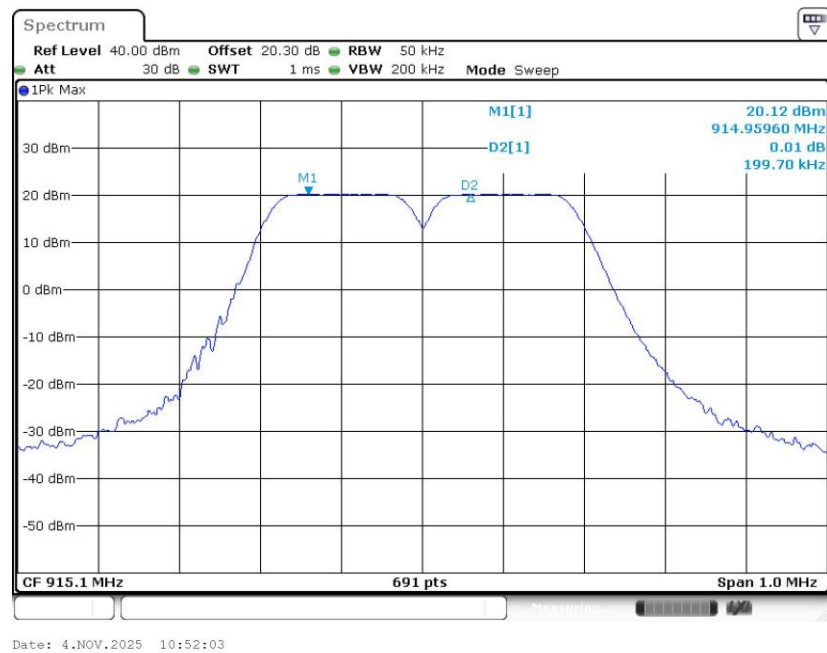
Please refer to Appendix A.

SF7:

Channel Separation Plot on Channel 1 - 2

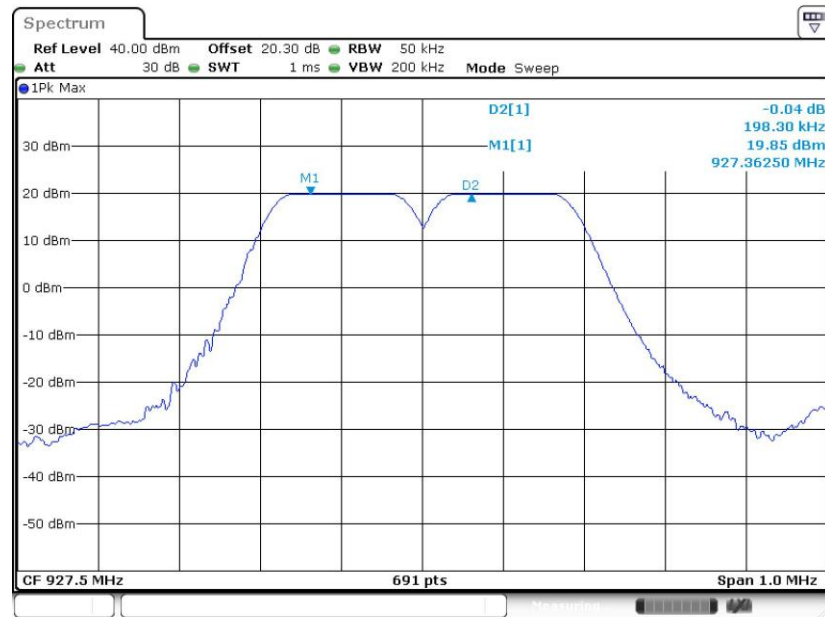


Channel Separation Plot on Channel 64 - 65





Channel Separation Plot on Channel 128



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3.3 Dwell Time Measurement

3.3.1 Limit of Dwell Time

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.

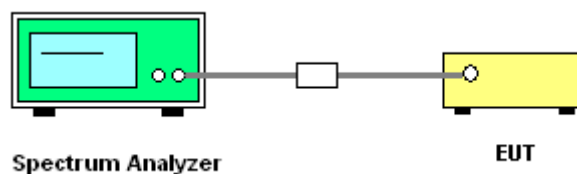
3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.3.3 Test Procedures

1. The testing follows ANSI C63.10-2020 clause 7.8.4.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 100 KHz; VBW = 300KHz; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.3.4 Test Setup



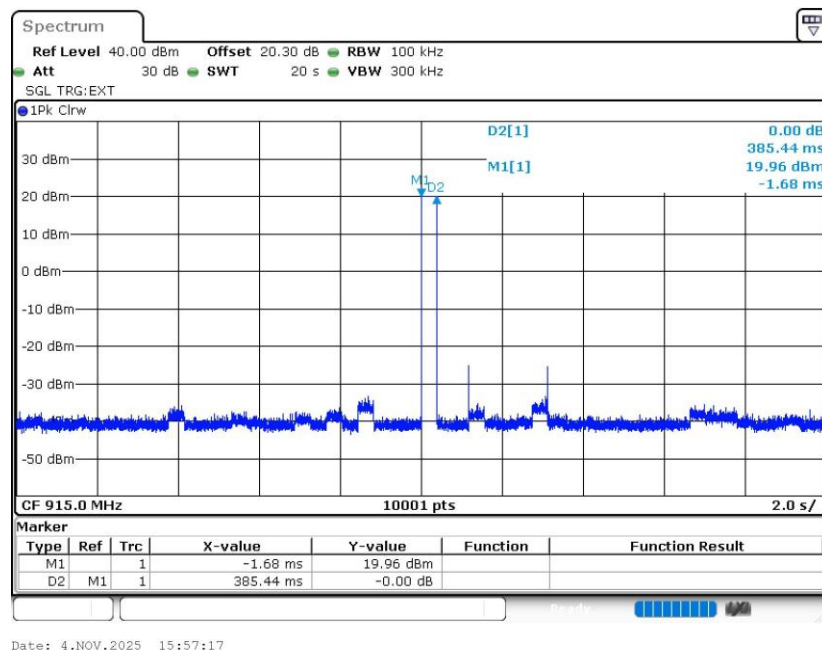


3.3.5 Test Result of Dwell Time

Please refer to Appendix A.

SF7:

DT on-time and Hops over 20 sec period



Remark:

Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time
= 1 (hop) x 385.44 (ms)
= 0.385 (sec)

3.4 20dB and 99% Bandwidth Measurement

3.4.1 Limit of 20dB and 99% Bandwidth

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

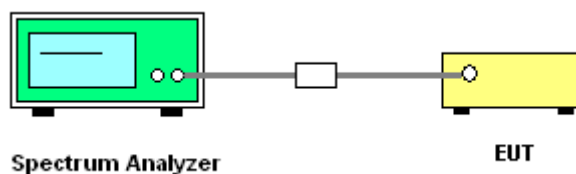
3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.4.3 Test Procedures

1. The testing follows ANSI C63.10-2020 clause 6.9.2 and 6.9.3.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.
Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel;
The RBW is set to 1% to 5% of the 99% OBW, the VBW is set to 3 times the RBW;
Sweep = auto; Detector function = peak; Trace = max hold.
5. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.
The RBW is set to 1% to 5% of the 99% OBW, the VBW is set to 3 times the RBW;
Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

3.4.4 Test Setup



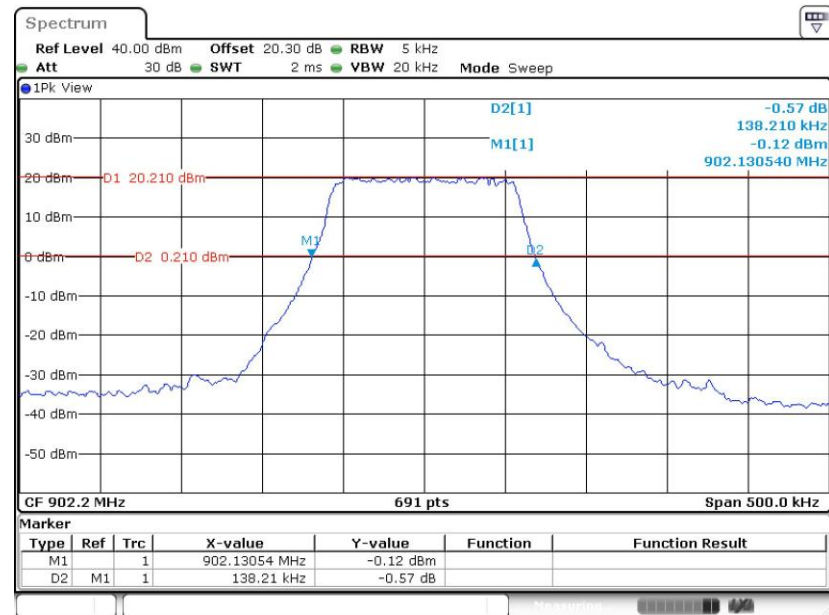
3.4.5 Test Result of 20dB Bandwidth

Please refer to Appendix A.

