

# **RF TEST REPORT**

Report No.:	SET2016-17188

Product Name: Bluetooth smart watches

FCC ID: 2AA7D-ZEST1

**IC:** 12131A-ZEST1

Model No. : ZeSport

Applicant: KRONOZ

Address: ROUTE DE VALAVRAN 96 GENTHOD Switzerland

Dates of Testing: 08/20/2016 - 09/12/2016

Issued by: CCIC-SET

Lab Location: Electronic Testing Building, Shahe Road, Xili, Nanshan District, Shenzhen, 518055, P. R. China

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	Test Report			
Product Name:	Bluetooth smart watches			
Model No:	ZeSport			
Trade Name:				
Brand Name:	N/A			
Applicant	KRONOZ			
Applicant Address:	ROUTE DE VALAVRAN 96 GENTHOD Switzerland			
Manufacturer:	KRONOZ			
Manufacturer Address:	ROUTE DE VALAVRAN 96 GENTHOD Switzerland			
Test Standards	: 47 CFR Part 15 Subpart C 2015: Radio Frequency Devices			
	ANSI C63.10:2013: American National Standard for			
	Testing Unlicensed Wireless Devices			
	RSS-247:Issue 1,December2015 / RSS-GEN Issue 4, November 2014			
	DA 00-705: Filing and Measurement Guidelines			
	for Frequency Hopping Spread Spectrum Systems			
Test Result	PASS			
Tested by	Wei 2016.09.14			
	Lu Lei, Test Engineer			
Reviewed by	Zhu Q: 2016.09.14			
	Zhu Qi, Senior Egineer			
Approved by:	War lian 2016.09.14			
	Wu Li'an, Manager			



# **TABLE OF CONTENTS**

1. 0	GENERAL INFORMATION	4
1.1.	EUT Description	4
1.2.	Test Standards and Results	5
1.3.	Frequency Hopping System Requirements	6
1.4.	Facilities and Accreditations	7
2. 4	7 CFR PART 15C REQUIREMENTS	8
2.1.	Antenna requirement	8
2.2.	Number of Hopping Frequency	9
2.3.	Peak Output Power	.12
2.4.	20dB Bandwidth	.14
2.5.	Carried Frequency Separation	.21
2.6.	Dwell time	.24
2.7.	Conducted Spurious Emissions	.31
2.8.	Conducted Band Edge	.41
2.9.	Conducted Emission	.48
2.10.	Radiated Band Edges and Spurious Emission	.52
3. L	LIST OF MEASURING EQUIPMENT	.60
4. U	JNCERTAINTY OF EVALUATION	.61

Change History				
Issue	Date	Reason for change		
1.0 2016.09.14		First edition		



# 1. General Information

### **1.1. EUT Description**

EUT Type	Bluetooth smart watches		
Hardware Version	SW02 v1.3		
C. C. C.	SW02 PCB01 gprs MT2502 S00.SY1301 ZESPORT V1		
Software Version	SIRI		
EUT supports Radios application	Bluetooth V3.0+EDR		
Frequency Range	Bluetooth EDR	2402MHz~2480MHz	
Channel Number	Bluetooth EDR	79	
Bit Rate of Transmitter	Bluetooth EDR	1/2/3Mbps	
Modulation Type	Bluetooth EDR GFSK, π/4-DQPSK,8DPSK		
Antenna Type	Chip Antenna		
Antenna Gain	2.0dBi		

Note 1: The EUT is a Bluetooth smart watches, it contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies allocated for the Bluetooth Module is F(MHz)=2402+1\*n (0<=n<=78). The lowest, middle, highest channel numbers of the Bluetooth Module used and tested in this report are separately 0 (2402MHz), 39 (2441MHz) and 78 (2480MHz).

Note 2: a. When power on, the EUT will scan the whole frequency until a Connection command from the other BT devices.

b. When receiving the signal from the other BT devices, The EUT transmit are sponse signal.c. The other devices receive the response signal and recognize it, then send a connection command to establish the connection.

d. After the connection establish successfully, the data transmission is beginning. At the same time, the both devices will shift frequencies in synchronization per a same pseudo randomly ordered list of hopping frequencies, the hopping rate is1600 times per second. This device conforms to the criteria in FCC Public Notice DA 00-705.

e. The bandwidth of the receiver, which is set to a fixed width by the software.

Note 3: Bluetooth signal has 9 packages DH1, DH3, DH5, 3DH1, 3DH3, 3DH5, 5DH1, 5DH3, 5DH5, DH5 package is largest, we are testing DH5 in the document.



## 1.2. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiators) for the EUT FCC / IC Certification:

No.	Identity	Document Title
1	47 CFR Part 15 Subpart C 2013	Radio Frequency Devices
2	ANSI C63.10 2013	American National Standard for Testing Unlicensed Wireless Devices
3	RSS-GEN: Issue 4,November 2014	General Requirements and Information for the Certification of Radio Apparatus
4	RSS-247:Issue 1,December2015:	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Standard(s) Section		Description	Result	
INO.	FCC	IC	Description	Nesuit	
1	15.203	8.3	Antenna Requirement	PASS	
2	15.247(a)	RSS-247 Issue1 - 5.1	Number of Hopping Frequency	PASS	
3	15.247(b)	RSS-247 Issue1 - 5.4	Peak Output Power	PASS	
4	15.247(a)	RSS-247 Issue1 - 5.1	Bandwidth	PASS	
5	15.247(a)	RSS-247 Issue1 - 5.1	Carrier Frequency Separation	PASS	
6	15.247(a)	RSS-247 Issue1 - 5.1	Time of Occupancy (Dwell time)	PASS	
7	15.247(d)	RSS-247 Issue1 - 5.5	Conducted Spurious Emission	PASS	
8	15.247(d)	RSS-247 Issue1 - 5.5	Conducted Band Edge	PASS	
0		RSS - Gen	Conducted Band Edge	rass	
9	15.207	RSS-GEN	Conducted Emission	PASS	
10	15.209	RSS-247 Issue1 - 5.5	Radiated Band Edges and Spurious	PASS	
10	15.247(c)	RSS - Gen	Emission	rass	

Note 1: The tests were performed according to the method of measurements prescribed in DA-00-705.

Note 2: The test of Radiated Emission was performed according to the method of measurements prescribed in ANSI C63.10 2013.



# **1.3.** Frequency Hopping System Requirements

## **1.3.1.** Standard Applicable

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly 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.

(g) 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.

(h) 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 hopsets 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.

## **1.3.2.** Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses Bluetooth radio which operates in 2400-2483.5 MHz band. Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 79 bands (1 MHz each; centred from 2402 to 2480 MHz) in the range 2,400-2,483.5 MHz. The transmitter switches hop frequencies 1,600 times per second to assure a high degree of data security. All Bluetooth devices participating in a given piconet are synchronized to the frequency-hopping channel for the piconet. The frequency hopping sequence is determined by the master's device address and the phase of the hopping sequence (the frequency to hop at a specific time) is determined by the master's internal clock. Therefore, all slaves in a piconet must know the master's device address and must synchronize their clocks with the master's clock.

Adaptive Frequency Hopping (AFH) was introduced in the Bluetooth specification to provide an effective way for a Bluetooth radio to counteract normal interference. AFH identifies "bad" channels, where either other wireless devices are interfering with the Bluetooth signal or the Bluetooth signal is interfering with another device. The AFH-enabled Bluetooth device will then communicate with other devices within its piconet to share details of any identified bad channels. The devices will then switch to alternative available "good" channels, away from the areas of interference, thus having no



impact on the bandwidth used.

This device was tested with a bluetooth system receiver to check that the device maintained hopping synchronization, and the device complied with these requirements for DA 00-705 and FCC Part 15.247 rule.

## **1.3.3. EUT Pseudorandom Frequency Hopping Sequence**

Pseudorandom Frequency Hopping Sequence Table as below:

Channel: 08, 24, 40, 56, 40, 56, 72, 09, 01, 09, 33, 41, 33, 41, 65, 73, 53, 69, 06, 22, 04, 20, 36, 52, 38, 46, 70, 78,68, 76, 21, 29, 10, 26, 42, 58, 44, 60, 76, 13, 03, 11, 35, 43, 37, 45, 69, 77, 55, 71, 08, 24, 08, 24, 40, 56, 40, 48, 72, 01, 72, 01, 25, 33, 12, 28, 44, 60, 42, 58, 74, 11, 05, 13, 37, 45 etc.

The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

#### **1.4.** Facilities and Accreditations

#### 1.4.1. Facilities

#### CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories

(identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: February 28, 2015. Valid time is until February 27, 2018.

#### FCC-Registration No.: 317478

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 317478, Renewal date Jul. 18, 2014, valid time is until Jul. 18, 2017.

#### IC-Registration No.: 5377B

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B on Dec.03, 2014, valid time is until Dec.03, 2017.



#### 1.4.2. Test Environment Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 -60
Atmospheric Pressure (kPa):	86KPa-106KPa

# 2. 47 CFR Part 15C Requirements

## 2.1. Antenna requirement

#### 2.1.1. Applicable Standard

According to FCC 15.203, 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.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

#### 2.1.2. Antenna Information

Antenna Category: Internal antenna

An Internal antenna was soldered to the antenna port of EUT via an adaptor cable can't be removed.

#### Antenna General Information:

No.	EUT	Ant. Cat.	Gain(dBi)
1	Bluetooth smart watches	Chip	2

#### 2.1.3. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.



## 2.2. Number of Hopping Frequency

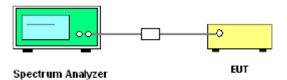
### 2.2.1. Limit of Number of Hopping Frequency

Frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

#### 2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

#### 2.2.3. Test Setup



#### 2.2.4. Test Procedure

- 1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Enable the EUT hopping function.

