FCC Test Report

Report No.: AGC03485200901FE03

FCC ID	:	2AXQT-LWM023VB
APPLICATION PURPOSE	:	Original Equipment
PRODUCT DESIGNATION	:	LoRa RF Communication Module
BRAND NAME	:	Hangzhou Lowan Information
MODEL NAME	:	LW-M023-VB
APPLICANT	:	Hangzhou Lowan Information Technology Co., Ltd
DATE OF ISSUE	:	Nov. 16, 2020
STANDARD(S)	:	FCC Part 15.247
REPORT VERSION	:	V1.0

***A**ttestation of **G**lobal **C**ompliance (Shenzhen) Co., Ltd*

REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Nov. 16, 2020	Valid	Initial Release

TABLE OF CONTENTS

1. VERIFICATION OF CONFORMITY 5
2. GENERAL INFORMATION 6
2.1. PRODUCT DESCRIPTION 6
2.2. TABLE OF CARRIER FREQUENCYS 6
2.3. RECEIVER INPUT BANDWIDTH 7
2.4. EXAMPLE OF A HOPPING SEQUENCY IN DATA MODE 7
2.5. EQUALLY AVERAGE USE OF FREQUENCIES AND BEHAVIOUR 7
2.6. RELATED SUBMITTAL(S) / GRANT (S) 7
2.7. TEST METHODOLOGY 7
2.8. SPECIAL ACCESSORIES 7
2.9. EQUIPMENT MODIFICATIONS 7
2.10. ANTENNA REQUIREMENT 7
3. MEASUREMENT UNCERTAINTY 8
4. DESCRIPTION OF TEST MODES 9
5. SYSTEM TEST CONFIGURATION 10
5.1. CONFIGURATION OF EUT SYSTEM 10
5.2. EQUIPMENT USED IN EUT SYSTEM 10
5.3. SUMMARY OF TEST RESULTS 10
6. TEST FACILITY 11
7. PEAK OUTPUT POWER 12
7.1. MEASUREMENT PROCEDURE 12
7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 12
7.3. LIMITS AND MEASUREMENT RESULT 13
8. 20DB BANDWIDTH 17
8.1. MEASUREMENT PROCEDURE 17
8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 17
8.3. LIMITS AND MEASUREMENT RESULTS 17
9. CONDUCTED SPURIOUS EMISSION 21
9.1. MEASUREMENT PROCEDURE 21
9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) 21
9.3. MEASUREMENT EQUIPMENT USED 21
9.4. LIMITS AND MEASUREMENT RESULT 21
10. RADIATED EMISSION 32

10.1. MEASUREMENT PROCEDURE 32
10.2. TEST SETUP 34
10.3. LIMITS AND MEASUREMENT RESULT 35
10.4. TEST RESULT 35
11. NUMBER OF HOPPING FREQUENCY 41
11.1. MEASUREMENT PROCEDURE 41
11.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION) 41
11.3. MEASUREMENT EQUIPMENT USED 41
11.4. LIMITS AND MEASUREMENT RESULT 41
12. TIME OF OCCUPANCY (DWELL TIME) 43
12.1. MEASUREMENT PROCEDURE 43
12.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION) 43
12.3. MEASUREMENT EQUIPMENT USED 43
12.4. LIMITS AND MEASUREMENT RESULT 43
13. FREQUENCY SEPARATION 51
13.1. MEASUREMENT PROCEDURE 51
13.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION) 51
13.3. MEASUREMENT EQUIPMENT USED 51
13.4. LIMITS AND MEASUREMENT RESULT 51
14. FCC LINE CONDUCTED EMISSION TEST 53
14.1. LIMITS OF LINE CONDUCTED EMISSION TEST 53
14.2. BLOCK DIAGRAM OF LINE CONDUCTED EMISSION TEST 53
14.3. PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST 54
14.4. FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST 54
14.5. TEST RESULT OF LINE CONDUCTED EMISSION TEST 55
APPENDIX A: PHOTOGRAPHS OF TEST SETUP 57
APPENDIX B: PHOTOGRAPHS OF EUT 59

1. VERIFICATION OF CONFORMITY

Applicant	Hangzhou Lowan Information Technology Co., Ltd
Address	19th Floor, Building A1, 1899 Gudun Road, Yuhang District, Hangzhou, China
Manufacturer	Hangzhou Lowan Information Technology Co., Ltd
Address	19th Floor, Building A1, 1899 Gudun Road, Yuhang District, Hangzhou, China
Factory	Hangzhou Lowan Information Technology Co., Ltd
Address	19th Floor, Building A1, 1899 Gudun Road, Yuhang District, Hangzhou, China
Product Designation	LoRa RF Communication Module
Brand Name	Hangzhou Lowan Information
Test Model	LW-M023-VB
Date of test	Oct. 22, 2020 to Nov. 16, 2020
Deviation	No any deviation from the test method
Condition of Test Sample	Normal
Test Result	Pass
Report Template	AGCRT-US-BR/RF

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.247.

Prepared By	Sky Dong (Project Engineer)	Nov. 16, 2020
Reviewed By	Max Zhang (Reviewer)	Nov. 16, 2020
Approved By	Forrest Lei (Authorized Officer)	Nov. 16, 2020

2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is “RFID” designed as a “LoRa RF Communication Module”. It is designed by way of utilizing the FHSS technology to achieve the system operation.

A major technical description of EUT is described as following

Operation Frequency	902MHz to 928MHz
RF Output Power	20.056dBm(Max)
Modulation	GFSK(FHSS)
BW/Frequency Range	125kHz/250kHz
Number of channels	64
Hardware Version	V1.0
Software Version	V1.0
Antenna Designation	spring antenna (Comply with requirements of the FCC part 15.203)
Antenna Gain	0dBi
Power Supply	DC 5V from USB Serial Board

2.2. TABLE OF CARRIER FREQUENCYS

Frequency Band	Channel Number	Frequency
902.3~927.5MHZ	0	902.3MHz
	1	902.7MHz
	:	:
	62	927.1MHz
	63	927.5MHz

Note: The channel spacing is 0.4MHz.

2.3. RECEIVER INPUT BANDWIDTH

The input bandwidth of the receiver is 125kHz and 250kHz.

2.4. EXAMPLE OF A HOPPING SEQUENCY IN DATA MODE

Example of a 60 hopping sequence in data mode:

21,23,33,25,27,31,07,09,13,11,15,02,06,01,03,05,04,08,10,12,14,16,17,18,19,20,

24,26,27,28,29,30,32,34,35,36,37,38,40,41,42,43,45,44,47,46,48,49,50,51, 52, 53, 54, 55, 56, 57, 58, 59, 60

2.5. EQUALLY AVERAGE USE OF FREQUENCIES AND BEHAVIOUR

The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter.

2.6. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.7. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

2.8. SPECIAL ACCESSORIES

Refer to section 5.2.

2.9. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

2.10. ANTENNA REQUIREMENT

This intentional radiator is designed with a spring antenna of an antenna to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

For more information of the antenna, please refer to the APPENDIX B: PHOTOGRAPHS OF EUT.

3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

- Uncertainty of Conducted Emission, Uc = ±3.2 dB
- Uncertainty of Radiated Emission below 1GHz, Uc = ±3.9 dB
- Uncertainty of Radiated Emission above 1GHz, Uc = ±4.8 dB
- Uncertainty of total RF power, conducted, Uc = ±0.8dB
- Uncertainty of spurious emissions, conducted, Uc = ±2.7dB
- Uncertainty of Occupied Channel Bandwidth: Uc = ±2 %
- Uncertainty of Dwell Time: Uc = ±2 %
- Uncertainty of Frequency: Uc = ±2 %

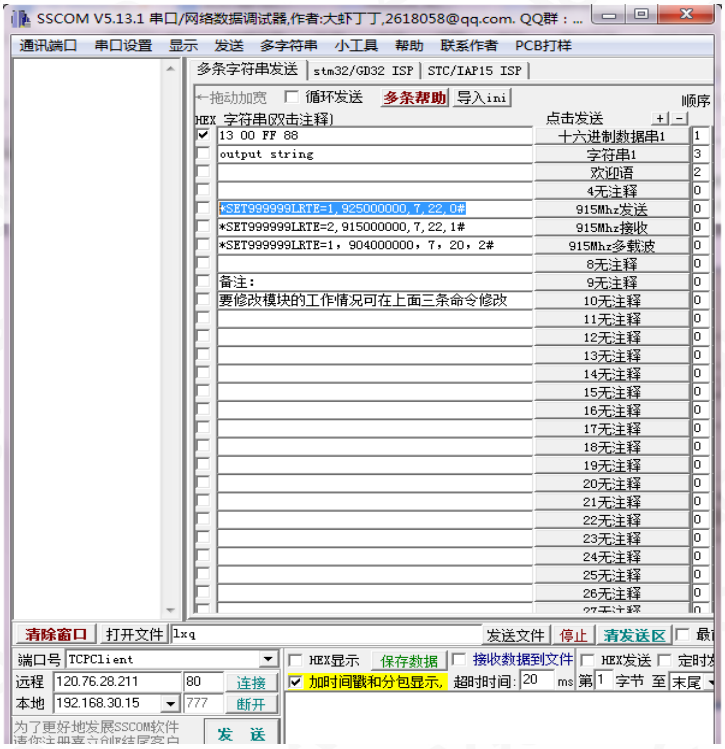
4. DESCRIPTION OF TEST MODES

NO.	TEST MODE DESCRIPTION
1	Low channel TX
2	Middle channel TX
3	High channel TX
4	Hopping mode

Note:

1. Only the result of the worst case was recorded in the report, if no other cases.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.
3. The test software is the sscom V5.13.1 which can set the EUT into the individual test modes.

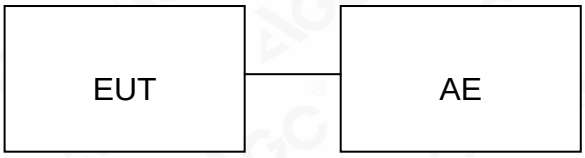
Software Setting



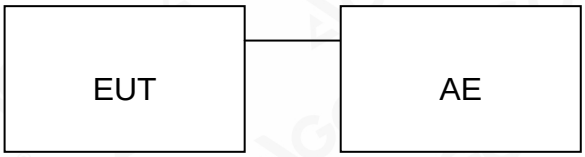
5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Radiated Emission Configure:



Conducted Emission Configure:



5.2. EQUIPMENT USED IN EUT SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	LoRa RF Communication	LW-M023-VB	2AXQT-LWM023VB	EUT
2	Adapter	TPA-46050100VU	DC 5V	AE

5.3. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.247	Peak Output Power	Compliant
§15.247	20 dB Bandwidth	Compliant
§15.247	Spurious Emission	Compliant
15.247&15.209	Radiated Emission	Compliant
§15.207	Conduction Emission	Compliant
§15.247	Number of Hopping Frequency	Compliant
§15.247	Time of Occupancy	Compliant
§15.247	Frequency Separation	Compliant

6. TEST FACILITY

Test Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Designation Number	CN1259
FCC Test Firm Registration Number	975832
A2LA Cert. No.	5054.02
Description	Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by A2LA

TEST EQUIPMENT OF CONDUCTED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESPI	101206	Jun. 08, 2020	Jun. 07, 2021
LISN	R&S	ESH2-Z5	100086	Aug. 24, 2020	Aug. 23, 2021
Test software	R&S	ES-K1 (Ver V1.71)	N/A	N/A	N/A

TEST EQUIPMENT OF RADIATED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESCI	10096	May 15, 2020	May 14, 2021
EXA Signal Analyzer	Aglient	N9010A	MY53470504	Dec. 12, 2019	Dec. 11, 2020
2.4GHz Fliter	EM Electronics	2400-2500MHz	N/A	Feb. 26, 2020	Feb. 25, 2021
Attenuator	ZHINAN	E-002	N/A	Aug. 24, 2020	Aug. 23, 2021
Horn antenna	SCHWARZBECK	BBHA 9170	#768	Sep. 21, 2017	Sep. 20, 2020
Active loop antenna (9K-30MHz)	ZHINAN	ZN30900C	18051	Jun. 12, 2020	Jun. 11, 2021
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	May. 24, 2020	May. 23, 2021
Broadband Preamplifier	ETS LINDGREN	3117PA	00225134	Oct. 15, 2019	Oct. 16, 2020
ANTENNA	SCHWARZBECK	VULB9168	D69250	Jan. 09, 2019	Jan. 08, 2021
Test software	Tonscend	JS32-RE (Ver.2.5)	N/A	N/A	N/A

7. PEAK OUTPUT POWER

7.1. MEASUREMENT PROCEDURE

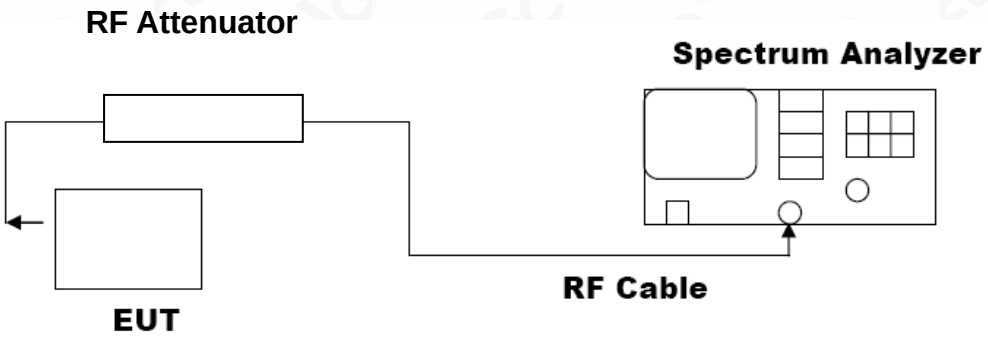
For peak power test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
3. RBW > 20 dB bandwidth of the emission being measured.
4. VBW ≥RBW.
5. Sweep: Auto.
6. Detector function: Peak.
7. Trace: Max hold.

Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power, after any corrections for external attenuators and cables.

7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

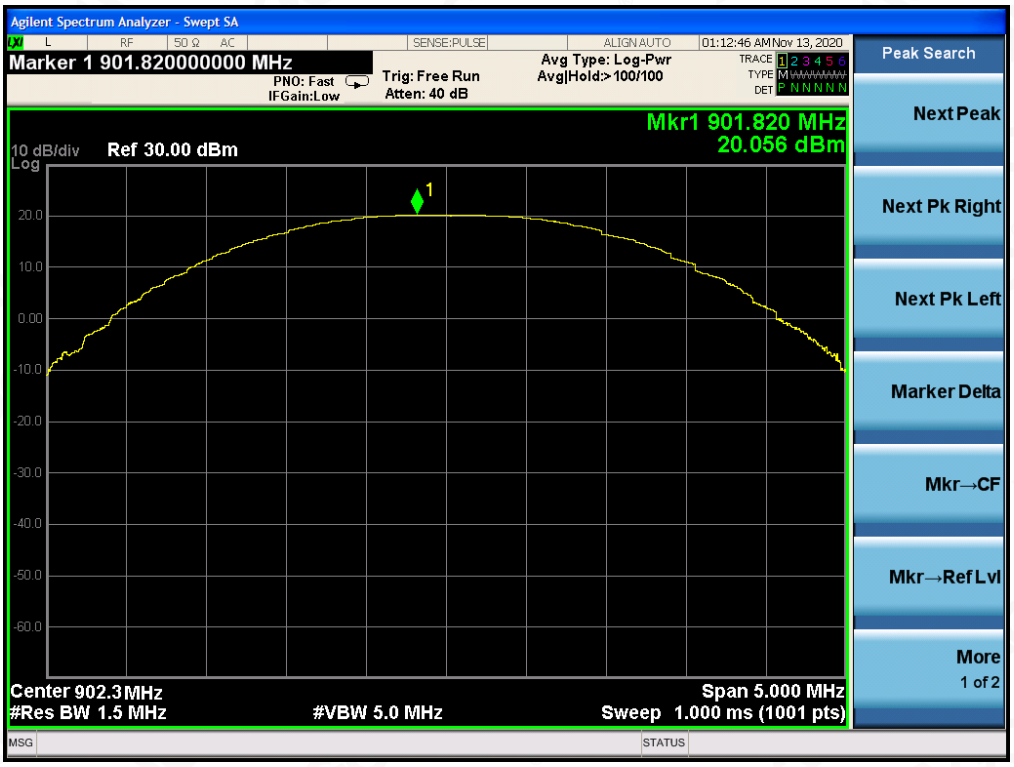
PEAK POWER TEST SETUP



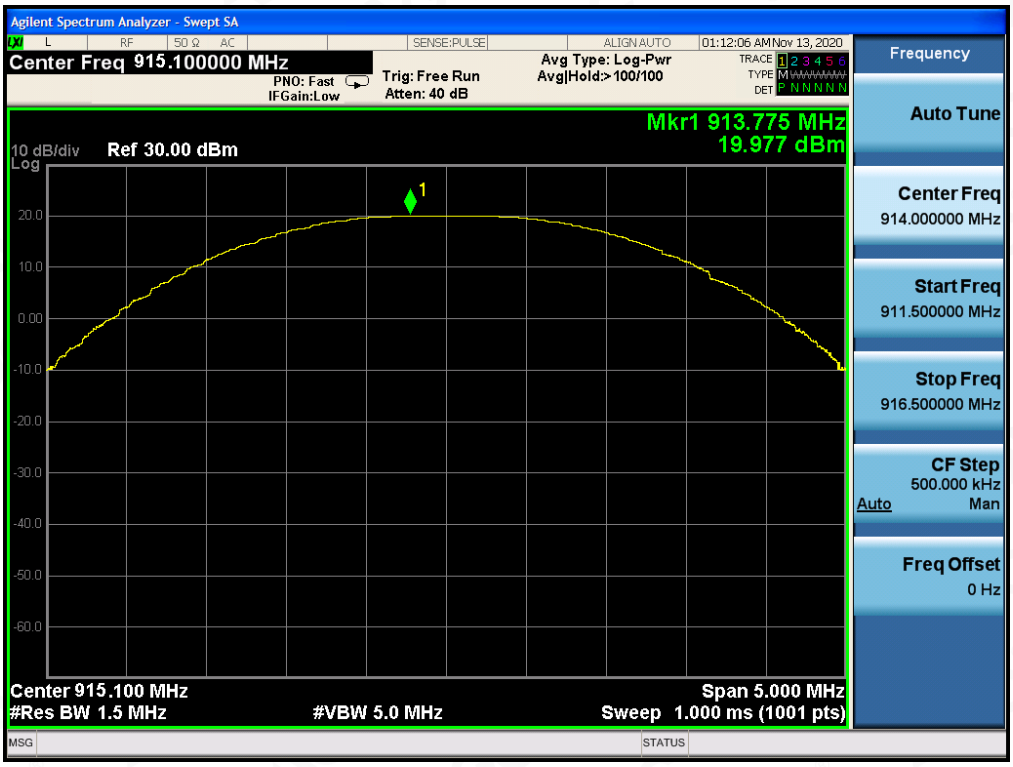
7.3. LIMITS AND MEASUREMENT RESULT

PEAK OUTPUT POWER MEASUREMENT RESULT FOR GFSK MOUDULATION(BW=125kHz)			
Frequency (MHz)	**Peak Power (dBm)**	**Applicable Limits (dBm)**	**Pass or Fail**
902.3	20.056	30	Pass
915.1	19.977	30	Pass
927.5	19.776	30	Pass

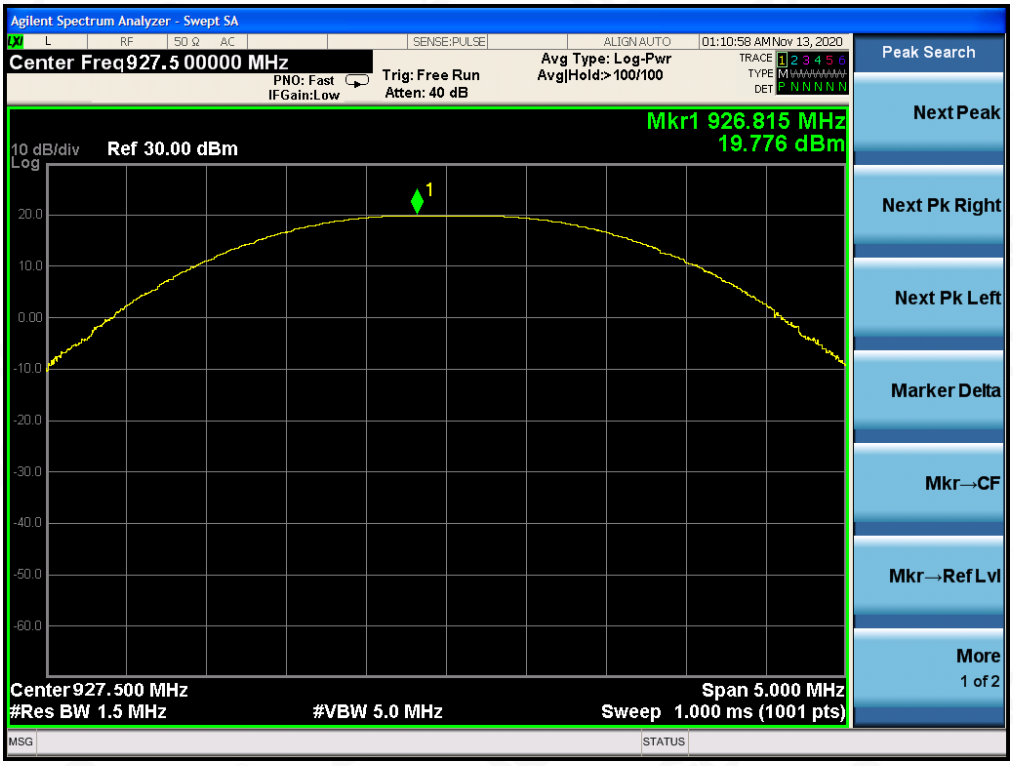
Low Channel



Middle Channel

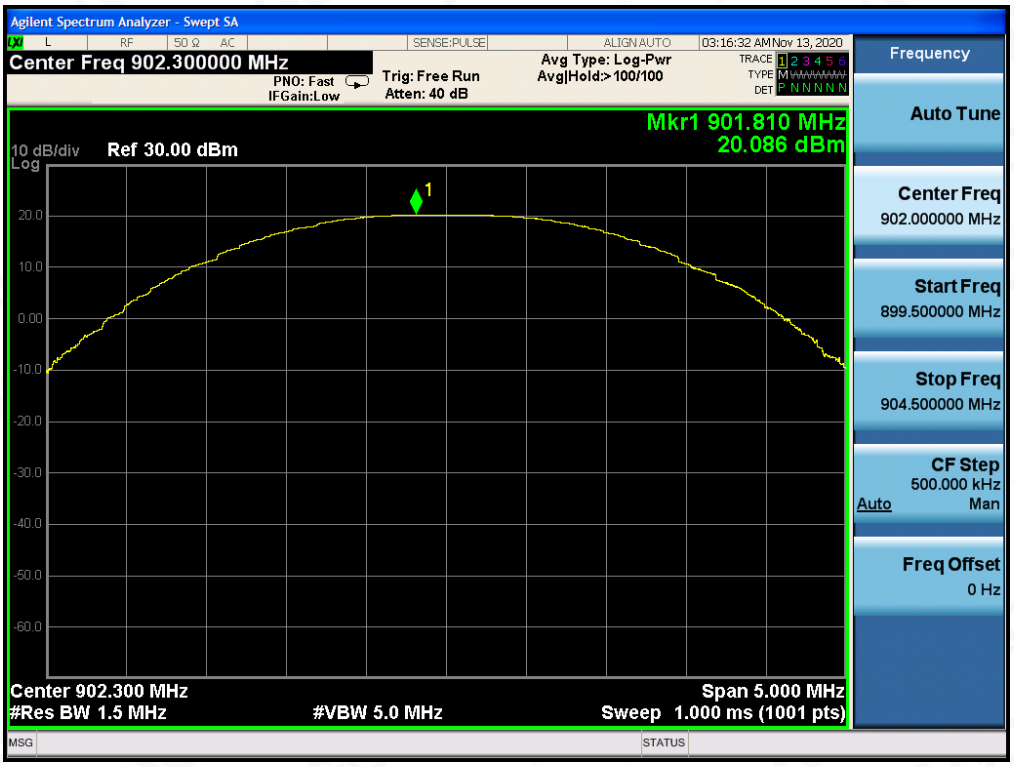


High Channel

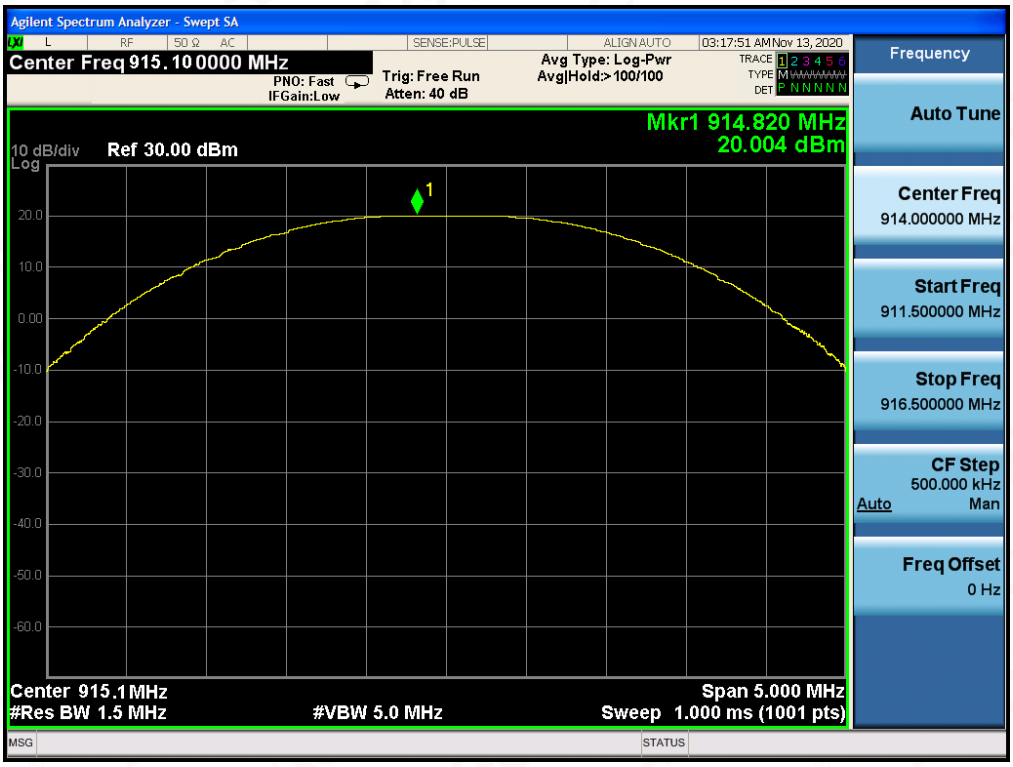


PEAK OUTPUT POWER MEASUREMENT RESULT FOR GFSK MOUDULATION(BW=250kHz)			
Frequency (MHz)	**Peak Power (dBm)**	**Applicable Limits (dBm)**	**Pass or Fail**
902.3	20.086	30	Pass
915.1	20.004	30	Pass
927.5	19.862	30	Pass