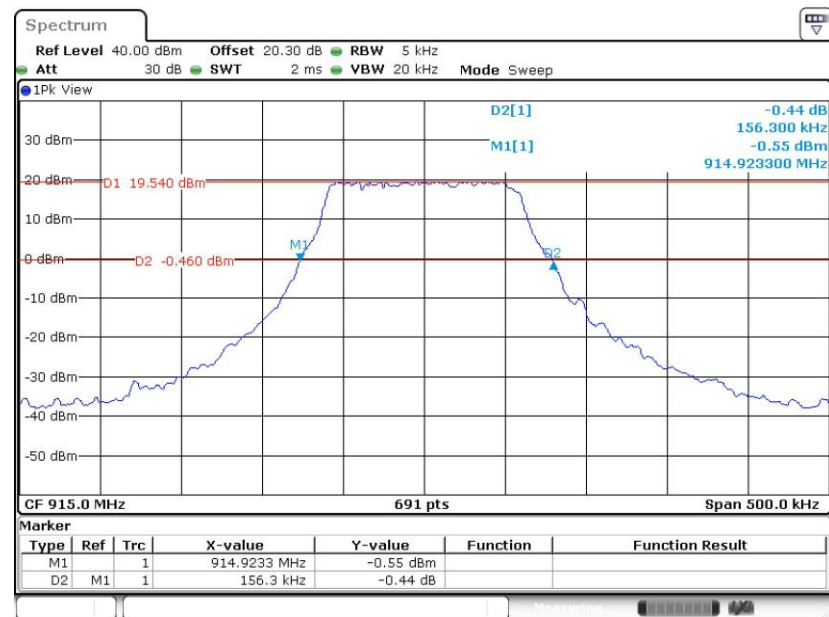


SF7:

20 dB Bandwidth Plot on Channel 1

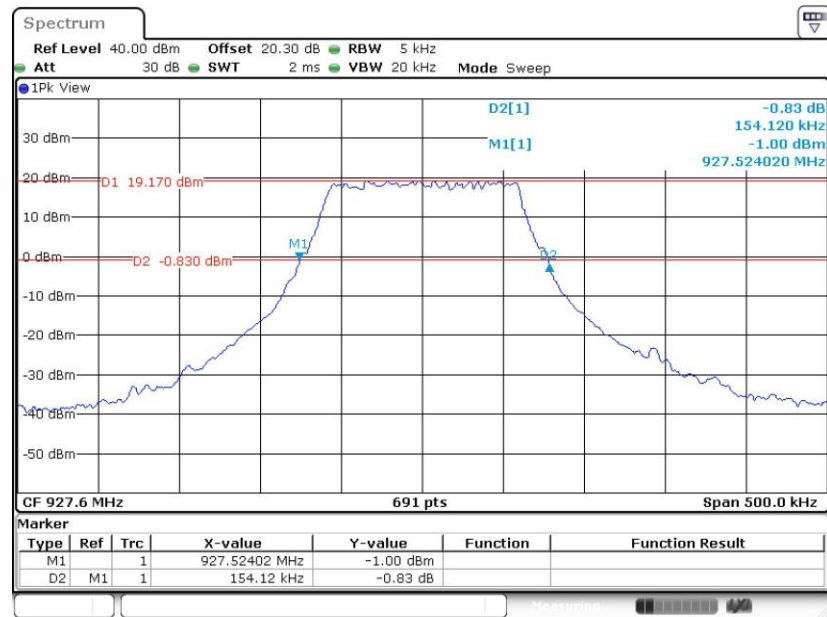


20 dB Bandwidth Plot on Channel 65





20 dB Bandwidth Plot on Channel 128



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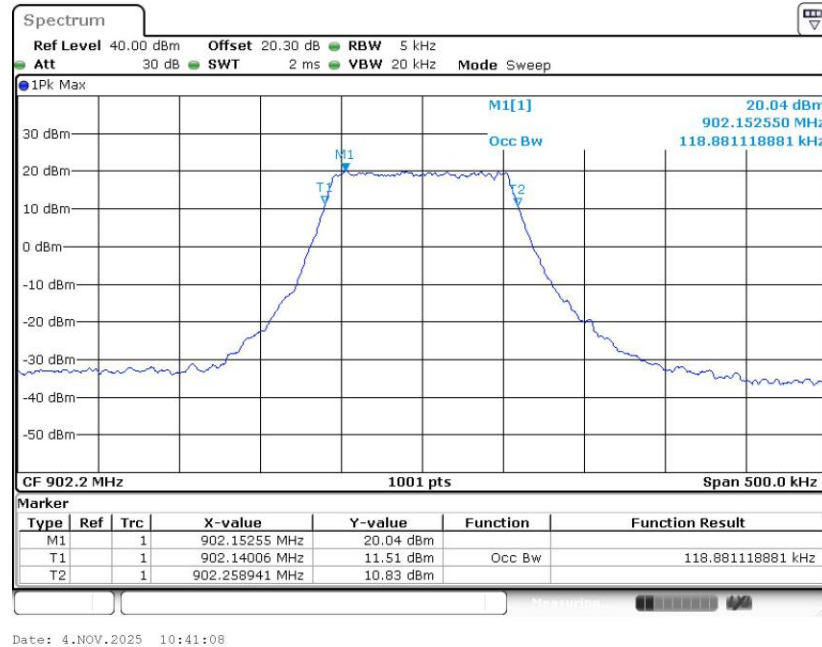


3.4.6 Test Result of 99% Occupied Bandwidth

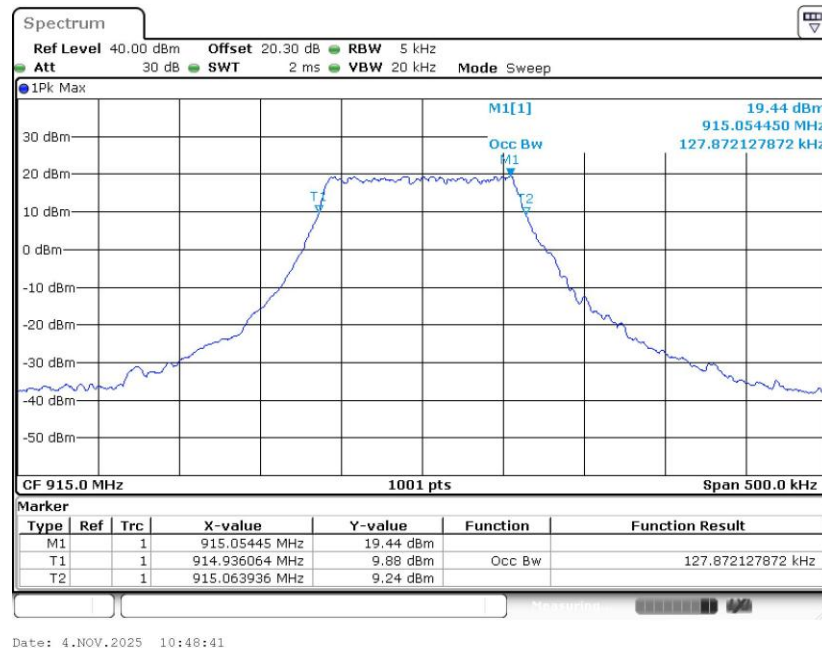
Please refer to Appendix A.

SF7:

99% Occupied Bandwidth Plot on Channel 1

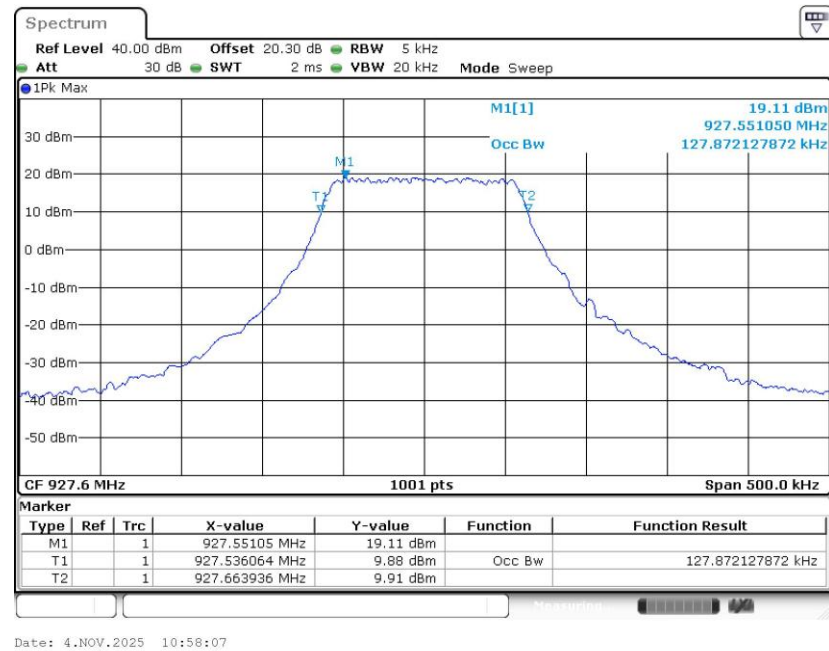


99% Occupied Bandwidth Plot on Channel 65





99% Occupied Bandwidth Plot on Channel 128



Note : The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.5 Output Power Measurement

3.5.1 Limit of Output Power

The maximum peak conducted output power of the intentional radiator shall not exceed the following:
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.

