Report Number: 68.950.18.0283.01



FCC - TEST REPORT

Report Number	68.950.18.0283.01 Date of Issue: August 16, 2018
Model	M87FX
Product Type	Tommy Jeans / Hilfiger wireless speaker
Applicant	BRAND ADDITION LTD
Address	Trafford Wharf Road, Manchester, M17 1DD
Production Facility	Shenzhen Jonter Digital Co.,Ltd
Address	Building 4, Jinfo Industrial Park, Hezhou Village, Xixiang
	Town, Bao'an District, Shenzhen 51800, China.
Test Result	■ Positive □ Negative
Total pages including Appendices	56

TÜV SÜD CERTIFICATION AND TESTING (CHINA) CO., LTD. SHENZHEN BRANCH is a subcontractor to TÜV SÜD Product Service GmbH according to the principles outlined in ISO 17025. TÜV SÜD CERTIFICATION AND TESTING (CHINA) CO., LTD. SHENZHEN BRANCH reports apply only to the specific samples tested under stated test conditions. Construction of the actual test samples has been documented. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. The manufacturer'importer is responsible to the Competent Authorities in Europe for any modifications made to the production units which result in non-compliance to the relevant regulations TÜV SÜD CERTIFICATION AND TESTING (CHINA) CO., LTD. SHENZHEN BRANCH shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD CERTIFICATION AND TESTING (CHINA) CO., LTD. SHENZHEN BRANCH issued reports. This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval.



1 Table of Contents

1	Tab	ble of Contents	2
2	Det	tails about the Test Laboratory	3
3	Des	scription of the Equipment Under Test	4
4	Sun	mmary of Test Standards	5
5	Sun	mmary of Test Results	6
6	Ger	neral Remarks	7
7	Tes	st Setups	8
8	Sys	stems test configuration	9
9	Tec	chnical Requirement	10
ç	9.1	Conducted peak output power	13
ç).2	20 dB bandwidth	20
ę	9.3	Carrier Frequency Separation	27
ç	9.4	Number of hopping frequencies	30
ç	9.5	Dwell Time	32
ç	9.6	Spurious RF conducted emissions	35
ç	9.7	Band edge testing	46
ç	9.8	Spurious radiated emissions for transmitter	51
10	Tes	st Equipment List	55
11	Sys	stem Measurement Uncertainty	56



2 Details about the Test Laboratory

Details about the Test Laboratory

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District Shenzhen 518052 P.R. China
Telephone: Fax:	86 755 8828 6998 86 755 828 5299
FCC Registration	514049
IC Registration No:	10320A-1



3 Description of the Equipment Under Test

Product:	Tommy Jeans / Hilfiger wireless speaker
Model no.:	M87FX
FCC ID:	2ALSK-M87FX
Options and accessories:	USB Cable, AUX IN Cable
Rating:	DC3.7V, 610mAh (Supplied by Li-ion rechargeable battery) DC5.0V, 1.0A (Charged by the mini-USB port)
RF Transmission	2402MHz-2480MHz
Frequency: No. of Operated Channel:	79
Modulation:	GFSK, π/4-DQPSK, 8-DPSK
Antenna Type:	Integrated antenna
Antenna Gain:	0dBi
Description of the EUT:	The EUT is a music box with Bluetooth3.0 function.



4 Summary of Test Standards

Test Standards			
FCC Part 15 Subpart C	PART 15 - RADIO FREQUENCY DEVICES		
10-1-2017 Edition	Subpart C - Intentional Radiators		

All the test methods were according to Public Notice DA 00-705 -Frequency Hopper Spread Spectrum Test Procedure released by FCC on March 30, 2000 and ANSI C63.10-2013.



5 Summary of Test Results

Technical Requirements					
FCC Part 15 Subpart C	;				
Test Condition		Pages	Test Result		
§15.207	Conducted emission AC power port	10	Pass		
§15.247(b)(1)	Conducted peak output power	13	Pass		
§15.247(e)	Power spectral density*		N/A		
§15.247(a)(2)	6dB bandwidth		N/A		
§15.247(a)(1)	20dB bandwidth and 99% Occupied Bandwidth	20	Pass		
§15.247(a)(1)	Min. of Hopping Channel Carrier Frequency Separation	27	Pass		
§15.247(a)(1)(iii)	Min number of hopping frequencies	30	Pass		
§15.247(a)(1)(iii)	Dwell Time - Average Time of Occupancy	32	Pass		
§15.247(d)	Spurious RF conducted emissions	32	Pass		
§15.247(d)	Band edge	39	Pass		
§15.247(d) & §15.209 &15.205	Spurious radiated emissions for transmitter and receiver	42	Pass		
§15.203	Antenna requirement	See note 2	Pass		

Note 1: N/A=Not Applicable.

Note 2: The EUT uses an Integrated antenna, which gain is 0dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.



6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2ALSK-M87FX, complies with Section 15.207, 15.205, 15.209, 15.247 of the FCC Part 15, Subpart C rules.

M87FX is a Bluetooth music box. The TX and RX range is 2402MHz-2480MHz for BDR+EDR.

SUMMARY:

All tests according to the regulations cited on page 5 were

- Performed
- □ Not Performed
- The Equipment Under Test
- - Fulfills the general approval requirements.
- □ **Does not** fulfill the general approval requirements.

Sample Received Date: July 28, 2018

Testing Start Date: August 1, 2018

Testing End Date:

Reviewed by:

Prepared by:

SUD

August 14, 2018

Johnshi

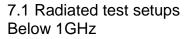
John Zhi EMC Section Manage.

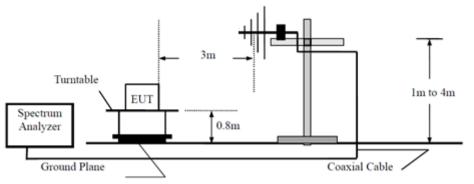
Moon Xiong EMC Project Engineer

Tested by:

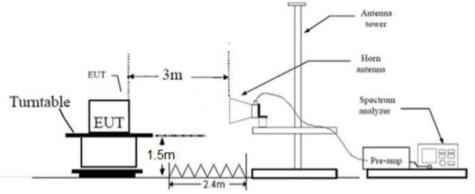
Louise Liu EMC Test Engineer

7 Test Setups

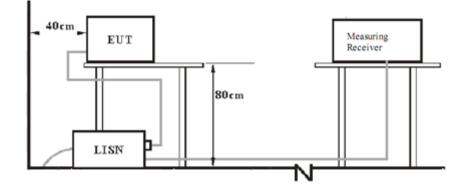




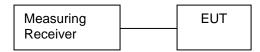
Above 1GHz



7.2 AC Power Line Conducted Emission test setups



7.3 Conducted RF test setups



EMC_SZ_FR_23.01 FCC Release 2017-06-20





8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Notebook	Lenovo	X220	

Test software: BK test tool, which used to control the EUT in continues transmitting mode

The system was configured to hopping mode and non-hopping mode.

Hopping mode: typical working mode (normal hopping status)

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power



9 Technical Requirement

9.1 Conducted emission AC power port

Test Method

- 1. The EUT was placed on a table, which is 0.8m above ground plane
- 2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
- 3. Maximum procedure was performed to ensure EUT compliance
- 4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

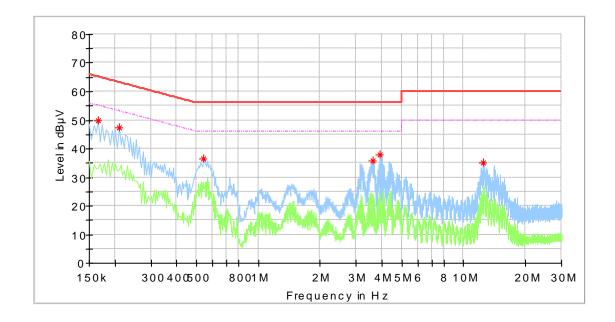
According to §15.107, conducted emissions limit as below:

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

*Decreasing linearly with logarithm of the frequency

Report Number: 68.950.18.0283.01

Model: Test mode: Test Voltage: Test By: Remark: M87FX Normal working, BT link 120V/60Hz Adam

