RF TEST REPORT

Report No.:	SET2016-17188
Product Name:	Bluetooth smart watches
FCC ID:	2AA7D-ZEST1
IC:	12131A-ZEST1
Model No. :	ZeSport
Applicant:	KRONOZ
Address:	ROUTE DE VALAVRAN 96 GENTHOD Switzerland
Dates of Testing:	08/20/2016 — 09/12/2016
Issued by:	CCIC-SET
Lab Location:	Electronic Testing Building, Shahe Road, Xili, Nanshan District, Shenzhen, 518055, P. R. China
	Tel: 86 755 26627338 **Fax:** 86 755 26627238

This test report consists of **61** pages in total. It may be duplicated completely for legal use with the approval of the applicant. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product endorsement by CCIC-SET. The test results in the report only apply to the tested sample. The test report shall be invalid without all the signatures of testing engineers, reviewer and approver. Any objections must be raised to CCIC-SET within 20 days since the date when the report is received. It will not be taken into consideration beyond this limit.

Test Report

Product Name.....:	Bluetooth smart watches
Model No. .....:	ZeSport
Trade Name.....:	MYKRONOZ
Brand Name .....:	N/A
Applicant.....:	KRONOZ
Applicant Address.....:	ROUTE DE VALAVRAN 96 GENTHOD Switzerland
Manufacturer .....:	KRONOZ
Manufacturer Address .....:	ROUTE DE VALAVRAN 96 GENTHOD Switzerland
Test Standards.....:	47 CFR Part 15 Subpart C 2015：Radio Frequency Devices ANSI C63.10:2013：American National Standard for Testing Unlicensed Wireless Devices RSS-247:Issue 1,December2015 / RSS-GEN Issue 4, November 2014 DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
Test Result .....:	PASS
Tested by .....:	2016.09.14 Lu Lei，Test Engineer
Reviewed by.....:	2016.09.14 Zhu Qi, Senior Egineer
Approved by .....:	2016.09.14 Wu Li'an，Manager

TABLE OF CONTENTS

Change History		
Issue	Date	Reason for change
1.0	2016.09.14	First edition

1. General Information

1.1. EUT Description

EUT Type	Bluetooth smart watches	
Hardware Version	SW02_v1.3	
Software Version	SW02_PCB01_gprs_MT2502_S00.SY1301_ZESPORT_V1_SIRI	
EUT supports Radios application	Bluetooth V3.0+EDR	
Frequency Range	Bluetooth EDR	2402MHz~2480MHz
Channel Number	Bluetooth EDR	79
Bit Rate of Transmitter	Bluetooth EDR	1/2/3Mbps
Modulation Type	Bluetooth EDR	GFSK, π /4-DQPSK,8DPSK
Antenna Type	Chip Antenna	
Antenna Gain	2.0dBi	

Note 1: The EUT is a Bluetooth smart watches, it contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth Module is F(MHz)=2402+1*n (0<=n<=78). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).

Note 2: a. When power on, the EUT will scan the whole frequency until a Connection command from the other BT devices.

b. When receiving the signal from the other BT devices, The EUT transmit are sponse signal.

c. The other devices receive the response signal and recognize it, then send a connection command to establish the connection.

d. After the connection establish successfully, the data transmission is beginning. At the same time, the both devices will shift frequencies in synchronization per a same pseudo randomly ordered list of hopping frequencies, the hopping rate is1600 times per second. This device conforms to the criteria in FCC Public Notice DA 00-705.

e. The bandwidth of the receiver, which is set to a fixed width by the software.

Note 3: Bluetooth signal has 9 packages DH1, DH3, DH5, 3DH1, 3DH3, 3DH5, 5DH1, 5DH3, 5DH5, DH5 package is largest, we are testing DH5 in the document.

1.2. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC / IC Certification:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart C 2013	Radio Frequency Devices
2	ANSI C63.10 2013	American National Standard for Testing Unlicensed Wireless Devices
3	RSS-GEN: Issue 4,November 2014	General Requirements and Information for the Certification of Radio Apparatus
4	RSS-247:Issue 1,December2015:	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Standard(s) Section		Description	Result
	FCC	IC		
1	15.203	8.3	Antenna Requirement	PASS
2	15.247(a)	RSS-247 Issue1 - 5.1	Number of Hopping Frequency	PASS
3	15.247(b)	RSS-247 Issue1 - 5.4	Peak Output Power	PASS
4	15.247(a)	RSS-247 Issue1 - 5.1	Bandwidth	PASS
5	15.247(a)	RSS-247 Issue1 - 5.1	Carrier Frequency Separation	PASS
6	15.247(a)	RSS-247 Issue1 - 5.1	Time of Occupancy (Dwell time)	PASS
7	15.247(d)	RSS-247 Issue1 - 5.5	Conducted Spurious Emission	PASS
8	15.247(d)	RSS-247 Issue1 - 5.5 RSS - Gen	Conducted Band Edge	PASS
9	15.207	RSS-GEN	Conducted Emission	PASS
10	15.209 15.247(c)	RSS-247 Issue1 - 5.5 RSS - Gen	Radiated Band Edges and Spurious Emission	PASS

Note 1: The tests were performed according to the method of measurements prescribed in DA-00-705.

Note 2: The test of Radiated Emission was performed according to the method of measurements prescribed in ANSI C63.10 2013.

1.3. Frequency Hopping System Requirements

1.3.1. Standard Applicable

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

1.3.2. Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no

impact on the bandwidth used.

This device was tested with a bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for DA 00-705 and FCC Part 15.247 rule.

1.3.3. EUT Pseudorandom Frequency Hopping Sequence

Pseudorandom Frequency Hopping Sequence Table as below:
Channel: 08, 24, 40, 56, 40, 56, 72, 09, 01, 09, 33, 41, 33, 41, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78,68, 76, 21, 29, 10, 26, 42, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 55, 71, 08, 24, 08, 24, 40, 56, 40, 48,72, 01, 72, 01, 25, 33, 12, 28, 44, 60, 42, 58, 74, 11, 05, 13, 37, 45 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

1.4. Facilities and Accreditations

1.4.1. Facilities

CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories

(identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: February 28, 2015. Valid time is until February 27, 2018.

FCC-Registration No.: 317478

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 317478, Renewal date Jul. 18, 2014, valid time is until Jul. 18, 2017.

IC-Registration No.: 5377B

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B on Dec.03, 2014, valid time is until Dec.03, 2017.

1.4.2. Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86KPa-106KPa

2. 47 CFR Part 15C Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

2.1.2. Antenna Information

Antenna Category: Internal antenna

An Internal antenna was soldered to the antenna port of EUT via an adaptor cable can't be removed.

Antenna General Information:

No.	EUT	Ant. Cat.	Gain(dBi)
1	Bluetooth smart watches	Chip	2

2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2. Number of Hopping Frequency

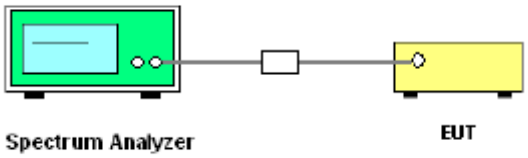
2.2.1. Limit of Number of Hopping Frequency

Frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



2.2.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
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≥1% of the span; VBW≥RBW; 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.

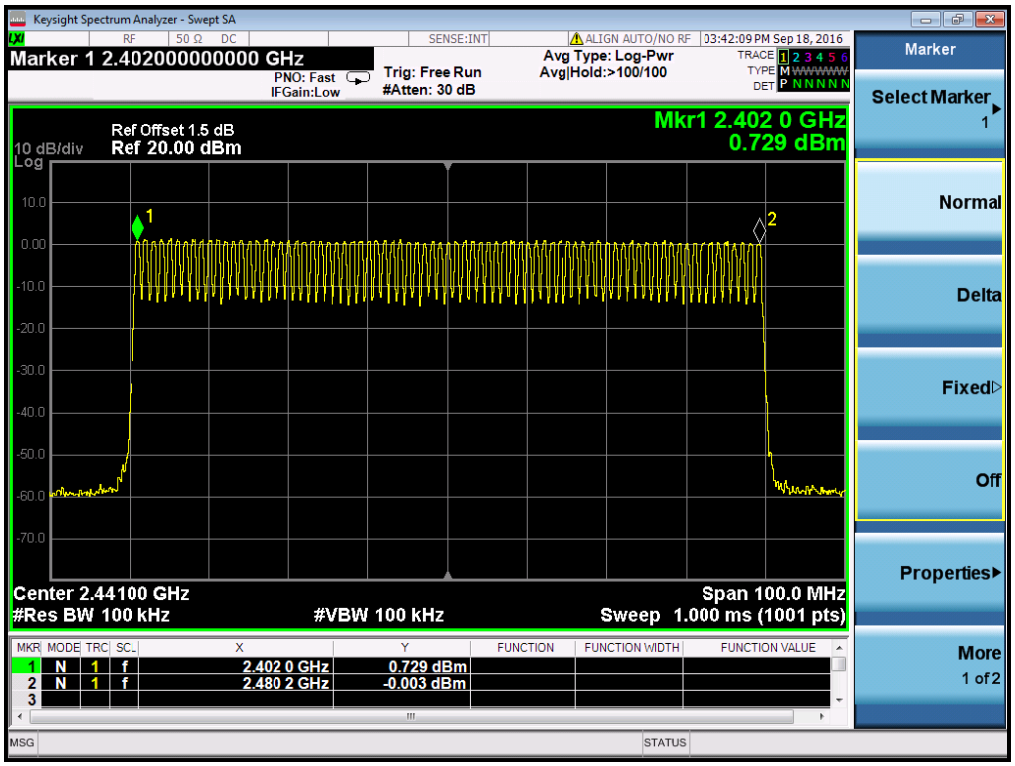
2.2.5. Test Results of Number of Hopping Frequency

The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency.

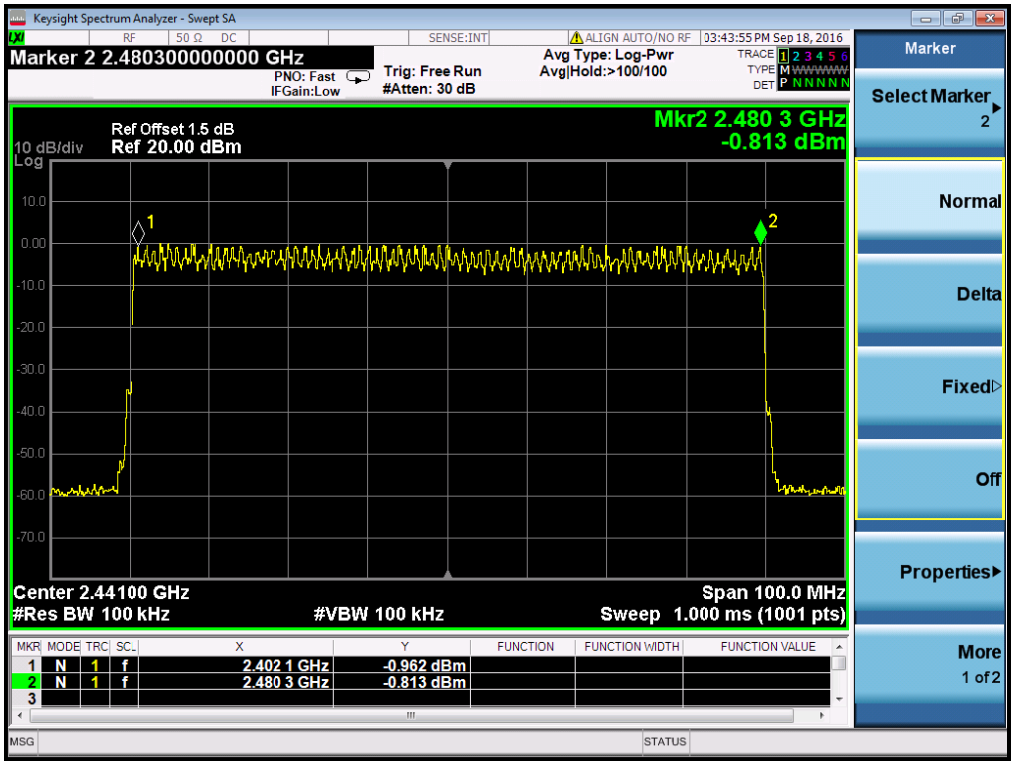
A. Test Verdict:

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Refer to Plot	Verdict
GFSK	2400 - 2483.5	79	15	Plot A	PASS
π/4-DQPSK	2400 - 2483.5	79	15	Plot B	PASS
8-DPSK	2400 - 2483.5	79	15	Plot C	PASS

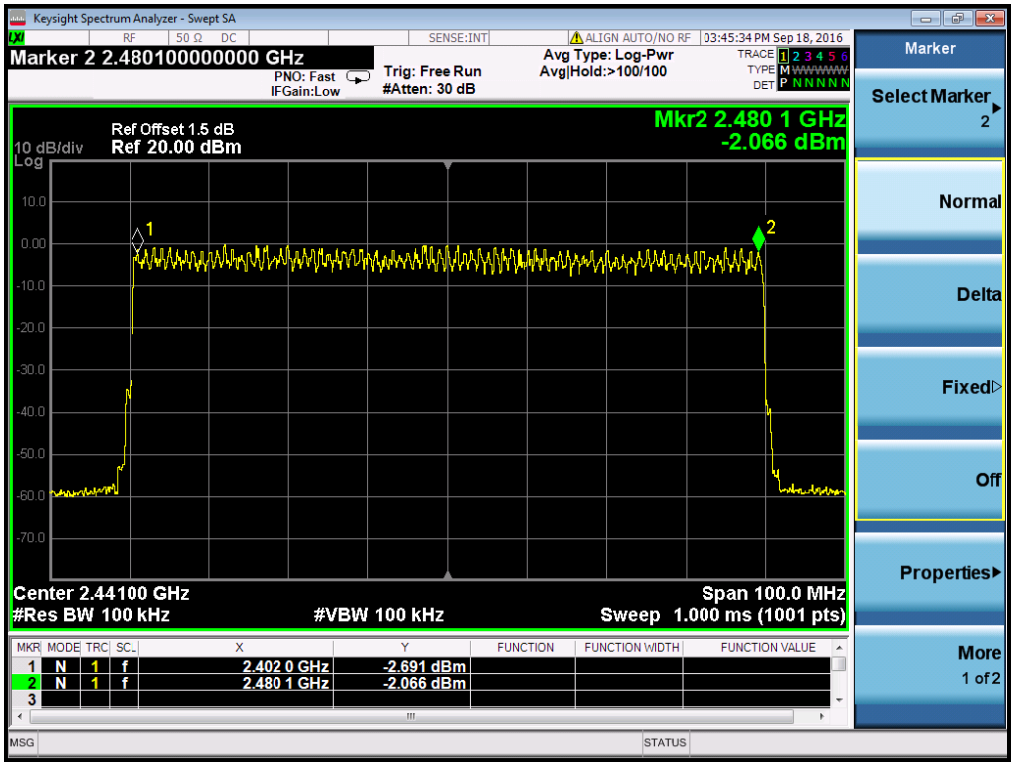
Test Plots:



(Plot A: GFSK)



(Plot B: π/4-DQPSK)



(Plot C: 8- DPSK)

2.3. Peak Output Power

2.3.1. Limit of Peak Output Power

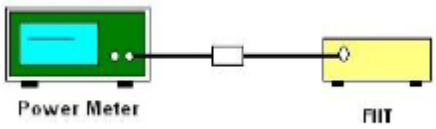
Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.

Requency hopping systems operating in the 2400-2483.5 MHz band may have hopping chann el carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hoppi ng channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
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.

2.3.5. Test Result

Test Mode	Channel	Frequency (MHz)	RF Power(dBm)	Ant. Gain(dBi)	Radiated power (dBm)	Limit (dBm)	Verdict
GFSK	0	2402	1.960	2.0	3.960	21	PASS
	39	2441	1.644		3.644		PASS
	78	2480	1.284		3.284		PASS
π/4-DQPSK	0	2402	1.125		3.125		PASS
	39	2441	0.711		2.711		PASS
	78	2480	0.375		2.375		PASS
8- DPSK	0	2402	1.568		3.568		PASS
	39	2441	1.257		3.257		PASS
	78	2480	0.800		2.800		PASS

2.4. 20dB Bandwidth

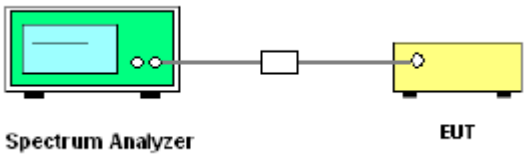
2.4.1. Definition

According to FCC §15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth (10*log1% = 20dB) taking the total RF output power.

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.4.3. Test Setup



2.4.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.

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 3 times the 20 dB bandwidth, centered on a hopping channel;

   RBW≥1% of the 20 dB bandwidth; VBW≥RBW; Sweep = auto; Detector function = peak;

   Trace = max hold.

5. Use the following spectrum analyzer setting for 99% Bandwidth measurement.

   For 99% Bandwidth measurement, the RBW=30kHz, and VBW=100kHz, Sweep=auto

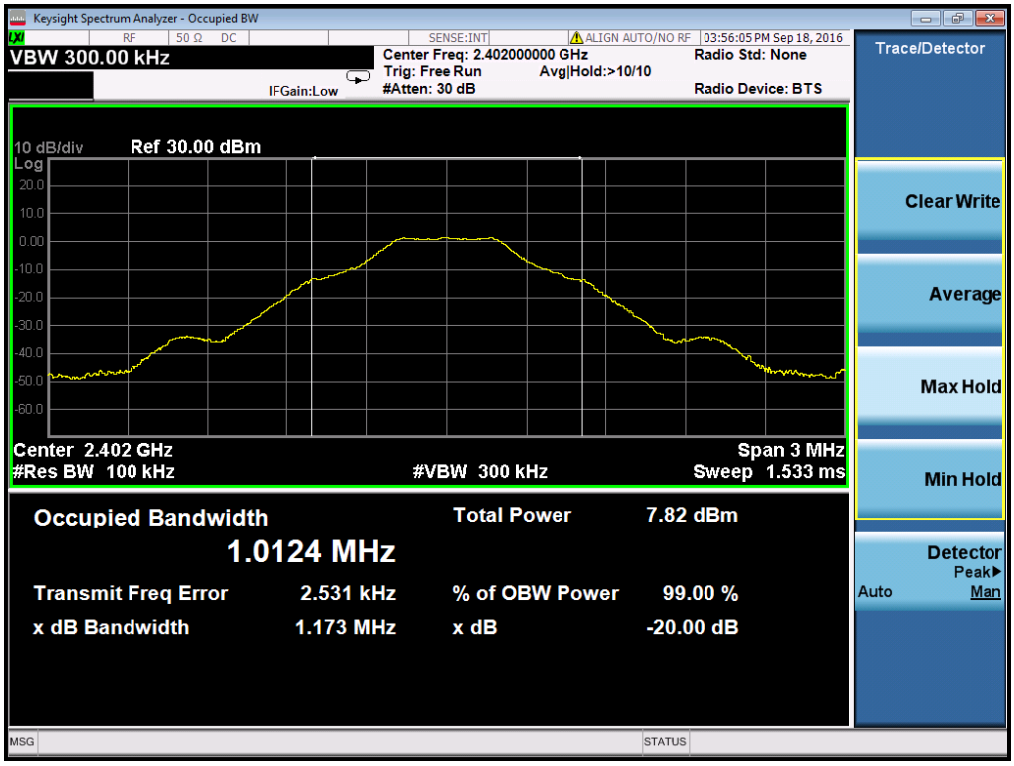
   Detector function=sample ,Trace = max. hold

6. Measure and record the results in the test report.

2.4.5. Test Results of 20dB Bandwidth

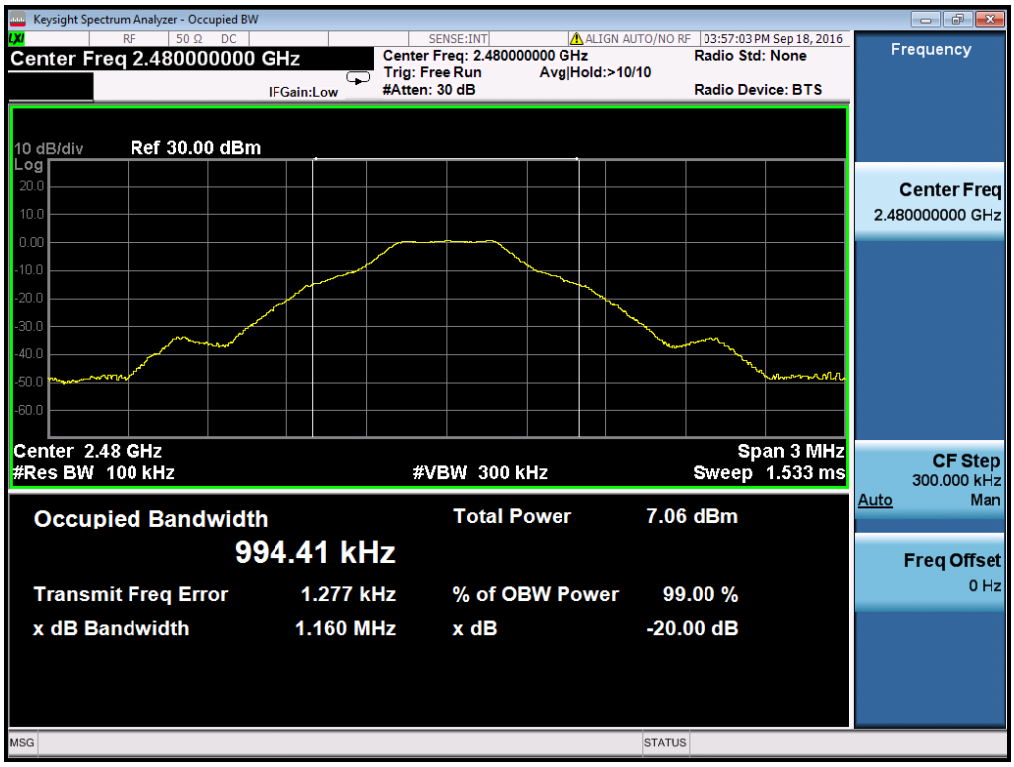
Mode	Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% bandwidth (MHz)
GFSK	0	2402	1.173	1.012
	39	2441	1.170	1.004
	78	2480	1.160	0.994
π/4-DQPSK	0	2402	1.384	1.227
	39	2441	1.382	1.225
	78	2480	1.372	1.221
8-DPSK	0	2402	1.382	1.227
	39	2441	1.382	1.231
	78	2480	1.379	1.224