 $RBW \ge 1\%$  of the span;  $VBW \ge RBW$ ; Sweep = auto; Detector function = peak;

Trace = max hold.

- 6. The number of hopping frequency used is defined as the number of total channel.
- 7. Record the measurement data derived from spectrum analyzer.



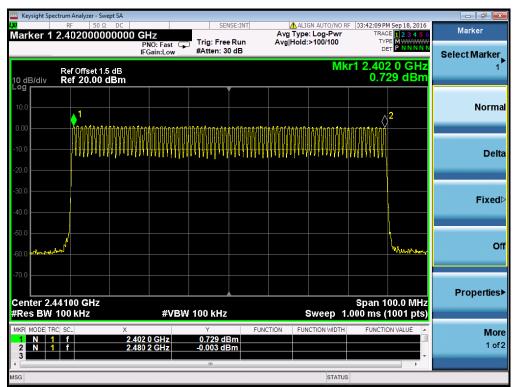
### 2.2.5. Test Results of Number of Hopping Frequency

The Bluetooth Module operates at hopping-on test mode; the frequencies number employed is counted to verify the Module's using the number of hopping frequency.

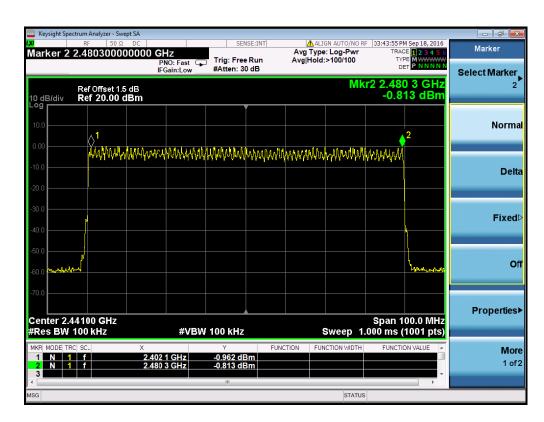
#### A. Test Verdict:

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Refer to Plot	Verdict
GFSK	2400 - 2483.5	79	15	Plot A	PASS
π/4-DQPSK	2400 - 2483.5	79	15	Plot B	PASS
8-DPSK	2400 - 2483.5	79	15	Plot C	PASS

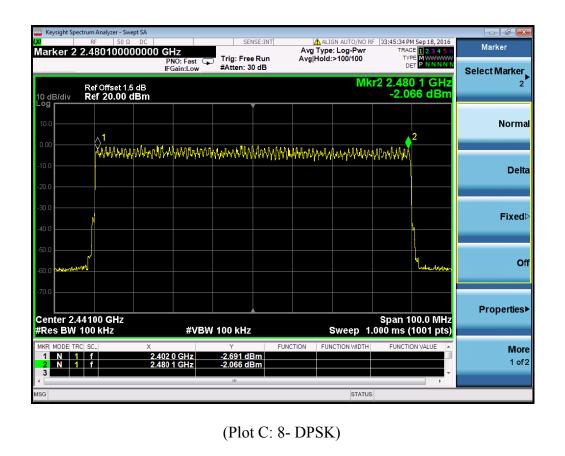
Test Plots:



(Plot A: GFSK)



(Plot B:  $\pi/4$ -DQPSK)





## 2.3. Peak Output Power

## 2.3.1. Limit of Peak Output Power

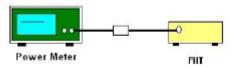
Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts.

Requency hopping systems operating in the 2400-2483.5 MHz band may have hopping chann el carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hoppi ng channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### 2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.3.3. Test Setup



## 2.3.4. Test Procedures

- 1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- 2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Measure the conducted output power with cable loss and record the results in the test report.
- 5. Measure and record the results in the test report.



# 2.3.5. Test Result

Test Mode	Channel	Frequency (MHz)	RF Power(dBm)	Ant. Gain(dBi)	Radiated power (dBm)	Limit (dBm)	Verdict
	0	2402	1.960		3.960		PASS
GFSK	39	2441	1.644		3.644		PASS
!	78	2480	1.284		3.284	-	PASS
	0	2402	1.125		3.125		PASS
$\pi/4$ -DQPSK	39	2441	0.711	2.0	2.711	21	PASS
	78	2480	0.375		2.375		PASS
	0	2402	1.568		3.568		PASS
8- DPSK	39	2441	1.257		3.257		PASS
ſ	78	2480	0.800		2.800		PASS



## 2.4. 20dB Bandwidth

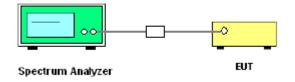
#### 2.4.1. Definition

According to FCC  $\frac{15.247(a)(1)}{a}$ , the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth ( $10*\log 1\% = 20$ dB) taking the total RF output power.

#### 2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.4.3. Test Setup



### 2.4.4. Test Procedure

- 1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel;

 $RBW \ge 1\%$  of the 20 dB bandwidth;  $VBW \ge RBW$ ; Sweep = auto; Detector function = peak;

Trace = max hold.

5. Use the following spectrum analyzer setting for 99% Bandwidth measurement.

For 99% Bandwidth measurement, the RBW=30kHz, and VBW=100kHz, Sweep=auto

Detector function=sample ,Trace = max. hold

6. Measure and record the results in the test report.



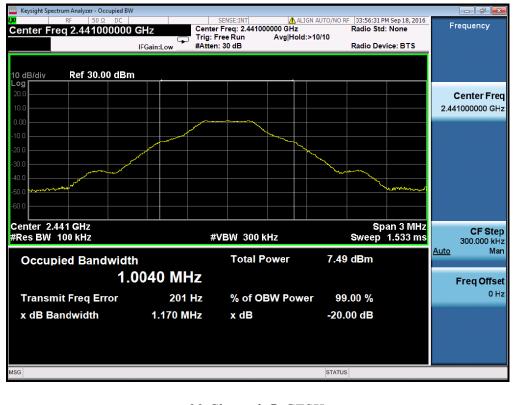
# 2.4.5. Test Results of 20dB Bandwidth

Mode	Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% bandwidth (MHz)
	0	2402	1.173	1.012
GFSK	39	2441	1.170	1.004
	78	2480	1.160	0.994
	0	2402	1.384	1.227
$\pi/4$ -DQPSK	39	2441	1.382	1.225
	78	2480	1.372	1.221
	0	2402	1.382	1.227
8-DPSK	39	2441	1.382	1.231
	78	2480	1.379	1.224

#### 2.4.6. Test Results (plots) of Bandwidth



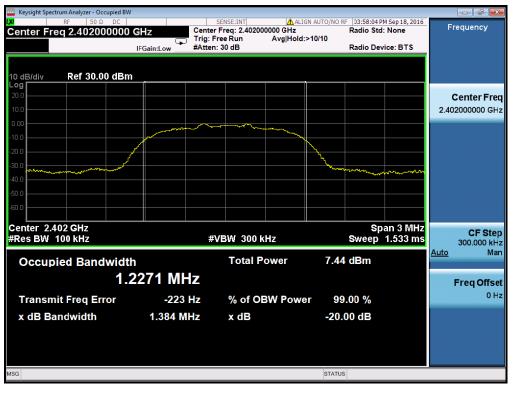
0 Channel @ GFSK



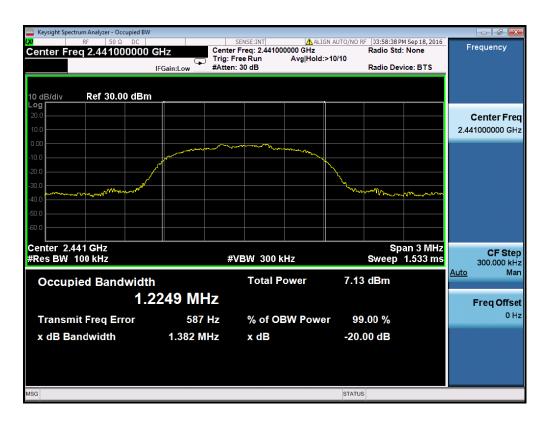
39 Channel @ GFSK



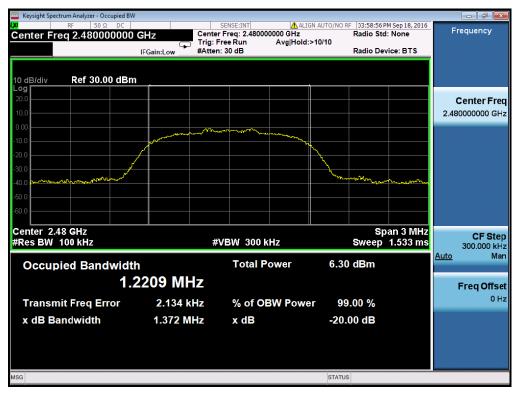
78 Channel @ GFSK



0 Channel @  $\pi/4$ -DQPSK



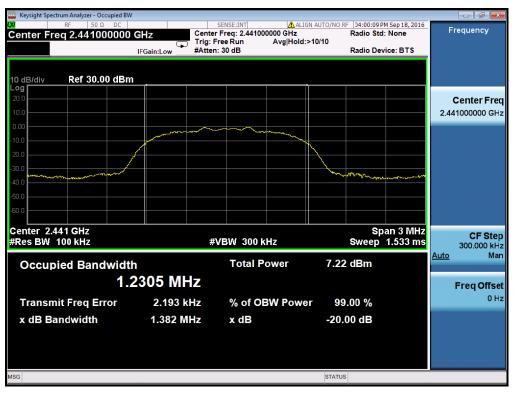
39 Channel @  $\pi/4$ -DQPSK



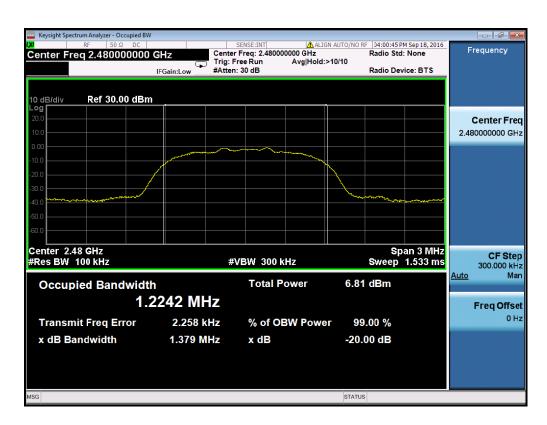
78 Channel @  $\pi/4$ -DQPSK



0 Channel @ 8-DPSK



39 Channel @ 8-DPSK



78 Channel @ 8-DPSK



## 2.5. Carried Frequency Separation

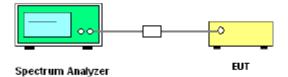
#### 2.5.1. Limit of Carried Frequency Separation

