9 kHz ~ 25 GHz Data (Modulation : *8DPSK*)

▪ Lowest Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2387.47	H	X	PK	45.66	0.69	N/A	N/A	46.35	74.00	27.65
2387.47	H	X	AV	45.66	0.69	-24.79	N/A	21.56	54.00	32.44
4804.03	H	Z	PK	44.11	4.77	N/A	N/A	48.88	74.00	25.12
4804.03	H	Z	AV	44.11	4.77	-24.79	N/A	24.09	54.00	29.91

▪ Middle Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4882.27	H	Z	PK	44.11	5.11	N/A	N/A	49.22	74.00	24.78
4882.27	H	Z	AV	44.11	5.11	-24.79	N/A	24.43	54.00	29.57

▪ Highest Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.56	H	X	PK	49.24	0.94	N/A	N/A	50.18	74.00	23.82
2483.56	H	X	AV	49.24	0.94	-24.79	N/A	25.39	54.00	28.61
4959.95	H	Z	PK	43.97	5.34	N/A	N/A	49.31	74.00	24.69
4959.95	H	Z	AV	43.97	5.34	-24.79	N/A	24.52	54.00	29.48

▪ **Note.**

1. The radiated emissions were investigated up to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

   For finding emissions, the test distance might be reduced from 3m to 1m.　In this case, the distance factor(-9.54dB) is applied to the result.

   - Calculation of distance factor = 20 log(applied distance / required distance) = **20 log(1 m / 3 m)** = **-9.54 dB**

   When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

   - Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = **2.88 ms**

   - 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = **100 / (2.88 X 20)** = **1.74** ≒ **2**

   - The Worst Case Dwell Time = T [ms] x H' = **2.88 ms X 2** = **5.76 ms**

   - D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = **20 log(5.76 / 100)** = **-24.79 dB**

4. Sample Calculation.

   Margin = Limit – Result　/　Result = Reading + T.F + D.C.F　/　T.F = AF + CL – AG

   Where, T.F = Total Factor,　AF = Antenna Factor,　CL = Cable Loss,　AG = Amplifier Gain.

9 kHz ~ 25 GHz Data (Modulation : *GFSK*) _ Wireless Charging

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2388.17	H	X	PK	45.49	0.69	N/A	N/A	46.18	74.00	27.82
2388.17	H	X	AV	45.49	0.69	-24.79	N/A	21.39	54.00	32.61
4804.13	H	X	PK	44.64	4.77	N/A	N/A	49.41	74.00	24.59
4804.13	H	X	AV	44.64	4.77	-24.79	N/A	24.62	54.00	29.38

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4881.72	H	X	PK	44.14	5.10	N/A	N/A	49.24	74.00	24.76
4881.72	H	X	AV	44.14	5.10	-24.79	N/A	24.45	54.00	29.55

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.52	H	X	PK	50.04	0.94	N/A	N/A	50.98	74.00	23.02
2483.52	H	X	AV	50.04	0.94	-24.79	N/A	26.19	54.00	27.81
4959.70	H	X	PK	44.38	5.34	N/A	N/A	49.72	74.00	24.28
4959.70	H	X	AV	44.38	5.34	-24.79	N/A	24.93	54.00	29.07

▪ **Note.**

1. The radiated emissions were investigated up to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

  For finding emissions, the test distance might be reduced from 3m to 1m.　In this case, the distance factor(-9.54dB) is applied to the result.

   - Calculation of distance factor = 20 log(applied distance / required distance) = **20 log(1 m / 3 m)** = **-9.54 dB**

  When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

   - Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = **2.88 ms**

   - 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = **100 / (2.88 X 20)** = **1.74** ≒ **2**

   - The Worst Case Dwell Time = T [ms] x H' = **2.88 ms X 2** = **5.76 ms**

   - D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = **20 log(5.76 / 100)** = **-24.79 dB**

4. Sample Calculation.

  Margin = Limit – Result　/　Result = Reading + T.F + D.C.F　/　T.F = AF + CL – AG

  Where, T.F = Total Factor,　AF = Antenna Factor,　CL = Cable Loss,　AG = Amplifier Gain.

9 kHz ~ 25 GHz Data (Modulation : π/4DQPSK) _ Wireless Charging

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2388.08	H	X	PK	45.55	0.69	N/A	N/A	46.24	74.00	27.76
2388.08	H	X	AV	45.55	0.69	-24.79	N/A	21.45	54.00	32.55
4803.72	H	X	PK	43.94	4.77	N/A	N/A	48.71	74.00	25.29
4803.72	H	X	AV	43.94	4.77	-24.79	N/A	23.92	54.00	30.08

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4882.22	H	X	PK	44.99	5.11	N/A	N/A	50.10	74.00	23.90
4882.22	H	X	AV	44.99	5.11	-24.79	N/A	25.31	54.00	28.69

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.58	H	X	PK	48.20	0.94	N/A	N/A	49.14	74.00	24.86
2483.58	H	X	AV	48.20	0.94	-24.79	N/A	24.35	54.00	29.65
4959.93	H	X	PK	44.66	5.34	N/A	N/A	50.00	74.00	24.00
4959.93	H	X	AV	44.66	5.34	-24.79	N/A	25.21	54.00	28.79

▪ **Note.**

1. The radiated emissions were investigated up to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

   For finding emissions, the test distance might be reduced from 3m to 1m.   In this case, the distance factor(-9.54dB) is applied to the result.

   - Calculation of distance factor = 20 log(applied distance / required distance) = **20 log(1 m / 3 m)** = **-9.54 dB**

   When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

   - Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = **2.88 ms**

   - 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = **100 / (2.88 X 20)** = **1.74 ≒ 2**

   - The Worst Case Dwell Time = T [ms] x H' = **2.88 ms X 2** = **5.76 ms**

   - D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = **20 log(5.76 / 100)** = **-24.79 dB**

4. Sample Calculation.

   Margin = Limit – Result   /   Result = Reading + T.F + D.C.F   /   T.F = AF + CL – AG

   Where, T.F = Total Factor,   AF = Antenna Factor,   CL = Cable Loss,   AG = Amplifier Gain.

.

9 kHz ~ 25 GHz Data (Modulation : *8DPSK*) _ Wireless Charging

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.76	H	X	PK	46.04	0.70	N/A	N/A	46.74	74.00	27.26
2389.76	H	X	AV	46.04	0.70	-24.79	N/A	21.95	54.00	32.05
4804.39	H	X	PK	44.48	4.77	N/A	N/A	49.25	74.00	24.75
4804.39	H	X	AV	44.48	4.77	-24.79	N/A	24.46	54.00	29.54

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4881.72	H	X	PK	44.54	5.10	N/A	N/A	49.64	74.00	24.36
4881.72	H	X	AV	44.54	5.10	-24.79	N/A	24.85	54.00	29.15

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.67	H	X	PK	49.38	0.94	N/A	N/A	50.32	74.00	23.68
2483.67	H	X	AV	49.38	0.94	-24.79	N/A	25.53	54.00	28.47
4959.82	H	X	PK	44.18	5.34	N/A	N/A	49.52	74.00	24.48
4959.82	H	X	AV	44.18	5.34	-24.79	N/A	24.73	54.00	29.27

▪ **Note.**

1. The radiated emissions were investigated up to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

   For finding emissions, the test distance might be reduced from 3m to 1m.   In this case, the distance factor(-9.54dB) is applied to the result.

   - Calculation of distance factor = 20 log(applied distance / required distance) = **20 log(1 m / 3 m)** = **-9.54 dB**

   When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. D.C.F Calculation. (D.C.F = Duty Cycle Correction Factor)

   - Time to cycle through all channels = Δt = T [ms] X 20 minimum hopping channels , where T = pulse width = **2.88 ms**

   - 100 ms / Δt [ms] = H -> Round up to next highest integer, to account for worst case, H' = **100 / (2.88 X 20)** = **1.74 ≒ 2**

   - The Worst Case Dwell Time = T [ms] x H' = **2.88 ms X 2** = **5.76 ms**

   - D.C.F = 20 Log(The Worst Case Dwell Time / 100 ms) dB = **20 log(5.76 / 100)** = **-24.79 dB**

4. Sample Calculation.

   Margin = Limit – Result   /   Result = Reading + T.F + D.C.F   /   T.F = AF + CL – AG

   Where, T.F = Total Factor,   AF = Antenna Factor,   CL = Cable Loss,   AG = Amplifier Gain.
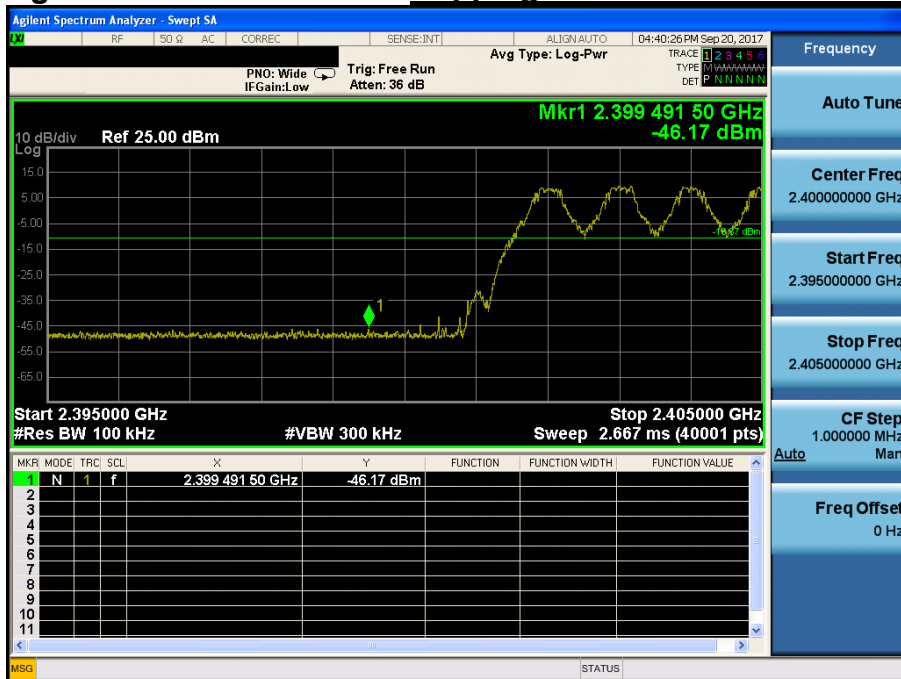
7.4.2. Conducted Spurious Emissions

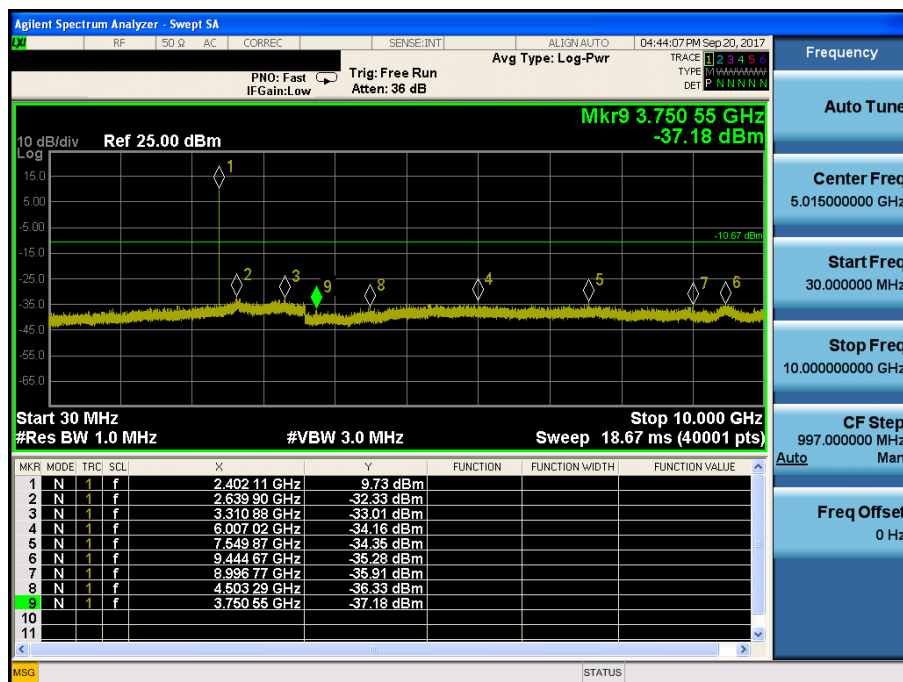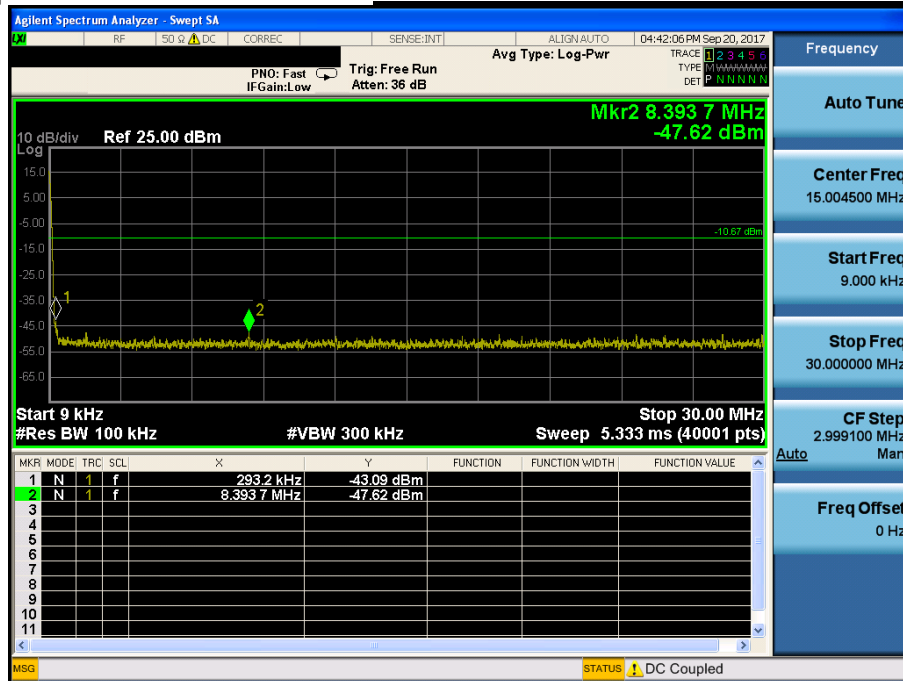**Low Band-edge**   *Lowest Channel & Modulation : GFSK*
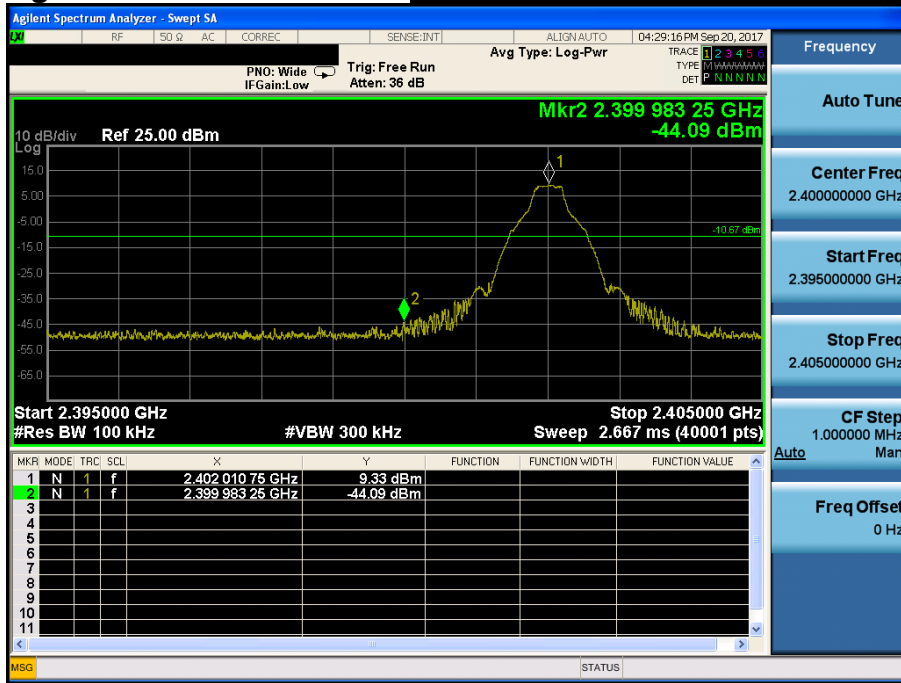
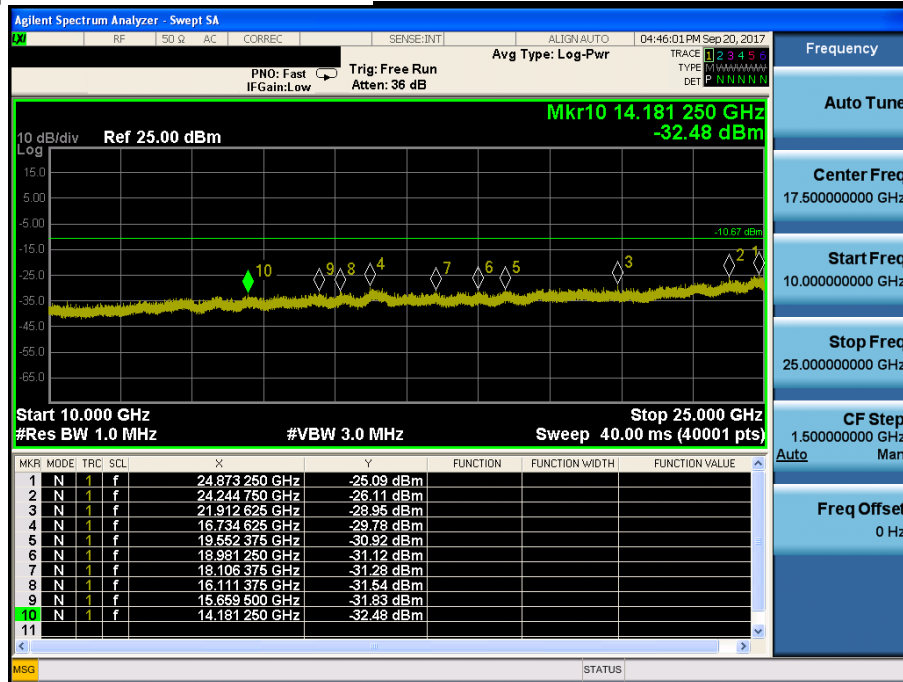**Low Band-edge**   *Hopping mode & Modulation : GFSK*