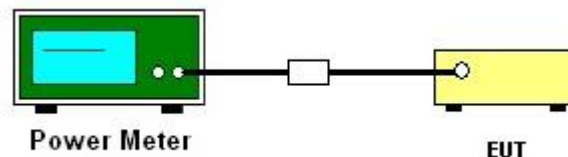
3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.5.3 Test Procedures

1. The testing follows ANSI C63.10-2020 clause 7.8.5.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

3.5.4 Test Setup



3.5.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.6 Conducted Band Edges Measurement

3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

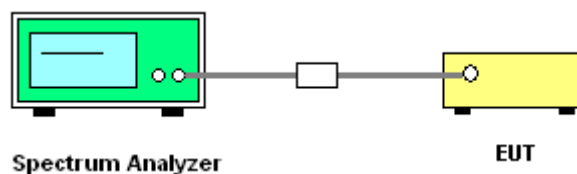
3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.6.3 Test Procedures

1. The testing follows ANSI C63.10-2020 clause 7.8.6.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz, VBW = 300kHz. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

3.6.4 Test Setup

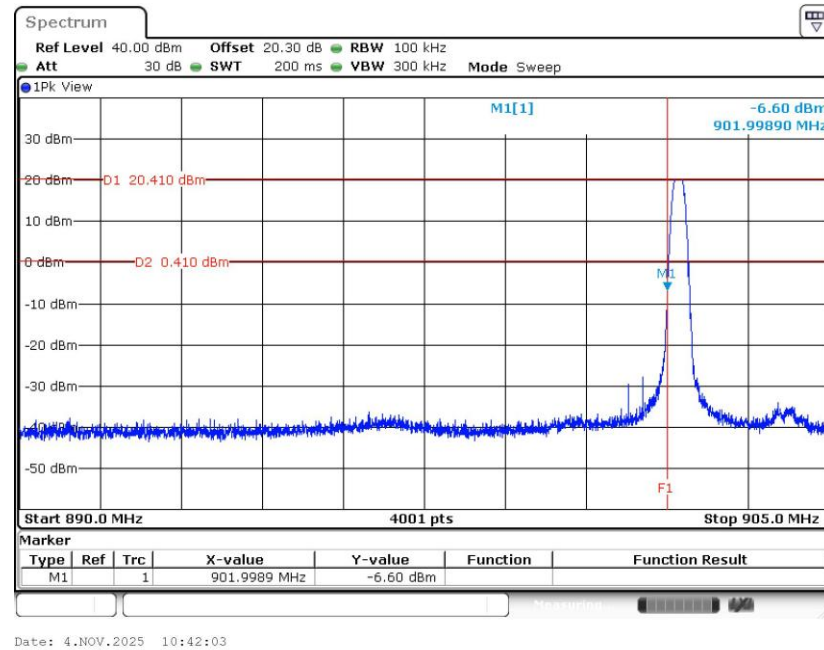




3.6.5 Test Result of Conducted Band Edges

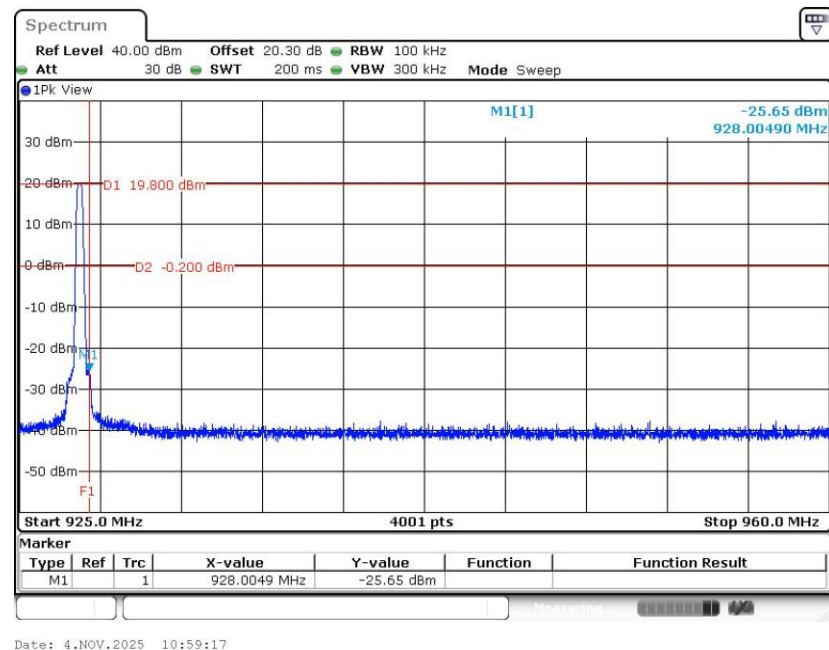
SF7:

Low Band Edge Plot on Channel 1



Note: F1= 902MHz

High Band Edge Plot on Channel 128



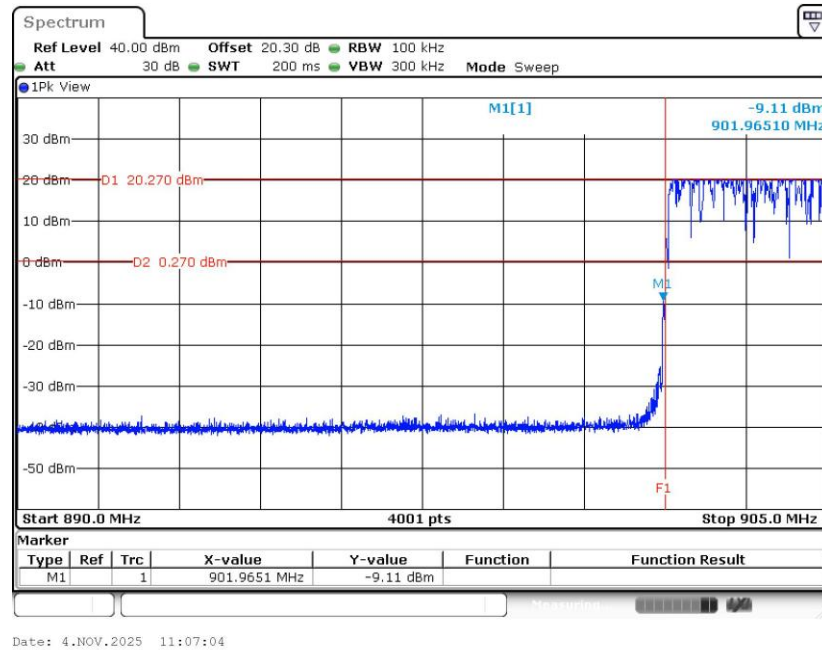
Note: F1= 928MHz



3.6.6 Test Result of Conducted Hopping Mode Band Edges

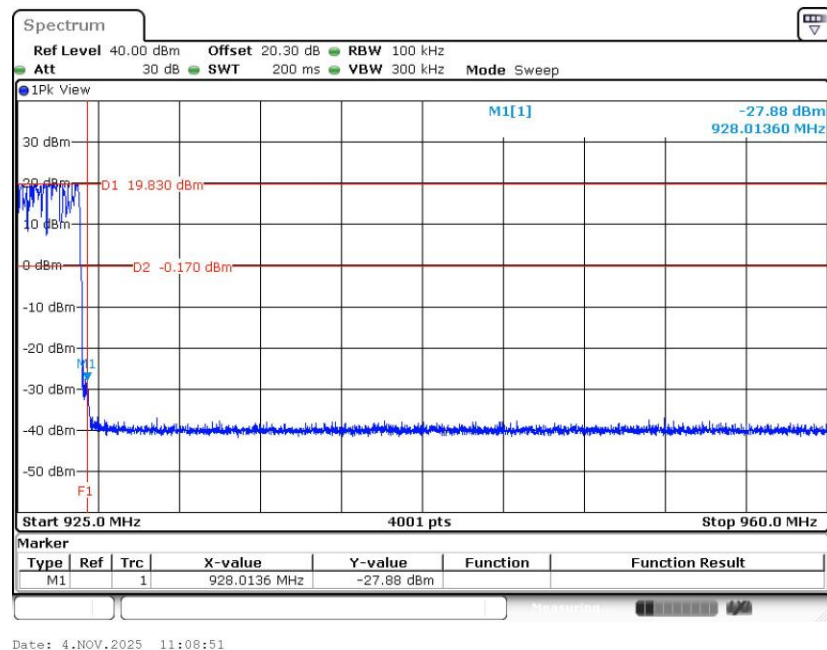
SF7:

Hopping Mode Low Band Edge Plot



Note: F1= 902MHz

Hopping Mode High Band Edge Plot



Note: F1= 928MHz

3.7 Conducted Spurious Emission Measurement

3.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

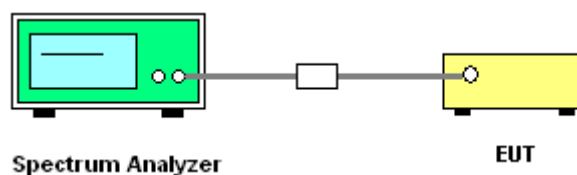
3.7.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.7.3 Test Procedure

1. The testing follows ANSI C63.10-2020 clause 7.8.7.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.7.4 Test Setup