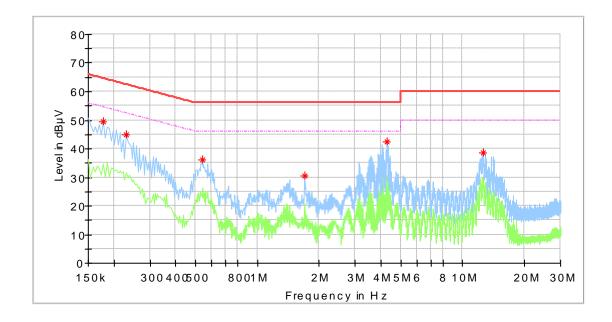


Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.166000	49.94		65.16	15.21	L1	OFF	10.2
0.210000	47.39		63.21	15.82	L1	OFF	10.2
0.542000	36.59		56.00	19.41	L1	OFF	10.2
3.622000	35.84	-	56.00	20.16	L1	OFF	10.3
3.898000	37.82		56.00	18.18	L1	OFF	10.3
12.530000	35.03		60.00	24.97	L1	OFF	10.6

Report Number: 68.950.18.0283.01

Model: Test mode: Test Voltage: Test By: Remark: M87FX Normal working, BT link 120V/60Hz Adam



Critical_Freqs

Frequency	MaxPeak	Average	Limit	Margin	Line	Filter	Corr.
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)			(dB)
0.178000	49.35		64.58	15.23	Ν	OFF	10.3
0.230000	44.85		62.45	17.60	Ν	OFF	10.3
0.542000	36.03		56.00	19.97	Ν	OFF	10.4
1.694000	30.55		56.00	25.45	Ν	OFF	10.4
4.286000	42.58		56.00	13.42	Ν	OFF	10.5
12.574000	38.76		60.00	21.24	Ν	OFF	11.0

9.2 Conducted peak output power

Test Method

- Use the following spectrum analyzer settings: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
- 2. Add a correction factor to the display.
- 3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power

Limits

Frequency Range	Limit	Limit
MHz	W	dBm
2400-2483.5	≤1	≤30





Conducted peak output power

Bluetooth Mode GFSK modulation Test Result					
	Conducted Peak				
Frequency	Output Power	Result			
MHz	dBm				
Low channel 2402MHz	-3.55	Pass			
Middle channel 2441MHz	-4.14	Pass			
High channel 2480MHz	-4.65	Pass			

	L			_
Spectrum				
Ref Level 30.00 dB Att 40 c Count 100/100		 RBW 3 MHz VBW 10 MHz 	Mode Auto Sweep	X
1Pk View				
			M1[1]	-3.55 dBn 2.4018840 GH
20 dBm				
10 dBm				
0 dBm		M1		
-10 dBm				
-20 dBm				
-30 dBm				
.40 dBm				
-50 dBm				
-60 dBm				
CF 2.402 GHz		691 pts	5	Span 8.0 MHz
			Measuring	08.08.2018

Low channel 2402MHz

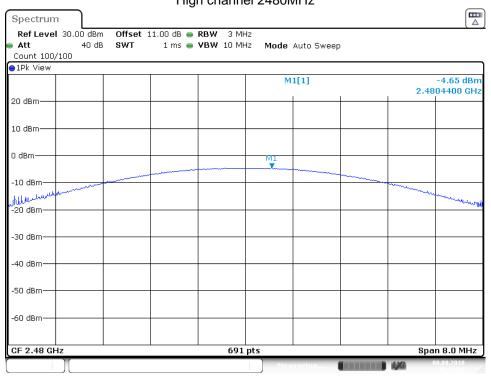
Date:8.AUG.2018 16:08:30



Ref Level 30.00 dB			RBW 3 MHz				
Att 40 c Count 100/100	db SWT	1 ms 👄	VBW 10 MHz	Mode Auto Sw	еер		
1Pk View							
JIFK VIEW		1		M1[1]			-4.14 dBr
				wiftl			19650 GH
20 dBm		_				+	
10 dBm							
0 dBm	_		ML				
			¥				
-10 dBm							
-10 dBm						- marine	mande
-20 dBm							u
20 0.0.11							
-30 dBm							
oo abiii							
-40 dBm							
-to abili							
-50 dBm							
SO GBII							
-60 dBm							
-00 ubm							
CF 2.441 GHz			691 pt	5		Spar	n 8.0 MHz

Middle channel 2441MHz

Date: 8 AUG 2018 16:10:47



High channel 2480MHz

Date: 8 AUG 2018 16:12:04

-



Bluetooth Mode π/4-DQPSK modulation Test Result Conducted Peak

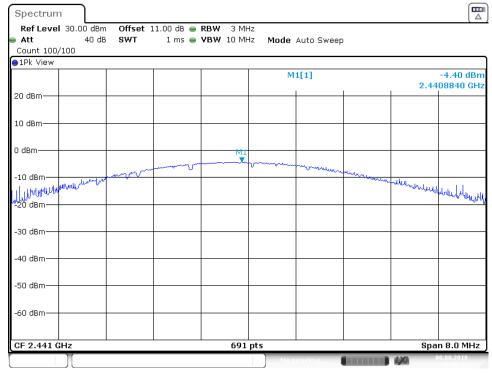
Frequency	Output Power	Result
MHz	dBm	
Low channel 2402MHz	-3.82	Pass
Middle channel 2441MHz	-4.40	Pass
High channel 2480MHz	-4.90	Pass

			Lov	v channe	el 2402N	/Hz			
Spectrum	ı)								
	30.00 dBm		11.00 dB 👄		-				
Att Count 100/	40 dE /100	SWT	1 ms 👄	VBW 10 MH	z Mode	Auto Sweep)		
●1Pk View									
					М	1[1]			-3.82 dBm
20 dBm-								2.40	16180 GHz
10 dBm									
0 dBm				M1					
10 40		mon	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	J		monina	min		
-10 dBm	MMMM						mont	methodally	Markad L. 1
-20 dBm								, in the second	- which we
-30 dBm									
-40 dBm									
-50 dBm									
SS abri									
-60 dBm									
CF 2.402 G	Hz	I	I	691	pts		I	 Spa	n 8.0 MHz
][Mela	suring		1/0)8.08.2018 16:16:14

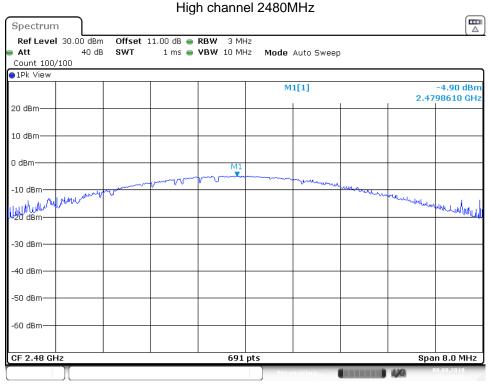
Date:8AUG 2018 16:16:14



Middle channel 2441MHz



Date:8AUG 2018 16:18:24



Date:8AUG 2018 16:19:41



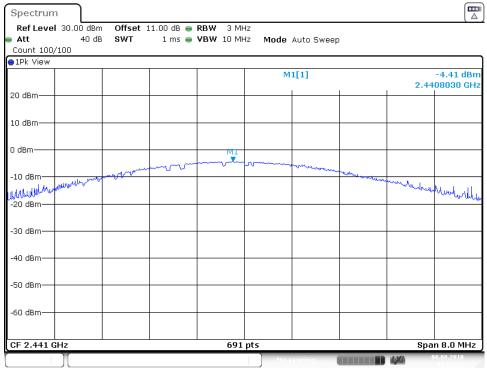
Bluetooth Mode 8D	PSK modulation Test	Result
	Conducted Peak	
Frequency	Output Power	Result

Frequency MHz	Output Power dBm	Result
Low channel 2402MHz	-3.73	Pass
Middle channel 2441MHz	-4.41	Pass
High channel 2480MHz	-4.90	Pass

Spectrum
RefLevel 30.00 dBm Offset 11.00 dB
1Pk View
M1[1] -3.73 di 2.4018150 G
20 dBm
10 dBm
3 dBm
10 dBm
10 dBm
30 dBm
40 dBm
50 dBm
60 dBm
CF 2.402 GHz 691 pts Span 8.0 MH

