HCT CO.,LTD.
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:
September 17, 2021

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

Report No.: HCT-RF-2109-FC020

FCC ID:	**A3LSMG990E**
APPLICANT:	**SAMSUNG Electronics Co., Ltd.**

Model:	SM-G990E/DS
Additional Model:	SM-G990E
EUT Type:	Mobile Phone
Max. RF Output Power:	15.181 dBm (32.97 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 (DSS)
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 : Jin Gwan Lee
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-2109-FC020	September 17, 2021	- First Approval Report

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1. EUT DESCRIPTION

Model	SM-G990E/DS
Additional Model	SM-G990E
EUT Type	Mobile Phone
Power Supply	DC 4.20 V
Frequency Range	2 402 MHz ~ 2 480 MHz
Max. RF Output Power	15.181 dBm (32.97 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	August 18, 2021 ~ September 10, 2021
Serial number	Radiated: R3CR803NW1R Conducted: R3CR803N9YT

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 2.4 GHz and 5 GHz bands simultaneously on each antenna.

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

Non-DBS	5 GHz WiFi Ant.1	5 GHz WiFi Ant.2	Bluetooth
5 GHz 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.

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 30 MHz 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 1 GHz. Above 1 GHz with 1.5 m 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 equipment's, 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."

(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 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.05 (Confidence level about 95 %, k=2)

8. DESCRIPTION OF TESTS

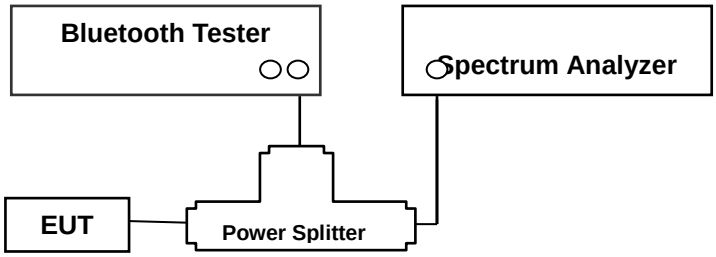
8.1. Conducted Maximum Peak Output Power

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 Measured Power + Power Splitter loss + Cable loss(2 ea)

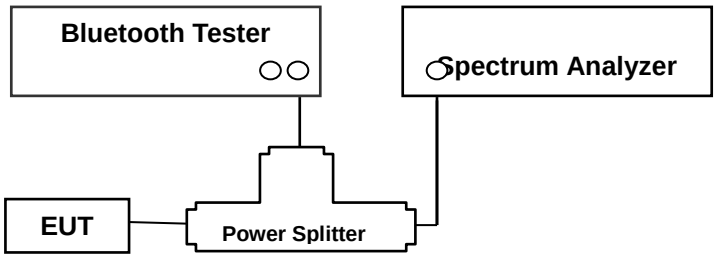
= 10 dBm + 6 dB + 1.5 dB = 17.5 dBm

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)

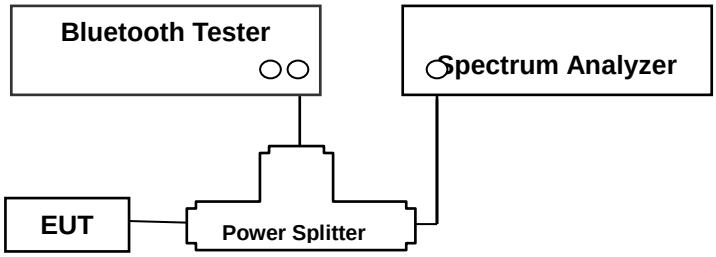
1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer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

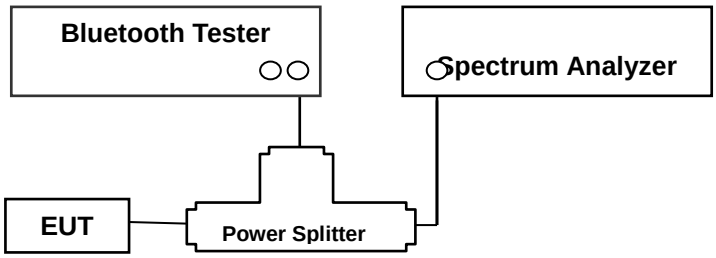
1) Span: Set between two times and five times the OBW
2) RBW: 1 % to 5 % of the OBW.
3) VBW ≥ 3 x RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) All the trace to stabilize.

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)

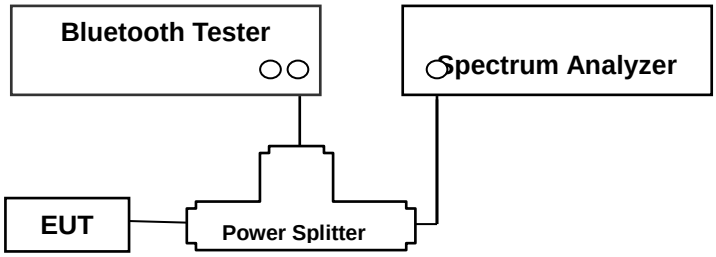
1) Span: the frequency band of operation
2) RBW: To identify clearly the individual channels, set the RBW to less than 30 % of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3) VBW ≥ RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) Allow the trace to stabilize.

8.5. Time of Occupancy

Limit

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5MHz 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.

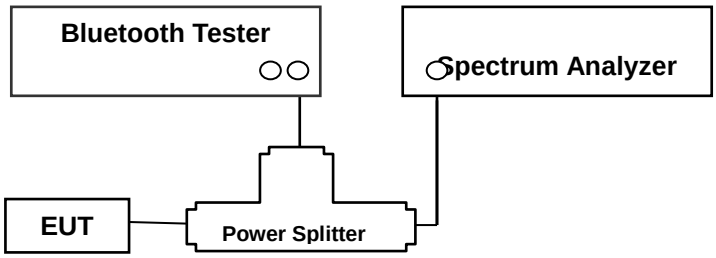
Dwell time = Tx-time x 106.667 = 308.27 (ms)

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	6.44
100	6.54
200	6.64
300	6.73
400	6.85
500	6.85
600	6.85
700	6.91
800	6.93
900	6.96
1000	7.06
2000	7.38
2400	7.55
2500	7.54
3000	7.96
4000	7.70
5000	7.82
6000	8.03
7000	8.03
8000	8.13
9000	8.17
10 000	8.38
11 000	8.40
12 000	8.51
13 000	8.68
14 000	8.77
15 000	8.91
16 000	8.96
17 000	8.98
18 000	9.19
19 000	9.19
20 000	9.44
21 000	9.63
22 000	9.50
23 000	9.20
24 000	9.36
25 000	9.37
26 000	9.39

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

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

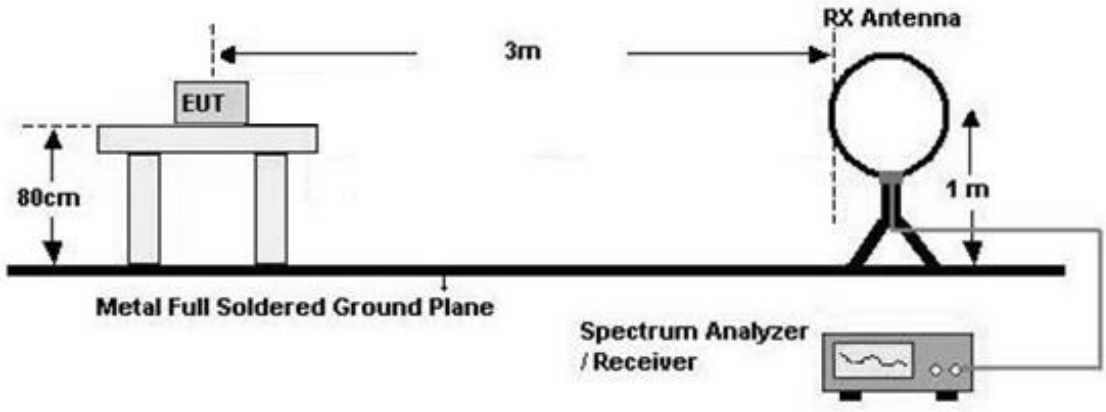
8.7. Radiated Test

Limit

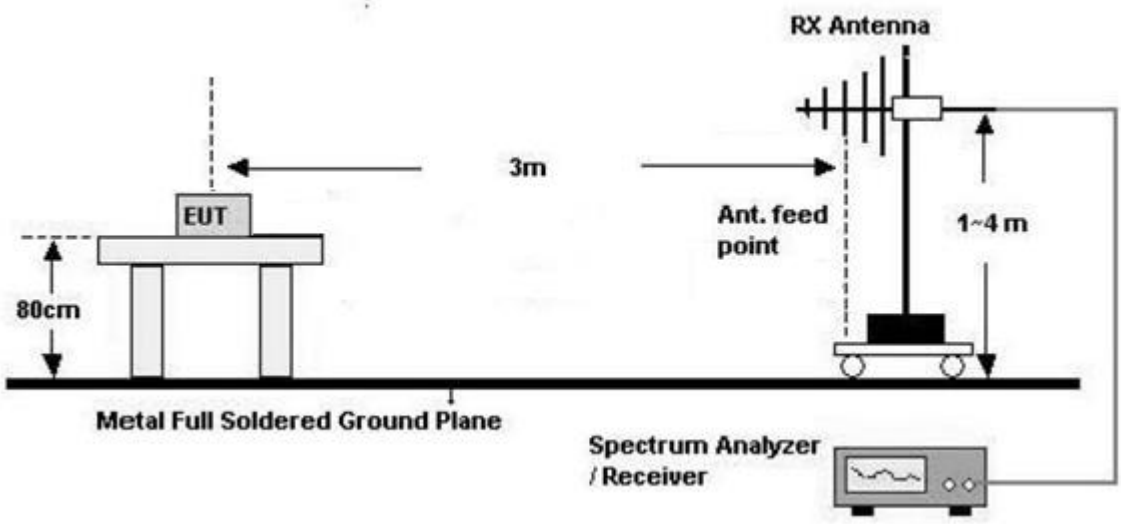
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

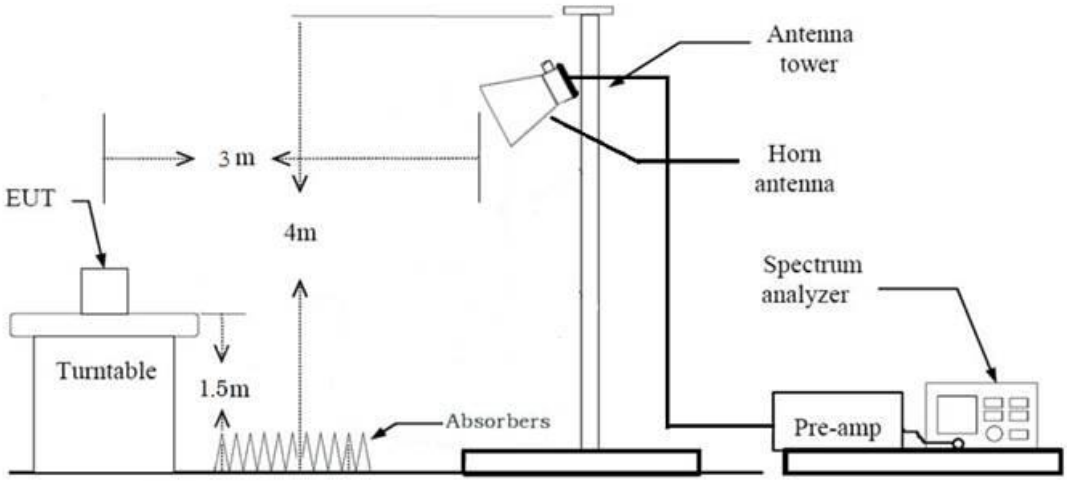
Below 30 MHz



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 3 m from the EUT
3. The EUT is placed on a turntable, which is 0.8 m 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 = Measured level + 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 1 GHz)

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 0.8 m above ground plane.
3. The Hybrid antenna was placed at a location 3 m from the EUT, which is varied from 1m to 4 m 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 = Measured level + 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):
      - 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
   ◆ 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)

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

(2)Measurement(Avg)

Measured level(Avg) + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F) + D.C.C.F(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):
   - 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

   ◆ 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) Measurement(Peak)
    = Measured level(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)

    (2) Measurement(Avg)
    = Measured level(Avg) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F) + D.C.C.F(AFH)
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) = Measured level + 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, Z
   - Radiated Restricted Band Edge : Z
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. We were performed the RSE test in condition of co-location. There has no significant emission raised.
   - WWAN+WLAN 5 GHz+BT
6. SM-G990E/DS, SM-G990E were tested and the worst case results are reported.
   (Worst case : SM-G990E/DS)

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 : X, Z
3. Test case

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

Non-DBS	5 GHz WiFi Ant.1	5 GHz WiFi Ant.2	Bluetooth Ant.1	Test case
5 GHz 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-G990E/DS [DTS], [UNII] Test Report.)

Test case	Description	2.4 GHz Emission	5 GHz Emission	Bluetooth Emission
1	Antenna	Ant 1	Ant All	-
	Channel	1	165	-
	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	6	165	-
	Data Rate	MCS0	6 Mbps	-
	Mode	802.11g	802.11a	-

Test case	Description	5 GHz Emission	Bluetooth Emission
3	Antenna	Ant All	Ant 1
	Channel	165	78
	Data Rate	6 Mbps	1 Mbps
	Mode	802.11a	GFSK

5. SM-G990E/DS, SM-G990E were tested and the worst case results are reported.
(Worst case : SM-G990E/DS)

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-G990E/DS, SM-G990E were tested and the worst case results are reported.
(Worst case : SM-G990E/DS)

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-G990E/DS, SM-G990E were tested and the worst case results are reported.
(Worst case : SM-G990E/DS)

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 20 dB 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	14.949	31.25	125
Mid	2441	13.877	24.42	
High	2480	15.181	32.97	

Channel	Frequency (MHz)	Output Power (8DPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	12.655	18.43	125
Mid	2441	13.067	20.26	
High	2480	12.179	16.52	

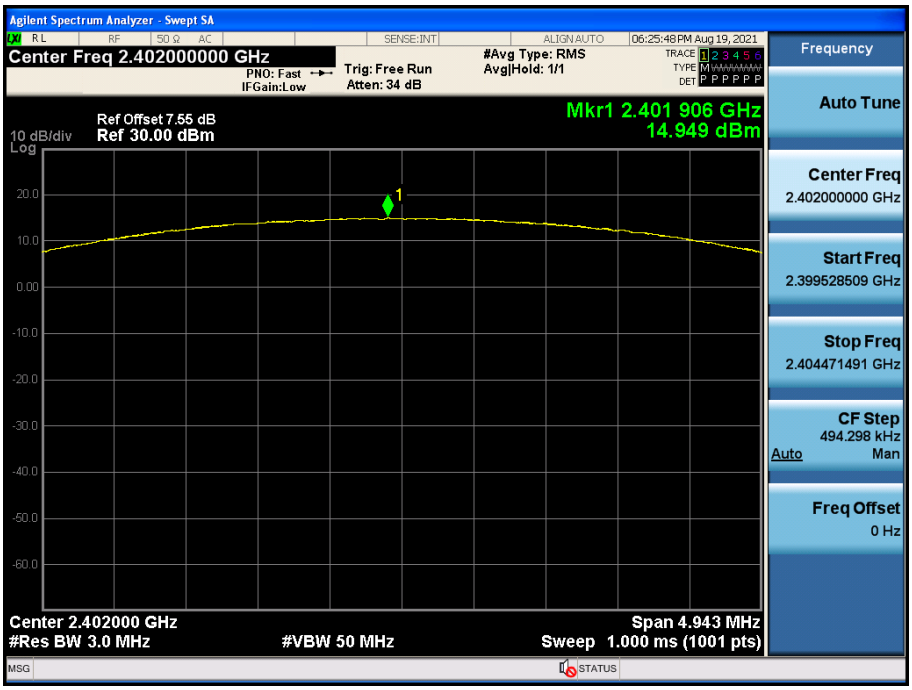
Channel	Frequency (MHz)	Output Power (π/4DQPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	12.200	16.60	125
Mid	2441	12.508	17.82	
High	2480	11.717	14.85	

Note:

1. Spectrum measured levels are not plot data.
   The power results in plot is already including the actual values of loss for the splitter and cable combination.
2. Actual value of loss for the splitter and cable combination is 7.55 dB at 2400 MHz
   and is 7.55 dB at 2500 MHz. So, 7.55 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.

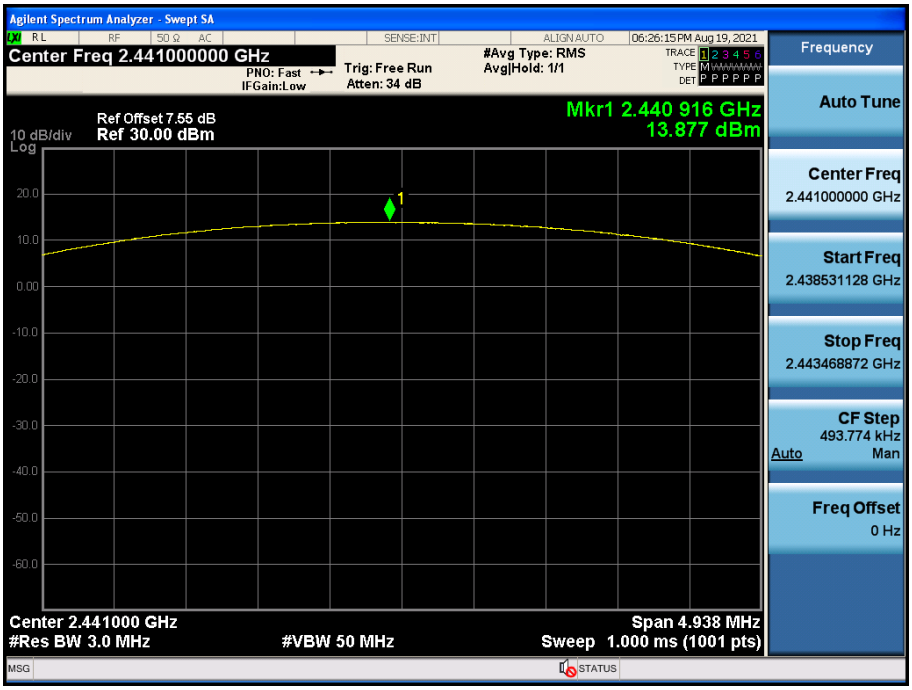
Test Plots (GFSK)

Peak Power (CH.0)



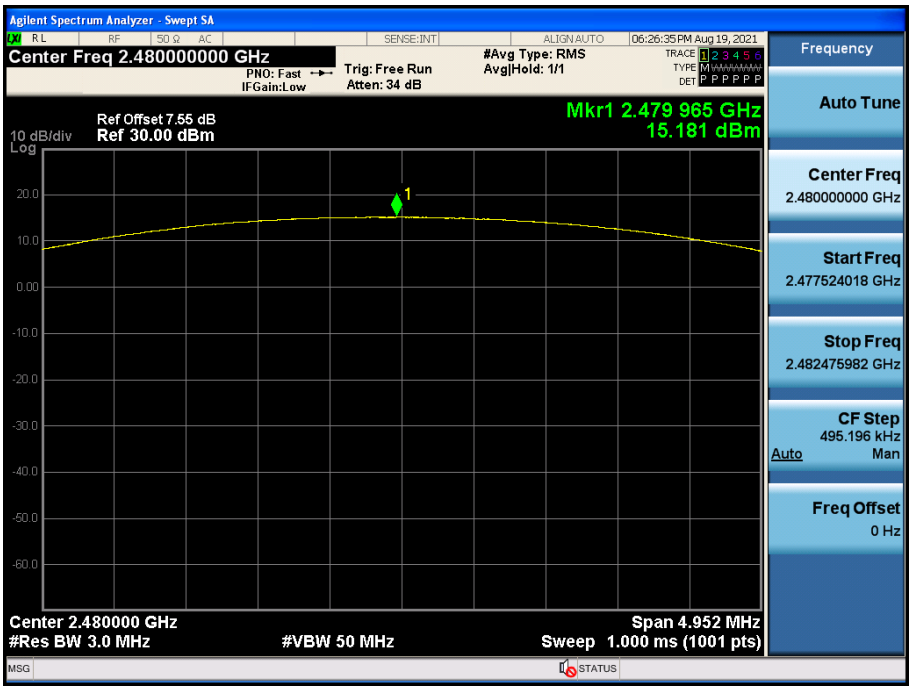
Test Plots (GFSK)

Peak Power (CH.39)



