



FCC Test Report

Report No.: RDK-17OC0110VTSPB-1

FCC ID: 2AOY2ALLHOP

Product: Bluetooth player

Model: JL8248

Received Date: Nov.22, 2017

Test Date: Nov.22, 2017 to Feb.26, 2018

Issued Date: Feb.27, 2018

Applicant: Shanghai Homsteel Industry Co.,Ltd

Address: No.49 Tianying Road, Qingpu District, Shanghai, China

Manufacturer: Shanghai Homsteel Industry Co.,Ltd

Address: No.49 Tianying Road, Qingpu District, Shanghai, China

Issued By: BUREAU VERITAS ADT (Shanghai) Corporation

Lab Address: No. 829, Xinzhuan Road, Shanghai, P.R.China (201612)

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Release Control Record

Issue No.	Description	Date Issued
RDK-17OC0110VTSPB-1	Original release	Feb.27, 2018

1 Certificate of Conformity

Product: Bluetooth player

Brand: --

Model: JL8248

Applicant: Shanghai Homsteel Industry Co.,Ltd

Test Date: Nov.22, 2017 to Feb.26, 2018

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)

ANSI C63.10:2013

The above equipment has been tested by **BUREAU VERITAS ADT (Shanghai) Corporation**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : , **Date:** Jan.16, 2018

Bing YE
Testing Engineer

Approved by : , **Date:** Jan.16, 2018

Joy ZHU
Testing Manager

2 Summary of Test Results

The EUT has been tested according to the following specifications:

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	PASS	Meet the requirement of limit.
15.247(a)(1)(iii)	Dwell Time on Each Channel	PASS	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	PASS	Meet the requirement of limit.
15.247(b)	Maximum Peak Output Power	PASS	Meet the requirement of limit.
15.205 / 15.209 / 15.247(d)	Radiated Emissions & Band Edge Measurement	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

Note: The data shown in the report is the worst case data when the EUT is powered by AC120V, 60Hz.

2.1 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Hybrid antenna(25MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1001	Feb.28, 17	Feb.27, 19
Horn Antenna(1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	Sep.01, 17	Aug.31, 19
Pre-Amplifier(100kHz-1.3GHz)	Agilent	8447D	E1A2001	Oct.19, 2017	Oct.18, 18
Pre-Amplifier(1GHz-26.5GHz)	Agilent	8449B	E1A2002	Mar. 27, 17	Mar. 26, 19
EMI test recerver	R&S	ESR7	E1R1005	Nov.29, 17	Nov.28, 18
Spectrum Analyzer	Keysight	N9030B	E1S1003	Jun. 13, 17	Jun. 12, 18
EMI test recerver	R&S	ESCS30	E1R1001	Mar.27, 17	Mar.26, 18
LISN	R&S	ENV216	E1L1011	Aug.01, 16	Jul.31, 18
Test Software	Toyo	Toyo	N/A	N/A	N/A
Test Software	Keysight	V1.01.10	N/A	N/A	N/A

2.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

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

Measurement	Frequency	Expanded Uncertainty ($k=2$) (\pm)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.83 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.36 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.47 dB
	6GHz ~ 18GHz	3.75 dB
	18GHz ~ 40GHz	3.30 dB

2.3 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Bluetooth player
Brand	--
Test Model	JL8248
Model Difference	--
Power Rating	100-240V~, 50/60Hz
Modulation Type	GFSK, $\pi/4$ -DQPSK
Modulation Technology	BT-EDR, FHSS
Operating Frequency	2.402 ~ 2.480GHz
Number of Channel	79
Output Power	-3.98dBm
Antenna Type	PCB antenna
Antenna Connector	--
Antenna Gain	-0.68dBi

Note: For more details, please refer to the User's manual of the EUT.

3.2 Description of Test Modes

79 channels are provided for BT-EDR mode:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

3.2.1 Test Mode Applicability:

EUT Configure Mode	Applicable to				Description
	RE ≥ 1G	RE < 1G	PLC	APCM	
-	√	√	-	√	-

Where **RE≥1G**: Radiated Emission above 1GHz

RE≤1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission

APCM: Antenna Port Conducted Measurement

Radiated Emission Test (Above 1 GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Radiated Emission Test (Below 1 GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	78	FHSS	8DPSK	3DH5

Power Line Conducted Emission Test:

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	78	FHSS	8DPSK	3DH5

Antenna Port Conducted Measurement

- This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
-	0 to 78	0, 39, 78	FHSS	GFSK	DH5
-	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

3.2.2 Test Condition:

Applicable to	Normal Environmental Conditions	Normal Input Power
RE \geq 1G	23deg. C, 58%RH	AC120V 60Hz
RE < 1G	23deg. C, 58%RH	AC120V 60Hz
PLC	22deg. C, 54%RH	AC120V 60Hz
APCM	25deg. C, 60%RH	AC120V 60Hz

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

FCC Part 15, Subpart C (15.247)

FCC DA 00705

ANSI C63.10:2013

All relaxed test items have been performed and recorded as per the above standard.

4 Test Procedure and Results

4.1 Conducted Emission Measurement

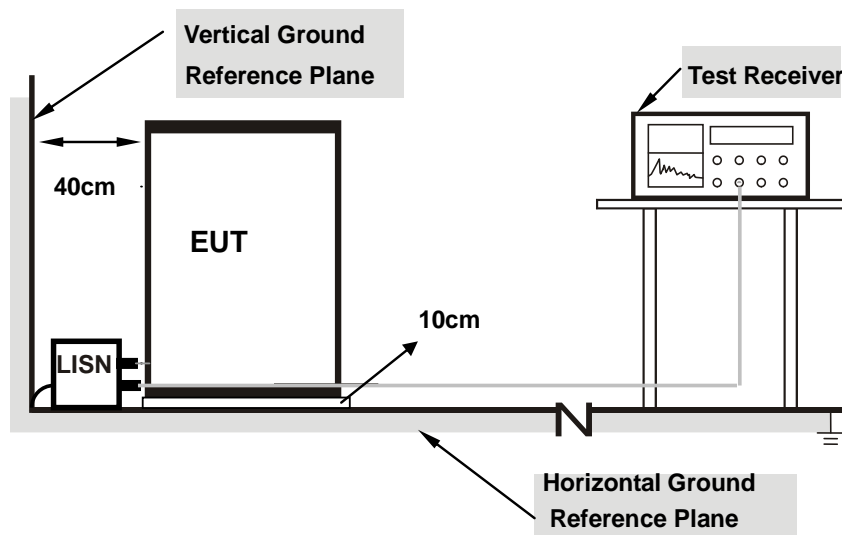
4.1.1 Limit

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

4.1.2 Test Setup



Note: 1. Support units were connected to second LISN.

4.1.3 Test Procedures

- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

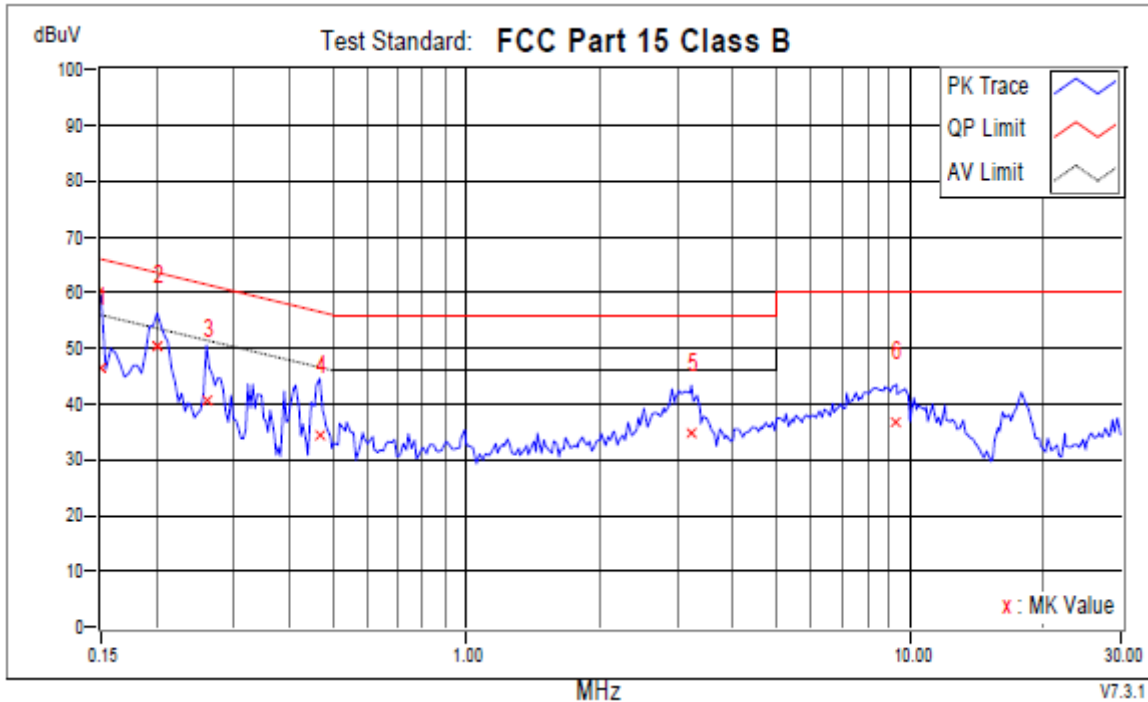
NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.1.4 Deviation of Test Standard

No deviation.

4.1.5 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
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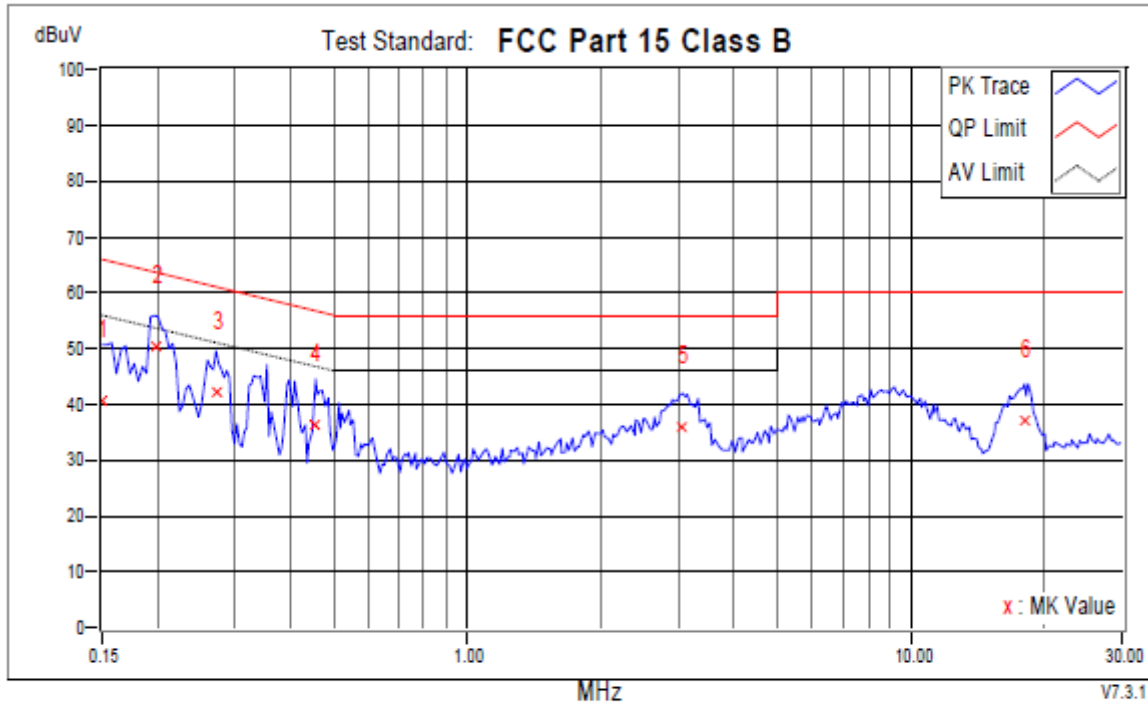


No.	Frequency	Corr. Factor	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
	MHz		QP	AV	QP	AV	QP	AV	QP	AV	
1	0.15000	9.61	36.68	10.37	46.29	19.98	66.00	56.00	-19.71	-36.02	
+2	0.20083	9.61	40.90	26.73	50.51	36.34	63.58	53.58	-13.07	-17.24	
3	0.25948	9.61	30.90	14.62	40.51	24.23	61.45	51.45	-20.94	-27.22	
4	0.46671	9.61	24.82	15.93	34.43	25.54	56.57	46.57	-22.14	-21.03	
5	3.21697	9.70	25.22	11.30	34.92	21.00	56.00	46.00	-21.08	-25.00	
6	9.33612	9.47	27.23	17.87	36.70	27.34	60.00	50.00	-23.30	-22.66	

REMARKS:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
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No.	Frequency	Corr. Factor	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
	MHz		QP	AV	QP	AV	QP	AV	QP	AV	
1	0.15000	9.61	31.04	6.79	40.65	16.40	66.00	56.00	-25.35	-39.60	
+2	0.19992	9.61	40.90	25.29	50.51	34.90	63.61	53.61	-13.10	-18.71	
3	0.27121	9.61	32.42	16.16	42.03	25.77	61.08	51.08	-19.05	-25.31	
4	0.45498	9.61	26.55	13.62	36.16	23.23	56.78	46.78	-20.62	-23.55	
5	3.05666	9.69	26.12	10.48	35.81	20.17	56.00	46.00	-20.19	-25.83	
6	18.05851	10.48	26.80	17.63	37.28	28.11	60.00	50.00	-22.72	-21.89	

REMARKS:

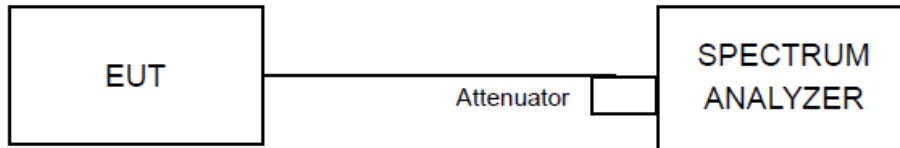
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

4.2 Number of Hopping Frequency Used

4.2.1 Limit

At least 15 channels frequencies, and should be equally spaced.