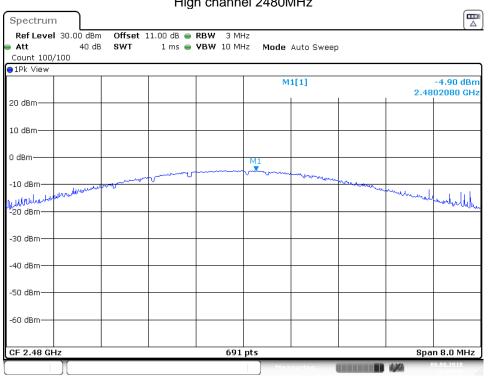
Date:8AUG 2018 16:21:27





Middle channel 2441MHz

Date: 8 AUG 2018 16:23:32



High channel 2480MHz

Date: 8 AUG 2018 16:24:48



9.3 20 dB bandwidth and 99% Occupied Bandwidth

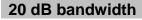
Test Method

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- 3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
- 4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit [kHz]

N/A



Bluetooth Mode GFSK Modulation test result

Frequency	20 dB Bandwidth	Limit	Result
MHz	kHz	kHz	
2402	1200		Pass
2441	1206		Pass
2480	1215		Pass

Low channel 2402MHz

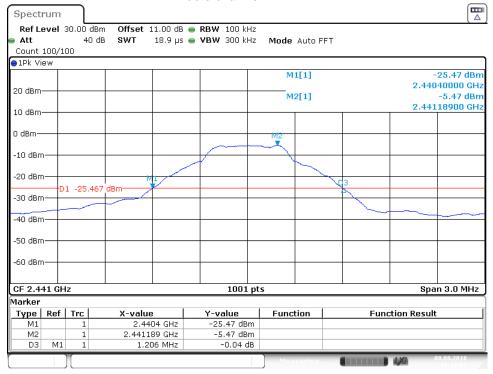
Spectrum						
Ref Level Att Count 100/	40		● RBW 100 kHz ● VBW 300 kHz		D FFT	\
●1Pk View						
20 dBm				M1[1]		-25.03 dBn 2.40140300 GH: -4.92 dBn
10 dBm						2.40218600 GH
0 dBm				<u>M2</u>		
-10 dBm				~		
-20 dBm	01 -24.9	922 dBm				
-30 dBm						
-40 dBm						
-50 dBm						
-60 dBm						
CF 2.402 G	Hz		1001 p	ts		Span 3.0 MHz
Marker						
Type Ref	Trc	X-value	Y-value	Function	Fu	nction Result
M1	1	2.401403 GHz	-25.03 dBm			
M2	1	2.402186 GHz	-4.92 dBm			
D3 M:	l 1	1.2 MHz	0.02 dB			
				Measurin		08.08.2018

Date:8AUG 2018 16:08:50



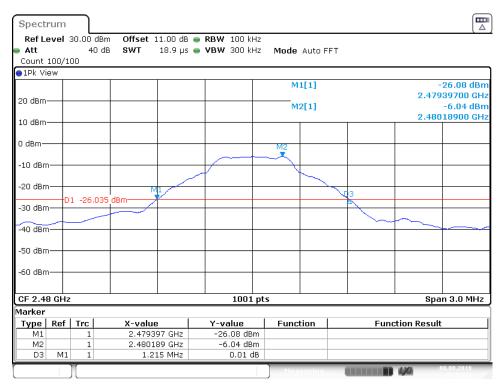


Middle channel 2441MHz



Date: 8 AUG 2018 16:11:08

High channel 2480MHz



Date:8AUG 2018 16:12:24



20 dB bandwidth

Bluetooth Mode π /4-DQPSK Modulation test result

20 dB Bandwidth	Limit	Result	
kHz	kHz		-
1368		Pass	-
1365		Pass	
1362		Pass	
	kHz 1368 1365	kHz kHz 1368 1365	kHz kHz 1368 Pass 1365 Pass

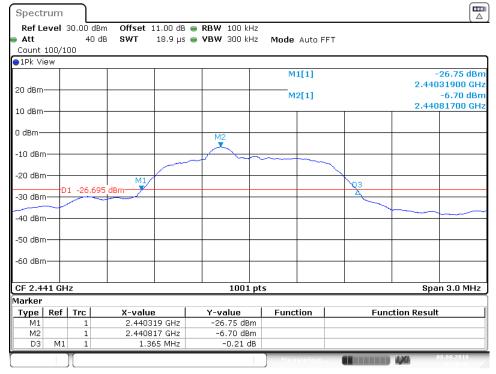
Spectru	Jm												
Ref Le	vel	30.00 d	Bm Offset	11.00 dB	■ RBW 100	kHz							(
🛛 Att		40	dB SWT	18.9 µs	👄 VBW 300	kHz	Mode	Auto F	FT				
Count 1	<u> </u>	00											
⊖1Pk Vie	w												
							M	1[1]					26.20 dBm
20 dBm—													31900 GHz
							M	2[1]					-6.12 dBm 31700 GHz
10 dBm—						+						2.4010	51700 GH2
0 dBm—					M2	+							
-10 dBm-													
10 0.0111					-1	\uparrow			\sim				
-20 dBm-			M1.	/							_		
	—D	1 -26.1	.24 dBm 🚽	, 		_				23			
-30 dBm-						+				$\overline{}$			
-40 dBm-										_			
-40 ubiii-													
-50 dBm-				_		—					_		
-60 dBm-						+							
CF 2.40	2 GH	z			100)1 pts	s		·			Spar	1 3.0 MHz
Marker													
	Ref	Trc	X-valı		Y-value		Func	tion		Fu	nction	Result	
M1		1		319 GHz	-26.20 c								
M2 D3	M1	1		817 GHz 368 MHz	-6.12 c -0.02								
J3	MI		1.,	SOS MHZ	-0.02	uB	<u> </u>						
		Л					Mea				1/4	0	16:16:34

Low channel 2402MHz

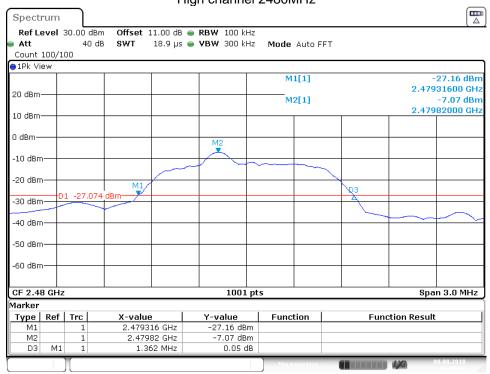
Date:8AUG 2018 16:16:34



Middle channel 2441MHz

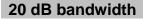


Date: 8 AUG 2018 16:18:44



High channel 2480MHz

Date: 8 AUG 2018 16:20:01



Bluetooth Mode 8DPSK Modulation test result

Frequency	20 dB Bandwidth	Limit	Result
MHz	kHz	kHz	
2402	1374		Pass
2441	1410		Pass
2480	1359		Pass

Spectr	um										
Ref Le Att Count 1		40	dBm Offset :)dB SWT		● RBW 100 kH ● VBW 300 kH		1ode Auto I	FFT			× *
😑 1Pk Vie	ЭW										
20 dBm-							M1[1]			2.4	-26.36 dBm 0131300 GHz
10 dBm-							M2[1]			2.4	-6.07 dBm 0181700 GHz
10 ubiii-											
0 dBm—					M2						
-10 dBm					\rightarrow	~					
-20 dBm			M1/						` 123		
-30 dBm		1 -26.	069 dBm						A		
-40 dBm	_										<u> </u>
-50 dBm											
-60 dBm											
CF 2.40	12 CH	17			1001	nts				9	pan 3.0 MHz
Marker					1301	PC3					pan 0.0 milz
	Ref	Trc	X-value	. 1	Y-value	1	Function	1	Euro	ction Res	ult I
M1	Kel	1	2,4013		-26.36 dBr		runction		Full	ICCIOIL KES	unc
M2		1	2.4018		-6.07 dBr						
D3	M1	1		74 MHz	-0.05 d						
][Measuring			1,70	08.08.2018