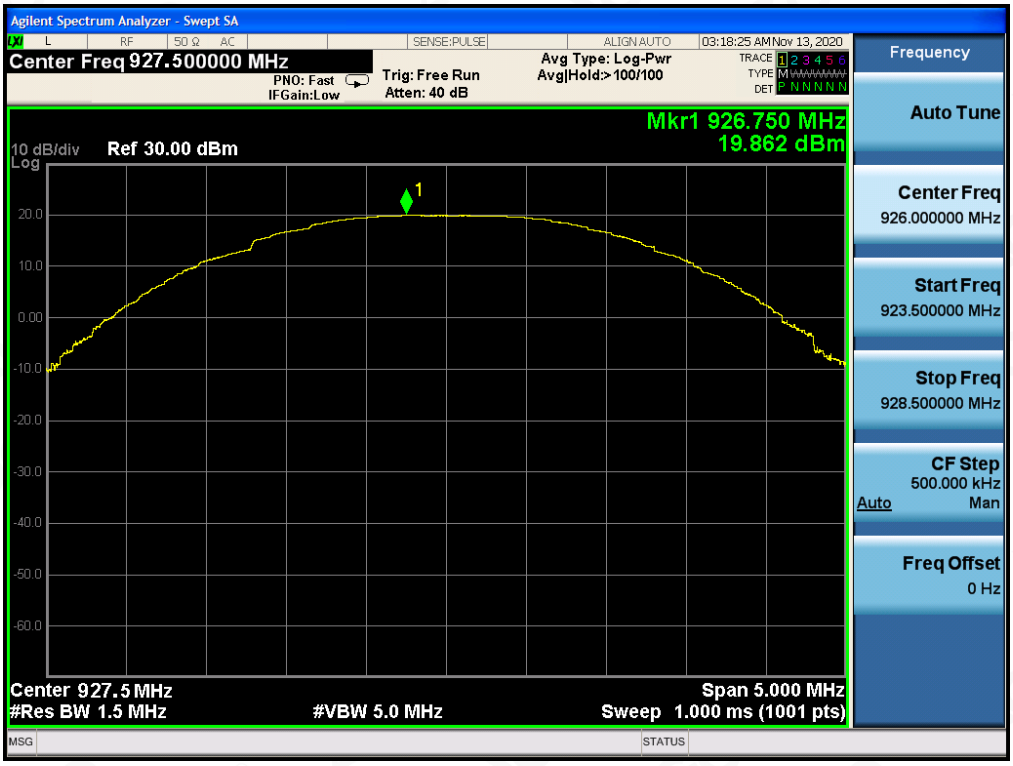
Low Channel



Middle Channel



High Channel



8. 20DB BANDWIDTH

8.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hoping channel
   The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

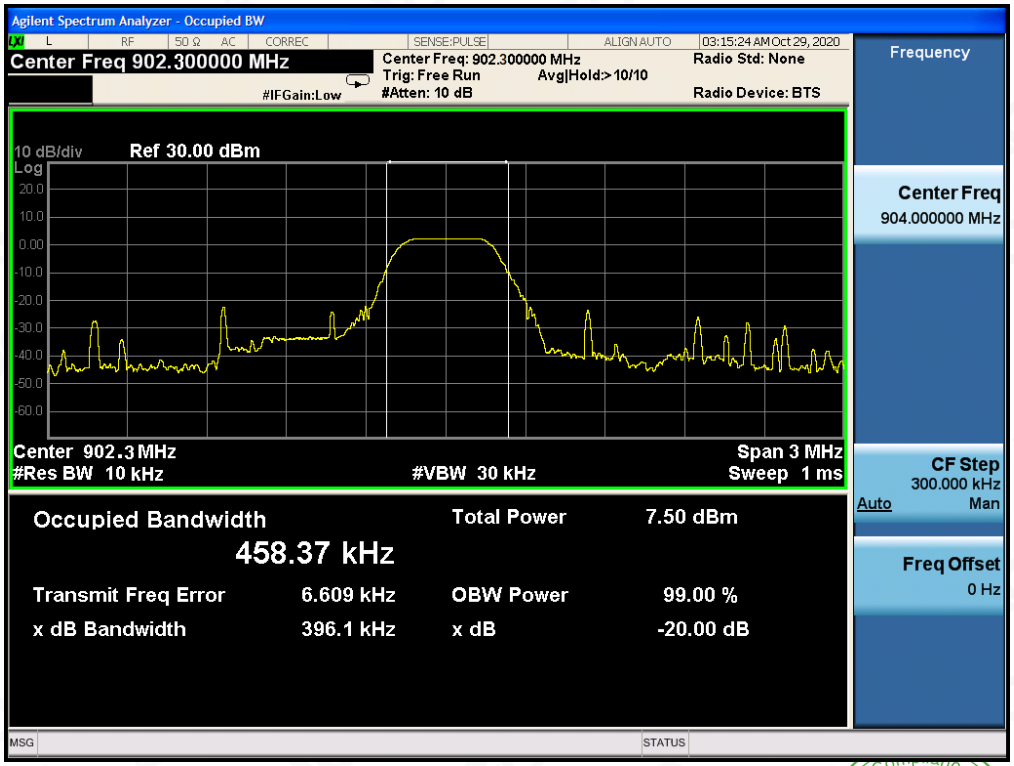
8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 7.2.

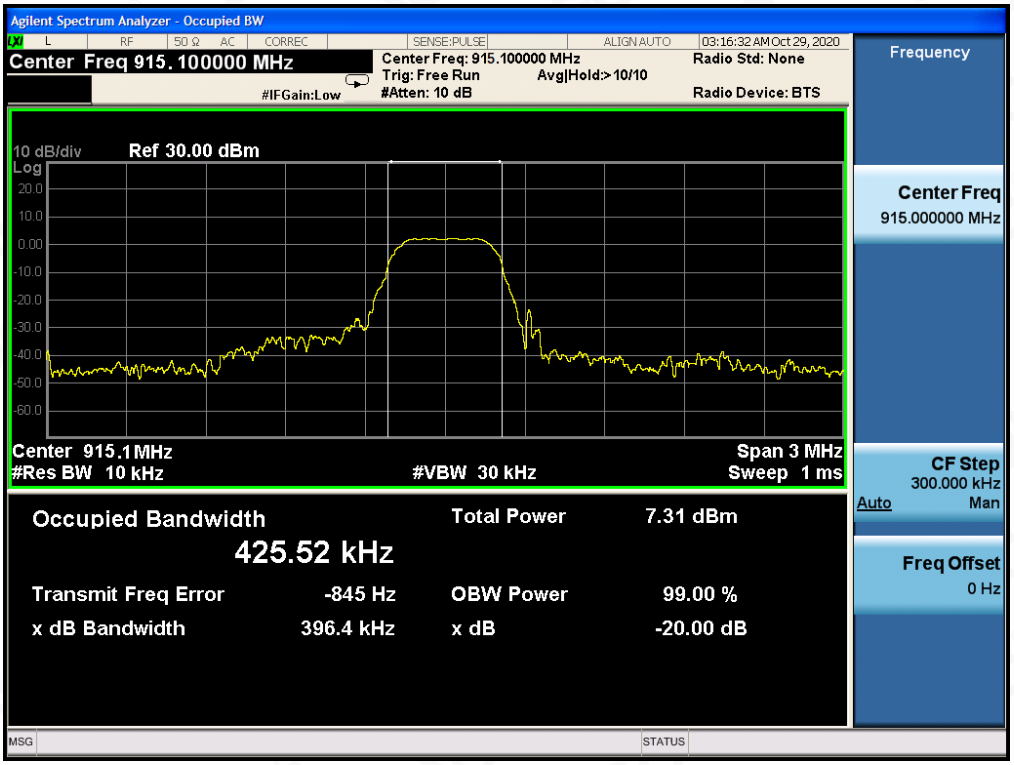
8.3. LIMITS AND MEASUREMENT RESULTS

MEASUREMENT RESULT FOR GFSK MOUDULATION(BW=125kHz)			
Applicable Limits	Measurement Result		
	Test Data (kHz)		Criteria
500kHz	Low Channel	396.1	PASS
	Middle Channel	396.4	PASS
	High Channel	388.6	PASS

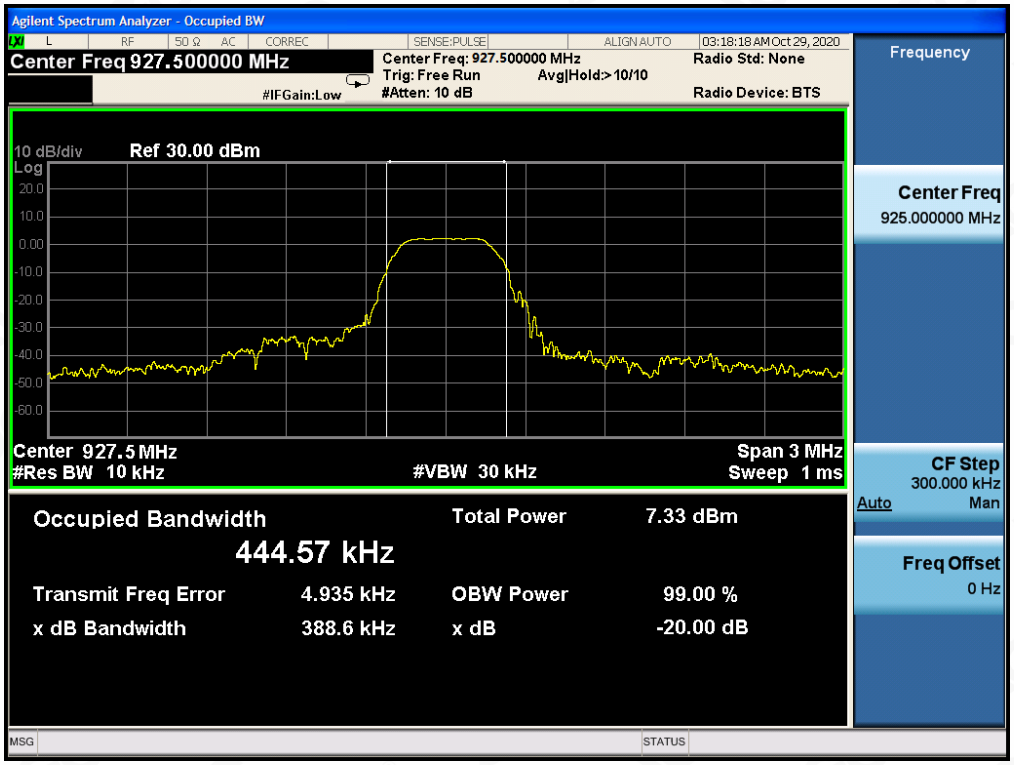
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

