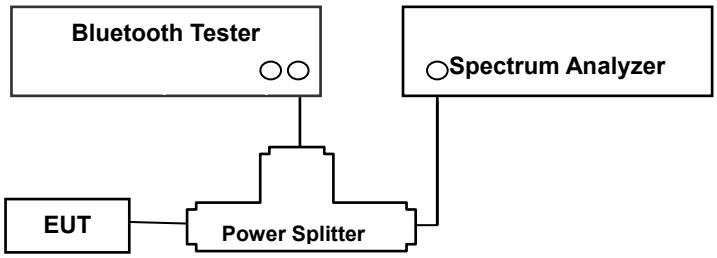
9.5 TIME OF OCCUPANCY (DWELL TIME)

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off.

EUT was set to transmit the longest packet type (DH5)

The Spectrum Analyzer is set to (7.8.4 in ANSI 63.10-2013)

1) Span: Zero span, centered on a hopping channel
2) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
3) Sweep = as necessary to capture the entire dwell time per hopping channel
4) Detector: Peak
5) Trace: Max hold

The marker-delta function was used to determine the dwell time.

Normal Mode / EDR Mode

DH 5(The longest packet type for GFSK)

CH Mid : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)

2-DH 5(The longest packet type for π/4DQPSK)

CH Mid : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)

3-DH 5(The longest packet type for 8DPSK)

CH Mid : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)

AFH Mode

DH 5(The longest packet type for GFSK)

CH Mid : 2.890 * (800/6)/20 * 8.0 = 154.13 (ms)

2-DH 5(The longest packet type for π/4DQPSK)

CH Mid : 2.890 * (800/6)/20 * 8.0 = 154.13 (ms)

3-DH 5(The longest packet type for 8DPSK)

CH Mid : 2.890 * (800/6)/20 * 8.0 = 154.13 (ms)

Note :

A DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 hops per second with 79 channels. So the system have each channel 3.3755 times per second and so for 31.6 seconds the system have 106.7 times of appearance. Each tx-time per appearance of DH5 is 2.892 ms.

Dwell time = Tx-time * 106.7

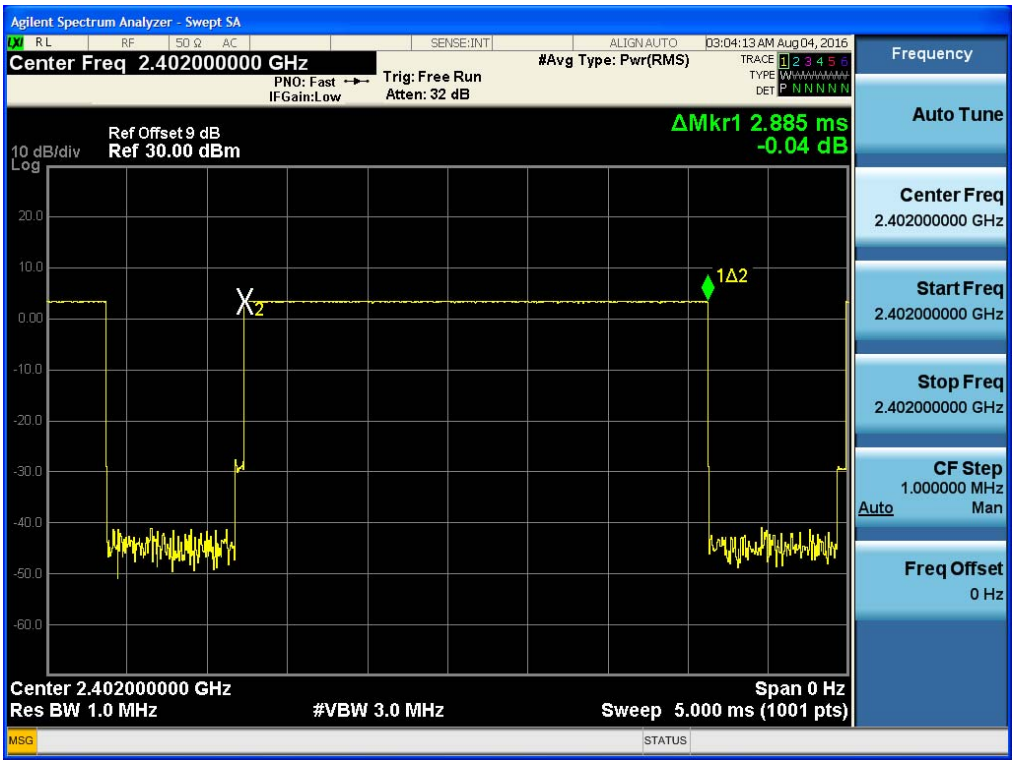
TEST RESULTS

See the table.

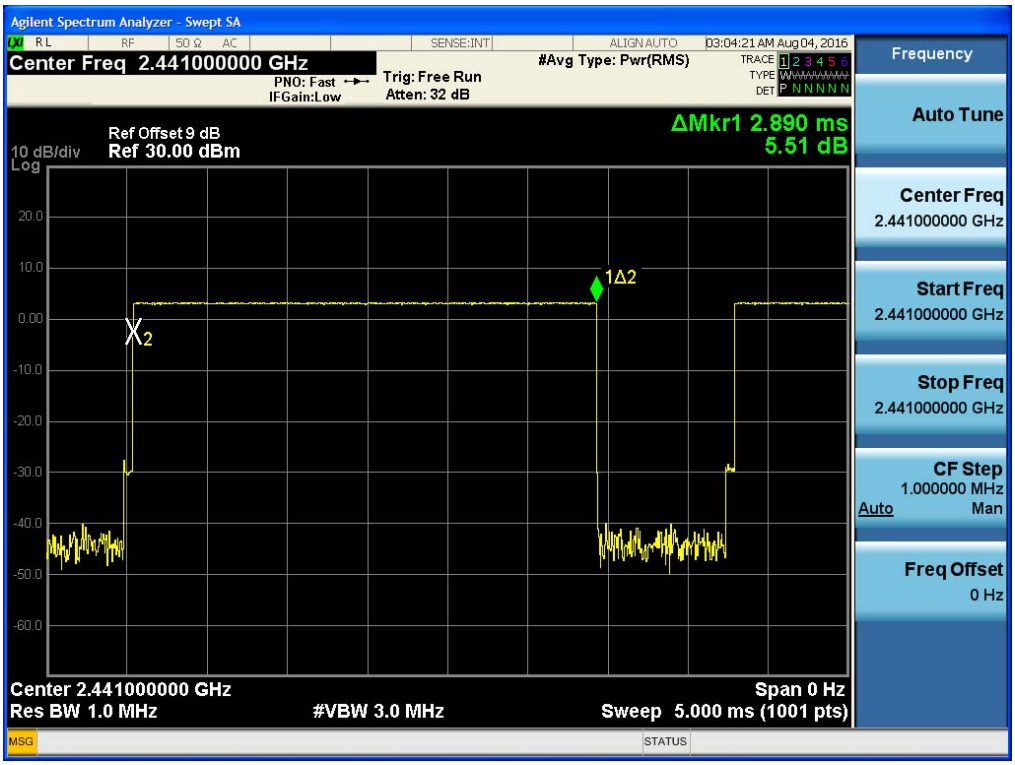
	Channel	GFSK	8DPSK	π/4DQPSK
Pulse Time (ms)	Low	2.885	2.895	2.890
	Mid	2.890	2.890	2.890
	High	2.885	2.890	2.890

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)	Result
Total of Dwell (ms)	Low	307.73	308.80	308.27	32	400	PASS
	Mid	308.27	308.27	308.27	32		PASS
	High	307.73	308.27	308.27	32		PASS

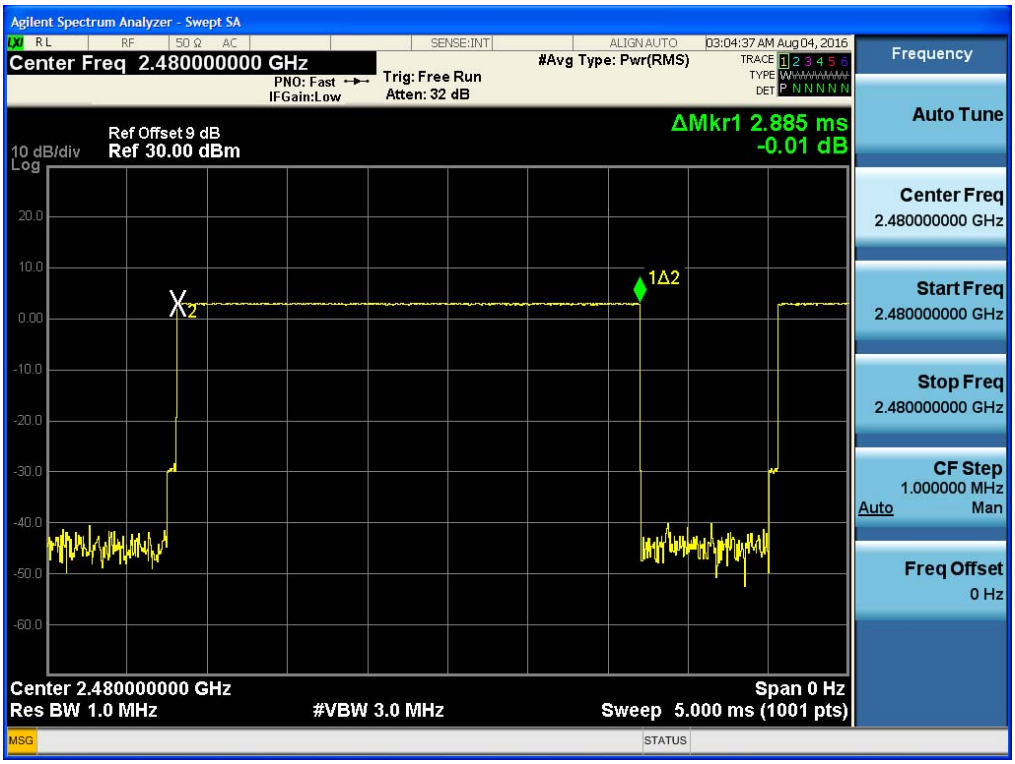
Test Plots (GFSK)
Dwell Time (CH.0)



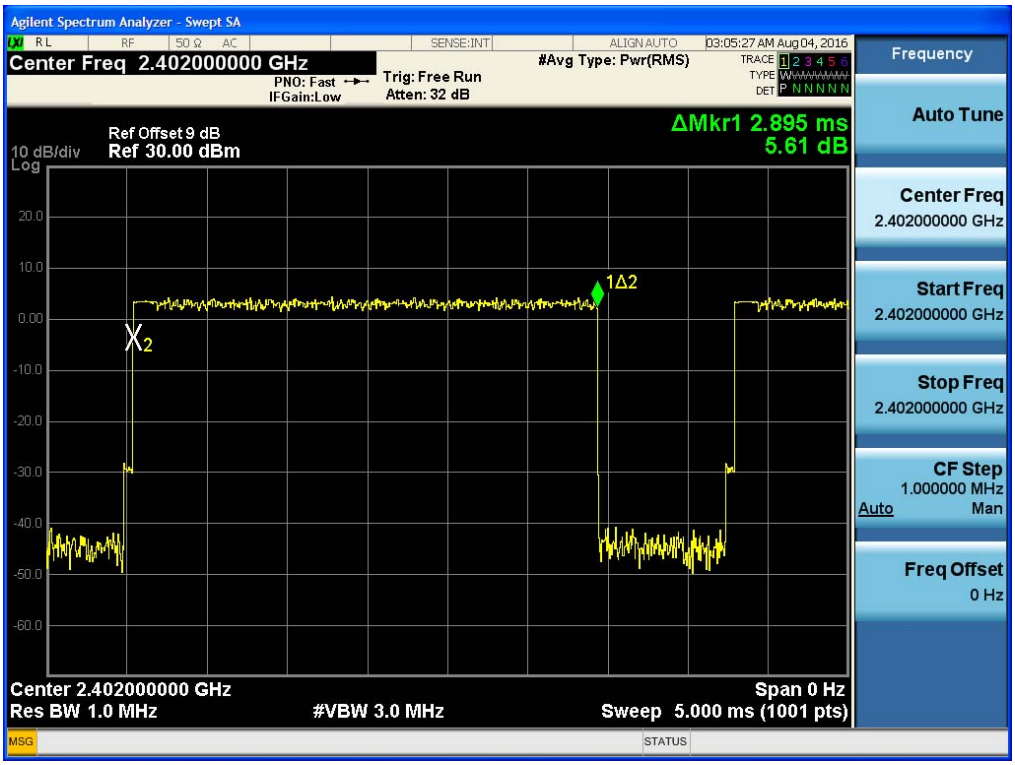
Test Plots (GFSK)
Dwell Time (CH.39)



Test Plots (GFSK)
Dwell Time (CH.78)

