74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA
TEL: +82-31-645-6300 FAX: +82-31-645-6401

FCC BT REPORT

Certification

Applicant Name:
SAMSUNG Electronics Co., Ltd.

Address:
129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea

Date of Issue:
June 15, 2021

Test Site/Location:
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA

Report No.: HCT-RF-2105-FC034-R2

FCC ID:	**A3LSMG990U**
APPLICANT:	**SAMSUNG Electronics Co., Ltd.**

Model:	SM-G990U
Additional Model:	SM-G990U1/DS, SM-G990U1
EUT Type:	Mobile Phone
Max. RF Output Power:	14.726 dBm (29.69 mW)
Frequency Range:	2 402 MHz – 2 480 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

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules under normal use and maintenance.

REVIEWED BY

Report prepared by : Jeong Ho Kim
Engineer of Telecommunication Testing Center

Report approved by : Jong Seok Lee
Manager of Telecommunication Testing Center

This test results were applied only to the test methods required by the standard.

This laboratory is not accredited for the test results marked *.
The above Test Report is the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA. (HCT Accreditation No.: KT197)

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-2105-FC034	May 26, 2021	- First Approval Report
HCT-RF-2105-FC034-R1	June 08, 2021	- Test Plot Revised (On Page.32~35)
HCT-RF-2105-FC034-R2	June 15, 2021	- Added the Additional Model.

Table of Contents

1. EUT DESCRIPTION

Model	SM-G990U
Additional Model	SM-G990U1/DS, SM-G990U1
EUT Type	Mobile Phone
Power Supply	DC 3.88 V
Frequency Range	2 402 MHz ~ 2 480 MHz
Max. RF Output Power	14.726 dBm (29.69 mW)
BT Operating Mode	Normal, EDR, AFH
Modulation Type	GFSK(Normal), π/4DQPSK and 8DPSK(EDR)
Modulation Technique	FHSS
Number of Channels	79 Channels, Minimum 20 Channels(AFH)
Date(s) of Tests	April 01, 2021 ~ May 26, 2021
Serial number	Radiated: UDE0597M Conducted: UE31313M

ANTENNA CONFIGURATIONS for Bluetooth

1. The device employs MIMO technology. Below are the possible configurations

Configurations	SISO		Dual BT
	Ant1(core-0)	Ant2(Core-1)	Ant1 & Ant2
Bluetooth	O	X	X

Note:

1. O = Support, X = Not Support
2. SISO = Single Input Single Output
3. Dual BT = Single Output 1& 2

2.This device supports simultaneous transmission operation, which allows for two channels to operate independent of one another in the 2.4GHz and 5GHz bands simultaneously on each antenna.

RSDB Scenario	2.4 GHz WiFi Ant.1	2.4 GHz WiFi Ant.2	5GHz WiFi Ant.1	5GHz WiFi Ant.2
2.4 GHz WiFi + 5GHz WiFi MIMO	On		On	On
2.4 GHz WiFi + 5GHz WiFi MIMO		On	On	On
2.4 GHz WiFi MIMO + 5GHz WiFi MIMO	On	On	On	On

Non-DBS	5GHz WiFi Ant.1	5GHz WiFi Ant.2	Bluetooth Ant.1
5GHz WiFi MIMO + Bluetooth	On	On	On

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.

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

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device (ANSI C63.10-2013, KDB 558074) is used in the measurement of the test device.

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 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 6.6.5 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.

Espectially, 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.”

(1) The antennas of this E.U.T are permanently attached.

(2) 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)	5.05

8. DESCRIPTION OF TESTS

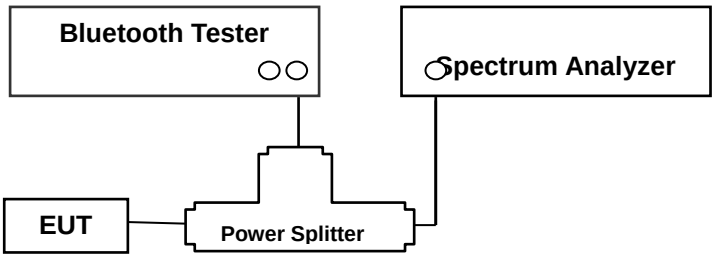
8.1. Conducted Maximum Peak Output Power

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 & Procedure 10(b)(6)(i) in KDB 558074 v05r02)

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)

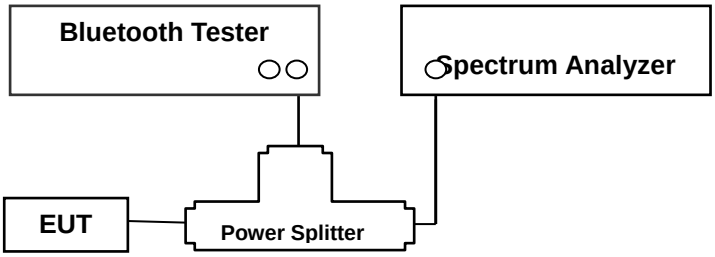
= 10 dBm + 6 dB + 1.5 dB = 17.5 dBm

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 & Procedure 8.5 and 8.6 in KDB 558074 v05r02)

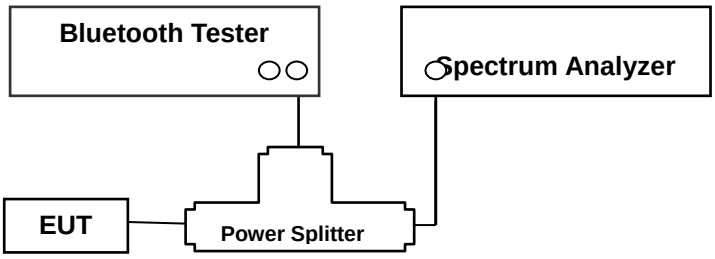
1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer 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(Frequency Separation)

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 & Procedure 10(b)(6)(iii) in KDB 558074 v05r02)

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.

Test Procedure (20 dB Bandwidth)

And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (6.9.2 in ANSI 63.10-2013)

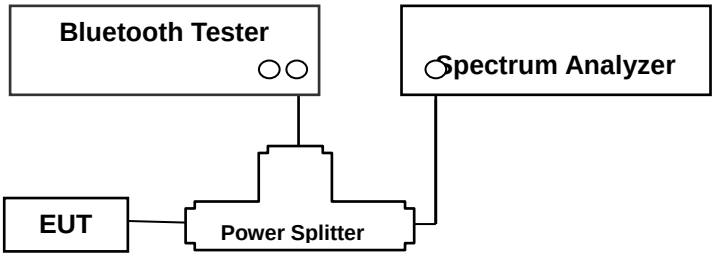
1) Span: Set between two times and five times the OBW
2) RBW: 1% to 5% of the OBW.
3) VBW ≥ 3 x RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) All the trace to stabilize.

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 & Procedure 10(b)(4) in KDB 558074 v05r02)

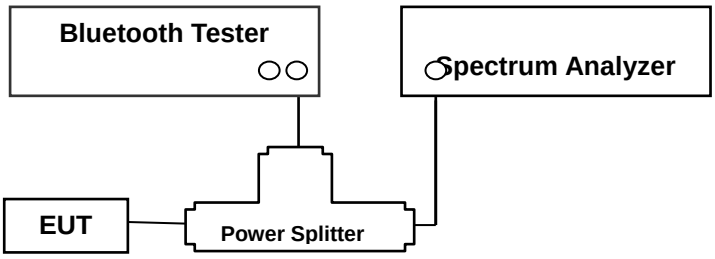
1) Span: the frequency band of operation
2) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3) VBW ≥ RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) Allow the trace to stabilize.

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 & Procedure 10(b)(6)(iv) in KDB 558074 v05r02)

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.

(1) Non-AFH Mode

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

(2) AFH Mode

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

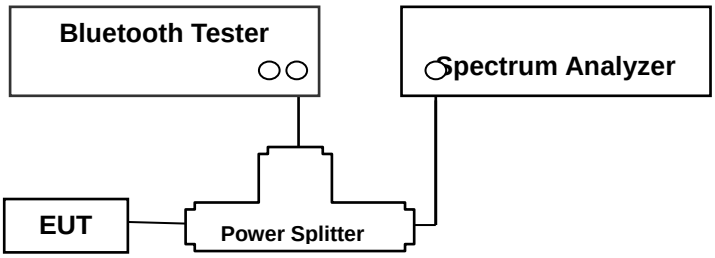
Dwell time = Tx-time x 106.667 = 308.27 (ms)

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 & Procedure 8.5 and 8.6 in KDB 558074 v05r02)

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	26.14
100	26.26
200	26.38
300	26.50
400	26.57
500	26.63
600	26.68
700	26.73
800	26.77
900	26.83
1000	26.89
2000	27.24
2400	27.37
2480	27.38
2500	27.38
3000	27.51
4000	27.80
5000	28.08
5150	28.16
5850	28.40
6000	28.46
7000	28.55
8000	28.62
9000	28.69
10000	28.76
11000	28.80
12000	28.88
13000	28.96
14000	28.94
15000	28.96
16000	29.01
17000	29.05
18000	29.11
19000	29.14
20000	29.20
21000	29.41
22000	29.38
23000	29.58
24000	29.41
25000	29.44
26000	29.64

Note : 1. 2400 ~ 2500 MHz is fundamental frequency range.

2. Factor = Attenuator(20dB) + Cable loss(2 EA) + Splitter loss(6 dB) + EUT Cable loss

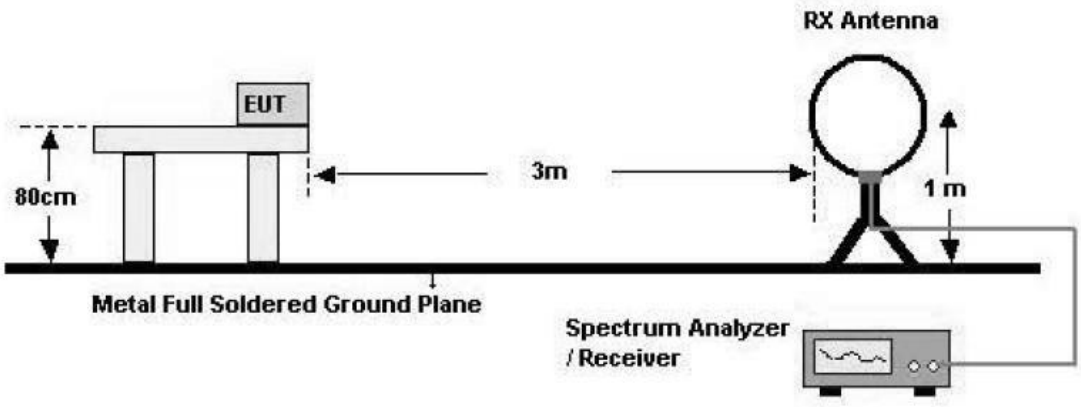
8.7. Radiated Test

Limit

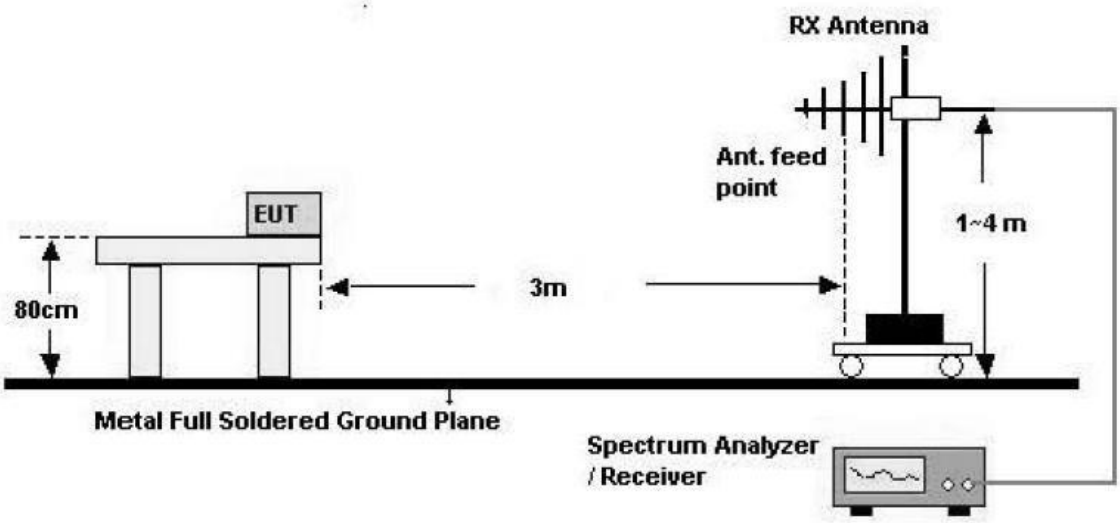
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

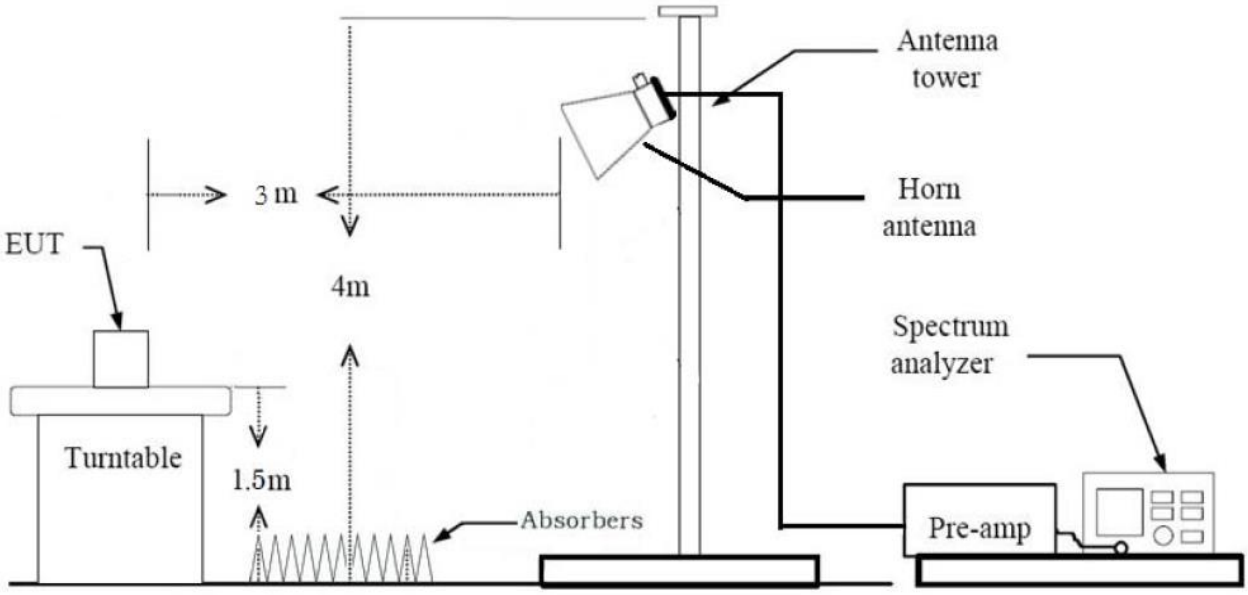
Below 30 MHz



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 and Parallel to the ground plane 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) = 40log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40log(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 x RBW

9. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
10. 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.

KDB 414788 OFS and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

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. The Hybrid antenna was placed at a location 3m from the EUT, which is varied from 1m to 4m to find out the highest emissions.
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. Spectrum Setting
   (1) Measurement Type(Peak):
   - Measured Frequency Range : 30 MHz – 1 GHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 100 kHz
   - VBW ≥ 3 x 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
7. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)
8. 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.

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 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
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):
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Average):
      - Average value of pulsed emissions
      - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in Number.14 (On Page. 24)
   ◆ Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB
10. 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.
11. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
12. Total
   (1)Measurement(Peak)

Reading Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

   (2)Measurement(Avg)

Reading Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F) + + DCCF(AFH)

13. 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 ' = 2.9 ms

d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB

14. 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

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 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting
   (1) Measurement Type(Peak):
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Average):
      - Average value of pulsed emissions
      - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in Number.14 (On Page. 24)
   ◆ Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB
9. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
10. Total
   [1]Normal (Peak)
   = Reading Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)

   [2]Normal (Avg)
   = Reading Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F) + D.C.C.F
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.

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[a]	56 to 46[a]
0.50 to 5	56	46
5 to 30	60	50

[a]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.
5. The EUT is the device operating below 30 MHz.
   - For unterminated the Antenna, the AC line conducted tests are performed with the antenna connected
   - For terminated the Antenna, the AC line conducted tests are performed with a dummy load connected to the EUT antenna output terminal.

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.
   - Mode : Stand alone, Stand alone + External accessories (Earphone, etc)
   - Worstcase : Stand alone
2. EUT Axis
   - Radiated Spurious Emissions : Y
   - 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
4. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.
   - Position : Horizontal, Vertical, Parallel to the ground plane
5. SM-G990U, SM-G990U1/DS, SM-G990U1 were tested and the worst case results are reported.
   (Worst case : SM-G990U)
6. We were performed the RSE test in condition of co-location. There has no significant emission raised.
   - WWAN+WLAN 5GHz+BT

Radiated test(DBS)

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone, Stand alone + External accessories(Earphone, etc)
   - Worstcase : Stand alone
2. EUT Axis
   - Radiated Spurious Emissions : Y,Z
3. Test case

RSDB Scenario	2.4 GHz WiFi Ant.1	2.4 GHz WiFi Ant.2	5GHz WiFi Ant.1	5GHz WiFi Ant.2	Test case
2.4 GHz WiFi + 5GHz WiFi MIMO	On		On	On	-
2.4 GHz WiFi + 5GHz WiFi MIMO		On	On	On	Case 1
2.4 GHz WiFi MIMO + 5GHz WiFi MIMO	On	On	On	On	Case 2

Non-DBS	5GHz WiFi Ant.1	5GHz WiFi Ant.2	Bluetooth Ant.1	Test case
5GHz WiFi MIMO + Bluetooth	On	On	On	Case 3

4. The following tables show the worst case configurations determined during testing.
(Worst case: The lowest margin condition the channels and modes were selected for test.)
(Test case 1,2 Result : Please refer to the SM-G990U [DTS], [UNII] Test Report.)