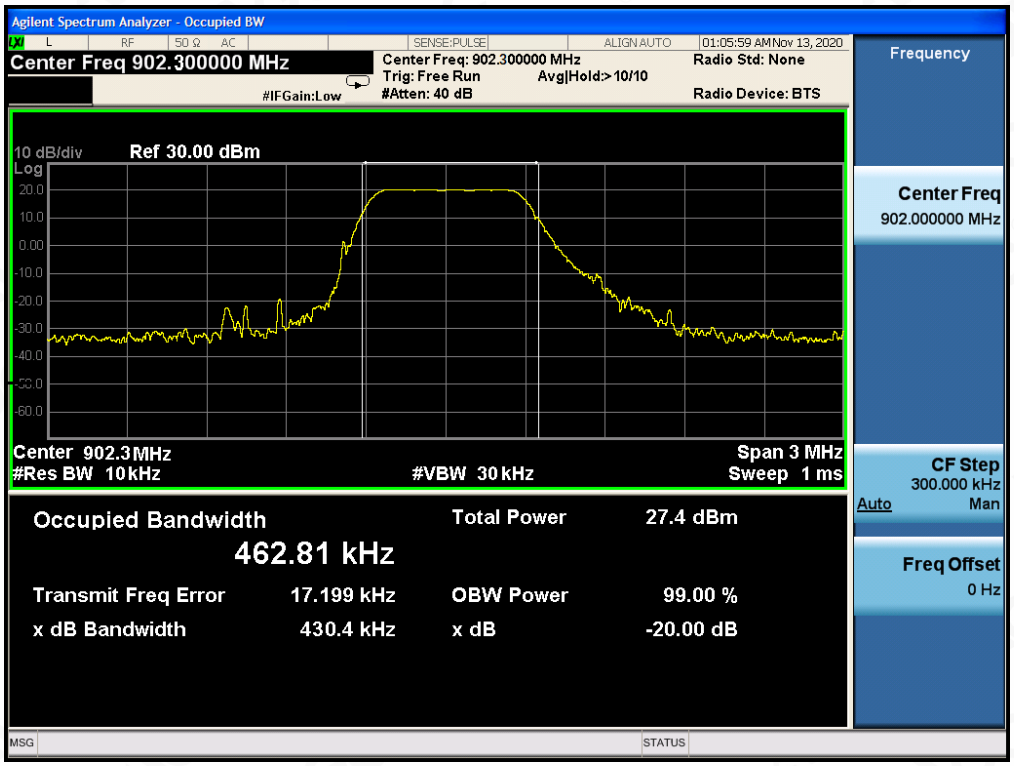


TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL

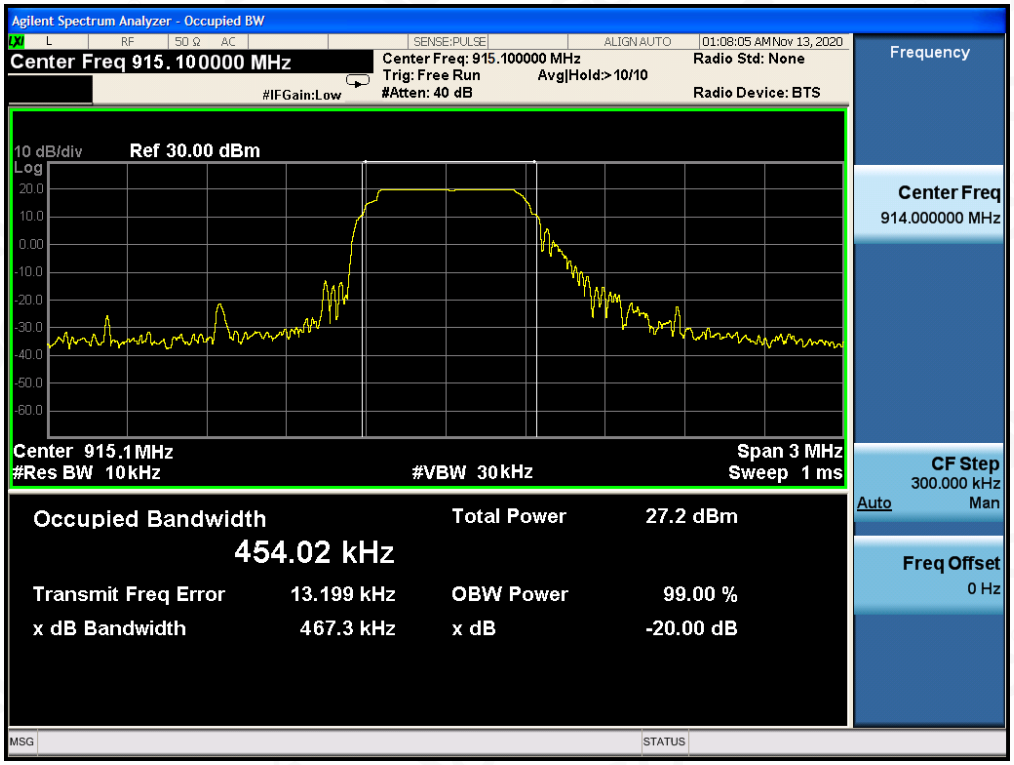


MEASUREMENT RESULT FOR GFSK MOUDULATION(BW=250kHz)			
Applicable Limits	Measurement Result		
	Test Data (kHz)		Criteria
500kHz	Low Channel	430.4	PASS
	Middle Channel	467.3	PASS
	High Channel	469.5	PASS

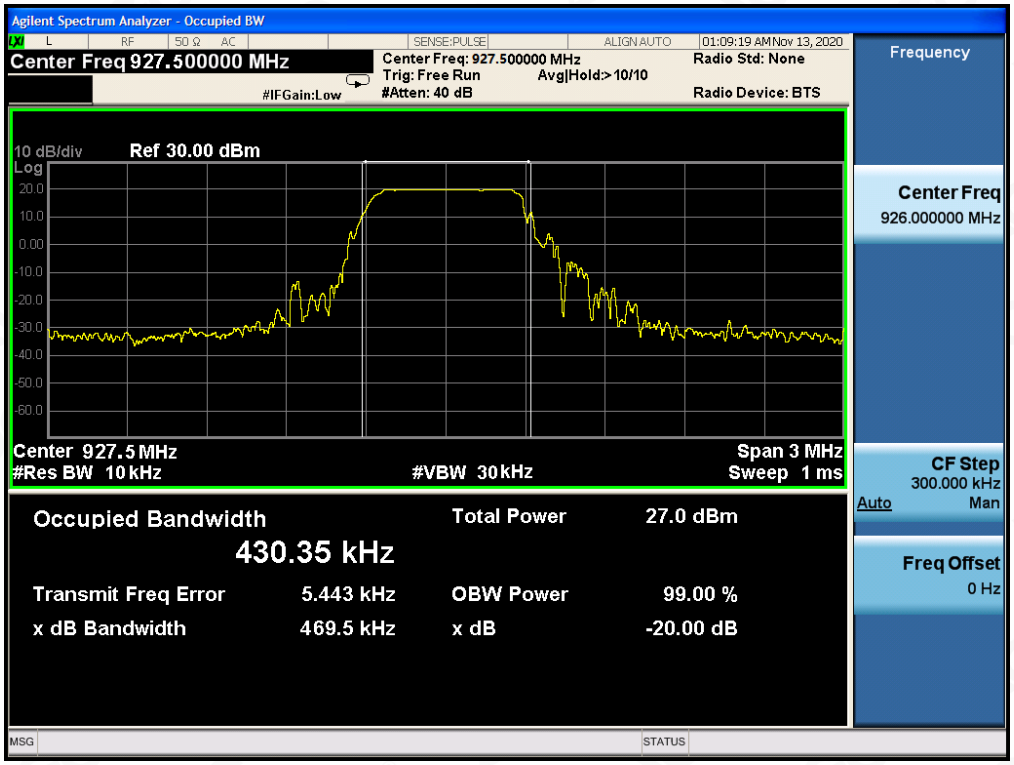
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL



TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL



9. CONDUCTED SPURIOUS EMISSION

9.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
   RBW = 100 kHz; VBW= 300 kHz; Sweep = auto; Detector function = peak.
4. Set SPA Trace 1 Max hold, then View.

9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2

9.3. MEASUREMENT EQUIPMENT USED

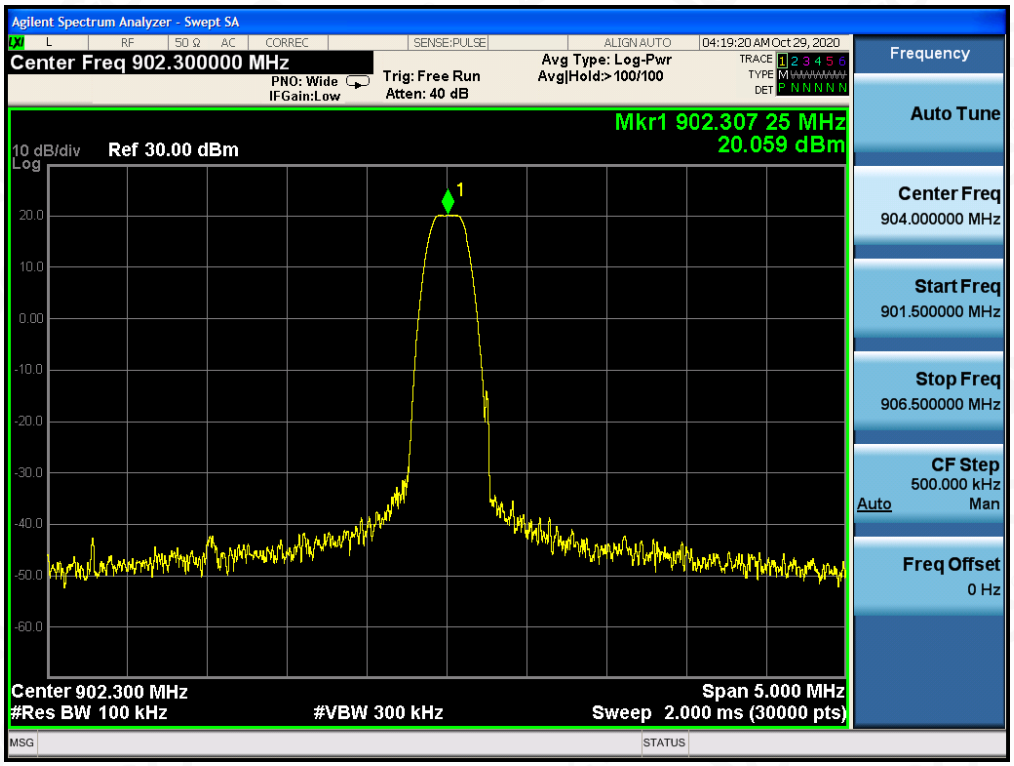
The same as described in section 6

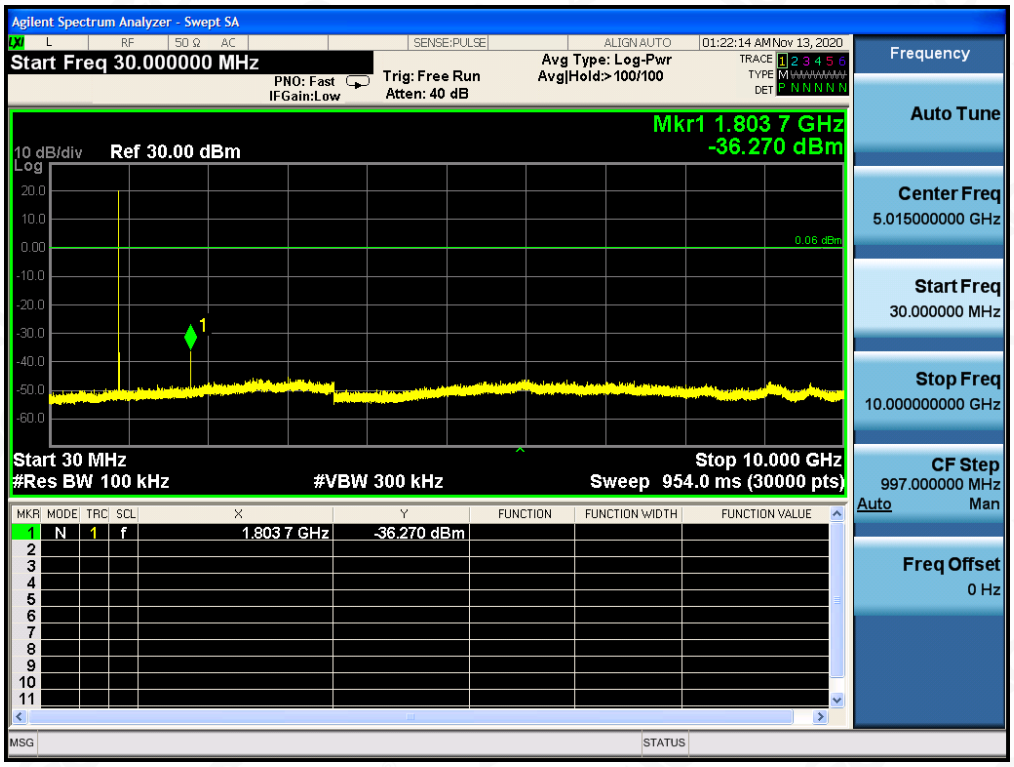
9.4. LIMITS AND MEASUREMENT RESULT

LIMITS AND MEASUREMENT RESULT		
Applicable Limits	**Measurement Result**	
	Test Data	**Criteria**
In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a))	At least -20dBc than the limit Specified on the BOTTOM Channel	PASS
	At least -20dBc than the limit Specified on the TOP Channel	PASS

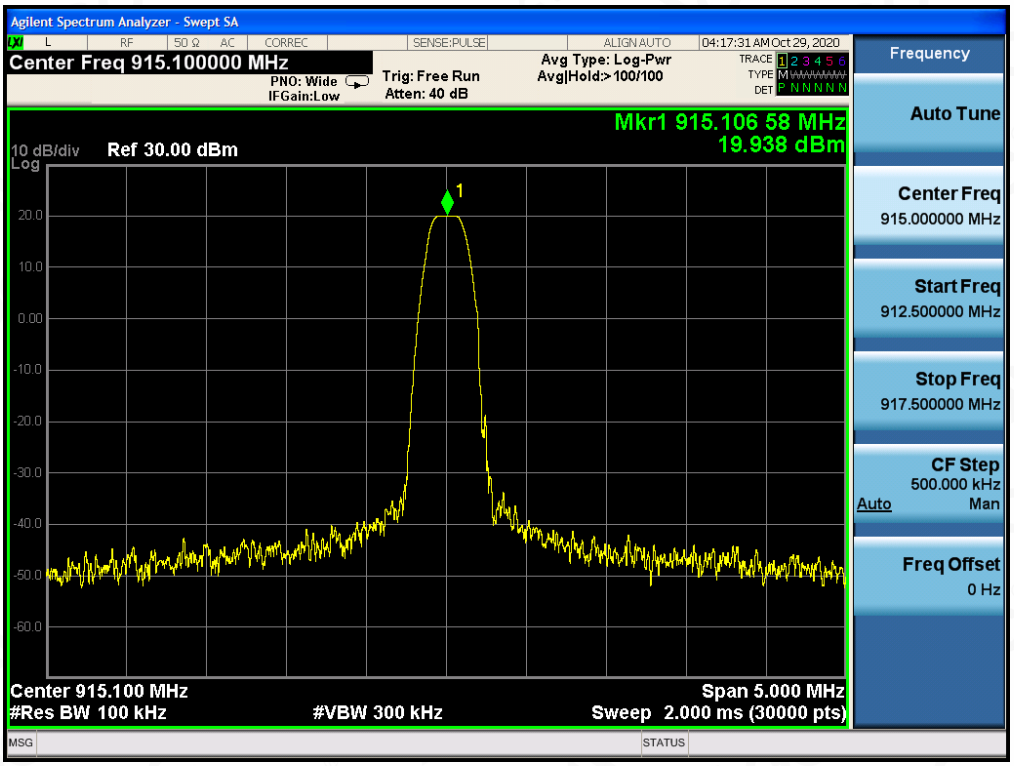
TEST RESULT FOR ENTIRE FREQUENCY RANGE(BW=125kHz)

