

FCC BT REPORT

Certification

Applicant Name: HYUNDAI MOBIS CO., LTD. Date of Issue: January 17, 2019

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Report No.: HCT-RF-1901-FC014

FCC ID: TQ8-ATC42G2AN

APPLICANT: HYUNDAI MOBIS CO., LTD.

ATC42G2AN

Model:

Additional Model:	ATC43G2AN, ATC41G7AN
EUT Type:	Car Audio System
Max. RF Output Power:	2.800 dBm (1.91 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)

Report prepared by : Se Wook Park Engineer of Telecommunication testing center

Alt

Approved by : Kwon Jeong Manager of Telecommunication testing center

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Version

TEST REPORT NO.	DATE	DESCRIPTION	
HCT-RF-1901-FC014	January 17, 2019	- First Approval Report	



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1. EUT DESCRIPTION

Model	ATC42G2AN	
Additional Model	ATC43G2AN, ATC41G7AN	
ЕИТ Туре	Car Audio System	
Power Supply	DC 14.40 V	
Frequency Range	2402 MHz - 2480 MHz	
Max. RF Output Power	2.800 dBm (1.91 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	79Channels, Minimum 20 Channels(AFH)	
Antenna Specification	Manufacturer: LG Innotek, Co. Ltd. Antenna type: Bluetooth Single Band Antenna Peak Gain : 0.29 dBi	
Date(s) of Tests	November 9, 2018 ~ November 30, 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

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device (ANSI C63.10-2013) 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 3.75 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

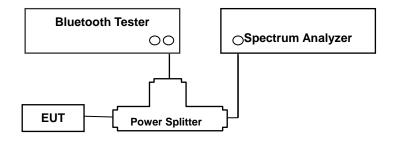
8.1. Conducted Maximum Peak Output Power

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

Sample Calculation

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

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

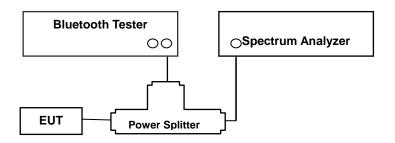


8.2. Conducted Band Edge(Out of Band Emissions)

<u>Limit</u>

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

Test Configuration



Test Procedure

This test is performed with hopping off and hopping on.

The Spectrum Analyzer is set to (6.10.4 in ANSI 63.10-2013)

- 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

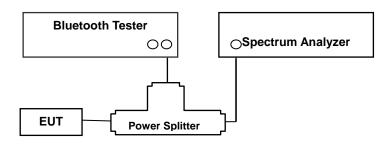


8.3. Frequency Separation & 20 dB Bandwidth

<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.

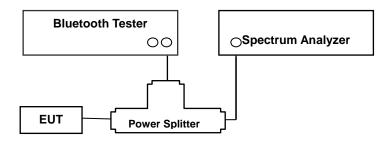


8.4. Number of Hopping Frequencies

<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.

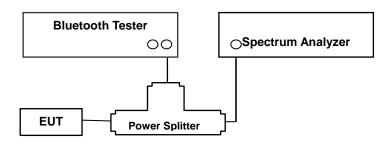


8.5. Time of Occupancy

<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)

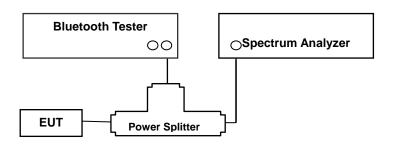


8.6. Conducted Spurious Emissions

<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	7.18
100	6.35
200	7.04
300	6.58
400	6.26
500	5.95
600	6.17
700	6.34
800	6.72
900	7.08
1000	7.38
2000	7.21
2400*	7.40
2500*	7.44
3000	7.88
4000	8.95
5000	9.57
6000	6.68
7000	9.99
8000	8.34
9000	9.61
10000	10.47
11000	8.96
12000	9.73
13000	8.84
14000	9.50
15000	11.54
16000	8.14
17000	11.73
18000	9.71
19000	10.40
20000	11.69
21000	10.72
22000	12.31
23000	9.85
24000	12.52
25000	11.07
26000	10.50

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

2. Factor = Cable loss + Splitter loss



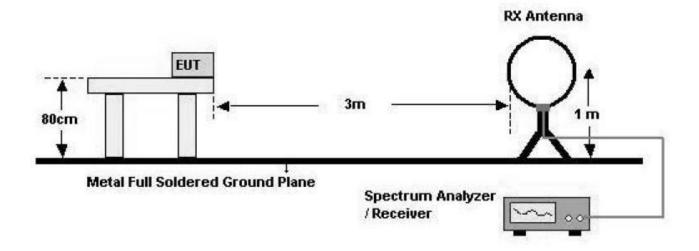
8.7. Radiated Test

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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

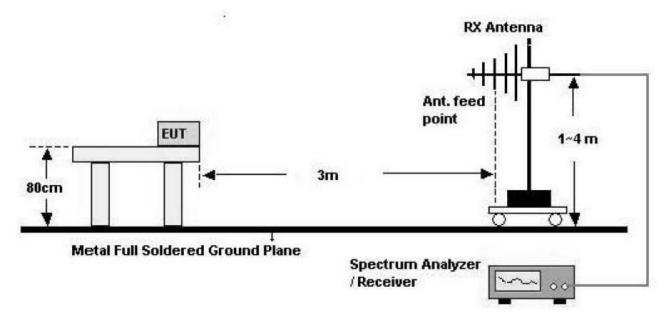
Test Configuration

Below 30 MHz

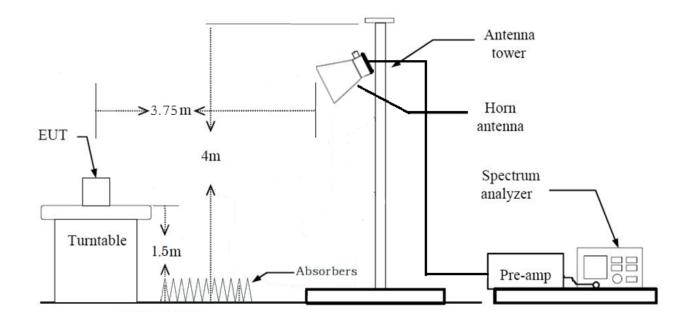




30 MHz - 1 GHz



Above 1 GHz





Test Procedure of Radiated spurious emissions(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 in detecting antenna.
- 5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 6. Distance Correction Factor(0.009 MHz 0.490 MHz) = $40*\log(3 \text{ m}/300 \text{ m}) = -80 \text{ dB}$
 - Measurement Distance : 3 m
- 7. Distance Correction Factor(0.490 MHz 30 MHz) = $40*\log(3 \text{ m}/30 \text{ m}) = -40 \text{ dB}$
 - Measurement Distance : 3 m
- 8. Spectrum Setting
 - Frequency Range = 9 kHz ~ 30 MHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 9 kHz
 - VBW \ge 3*RBW
- 9. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)
- 10. The test results for below 30 MHz is correlated to an open site.

The result on OATS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

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. 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. Spectrum Setting
 - (1) Measurement Type(Peak):
 - Measured Frequency Range : 30 MHz 1 GHz
 - Detector = Peak
 - Trace = Maxhold
 - RBW = 100 kHz
 - VBW ≥ 3*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
- 6. Total = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L)



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 \ge 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
 - = Reading Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)



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.
- 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.
- 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
 - π/4DQPSK : 2-DH5
 - 8DPSK : 3-DH5
- 5. ATC42G2AN & Additional Models were tested and the worst case results are reported.

(Worst case : ATC42G2AN)

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)

3. ATC42G2AN & Additional Models were tested and the worst case results are reported.

(Worst case : ATC42G2AN)



FCC ID: TQ8-ATC42G2AN

9. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§15.247(a)(1)	N/A		PASS
Occupied Bandwidth	N/A	N/A		N/A
Conducted Maximum Peak Output Power	§15.247(b)(1)	< 0.125 W		PASS
Carrier Frequency Separation	§15.247(a)(1)	> 25 kHz or >2/3 of the 20dB BW		PASS
Number of Hopping Frequencies	§15.247(a)(1)(iii) ≥ 15		Conducted	PASS
Time of Occupancy	§15.247(a)(1)(iii)	< 400 ms		PASS
Conducted Spurious Emissions	§15.247(d)	> 20 dB for all out-of band emissions		PASS
Band Edge (Out of Band Emissions)	§15.247(d)	> 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	§15.207(a)	cf. Section 8.8		N/A
Radiated Spurious Emissions	§15.247(d), 15.205, 15.209	cf. Section 8.7	Dedicted	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.7	Radiated	PASS

Note:

We don't perform AC Conducted Emissions test. Because this EUT is used with vehicle.



