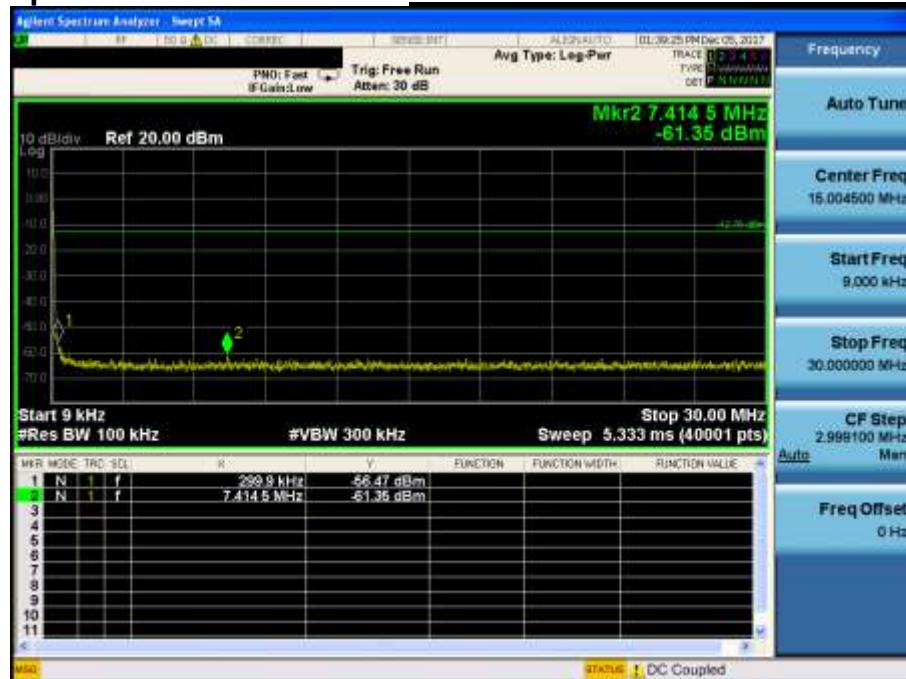


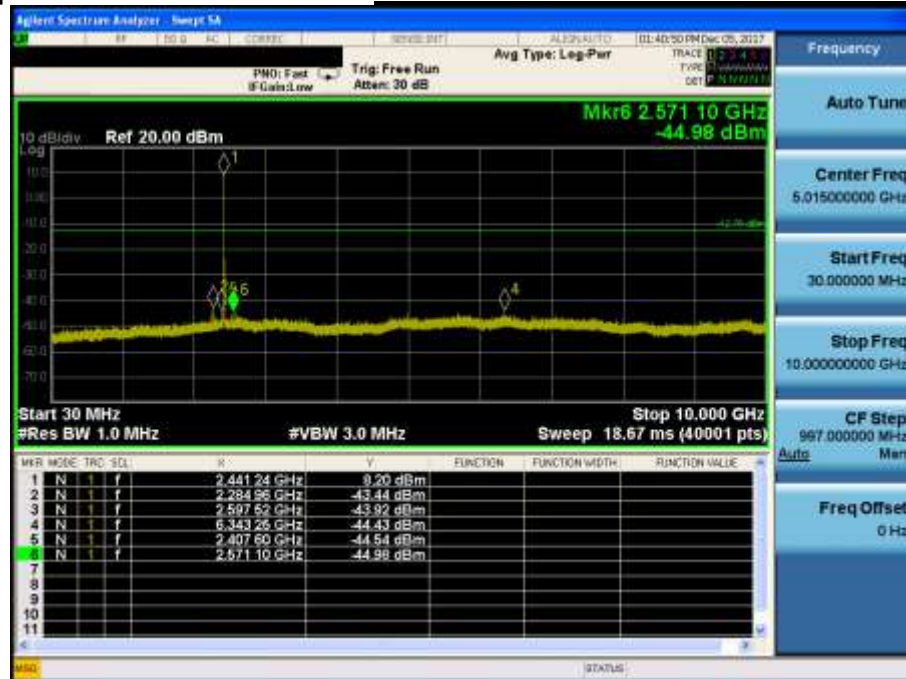
## Reference for limit

Middle Channel & Modulation : GFSK

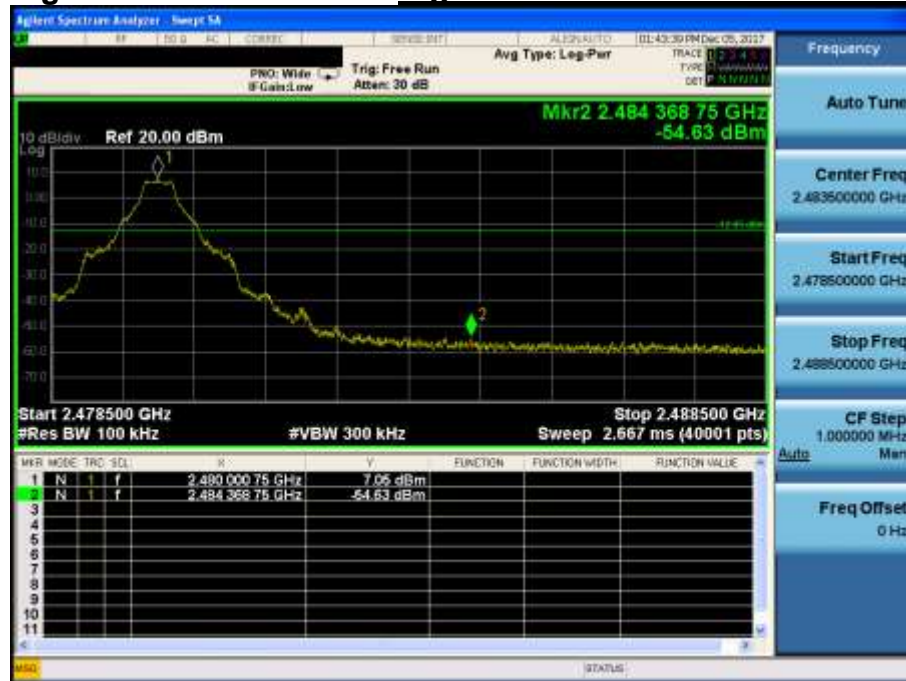
## Conducted Spurious Emissions

Middle Channel & Modulation : GFSK

## Conducted Spurious Emissions

Middle Channel & Modulation : GFSK

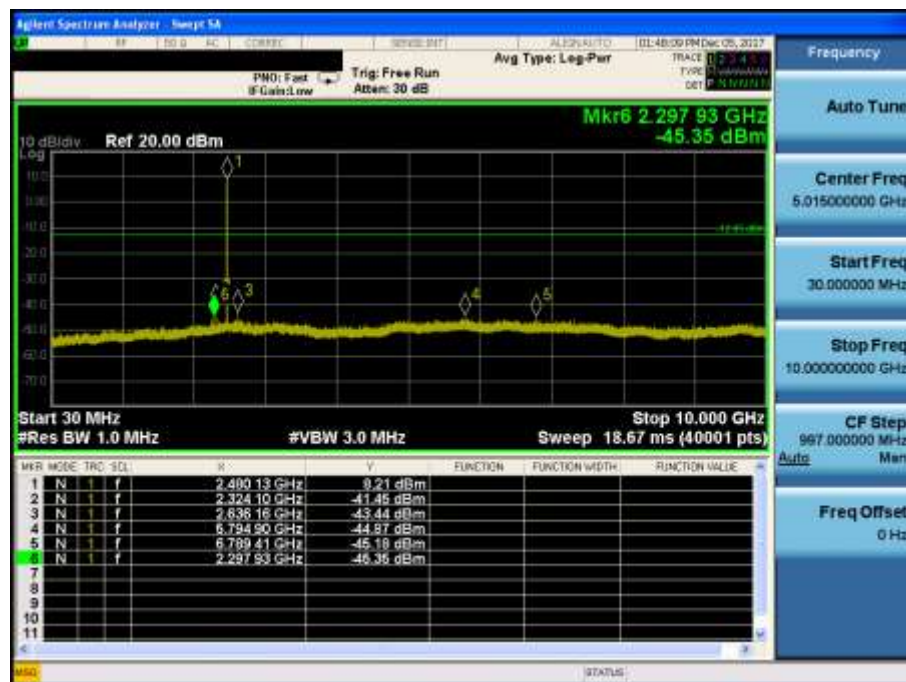
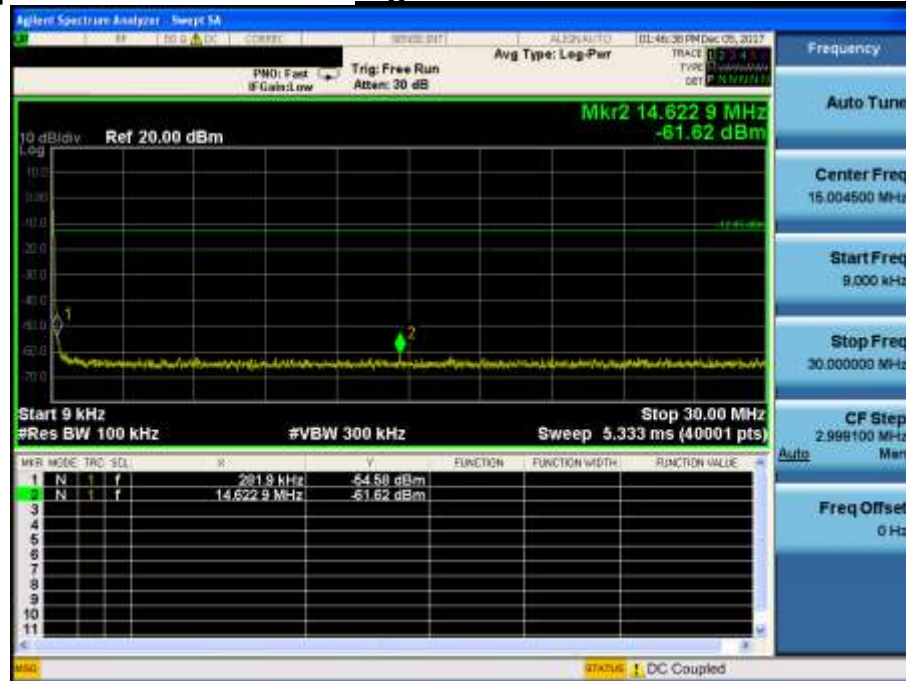
High Band-edge

Highest Channel & Modulation : GFSK

High Band-edge

Hopping mode & Modulation : GFSK

# Conducted Spurious Emissions *Highest Channel & Modulation : GFSK*





## Conducted Spurious Emissions *Highest Channel & Modulation : GFSK*



Low Band-edge

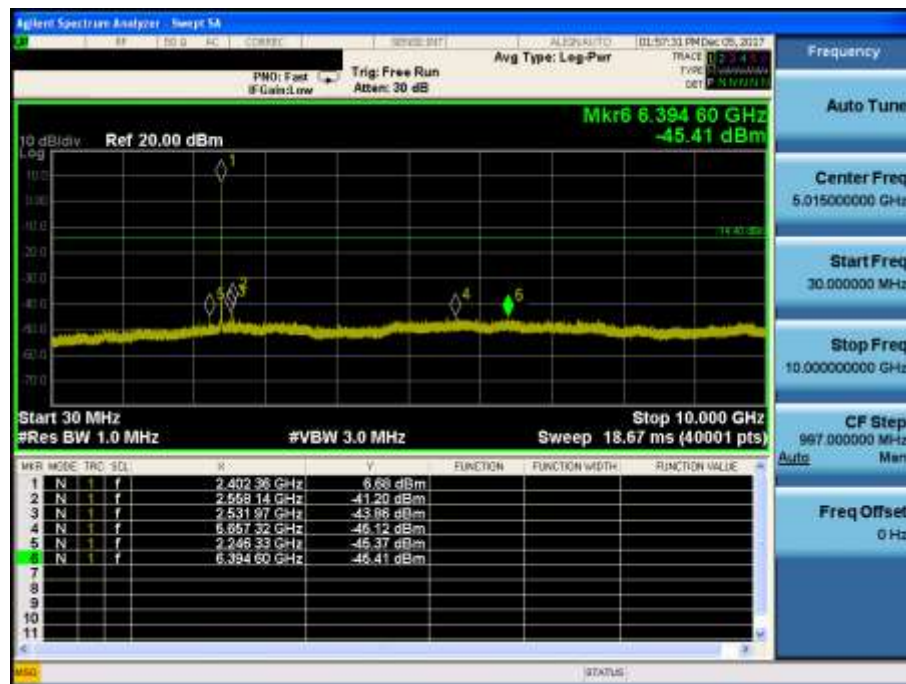
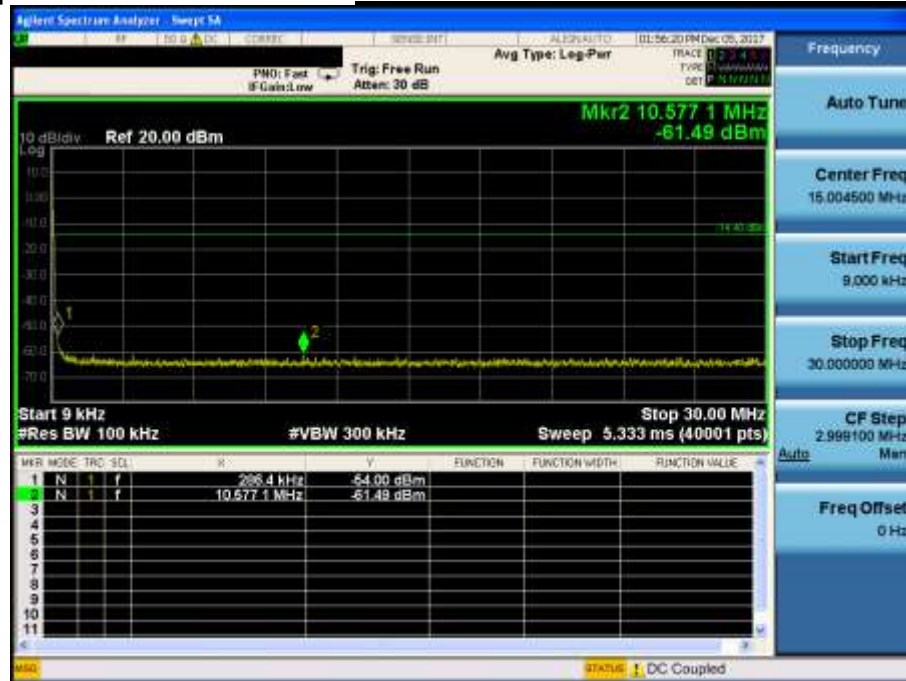
Lowest Channel & Modulation :  $\pi/4$ DQPSK



Low Band-edge

Hopping mode & Modulation :  $\pi/4$ DQPSK



**Conducted Spurious Emissions**      ***Lowest Channel & Modulation :  $\pi/4$ DQPSK***

# Conducted Spurious Emissions Lowest Channel & Modulation : $\pi/4$ DQPSK

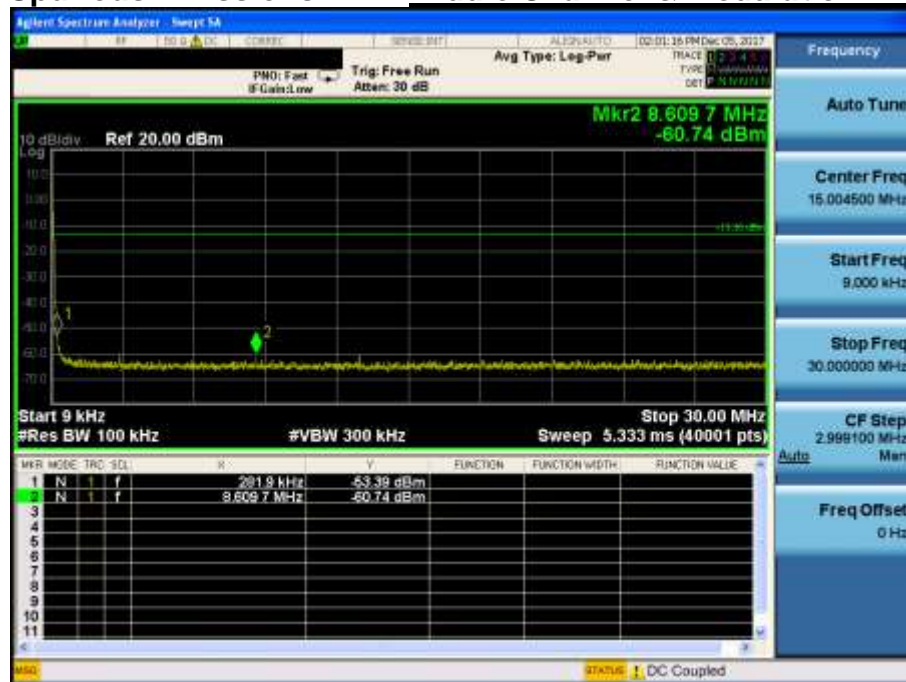


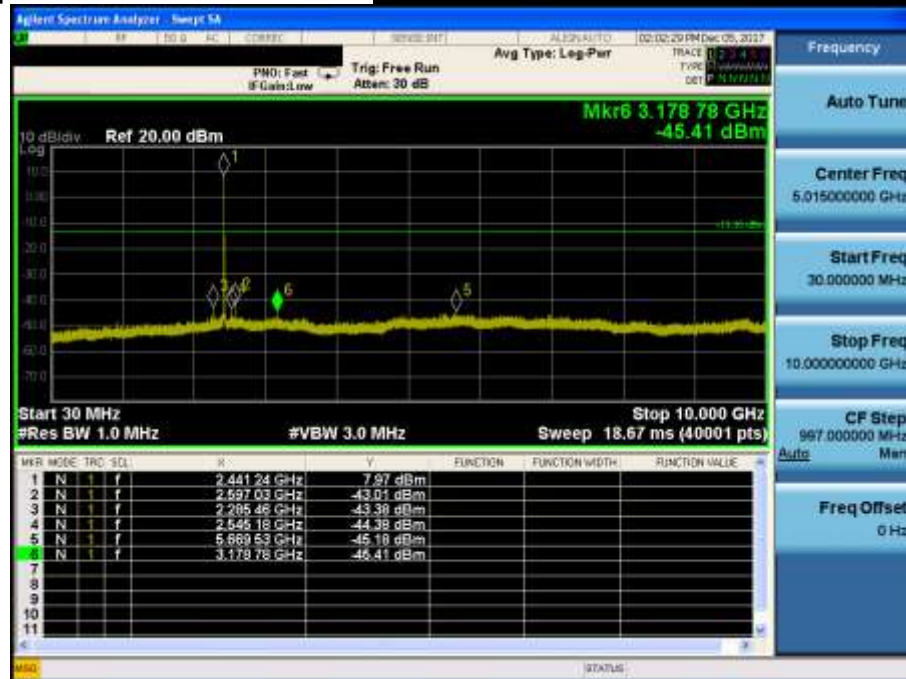


## Reference for limit

Middle Channel & Modulation :  $\pi/4$ DQPSK

## Conducted Spurious Emissions

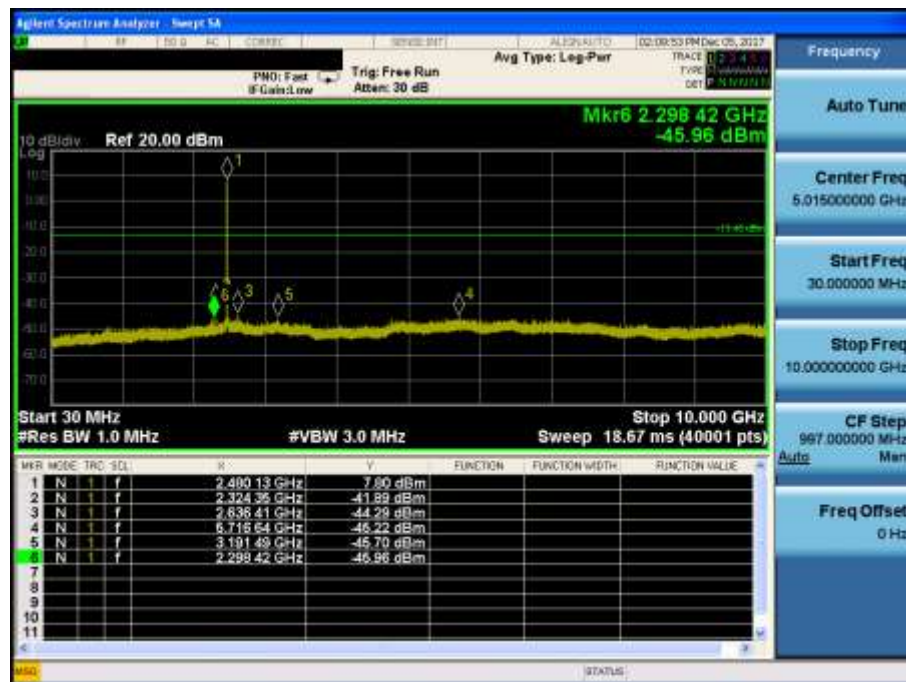
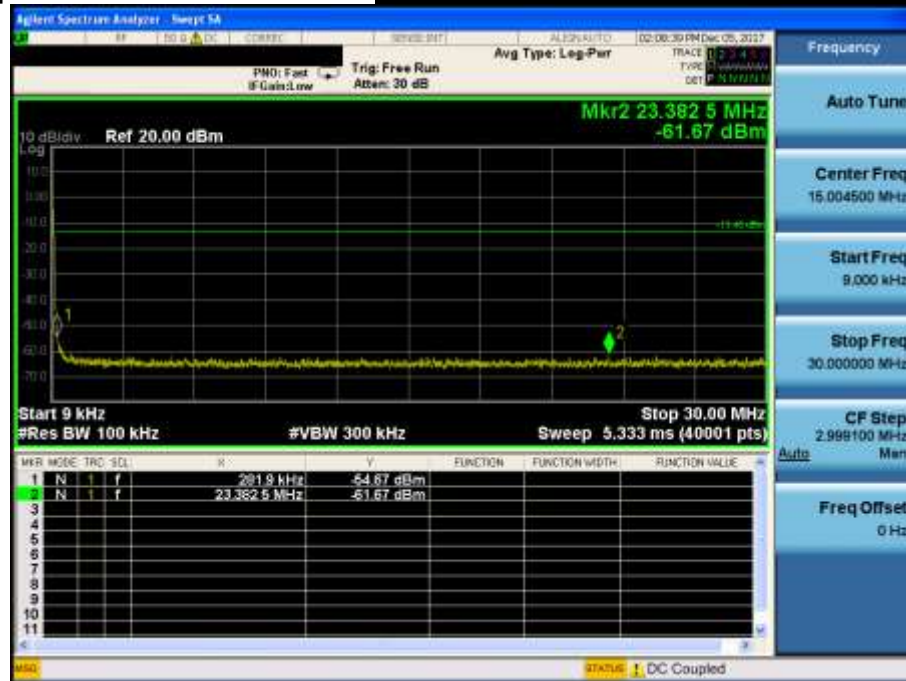
Middle Channel & Modulation :  $\pi/4$ DQPSK

