

FCC BT REPORT

Certification

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Date of Issue: September 27, 2018 Test Site/Location:

HCT CO., LTD., 74,Seoicheon-ro 578beon-gil,Majangmyeo,Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA **Report No.:** HCT-RF-1809-FC104

FCC ID:

TQ8-ATB30SNAN

APPLICANT: HYUNDAI MOBIS CO., LTD.

Model:	ATB30SNAN
EUT Type:	Car Audio System
Max. RF Output Power:	1.654 dBm (1.464 mW)
Frequency Range:	2402 MHz - 2480 MHz (Bluetooth)
Modulation type	GFSK(Normal), π /4DQPSK and 8DPSK(EDR)
FCC Classification:	FCC Part 15 Spread Spectrum Transmitter
FCC Rule Part(s):	Part 15 subpart C 15.247

The measurements shown in this report were made in accordance with the procedures specified in §2.947. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

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As

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Version

TEST REPORT NO.	DATE	DESCRIPTION	
HCT-RF-1809-FC104	September 27, 2018	- First Approval Report	



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1. EUT DESCRIPTION

Model	ATB30SNAN	
ЕИТ Туре	Car Audio System	
Power Supply	DC 14.4 V	
Frequency Range	2402 MHz - 2480 MHz	
Max. RF Output Power	1.654 dBm (1.464 mW)	
BT Operating Mode	Normal, EDR, AFH	
Modulation Type	GFSK(Normal), π/4DQPSK and 8DPSK(EDR)	
Modulation Technique	FHSS	
Bluetooth Version	3.0	
Number of Channels	79 Channels, Minimum 20 Channels(AFH)	
Antenna Specification	Antenna type: Chip Antenna Peak Gain : -0.10 dBi	
Date(s) of Tests	September 10, 2018 ~ September 17, 2018	

2. Requirements for Bluetooth transmitter(15.247)

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

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

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

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



3. TEST METHODOLOGY

FCC KDB 558074 D01 15.247 Meas Guidance v05 dated August 24, 2018 entitled "guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices and the measurement procedure described in ANSI C63.10(Version : 2013) 'the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices'.

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 3.75 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 8 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).

Conducted Antenna Terminal

See Section from 7.8.2 to 7.8.8.(ANSI 63.10-2013)

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."

- * The antennas of this E.U.T are permanently attached.
- * 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)	5.71



8. DESCRIPTION OF TESTS

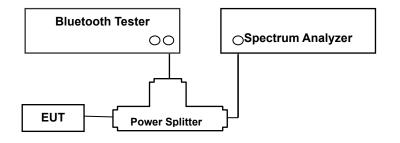
8.1. Conducted Maximum Peak Output Power

<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)

- 1) Span: approximately 5 times the 20 dB bandwidth, centered on a hopping channel
- 2) RBW > the 20 dB bandwidth of the emission being measured
- 3) VBW ≥ RBW
- 4) Sweep = Auto
- 5) Detector = Peak
- 6) Trace = Max hold

Sample Calculation

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

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

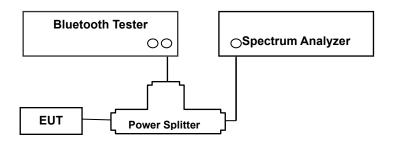


8.2. Conducted Band Edge(Out of Band Emissions)

<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)

- 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

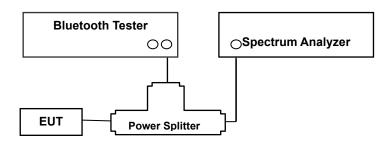


8.3. Frequency Separation & 20 dB Bandwidth

<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

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)

- 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.

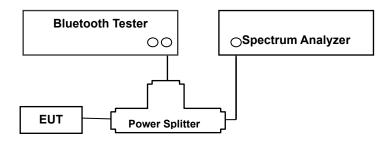


8.4. Number of Hopping Frequencies

<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)

- 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.

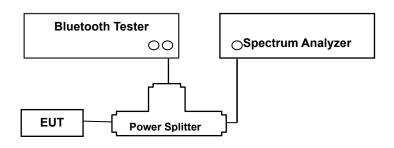


8.5. Time of Occupancy

<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)

- 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.

