

# Qingdao Intelligent&Precise Electronics Co., Ltd RF TEST REPORT

### **Report Type:**

FCC Part 15.247 & ISED RSS-247 RF report

Model: ZDGF7638GU-C

**REPORT NUMBER:** 190101102SHA-001

**ISSUE DATE:** February 25, 2019

**DOCUMENT CONTROL NUMBER:** TTRF15.247-01\_V1 © 2018 Intertek





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Report no.: 190101102SHA-001

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FCC ID:	2AJVQ-7638GUC
IC:	22470-7638GUC

#### SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification: 47CFR Part 15 (2018): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

**RSS-247 Issue 2 (February 2017):** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5 (April 2018): General Requirements for Compliance of Radio Apparatus

**PREPARED BY:** 

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# **Revision History**

Report No.	Version	Description	Issued Date
190101102SHA-001	Rev. 01	Initial issue of report	February 25, 2019



TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
20 dB Bandwidth	15.247(a)(1)	RSS-247 Issue 2 Clause 5.1	Pass
Carrier Frequency Separation	15.247(a)(1)	RSS-247 Issue 2 Clause 5.1	Pass
Output power	15.247(b)(1)	RSS-247 Issue 2 Clause 5.4	Pass
Radiated Emissions	15.205 & 15.209	RSS-Gen Issue 5 Clause 8.9&8.10	Pass
Conducted Spurious Emissions & Band Edge	15.247(d)	RSS-247 Issue 2 Clause 5.5	Pass
Power line conducted emission	15.207	RSS-Gen Issue 5 Clause 8.8	Pass
Number of Hopping Frequencies	15.247(a)(1)(iii)	RSS-247 Issue 2 Clause 5.1	Pass
Dwell time	15.247(a)(1)(iii)	RSS-247 Issue 2 Clause 5.1	Pass
Occupied bandwidth	-	RSS-Gen Issue 5 Clause 6.6	Tested
Antenna requirement	15.203	-	Pass

# **Measurement result summary**

Notes: 1: NA =Not Applicable

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# **1 GENERAL INFORMATION**

# 1.1 Description of Equipment Under Test (EUT)

Product name:	Wireless Module
Type/Model:	ZDGF7638GU-C
Description of EUT:	EUT is a Wireless Module with WiFi function and Bluetooth function, and has only one model.
Rating:	DC 5V
EUT type:	Table top 🔲 Floor standing
Software Version:	/
Hardware Version:	/
Sample received date:	January 14, 2019
Date of test:	January 14, 2019 ~ February 22, 2019

# **1.2 Technical Specification**

Frequency Band:	2400MHz ~ 2483.5MHz
Support Standards:	Bluetooth BR+EDR
Operating Frequency:	2402MHz to 2480MHz
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Type of Modulation:	GFSK, π/4-DQPSK, 8DPSK
Channel Number:	79 (0 - 78)
Channel Separation:	1 MHz
Antenna:	PIFA Antenna, 1.5dBi

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# **1.3 Frequency Hopping System Requirement**

#### Test Requirement: Section 15.247 (a)(1), (g), (h) requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

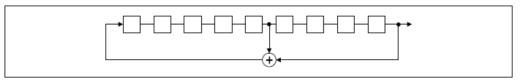
The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hop sets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

#### Compliance for section 15.247(a)(1)

According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a nine stages shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs;

i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: 2<sup>9</sup> -1 = 511 bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

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An example of Pseudorandom Frequency Hopping Sequence as follow:

20 62 46 77	7 64	8 73	16 75 1

Each frequency used equally on the average by each transmitter.

According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.

#### Compliance for section 15.247(g)

According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.

#### Compliance for section 15.247(h)

According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinate with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.



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# 1.4 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized,	CNAS Accreditation Lab Registration No. CNAS L0139
certified, or accredited by these	FCC Accredited Lab Designation Number: CN1175
organizations:	IC Registration Lab CAB identifier.: CN0051
	VCCI Registration Lab Registration No.: R-14243, G-10845, C-14723, T-12252
	A2LA Accreditation Lab Certificate Number: 3309.02

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**2 TEST SPECIFICATIONS** 

# 2.1 Standards or specification

47CFR Part 15 (2018) ANSI C63.10 (2013) RSS-247 Issue 2 (February 2017) RSS-Gen Issue 5 (April 2018)

# 2.2 Mode of operation during the test

While testing the transmitter mode of the EUT, the internal modulation is applied. All the functions of the host device except the BT module were set on stand-by mode.

Software name	Manufacturer	Version	Supplied by
Combo Tool	МТК	W1644	Client

The lowest, middle and highest channel were tested as representatives.

Frequency Band (MHz)	Mode	Lowest (MHz)	Middle (MHz)	Highest (MHz)
2400-2483.5	GFSK	2402	2441	2480
	π/4-DQPSK	2402	2441	2480
	8DPSK	2402	2441	2480

#### The worst-case modulation configuration:

Worst Modulation Used for Conformance Testing						
Bluetooth Mode Data Rate Packet Type Worst						
BR-1Mbps	DH1,DH3,DH5	BR-1Mbps DH5				
EDR-2Mbps	2DH1,2DH3,2DH5	EDR-2Mbps 2DH5				
EDR-3Mbps	3DH1,3DH3,3DH5	EDR-3Mbps 3DH5				
	BR-1Mbps EDR-2Mbps	BR-1Mbps DH1,DH3,DH5 EDR-2Mbps 2DH1,2DH3,2DH5				

Note: The BR-1Mbps DH5 mode was chosen for radiation emission bellow 1GHz and Conducted emission testing as representative in this report.

Power Setting parameter						
Mode	Channel					
Woue	Lowest	Middle	Highest			
GFSK	7	7	7			
π/4-DQPSK	7	7	7			
8DPSK	7	7	7			



# 2.3 Test software list

Test Items	est Items Software Manufacturer		Version	
Conducted emission	ESxS-K1	R&S	V2.1.0	
Radiated emission	ES-K1	R&S	V1.71	

# 2.4 Test peripherals list

Item No.	Name	Name Band and Model	
1	Laptop computer	DELL 5480	-

# **2.5** Test environment condition:

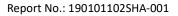
Test items	Temperature	Humidity	
20 dB Bandwidth			
Output power			
Carrier Frequency Separation			
Number of Hopping Frequencies	22°C	56% RH	
Dwell time			
Occupied bandwidth			
Conducted Spurious Emissions & Band Edge			
Radiated Emissions	22°C	56%RH	
Power line conducted emission	21°C	54%RH	

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# 2.6 Instrument list

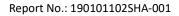
Conducted Emission/Disturbance Power/Tri-loop Test/CDN method									
Used	Equipment	Manufacturer	Туре	Internal no.	Due date				
$\boxtimes$	Test Receiver	R&S	ESCS 30	EC 2107	2019-07-15				
$\boxtimes$	A.M.N.	R&S	ESH2-Z5	EC 3119	2019-11-30				
	A.M.N.	R&S	ENV 216	EC 3393	2019-07-04				
	A.M.N.	R&S	ENV4200	EC 3558	2019-06-10				
Radiated Emission									
Used	Equipment	Manufacturer	Туре	Internal no.	Due date				
$\boxtimes$	Test Receiver	R&S	ESIB 26	EC 3045	2019-09-12				
$\boxtimes$	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2019-06-10				
×	Pre-amplifier	R&S	AFS42- 00101800-25-S- 42	EC5262	2019-06-10				
$\boxtimes$	Horn antenna	R&S	HF 906	EC 3049	2019-11-17				
	Horn antenna	ETS	3117	EC 4792-1	2020-01-09				
$\boxtimes$	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2020-07-09				
	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2019-03-07				
RF test									
Used	Equipment	Manufacturer	Туре	Internal no.	Due date				
$\boxtimes$	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2019-03-05				
	Power sensor	Agilent	U2021XA	EC 5338-1	2019-03-05				
	Vector Signal Generator	Agilent	N5182B	EC 5175	2019-03-05				
	Spectrum analyzer	R&S	CMW500	EC5944	2019-12-22				
	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2019-03-05				
	Mobile Test System	Litepoint	lqxel	EC 5176	2020-01-08				
	Test Receiver	R&S	ESCI 7	EC 4501	2019-09-12				
Tet Site									
Used	Equipment	Manufacturer	Туре	Internal no.	Due date				
$\boxtimes$	Shielded room	Zhongyu	-	EC 2838	2020-01-14				
	Shielded room	Zhongyu	-	EC 2839	2020-01-14				
$\boxtimes$	Semi-anechoic chamber	Albatross project	-	EC 3048	2019-07-31				
	Fully-anechoic chamber	Albatross project	-	EC 3047	2019-07-31				
Additional	instrument								
Used	Equipment	Manufacturer	Туре	Internal no.	Due date				
$\boxtimes$	Therom- Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2019-02-28				
	Therom-	ZJ1-2A	S.M.I.F.	EC 2122	2019-03-11				





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	Hygrograph				
$\boxtimes$	Therom- Hygrograph	ZJ1-2A	S.M.I.F.	EC 5198	2020-01-18
$\boxtimes$	Therom- Hygrograph	ZJ1-2A	S.M.I.F.	EC 3326	2019-03-28
	Pressure meter	YM3	Shanghai Mengde	EC 3320	2019-07-01

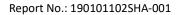




# 2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Measurement uncertainty
Maximum peak output power	$\pm 0.74$ dB
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Emission outside the frequency band	± 2.89dB
Power line conducted emission	± 3.19dB





# 3 20dB bandwidth

Test result: Pass

# 3.1 Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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, provided the systems operate with an output power no greater than 125mW.

