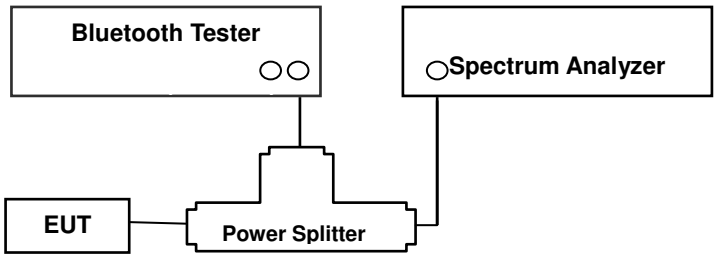
9.4 NUMBER OF HOPPING FREQUENCY

LIMIT

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands shall use at least 15 hopping frequencies.

Test Configuration



TEST PROCEDURE

The Bluetooth frequency hopping function of the EUT was enabled.

The Spectrum Analyzer is set to (7.8.3 in ANSI 63.10-2013)

1) Span: the frequency band of operation
2) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3) VBW ≥ RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) Allow the trace to stabilize.

TEST RESULTS

No non-compliance noted

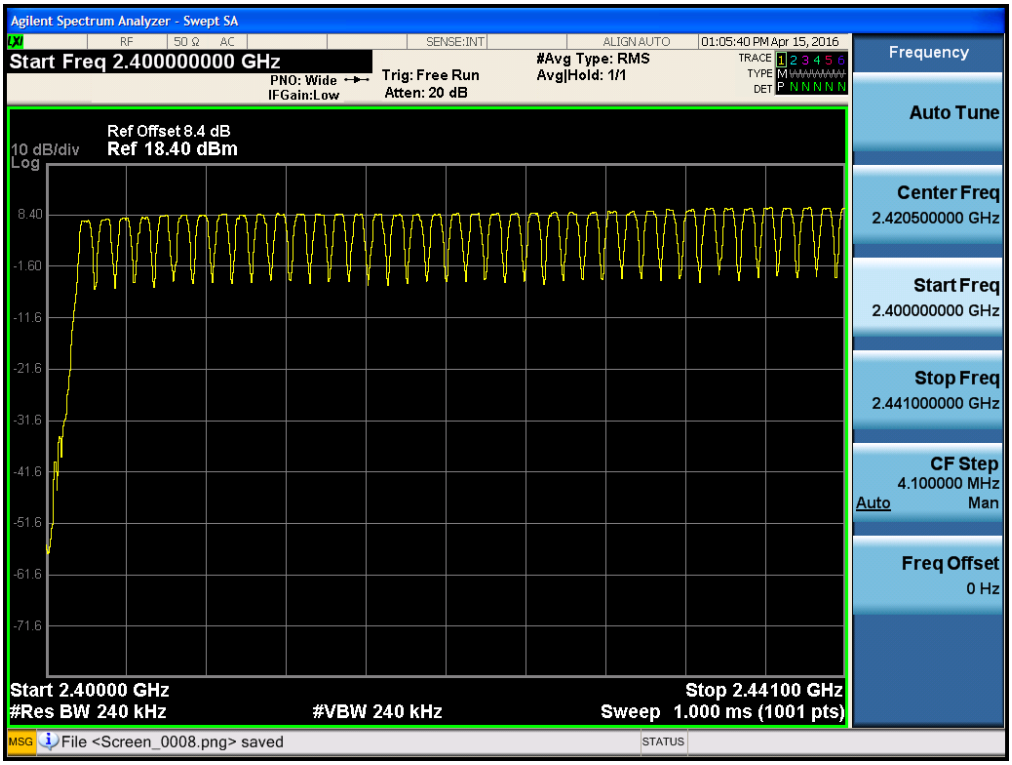
Test Data

Result (No. of CH)			Limit	Result
GFSK	8DPSK	π/4DQPSK		
79	79	79	>15	Pass

Note : In case of AFH mode, minimum number of hopping channels is 20.

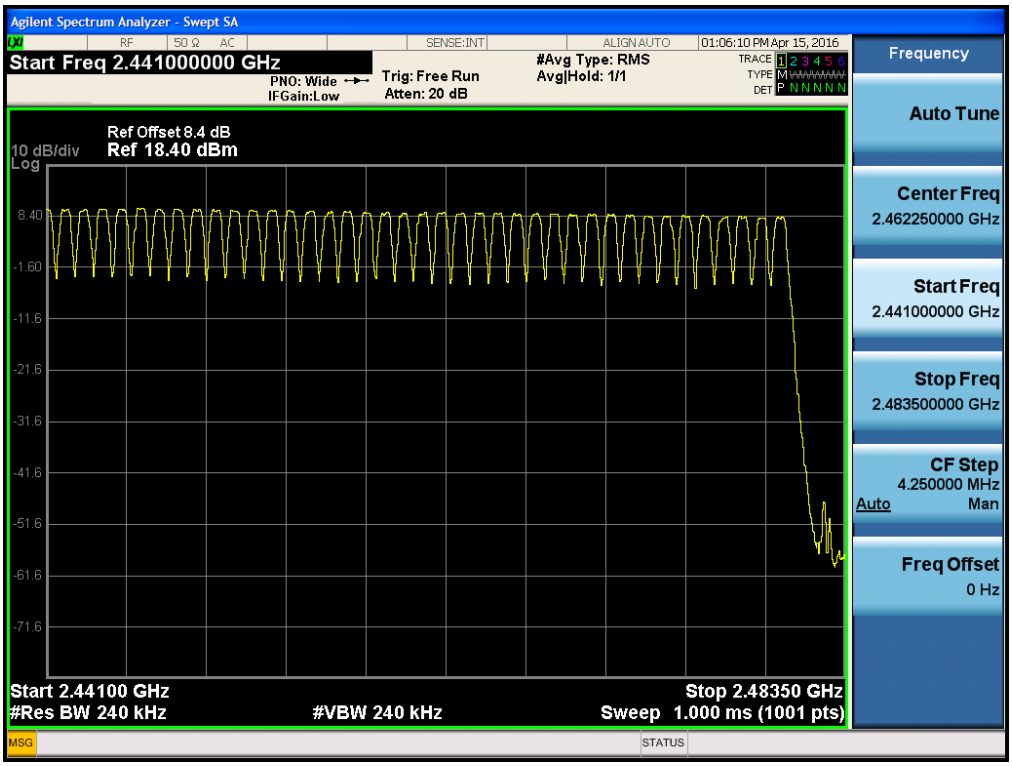
Test Plots (GFSK)

Number of Channels (2.4 GHz - 2.441 GHz)



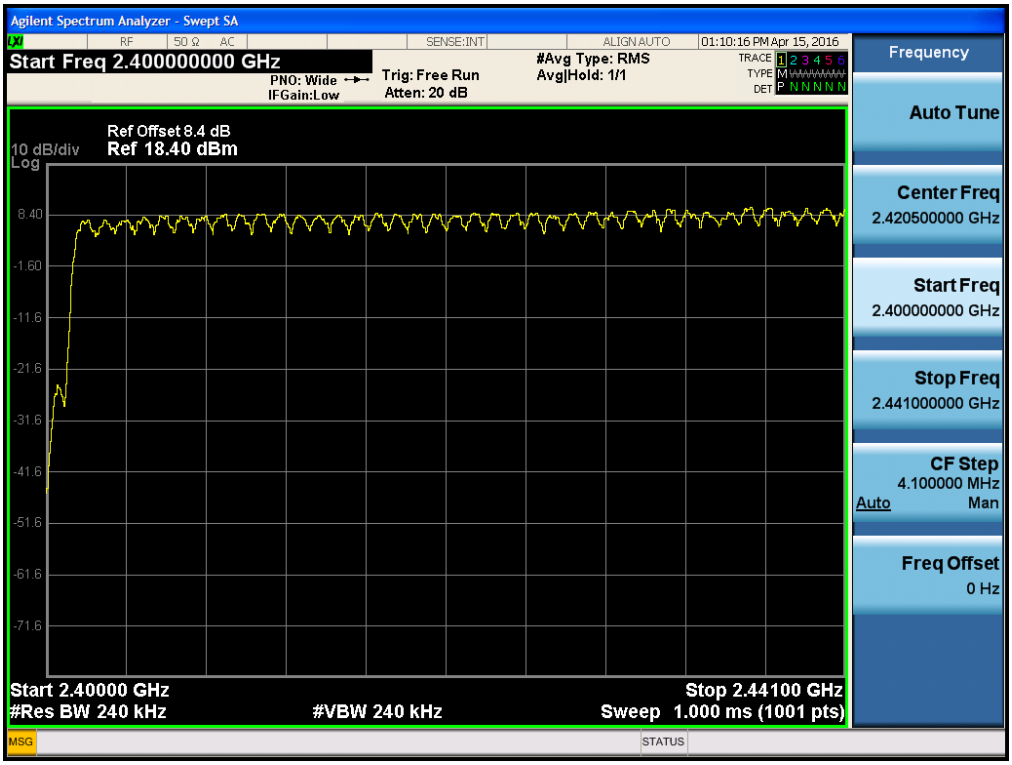
Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



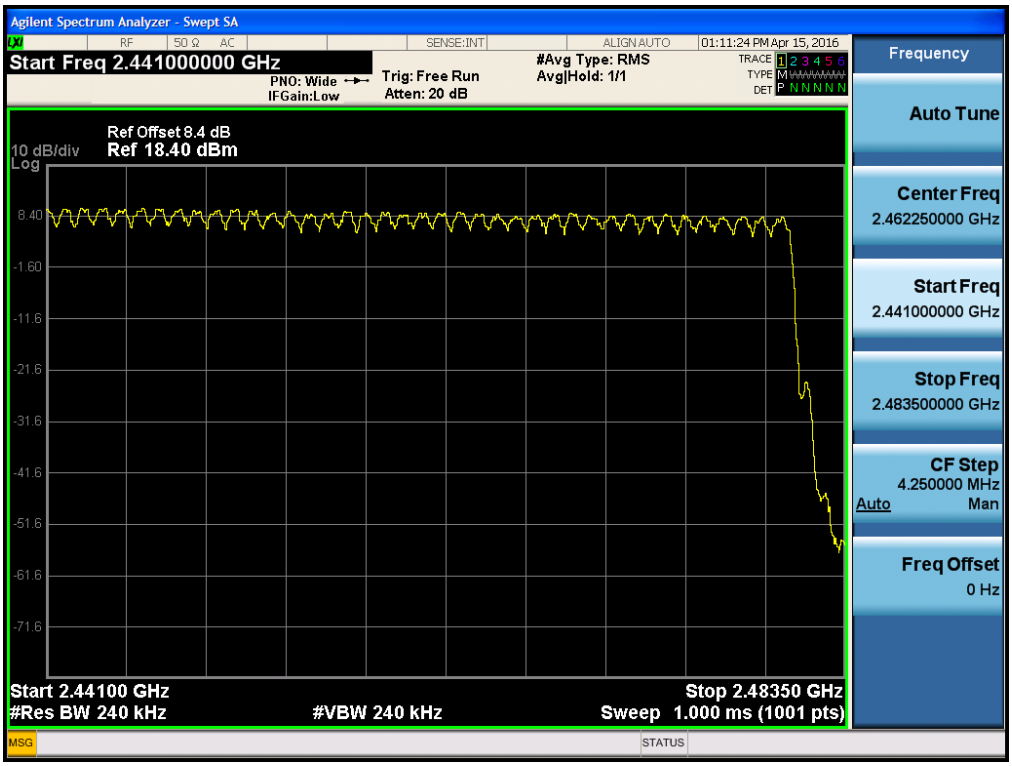
Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)

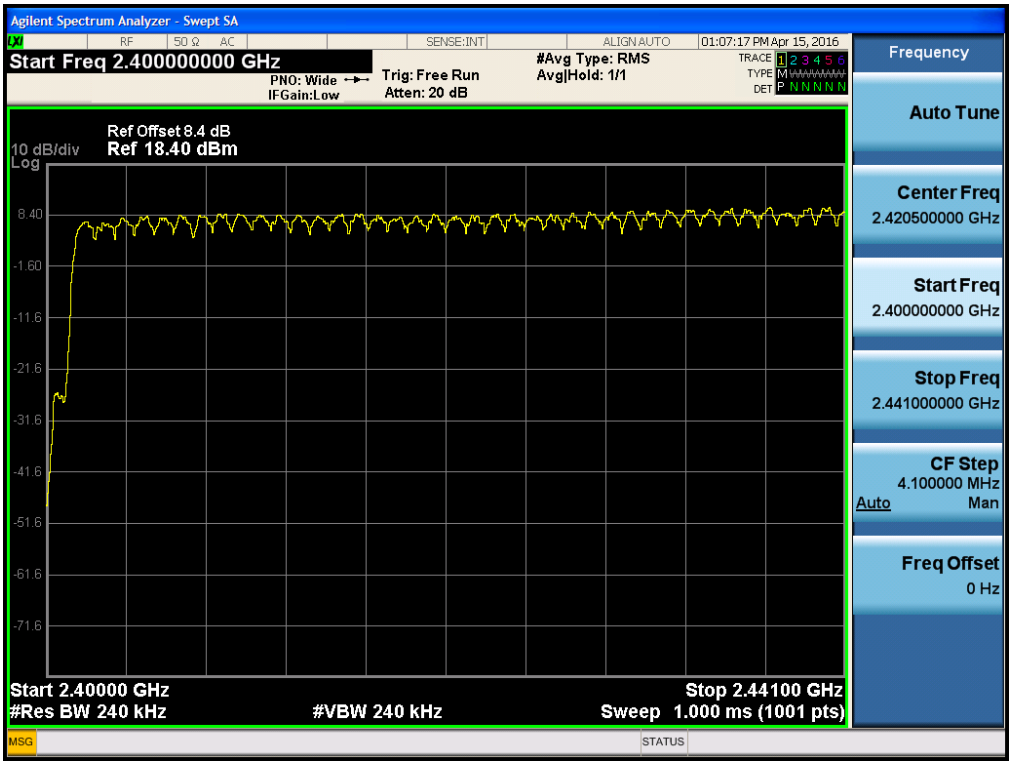


Test Plots (8DPSK)

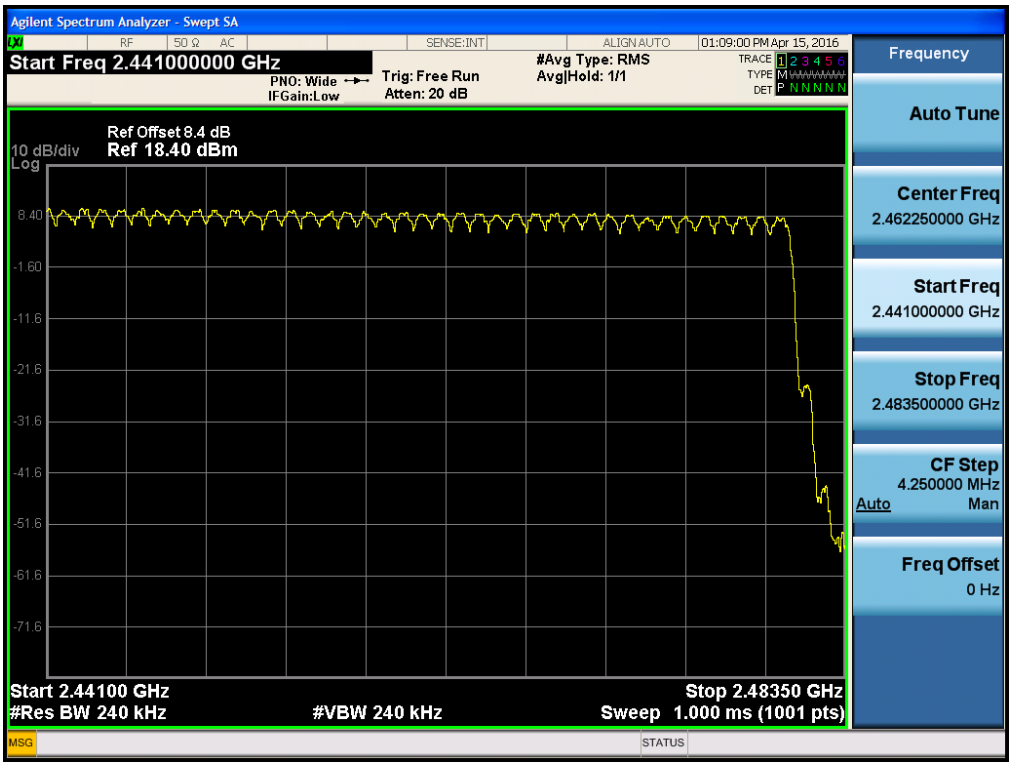
Number of Channels (2.441 GHz - 2.4835 GHz)