4.2.2 Test Setup



4.2.3 Test Procedures

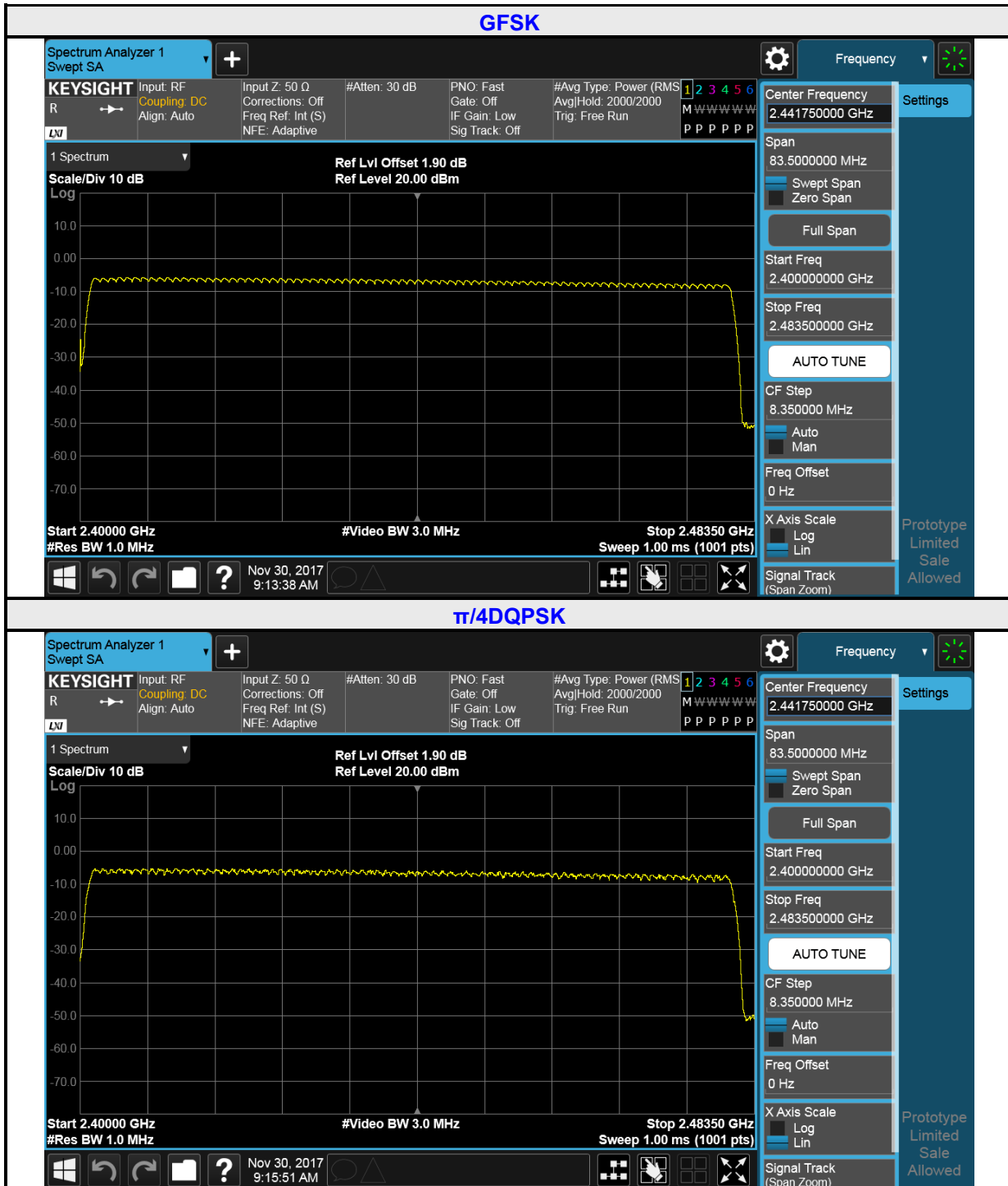
- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- Set the SA on View mode and then plot the result on SA screen.
- Repeat above procedures until all frequencies measured were complete.

4.2.4 Deviation of Test Standard

No deviation.

4.2.5 Test Results

There are 79 hopping frequencies in the hopping mode. Please refer to next page for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

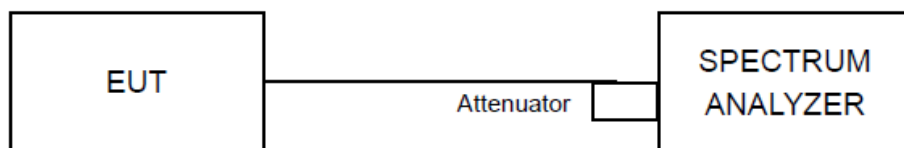


4.3 Dwell Time on Each Channel

4.3.1 Limit

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.

4.3.2 Test Setup



4.3.3 Test Procedures

- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- Repeat above procedures until all different time-slot modes have been completed.

4.3.4 Deviation of Test Standard

No deviation.

4.3.5 Test Results

GFSK

Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	318	0.36	116	400
DH3	172	1.62	279	400
DH5	113	2.87	324	400

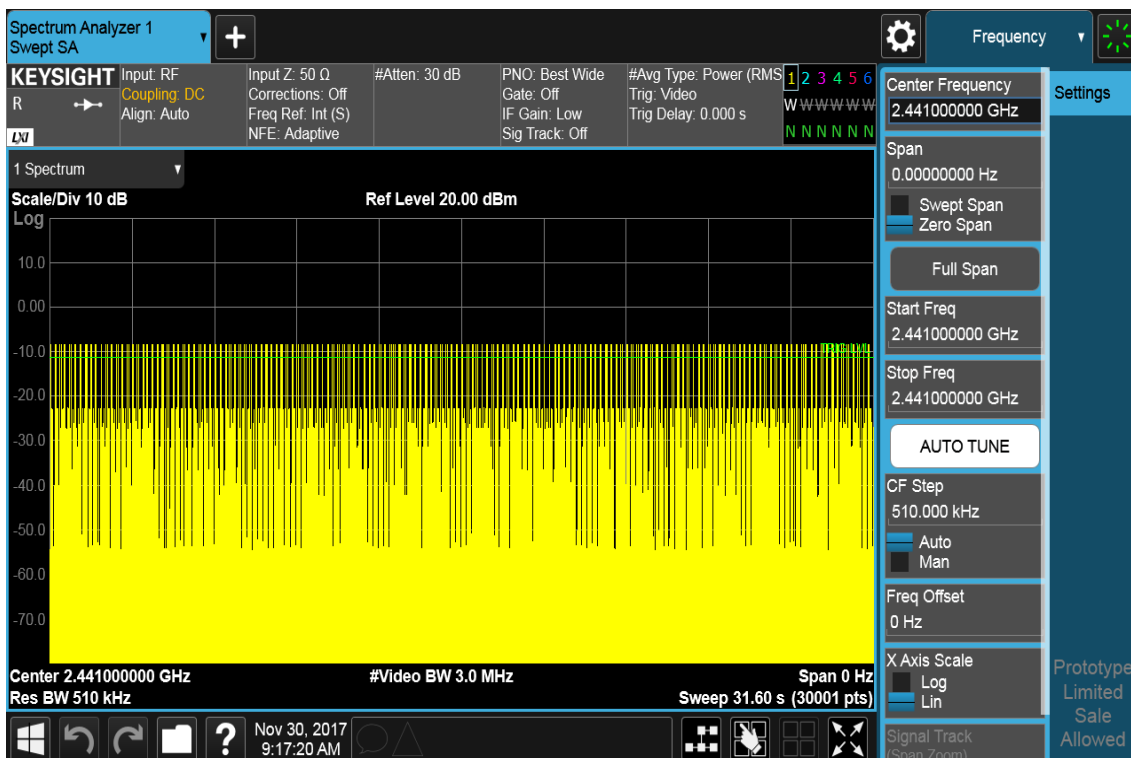
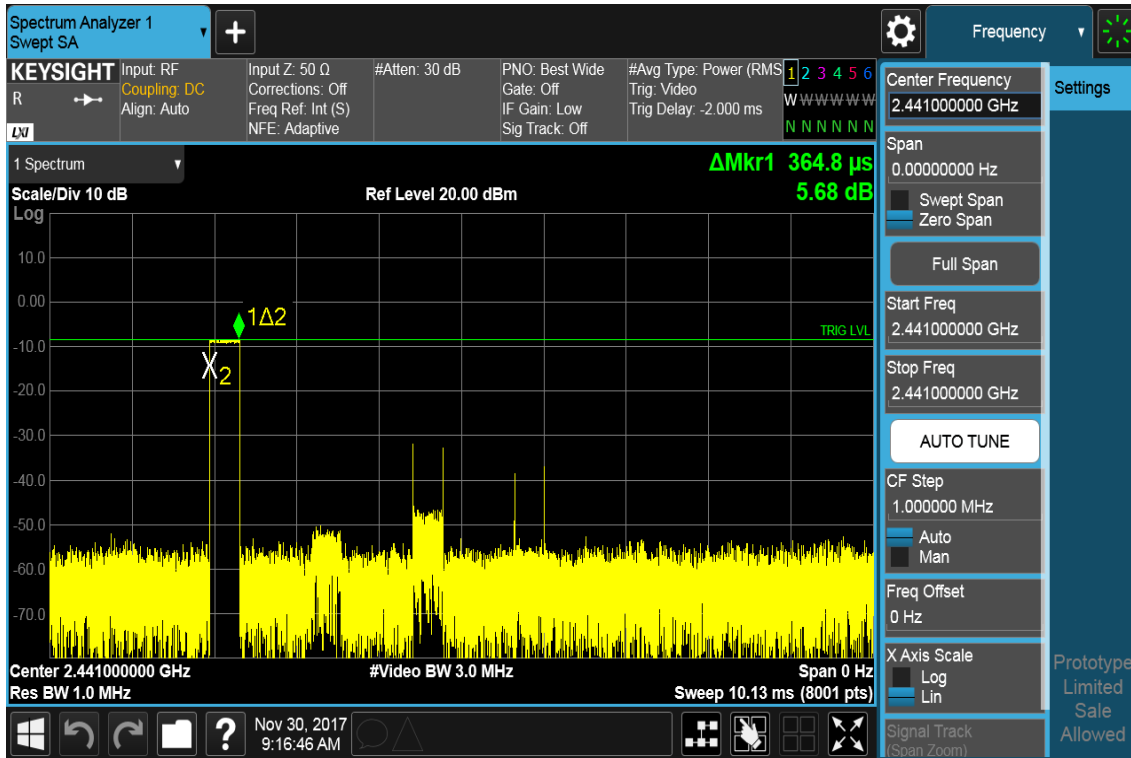
$\pi/4$ DQPSK

Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	318	0.37	119	400
DH3	165	1.63	268	400
DH5	119	2.87	342	400

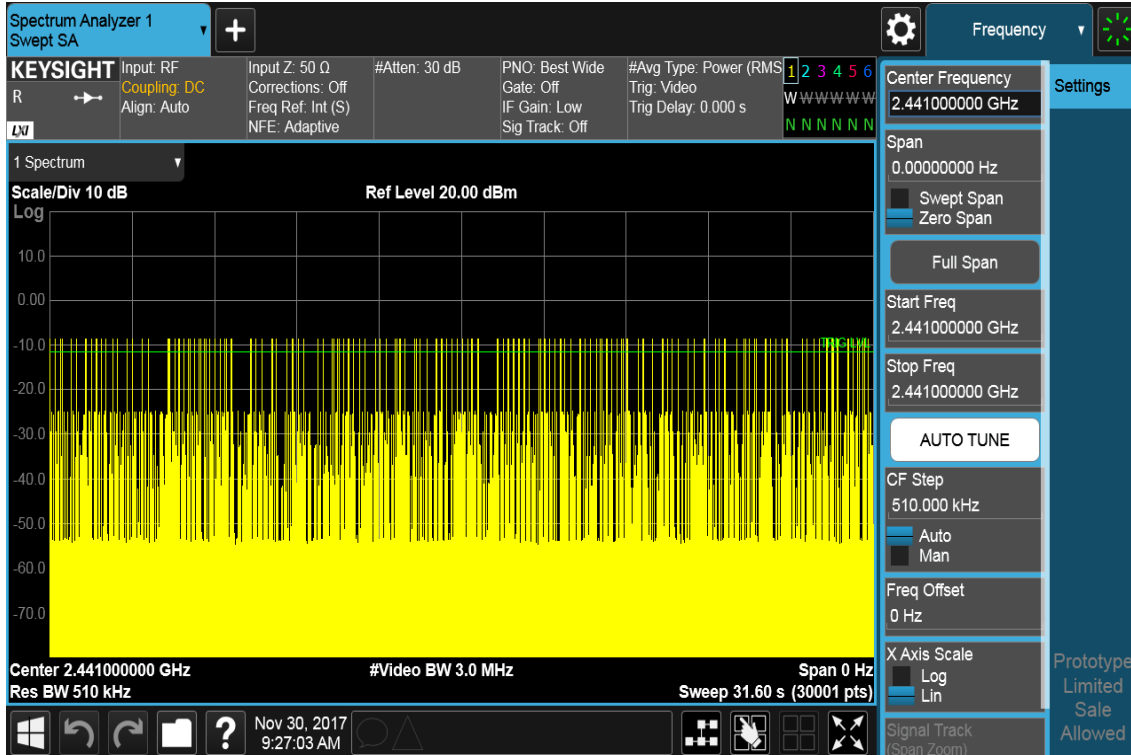
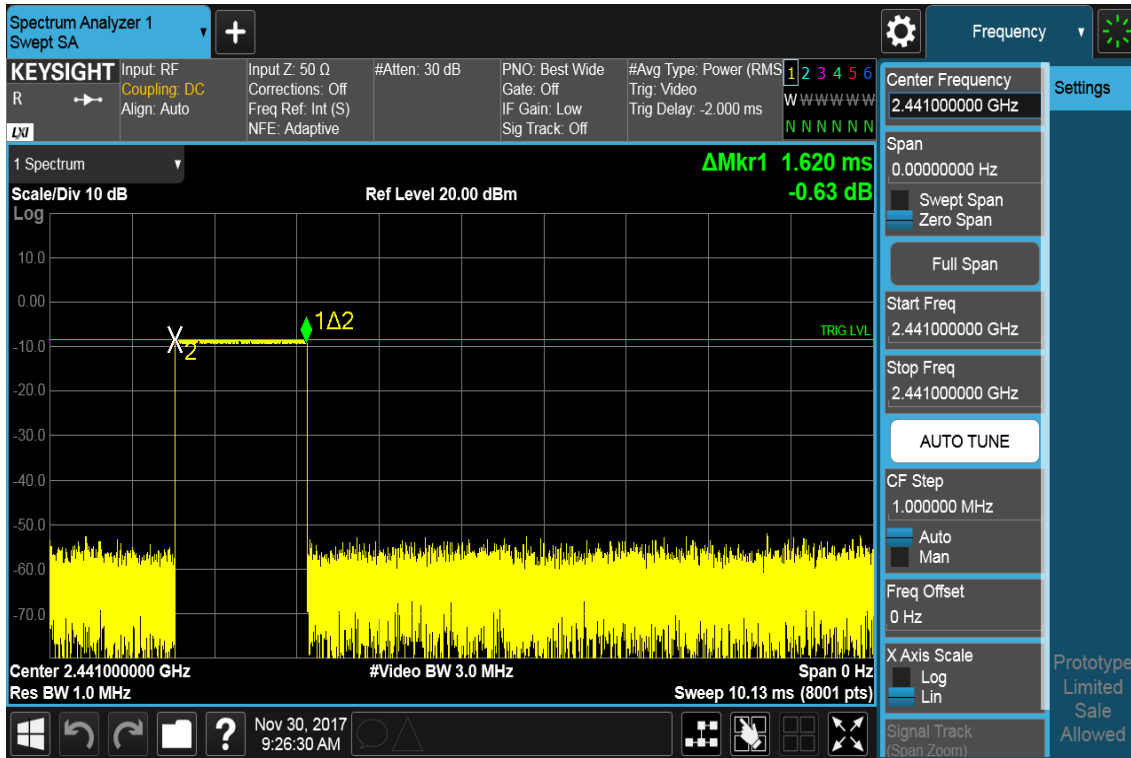
NOTE: Test plots of the transmitting time slot are shown on next page.

