

# FCC BT REPORT Certification

Applicant Name: SAMSUNG Electronics Co., Ltd.

#### Address:

129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea Date of Issue: June 15, 2021

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

# FCC ID:

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

# APPLICANT: SAMSUNG Electronics Co., Ltd.

Model:	SM-G990U
Additional Model:	SM-G990U1/DS, SM-G990U1
EUT Type:	Mobile Phone
Max. RF Output Power:	14.726 dBm (29.69 mW)
Frequency Range:	2 402 MHz – 2 480 MHz (Bluetooth)
Modulation type	GFSK(Normal), $\pi$ /4DQPSK and 8DPSK(EDR)
FCC Classification:	FCC Part 15 Spread Spectrum Transmitter
FCC Rule Part(s):	Part 15 subpart C 15.247

A3LSMG990U

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.



FCC ID: A3LSMG990U

**REVIEWED BY** 

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

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

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

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

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# **Version**

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



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### **1. EUT DESCRIPTION**

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



#### ANTENNA CONFIGURATIONS for Bluetooth

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

Configurations	SI	Dual BT	
Configurations	Ant1(core-0)	Ant2(Core-1)	Ant1 & Ant2
Bluetooth	0	Х	Х

Note:

- 1. O = Support, X = Not Support
- 2. SISO = Single Input Single Output
- 3. Dual BT = Single Output 1& 2
- 2. This device supports simultaneous transmission operation, which allows for two channels to operate independent of one another in the 2.4 GHz and 5 GHz bands simultaneously on each antenna.

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

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

# 2. Requirements for Bluetooth transmitter(15.247)

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

- 1) This system is hopping pseudo-randomly.
- 2) Each frequency is used equally on the average by each transmitter.
- 3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
- 4) The receiver shifts frequencies in synchronization with the transmitted signals.

• 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.

• 15.247(h): The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.



#### **3. TEST METHODOLOGY**

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

#### **EUT CONFIGURATION**

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

#### EUT EXERCISE

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

#### **GENERAL TEST PROCEDURES**

#### Conducted Emissions

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

#### **Radiated Emissions**

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.6.5 of ANSI C63.10. (Version: 2013). To record the final measurements, the analyzer detector function was set to CISPR quasi-peak mode and the bandwidth of the spectrum analyzer was set to 120 kHz for frequencies below 1 GHz or 1 MHz for frequencies above 1 GHz. For average measurements above 1 GHz, the analyzer was set to peak detector with a reduced VBW setting(RBW = 1 MHz, VBW = 1/T Hz, where T = Pulse width).

#### **DESCRIPTION OF TEST MODES**

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



#### 4. INSTRUMENT CALIBRATION

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

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

#### 5. FACILITIES AND ACCREDITATIONS

#### FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil,

Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.

The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

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

#### EQUIPMENT

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

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

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

#### 6. ANTENNA REQUIREMENTS

#### According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- (1) The antennas of this E.U.T are permanently attached.
- (2) The E.U.T Complies with the requirement of §15.203

# 7. MEASUREMENT UNCERTAINTY

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

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

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

Parameter	Expanded Uncertainty (dB)		
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82		
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40		
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80		
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70		
Radiated Disturbance (18 GHz ~ 40 GHz)	5.05		



#### 8. DESCRIPTION OF TESTS

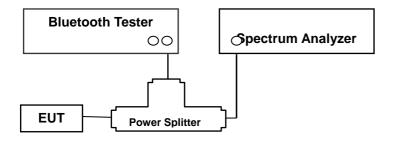
#### 8.1. Conducted Maximum Peak Output Power

#### <u>Limit</u>

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 nonoverlapping 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  $\geq$  RBW
- 4) Sweep = Auto
- 5) Detector = Peak
- 6) Trace = Max hold

#### **Sample Calculation**

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

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

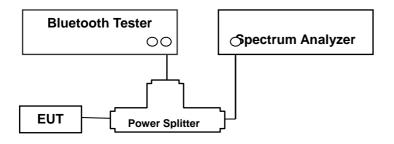


#### 8.2. Conducted Band Edge(Out of Band Emissions)

#### <u>Limit</u>

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
- 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

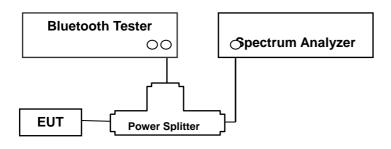


#### 8.3. Frequency Separation & 20 dB Bandwidth

#### <u>Limit</u>

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  $\geq$  3 x RBW
- 4) Sweep: Auto
- 5) Detector: Peak
- 6) Trace: Max hold
- 7) All the trace to stabilize.

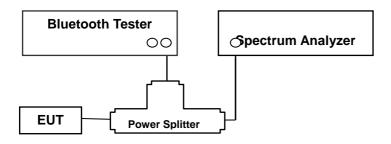


#### 8.4. Number of Hopping Frequencies

#### <u>Limit</u>

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.

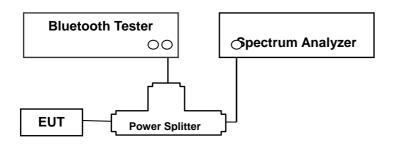


#### 8.5. Time of Occupancy

#### <u>Limit</u>

According to \$15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

#### Test Configuration



#### Test Procedure

This test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.4 in ANSI 63.10-2013 & Procedure 10(b)(6)(iv) in KDB 558074 v05r02)

- 1) Span: Zero span, centered on a hopping channel
- 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)

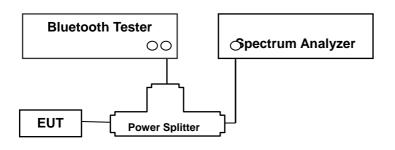


#### 8.6. Conducted Spurious Emissions

#### <u>Limit</u>

Conducted > 20 dBc

#### Test Configuration



#### Test Procedure

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer.

The Spectrum Analyzer is set to (7.8.8 in ANSI 63.10-2013 & Procedure 8.5 and 8.6 in KDB 558074 v05r02)

- 1) Span: 30 MHz to 10 times the operating frequency in GHz.
- 2) RBW: 100 kHz
- 3) VBW: 300 kHz
- 4) Sweep: Coupled
- 5) Detector: Peak

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

This test is performed with hopping off.



#### Factors for frequency

Freq(MHz)	Factor(dB)		
30	26.14		
100	26.26		
200	26.38		
300	26.50		
400	26.57		
500	26.63		
600	26.68		
700	26.73		
800	26.77		
900	26.83		
1000	26.89		
2000	27.24		
2400	27.37		
2480	27.38		
2500	27.38		
3000	27.51		
4000	27.80		
5000	28.08		
5150	28.16		
5850	28.40		
6000	28.46		
7000	28.55		
8000	28.62		
9000	28.69		
10000	28.76		
11000	28.80		
12000	28.88		
13000	28.96		
14000	28.94		
15000	28.96		
16000	29.01		
17000	29.05		
18000	29.11		
19000	29.14		
20000	29.20		
21000	29.41		
22000	29.38		
23000	29.58		
24000	29.41		
25000	29.44		
26000	29.64		

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

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



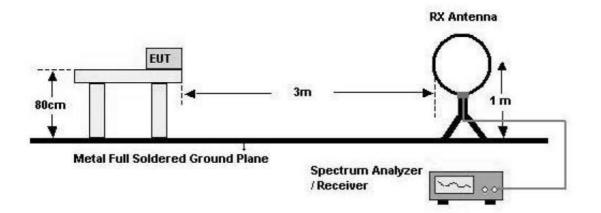
### 8.7. Radiated Test

# <u>Limit</u>

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

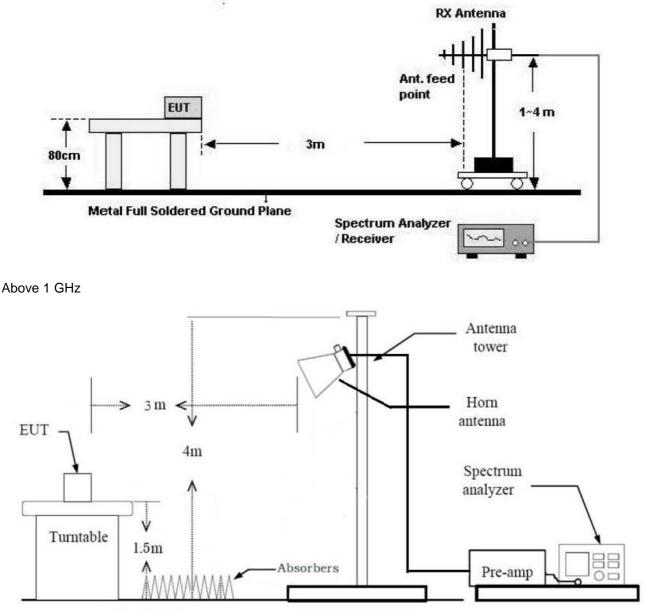
#### **Test Configuration**

Below 30 MHz





#### 30 MHz - 1 GHz



#### Test Procedure of Radiated spurious emissions(Below 30 MHz)

- 1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
- 2. The loop antenna was placed at a location 3m from the EUT
- 3. The EUT is placed on a turntable, which is 0.8m above ground plane.
- 4. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
- 5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 6. Distance Correction Factor(0.009 MHz 0.490 MHz) = 40log(3 m/300 m) = 80 dB Measurement Distance : 3 m
- Distance Correction Factor(0.490 MHz 30 MHz) = 40log(3 m/30 m) = 40 dB Measurement Distance : 3 m
- 8. Spectrum Setting



- Frequency Range = 9 kHz ~ 30 MHz
- Detector = Peak
- Trace = Maxhold
- RBW = 9 kHz
- VBW ≥ 3 x RBW
- 9. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

#### KDB 414788 OFS and Chamber Correlation Justification

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

case test result.