**Conducted Spurious Emissions** *Middle Channel & Modulation :  $\pi/4$ DQPSK*

**High Band-edge*****Highest Channel & Modulation :  $\pi/4$ DQPSK*****High Band-edge*****Hopping mode & Modulation :  $\pi/4$ DQPSK***

## Conducted Spurious Emissions

## Highest Channel & Modulation : $\pi/4$ DQPSK





## Conducted Spurious Emissions

Highest Channel & Modulation :  $\pi/4$ DQPSK

## Low Band-edge

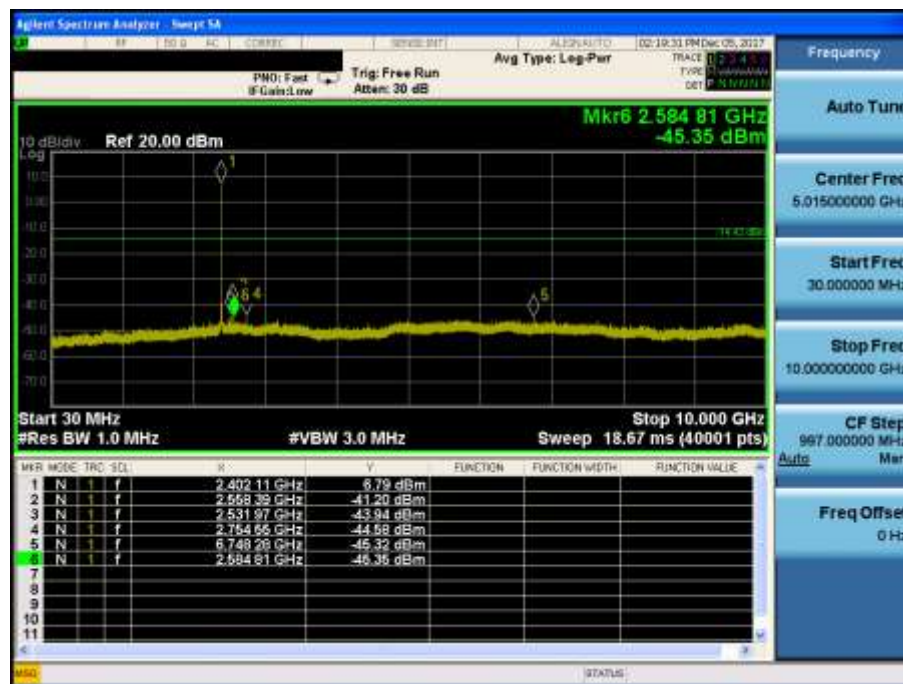
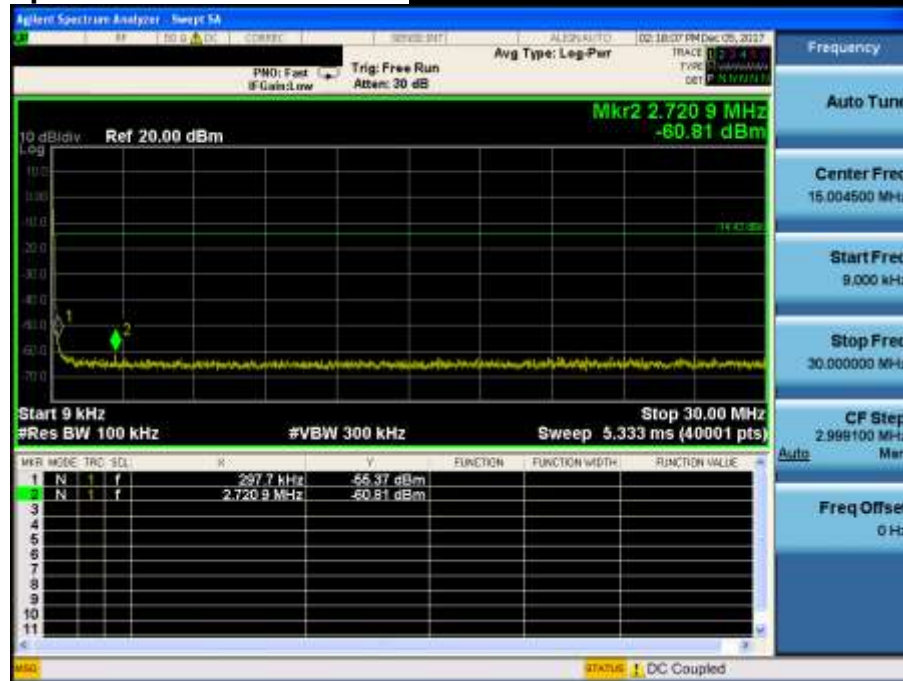
Lowest Channel & Modulation : 8DPSK

## Low Band-edge

Hopping mode & Modulation : 8DPSK

## Conducted Spurious Emissions

## Lowest Channel & Modulation : 8DPSK



## Conducted Spurious Emissions

## Lowest Channel & Modulation : 8DPSK

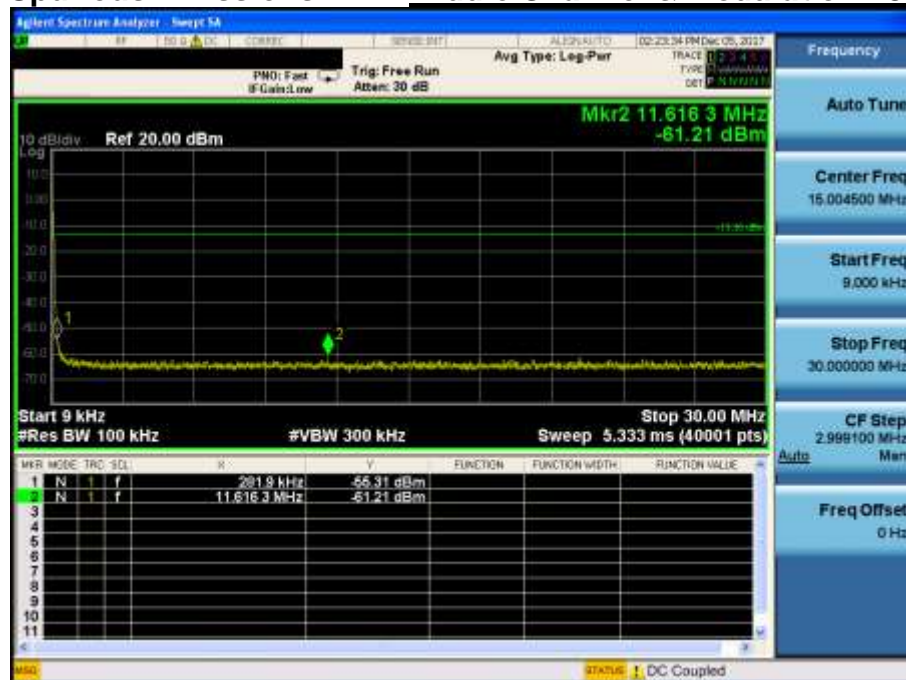




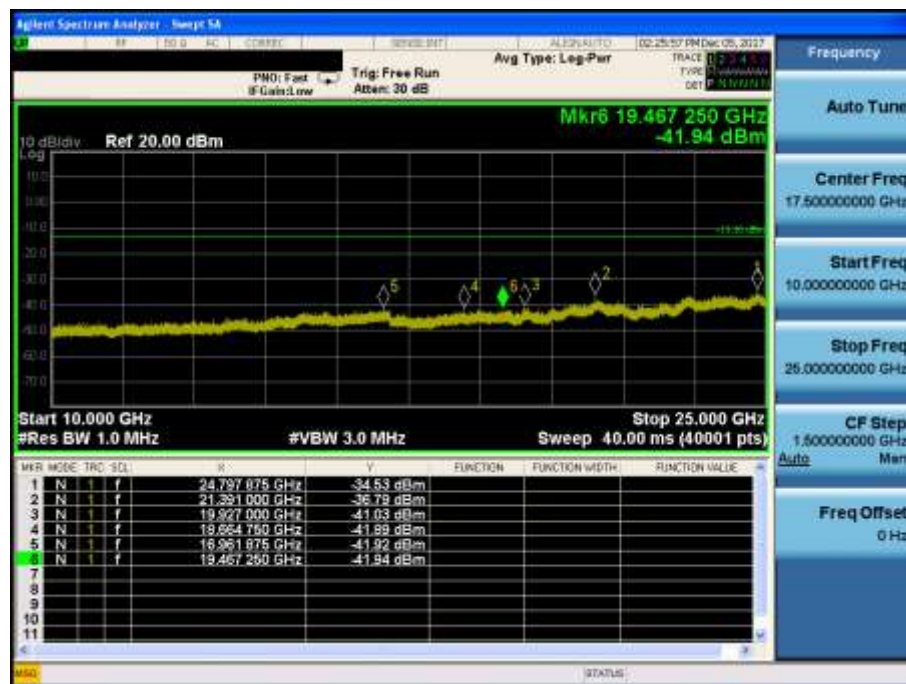
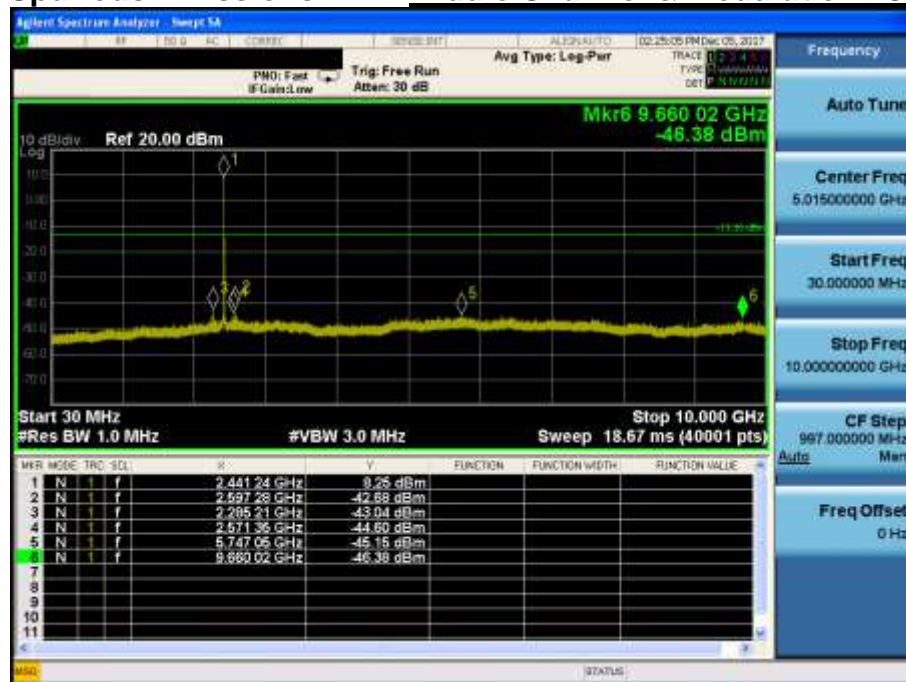
## Reference for limit

Middle Channel & Modulation : 8DPSK

## Conducted Spurious Emissions

Middle Channel & Modulation : 8DPSK

## Conducted Spurious Emissions

Middle Channel & Modulation : 8DPSK

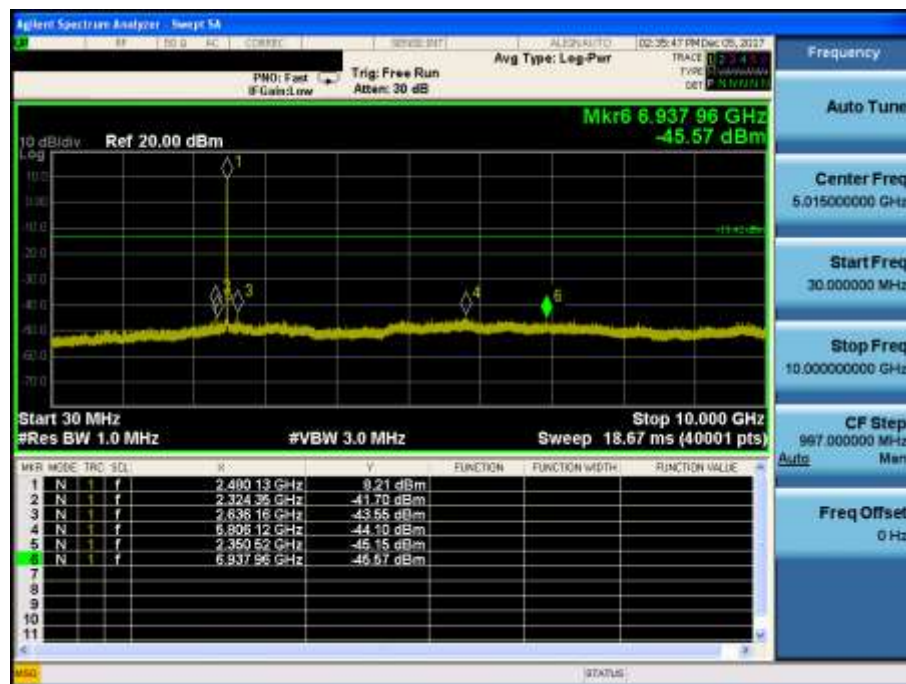
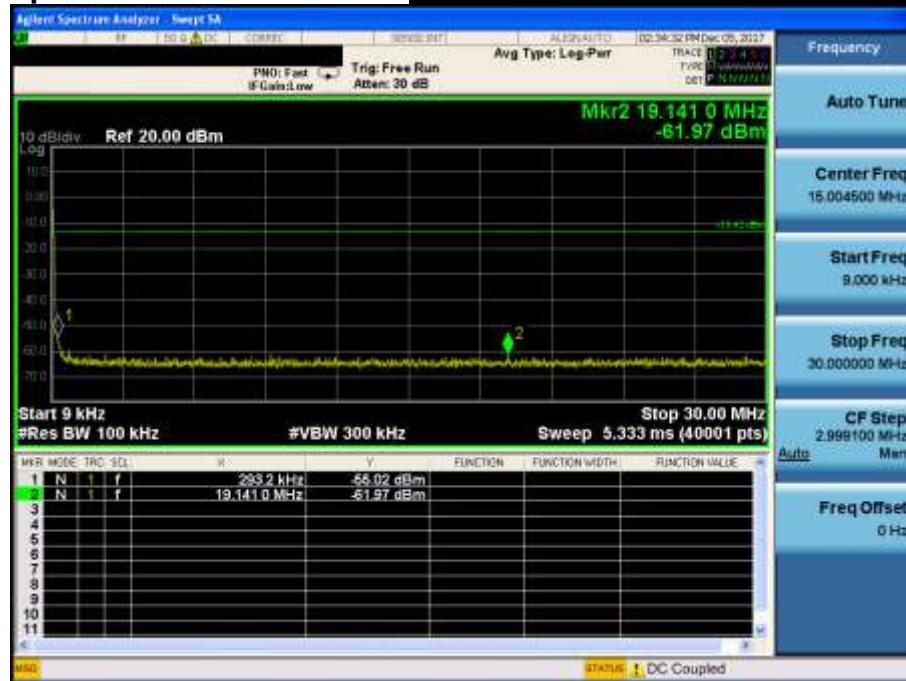
## High Band-edge

Highest Channel & Modulation : 8DPSK

## High Band-edge

Hopping mode & Modulation : 8DPSK

## Conducted Spurious Emissions

Highest Channel & Modulation : 8DPSK



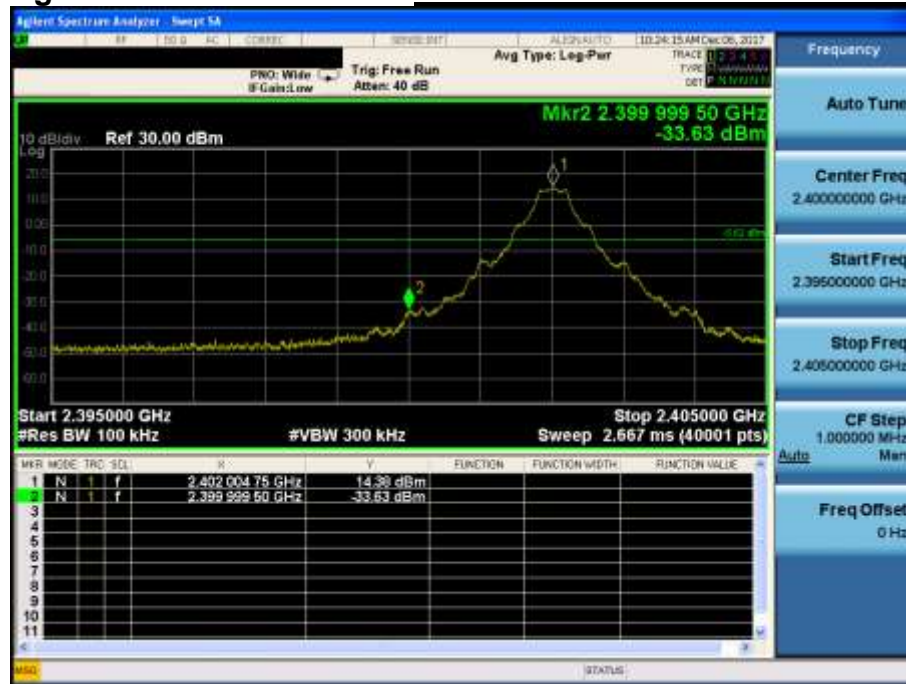
# Conducted Spurious Emissions

## Highest Channel & Modulation : 8DPSK



## &lt;Module 2&gt;

## Low Band-edge

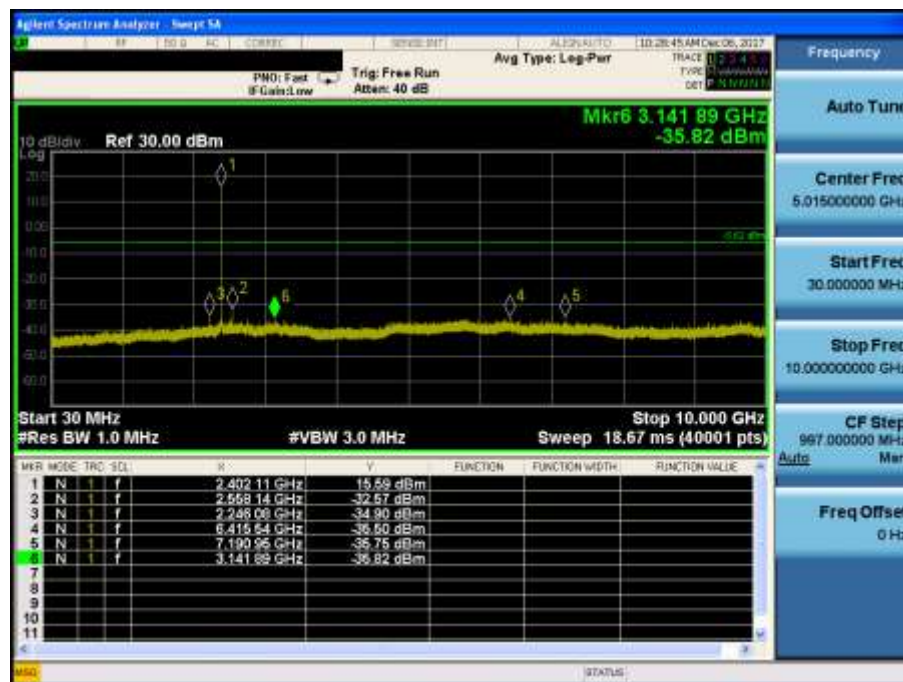
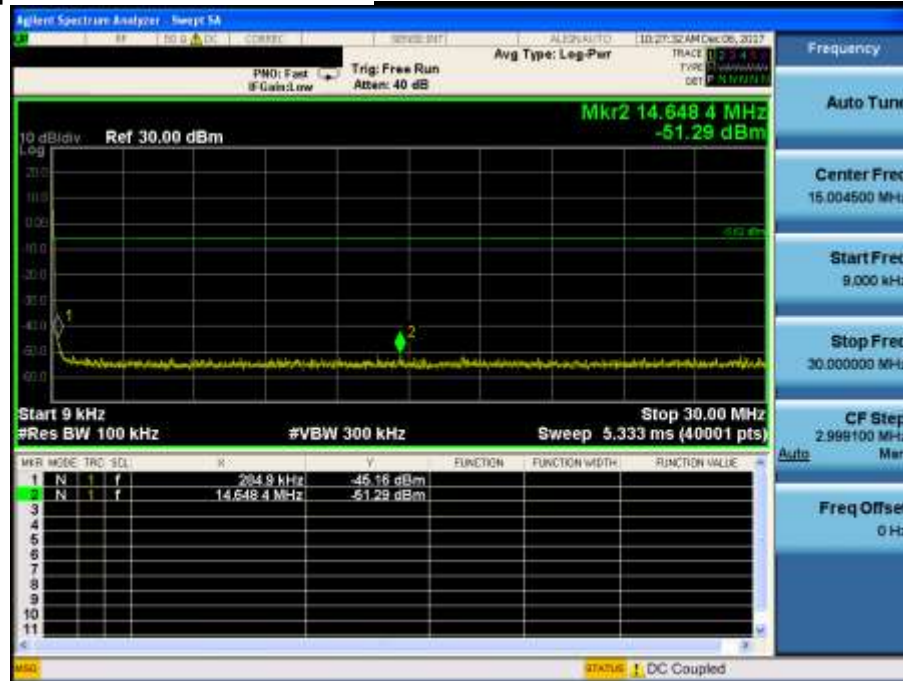
Lowest Channel & Modulation : GFSK