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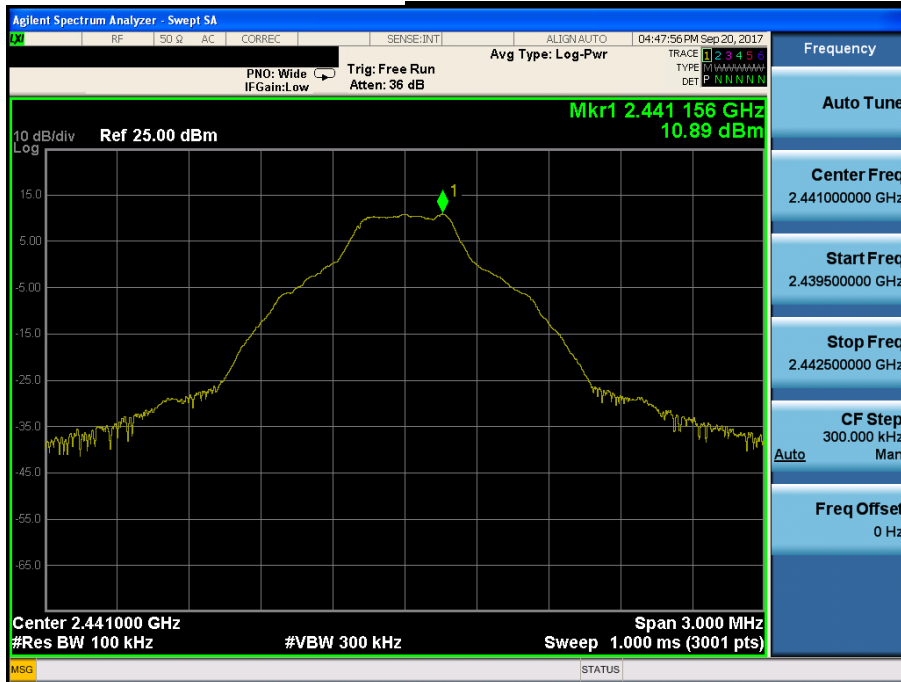
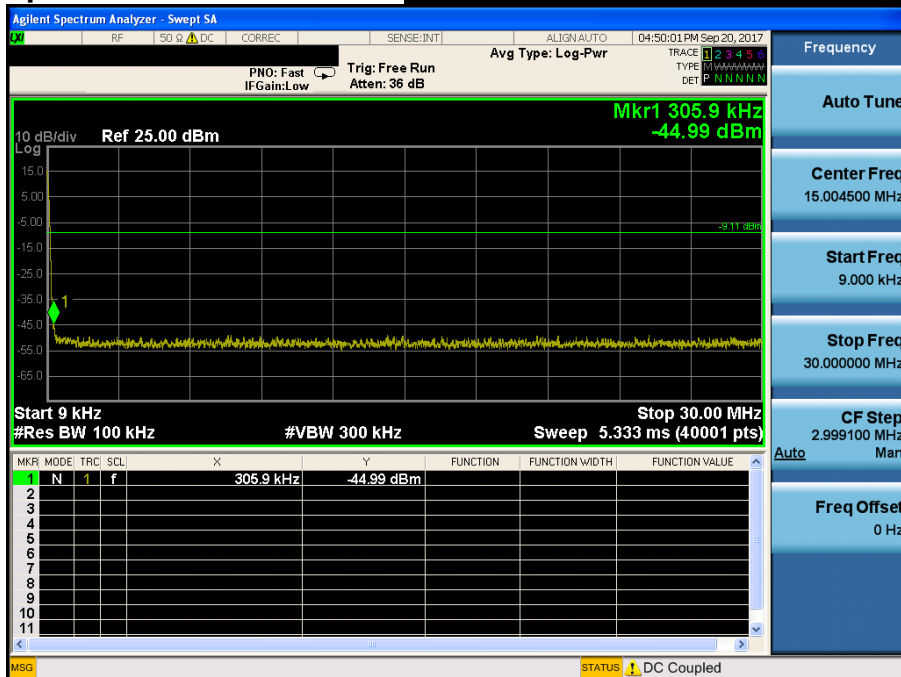## Conducted Spurious Emissions　　　*Lowest Channel & Modulation : GFSK*