#### Test Procedure of Radiated spurious emissions(Below 1GHz)

- 1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
- 2. The EUT is placed on a turntable, which is 0.8m above ground plane.
- 3. The Hybrid antenna was placed at a location 3m from the EUT, which is varied from 1m to 4m to find out the highest emissions.
- 4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
- 5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 6. Spectrum Setting
  - (1) Measurement Type(Peak):
    - Measured Frequency Range : 30 MHz 1 GHz
    - Detector = Peak
    - Trace = Maxhold
    - RBW = 100 kHz
    - VBW ≥ 3 x RBW
  - (2) Measurement Type(Quasi-peak):
    - Measured Frequency Range : 30 MHz 1 GHz
    - Detector = Quasi-Peak
    - RBW = 120 kHz
    - % In general, (1) is used mainly
- 7. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)
- 8. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.



#### Test Procedure of Radiated spurious emissions (Above 1 GHz)

- 1. Radiated test is performed with hopping off.
- 2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
- 3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
- 4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 5. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- 6. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 7. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 8. The unit was tested with its standard battery.
- 9. Spectrum Setting
  - (1) Measurement Type(Peak):
    - Measured Frequency Range : 1 GHz 25 GHz
    - Detector = Peak
    - Trace = Maxhold
    - RBW = 1 MHz
    - VBW  $\ge$  3 x RBW
  - (2) Measurement Type(Average):
    - Average value of pulsed emissions
    - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in Number.14 (On Page. 24)
    - Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB
- 10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
- 11. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
- 12. Total

(1)Measurement(Peak)

Reading Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F) (2)Measurement(Avg)

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



13. Duty Cycle Correction Factor (79 channel hopping)

- a. Time to cycle through all channels=  $\Delta$  t=  $\tau$  [ms] x 79 channels = 229.100 ms, where  $\tau$  = pulse width
- b. 100 ms/  $\Delta t$  [ms] = H  $\rightarrow$  Round up to next highest integer, H ' =1
- c. Worst Case Dwell Time = T [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=  $\Delta$  t=  $\tau$  [ms] x 20 channels = 58.00 ms, where  $\tau$  = pulse width
  - b. 100 ms/  $\Delta t$  [ms] = H  $\rightarrow$  Round up to next highest integer, H ' = 2
  - c. Worst Case Dwell Time = T [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  $\ge$  3 x RBW
  - (2) Measurement Type(Average):
    - Average value of pulsed emissions
    - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in Number.14 (On Page. 24)
    - Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB
- 9. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
- 10. Total

[1]Normal (Peak)

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

[2]Normal (Avg)

- = Reading Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F) + D.C.C.F
- 11. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.



#### 8.8. AC Power line Conducted Emissions

#### <u>Limit</u>

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 Pango (MHz)	Limits (dBµV)		
Frequency Range (MHz)	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 30 MHz.
  - For unterminated the Antenna, the AC line conducted tests are performed with the antenna connected
  - For terminated the Antenna, the AC line conducted tests are performed with a dummy load connected to the EUT antenna output terminal.

#### **Sample Calculation**

Quasi-peak(Final Result) = Reading Value + Correction Factor



#### 8.9. Worst case configuration and mode

#### Radiated test

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

3. All data rate of operation were investigated and the test results are worst case in highest datarate of each mode.

- GFSK : DH5
- $\pi/4DQPSK$  : 2-DH5
- 8DPSK : 3-DH5
- 4. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.Position : Horizontal, Vertical, Parallel to the ground plane
- 5. SM-G990U, SM-G990U1/DS, SM-G990U1 were tested and the worst case results are reported.

(Worst case : SM-G990U)

- 6. We were performed the RSE test in condition of co-location. There has no significant emission raised.
  - WWAN+WLAN 5GHz+BT

#### Radiated test(DBS)

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

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

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



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

(Worst case: The lowest margin condition the channels and modes were selected for test.)

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

#### (Test case 1,2 Result : Please refer to the SM-G990U [DTS], [UNII] Test Report.)

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

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

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

#### AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.

- Mode : Stand alone + External accessories(Earphone, etc)+Travel Adapter

Stand alone + Travel Adapter

- Worstcase : Stand alone + Travel Adapter
- 2. SM-G990U, SM-G990U1/DS, SM-G990U1 were tested and the worst case results are reported. (Worst case : SM-G990U)

#### Conducted test

- 1. The EUT was configured with data rate of highest power.
  - GFSK : DH5
  - $\pi/4DQPSK$  : 2-DH5
  - 8DPSK : 3-DH5
- 2. AFH & Non-AFH were tested and the worst case results are reported.
  - (Worst case : Non-AFH)
- 3. SM-G990U, SM-G990U1/DS, SM-G990U1 were tested and the worst case results are reported.

(Worst case : SM-G990U)



# 9. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§15.247(a)(1)	N/A		PASS
Occupied Bandwidth	N/A	N/A		N/A
Conducted Maximum Peak Output Power	§15.247(b)(1)	< 0.125 W		PASS
Carrier Frequency Separation	§15.247(a)(1)	> 25 kHz or >2/3 of the 20dB BW	-	PASS
Number of Hopping Frequencies	§15.247(a)(1)(iii)	≥ 15	Conducted	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	Dadistral	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.7	- Radiated	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)	(1100)
Low	2402	12.927	19.62	
Mid	2441	13.419	21.97	125
High	2480	14.483	28.07	

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

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

#### Note:

1. Spectrum reading values are not plot data.

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

2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.

Actual value of loss for the splitter and cable combination is 27.37 dB at 2400 MHz and is 27.38 dB at 2500 MHz.

So, 27.38 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.



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

enter Fr	RF 50Ω AC eq 2.402000000 G	Hz PNO: Fast ↔ FGain:Low	SENSE: INT Trig: Free Run Atten: 8 dB	ALIGNAUTO #Avg Type: RMS Avg Hold: 1/1	02:18:22 PM May 25, 2021 TRACE 1 2 3 4 5 6 TYPE M WWW DET P P P P P P	Frequency
0 dB/div	Ref Offset 27.38 dB Ref 25.00 dBm			Mkr1	2.402 103 GHz 12.927 dBm	Auto Tur
15.0			<b>↓</b> 1			Center Fre 2.402000000 GH
5.00						<b>Start Fre</b> 2.399546557 Gi
25.0						<b>Stop Fr</b> 2.404453443 G
5.0						<b>CF Ste</b> 490.689 ki <u>Auto</u> M
5.0						Freq Offs 0
enter 2.4	02000 GHz	<i>4</i> ) (D))	50 MHz		Span 4.907 MHz I.000 ms (1001 pts)	

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

center Fr	RF 50Ω AC Teq 2.441000000	GHZ PNO: Fast ↔ IFGain:Low	Trig: Free Run Atten: 8 dB	ALIGNAUTO #Avg Type: RMS Avg Hold: 1/1	02:18:34 PM May 25, 2021 TRACE 1 2 3 4 5 6 TYPE MWWWW DET P P P P P P	Frequency
0 dB/div	Ref Offset 27.38 dB Ref 25.00 dBm			Mkr	1 2.440 728 GHz 13.419 dBm	Auto Tur
15.0			<b>↓</b> 1			<b>Center Fre</b> 2.441000000 GF
5.00						<b>Start Fr</b> 2.438529867 G
25.0						<b>Stop Fr</b> 2.443470133 G
5.0						<b>CF St</b> 494.027 k <u>Auto</u> M
5.0						Freq Offs 0
65.0						
enter 2.4 Res BW	41000 GHz 3.0 MHz	#VBW	/ 50 MHz	Sweep	Span 4.940 MHz 1.000 ms (1001 pts)	