GFSK

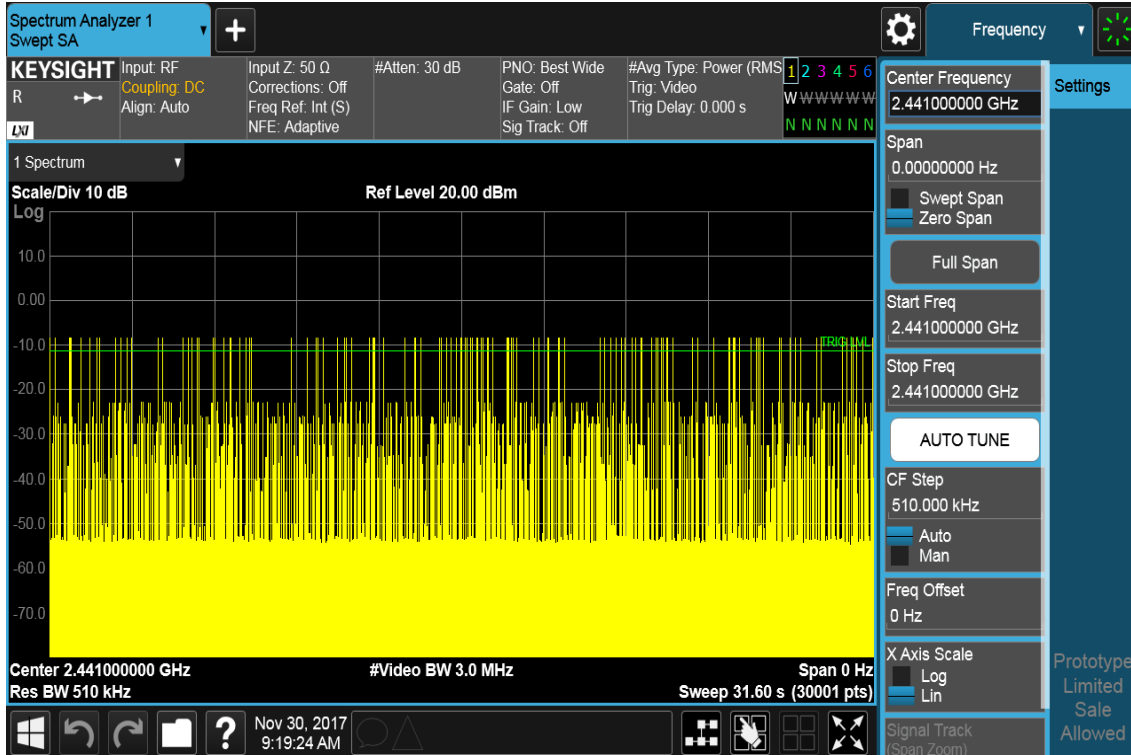
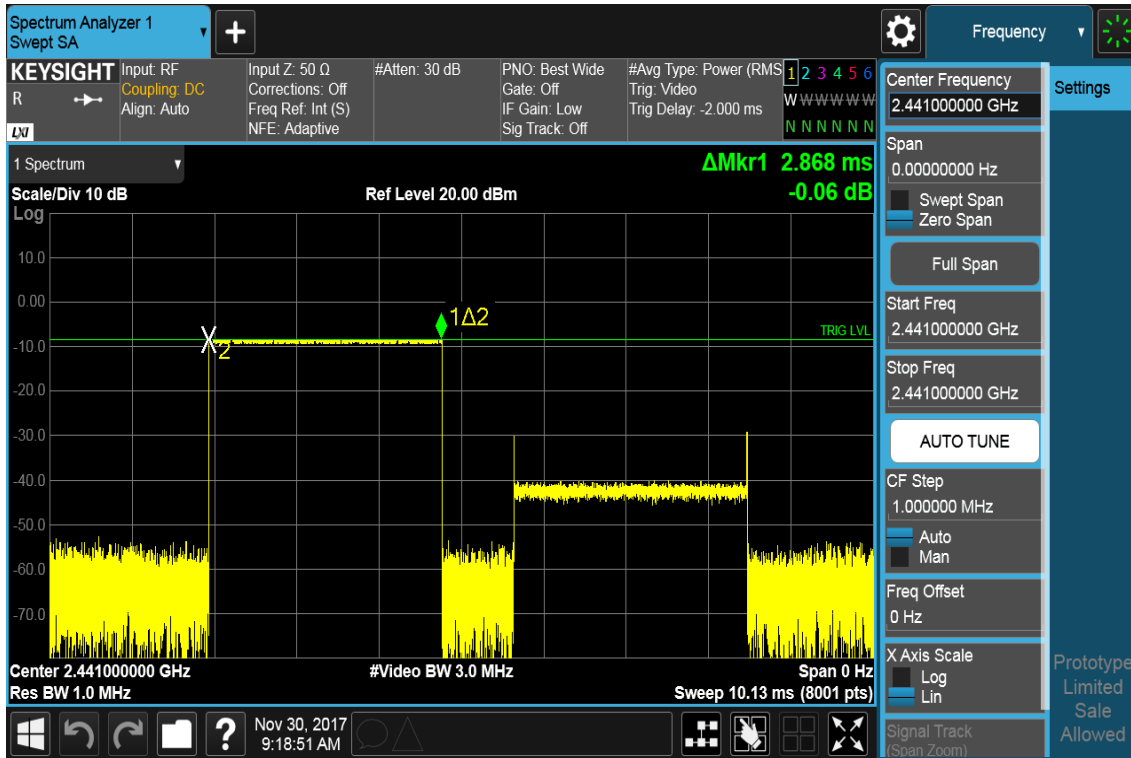
DH1



DH3

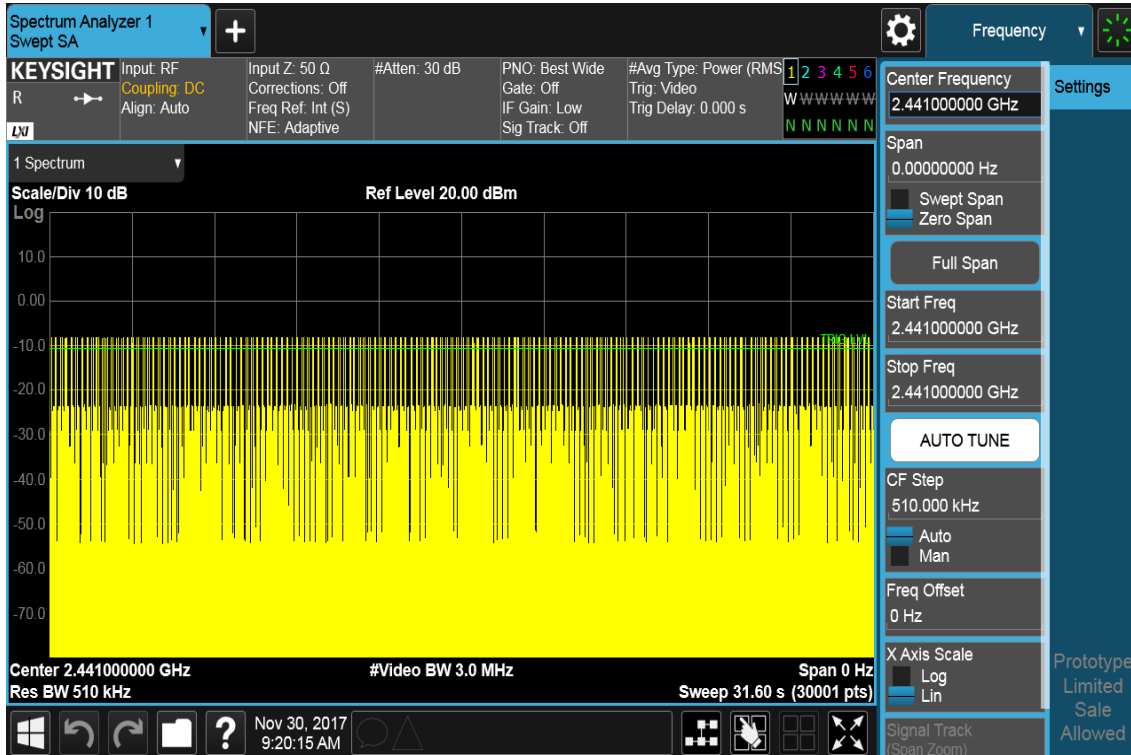
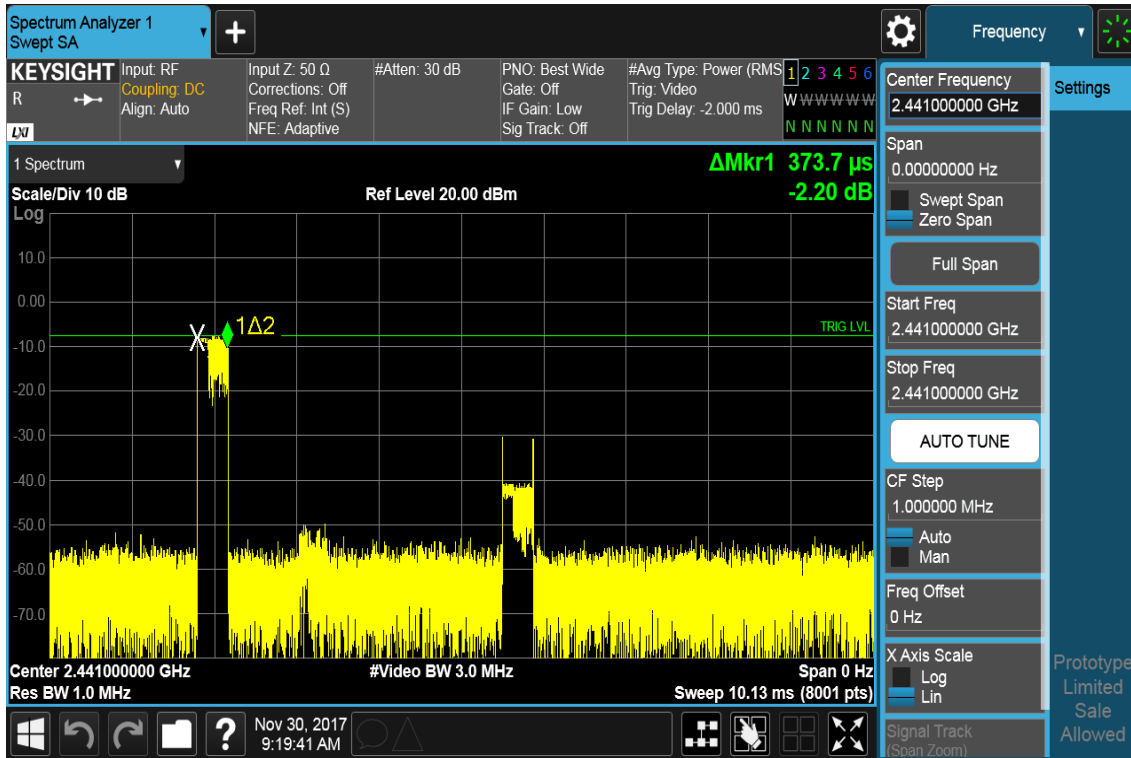


DH5

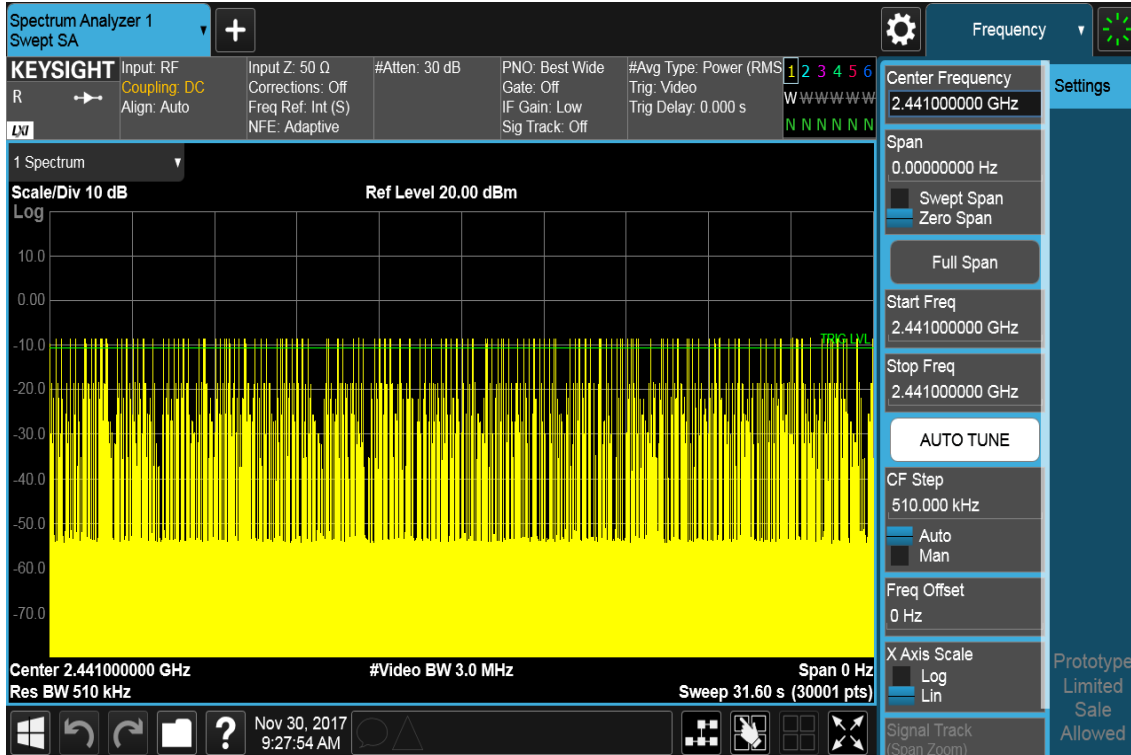
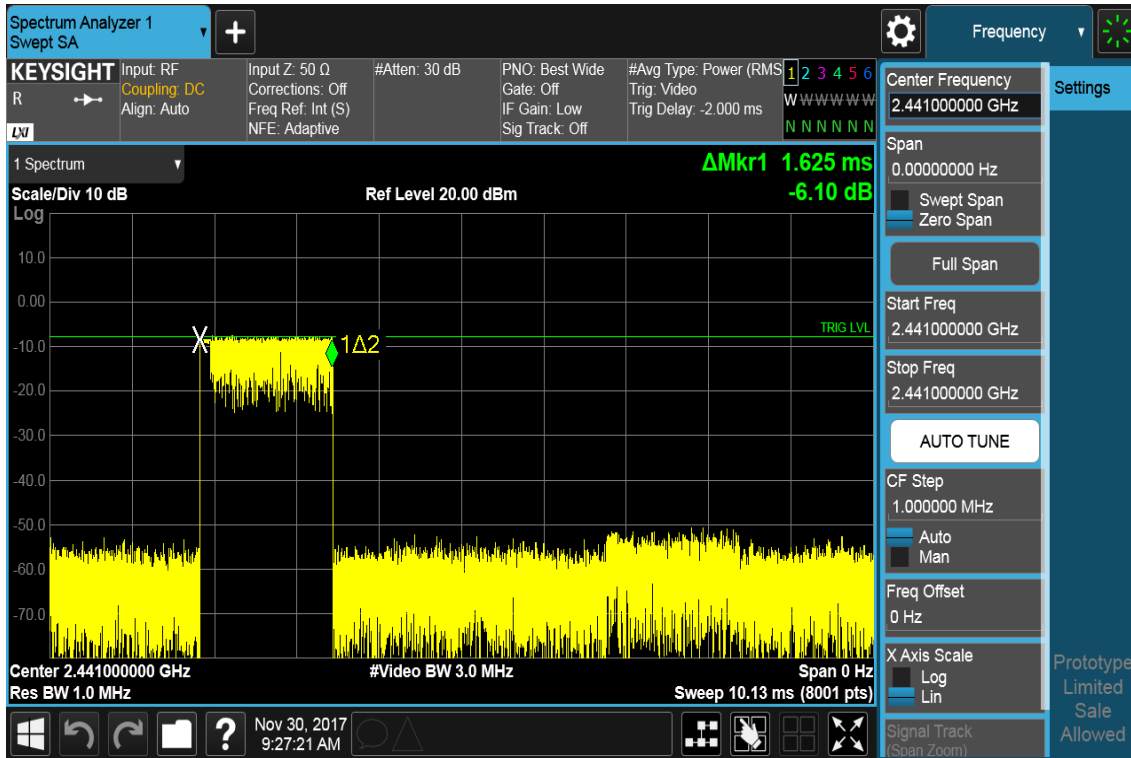