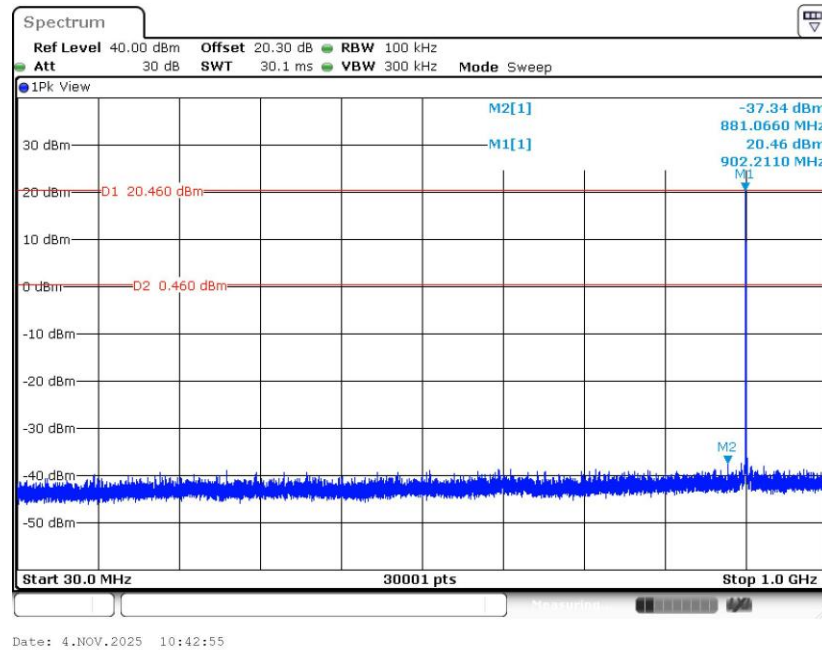




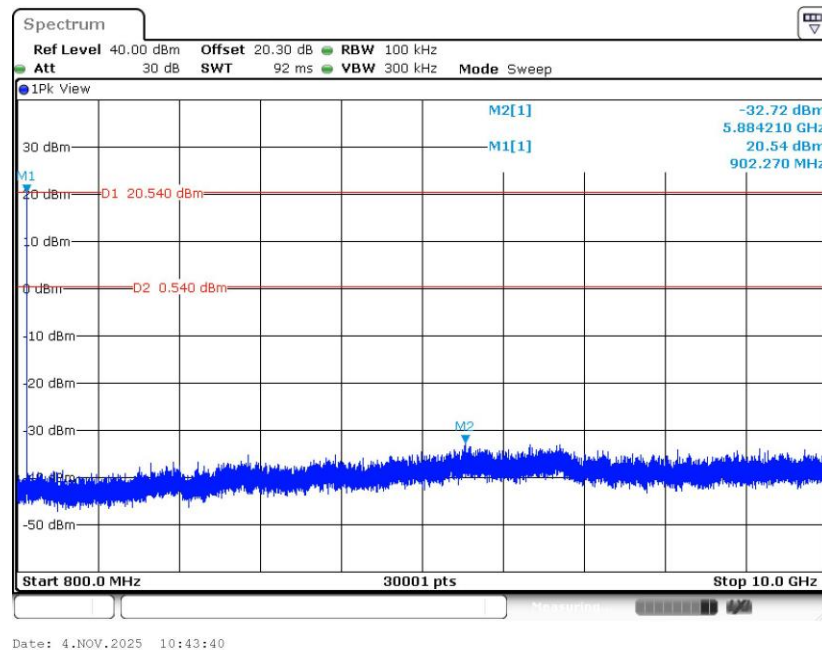
3.7.5 Test Result of Conducted Spurious Emission

SF7:

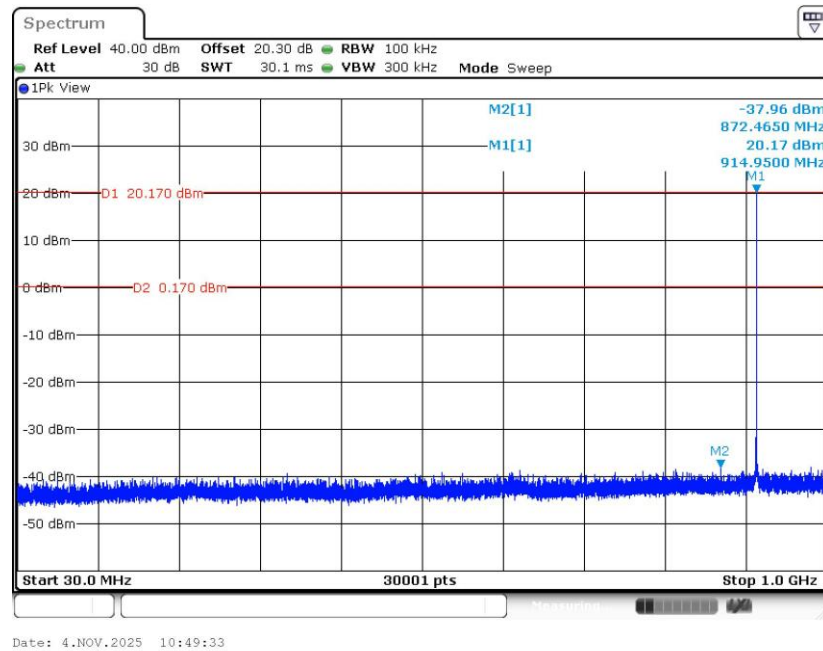
CSE Plot on Ch 1



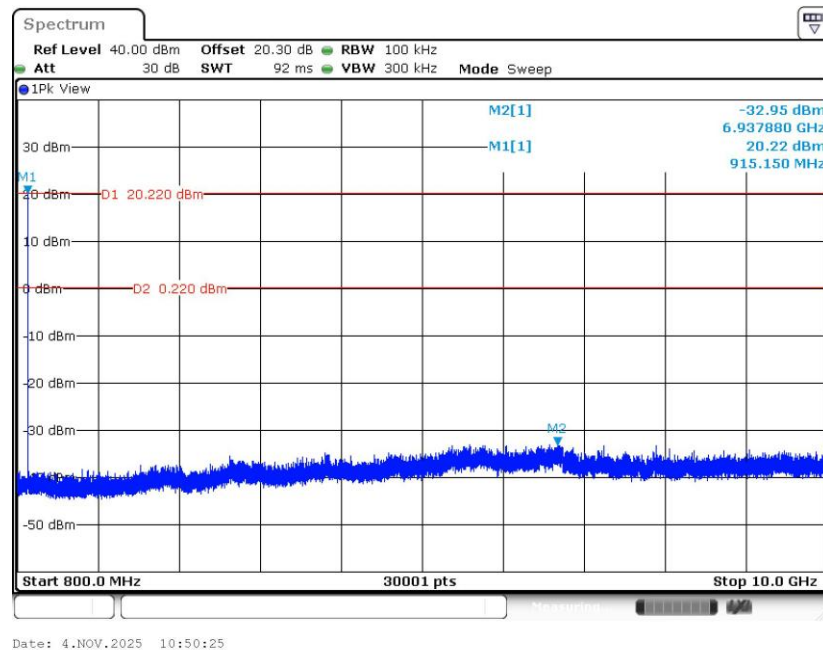
CSE Plot on Ch 1



CSE Plot on Ch 65

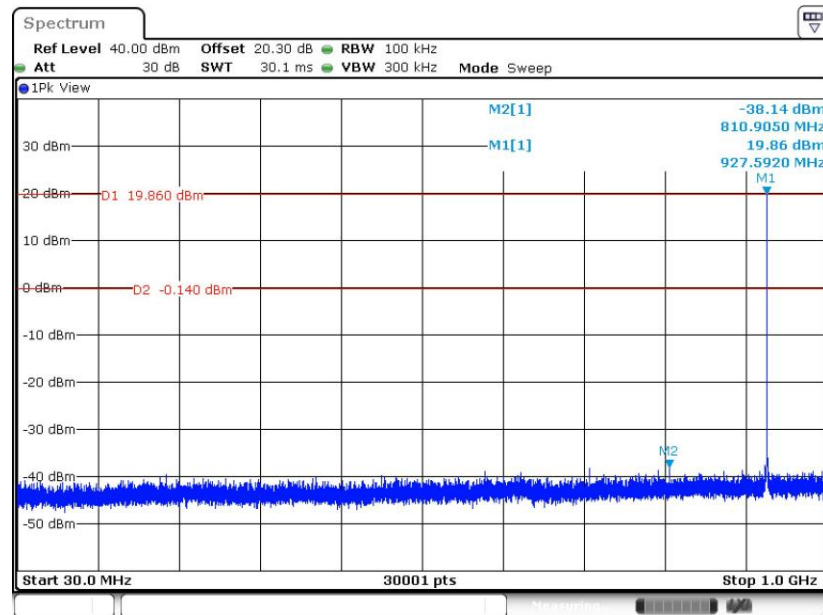


CSE Plot on Ch 65



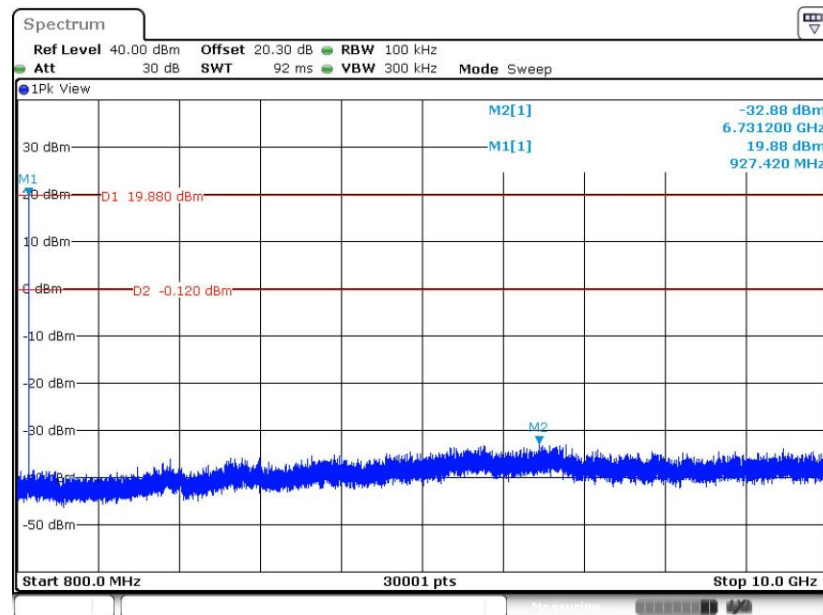


CSE Plot on Ch 128



Date: 4.NOV.2025 11:00:11

CSE Plot on Ch 128



Date: 4.NOV.2025 11:01:04

3.8 Radiated Spurious Emission Measurement

3.8.1 Limit of Radiated Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/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

3.8.2 Measuring Instruments

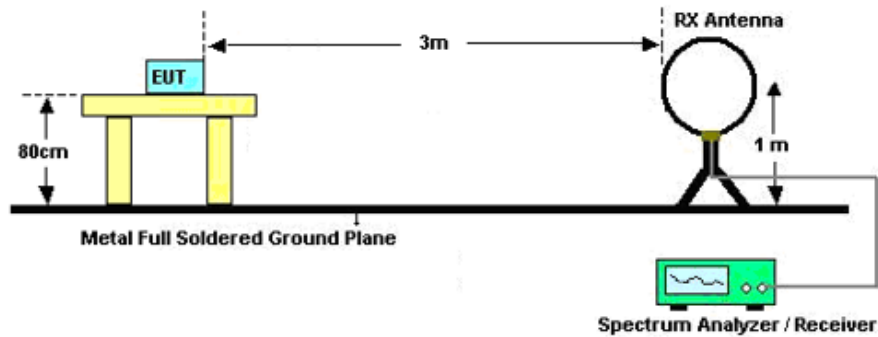
The measuring equipment is listed in the section 4 of this test report.

