FCC RF Test Report

APPLICANT	**:**	**Ring LLC**
EQUIPMENT	**:**	**Video Doorbell Pro 2**
BRAND NAME	**:**	**Ring**
MODEL NAME	**:**	**5AT2S2**
FCC ID	**:**	**2AEUPBHALP032**
STANDARD	**:**	**FCC Part 15 Subpart C §15.247**
CLASSIFICATION	**:**	**(DTS) Digital Transmission System**
TEST DATE(S)	**:**	**Feb. 09, 2022 ~ Apr. 21, 2022**

We, Sporton International Inc. (Kunshan), 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. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia

ACCREDITED
Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR090815-03A	Rev. 01	Initial issue of report	Jul. 05, 2022

SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	-
3.1	-	99% Bandwidth	-	Pass	-
3.2	15.247(b)(3)	Output Power	≤ 30dBm	Pass	-
3.3	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	-
3.4	15.247(d)	Conducted Band Edges and Spurious Emission	≤ 30dBc	Pass	-
3.5	15.247(d)	Radiated Band Edges and Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 28.63 dB at 1828.00 MHz
3.6	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 15.87 dB at 0.151 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-
Remark: The manufacturer declared the EUT does not support charging function during Link mode.					

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Applicant

Ring LLC
1523 26th Street, Santa Monica, CA 90404, USA

1.2 Manufacturer

Goertek Inc.
No.268 Dongfang Road High-Tech Industrial Development District, Weifang Shandong, China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Video Doorbell Pro 2
Brand Name	Ring
Model Name	5AT2S2
FCC ID	2AEUPBHALP032
EUT supports Radios application	WLAN 2.4GHz 802.11b/g/n HT20 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE LoRa DTS/LoRa FHSS/FSK FHSS Radar
HW Version	R6
SW Version	7.1.61
EUT Stage	Production Unit

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

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	902.5 MHz ~ 926.5 MHz
Number of Channels	31
Bandwidth / Spread Factor	500kHz / 5, 7, 11
Maximum Output Power to Antenna	LoRa DTS SF5 : 15.16 dBm (0.0328 W) LoRa DTS SF7 : 15.09 dBm (0.0323 W) LoRa DTS SF11 : 15.17 dBm (0.0329 W)
99% Occupied Bandwidth	LoRa DTS SF5 : 0.547MHz LoRa DTS SF7 : 0.538MHz LoRa DTS SF11 : 0.547MHz
Antenna Type / Gain	IFA Antenna with gain -1.01 dBi
Type of Modulation	LoRa

1.5 Modification of EUT

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

1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	**Sporton Site No.**	**FCC Designation No.**	**FCC Test Firm Registration No.**
	CO01-KS 03CH04-KS TH01-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacture	Name	Version
1.	03CH04-KS	AUDIX	E3	6.2009-8-24a
2.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 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 C63.10-2013

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)
902.5-926.5 MHz	1	902.5	17	915.3
	2	903.3	18	916.1
	3	904.1	19	916.9
	4	904.9	20	917.7
	5	905.7	21	918.5
	6	906.5	22	919.3
	7	907.3	23	920.1
	8	908.1	24	920.9
	9	908.9	25	921.7
	10	909.7	26	922.5
	11	910.5	27	923.3
	12	911.3	28	924.1
	13	912.1	29	924.9
	14	912.9	30	925.7
	15	913.7	31	926.5
	16	914.5		

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: conduction emission (150 kHz to 30 MHz), 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.

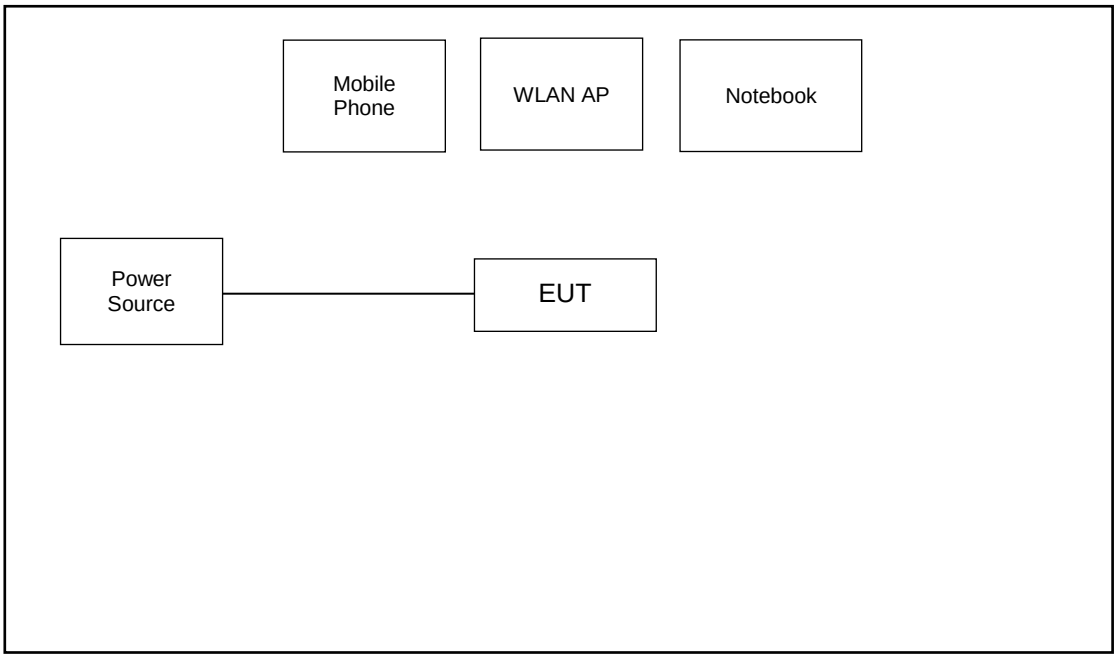
b. AC power line Conducted Emission was tested under maximum output power.

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

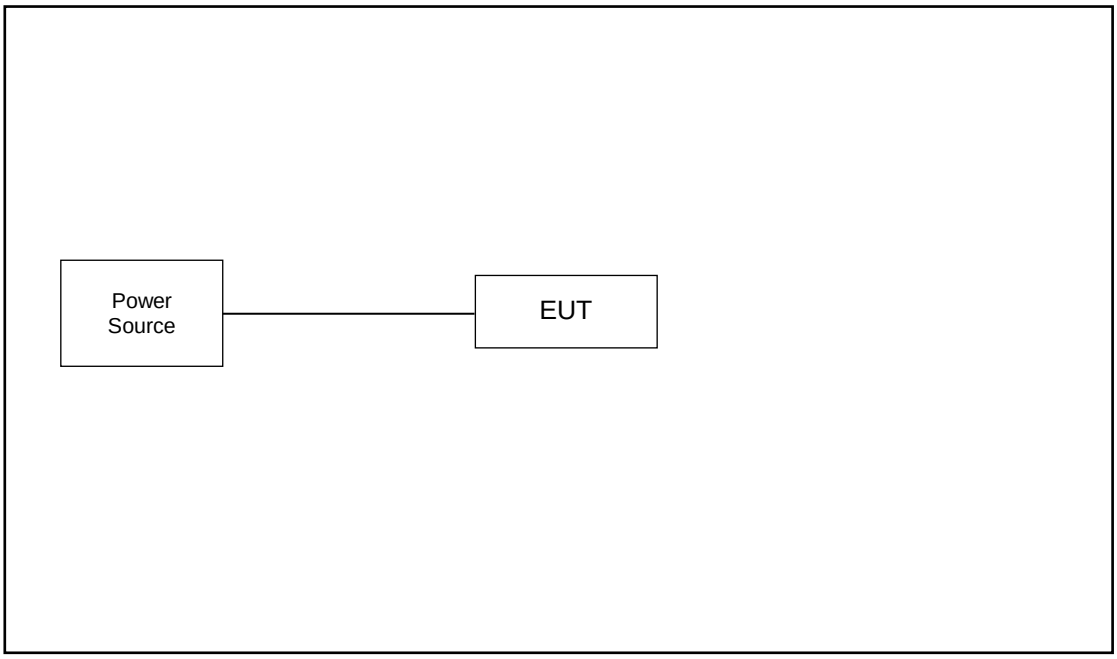
Summary table of Test Cases	
Test Item	**Data Rate / Modulation**
	Lora 500KHz DTS
Conducted TCs	Mode 1: LoRa Tx CH01_902.5 MHz Mode 2: LoRa Tx CH16_914.5 MHz Mode 3: LoRa Tx CH31_926.5 MHz
Radiated TCs	Mode 1: LoRa Tx CH01_902.5 MHz Mode 2: LoRa Tx CH16_914.5 MHz Mode 3: LoRa Tx CH31_926.5 MHz
AC Conducted Emission	Mode 1 : Lora Tx + Bluetooth Link + WLAN Link(2.4G) + Adapter + 24G Radar Tx

2.3 Connection Diagram of Test System

For Conducted Emission:



For Radiated Emission:



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
2.	Mobile Phone	MOTO	XT1952-1	N/A	N/A	N/A
3.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m

2.5 EUT Operation Test Setup

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

2.6 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 4.8 dB and 10dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.8 + 10 = 14.8 (dB)

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

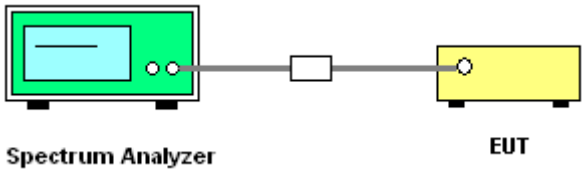
3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.1.3 Test Procedures

1. The testing follows ANSI C63.10-2013 clause 11.8
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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 30kHz and set the Video bandwidth (VBW) = 100kHz.
6. Measure and record the results in the test report.

3.1.4 Test Setup

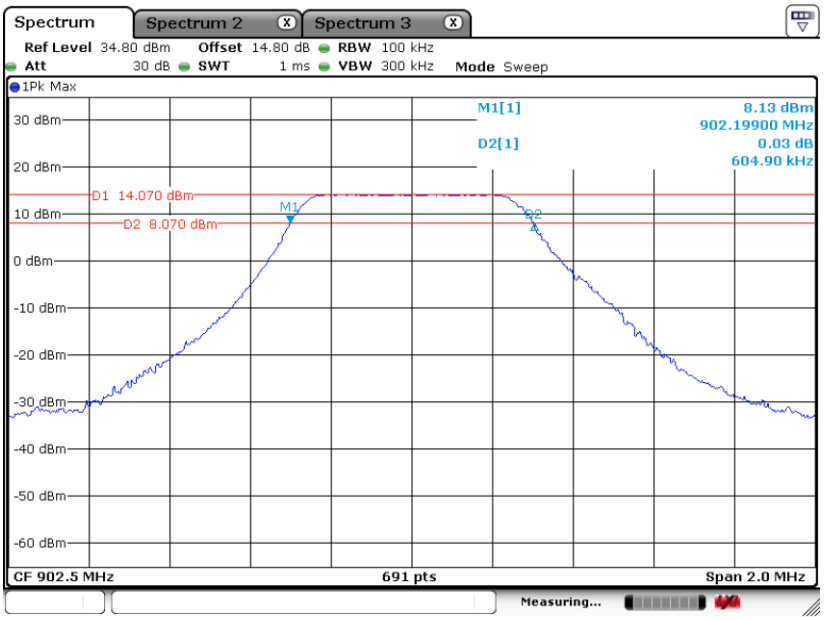


3.1.5 Test Result of 6dB Bandwidth

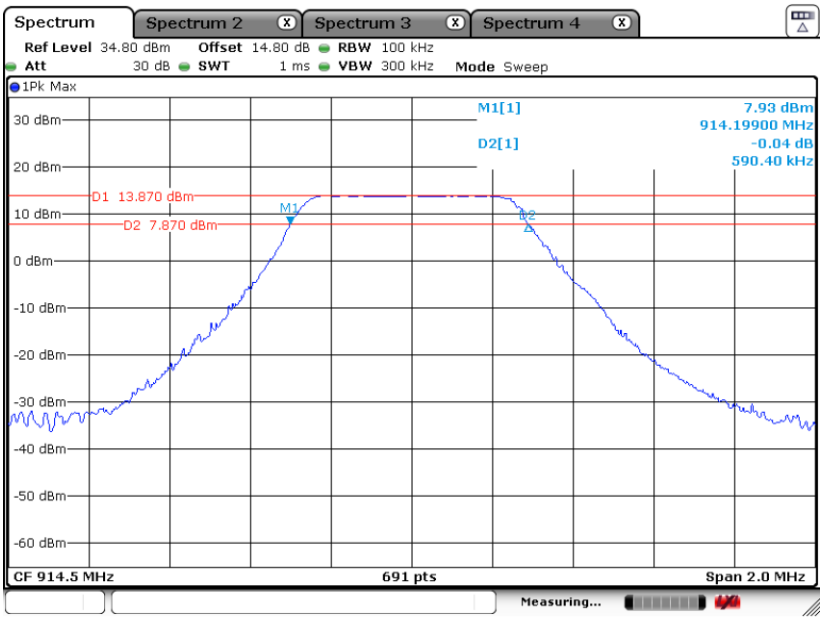
Please refer to Appendix A.

For SF5:

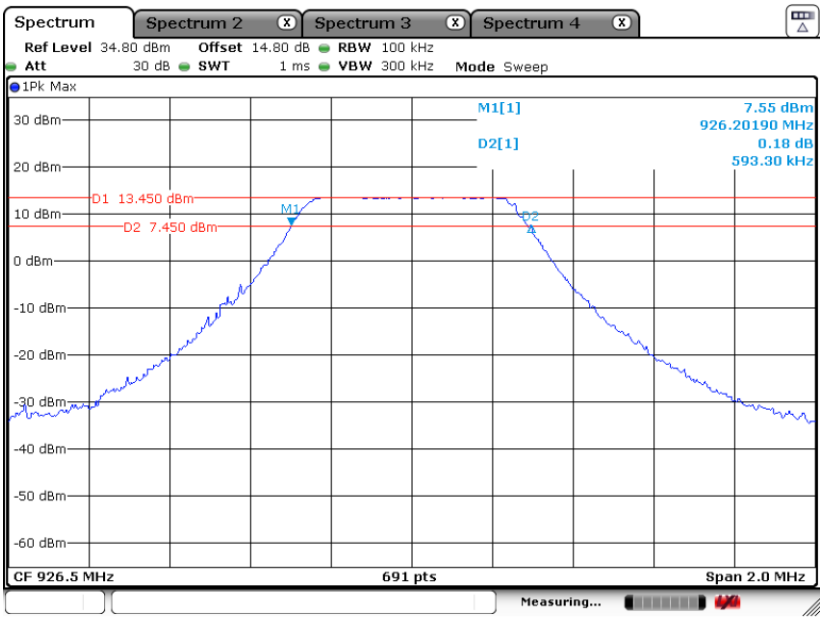
6 dB Bandwidth Plot on 902.5MHz



6 dB Bandwidth Plot on 914.5 MHz



6 dB Bandwidth Plot on 926.5 MHz



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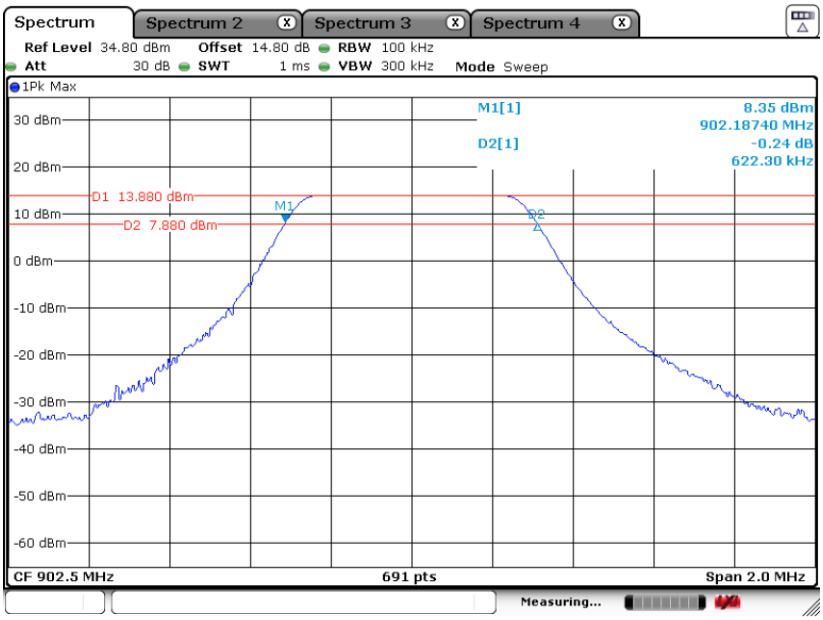
For SF7:

6 dB Bandwidth Plot on 902.5 MHz



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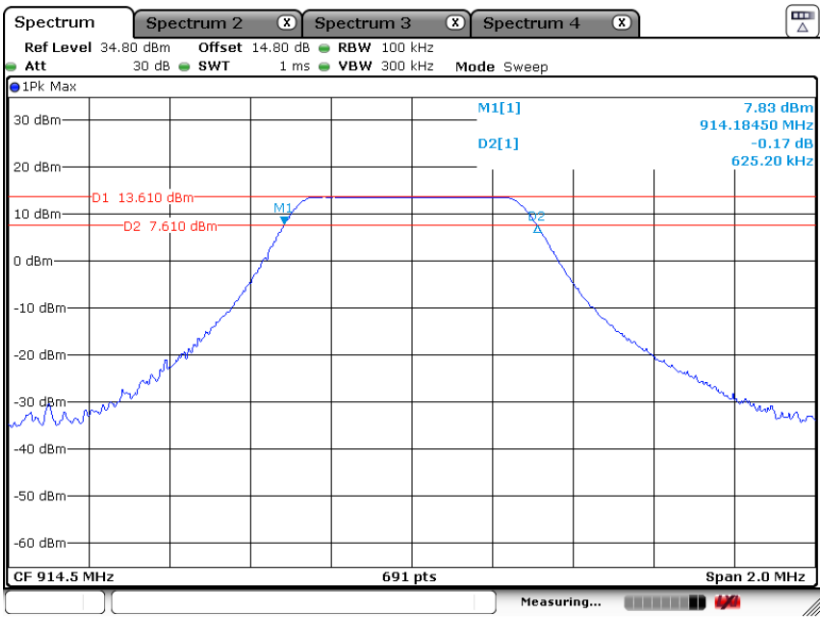
6 dB Bandwidth Plot on 914.5 MHz