Test Plots (π/4DQPSK)
Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (π/4DQPSK)
Number of Channels (2.441 GHz - 2.4835 GHz)

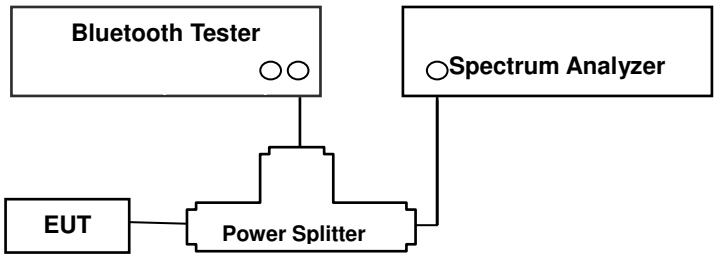


9.5 TIME OF OCCUPANCY (DWELL TIME)

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 : 2.885 * (1600/6)/79 * 31.6 = 307.73 (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 : 2.885 * (800/6)/20 * 8.0 = 153.87 (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

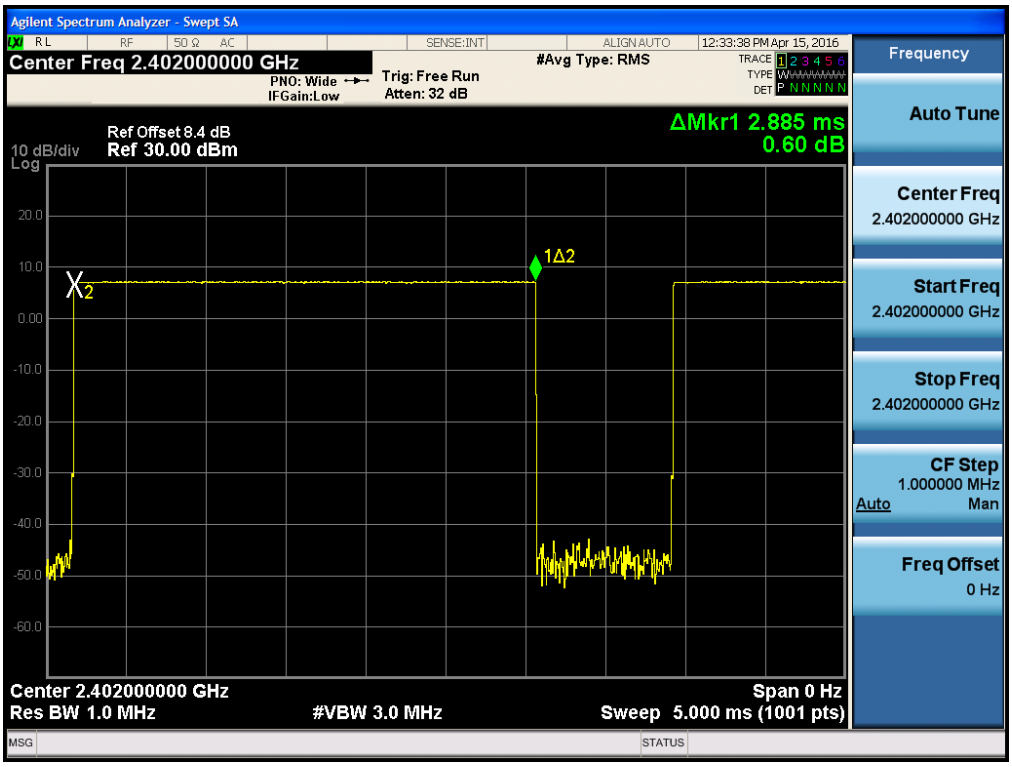
TEST RESULTS

See the table.

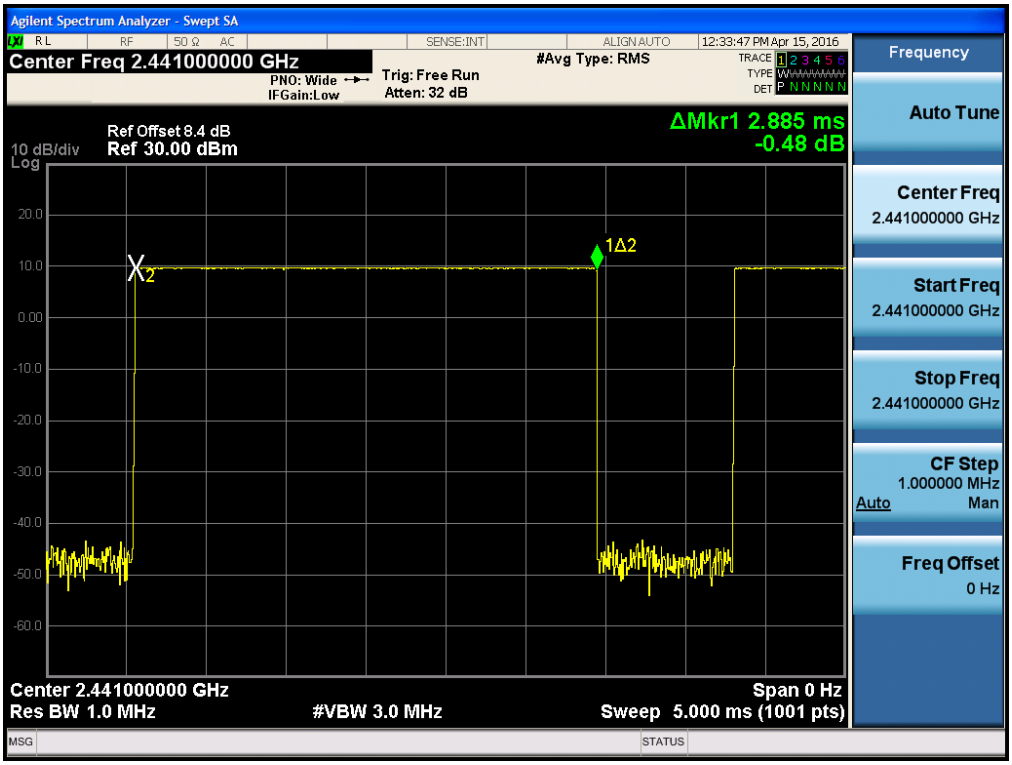
	Channel	GFSK	8DPSK	π/4DQPSK
Pulse Time (ms)	Low	2.885	2.890	2.890
	Mid	2.885	2.890	2.890
	High	2.885	2.890	2.890

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)	Result
Total of Dwell (ms)	Low	307.73	308.27	308.27	31.6	400	PASS
	Mid	307.73	308.27	308.27	31.6		PASS
	High	307.73	308.27	308.27	31.6		PASS

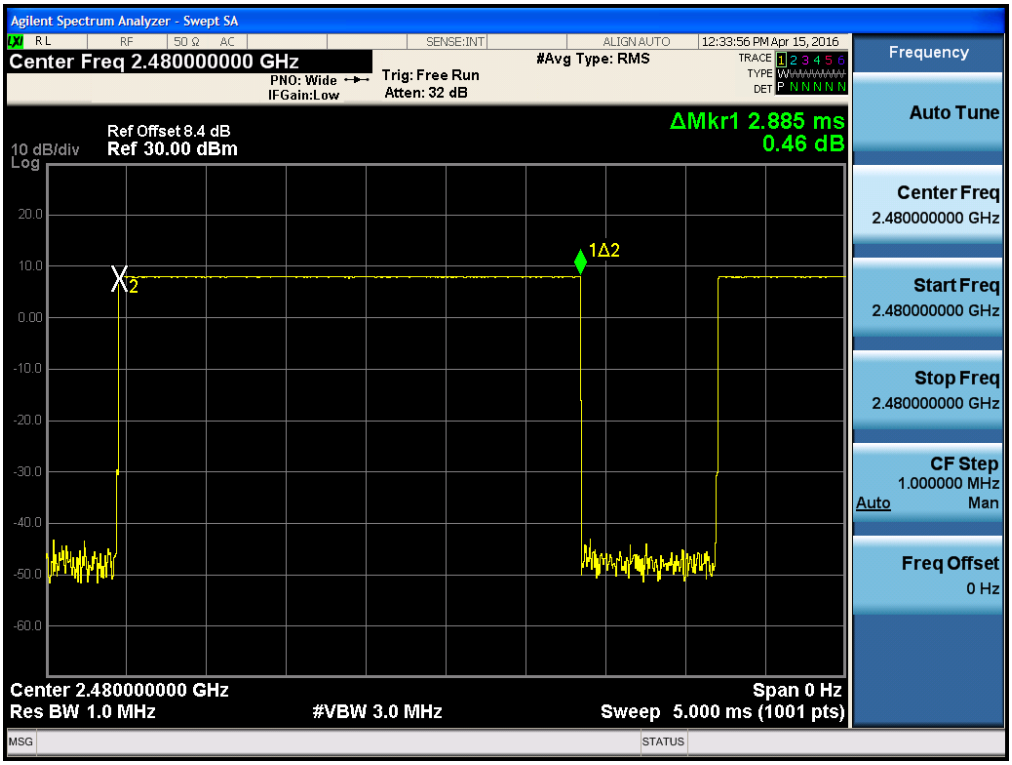
Test Plots (GFSK)
Dwell Time (CH.0)



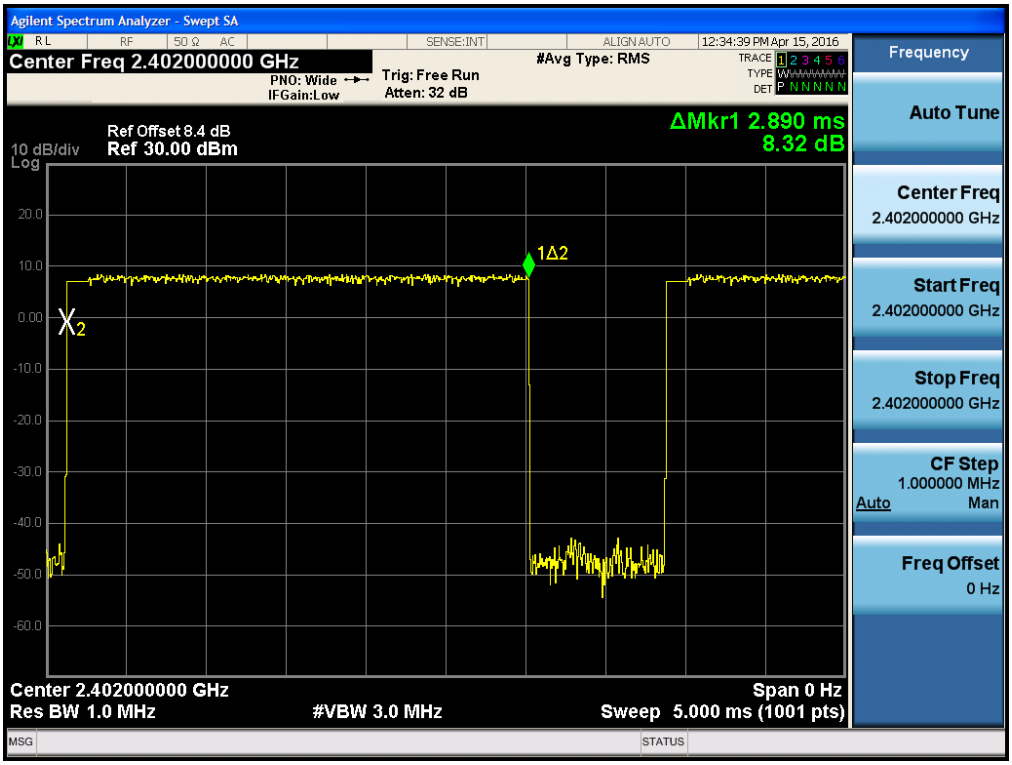
Test Plots (GFSK)
Dwell Time (CH.39)



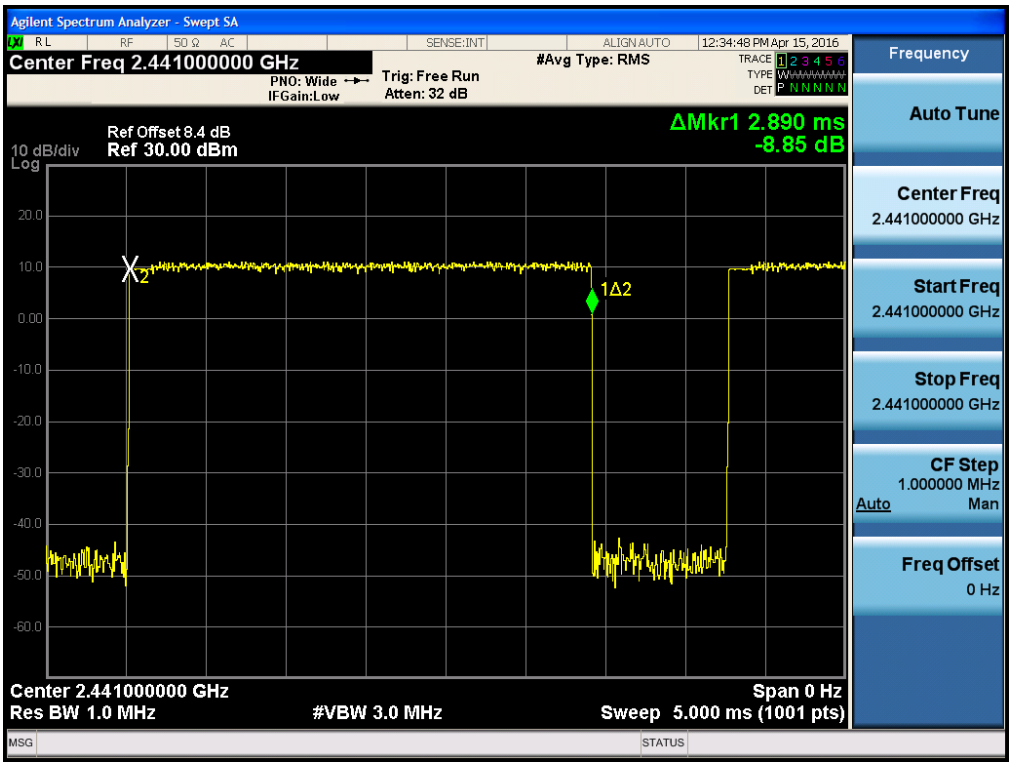
Test Plots (GFSK)
Dwell Time (CH.78)