Test case	Description	2.4 GHz Emission	5 GHz Emission	Bluetooth Emission
1	Antenna	Ant 2	Ant All	-
	Channel	9	116	-
	Data Rate	1 Mbps	6 Mbps	-
	Mode	802.11b	802.11a	-

Test case	Description	2.4 GHz Emission	5 GHz Emission	Bluetooth Emission
2	Antenna	Ant All	Ant All	-
	Channel	11	116	-
	Data Rate	6 Mbps	6 Mbps	-
	Mode	802.11g	802.11a	-

Test case	Description	5 GHz Emission	Bluetooth Emission
3	Antenna	Ant All	Ant 1
	Channel	116	78
	Data Rate	6 Mbps	1 Mbps
	Mode	802.11a	π/4DQPSK

5. SM-G990U, SM-G990U1/DS, SM-G990U1 were tested and the worst case results are reported.
(Worst case : SM-G990U)

AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.
- Mode : Stand alone + External accessories(Earphone, etc)+Travel Adapter
Stand alone + Travel Adapter
- Worstcase : Stand alone + Travel Adapter
2. SM-G990U, SM-G990U1/DS, SM-G990U1 were tested and the worst case results are reported.
(Worst case : SM-G990U)

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)
3. SM-G990U, SM-G990U1/DS, SM-G990U1 were tested and the worst case results are reported.
(Worst case : SM-G990U)

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	N/A	N/A		N/A
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		PASS
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: Average Power data refer to SAR report

10. TEST RESULT

10.1 PEAK POWER

Channel	Frequency (MHz)	Output Power (GFSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	12.927	19.62	125
Mid	2441	13.419	21.97	
High	2480	14.483	28.07	

Channel	Frequency (MHz)	Output Power (8DPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	10.823	12.09	125
Mid	2441	14.726	29.69	
High	2480	13.614	22.98	

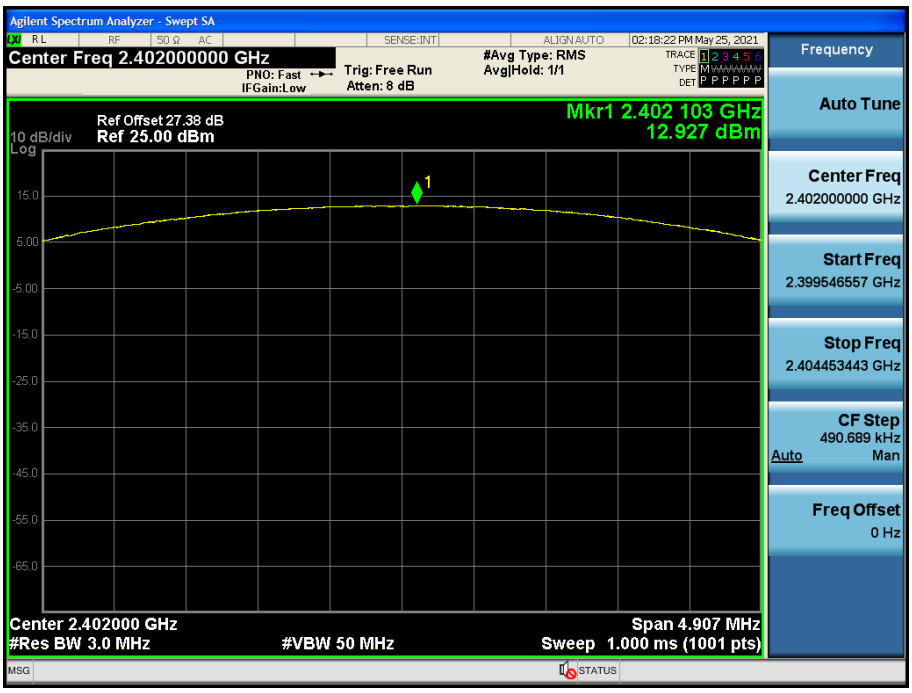
Channel	Frequency (MHz)	Output Power (π/4DQPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	10.292	10.70	125
Mid	2441	14.207	26.35	
High	2480	13.143	20.62	

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 27.37 dB at 2400 MHz
   and is 27.38 dB at 2500 MHz.
   So, 27.38 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.

Test Plots (GFSK)

Peak Power (CH.0)



Test Plots (GFSK)

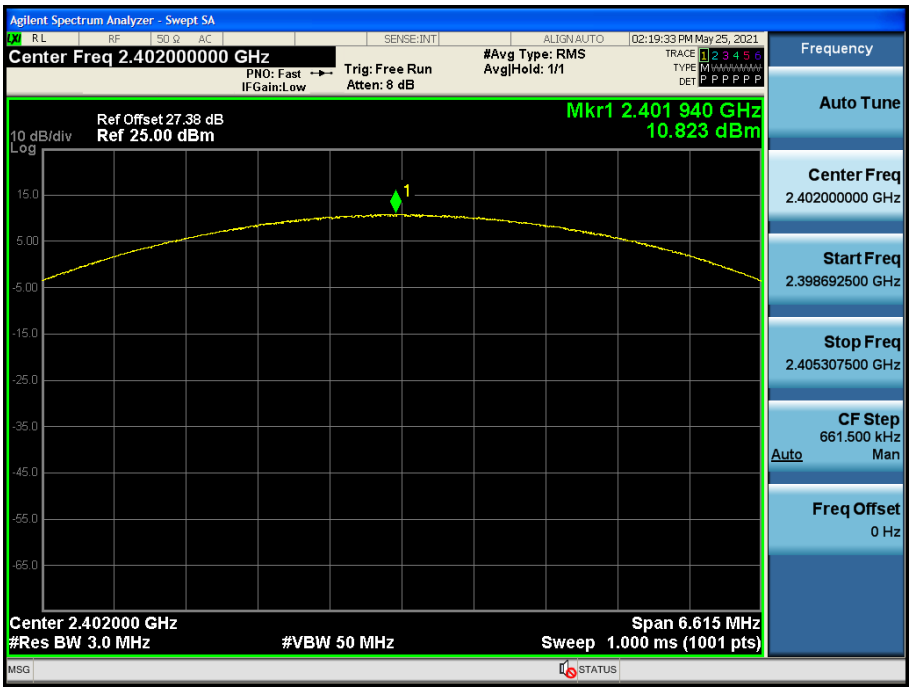
Peak Power (CH.39)

Test Plots (GFSK)

Peak Power (CH.78)

Test Plots (8DPSK)

Peak Power (CH.0)

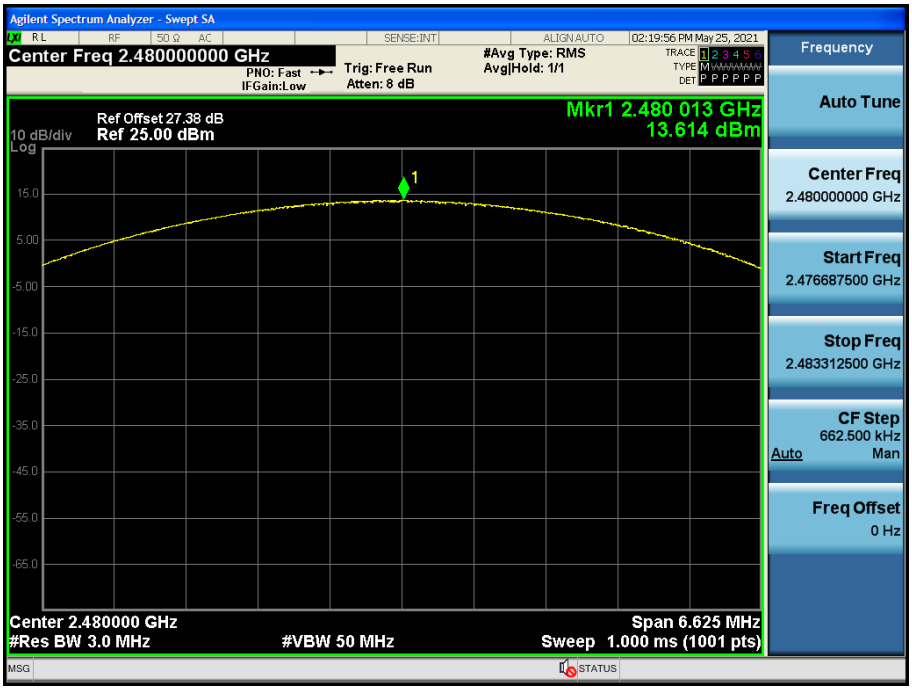


Test Plots (8DPSK)

Peak Power (CH.39)

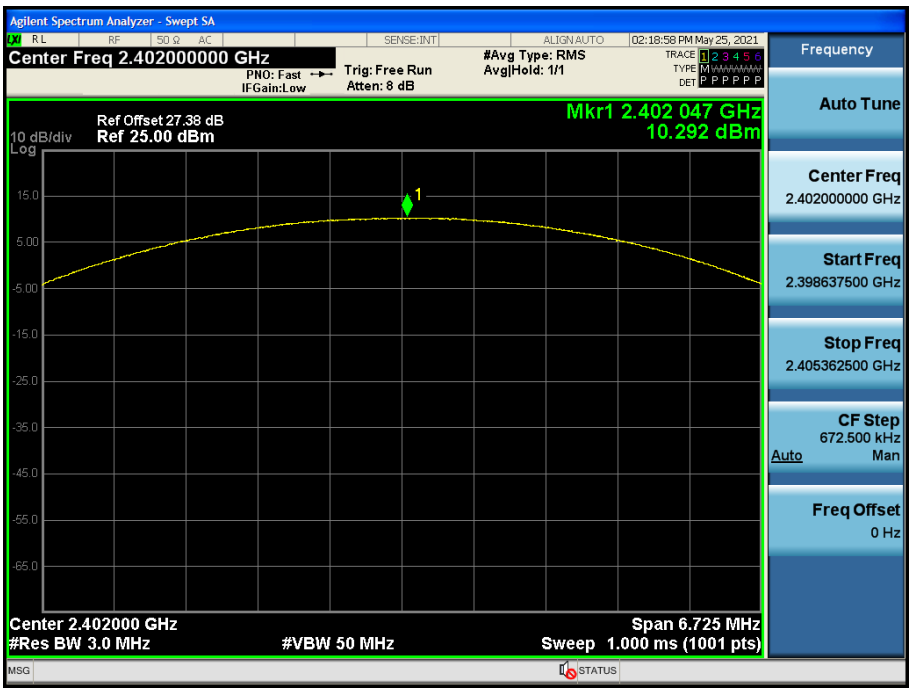
Test Plots (8DPSK)

Peak Power (CH.78)



Test Plots (π/4DQPSK)

Peak Power (CH.0)

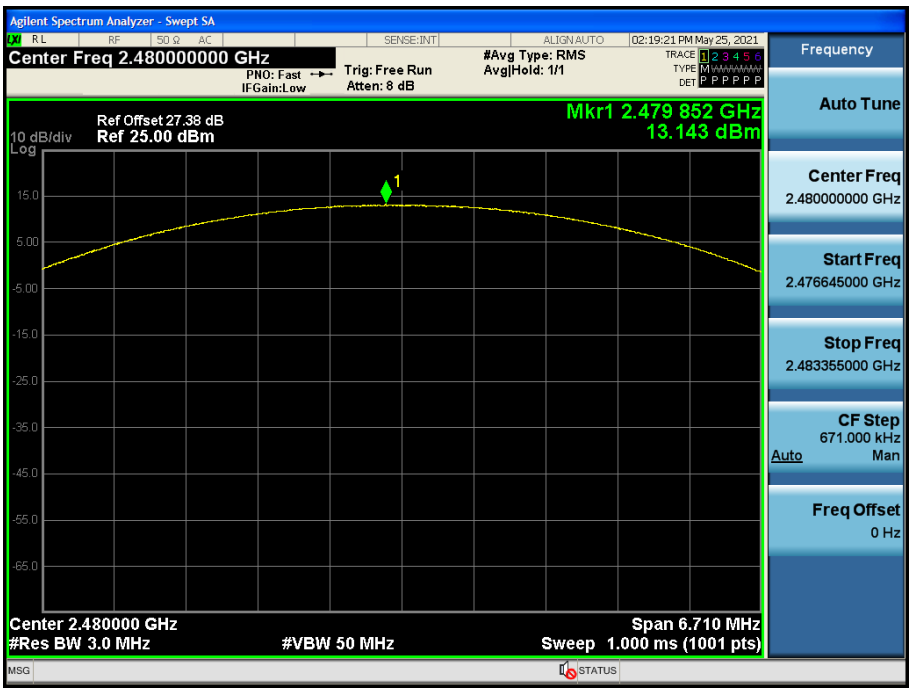


Test Plots (π/4DQPSK)

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	65.981	62.158	61.321	20
Upper	67.490	65.181	64.640	

With hopping

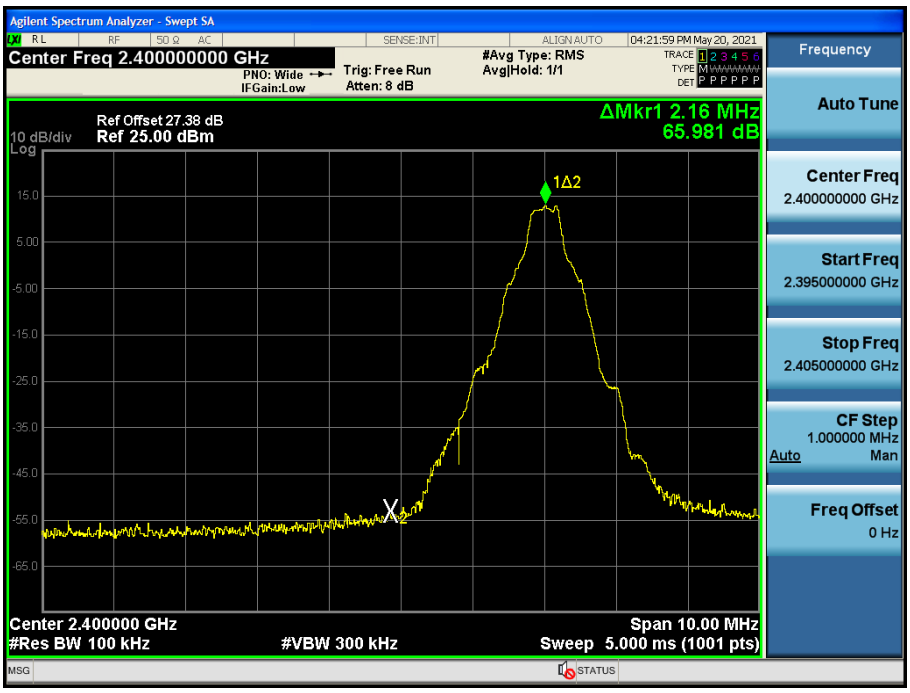
Outside Frequency Band	GFSK (dB)	8DPSK (dB)	π/4DQPSK (dB)	Limit (dBc)
Lower	66.678	63.933	64.211	20
Upper	69.154	64.671	64.517	

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 27.37 dB at 2400 MHz
   and is 27.38 dB at 2500 MHz.
   So, 27.38 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.

Test Plots without hopping (GFSK)

Band Edges (CH.0)



Test Plots without hopping (GFSK)

Band Edges (CH.78)

Test Plots without hopping (8DPSK)

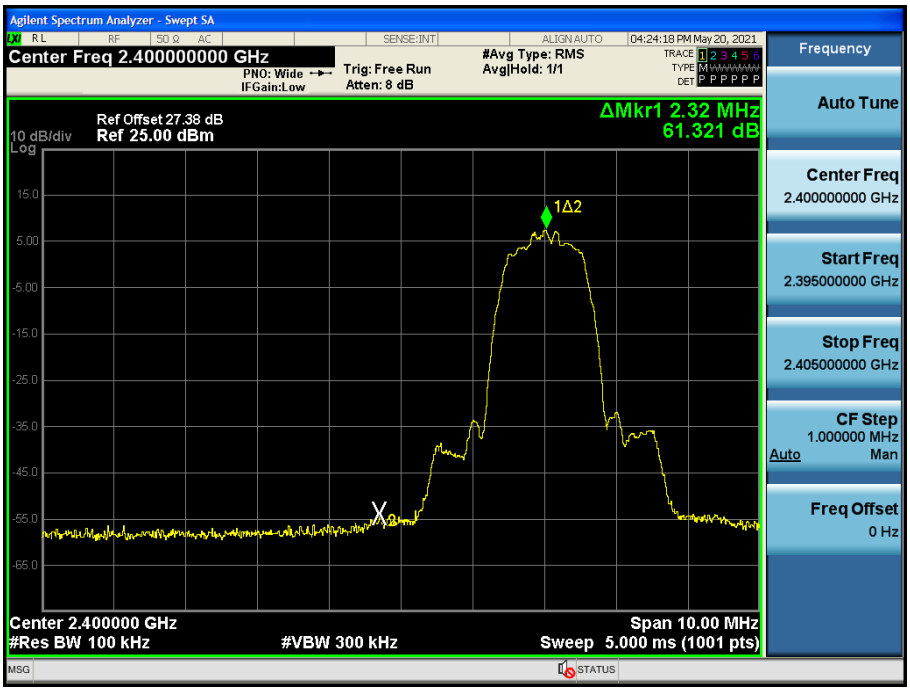
Band Edges (CH.0)

Test Plots without hopping (8DPSK)

Band Edges (CH.78)

Test Plots without hopping (π/4DQPSK)

Band Edges (CH.0)

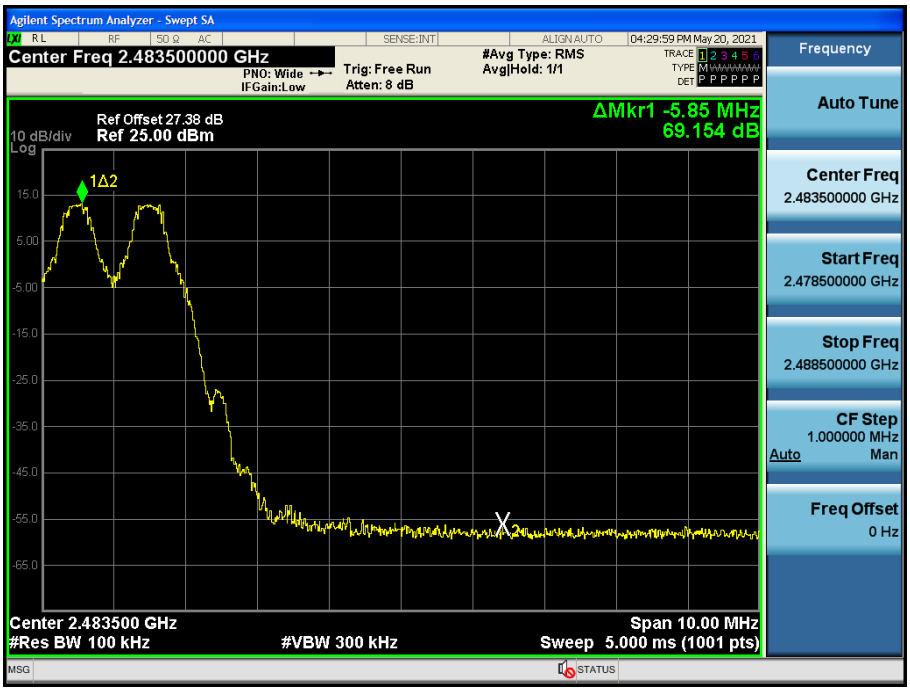


Test Plots without hopping (π/4DQPSK)

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	886.80	1194.6	1196.2
CH.39	884.69	1199.5	1194.1
CH.78	883.60	1199.3	1192.9

20dB BW (kHz)			
Channel	**GFSK**	**8DPSK**	**π/4DQPSK**
CH.0	981.4	1323	1345
CH.39	988.1	1328	1338
CH.78	993.8	1325	1342

