

# FCC BT REPORT

## Certification

**Applicant Name:**  
SAMSUNG Electronics Co., Ltd.

**Date of Issue:**  
June 17, 2022

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

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

**Report No.:** HCT-RF-2206-FC007

**FCC ID:** A3LSMG990B2

**APPLICANT:** SAMSUNG Electronics Co., Ltd.

**Model:** SM-G990B2/DS  
**Additional Model:** SM-G990B2  
**EUT Type:** Mobile Phone  
**Max. RF Output Power:** 15.967 dBm (39.51 mW)  
**Frequency Range:** 2402 MHz– 2480 MHz (Bluetooth)  
**Modulation type** GFSK(Normal),  $\pi/4$ DQPSK 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

Report No.: HCT-RF-2206-FC007

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REVIEWED BY



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Report prepared by : Se Wook Park  
Engineer of Telecommunication Testing Center

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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)

\* The report shall not be reproduced except in full(only partly) without approval of the laboratory.

## Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-2206-FC007	June 17, 2022	- First Approval Report

# Table of Contents

REVIEWED BY .....	2
1. EUT DESCRIPTION .....	5
2. Requirements for Bluetooth transmitter(15.247).....	6
3. TEST METHODOLOGY .....	6
EUT CONFIGURATION .....	6
EUT EXERCISE .....	7
GENERAL TEST PROCEDURES .....	7
DESCRIPTION OF TEST MODES .....	7
4. INSTRUMENT CALIBRATION.....	8
5. FACILITIES AND ACCREDITATIONS .....	8
FACILITIES .....	8
EQUIPMENT .....	8
6. ANTENNA REQUIREMENTS .....	8
7. MEASUREMENT UNCERTAINTY .....	9
8. DESCRIPTION OF TESTS.....	10
9. SUMMARY OF TEST RESULTS .....	27
10. TEST RESULT .....	28
10.1 PEAK POWER .....	28
10.2 BAND EDGES.....	34
10.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW).....	41
10.4 NUMBER OF HOPPING FREQUENCY .....	49
10.5 TIME OF OCCUPANCY (DWELL TIME) .....	53
10.6 SPURIOUS EMISSIONS.....	59
10.6.1 CONDUCTED SPURIOUS EMISSIONS .....	59
10.6.2 RADIATED SPURIOUS EMISSIONS.....	67
10.6.3 RADIATED RESTRICTED BAND EDGES .....	74
10.7 POWERLINE CONDUCTED EMISSIONS .....	77
11. LIST OF TEST EQUIPMENT .....	81
12. ANNEX A_ TEST SETUP PHOTO.....	83

## 1. EUT DESCRIPTION

<b>Model</b>	SM-G990B2/DS
<b>Additional Model</b>	SM-G990B2
<b>EUT Type</b>	Mobile Phone
<b>Power Supply</b>	DC 4.20 V
<b>Frequency Range</b>	2 402 MHz ~ 2 480 MHz
<b>Max. RF Output Power</b>	15.967 dBm (39.51 mW)
<b>BT Operating Mode</b>	Normal, EDR, AFH
<b>Modulation Type</b>	GFSK(Normal), $\pi/4$ DQPSK and 8DPSK(EDR)
<b>Modulation Technique</b>	FHSS
<b>Number of Channels</b>	79 Channels, Minimum 20 Channels(AFH)
<b>Date(s) of Tests</b>	May 26, 2022 ~ June 17, 2022
<b>Serial number</b>	Radiated: R3CT409L9YB Conducted : 6384e63128197ece

## **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  $U_{\text{CISPR}}$  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

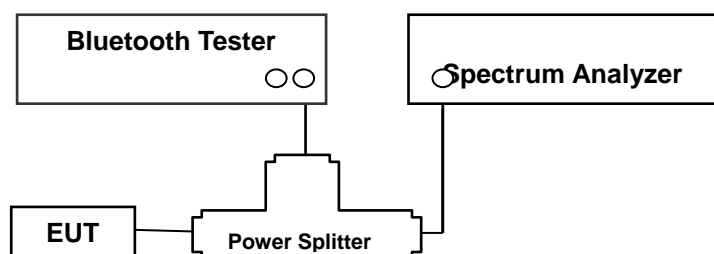
### 8.1. Conducted Maximum Peak Output Power

#### 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

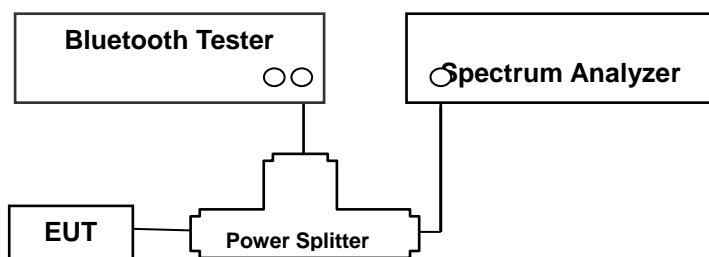
Output Power = Spectrum Measured Power + Power Splitter loss + Cable loss(2 ea)  
= 10 dBm + 6 dB + 1.5 dB = 17.5 dBm

## 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)

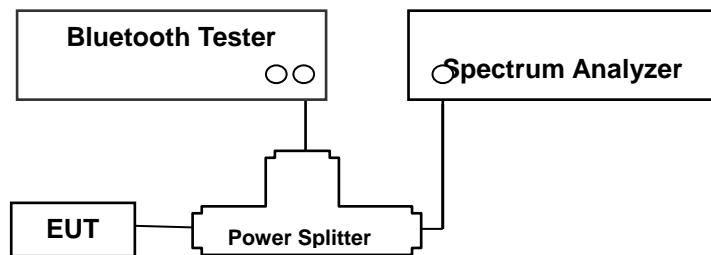
- 1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
- 2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than  $[10 \log(\text{OBW}/\text{RBW})]$  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  $\geq$  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)

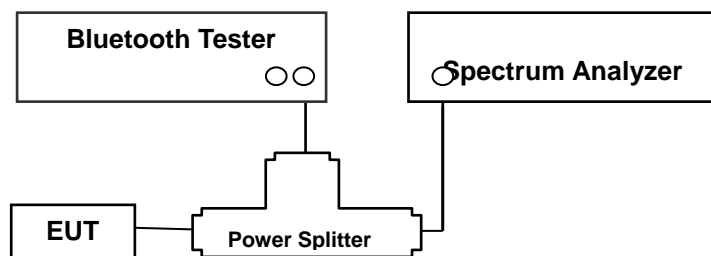
- 1) Span: Set between two times and five times the OBW
- 2) RBW: 1 % to 5 % of the OBW.
- 3) VBW  $\geq 3 \times$  RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) All the trace to stabilize.

#### 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)

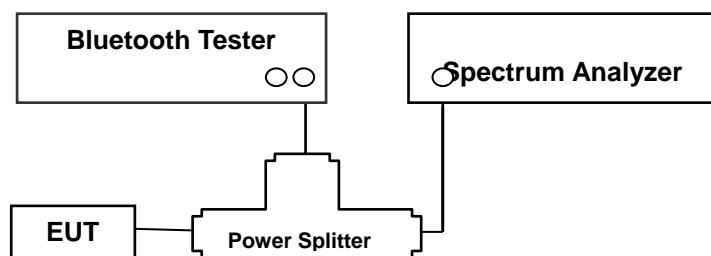
- 1) Span: the frequency band of operation
- 2) RBW: To identify clearly the individual channels, set the RBW to less than 30 % of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- 3) VBW  $\geq$  RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) Allow the trace to 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  $\leq$  channel spacing and where possible RBW should be set  $\gg 1 / T$ , 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) :  $2.890 \times (1600/6)/79 \times 31.6 = 308.27$  (ms)
- 2-DH 5 ( $\pi/4$ DQPSK) :  $2.890 \times (1600/6)/79 \times 31.6 = 308.27$  (ms)
- 3-DH 5 (8DPSK) :  $2.890 \times (1600/6)/79 \times 31.6 = 308.27$  (ms)

(2) AFH Mode

- DH 5 (GFSK) :  $2.890 \times (800/6)/20 \times 8.0 = 154.13$  (ms)
- 2-DH 5 ( $\pi/4$ DQPSK) :  $2.890 \times (800/6)/20 \times 8.0 = 154.13$  (ms)
- 3-DH 5 (8DPSK) :  $2.890 \times (800/6)/20 \times 8.0 = 154.13$  (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)

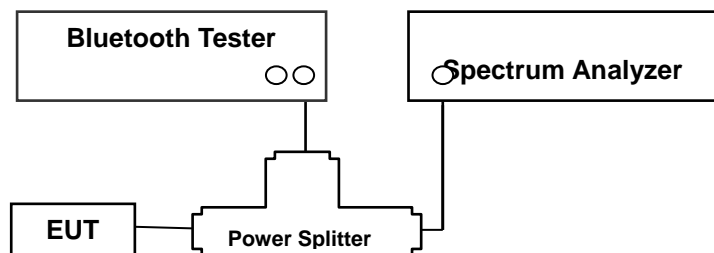


## 8.6. Conducted Spurious Emissions

### 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	<b>7.55</b>
2 500	<b>7.55</b>
3 000	7.56
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
24 000	9.37
25 000	9.39
26 000	9.45

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

2. Factor = Cable loss(2 EA) + Splitter loss(6 dB) + EUT Cable loss(0.35 dB)

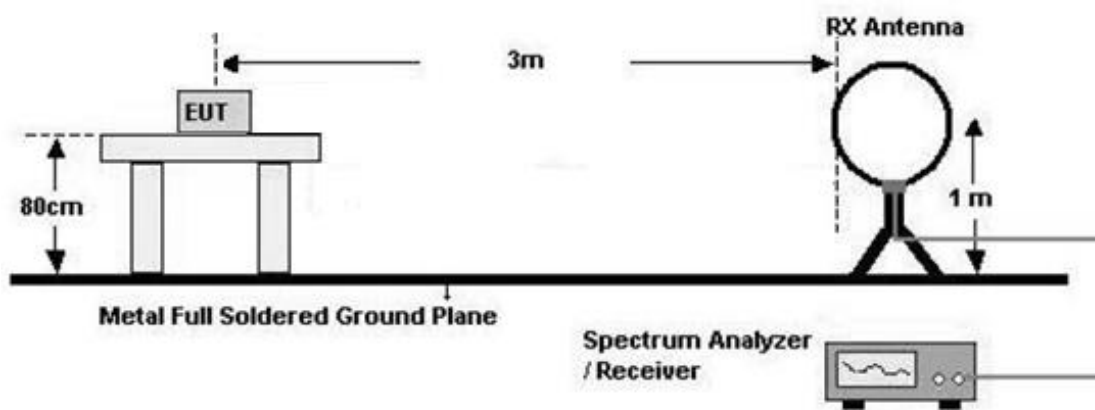
**8.7. Radiated Test**

**Limit**

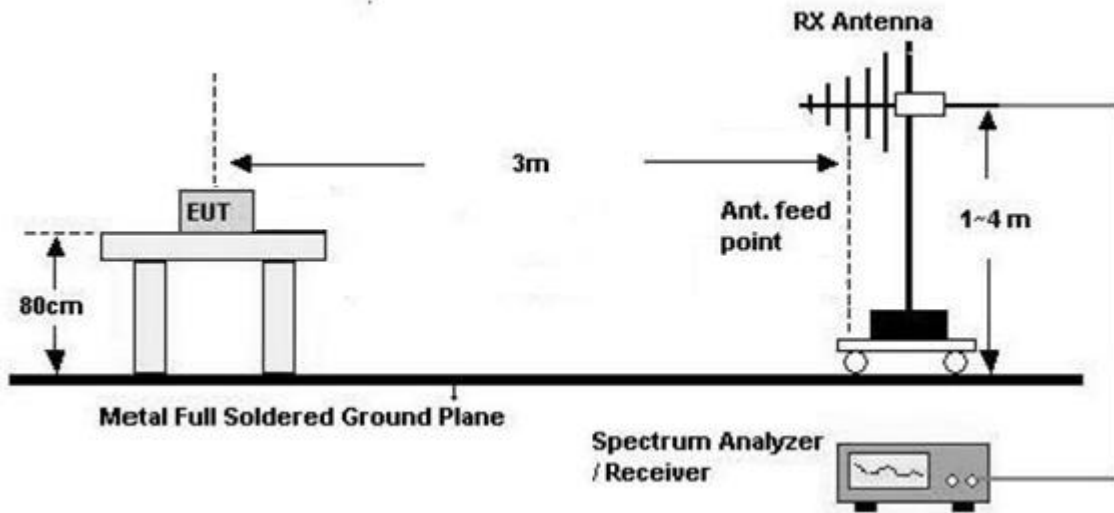
Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

**Test Configuration**

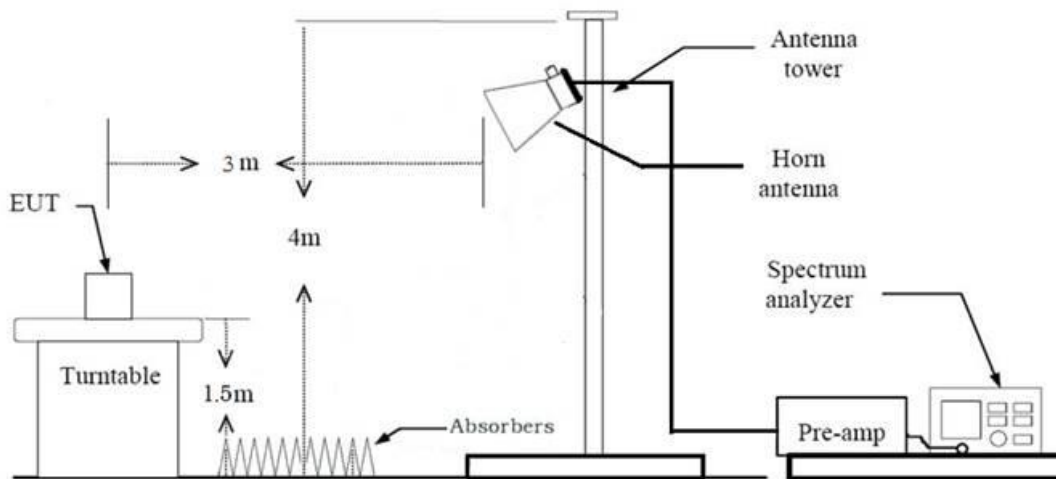
Below 30 MHz



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) =  $40\log(3\text{ m}/300\text{ m}) = - 80\text{ dB}$   
Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) =  $40\log(3\text{ m}/30\text{ m}) = - 40\text{ dB}$   
Measurement Distance : 3 m

#### 8. Spectrum Setting

- Frequency Range = 9 kHz ~ 30 MHz
- Detector = Peak
- Trace = Maxhold
- RBW = 9 kHz
- VBW  $\geq 3 \times$  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  $\geq 3 \times$  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  $\geq 3 \times$  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  $\geq 1/\tau$  Hz, where  $\tau$  = pulse width in seconds

The actual setting value of VBW = 1 kHz
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 =  $20\log(\text{test distance} / \text{specific distance})$  (dB)
12. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)

### **Test Procedure of Radiated Restricted Band Edge**

1. Radiated test is performed with hopping off.
2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m 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  $\geq 3 \times$  RBW
  - (2) Measurement Type(Average):
    - Detector = Peak
    - Trace = Maxhold
    - RBW = 1 MHz
    - VBW  $\geq 1/\tau$  Hz, where  $\tau$  = pulse width in seconds

The actual setting value of VBW = 1 kHz
9. Distance extrapolation factor =  $20\log(\text{test distance} / \text{specific distance})$  (dB)
10. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + 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  $\mu$ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56 <sup>(a)</sup>	56 to 46 <sup>(a)</sup>
0.50 to 5	56	46
5 to 30	60	50

<sup>(a)</sup>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 30MHz.
  - 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 : 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
  - $\pi/4$ DQPSK : 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-G990B2/DS, SM-G990B2 were tested and the worst case results are reported.  
(Worst case : SM-G990B2/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 : Y, Z
3. This device supports simultaneous transmission operation, which allows for two channels to operate independent of one another in the 2.4 GHz, 5 GHz or simultaneously on each antenna.

DBS	5GHz WiFi Ant.1	5GHz WiFi Ant.2	Bluetooth Ant.1	Test case
5GHz WiFi MIMO + Bluetooth	On	On	On	<u>Case 1</u>

Case 1: Please refer to the SM-G990B2/DS [UNII] Test Report.

RSDB Scenario	Bluetooth Ant.1	2.4 GHz WiFi Ant.1	2.4 GHz WiFi Ant.2	5GHz WiFi Ant.1	5GHz WiFi Ant.2	Test case
Bluetooth + 2.4 GHz WiFi + 5GHz WiFi MIMO	On	-	On	On	On	-
2.4 GHz WiFi MIMO + 5GHz WiFi MIMO	-	On	On	On	On	<u>Case 2</u>

Case 2: Please refer to the SM-G990B2/DS [UNII] & [DTS] Test Report.

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

Description	Bluetooth Emission	5 GHz Emission
Antenna	ANT1	ANT ALL
Channel	39	52
Data Rate	1 Mbps	MCS0
Mode	GFSK : DH5	802.11n(HT20)

Description	2.4 GHz Emission	5 GHz Emission
Antenna	ANT ALL	ANT ALL
Channel	6	52
Data Rate	6 Mbps	MCS0
Mode	802.11g	802.11n(HT20)

**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-G990B2/DS, SM-G990B2 were tested and the worst case results are reported.

(Worst case : SM-G990B2/DS)

**Conducted test**

1. The EUT was configured with data rate of highest power.

- GFSK : DH5
- $\pi/4$ DQPSK : 2-DH5
- 8DPSK : 3-DH5

2. AFH & Non-AFH were tested and the worst case results are reported.

(Worst case : Non-AFH)

3. SM-G990B2/DS, SM-G990B2 were tested and the worst case results are reported.

(Worst case : SM-G990B2/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-ofband emissions		PASS
Band Edge (Out of Band Emissions)	§15.247(d)	> 20 dB for all out-ofband 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
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	14.241	26.55	125
Mid	2441	15.967	39.51	
High	2480	14.117	25.80	

Channel	Frequency (MHz)	Output Power (8DPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	12.654	18.42	125
Mid	2441	14.433	27.75	
High	2480	12.481	17.71	

Channel	Frequency (MHz)	Output Power ( $\pi/4$ DQPSK)		Limit (mW)
		(dBm)	(mW)	
Low	2402	12.084	16.16	125
Mid	2441	13.960	24.89	
High	2480	11.974	15.75	

**Note:**

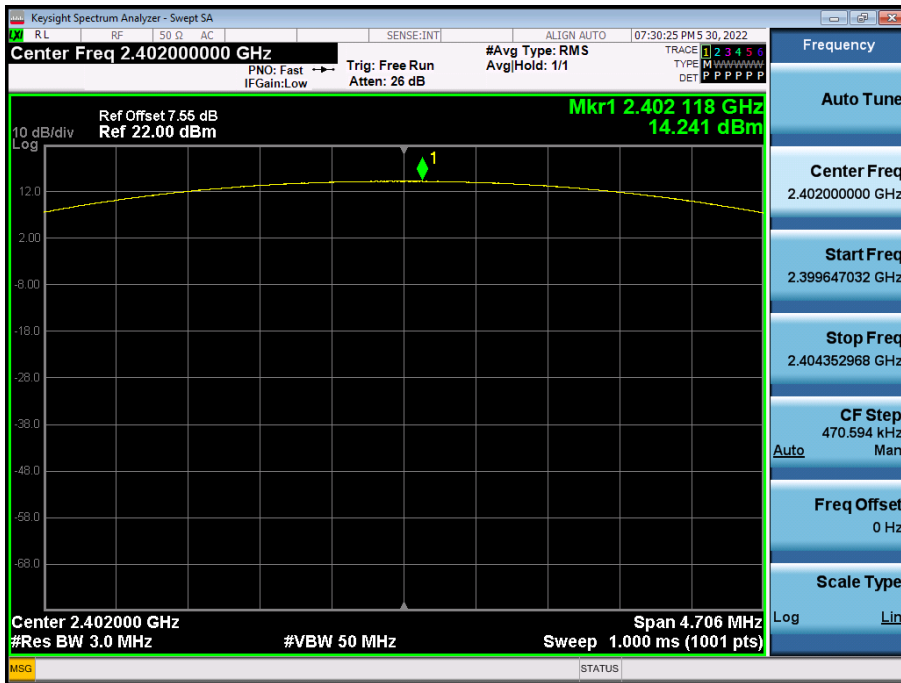
1. Spectrum measured values are not plot data.