# 3.2 Measurement Procedure

The EUT was tested according to Subclause 7.8 of ANSI C63.10.

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum 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.
- d) Steps a) through c) might require iteration to adjust within the specified tolerances.
- e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target "-xx dB down" requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- f) Set detection mode to peak and trace mode to max hold.
- g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
- h) Determine the "-xx dB down amplitude" using [(reference value) xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).
- j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "-xx dB down amplitude" determined in step h). If a marker is below this "-xx dB down amplitude" value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the "-xx dB down

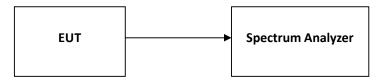


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amplitude" determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

# 3.3 Test Configuration



# 3.4 Test Results of 20dB bandwidth

Please refer to Appendix A.

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# 4 Carrier Frequency Separation

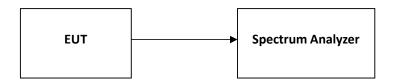
Test result: Pass

#### 4.1 Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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, provided the systems operate with an output power no greater than 125mW.

# 4.2 Test Configuration



# 4.3 Test Procedure and test setup

The EUT was tested according to Subclause 7.8 of ANSI C63.10.

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: Wide enough to capture the peaks of two adjacent channels.
- b) RBW: Start with the RBW set to approx. imately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- c) Video (or average) bandwidth (VBW)  $\geq$  RBW.
- d) Sweep: Auto.
- e) Detector function: Peak.
- f) Trace: Max hold.
- g) Allow the trace to stabilize.
- a) Use the marker-delta function to determine the separation between the peaks of the adjacent channels.
- b) Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

# 4.4 Test Results of Carrier Frequency Separation

Please refer to Appendix A.



# 5 Output power

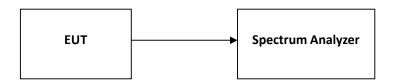
Test result: Pass

### 5.1 Limit

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 watt. (The e.i.r.p. shall not exceed 4 W)

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

# 5.2 Test Configuration



### 5.3 Measurement Procedure

The EUT was tested according to Subclause 7.8 of ANSI C63.10.

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

- a) Use the following spectrum analyzer settings:
  - 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
  - 2) RBW > 20 dB bandwidth of the emission being measured.
  - 3) VBW  $\geq$  RBW.
  - 4) Sweep: Auto.
  - 5) Detector function: Peak.
  - 6) Trace: Max hold.
- b) Allow trace to stabilize.
- c) Use the marker-to-peak function to set the marker to the peak of the emission.
- d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
- e) A plot of the test results and setup description shall be included in the test report.

# 5.4 Test Results of Output Power

Please refer to Appendix A.



# 6 Radiated Emissions

Test result: Pass

# 6.1 Limit

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified showed as below:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

# 6.2 Measurement Procedure

#### For Radiated emission below 30MHz:

- a) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meters chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) Both X and Y axes of the antenna are set to make the measurement.
- d) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

#### NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.



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#### For Radiated emission above 30MHz:

- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meters chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f) The test-receiver system was set to peak and average detector function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

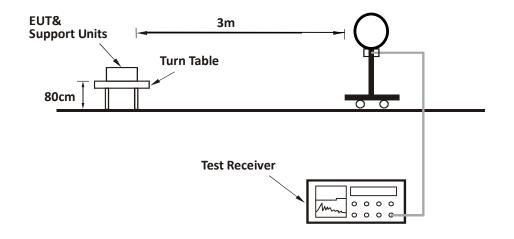
#### Note:

- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 3 x RBW (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
- 4. All modes of operation were evaluated and the worst-case emissions were reported

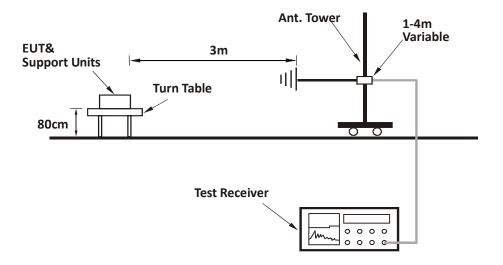


# 6.3 Test Configuration

For Radiated emission below 30MHz:

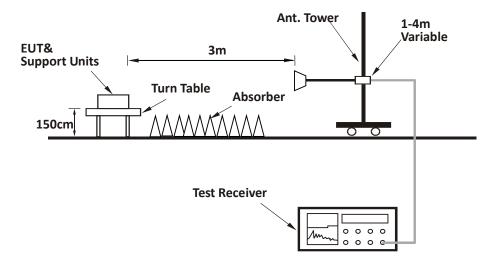


For Radiated emission 30MHz to 1GHz:





#### For Radiated emission above 1GHz:





# 6.4 Test Results of Radiated Emissions

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

EUT was tested with WiFi on and off, and the worst data was listed in the report.

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
Н	31.94	28.30	17.50	40	11.70	РК
Н	134.97	25.90	12.60	43.5	17.60	РК
н	243.83	34.70	13.30	46	11.30	РК
н	247.72	35.00	13.80	46	11.00	РК
н	350.74	30.90	16.30	46	15.10	РК
н	959.18	31.30	24.10	46	14.70	РК
V	30.00	25.80	18.60	40	14.20	РК
V	43.61	25.30	11.50	40	14.70	РК
V	92.20	31.50	10.30	43.5	12.00	РК
V	125.25	29.10	13.00	43.5	14.40	РК
V	255.49	29.70	14.70	46	16.30	РК
V	959.18	29.50	24.10	46	16.50	РК

#### Test data below 1GHz:

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#### Test result of 1GHz to 25GHz:

#### GFSK (DH5) Modulation:

СН	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
	Н	2402	34.10	99.00	Fundamental	/	РК
L	н	2390	34.20	52.50	74.00	21.50	РК
	V	2390	34.20	47.50	74.00	26.50	РК
М	Н	2441	34.20	98.00	Fundamental	/	РК
Н	Н	2480	34.40	100.80	Fundamental	/	РК
	Н	2483.5	34.80	52.50	74.00	21.50	РК

#### π/4DQPSK (2DH5) Modulation:

СН	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
	Н	2402	34.10	99.50	Fundamental	/	РК
	Н	2390	34.20	52.50	74.00	21.50	РК
М	Н	2441	34.20	99.00	Fundamental	/	РК
	Н	2480	34.40	98.50	Fundamental	/	РК
Н	Н	2483.5	34.80	52.50	74.00	21.50	РК

#### 8DPSK (3DH5) Modulation:

СН	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
	Н	2402	34.10	99.50	Fundamental	/	РК
L	Н	2390	34.20	52.50	74.00	21.50	РК
М	Н	2441	34.20	99.00	Fundamental	/	РК
Н	Н	2480	34.40	98.50	Fundamental	/	РК
	Н	2483.5	34.80	52.50	74.00	21.50	РК

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.

2. Corrected Reading = Original Receiver Reading + Correct Factor

- 3. Margin = Limit Corrected Reading
- 4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,

Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV, Limit = 40.00dBuV/m. Then Correct Factor = 30.20 + 2.00 - 32.00 = 0.20dB/m; Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m; Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.