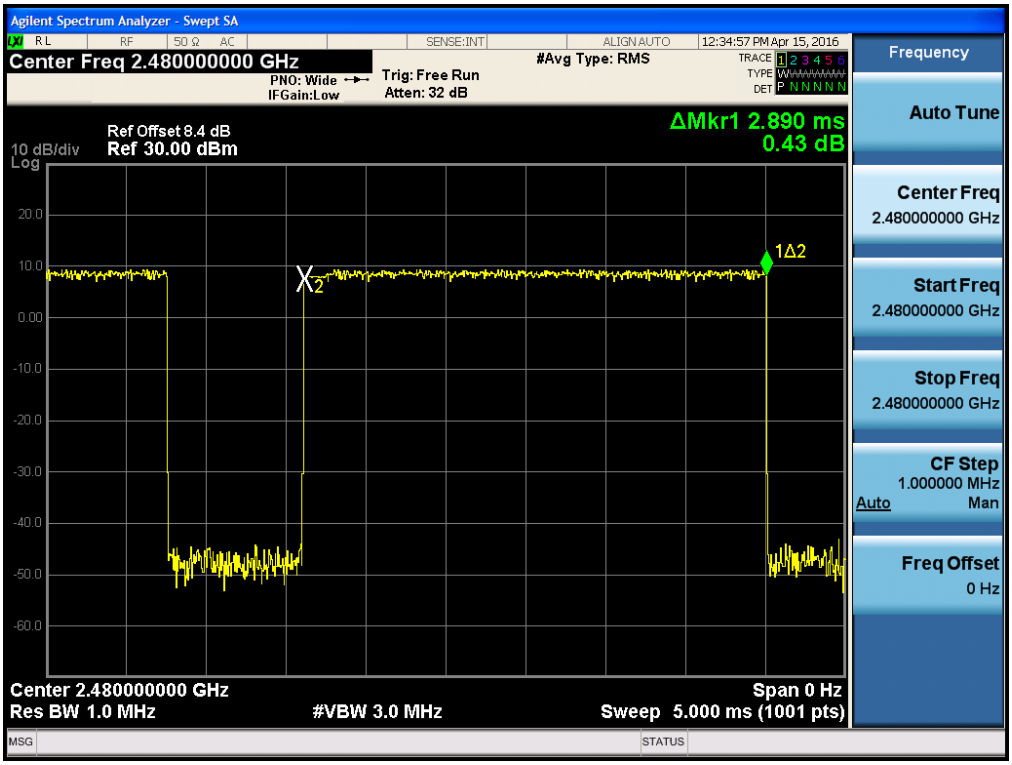
Test Plots (8DPSK)
Dwell Time (CH.0)



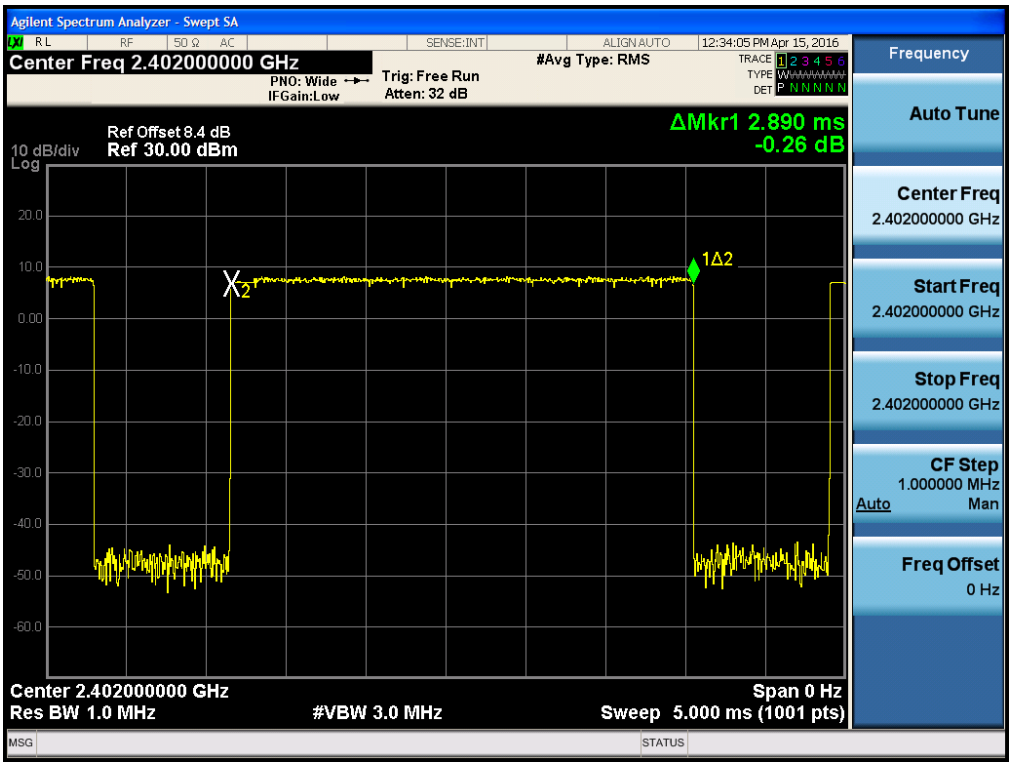
Test Plots (8DPSK)
Dwell Time (CH.39)



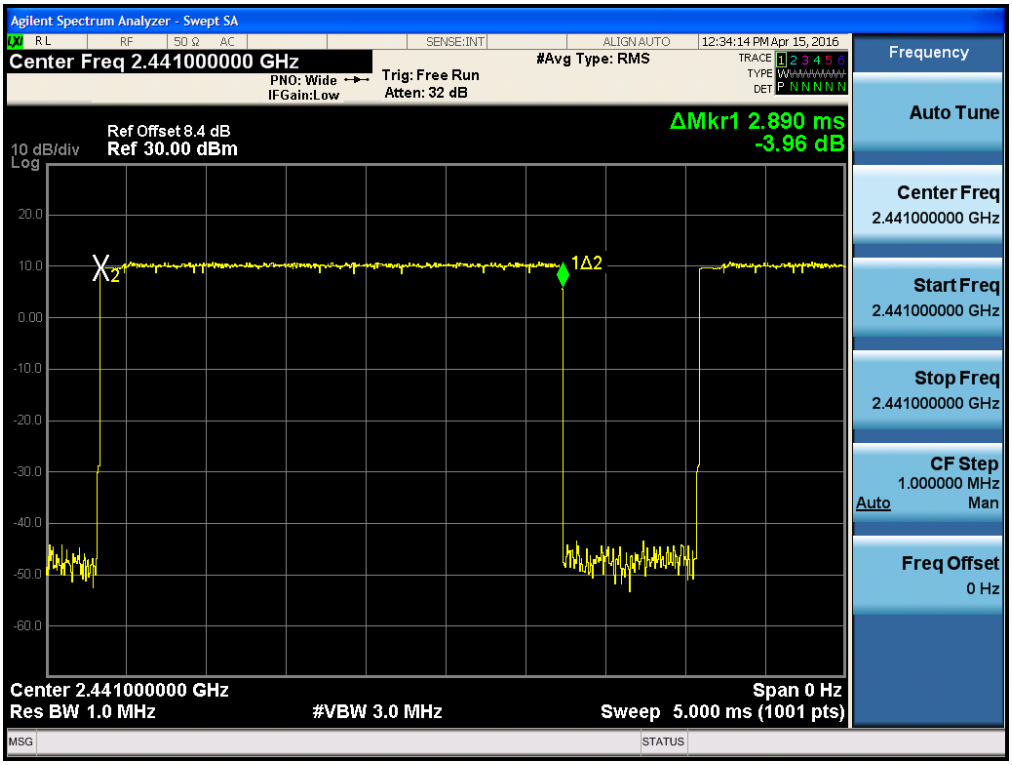
Test Plots (8DPSK)
Dwell Time (CH.78)



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

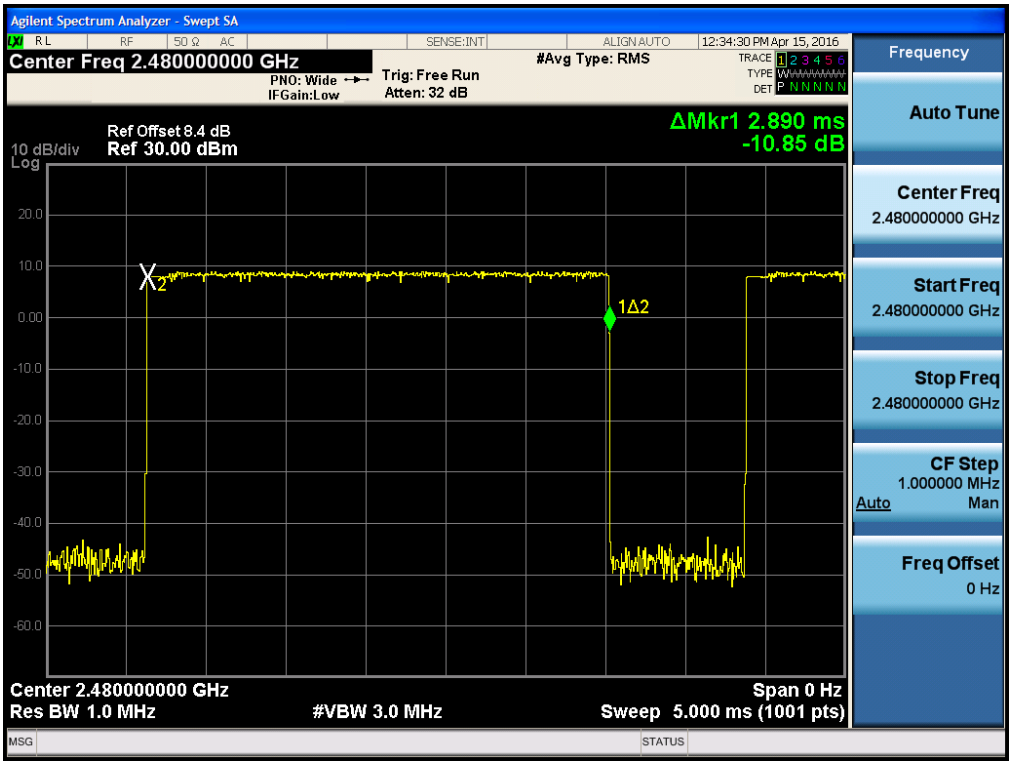


Test Plots (π/4DQPSK)
Dwell Time (CH.39)



Test Plots (π/4DQPSK)

Dwell Time (CH.78)



9.6 SPURIOUS EMISSIONS

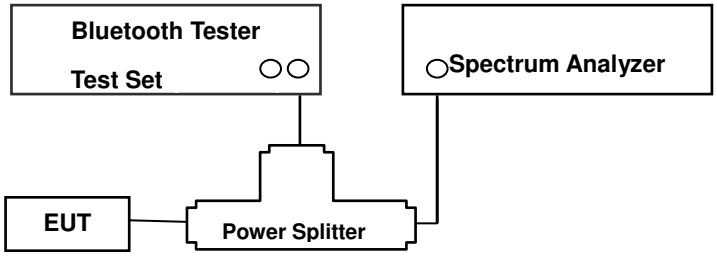
9.6.1 CONDUCTED SPURIOUS EMISSIONS

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.

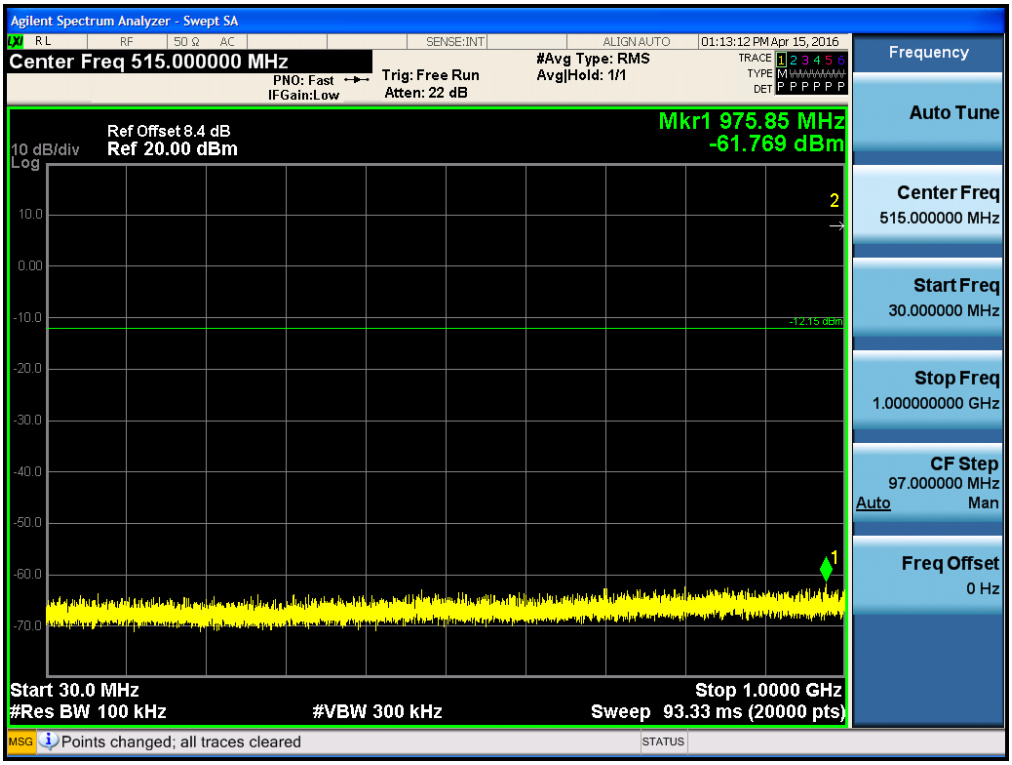
FACTORS FOR FREQUENCY

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

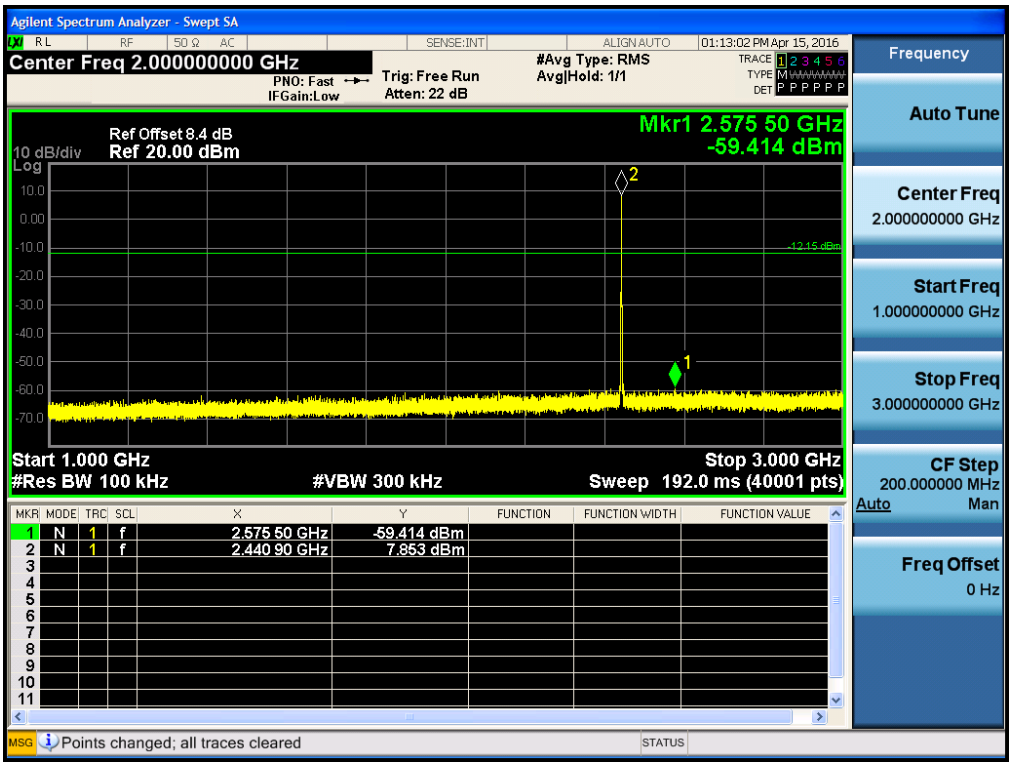
Note : 1. '*' is fundamental frequency range.

