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FCC BT REPORT

Certification

pplicant Name:
SAMSUNG Electronics Co., Ltd.

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

Date of Issue:
May 13, 2022

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

Report No.: HCT-RF-2205-FC011

FCC ID:	**A3LSMG990U2**
APPLICANT:	**SAMSUNG Electronics Co., Ltd.**

Model:	SM-G990U2
Additional Model:	SM-G990U3/DS
EUT Type:	Mobile Phone
Max. RF Output Power:	15.688dBm (37.05mW)
Frequency Range:	2402 MHz– 2480 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-2205-FC011	May 13, 2022	- First Approval Report

Table of Contents

1. EUT DESCRIPTION

Model	SM-G990U2
Additional Model	SM-G990U3/DS
EUT Type	Mobile Phone
Power Supply	DC 3.88 V
Frequency Range	2 402 MHz ~ 2 480 MHz
Max. RF Output Power	15.688dBm (37.05mW)
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 06, 2022 ~ May 10, 2022
Serial number	Radiated: R3CT30Q0R8W Conducted : 0e0b0f75a61f032c

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)	2.00 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.40 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.74 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.51 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.92 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.48 (Confidence level about 95 %, k=2)

8. DESCRIPTION OF TESTS

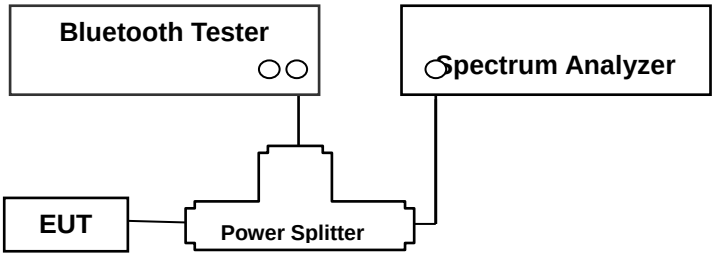
8.1. Conducted Maximum Peak Output Power

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

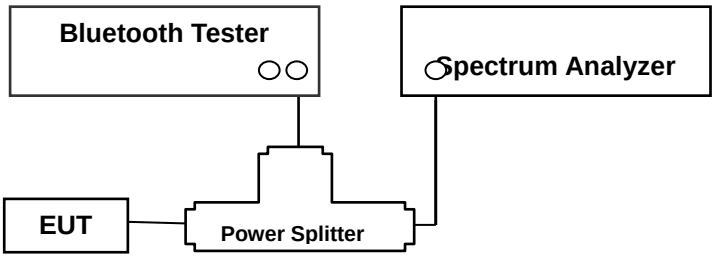
Output Power = Spectrum Measured Power + Power Splitter loss + Cable loss(2 ea) + EUT Cable loss
= 10dBm + 6 dB + 1.5 dB = 17.5 dBm

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)

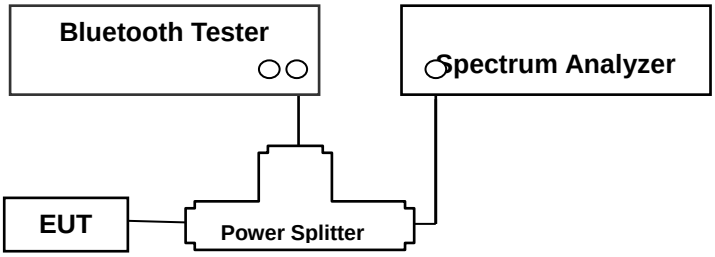
1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer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

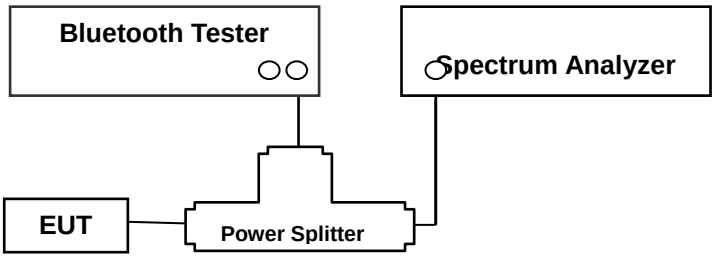
1) Span: Set between two times and five times the OBW
2) RBW: 1 % to 5 % of the OBW.
3) VBW ≥ 3 x RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) All the trace to stabilize.

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)

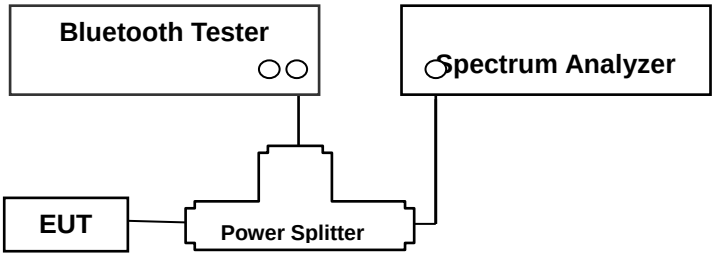
1) Span: the frequency band of operation
2) RBW: To identify clearly the individual channels, set the RBW to less than 30 % of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3) VBW ≥ RBW
4) Sweep: Auto
5) Detector: Peak
6) Trace: Max hold
7) Allow the trace to stabilize.

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.

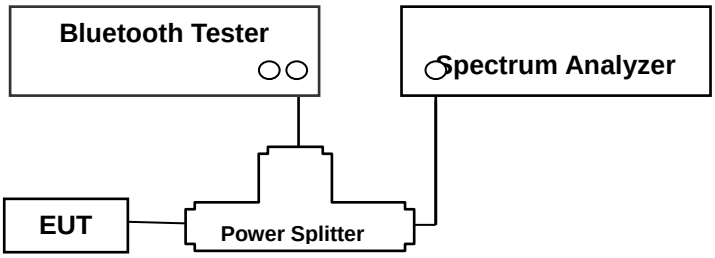
Dwell time = Tx-time x 106.667 = 308.27 (ms)

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	6.46
100	6.54
200	6.62
300	6.75
400	6.81
500	6.83
600	6.83
700	6.87
800	6.91
900	6.94
1 000	6.98
2 000	7.25
2 400	**7.57**
2 500	**7.57**
3 000	7.46
4 000	7.64
5 000	7.84
6 000	7.84
7 000	7.95
8 000	7.94
9 000	8.13
10 000	8.25
11 000	8.38
12 000	8.52
13 000	8.61
14 000	8.73
15 000	8.84
16 000	8.92
17 000	9.04
18 000	9.06
19 000	9.05
20 000	9.10
21 000	9.13
22 000	9.20
23 000	9.36
24000	9.37
25000	9.39
26000	9.45

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

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

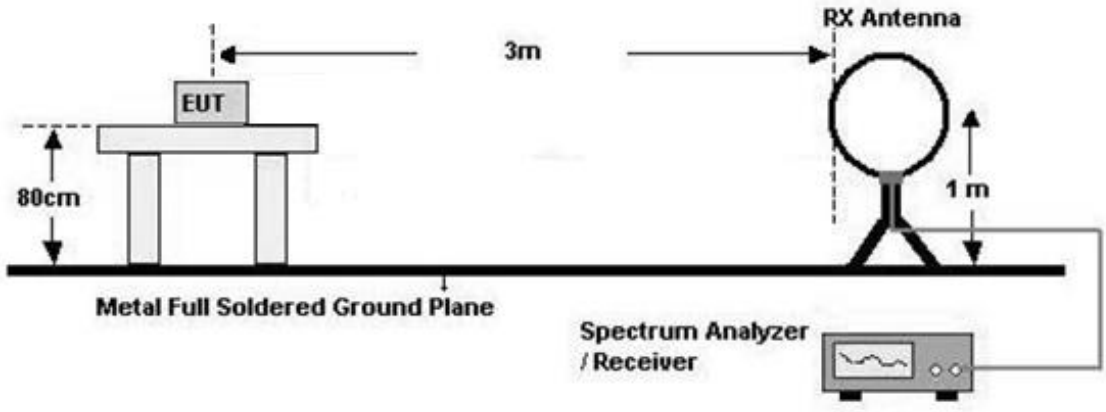
8.7. Radiated Test

Limit

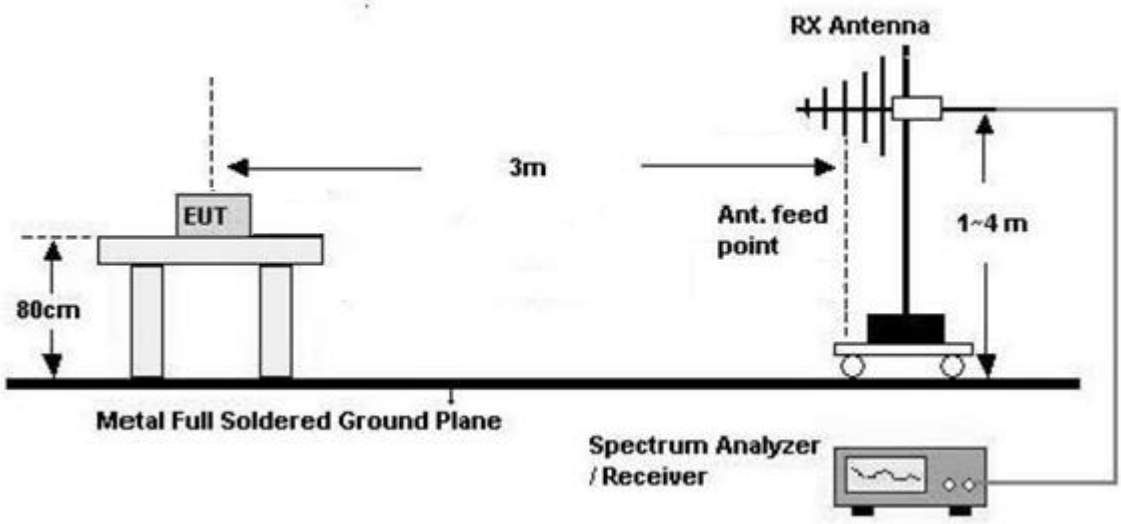
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

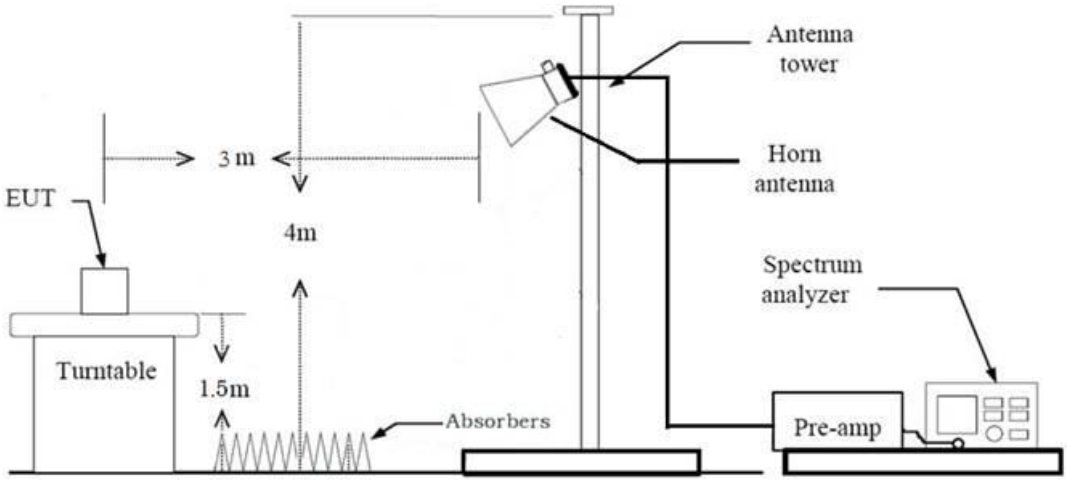
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions(Below30 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 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 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 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):

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

(2)Measurement(Avg)

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

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 Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)
   (2)Measurement(Avg)
   = Measured Value(Avg) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.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) = Measured 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, Z
   - 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-G990U2, SM-G990U3/DS were tested and the worst case results are reported.(Worst case : SM-G990U2)

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. The following tables show the worst case configurations determined during testing.

(Test case 1 Result : Please refer to the SM-G990U2 [UNII ax, DTS] Test Report.)

Test case	Description	2.4 GHz Emission	5 GHz Emission	Bluetooth Emission
1	Antenna	Ant All	Ant All	-
	Channel	1	165	-
	Data Rate	11 Mbps	MCS0	-
	Mode	802.11b	802.11ax(HE20) 52T RU38	-

Test case	Description	5 GHz Emission	Bluetooth Emission
2	Antenna	Ant All	Ant 1
	Channel	165	0
	Data Rate	MCS0	1 Mbps
	Mode	802.11ax / HE20 / 52T / RU38	GFSK : DH5

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-G990U2, SM-G990U3/DS were tested and the worst case results are reported.(Worst case : SM-G990U2)

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-G990U2, SM-G990U3/DS were tested and the worst case results are reported.(Worst case : SM-G990U2)

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	13.193	20.86	125
Mid	2441	15.688	37.05	
High	2480	14.911	30.98	

Channel	Frequency (MHz)	Output Power (8DPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	11.053	12.74	125
Mid	2441	14.104	25.73	
High	2480	13.278	21.27	

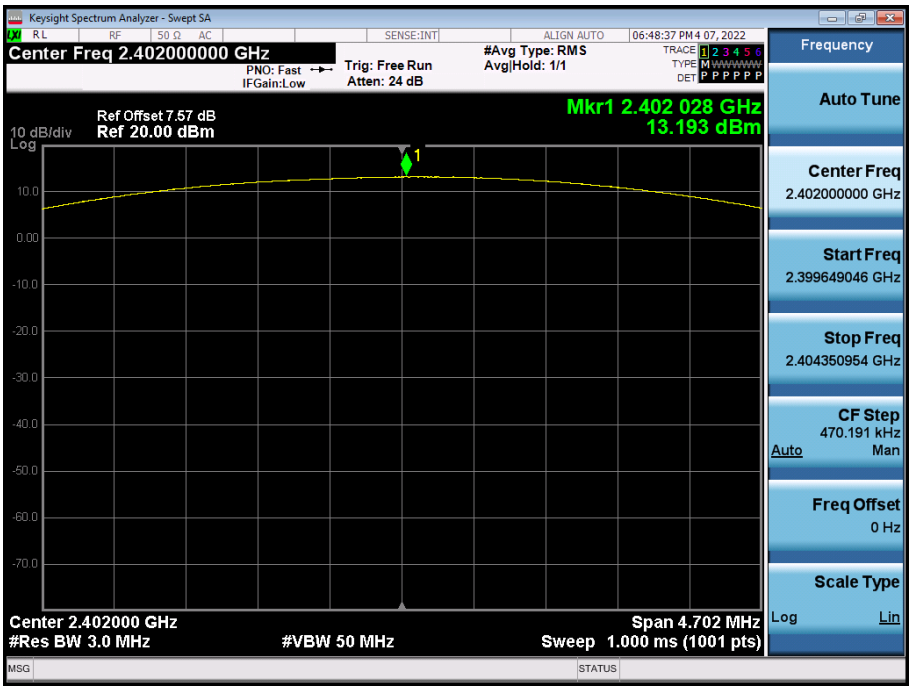
Channel	Frequency (MHz)	Output Power (π/4DQPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	10.671	11.67	125
Mid	2441	13.542	22.60	
High	2480	12.703	18.63	

Note:

1. Spectrum measured 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. Actual value of loss for the splitter and cable combination is 7.57 dB at 2400 MHz
   and is 7.57 dB at 2500 MHz.So, 7.57 dB is offset. And the offset gap in the 2.4 GHzrange do not affect the conducted peak power final result.

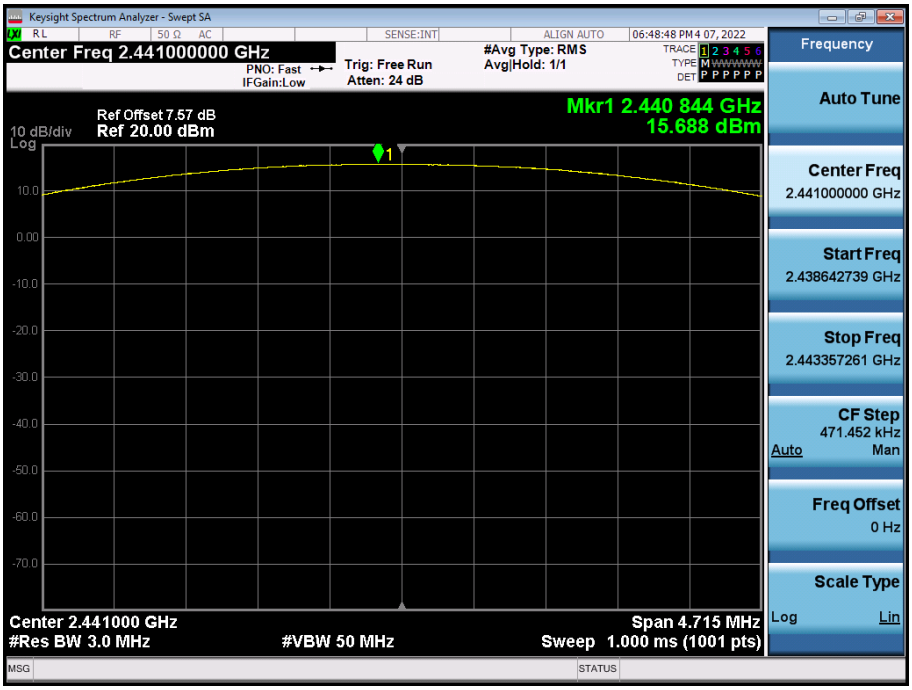
Test Plots (GFSK)

Peak Power (CH.0)



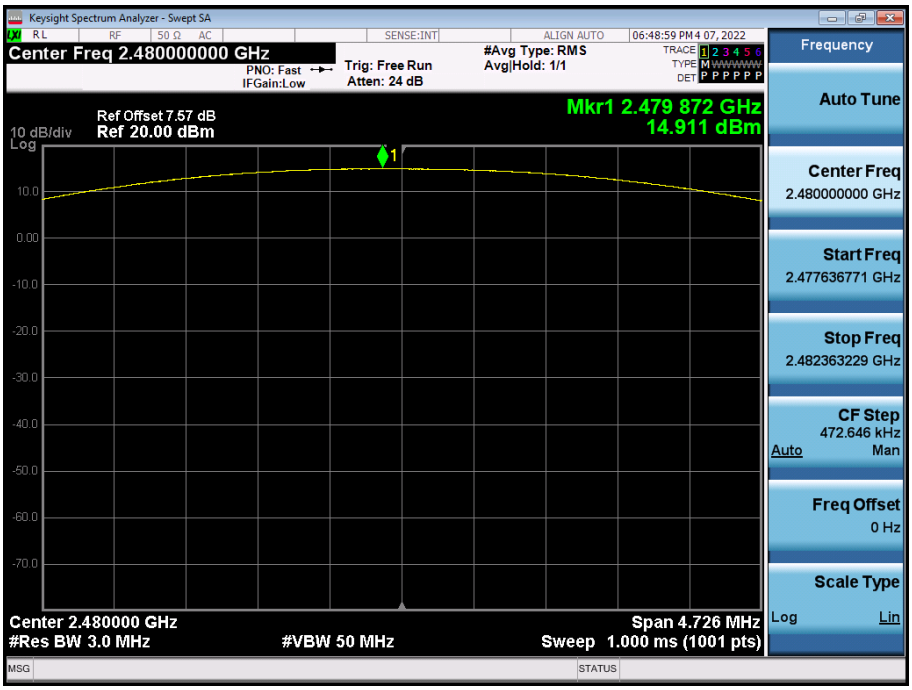
Test Plots (GFSK)

Peak Power (CH.39)