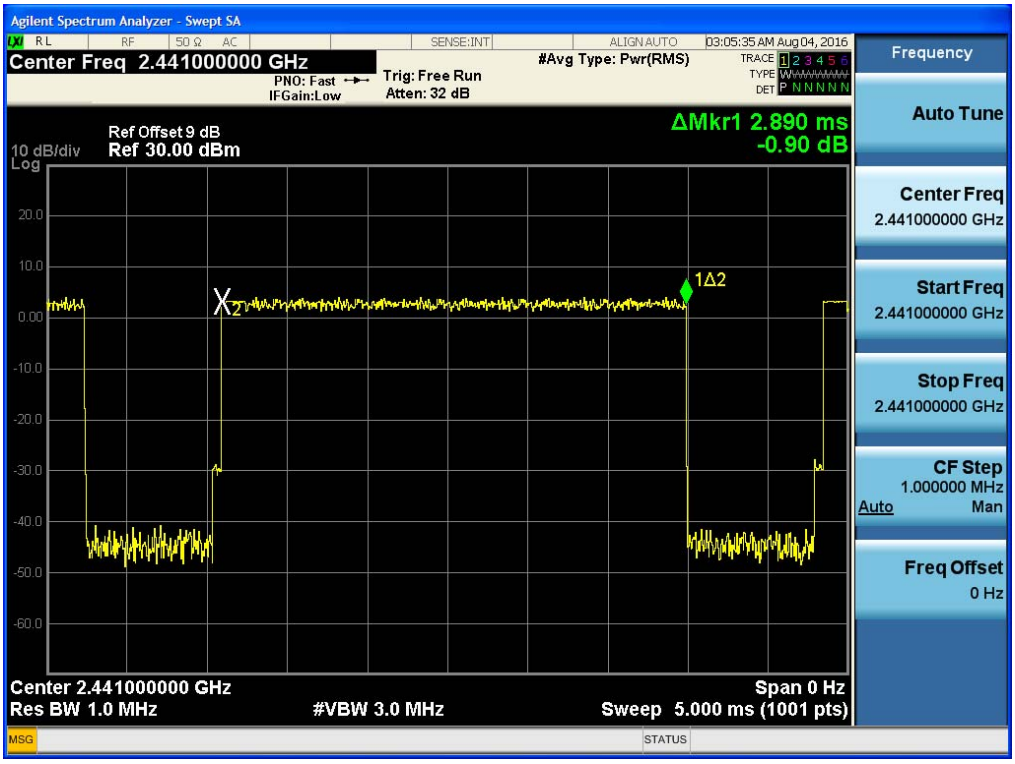


Test Plots (8DPSK)
Dwell Time (CH.0)



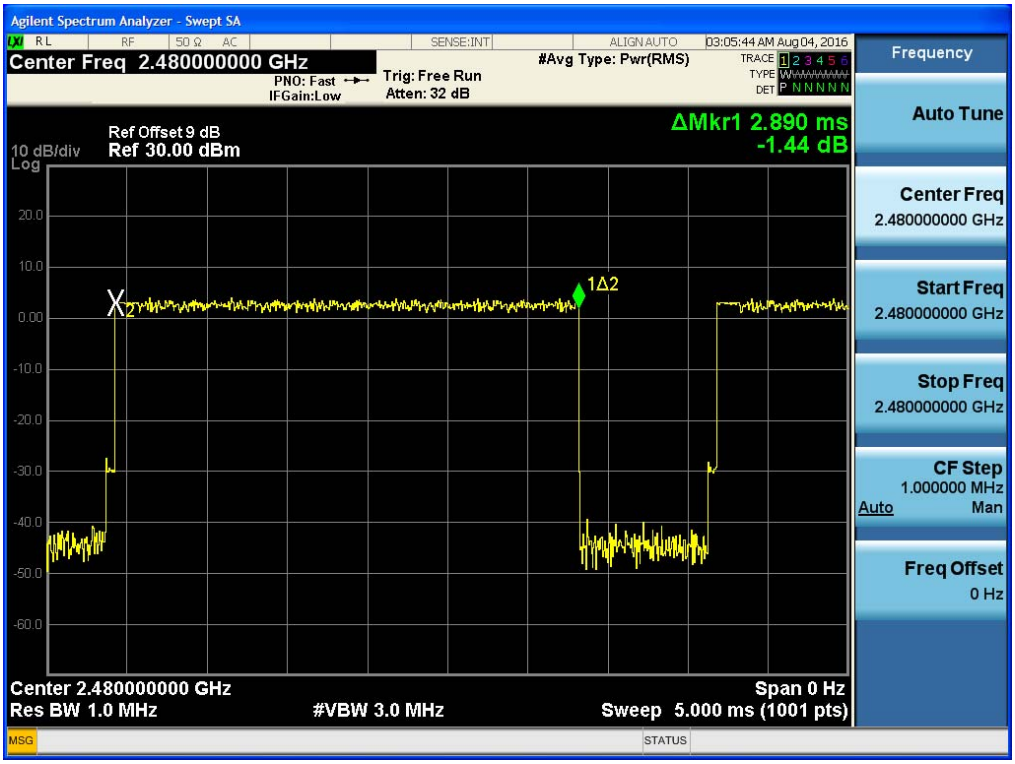
Test Plots (8DPSK)

Dwell Time (CH.39)

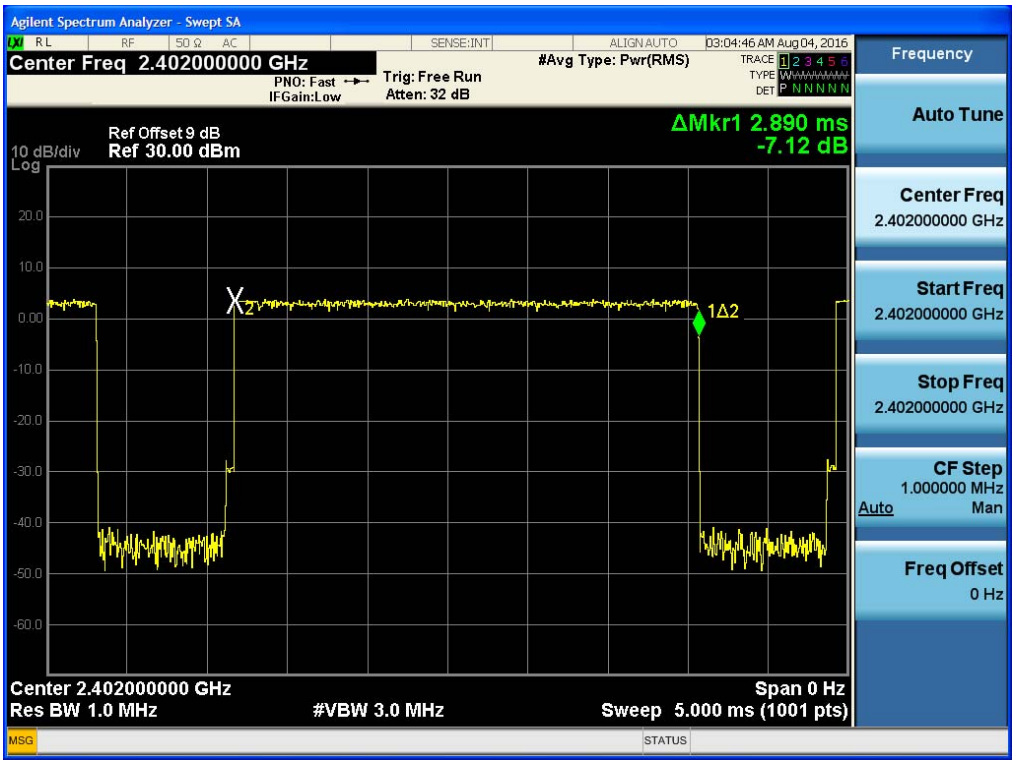


Test Plots (8DPSK)

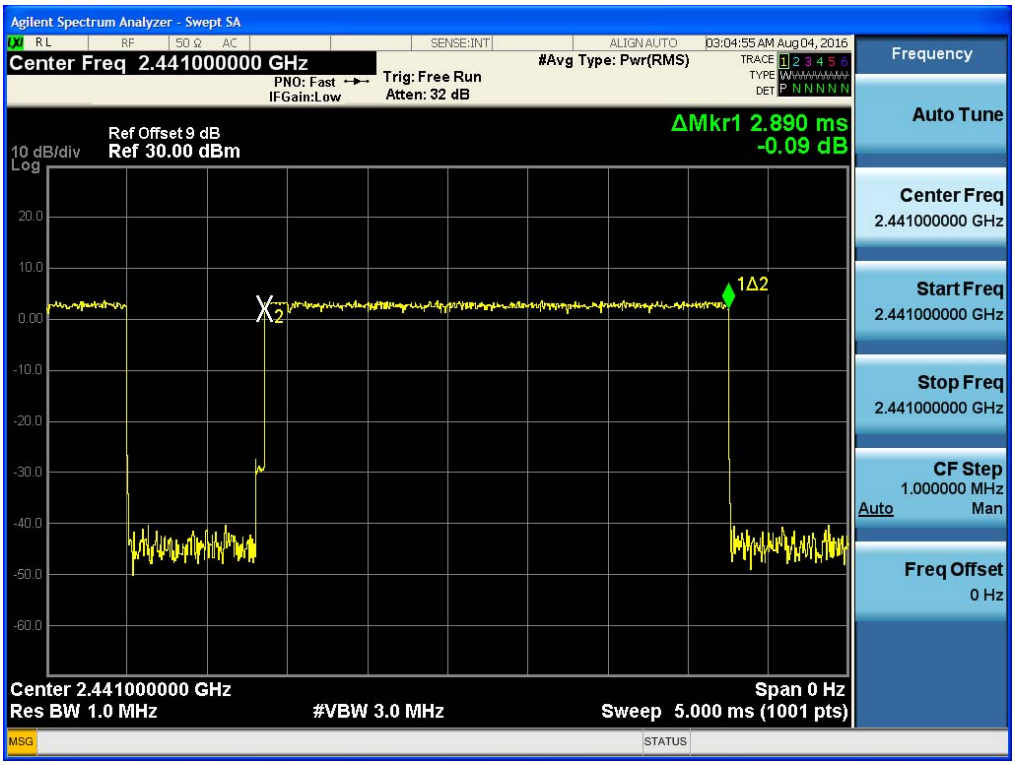
Dwell Time (CH.78)



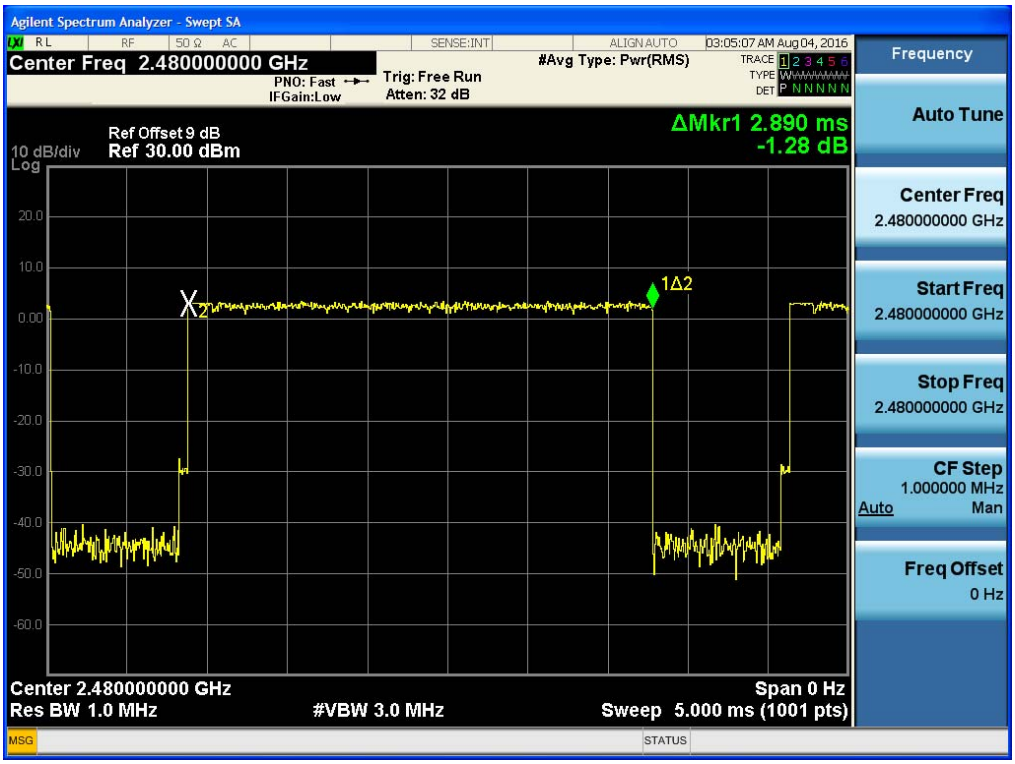
Test Plots (π/4DQPSK)
Dwell Time (CH.0)



Test Plots (π/4DQPSK)
Dwell Time (CH.39)



Test Plots (π/4DQPSK)
Dwell Time (CH.78)



9.6 SPURIOUS EMISSIONS

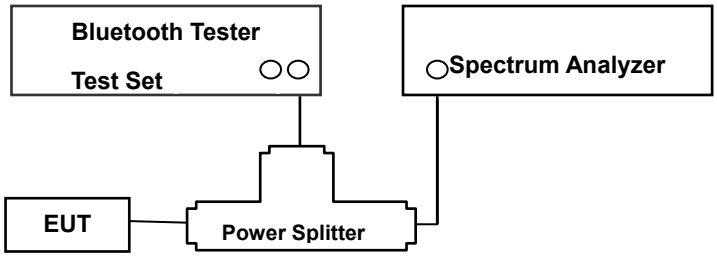
9.6.1 CONDUCTED SPURIOUS EMISSIONS

Test Requirements and limit, §15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Limit : 20 dBc

Test Configuration



TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer.