10. TEST RESULT

10.1 PEAK POWER

Channel	Frequency	Output Power (GFSK)		Limit
	(MHz)	(dBm)	(mW)	(mW)
Low	2402	2.716	1.87	
Mid	2441	2.800	1.91	125
High	2480	1.745	1.49	

Channel	Frequency	Output Power (8DPSK)		Limit
	(MHz)	(dBm)	(mW)	(mW)
Low	2402	0.875	1.22	
Mid	2441	1.112	1.29	125
High	2480	0.234	1.06	

Channel	Frequency	(π/4DQPSK)		
	(MHz)	(dBm)	(mW)	(mW)
Low	2402	0.388	1.09	
Mid	2441	0.642	1.16	125
High	2480	-0.271	0.94	

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.

 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 7.36 dB at 2402 MHz and is 7.44 dB at 2480 MHz.

So, 7.7 dB is offset.(Includes Eut cable loss) 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)

RL	RF 50Ω AC req 2.402000000	GHz	SENSE:INT	ALIGNAUTO #Avg Type: RMS	05:49:25 PM Nov 28, 2018 TRACE 1 2 3 4 5 6	Frequency
		PNO: Fast ↔ IFGain:Low	 Trig: Free Run Atten: 24 dB 	Avg Hold: 1/1	TYPE MWWWWW DET P P P P P P	
0 dB/div	Ref Offset 7.7 dB Ref 20.00 dBm			Mkr1	2.401 870 GHz 2.716 dBm	Auto Tur
.og						Center Fre
10.0			↓ ↓			2.402000000 Gł
						Start Fr
10.0						2.399502363 G
10.0						Stop Fr
:0.0						2.404497637 G
0.0						CF Ste 499.527 k
i0.0						<u>Auto</u> M
i0.0						Freq Offs
'0.0						0
enter 2.4 Res BW	102000 GHz 3.0 MHz	#VBV	/ 50 MHz	Sweep 1	Span 4.995 MHz .000 ms (1001 pts)	

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





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

RL	um Analyzer - Swept SA RF 50 Ω AC		SENSE:INT	ALIGNAUTO	05:49:48 PM Nov 28, 2018	
enter Fi	req 2.480000000	GHz PNO: Fast		#Avg Type: RMS Avg Hold: 1/1	TRACE 123456 TYPE MWWWW DET PPPPP	Frequency
0 dB/div	Ref Offset 7.7 dB Ref 20.00 dBm			Mkr1	2.479 865 GHz 1.745 dBm	Auto Tun
10.0						Center Fre 2.480000000 G⊦
10.0						Start Fre 2.477493744 GF
80.0						Stop Fre 2.482506256 GF
0.0						CF St e 501.251 ki <u>Auto</u> M
0.0						Freq Offs
70.0	180000 GHz					
Res BW		#VB	W 50 MHz	Sweep 1	Span 5.013 MHz .000 ms (1001 pts)	

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





Test Plots (8DPSK)

Peak Power (CH.39)

LXI RL	um Analyzer - Swept SA RF 50 Ω AC req 2.441000000	GHz PNO: Fast ↔ IFGain:Low	SENSE:INT	ALIGNAUTO #Avg Type: RMS Avg Hold: 1/1	05:50:47 PM Nov 28, 2018 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P	Frequency
10 dB/div	Ref Offset 7.7 dB Ref 20.00 dBm	IF Gam.Low		Mkr	1 2.440 859 GHz 1.112 dBm	Auto Tune
10.0			▲1			Center Fred 2.441000000 GH
-10.0						Start Fre 2.437647500 GH
-20.0						Stop Fre 2.444352500 GH
-40.0						CF Ste 670.500 kH <u>Auto</u> Ma
-60.0						Freq Offse 0 H
-70.0 Center 2.4 #Res BW	141000 GHz 3.0 MHz	#VBM	(50 MHz	Sweep	Span 6.705 MHz 1.000 ms (1001 pts)	
ISG				I o stati		

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





Test Plots (π/4DQPSK)

Peak Power (CH.0)

Agilent Spectri X/ RL	um Analyzer - Swept SA RF 50 Ω AC		SENSE:INT	ALIGNAUTO	05:50:01 PM Nov 28, 2018	
	req 2.40200000	D GHz PNO: Fast + IFGain:Low		#Avg Type: RMS Avg Hold: 1/1	TRACE 123456 TYPE M	Frequency
10 dB/div	Ref Offset 7.7 dB Ref 20.00 dBm			Mkr1	2.401 871 GHz 0.388 dBm	Auto Tune
10.0						Center Fre 2.402000000 GH
•10.0						Start Fre 2.398602500 G⊦
-20.0						Stop Fre 2.405397500 G⊦
40.0						CF Ste 679.500 kł <u>Auto</u> Ma
60.0						Freq Offs 0 ⊦
-70.0	102000 GHz				Span 6.795 MHz	
#Res BW		#VB	W 50 MHz	Sweep 1	.000 ms (1001 pts)	

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

enter F	RF 50 Ω AC req 2.441000000	GHz	SENSE: INT	ALIGNAUTO #Avg Type: RMS Avg Hold: 1/1	TRACE 1 2 3 4 5 6	Frequency
		PNO: Fast ↔ IFGain:Low	Atten: 24 dB	Avginola, 1/1	TYPE MWWWWW DET P P P P P	
0 dB/div	Ref Offset 7.7 dB Ref 20.00 dBm			Mkr	1 2.440 710 GHz 0.642 dBm	Auto Tur
						Center Fre
10.0						2.441000000 GH
			♦ ¹			
).00						Start Fre
0.0						2.437622500 GH
0.0						Stop Fre
						2.444377500 GI
0.0						
10.0						CF Ste
.0.0						675.500 kl
io.o						<u>Auto</u> Ma
						Eren Offe
0.0						Freq Offs
10.0						U U
0.0						
	441000 GHz 3.0 MHz	#VBV	V 50 MHz	Sween	Span 6.755 MHz 1.000 ms (1001 pts)	



Test Plots (π /4DQPSK)

Peak Power (CH.78)

Center Fi	RF 50 Ω AC req 2.480000000	GHz PNO: Fast	SENSE:INT Trig: Free Run Atten: 24 dB	ALIGNAUTO #Avg Type: RMS Avg Hold: 1/1	05:50:23 PM Nov 28, 2018 TRACE 2 3 4 5 6 TYPE MWWWWW DET P P P P P P	Frequency
10 dB/div	Ref Offset 7.7 dB Ref 20.00 dBm	IFGain:Luw	Atten. 24 QB	Mkr1	2.479 851 GHz -0.271 dBm	Auto Tun
- og 10.0			1			Center Fre 2.480000000 G⊦
0.00						Start Fre 2.476612500 GH
20.0						Stop Fre 2.483387500 GF
40.0						CF Ste 677.500 kł <u>Auto</u> Mi
60.0						Freq Offs 0 F
	480000 GHz				Span 6.775 MHz	
Center 2.4 #Res BW		#VBW	50 MHz	Sweep 7	1.000 ms (1001 pts)	



10.2 BAND EDGES

Without hopping

Outeide Frequency Dond	GFSK	8DPSK	π/4DQPSK	Limit
Outside Frequency Band	(dB)	(dB)	(dB)	(dBc)
Lower	61.692	58.438	57.607	20
Upper	64.514	63.324	62.962	20

With hopping

Outeide Frequency Pond	GFSK	8DPSK	π/4DQPSK	Limit
Outside Frequency Band	(dB)	(dB)	(dB)	(dBc)
Lower	63.243	61.215	58.429	20
Upper	60.165	57.873	59.865	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 7.36 dB at 2402 MHz

and is 7.44 dB at 2480 MHz.