Low channel 2402MHz

Date: 8 AUG 2018 16:21:48

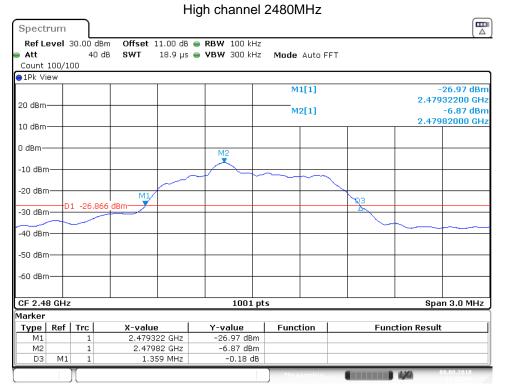




Middle channel 2441MHz

Spect	rum)									
Ref L Att	evel		dBm Offset 0 dB SWT		 RBW 100 k VBW 300 k 		Mode Aut	- EET			
Count	100/1		o do om i	10.9 ps	• • • • • • • • • • • • • • • • • • •		Mode Aut	UFFI			
😑 1Pk Vi	ew										
							M1[1]				-26.86 dBm 030700 GHz
20 dBm						+	M2[1]			2.44	-6.74 dBm
10 dBm	_								1	2.44	081400 GHz
0 dBm-				_	M2						
-10 dBn	n					-					
-20 dBn	n		M1/					<u> </u>			
	D	1 -26	.735 dBm						23		
-30 dBn											
-40 dBn	n					-					
-50 dBn	n										
-60 dBn	n										
CF 2.4	41 G⊢	z			100	1 pts				Spa	an 3.0 MHz
Marker											
Туре	Ref	Trc	X-valu		Y-value		Function	_	Fun	ction Resul	<u>t</u>
M1 M2		1		307 GHz 814 GHz	-26.86 dl -6.74 dl			_			
D3	M1	1		.41 MHz	0.03						
							Measurin	10		1,00	08.08.2018

Date:8AUG 2018 16:23:52



Date:8AUG 2018 16:25:09

9.4 Carrier Frequency Separation

Test Method

- Use the following spectrum analyzer settings: Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
- 2. By using the Max-Hold function record the separation of two adjacent channels.
- 3. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function.
- 4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit kHz ≥25KHz or 2/3 of the 20 dB bandwidth which is greater

GFSK Modulation Limit

Frequency MHz	2/3 of 20 dB Bandwidth kHz
2402	631
2441	633.9
2480	633.9





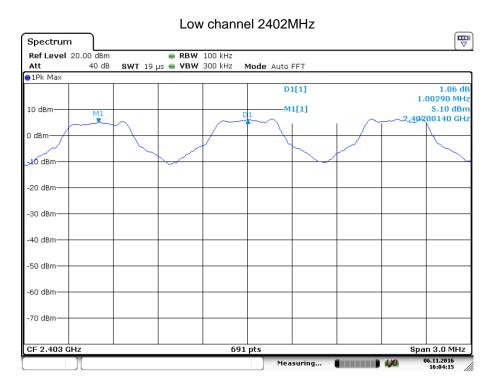
Carrier Frequency Separation

Test result: The measurement was performed with the typical configuration (normal hopping status), here GFSK modulation mode was used to show compliance.

GFSK Modulation test result

_

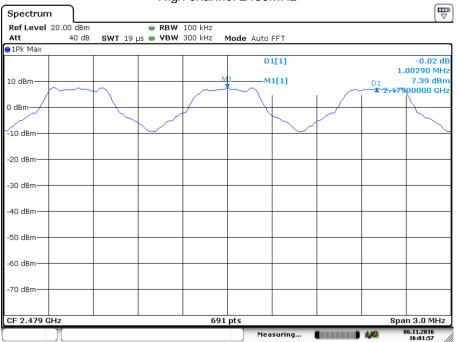
Frequency MHz	Carrier Frequency Separation kHz	Result
2402	1002.9	Pass
2441	1002.9	Pass
2480	1002.9	Pass





Middle channel 2441MHz **-**Spectrum Ref Level 20.00 dBm Att 40 dB ● RBW 100 kHz SWT 19 µs ● VBW 300 kHz Mode Auto FFT ●1Pk Max 0.00 dB D1[1] 1.00290 MHz 7.19 dBm 2.44000140 GHz 10 dBm M1[1] M1 T 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm CF 2.441 GHz 691 pts Span 3.0 MHz Measuring... 06.11.2016 16:05:05





EMC_SZ_FR_23.01 FCC Release 2017-06-20



9.5 Number of hopping frequencies

Test Method

- Use the following spectrum analyzer settings: Span = wide enough to capture the peaks of two adjacent channels, RBW ≥ 1% of the span, VBW) ≥RBW, Sweep = auto, Detector function = peak
- 2. Set the spectrum analyzer on Max-Hold Mode, and then keep the EUT in hopping mode.
- 3. Record all the signals from each channel until each one has been recorded.
- 4. Repeat above procedures until all frequencies measured were complete.

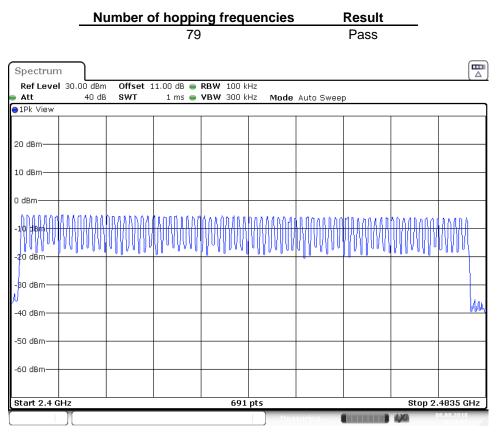
Limit

Limit <u>number</u> ≥ 15



Number of hopping frequencies

Test result: The measurement was performed with the typical configuration (normal hopping status), and the total hopping channels is constant for the all modulation mode according with the Bluetooth Core Specification. Here GFSK modulation mode was used to show compliance.



Date: 8 AUG 2018 16:27:58



9.6 Dwell Time

Test Method

- 1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable. Equipment mode: Spectrum analyzer
- 2. RBW: 1MHz; VBW: 1MHz; SPAN: Zero Span
- 3. Adjust the center frequency of spectrum analyzer on any frequency be measured.
- 4. Measure the Dwell Time by spectrum analyzer Marker function.
- 5. Repeat above procedures until all frequencies measured were complete.

Limit

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



Dwell Time

Dwell time

The maximum dwell time shall be 0.4 s.

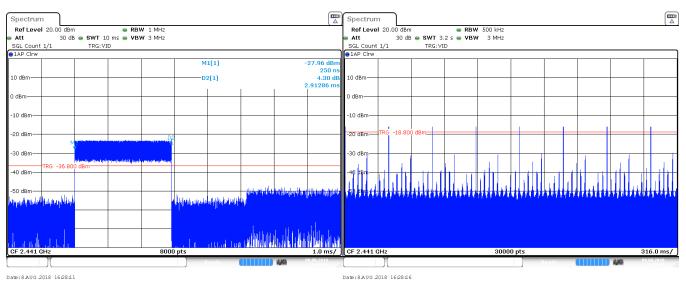
According to the Bluetooth Core Specification, the worse result (DH5 mode) was reported to show compliance.