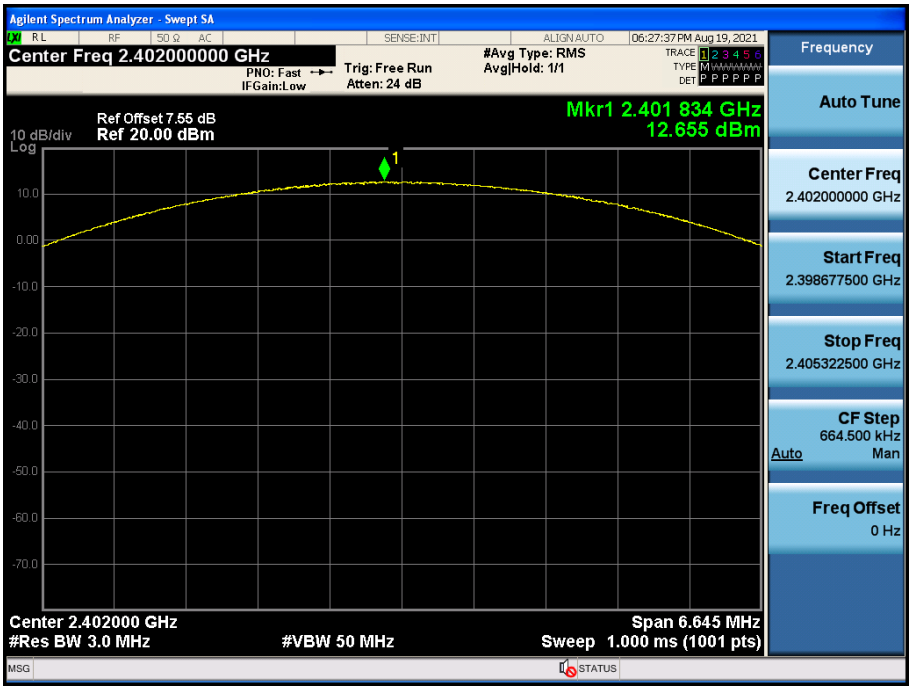
Test Plots (GFSK)

Peak Power (CH.78)



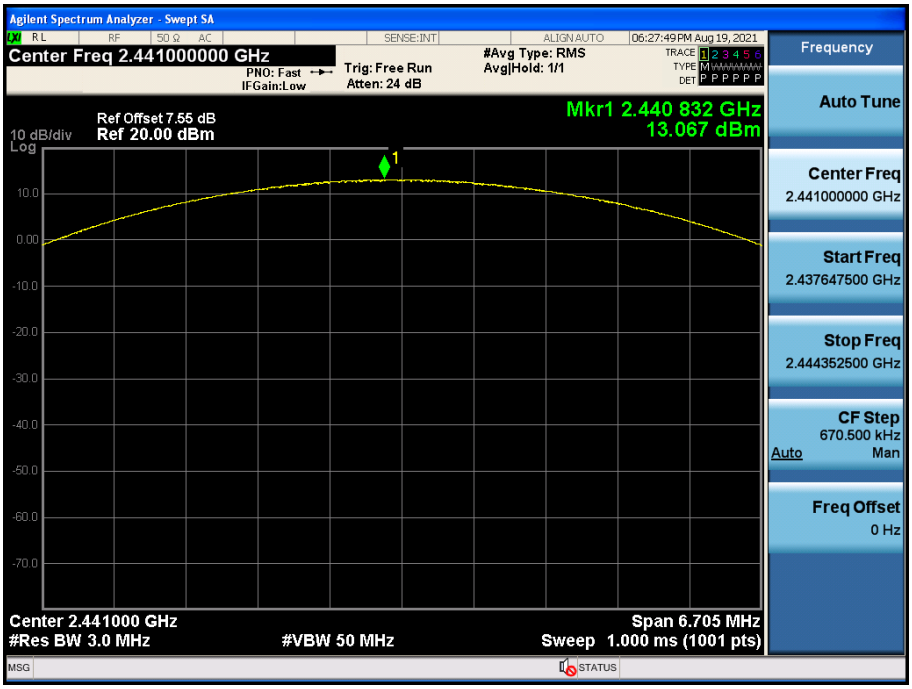
Test Plots (8DPSK)

Peak Power (CH.0)



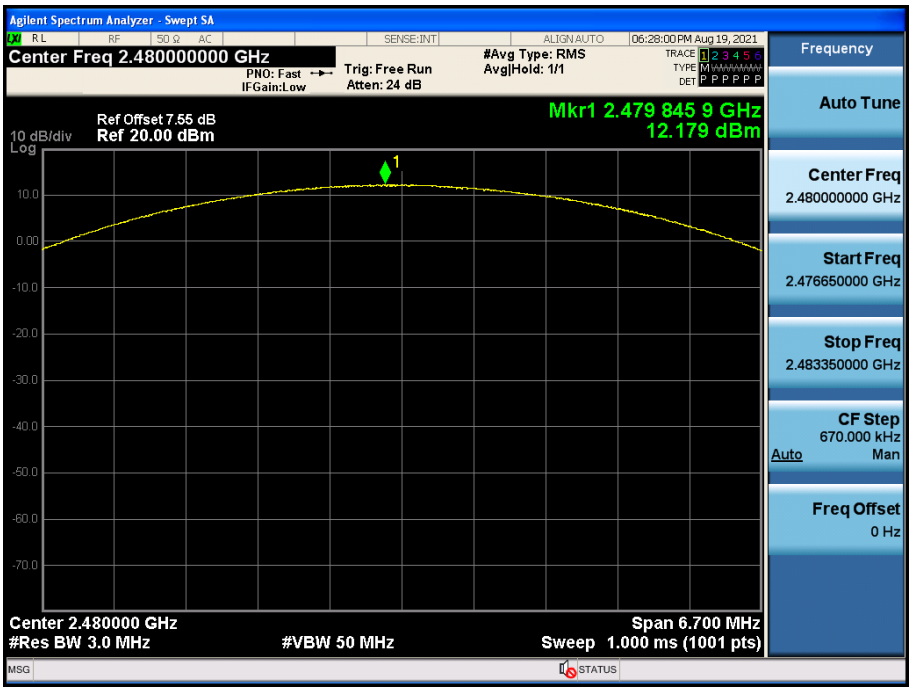
Test Plots (8DPSK)

Peak Power (CH.39)

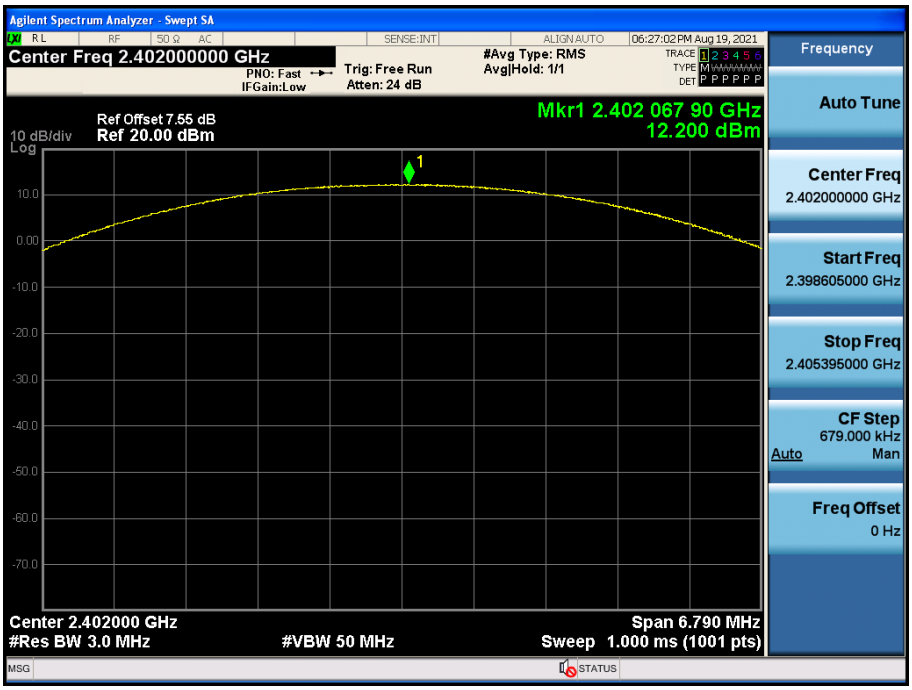


Test Plots (8DPSK)

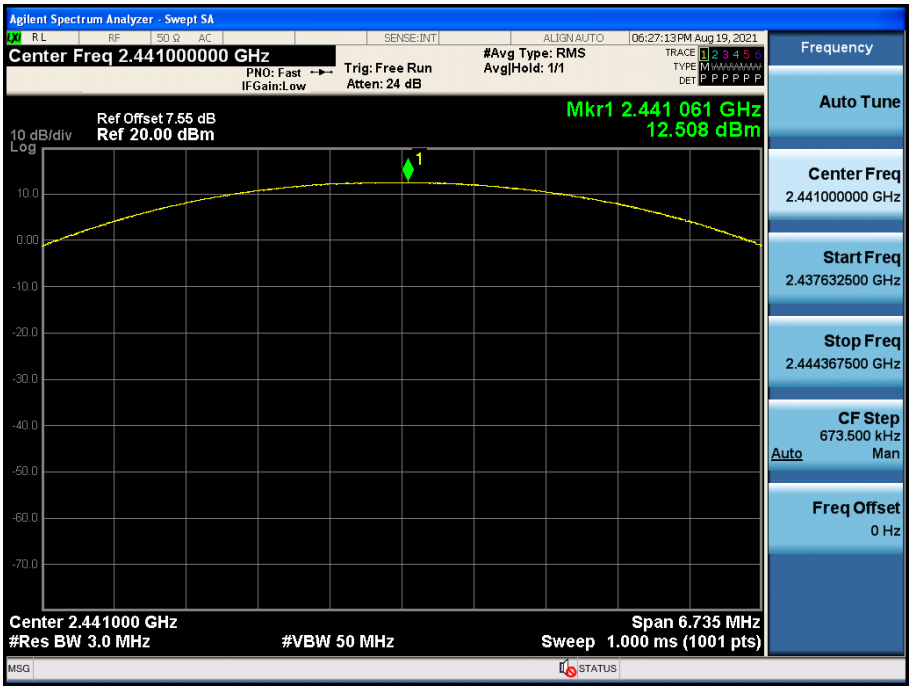
Peak Power (CH.78)



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

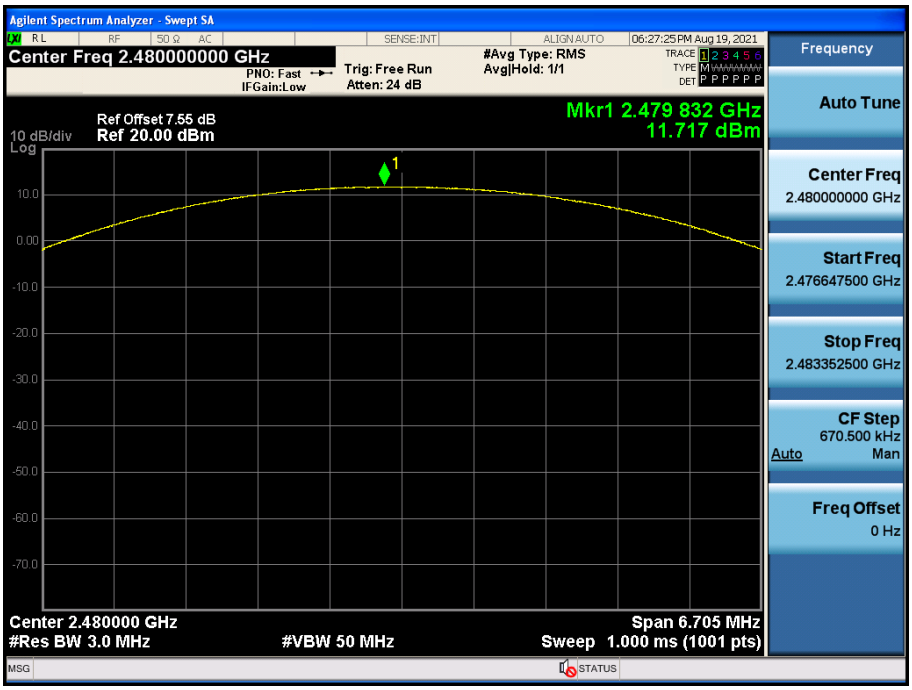


Test Plots (π/4DQPSK)
Peak Power (CH.39)



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	65.930	60.244	60.342	20
Upper	68.099	64.864	65.437	

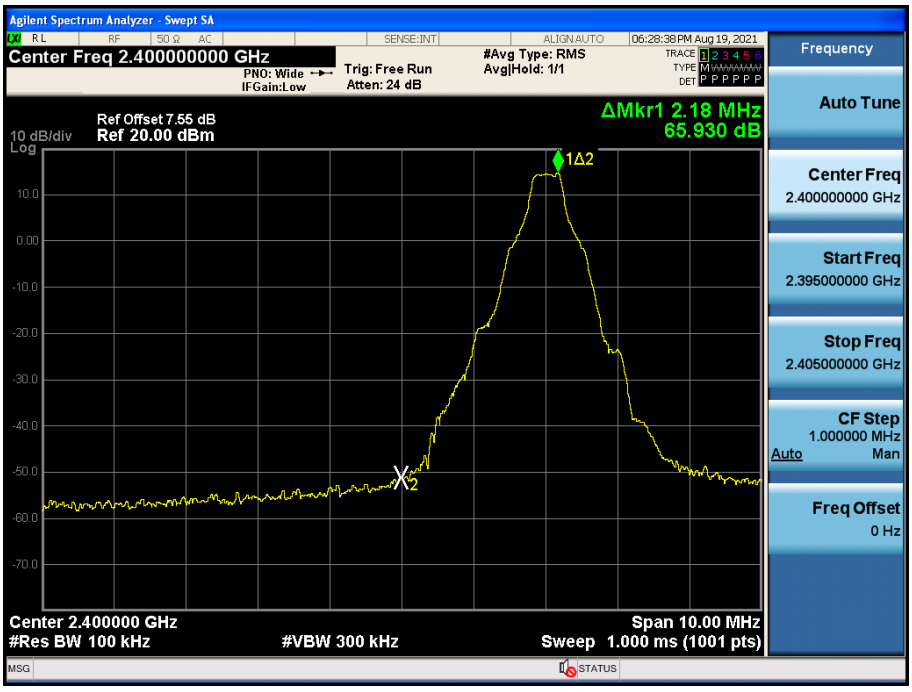
With hopping

Outside Frequency Band	GFSK (dB)	8DPSK (dB)	π/4DQPSK (dB)	Limit (dBc)
Lower	68.454	61.930	59.750	20
Upper	70.250	65.493	66.300	

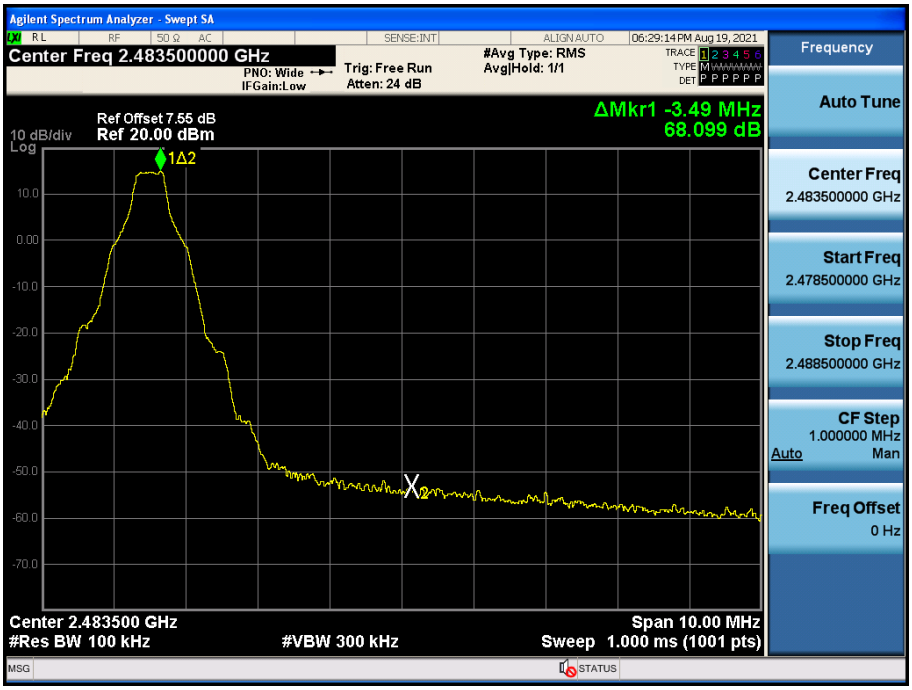
Note :

1. Spectrum measured levels are not plot data.
   The power results in plot is already including the actual values of loss for the splitter and cable combination.
2. Actual value of loss for the splitter and cable combination is 7.55 dB at 2400 MHz
   and is 7.55 dB at 2500 MHz. So, 7.55 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.

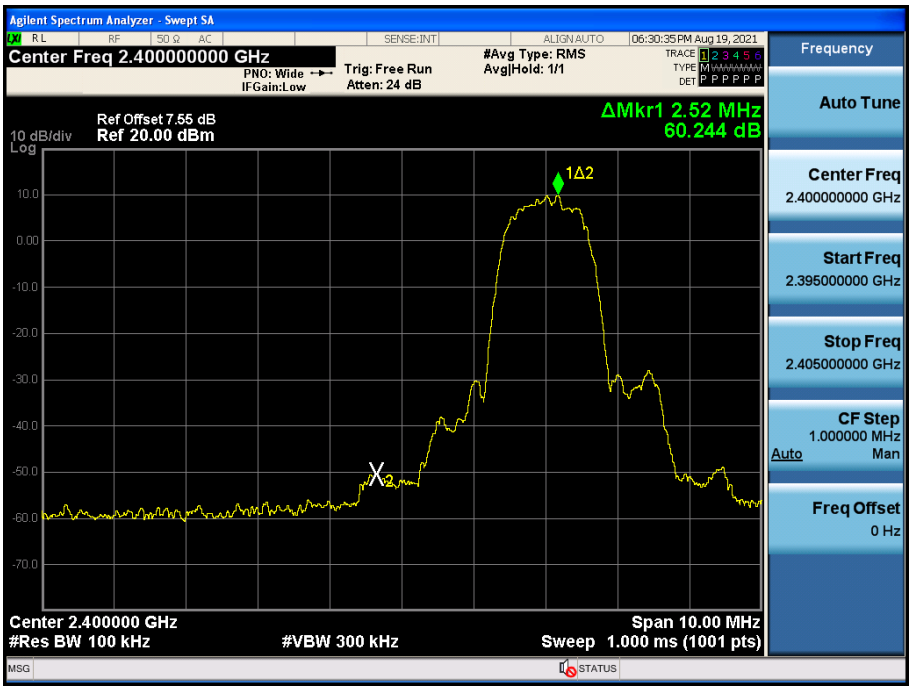
Test Plots without hopping (GFSK)
Band Edges (CH.0)



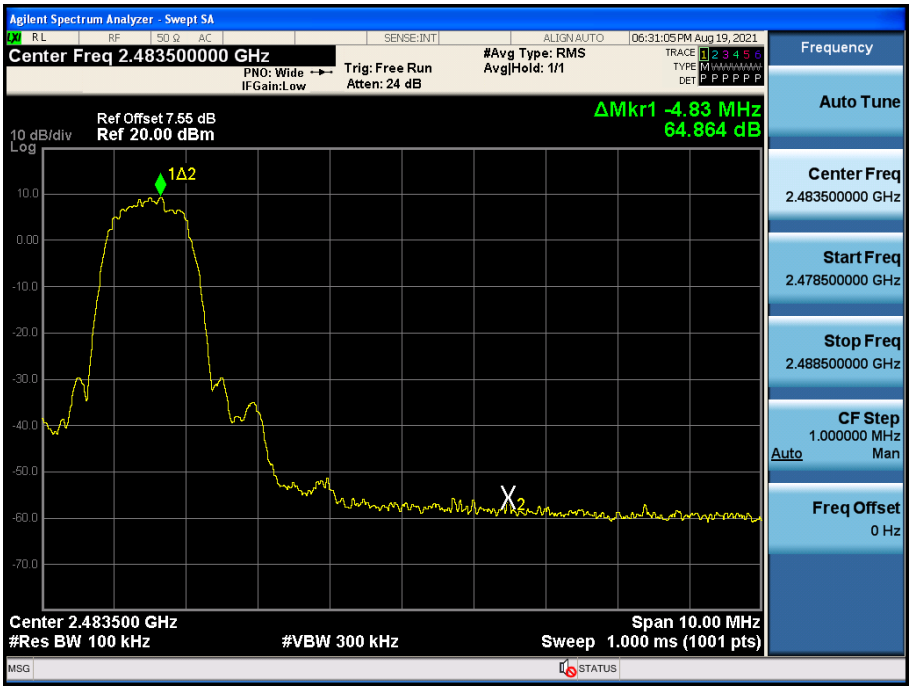
Test Plots without hopping (GFSK)
Band Edges (CH.78)



