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FCC BT REPORT

Certification

Applicant Name:
SONY CORPORATION

Address:
1-7-1 Konan Minato-ku Tokyo, 108-0075 Japan

Date of Issue:
March 11, 2019

Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon,
Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-RF-1903-FC004

FCC ID:	**AK8DSXB700**
APPLICANT:	**SONY CORPORATION**

Model:	DSX-B700
EUT Type:	FM/AM Bluetooth CAR AUDIO
Max. RF Output Power:	1.121 dBm (1.294 mW)
Frequency Range:	2402 MHz - 2480 MHz (Bluetooth)
Modulation type	GFSK(Normal), π/4DQPSK and 8DPSK(EDR)
FCC Classification:	FCC Part 15 Spread Spectrum Transmitter
FCC Rule Part(s):	Part 15 subpart C 15.247

The measurements shown in this report were made in accordance with the procedures specified in §2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Report prepared by : Se Wook Park
Engineer of Telecommunication testing center

Approved by : Kwon Jeong
Manager of Telecommunication testing center

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1903-FC004	March 11, 2019	- First Approval Report

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1. EUT DESCRIPTION

Manufacturer	SONY CORPORATION
Assembly Plant	SONY TECHNOLOGY(THAILAND) CO., LTD.
Assembly Plant Address	Head Office 700/402 Moo 7, Amata City Chonburi Industrial Estate, Don Hua Roh, Muang Chonburi, Chonburi 20000, Thailand
Model	DSX-B700
EUT Type	FM/AM Bluetooth CAR AUDIO
Power Supply	DC 12.0 V
Frequency Range	2402 MHz - 2480 MHz
Max. RF Output Power	1.121 dBm (1.294 mW)
BT Operating Mode	Normal, EDR, AFH
Modulation Type	GFSK(Normal), π/4DQPSK and 8DPSK(EDR)
Modulation Technique	FHSS
Bluetooth Version	3.0
Temperature range	-20°C to +60°C
Number of Channels	79Channels, Minimum 20 Channels(AFH)
Antenna Specification	Antenna type: Type : Top-GND-coupled loop Peak Gain : -7.4 dBi
Date(s) of Tests	March 04, 2019 ~ March 08, 2019

2. REQUIREMENTS FOR BLUETOOTH TRANSMITTER (15.247)

This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:

1) This system is hopping pseudo-randomly.
2) Each frequency is used equally on the average by each transmitter.
3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
4) The receiver shifts frequencies in synchronization with the transmitted signals.
   - 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.
   - 15.247(h): The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

3. TEST METHODOLOGY

FCC KDB 558074 D01 15.247 Meas Guidance v05r01 dated February 11, 2019 entitled “guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices and the measurement procedure described in ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3.75 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013). To record the final measurements, the analyzer detector function was set to CISPR quasi-peak mode and the bandwidth of the spectrum analyzer was set to 120 kHz for frequencies below 1 GHz or 1 MHz for frequencies above 1 GHz. For average measurements above 1 GHz, the analyzer was set to peak detector with a reduced VBW setting(RBW = 1 MHz, VBW = 1/T Hz, where T = Pulse width).

DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 of this section."

* The antennas of this E.U.T are permanently attached.

* The E.U.T Complies with the requirement of §15.203

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70
Radiated Disturbance (18 GHz ~ 40 GHz)	5.71

8. DESCRIPTION OF TESTS

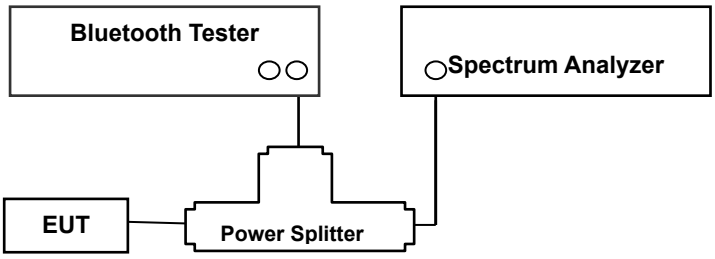
8.1. Conducted Maximum Peak Output Power

Limit

The maximum peak output power of the intentional radiator shall not exceed the following:

1. For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 W. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 W.
2. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak detector mode. This test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.5 in ANSI 63.10-2013)

1) Span: approximately 5 times the 20 dB bandwidth, centered on a hopping channel
2) RBW > the 20 dB bandwidth of the emission being measured
3) VBW ≥ RBW
4) Sweep = Auto
5) Detector = Peak
6) Trace = Max hold

Sample Calculation

Output Power = Spectrum Reading Power + Power Splitter loss + Cable loss(2 ea)

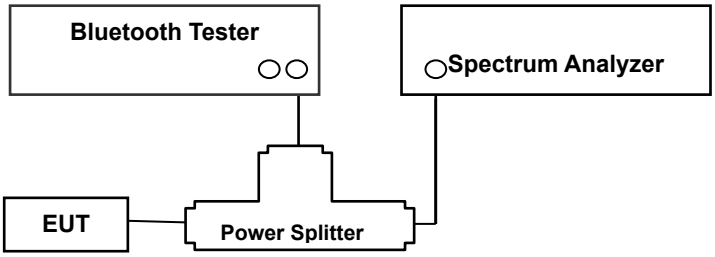
= 10 dBm + 6 dB + 1.2 dB = 17.2 dBm

8.2. Conducted Band Edge(Out of Band Emissions)

Limit

According to §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.

Test Configuration



Test Procedure

This test is performed with hopping off and hopping on.

The Spectrum Analyzer is set to (6.10.4 in ANSI 63.10-2013)

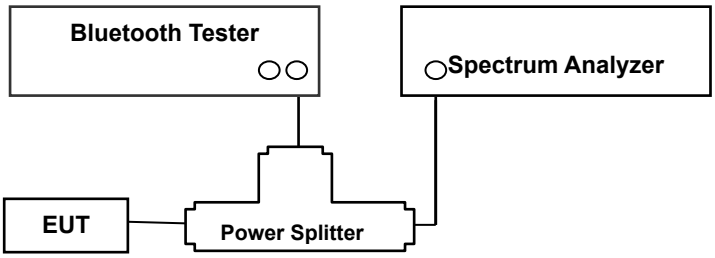
1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
3) Attenuation: Auto (at least 10 dB preferred).
4) Sweep time: Coupled.
5) RBW: 100 kHz
6) VBW: 300 kHz
7) Detector: Peak
8) Trace: Max hold

8.3. Frequency Separation & 20 dB Bandwidth

Limit

According to §15.247(a)(1), Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Configuration



Test Procedure

The Channel Separation test is performed with hopping on.
And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.2 in ANSI 63.10-2013)

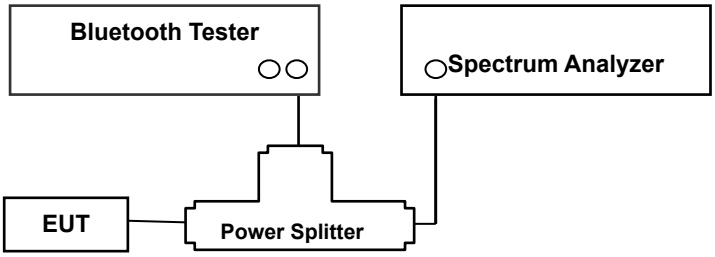
1) Span: Wide enough to capture the peaks of two adjacent channels
2) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
3) VBW ≥ RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) All the trace to stabilize.
8) Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

8.4. Number of Hopping Frequencies

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)

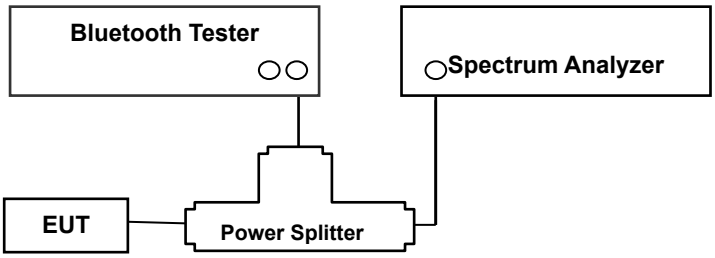
1) Span: the frequency band of operation
2) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3) VBW ≥ RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) Allow the trace to stabilize.

8.5. Time of Occupancy

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.

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.

Sample Calculation

The following calculation process is not relevant to our measurement results. It is just an example.

* Non-AFH Mode

- DH 5 (GFSK) : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)
- 2-DH 5 (π/4DQPSK) : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)
- 3-DH 5 (8DPSK) : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)

* AFH Mode

- DH 5 (GFSK) : 2.890 * (800/6)/20 * 8.0 = 154.13 (ms)
- 2-DH 5 (π/4DQPSK) : 2.890 * (800/6)/20 * 8.0 = 154.13 (ms)
- 3-DH 5 (8DPSK) : 2.890 * (800/6)/20 * 8.0 = 154.13 (ms)

Note :

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 106.667 times of appearance.

Each tx-time per appearance of DH5 is 2.890 ms.

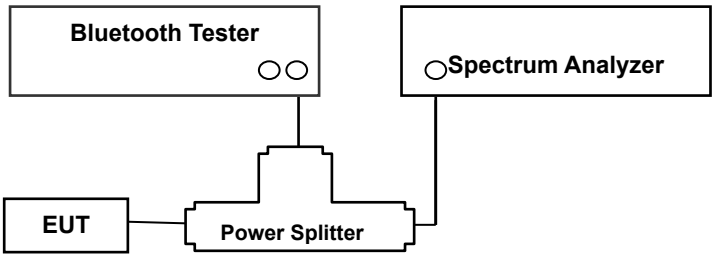
Dwell time = Tx-time * 106.667 = 308.27 (ms)

8.6. Conducted Spurious Emissions

Limit

Conducted > 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 25 GHz range with the transmitter set to the lowest, middle, and highest channels.
This test is performed with hopping off.

Factors for frequency

Freq(MHz)	Factor(dB)
30	6.98
100	6.15
200	6.84
300	6.38
400	6.06
500	5.75
600	5.97
700	6.14
800	6.52
900	6.88
1000	7.18
2000	7.01
2400*	7.17
2500*	7.20
3000	7.68
4000	8.75
5000	9.37
6000	6.48
7000	9.79
8000	8.14
9000	9.41
10000	10.27
11000	8.76
12000	9.53
13000	8.64
14000	9.30
15000	11.34
16000	7.94
17000	11.53
18000	9.51
19000	10.20
20000	11.49
21000	10.52
22000	12.11
23000	9.65
24000	12.32
25000	10.87
26000	10.30

Note : 1. '*' is fundamental frequency range.
2. Factor = Cable loss + Splitter loss

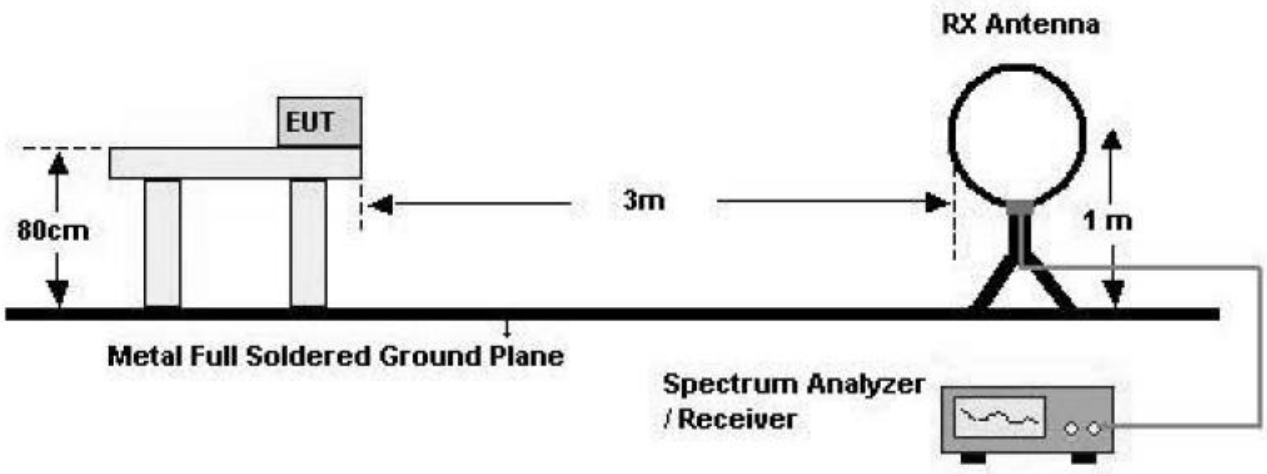
8.7. Radiated Test

Limit

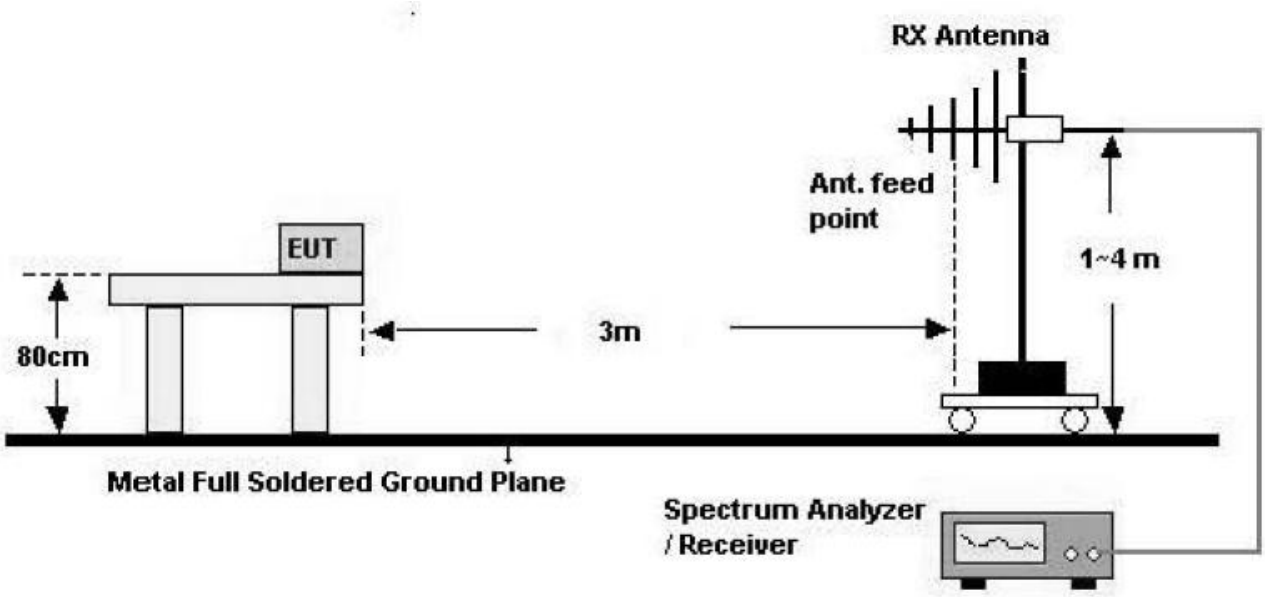
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