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 7.55 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.

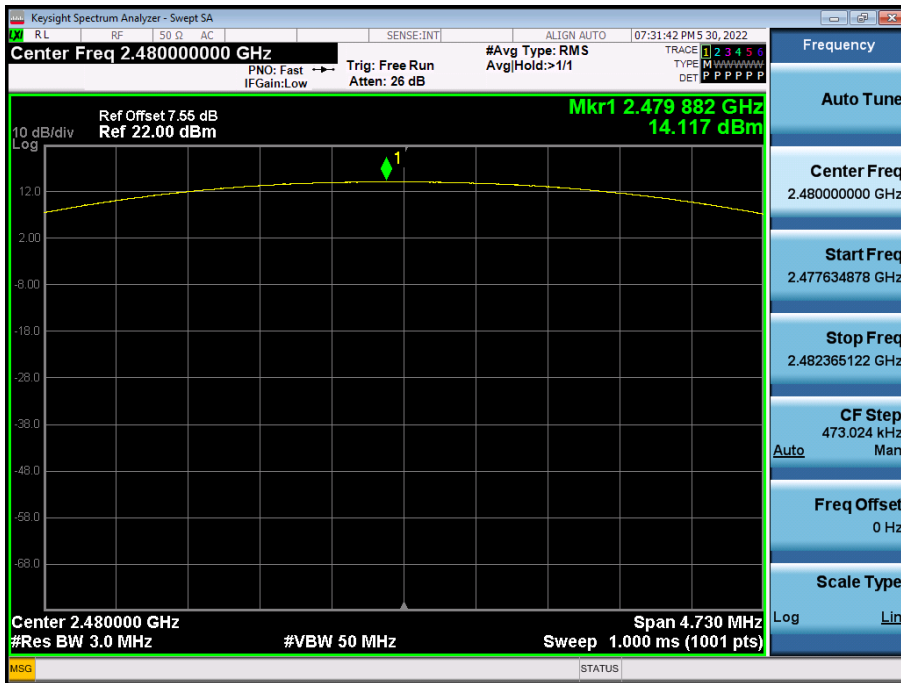
Test Plots (GFSK)  
Peak Power (CH.0)



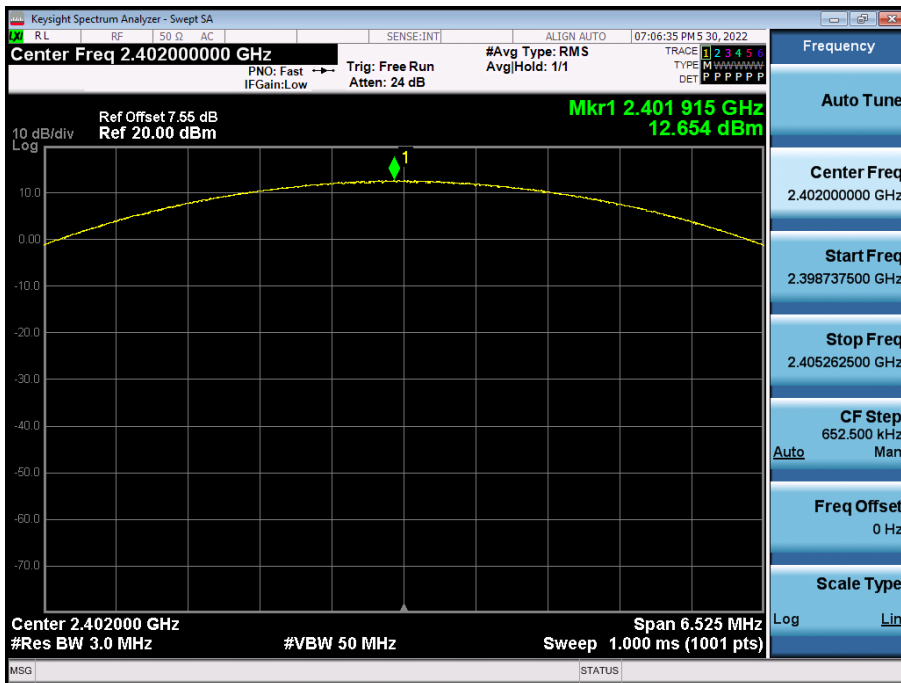
Test Plots (GFSK)  
Peak Power (CH.39)



Test Plots (GFSK)  
Peak Power (CH.78)

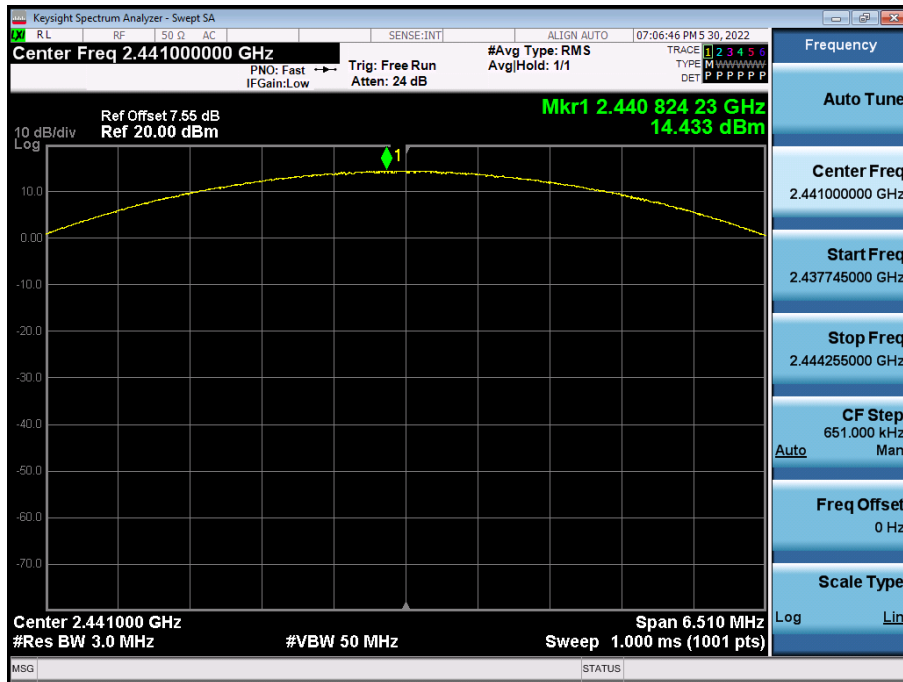


Test Plots (8DPSK)  
Peak Power (CH.0)



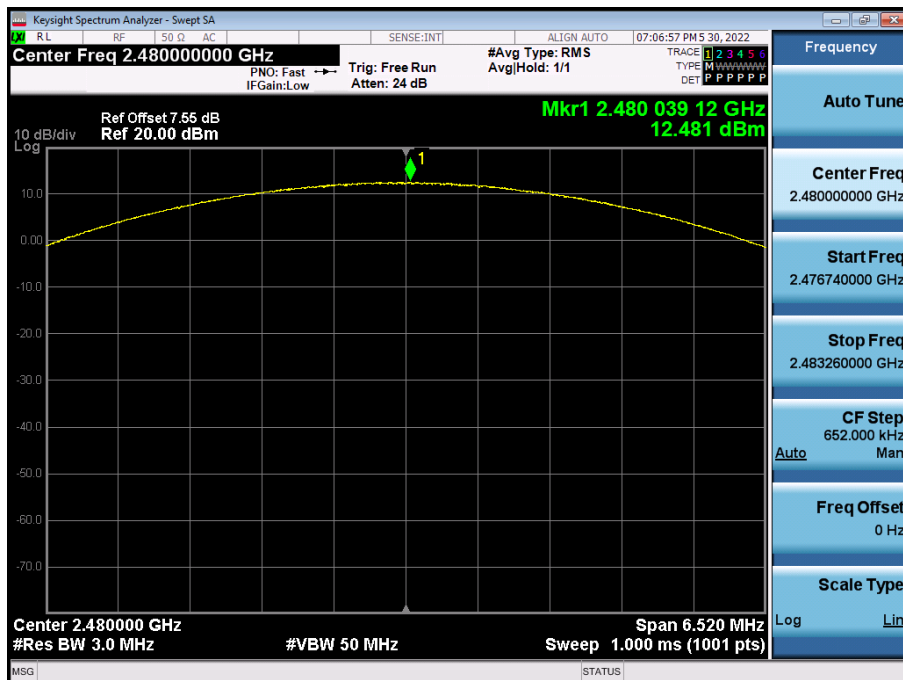
Test Plots (8DPSK)

Peak Power (CH.39)



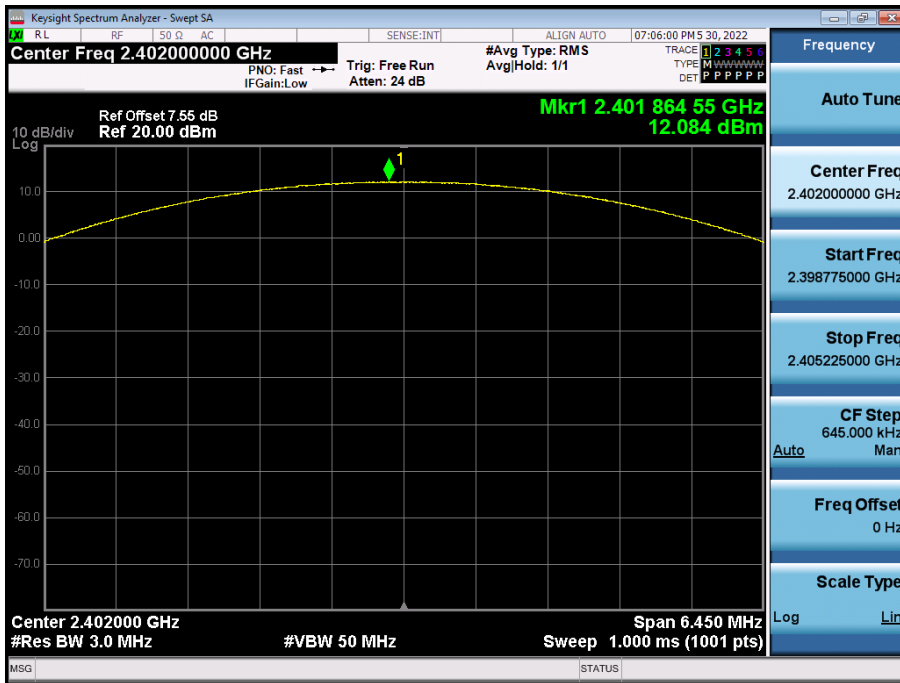
Test Plots (8DPSK)

Peak Power (CH.78)



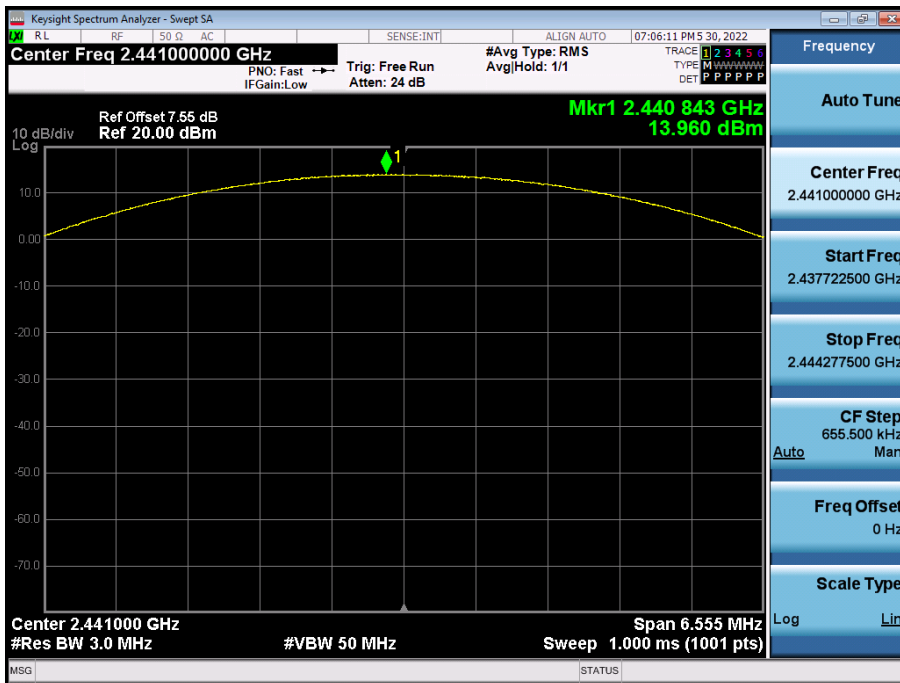
Test Plots ( $\pi/4$ DQPSK)

Peak Power (CH.0)



Test Plots ( $\pi/4$ DQPSK)

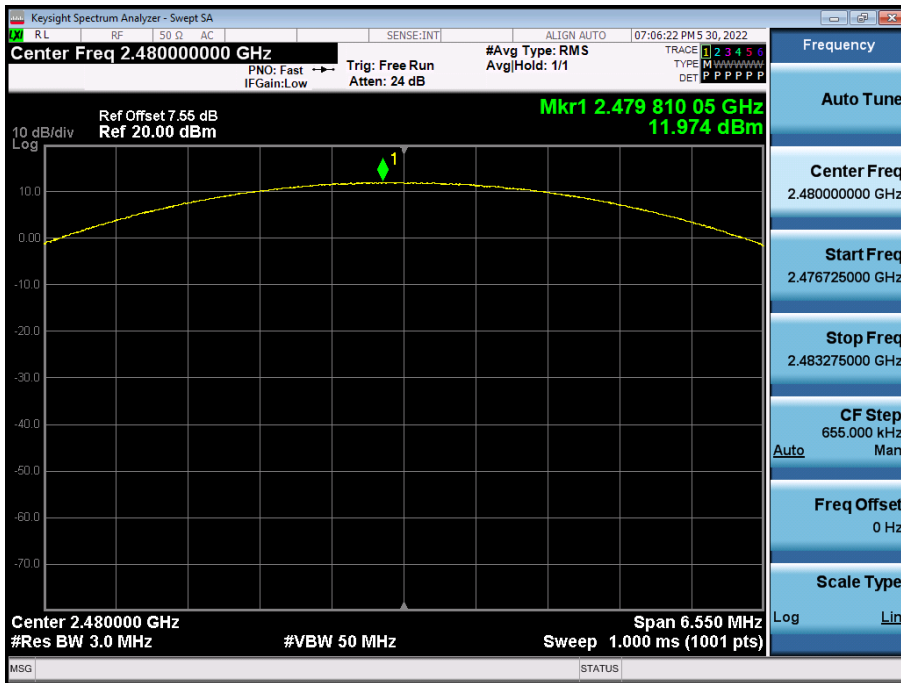
Peak Power (CH.39)





Test Plots ( $\pi/4$ DQPSK)

Peak Power (CH.78)



## 10.2 BAND EDGES

### Without hopping

Outside Frequency Band	GFSK (dB)	8DPSK (dB)	$\pi/4$ DQPSK (dB)	Limit (dBc)
Lower	59.907	56.975	57.862	20
Upper	66.460	63.448	63.806	

### With hopping

Outside Frequency Band	GFSK (dB)	8DPSK (dB)	$\pi/4$ DQPSK (dB)	Limit (dBc)
Lower	58.857	57.956	57.647	20
Upper	63.505	60.908	61.603	

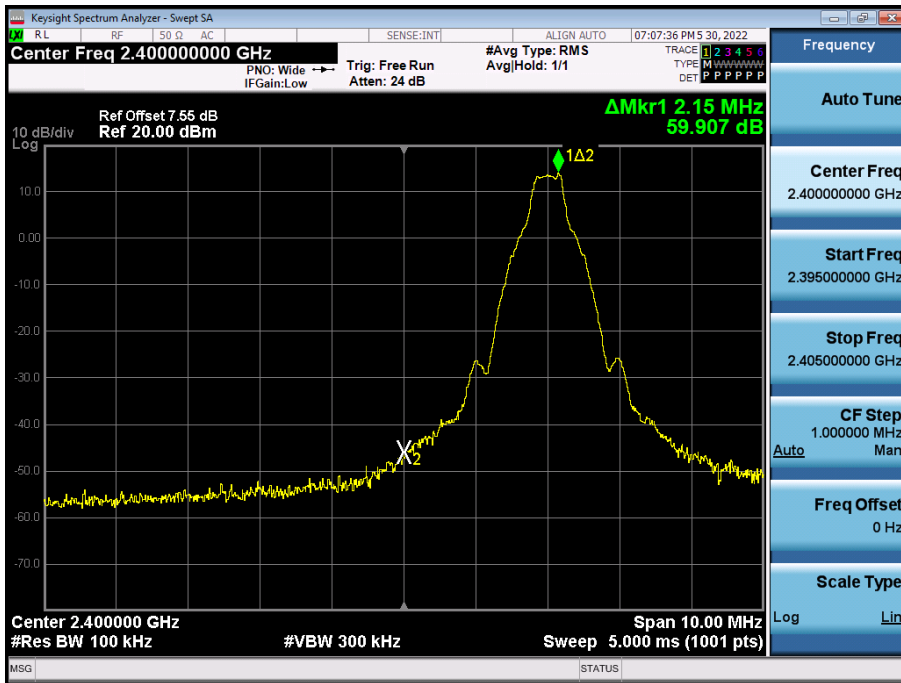
### Note :

1. Spectrum measured levels are not plot data.

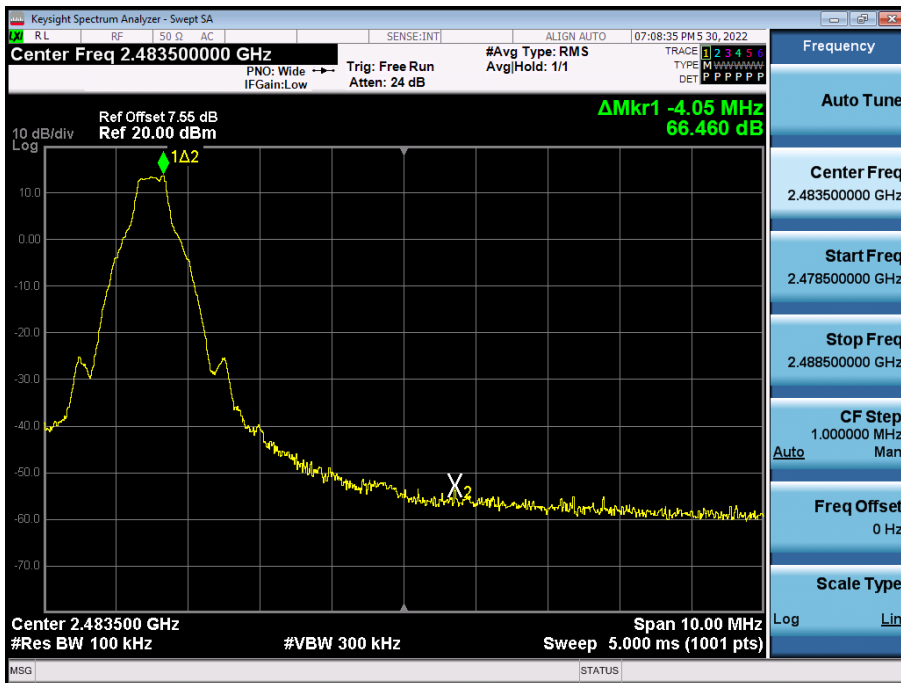
The power results in plot is already including the actual values of loss for the splitter and cable combination.

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.