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

#### 2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

#### 2.5.3. Test Setup



#### 2.5.4. Test Procedure

- 1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Enable the EUT hopping function.
- 5. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels;  $RBW \ge 1\%$  of the span;

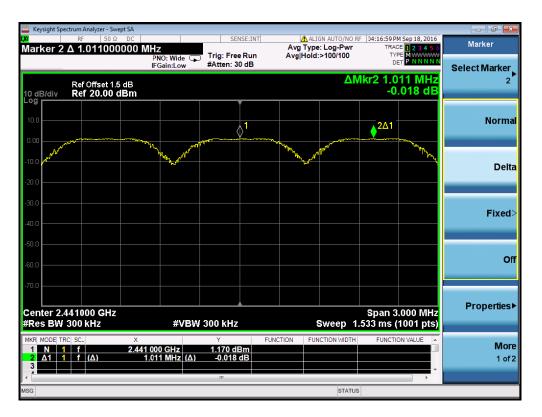
VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold.

6. Measure and record the results in the test report.



#### 2.5.5. Test Results of Carried Frequency Separation

Test mode	Frequency Separation(MHz)	(2/3 of 20dB BW) Limits (MHz)	Verdict
GFSK	1.011	0.782	PASS
$\pi/4$ -DQPSK	1.014	0.923	PASS
8-DPSK	1.020	0.921	PASS



(Plot A: GFSK)



(Plot B:  $\pi/4$ -DQPSK)



(Plot C: 8-DPSK)



## 2.6. Dwell time

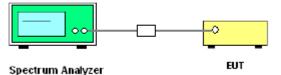
### 2.6.1. Limit of Dwell Time

The average time of occupancy 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.

#### 2.6.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

## 2.6.3. Test Setup



#### 2.6.1. Test Procedure

- 1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
- The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Enable the EUT hopping function.
- 5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW≥RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
- 6. Measure and record the results in the test report.

#### 2.6.2. Test Result

For DH1 package type:

{Total of Dwell} = {Pulse Time} \* (1600 / 2) / {Number of Hopping Frequency} \* {Period} {Period} = 0.4s \* {Number of Hopping Frequency}

For DH3 package type:

{Total of Dwell} = {Pulse Time} \* (1600 / 4) / {Number of Hopping Frequency} \* {Period}

{Period} = 0.4s \* {Number of Hopping Frequency}

For DH3 package type:

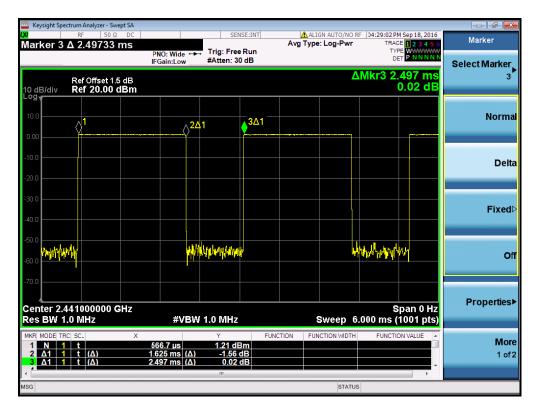
{Total of Dwell} = {Pulse Time} \* (1600 / 6) / {Number of Hopping Frequency} \* {Period}

{Period} = 0.4s \* {Number of Hopping Frequency}

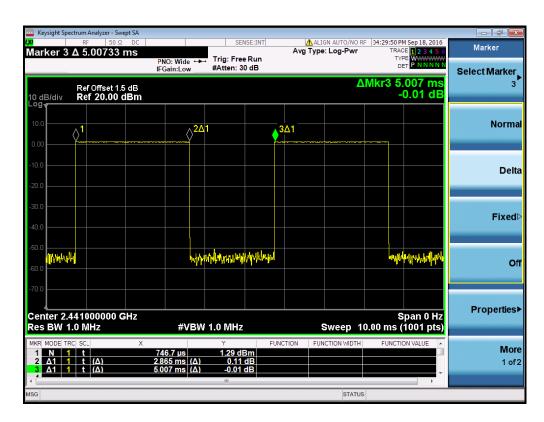
Modulation	Packet Type	Channel	Pulse Time (ms)	Dwell Time (ms)	Limit (ms)	Verdict
	DH1	39	0.365	116.80		PASS
GFSK	DH3	39	1.625	260.00		PASS
	DH5	39	2.865	305.61		PASS
	DH1	39	0.377	120.64		PASS
π/4-DQPSK	DH3	39	1.631	260.96	400	PASS
	DH5	39	2.871	306.25		PASS
	DH1	39	0.375	120.00		PASS
8-DPSK	DH3	39	1.623	259.68		PASS
	DH5	39	2.883	307.53		PASS

Keysight Spe	ectrum Analyzer - Swept SA								
XI	RF 50 Ω DC		SEN	SE:INT		IGN AUTO/NO RI e: Log-Pwr			Marker
Marker 3	Δ 2.49733 ms	PNO: Wide ↔	, Trig: Free		Avgiyp	e: Log-Pwr	TY	CE 1 2 3 4 5 6 PE WWWWWW ET P NNNN	
		IFGain:Low	#Atten: 30	) dB					Select Marker
10 dB/div Log <del>√</del>	Ref Offset 1.5 dB Ref 20.00 dBm					Δ		.497 ms 0.01 dB	3
10.0									Norma
0.00		2 <mark>∆1</mark>					3∆1	<b></b>	
-10.0									
-20.0									Delt
-30.0									Fixed
-40.0									
50.0	New New Joseph Lab Ada	11.1w+114+1		a alternational	hankalu	M. W.L. MA		Alter Markhiller	
-60.0	di Alanda mana	a part frank	l a l a a a b b b	M. Maxde PUN	ulishi hali di	antatata ana t		i bas Ast sillik	Of
-70.0									
Center 2	441000000 GHz							Span 0 Hz	Properties
Res BW 1		#VBW	/ 1.0 MHz			Sweep 4.			
MKR MODE TF	RC  SCL  X	746.7 us	Y A AE HE		TION   FU	NCTION WIDTH	FUNCTI	ON VALUE	Mor
2 <u>Δ1</u> 1	$t (\Delta)$	365.3 μs (Δ) 2.497 ms (Δ)	<u>1.15 dE</u> -0.35 d -0.01 d	1B					1 of:
<		2.457 ms (Δ)	-0.011					* •	
1SG						STATUS			