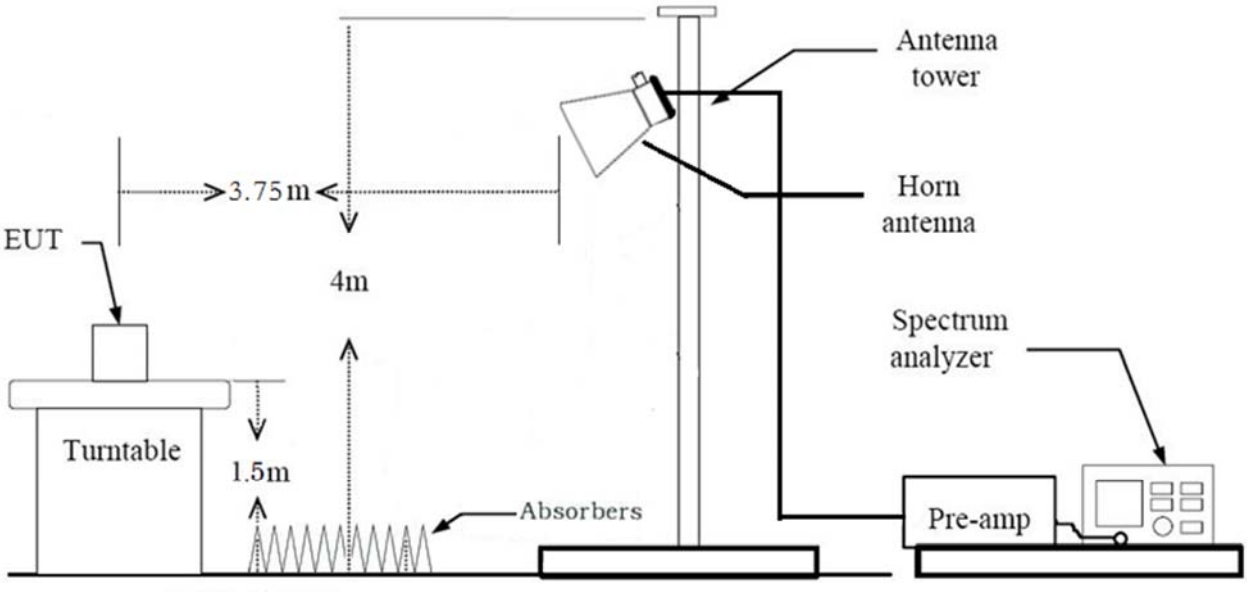
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions(Below 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) = 40*log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40*log(3 m/30 m) = - 40 dB
   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 9 kHz
   - VBW ≥ 3*RBW
9. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
10. The test results for below 30 MHz is correlated to an open site.
    The result on OFS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

Test Procedure of Radiated spurious emissions(Below 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Spectrum Setting
   (1) Measurement Type(Peak):
   - Measured Frequency Range : 30 MHz – 1 GHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 100 kHz
   - VBW ≥ 3*RBW

   (2) Measurement Type(Quasi-peak):
   - Measured Frequency Range : 30 MHz – 1 GHz
   - Detector = Quasi-Peak
   - RBW = 120 kHz

   *In general, (1) is used mainly
6. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. Radiated test is performed with hopping off.
2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. 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).
   *Distance extrapolation factor = 20*log (test distance / specific distance) (dB)
7. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
8. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
9. The unit was tested with its standard battery.
10. Spectrum Setting
    (1) Measurement Type(Peak):
        - Measured Frequency Range : 1 GHz – 25 GHz
        - Detector = Peak
        - Trace = Maxhold
        - RBW = 1 MHz
        - VBW ≥ 3*RBW
    (2) Measurement Type(Average):
        - We performed using a reduced video BW method was done with the analyzer in linear mode
        - Measured Frequency Range : 1 GHz – 25 GHz
        - Detector = Peak
        - Trace = Maxhold
        - RBW = 1 MHz
        - VBW ≥ 1/τ Hz, where τ = pulse width in seconds
          The actual setting value of VBW = 1 kHz
11. Measurement value 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.
12. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(G) + Distance Factor(D.F)

Test Procedure of Radiated Restricted Band Edge

1. Radiated test is performed with hopping off.
2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. 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).
   *Distance extrapolation factor = 20*log (test distance / specific distance) (dB)
7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
8. The unit was tested with its standard battery.
9. Spectrum Setting
   (1) Measurement Type(Peak):
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3*RBW
   (2) Measurement Type(Average):
      - We performed using a reduced video BW method was done with the analyzer in linear mode
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 1/τ Hz, where τ = pulse width in seconds
        The actual setting value of VBW = 1 kHz

10. Total(Measurement Type : Peak)
    = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

    Total(Measurement Type : Average)
    = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

8.8. AC Power line Conducted Emissions

Limit

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 μH/50 ohms line impedance stabilization network (LISN).

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

*Decreases with the logarithm of the frequency.

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 Annex A 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

8.9. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
2. EUT Axis
   - Radiated Spurious Emissions : X
   - Radiated Restricted Band Edge : X
3. All data rate of operation were investigated and the test results are worst case in highest datarate of each mode.
   - GFSK : DH5
   - π/4DQPSK : 2-DH5
   - 8DPSK : 3-DH5

AC Power line Conducted Emissions

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

Conducted test

1. The EUT was configured with data rate of highest power.
   - GFSK : DH5
   - π/4DQPSK : 2-DH5
   - 8DPSK : 3-DH5
2. AFH & Non-AFH were tested and the worst case results are reported.
   (Worst case : Non-AFH)

9. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§15.247(a)(1)	N/A	Conducted	PASS
Occupied Bandwidth	§2.1049	N/A		PASS
Conducted Maximum Peak Output Power	§15.247(b)(1)	< 0.125 W		PASS
Carrier Frequency Separation	§15.247(a)(1)	> 25 kHz or >2/3 of the 20dB BW		PASS
Number of Hopping Frequencies	§15.247(a)(1)(iii)	≥ 15		PASS
Time of Occupancy	§15.247(a)(1)(iii)	< 400 ms		PASS
Conducted Spurious Emissions	§15.247(d)	> 20 dB for all out-of band emissions		PASS
Band Edge (Out of Band Emissions)	§15.247(d)	> 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	§15.207(a)	cf. Section 8.8		N/A (Note1)
Radiated Spurious Emissions	§15.247(d), 15.205, 15.209	cf. Section 8.7	Radiated	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.7		PASS

Note:

1. We don't perform powerline conducted emission test. Because this EUT is used with vehicle.

10. TEST RESULT

10.1 PEAK POWER

Channel	Frequency (MHz)	Output Power (GFSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	-0.958	0.80	125
Mid	2441	-0.471	0.90	
High	2480	-1.573	0.70	

Channel	Frequency (MHz)	Output Power (8DPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	0.917	1.24	125
Mid	2441	1.121	1.29	
High	2480	0.115	1.03	

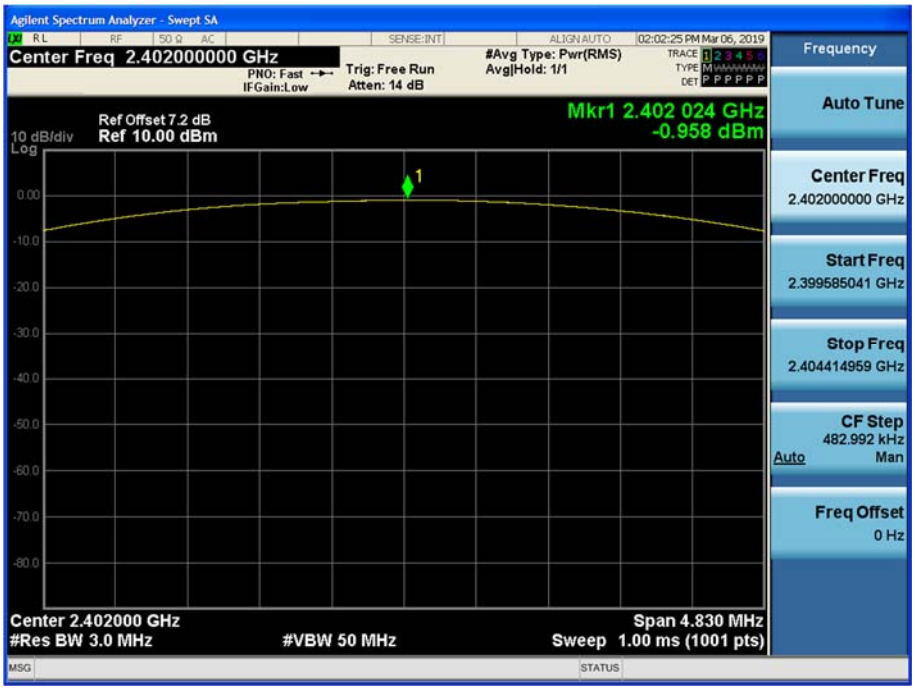
Channel	Frequency (MHz)	Output Power (π/4DQPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	0.471	1.11	125
Mid	2441	0.631	1.16	
High	2480	-0.373	0.92	

Note:

1. Spectrum reading values are not plot data.
   The power results in plot is already including the actual values of loss for the splitter and cable combination.
2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.
   Actual value of loss for the splitter and cable combination is 7.20 dB.

Test Plots (GFSK)

Peak Power (CH.0)



Test Plots (GFSK)

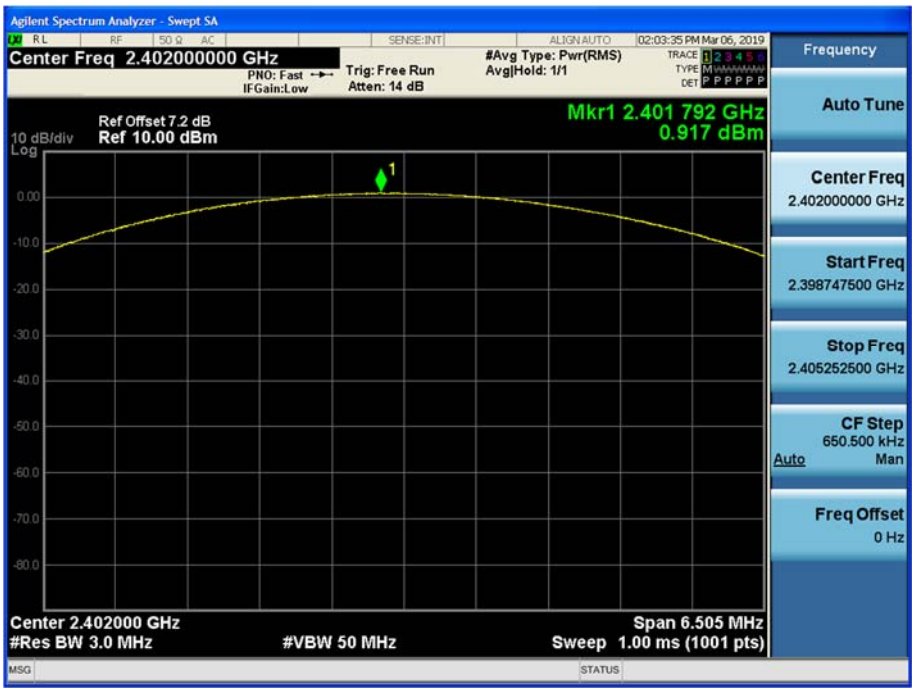
Peak Power (CH.39)

Test Plots (GFSK)

Peak Power (CH.78)

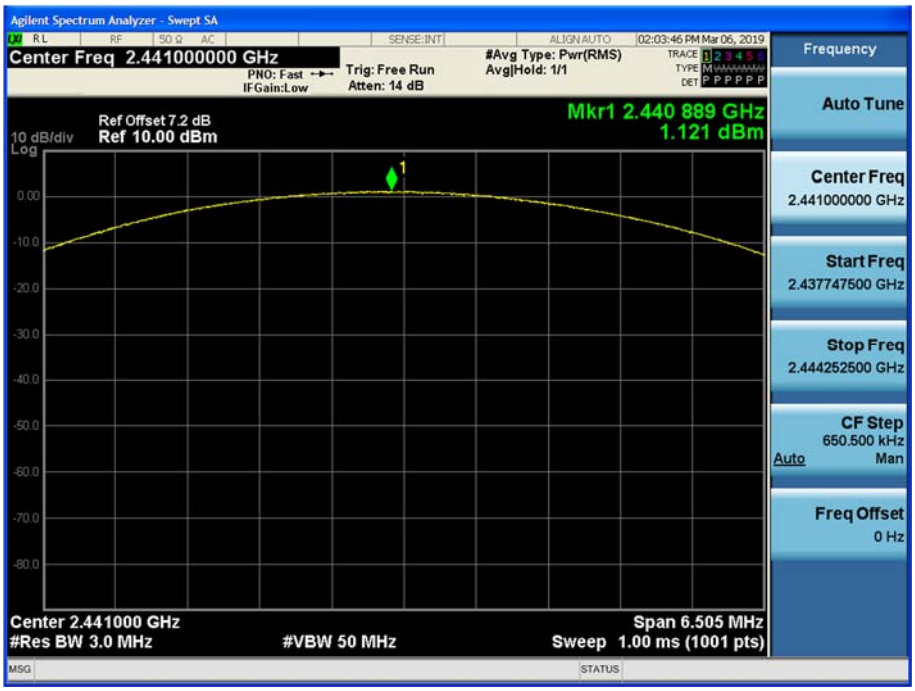
Test Plots (8DPSK)

Peak Power (CH.0)



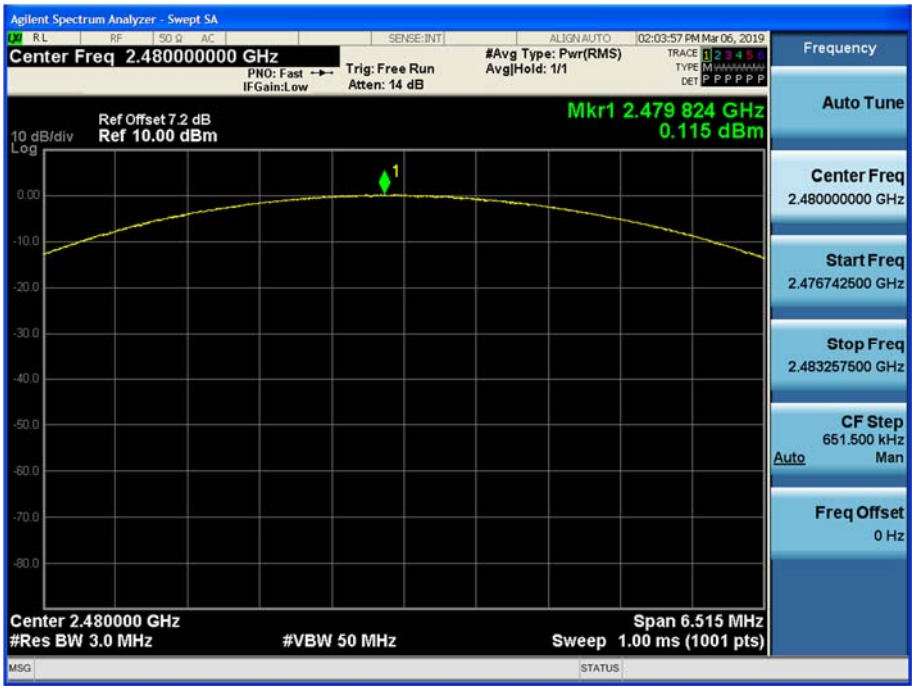
Test Plots (8DPSK)

Peak Power (CH.39)

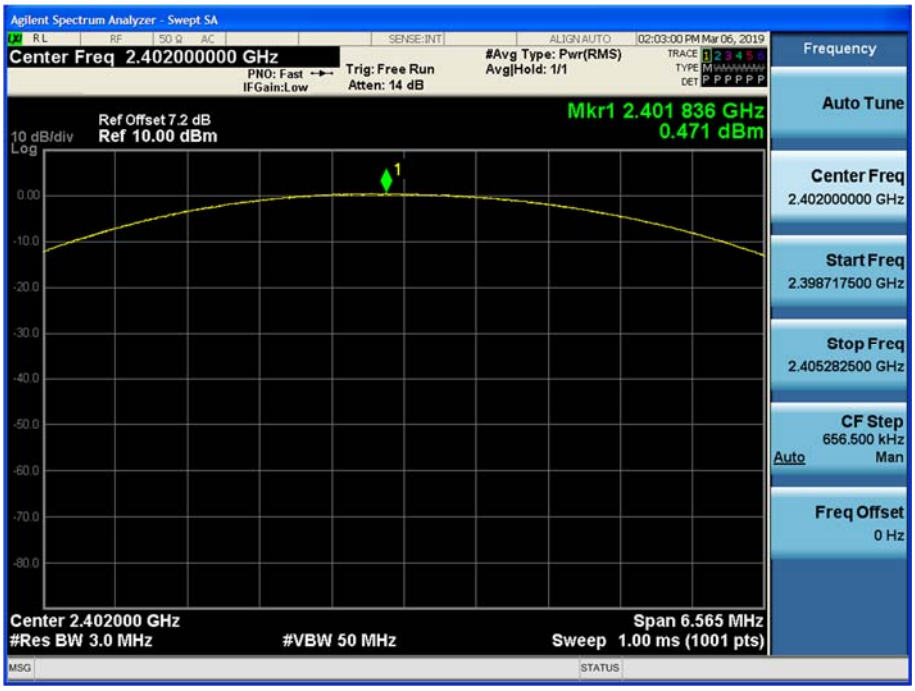


Test Plots (8DPSK)