2.4.6. Test Results (plots) of Bandwidth

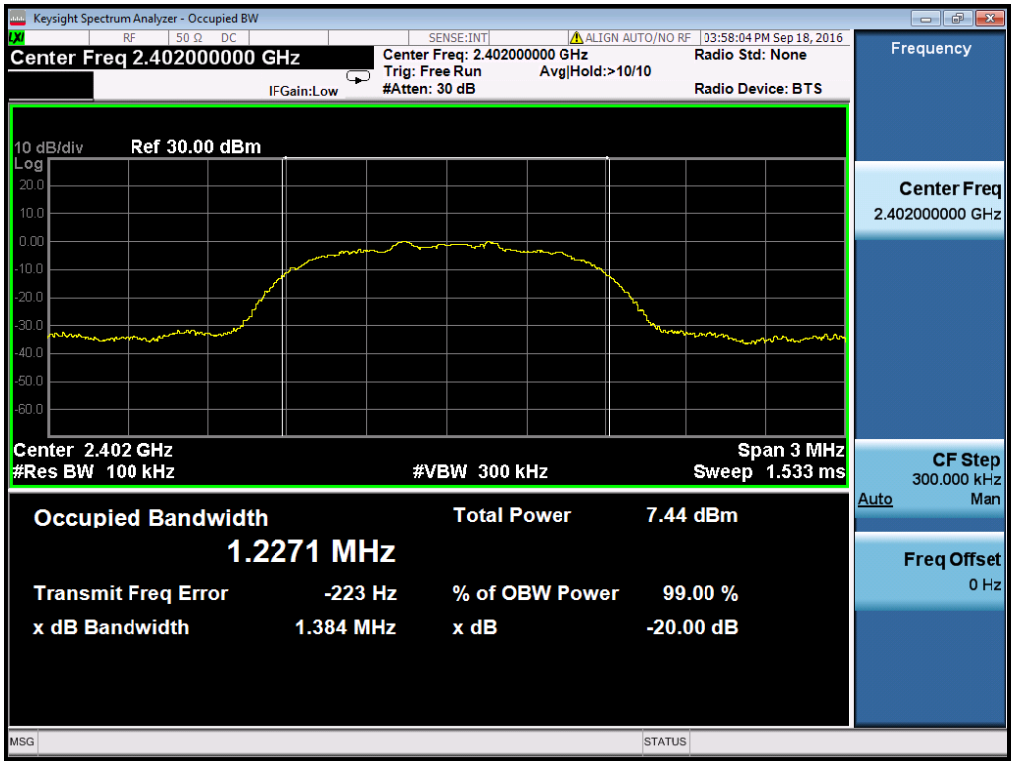


0 Channel @ GFSK

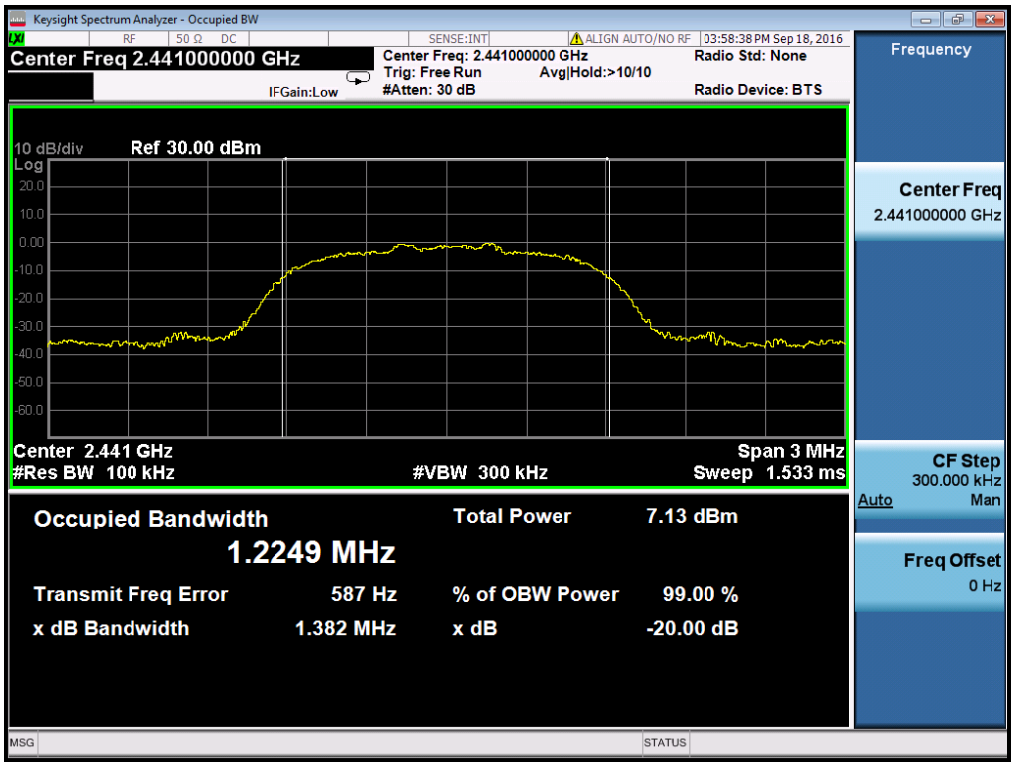
39 Channel @ GFSK



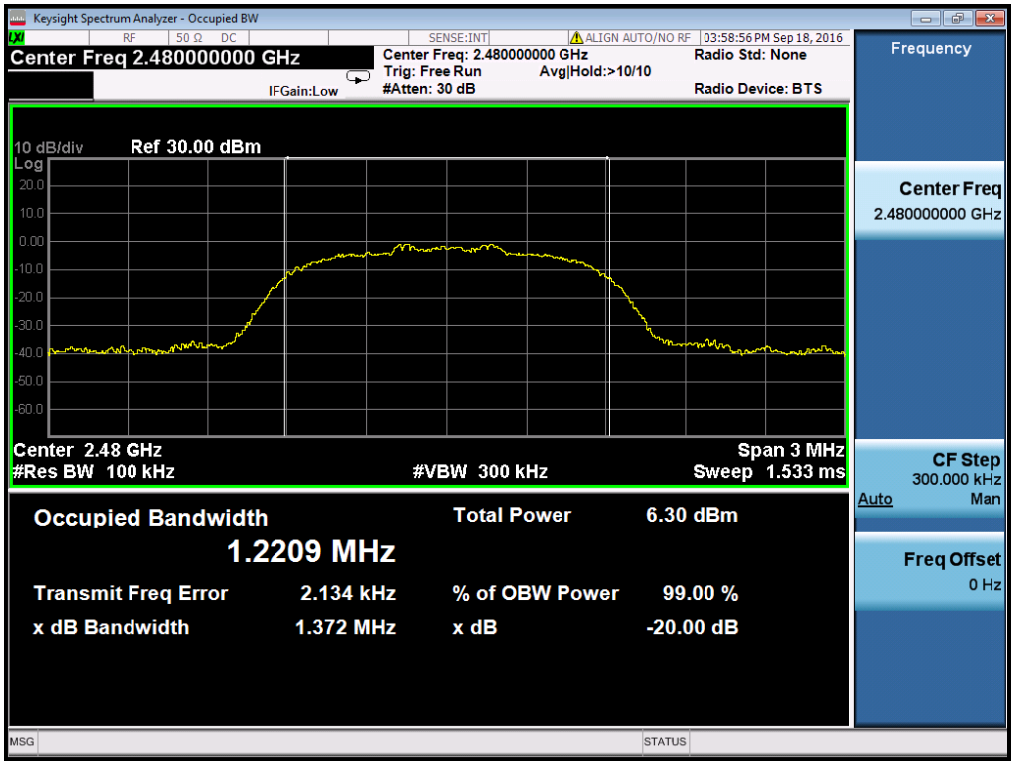
78 Channel @ GFSK



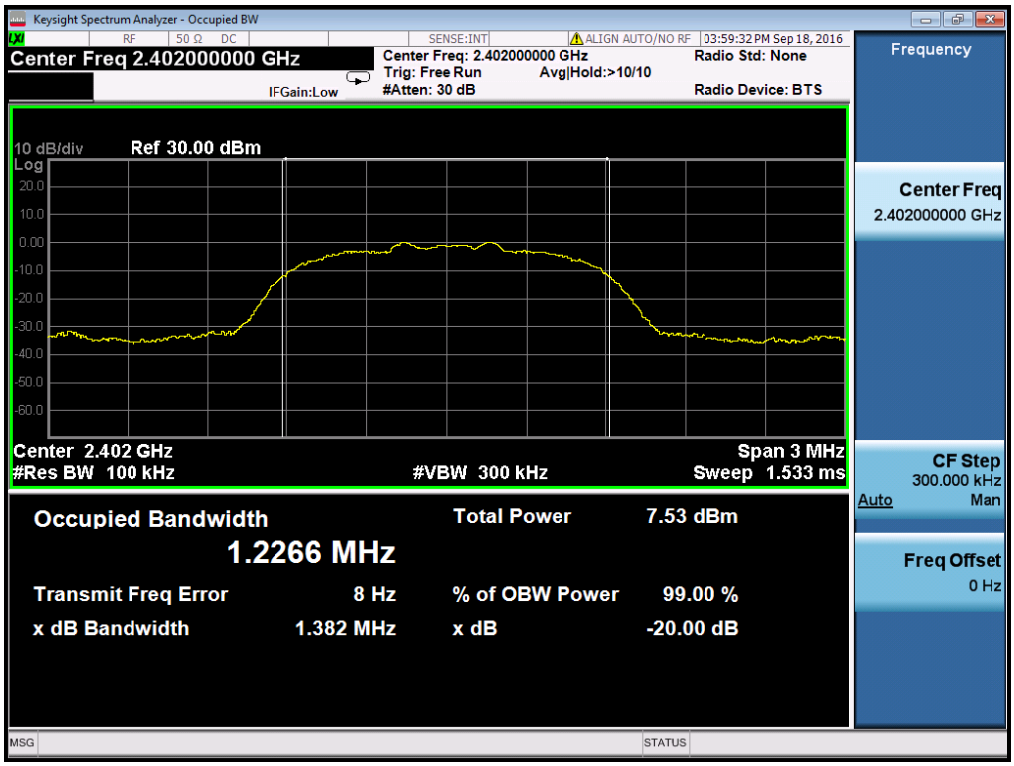
0 Channel @ π/4-DQPSK



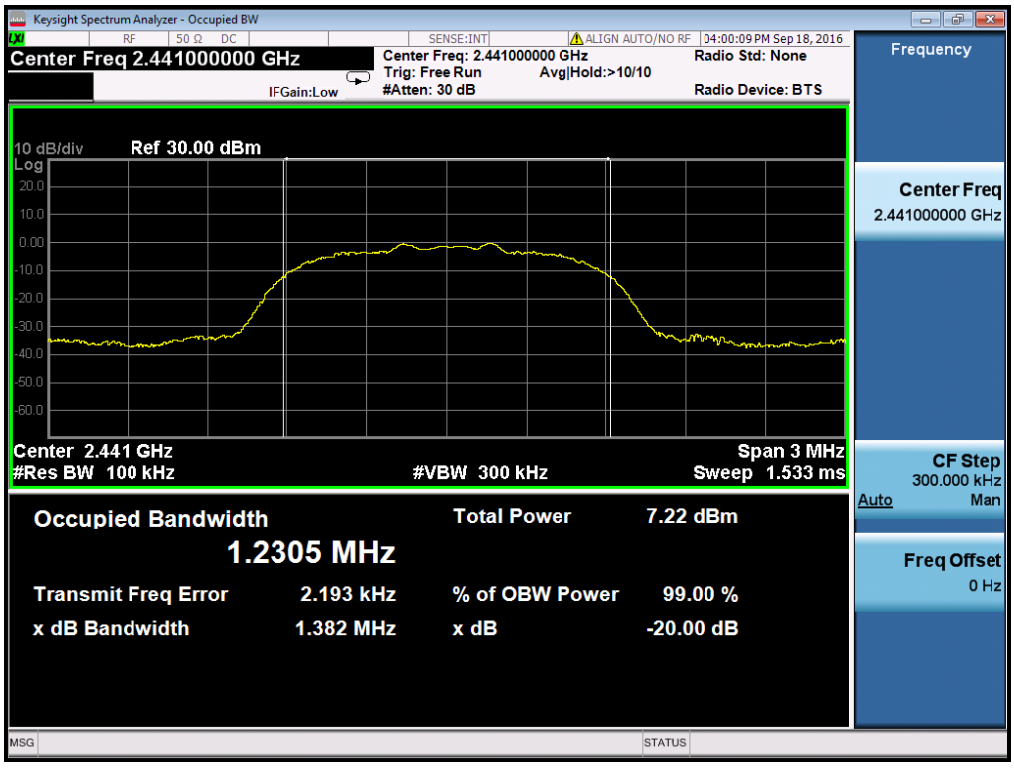
39 Channel @ π/4-DQPSK



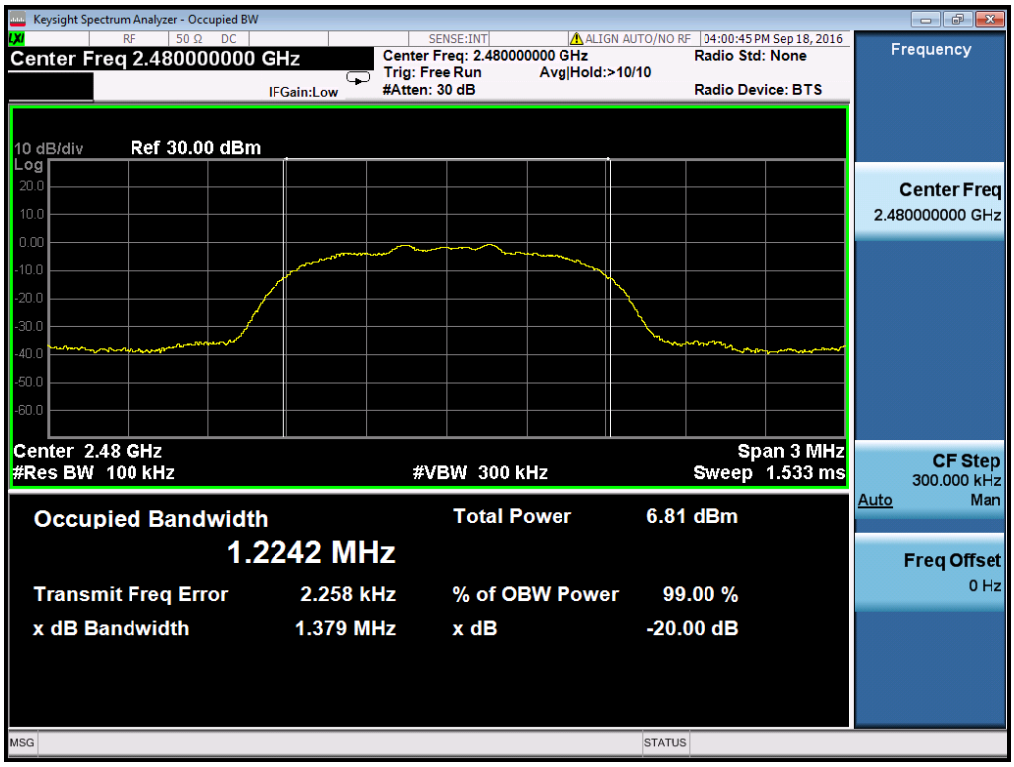
78 Channel @ π/4-DQPSK



0 Channel @ 8-DPSK



39 Channel @ 8-DPSK



78 Channel @ 8-DPSK

2.5. Carried Frequency Separation

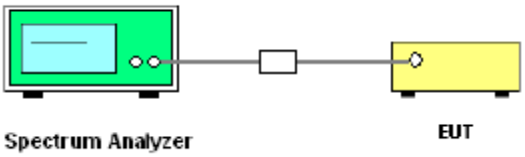
2.5.1. Limit of Carried Frequency Separation

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.5.3. Test Setup



2.5.4. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.

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:

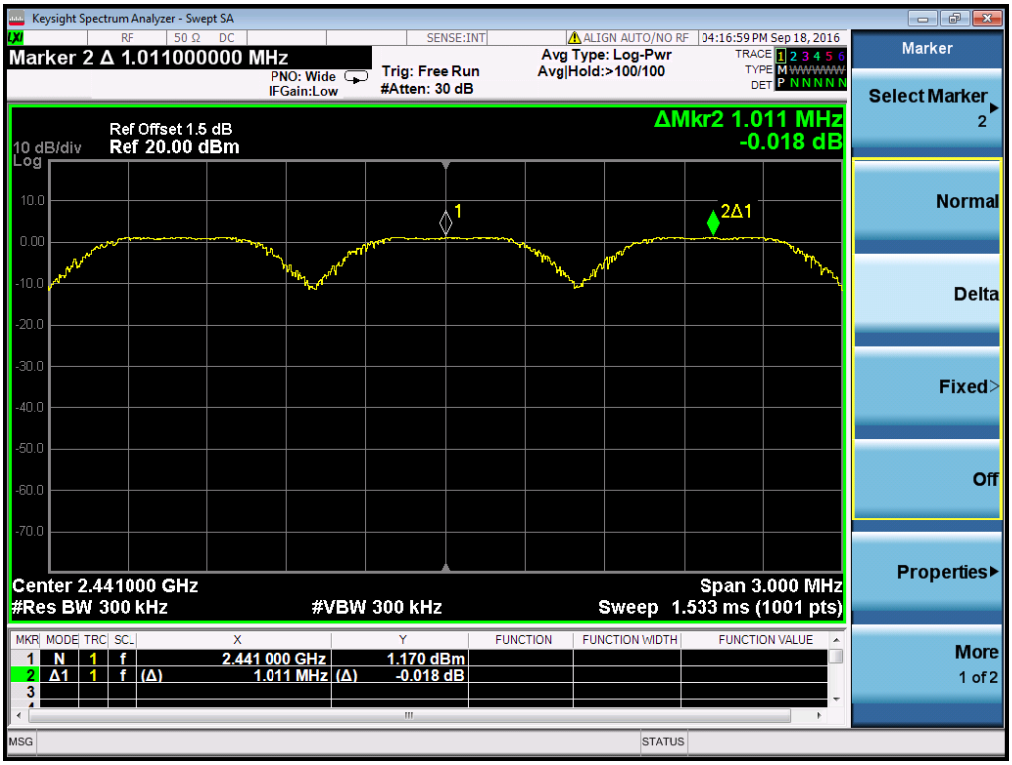
   Span = wide enough to capture the peaks of two adjacent channels; RBW≥1% of the span;

   VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold.

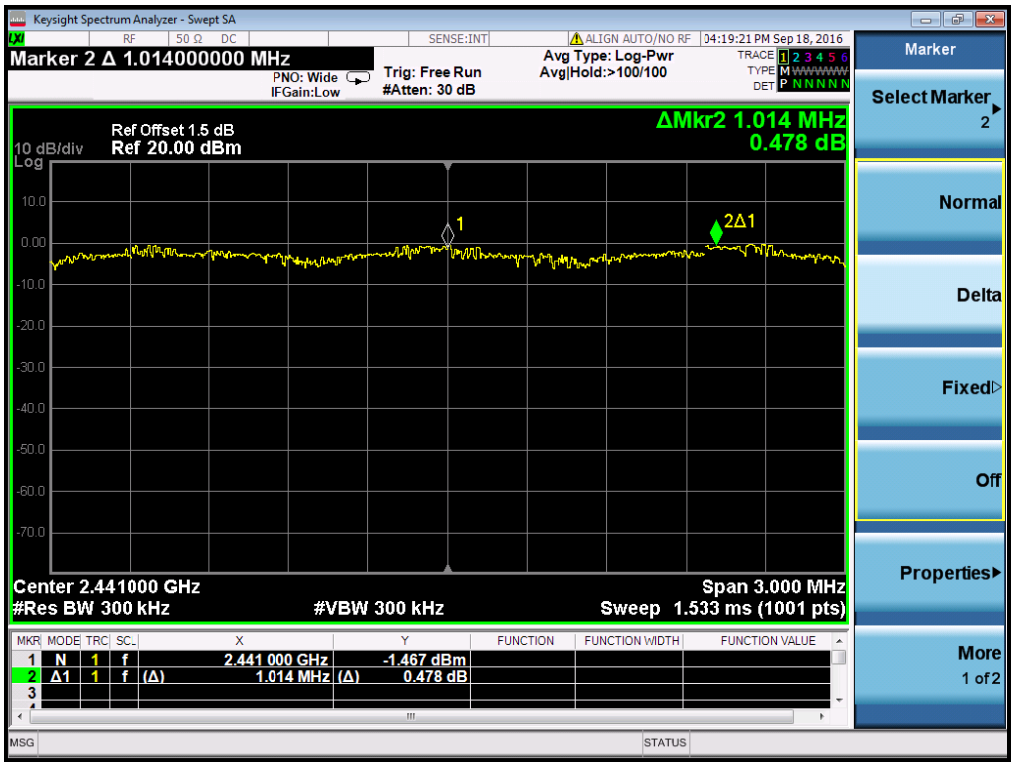
6. Measure and record the results in the test report.