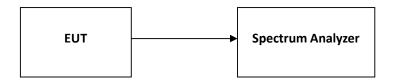
# 7 Conducted Spurious Emissions & Band Edge

Test result: Pass

# 7.1 Limit

In any 100kHz bandwidth outside the frequency band in which the spread spectrum 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 100kHz bandwidth within the band that contains the highest level of the desired power.

# 7.2 Test Configuration



# 7.3 Measurement Procedure

- a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e)
- b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).
- c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent "normal mode of operation" as specified in 6.10.3. of ANSI C63.10.
- d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6 of ANSI C63.10, and orient the EUT and measurement antenna positions to produce the highest emission level.
- e) Perform the test as follows:
  - 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 that fall outside of the authorized band of operation.
  - 2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
  - 3) Attenuation: Auto (at least 10 dB preferred).
  - 4) Sweep time: Coupled.
  - 5) Resolution bandwidth: 100 kHz
  - 6) Video bandwidth: 300 kHz
  - 7) Detector: Peak
  - 8) Trace: Max hold
- f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to



#### **TEST REPORT**

oscillator overshoot.

- g) Set the marker on the emission at the band edge, or on the highest modulation product outside of
- a) the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- h) Repeat step c) through step e) for every applicable modulation.
- i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).
- j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

# 7.4 Test Results of Conducted Spurious Emissions & Band Edge

Please refer to Appendix A

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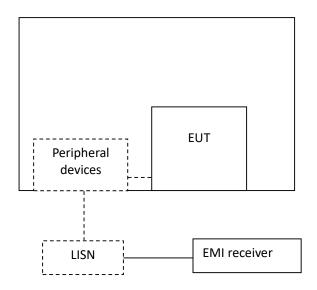
# 8 Power line conducted emission

Test result: Pass

# 8.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)				
	QP	AV			
0.15-0.5	66 to 56*	56 to 46 *			
0.5-5	56	46			
5-30	60	50			
* Decreases with the logarithm of the frequency.					

# 8.2 Test Configuration





TEST REPORT

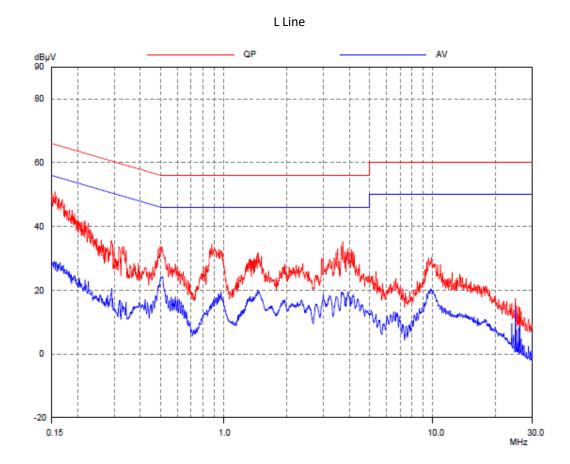
# 8.3 Measurement Procedure

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50  $\Omega$  LISN port (to which the EUT is connected), where permitted, terminated into a 50  $\Omega$  measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50  $\Omega$  measuring port is terminated by a measuring instrument having 50  $\Omega$  input impedance. All other ports are terminated in 50  $\Omega$  loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

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# 8.4 Test Results of Power line conducted emission

Frequency	Quasi-peak			Average			
(MHz)	level dB(μV)	Limit dB(µV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)	
0.16	50.83	65.67	14.84	28.98	55.67	26.69	
0.50	32.24	56.02	23.78	24.11	46.02	21.91	
0.88	34.34	56.00	21.66	16.02	46.00	29.98	
1.47	31.78	56.00	24.22	19.56	46.00	26.44	
3.72	35.20	56.00	20.80	19.21	46.00	26.79	
9.88	30.24	60.00	29.76	20.14	50.00	29.86	



N Line

Frequency	Quasi-peak			Average		
(MHz)	level dB(μV)	Limit dB(µV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.16	49.83	65.24	15.41	28.40	55.24	26.84
0.50	37.13	56.00	18.87	29.16	46.00	16.84
3.39	34.42	56.00	21.58	17.06	46.00	28.94
3.88	33.82	56.00	22.18	14.10	46.00	31.90
9.57	31.56	60.00	28.44	19.04	50.00	30.96
10.00	33.04	60.00	26.96	20.78	50.00	29.22

*Remark:* 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.

- 2. Corrected Reading = Original Receiver Reading + Correct Factor
- 3. Margin = Limit Corrected Reading
- 4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

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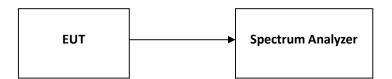
# 9 Number of Hopping Frequencies

Test result: Pass

### 9.1 Limit

Number of Hopping Frequencies in the 2400-2483.5 MHz band shall use at least 15 channels.

# 9.2 Test Configuration



# 9.3 Test procedure and test setup

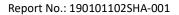
The EUT was tested according to Subclause 7.8 of ANSI C63.10.

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel
- c) spacing or the 20 dB bandwidth, whichever is smaller.
- d) VBW  $\geq$  RBW.
- e) Sweep: Auto.
- f) Detector function: Peak.
- g) Trace: Max hold.
- h) Allow the trace to stabilize.

# 9.4 Test Results of Number of Hopping Frequencies

Please refer to Appendix A





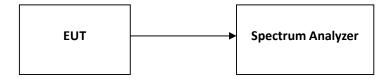
# 10 Dwell Time

Test result: Pass

# 10.1 Limit

The dwell time on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

# **10.2 Test Configuration**



# 10.3 Test procedure and test setup

The EUT was tested according to Subclause 7.8 of ANSI C63.10.

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
- c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- d) Detector function: Peak.
- e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation: (Number of hops in the period specified in the requirements) = (number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)



The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

# 10.4 Test Results of Dwell Time

Please refer to Appendix A



# **11 Occupied Bandwidth**

Test result: Tested

# 11.1 Limit

None

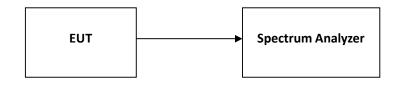
# **11.2 Measurement Procedure**

The EUT was tested according to Subclause 7.8 of ANSI C63.10 and RSS-Gen.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 x RBW.

# **11.3 Test Configuration**



# **11.4 The results of Occupied Bandwidth**

Please refer to Appendix A



# **12** Antenna requirement

#### **Requirement:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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.

#### **Result:**

EUT uses permanently attached antenna to the intentional radiator, so it can comply with the provisions of this section.



## **Appendix A: Test results**

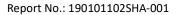
- 1. Peak Output Power
  - 1.1 Test Data

BT Maximum Output Power									
Mode	Test Frequency	Packet Type	Power(dBm)	Result					
GFSK	2402	DH5	3.44	Pass					
GFSK	2441	DH5	3.72	Pass					
GFSK	2480	DH5	3.98	Pass					
DQPSK	2402	2DH5	5.96	Pass					
DQPSK	2441	2DH5	6.20	Pass					
DQPSK	2480	2DH5	6.48	Pass					
8DPSK	2402	3DH5	6.20	Pass					
8DPSK	2441	3DH5	6.44	Pass					
8DPSK	2480	3DH5	6.72	Pass					

BT EIRP								
Max power (dBm)	Max EIRP (dBm)	Max EIRP (W)	Result					
6.72	8.22	0.007	Pass					