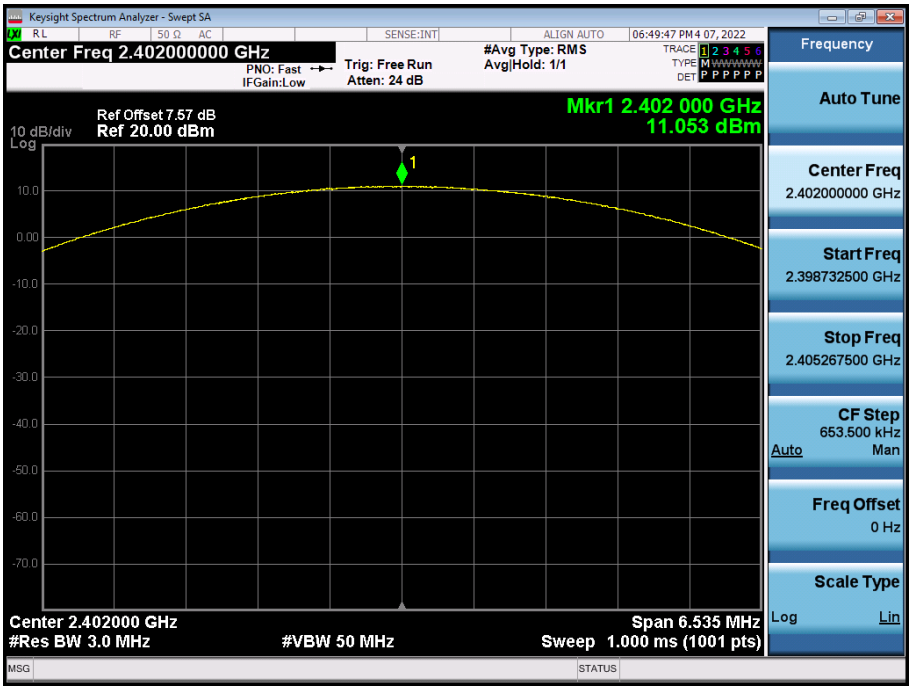
Test Plots (GFSK)

Peak Power (CH.78)



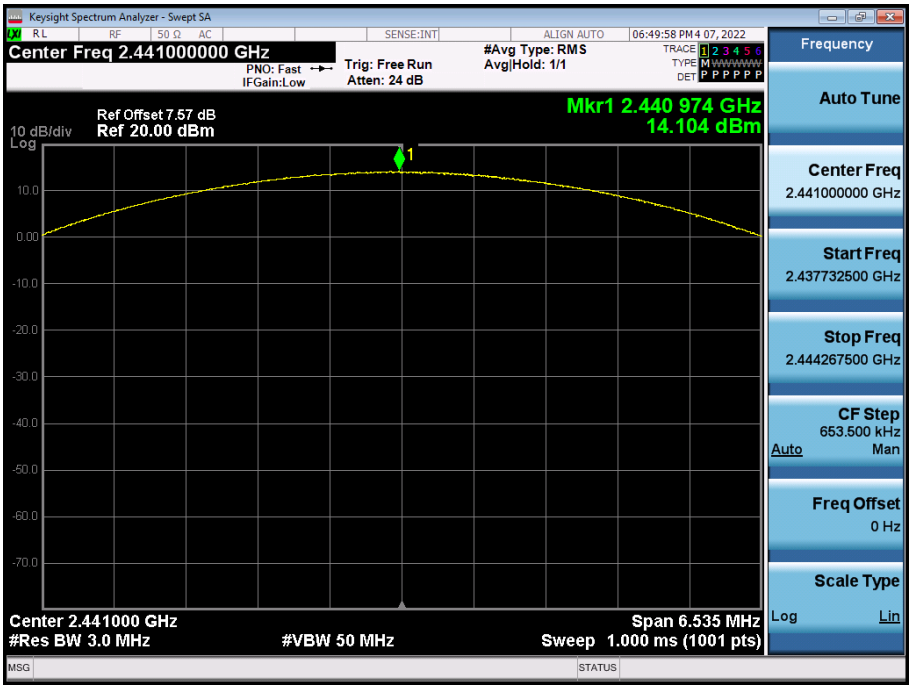
Test Plots (8DPSK)

Peak Power (CH.0)



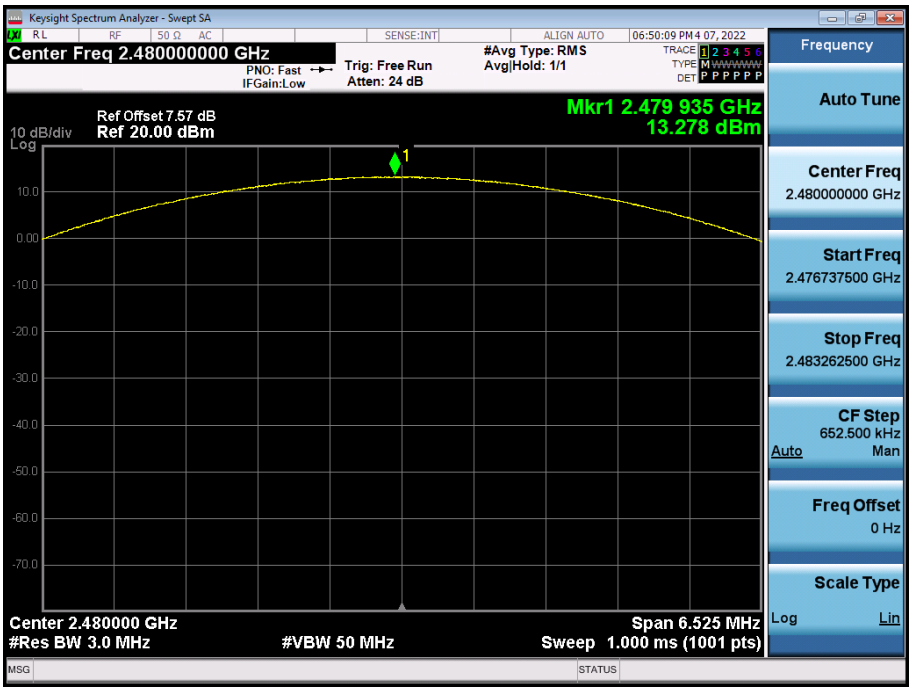
Test Plots (8DPSK)

Peak Power (CH.39)

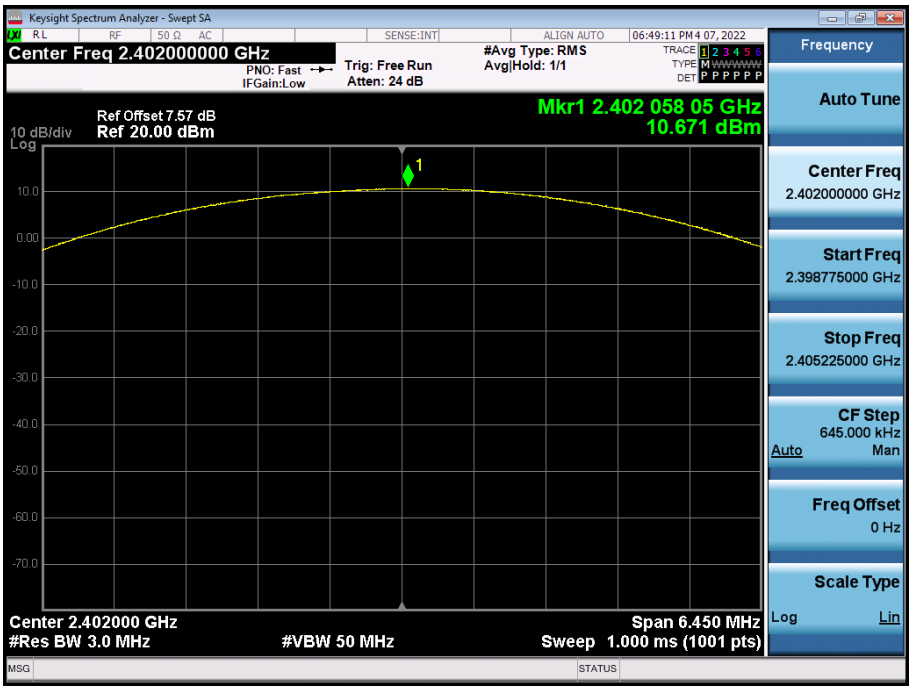


Test Plots (8DPSK)

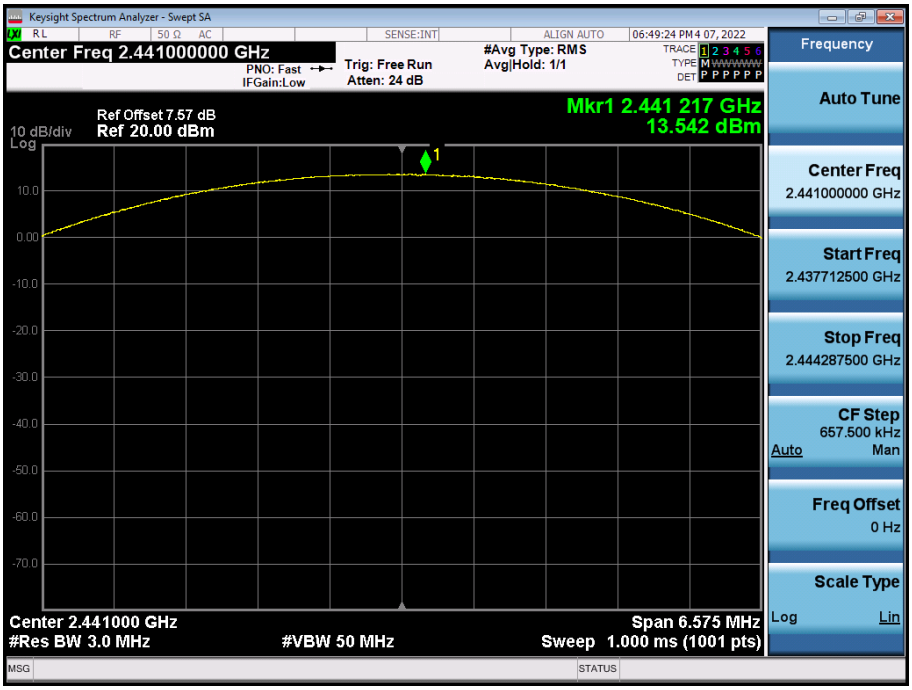
Peak Power (CH.78)



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

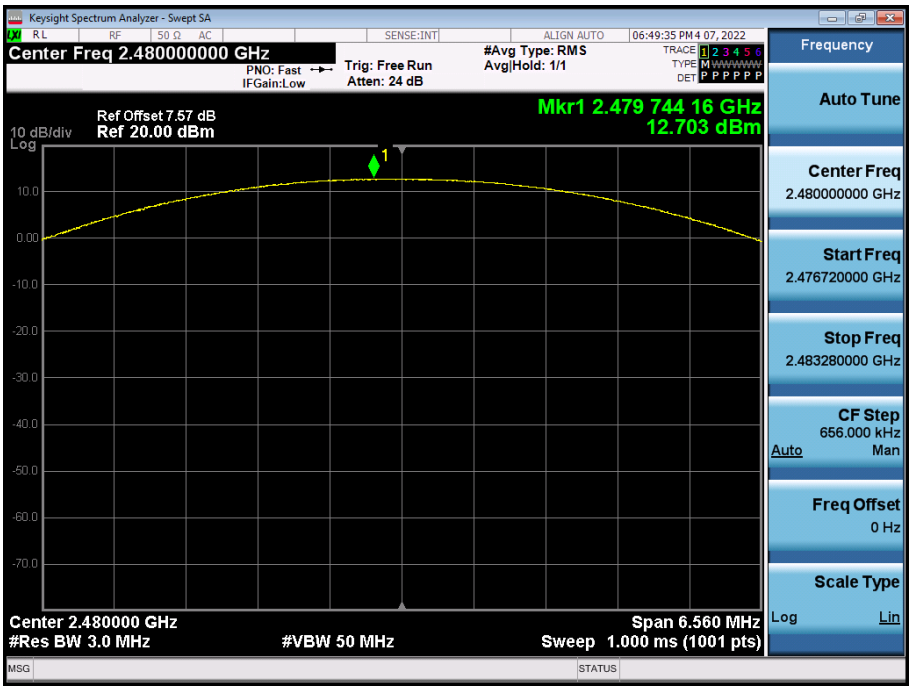


Test Plots (π/4DQPSK)
Peak Power (CH.39)



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	62.885	61.212	62.572	20
Upper	67.477	63.540	63.633	

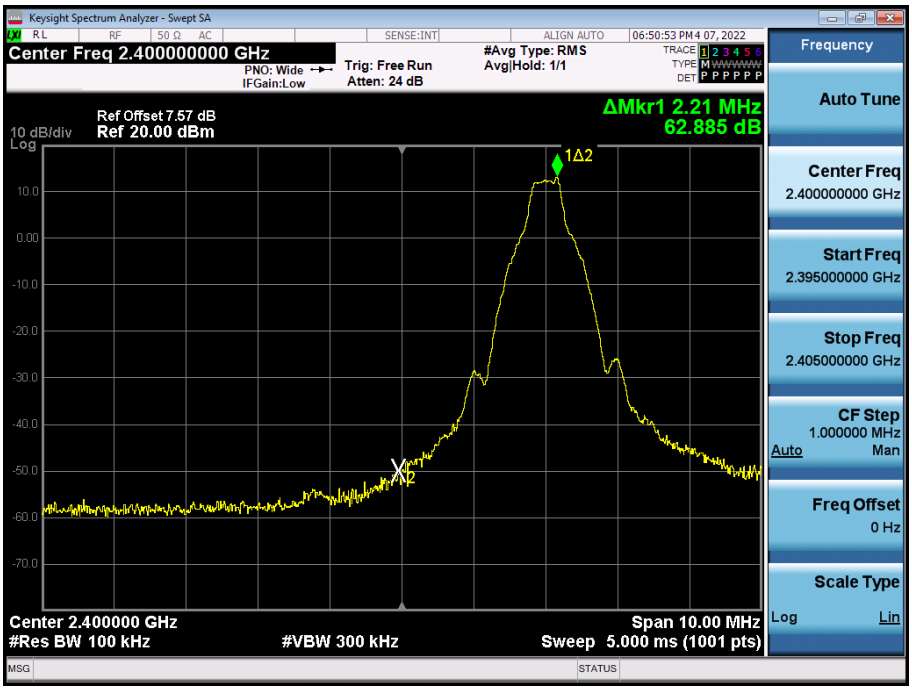
With hopping

Outside Frequency Band	GFSK (dB)	8DPSK (dB)	π/4DQPSK (dB)	Limit (dBc)
Lower	62.465	61.666	64.100	20
Upper	61.169	59.840	58.897	

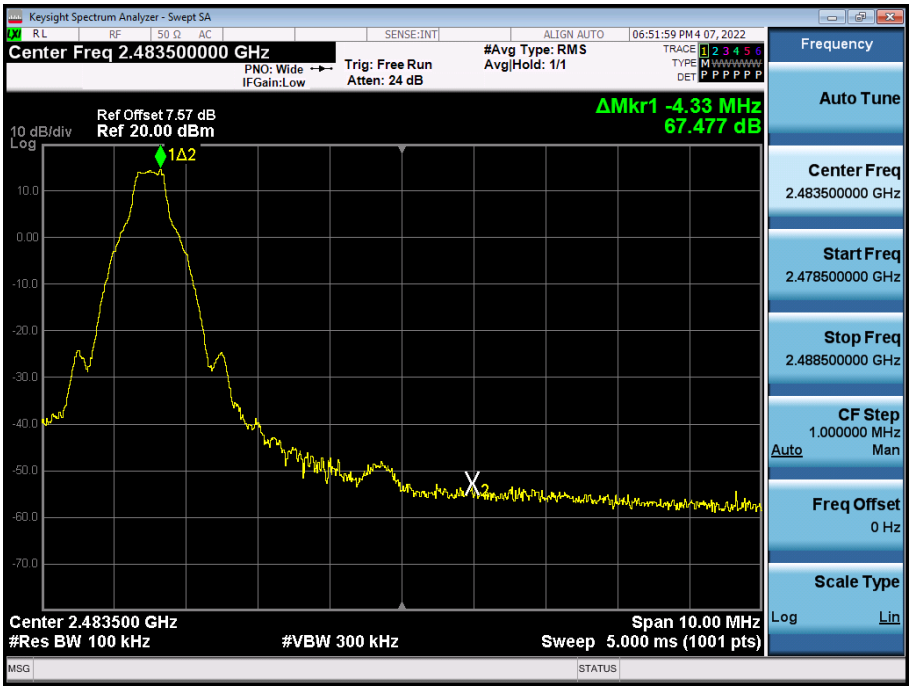
Note :

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 7.57 dB at 2400 MHz
   and is 7.57 dB at 2500 MHz.So, 7.57 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.

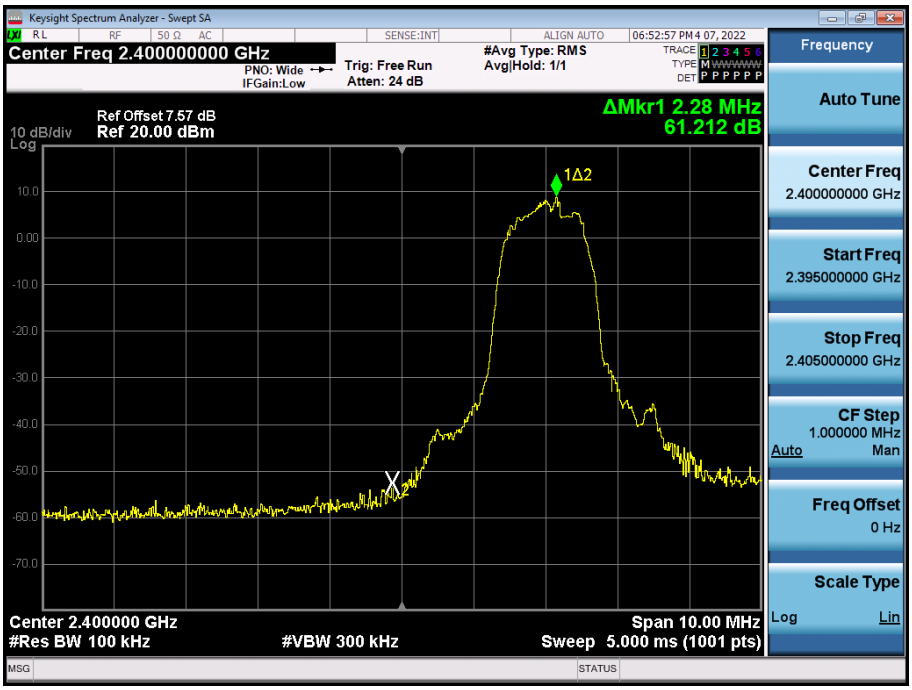
Test Plots without hopping (GFSK)
Band Edges (CH.0)



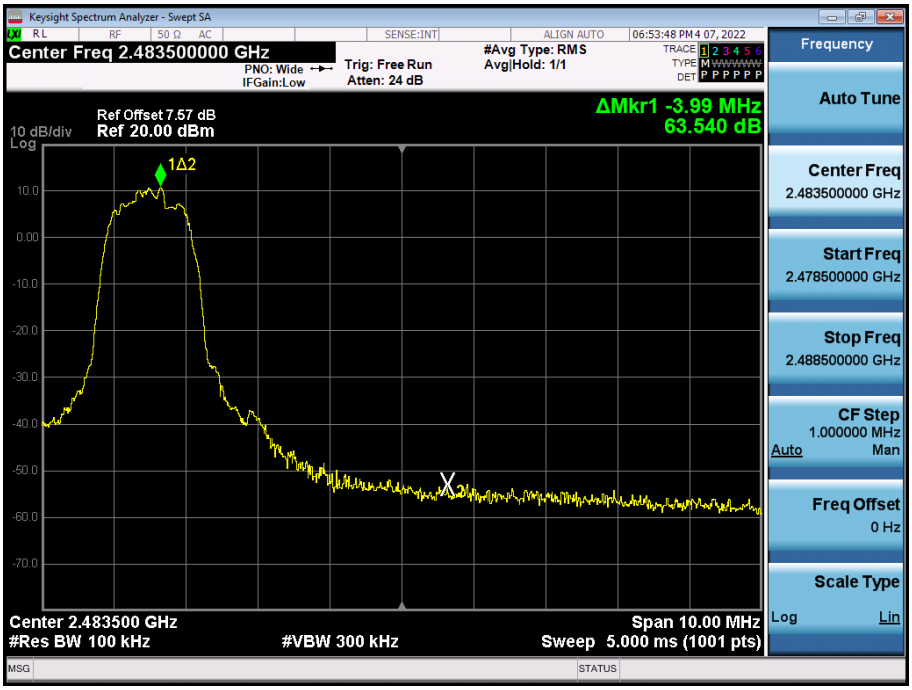
Test Plots without hopping (GFSK)
Band Edges (CH.78)