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

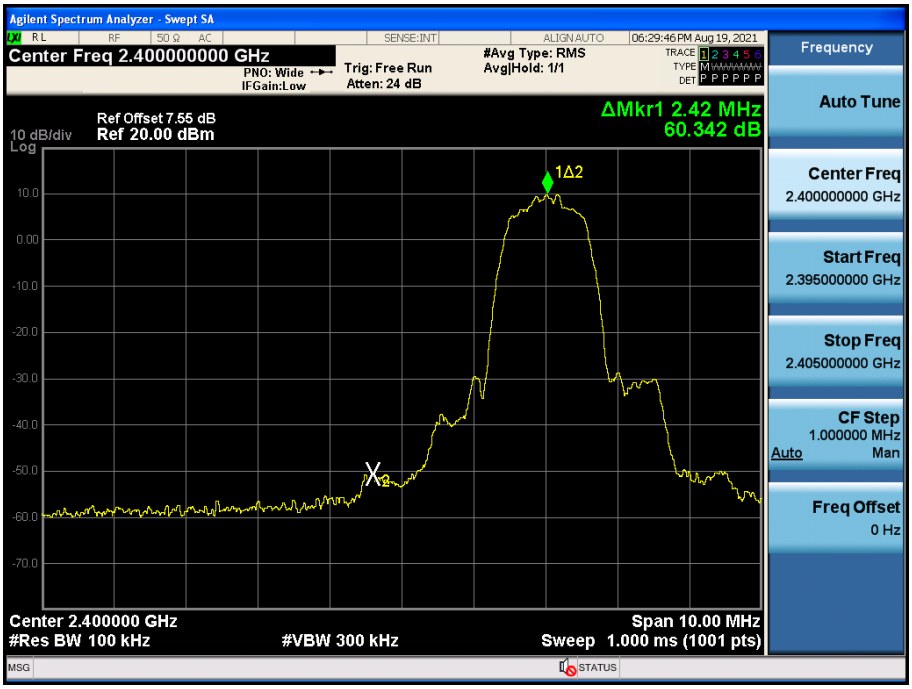


Test Plots without hopping (8DPSK)
Band Edges (CH.78)



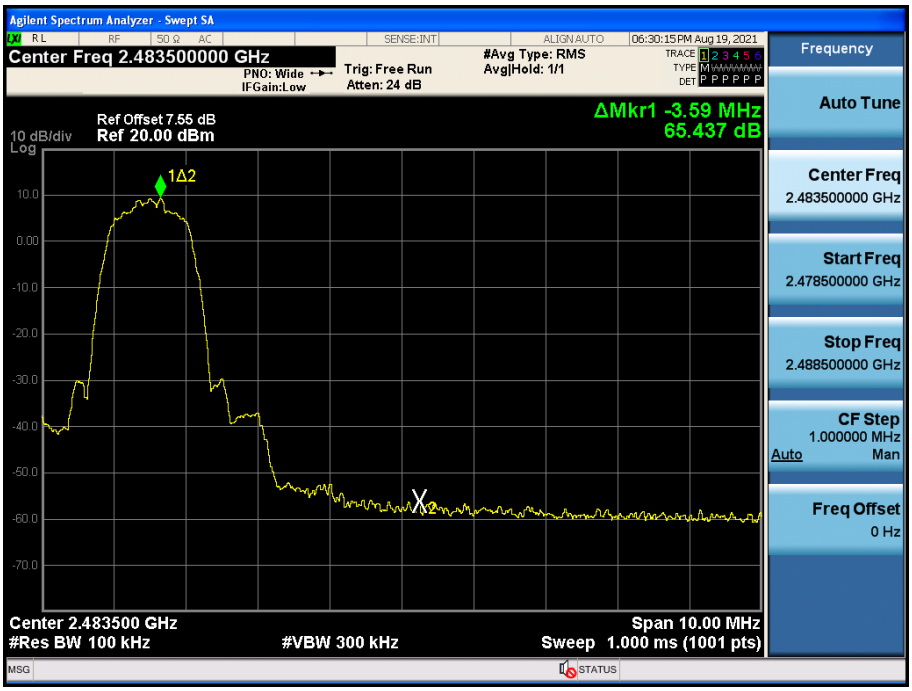
Test Plots without hopping (π/4DQPSK)

Band Edges (CH.0)

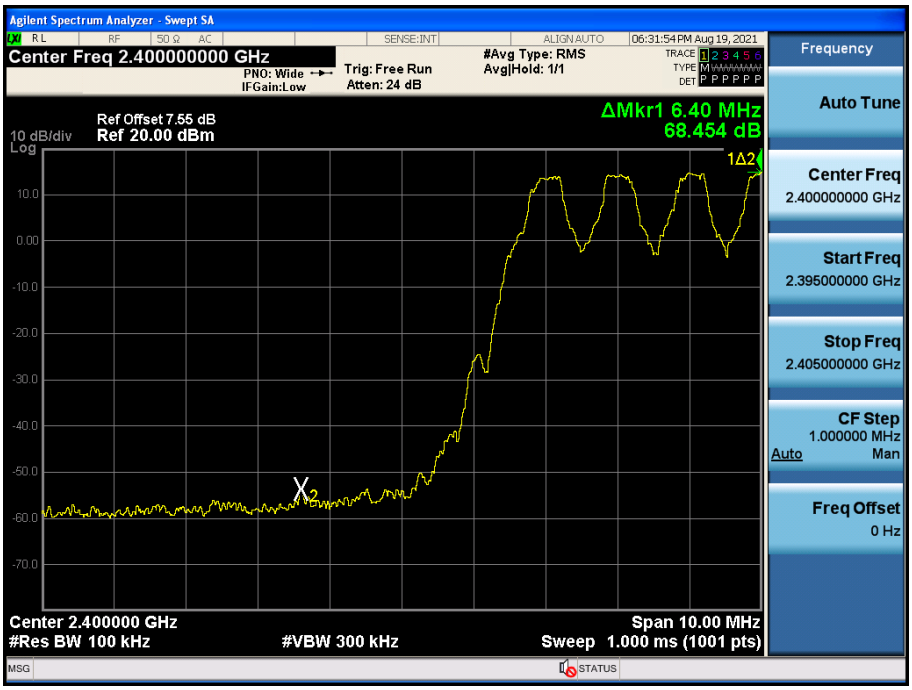


Test Plots without hopping (π/4DQPSK)

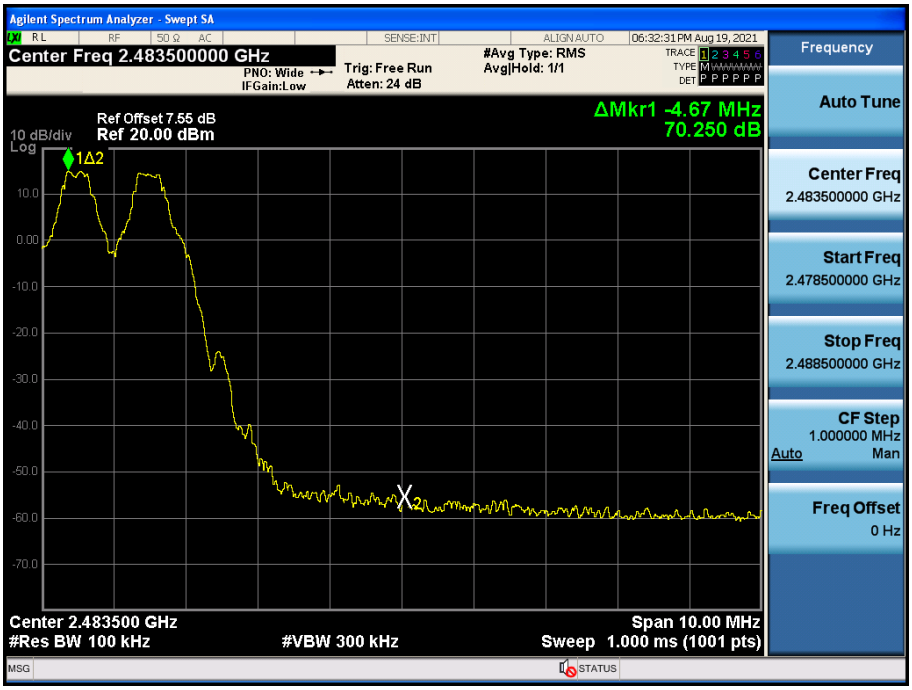
Band Edges (CH.78)



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



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



Test Plots with hopping (8DPSK)

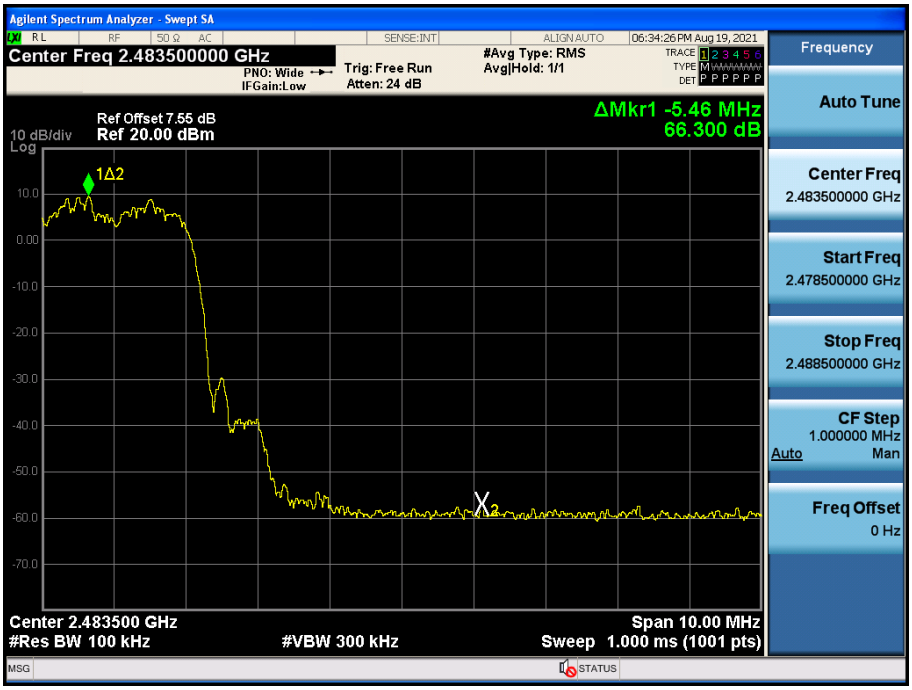
Band Edges (CH.0)

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	886.15	1206.6	1202.8
CH.39	889.05	1209.0	1199.9
CH.78	888.32	1209.4	1197.2

20 dB BW (kHz)			
Channel	**GFSK**	**8DPSK**	**π/4DQPSK**
CH.0	988.6	1329	1358
CH.39	987.5	1341	1347
CH.78	990.4	1340	1341

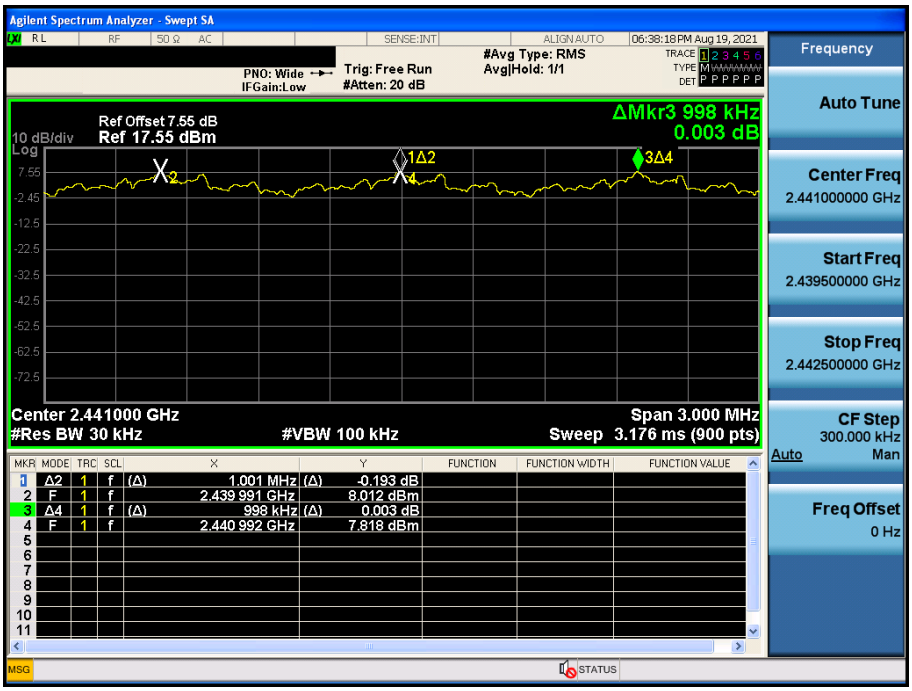
Channel Separation(kHz)			Limit
GFSK	**8DPSK**	**π/4DQPSK**	**(kHz)**
998	998	998	>25 kHz or >2/3 of the 20 dB BW

Test Plots (GFSK)

Channel Separation

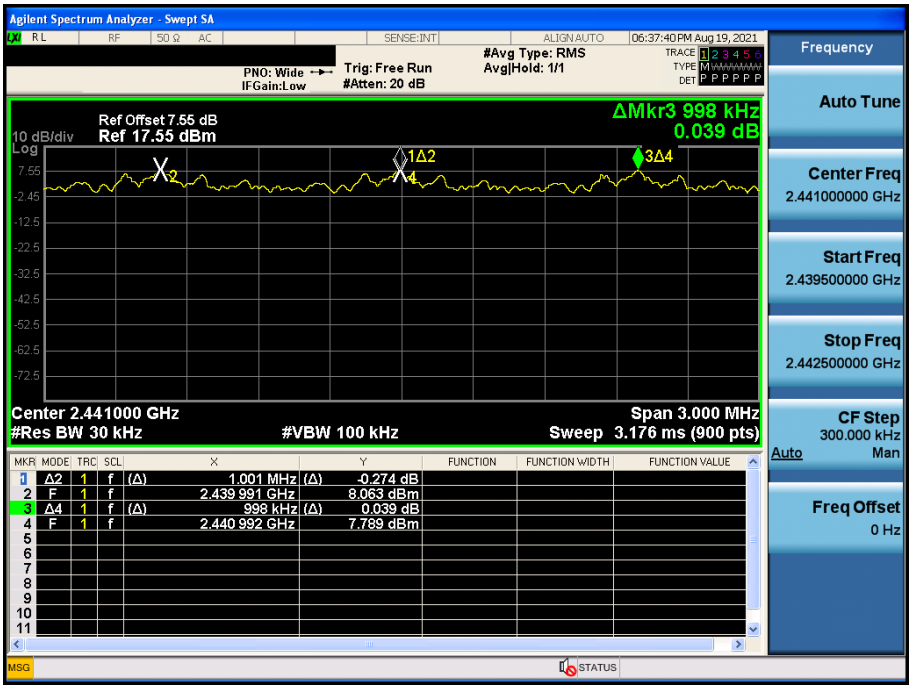
Test Plots (8DPSK)

Channel Separation



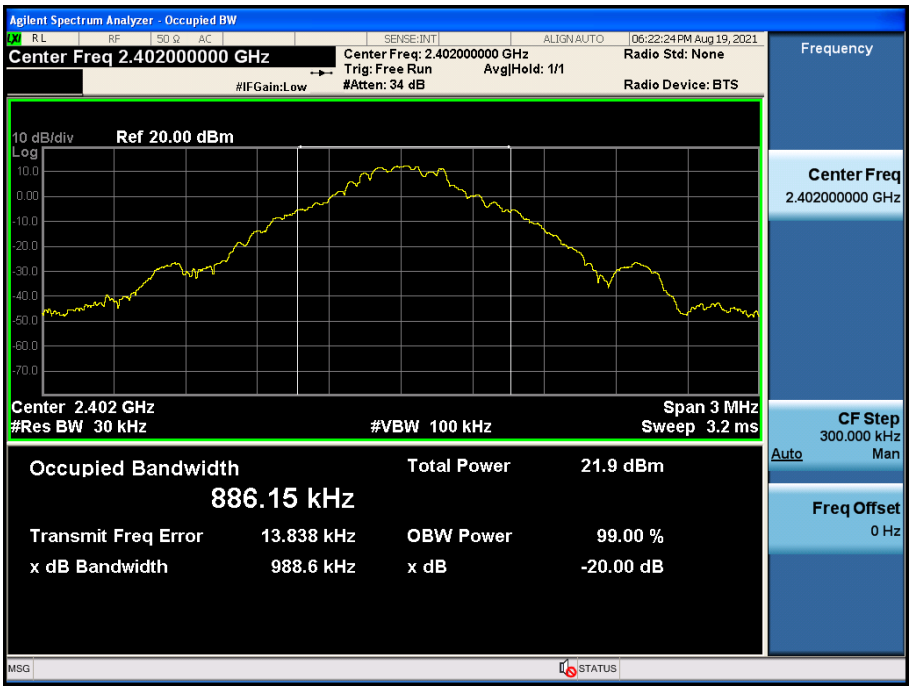
Test Plots (π/4DQPSK)

Channel Separation



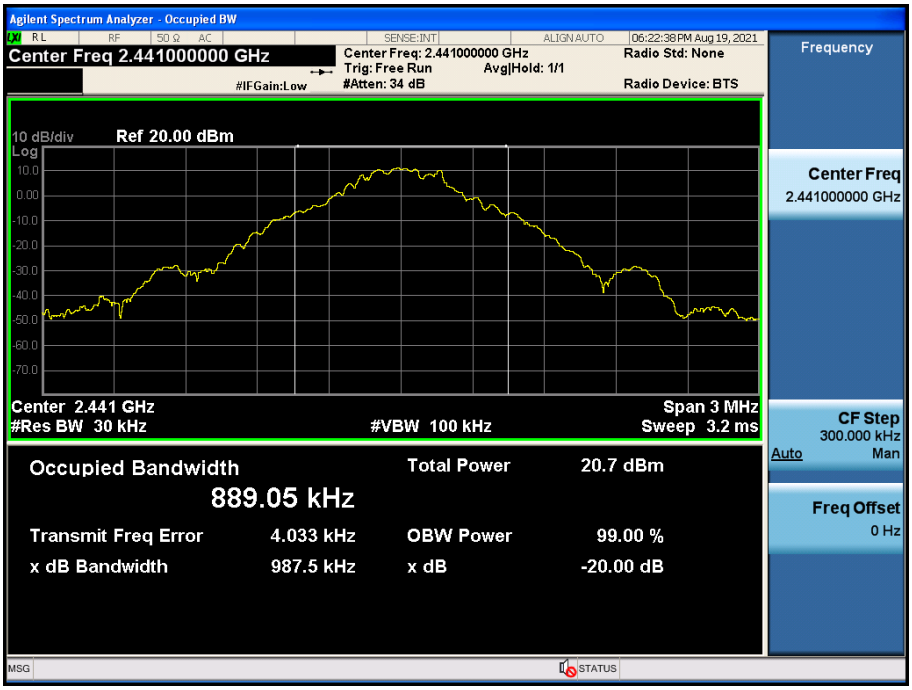
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



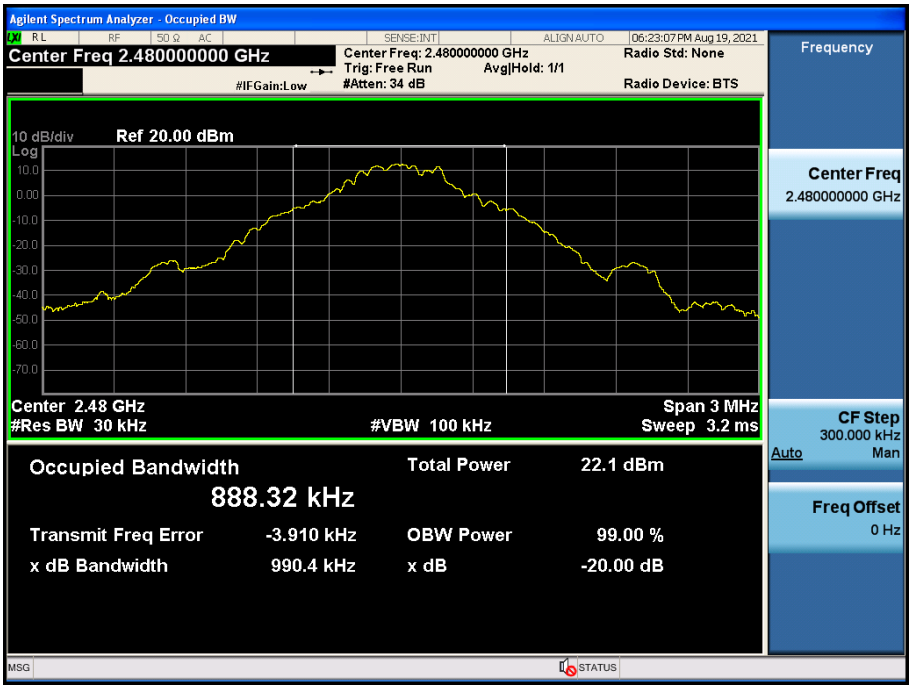
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