2.5.5. Test Results of Carried Frequency Separation

Test mode	Frequency Separation(MHz)	(2/3 of 20dB BW) Limits (MHz)	Verdict
GFSK	1.011	0.782	PASS
π/4-DQPSK	1.014	0.923	PASS
8-DPSK	1.020	0.921	PASS



(Plot A: GFSK)



(Plot B: π/4-DQPSK)

(Plot C: 8-DPSK)

2.6. Dwell time

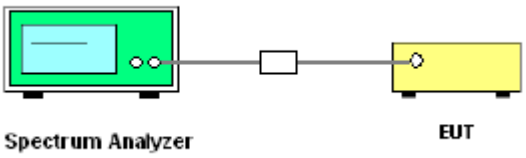
2.6.1. Limit of Dwell Time

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

2.6.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.6.3. Test Setup



2.6.1. Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
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 = 1 MHz; VBW≥RBW; 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.

2.6.2. Test Result

For DH1 package type:

{Total of Dwell} = {Pulse Time} * (1600 / 2) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4s * {Number of Hopping Frequency}

For DH3 package type:

{Total of Dwell} = {Pulse Time} * (1600 / 4) / {Number of Hopping Frequency} * {Period}

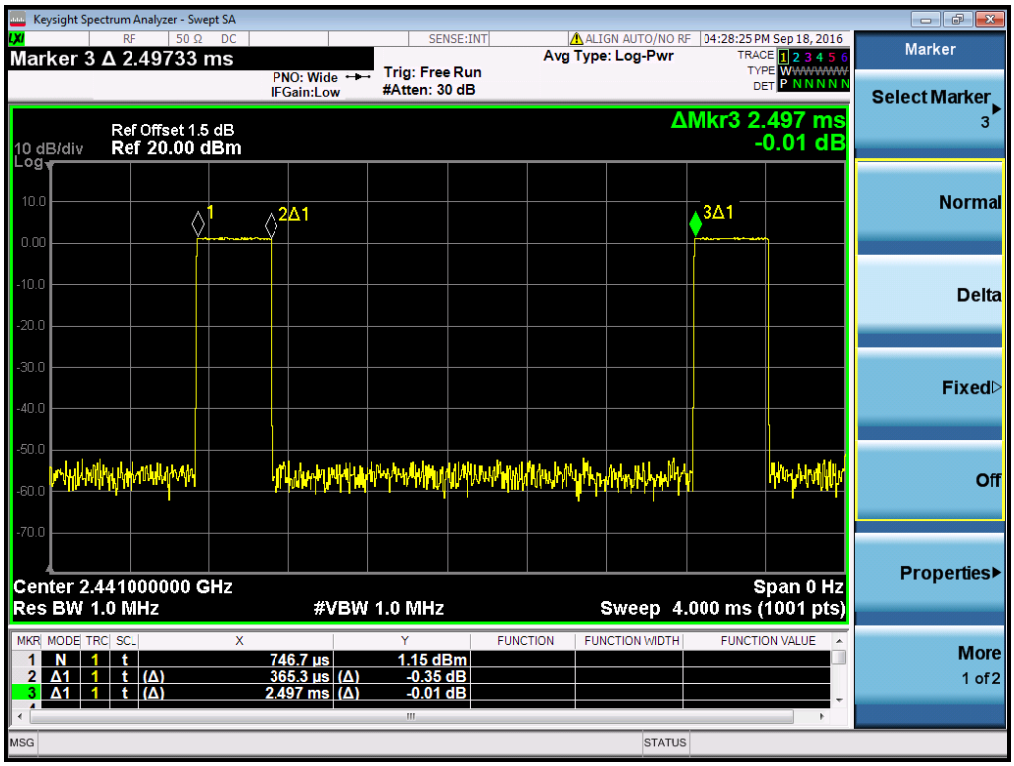
{Period} = 0.4s * {Number of Hopping Frequency}

For DH3 package type:

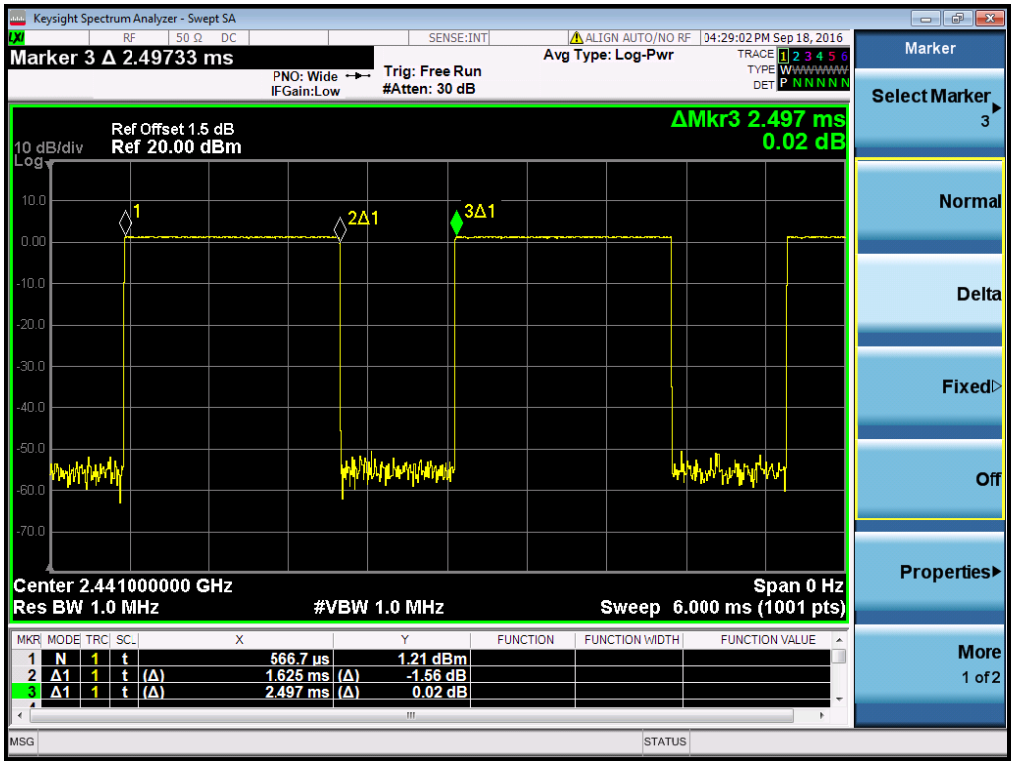
{Total of Dwell} = {Pulse Time} * (1600 / 6) / {Number of Hopping Frequency} * {Period}

{Period} = 0.4s * {Number of Hopping Frequency}

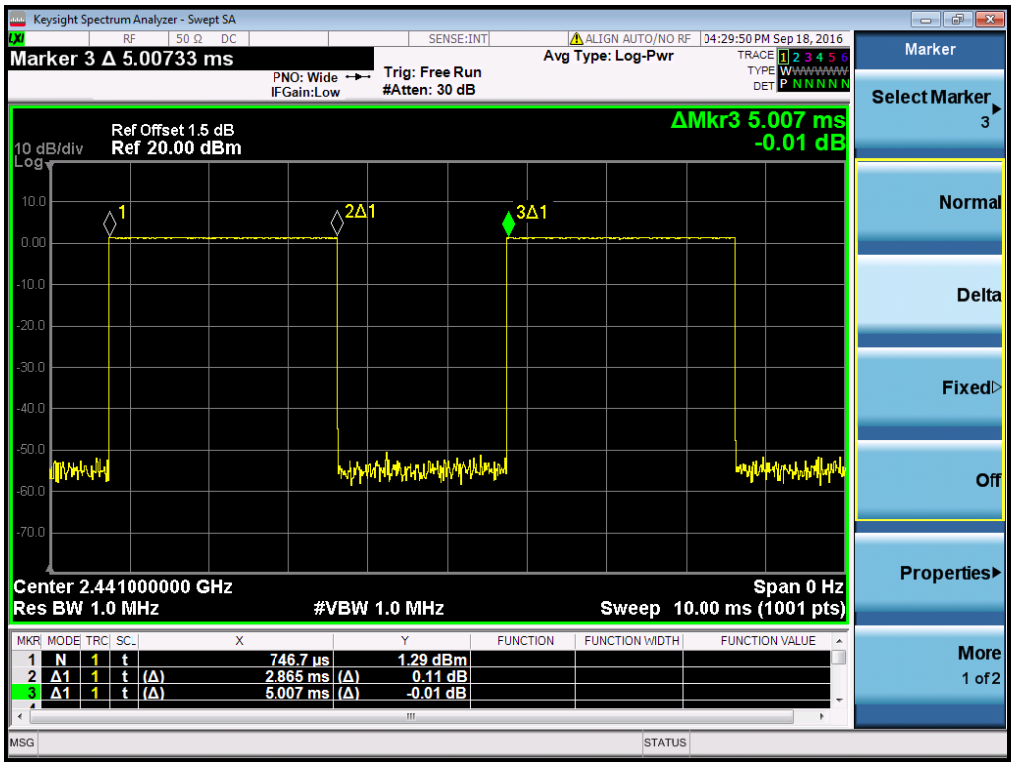
Modulation	Packet Type	Channel	Pulse Time (ms)	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	DH1	39	0.365	116.80	400	PASS
	DH3	39	1.625	260.00		PASS
	DH5	39	2.865	305.61		PASS
π/4-DQPSK	DH1	39	0.377	120.64		PASS
	DH3	39	1.631	260.96		PASS
	DH5	39	2.871	306.25		PASS
8-DPSK	DH1	39	0.375	120.00		PASS
	DH3	39	1.623	259.68		PASS
	DH5	39	2.883	307.53		PASS