$\pi/4$ DQPSK

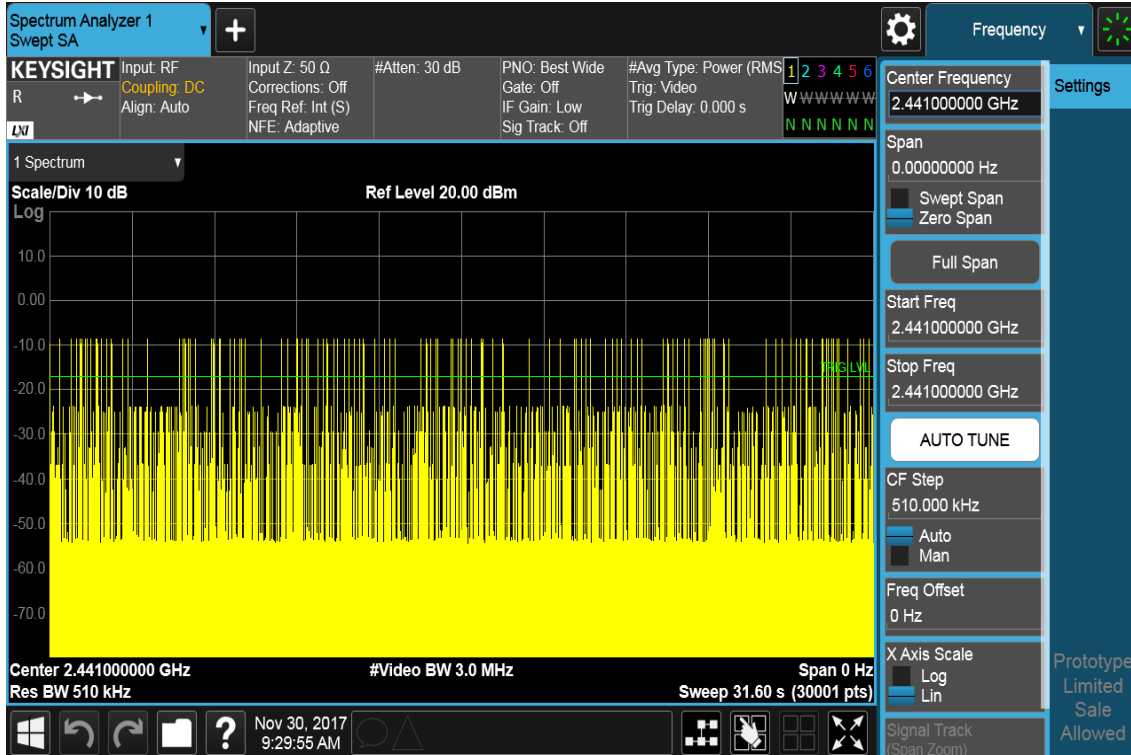
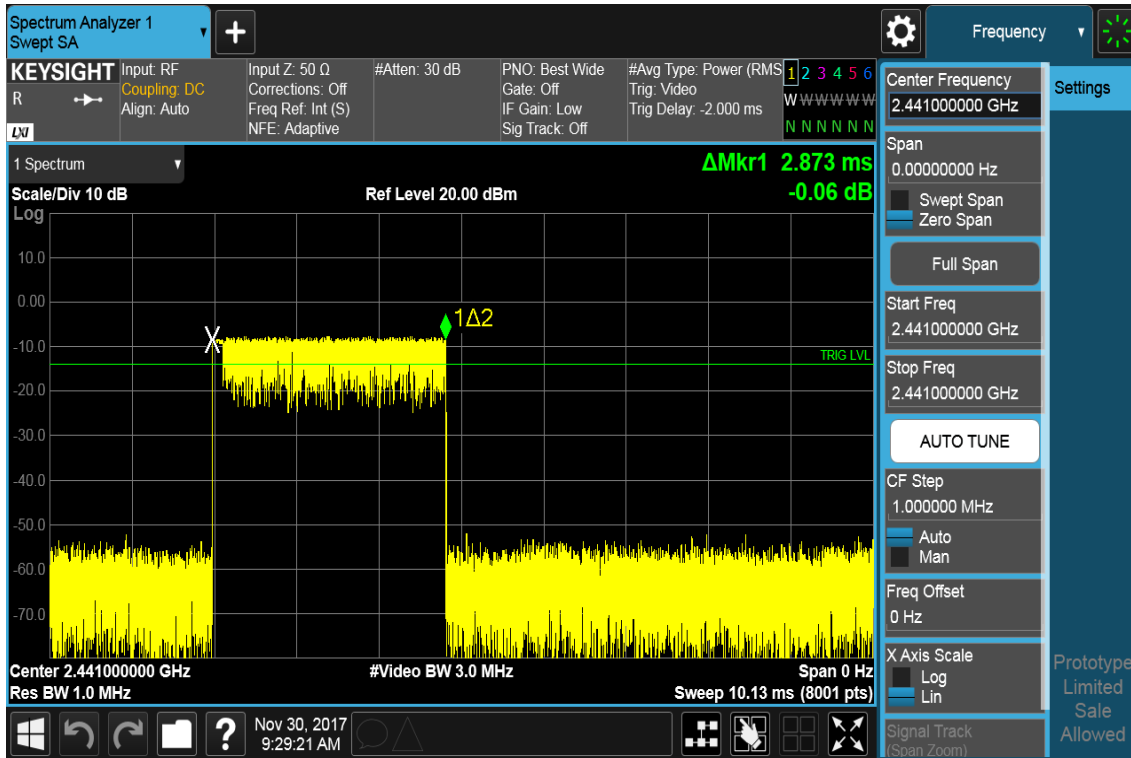
DH1



DH3



DH5

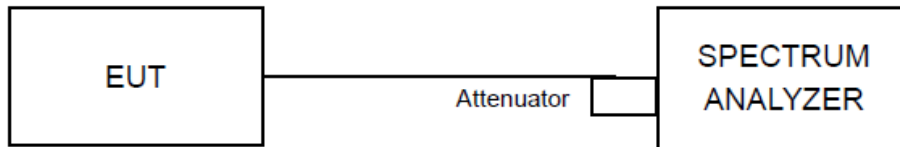


4.4 Channel Bandwidth

4.4.1 Limit

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

4.4.2 Test Setup



4.4.3 Test Procedures

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- Repeat above procedures until all frequencies measured were complete.

4.4.4 Deviation of Test Standard

No deviation.

4.4.5 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.4.6 Test Results

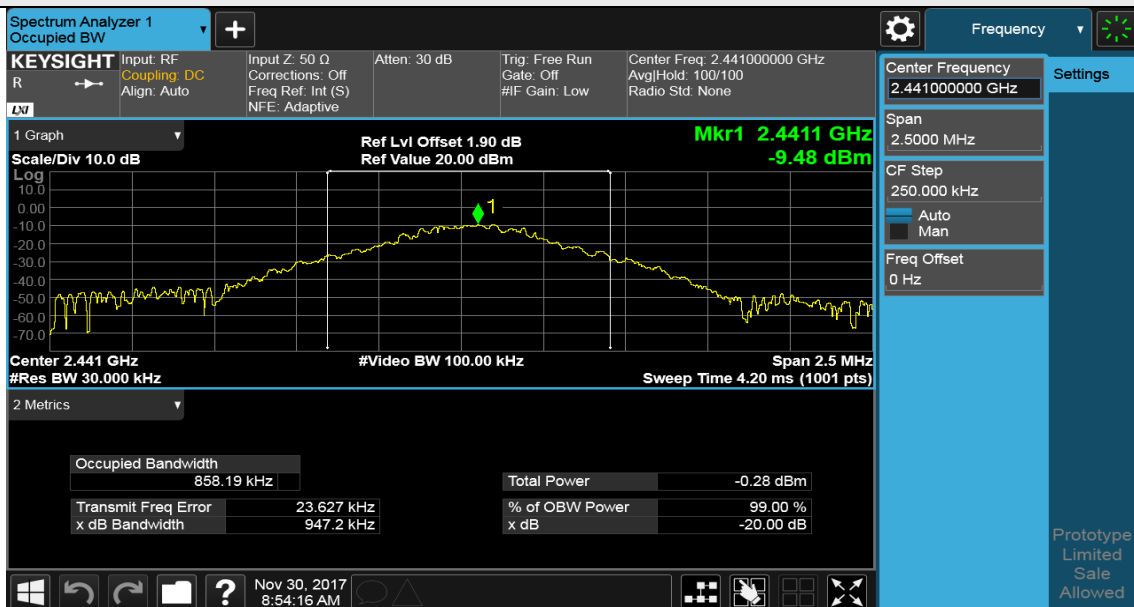
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	
		GFSK	$\pi/4$ DQPSK
0	2402	0.9515	1.309
39	2441	0.9472	1.309
78	2480	0.9474	1.327

Spectrum Plot

GFSK 2402MHz



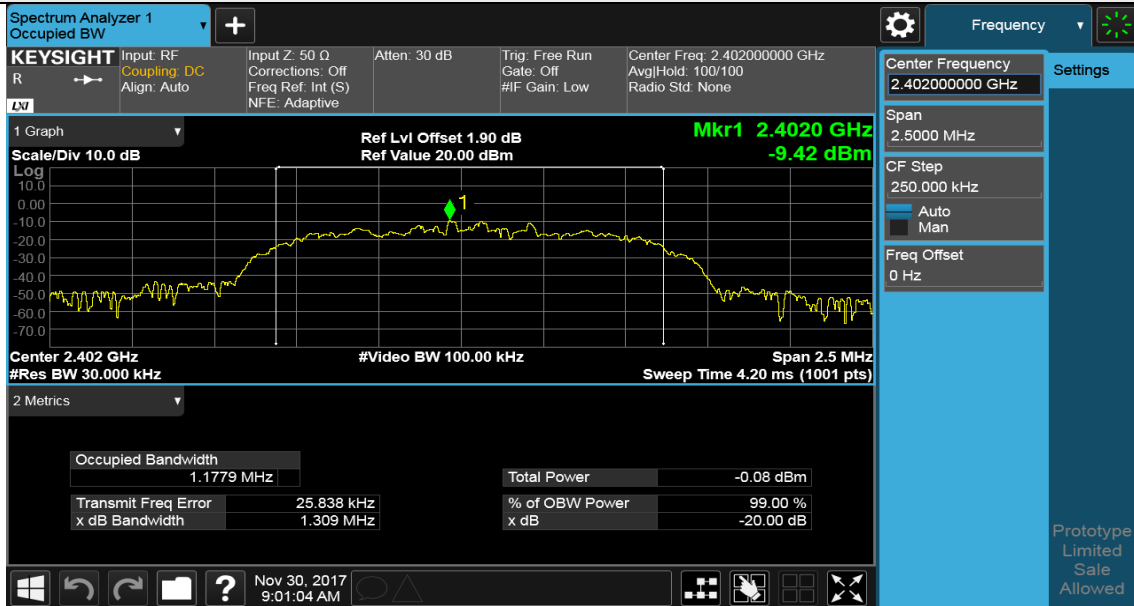
GFSK 2441MHz



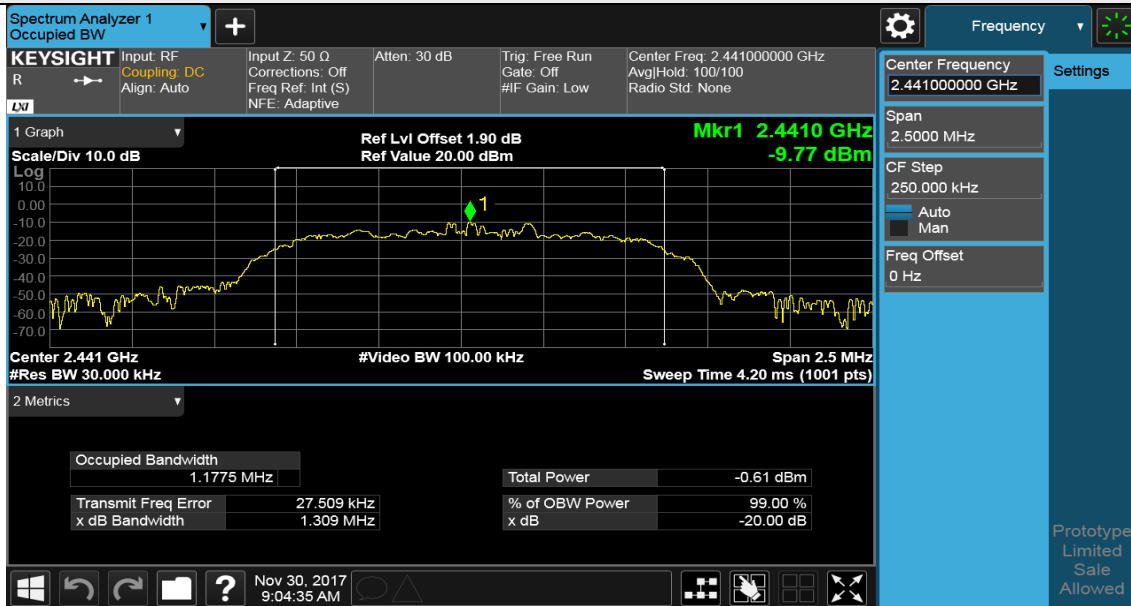
GFSK 2480MHz



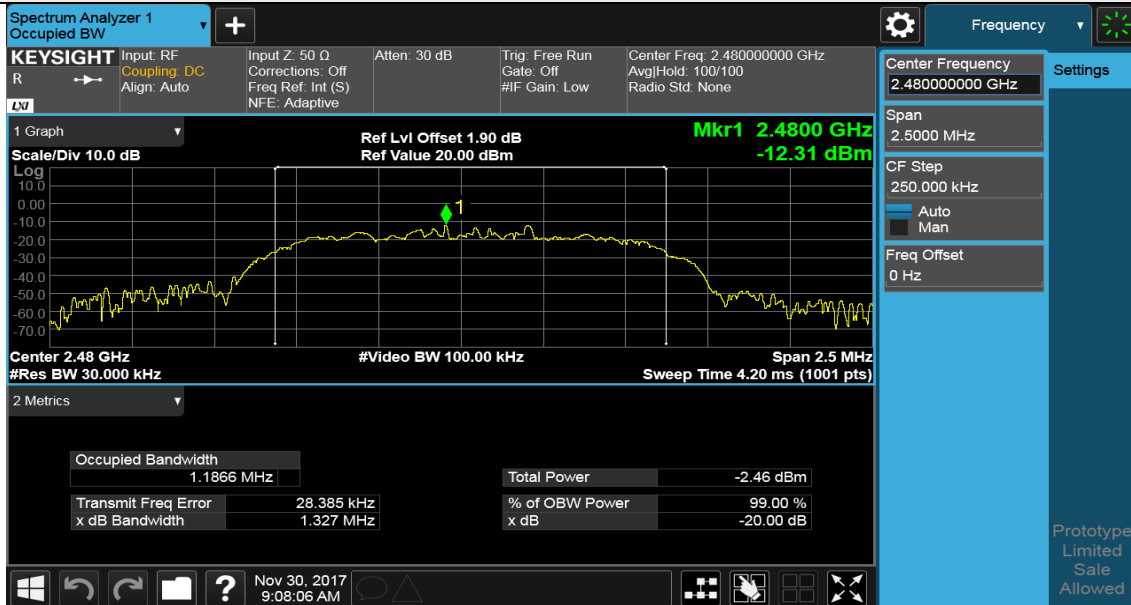
π /4DQPSK 2402MHz



π/4DQPSK 2441MHz



π/4DQPSK 2480MHz

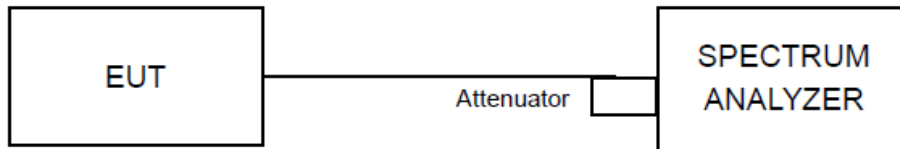


4.5 Hopping Channel Separation

4.5.1 Limit

At least 25kHz or two-third of 20dB hopping channel bandwidth (whichever is greater)

4.5.2 Test Setup



4.5.3 Test Procedures

Measurement Procedure REF

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
- By using the MaxHold function record the separation of two adjacent channels.
- Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
- Repeat above procedures until all frequencies measured were complete.