* Mon-AFH Mode

- DH 5 (GFSK) : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)
- 2-DH 5 (π/4DQPSK) : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)
- 3-DH 5 (8DPSK) : 2.890 * (1600/6)/79 * 31.6 = 308.27 (ms)

* AFH Mode

- DH 5 (GFSK) : 2.890 * (800/6)/20 * 8.0 = 154.13 (ms)
- 2-DH 5 (π/4DQPSK) : 2.890 * (800/6)/20 * 8.0 = 154.13 (ms)
- 3-DH 5 (8DPSK) : 2.890 * (800/6)/20 * 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 * 106.667 = 308.27 (ms)

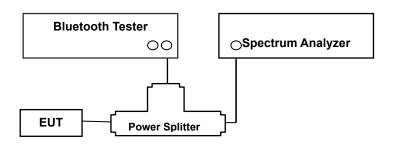


8.6. Conducted Spurious Emissions

<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)

- 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	7.48
100	6.65
200	7.34
300	6.88
400	6.56
500	6.25
600	6.47
700	6.64
800	7.02
900	7.38
1000	7.68
2000	7.51
2400*	7.7
2500*	7.74
3000	8.18
4000	9.25
5000	9.87
6000	6.98
7000	10.29
8000	8.64
9000	9.91
10000	10.77
11000	9.26
12000	10.03
13000	9.14
14000	9.8
15000	11.84
16000	8.44
17000	12.03
18000	10.01
19000	10.7
20000	11.99
21000	11.02
22000	12.61
23000	10.15
24000	12.82
25000	11.37
26000	10.8

Note : 1. '*' is fundamental frequency range.

2. Factor = Cable loss + Splitter loss



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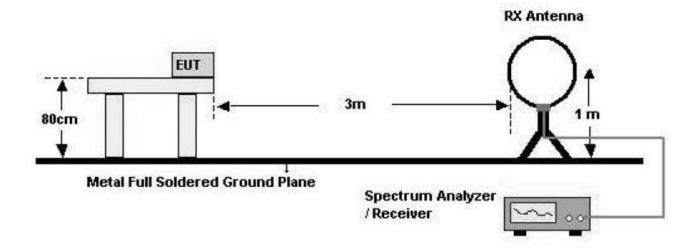
8.7. Radiated Test

Li	im	it

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

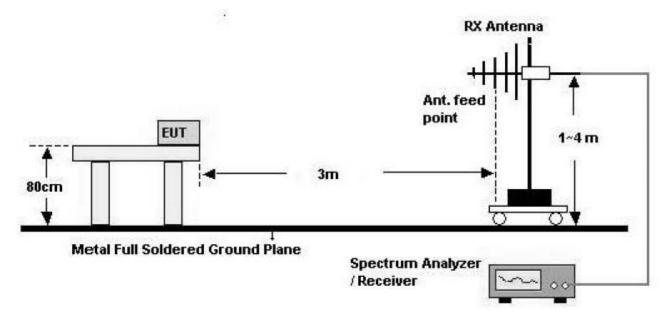
Test Configuration

Below 30 MHz

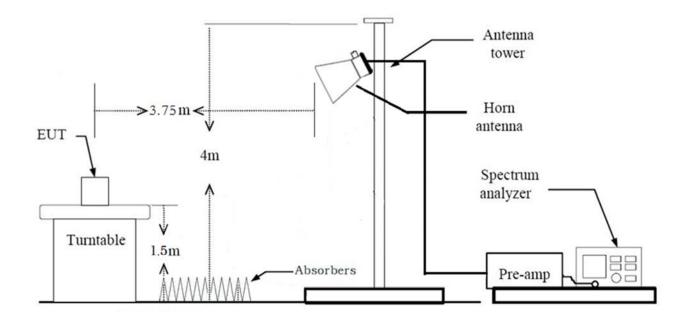




30 MHz - 1 GHz



Above 1 GHz





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 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- 6. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
 *Distance extrapolation factor = 20*log (test distance / specific distance) (dB)
- 7. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 8. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 9. The unit was tested with its standard battery.
- 10. Spectrum Setting
 - (1) Measurement Type(Peak):
 - Measured Frequency Range : 1 GHz 25 GHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 1 MHz
 - VBW ≥ 3*RBW
 - (2) Measurement Type(Average):
 - We performed using a reduced video BW method was done with the analyzer in linear mode
 - Measured Frequency Range : 1 GHz 25 GHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 1 MHz
 - VBW \ge 1/T Hz, where T = pulse width in seconds
 - The actual setting value of VBW = 1 kHz
- 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.
- 12. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) Amp Gain(G) + Distance Factor(D.F)



