

# **TEST REPORT**

APPLICANT	: Sound Bubble LLC
PRODUCT NAME	: Ear Bolts
MODEL NAME	: LA-S062
BRAND NAME	: Sound Bubble LLC
FCC ID	: 2AOYZEB1BTV1020218X
STANDARD(S)	: 47 CFR Part 15 Subpart C
TEST DATE	: 2018-01-15 to 2018-02-02
ISSUE DATE	: 2018-04-08

Tested by:

Li Jung Zong

Li Jingzong (Test Engineer)

Approved by:

Andy Yeh (Technical Director)

NOTE: This document is issued by MORLAB, the test report shall not be reproduced except in full without prior written permission of the company. The test results apply only to the particular sample(s) tested and to the specific tests carried out which is available on request for validation and information confirmed at our website.



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China

Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn E-mail: service@morlab.cn





### DIRECTORY

1. Technical Information 4
1.1. Manufacturer and Factory Information 4
1.2. Equipment Under Test (EUT) Description 4
1.3. Test Standards and Results 5
1.4. Environmental Conditions 5
2. 47 CFR Part 15C Requirements 6
2.1. Antenna requirement 6
2.2. Number of Hopping Frequency 6
2.3. Peak Output Power ······10
2.4. 20dB Bandwidth ······17
2.5. Carried Frequency Separation24
2.6. Time of Occupancy (Dwell time)27
2.7. Conducted Spurious Emissions
2.8. Restricted Frequency Bands
2.9. Conducted Emission56
2.10. Radiated Emission60
Annex A Test Uncertainty73
Annex B Testing Laboratory Information74





Change History						
Issue	Date	Reason for change				
1.0	2018-04-08	First edition				



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



## **1.** Technical Information

Note: Provide by applicant.

### **1.1. Applicant and Manufacturer Information**

Applicant:	Sound Bubble LLC
Applicant Address:	2256 Saint Margarets Court, Livermore, CA94550, USA
Manufacturer:	Dongguan Manchun Electronic Technology Co., Ltd.
Manufacturer Address:	No.2, Lanyuan road, Zengtian Industrial Park, Chang'an Town,
	Dongguan City, Guangdong Province, China

### **1.2. Equipment Under Test (EUT) Description**

Product Name:	Ear Bolts
Serial No:	(N/A, marked #1 by test site)
Hardware Version:	B04G
Software Version:	VER1.0
Modulation Type:	FHSS (GFSK(1Mbps), π/4-DQPSK(EDR 2Mbps),
	8-DPSK(EDR 3Mbps))
	The frequency range used is 2402MHz – 2480MHz
Operating Frequency Range:	(79 channels, at intervals of 1MHz);
	The frequency block is 2400MHz to 2483.5MHz.
Bluetooth Version:	Bluetooth 4.1(BR/EDR)
Antenna Type:	PIFA Antenna
Antenna Gain:	2.0 dBi

**Note 1:** The EUT contains Bluetooth Module operating at 2.4GHz ISM band; the frequencies 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:** The EUT connected to the serial port of the computer with a serial communication cable, we use the dedicated software to control the EUT into the test mode, and then use MT8852B base station to control the EUT continuous transmission.

**Note 3:** For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.





### **1.3. 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 ID Certification:

No	Identity			Document Title				
1	47 CFR Part 15 (10-1-15 Edition)			Radio Frequency Devices				
Test d	est detailed items/section required by FCC rules and results are as below:							
No.	Section in CFR 47	Description		Test Date	Test Engineer	Result		
1	15.203	Antenna Requirement		N/A	N/A	PASS		
2	15.247(a)	Number of Hopping Frequer	псу	Jan 15, 2018	Li Jingzong	PASS		
3	15.247(b)	Peak Output Power		Jan 15, 2018& Apr 08, 2018	Li Jingzong	PASS		
4	15.247(a)	20dB Bandwidth		Jan 15, 2018	Li Jingzong	PASS		
5	15.247(a)	Carrier Frequency Separation	on	Jan 15, 2018	Li Jingzong	PASS		
6	15.247(a)	Time of Occupancy (Dwell ti	me)	Jan 15, 2018	Li Jingzong	PASS		
7	15.247(d)	Conducted Spurious Emission	on	Jan 15, 2018	Li Jingzong	PASS		
8	15.247(d)	Restricted Frequency Bands	3	Jan 20, 2018	Peng Xuewei	PASS		
9	15.209, 15.247(d)	Radiated Emission		Jan 20, 2018	Peng Xuewei	PASS		
10	15.207	Conducted Emission		Jan 20, 2018	Peng Xuewei	PASS		

**Note:** The tests were performed according to the method of measurements prescribed in ANSI C63.10-2013.

### **1.4. Environmental Conditions**

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

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







## 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.

#### 2.1.2. Result: Compliant

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. Requirement

According to FCC §15.247(a)(1)(iii), frequency hopping systems operating in the 2400MHz to 2483.5MHz bands shall use at least 15 hopping frequencies.

#### 2.2.2. Test Description

#### A. Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set with Attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the SS, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.





**B.** Equipments List:

Please reference ANNEX A(1.5).

#### 2.2.3. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings: Span = the frequency band of operation RBW  $\geq$  1% of the span VBW  $\geq$  RBW Sweep = auto Detector function = peak Trace = max hold Allow the trace to stabilize

#### 2.2.4. Test Result

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.

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

#### A. Test Verdict:





#### B. Test Plots:

gilent Spectr	um Analyzer - Swe	ept SA								
larker 1	RF 50 Ω	AC	-lz	SEN	ISE:INT	Avg Type	ALIGNAUTO : Log-Pwr	01:49:01 PM TRAC	4 Jan 15, 2018 E <mark>1 2 3 4 5 6</mark>	Marker
		PI IF(	NO: Fast 🖵 Gain:Low	Trig: Free Atten: 24	e Run dB	Avg Hold:	> 10/10	TYF De	PEMWWWWWW TPNNNNN	Select Marker
0 dB/div	Ref Offset 1.5 Ref 15.00 d	dB IBm					ΔMkr	-2	3 0 MHz .575 dB	1
5 00 <b>1</b>									142	Norma
X2		*****	*******		******	******	******	*****		
5.00										Delta
15.0										
25.0										Fixed
35.0										
45.0										Off
55.0										
65.0										Properties •
75.0										
start 2. <u>40</u>	000 GHz							Stop 2. <u>48</u>	3350 GHz	More 1 of 2
Res BW	1.0 MHz		#VBW	3.0 MHz			Sweep 1	000 ms (	1001 pts)	
sg							STATUS			

(GFSK)





RF 50 Ω AC	SENSE:INT	ALIGN AUTO	01:50:30 PM Jan 15, 2018	Dook Soorah
rker 1 79.158000000 M	HZ PNO: Fast 😱 Trig: Free Run IEGain: I ow Atten: 24 dB	Avg Type: Log-Pwr Avg Hold:>10/10	TRACE 123456 TYPE MWWWWW DET PNNNNN	Peak Search
Ref Offset 1.5 dB B/div Ref 15.00 dBm		ΔMkr	1 79.158 0 MHz -1.921 dB	Next Peal
X2		man management	142	Next Pk Righ
				Next Pk Lef
				Marker Delta
				Mkr→CF
				Mkr→RefLv
rt 2.40000 GHz			Stop 2.48350 GHz	More 1 of 2

#### $(\pi/4-DQPSK)$



(8- DPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn

E-mail: service@morlab.cn



### 2.3. Peak Output Power

#### 2.3.1. Requirement

According to FCC §15.247(b)(1), for frequency hopping systems that operates in the 2400MHz to 2483.5MHz band employing at least 75 hopping channels, the maximum peak output power of the intentional radiator shall not exceed 1Watt. For all other frequency hopping systems in the 2400MHz to 2483.5MHz band, it is 0.125Watts.