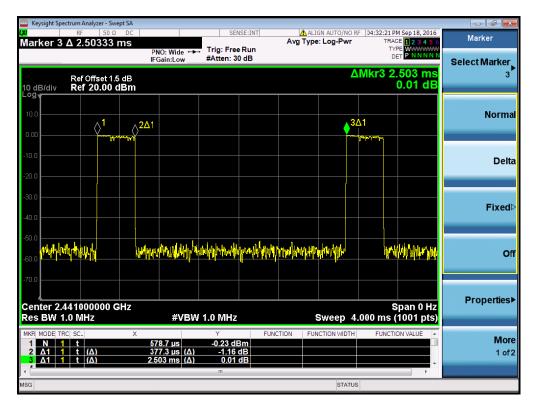
39 Channel @ DH1



39 Channel @ DH3



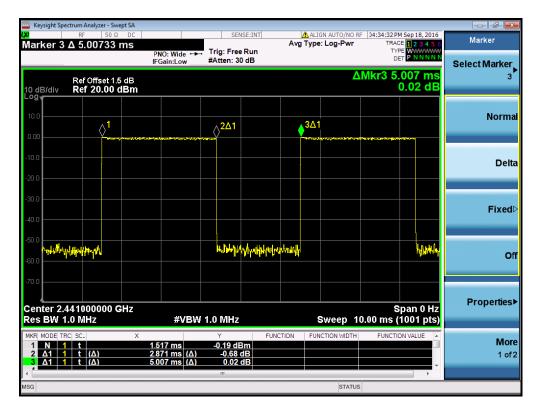
39 Channel @ DH5



39 Channel @ 2DH1

(X) RF 50 Ω DC (X) Marker 3 Δ 2.49733 ms	SEN	SE:INT ALIGN A	UTO/NO RF 04:33:47 PM Sep 18, 2 09-Pwr TRACE 1 2 3 4	
Marker 5 & 2.49755 ms	PNO: Wide ↔ Trig: Free IEGain:Low #Atten: 30	Run		N N
	IFGain:Low #Atten: 30	dB		Select Marker
Ref Offset 1.5 dB 10 dB/div Ref 20.00 dBm			ΔMkr3 2.497 n 0.74 c	IS 3 B
Log				
10.0				Normal
0.00	2Δ1			
0.00		ad and a factor of the second seco		
-10.0				Delta
-20.0				
~~~				
-30.0				Fixed⊳
-40.0				
-50.0				
44 <sup>1</sup> 44	white a life of the life of the		hours and the state	Off
-60.0				
-70.0				
				Properties►
Center 2.441000000 GHz Res BW 1.0 MHz	#VBW 1.0 MHz	Swe	Span 0   eep   6.000 ms (1001 p	HZ .
MKR MODE TRC SCL X	Y	FUNCTION FUNCTIO	N WIDTH FUNCTION VALUE	More
1 N 1 t 2 $\Delta 1 1 t (\Delta)$	266.7 μs -0.95 dB 1.631 ms (Δ) -0.79 c	IB		1 of 2
3 Δ1 1 t (Δ)	2.497 ms (Δ) 0.74 c	IB		-
MSG	III		STATUS	
MSG			STATUS	

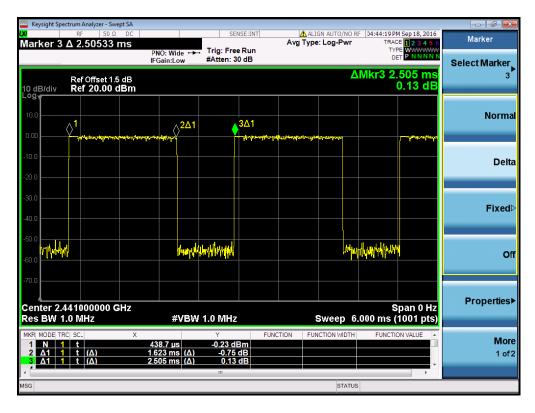
39 Channel @ 2DH3



39 Channel @ 2DH5

🚾 Keysight Spe	ectrum Analyze	er - Swept SA									- d <b>-</b>
<mark>x</mark> Marker 3	RF	50 Ω DC			SENSE:IN	Т		IGN AUTO/N e: Log-Pw		CE 1 2 3 4 5 6	Marker
markere	<b>A</b> 2.400		PNO: Wid IFGain:Lo		: Free Run en: 30 dB			-	TY D		Select Marker,
10 dB/div Log <del>√</del>		et 1.5 dB .00 dBm	1						ΔMkr3 2	.499 ms 0.00 dB	Select Marker
10.0	) <sup>1</sup> ⟨	2∆1						3∆1			Norma
0.00	ALC AND	/									
-10.0											Delta
-20.0											
-30.0											Fixed
-50.0		Mary Mary M	n/vortper/hime	WHAN HAN	and productions	halling	nt llynter		kypyrndadd	mhampaul	O
-70.0											
											Properties
Center 2.4 Res BW 1		00 GHZ	#\	/BW 1.0 I	ЛНz			Sweep	s ب 4.000 ms	Span 0 Hz (1001 pts)	
MKR MODE TF	RC  SCL		× 228.7 us	Y	18 dBm	FUNCT	ION FL	INCTION WIDT	TH FUNCTI	ON VALUE	Mor
2 Δ1 1 3 Δ1 1	t (Δ) t (Δ)		<u>375.3 µs</u> 2.499 ms	(Δ) -	0.50 dB 0.00 dB						1 of:
•				1						•	
ISG								STAT	rus		

39 Channel @ 3DH1



39 Channel @ 3DH3

		PNO: Wide 🕶	Trig: Free Run		Wr TRACE 1 2 3 4 5	6 Marker
		IFGain:Low	#Atten: 30 dB		DET PNNN	Select Marker
.og	ef Offset 1.5 dB ef 20.00 dBm				ΔMkr3 5.005 ms 0.00 dE	5 3
10.0						Norm
0.00		alawan wanan tarakan sa	<u>~</u> 2∆1	3∆1	uphiliser and a construction of the second	
10.0						Del
20.0						
30.0						Fixed
40.0						
	<b>M</b> rv <b>N</b>		Humphonether	NB WHINK	www.	c c
70.0						
						Properties
Center 2.441 Res BW 1.0 N		#VBW	1.0 MHz	Swee	Span 0 Hz 10.00 ms (1001 pts	
IKR MODE TRC SC	DL X	1.539 ms	-0.09 dBm	UNCTION FUNCTION W	IDTH FUNCTION VALUE	Mo
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	(Δ) (Δ)	2.883 ms (Δ) 5.005 ms (Δ)	-1.59 dB 0.00 dB			10

39 Channel @ 3DH5



# 2.7. Conducted Spurious Emissions

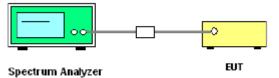
#### 2.7.1. Limit of Spurious Emission

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

#### 2.7.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

### 2.7.3. Test Setup



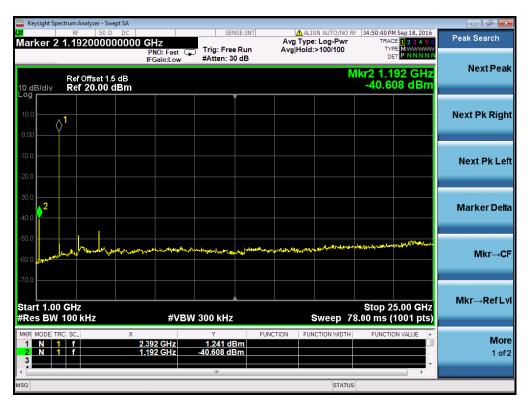
#### 2.7.4. Test Procedure

- The testing follows the guidelines in Spurious RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines
- The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Set RBW = 100 kHz, VBW = 300 kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
- 5. Measure and record the results in the test report.
- 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

#### 2.7.5. Test Result

Peak Search	F 05:00:38 PM Sep 18, 2016 TRACE 1 2 3 4 5 6	Type: Log-Pwr	Avg	SENSE:I	ЛНz	ter - Swept SA 50 Ω DC 0000000 N	RF	
Next Peal		Hoid:>100/100		Trig: Free Ru #Atten: 30 dB	PNO: Fast IFGain:Low	set 1.5 dB	Ref Off	
Next Pk Righ	-58.818 dBm					0.00 dBm	Ref 2	dB/div g
Next Pk Le								.0
Marker Delt								.0
Mkr→C	intherperdent with the second state	อาโรงสารมายเหลือเป็		iughteriterypen-groupele	wythydiaeddaedd me	hallongound	un an	
Mkr→RefLv	Stop 1.0000 GHz .200 ms (1001 pts)	Sweep 3		V 300 kHz	#VE	2	300 GHz 100 kH	art 0.0
Mon 1 of:	FUNCTION VALUE	FUNCTION WIDTH	FUNCTION	Y -58.818 dBm	3.67 MHz	× 91	RC SCL	R MODE T
	,	STATUS						1

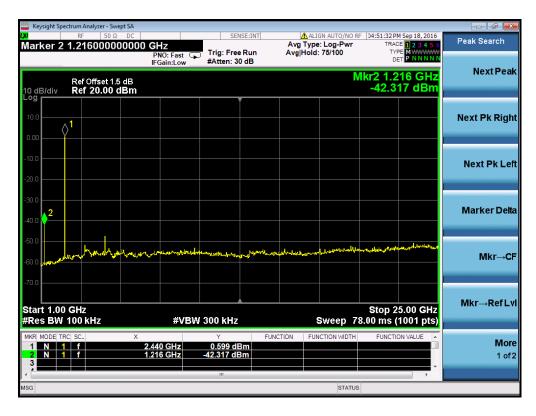
Low Channel 30MHz to 1GHz @ GFSK Mode



Low Channel 1GHz to 25GHz @ GFSK Mode

Marker 1 850.6200	0 Ω DC DOOOOOO MHZ PNO: Fast IFGain:Low		ALIGN AUTO/NO F Avg Type: Log-Pwr Avg Hold:>100/100	US:00:44 PM Sep 18, 2016 TRACE 2 3 4 5 6 TYPE MWWWWW DET P NNNNN	Peak Search