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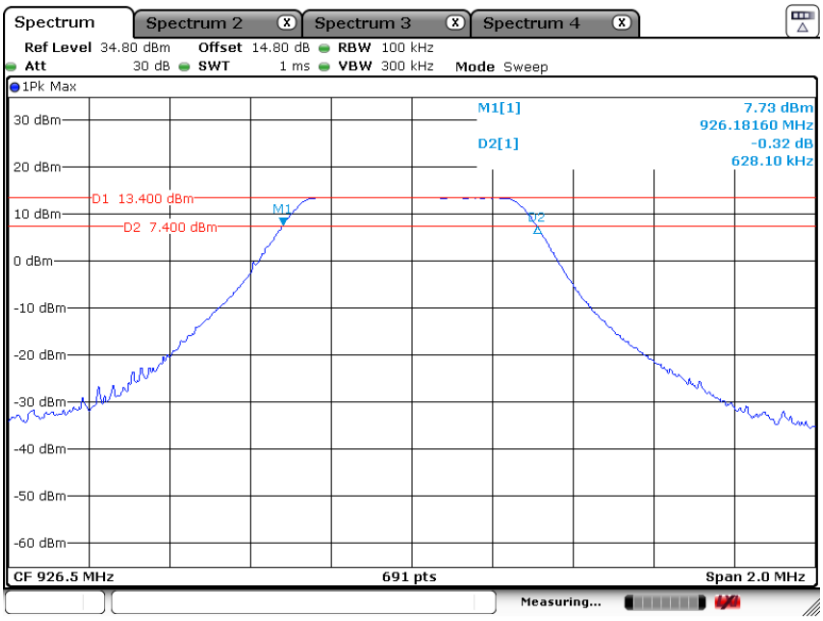
6 dB Bandwidth Plot on 926.5 MHz



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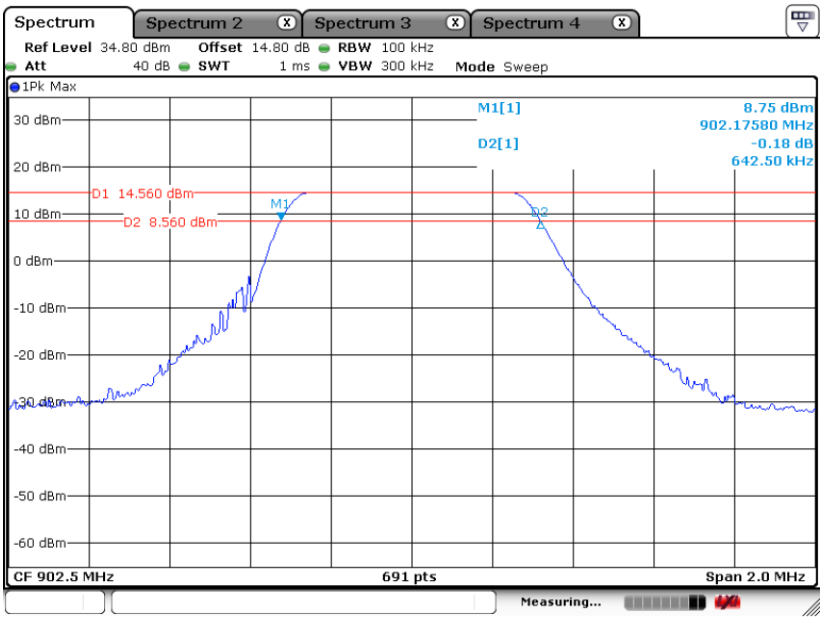
For SF11:

6 dB Bandwidth Plot on 902.5MHz



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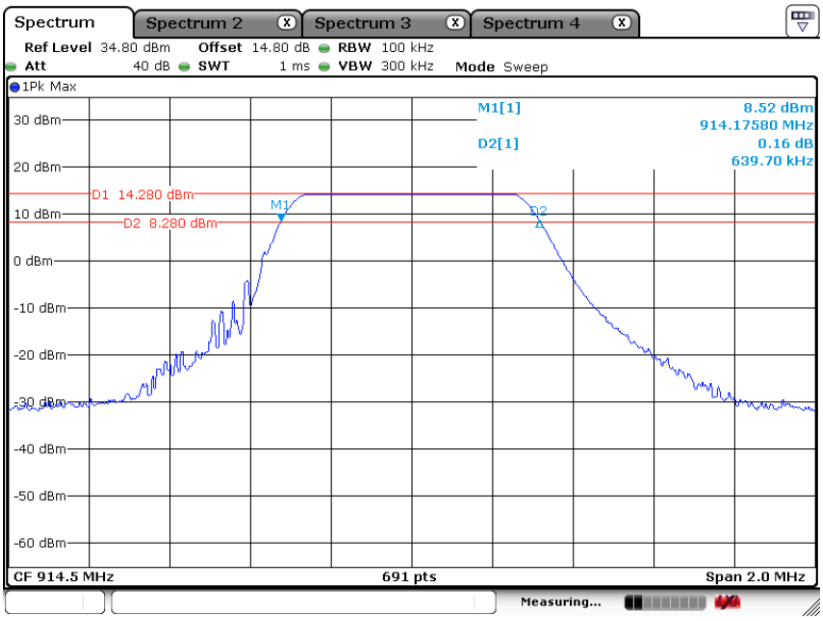
6 dB Bandwidth Plot on 914.5 MHz



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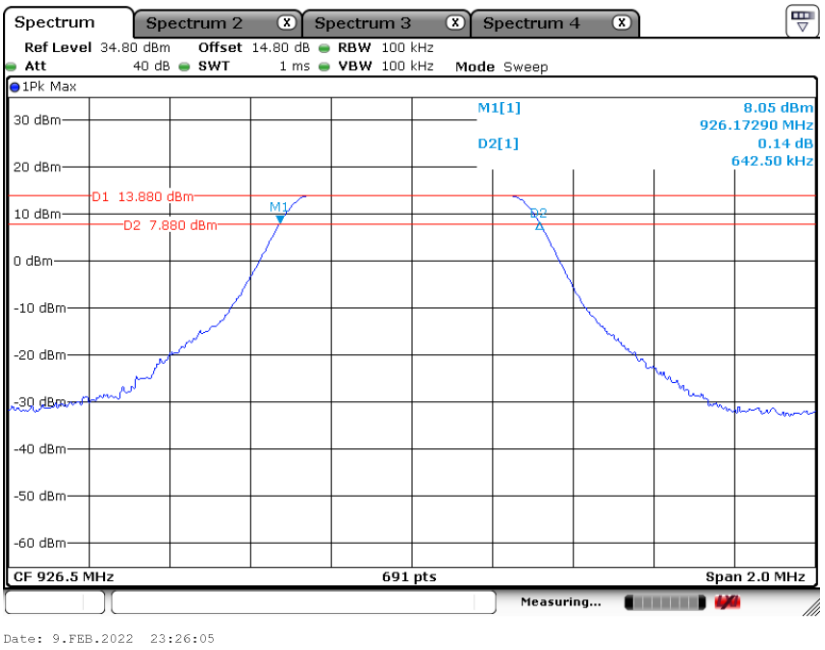
6 dB Bandwidth Plot on 926.5 MHz

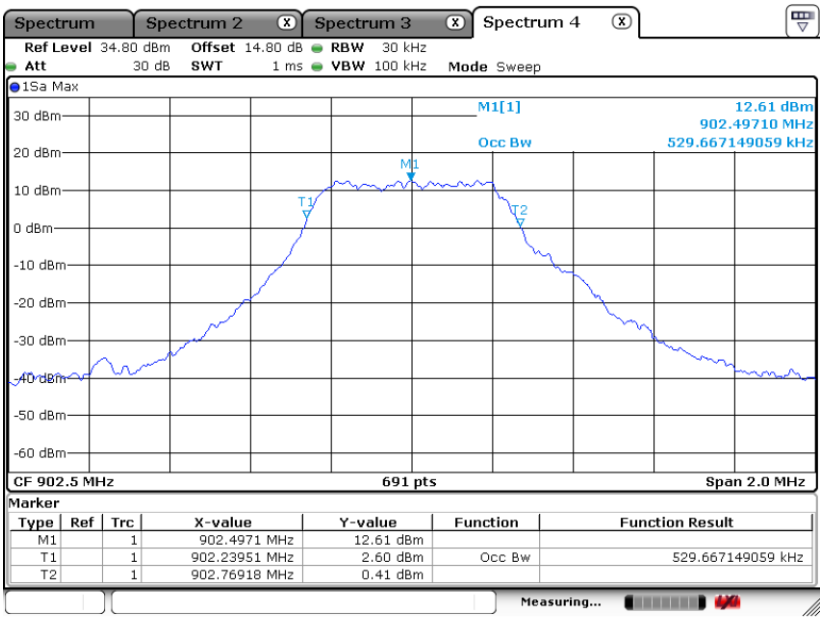


3.1.6 Test Result of 99% Occupied Bandwidth

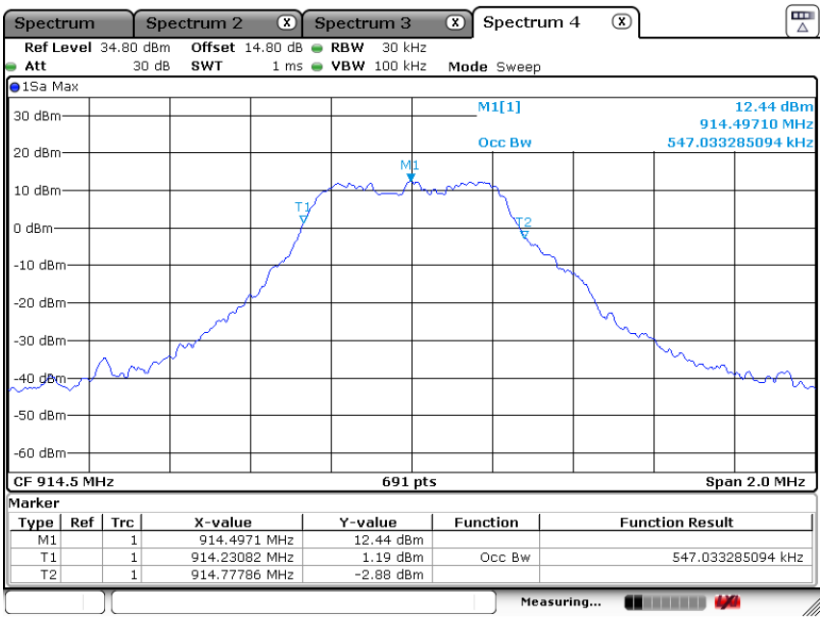
Please refer to Appendix A.

For SF5:

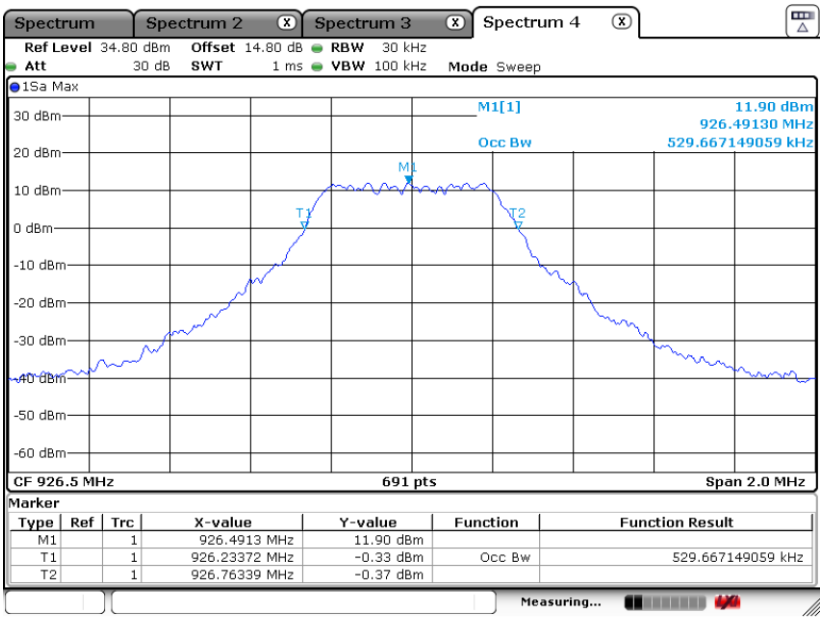
99% Bandwidth Plot on 902.5 MHz



99% Occupied Bandwidth Plot on 914.5 MHz

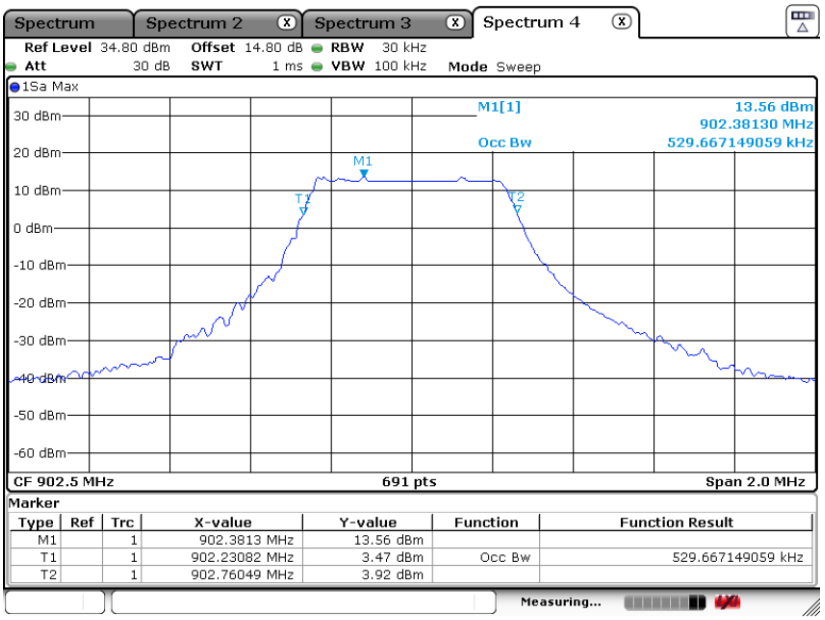


99% Occupied Bandwidth Plot on 926.5 MHz

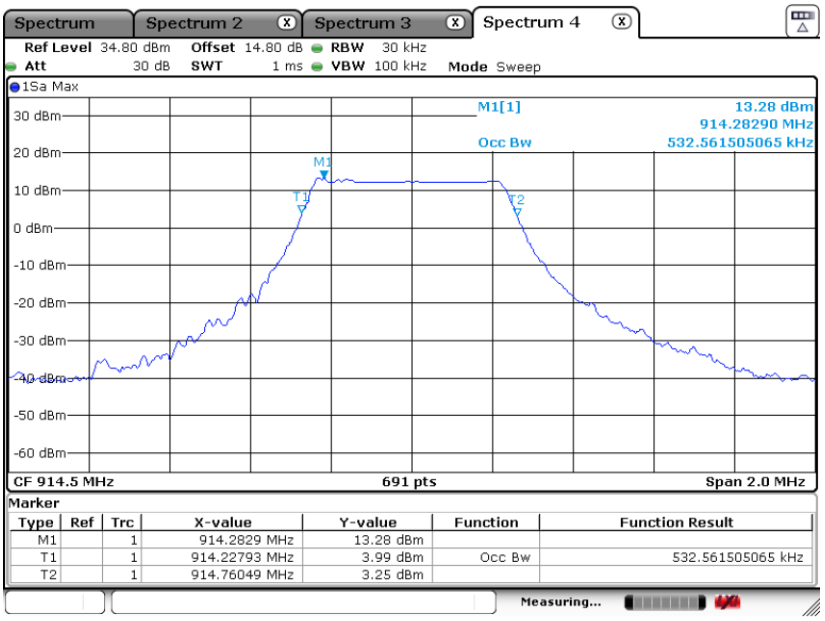


For SF7:

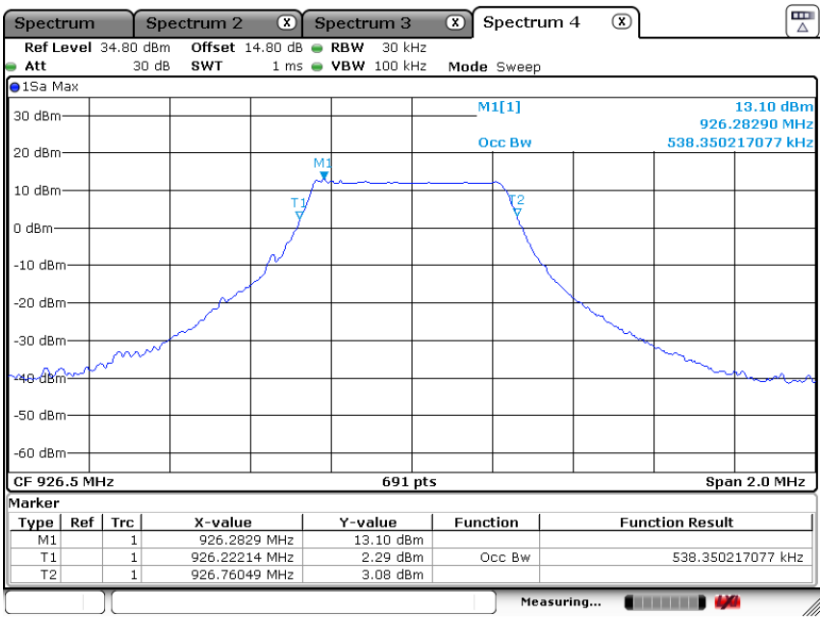
99% Bandwidth Plot on 902.5 MHz



99% Occupied Bandwidth Plot on 914.5 MHz

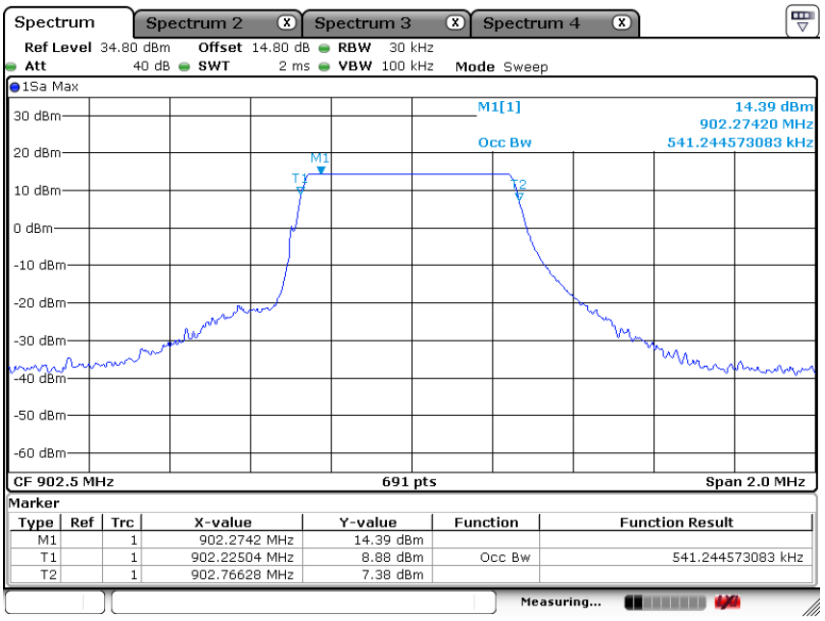


99% Occupied Bandwidth Plot on 926.5 MHz



For SF11:

99% Bandwidth Plot on 902.5MHz



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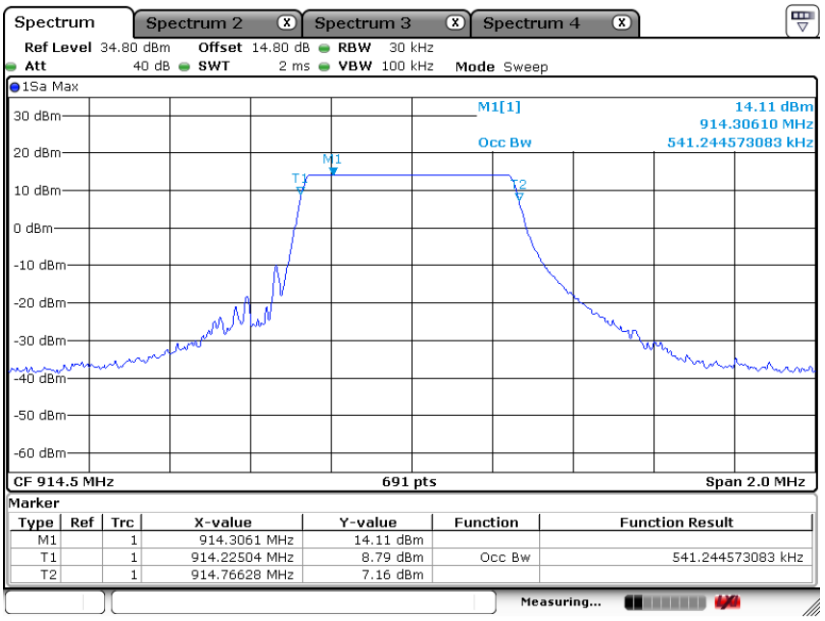
99% Bandwidth Plot on 914.5 MHz



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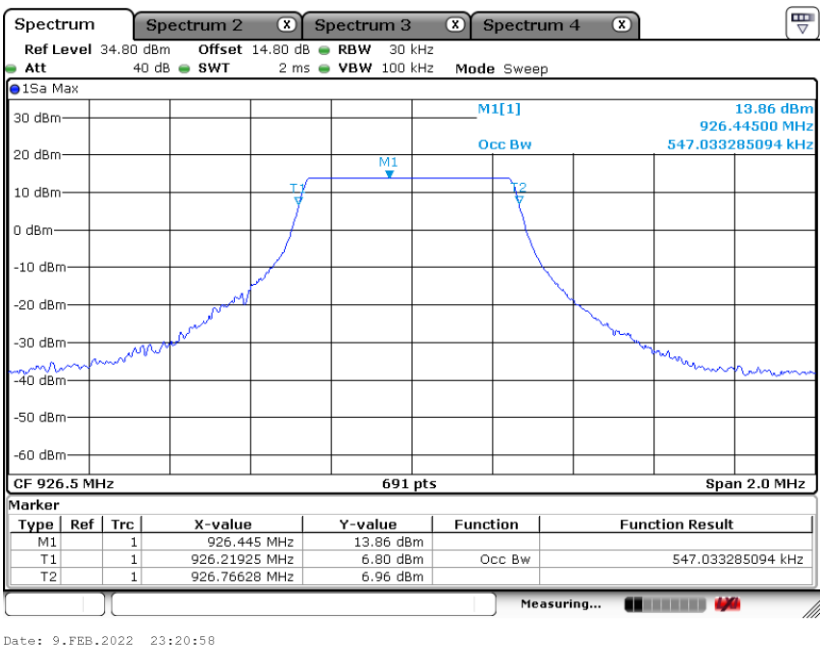
99% Bandwidth Plot on 926.5 MHz



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

3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 902-928MHz, the limit for output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

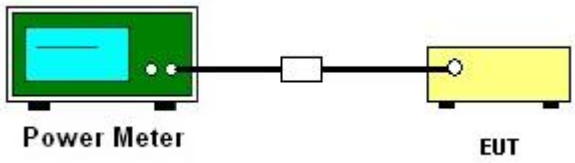
3.2.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.2.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.2.3.2 Method AVGPM-G method.
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 and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

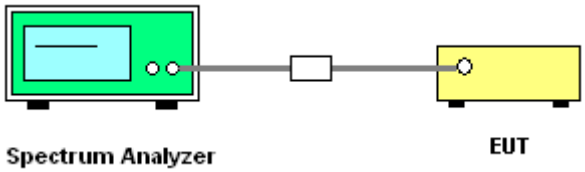
3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.3.3 Test Procedures

1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.5 Method AVGPSD-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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = power averaging (rms), Sweep time = auto couple. Use the peak marker function to determine the maximum power level.
6. Employ trace averaging (rms) mode over a minimum of 100 traces.
7. Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
8. Measure and record the results in the test report.
9. Add [10 log (1 / D)], where D is the duty cycle.
10. The Measured power density (dBm)/ 100kHz is a reference level and used as 30dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



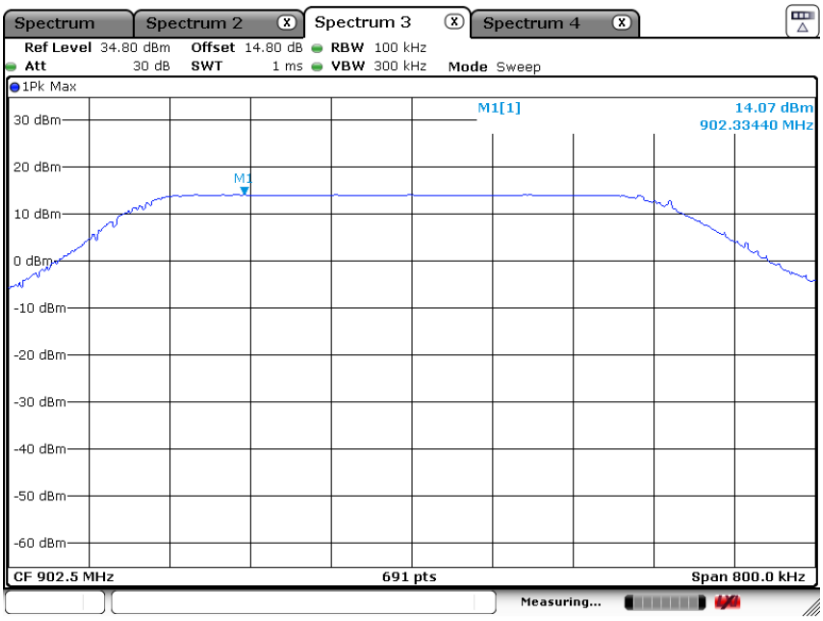
3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

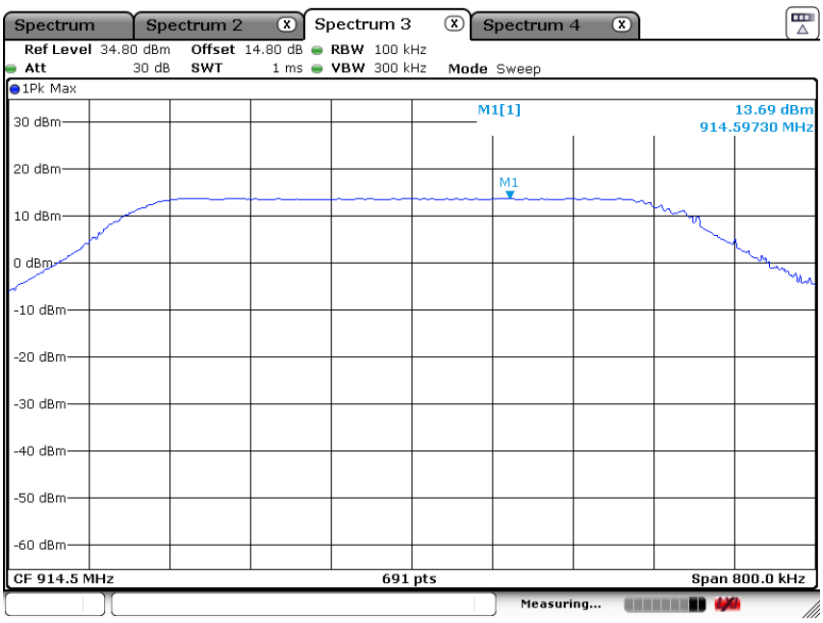
3.3.6 Test Result of Power Spectral Density Plots (100kHz)

For SF5:

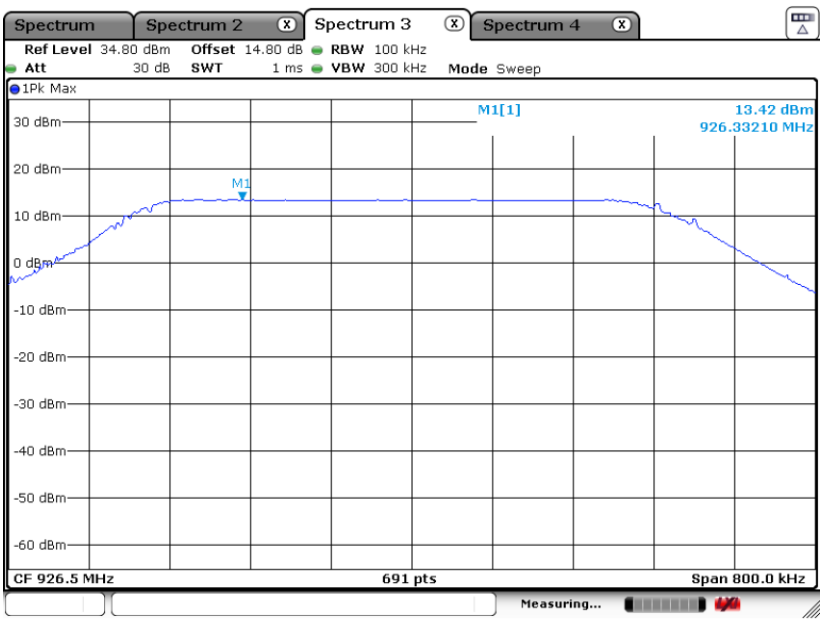
PSD 100kHz Plot on 902.5 MHz



PSD 100kHz Plot on 914.5 MHz

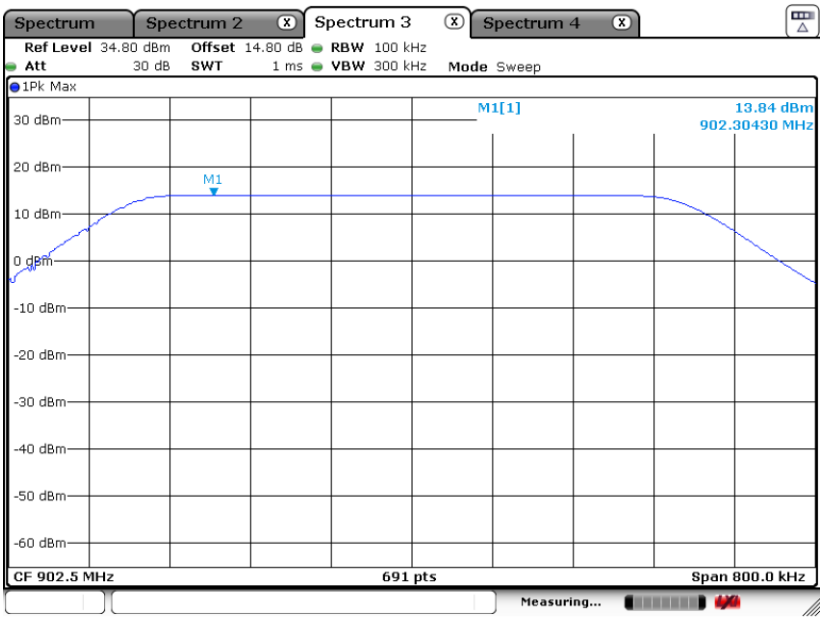


PSD 100kHz Plot on 926.5 MHz

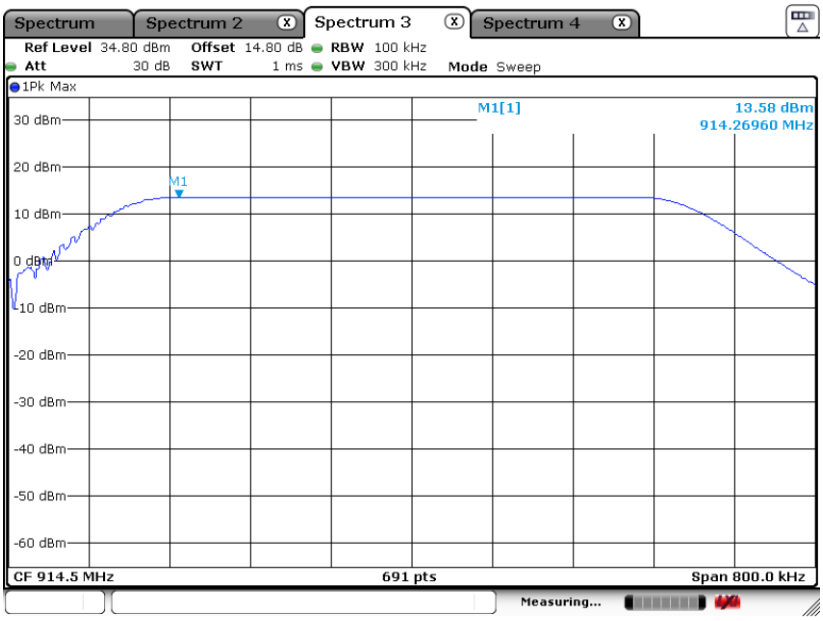


For SF7:

PSD 100kHz Plot on 902.5 MHz



PSD 100kHz Plot on 914.5 MHz



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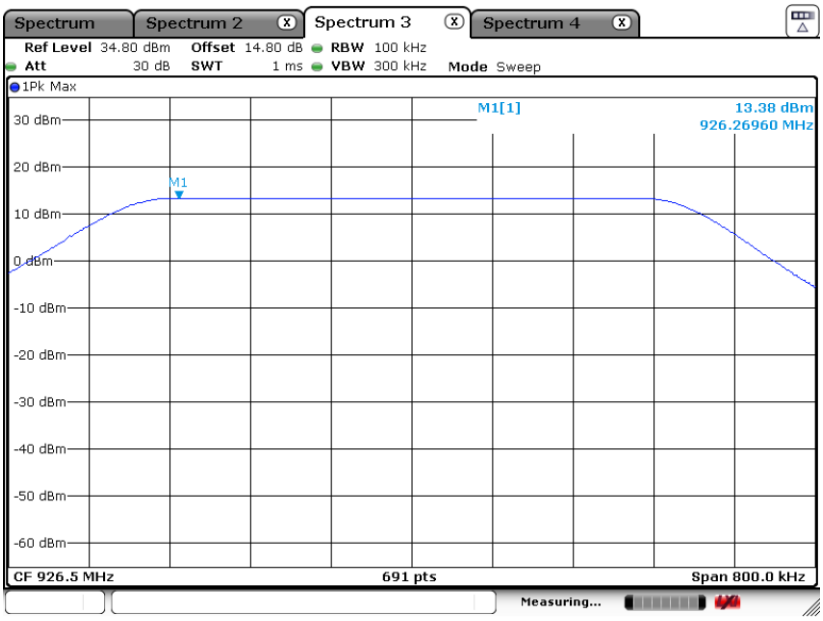
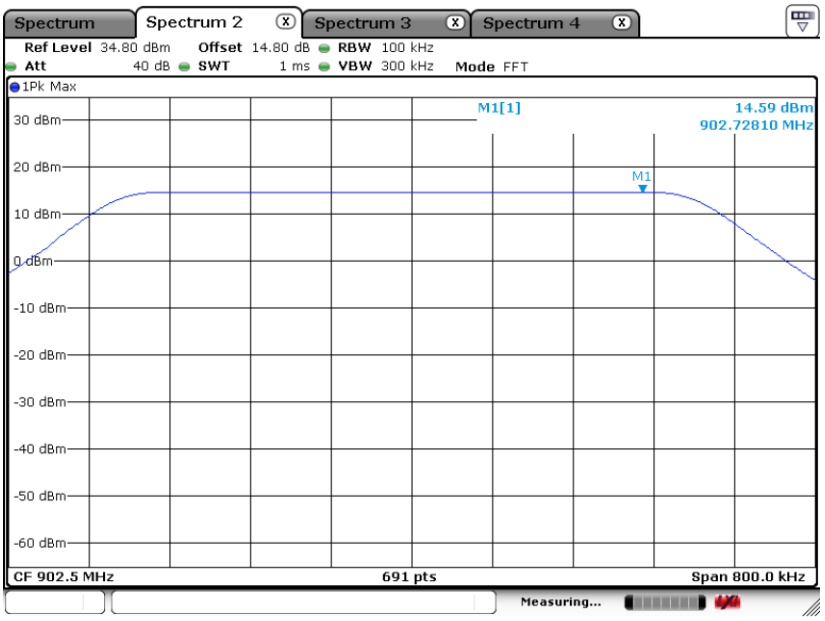
PSD 100kHz Plot on 926.5 MHz