3.8.3 Test Procedures

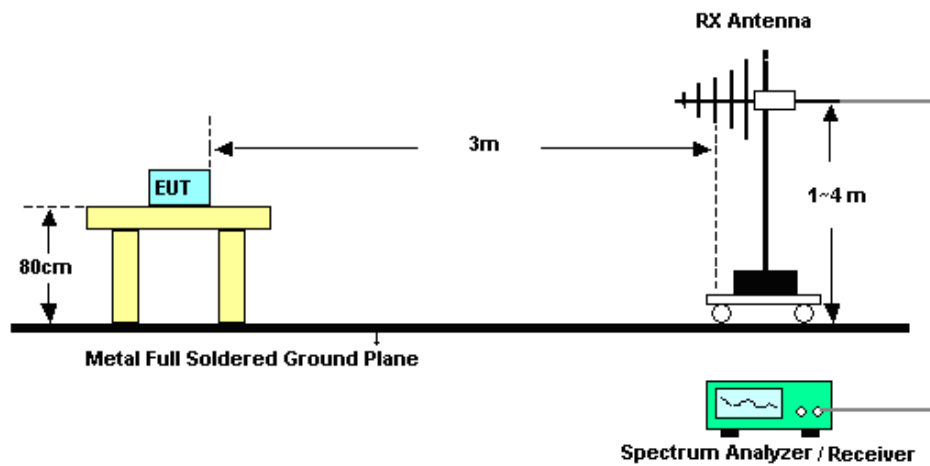
1. The testing follows ANSI C63.10-2020 clause 6.3, 6.5 and 6.6.
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1 \text{ GHz}$, RBW=1MHz for $f > 1\text{GHz}$; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
 - (3) For average measurement: use duty cycle correction factor method.
Duty cycle = On time/100 milliseconds
On time = $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$
Where N_1 is number of type 1 pulses, L_1 is length of type 1 pulses, etc.
Average Emission Level = Peak Emission Level + $20 * \log(\text{Duty cycle})$
7. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
8. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
9. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

3.8.4 Test Setup

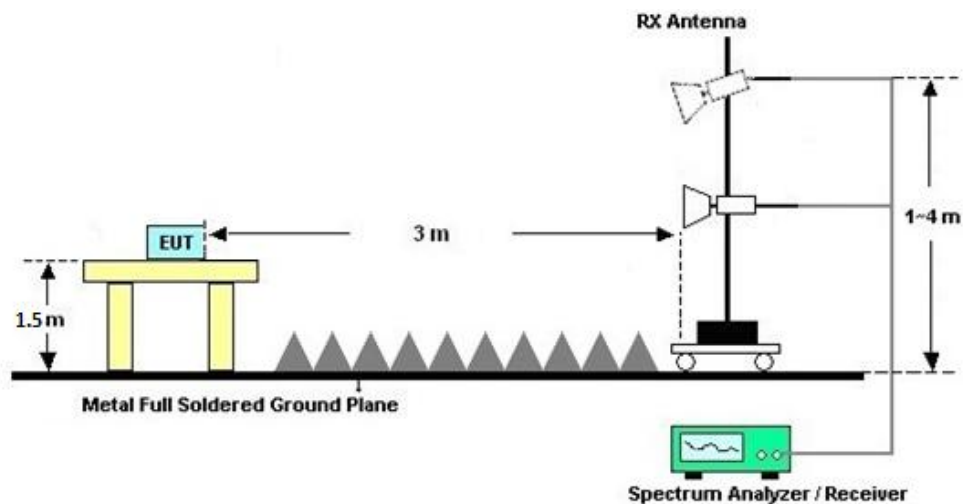
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz





3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.8.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C&D.

3.8.7 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix C&D.

3.8.8 Duty cycle

Please refer to Appendix E

3.9 AC Conducted Emission Measurement

3.9.1 Limit of AC Conducted Emission

For equipment 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.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

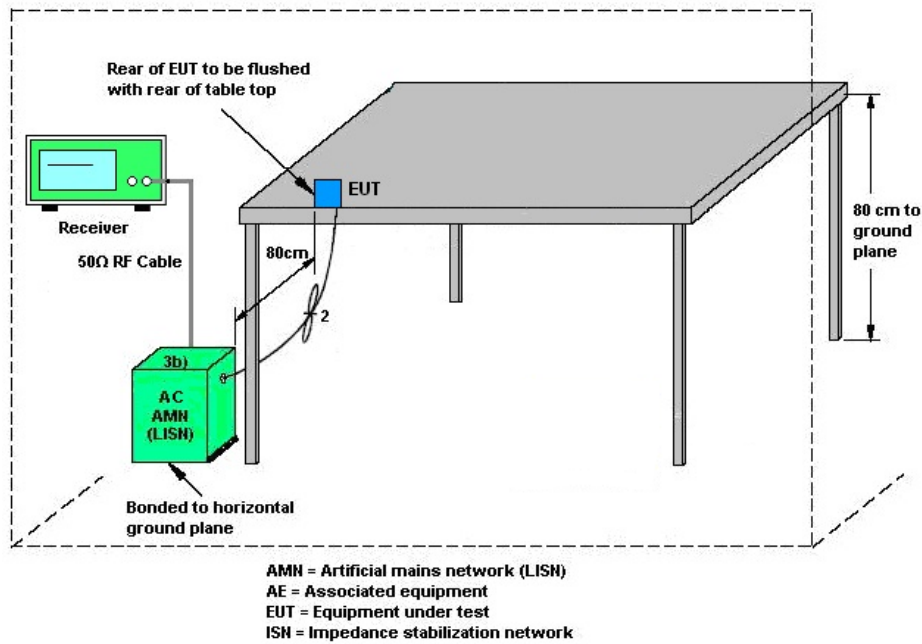
3.9.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.9.3 Test Procedures

10. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
11. Connect EUT to the power mains through a line impedance stabilization network (LISN).
12. All the support units are connecting to the other LISN.
13. The LISN provides 50 ohm coupling impedance for the measuring instrument.
14. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
15. Both sides of AC line were checked for maximum conducted interference.
16. The frequency range from 150 kHz to 30 MHz was searched.
17. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.9.4 Test Setup



3.9.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



3.10 Antenna Requirements

3.10.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 rule.

3.10.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.10.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101078	10Hz~40GHz	Apr. 02, 2025	Nov. 04, 2025	Apr. 01, 2026	Conducted (TH01-SZ)
Pulse Power Sensor	Anritsu	MA2411B	1339473	30MHz~40GHz	Dec. 25, 2024	Nov. 04, 2025	Dec. 24, 2025	Conducted (TH01-SZ)
Power Meter	Anritsu	ML2495A	1218010	50MHz Bandwidth	Oct. 13, 2025	Nov. 04, 2025	Oct. 12, 2026	Conducted (TH01-SZ)
Attenuator	Woken Tech	WK0602-10	4	10dB	Jan. 13, 2025	Nov. 04, 2025	Jan. 12, 2026	Conducted (TH01-SZ)
EMI Test Receiver&SA	KEYSIGHT	N9038A	MY54450083	20Hz~8.4GHz	Apr. 02, 2025	Nov. 07, 2025~Dec. 03, 2025	Apr. 01, 2026	Radiation (03CH03-SZ)
EXA Signal Analyzer	KEYSIGHT	N9010B	MY59071191	10KHz~44GHz	Apr. 02, 2025	Nov. 07, 2025~Dec. 03, 2025	Apr. 01, 2026	Radiation (03CH03-SZ)
Loop Antenna	R&S	HFH2-Z2E	101141	9kHz~30MHz	Dec. 28, 2024	Nov. 07, 2025~Dec. 03, 2025	Dec. 27, 2025	Radiation (03CH03-SZ)
Bilog Antenna	TeseQ	CBL6112D	35408	30MHz~2GHz	Aug. 19, 2025	Nov. 07, 2025~Dec. 03, 2025	Aug. 18, 2026	Radiation (03CH03-SZ)
Double Ridge Guide Antenna	ETS-Lindgren	Burgeon-3117	00240107	1GHz~18GHz	Jul. 13, 2025	Nov. 07, 2025~Dec. 03, 2025	Jul. 12, 2026	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz	Jul. 03, 2025	Nov. 07, 2025~Dec. 03, 2025	Jul. 02, 2026	Radiation (03CH03-SZ)
SHF-EHF Horn	com-power	AH-840	101071	18GHz~40GHz	Apr. 03, 2025	Nov. 07, 2025~Dec. 03, 2025	Apr. 02, 2027	Radiation (03CH03-SZ)
Amplifier	EM Electronics	EM330	060756	0.01Hz~3000MHz	Apr. 02, 2025	Nov. 07, 2025~Dec. 03, 2025	Apr. 01, 2026	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	AMF-7D-00101800-30-10P-R	1943528	1GHz~18GHz	Oct. 13, 2025	Nov. 07, 2025~Dec. 03, 2025	Oct. 12, 2026	Radiation (03CH03-SZ)
HF Amplifier	Keysight	83017A	MY53270357	500MHz~26.5GHz	Apr. 02, 2025	Nov. 07, 2025~Dec. 03, 2025	Apr. 01, 2026	Radiation (03CH03-SZ)
AC Power Source	Chroma	61601	616010002729	N/A	Oct. 17, 2025	Nov. 07, 2025~Dec. 03, 2025	Oct. 16, 2026	Radiation (03CH03-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Nov. 07, 2025~Dec. 03, 2025	NCR	Radiation (03CH03-SZ)
Antenna Mast	EM	EM1000	N/A	1 m~4 m	NCR	Nov. 07, 2025~Dec. 03, 2025	NCR	Radiation (03CH03-SZ)
EMI Receiver	R&S	ESR7	102297	9kHz~7GHz;	Jul. 02, 2025	Nov. 12, 2025	Jul. 01, 2026	Conduction (CO02-SZ)
AC LISN	R&S	ENV216	101499	9kHz~30MHz	Jul. 03, 2025	Nov. 12, 2025	Jul. 02, 2026	Conduction (CO02-SZ)
AC Power Source	CHROMA	61601	616010002470	100Vac~250Vac	Dec.25, 2024	Nov. 12, 2025	Dec. 24, 2025	Conduction (CO02-SZ)