Ref Offset 0 dB/div Ref 20.0			M	kr1 850.62 MHz -59.462 dBm	Next Pea
10.0					Next Pk Rig
20.0					Next Pk L
40.0					Marker De
	مەرىيە بىرەر يەرىپىيە ئىلىرىدىلەت بىرىرىيە بەر يەرىپىيە ئىلىرىدىلەت بىرىيە بەر يەرىپى	digate to a statistical and the state of the	he can be a first and the second of the second s		Mkr⊸(
70.0 Start 0.0300 GHz #Res BW 100 kHz	#V	BW 300 kHz	Sweep 3	Stop 1.0000 GHz .200 ms (1001 pts)	Mkr→RefL
MKR MODE TRC SC.	× 850.62 MHz	Y -59.462 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<b>M</b> o 1 o

Mid Channel 30MHz to 1GHz @ GFSK Mode



Mid Channel 1GHz to 25GHz @ GFSK Mode

RF 50 Ω DC Iarker 1 872.93000000	SENSE:INT O MHZ PNO: Fast IFGain:Low Fain:Low SENSE:INT Trig: Free Run #Atten: 30 dB	Avg Type: Log-Pwr TRACE 1234 Avg Hold:>100/100 TYPE W	5 6 Peak Search
Ref Offset 1.5 dB 0 dB/div Ref 20.00 dBm		Mkr1 872.93 MH -58.774 dB	lz NextPea m
			Next Pk Rig
20.0			Next Pk Lo
10.0			Marker De
	anglani baya, yakinanginfankilikinkanan Minterina	- Jane Jane Jane Market State Stat	Mkr→
70.0 Itart 0.0300 GHz Res BW 100 kHz	#VBW 300 kHz	Stop 1.0000 GF Sweep 3.200 ms (1001 pf	
KR     MODE     TRC     SC.     >>       1     N     1     f	872.93 MHz -58.774 dBm	FUNCTION   FUNCTION WIDTH   FUNCTION VALUE	<b>M</b> o 1 o

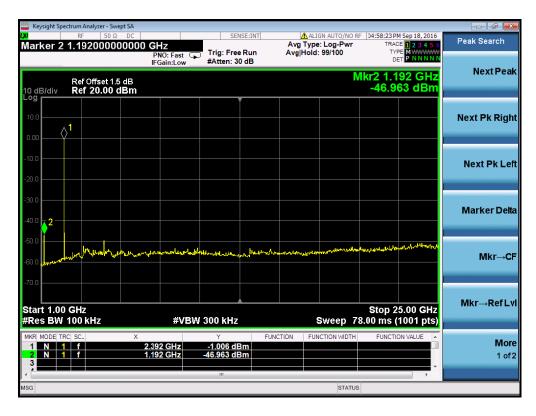
High Channel 30MHz to 1GHz @ GFSK Mode



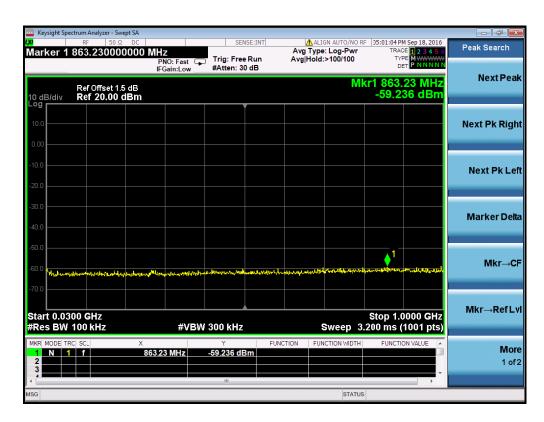
High Channel 1GHz to 25GHz @ GFSK Mode

Arker 1 807.94000000		Avg Type: Log-Pwr n Avg Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET PNNNNN	Search
Ref Offset 1.5 dB 0 dB/div Ref 20.00 dBn		Mkr′	807.94 MHz -59.074 dBm	ext Pe
			Next	Pk Rig
20.0			Nex	t Pk L
40.0			Mar	ker De
50.0 50.0 <mark>/4</mark>	(ตะกัน, มหารณะ คุณะกรณะสี่งาวรุงส์ ปางชีวารแก่น-การการไป-ไปไป	production and a state of the s	Indetermine the strategy of	Mkr→(
Start 0.0300 GHz Res BW 100 kHz	#VBW 300 kHz	Sweep 3.20	top 1.0000 GHz 0 ms (1001 pts)	→RefL
KR MODE TRC SC. 1 N 1 f 2 3	X Y 807.94 MHz -59.074 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<b>Мс</b> 1 с

Low Channel 30MHz to 1GHz  $@\pi/4$ -DQPSK



Low Channel 1GHz to 25GHz  $@\pi/4$ -DQPSK



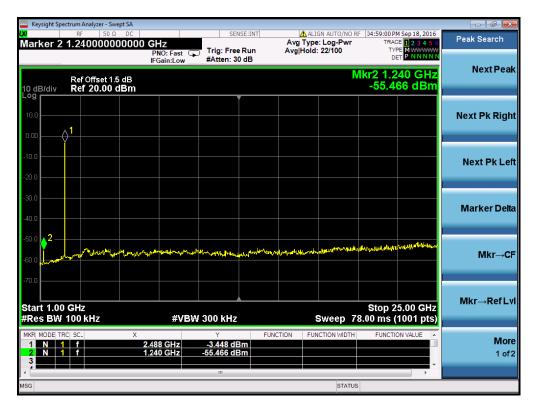
Mid Channel 30MHz to 1GHz  $@\pi/4$ -DQPSK



Mid Channel 1GHz to 25GHz @π/4-DQPSK

a Marker 1	RF 50 Ω 903.000000	000 MHz PNO: Fast		Avg un Avg	ALIGN AUTO/NO RF Type: Log-Pwr Hold:>100/100	05:01:12 PM Sep 18, 2016 TRACE 1 2 3 4 5 6 TYPE MWWWW DET P N N N N N	Peak Search
10 dB/div	Ref Offset 1.5 Ref 20.00 d		#Atten: 30 di	D	Mk	r1 903.00 MHz -57.342 dBm	Next Pea
- <b>og</b> 10.0							Next Pk Rig
20.0							Next Pk Lo
30.0 40.0							Marker De
	abilemurration and an angle	when all from all appression for		ปรุงสี่จะปฏ1. เปร. กับระศักร	ىرى ئەربەيلىرى ئەربەر بىرى ئەربەر يەر يەر يەر يەر يەر يەر يەر يەر يەر ي	1	Mkr→
5tart 0.03 Res BW		#V	BW 300 kHz		Sweep 3.	Stop 1.0000 GHz 200 ms (1001 pts)	Mkr→RefL
MKR MODE TR 1 N 1 2 3		× 903.00 MHz	Y -57.342 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	<b>М</b> с 1 о

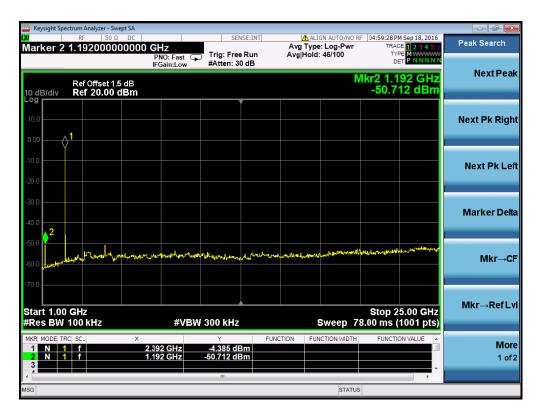
High Channel 30MHz to 1GHz  $@\pi/4$ -DQPSK



High Channel 1GHz to 25GHz  $@\pi/4$ -DQPSK



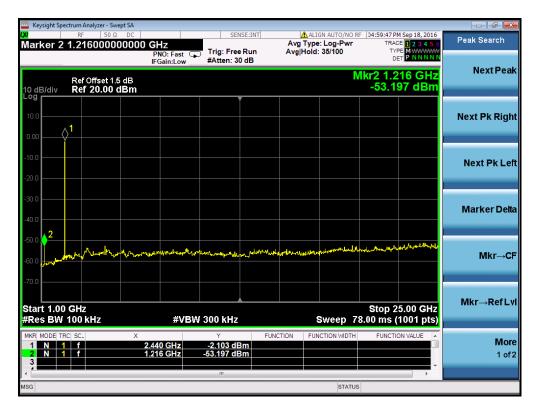
Low Channel 30MHz to 1GHz @ 8-DPSK



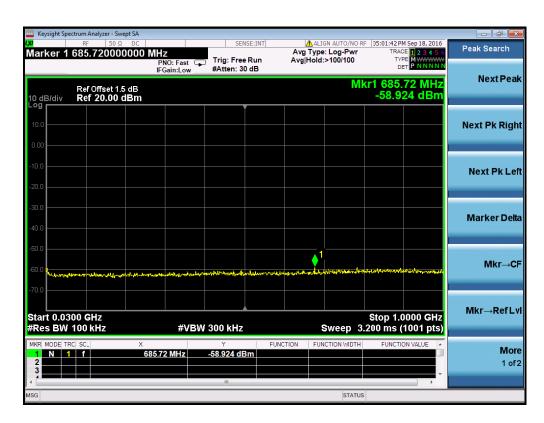
Low Channel 1GHz to 25GHz @ 8-DPSK

RF Iarker 1 909	50 Ω DC .790000000 I	MHZ PNO:Fast ⊂ IFGain:Low	SENSE:IN Trig: Free Rur #Atten: 30 dB	Avg	ALIGN AUTO/NO RF Type: Log-Pwr Iold:>100/100	05:01:32 PM Sep 18, 2016 TRACE <b>1 2 3 4 5 6</b> TYPE <b>MWWWWW</b> DET <b>P N N N N N</b>	Peak Search
	Offset 1.5 dB f 20.00 dBm				Mk	r1 909.79 MHz -58.487 dBm	Next Pe
10.0 0.00							Next Pk Rig
20.0							Next Pk L
40.0							Marker De
	14926.ht.u.M.Jonacology.Vac.olagaber.)	Langer Barrier State of States	proved annotation of the fea	alubroadenshraverrie	sacar or mitting to be to a the	1	Mkr→
tart 0.0300 0 Res BW 100		#VB\	N 300 kHz		Sweep 3.:	Stop 1.0000 GHz 200 ms (1001 pts)	Mkr→Refl
KR MODE TRC SC.		9.79 MHz	Y -58.487 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	<b>M</b> c 1 c

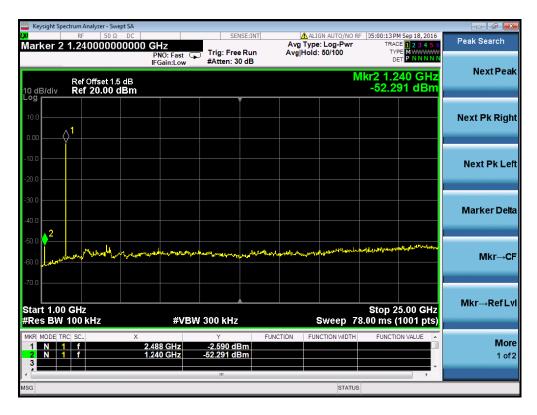
Mid Channel 30MHz to 1GHz @ 8-DPSK



Mid Channel 1GHz to 25GHz @ 8-DPSK



High Channel 30MHz to 1GHz @ 8-DPSK



High Channel 1GHz to 25GHz @ 8-DPSK



## 2.8. Conducted Band Edge

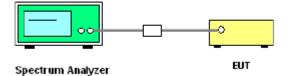
## 2.8.1. Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

#### 2.8.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

#### 2.8.3. Test Setup



## 2.8.4. Test Procedure

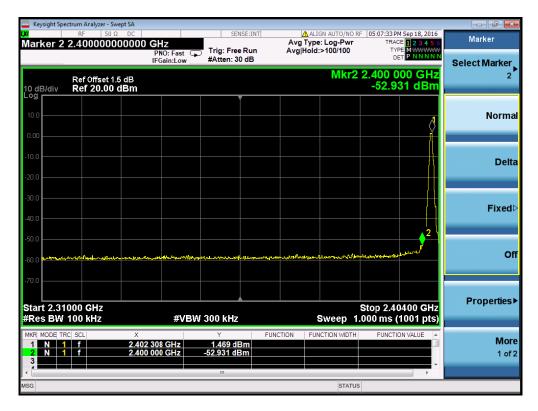