Test Procedure of Radiated Restricted Band Edge

- 1. Radiated test is performed with hopping off.
- 2. The EUT is placed on a turntable, which is 1.5 m above ground plane.
- 3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
- 4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 5. EUT is set 3.75 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- 6. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
 *Distance extrapolation factor = 20*log (test distance / specific distance) (dB)
- 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):
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 1 MHz
 - VBW ≥ 3*RBW
 - (2) Measurement Type(Average):
 - We performed using a reduced video BW method was done with the analyzer in linear mode
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 1 MHz
 - VBW \ge 1/T Hz, where T = pulse width in seconds

The actual setting value of VBW = 1 kHz

- 10. Total(Measurement Type : Peak)
 - = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

Total(Measurement Type : Average)

- = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
- + Duty Cycle Correction Factor



- 11. Duty Cycle Correction Factor (79 channel hopping)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H '=1
 - c. Worst Case Dwell Time = τ [ms] x H ' = 2.9 ms
 - d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
- 12. Duty Cycle Correction Factor(AFH mode minimum channel number case 20 channels)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ 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



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 μ H/50 ohms line impedance stabilization network (LISN).

	Limits (dBµV)		
Frequency Range (MHz)	Quasi-peak	Average	
0.15 to 0.50	66 to 56*	56 to 46*	
0.50 to 5	56	46	
5 to 30	60	50	

*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.

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
 - Worstcase : Stand alone
- 2. EUT Axis
 - Radiated Spurious Emissions : X
 - Radiated Restricted Band Edge : X
- 3. We applied DCCF in the test result which hopping channel number is 20.
- 4. 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

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		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			<u>See</u> <u>Note1</u>
Radiated Spurious Emissions	\$15.247(d), ins 15.205, cf. Section 8.7 15.209		Dedicted	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.7		PASS

Note:

1. This device is installed in a car. Therefore the power source is a battery of car.



10. TEST RESULT

10.1 PEAK POWER

Channel	Frequency	Output Power (GFSK)		Limit
	(MHz)	(dBm)	(mW)	(mW)
Low	2402	-0.174	0.961	
Mid	2441	-0.169	0.962	125
High	2480	0.186	1.044	

Channel	Frequency	Output Power (8DPSK)		Limit
	(MHz)	(dBm)	(mW)	(mW)
Low	2402	1.266	1.338	
Mid	2441	1.321	1.356	125
High	2480	1.654	1.464	

Channel	Frequency	Outpu (π/4D	Limit	
	(MHz)	(dBm)	(mW)	(mW)
Low	2402	0.652	1.162	
Mid	2441	0.690	1.172	125
High	2480	1.065	1.278	

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.

So, 7.7 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)

ASG				STATUS			
Center 2.402000 GHz #Res BW 3.0 MHz	#VBW 50 MH	z	ş	Sweep 1.	Span 4.: 000 ms (1	882 MHz 001 pts)	
.80.0							01
70.0							Freq Offs
60.0							Auto Ma
50.0							CF Ste 488,170 kl
40.0						_	2.404440849 GI
30.0							Stop Fre
20.0							2.399559151 G
10.0							Start Fre
0.00		·					2.402000000 G
-og		1					Center Fre
Ref Offset 7.7 dB 0 dB/div Ref 10.00 dBm				Mkr1	2.401 99 -0.17	90 GHz '4 dBm	Auto Tu
Center Freq 2.40200000	PNO: Fast ++ Trig: Fi IFGain:Low Atten:	ree Run 14 dB	Avg Hold:	1/1	TYPE	1 2 3 4 3 6 M P P P P P P P	
Agilent Spectrum Analyzer - Swept SA RL RF 50 Ω AC		SENSE:INT	#Avg Type	LIGN AUTO		Sep 11, 2018	Frequency

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

📕 Agilent Spectrum Analyzer - Swept SA					
Center Freq 2.441000000			#Avg Type: RMS Avg Hold: 1/1		Frequency
Ref Offset 7.7 dB 0 dB/div Ref 10.00 dBm	IFGain:Low Auen. In		М	kr1 2.441 064 GHz -0.169 dBm	Auto Tun
• • • • • • • • • • • • • • • • • • •		∮ ¹			Center Fre 2.441000000 GH
20.0					Start Fre 2.438557659 GH
0.0					Stop Fre 2.443442341 GF
					CF Ste 488.468 ki Auto Mi
0.0					Freq Offs 0 I
enter 2.441000 GHz Res BW 3.0 MHz	#VBW 50 MHz		Swoo	Span 4.885 MHz p 1.000 ms (1001 pts)	
			1.000	TATUS	