The Spectrum Analyzer is set to (7.8.8 in ANSI 63.10-2013)

1) Span: 30 MHz to 10 times the operating frequency in GHz.
2) RBW: 100 kHz
3) VBW: 300 kHz
4) Sweep: Coupled
5) Detector: Peak

Measurements are made over the 30 MHz to 26 GHz range with the transmitter set to the lowest, middle, and highest channels.

This test is performed with hopping off.

TEST RESULTS

No non-compliance noted.

Note : In order to simplify the report, attached plots were only the worst case channel and data rate.

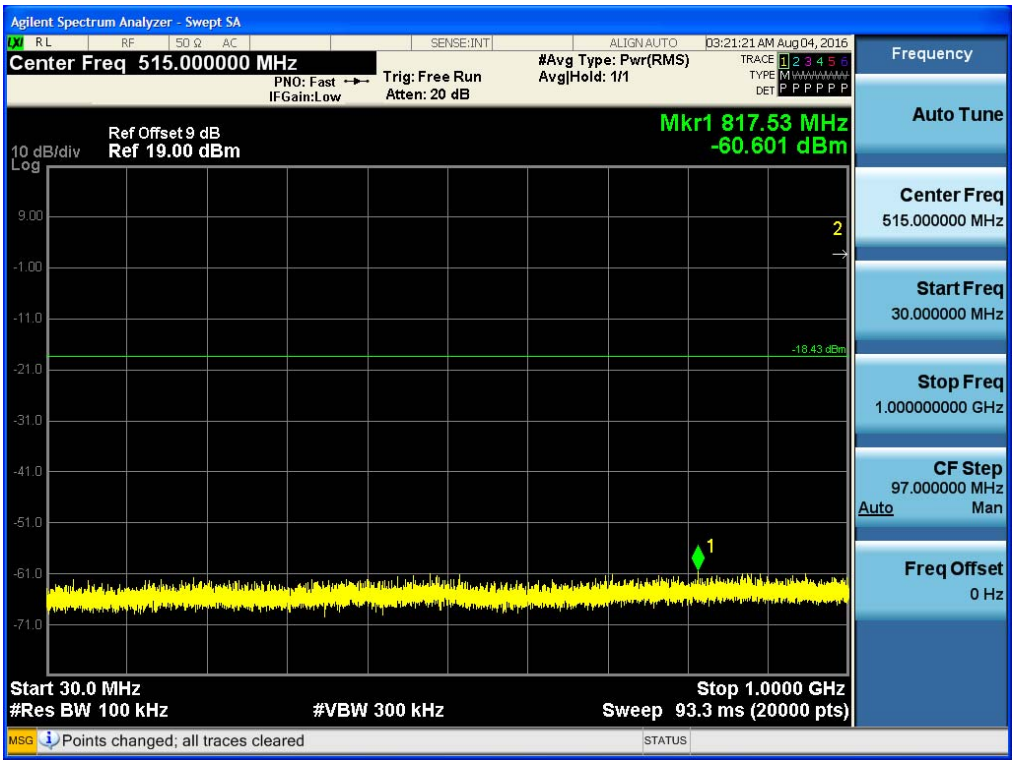
FACTORS FOR FREQUENCY

Freq(MHz)	Factor(dB)
30	7.18
100	6.35
200	7.04
300	6.58
400	6.26
500	5.95
600	6.17
700	6.34
800	6.72
900	7.08
1000	7.38
2000	7.78
2400*	7.36
2500*	7.44
3000	7.88
4000	8.95
5000	9.57
6000	6.68
7000	9.99
8000	8.34
9000	9.61
10000	10.47
11000	8.96
12000	9.73
13000	8.84
14000	9.50
15000	11.54
16000	8.14
17000	11.73
18000	9.71
19000	10.40
20000	11.69
21000	10.72
22000	12.31
23000	9.85
24000	12.52
25000	11.07
26000	10.50

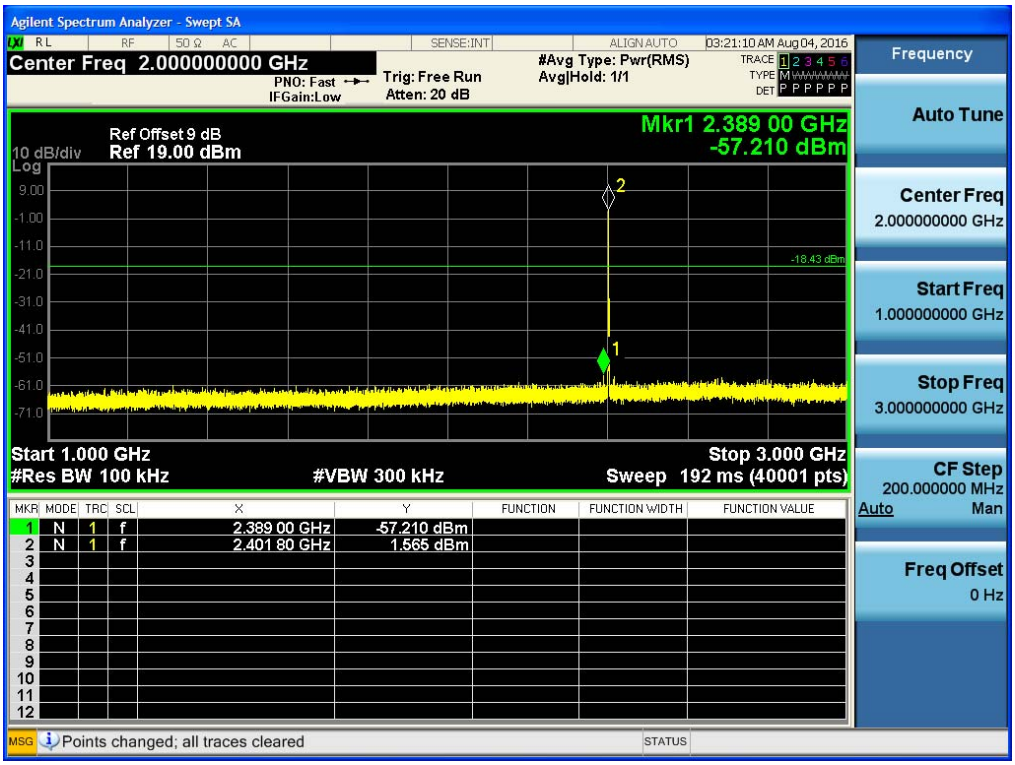
Note : 1. '*' is fundamental frequency range.

2. Factor = Cable loss + Splitter loss

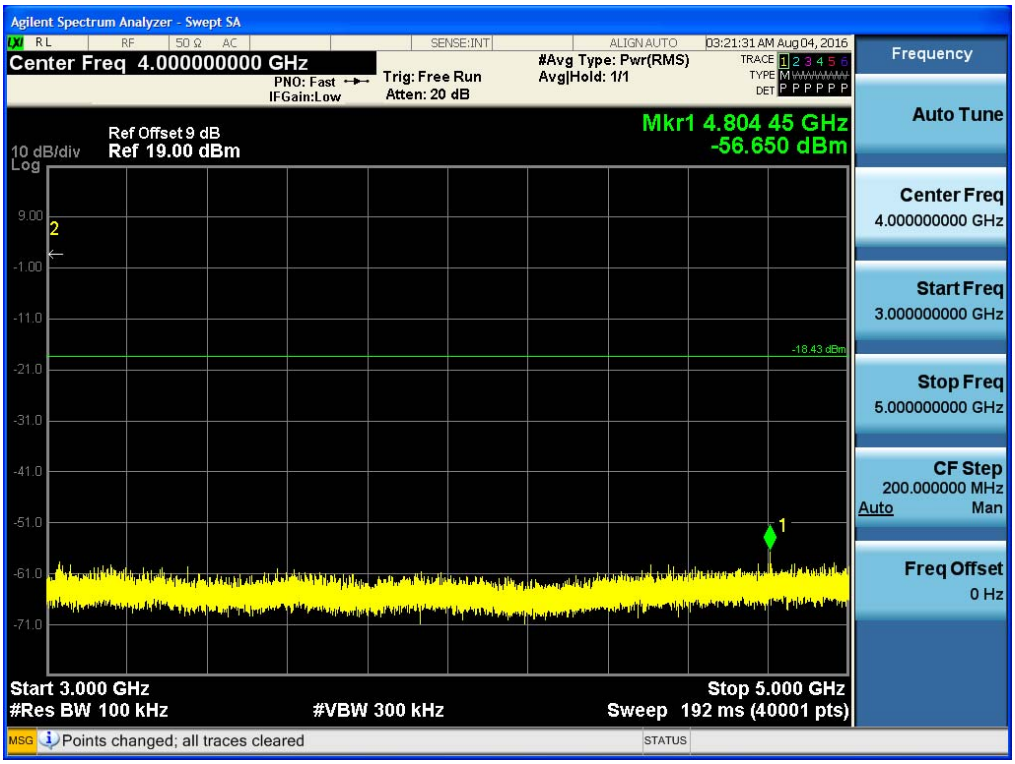
Test Plots (8DPSK)- 30 MHz - 1 GHz
Spurious Emission (CH.0)



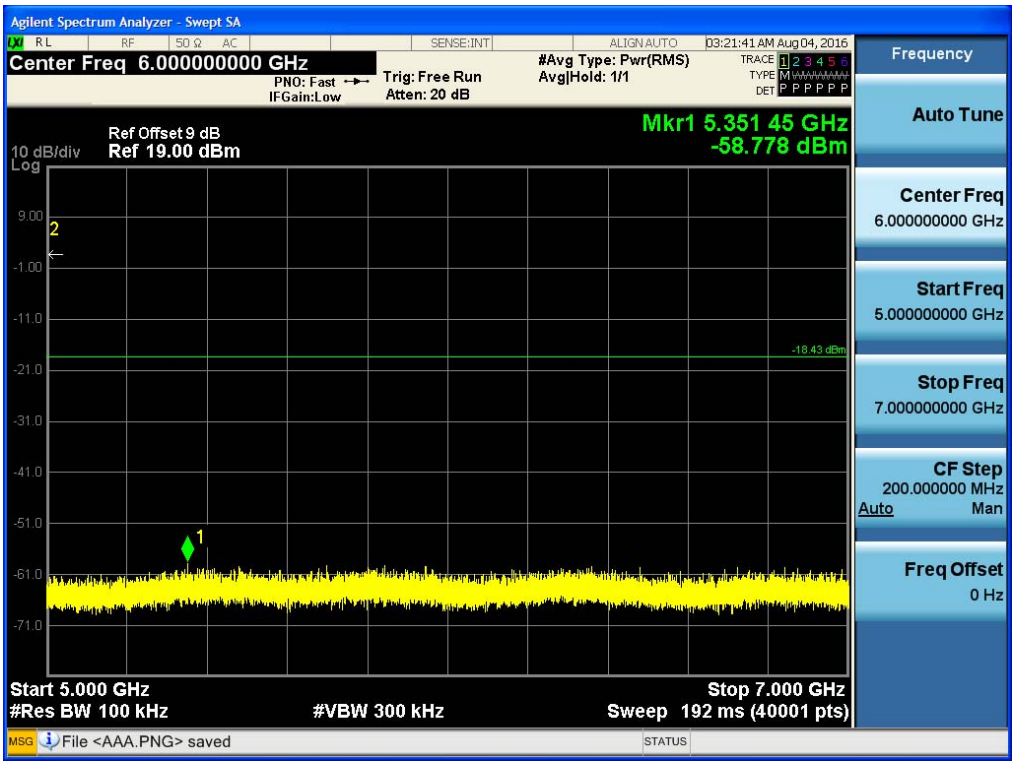
Test Plots (8DPSK)- 1 GHz – 3 GHz
Spurious Emission (CH.0)



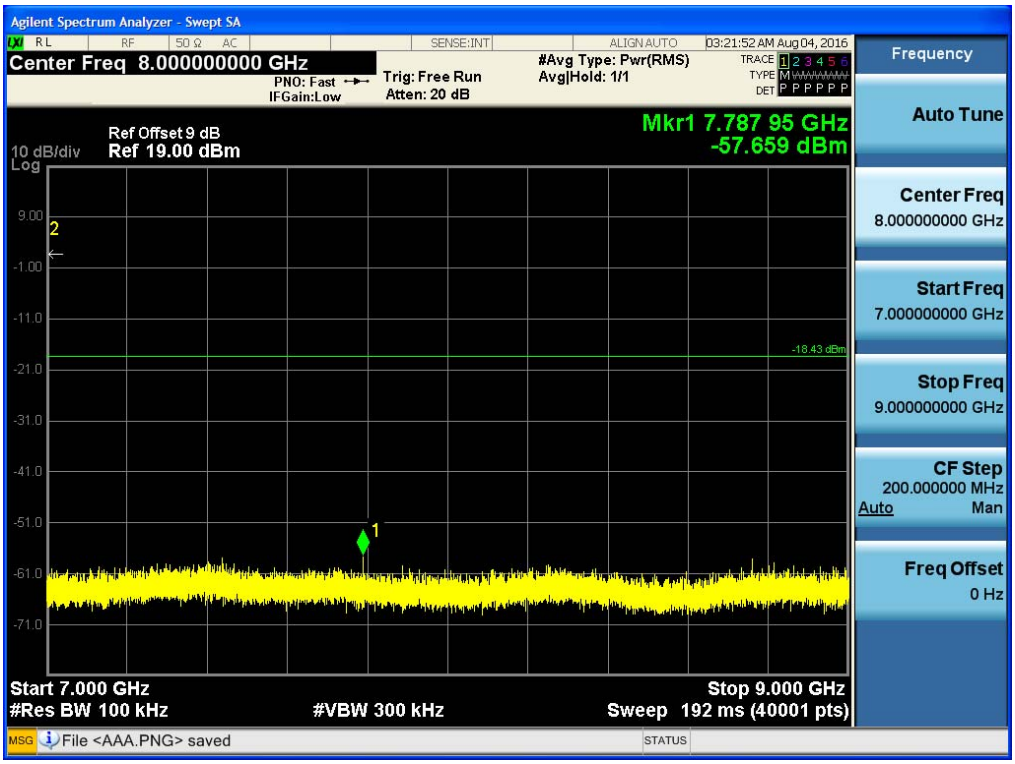
Test Plots(8DPSK)- 3 GHz - 5 GHz
Spurious Emission (CH.0)