#### 2.3.2. Test Description

#### A. Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set with Attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the SS, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

#### B. Equipments List:

Please reference ANNEX A(1.5).

#### 2.3.3. Test Result

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the module. The lowest, middle and highest channel were tested by USB Wideband Power Sensor.





#### 2.3.3.1 GFSK Mode

#### A. Test Verdict:

Channel	Frequency	Measured Outp	Lin	nit	Vardiat	
Channel	(MHz) dBm		W	dBm	W	verdict
0	2402	4.72	0.00296		1	PASS
39	2441	4.73	0.00297	30		PASS
78	2480	3.23	0.00210			PASS

#### B. Test Plots:

Agilent Spectrum Ana X RF Marker 1 2.40	Ilyzer - Swept SA 50 Q AC 2066000000 GI P	Hz NO: Fast 😱	SEN	SE:INT	Avg Type Avg Hold:	ALIGN AUTO :: Log-Pwr >10/10	12:53:59 PM TRAC TYP	4 Jan 15, 2018 E <b>1 2 3 4 5 6</b> E M <del>WWWW</del>	Peak Search
Ref 10 dB/div Ref	Offset 1.5 dB 16.50 dBm	Gain:Low	Atten: 26	ab		Mkr1	2.402 0 4.7	66 GHz 18 dBm	Next Peak
6.50				<b>♦</b> <sup>1</sup>					Next Pk Right
-3.50									Nevt Pk Left
-13.5									NEXT PR LET
-23.5									Marker Delta
-43.5									Mkr→CF
-53.5									
-63.5									Mkr→RefLvl
Center 2 40200	00 GHz						Snan 3	000 MHz	More 1 of 2
#Res BW 1.0 N	1Hz	#VBW	3.0 MHz			Sweep 1. STATUS	.000 ms (	1001 pts)	

(GFSK, Channel 0, 2402MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China





#### (GFSK, Channel 39, 2441MHz)



#### (GFSK, Channel 78, 2480MHz)

MORLAB

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



#### 2.3.3.2 π/4-DQPSK Mode

#### A. Test Verdict:

Channel	Frequency	Measured Outp	ut Peak Power	Limit		Vardiat
Channel	(MHz)	dBm	W	dBm	W	verdict
0	2402	1.19	0.00132			PASS
39	2441	2.54	0.00179	30	1	PASS
78	2480	2.95	0.00197			PASS

#### B. Test Plots:

Agilent Spectr	rum Analyzer - Swe	ept SA		SEN	ISE-INIT		ALIGNALITO	03:20:31 P	A Apr 08, 2018	
Marker 1	2.4018650	00000 G	HZ	Trig: Free	Run	Avg Type Avg Hold:	: Log-Pwr >10/10	TRAC		Peak Search
		IF	Gain:Low	Atten: 20	dB		D. d. Ld.	DE		Next Peak
10 dB/div	Ref Offset 1.5 Ref 10.00 c	idB dBm					IVIKET	2.401 8	88 dBm	
209				<b>♦</b> <sup>1</sup>						Next Pk Pight
0.00		*****								Next PK Right
-10.0										
-20 0										Next Pk Left
-20.0										
-30.0										Marker Delta
-40.0										
-50.0										Mkr→CF
-60.0										
-70.0										Mkr→RefLvl
-80.0										More
Center 24	102000 GHz							Snan 3	000 MHz	1 of 2
#Res BW	1.5 MHz		#VBW	5.0 MHz			Sweep 1	.000 ms (	1001 pts)	
MSG							STATUS			

(π/4-DQPSK, Channel 0, 2402MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



Agilent Spect	rum Analyzer - Swept	SA							
Marker 1	RF 50Ω / 2.440859000	∞ 000 GHz	SEP		Avg Type	LIGNAUTO	03:20:13 Pf TRAC	M Apr 08, 2018 CE 123456	Peak Search
		PNO: Fast ( IFGain:Low	Atten: 20	dB	Avg Hold:	>10/10	DI		
10 dB/div	Ref Offset 1.5 dl Ref 10.00 dB	з m				Mkr	2.440 8 2.5	859 GHz 43 dBm	NextPeak
Log			↓ <sup>1</sup>						
0.00									Next Pk Right
-10.0									
									Next Pk Left
-20.0									
-30.0									
									Marker Delta
-40.0									
-50.0									Mkr_CE
-60.0									
-70.0									Mkr→RefLvl
.80.0									
-00.0									More
Center 2.	441000 GHz						Span 3	.000 MHz	1 of 2
#Res BW	1.5 MHz	#VB	W 5.0 MHz			Sweep	1.000 ms (	1001 pts)	
MSG						STATU	s		

(π/4-DQPSK, Channel 39, 2441MHz)



(π/4-DQPSK, Channel 78, 2480MHz)

MORLAB

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



#### 2.3.3.3 8-DPSK Mode

#### A. Test Verdict:

Channel	Frequency	Measured Outp	Lim	nit	Vordiot	
Channel	(MHz)	dBm	W	dBm	W	verdict
0	2402	1.33	0.00136			PASS
39	2441	2.66	0.00185	30	1	PASS
78	2480	3.14	0.00206			PASS

#### B. Test Plots:

Agile	nt Spectrum	Analyzer - Sw	ept SA		CEN	ICE-INT		ALIGNALITO	02:17:17.0	4 Apr 09, 2019	
Ma	rker 1 2.	4019400	00000 G	Hz NO: East	Trig: Free	Run	Avg Type Avg Hold:	: Log-Pwr >10/10	TRAC	E 1 2 3 4 5 6 E M <del>WARMAN</del>	Peak Search
			IF	Gain:Low	Atten: 20	dB		Mket	DI		Next Peak
10 d	F IB/div F	Ref Offset 1.9 Ref 10.00 (	5 dB d <b>Bm</b>					IVIKI I	1.3	28 dBm	
LUg					<b>▲</b> <sup>1</sup>						
0.00	) 										Next PK Right
-10.0	]										
											Next Pk Left
-20.0	]										
-30.0											Marilan Daka
-40.0	1										Marker Delta
-50.0	)										Mkr→CF
-60.0	) <u> </u>										
70.0											Mire Doff of
-70.0											wikr→RefLVi
-80.0											
											More 1 of 2
Cer #Re	nter 2.40: es BW <u>1.</u> :	2000 GHz 5 MHz		#VBW	5.0 MHz			Sweep 1	Span 3 .000 m <u>s (</u>	.000 MHz 1001 pts)	. 012
MSG								STATUS	3		