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

Agilent Spectrum Analyzer - Swept SA				- 6 -
24 RL RF 50Ω AC Center Freq 2.480000000	PNO: Fast Trig: Free Run	#Avg Type: RMS Avg Hold: 1/1	07:03:02 PM Sep 11, 2018 TRACE 2 3 4 5 6 TYPE M DET P P P P P P	Frequency
Ref Offset 7.7 dB 10 dB/div Ref 10.00 dBm	IFGain:Low Atten: 14 dB	Mkr1	2.480 029 GHz 0.186 dBm	Auto Tune
0.00	1			Center Free 2.480000000 GH:
-10.0				Start Free 2.477561666 GH
-30.0				Stop Fre 2.482438334 GH
50.0				CF Ste 487.667 kH Auto Ma
70.0				Freq Offse 0 H
Center 2.480000 GHz #Res BW 3.0 MHz	#VBW 50 MHz	Swaan	Span 4.877 MHz .000 ms (1001 pts)	
MSG	#4B44 50 14112	Sweep		

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





Test Plots (8DPSK)

Peak Power (CH.39)

Agilent Spectrum Analyzer - Swept SA		eure url			- 6 🐱
x RL RF 50Ω AC Center Freq 2.44100000	0 GHz	ee Run	#Avg Type: RMS Avg Hold: 1/1	07:04:01 PM Sep 11, 2018 TRACE 1 2 3 4 5 6 TYPE M	Frequency
	IFGain:Low Atten:			DET PPPPP	Auto Tune
Ref Offset 7.7 dB 10 dB/div Ref 10.00 dBm			MKF1 2.4	1.321 dBm	
		↓ ¹			Center Fre
0.00					2.441000000 GH
10.0					Start Fre
20.0					2.437780000 GH
30.0					Stop Fre
40.0					2.444220000 GH
50.0					CF Ste
					644.000 kH Auto Ma
50.0					Freq Offs
70.0					0 Freq Onso
30.0					
Center 2.441000 GHz Res BW 3.0 MHz	#VBW 50 MH	z	Sweep 1	Span 6.440 MHz .000 ms (1001 pts)	
ISG			K STATUS		

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





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

	trum Analyzer - Swept SA						
Center F	RF 50 Ω AC req 2.402000000	GHz	SENSE:INT	#Avg Type: F	RMS	TRACE 1 2 3 4 5 6	Frequency
		PNO: Fast ++- IFGain:Low	Trig: Free Run Atten: 14 dB	Avg Hold: 1/			Auto Tune
10 dB/div Log	Ref Offset 7.7 dB Ref 10.00 dBm					0.652 dBm	
			▲1				Center Fred
0.00							2.402000000 GHz
-10.0							
The second se							Start Fred 2.398810000 GHz
-20.0							2.398810000 GH2
-30.0							Stop Fred
-40.0							2.405190000 GH
-40.0							
-50.0							CF Step 638.000 kH:
-60.0							Auto Mar
							Freq Offse
-70.0							0 Hz
-80.0							
	102000 GHz	10.001	CO. 1411-		Sp	an 6.380 MHz	
#Res BW	3.0 MHZ	#VBW	50 MHz		status	ms (1001 pts)	
100					0 014105		

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





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

							Analyzer - Swept SA	
Frequency	:03:38 PM Sep 11, 2018 TRACE 1 2 3 4 5 6		#Avg Ty	SENSE:INT		GHz	RF 50 Ω AC 2.480000000	RL
Auto Tune	туре DET РРРРРР 140 36 GHz		Avg Hol	ree Run : 14 dB	Atten:	PNO: Fast ++ IFGain:Low	ef Offset 7.7 dB	
	1.065 dBm						ef 10.00 dBm	dB/div g
Center Freq 2.48000000 GHz				♦ ¹				00
								10
Start Freq 2.476810000 GHz								1.0
Stop Fred 2.483190000 GHz								
								.0
CF Step 638.000 kH: Auto Mar								.0
Freg Offse								.0
0 Ha								.0
								.0
	oan 6.380 MHz ms (1001 pts)	Sweep 1.		z	/ 50 MHz	#VBM	000 GHz MHz	enter 2.4 tes BW 3
	na an an third and a	STATUS						



10.2 BAND EDGES

Without hopping

Outside Frequency Pand	GFSK	8DPSK	π/4DQPSK	Limit
Outside Frequency Band	(dB)	(dB)	(dB)	(dBc)
Lower	62.052	60.899	60.636	20
Upper	64.692	66.000	64.880	20

With hopping

Outside Frequency Dand	GFSK	8DPSK	π/4DQPSK	Limit
Outside Frequency Band	(dB)	(dB)	(dB)	(dBc)
Lower	57.191	58.152	57.136	20
Upper	58.388	58.721	59.269	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.