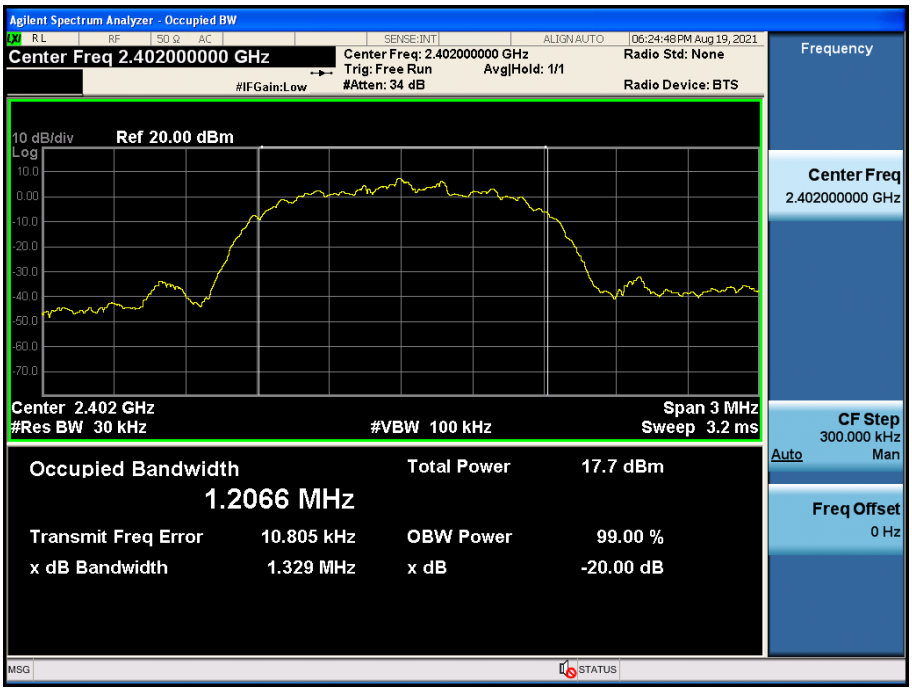
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



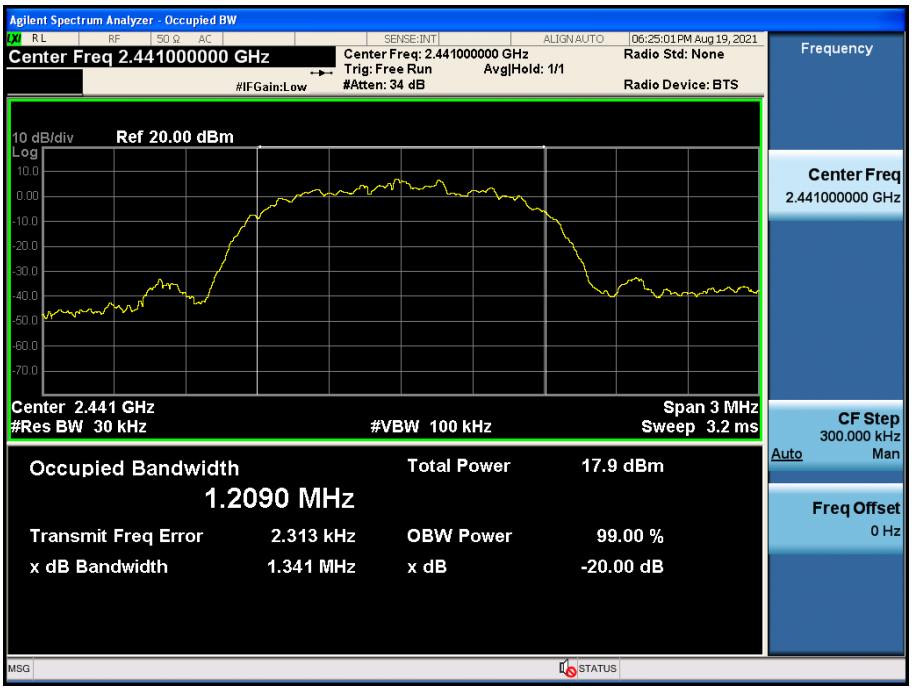
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



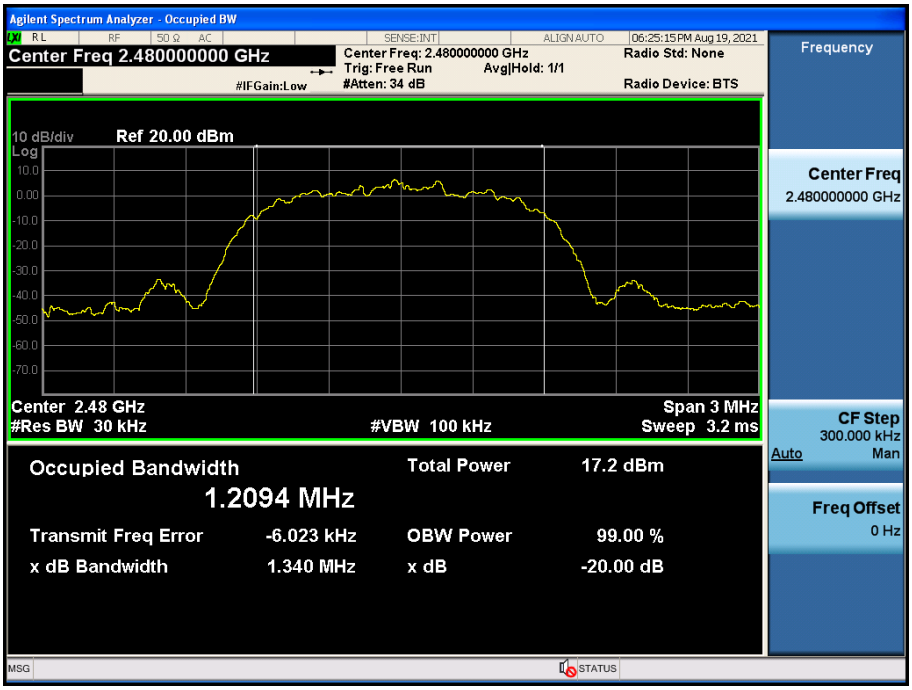
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



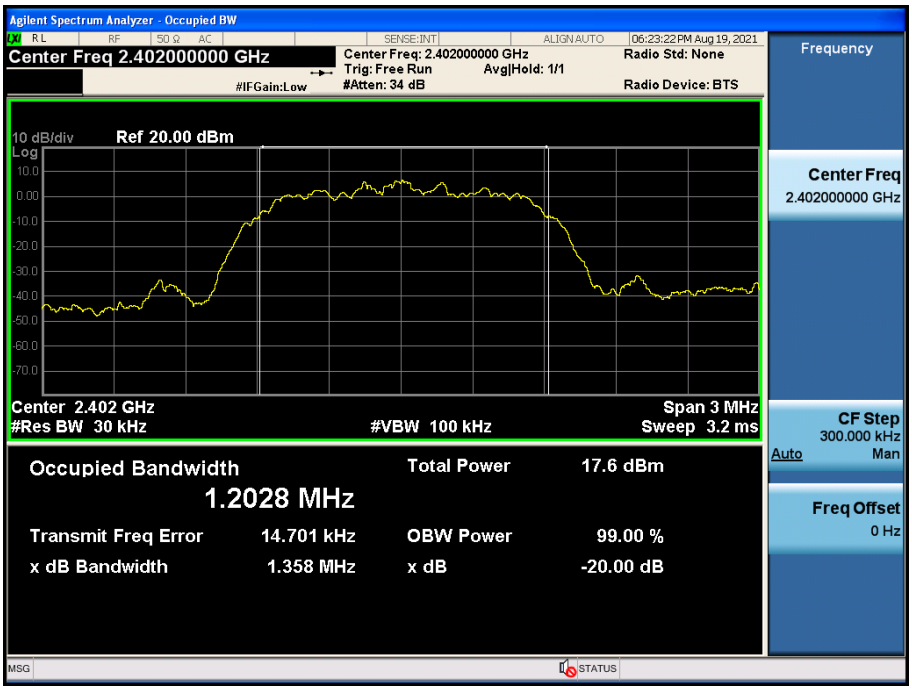
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



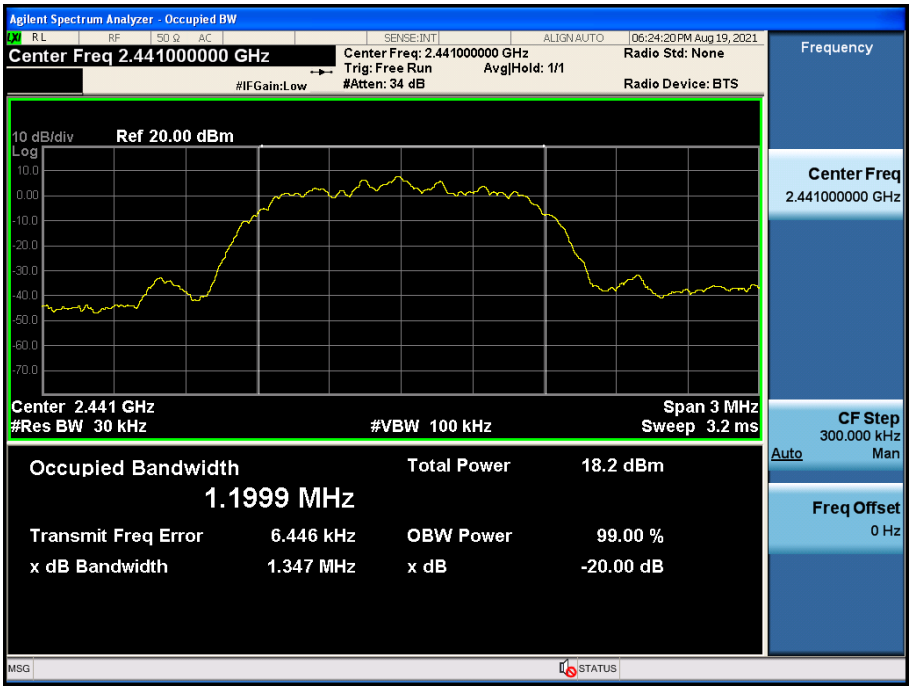
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



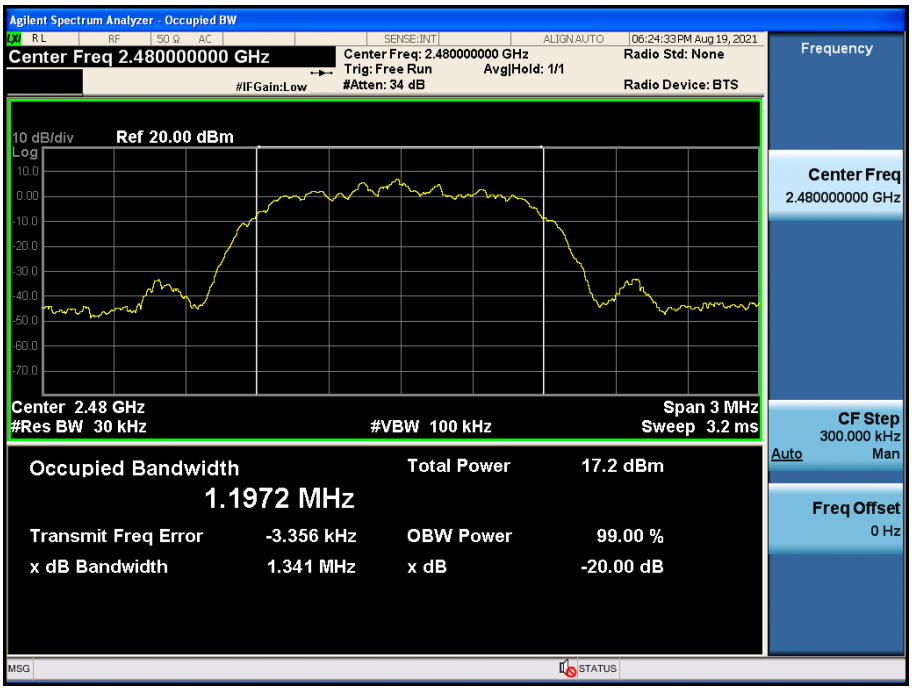
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



10.4 NUMBER OF HOPPING FREQUENCY

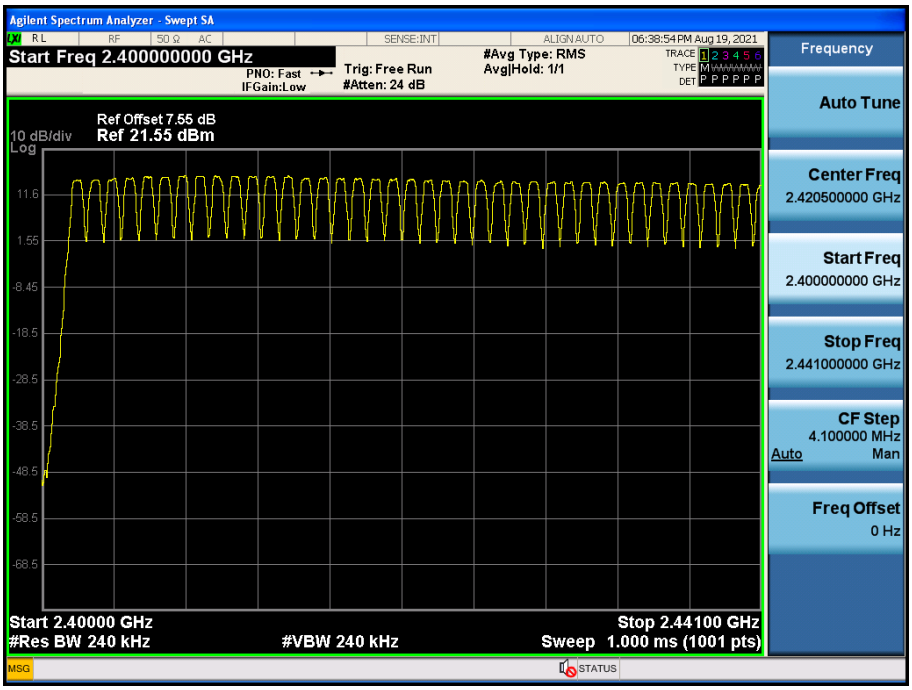
Result (No. of CH)			Limit
GFSK	8DPSK	π/4DQPSK	
79	79	79	>15

Note :

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

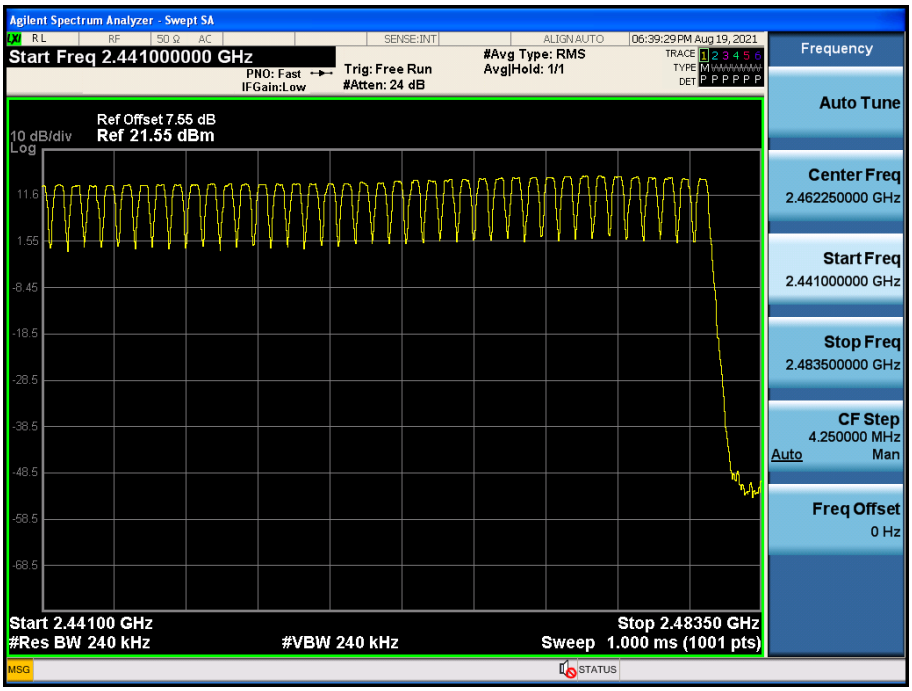
Test Plots (GFSK)

Number of Channels (2.4 GHz - 2.441 GHz)



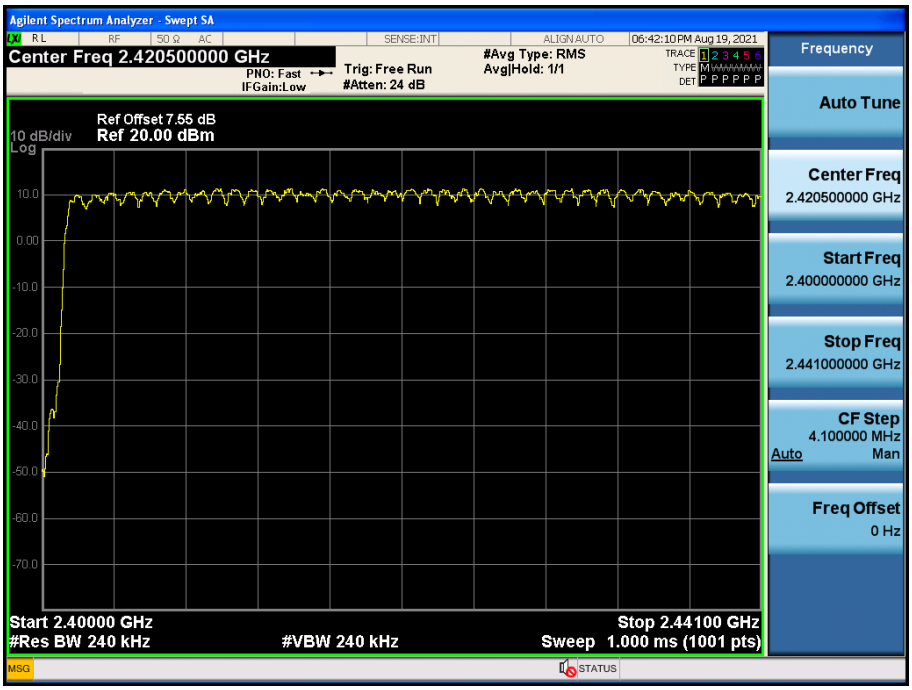
Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.483.5 GHz)



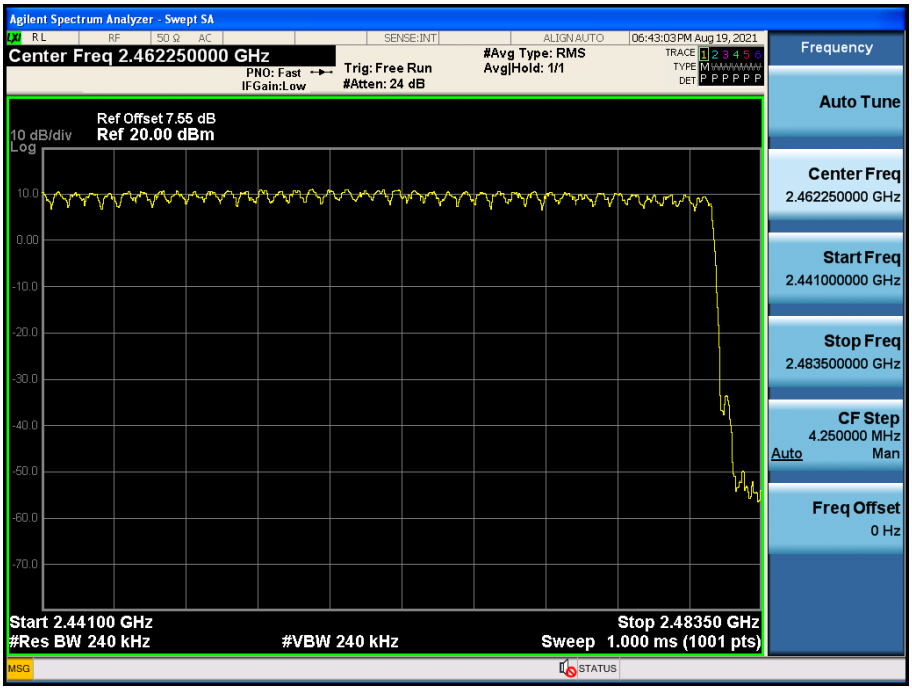
Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