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

Center Freq 2.480000000 GHz PNO: Fas IFGain:Lo Ref Offset 27.38 dB Cog 15.0 5.00 -5.00 -5.00 -5.00 -5.00 -5.00 -45.0 -45.0		#AvgTvpe: RMS AvgHold: 1/1 Mkr1	ТРАСЕ [] 234 5 6 ТУРЕ МУЛИЧИСТИ РЕГРИРИТИСТИ 2.479 920 GHz 14.483 dBm	Auto Tune Center Frec 2.48000000 GHz Start Frec 2.477515394 GHz Stop Frec 2.482484606 GHz
Ref Offset 27.38 dB       Log     Ref 25.00 dBm       16.0		Mkr1	2.479 920 GHz	Center Free 2.48000000 GHz Start Free 2.477515394 GHz Stop Free
15.0 5.00 -5.00 -5.0 -25.0 -35.0				2.48000000 GH2 Start Fred 2.477515394 GH2 Stop Fred
-5 00 -15 0 -25 0 -35 0				2.477515394 GH Stop Free
-25.0				
43.0				CF Ste 496.921 kH Auto Ma
55.0				<b>Freq Offs</b> 0 F
.65 0 Center 2.480000 GHz			Span 4.969 MHz	
	BW 50 MHz	Sweep 1	1.000 ms (1001 pts)	

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





# Test Plots (8DPSK)

Peak Power (CH.39)

XI RL	rum Analyzer - Swept SA RF 50 Ω AC req 2.441000000	CH2	SENSE:INT	ALIGNAUTO #Avg Type: RMS	02:19:45 PM May 25, 2021 TRACE 1 2 3 4 5 6	Frequency
10 dB/div	Ref Offset 27.38 dB Ref 25.00 dBm	PNO: Fast ++ IFGain:Low	Trig: Free Run Atten: 8 dB	Avg Hold: 1/1	туре рет р р р р р р 440 880 48 GHz 14.726 dBm	Auto Tune
			<b>↓</b> <sup>1</sup>	****		<b>Center Fre</b> 2.441000000 GH
5.00						<b>Start Fre</b> 2.437680000 GH
25.0						<b>Stop Fre</b> 2.444320000 GF
45.0						CF Ste 664.000 kł <u>Auto</u> Ma
55.0						Freq Offs 0 F
Center 2.4	441000 GHz	#\/B\A	50 MHz	Sween	Span 6.640 MHz 1.000 ms (1001 pts)	
SG			oo minz	STATU		

#### Test Plots (8DPSK) Peak Power (CH.78)





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

RL RF Center Freq 2		Hz PNO: Fast ↔ FGain:Low	SENSE: INT Trig: Free Run Atten: 8 dB	ALIGNAUTO #Avg Type: RMS Avg Hold: 1/1	02:18:58 PM May 25, 2021 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P P	Frequency
	Dffset 27.38 dB 25.00 dBm	Sumesw		Mki	1 2.402 047 GHz 10.292 dBm	Auto Tur
15.0			<sup>1</sup>			<b>Center Fre</b> 2.402000000 GH
5.00						<b>Start Fr</b> 2.398637500 G
5.0						<b>Stop Fr</b> 2.405362500 G
5.0						CF St 672.500 k <u>Auto</u> M
5.0						Freq Offs 0
5.0						
enter 2.40200 Res BW 3.0 M		#VBW	50 MHz	Sweep	Span 6.725 MHz 1.000 ms (1001 pts)	

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





# Test Plots (π/4DQPSK) Peak Power (CH.78)

X/RL	RF 50 Ω AC		SENSE:INT	ALIGNAUTO	02:19:21 PM May 25, 2021	_	
Center F	req 2.48000000	PNO: Fast ↔ IFGain:Low	Trig: Free Run Atten: 8 dB	#Avg Type: RMS Avg Hold: 1/1	TRACE 123456 TYPE MWWWW DET P P P P P	Frequency	
10 dB/div	Ref Offset 27.38 dB Ref 25.00 dBm			Mkr1 2.479 852 GHz 13.143 dBm		Auto Tur	
- <b>og</b> 15.0			↓1			Center Fre 2.480000000 Gi	
5.00						<b>Start Fr</b> 2.476645000 G	
25.0						<b>Stop Fr</b> 2.483355000 G	
45.0						<b>CF St</b> 671.000 k <u>Auto</u> M	
55.0						Freq Offs 0	
	480000 GHz				Span 6.710 MHz		
Res BW	3.0 MHZ	#VBW	50 MHz	Sweep 1	.000 ms (1001 pts)		



### 10.2 BAND EDGES

#### Without hopping

Outside Frequency Bond	GFSK	8DPSK	π/4DQPSK	Limit
Outside Frequency Band	(dB)	(dB)	(dB)	(dBc)
Lower	65.981	62.158	61.321	00
Upper	67.490	65.181	64.640	20

#### With hopping

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

#### Note :

1. Spectrum reading values are not plot data.

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

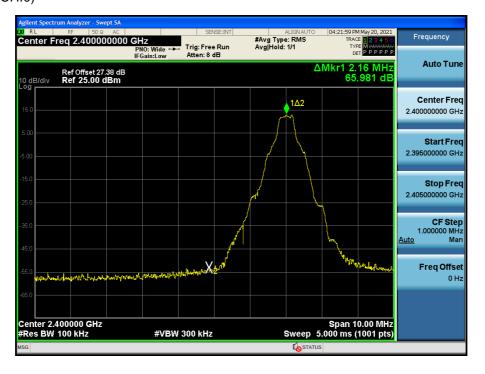
2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.

Actual value of loss for the splitter and cable combination is 27.37 dB at 2400 MHz and is 27.38 dB at 2500 MHz.

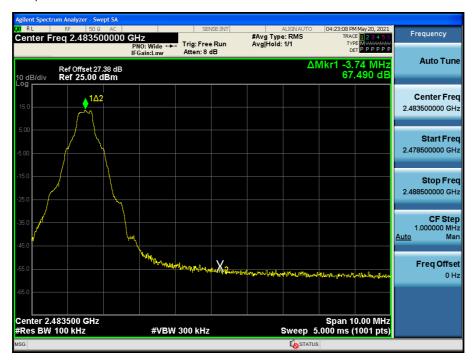
So, 27.38 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.



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



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



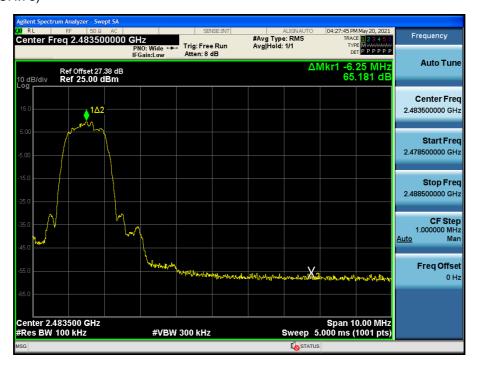


Test Plots without hopping (8DPSK)

Band Edges (CH.0)



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



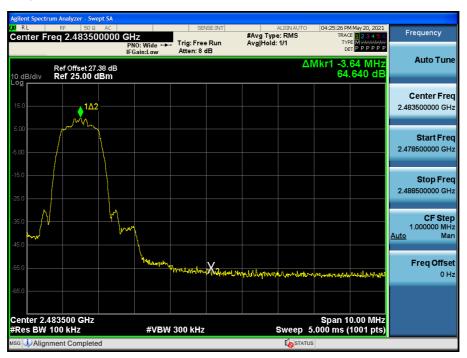


### Test Plots without hopping ( $\pi$ /4DQPSK)

Band Edges (CH.0)



Test Plots without hopping ( $\pi$ /4DQPSK) Band Edges (CH.78)

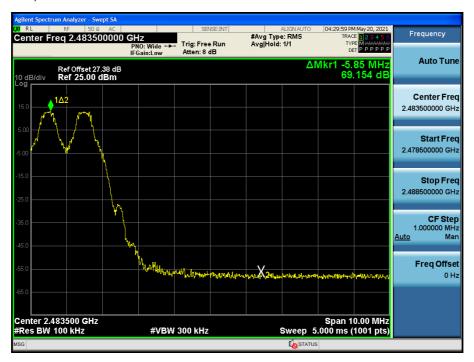




Test Plots with hopping (GFSK) Band Edges (CH.0)



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



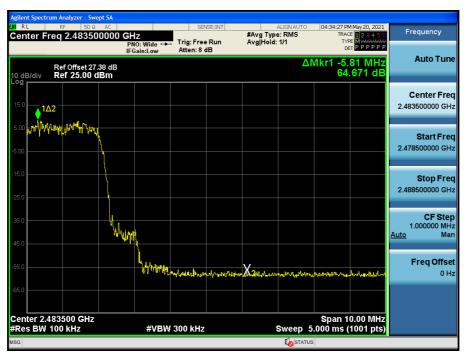


### Test Plots with hopping (8DPSK)

Band Edges (CH.0)



