# **TEST REPORT**

FCC BT Test for IL7FB Certification

APPLICANT LG Electronics Inc.

**REPORT NO.** HCT-RF-2101-FC113

DATE OF ISSUE January 28, 2021

> Tested by Jin Gwan Lee

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TEST REPORT FCC BT Test for IL7FB	REPORT NO. HCT-RF-2101-FC113 DATE OF ISSUE January 28, 2021 Additional Model -	
Applicant	<b>LG Electronics Inc.</b> 222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, 451-713, Korea	
Eut Type Model Name	Faceplate RADIO ASM-RECEIVER IL7FB	
FCC ID	BEJIL7FB2	
Max. RF Output Power	5.399 dBm (3.47 mW)	
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	
	The result shown in this test report refer only to the sample(s) tested unless otherwise stated. This test results were applied only to the test methods required by the standard.	



#### **REVISION HISTORY**

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	January 28, 2021	Initial Release

**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.

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



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#### **1. EUT DESCRIPTION**

Model	IL7FB	
Additional Model	-	
ЕИТ Туре	Faceplate RADIO ASM-RECEIVER	
Power Supply	DC 12.0 V	
Frequency Range	2402 MHz - 2480 MHz	
Max. RF Output Power	5.399 dBm (3.47 mW)	
BT Operating Mode	Normal, EDR, AFH	
Modulation Type	GFSK(Normal), π/4DQPSK and 8DPSK(EDR)	
Modulation Technique	FHSS	
Number of Channels	79Channels, Minimum 20 Channels(AFH)	
Antenna Peak Gain	4.80 dBi	
Date(s) of Tests	December 11, 2020 ~ January 22, 2021	
EUT serial numbers	Conduction : 012023413 Radiation : 012023422	



### 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

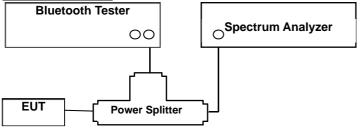
#### 8.1. Conducted Maximum Peak Output Power

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

The maximum peak output power of the intentional radiator shall not exceed the following:

- 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

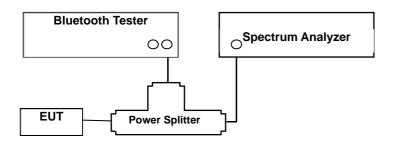


## 8.2. Conducted Band Edge(Out of Band Emissions)

#### Limit

According to § 15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

#### **Test Configuration**



#### **Test Procedure**

This test is performed with hopping off and hopping on.

The Spectrum Analyzer is set to (6.10.4 in ANSI 63.10-2013 & Procedure 8.5 and 8.6 in KDB 558074 v05r02)

- 1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
- 2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
- 3) Attenuation: Auto (at least 10 dB preferred).
- 4) Sweep time: Coupled.
- 5) RBW: 100 kHz
- 6) VBW: 300 kHz
- 7) Detector: Peak
- 8) Trace: Max hold

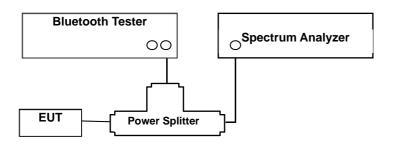


#### 8.3. Frequency Separation & 20 dB Bandwidth

#### Limit

According to § 15.247(a)(1), Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

#### **Test Configuration**



#### **Test Procedure(Frequency Separation)**

The Channel Separation test is performed with hopping on. And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (7.8.2 in ANSI 63.10-2013 & Procedure 10(b)(6)(iii) in KDB 558074 v05r02)

- 1) Span: Wide enough to capture the peaks of two adjacent channels
- 2) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- 3) VBW  $\geq$  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.

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.

Test Procedure (20 dB Bandwidth)

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



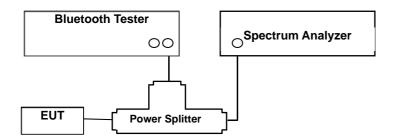


#### 8.4. Number of Hopping Frequencies

#### 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.

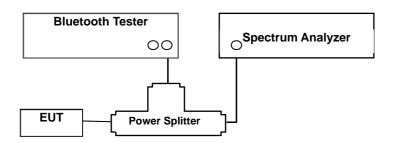


#### 8.5. Time of Occupancy

#### Limit

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

#### **Test Configuration**



#### **Test Procedure**

This test is performed with hopping off.

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

- 1) Span: Zero span, centered on a hopping channel
- 2) RBW shall be  $\leq$  channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
- 3) Sweep = as necessary to capture the entire dwell time per hopping channel
- 4) Detector: Peak
- 5) Trace: Max hold

The marker-delta function was used to determine the dwell time.



#### Sample Calculation

The following calculation process is not relevant to our measurement results. It is just an example.

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

#### (2) AFH Mode

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

Note :

DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving.

Then the system makes worst case 1600/6 hops per second with 79 channels. So the system have each channel 3.3755 times per second and so for 31.6 seconds the system have 106.667 times of appearance.

Each tx-time per appearance of DH5 is 2.890 ms. Dwell time = Tx-time x 106.667 = 308.27 (ms)



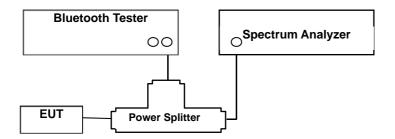


#### 8.6. Conducted Spurious Emissions

Limit

Conducted > 20 dBc

#### **Test Configuration**



#### **Test Procedure**

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

The transmitter output is connected to the spectrum analyzer.

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

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

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

This test is performed with hopping off.



Factors for	frequency
-------------	-----------

Freq(MHz)	Factor(dB)
30	6.59
100	6.69
200	6.79
300	6.88
400	7.00
500	7.00
600	7.00
700	7.06
800	7.08
900	7.11
1000	7.21
2000	7.53
2400	7.70
2500	7.69
3000	8.11
4000	7.85
5000	797
6000	8.18
7000	8.18
8000	8.28
9000	8.32
10000	8.53
11000	8.55
12000	8.66
13000	8.83
14000	8.92
15000	9.06
16000	9.11
17000	9.13
18000	9.34
19000	9.34
20000	9.59
21000	9.78
22000	9.65
23000	9.35
24000	9.51
25000	9.52
26000	9.54

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

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



#### 8.7. Radiated Test

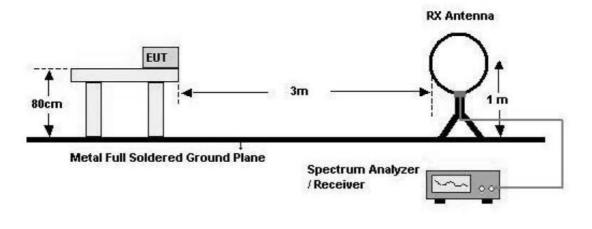
#### <u>Limit</u>

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

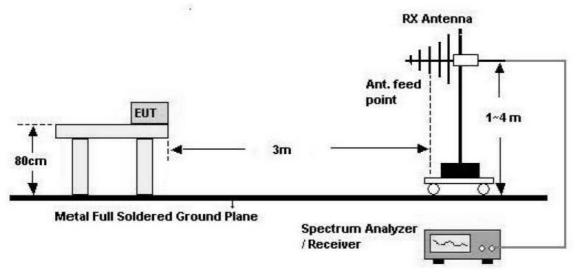


#### **Test Configuration**

Below 30 MHz

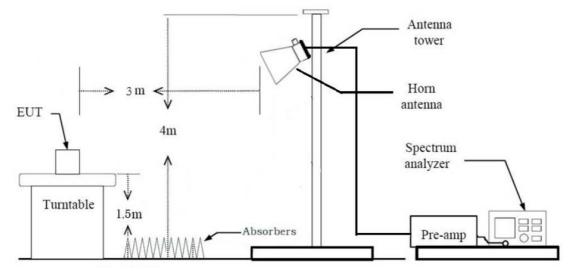


30 MHz - 1 GHz





#### Above 1 GHz



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

- 1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
- 2. The loop antenna was placed at a location 3m from the EUT
- 3. The EUT is placed on a turntable, which is 0.8m above ground plane.
- 4. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.

5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.

6. Distance Correction Factor(0.009 MHz - 0.490 MHz) = 40log(3 m/300 m) = - 80 dB

Measurement Distance : 3 m

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

Measurement Distance : 3 m

- 8. Spectrum Setting
  - Frequency Range = 9 kHz ~ 30 MHz
  - Detector = Peak
  - Trace = Maxhold
  - RBW = 9 kHz
  - VBW  $\geq$  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  $\geq$  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  $\geq$  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. 23)
    - \* 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 = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G) + Distance Factor(D.F)



- 13. Duty Cycle Correction Factor (79 channel hopping)
  - a. Time to cycle through all channels =  $\Delta$  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  $\,^{\cdot}\,$  =1
  - c. Worst Case Dwell Time =  $\tau$  [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 =  $\tau$  [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  $\geq$  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.13 (On Page. 24)
    - \* Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB



- (3) Marker-delta method
- ANSI C63.10-2013(Section 6.10.6) Marker-delta method used.
- (For 2388 ~ 2390MHz & 2483.5 ~ 2485.5MHz) Measure according to the following procedure
- - Under 1GHz = RBW : 100kHz, VBW :300kHz
  - Above 1GHz = RBW : 1MHz, VBW : 3MHz (for Peak and Avg detector)
  - Note : Avg Result DCCF applied.
- 2 Band edge and maximum fundamental emission levels are measured with a marker delta.
  - Span encompass both Peak of the fundamental and band-edge under investigation.
  - Set RBW to 1% of hte total Span(At least 30 kHz)
  - VBW  $\geq$  3 x RBW
- 3 subtract the 2 from 1 is the Result Field Strengths Level for Band edge
- 9. Distance extrapolation factor = 20log (test distance / specific distance) (dB)

10. Total

[1]Normal (Peak)

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

[2]Normal (Avg)

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

[3]Marker-delta (Peak)

- ① Fundamental emission measurement
- = Fundamental Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)
- 2 marker delta. Value
- 3 (Total) = 1 2

[4]Marker-delta (Avg)

- ① Fundamental emission measurement
- = Fundamental Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)
- 2 marker delta. Value
- 3 (Total) = (1 2) +D.C.C.F



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





#### 8.8. AC Power line Conducted Emissions

#### Limit

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN).