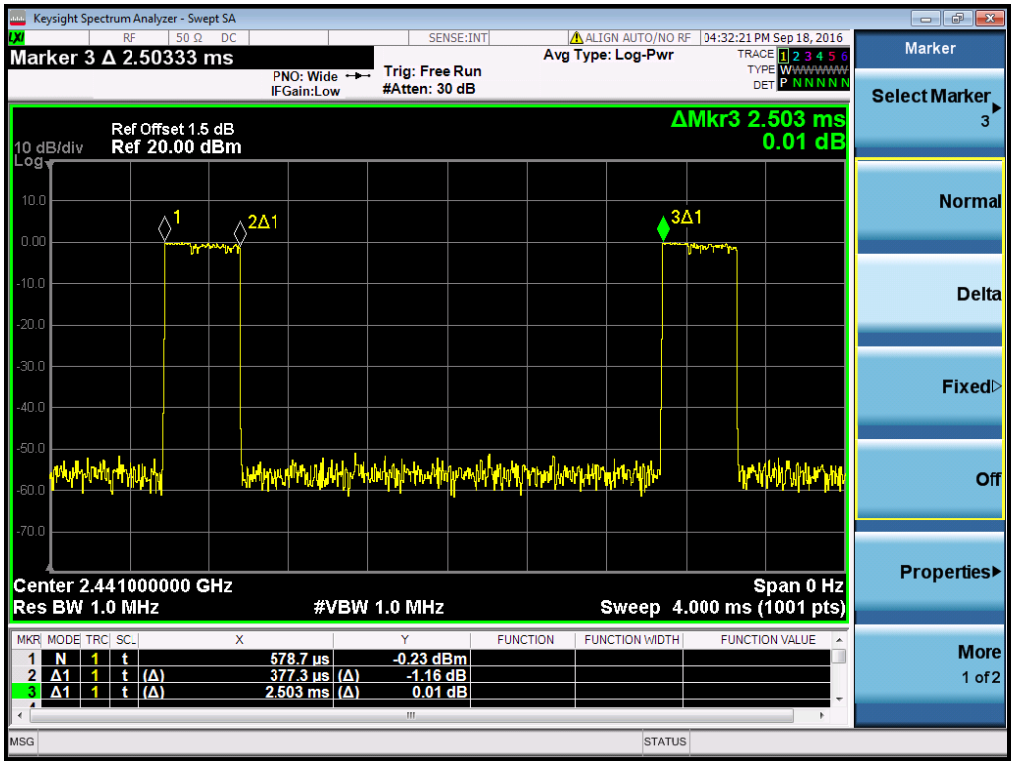
39 Channel @ DH1



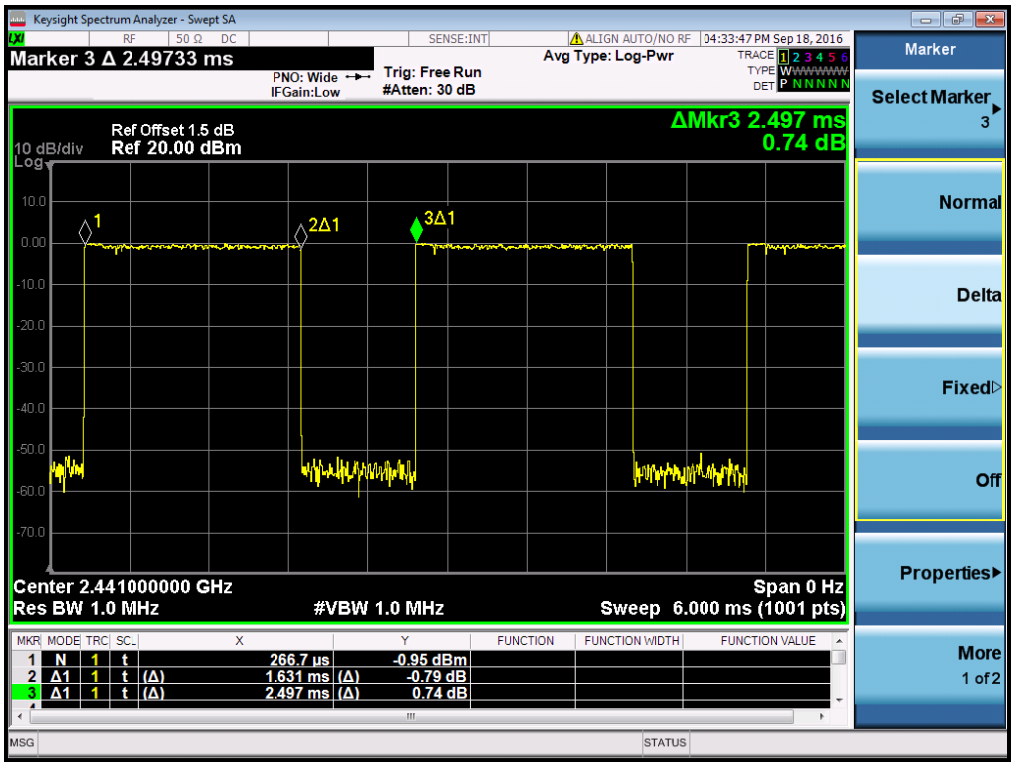
39 Channel @ DH3



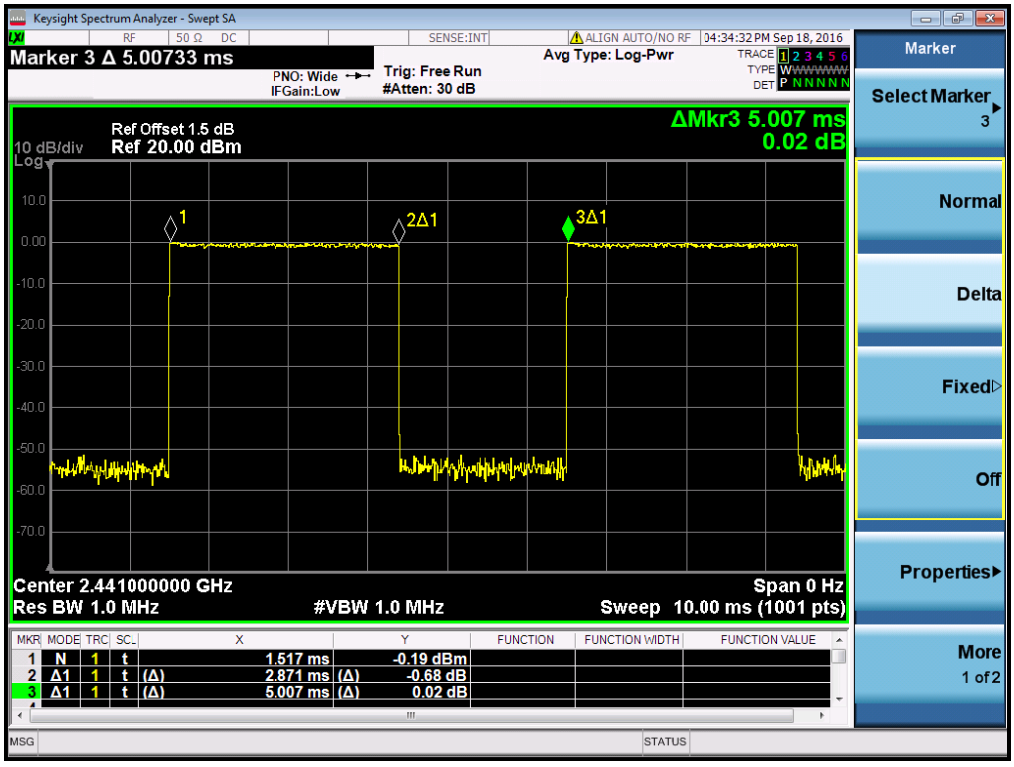
39 Channel @ DH5



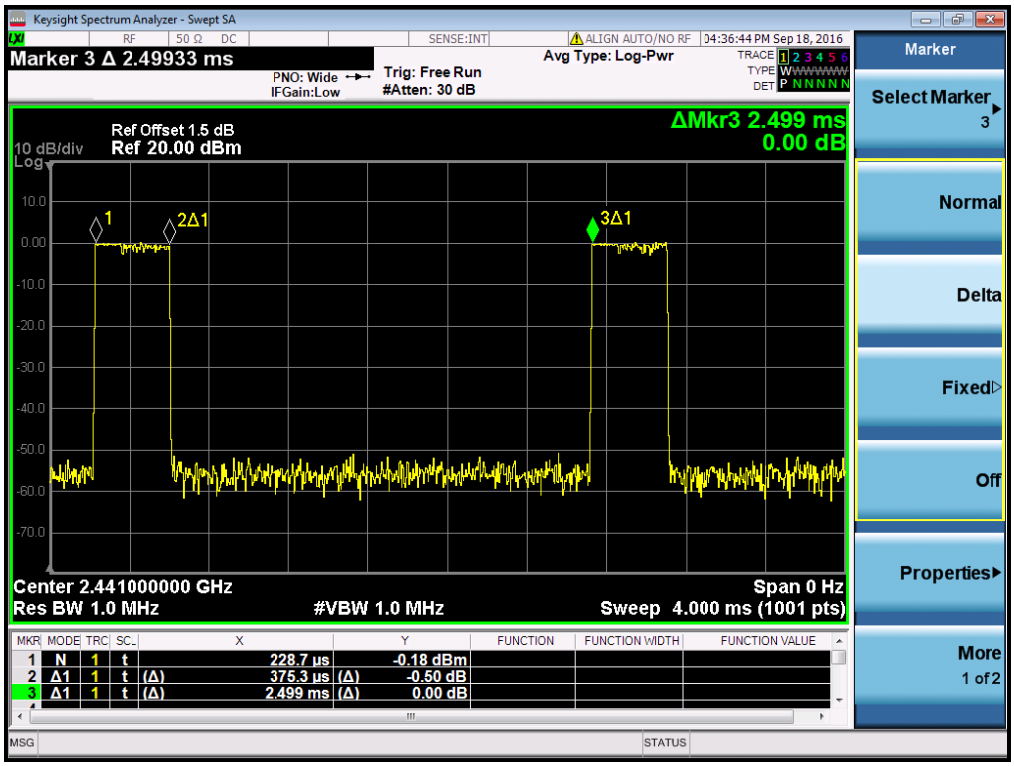
39 Channel @ 2DH1



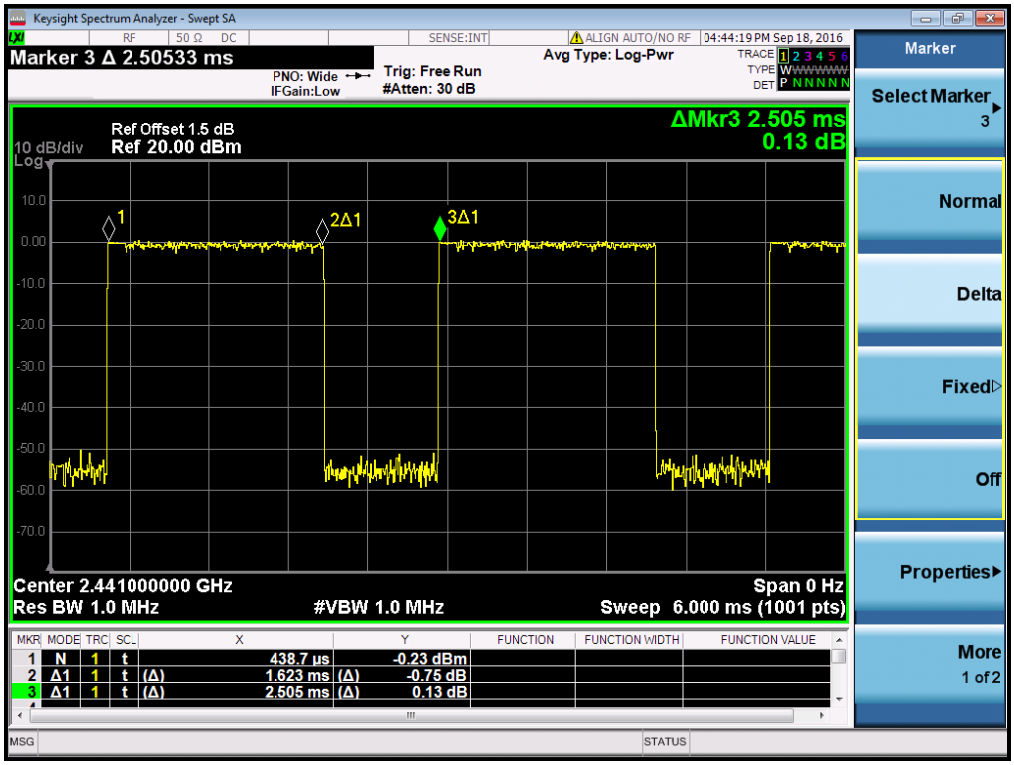
39 Channel @ 2DH3



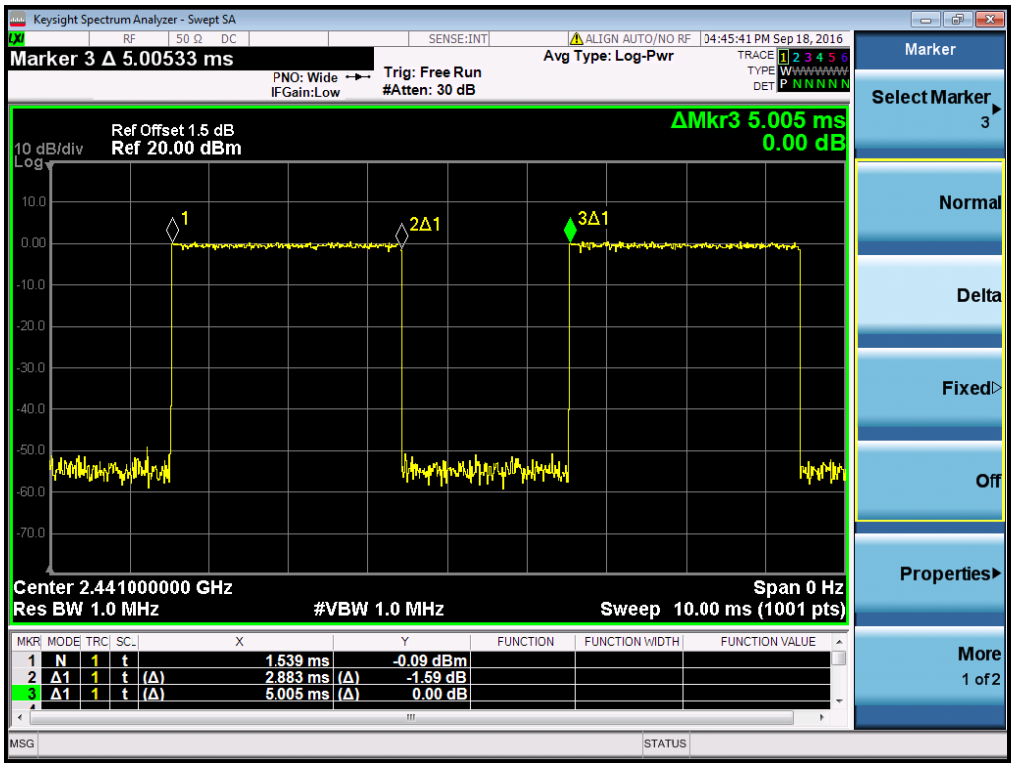
39 Channel @ 2DH5



39 Channel @ 3DH1



39 Channel @ 3DH3



39 Channel @ 3DH5

2.7. Conducted Spurious Emissions

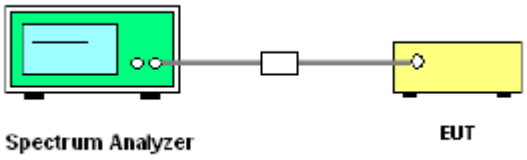
2.7.1. Limit of Spurious Emission

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.

2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.7.3. Test Setup



2.7.4. Test Procedure

1. The testing follows the guidelines in Spurious RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines

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.

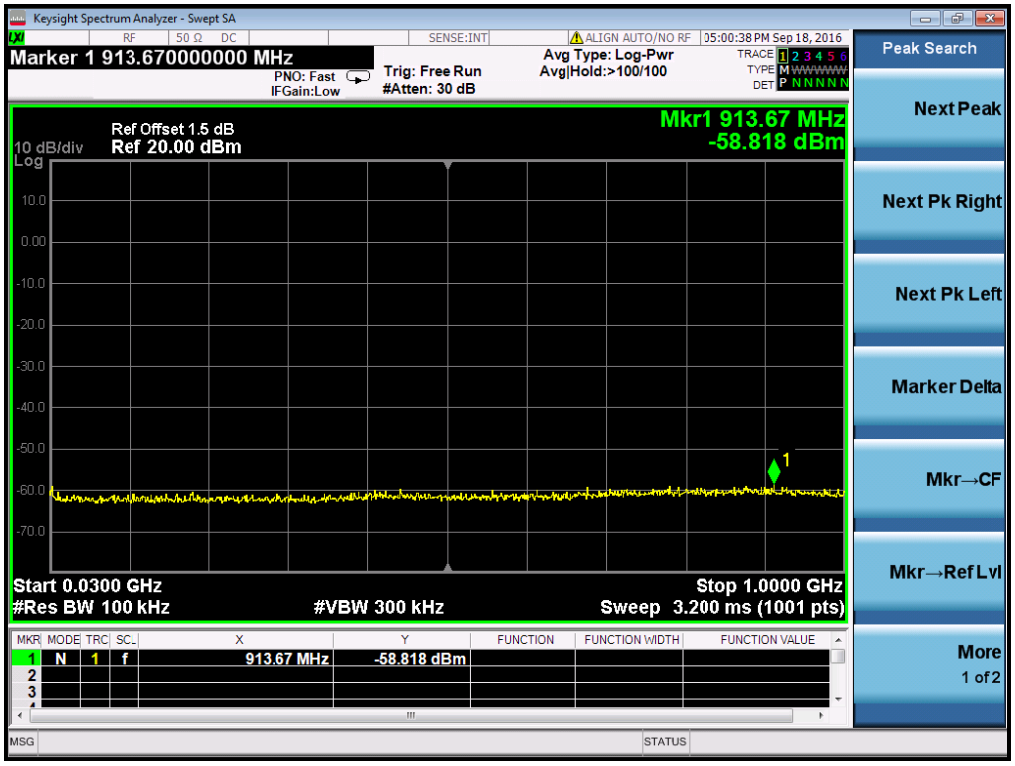
3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Set RBW = 100 kHz, VBW = 300 kHz, 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.

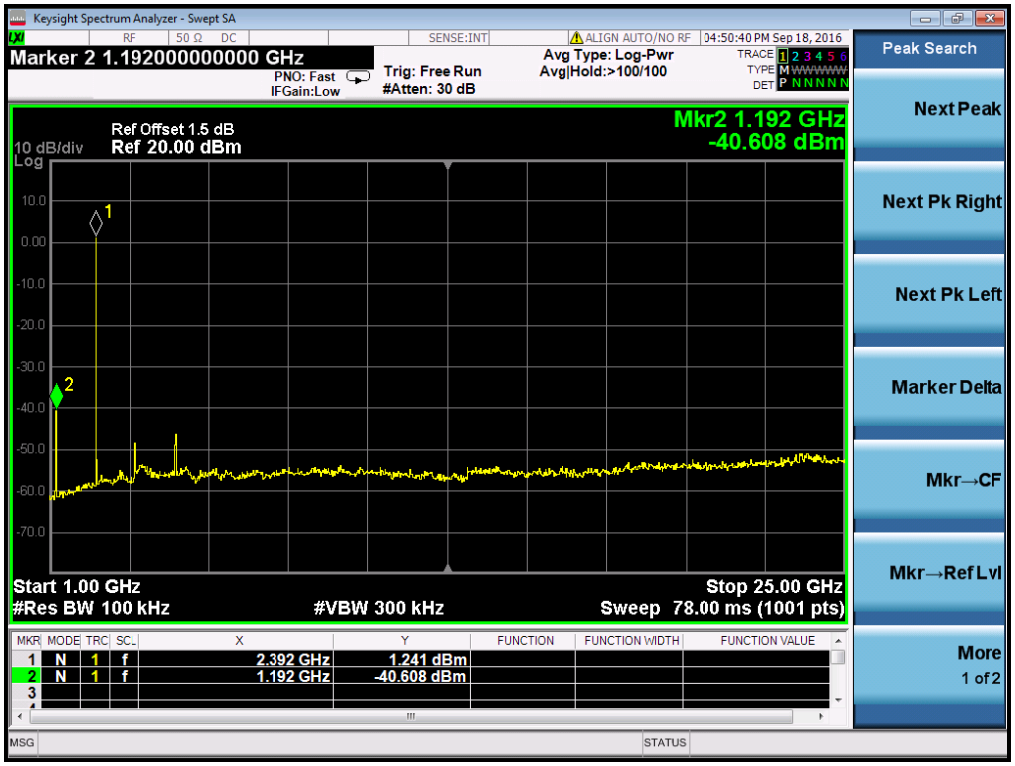
5. Measure and record the results in the test report.