# Test Plots with hopping (8DPSK) Band Edges (CH.78)





Test Plots with hopping ( $\pi$ /4DQPSK)

Band Edges (CH.0)



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





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

99% BW (kHz)									
Channel	GFSK	8DPSK	π/4DQPSK						
CH.0	886.80	1194.6	1196.2						
CH.39	884.69	1199.5	1194.1						
CH.78	883.60	1199.3	1192.9						

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

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



# Test Plots (GFSK)

### **Channel Separation**

Agilent Spectr	RF	50 Ω	AC 0000 GH:	Z ): Wide ↔		BE:INT	#Avg Typ Avg Hold		TRAC	4 May 20, 2021 <sup>26</sup> <mark>1 2 3 4 5 6</mark> 26 M WAAWAAA T P P P P P P P	Frequency
10 dB/div	Ref Ref	Offset 27. * <b>25.00</b> d	IFG 38 dB	ain:Low	#Atten: 20	dB		ΔN	1kr3 1.0		Auto Tune
Log 15.0 5.00	مہ ر	<u>√~X₂</u> √				1 <u>∆2</u> 1 <u>√</u> √	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	304	<u></u>	Center Freq 2.441000000 GHz
-15.0 -25.0 -35.0				~~~~·							Start Freq 2.439500000 GHz
-45.0 -55.0 -65.0											<b>Stop Freq</b> 2.442500000 GHz
Center 2. #Res BW	30 k			#VBW	/ 100 kHz				3.176 ms	.000 MHz (900 pts)	CF Step 300.000 kHz Auto Mar
MKR     MODE     T       1     Δ2     1       2     F     1       3     Δ4     1       4     F     1       5     6     6	1 f 1 f	(Δ) (Δ)	2.439 991	MHz (Δ)	√ -0.071 d 10.101 dB 0.156 d 10.030 dB	m dB		NCTION WIDTH	FUNCTIO		Freq Offset 0 Hz
7 8 9 10 11					11						
MSG								<b>I</b> o STATUS	6		

# Test Plots (8DPSK) Channel Separation





## Test Plots (π/4DQPSK)

### **Channel Separation**

Agilent Spectru	<mark>im Ana</mark> RE	l <mark>iyzer - Swe</mark> 50 Q			SEN	EINT		ALIGNAUTO	04:36:19.P	4 May 20, 2021		
Center Fr	eq 2		0000 GH	Z IO: Wide ↔	Trig: Free	Run	#Avg Typ Avg Hold		TRAC	E 123456	Frequency	′
			IFC	Gain:Low	#Atten: 20	dB				тррррр	Auto T	une
10 dB/div		Offset 27 25.00 c						ΔΝ	1kr3 1.0 0	01 MHz .026 dB		une
Log 15.0						1Δ2			3∆4		Center F	req
5.00	$\sim$	~_X2	man	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim$	<b>\$</b> ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	mm	$\sim$	who who	~~~~~~	2.441000000	GHz
-5.00												
-15.0											Start F	
-35.0											2.439500000	GHz
-45.0											Oton F	
-55.0											Stop F 2.442500000	
-65.0												
Center 2.4 #Res BW ∺				#VBW	100 kHz			Sweep	Span 3 3.176 ms	.000 MHz (900 pts)	CF 9 300.000	kHz
MKR MODE TR		<i>(</i> Δ)	× 1.00	1 MHz (Δ)	۲ 0.076 c		CTION FUI	NCTION WIDTH	FUNCTIO	IN VALUE	Auto	Man
2 F 1 3 A4 1	f	(Δ)	2.439 98		8.329 dB 0.026 c	m					Freq Of	fset
4 F 1	f	(0)	2.440 98		8.405 dB							0 Hz
6												
8												
10 11										~		
< MSG					311			STATUS	,	>		
mag								No STATUS				



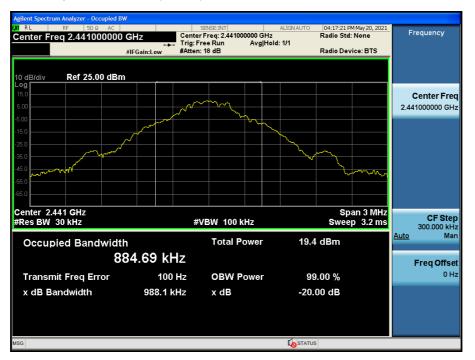
### Test Plots (GFSK)

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)



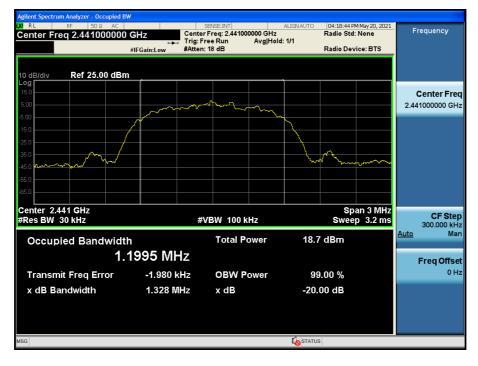
### Test Plots (8DPSK) 20 dB Bandwidth & Occupied Bandwidth (CH.0)





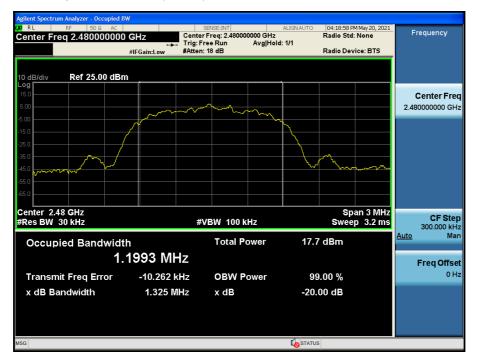
# Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



### Test Plots (8DPSK)

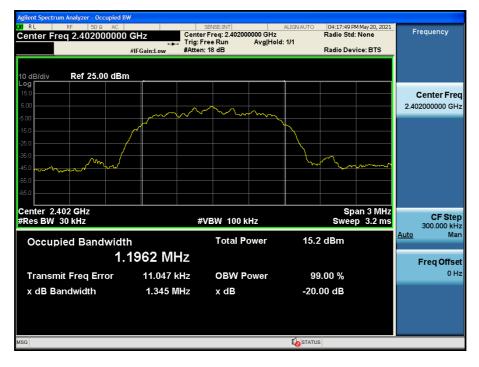
20 dB Bandwidth & Occupied Bandwidth (CH.78)





### Test Plots ( $\pi$ /4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



#### Test Plots (π/4DQPSK)

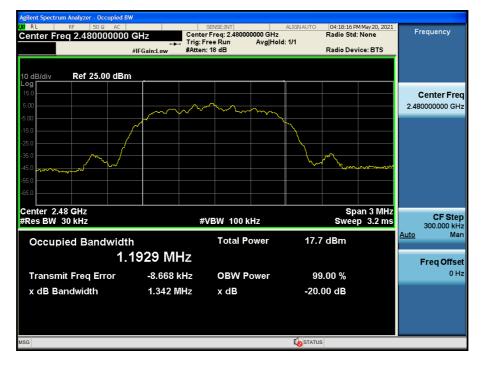
20 dB Bandwidth & Occupied Bandwidth (CH.39)





### Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)





#### **10.4 NUMBER OF HOPPING FREQUENCY**

	Limit						
GFSK	GFSK 8DPSK π/4DQPSK						
79	79	79	>15				

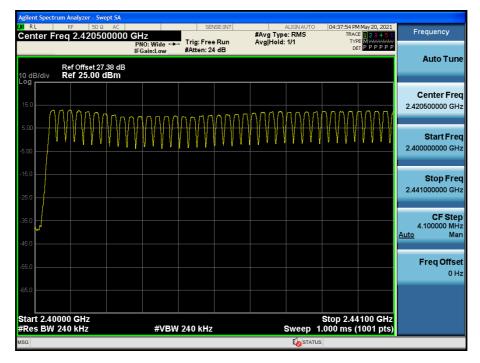
### Note :

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)

Agilent Spectrum Analyzer - Swept SA X RL RF 50 Ω AC Center Freq 2.420500000	PNO: Wide +++ T	sense:int	ALIGN AUTO #Avg Type: RMS Avg Hold: 1/1	04:43:38 PM May 20, 2021 TRACE 1 2 3 4 5 6 TYPE M WWWWW	Frequency
Ref Offset 27.38 dB 10 dB/div Ref 25.00 dBm	IFGain:Low #	Atten: 24 dB		DETPPPPP	Auto Tune
			$\sim$	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	<b>Center Freq</b> 2.420500000 GHz
5.00					Start Fred 2.400000000 GH;
-15.0					Stop Free 2.441000000 GH
-35.0					<b>CF Step</b> 4.100000 MH <u>Auto</u> Mar
-65.0					Freq Offse 0 H:
Start 2.40000 GHz #Res BW 240 kHz	#VBW 24	IO KHZ		Stop 2.44100 GHz .000 ms (1001 pts)	
usg 🧼 Alignment Completed			to status	6	