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

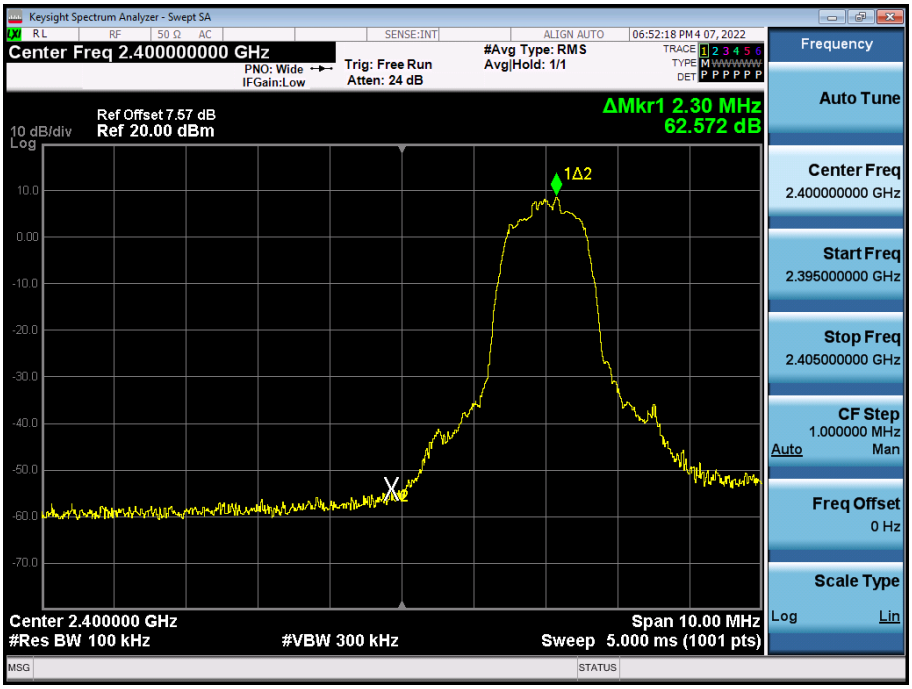


Test Plots without hopping (8DPSK)
Band Edges (CH.78)



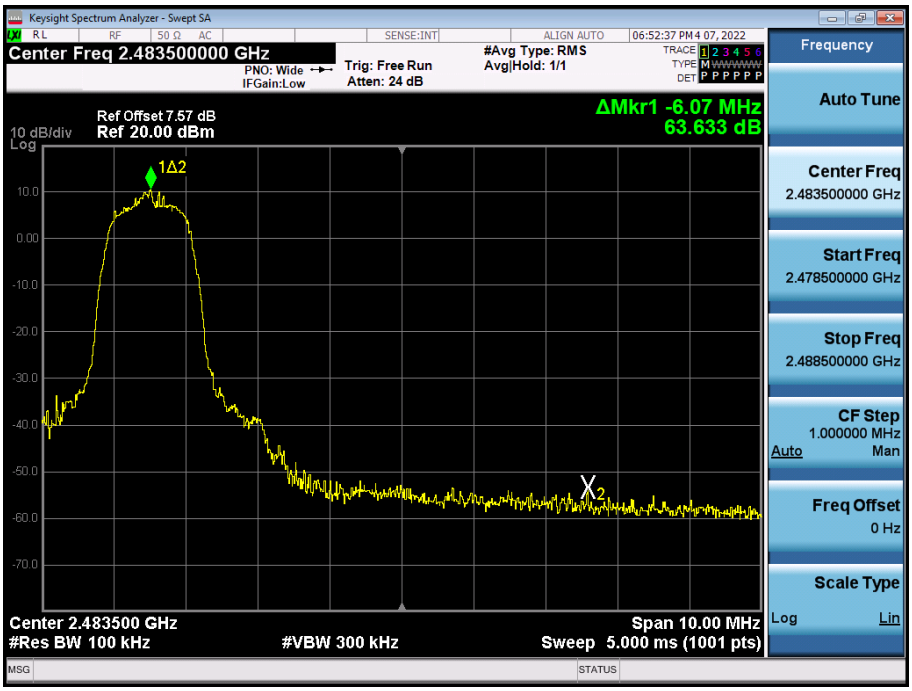
Test Plots without hopping (π/4DQPSK)

Band Edges (CH.0)



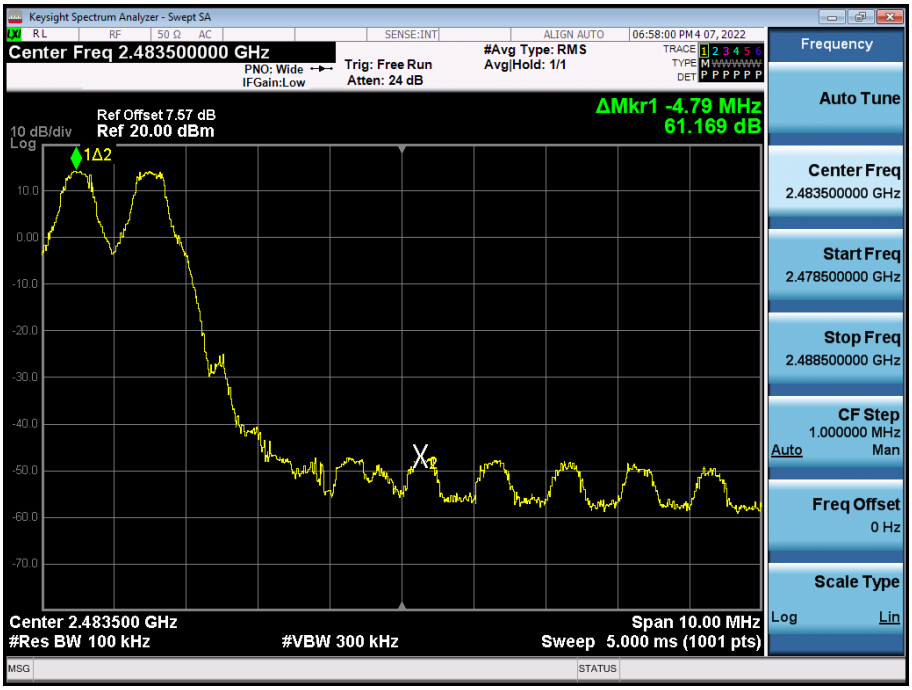
Test Plots without hopping (π/4DQPSK)

Band Edges (CH.78)



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

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

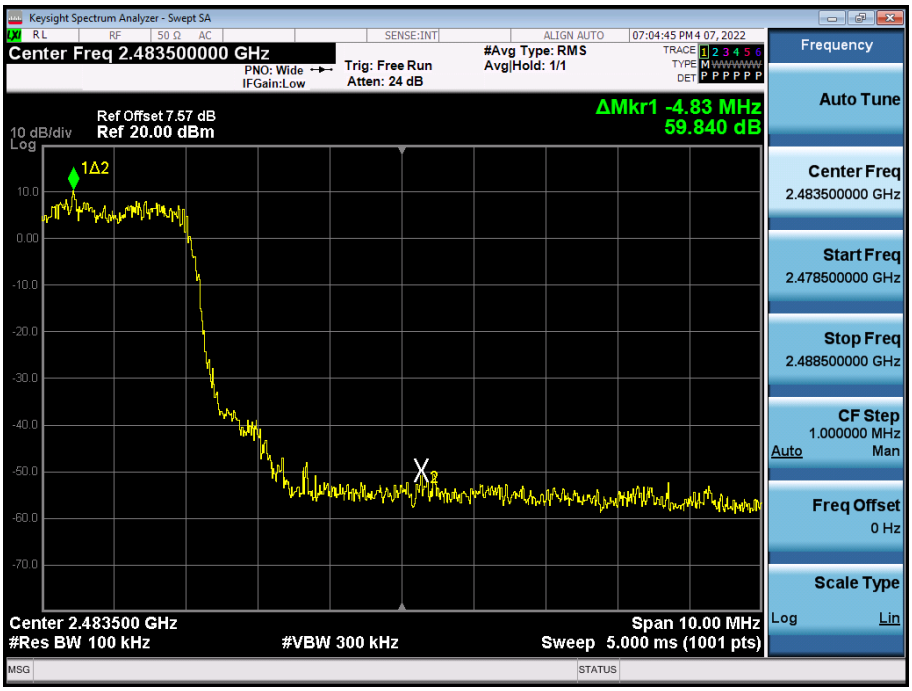


Test Plots with hopping (8DPSK)

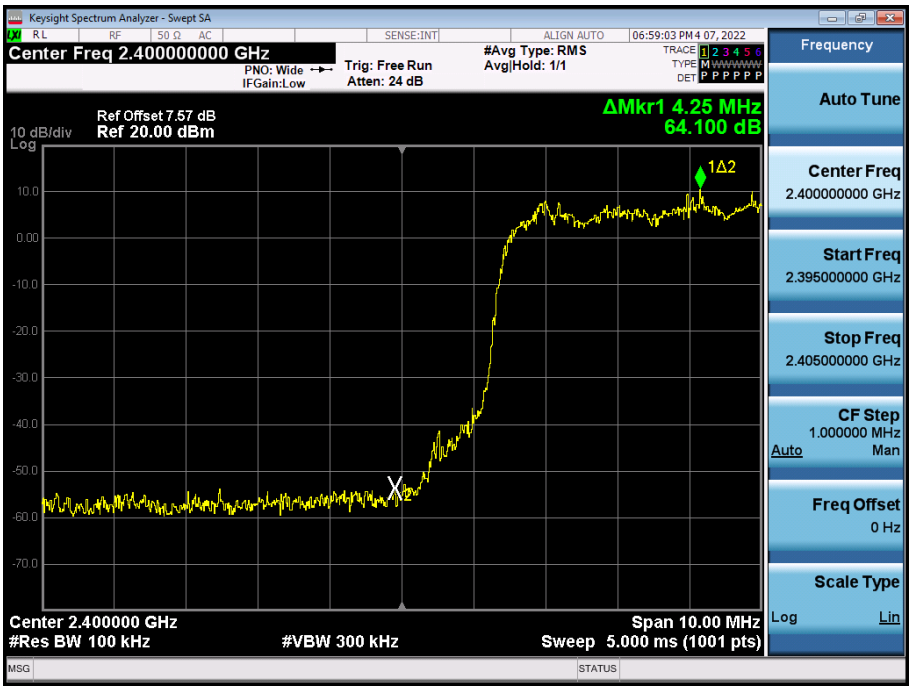
Band Edges (CH.0)

Test Plots with hopping (8DPSK)

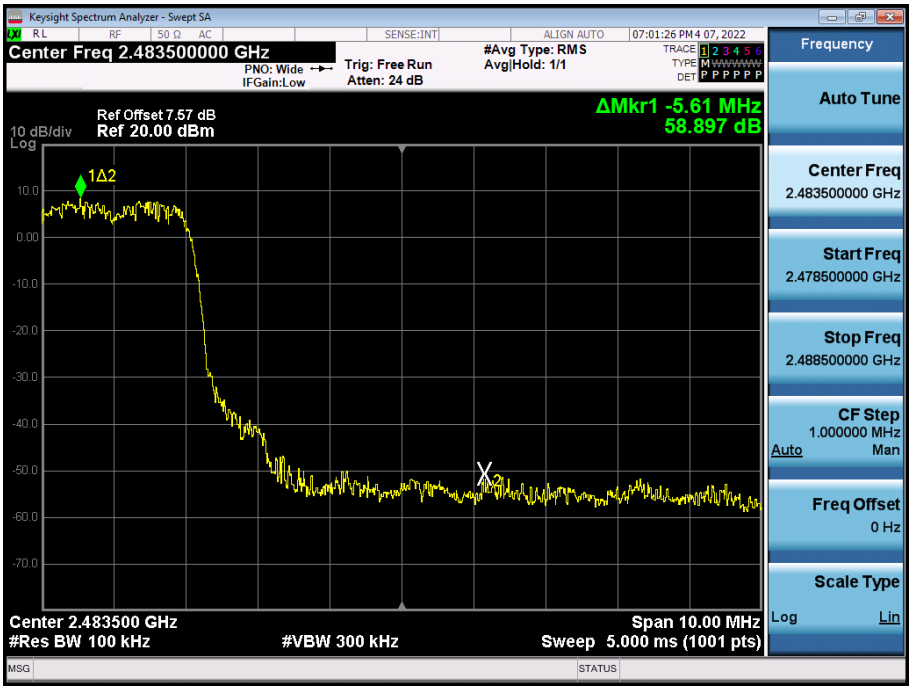
Band Edges (CH.78)



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	833.84	1175.9	1177.3
CH.39	832.04	1179.6	1171.8
CH.78	834.34	1181.2	1175.0

20dB BW (kHz)			
Channel	**GFSK**	**8DPSK**	**π/4DQPSK**
CH.0	940.4	1307	1290
CH.39	942.9	1307	1315
CH.78	945.3	1305	1312

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

Test Plots (GFSK)

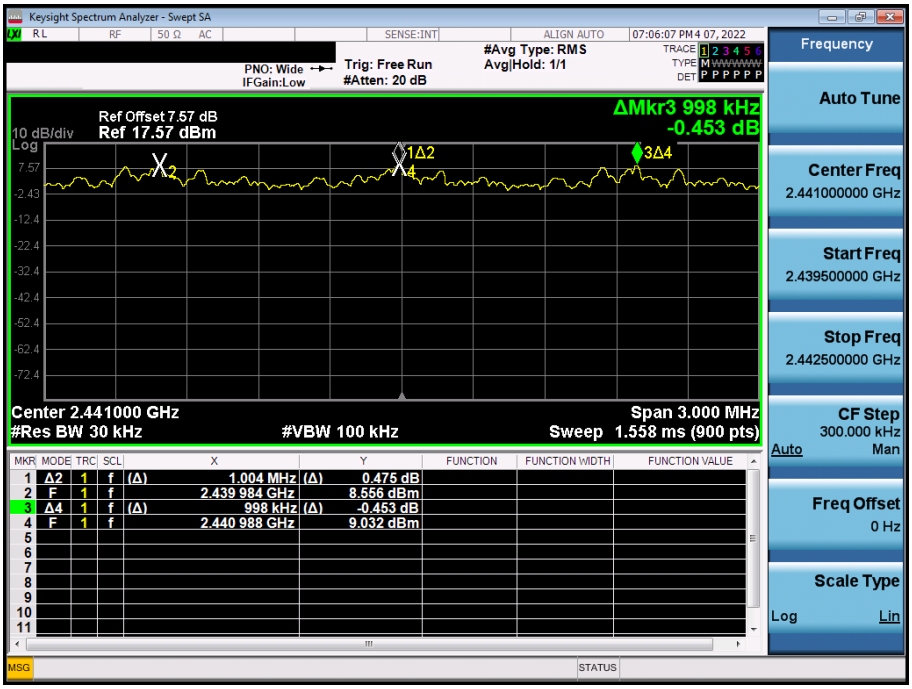
Channel Separation

Test Plots (8DPSK)

Channel Separation

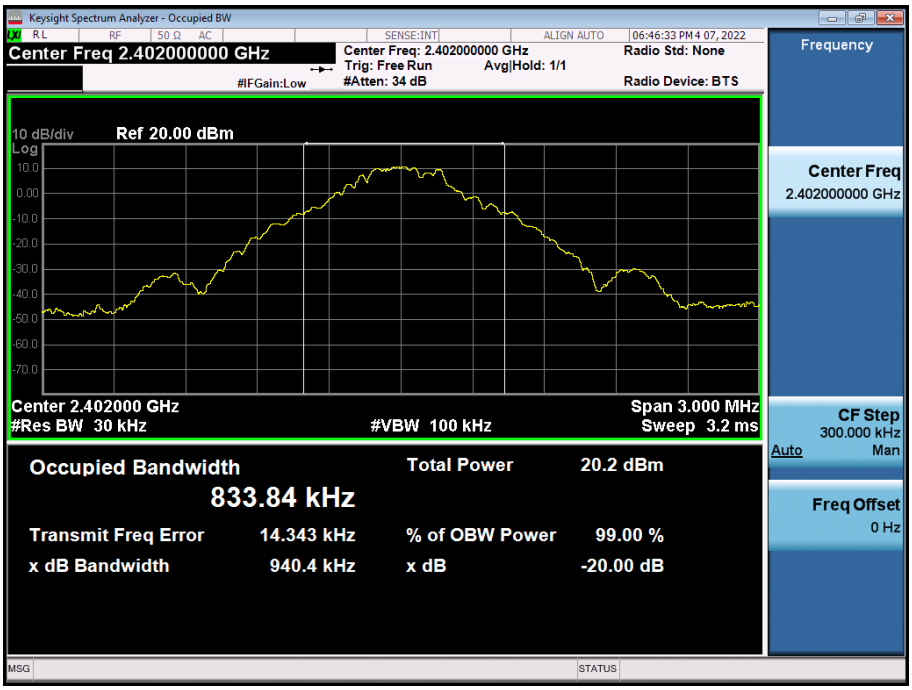
Test Plots (π/4DQPSK)

Channel Separation



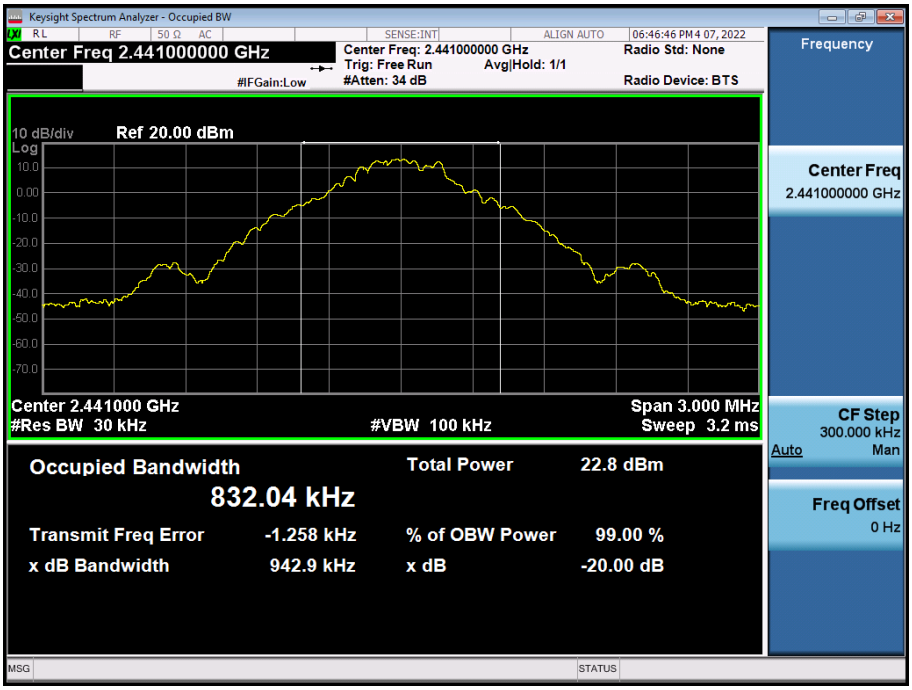
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



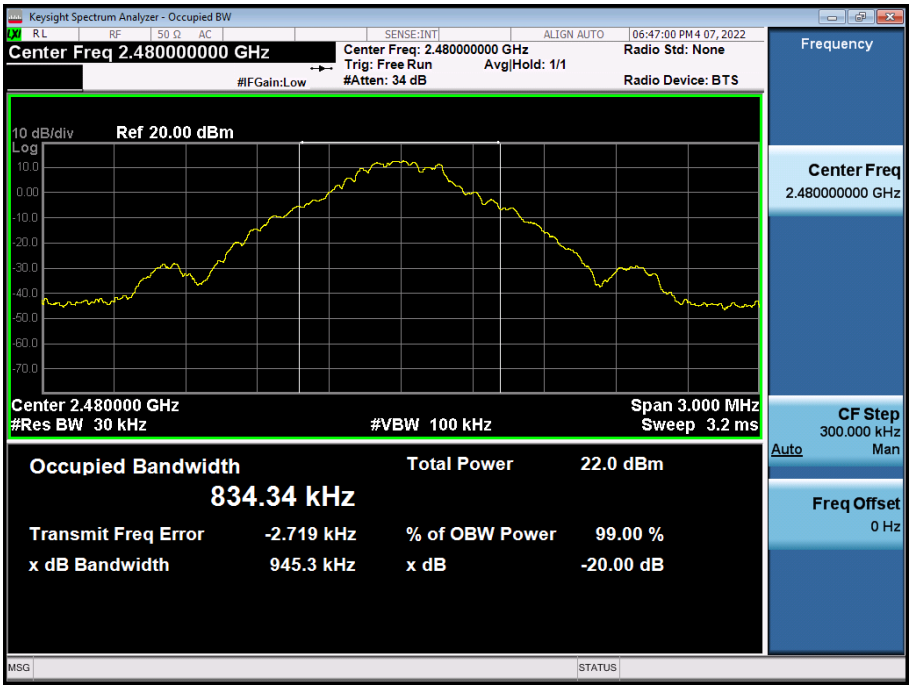
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