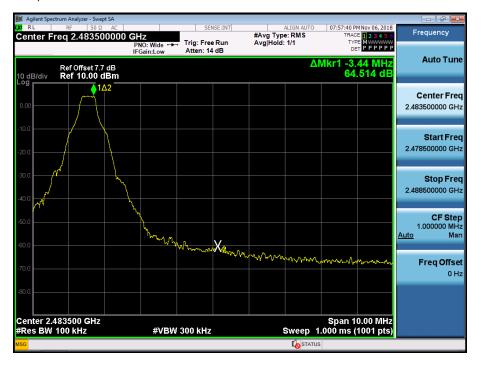
So, 7.7 dB is offset.(Includes Eut cable loss) And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result.



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)

> RF
> 50 Ω
> AC
>
>
> Center Freq 2.400000000 GHz
> Trig: Free Run
>
>
> PNO: Wide
> Atten: 14 dB
> Nov 06, 2018 **1** 2 3 4 5 6 MWWWWW P P P P P P P #Avg Type: RMS Avg|Hold: 1/1 Frequency TYPE Auto Tune ΔMkr1 2.11 MHz 58.438 dE Ref Offset 7.7 dB Ref 10.00 dBm 0 dB/d **Center Freq** 1<u>∆</u>2 2.40000000 GHz Start Freq 2.395000000 GHz Stop Freq 2.405000000 GHz CF Step 1.000000 MHz Man Auto Mryr~ Freq Offset 0 Hz Center 2.400000 GHz #Res BW 100 kHz Span 10.00 MHz Sweep 1.000 ms (1001 pts) #VBW 300 kHz STATU:

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



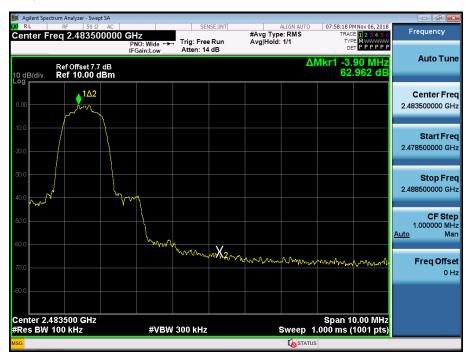


Test Plots without hopping (π /4DQPSK)

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	899.98	1217.0	1207.3			
CH.39	900.61	1217.2	1209.5			
CH.78	897.85	1216.7	1206.2			

20dB BW (kHz)						
Channel	GFSK	8DPSK	π/4DQPSK			
CH.0	997.1	1342.0	1356.0			
CH.39	1001.0	1338.0	1356.0			
CH.78	991.4	1340.0	1355.0			

	Limit		
GFSK	8DPSK	8DPSK π/4DQPSK	
			>25 kHz
971	1001	994	or
			>2/3 of the 20dB BW



Test Plots (GFSK)

Channel Separation

🔰 Agilent Spectrum Analyzer - Swept SA				
RL RF 50 Ω AC Center Freq 2.441000000	GH7	ALIGN AUTO #Avg Type: RMS	08:03:23 PM Nov 06, 2018 TRACE 1 2 3 4 5 6	Frequency
	PNO: Wide +++ Trig: Free Run IEGain:Low #Atten: 20 dB	Avg Hold: 1/1	DET P P P P P	
Ref Offset 7.7 dB	n oumeon		ΔMkr3 971 kHz	Auto Tune
10 dB/div Ref 10.00 dBm			0.057 dB	
0.00 X2				Center Freq
-10.0			ma	2.441000000 GHz
-20.0			· · · ·	
-30.0				Start Freq
-40.0				2.439500000 GHz
-50.0				
-60.0				Stop Freq
-70.0				2.442500000 GHz
-80.0				
Center 2.441000 GHz	40 (BW) 400 LUL-	0	Span 3.000 MHz	CF Step 300.000 kHz
#Res BW 30 kHz	#VBW 100 kHz		3.176 ms (900 pts)	Auto Man
	1.028 MHz (Δ) -0.141 dB	INCTION FUNCTION WIDTH	FUNCTION VALUE	
$\begin{array}{ c c c c c c c c c } \hline 2 & F & 1 & f & 2.440 \\ \hline 3 & \Delta 4 & 1 & f & (\Delta) \\ \hline \end{array}$	011 GHz 2.149 dBm 971 kHz (Δ) 0.057 dB			Freq Offset
4 F 1 f 2.441	038 GHz 2.008 dBm		=	0 Hz
6				
8				
10				
	m			
MSG			3	

Test Plots (8DPSK) Channel Separation

🔟 Agilent Spe	ctrum Analyzer - Swept SA							
LXI RL	RF 50 Ω A	С	SENS	SE:INT	ALIGN AUTO	08:04:41 PM Nov 0		Frequency
Center F	req 2.4410000	PNO: Wide IFGain:Low	→→ Trig: Free #Atten: 20	Run Av	/g Type: RMS g Hold: 1/1	TRACE 1 2 3 TYPE MWA DET P P F	www.	
10 dB/div	Ref Offset 7.7 dE Ref 10.00 dBr				Δ	/kr3 1.001 N 0.161		Auto Tune
Log 0.00 -10.0 -20.0	~~X2~	`	~~~~	1Δ2 14		3Δ4	~~	Center Freq 2.441000000 GHz
-30.0 -40.0 -50.0								Start Freq 2.439500000 GHz
-60.0 -70.0 -80.0								Stop Freq 2.442500000 GHz
#Res BW			BW 100 kHz			Span 3.000 3.176 ms (900	pts)	CF Step 300.000 kHz Auto Man
	f (Δ)	× <u>1.001 MHz</u> (2.440 011 GHz	Δ) 0.047 d -2.730 dB		FUNCTION WIDTH	FUNCTION VALU	Ē	_
3 <u>∆</u> 4 ⁴ 4 F ⁴ 5 5		1.001 MHz(2.441 012 GHz	<u>Δ) 0.161 d</u> -2.684 dB				=	Freq Offset 0 Hz
6 7 8								
9 10 11							•	
MSG			III		STATU:	5	,	



Test Plots (π/4DQPSK)

Channel Separation

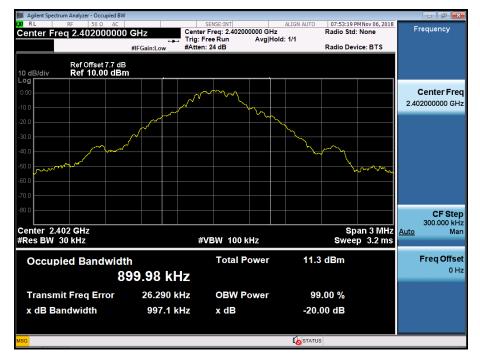
🚺 Agilent Spectrum Analyzer - Swept SA				- đ ×
X RL RF 50 Ω AC Center Freq 2.441000000		#Avg Type: RMS	08:04:01 PM Nov 06, 2018 TRACE 1 2 3 4 5 6 TYPE M WWWWW	Frequency
Ref Offset 7.7 dB 10 dB/div Ref 10.00 dBm	PNO: Wide Trig: Free Ru IFGain:Low #Atten: 20 dB		Mkr3 1.001 MHz 0.008 dB	Auto Tune
Log 0.00 -10.0 -20.0		<u>2</u>	304	Center Freq 2.441000000 GHz
-30.0				Start Freq 2.439500000 GHz
-60.0 -70.0 -80.0				Stop Freq 2.442500000 GHz
Center 2.441000 GHz #Res BW 30 kHz	#VBW 100 kHz		Span 3.000 MHz 3.176 ms (900 pts)	CF Step 300.000 kHz <u>Auto</u> Mar
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	994 kHz (Δ) 0.027 dB 0 014 GHz -2.703 dBm 1.001 MHz (Δ) 0.008 dB 1 008 GHz -2.676 dBm	FUNCTION FUNCTION WIDTI		Freq Offset 0 Hz
6 7 8 9 10 11				
∢ [m	STAT	US	



FCC ID: TQ8-ATC42G2AN

Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)

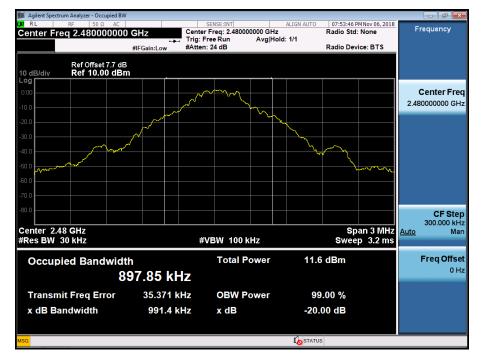




FCC ID: TQ8-ATC42G2AN

Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)