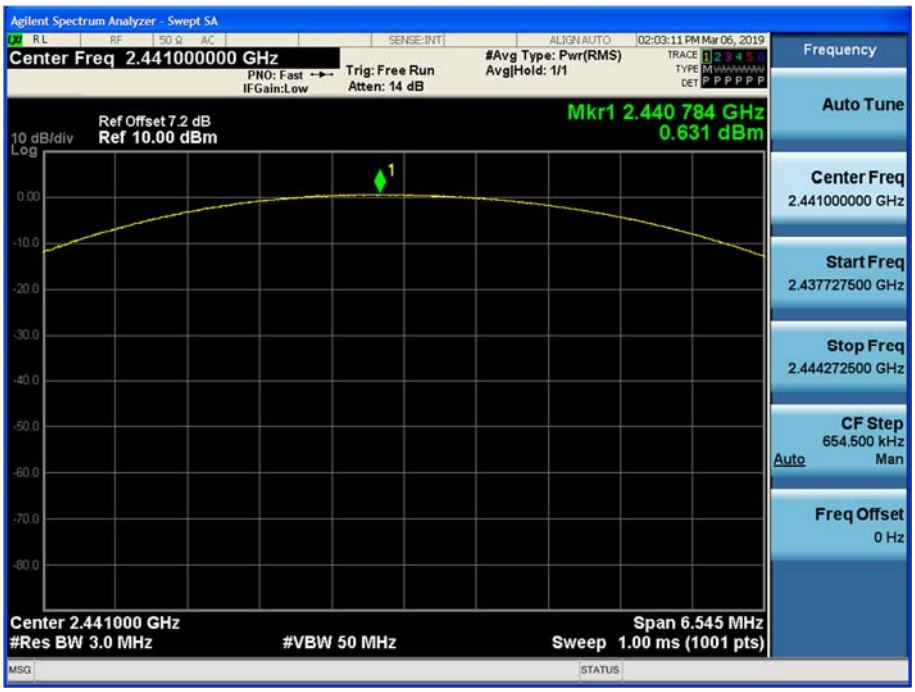
Peak Power (CH.78)



Test Plots (π/4DQPSK)
Peak Power (CH.0)

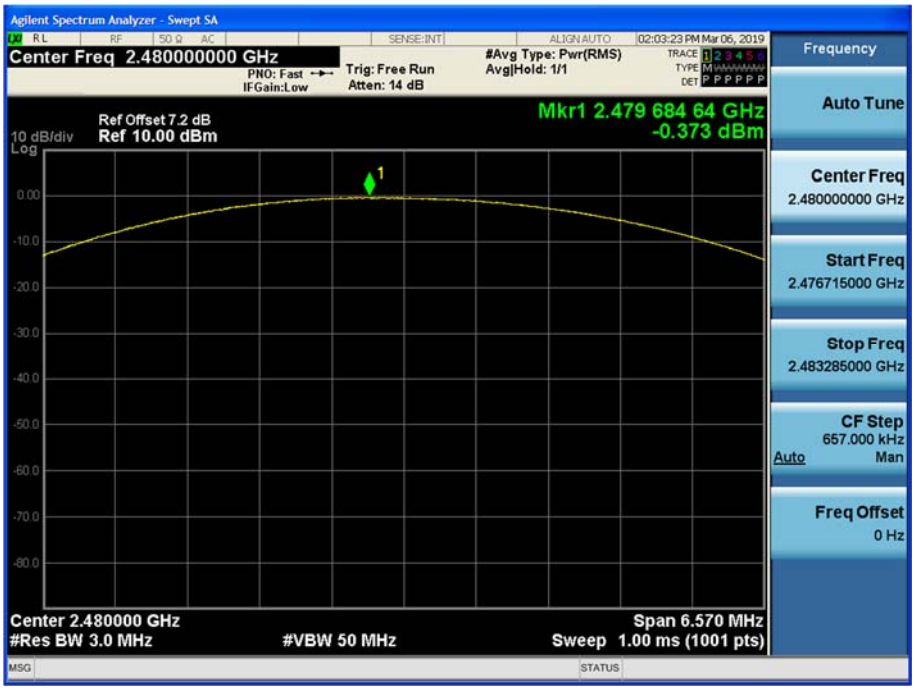


Test Plots (π/4DQPSK)
Peak Power (CH.39)



Test Plots (π/4DQPSK)

Peak Power (CH.78)



10.2 BAND EDGES

Without hopping

Outside Frequency Band	GFSK (dB)	8DPSK (dB)	π/4DQPSK (dB)	Limit (dBc)
Lower	54.174	39.288	39.220	20
Upper	60.902	62.208	63.028	

With hopping

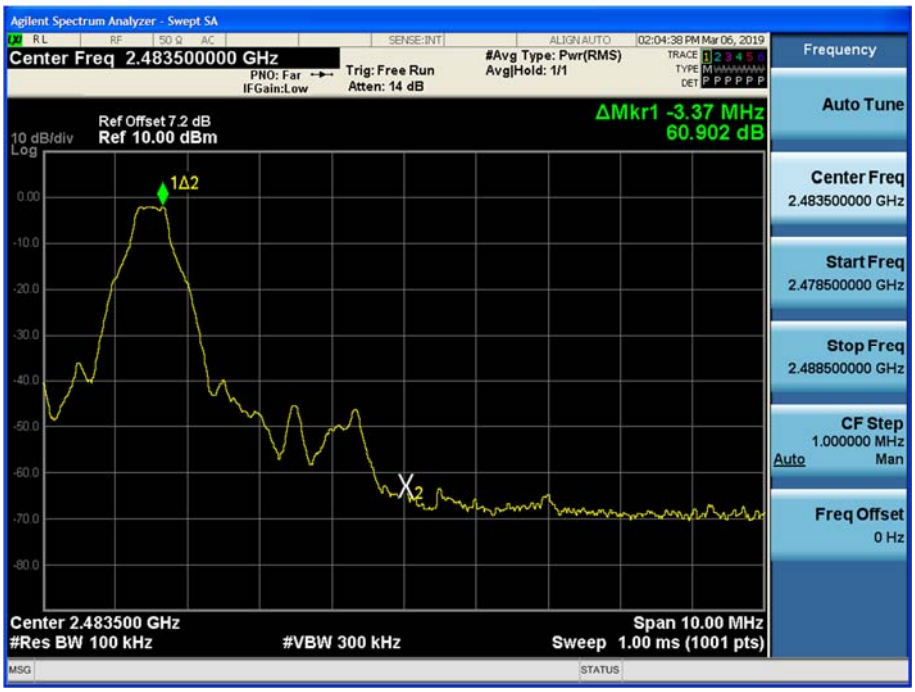
Outside Frequency Band	GFSK (dB)	8DPSK (dB)	π/4DQPSK (dB)	Limit (dBc)
Lower	52.610	44.811	39.335	20
Upper	55.440	57.403	56.400	

Note :

1. Spectrum reading values are not plot data.
   The power results in plot is already including the actual values of loss for the splitter and cable combination.
2. 2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.
   Actual value of loss for the splitter and cable combination is 7.20 dB.

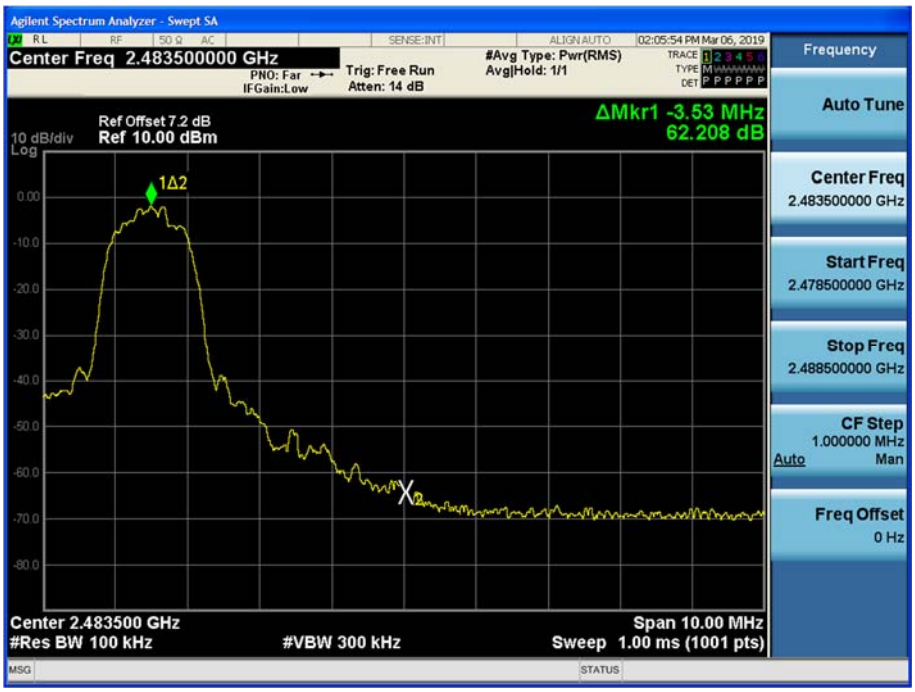
Test Plots without hopping (GFSK)
Band Edges (CH.0)

Test Plots without hopping (GFSK)
Band Edges (CH.78)



Test Plots without hopping (8DPSK)
Band Edges (CH.0)

Test Plots without hopping (8DPSK)
Band Edges (CH.78)

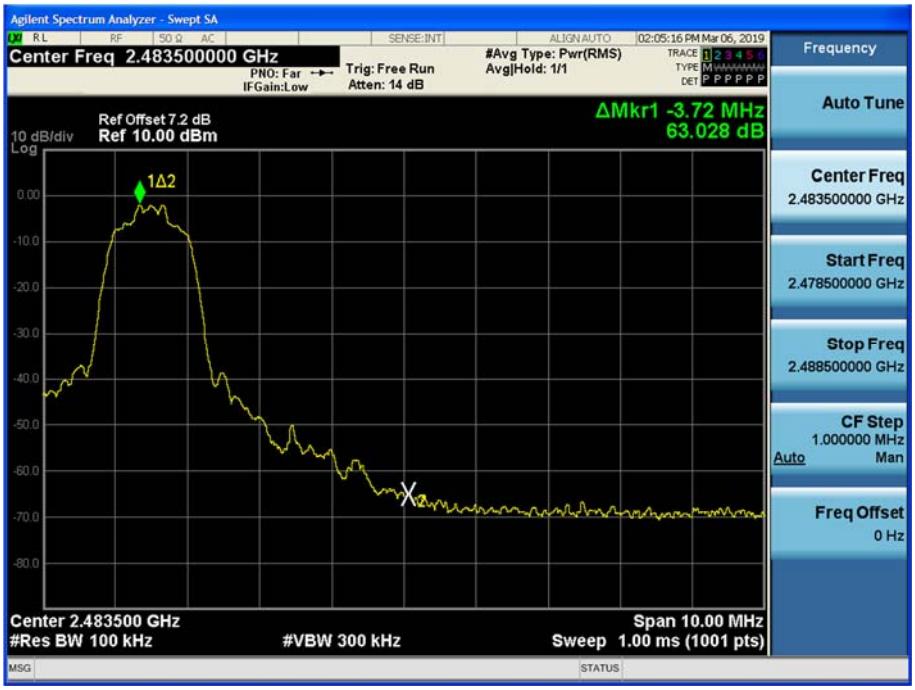


Test Plots without hopping (π/4DQPSK)

Band Edges (CH.0)

Test Plots without hopping (π/4DQPSK)

Band Edges (CH.78)



Test Plots with hopping (GFSK)
Band Edges (CH.0)

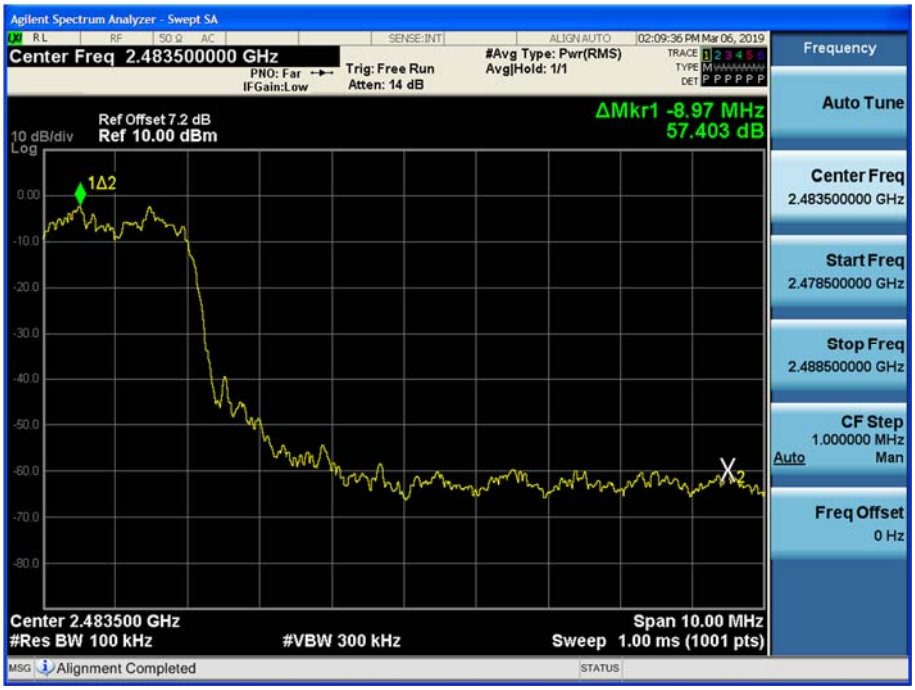
Test Plots with hopping (GFSK)
Band Edges (CH.78)

Test Plots with hopping (8DPSK)

Band Edges (CH.0)

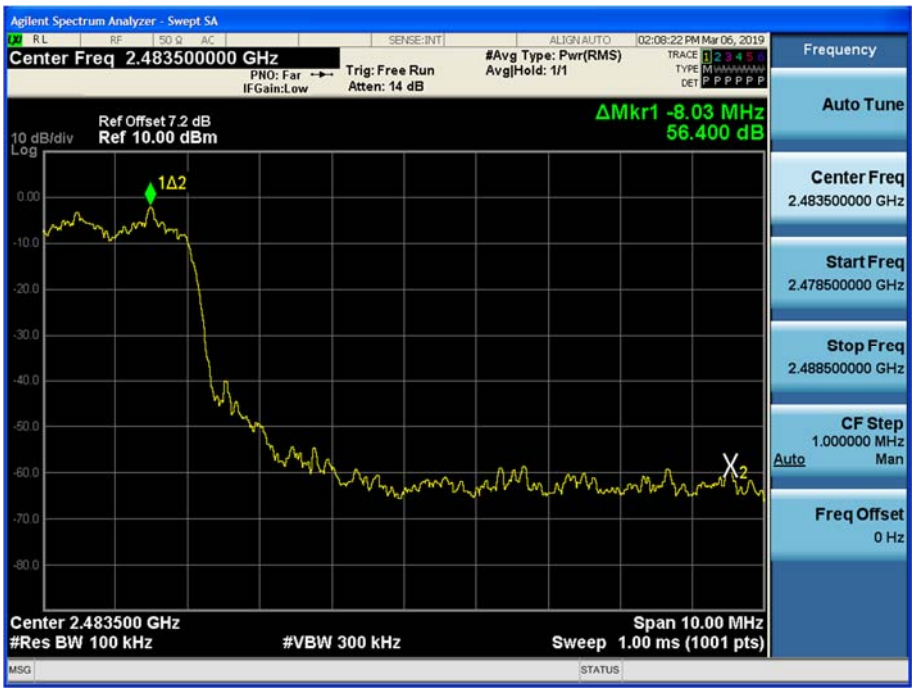
Test Plots with hopping (8DPSK)