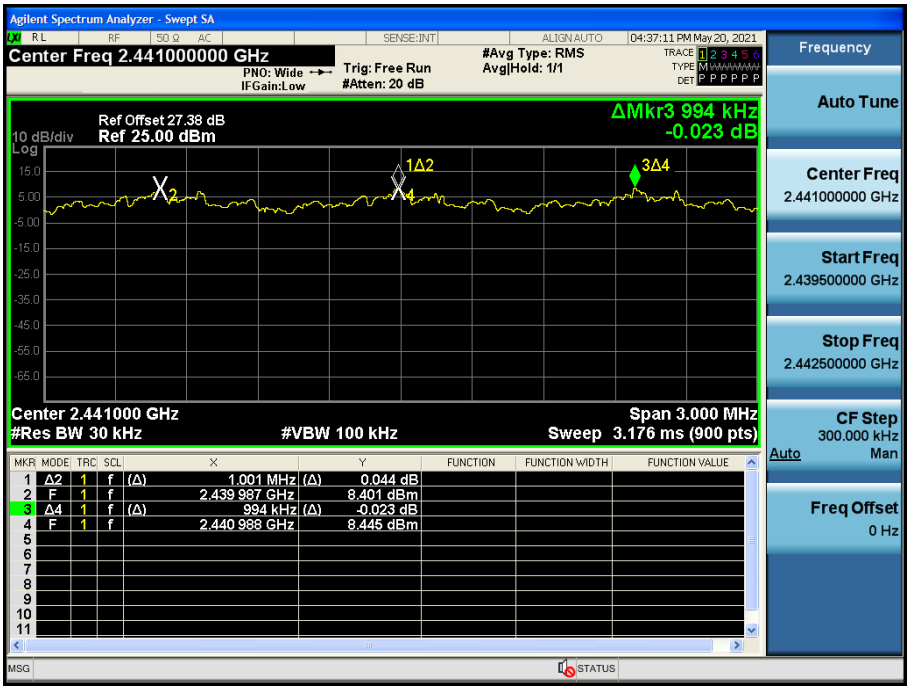
Channel Separation(kHz)			Limit
GFSK	**8DPSK**	**π/4DQPSK**	**(kHz)**
1001	994	1001	>25 kHz or >2/3 of the 20dB BW

Test Plots (GFSK)

Channel Separation

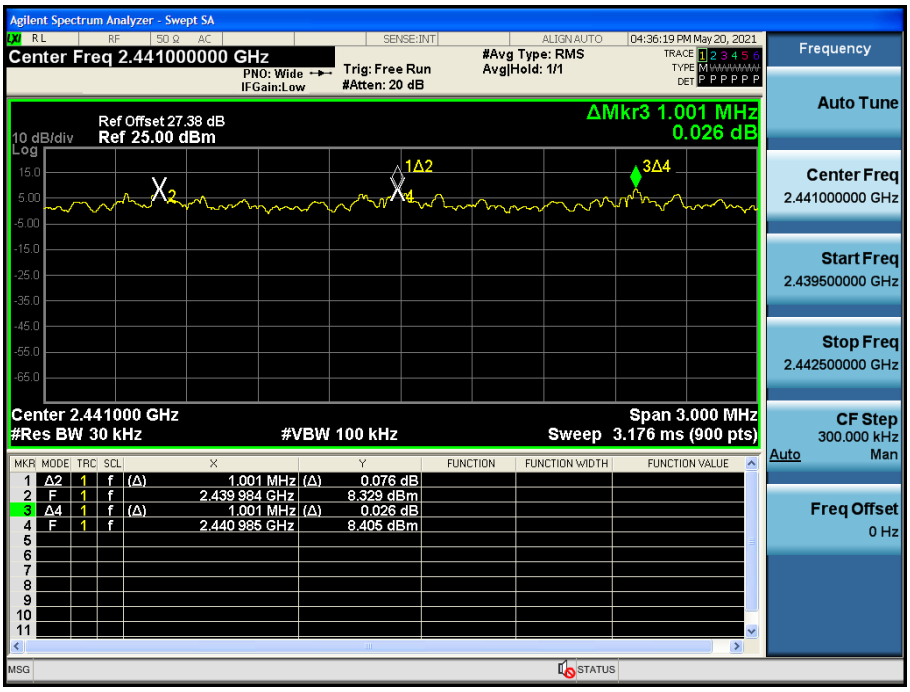
Test Plots (8DPSK)

Channel Separation



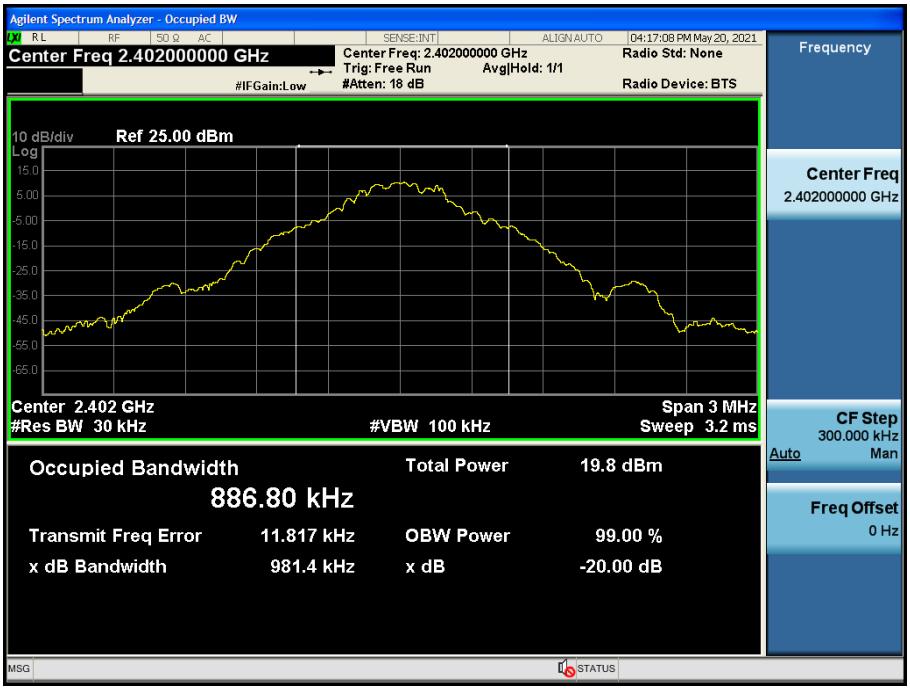
Test Plots (π/4DQPSK)

Channel Separation



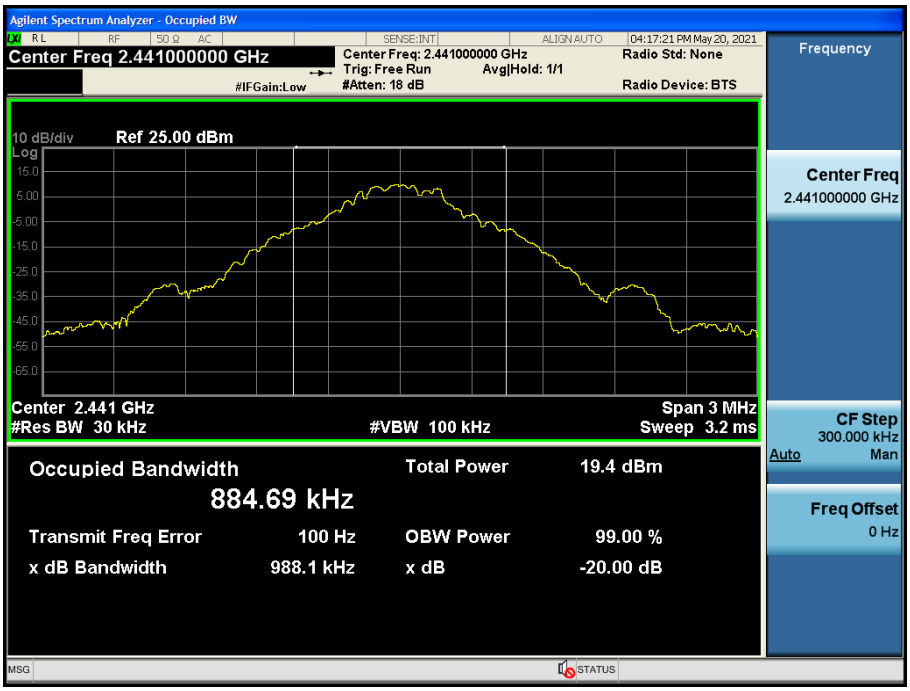
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



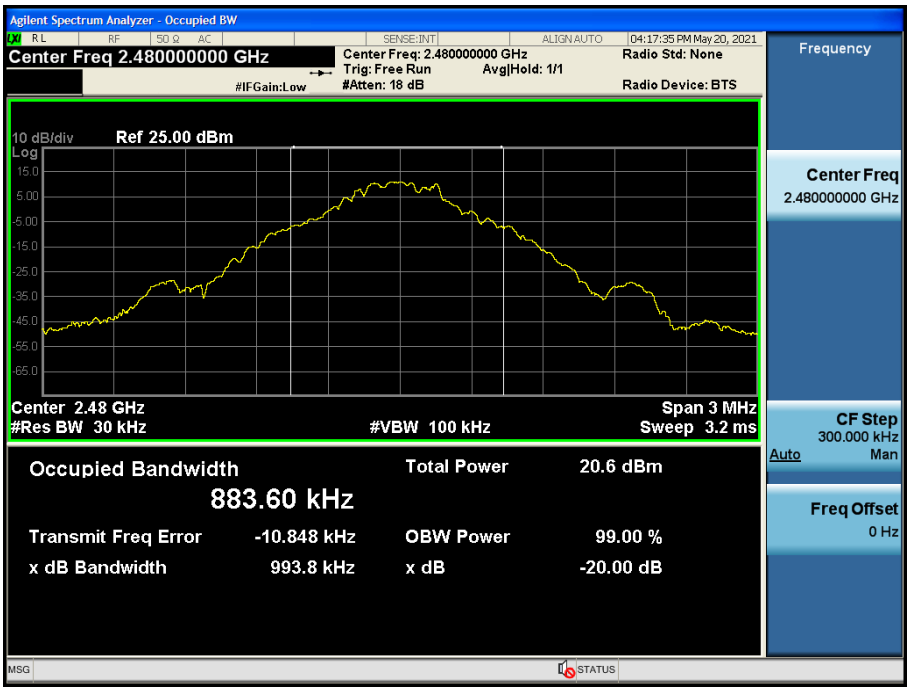
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



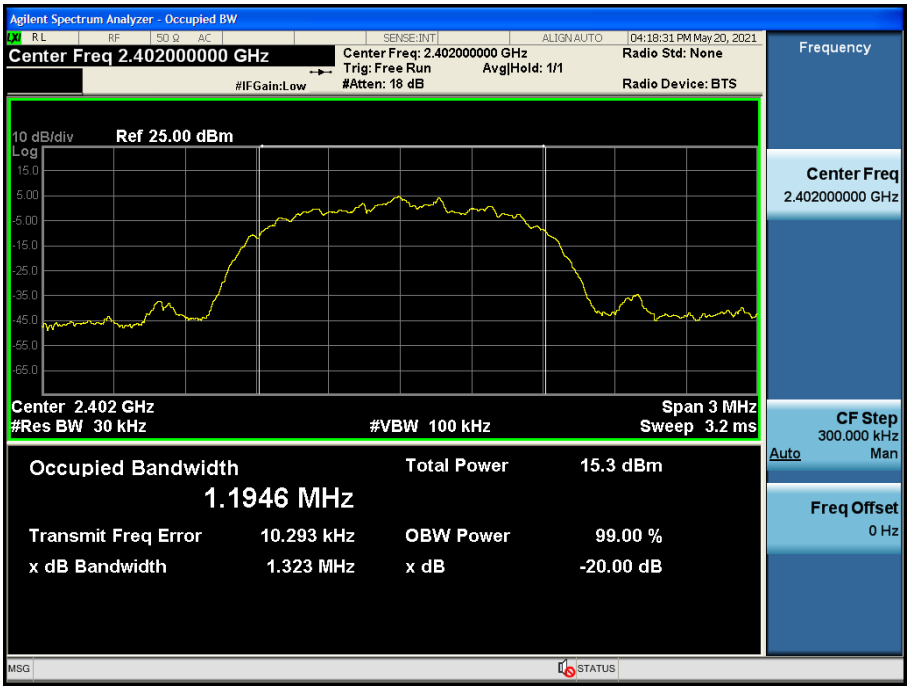
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



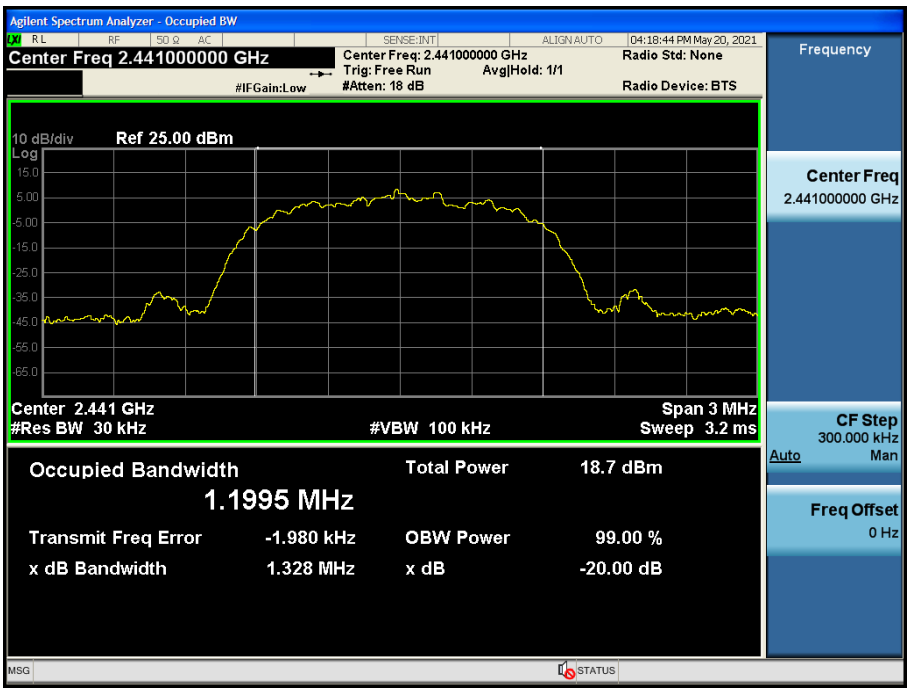
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



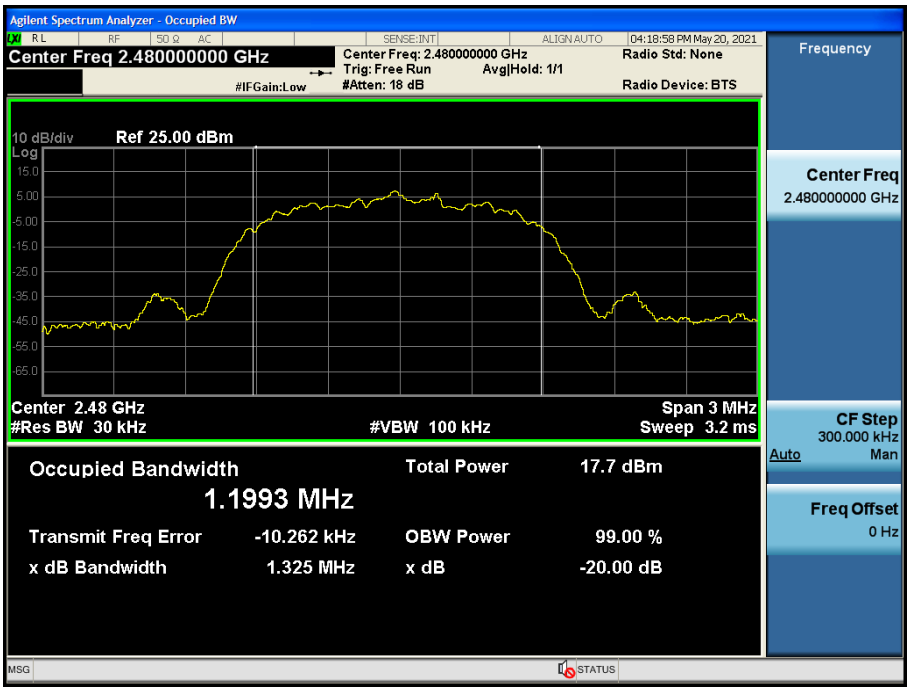
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



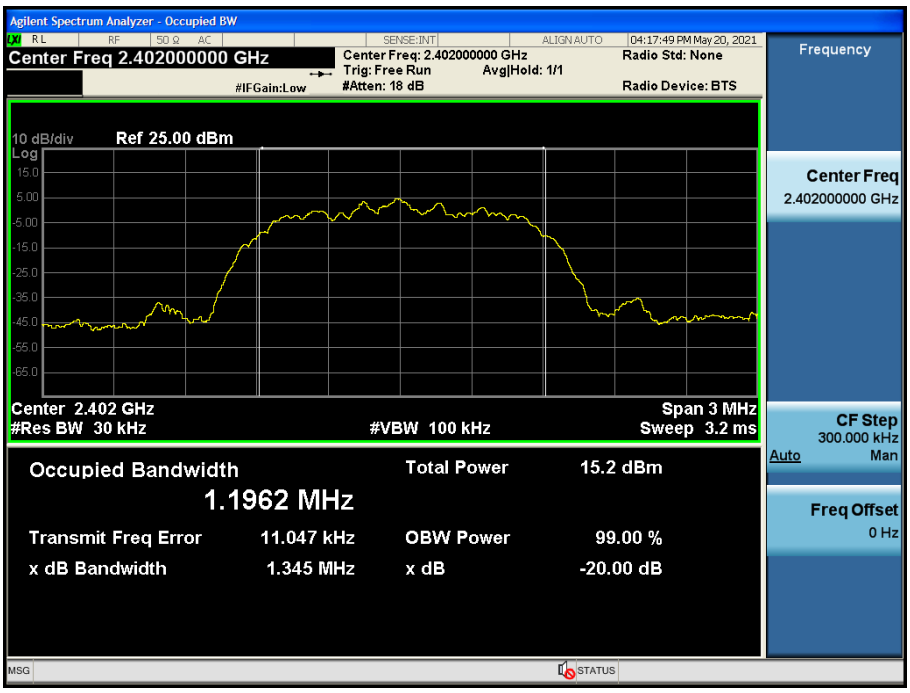
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