# Test Plots (8DPSK)

Number of Channels (2.441 GHz - 2.483.5 GHz)

		m Analyzer											
UXI R Cen		RF 5	io Ω AC		7	SEM	ISE:INT	#Avg Type	ALIGN AUTO e: RMS	TRAC	4 May 20, 202 E <u>1 2 3 4 5</u>	6	Frequency
				PN	O: Wide ↔ ain:Low	#Atten: 24		Avg[Hold:	1/1	TYI Di	РЕ Миллина ТРРРРР	P	8. da 7. ma
10 di Log	3/div	Ref Offse Ref 25.0											Auto Tune
15.0													Center Freq
5.00	$\gamma\gamma\gamma\gamma\gamma$	$\sqrt{\sqrt{2}}$	᠕᠕	᠕᠕᠕	᠂᠋ᡎᡝᡳᡃᠬ	᠋ᢩᡘ᠕᠂ᡁᢉ	ᢦᡝᠵᢦᠬ	$\sim$	ᢉᢉᡃ᠕	$\gamma \gamma \gamma \gamma \gamma$	$\gamma\gamma$		2.462250000 GHz
													<b>Start Freq</b> 2.441000000 GHz
-5.00													2.441000000 0112
-15.0													<b>Stop Freq</b> 2.483500000 GHz
-25.0													05.04.0
-35.0											11	•	CF Step 4.250000 MHz Auto Man
-45.0													
-55.0													Freq Offset 0 Hz
-65.0													
Star	+ 2 4 4 1	00 GHz								Stop 2.4	2250 CH		
		40 kHz			#VBW	240 kHz		:	Sweep 1	.000 ms (	1001 pts	2 5)	
MSG									<b>I</b> STATU	6			



# Test Plots (π/4DQPSK)

Number of Channels (2.4 GHz - 2.441 GHz)

Agilent Spectrum Analyzer - Swept SA       №     RL     RF     50 Ω     AC       Center Freq 2.420500000	GHz	#Avg Typ	e: RMS TRA	M May 20, 2021 CE <mark>1</mark> 2 3 4 5 6	Frequency
Ref Offset 27.38 dB 10 dB/div Ref 25.00 dBm	PNO: Wide +++ Trig: Fre IFGain:Low #Atten: 2		: 1/1 TY		Auto Tune
	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				Center Freq 2.420500000 GHz
5.00					Start Fred 2.400000000 GH:
-15.0					<b>Stop Fred</b> 2.441000000 GH:
-35.0				Au	<b>CF Stej</b> 4.100000 MH <u>uto</u> Ma
65 0					<b>Freq Offse</b> 0 H
Start 2.40000 GHz #Res BW 240 kHz	#VBW 240 kHz		Stop 2.4 Sweep 1.000 ms	4100 GHz (1001 pts)	
MSG			<b>I</b> ostatus		

### Test Plots (π/4DQPSK)

Number of Channels (2.441 GHz - 2.483.5 GHz)

		m Analyzer - Sw									
Cen		RF 50 S	2 AC 50000 G	Hz		NSE:INT	#Avg Typ		TRAC	4 May 20, 2021	Frequency
			P	NO: Wide 🔸 Gain:Low	Trig: Fre #Atten: 2		Avg Hold:	: 1/1	TYI		
10 dE Log		Ref Offset 27 Ref 25.00									Auto Tune
15.0	~~~~	ᡝᠰᢇᠰᠰ	<u>1000000000000000000000000000000000000</u>	ᡟᠬᠬᡝ	hhr.m.m.r.	1.~~~~	~~~~				Center Freq 2.462250000 GHz
5.00 -5.00		1 V Y Y -			4 1 1 2		1 4 7 7 7	1 7 7 1	₩ ₩ ₩ ¥		Start Freq 2.441000000 GHz
-15.0 -25.0											Stop Freq 2.483500000 GHz
-35.0 -45.0										horse	CF Step 4.250000 MHz <u>Auto</u> Man
-55.0											Freq Offset 0 Hz
-65.0											
		00 GHz 40 kHz		#VBW	240 kHz			Sweep	Stop 2.43 1.000 ms (	3350 GHz 1001 pts)	
MSG											



### 10.5 TIME OF OCCUPANCY (DWELL TIME)

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

# Non-AFH Mode

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

#### AFH Mode

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



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

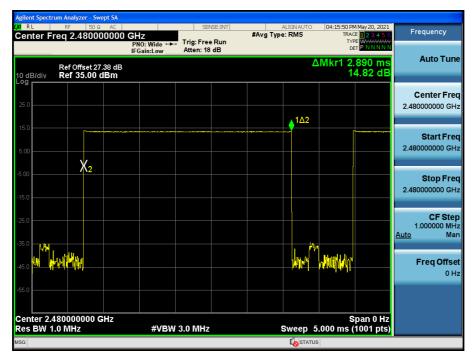


### Test Plots (GFSK) Dwell Time (CH.39)





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



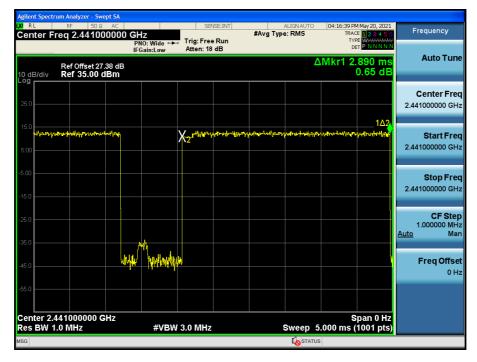
### Test Plots (8DPSK) Dwell Time (CH.0)





# Test Plots (8DPSK)

Dwell Time (CH.39)



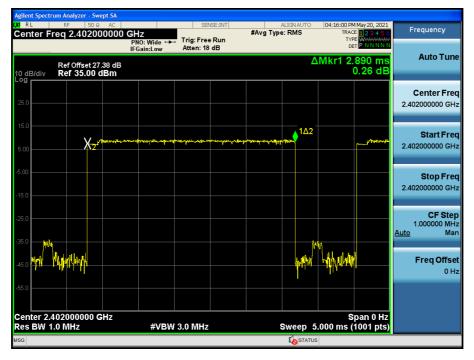
### Test Plots (8DPSK) Dwell Time (CH.78)



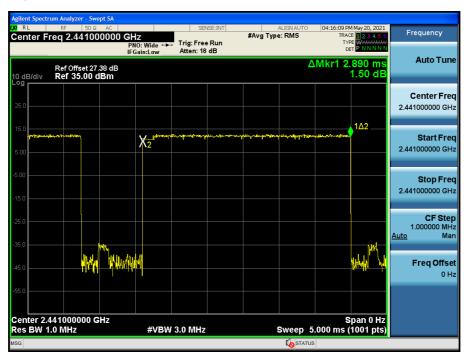


# Test Plots (π/4DQPSK)

# Dwell Time (CH.0)



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





# Test Plots ( $\pi$ /4DQPSK)

Dwell Time (CH.78)





#### **10.6 SPURIOUS EMISSIONS**

#### 10.6.1 CONDUCTED SPURIOUS EMISSIONS

Test Result : please refer to the plot below.