## Low Band-edge

Hopping mode & Modulation : GFSK

## Conducted Spurious Emissions

## Lowest Channel & Modulation : GFSK



# Conducted Spurious Emissions Lowest Channel & Modulation : GFSK

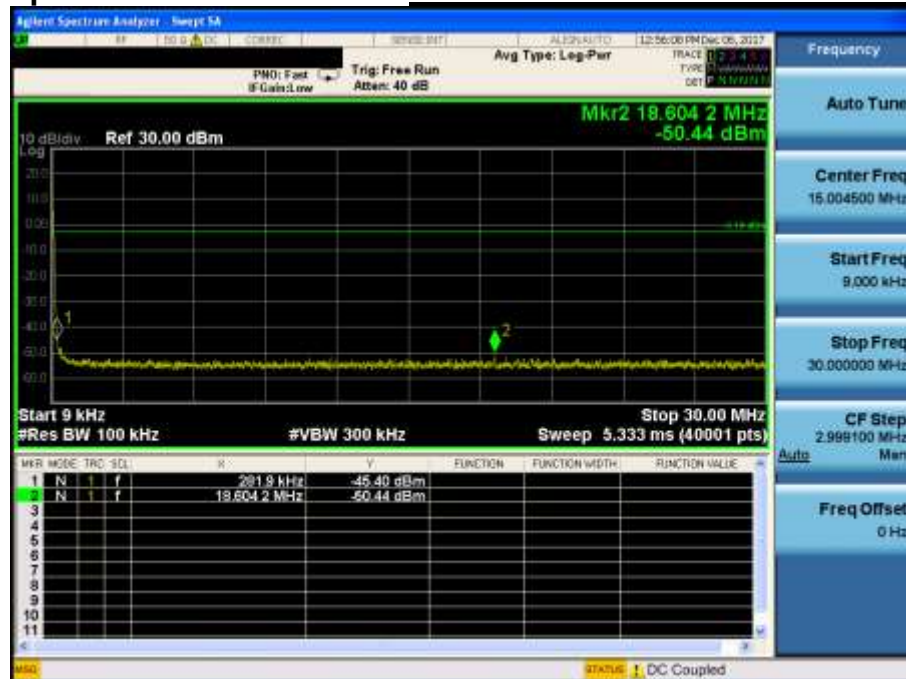




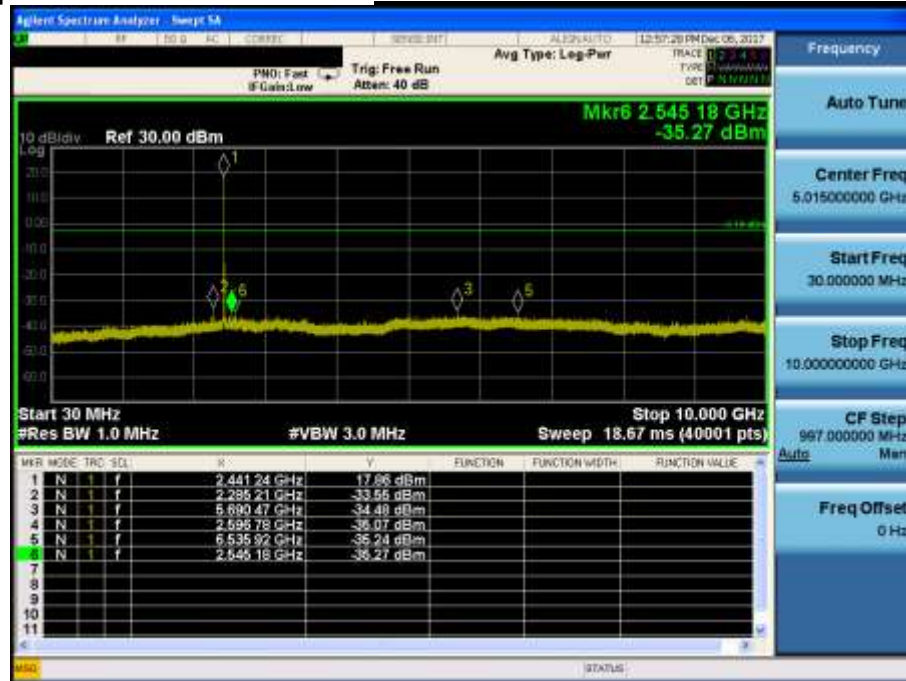
## Reference for limit

Middle Channel & Modulation : GFSK

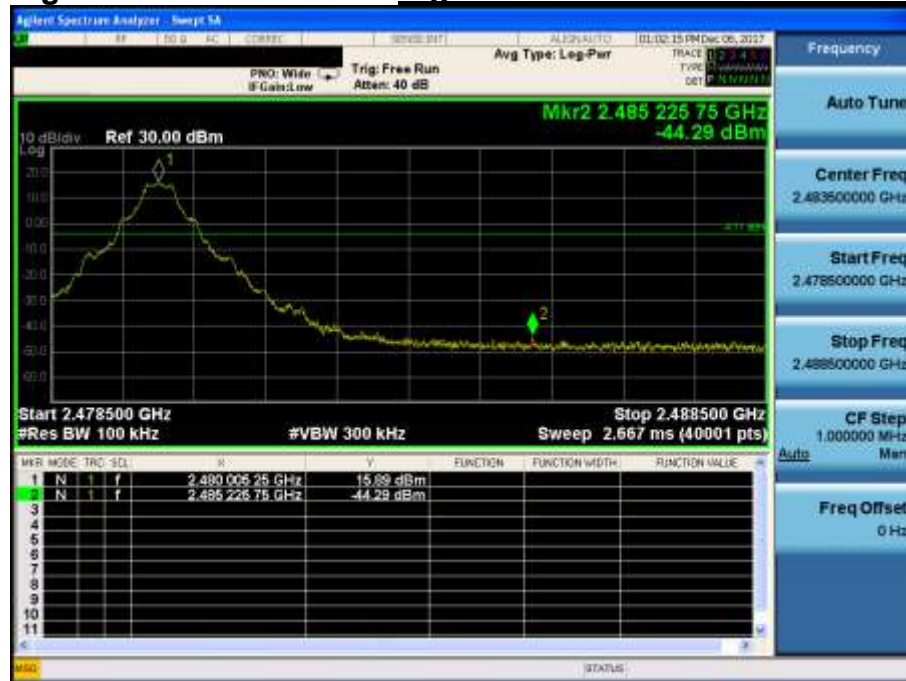
## Conducted Spurious Emissions

Middle Channel & Modulation : GFSK

## Conducted Spurious Emissions

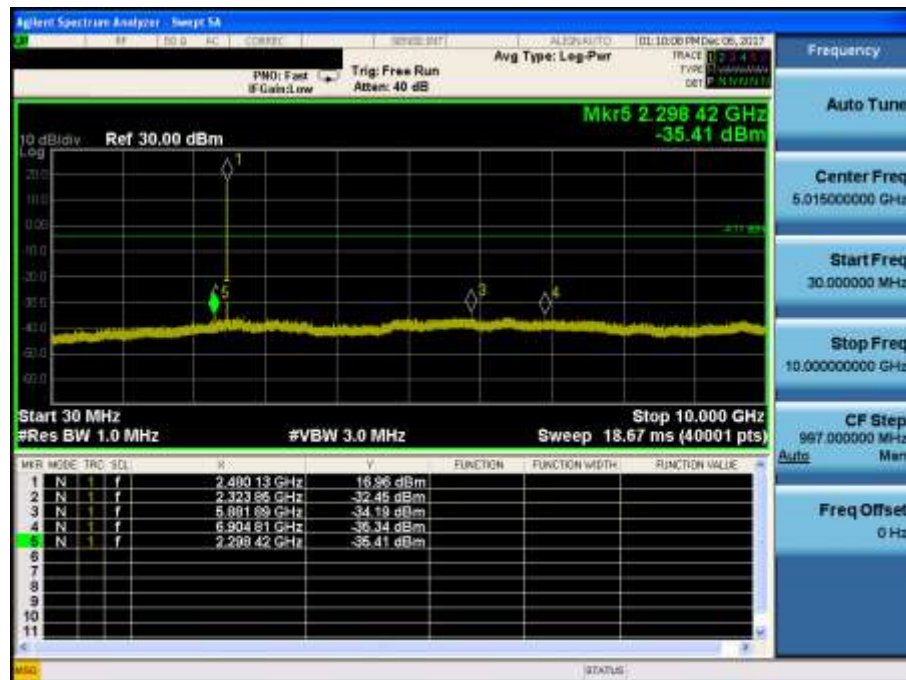
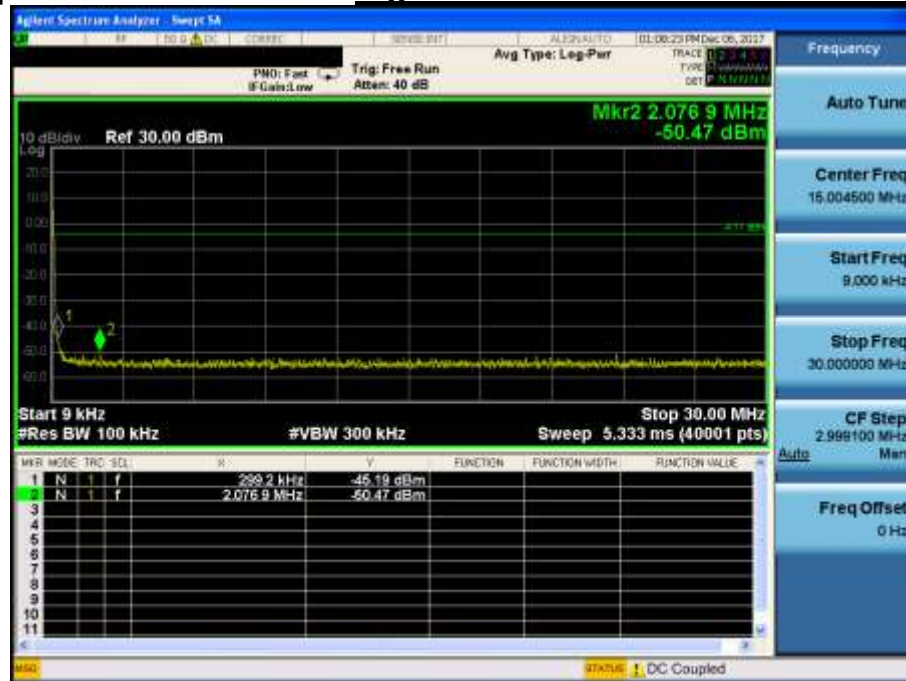
Middle Channel & Modulation : GFSK

## High Band-edge

Highest Channel & Modulation : GFSK

## High Band-edge

Hopping mode & Modulation : GFSK

**Conducted Spurious Emissions**      ***Highest Channel & Modulation : GFSK***



# Conducted Spurious Emissions *Highest Channel & Modulation : GFSK*



## Low Band-edge

Lowest Channel & Modulation :  $\pi/4$ DQPSK

## Low Band-edge

Hopping mode & Modulation :  $\pi/4$ DQPSK



# Conducted Spurious Emissions Lowest Channel & Modulation : $\pi/4$ DQPSK

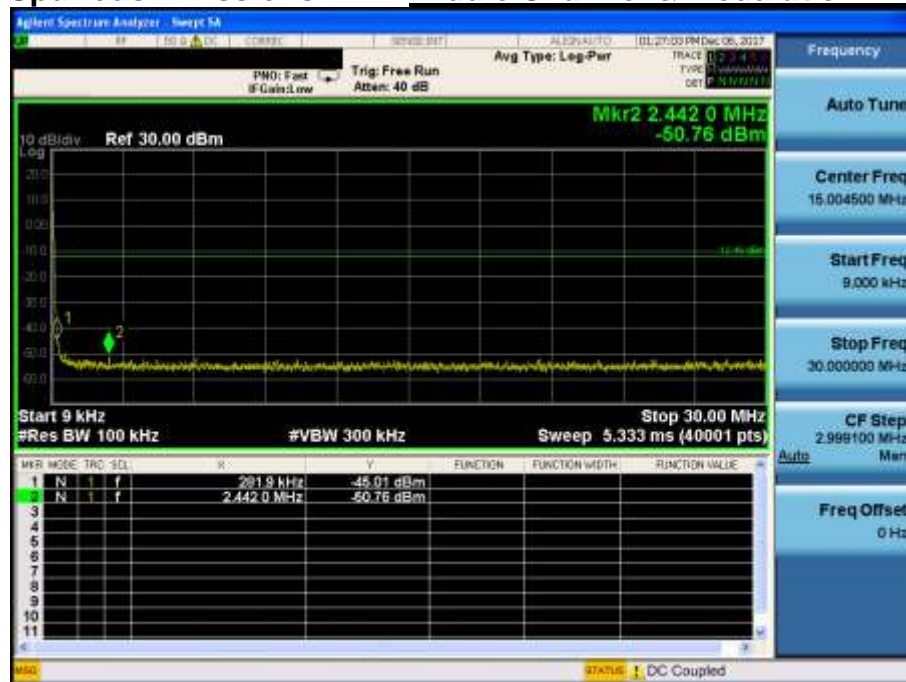




## Reference for limit

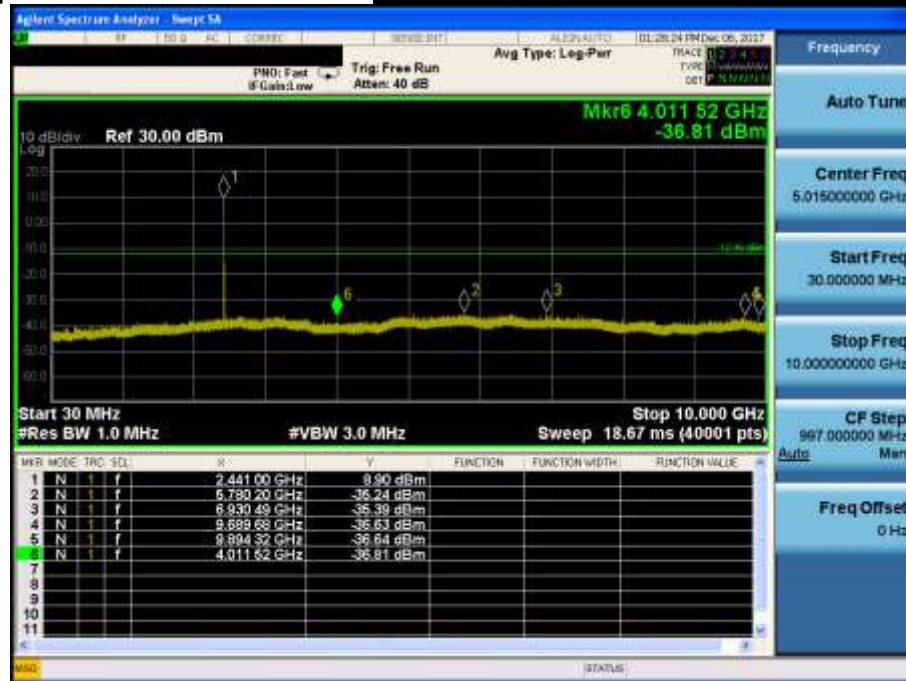
Middle Channel & Modulation :  $\pi/4$ DQPSK

## Conducted Spurious Emissions

Middle Channel & Modulation :  $\pi/4$ DQPSK

## Conducted Spurious Emissions

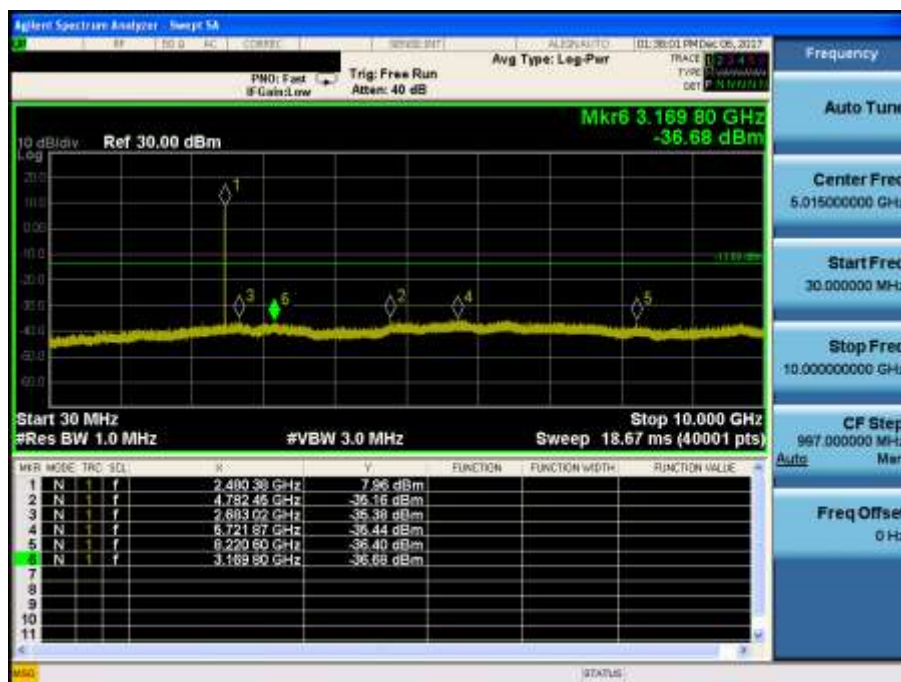
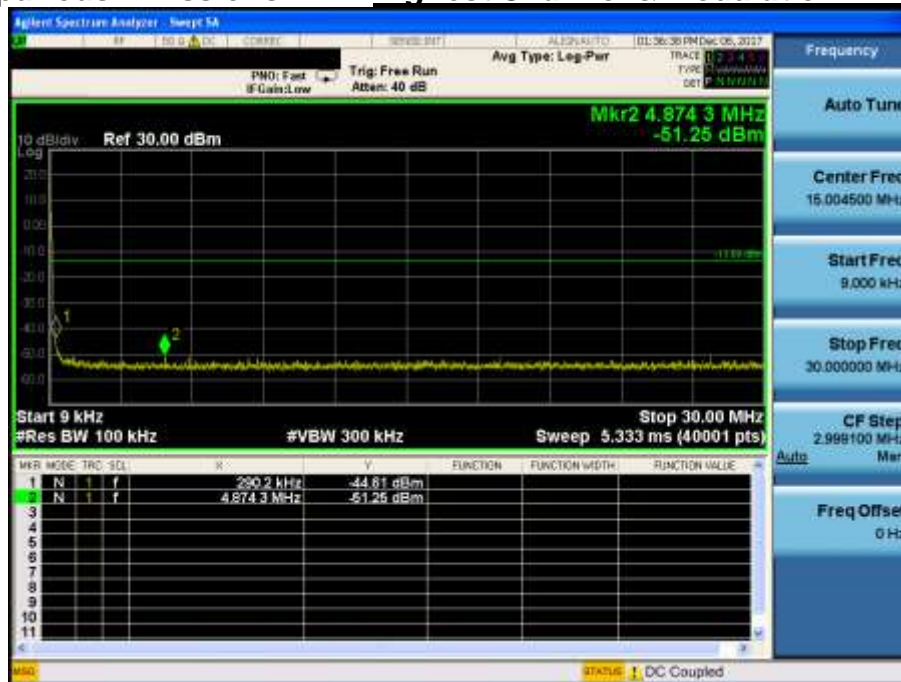
## Middle Channel & Modulation : $\pi/4$ DQPSK



**High Band-edge****Highest Channel & Modulation :  $\pi/4$ DQPSK****High Band-edge****Hopping mode & Modulation :  $\pi/4$ DQPSK**