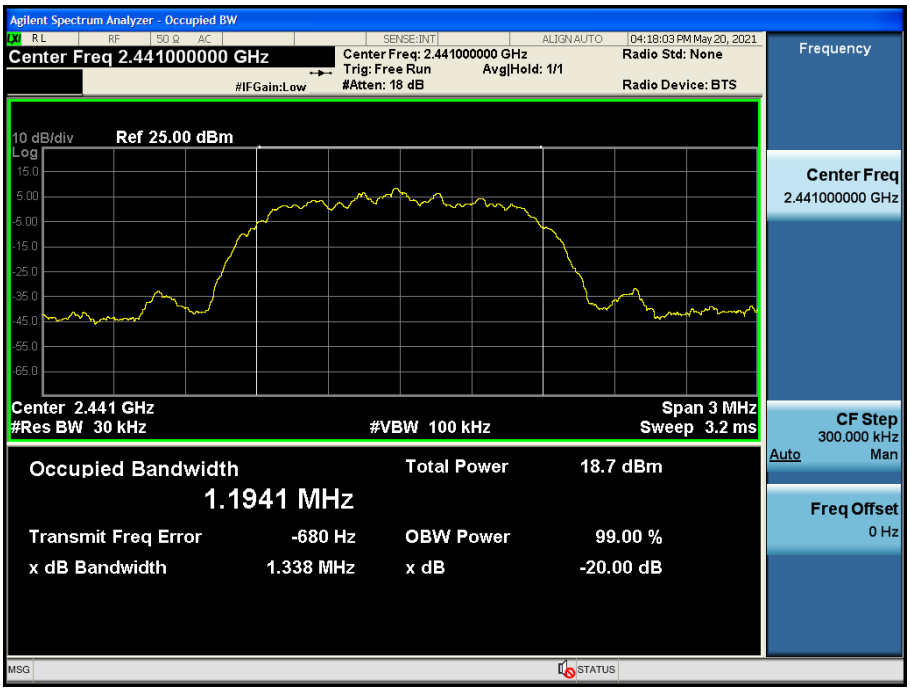
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



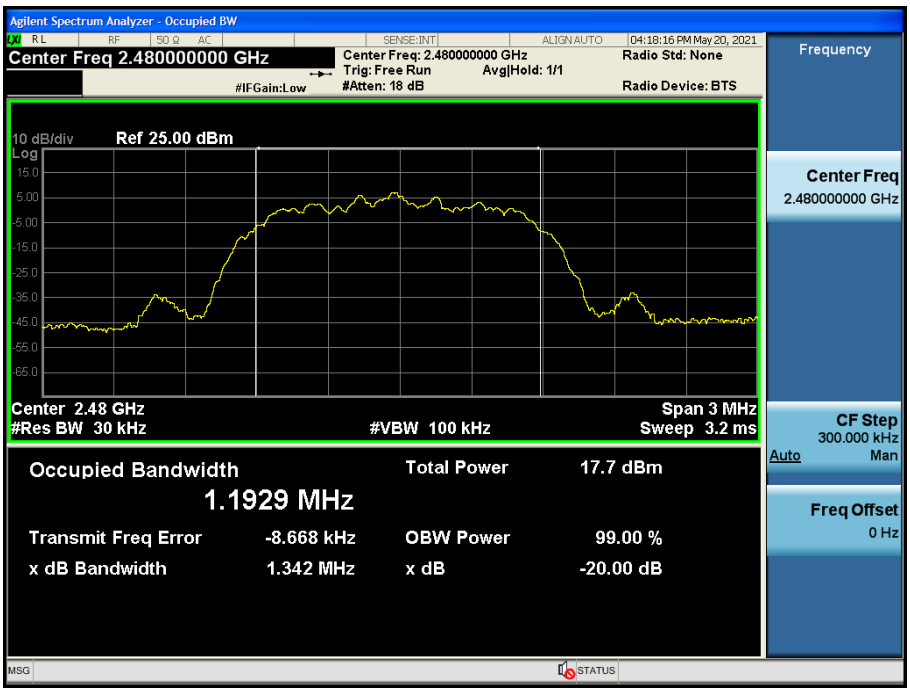
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



10.4 NUMBER OF HOPPING FREQUENCY

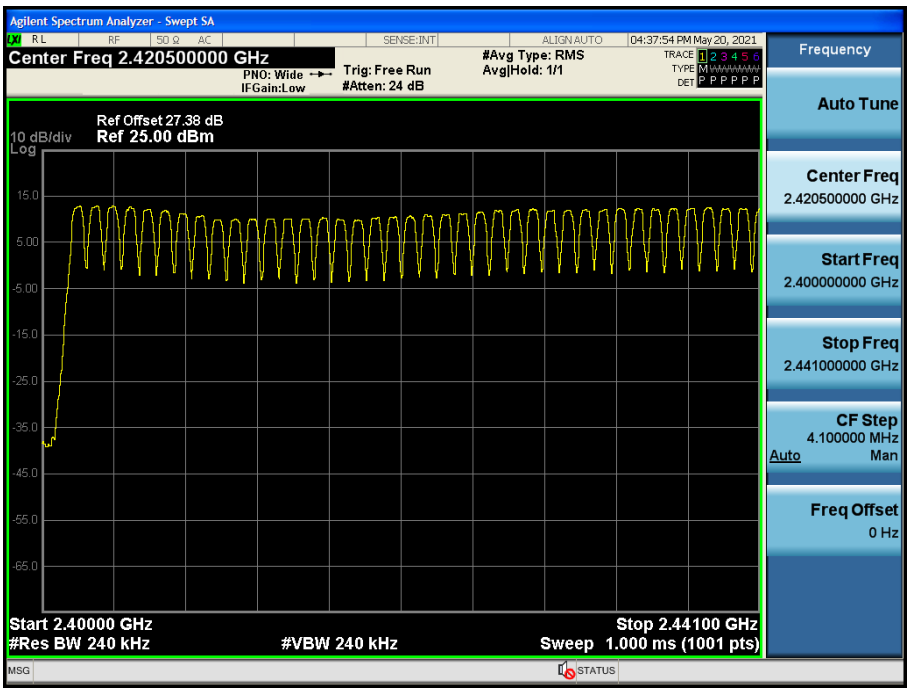
Result (No. of CH)			Limit
GFSK	8DPSK	π/4DQPSK	
79	79	79	>15

Note :

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

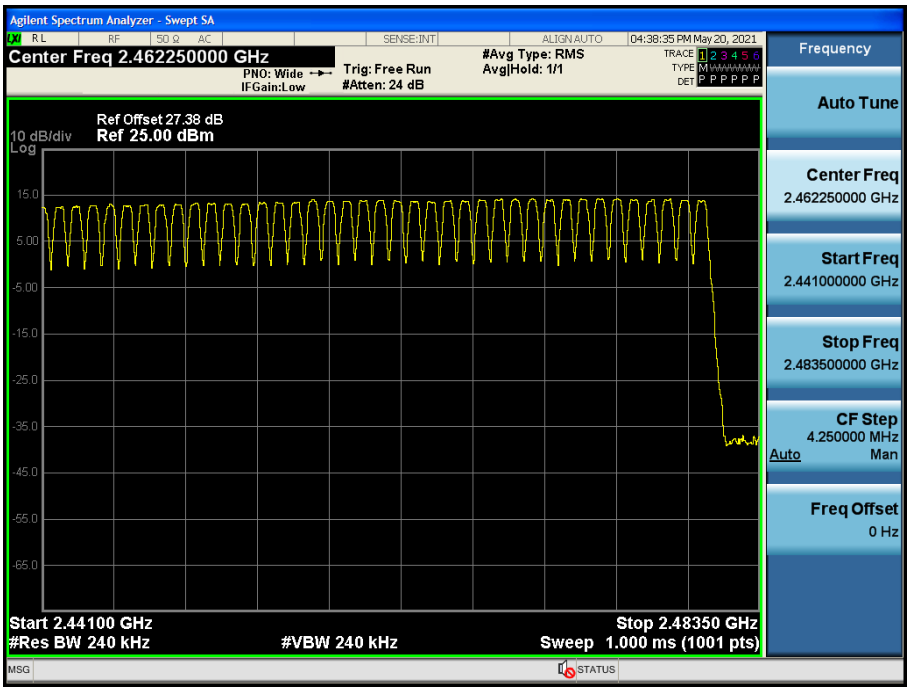
Test Plots (GFSK)

Number of Channels (2.4 GHz - 2.441 GHz)



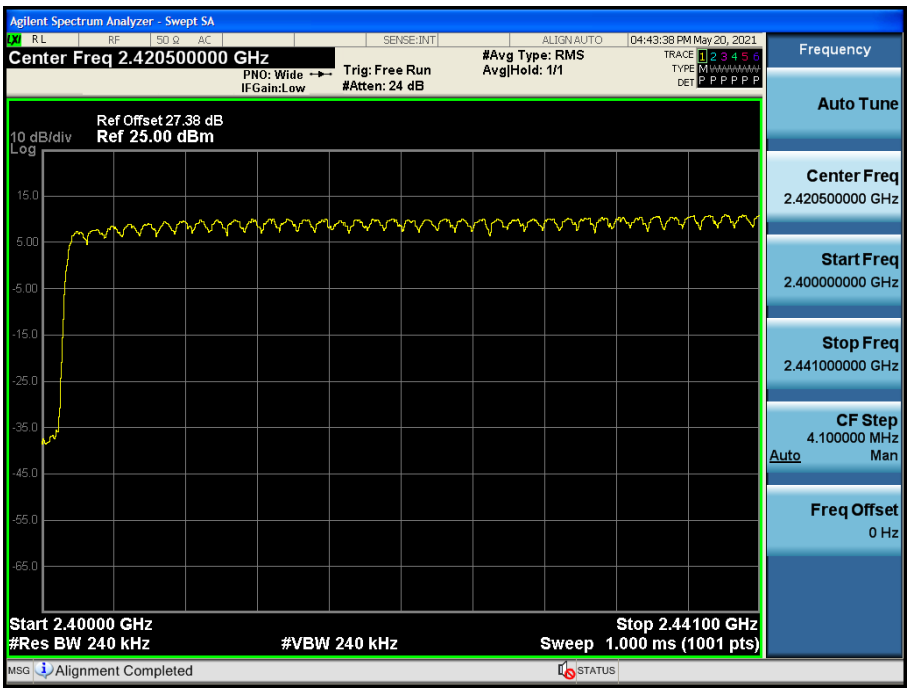
Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.483.5 GHz)



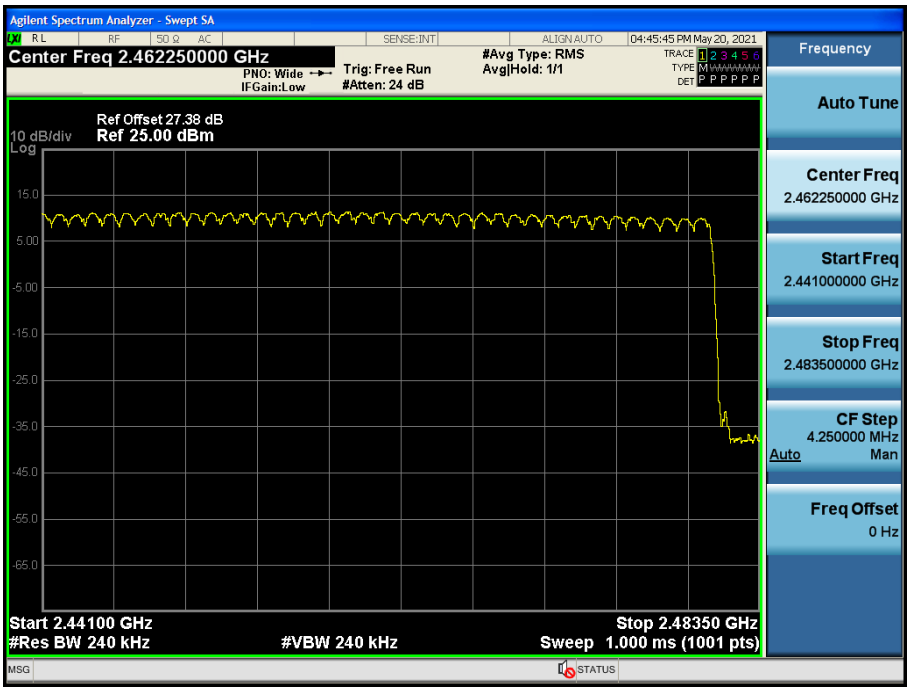
Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



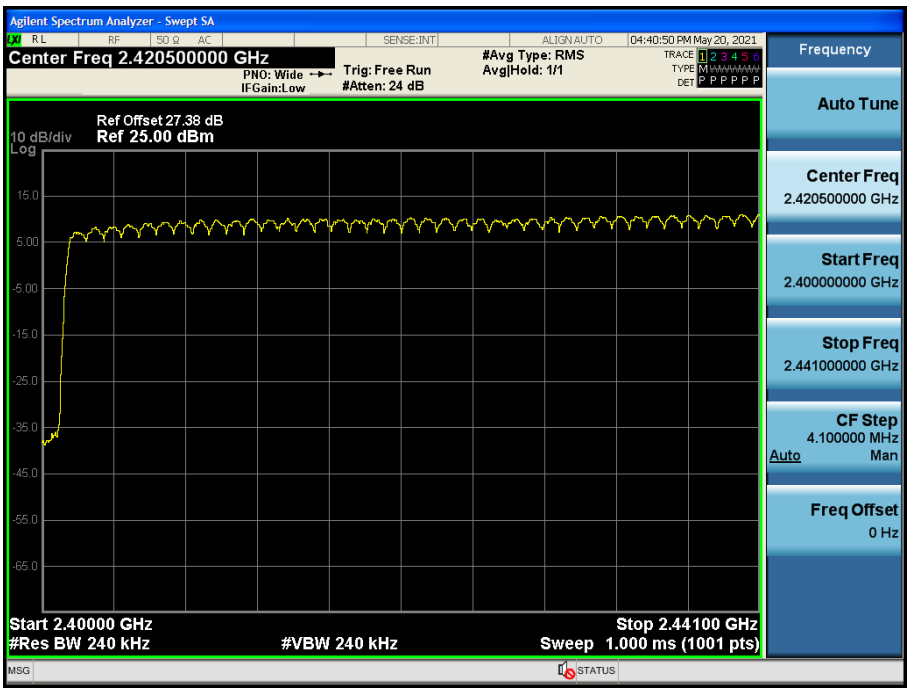
Test Plots (8DPSK)

Number of Channels (2.441 GHz - 2.483.5 GHz)



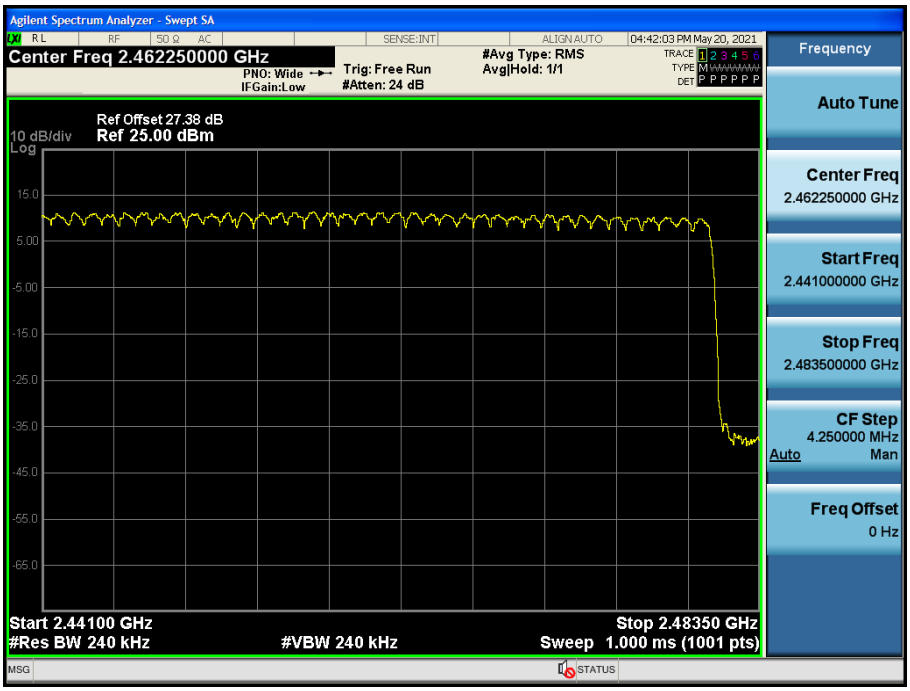
Test Plots (π/4DQPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (π/4DQPSK)

Number of Channels (2.441 GHz - 2.483.5 GHz)



10.5 TIME OF OCCUPANCY (DWELL TIME)

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

Non-AFH Mode

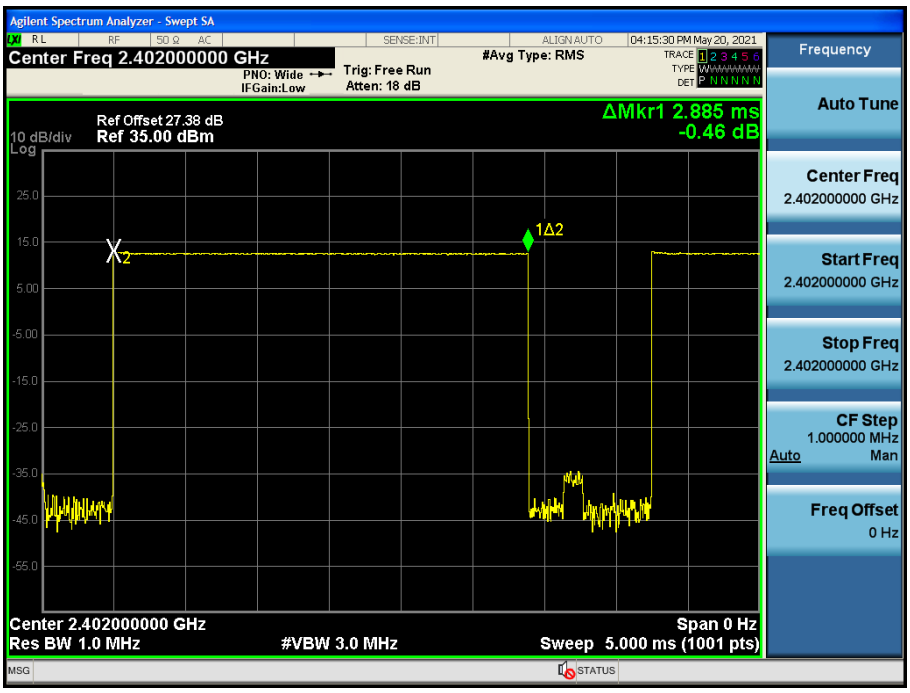
	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of Dwell (ms)	Low	307.73	308.27	308.27	31.6	400
	Mid	307.73	308.27	308.27	31.6	
	High	308.27	308.27	308.27	31.6	

AFH Mode

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of Dwell (ms)	Low	153.87	154.13	154.13	8.0	400
	Mid	153.87	154.13	154.13	8.0	
	High	154.13	154.13	154.13	8.0	

Test Plots (GFSK)

Dwell Time (CH.0)