Date: 23.FEB.2022 16:41:10

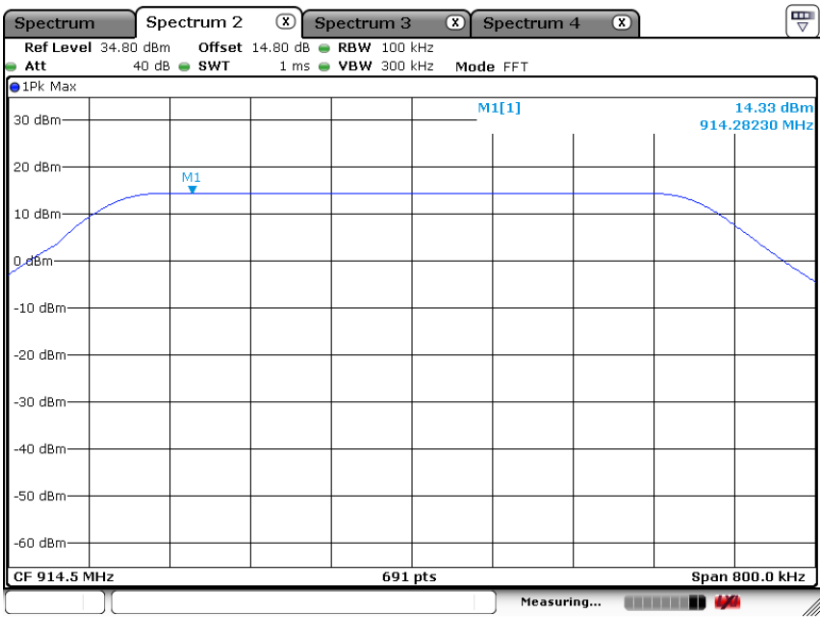
For SF11:

PSD 100kHz Plot on 902.5 MHz



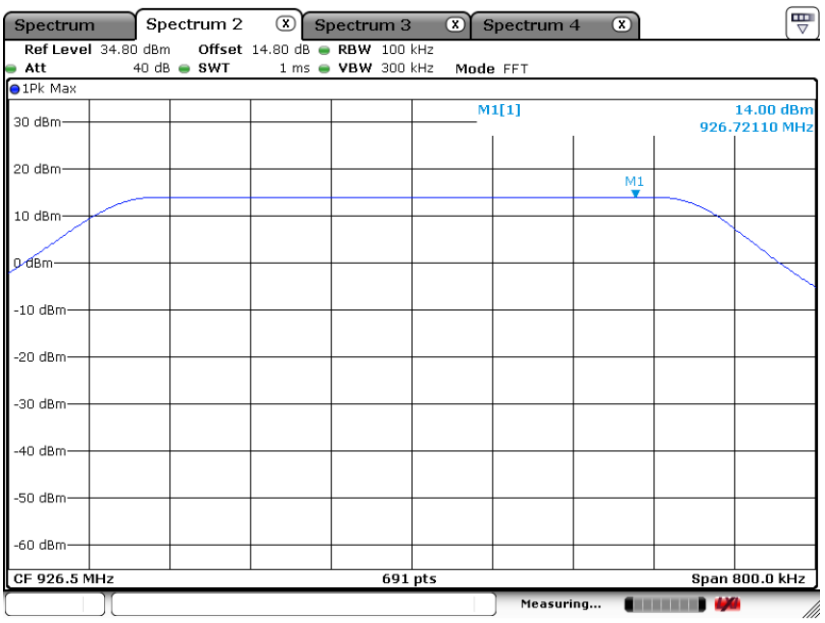
Date: 9.FEB.2022 22:58:19

PSD 100kHz Plot on 914.5 MHz



Date: 9.FEB.2022 23:41:56

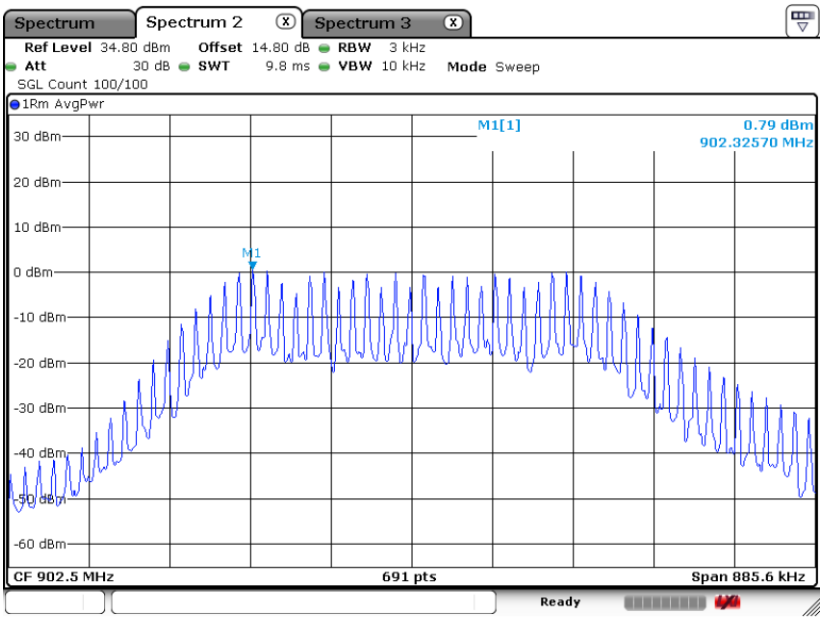
PSD 100kHz Plot on 926.5 MHz



3.3.7 Test Result of Power Spectral Density Plots (3kHz)

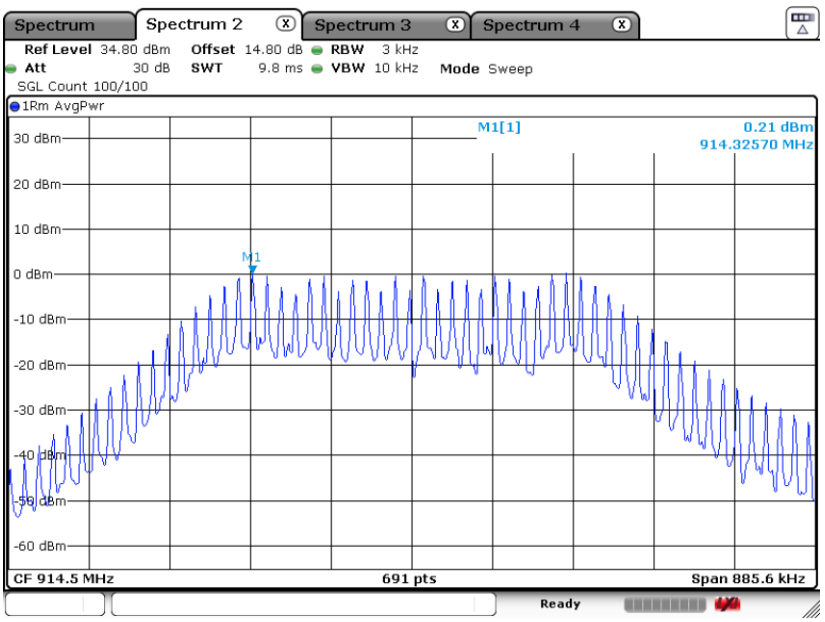
For SF5:

PSD 3kHz Plot on 902.5 MHz



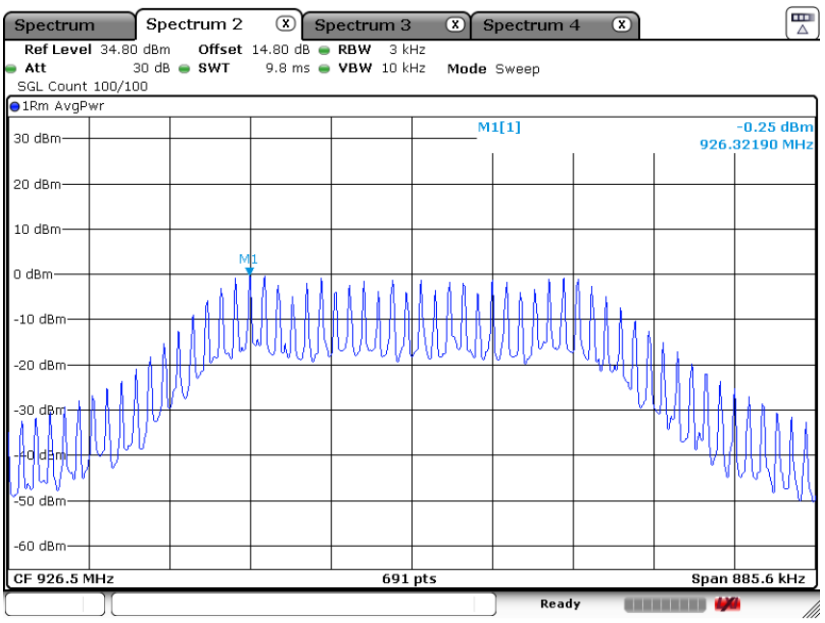
Date: 23.FEB.2022 13:40:23

PSD 3kHz Plot on 914.5 MHz



Date: 23.FEB.2022 14:39:49

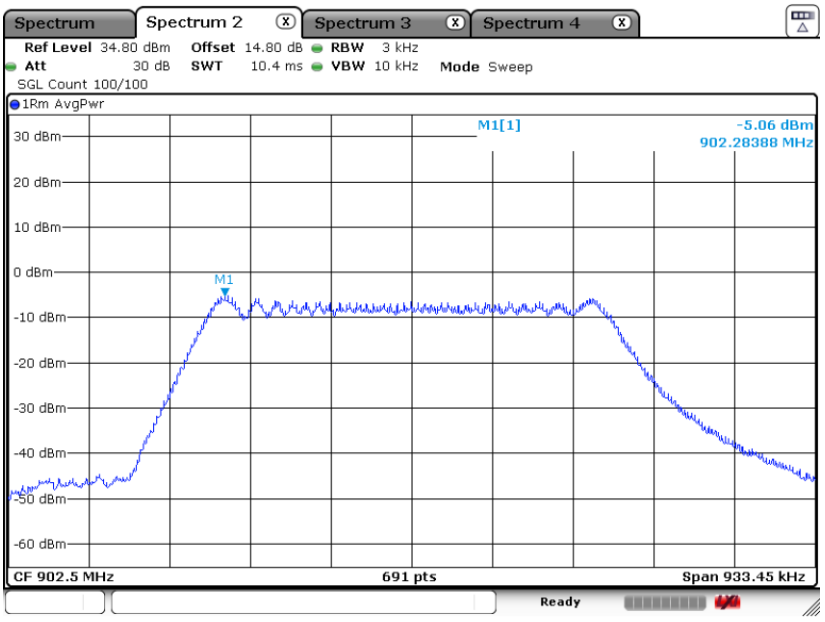
PSD 3kHz Plot on 926.5 MHz



Date: 23.FEB.2022 15:45:16

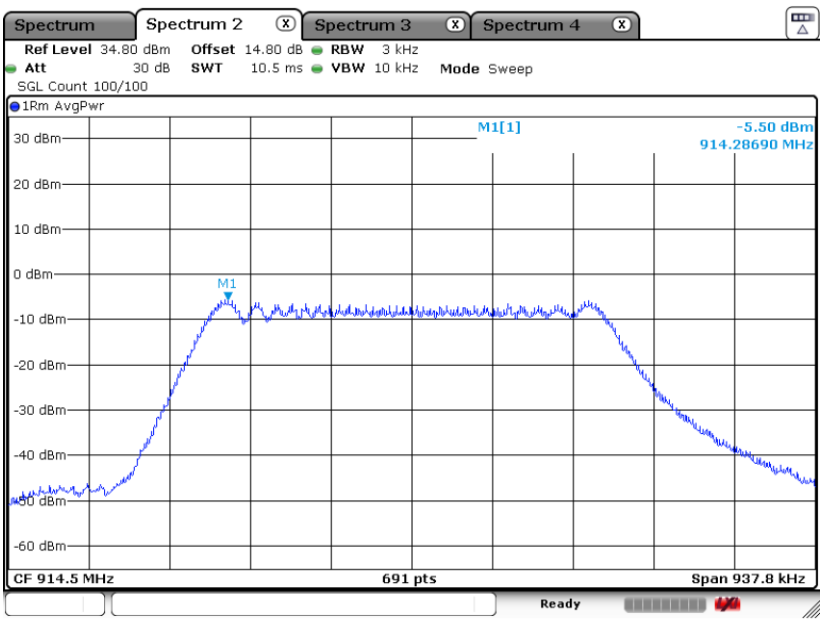
For SF7:

PSD 3kHz Plot on 902.5 MHz



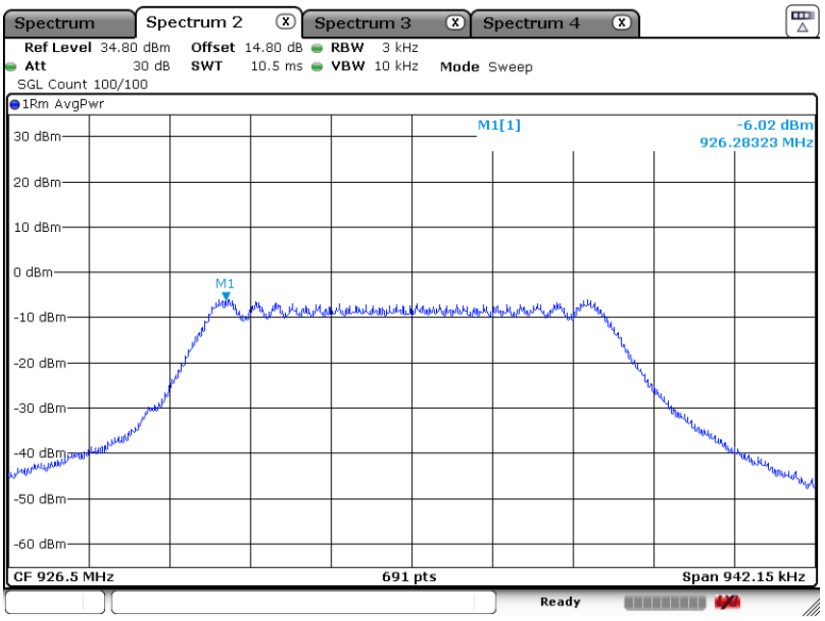
Date: 23.FEB.2022 16:25:31

PSD 3kHz Plot on 914.5 MHz



Date: 23.FEB.2022 16:33:40

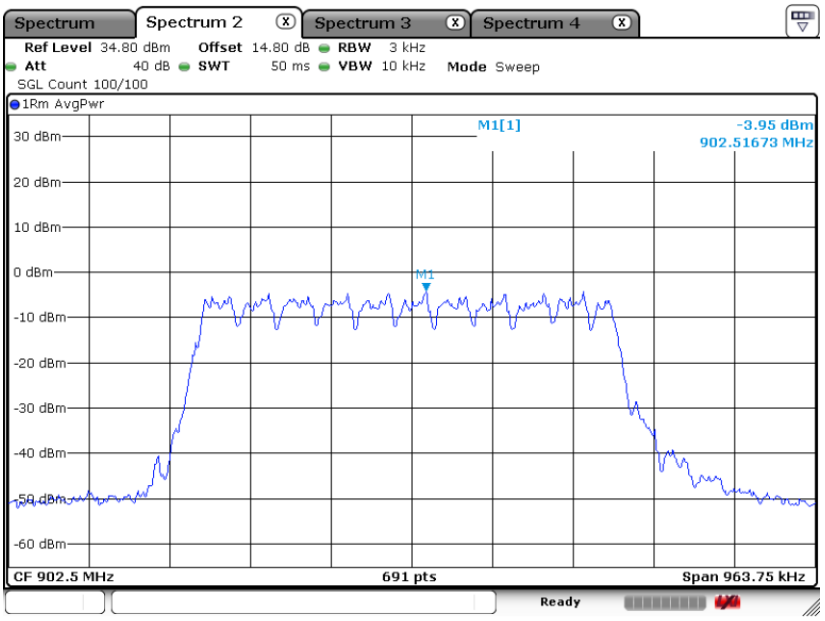
PSD 3kHz Plot on 926.5 MHz



Date: 23.FEB.2022 16:40:16

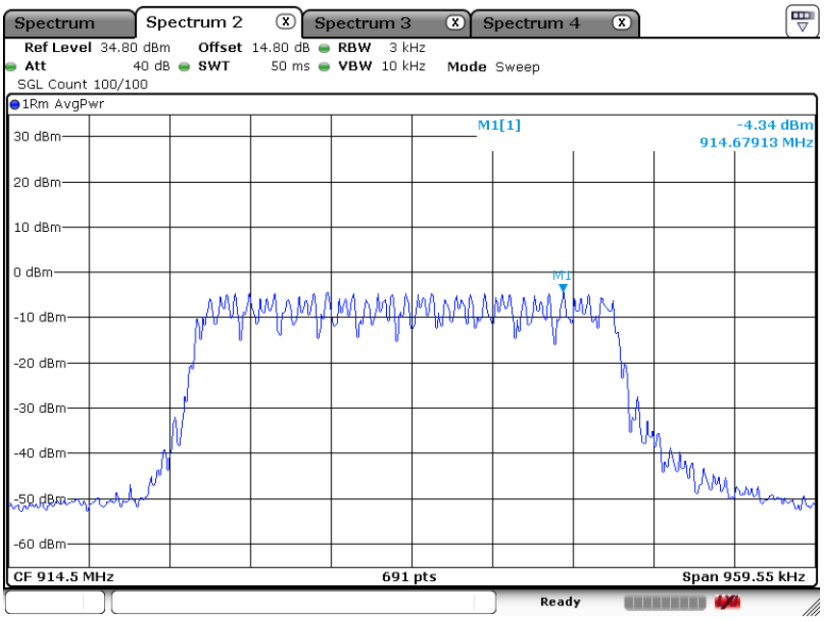
For SF11:

PSD 3kHz Plot on 902.5 MHz



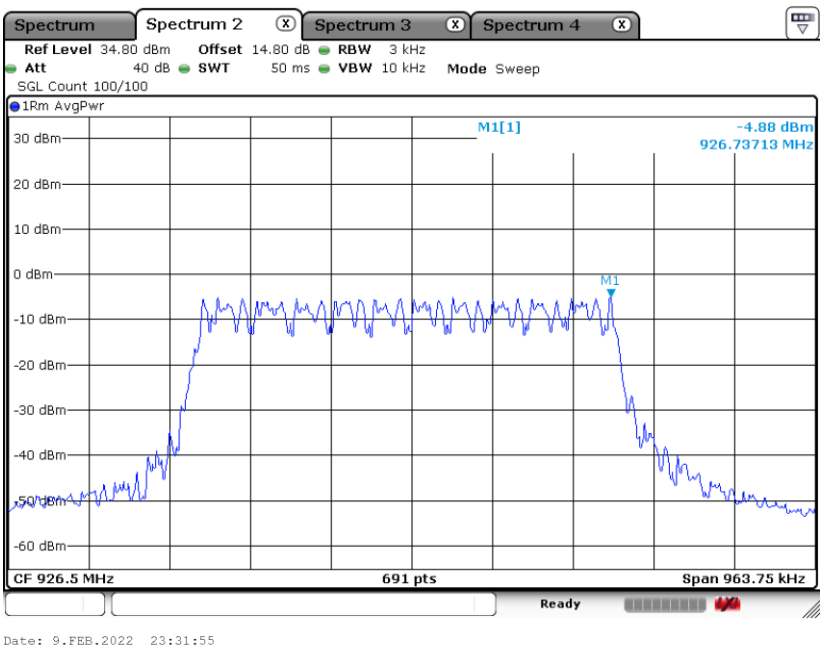
Date: 9.FEB.2022 22:54:29

PSD 3kHz Plot on 914.5 MHz



Date: 9.FEB.2022 23:40:27

PSD 3kHz Plot on 926.5 MHz



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 30 dB down from the highest emission level within the authorized band.