## Conducted Spurious Emissions

## Highest Channel & Modulation : $\pi/4$ DQPSK



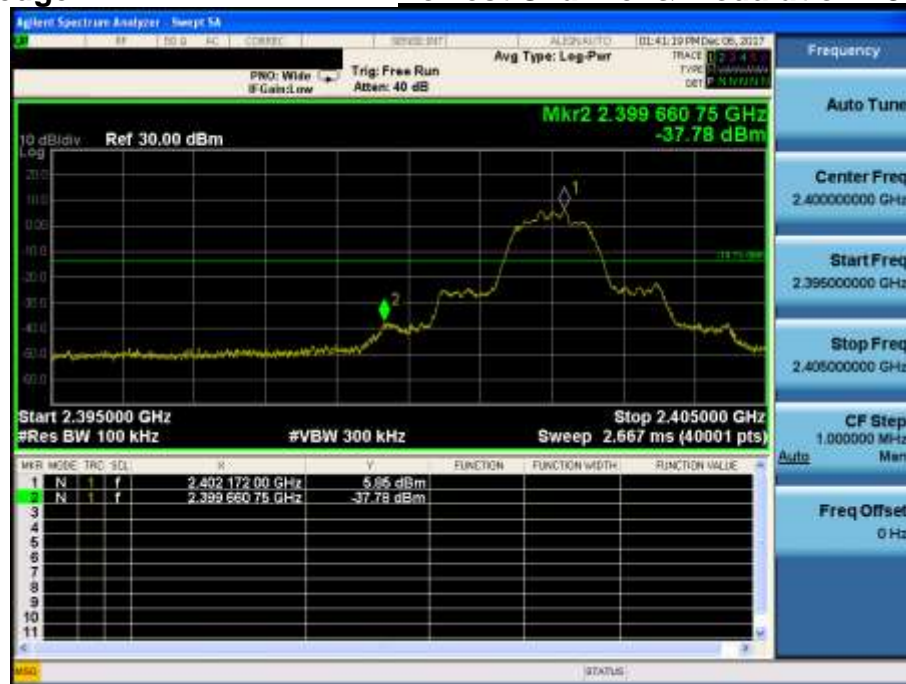


# Conducted Spurious Emissions

## Highest Channel & Modulation : $\pi/4$ DQPSK



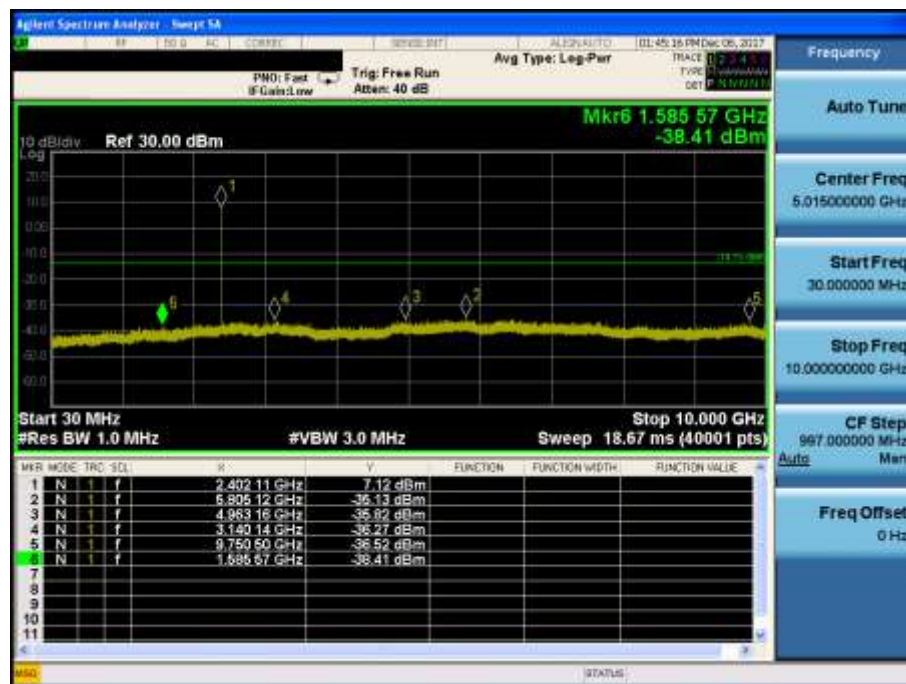
## Low Band-edge

Lowest Channel & Modulation : 8DPSK

## Low Band-edge

Hopping mode & Modulation : 8DPSK

## Conducted Spurious Emissions

Lowest Channel & Modulation : 8DPSK

# Conducted Spurious Emissions Lowest Channel & Modulation : 8DPSK

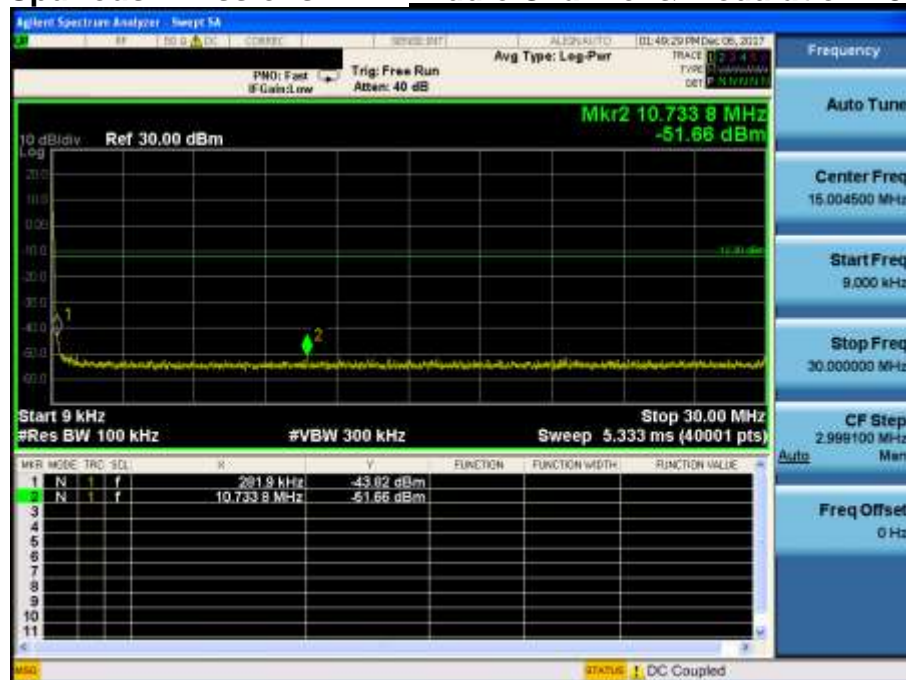




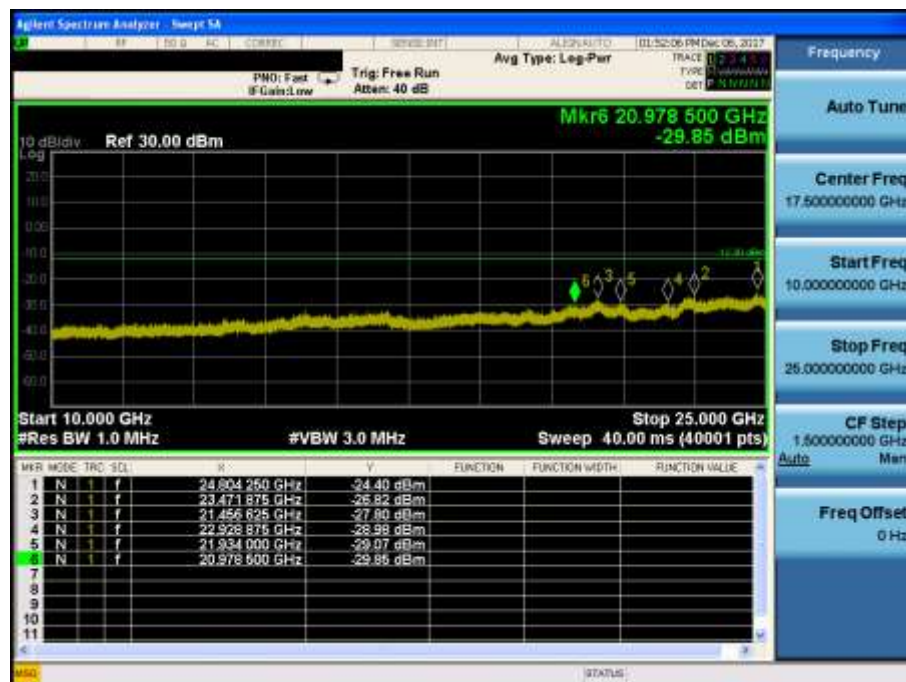
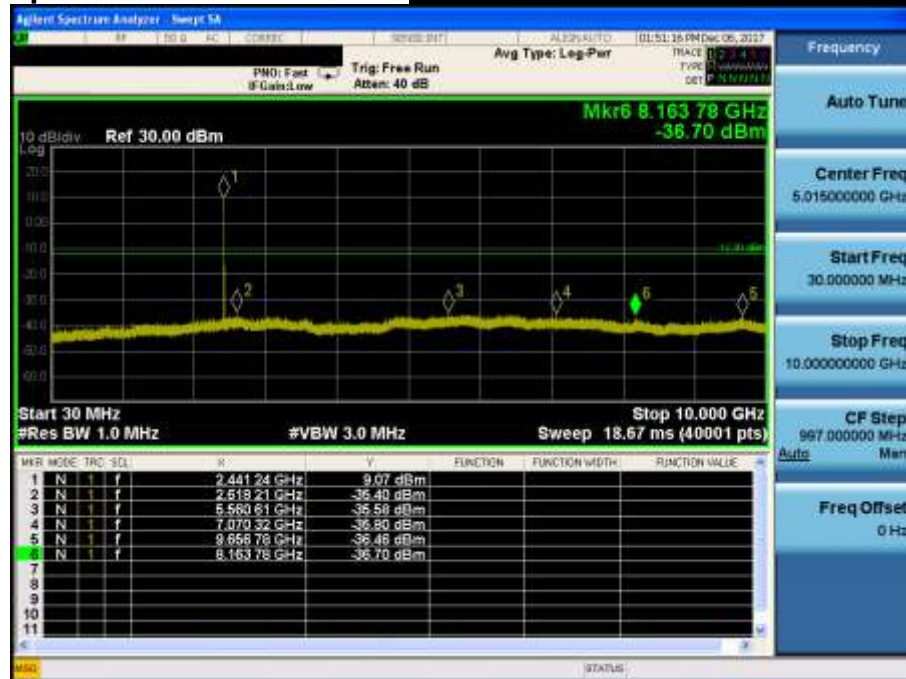
## Reference for limit

Middle Channel & Modulation : 8DPSK

## Conducted Spurious Emissions

Middle Channel & Modulation : 8DPSK

## Conducted Spurious Emissions

Middle Channel & Modulation : 8DPSK

## High Band-edge

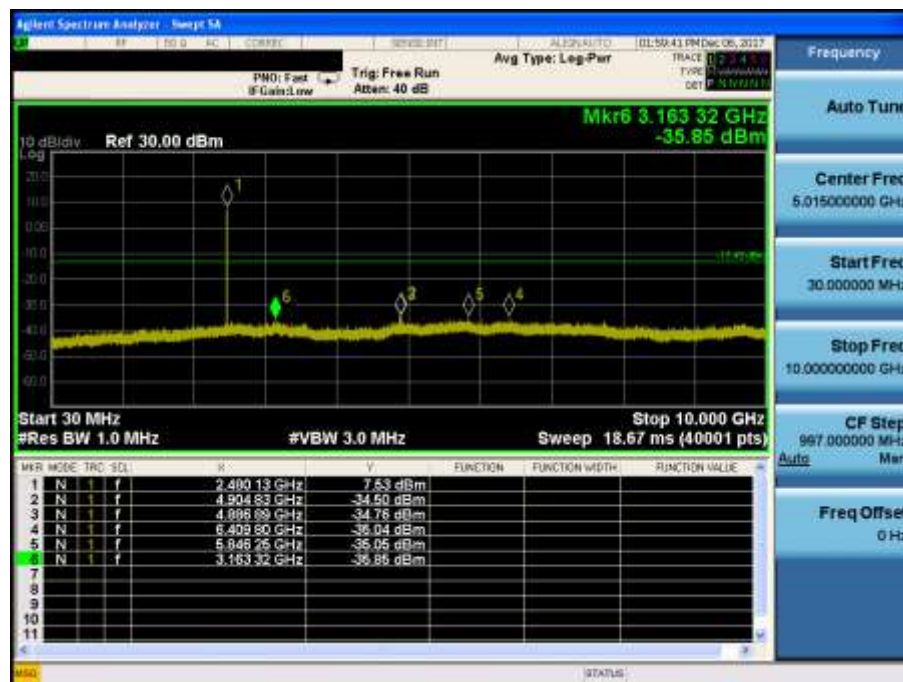
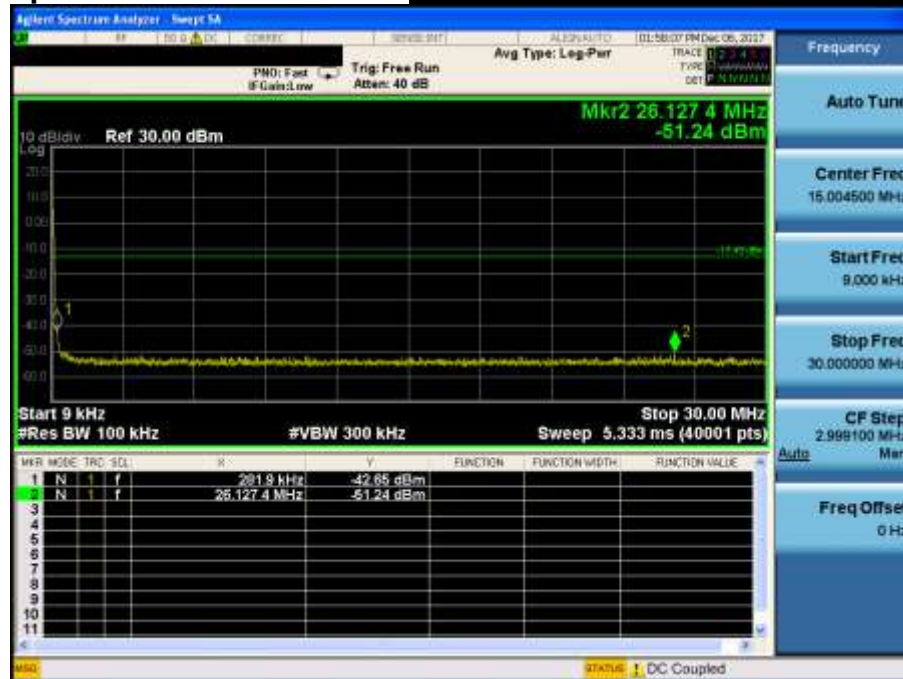
Highest Channel & Modulation : 8DPSK

## High Band-edge

Hopping mode & Modulation : 8DPSK

## Conducted Spurious Emissions

## Highest Channel & Modulation : 8DPSK





# Conducted Spurious Emissions

## Highest Channel & Modulation : 8DPSK



## 8. Transmitter AC Power Line Conducted Emission

### 8.1 Test Setup

See test photographs for the actual connections between EUT and support equipment.

### 8.2 Limit

According to §15.207(a) for an intentional radiator 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, as measured using a 50 uH/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

\* Decreases with the logarithm of the frequency

### 8.3 Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

## 8.4 Test Results

### Module 1(Internal Antenna 1)

AC Line Conducted Emissions (Graph) = Modulation : 8DPSK

### Results of Conducted Emission

DTNC

Date 2017-12-14

Order No.  
Model No.  
Serial No.  
Test Condition

DTNC1710-08182  
SP51

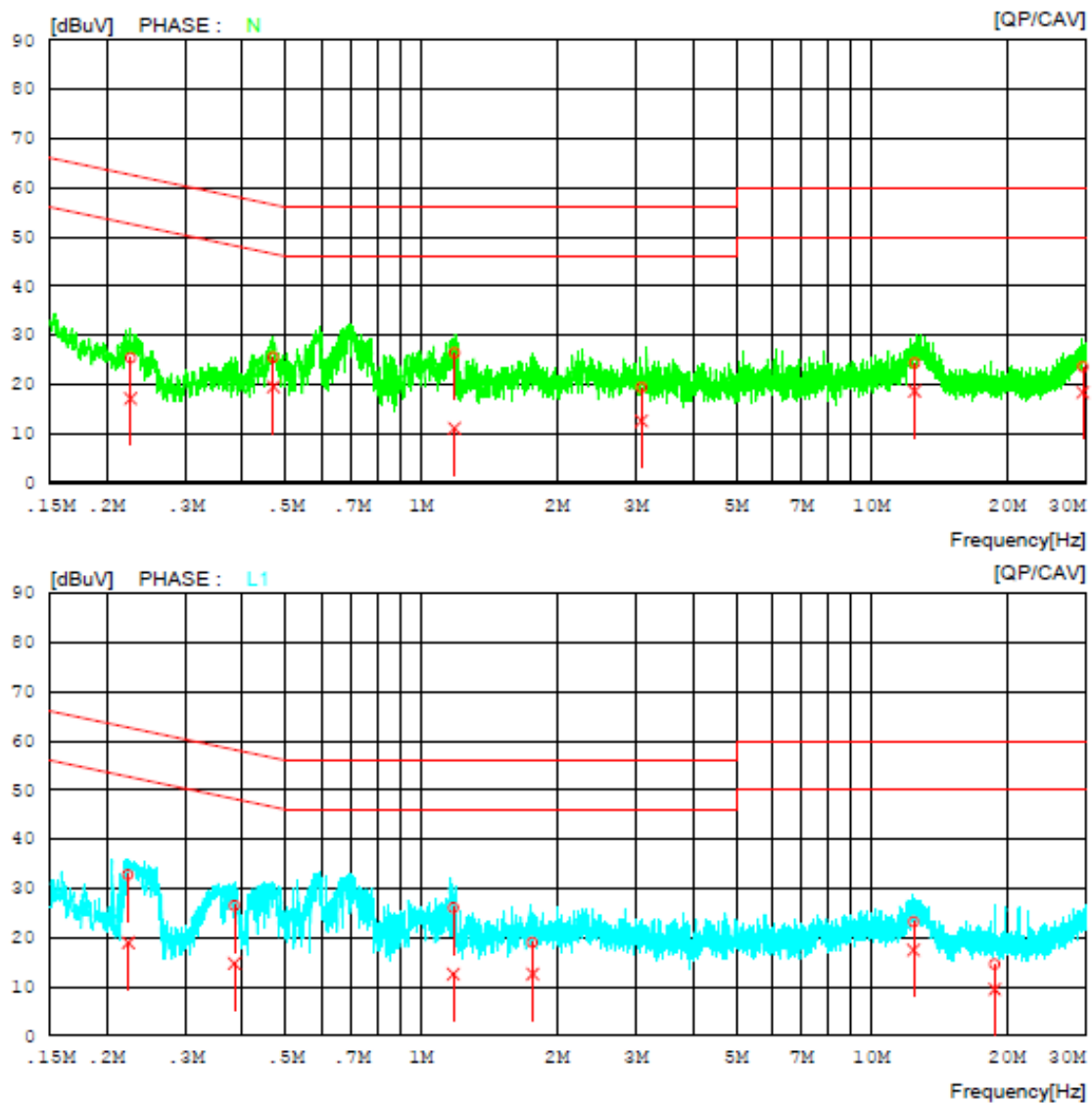
Reference No.  
Power Supply  
Temp/Humi.  
Operator

25 / 43  
S.G.LEE

Memo

BT\_Module1

LIMIT : FCC P15.207 QP  
FCC P15.207 AV



# AC Line Conducted Emissions (List) = Modulation : **8DPSK**

## Results of Conducted Emission

DTNC

Date 2017-12-14

Order No.	DTNC1710-08182	Reference No.	
Model No.	SP51	Power Supply	
Serial No.		Temp/Humi.	25 / 43
Test Condition		Operator	S.G.LEE

Memo BT\_Module1

LIMIT : FCC P15.207 QP  
FCC P15.207 AV

NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	0.22622	15.46	7.19	9.94	25.40	17.13	62.59	52.59	37.19	35.46	N
2	0.46928	15.47	9.46	9.98	25.45	19.44	56.53	46.53	31.08	27.09	N
3	1.18460	16.39	1.03	10.00	26.39	11.03	56.00	46.00	29.61	34.97	N
4	3.08600	9.31	2.53	10.05	19.36	12.58	56.00	46.00	36.64	33.42	N
5	12.47180	14.04	8.36	10.24	24.28	18.60	60.00	50.00	35.72	31.40	N
6	29.46720	13.05	7.91	10.47	23.52	18.38	60.00	50.00	36.48	31.62	N
7	0.22336	22.69	8.92	9.94	32.63	18.86	62.69	52.69	30.06	33.83	L1
8	0.38449	16.43	4.71	9.97	26.40	14.68	58.18	48.18	31.78	33.50	L1
9	1.17920	15.93	2.56	10.00	25.93	12.56	56.00	46.00	30.07	33.44	L1
10	1.76580	8.87	2.53	10.03	18.90	12.56	56.00	46.00	37.10	33.44	L1
11	12.40660	12.90	7.15	10.24	23.14	17.39	60.00	50.00	36.86	32.61	L1
12	18.78720	4.09	-0.94	10.37	14.46	9.43	60.00	50.00	45.54	40.57	L1



## Module 2(External Antenna 1)

AC Line Conducted Emissions (Graph) = Modulation : GFSK

### Results of Conducted Emission

DTNC

Date 2017-12-14

Order No.  
Model No.  
Serial No.  
Test Condition

DTNC1710-08182  
SP51

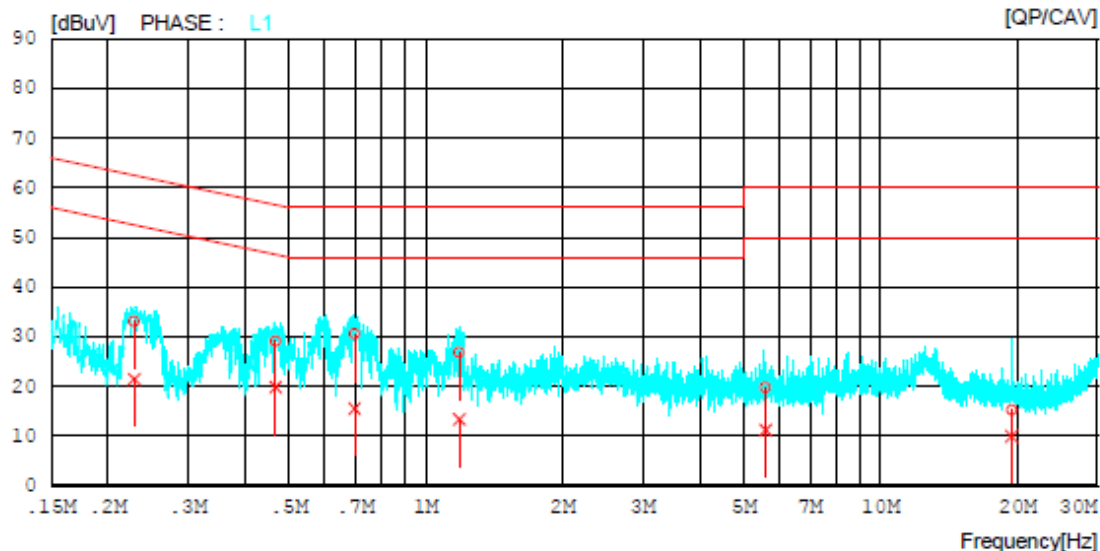
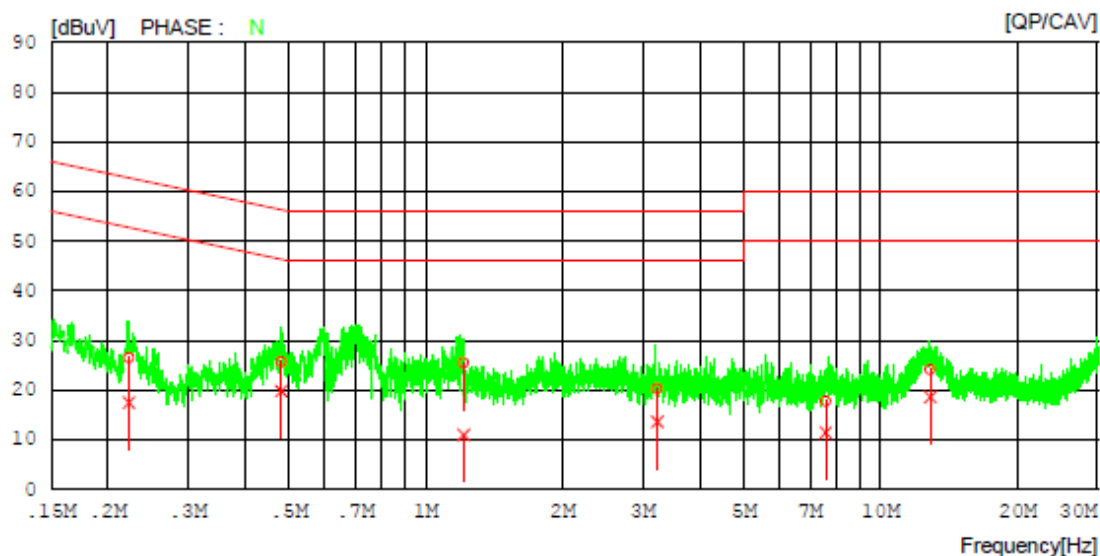
Reference No.  
Power Supply  
Temp/Humi.  
Operator