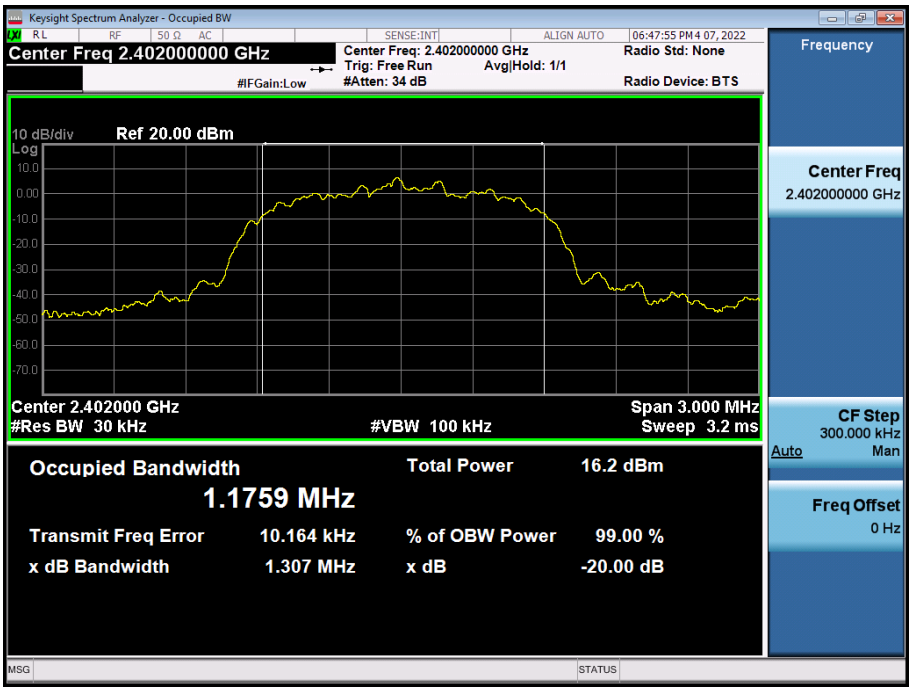
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



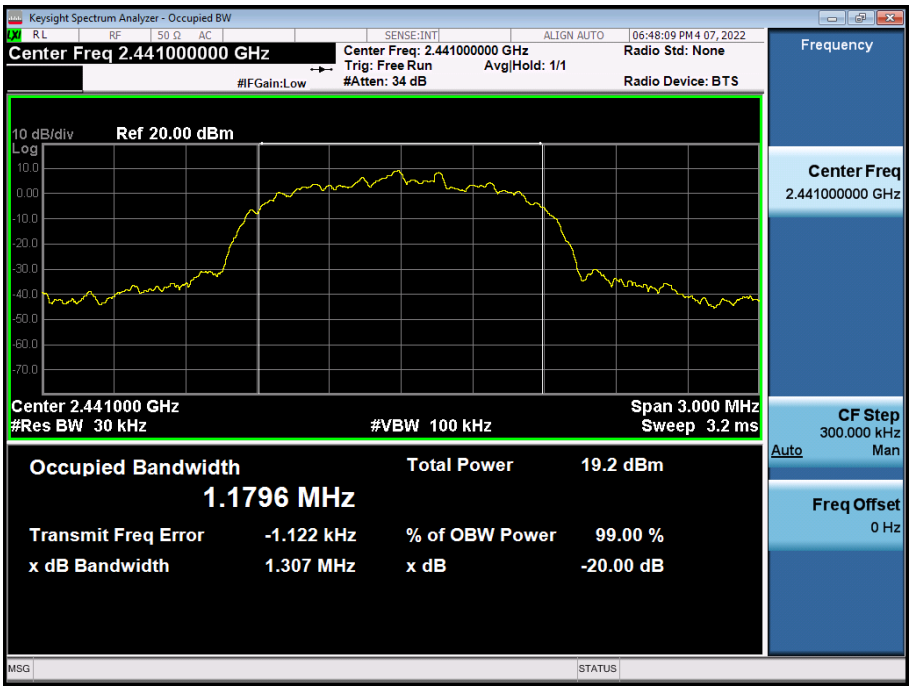
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



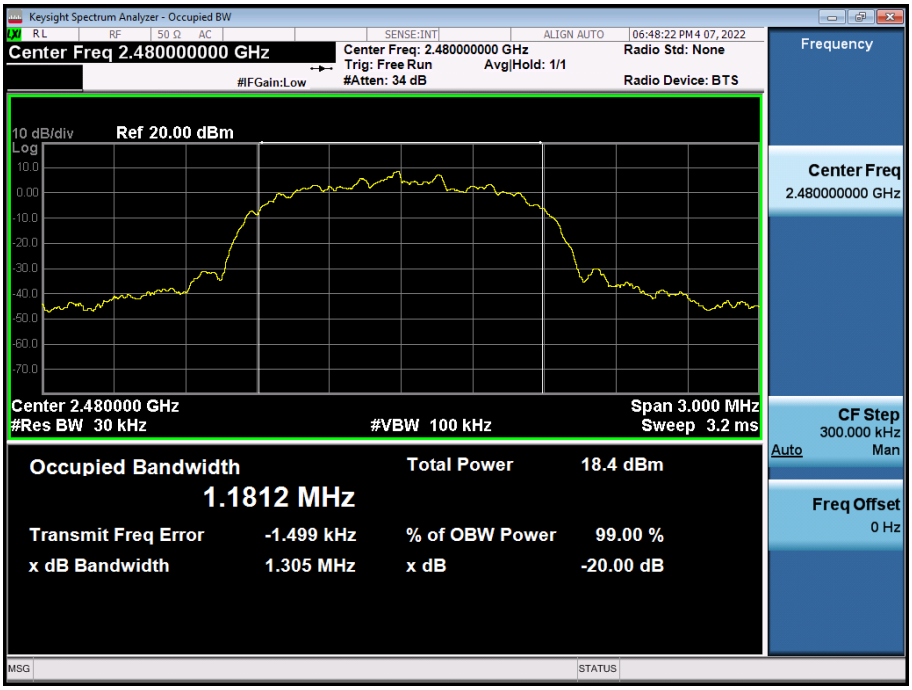
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



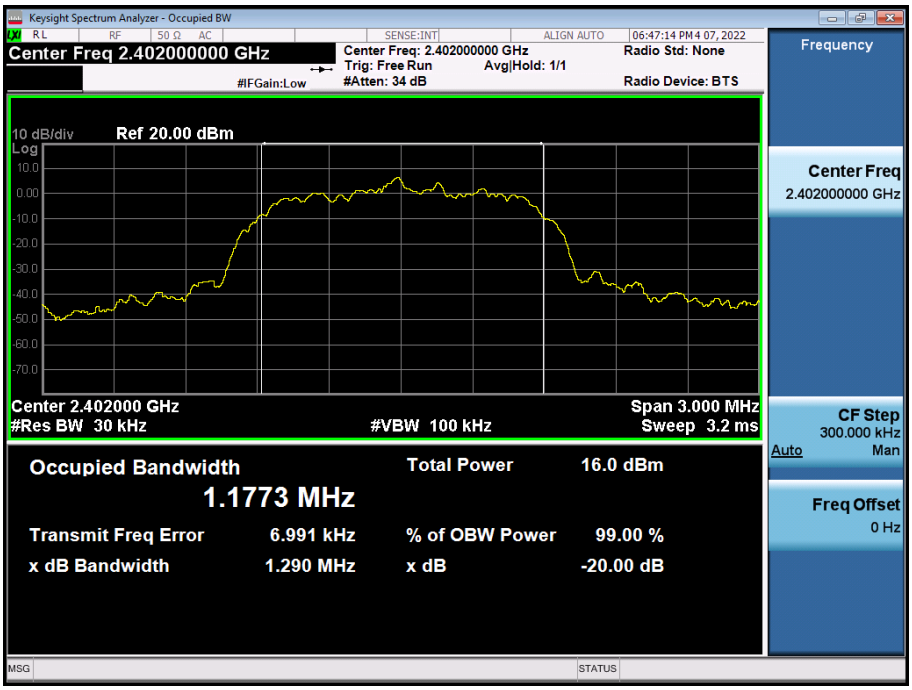
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



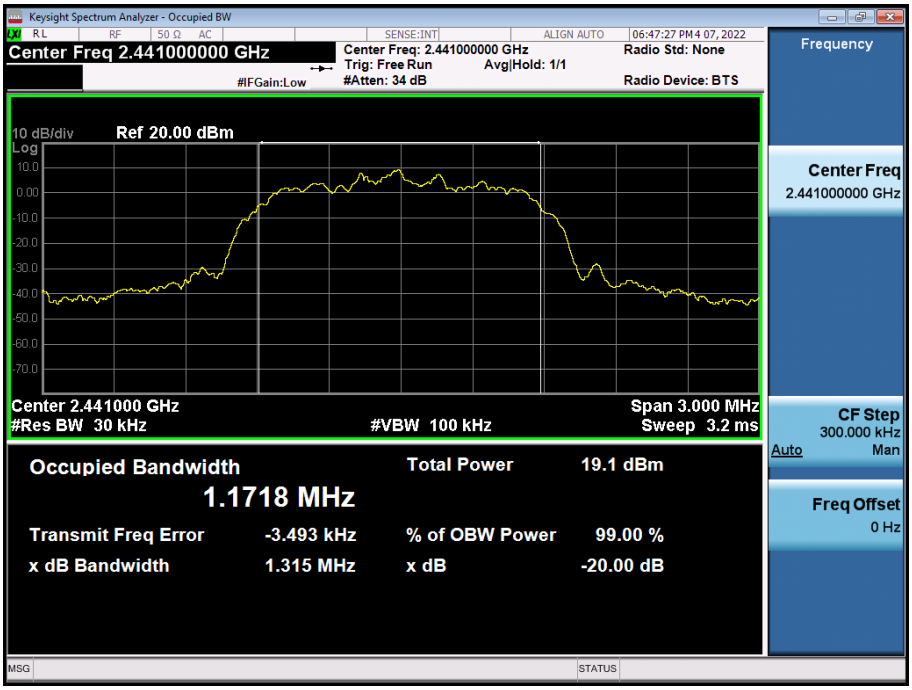
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



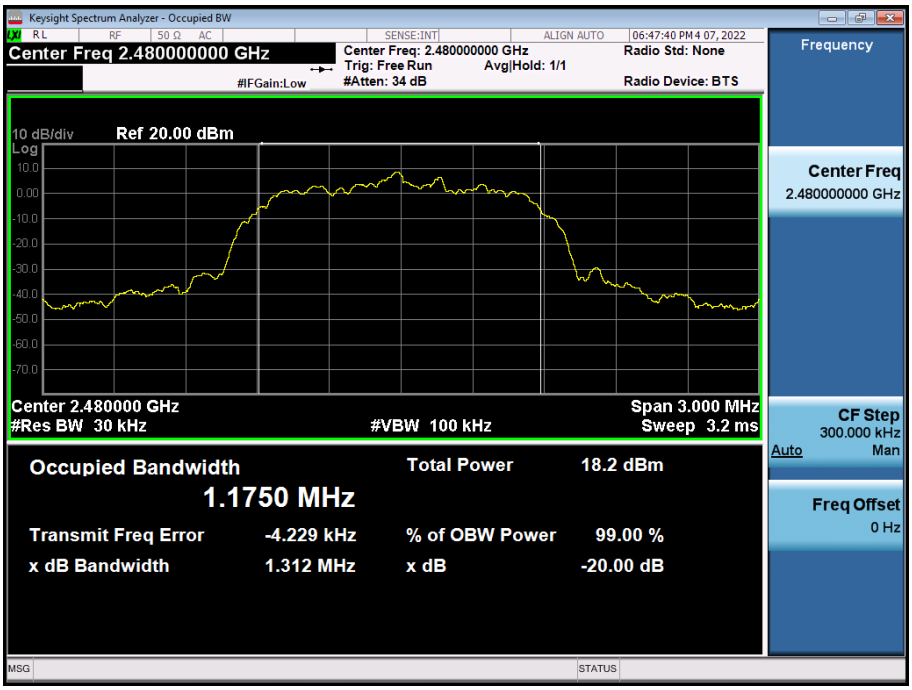
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



10.4 NUMBER OF HOPPING FREQUENCY

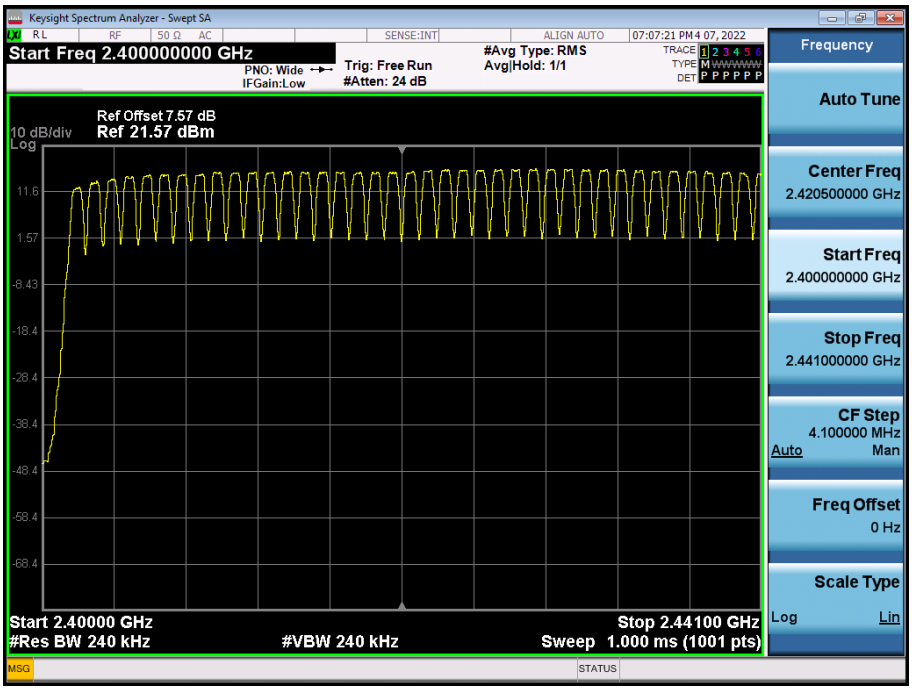
Result (No. of CH)			Limit
GFSK	8DPSK	π/4DQPSK	
79	79	79	>15

Note :

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

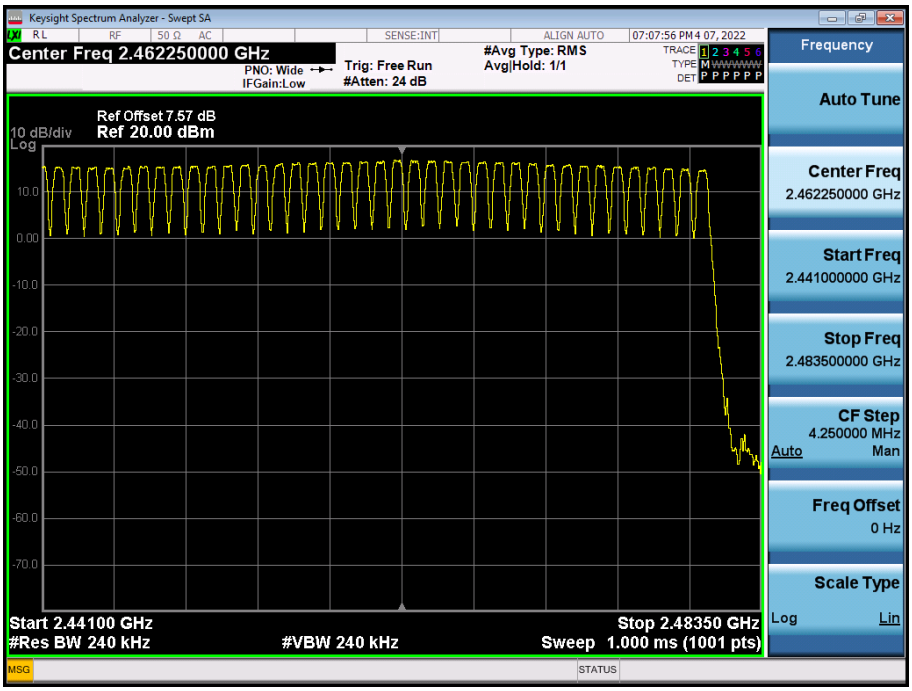
Test Plots (GFSK)

Number of Channels (2.4 GHz- 2.441 GHz)



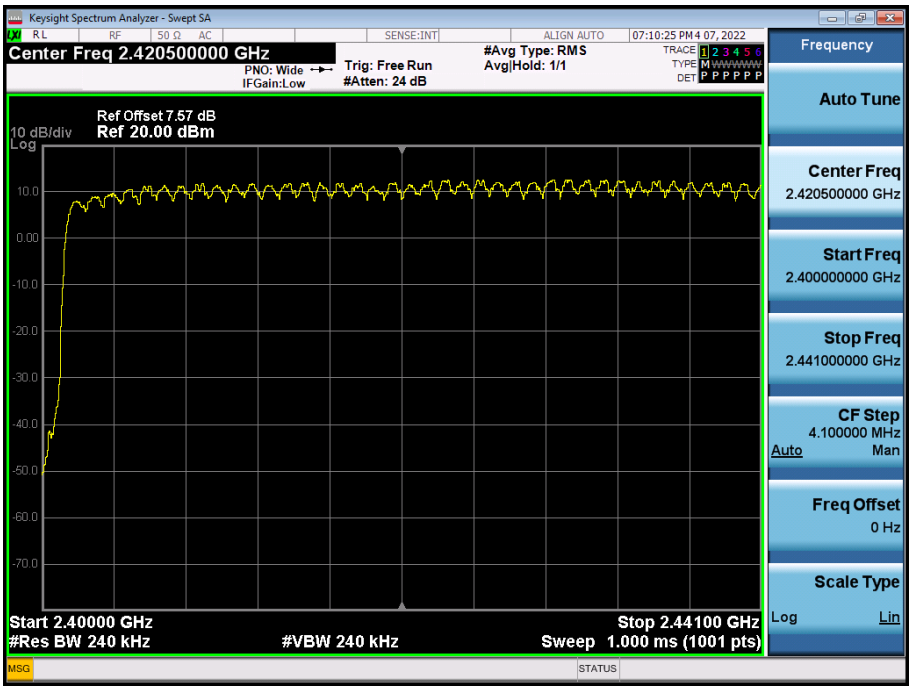
Test Plots (GFSK)

Number of Channels (2.441 GHz- 2.483.5 GHz)



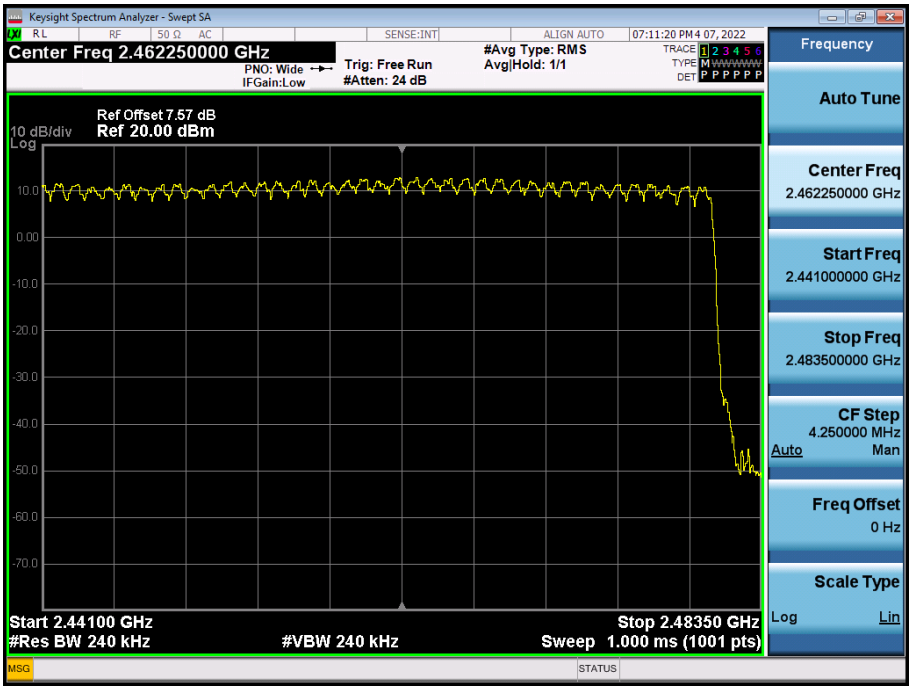
Test Plots (8DPSK)