4.5.4 Deviation of Test Standard

No deviation.



BUREAU
VERITAS

4.5.5 Test Results

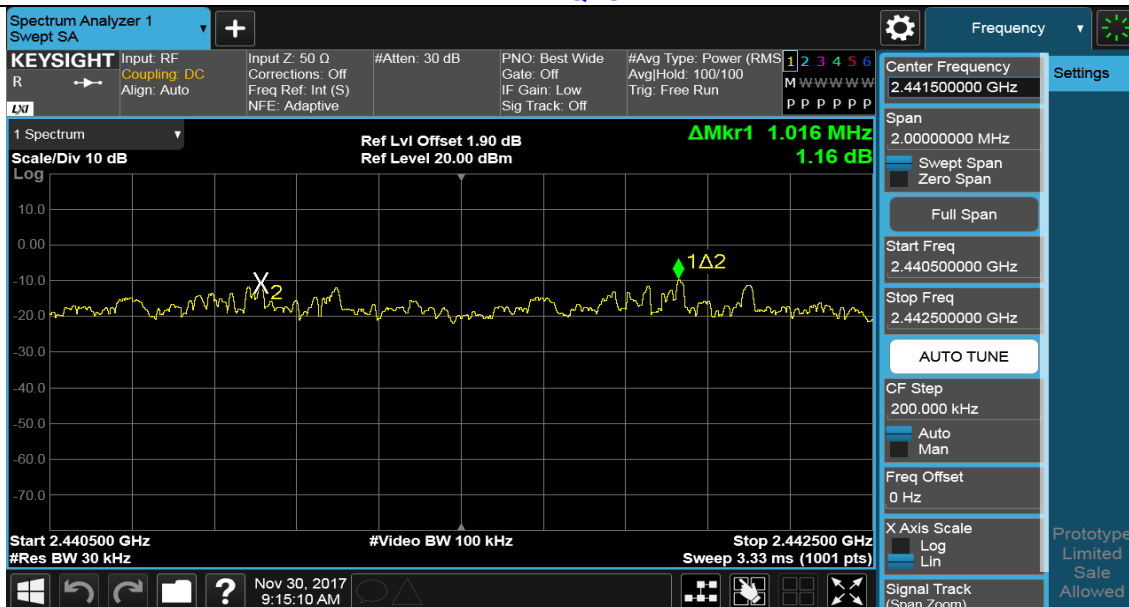
Test Mode	Channel	Result	Limit	Pass / Fail
GFSK	HOP	1.002	0.952	PASS
$\pi/4$ DQPSK	HOP	1.016	0.885	PASS

Spectrum Plot

GFSK



$\pi/4$ DQPSK

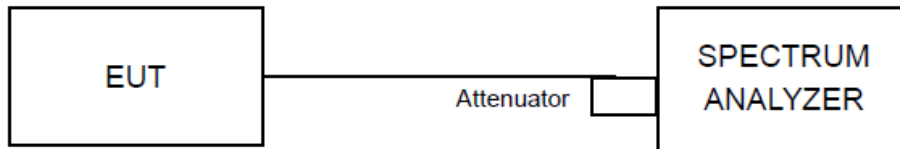


4.6 Maximum Output Power

4.6.1 Limit

The Maximum Output Power Measurement is 125mW(21dBm).

4.6.2 Test Setup



4.6.3 Test Procedures

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3MHz RBW and 10 MHz VBW.
- Measure the captured power within the band and recording the plot.
- Repeat above procedures until all frequencies required were complete.

4.6.4 Deviation of Test Standard

No deviation.

4.6.5 EUT Operating Condition

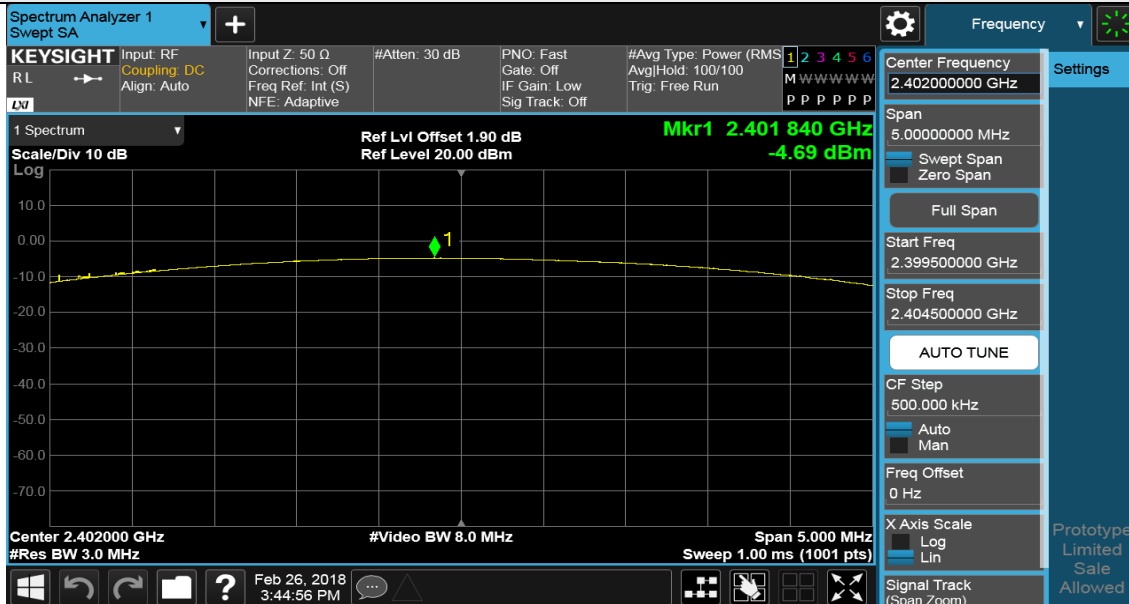
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.6.6 Test Results

Test Mode	Channel	Result (dBm)	Limit (dBm)	Pass / Fail
GFSK	0	-4.69	30	PASS
GFSK	39	-5.88	30	PASS
GFSK	78	-7.57	30	PASS
π /4DQPSK	0	-3.98	21	PASS
π /4DQPSK	39	-4.93	21	PASS
π /4DQPSK	78	-6.61	21	PASS

Spectrum Plot of Worst Value

GFSK / CH 0



π /4DQPSK / CH 0



4.7 Conducted Out of Band Emission Measurement

4.7.1 Limit

Below -20dB of the highest emission level of operating band (in 100kHz RBW).

4.7.2 Test Procedures

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100 kHz and 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

4.7.3 Deviation of Test Standard

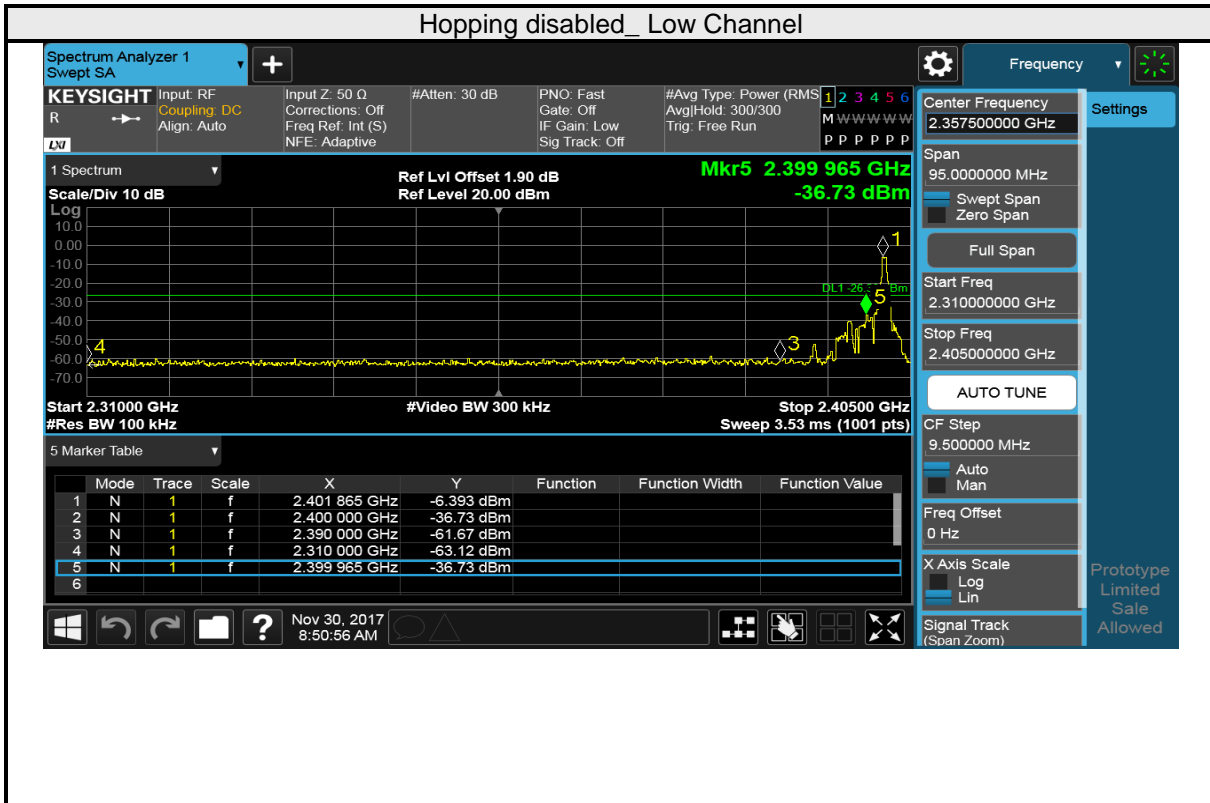
No deviation.

4.7.4 Test Results

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

TestMode	ChName	Channel	Max. Level	Result	Limit	Verdict
DH5	Low	2402	-6.39	-36.73	-26.39	PASS
DH5	High	2480	-8.43	-58.94	-28.43	PASS
DH5	Low	HOP	-6.80	-37.22	-26.8	PASS
DH5	High	HOP	-9.08	-58.77	-29.08	PASS
2DH5	Low	2402	-6.01	-36.89	-26.01	PASS
2DH5	High	2480	-8.95	-57.25	-28.95	PASS
2DH5	Low	HOP	-6.93	-37.24	-26.93	PASS
2DH5	High	HOP	-13.45	-59.29	-33.45	PASS

GFSK



Hopping disabled_ High Channel

Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF Coupling: DC Align: Auto
Input Z: 50 Ω Corrections: Off Freq Ref: Int (S) NFE: Adaptive
#Atten: 30 dB PNO: Best Wide Gate: Off IF Gain: Low Sig Track: Off
#Avg Type: Power (RMS) Avg/Hold: 300/300 Trig: Free Run

Center Frequency: 2.489000000 GHz
Span: 22.0000000 MHz
Start Freq: 2.478000000 GHz
Stop Freq: 2.500000000 GHz
AUTO TUNE
CF Step: 2.200000 MHz
Freq Offset: 0 Hz
X Axis Scale: Lin
Signal Track (Span Zoom)

Ref Lvl Offset 1.90 dB
Ref Level 20.00 dBm
Mkr4 2.495 226 GHz
-58.94 dBm
DL1 -28.43 dBm

1 Spectrum
Scale/Div 10 dB
Log
Start 2.47800 GHz #Video BW 300 kHz Stop 2.50000 GHz
#Res BW 100 kHz Sweep 1.00 ms (1001 pts)

Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.490 200 GHz	-8.426 dBm		
2	N	1	f	2.483 500 GHz	-62.50 dBm		
3	N	1	f	2.500 000 GHz	-61.72 dBm		
4	N	1	f	2.495 226 GHz	-58.94 dBm		
5							
6							

Nov 30, 2017 8:57:50 AM

Hopping enabled_ Low Channel

Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF Coupling: DC Align: Auto
Input Z: 50 Ω Corrections: Off Freq Ref: Int (S) NFE: Adaptive
#Atten: 30 dB PNO: Fast Gate: Off IF Gain: Low Sig Track: Off
#Avg Type: Power (RMS) Avg/Hold: 300/300 Trig: Free Run

Center Frequency: 2.357500000 GHz
Span: 95.0000000 MHz
Start Freq: 2.310000000 GHz
Stop Freq: 2.405000000 GHz
AUTO TUNE
CF Step: 9.500000 MHz
Freq Offset: 0 Hz
X Axis Scale: Lin
Signal Track (Span Zoom)

Ref Lvl Offset 1.90 dB
Ref Level 20.00 dBm
Mkr5 2.399 965 GHz
-37.22 dBm
DL1 -28.43 dBm

1 Spectrum
Scale/Div 10 dB
Log
Start 2.31000 GHz #Video BW 300 kHz Stop 2.40500 GHz
#Res BW 100 kHz Sweep 3.53 ms (1001 pts)

Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.405 000 GHz	-6.802 dBm		
2	N	1	f	2.400 000 GHz	-37.22 dBm		
3	N	1	f	2.390 000 GHz	-61.99 dBm		
4	N	1	f	2.310 000 GHz	-63.19 dBm		
5	N	1	f	2.399 965 GHz	-37.22 dBm		
6							

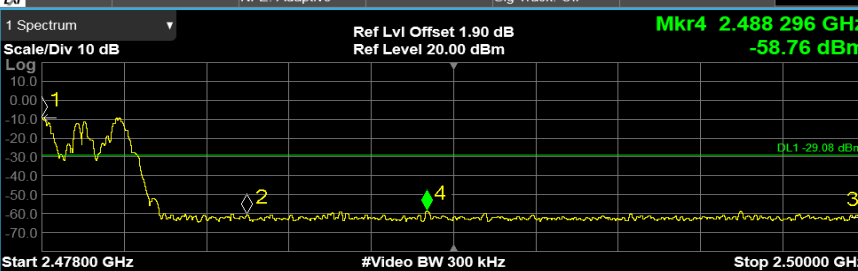
Nov 30, 2017 9:13:55 AM

Hopping enabled_ High Channel

Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF Input Z: 50 Ω #Atten: 30 dB PNO: Best Wide #Avg Type: Power (RMS) 1 2 3 4 5 6
 R Coupling: DC Corrections: Off Gate: Off Avg/Hold: 300/300 M WWWWWW
 Align: Auto Freq Ref: Int (S) IF Gain: Low Trig: Free Run P P P P P P
 NFE: Adaptive Sig Track: Off