2. Factor = Cable loss + Splitter loss

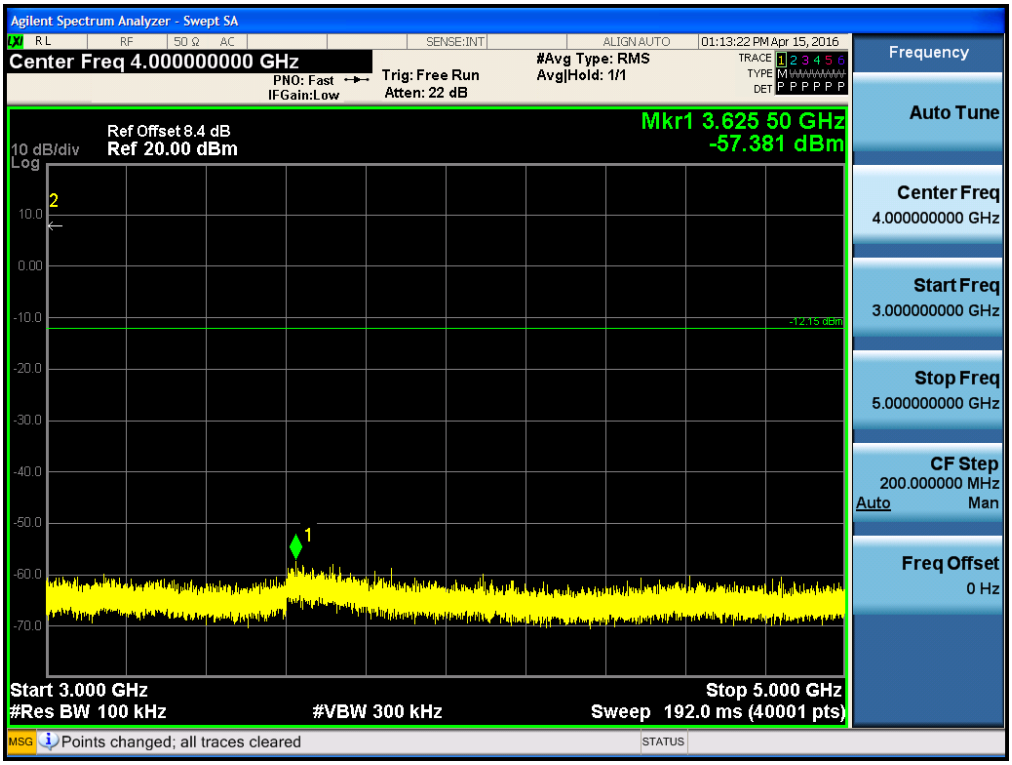
Test Plots (8DPSK)- 30 MHz - 1 GHz
Spurious Emission (CH.39)



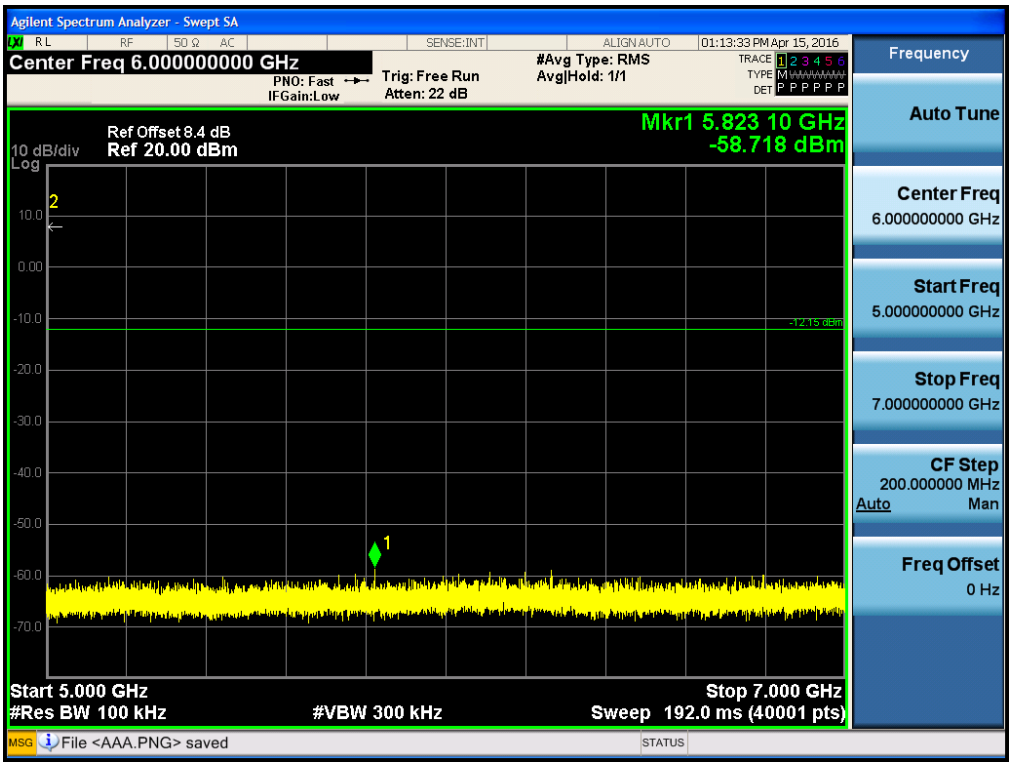
Test Plots (8DPSK)- 1 GHz – 3 GHz
Spurious Emission (CH.39)



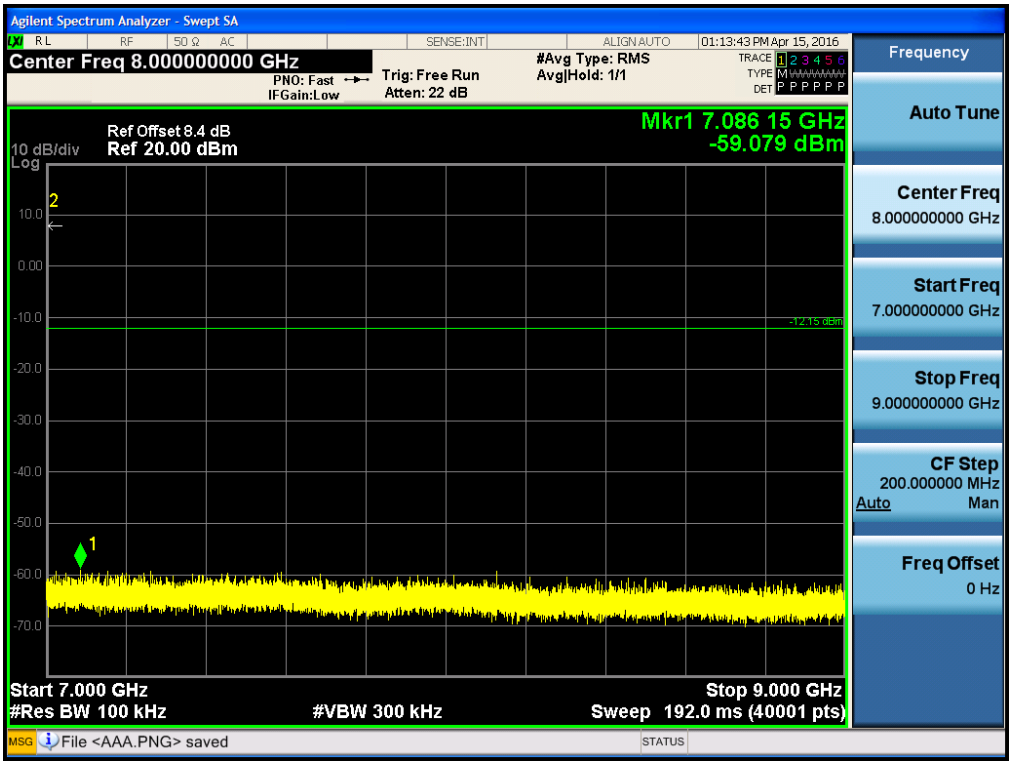
Test Plots(8DPSK)- 3 GHz - 5 GHz
Spurious Emission (CH.39)



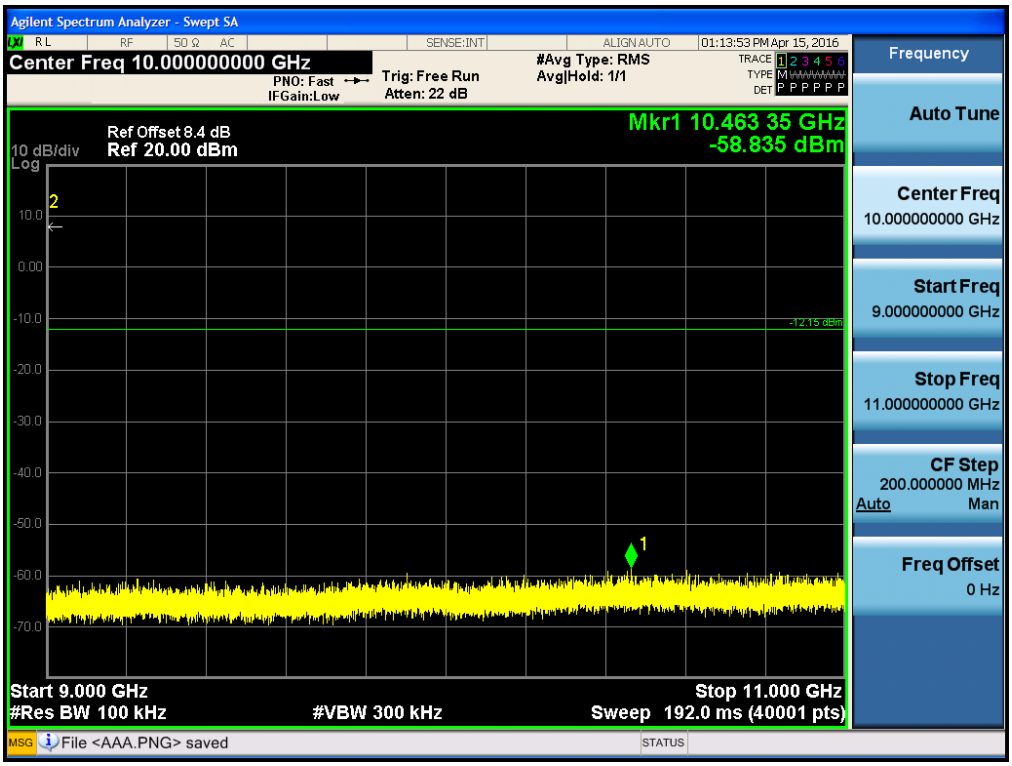
Test Plots (8DPSK)- 5 GHz - 7 GHz
Spurious Emission (CH.39)



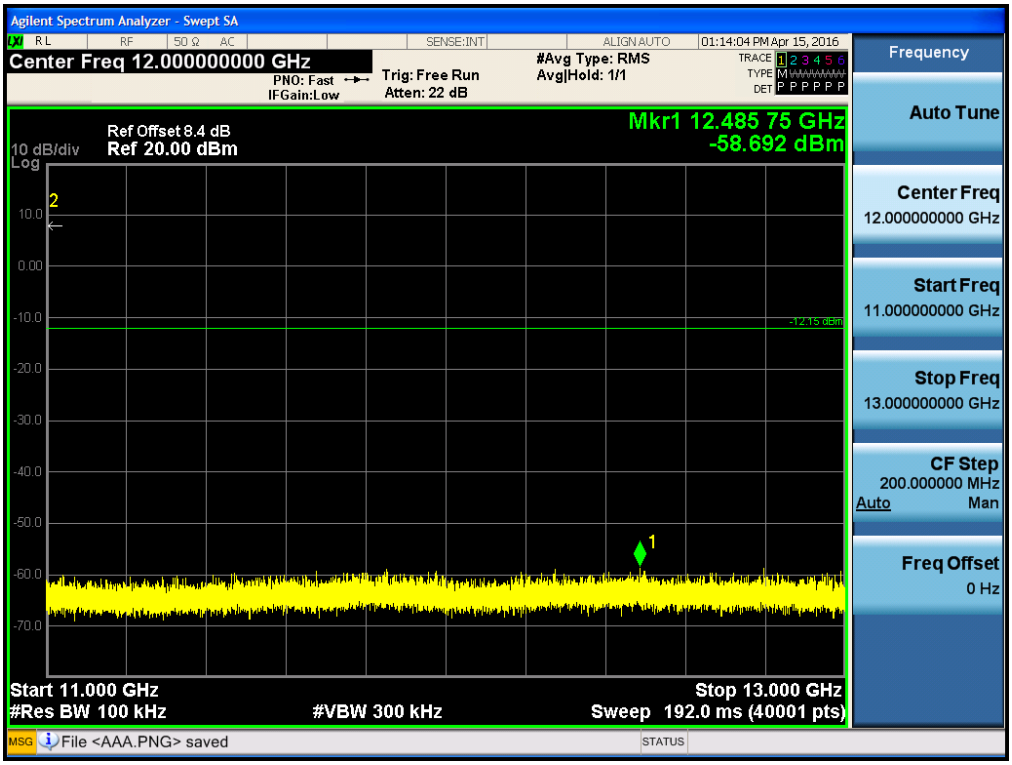
Test Plots(8DPSK)- 7 GHz - 9 GHz
Spurious Emission (CH.39)