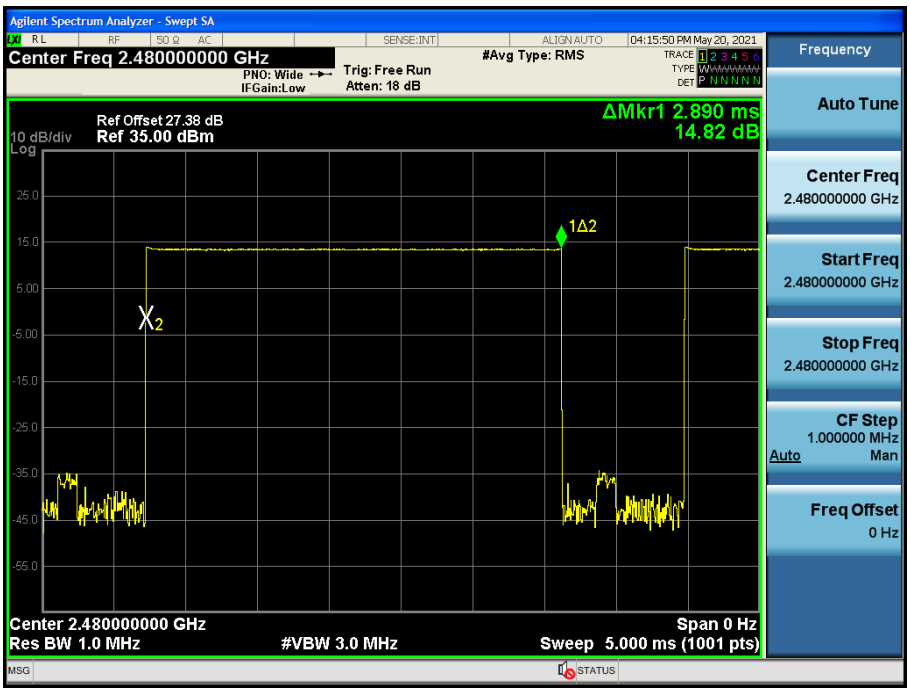


Test Plots (GFSK)

Dwell Time (CH.39)

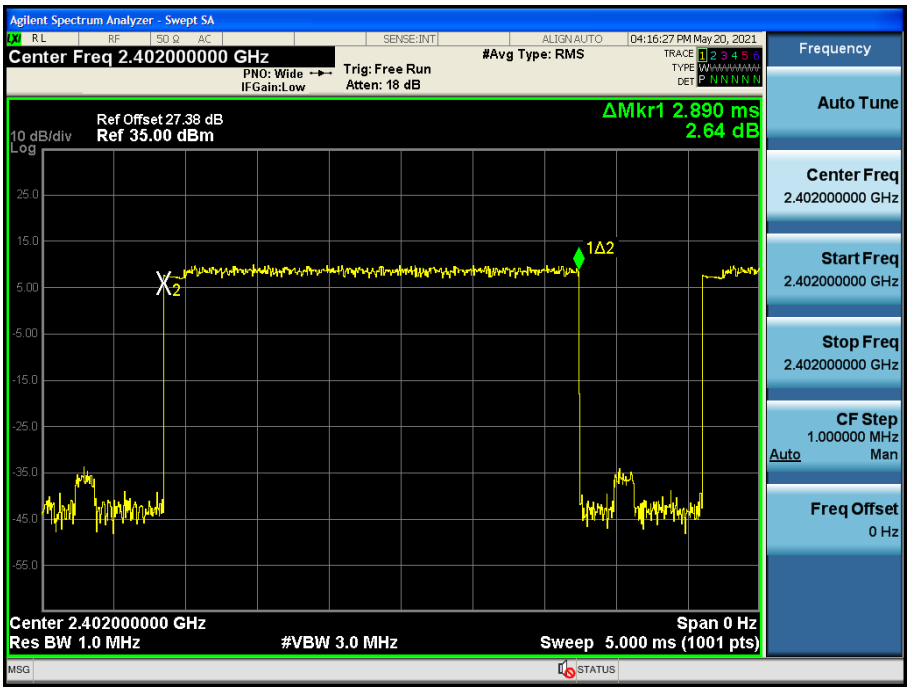
Test Plots (GFSK)

Dwell Time (CH.78)



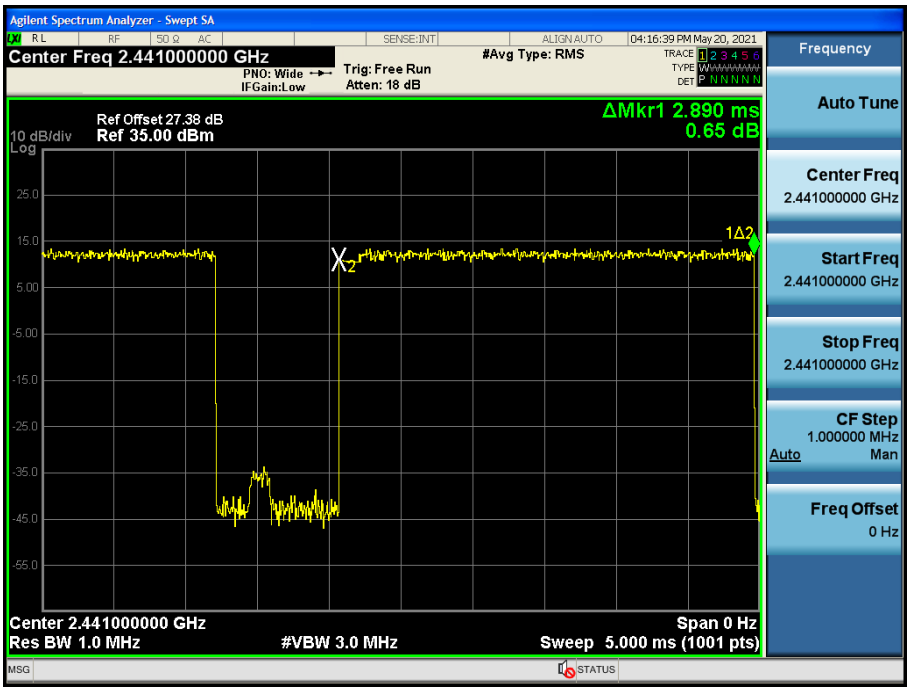
Test Plots (8DPSK)

Dwell Time (CH.0)



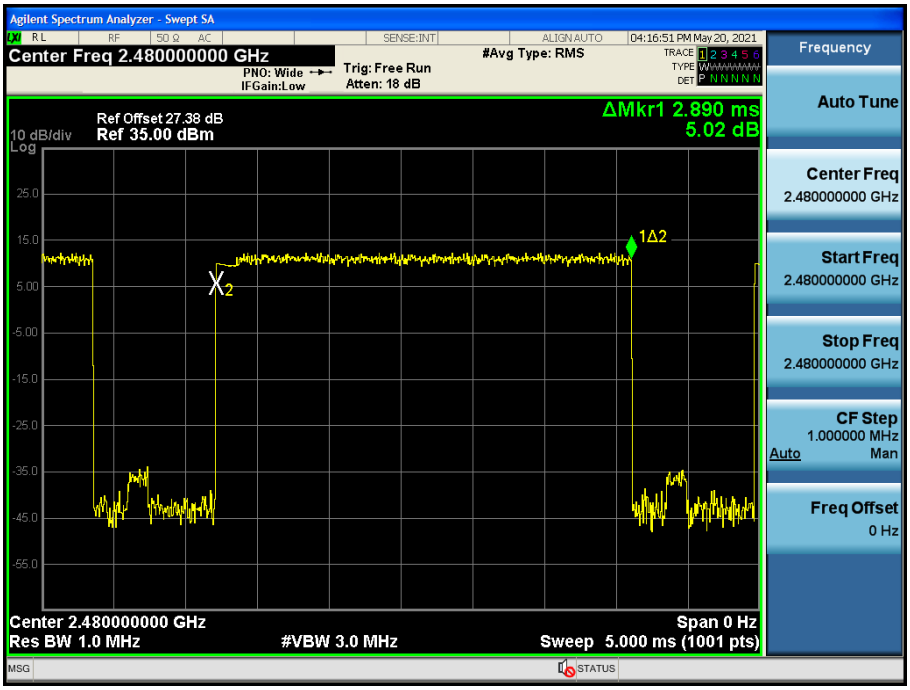
Test Plots (8DPSK)

Dwell Time (CH.39)



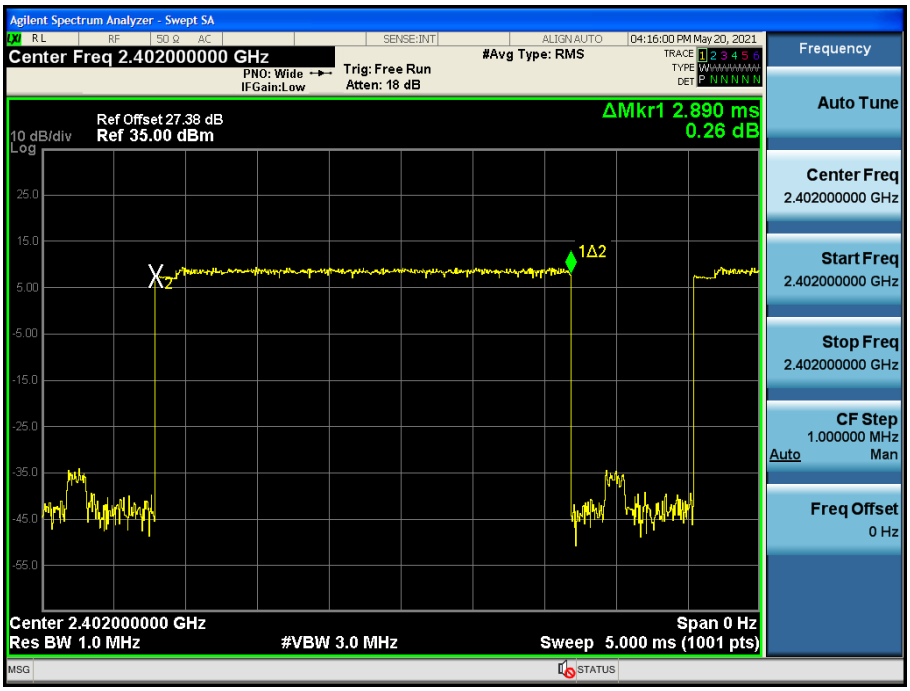
Test Plots (8DPSK)

Dwell Time (CH.78)



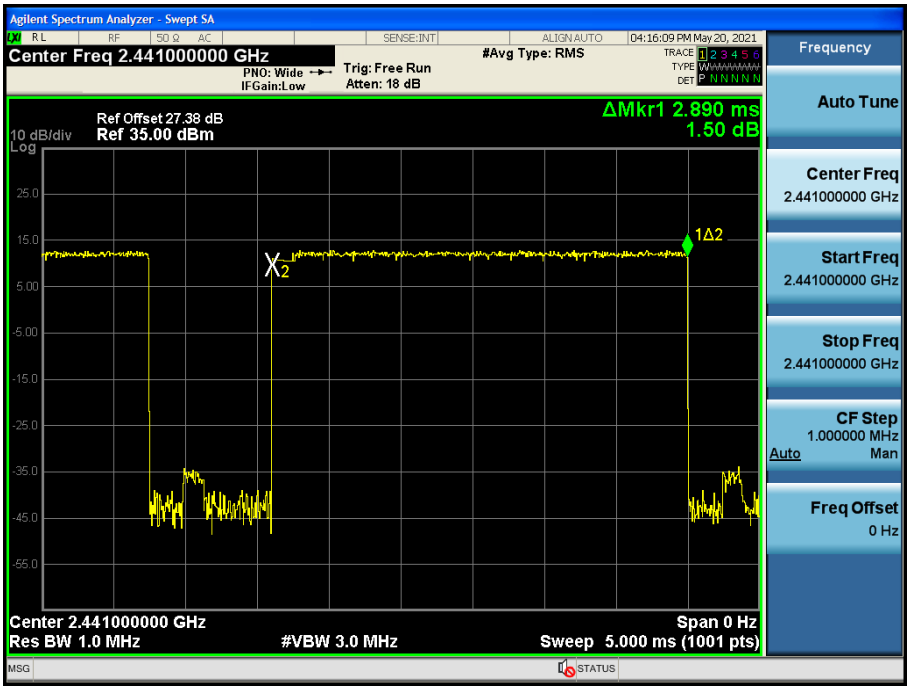
Test Plots (π/4DQPSK)

Dwell Time (CH.0)



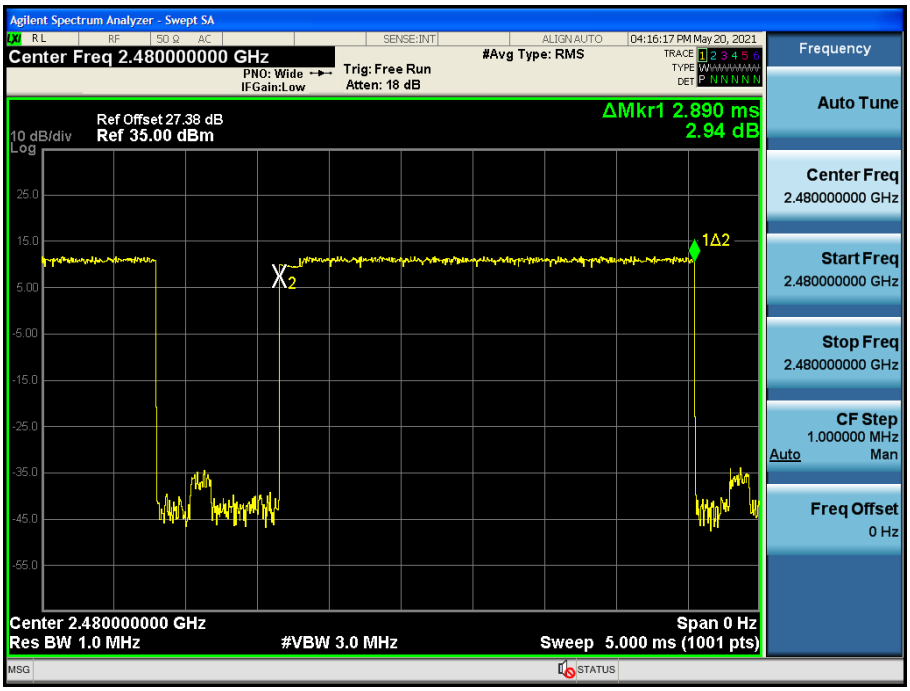
Test Plots (π/4DQPSK)

Dwell Time (CH.39)



Test Plots (π/4DQPSK)

Dwell Time (CH.78)



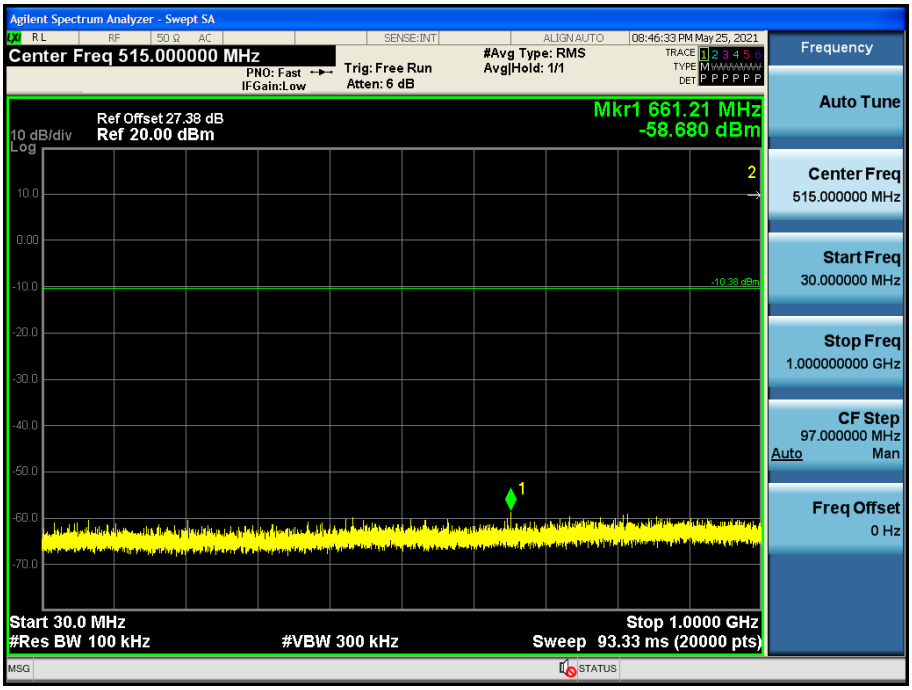
10.6 SPURIOUS EMISSIONS

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.