1 Spectrum Ref Lvl Offset 1.90 dB **Mkr4 2.488 296 GHz**
 Scale/Div 10 dB Ref Level 20.00 dBm **-58.76 dBm**



Start 2.47800 GHz #Video BW 300 kHz Stop 2.50000 GHz
 #Res BW 100 kHz Sweep 1.00 ms (1001 pts)

5 Marker Table

	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.478 022 GHz	-9.083 dBm			
2	N	1	f	2.483 500 GHz	-60.64 dBm			
3	N	1	f	2.500 000 GHz	-62.20 dBm			
4	N	1	f	2.488 296 GHz	-58.76 dBm			
5								
6								

Frequency

Center Frequency
2.489000000 GHz

Span
22.0000000 MHz

Start Freq
2.478000000 GHz

Stop Freq
2.500000000 GHz

AUTO TUNE

CF Step
2.200000 MHz

Freq Offset
0 Hz

X Axis Scale
Log

Signal Track
(Span Zoom)

Settings

Prototype
Limited
Sale
Allowed

π/4DQPSK

Hopping disabled_ Low Channel

Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF Input Z: 50 Ω #Atten: 30 dB PNO: Fast #Avg Type: Power (RMS) 1 2 3 4 5 6
 Coupling: DC Corrections: Off Gate: Off Avg/Hold: 300/300 M WWW WWW
 Align: Auto Freq Ref: Int (S) NFE: Adaptive IF Gain: Low Sig Track: Off Trig: Free Run P P P P P P

1 Spectrum
 Scale/Div 10 dB Ref Lvl Offset 1.90 dB Mkr5 2.399 965 GHz
 Log Ref Level 20.00 dBm -36.89 dBm
 Start 2.31000 GHz #Video BW 300 kHz Stop 2.40500 GHz
 #Res BW 100 kHz Sweep 3.53 ms (1001 pts)

Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.401 865 GHz	-6.011 dBm		
2	N	1	f	2.400 000 GHz	-36.89 dBm		
3	N	1	f	2.390 000 GHz	-61.36 dBm		
4	N	1	f	2.310 000 GHz	-61.68 dBm		
5	N	1	f	2.399 965 GHz	-36.89 dBm		
6							

Nov 30, 2017 9:01:19 AM

Settings
 Center Frequency 2.357500000 GHz
 Span 95.0000000 MHz
 Start Freq 2.310000000 GHz
 Stop Freq 2.405000000 GHz
 AUTO TUNE
 CF Step 9.500000 MHz
 Freq Offset 0 Hz
 X Axis Scale Log
 Signal Track (Span Zoom)

Hopping disabled_ High Channel

Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF Input Z: 50 Ω #Atten: 30 dB PNO: Best Wide #Avg Type: Power (RMS) 1 2 3 4 5 6
 Coupling: DC Corrections: Off Gate: Off Avg/Hold: 300/300 M WWW WWW
 Align: Auto Freq Ref: Int (S) NFE: Adaptive IF Gain: Low Sig Track: Off Trig: Free Run P P P P P P

1 Spectrum
 Scale/Div 10 dB Ref Lvl Offset 1.90 dB Mkr4 2.495 622 GHz
 Log Ref Level 20.00 dBm -57.25 dBm
 Start 2.47800 GHz #Video BW 300 kHz Stop 2.50000 GHz
 #Res BW 100 kHz Sweep 1.00 ms (1001 pts)

Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.480 046 GHz	-8.952 dBm		
2	N	1	f	2.483 500 GHz	-61.42 dBm		
3	N	1	f	2.500 000 GHz	-62.24 dBm		
4	N	1	f	2.495 622 GHz	-57.25 dBm		
5							
6							

Nov 30, 2017 9:08:24 AM

Settings
 Center Frequency 2.489000000 GHz
 Span 22.0000000 MHz
 Start Freq 2.478000000 GHz
 Stop Freq 2.500000000 GHz
 AUTO TUNE
 CF Step 2.200000 MHz
 Freq Offset 0 Hz
 X Axis Scale Log
 Signal Track (Span Zoom)

Hopping enabled_ Low Channel

Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF Input Z: 50 Ω #Atten: 30 dB PNO: Fast #Avg Type: Power (RMS) 1 2 3 4 5 6
 Coupling: DC Corrections: Off Gate: Off Avg/Hold: 300/300 M W W W W W W W
 Align: Auto Freq Ref: Int (S) IF Gain: Low Trig: Free Run P P P P P P
 NFE: Adaptive Sig Track: Off

Center Frequency: 2.357500000 GHz

Span: 95.0000000 MHz
 Swept Span
 Zero Span

Full Span

Start Freq: 2.310000000 GHz

Stop Freq: 2.405000000 GHz

AUTO TUNE

CF Step: 9.500000 MHz
 Auto
 Man

Freq Offset: 0 Hz

X Axis Scale: Log
 Lin

Signal Track (Span Zoom)

Settings

Prototype Limited Sale Allowed

1 Spectrum

Scale/Div 10 dB

Ref Lvl Offset 1.90 dB
 Ref Level 20.00 dBm

Mkr5 2.399 965 GHz
 -37.24 dBm

Start 2.31000 GHz #Video BW 300 kHz Stop 2.40500 GHz
 #Res BW 100 kHz Sweep 3.53 ms (1001 pts)

5 Marker Table

Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.405 000 GHz	-6.928 dBm		
2	N	1	f	2.400 000 GHz	-37.24 dBm		
3	N	1	f	2.390 000 GHz	-62.70 dBm		
4	N	1	f	2.310 000 GHz	-62.91 dBm		
5	N	1	f	2.399 965 GHz	-37.24 dBm		
6							

Nov 30, 2017 9:16:10 AM

Hopping enabled_ High Channel

Spectrum Analyzer 1
Swept SA

KEYSIGHT Input: RF Input Z: 50 Ω #Atten: 30 dB PNO: Best Wide #Avg Type: Power (RMS) 1 2 3 4 5 6
 Coupling: DC Corrections: Off Gate: Off Avg/Hold: 300/300 M W W W W W W W
 Align: Auto Freq Ref: Int (S) IF Gain: Low Trig: Free Run P P P P P P
 NFE: Adaptive Sig Track: Off

Center Frequency: 2.489000000 GHz

Span: 22.0000000 MHz
 Swept Span
 Zero Span

Full Span

Start Freq: 2.478000000 GHz

Stop Freq: 2.500000000 GHz

AUTO TUNE

CF Step: 2.200000 MHz
 Auto
 Man

Freq Offset: 0 Hz

X Axis Scale: Log
 Lin

Signal Track (Span Zoom)

Settings

Prototype Limited Sale Allowed

1 Spectrum

Scale/Div 10 dB

Ref Lvl Offset 1.90 dB
 Ref Level 20.00 dBm

Mkr4 2.486 250 GHz
 -59.29 dBm

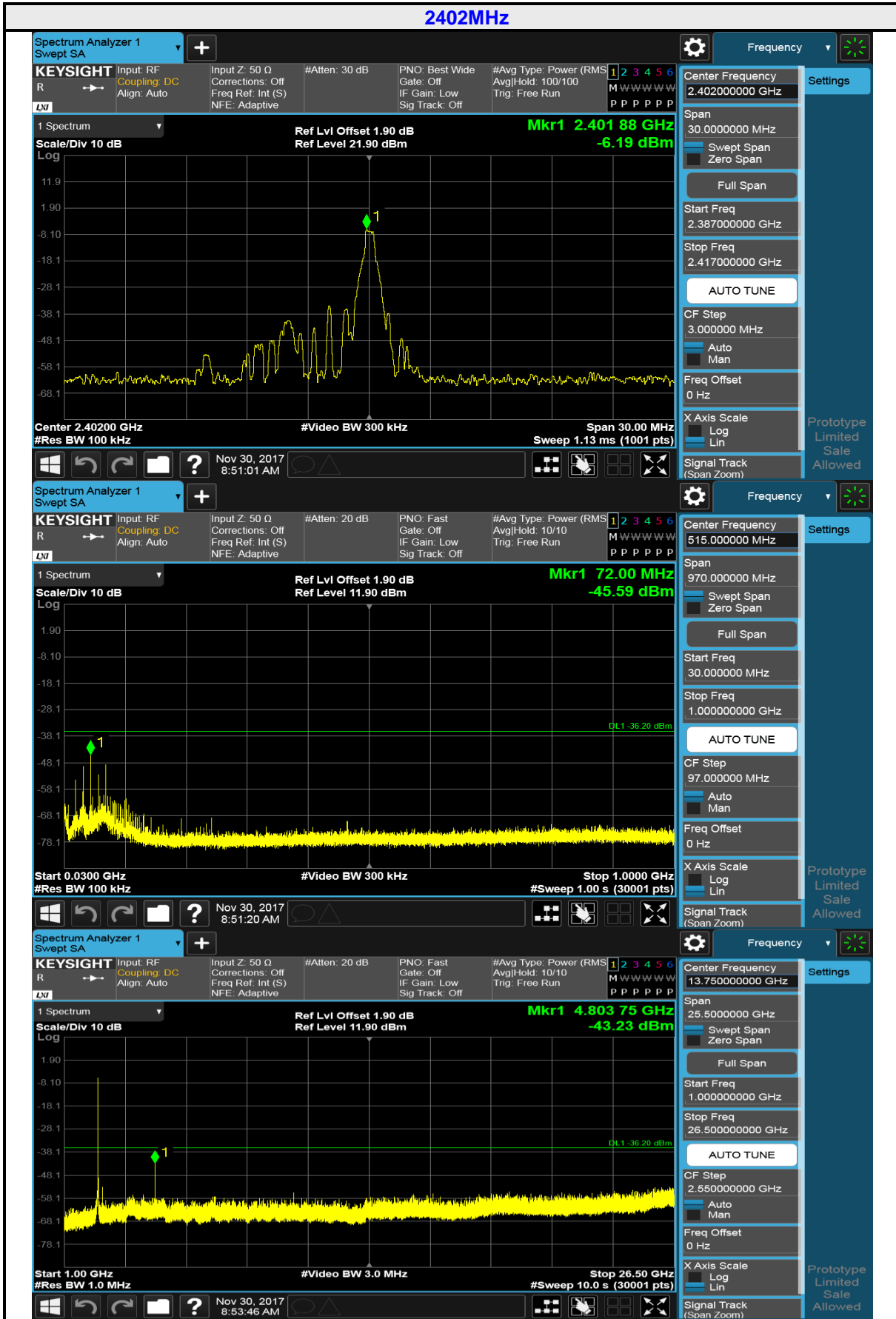
Start 2.47800 GHz #Video BW 300 kHz Stop 2.50000 GHz
 #Res BW 100 kHz Sweep 1.00 ms (1001 pts)

5 Marker Table

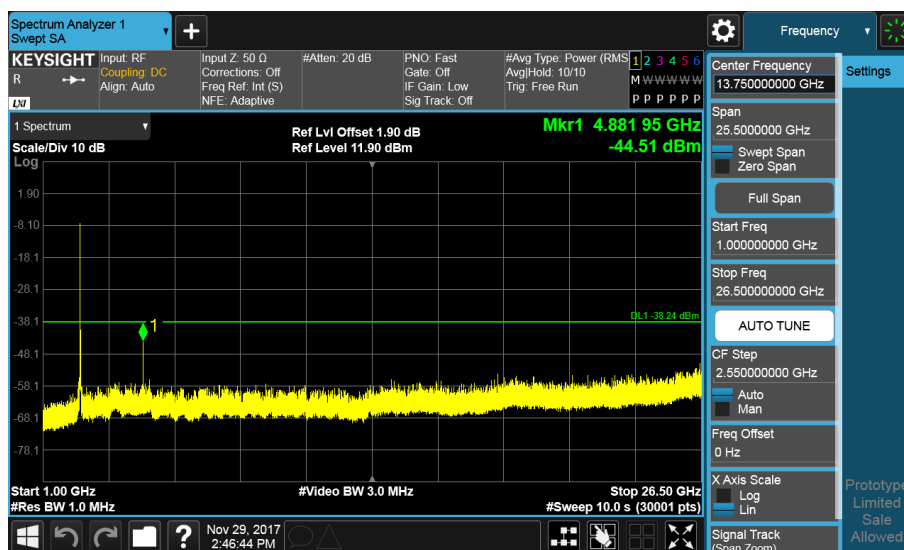
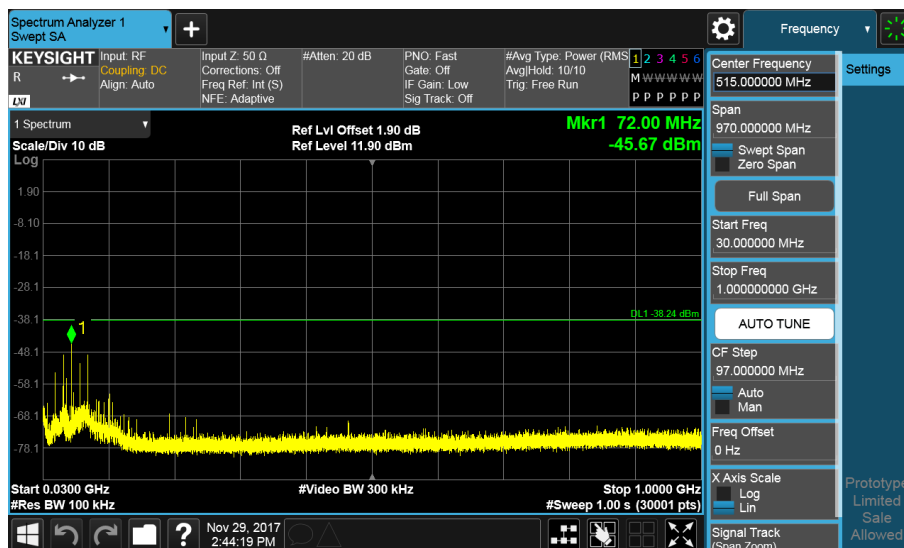
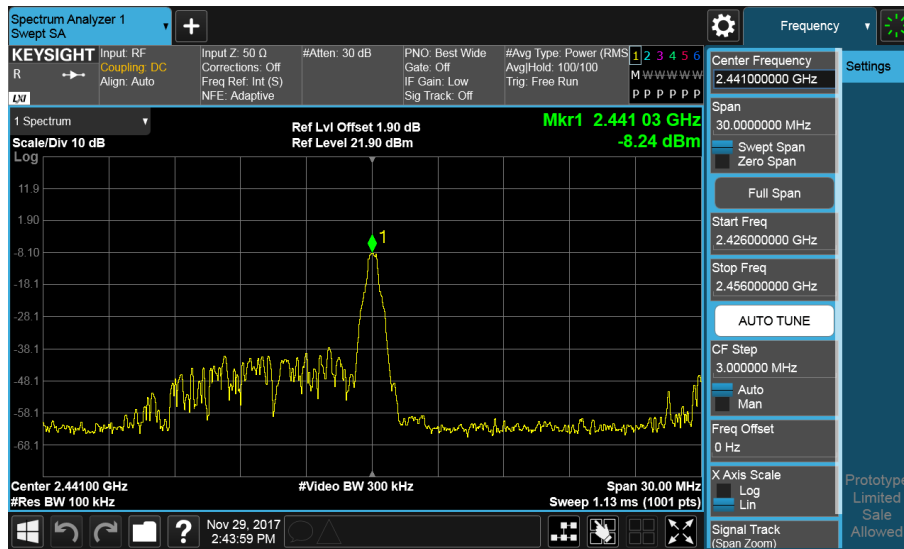
Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	N	1	f	2.478 682 GHz	-13.45 dBm		
2	N	1	f	2.483 500 GHz	-62.09 dBm		
3	N	1	f	2.500 000 GHz	-61.76 dBm		
4	N	1	f	2.486 250 GHz	-59.29 dBm		
5							
6							