	GFSK,240	2MHz,DH5		GFSK,2441MHz,DH5			
Spectrum Analyzer 1 Swept SA	•		Frequency •	Spectrum Analyzer 1 Swept SA	+		Frequency •
KEYSIGHT Input. RF RL Aign Of LV	Input Z 50 Ω #Atten 30 dB PNO. F Corrections: Off Preamp: Off Gate: C Freq Ref. Int (S) IF Gain NFE: Adaptive Sig Tra	tf Trig Free Run MWWWWW	Center Frequency 240200000 GHz	KEYSIGHT Input RF RL Aign Of Aign Of	Input Z: 50 Ω #Alten: 30 dB PNO. Fast Corrections: Off Preamp: Off Gate: Off Freq Ref. Int (S) IF Gain: Low NFE: Adaptive Sig Track: Cf		Center Frequency 2.441000000 GHz
1 Spectrum v Scale/Div 10 dB	Ref Lvi Offset 0.50 dB Ref Level 20.00 dBm	Mkr1 2.401 964 GHz 3.43 dBm	6.00000000 MHz Swept Span Zero Span	1 Spectrum v Scale/Div 10 dB Log	Ref Lvi Offset 0.50 dB Ref Level 20.00 dBm	Mkr1 2.441 000 GHz 3.72 dBm	6.00000000 MHz Swept Span Zero Span
10.0	1		Full Span	10.0	1		Full Span
0.00			Start Freq 2.399000000 GHz	0.00			Start Freq 2.438000000 GHz
-20.0			Stop Freq 2.405000000 GHz	-20.0			Stop Freq 2.444000000 GHz
			AUTO TUNE CF Step 600.000 kHz	-30.0			AUTO TUNE CF Step 600.000 kHz
			Auto	-50.0			Auto
			Freq Offset 0 Hz	-70.0			Freq Offset 0 Hz
Center 2.402000 GHz #Res BW 2.0 MHz	#Video BW 6.0 MHz	Span 6.000 MHz Sweep 1.00 ms (1001 pts)	Limited	E Center 2.441000 GHz #Res BW 2.0 MHz	#Video BW 6.0 MHz	Span 6.000 MHz Sweep 1.00 ms (1001 pts)	X Axis Scale Log Lin Sale
<b>ا</b> ک	2 Jan 10, 2019	X - 8 = .	Sale Signal Track InStein Zeom	<b>1</b> 7 7	? Jan 10, 2019 🗩		Sale Signal Track Allow
	GFSK,248	0MHz,DH5			DQPSK,2402	MHz,2DH5	

		Frequency		Spectrum Analyzer 1	6		Frequency
IF Gain: Low	Avg Type: Log-Power Trig: Free Run MWWWWW P N N N N N	Center Frequency 2.480000000 GHz	Settings	KEYSIGHT Input RF RL	Freq Ref. Int (S) IF Gain	1. Low	Center Frequency 2.402000000 GHz
Ref Lvi Offset 0.50 dB	Mkr1 2.480 000 GHz 3.98 dBm	Span 6.00000000 MHz Street Span		1 Spectrum 🔹	Ref Lvi Offset 0.50 dB	Mkr1 2.402 138 GHz	Span 6.00000000 MHz Sweet Span
				Log			Swept Span Zero Span Full Span
		Start Freq		0.00			Start Freq
		Stop Freq		-10.0			2.399000000 GHz Stop Freq
				-20.0			2.405000000 GHz
		CF Step		-40.0			CF Step 600.000 kHz
				-50.0			Auto Man
		Freq Offset 0 Hz		-70.0			Freq Offset 0 Hz
#Video BW 6.0 MHz	Span 6.000 MHz	X Axis Scale Log	Prototype	Center 2.402000 GHz	#Video BW 6.0 MHz	Span 6.000 MHz	X Axis Scale
Θ		Signal Track	Sale		Jan 10, 2019		Lin Li Signal Track A
		A South Zeermin			and the second s		a sount zoonn
HABAN 20 HD DAVA From	An Turo Leo Boser	Frequency		andreak		Set An Time Las Press	Frequency
Preamp: Off Gate: Off IF Gain: Low	DO THE WORLD	Center Frequency 2.441000000 GHz	Settings	RL Coupling DC Align Off	Corrections: Off Preamp: Off Gate: C Freq Ref. Int (S) IF Gain	1 Low	Center Frequency 2.480000000 GHz
Ref Lvi Offset 0.50 dB	Mkr1 2.441 180 GHz	Span 6.00000000 MHz		1 Spectrum 🔹	Ref Lvi Offset 0.50 dB	Mkr1 2.480 138 GHz	Span 6.00000000 MHz
	0.20 0.21			Log	Kei Levei 20.00 dBin	0.40 0.511	Swept Span Zero Span
		Full Span Start Freq		0.00			Full Span Start Freq
		2.438000000 GHz Stop Freg		-10.0			2.477000000 GHz Stop Freq
		2.444000000 GHz		-20.0			2.483000000 GHz
		CF Step		-40.0			AUTO TUNE CF Step
		Auto		-50.0			600.000 kHz Auto Man
		Freq Offset		-60.0			Freq Offset 0 Hz
#Video BW 6.0 MHz	Span 6.000 MHz	X Axis Scale	Prototype	Center 2.480000 GHz	#Video BW 6.0 MHz	Span 6.000 MHz	V Avia Pasia
		Signal Track	Limited Sale Allowed		Jan 10, 2019		Log Lin Signel Track: A
	12 Summer Street Land Street Stree	riscen Zeomi			A PROPERTY OF THE PROPERTY OF		i Sten Zoomi
<i>"</i>		Frequency	· 😹	onopcon	+		Frequency
Preamp: Off Gate: Off IF Gain: Low	Ing: Free Run MWWWWW	Center Frequency 2.402000000 GHz	Settings	RL Couping DC Aign Of	Corrections: Off Preamp: Off Gate: C	1 Inv	Center Frequency 2.441000000 GHz
Ref Lvi Offset 0.50 dB	Mkr1 2.402 000 GHz	Span 6.00000000 MHz		1 Spectrum 🔹	Ref Lvi Offset 0.50 dB	Mkr1 2.441 018 GHz	Span 6.00000000 MHz
				Log			Swept Span Zero Span
	~	Start Freq		1.00			Full Span Start Freq
		Stop Freq		-10.0			2.438000000 GHz Stop Freq
		2.40500000 GHz		-20.0			2.444000000 GHz
		CF Step		-40.0			CF Step
		600.000 kHz Auto Man		-59.0			600.000 kHz Auto Man
		Freq Offset 0 Hz		-50.0			Freq Offset 0 Hz
		UHZ					
#Video BW 6.0 MHz	Span 6.000 MHz Sweep 1.00 ms (1001 pts)	X Axis Scale	Prototype Limited Sale	Center 2.441000 GHz #Res BW 2.0 MHz	#Video BW 6.0 MHz	Span 6.000 MHz Sweep 1.00 ms (1001 pts)	X Axis Scale Log Lin
	Picture         Picture           Ref.Luc Office: 6.50 dB Ref.Luc of 50 dB         Image: 100 million           Ref.Luc of fice: 6.50 dB         Ref.Luc of fice: 6.50 dB           Ref.Luc of fice: 6.50 dB         Ref.Luc of fice: 6.50 dB           Ref.Luc of fice: 6.50 dB         Image: 100 million           Ref.Luc of fice: 6.50 million         Image: 100 million           Ref.Luc of fice: 6.50 million         Image: 100 million           Ref.Luc of fice: 6.50 million         Image: 100 million	P Gen: Wight and Wight 2,440,000,GH2             Ref Live 200,0 GH2               Miler 1,2,440,000,GH2             Ref Live 200,0 GH2             Separa.600            Ref Live 200,0 GH2               Separa.600               Miler 1,2,440,000,GH2            Video BW 50,0 Miz               Separa.600               Separa.600            Video BW 50,0 Miz               Separa.600               Separa.600            Video BW 50,0 Miz               Separa.600               Separa.600            Ploten 20,0 GB               Ploten 20,0               Mizr               Separa.600            Ploten 20,0 GB               Ploten 20,0               Mizr               Separa.600            Ploten 20,0 GB               Ploten 20,0               Mizr               Zepara.0            Ploten 20,0 GB               Ploten 20,0               Mizr               Zepara.0               Zepara.0            Ploten 20,0               Ploten 20,0               Separa.6               Nizr               Separa.6 <t< td=""><td>9       Formury       Part Harthing       24000000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.409 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.409 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.409 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.409 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.400 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.401 CH2       Part Harbin 1.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Part Harbin 1.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Part Harbin 1.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Part Harbin 1.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.4421 100 CH2</td><td>Big (Fight Low)       Perturn No.       Perturn No.<!--</td--><td>Bit Card Law       Print of Card Law       Print o</td><td>Private Bit La dira:          Private Bit La dira:</td><td>Transfer Model and Ministry Links of Min</td></td></t<>	9       Formury       Part Harthing       24000000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.409 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.409 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.409 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.409 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.400 000 CH2       Source 5.00000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.401 CH2       Part Harbin 1.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Part Harbin 1.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Part Harbin 1.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Part Harbin 1.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.441 100 CH2       Source 6.0000 CH2         Part Livit Officet 6.50 dB       Mitr1 2.4421 100 CH2	Big (Fight Low)       Perturn No.       Perturn No. </td <td>Bit Card Law       Print of Card Law       Print o</td> <td>Private Bit La dira:          Private Bit La dira:</td> <td>Transfer Model and Ministry Links of Min</td>	Bit Card Law       Print of Card Law       Print o	Private Bit La dira:          Private Bit La dira:	Transfer Model and Ministry Links of Min