(8-DPSK, Channel 0, 2402MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



Agilent Spectr	um Analyzer - Swept	SA							
Marker 1	<b>2.440949000</b>	000 GHz	5E	NSEINT	Avg Type	Log-Pwr	103:19:09 PM TRAC	4 Apr 08, 2018	Peak Search
		PNO: Fas IFGain:Lov	t 🕞 Trig: Fre w Atten: 20	e Run )dB	Avg Hold:	>10/10	DE		
10 dB/div	Ref Offset 1.5 dl Ref 10.00 dB	B m				Mkr1	2.440 9 2.6	49 GHz 55 dBm	Next Peak
			•	1					
0.00									Next Pk Right
-10.0									
10.0									Next Pk Left
-20.0									
-30.0									
									Marker Delta
-40.0									
-50.0									Mkr. CE
									WIKI→CF
-60.0									
-70.0									Mkr→RefLvl
-80.01									More
Center 2	141000 CHz						Snan 3	000 MHz	1 of 2
#Res BW	1.5 MHz	#\	/BW 5.0 MHz			Sweep 1	1.000 ms (	1001 pts)	
MSG						STATU	S		

#### (8-DPSK, Channel 39, 2441MHz)



#### (8-DPSK, Channel 78, 2480MHz)

**MORLAB** 

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn

E-mail: service@morlab.cn



#### 2.4.1. Definition

According to FCC \$15.247(a)(1), the 20dB bandwidth is known as the 99% emission bandwidth, or 20dB bandwidth (10\*log1% = 20dB) taking the total RF output power.

#### 2.4.2. Test Description

#### A. Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set with Attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the SS, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

#### B. Equipments List:

Please reference ANNEX A(1.5).

#### 2.4.3. Test Procedure

Use the following spectrum analyzer settings: 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







#### 2.4.4. Test Result

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to record the 20dB bandwidth of the Module.

#### 2.4.4.1 GFSK Mode

#### A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	0.9494	PASS
39	2441	0.9480	PASS
78	2480	0.9453	PASS

#### B. Test Plots:



(GFSK, Channel 0, 2402MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China











#### (GFSK, Channel 78, 2480MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn



#### 2.4.4.2 π/4-DQPSK Mode

#### A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	1.268	PASS
39	2441	1.238	PASS
78	2480	1.266	PASS

#### B. Test Plots:



(π/4-DQPSK, Channel 0, 2402MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China











(π/4-DQPSK, Channel 78, 2480MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



#### 2.4.4.3 8-DPSK Mode

#### A. Test Verdict:

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Result
0	2402	1.276	PASS
39	2441	1.272	PASS
78	2480	1.272	PASS

#### B. Test Plots:



(8-DPSK, Channel 0, 2402MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China











#### (8-DPSK, Channel 78, 2480MHz)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn

E-mail: service@morlab.cn



### 2.5. Carried Frequency Separation

#### 2.5.1. Definition

According to FCC §15.247(a)(1), 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. Test Description

#### A. Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set with Attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the SS, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

#### B. Equipments List:

Please reference ANNEX A(1.5).

#### 2.5.3. Test Procedure

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

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW)  $\geq$  1% of the span

Video (or Average) Bandwidth (VBW)  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



#### 2.5.4. Test Result

The Bluetooth Module operates at hopping-on test mode. For any adjacent channels (e.g. the channel 39 and 40 as showed in the Plot A), the Module does have hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel (refer to section 2.4.4), whichever is greater. So, the verdict is PASSING

Test Mode	Measured		20dB		
	Channel	Separation	bandwidth	Min. Limit	Verdict
	Numbers	Separation	(MHz)		
GFSK	39 and 40	1.011	0.9453	two thirds of the	PASS
π/4-DQPSK	39 and 40	1.008	1.238	20dR bandwidth	PASS
8-DPSK	39 and 40	1.002	1.272		PASS



(GFSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



gilent Spectrum Analyzer - Swept SA	HZ PN0: East Trig: Free Run	ALIGNAUTO Avg Type: Log-Pwr Avg Hold:>10/10	01:46:27 PM Jan 15, 2018 TRACE 12 3 4 5 6 TYPE MWWWWW	Marker
Ref Offset 1.5 dB 0 dB/div Ref 15.00 dBm	IFGain:Low Atten: 24 dB	ΔΝ	/kr1 1.008 MHz 0.525 dB	Select Marker
5.00			1Δ2	Normal
5.00				Delta
25.0				Fixed⊳
15.0				Off
5.0				Pronerties►
75.0				More
Center 2.441000 GHz #Res BW 300 kHz	#VBW 1.0 MHz	Sweep 1	Span 3.000 MHz .000 ms (1001 pts)	1 of 2

#### $(\pi/4-DQPSK)$



(8-DPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



### 2.6. Time of Occupancy (Dwell time)

#### 2.6.1. Requirement

According to FCC §15.247(a) (1) (iii), frequency hopping systems in the 2400 - 2483.5MHz band shall use at least 15 non-overlapping channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

#### 2.6.2. Test Description

#### A. Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set with Attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the SS, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

#### B. Equipments List:

Please reference ANNEX A(1.5).

#### 2.6.3. Test Procedure

Option 1:

DH1: Dwell time equal to Pulse time (ms) \*(1600 / 2 /79)\*31.6 Millisecond DH3: Dwell time equal to Pulse time (ms) \* (1600 /4 /79) \*31.6 Millisecond DH5: Dwell time equal to Pulse Time (ms)\* (1600 / 6 /79) \*31.6 Millisecond





#### 2.6.4. Test Result

#### 2.6.4.1 GFSK Mode

#### A. Test Verdict:

DH	Pulse Width	Dwall Time (ma)	Limit (acc)	Vardiat
Packet	(ms)	Dweir Time (ms)	Limit (Sec)	verdict
DH1	0.38	121.92		PASS
DH3	1.63	261.12	0.4	PASS
DH5	2.90	309.12		PASS

#### B. Test Plots:



(DH1, GFSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



<mark>K/</mark>	RF 50 Ω	AC		SEN	ISE:INT	Aug Type		TO 01:33:39 P	M Jan 15, 2018	Peak Search
narker 1	1.03200 ms	PI	NO: Fast 🔸	Trig: Free	Run	Ut B Libe	LUG-F	TY D		
I0 dB/div	Ref Offset 1.5 Ref 15.00 d	dB Bm	ain:Low	Atten. 24	<b>a</b> D			ΔMkr1 1	.632 ms 0.41 dB	NextPea
- <b>og</b> 5.00							$ \rightarrow$	( <mark>2</mark>	1Δ2	Next Pk Rigl
15.00										Next Pk Le
25.0										Marker De
45.0										Mkr→(
55 0	Monthewa	ham.A		1.	MUMWH	not William				
65.0	1 <b>1</b> 991/101/111	μψ	vilipph <sup>laphill</sup>	NNN WY	<b>VI</b> HAW		All the		Malfalyndy Junty	Mkr→RefL
75.0										Mo
Center 2.4	441000000 G	Hz							an 0 Hz	1 0
							_			

#### (DH3, GFSK)



(DH5, GFSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn

Fax: 86-755-36698525 E-mail: service@morlab.cn



#### 2.6.4.2 π/4-DQPSK Mode

#### A. Test Verdict:

DH Packet	Pulse Width (ms)	Dwell Time (ms)	Limit (sec)	Verdict
DH1	0.4	128.00		PASS
DH3	1.64	262.40	0.4	PASS
DH5	2.90	309.33		PASS