So, 7.7 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.

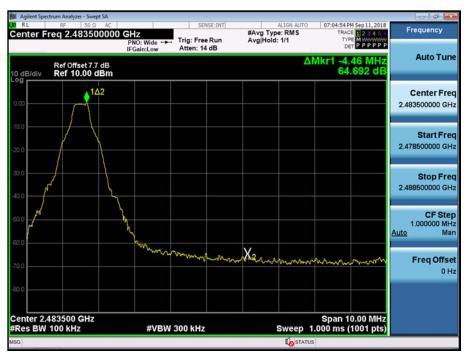


Test Plots without hopping (GFSK)

Band Edges (CH.0)

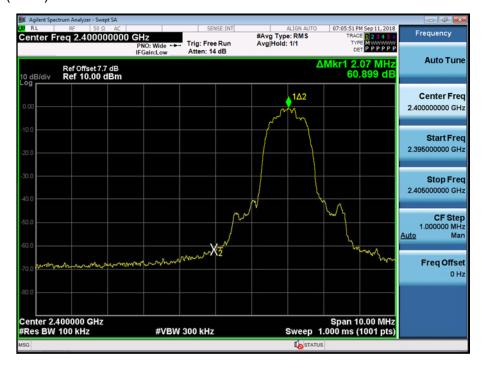


Test Plots without hopping (GFSK) Band Edges (CH.78)

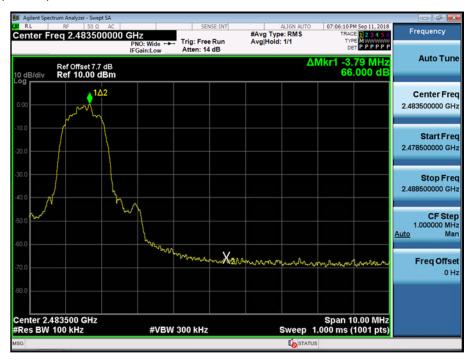




Test Plots without hopping (8DPSK) Band Edges (CH.0)



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



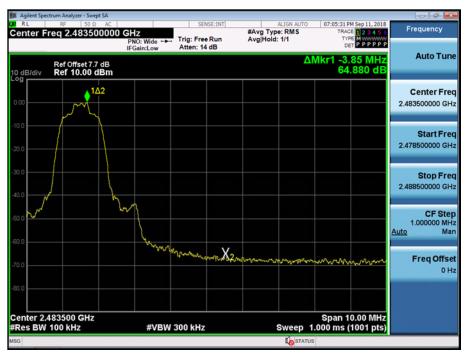


Test Plots without hopping (π /4DQPSK)

Band Edges (CH.0)

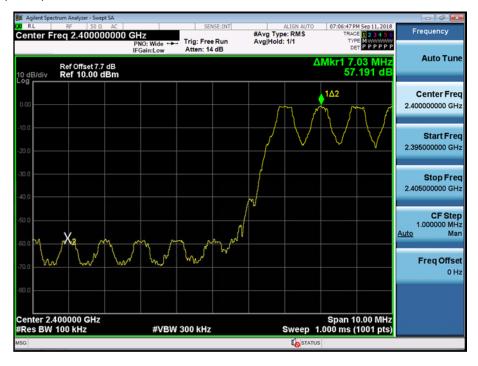


Test Plots without hopping (π /4DQPSK) Band Edges (CH.78)





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



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



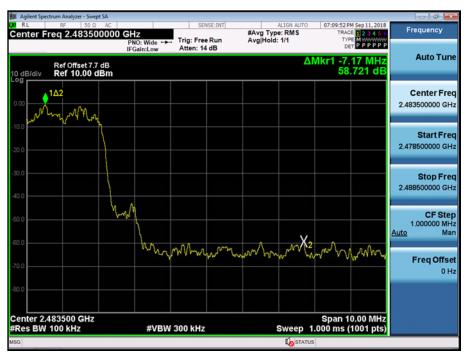


Test Plots with hopping (8DPSK)