The Dwell Time = Burst Width * Total Hops. The detailed calculations are showed as follows: The duration for dwell time calculation: 0.4 [s] * hopping number = 0.4 [s] * 79 [ch] = 31.6 [s*ch]; The burst width, which is directly measured, refers to the duration on one channel hop. The maximum number of hopping channels in 31.6s for DH5=1600 / 6 / 79 *31.6=106.67

Modulation	Mode	Reading (ms)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	DH5	2.91	80	233	< 400	Pass
π/4-DQPSK	2DH5	2.93	80	234	< 400	Pass
8-DPSK	3DH5	2.91	80	233	< 400	Pass

Test Result

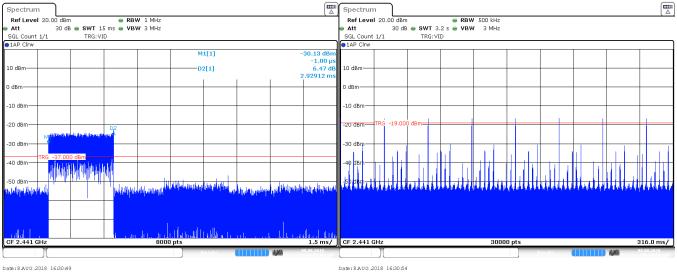
GFSK Modulation



DH5



$\pi/4$ -DQPSK Modulation



2DH5

8-DPSK Modulation Spectrum Spectrum Ref Level 20.00 dBm Ref Level 20.00 dBm Att 30 dB 00 dBm • RBW 1 MHz 30 dB • SWT 10 ms • VBW 3 MHz L 00 dBm • RBW 500 kHz 30 dB • SWT 3.2 s • VBW 3 MHz Att SGL Count 1/1 TRG: VID SGL Count 1/1 1AP Clrw TRG: VID M1[1] 34.89 250 n 11.39 d .91286 m 10 dBm D2[1] 10 dBm 0 dBr) dBm -10 dBm -10 dBm -20 dBm -20 dBm -30 dBm -30 dB -40 dBm -50 dBm-CF 2.441 GH 8000 pts 316.0 ms/ 30000 pts

Date:8AUG 2018 16:33:20

Date: 8 AUG 2018 16:33:26

3DH5

EMC_SZ_FR_23.01 FCC Release 2017-06-20



9.7 Spurious RF conducted emissions

Test Method

- 1. 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, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
- 2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
- 3. The level displayed must comply with the limit specified in this Section. Submit these plots.
- 4. Repeat above procedures until all frequencies measured were complete.

Limit

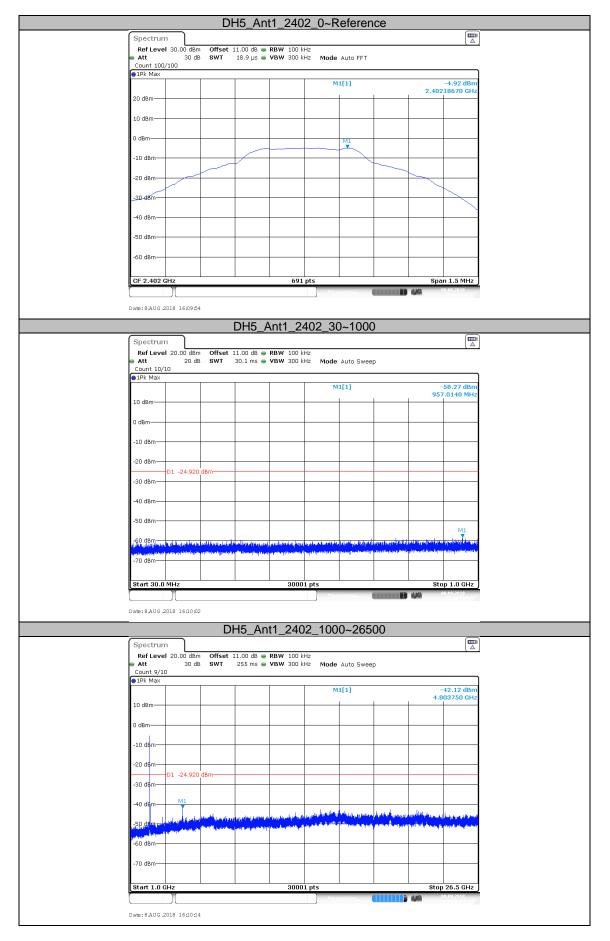
Frequency Range MHz	Limit (dBc)
30-25000	-20



Spurious RF conducted emissions

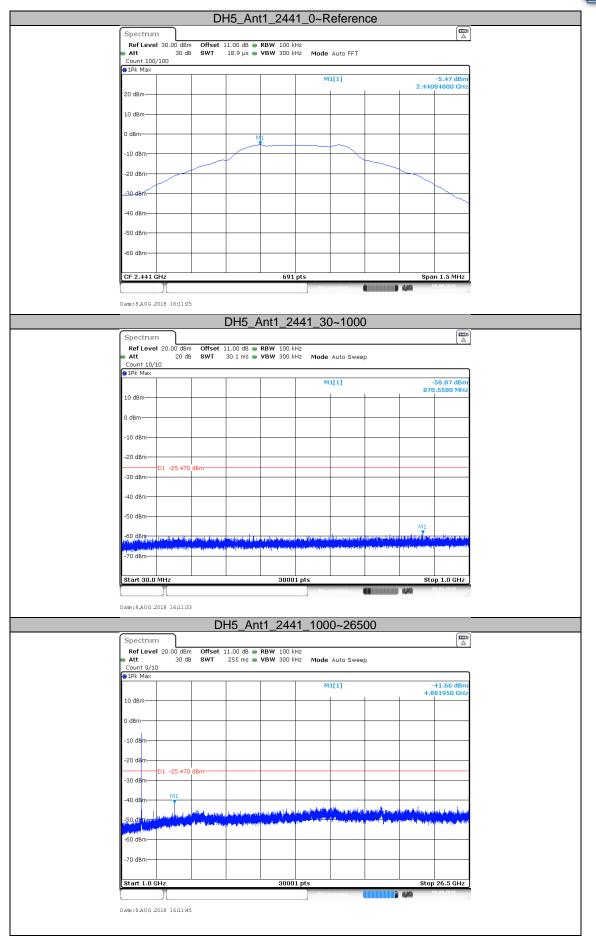
TestMode	Antenna	Channel	FreqRange	RefLevel	Result	Limit	Verdict
		2402	Reference	-4.92	-4.92		PASS
		2402	30~1000	-4.92	-58.27	-24.92	PASS
		2402	1000~26500	-4.92	-42.12	-24.92	PASS
		2441	Reference	-5.47	-5.47		PASS
DH5	Ant1	2441	30~1000	-5.47	-58.87	-25.47	PASS
		2441	1000~26500	-5.47	-41.66	-25.47	PASS
		2480	Reference	-6.08	-6.08		PASS
		2480	30~1000	-6.08	-59.19	-26.08	PASS
		2480	1000~26500	-6.08	-40.06	-26.08	PASS
		2402	Reference	-6.28	-6.28		PASS
		2402	30~1000	-6.28	-58.79	-26.28	PASS
		2402	1000~26500	-6.28	-41.11	-26.28	PASS
		2441	Reference	-6.94	-6.94		PASS
2DH5	Ant1	2441	30~1000	-6.94	-59.02	-26.94	PASS
		2441	1000~26500	-6.94	-41.02	-26.94	PASS
		2480	Reference	-7.25	-7.25		PASS
		2480	30~1000	-7.25	-58.9	-27.25	PASS
		2480	1000~26500	-7.25	-40.49	-27.25	PASS
		2402	Reference	-5.99	-5.99		PASS
		2402	30~1000	-5.99	-59.04	-25.99	PASS
		2402	1000~26500	-5.99	-39.67	-25.99	PASS
		2441	Reference	-6.70	-6.70		PASS
3DH5	Ant1	2441	30~1000	-6.70	-59.07	-26.7	PASS
		2441	1000~26500	-6.70	-41.5	-26.7	PASS
		2480	Reference	-7.27	-7.27		PASS
		2480	30~1000	-7.27	-58.4	-27.27	PASS
		2480	1000~26500	-7.27	-40.23	-27.27	PASS