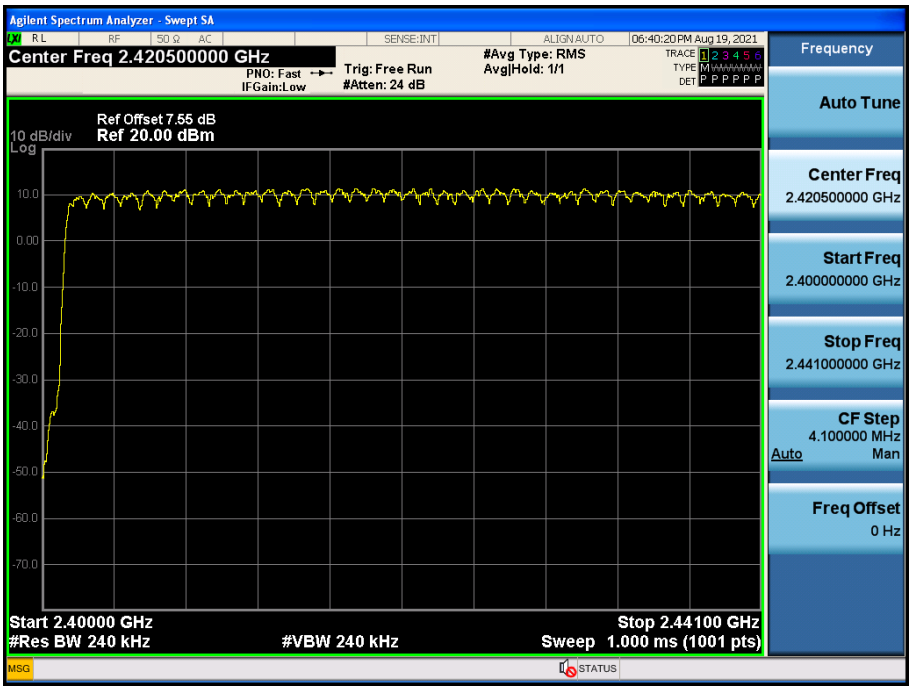
Test Plots (8DPSK)

Number of Channels (2.441 GHz - 2.483.5 GHz)



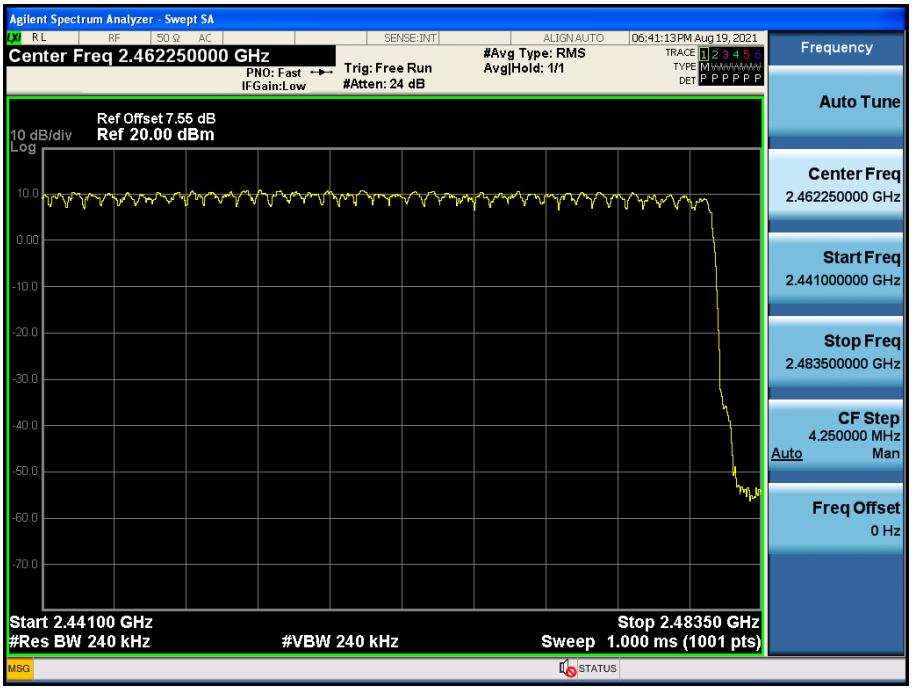
Test Plots (π/4DQPSK)

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

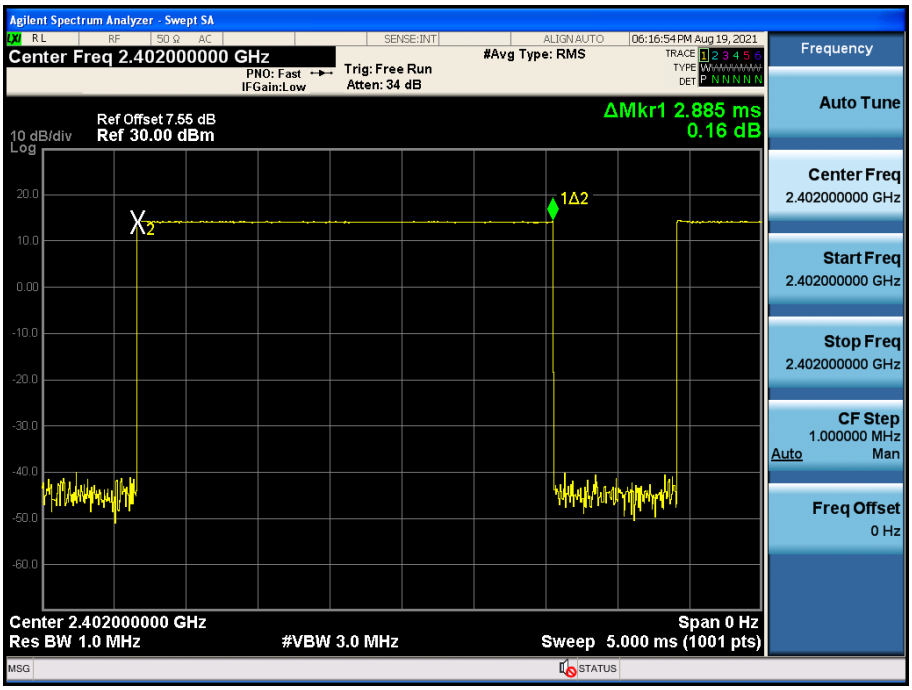
Non-AFH Mode

	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	

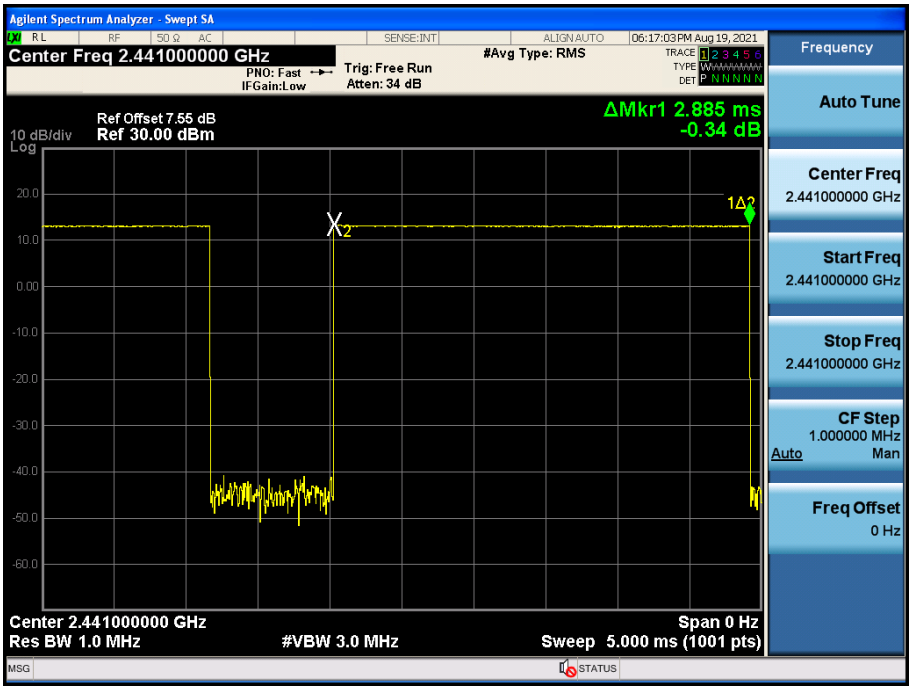
AFH Mode

	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)

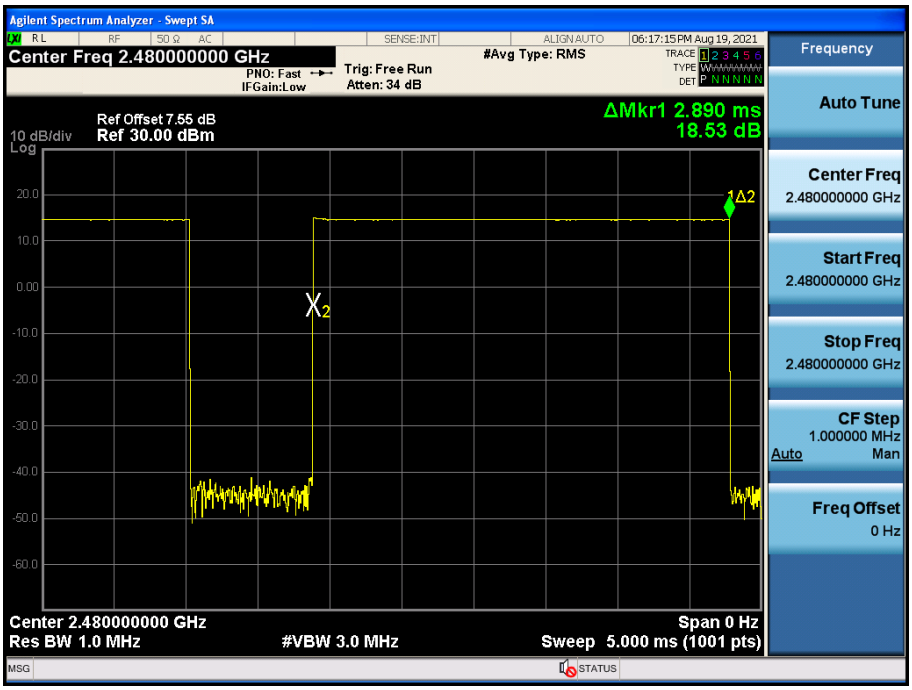


Test Plots (GFSK)
Dwell Time (CH.39)



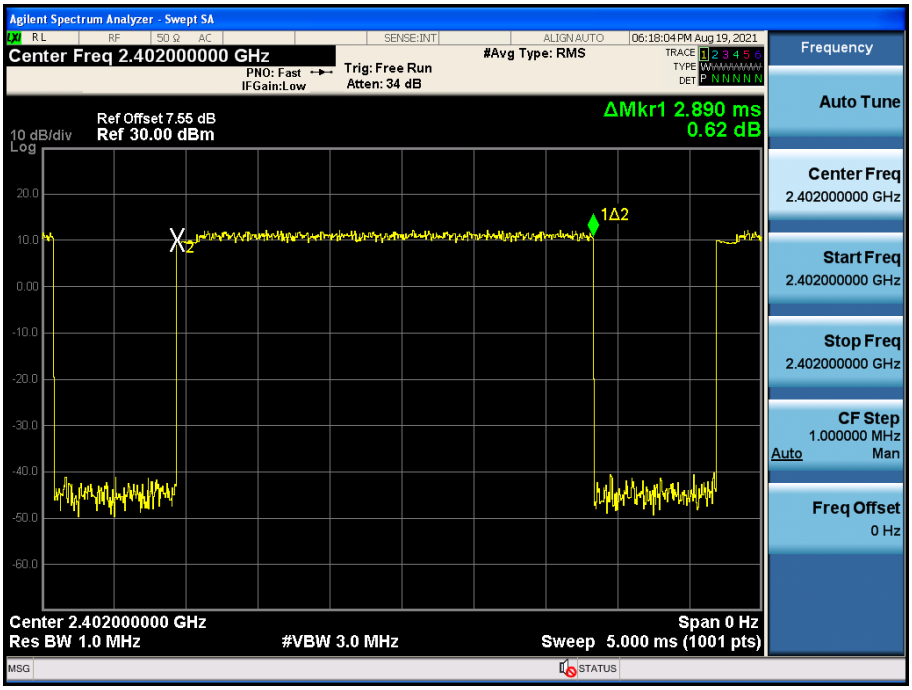
Test Plots (GFSK)

Dwell Time (CH.78)



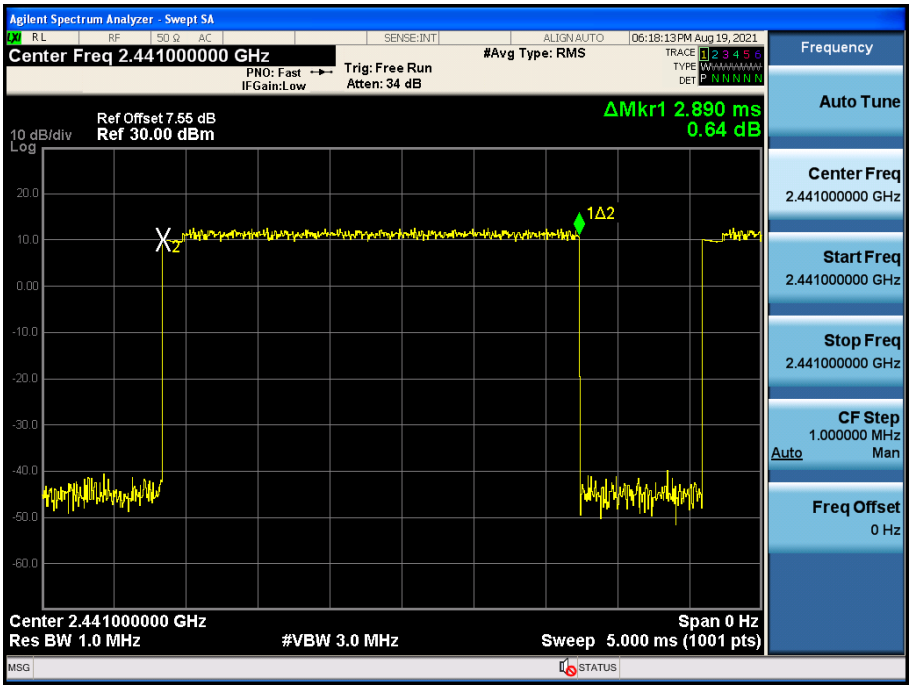
Test Plots (8DPSK)

Dwell Time (CH.0)



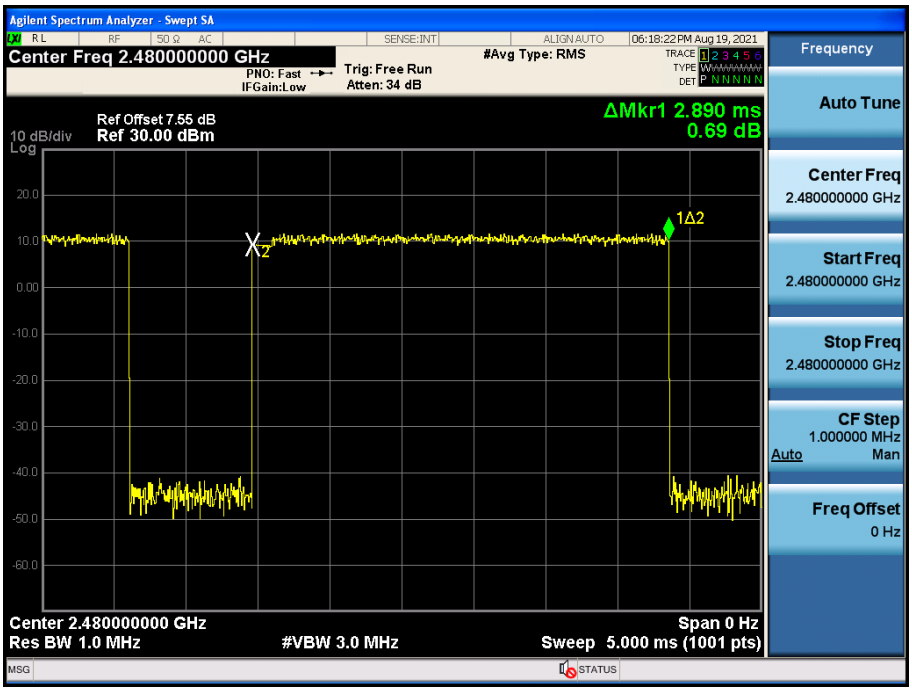
Test Plots (8DPSK)

Dwell Time (CH.39)



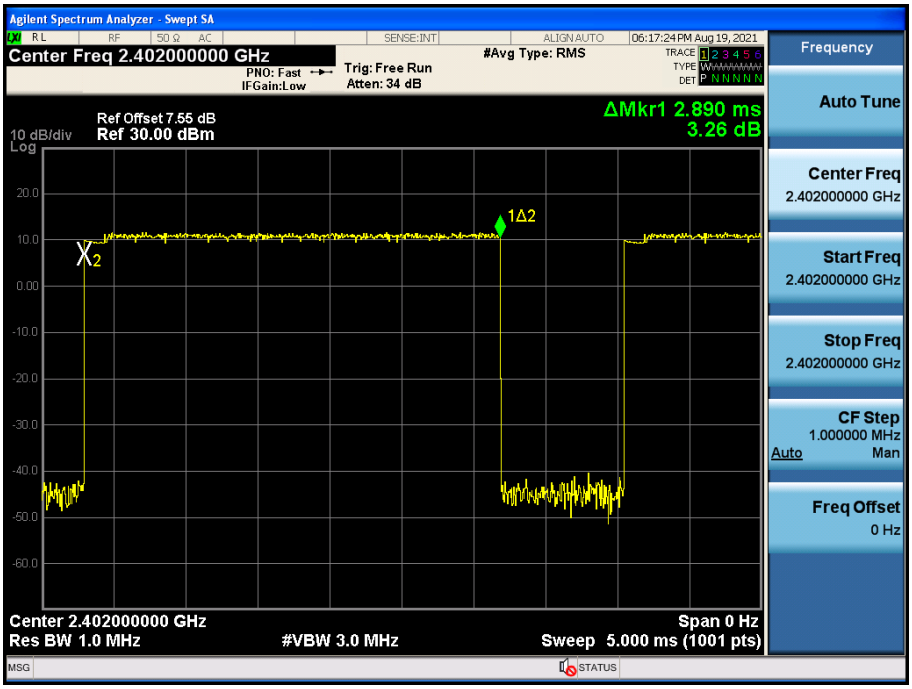
Test Plots (8DPSK)

Dwell Time (CH.78)



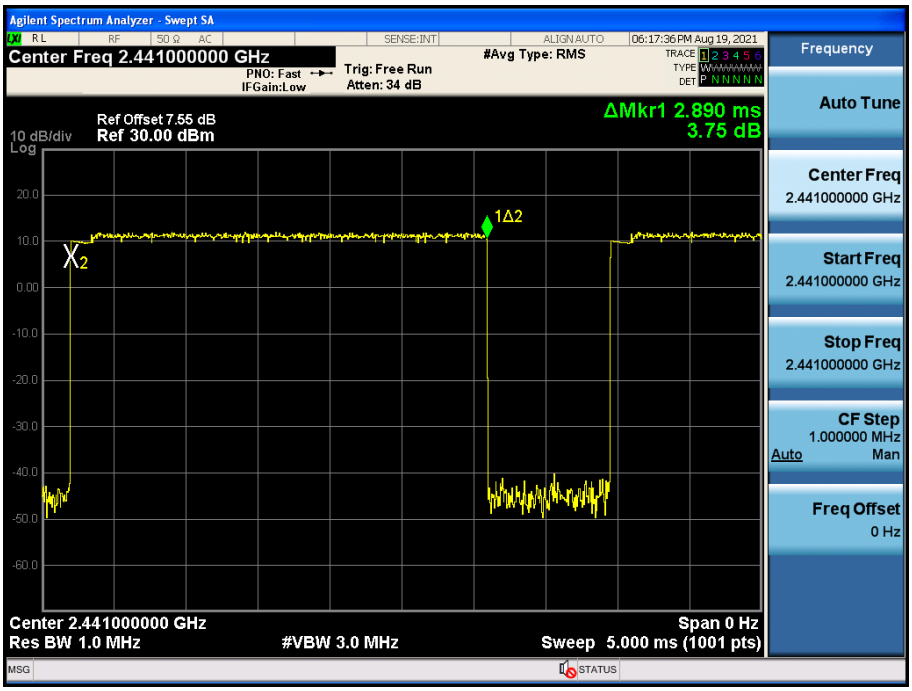
Test Plots (π/4DQPSK)

Dwell Time (CH.0)