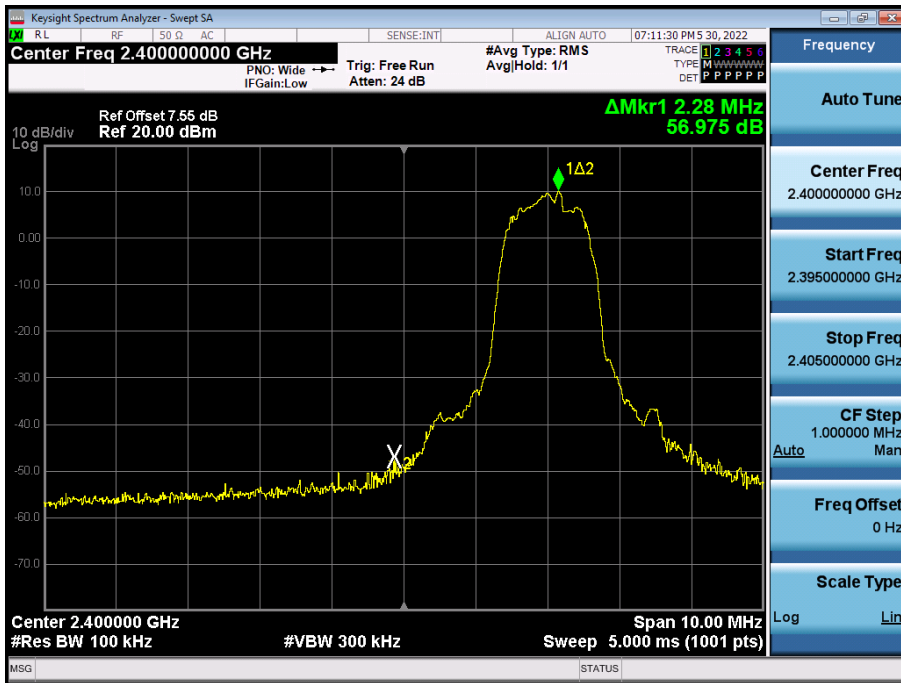
Test Plots without hopping (GFSK)  
Band Edges (CH.0)



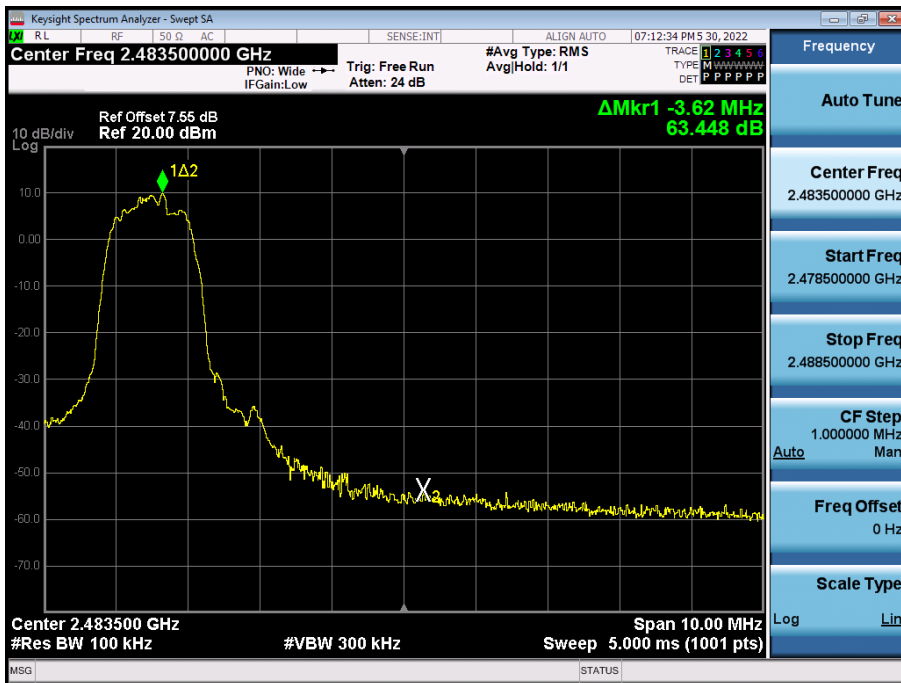
Test Plots without hopping (GFSK)  
Band Edges (CH.78)



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

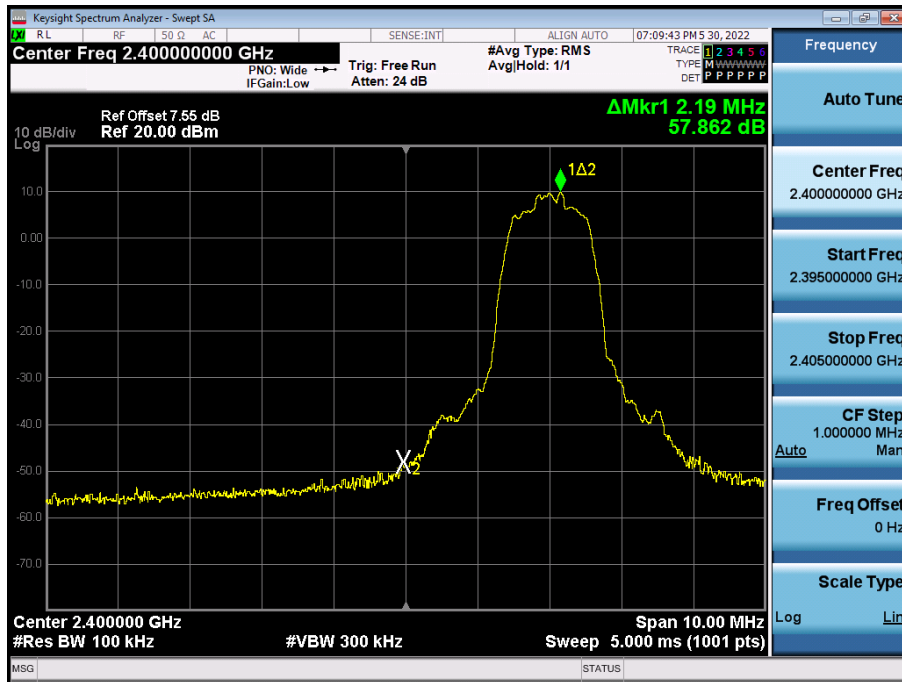


Test Plots without hopping (8DPSK)  
Band Edges (CH.78)



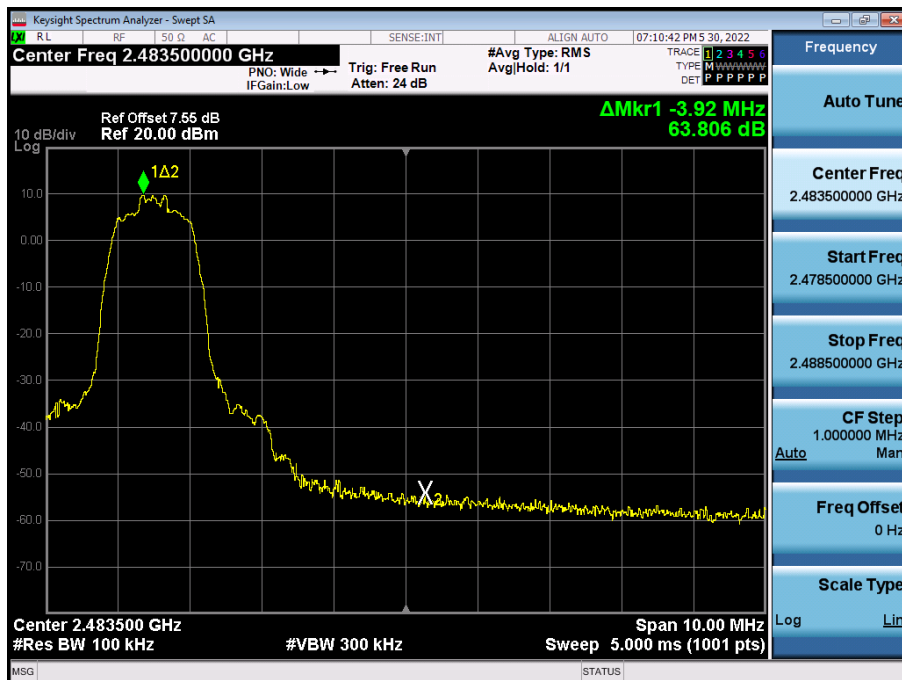
Test Plots without hopping ( $\pi/4$ DQPSK)

Band Edges (CH.0)



Test Plots without hopping ( $\pi/4$ DQPSK)

Band Edges (CH.78)



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



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



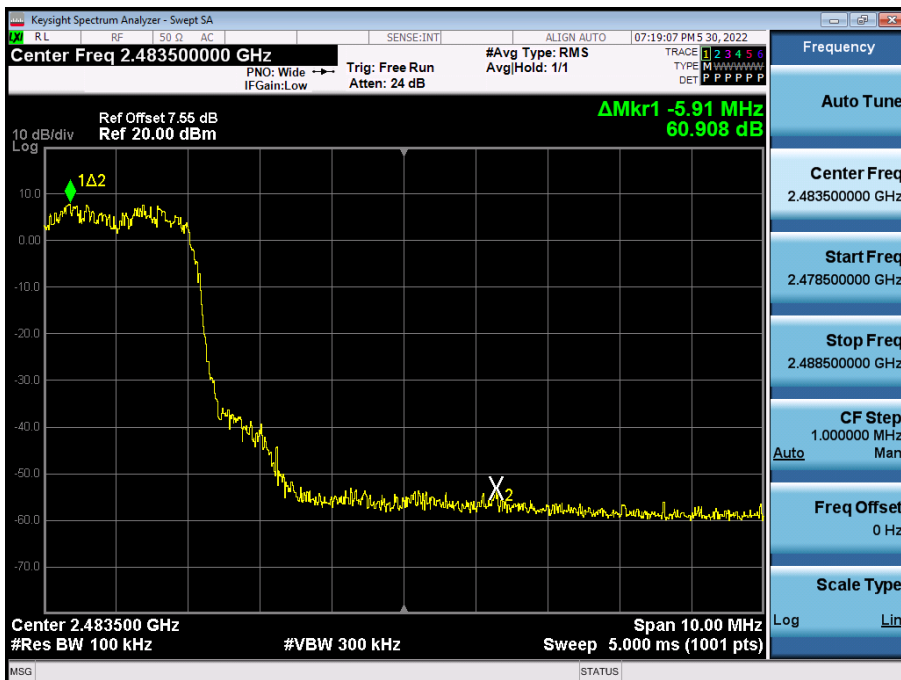
Test Plots with hopping (8DPSK)

Band Edges (CH.0)



Test Plots with hopping (8DPSK)

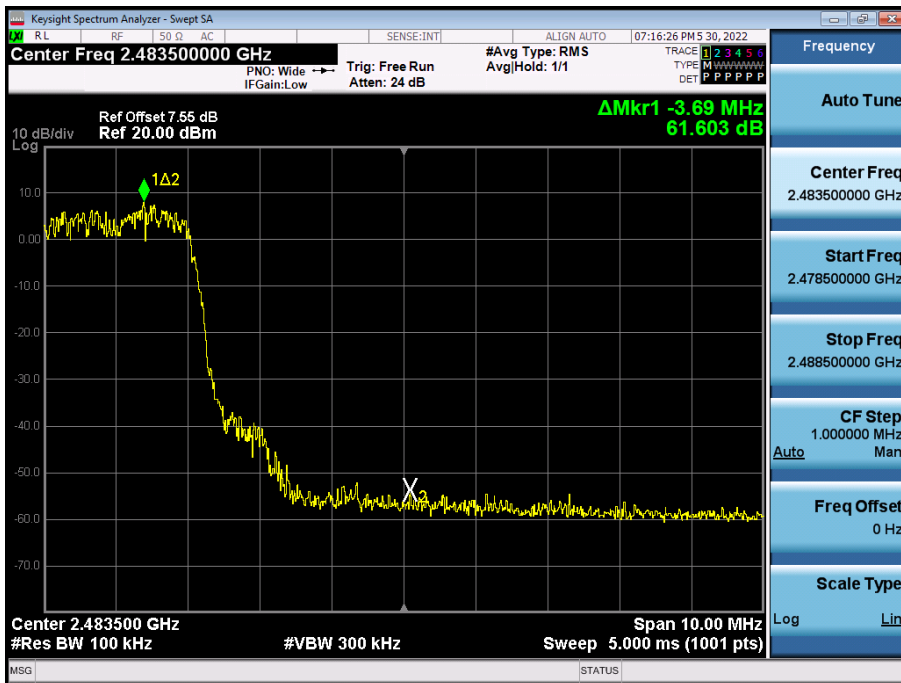
Band Edges (CH.78)



Test Plots with hopping ( $\pi/4$ DQPSK)  
Band Edges (CH.0)



Test Plots with hopping ( $\pi/4$ DQPSK)  
Band Edges (CH.78)





**10.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW)**

99% BW (kHz)			
Channel	GFSK	8DPSK	$\pi/4$ DQPSK
CH.0	834.23	1178.8	1173.0
CH.39	832.60	1181.3	1176.9
CH.78	830.94	1181.0	1171.3

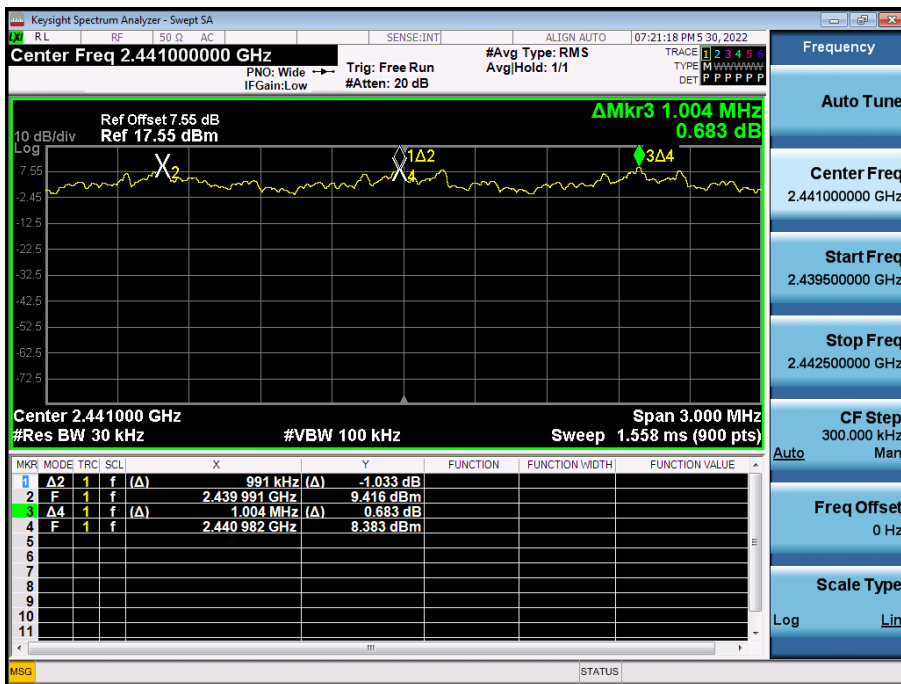
20dB BW (kHz)			
Channel	GFSK	8DPSK	$\pi/4$ DQPSK
CH.0	941.2	1305	1290
CH.39	943.6	1302	1311
CH.78	946.0	1304	1310

GFSK	Channel Separation(kHz)		Limit (kHz)
	8DPSK	$\pi/4$ DQPSK	
971	991	994	>25 kHz or >2/3 of the 20 dB BW

Test Plots (GFSK)  
Channel Separation

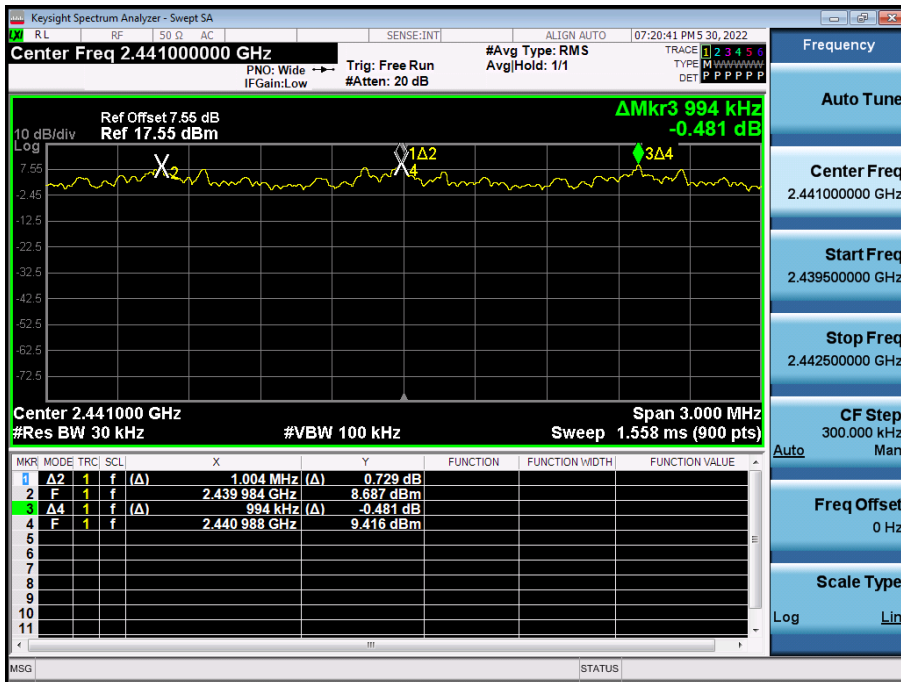


Test Plots (8DPSK)  
Channel Separation



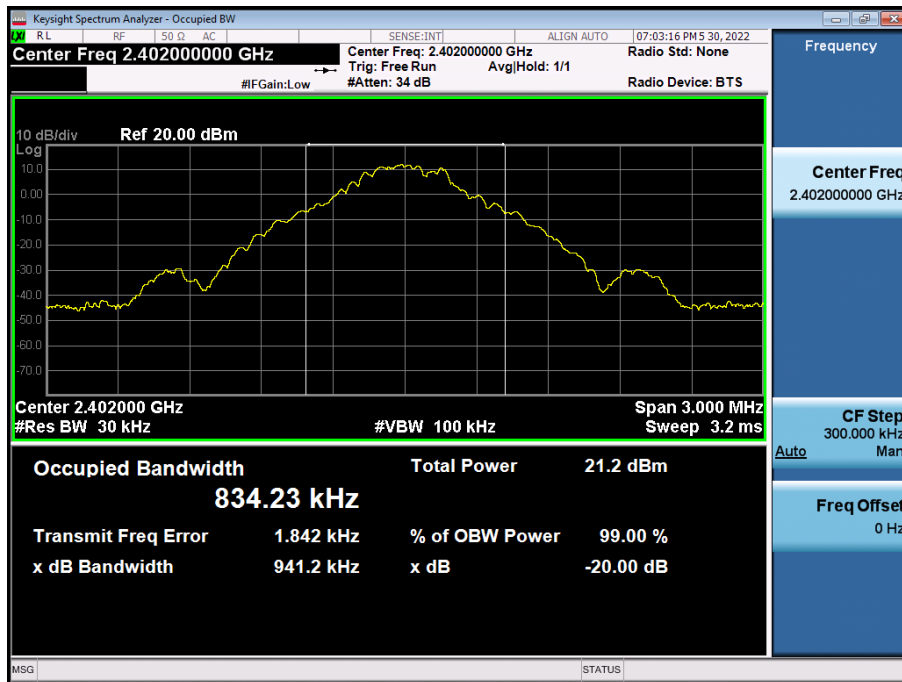
Test Plots ( $\pi/4$ DQPSK)

Channel Separation



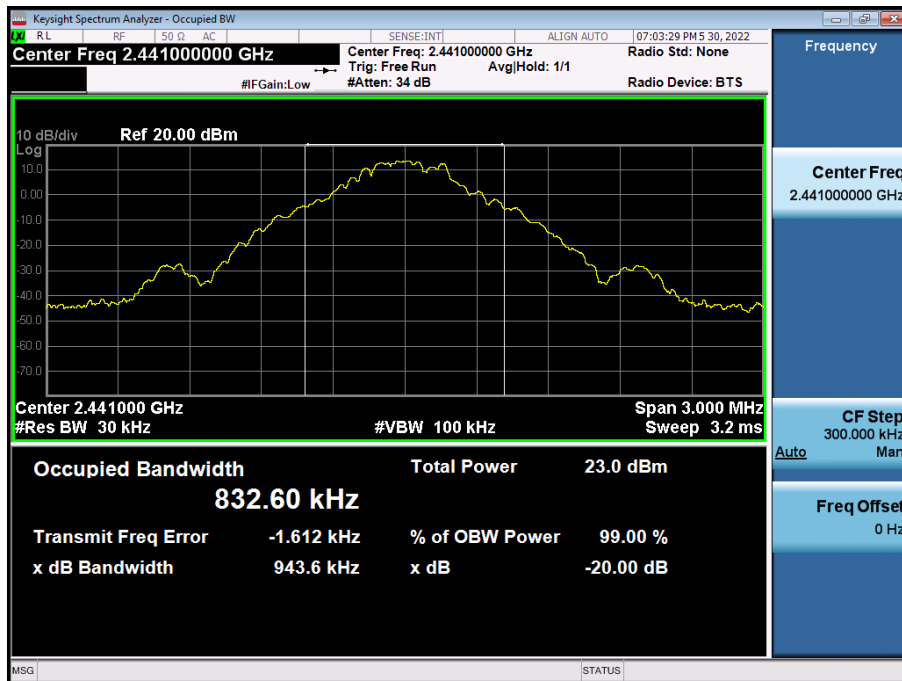
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