25 / 43  
S.G.LEE

Memo

BT\_Module2

LIMIT : FCC P15.207 QP  
FCC P15.207 AV



# AC Line Conducted Emissions (List) = Modulation : GFSK

## Results of Conducted Emission

DTNC

Date 2017-12-14

Order No.  
Model No.  
Serial No.  
Test Condition

DTNC1710-08182  
SP51

Reference No.  
Power Supply  
Temp/Humi.  
Operator

25 / 43  
S.G.LEE

Memo

BT\_Module2

LIMIT : FCC P15.207 QP  
FCC P15.207 AV

NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	0.22245	16.59	7.48	9.94	26.53	17.42	62.73	52.73	36.20	35.31	N
2	0.48093	15.70	9.78	9.99	25.69	19.77	56.32	46.32	30.63	26.55	N
3	1.21100	15.51	0.92	10.00	25.51	10.92	56.00	46.00	30.49	35.08	N
4	3.22680	10.14	3.53	10.06	20.20	13.59	56.00	46.00	35.80	32.41	N
5	7.56860	7.56	1.31	10.15	17.71	11.46	60.00	50.00	42.29	38.54	N
6	12.84800	13.78	8.29	10.26	24.04	18.55	60.00	50.00	35.96	31.45	N
7	0.22831	23.05	11.50	9.94	32.99	21.44	62.51	52.51	29.52	31.07	L1
8	0.46750	19.07	9.83	9.98	29.05	19.81	56.56	46.56	27.51	26.75	L1
9	0.69705	20.52	5.51	9.96	30.48	15.47	56.00	46.00	25.52	30.53	L1
10	1.18360	16.73	3.27	10.00	26.73	13.27	56.00	46.00	29.27	32.73	L1
11	5.58480	9.66	1.00	10.10	19.76	11.10	60.00	50.00	40.24	38.90	L1
12	19.40640	4.81	-0.48	10.38	15.19	9.90	60.00	50.00	44.81	40.10	L1

## 9. Antenna Requirement

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

**Conclusion: Comply**

The internal type antenna of module 1 is permanently attached on the board.  
And the external type antenna of module 2 employs a unique antenna connector.  
Therefore this E.U.T Complies with the requirement of §15.203

### - Minimum Standard :

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.
--

## 10. Occupied Bandwidth (99 %)

### 10.1 Test Setup

Refer to the APPENDIX I.

### 10.2 Limit

Limit : Not Applicable

### 10.3 Test Procedure

The 99 % power bandwidth was measured with a calibrated spectrum analyzer.

The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately  $3 \times \text{RBW}$ .

Spectrum analyzer plots are included on the following pages.

### 10.4 Test Results

#### <Module 1>

Modulation	Tested Channel	Test Results (MHz)
<u><b>GFSK</b></u>	Lowest	0.975
	Middle	0.994
	Highest	<b>0.995</b>
<u><b><math>\pi/4</math>DQPSK</b></u>	Lowest	<b>1.345</b>
	Middle	1.337
	Highest	1.336
<u><b>8DPSK</b></u>	Lowest	<b>1.303</b>
	Middle	1.298
	Highest	1.299

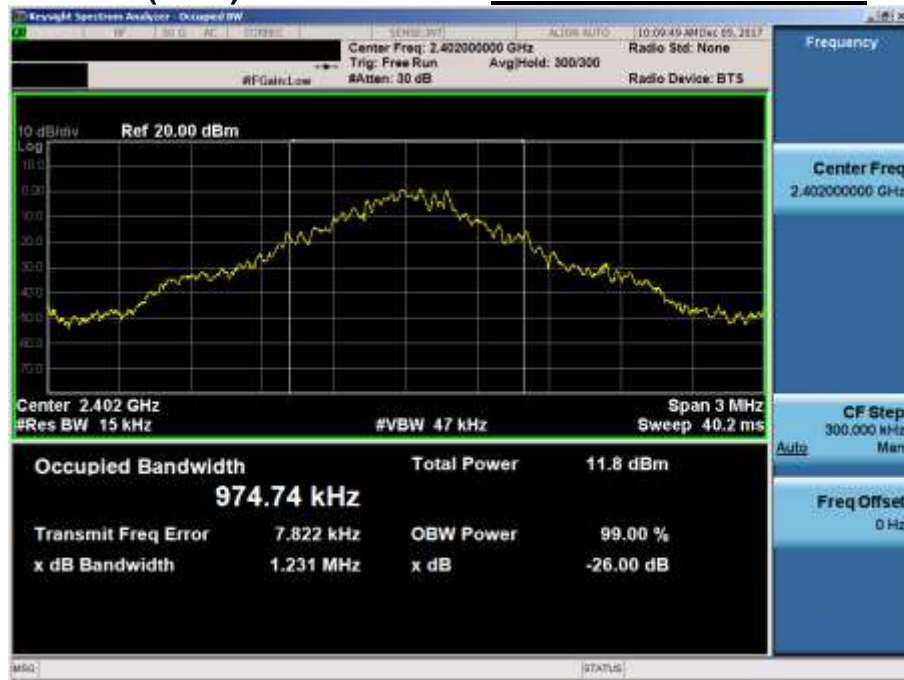


<Module 2>

Modulation	Tested Channel	Test Results (MHz)
<b><u>GFSK</u></b>	Lowest	1.003
	Middle	1.008
	Highest	1.011
<b><u><math>\pi/4</math>DQPSK</u></b>	Lowest	1.211
	Middle	1.205
	Highest	1.206
<b><u>8DPSK</u></b>	Lowest	1.209
	Middle	1.207
	Highest	1.211

## &lt;Module 1&gt;

## Occupied Bandwidth (99 %)

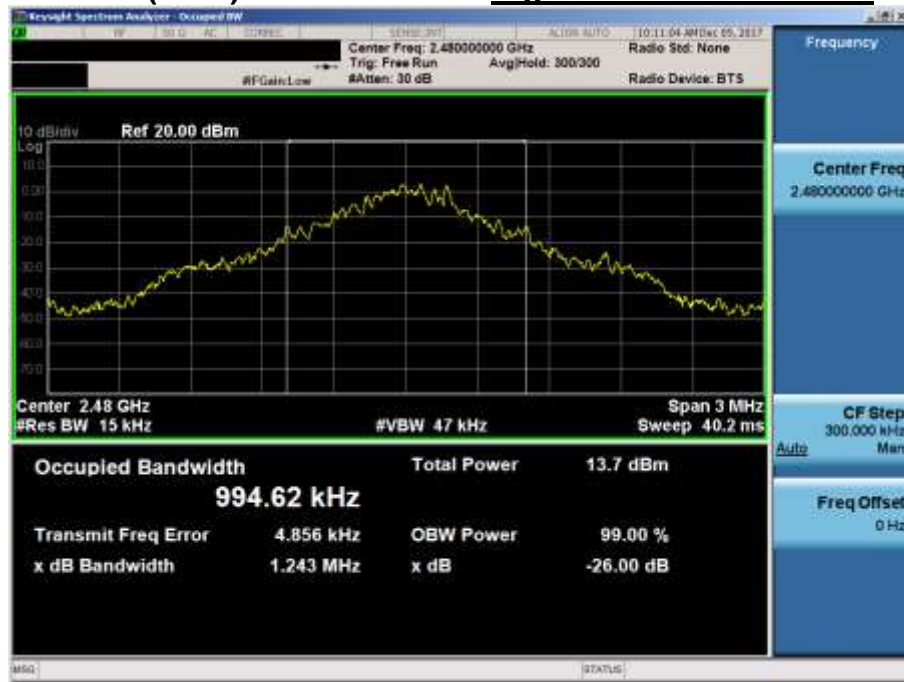
Lowest Channel & GFSK

## Occupied Bandwidth (99 %)

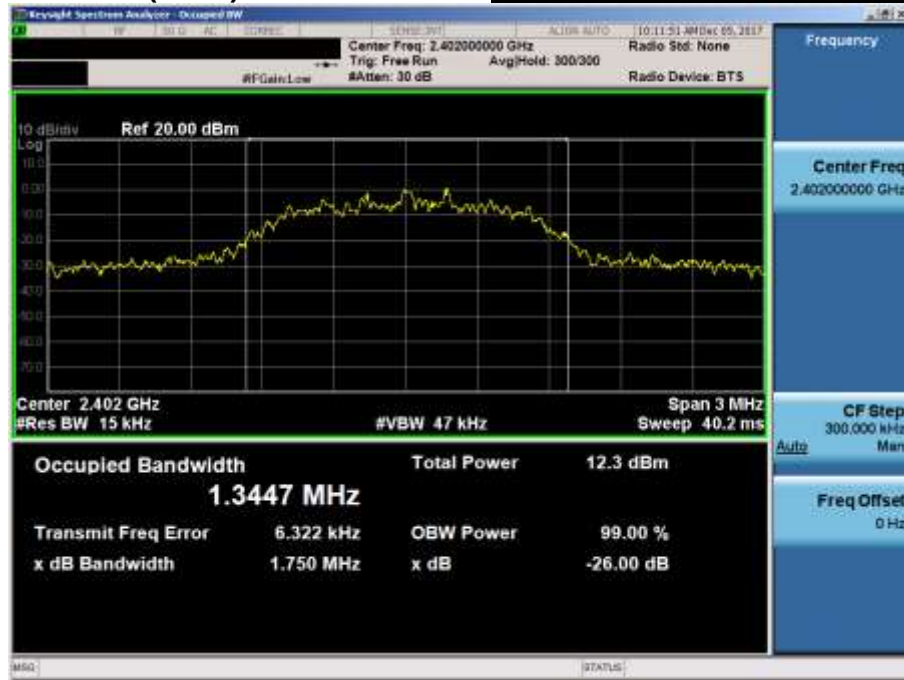
Middle Channel & GFSK

## Occupied Bandwidth (99 %)

## Highest Channel & GFSK



## Occupied Bandwidth (99 %)

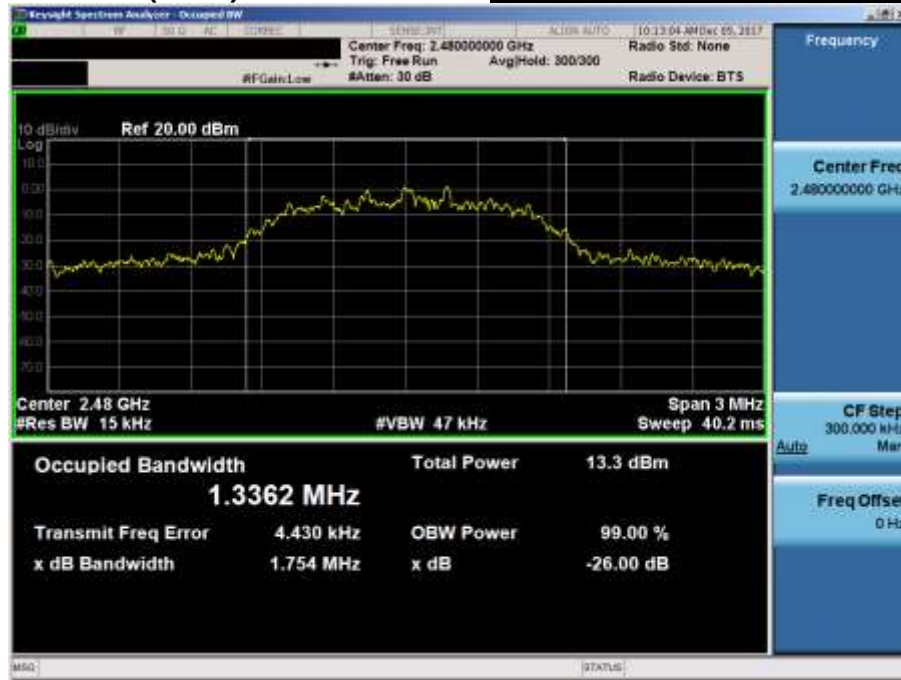
Lowest Channel &  $\pi/4$  DQPSK

## Occupied Bandwidth (99 %)

Middle Channel &  $\pi/4$  DQPSK

Occupied Bandwidth (99 %)

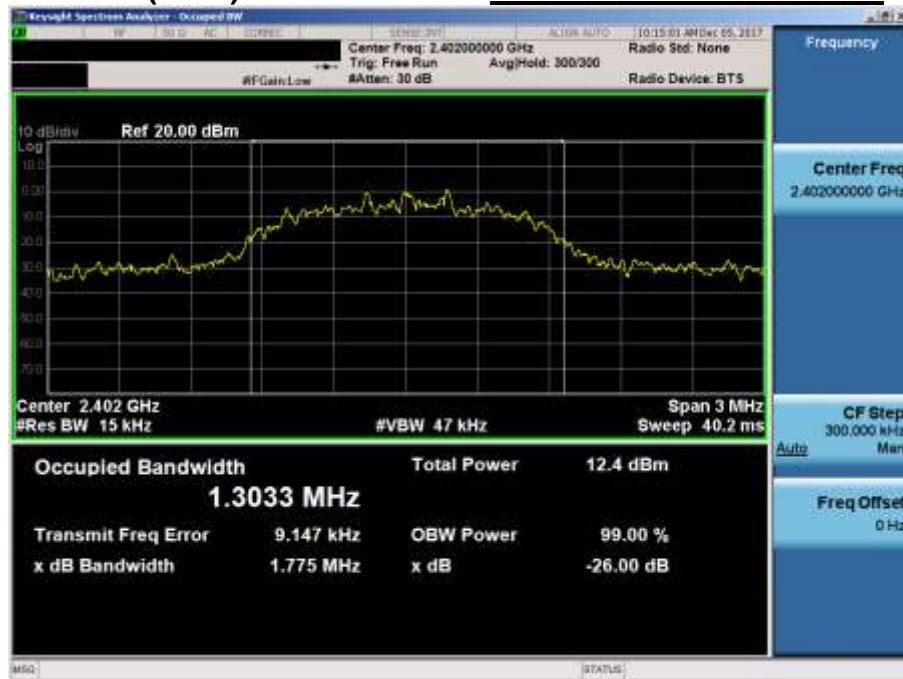
Highest Channel &  $\pi/4$  DQPSK





## Occupied Bandwidth (99 %)

## Lowest Channel & 8DPSK



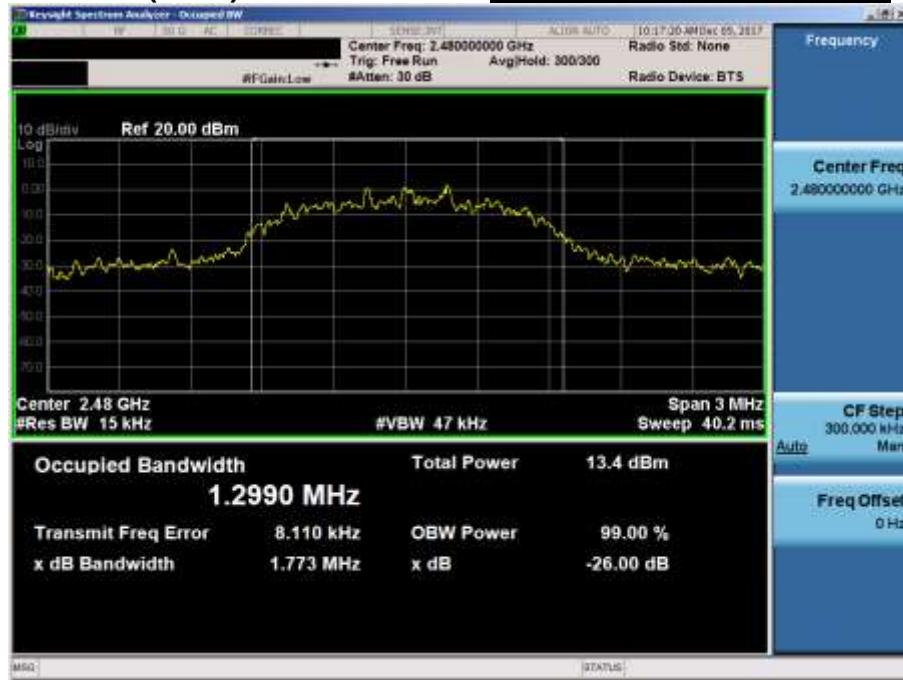
## Occupied Bandwidth (99 %)

## Middle Channel & 8DPSK



Occupied Bandwidth (99 %)

Highest Channel & 8DPSK



## &lt;Module 2&gt;

## Occupied Bandwidth (99 %)

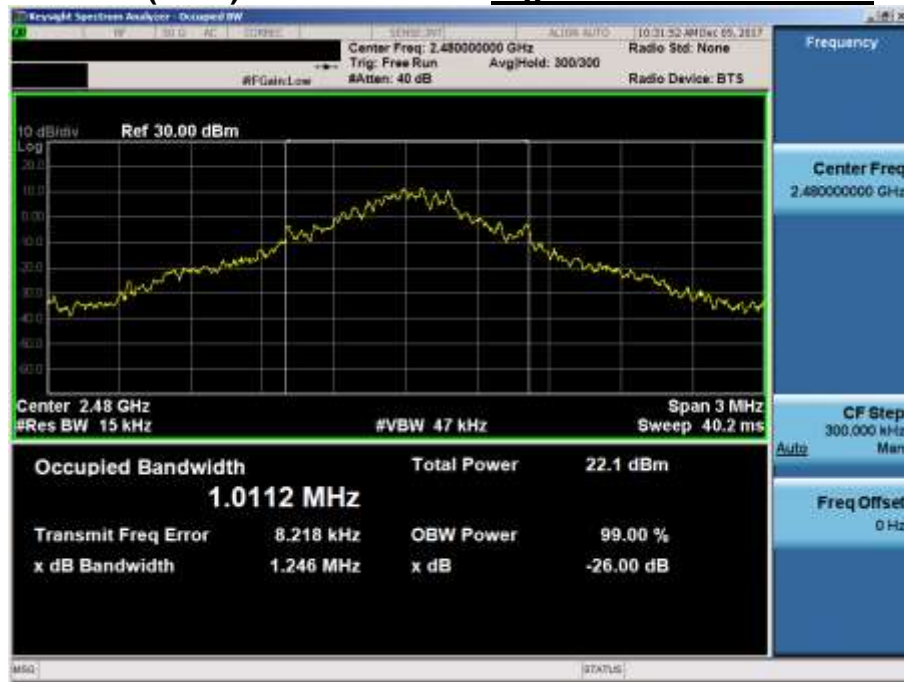
Lowest Channel & GFSK

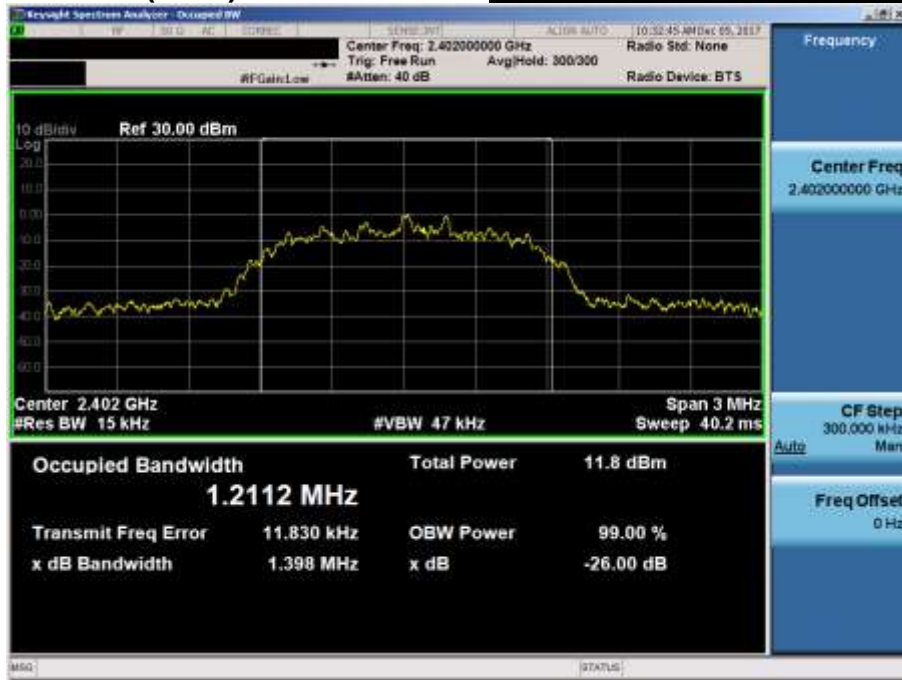
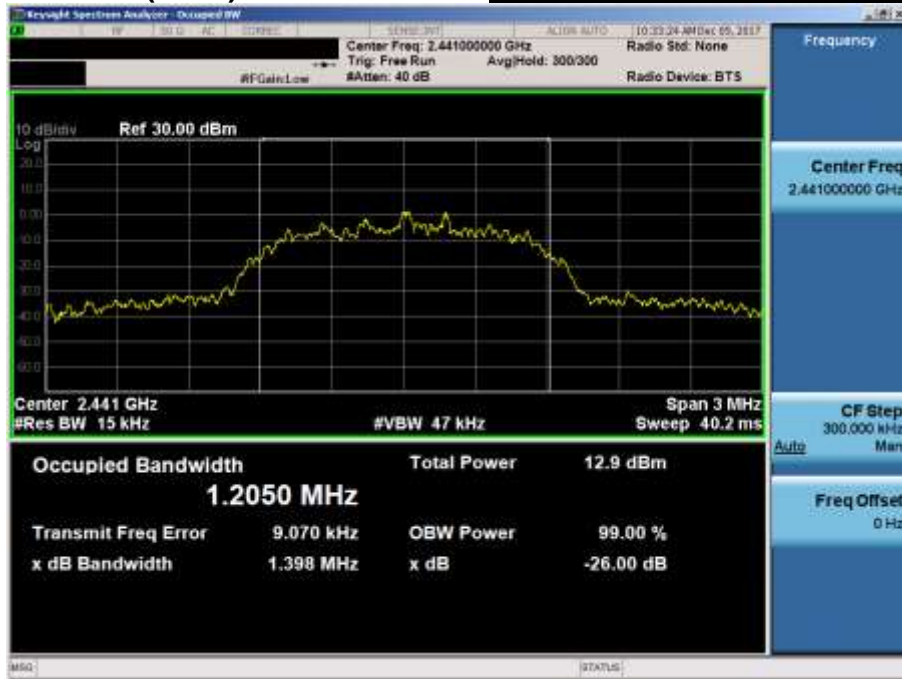
## Occupied Bandwidth (99 %)