	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
- Worstcase : Stand alone
- 2. EUT Axis

- Radiated Spurious Emissions : X

- Radiated Restricted Band Edge : X

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

- GFSK : DH5
- π/4DQPSK : 2-DH5
- 8DPSK : 3-DH5

4. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.

- Position : Horizontal, Vertical, Parallel to the ground plane

#### **AC Power line Conducted Emissions**

1. We don't perform powerline conducted emission test. Because this EUT is used with vehicle.

#### Conducted test

- 1. The EUT was configured with data rate of highest power.
  - GFSK : DH5
  - π/4DQPSK : 2-DH5
  - 8DPSK : 3-DH5
- 2. AFH & Non-AFH were tested and the worst case results are reported.

(Worst case : Non-AFH)



#### 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		PASS
Time of Occupancy	§ 15.247(a)(1)(iii)	< 400 ms	Conducted	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		N/A(#Note)
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	cf. Section 8.7	Dediated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	cf. Section 8.7	Radiated	PASS

#Note: Not Tested.



#### **10. TEST RESULT**

**10.1 PEAK POWER** 

Frequency Channel (MHz)	Output Power (GFSK)		Limit	
	(MHZ)	(dBm)	(mW)	— (mW)
Low	2402	2.140	1.64	
Mid	2441	2.837	1.92	125
High	2480	2.889	1.94	

Channel	Frequency	Output Power (8DPSK)		Limit
	(MHz)	(dBm)	(mW)	(mW)
Low	2402	4.810	3.03	
Mid	2441	5.399	3.47	125
High	2480	5.172	3.29	

FChannel	Frequency	Outpu (π/4D	Limit	
	(MHz)	(dBm)	(mW)	(mW)
Low	2402	4.348	2.72	
Mid	2441	5.023	3.18	125
High	2480	4.775	3.00	

#### 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 7.70 dB at 2400 MHz and is 7.70 dB at 2500 MHz.

So, 7.70 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)

Reysight Spectrum Analyzer - Swept SA       RL     RF     50 Ω     AC       Center Freq 2.402000000			ALIGN AUTO #Avg Type: RMS Avg Hold: 1/1	08:01:30 PM Jan 07, 2021 TRACE 2 3 4 5 TYPE MWWWWW DET PPPPP	Frequency
Ref Offset 7.7 dB 0 dB/div Ref 20.00 dBm			Mkr	1 2.402 090 GHz 2.140 dBm	Auto Tun
10.0		↓ <sup>1</sup>			Center Fre 2.402000000 GF
0.00					Start Fre 2.399504724 GF
20.0					<b>Stop Fr</b> 2.404495276 G
40.0					CF Ste 499.055 k <u>Auto</u> M
60.0					Freq Offs 01
70.0					Scale Typ
Center 2.402000 GHz Res BW 3.0 MHz	#VBW 50 MHz	2	Sweep	Span 4.991 MHz 1.000 ms (1001 pts)	Log <u>L</u>

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

Keysight Spectrum Analyzer - Swept SA RL RF 50 Ω AC	SENSE:INT	ALIGN AUTO	08:02:18 PM Jan 07, 2021	
enter Freq 2.4410000	PNO: Fast	#Avg Type: RMS Avg Hold: 1/1	TRACE 1 2 3 4 5 0 TYPE M WWWWW DET PPPPP	Frequency
Ref Offset 7.7 dB		Mkr1	2.440 824 GHz 2.837 dBm	Auto Tu
0.0	1			Center Fr 2.441000000 G
0.00				Start Fi 2.438491705 0
0.0				Stop Fr 2.443508295 (
0.0				CF S 501.659 Auto
0.0				Freq Off
0.0				C Scale Ty
enter 2.441000 GHz Res BW 3.0 MHz	#VBW 50 MHz	Sweep 1	Span 5.017 MHz I.000 ms (1001 pts)	
o l		STATU	s	



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

RL RF 50 Q AC Center Freq 2.480000000	GHz PNO: Fast	#Avg Type: RMS	08:02:43 PM Jan 07, 2021 TRACE 2 3 4 5 0 TYPE MWWWWW DET P P P P P P	Frequency
Ref Offset 7.7 dB 0 dB/div Ref 20.00 dBm		Mkr	2.480 145 GHz 2.889 dBm	Auto Tun
10.0		ji		Center Fre 2.480000000 GH
0.00				Start Fre 2.477507488 GH
20.0				Stop Fre 2.482492512 GH
×0.0				CF Ste 498.502 ki Auto Ma
50.0				Freq Offs 0 F
70.0				Scale Typ
enter 2.480000 GHz Res BW 3.0 MHz	#VBW 50 MHz	Sweep 1	Span 4.985 MHz 1.000 ms (1001 pts)	Log <u>L</u>

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

Keysight Spectrum Analyzer - Swept					
RL RF 50 Ω Center Freq 2.402000		SENSE:INT Trig: Free Run Atten: 24 dB	#Avg Type: RMS Avg Hold: 1/1	07:45:43 PM Jan 07, 2021 TRACE 1 2 3 4 5 1 TYPE M WWWW DET P P P P P P	Frequency
Ref Offset 7.7 o 0 dB/div Ref 20.00 dE	lB ≩m		Mkr1	2.401 980 GHz 4.810 dBm	Auto Tu
10.0		1			Center Fr 2.402000000 G
0.00					Start Fr 2.398647500 0
00					Stop F 2.405352500 (
0.0					CF S 670.500 <u>Auto</u> I
0.0					Freq Off
0.0					Scale Ty
enter 2.402000 GHz Res BW 3.0 MHz	#VBW	50 MHz	Sweep 1	Span 6.705 MHz 1.000 ms (1001 pts)	Log
SG			STATU	s	



### Test Plots (8DPSK)

Peak Power (CH.39)

RL RE 50.0 AC		and the second s			- 6
RL RF 50 R AC enter Freq 2.441000000	PNO: Fast	rig: Free Run	#Avg Type: RMS Avg Hold: 1/1	07:46:19 PM Jan 07, 2021 TRACE 1 2 3 4 5 5 TYPE M	Frequency
Ref Offset 7.7 dB dB/div Ref 20.00 dBm	IFGain:Low A	atten: 24 dB	Mkr1	2.441 013 GHz 5.399 dBm	Auto Tun
0.0		1			Center Fre 2.441000000 GF
0.0					Start Fre 2.437647500 GF
0.0					Stop Fre 2.444352500 G
					CF Ste 670.500 ki <u>Auto</u> M
0.0					Freq Offs 0
enter 2.441000 GHz				Opull 0.705 Mill2	Scale Typ
Res BW 3.0 MHz	#VBW 50	MHz	Sweep 1	.000 ms (1001 pts)	

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

	ectrum Analyzer - Swept SA					6
Center Fi	RF 50 Ω AC req 2.480000000	PNO: Fast	Trig: Free Run Atten: 24 dB	#Avg Type: RMS Avg Hold: 1/1	07:46:30 PM Jan 07, 2021 TRACE 2 3 4 5 TYPE M DET P P P P P P	Frequency
0 dB/div	Ref Offset 7.7 dB Ref 20.00 dBm			Mkr	1 2.479 940 GHz 5.172 dBm	Auto Tur
10.0			1			Center Fre 2.480000000 Gi
10.0						<b>Start Fr</b> 2.476652500 G
20.0						Stop Fr 2.483347500 G
±0.0						CF St 669.500 F Auto M
50.0						Freq Off 0
70.0						Scale Ty
Center 2.4 Res BW	480000 GHz 3.0 MHz	#VBW	50 MHz	Sweep	Span 6.695 MHz 1.000 ms (1001 pts)	Log j
ISG				STAT	JS	



#### Test Plots (π/4DQPSK)

#### Peak Power (CH.0)



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

Keysight Spectrum Analyzer - Swept SA RL RF 50 Ω AC		SENSE:INT	ALIGN AUTO	07:45:19 PM Jan 07, 2021	6
Center Freq 2.44100000	O GHz	rig: Free Run	#Avg Type: RMS Avg Hold: 1/1	TRACE 2 2 4 5 0 TYPE MWWWWW DET P P P P P	Frequency
Ref Offset 7.7 dB 0 dB/div Ref 20.00 dBm			Mkr1	2.441 007 GHz 5.023 dBm	Auto Tur
10.0		1			Center Fre 2.441000000 GH
0.00					Start Fre 2.437607500 G
20.0					<b>Stop Fr</b> 2.444392500 G
40.0					CF Sto 678.500 k Auto M
50.0 50.0					Freq Offs 0
70.0					Scale Ty
Center 2.441000 GHz Res BW 3.0 MHz	#VBW 50	MHz	Sweep 1	Span 6.785 MHz .000 ms (1001 pts)	Log <u>L</u>
SG			STATUS		



Lin

Span 6.780 MHz Log Sweep 1.000 ms (1001 pts)

#### Test

Center 2.480000 GHz #Res BW 3.0 MHz

Test Plots (π/4DQPSK)					
Peak Power (CH.78)					
Keysight Spectrum Analyzer - Swept SA		SENSE:INT	ALIGN AUTO	07:45:30 PM Jan 07, 2021	
Center Freq 2.48000000	GHz PNO: Fast		#Avg Type: RMS Avg Hold: 1/1	TRACE 2 3 4 5 TYPE MWWWWW DET PPPPP	Frequency
	IFGain:Low	Atten: 24 dB	-		
Ref Offset 7.7 dB       10 dB/div     Ref 20.00 dBm       Log			Mkr1 2.4	479 952 54 GHz 4.775 dBm	Auto Tune
		l l			Center Freq
10.0					2.48000000 GHz
0.00					Start Freq
-10.0					2.476610000 GHz
-20.0					Stop Freq
-30.0					2.483390000 GHz
-40.0					CF Step 678.000 kHz
-50.0					Auto Man
					Freq Offset
-60.0					0 Hz
-70.0					Scale Type

#VBW 50 MHz



#### **10.2 BAND EDGES**

#### Without hopping

Outside Frequency Band	GFSK	8DPSK	π/4DQPSK	Limit
	(dB)	(dB)	(dB)	(dBc)
Lower	57.090	57.312	56.762	20
Upper	59.761	60.077	59.528	20

#### With hopping

Outside Frequency Band	GFSK	8DPSK	π/4DQPSK	Limit
	(dB)	(dB)	(dB)	(dBc)
Lower	54.201	55.832	54.707	20
Upper	50.273	50.820	50.048	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.