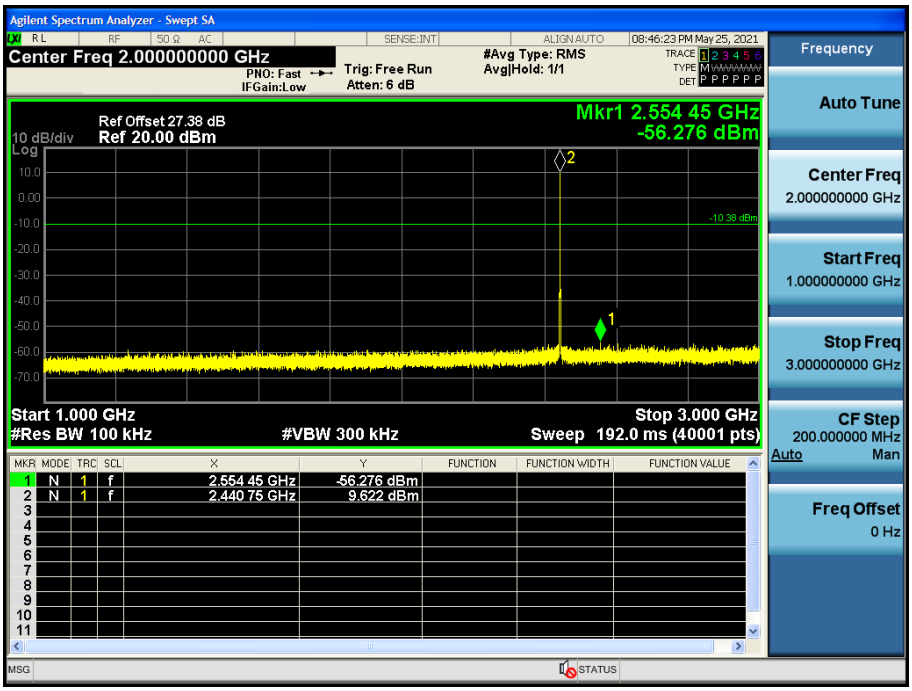
Test Plots (8DPSK) 30 MHz - 1 GHz

Spurious Emission (CH.39)



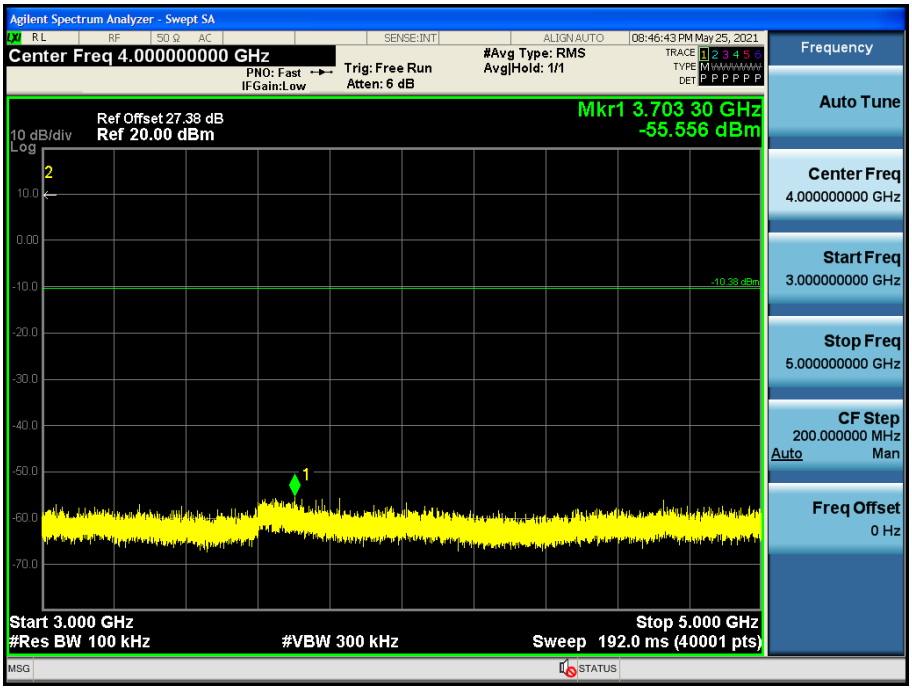
Test Plots (8DPSK) 1 GHz – 3 GHz

Spurious Emission (CH.39)



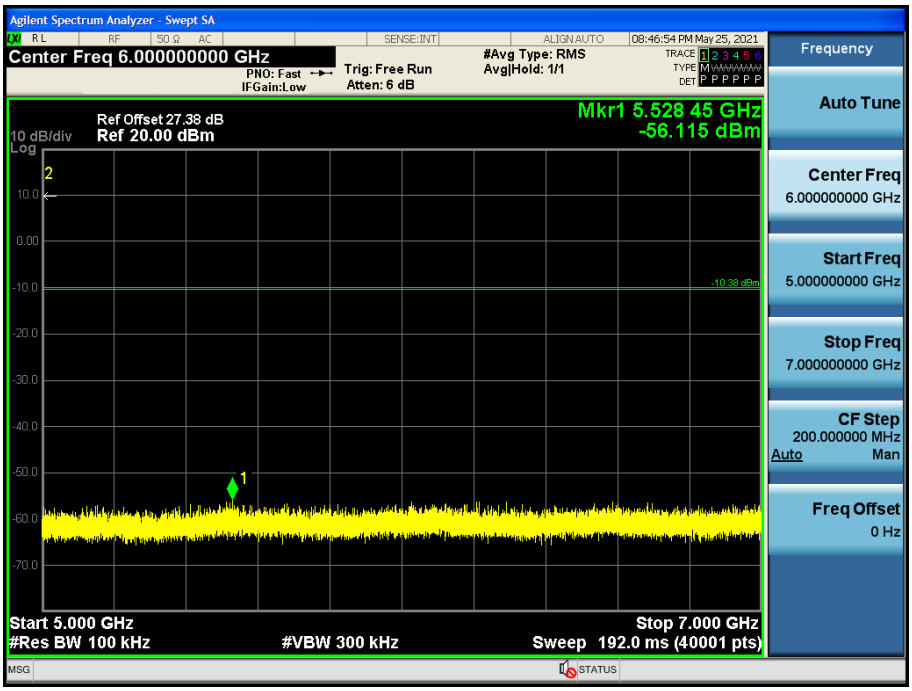
Test Plots(8DPSK) 3 GHz - 5 GHz

Spurious Emission (CH.39)



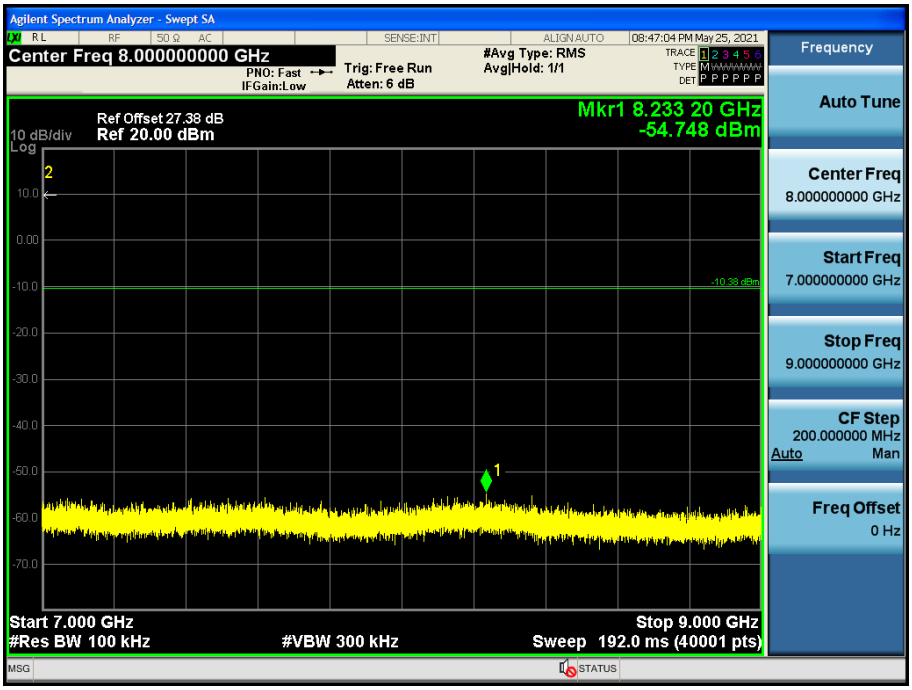
Test Plots (8DPSK) 5 GHz - 7 GHz

Spurious Emission (CH.39)



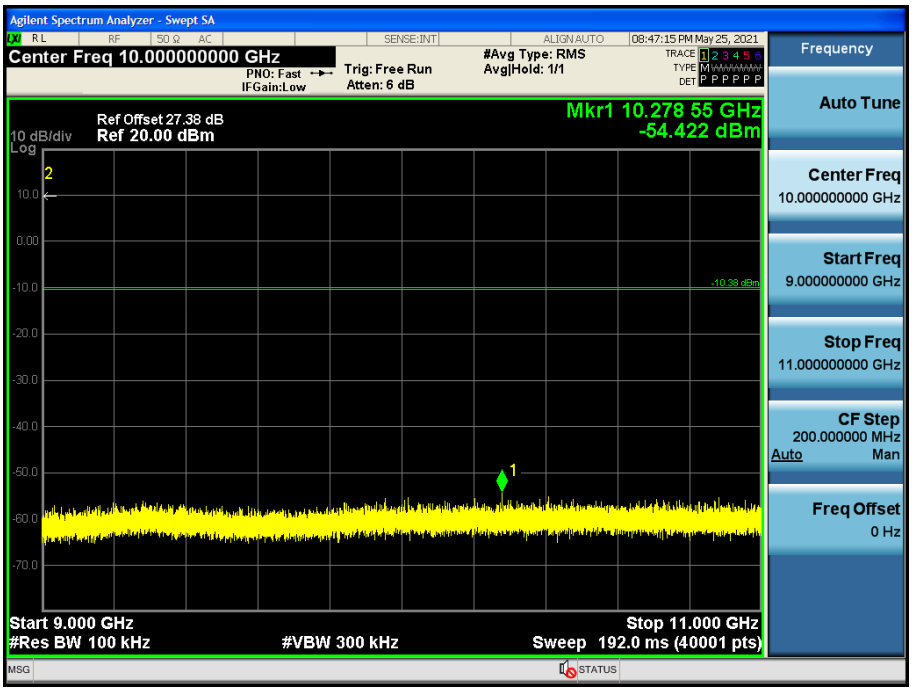
Test Plots(8DPSK) 7 GHz - 9 GHz

Spurious Emission (CH.39)



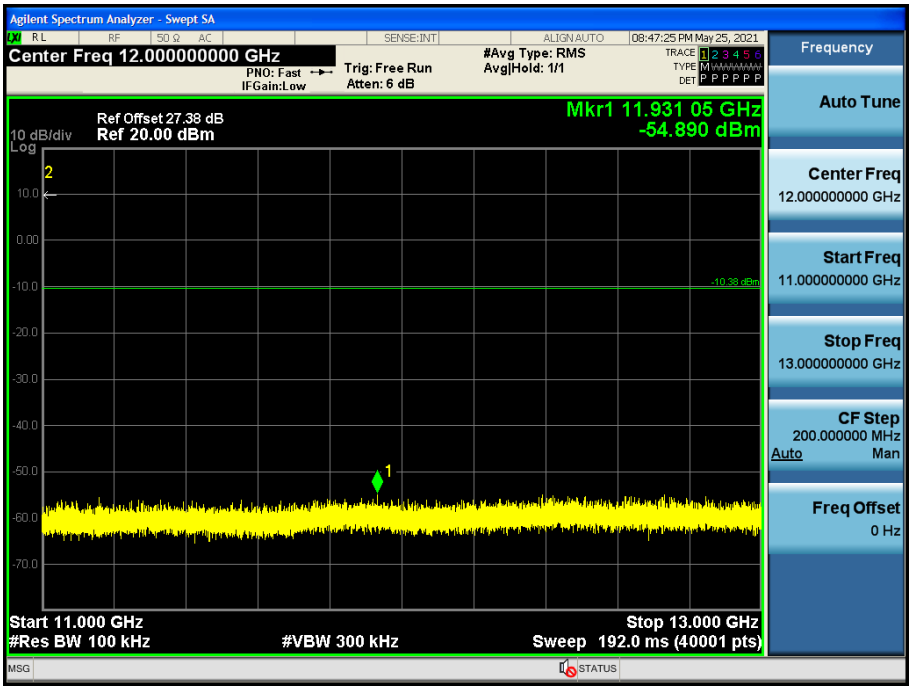
Test Plots(8DPSK) 9 GHz - 11 GHz

Spurious Emission (CH.39)



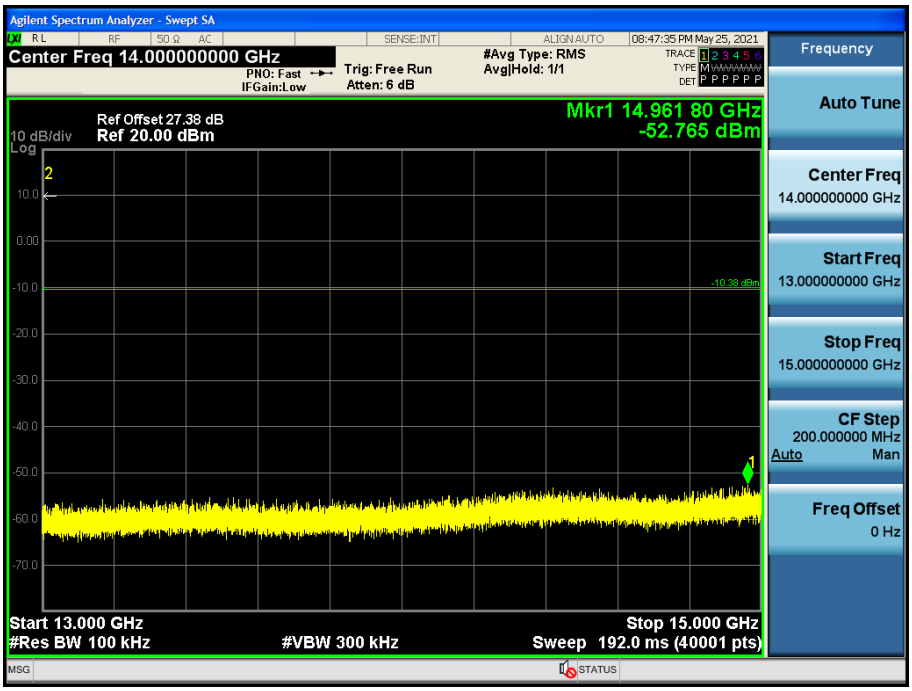
Test Plots(8DPSK) 11 GHz - 13 GHz

Spurious Emission (CH.39)



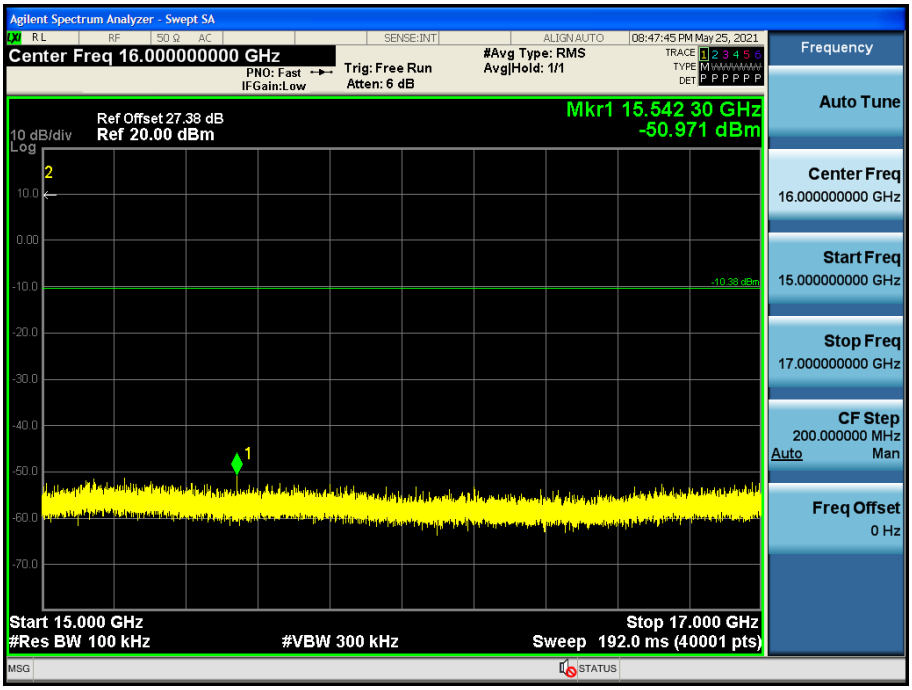
Test Plots (8DPSK) 13 GHz – 15 GHz

Spurious Emission (CH.39)



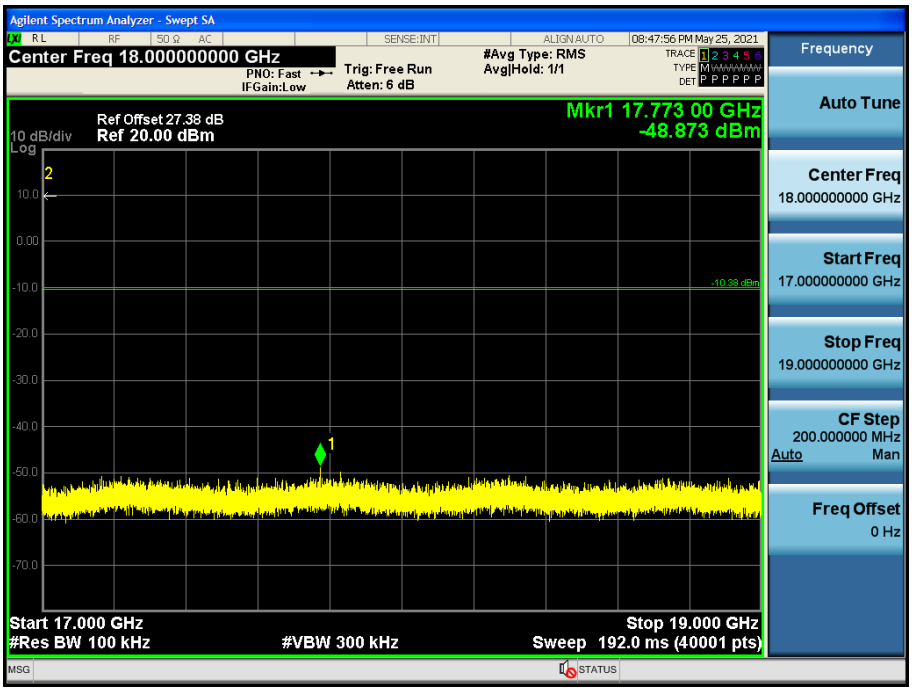
Test Plots(8DPSK) 15 GHz - 17 GHz

Spurious Emission (CH.39)



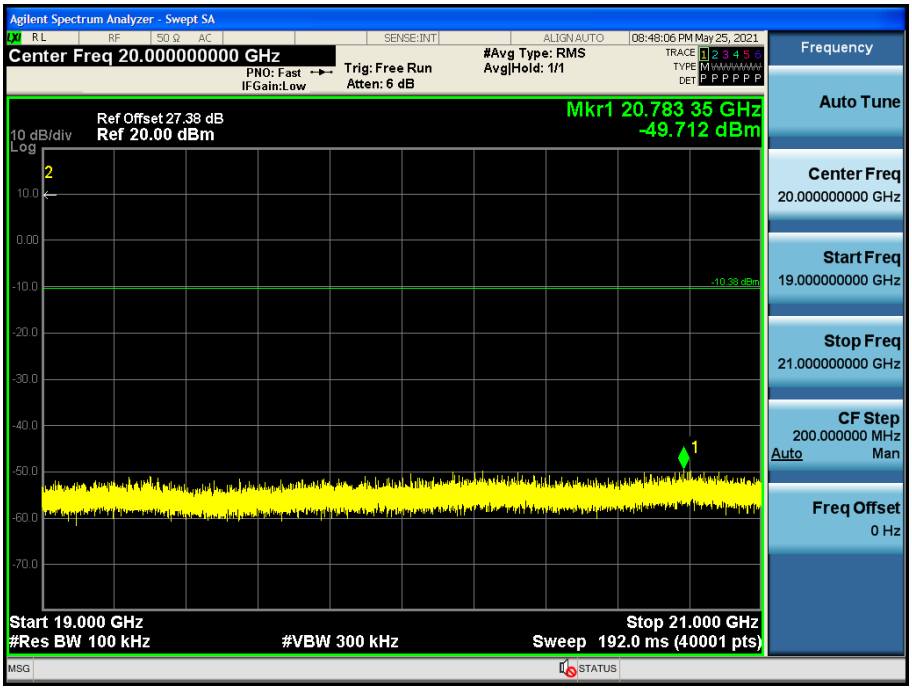
Test Plots(8DPSK) 17 GHz - 19 GHz

Spurious Emission (CH.39)