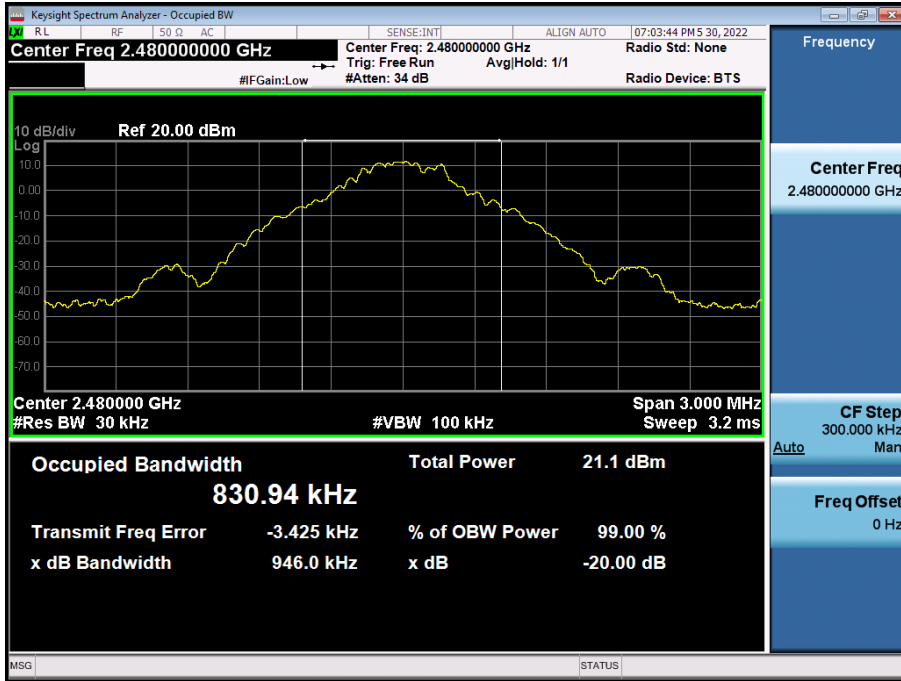
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



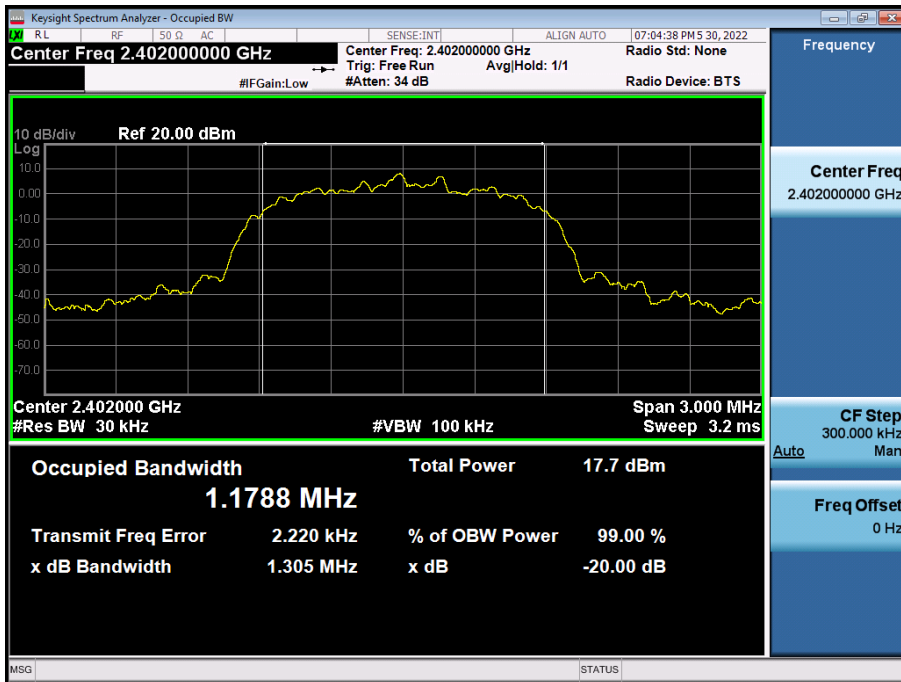
Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



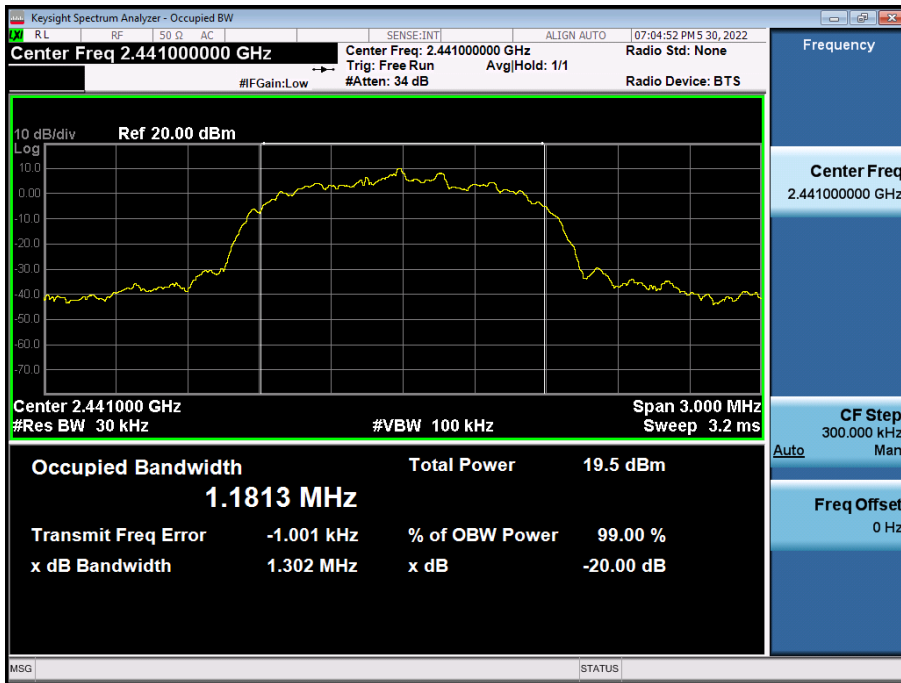
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



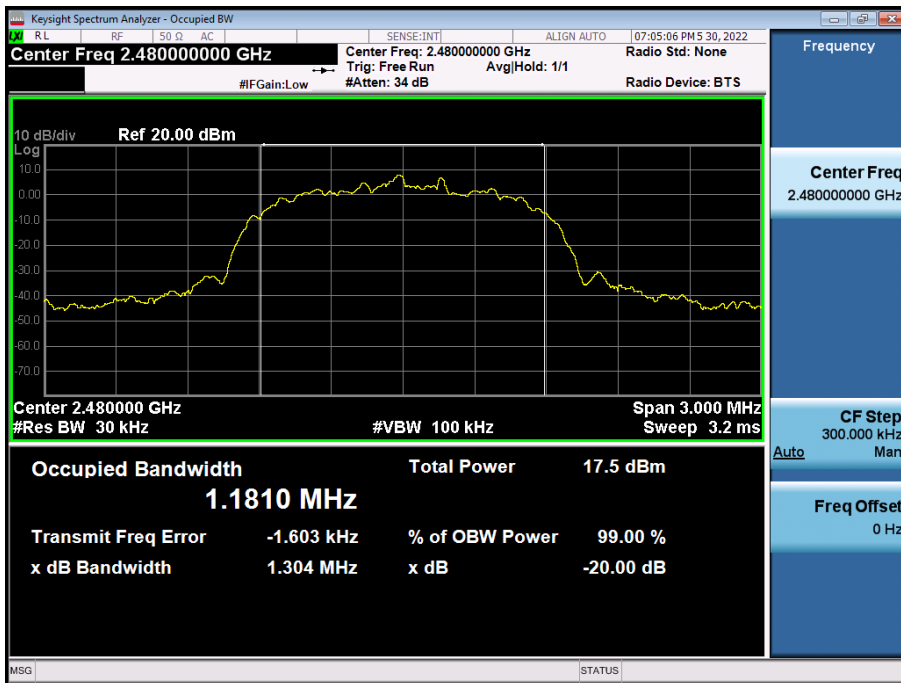
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



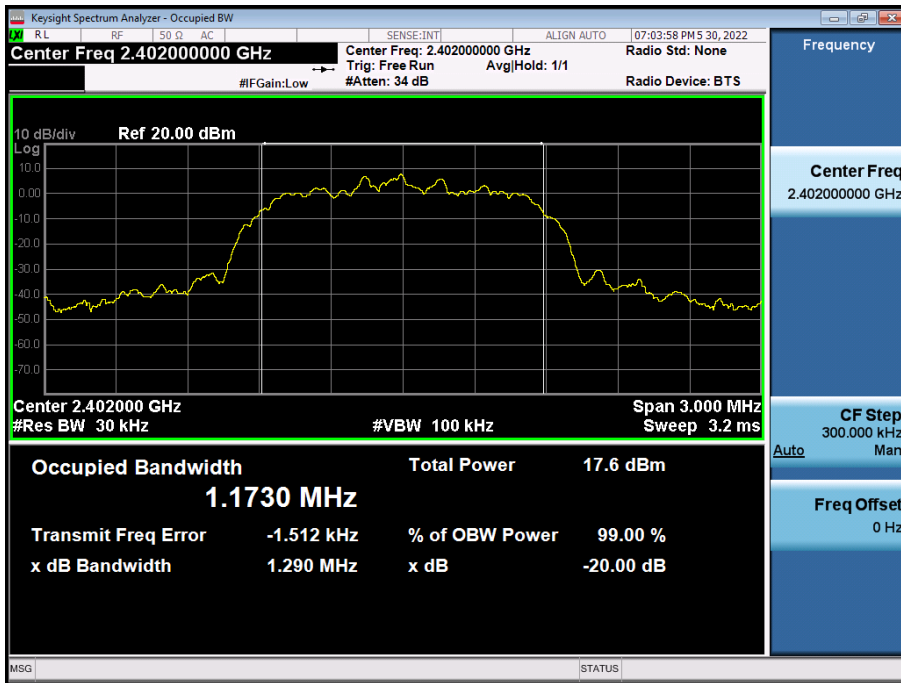
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



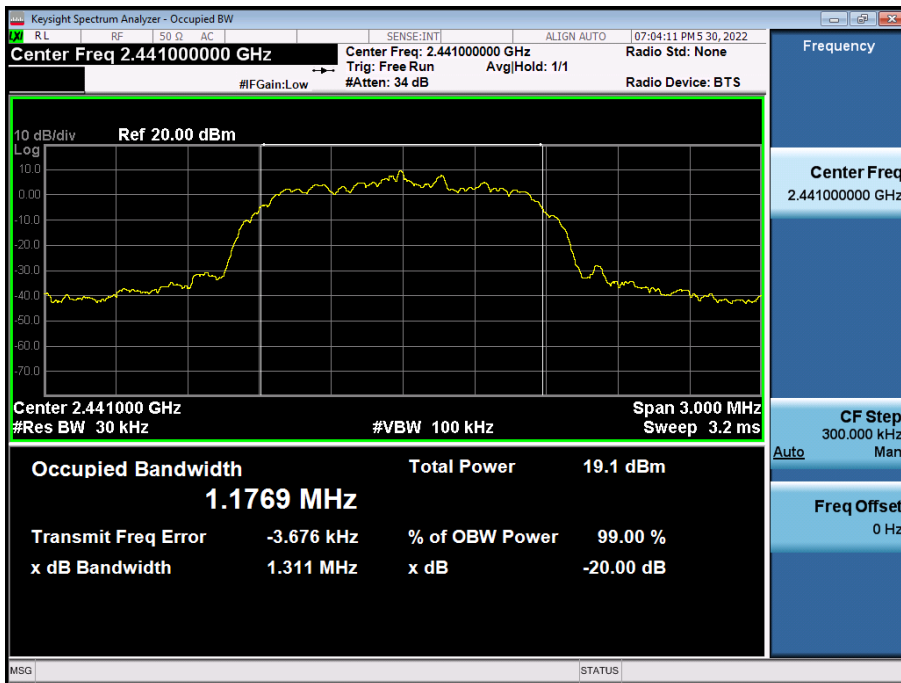
Test Plots ( $\pi/4$ DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



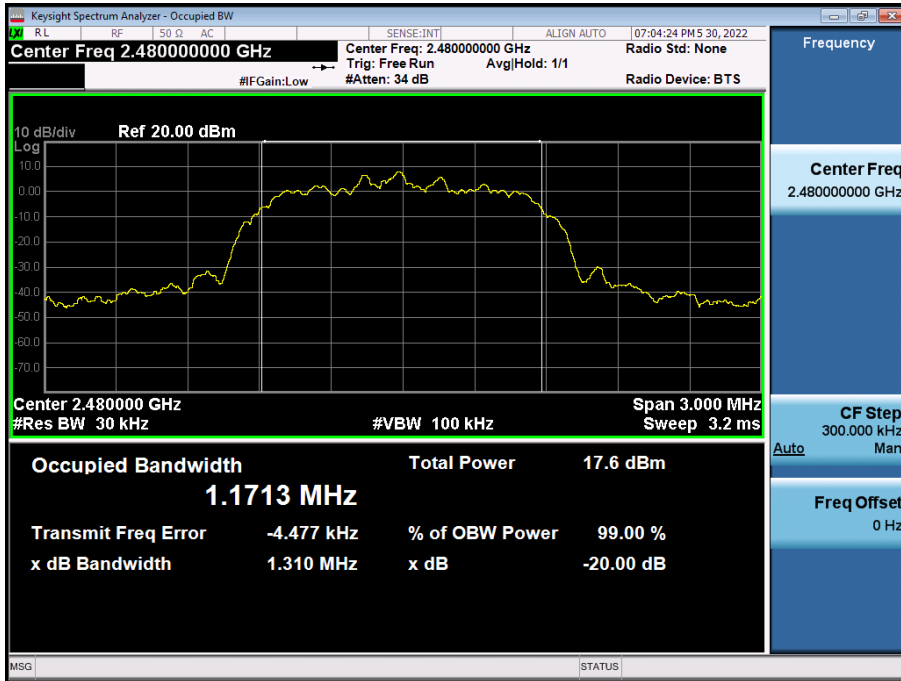
Test Plots ( $\pi/4$ DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



Test Plots ( $\pi/4$ DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)





#### 10.4 NUMBER OF HOPPING FREQUENCY

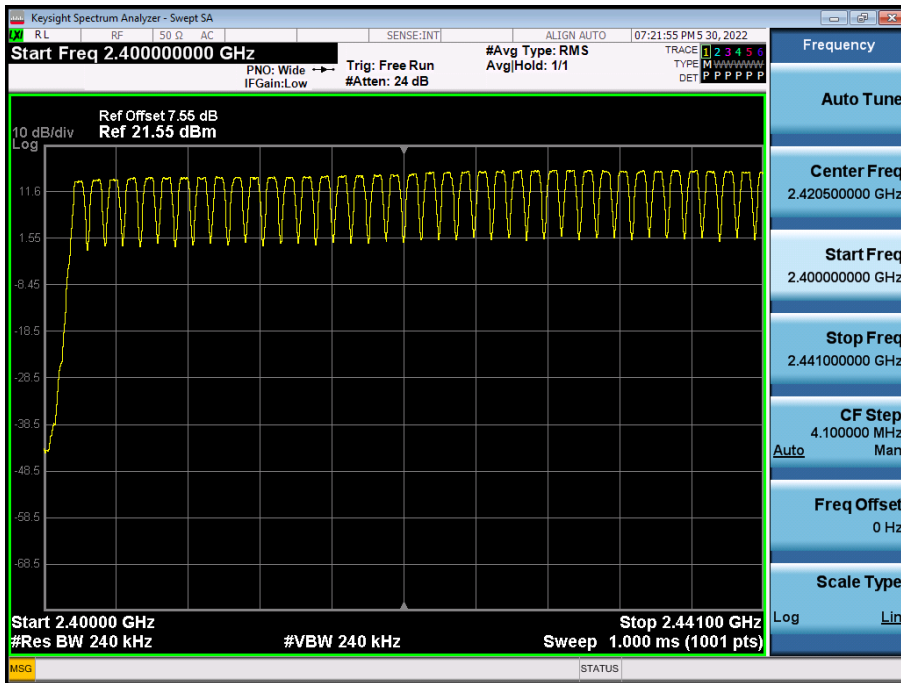
Result (No. of CH)			Limit
GFSK	8DPSK	$\pi/4$ DQPSK	
79	79	79	>15

**Note :**

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

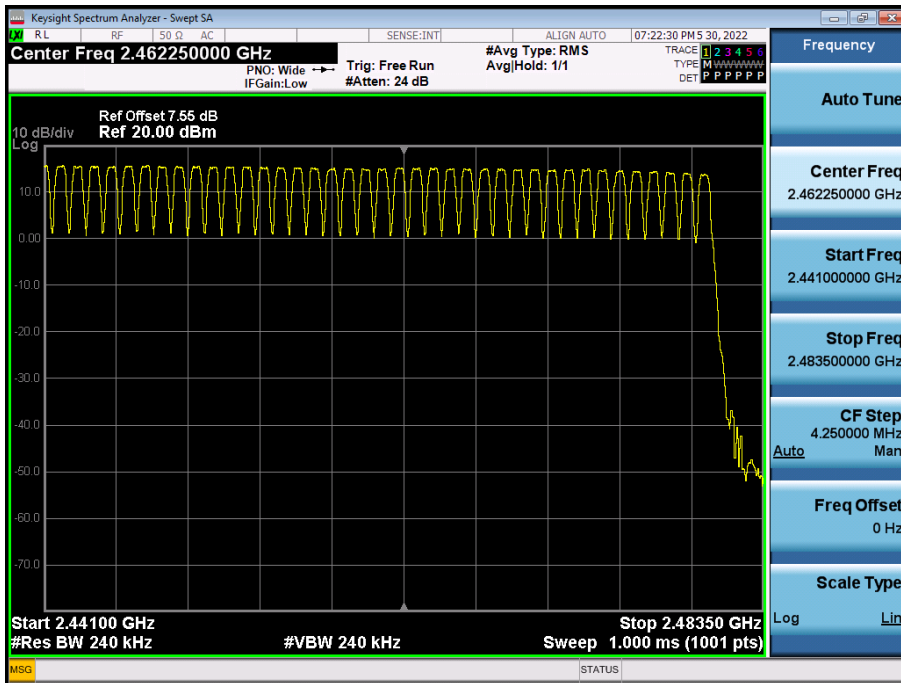
Test Plots (GFSK)

Number of Channels (2.4 GHz- 2.441 GHz)