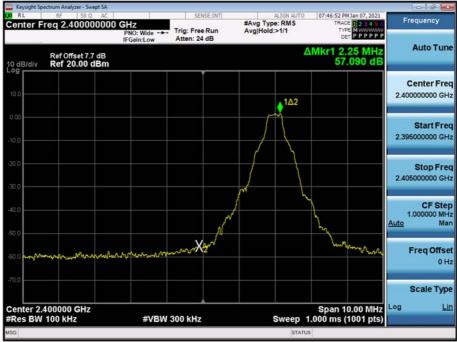
2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 7.70 dB at 2400 MHz and is 7.70 dB at 2500 MHz.

So, 7.70 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.

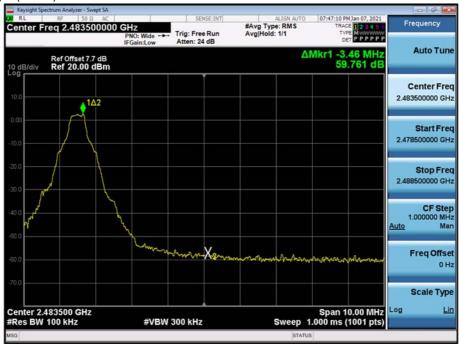


# Test Plots without hopping (GFSK)

Band Edges (CH.0)



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



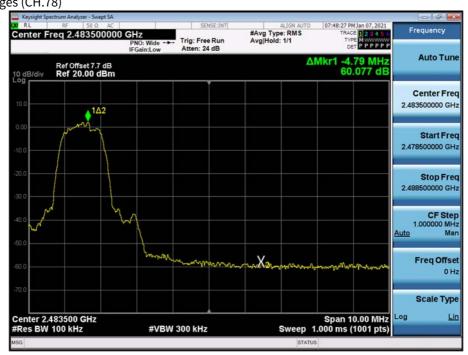


# Test Plots without hopping (8DPSK)

Band Edges (CH.0)



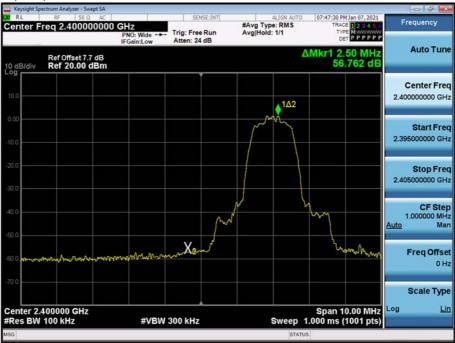
Test Plots without hopping (8DPSK) Band Edges (CH.78)



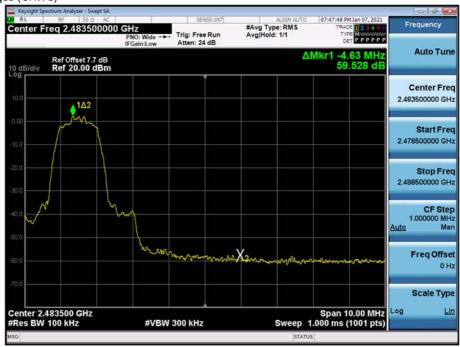


### Test Plots without hopping ( $\pi$ /4DQPSK)

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) ALIGN AUTO #Avg Type: RMS Avg|Hold: 1/1 Center Freq 2.483500000 GHz PNO: Wide -IFGain:Low RI SENSE:IN 07:54:25 PM Jan 07, 2021 Frequency TYPE MULTINE Trig: Free Run Atten: 24 dB Auto Tune ΔMkr1 -7.82 MHz 50.820 dB Ref Offset 7.7 dB Ref 20.00 dBm 0 dB/d Center Freq 2.483500000 GHz ▲1∆2 Start Freq 2.478500000 GHz Stop Freq 2.488500000 GHz CF Step 1.000000 MHz Man mo Auto X2 11 m Freq Offset 0 Hz Scale Type Center 2.483500 GHz #Res BW 100 kHz Span 10.00 MHz Sweep 1.000 ms (1001 pts) Log Lin #VBW 300 kHz



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



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





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

99% BW (kHz)								
Channel	GFSK	8DPSK	π/4DQPSK					
CH.0	904.76	1212.7	1208.4					
CH.39	903.66	1212.3	1208.1					
CH.78	904.23	1212.6	1208.2					

20dB BW (kHz)								
Channel	GFSK	8DPSK	π/4DQPSK					
CH.0	998.1	1341	1356					
CH.39	1003	1341	1357					
CH.78	997.0	1339	1356					

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



# Test Plots (GFSK)

#### **Channel Separation**



Test Plots (8DPSK) Channel Separation





# Test Plots (π/4DQPSK)

### **Channel Separation**

RL RL	Spectr	um A	nalyzer - Swept 50 Ω			SENSE:IN	7	ALIGN AUTO	07-55-47 0	4 Jan 07, 2021	_	0 0
	Fre			000 GHz PNO: Wid IFGain:Lo		g: Free Run tten: 20 dB	#Avg	Type: RMS Hold: 1/1	TRAC	E 1 2 3 4 5 6 E M	Fr	equency
) dB/div		Ref Ref	Offset 7.7 d 17.70 dB	в				ΔΝ	Akr3 1.0 -0.	01 MHz 107 dB		Auto Tur
2.30 2.3	~	~	~X2~	<b>````</b>	$\sim$	1Δ2	? ^~~~~~~		304	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		Center Fro
2.3 — 2.3 — 2.3 —											2.43	<b>Start Fr</b> 9500000 G
2.3 2.3 2.3											2.44	<b>Stop Fr</b> 2500000 G
Res BV	N 3	0 k	00 GHz Hz		/BW 100	kHz			1.019 ms		Auto	CF St 300.000 k M
KR MODE			(A)	× 1.001 MHz	(Δ)	9 0.042 dB	FUNCTION	FUNCTION WIDTH	FUNCTIO	ON VALUE ·		
2 F 3 Δ4 4 F 5	111	f f f	(Δ)	2.439 981 GHz 1.001 MHz 2.440 982 GHz	-0, (Δ) -	434 dBm 0.107 dB 476 dBm						Freq Offs 0
7												Scale Ty
0											Log	1
-		_				m			16			



#### 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)

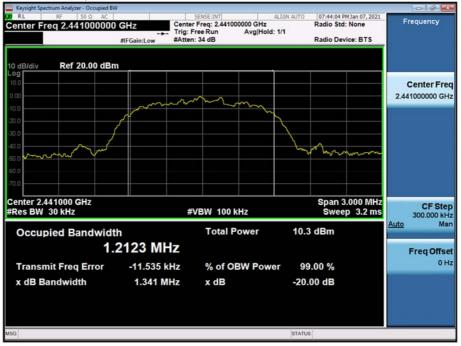
20 dB Bandwidth & Occupied Bandwidth (CH.0)





# Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



#### Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)





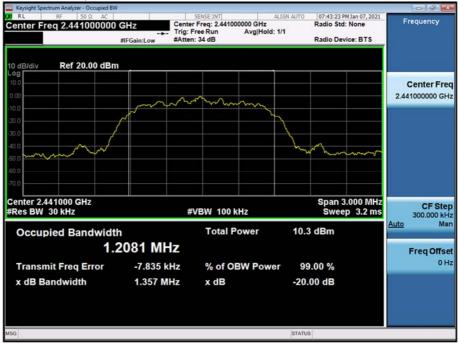
# Test Plots ( $\pi$ /4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



Test Plots ( $\pi$ /4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)





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

20 dB Bandwidth & Occupied Bandwidth (CH.78)





# **10.4 NUMBER OF HOPPING FREQUENCY**

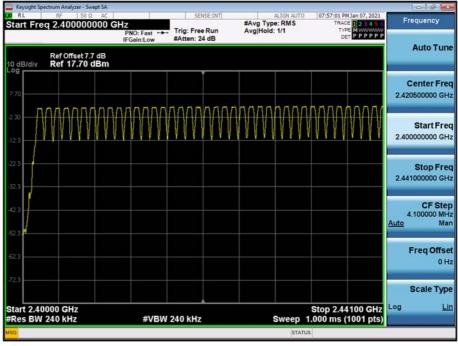
GFSK	8DPSK	π/4DQPSK	Limit
79	79 79		>15

#### Note :

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

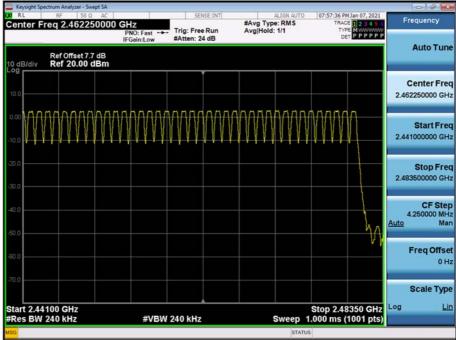


# Test Plots (GFSK) Number of Channels (2.4 GHz - 2.441 GHz)



# Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)

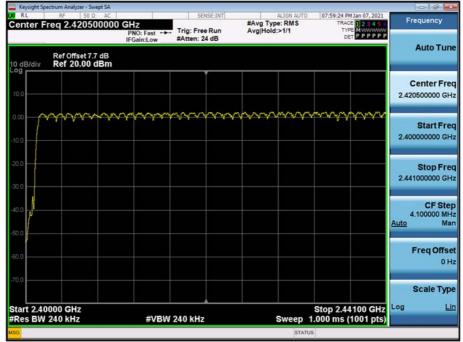


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# Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



#### Test Plots (8DPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)

Keysight Spectrum Analyzer - Swept SA	1 1 2000000			000
Center Freq 2.462250000		#Avg Type: RMS Avg Hold: 1/1	07:59:58 PM Jan 07, 2021 TRACE 1 2 3 4 5 0 TYPE	Frequency
Ref Offset 7.7 dB	PNO: Fast - Trig: Free Run IFGain:Low #Atten: 24 dB	Avgrou. In	DETPPPPP	Auto Tur
10.0				Center Fre 2.462250000 G
0.00 <b>000 000 000 000 000 000 000 000 00</b>			~~~~	<b>Start Fr</b> 2.441000000 G
20.0				Stop Fr 2.483500000 G
				CF St 4.250000 M Auto N
50.0				Freq Off 0
70.0 start 2.44100 GHz		SI	op 2.48350 GHz	Scale Ty Log
Res BW 240 kHz	#VBW 240 kHz	Sweep 1.0	00 ms (1001 pts)	