Number of Channels (2.4 GHz- 2.441 GHz)



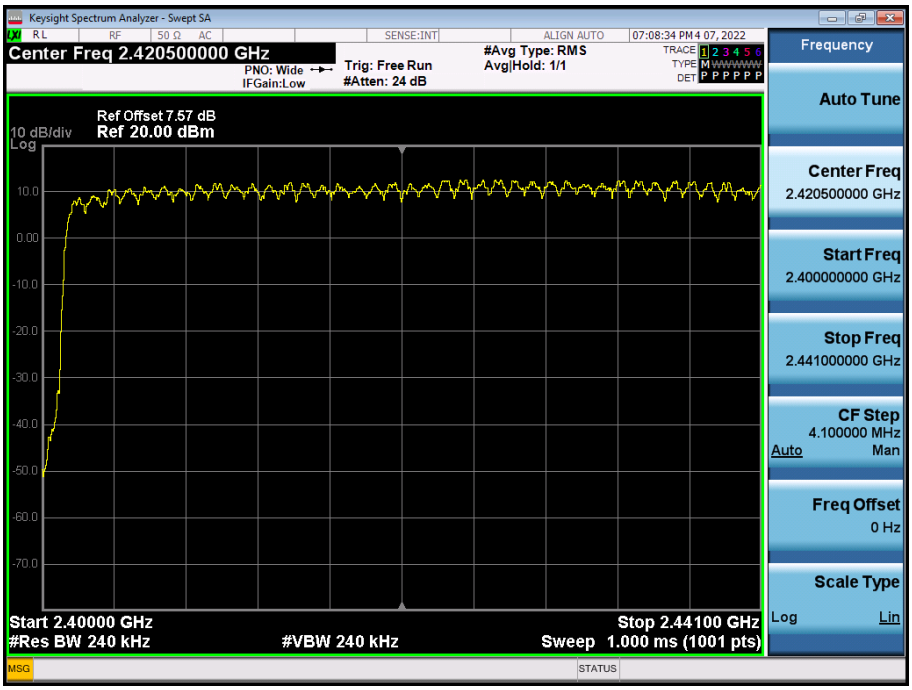
Test Plots (8DPSK)

Number of Channels (2.441 GHz- 2.483.5 GHz)



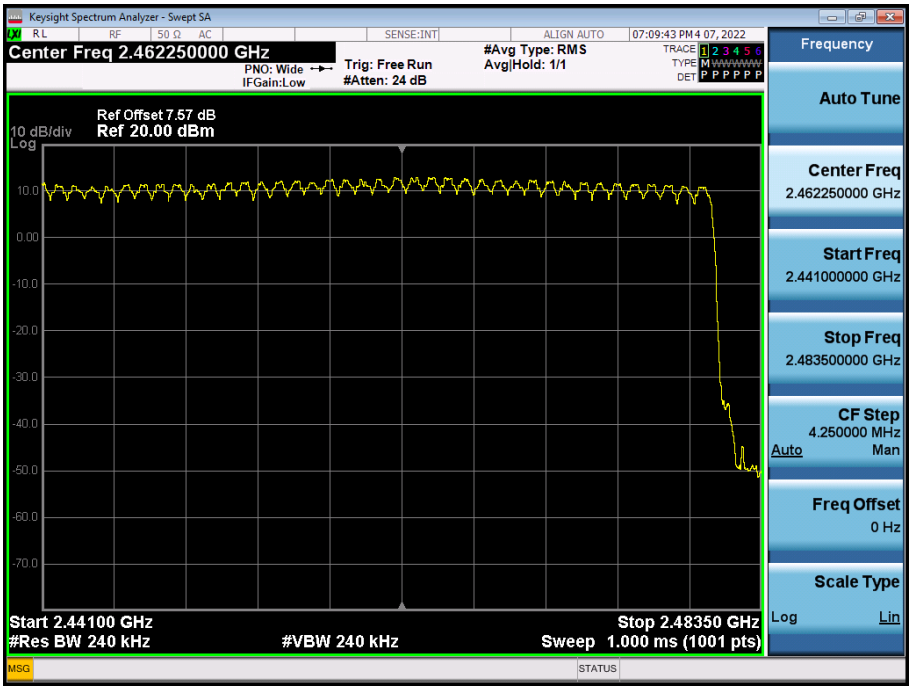
Test Plots (π/4DQPSK)

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	2.880	2.890	2.885
	Mid	2.885	2.885	2.885
	High	2.885	2.885	2.885

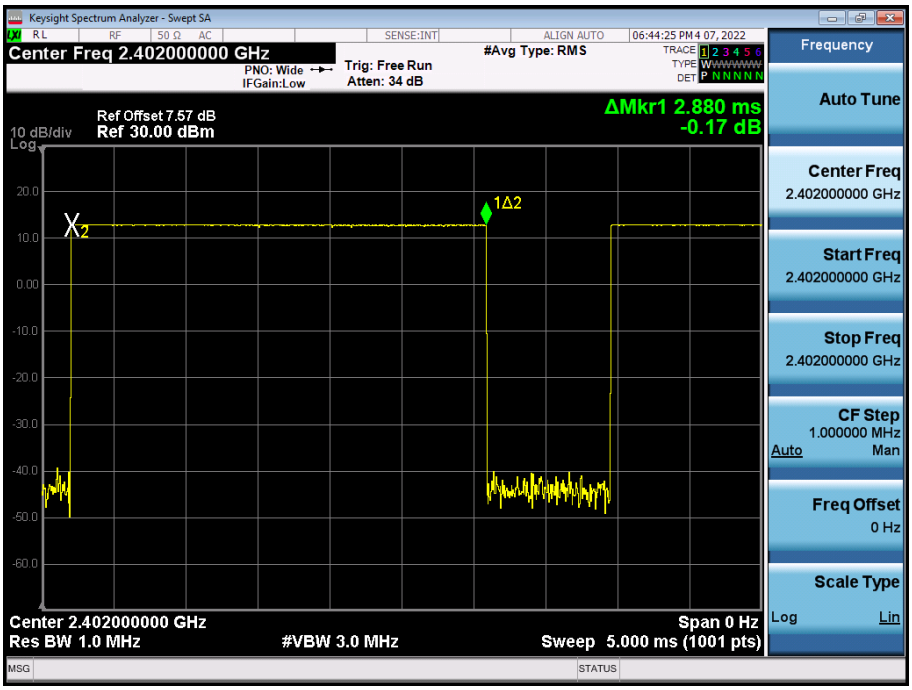
Non-AFH Mode

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of Dwell (ms)	Low	307.20	308.27	307.73	31.6	400
	Mid	307.73	307.73	307.73	31.6	
	High	307.73	307.73	307.73	31.6	

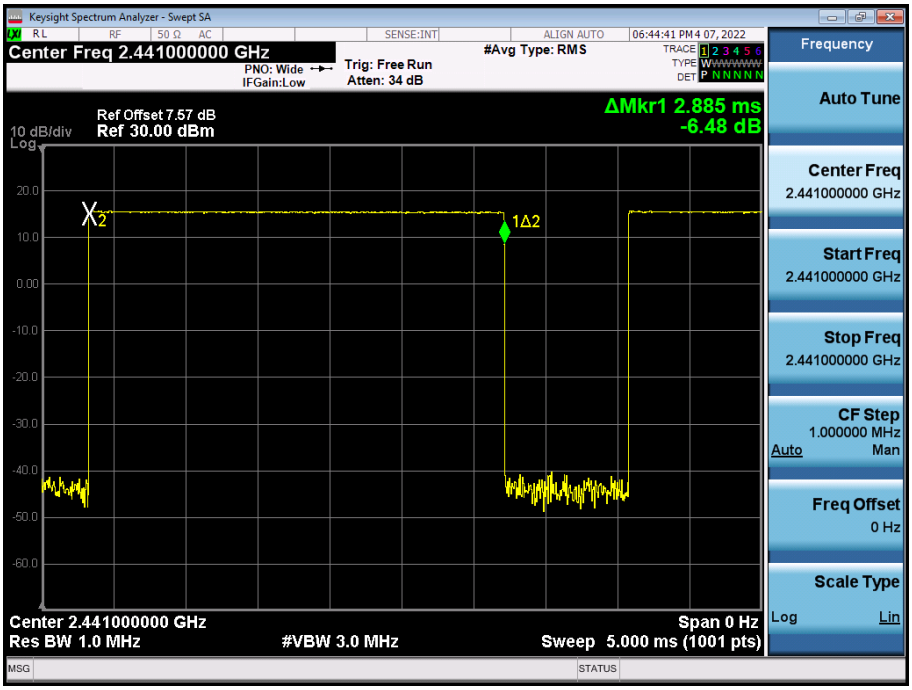
AFH Mode

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of Dwell (ms)	Low	153.60	154.13	153.87	8.0	400
	Mid	153.87	153.87	153.87	8.0	
	High	153.87	153.87	153.87	8.0	

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

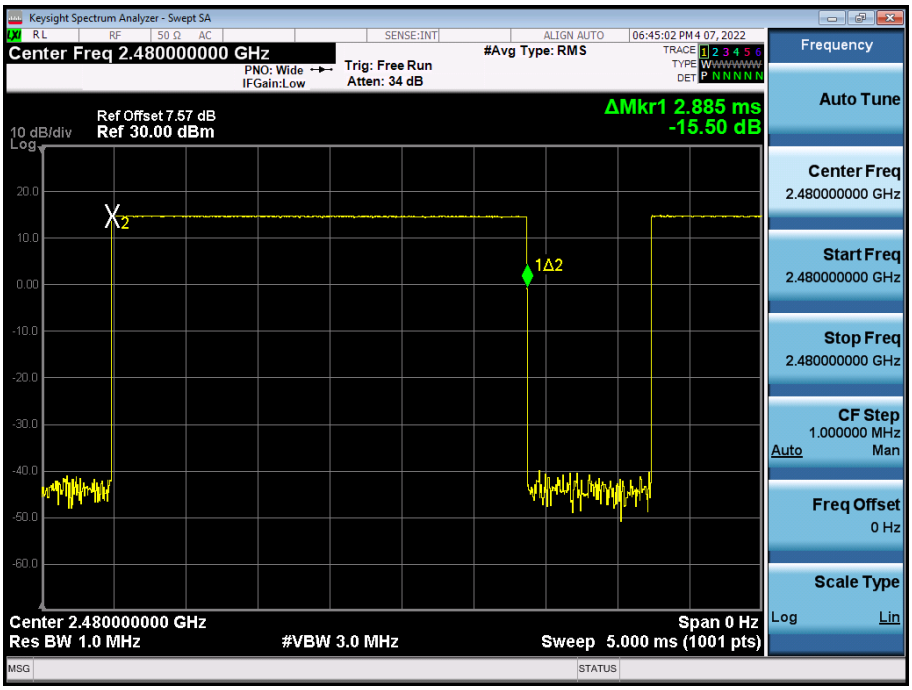


Test Plots (GFSK)
Dwell Time (CH.39)



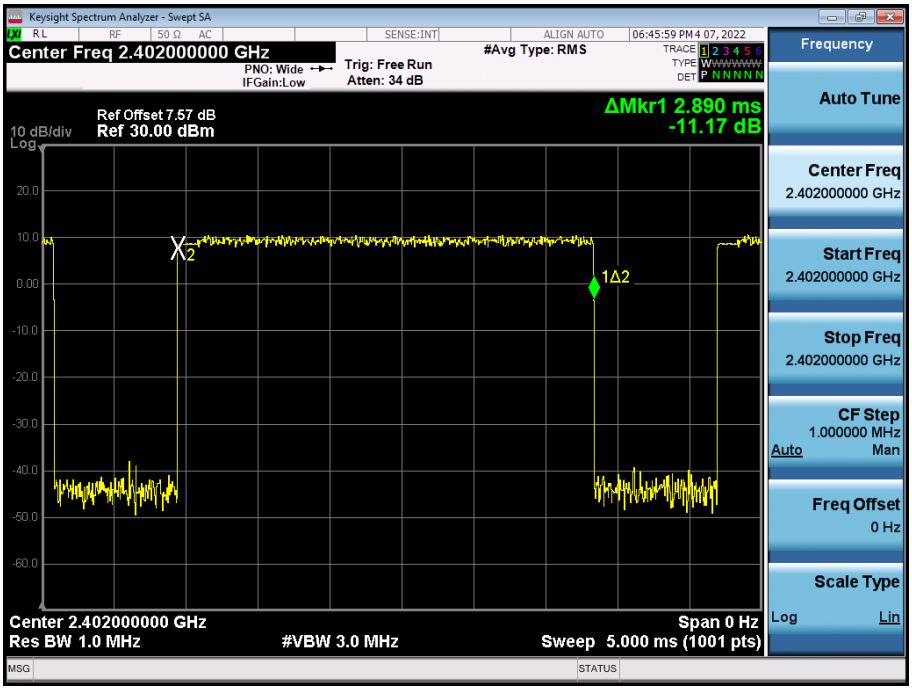
Test Plots (GFSK)

Dwell Time (CH.78)



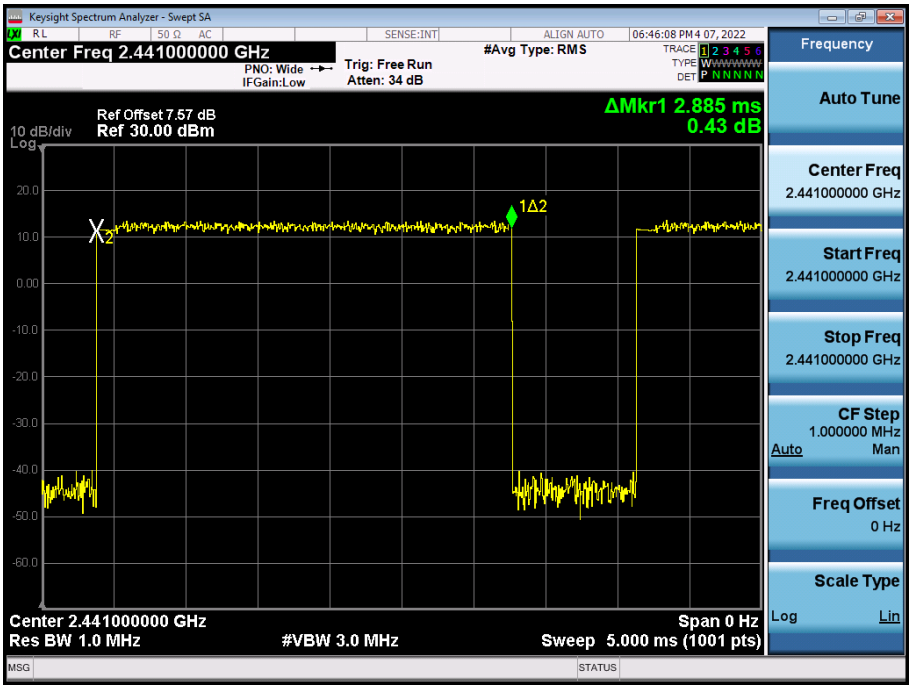
Test Plots (8DPSK)

Dwell Time (CH.0)



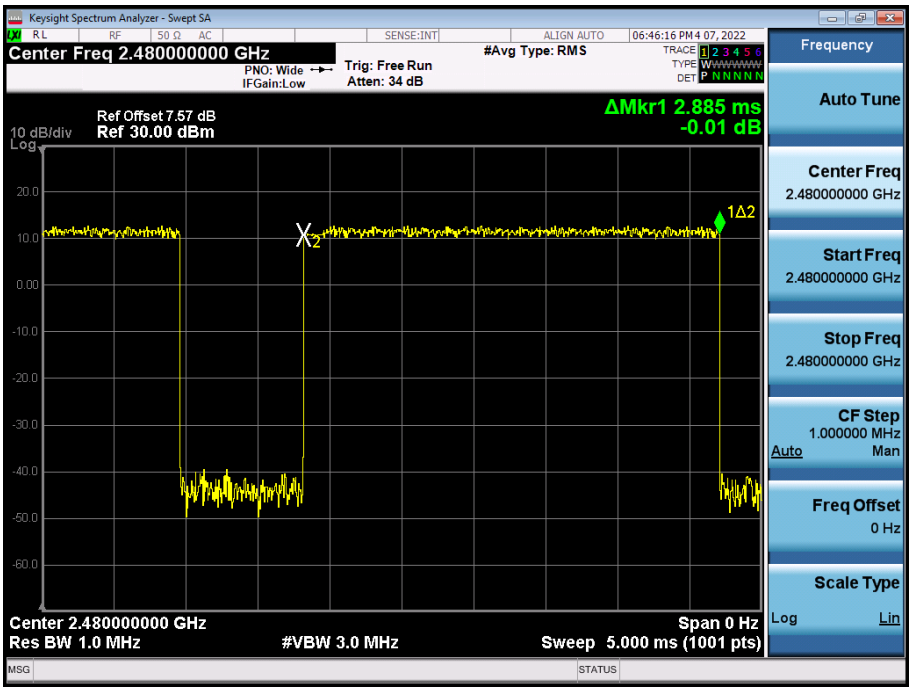
Test Plots (8DPSK)

Dwell Time (CH.39)



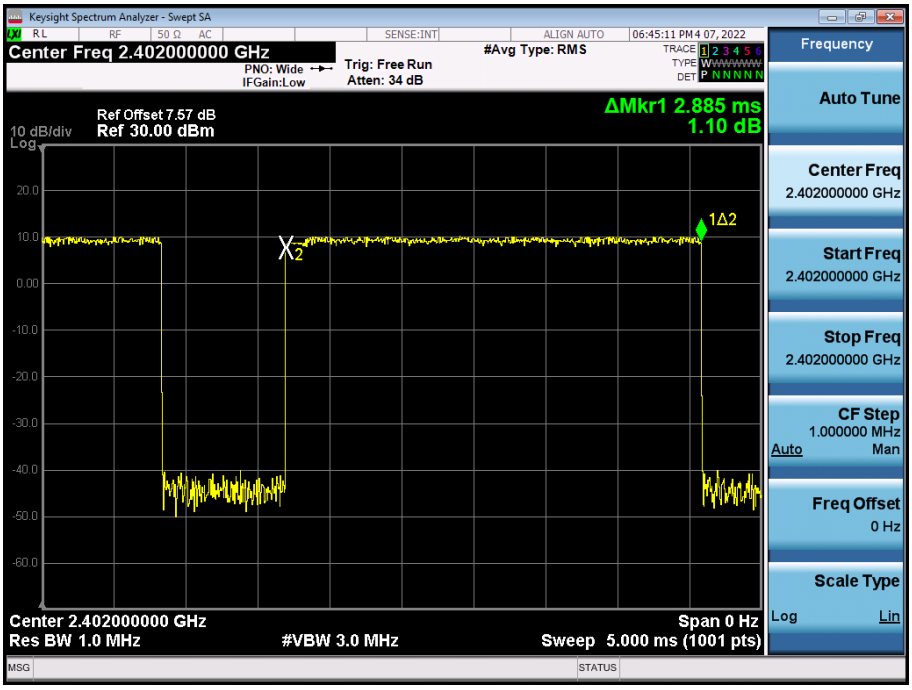
Test Plots (8DPSK)

Dwell Time (CH.78)



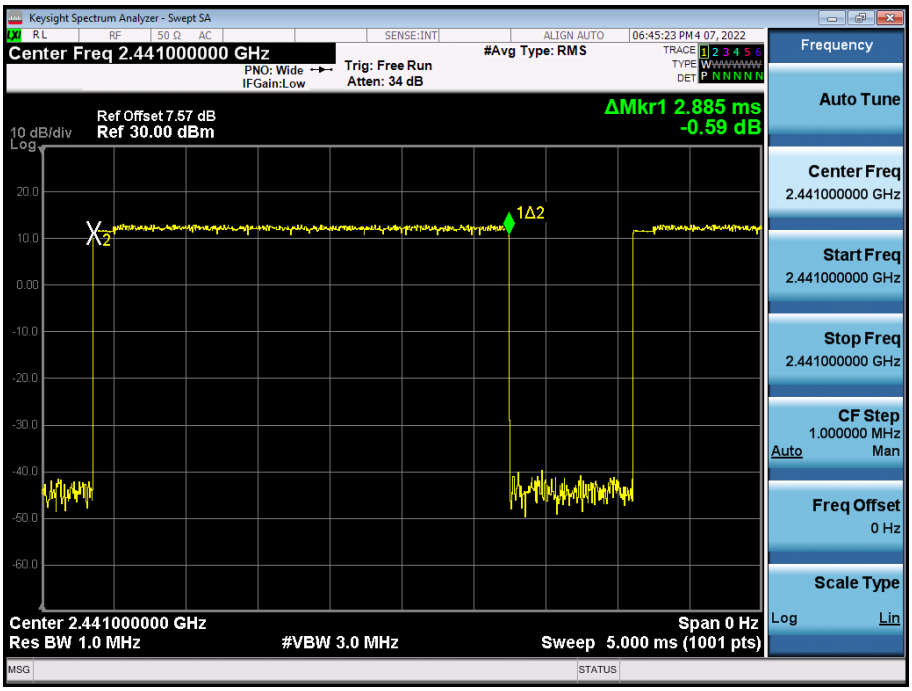
Test Plots (π/4DQPSK)