6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

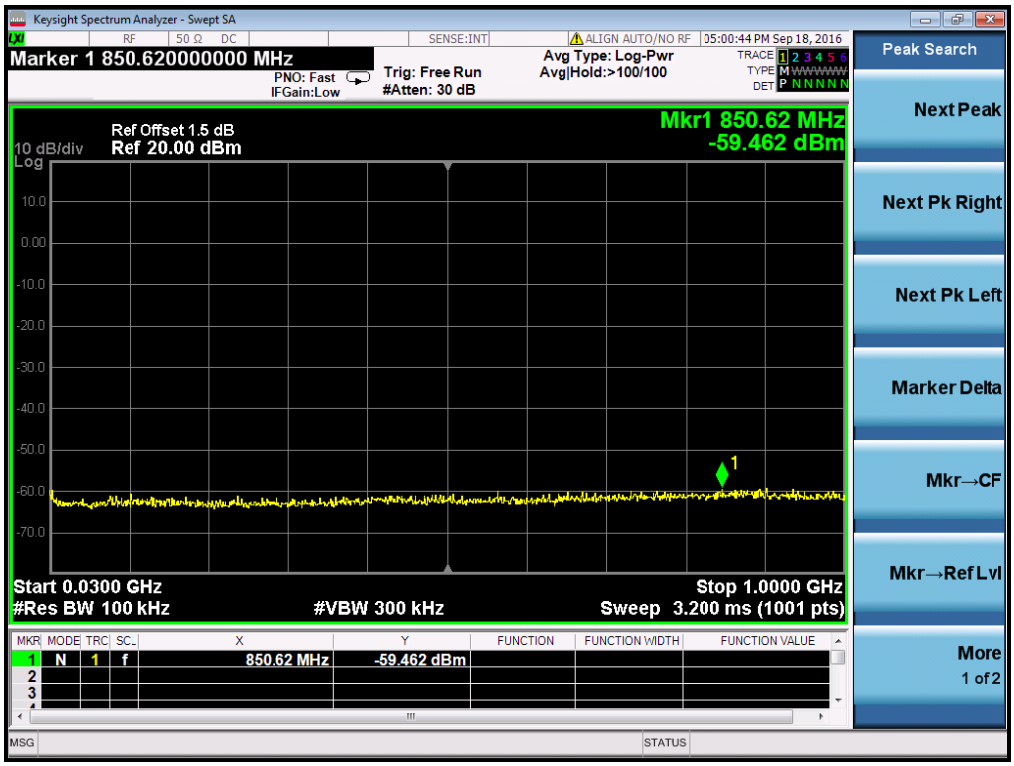
2.7.5. Test Result



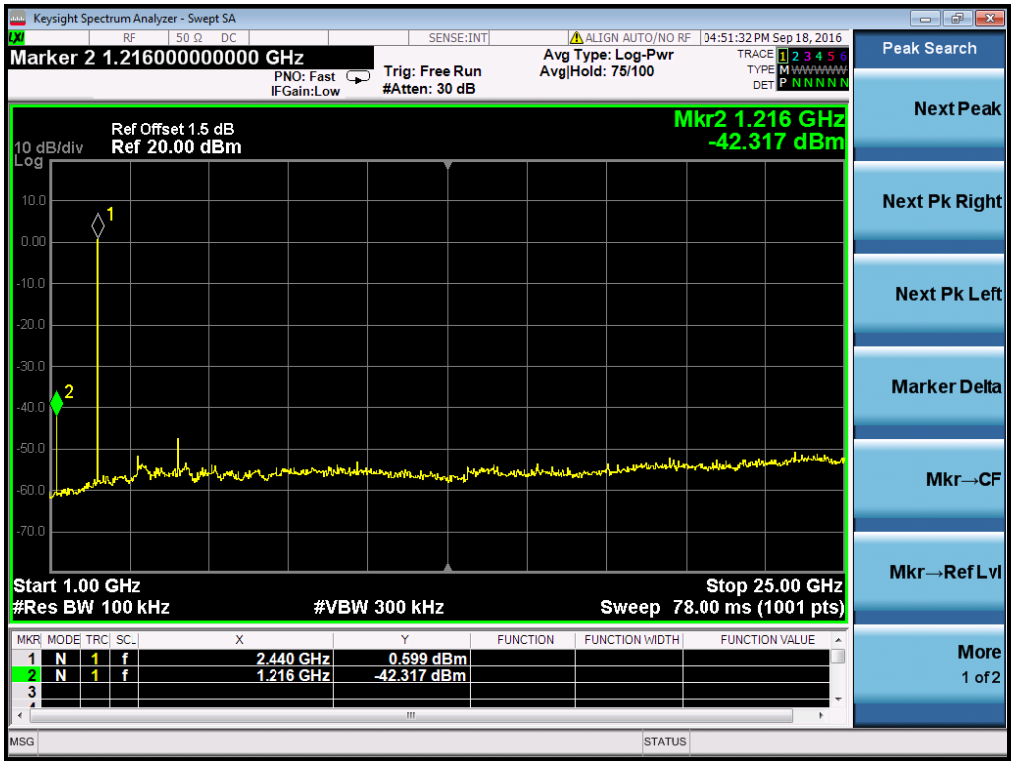
Low Channel 30MHz to 1GHz @ GFSK Mode



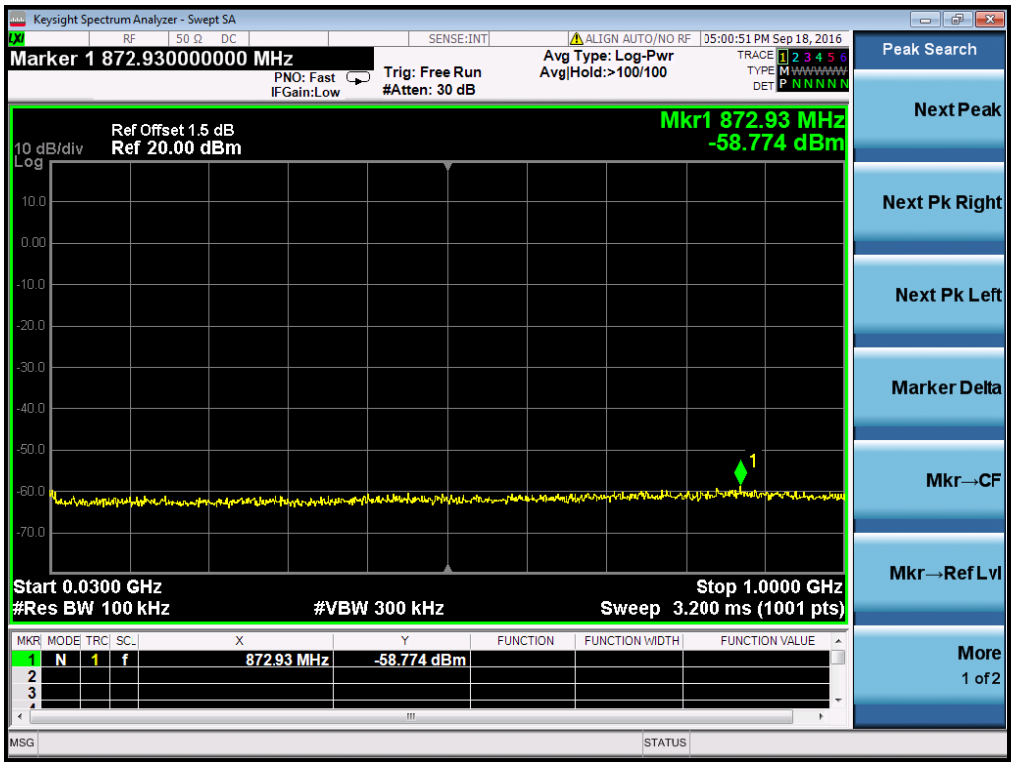
Low Channel 1GHz to 25GHz @ GFSK Mode



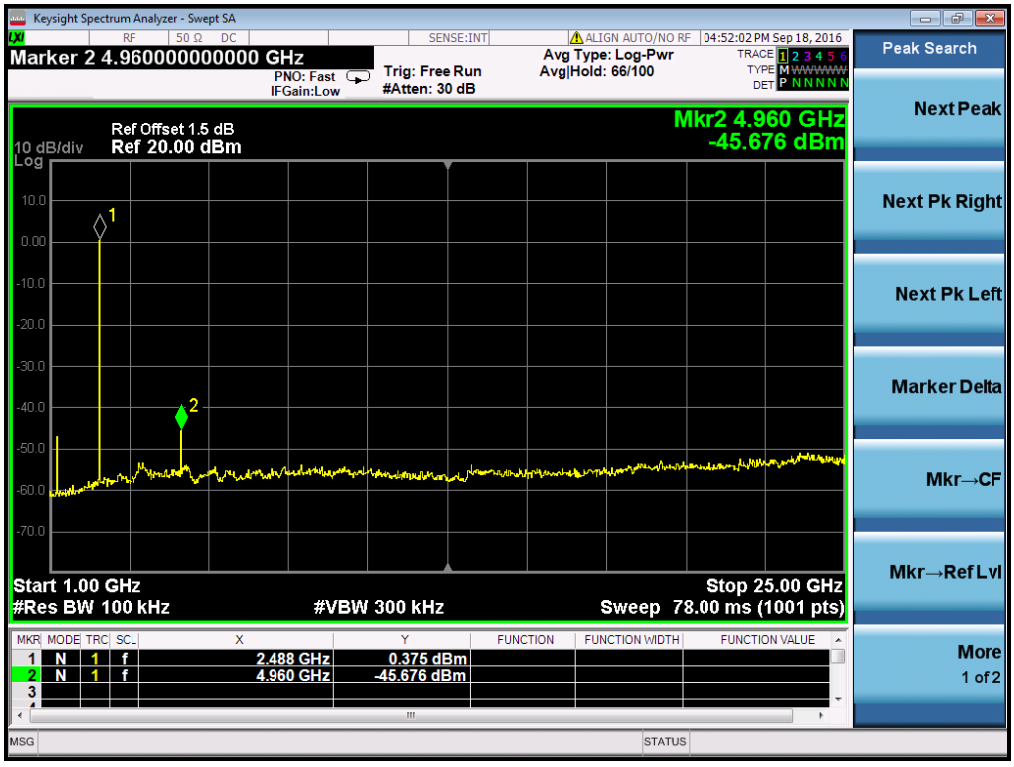
Mid Channel 30MHz to 1GHz @ GFSK Mode



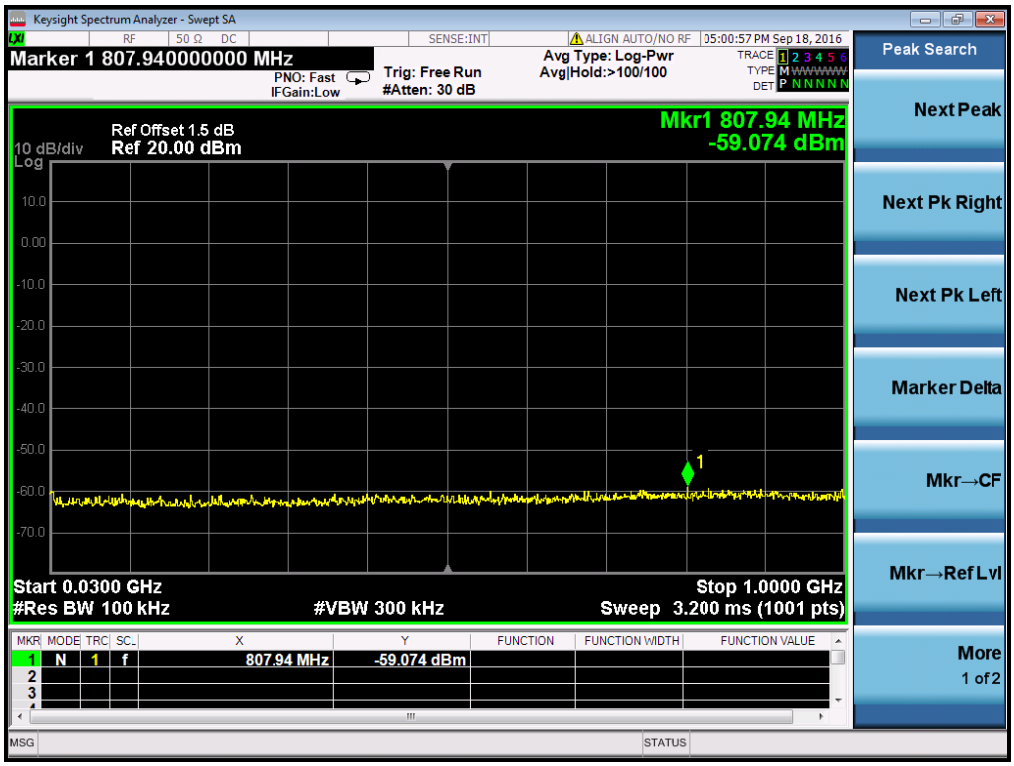
Mid Channel 1GHz to 25GHz @ GFSK Mode



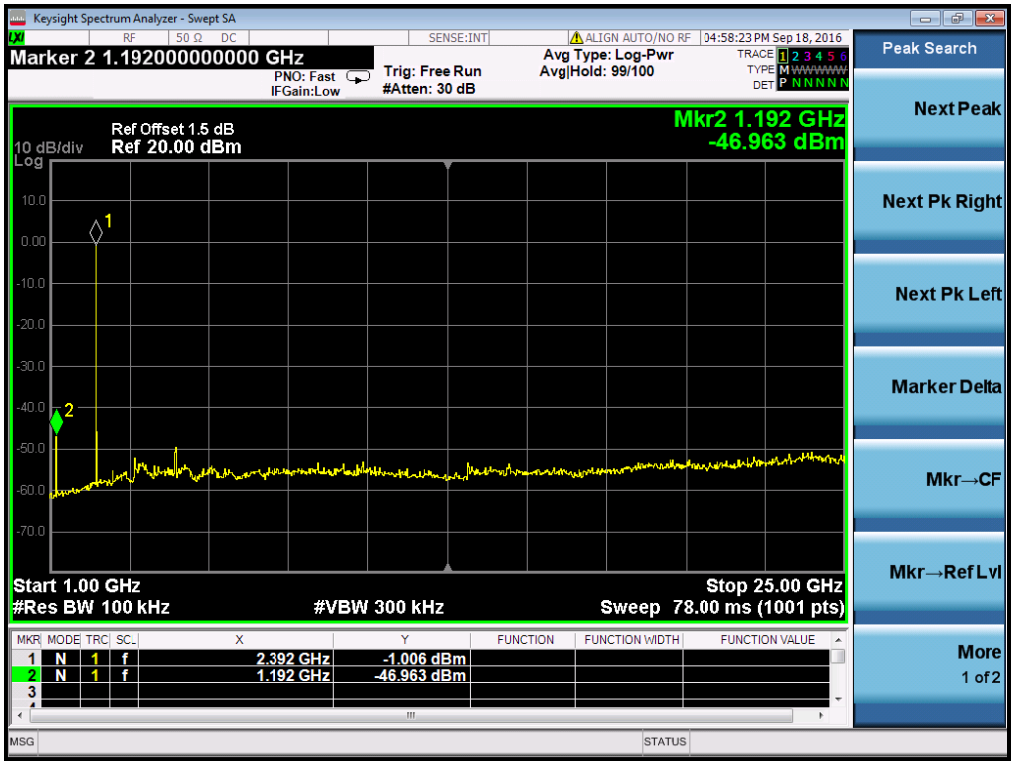
High Channel 30MHz to 1GHz @ GFSK Mode



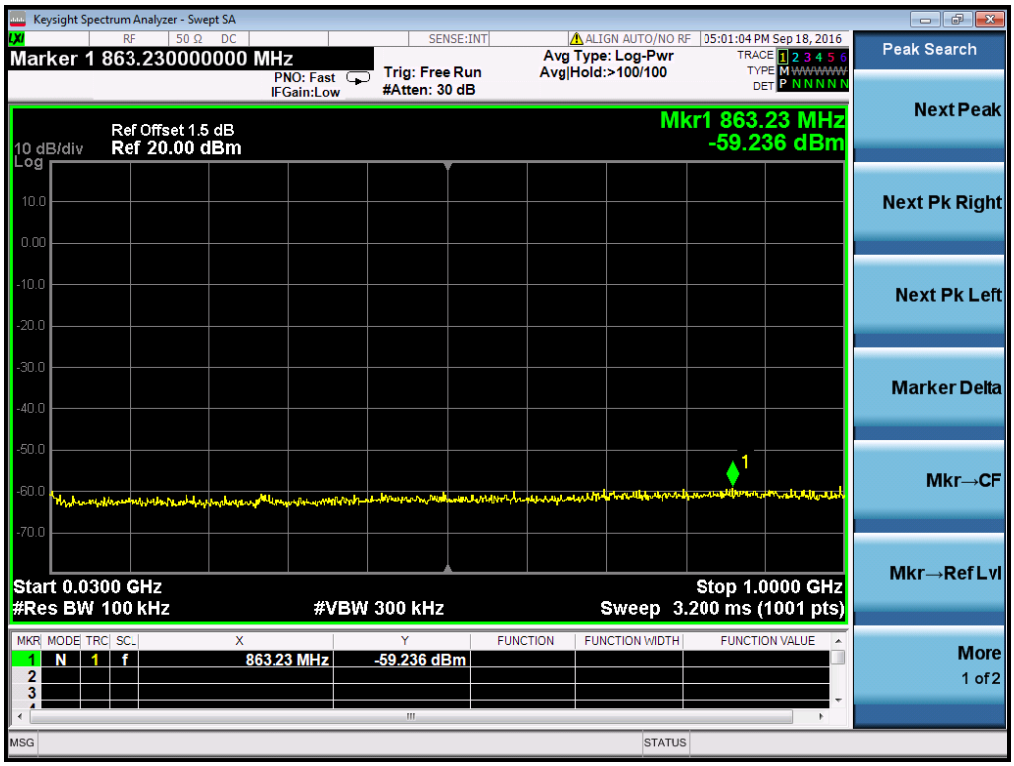
High Channel 1GHz to 25GHz @ GFSK Mode



Low Channel 30MHz to 1GHz @π/4-DQPSK

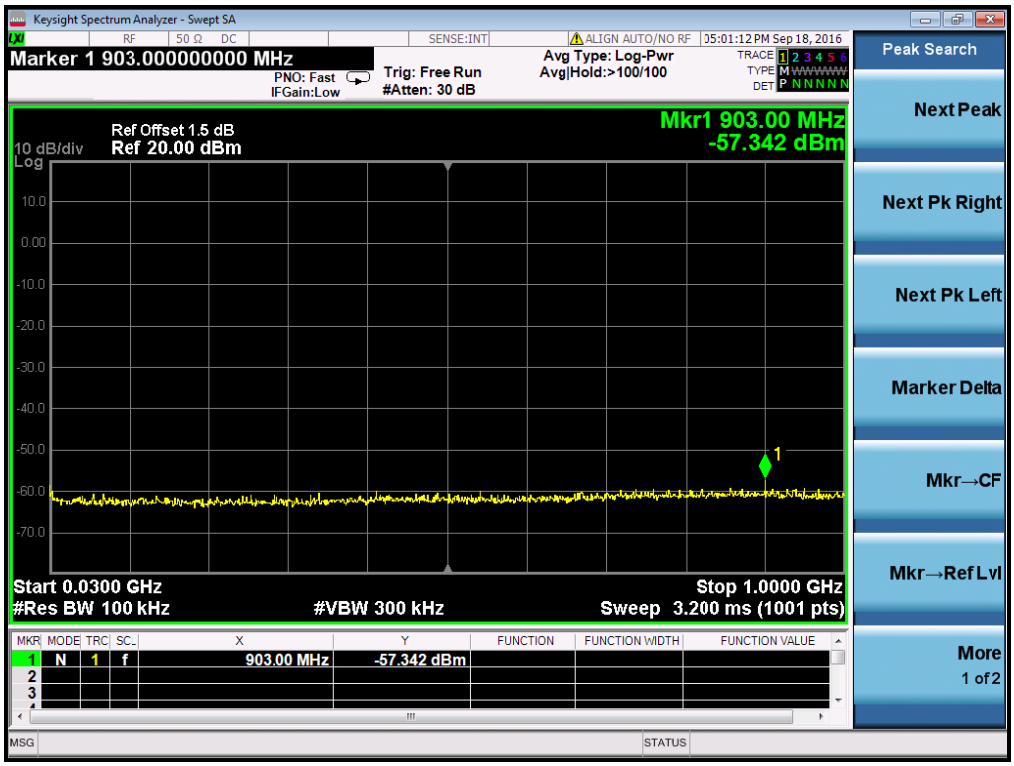


Low Channel 1GHz to 25GHz @π/4-DQPSK

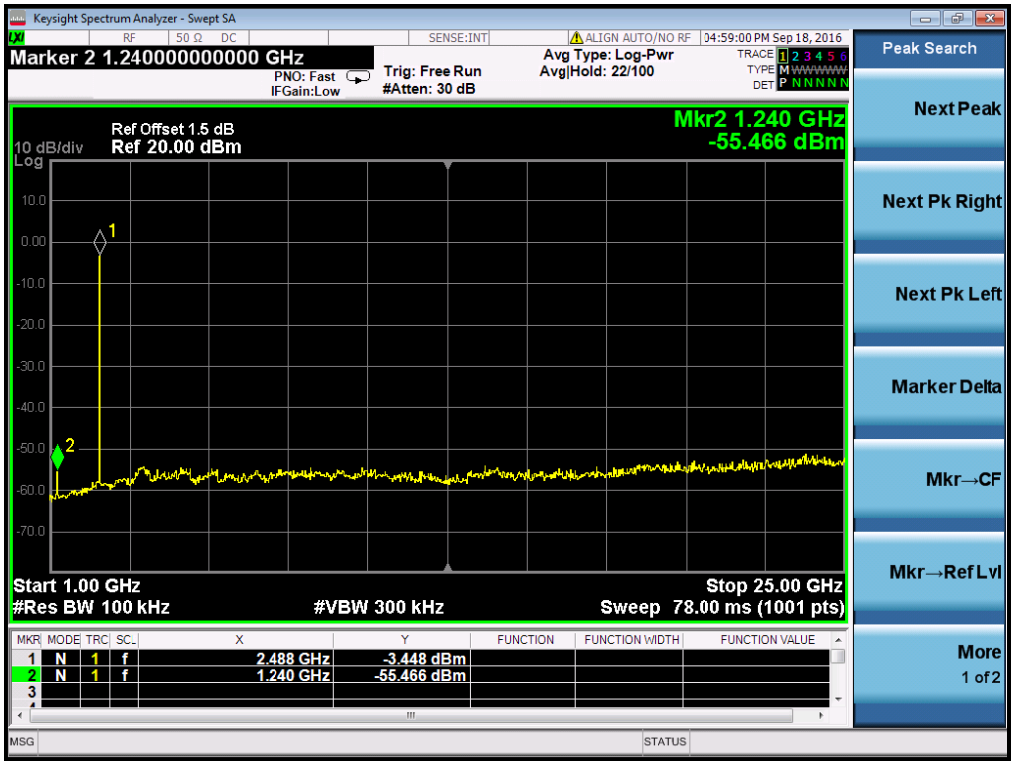


Mid Channel 30MHz to 1GHz @π/4-DQPSK

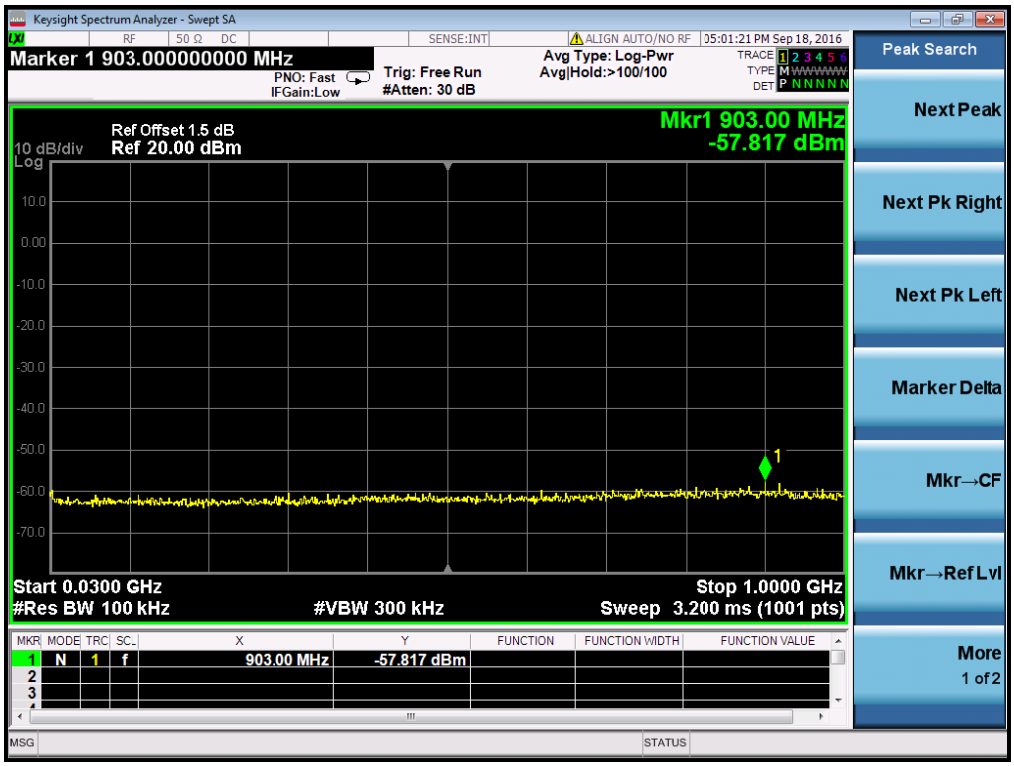
Mid Channel 1GHz to 25GHz @π/4-DQPSK



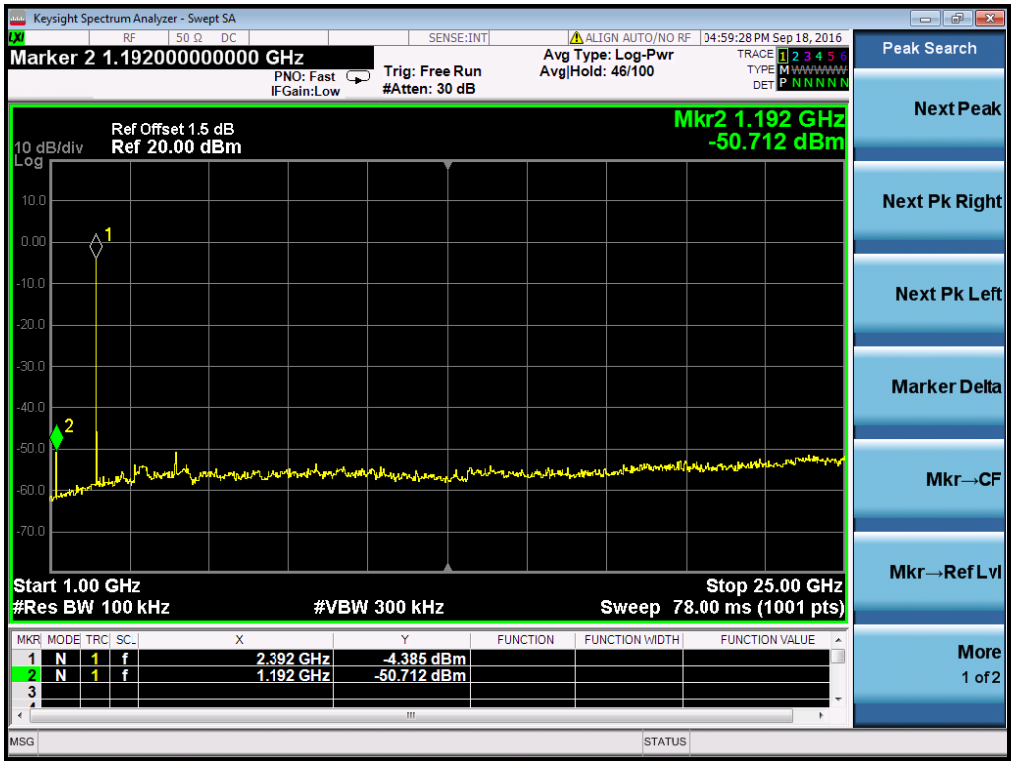
High Channel 30MHz to 1GHz @π/4-DQPSK



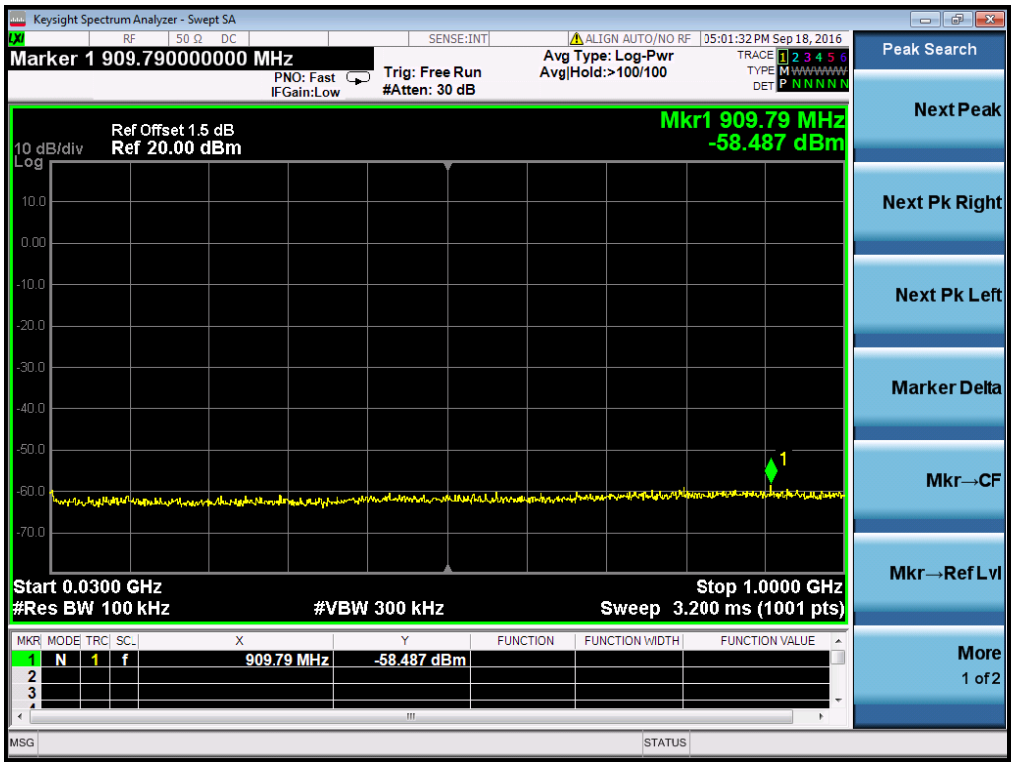
High Channel 1GHz to 25GHz @π/4-DQPSK



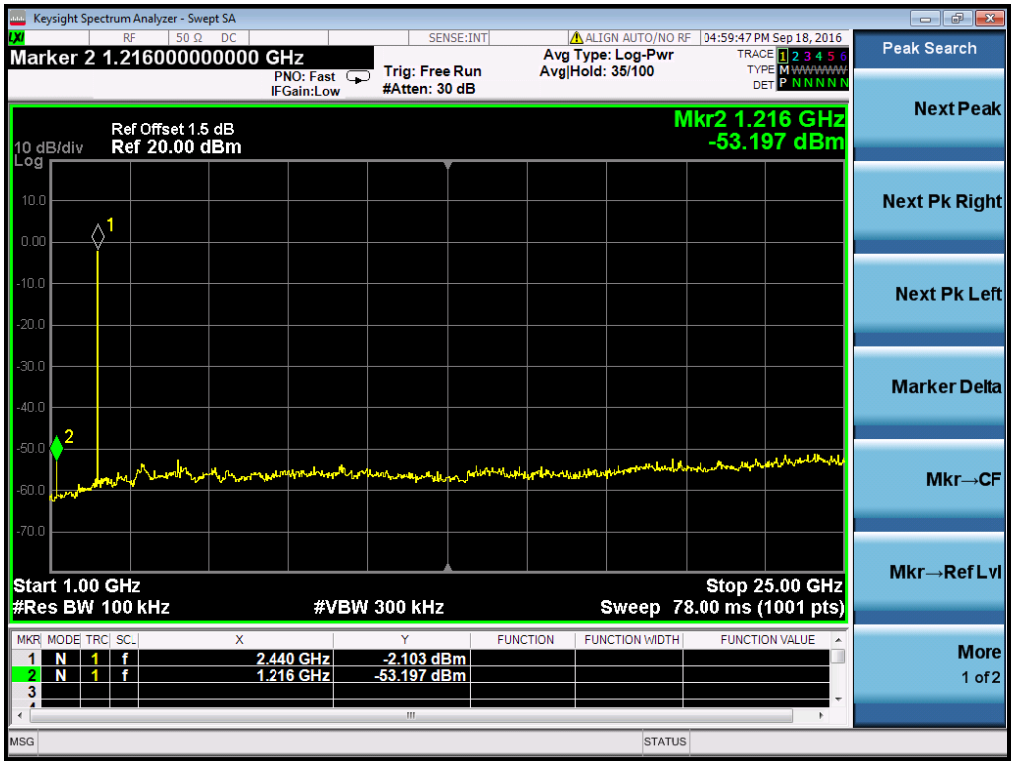
Low Channel 30MHz to 1GHz @ 8-DPSK