3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.4.3 Test Procedure

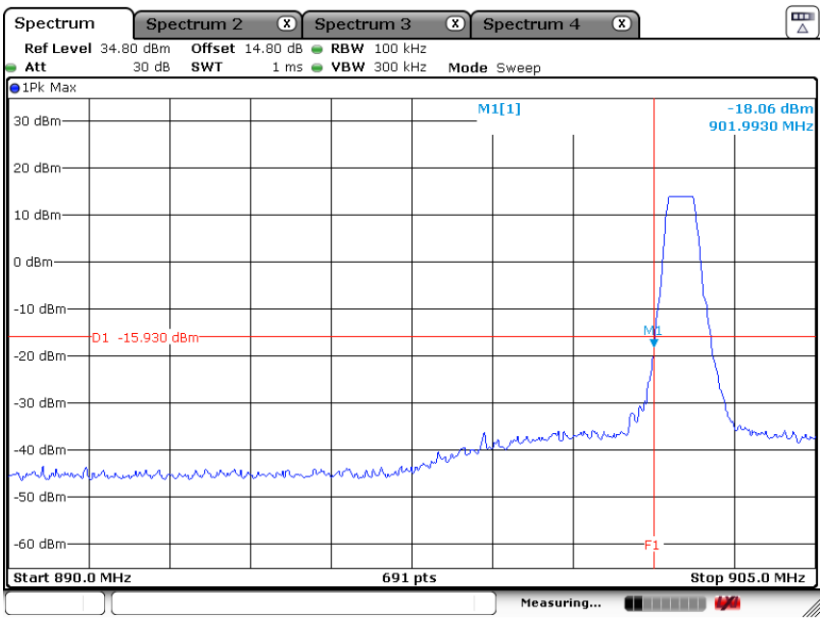
1. The testing follows ANSI C63.10-2013 clause 11.13
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
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.

3.4.4 Test Setup

3.4.5 Test Result of Conducted Band Edges Plots

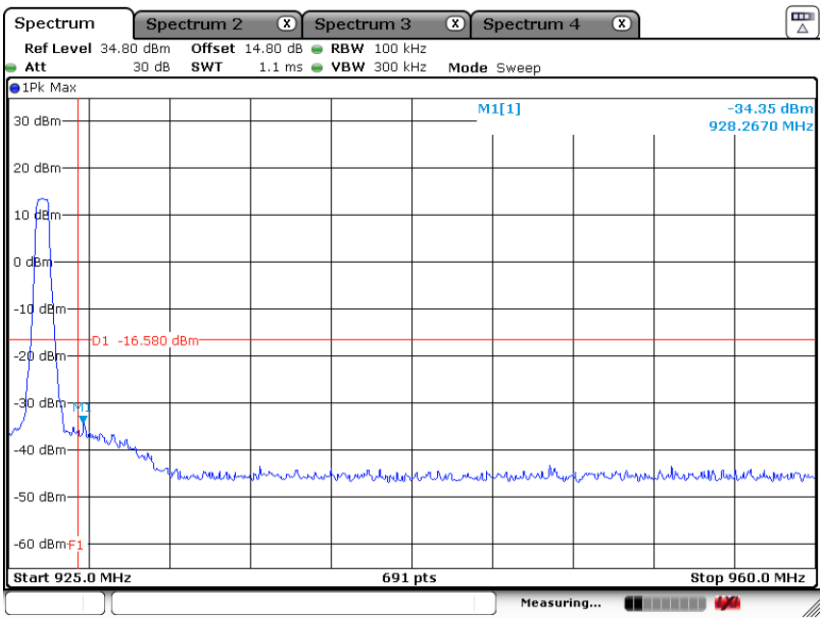
For SF5:

Low Band Edge Plot on 902.5 MHz



Date: 23.FEB.2022 14:31:03

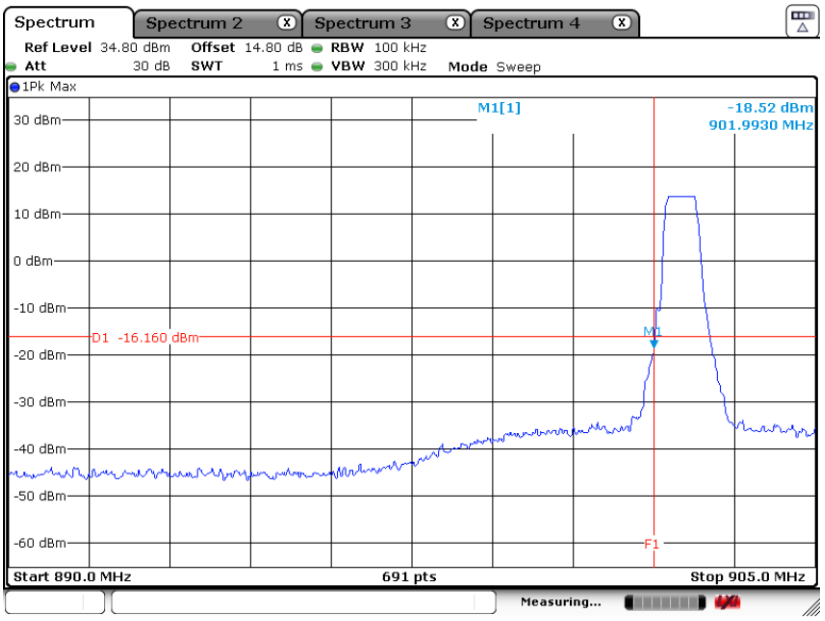
High Band Edge Plot on 926.5 MHz



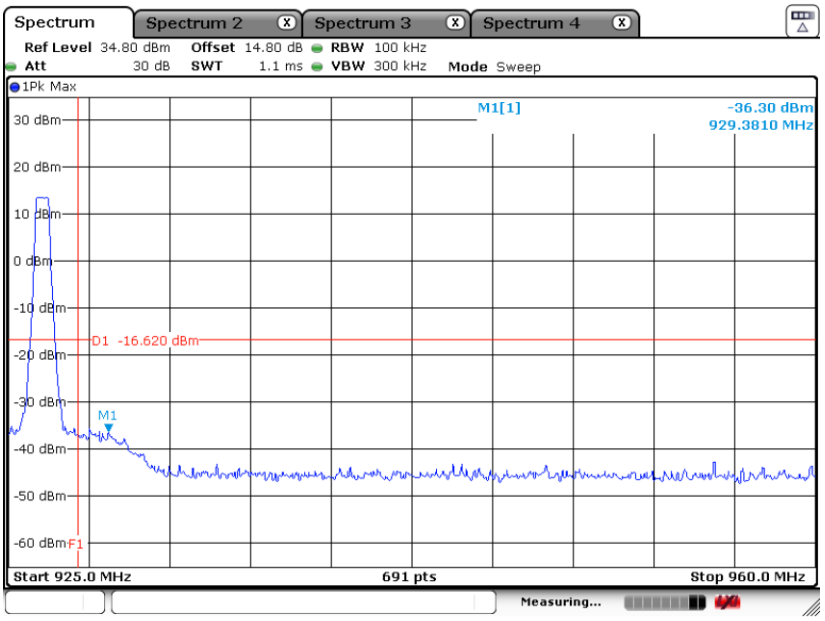
Date: 23.FEB.2022 15:50:17

For SF7:

Low Band Edge Plot on 902.5 MHz

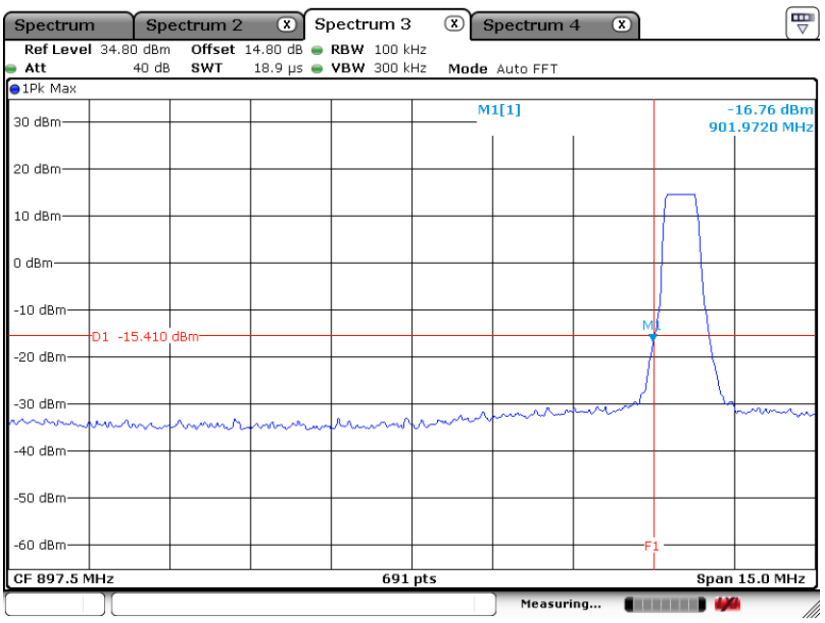


High Band Edge Plot on 926.5 MHz



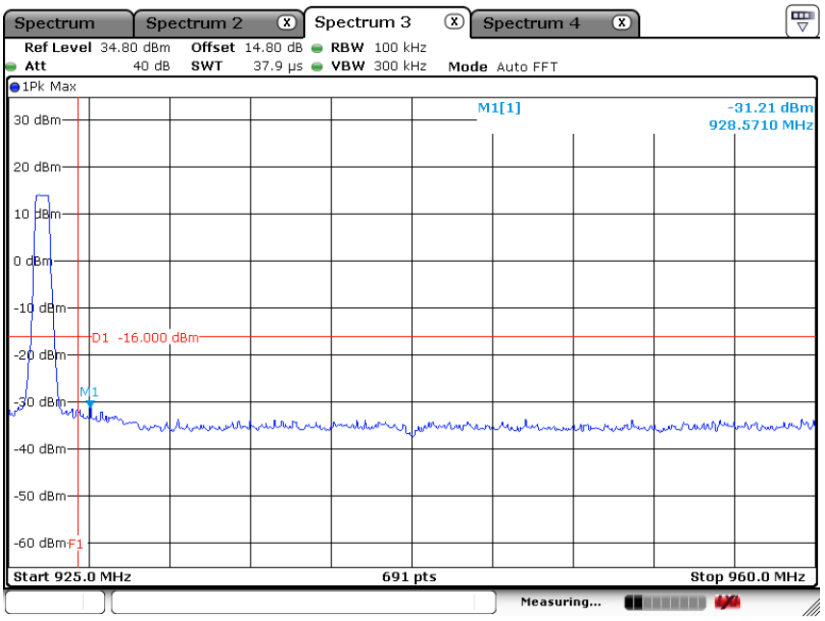
For SF11:

Low Band Edge Plot on 902.5 MHz



Date: 9.FEB.2022 23:07:31

High Band Edge Plot on 926.5 MHz

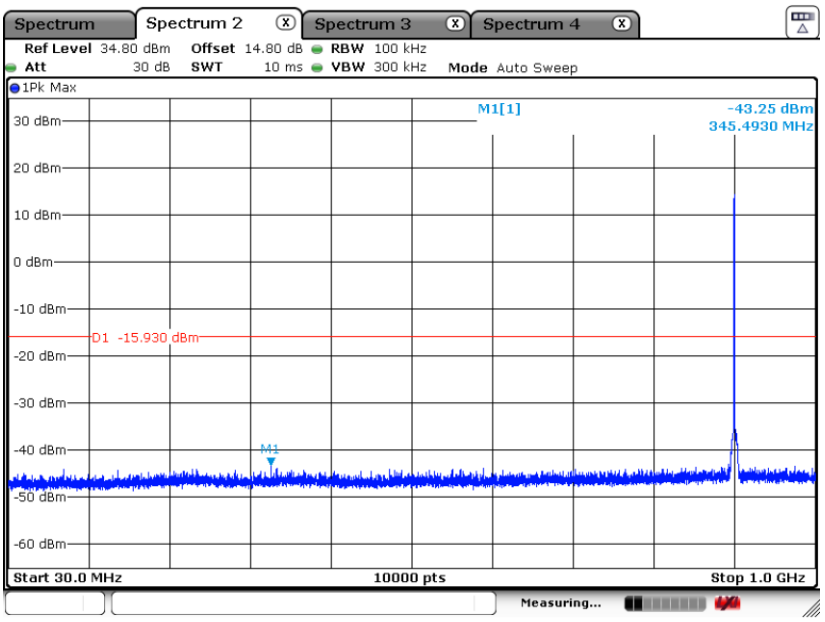


Date: 9.FEB.2022 23:33:49

3.4.6 Test Result of Conducted Spurious Emission Plots

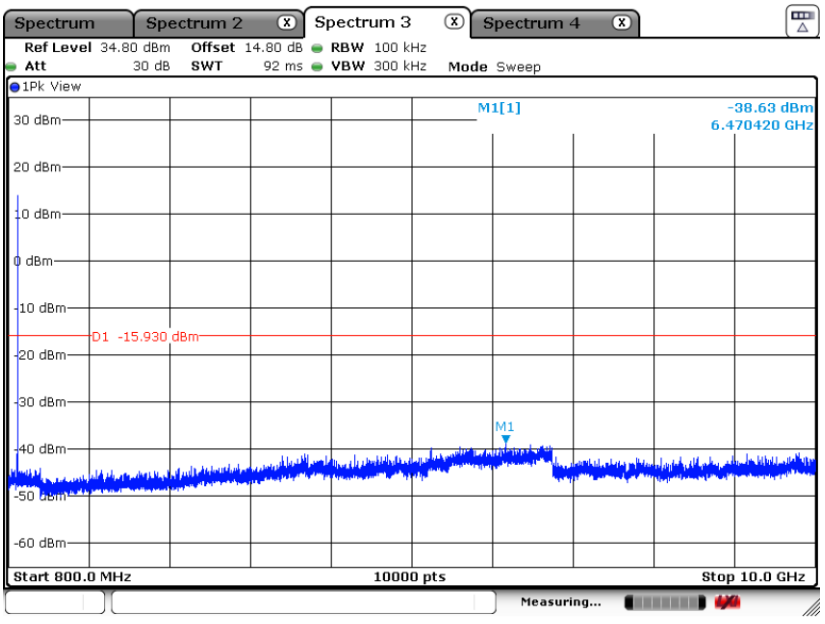
For SF5:

Conducted Spurious Emission Plot on 902.5 MHz



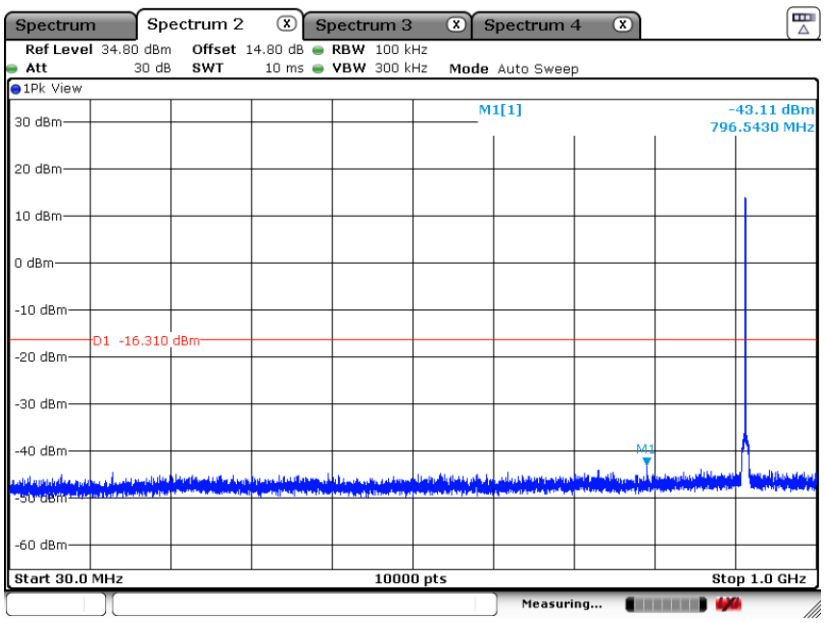
Date: 23.FEB.2022 14:33:31

Conducted Spurious Emission Plot on 902.5 MHz



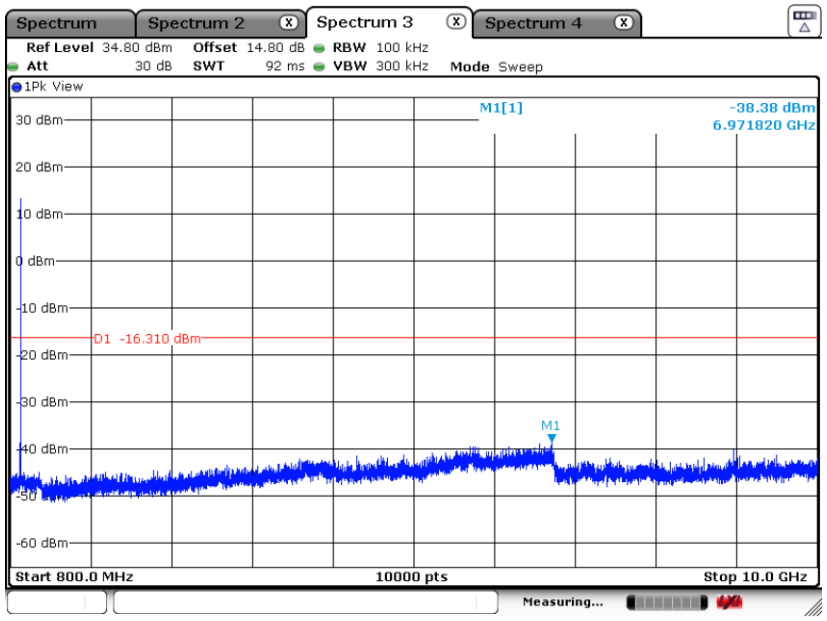
Date: 23.FEB.2022 14:36:07

Conducted Spurious Emission Plot on 914.5 MHz



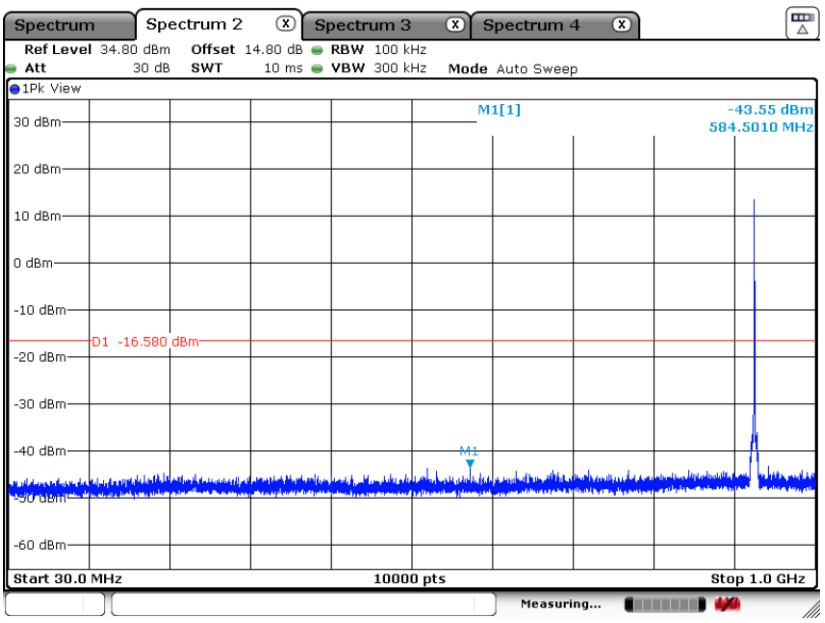
Date: 23.FEB.2022 15:39:48

Conducted Spurious Emission Plot on 914.5 MHz



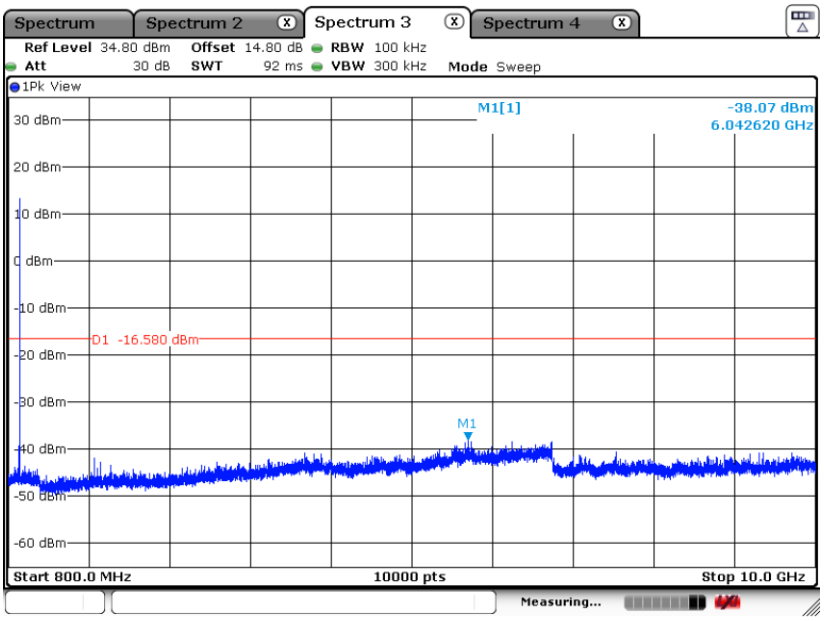
Date: 23.FEB.2022 15:42:29

Conducted Spurious Emission Plot on 926.5 MHz



Date: 23.FEB.2022 15:48:36

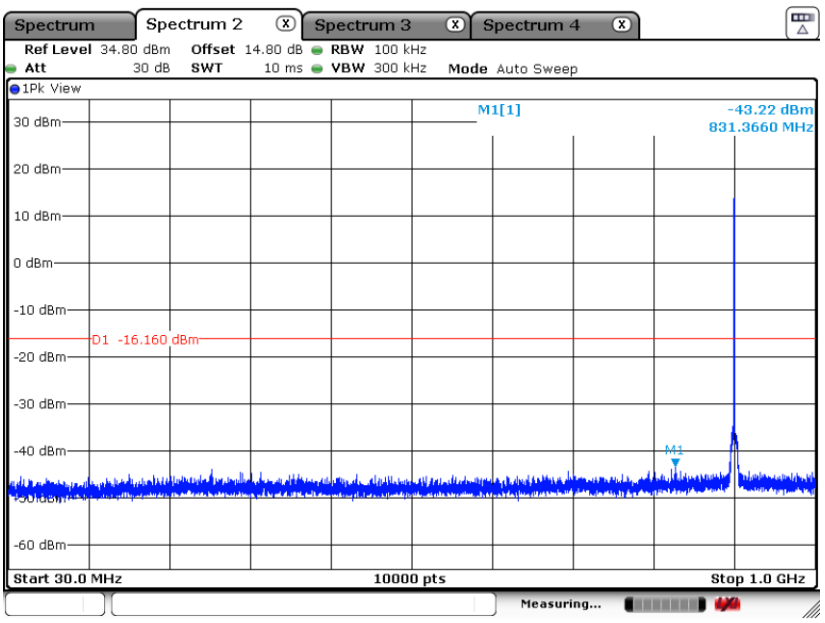
Conducted Spurious Emission Plot on 926.5 MHz



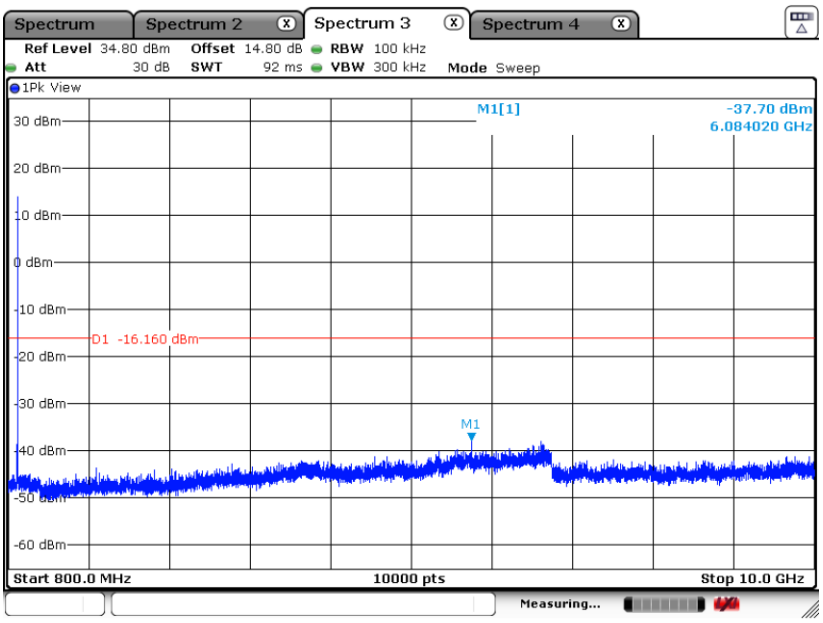
Date: 23.FEB.2022 15:47:28

For SF7:

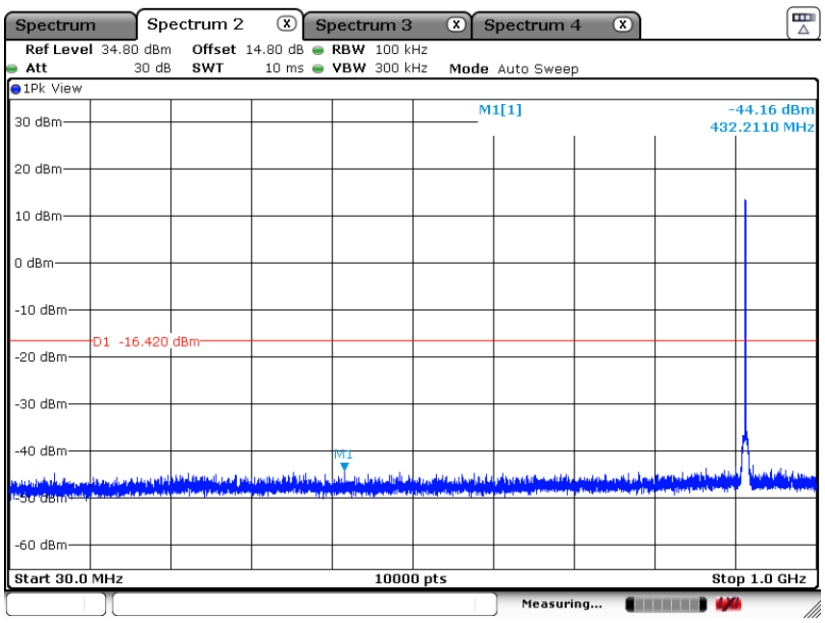
Conducted Spurious Emission Plot on 902.5 MHz



Conducted Spurious Emission Plot on 902.5 MHz

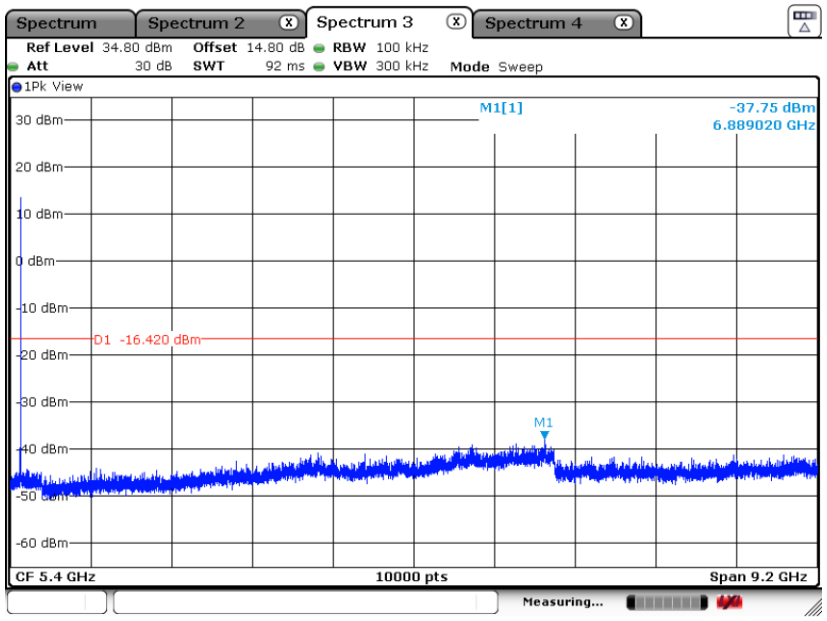


Conducted Spurious Emission Plot on 914.5 MHz



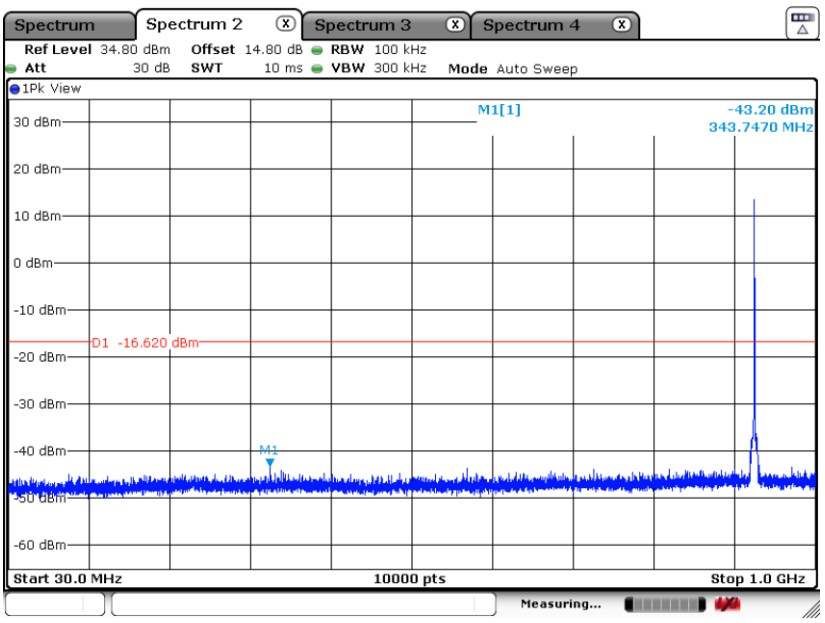
Date: 23.FEB.2022 16:36:04

Conducted Spurious Emission Plot on 914.5 MHz

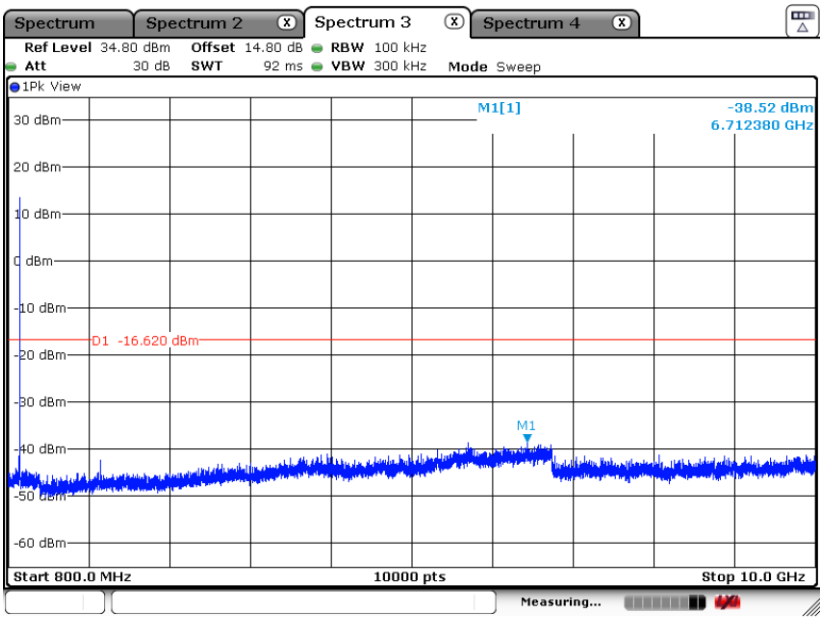


Date: 23.FEB.2022 16:37:45

Conducted Spurious Emission Plot on 926.5 MHz

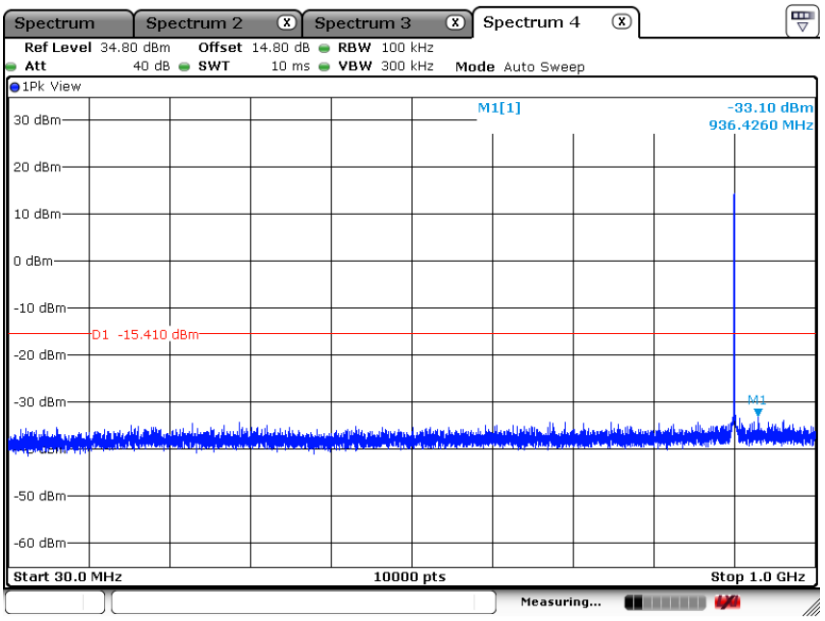


Conducted Spurious Emission Plot on 926.5 MHz

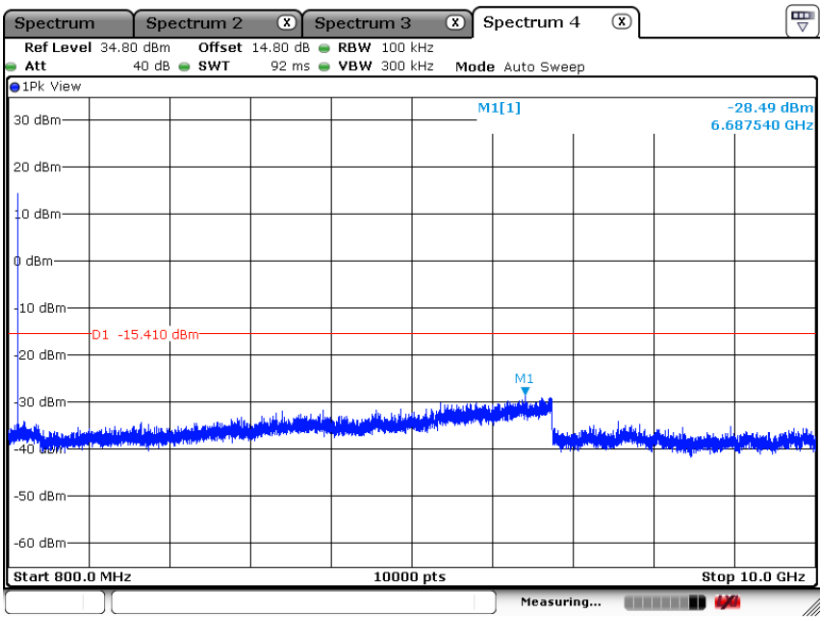


For SF11:

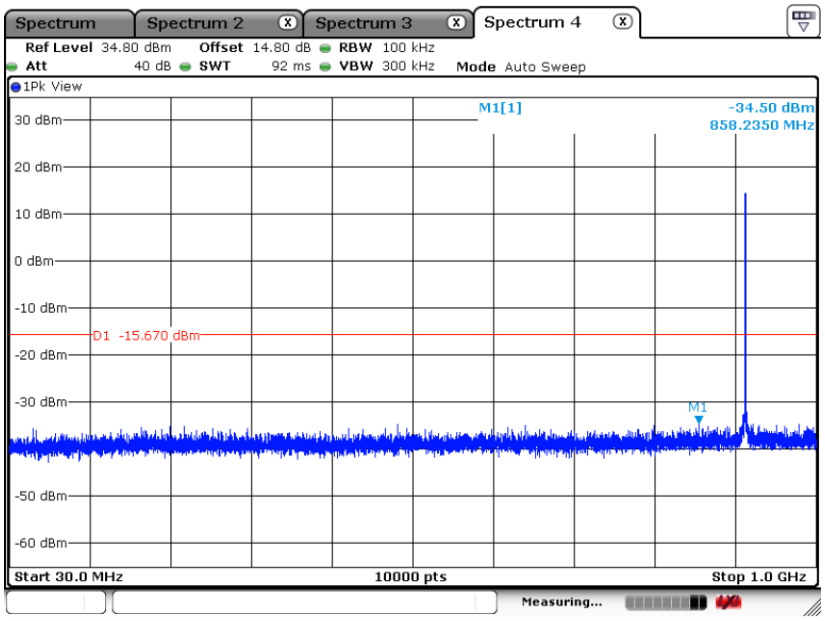
Conducted Spurious Emission Plot on 902.5 MHz



Conducted Spurious Emission Plot on 902.5 MHz

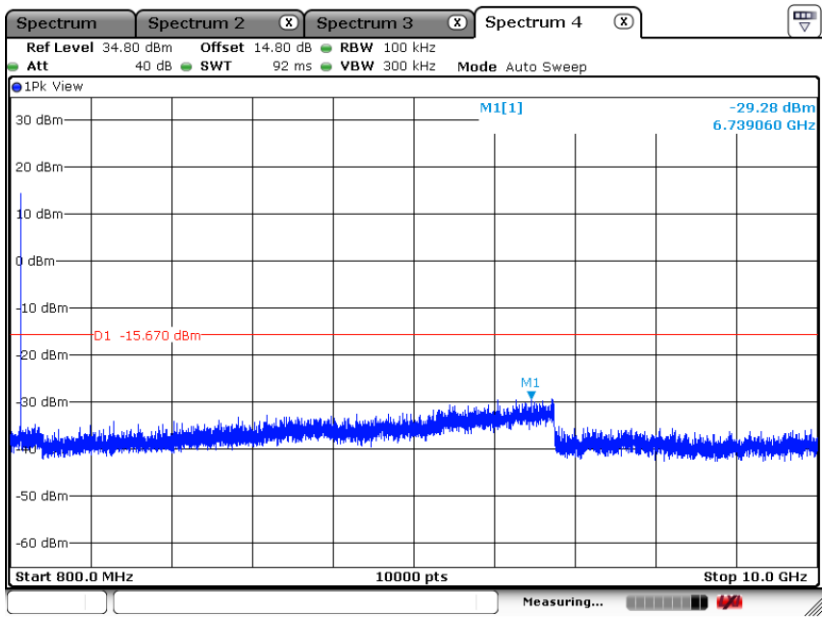


Conducted Spurious Emission Plot on 914.5 MHz



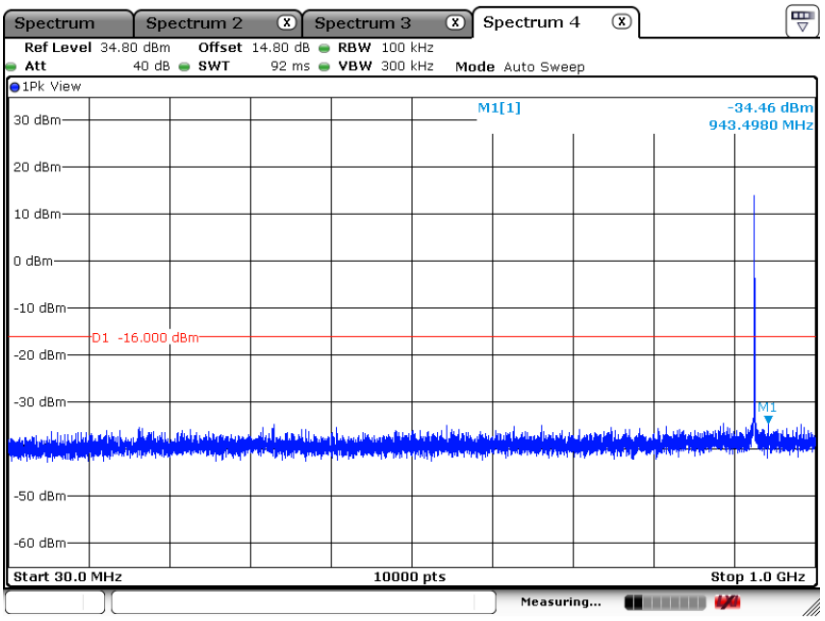
Date: 9.FEB.2022 23:43:15

Conducted Spurious Emission Plot on 914.5 MHz

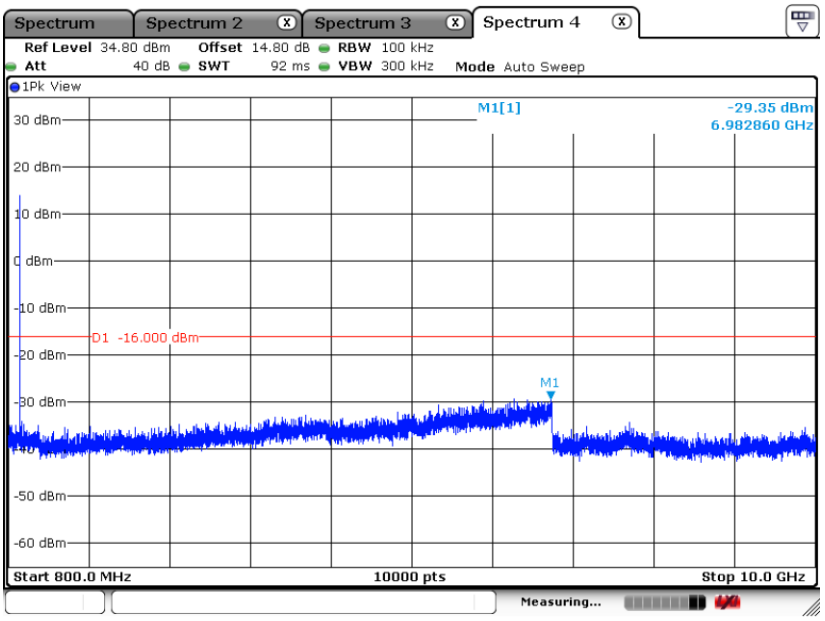


Date: 9.FEB.2022 23:43:54

Conducted Spurious Emission Plot on 926.5 MHz



Conducted Spurious Emission Plot on 926.5 MHz



3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and 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. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. 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

3.5.2 Measuring Instruments

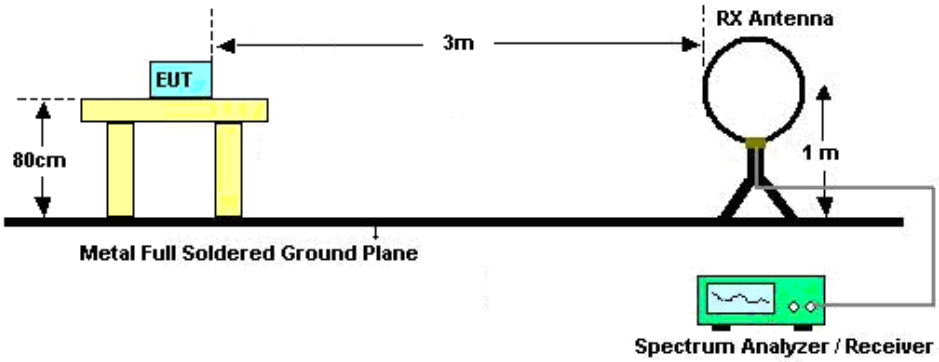
The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.5.3 Test Procedures

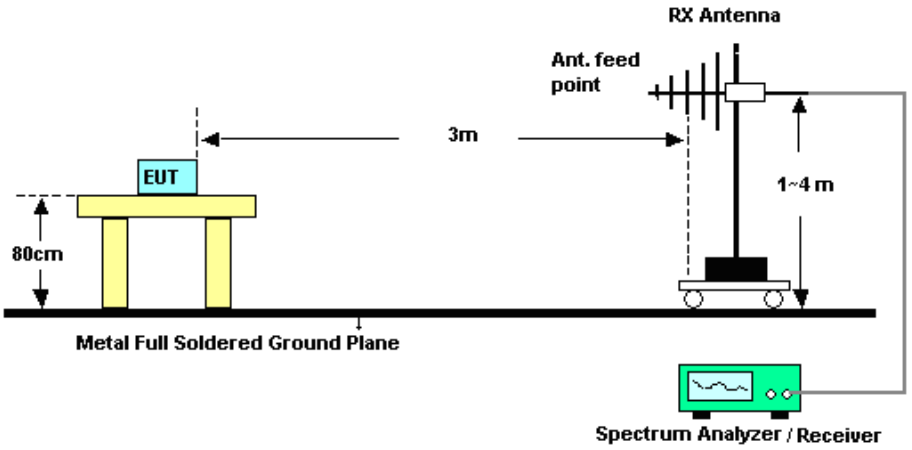
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. 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.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. 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.
7. 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.
8. 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 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

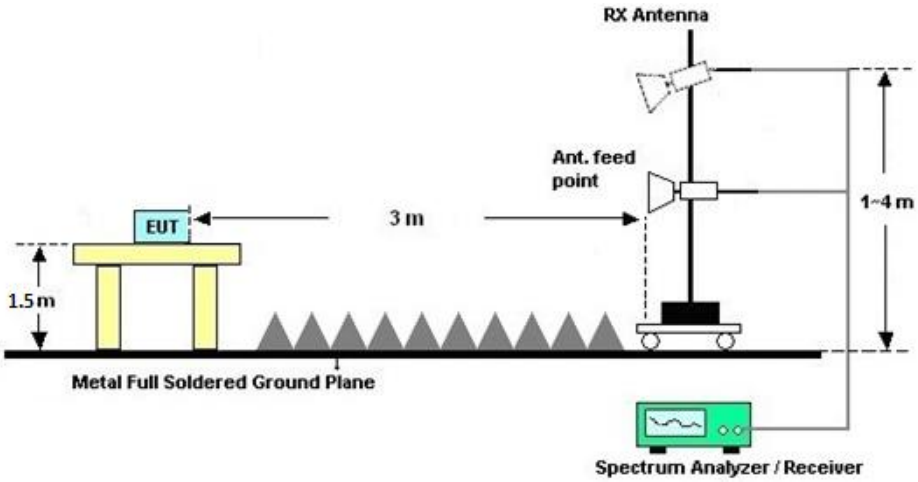
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.5.5 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.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.5.7 Duty Cycle

Please refer to Appendix D.

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

Please refer to Appendix C.

3.6 AC Conducted Emission Measurement

3.6.1 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.

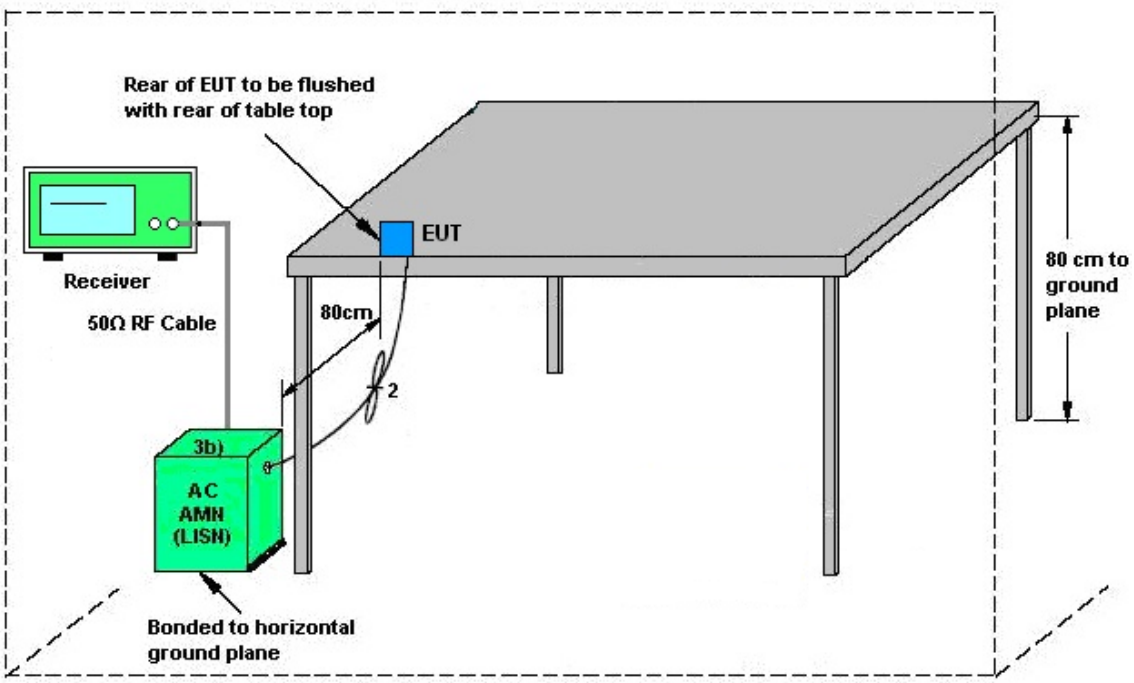
3.6.2 Measuring Instruments

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

3.6.3 Test Procedures

1. 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.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. 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.

3.6.4 Test Setup



AMN = Artificial mains network (LISN)
AE = Associated equipment
EUT = Equipment under test
ISN = Impedance stabilization network

3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

3.7 Antenna Requirements

3.7.1 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.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 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	101040	10Hz~40GHz	Oct. 14, 2021	Feb. 09, 2022~ Feb. 23, 2022	Oct. 13, 2022	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 05, 2022	Feb. 09, 2022~ Feb. 23, 2022	Jan. 04, 2023	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 05, 2022	Feb. 09, 2022~ Feb. 23, 2022	Jan. 04, 2023	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY57290151	3Hz~8.5GHz;Max 30dBm	Jul. 12, 2021	Apr. 02, 2022	Jul. 11, 2022	Radiation (03CH04-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz-44G,MAX 30dB	Apr.13, 2021	Apr. 02, 2022	Apr. 12, 2022	Radiation (03CH04-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 30, 2021	Apr. 02, 2022	Oct. 29, 2022	Radiation (03CH04-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz-1GHz	May 30, 2021	Apr. 02, 2022	May 29, 2022	Radiation (03CH04-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 25, 2021	Apr. 02, 2022	Apr. 24, 2022	Radiation (03CH04-KS)
Amplifier	Burgeon	BPA-530	102219	0.01MHz ~3000MHz	Nov 01, 2021	Apr. 02, 2022	Oct 31, 2022	Radiation (03CH04-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 05, 2022	Apr. 02, 2022	Jan. 04, 2023	Radiation (03CH04-KS)
Amplifier	Keysight	83017A	MY57280106	500MHz~26.5GHz	Oct. 12, 2021	Apr. 02, 2022	Oct. 11, 2022	Radiation (03CH04-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Apr. 02, 2022	NCR	Radiation (03CH04-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Apr. 02, 2022	NCR	Radiation (03CH04-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Apr. 02, 2022	NCR	Radiation (03CH04-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 20, 2022	Apr. 21, 2022	Apr. 19, 2023	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 14, 2021	Apr. 21, 2022	Oct. 13, 2022	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Apr. 20, 2022	Apr. 21, 2022	Apr. 19, 2023	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 14, 2021	Apr. 21, 2022	Oct. 13, 2022	Conduction (CO01-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. 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 Emission Measurement (150kHz ~ 30MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**2.9dB**

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 (1000 MHz ~ 18000 MHz)

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

Appendix A. Conducted Test Results

Report Number : FR090815-03A

Test Engineer:	Gene Wang	Temperature:	20~26	°C
Test Date:	2022/2/9~2022/2/23	Relative Humidity:	40~51	%

LoRa-DTS-Spreading Factor 5

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Channel	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
SF5	1	902.5Mhz	0.530	0.605	0.50	Pass
SF5	16	914.5Mhz	0.547	0.590	0.50	Pass
SF5	31	926.5Mhz	0.530	0.593	0.50	Pass

TEST RESULTS DATA
Average Power Table

Mod.	Channel	Freq. (MHz)	Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
SF5	1	902.5Mhz	15.16	30.00	-1.01	14.15	36.00	Pass
SF5	16	914.5Mhz	14.98	30.00	-1.01	13.97	36.00	Pass
SF5	31	926.5Mhz	14.61	30.00	-1.01	13.60	36.00	Pass

TEST RESULTS DATA
Average Power Table
(Duty Factor)

Mod.	Channel	Freq. (MHz)	Duty Factor (dB)
SF5	1	902.5Mhz	0.17
SF5	16	914.5Mhz	0.17
SF5	31	926.5Mhz	0.17

TEST RESULTS DATA
Peak Power Density

Mod.	Channel	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
SF5	1	902.5Mhz	14.07	0.79	-1.01	8.00	Pass
SF5	16	914.5Mhz	13.69	0.21	-1.01	8.00	Pass
SF5	31	926.5Mhz	13.42	-0.25	-1.01	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

Report Number : FR090815-03A

LoRa-DTS-Spreading Factor 7

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Channel	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
SF7	1	902.5Mhz	0.530	0.622	0.50	Pass
SF7	16	914.5Mhz	0.533	0.625	0.50	Pass
SF7	31	926.5Mhz	0.538	0.628	0.50	Pass

TEST RESULTS DATA
Average Power Table

Mod.	Channel	Freq. (MHz)	Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
SF7	1	902.5Mhz	15.09	30.00	-1.01	14.08	36.00	Pass
SF7	16	914.5Mhz	15.04	30.00	-1.01	14.03	36.00	Pass
SF7	31	926.5Mhz	14.41	30.00	-1.01	13.40	36.00	Pass

TEST RESULTS DATA
Average Power Table
(Duty Factor)

Mod.	Channel	Freq. (MHz)	Duty Factor (dB)
SF7	1	902.5Mhz	0.03
SF7	16	914.5Mhz	0.03
SF7	31	926.5Mhz	0.03