Dwell Time (CH.0)



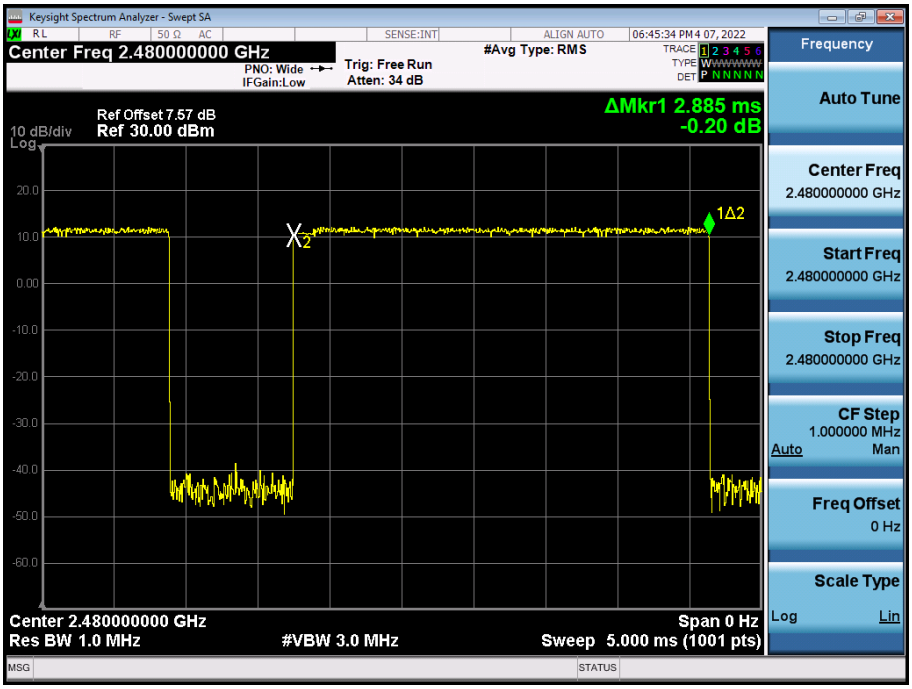
Test Plots (π/4DQPSK)

Dwell Time (CH.39)



Test Plots (π/4DQPSK)

Dwell Time (CH.78)



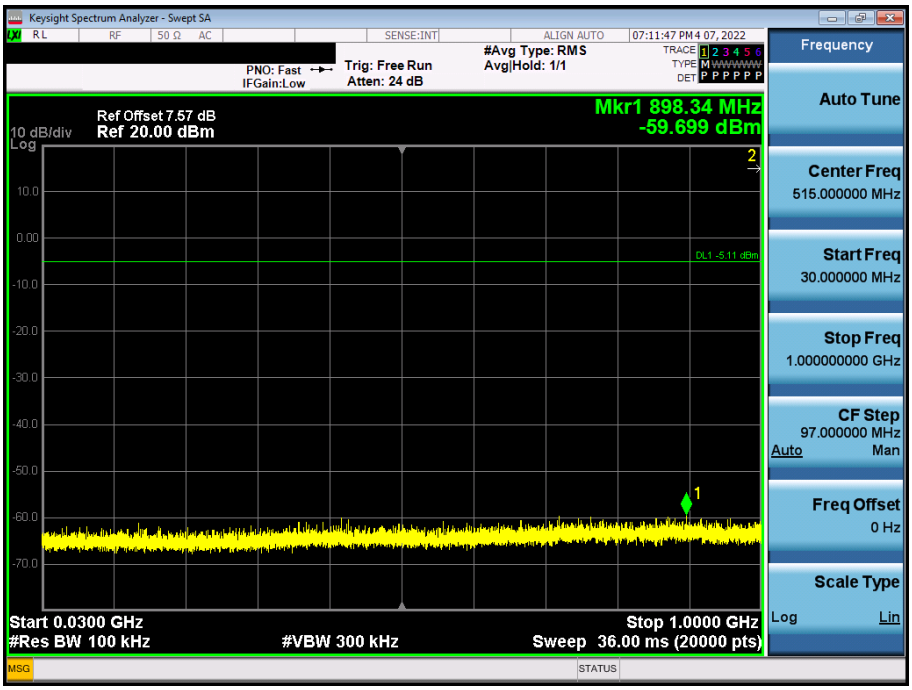
10.6 SPURIOUS EMISSIONS

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.

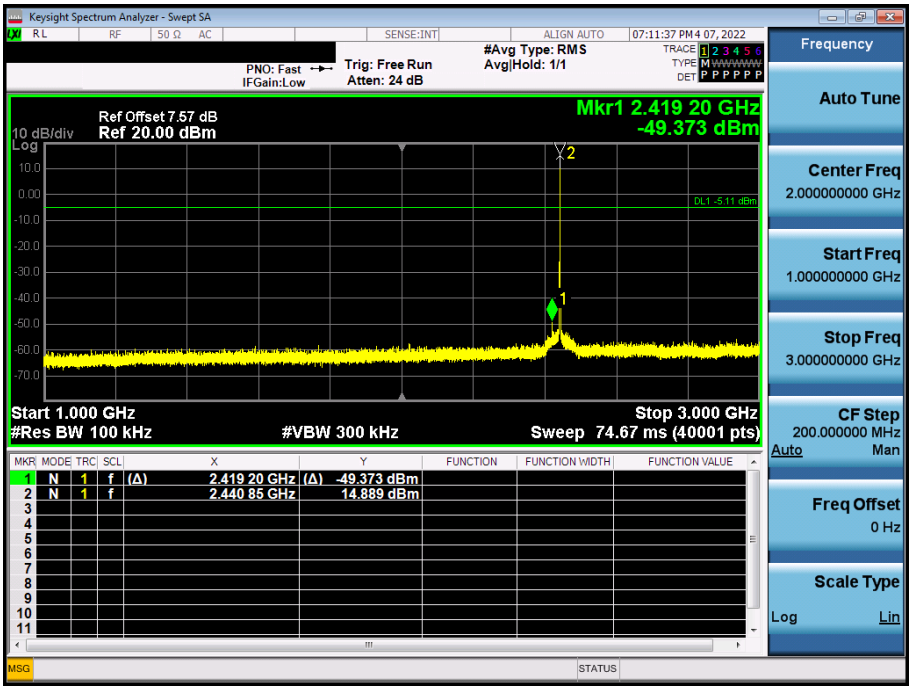
Test Plots (GFSK)- 30 MHz - 1 GHz

Spurious Emission (CH.39)



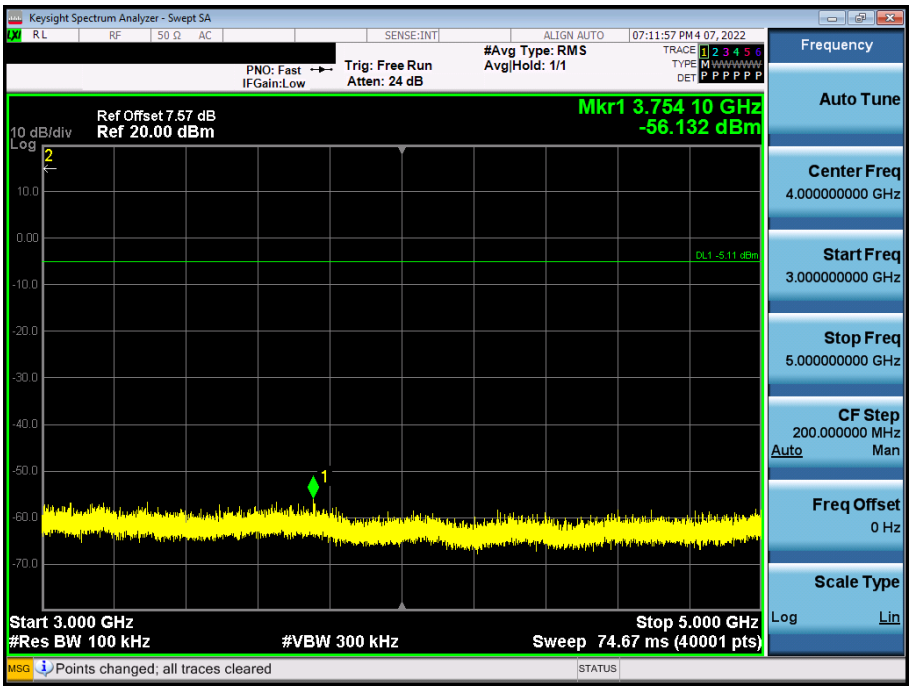
Test Plots (GFSK)- 1 GHz – 3 GHz

Spurious Emission (CH.39)



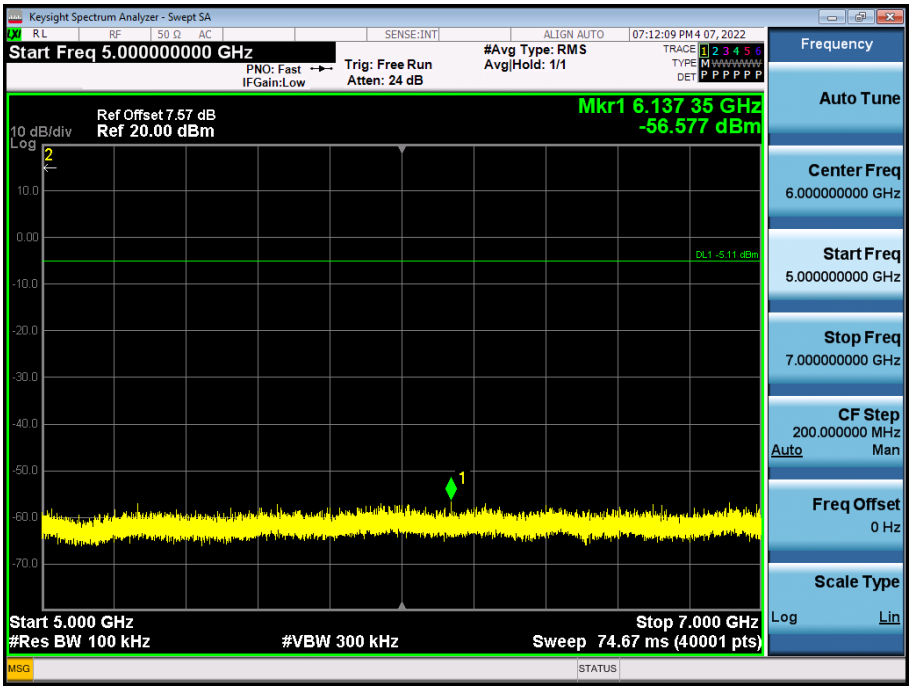
Test Plots(GFSK)- 3 GHz - 5 GHz

Spurious Emission (CH.39)



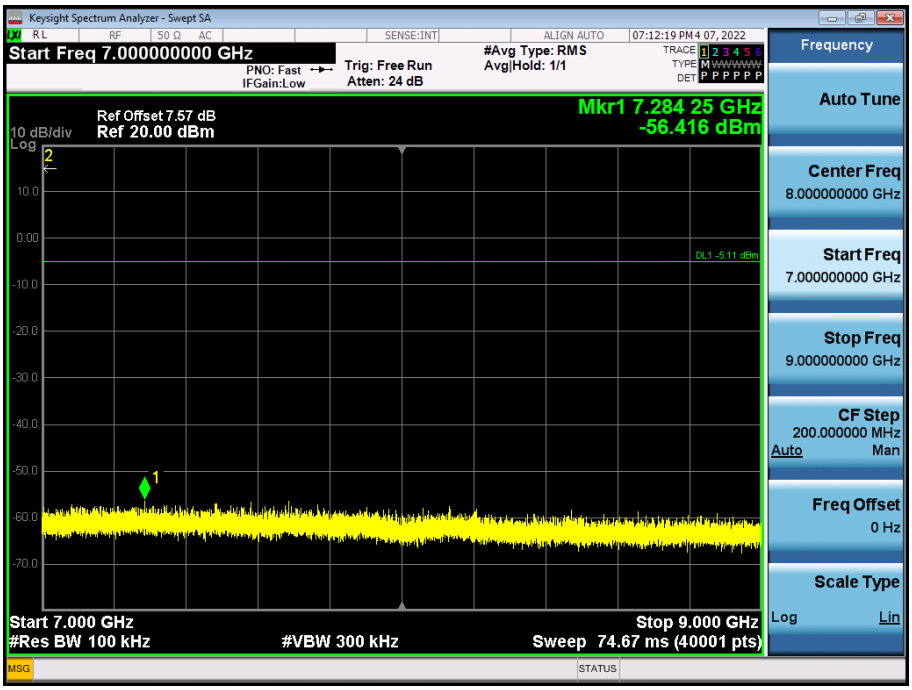
Test Plots (GFSK)- 5 GHz - 7 GHz

Spurious Emission (CH.39)



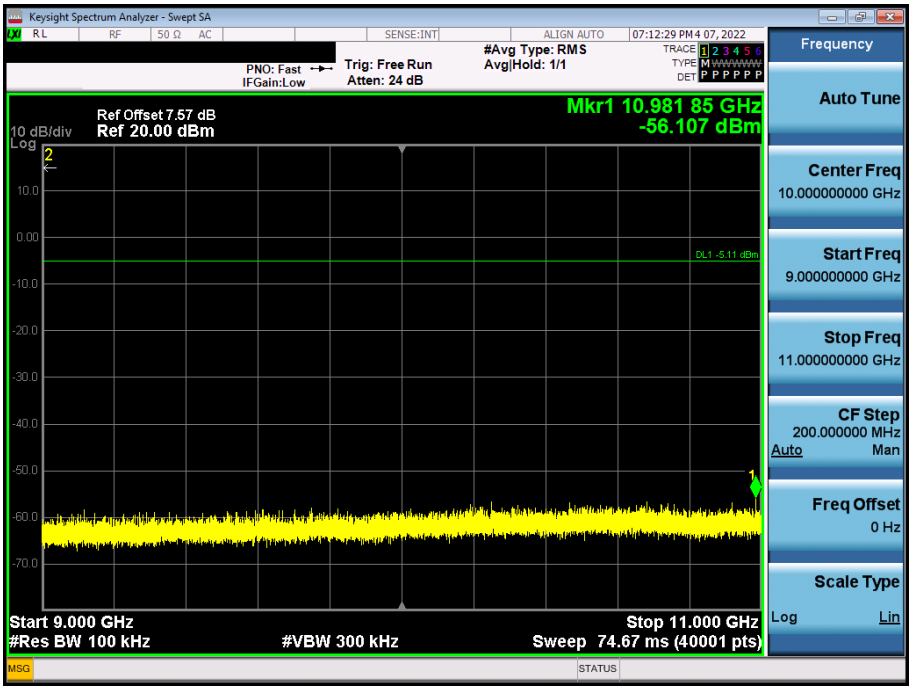
Test Plots(GFSK)- 7 GHz - 9 GHz

Spurious Emission (CH.39)



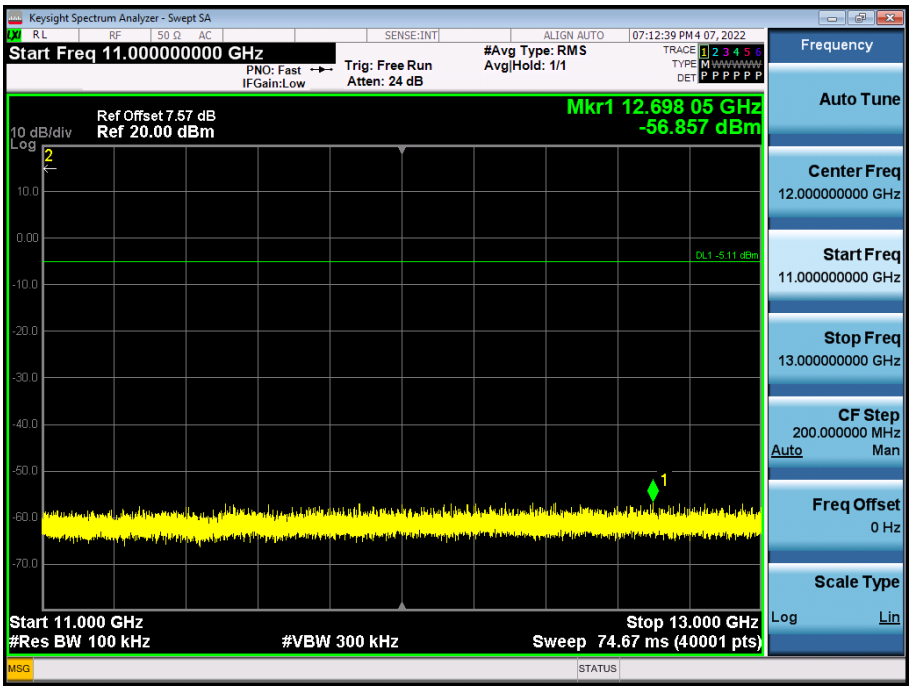
Test Plots(GFSK)- 9 GHz - 11 GHz

Spurious Emission (CH.39)



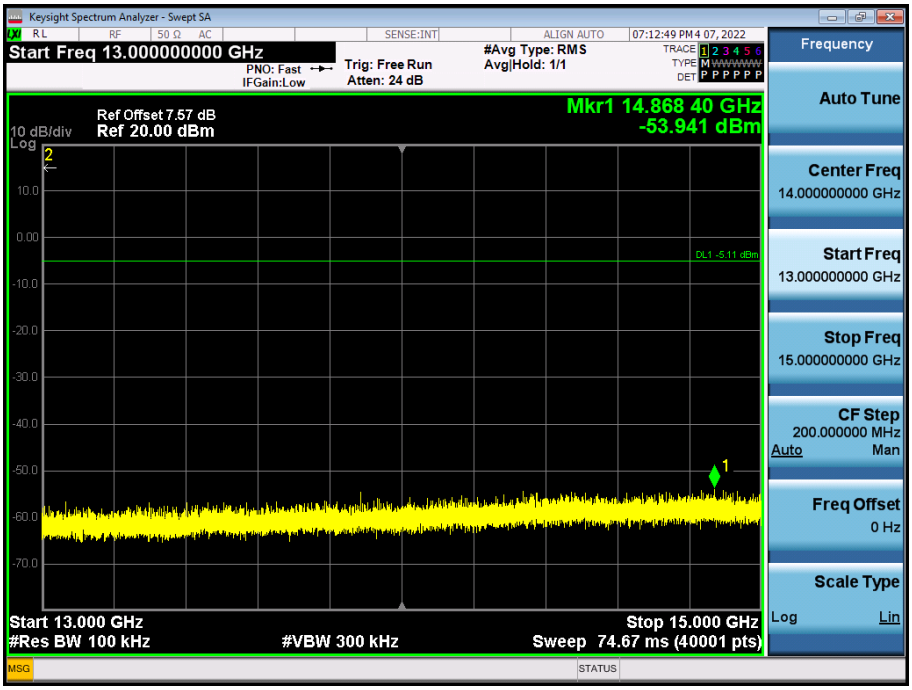
Test Plots(GFSK) 11 GHz - 13 GHz

Spurious Emission (CH.39)