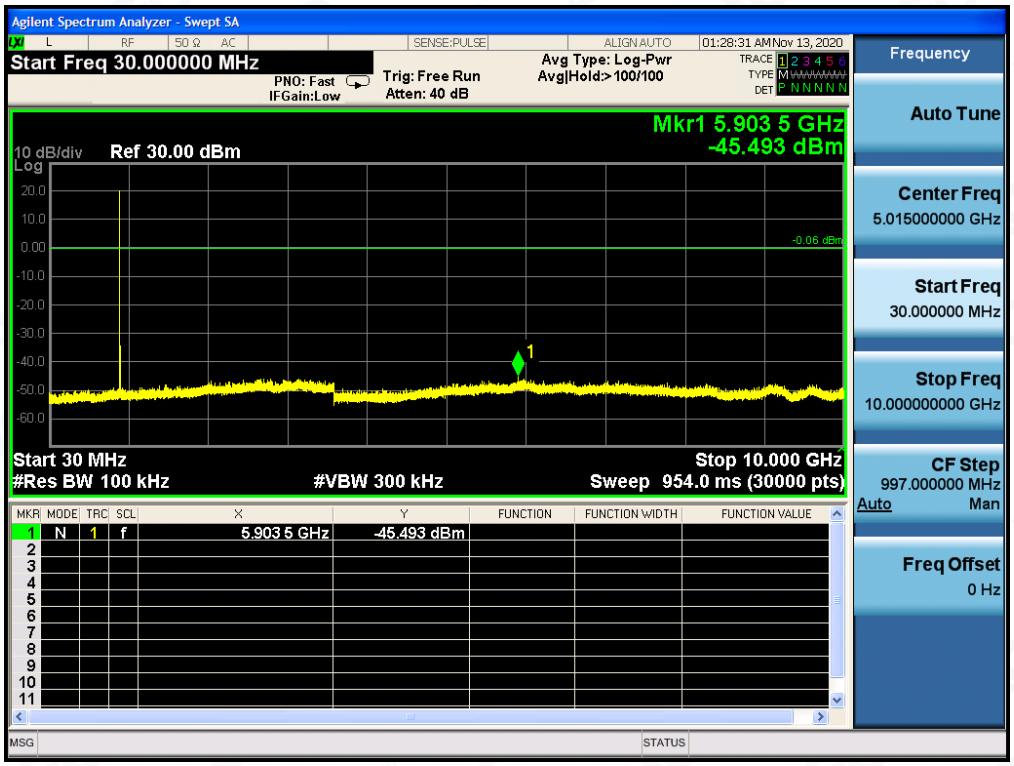
GFSK MODULATION IN LOW CHANNEL



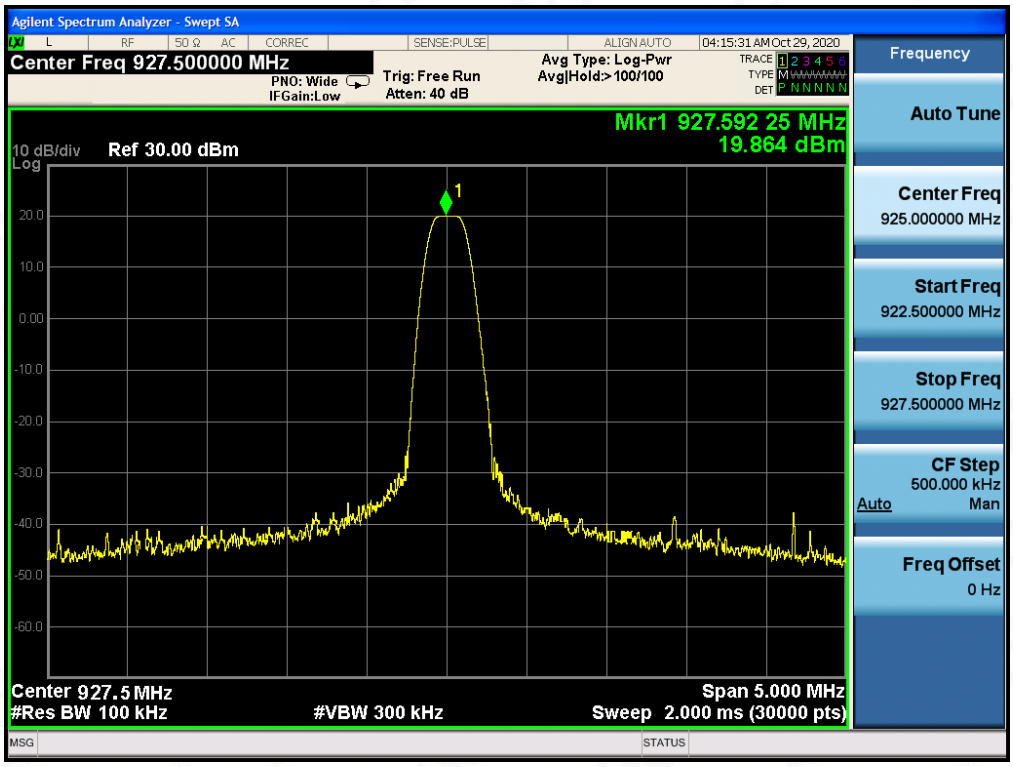


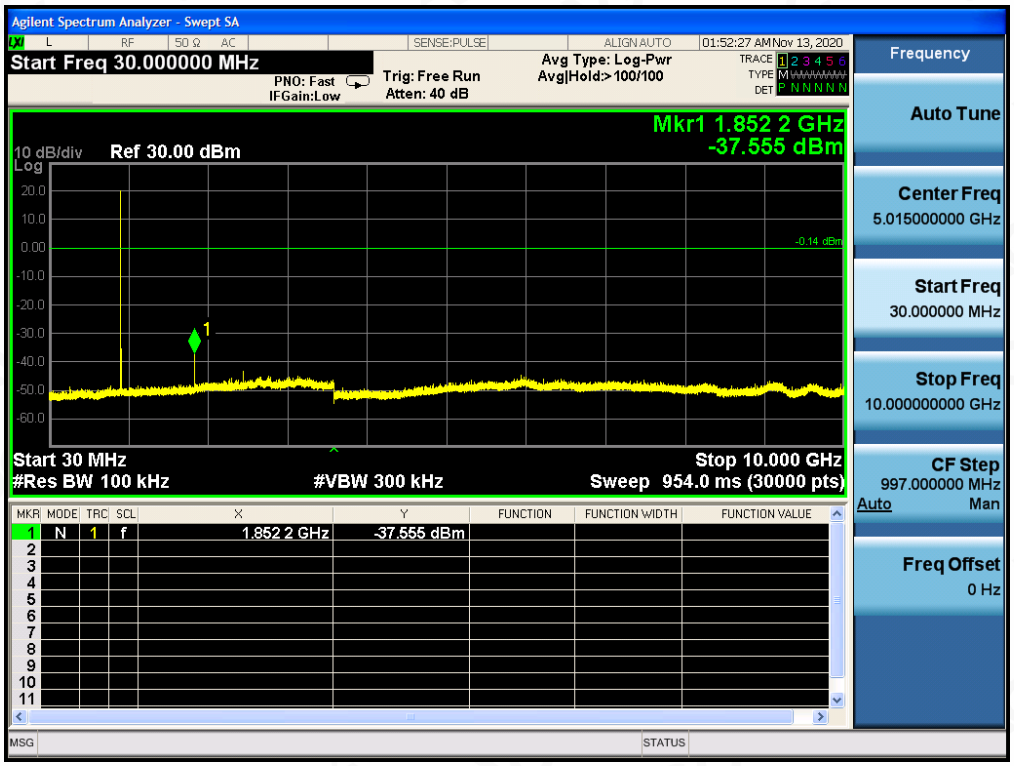
GFSK MODULATION IN MIDDLE CHANNEL





GFSK MODULATION IN HIGH CHANNEL



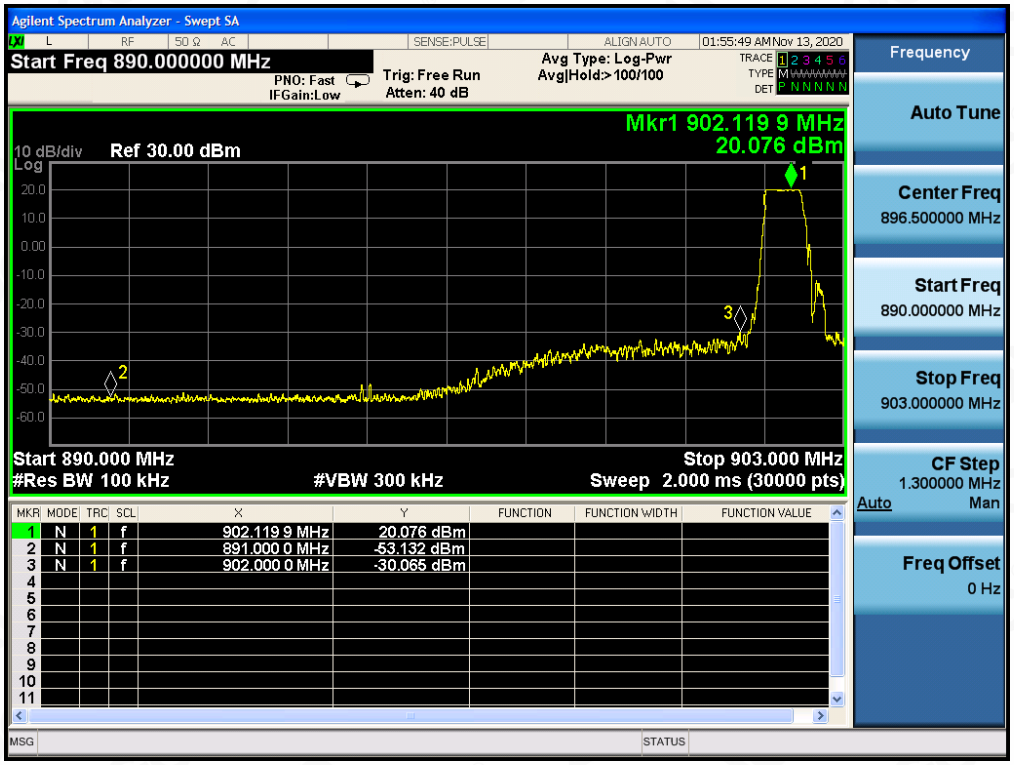


Note: The peak emissions without marker on the above plots are fundamental wave and need not to compare with the limit.

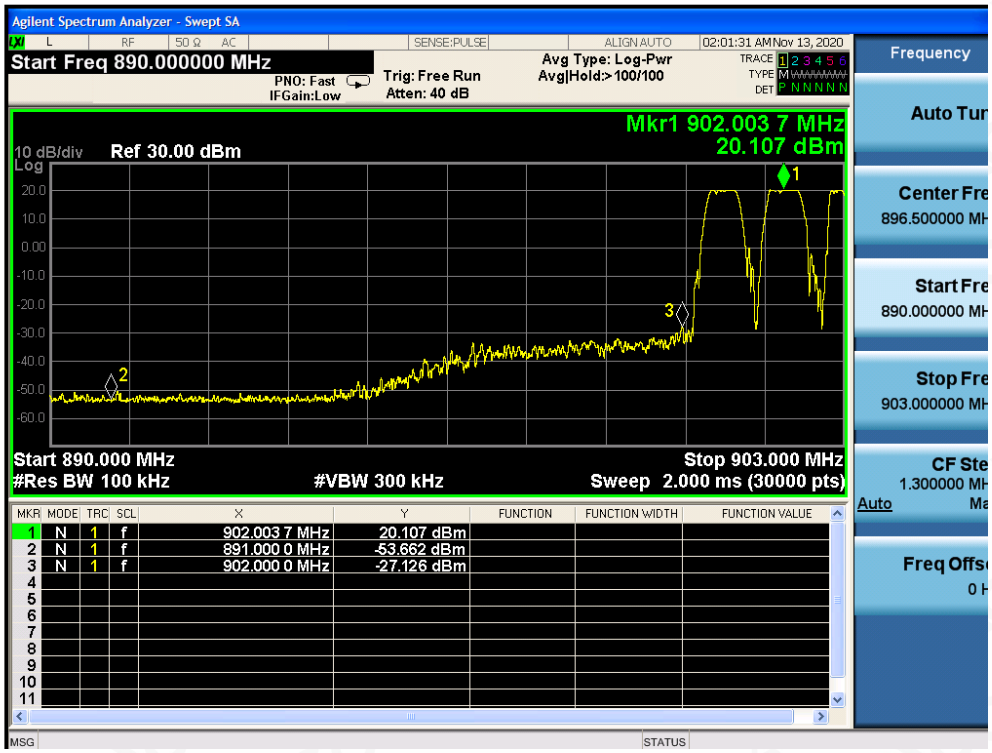
TEST RESULT FOR BAND EDGE(BW=125kHz)