1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of

FCC Public Notice DA 00-705 Measurement Guidelines.

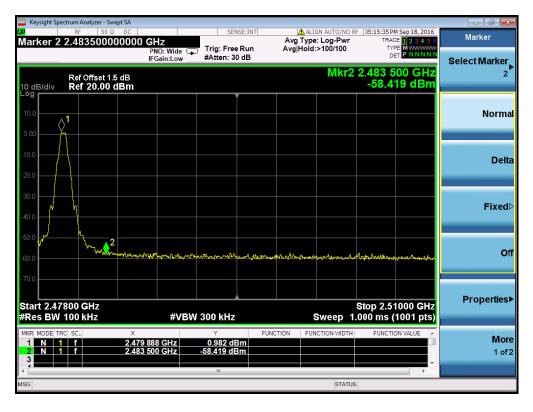
- 2. Set to the maximum power setting and enable the EUT transmit continuously.
- 3. Set RBW = 100kHz (≥1% span=10MHz ), VBW = 300kHz (≥RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
- 4. Enable hopping function of the EUT and then repeat step 2. and 3.
- 5. Measure and record the results in the test report.

## 2.8.5. Test Results of Conducted Band Edge

Band edge - Conducted (Un-hopping)



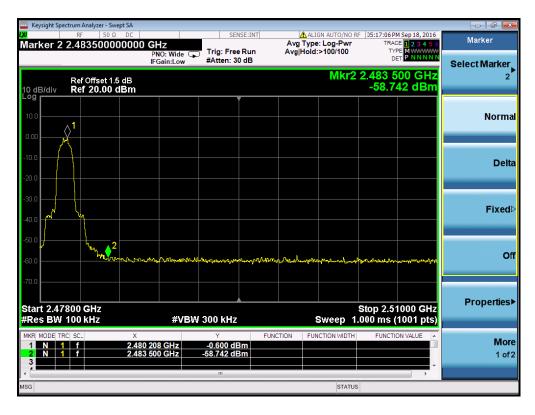
#### Low Band Edge Plot on channel 0 @ GFSK



High Band Edge Plot on channel 78 @ GFSK

d l	trum Analyzer - Swep       RF     50 Ω <b>2.40193200</b>	DC	SENSE:INT	ALIGN AUTO/NO Avg Type: Log-Pwr Avg Hold:>100/100	RF 05:08:55 PM Sep 18, 2016 TRACE 1 2 3 4 5 6 TYPE MWWWWW	Peak Search
10 dB/div	Ref Offset 1.5 Ref 20.00 di	IFGain:Low	#Atten: 30 dB	-	2.401 932 GHz -0.219 dBm	Next Pea
.og 10.0					<b>1</b>	Next Pk Rig
20.0						Next Pk Lo
30.0 <b></b> 40.0 <b></b>						Marker De
50.0	edantarian-Aragata	thatensongungtos	un Miglinen ak Anting Marinesia	Marin and and an and an and an and an and an	2 marananybelakerar	Mkr→0
70.0 Start 2.310		#\/B	W 300 kHz	Sween	Stop 2.40400 GHz .000 ms (1001 pts)	Mkr→RefL
		× 2.401 932 GHz 2.400 000 GHz	Y -0.219 dBm -50.697 dBm	FUNCTION FUNCTION WIDTH		<b>Мо</b> 1 о

Low Band Edge Plot on channel 0  $@\pi/4$ -DQPSK



High Band Edge Plot on channel 78  $@\pi/4$ -DQPSK

larker 2	RF 50 2.4000000	000000 G	Hz NO: Fast ⊂	Trig: Free		Avg Type	GN AUTO/NO RE : Log-Pwr :>100/100	TRAC	A Sep 18, 2016 E 1 2 3 4 5 6 E M WWWWWW T P N N N N N	Marker
0 dB/div	Ref Offset 1 Ref 20.00	.5 dB	Gain:Low	#Atten: 30	dB		Mkr2	2.400 0	00 GHz 15 dBm	Select Marke
10.0 0.00										Norm
20.0									Å	De
30.0 40.0										Fixe
50.0	Margara and the	yorse typederseterseen		www.fich <sup>Da</sup> fergedw.cofferdfa.cof.e	ฟมีการสารางสาราง	a truge and a	anti ana ana ana ana ana ana ana ana ana an	and and the second second	a par offer	(
	000 GHz 100 kHz		#\/B)	N 300 kHz			Sweep 1.	Stop 2.40	)400 GHz 1001 pts)	Propertie
IKR MODE TR 1 N 1 2 N 1 3		× 2.401 93 2.400 00	32 GHz	Y -0.036 dB -49.915 dB			ICTION WIDTH		DN VALUE	<b>M</b> c 1 c

Low Band Edge Plot on channel 0 @8-DPSK



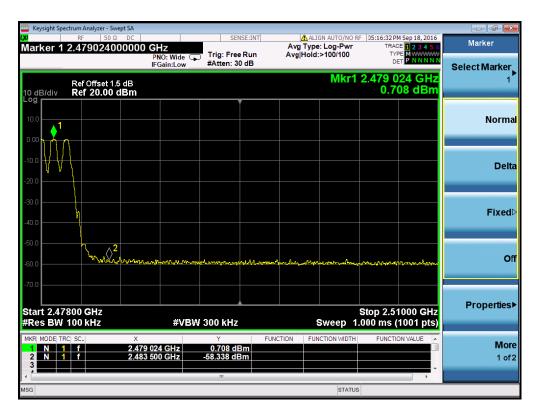
High Band Edge Plot on channel 78 @8-DPSK



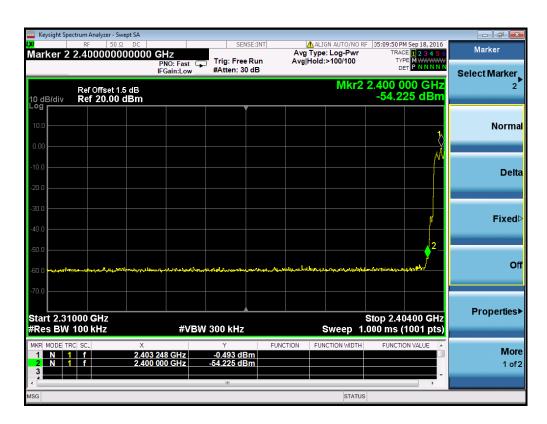
#### Band edge - Conducted (hopping)

X		DC	SENS	E:INT		05:08:06 PM Sep 18, 2016	
Marker 2	2.400000000	000 GHz PNO: Fast IFGain:Low	Trig: Free #Atten: 30	Run Av	g Type: Log-Pwr g Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE MWWWW DET P NNNN	Marker Select Marker
10 dB/div	Ref Offset 1.5 d Ref 20.00 dB	B m			Mkr2	2.400 000 GHz -58.452 dBm	2
10.0						h	Norma
10.00							
-20.0							Delt
-30.0							Fixed
-40.0							
-60.0 <mark>Aphadasa</mark>	terangepartan data mang filo.	mann	-Norman providence	angles, Professional Confessions	hanipen hat generated	www.www.www.www.	0
-70.0							Properties
Start 2.31 #Res BW		#V	BW 300 kHz			Stop 2.40400 GHz 000 ms (1001 pts)	
MKR MODE TRO 1 N 1 2 N 1 3	f	X 2.403 154 GHz 2.400 000 GHz	Y 0.589 dB -58.452 dBi		FUNCTION WIDTH	FUNCTION VALUE	Mor 1 of
sg			m		STATUS	•	

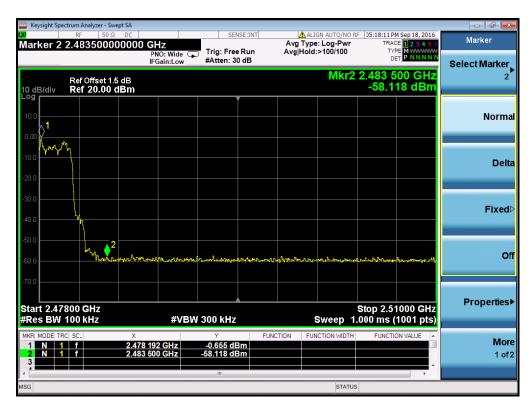
Low Band Edge Plot on channel 0 @ GFSK



High Band Edge Plot on channel 78 @ GFSK



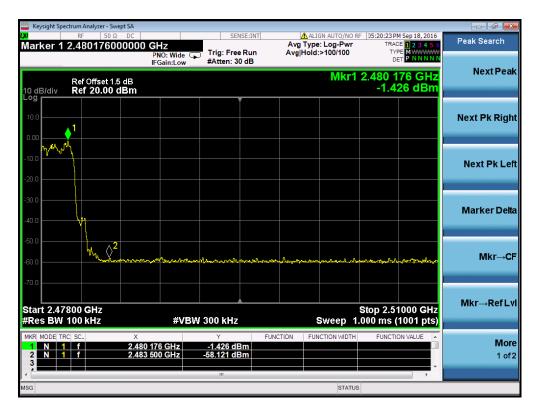
Low Band Edge Plot on channel 0  $@\pi/4$ -DQPSK



High Band Edge Plot on channel 0  $@\pi/4$ -DQPSK

Keysight Spectrum Analyzer - RF 5 Marker 1 2.401932	0Ω DC	SENSE:INT Trig: Free Run #Atten: 30 dB	ALIGN AUTO/NO RF	05:13:31 PM Sep 18, 2016 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P N N N N	Peak Search
Ref Offset 0 dB/div Ref 20.0			Mkr1 2.	401 932 GHz -0.274 dBm	NextPea
10.0					Next Pk Rig
20.0				///	Next Pk Le
40.0					Marker De
50.0 50.0 <b>Mututuranu</b> uuuu	มะปั <sub>ย</sub> อ <sub>ม</sub> ะบุระบุระสุมสถางใช้ชื่อสุขาภาพิตะส่ง	ແລ້ໄດ <sub>ອ</sub> ເຕີເລຍັງການເປັນເຊິ່ງການໂດ-ການຊາງໃນກ	pijuteficen of n Alfrid International Anthr	ownitine of the second	Mkr→C
Start 2.31000 GHz Res BW 100 kHz	#VB	W 300 kHz	Steep 1.00	op 2.40400 GHz 10 ms (1001 pts)	Mkr→RefL
IKR MODE TRC SCL 1 N 1 f 2 N 1 f 3 J	× 2.401 932 GHz 2.400 000 GHz	Y FUT -0.274 dBm -51.424 dBm	NCTION FUNCTION WIDTH	FUNCTION VALUE	<b>Mo</b> 1 of

Low Band Edge Plot on channel 0 @8-DPSK