**TEST REPORT** 

Spectrum Analyzer 1 Swept SA	+			
KEYSIGHT Input. RF RL Align. Off	Input Z: 50 Ω Corrections: Off Freq Ref. Int (S) NFE: Adaptive	#Allen. 30 dB Preamp: Off	PNO. Fast Gate: Off IF Gain: Low Sig Track: Off	Avg Type. Log- Trig: Free Run

SIGHT Input RF Couping: DC Aign: Of	Corrections: Off Preamp: Off Freq Ref. Int (S)	PNO.Fast Avg. Gate:Off Trig IF Gain:Low Sig Track:Off		PNNNNN	Center Frequency 2.480000000 GHz	Settings
LV 1 Spectrum v Scale/Div 10 dB Log	Ref Lvi Offset 0.50 Ref Level 20.00 dBr		Mkr1 2.479 6	970 GHz .72 dBm	Span 6.0000000 MHz Swept Span Zero Span	
10.0					Full Span Start Freq 2.477000000 GHz	
-20.0					Stop Freq 2.483000000 GHz AUTO TUNE	
-40.0					CF Step 600.000 kHz Auto Man	
-70.0					Freq Offset 0 Hz X Avis Scale	Dealabas
Center 2.480000 GHz #Res BW 2.0 MHz	#Video BW 6.0 MH	z	Sweep 1.00 m		Log	Prototype Limited Sale
¶ ∩ d I ?	Jan 10, 2019 6:18:53 PM			-X	Signal Track i Sven Zeomi	Allowed

Frequency •

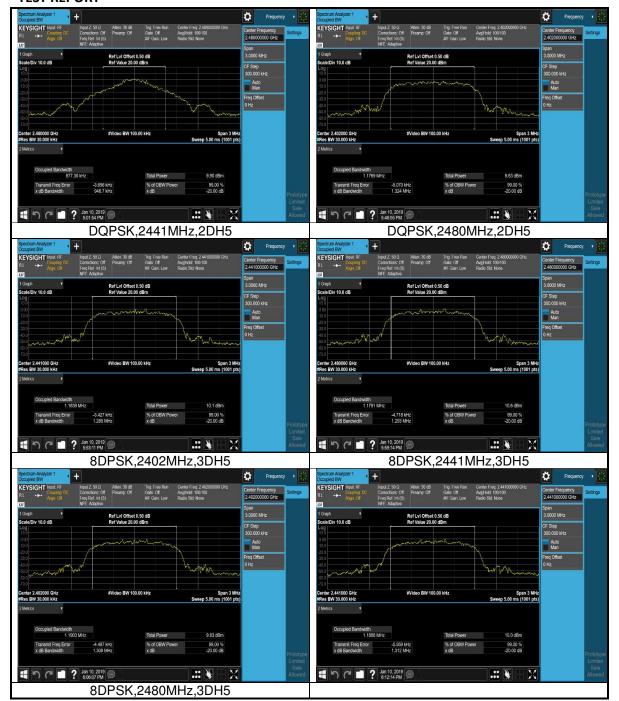


### 2. 20dB Bandwidth

#### 2.1 Test Data

BT Occupied 20dB Bandwidth									
Mode	Test Frequency	Packet Type	20dB Occupied Bandwidth(kHz)	Result					
GFSK	2402	DH5	952.0	Pass					
GFSK	2441	DH5	956.3	Pass					
GFSK	2480	DH5	946.7	Pass					
DQPSK	2402	2DH5	1323.9	Pass					
DQPSK	2441	2DH5	1289.4	Pass					
DQPSK	2480	2DH5	1292.8	Pass					
8DPSK	2402	3DH5	1307.5	Pass					
8DPSK	2441	3DH5	1311.5	Pass					
8DPSK	2480	3DH5	1317.3	Pass					







Spectrum Analyzer 1				Frequency	- *
RL Aign Off	Input Z 50 Ω Atlen. 30 dB Corrections: Off Preamp: Off Freq Ref. Int (S) NFE: Adaptive	Gate: Off Av	enter Freq. 2.480000000 GHz vg)Hold: 100/100 adio Std. None	2.480000000 GHz	Settings
1 Graph • Scale/Div 10.0 dB	Ref Lvi Offset 0. Ref Value 20.00			Span 3.0000 MHz CF Step	
10.0		many		300.000 kHz Auto Man	
-20.0 -30.0 -50.0	nt l		and the man was	Freq Offset 0 Hz	
-60.0 -70.0 Center 2.480000 GHz	#Video BW 100.0		Span 3 MHz		
#Res BW 30.000 kHz 2 Metrics v			Sweep 5.00 ms (1001 pts)		
Occupied Bandwidth 1.1894	4 MHz	Total Power	10.3 dBm		
Transmit Freq Error x dB Bandwidth	-6.317 kHz 1.317 MHz	% of OBW Power x dB	99.00 % -20.00 dB		Prototype
4 り ペ 1 ?	Jan 10, 2019 6:17:46 PM				Limited Sale Allowed

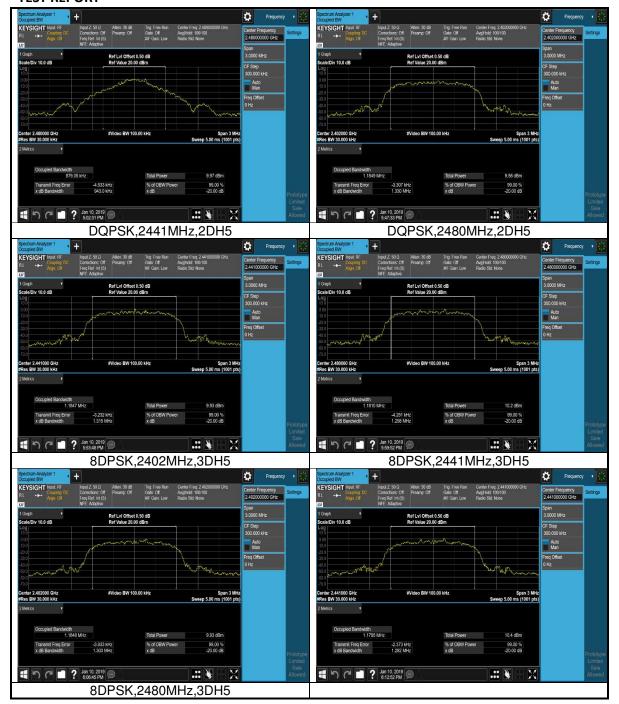


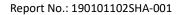
### 3. Occupied Bandwidth

#### 3.1 Test Data

BT 99% Occupied Bandwidth									
Mode	Test Frequency	Packet Type	99% Occupied Bandwidth(kHz)	Result					
GFSK	2402	DH5	886.21	Pass					
GFSK	2441	DH5	893.84	Pass					
GFSK	2480	DH5	879.05	Pass					
DQPSK	2402	2DH5	1184.91	Pass					
DQPSK	2441	2DH5	1184.69	Pass					
DQPSK	2480	2DH5	1181.05	Pass					
8DPSK	2402	3DH5	1184.76	Pass					
8DPSK	2441	3DH5	1179.51	Pass					
8DPSK	2480	3DH5	1186.48	Pass					







Spectrum Analyzer 1  Cccupied BW			\$	Frequency •	
L +++ Coupling DC Com Align Of Freq	it Z. 50 Ω Atten. 30 dB rections: Off Preamp: Off 1 Ref. Int (S) 2 Adaptive	Trig. Free Run Center Free Gete: Off Avg Hold: 1 #F Gam. Low Radio Std		Frequency 000000 GHz	
1 Graph v Scale/Div 10.0 dB	Ref Lvi Offset 0.5 Ref Value 20.00 c		3.000		
Log			CF Sta 300.0	ip 00 kHz	
0.00	and the second second	manny		uto an	
200 300 400 500 600		Jon way	MMM Preq ( 0 Hz	iffset	
-70.0 Center 2.480000 GHz #Res BW 30.000 kHz	#Video BW 100.0		Span 3 MHz weep 5.00 ms (1001 pts)		
2 Metrics V					
Occupied Bandwidth 1,1865 MHz		Total Power	10.4 dBm		
Transmit Freq Error	-2.560 kHz	% of OBW Power	99.00 %		
x dB Bandwidth	1.287 MHz	x dB	-20.00 dB	Prototy	
📲 ) d 🔳 ? 🚛	n 10, 2019 18:24 PM		: : :	Sale	