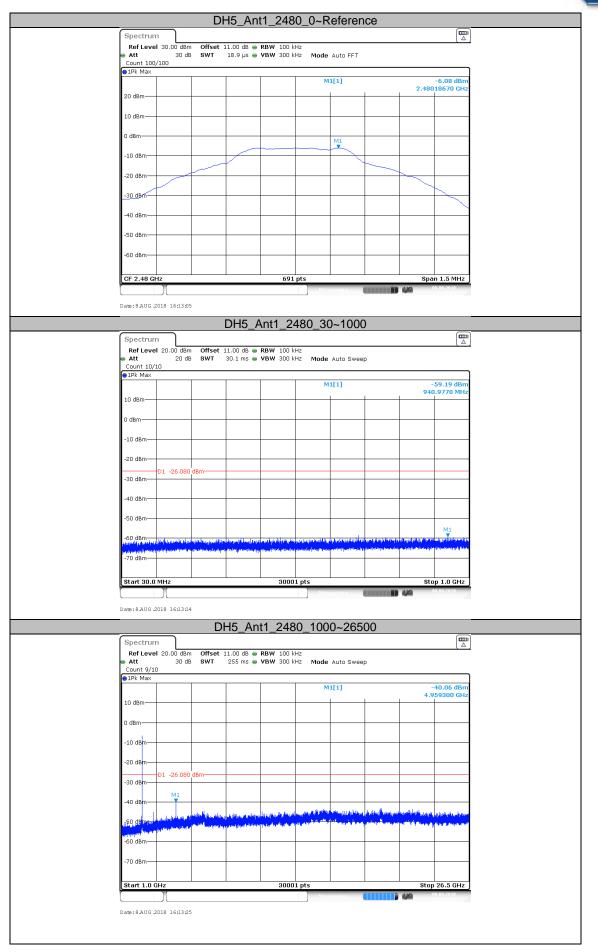
EMC_SZ_FR_23.01 FCC Release 2017-06-20





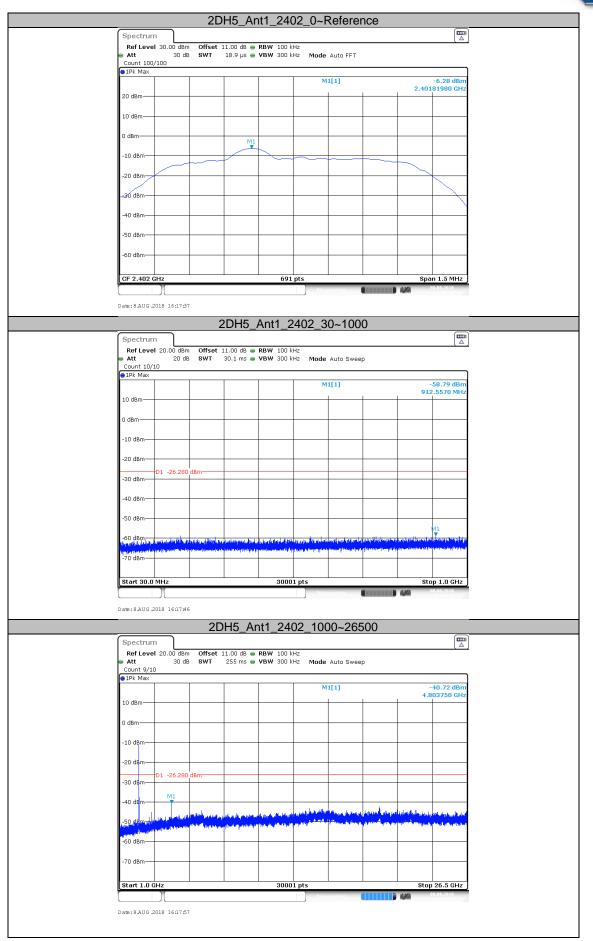
EMC_SZ_FR_23.01 FCC Release 2017-06-20





EMC_SZ_FR_23.01 FCC Release 2017-06-20

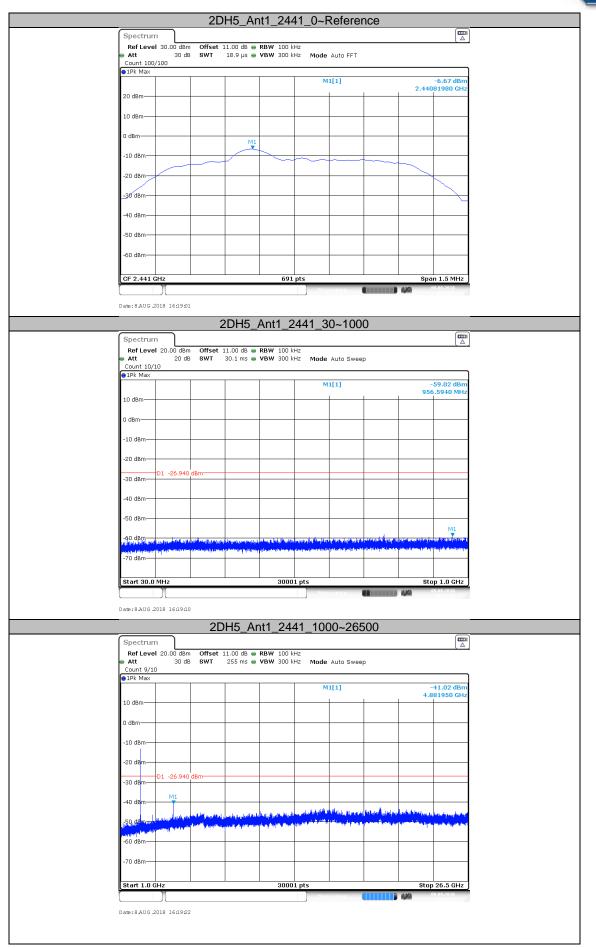




EMC_SZ_FR_23.01 FCC Release 2017-06-20 TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District, Shenzhen 518052, P.R. China

Page 40 of 56

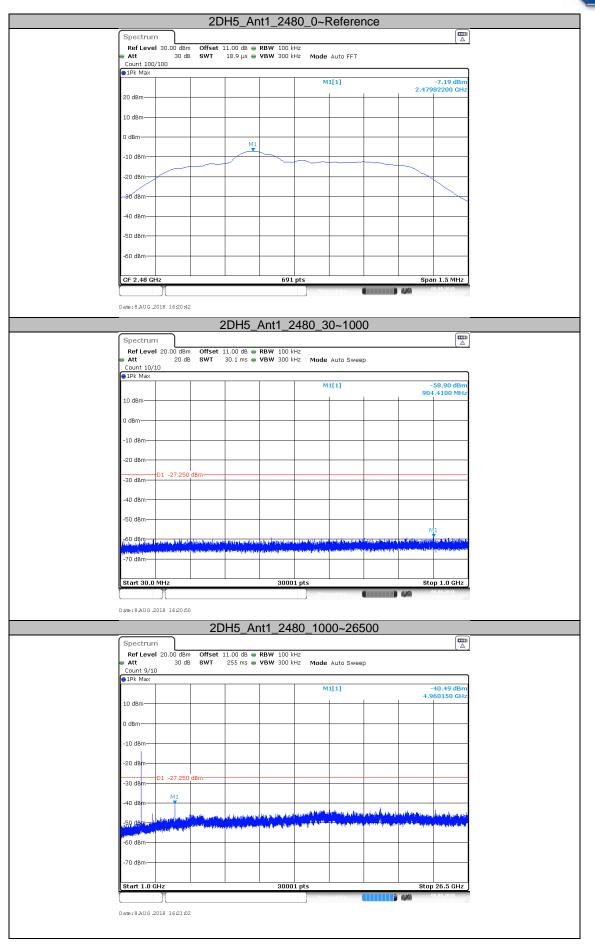




EMC_SZ_FR_23.01 FCC Release 2017-06-20 TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint Road 2, Nanshan District, Shenzhen 518052, P.R. China