GFSK MODULATION IN LOW CHANNEL

Hopping off

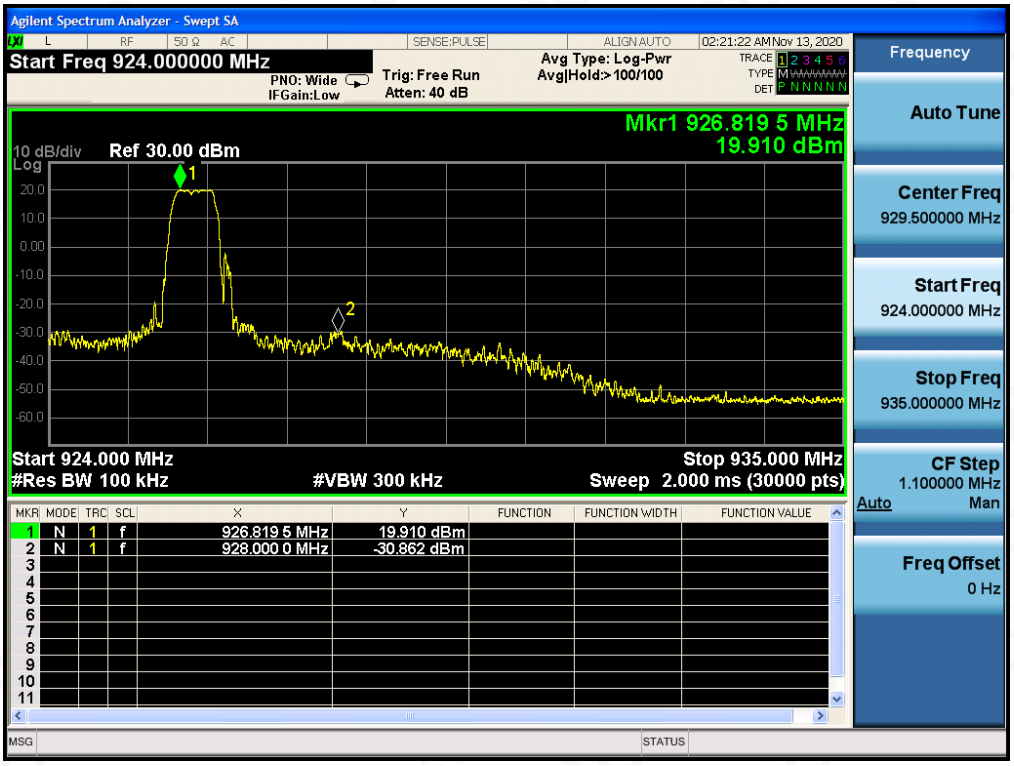


Hopping on



GFSK MODULATION IN HIGH CHANNEL

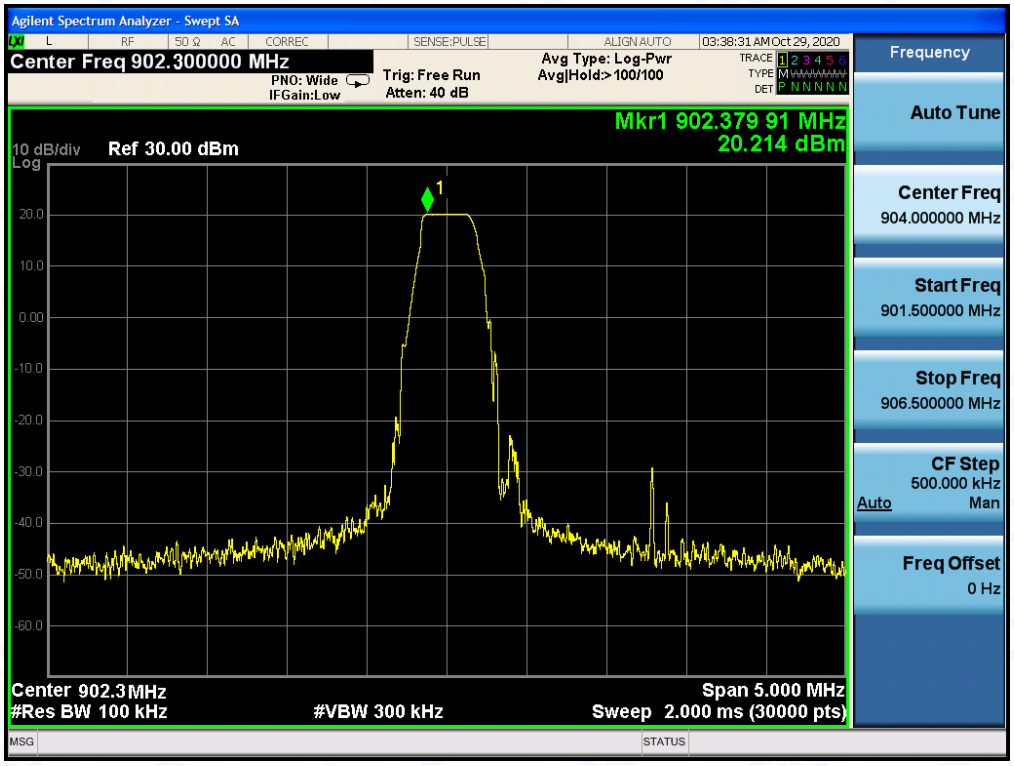
Hopping off

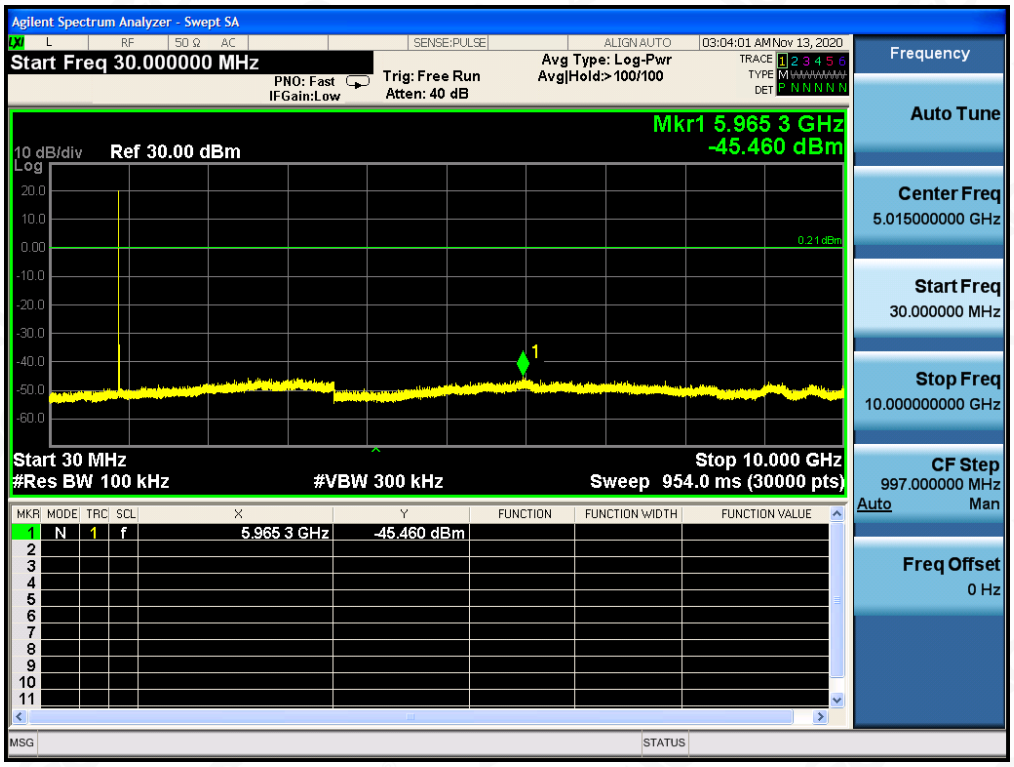


Hopping on

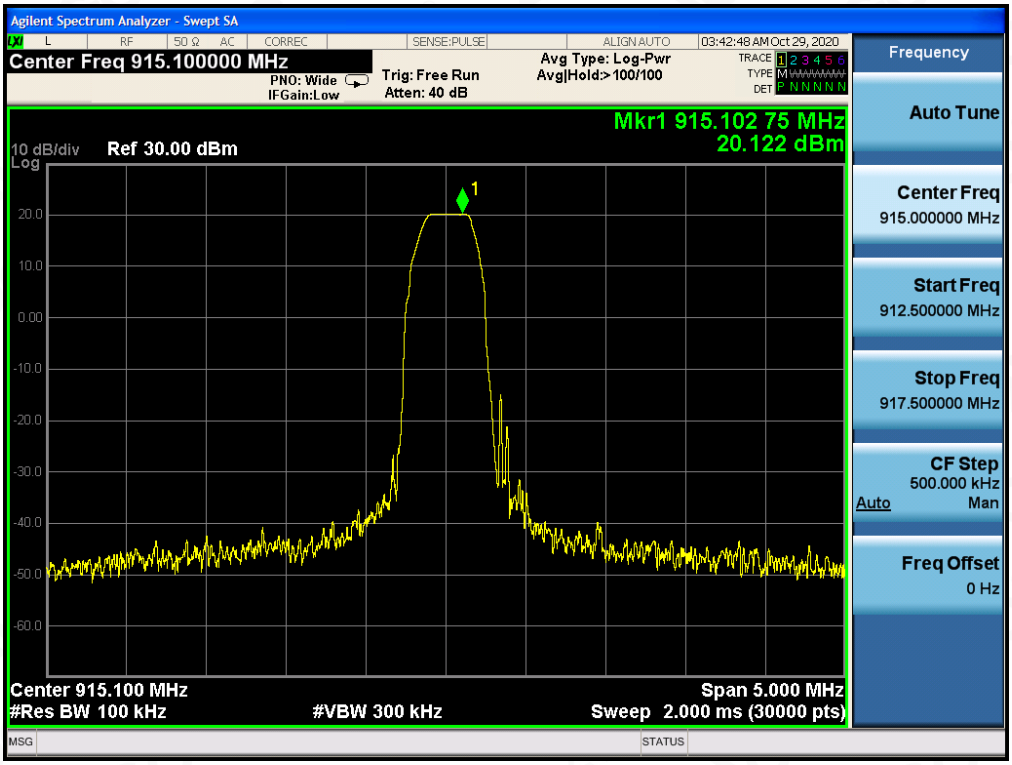
TEST RESULT FOR ENTIRE FREQUENCY RANGE(BW=250kHz)