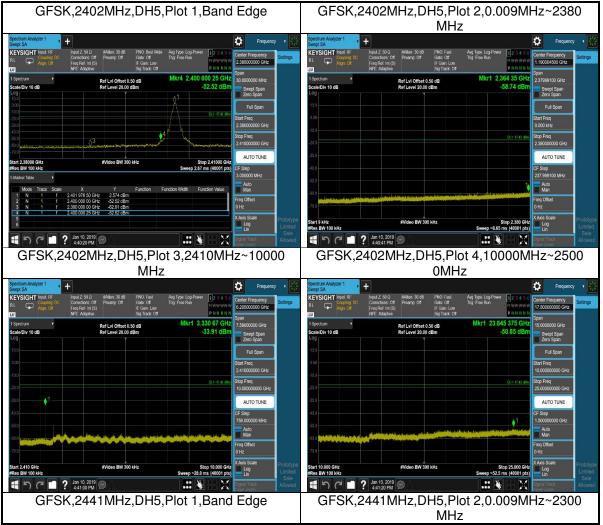
### 4. Conducted Spurious Emissions & Band Edge

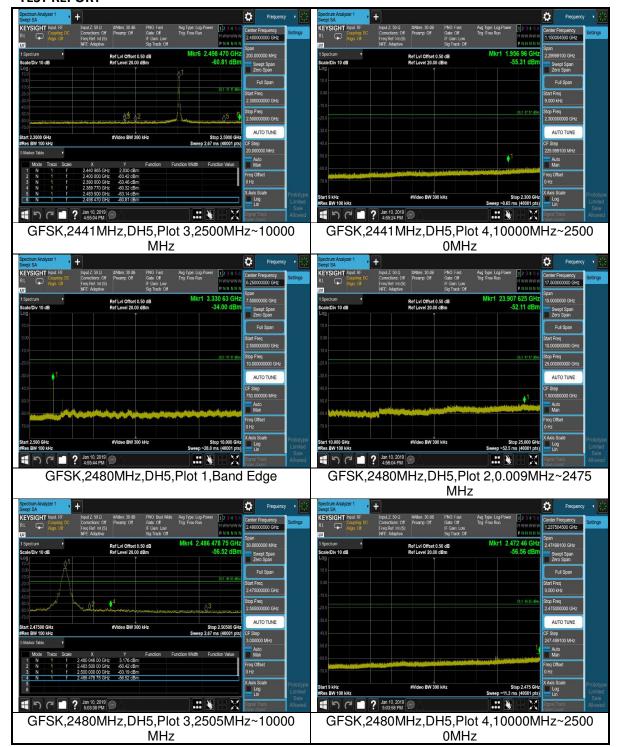
### 4.1 Test Data

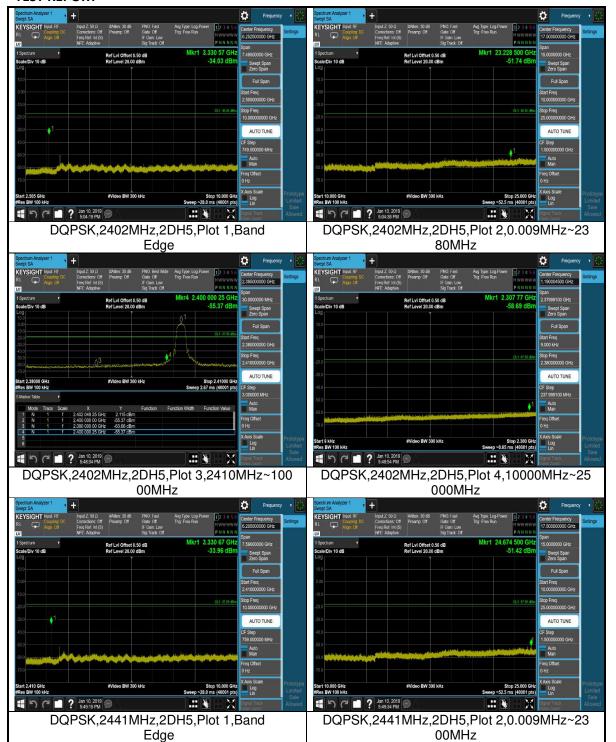
BT Transmitter Spurious Emission									
Mode	Test Frequency (MHz)	Packet Type	Frequency Range	Power (dBm)	Result				
GFSK	2402	DH5	0.009MHz~2380MHz	-58.74	Pass				
GFSK	2402	DH5	10000MHz~25000MHz	-50.85	Pass				
GFSK	2402	DH5	2410MHz~10000MHz	-33.91	Pass				
GFSK	2402	DH5	Band Edge	-52.52	Pass				
GFSK	2441	DH5	0.009MHz~2300MHz	-55.31	Pass				
GFSK	2441	DH5	10000MHz~25000MHz	-52.11	Pass				
GFSK	2441	DH5	2500MHz~10000MHz	-34.00	Pass				
GFSK	2441	DH5	Band Edge	-60.32	Pass				
GFSK	2480	DH5	0.009MHz~2475MHz	-56.56	Pass				
GFSK	2480	DH5	10000MHz~25000MHz	-51.74	Pass				
GFSK	2480	DH5	2505MHz~10000MHz	-34.03	Pass				
GFSK	2480	DH5	Band Edge	-56.52	Pass				
DQPSK	2402	2DH5	0.009MHz~2380MHz	-58.69	Pass				
DQPSK	2402	2DH5	10000MHz~25000MHz	-51.42	Pass				
DQPSK	2402	2DH5	2410MHz~10000MHz	-33.96	Pass				
DQPSK	2402	2DH5	Band Edge	-55.37	Pass				
DQPSK	2441	2DH5	0.009MHz~2300MHz	-59.00	Pass				
DQPSK	2441	2DH5	10000MHz~25000MHz	-52.04	Pass				
DQPSK	2441	2DH5	2500MHz~10000MHz	-33.92	Pass				
DQPSK	2441	2DH5	Band Edge	-60.35	Pass				
DQPSK	2480	2DH5	0.009MHz~2475MHz	-40.83	Pass				
DQPSK	2480	2DH5	10000MHz~25000MHz	-51.04	Pass				
DQPSK	2480	2DH5	2505MHz~10000MHz	-33.94	Pass				
DQPSK	2480	2DH5	Band Edge	-57.07	Pass				
8DPSK	2402	3DH5	0.009MHz~2380MHz	-40.79	Pass				
8DPSK	2402	3DH5	10000MHz~25000MHz	-51.92	Pass				
8DPSK	2402	3DH5	2410MHz~10000MHz	-33.92	Pass				