#### B. Test Plots:



(DH1, π/4-DQPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



arker 1	RF 50 Ω 1.63500 ms	AC S	NO:East + •	S⊟ Trig:Fre	NSE:INT		Avg Type	ALIGNAUTO e: Log-Pwr	01:36:58 P TRAI TY	M Jan 15, 2018 CE <mark>1 2 3 4 5 6</mark> PE W <del>MMMMM</del>	Peak Search
I0 dP/diu	Ref Offset 1.5	dB	Gain:Low	Atten: 24	4 dB			Ĺ	Mkr1 1	.635 ms	Next Pea
5.00				X2		1∆2					Next Pk Rigi
5.00											Next Pk Le
25.0 35.0											Marker De
45.0 55.0		4							L.m. b		Mkr→C
65.0		n hala an	()#741/Hpa4/1.d	qq <sup>an</sup> i		u AV	and later of the second se	n haite an the second secon	al and the free line	all f <sup>el</sup> out the s	Mkr→RefL
Center 2.	441000000 G	iHz							8	Span 0 Hz	<b>Mo</b> i 1 of

#### (DH3, $\pi/4$ -DQPSK)



(DH5,  $\pi/4$ -DQPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn



#### 2.6.4.3 8-DPSK mode

#### A. Test Verdict:

DH Packet	Pulse Width (ms)	Dwell Time (ms)	Limit (sec)	Verdict
DH1	0.4	128.00		PASS
DH3	1.64	262.40	0.4	PASS
DH5	2.84	302.93		PASS

#### B. Test Plots:



(DH1, 8-DPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



	Analyzer Swept SA   RF 50 Ω   AC		SEM	ISE:INT	Aug Type		01:41:30 P	4 Jan 15, 2018	Peak Search
harker 1 1.	63500 ms	PNO: Fast ↔ IFGain:Low	Trig: Free Atten: 24	Run dB	Avg type	Log-r wi	TYI	PE WWWWWW PE WWWWWWW ET P N N N N N	
R 0 dB/div R	ef Offset 1.5 dB ef 15.00 dBm					L	\Mkr1 1.	.635 ms 0.68 dB	NextPea
5.00		X2	1Δ2						Next Pk Righ
15.0									Next Pk Le
25.0 444044444444444444444444444444444444									Marker Del
45.0					16.4	. Jai			Mkr→C
65.0	hannah dan kana kana kana kana kana kana kana	hMM	introduce	allananan	halvy' dentation	kolon laitely Many	yMYLohipuph	vhl <mark>en<sub>li</sub>ugual</mark> t	Mkr→RefL
75.0									Moi 1 of
enter 2.441		#\/D\/	2 0 MH-			Sween	5 00 me (	1001 pte	

#### (DH3, 8-DPSK)



(DH5, 8-DPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn



### 2.7. Conducted Spurious Emissions

#### 2.7.1. Requirement

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

#### 2.7.2. Test Description

#### A. Test Setup:



The Bluetooth Module of the EUT is coupled to the Spectrum Analyzer (SA) and the Bluetooth Test Set with Attenuators through the Power Splitter; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the SS, and is set to operate under test mode transmitting 339 bytes DH5 packages at maximum power.

#### B. Equipments List:

Please reference ANNEX A(1.5).

#### 2.7.3. Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz ∨BW ≥ RBW Sweep = auto Detector function = peak



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China





Trace = max hold Allow the trace to stabilize.

#### 2.7.4. Test Result

The Bluetooth Module operates at hopping-off test mode. The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions.

#### 2.7.4.1 GFSK Mode

#### A. Test Verdict:

Channel	Froqueney	Moasured Max, Out of Band	Limit			
				Calculated	Verdict	
	(IVI⊓∠)		Camer Lever	-20dBc Limit		
0	2402	-45.73	3.71	-16.29	PASS	
39	2441	-45.79	4.35	-15.65	PASS	
78	2480	-46.71	2.53	-17.47	PASS	

#### B. Test Plots:

Note: the power of the Module transmitting frequency should be ignored.



(Channel = 0, 30MHz to 25GHz, GFSK Mode)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn

E-mail: service@morlab.cn





#### (Channel = 0, Band edge, GFSK Mode)



#### (Channel = 0, Band edge with hopping on, GFSK Mode)

MORLAB

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China


Agilent Spectrum Analyzer - Swept SA					
X RF 50 Ω AC	GH7 SENSE:	INT Avg Type	ALIGNAUTO : Log-Pwr	01:25:06 PM Jan 15, 2018 TRACE 1 2 3 4 5	Peak Search
	NO: Fast Trig: Free Right Atten: 26 dE	un Avg Hold: 3	> 10/10	DET P N N N N	₩ N
	Gam.Low Philon Lo VI	-	Mkr	2 24 001 GH	Next Peak
Ref Offset 1.5 dB 10 dB/div Ref 16.50 dBm				-45.785 dBm	
0.50 Y					Next Pk Right
-3.50					
-13.5					
-33.5					Next Pk Left
-43.5				<b>2</b>	
-53.5				man	
-63.5 -63.5	men man marken	and a stand of the stand of the stand			Marker Delta
-73.5					
				<u></u>	
Start 30 MHz #Res BW 100 kHz	#VBW 300 kHz		Sween 2	Stop 25.00 GHz 386 s (2001 nts	Mkr.sCE
		EUNICTION EUN			INIKI→CI
1 N 1 f 2.4	40 GHz 4.350 dBm			TONCHON VALUE	
2 N 1 f 24.0	01 GHz -45.785 dBm				Min Defini
4					MKr→RetLvi
6					
8					More
9					1 of 2
MSG			STATUS		

Peak Search	40 PM Jan 15, 2018	LIGN AUTO 01		NSE:INT	SEM		<mark>Swept SA</mark> ງ Ω AC	nalyzer - S F 50	<b>trum /</b>	nt Spe
NextPea	TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P N N N N N	Log-Pwr 10/10	Avg Ty Avg Ho	e Run 6 dB	Trig: Free Atten: 26	GHz PNO: Fast IFGain:Low	25000000	68787	2 24	rker
	.708 dBm						1.5 dB 0 dBm	f Offset ef 16.50	R R	dB/div
Next Pk Rig										
Next Pk L	3									5
Marker De		and a second	and strange strange	a de la constantina d Internet de la constantina de la constant	Neg Antoneo Anto	the descented	and the second	April - Lawel Late		5 5 5
Mkr→	p 25.00 GHz s (2001 pts)	Sweep 2.3			/ 300 kHz	#VE		kHz	MHz V 100	art 30 es B\
Mkr→RefL		CTION WIDTH	JNCTION	Bm Bm	2.529 dE -46.708 dE	477 GHz 688 GHz	× 24.			N N N
<b>Mo</b> 1 o										
	>									

#### (Channel = 39, 30MHz to 25GHz, GFSK Mode)

(Channel = 78, 30MHz to 25GHz, GFSK Mode)







(Channel = 78, Band edge, GFSK Mode)



(Channel = 78, Band edge with hopping on, GFSK Mode)

MORLAB



## 2.7.4.2 $\pi$ /4-DQPSK Mode

#### A. Test Verdict:

	Channel Frequency Measured Max. Out of Emission (dBm	Macourad Max, Out of Pand	Limit	(dBm)	
Channel			Carrier	Calculated	Verdict
	(IVITZ)		Level	-20dBc Limit	
0	2402	-46.40	-1.99	-21.99	PASS
39	2441	-46.78	-0.65	-20.65	PASS
78	2480	-49.06	-0.67	-20.67	PASS

#### B. Test Plots:

Note: the power of the Module transmitting frequency should be ignored.