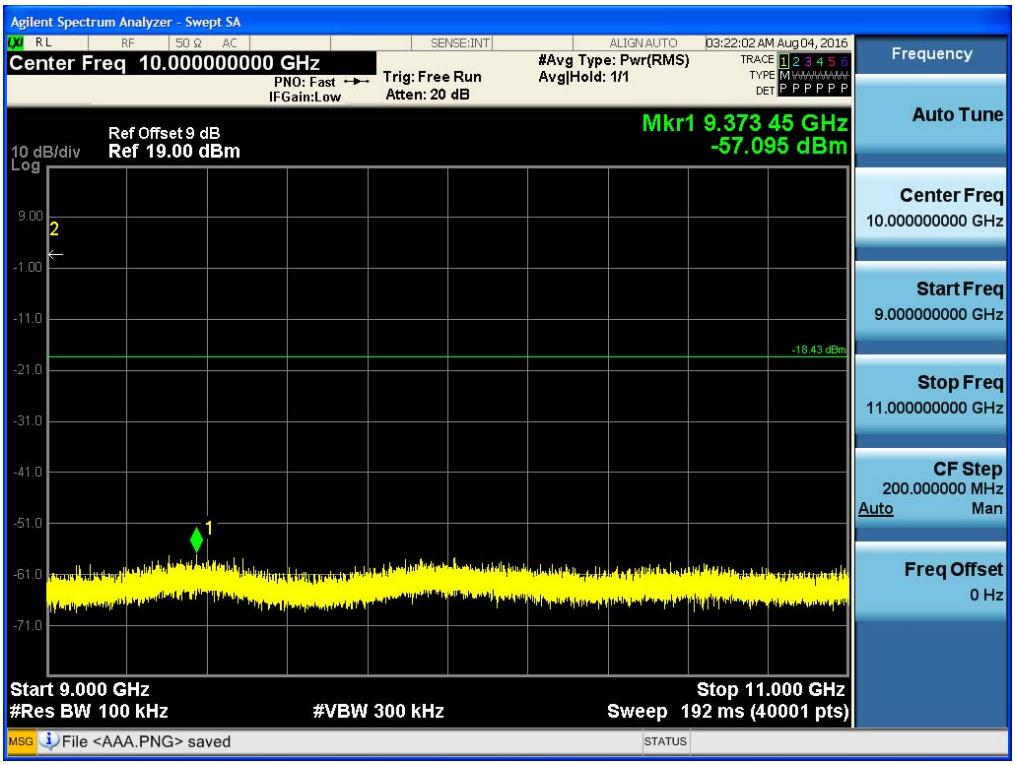
Test Plots (8DPSK)- 5 GHz - 7 GHz
Spurious Emission (CH.0)



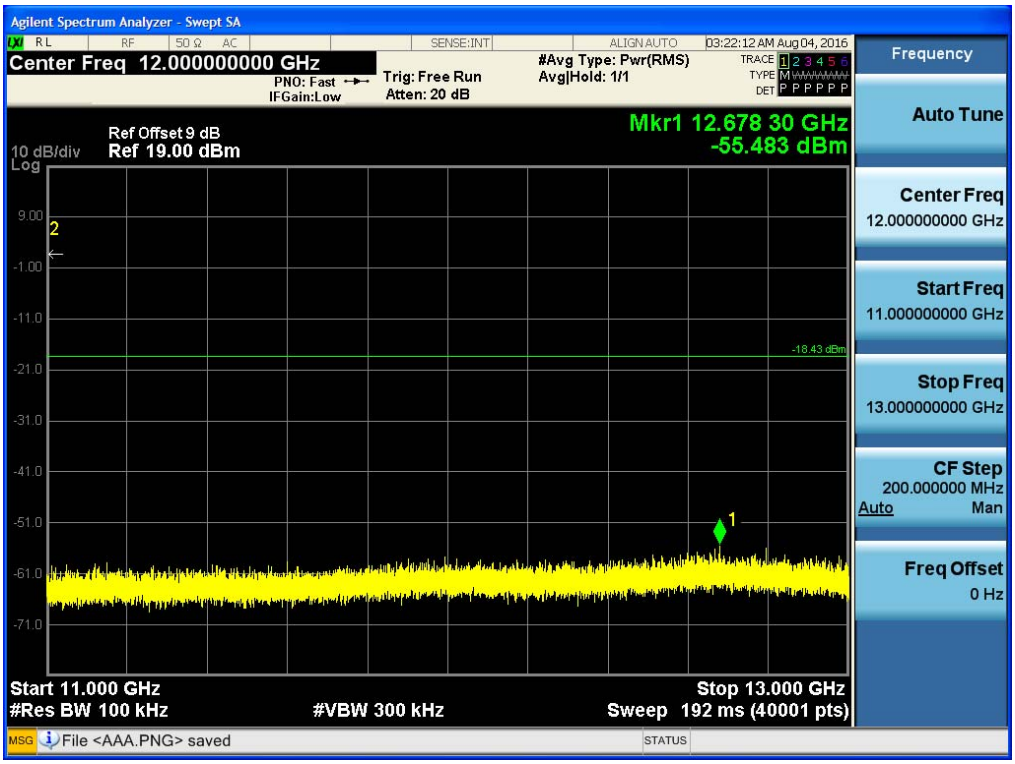
Test Plots(8DPSK)- 7 GHz - 9 GHz
Spurious Emission (CH.0)



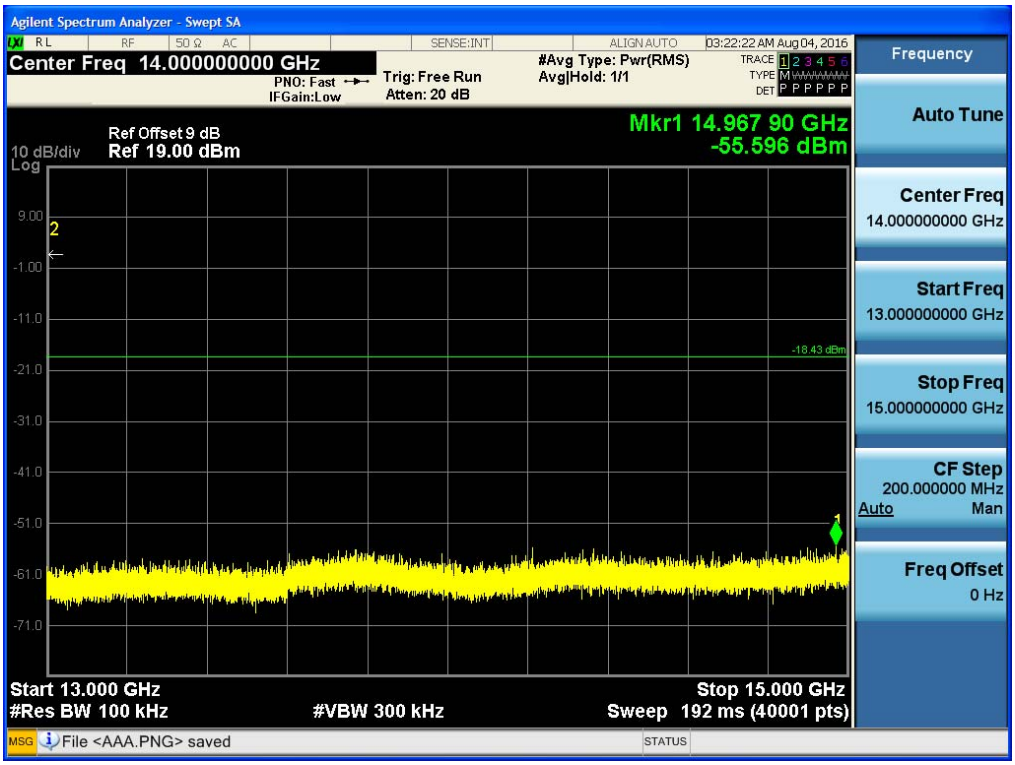
Test Plots(8DPSK)- 9 GHz - 11 GHz
Spurious Emission (CH.0)



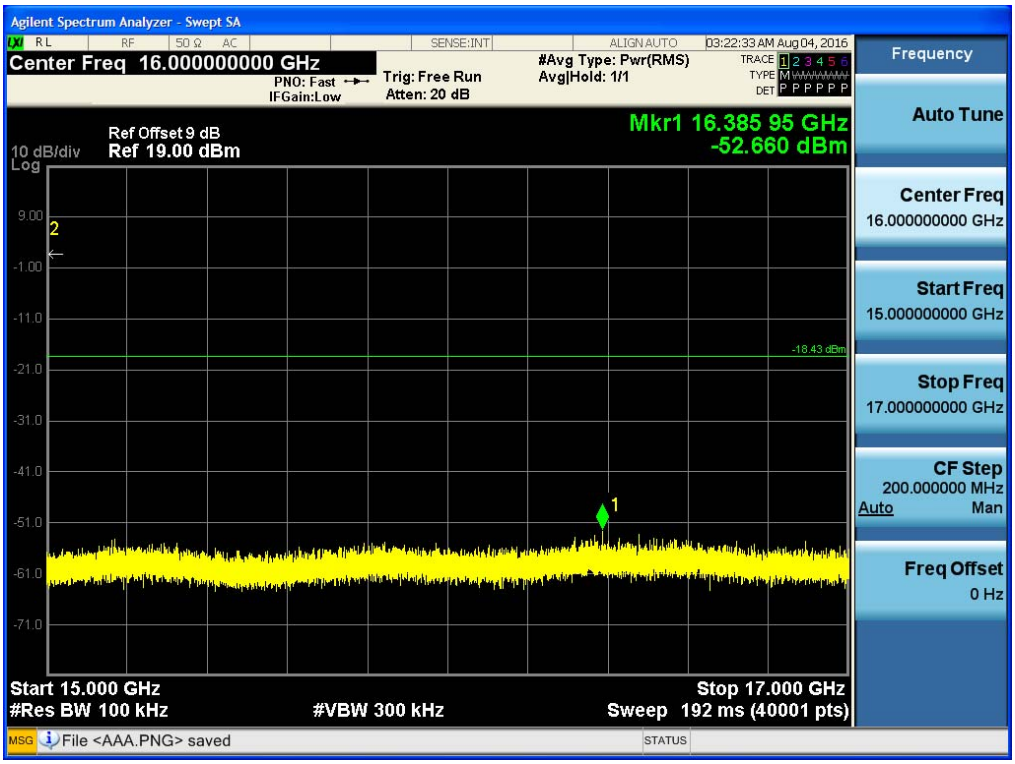
Test Plots(8DPSK) 11 GHz - 13 GHz
Spurious Emission (CH.0)



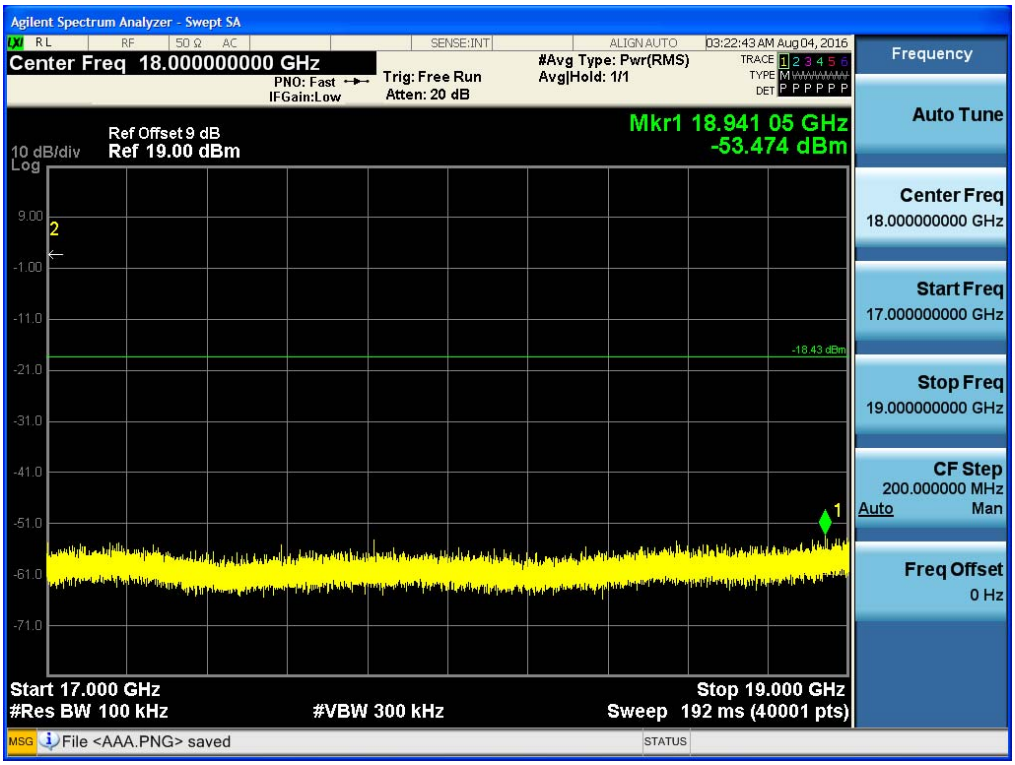
Test Plots (8DPSK)- 13 GHz – 15 GHz
Spurious Emission (CH.0)