Test Plots (8DPSK)

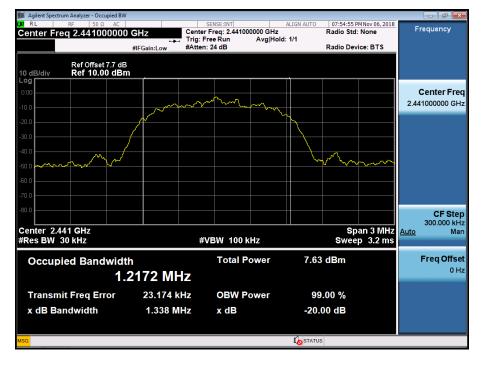
20 dB Bandwidth & Occupied Bandwidth (CH.0)





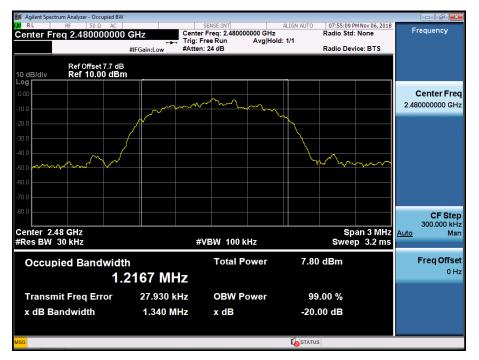
Test Plots (8DPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.39)



Test Plots (8DPSK)

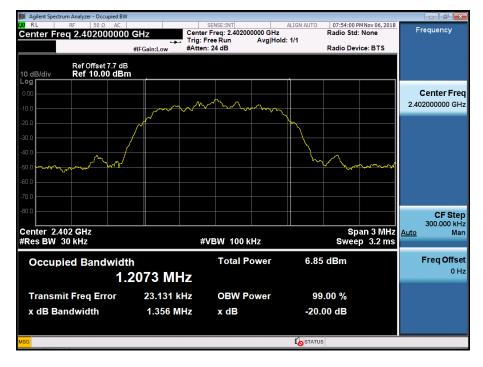
20 dB Bandwidth & Occupied Bandwidth (CH.78)





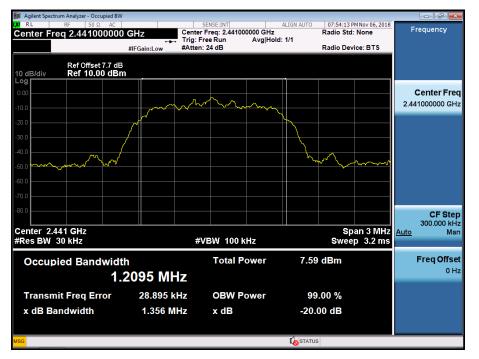
Test Plots (π/4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.0)



Test Plots (π/4DQPSK)

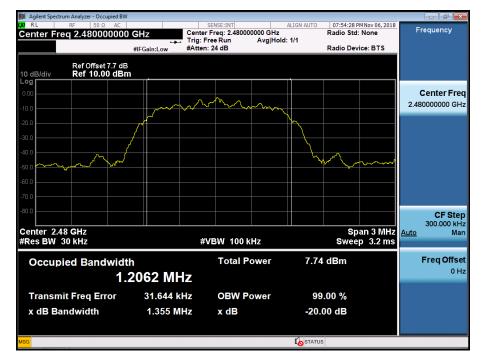
20 dB Bandwidth & Occupied Bandwidth (CH.39)





Test Plots (π /4DQPSK)

20 dB Bandwidth & Occupied Bandwidth (CH.78)





10.4 NUMBER OF HOPPING FREQUENCY

	L insit		
GFSK	GFSK 8DPSK		Limit
79	79	79	>15

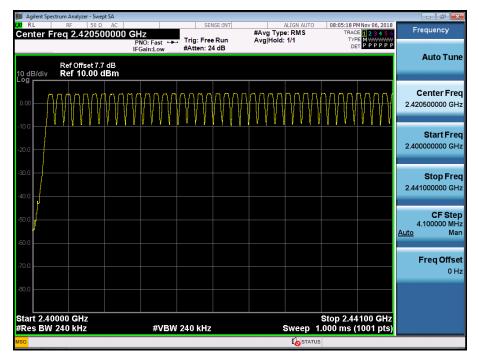
Note :

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



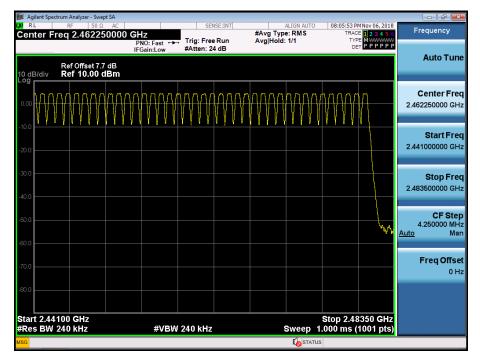
Test Plots (GFSK)

Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)





Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)

Mailent Spectrum Analyzer - Swept SA				
Center Freq 2.420500000		#Avg Type: RMS	TRACE 1 2 3 4 5 6	Frequency
Ref Offset 7.7 dB 10 dB/div Ref 10.00 dBm	PNO: Fast Trig: Free Run IFGain:Low #Atten: 24 dB	Avg Hold:>1/1	TYPE MWWWWW DET PPPPP	Auto Tune
0.00	᠕ᡙᡨᡊᠰ᠋ᢆᢣ᠕ᡔ᠕ᡔ᠕ᡔᡀᡨᡳᠬ᠕ᠰ	www.	wwwww	Center Freq 2.420500000 GHz
-20.0				Start Freq 2.400000000 GHz
-30.0				Stop Freq 2.441000000 GHz
-50.0				CF Step 4.100000 MHz Auto Man
-70.0				Freq Offset 0 Hz
^{-80.0} Start 2.40000 GHz #Res BW 240 kHz	#VBW 240 kHz	Sweep 1.000	p 2.44100 GHz ms (1001 pts)	
MSG		I STATUS		

Test Plots (8DPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)





Test Plots (π/4DQPSK)

Number of Channels (2.4 GHz - 2.441 GHz)

Mailent Spectrum Analyzer - Swept SA				
Center Freq 2.420500000		ALIGN AUTO #Avg Type: RMS	08:06:30 PM Nov 06, 2018 TRACE 1 2 3 4 5 6 TYPE MWWWW	Frequency
Ref Offset 7.7 dB 10 dB/div Ref 10.00 dBm	PNO: Fast +++ Trig: Free Run IFGain:Low #Atten: 24 dB	Avg Hold: 1/1	DET PPPPP	Auto Tune
	white the second s	᠕᠕᠕ᠰ᠕᠕	᠕ᡙᠬᠯ᠆ᠰᡙ	Center Freq 2.420500000 GHz
-10.0				Start Freq 2.400000000 GHz
-30.0				Stop Fred 2.441000000 GHz
-60.0				CF Step 4.100000 MHz <u>Auto</u> Mar
-70.0				Freq Offset 0 Hz
-80.0 Start 2.40000 GHz #Res BW 240 kHz	#VBW 240 kHz	Sween 1	Stop 2.44100 GHz 000 ms (1001 pts)	
MSG	7 10 10 240 KHZ	Sweep 1.	ooo ma (1001 pts)	

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	Low	2.890	2.890	2.890
Time	Mid	2.890	2.895	2.890
(ms)	High	2.885	2.890	2.890

Non-AFH Mode

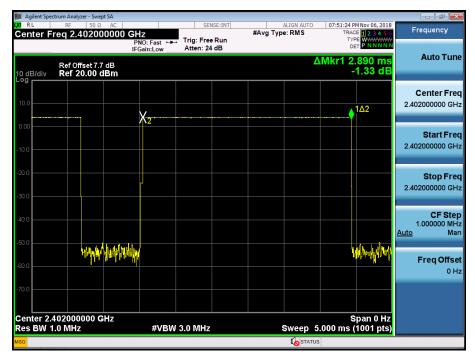
	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of	Low	308.27	308.27	308.27	31.6	
Dwell	Mid	308.27	308.80	308.27	31.6	400
(ms)	High	307.73	308.27	308.27	31.6	

AFH Mode

	Channel	GFSK	8DPSK	π/4DQPSK	Period Time (s)	Limit (ms)
Total of	Low	154.13	154.13	154.13	8.0	
Dwell	Mid	154.13	154.40	154.13	8.0	400
(ms)	High	153.87	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)