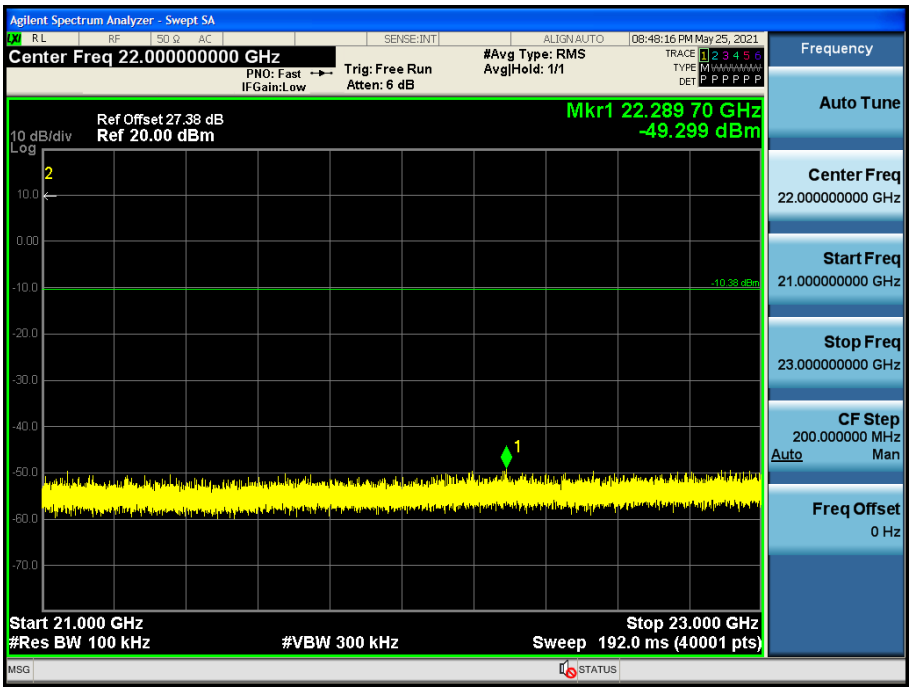
Test Plots (8DPSK) 19 GHz - 21 GHz

Spurious Emission (CH.39)



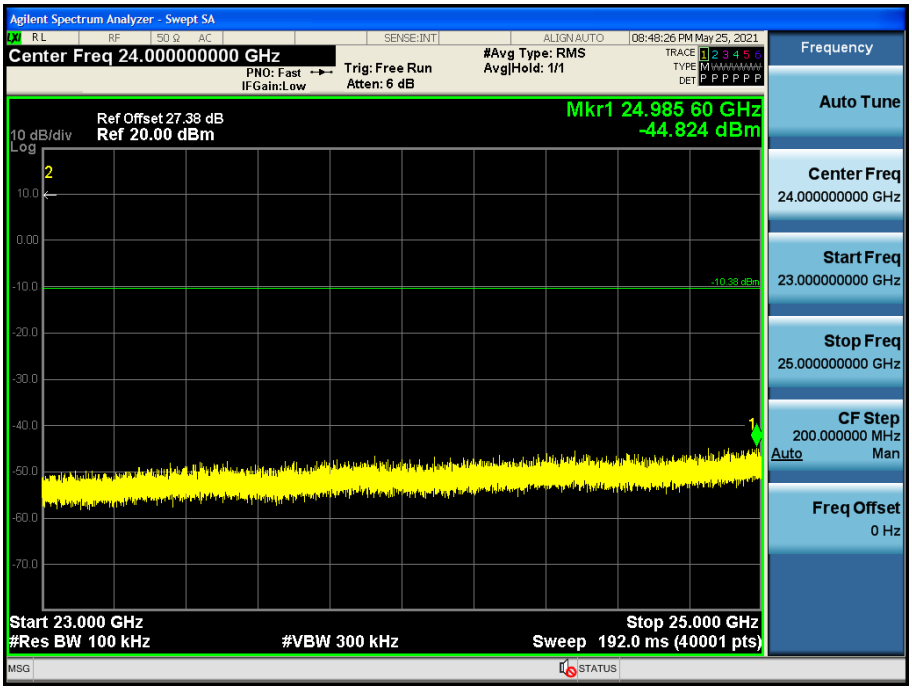
Test Plots (8DPSK) 21 GHz - 23 GHz

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 = 40log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
4. Radiated test is performed with hopping off.

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]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	40.56	4.08	V	0.00	44.64	73.98	29.34	PK
4804	40.56	4.08	V	-24.73	19.91	53.98	34.07	AV
7206	37.07	12.05	V	0.00	49.12	73.98	24.86	PK
7206	37.07	12.05	V	-24.73	24.39	53.98	29.59	AV
4804	41.40	4.08	H	0.00	45.48	73.98	28.50	PK
4804	41.40	4.08	H	-24.73	20.75	53.98	33.23	AV
7206	38.51	12.05	H	0.00	50.56	73.98	23.42	PK
7206	38.51	12.05	H	-24.73	25.83	53.98	28.15	AV

Operation Mode: CH Mid(GFSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	40.85	4.01	V	0.00	44.86	73.98	29.12	PK
4882	40.85	4.01	V	-24.73	20.13	53.98	33.85	AV
7323	37.21	12.49	V	0.00	49.70	73.98	24.28	PK
7323	37.21	12.49	V	-24.73	24.97	53.98	29.01	AV
4882	41.22	4.01	H	0.00	45.23	73.98	28.75	PK
4882	41.22	4.01	H	-24.73	20.50	53.98	33.48	AV
7323	39.17	12.49	H	0.00	51.66	73.98	22.32	PK
7323	39.17	12.49	H	-24.73	26.93	53.98	27.05	AV

Operation Mode: CH High(GFSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	40.67	4.55	V	0.00	45.22	73.98	28.76	PK
4960	40.67	4.55	V	-24.73	20.49	53.98	33.49	AV
7440	38.70	12.60	V	0.00	51.30	73.98	22.68	PK
7440	38.70	12.60	V	-24.73	26.57	53.98	27.41	AV
4960	41.91	4.55	H	0.00	46.46	73.98	27.52	PK
4960	41.91	4.55	H	-24.73	21.73	53.98	32.25	AV
7440	39.32	12.60	H	0.00	51.92	73.98	22.06	PK
7440	39.32	12.60	H	-24.73	27.19	53.98	26.79	AV

Operation Mode: CH Low(π/4DQPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	40.46	4.08	V	0.00	44.54	73.98	29.44	PK
4804	40.46	4.08	V	-24.73	19.81	53.98	34.17	AV
7206	37.59	12.05	V	0.00	49.64	73.98	24.34	PK
7206	37.59	12.05	V	-24.73	24.91	53.98	29.07	AV
4804	41.34	4.08	H	0.00	45.42	73.98	28.56	PK
4804	41.34	4.08	H	-24.73	20.69	53.98	33.29	AV
7206	38.26	12.05	H	0.00	50.31	73.98	23.67	PK
7206	38.26	12.05	H	-24.73	25.58	53.98	28.40	AV

Operation Mode: CH Mid(π/4DQPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	40.32	4.01	V	0.00	44.33	73.98	29.65	PK
4882	40.32	4.01	V	-24.73	19.60	53.98	34.38	AV
7323	37.65	12.49	V	0.00	50.14	73.98	23.84	PK
7323	37.65	12.49	V	-24.73	25.41	53.98	28.57	AV
4882	40.78	4.01	H	0.00	44.79	73.98	29.19	PK
4882	40.78	4.01	H	-24.73	20.06	53.98	33.92	AV
7323	38.97	12.49	H	0.00	51.46	73.98	22.52	PK
7323	38.97	12.49	H	-24.73	26.73	53.98	27.25	AV

Operation Mode: CH High(π/4DQPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	41.08	4.55	V	0.00	45.63	73.98	28.35	PK
4960	41.08	4.55	V	-24.73	20.90	53.98	33.08	AV
7440	38.93	12.60	V	0.00	51.53	73.98	22.45	PK
7440	38.93	12.60	V	-24.73	26.80	53.98	27.18	AV
4960	41.97	4.55	H	0.00	46.52	73.98	27.46	PK
4960	41.97	4.55	H	-24.73	21.79	53.98	32.19	AV
7440	40.06	12.60	H	0.00	52.66	73.98	21.32	PK
7440	40.06	12.60	H	-24.73	27.93	53.98	26.05	AV

Operation Mode: CH Low(8DPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	40.55	4.08	V	0.00	44.63	73.98	29.35	PK
4804	40.55	4.08	V	-24.73	19.90	53.98	34.08	AV
7206	37.30	12.05	V	0.00	49.35	73.98	24.63	PK
7206	37.30	12.05	V	-24.73	24.62	53.98	29.36	AV
4804	41.41	4.08	H	0.00	45.49	73.98	28.49	PK
4804	41.41	4.08	H	-24.73	20.76	53.98	33.22	AV
7206	38.75	12.05	H	0.00	50.80	73.98	23.18	PK
7206	38.75	12.05	H	-24.73	26.07	53.98	27.91	AV

Operation Mode: CH Mid(8DPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	40.01	4.01	V	0.00	44.02	73.98	29.96	PK
4882	40.01	4.01	V	-24.73	19.29	53.98	34.69	AV
7323	37.21	12.49	V	0.00	49.70	73.98	24.28	PK
7323	37.21	12.49	V	-24.73	24.97	53.98	29.01	AV
4882	40.50	4.01	H	0.00	44.51	73.98	29.47	PK
4882	40.50	4.01	H	-24.73	19.78	53.98	34.20	AV
7323	39.00	12.49	H	0.00	51.49	73.98	22.49	PK
7323	39.00	12.49	H	-24.73	26.76	53.98	27.22	AV

Operation Mode: CH High(8DPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	40.62	4.55	V	0.00	45.17	73.98	28.81	PK
4960	40.62	4.55	V	-24.73	20.44	53.98	33.54	AV
7440	38.39	12.60	V	0.00	50.99	73.98	22.99	PK
7440	38.39	12.60	V	-24.73	26.26	53.98	27.72	AV
4960	42.17	4.55	H	0.00	46.72	73.98	27.26	PK
4960	42.17	4.55	H	-24.73	21.99	53.98	31.99	AV
7440	39.23	12.60	H	0.00	51.83	73.98	22.15	PK
7440	39.23	12.60	H	-24.73	27.10	53.98	26.88	AV

[Non-DBS Mode]

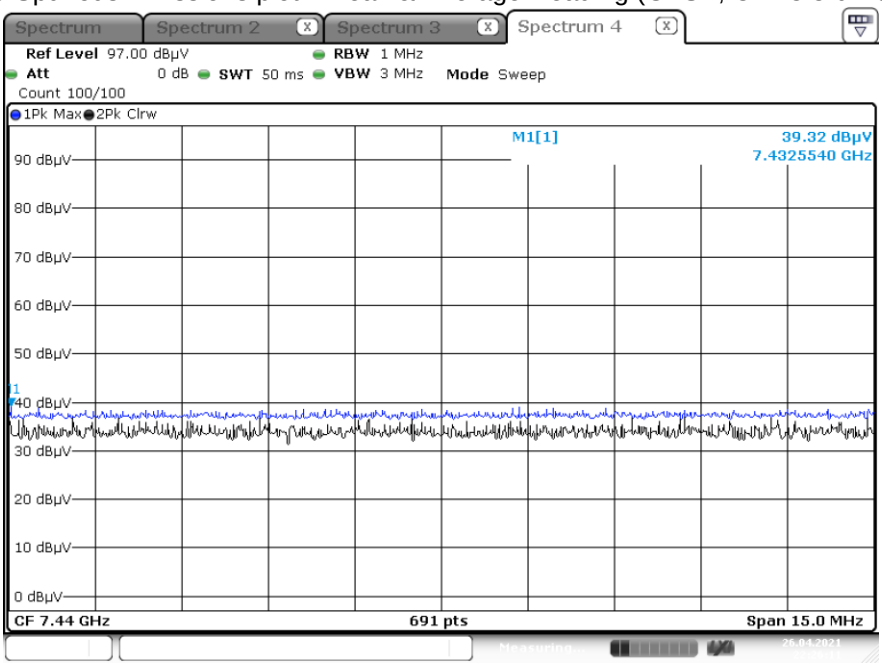
Test case 3

BT π/4DQPSK ch.78 & 802.11a ch.116 U-NII 2C Ant All

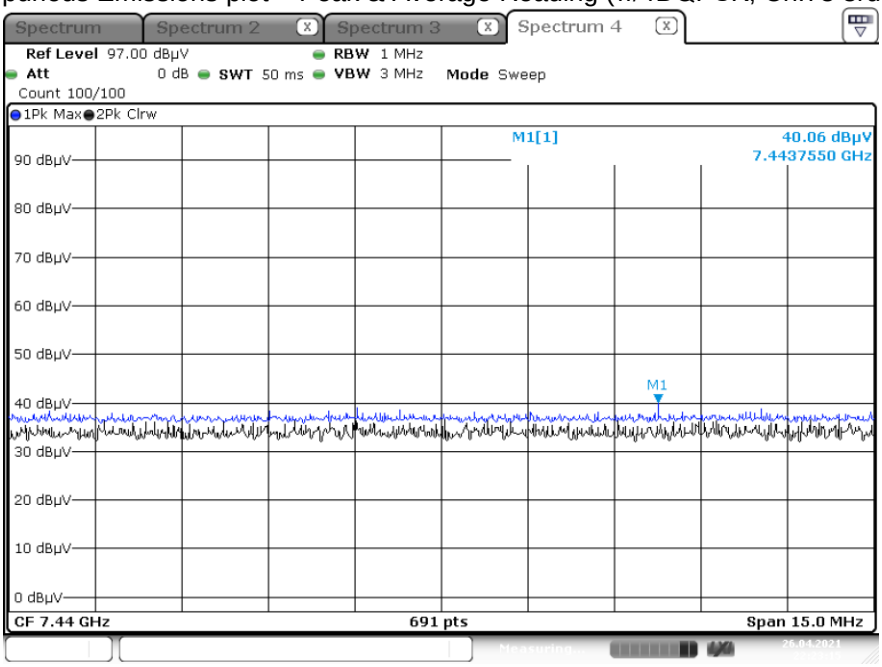
Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	41.66	4.55	V	0.00	46.21	73.98	27.77	PK
4960	41.66	4.55	V	-24.73	21.48	53.98	32.50	AV
7440	39.49	12.60	V	0.00	52.09	73.98	21.89	PK
7440	39.49	12.60	V	-24.73	27.36	53.98	26.62	AV
4960	41.72	4.55	H	0.00	46.27	73.98	27.71	PK
4960	41.72	4.55	H	-24.73	21.54	53.98	32.44	AV
7440	38.96	12.60	H	0.00	51.56	73.98	22.42	PK
7440	38.96	12.60	H	-24.73	26.83	53.98	27.15	AV

RESULT PLOTS (Worst case : Y-H)

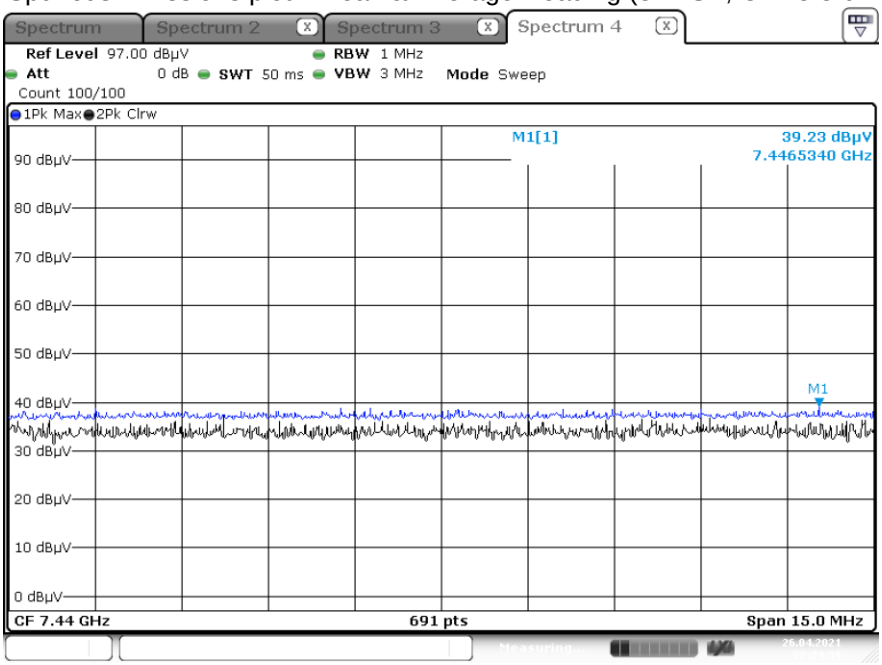
Radiated Spurious Emissions plot – Peak & Average Reading (GFSK, Ch.78 3rd Harmonic)



Radiated Spurious Emissions plot – Peak & Average Reading (π/4DQPSK, Ch.78 3rd Harmonic)



Radiated Spurious Emissions plot – Peak & Average Reading (8DPSK, Ch.78 3rd Harmonic)

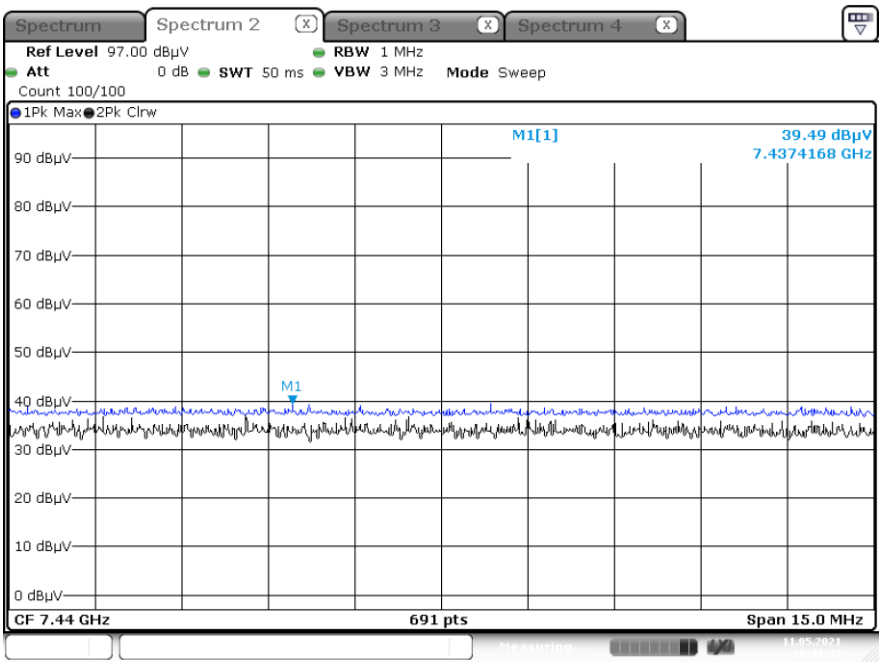


Note:

Plot of worst case are only reported.