(Channel = 0, 30MHz to 25GHz,  $\pi/4$ -DQPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China









(Channel = 0, Band edge with hopping on,  $\pi/4$ -DQPSK)

MORLAB

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



Agilent Spectrum Analyzer - Swept SA				
Marker 2 24.675390000000 GHz	SENSE:INT	Avg Type: Log-Pwr	01:12:00 PM Jan 15, 2018 TRACE 1 2 3 4 5 6	Peak Search
PNO: Fas IFGain:Los	t 🕞 Trig: Free Run w Atten: 26 dB	Avg Hold:>10/10	DET P NNNN	
Ref Offset 1.5 dB 10 dB/div Ref 16.50 dBm		М	kr2 24.675 GHz -46.775 dBm	Next Peak
6.50 1 3.50				Next Pk Right
-23.5 				Next Pk Left
-53.5 -63.5		and the state of t		Marker Delta
Start 30 MHz #Res BW 100 kHz #V	/BW 300 kHz		Stop 25.00 GHz 2.386 s (2001 pts)	Mkr→CF
1 N 1 f 2.440 GHz 2 N 1 f 24.675 GHz 3 4 5 6 6	-0.651 dBm -46.775 dBm			Mkr→RefLvl
7 8 9 10 11			~	More 1 of 2
MSG		STATUS	3	

(Channel = 39, 30MHz to 25GHz,  $\pi/4$ -DQPSK)



(Channel = 78, 30MHz to 25GHz,  $\pi/4$ -DQPSK)

MORLAB



Agilent Spectrum Analyzer - Swept SA           02         RF         50.Ω         AC           Marker 2 2.483790000000         GHz           PNO: W         PNO: W	ide 😱 Trig: Free Run	ALIGNAUTO Avg Type: Log-Pwr Avg Hold:>10/10	01:13:49 PM Jan 15, 2018 TRACE 1 2 3 4 5 6 TYPE M	Marker
Ref Offset 1.5 dB	ow Atten: 26 dB	Mkr	2 2.483 79 GHz -59.583 dBm	Select Marker
6.50 -3.50				Normal
-13.5				Delta
-63.5	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	munnana		Fixed⊳
Center 2.483500 GHz #Res BW 100 kHz ;	≠VBW 300 kHz	Sweep 1	Span 10.00 MHz .000 ms (1001 pts)	Off
MMM MUDE         THC SLL         X           1         N         1         f         2.480 07 GH           2         N         1         f         2.483 79 GH           3         4         5         5         6	z 0.211 dBm z -59.583 dBm			Properties►
7 8 9 9 10 11			×	More 1 of 2
MSG		STATUS	3	

(Channel = 78, Band edge,  $\pi/4$ -DQPSK)



(Channel = 78, Band edge with hopping on,  $\pi$ /4-DQPSK)





#### 2.7.4.3 8-DPSK Mode

#### A. Test Verdict:

	Fraguanay	Maggurad Max, Out of Pand	Limi	t (dBm)	
Channel	nel (MHz) Measured Max. Out (MHz) Emission (dBn	Emission (dBm)	Carrier	Calculated	Verdict
	(IVITZ)	Emission (dBm)	Level	-20dBc Limit	
0	2402	-46.44	-0.28	-20.28	PASS
39	2441	-46.64	-1.60	-21.60	PASS
78	2480	-46.24	-2.71	-22.71	PASS

#### B. Test Plots:

Note: the power of the Module transmitting frequency should be ignored.



(Channel = 0, 30MHz to 25GH, 8-DPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China





(Channel = 0, Band edge, 8-DPSK)



(Channel = 0, Band edge with hopping on, 8-DPSK)

MORLAB



Agilent Spectrum Analyzer - Swept SA	or tor thirl		01.05.41.04.2	
Marker 2 24.675390000000 GHz	Thim Free Dum	Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6	Peak Search
PNO: Fast IFGain:Lov	Atten: 26 dB	Avginoid>10/10	DET P NNNN	
Ref Offset 1.5 dB 10 dB/div Ref 16.50 dBm		М	kr2 24.675 GHz -46.635 dBm	Next Peak
6.50 1 3.50				Next Pk Right
-23.5				Next Pk Left
-53 5 -63 5 -73 5	and a second and a second a s	araantin Panta pila araata gada	m	Marker Delta
Start 30 MHz #Res BW 100 kHz #V	/BW 300 kHz	Sweep	Stop 25.00 GHz 2.386 s (2001 pts)	Mkr→CF
I         I         f         2.440 GHz           2         N         1         f         24.675 GHz           3         4         4         5         6	-1.598 dBm -46.635 dBm			Mkr→RefLvl
7 8 9 10 11				More 1 of 2
MSG		STATUS	3	

(Channel = 39, 30MHz to 25GHz, 8-DPSK)



(Channel = 78, 30MHz to 25GH, 8-DPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



Agilent Spectrum Analyzer - Swept SA				
Marker 2 2.483500000000 GHz	SENSE:INT	Avg Type: Log-Pwr	01:01:50 PM Jan 15, 2018 TRACE 1 2 3 4 5 6	Marker
PNO: Wide IFGain:Lov	Atten: 26 dB	Avg Hold:>10/10	DET P N N N N	Select Marker
Ref Offset 1.5 dB 10 dB/div Ref 16.50 dBm		Mkr	2 2.483 50 GHz -61.494 dBm	2
650 1 -3.50				Normal
-23.5 -33.5				Delta
-63.5 	2- Municipal 2-	Munnen marine		Fixed⊳
Center 2.483500 GHz #Res BW 100 kHz #V	BW 300 kHz	Sweep 1	Span 10.00 MHz .000 ms (1001 pts)	Off
MADE         INC.         A         F         2.480 07 GHz         C <thc< th=""> <thc< th=""> <thc< th=""></thc<></thc<></thc<>	0.364 dBm -61.494 dBm			Properties►
7 8 9 10 11			v	More 1 of 2
MSG		STATUS	3	

(Channel = 78, Band edg, 8-DPSK)



(Channel = 78, Band edge with hopping on, 8-DPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China





# 2.8. Restricted Frequency Bands

#### 2.8.1. Requirement

According to FCC section 15.247(d), in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a).

## 2.8.2. Test Description





The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading. During the measurement, the Bluetooth Module of the EUT is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under non hopping-on test mode transmitting 339 bytes DH5, 679 bytes 2DH5 and 1021 bytes 3DH5 packages at maximum power. For the Test Antenna:

Horn Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



**B.** Equipments List:

Please reference ANNEX A(1.5).

#### 2.8.3. Test Procedure

Span = wide enough to fully capture the emission being measured RBW = 1 MHz for  $f \ge 1$ GHz, 100 KHz for f < 1GHz VBW = 3 MHz for peak and 10Hz for average Sweep = auto Detector function = peak Trace = max hold Allow the trace to stabilize.

#### 2.8.4. Test Result

The lowest and highest channels are tested to verify Restricted Frequency Bands.