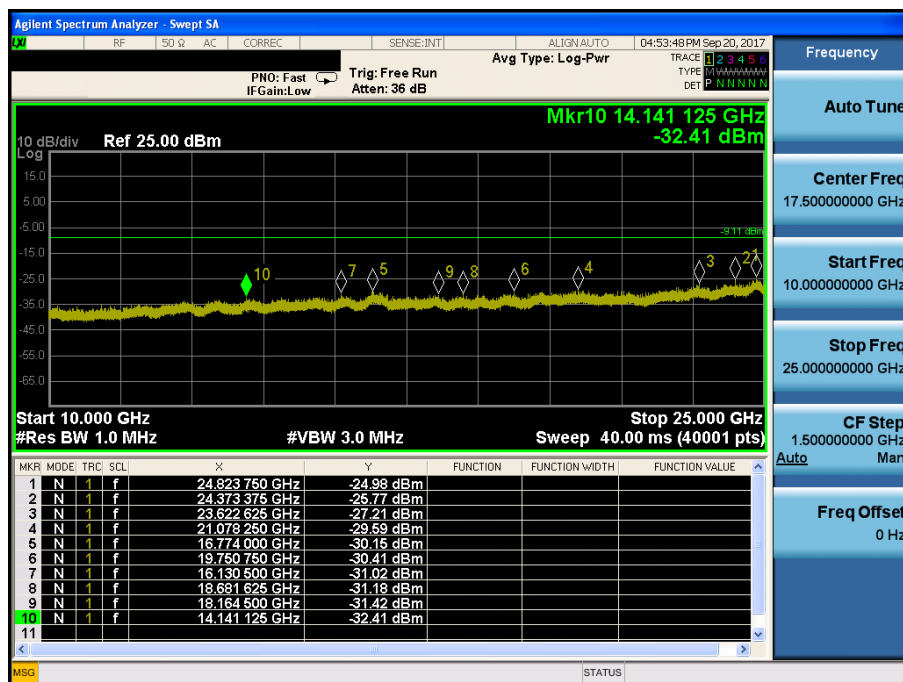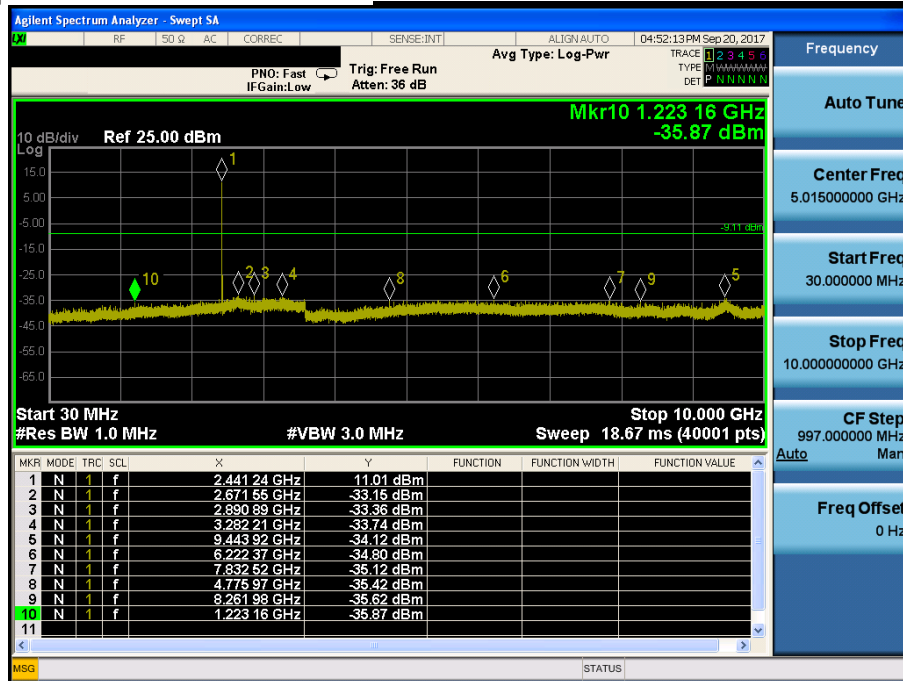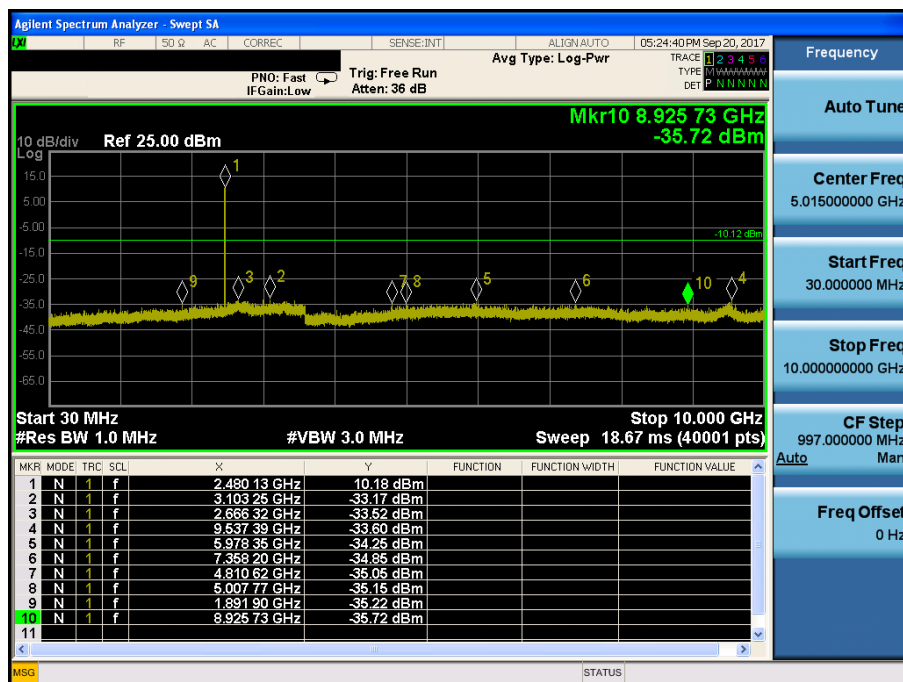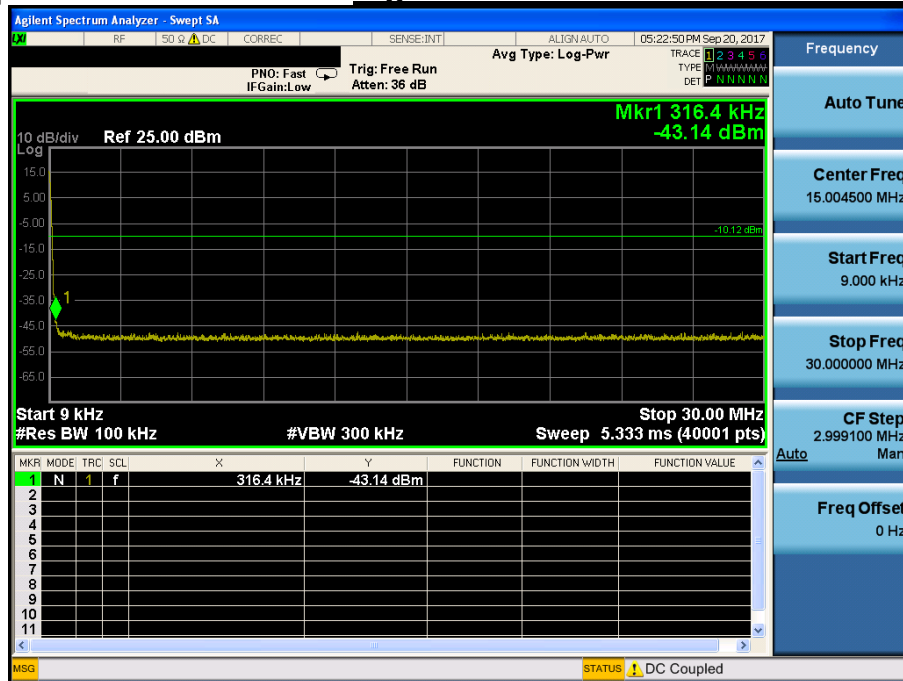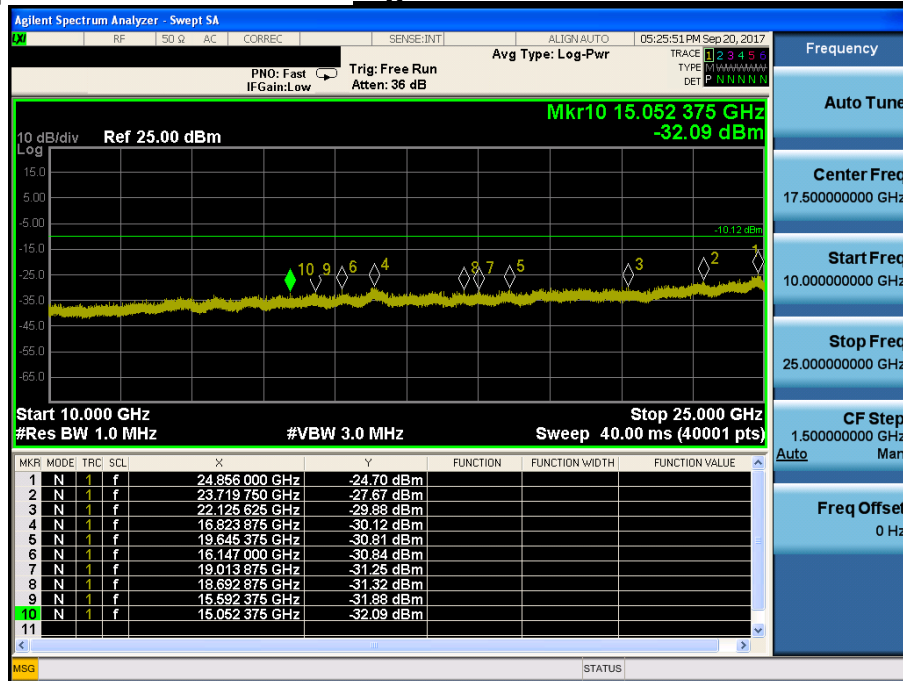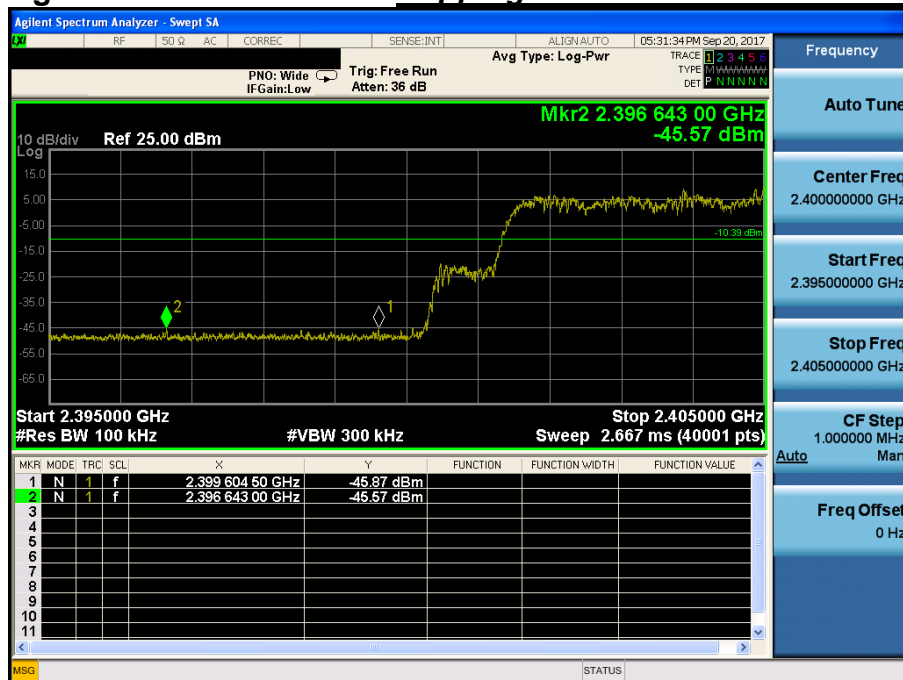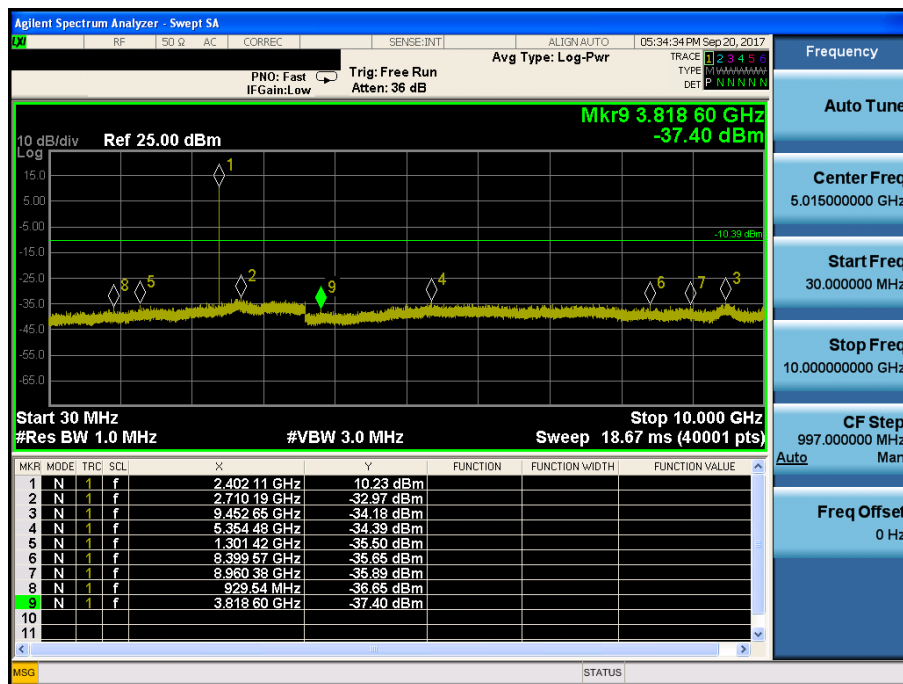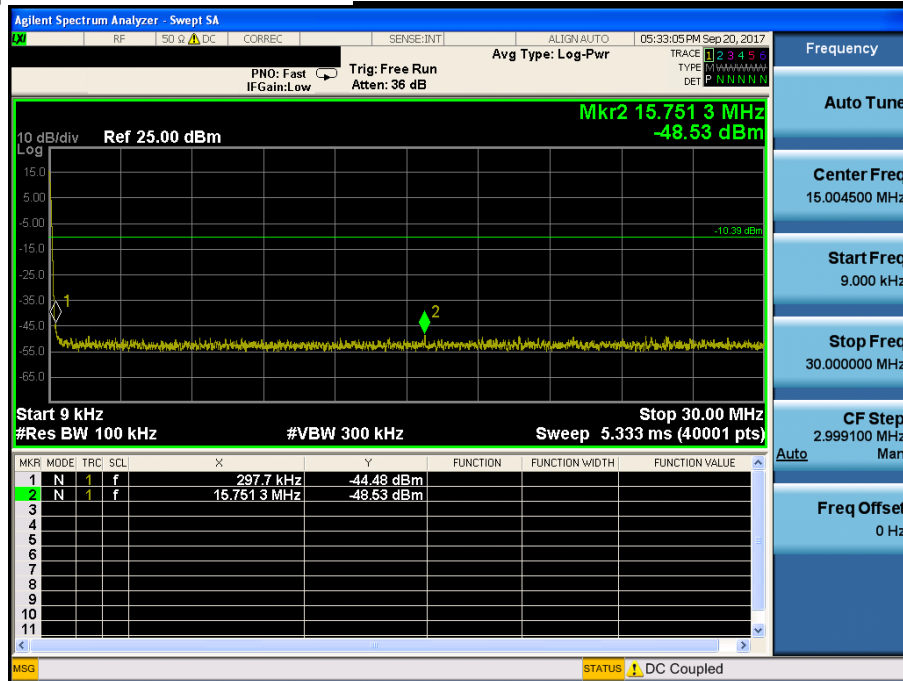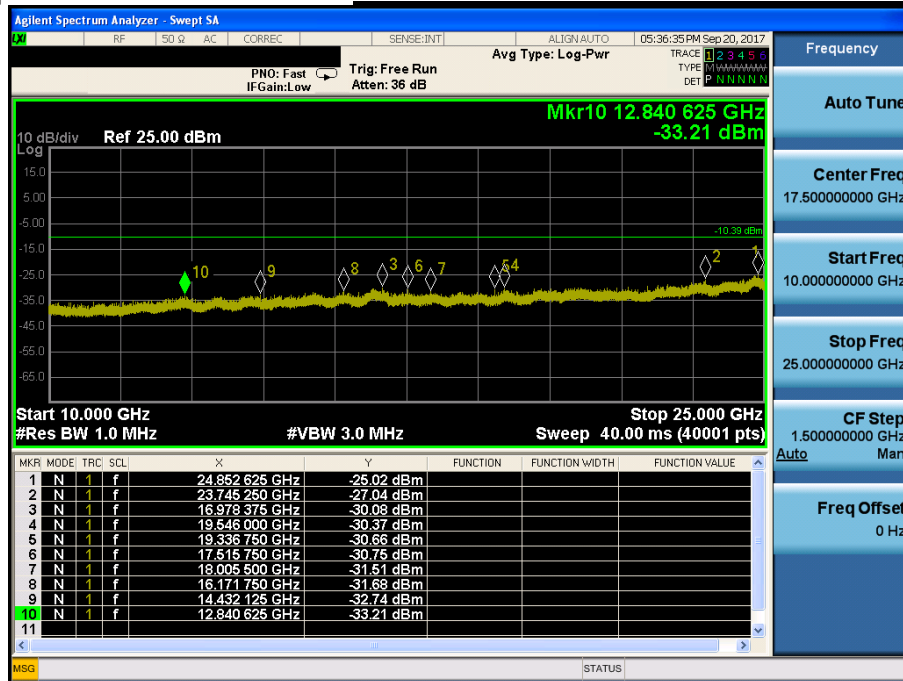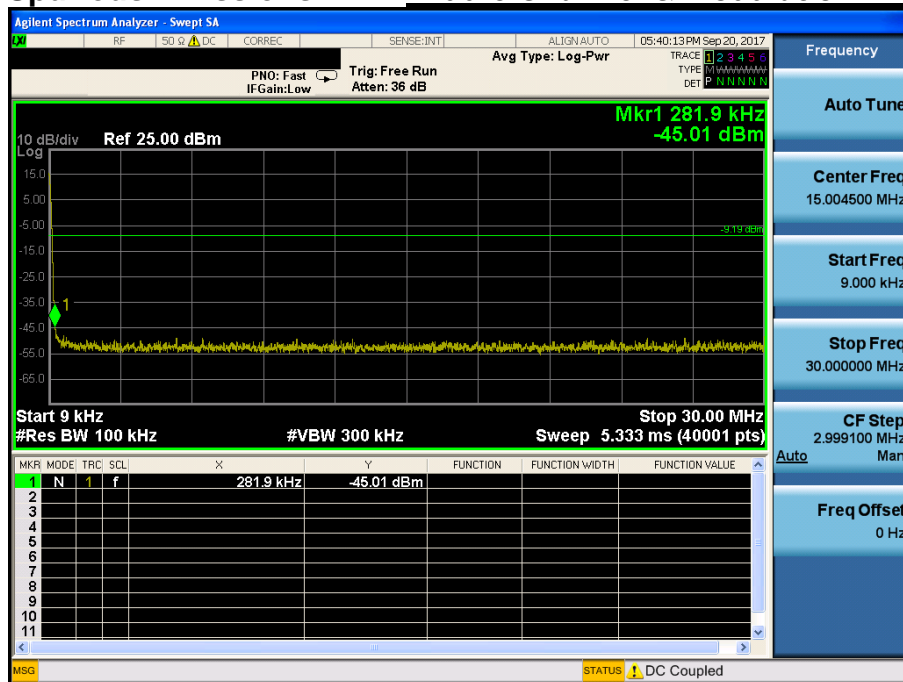## Reference for limit   *Middle Channel & Modulation : GFSK*

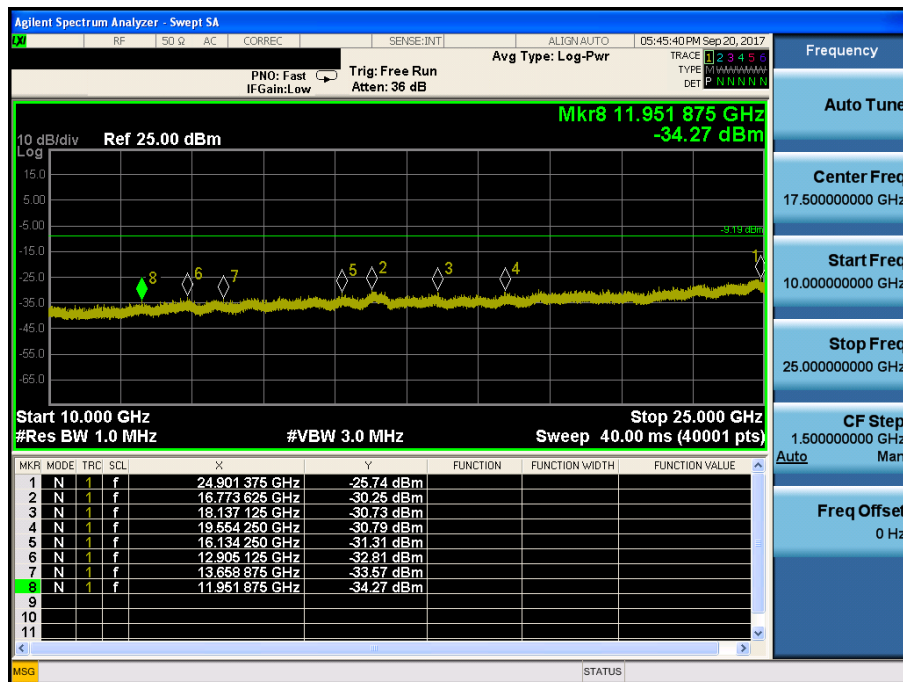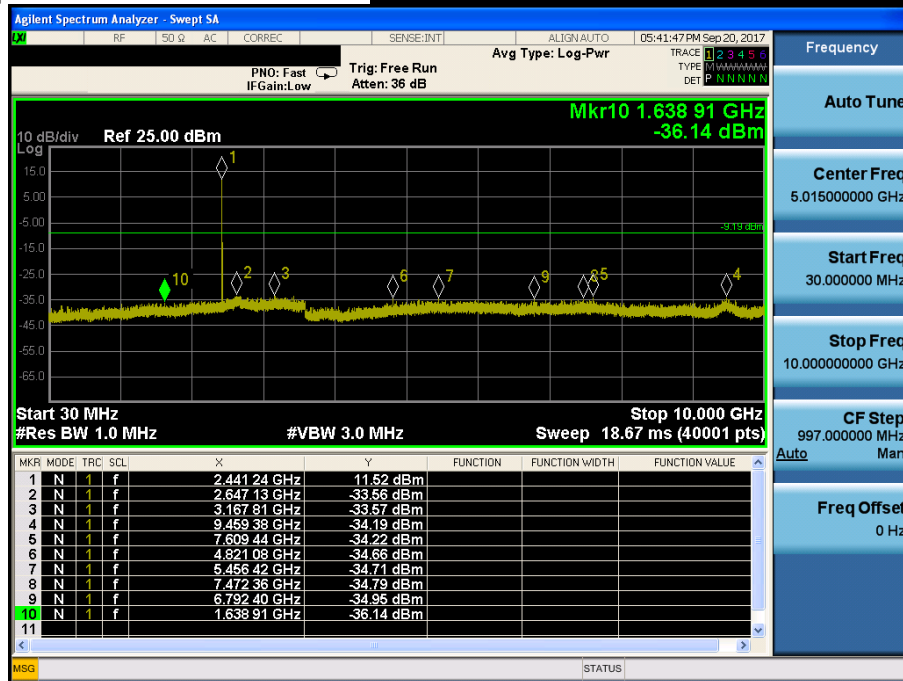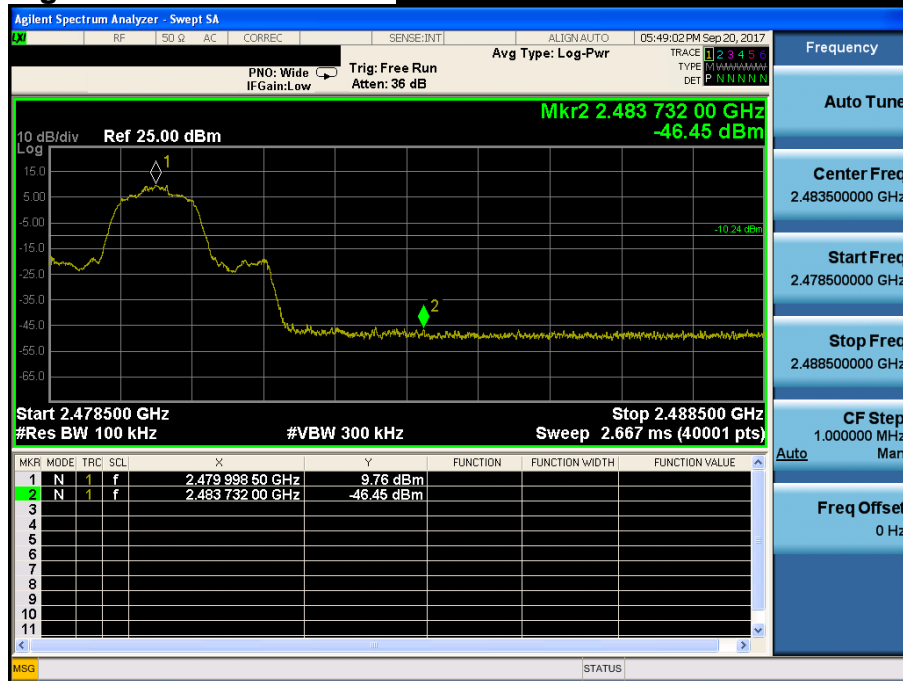## Conducted Spurious Emissions   *Middle Channel & Modulation : GFSK*