Nov 30, 2017 9:16:27 AM

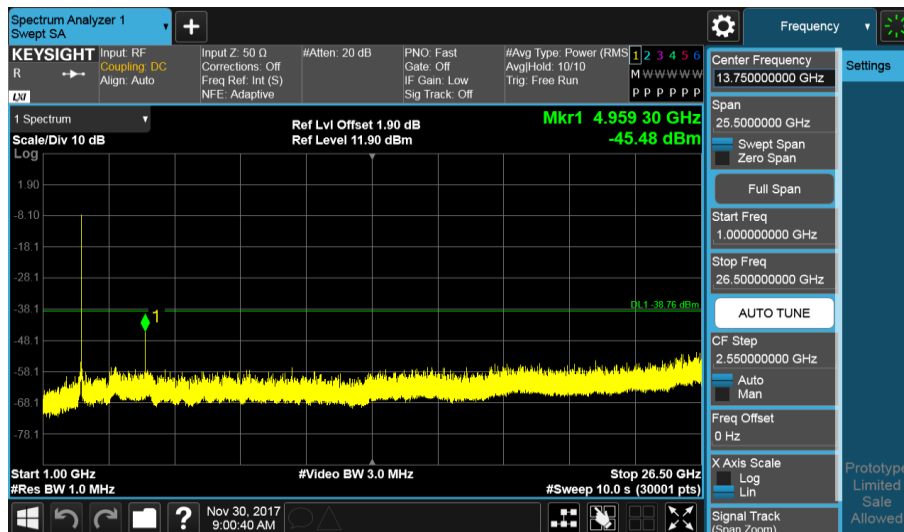
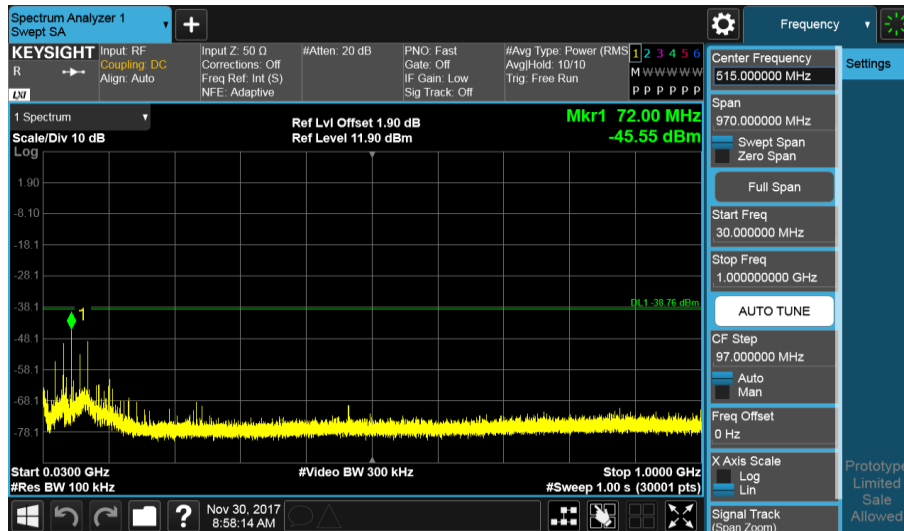
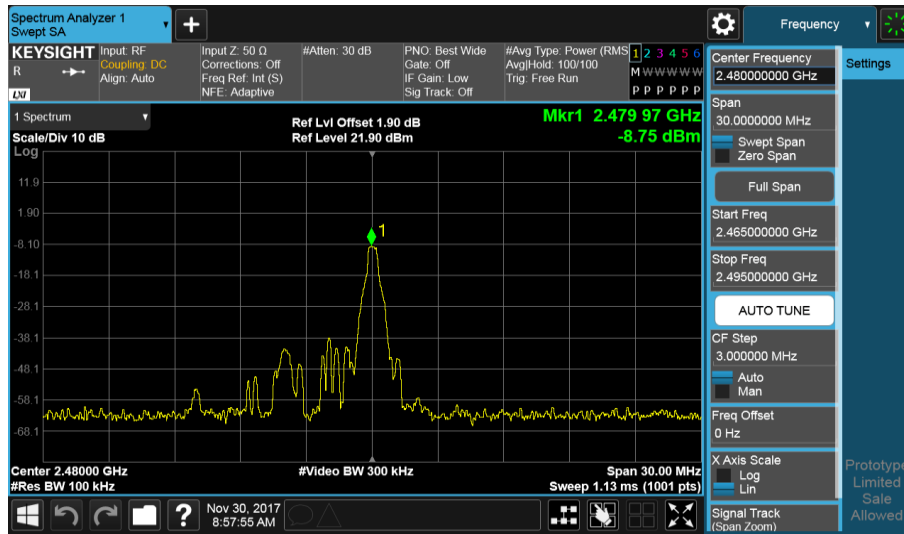
Out of Band Emission GFSK



2441MHz

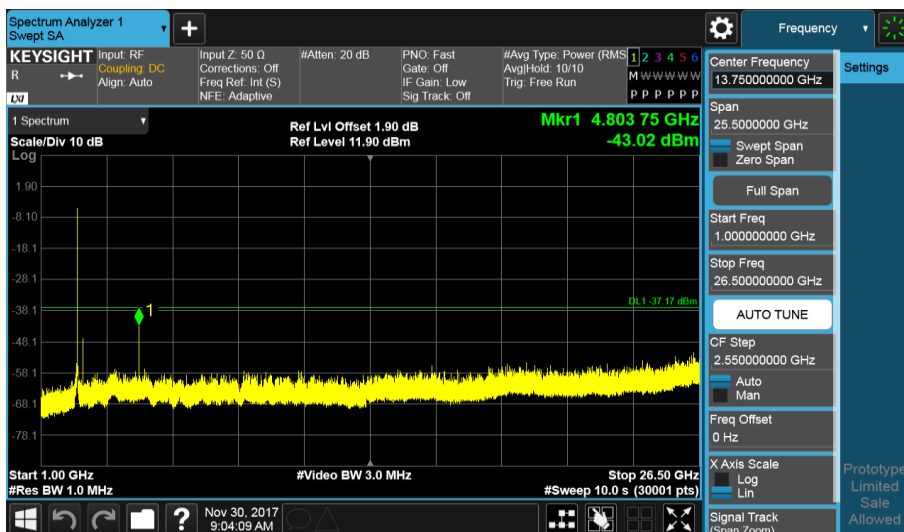
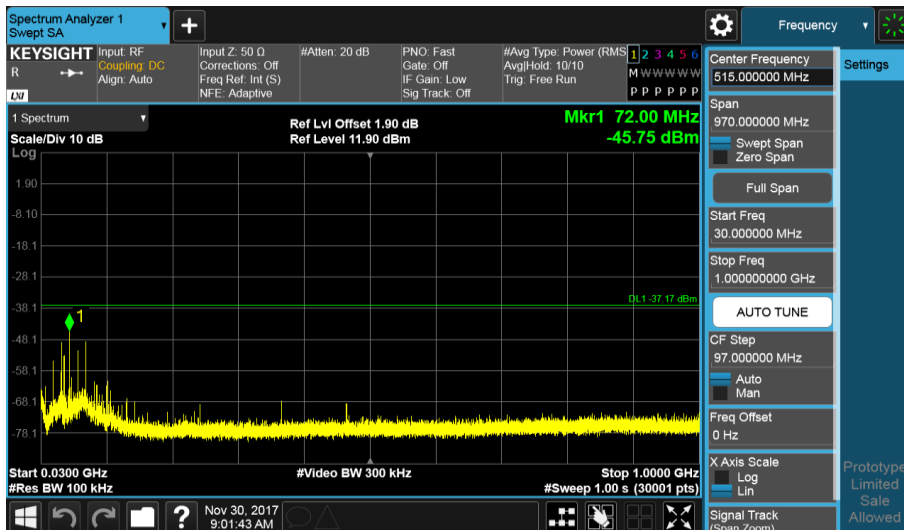
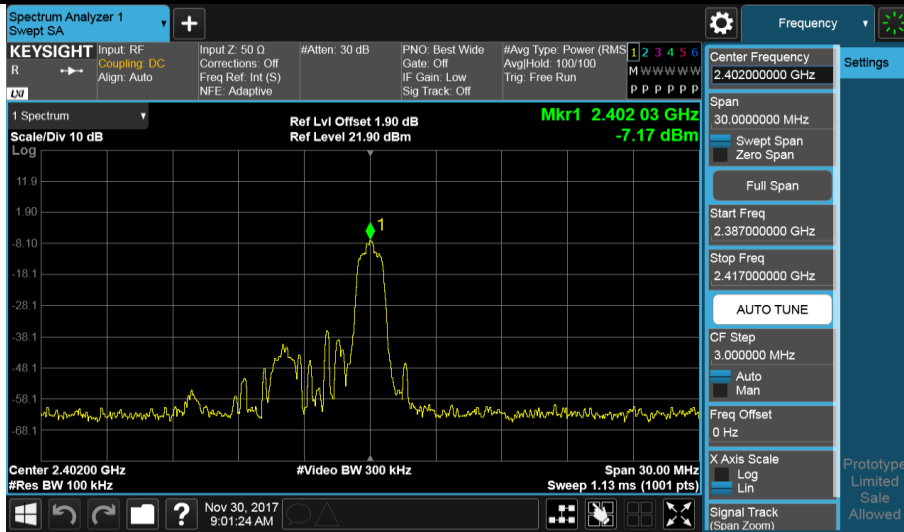


2480MHz

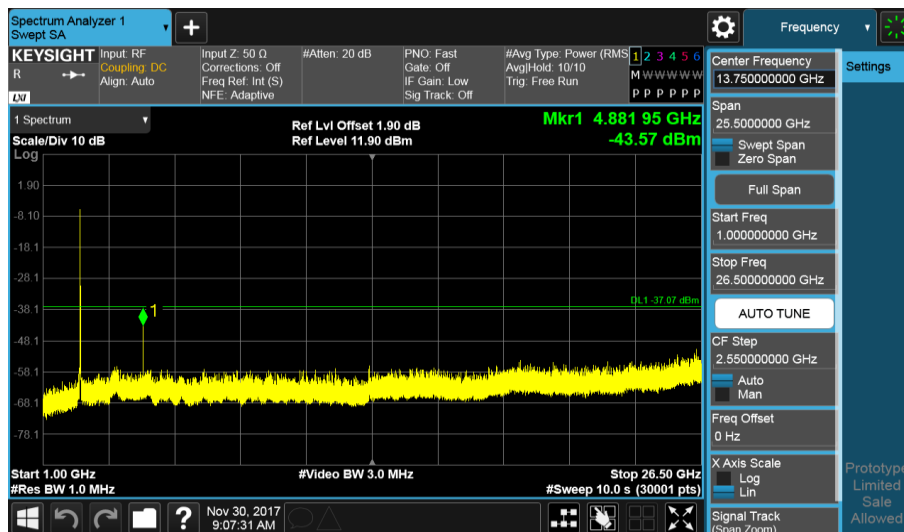
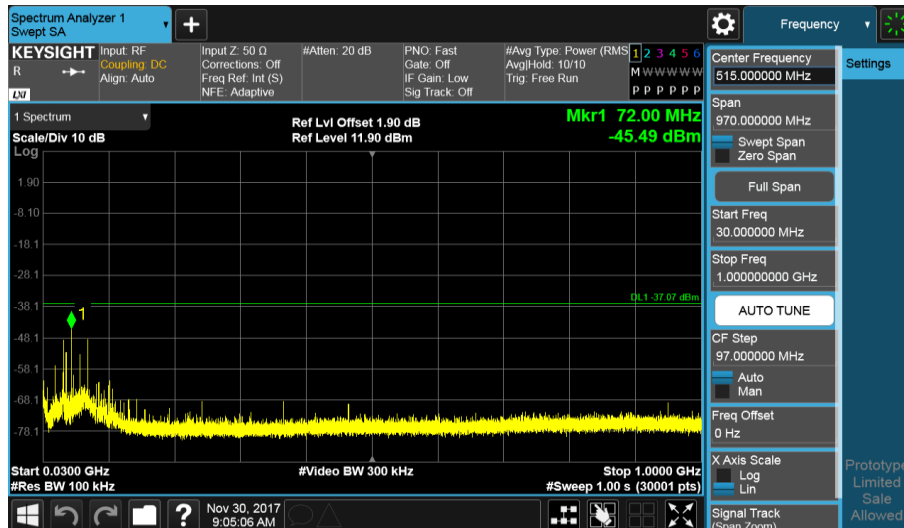
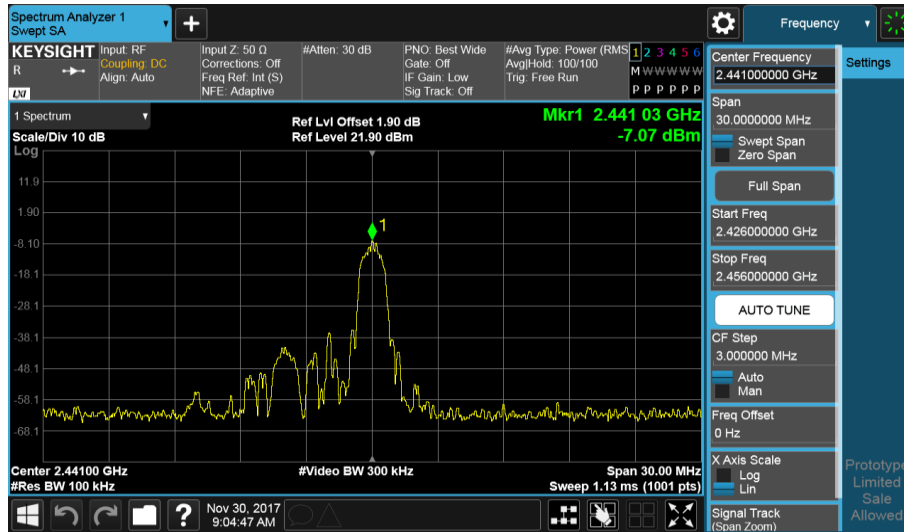