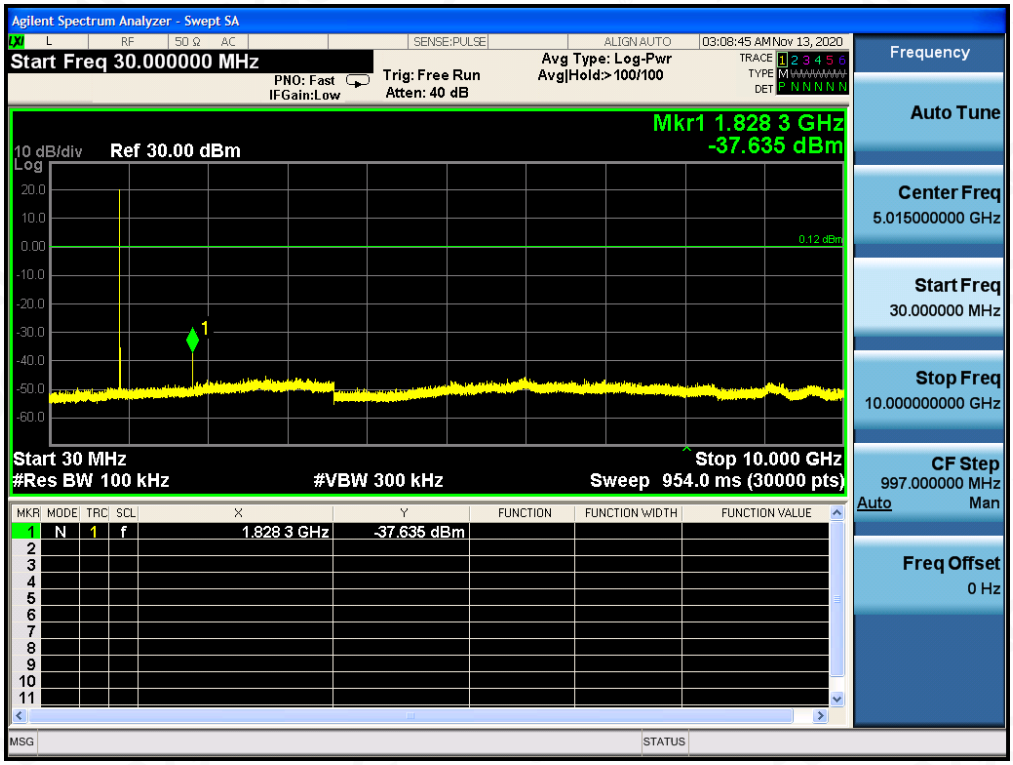
GFSK MODULATION IN LOW CHANNEL



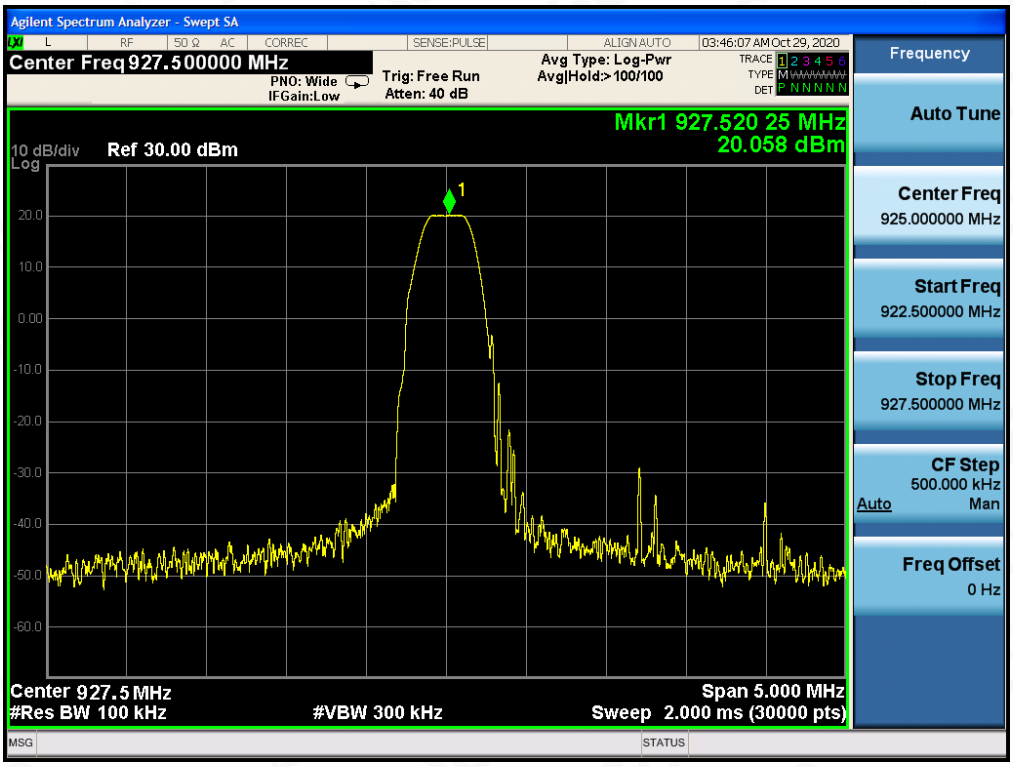


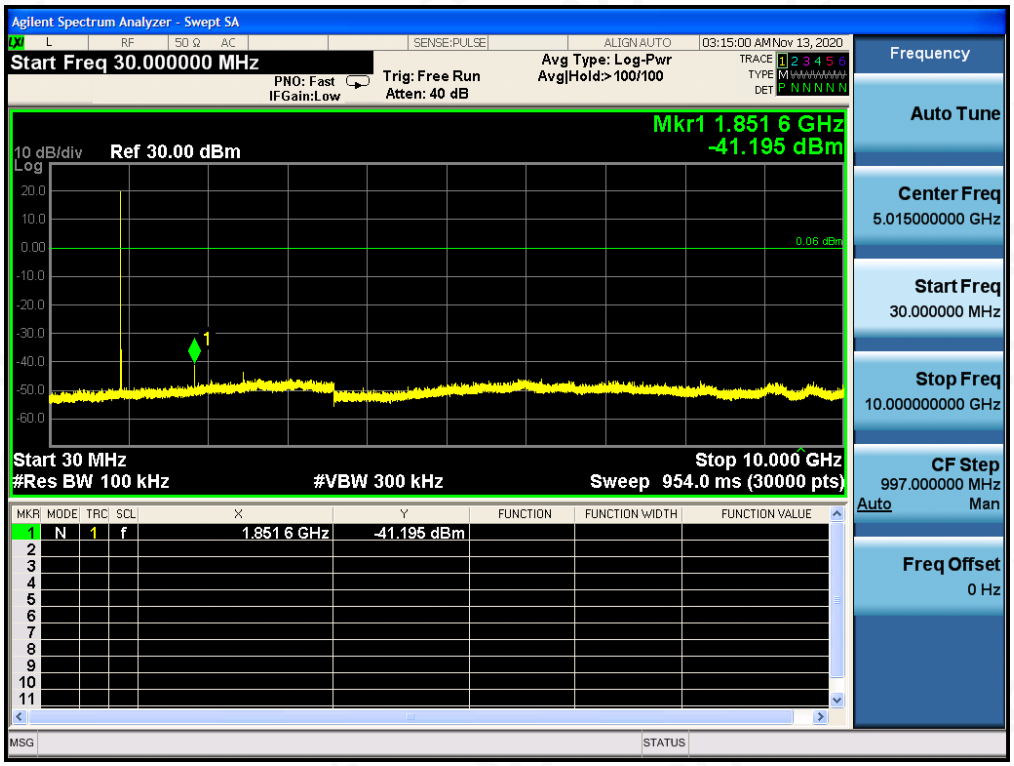
GFSK MODULATION IN MIDDLE CHANNEL





GFSK MODULATION IN HIGH CHANNEL



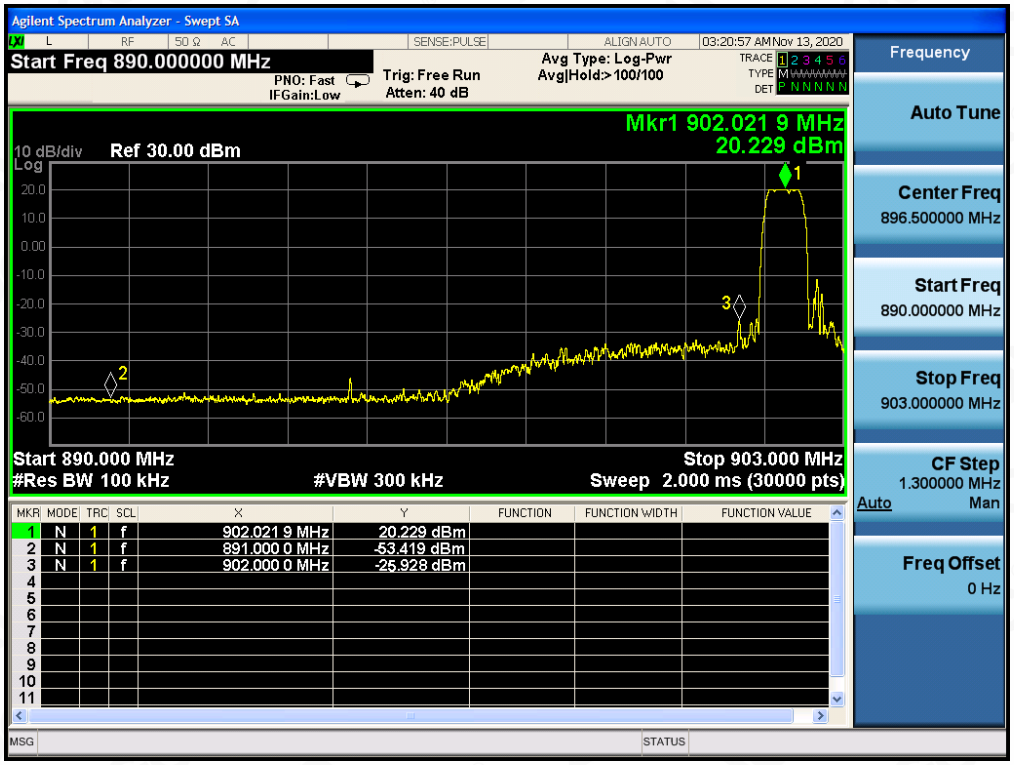


Note: The peak emissions without marker on the above plots are fundamental wave and need not to compare with the limit.

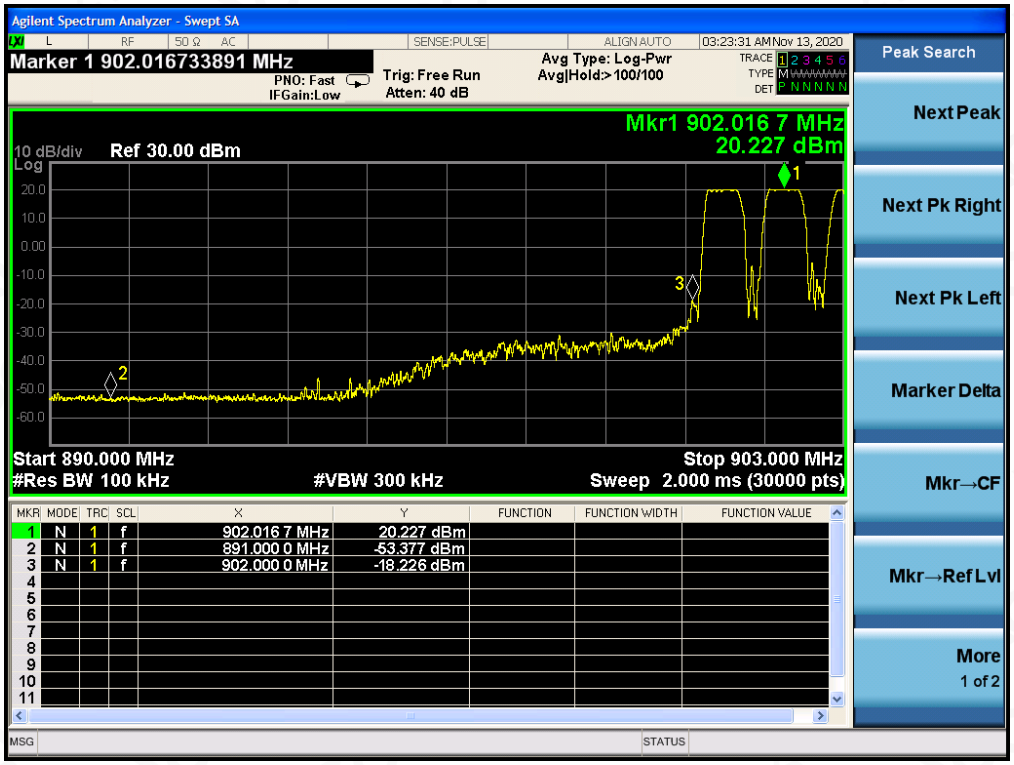
TEST RESULT FOR BAND EDGE(BW=250kHz)

GFSK MODULATION IN LOW CHANNEL

Hopping off

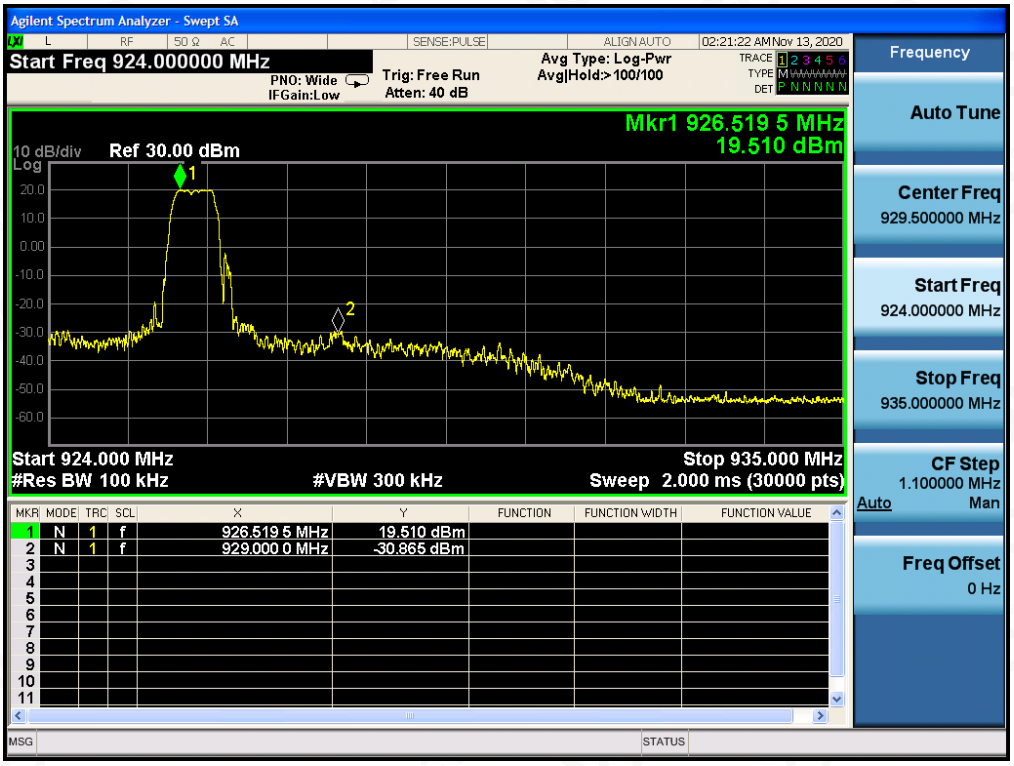


Hopping on



GFSK MODULATION IN HIGH CHANNEL

Hopping off



Hopping on

10. RADIATED EMISSION

10.1. MEASUREMENT PROCEDURE

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

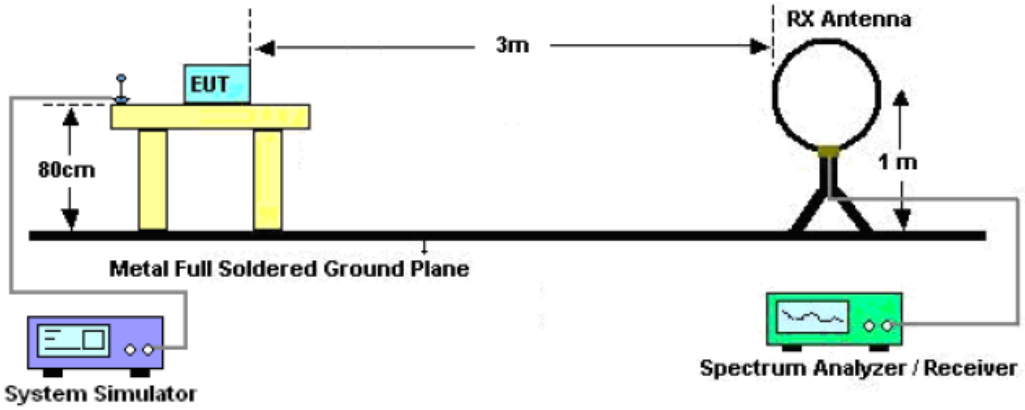
The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP
Start ~Stop Frequency	1GHz~26.5GHz 1MHz/1MHz for Peak, 1MHz/10Hz for Average