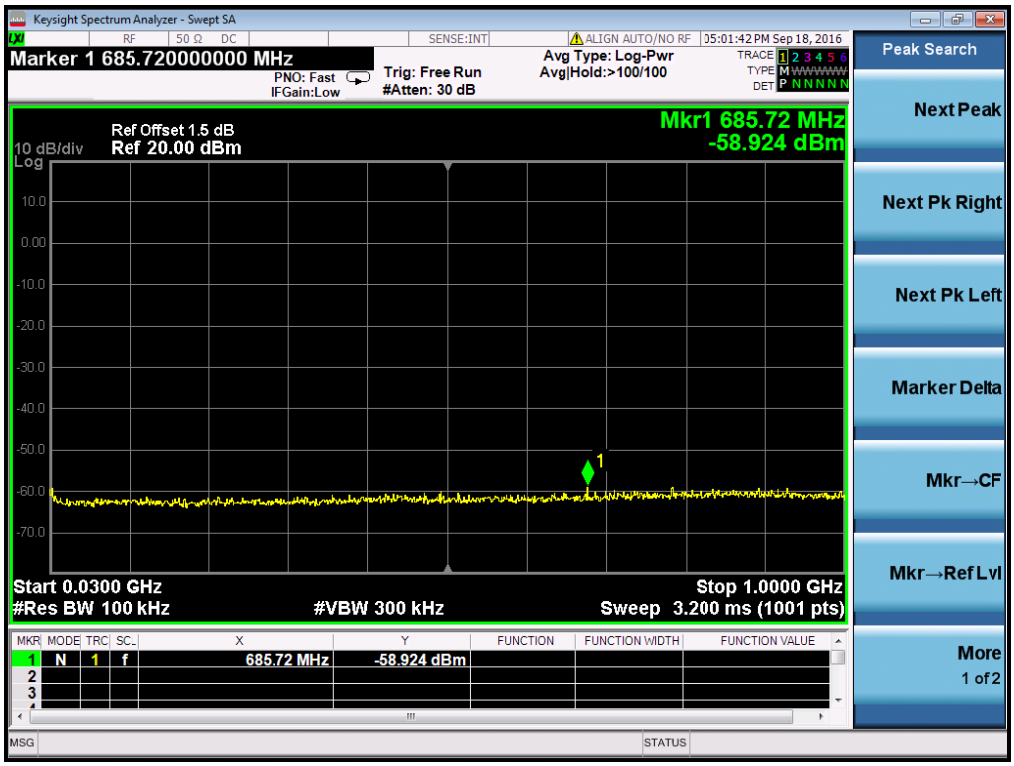
Low Channel 1GHz to 25GHz @ 8-DPSK



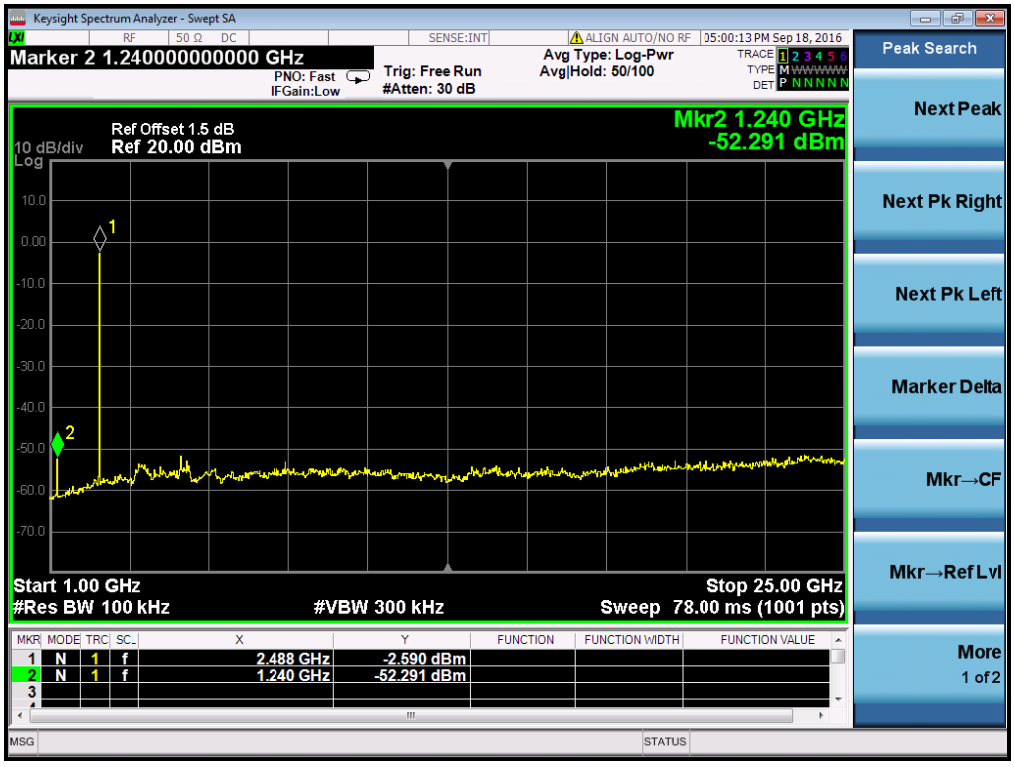
Mid Channel 30MHz to 1GHz @ 8-DPSK



Mid Channel 1GHz to 25GHz @ 8-DPSK



High Channel 30MHz to 1GHz @ 8-DPSK



High Channel 1GHz to 25GHz @ 8-DPSK

2.8. Conducted Band Edge

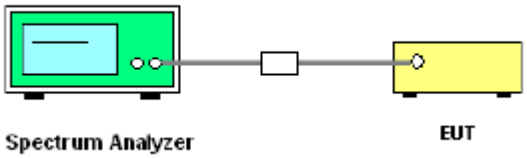
2.8.1. Limit of Band Edges

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.

2.8.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.8.3. Test Setup

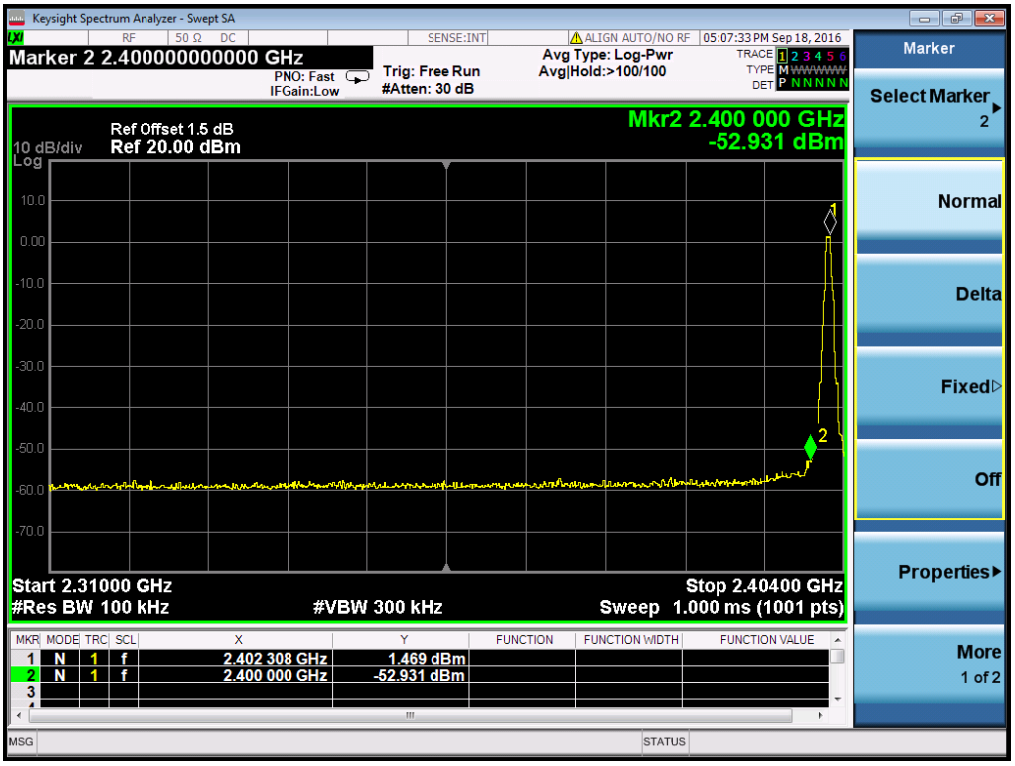


2.8.4. Test Procedure

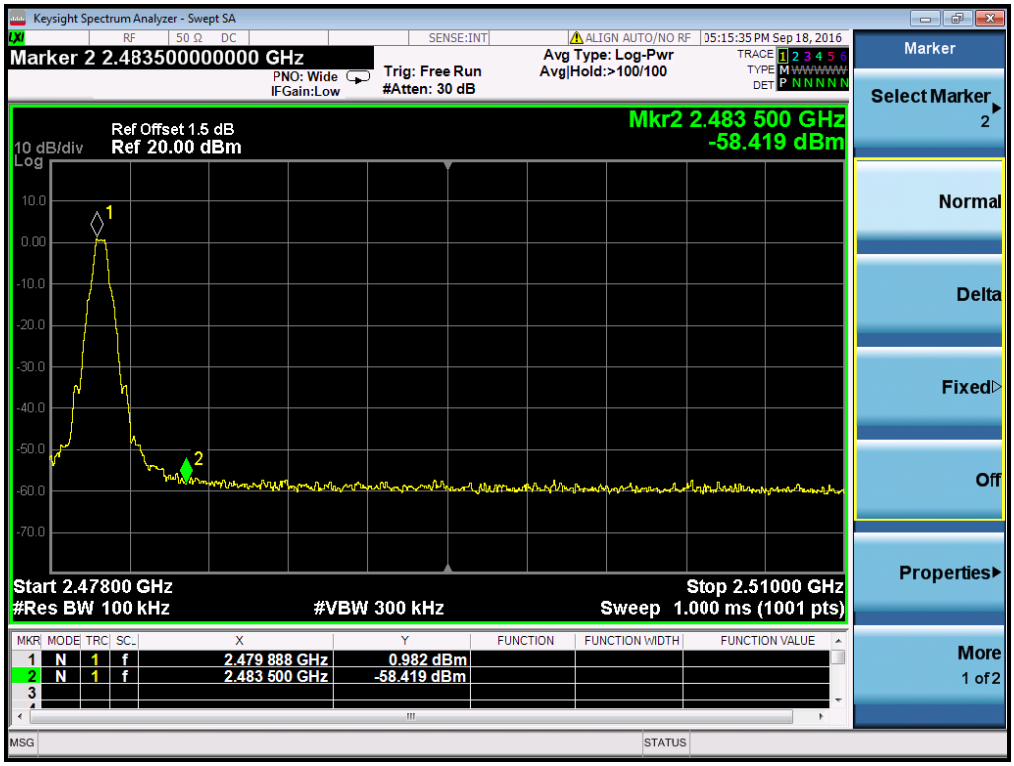
1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz (≥1% span=10MHz), VBW = 300kHz (≥RBW). Band edge emissions must 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.

2.8.5. Test Results of Conducted Band Edge

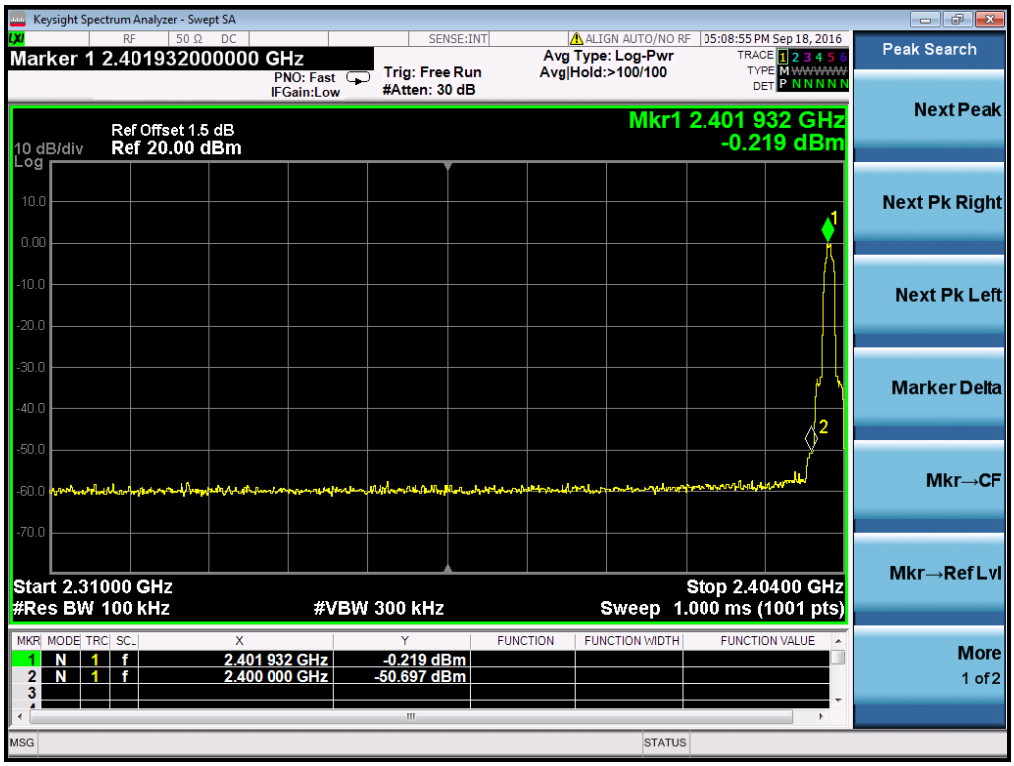
Band edge – Conducted (Un-hopping)



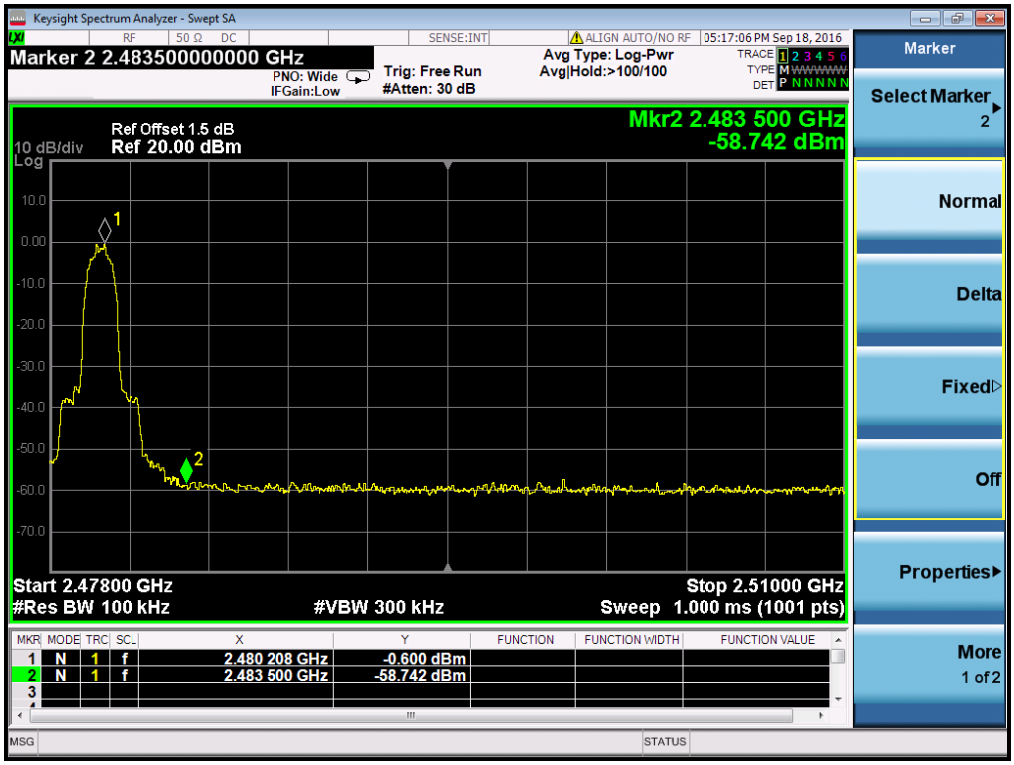
Low Band Edge Plot on channel 0 @ GFSK



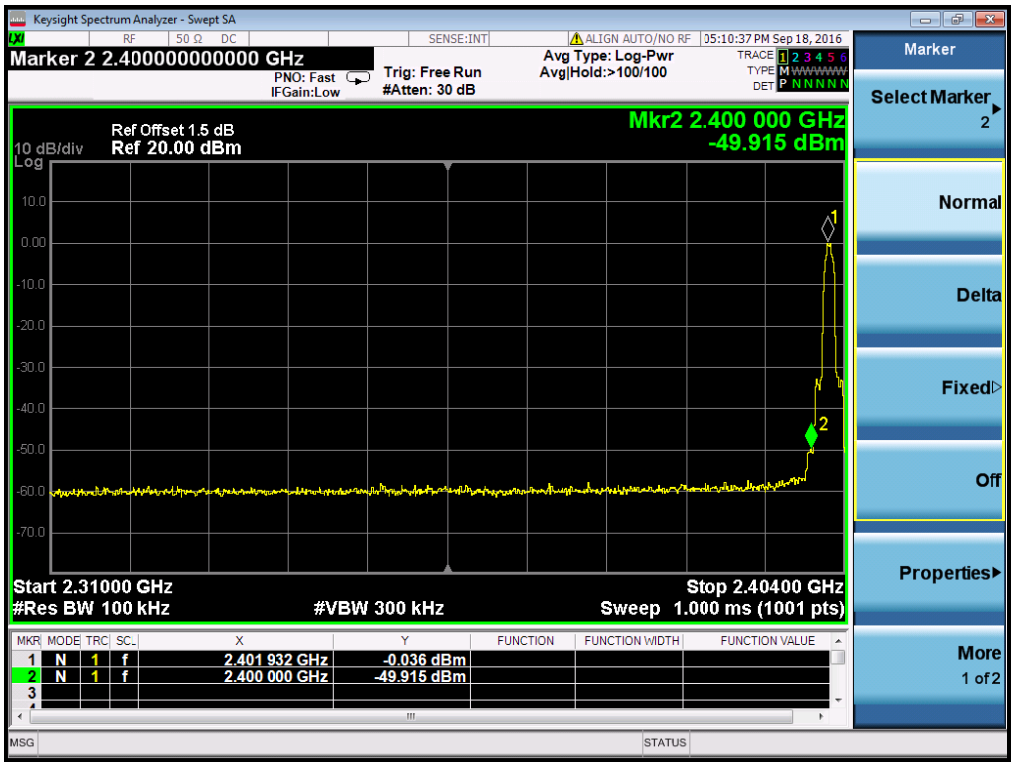
High Band Edge Plot on channel 78 @ GFSK



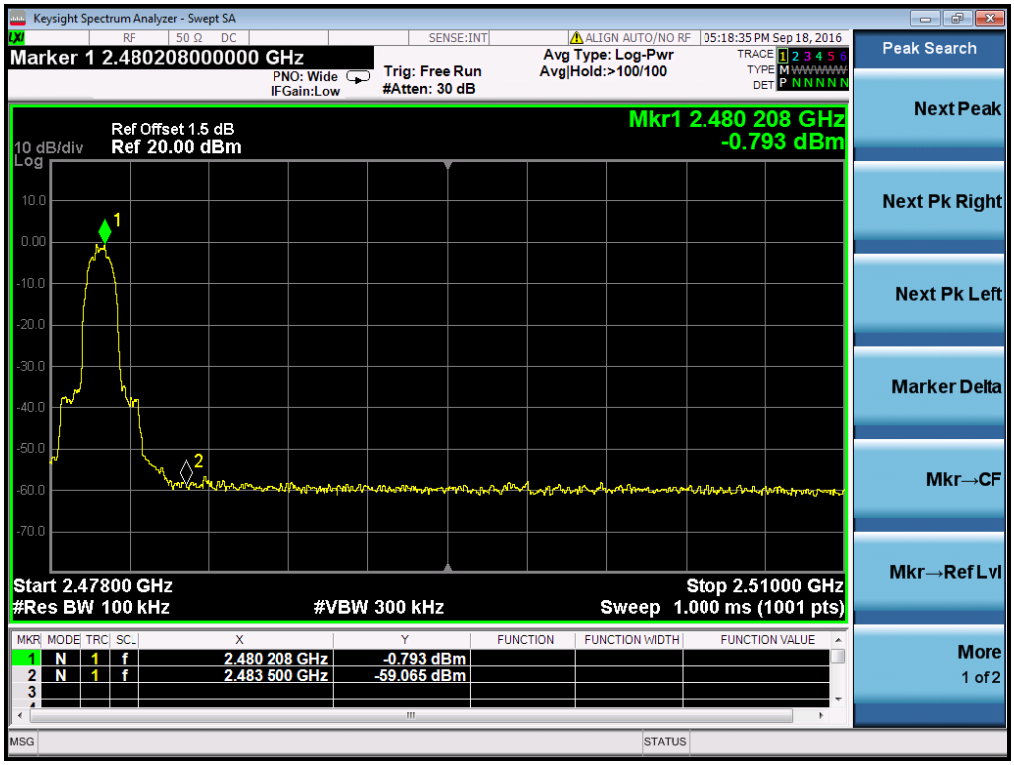
Low Band Edge Plot on channel 0 @π/4-DQPSK