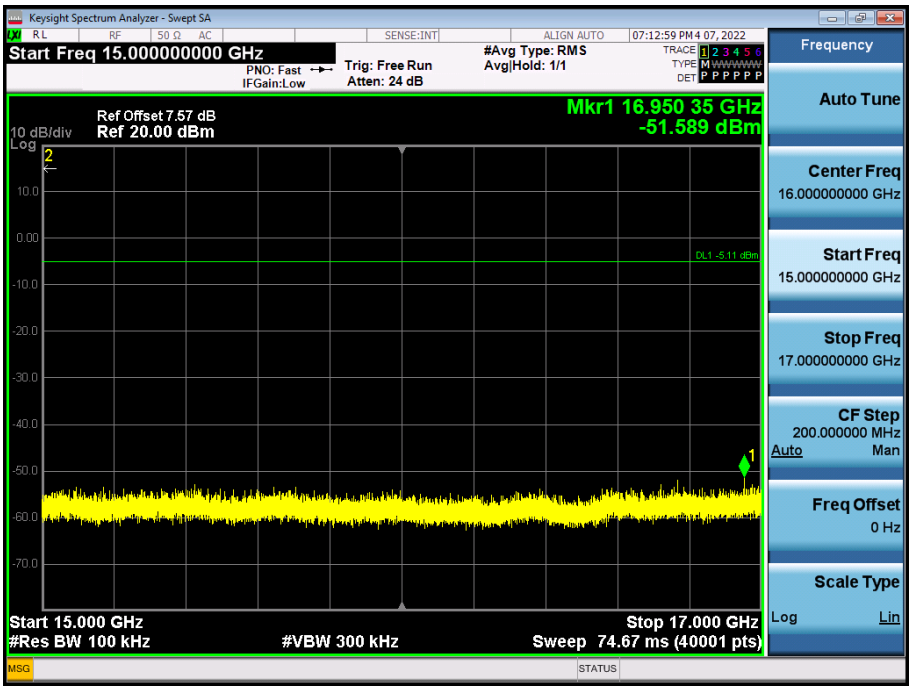
Test Plots (GFSK)- 13 GHz – 15 GHz

Spurious Emission (CH.39)



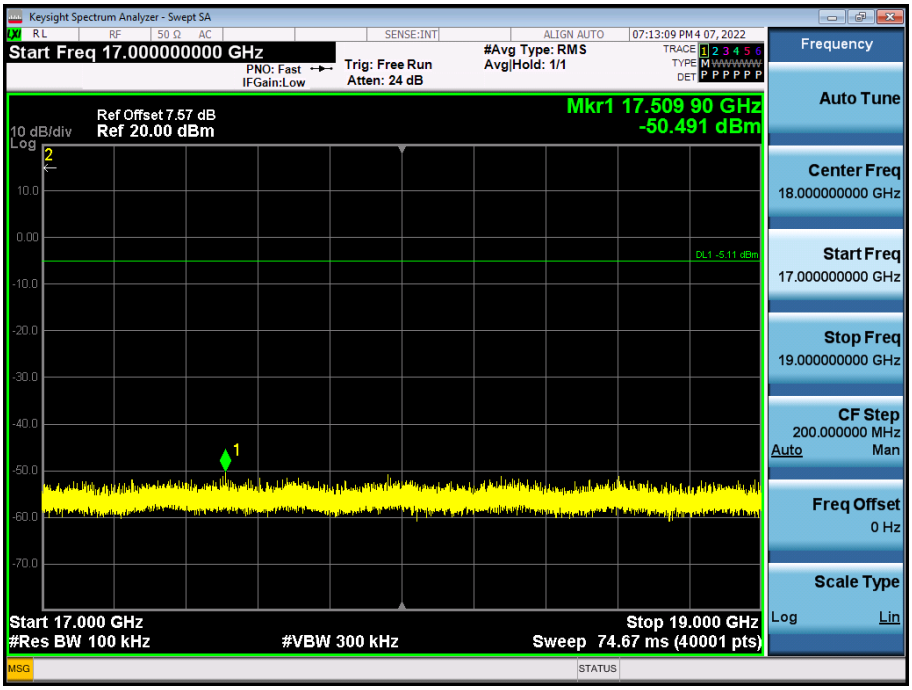
Test Plots(GFSK)– 15 GHz - 17 GHz

Spurious Emission (CH.39)



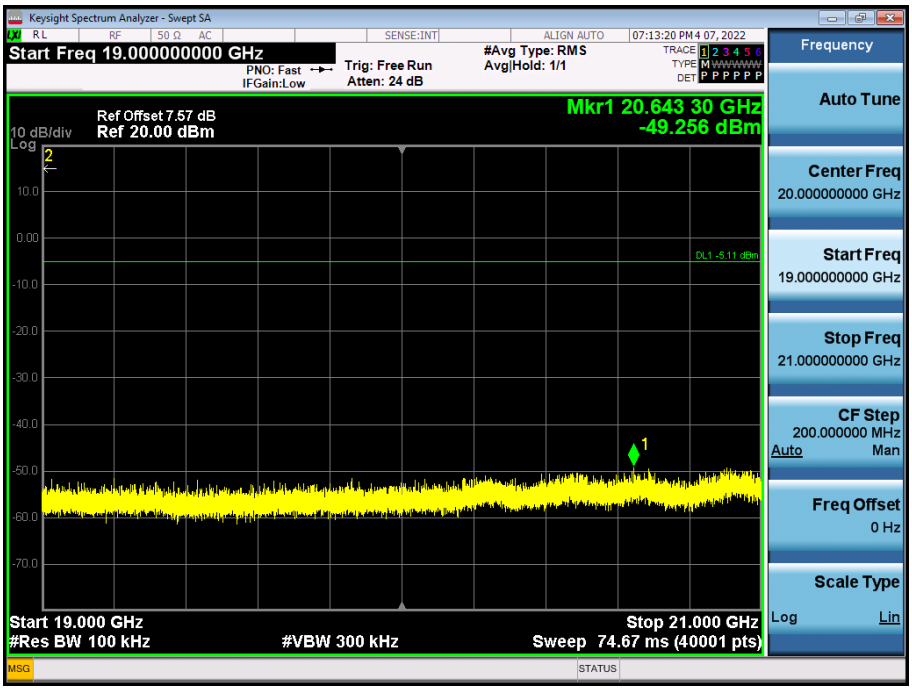
Test Plots(GFSK)- 17 GHz - 19 GHz

Spurious Emission (CH.39)



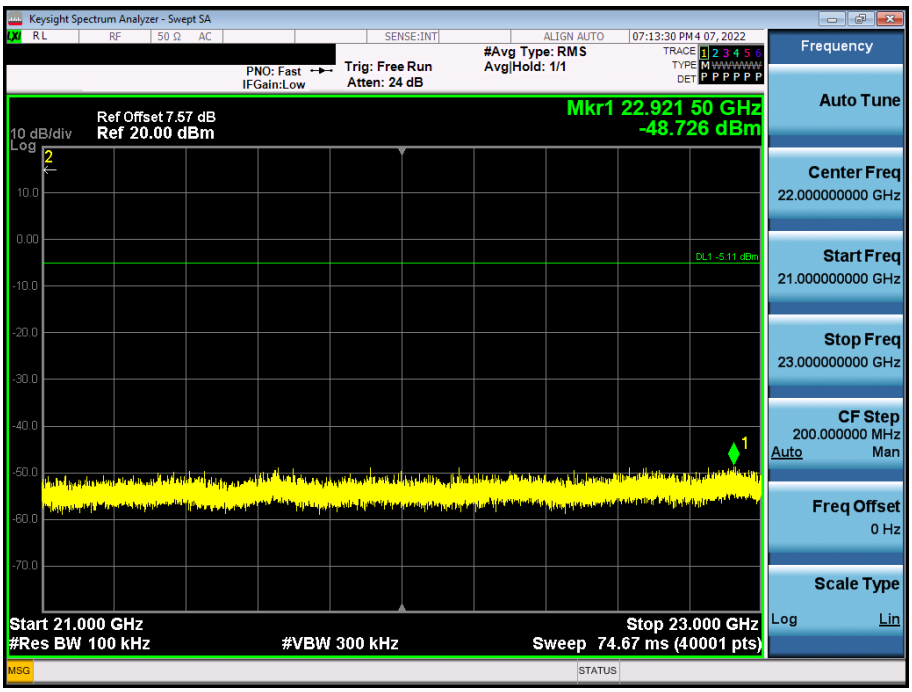
Test Plots (GFSK)- 19 GHz - 21 GHz

Spurious Emission (CH.39)



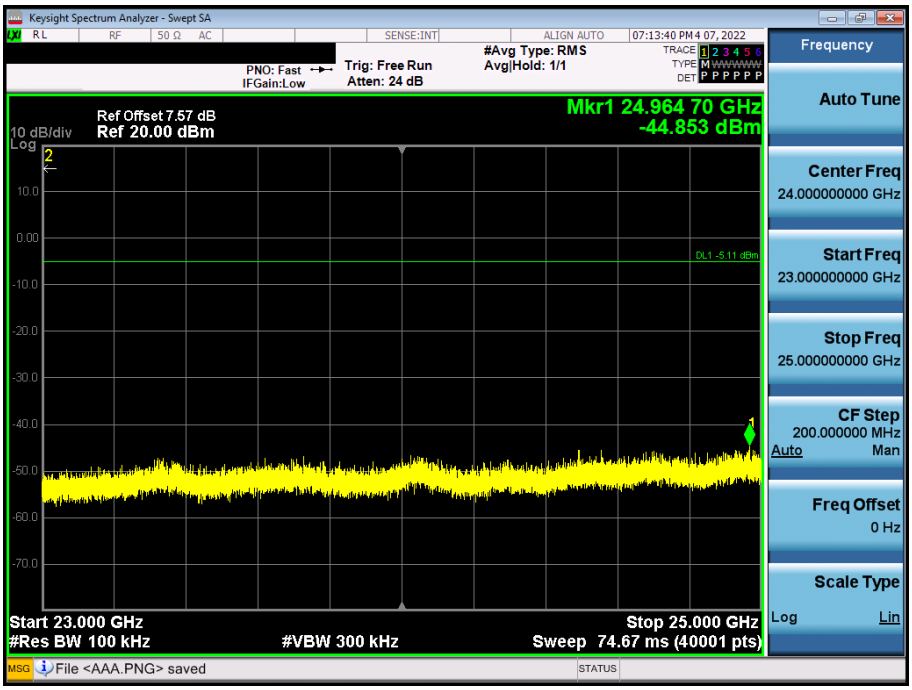
Test Plots (GFSK)- 21 GHz - 23 GHz

Spurious Emission (CH.39)



Test Plots (GFSK)- 23 GHz - 25 GHz

Spurious Emission (CH.39)



10.6.2 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30MHz

Frequency	Measured Value	A.F+C.L+D.F	POL	Total	Limit	Margin
[MHz]	[dBµV]	[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]	[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 Value [dBµV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4804	44.12	2.76	V	46.88	73.98	27.10	PK
4804	30.10	2.76	V	32.86	53.98	21.12	AV
7206	41.33	8.96	V	50.29	73.98	23.69	PK
7206	28.58	8.96	V	37.54	53.98	16.44	AV
4804	44.41	2.76	H	47.17	73.98	26.81	PK
4804	30.88	2.76	H	33.64	53.98	20.34	AV
7206	**40.92**	**8.96**	**H**	**49.88**	**73.98**	**24.10**	**PK**
7206	**28.71**	**8.96**	**H**	**37.67**	**53.98**	**16.31**	**AV**

Operation Mode: CH Mid(GFSK)

Frequency [MHz]	Measured Value [dBµV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4882	42.90	3.15	V	46.05	73.98	27.93	PK
4882	29.57	3.15	V	32.72	53.98	21.26	AV
7323	40.96	9.45	V	50.41	73.98	23.57	PK
7323	26.86	9.45	V	36.31	53.98	17.67	AV
4882	41.99	3.15	H	45.14	73.98	28.84	PK
4882	29.05	3.15	H	32.20	53.98	21.78	AV
7323	41.15	9.45	H	50.60	73.98	23.38	PK
7323	27.44	9.45	H	36.89	53.98	17.09	AV

Operation Mode: CH High(GFSK)

Frequency [MHz]	Measured Value [dBµV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4960	41.85	2.23	V	44.08	73.98	29.90	PK
4960	29.20	2.23	V	31.43	53.98	22.55	AV
7440	40.11	10.35	V	50.46	73.98	23.52	PK
7440	26.93	10.35	V	37.28	53.98	16.70	AV
4960	40.56	2.23	H	42.79	73.98	31.19	PK
4960	28.97	2.23	H	31.20	53.98	22.78	AV
7440	40.39	10.35	H	50.74	73.98	23.24	PK
7440	27.02	10.35	H	37.37	53.98	16.61	AV

Operation Mode: CH Low(π/4DQPSK)

Frequency [MHz]	Measured Value [dBμV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4804	44.49	2.76	V	47.25	73.98	26.73	PK
4804	29.90	2.76	V	32.66	53.98	21.32	AV
7206	40.05	8.96	V	49.01	73.98	24.97	PK
7206	28.36	8.96	V	37.32	53.98	16.66	AV
4804	43.99	2.76	H	46.75	73.98	27.23	PK
4804	28.85	2.76	H	31.61	53.98	22.37	AV
7206	40.39	8.96	H	49.35	73.98	24.63	PK
7206	26.27	8.96	H	35.23	53.98	18.75	AV

Operation Mode: CH Mid(π/4DQPSK)

Frequency [MHz]	Measured Value [dBμV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4882	42.34	3.15	V	45.49	73.98	28.49	PK
4882	28.97	3.15	V	32.12	53.98	21.86	AV
7323	40.08	9.45	V	49.53	73.98	24.45	PK
7323	26.14	9.45	V	35.59	53.98	18.39	AV
4882	41.55	3.15	H	44.70	73.98	29.28	PK
4882	27.88	3.15	H	31.03	53.98	22.95	AV
7323	40.29	9.45	H	49.74	73.98	24.24	PK
7323	27.25	9.45	H	36.70	53.98	17.28	AV

Operation Mode: CH High(π/4DQPSK)

Frequency [MHz]	Measured Value [dBμV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4960	42.56	2.23	V	44.79	73.98	29.19	PK
4960	28.60	2.23	V	30.83	53.98	23.15	AV
7440	38.14	10.35	V	48.49	73.98	25.49	PK
7440	25.89	10.35	V	36.24	53.98	17.74	AV
4960	41.96	2.23	H	44.19	73.98	29.79	PK
4960	27.95	2.23	H	30.18	53.98	23.80	AV
7440	39.49	10.35	H	49.84	73.98	24.14	PK
7440	26.01	10.35	H	36.36	53.98	17.62	AV

Operation Mode: CH Low(8DPSK)

Frequency [MHz]	Measured Value [dBμV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4804	43.77	2.76	V	46.53	73.98	27.45	PK
4804	29.84	2.76	V	32.60	53.98	21.38	AV
7206	40.51	8.96	V	49.47	73.98	24.51	PK
7206	25.98	8.96	V	34.94	53.98	19.04	AV
4804	43.66	2.76	H	46.42	73.98	27.56	PK
4804	29.81	2.76	H	32.57	53.98	21.41	AV
7206	40.53	8.96	H	49.49	73.98	24.49	PK
7206	26.27	8.96	H	35.23	53.98	18.75	AV

Operation Mode: CH Mid(8DPSK)

Frequency [MHz]	Measured Value [dBμV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4882	42.51	3.15	V	45.66	73.98	28.32	PK
4882	28.98	3.15	V	32.13	53.98	21.85	AV
7323	40.02	9.45	V	49.47	73.98	24.51	PK
7323	27.11	9.45	V	36.56	53.98	17.42	AV
4882	41.55	3.15	H	44.70	73.98	29.28	PK
4882	28.28	3.15	H	31.43	53.98	22.55	AV
7323	40.09	9.45	H	49.54	73.98	24.44	PK
7323	27.26	9.45	H	36.71	53.98	17.27	AV

Operation Mode: CH High(8DPSK)

Frequency [MHz]	Measured Value [dBµV]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
4960	41.80	2.23	V	44.03	73.98	29.95	PK
4960	28.60	2.23	V	30.83	53.98	23.15	AV
7440	38.65	10.35	V	49.00	73.98	24.98	PK
7440	24.99	10.35	V	35.34	53.98	18.64	AV
4960	40.98	2.23	H	43.21	73.98	30.77	PK
4960	28.16	2.23	H	30.39	53.98	23.59	AV
7440	39.60	10.35	H	49.95	73.98	24.03	PK
7440	25.90	10.35	H	36.25	53.98	17.73	AV

[DBS Mode]

WLAN/BT Ant : Bluetooth (GFSK) CH.0 & 802.11ax20 52T RU38MCS0 ch.165

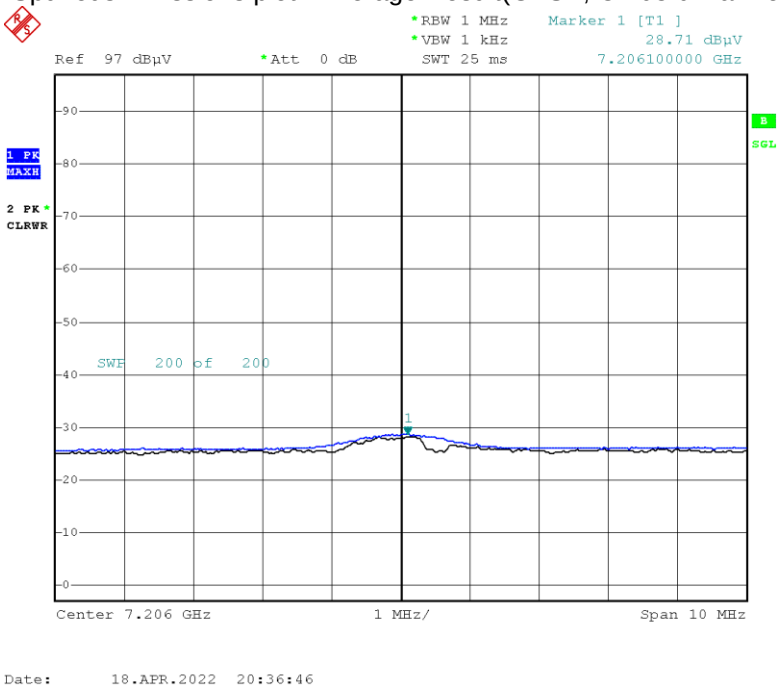
Frequency [MHz]	Measured Value [dBµV]	CL+AF+DF-AG [dB/m]	Pol. [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
7206	40.53	8.96	H	49.49	73.98	24.49	PK
7206	27.52	8.96	H	36.48	53.98	17.50	AV

Note :

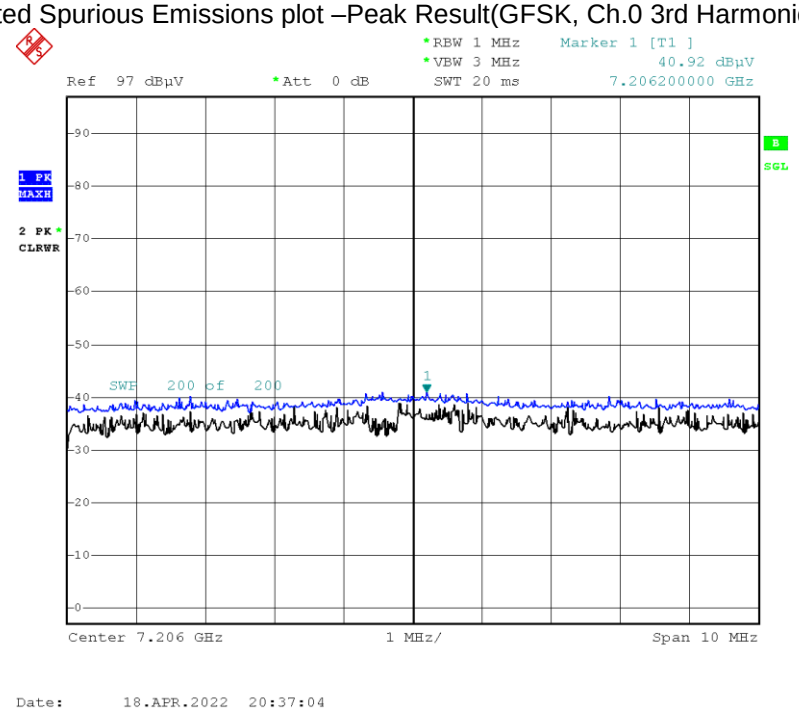
1. Used duty cycle correction factor.
2. WLAN DBS Data refer to UNII_ax Test Report.