Band Edges (CH.0)



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





Test Plots with hopping (π /4DQPSK) Band Edges (CH.0)



Test Plots with hopping (π /4DQPSK) Band Edges (CH.78)





10.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW)

99% BW (kHz)									
Channel	GFSK	8DPSK	π/4DQPSK						
CH.0	874.35	1155.9	1151.9						
CH.39	875.77	1156.3	1152.3						
CH.78	875.43	1156.7	1151.8						

20dB BW (kHz)									
Channel	GFSK	8DPSK	π/4DQPSK						
CH.0	976	1287	1276						
CH.39	977	1288	1277						
CH.78	975	1291	1276						

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



Test Plots (GFSK)

Channel Separation

Magilent Spectrum Analyzer - Swept SA				
Center Freq 2.44100000	00 GHz PNO: Wide Trig: Free Run	ALIGN AUTO #Avg Type: RMS Avg Hold: 1/1	07:10:35 PM Sep 11, 2018 TRACE 2 3 4 5 6 TYPE MUMUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUU	Frequency
Ref Offset 7.7 dB 10 dB/div Ref 10.00 dBm	IFGain:Low #Atten: 20 dB		ст <u>РРРРРР</u> kr3 1.001 MHz 0.025 dB	Auto Tune
Log 0.00 -10.0 -20.0	1 <u>1</u> 22	w.	304	Center Free 2.441000000 GH:
-30.0				Start Fre 2.439500000 GH
-60.0 -70.0 -80.0				Stop Free 2.442500000 GH
Center 2.441000 GHz #Res BW 30 kHz	#VBW 100 kHz		Span 3.000 MHz .176 ms (900 pts)	CF Stej 300.000 kH Auto Ma
3 Δ4 1 f (Δ)	 C Y Y 1.001 MHz (Δ) -0.001 dB 440 014 GHz -2.741 dBm 1.001 MHz (Δ) 0.025 dB 441 015 GHz -2.742 dBm 	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	Freq Offse
	m/			
MSG Points changed; all traces	s cleared	to status		

Test Plots (8DPSK) Channel Separation

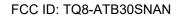




Test Plots (π/4DQPSK)

Channel Separation

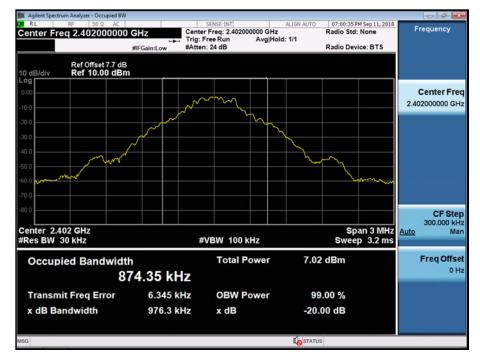
		alyzer - Swept											- 0
Center Fi	req 2	50 Ω 2.441000	0000 GH	Z IO: Wide		Trig: Free			ALIGN AUTO Type: RMS fold: 1/1	TRAC	M Sep 11, 2018 CE 1 2 3 4 5 6 PE M	F	requency
10 dB/div		Offset 7.7 10.00 dl	dB	Sain:Low		#Atten: 20	dB		Δι	/kr3 1.0	01 MHz .096 dB		Auto Tune
-10.0	\sim	<u>~X2</u>	~~~~	~~~	~	~^X	1∆2 ¥,^	~~~~	^	3Δ4	~~~~~		Center Freq 1000000 GHz
-30.0 -40.0 -50.0												2.43	Start Fred 9500000 GH2
-60.0 -70.0 -80.0												2.44	Stop Free 2500000 GH2
Center 2.4 #Res BW	30 k			#VE	BW 1	100 kHz				3.176 ms	.000 MHz (900 pts)	Auto	CF Step 300.000 kH: Mar
MKR MODE TR 1 A2 1 2 F 1 3 A4 1 4 F 1 5 6 7	f f	(Δ) (Δ)	2.439 987	1 MHz (Δ)	¥ 0.123 d -2.902 dB -0.096 d -2.779 dB	IB m IB	NCTION	FUNCTION WIDTH	FUNCTI	ON VALUE		Freq Offse 0 Ha
7 8 9 10 11						m							
usg 🧼 Point	ts cha	nged; all tra	aces cleare	ed						S			