# Test Plots (π/4DQPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



# Test Plots (π/4DQPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)





# **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

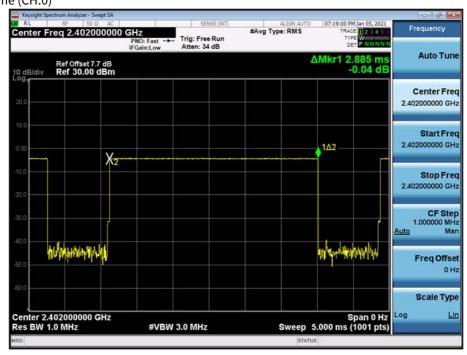
Total of	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Dwell	Low	307.73	308.27	308.27	31.6	
(ms)	Mid	307.73	308.27	308.27	31.6	400
	High	308.27	308.27	308.27	31.6	

#### AFH Mode

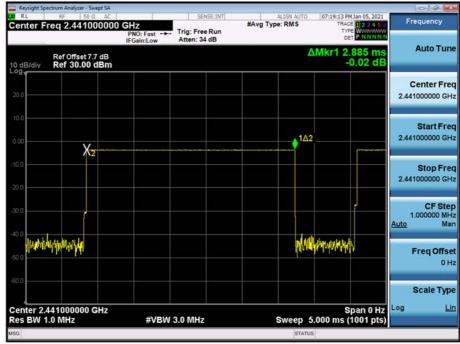
Total of	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Dwell	Low	153.87	154.13	154.13	8.0	
(ms)	Mid	153.87	154.13	154.13	8.0	400
	High	154.13	154.13	154.13	8.0	



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

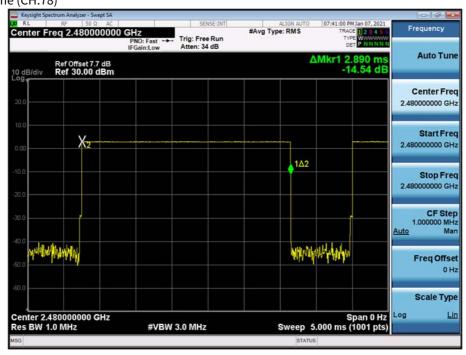


### Test Plots (GFSK) Dwell Time (CH.39)





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



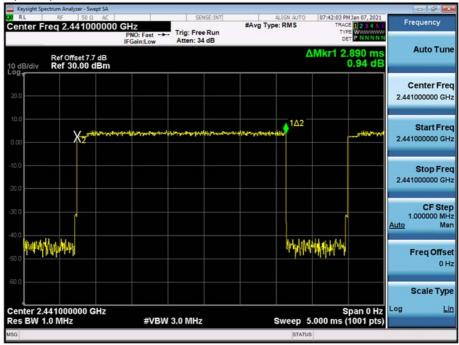
Test Plots (8DPSK) Dwell Time (CH.0)



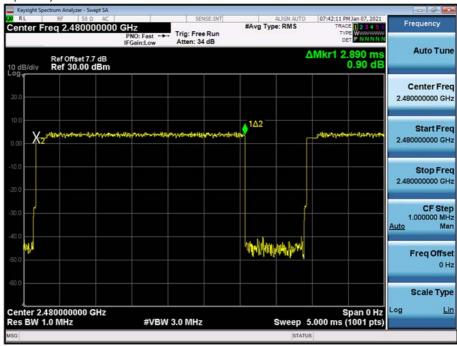


# Test Plots (8DPSK)

Dwell Time (CH.39)



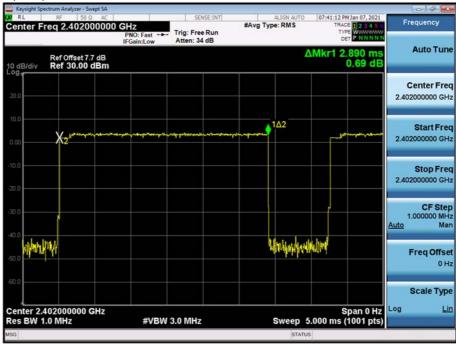
### Test Plots (8DPSK) Dwell Time (CH.78)





#### Test Plots (π/4DQPSK)

Dwell Time (CH.0)



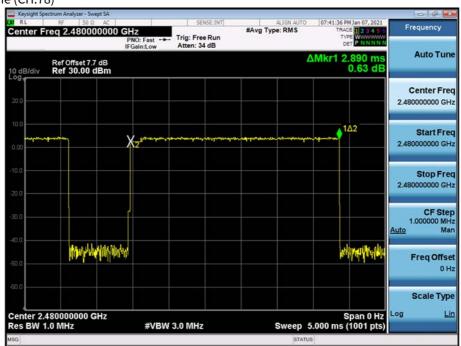
Test Plots (π/4DQPSK) Dwell Time (CH.39)





#### Test Plots (π/4DQPSK)

Dwell Time (CH.78)







### **10.6 SPURIOUS EMISSIONS**

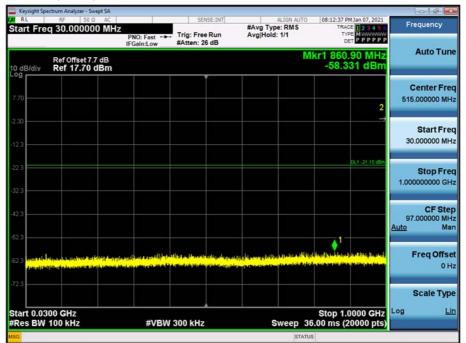
### **10.6.1 CONDUCTED SPURIOUS EMISSIONS**

Test Result : please refer to the plot below. In order to simplify the report, attached plots were only the worst case channel and data rate.

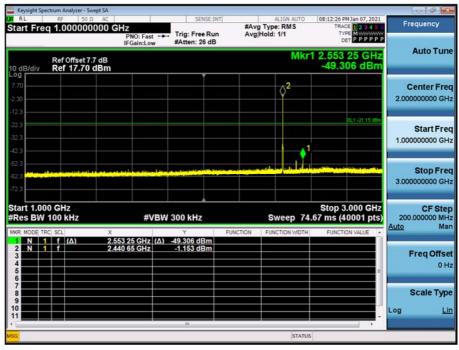


# Test Plots (8DPSK)- 30 MHz - 1 GHz

Spurious Emission (CH.39)



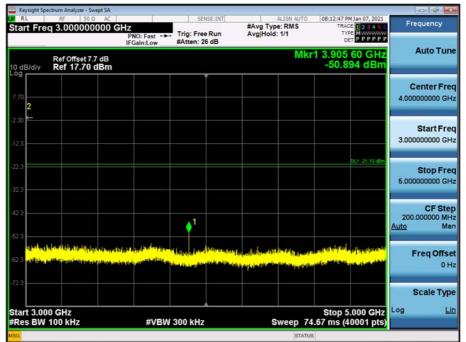
#### Test Plots (8DPSK)- 1 GHz – 3 GHz



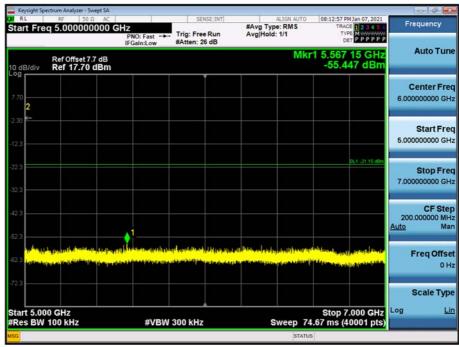


### Test Plots (8DPSK)- 3 GHz - 5 GHz

Spurious Emission (CH.39)



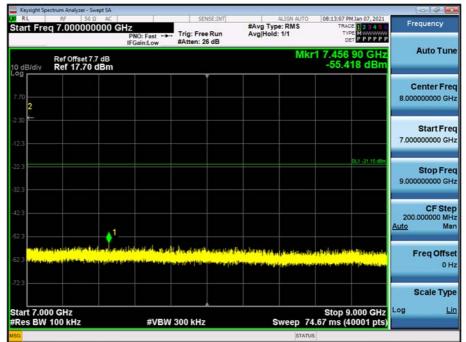
#### Test Plots (8DPSK)- 5 GHz - 7 GHz



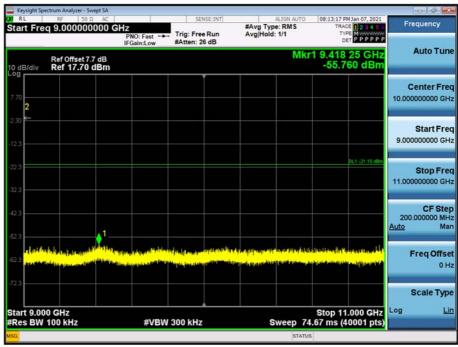


# Test Plots (8DPSK)- 7 GHz - 9 GHz

Spurious Emission (CH.39)



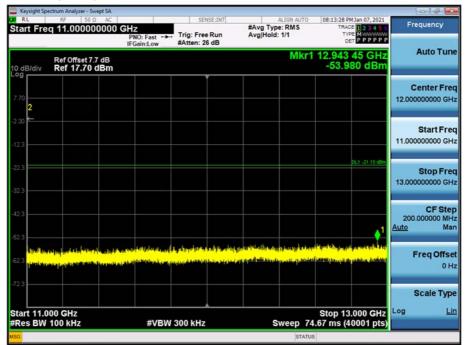
# Test Plots (8DPSK)- 9 GHz - 11 GHz





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

Spurious Emission (CH.39)



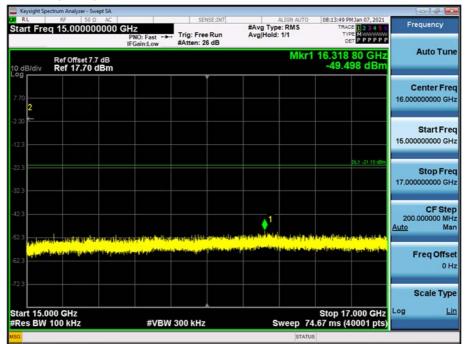
#### Test Plots (8DPSK)- 13 GHz - 15 GHz