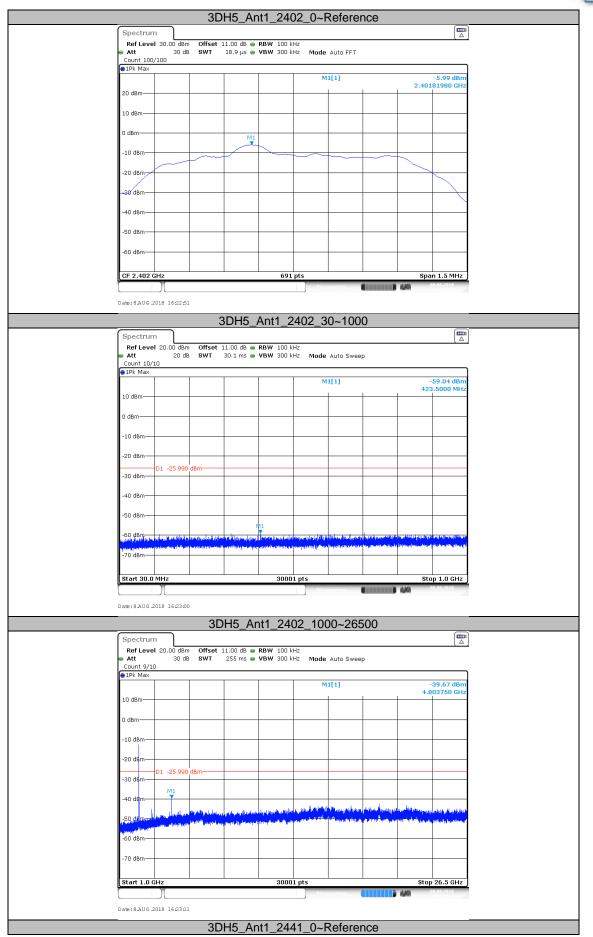
Page 41 of 56





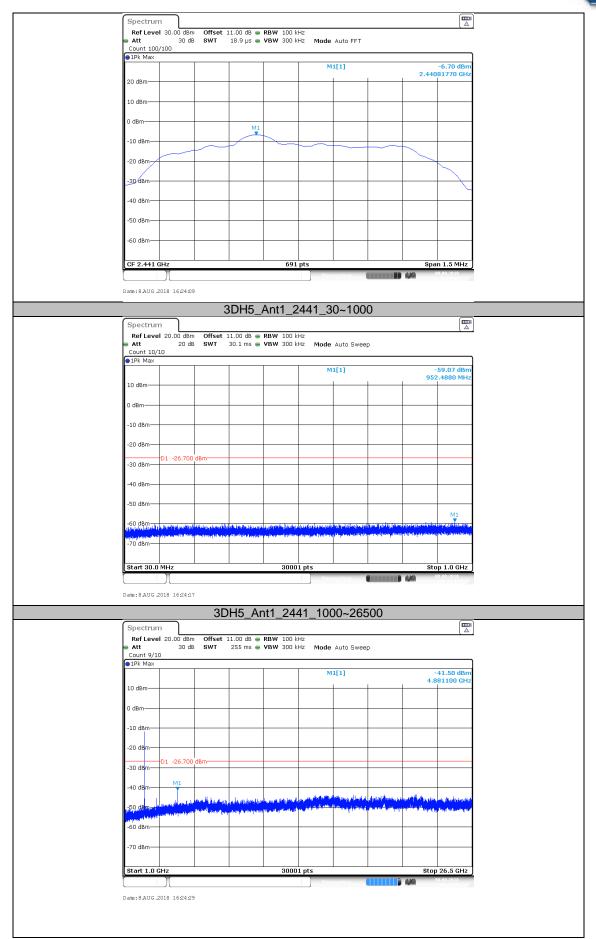
EMC_SZ_FR_23.01 FCC Release 2017-06-20





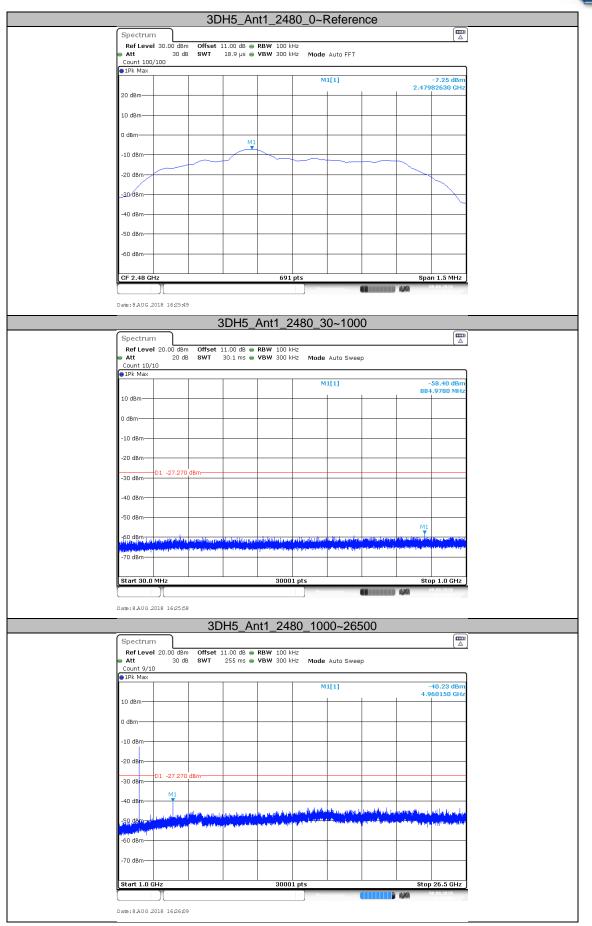
EMC_SZ_FR_23.01 FCC Release 2017-06-20





EMC_SZ_FR_23.01 FCC Release 2017-06-20





EMC_SZ_FR_23.01 FCC Release 2017-06-20



9.8 Band edge testing

Test Method

- Use the following spectrum analyzer settings: Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section. .
- 4 Repeat the test at the hopping off and hopping on mode, submit all the plots.

Limit:

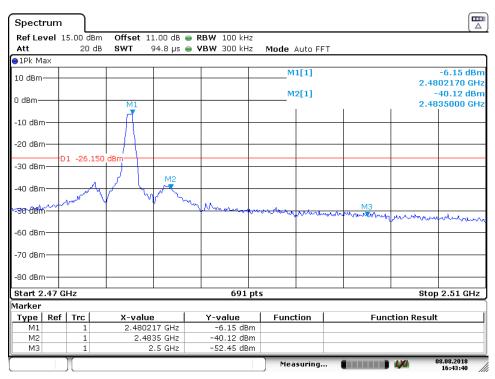
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.



GFSK mode:

Spectru	m												
Ref Leve Att		dBm 0 dB	Offset 1: SWT		RBW 1								<u> </u>
Pk Max		UUB	3111	1.1 ms	VDW 3		Mode	AUTO SV	veep				
10 dBm—							M	1[1]			2.	-4.88 d 402040	
0 dBm							M	2[1]				-40.41 d 400000	
-10 dBm—													
-20 dBm—	D1 -24	1 000	dBm-										\square
-30 dBm—	01 -2	+.000										h.,	\square
-40 dBm—											M3	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	_lad
-50 dBm—				- white	montenelist	www.ww	wellight		www. the her	Mullion	M3 mlutanth		
~6QvdBra~	www.ww	ana ka	and the second secon	unde :									
-70 dBm—													
-80 dBm—					_								
CF 2.357	5 GHz					691 pts	5				Spai	n 95.0 M	IHz
Marker													
	ef Tro		X-value		Y-va		Func	tion		Fund	tion Resu	t	
M1		1		04 GHz		88 dBm							
M2 M3		1		2.4 GHz 39 GHz		41 dBm 23 dBm							
							Mea	suring.			1/0	08.08.2018 16:42:19	

Date: 8 AUG 2018 16:42:20

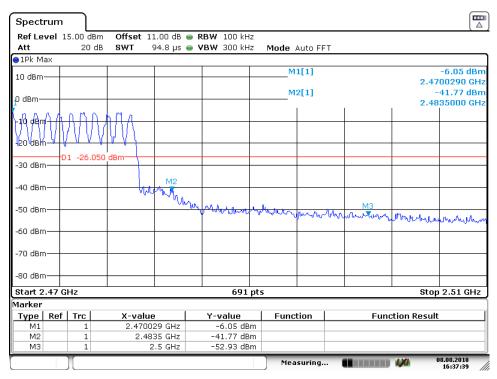


Date:8.AUG 2018 16:43:41



Spect	rum													
Ref Le Att	vel		iBm dB	Offset : SWT		_	RBW 100 kH /BW 300 kH							
ALL	24	20	uв	5W1	1.1 ms	• •	/ BW 300 KH	z	Mode /	Auto SI	weep			
10 dBm									м	1[1]			2.4	-5.06 dBn 102040 GH;
0 dBm—	_								M	2[1]			-	-36.15 dBn 100000\&H
-10 dBm	<u>ا</u> ر													<u>I </u> ∭
-20 dBrr		D1 -25.	060	dBm										1.1
-30 dBr		51 -25.	.000	abin										M2
-40 dBm													M3	
-60 d80	M	MM	W	MMW	MMM	M	What	M	MM	uuniin	pro ^{bue} ti	htsport		
-70 dBrr)		_											
-80 dBm	<u>ا</u> ر													
Start 2	.31 (GHz			1		691	pts		I		1	Stop	2.405 GHz
Marker														
Type M1	Ref	Trc 1		<u>X-valu</u>	1 e 204 GHz		<u>Y-value</u> -5.06 dB		Func	tion		Fund	tion Result	t
M2 M3		1			2.4 GHz .39 GHz		-36.15 dB -46.46 dB	m						
)[2	109 0112	1	10,10 00		Mea	suring.			1/0	08.08.2018 16:38:35