Middle Channel & GFSK

## Occupied Bandwidth (99 %)

## Highest Channel & GFSK

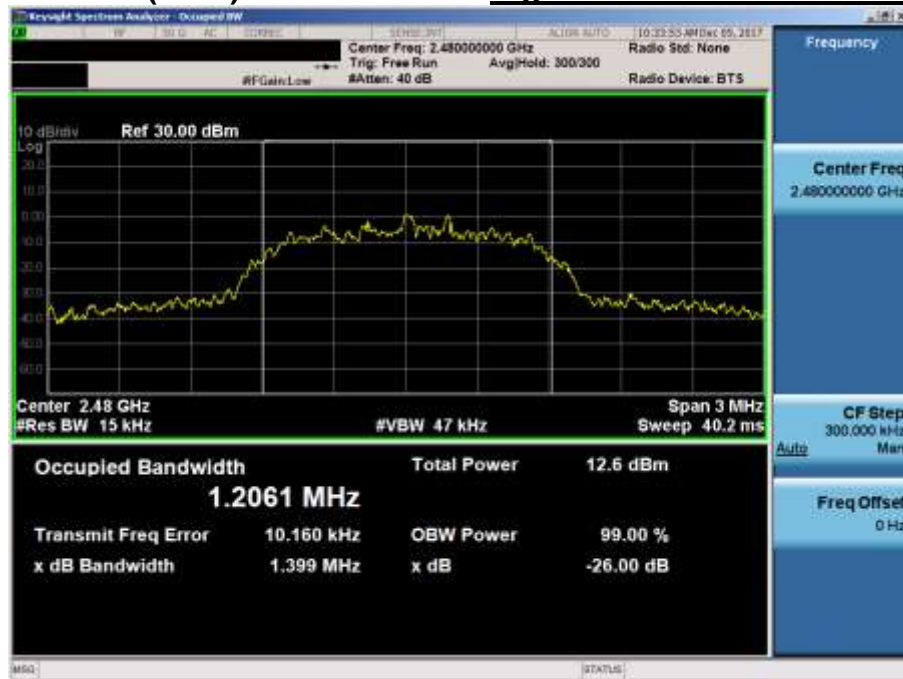


**Occupied Bandwidth (99 %)****Lowest Channel &  $\pi/4$  DQPSK****Occupied Bandwidth (99 %)****Middle Channel &  $\pi/4$  DQPSK**



## Occupied Bandwidth (99 %)

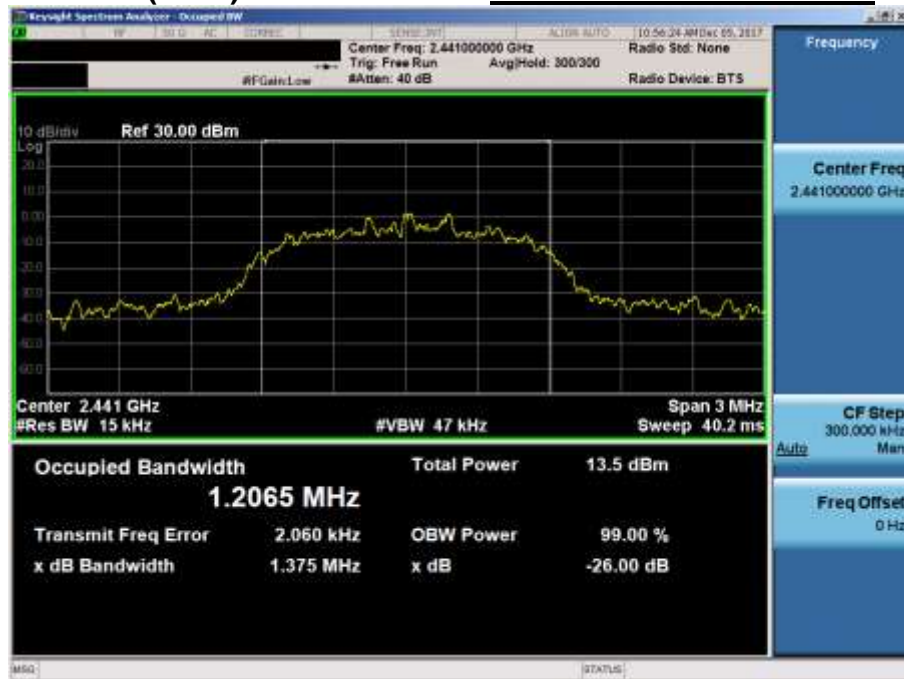
## Highest Channel & $\pi/4$ DQPSK



## Occupied Bandwidth (99 %)

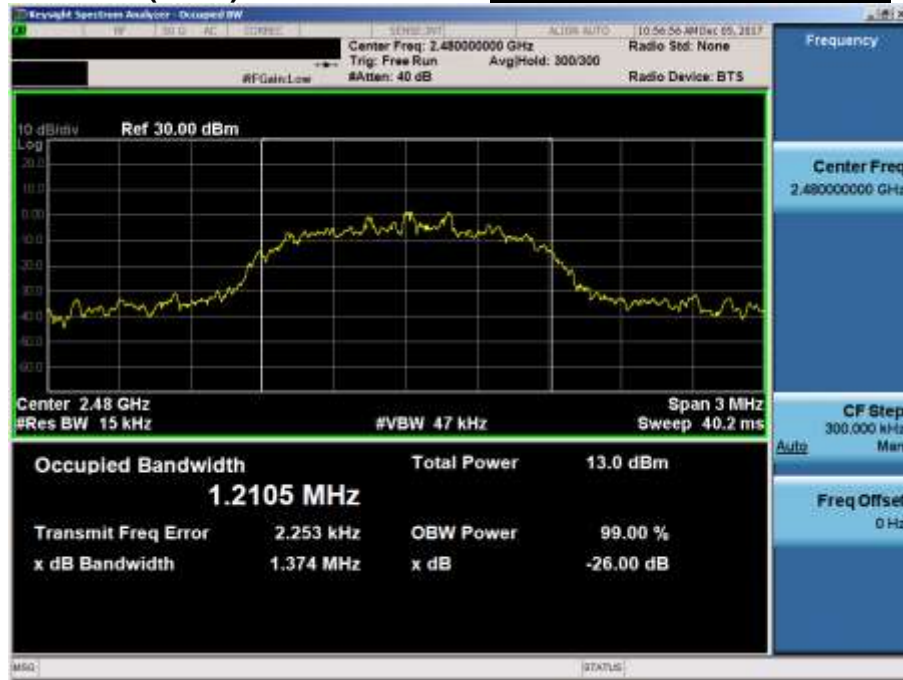
Lowest Channel & 8DPSK

## Occupied Bandwidth (99 %)

Middle Channel & 8DPSK

Occupied Bandwidth (99 %)

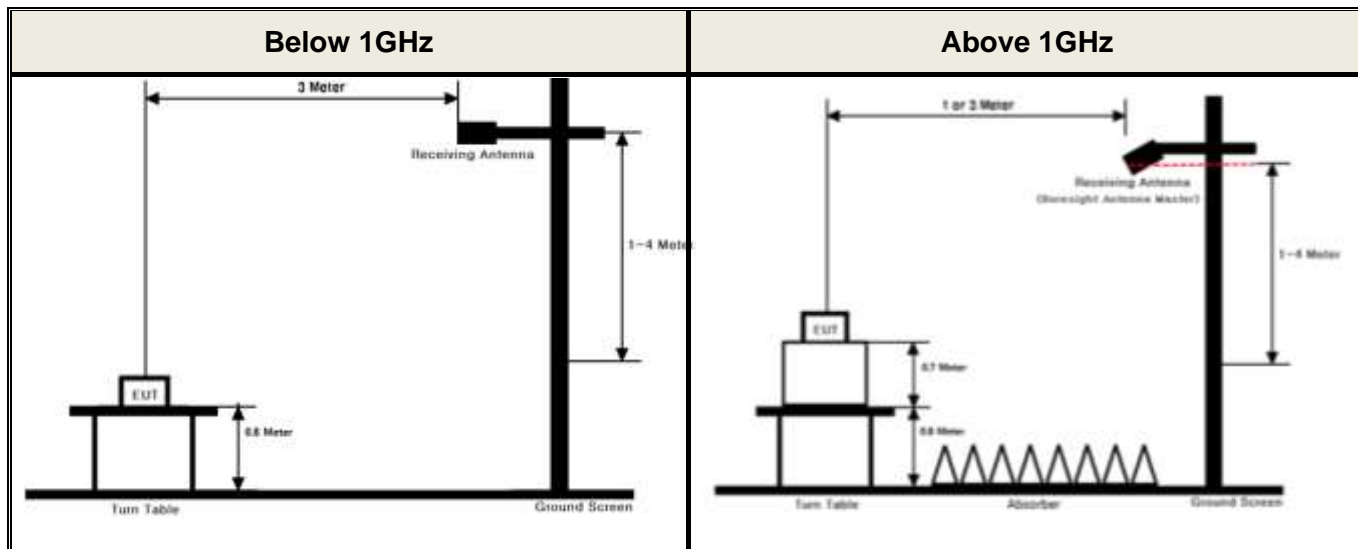
Highest Channel & 8DPSK



## APPENDIX I

### Test set up diagrams

#### ▪ Radiated Measurement



#### ▪ Conducted Measurement

##### Spectrum Analyzer



EUT

Cable A

#### Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.07	15	3.18
1	0.75	20	4.15
2.402 & 2.440 & 2.480	1.20	25	4.55
5	1.80	-	-
10	2.33	-	-

Note 1 : The path loss from EUT to Spectrum analyzer were measured and used for test.