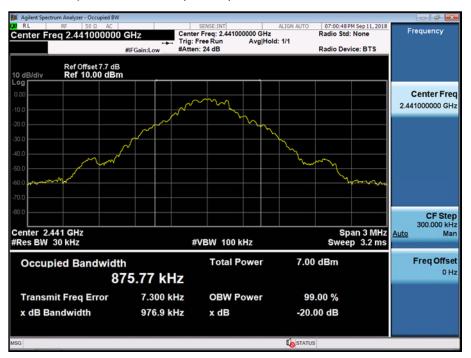


Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



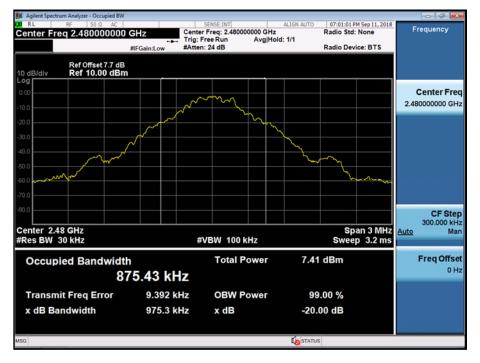
Test Plots (GFSK) 20 dB Bandwidth & Occupied Bandwidth (CH.39)





Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



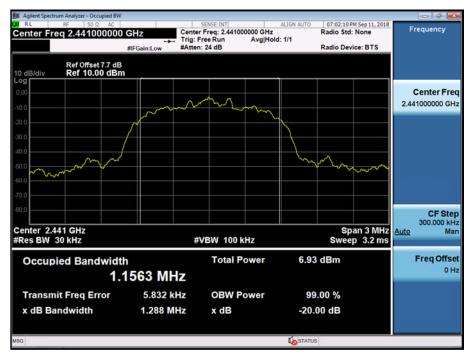
Test Plots (8DPSK) 20 dB Bandwidth & Occupied Bandwidth (CH.0)





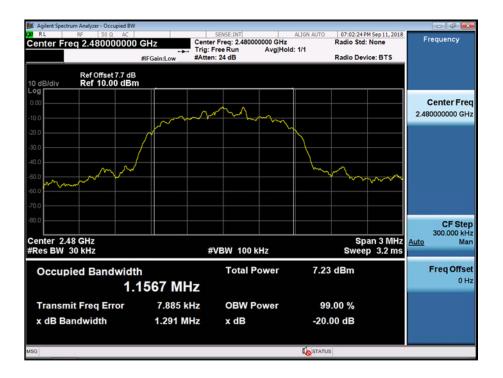
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



Test Plots (8DPSK)

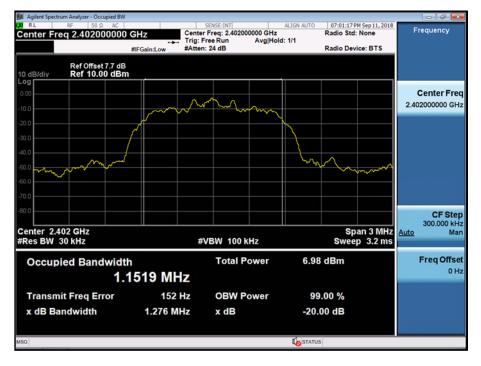
20 dB Bandwidth & Occupied Bandwidth (CH.78)



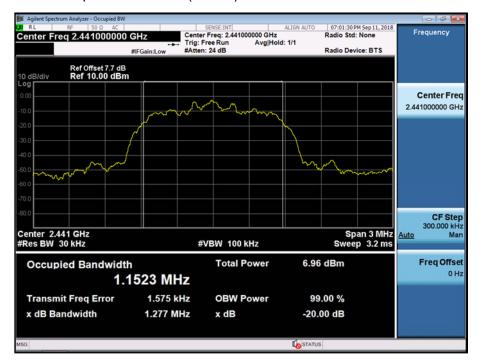


Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



Test Plots (π/4DQPSK) 20 dB Bandwidth & Occupied Bandwidth (CH.39)

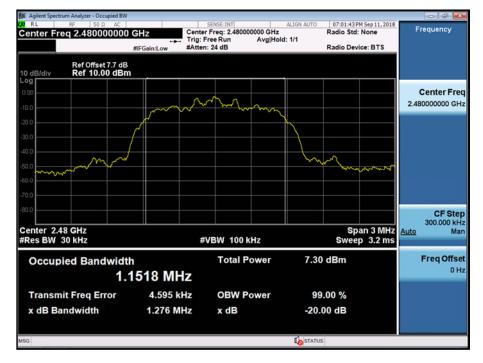




Report No.: HCT-RF-1809-FC104

Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)