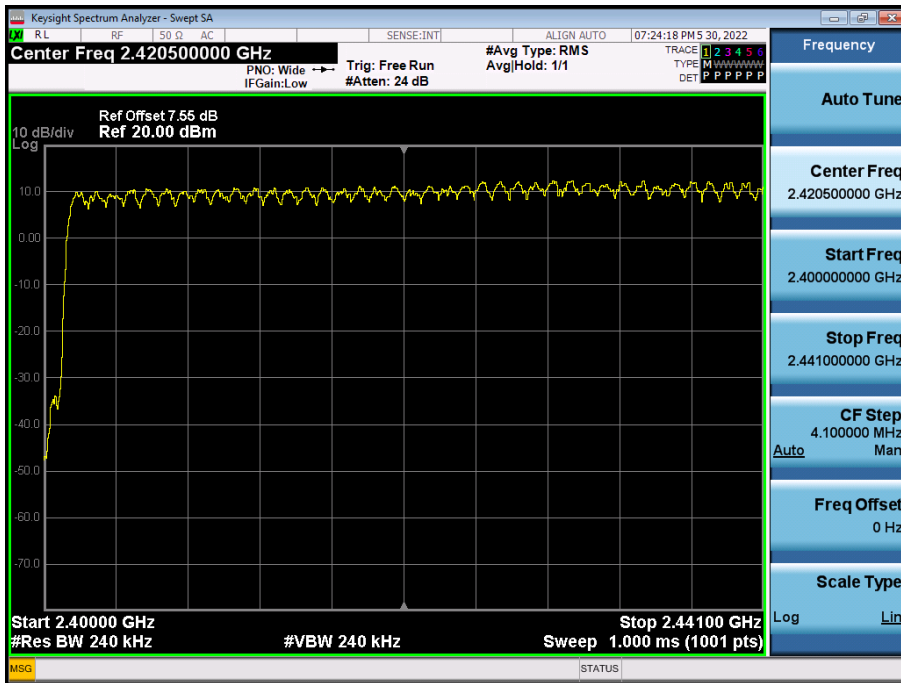
Test Plots (GFSK)

Number of Channels (2.441 GHz- 2.483.5 GHz)



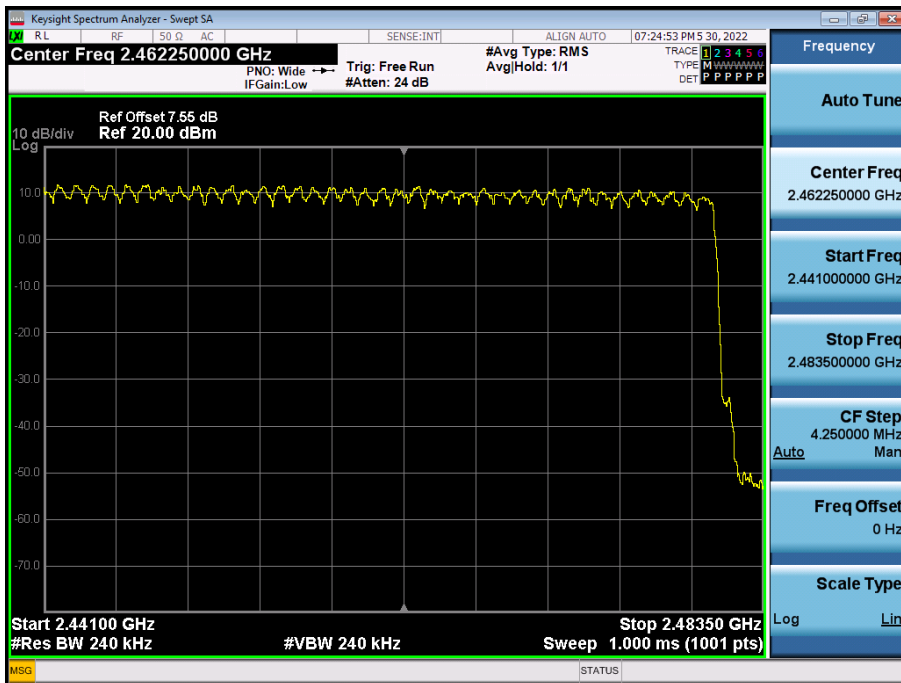
Test Plots (8DPSK)

Number of Channels (2.4 GHz- 2.441 GHz)



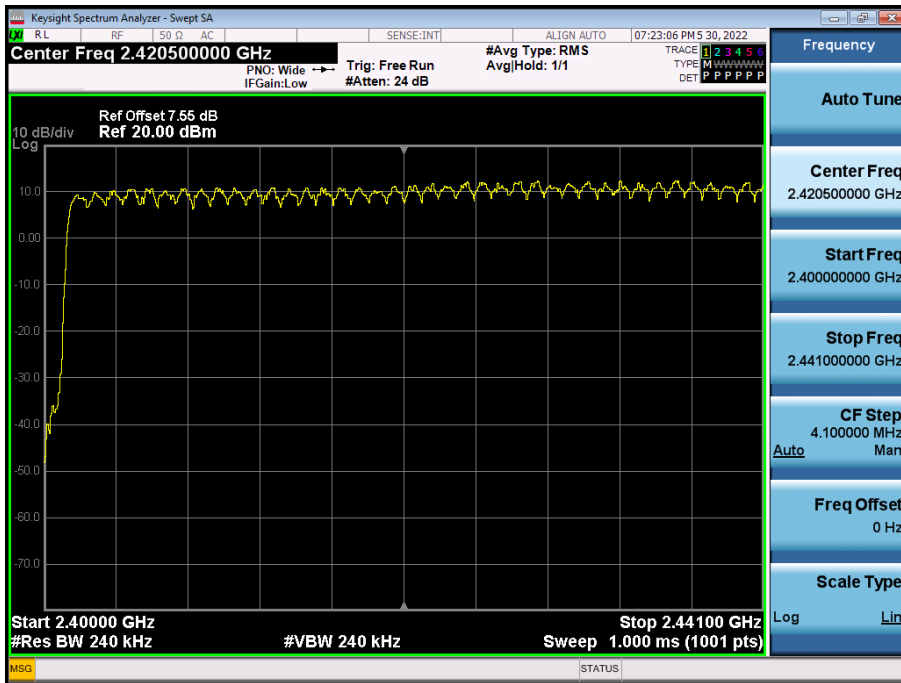
Test Plots (8DPSK)

Number of Channels (2.441 GHz- 2.483.5 GHz)



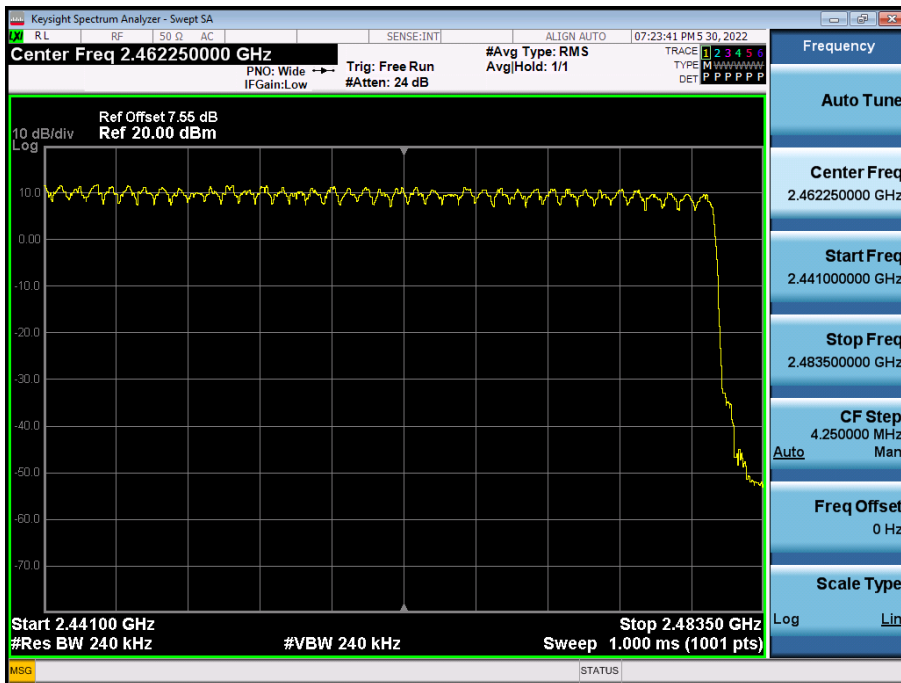
Test Plots ( $\pi/4$ DQPSK)

Number of Channels (2.4 GHz- 2.441 GHz)



Test Plots ( $\pi/4$ DQPSK)

Number of Channels (2.441 GHz- 2.483.5 GHz)



**10.5 TIME OF OCCUPANCY (DWELL TIME)**

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

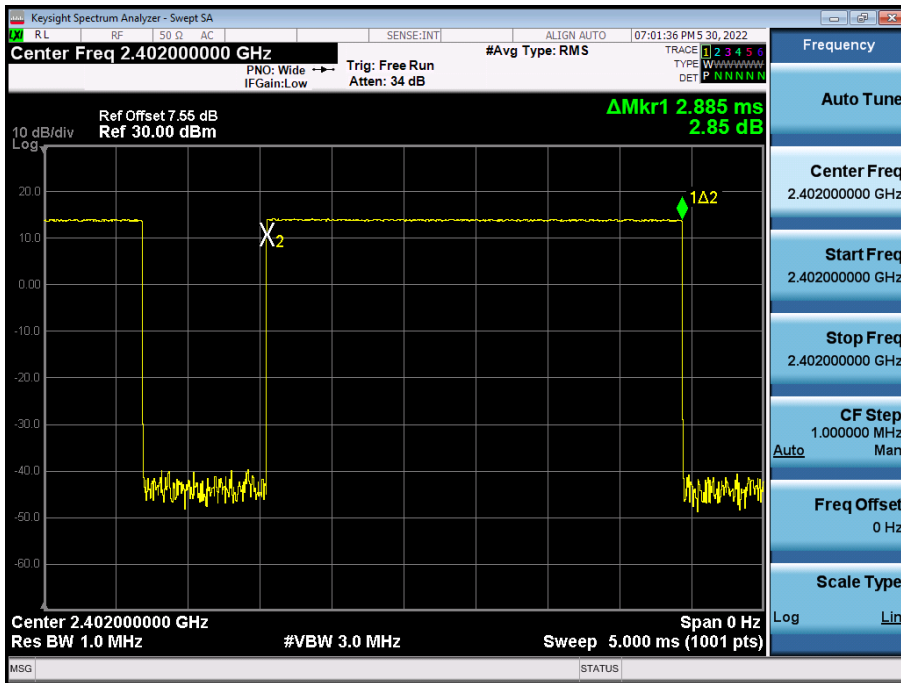
**Non-AFH Mode**

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

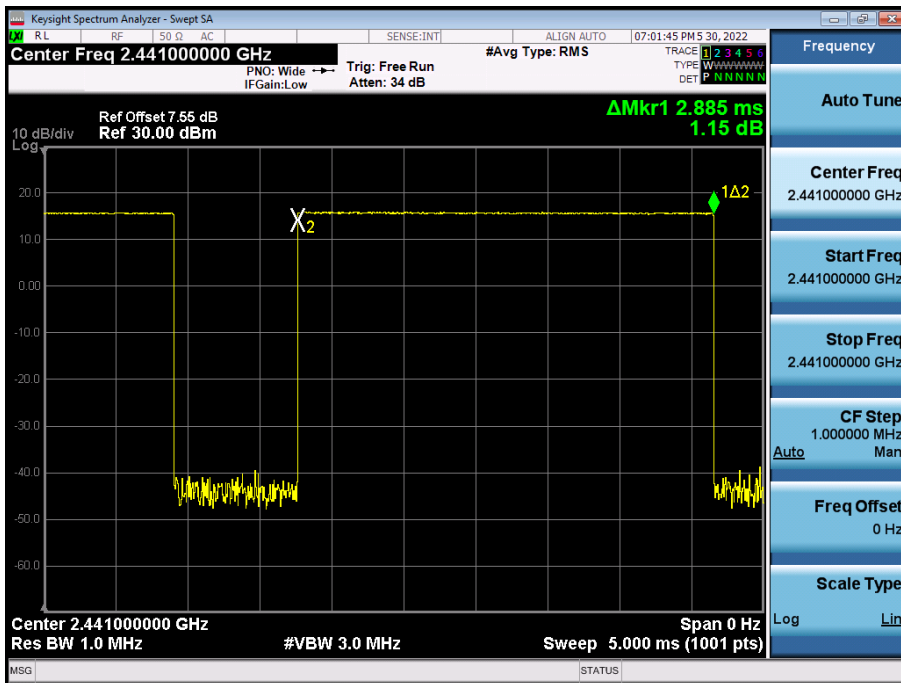
**AFH Mode**

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

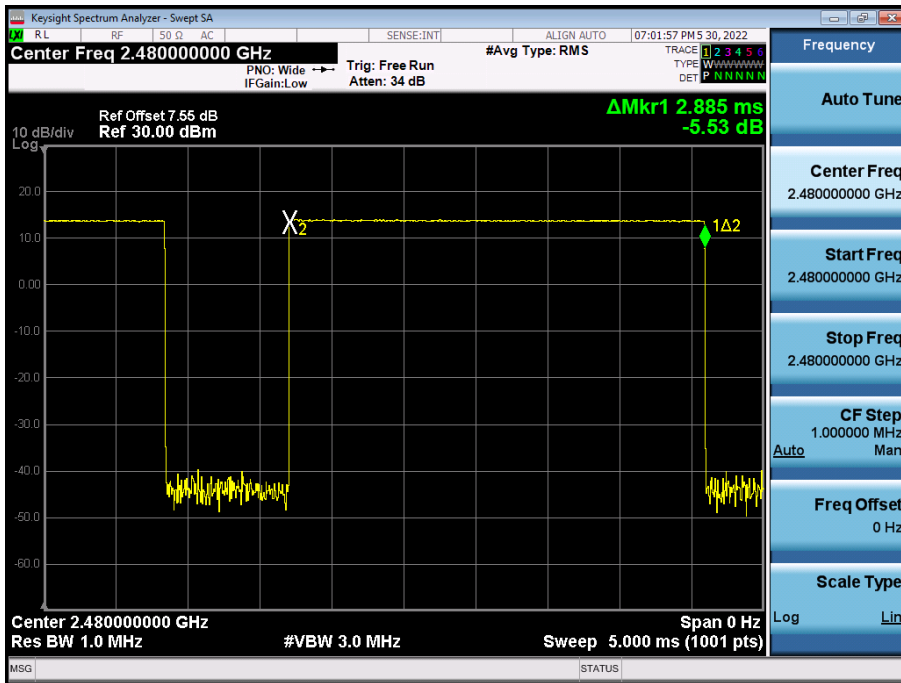
Test Plots (GFSK)  
Dwell Time (CH.0)



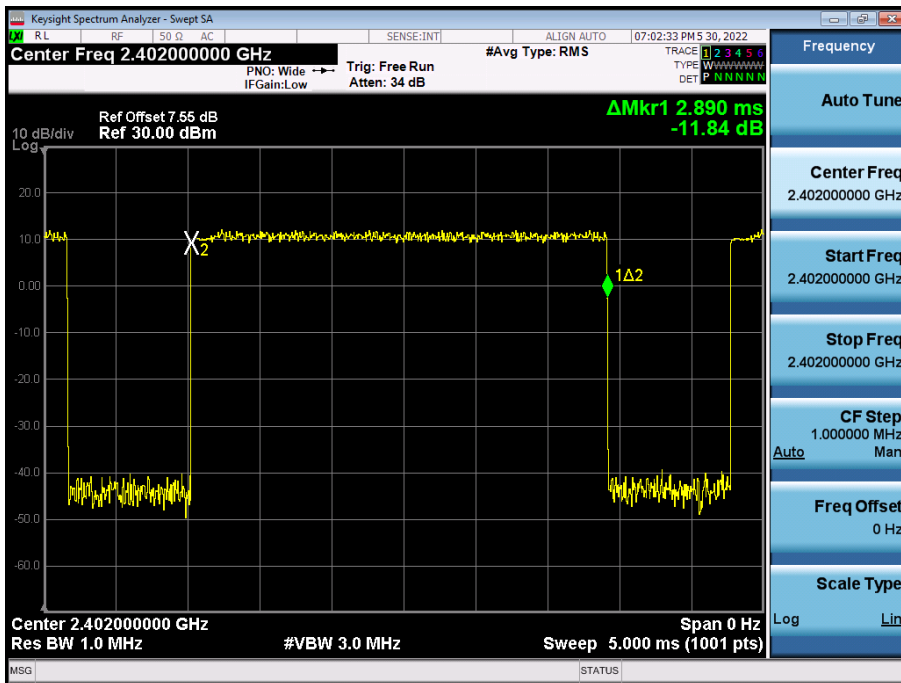
Test Plots (GFSK)  
Dwell Time (CH.39)



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

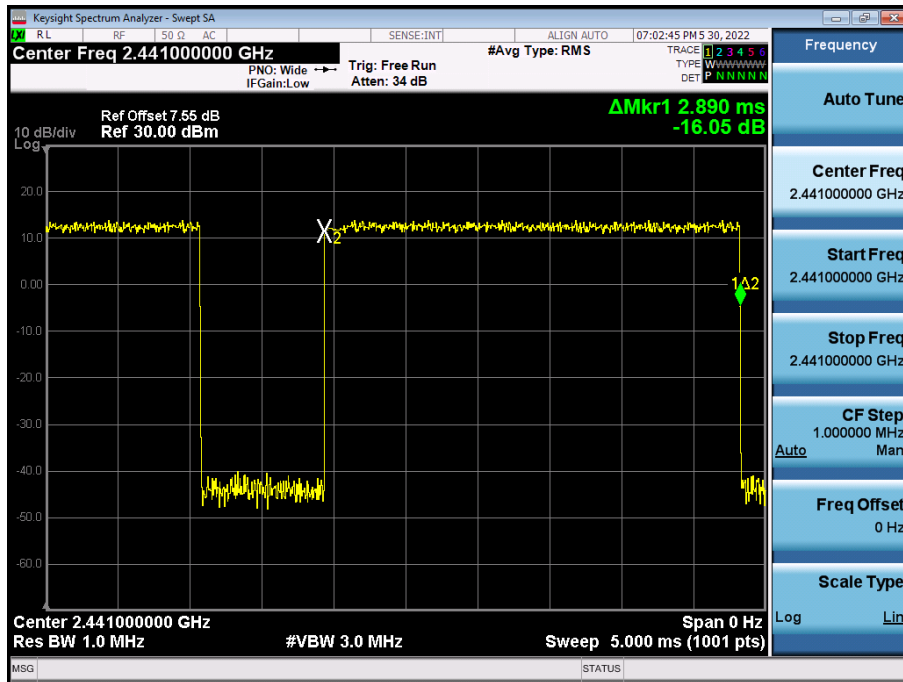


Test Plots (8DPSK)  
Dwell Time (CH.0)



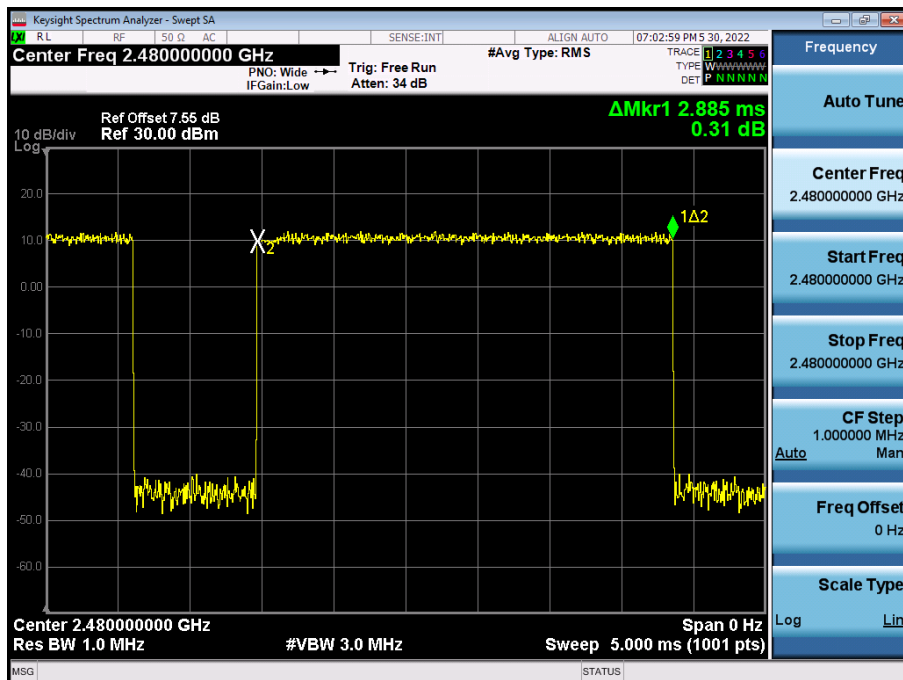
Test Plots (8DPSK)

Dwell Time (CH.39)



Test Plots (8DPSK)