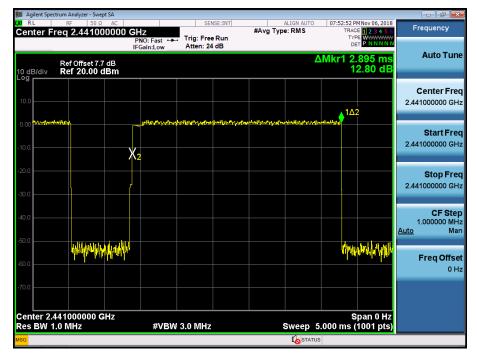
Test Plots (8DPSK) Dwell Time (CH.0)



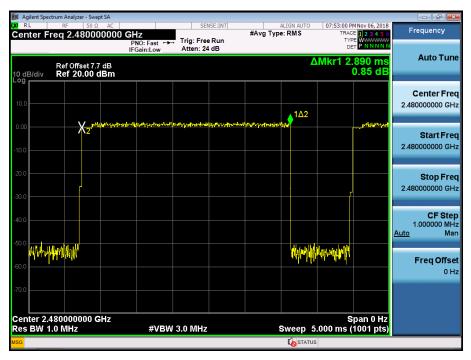


Test Plots (8DPSK)

Dwell Time (CH.39)

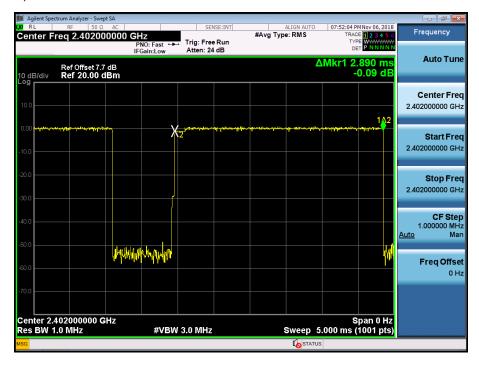


Test Plots (8DPSK) Dwell Time (CH.78)





Test Plots (π/4DQPSK) Dwell Time (CH.0)



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





Test Plots (π /4DQPSK)

Dwell Time (CH.78)

Agilent Spectrum An				0510	or we			07.50.05.05			7
Center Freq 2		AC 0000 GH	IZ NO: Fast ↔	Trig: Free		#Avg Typ	ALIGN AUTO e: RMS	TRAC TYP	MNov 06, 2018 E 1 2 3 4 5 6 E W M N N N N	Frequenc	су
Ref 10 dB/div Ref	Offset 7.7 d 20.00 dE	dB	Gain:Low	Atten: 24	dB		Δ	Mkr1 2.	890 ms 4.44 dB	Auto	Tun
10.0										Center 2.48000000	
.10.0	X2***	waleye wakates	nn an air an	YH:4YWX,~4KHK?	مىلىم رىلە	np-dr-frighternende	1∆2 -		enersplay	Start 2.48000000	
30.0	_									Stop 2.48000000	
40.0										CF 1.00000 <u>Auto</u>	Ste 0 MH Ma
	NH						W	Minin a M		Freq C	Offs 0⊦
70.0											
Center 2.48000 Res BW 1.0 Mi		lz	#VBW	3.0 MHz			Sweep 5	S .000 ms (pan 0 Hz 1001 pts)		
SG											



10.6 SPURIOUS EMISSIONS

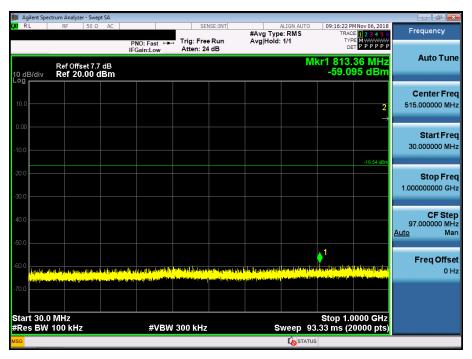
10.6.1 CONDUCTED SPURIOUS EMISSIONS

Test Result : please refer to the plot below.

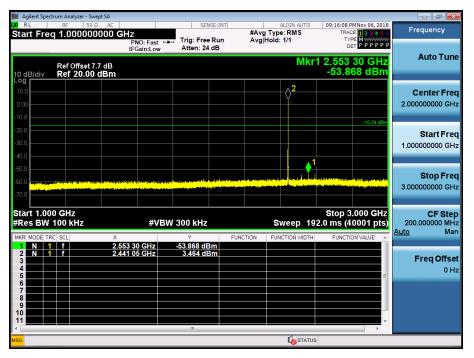
In order to simplify the report, attached plots were only the worst case channel and data rate.

Test Plots (GFSK)- 30 MHz - 1 GHz

Spurious Emission (CH.39)



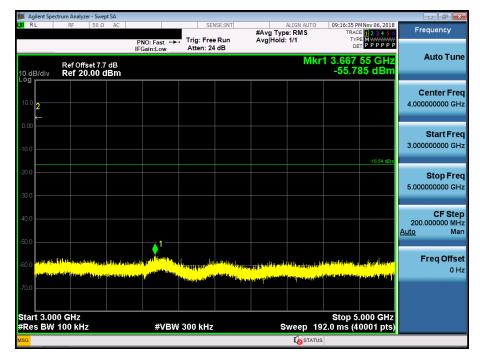
Test Plots (GFSK)- 1 GHz – 3 GHz Spurious Emission (CH.39)



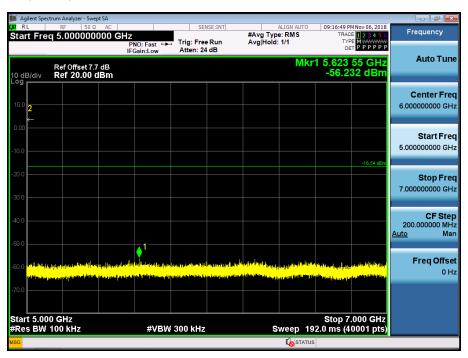


Test Plots (GFSK)- 3 GHz - 5 GHz

Spurious Emission (CH.39)



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

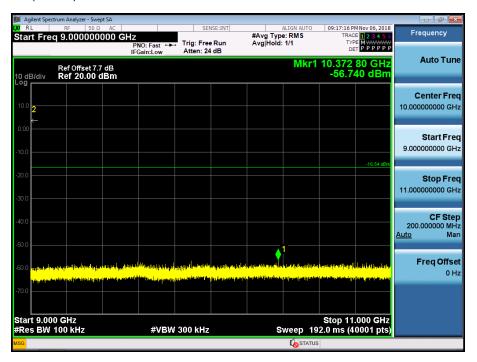




T Test Plots (GFSK)- 7 GHz - 9 GHz Spurious Emission (CH.39)

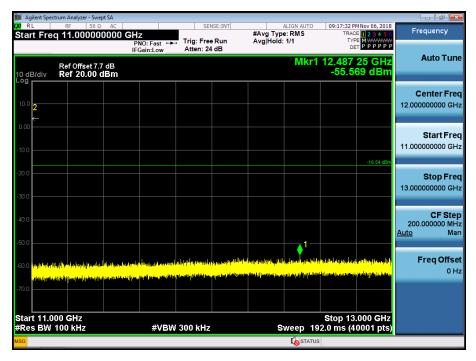
		trum Analyzer - Sw	ept SA								
L <mark>XI</mark> RI Star		RF 50 9			SEI	NSE:INT	#Avg Typ	ALIGN AUTO		M Nov 06, 2018	Frequency
Stal	LFIC	47.000000		PNO: Fast ↔	Trig: Free Atten: 24		Avg Hold:		TYP		
				IFGain:Low	Atten: 24	t ab		Miles			Auto Tune
10 dE	7/410	Ref Offset 7 Ref 20.00	.7 dB					WIKE	-55.1	65 GHz 85 dBm	
Log	3/017	Rei 20.00	иыш				1				
											Center Free
10.0	2										8.00000000 GH:
	←										
0.00											Start Fred
-10.0											7.000000000 GH:
- 10.0										-16.54 dBm	
-20.0										-10.34 0.51	Oton Eng
											Stop Fred 9.000000000 GH;
-30.0											9.00000000 GH2
											05.01
-40.0											CF Step 200.000000 MH
											<u>Auto</u> Mar
-50.0		1									
-60.0	والمداول	Les de la de la composition	. I have a second second	hit berlitelyster	ورا و و العالم ال	6.46					Freq Offse
	البدية المار	aujile mili bikatan u	international control	and a second	adation of the property of	allen her sig alle a	ىدانىغۇرارلىر بەيمىرىغى بە	antidate formation	STRUCT THE PARTY AND IN	restantions in the second	0 H:
-70.0									a far ta fa la fai a fai fai fai fai fai fai fai fai		
	t 7.00 s B14(0 GHz 100 kHz		#VBA	/ 300 kHz		9	ween 10	Stop 9	.000 GHz 0001 pts)	
MSG	5-15-14	NOV NILZ		~ * D M	-000 MHZ		3	STATUS		oor rpts)	
mod								No STATUS			