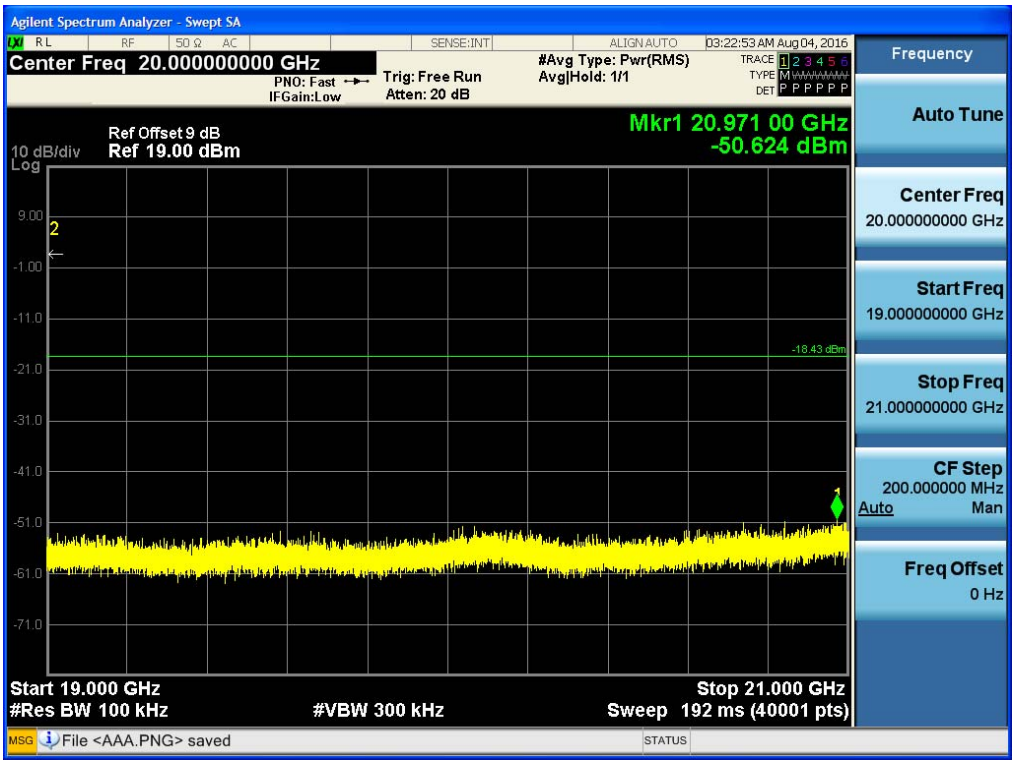
Test Plots(8DPSK)– 15 GHz - 17 GHz
Spurious Emission (CH.0)



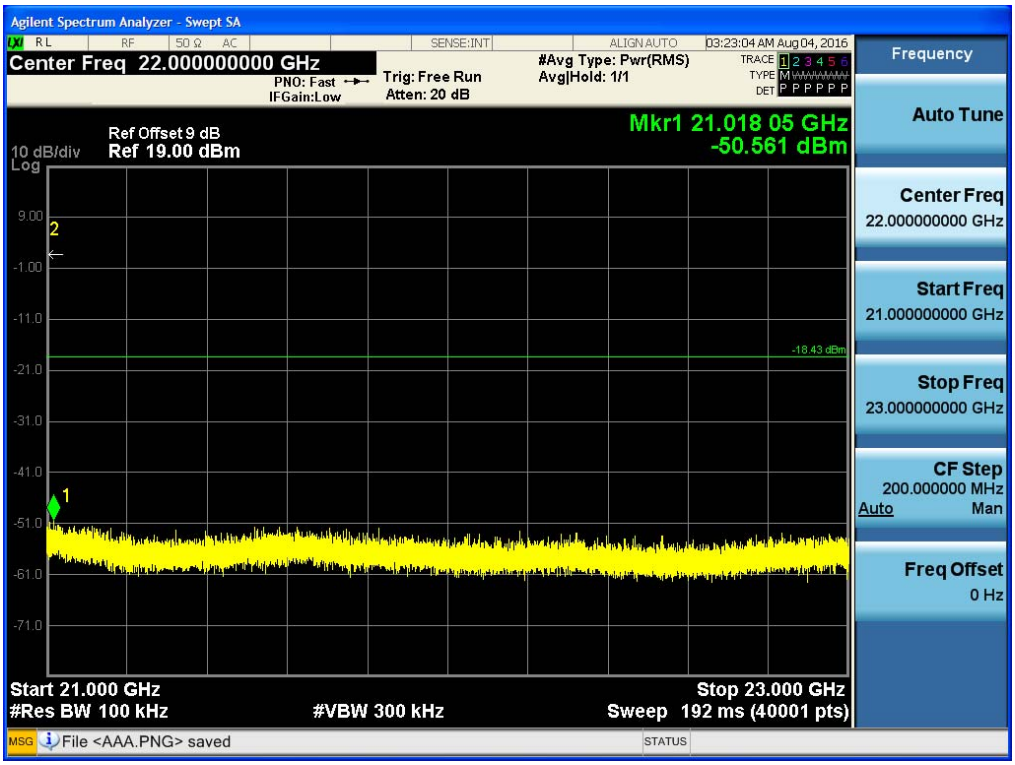
Test Plots(8DPSK)- 17 GHz - 19 GHz
Spurious Emission (CH.0)



Test Plots (8DPSK)- 19 GHz - 21 GHz
Spurious Emission (CH.0)

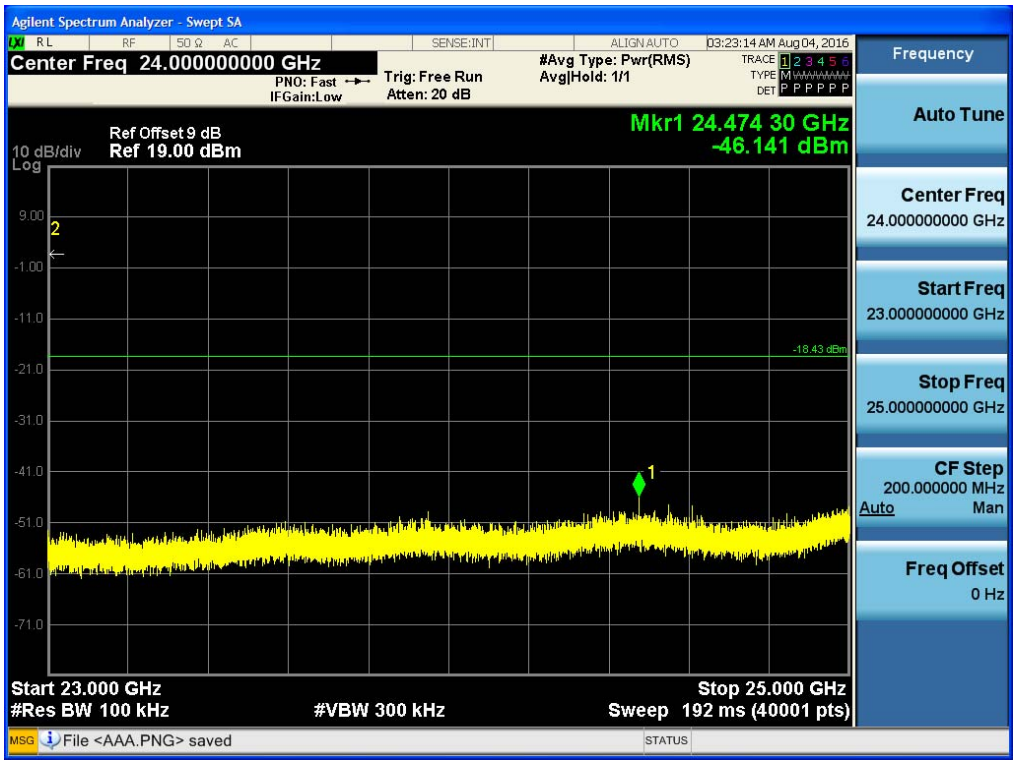


Test Plots (8DPSK)- 21 GHz - 23 GHz
Spurious Emission (CH.0)



Test Plots (8DPSK)- 23 GHz - 25 GHz

Spurious Emission (CH.0)



9.6.2 RADIATED SPURIOUS EMISSIONS

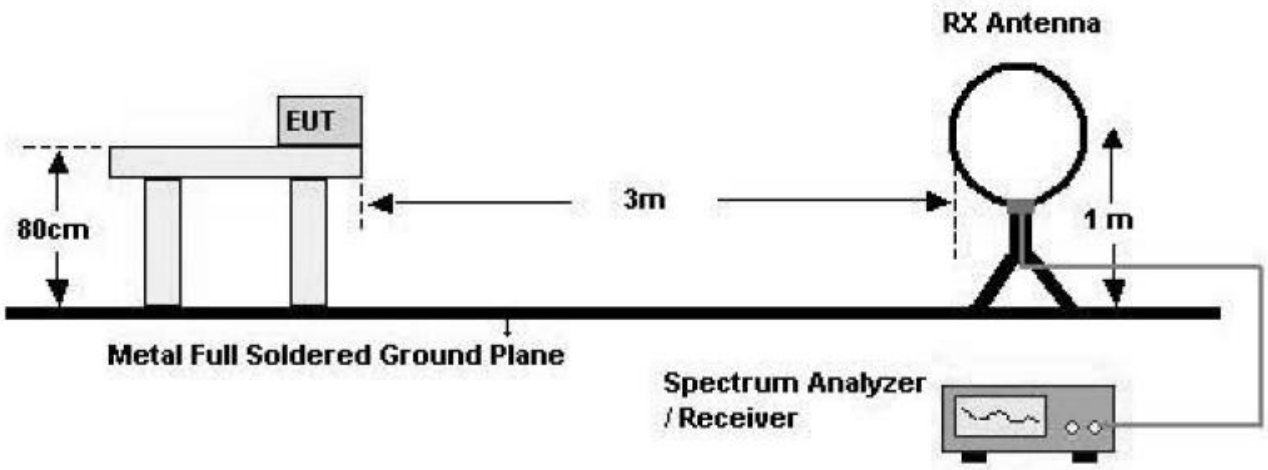
LIMIT : §15.247(d), §15.205, §15.209

1. 20dBc in any 100kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

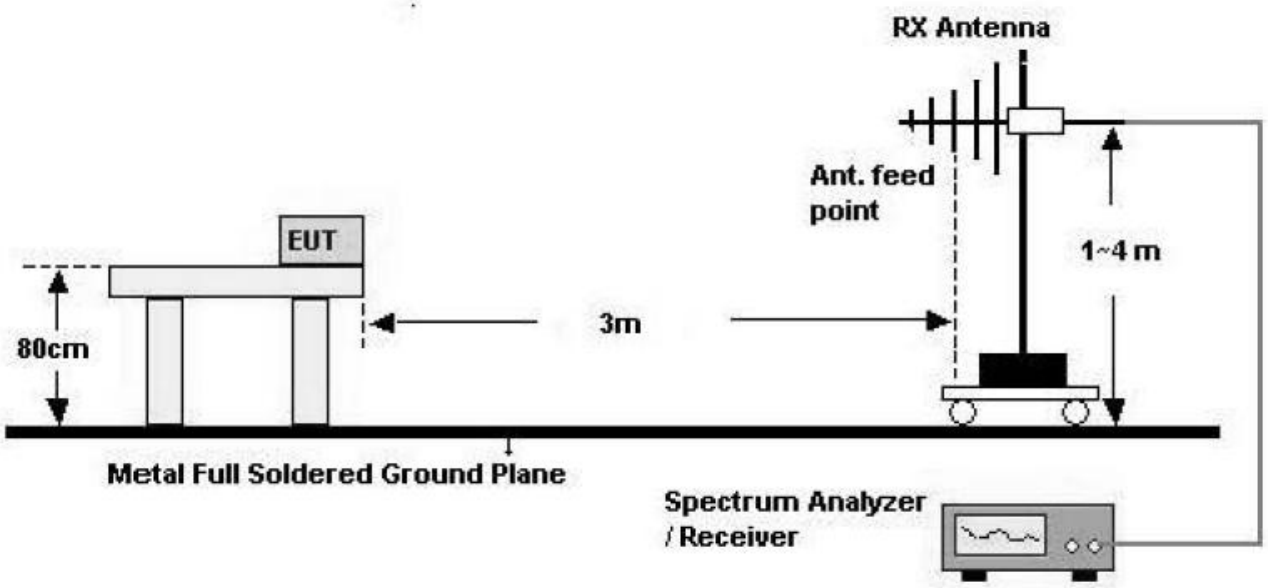
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