Conducted Spurious Emissions   *Middle Channel & Modulation : GFSK*

High Band-edge   *Highest Channel & Modulation : GFSK*
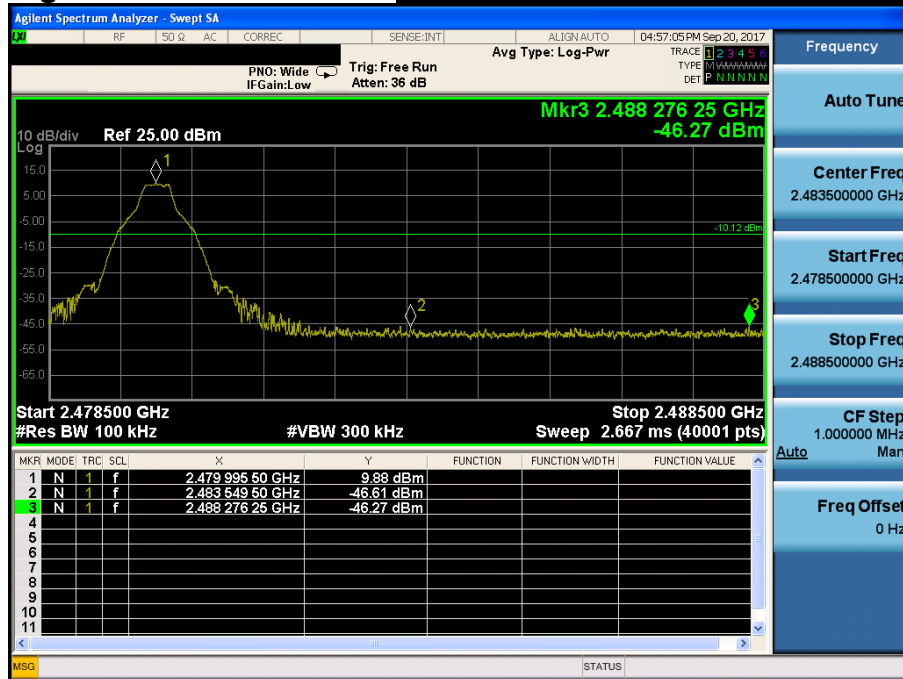
High Band-edge   *Hopping mode & Modulation : GFSK*

Conducted Spurious Emissions   *Highest Channel & Modulation : GFSK*

Conducted Spurious Emissions   *Highest Channel & Modulation : GFSK*

Low Band-edge   *Lowest Channel & Modulation : π/4DQPSK*

Low Band-edge   *Hopping mode & Modulation : π/4DQPSK*

Conducted Spurious Emissions   *Lowest Channel & Modulation : π/4DQPSK*

Conducted Spurious Emissions   *Lowest Channel & Modulation : π/4DQPSK*
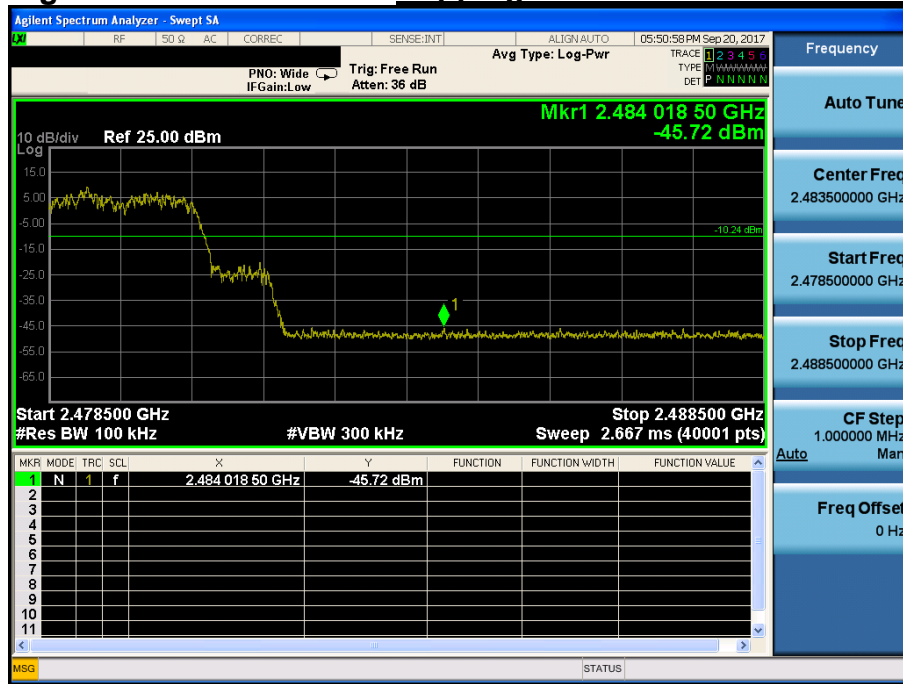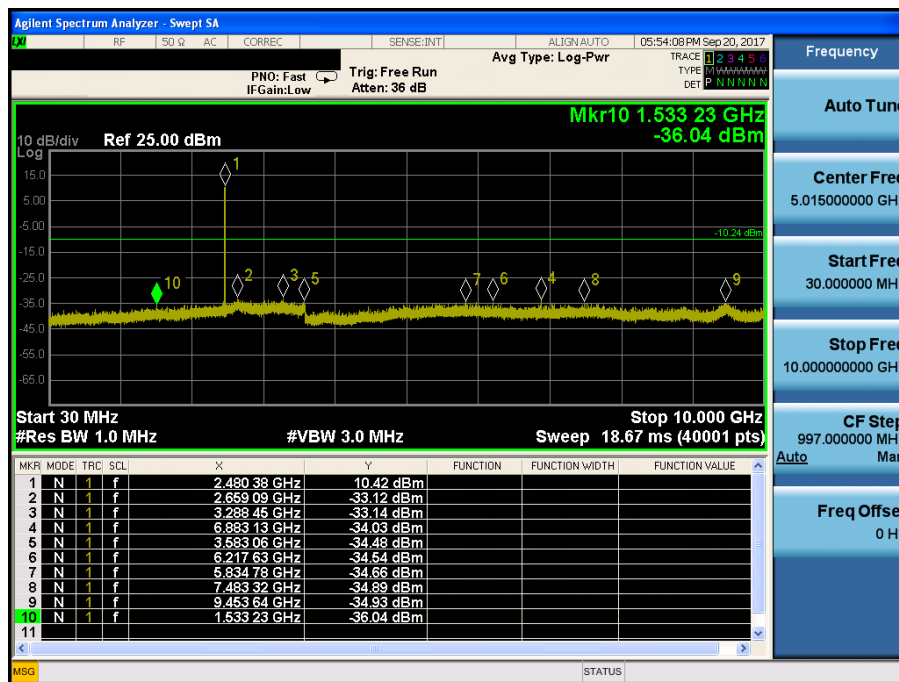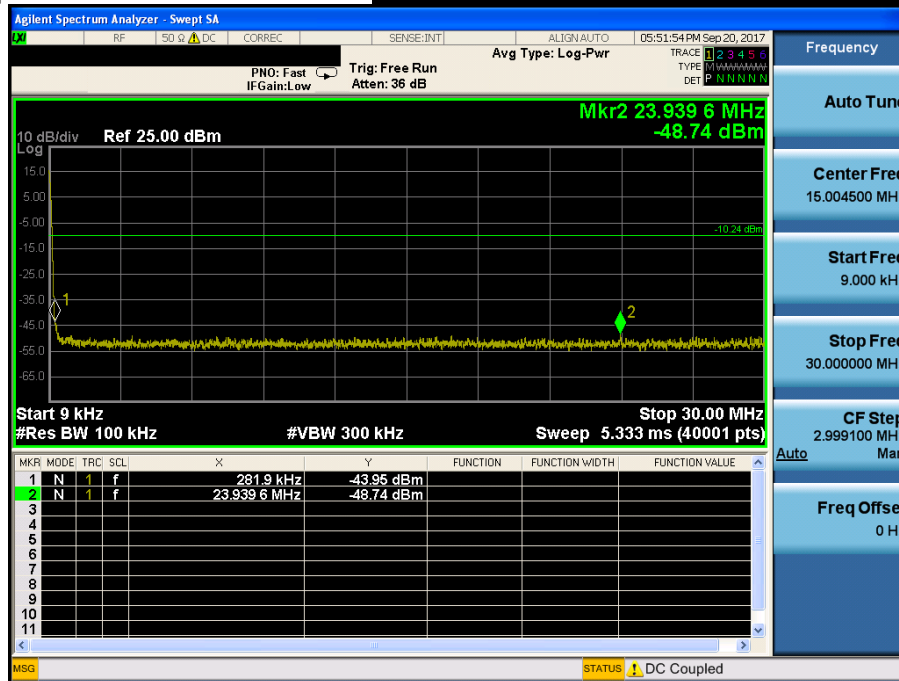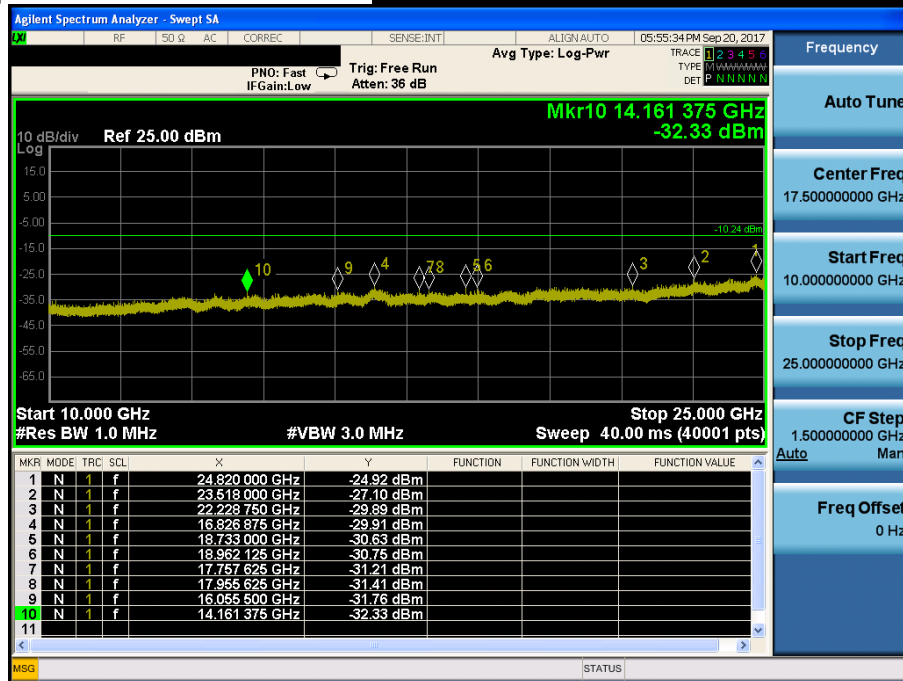
Reference for limit   *Middle Channel & Modulation : π/4DQPSK*

Conducted Spurious Emissions   *Middle Channel & Modulation : π/4DQPSK*

Conducted Spurious Emissions   *Middle Channel & Modulation : π/4DQPSK*

High Band-edge   *Highest Channel & Modulation : π/4DQPSK*

High Band-edge   *Hopping mode & Modulation : π/4DQPSK*

Conducted Spurious Emissions   *Highest Channel & Modulation : π/4DQPSK*
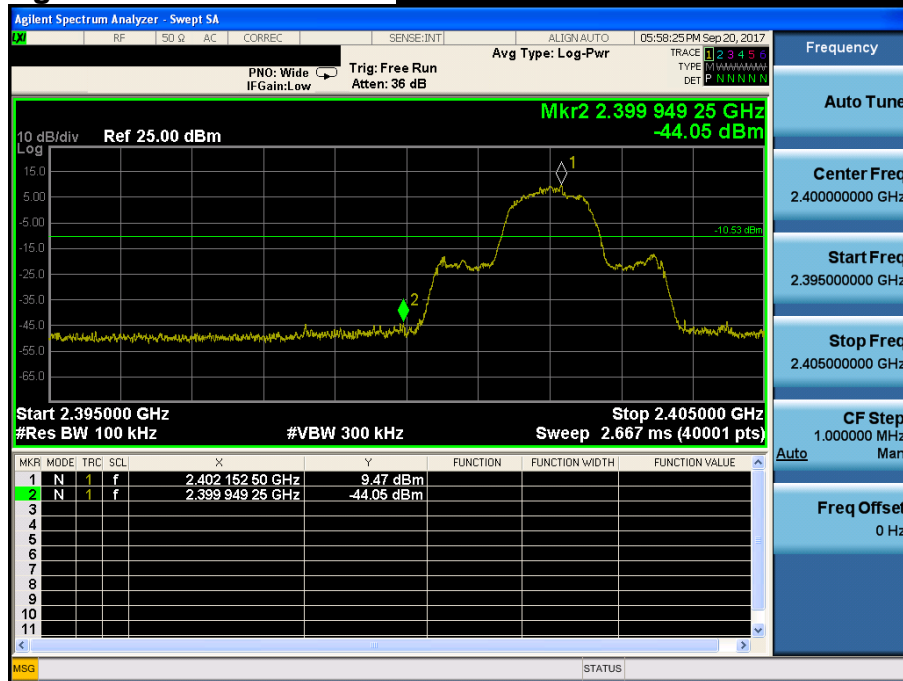
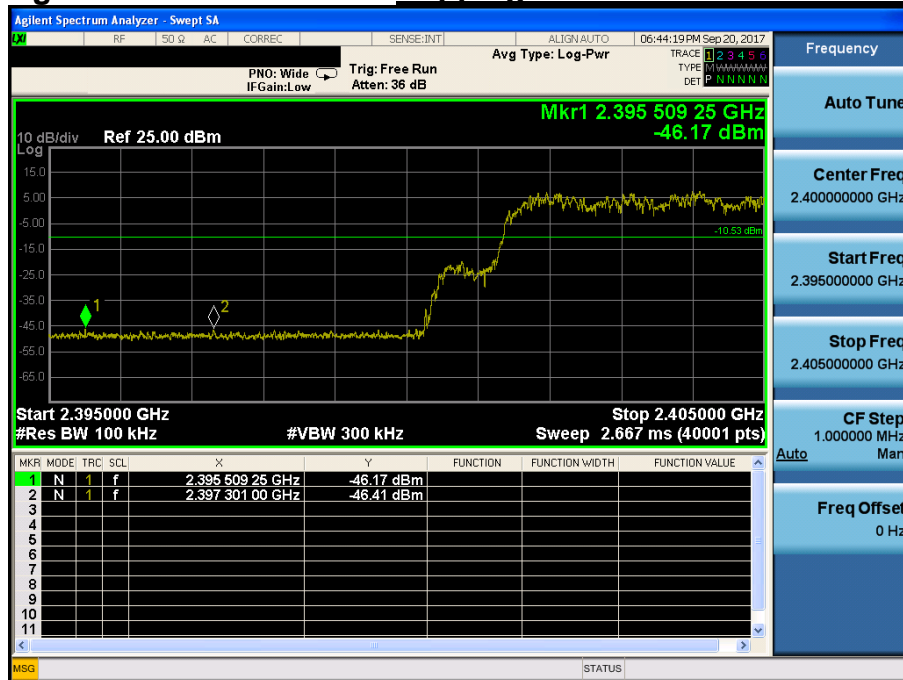## Conducted Spurious Emissions   *Highest Channel & Modulation : π/4DQPSK*