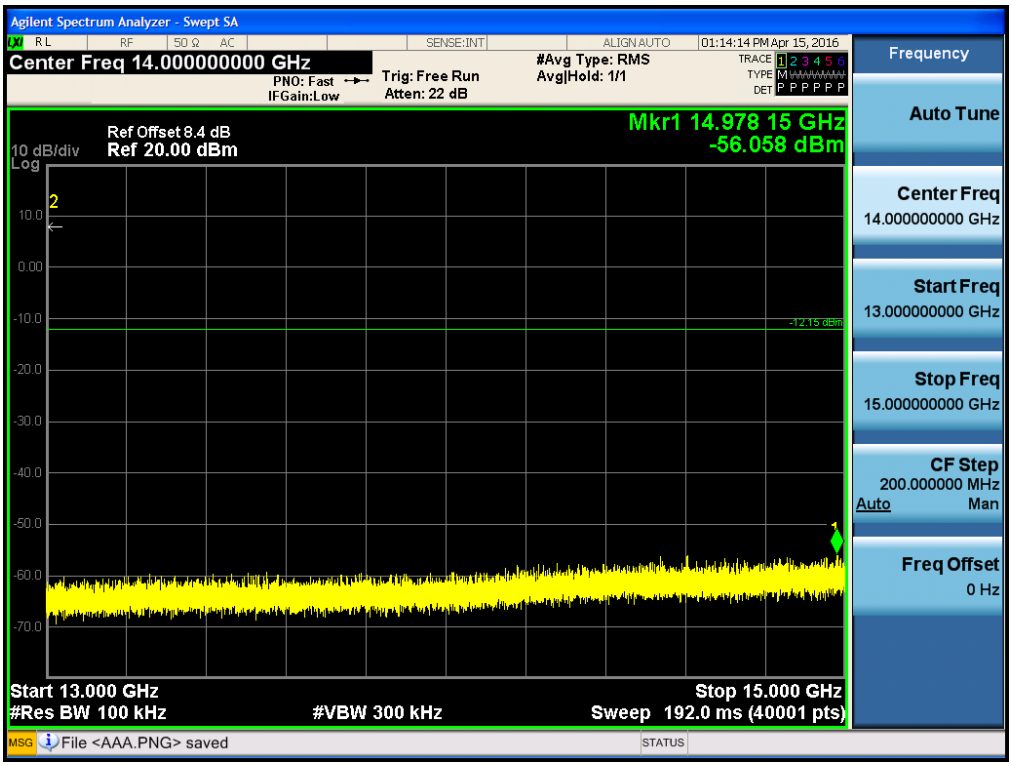
Test Plots(8DPSK)- 9 GHz - 11 GHz
Spurious Emission (CH.39)



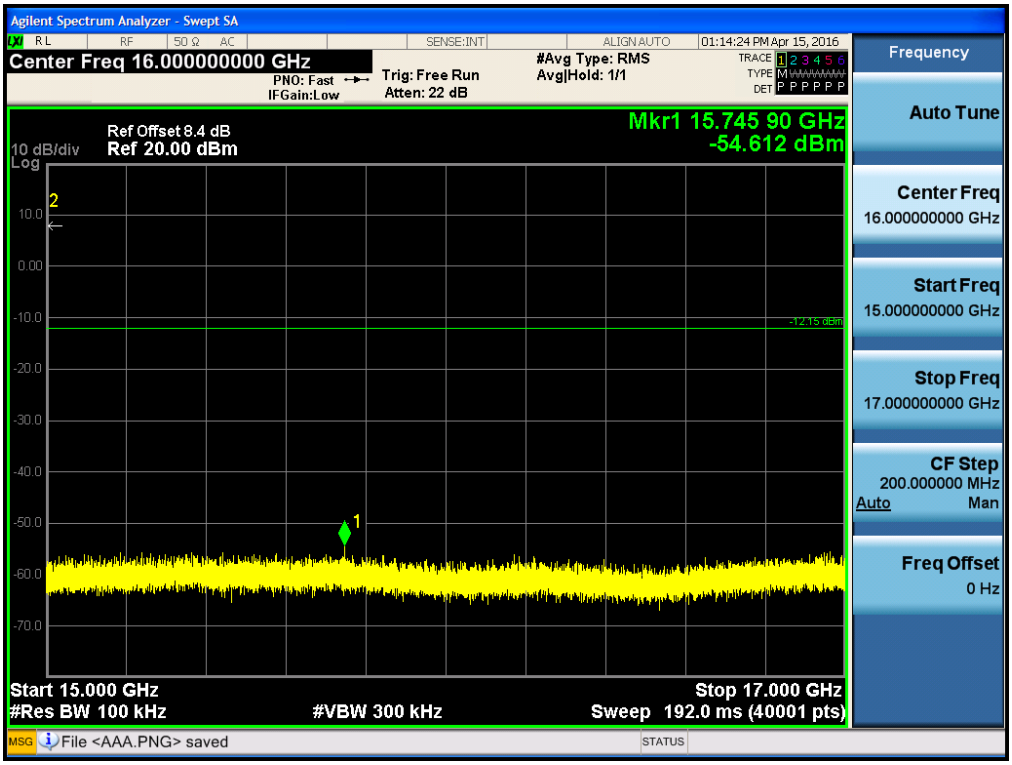
Test Plots(8DPSK) 11 GHz - 13 GHz
Spurious Emission (CH.39)



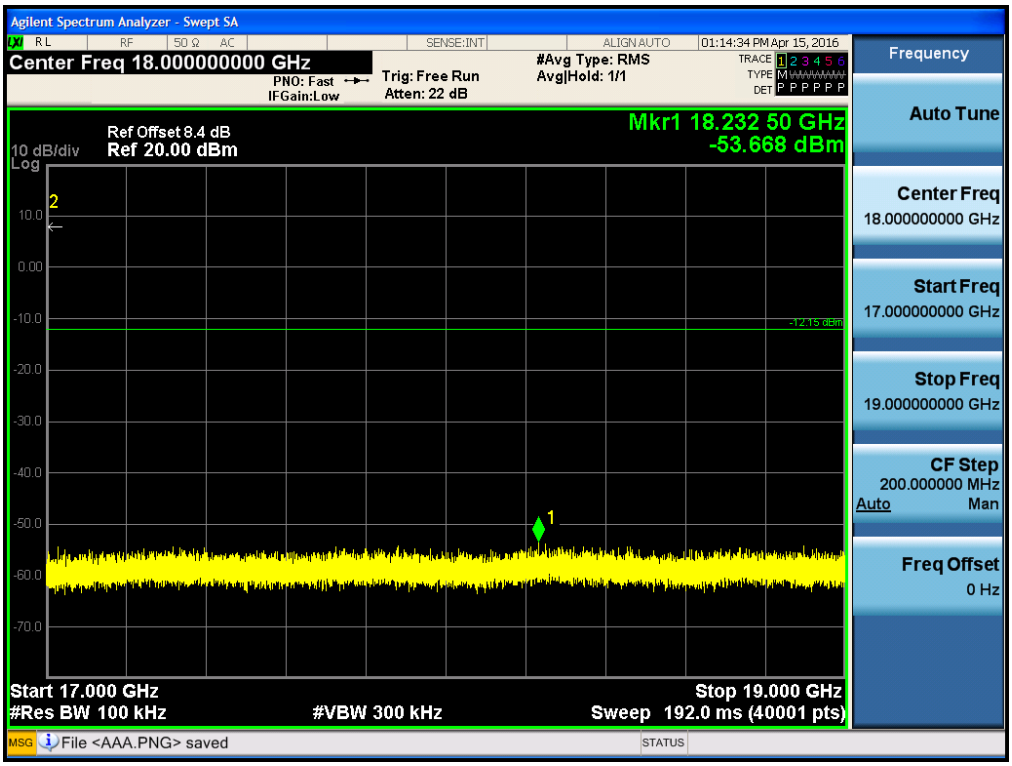
Test Plots (8DPSK)- 13 GHz – 15 GHz
Spurious Emission (CH.39)



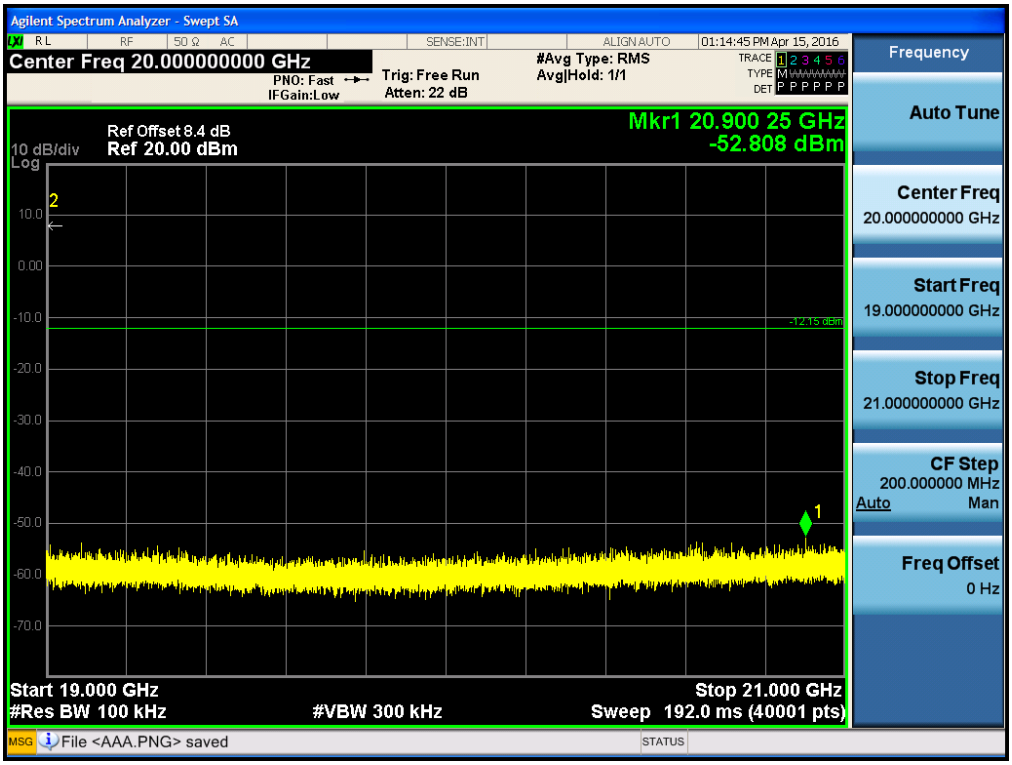
Test Plots(8DPSK)– 15 GHz - 17 GHz
Spurious Emission (CH.39)



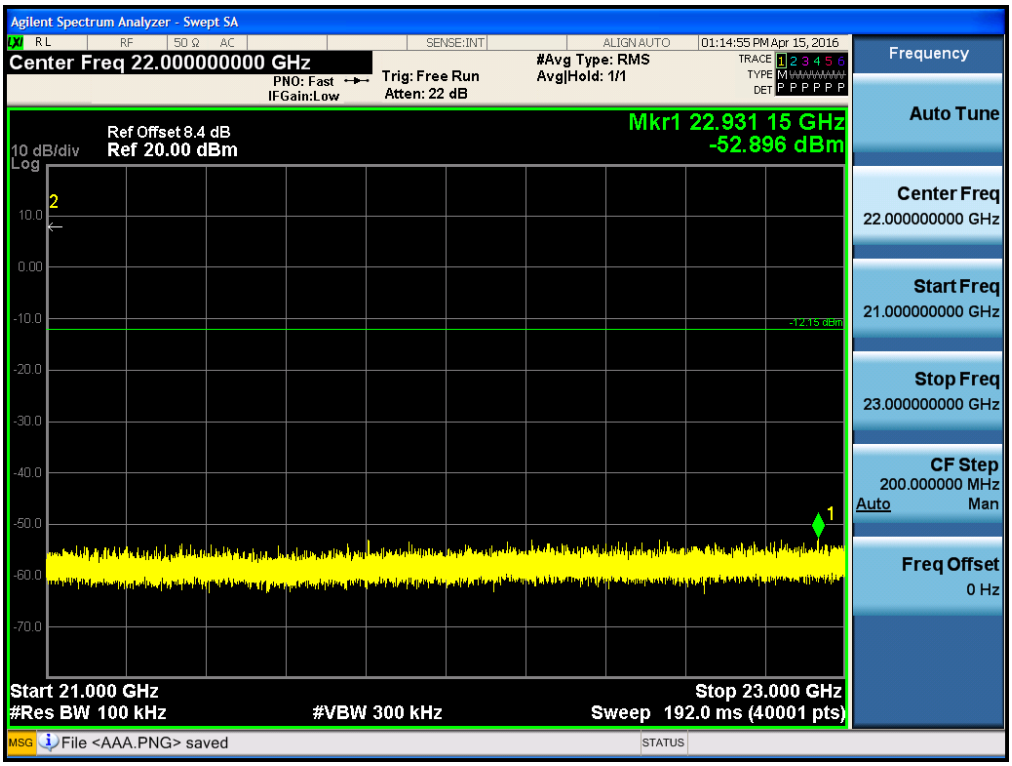
Test Plots(8DPSK)- 17 GHz - 19 GHz
Spurious Emission (CH.39)



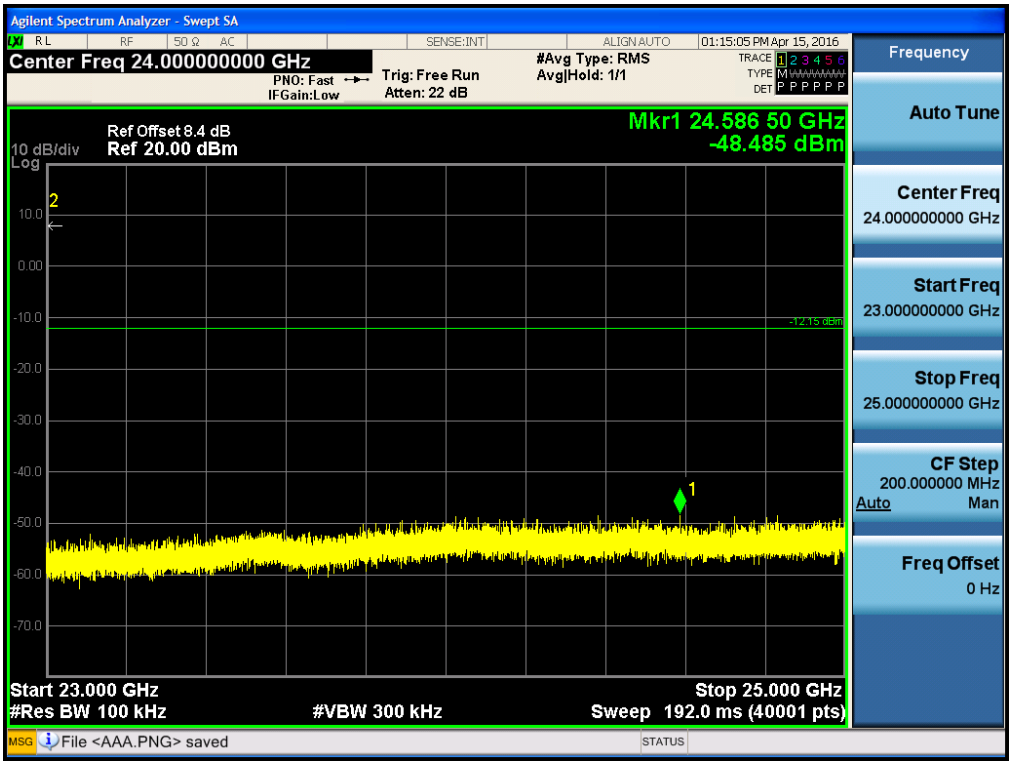
Test Plots (8DPSK)- 19 GHz - 21 GHz
Spurious Emission (CH.39)



Test Plots (8DPSK)- 21 GHz - 23 GHz
Spurious Emission (CH.39)



Test Plots (8DPSK)- 23 GHz - 25 GHz
Spurious Emission (CH.39)



9.6.2 RADIATED SPURIOUS EMISSIONS

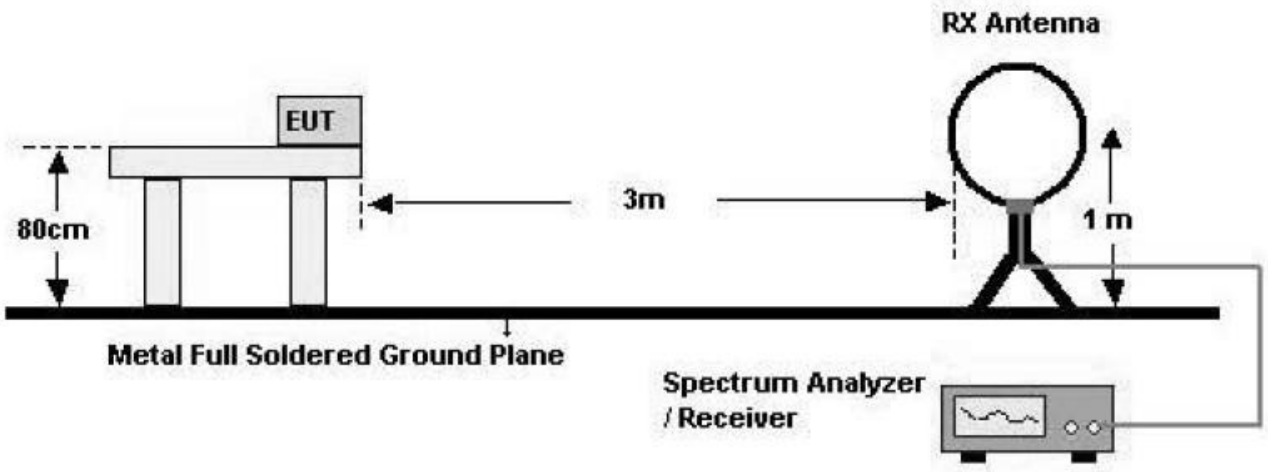
LIMIT : §15.247(d), §15.205, §15.209

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.