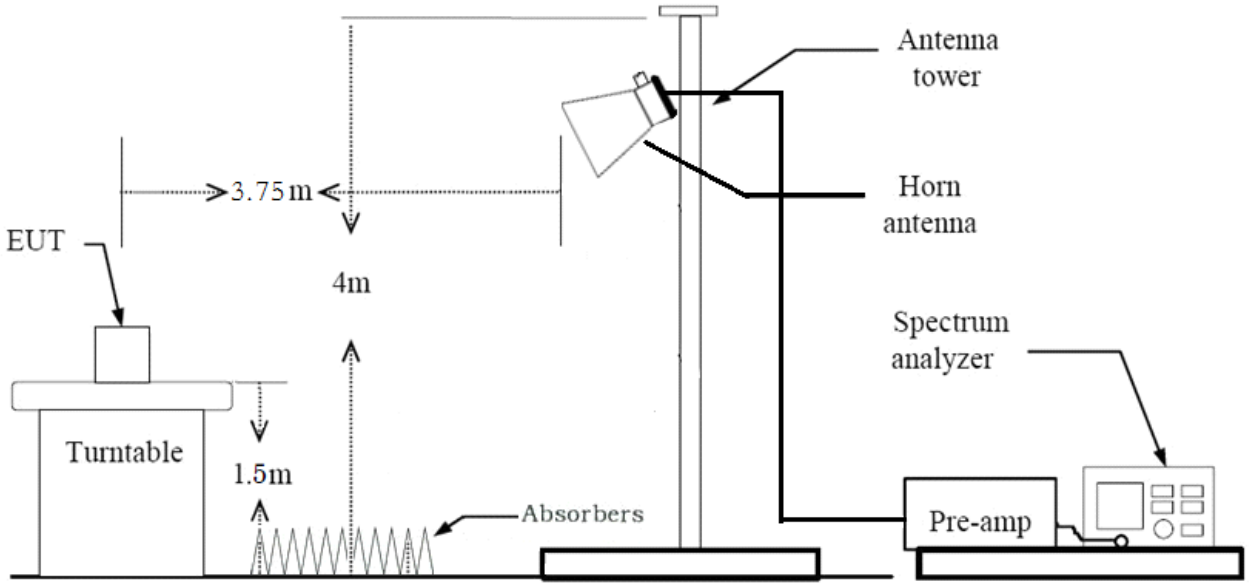
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



TEST PROCEDURE

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum Setting

   a. Peak: 1 GHz – 25 GHz, RBW = 1 MHz, VBW ≥3*RBW

   b. Average: 1 GHz – 25 GHz, RBW = 1 MHz, VBW ≥ 1/τ Hz, where τ = pulse width in seconds.

Note :

1. We are performed the RSE and radiated band edge using standard radiated method.
2. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
3. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
4. The duty cycle factor for BT mode.

BT Mode	T_{on} (ms)	VBW(1/T) (Hz)	The actual setting value of VBW (Hz)
GFSK	2.885	347	1000
π/4DQPSK	2.890	346	1000
8DPSK	2.890	346	1000

TEST RESULTS

9 kHz – 30MHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. This test is performed with hopping off.
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

TEST RESULTS

Below 1 GHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. This test is performed with hopping off.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Above 1 GHz

Operation Mode: CH Low(GFSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4804	55.92	-0.61	V	0	55.31	73.98	18.67	PK
4804	50.68	-0.61	V	-24.73	25.34	53.98	28.64	AV
7206	45.75	8.78	V	0	54.53	73.98	19.45	PK
7206	32.16	8.78	V	-24.73	16.21	53.98	37.77	AV
4804	56.36	-0.61	H	0	55.75	73.98	18.23	PK
4804	51.87	-0.61	H	-24.73	26.53	53.98	27.45	AV
7206	46.10	8.78	H	0	54.88	73.98	19.10	PK
7206	32.24	8.78	H	-24.73	16.29	53.98	37.69	AV

Operation Mode: CH Low(8DPSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4804	56.34	-0.61	V	0	55.73	73.98	18.25	PK
4804	46.61	-0.61	V	-24.73	21.27	53.98	32.71	AV
7206	45.59	8.78	V	0	54.37	73.98	19.61	PK
7206	32.11	8.78	V	-24.73	16.16	53.98	37.82	AV
4804	56.77	-0.61	H	0	56.16	73.98	17.82	PK
4804	47.62	-0.61	H	-24.73	22.28	53.98	31.70	AV
7206	46.15	8.78	H	0	54.93	73.98	19.05	PK
7206	32.10	8.78	H	-24.73	16.15	53.98	37.83	AV

Operation Mode: CH Low(π/4DQPSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4804	55.68	-0.61	V	0	55.07	73.98	18.91	PK
4804	46.46	-0.61	V	-24.73	21.12	53.98	32.86	AV
7206	46.07	8.78	V	0	54.85	73.98	19.13	PK
7206	32.08	8.78	V	-24.73	16.13	53.98	37.85	AV
4804	56.29	-0.61	H	0	55.68	73.98	18.30	PK
4804	47.50	-0.61	H	-24.73	22.16	53.98	31.82	AV
7206	46.23	8.78	H	0	55.01	73.98	18.97	PK
7206	32.18	8.78	H	-24.73	16.23	53.98	37.75	AV

*A.F. : Antenna Factor / C.L. : Cable Loss / AMP.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
6. Spectrum setting:
   a. Peak Setting 1 GHz – 25 GHz, RBW = 1 MHz, VBW = 3 MHz.
   b. Average Setting 1 GHz – 25 GHz, RBW = 1 MHz, VBW ≥ 1/τ Hz, where τ = pulse width in seconds. We performed using a reduced video BW method was done with the analyzer in linear mode.
7. FYI : Duty Cycle Correction Factor (79 channel hopping)
   a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
   b. 100 ms/ Δt [ms] = *H* → Round up to next highest integer, *H ' =1*
   c. Worst Case Dwell Time = τ [ms] x *H '* = 2.900 ms
   d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
8. Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)
   a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
   b. 100 ms/ Δt [ms] = *H* → Round up to next highest integer, *H ' = 2*
   c. Worst Case Dwell Time = τ [ms] x *H '* = 5.800 ms

d. Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB

e. We applied DCCF in the test result which hopping channel number is 20.

9. We have done Normal Mode and EDR Mode test.

10. This test is performed with hopping off.

11. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Operation Mode: CH Mid(GFSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4882	55.74	0.19	V	0	55.93	73.98	18.05	PK
4882	48.86	0.19	V	-24.73	24.32	53.98	29.66	AV
7323	46.42	8.85	V	0	55.27	73.98	18.71	PK
7323	32.49	8.85	V	-24.73	16.61	53.98	37.37	AV
4882	56.05	0.19	H	0	56.24	73.98	17.74	PK
4882	49.93	0.19	H	-24.73	25.39	53.98	28.59	AV
7323	46.91	8.85	H	0	55.76	73.98	18.22	PK
7323	32.65	8.85	H	-24.73	16.77	53.98	37.21	AV

Operation Mode: CH Mid(8DPSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4882	54.96	0.19	V	0	55.15	73.98	18.83	PK
4882	45.28	0.19	V	-24.73	20.74	53.98	33.24	AV
7323	46.72	8.85	V	0	55.57	73.98	18.41	PK
7323	32.63	8.85	V	-24.73	16.75	53.98	37.23	AV
4882	55.53	0.19	H	0	55.72	73.98	18.26	PK
4882	45.44	0.19	H	-24.73	20.90	53.98	33.08	AV
7323	46.47	8.85	H	0	55.32	73.98	18.66	PK
7323	32.57	8.85	H	-24.73	16.69	53.98	37.29	AV

Operation Mode: CH Mid(π/4DQPSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4882	54.38	0.19	V	0	54.57	73.98	19.41	PK
4882	44.51	0.19	V	-24.73	19.97	53.98	34.01	AV
7323	46.40	8.85	V	0	55.25	73.98	18.73	PK
7323	32.54	8.85	V	-24.73	16.66	53.98	37.32	AV
4882	55.27	0.19	H	0	55.46	73.98	18.52	PK
4882	45.45	0.19	H	-24.73	20.91	53.98	33.07	AV
7323	46.78	8.85	H	0	55.63	73.98	18.35	PK
7323	32.59	8.85	H	-24.73	16.71	53.98	37.27	AV

*A.F. : Antenna Factor / C.L. : Cable Loss / AMP.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
6. Spectrum setting:
   a. Peak Setting 1 GHz – 25 GHz, RBW = 1 MHz, VBW = 3 MHz.
   b. Average Setting 1 GHz – 25 GHz, RBW = 1 MHz, VBW ≥ 1/τ Hz, where τ = pulse width in seconds. We performed using a reduced video BW method was done with the analyzer in linear mode.
7. FYI : Duty Cycle Correction Factor (79 channel hopping)
   a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
   b. 100 ms/ Δt [ms] = *H* → Round up to next highest integer, *H ' =1*
   c. Worst Case Dwell Time = τ [ms] x *H '* = 2.900 ms
   d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
8. Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)
   a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
   b. 100 ms/ Δt [ms] = *H* → Round up to next highest integer, *H ' = 2*
   c. Worst Case Dwell Time = τ [ms] x *H '* = 5.800 ms

d. Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB

e. We applied DCCF in the test result which hopping channel number is 20.

9. We have done Normal Mode and EDR Mode test.

10. This test is performed with hopping off.

11. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Operation Mode: CH High(GFSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4960	55.02	0.92	V	0	55.94	73.98	18.04	PK
4960	48.35	0.92	V	-24.73	24.54	53.98	29.44	AV
7440	46.64	9.03	V	0	55.67	73.98	18.31	PK
7440	32.47	9.03	V	-24.73	16.77	53.98	37.21	AV
4960	55.58	0.92	H	0	56.50	73.98	17.48	PK
4960	49.59	0.92	H	-24.73	25.78	53.98	28.20	AV
7440	46.90	9.03	H	0	55.93	73.98	18.05	PK
7440	32.62	9.03	H	-24.73	16.92	53.98	37.06	AV

Operation Mode: CH High(8DPSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4960	54.25	0.92	V	0	55.17	73.98	18.81	PK
4960	44.06	0.92	V	-24.73	20.25	53.98	33.73	AV
7440	46.02	9.03	V	0	55.05	73.98	18.93	PK
7440	32.36	9.03	V	-24.73	16.66	53.98	37.32	AV
4960	55.08	0.92	H	0	56.00	73.98	17.98	PK
4960	45.16	0.92	H	-24.73	21.35	53.98	32.63	AV
7440	46.59	9.03	H	0	55.62	73.98	18.36	PK
7440	32.44	9.03	H	-24.73	16.74	53.98	37.24	AV

Operation Mode: CH High (π/4DQPSK)

Frequency [MHz]	Reading dBuV	AN.+CL-AMP G [dB]	ANT. POL [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Detect
4960	55.13	0.92	V	0	56.05	73.98	17.93	PK
4960	44.09	0.92	V	-24.73	20.28	53.98	33.70	AV
7440	46.57	9.03	V	0	55.60	73.98	18.38	PK
7440	32.39	9.03	V	-24.73	16.69	53.98	37.29	AV
4960	55.64	0.92	H	0	56.56	73.98	17.42	PK
4960	45.13	0.92	H	-24.73	21.32	53.98	32.66	AV
7440	46.68	9.03	H	0	55.71	73.98	18.27	PK
7440	32.55	9.03	H	-24.73	16.85	53.98	37.13	AV

*A.F. : Antenna Factor / C.L. : Cable Loss / AMP.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
6. Spectrum setting:
   a. Peak Setting 1 GHz – 25 GHz, RBW = 1 MHz, VBW = 3 MHz.
   b. Average Setting 1 GHz – 25 GHz, RBW = 1 MHz, VBW ≥ 1/τ Hz, where τ = pulse width in seconds. We performed using a reduced video BW method was done with the analyzer in linear mode.
7. FYI : Duty Cycle Correction Factor (79 channel hopping)
   a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
   b. 100 ms/ Δt [ms] = *H* → Round up to next highest integer, *H ' =1*
   c. Worst Case Dwell Time = τ [ms] x *H '* = 2.900 ms
   d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
8. Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)
   a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
   b. 100 ms/ Δt [ms] = *H* → Round up to next highest integer, *H ' = 2*
   c. Worst Case Dwell Time = τ [ms] x *H '* = 5.800 ms

d. Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB

e. We applied DCCF in the test result which hopping channel number is 20.

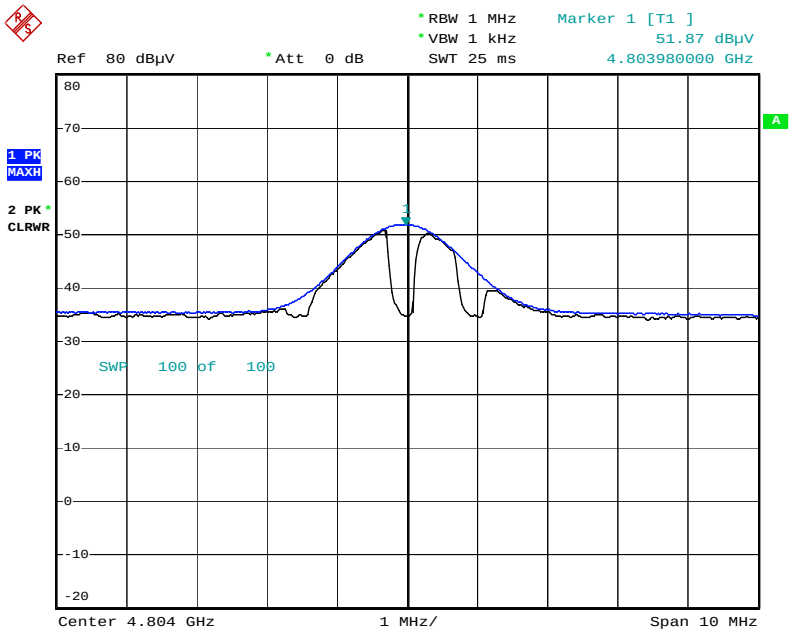
9. We have done Normal Mode and EDR Mode test.