Band Edges (CH.78)



Test Plots with hopping (π/4DQPSK)
Band Edges (CH.0)

Test Plots with hopping (π/4DQPSK)
Band Edges (CH.78)



10.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW)

99% BW (kHz)			
Channel	GFSK	8DPSK	π/4DQPSK
CH.0	879.86	1174.5	1165.9
CH.39	872.44	1173.7	1165.2
CH.78	871.29	1172.6	1166.4

20dB BW (kHz)			
Channel	GFSK	8DPSK	π/4DQPSK
CH.0	966	1301	1313
CH.39	1025	1301	1309
CH.78	1023	1303	1314

Channel Separation(kHz)			Limit
GFSK	8DPSK	π/4DQPSK	(kHz)
998	1001	994	>25 kHz or >2/3 of the 20dB BW

Test Plots (GFSK)

Channel Separation

Test Plots (8DPSK)

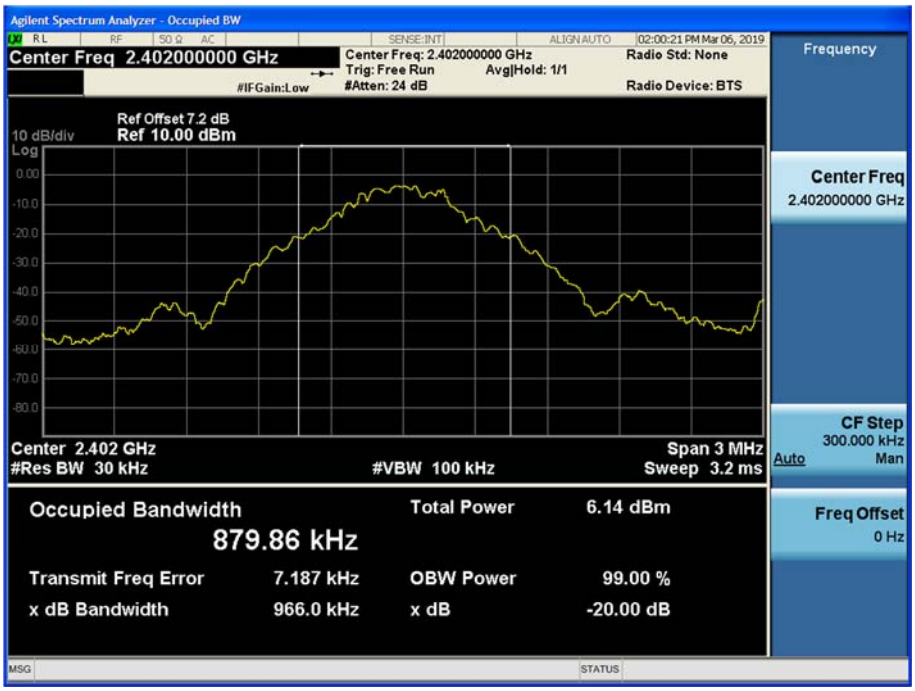
Channel Separation

Test Plots (π/4DQPSK)

Channel Separation

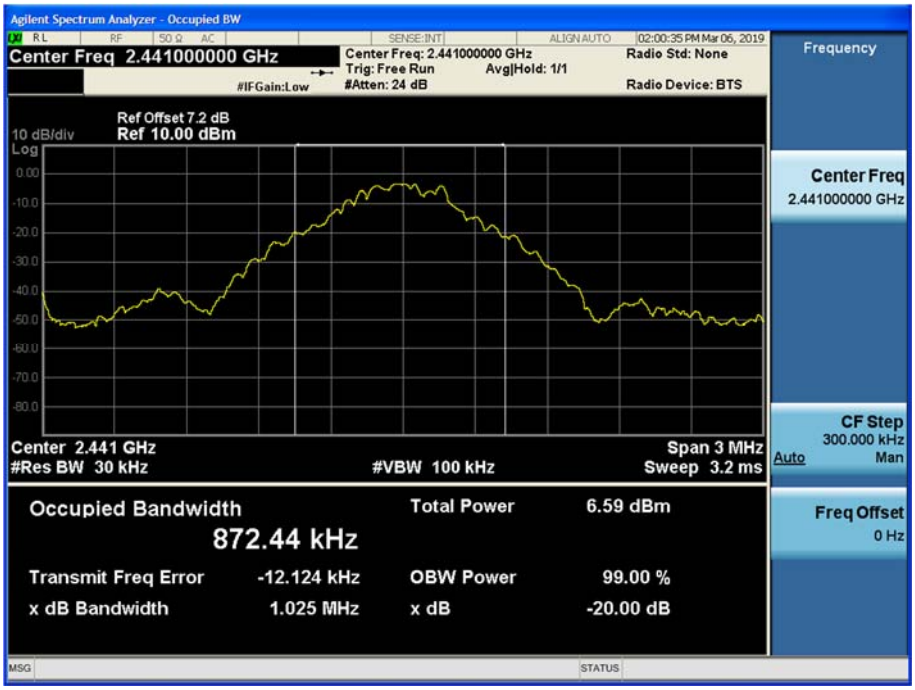
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)

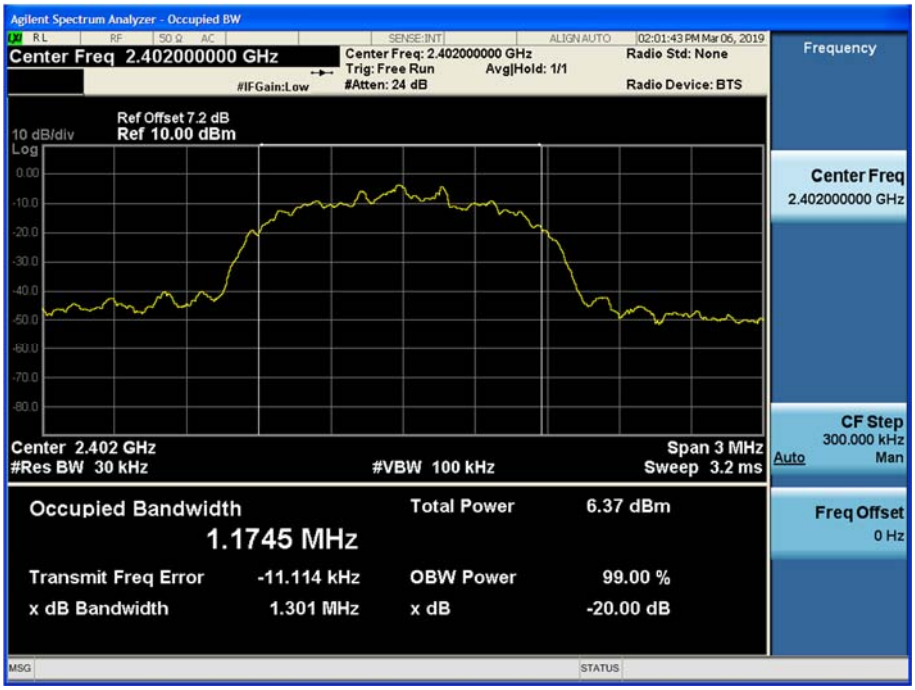


Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)

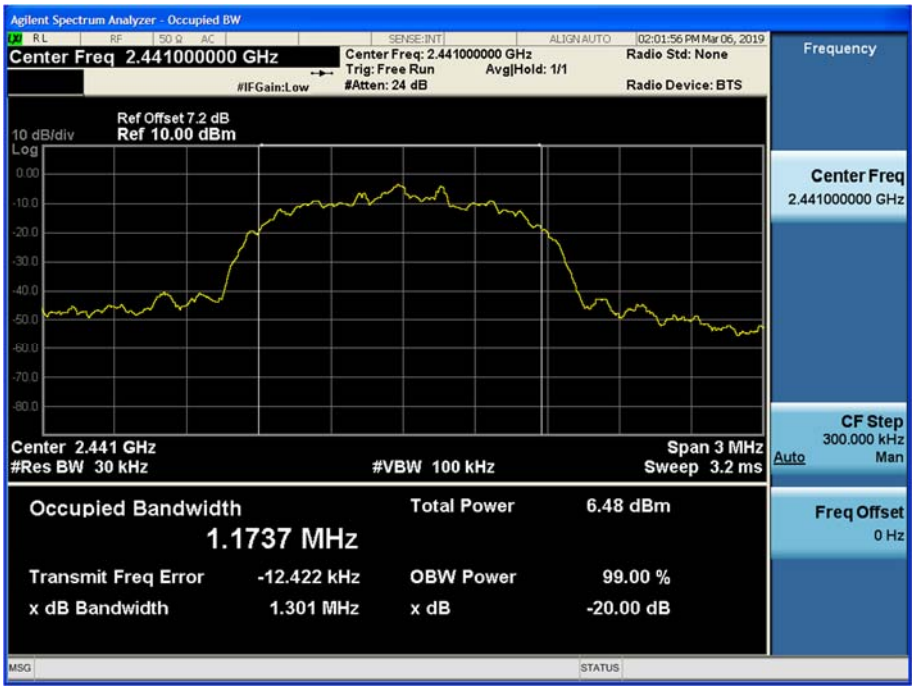
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)

Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)

Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)

Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)

10.4 NUMBER OF HOPPING FREQUENCY

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

Note :

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

Test Plots (GFSK)

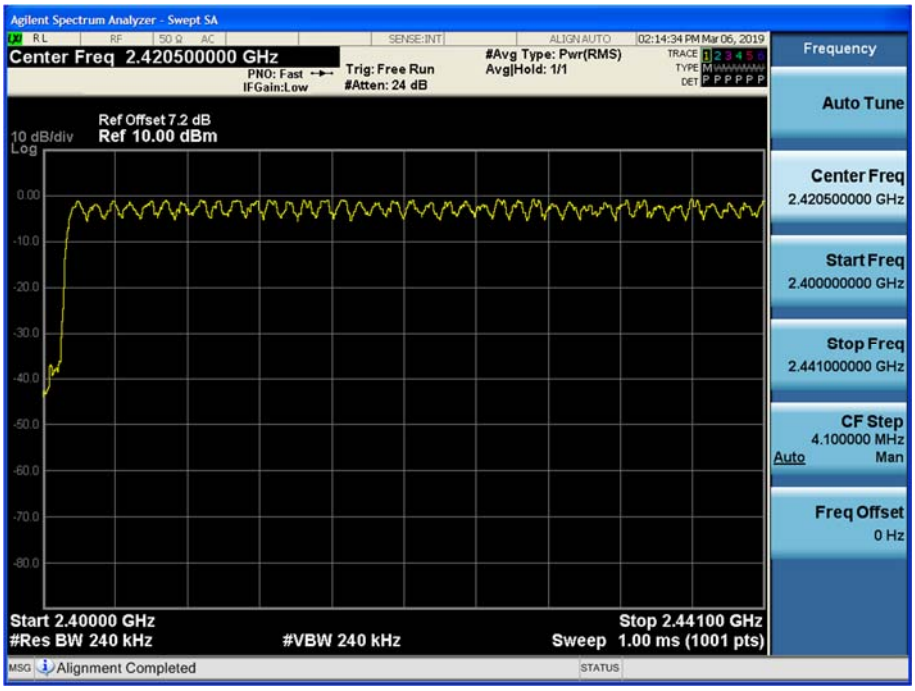
Number of Channels (2.4 GHz - 2.441 GHz)

Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)

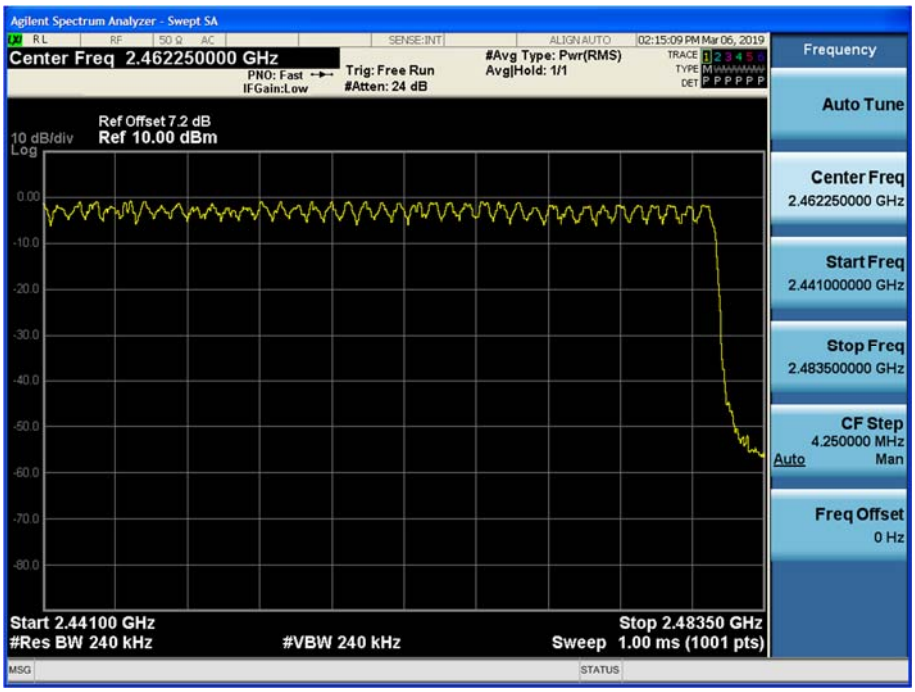
Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



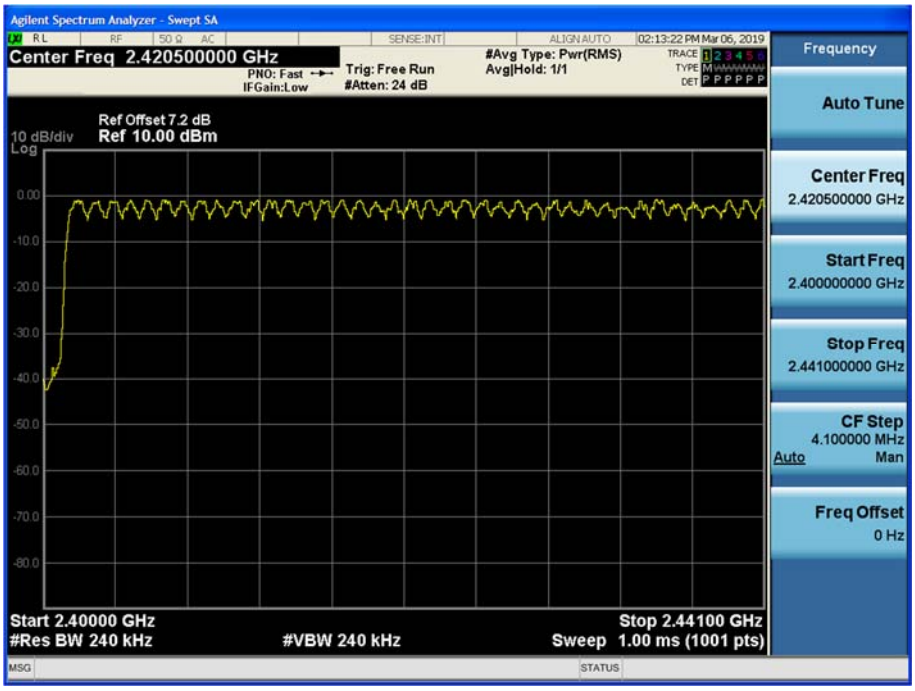
Test Plots (8DPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