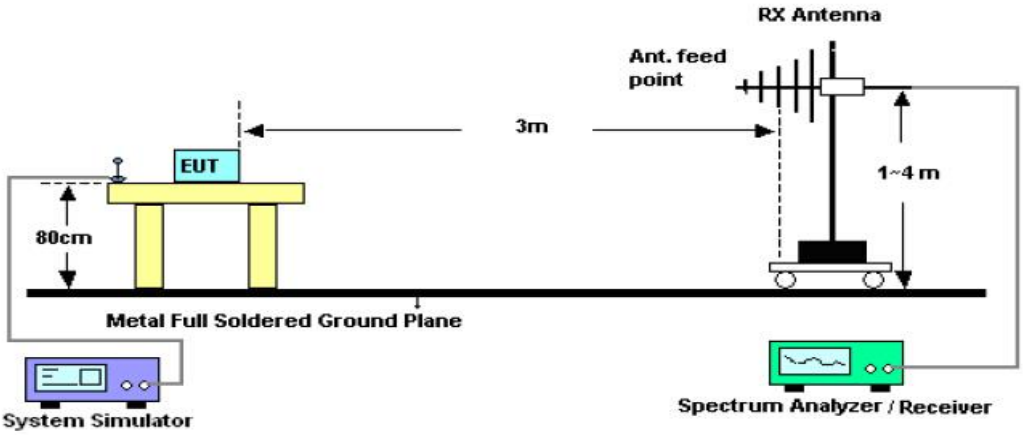
Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

10.2. TEST SETUP

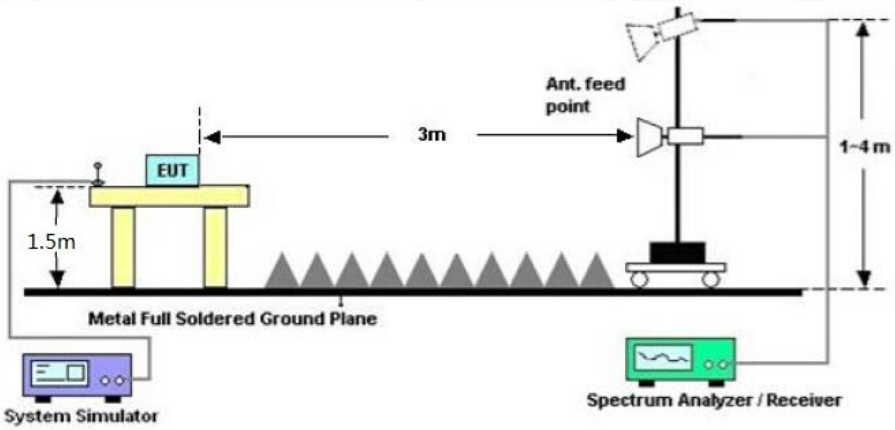
Radiated Emission Test-Setup Frequency Below 30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



RADIATED EMISSION TEST SETUP ABOVE 1000MHz



10.3. LIMITS AND MEASUREMENT RESULT

15.209(a) Limit in the below table has to be followed

Frequencies (MHz)	Field Strength (micorvolts/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

Note: All modes were tested For restricted band radiated emission,
the test records reported below are the worst result compared to other modes.

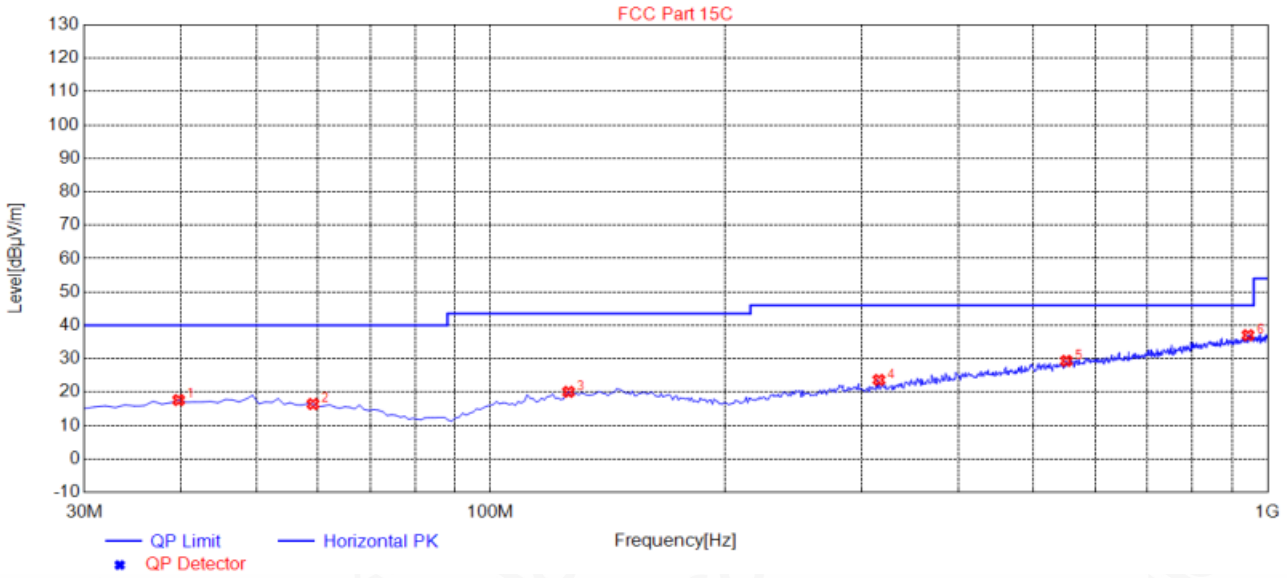
10.4. TEST RESULT

RADIATED EMISSION BELOW 30MHZ

The amplitude of spurious emissions from 9kHz to 30MHz which are attenuated more than 20 dB below the permissible value need not be reported.

RADIATED EMISSION BELOW 1GHZ

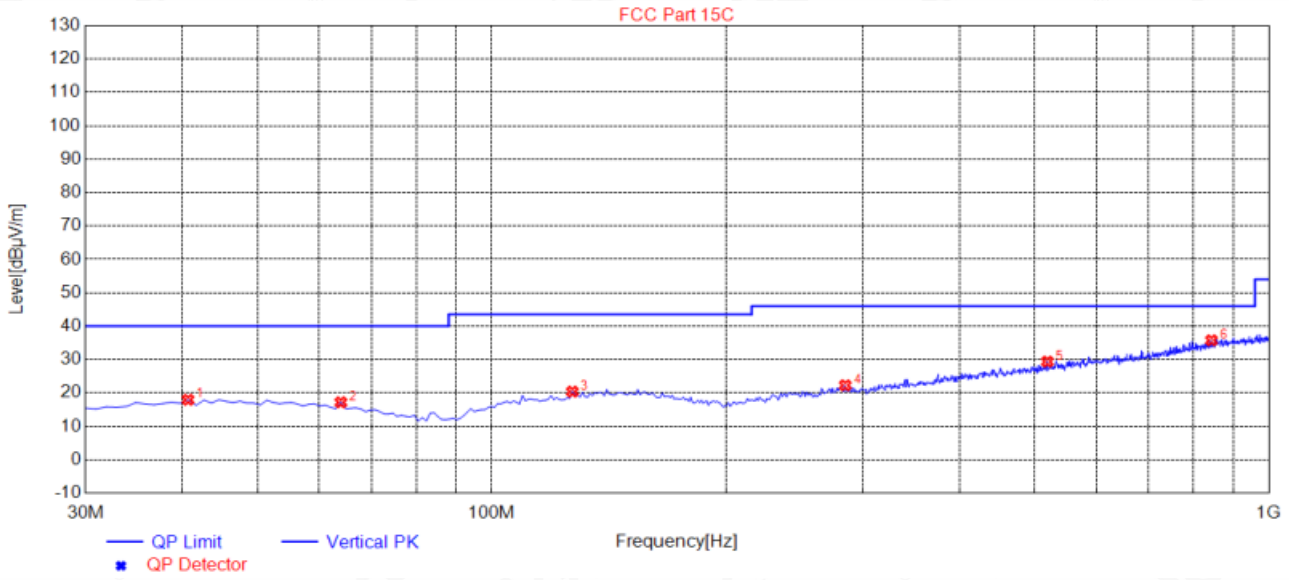
EUT	LoRa RF Communication Module	**Model Name**	LW-M023-VB
Temperature	25℃	**Relative Humidity**	55.4%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	Mode 1	**Antenna**	Horizontal



Suspected Data List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	39.7000	17.61	11.86	40.00	22.39	150	134	Horizontal
2	59.1000	16.44	10.98	40.00	23.56	150	355	Horizontal
3	126.030	20.08	13.88	43.50	23.42	150	43	Horizontal
4	316.150	23.65	16.52	46.00	22.35	150	27	Horizontal
5	550.890	29.36	23.28	46.00	16.64	150	54	Horizontal
6	943.740	37.04	30.65	46.00	8.96	150	168	Horizontal

RESULT: PASS

EUT	LoRa RF Communication Module	Model Name	LW-M023-VB
Temperature	25℃	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	Vertical



Suspected Data List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	40.6700	17.95	11.91	40.00	22.05	150	248	Vertical
2	63.9500	17.19	10.25	40.00	22.81	150	217	Vertical
3	127.000	20.39	13.95	43.50	23.11	150	338	Vertical
4	285.110	22.28	16.24	46.00	23.72	150	31	Vertical
5	518.880	29.38	22.57	46.00	16.62	150	79	Vertical
6	843.830	35.76	29.19	46.00	10.24	150	73	Vertical

RESULT: PASS

Note:

1. Factor=Antenna Factor + Cable loss, Margin= Limit- Measurement.

2. The “Factor” value can be calculated automatically by software of measurement system.

3. All test modes had been pre-tested. The bandwidth of 250kHz mode 1 is the worst case and recorded in the report.

RADIATED EMISSION ABOVE 1GHZ

EUT	LoRa RF Communication Module	Model Name	LW-M023-VB
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
2704.003	60.51	-9.27	51.24	74.00	-22.76	peak
2704.003	51.22	-9.27	41.95	54.00	-12.05	AVG
3608.005	56.92	-7.68	49.24	74.00	-24.76	peak
3608.005	46.35	-7.68	38.67	54.00	-15.33	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT	LoRa RF Communication Module	Model Name	LW-M023-VB
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
2704.003	59.32	-9.27	50.05	74.00	-23.95	peak
2704.003	53.51	-9.27	44.24	54.00	-9.76	AVG
3608.005	58.68	-7.68	51.00	74.00	-23.00	peak
3608.005	50.48	-7.68	42.80	54.00	-11.20	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT	LoRa RF Communication Module	Model Name	LW-M023-VB
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 2	Antenna	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
2742.225	61.31	-9.18	52.13	74.00	-21.87	peak
2742.225	50.48	-9.18	41.30	54.00	-12.70	AVG
3656.009	57.36	-7.54	49.82	74.00	-24.18	peak
3656.009	49.20	-7.54	41.66	54.00	-12.34	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT	LoRa RF Communication Module	Model Name	LW-M023-VB
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 2	Antenna	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
2742.225	59.42	-9.18	50.24	74.00	-23.76	peak
2742.225	51.20	-9.18	42.02	54.00	-11.98	AVG
3656.009	59.10	-7.54	51.56	74.00	-22.44	peak
3656.009	49.38	-7.54	41.84	54.00	-12.16	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT	LoRa RF Communication Module	Model Name	LW-M023-VB
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 3	Antenna	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
2778.002	61.82	-9.07	52.75	74.00	-21.25	peak
2778.002	50.35	-9.07	41.28	54.00	-12.72	AVG
3704.005	58.26	-7.38	50.88	74.00	-23.12	peak
3704.005	51.27	-7.38	43.89	54.00	-10.11	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT	LoRa RF Communication Module	Model Name	LW-M023-VB
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 3	Antenna	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
2778.002	62.30	-9.07	53.23	74.00	-20.77	peak
2778.002	51.60	-9.07	42.53	54.00	-11.47	AVG
3704.005	57.87	-7.38	50.49	74.00	-23.51	peak
3704.005	48.39	-7.38	41.01	54.00	-12.99	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

RESULT: PASS

Note:

Other emissions from 1G~10GHz are attenuated more than 20 dB below the permissible value. No recording in the test report.

Factor = Antenna Factor + Cable loss - Amplifier gain, Over=Measure-Limit.

The “Factor” value can be calculated automatically by software of measurement system.

The bandwidth of 250kHz is the worst case and recorded in the report.

11. NUMBER OF HOPPING FREQUENCY

11.1. MEASUREMENT PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
1. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
2. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. VBW ≥ RBW. Sweep: Auto. Detector function: Peak. Trace: Max hold.
4. Allow the trace to stabilize.

11.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

11.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

11.4. LIMITS AND MEASUREMENT RESULT

TOTAL NO. OF HOPPING CHANNEL(BW=125kHz)	LIMIT (NO. OF CH)	MEASUREMENT (NO. OF CH)	RESULT
	>=25	64	PASS

TEST PLOT FOR NO. OF TOTAL CHANNELS