10.4 NUMBER OF HOPPING FREQUENCY

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

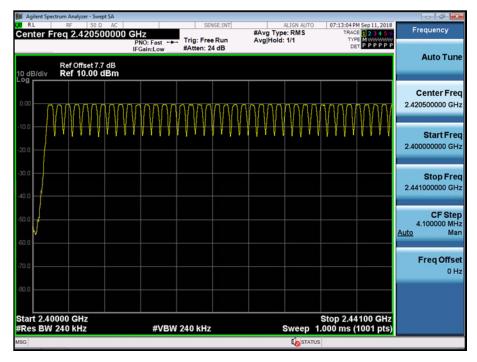
Note :

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



Report No.: HCT-RF-1809-FC104

Test Plots (GFSK)



Test Plots (GFSK)





Report No.: HCT-RF-1809-FC104

Test Plots (8DPSK)

Milent Spectrum Analyzer - Swept SA					
Center Freq 2.420500000	GHz	SENSE:INT	#Avg Type: RMS	07:15:27 PM Sep 11, 2018 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast ++-	Trig: Free Run #Atten: 24 dB	Avg Hold:>1/1	TYPE MWWWWWW DET PPPPP	
Ref Offset 7.7 dB					Auto Tune
10 dB/div Ref 10.00 dBm					
LUg					Center Freq
0.00	2 4 4 13 4 10	ANAAAMA	100 Mann		2.420500000 GHz
M M M M M	A 4 A A A.P	ሲታታላ ላ ላ ላ ላ	4000000000	$(\gamma \gamma $	
-10.0					Start Freq
-20.0					2.400000000 GHz
-20.0					
-30.0					Stop Freq
					2.441000000 GHz
-40.0					
-50.0					CF Step
					4.100000 MHz Auto Man
-60.0					
					Freq Offset
-70.0					0 Hz
-80.0					
Start 2.40000 GHz				Stop 2.44100 GHz	
#Res BW 240 kHz	#VBW	240 kHz	Sweep 1	.000 ms (1001 pts)	
MSG			STATU		

Test Plots (8DPSK)

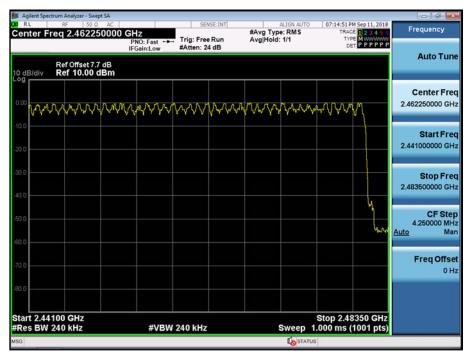




Test Plots (π/4DQPSK)

Agilent Spectrum Analyzer - Swept SA							- # *
Center Freq 2.420500000	GHz	SENSE:INT	#Avg Type		TRAC	M Sep 11, 2018	Frequency
	PNO: Fast Trig: Fi IFGain:Low #Atten:	ree Run 24 dB	Avg Hold:	1/1	DE	PPPPPP	
Ref Offset 7.7 dB							Auto Tune
10 dB/div Ref 10.00 dBm							
							Center Freq
0.00 MAAAAAAA	MMMM	лллл	MAA	a.a.m.a.	nann	MALLA	2.420500000 GHz
-10.0	4 0 - D Q 1 7 0 1				V r i v	• • • •	
							Start Freq
-20.0							2.40000000 GHz
-30.0							
							Stop Freq 2.441000000 GHz
-40.0							
-50.0							CF Step
-50.0							4.100000 MHz Auto Man
-60.0							
							Freq Offset
-70.0							0 Hz
-80.0							
Start 2.40000 GHz					Stop 2.44	100 GHz	
#Res BW 240 kHz	#VBW 240 kH	z				1001 pts)	
MSG				STATUS			

Test Plots (π/4DQPSK)





10.5 TIME OF OCCUPANCY (DWELL TIME)

	Channel	GFSK	8DPSK	π/4DQPSK
Pulse	Low	2.890	2.890	2.890
Time	Mid	2.890	2.895	2.890
(ms)	High	2.890	2.895	2.890

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of	Low	308.27	308.27	308.27	31.6	
Dwell (ms)	Mid	308.27	308.80	308.27	31.6	400
	High	308.27	308.80	308.27	31.6	