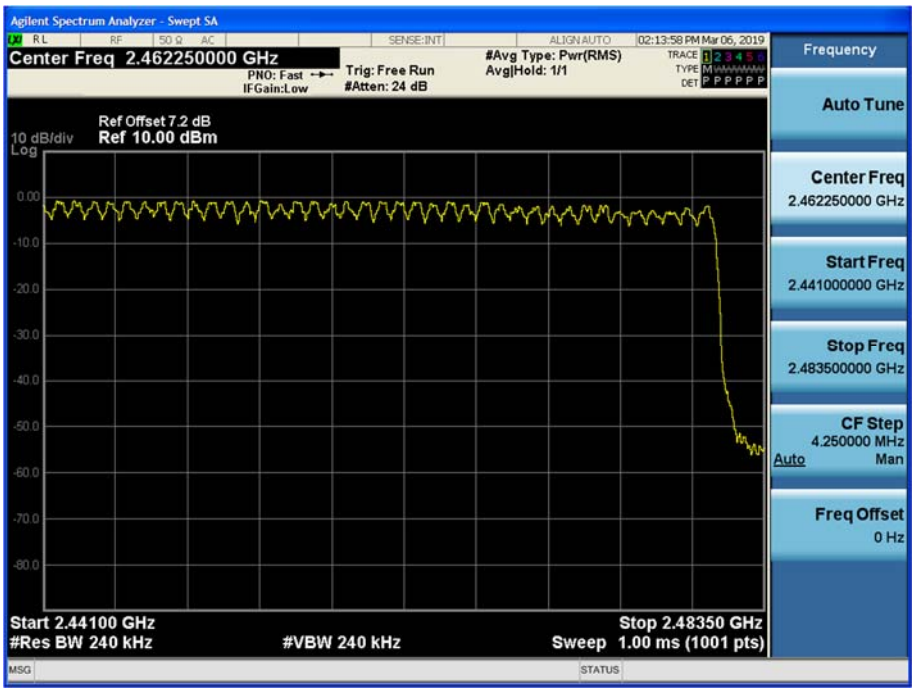
Test Plots (π/4DQPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (π/4DQPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



10.5 TIME OF OCCUPANCY (DWELL TIME)

	Channel	GFSK	8DPSK	π/4DQPSK
Pulse Time (ms)	Low	2.900	2.910	2.905
	Mid	2.895	2.905	2.905
	High	2.895	2.905	2.905

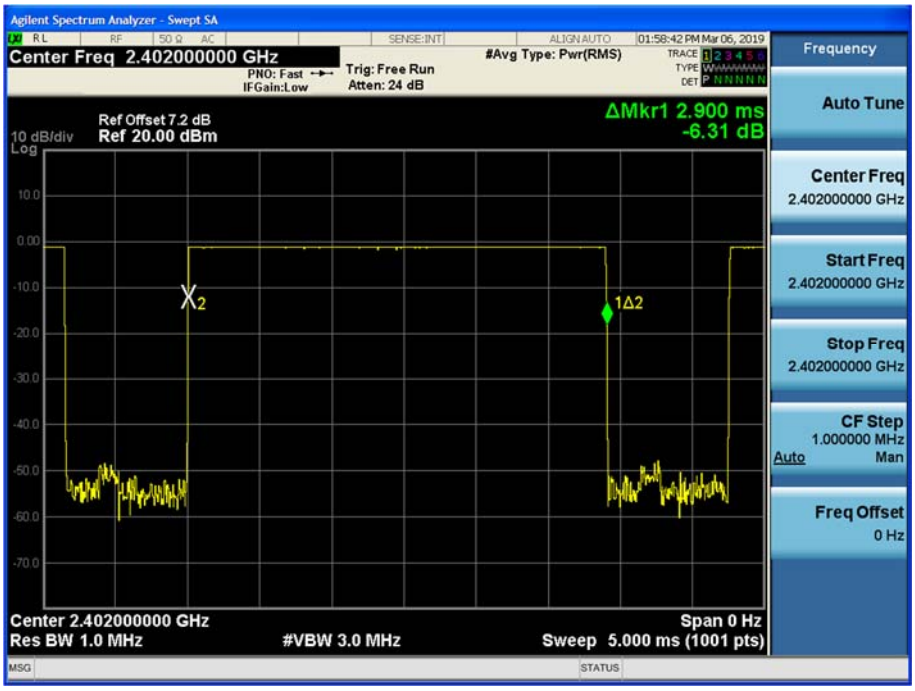
Non-AFH Mode

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of Dwell (ms)	Low	309.33	310.40	309.87	31.6	400
	Mid	308.80	309.87	309.87	31.6	
	High	308.80	309.87	309.87	31.6	

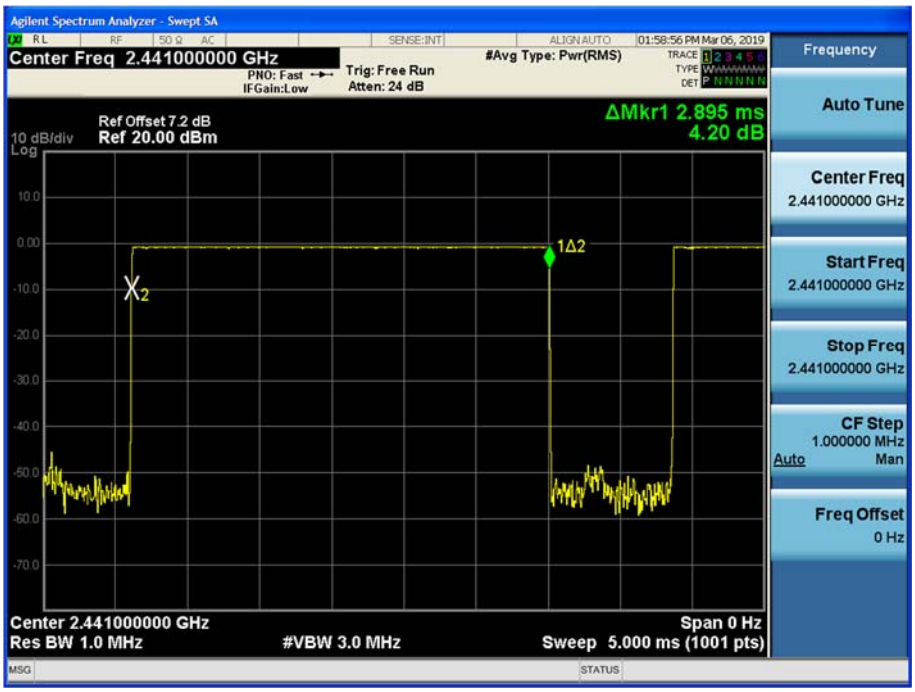
AFH Mode

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of Dwell (ms)	Low	154.67	155.20	154.94	8.0	400
	Mid	154.40	154.94	154.94	8.0	
	High	154.40	154.94	154.94	8.0	

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



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

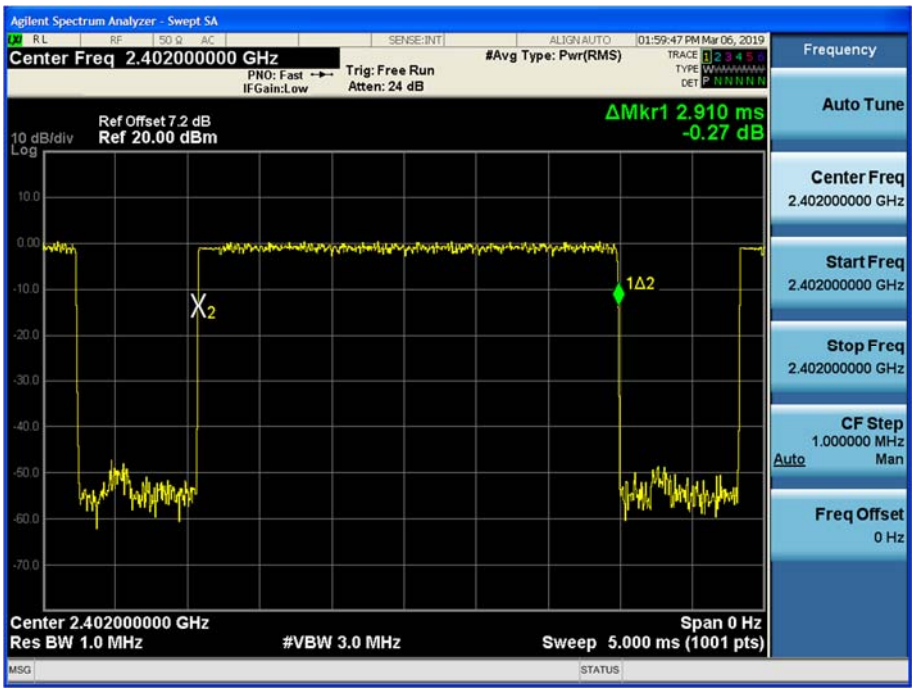


Test Plots (GFSK)

Dwell Time (CH.78)

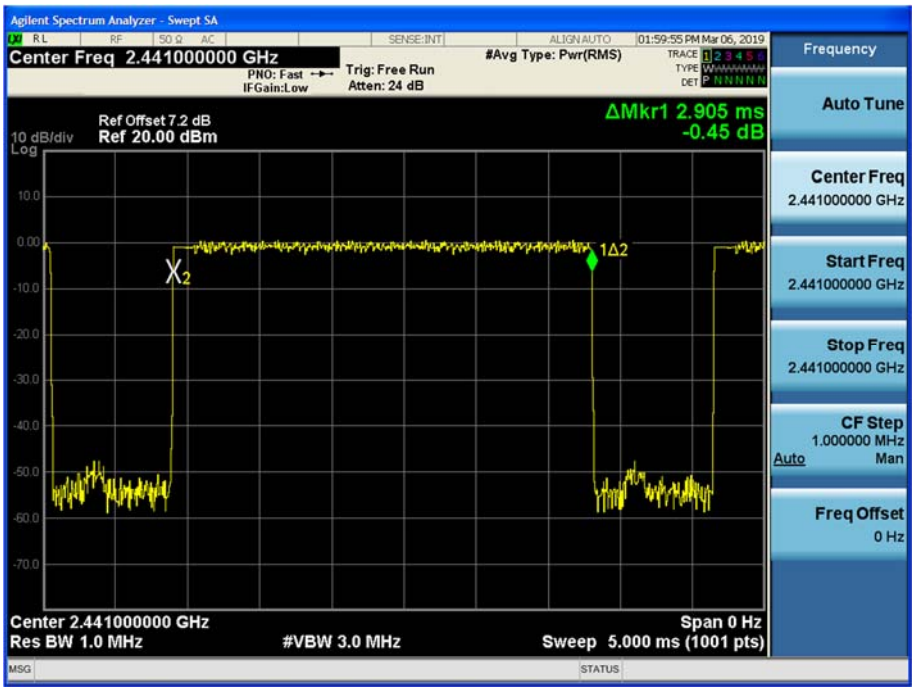
Test Plots (8DPSK)

Dwell Time (CH.0)



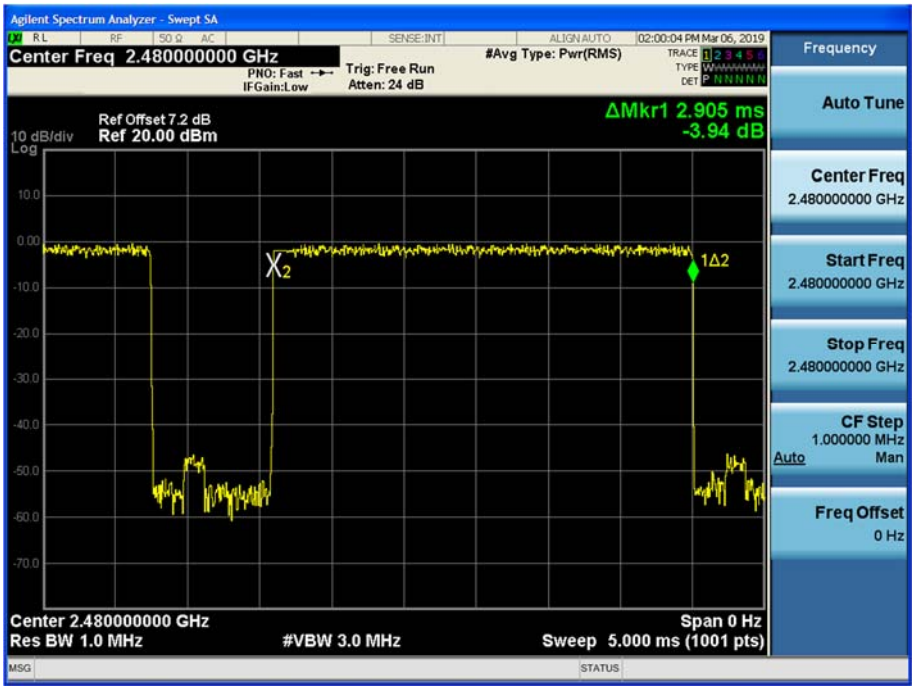
Test Plots (8DPSK)

Dwell Time (CH.39)

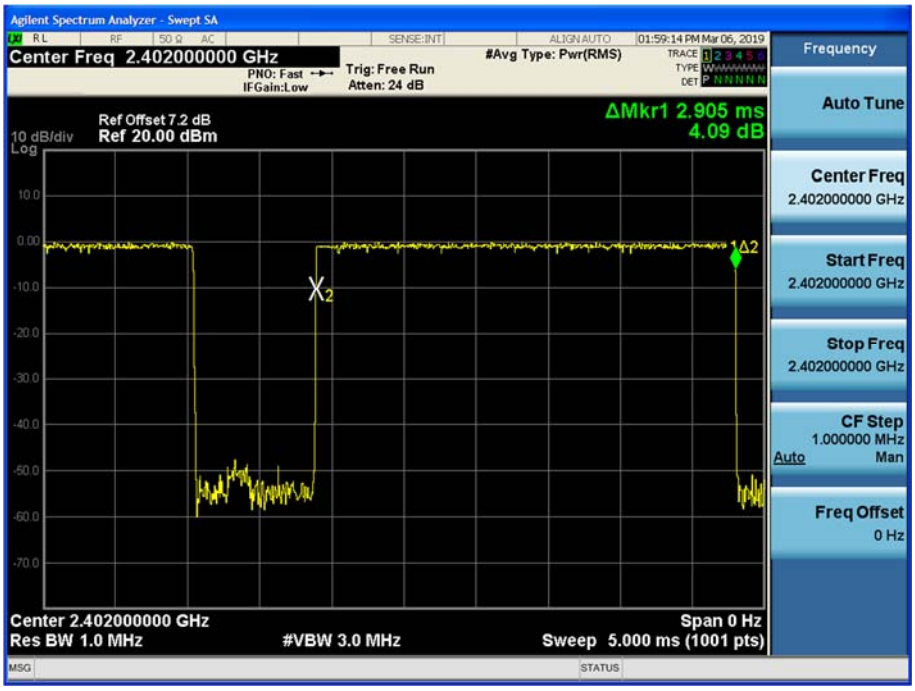


Test Plots (8DPSK)

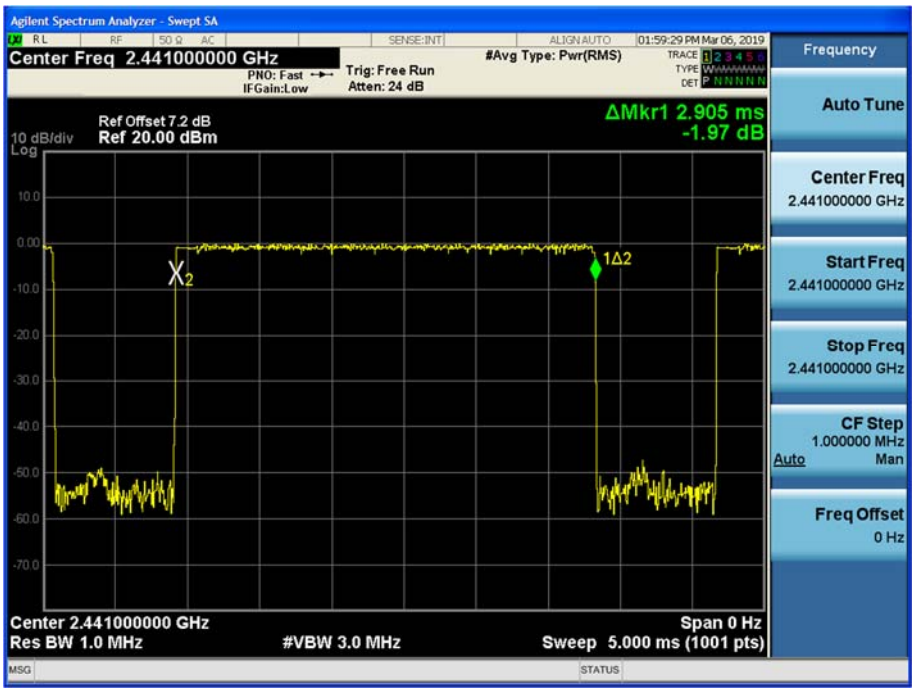
Dwell Time (CH.78)