High Band Edge Plot on channel 0 @8-DPSK



## 2.9. Conducted Emission

## 2.9.1. Limit of Conducted Emission

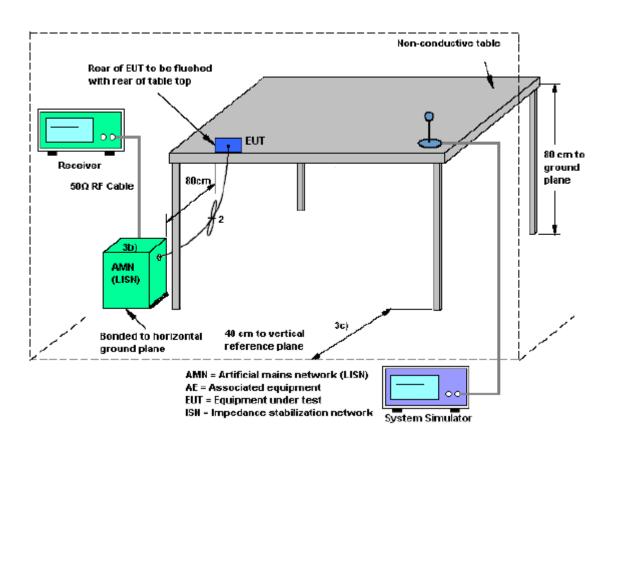
For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency range (MHz)	Conducted L	.imit (dBµV)
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

#### 2.9.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

## 2.9.3. Test Setup





#### 2.9.4. Test Procedures

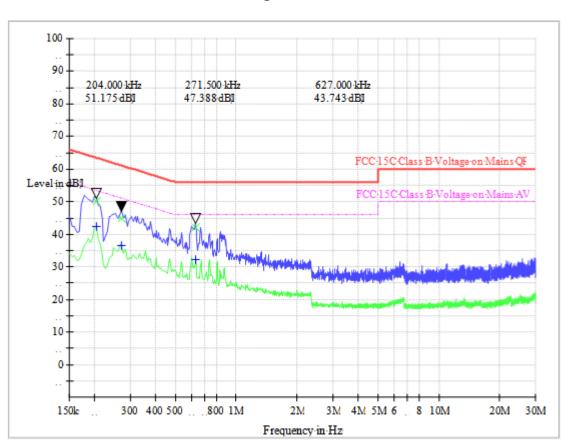
- 1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- 2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
- 3. All the support units are connecting to the other LISN.
- 4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
- 5. The FCC states that a 50 ohm, 50 micrometry LISN should be used.
- 6. Both sides of AC line were checked for maximum conducted interference.
- 7. The frequency range from 150 kHz to 30 MHz was searched.
- 8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth =

9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

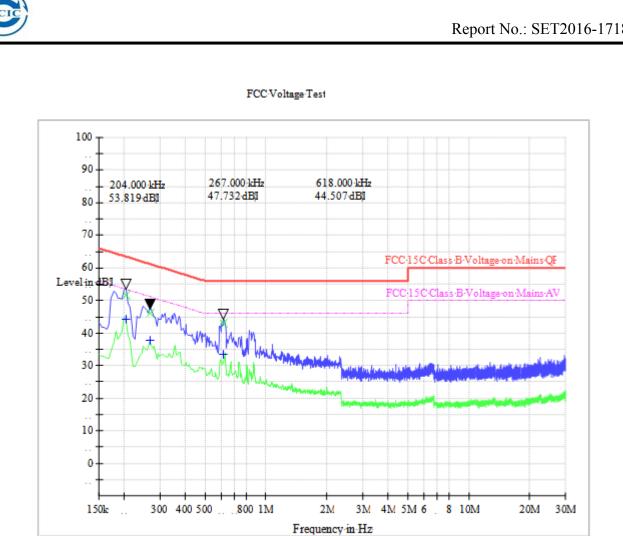
#### 2.9.3. Test Results of Conducted Emission

The EUT configuration of the emission tests is Bluetooth Link + USB Cable (Charging from Adapter).





	<b>Conducted Disturbance at Mains Terminals</b>									
L Test Data										
QP AV										
Frequency (MHz)	Limits (dBµV)	Measurement Value (dBµV)	Frequency (MHz)	Limits (dBµV)	Measurement Value (dBµV)					
0.204	63.4	51.175	0.204	53.4	42.30					
0.272	61.1	47.388	0.272	51.1	36.52					
0.627	56.0	43.743	0.627	46	32.33					
		L Test	Curve							



(Plot B: N Phase)

	Conducted Disturbance at Mains Terminals										
	N Test Data										
QP AV											
Frequency (MHz)	Limits (dBµV)	Measurement Value (dBµV)	Frequency (MHz)	Limits (dBµV)	Measurement Value (dBµV)						
0.204	63.4	53.819	0.204	53.4	44.32						
0.267	61.2	47.732	0.267	51.2	37.88						
0.618	56.0	44.507	0.618	46	33.48						
		N Test	Curve								

**Test Result: PASS** 



## 2.10. Radiated Band Edges and Spurious Emission

#### 2.10.1. Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

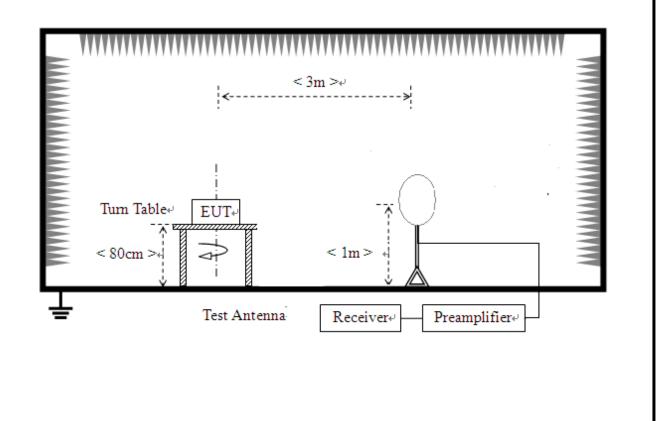
Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

#### 2.10.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

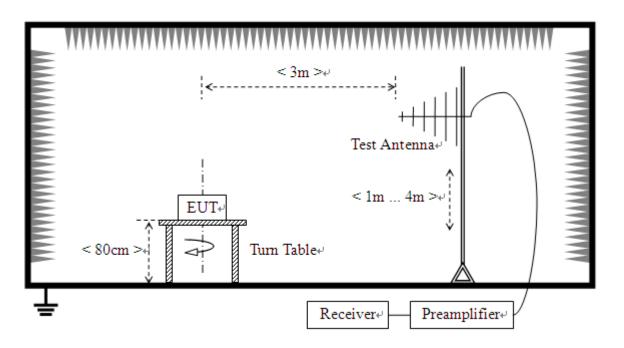
#### 2.10.3. Test Setup

1) For radiated emissions from 9kHz to 30MHz

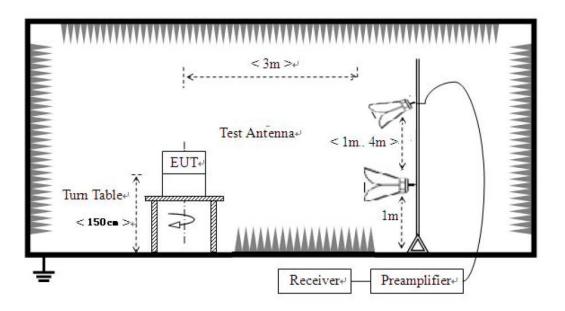




2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz





#### 2.10.4. Test Procedure

- The testing follows the guidelines in Spurious Radiated Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
- 2. The EUT was placed on a turntable with 0.8/1.5 meter for below 1GHz and 1.5 meter for above 1GHz above ground.
- 3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 4. For each suspected emission, the EUT was arranged to its worst case and then tune the

Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.

- 5. Set to the maximum power setting and enable the EUT transmit continuously.
- 6. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;

(2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f > 1GHz ; VBW $\ge$ RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak

(3) For average measurement: use duty cycle correction factor method per 15.35(c).

Duty cycle = On time/100 milliseconds

On time =  $N_1 * L_1 + N_2 * L_2 + ... + N_{n-1} * L N_{n-1} + Nn * Ln$ 

Where  $N_1$  is number of type 1 pulses, L1 is length of type 1 pulses, etc.

Average Emission Level = Peak Emission Level + 20\*log(Duty cycle)

- 7. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 8. All modes (three orthogonal orientations) of operation were investigated and the worst-case emissions are reported.

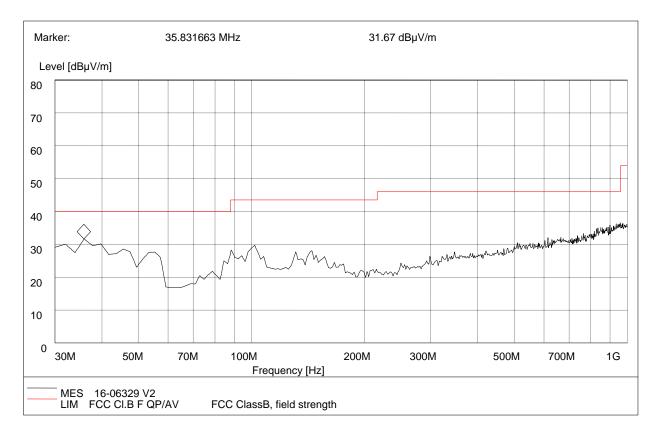


## 2.10.5. Test Results of Radiated Band Edge and Spurious Emission

#### For 9 KHz to 30 MHz

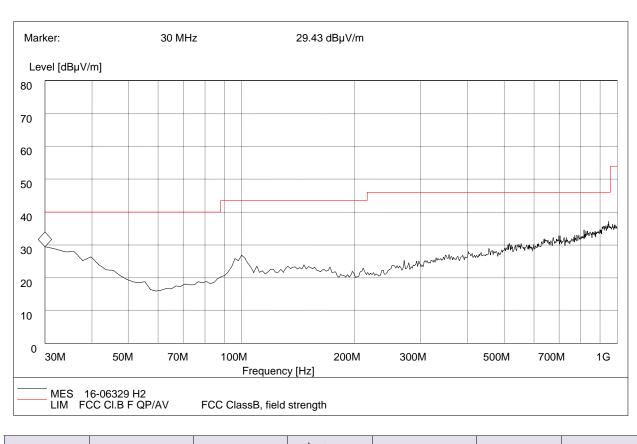
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

#### For 30MHz to 1000MHz



Frequency (MHz)	QuasiPeak (dB µ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB µ V/m)	Antenna	Verdict
35.83	34.67	120.000	100.0	40.0	Vertical	Pass

(Plot A: 30MHz to 1GHz, Antenna Vertical)



Frequency (MHz)	QuasiPeak (dB µ V/m)	Bandwidth (kHz)	Antenna height (cm)	Limit (dB µ V/m)	Antenna	Verdict
30.00	29.43	120.000	100.0	40.0	Horizontal	Pass

(Plot B: 30MHz to 1GHz, Antenna Horizontal)