NCR: No Calibration Required.

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Measurement

Test Item	Uncertainty
Conducted Spurious Emission & Bandedge	±1.34 dB
Occupied Channel Bandwidth	±0.012 MHz
Conducted Power	±1.34 dB
Conducted Power Spectral Density	±1.32 dB
Frequency	±1.3 Hz

Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.5dB
---	-------

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.9dB
---	-------

Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------

----- THE END -----



Appendix A. Conducted Test Results

LoRa-FHSS-Spreading Factor 7

Test Engineer:	Liu Qiu Qiu	Temperature:	20~26	°C
Test Date:	2025/11/4	Relative Humidity:	40~51	%

TEST RESULTS DATA
20dB and 99% Occupied Bandwidth

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Bandwidth (MHz)	20db BW (MHz)	20db BW Limit (MHz)	Pass/Fail
Lora(FHSS)-SF7	125Kbps	1	1	902.2	0.119	0.138	0.500	Pass
Lora(FHSS)-SF7	125Kbps	1	65	915	0.128	0.156	0.500	Pass
Lora(FHSS)-SF7	125Kbps	1	128	927.6	0.128	0.154	0.500	Pass

Hopping Channel Separation Measurement

Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Hopping Channel Separation Measurement (MHz)	Hopping Channel Separation Measurement Limit (MHz)	Pass/Fail
Lora(FHSS)-SF7	125Kbps	1	1	902.2	0.200	0.1382	Pass
Lora(FHSS)-SF7	125Kbps	1	65	915	0.200	0.1563	Pass
Lora(FHSS)-SF7	125Kbps	1	128	927.6	0.198	0.1541	Pass

TEST RESULTS DATA
Dwell Time

Mod.	Hopping Channel Number Rate	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Lora(FHSS)-SF7	128	1	385.44	0.385	0.4	Pass

TEST RESULTS DATA
Peak Power Table

mode	Freq. (MHz)	NTX	Peak Power (dBm)	Power Setting	Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Test Result
Lora(FHSS)-SF7	902.2	1	20.98	22.00	30.00	3.32	24.30	36	Pass
	915	1	20.75	22.00	30.00	3.32	24.07	36	Pass
	927.6	1	20.43	22.00	30.00	3.32	23.75	36	Pass

TEST RESULTS DATA
Number of Hopping Frequency

Number of Hopping (Channel)	Limits (Channel)	Pass/Fail
128	> 50	Pass

LoRa-FHSS-Spreading Factor 8

Test Engineer:	Liu Qiu Qiu	Temperature:	20~26	°C
Test Date:	2025/11/4	Relative Humidity:	40~51	%

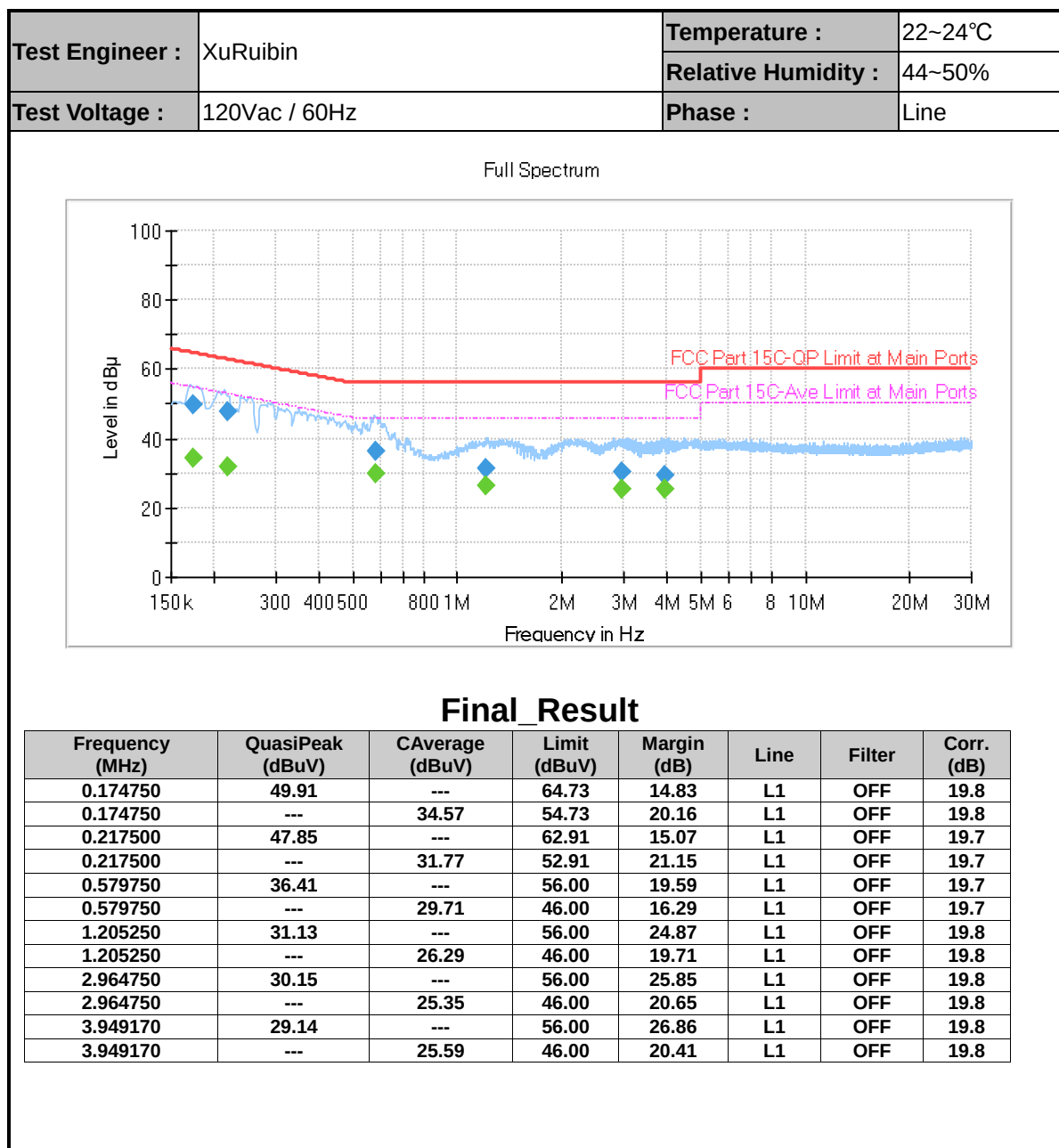
<u>TEST RESULTS DATA</u> <u>Peak Power Table</u>									
mode	Freq. (MHz)	NTX	Peak Power (dBm)	Power Setting	Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Test Result
Lora(FHSS)-SF8	902.2	1	20.79	22.00	30.00	3.32	24.11	36	Pass
	915	1	20.56	22.00	30.00	3.32	23.88	36	Pass
	927.6	1	20.28	22.00	30.00	3.32	23.60	36	Pass

LoRa-FHSS-Spreading Factor 9

Test Engineer:	Liu Qiu Qiu	Temperature:	20~26	°C
Test Date:	2025/11/4	Relative Humidity:	40~51	%