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

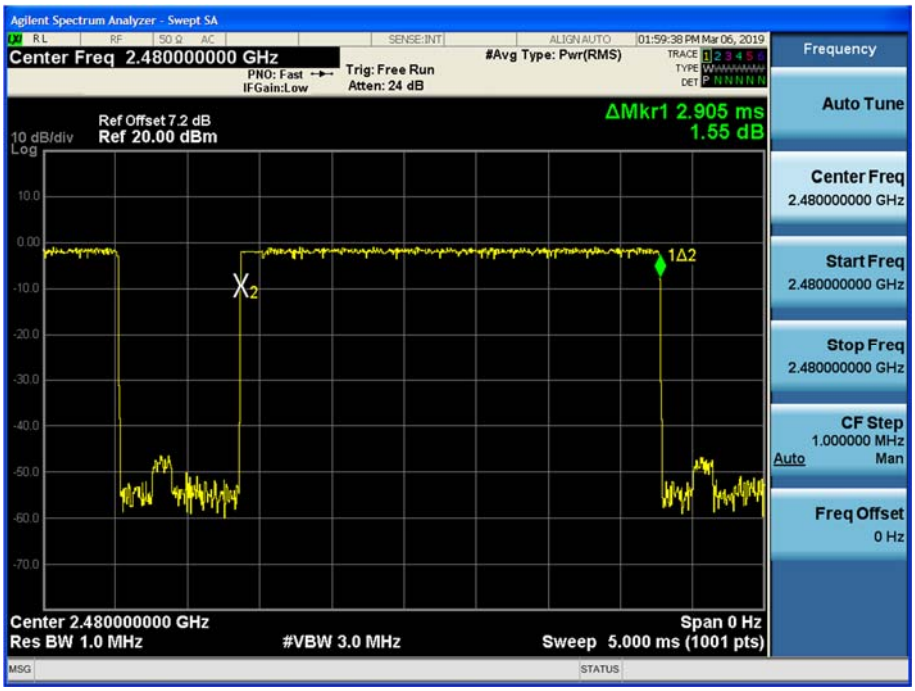


Test Plots (π/4DQPSK)
Dwell Time (CH.39)



Test Plots (π/4DQPSK)

Dwell Time (CH.78)



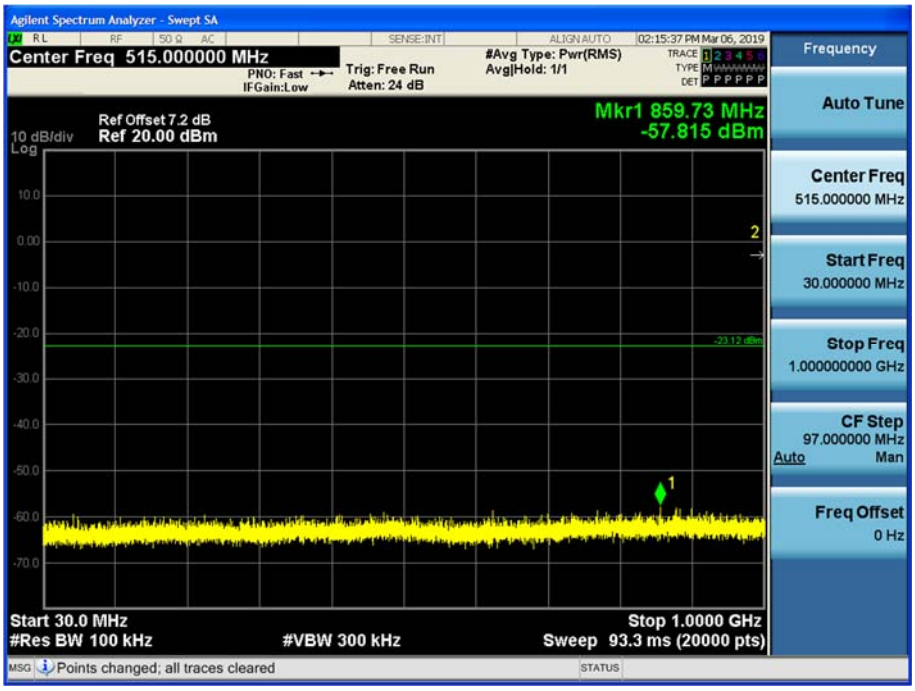
10.6 SPURIOUS EMISSIONS

10.6.1 CONDUCTED SPURIOUS EMISSIONS

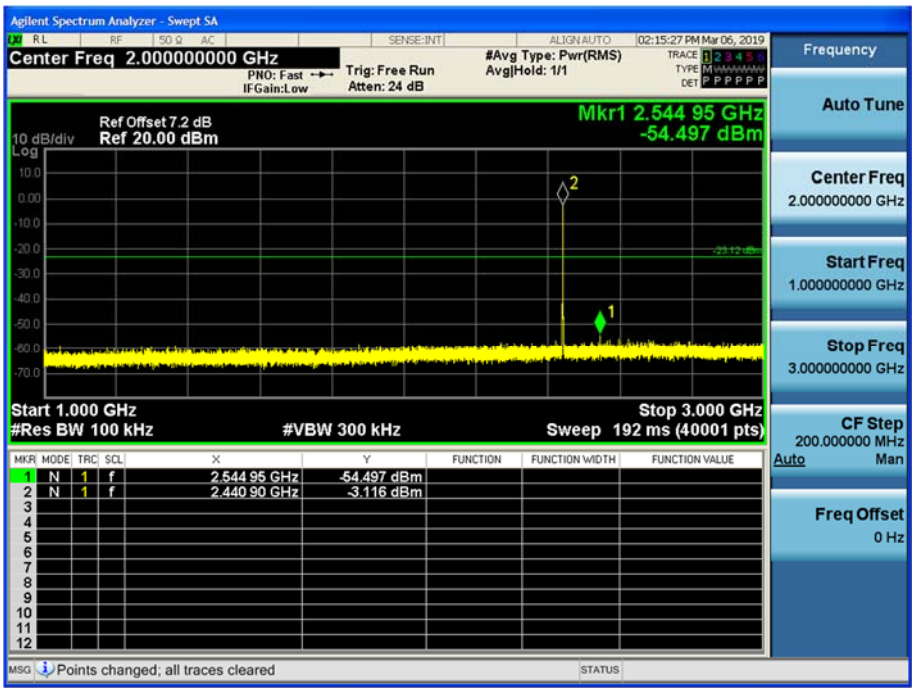
Test Result : please refer to the plot below.

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

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

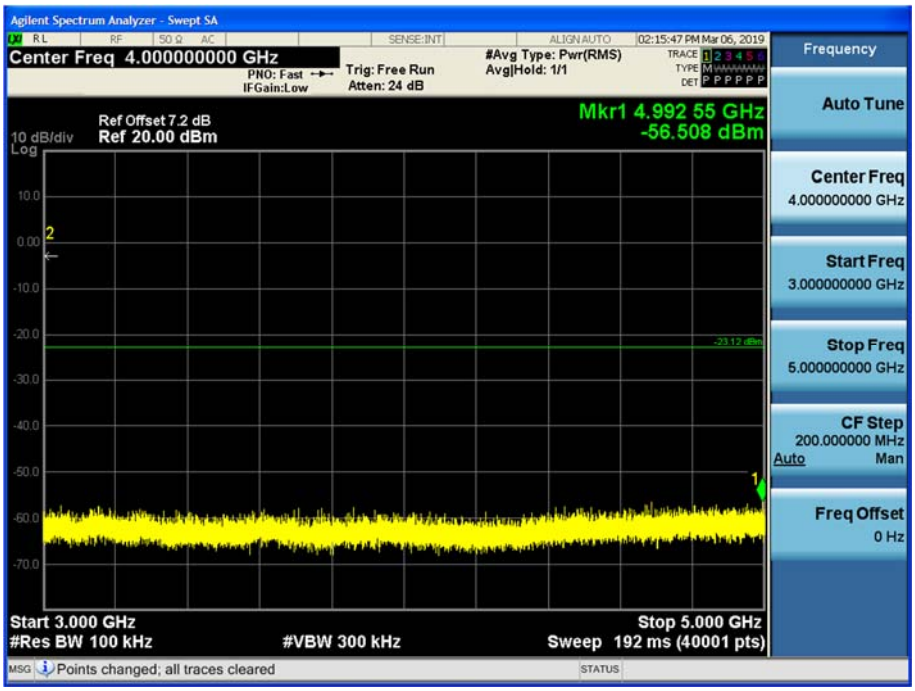


Test Plots (8DPSK)- 1 GHz – 3 GHz
Spurious Emission (CH.39)



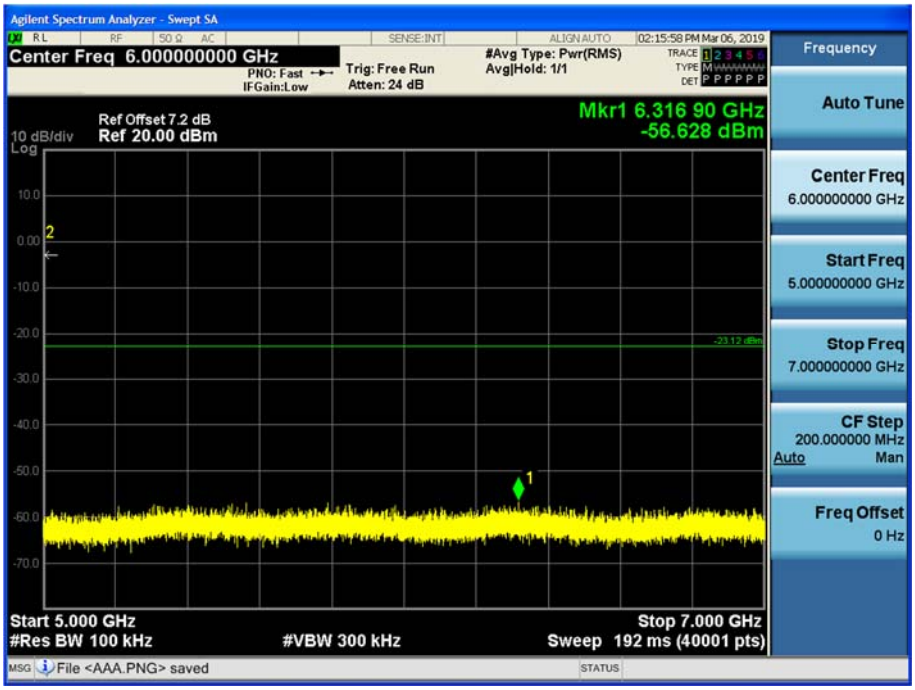
Test Plots(8DPSK)- 3 GHz - 5 GHz

Spurious Emission (CH.39)

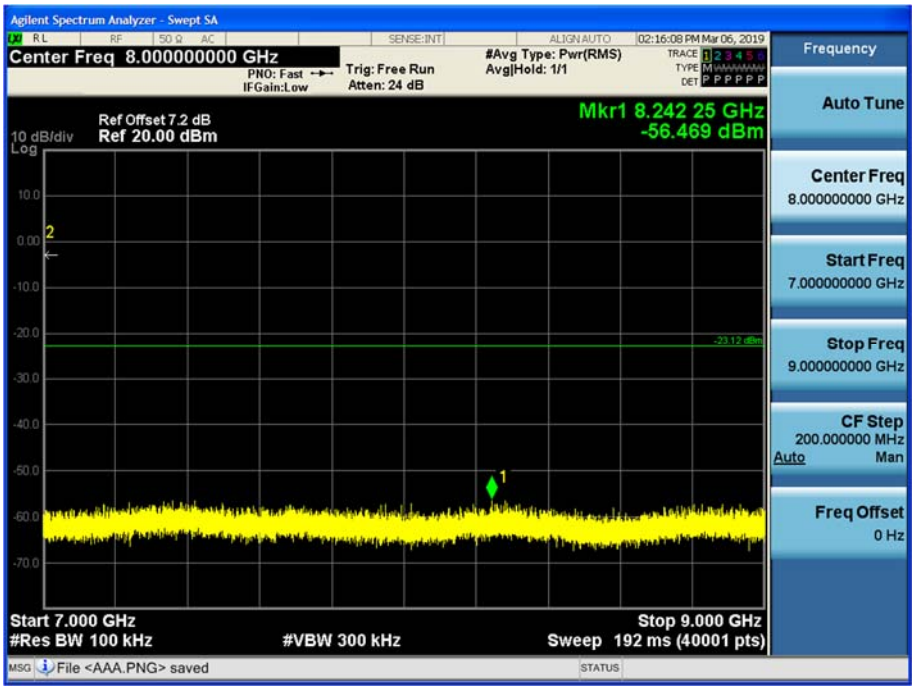


Test Plots (8DPSK)- 5 GHz - 7 GHz

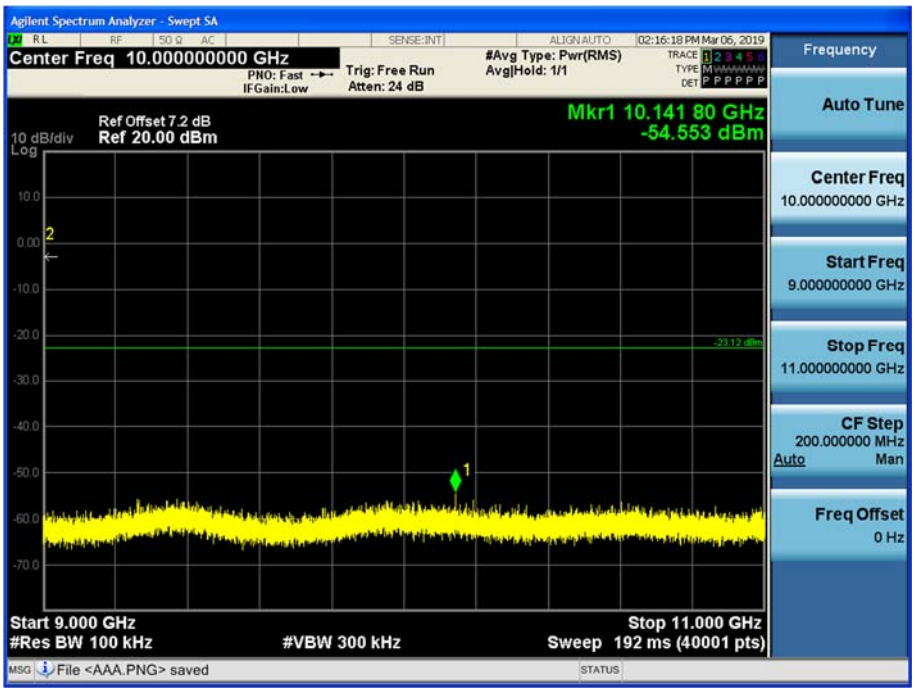
Spurious Emission (CH.39)