The measurement results are obtained as below:

 $E [dB\mu V/m] = U_R + A_T + A_{Factor} [dB]; AT = L_{Cable loss} [dB]-G_{preamp} [dB]$ 

AT: Total correction Factor except Antenna

UR: Receiver Reading

Gpreamp: Preamplifier Gain

AFactor: Antenna Factor at 3m

**Note:** Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

#### 2.8.4.1 GFSK Mode

A. Test Verdict:

Channel	Frequency (MHz)	Detector PK/ AV	Receiver Reading U <sub>R</sub> (dBuV)	A <sub>T</sub> (dB)	A <sub>Factor</sub> (dB@3m)	Max. Emission E (dBµV/m)	Limit (dBµV/m)	Verdict
0	2383.29	PK	45.68	-33.63	32.56	44.61	74	Pass
0	2380.81	AV	33.37	-33.63	32.56	32.30	54	Pass
78	2485.30	PK	46.55	-33.18	32.5	45.87	74	Pass
78	2485.57	AV	33.47	-33.18	32.5	32.79	54	Pass



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China

Tel: 86-755-36698555

Fax: 86-755-36698525

Http://www.morlab.cn

E-mail: service@morlab.cn



#### B. Test Plots:

📕 Keysight Spectrum Analyzer - Sw 03:01:01 PM Jan 20, 2018 TRACE 1 2 3 4 5 ( TYPE MWWWW DET P NNNN ALIGN OFF Avg Type: Voltage Avg|Hold:>100/100 D Marker Marker 1 2.383290780142 GHz Trig: Free Run #Atten: 6 dB PNO: Fast IFGain:Low Select Marker Mkr1 2.383 291 GHz 45.682 dBµV Ref 100.00 dBµV 10 dB/div Log **r** Normal **∂**<sup>2</sup> Delta **Fixed** Start 2.30000 GHz #Res BW (CISPR) 1 MHz Stop 2.40400 GHz Sweep 1.100 ms (5500 pts) #VBW 3.0 MHz Off FUNCTION EUI 2.383 291 GHz 2.390 000 GHz 45.682 dBµV 43.960 dBµV **Properties**► More 1 of 2

(Channel = 0, PEAK, GFSK)



(Channel = 0, AVERAGE, GFSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



Keysight Spectrum Analyzer - Swept SA	C	INSEITINT	ALIGN OFF	02:49:42 PM Jan 20, 2018	
Marker 2 2.485304000000	GHz PNO: Fast C Trig: Fre	Avg e Run Avg	Type: Voltage Hold:>100/100	TRACE 1 2 3 4 5 6 TYPE MWWWW DET P N N N N	Marker
10 dB/div Ref 106.99 dBµV	IFGain:Low Atten: 1	U dB	Mkr2	2.485 304 GHz 46.551 dBµV	Select Marker
97.0 87.0					Norma
77.0 67.0 57.0 47.0	2				Delta
37.0					Fixed▷
Start 2.47800 GHz ≉Res BW (CISPR) 1 MHz	#VBW 3.0 MH;	2	Sweep 1	Stop 2.50000 GHz .000 ms (1001 pts)	Of
MKR MODE TRC SCL X 1 N 1 f 2.483 2 N 1 f 2.483 3 4 5 6 6	500 GHz 45.268 dl 304 GHz 46.551 dl	FUNCTION BUV BUV	FUNCTION WIDTH	FUNCTION VALUE	Properties
7 8 9 9 9 10 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1					More 1 of 2

(Channel = 78, PEAK, GFSK)



## (Channel = 78, AVERAGE, GFSK)

**MORLAB** 

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn

Fax: 86-755-36698525 E-mail: service@morlab.cn



### 2.8.4.2 π/4-DQPSK Mode

#### A. Test Verdict:

Channel	Frequency	Detector	Receiver Reading	A <sub>T</sub>	A <sub>Factor</sub>	Max. Emission	Limit	Verdict
	(MHz)	PK/ AV	U <sub>R</sub> (dBuV)	(dB)	(dB@3m)	E (dBµV/m)	(dBµV/m)	Voralet
0	2364.48	PK	43.74	-33.63	32.56	42.67	74	Pass
0	2369.58	AV	32.69	-33.63	32.56	31.62	54	Pass
78	2485.95	PK	44.74	-33.18	32.5	44.06	74	Pass
78	2484.01	AV	32.83	-33.18	32.5	32.15	54	Pass

#### B. Test Plots:



(Channel = 0, PEAK,  $\pi$ /4-DQPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China





	.2018	M Jan 20, 2	01:29:26 P	ALIGN OFF			ENSE:I	SE		ept SA	nalyzer - Swo SEL 50 Ω	trum A	ght Spect	Keysi R L
Marker	3 4 5 6 WWW N N N N	DE 1234 PE MWW ET P N N 1	TRAC TYL DI	: Voltage >100/100	Avg Ty Avg Hol	in	ee Ru 10 dB	Trig: Fre	GHz PNO:Fast ⊂ IFGain:Low	00000	95760	2.36	er 1 2	ark
Select Marke	GHz 3μV	76 G 1 dB	2.369 5	Mkr1						dBµV	106.99	Ref	div	dB/
Norn														
	Λ													 
De														
Fixe			\ <sup>2</sup>											'.0 _ '.0 _
			<b>6</b> 4 0, <b>4</b> 4		~						811-		0.000	
	GHZ pts)	1001 p	Stop 2.4 11.93 s (	Sweep				/ 10 Hz	#VB	Hz	GHZ PR)1M	CISI	2.300 BW (	art les
	E 🔺	ON VALUE	FUNCTI	CTION WIDTH	DN F	FUNC	BuV	Y 32.691 dl	576 GHz	× 2.369		SCL		R MC
Propertie							Βμν	J2.000 UI		2.390				
M														
1 (														

(Channel = 0, AVERAGE,  $\pi/4$ -DQPSK)



(Channel = 78, PEAK,  $\pi/4$ -DQPSK)

**MORLAB** 

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Fax: 86-755-36698525 Http://www.morlab.cn

E-mail: service@morlab.cn



MORL	AB

🚺 Keysight Spectrum Analyzer - Swept SA [X] RL RF 50 Ω DC	SENSE:I	INT ALIGN OFF	02:26:31 PM Jan 20, 2018	Marker
Marker 2 2.484013093290	PNO: Fast Trig: Free Ru IFGain:Low #Atten: 6 dB	in Avg Hold:>100/100		Select Marker
10 dB/div Ref 90.00 dBµV		Mkr2	2.484 013 GHz 32.830 dBµV	2
80.0 70.0				Normal
60.0 50.0				Delte
40.0	↓2			Dena
0.00				Fixed⊵
Start 2.47800 GHz #Res BW (CISPR) 1 MHz	#VBW 10 Hz	Sweep	Stop 2.50000 GHz 2.523 s (5500 pts)	Off
MKR MODE TRC SCL X	Y 500 GHz 32 819 dBuV	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	
2 N 1 f 2.484 3 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	013 GHz 32.830 dBµV			Properties►
				More
			-	1012

(Channel = 78, AVERAGE,  $\pi/4$ -DQPSK)

#### 2.8.4.3 8-DPSK Mode

#### A. Test Verdict:

Channel	Frequency	Detector	Receiver Reading	A <sub>T</sub>	A <sub>Factor</sub>	Max. Emission	Limit	Verdict
Chamler	(MHz)	PK/ AV	UR         (dB)         (dB@3m)           PK/ AV         (dBuV)         (dB@3m)	E (dBµV/m)	(dBµV/m)	, er allot		
0	2363.86	PK	44.51	-33.63	32.56	43.44	74	Pass
0	2370.93	AV	32.72	-33.63	32.56	31.65	54	Pass
78	2484.28	PK	44.80	-33.18	32.5	44.12	74	Pass
78	2483.71	AV	33.50	-33.18	32.5	32.82	54	Pass