[Non-DBS Mode]

Radiated Spurious Emissions plot – Peak & Average Reading (Test case 3, Z-V, 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 -A.G+ATT [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	50.91	3.32	H	0	54.23	73.98	19.75	PK
2390.0	50.91	3.32	H	-24.73	29.50	53.98	24.48	AV
2390.0	51.67	3.32	V	0	54.99	73.98	18.99	PK
2390.0	51.67	3.32	V	-24.73	30.26	53.98	23.72	AV
2483.5	54.86	3.78	H	0	58.64	73.98	15.34	PK
2483.5	54.86	3.78	H	-24.73	33.91	53.98	20.07	AV
2483.5	64.20	3.78	V	0	67.98	73.98	6.00	PK
2483.5	64.20	3.78	V	-24.73	43.25	53.98	10.73	AV

Operation Mode	EDR(π/4DQPSK)
Operating Frequency	2402 MHz, 2480 MHz
Channel No	CH 0, CH 78

Frequency [MHz]	Reading [dBuV]	A.F + C.L + D.F -A.G+ATT [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	49.42	3.32	H	0	52.74	73.98	21.24	PK
2390.0	49.42	3.32	H	-24.73	28.01	53.98	25.97	AV
2390.0	50.88	3.32	V	0	54.20	73.98	19.78	PK
2390.0	50.88	3.32	V	-24.73	29.47	53.98	24.51	AV
2483.5	52.36	3.78	H	0	56.14	73.98	17.84	PK
2483.5	52.36	3.78	H	-24.73	31.41	53.98	22.57	AV
2483.5	63.51	3.78	V	0	67.29	73.98	6.69	PK
2483.5	63.51	3.78	V	-24.73	42.56	53.98	11.42	AV

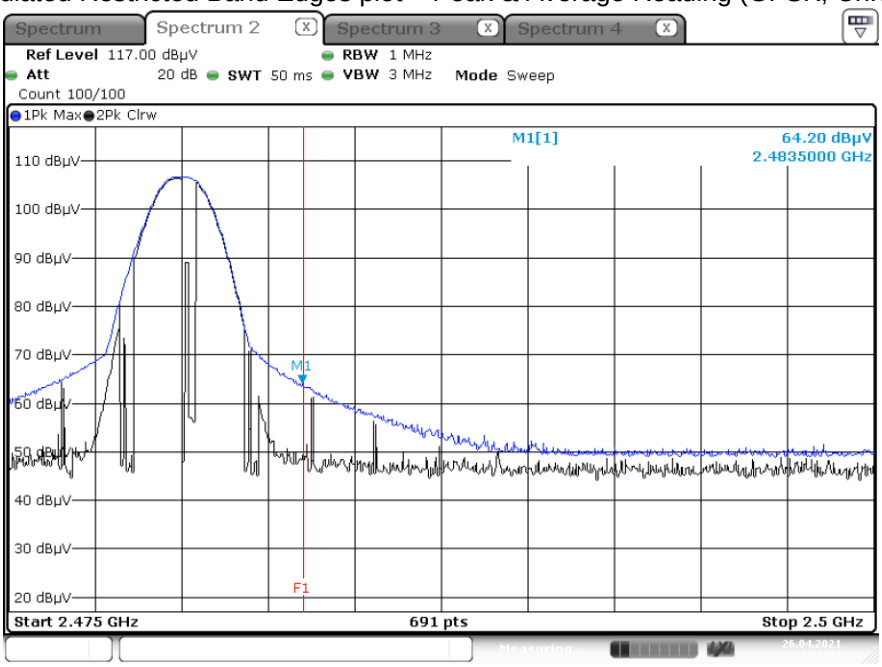
Operation Mode	EDR(8DPSK)
Operating Frequency	2402 MHz, 2480 MHz
Channel No	CH 0, CH 78

Frequency [MHz]	Reading [dBuV]	A.F + C.L + D.F -A.G+ATT [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	50.11	3.32	H	0	53.43	73.98	20.55	PK
2390.0	50.11	3.32	H	-24.73	28.70	53.98	25.28	AV
2390.0	50.78	3.32	V	0	54.10	73.98	19.88	PK
2390.0	50.78	3.32	V	-24.73	29.37	53.98	24.61	AV
2483.5	51.58	3.78	H	0	55.36	73.98	18.62	PK
2483.5	51.58	3.78	H	-24.73	30.63	53.98	23.35	AV
2483.5	63.56	3.78	V	0	67.34	73.98	6.64	PK
2483.5	63.56	3.78	V	-24.73	42.61	53.98	11.37	AV

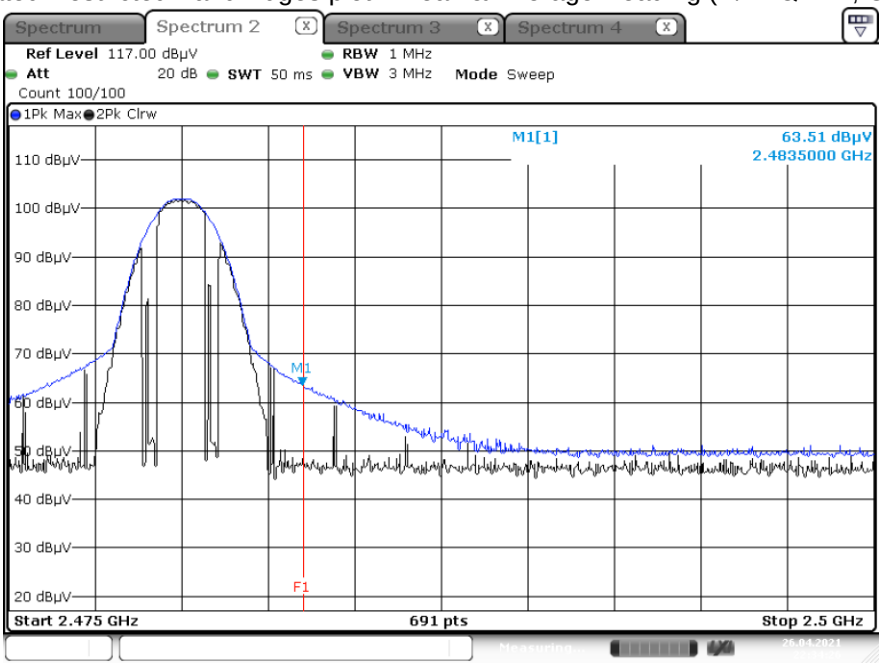
RESULT PLOTS

(Worst case : Z-V)

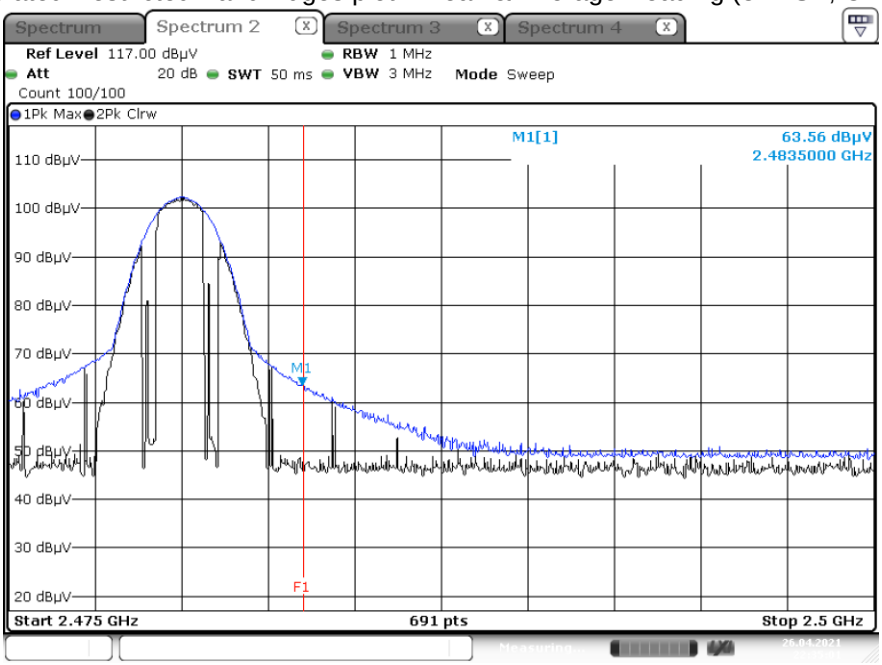
Radiated Restricted Band Edges plot – Peak & Average Reading (GFSK, Ch.78)



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



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



Note:

Plot of worst case are only reported.

10.7 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions (Line 1)

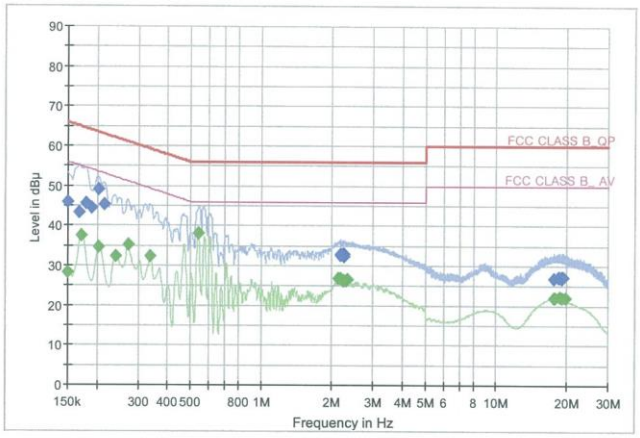
BT MODE_L1 1 / 2

Test Report

Common Information

EUT :	SM-G990U
Manufacturer :	SAMSUNG
Test Site:	SHIELD ROOM
Operating Conditions :	BT MODE_L1

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	45.97	66.00	20.03	9.000	L1	OFF	9.7
0.1680	43.32	65.06	21.74	9.000	L1	OFF	9.6
0.1793	45.52	64.52	19.00	9.000	L1	OFF	9.6
0.1905	44.31	64.02	19.70	9.000	L1	OFF	9.6
0.2040	49.01	63.45	14.44	9.000	L1	OFF	9.6
0.2153	45.15	63.00	17.85	9.000	L1	OFF	9.6
2.1718	32.59	56.00	23.41	9.000	L1	OFF	9.7
2.1763	32.96	56.00	23.04	9.000	L1	OFF	9.7
2.1808	32.90	56.00	23.10	9.000	L1	OFF	9.7
2.2213	32.87	56.00	23.13	9.000	L1	OFF	9.7
2.2640	32.83	56.00	23.17	9.000	L1	OFF	9.7
2.2685	32.45	56.00	23.55	9.000	L1	OFF	9.7
17.5865	26.71	60.00	33.29	9.000	L1	OFF	10.3
18.5810	27.08	60.00	32.92	9.000	L1	OFF	10.4
18.7880	27.02	60.00	32.98	9.000	L1	OFF	10.4
19.0738	26.98	60.00	33.02	9.000	L1	OFF	10.4
19.1998	26.92	60.00	33.08	9.000	L1	OFF	10.4
19.2605	27.13	60.00	32.87	9.000	L1	OFF	10.4

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BT MODE_L1 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	28.26	56.00	27.74	9.000	L1	OFF	9.7
0.1725	37.37	54.84	17.47	9.000	L1	OFF	9.6
0.2040	34.64	53.45	18.81	9.000	L1	OFF	9.6
0.2400	32.23	52.10	19.86	9.000	L1	OFF	9.6
0.2715	35.19	51.07	15.88	9.000	L1	OFF	9.6
0.3368	32.26	49.28	17.02	9.000	L1	OFF	9.6
0.5405	38.19	46.00	7.81	9.000	L1	OFF	9.6
2.1403	26.89	46.00	19.11	9.000	L1	OFF	9.7
2.1785	26.96	46.00	19.04	9.000	L1	OFF	9.7
2.2190	26.26	46.00	19.74	9.000	L1	OFF	9.7
2.2640	26.36	46.00	19.64	9.000	L1	OFF	9.7
2.3023	26.39	46.00	19.61	9.000	L1	OFF	9.7
2.3450	26.41	46.00	19.59	9.000	L1	OFF	9.8
17.5865	21.86	50.00	28.14	9.000	L1	OFF	10.3
17.9668	21.94	50.00	28.06	9.000	L1	OFF	10.3
18.6778	22.09	50.00	27.91	9.000	L1	OFF	10.4
19.1728	22.06	50.00	27.94	9.000	L1	OFF	10.4
19.7353	21.81	50.00	28.19	9.000	L1	OFF	10.4

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Conducted Emissions (Line 2)

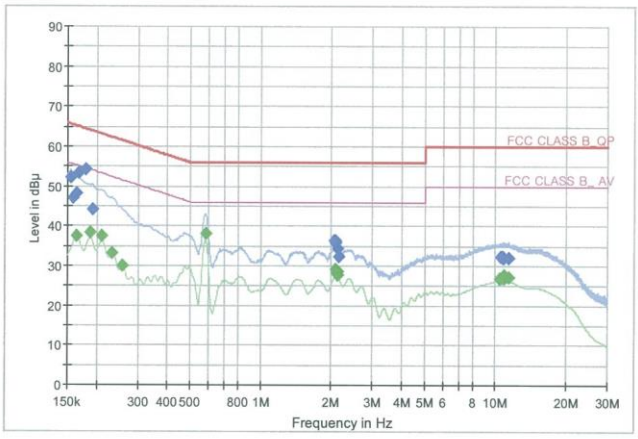
BT MODE_N 1 / 2

Test Report

Common Information

EUT :	SM-G990U
Manufacturer :	SAMSUNG
Test Site:	SHIELD ROOM
Operating Conditions :	BT MODE_N

Full Spectrum



Preview Result 2-AVG
FCC CLASS B_AV
Preview Result 1-PK+
Final_Result QPK
FCC CLASS B_QP
Final_Result CAV

Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	52.17	65.75	13.58	9.000	N	OFF	9.6
0.1590	46.90	65.52	18.62	9.000	N	OFF	9.6
0.1635	48.28	65.28	17.01	9.000	N	OFF	9.6
0.1680	53.46	65.06	11.60	9.000	N	OFF	9.6
0.1793	54.10	64.52	10.42	9.000	N	OFF	9.6
0.1928	44.21	63.92	19.71	9.000	N	OFF	9.6
2.0705	36.48	56.00	19.52	9.000	N	OFF	9.7
2.0750	36.30	56.00	19.70	9.000	N	OFF	9.7
2.0795	36.00	56.00	20.00	9.000	N	OFF	9.7
2.0930	35.72	56.00	20.28	9.000	N	OFF	9.7
2.1290	34.22	56.00	21.78	9.000	N	OFF	9.7
2.1650	32.18	56.00	23.82	9.000	N	OFF	9.7
10.4833	32.18	60.00	27.82	9.000	N	OFF	10.1
10.6655	32.18	60.00	27.82	9.000	N	OFF	10.1
10.7420	32.11	60.00	27.89	9.000	N	OFF	10.1
10.8208	32.17	60.00	27.83	9.000	N	OFF	10.1
10.9490	32.10	60.00	27.90	9.000	N	OFF	10.2
11.4305	32.01	60.00	27.99	9.000	N	OFF	10.2

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BT MODE_N 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1635	37.49	55.28	17.80	9.000	N	OFF	9.6
0.1883	38.32	54.11	15.80	9.000	N	OFF	9.6
0.2108	37.50	53.18	15.68	9.000	N	OFF	9.6
0.2333	33.19	52.33	19.14	9.000	N	OFF	9.6
0.2580	30.12	51.50	21.37	9.000	N	OFF	9.6
0.5833	38.08	46.00	7.92	9.000	N	OFF	9.6
2.0908	29.21	46.00	16.79	9.000	N	OFF	9.7
2.0998	28.31	46.00	17.69	9.000	N	OFF	9.7
2.1043	27.85	46.00	18.15	9.000	N	OFF	9.7
2.1133	28.68	46.00	17.32	9.000	N	OFF	9.7
2.1223	28.48	46.00	17.52	9.000	N	OFF	9.7
2.1313	27.56	46.00	18.44	9.000	N	OFF	9.7
10.4788	26.84	50.00	23.16	9.000	N	OFF	10.1
10.5328	26.79	50.00	23.21	9.000	N	OFF	10.1
10.5553	26.83	50.00	23.17	9.000	N	OFF	10.1
10.8838	26.86	50.00	23.14	9.000	N	OFF	10.2
10.9490	27.67	50.00	22.33	9.000	N	OFF	10.2
11.4305	27.02	50.00	22.98	9.000	N	OFF	10.2

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11. LIST OF TEST EQUIPMENT

Conducted Test

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216 / LISN	09/04/2020	Annual	102245
Rohde & Schwarz	ESR / EMI Test Receiver	09/16/2020	Annual	101910
ESPEC	SU-642 /Temperature Chamber	07/30/2020	Annual	0093000718
Agilent	N9020A / Signal Analyzer	05/03/2021	Annual	MY51110085
Agilent	N9030A / Signal Analyzer	03/09/2021	Annual	MY49432108
Agilent	N1911A / Power Meter	04/08/2021	Annual	MY45100523
Agilent	N1921A / Power Sensor	04/08/2021	Annual	MY57820067
Agilent	87300B / Directional Coupler	11/10/2020	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	02/09/2021	Annual	10545
HP	E3632A / DC Power Supply	09/16/2020	Annual	MY40004427
HP	8493C / Attenuator(10 dB)(DC-26.5 GHz)	06/26/2020	Annual	07560
HP	8493C / Attenuator(10 dB)(DC-26.5 GHz)	07/03/2020	Annual	08285
Rohde & Schwarz	18N-20dB / Attenuator(20 dB)	03/08/2021	Annual	8
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	02/23/2021	Annual	100808

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
Audix	EM1000 / Controller	N/A	N/A	060520
Audix	Turn Table	N/A	N/A	N/A
TNM system	FBSM-01B / Amp & Filter Bank Switch Controller	N/A	N/A	N/A
Schwarzbeck	Loop Antenna	03/19/2020	Biennial	1513-333
Schwarzbeck	VULB 9168 / Hybrid Antenna	08/02/2019	Biennial	01039
Schwarzbeck	BBHA 9120D / Horn Antenna	08/01/2019	Biennial	9120D-1151
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	02/11/2020	Biennial	BBHA9170124
Rohde & Schwarz	FSV(10 Hz ~ 40 GHz) / Spectrum Analyzer	05/14/2021	Annual	101055
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	01/06/2021	Annual	2
Wainwright Instruments	WRCJV12-4900-5100-5900-6100-50SS	06/24/2021	Annual	5
Wainwright Instruments	WRCJV12-4900-5100-5900-6100-50SS	06/24/2021	Annual	6
CERNEX	CBL18265035 / Power Amplifier	12/04/2020	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	03/23/2021	Annual	25956
TNM system	FBSM-05B / HPF(3~18GHz) + LNA1(1~18GHz)	01/20/2021	Annual	F6
TNM system	FBSM-05B / ATT(10dB) + LNA1(1~18GHz)	01/20/2021	Annual	None
TNM system	FBSM-05B / ATT(3dB) + LNA1(1~18GHz)	01/20/2021	Annual	None
TNM system	FBSM-05B / LNA1(1~18GHz)	01/20/2021	Annual	25540
TNM system	FBSM-05B / HPF(7~18GHz) + LNA2(6~18GHz)	01/20/2021	Annual	28550
TNM system	FBSM-05B / Thru(30MHz ~ 18GHz)	01/20/2021	Annual	None
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	02/08/2021	Annual	1
Weinschel	2-3 / Attenuator (3 dB)	10/07/2020	Annual	BR0617
H+S	5910-N-50-010 / Attenuator(10 dB)	10/28/2020	Annual	None
Rohde & Schwarz	ESCI / Test Receiver	06/10/2020	Annual	100584
TESCOM	TC-3000C / Bluetooth Tester	04/19/2021	Annual	3000C000175

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

12. ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-2105-FC034-P