Date: 8 AUG 2018 16:38:35



Date: 8 AUG 2018 16:37:40

EMC_SZ_FR_23.01 FCC Release 2017-06-20



8DPSK mode:

Spectrum Ref Level 15.00 dBm Offset 11.00 dB 👄 RBW 100 kHz Att 20 dB SWT 1.1 ms 👄 **VBW** 300 kHz Mode Auto Sweep ⊖1Pk Ma× M1[1] -5.89 dBn 10 dBm 2.401770 GH M2[1] -39.17 dBn 0 dBm 2.400000MGH -10 dBm -20 dBm D1 -25.890 dBm--30 dBm-HMB -40 dBm-Manut -50 dBm ulphur have have 1. d0 d8m -70 dBm -80 dBm CF 2.3575 GHz 691 pts Span 95.0 MHz Marker Type Ref Trc X-value Y-value Function Function Result 2.40177 GHz -5.89 dBm M1 1 M2 2.4 GHz -39.17 dBm ΜЗ 1 2.39 GHz -50.07 dBm 08.08.2018 16:41:07 Measuring...

Date: 8 AUG 2018 16:41:08

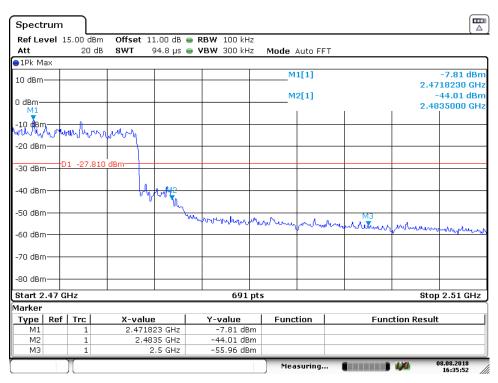
Spectrum Offset 11.00 dB 👄 RBW 100 kHz Ref Level 15.00 dBm 20 dB 94.8 µs 👄 **VBW** 300 kHz Att SWT Mode Auto FFT ●1Pk Max M1[1] -7.10 dBn 10 dBm 2.4798120 GH M2[1] -41.13 dBn 0 dBm 2.4835000 GH -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm monallow In your an -60 dBm -70 dBm -80 dBm Span 40.0 MHz CF 2.49 GHz 691 pts Marker Type | Ref | Trc Function **Function Result** X-value Y-value 2.479812 GHz -7.10 dBm M1 M2 1 2.4835 GHz -41.13 dBm ΜЗ 1 2.5 GHz -54.88 dBm 08.08.2018 16:44:43 Measuring...

Date:8.AUG 2018 16:44:44



Spectr	um												
Ref Lev Att	el 15	.00 dBi 20 d			RBW 100 kH VBW 300 kH	-	Mode		veen				
●1Pk Ma	x	20 0	o oni i				moue	Auto J.	меер				
10 dBm-	_						М	1[1]				-10.94	
							M	2[1]			2	-39.46	
0 dBm—	-					-		2[1]			2	.400000	
													M
-10 dBm-													h
-20 dBm-	_				_								+
-30 dBm-	-01	20.0	40 dBm										
40 - 10		-30.9										JM	2
-40 dBm-											МЗ	ut	
-50 dBm-	which	Wantana	an which where the	CANNA	an Mar Mr. When which he he	ALA	Land And	N. J.R. TANK	meller	abreacht	the for the word	week	-
-60 dBm-				~~ //	. J J		oll	1.00 U .00					
-70 dBm-													
-80 dBm-													
						L							
CF 2.35	75 GF	1Z			691	pts					spa	n 95.0 M	YIH2
Marker Type	Ref	Trc	X-value	1	Y-value	1	Func	tion	1	Eu	nction Resu	ult	
M1	NG1	1	2.40314	GHz	-10.94 dB	m	T unc	cion		rui	ICTON RESU		
M2		1		GHz	-39.46 dB								
MЗ		1	2.39	GHz	-51.23 dB	m							
							Mea	suring.			1,00	08.08.201	

Date:8AUG 2018 16:40:11



Date:8AUG 2018 16:35:52

EMC_SZ_FR_23.01 FCC Release 2017-06-20 Page 50 of 56



9.9 Spurious radiated emissions for transmitter

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.

3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

5: Use the following spectrum analyzer settings According to C63.10:

For Above 1GHz

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 1MHz, VBW≥RBW for peak measurement and VBW = 10Hz for average measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious RBW = 100 KHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Note:

1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.

2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.

3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (20log(1/duty cycle)).

4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.



Limit

The radio emission outside the operating frequency band shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK



Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

The only worse case (which is subject to the maximum EIRP, GFSK mode) test result is listed in the report.

Transmitting spurious emission test result as below:

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
Danu	MHz	dBuV/m		dBµV/m		dBuV/m	(dB)	
30-	878.372778	31.21	Н	46	QP	14.79	-16.2	Pass
1000MHz	879.127222	27.66	V	40	QP	18.34	-16.1	Pass
	4803.750000	51.10	Н	74	PK	22.9	2.8	Pass
1000-			Н	54	AV			Pass
25000MHz	4803.281250	49.11	V	74	PK	24.89	2.9	Pass
			V	54	AV			Pass

GFSK Modulation 2441MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
Dallu	MHz	dBuV/m		dBµV/m		dBuV/m	(dB)	
30-			Н	43.5	QP			Pass
1000MHz			Н	46	QP			Pass
	7323.750000	49.00	Н	74	PK	5.0	5.6	Pass
1000-			Н	54	AV			Pass
25000MHz	4881.562500	46.88	V	74	PK	8.86	5.7	Pass
			V	54	AV			Pass



GFSK Modulation 2480MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
Danu	MHz	dBuV/m		dBµV/m		dBuV/m	(dB)	
30-			Н	43.5	QP			Pass
1000MHz			Н	46	QP			Pass
	4960.312500	50.82	Н	74	PK	23.18	3.2	Pass
1000-			Н	54	AV			Pass
25000MHz	7440.468750	47.48	V	74	PK	26.52	6.3	Pass
			V	54	AV			Pass

Remark:

- (1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- (2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
- (3) Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain Below 1GHz: Corrector factor = Antenna Factor + Cable Loss



10 Test Equipment List

List of Test Instruments

Radiated Spurious Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE	
Signal Analyzer	Rohde & Schwarz	FSV40	101031	2019-7-6	
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	708	2019-6-28	
Horn Antenna	Rohde & Schwarz	HF907	102295	2019-6-28	
Wideband Horn Antenna	Q-PAR	QWH-SL-18-40-K- SG	12827	2019-7-6	
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2019-7-6	
Pre-amplifier	Rohde & Schwarz	SCU 40A	100432	2019-7-6	
Fully Anechoic Chamber	TDK	8X4X4		2020-7-7	
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A	

TS8997 Test System

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Generator	Rohde & Schwarz	SMB100A	108272	2019-7-6
Vector Signal Generator	Rohde & Schwarz	SMBV100A	262825	2019-7-6
Communication Synthetical Test Instrument	munication Rohde & Schwarz hetical Test		101251	2019-5-31
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2019-7-6
Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2019-7-6
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2019-7-6
Power Splitter	Weinschel	1580	SC319	2019-7-5
10dB Attenuator	Weinschel	4M-10	43152	2019-7-6
10dB Attenuator	R&S	DNF	DNF-001	2019-7-6
10dB Attenuator	R&S	DNF	DNF-002	2019-7-6
10dB Attenuator	R&S	DNF	DNF-003	2019-7-6
10dB Attenuator	R&S	DNF	DNF-004	2019-7-6
Test software	Rohde & Schwarz	EMC32	Version 10.38.00	N/A
Test software	Tonscend	System for BT/WIFI	Version 2.6	N/A



11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertaint	ty
Test Items	Extended Uncertainty
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.80dB; Vertical: 4.87dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.59dB; Vertical: 4.58dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.16dB Frequency test involved: 0.6×10 ⁻⁷ or 1%