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



# Test Plots (8DPSK) 30 MHz - 1 GHz

Spurious Emission (CH.39)

RL		RF 50	Ω AC			SEI	NSE:INT		ALIGNAUTO		M May 25, 2021	Eng	
enter	r Frec	515.00	00000	MHz PNO: Fas IFGain:Lo		Trig: Free Atten: 6		#Avg Typ Avg Hold:		TRAC TY D	<sup>2E</sup>		quency
0 dB/di		ef Offset 2 ef 20.00							M	kr1 661. -58.6	21 MHz 80 dBm		Auto Tun
10.0											2 →		enter Fre 000000 M⊦
0.00											-10.38 dBm		Start Fre
0.0													<b>Stop Fr</b> 000000 GI
D.0												97. <u>Auto</u>	CF Ste 000000 M M
	Alles frage	a <mark>lere costa das</mark>	lip protosou	Halffeld (1997) (1997)	u kalhda	, and a little state	tin and a table last		en myter der für til som 1. myter der första könnt	i ( ang ang ang ang ang ang ang ang ang ang	a <mark>tu dağı başaşı tarihi da anı anı anı</mark> A sanalar da 1,4 anı <del>da a</del> nı anı anı	F	req Offs
	n an Liking (a air	in di li di aka ya di in	dyiset and the second	ortta indiani	14 ( <b>1</b> 4 - 14 ) <sup>(14</sup>	and Marine Bridge	and the star of the	a site, ha a shirt a si a site					
	0.0 MI SW 100			#	VBW	300 kHz		s	weep 93	Stop 1.0 .33 ms (2	0000 GHz 0000 pts)		
G									<b>I</b> STATUS				

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

Agilent Spectr	rum Analyzer - Sw	rept <u>S</u> A					
LXI RL	RF 50 Ω	2 AC	SENSE	INT	ALIGNAUTO	08:46:23 PM May 25, 2021	
Center F	req 2.0000	00000 GHz PNO: Fa IFGain:Lo	st Trig: Free R bw Atten: 6 dB		g Type: RMS  Hold: 1/1	TRACE 12345 TYPE MWWWW DET PPPP	
10 dB/div	Ref Offset 27 Ref 20.00				Mkr	1 2.554 45 GHz -56.276 dBm	
Log 10.0 0.00 -10.0					<u></u>	-10.38 dBr	Center Freq 2.000000000 GHz
-20.0 -30.0 -40.0							Start Freq 1.000000000 GHz
-50.0 -60.0 -70.0		The spectrum are present (an internet) in the spectrum of a strategic data to an internet better and stratighter	इत्यम् अपने प्रियम् कार्यक्रमोत्स् विभिन्न स्वरूप्त स्वर्थक्त् स्वर्थक् राजित्यक्त क्रिस्ट्रा कार्यक्रमा स्वरूप्त स्वर्थक्त्	1		Ly particular de la processión de la compactica de la compactica de la compactica de la compactica de la comp La compactica de la compact	Stop Freq 3.000000000 GHz
Start 1.00 #Res BW		#	VBW 300 kHz		Sweep 19	Stop 3.000 GHz 2.0 ms (40001 pts	CF Step 200.000000 MHz Auto Man
MKR MODE TH		×	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Auto
1 N 1		2.554 45 GH		۱			
2 N 1 3 4 5 5	f	2.440 75 GHz	9.622 dBn				Freq Offset 0 Hz
6 7 8 9 10 11						~	
MSG						3	

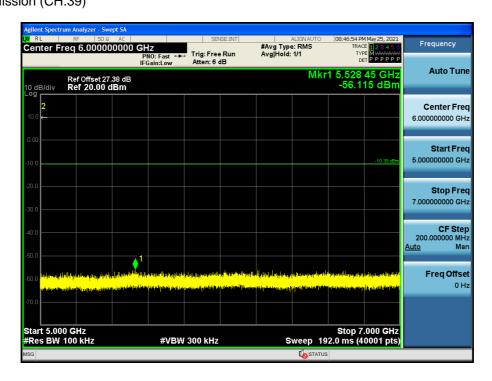


### Test Plots(8DPSK) 3 GHz - 5 GHz

Spurious Emission (CH.39)

X/RL		RE	er - Swe 50 Ω				SEI	NSE:INT		ALIGNAUTO	08:46:43 PM	4 May 25, 2021	
				0000	GHz PNO: Fa IFGain:L			e Run	#Avg Typ Avg Hold:	e: RMS	TRAC	E 1 2 3 4 5 6 E M 44 44 44 44 44 44 44 44 44 44 54 64 64 64 64 64 64 64 64 64 64 64 64 64	Frequency
10 dB	/div	Ref Off Ref 2	set 27. 0.00 d	38 dB I <b>Bm</b>	II OUIIIL					Mkr		30 GHz 56 dBm	Auto Tun
10.0	<mark>2</mark> ←												Center Fre 4.000000000 G⊦
0.00												-10.38 dBm	<b>Start Fre</b> 3.000000000 G⊦
20.0 30.0													Stop Fre 5.000000000 G⊦
40.0						- 1							CF Ste 200.000000 M⊦ <u>Auto</u> Ma
-60.0 <mark>1</mark>		han hayan t	ebilendlije <sup>mal</sup> ebilendlije	(k) in the second s	, Logi, J. <sup>20</sup> (1996) Marine Marine	et adda Weinighter Weinighter	ulaus editelite dissesperation	alba dat taran <sup>Abara</sup> na aray	di se ni li se de la como de la co	terden för talland Referenset av sögare	na an tana Panganana	ng phinistration Sector all any photoe	Freq Offso 0 ⊦
-70.0 -	3.000												
		100 kH	z		#	VBW	300 kHz		s	weep 19	2.0 ms (4	.000 GHz 0001 pts)	
ISG										<b>I</b> STATUS			

Test Plots (8DPSK) 5 GHz - 7 GHz Spurious Emission (CH.39)



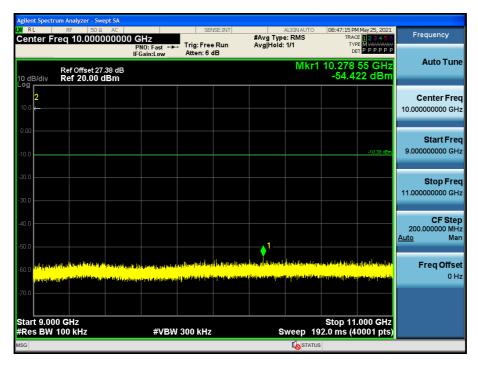


### Test Plots(8DPSK) 7 GHz - 9 GHz

Spurious Emission (CH.39)

RL	RF	r - Swept SA 50 Ω AC		SEI	NSE:INT		ALIGNAUTO		1 May 25, 2021	F
enter	Freq 8.00	0000000	PNO: Fast ↔ IFGain:Low	Trig: Free Atten: 6		#Avg Typ Avg Hold:		TRAC TYF DE	E 1 2 3 4 5 6 E M M M M M M P P P P P P P	Frequency
0 dB/div		et 27.38 dB . <b>00 dBm</b>					Mkr	1 8.233 -54.7	20 GHz 48 dBm	Auto Tune
2 10.0 ←										<b>Center Fre</b> 8.000000000 GH
0.0									-10.38 dBm,	<b>Start Fre</b> 7.000000000 GH
0.0										<b>Stop Fre</b> 9.000000000 G⊦
10.0										<b>CF Ste</b> 200.000000 M⊦ <u>Auto</u> Ma
50.0	Nelsi ki posebi ba <sup>Nil</sup> Koja te ospisao		<mark>hini kalinya kapatela</mark> <mark>Tahini kalinya kapatela ka</mark>	Contraction of the	hillion an a bha fhair An an		a kalal manaka ka	l di la dit se di subolo Li si si su pi su di succi	ulture e stitle d'est e se stitle e state de st	Freq Offse 0 H
70.0										
	000 GHz W 100 kHz		#VBW	/ 300 kHz		s	weep 19	Stop 9 2.0 ms (4	.000 GHz 0001 pts)	
SG								·	"	

Test Plots(8DPSK) 9 GHz - 11 GHz



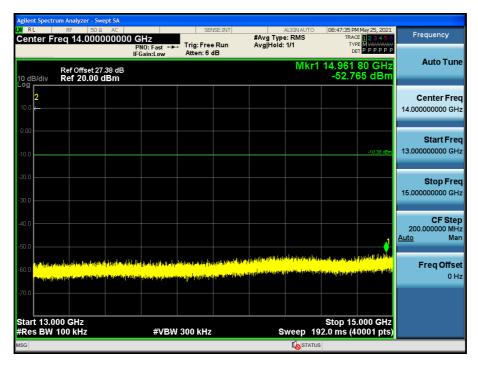


### Test Plots(8DPSK) 11 GHz - 13 GHz

Spurious Emission (CH.39)

RL		50Ω AC		SEI	NSE:INT		ALIGN AUTO		4 May 25, 2021	Frequency
enter	Freq 12.0	00000000	FNO: Fast ↔ IFGain:Low	Trig: Free Atten: 6		#Avg Typ Avg Hold:		TYI DI	Е <mark>123456</mark> ЕМ <del>имииии</del> ТРРРРРР	( requeries
0 dB/div		et 27.38 dB 00 dBm					Mkr1	11.931 -54.8	05 GHz 90 dBm	Auto Tu
2 10.0										<b>Center Fr</b> 12.000000000 G
10.0									-10.38 dBm,	<b>Start Fr</b> 11.000000000 G
20.0										<b>Stop Fr</b> 13.000000000 G
40.0										<b>CF St</b> e 200.000000 M <u>Auto</u> M
n n lindik		the hash of the providence of	derlere son betreverlikte <mark>An son son son son son son son son son so</mark>	kalan ing ding kalang ba	so the second second se	<mark>in telebong berkerent</mark> Manapatel song			and the second	Freq Offs 0
70.0										
	1.000 GHz W 100 kHz		#VBW	/ 300 kHz		s	weep 19	Stop 13 2.0 ms (4	.000 GHz 0001 pts)	
SG							<b>I</b> STATUS			