Note: All modes of operation were investigated and found mode 3 is the worst mode, the worst-case emissions are reported



## For 1GHz to 25 GHz

NOTE: All of the EUT Configure Mode were tested and found GFSK mode is the worst mode, the worst case is recorded in this report.

AN	ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (GFSK-2402MHz)								
No.	Frequency (MHz)	Emss Lev (dBuV	el	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	2390.00	56.70	РК	74.0	-17.3	1.51 H	228	55.4	1.3
2	2390.00	43.50	AV	54.0	-10.5	1.51 H	228	42.2	1.3
3	*2402.00	76.60	РК	/	/	1.53 H	112	75	1.6
4	*2402.00	65.80	AV	/	/	1.53 H	112	64.2	1.6
5	4804.00	50.50	РК	74.00	-23.5	1.50 H	254	44.1	6.4
6	4804.00	42.80	AV	54.00	-11.2	1.50 H	254	36.4	6.4
A	NTENNA P	OLAR	ITY 8	test di	STANCE	E: VERTIC	ALAT 3 M	(GFSK-2402	2MHz)
No.	Frequency (MHz)	Emss Lev (dBuV	el	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	2390.00	56.90	РК	74.0	-17.1	1.51 V	228	55.6	1.3
2	2390.00	44.30	AV	54.0	-9.7	1.51 V	228	43	1.3
3	*2402.00	77.10	РК	/	/	1.53 V	112	75.5	1.6
4	*2402.00	67.60	AV	/	/	1.53 V	112	66	1.6
5	4804.00	51.40	РК	74.00	-22.6	1.51 V	254	45	6.4
6	4804.00	43.70	AV	54.00	-10.3	1.51 V	254	37.3	6.4



ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (GFSK_2441MHz)									
No.	Frequency (MHz)	Emss Lev (dBuV	el	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	*2441.00	77.80	РК	/	/	1.51 H	210	75.7	2.1
2	*2441.00	66.70	AV	/	/	1.51 H	210	64.6	2.1
3	4882.00	54.50	РК	74.00	-19.5	1.53 H	272	48	6.5
4	4882.00	43.6	AV	54.00	-10.4	1.53 H	272	37.1	6.5
A	NTENNA P	OLARI	TY &	TEST DI	STANCE	<b>C: VERTIC</b>	ALAT 3 M	(GFSK_244	1MHz)
No.	Frequency (MHz)	Emss Lev (dBuV	el	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)
1	*2441.00	78.40	РК	/	/	1.50 V	210	76.3	2.1
2	*2441.00	67.10	AV	/	/	1.51 V	210	65	2.1
3	4884.00	55.50	РК	74.00	-18.5	1.51 V	272	49	6.5
4	4884.00	42.80	AV	54.00	-11.2	1.51 V	272	36.3	6.5



AN	ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M (GFSK _2480MHz)									
No.	Frequency (MHz)	Emss Lev (dBuV	el	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)	
1	*2480.00	77.00	РК	/	/	1.55 H	215	74.4	2.6	
2	*2480.00	66.50	AV	/	/	1.55 H	215	63.9	2.6	
3	2483.50	56.80	РК	74.0	-17.2	1.55 H	211	54.2	2.6	
4	2483.50	45.20	AV	54.0	-8.8	1.55 H	211	42.6	2.6	
5	4960.00	52.20	РК	74.0	-21.8	1.55 H	320	45.5	6.7	
6	4960.00	45.10	AV	54.0	-8.9	1.55 H	320	38.4	6.7	
Al	NTENNA P	OLARI	TY &	TEST DIS	STANCE	: VERTICA	ALAT3M	(GFSK _248	0MHz)	
No.	Frequency (MHz)	Emss Lev (dBuV	el	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV/m)	Correction Factor (dB/m)	
1	*2480.00	76.10	РК	/	/	1.55 V	215	73.5	2.6	
2	*2480.00	67.10	AV	/	/	1.55 V	215	64.5	2.6	
3	2483.50	56.30	РК	74.0	-17.7	1.55 V	211	53.7	2.6	
4	2483.50	45.90	AV	54.0	-8.1	1.55 V	211	43.3	2.6	
5	4960.00	53.70	РК	74.0	-20.3	1.55 V	320	47	6.7	
6	4960.00	42.60	AV	54.0	-11.4	1.55 V	320	35.9	6.7	

#### **REMARKS**:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)

2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)

- Pre-Amplifier Factor(dB)

3. The other emission levels were very low against the limit.

4. Margin value = Emission Level - Limit value

5. " \* ": Fundamental frequency.



# 3. List of measuring equipment

Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.
1	EMI TEST RECEIVER	Rohde&Schwarz	ESI 26	100009	2015/11/02
2	RF TEST PANEL	Rohde&Schwarz	TS / RSP	335015/ 0017	N/A
3	EMI TEST SOFTWARE	Rohde&Schwarz	ESK1	N/A	N/A
4	Ultra-Broadband Antenna	ShwarzBeck	VULB9163	538	2015/11/08
5	HORN ANTENNA	ShwarzBeck	9120D	1011	2015/11/08
6	Loop Antenna	Rohde&Schwarz	HZ-9	838622\013	2015/11/08
7	Pre-amplifer	ShwarzBeck	BBV 9743	9743-0022	2015/11/02
8	TURNTABLE	MATURO	TT2.0	N/A	N/A
9	ANTENNA MAST	MATURO	TAM-4.0-P	N/A	N/A
10	EMI TEST SOFTWARE	Audix	E3	N/A	N/A
11	Test cable	Siva Cables Italy	RG 58A/U	W14.02	2015/12/05
12	Climate Chamber	ESPEC	EL-10KA	05107008	2015/11/02
13	Spectrum Analyzer	Kysight	N9030A	ATO-67098	2016/07/19
14	Power Meter	Rohde&Schwarz	NRP2	1020.1809.02	2016.06.02
15	Power Sensor	Rohde&Schwarz	NRP-Z81	823.3618.03	2016.06.02
16	Spectrum Analyzer	R&S	FSP40	1164.4391.40	2016.07.07



## 4. Uncertainty of Evaluation

Where relevant, the following measurement uncertainty levels have been estimated for tests

performed on the EUT as specified in CISPR 16-4-2

Measurement	Frequency	Uncertainty
Conducted emissions	9kHz~30MHz	3.39dB
	30MHz~1000MHz	4.24dB
Radiated emissions	1G~18GHz	5.16dB
	18G~40GHz	5.54dB

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

#### \*\* END OF REPORT \*\*