Test Plots (GFSK)- 9 GHz - 11 GHz Spurious Emission (CH.39)

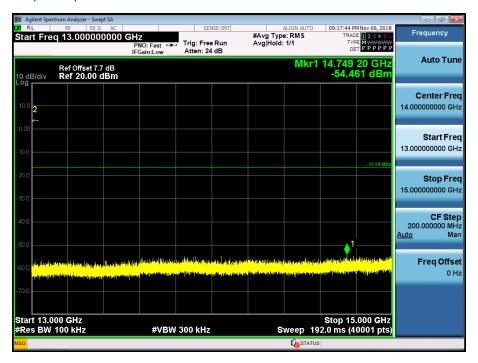




Test Plots (GFSK)-11 GHz - 13 GHz Spurious Emission (CH.39)

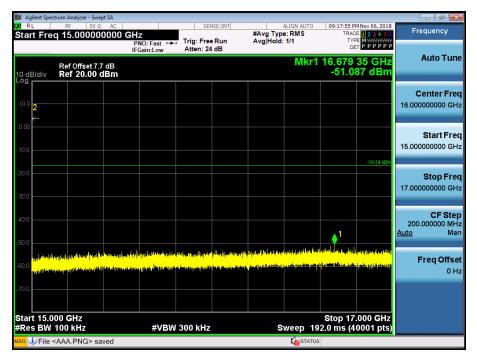


Test Plots (GFSK)- 13 GHz – 15 GHz Spurious Emission (CH.39)

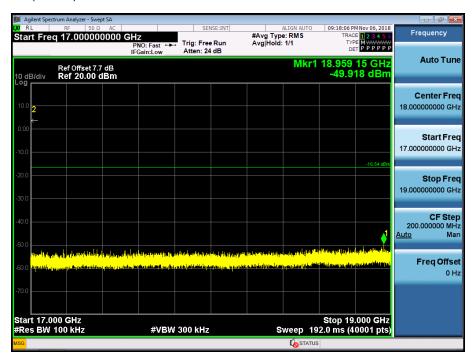




Test Plots (GFSK)– 15 GHz - 17 GHz Spurious Emission (CH.39)

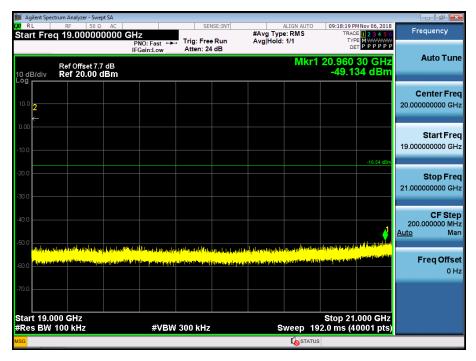


Test Plots (GFSK)- 17 GHz - 19 GHz Spurious Emission (CH.39)

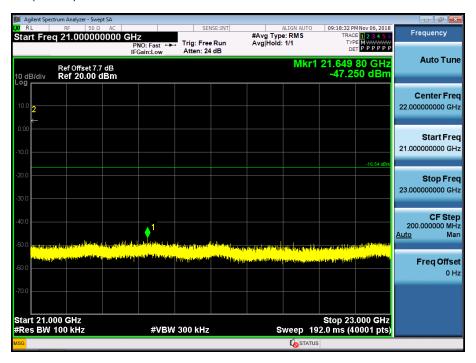




Test Plots (GFSK)- 19 GHz - 21 GHz Spurious Emission (CH.39)



Test Plots (GFSK)- 21 GHz - 23 GHz Spurious Emission (CH.39)





Test Plots (GFSK)- 23 GHz - 25 GHz Spurious Emission (CH.39)

	trum Analyzer - Swept SA								
XI RL Start Fre	RF 50 Ω A q 23.0000000		SEN	ISE:INT	#Avg Typ	ALIGN AUTO e: RMS		M Nov 06, 2018	Frequency
Otart ITC	q 23.0000000	PNO: Fast ↔ IFGain:Low	Trig: Free Atten: 24		Avg Hold:		TYP		
			Atten: 24	ub		Mkr	1 24.895	55 CH7	Auto Tune
10 dB/div Log	Ref Offset 7.7 dE Ref 20.00 dB						-44.5	95 dBm	
_ vg									Center Freg
10.0									24.000000000 GHz
∠ ←									
0.00									Start Freq
									23.000000000 GHz
-10.0									20.000000000000
-20.0								-16.54 dBm	
-20.0									Stop Freq
-30.0									25.00000000 GHz
-40.0								1	CF Step 200.000000 MHz
		. Inc. Mark		المتعداية إنها الط	and distant	مداناته الم	dia bibuta da ana	In the Island	<u>Auto</u> Man
-50.0 <mark>Acaleinin</mark> i	, dan berekana di dan bada da b	da e la dela del del de la del de la dela de			1.5		و المراجلة والمالية المالية	and the second section of the second s	
Manager and American	e e de se presidente de la deservation de la companya de la companya de la companya de la companya de la compa	North States and States	(all all all all all all all all all all	a na high a statu an a					Freq Offset
-60.0									0 Hz
-70.0									
Start 23.0 #Res BW		#VBV	V 300 kHz		s	weep '	25 Stop 192.0 ms	.000 GHz 0001 pts)	
MSG						E STAT		(15)	
						V			



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 = 40*log (specific distance / test distance) (dB)
- 3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
- 4. Radiated test is performed with hopping off.
- 5. The test results for below 30 MHz is correlated to an open site.

The result on OATS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

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.



FCC ID: TQ8-ATC42G2AN

Frequency Range : Above 1 GHz

Operation Mode: CH Low(GFSK)

Frequency	Reading	A.F + C.L - A.G + D.F	Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4804	50.74	1.83	V	52.57	73.98	21.41	PK
4804	36.90	1.83	V	38.73	53.98	15.25	AV
7206	49.46	9.65	V	59.11	73.98	14.87	PK
7206	36.03	9.65	V	45.68	53.98	8.30	AV
4804	50.08	1.83	Н	51.91	73.98	22.07	PK
4804	36.54	1.83	н	38.37	53.98	15.61	AV
7206	49.44	9.65	Н	59.09	73.98	14.89	PK
7206	35.78	9.65	Н	45.43	53.98	8.55	AV

Operation Mode: CH Low(8DPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	51.19	1.83	V	53.02	73.98	20.96	PK
4804	36.76	1.83	V	38.59	53.98	15.39	AV
7206	49.89	9.65	V	59.54	73.98	14.44	PK
7206	36.07	9.65	V	45.72	53.98	8.26	AV
4804	49.90	1.83	Н	51.73	73.98	22.25	PK
4804	35.41	1.83	Н	37.24	53.98	16.74	AV
7206	48.75	9.65	Н	58.4	73.98	15.58	PK
7206	36.03	9.65	Н	45.68	53.98	8.30	AV

Operation Mode: CH Low(π/4DQPSK)

Frequency	Reading	A.F + C.L - A.G + D.F	Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4804	50.72	1.83	V	52.55	73.98	21.43	PK
4804	37.04	1.83	V	38.87	53.98	15.11	AV
7206	49.41	9.65	V	59.06	73.98	14.92	PK
7206	36.00	9.65	V	45.65	53.98	8.33	AV
4804	50.46	1.83	Н	52.29	73.98	21.69	PK
4804	36.85	1.83	Н	38.68	53.98	15.30	AV
7206	49.26	9.65	Н	58.91	73.98	15.07	PK
7206	35.58	9.65	Н	45.23	53.98	8.75	AV