TEST RESULTS DATA
Peak Power Density

Mod.	Channel	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
SF7	1	902.5Mhz	13.84	-5.06	-1.01	8.00	Pass
SF7	16	914.5Mhz	13.58	-5.50	-1.01	8.00	Pass
SF7	31	926.5Mhz	13.38	-6.02	-1.01	8.00	Pass

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

LoRa-DTS-Spreading Factor 11

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

Mod.	Channel	Freq. (MHz)	99% Occupied BW (MHz)	6dB BW (MHz)	6dB BW Limit (MHz)	Pass/Fail
SF11	1	902.5Mhz	0.541	0.643	0.50	Pass
SF11	16	914.5Mhz	0.541	0.640	0.50	Pass
SF11	31	926.5Mhz	0.547	0.643	0.50	Pass

TEST RESULTS DATA
Average Power Table

Mod.	Channel	Freq. (MHz)	Conducted Power (dBm)	Conducted Power Limit (dBm)	DG (dBi)	EIRP Power (dBm)	EIRP Power Limit (dBm)	Pass /Fail
SF11	1	902.5Mhz	15.17	30.00	-1.01	14.16	36.00	Pass
SF11	16	914.5Mhz	15.06	30.00	-1.01	14.05	36.00	Pass
SF11	31	926.5Mhz	14.70	30.00	-1.01	13.69	36.00	Pass

TEST RESULTS DATA
Average Power Table
(Duty Factor)

Mod.	Channel	Freq. (MHz)	Duty Factor (dB)
SF11	1	902.5Mhz	0.00
SF11	16	914.5Mhz	0.00
SF11	31	926.5Mhz	0.00

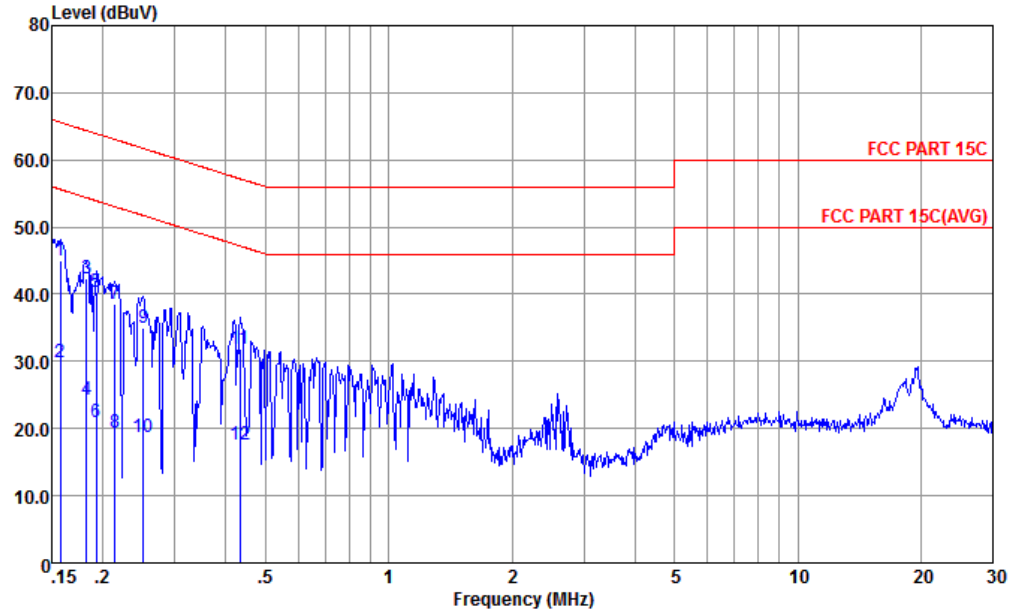
TEST RESULTS DATA
Peak Power Density

Mod.	Channel	Freq. (MHz)	Peak PSD (dBm /100kHz)	Peak PSD (dBm /3kHz)	DG (dBi)	Peak PSD Limit (dBm /3kHz)	Pass/Fail
SF11	1	902.5Mhz	14.59	-3.95	-1.01	8.00	Pass
SF11	16	914.5Mhz	14.33	-4.34	-1.01	8.00	Pass
SF11	31	926.5Mhz	14.00	-4.88	-1.01	8.00	Pass

Note:，PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

Appendix B. AC Conducted Emission Test Results

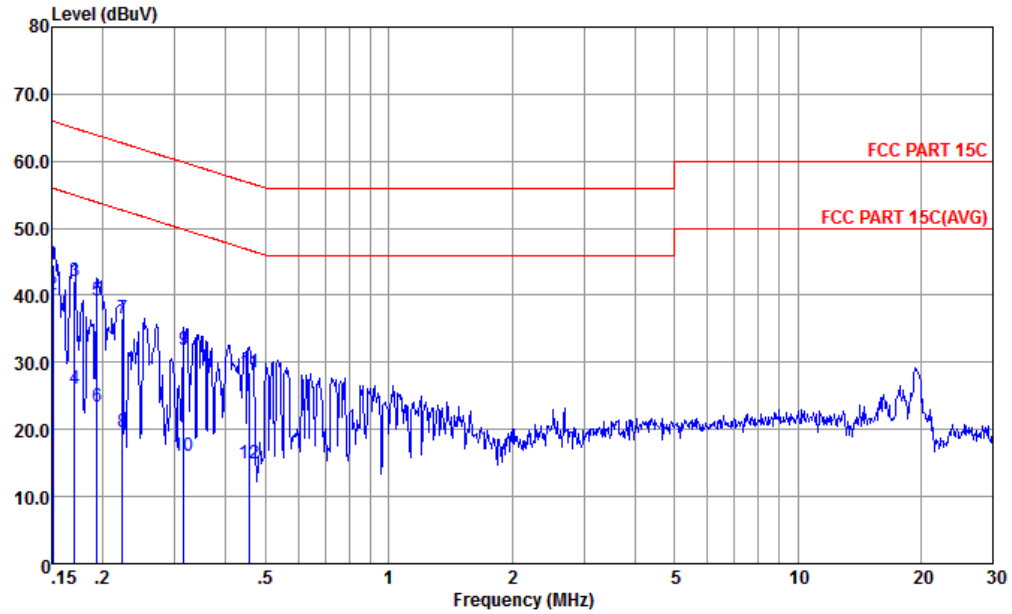
Test Engineer :	Amos Zhang	**Temperature :**	24.2~25.6℃
		Relative Humidity :	37~39%
Test Voltage :	120Vac / 60Hz	**Phase :**	Line



Site : CO01-KS
Condition : FCC PART 15C LISN-060105-L LINE

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	*	0.157	44.98	-20.62	65.60	34.50	0.02	10.46	QP
2		0.157	29.78	-25.82	55.60	19.30	0.02	10.46	Average
3		0.182	42.23	-22.14	64.37	31.80	0.03	10.40	QP
4		0.182	24.33	-30.04	54.37	13.90	0.03	10.40	Average
5		0.192	40.32	-23.61	63.93	29.90	0.04	10.38	QP
6		0.192	21.02	-32.91	53.93	10.60	0.04	10.38	Average
7		0.214	38.60	-24.45	63.05	28.20	0.05	10.35	QP
8		0.214	19.30	-33.75	53.05	8.90	0.05	10.35	Average
9		0.251	34.89	-26.84	61.73	24.50	0.06	10.33	QP
10		0.251	18.69	-33.04	51.73	8.30	0.06	10.33	Average
11		0.433	31.95	-25.25	57.20	21.60	0.09	10.26	QP
12		0.433	17.65	-29.55	47.20	7.30	0.09	10.26	Average

Test Engineer :	Amos Zhang	Temperature :	24.2~25.6℃
		Relative Humidity :	37~39%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral



Site : CO01-KS
Condition : FCC PART 15C LISN-060105-N NEUTRAL

		Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
		MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1		0.151	44.49	-21.47	65.96	33.90	0.11	10.48	QP
2	*	0.151	40.09	-15.87	55.96	29.50	0.11	10.48	Average
3		0.170	42.03	-22.91	64.94	31.49	0.11	10.43	QP
4		0.170	26.03	-28.91	54.94	15.49	0.11	10.43	Average
5		0.193	39.28	-24.61	63.89	28.80	0.10	10.38	QP
6		0.193	23.38	-30.51	53.89	12.90	0.10	10.38	Average
7		0.223	36.65	-26.05	62.70	26.20	0.10	10.35	QP
8		0.223	19.65	-33.05	52.70	9.20	0.10	10.35	Average
9		0.315	31.90	-27.94	59.84	21.50	0.10	10.30	QP
10		0.315	16.00	-33.84	49.84	5.60	0.10	10.30	Average
11		0.456	28.56	-28.20	56.76	18.20	0.11	10.25	QP
12		0.456	14.96	-31.80	46.76	4.60	0.11	10.25	Average

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)

Appendix C. Radiated Spurious Emission

902~928MHz

LoRa DTS SF=5

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
902.5MHz		398.6	44.02	-39.55	83.57	51.1	22.67	3.05	32.8	100	360	P	H
		902.03	113.57	---	---	114.05	27.42	4.59	32.49	100	360	P	H
		487.84	38.47	-36.53	75	43.6	24.27	3.38	32.78	100	0	P	V
		902.03	105	---	---	105.48	27.42	4.59	32.49	100	0	P	V
914.5MHz		398.6	44.93	-38.42	83.35	52.01	22.67	3.05	32.8	100	0	P	H
		914.64	113.35	---	---	113.61	27.55	4.63	32.44	100	0	P	H
		490.75	38.21	-37.61	75.82	43.27	24.33	3.39	32.78	100	360	P	V
		914.64	105.82	---	---	106.08	27.55	4.63	32.44	100	360	P	V
926.5MHz		398.6	45.02	-38.35	83.37	52.1	22.67	3.05	32.8	100	0	P	H
		926.28	113.37	---	---	113.45	27.66	4.65	32.39	100	0	P	H
		492.69	38.04	-37.37	75.41	43.07	24.36	3.39	32.78	100	360	P	V
		926.28	105.41	---	---	105.49	27.66	4.65	32.39	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

LoRa DTS SF=5

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
902.5MHz		1801	40.18	-43.39	83.57	66.93	30.3	6.27	63.32	300	0	P	H
		1801	44.66	-30.34	75	71.41	30.3	6.27	63.32	100	0	P	V
914.5MHz		1828	45.51	-37.84	83.35	72.03	30.5	6.31	63.33	100	360	P	H
		1828	43.61	-32.21	75.82	70.13	30.5	6.31	63.33	300	360	P	V
926.5MHz		1855	45.01	-38.36	83.37	71.4	30.6	6.34	63.33	100	360	P	H
		1855	45.41	-30	75.41	71.8	30.6	6.34	63.33	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line												

LoRa DTS SF=7

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
902.5MHz		399.57	44.13	-39.26	83.39	51.18	22.7	3.05	32.8	100	360	P	H
		902.03	113.39	---	---	113.87	27.42	4.59	32.49	100	360	P	H
		492.69	38.17	-36.23	74.4	43.2	24.36	3.39	32.78	100	0	P	V
		903	104.4	---	---	104.86	27.43	4.6	32.49	100	0	P	V
914.5MHz		397.63	44.98	-37.92	82.9	52.09	22.65	3.04	32.8	100	360	P	H
		914.64	112.9	---	---	113.16	27.55	4.63	32.44	100	360	P	H
		492.69	38.01	-44.06	82.07	43.04	24.36	3.39	32.78	100	0	P	V
		914.64	112.07	---	---	112.33	27.55	4.63	32.44	100	0	P	V
926.5MHz		399.57	45.02	-38.64	83.66	52.07	22.7	3.05	32.8	100	360	P	H
		926.28	113.66	---	---	113.74	27.66	4.65	32.39	100	360	P	H
		488.81	38.14	-37.85	75.99	43.25	24.29	3.38	32.78	100	0	P	V
		926.28	105.99	---	---	106.07	27.66	4.65	32.39	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line												

LoRa DTS SF=7

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
902.5MHz		1801	46.37	-37.02	83.39	73.12	30.3	6.27	63.32	300	0	P	H
		1801	45.01	-29.39	74.4	71.76	30.3	6.27	63.32	100	0	P	V
914.5MHz		1828	42.52	-40.38	82.9	69.04	30.5	6.31	63.33	300	0	P	H
		1828	45.79	-36.28	82.07	72.31	30.5	6.31	63.33	100	0	P	V
926.5MHz		1855	44.33	-39.33	83.66	70.72	30.6	6.34	63.33	300	0	P	H
		1855	45.81	-30.18	75.99	72.2	30.6	6.34	63.33	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

LoRa DTS SF=11

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
902.5MHz		398.6	44.51	-38.71	83.22	51.59	22.67	3.05	32.8	100	360	P	H
		902.03	113.22	---	---	113.7	27.42	4.59	32.49	100	360	P	H
		490.75	37.96	-42.7	80.66	43.02	24.33	3.39	32.78	100	0	P	V
		903	110.66	---	---	111.12	27.43	4.6	32.49	100	0	P	V
914.5MHz		399.57	44.85	-38.24	83.09	51.9	22.7	3.05	32.8	100	360	P	H
		914.64	113.09	---	---	113.35	27.55	4.63	32.44	100	360	P	H
		491.72	37.85	-37.55	75.4	42.9	24.34	3.39	32.78	100	0	P	V
		914.64	105.4	---	---	105.66	27.55	4.63	32.44	100	0	P	V
926.5MHz		398.6	44.94	-38.61	83.55	52.02	22.67	3.05	32.8	100	360	P	H
		926.28	113.55	---	---	113.63	27.66	4.65	32.39	100	360	P	H
		491.72	37.34	-38.48	75.82	42.39	24.34	3.39	32.78	100	0	P	V
		926.28	105.82	---	---	105.9	27.66	4.65	32.39	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line												

LoRa DTS SF=11

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
902.5MHz		1801	45.73	-37.49	83.22	72.48	30.3	6.27	63.32	300	0	P	H
		1801	44.93	-35.73	80.66	71.68	30.3	6.27	63.32	100	0	P	V
914.5MHz		1828	43.96	-39.13	83.09	70.48	30.5	6.31	63.33	300	0	P	H
		1828	46.77	-28.63	75.4	73.29	30.5	6.31	63.33	100	0	P	V
926.5MHz		1855	42.12	-41.43	83.55	68.51	30.6	6.34	63.33	300	0	P	H
		1855	45.63	-30.19	75.82	72.02	30.6	6.34	63.33	100	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
902.5MHz		398.6	44.02	-39.55	83.57	51.1	22.67	3.05	32.8	100	360	P	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 902.5MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 22.67(dB/m) + 3.05(dB) + 51.1(dBμV) – 32.8 (dB)

= 44.02 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 44.02(dBμV/m) – 83.57(dBμV/m)

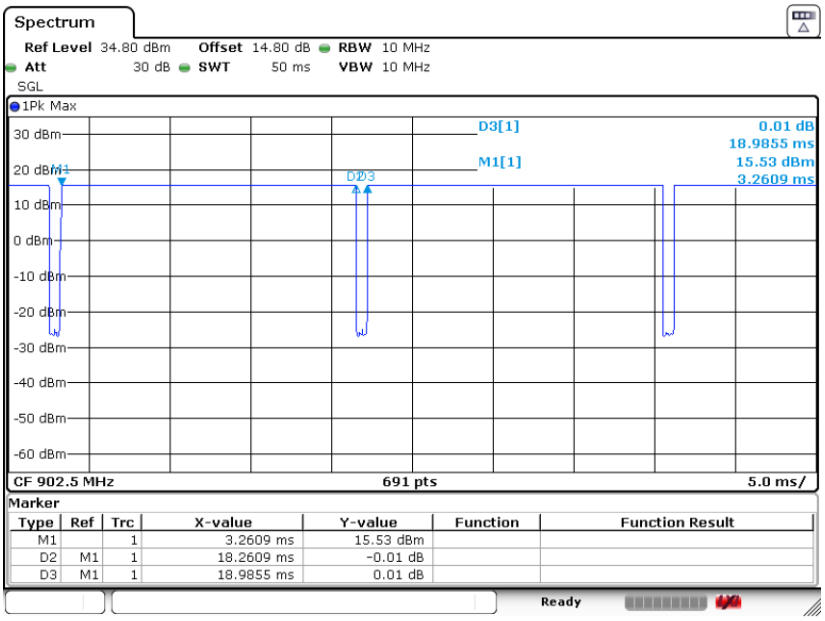
= -39.55(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.

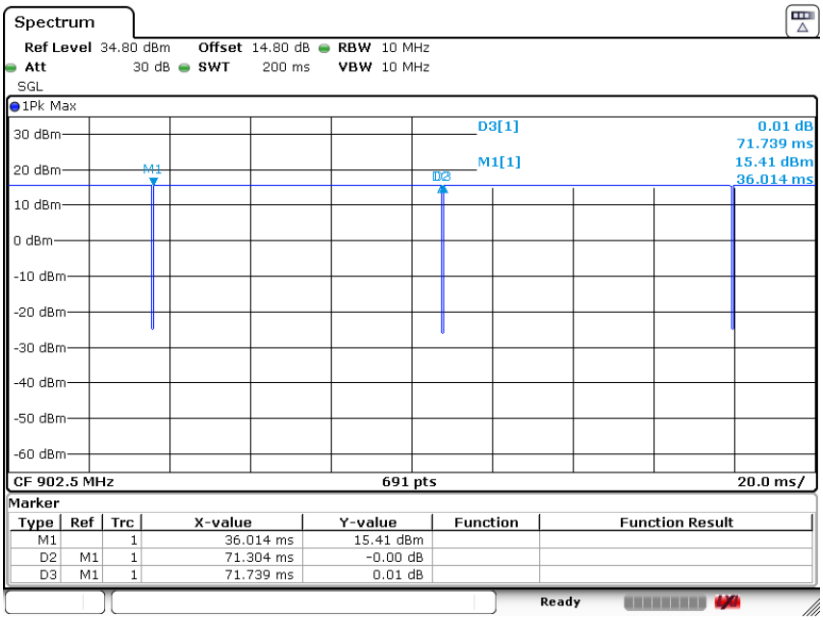
Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(s)	1/T(kHz)	VBW Setting
LoRa DTS SF5	96.18	18.261	0.055	0.13kHz
LoRa DTS SF7	99.39	-	-	10Hz
LoRa DTS SF11	100	-	-	10Hz

LoRa DTS SF5



LoRa DTS SF7



LoRa DTS SF11