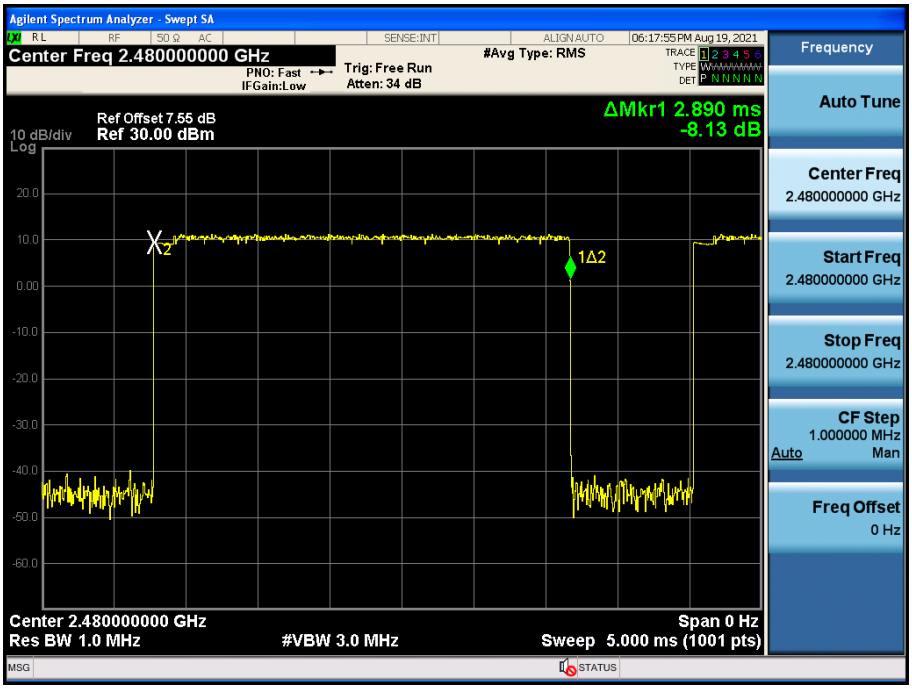
Test Plots (π/4DQPSK)

Dwell Time (CH.39)



Test Plots (π/4DQPSK)

Dwell Time (CH.78)



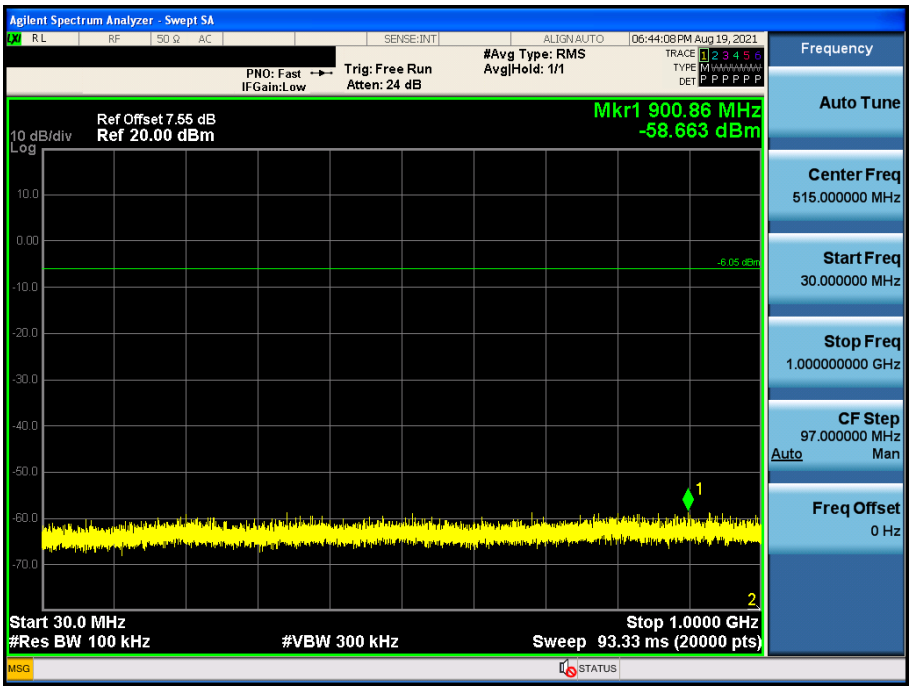
10.6 SPURIOUS EMISSIONS

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.

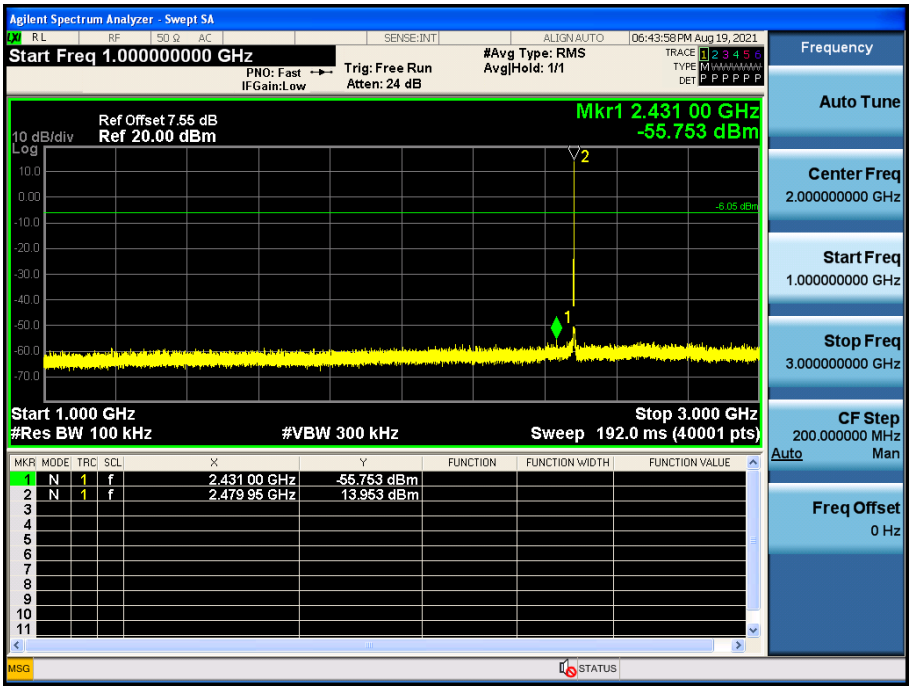
Test Plots (GFSK)- 30 MHz - 1 GHz

Spurious Emission (CH.78)



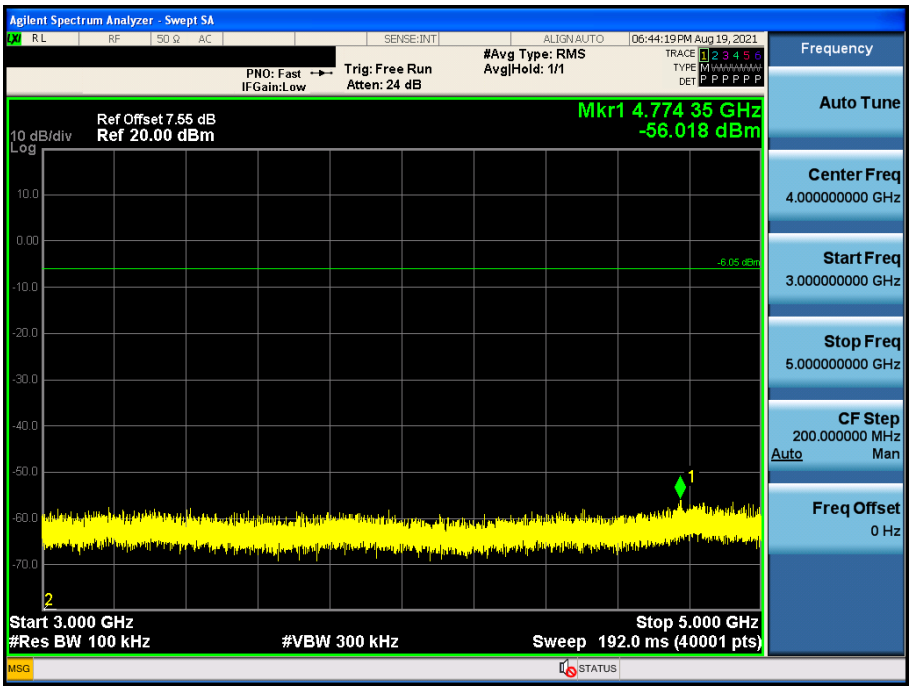
Test Plots (GFSK)- 1 GHz – 3 GHz

Spurious Emission (CH.78)



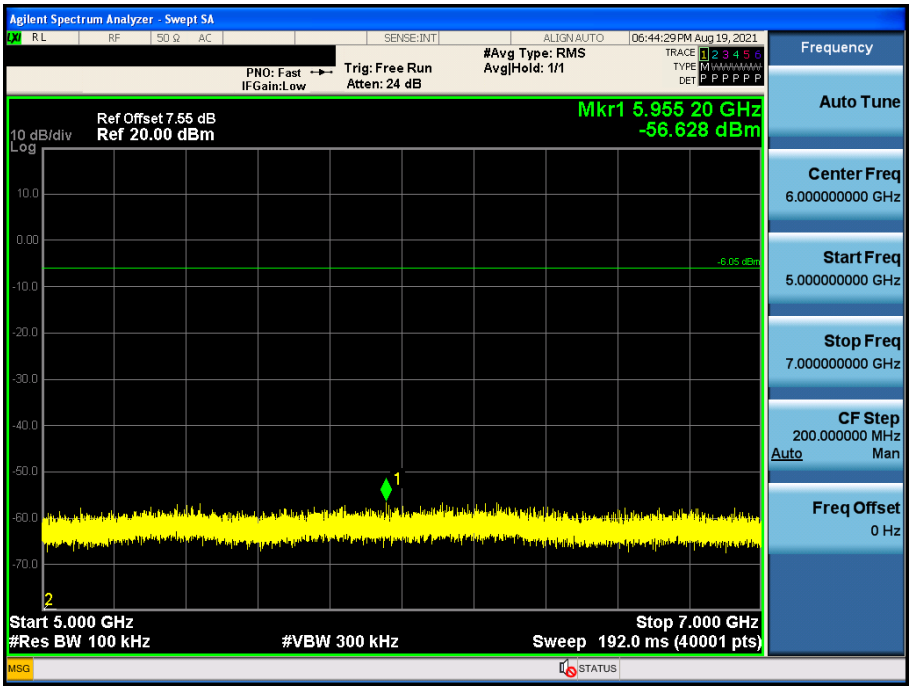
Test Plots(GFSK)- 3 GHz - 5 GHz

Spurious Emission (CH.78)



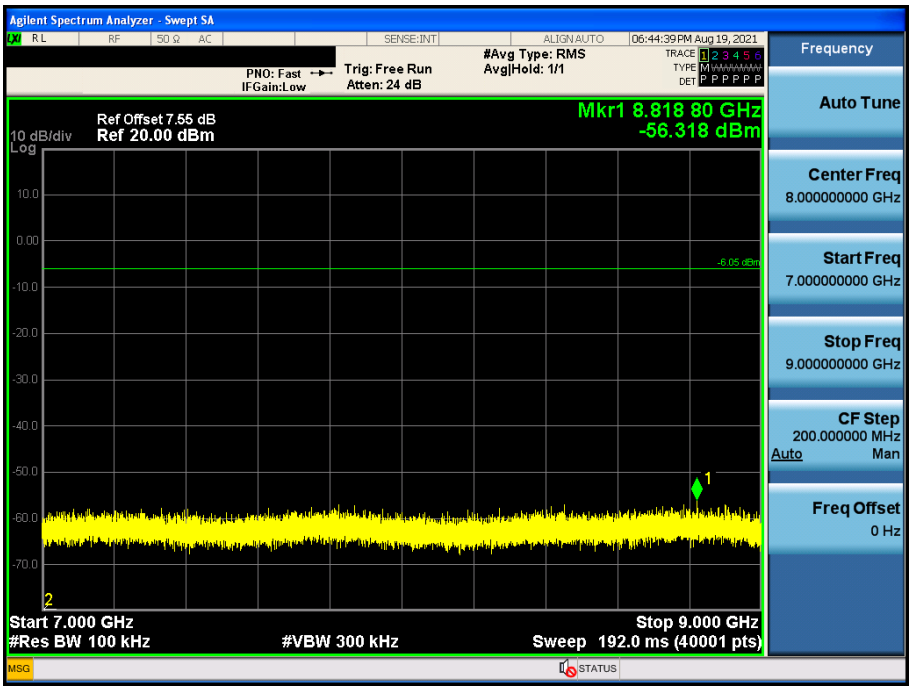
Test Plots (GFSK)- 5 GHz - 7 GHz

Spurious Emission (CH.78)



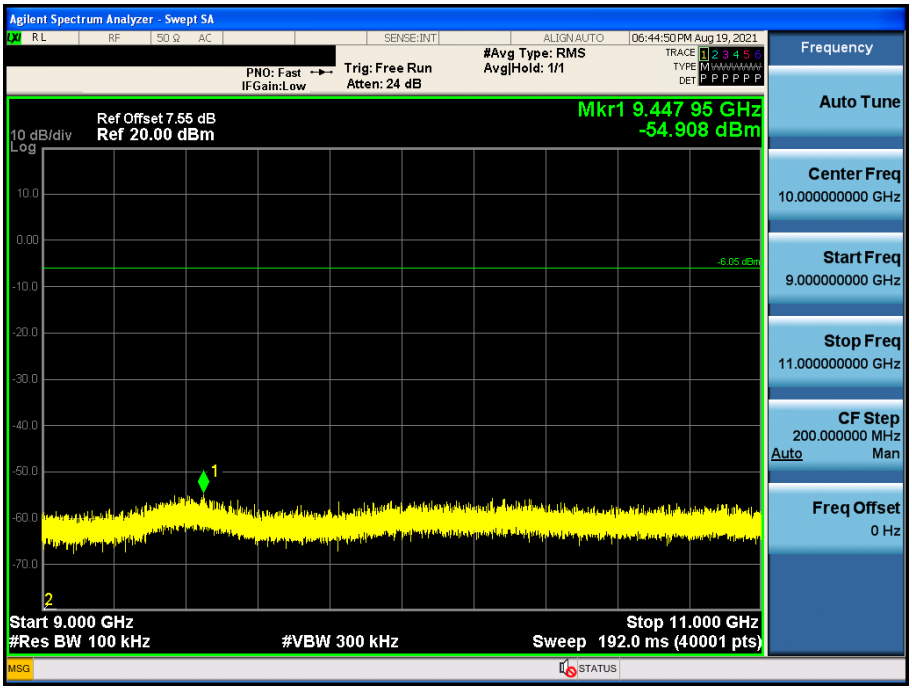
Test Plots(GFSK)- 7 GHz - 9 GHz

Spurious Emission (CH.78)



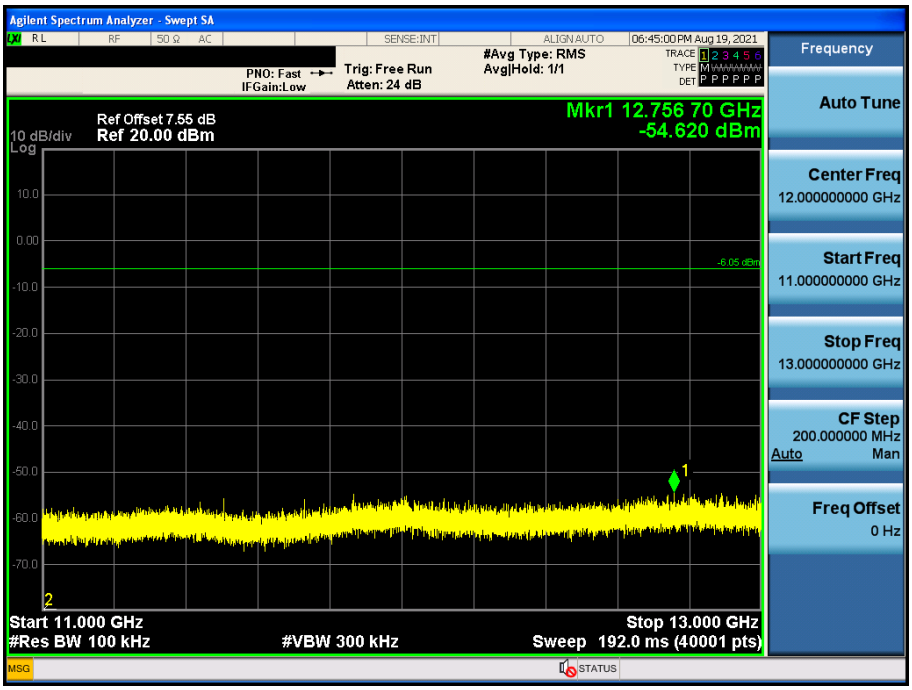
Test Plots(GFSK)- 9 GHz - 11 GHz

Spurious Emission (CH.78)



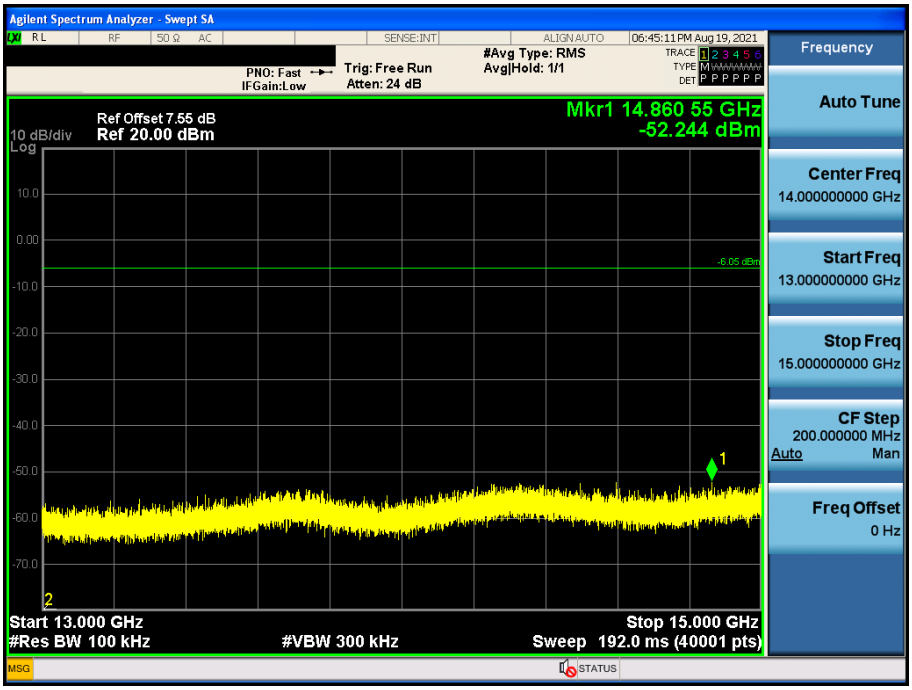
Test Plots(GFSK) 11 GHz - 13 GHz

Spurious Emission (CH.78)



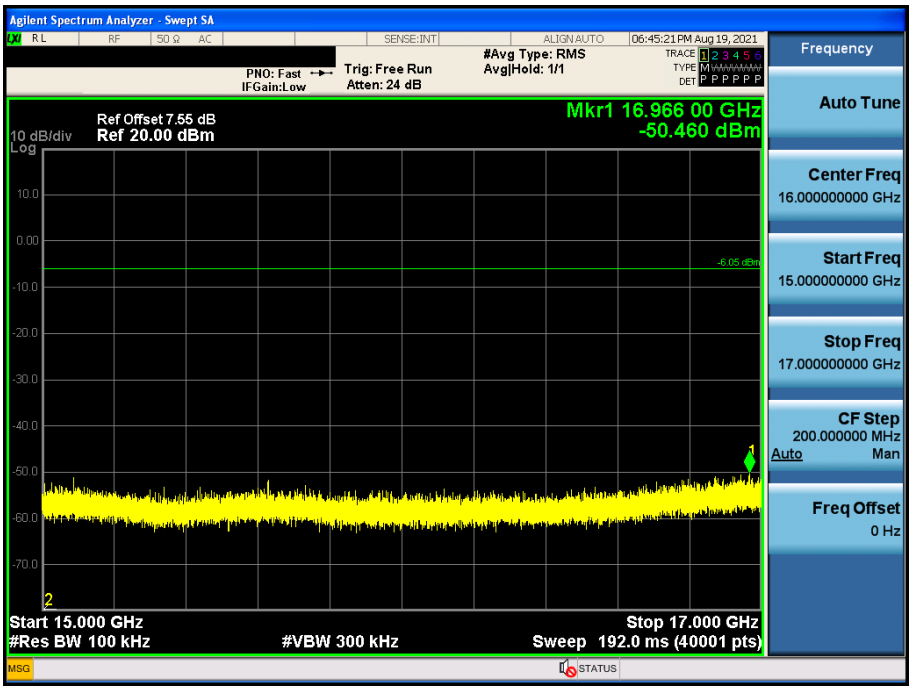
Test Plots (GFSK)- 13 GHz – 15 GHz

Spurious Emission (CH.78)