Dt&C

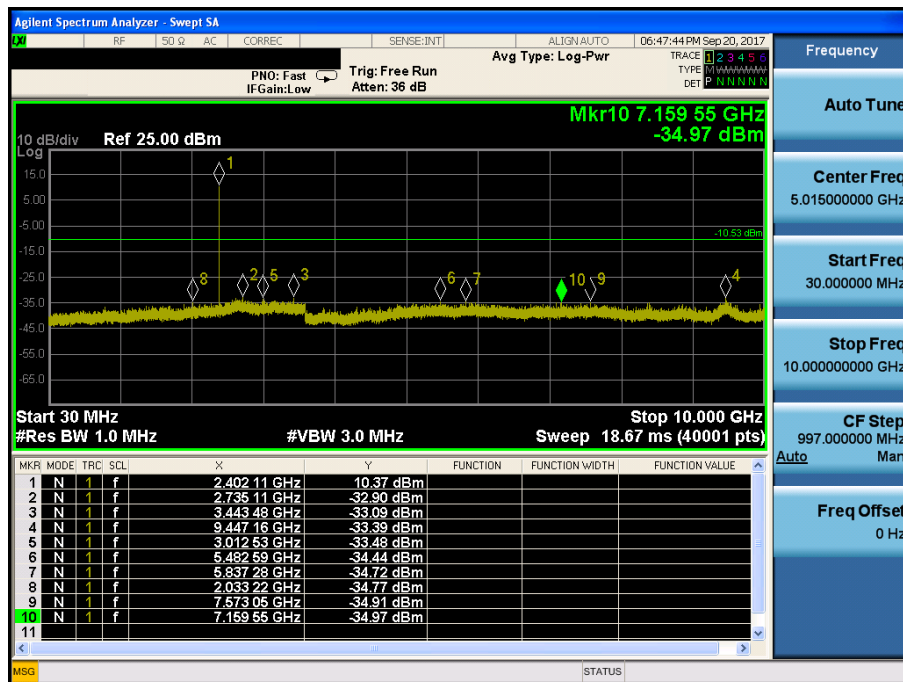**Low Band-edge**   *Lowest Channel & Modulation : 8DPSK*
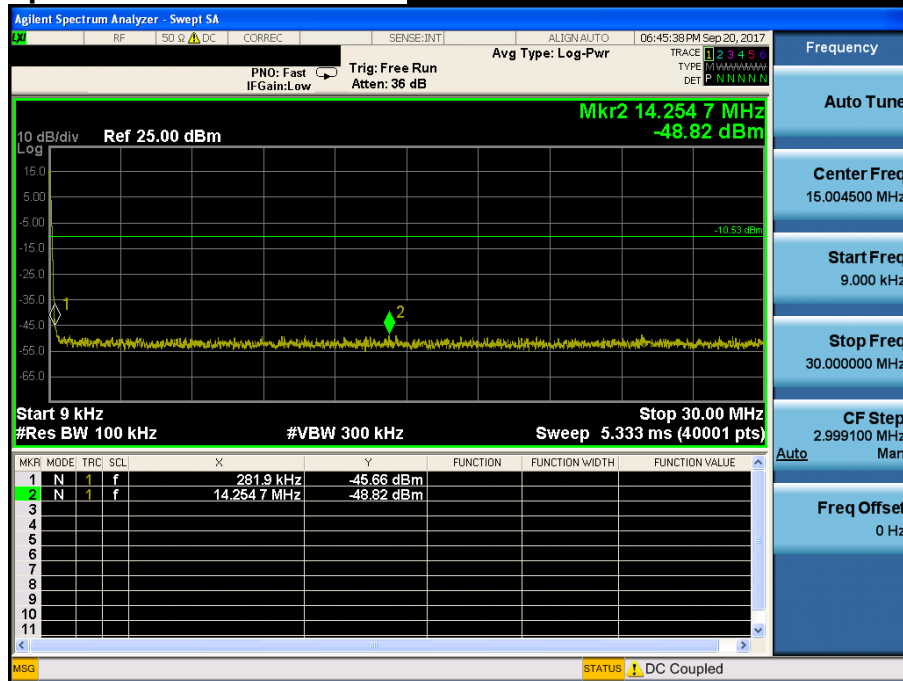

Low Band-edge   *Hopping mode & Modulation : 8DPSK*

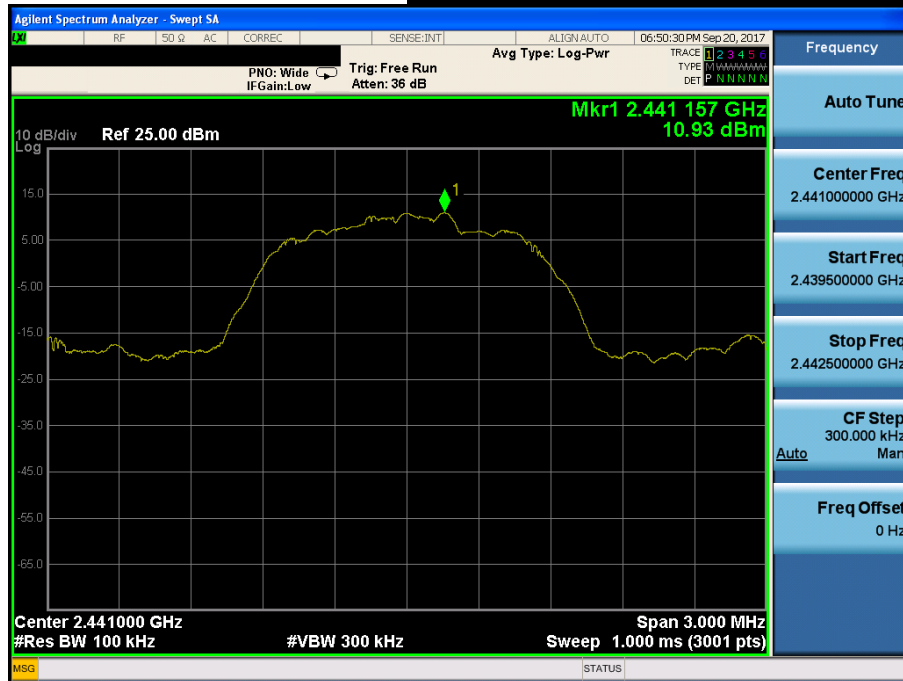## Conducted Spurious Emissions   *Lowest Channel & Modulation : 8DPSK*

Conducted Spurious Emissions   *Lowest Channel & Modulation : 8DPSK*
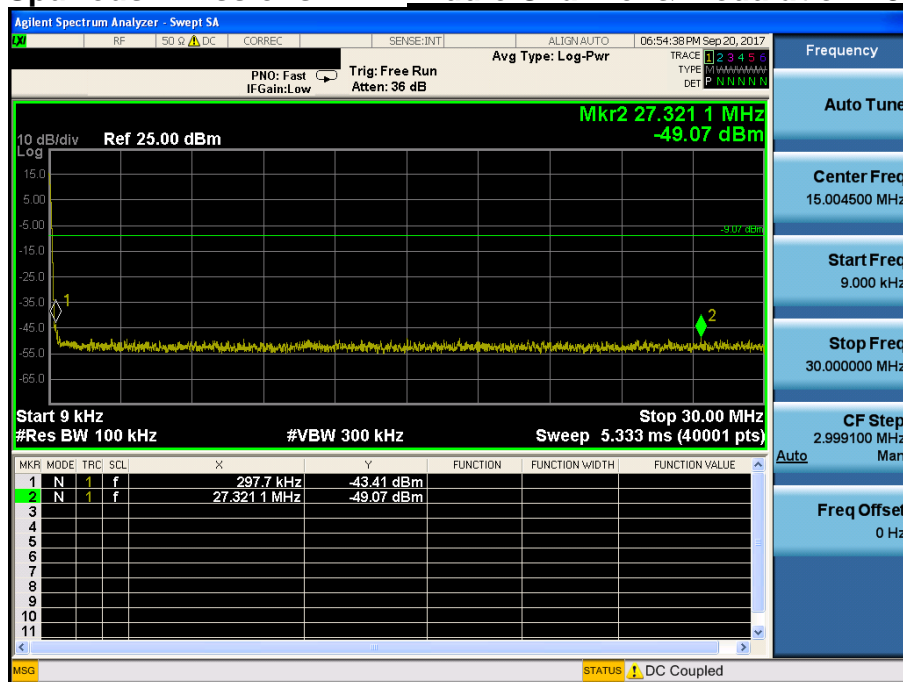
Dt&C

Reference for limit   *Middle Channel & Modulation : 8DPSK*
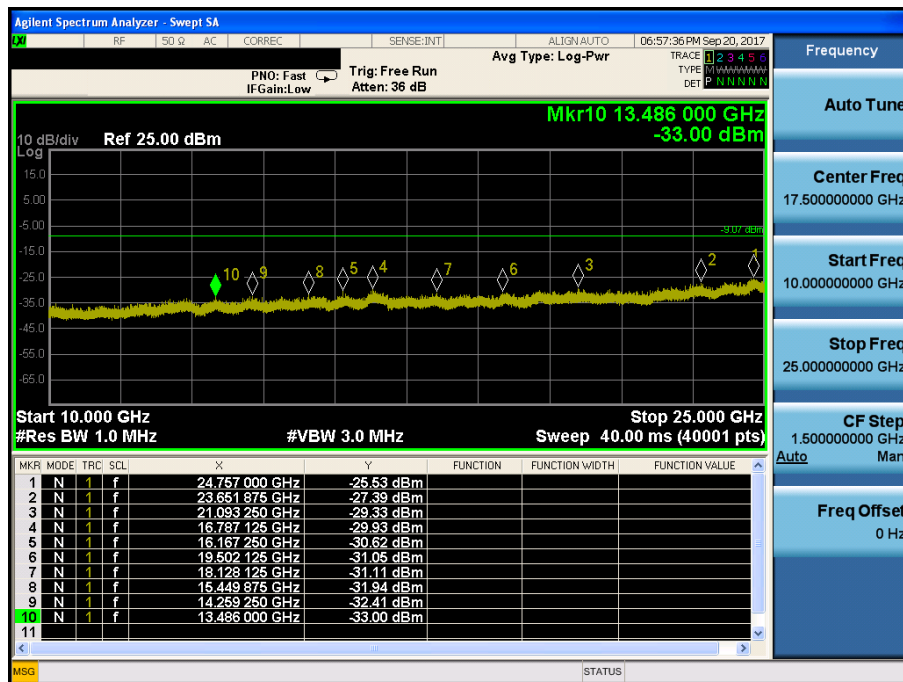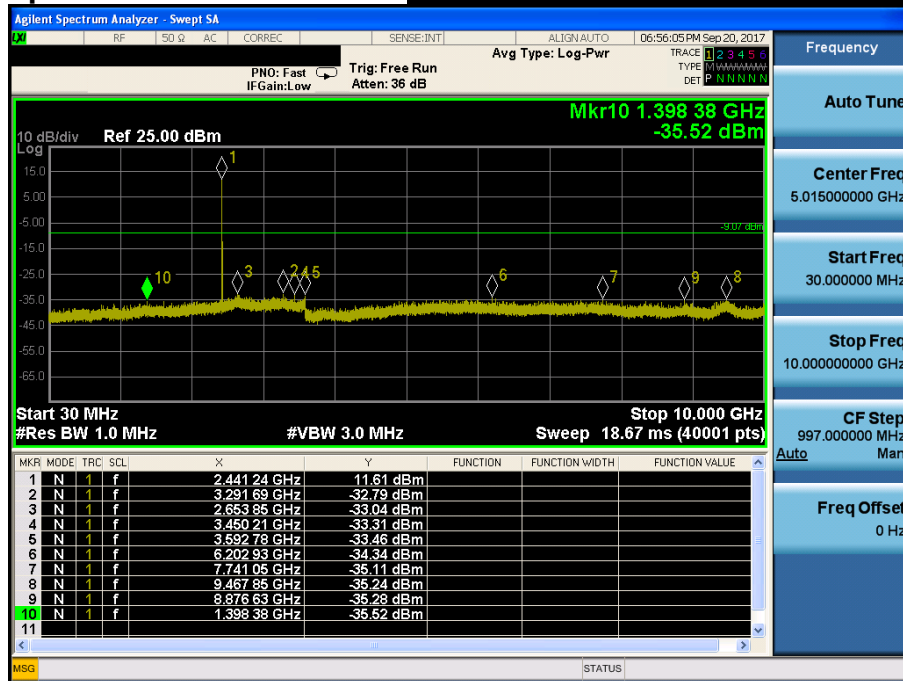

Conducted Spurious Emissions   *Middle Channel & Modulation : 8DPSK*

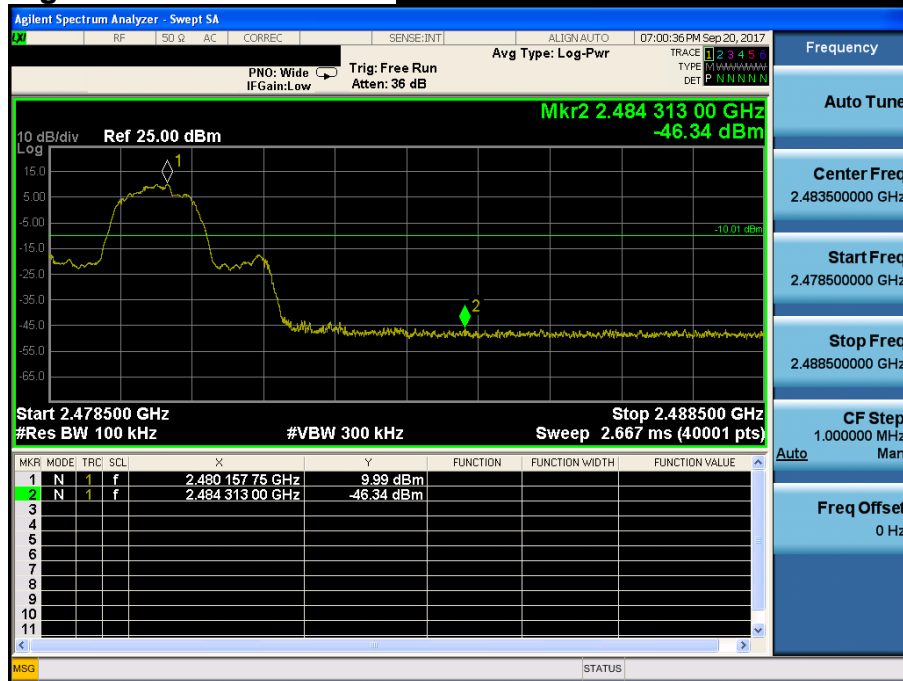## Conducted Spurious Emissions   *Middle Channel & Modulation : 8DPSK*
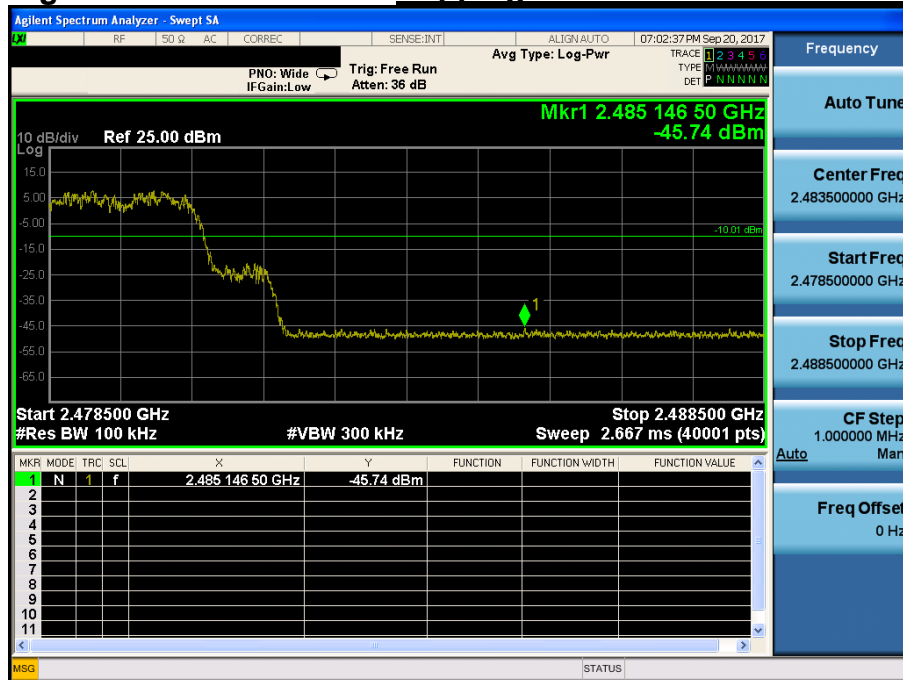
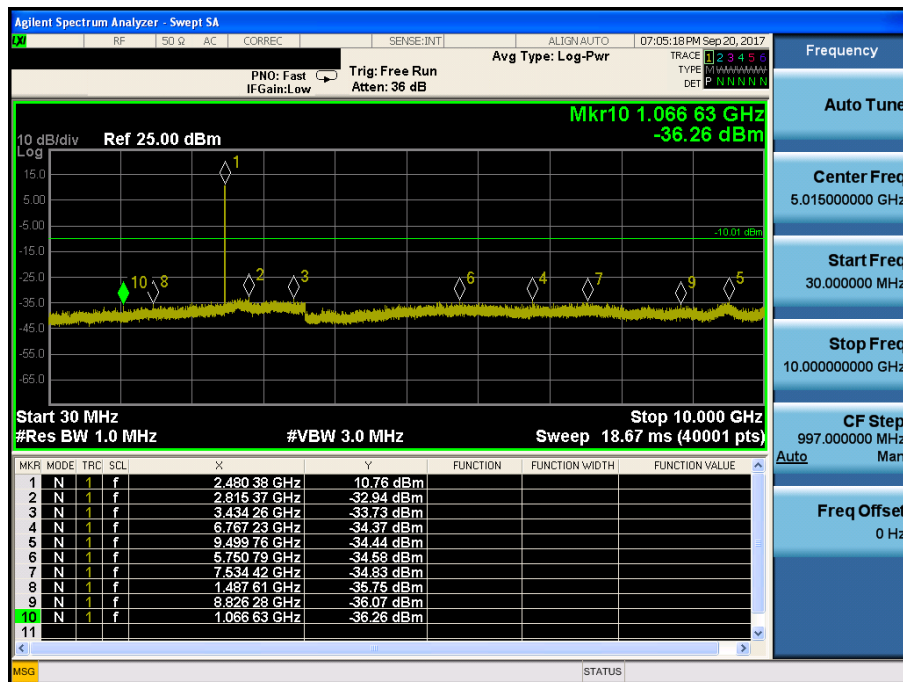**High Band-edge**   *Highest Channel & Modulation : 8DPSK*
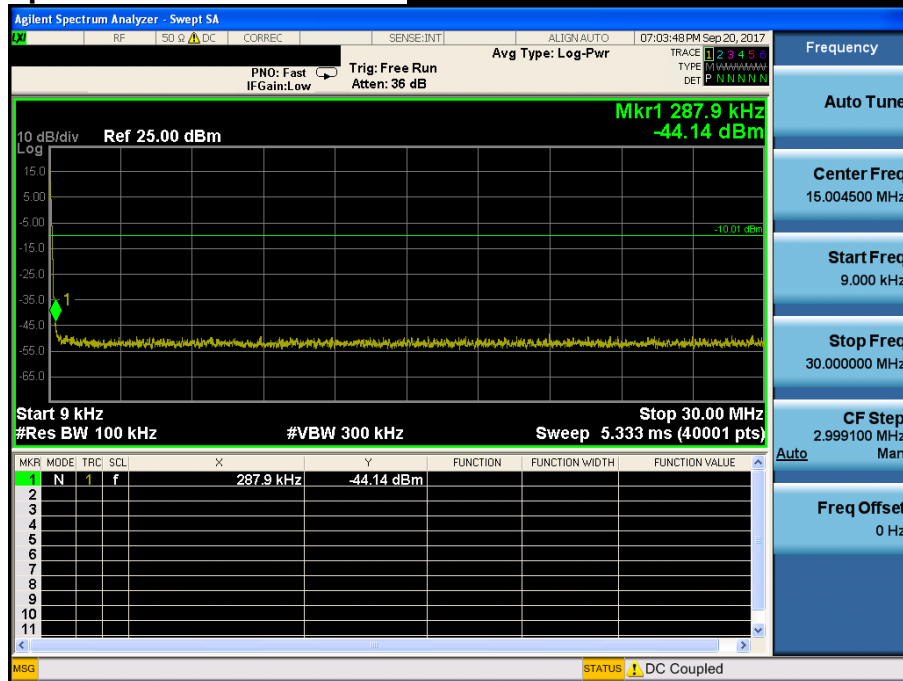