Path loss ( S/A's Correction factor) = Cable A

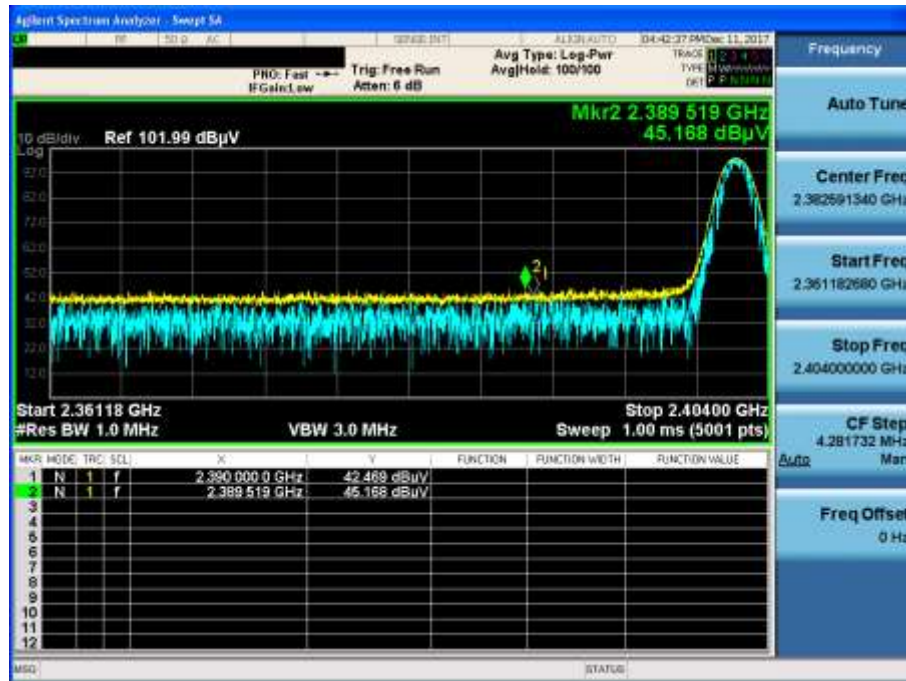
## APPENDIX II

### Unwanted Emissions (Radiated) Test Plot

#### Module 1 (Internal Antenna 1)

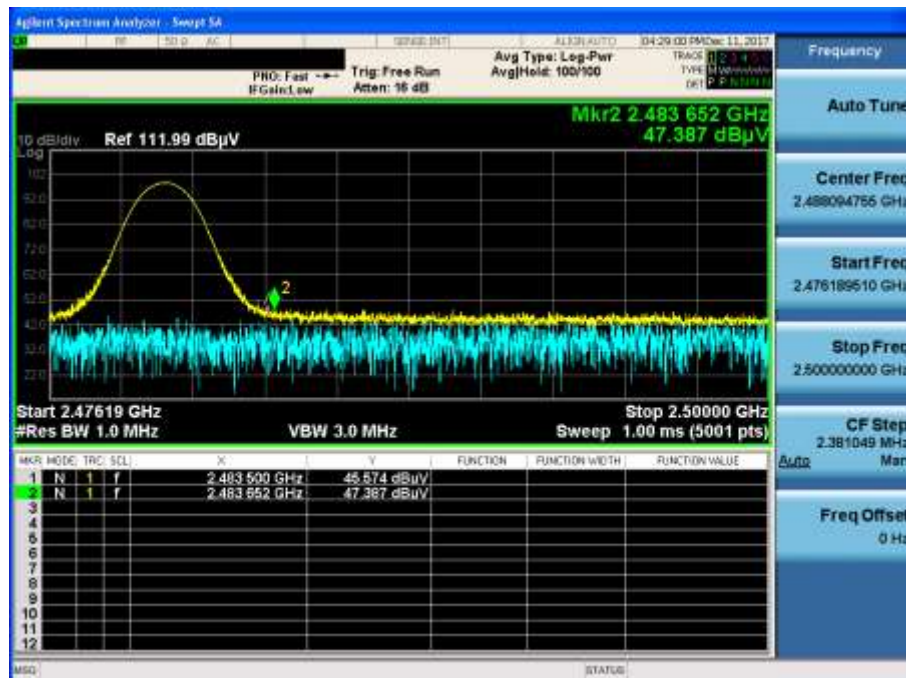
GFSK & Lowest & X & Hor

Detector Mode : PK



GFSK & Highest & X & Hor

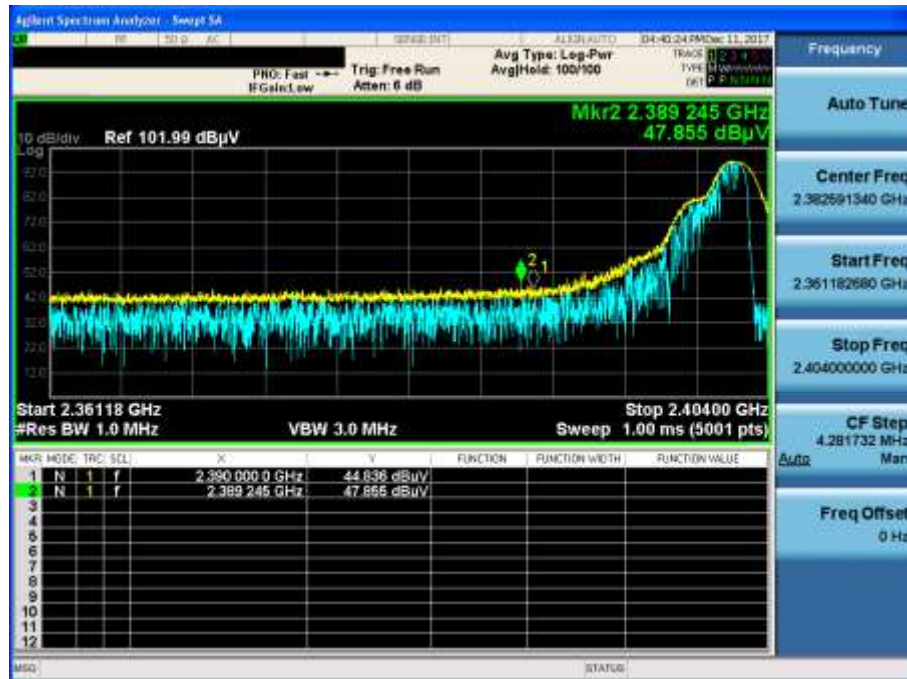
Detector Mode : PK





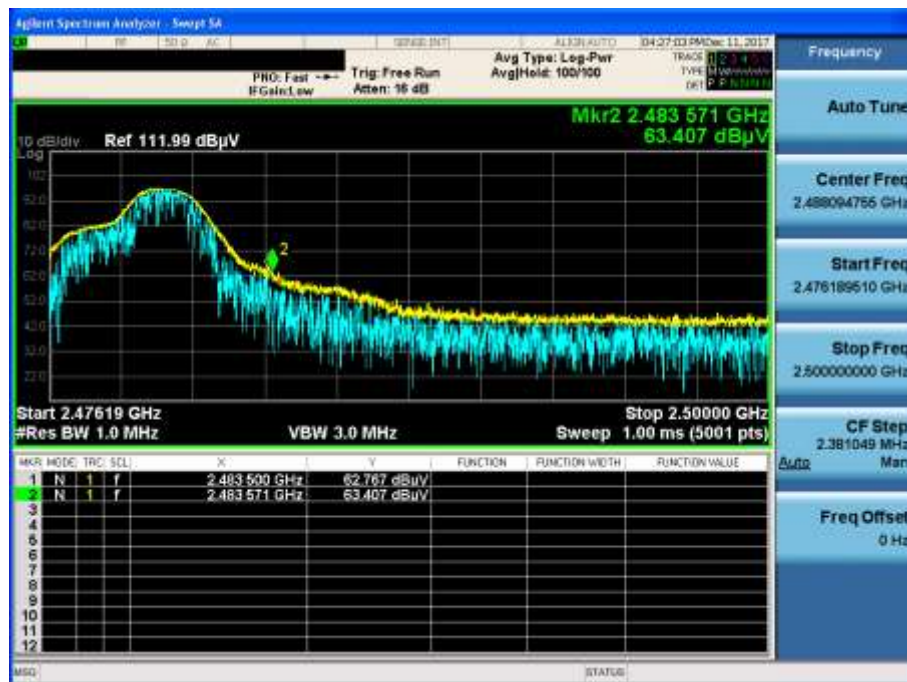
$\pi/4$ DQPSK & Lowest & X & Hor

Detector Mode : PK



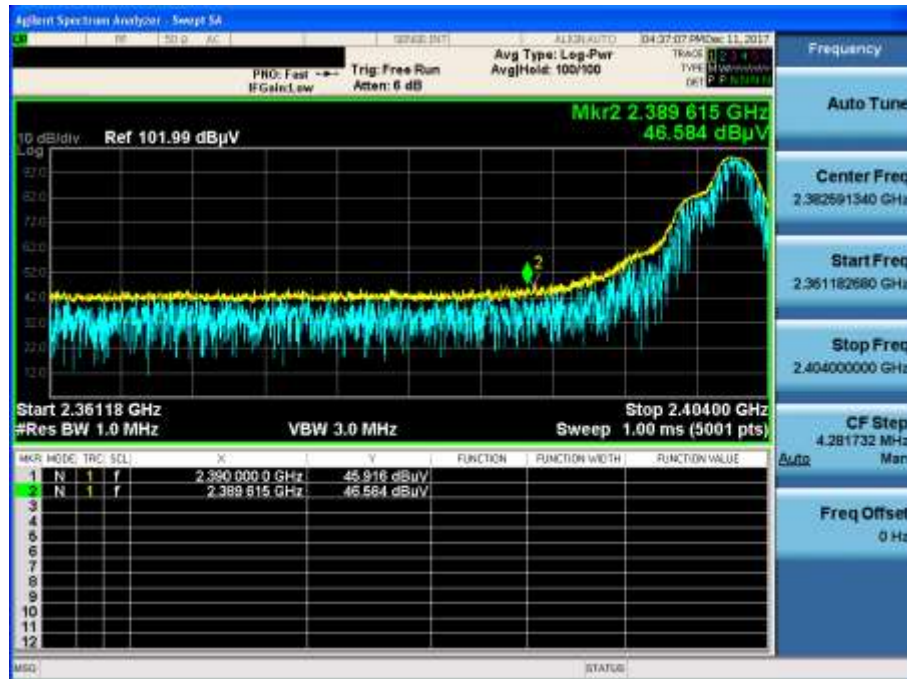
$\pi/4$ DQPSK & Highest & X & Hor

Detector Mode : PK



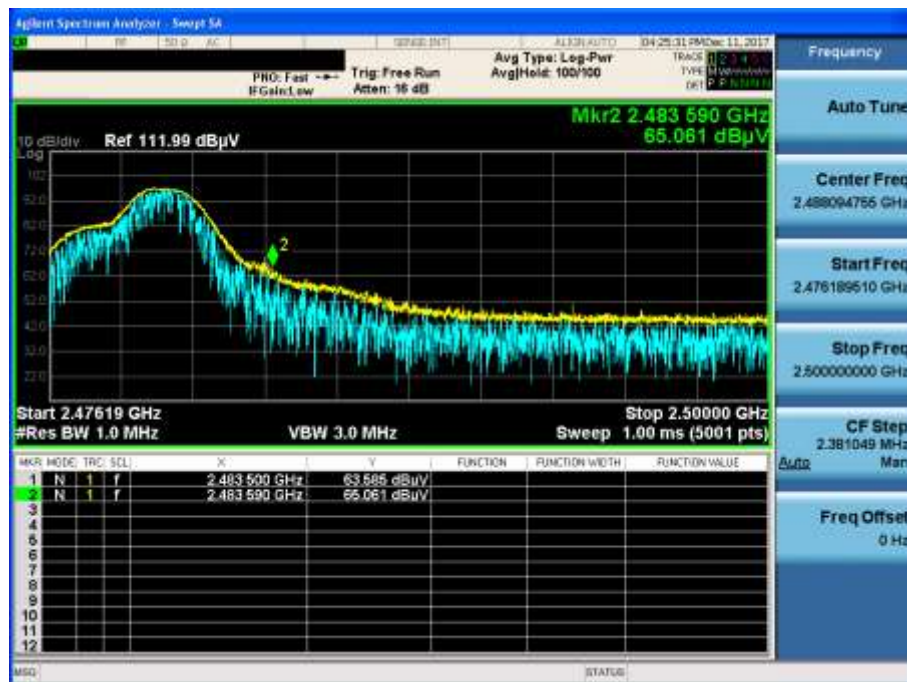
## 8DPSK &amp; Lowest &amp; X &amp; Hor

Detector Mode : PK



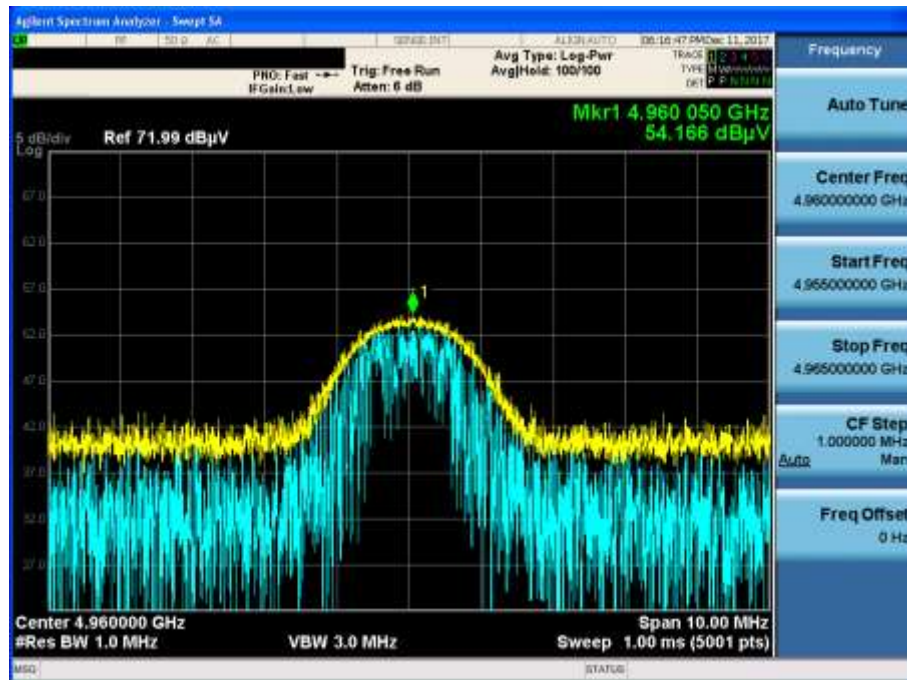
## 8DPSK &amp; Highest &amp; X &amp; Hor

Detector Mode : PK



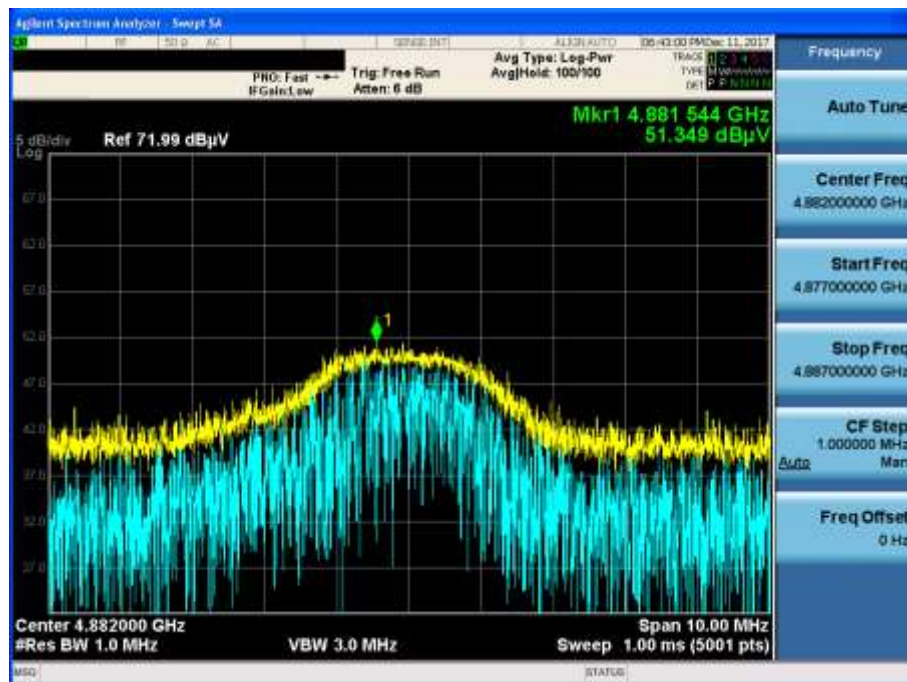
GFSK & Highest & Z & Hor

Detector Mode : PK



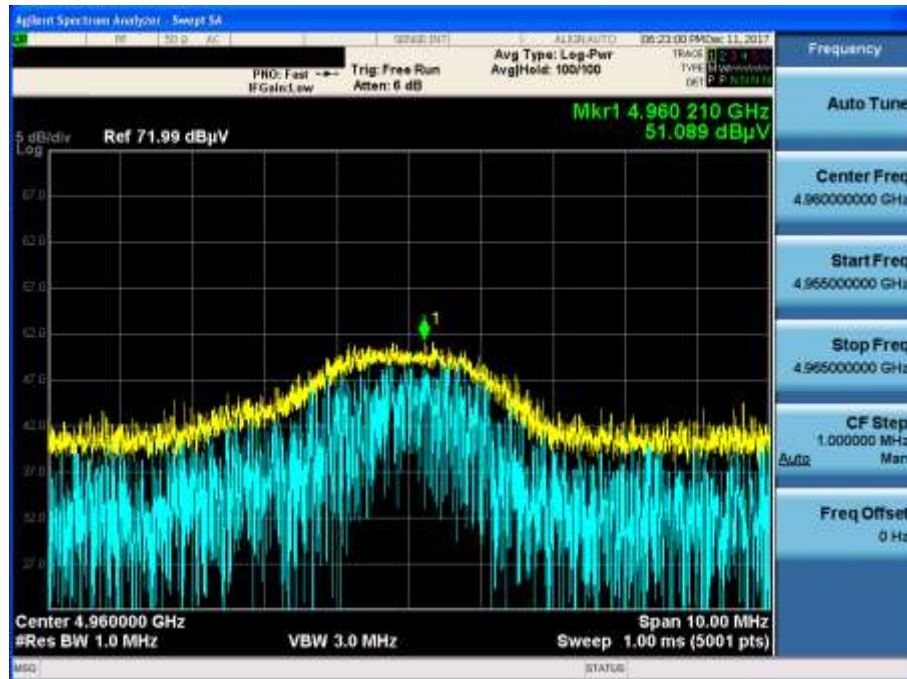
$\pi/4$ DQPSK & Middle & Z & Hor

Detector Mode : PK



8DPSK & Highest & Z & Hor

Detector Mode : PK

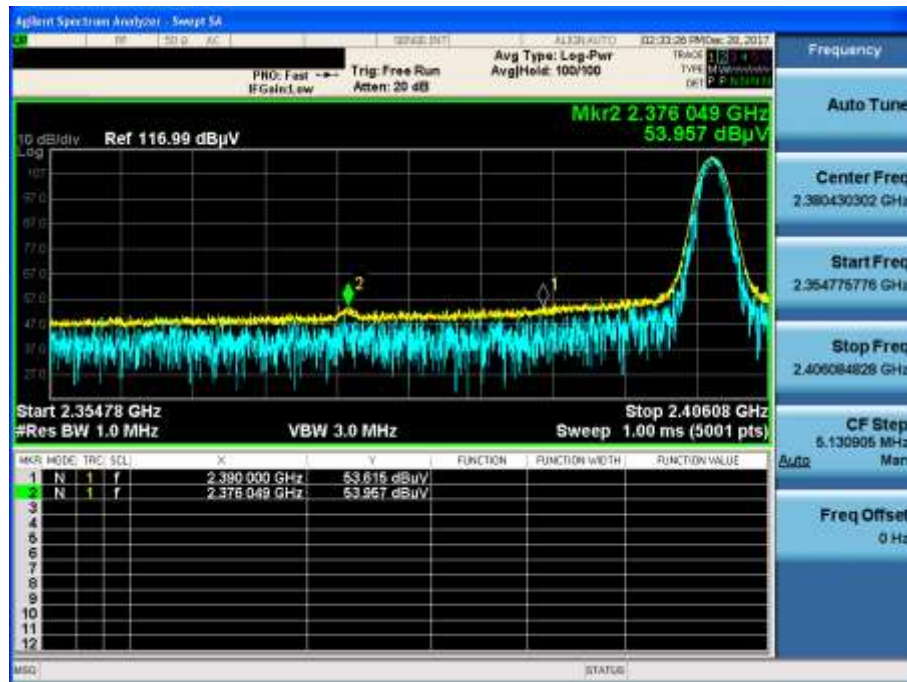




## Module 2(Enternal Antenna 1)

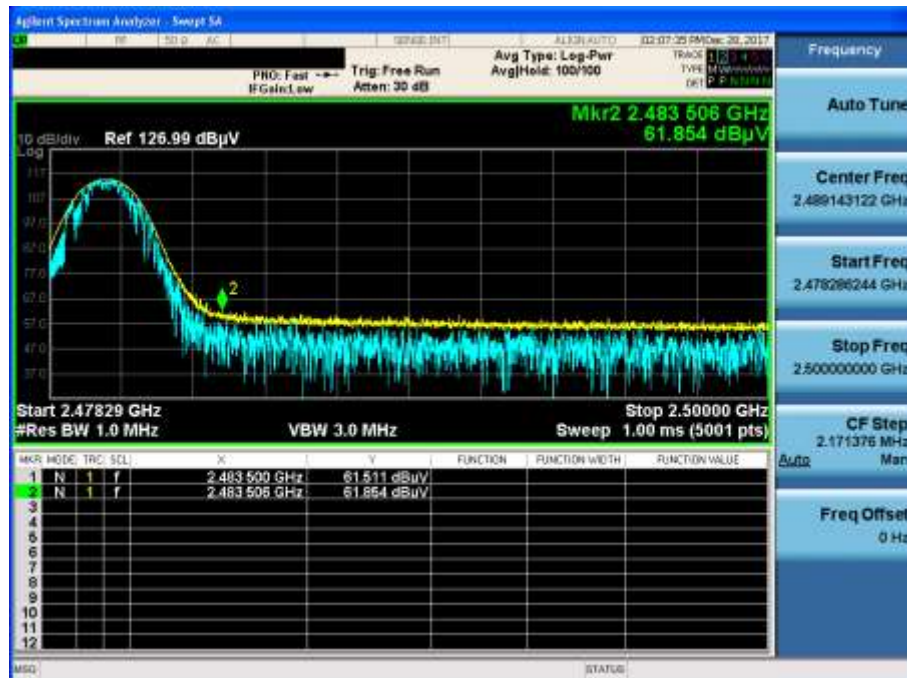
## GFSK &amp; Lowest &amp; X &amp; Hor

Detector Mode : PK



## GFSK &amp; Highest &amp; X &amp; Hor

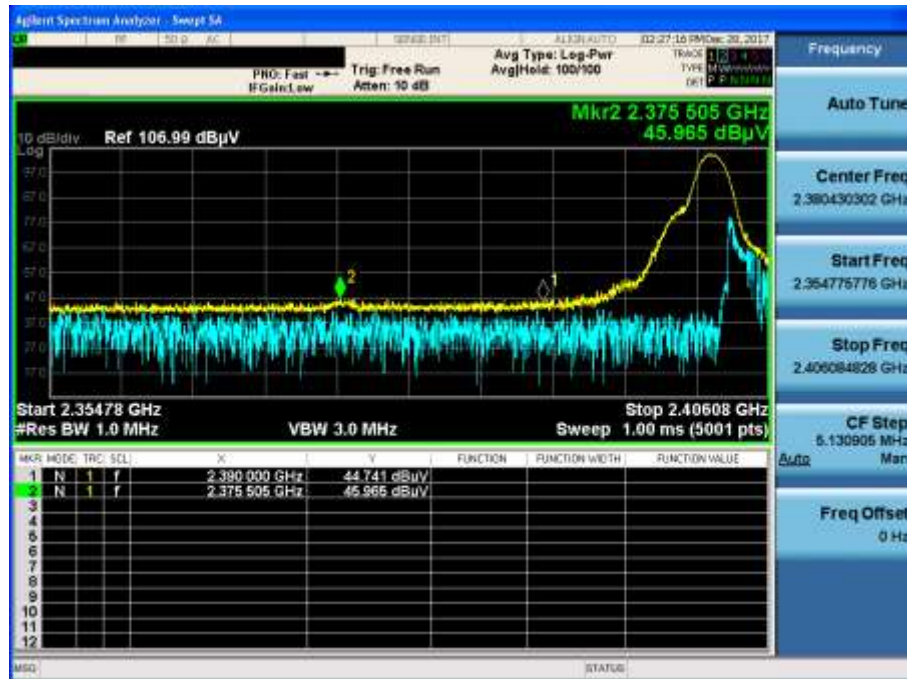
Detector Mode : PK





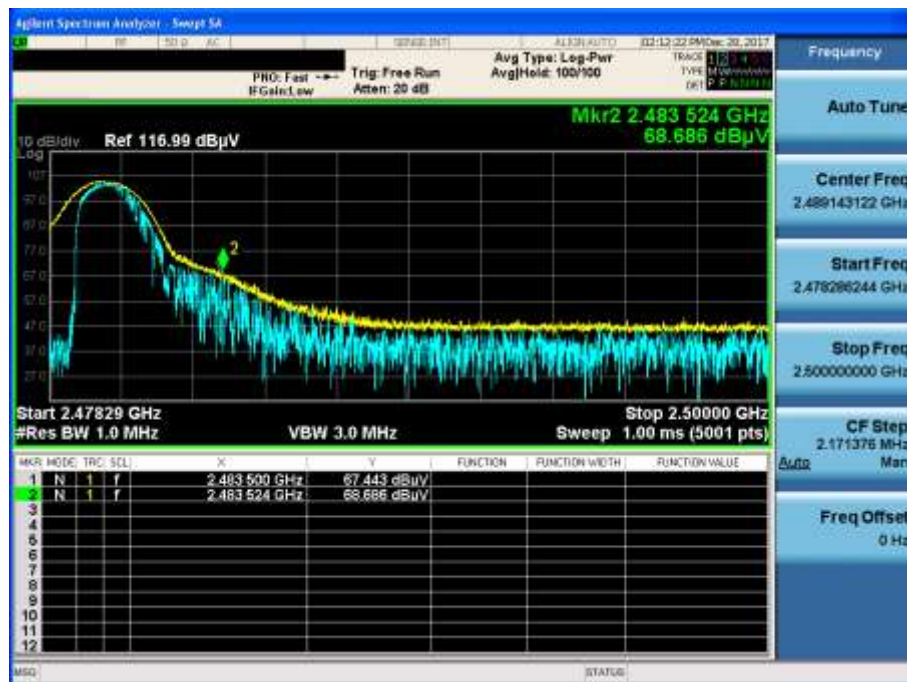
$\pi/4$ DQPSK & Lowest & X & Hor

Detector Mode : PK



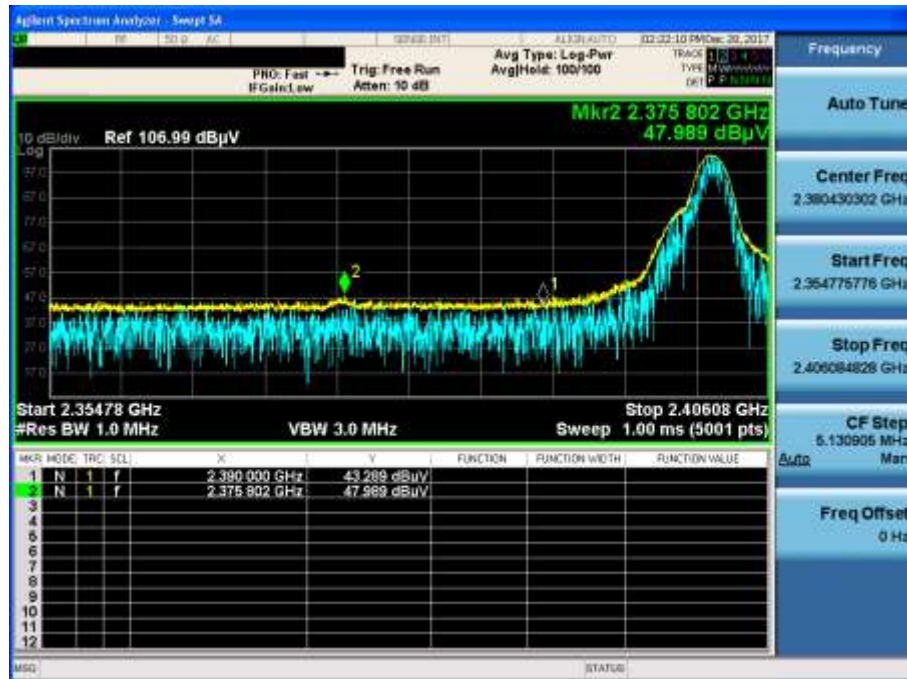
$\pi/4$ DQPSK & Highest & X & Hor

Detector Mode : PK



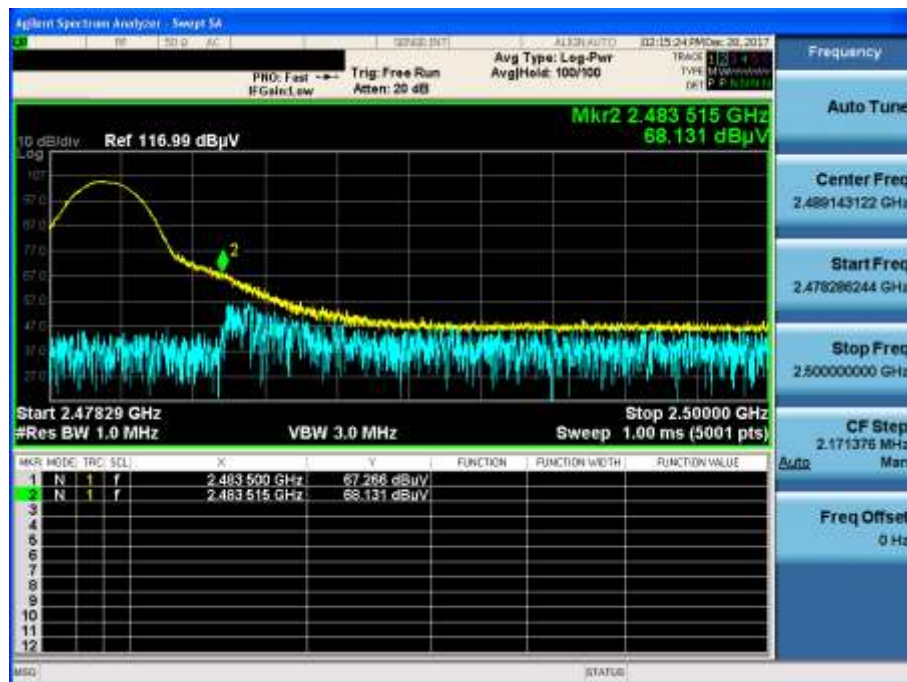
## 8DPSK &amp; Lowest &amp; X &amp; Hor

Detector Mode : PK



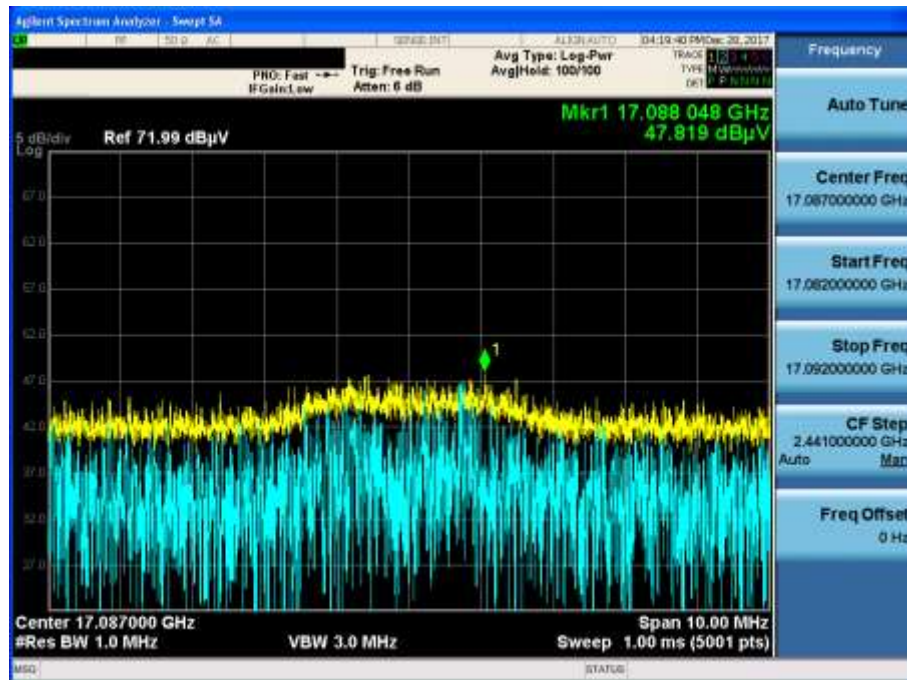
## 8DPSK &amp; Highest &amp; X &amp; Hor