10. This test is performed with hopping off.

11. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

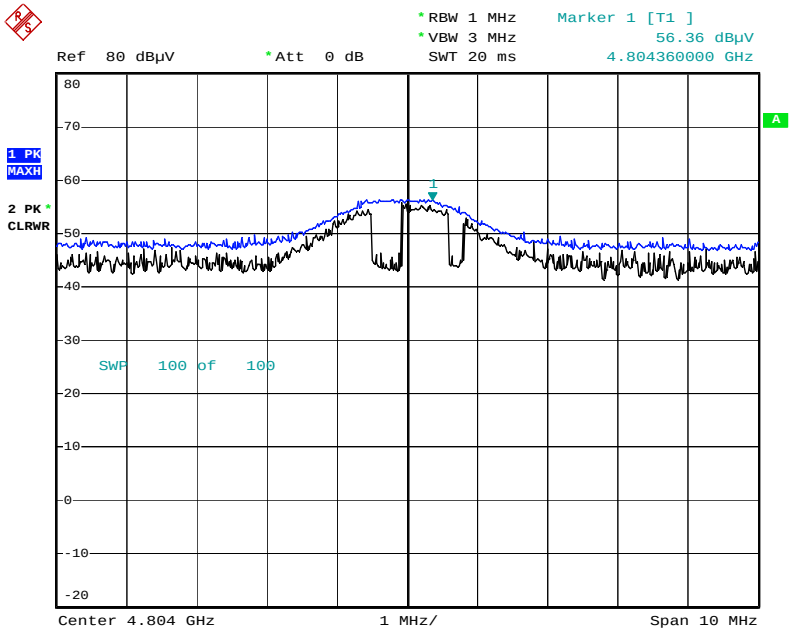
▣ RESULT PLOTS (Worst case : X-H)

Radiated Spurious Emissions plot – Average Reading (GFSK, Ch.0 2nd Harmonic)



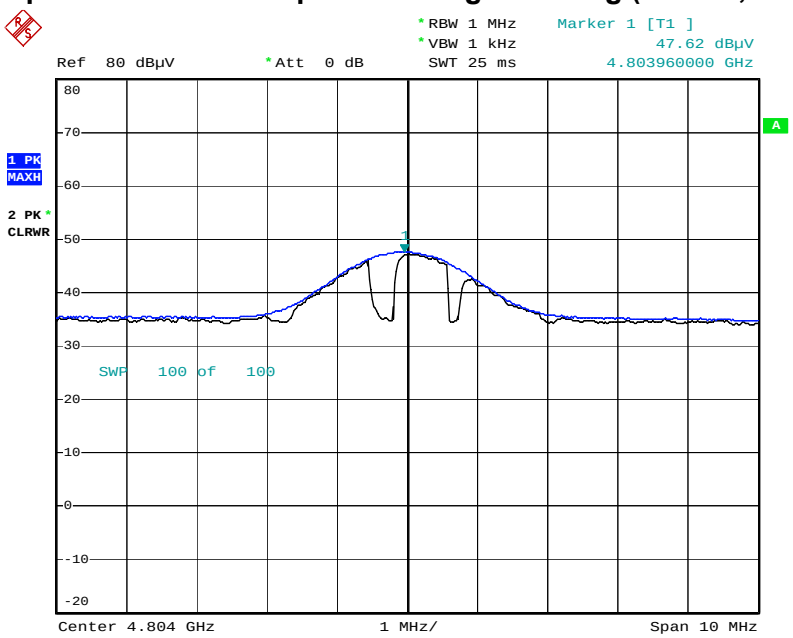
Date: 8.AUG.2016 16:39:53

Radiated Spurious Emissions plot – Peak Reading (GFSK, Ch.0 2nd Harmonic)



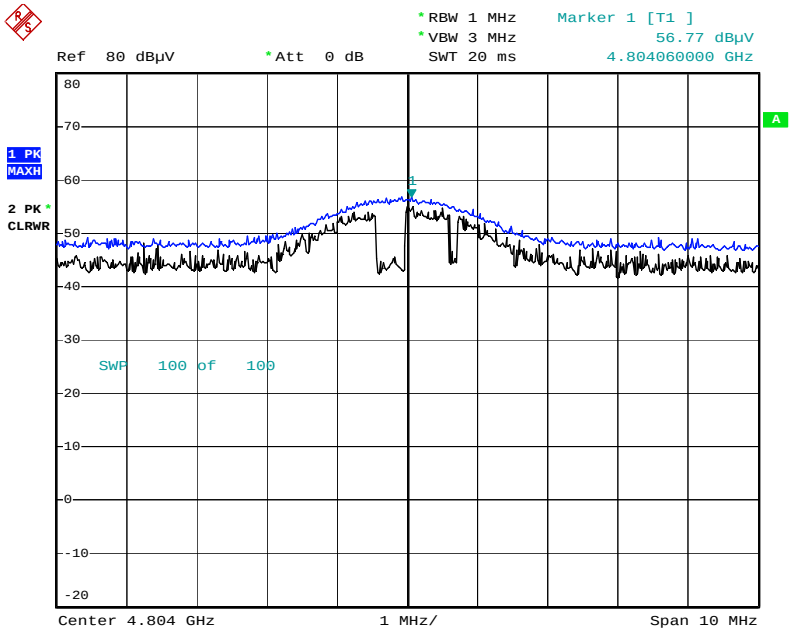
Date: 8.AUG.2016 16:40:24

Radiated Spurious Emissions plot – Average Reading (8DPSK, Ch.0 2nd Harmonic)



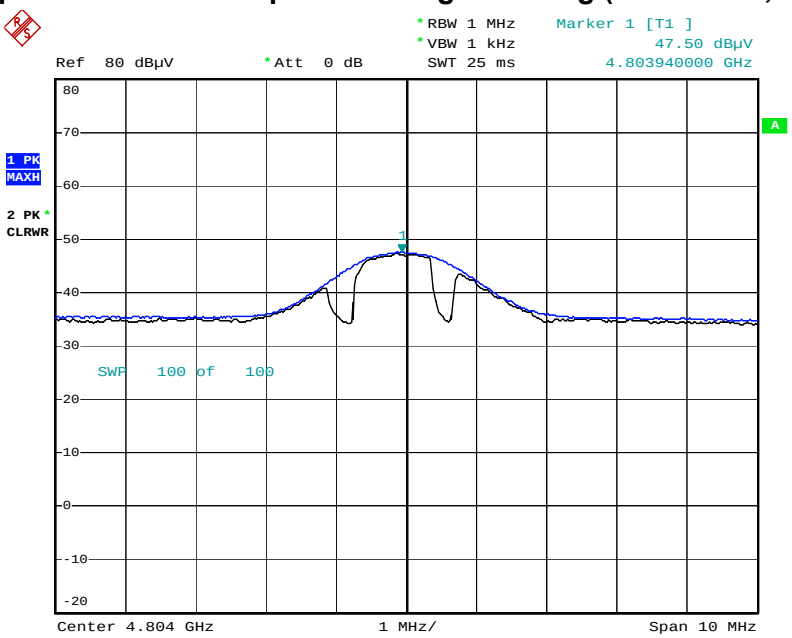
Date: 8.AUG.2016 16:38:15

Radiated Spurious Emissions plot – Peak Reading (8DPSK, Ch.0 2nd Harmonic)



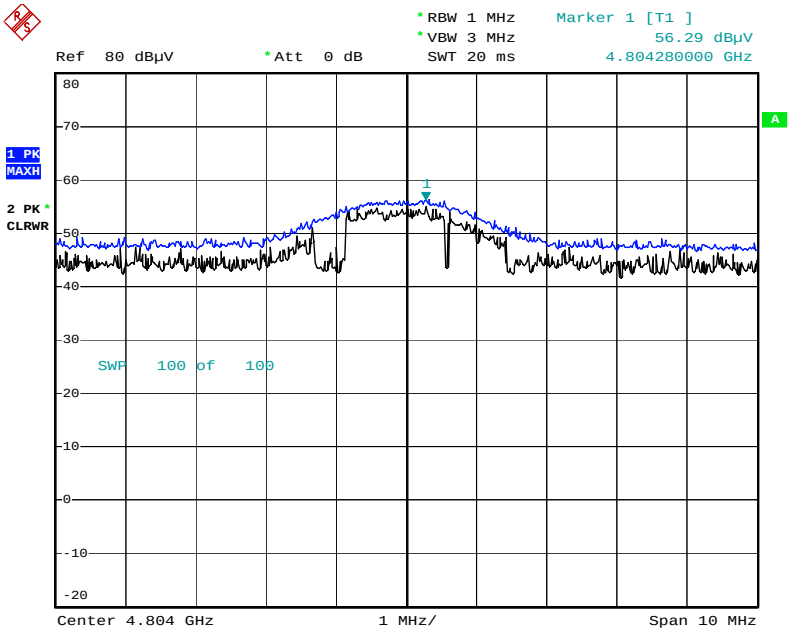
Date: 8.AUG.2016 16:37:48

Radiated Spurious Emissions plot – Average Reading (π/4DQPSK, Ch.0 2nd Harmonic)



Date: 8.AUG.2016 16:38:45

Radiated Spurious Emissions plot – Peak Reading (π/4DQPSK, Ch.0 2nd Harmonic)



Date: 8.AUG.2016 16:37:16

9.6.3 RADIATED RESTRICTED BAND EDGES

Test Requirements and limit, §15.247(d), §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c).

Operation Mode	Normal(GFSK)
Operating Frequency	2402 MHz, 2480 MHz
Channel No	CH 0, CH 78

Frequency [MHz]	Reading dBuV	※ A.F.+C.L.+D.F. [dB]	Ant. Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	25.34	32.68	H	0	58.02	73.98	15.96	PK
2390.0	12.25	32.68	H	-24.73	20.20	53.98	33.78	AV
2390.0	25.68	32.68	V	0	58.36	73.98	15.62	PK
2390.0	12.30	32.68	V	-24.73	20.25	53.98	33.73	AV
2483.5	27.09	33.05	H	0	60.14	73.98	13.84	PK
2483.5	21.36	33.05	H	-24.73	29.68	53.98	24.30	AV
2483.5	28.19	33.05	V	0	61.24	73.98	12.74	PK
2483.5	22.52	33.05	V	-24.73	30.84	53.98	23.14	AV

Operation Mode EDR(8DPSK)

Operating Frequency 2402 MHz , 2480 MHz

Channel No CH 0, CH 78

Frequency [MHz]	Reading dBuV	※ A.F.+C.L.+D.F. [dB]	Ant. Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	25.46	32.68	H	0	58.14	73.98	15.84	PK
2390.0	12.09	32.68	H	-24.73	20.04	53.98	33.94	AV
2390.0	25.67	32.68	V	0	58.35	73.98	15.63	PK
2390.0	12.17	32.68	V	-24.73	20.12	53.98	33.86	AV
2483.5	27.16	33.05	H	0	60.21	73.98	13.77	PK
2483.5	20.16	33.05	H	-24.73	28.48	53.98	25.50	AV
2483.5	27.90	33.05	V	0	60.95	73.98	13.03	PK
2483.5	21.43	33.05	V	-24.73	29.75	53.98	24.23	AV

Operation Mode EDR(π/4DQPSK)

Operating Frequency 2402 MHz , 2480 MHz

Channel No CH 0, CH 78

Frequency [MHz]	Reading dBuV	※ A.F.+CL + D.F. [dB]	Ant. Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	25.49	32.68	H	0	58.17	73.98	15.81	PK
2390.0	12.14	32.68	H	-24.73	20.09	53.98	33.89	AV
2390.0	25.24	32.68	V	0	57.92	73.98	16.06	PK
2390.0	12.08	32.68	V	-24.73	20.03	53.98	33.95	AV
2483.5	27.95	33.05	H	0	61.00	73.98	12.98	PK
2483.5	20.15	33.05	H	-24.73	28.47	53.98	25.51	AV
2483.5	27.89	33.05	V	0	60.94	73.98	13.04	PK
2483.5	21.37	33.05	V	-24.73	29.69	53.98	24.29	AV

*A.F. : Antenna Factor

C.L. : Cable Loss

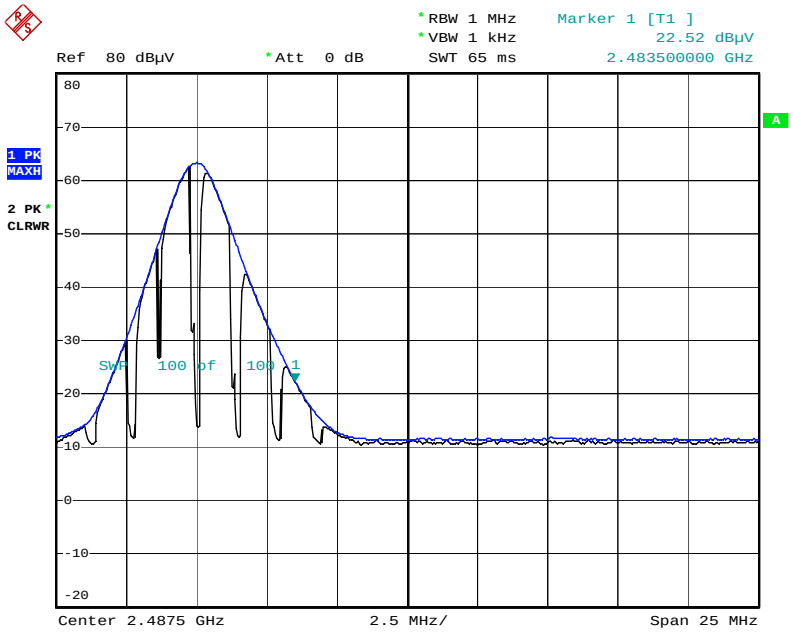
D.F. : Distance Factor

Notes:

1. Frequency range of measurement = 2483.5 MHz ~ 2500 MHz
2. Total = Reading Value + Antenna Factor + Cable Loss + Distance Factor + Duty Cycle Correction Factor
3. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
4. Spectrum setting:
   a. Peak Setting 1 GHz – 25 GHz, RBW = 1 MHz, VBW = 3 MHz.
   b. Average Setting 1 GHz – 25 GHz, RBW = 1 MHz, VBW ≥ 1/τ Hz, where τ = pulse width in seconds.
   We performed using a reduced video BW method was done with the analyzer in linear mode.
5. FYI : Duty Cycle Correction Factor (79 channel hopping)
   a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
   b. 100 ms/ Δt [ms] = *H* → Round up to next highest integer, *H ' =1*
   c. Worst Case Dwell Time = τ [ms] x *H '* = 2.900 ms
   d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
6. Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)
   a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
   b. 100 ms/ Δt [ms] = *H* → Round up to next highest integer, *H ' = 2*
   c. Worst Case Dwell Time = τ [ms] x *H '* = 5.800 ms
   d. Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB
   e. We applied DCCF in the test result which hopping channel number is 20.
7. We have done Normal Mode, EDR Mode.
8. This test is performed with hopping off.
9. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

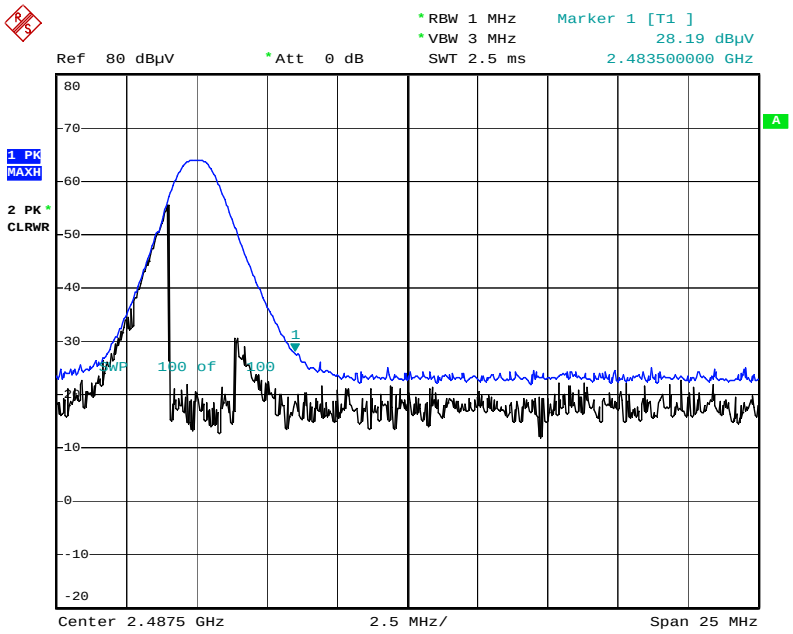
▣ RESULT PLOTS (Worst case : X-V)

Radiated Restricted Band Edges plot – Average Reading (GFSK, Ch.78)



Date: 5.AUG.2016 17:29:54

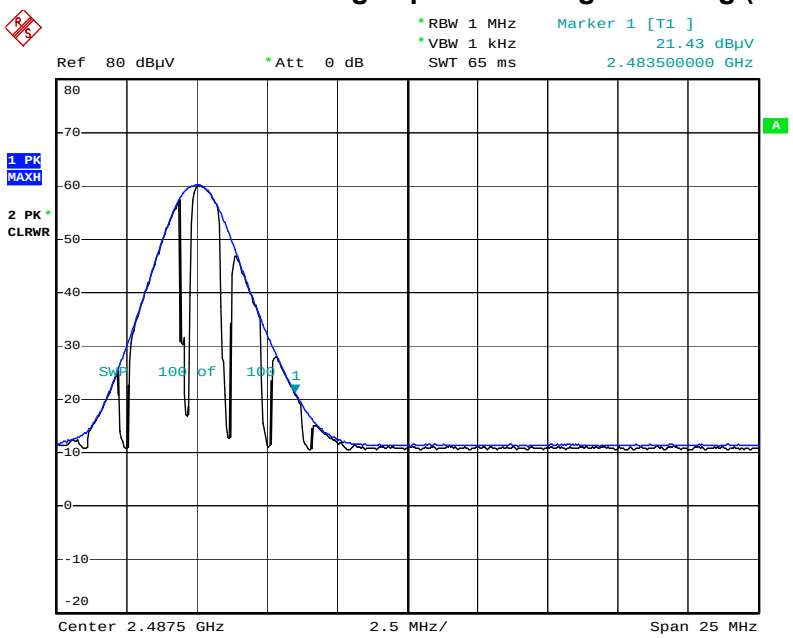
Radiated Restricted Band Edges plot – Peak Reading (GFSK, Ch.78)



Date: 5.AUG.2016 17:26:48

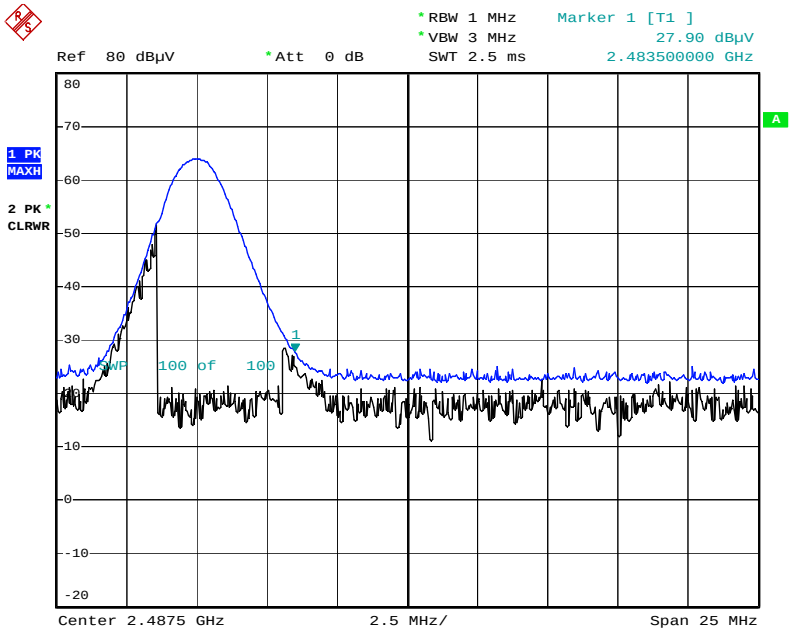
Note : Only the worst case plots for Radiated Restricted Band Edges.

Radiated Restricted Band Edges plot – Average Reading (8DPSK, Ch.78)



Date: 5.AUG.2016 17:28:18

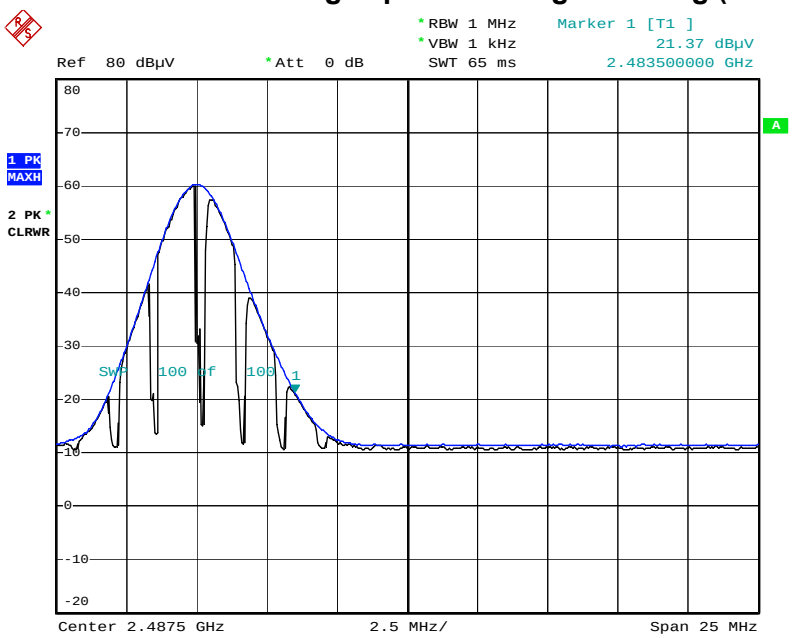
Radiated Restricted Band Edges plot – Peak Reading (8DPSK, Ch.78)



Date: 5.AUG.2016 17:27:43

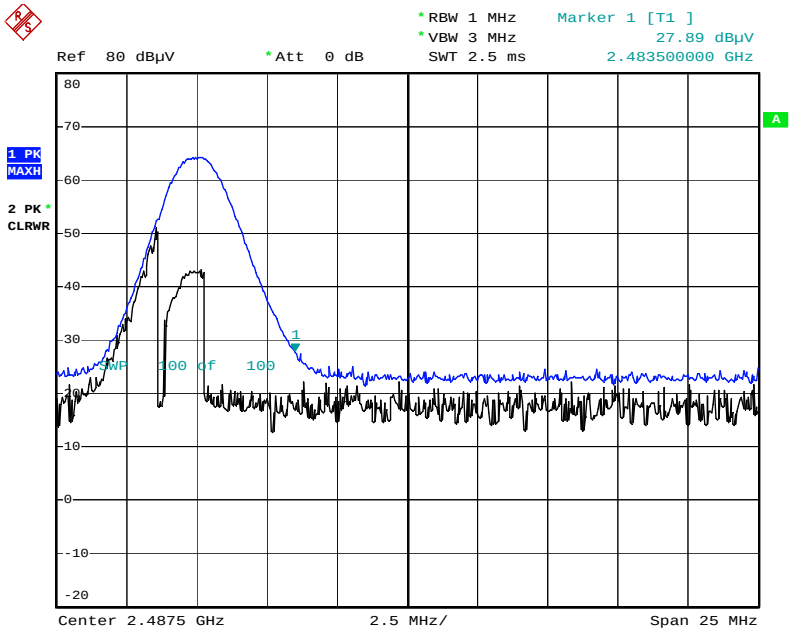
Note : Only the worst case plots for Radiated Restricted Band Edges.

Radiated Restricted Band Edges plot – Average Reading (π/4DQPSK, Ch.78)



Date: 5.AUG.2016 17:28:51

Radiated Restricted Band Edges plot – Peak Reading (π/4DQPSK, Ch.78)



Date: 5.AUG.2016 17:27:13

Note : Only the worst case plots for Radiated Restricted Band Edges.

9.7 POWERLINE CONDUCTED EMISSIONS

LIMIT

For an intentional radiator which 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 250 microvolt (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.

Sample Calculation

Quasi-peak(Final Result) = Reading Value + Correction Factor

Note : We don’t perform powerline conducted emission test. Because this EUT is used with vehicle.

10. LIST OF TEST EQUIPMENT

10.1 LIST OF TEST EQUIPMENT(Conducted Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216 / LISN	12/28/2015	Annual	100073
Rohde & Schwarz	ESCI / Test Receiver	12/28/2015	Annual	100584
Agilent	N9020A / Signal Analyzer	06/24/2016	Annual	MY51110085
Agilent	N9030A / Signal Analyzer	11/24/2015	Annual	MY49431210
Agilent	N1911A / Power Meter	03/11/2016	Annual	MY45100523
Agilent	N1921A / Power Sensor	03/11/2016	Annual	MY52260025
Agilent	87300B / Directional Coupler	11/30/2015	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	06/14/2016	Annual	05001
Hewlett Packard	E3632A / DC Power Supply	03/09/2016	Annual	KR75303962
Agilent	8493C / Attenuator(10 dB)	07/15/2016	Annual	07560
Rohde & Schwarz	CBT / Bluetooth Tester	05/16/2016	Annual	100422

10.2 LIST OF TEST EQUIPMENT(Radiated Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Audix	AM4000 / Antenna Position Tower	N/A	N/A	N/A
Audix	Turn Table	N/A	N/A	N/A
Audix	EM1000 / Controller	N/A	N/A	060520
Rohde & Schwarz	Loop Antenna	02/23/2016	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/15/2015	Biennial	255
Schwarzbeck	BBHA 9120D / Horn Antenna	05/07/2015	Biennial	937
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	09/03/2015	Biennial	BBHA9170541
Rohde & Schwarz	FSP / Spectrum Analyzer	09/24/2015	Annual	100688
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/23/2015	Annual	101068-SZ
Wainwright Instruments	WHK3.0/18G-10EF / High Pass Filter	06/24/2016	Annual	8
Wainwright Instruments	WHFX7.0/18G-8SS / High Pass Filter	05/13/2016	Annual	29
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	07/06/2016	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	01/26/2016	Annual	2
Agilent	8493C-10 / Attenuator(10 dB)	08/11/2016	Annual	76649
CERNEX	CBLU1183540 / Power Amplifier	07/15/2016	Annual	22964
CERNEX	CBL06185030 / Power Amplifier	07/15/2016	Annual	22965
CERNEX	CBL18265035 / Power Amplifier	07/11/2016	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	07/11/2016	Annual	25956
TESCOM	TC-3000C / Bluetooth Tester	04/01/2016	Annual	3000C000276