High Band-edge   *Hopping mode & Modulation : 8DPSK*

Conducted Spurious Emissions　　　*Highest Channel & Modulation : 8DPSK*

Conducted Spurious Emissions   *Highest Channel & Modulation : 8DPSK*

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	24.801 250 GHz	-24.18 dBm			
2	N	1	f	16.817 125 GHz	-29.90 dBm			
3	N	1	f	19.630 000 GHz	-30.61 dBm			
4	N	1	f	18.025 750 GHz	-31.09 dBm			
5	N	1	f	15.771 625 GHz	-31.65 dBm			
6	N	1	f	14.197 000 GHz	-32.34 dBm			

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.
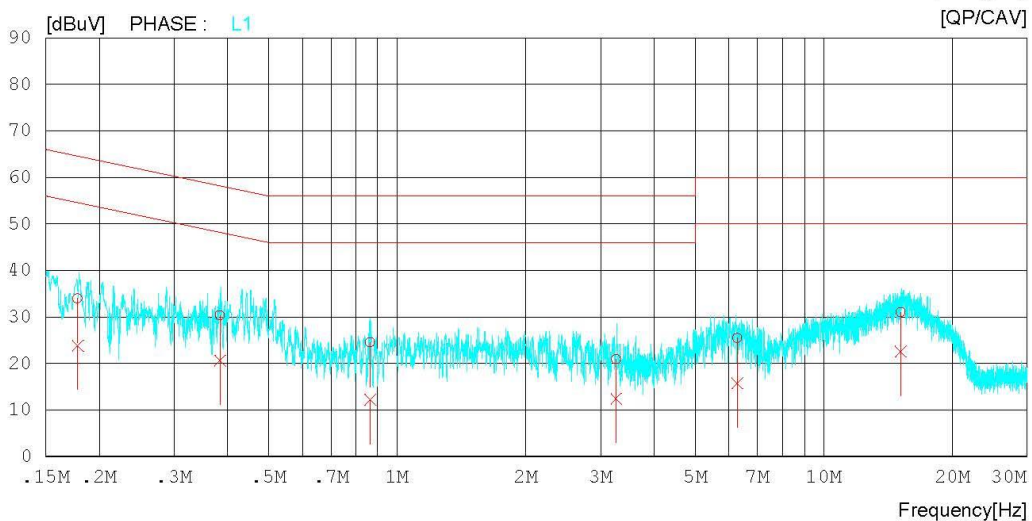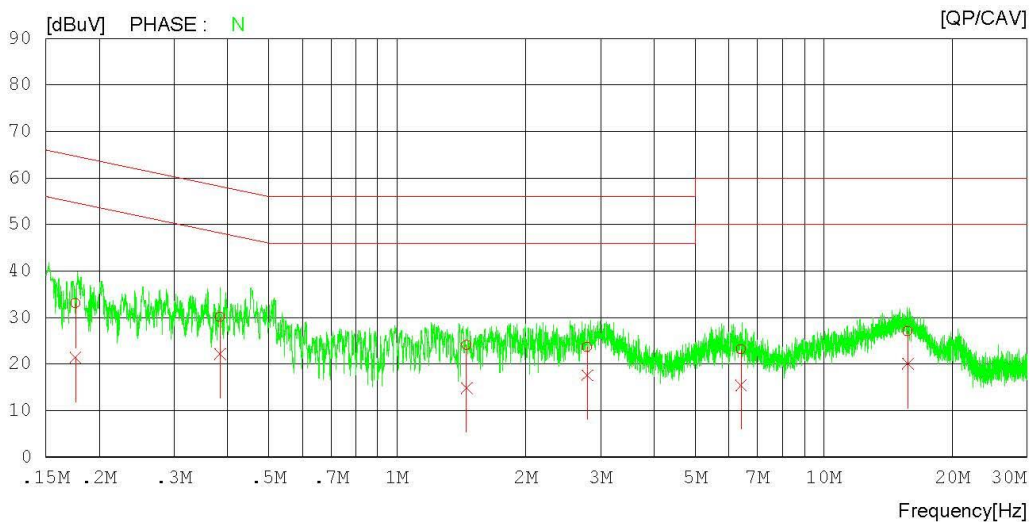
1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.

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

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

Results of Conducted Emission

DTNC　　　　　　　　　　　　　　　　　　　　　　　　Date　2017-10-13

Order No.	DTNC1709-06811	Referrence No.	
Model No.	DS1704	Power Supply	120V/60Hz
Serial No.		Temp/Humi.	22/45
Test Condition		Operator	S.G LEE

Memo　　　　　　　BT

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

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

Results of Conducted Emission

DTNC   Date 2017-10-13

Order No.	DTNC1709-06811	Referrence No.	
Model No.	DS1704	Power Supply	120V/60Hz
Serial No.		Temp/Humi.	22/45
Test Condition		Operator	S.G LEE

Memo   BT

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

NO	FREQ	READING QP	CAV	C.FACTOR	RESULT QP	CAV	LIMIT QP	CAV	MARGIN QP	CAV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.17602	23.13	11.56	9.90	33.03	21.46	64.67	54.67	31.64	33.21	N
2	0.38413	20.25	12.24	9.90	30.15	22.14	58.19	48.19	28.04	26.05	N
3	1.45380	14.16	4.92	9.93	24.09	14.85	56.00	46.00	31.91	31.15	N
4	2.78880	13.69	7.64	9.97	23.66	17.61	56.00	46.00	32.34	28.39	N
5	6.39600	13.17	5.39	10.05	23.22	15.44	60.00	50.00	36.78	34.56	N
6	15.73840	16.76	9.85	10.24	27.00	20.09	60.00	50.00	33.00	29.91	N
7	0.17830	24.06	13.91	9.90	33.96	23.81	64.56	54.56	30.60	30.75	L1
8	0.38408	20.40	10.65	9.90	30.30	20.55	58.19	48.19	27.89	27.64	L1
9	0.86435	14.53	2.20	9.93	24.46	12.13	56.00	46.00	31.54	33.87	L1
10	3.25920	10.88	2.40	9.99	20.87	12.39	56.00	46.00	35.13	33.61	L1
11	6.27060	15.37	5.66	10.05	25.42	15.71	60.00	50.00	34.58	34.29	L1
12	15.14220	20.71	12.31	10.24	30.95	22.55	60.00	50.00	29.05	27.45	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 antenna is attached on the device by means of unique coupling method (Spring Tension).
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 × RBW.

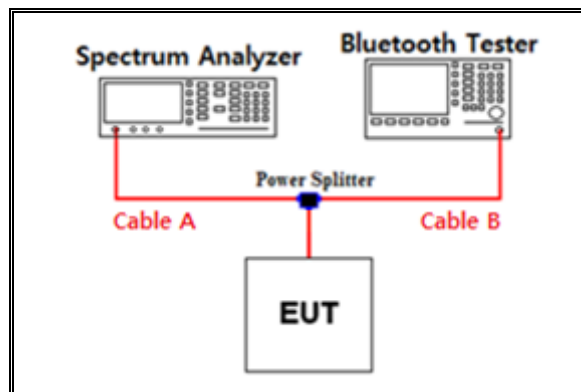Spectrum analyzer plots are included on the following pages.

10.4 Test Results

- NA

APPENDIX I

Test set up diagrams

▪ **Radiated Measurement**

Below 1GHz	Above 1GHz
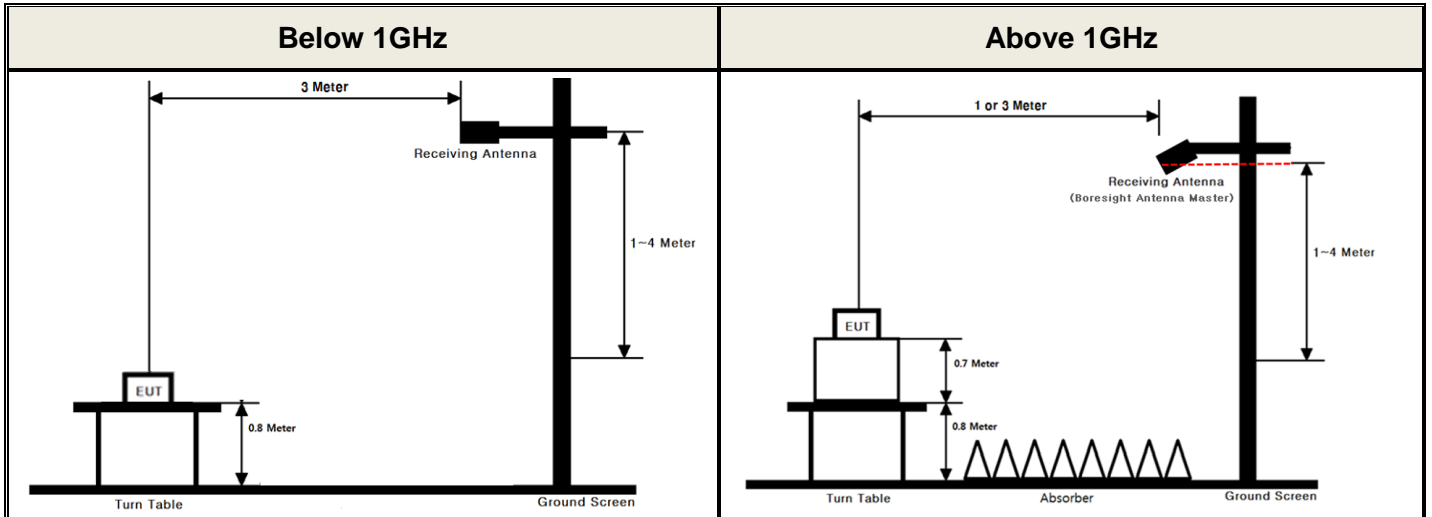
▪ **Conducted Measurement**

Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	6.07	15	9.88
1	6.75	20	10.85
2.402 & 2.440 & 2.480	7.50	25	11.25
5	8.30	-	-
10	9.03	-	-

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 + Power splitter

APPENDIX II

Unwanted Emissions (Radiated) Test Plot _ Normal

GFSK & Lowest & X & Hor   **Detector Mode : PK**
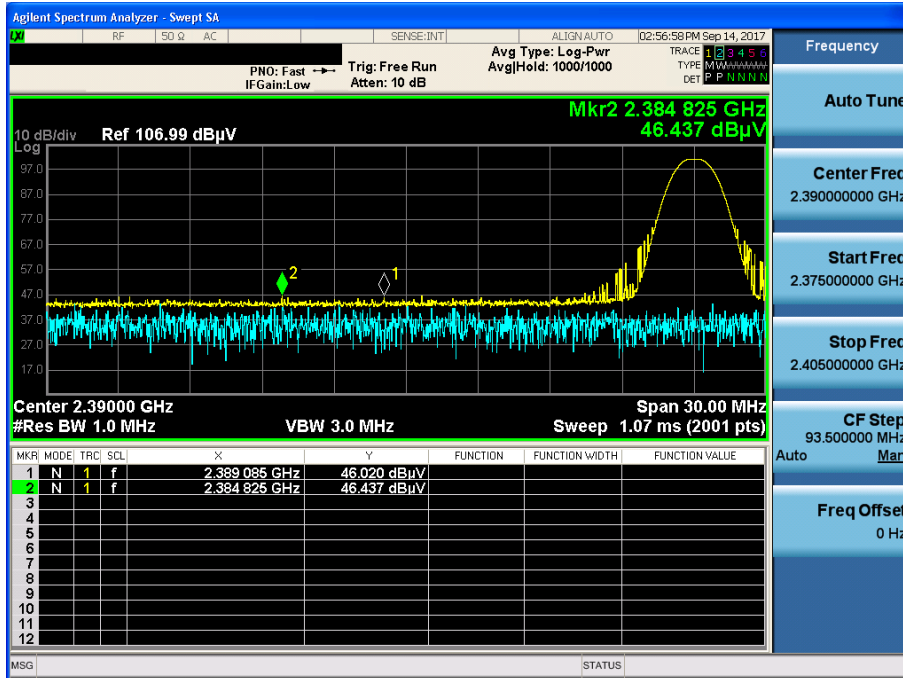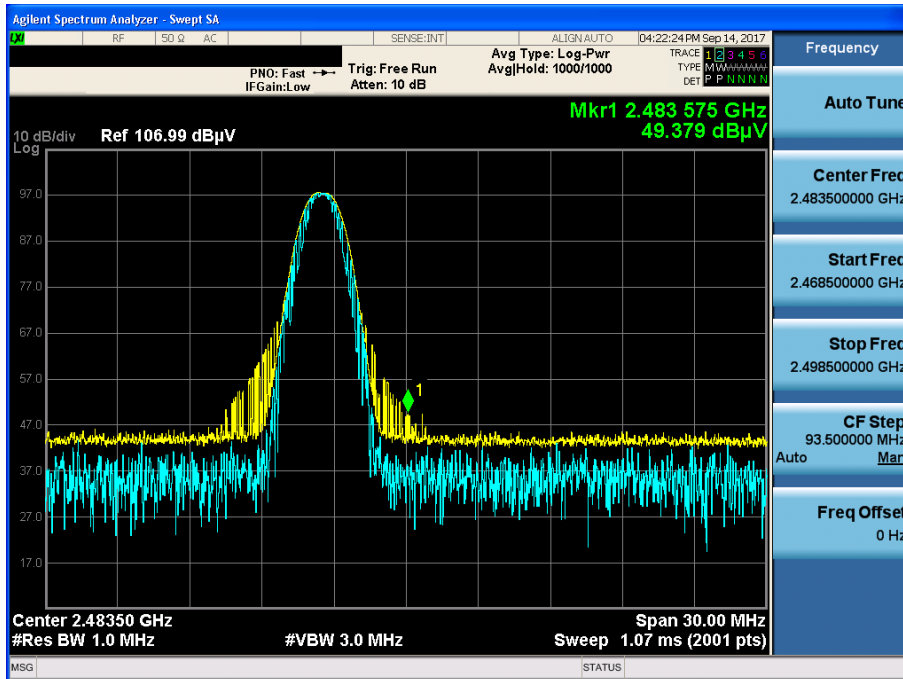
GFSK & Highest & X & Hor   **Detector Mode : PK**