Detector Mode : PK

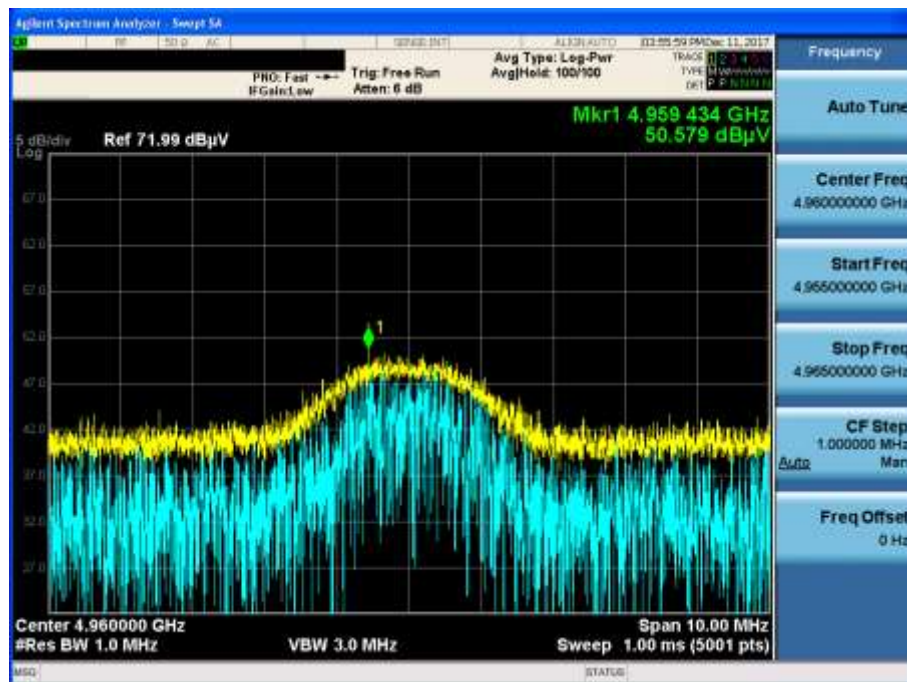


## GFSK &amp; Middle &amp; Y &amp; Ver

Detector Mode : PK

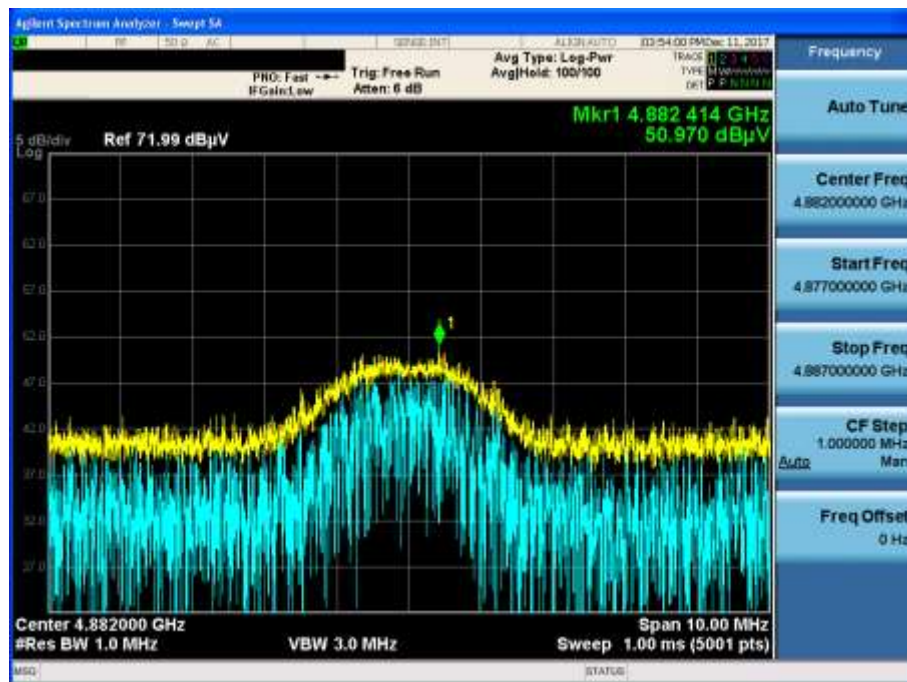
 $\pi/4$ DQPSK & Highest & Z & Ver

Detector Mode : PK



8DPSK & Middle & Z & Ver

Detector Mode : PK

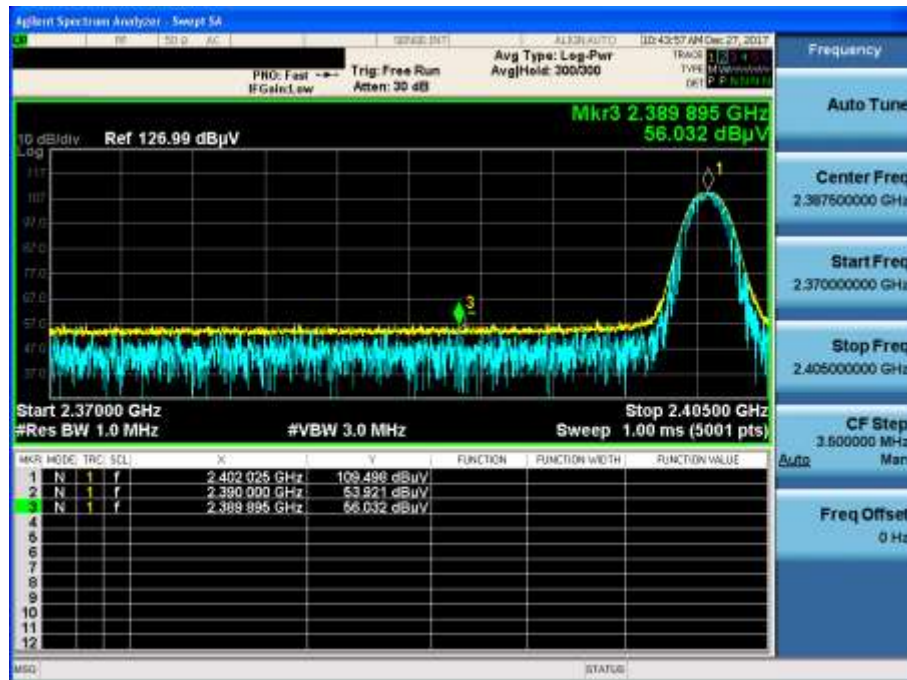




## Module 2(Enternal Antenna 2)

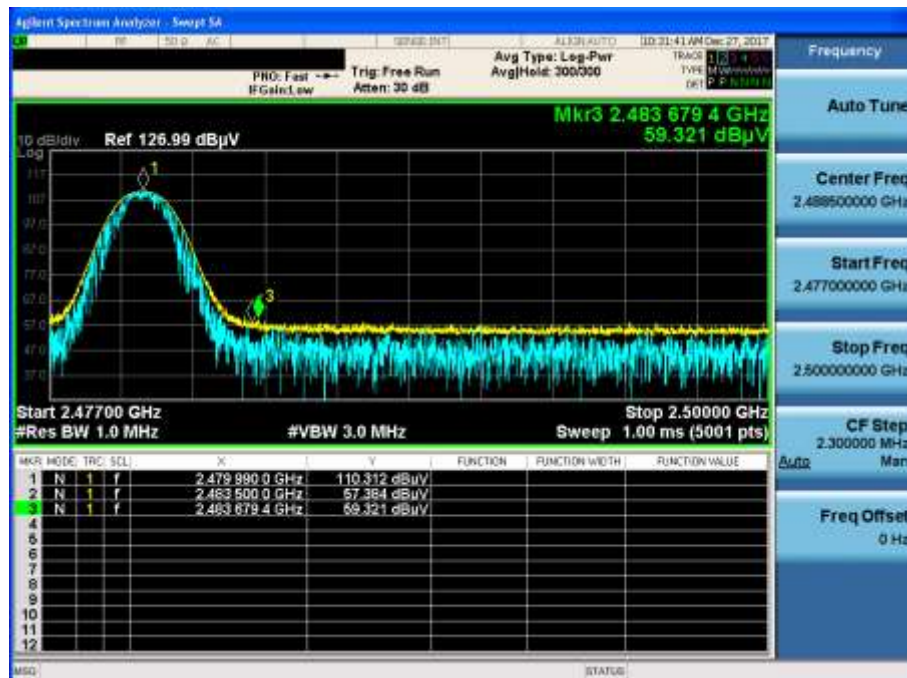
GFSK &amp; Lowest &amp; Y &amp; Ver

Detector Mode : PK



GFSK &amp; Highest &amp; Y &amp; Ver

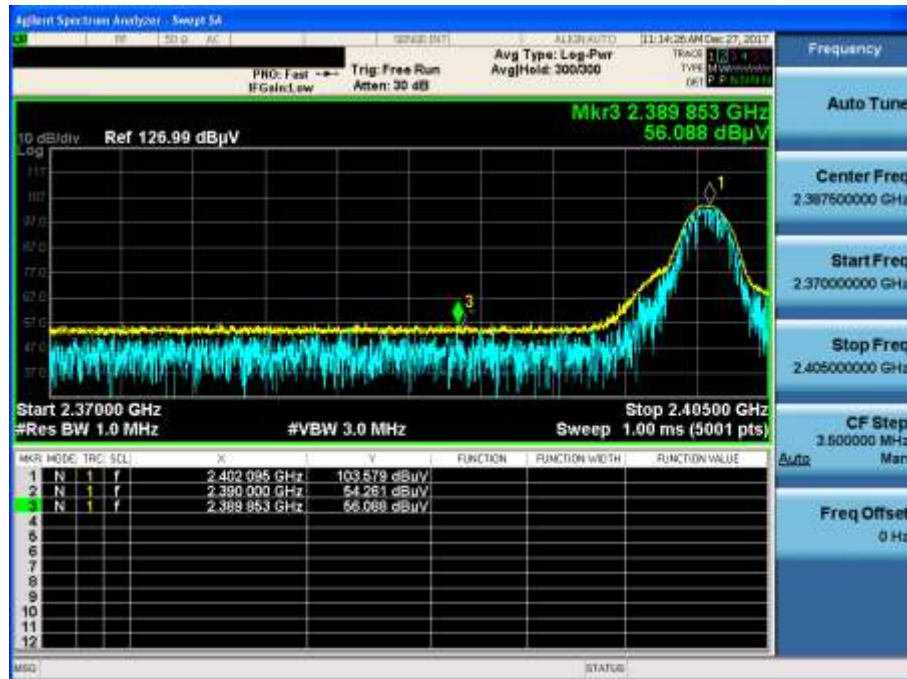
Detector Mode : PK



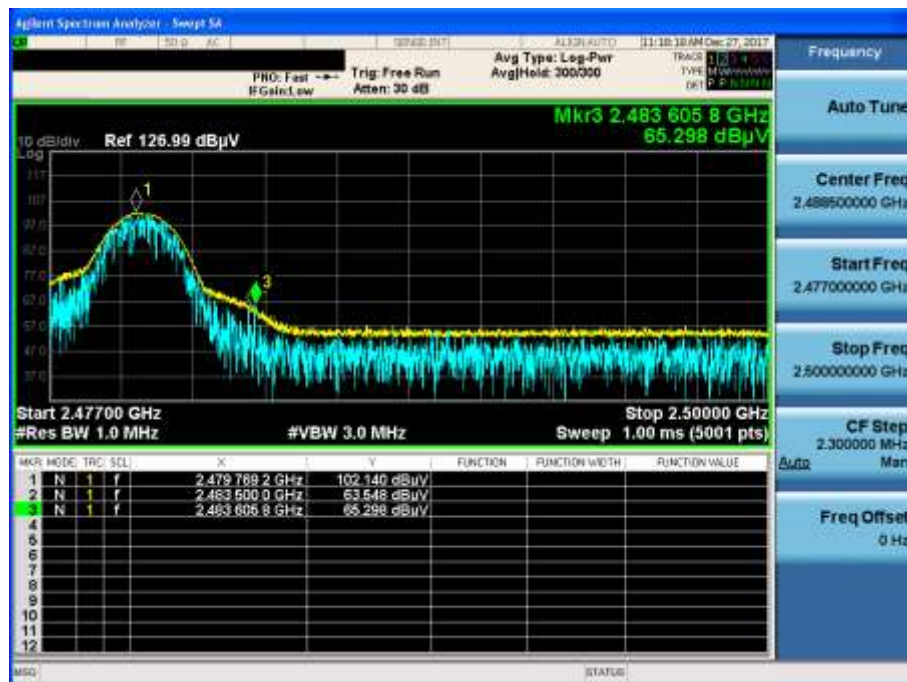


$\pi$ /4DQPSK & Lowest & X & Hor

Detector Mode : PK

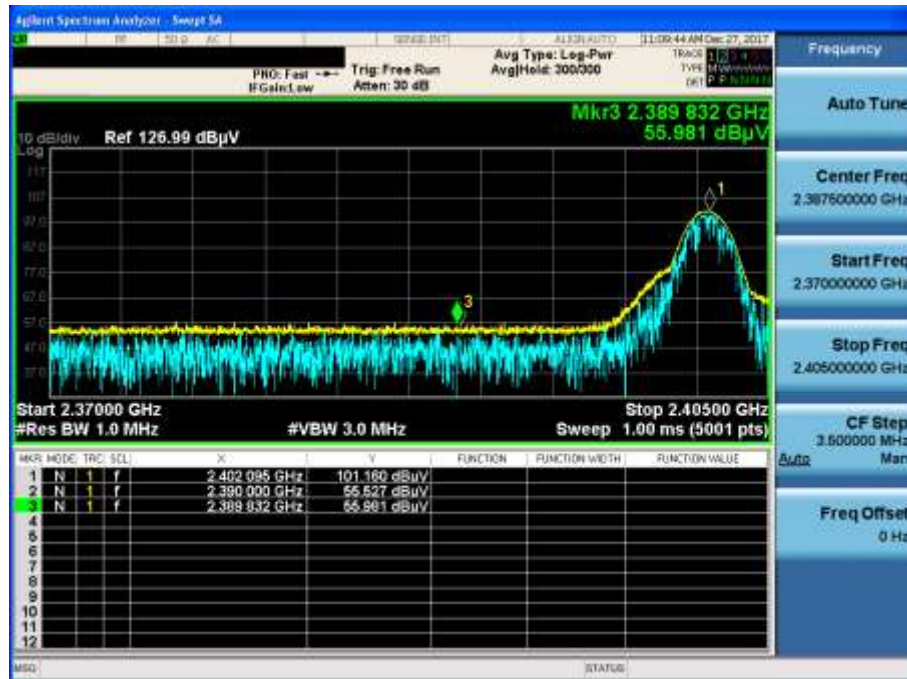
 $\pi$ /4DQPSK & Highest & X & Hor

Detector Mode : PK



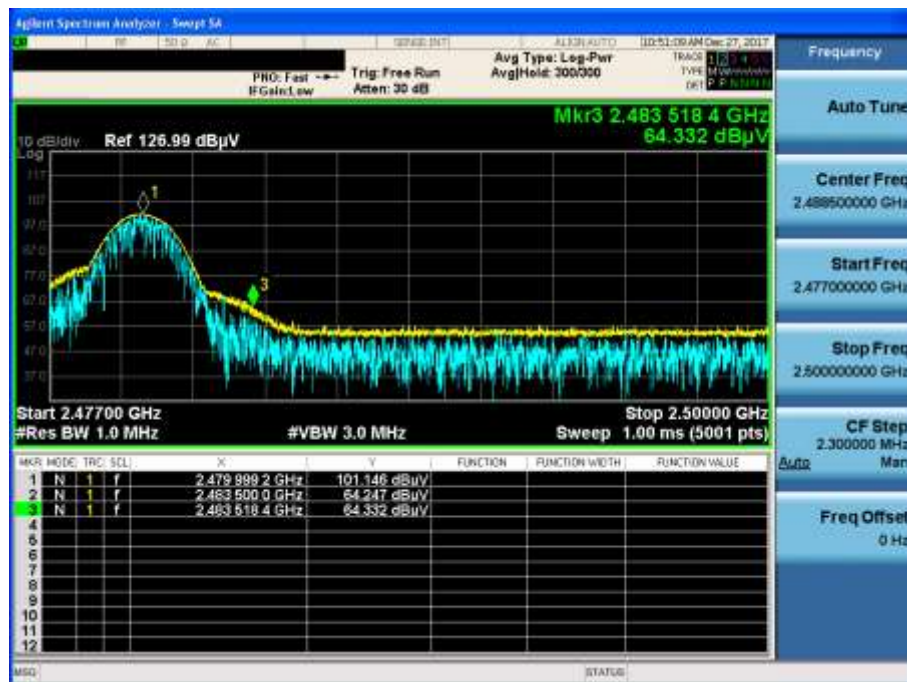
## 8DPSK &amp; Lowest &amp; X &amp; Hor

Detector Mode : PK



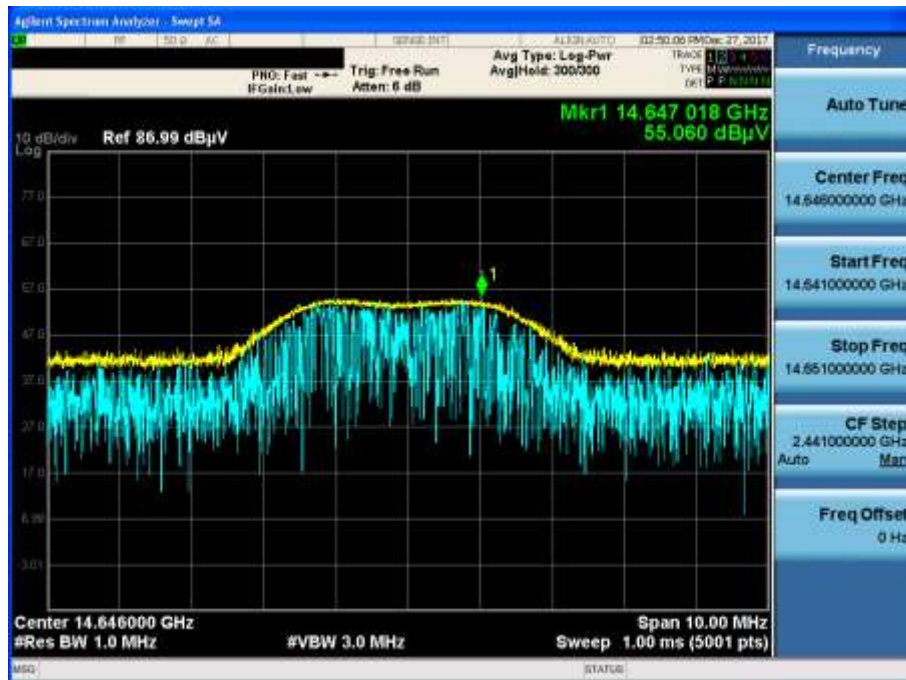
## 8DPSK &amp; Highest &amp; X &amp; Hor

Detector Mode : PK

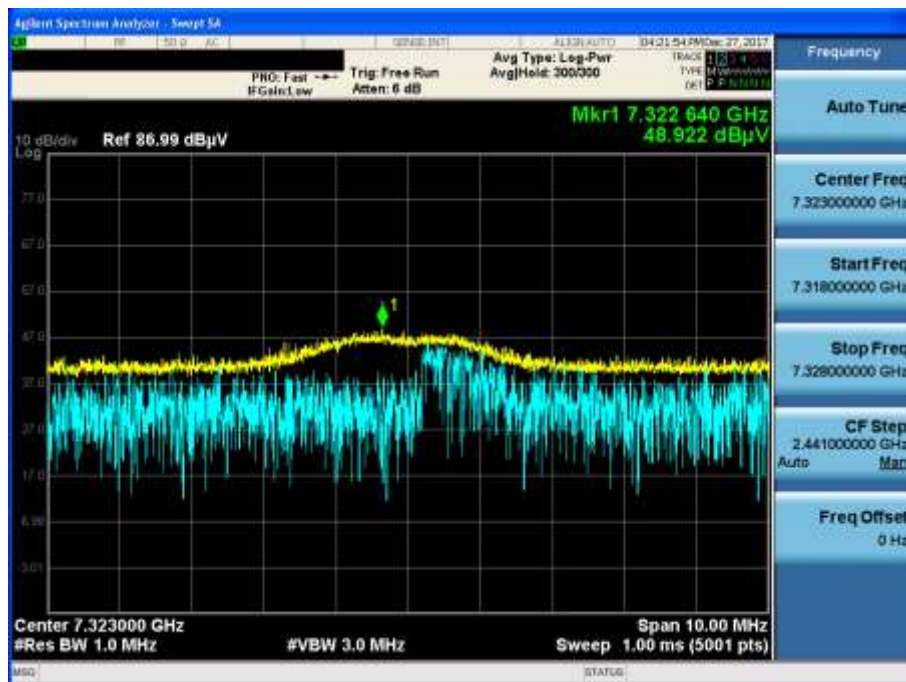


## GFSK &amp; Middle &amp; Z &amp; Ver

Detector Mode : PK

 $\pi/4$ DQPSK & Middle & Z & Ver

Detector Mode : PK



8DPSK & Lowest & Z & Ver

Detector Mode : PK