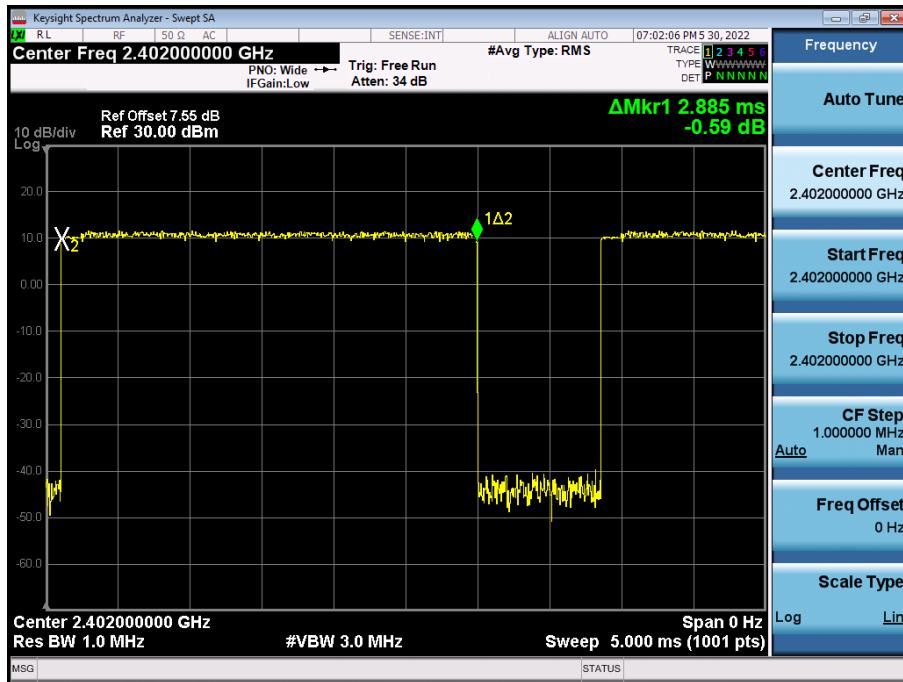
Dwell Time (CH.78)





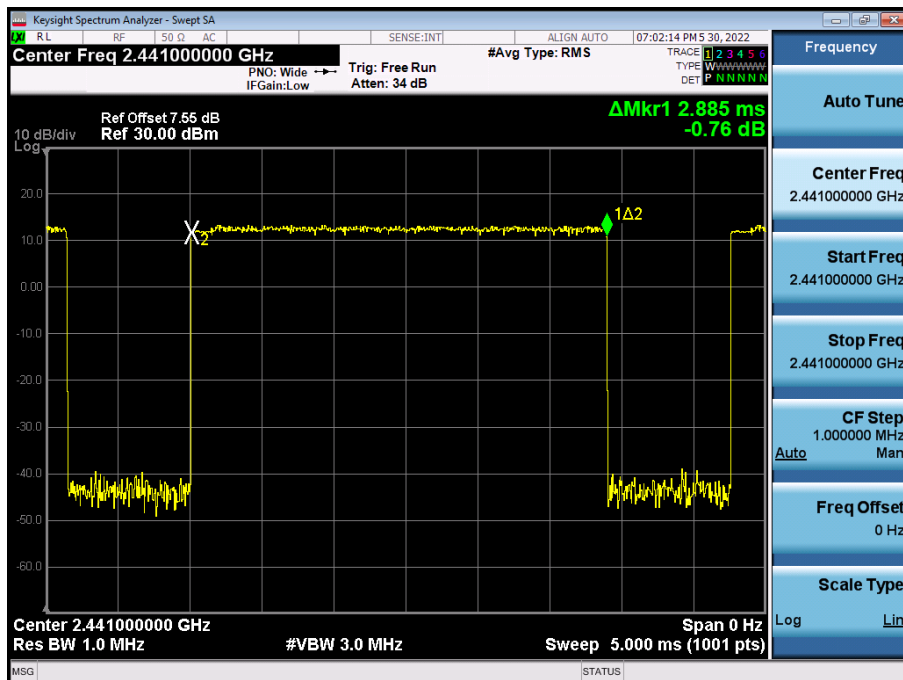
Test Plots ( $\pi/4$ DQPSK)

Dwell Time (CH.0)



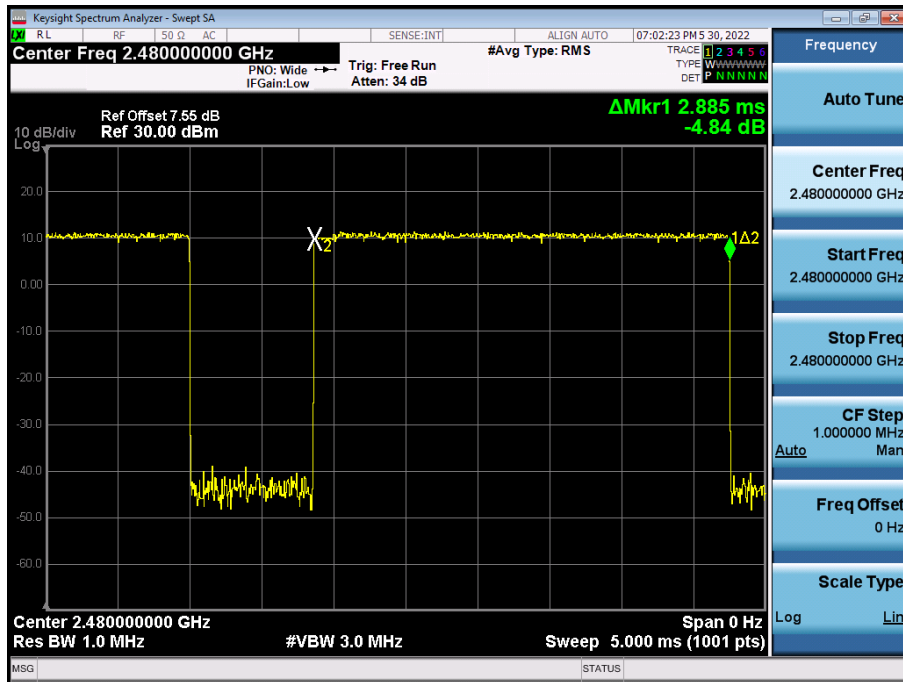
Test Plots ( $\pi/4$ DQPSK)

Dwell Time (CH.39)



Test Plots ( $\pi/4$ DQPSK)

Dwell Time (CH.78)



## **10.6 SPURIOUS EMISSIONS**

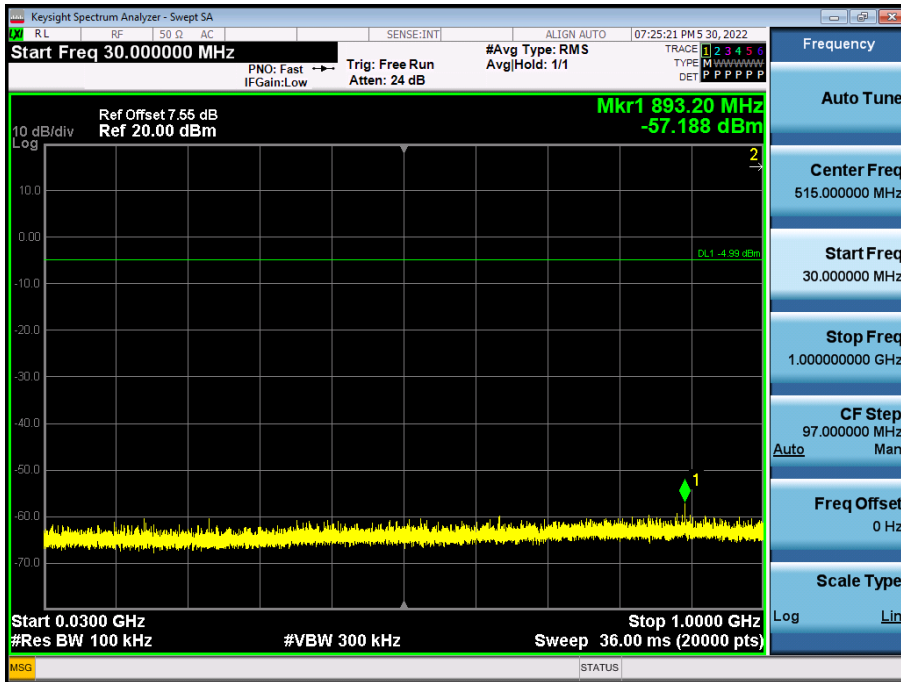
### **10.6.1 CONDUCTED SPURIOUS EMISSIONS**

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.

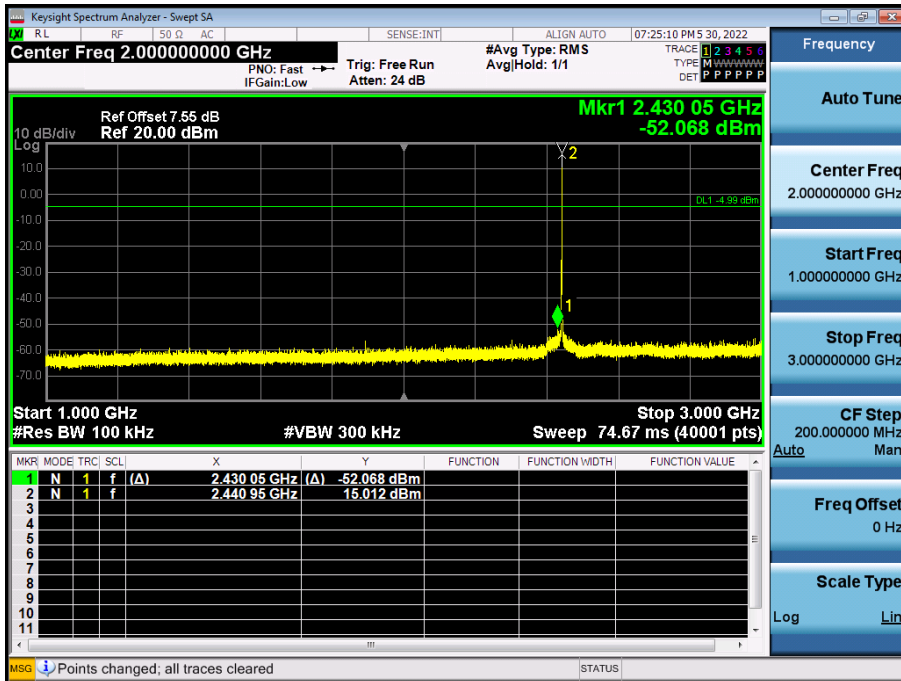
Test Plots (GFSK)- 30 MHz - 1 GHz

Spurious Emission (CH.39)



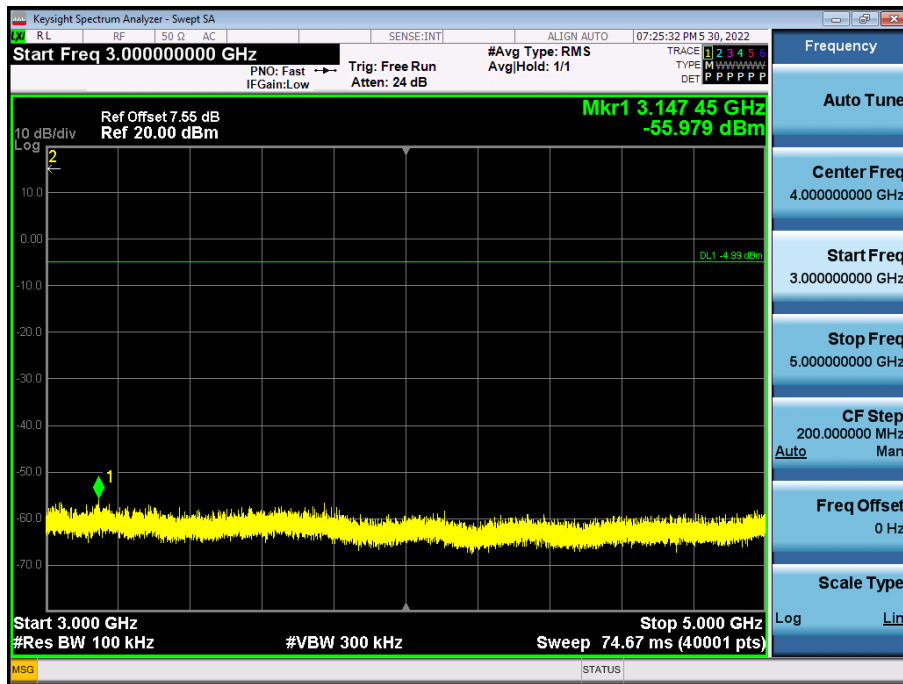
Test Plots (GFSK)- 1 GHz – 3 GHz

Spurious Emission (CH.39)



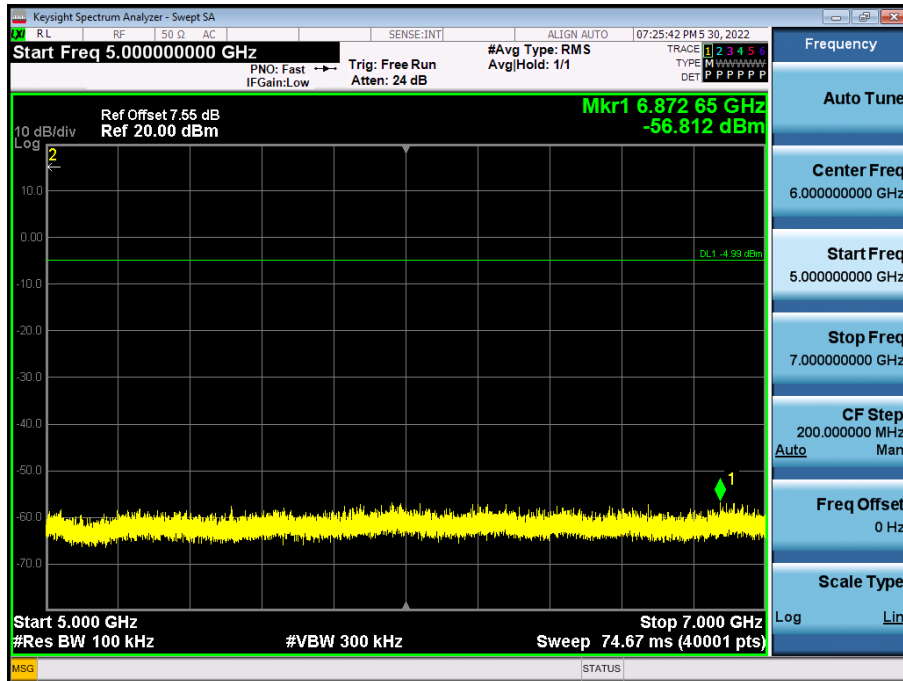
Test Plots(GFSK)- 3 GHz - 5 GHz

Spurious Emission (CH.39)



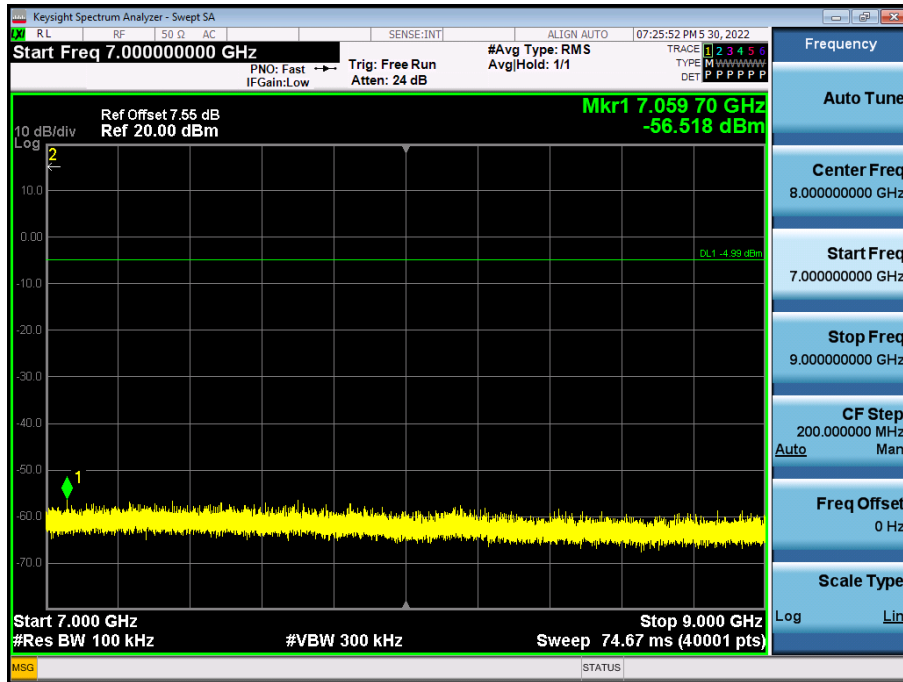
Test Plots (GFSK)- 5 GHz - 7 GHz

Spurious Emission (CH.39)



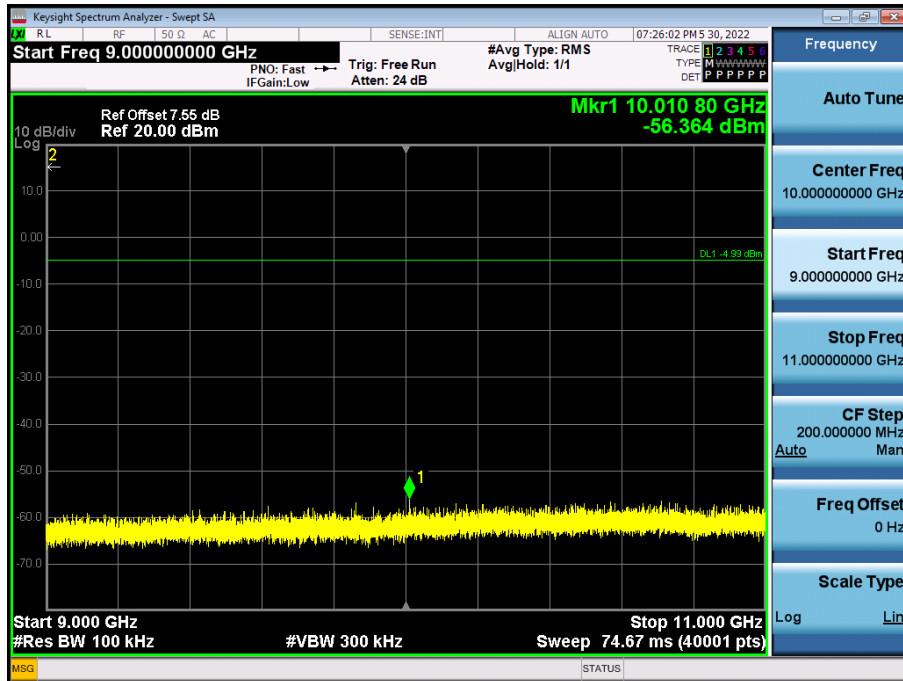
Test Plots(GFSK)- 7 GHz - 9 GHz

Spurious Emission (CH.39)



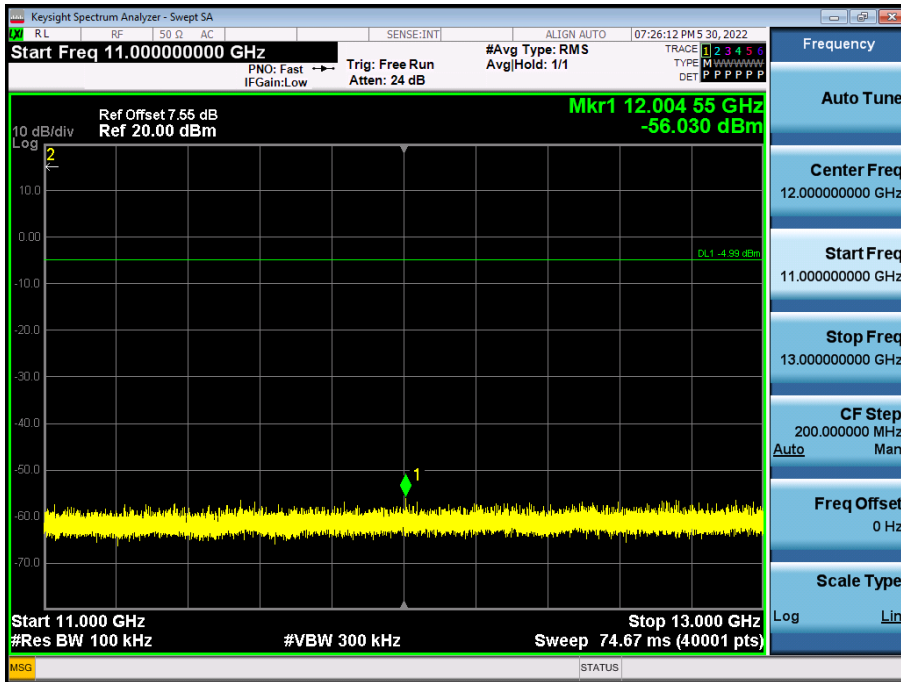
Test Plots(GFSK)- 9 GHz - 11 GHz

Spurious Emission (CH.39)