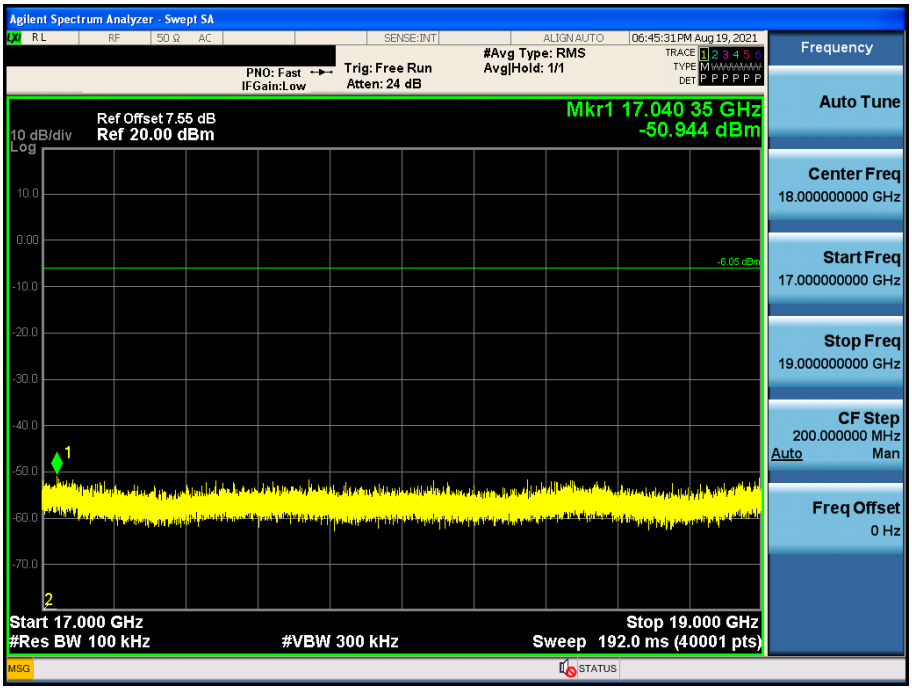
Test Plots(GFSK)– 15 GHz - 17 GHz

Spurious Emission (CH.78)



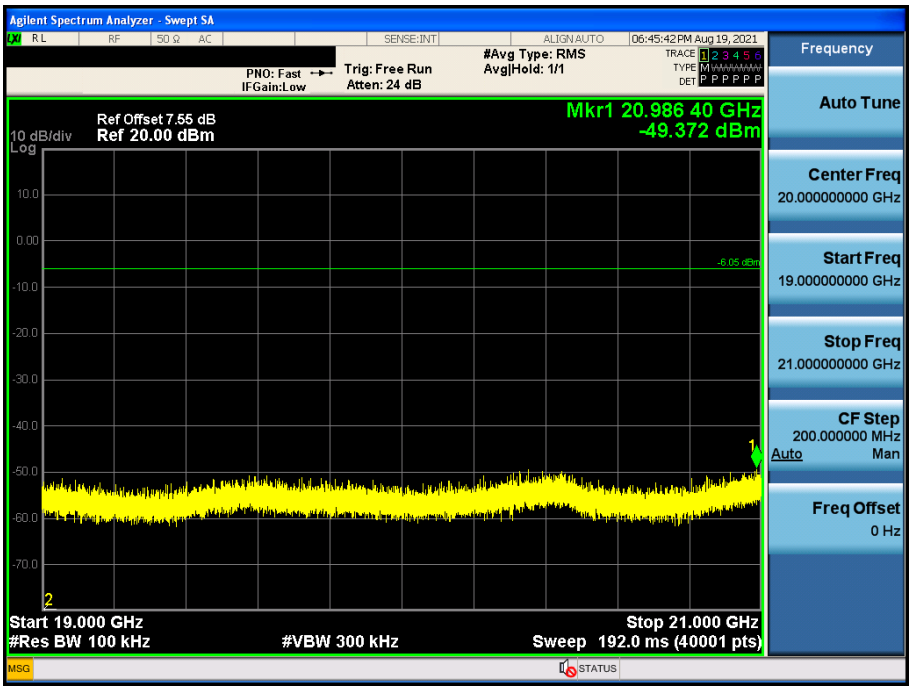
Test Plots(GFSK)- 17 GHz - 19 GHz

Spurious Emission (CH.78)



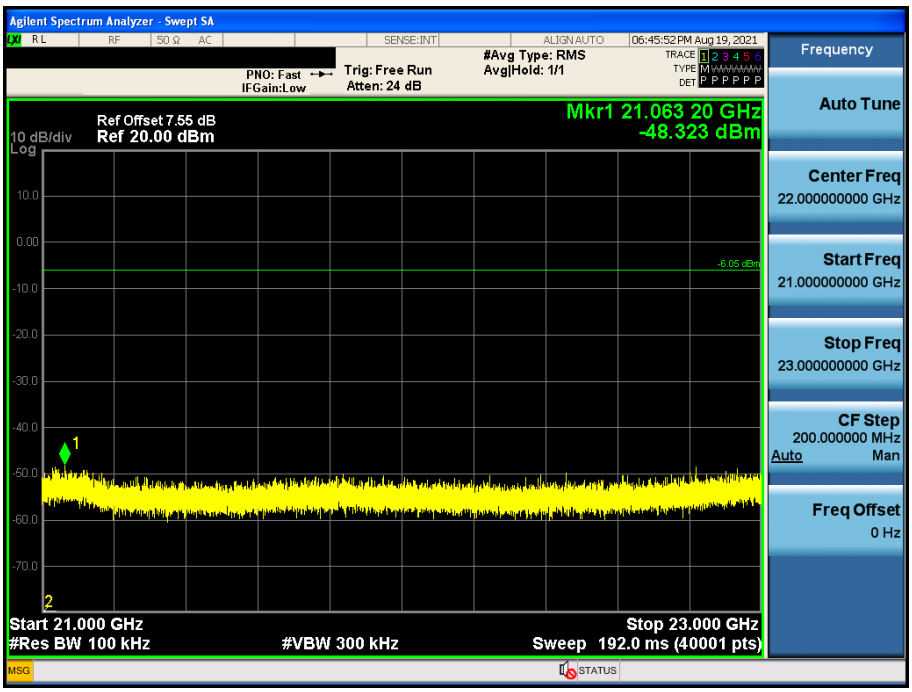
Test Plots (GFSK)- 19 GHz - 21 GHz

Spurious Emission (CH.78)



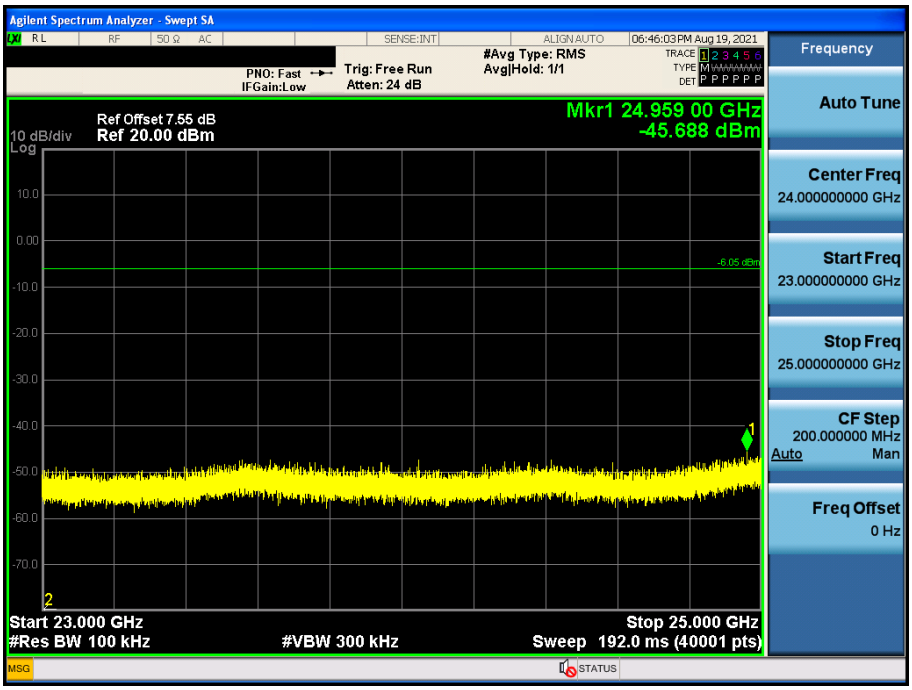
Test Plots (GFSK)- 21 GHz - 23 GHz

Spurious Emission (CH.78)



Test Plots (GFSK)- 23 GHz - 25 GHz

Spurious Emission (CH.78)



10.6.2 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured Value	A.F+C.L+D.F	POL	Total	Limit	Margin
[MHz]	[dBμV/m]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/m]	[dB]
No Critical peaks found						

Note:

1. The Measured 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 (dBμV) + Distance extrapolation factor
4. Radiated test is performed with hopping off.

Frequency Range : Below 1 GHz

Frequency	Measured Value	A.F+C.L	POL	Total	Limit	Margin
[MHz]	[dBμV/m]	[dB/m]	[H/V]	[dBμV/m]	[dBμV/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]	Measured Level [dBµV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4804	44.41	2.76	V	0	47.17	73.98	26.81	PK
4804	30.75	2.76	V	-24.73	8.77	53.98	45.21	AV
7206	40.69	8.96	V	0	49.65	73.98	24.33	PK
7206	27.14	8.96	V	-24.73	11.37	53.98	42.61	AV
4804	44.43	2.76	H	0	47.19	73.98	26.79	PK
4804	30.84	2.76	H	-24.73	8.86	53.98	45.12	AV
7206	40.58	8.96	H	0	49.54	73.98	24.44	PK
7206	27.15	8.96	H	-24.73	11.38	53.98	42.60	AV

Operation Mode: CH Mid(GFSK)

Frequency [MHz]	Measured Level [dBµV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4882	43.19	3.15	V	0	46.34	73.98	27.64	PK
4882	29.29	3.15	V	-24.73	7.71	53.98	46.27	AV
7323	41.21	9.45	V	0	50.66	73.98	23.32	PK
7323	27.28	10.20	V	-24.73	12.75	53.98	41.23	AV
4882	43.13	3.15	H	0	46.28	73.98	27.70	PK
4882	29.22	3.15	H	-24.73	7.64	53.98	46.34	AV
7323	40.63	9.45	H	0	50.08	73.98	23.90	PK
7323	27.17	10.20	H	-24.73	12.64	53.98	41.34	AV

Operation Mode: CH High(GFSK)

Frequency [MHz]	Measured Level [dBµV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4960	42.66	2.23	V	0	44.89	73.98	29.09	PK
4960	29.52	2.23	V	-24.73	7.01	53.98	46.97	AV
7440	41.37	10.35	V	0	51.72	73.98	22.26	PK
7440	28.34	10.35	V	-24.73	13.96	53.98	40.02	AV
4960	42.71	2.23	H	0	44.94	73.98	29.04	PK
4960	29.04	2.23	H	-24.73	6.53	53.98	47.45	AV
7440	40.61	10.35	H	0	50.96	73.98	23.02	PK
7440	28.08	10.35	H	-24.73	13.70	53.98	40.28	AV

Operation Mode: CH Low(π/4DQPSK)

Frequency [MHz]	Measured Level [dBμV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4804	44.87	2.76	V	0	47.63	73.98	26.35	PK
4804	30.56	2.76	V	-24.73	8.58	53.98	45.40	AV
7206	41.41	8.96	V	0	50.37	73.98	23.61	PK
7206	26.95	8.96	V	-24.73	11.18	53.98	42.80	AV
4804	43.93	2.76	H	0	46.69	73.98	27.29	PK
4804	29.86	2.76	H	-24.73	7.88	53.98	46.10	AV
7206	40.85	8.96	H	0	49.81	73.98	24.17	PK
7206	27.20	8.96	H	-24.73	11.43	53.98	42.55	AV

Operation Mode: CH Mid(π/4DQPSK)

Frequency [MHz]	Measured Level [dBμV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4882	42.94	3.15	V	0	46.09	73.98	27.89	PK
4882	29.42	3.15	V	-24.73	7.84	53.98	46.14	AV
7323	40.92	9.45	V	0	50.37	73.98	23.61	PK
7323	27.18	10.20	V	-24.73	12.65	53.98	41.33	AV
4882	43.43	3.15	H	0	46.58	73.98	27.40	PK
4882	29.80	3.15	H	-24.73	8.22	53.98	45.76	AV
7323	39.91	9.45	H	0	49.36	73.98	24.62	PK
7323	27.06	10.20	H	-24.73	12.53	53.98	41.45	AV

Operation Mode: CH High(π/4DQPSK)

Frequency [MHz]	Measured Level [dBμV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4960	42.45	2.23	V	0	44.68	73.98	29.30	PK
4960	28.78	2.23	V	-24.73	6.27	53.98	47.71	AV
7440	40.35	10.35	V	0	50.70	73.98	23.28	PK
7440	26.79	10.35	V	-24.73	12.41	53.98	41.57	AV
4960	43.10	2.23	H	0	45.33	73.98	28.65	PK
4960	28.79	2.23	H	-24.73	6.28	53.98	47.70	AV
7440	39.83	10.35	H	0	50.18	73.98	23.80	PK
7440	26.75	10.35	H	-24.73	12.37	53.98	41.61	AV

Operation Mode: CH Low(8DPSK)

Frequency [MHz]	Measured Level [dBµV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4804	44.34	2.76	V	0	47.10	73.98	26.88	PK
4804	30.62	2.76	V	-24.73	8.64	53.98	45.34	AV
7206	40.81	8.96	V	0	49.77	73.98	24.21	PK
7206	26.88	8.96	V	-24.73	11.11	53.98	42.87	AV
4804	43.32	2.76	H	0	46.08	73.98	27.90	PK
4804	30.07	2.76	H	-24.73	8.09	53.98	45.89	AV
7206	40.84	8.96	H	0	49.80	73.98	24.18	PK
7206	27.22	8.96	H	-24.73	11.45	53.98	42.53	AV

Operation Mode: CH Mid(8DPSK)

Frequency [MHz]	Measured Level [dBµV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4882	42.75	3.15	V	0	45.90	73.98	28.08	PK
4882	29.24	3.15	V	-24.73	7.66	53.98	46.32	AV
7323	41.13	9.45	V	0	50.58	73.98	23.40	PK
7323	27.19	10.20	V	-24.73	12.66	53.98	41.32	AV
4882	43.75	3.15	H	0	46.90	73.98	27.08	PK
4882	29.99	3.15	H	-24.73	8.41	53.98	45.57	AV
7323	40.76	9.45	H	0	50.21	73.98	23.77	PK
7323	27.07	10.20	H	-24.73	12.54	53.98	41.44	AV

Operation Mode: CH High(8DPSK)

Frequency [MHz]	Measured Level [dBµV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4960	42.58	2.23	V	0	44.81	73.98	29.17	PK
4960	28.78	2.23	V	-24.73	6.27	53.98	47.71	AV
7440	40.73	10.35	V	0	51.08	73.98	22.90	PK
7440	26.71	10.35	V	-24.73	12.33	53.98	41.65	AV
4960	43.23	2.23	H	0	45.46	73.98	28.52	PK
4960	28.82	2.23	H	-24.73	6.31	53.98	47.67	AV
7440	40.39	10.35	H	0	50.74	73.98	23.24	PK
7440	26.62	10.35	H	-24.73	12.24	53.98	41.74	AV

[Non-DBS Mode]

Test case 3

WLAN/BT Ant : 802.11a ch. 165 & Bluetooth Ch. 78 (GFSK)

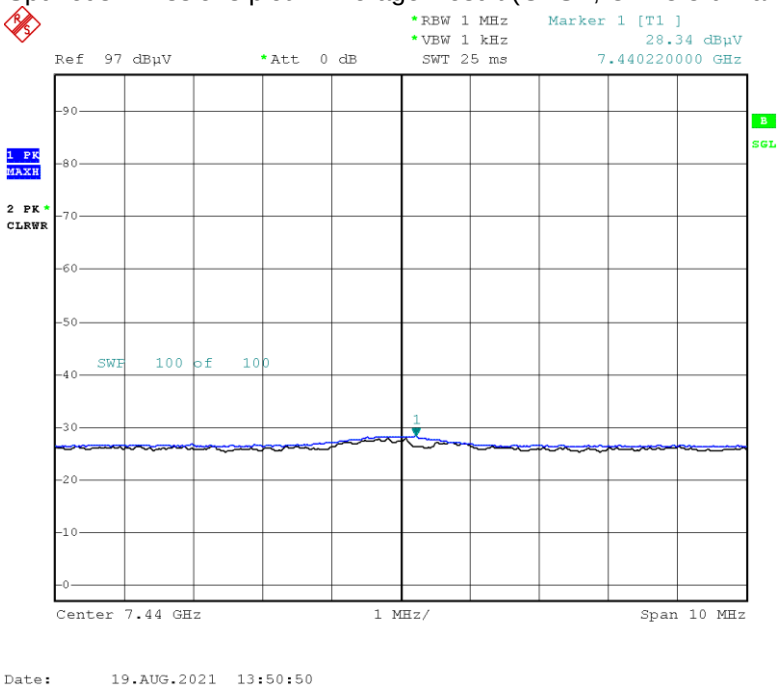
Operation Mode:	802.11a & GFSK
Transfer Rate (MCS Index):	6 Mbps & 1 Mbps
Operating Frequency	5 825 & 2 480 MHz
Channel No.	165 Ch & 78 Ch

Frequency [MHz]	Measured Level [dBµV]	A.F+C.L-A.G+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4960	43.01	2.23	V	0	45.24	73.98	28.74	PK
4960	29.55	2.23	V	-24.73	7.04	53.98	46.94	AV
7440	41.23	10.35	V	0	51.58	73.98	22.40	PK
7440	28.52	10.35	V	-24.73	14.14	53.98	39.84	AV
4960	43.65	2.23	H	0	45.88	73.98	28.10	PK
4960	29.85	2.23	H	-24.73	7.34	53.98	46.64	AV
7440	40.65	10.35	H	0	51.00	73.98	22.98	PK
7440	28.02	10.35	H	-24.73	13.64	53.98	40.34	AV

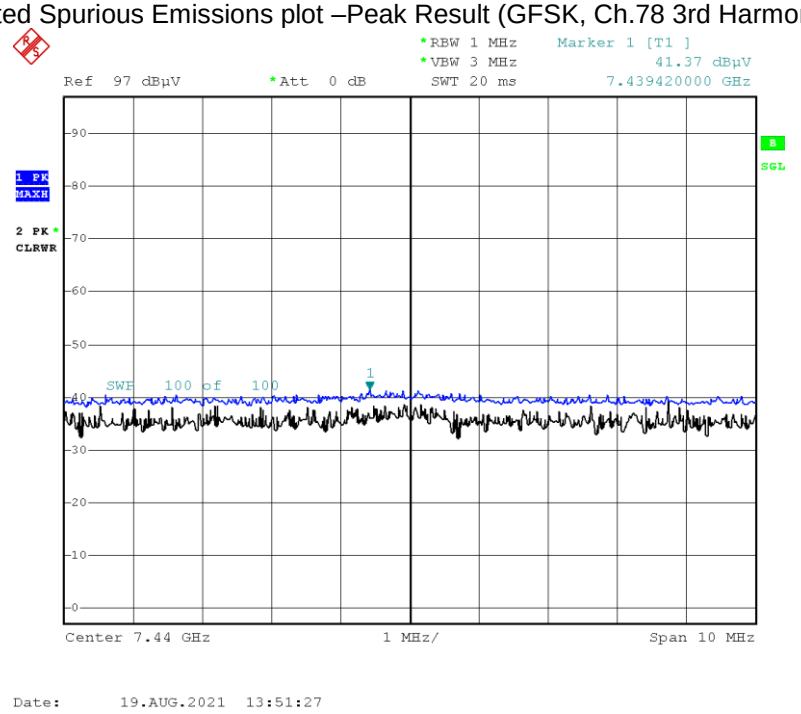
Note : WLAN DBS Data refer to UNII Test Report.