Test Plots (8DPSK) 13 GHz – 15 GHz



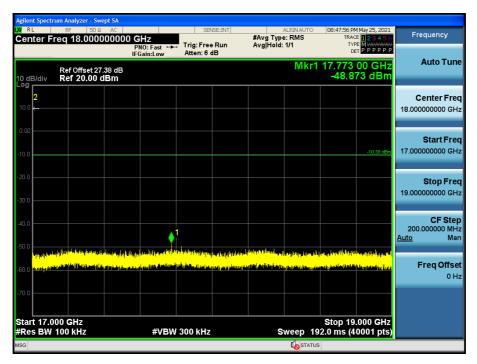


### Test Plots(8DPSK) 15 GHz - 17 GHz

Spurious Emission (CH.39)

RL	RF 50	IΩ AC		SEN	ISE:INT		ALIGNAUTO		4 May 25, 2021	English
Center F	req 16.000	F	HZ NO: Fast ↔ Gain:Low	Trig: Free Atten: 6		#Avg Type Avg Hold:		TRAC TYP DE	E 123456 E MWWWWWW T P P P P P P	Frequency
0 dB/div	Ref Offset 2 Ref 20.00	27.38 dB					Mkr1	15.542 -50.9	30 GHz 71 dBm	Auto Tun
.og 10.0										Center Fre 16.00000000 G⊦
10.0									-10.38 dBm,	<b>Start Fre</b> 15.000000000 GF
20.0										<b>Stop Fre</b> 17.000000000 GF
40.0		^1								CF Ste 200.000000 MH <u>Auto</u> Ma
<mark>ارتندیون</mark> 60.0 <mark>ویدیون</mark>	The physical and a second s Second second	a second second	d to to not			ller Hellisterer Velsyn seren ach				Freq Offs 0 ⊦
70.0 Start 15.0 Res BW			#\/B)A	300 kHz			ween 10	Stop 17	.000 GHz 0001 pts)	
SG			<i>"</i> VDW	300 KHZ		3	status		ooo r pisj	

Test Plots(8DPSK) 17 GHz - 19 GHz





### Test Plots (8DPSK) 19 GHz - 21 GHz

Spurious Emission (CH.39)

Agilent Spectru	um Analyzer - Swo RF 50 Ω	ept SA AC		SEA	ISE:INT		ALIGNAUTO	09:49:06 D	4 May 25, 2021	
	eq 20.0000	000000 G	Hz NO: Fast ++ Gain:Low		Run	#Avg Typ Avg Hold:	e: RMS	TRAC	E 1 2 3 4 5 6 E MWWWWWW T P P P P P P	Frequency
10 dB/div	Ref Offset 27 Ref 20.00 (						Mkr1	20.783 -49.7	35 GHz 12 dBm	Auto Tune
2 10.0 ←										Center Fred 20.000000000 GHz
-10.0									-10.38 dBm	Start Freq 19.000000000 GHz
-20.0										Stop Fred 21.000000000 GHz
-40.0	. A simple week a field of week and	e and white	er konkatde	dan ala li din	1. kalimeta surdi Ju	n Manadah Jalata Ja	U saka uko tuto da	, canada la ponya sa		CF Step 200.000000 MHz <u>Auto</u> Mar
	at a per al a ser a ser a de la ma									Freq Offset 0 Hz
Start 19.00 #Res BW			#VBW	300 kHz		s	weep <u>19</u>	Stop 21 2.0 ms (4	.000 GHz 0001 pts)	
ISG								6		

Test Plots (8DPSK) 21 GHz - 23 GHz





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

RL	RF	50 Ω AC		SEI	NSE:INT		ALIGNAUTO		4 May 25, 2021	Frequency
Center	r Freq 24	.00000000	00 GHz PNO: Fast ↔ IFGain:Low	Trig: Free Atten: 6		#Avg Typ Avg Hold	e: RMS : 1/1	TYP	E 123456 E MWWWWWW T P P P P P P	rrequeitcy
0 dB/di		set 27.38 dB 0.00 dBm					Mkr1	24.985	60 GHz 24 dBm	Auto Tun
.og 2 10.0 ←										Center Fre 24.000000000 GF
0.00									-10.38 dBm,	<b>Start Fre</b> 23.000000000 GF
20.0										<b>Stop Fr</b> 25.000000000 G
40.0		1	haansiigangi kulusinki	te ti cata contañ teloro	ded of a located	takatun kalan katiku la	altin fatti ndilan pain	an a		<b>CF Ste</b> 200.000000 MI <u>Auto</u> Mi
	an bandara na minina An alagunana na Mar	anta hayar (aya Maniyara haya	ender Entreter för ettagtander Frankrigen av den standare	ukanyin <sup>j</sup> ahahan du	rasional Angelia	a, and data of a film	wayada dipolitika	elaikinen konterligit	iaisini di Gerja Di Petter	Freq Offs
70.0										
	3.000 GHz W 100 kH		#VBV	V 300 kHz		s	weep 19	Stop 25 2.0 ms (4	.000 GHz 0001 pts)	
SG							<b>I</b> STATUS	3		



### 10.6.2 RADIATED SPURIOUS EMISSIONS

#### Frequency Range : 9 kHz – 30MHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin			
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB			
No Critical peaks found										

#### Note:

1. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.

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

#### Frequency Range : Below 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin			
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB			
No Critical peaks found										

#### Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.

2. Radiated test is performed with hopping off.



# Frequency Range : Above 1 GHz

Operation Mode: CH Low(GFSK)

Frequency	U	A.F + C.L - A.G + D.F	Pol.	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBuV]	[dB]	[H/V]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
4804	40.56	4.08	V	0.00	44.64	73.98	29.34	PK
4804	40.56	4.08	V	-24.73	19.91	53.98	34.07	AV
7206	37.07	12.05	V	0.00	49.12	73.98	24.86	PK
7206	37.07	12.05	V	-24.73	24.39	53.98	29.59	AV
4804	41.40	4.08	Н	0.00	45.48	73.98	28.50	PK
4804	41.40	4.08	н	-24.73	20.75	53.98	33.23	AV
7206	38.51	12.05	Н	0.00	50.56	73.98	23.42	PK
7206	38.51	12.05	Н	-24.73	25.83	53.98	28.15	AV

Operation Mode: CH Mid(GFSK)

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

Operation Mode: CH High(GFSK)

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



# Operation Mode: CH Low(π/4DQPSK)

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

Operation Mode: CH Mid(π/4DQPSK)

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

Operation Mode: CH High(π/4DQPSK)

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



### Operation Mode: CH Low(8DPSK)

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

Operation Mode: CH Mid(8DPSK)

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

Operation Mode: CH High(8DPSK)

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



## [Non-DBS Mode]

## Test case 3

## BT $\pi/4DQPSK$ ch.78 & 802.11a ch.116 U-NII 2C Ant All

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



### RESULT PLOTS (Worst case : Y-H)

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

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					Mos	surina		4.00	6.04.2021

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

Ref Level 97.0 Att		SWT 50	ms e VB	WIMHz WI3MHz	Mode Swe	on			
Count 100/100	0 40 -	0111 30	1113 - 10	N O MIL	mode 5we	,ep			
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90 dBµV					M	1[1]			10.06 dBµ¥ 37550 GHz
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70 dBµV									
60 dBµV									
50 dBµV									
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20 dBµV									
10 dBµV									
0 dBµV									
CF 7.44 GHz				691	nts		I	Snan	15.0 MHz



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

Spectrum Ref Level 97.0	Spectrum 2	Spect BW 1	rum 3 🛛 🔊	Spectrum 4	t X		
Att		50 ms - VBW 3		weep			
Count 100/100							
●1Pk Max●2Pk C	rw						
90 dBµV				M1[1]			39.23 dBµV 65340 GHz
80 dBµV							
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CF 7.44 GHz			691 pts			Span	15.0 MHz

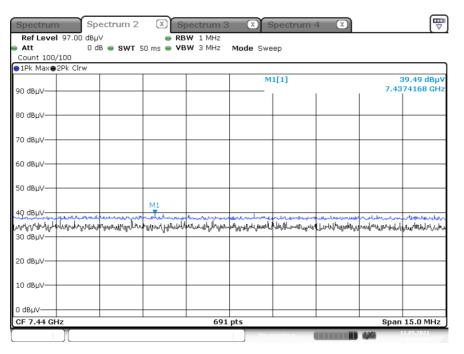
## Note:

Plot of worst case are only reported.



## [Non-DBS Mode]

Radiated Spurious Emissions plot - Peak & Average Reading (Test case 3, Z-V, 3rd Harmonic)



## Note:

Plot of worst case are only reported.