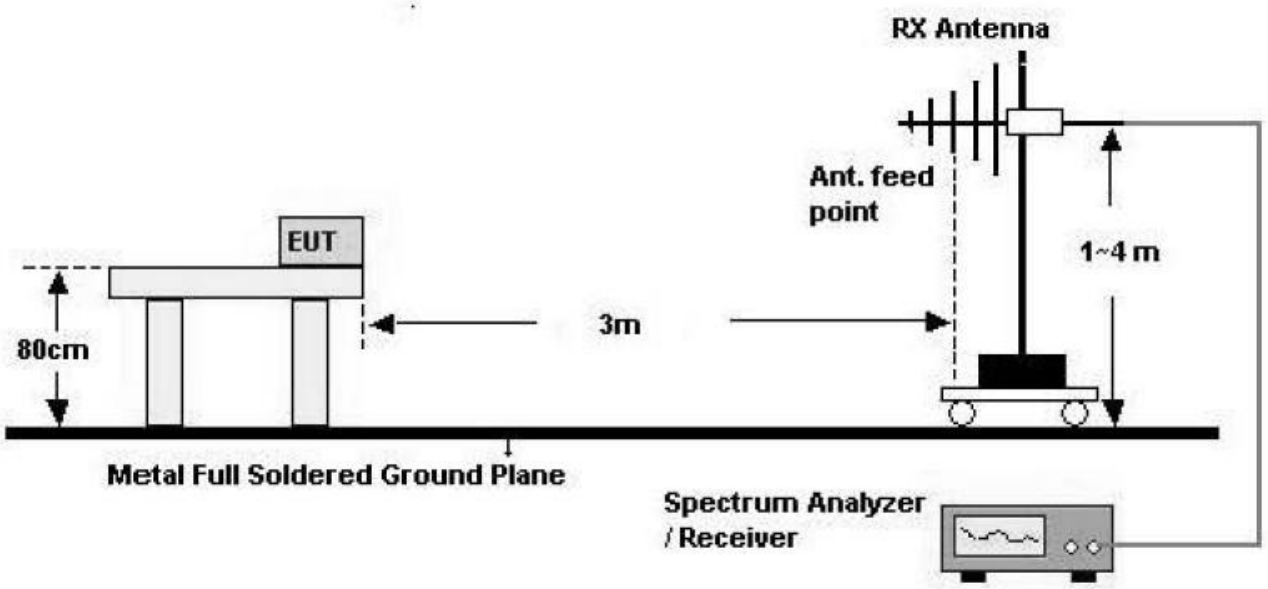
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

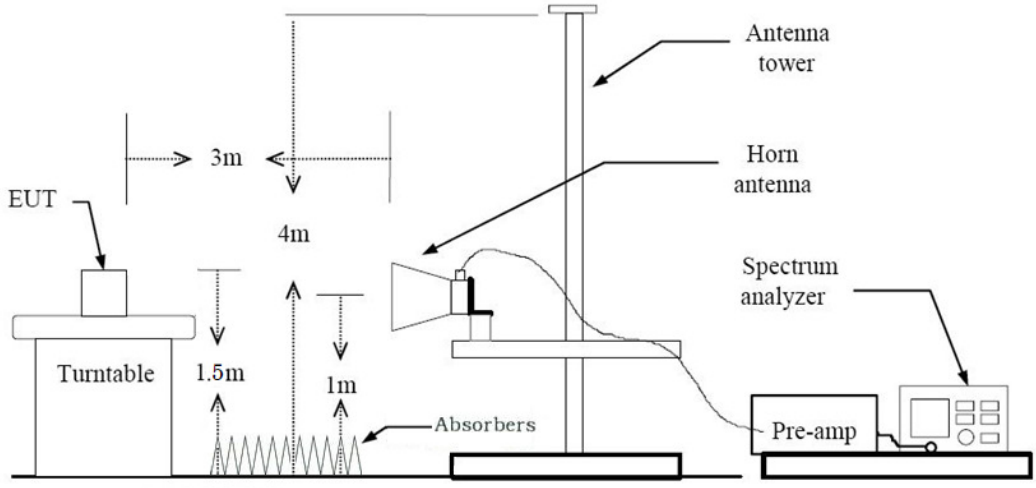
Below 30 MHz



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 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. The duty cycle factor for BT mode.

BT Mode	T_{on} (ms)	VBW(1/T) (Hz)	The actual setting value of VBW (Hz)
GFSK	2.890	346	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	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	49.58	-2.96	V	46.62	73.98	27.36	PK
4804	37.00	-2.96	V	34.04	53.98	19.94	AV
7206	46.10	6.88	V	52.98	73.98	21.00	PK
7206	34.69	6.88	V	41.57	53.98	12.41	AV
4804	49.13	-2.96	H	46.17	73.98	27.81	PK
4804	36.28	-2.96	H	33.32	53.98	20.66	AV
7206	46.93	6.88	H	53.81	73.98	20.17	PK
7206	34.85	6.88	H	41.73	53.98	12.25	AV

Operation Mode: CH Low(8DPSK)

Frequency [MHz]	Reading DBuV	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	49.80	-2.96	V	46.84	73.98	27.14	PK
4804	36.64	-2.96	V	33.68	53.98	20.30	AV
7206	47.59	6.88	V	54.47	73.98	19.51	PK
7206	34.16	6.88	V	41.04	53.98	12.94	AV
4804	49.52	-2.96	H	46.56	73.98	27.42	PK
4804	36.39	-2.96	H	33.43	53.98	20.55	AV
7206	48.04	6.88	H	54.92	73.98	19.06	PK
7206	34.47	6.88	H	41.35	53.98	12.63	AV

Operation Mode: CH Low(π/4DQPSK)

Frequency [MHz]	Reading DBuV	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	50.32	-2.96	V	47.36	73.98	26.62	PK
4804	36.62	-2.96	V	33.66	53.98	20.32	AV
7206	46.85	6.88	V	53.73	73.98	20.25	PK
7206	34.21	6.88	V	41.09	53.98	12.89	AV
4804	49.93	-2.96	H	46.97	73.98	27.01	PK
4804	36.30	-2.96	H	33.34	53.98	20.64	AV
7206	47.29	6.88	H	54.17	73.98	19.81	PK
7206	34.44	6.88	H	41.32	53.98	12.66	AV

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP GAIN: AMPLIFIER GAIN

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
5. 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.
6. 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
7. 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.

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

9. This test is performed with hopping off.

10. 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	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	50.87	-2.60	V	48.27	73.98	25.71	PK
4882	37.39	-2.60	V	34.79	53.98	19.19	AV
7323	46.85	6.11	V	52.96	73.98	21.02	PK
7323	34.07	6.11	V	40.18	53.98	13.80	AV
4882	50.76	-2.60	H	48.16	73.98	25.82	PK
4882	37.22	-2.60	H	34.62	53.98	19.36	AV
7323	47.10	6.11	H	53.21	73.98	20.77	PK
7323	34.36	6.11	H	40.47	53.98	13.51	AV

Operation Mode: CH Mid(8DPSK)

Frequency [MHz]	Reading DBuV	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	50.56	-2.60	V	47.96	73.98	26.02	PK
4882	37.23	-2.60	V	34.63	53.98	19.35	AV
7323	46.72	6.11	V	52.83	73.98	21.15	PK
7323	34.01	6.11	V	40.12	53.98	13.86	AV
4882	50.24	-2.60	H	47.64	73.98	26.34	PK
4882	37.05	-2.60	H	34.45	53.98	19.53	AV
7323	47.36	6.11	H	53.47	73.98	20.51	PK
7323	34.12	6.11	H	40.23	53.98	13.75	AV

Operation Mode: CH Mid(π/4DQPSK)

Frequency [MHz]	Reading DBuV	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	50.16	-2.60	V	47.56	73.98	26.42	PK
4882	37.47	-2.60	V	34.87	53.98	19.11	AV
7323	46.53	6.11	V	52.64	73.98	21.34	PK
7323	33.86	6.11	V	39.97	53.98	14.01	AV
4882	49.55	-2.60	H	46.95	73.98	27.03	PK
4882	37.24	-2.60	H	34.64	53.98	19.34	AV
7323	46.87	6.11	H	52.98	73.98	21.00	PK
7323	34.07	6.11	H	40.18	53.98	13.80	AV

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP GAIN: AMPLIFIER GAIN

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
5. 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.
6. 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
7. 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.

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

9. This test is performed with hopping off.

10. 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	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	50.49	-2.53	V	47.96	73.98	26.02	PK
4960	37.40	-2.53	V	34.87	53.98	19.11	AV
7440	46.22	5.73	V	51.95	73.98	22.03	PK
7440	32.58	5.73	V	38.31	53.98	15.67	AV
4960	50.38	-2.53	H	47.85	73.98	26.13	PK
4960	37.18	-2.53	H	34.65	53.98	19.33	AV
7440	46.71	5.73	H	52.44	73.98	21.54	PK
7440	32.82	5.73	H	38.55	53.98	15.43	AV

Operation Mode: CH High(8DPSK)

Frequency [MHz]	Reading DBuV	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	50.18	-2.53	V	47.65	73.98	26.33	PK
4960	37.10	-2.53	V	34.57	53.98	19.41	AV
7440	45.62	5.73	V	51.35	73.98	22.63	PK
7440	32.29	5.73	V	38.02	53.98	15.96	AV
4960	49.00	-2.53	H	46.47	73.98	27.51	PK
4960	36.88	-2.53	H	34.35	53.98	19.63	AV
7440	46.21	5.73	H	51.94	73.98	22.04	PK
7440	32.65	5.73	H	38.38	53.98	15.60	AV

Operation Mode: CH High (π/4DQPSK)

Frequency [MHz]	Reading DBuV	※A.F+CL-AMP GAIN [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	50.13	-2.53	V	47.60	73.98	26.38	PK
4960	37.25	-2.53	V	34.72	53.98	19.26	AV
7440	46.11	5.73	V	51.84	73.98	22.14	PK
7440	32.58	5.73	V	38.31	53.98	15.67	AV
4960	49.71	-2.53	H	47.18	73.98	26.80	PK
4960	36.96	-2.53	H	34.43	53.98	19.55	AV
7440	46.35	5.73	H	52.08	73.98	21.90	PK
7440	32.89	5.73	H	38.62	53.98	15.36	AV

※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP GAIN: AMPLIFIER GAIN

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
5. 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.
6. 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
7. 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.

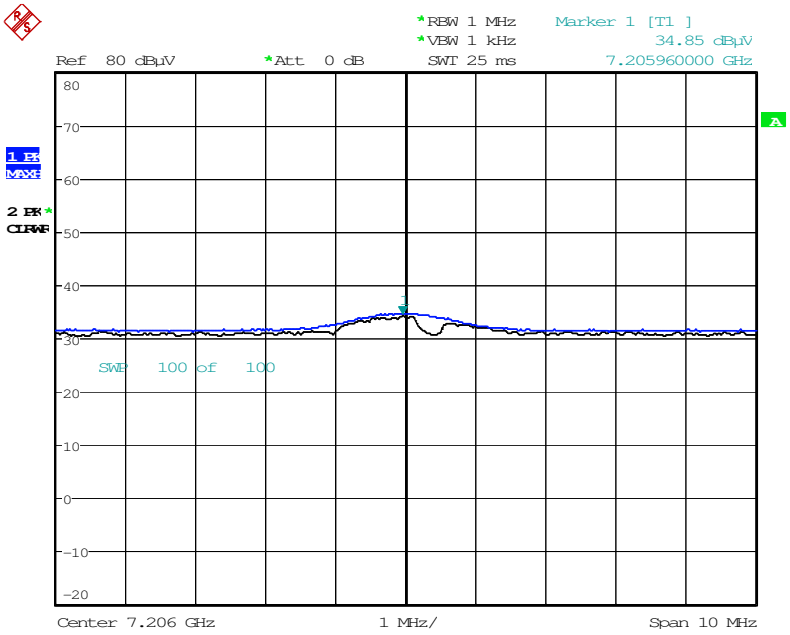
8. We have done Normal Mode and EDR Mode test.