$\pi/4$ DQPSK

2402MHz



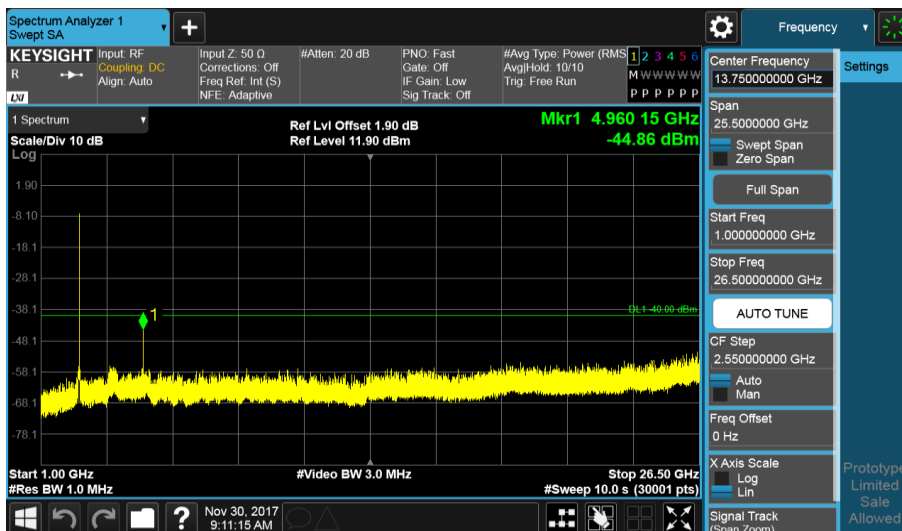
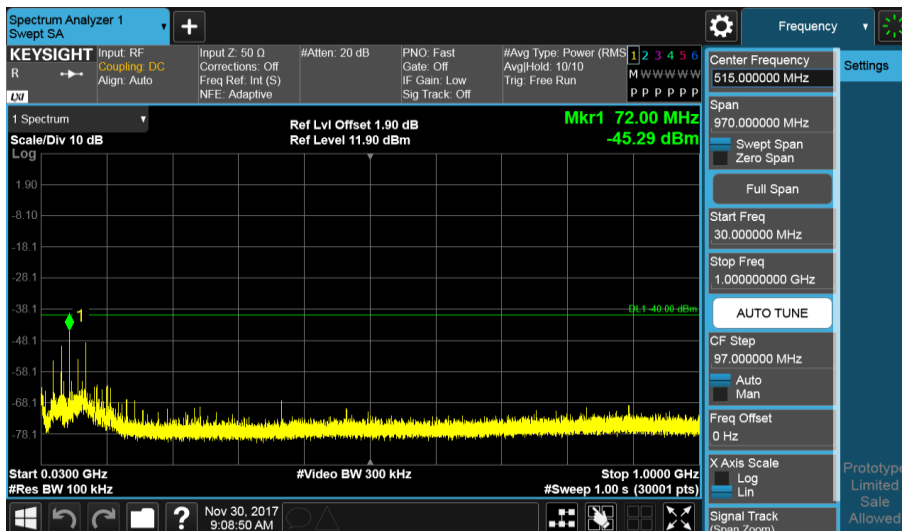
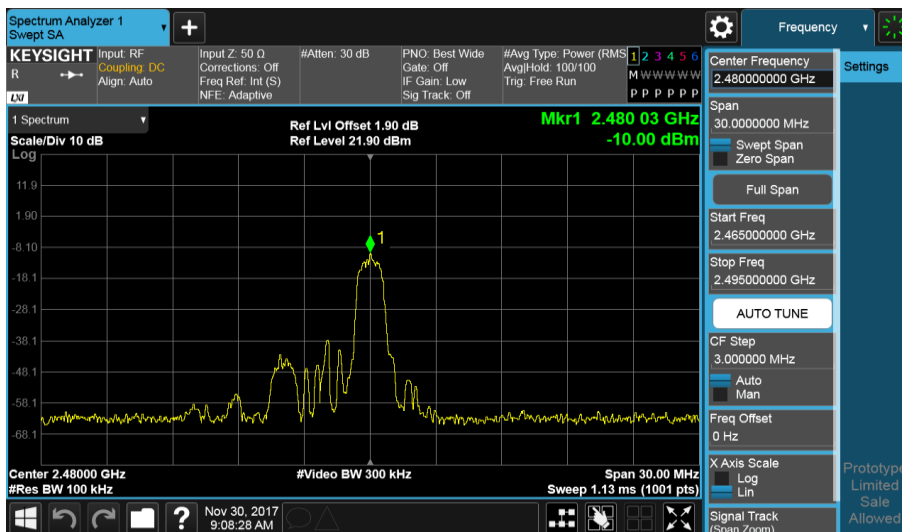
2441MHz





BUREAU
VERITAS

2480MHz



4.8 Radiated Emission Measurement

4.8.1 Limits

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

Frequencies (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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.8.2 Test Procedures

For Radiated emission below 30MHz

- a. The EUT was placed on the top of a board 10cm above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Both X and Y axes of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotate table was turned from 0 degree to 360 degree to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Note:

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a board 10cm above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

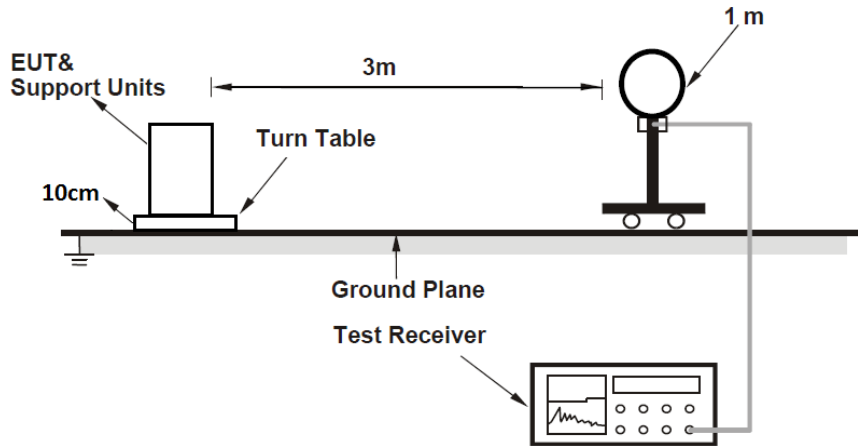
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for RMS Average (Duty cycle < 98 %) for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle \geq 98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

4.8.3 Deviation from Test Standard

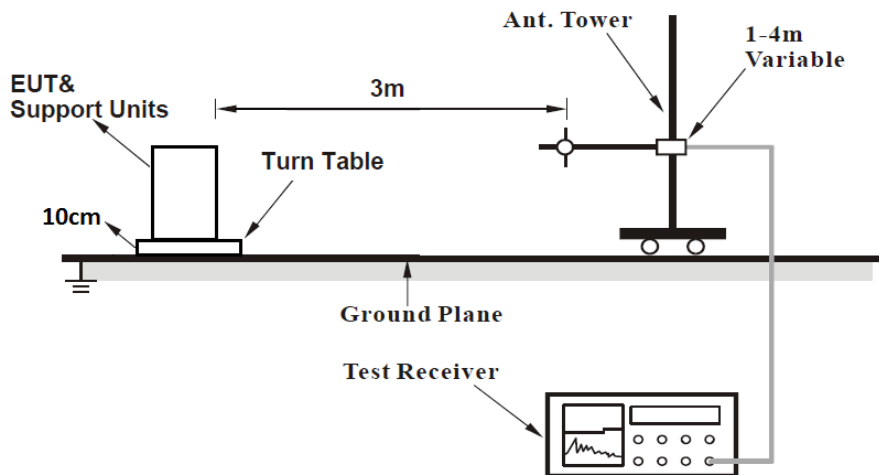
No deviation.

4.8.4 Test Setup

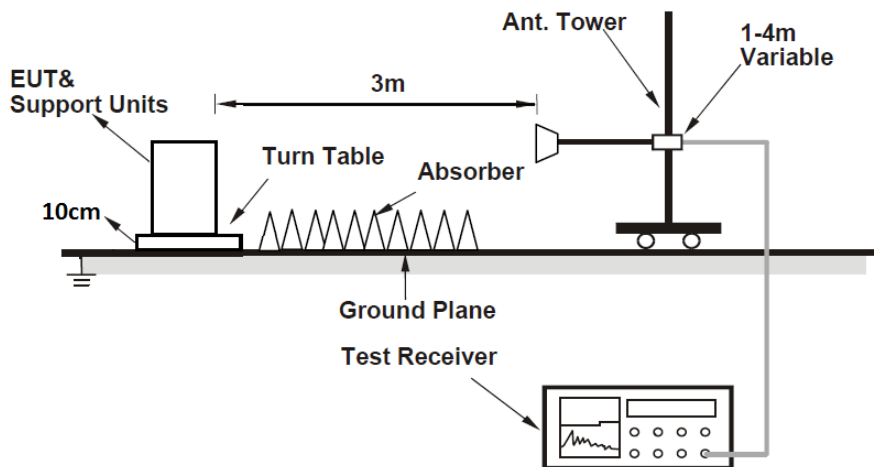
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.8.5 EUT Operating Conditions

- a. Placed the EUT on a testing table.
- b. Use the software to control the EUT under transmission condition continuously at specific channel frequency.

4.8.6 Test Results

Radiated Emissions Range 9kHz~30MHz

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

Radiated Emissions Range 30MHz~1GHz

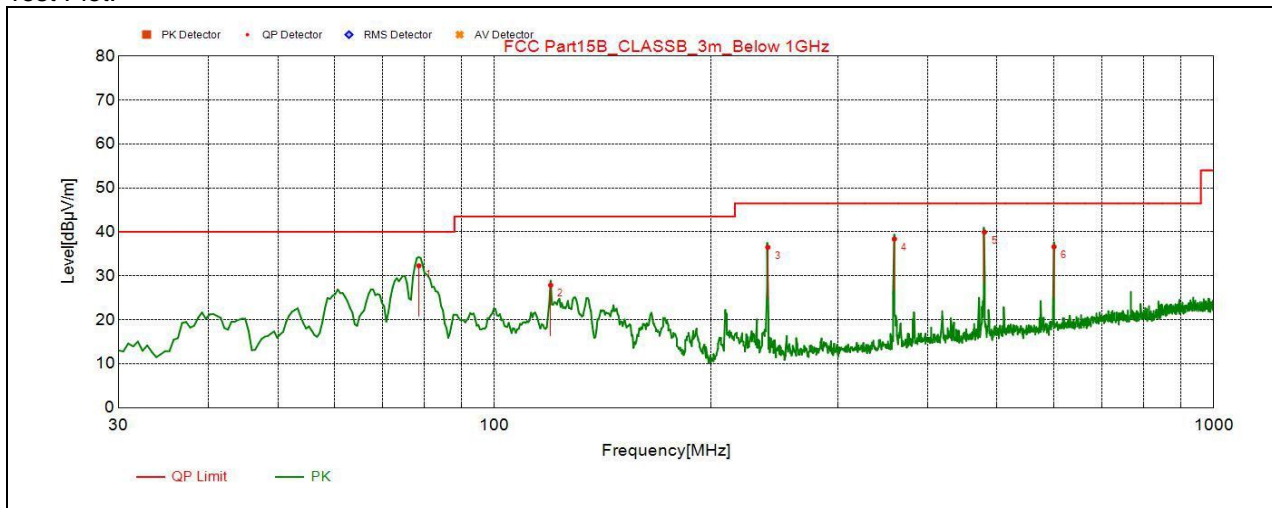
Channel	TX Channel 0	Detector Function	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	Antenna Polarity	Horizontal

Spurious Emission Level					
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)
1	78.500	32.29	40	-7.71	-18.68
2	119.72	27.89	43.5	-15.61	-17.58
3	240.00	36.50	46.5	-10.00	-16.14
4	359.80	38.39	46.5	-8.11	-13
5	480.08	39.96	46.5	-6.54	-11.09
6	599.87	36.61	46.5	-9.89	-9.31

REMARKS:

1. Emission Level(dBuV/m) = Spectrum reading (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

Test Plot:



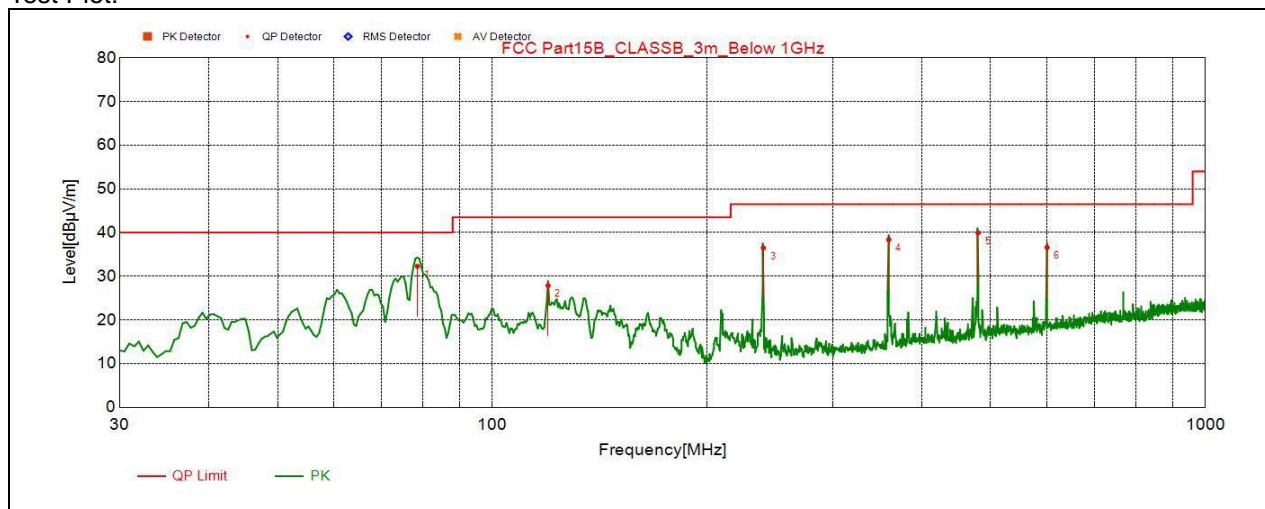
Channel	TX Channel 0	Detector Function	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	Antenna Polarity	Vertical

Spurious Emission Level					
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)
1	78.500	32.29	40	-7.71	-18.68
2	119.72	27.89	43.5	-15.61	-17.58
3	240.00	36.50	46.5	-10.00	-16.14
4	359.80	38.39	46.5	-8.11	-13
5	480.08	39.96	46.5	-6.54	-11.09
6	599.87	36.61	46.5	-9.89	-9.31

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (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

Test Plot:



Radiated Emission Range 1GHz~10th Harmonic
GFSK

Channel	TX Channel 0	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4804.00	51.58	74.00	-22.42	4.38	H	PK
2	4804.00	39.67	54.00	-14.33	4.38	H	AV
3	4804.00	40.15	54.00	-13.85	4.38	V	PK
4	4804.00	52.45	74.00	-21.55	4.38	V	AV

Channel	TX Channel 40	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4884.00	51.84	74.00	-22.16	4.54	H	PK
2	4884.00	39.85	54.00	-14.15	4.54	H	AV
3	4884.00	52.88	74.00	-21.12	4.54	V	PK
4	4884.00	40.46	54.00	-13.54	4.54	V	AV

Channel	TX Channel 78	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4960.00	39.94	54.00	-14.06	4.72	H	PK
2	4960.00	51.51	74.00	-22.49	4.72	H	AV
3	4960.00	52.27	74.00	-21.73	4.72	V	PK
4	4960.00	40.4	54.00	-13.60	4.72	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (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

π/4DQPSK

Channel	TX Channel 0	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4804.00	51.28	74.00	-22.72	4.38	H	PK
2	4804.00	39.22	54.00	-14.78	4.38	H	AV
3	4804.00	52.04	74.00	-21.96	4.38	V	PK
4	4804.00	39.48	54.00	-14.52	4.38	V	AV

Channel	TX Channel 40	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4884.00	49.88	74.00	-24.12	4.54	H	PK
2	4884.00	37.29	54.00	-16.71	4.54	H	AV
3	4884.00	51.12	74.00	-22.88	4.54	V	PK
4	4884.00	39.25	54.00	-14.75	4.54	V	AV

Channel	TX Channel 78	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	4960.00	51.23	74.00	-22.77	4.72	H	PK
2	4960.00	39.94	54.00	-14.06	4.72	H	AV
3	4960.00	52.26	74.00	-21.74	4.72	V	PK
4	4960.00	40.17	54.00	-13.83	4.72	V	AV

REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (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



**BUREAU
VERITAS**

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

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