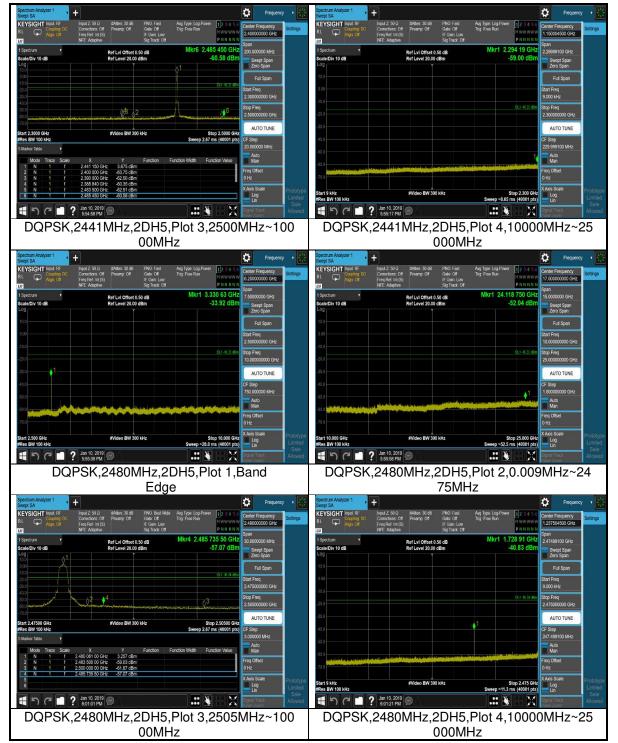
### TEST REPORT

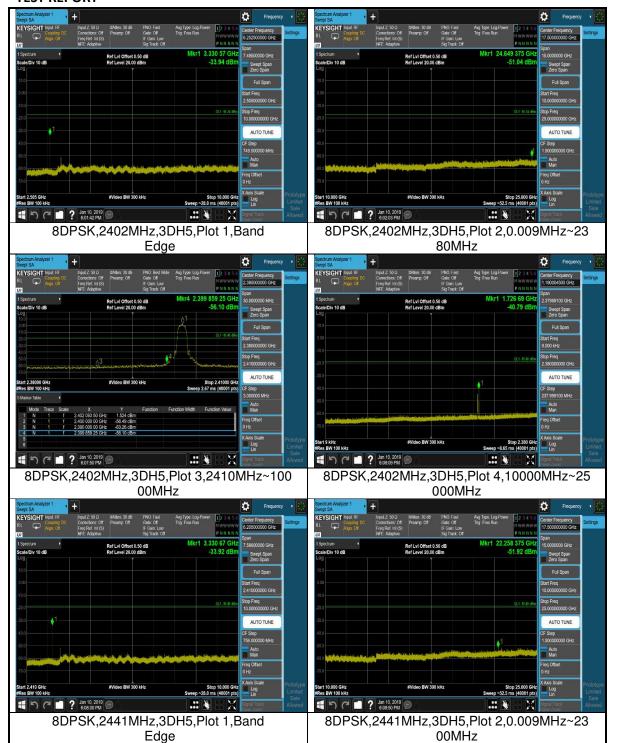
8DPSK	2402	3DH5	Band Edge	-56.10	Pass
8DPSK	2441	3DH5	0.009MHz~2300MHz	-58.41	Pass
8DPSK	2441	3DH5	10000MHz~25000MHz	-52.11	Pass
8DPSK	2441	3DH5	2500MHz~10000MHz	-33.91	Pass
8DPSK	2441	3DH5	Band Edge	-59.55	Pass
8DPSK	2480	3DH5	0.009MHz~2475MHz	-57.06	Pass
8DPSK	2480	3DH5	10000MHz~25000MHz	-51.67	Pass
8DPSK	2480	3DH5	2505MHz~10000MHz	-33.75	Pass
8DPSK	2480	3DH5	Band Edge	-57.66	Pass

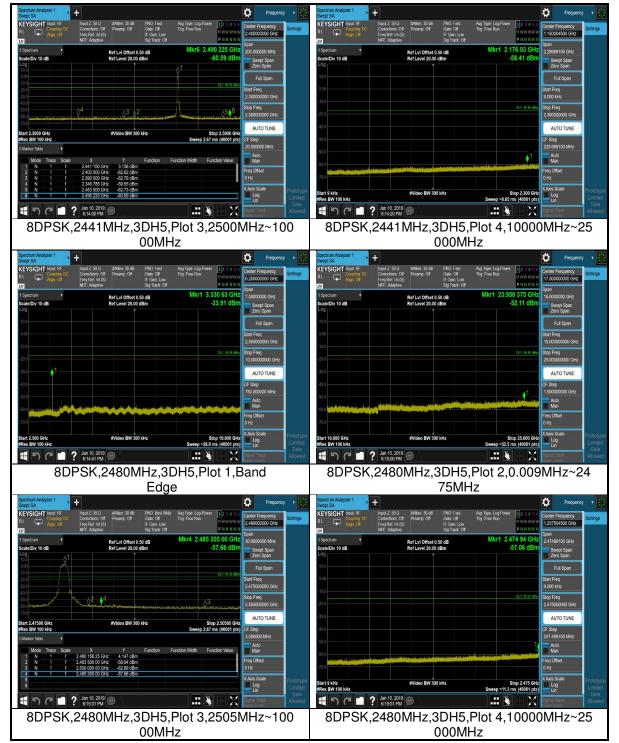












L Couping DC Align Off	Input Z: 50 Ω #Atten: 30 dB PNO, Fast Conactions: Off Proamp: Off Gate: Off Free Ref Inf (S) IF Gam. Low NEE: Adaptive Sig Track: C		6.252500000 GHz	tings Spectrum Analyzer 1 Swept SA KEYSIGHT Input RF RL Cauping DC Argn. Of	Input Z: 50 Ω #Atten: 30 dB PNO: Fast Connections: Off Preamp: Off Gate Off Freq Ref Int (S) IF Gam: Low NFE: Adaptive Sig Track: Of	Avg Type: Log-Power 123456 Trig: Free Run NWWWWWW	Center Frequency 17.50000000 GHz
Spectrum v cale/Div 10 dB	Ref Lvi Offset 0.50 dB Ref Level 20.00 dBm	Mkr1 3.330 57 GHz -33.75 dBm	Span 7.49500000 GHz Swept Span Zero Span	1 Spectrum v Scale/Div 10 dB Log	Ref Lvi Offset 0.50 dB Ref Level 20.00 dBm	Mkr1 23.475 250 GHz -51.67 dBm	Span 15.0000000 GHz Swept Span Zero Span
			Full Span	10.0			Full Span
			Start Freq 2.505000000 GHz	0.00			Start Freq 10.000000000 GHz
)		0L1-1585 dBm	Stop Freq 10.000000000 GHz	-20.0		UL1-15-85 dBm	Stop Freq 25.000000000 GHz
<b>∮</b> 1			AUTO TUNE	-30.0			AUTO TUNE
			CF Step 749.500000 MHz	40.0		1	CF Step 1.500000000 GHz
			Auto Man	- SU	a state of the second stat		Auto Man
		التلاف الظلية طلقاه وم	Freq Offset 0 Hz	-70.0			Freq Offset 0 Hz
t 2.505 GHz s BW 100 kHz	#Video BW 300 kHz	Stop 10.000 GHz Sweep ~28.0 ms (40001 pts)	Log	Start 10.000 GHz mited #Res BW 100 kHz	#Video BW 300 kHz	Stop 25.000 GHz Sweep ~52.5 ms (40001 pts)	
501?	Jan 10, 2019			Sale lowed	Jan 10, 2019 🗩 💧		Signal Track A

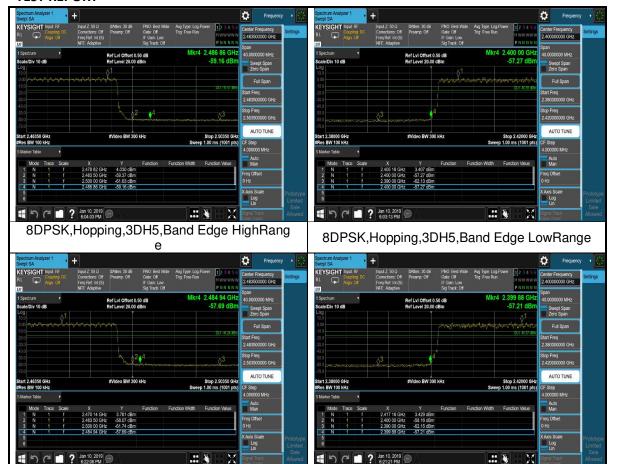


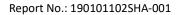
### 5. Band Edge - Hopping on mode

### 5.1 Test Data

	BT Frequency Band Edges-Conducted						
Mode	Test Range (MHz)	Packet Type	Hopping Mode	Band Edge (dBm)	Limit	Result	
GFSK	2380~2420	DH5	Hopping On	-52.09	-17.048	Pass	
GFSK	2463.5~2503.5	DH5	Hopping On	-59.09	-16.802	Pass	
DQPSK	2380~2420	2DH5	Hopping On	-57.27	-16.593	Pass	
DQPSK	2463.5~2503.5	2DH5	Hopping On	-59.16	-15.97	Pass	
8DPSK	2380~2420	3DH5	Hopping On	-57.21	-16.571	Pass	
8DPSK	2463.5~2503.5	3DH5	Hopping On	-57.69	-16.239	Pass	