Operation Mode: CH Mid(GFSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	50.49	2.31	V	52.8	73.98	21.18	PK
4882	36.32	2.31	V	38.63	53.98	15.35	AV
7323	50.01	9.96	V	59.97	73.98	14.01	PK
7323	36.03	9.96	V	45.99	53.98	7.99	AV
4882	49.34	2.31	Н	51.65	73.98	22.33	PK
4882	35.41	2.31	Н	37.72	53.98	16.26	AV
7323	49.26	9.96	Н	59.22	73.98	14.76	PK
7323	35.41	9.96	Н	45.37	53.98	8.61	AV

Operation Mode: CH Mid(8DPSK)

Frequency	Reading	A.F + C.L - A.G + D.F	Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4882	50.46	2.31	V	52.77	73.98	21.21	PK
4882	36.49	2.31	V	38.8	53.98	15.18	AV
7323	50.09	9.96	V	60.05	73.98	13.93	PK
7323	35.97	9.96	V	45.93	53.98	8.05	AV
4882	49.88	2.31	Н	52.19	73.98	21.79	PK
4882	35.62	2.31	Н	37.93	53.98	16.05	AV
7323	48.34	9.96	Н	58.3	73.98	15.68	PK
7323	35.52	9.96	Н	45.48	53.98	8.50	AV

Operation Mode: CH Mid(π /4DQPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	49.78	2.31	V	52.09	73.98	21.89	PK
4882	36.19	2.31	V	38.5	53.98	15.48	AV
7323	50.08	9.96	V	60.04	73.98	13.94	PK
7323	36.00	9.96	V	45.96	53.98	8.02	AV
4882	48.65	2.31	Н	50.96	73.98	23.02	PK
4882	35.87	2.31	Н	38.18	53.98	15.80	AV
7323	48.72	9.96	Н	58.68	73.98	15.30	PK
7323	35.76	9.96	Н	45.72	53.98	8.26	AV



Operation Mode: CH High(GFSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	50.55	2.26	V	52.81	73.98	21.17	PK
4960	36.64	2.26	V	38.90	53.98	15.08	AV
7440	49.30	9.78	V	59.08	73.98	14.90	PK
7440	35.52	9.78	V	45.3	53.98	8.68	AV
4960	49.51	2.26	Н	51.77	73.98	22.21	PK
4960	36.59	2.26	Н	38.85	53.98	15.13	AV
7440	48.71	9.78	Н	58.49	73.98	15.49	PK
7440	34.12	9.78	Н	43.9	53.98	10.08	AV

Operation Mode: CH High(8DPSK)

Frequency	Reading	A.F + C.L - A.G + D.F	Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4960	50.19	2.26	V	52.45	73.98	21.53	PK
4960	36.53	2.26	V	38.79	53.98	15.19	AV
7440	49.80	9.78	V	59.58	73.98	14.40	PK
7440	35.46	9.78	V	45.24	53.98	8.74	AV
4960	49.77	2.26	Н	52.03	73.98	21.95	PK
4960	35.41	2.26	н	37.67	53.98	16.31	AV
7440	47.51	9.78	н	57.29	73.98	16.69	PK
7440	34.79	9.78	Н	44.57	53.98	9.41	AV

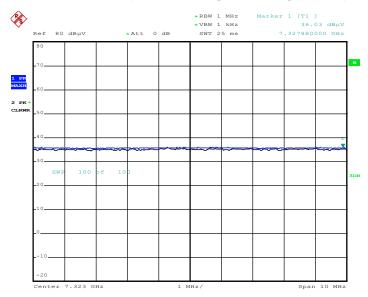
Operation Mode: CH High (π /4DQPSK)

Frequency [MHz]	Reading [dBuV]	A.F + C.L - A.G + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	50.61	2.26	V	52.87	73.98	21.11	PK
4960	36.69	2.26	V	38.95	53.98	15.03	AV
7440	48.94	9.78	V	58.72	73.98	15.26	PK
7440	35.46	9.78	V	45.24	53.98	8.74	AV
4960	49.53	2.26	Н	51.79	73.98	22.19	PK
4960	36.62	2.26	Н	38.88	53.98	15.10	AV
7440	48.52	9.78	Н	58.3	73.98	15.68	PK
7440	34.78	9.78	Н	44.56	53.98	9.42	AV



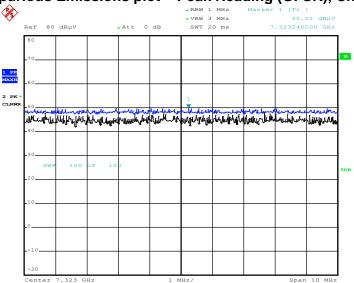
RESULT PLOTS (Worst case : X-V)

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



Date: 2.JAN.2003 20:50:29

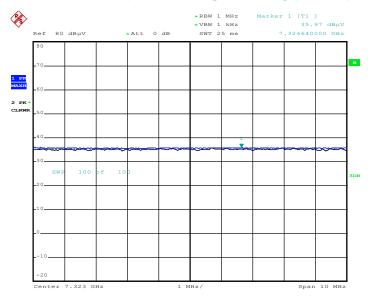
Radiated Spurious Emissions plot – Peak Reading (GFSK), Ch.39 3rd Harmonic)



Date: 2.JAN.2003 20:50:00

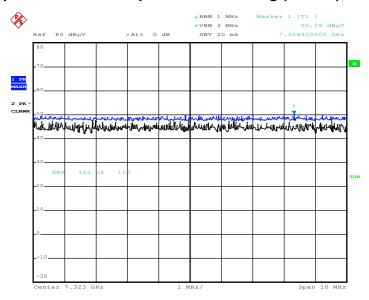


Radiated Spurious Emissions plot – Average Reading (8DPSK), Ch.39 3rd Harmonic)



Date: 2.JAN.2003 20:51:40

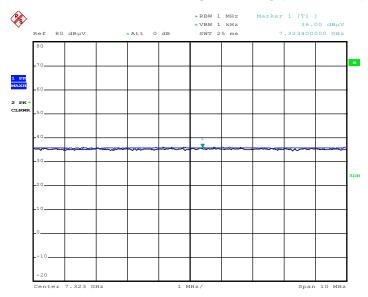
Radiated Spurious Emissions plot – Peak Reading (8DPSK), Ch.39 3rd Harmonic)



Date: 2.JAN.2003 20:52:09

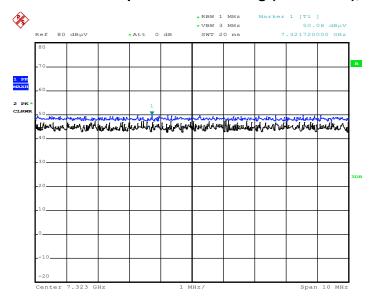


Radiated Spurious Emissions plot – Average Reading (π/4DQPSK), Ch.39 3rd Harmonic)



Date: 2.JAN.2003 20:45:35

Radiated Spurious Emissions plot – Peak Reading (π/4DQPSK), Ch.39 3rd Harmonic)



Date: 2.JAN.2003 20:46:00

Note:

Plot of worst case are only reported.