## 10.6.3 RADIATED RESTRICTED BAND EDGES

Operation Mode	Normal(GFSK)
Operating Frequency	2402 MHz, 2480 MHz
Channel No	CH 0, CH 78

Frequency	Reading	A.F + C.L + D.F -A.G+ATT	Pol.	Duty Cycle Correction	Total	Limit	Margin	Measurement Type
[MHz]	[dBuV]	[dB]	[H/V]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	
2390.0	50.91	3.32	Н	0	54.23	73.98	19.75	PK
2390.0	50.91	3.32	Н	-24.73	29.50	53.98	24.48	AV
2390.0	51.67	3.32	V	0	54.99	73.98	18.99	PK
2390.0	51.67	3.32	V	-24.73	30.26	53.98	23.72	AV
2483.5	54.86	3.78	Н	0	58.64	73.98	15.34	PK
2483.5	54.86	3.78	Н	-24.73	33.91	53.98	20.07	AV
2483.5	64.20	3.78	V	0	67.98	73.98	6.00	PK
2483.5	64.20	3.78	V	-24.73	43.25	53.98	10.73	AV

Operation Mode

EDR(π/4DQPSK)

2402 MHz, 2480 MHz

**Operating Frequency** 

Channel No

CH 0, CH 78

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



Operation Mode

Operating Frequency

Channel No

EDR(8DPSK)

2402 MHz, 2480 MHz

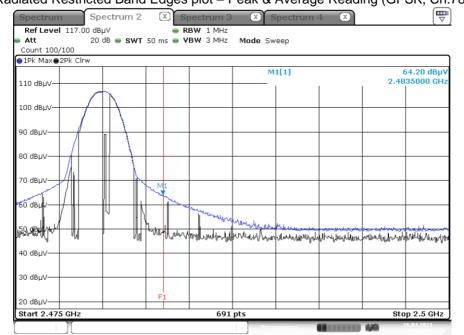
CH 0, CH 78

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



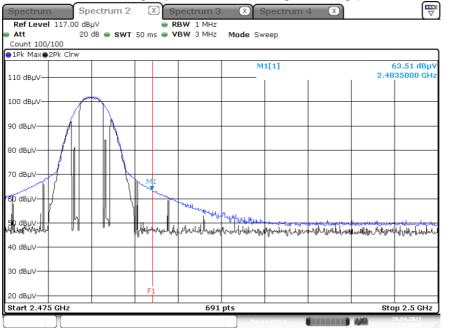
### RESULT PLOTS

#### (Worst case : Z-V)



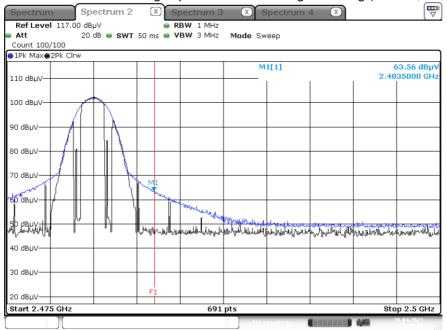
Radiated Restricted Band Edges plot – Peak & Average Reading (GFSK, Ch.78)

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





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



## Note:

Plot of worst case are only reported.



FCC ID: A3LSMG990U

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## **10.7 POWERLINE CONDUCTED EMISSIONS**

## **Conducted Emissions (Line 1)**

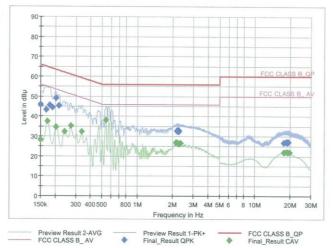
BT MODE\_L1

# **Test Report**

## **Common Information**

EUT : Manufacturer : Test Site: Operating Conditions : SM-G990U SAMSUNG SHIELD ROOM BT MODE\_L1





#### Final\_Result\_QPK

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

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BT MODE\_L1

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

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## Conducted Emissions (Line 2)

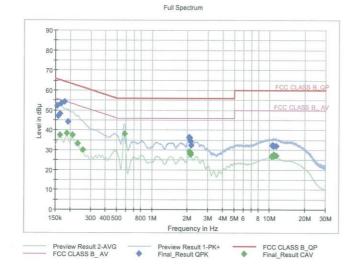
BT MODE\_N

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# **Test Report**

#### **Common Information**

EUT : Manufacturer : Test Site: Operating Conditions : SM-G990U SAMSUNG SHIELD ROOM BT MODE\_N



#### Final\_Result\_QPK

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

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BT MODE\_N

2/2

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

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# **11. LIST OF TEST EQUIPMENT**

### **Conducted Test**

Manufacturer	Model / Equipment	Calibration	Calibration	Serial No.	
Wanuracturer		Date	Interval	Serial No.	
Rohde & Schwarz	ENV216 / LISN	09/04/2020	Annual	102245	
Rohde & Schwarz	ESR / EMI Test Receiver	09/16/2020	Annual	101910	
ESPEC	SU-642 /Temperature Chamber	07/30/2020	Annual	0093000718	
Agilent	N9020A / Signal Analyzer	05/03/2021	Annual	MY51110085	
Agilent	N9030A / Signal Analyzer	03/09/2021	Annual	MY49432108	
Agilent	N1911A / Power Meter	04/08/2021	Annual	MY45100523	
Agilent	N1921A / Power Sensor	04/08/2021	Annual	MY57820067	
Agilent	87300B / Directional Coupler	11/10/2020	Annual	3116A03621	
Hewlett Packard	11667B / Power Splitter	02/09/2021	Annual	10545	
HP	E3632A / DC Power Supply	09/16/2020	Annual	MY40004427	
HP	8493C / Attenuator(10 dB)(DC-26.5 GHz)	06/26/2020	Annual	07560	
HP	8493C / Attenuator(10 dB)(DC-26.5 GHz)	07/03/2020	Annual	08285	
Rohde & Schwarz	18N-20dB / Attenuator(20 dB)	03/08/2021	Annual	8	
Rohde & Schwarz	EMC32 / Software	N/A	N/A	N/A	
HCT CO., LTD.	FCC WLAN&BT&BLE Conducted Test Software	N/A	N/A	N/A	
	v3.0				
Rohde & Schwarz	CBT / Bluetooth Tester	02/23/2021	Annual	100808	

#### Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.

2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.



#### **Radiated Test**

<b></b>		Calibration	Calibration	
Manufacturer	Model / Equipment	Date	Interval	Serial No.
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Audix	EM1000 / Controller	N/A	N/A	060520
Audix	Turn Table	N/A	N/A	N/A
TNM system	FBSM-01B / Amp & Filter Bank Switch Controller	N/A	N/A	N/A
Schwarzbeck	Loop Antenna	03/19/2020	Biennial	1513-333
Schwarzbeck	VULB 9168 / Hybrid Antenna	08/02/2019	Biennial	01039
Schwarzbeck	BBHA 9120D / Horn Antenna	08/01/2019	Biennial	9120D-1151
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	02/11/2020	Biennial	BBHA9170124
Rohde & Schwarz	FSV(10 Hz ~ 40 GHz) / Spectrum Analyzer	05/14/2021	Annual	101055
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	01/06/2021	Annual	2
Wainwright Instruments	WRCJV12-4900-5100-5900-6100-50SS	06/24/2021	Annual	5
Wainwright Instruments	WRCJV12-4900-5100-5900-6100-50SS	06/24/2021	Annual	6
CERNEX	CBL18265035 / Power Amplifier	12/04/2020	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	03/23/2021	Annual	25956
TNM system	FBSM-05B / HPF(3~18GHz) + LNA1(1~18GHz)	01/20/2021	Annual	F6
TNM system	FBSM-05B / ATT(10dB) + LNA1(1~18GHz)	01/20/2021	Annual	None
TNM system	FBSM-05B / ATT(3dB) + LNA1(1~18GHz)	01/20/2021	Annual	None
TNM system	FBSM-05B / LNA1(1~18GHz)	01/20/2021	Annual	25540
TNM system	FBSM-05B / HPF(7~18GHz) + LNA2(6~18GHz)	01/20/2021	Annual	28550
TNM system	FBSM-05B / Thru(30MHz ~ 18GHz)	01/20/2021	Annual	None
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	02/08/2021	Annual	1
Weinschel	2-3 / Attenuator (3 dB)	10/07/2020	Annual	BR0617
H+S	5910-N-50-010 / Attenuator(10 dB)	10/28/2020	Annual	None
Rohde & Schwarz	ESCI / Test Receiver	06/10/2020	Annual	100584
TESCOM	TC-3000C / Bluetooth Tester	04/19/2021	Annual	3000C000175

#### 'Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.

2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

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



# 12. ANNEX A\_ TEST SETUP PHOTO

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

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