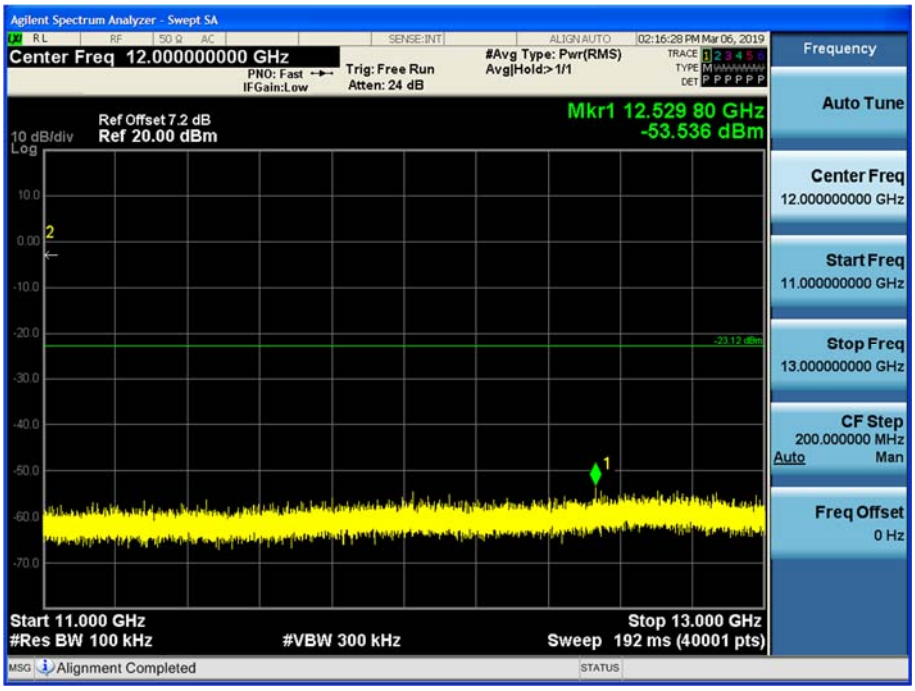
Test Plots(8DPSK)- 7 GHz - 9 GHz
Spurious Emission (CH.39)



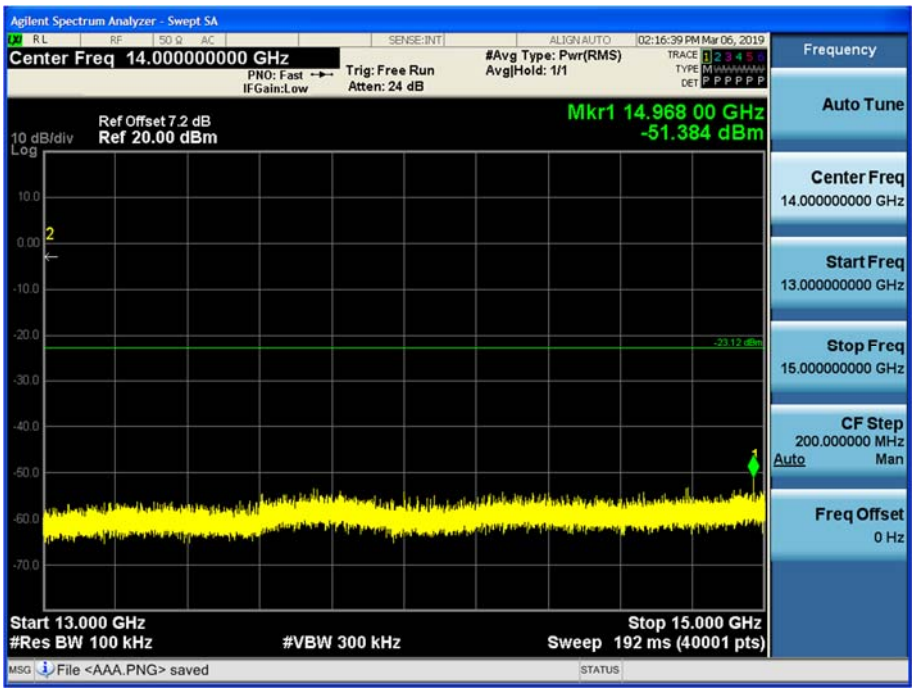
Test Plots(8DPSK)- 9 GHz - 11 GHz
Spurious Emission (CH.39)



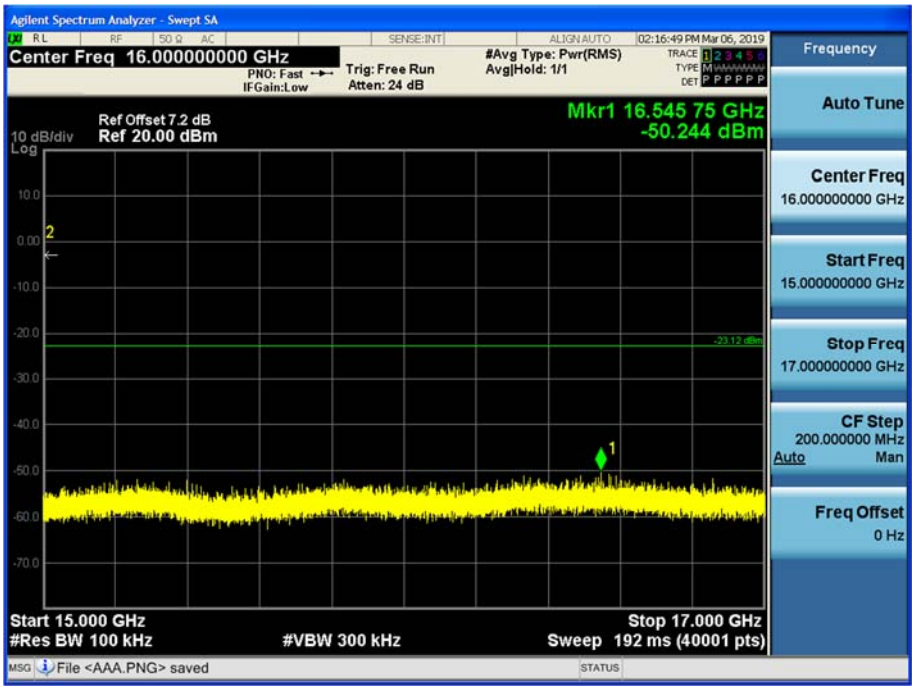
Test Plots(8DPSK) 11 GHz - 13 GHz
Spurious Emission (CH.39)



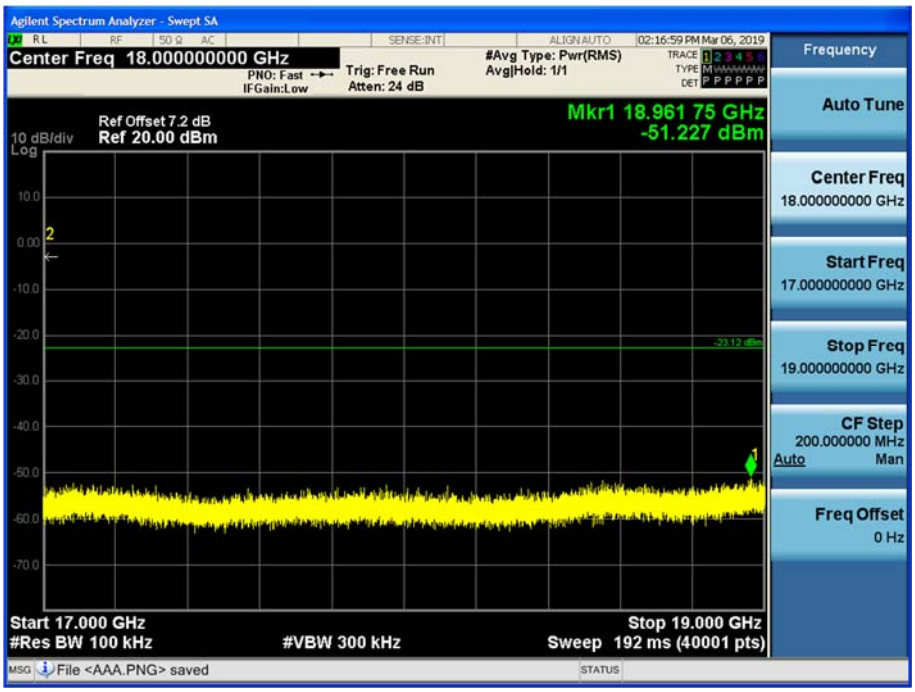
Test Plots (8DPSK)- 13 GHz – 15 GHz
Spurious Emission (CH.39)



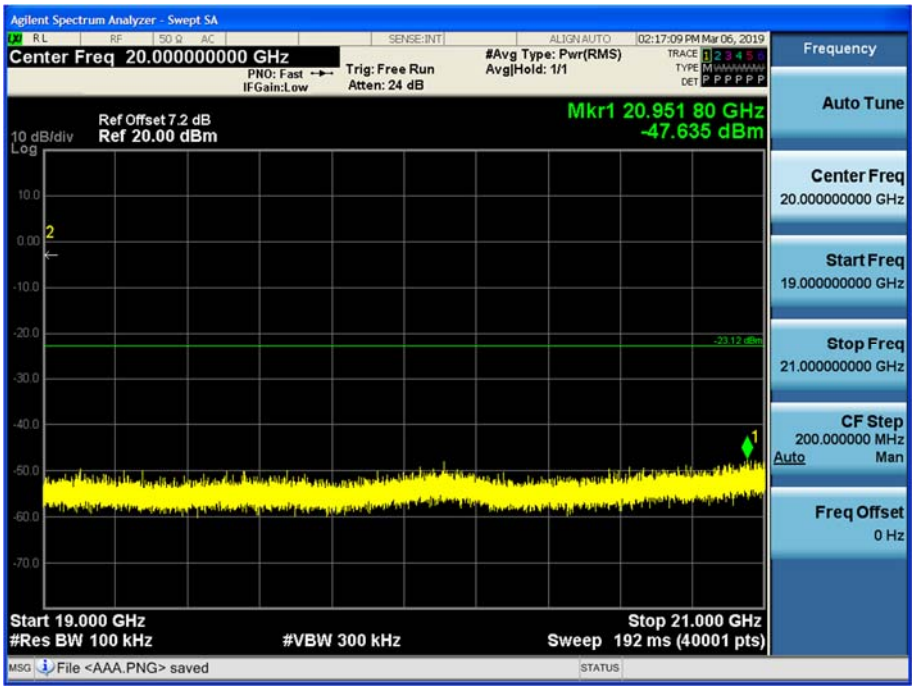
Test Plots(8DPSK)– 15 GHz - 17 GHz
Spurious Emission (CH.39)



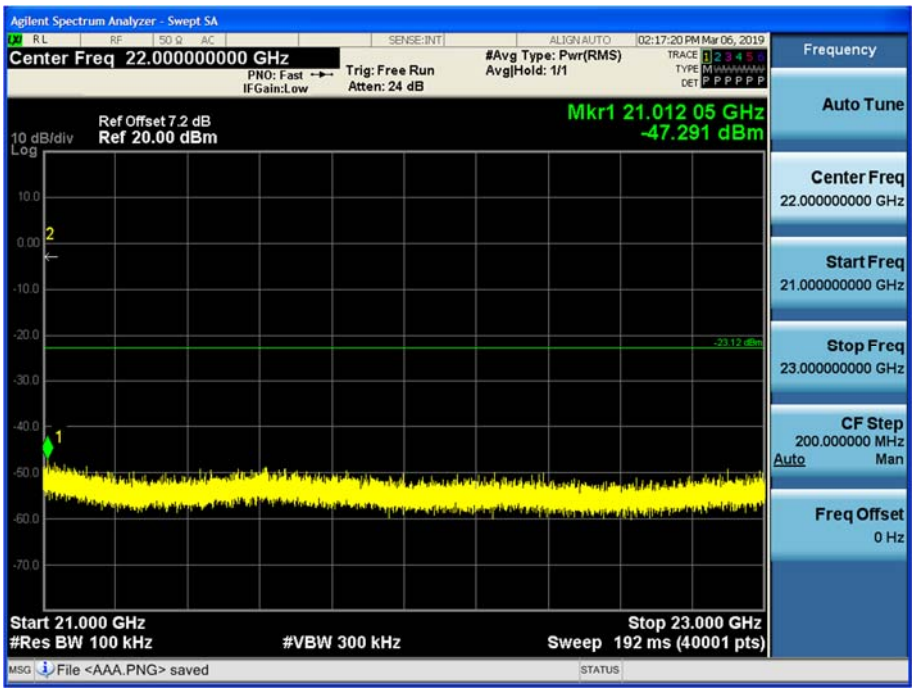
Test Plots(8DPSK)- 17 GHz - 19 GHz
Spurious Emission (CH.39)



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

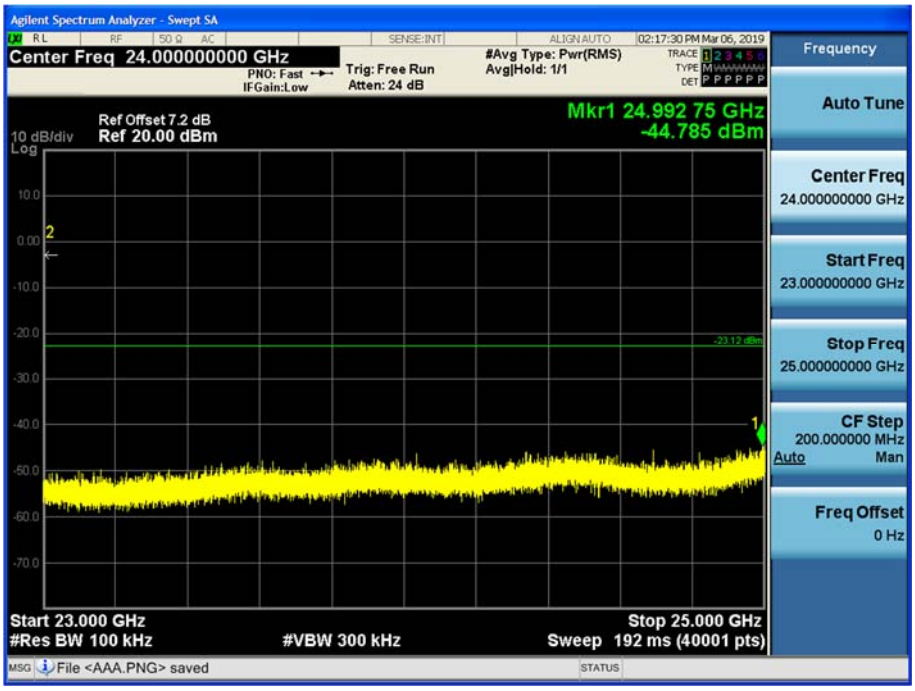


Test Plots (8DPSK)- 21 GHz - 23 GHz
Spurious Emission (CH.39)



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

Spurious Emission (CH.39)



10.6.2 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30MHz

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							

Note:

1. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor = 40*log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
4. Radiated test is performed with hopping off.
5. The test results for below 30 MHz is correlated to an open site.
   The result on OFS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

Frequency Range : Below 1 GHz

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							

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
2. Radiated test is performed with hopping off.