π/4DQPSK & Lowest & X & Hor **Detector Mode : PK**
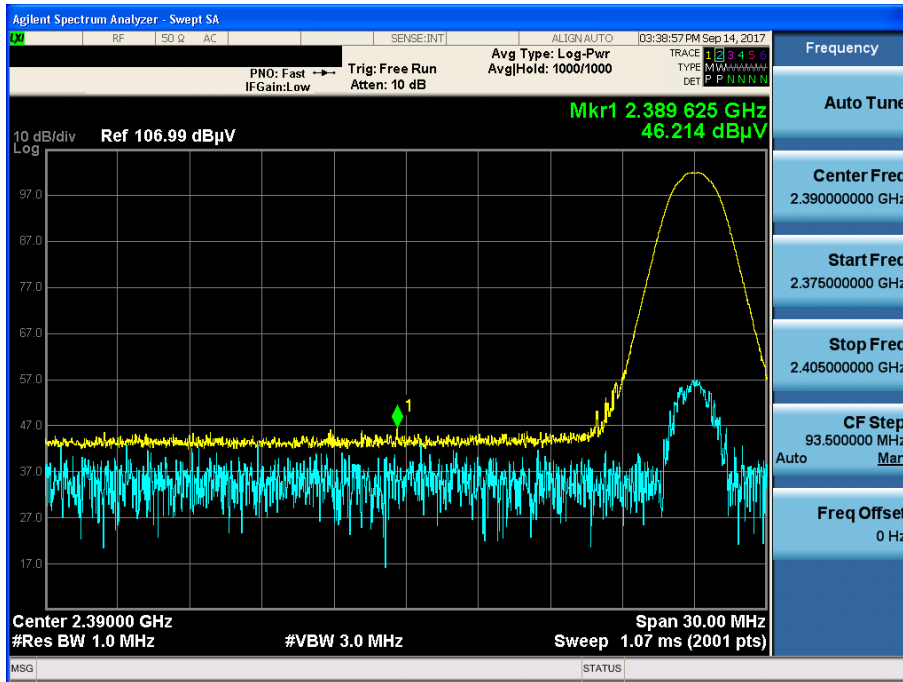
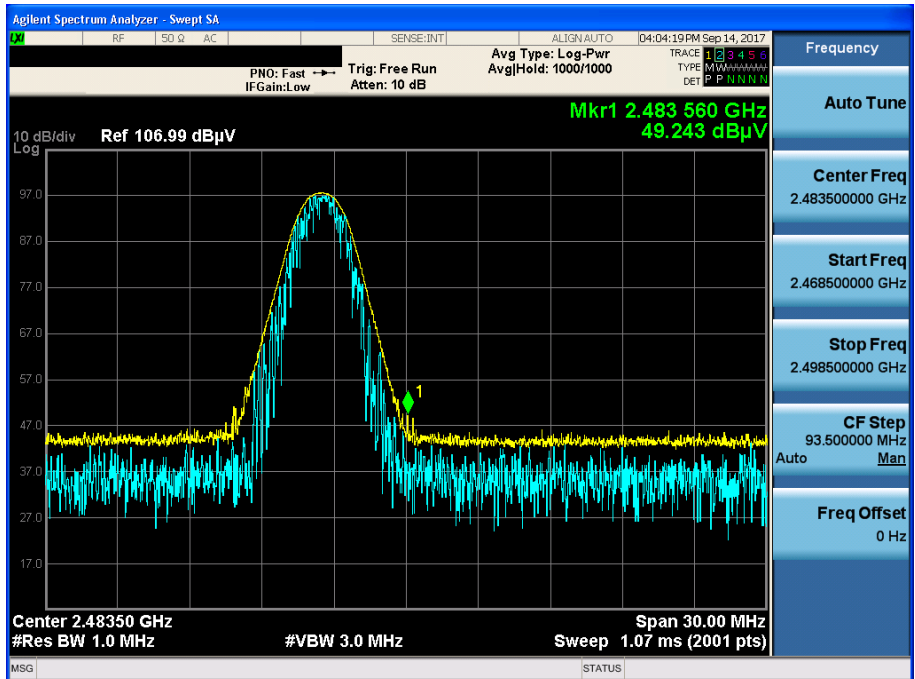**π/4DQPSK & Highest & X & Hor** **Detector Mode : PK**
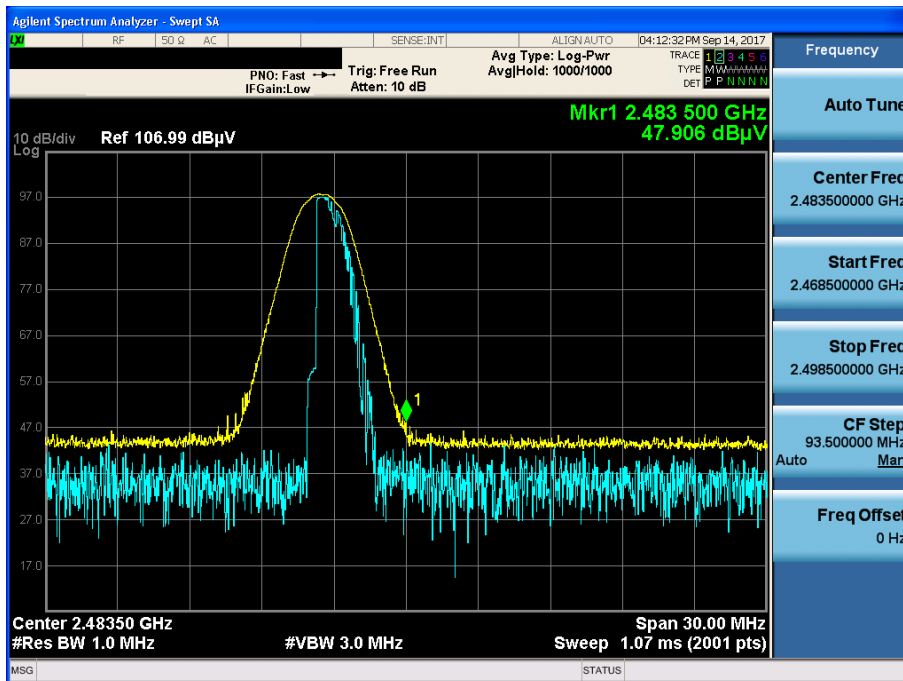
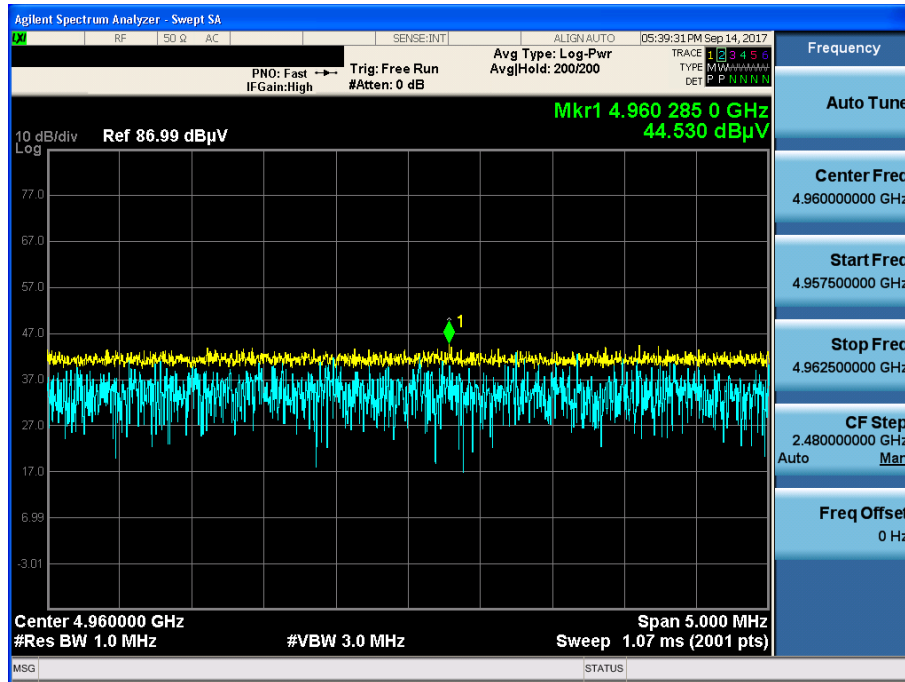## 8DPSK & Lowest & X & Hor
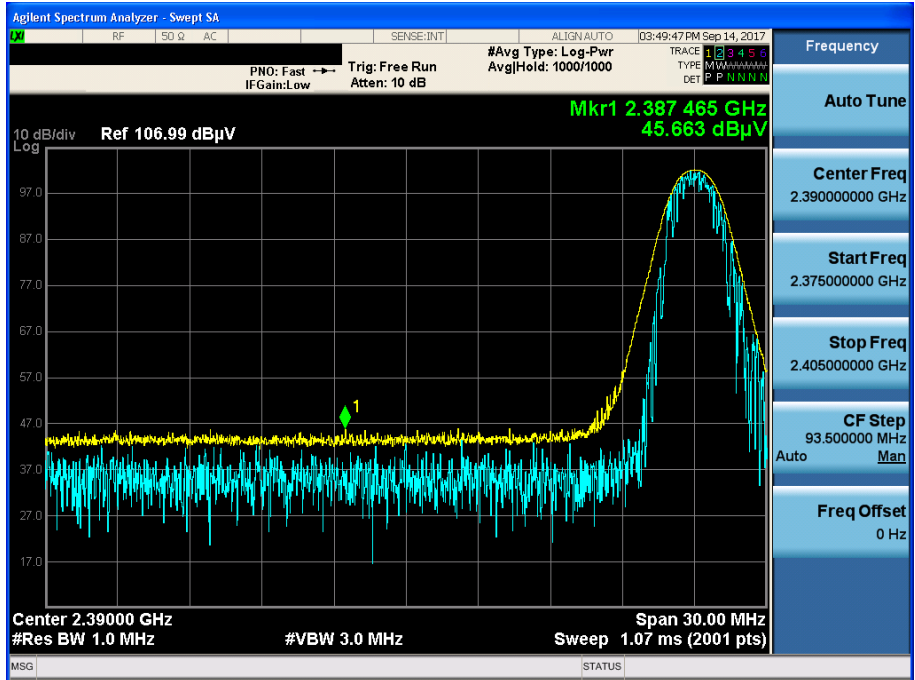
Detector Mode : PK
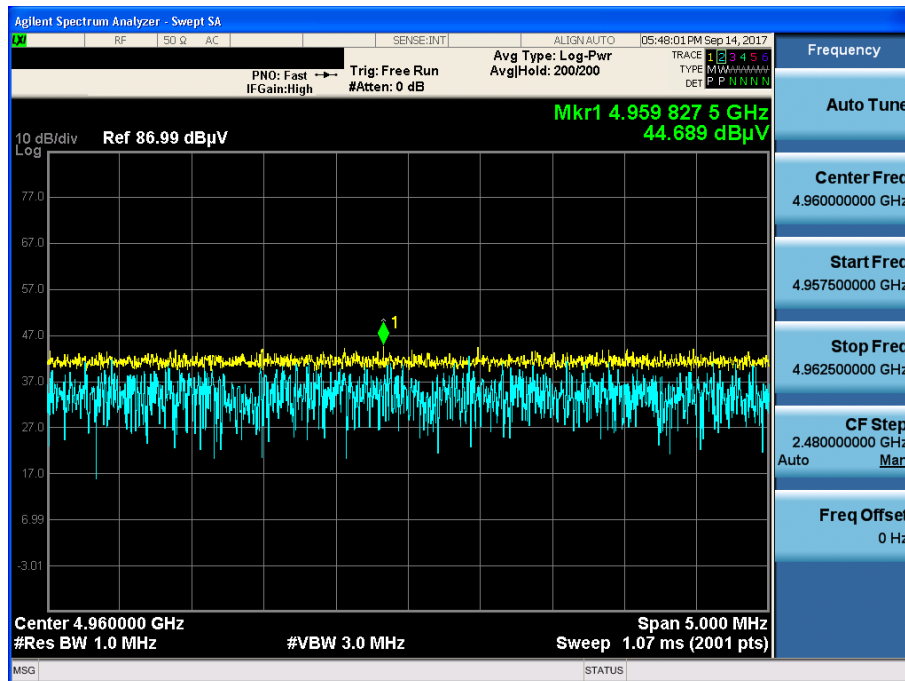