High Band Edge Plot on channel 78 @π/4-DQPSK

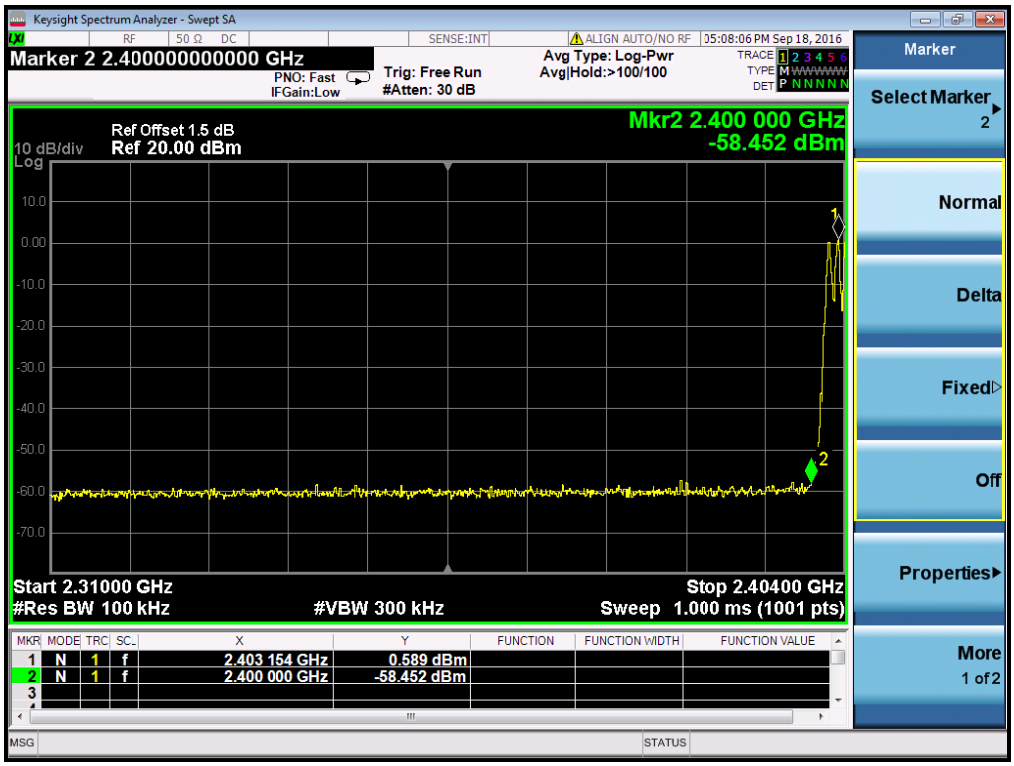


Low Band Edge Plot on channel 0 @8-DPSK

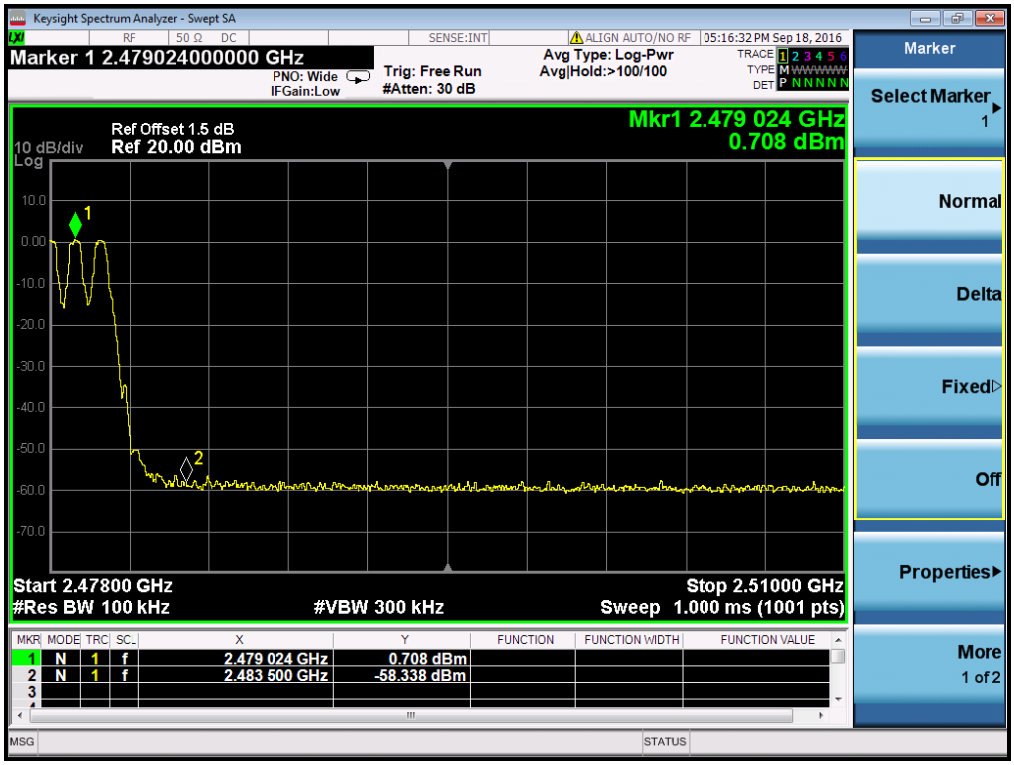


High Band Edge Plot on channel 78 @8-DPSK

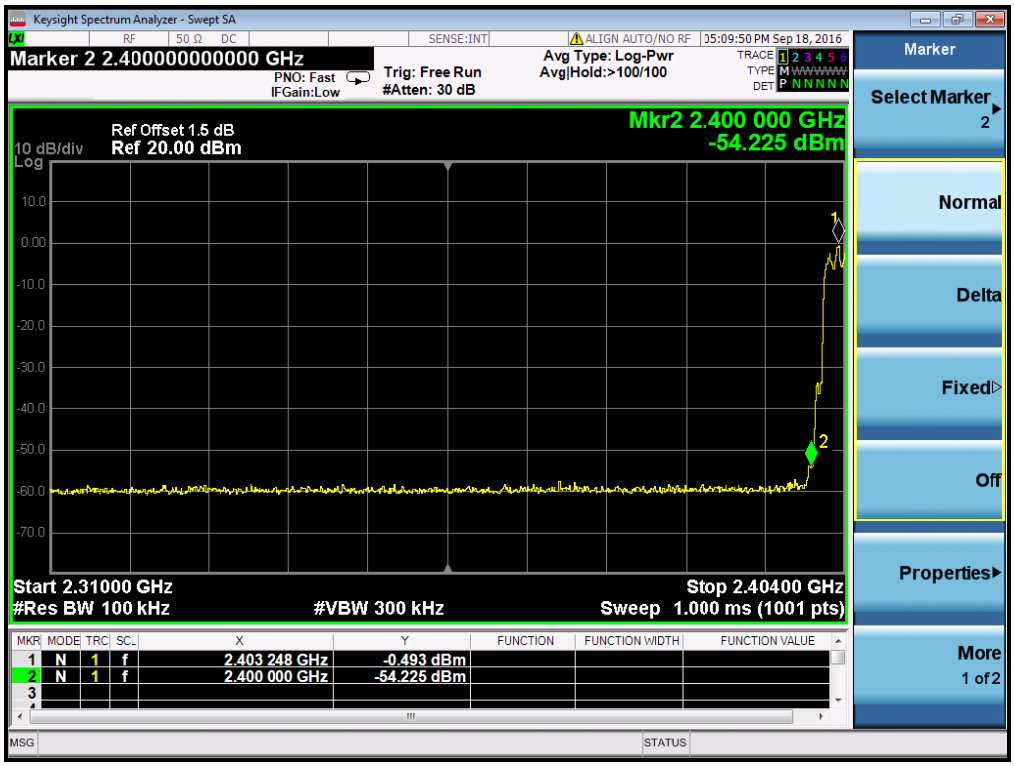
Band edge - Conducted (hopping)



Low Band Edge Plot on channel 0 @ GFSK

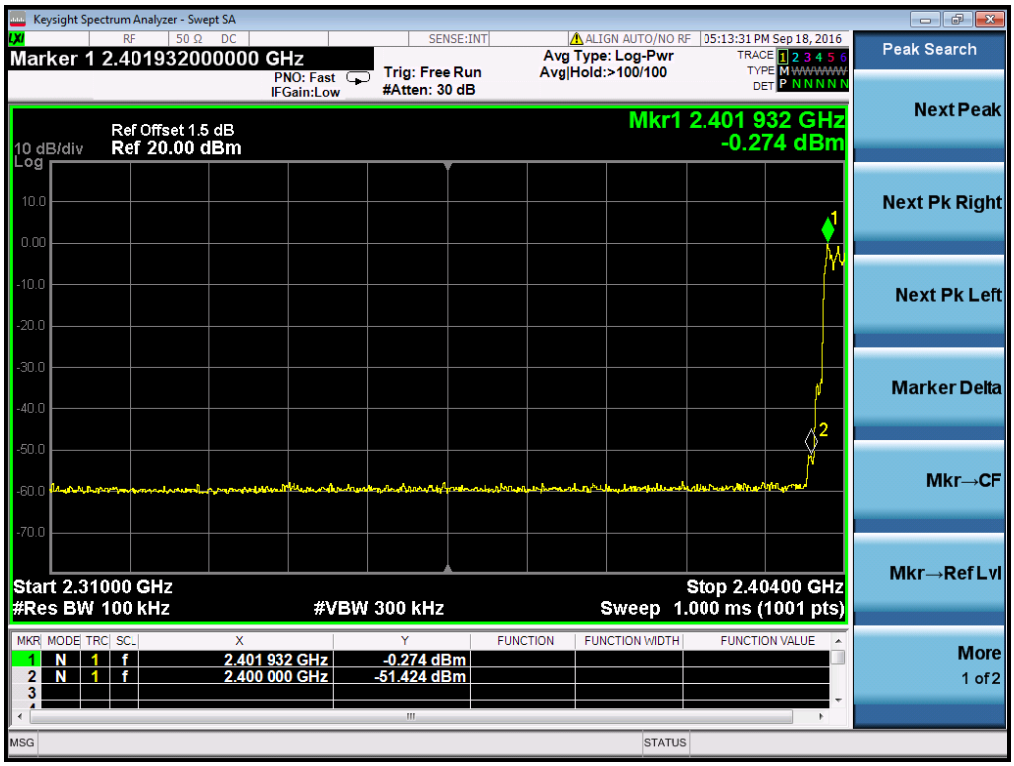


High Band Edge Plot on channel 78 @ GFSK

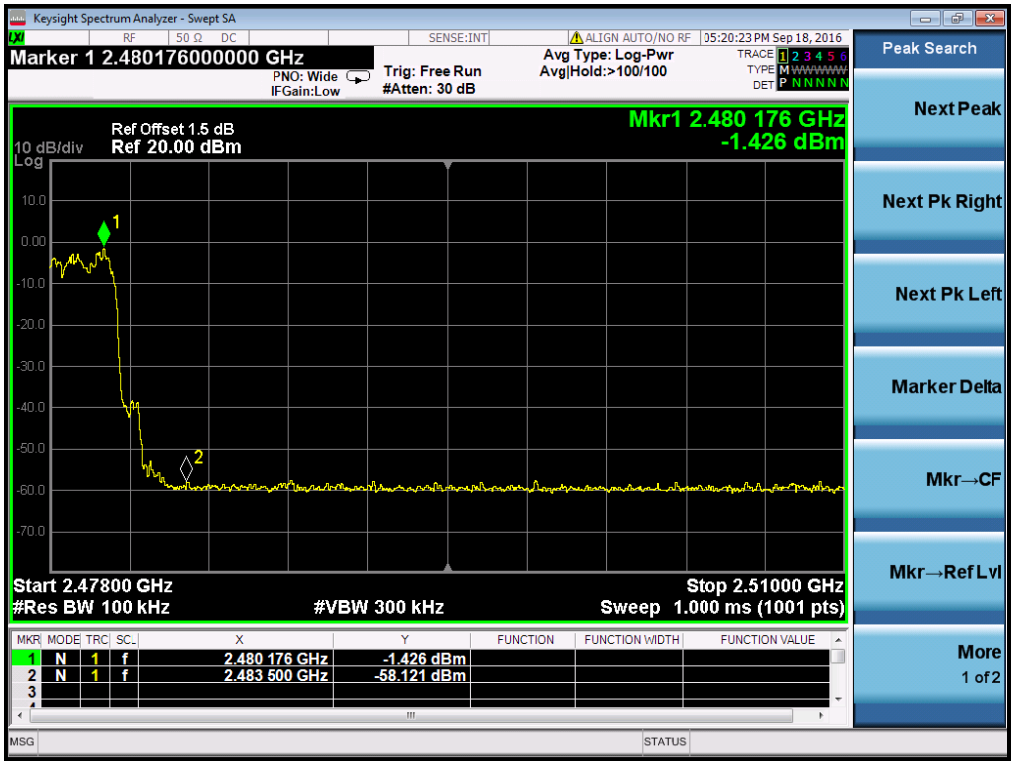


Low Band Edge Plot on channel 0 @π/4-DQPSK

High Band Edge Plot on channel 0 @π/4-DQPSK



Low Band Edge Plot on channel 0 @8-DPSK



High Band Edge Plot on channel 0 @8-DPSK

2.9. Conducted Emission

2.9.1. Limit of Conducted Emission

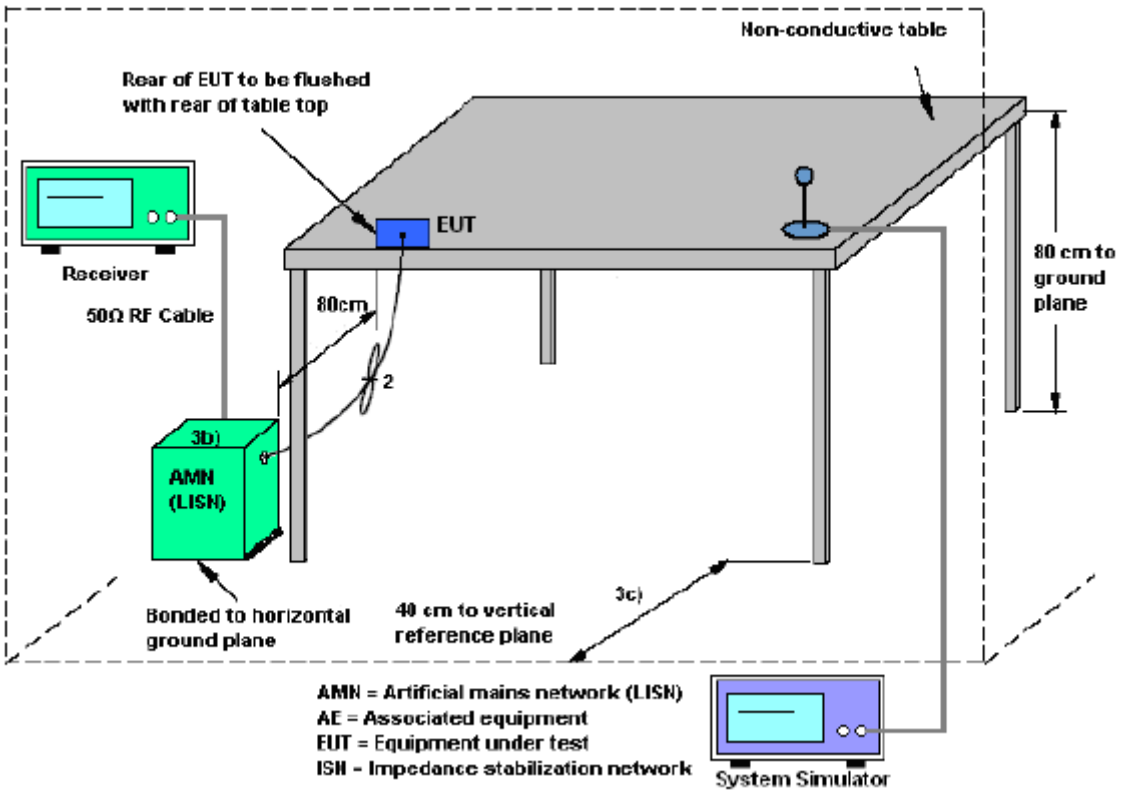
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

2.9.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.9.3. Test Setup

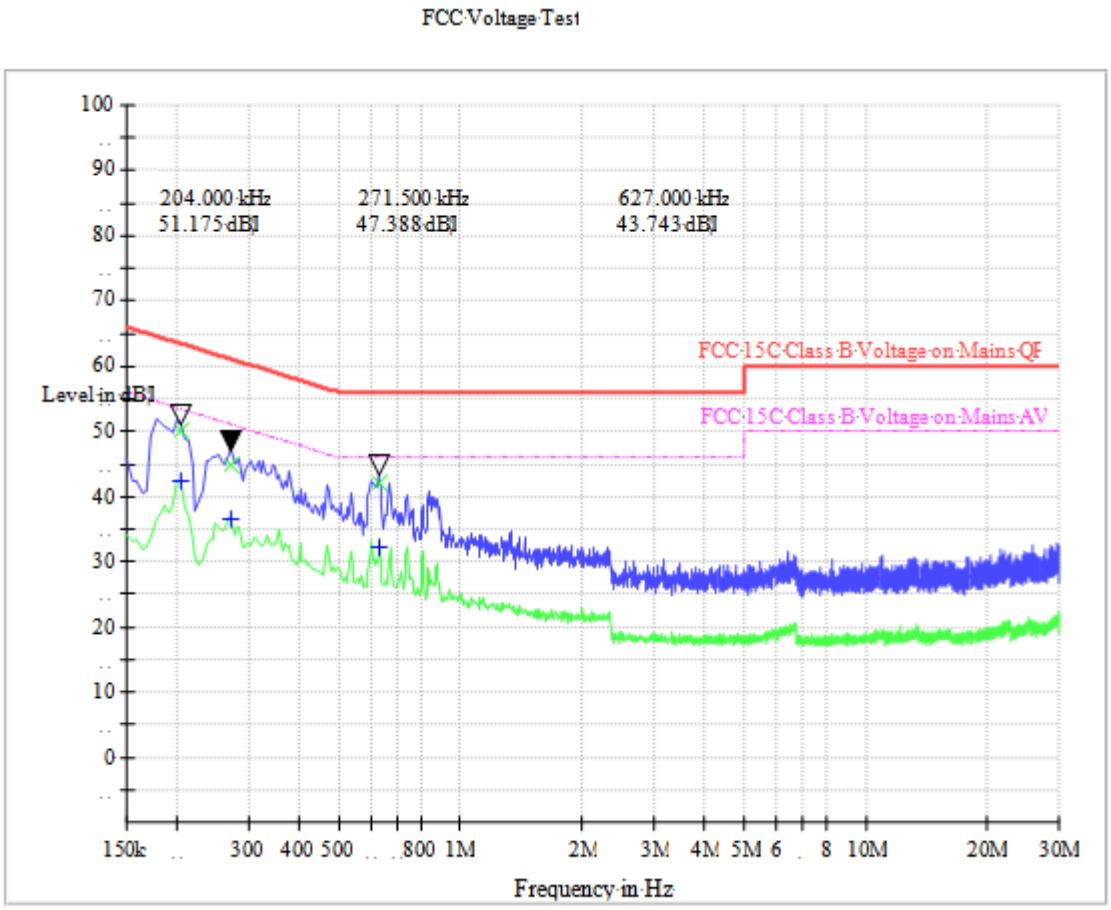


2.9.4. Test Procedures

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 micrometry 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.

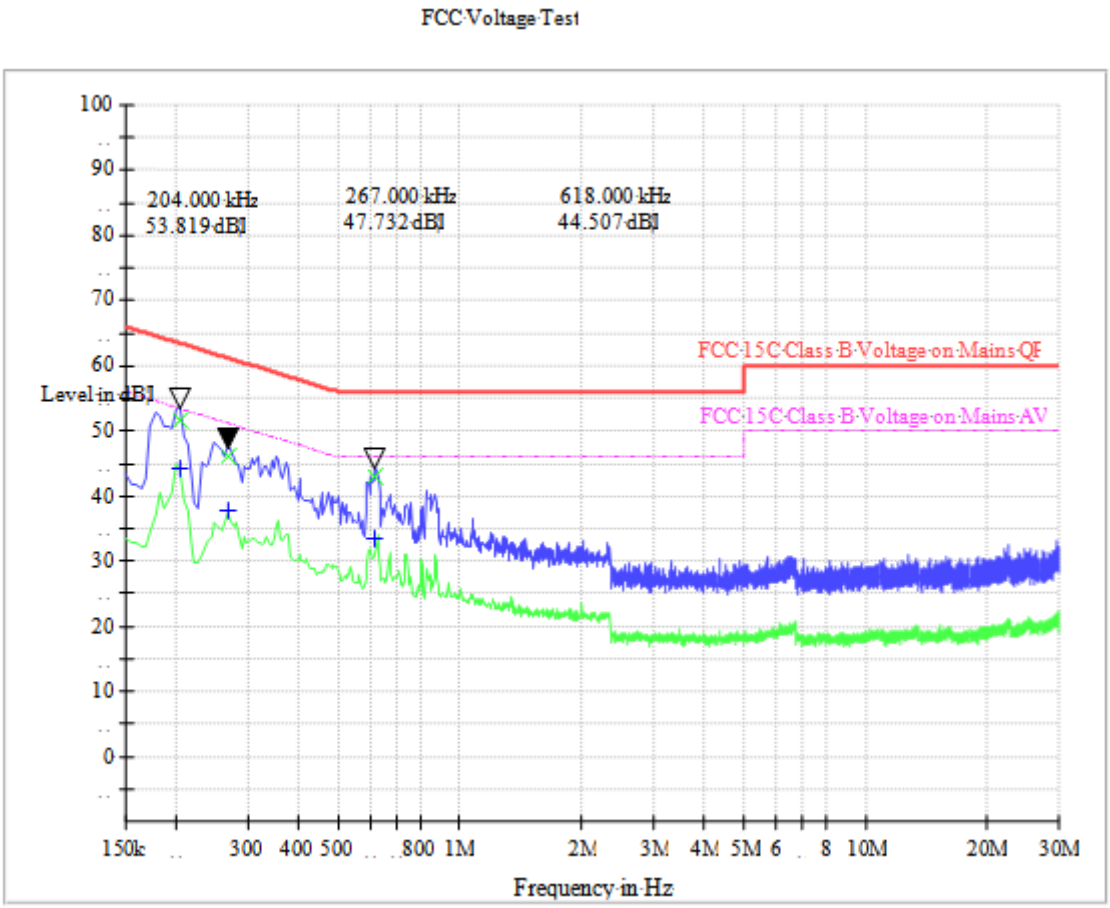
2.9.3. Test Results of Conducted Emission

The EUT configuration of the emission tests is Bluetooth Link + USB Cable (Charging from Adapter).