RL RL	RF 50 Q AC	SENSE:INT	ALIGN AUTO	08:13:38 PM Jan 07, 2021	
tart Fre	q 13.000000000		#Avg Type: RMS Avg Hold: 1/1	TRACE 2 3 4 5 6 TYPE MWWWW DET P P P P P P	Frequency
) dB/div	Ref Offset 7.7 dB Ref 17.70 dBm		Mkr1	14.951 65 GHz -52.681 dBm	Auto Tur
.70 2					Center Fro 14.000000000 Gi
2.3					Start Fr 13.000000000 G
2.3				0L1-21.15 dBm	Stop Fr 15.00000000 G
2.3					CF St 200.000000 M <u>Auto</u> M
2.3 <sup>244</sup> (.)	a an	a na sa atan da ka		The second frequencies of the second	Freq Offs 0
2.3					Scale Ty
	000 GHz 100 kHz	#VBW 300 kHz	Sweep 74	Stop 15.000 GHz .67 ms (40001 pts)	Log
G			STATU	5	



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

Spurious Emission (CH.39)



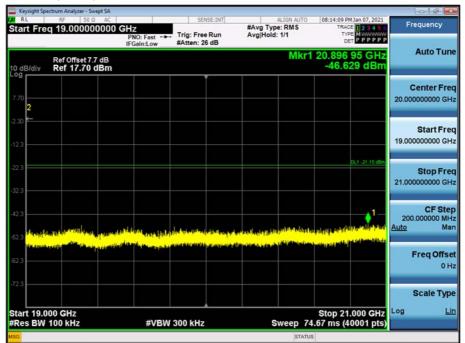
#### Test Plots (8DPSK)- 17 GHz - 19 GHz

Keysight Spectrum Analyzer - Swept SA       RL     RF     50 Ω     AC	SENSE:INT	ALIGN AUTO	08:13:59 PM Jan 07, 2021	
tart Freq 17.000000000		#Avg Type: RMS Avg Hold: 1/1	TRACE 2 3 4 5 0 TYPE M	Frequency
Ref Offset 7.7 dB dB/div Ref 17.70 dBm		Mkr1	18.916 65 GHz -46.750 dBm	Auto Tur
.70 2				Center Fre 18.000000000 GF
2.3				Start Fr 17.000000000 G
23			EL1 -21.15 dBm	<b>Stop Fr</b> 19.00000000 G
23	tra kandilikisi dafa ata sodi filasi judiba del	المتعادية ومتلاوم والماسط	1-	CF St 200.000000 M <u>Auto</u> M
2.3 And the state of the barrier in the state			e Regel Marson, se de la merio de la marson de la deplace	Freq Offs 0
2.3 tart 17.000 GHz			Stop 19.000 GHz	Scale Ty
Res BW 100 kHz	#VBW 300 kHz	Sweep 74	.67 ms (40001 pts)	



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

Spurious Emission (CH.39)



#### Test Plots (8DPSK)- 21 GHz - 23 GHz

RL RF 50 Ω AC		SENSE:INT	ALIGN AUTO	08:14:19 PM Jan 07, 2021	Frequency
tart Freq 21.00000000	PNO: Fast	Trig: Free Run #Atten: 26 dB	#Avg Type: RMS Avg Hold: 1/1	TYPE MWWWW DET PPPPP	Frequency
Ref Offset 7.7 dB dB/div Ref 17.70 dBm			Mkr1	21.229 15 GHz -45.921 dBm	Auto Tur
2 2					Center Fre 22.000000000 Gi
2.3					Start Fr 21.000000000 G
2.3				CL1 -21.15 dBm	Stop Fr 23.00000000 G
	usuraathikanskolahaalaad		and the state of the	lujtotok (relisitk) issoo	CF St 200.000000 M <u>Auto</u> N
2.3		fraith free alter free affects	in the black of a basis of the bill of the second of the bill of the b	anne dan serietat i Rollinia dinerae.	Freq Offs 0
2.3					Scale Ty
tart 21.000 GHz Res BW 100 kHz	#VBW 3	300 kHz	Sweep 74	Stop 23.000 GHz .67 ms (40001 pts)	Log



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

RL tart Fre	RF 50 Ω A			ISE:INT	#Avg Type		TRAC	4 Jan 07, 2021 E 1 2 3 4 5 0	Fre	quency
		PNO: Fast - IFGain:Low	Trig: Free #Atten: 2		Avg Hold:		DE	T P P P P P P		
0 dB/div	Ref Offset 7.7 dB Ref 17.70 dBr					Mkr1		15 GHz 81 dBm	-	Auto Tun
7.70 <b>2</b>										enter Fre
12.3										Start Fre
32.3								DL1-21.15 dBm		Stop Fre
2.3	wand strandstorth sta	in gung a spin kalden keiler	والمراجع والمراجع	Rifeen (j) en			an ya dindula in Mana a ma ƙasara	Contraction of	200.0 <u>Auto</u>	CF Ste
52.3 134-wir 52.3	n na hadin di na katala di katala di katala Mangana mangana katala di katala katala katala katala katala katala	in an an the first first the first state of the fir	and the second second						F	req Offs 0 I
72.3	100 GHz						Stop 25	.000 GHz	S	cale Typ
	100 kHz	#VB	W 300 kHz		S	weep 74	.67 ms (4	0001 pts)		



### **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)

Operation Mo	ode: CH Low(GF	SK)					
Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	- Detect
[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Delect
4804	44.87	2.98	V	47.85	73.98	26.13	PK
4804	30.14	2.98	V	33.12	53.98	20.86	AV
7206	40.49	9.57	V	50.06	73.98	23.92	PK
7206	26.62	9.57	V	36.19	53.98	17.79	AV
4804	44.28	2.98	Н	47.26	73.98	26.72	PK
4804	30.08	2.98	Н	33.06	53.98	20.92	AV
7206	40.28	9.57	Н	49.85	73.98	24.13	PK
7206	26.58	9.57	Н	36.15	53.98	17.83	AV
Operation Mo	ode: CH Mid(GF	SK)	1				
Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Detect
[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Delect
4882	42.71	3.33	V	46.04	73.98	27.94	PK
4882	28.78	3.33	V	32.11	53.98	21.87	AV
7323	40.71	10.20	V	50.91	73.98	23.07	PK
7323	27.12	10.20	V	37.32	53.98	16.66	AV
4882	41.99	3.33	н	45.32	73.98	28.66	PK
4882	28.64	3.33	Н	31.97	53.98	22.01	AV
7323	40.54	10.20	Н	50.74	73.98	23.24	PK
7323	27.09	10.20	Н	37.29	53.98	16.69	AV
Operation Mo	ode: CH High(G	FSK)		1			
Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Detect
[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Deteet
4960	41.98	2.36	V	44.34	73.98	29.64	PK
4960	28.44	2.36	V	30.80	53.98	23.18	AV
7440	40.46	10.72	V	51.18	73.98	22.80	PK
7440	27.02	10.72	V	37.74	53.98	16.24	AV
4960	42.61	2.36	Н	44.97	73.98	29.01	PK
4960	28.64	2.36	Н	31.00	53.98	22.98	AV
7440	40.28	10.72	Н	51.00	73.98	22.98	PK
7440	27.00	10.72	Н	37.72	53.98	16.26	AV