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



## B. Test Plots:

🍺 Keysight Spectrum Analyzer - Swept SA 01:26:49 PM Jan 20, 2018 TRACE 1 2 3 4 5 ( TYPE M Avg Type: Voltage Avg|Hold:>100/100 D Trace/Detector Marker 1 2.363856000000 GHz Trig: Free Run Atten: 10 dB PNO: Fast 😱 IFGain:Low Select Trace Mkr1 2.363 856 GHz 44.514 dBµV 10 dB/div Ref 106.99 dBµV **Clear Write** Trace Average **∆**<sup>2</sup> ▲1 Max Hold Start 2.30000 GHz #Res BW (CISPR) 1 MHz Stop 2.40400 GHz Sweep 1.000 ms (1001 pts) #VBW 3.0 MHz **Min Hold** 2.363 856 GHz 2.390 000 GHz 44.514 dBµV 43.780 dBµV N 1 f View Blank Trace On More 1 of 3

(Channel = 0, PEAK, 8-DPSK)



(Channel = 0, AVERAGE, 8-DPSK)

MORLAB

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



Marker	1 Jan 20, 2018 E <mark>1 2 3 4 5 6</mark> E M WWWWW	02:42:55 PI TRAC TYP	ALIGN OFF Type: Voltage Hold:>100/100	T Avg	SENSE:II	HZ PNO: Fast	Ept SA DC D0000 GI P	Analyzer - Sw RESEL 50 Ω 842800	vsight Spectru L RF I ker 2 2.
Select Marker	80 GHz 1 dBµV	2.484 2 44.80	Mkr2		Atten: 10 dB	Gain:Low	dBµV	ef 106.99	B/div
Norma									
Delta						2	1 <b>▲</b>		
Fixed	**************************************		at we all a second s	Next-the hose	and an and a second	n na sain an air	And the second second		
o	0000 GHz 1001 pts)	Stop 2.50 .000 ms (	Sweep 1		3.0 MHz	#VB	Hz	) GHz SPR) 1 M	t 2.4780 s BW (C
Properties	E E	FUNCTIO	FUNCTION WIDTH	FUNCTION	Υ 43.544 dBμV 44.801 dBμV	00 GHz 30 GHz	× 2.483 50 2.484 28		MODE TRC 5

(Channel = 78, PEAK, 8-DPSK)



## (Channel = 78, AVERAGE, 8-DPSK)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



# 2.9. Conducted Emission

## 2.9.1. Requirement

According to RSS-GEN section 8.8, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a  $50\mu$ H/50 $\Omega$  line impedance stabilization network (LISN).

Frequency ra	ange	Conducted Limit (dBµV)		
(MHz)		Quai-peak	Average	
0.15 - 0.50		66 to 56	56 to 46	
0.50 - 5		56	46	
5- 30		60	50	

NOTE:

(a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

## 2.9.2. Test Description

#### A. Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.

The factors of the site are calibrated to correct the reading. During the measurement, the Bluetooth



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



EUT is activated and controlled by the Bluetooth Service Supplier (SS) via a Common Antenna, and is set to operate under hopping-on test mode transmitting 339 bytes DH5 packages at maximum power.

#### B. Equipments List:

Please reference ANNEX A(1.5).

#### 2.9.3. Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

#### A. Test setup:

The EUT configuration of the emission tests is  $\underline{\text{EUT} + \text{Link.}}$ **Note:** The test voltage is AC 120V/60Hz.





#### B. Test Plots:



(Plot A: L Phase)

NO. Fre.		Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
	(MHz)	Quai-peak	Average	Quai-peak	Average		
1	0.22	32.96	27.15	62.63	52.63		PASS
2	0.51	27.89	22.16	56.00	46.00		PASS
3	0.87	24.62	18.63	56.00	46.00	Lino	PASS
4	6.52	16.58	10.54	60.00	50.00	LITE	PASS
5	13.44	17.25	10.84	60.00	50.00		PASS
6	22.52	20.22	13.66	60.00	50.00		PASS







(Plot B: N Phase)

NO. Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict	
	Quai-peak	Average	Quai-peak	Average			
1	0.20	33.81	27.89	63.43	53.43		PASS
2	0.51	26.79	20.77	56.00	46.00		PASS
3	0.80	24.01	17.97	56.00	46.00	Noutrol	PASS
4	4.07	21.97	16.02	56.00	46.00	neutrai	PASS
5	8.69	15.49	9.39	60.00	50.00		PASS
6	22.50	19.31	12.58	60.00	50.00		PASS



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



# 2.10. Radiated Emission

### 2.10.1. Requirement

According to FCC section 15.247(d), radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

Note:

- 1. For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
- For above 1000MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK)

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table)





## 2.10.2. Test Description

#### A. Test Setup:

1) For radiated emissions from 9kHz to 30MHz



2) For radiated emissions from 30MHz to1GHz





SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



3) For radiated emissions above 1GHz



The RF absorbing material used on the reference ground plane and on the turntable have a maximum height (thickness) of 30 cm (12 in) and have a minimum-rated attenuation of 20 dB at all frequencies from 1 GHz to 18 GHz.

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSI C63.10 (2013). For radiated emissions below or equal to 1GHz, the EUT was set-up on insulator 80cm above the Ground Plane, For radiated emissions above 1GHz, The EUT was set-up on insulator 150cm above the Ground Plane. The set-up and test methods were according to ANSI C63.10.

The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

For the Test Antenna:

(a) In the frequency range of 9kHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.

(b) In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Place the test antenna at 3m away from area of the EUT, while keeping the test antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The test antenna may have to be



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China



higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final test antenna elevation shall be that which maximizes the emissions. The test antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. The emission levels at both horizontal and vertical polarizations should be tested.

## B. Equipments List:

Please refer ANNEX A(1.5).

## 2.10.3. Test Procedure

Use the following spectrum analyzer settings: Span = wide enough to fully capture the emission being measured RBW = 1 MHz for  $f \ge 1$  GHz, 100 kHz for f < 1 GHz VBW  $\ge$  RBW Sweep = auto Detector function = peak Trace = max hold

## 2.10.4. Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak limit, it is unnecessary to perform an quasi-peak measurement.

The measurement results are obtained as below:

 $\begin{array}{l} \mathsf{E} \; [\mathsf{dB} \mu \mathsf{V}/\mathsf{m}] = \mathsf{U}_\mathsf{R} + \mathsf{A}_\mathsf{T} + \mathsf{A}_\mathsf{Factor} \; [\mathsf{dB}]; \; \mathsf{A}_\mathsf{T} = \mathsf{L}_\mathsf{Cable \; loss} \; [\mathsf{dB}] \text{-} \mathsf{G}_\mathsf{preamp} \; [\mathsf{dB}] \\ \mathsf{A}_\mathsf{T} \text{: Total correction Factor except Antenna} \\ \mathsf{U}_\mathsf{R} \text{: Receiver Reading} \\ \mathsf{G}_\mathsf{preamp} \text{: Preamplifier Gain} \\ \mathsf{A}_\mathsf{Factor} \text{: Antenna Factor at 3m} \end{array}$ 

During the test, the total correction Factor AT and  $A_{Factor}$  were built in test software.