10.6.3 RADIATED RESTRICTED BAND EDGES

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

Frequency [MHz]	Reading [dBuV]	A.F + C.L + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	20.10	35.09	H H	55.19	73.98	18.79	PK
2390.0	8.78	35.09	Н	43.87	53.98	10.11	AV
2390.0	21.11	35.09	V	56.20	73.98	17.78	PK
2390.0	8.91	35.09	V	44.00	53.98	9.98	AV
2483.5	26.34	35.11	Н	61.45	73.98	12.53	PK
2483.5	8.90	35.11	Н	44.01	53.98	9.98	AV
2483.5	21.73	35.11	V	56.84	73.98	17.14	PK
2483.5	9.15	35.11	V	44.26	53.98	9.72	AV

Operation Mode Operating Frequency Channel No EDR(8DPSK)

CH 0, CH 78

2402 MHz, 2480 MHz

Frequency [MHz]	Reading [dBuV]	A.F + C.L + D.F [dB]	Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	1.86	35.09	н	36.95	73.98	37.03	PK
2390.0	8.90	35.09	н	43.99	53.98	9.99	AV
2390.0	21.90	35.09	V	56.99	73.98	16.99	PK
2390.0	8.78	35.09	V	43.87	53.98	10.11	AV
2483.5	26.13	35.11	н	61.24	73.98	12.74	PK
2483.5	8.96	35.11	Н	44.07	53.98	9.92	AV
2483.5	22.73	35.11	V	57.84	73.98	16.14	PK
2483.5	9.18	35.11	V	44.29	53.98	9.69	AV



Operation Mode

EDR(π/4DQPSK)

Operating Frequency

2402 MHz, 2480 MHz

Channel No

CH 0, CH 78

Frequency	Reading	A.F + C.L + D.F	Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
2390.0	21.26	35.09	Н	56.35	73.98	17.63	PK
2390.0	8.75	35.09	Н	43.84	53.98	10.14	AV
2390.0	21.67	35.09	V	56.76	73.98	17.22	PK
2390.0	8.91	35.09	V	44.00	53.98	9.98	AV
2483.5	26.19	35.11	Н	61.30	73.98	12.68	PK
2483.5	8.81	35.11	н	43.92	53.98	10.06	AV
2483.5	23.56	35.11	V	58.67	73.98	15.31	PK
2483.5	9.37	35.11	V	44.48	53.98	9.50	AV

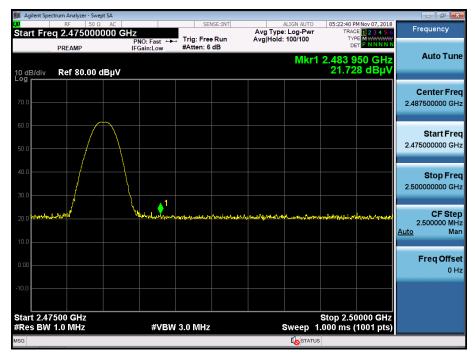


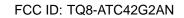
RESULT PLOTS (Worst case : X-V)

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



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



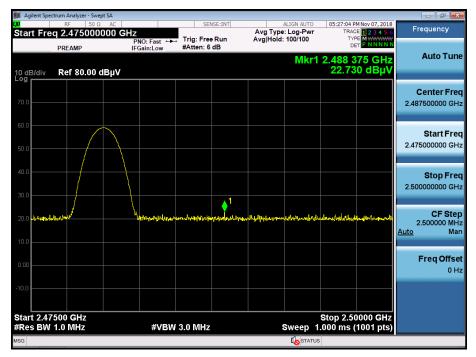


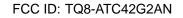


Radiated Restricted Band Edges plot – Average Reading (8DPSK), (Ch.78)

🊺 Agil	ent Spectrum Analyzer -	Swept SA								- ē 🔀
<mark>.x</mark> Start	^{RF} Freq 2.4750				ISE:INT	Avg Type	ALIGN AUTO	TRAC	M Nov 07, 2018 E 1 2 3 4 5 6 E M WWWWW	Frequency
	PREAMP		PNO: Fast ++- Gain:Low	Trig: Free #Atten: 6		Avg Hold	100/100	DI		
10 dB Log r	/div Ref 80.0	0 dBµV					Mkr	2.484 1 9.18	50 GHz 1 dBµV	Auto Tune
70.0										Center Freq 2.487500000 GHz
60.0 - 50.0 -										Start Freq 2.475000000 GHz
40.0 - 30.0 -										Stop Freq 2.500000000 GHz
20.0 -			1							CF Step 2.500000 MHz <u>Auto</u> Man
0.00 -										Freq Offset 0 Hz
-10.0										
	2.47500 GHz BW 1.0 MHz		#VBW	1.0 kHz			Sweep	Stop 2.50 19.53 ms (0000 GHz 1001 pts)	
MSG							I ostatu			

Radiated Restricted Band Edges plot – Peak Reading (8DPSK), (Ch.78)



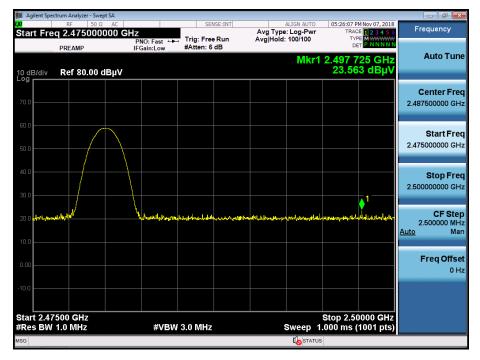




Radiated Restricted Band Edges plot – Average Reading (π /4DQPSK), (Ch.78)

🎉 Agilent Spec	trum Analyzer - Swept SA					
Start Fre	RF 50 Ω AC q 2.475000000 (GHz PNO: Fast ↔→	SENSE:INT	ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 100/100	05:25:28 PM Nov 07, 2018 TRACE 1 2 3 4 5 6 TYPE MWWWWW	Frequency
10 dB/div	Ref 80.00 dBµV	IFGain:Low	#Atten: 6 dB	Mkr1	2.487 150 GHz 9.372 dBµV	Auto Tune
70.0						Center Freq 2.487500000 GHz
60.0						Start Freq 2.475000000 GHz
40.0						Stop Freq 2.50000000 GHz
20.0			▲1			CF Step 2.500000 MHz <u>Auto</u> Man
0.00						Freq Offset 0 Hz
-10.0 Start 2.47	500 GHz				Stop 2.50000 GHz	
#Res BW		#VBW	1.0 kHz	Sweep 1	9.53 ms (1001 pts)	

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



Note:

Plot of worst case are only reported.



11 LIST OF TEST EQUIPMENT

Conducted Test

Manufacturer	Model / Emvirement	Calibration	Calibration	Serial No.	
Wanuracturer	Model / Equipment	Date	Interval	Senai No.	
Rohde & Schwarz	ESCI / Test Receiver	06/27/2018	Annual	100033	
ESPAC	SU-642 /Temperature Chamber	03/30/2018	Annual	0093008124	
Agilent	N9020A / Signal Analyzer	06/08/2018	Annual	MY51110085	
Agilent	N1911A / Power Meter	04/16/2018	Annual	MY45100523	
Agilent	N1921A / Power Sensor	04/16/2018	Annual	MY52260025	
Hewlett Packard	11667B / Power Splitter	06/07/2018	Annual	05001	
Hewlett Packard	E3632A / DC Power Supply	06/26/2018	Annual	KR75303960	
Agilent	8493C / Attenuator(10 dB)	07/10/2018	Annual	07560	
Rohde & Schwarz	EMC32 / Software	N/A	N/A	N/A	
	FCC WLAN&BT&BLE Conducted Test Software	N/A	N/A	N/A	
HCT CO., LTD.	v3.0	IN/A	IN/A	IN/A	
Rohde & Schwarz	CBT / Bluetooth Tester	05/17/2018	Annual	100422	

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
Audix	EM1000 / Controller	N/A	N/A	060520
Audix	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	08/23/2018	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/06/2017	Biennial	760
Schwarzbeck	VULB 9160 / TRILOG Antenna	08/09/2018	Biennial	9160-3368
Schwarzbeck	BBHA 9120D / Horn Antenna	06/30/2017	Biennial	1300
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	12/04/2017	Biennial	BBHA9170541
Rohde & Schwarz	FSP(9 kHz ~ 40 GHz) / Spectrum Analyzer	07/24/2018	Annual	100843
Wainwright Instruments	WHK3.0/18G-10EF / High Pass Filter	01/03/2018	Annual	F6
Wainwright Instruments	WHKX7.0/18G-8SS / High Pass Filter	05/09/2018	Annual	29
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	06/29/2018	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	01/03/2018	Annual	2
Weinschel	2-3 / Attenuator (3 dB)	10/10/2018	Annual	BR0617
H+S	5910-N-50-010 / Attenuator(10 dB)	11/08/2018	Annual	NONE
CERNEX	CBLU1183540B-01 / Power Amplifier	12/26/2017	Annual	25540
CERNEX	CBL06185030 / Power Amplifier	03/28/2018	Annual	28550
CERNEX	CBL18265035 / Power Amplifier	01/10/2018	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	06/29/2018	Annual	25956
TESCOM	TC-3000C / Bluetooth Tester	03/27/2018	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.



12 ANNEX A_ TEST SETUP PHOTO

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

No.	Description
1	HCT-RF-1901-FC011-P
2	HCT-RF-1901-FC012-P
3	HCT-RF-1901-FC013-P
4	HCT-RF-1901-FC014-P
5	HCT-RF-1901-FC015-P