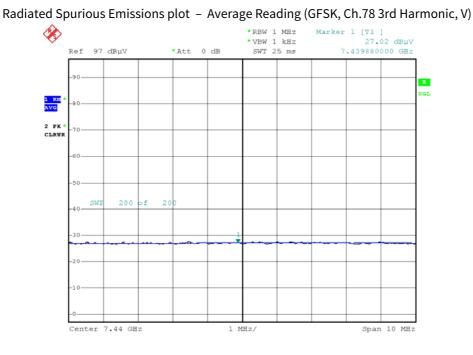
FrequencyReadingAN.+CL-AMP GANT. POLTotalLimitMargin (MarginPeres[MH2]dBuV(dB](H/V)(dBuV/m)(dBU/m)(dBUPK480444.582.98V47.5673.9826.42PK480430.242.98V49.7673.9820.76AV720640.199.57V49.7673.9824.22PK720626.699.57V36.2653.9817.72AV480430.082.98H46.2473.9827.74PK480430.082.98H33.0653.9820.92AV720640.119.57H49.6873.9824.30PK720640.119.57H33.0653.9820.92AV720626.699.57H33.0653.9820.92AV720640.119.57H36.0653.9820.92AV7206RedingAN.+CL-MPGNT.POLTotalLimitMargin[m42]GBUV[dB1[H/V][dBU/m][dBU/m][dB1Y488228.923.33V46.2073.9823.18PK488228.923.33H31.9053.9816.73AV732340.6010.20FK31.9053.9823.44PK732327.0510.20H31.9053.9	Operation Mo	ode: CH Low(π/	4DQPSK)					
[MH2]dBuV[dB][H/V][dBuV/m][dBuV/m][dB480444.582.98V47.5673.9826.42PK480430.242.98V33.2253.9820.76AV720640.199.57V49.7673.9824.22PK720626.699.57V36.2653.9817.72AV480443.262.98H46.2473.9827.74PK480430.082.98H36.0353.9820.92AV720640.119.57H36.0353.9824.30PK720626.649.57H36.0353.9824.30PK0peration Mote:CH Mid(n/UQPSK)TotalLimitMargin [dBuV/m]PeteeFrequencyReadingAN.+CL-AMP GANT. POLTotalLimitMargin [A333V32.2553.9821.73AV488242.873.33V32.2553.9816.73AVAV732327.0510.20V37.2553.9816.73AV732327.0510.20H37.2153.9816.73AV732327.0110.20H37.2153.9816.77AV732327.0110.20H37.2153.9816.77AV732327.0110.20H37.2153.9823.44PK7323 <td< td=""><td>Frequency</td><td>Reading</td><td>AN.+CL-AMP G</td><td>ANT. POL</td><td>Total</td><td>Limit</td><td>Margin</td><td>Dotoct</td></td<>	Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Dotoct
480430.242.98V33.2253.9820.76AV720640.199.57V49.7673.9824.22PK720626.699.57V36.2653.9817.72AV480443.262.98H46.2473.9827.74PK480430.082.98H33.0653.9820.92AV720640.119.57H49.6873.9824.30PK720626.469.57H36.0353.9817.75AVOperation Mode: CH Mid(n/JDQPSK)FrequencyReadingAN.+CL-AMP GANT. POLTotalLimitMargin[MH2]dBuV[dB][H/V][dBuV/m][dBuV/m][dB]PK488242.873.33V46.2073.9827.78PK488228.923.33V32.2553.9821.73AV732340.6010.20V50.8073.9823.18PK732327.0510.20V37.2553.9816.73AV488228.573.33H45.0273.9823.44PK732327.0110.20H37.2153.9816.77AVQperation Mode: CH High ( $\pi$ /DQPSK)FFFFFrequencyReadingAN.+CL-AMP GANT. POLTotalLimitMargin732327.0510.20H37.9153	[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Delect
720640.199.57V49.7673.9824.22PK720626.699.57V36.2653.9817.72AV480443.262.98H46.2473.9827.74PK480430.082.98H33.0653.9820.92AV720626.469.57H49.6873.9824.30PK720626.469.57H36.073.9824.30PK720626.469.57H36.073.9824.30PK720626.469.57H36.073.9824.30PK720626.479.57H36.073.9824.30PK720626.469.57H36.073.9824.30PK720626.479.57H36.073.9824.30PK720626.469.57H36.07TotalLimitMargin[MH2]dBuV[MB][H/V][dBuV/m][dBuV/m][dB[MH2]dBuV[dB][H/V][dBuV/m][dBuV/m][dB733327.0510.20V37.2553.9823.48PK732327.0510.20H31.9053.9823.44PK732327.0110.20H31.9053.9823.44PK732327.0110.20H31.9053.9816.77AV732327.0	4804	44.58	2.98	V	47.56	73.98	26.42	PK
$7206$ $26.69$ $9.57$ $V$ $36.26$ $53.98$ $17.72$ $AV$ $4804$ $43.26$ $2.98$ $H$ $46.24$ $73.98$ $27.74$ $PK$ $4804$ $30.08$ $2.98$ $H$ $33.06$ $53.98$ $20.92$ $AV$ $7206$ $40.11$ $9.57$ $H$ $49.68$ $73.98$ $24.30$ $PK$ $7206$ $26.46$ $9.57$ $H$ $36.03$ $53.98$ $17.95$ $AV$ $Operation Note: CH Mid(\pi/V UPSK)H36.0353.9817.95AVPrequencyReadingAN:-CL-AMP GANT.POLTotalLimitMargin[MH2]dBuV[dB][H/V][dBu//m][dB]PK488228.923.33V46.2073.9821.73AV732340.6010.20V37.2553.9816.73AV732327.0510.20V37.2553.9816.73AV488228.573.33H31.9053.9822.08AV732340.3410.20H37.2153.9816.77AV732340.3410.20H31.9053.9823.44PK732327.0110.20H37.2153.9816.77AV732340.3410.20H37.2153.9823.44$	4804	30.24	2.98	V	33.22	53.98	20.76	AV
480443.262.98H46.2473.9827.74PK480430.082.98H33.0653.9820.92AV720640.119.57H49.6873.9824.30PK720626.469.57H30.0353.9817.95AVOperation Mode: CH Mid(r/JUPSK)US3.9817.95AVSteadingAN.+CL-AMP GANT.POLTotalLimitMargin [dBuV/m][MHz]dBuV[dB][H/V][dBuV/m][dBuV/m][dB488228.923.33V46.2073.9827.78PK488228.923.33V32.2553.9816.73AV732340.6010.20V50.8073.9823.18PK732327.0510.20V37.2553.9816.73AV488228.573.33H45.0273.9828.96PK488228.573.33H31.9053.9816.77AV732327.0110.20H37.2153.9816.77AV732327.0110.20H37.2153.9816.77AV732327.0110.20H37.2153.9816.77AV732327.0110.20H37.2153.9816.77AV7400ABUV[dB][H/V][dBUV/m][dB]PK732327.01	7206	40.19	9.57	V	49.76	73.98	24.22	PK
4804     30.08     2.98     H     33.06     53.98     20.92     AV       7206     40.11     9.57     H     49.68     73.98     24.30     PK       7206     26.46     9.57     H     36.03     53.98     17.95     AV       Operation Moter     VEN     V	7206	26.69	9.57	V	36.26	53.98	17.72	AV
7206     40.11     9.57     H     49.68     73.98     24.30     PK       7206     26.46     9.57     H     36.03     53.98     17.95     AV       Operation Model (TA/DQPSK)     Frequency     Reading     AN.+CL-AMP G     ANT.POL     Total     Limit     Margin     Peter       [MHz]     dBuV     [dB]     [H/V]     [dBuVm]     [dBuV/m]     [dBuV/m]     PK       4882     42.87     3.33     V     46.20     73.98     27.78     PK       4882     28.92     3.33     V     32.25     53.98     21.73     AV       7323     40.60     10.20     V     50.80     73.98     23.18     PK       4882     28.57     10.20     V     37.25     53.98     16.73     AV       7323     40.34     10.20     H     31.90     53.98     22.08     AV       7323     27.01     10.20     H     37.21     53.98     16.77     AV <t< td=""><td>4804</td><td>43.26</td><td>2.98</td><td>Н</td><td>46.24</td><td>73.98</td><td>27.74</td><td>PK</td></t<>	4804	43.26	2.98	Н	46.24	73.98	27.74	PK
7206     26.46     9.57     H     36.03     53.98     17.95     AV       Operation Mode: CH Mid(rat/DQPSK)     Frequency     Reading     AN.+CL-AMP G     ANT. POL     Total     Limit     Margin     Peteo       [MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBuV/m]     [dB]     PK       4882     42.87     3.33     V     46.20     73.98     27.78     PK       4882     28.92     3.33     V     32.25     53.98     21.73     AV       7323     40.60     10.20     V     50.80     73.98     23.18     PK       7323     27.05     10.20     V     37.25     53.98     16.73     AV       4882     28.57     3.33     H     45.02     73.98     28.96     PK       4882     28.57     3.33     H     31.90     53.98     16.73     AV       7323     40.34     10.20     H     31.90     53.98     23.44     PK	4804	30.08	2.98	Н	33.06	53.98	20.92	AV
Operation Mode: CH Mid(π/4DQPSK)       Frequency     Reading     AN.+CL-AMP G     ANT. POL     Total     Limit     Margin     Detect       [MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBU/m]     [dB]     PK       4882     42.87     3.33     V     46.20     73.98     27.78     PK       4882     28.92     3.33     V     32.25     53.98     21.73     AV       7323     40.60     10.20     V     50.80     73.98     23.18     PK       7323     27.05     10.20     V     37.25     53.98     16.73     AV       4882     28.57     3.33     H     45.02     73.98     28.96     PK       4882     28.57     3.33     H     31.90     53.98     16.73     AV       7323     40.34     10.20     H     37.21     53.98     16.77     AV       Operation Mote: CH High (π/4DQPSK)     [dBuV     [dB]     [H/V]     [dBuV/m]     [dB]     P	7206	40.11	9.57	Н	49.68	73.98	24.30	PK
FrequencyReadingAN.+CL-AMP GANT. POLTotalLimitMargin <td>7206</td> <td>26.46</td> <td>9.57</td> <td>Н</td> <td>36.03</td> <td>53.98</td> <td>17.95</td> <td>AV</td>	7206	26.46	9.57	Н	36.03	53.98	17.95	AV
Image: MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dB]     [dB]       4882     42.87     3.33     V     46.20     73.98     27.78     PK       4882     28.92     3.33     V     32.25     53.98     21.73     AV       7323     40.60     10.20     V     50.80     73.98     23.18     PK       7323     27.05     10.20     V     50.80     73.98     28.96     PK       4882     41.69     3.33     H     45.02     73.98     28.96     PK       4882     28.57     3.33     H     31.90     53.98     22.08     AV       7323     27.01     10.20     H     50.54     73.98     23.44     PK       4882     28.57     3.33     H     31.90     53.98     16.77     AV       Operation Mode: CH High (π/4DQPSK)     Integer (π/4DQPSK)     Integer (π/4DQPSK)     Integer (mHz)     Margin     Detecter (MHz)       M460     28.42     2.36 <td>Operation Mo</td> <td>ode: CH Mid(π/4</td> <td>4DQPSK)</td> <td>1</td> <td></td> <td></td> <td></td> <td>1</td>	Operation Mo	ode: CH Mid(π/4	4DQPSK)	1				1
[MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBuV/m]     [dB]       4882     42.87     3.33     V     46.20     73.98     27.78     PK       4882     28.92     3.33     V     32.25     53.98     21.73     AV       7323     40.60     10.20     V     50.80     73.98     23.18     PK       7323     27.05     10.20     V     37.25     53.98     16.73     AV       4882     41.69     3.33     H     45.02     73.98     28.96     PK       4882     28.57     3.33     H     31.90     53.98     22.08     AV       7323     40.34     10.20     H     31.90     53.98     23.44     PK       7323     27.01     10.20     H     37.21     53.98     16.77     AV       Operation Mote: CH High (π/H2QPSK)     Total     Limit     Margin     Margin     10.72     V     30.78     53.98     23.20     PK	Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Detect
4882     28.92     3.33     V     32.25     53.98     21.73     AV       7323     40.60     10.20     V     50.80     73.98     23.18     PK       7323     27.05     10.20     V     37.25     53.98     16.73     AV       4882     41.69     3.33     H     45.02     73.98     28.96     PK       4882     28.57     3.33     H     31.90     53.98     22.08     AV       7323     40.34     10.20     H     50.54     73.98     23.44     PK       7323     27.01     10.20     H     37.21     53.98     16.77     AV       Operation Mote: CH High (π/4DQPSK)     Frequency     Reading     AN.+CL-AMP G     ANT. POL     Total     Limit     Margin     PK       4960     41.93     2.36     V     44.29     73.98     29.69     PK       4960     28.42     2.36     V     30.78     53.98     23.20     AV       744	[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Delect
732340.6010.20V50.8073.9823.18PK732327.0510.20V37.2553.9816.73AV488241.693.33H45.0273.9828.96PK488228.573.33H31.9053.9822.08AV732340.3410.20H50.5473.9823.44PK732327.0110.20H37.2153.9816.77AVOperation Mote: CH High (π/4DQPSK)H37.2153.9816.77AVFrequencyReadingAN.+CL-AMP GANT. POLTotalLimitMargin [dBuV/m]Detection[MHz]dBuV[dB][H/V][dBuV/m][dBuV/m][dB]PK496028.422.36V30.7853.9823.20AV744026.5510.72V37.2753.9816.71AV496028.582.36H44.6773.9829.69PK496042.312.36H44.6773.9829.31PK496042.312.36H30.9453.9823.04AV496028.582.36H30.9453.9823.04AV496028.582.36H30.9453.9823.04AV496028.582.36H30.9453.9823.04AV496028.582.36H30.945	4882	42.87	3.33	V	46.20	73.98	27.78	PK
732327.0510.20V37.2553.9816.73AV488241.693.33H45.0273.9828.96PK488228.573.33H31.9053.9822.08AV732340.3410.20H50.5473.9823.44PK732327.0110.20H37.2153.9816.77AVOperation K27.0110.20H37.2153.9816.77AVOperation K(High (π/4DQPSK))H37.2153.9816.77AVOperation Model: CH High (π/4DQPSK)ImitMargin (dB)Margin (dB)Detect[MHz]dBuV[dB][H/V][dBuV/m][dB]PK496041.932.36V44.2973.9829.69PK496028.422.36V30.7853.9823.20AV744040.4510.72V51.1773.9822.81PK744026.5510.72V37.2753.9816.71AV496042.312.36H44.6773.9829.31PK496028.582.36H30.9453.9823.04AV496028.582.36H30.9453.9823.04AV496028.582.36H30.9453.9823.04AV496028.582.36H30.9453.9823.04AV <td>4882</td> <td>28.92</td> <td>3.33</td> <td>V</td> <td>32.25</td> <td>53.98</td> <td>21.73</td> <td>AV</td>	4882	28.92	3.33	V	32.25	53.98	21.73	AV
4882     41.69     3.33     H     45.02     73.98     28.96     PK       4882     28.57     3.33     H     31.90     53.98     22.08     AV       7323     40.34     10.20     H     50.54     73.98     23.44     PK       7323     27.01     10.20     H     37.21     53.98     23.44     PK       7323     27.01     10.20     H     37.21     53.98     16.77     AV       Operation Mode: CH High (π/4DQPSK)     Frequency     Reading     AN.+CL-AMP G     ANT. POL     Total     Limit     Margin     Peter       [MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dB]     PK       4960     41.93     2.36     V     44.29     73.98     29.69     PK       4960     28.42     2.36     V     30.78     53.98     23.20     AV       7440     40.45     10.72     V     51.17     73.98     22.81     PK       4960	7323	40.60	10.20	V	50.80	73.98	23.18	PK
4882     28.57     3.33     H     31.90     53.98     22.08     AV       7323     40.34     10.20     H     50.54     73.98     23.44     PK       7323     27.01     10.20     H     37.21     53.98     16.77     AV       Operation Mode: CH High (π/4DQPSK)      53.98     16.77     AV       Image: CH High (π/4DQPSK)     AN.+CL-AMP G     ANT. POL     Total     Limit     Margin     Detect       [MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBu     PK       4960     41.93     2.36     V     44.29     73.98     29.69     PK       4960     28.42     2.36     V     30.78     53.98     23.20     AV       7440     40.45     10.72     V     31.17     73.98     22.81     PK       4960     42.31     2.36     H     44.67     73.98     23.04     AV       4960     28.58     2.36     H     30.94     53.98 <td>7323</td> <td>27.05</td> <td>10.20</td> <td>V</td> <td>37.25</td> <td>53.98</td> <td>16.73</td> <td>AV</td>	7323	27.05	10.20	V	37.25	53.98	16.73	AV
7323     40.34     10.20     H     50.54     73.98     23.44     PK       7323     27.01     10.20     H     37.21     53.98     16.77     AV       Operation Model CH High ( $\pi$ /4DQPSK)      53.98     16.77     AV       Frequency     Reading     AN.+CL-AMP G     ANT. POL     Total     Limit     Margin (dB)     Detect       [MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBuV/m]     [dB]     Detect       4960     41.93     2.36     V     44.29     73.98     29.69     PK       4960     28.42     2.36     V     30.78     53.98     23.20     AV       7440     40.45     10.72     V     51.17     73.98     22.81     PK       4960     42.31     2.36     H     44.67     73.98     29.31     PK       4960     42.31     2.36     H     30.94     53.98     16.71     AV       4960     28.58     2.36     H	4882	41.69	3.33	Н	45.02	73.98	28.96	PK
732327.0110.20H37.2153.9816.77AVOperation Mode: CH High (π/4DQPSK)FrequencyReadingAN.+CL-AMP GANT. POLTotalLimitMargin[MHz]dBuV[dB][H/V][dBuV/m][dBuV/m][dB]496041.932.36V44.2973.9829.69PK496028.422.36V30.7853.9823.20AV744040.4510.72V51.1773.9822.81PK744026.5510.72V37.2753.9816.71AV496042.312.36H44.6773.9829.31PK496028.582.36H30.9453.9823.04AV496040.1710.72H50.8973.9823.09PK	4882	28.57	3.33	Н	31.90	53.98	22.08	AV
Operation Mode: CH High (π/4DQPSK)     Frequency     Reading     AN.+CL-AMP G     ANT. POL     Total     Limit     Margin     Detect       [MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBuV/m]     [dB]     Detect       4960     41.93     2.36     V     44.29     73.98     29.69     PK       4960     28.42     2.36     V     30.78     53.98     23.20     AV       7440     40.45     10.72     V     51.17     73.98     22.81     PK       7440     26.55     10.72     V     37.27     53.98     16.71     AV       4960     42.31     2.36     H     44.67     73.98     29.31     PK       4960     28.58     2.36     H     30.94     53.98     23.04     AV       4960     28.58     2.36     H     30.94     53.98     23.04     AV       4960     28.58     2.36     H     30.94     53.98     23.09     PK  4	7323	40.34	10.20	Н	50.54	73.98	23.44	PK
Frequency     Reading     AN.+CL-AMP G     ANT. POL     Total     Limit     Margin     Deter       [MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBuV/m]     [dB]       4960     41.93     2.36     V     44.29     73.98     29.69     PK       4960     28.42     2.36     V     30.78     53.98     23.20     AV       7440     40.45     10.72     V     51.17     73.98     22.81     PK       7440     26.55     10.72     V     37.27     53.98     16.71     AV       4960     42.31     2.36     H     44.67     73.98     29.31     PK       4960     28.58     2.36     H     30.94     53.98     16.71     AV       4960     28.58     2.36     H     30.94     53.98     23.04     AV       4960     28.58     2.36     H     30.94     53.98     23.04     AV       7440     40.17     10.72 <t< td=""><td>7323</td><td>27.01</td><td>10.20</td><td>Н</td><td>37.21</td><td>53.98</td><td>16.77</td><td>AV</td></t<>	7323	27.01	10.20	Н	37.21	53.98	16.77	AV
Image: MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBuV/m]     [dB]     Detection       4960     41.93     2.36     V     44.29     73.98     29.69     PK       4960     28.42     2.36     V     30.78     53.98     23.20     AV       7440     40.45     10.72     V     51.17     73.98     22.81     PK       7440     26.55     10.72     V     37.27     53.98     16.71     AV       4960     42.31     2.36     H     44.67     73.98     29.31     PK       4960     28.58     2.36     H     30.94     53.98     16.71     AV       4960     28.58     2.36     H     30.94     53.98     23.04     AV       4960     28.58     2.36     H     30.94     53.98     23.04     AV       4960     28.58     2.36     H     50.89     73.98     23.09     PK       7440     40.17     10.72	Operation Mo	ode: CH High (π	/4DQPSK)					
[MHz]     dBuV     [dB]     [H/V]     [dBuV/m]     [dBuV/m]     [dB]       4960     41.93     2.36     V     44.29     73.98     29.69     PK       4960     28.42     2.36     V     30.78     53.98     23.20     AV       7440     40.45     10.72     V     51.17     73.98     22.81     PK       7440     26.55     10.72     V     37.27     53.98     16.71     AV       4960     42.31     2.36     H     44.67     73.98     29.31     PK       4960     28.58     2.36     H     30.94     53.98     16.71     AV       4960     28.58     2.36     H     30.94     53.98     23.04     AV       4960     28.58     2.36     H     30.94     53.98     23.04     AV       7440     40.17     10.72     H     50.89     73.98     23.09     PK	Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Detect
496028.422.36V30.7853.9823.20AV744040.4510.72V51.1773.9822.81PK744026.5510.72V37.2753.9816.71AV496042.312.36H44.6773.9829.31PK496028.582.36H30.9453.9823.04AV744040.1710.72H50.8973.9823.09PK	[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Dettet
7440     40.45     10.72     V     51.17     73.98     22.81     PK       7440     26.55     10.72     V     37.27     53.98     16.71     AV       4960     42.31     2.36     H     44.67     73.98     29.31     PK       4960     28.58     2.36     H     30.94     53.98     23.04     AV       7440     40.17     10.72     H     50.89     73.98     23.09     PK	4960	41.93	2.36	V	44.29	73.98	29.69	PK
7440     26.55     10.72     V     37.27     53.98     16.71     AV       4960     42.31     2.36     H     44.67     73.98     29.31     PK       4960     28.58     2.36     H     30.94     53.98     23.04     AV       7440     40.17     10.72     H     50.89     73.98     23.09     PK	4960	28.42	2.36	V	30.78	53.98	23.20	AV
4960     42.31     2.36     H     44.67     73.98     29.31     PK       4960     28.58     2.36     H     30.94     53.98     23.04     AV       7440     40.17     10.72     H     50.89     73.98     23.09     PK	7440	40.45	10.72	V	51.17	73.98	22.81	PK
4960     28.58     2.36     H     30.94     53.98     23.04     AV       7440     40.17     10.72     H     50.89     73.98     23.09     PK	7440	26.55	10.72	V	37.27	53.98	16.71	AV
7440 40.17 10.72 H 50.89 73.98 23.09 PK	4960	42.31	2.36	Н	44.67	73.98	29.31	PK
	4960	28.58	2.36	Н	30.94	53.98	23.04	AV
7440 26.27 10.72 H 36.99 53.98 16.99 AV	7440	40.17	10.72	Н	50.89	73.98	23.09	PK
	7440	26.27	10.72	Н	36.99	53.98	16.99	AV