Frequency Range : Above 1 GHz

Operation Mode: CH Low(GFSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	44.17	2.17	V	46.34	73.98	27.64	PK
4804	32.03	2.17	V	34.20	53.98	19.78	AV
7206	40.82	8.97	V	49.79	73.98	24.19	PK
7206	27.27	8.97	V	36.24	53.98	17.74	AV
4804	43.98	2.17	H	46.15	73.98	27.83	PK
4804	31.96	2.17	H	34.13	53.98	19.85	AV
7206	40.68	8.97	H	49.65	73.98	24.33	PK
7206	27.16	8.97	H	36.13	53.98	17.85	AV

Operation Mode: CH Low(8DPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	44.59	2.17	V	46.76	73.98	27.22	PK
4804	32.11	2.17	V	34.28	53.98	19.70	AV
7206	40.54	8.97	V	49.51	73.98	24.47	PK
7206	27.25	8.97	V	36.22	53.98	17.76	AV
4804	44.42	2.17	H	46.59	73.98	27.39	PK
4804	31.99	2.17	H	34.16	53.98	19.82	AV
7206	40.34	8.97	H	49.31	73.98	24.67	PK
7206	27.21	8.97	H	36.18	53.98	17.80	AV

Operation Mode: CH Low(π/4DQPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	44.05	2.17	V	46.22	73.98	27.76	PK
4804	32.00	2.17	V	34.17	53.98	19.81	AV
7206	40.89	8.97	V	49.86	73.98	24.12	PK
7206	27.16	8.97	V	36.13	53.98	17.85	AV
4804	43.99	2.17	H	46.16	73.98	27.82	PK
4804	31.94	2.17	H	34.11	53.98	19.87	AV
7206	40.76	8.97	H	49.73	73.98	24.25	PK
7206	27.11	8.97	H	36.08	53.98	17.90	AV

Operation Mode: CH Mid(GFSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	41.61	2.68	V	44.29	73.98	29.69	PK
4882	29.36	2.68	V	32.04	53.98	21.94	AV
7323	40.99	9.03	V	50.02	73.98	23.96	PK
7323	27.18	9.03	V	36.21	53.98	17.77	AV
4882	41.29	2.68	H	43.97	73.98	30.01	PK
4882	29.19	2.68	H	31.87	53.98	22.11	AV
7323	40.87	9.03	H	49.90	73.98	24.08	PK
7323	27.05	9.03	H	36.08	53.98	17.90	AV

Operation Mode: CH Mid(8DPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	41.97	2.68	V	44.65	73.98	29.33	PK
4882	29.31	2.68	V	31.99	53.98	21.99	AV
7323	40.58	9.03	V	49.61	73.98	24.37	PK
7323	27.12	9.03	V	36.15	53.98	17.83	AV
4882	41.76	2.68	H	44.44	73.98	29.54	PK
4882	29.23	2.68	H	31.91	53.98	22.07	AV
7323	40.34	9.03	H	49.37	73.98	24.61	PK
7323	27.05	9.03	H	36.08	53.98	17.90	AV

Operation Mode: CH Mid(π/4DQPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	41.59	2.68	V	44.27	73.98	29.71	PK
4882	29.22	2.68	V	31.9	53.98	22.08	AV
7323	40.84	9.03	V	49.87	73.98	24.11	PK
7323	27.04	9.03	V	36.07	53.98	17.91	AV
4882	41.28	2.68	H	43.96	73.98	30.02	PK
4882	29.19	2.68	H	31.87	53.98	22.11	AV
7323	40.59	9.03	H	49.62	73.98	24.36	PK
7323	27.01	9.03	H	36.04	53.98	17.94	AV

Operation Mode: CH High(GFSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	41.26	1.54	V	42.80	73.98	31.18	PK
4960	29.88	1.54	V	31.42	53.98	22.56	AV
7440	40.25	9.82	V	50.07	73.98	23.91	PK
7440	27.11	9.82	V	36.93	53.98	17.05	AV
4960	41.16	1.54	H	42.70	73.98	31.28	PK
4960	29.76	1.54	H	31.30	53.98	22.68	AV
7440	40.16	9.82	H	49.98	73.98	24.00	PK
7440	27.08	9.82	H	36.90	53.98	17.08	AV

Operation Mode: CH High(8DPSK)

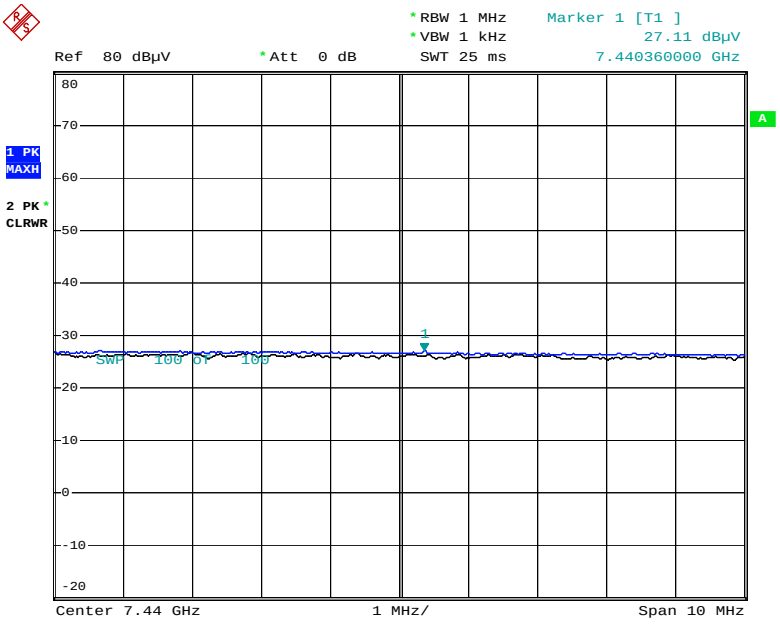
Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	41.98	1.54	V	43.52	73.98	30.46	PK
4960	29.23	1.54	V	30.77	53.98	23.21	AV
7440	40.49	9.82	V	50.31	73.98	23.67	PK
7440	27.06	9.82	V	36.88	53.98	17.10	AV
4960	41.36	1.54	H	42.90	73.98	31.08	PK
4960	29.13	1.54	H	30.67	53.98	23.31	AV
7440	40.29	9.82	H	50.11	73.98	23.87	PK
7440	27.02	9.82	H	36.84	53.98	17.14	AV

Operation Mode: CH High (π/4DQPSK)

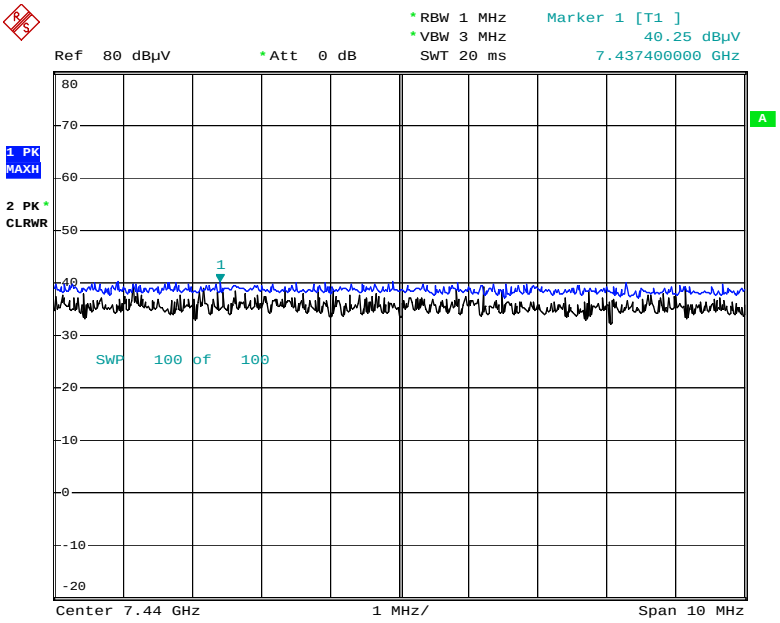
Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	42.50	1.54	V	44.04	73.98	29.94	PK
4960	29.49	1.54	V	31.03	53.98	22.95	AV
7440	40.60	9.82	V	50.42	73.98	23.56	PK
7440	27.09	9.82	V	36.91	53.98	17.07	AV
4960	42.19	1.54	H	43.73	73.98	30.25	PK
4960	29.24	1.54	H	30.78	53.98	23.20	AV
7440	40.34	9.82	H	50.16	73.98	23.82	PK
7440	27.04	9.82	H	36.86	53.98	17.12	AV

RESULT PLOTS (Worst case : X-V)

Radiated Spurious Emissions plot – Average Reading (GFSK, Ch.78 3rd Harmonic)



Radiated Spurious Emissions plot – Peak Reading (GFSK, Ch.78 3rd Harmonic)



Note:

Plot of worst case are only reported.

10.6.3 RADIATED RESTRICTED BAND EDGES

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]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	40.39	0.22	H	40.61	73.98	33.37	PK
2390.0	28.57	0.22	H	28.79	53.98	25.19	AV
2390.0	40.38	0.22	V	40.60	73.98	33.38	PK
2390.0	28.74	0.22	V	28.96	53.98	25.02	AV
2483.5	43.84	0.65	H	44.49	73.98	29.49	PK
2483.5	39.29	0.65	H	39.94	53.98	14.04	AV
2483.5	44.40	0.65	V	45.05	73.98	28.93	PK
2483.5	39.41	0.65	V	40.06	53.98	13.92	AV

Operation Mode	EDR(8DPSK)

Operating Frequency	2402 MHz
Channel No	CH 0

Frequency [MHz]	Reading [dBuV]	A.F + C.L + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	41.05	0.22	H	41.27	73.98	32.71	PK
2390.0	28.36	0.22	H	28.58	53.98	25.40	AV
2390.0	41.12	0.22	V	41.34	73.98	32.64	PK
2390.0	28.59	0.22	V	28.81	53.98	25.17	AV

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

Frequency [MHz]	Reading [dBuV]	A.F + C.L + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	44.39	0.65	H	45.04	73.98	28.94	PK
2483.5	39.11	0.65	H	39.76	53.98	14.22	AV
2483.5	44.76	0.65	V	45.41	73.98	28.57	PK
2483.5	39.22	0.65	V	39.87	53.98	14.11	AV

Operation Mode	EDR(π/4DQPSK)
Operating Frequency	2402 MHz
Channel No	CH 0

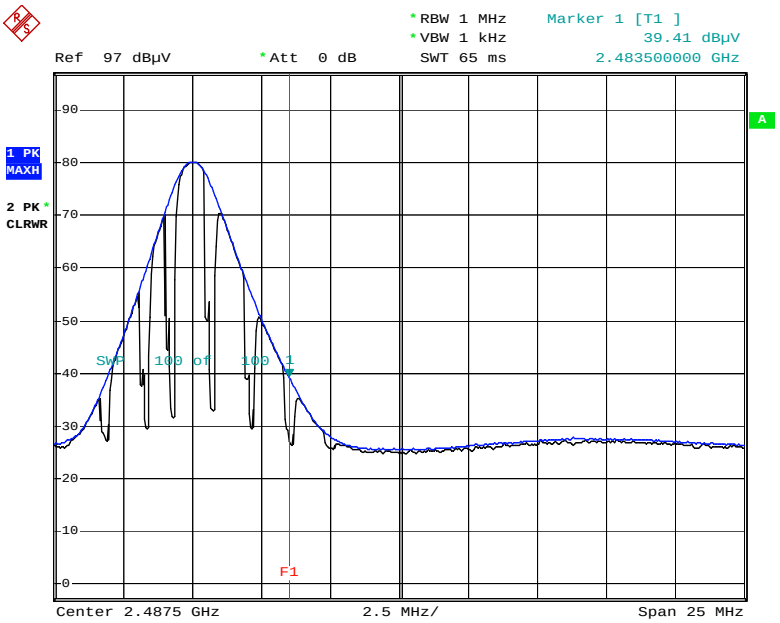
Frequency [MHz]	Reading [dBuV]	A.F + C.L + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	41.37	0.22	H	41.59	73.98	32.39	PK
2390.0	28.21	0.22	H	28.43	53.98	25.55	AV
2390.0	41.64	0.22	V	41.86	73.98	32.12	PK
2390.0	28.56	0.22	V	28.78	53.98	25.20	AV

Operation Mode	EDR(π/4DQPSK)
Operating Frequency	2480 MHz
Channel No	CH 78

Frequency [MHz]	Reading [dBuV]	A.F + C.L + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	44.16	0.65	H	44.81	73.98	29.17	PK
2483.5	38.68	0.65	H	39.33	53.98	14.65	AV
2483.5	44.33	0.65	V	44.98	73.98	29.00	PK
2483.5	39.16	0.65	V	39.81	53.98	14.17	AV

RESULT PLOTS (Worst case : X-V)

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



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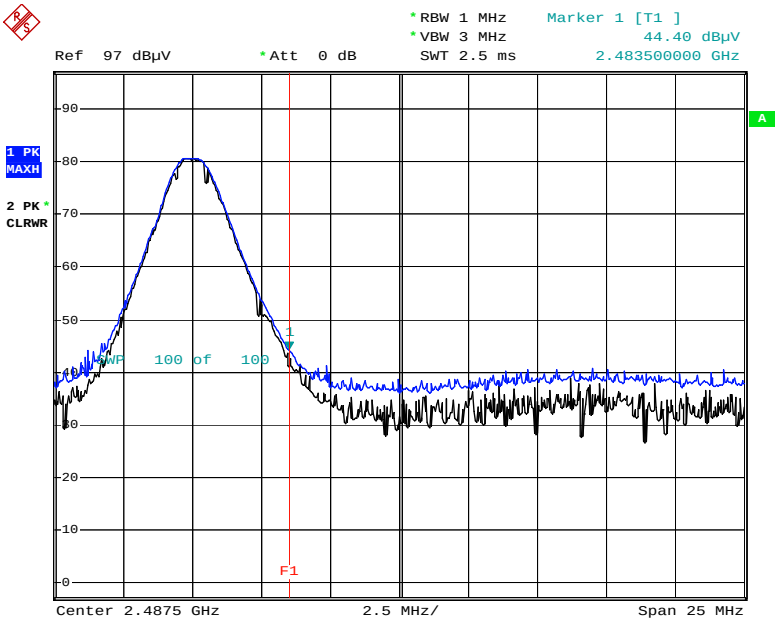
Radiated Restricted Band Edges plot – Peak Reading (GFSK, Ch.78)



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Note:

Plot of worst case are only reported.

11 LIST OF TEST EQUIPMENT

Conducted Test

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216 / LISN	12/12/2018	Annual	102245
Rohde & Schwarz	ESCI / Test Receiver	06/27/2018	Annual	100033
ESPAC	SU-642 /Temperature Chamber	03/30/2018	Annual	0093008124
Agilent	N9020A / Signal Analyzer	06/08/2018	Annual	MY51110085
Agilent	N9030A / Signal Analyzer	11/20/2018	Annual	MY49431210
Agilent	N1911A / Power Meter	04/16/2018	Annual	MY45100523
Agilent	N1921A / Power Sensor	04/16/2018	Annual	MY52260025
Agilent	87300B / Directional Coupler	11/20/2018	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	06/07/2018	Annual	05001
Hewlett Packard	E3632A / DC Power Supply	06/26/2018	Annual	KR75303960
Agilent	8493C / Attenuator(10 dB)	07/10/2018	Annual	07560
Rohde & Schwarz	EMC32 / Software	N/A	N/A	N/A
HCT CO., LTD.	FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	N/A	N/A
Rohde & Schwarz	CBT / Bluetooth Tester	05/17/2018	Annual	100422

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

Radiated Test

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Emco	2090 / Controller	N/A	N/A	060520
Ets	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	08/23/2018	Biennial	1513-175
Schwarzbeck	VULB 9160 / Hybrid Antenna	08/09/2018	Biennial	3368
Schwarzbeck	BBHA 9120D / Horn Antenna	11/21/2017	Biennial	9120D-1191
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	12/04/2017	Biennial	BBHA9170541
Rohde & Schwarz	FSP(9 kHz ~ 30 GHz) / Spectrum Analyzer	09/19/2018	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/19/2018	Annual	101068-SZ
Wainwright Instruments	WHKX10-2700-3000-18000-40SS / High Pass Filter	01/03/2019	Annual	4
Wainwright Instruments	WHKX8-6090-7000-18000-40SS / High Pass Filter	01/03/2019	Annual	5
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	06/29/2018	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	01/03/2019	Annual	2
Api tech.	18B-03 / Attenuator (3 dB)	06/07/2018	Annual	2
WEINSCHEL	56-10 / Attenuator(10 dB)	10/10/2018	Annual	72316
CERNEX	CBLU1183540B-01/Broadband Bench Top LNA	01/03/2019	Annual	28549
CERNEX	CBL06185030 / Broadband Low Noise Amplifier	01/03/2019	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	01/03/2019	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	06/29/2018	Annual	25956
TESCOM	TC-3000C / Bluetooth Tester	03/27/2018	Annual	3000C000276

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

12 ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-1903-FC004-P