RESULT PLOTS

Radiated Spurious Emissions plot –Average Result(GFSK, Ch.03rd Harmonic, Y-H)



Radiated Spurious Emissions plot –Peak Result(GFSK, Ch.0 3rd Harmonic, Y-H)



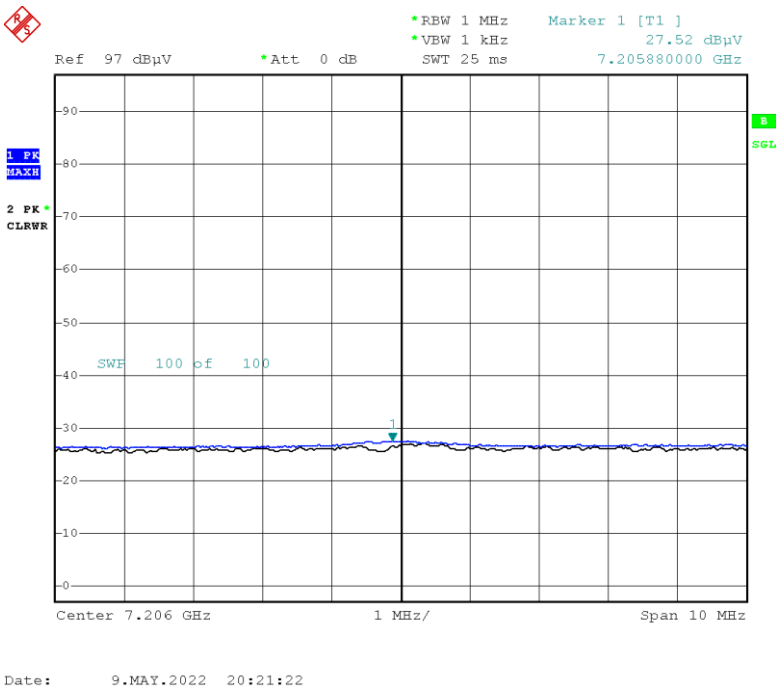
Note:

Plot of worst case are only reported.

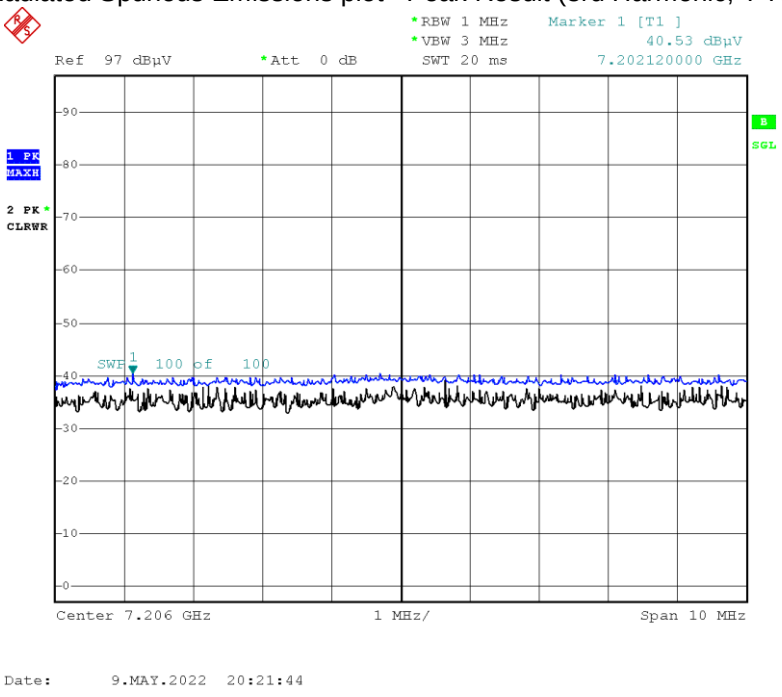
RESULT PLOTS(DBS)

WLAN/BT Ant : Bluetooth (GFSK) CH.0 & 802.11a x20 52T RU38 MCS0 ch.165

Radiated Spurious Emissions plot – Average Result (3rd Harmonic, Y-H)



Radiated Spurious Emissions plot –Peak Result (3rd Harmonic, Y-H)



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 Value [dBµV]	A.F.+C.L-A.G +ATT+D.F [dB/m]	Pol. [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2390.0	22.08	33.78	H	55.86	73.98	18.12	PK
2390.0	11.54	33.78	H	45.32	53.98	8.66	AV
2390.0	22.45	33.78	V	56.22	73.98	17.76	PK
2390.0	11.35	33.78	V	45.13	53.98	8.85	AV
2483.5	**24.81**	**34.10**	**H**	**58.90**	**73.98**	**15.08**	**PK**
2483.5	**16.53**	**34.10**	**H**	**50.63**	**53.98**	**3.35**	**AV**
2483.5	26.10	34.10	V	60.20	73.98	13.78	PK
2483.5	15.84	34.10	V	49.94	53.98	4.04	AV

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

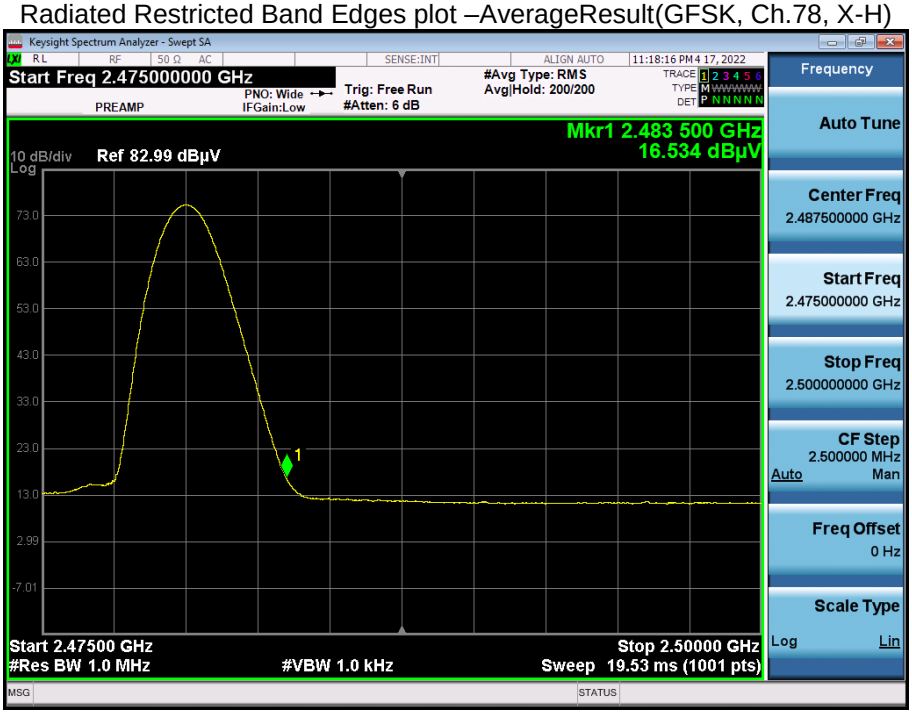
Frequency [MHz]	Measured Value [dBµV]	A.F.+C.L-A.G +ATT+D.F [dB/m]	Pol. [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2390.0	21.70	33.78	H	55.48	73.98	18.50	PK
2390.0	11.32	33.78	H	45.09	53.98	8.89	AV
2390.0	20.85	33.78	V	54.63	73.98	19.35	PK
2390.0	11.10	33.78	V	44.87	53.98	9.11	AV
2483.5	23.00	34.10	H	57.10	73.98	16.88	PK
2483.5	15.25	34.10	H	49.35	53.98	4.63	AV
2483.5	22.75	34.10	V	56.85	73.98	17.13	PK
2483.5	14.61	34.10	V	48.71	53.98	5.27	AV

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

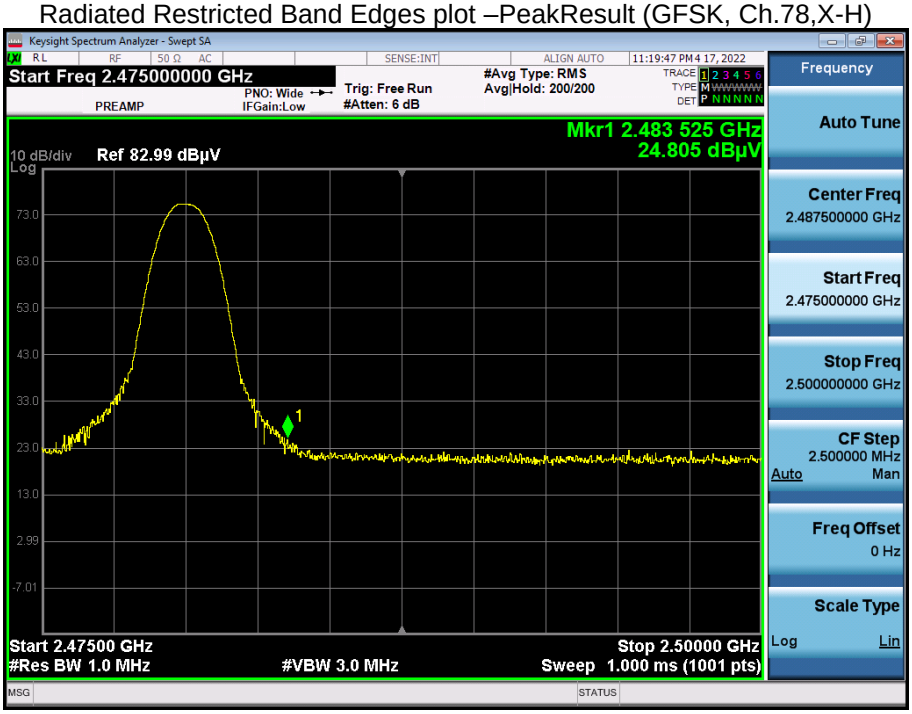
Frequency [MHz]	Measured Value [dBµV]	A.F.+C.L-A.G +ATT+D.F [dB/m]	Pol. [H/V]	Total [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Measurement Type
2390.0	21.71	33.78	H	55.49	73.98	18.49	PK
2390.0	11.57	33.78	H	45.35	53.98	8.63	AV
2390.0	20.95	33.78	V	54.73	73.98	19.25	PK
2390.0	11.16	33.78	V	44.93	53.98	9.05	AV
2483.5	25.29	34.10	H	59.39	73.98	14.59	PK
2483.5	15.23	34.10	H	49.33	53.98	4.65	AV
2483.5	22.85	34.10	V	56.95	73.98	17.03	PK
2483.5	14.87	34.10	V	48.97	53.98	5.01	AV

RESULT PLOTS

Radiated Restricted Band Edges plot –AverageResult(GFSK, Ch.78, X-H)



Radiated Restricted Band Edges plot –PeakResult (GFSK, Ch.78,X-H)



Note:

Plot of worst case are only reported.

10.7 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions (Line 1)

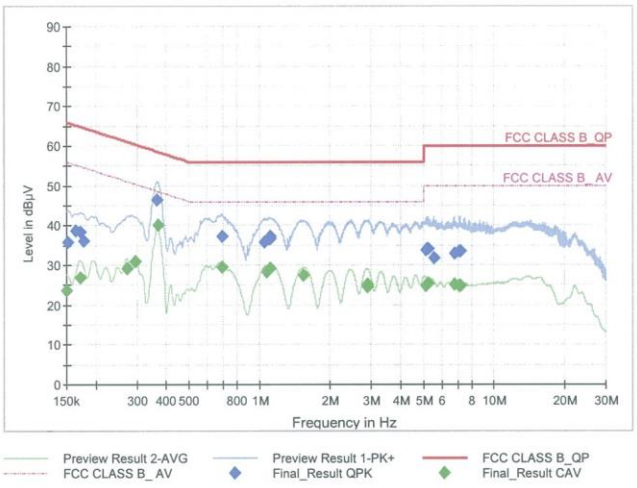
Test 1 / 2

Test Report

Common Information

EUT :	SM-G990U2
Manufacturer :	SAMSUNG Electronics Co., Ltd.
Test Site:	SHIELD ROOM
Operating Conditions :	BT_L1
Operator Name:	
Comment:	

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1523	35.84	65.88	30.04	9.000	L1	OFF	9.6
0.1635	38.77	65.28	26.51	9.000	L1	OFF	9.6
0.1725	38.24	64.84	26.60	9.000	L1	OFF	9.6
0.1770	35.92	64.63	28.70	9.000	L1	OFF	9.6
0.3660	46.48	58.59	12.11	9.000	L1	OFF	9.6
0.6890	37.35	56.00	18.65	9.000	L1	OFF	9.7
1.0513	35.64	56.00	20.36	9.000	L1	OFF	9.7
1.0963	36.68	56.00	19.32	9.000	L1	OFF	9.7
1.1075	36.50	56.00	19.50	9.000	L1	OFF	9.7
1.1143	37.08	56.00	18.92	9.000	L1	OFF	9.7
5.1373	33.83	60.00	26.17	9.000	L1	OFF	9.9
5.1508	33.68	60.00	26.32	9.000	L1	OFF	9.9
5.1778	34.14	60.00	25.86	9.000	L1	OFF	9.9
5.2273	34.09	60.00	25.91	9.000	L1	OFF	9.9
5.5243	31.83	60.00	28.17	9.000	L1	OFF	9.9
6.7663	33.02	60.00	26.98	9.000	L1	OFF	9.9
7.1128	33.57	60.00	26.43	9.000	L1	OFF	9.9
7.1645	33.39	60.00	26.61	9.000	L1	OFF	9.9

2022-04-30 오후 3:42:32

Test 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	23.57	56.00	32.43	9.000	L1	OFF	9.6
0.1725	26.80	54.84	28.04	9.000	L1	OFF	9.6
0.2715	29.16	51.07	21.91	9.000	L1	OFF	9.6
0.2940	30.74	50.41	19.67	9.000	L1	OFF	9.6
0.3683	40.09	48.54	8.45	9.000	L1	OFF	9.6
0.6913	29.34	46.00	16.66	9.000	L1	OFF	9.7
1.0738	28.15	46.00	17.85	9.000	L1	OFF	9.7
1.1165	29.22	46.00	16.78	9.000	L1	OFF	9.7
1.5463	27.48	46.00	18.52	9.000	L1	OFF	9.7
2.8828	24.49	46.00	21.51	9.000	L1	OFF	9.8
2.8985	24.98	46.00	21.02	9.000	L1	OFF	9.8
5.1080	24.68	50.00	25.32	9.000	L1	OFF	9.9
5.2700	25.46	50.00	24.54	9.000	L1	OFF	9.9
6.7640	25.17	50.00	24.83	9.000	L1	OFF	9.9
7.1398	24.71	50.00	25.29	9.000	L1	OFF	9.9
7.1690	24.85	50.00	25.15	9.000	L1	OFF	9.9
7.1915	24.80	50.00	25.20	9.000	L1	OFF	9.9
7.1960	24.71	50.00	25.29	9.000	L1	OFF	9.9

2022-04-30 오후 3:42:32

Conducted Emissions (Line 2)

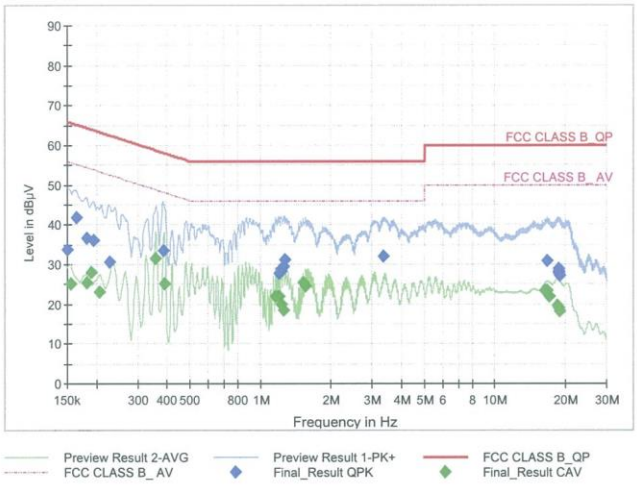
Test 1 / 2

Test Report

Common Information

EUT :	SM-G990U2
Manufacturer :	SAMSUNG Electronics Co., Ltd.
Test Site:	SHIELD ROOM
Operating Conditions :	BT_N
Operator Name:	
Comment:	

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	33.89	66.00	32.11	9.000	N	OFF	9.6
0.1635	41.88	65.28	23.40	9.000	N	OFF	9.6
0.1815	36.66	64.42	27.76	9.000	N	OFF	9.6
0.1950	36.11	63.82	27.71	9.000	N	OFF	9.6
0.2265	30.48	62.58	32.10	9.000	N	OFF	9.6
0.3840	33.46	58.19	24.73	9.000	N	OFF	9.6
1.1998	27.68	56.00	28.32	9.000	N	OFF	9.7
1.2245	28.16	56.00	27.84	9.000	N	OFF	9.7
1.2313	28.94	56.00	27.06	9.000	N	OFF	9.7
1.2560	29.42	56.00	26.58	9.000	N	OFF	9.7
1.2673	31.14	56.00	24.86	9.000	N	OFF	9.7
3.3575	31.91	56.00	24.09	9.000	N	OFF	9.8
16.7270	31.00	60.00	29.00	9.000	N	OFF	10.3
18.6598	28.72	60.00	31.28	9.000	N	OFF	10.4
18.6913	28.37	60.00	31.63	9.000	N	OFF	10.4
18.7385	28.08	60.00	31.92	9.000	N	OFF	10.4
18.7700	27.81	60.00	32.19	9.000	N	OFF	10.4
19.0153	27.08	60.00	32.92	9.000	N	OFF	10.4

2022-04-30 오후 3:36:57

Test 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1545	25.21	55.75	30.54	9.000	N	OFF	9.6
0.1815	25.48	54.42	28.94	9.000	N	OFF	9.6
0.1905	27.96	54.02	26.05	9.000	N	OFF	9.6
0.2063	22.94	53.36	30.42	9.000	N	OFF	9.6
0.3570	31.58	48.80	17.22	9.000	N	OFF	9.6
0.3885	25.15	48.10	22.95	9.000	N	OFF	9.6
1.1660	21.84	46.00	24.16	9.000	N	OFF	9.7
1.1975	21.82	46.00	24.18	9.000	N	OFF	9.7
1.2268	20.01	46.00	25.99	9.000	N	OFF	9.7
1.2583	18.51	46.00	27.49	9.000	N	OFF	9.7
1.5238	25.29	46.00	20.71	9.000	N	OFF	9.7
1.5553	24.46	46.00	21.54	9.000	N	OFF	9.7
16.3693	23.25	50.00	26.75	9.000	N	OFF	10.3
16.7293	23.35	50.00	26.65	9.000	N	OFF	10.3
17.0555	22.06	50.00	27.94	9.000	N	OFF	10.3
18.5338	19.63	50.00	30.37	9.000	N	OFF	10.4
18.6215	19.04	50.00	30.96	9.000	N	OFF	10.4
18.8780	18.09	50.00	31.91	9.000	N	OFF	10.4

2022-04-30 오후 3:36:57

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
EMI Test Receiver	ESR	Rohde & Schwarz	101910	06/17/2022	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	03/04/2023	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/07/2022	Annual
Power Meter	N1911A	Agilent	MY45100523	03/24/2023	Annual
Power Sensor	N1921A	Agilent	MY57820067	03/24/2023	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/02/2022	Annual
Power Splitter	11667B	Hewlett Packard	10545	02/03/2023	Annual
DC Power Supply	E3646A	Agilent	MY40002937	12/14/2022	Annual
Attenuator(10 dB)(DC-26.5 GHz)	5910-N-50-010	H+S	00801	10/29/2022	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	03/07/2023	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	HCT CO., LTD.	N/A	N/A	N/A
Bluetooth Tester	CBT	Rohde & Schwarz	100808	02/22/2023	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	EM2090	Emco	060520	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/17/2024	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	09/04/2022	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	11/18/2023	Biennial
Horn Antenna(15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	04/12/2023	Biennial
Amp &Filter Bank Switch Controller	FBSM-01A	TNM system	0	N/A	N/A
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	01/06/2023	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/24/2022	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/24/2022	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	02/07/2023	Annual
ATT(3 dB) + LNA2(6~18 GHz)	18B-03, CBL06185030	WEINSCHEL CERNEX	N/A	12/22/2022	Annual
ATT(10 dB) + LNA1(0.1~18 GHz)	56-10, CBLU1183540B-01	Api tech, CERNEX	N/A	12/22/2022	Annual
High Pass Filter	WHKX10-2700-3000-18000-40SS	Wainwright Instruments	N/A	12/22/2022	Annual
High Pass Filter	WHKX8-6090-7000-18000-40SS	Wainwright Instruments	N/A	12/22/2022	Annual
Thru	COAXIAL ATTENUATOR	T&M SYSTEM	N/A	12/22/2022	Annual
Power Amplifier	CBL18265035	CERNEX	22966	12/02/2022	Annual
Power Amplifier	CBL26405040	CERNEX	25956	03/11/2023	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	04/05/2023	Annual
Spectrum Analyzer	FSP(9 kHz ~ 30 GHz)	Rohde & Schwarz	836650/016	09/13/2022	Annual
Spectrum Analyzer	FSV40-N(9 kHz ~ 30 GHz)	Rohde & Schwarz	101068-SZ	09/15/2022	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-2205-FC011-P