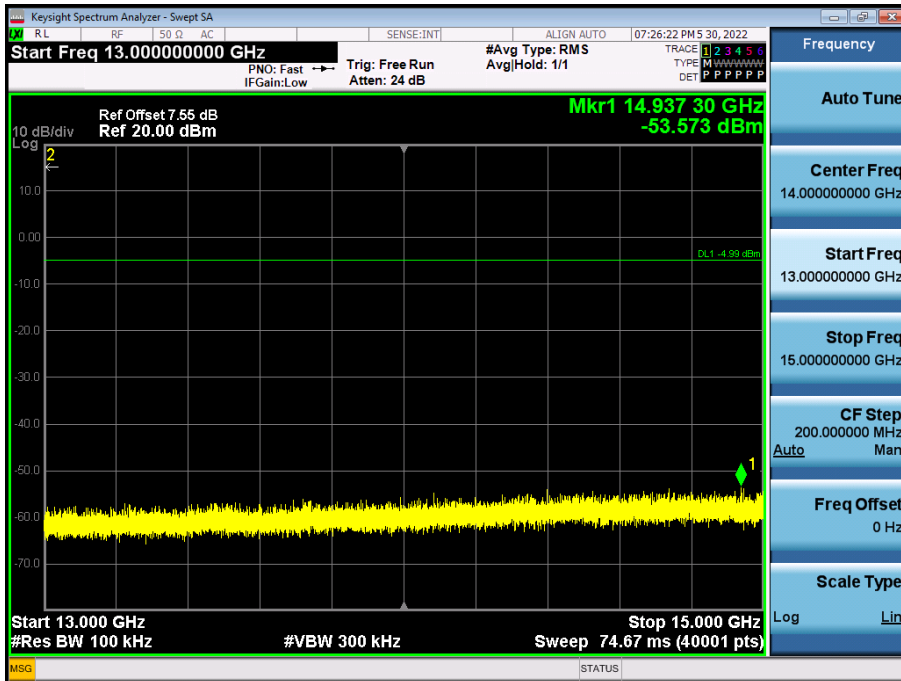
Test Plots(GFSK) 11 GHz - 13 GHz

Spurious Emission (CH.39)



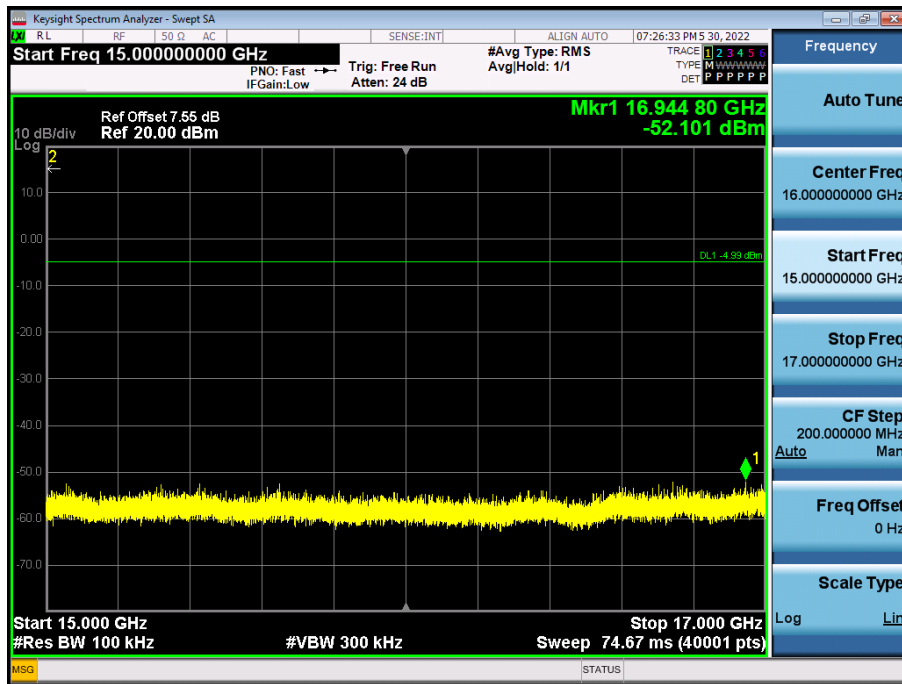
Test Plots (GFSK)- 13 GHz – 15 GHz

Spurious Emission (CH.39)



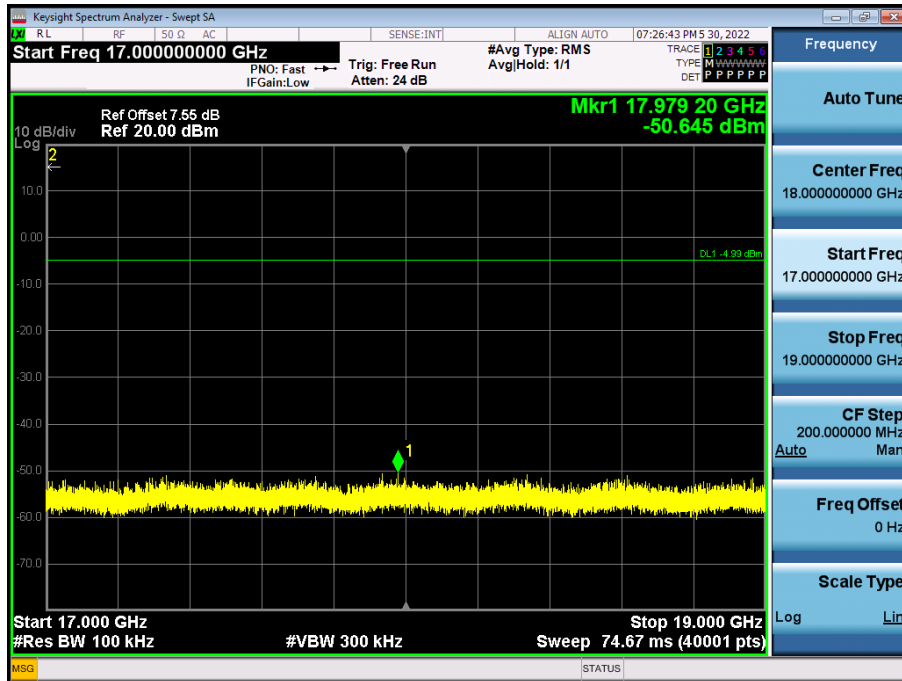
Test Plots(GFSK)- 15 GHz - 17 GHz

Spurious Emission (CH.39)



Test Plots(GFSK)- 17 GHz - 19 GHz

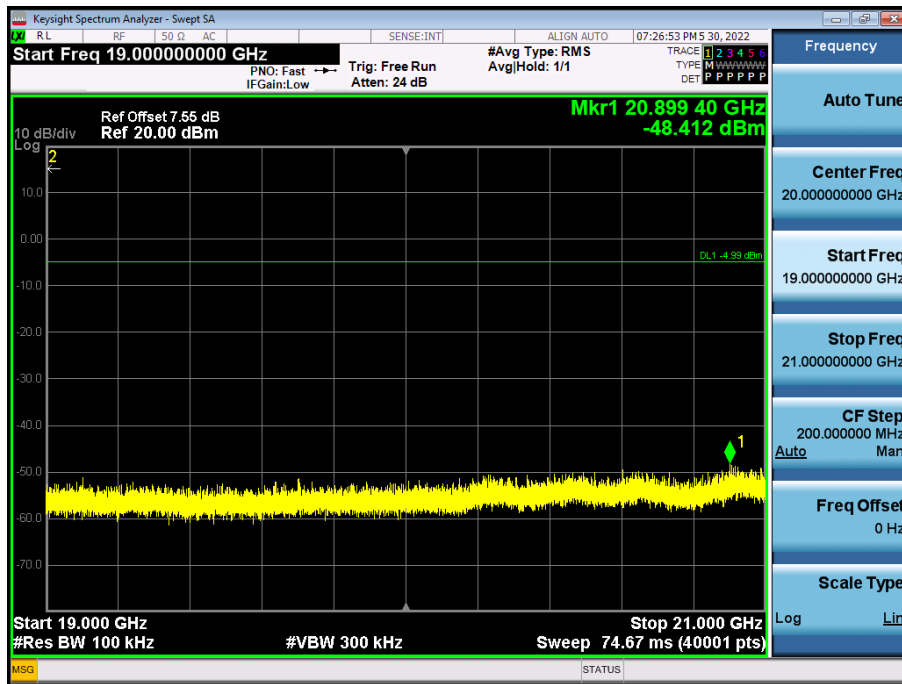
Spurious Emission (CH.39)





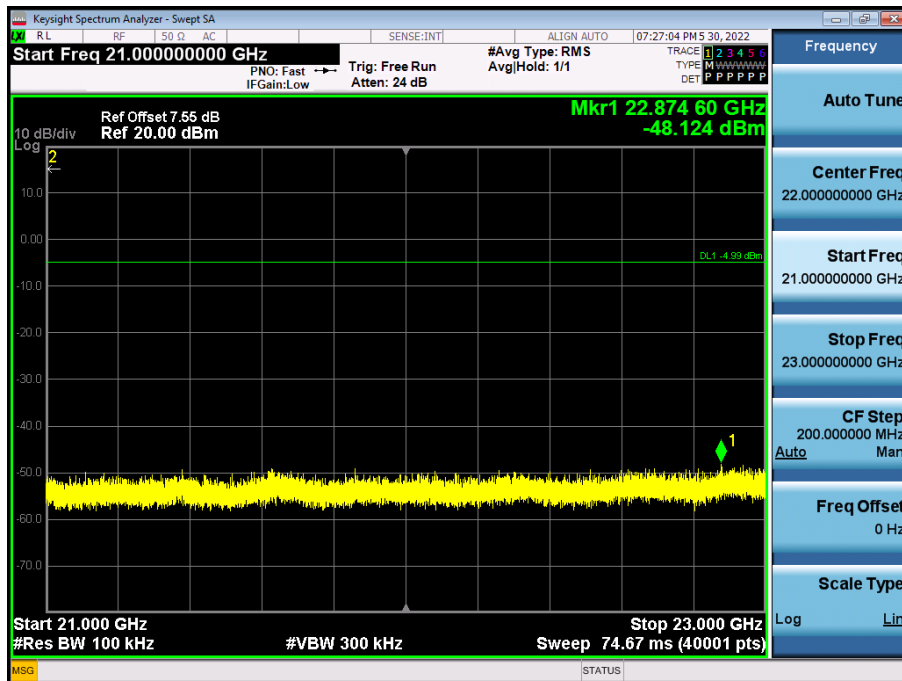
Test Plots (GFSK)- 19 GHz - 21 GHz

Spurious Emission (CH.39)



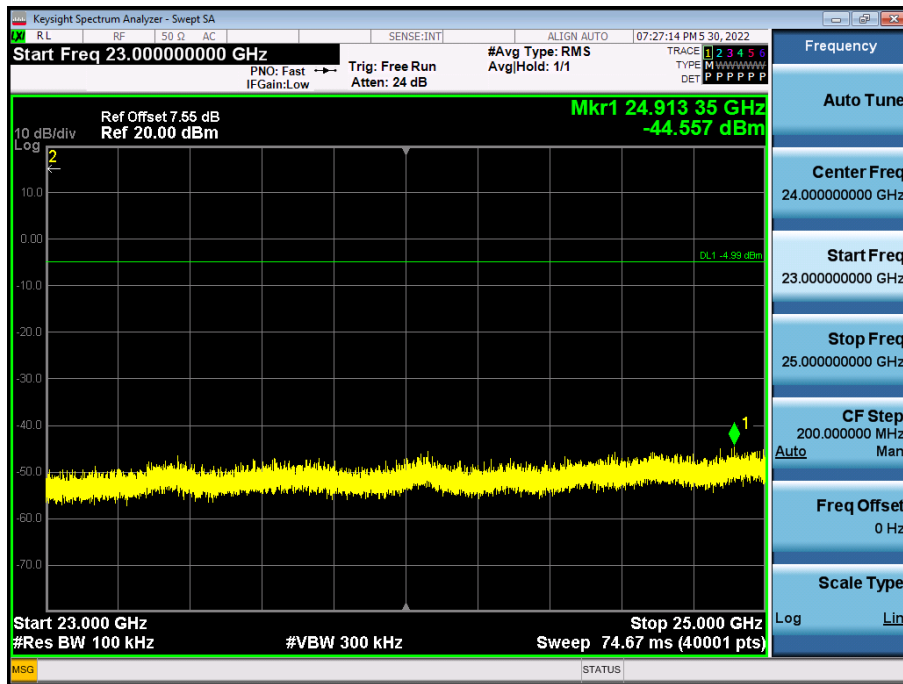
Test Plots (GFSK)- 21 GHz - 23 GHz

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 =  $40 \log(\text{specific distance} / \text{test distance})$  (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 [dB $\mu$ V]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
4804	43.85	2.56	V	46.41	73.98	27.57	PK
4804	29.84	2.56	V	32.40	53.98	21.58	AV
7206	40.79	8.81	V	49.60	73.98	24.38	PK
7206	26.70	8.81	V	35.51	53.98	18.47	AV
4804	44.23	2.56	H	46.79	73.98	27.19	PK
4804	30.16	2.56	H	32.72	53.98	21.26	AV
7206	40.49	8.81	H	49.30	73.98	24.68	PK
7206	27.14	8.81	H	35.95	53.98	18.03	AV

Operation Mode: CH Mid(GFSK)

Frequency [MHz]	Measured Value [dB $\mu$ V]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
4882	40.88	2.72	V	43.60	73.98	30.38	PK
4882	29.85	2.72	V	32.57	53.98	21.41	AV
7323	40.96	9.10	V	50.06	73.98	23.92	PK
7323	29.23	9.10	V	38.33	53.98	15.65	AV
4882	41.76	2.72	H	44.48	73.98	29.50	PK
4882	30.10	2.72	H	32.82	53.98	21.16	AV
7323	41.09	9.10	H	50.19	73.98	23.79	PK
7323	30.01	9.10	H	39.11	53.98	14.87	AV

Operation Mode: CH High(GFSK)

Frequency [MHz]	Measured Value [dB $\mu$ V]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
4960	40.19	2.31	V	42.50	73.98	31.48	PK
4960	29.21	2.31	V	31.52	53.98	22.46	AV
7440	38.96	10.21	V	49.17	73.98	24.81	PK
7440	27.38	10.21	V	37.59	53.98	16.39	AV
4960	41.76	2.31	H	44.07	73.98	29.91	PK
4960	29.71	2.31	H	32.02	53.98	21.96	AV
7440	39.81	10.21	H	50.02	73.98	23.96	PK
7440	27.72	10.21	H	37.93	53.98	16.05	AV

Operation Mode: CH Low( $\pi/4$ DQPSK)

Frequency [MHz]	Measured Value [dB $\mu$ V]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
4804	42.99	2.56	V	45.55	73.98	28.43	PK
4804	30.29	2.56	V	32.85	53.98	21.13	AV
7206	40.25	8.81	V	49.06	73.98	24.92	PK
7206	26.98	8.81	V	35.79	53.98	18.19	AV
4804	43.75	2.56	H	46.31	73.98	27.67	PK
4804	31.46	2.56	H	34.02	53.98	19.96	AV
7206	40.80	8.81	H	49.61	73.98	24.37	PK
7206	27.62	8.81	H	36.43	53.98	17.55	AV

Operation Mode: CH Mid( $\pi/4$ DQPSK)

Frequency [MHz]	Measured Value [dB $\mu$ V]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
4882	41.85	2.72	V	44.57	73.98	29.41	PK
4882	29.67	2.72	V	32.39	53.98	21.59	AV
7323	39.97	9.10	V	49.07	73.98	24.91	PK
7323	27.93	9.10	V	37.03	53.98	16.95	AV
4882	42.16	2.72	H	44.88	73.98	29.10	PK
4882	30.08	2.72	H	32.80	53.98	21.18	AV
7323	40.26	9.10	H	49.36	73.98	24.62	PK
7323	28.19	9.10	H	37.29	53.98	16.69	AV

Operation Mode: CH High( $\pi/4$ DQPSK)

Frequency [MHz]	Measured Value [dB $\mu$ V]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
4960	41.26	2.31	V	43.57	73.98	30.41	PK
4960	29.51	2.31	V	31.82	53.98	22.16	AV
7440	39.33	10.21	V	49.54	73.98	24.44	PK
7440	27.18	10.21	V	37.39	53.98	16.59	AV
4960	41.96	2.31	H	44.27	73.98	29.71	PK
4960	29.75	2.31	H	32.06	53.98	21.92	AV
7440	39.60	10.21	H	49.81	73.98	24.17	PK
7440	27.67	10.21	H	37.88	53.98	16.10	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	42.85	2.56	V	45.41	73.98	28.57	PK
4804	30.85	2.56	V	33.41	53.98	20.57	AV
7206	39.27	8.81	V	48.08	73.98	25.90	PK
7206	27.18	8.81	V	35.99	53.98	17.99	AV
4804	43.28	2.56	H	45.84	73.98	28.14	PK
4804	31.45	2.56	H	34.01	53.98	19.97	AV
7206	39.66	8.81	H	48.47	73.98	25.51	PK
7206	27.61	8.81	H	36.42	53.98	17.56	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	42.70	2.72	V	45.42	73.98	28.56	PK
4882	29.68	2.72	V	32.40	53.98	21.58	AV
7323	39.93	9.10	V	49.03	73.98	24.95	PK
7323	27.81	9.10	V	36.91	53.98	17.07	AV
4882	42.94	2.72	H	45.66	73.98	28.32	PK
4882	30.10	2.72	H	32.82	53.98	21.16	AV
7323	40.28	9.10	H	49.38	73.98	24.60	PK
7323	28.11	9.10	H	37.21	53.98	16.77	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	42.01	2.31	V	44.32	73.98	29.66	PK
4960	29.08	2.31	V	31.39	53.98	22.59	AV
7440	39.80	10.21	V	50.01	73.98	23.97	PK
7440	27.53	10.21	V	37.74	53.98	16.24	AV
4960	42.37	2.31	H	44.68	73.98	29.30	PK
4960	29.73	2.31	H	32.04	53.98	21.94	AV
7440	40.28	10.21	H	50.49	73.98	23.49	PK
7440	27.64	10.21	H	37.85	53.98	16.13	AV

**[DBS Mode]****Mode : Bluetooth (GFSK) CH.39 & 802.11n(HT20) MCS0 ch.52**

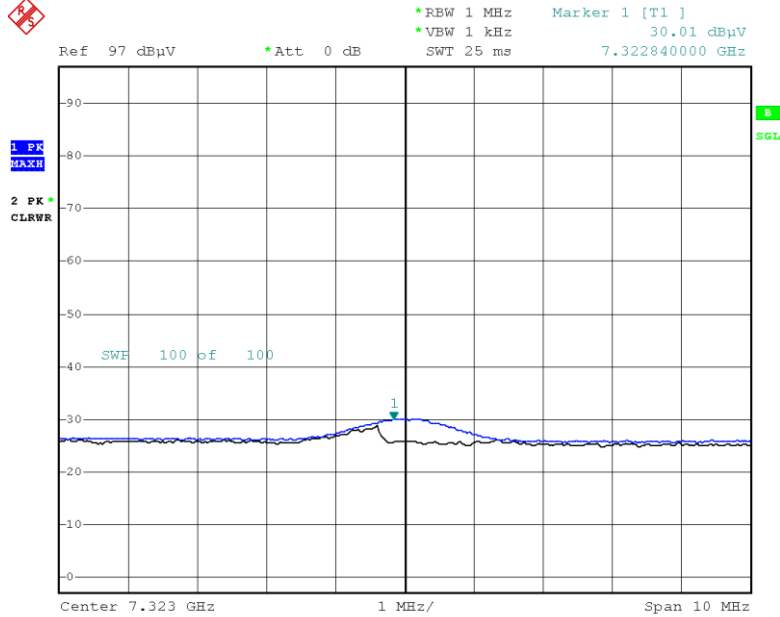
Frequency [MHz]	Measured Value [dB $\mu$ V]	A.F+C.L-A.G+D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
7323	41.98	9.10	V	51.08	73.98	22.90	PK
7323	29.68	9.10	V	38.78	53.98	15.20	AV
7323	42.04	9.10	H	51.14	73.98	22.84	PK
7323	30.07	9.10	H	39.17	53.98	14.81	AV