GFSK,I	Hopping,DH5,Band	Edge HighRange	GFSK,Ho	pping,DH5,Bar	nd Edge Lov	vRange
Spectrum Analyzer 1 Swept SA KEYSIGHT Input. RF RL Coupling: DC Alart. Off		Trequency         Frequency         Frequency         Settings           Spe: Log-Power         1233456         Center Frequency         Settings           Fise Run         N WW W/WW         2.483500000 GHz         Settings		.50Ω #Alten:30 dB PNO Best Wide ions:Off Proemp:Off Gato-Off ef Int (5)	Avg Type. Log-Power	Center Frequency Center Frequency Settings
1 Spectrum v Scale/Div 10 dB Log	NFE Adaptive Sig Track: Off Ref Lvi Offset 0.50 dB Ref Level 20.00 dBm	P NH II N N         Span           Mkr4         2.485         34 GHz           -59.09 dBm         Swept Span           Zero Span         Zero Span	VCI NFE A 1 Spettrum Scale/Div 10 dB Log 100	daptive Sig Track: Off Ref Lvi Offset 0.50 dB Ref Level 20.00 dBm	Mkr4 2.400 00 GHz -52.09 dBm	Span 40.0000000 MHz Swept Span Zero Span
		Full Span Start Freq 2.463500000 GHz	0 00 -10 0 -20 0 -30 0 -40 0	Ňwww		Full Span Start Freq 2.380000000 GHz
50.0 -80.0 -70.0 Start 2.46350 GHz	#Video BW 300 kHz	Stop 2.50350 GHz	500 600 -700 Start 2,38000 GHz	#Video BW 300 kHz	Stop 2.42000 GHz	Stop Freq 2.420000000 GHz AUTO TUNE
Marker Table         V           5 Marker Table         V           Mode Trace Scale         1           1         N         1           2         N         1           3         N         1           4         N         1           5         6         6	X Y Function Function 2.416 58 GHz 3.3196 dBm 2.483 59 GHz - 651 19 dBm 2.500 00 GHz - 651 14 dBm 2.2483 34 GHz - 591 09 dBm	Freq Offset Offset Offset U U U U U U U U U U U U U U U U U U U	2 N 1 f 2.40 3 N 1 f 2.30 4 N 1 f 2.40 5	K Y Function Fu 2 16 GHz 2.562 dBm 0 00 GHz - 52.09 dBm 0 00 GHz - 52.00 dBm 00 00 GHz - 52.06 dBm	Sweep 1.00 ms (1001 pts) nction Width Function Value	OF Step 4.00000 MHz Man Freq Offset 0 Hz XAvis Scale Un Protoly Limite
	? Isota 2019 ,Hopping,2DH5,Bai e	nd Edge HighRang		pping,2DH5,Ba	and Edge Lo	Sale Struet Tack Allowe







### 6. Number of Hopping Frequencies

6.1 Test Data

BT Number Of Hopping Channels					
Mode	Test Frequency	Packet Type	Hopping Number	Result	
GFSK	Hopping	DH5	79	Pass	

GFSK,Hopping,DH5	5,2400~2426.5MHz	GFSK,Hopping,DH5	,2426.5~2454.5MHz
Spectrum Analyzer 1 + Swept SA	Frequency •	Spectrum Analyzer 1	Frequency 1
KEYSIGHT         Input RF         Input Z 50 0         #Atlen: 30 dB         PNO: Best V           RL         Coupling: DC         Concisions: Off         Preamp: Off         Gate: Off           Free Ref Int (S)         Free Ref Int (S)         If Gen: Low         Sig Track: O	Mide Avg Type, Log-Power AvgHidd >11 W Ting: Fiee Run M WW WWW 2413250000 GHz P NN II NN	KEYSIGHT Input RF RL Company DC Align Of VT VV VI VI VI KEYSIGHT Input RF Company DC Company DC Free RF Int(S) NFE Adaptive VI VI VI VI VI VI VI VI VI VI	Avgihold>1/1 Center Frequency Settings
1 Spectrum Ref Lvi Offset 0.50 dB ScalerDiv 10 dB Ref Level 20.00 dBm	Span 25 5000000 MHz Swept Span Zero Span	1 Spectrum Ref Lvi Offset 0.50 dB Scale/Div 10 dB Ref Level 20.00 dBm Log	Span 28.0000000 MHz Swept Span Zero Span
	Full Span		Full Span
	Start Freq 2.40000000 GHz Stop Freq		Stop Freq
-20.0	2.426500000 GHz	-20.0	2.454500000 GHz
-40.0	CF Step 2.65000 MHz	.40.0	CF Step 2.800000 MHz
-50.0	Auto Man Freq Offset	-50.0	Auto Man Freq Offset
-70.0	0 Hz X Axis Scale	-700	0 Hz X Axis Scale Prototor
Start 2.40000 GHz #Video BW 300 kHz #Res BW 100 kHz	Sweep 1.00 ms (1001 pts)	#Res BW 100 kHz	Sweep 1.00 ms (1001 pts)
		ad 「「「」 ? Jan 10, 2019 の	Signal Track Allowed
GFSK,Hopping,DH5,			
Such as	Wide         Avg Type: Log-Power         12:14:5:6         Center Frequency         Setting           Avg Hold>1/1         N WWWWW         2:469000000 GHz         Setting		
1 Spectrum Ref Lvi Offset 0.50 dB Scale/Div 10 dB Ref Level 20.00 dBm	Span 29 0000000 MHz Swept Span Zero Span		
10.0	Euli Span		
	Start Freq 2.454500000 GHz		
-500	Stop Freq 2.483500000 GHz		
-30.0	CF Step		
-50.0	2.900000 MHz Auto Man		
.60.0			
-60.0	Freq Offset 0 Hz		
60		d	



### 7. Carrier Frequency Separation

#### 7.1 Test Data

	BT Carrier Frequency Separation						
Mode	Test Frequency	Packet Type	Range(MHz~MHz)	Separation(kHz)	Result		
GFSK	Hopping	DH5	2401.5MHz~2403.5MHz	1317	Pass		
GFSK	Hopping	DH5	2440.5MHz~2442.5MHz	1321	Pass		
GFSK	Hopping	DH5	2478.5MHz~2480.5MHz	989	Pass		





#### 8. Dwell time

#### 8.1 Test Data

			BT Dwell Time			
Mode	Test Frequency	Packet Type	Transmission Time(ms)	Number	Dwell Time(ms)	Result
GFSK	2402	DH1	0.370	120	44.36	Pass
GFSK	2402	DH3	1.628	140	227.97	Pass
GFSK	2402	DH5	2.877	90	258.94	Pass





**TEST REPORT** 

Align Of	Input Z. 50 0. #Atten: 30 dB PNO Best Wild Conections: Off Preamp: Off Gate: Off Free Ref Int (5) IF Gam. Low NFE: Adaptive Sig Track: Off	Avgiltok: 1/1 NVVVVVV Avgiltok: 1/1 NVVVVVV Ting: Free Run P N N II N V	2.402000000 GHz	etings SA KEYSIGHT Input. RF RL ++ Couping DC Aign. 01	the second	PNO Best Wide Avg Type. Gate: Off Avg[Hold: IF Gain: Low Trig: Free Sig Track: Off	1/1	2.402000000 GHz	Settin
Spectrum v tale/Div 10 dB	Ref Lvi Offset 0.50 dB Ref Level 20.00 dBm	Mkr1 2.326 3.39 dBn	Span S 0.00000000 Hz Swept Span	1 Spectrum	Ref Lvi Offset Ref Level 20.0	) dBm	ΔMkr1 2.877 ms 2.72 dB	Swept Span	
			Euli Span	10.0 9.00	X <sub>2</sub>	1Δ2		Ero Span Full Span	
0			Start Freq 2.402000000 GHz	-20.0				Start Freq 2.402000000 GHz	
0			Stop Freq 2.402000000 GHz	-500 -500 wardgrad	hedanstrycius	traphy and the first of the second second	9.v	Stop Freq 2.40200000 GHz	
			AUTO TUNE CF Step 1.000000 MHz	Center 2.402000000 GHz Res BW 1.0 MHz	#Video BW 3.		Span 0 Ha weep 10.0 ms (1001 pts		
a dillitica landa anna	hillesochilder sociale socialist station	helden hallester at her a halles	Auto Man Freq Offset 0 Hz	Mode Trace Sca $1 \Delta 2$ 1 t 2 F 1 t	le X Y (Δ) 2.877 ms (Δ) 2.717 dB 3.147 ms 0.1791 dBn		th Function Value	Auto Man Freq Offset 0 Hz	
ter 2.402000000 GHz BW 1.0 MHz	#Video BW 3.0 MHz	Span 0 H Sweep 3.16 s (1001 pts	X Avis Scale	rototype 5				X Axis Scale	Prot Lin
うべ!?	Jan 10, 2019 🗩			Sale Allowed	? Jan 10, 2019		: 🖎 – X	Signal Track	Sa Allo