9. This test is performed with hopping off.

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

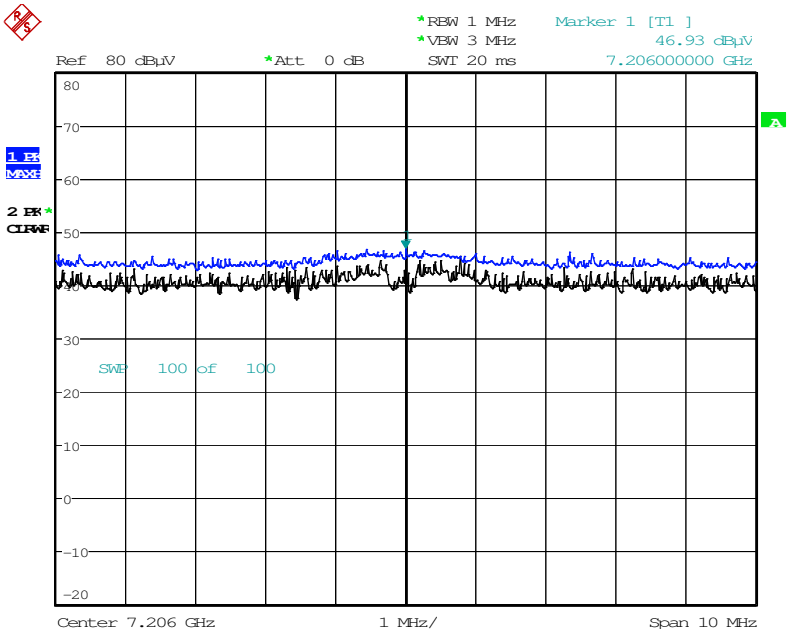
▣ RESULT PLOTS (Worst case : y-H)

Radiated Spurious Emissions plot – Average Reading (GFSK, Ch.0 3rd Harmonic)



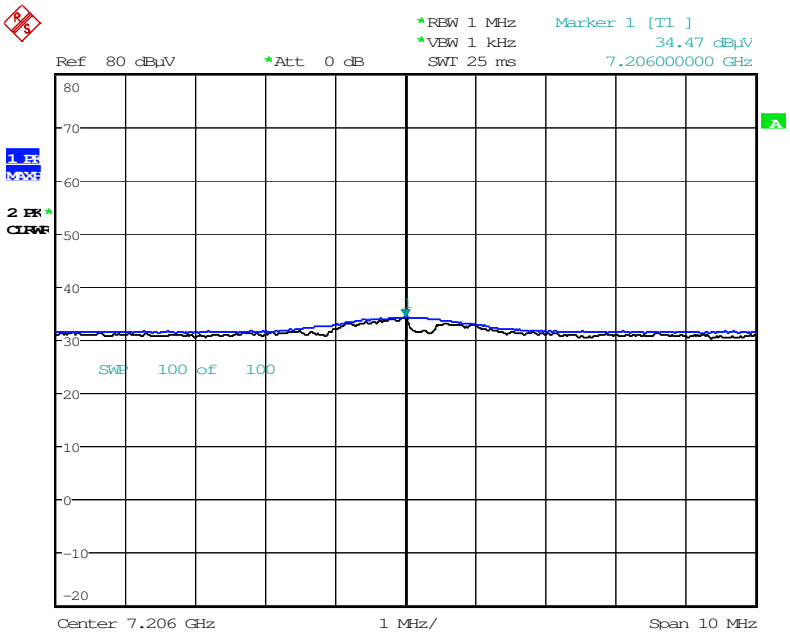
Date: 14.APR.2016 15:12:48

Radiated Spurious Emissions plot – Peak Reading (GFSK, Ch.0 3rd Harmonic)



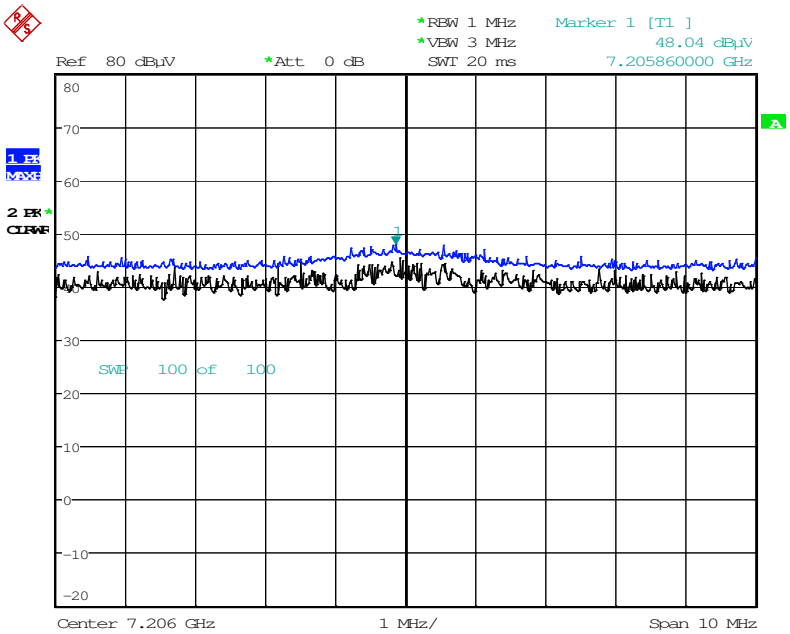
Date: 14.APR.2016 15:13:29

Radiated Spurious Emissions plot – Average Reading (8DPSK, Ch.0 3rd Harmonic)



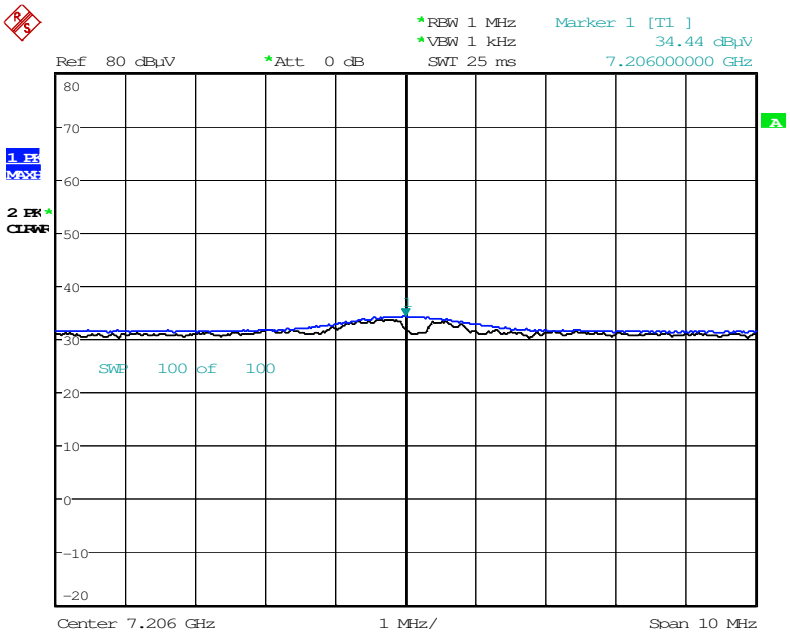
Date: 14.APR.2016 15:15:11

Radiated Spurious Emissions plot – Peak Reading (8DPSK, Ch.0 3rd Harmonic)



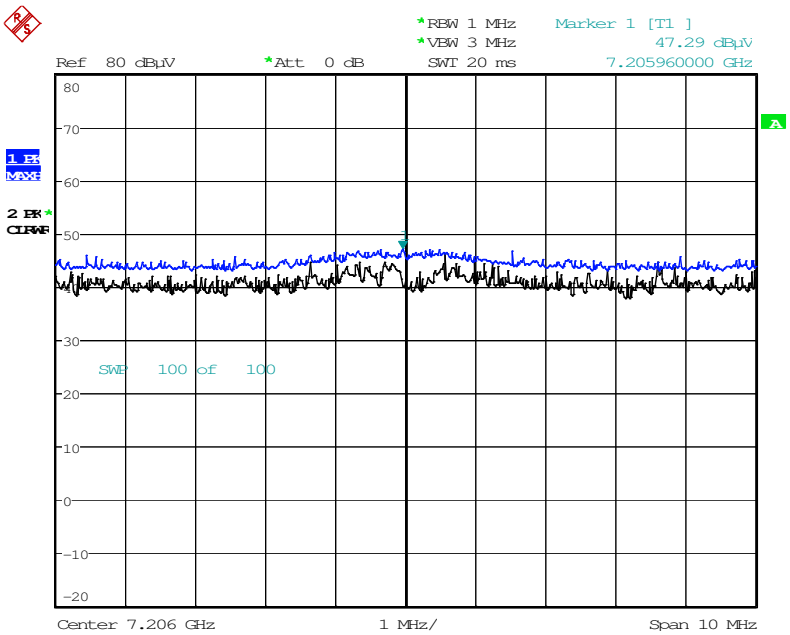
Date: 14.APR.2016 15:14:43

Radiated Spurious Emissions plot – Average Reading (π/4DQPSK, Ch.0 3rd Harmonic)



Date: 14.APR.2016 15:15:41

Radiated Spurious Emissions plot – Peak Reading (π/4DQPSK, Ch.0 3rd Harmonic)



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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.+CL [dB]	Ant. Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	25.96	31.31	H	0	57.27	73.98	16.71	PK
2390.0	12.35	31.31	H	-24.73	18.93	53.98	35.05	AV
2390.0	25.61	31.31	V	0	56.92	73.98	17.06	PK
2390.0	12.31	31.31	V	-24.73	18.89	53.98	35.09	AV
2483.5	32.13	31.37	H	0	63.50	73.98	10.48	PK
2483.5	28.92	31.37	H	-24.73	35.56	53.98	18.42	AV
2483.5	31.35	31.37	V	0	62.72	73.98	11.26	PK
2483.5	28.06	31.37	V	-24.73	34.70	53.98	19.28	AV

Operation Mode	EDR(8DPSK)
Operating Frequency	2402 MHz , 2480 MHz
Channel No	CH 0, CH 78

Frequency [MHz]	Reading dBuV	※ A.F.+CL [dB]	Ant. Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	25.43	31.31	H	0	56.74	73.98	17.24	PK
2390.0	12.28	31.31	H	-24.73	18.86	53.98	35.12	AV
2390.0	25.68	31.31	V	0	56.99	73.98	16.99	PK
2390.0	12.28	31.31	V	-24.73	18.86	53.98	35.12	AV
2483.5	32.17	31.37	H	0	63.54	73.98	10.44	PK
2483.5	28.77	31.37	H	-24.73	35.41	53.98	18.57	AV
2483.5	31.42	31.37	V	0	62.79	73.98	11.19	PK
2483.5	27.95	31.37	V	-24.73	34.59	53.98	19.39	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 [dB]	Ant. Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	25.73	31.31	H	0	57.04	73.98	16.94	PK
2390.0	12.26	31.31	H	-24.73	18.84	53.98	35.14	AV
2390.0	25.96	31.31	V	0	57.27	73.98	16.71	PK
2390.0	12.31	31.31	V	-24.73	18.89	53.98	35.09	AV
2483.5	32.80	31.37	H	0	64.17	73.98	9.81	PK
2483.5	28.74	31.37	H	-24.73	35.38	53.98	18.60	AV
2483.5	31.75	31.37	V	0	63.12	73.98	10.86	PK
2483.5	27.89	31.37	V	-24.73	34.53	53.98	19.45	AV

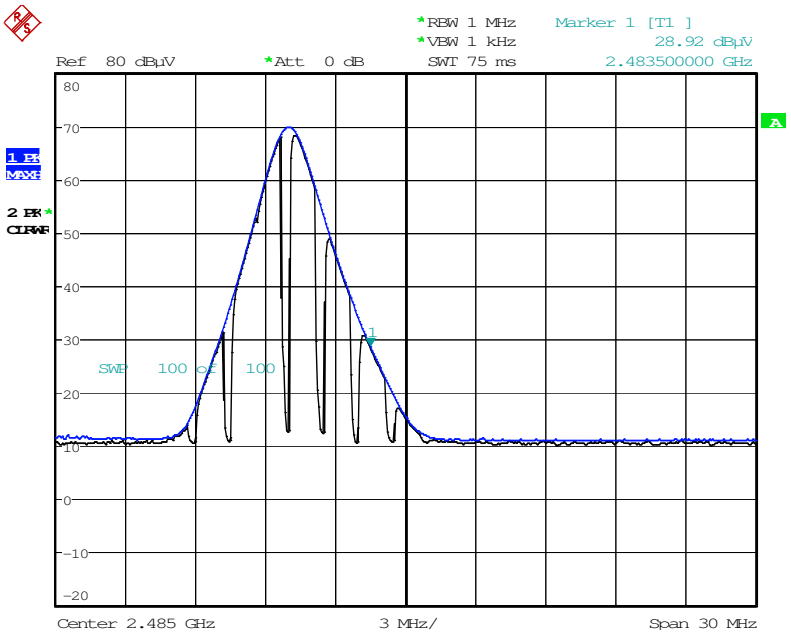
※ A·F: ANTENNA FACTOR
C·L: CABLE LOSS
AMP GAIN: AMPLIFIER GAIN

Notes:

1. Frequency range of measurement = 2483.5 MHz ~ 2500 MHz
2. Total = Reading Value + Antenna Factor + Cable Loss + Duty Cycle Correction Factor
3. 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.
4. 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
5. 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.
6. We have done Normal Mode, EDR Mode.
7. This test is performed with hopping off.
8. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

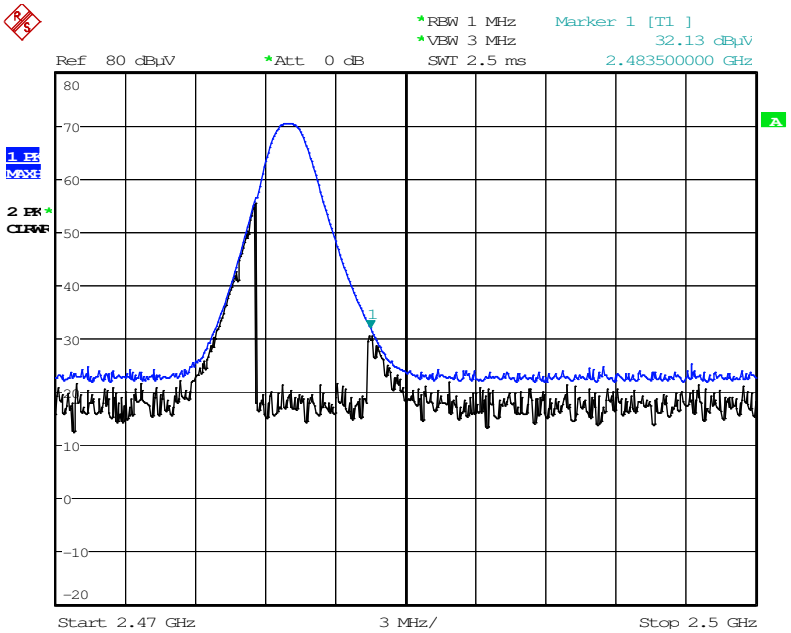
▣ RESULT PLOTS (Worst case : z-H)

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



Date: 12.APR.2016 17:49:41

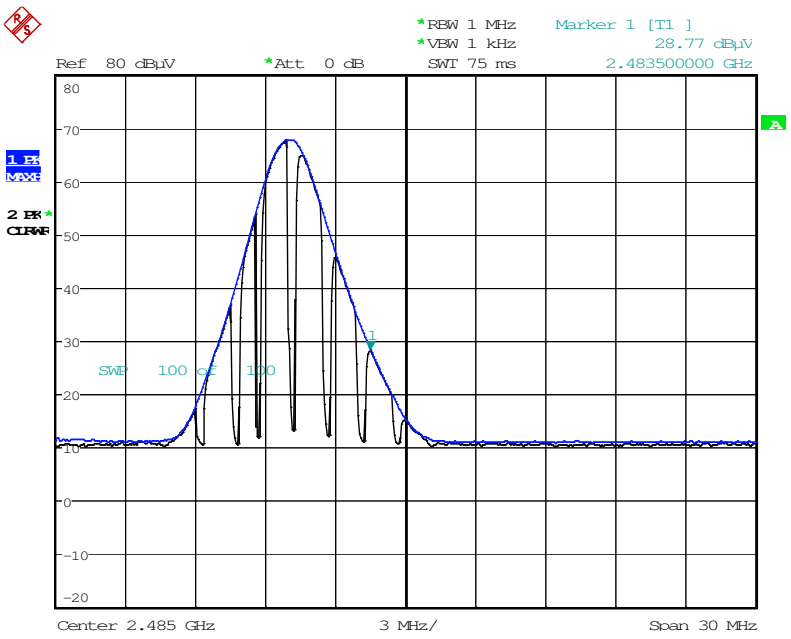
Radiated Restricted Band Edges plot – Peak Reading (GFSK, Ch.78)



Date: 12.APR.2016 17:46:36

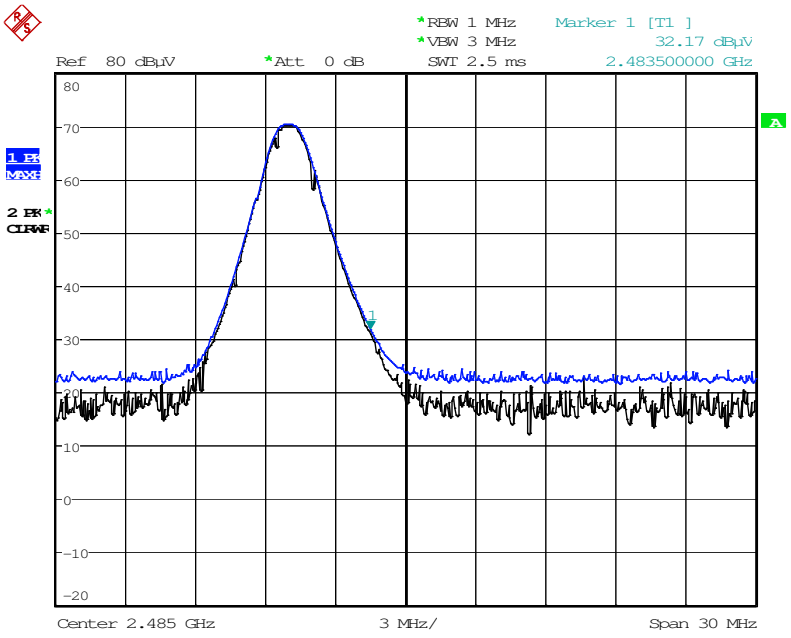
Note : Only the worst case plots for Radiated Restricted Band Edges.