Operation Mo	ode: CH Low(8[	PSK)					
Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Detect
[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Delect
4804	45.30	2.98	V	48.28	73.98	25.70	PK
4804	30.29	2.98	V	33.27	53.98	20.71	AV
7206	41.41	9.57	V	50.98	73.98	23.00	PK
7206	26.55	9.57	V	36.12	53.98	17.86	AV
4804	44.26	2.98	Н	47.24	73.98	26.74	PK
4804	30.14	2.98	Н	33.12	53.98	20.86	AV
7206	41.07	9.57	Н	50.64	73.98	23.34	PK
7206	26.42	9.57	Н	35.99	53.98	17.99	AV
Operation Mo	ode: CH Mid(8D	PSK)	1				
Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Detect
[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Dettett
4882	42.49	3.33	V	45.82	73.98	28.16	PK
4882	28.91	3.33	V	32.24	53.98	21.74	AV
7323	41.04	10.20	V	51.24	73.98	22.74	PK
7323	27.03	10.20	V	37.23	53.98	16.75	AV
4882	41.75	3.33	Н	45.08	73.98	28.90	PK
4882	28.49	3.33	н	31.82	53.98	22.16	AV
7323	41.00	10.20	Н	51.20	73.98	22.78	PK
7323	27.02	10.20	Н	37.22	53.98	16.76	AV
Operation Mo	ode: CH High(8	DPSK)	1				1
Frequency	Reading	AN.+CL-AMP G	ANT. POL	Total	Limit	Margin	Detect
[MHz]	dBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	
4960	42.07	2.36	V	44.43	73.98	29.55	PK
4960	28.45	2.36	V	30.81	53.98	23.17	AV
7440	39.87	10.72	V	50.59	73.98	23.39	PK
7440	26.44	10.72	V	37.16	53.98	16.82	AV
4960	42.52	2.36	Н	44.88	73.98	29.10	PK
4960	28.74	2.36	Н	31.10	53.98	22.88	AV
7440	39.57	10.72	Н	50.29	73.98	23.69	PK
7440	26.28	10.72	Н	37.00	53.98	16.98	AV