(Plot A: L Phase)

Conducted Disturbance at Mains Terminals					
L Test Data					
QP			**AV**		
Frequency (MHz)	**Limits (dBµV)**	**Measurement Value (dBµV)**	**Frequency (MHz)**	**Limits (dBµV)**	**Measurement Value (dBµV)**
0.204	63.4	51.175	0.204	53.4	42.30
0.272	61.1	47.388	0.272	51.1	36.52
0.627	56.0	43.743	0.627	46	32.33
L Test Curve					



(Plot B: N Phase)

Conducted Disturbance at Mains Terminals					
N Test Data					
QP			**AV**		
Frequency (MHz)	**Limits (dBµV)**	**Measurement Value (dBµV)**	**Frequency (MHz)**	**Limits (dBµV)**	**Measurement Value (dBµV)**
0.204	63.4	53.819	0.204	53.4	44.32
0.267	61.2	47.732	0.267	51.2	37.88
0.618	56.0	44.507	0.618	46	33.48
N Test Curve					

Test Result: PASS

2.10. Radiated Band Edges and Spurious Emission

2.10.1. 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. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

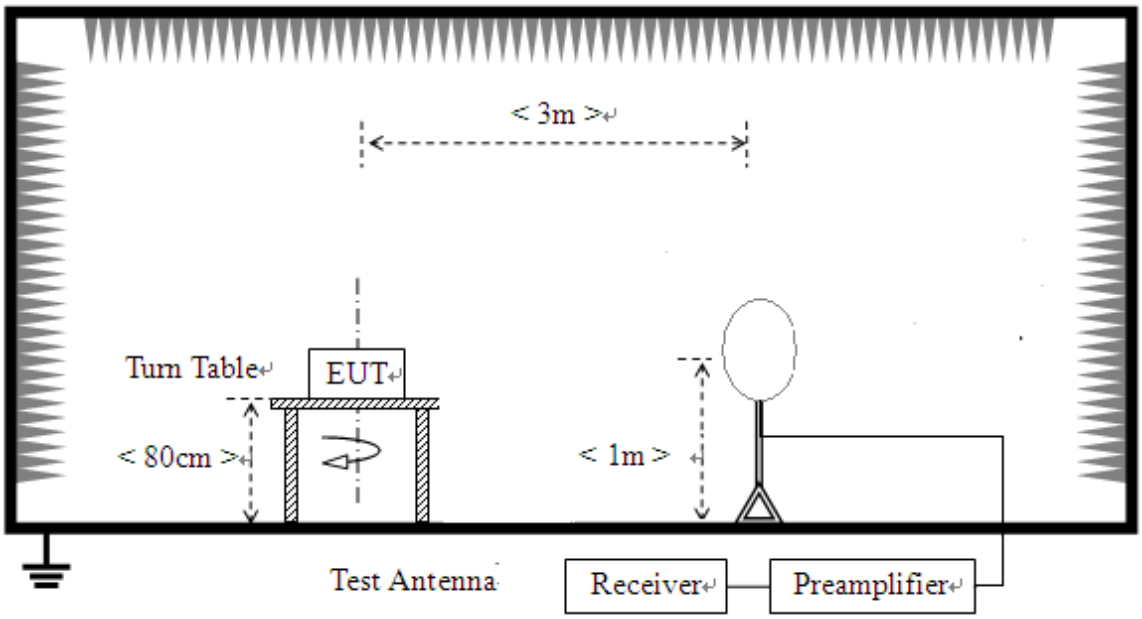
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

2.10.2. Measuring Instruments

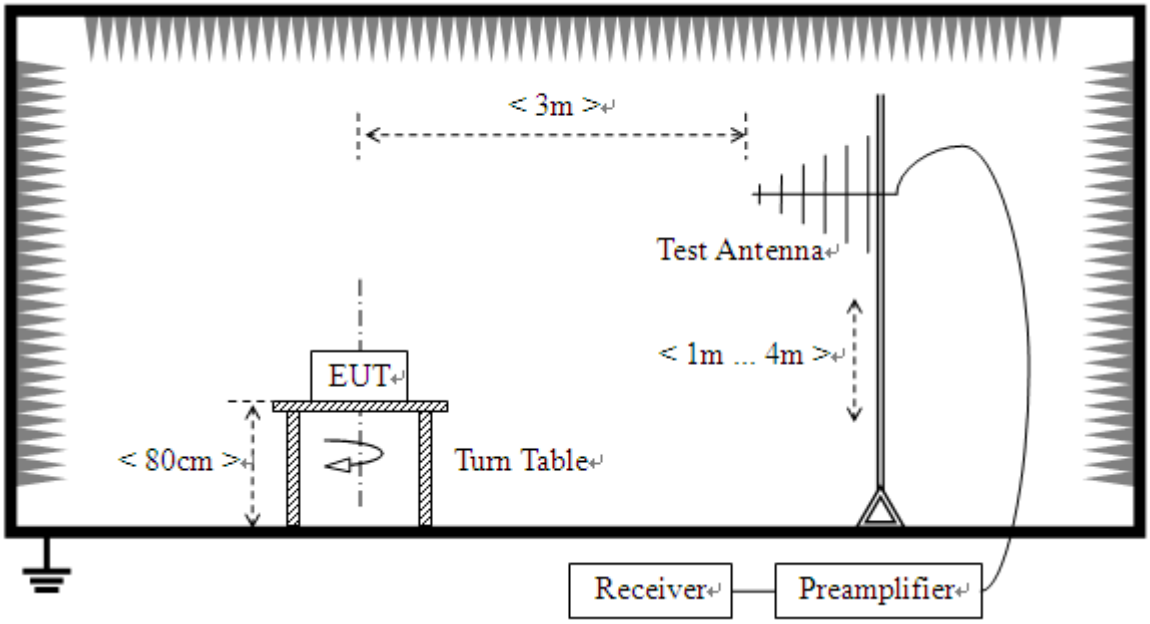
The measuring equipment is listed in the section 3 of this test report.

2.10.3. Test Setup

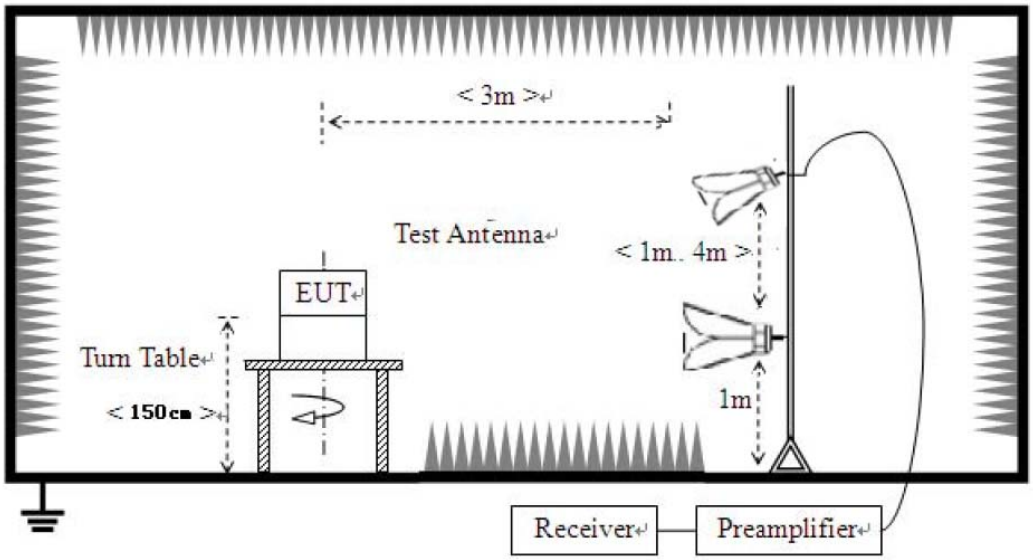
1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz



2.10.4. Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. The EUT was placed on a turntable with 0.8/1.5 meter for below 1GHz and 1.5 meter for above 1GHz 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 GHz, RBW=1MHz for f>1GHz ; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak

(3) For average measurement: use duty cycle correction factor method per 15.35(c).

Duty cycle = On time/100 milliseconds

On time = N_1*L_1+N_2*L_2+...+N_{n-1}*LN_{n-1}+Nn*Ln

Where N_1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.

Average Emission Level = Peak Emission Level + 20*log(Duty cycle)

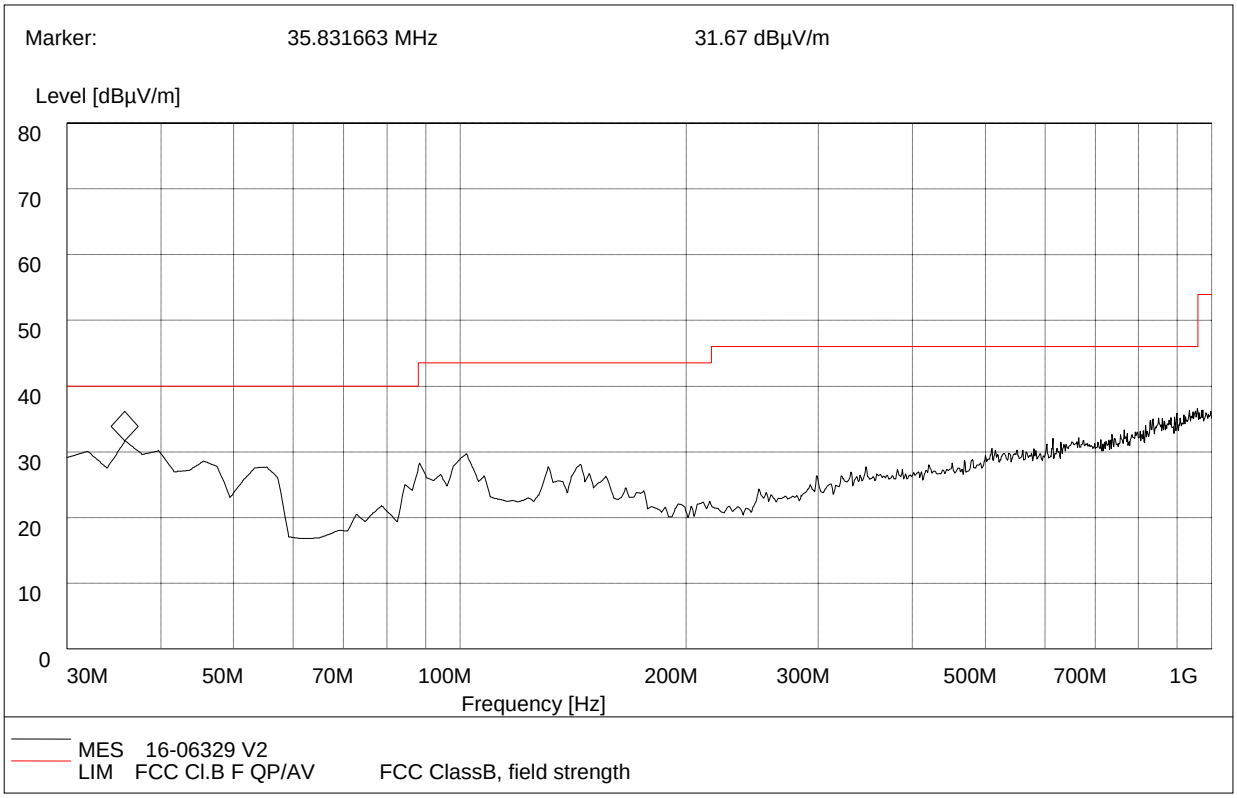
7. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
8. All modes (three orthogonal orientations) of operation were investigated and the worst-case emissions are reported.

2.10.5. Test Results of Radiated Band Edge and Spurious Emission

For 9 KHz to 30 MHz

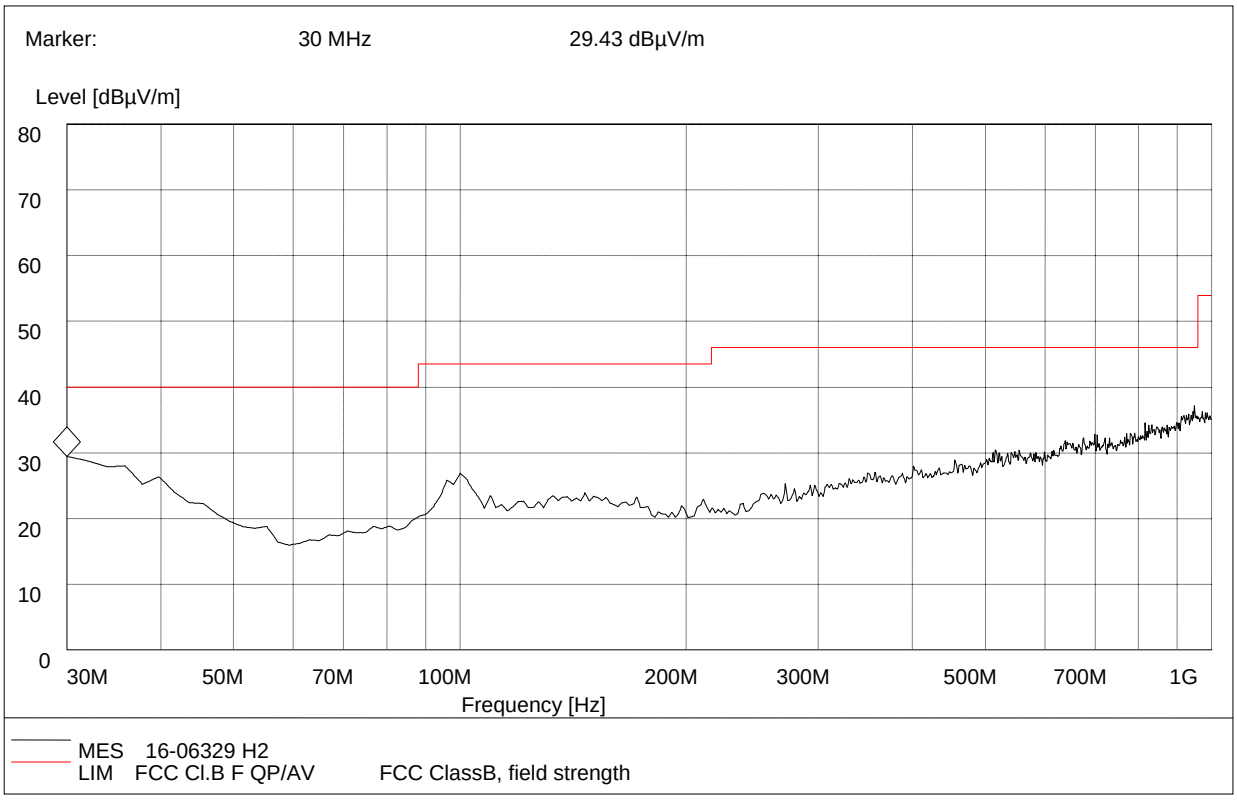
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

For 30MHz to 1000MHz



Frequency (MHz)	QuasiPeak (dB µ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB µ V/m)	Antenna	Verdict
35.83	34.67	120.000	100.0	40.0	Vertical	Pass

(Plot A: 30MHz to 1GHz, Antenna Vertical)



Frequency (MHz)	QuasiPeak (dB µ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB µ V/m)	Antenna	Verdict
30.00	29.43	120.000	100.0	40.0	Horizontal	Pass

(Plot B: 30MHz to 1GHz, Antenna Horizontal)

Note：All modes of operation were investigated and found mode 3 is the worst mode，the worst-case emissions are reported

For 1GHz to 25 GHz

NOTE: All of the EUT Configure Mode were tested and found GFSK mode is the worst mode，the worst case is recorded in this report.

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M（GFSK-2402MHz）									
No.	Frequency (MHz)	Emssion Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	2390.00	56.70	PK	74.0	-17.3	1.51 H	228	55.4	1.3
2	2390.00	43.50	AV	54.0	-10.5	1.51 H	228	42.2	1.3
3	*2402.00	76.60	PK	/	/	1.53 H	112	75	1.6
4	*2402.00	65.80	AV	/	/	1.53 H	112	64.2	1.6
5	4804.00	50.50	PK	74.00	-23.5	1.50 H	254	44.1	6.4
6	4804.00	42.80	AV	54.00	-11.2	1.50 H	254	36.4	6.4
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M（GFSK-2402MHz）									
No.	Frequency (MHz)	Emssion Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	2390.00	56.90	PK	74.0	-17.1	1.51 V	228	55.6	1.3
2	2390.00	44.30	AV	54.0	-9.7	1.51 V	228	43	1.3
3	*2402.00	77.10	PK	/	/	1.53 V	112	75.5	1.6
4	*2402.00	67.60	AV	/	/	1.53 V	112	66	1.6
5	4804.00	51.40	PK	74.00	-22.6	1.51 V	254	45	6.4
6	4804.00	43.70	AV	54.00	-10.3	1.51 V	254	37.3	6.4

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M（GFSK_2441MHz）									
No.	Frequency (MHz)	Emssion Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	*2441.00	77.80	PK	/	/	1.51 H	210	75.7	2.1
2	*2441.00	66.70	AV	/	/	1.51 H	210	64.6	2.1
3	4882.00	54.50	PK	74.00	-19.5	1.53 H	272	48	6.5
4	4882.00	43.6	AV	54.00	-10.4	1.53 H	272	37.1	6.5
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M（GFSK_2441MHz）									
No.	Frequency (MHz)	Emssion Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	*2441.00	78.40	PK	/	/	1.50 V	210	76.3	2.1
2	*2441.00	67.10	AV	/	/	1.51 V	210	65	2.1
3	4884.00	55.50	PK	74.00	-18.5	1.51 V	272	49	6.5
4	4884.00	42.80	AV	54.00	-11.2	1.51 V	272	36.3	6.5

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M（GFSK _2480MHz）									
No.	Frequency (MHz)	Emssion Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	*2480.00	77.00	PK	/	/	1.55 H	215	74.4	2.6
2	*2480.00	66.50	AV	/	/	1.55 H	215	63.9	2.6
3	2483.50	56.80	PK	74.0	-17.2	1.55 H	211	54.2	2.6
4	2483.50	45.20	AV	54.0	-8.8	1.55 H	211	42.6	2.6
5	4960.00	52.20	PK	74.0	-21.8	1.55 H	320	45.5	6.7
6	4960.00	45.10	AV	54.0	-8.9	1.55 H	320	38.4	6.7
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M（GFSK _2480MHz）									
No.	Frequency (MHz)	Emssion Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	*2480.00	76.10	PK	/	/	1.55 V	215	73.5	2.6
2	*2480.00	67.10	AV	/	/	1.55 V	215	64.5	2.6
3	2483.50	56.30	PK	74.0	-17.7	1.55 V	211	53.7	2.6
4	2483.50	45.90	AV	54.0	-8.1	1.55 V	211	43.3	2.6
5	4960.00	53.70	PK	74.0	-20.3	1.55 V	320	47	6.7
6	4960.00	42.60	AV	54.0	-11.4	1.55 V	320	35.9	6.7

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
   - Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level - Limit value
5. " * ": Fundamental frequency.

3. List of measuring equipment

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.
1	EMI TEST RECEIVER	Rohde&Schwarz	ESI 26	100009	2015/11/02
2	RF TEST PANEL	Rohde&Schwarz	TS / RSP	335015/ 0017	N/A
3	EMI TEST SOFTWARE	Rohde&Schwarz	ESK1	N/A	N/A
4	Ultra-Broadband Antenna	ShwarzBeck	VULB9163	538	2015/11/08
5	HORN ANTENNA	ShwarzBeck	9120D	1011	2015/11/08
6	Loop Antenna	Rohde&Schwarz	HZ-9	838622\013	2015/11/08
7	Pre-amplifer	ShwarzBeck	BBV 9743	9743-0022	2015/11/02
8	TURNTABLE	MATURO	TT2.0	N/A	N/A
9	ANTENNA MAST	MATURO	TAM-4.0-P	N/A	N/A
10	EMI TEST SOFTWARE	Audix	E3	N/A	N/A
11	Test cable	Siva Cables Italy	RG 58A/U	W14.02	2015/12/05
12	Climate Chamber	ESPEC	EL-10KA	05107008	2015/11/02
13	Spectrum Analyzer	Kysight	N9030A	ATO-67098	2016/07/19
14	Power Meter	Rohde&Schwarz	NRP2	1020.1809.02	2016.06.02
15	Power Sensor	Rohde&Schwarz	NRP-Z81	823.3618.03	2016.06.02
16	Spectrum Analyzer	R&S	FSP40	1164.4391.40	2016.07.07

4. Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2

Measurement	Frequency	Uncertainty
Conducted emissions	9kHz~30MHz	3.39dB
Radiated emissions	30MHz~1000MHz	4.24dB
	1G~18GHz	5.16dB
	18G~40GHz	5.54dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

** END OF REPORT **