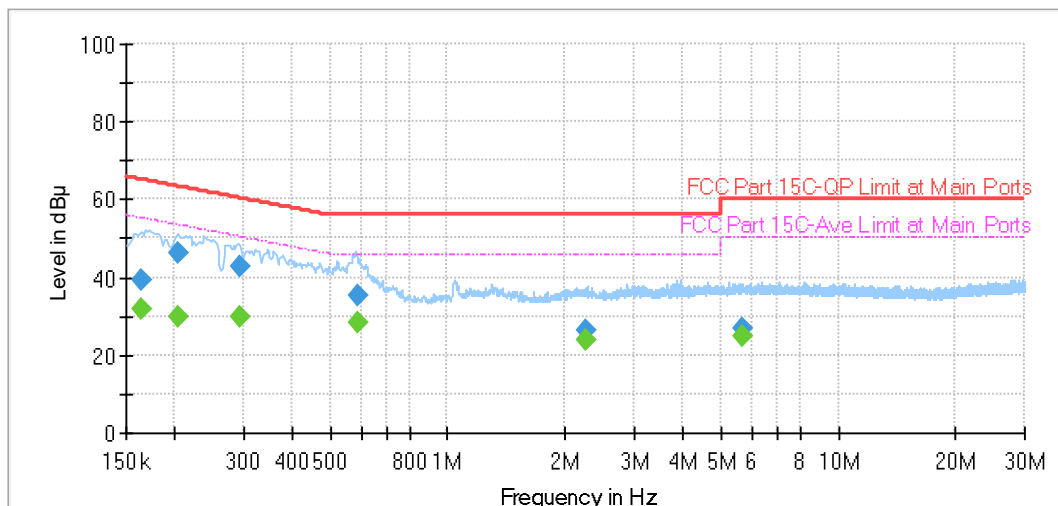
TEST RESULTS DATA									
Peak Power Table									
mode	Freq. (MHz)	NTX	Peak Power (dBm)	Power Setting	Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Test Result
Lora(FHSS)-SF9	902.2	1	20.77	22.00	30.00	3.32	24.09	36	Pass
	915	1	20.46	22.00	30.00	3.32	23.78	36	Pass
	927.6	1	20.26	22.00	30.00	3.32	23.58	36	Pass

Appendix B. AC Conducted Emission Test Results



Test Engineer :	XuRuibin	Temperature :	22~24°C
		Relative Humidity :	44~50%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral

Full Spectrum



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.163770	39.11	---	65.27	26.16	N	OFF	19.7
0.163770	---	31.71	55.27	23.56	N	OFF	19.7
0.204630	46.12	---	63.42	17.30	N	OFF	19.7
0.204630	---	29.85	53.42	23.58	N	OFF	19.7
0.292470	42.75	---	60.45	17.71	N	OFF	19.7
0.292470	---	29.84	50.45	20.62	N	OFF	19.7
0.586500	35.32	---	56.00	20.68	N	OFF	19.7
0.586500	---	28.31	46.00	17.69	N	OFF	19.7
2.258250	26.22	---	56.00	29.78	N	OFF	19.8
2.258250	---	23.79	46.00	22.21	N	OFF	19.8
5.680230	26.77	---	60.00	33.23	N	OFF	19.9
5.680230	---	24.90	50.00	25.10	N	OFF	19.9



Appendix C. Radiated Spurious Emission

Iora FHSS SF=7 (Harmonic @ 3m)

	Note	Frequency	Level	Margin	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
		(MHz)	(dBμV/m)	(dB)	Line (dBμV/m)	Level (dBμV)	Factor (dB/m)	Loss (dB)	Factor (dB)	Pos (cm)	Pos (deg)	Avg. (P/A)	(H/V)
902.2MHz		2706.6	45.72	-28.28	74	62.65	32.3	8.61	57.84	100	30	P	H
		2706.6	45.72	-8.28	54	62.65	32.3	8.61	57.84	100	30	A	H
		3608.8	43.65	-30.35	74	59.08	32.9	9.67	58	-	-	P	H
		2706.6	43.73	-30.27	74	60.66	32.3	8.61	57.84	100	124	P	V
		2706.6	43.73	-10.27	54	60.66	32.3	8.61	57.84	100	124	A	V
		3608.8	43.53	-30.47	74	58.96	32.9	9.67	58	-	-	P	V
915.0MHz		2745	44.98	-29.02	74	61.96	32.25	8.62	57.85	102	58	P	H
		2745	44.98	-9.02	54	61.96	32.25	8.62	57.85	102	58	A	H
		3660	42.28	-31.72	74	57.64	33	9.64	58	-	-	P	H
		2745	43.67	-30.33	74	60.65	32.25	8.62	57.85	125	32	P	V
		2745	43.67	-10.33	54	60.65	32.25	8.62	57.85	125	32	A	V
		3660	41.88	-32.12	74	57.24	33	9.64	58	-	-	P	V
927.6MHz		2782.8	44.99	-29.01	74	62	32.22	8.63	57.86	100	65	P	H
		2782.8	44.99	-9.01	54	62	32.22	8.63	57.86	100	65	A	H
		3710.4	41.11	-32.89	74	56.4	33.1	9.61	58	-	-	P	H
		2782.8	43.64	-30.36	74	60.65	32.22	8.63	57.86	124	53	P	V
		2782.8	43.64	-10.36	54	60.65	32.22	8.63	57.86	124	53	A	V
		3710.4	41.58	-32.42	74	56.87	33.1	9.61	58	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



< 30M-1G>

lor a FHSS SF=7 (LF @ 3m)

	Note	Frequency	Level	Margin	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
902.2MHz		136.7	20.82	-22.68	43.5	35.35	18.12	2.25	34.9	-	-	P	H
		277.35	23.61	-22.39	46	36.55	18.69	3.12	34.75	-	-	P	H
	*	902.2	113.72	----	----	114.16	29.14	4.42	34	-	-	P	H
		133.79	21.66	-21.84	43.5	36.45	17.88	2.23	34.9	-	-	P	V
		285.11	23.28	-22.72	46	35.9	18.96	3.15	34.73	-	-	P	V
	*	902.2	113.33	----	----	113.77	29.14	4.42	34	-	-	P	V
915MHz		127	20.93	-22.57	43.5	36.13	17.51	2.19	34.9	-	-	P	H
		278.32	23.62	-22.38	46	36.56	18.68	3.12	34.74	-	-	P	H
	*	915	117.14	----	----	117.35	29.34	4.45	34	-	-	P	H
		127	20.98	-22.52	43.5	36.18	17.51	2.19	34.9	-	-	P	V
		264.74	23.12	-22.88	46	36.58	18.24	3.07	34.77	-	-	P	V
	*	915	110.28	----	----	110.49	29.34	4.45	34	-	-	P	V
927.6MHz		136.7	21.42	-22.08	43.5	35.95	18.12	2.25	34.9	-	-	P	H
		276.38	23.57	-22.43	46	36.54	18.66	3.12	34.75	-	-	P	H
	*	927.6	113.85	----	----	113.64	29.74	4.47	34	-	-	P	H
		131.85	21.75	-21.75	43.5	36.71	17.72	2.22	34.9	-	-	P	V
		240.49	23.21	-22.79	46	37.69	17.38	2.96	34.82	-	-	P	V
	*	927.6	114.12	----	----	113.91	29.74	4.47	34	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

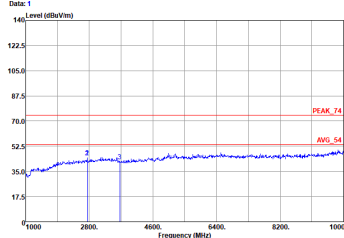
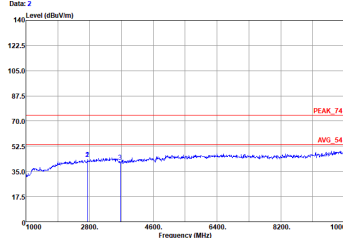


Appendix D. Radiated Spurious Emission Plots

LoRa 125KHz FHSS SF=7 (Harmonic @ 3m)

LoRa	Harmonic @ 3m										
ANT	LoRa 125KHz FHSS SF=7 CH01 902.2 Mhz										



LoRa	Harmonic @ 3m																																																																																	
ANT	LoRa 125KHz FHSS SF=7 CH65 915 Mhz																																																																																	
	Horizontal	Vertical																																																																																
Peak	Date: 1  140 122.5 105.0 87.5 70.0 52.5 35.0 17.5 1000 2000 4000 6000 8000 10000 Frequency (MHz) <table><tr><th></th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th></tr><tr><th>MHz</th><th>Level</th><th>Line</th><th>Level Factor</th><th>Loss Factor</th><th></th><th></th><th></th></tr><tr><td>1</td><td>2745.00</td><td>44.98</td><td>-29.82</td><td>74.00</td><td>61.96</td><td>32.25</td><td>8.62 57.85 102 58 Peak</td></tr><tr><td>2</td><td>2745.00</td><td>44.98</td><td>-9.02</td><td>54.00</td><td>61.96</td><td>32.25</td><td>8.62 57.85 102 58 Average</td></tr><tr><td>3</td><td>3660.00</td><td>42.28</td><td>-31.72</td><td>74.00</td><td>57.64</td><td>33.00</td><td>9.64 58.00 --- --- Peak</td></tr></table>		Over	Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	MHz	Level	Line	Level Factor	Loss Factor				1	2745.00	44.98	-29.82	74.00	61.96	32.25	8.62 57.85 102 58 Peak	2	2745.00	44.98	-9.02	54.00	61.96	32.25	8.62 57.85 102 58 Average	3	3660.00	42.28	-31.72	74.00	57.64	33.00	9.64 58.00 --- --- Peak	Date: 2  140 122.5 105.0 87.5 70.0 52.5 35.0 17.5 1000 2000 4000 6000 8000 10000 Frequency (MHz) <table><tr><th></th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th></tr><tr><th>MHz</th><th>Level</th><th>Line</th><th>Level Factor</th><th>Loss Factor</th><th></th><th></th><th></th></tr><tr><td>1</td><td>2745.00</td><td>43.67</td><td>-30.33</td><td>74.00</td><td>60.65</td><td>32.25</td><td>8.62 57.85 125 32 Peak</td></tr><tr><td>2</td><td>2745.00</td><td>43.67</td><td>-10.33</td><td>54.00</td><td>60.65</td><td>32.25</td><td>8.62 57.85 125 32 Average</td></tr><tr><td>3</td><td>3660.00</td><td>41.88</td><td>-32.12</td><td>74.00</td><td>57.24</td><td>33.00</td><td>9.64 58.00 --- --- Peak</td></tr></table>		Over	Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	MHz	Level	Line	Level Factor	Loss Factor				1	2745.00	43.67	-30.33	74.00	60.65	32.25	8.62 57.85 125 32 Peak	2	2745.00	43.67	-10.33	54.00	60.65	32.25	8.62 57.85 125 32 Average	3	3660.00	41.88	-32.12	74.00	57.24	33.00	9.64 58.00 --- --- Peak
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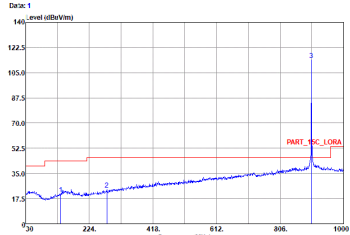
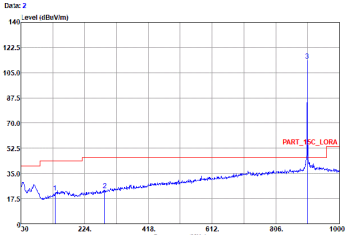