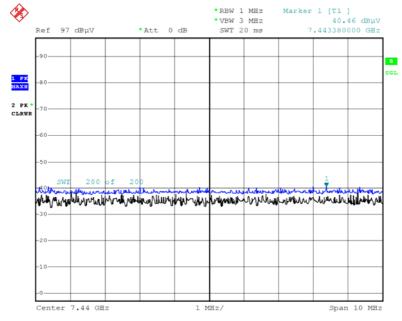


HCT



Date: 6.JAN.2021 20:08:44

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



Date: 6.JAN.2021 20:08:58

#### 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	AN.+CL -AMP G	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Detect
[MHz]	dBuV	[dB]	[H/V]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[dB]
2390.0	47.26	0.94	н	0	48.20	73.98	25.78	PK
2390.0	37.68	0.94	Н	-24.73	13.89	53.98	40.09	AV
2390.0	48.07	0.94	V	0	49.01	73.98	24.97	PK
2390.0	38.56	0.94	V	-24.73	14.77	53.98	39.21	AV
2483.5	56.48	1.20	н	0	57.68	73.98	16.30	PK
2483.5	52.45	1.20	Н	-24.73	28.91	53.98	25.07	AV
2483.5	57.79	1.20	V	0	58.99	73.98	14.99	PK
2483.5	55.08	1.20	V	-24.73	31.54	53.98	22.44	AV

Operation Mode Operating Frequency

Channel No

EDR(π/4DQPSK) 2402 MHz, 2480 MHz CH 0, CH 78

Frequency	Reading	AN.+CL -AMP G	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Detect
[MHz]	dBuV	[dB]	[H/V]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[dB]
2390.0	47.99	0.94	н	0	48.93	73.98	25.05	PK
2390.0	37.74	0.94	Н	-24.73	13.95	53.98	40.03	AV
2390.0	48.55	0.94	V	0	49.49	73.98	24.49	PK
2390.0	38.13	0.94	V	-24.73	14.34	53.98	39.64	AV
2483.5	59.00	1.20	Н	0	60.20	73.98	13.78	PK
2483.5	52.54	1.20	Н	-24.73	29.00	53.98	24.98	AV
2483.5	60.43	1.20	V	0	61.63	73.98	12.35	PK
2483.5	55.66	1.20	V	-24.73	32.12	53.98	21.86	AV

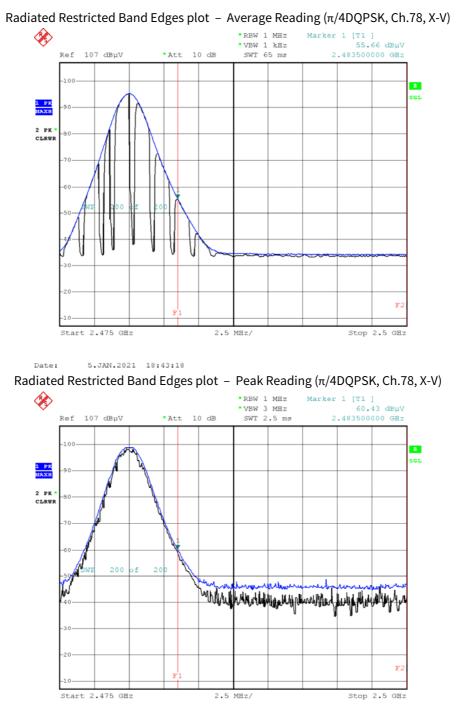


Operation Mode	EDR(8DPSK)
Operating Frequency	2402 MHz, 2480 MHz
Channel No	СН 0, СН 78

Frequency	Reading	AN.+CL -AMP G	ANT. POL	Duty Cycle Correction	Total	Limit	Margin	Detect
[MHz]	dBuV	[dB]	[H/V]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[dB]
2390.0	47.60	0.94	Н	0	48.54	73.98	25.44	PK
2390.0	37.56	0.94	Н	-24.73	13.77	53.98	40.21	AV
2390.0	48.11	0.94	V	0	49.05	73.98	24.93	PK
2390.0	38.03	0.94	V	-24.73	14.24	53.98	39.74	AV
2483.5	58.96	1.20	Н	0	60.16	73.98	13.82	PK
2483.5	52.42	1.20	Н	-24.73	28.88	53.98	25.10	AV
2483.5	60.25	1.20	V	0	61.45	73.98	12.53	PK
2483.5	55.83	1.20	V	-24.73	32.29	53.98	21.69	AV



# RESULT PLOTS



Date: 5.JAN.2021 18:43:38

### Note:

Plot of worst case are only reported.



# **11. LIST OF TEST EQUIPMENT**

#### **Conducted Test**

Manufacture		Calibratio	Calibratio		
	Model / Equipment	n	n	Serial No.	
r		Date	Interval		
Rohde &		00/04/2020	امريم	102245	
Schwarz	ENV216 / LISN	09/04/2020	Annual	102245	
Rohde &	ESCI / Test Receiver	06/10/2020	Annual	100584	
Schwarz	ESCI / Test Receiver	06/10/2020	Annual	100564	
ESPAC	SU-642 /Temperature Chamber	03/18/2020	Annual	0093008124	
Agilent	N9030A / Signal Analyzer	01/11/2021	Annual	MY49431210	
Rohde &	OSD 120 / Dowor Moscuroment Set	- 07/02/2020	Annual	101231	
Schwarz	OSP 120 / Power Measurement Set	07/02/2020	Annual	101231	
Agilent	N1911A / Power Meter	04/07/2020	Annual	MY45100523	
Keysight	N1921A / Power Sensor	06/08/2020	Annual	MY57820067	
Agilent	87300B / Directional Coupler	11/10/2020	Annual	3116A03621	
Hewlett	11007D / Dower Calitter	05/25/2020	معمدها	05001	
Packard	11667B / Power Splitter	05/25/2020	Annual	05001	
Hewlett	E3632A / DC Power Supply	06/12/2020	Annual	KD75202060	
Packard	ES032A/ DC Power Supply	00/12/2020	Annual	KR75303960	
Agilent	8493C / Attenuator(10 dB)	06/26/2020	Annual	07560	
Rohde &	EMC32 / Software	N/A	N/A	N/A	
Schwarz		IN/A	IN/A	IN/A	
HCT CO., LTD.	FCC WLAN&BT&BLE Conducted	N/A	N/A	N/A	
ner co., ETD.	Test Software v3.0	11/74	IN/A	N/A	
Rohde &	CBT / Bluetooth Tester	05/12/2020	Annual	100422	
Schwarz		03/12/2020	Aiiiuat	100422	
Agilent	11636A / Power Divider	07/24/2020	Annual	9109	
Agilent	N5182A / Vector Signal Generator	08/26/2020	Annual	MY50140312	

#### Note:

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

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



#### **Radiated Test**

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Emco	2090 / Controller	N/A	N/A	060520
Ets	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	05/18/2020	Biennial	1513-175
Schwarzbeck	VULB 9160 / Hybrid Antenna	08/19/2020	Biennial	9160-3368
Schwarzbeck	VULB 9168 / Hybrid Antenna	09/04/2020	Biennial	9168-0895
Schwarzbeck	BBHA 9120D / Horn Antenna	11/18/2019	Biennial	9120D-1191
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	11/29/2019	Biennial	BBHA9170541
Rohde & Schwarz	FSP(9 kHz ~ 30 GHz) / Spectrum Analyzer	09/14/2020	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/22/2020	Annual	101068-SZ
Wainwright Instruments	WRCJV2400/2483.5-2370/2520- 60/12SS / Band Reject Filter	01/06/2021	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	02/10/2020	Annual	1
CERNEX	CBLU1183540B-01/Broadband Bench Top LNA 56-10 / Attenuator(10 dB)	12/23/2020	Annual	N/A
CERNEX Api tech.	CBL06185030 / Broadband Low Noise Amplifier 18B-03 / Attenuator (3 dB)	12/23/2020	Annual	N/A
Wainwright Instruments	WHKX10-2700-3000-18000-40SS / High Pass Filter	12/23/2020	Annual	N/A
Wainwright Instruments	WHKX8-6090-7000-18000-40SS / High Pass Filter	12/23/2020	Annual	N/A
T&M SYSTEM	COAXIAL ATTENUATOR / Thru	12/23/2020	Annual	N/A
CERNEX	CBL18265035 / Power Amplifier	12/04/2020	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	03/23/2020	Annual	25956
TESCOM	TC-3000C / Bluetooth Tester	03/18/2020	Annual	3000C000276

#### 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-2101-FC113-P	