RESULT PLOTS

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



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

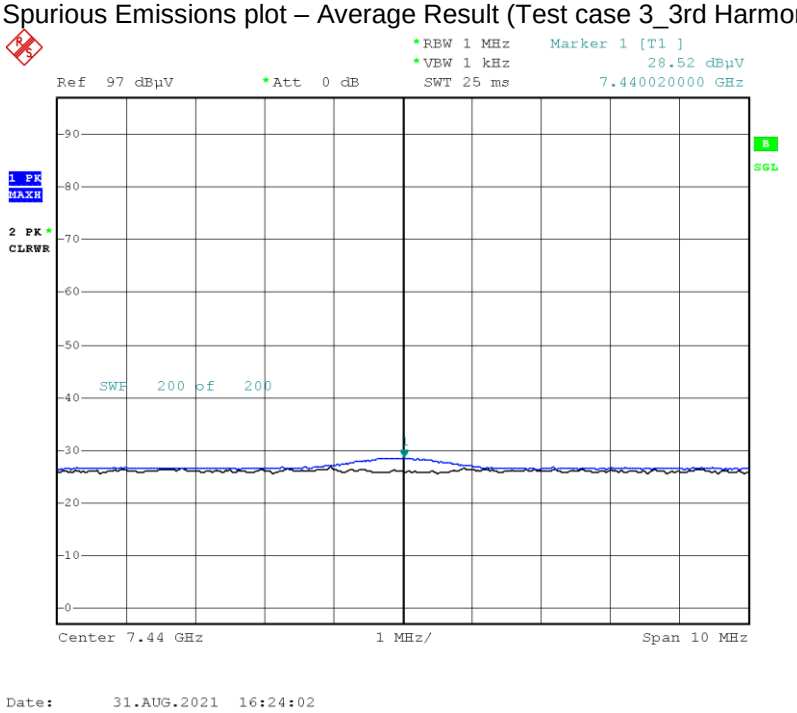


Note:

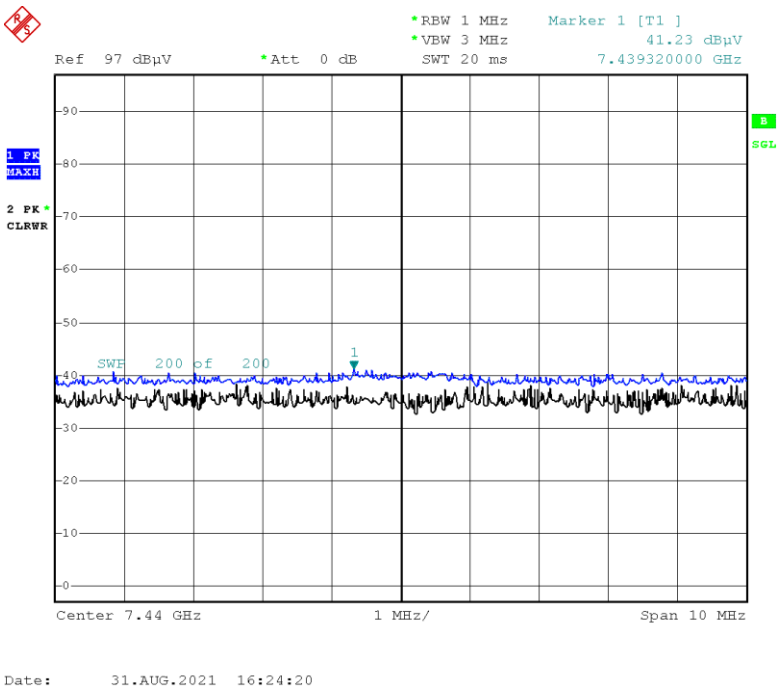
Plot of worst case are only reported.

[Non-DBS Mode]

Radiated Spurious Emissions plot – Average Result (Test case 3_3rd Harmonic, X-V)



Radiated Spurious Emissions plot –Peak Result (Test case 3_3rd Harmonic, X-V)



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]	Measured Level [dBµV]	A.F+C.L+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2390.0	19.01	33.78	H	0	52.79	73.98	21.19	PK
2390.0	8.12	33.78	H	-24.73	17.17	53.98	36.81	AV
2390.0	19.21	33.78	V	0	52.98	73.98	21.00	PK
2390.0	8.54	33.78	V	-24.73	17.59	53.98	36.39	AV
2483.5	22.67	34.10	H	0	56.77	73.98	17.21	PK
2483.5	14.85	34.10	H	-24.73	24.22	53.98	29.76	AV
2483.5	23.26	34.10	V	0	57.36	73.98	16.62	PK
2483.5	15.44	34.10	V	-24.73	24.81	53.98	29.17	AV

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

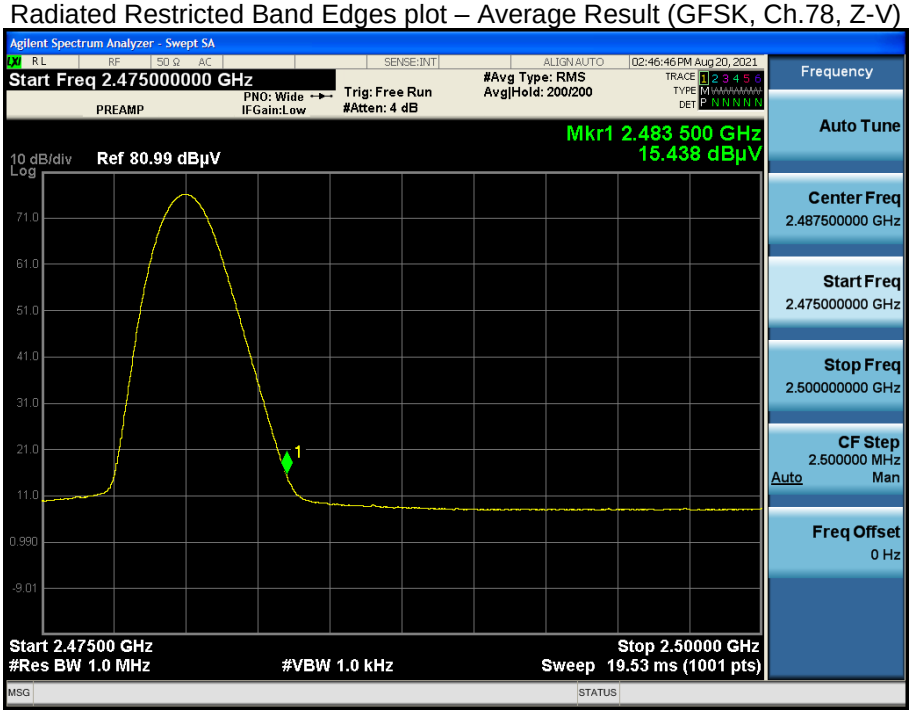
Frequency [MHz]	Measured Level [dBµV]	A.F+C.L+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2390.0	18.75	33.78	H	0	52.53	73.98	21.45	PK
2390.0	8.44	33.78	H	-24.73	17.48	53.98	36.50	AV
2390.0	18.97	33.78	V	0	52.75	73.98	21.23	PK
2390.0	8.55	33.78	V	-24.73	17.60	53.98	36.38	AV
2483.5	20.67	34.10	H	0	54.77	73.98	19.21	PK
2483.5	12.57	34.10	H	-24.73	21.94	53.98	32.04	AV
2483.5	21.05	34.10	V	0	55.15	73.98	18.83	PK
2483.5	13.34	34.10	V	-24.73	22.71	53.98	31.27	AV

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

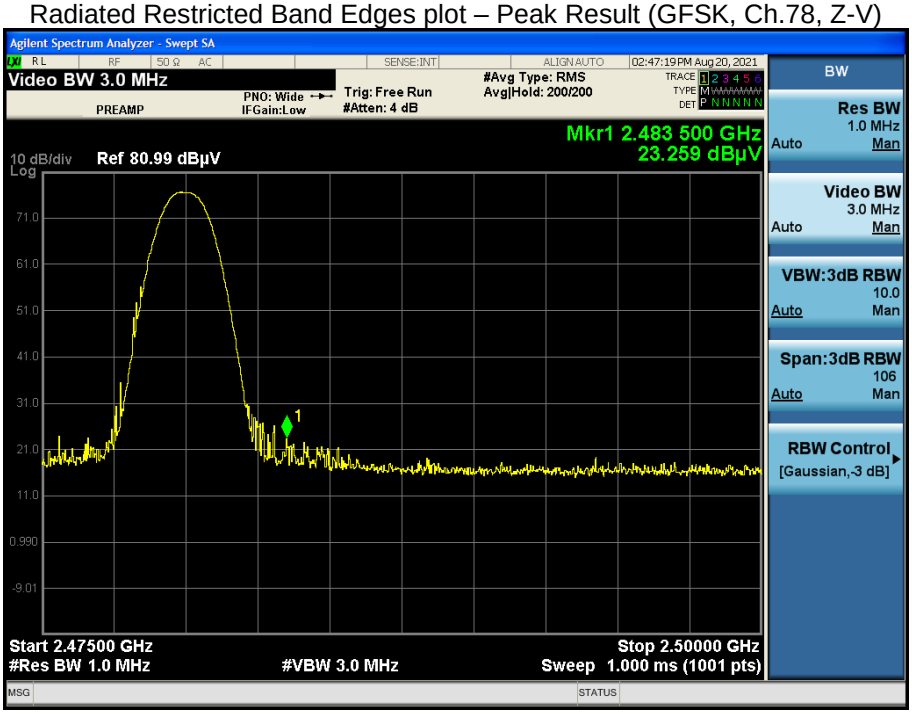
Frequency [MHz]	Measured Level [dBµV]	A.F+C.L+D.F [dB]	Pol. [H/V]	Duty Cycle Correction [dB]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2390.0	18.67	33.78	H	0	52.45	73.98	21.53	PK
2390.0	8.43	33.78	H	-24.73	17.48	53.98	36.50	AV
2390.0	18.97	33.78	V	0	52.75	73.98	21.23	PK
2390.0	8.60	33.78	V	-24.73	17.65	53.98	36.33	AV
2483.5	20.71	34.10	H	0	54.81	73.98	19.17	PK
2483.5	12.45	34.10	H	-24.73	21.81	53.98	32.17	AV
2483.5	21.06	34.10	V	0	55.16	73.98	18.82	PK
2483.5	13.48	34.10	V	-24.73	22.84	53.98	31.14	AV

RESULT PLOTS

Radiated Restricted Band Edges plot – Average Result (GFSK, Ch.78, Z-V)



Radiated Restricted Band Edges plot – Peak Result (GFSK, Ch.78, Z-V)



Note:

Plot of worst case are only reported.

10.7 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions (Line 1)

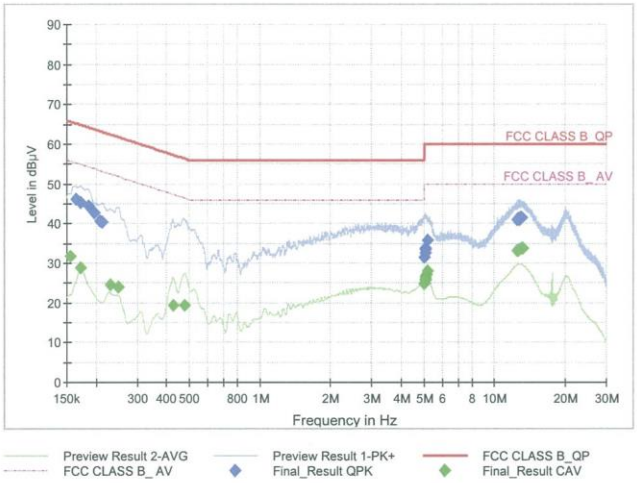
Test 1 / 2

Test Report

Common Information

EUT :	SM-G990E/DS
Manufacturer :	SAMSUNG
Test Site:	SHIELD ROOM
Operating Conditions :	BT L1
Operator Name:	
Comment:	

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1635	46.23	65.28	19.05	9.000	L1	OFF	9.6
0.1725	45.29	64.84	19.55	9.000	L1	OFF	9.6
0.1860	44.52	64.21	19.69	9.000	L1	OFF	9.6
0.1973	42.74	63.73	20.99	9.000	L1	OFF	9.6
0.2085	40.78	63.27	22.49	9.000	L1	OFF	9.6
0.2130	40.25	63.09	22.83	9.000	L1	OFF	9.6
5.0113	31.51	60.00	28.49	9.000	L1	OFF	9.9
5.0495	32.66	60.00	27.34	9.000	L1	OFF	9.9
5.0585	33.40	60.00	26.60	9.000	L1	OFF	9.9
5.0698	33.48	60.00	26.52	9.000	L1	OFF	9.9
5.0855	33.88	60.00	26.12	9.000	L1	OFF	9.9
5.1620	35.72	60.00	24.28	9.000	L1	OFF	9.9
12.5150	40.90	60.00	19.10	9.000	L1	OFF	10.1
12.6410	41.35	60.00	18.65	9.000	L1	OFF	10.1
12.6995	41.21	60.00	18.79	9.000	L1	OFF	10.2
12.7400	41.05	60.00	18.95	9.000	L1	OFF	10.2
12.9605	41.54	60.00	18.46	9.000	L1	OFF	10.2
13.1113	41.56	60.00	18.44	9.000	L1	OFF	10.2

Final_Result_CAV

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Test 2 / 2

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	31.72	55.75	24.03	9.000	L1	OFF	9.6
0.1725	28.84	54.84	26.00	9.000	L1	OFF	9.6
0.2288	24.51	52.50	27.99	9.000	L1	OFF	9.6
0.2490	23.90	51.79	27.89	9.000	L1	OFF	9.6
0.4268	19.40	47.32	27.91	9.000	L1	OFF	9.6
0.4785	19.25	46.37	27.12	9.000	L1	OFF	9.6
5.0270	24.77	50.00	25.23	9.000	L1	OFF	9.9
5.0540	25.60	50.00	24.40	9.000	L1	OFF	9.9
5.0698	26.04	50.00	23.96	9.000	L1	OFF	9.9
5.0833	26.41	50.00	23.59	9.000	L1	OFF	9.9
5.1080	26.99	50.00	23.01	9.000	L1	OFF	9.9
5.1643	28.06	50.00	21.94	9.000	L1	OFF	9.9
12.5150	33.25	50.00	16.75	9.000	L1	OFF	10.1
12.5983	33.28	50.00	16.72	9.000	L1	OFF	10.1
12.7400	33.57	50.00	16.43	9.000	L1	OFF	10.2
13.1113	33.76	50.00	16.24	9.000	L1	OFF	10.2
13.1270	33.79	50.00	16.21	9.000	L1	OFF	10.2
13.1698	33.74	50.00	16.26	9.000	L1	OFF	10.2

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Conducted Emissions (Line 2)

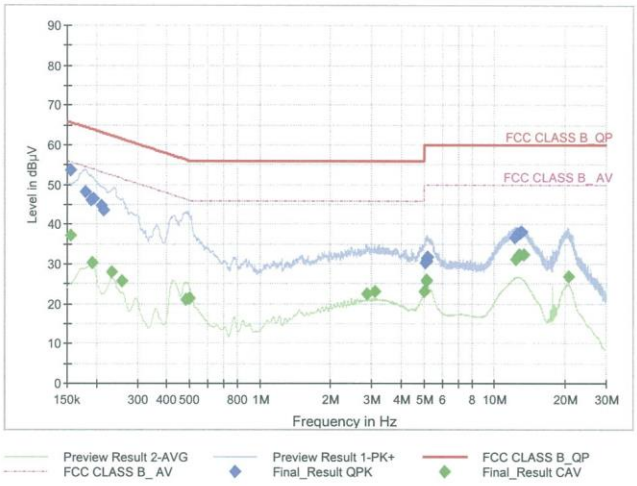
Test 1 / 2

Test Report

Common Information

EUT :	SM-G990E/DS
Manufacturer :	SAMSUNG
Test Site:	SHIELD ROOM
Operating Conditions :	BT N
Operator Name:	
Comment:	

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	53.70	65.75	12.05	9.000	N	OFF	9.6
0.1793	48.29	64.52	16.23	9.000	N	OFF	9.6
0.1905	46.07	64.02	17.94	9.000	N	OFF	9.6
0.1950	46.56	63.82	17.26	9.000	N	OFF	9.6
0.2108	44.60	63.18	18.58	9.000	N	OFF	9.6
0.2153	43.65	63.00	19.35	9.000	N	OFF	9.6
5.0990	30.22	60.00	29.78	9.000	N	OFF	9.9
5.1148	30.50	60.00	29.50	9.000	N	OFF	9.9
5.1305	30.94	60.00	29.06	9.000	N	OFF	9.9
5.1508	31.46	60.00	28.54	9.000	N	OFF	9.9
5.1688	31.61	60.00	28.39	9.000	N	OFF	9.9
5.1778	31.64	60.00	28.36	9.000	N	OFF	9.9
12.2113	36.61	60.00	23.39	9.000	N	OFF	10.2
12.2608	36.69	60.00	23.31	9.000	N	OFF	10.2
12.4453	37.36	60.00	22.64	9.000	N	OFF	10.2
12.7918	37.89	60.00	22.11	9.000	N	OFF	10.2
12.8750	37.88	60.00	22.12	9.000	N	OFF	10.2
13.0055	38.10	60.00	21.90	9.000	N	OFF	10.2

Final_Result_CAV

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Test 2 / 2

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	37.19	55.75	18.57	9.000	N	OFF	9.6
0.1928	30.43	53.92	23.49	9.000	N	OFF	9.6
0.2333	27.92	52.33	24.42	9.000	N	OFF	9.6
0.2580	25.57	51.50	25.92	9.000	N	OFF	9.6
0.4853	21.20	46.25	25.05	9.000	N	OFF	9.6
0.5000	21.28	46.00	24.72	9.000	N	OFF	9.6
2.8423	22.51	46.00	23.49	9.000	N	OFF	9.8
3.0808	23.00	46.00	23.00	9.000	N	OFF	9.8
5.0000	23.14	46.00	22.86	9.000	N	OFF	9.9
5.1238	25.62	50.00	24.38	9.000	N	OFF	9.9
5.1350	25.77	50.00	24.23	9.000	N	OFF	9.9
5.1395	25.94	50.00	24.06	9.000	N	OFF	9.9
12.2855	31.19	50.00	18.81	9.000	N	OFF	10.2
12.6028	32.04	50.00	17.96	9.000	N	OFF	10.2
12.6545	32.05	50.00	17.95	9.000	N	OFF	10.2
12.8053	32.31	50.00	17.69	9.000	N	OFF	10.2
13.3498	32.37	50.00	17.63	9.000	N	OFF	10.2
20.5813	26.87	50.00	23.13	9.000	N	OFF	10.5

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11. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	08/23/2022	Annual
Test Receiver	ESCI	Rohde & Schwarz	100033	06/15/2022	Annual
Temperature Chamber	SU-642	ESPAC	0093008124	03/15/2022	Annual
Signal Analyzer	N9020A	Agilent	MY47380318	01/28/2022	Annual
Signal Analyzer	N9030A	Agilent	MY49431210	01/11/2022	Annual
Power Meter	N1911A	Agilent	MY45100523	04/08/2022	Annual
Power Sensor	N1921A	Agilent	MY57820067	04/08/2022	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/10/2021	Annual
Power Splitter	11667B	Hewlett Packard	05001	05/20/2022	Annual
DC Power Supply	E3632A	Hewlett Packard	KR75303960	06/10/2022	Annual
Attenuator (10 dB)	5910-N-50-010	H+S	00801	10/28/2021	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	FCC WLAN&BT&BLE Conducted Test Software v3.0	HCT CO., LTD.	N/A	N/A	N/A
Bluetooth Tester	CBT	Rohde & Schwarz	100422	05/04/2022	Annual

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

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller (Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Controller	2090	Emco	060520	N/A	N/A
Turn Table	Turn Table	Ets	N/A	N/A	N/A
Loop Antenna	Loop Antenna	Rohde & Schwarz	1513-333	03/19/2022	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	09/04/2022	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	11/18/2021	Biennial
Horn Antenna (15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170541	11/29/2021	Biennial
Spectrum Analyzer	FSP (9 kHz ~ 30 GHz)	Rohde & Schwarz	836650/016	09/14/2021	Annual
Spectrum Analyzer	FSV40-N	Rohde & Schwarz	101068-SZ	09/22/2021	Annual
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	01/06/2022	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	02/08/2022	Annual
Attenuator (10 dB) 56-10	CBLU1183540B-01 56-10	CERNEX WEINSCHEL	N/A	12/23/2021	Annual
Broadband Low Noise Amplifier Attenuator (3 dB)	CBL06185030 18B-03	CERNEX Api tech.	N/A	12/23/2021	Annual
High Pass Filter	WHKX10-2700-3000-18000-40SS	Wainwright Instruments	N/A	12/23/2021	Annual
High Pass Filter	WHKX8-6090-7000-18000-40SS	Wainwright Instruments	N/A	12/23/2021	Annual
Thru	COAXIAL ATTENUATOR	T&M SYSTEM	N/A	12/23/2021	Annual
Power Amplifier	CBL18265035	CERNEX	22966	12/04/2021	Annual
Power Amplifier	CBL26405040	CERNEX	25956	03/23/2022	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000276	03/09/2022	Annual

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-2109-FC020-P