8DPSK & Highest & X & Hor

Detector Mode : PK

GFSK & Highest & Z & Hor   **Detector Mode : PK**

π/4DQPSK & Highest & Z & Hor   **Detector Mode : PK**
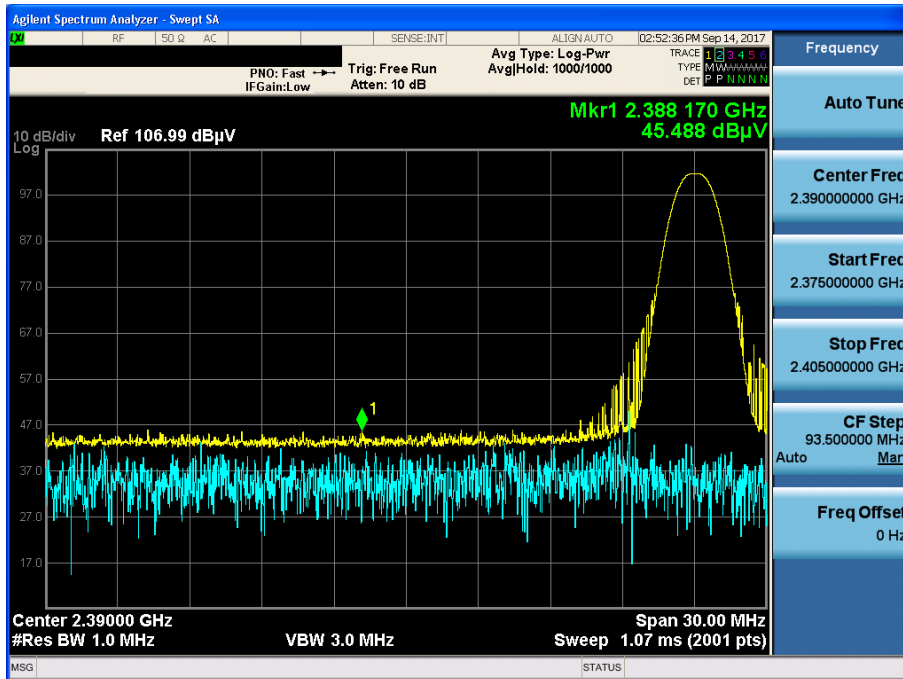
8DPSK & Highest & Z & Hor   **Detector Mode : PK**
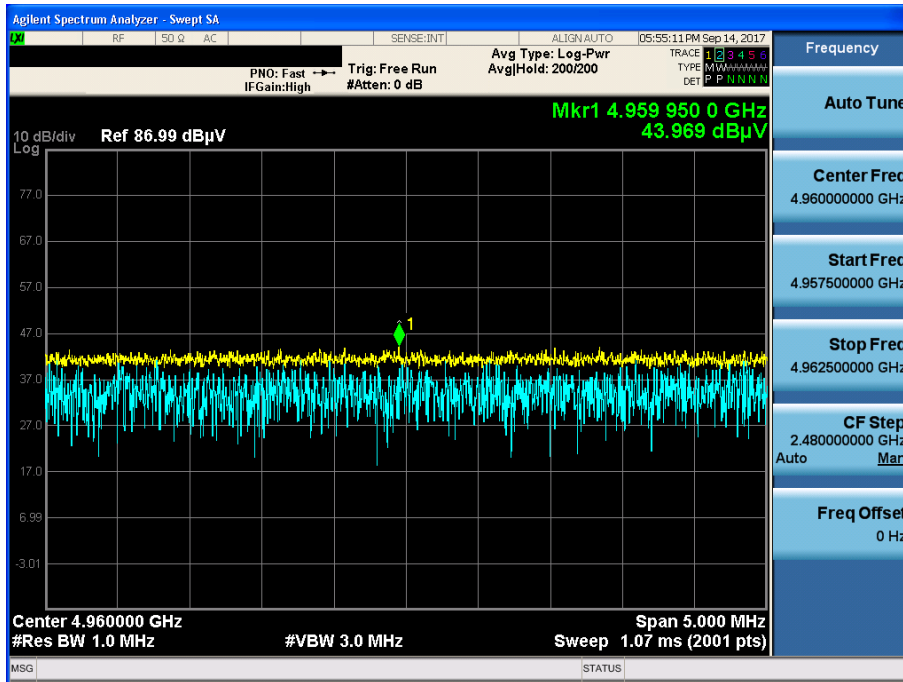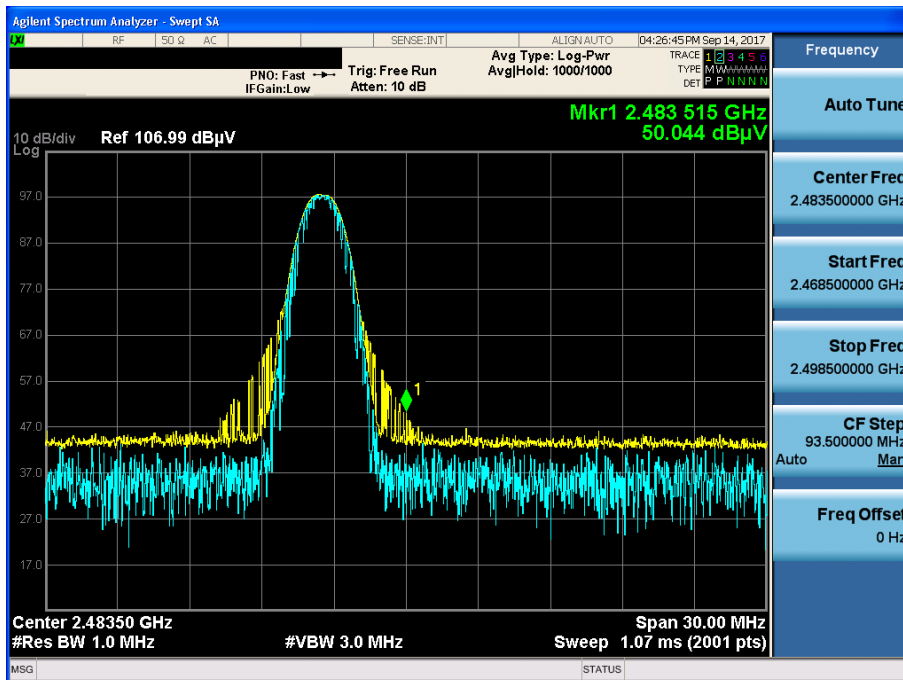
Unwanted Emissions (Radiated) Test Plot _ Wireless Charging

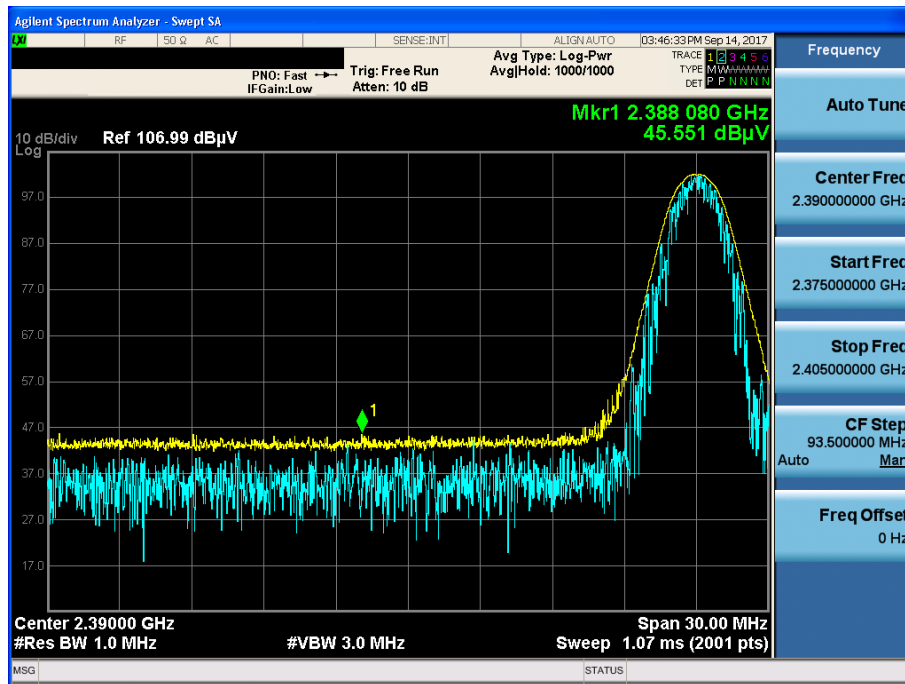**GFSK & Lowest & X & Hor**   **Detector Mode : PK**

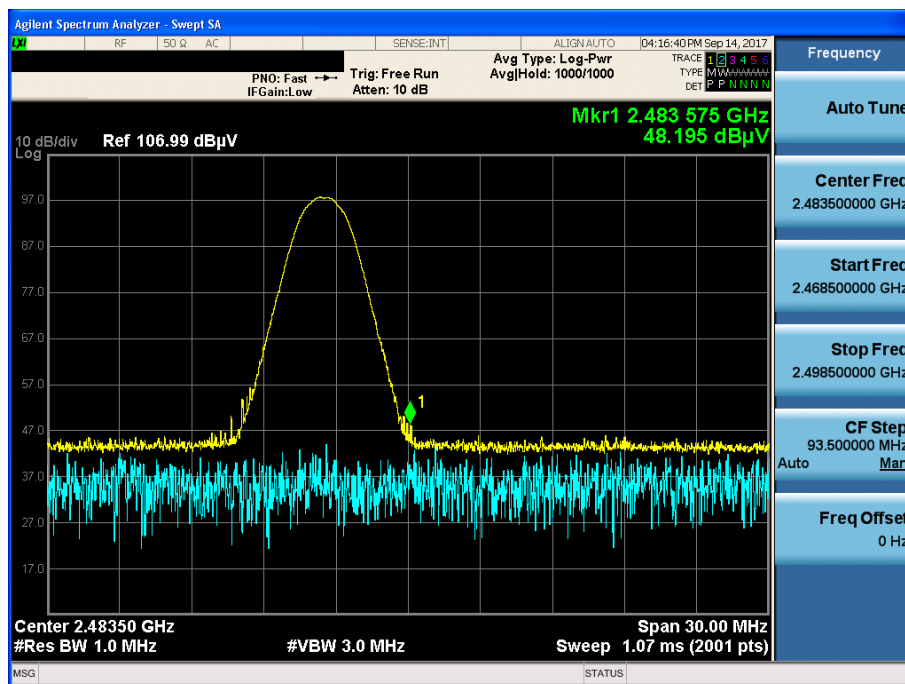**GFSK & Highest & X & Hor**   **Detector Mode : PK**

π/4DQPSK & Lowest & X & Hor   **Detector Mode : PK**

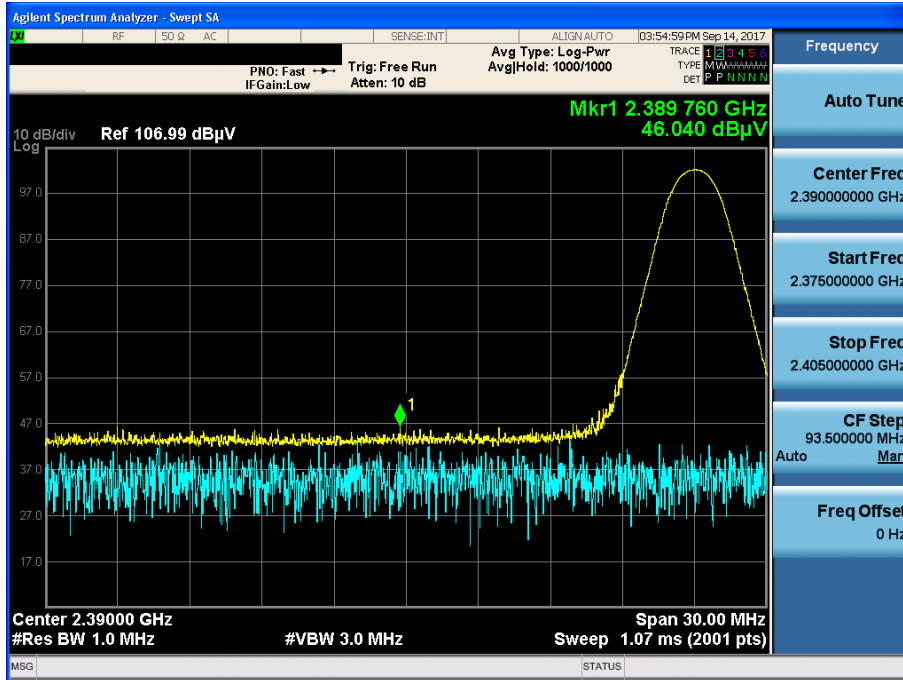**π/4DQPSK & Highest & X & Hor**   **Detector Mode : PK**

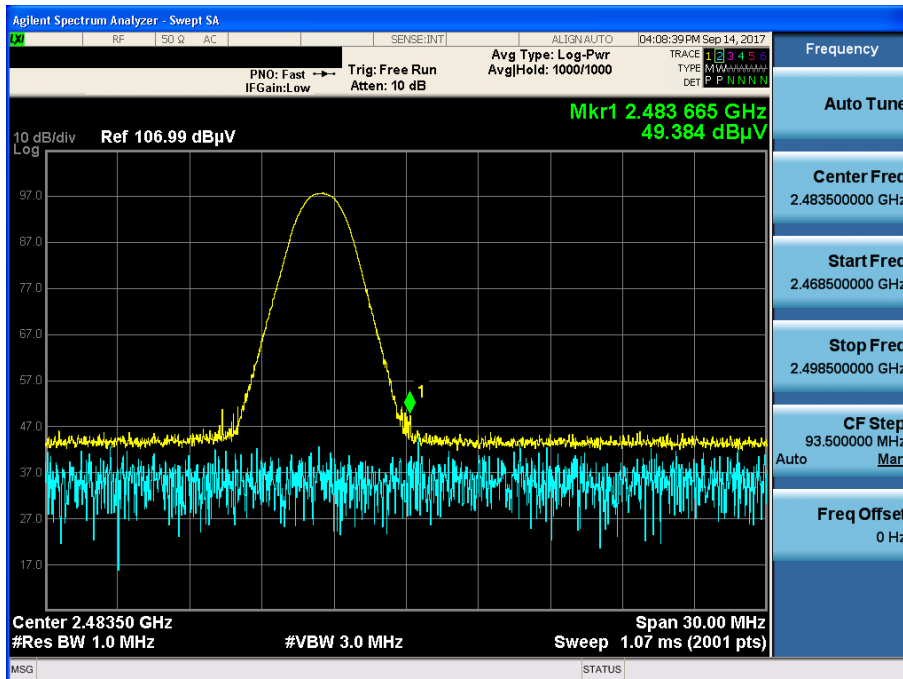## 8DPSK & Lowest & X & Hor   Detector Mode : PK
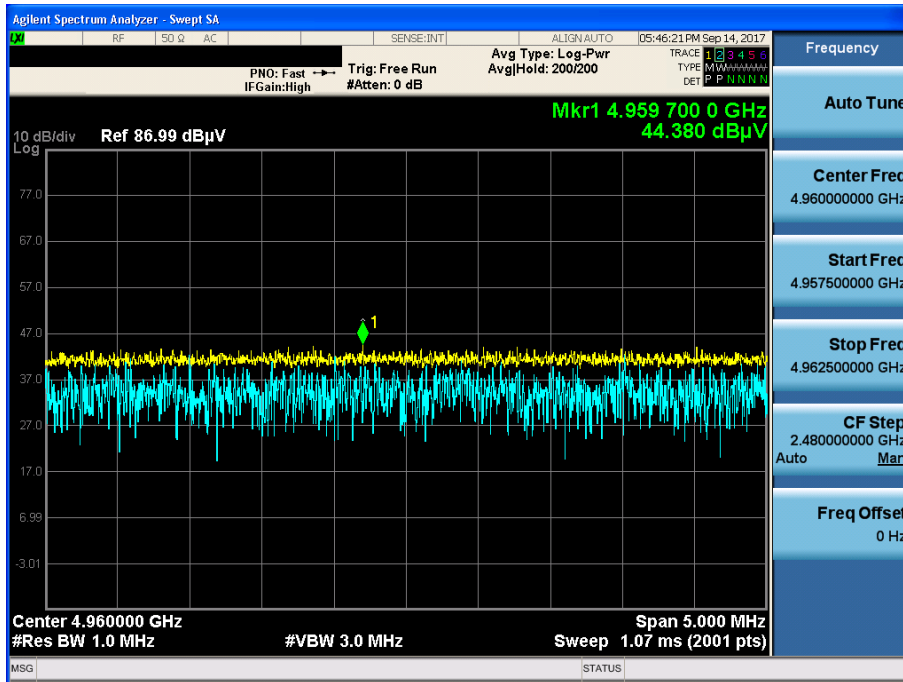

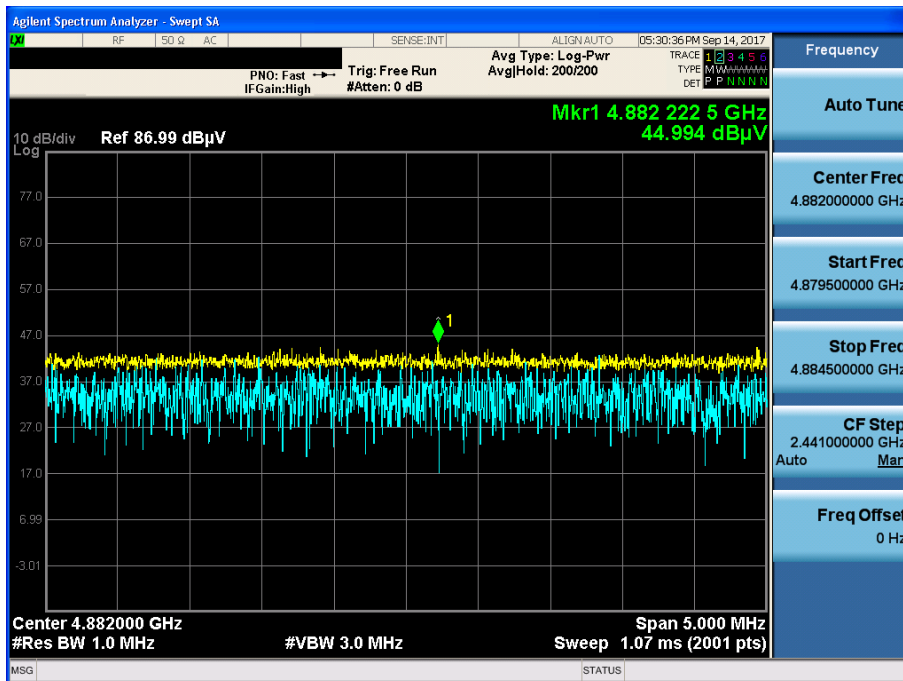## 8DPSK & Highest & X & Hor   Detector Mode : PK

GFSK & Highest & X & Hor　　　　　　　　　　　　　　Detector Mode : PK

π/4DQPSK & Middle & X & Hor　　　　　　　　　　　　Detector Mode : PK

8DPSK & Middle & X & Hor　　　　　　　　　　　　　　**Detector Mode : PK**