**Note :**

1. WLAN DBS Data refer to UNII Test Report.

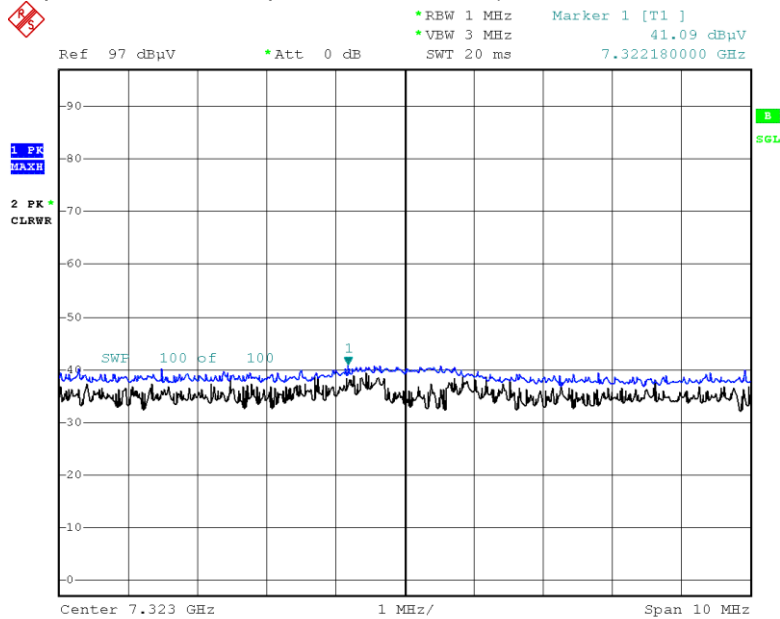
**RESULT PLOTS**

Radiated Spurious Emissions plot – Average Result (GFSK, Ch. 39 3rd Harmonic, H)



Date: 3.JUN.2022 21:20:15

Radiated Spurious Emissions plot – Peak Result (GFSK, Ch. 39 3rd Harmonic, H)



Date: 3.JUN.2022 21:20:27

**Note:**

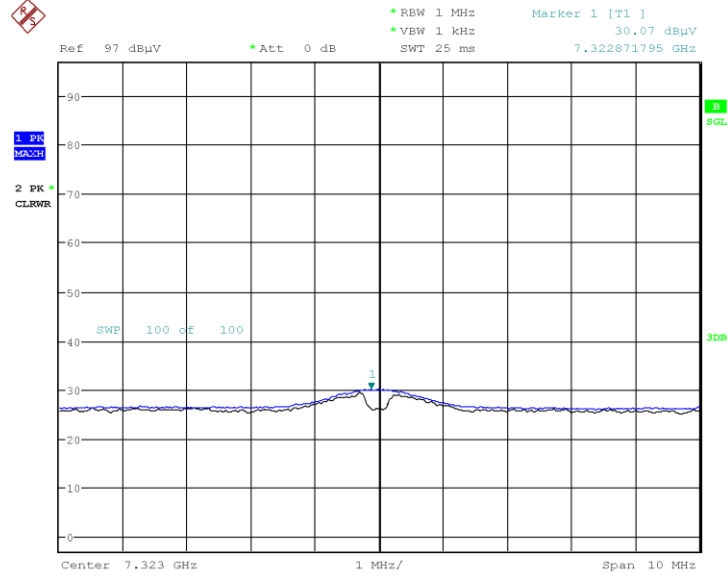
Plot of worst case are only reported.



**RESULT PLOTS(DBS)**

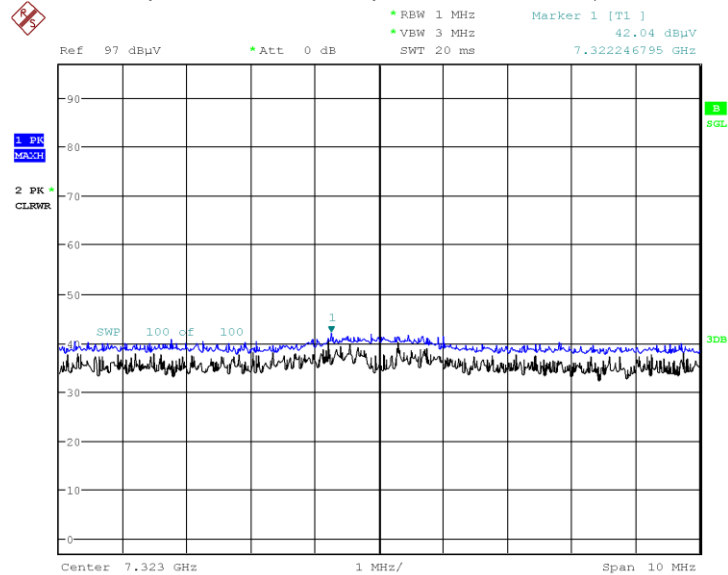
**Mode : Bluetooth (GFSK) CH.39 & 802.11n(HT20) MCS0 ch.52**

**Radiated Spurious Emissions plot – Average Result (3rd Harmonic, X-V)**



Date: 14.JUN.2022 15:54:24

**Radiated Spurious Emissions plot –Peak Result (3rd Harmonic, X-V)**



Date: 14.JUN.2022 15:54:40

**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 +ATT+D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
2390.0	20.19	35.43	H	55.62	73.98	18.36	PK
2390.0	9.62	35.43	H	45.05	53.98	8.93	AV
2390.0	20.30	35.43	V	55.72	73.98	18.26	PK
2390.0	9.71	35.43	V	45.14	53.98	8.84	AV
2483.5	26.04	35.57	H	61.60	73.98	12.38	PK
2483.5	12.52	35.57	H	48.09	53.98	5.89	AV
2483.5	26.05	35.57	V	61.61	73.98	12.37	PK
2483.5	13.37	35.57	V	48.94	53.98	5.04	AV

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

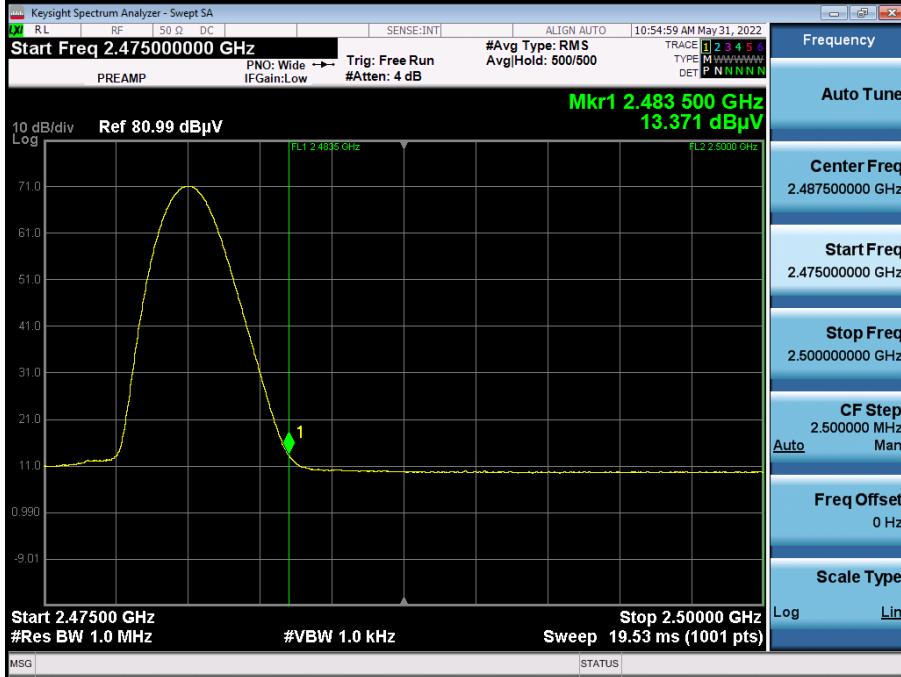
Frequency [MHz]	Measured Level [dBμV]	A.F+C.L +ATT+D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
2390.0	20.38	35.43	H	55.81	73.98	18.17	PK
2390.0	9.56	35.43	H	44.98	53.98	9.00	AV
2390.0	20.91	35.43	V	56.34	73.98	17.64	PK
2390.0	9.80	35.43	V	45.22	53.98	8.76	AV
2483.5	26.22	35.57	H	61.79	73.98	12.19	PK
2483.5	11.44	35.57	H	47.00	53.98	6.98	AV
2483.5	26.34	35.57	V	61.91	73.98	12.07	PK
2483.5	12.34	35.57	V	47.90	53.98	6.08	AV

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

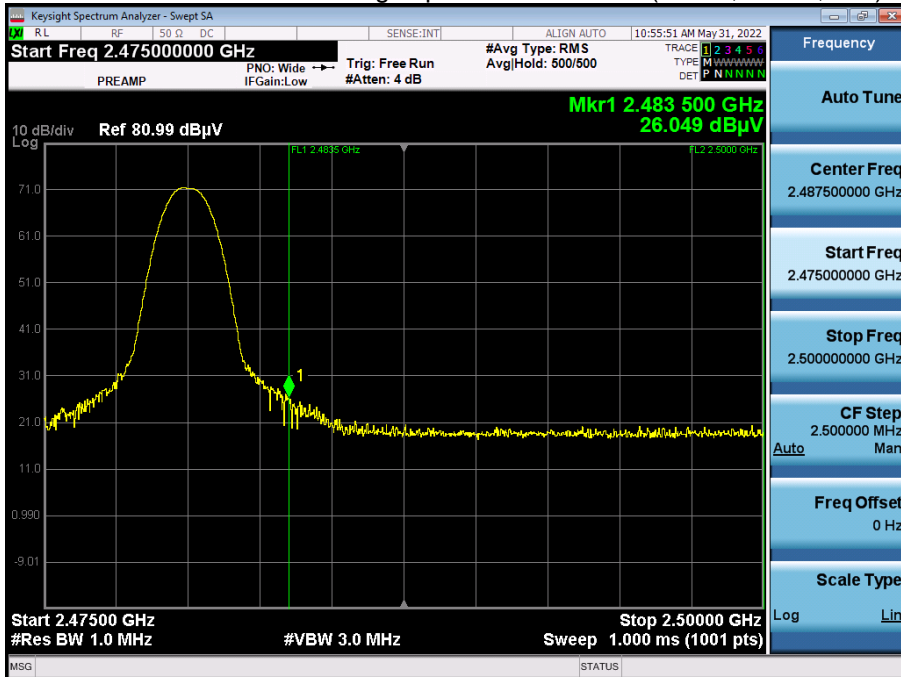
Frequency [MHz]	Measured Level [dBμV]	A.F+C.L +ATT+D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
2390.0	20.11	35.43	H	55.53	73.98	18.45	PK
2390.0	9.50	35.43	H	44.92	53.98	9.06	AV
2390.0	20.11	35.43	V	55.54	73.98	18.44	PK
2390.0	9.85	35.43	V	45.27	53.98	8.71	AV
2483.5	25.80	35.57	H	61.37	73.98	12.61	PK
2483.5	11.62	35.57	H	47.18	53.98	6.80	AV
2483.5	26.38	35.57	V	61.95	73.98	12.03	PK
2483.5	12.25	35.57	V	47.81	53.98	6.17	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

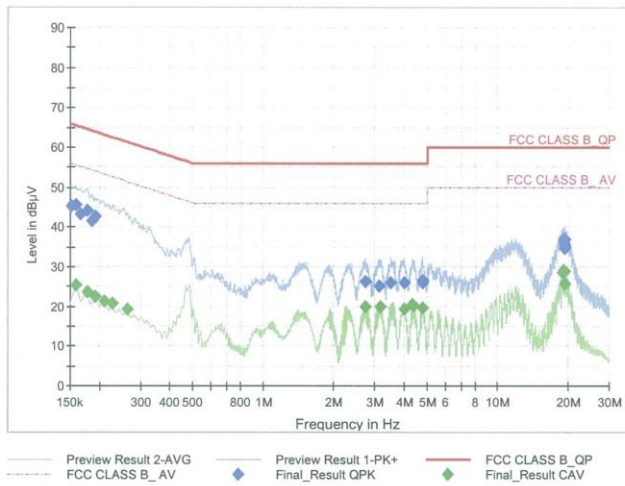
1 / 2

**Test Report**

**Common Information**

EUT : SM-G990B2/DS  
 Manufacturer : SAMSUNG Electronics Co., Ltd.  
 Test Site: SHIELD ROOM  
 Operating Conditions : BT\_L1 mode  
 Operator Name:  
 Comment:

Full Spectrum



**Final Result QPK**

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1523	45.30	65.88	20.57	9.000	L1	OFF	9.6
0.1590	45.54	65.52	19.97	9.000	L1	OFF	9.6
0.1658	43.35	65.17	21.82	9.000	L1	OFF	9.6
0.1770	44.11	64.63	20.52	9.000	L1	OFF	9.6
0.1860	41.67	64.21	22.54	9.000	L1	OFF	9.6
0.1928	42.72	63.92	21.19	9.000	L1	OFF	9.6
2.7365	26.29	56.00	29.71	9.000	L1	OFF	9.8
3.1325	25.02	56.00	30.98	9.000	L1	OFF	9.8
3.5105	26.00	56.00	30.00	9.000	L1	OFF	9.8
3.9988	26.05	56.00	29.95	9.000	L1	OFF	9.8
4.7683	25.96	56.00	30.04	9.000	L1	OFF	9.8
4.7728	26.61	56.00	29.39	9.000	L1	OFF	9.8
19.2178	36.02	60.00	23.99	9.000	L1	OFF	10.4
19.2223	36.80	60.00	23.20	9.000	L1	OFF	10.4
19.2403	36.84	60.00	23.16	9.000	L1	OFF	10.4
19.2605	35.46	60.00	24.54	9.000	L1	OFF	10.4
19.2830	34.97	60.00	25.03	9.000	L1	OFF	10.4
19.3348	34.80	60.00	25.40	9.000	L1	OFF	10.4

2022-06-16

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Test

2 / 2

**Final Result CAV**

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1590	25.38	55.52	30.14	9.000	L1	OFF	9.6
0.1770	23.61	54.63	31.02	9.000	L1	OFF	9.6
0.1928	22.50	53.92	31.42	9.000	L1	OFF	9.6
0.2108	21.23	53.18	31.95	9.000	L1	OFF	9.6
0.2265	20.70	52.58	31.88	9.000	L1	OFF	9.6
0.2625	19.38	51.35	31.97	9.000	L1	OFF	9.6
2.7343	19.83	46.00	26.17	9.000	L1	OFF	9.8
3.1595	19.86	46.00	26.14	9.000	L1	OFF	9.8
3.9965	19.46	46.00	26.54	9.000	L1	OFF	9.8
4.3498	20.34	46.00	25.66	9.000	L1	OFF	9.8
4.3678	20.10	46.00	25.90	9.000	L1	OFF	9.8
4.7683	19.73	46.00	26.27	9.000	L1	OFF	9.8
18.8218	28.48	50.00	21.52	9.000	L1	OFF	10.3
19.1840	28.49	50.00	21.51	9.000	L1	OFF	10.4
19.2020	28.87	50.00	21.13	9.000	L1	OFF	10.4
19.2200	29.19	50.00	20.81	9.000	L1	OFF	10.4
19.2380	28.84	50.00	21.16	9.000	L1	OFF	10.4
19.2740	25.81	50.00	24.19	9.000	L1	OFF	10.4

2022-06-16

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**Conducted Emissions (Line 2)**

Test

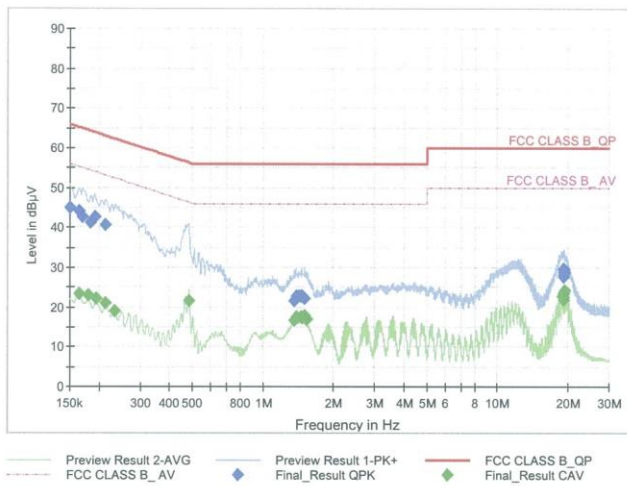
1 / 2

**Test Report**

**Common Information**

EUT : SM-G990B2/DS  
 Manufacturer : SAMSUNG Electronics Co., Ltd.  
 Test Site: SHIELD ROOM  
 Operating Conditions : BT\_N mode  
 Operator Name:  
 Comment:

Full Spectrum



**Final Result QPK**

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1500	45.00	66.00	21.00	9.000	N	OFF	9.6
0.1635	44.27	65.28	21.02	9.000	N	OFF	9.6
0.1703	42.82	64.95	22.13	9.000	N	OFF	9.6
0.1838	41.14	64.31	23.18	9.000	N	OFF	9.6
0.1928	42.56	63.92	21.35	9.000	N	OFF	9.6
0.2130	40.69	63.09	22.40	9.000	N	OFF	9.6
1.3618	21.77	56.00	34.23	9.000	N	OFF	9.7
1.3843	22.82	56.00	33.18	9.000	N	OFF	9.7
1.4225	22.76	56.00	33.24	9.000	N	OFF	9.7
1.4585	22.90	56.00	33.10	9.000	N	OFF	9.7
1.4720	22.64	56.00	33.36	9.000	N	OFF	9.7
1.5058	22.09	56.00	33.91	9.000	N	OFF	9.7
19.1390	28.15	60.00	31.85	9.000	N	OFF	10.4
19.1503	29.53	60.00	30.47	9.000	N	OFF	10.4
19.1683	29.72	60.00	30.28	9.000	N	OFF	10.4
19.1728	27.59	60.00	32.41	9.000	N	OFF	10.4
19.2155	28.89	60.00	31.11	9.000	N	OFF	10.4
19.3415	28.76	60.00	31.24	9.000	N	OFF	10.4

2022-06-16

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Test

2 / 2

**Final Result CAV**

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1635	23.29	55.28	31.99	9.000	N	OFF	9.6
0.1793	23.00	54.52	31.52	9.000	N	OFF	9.6
0.1950	22.12	53.82	31.71	9.000	N	OFF	9.6
0.2130	20.96	53.09	32.13	9.000	N	OFF	9.6
0.2333	19.10	52.33	33.23	9.000	N	OFF	9.6
0.4830	21.64	46.29	24.65	9.000	N	OFF	9.7
1.3640	16.80	46.00	29.20	9.000	N	OFF	9.7
1.3843	17.71	46.00	28.29	9.000	N	OFF	9.7
1.4585	17.55	46.00	28.45	9.000	N	OFF	9.7
1.4698	17.28	46.00	28.72	9.000	N	OFF	9.7
1.5080	17.77	46.00	28.23	9.000	N	OFF	9.7
1.5440	16.91	46.00	29.09	9.000	N	OFF	9.7
18.8218	22.89	50.00	27.11	9.000	N	OFF	10.4
19.1615	22.49	50.00	27.51	9.000	N	OFF	10.4
19.1975	21.83	50.00	28.17	9.000	N	OFF	10.4
19.2155	23.38	50.00	26.62	9.000	N	OFF	10.4
19.2358	23.73	50.00	26.27	9.000	N	OFF	10.4
19.3415	24.26	50.00	25.74	9.000	N	OFF	10.4

2022-06-16

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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
EMI Test Receiver	ESR	Rohde & Schwarz	101910	06/07/2023	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	06/13/2023	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/13/2023	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-2206-FC007-P