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



Date: 12.APR.2016 17:50:48

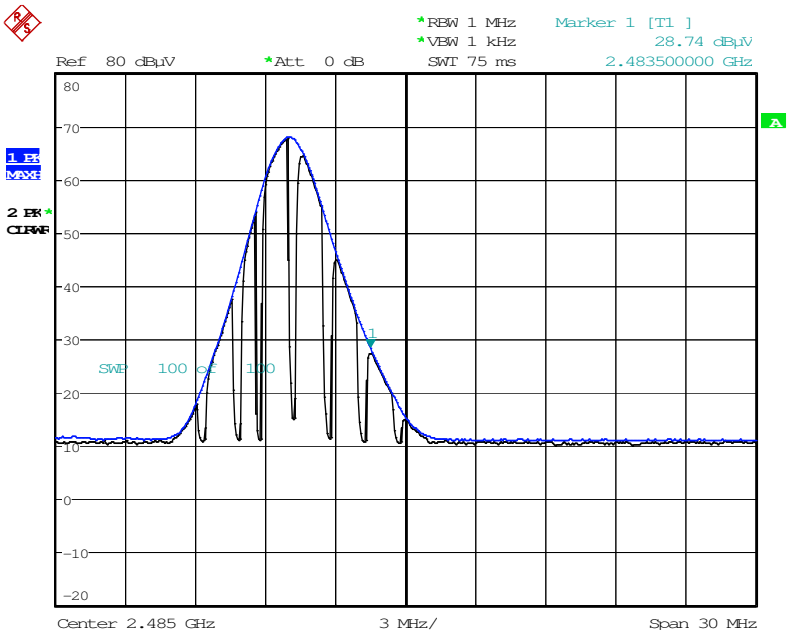
Radiated Restricted Band Edges plot – Peak Reading (8DPSK, Ch.78)



Date: 12.APR.2016 17:47:29

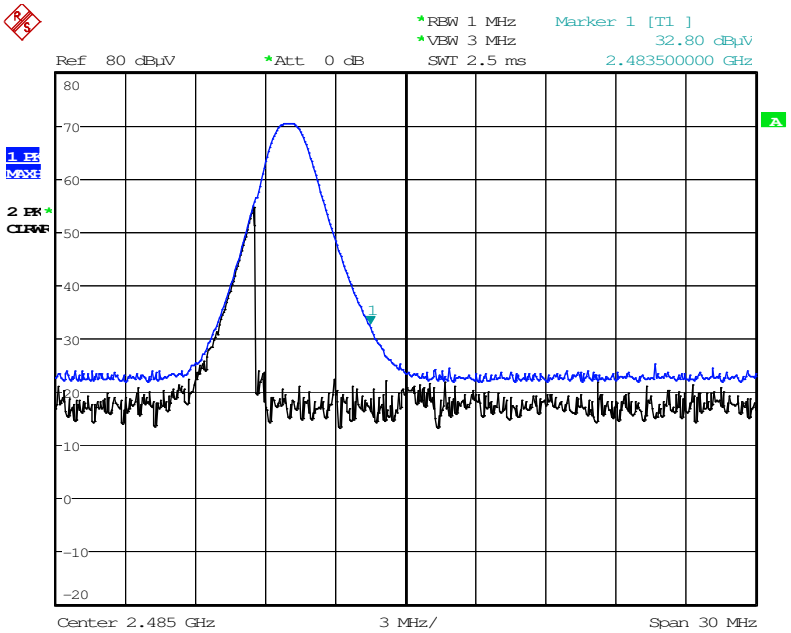
Note : Only the worst case plots for Radiated Restricted Band Edges.

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



Date: 12.APR.2016 17:50:26

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



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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

▣ RESULT PLOTS

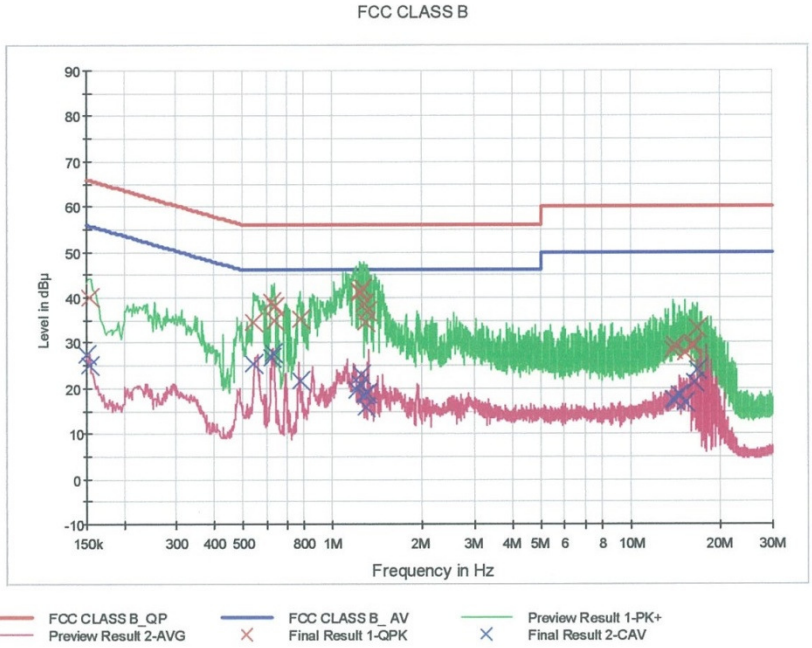
Conducted Emissions (Line 1)

BT MODE N 1 / 2

HCT TEST Report

Common Information

EUT:	KT1601
Manufacturer:	LG
Test Site:	SHIELD ROOM
Operating Conditions:	BT MODE



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.154000	40.0	9.000	Off	N	9.6	25.8	65.8
0.544000	34.5	9.000	Off	N	9.6	21.5	56.0
0.628000	39.0	9.000	Off	N	9.6	17.0	56.0
0.636000	37.9	9.000	Off	N	9.6	18.1	56.0
0.640000	34.9	9.000	Off	N	9.6	21.1	56.0
0.776000	35.3	9.000	Off	N	9.7	20.7	56.0
1.234000	40.9	9.000	Off	N	9.7	15.1	56.0
1.238000	41.5	9.000	Off	N	9.7	14.5	56.0
1.254000	42.1	9.000	Off	N	9.7	13.9	56.0
1.276000	38.7	9.000	Off	N	9.7	17.3	56.0
1.294000	34.7	9.000	Off	N	9.7	21.3	56.0
1.300000	36.8	9.000	Off	N	9.7	19.2	56.0
13.848000	28.3	9.000	Off	N	10.1	31.7	60.0
14.000000	29.3	9.000	Off	N	10.1	30.7	60.0
15.144000	27.7	9.000	Off	N	10.1	32.3	60.0
16.108000	29.9	9.000	Off	N	10.2	30.1	60.0
16.146000	29.1	9.000	Off	N	10.2	30.9	60.0
16.632000	33.3	9.000	Off	N	10.2	26.7	60.0

Final Result 2

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BT MODE N 2 / 2

Frequency (MHz)	CAverage (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	27.4	9.000	Off	N	9.6	28.6	56.0
0.154000	25.0	9.000	Off	N	9.6	30.8	55.8
0.544000	25.4	9.000	Off	N	9.6	20.6	46.0
0.624000	26.9	9.000	Off	N	9.6	19.1	46.0
0.630000	27.6	9.000	Off	N	9.6	18.4	46.0
0.776000	21.7	9.000	Off	N	9.7	24.3	46.0
1.198000	19.6	9.000	Off	N	9.7	26.4	46.0
1.236000	21.0	9.000	Off	N	9.7	25.0	46.0
1.240000	22.9	9.000	Off	N	9.7	23.1	46.0
1.276000	18.6	9.000	Off	N	9.7	27.4	46.0
1.294000	15.7	9.000	Off	N	9.7	30.3	46.0
1.300000	19.0	9.000	Off	N	9.7	27.0	46.0
13.848000	17.7	9.000	Off	N	10.1	32.3	50.0
13.996000	17.3	9.000	Off	N	10.1	32.7	50.0
14.474000	18.6	9.000	Off	N	10.1	31.4	50.0
15.144000	17.0	9.000	Off	N	10.1	33.0	50.0
16.402000	21.4	9.000	Off	N	10.2	28.6	50.0
16.632000	24.1	9.000	Off	N	10.2	25.9	50.0

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Conducted Emissions (Line 2)

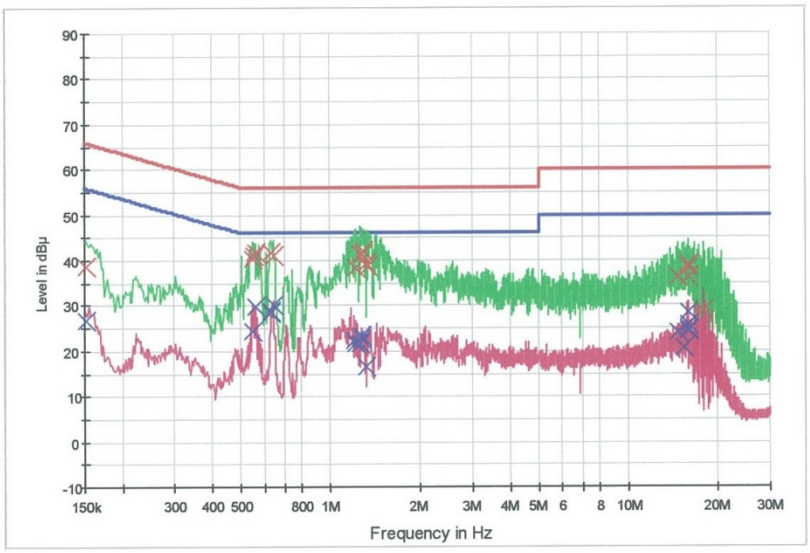
BT MODE L1 1 / 2

HCT TEST Report

Common Information

EUT:	KT1601
Manufacturer:	LG
Test Site:	SHIELD ROOM
Operating Conditions:	BT MODE

FCC CLASS B



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.152000	38.8	9.000	Off	L1	9.6	27.1	65.9
0.552000	40.4	9.000	Off	L1	9.7	15.6	56.0
0.556000	40.9	9.000	Off	L1	9.7	15.1	56.0
0.560000	41.8	9.000	Off	L1	9.7	14.2	56.0
0.634000	41.9	9.000	Off	L1	9.7	14.1	56.0
0.644000	40.9	9.000	Off	L1	9.7	15.1	56.0
1.222000	38.2	9.000	Off	L1	9.7	17.8	56.0
1.264000	41.5	9.000	Off	L1	9.7	14.5	56.0
1.280000	41.2	9.000	Off	L1	9.7	14.8	56.0
1.286000	42.0	9.000	Off	L1	9.7	14.0	56.0
1.326000	39.4	9.000	Off	L1	9.7	16.6	56.0
1.332000	38.5	9.000	Off	L1	9.7	17.5	56.0
14.760000	36.1	9.000	Off	L1	10.1	23.9	60.0
15.922000	38.5	9.000	Off	L1	10.2	21.5	60.0
15.926000	38.9	9.000	Off	L1	10.2	21.1	60.0
15.932000	38.8	9.000	Off	L1	10.2	21.2	60.0
15.944000	36.3	9.000	Off	L1	10.2	23.7	60.0
18.028000	28.7	9.000	Off	L1	10.2	31.3	60.0

Final Result 2

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BT MODE L1 2 / 2

Frequency (MHz)	CAverage (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.152000	26.7	9.000	Off	L1	9.6	29.2	55.9
0.552000	24.2	9.000	Off	L1	9.7	21.8	46.0
0.562000	29.7	9.000	Off	L1	9.7	16.3	46.0
0.630000	28.6	9.000	Off	L1	9.7	17.4	46.0
0.634000	28.8	9.000	Off	L1	9.7	17.2	46.0
0.644000	30.2	9.000	Off	L1	9.7	15.8	46.0
1.206000	22.3	9.000	Off	L1	9.7	23.7	46.0
1.222000	21.7	9.000	Off	L1	9.7	24.3	46.0
1.264000	21.7	9.000	Off	L1	9.7	24.3	46.0
1.272000	22.8	9.000	Off	L1	9.7	23.2	46.0
1.280000	23.2	9.000	Off	L1	9.7	22.8	46.0
1.326000	16.4	9.000	Off	L1	9.7	29.6	46.0
14.760000	24.1	9.000	Off	L1	10.1	25.9	50.0
15.492000	20.5	9.000	Off	L1	10.2	29.5	50.0
15.922000	25.8	9.000	Off	L1	10.2	24.2	50.0
15.926000	28.4	9.000	Off	L1	10.2	21.6	50.0
15.932000	24.3	9.000	Off	L1	10.2	25.7	50.0
15.944000	24.5	9.000	Off	L1	10.2	25.5	50.0

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Note : The Worst case of Conducted Emission is standalone mode.

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	E4440A/ Spectrum Analyzer	03/18/2016	Annual	US45303008
Agilent	N9020A / SIGNAL ANALYZER	06/30/2015	Annual	MY51110085
Agilent	N9030A / SIGNAL ANALYZER	11/24/2015	Annual	MY49431210
Agilent	N1911A/Power Meter	07/09/2015	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	06/15/2015	Annual	5001
Hewlett Packard	E3632A / DC POWER SUPPLY	03/09/2016	Annual	KR75303962
Agilent	8493C / Attenuator(10 dB)	07/23/2015	Annual	07560
Rohde & Schwarz	CBT / BLUETOOTH TESTER	05/11/2015	Annual	100422

10.2 LIST OF TEST EQUIPMENT(Radiated Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Schwarzbeck	VULB 9160/ TRILOG Antenna	10/10/2014	Biennial	3368
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
CERNEX	CBL18265035 / POWER AMP	07/27/2015	Annual	22966
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 Instrument	WHF3.0/18G-10EF / High Pass Filter	06/29/2015	Annual	8
Wainwright Instrument	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	07/06/2015	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	01/26/2016	Annual	2
Agilent	8493C-10 / Attenuator(10 dB)	08/20/2015	Annual	76649
Rohde & Schwarz	LOOP ANTENNA	02/23/2016	Biennial	1513-175
CERNEX	CBL06185030 / POWER AMP	07/21/2015	Annual	22965
CERNEX	CBLU1183540 / POWER AMP	07/21/2015	Annual	22964
CERNEX	CBL26405040 / Power Amplifier	07/09/2015	Annual	25956
Rohde & Schwarz	CBT / BLUETOOTH TESTER	05/11/2015	Annual	100422