**Note:** All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

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





### 2.10.4.1 GFSK Mode:

Plots for Channel = 0



(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 0)



(30MHz to 25GHz, Antenna Vertical, GFSK, channel 0)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn Fax: 86-755-36698525 E-mail: service@morlab.cn





#### Plot for Channel = 39



(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 39)



(30MHz to 25GHz, Antenna Vertical, GFSK, channel 39)

**MORLAB** 

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn E-mail: service@morlab.cn

Fax: 86-755-36698525



Plot for Channel = 78



(30MHz to 25GHz, Antenna Horizontal, GFSK, channel 78)



(30MHz to 25GHz, Antenna Vertical, GFSK, channel 78)

MORLAB

SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China

Tel: 86-755-36698555 Http://www.morlab.cn Fax: 86-755-36698525 E-mail: service@morlab.cn



#### 2.10.4.2 π/4-DQPSK Mode:

#### Plots for Channel = 0



(30MHz to 25GHz, Antenna Horizontal @  $\pi$ /4-DQPSK, channel 0)



(30MHz to 25GHz, Antenna Vertical @ π/4-DQPSK, channel 0)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn Fax: 86-755-36698525 E-mail: service@morlab.cn

Page 67 04



#### Plot for Channel = 39



(30MHz to 25GHz, Antenna Horizontal @  $\pi$ /4-DQPSK, channel 39)



(30MHz to 25GHz, Antenna Vertical @ π/4-DQPSK, channel 39)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn Fax: 86-755-36698525

E-mail: service@morlab.cn



#### Plot for Channel = 78



(30MHz to 25GHz, Antenna Horizontal @  $\pi$ /4-DQPSK, channel 78)



(30MHz to 25GHz, Antenna Vertical @ π/4-DQPSK, channel 78)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn

Fax: 86-755-36698525

E-mail: service@morlab.cn



#### 2.10.4.3 8-DPSK Mode:

#### Plots for Channel = 0



(30MHz to 25GHz, Antenna Horizontal @8-DPSK, channel 0)



(30MHz to 25GHz, Antenna Vertical @8-DPSK, channel 0)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn Fax: 86-755-36698525 E-mail: service@morlab.cn



#### Plot for Channel = 39



(30MHz to 25GHz, Antenna Vertical @8-DPSK, channel 39)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 Http://www.morlab.cn Fax: 86-755-36698525 E-mail: service@morlab.cn



#### Plot for Channel = 78



(30MHz to 25GHz, Antenna Horizontal @8-DPSK, channel 78)



(30MHz to 25GHz, Antenna Vertical @8-DPSK, channel 78)



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China Tel: 86-755-36698555 E-mail: service@morlab.cn Http://www.morlab.cn

Fax: 86-755-36698525


# **Annex A Test Uncertainty**

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

Test items	Uncertainty
Number of Hopping Frequency	±5%
Peak Output Power	±2.22dB
20dB Bandwidth	±5%
Carrier Frequency Separation	±5%
Time of Occupancy (Dwell time)	±5%
Conducted Spurious Emission	±2.77 dB
Restricted Frequency Bands	±5%
Radiated Emission	±2.95dB
Conducted Emission	±2.44dB

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





# **Annex B Testing Laboratory Information**

### 1. Identification of the Responsible Testing Laboratory

Company Name:	Shenzhen Morlab Communications Technology Co., Ltd.				
Department:	Morlab Laboratory				
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang				
	Road, Block 67, BaoAn District, ShenZhen, GuangDong				
	Province, P. R. China				
Responsible Test Lab	Mr. Su Feng				
Manager:					
Telephone:	+86 755 36698555				
Facsimile:	+86 755 36698525				

#### 2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.
	Morlab Laboratory
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang
	Road, Block 67, BaoAn District, ShenZhen, GuangDong
	Province, P. R. China

#### 3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013 and CISPR Publication 22; the FCC designation number is CN1192.





## REPORT No. : SZ17120057W02

## 4. Test Equipments Utilized

# 4.1 Conducted Test Equipments

Equipment Name	Serial No.	Туре	Manufacturer	Cal. Date	Cal. Due
Bluetooth Base Station	6K00006210	MT8852B	Anritsu	2017.05.24	2018.05.23
Power Splitter	NW521	1506A	Weinschel	2017.05.24	2018.05.23
Attenuator 1	(N/A.)	10dB	Resnet	2017.05.24	2018.05.23
Attenuator 2	(N/A.)	3dB	Resnet	2017.05.24	2018.05.23
EXA Signal Analzyer	MY53470836	N9010A	Agilent	2017.12.03	2018.12.02
RF cable (30MHz-26GHz)	CB01	RF01	Morlab	N/A	N/A
Coaxial cable	CB02	RF02	Morlab	N/A	N/A
SMA connector	CN01	RF03	HUBER-SUHNER	N/A	N/A

### 4.2 Conducted Emission Test Equipments

Equipment Name	Serial No.	Туре	Manufacturer	Cal. Date	Cal. Due
Receiver	MY56400093	N9038A	KEYSIGHT	2017.07.13	2018.07.12
LISN	812744	NSLK 8127	Schwarzbeck	2017.05.17	2018.05.16
Pulse Limiter	9391	VTSD	Schwarzbeck	2017.05.17	2018.05.16
(20dB)		9561-D			
Coaxial cable(BNC)	CB01	EMC01	Morlab	N/A	N/A
(30MHz-26GHz)					

## **4.3Auxiliary Test Equipment**

Equipment Name	Model No.	Brand Name	Manufacturer	Cal.Date	Cal. Due
Computer	T430i	Think Pad	Lenovo	N/A	N/A





## 4.4 Radiated Test Equipments

Equipment Name	Serial No.	Туре	Manufacturer	Cal. Date	Cal. Due
Receiver	MY54130016	N9038A	Agilent	2017.05.17	2018.05.16
Test Antenna - Bi-Log	9163-519	VULB 9163	Schwarzbeck	2017.05.14	2018.05.13
Test Antenna - Horn	9170C-531	BBHA9170	Schwarzbeck	2017.09.13	2018.09.12
Test Antenna - Loop	1519-022	FMZB1519	Schwarzbeck	2017.03.07	2018.03.06
Test Antenna - Horn	01774	BBHA 9120D	Schwarzbeck	2017.09.13	2018.09.12
Coaxial cable (N male) (9KHz-30MHz)	CB04	EMC04	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB02	EMC02	Morlab	N/A	N/A
Coaxial cable (N male) (30MHz-26GHz)	CB03	EMC03	Morlab	N/A	N/A
1-18GHz pre-Amplifier	MA02	TS-PR18	Rohde& Schwarz	2017.05.17	2018.05.16
18-26.5GHz pre-Amplifier	MA03	TS-PR18	Rohde& Schwarz	2017.05.17	2018.05.16
Anechoic Chamber	N/A	9m*6m*6m	CRT	2017.11.19	2020.11.18

\_\_\_\_\_ END OF REPORT

\_



SHENZHEN MORLAB COMMUNICATIONS TECHNOLOGY Co., Ltd. FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China

 Tel: 86-755-36698555
 Fax: 86-755-36698525

 Http://www.morlab.cn
 E-mail: service@morlab.cn