LoRa	Harmonic @ 3m										
ANT	LoRa 125KHz FHSS SF=7 CH128 927.6 Mhz										
	Horizontal										Vertical
Peak	Date: 1 Level (dBuV/m)										

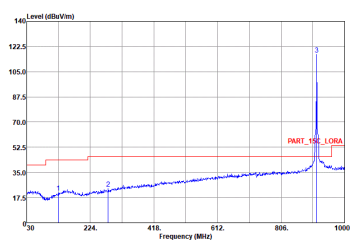
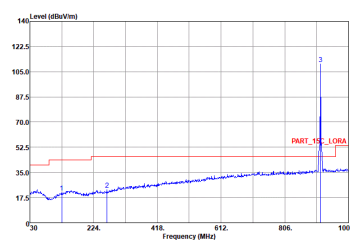


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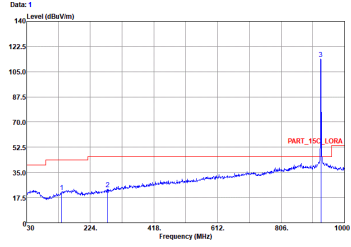
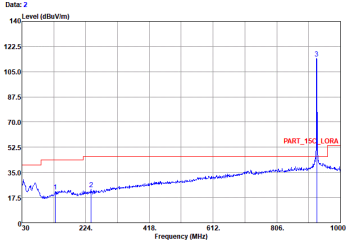
LoRa 125KHz FHSS SF=7 (LF @ 3m)

LoRa	LF @ 3m																																																																																																																							
ANT	LoRa 125KHz FHSS SF=7 CH01 902.2 Mhz																																																																																																																							
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Peak	Trace 1  <table><tr><th>Peak</th><th>Freq</th><th>Level</th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable</th><th>Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th><th></th></tr><tr><td>1</td><td>136.78</td><td>28.82</td><td>-22.68</td><td>43.58</td><td>35.35</td><td>13.12</td><td>2.25</td><td>34.98</td><td>---</td><td>Peak</td></tr><tr><td>2</td><td>277.35</td><td>23.61</td><td>-22.39</td><td>46.08</td><td>36.55</td><td>19.49</td><td>3.31</td><td>34.75</td><td>---</td><td>Peak</td></tr><tr><td>3</td><td>902.20</td><td>113.72</td><td>-----</td><td>114.16</td><td>29.14</td><td>4.42</td><td>34.88</td><td>---</td><td>---</td><td>Peak</td></tr></table>					Peak	Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark		MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	dB	cm	deg		1	136.78	28.82	-22.68	43.58	35.35	13.12	2.25	34.98	---	Peak	2	277.35	23.61	-22.39	46.08	36.55	19.49	3.31	34.75	---	Peak	3	902.20	113.72	-----	114.16	29.14	4.42	34.88	---	---	Peak	Trace 2  <table><tr><th>Peak</th><th>Freq</th><th>Level</th><th>Over</th><th>Limit</th><th>ReadAntenna</th><th>Cable</th><th>Preamp</th><th>A/Pos</th><th>T/Pos</th><th>Remark</th></tr><tr><th></th><th>MHz</th><th>dBuV/m</th><th>dB</th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dB</th><th>cm</th><th>deg</th><th></th></tr><tr><td>1</td><td>133.79</td><td>21.66</td><td>-21.84</td><td>43.58</td><td>36.45</td><td>17.83</td><td>2.23</td><td>34.98</td><td>---</td><td>Peak</td></tr><tr><td>2</td><td>285.11</td><td>23.28</td><td>-22.72</td><td>46.08</td><td>35.98</td><td>19.96</td><td>3.15</td><td>34.75</td><td>---</td><td>Peak</td></tr><tr><td>3</td><td>902.20</td><td>113.33</td><td>-----</td><td>113.77</td><td>29.14</td><td>4.42</td><td>34.88</td><td>---</td><td>---</td><td>Peak</td></tr></table>					Peak	Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark		MHz	dBuV/m	dB	dBuV/m	dBuV/m	dB	dB	cm	deg		1	133.79	21.66	-21.84	43.58	36.45	17.83	2.23	34.98	---	Peak	2	285.11	23.28	-22.72	46.08	35.98	19.96	3.15	34.75	---	Peak	3	902.20	113.33	-----	113.77	29.14	4.42	34.88	---	---	Peak
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LoRa	LF @ 3m																																																																																																										
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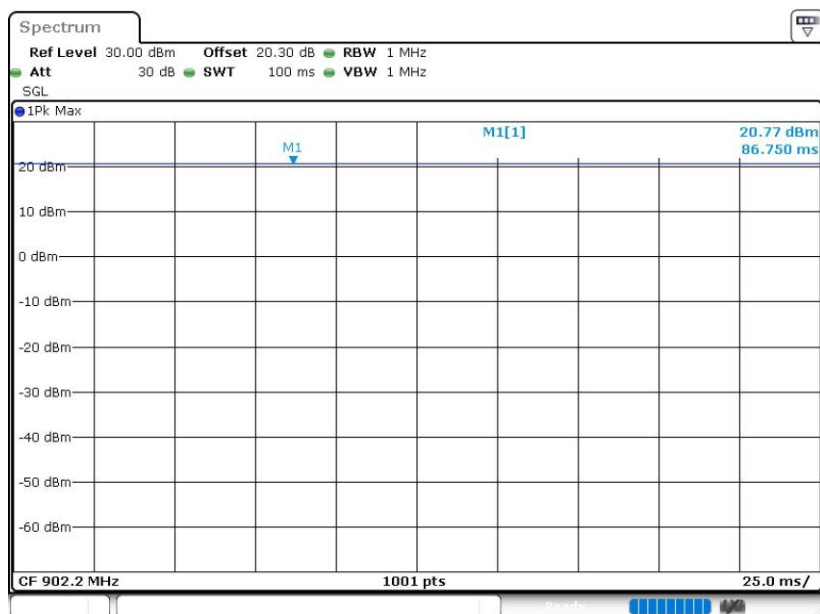


LoRa	LF @ 3m																																																																																																																									
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Appendix E. Duty Cycle Plots

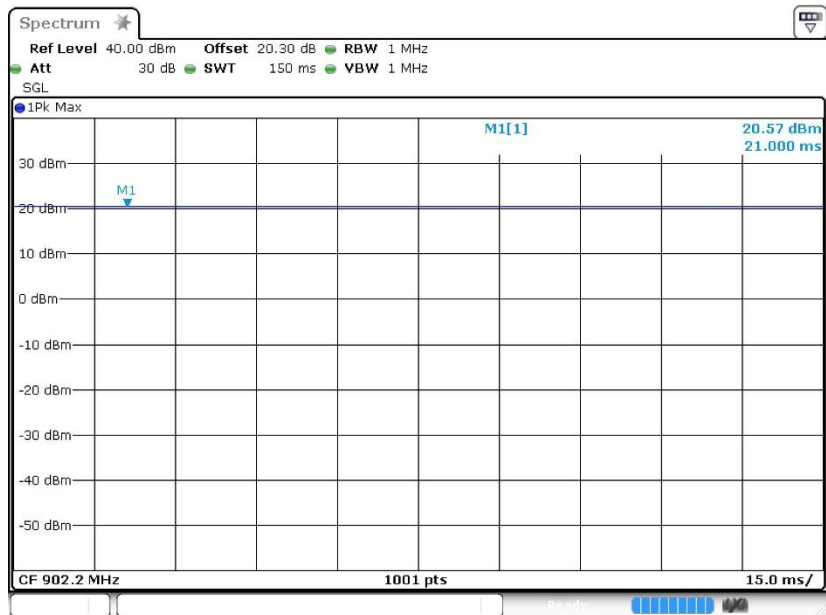
Band	Duty Cycle(%)	DCCF (dB)
LoRa(FHSS)SF7	100	0
LoRa(FHSS)SF8	100	0
LoRa(FHSS)SF9	100	0

LoRa(FHSS)SF 7





LoRa(FHSS)SF8



LoRa(FHSS)SF9

