Report Number: 68.910.16.025.01



## FCC - TEST REPORT

Report Number	68.910.16.025.01	Date of Issue: June 6, 2016
Model	: 0507, 0509, CE-56M, CE	-56MCL
Product Type	: SING-A-LONG Bluetooth	& MP3 Player with Dual Microphones
Applicant	: Bulk Unlimited Corp	
Address	: 199 Lee Ave. Suite 464 E	Brooklyn, NY,
	New York, United States	112011
Production Facility	: Shenzhen China East Ele	ectronics Co., Ltd.
Address	: No.8-14, JinYuan Rd., Jir	יYuan Industrial, He Ao,
-	Heng Gang, Long Gang,	Shenzhen, Guangdong, P. R. China
Test Result	: Positive DNegat	ive
Total pages including Appendices	: 50	

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# 2 Details about the Test Laboratory

## **Details about the Test Laboratory**

**Test Site** 

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 City, 518052, P. R. China
	FCC Registration Number: 502708
Telephone:	86 755 8828 6998

Fax: 86 755 8828 5299



# **3** Description of the Equipment Under Test

Product:	SING-A-LONG Bluetooth & MP3 Player with Dual Microphones
Model no.:	0509
FCC ID:	2AE67-0509
Options and accessories:	NIL
Rating:	DC 6V (Supplied by 4×1.5VDC AA batteries) or DC 5V (Powered by Micro USB port)
RF Transmission	2402MHz-2480MHz
Frequency: No. of Operated Channel:	79
Modulation:	GFSK, π/4-DQPSK, 8-DPSK
Antenna Type:	PCB antenna
Antenna Gain:	0dBi
Description of the EUT:	The Equipment Under Test (EUT) is a SING-A-LONG Bluetooth & MP3 Player with Dual Microphones operated at 2.4GHz.



## 4 Summary of Test Standards

Test Standards		
FCC Part 15 Subpart C	PART 15 - RADIO FREQUENCY DEVICES	
10-1-2015 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 C63.10-2013.



## 5 Summary of Test Results

	Technical Requirements			
FCC Part 15 Sub	oart C			
Test Condition		Pages	Test Result	Test Site
§15.207	Conducted emission AC power port	10	Pass	Site 2
§15.247(b)(1)	Conducted peak output power	13	Pass	Site 2
§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	Site 2
§15.247(a)(1)	Carrier frequency separation	27	Pass	Site 2
§15.247(a)(1)(iii)	Number of hopping frequencies	30	Pass	Site 2
§15.247(a)(1)(iii)	Dwell Time	32	Pass	Site 2
§15.247(d)	Spurious RF conducted emissions	35	Pass	Site 2
§15.247(d)	Band edge	39	Pass	Site 2
§15.247(d) & §15.209 &	Spurious radiated emissions for transmitter	46	Pass	Site 2
§15.203	Antenna requirement	See note 1	Pass	

Note 1: N/A=Not Applicable.

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

# TUV SUD

# 6 General Remarks

## Remarks

Model 0507, 0509, CE-56M and CE-56MCL are identical except model name and the color of enclosure. Therefore model 0509 was chosen as the representative model to perform full tests. This submittal(s) (test report) is intended for FCC ID: 2AE67-0509, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules.

## 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: May 25, 2016

Testing Start Date: June 1, 2016

Testing End Date: June 6, 2016

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

Reviewed by:

Prepared by:

and

Phoebe Hu EMC Project Manager

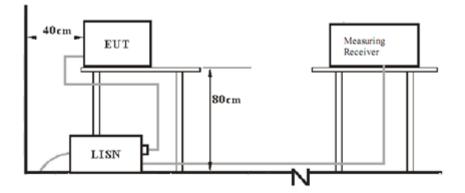
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Trevor You EMC Project Engineer

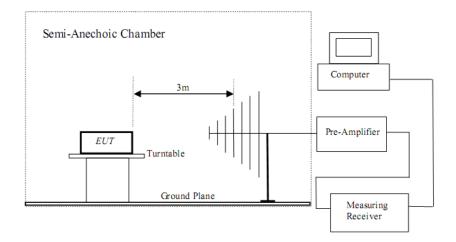


## 7 Test Setups

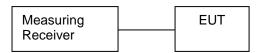
## 7.1 AC Power Line Conducted Emission test setups



## 7.2 Radiated test setups



## 7.3 Conducted RF test setups





## 8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Laptop	lenovo	X220	

Test software: HC\_Data\_test, 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

#### **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 an 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

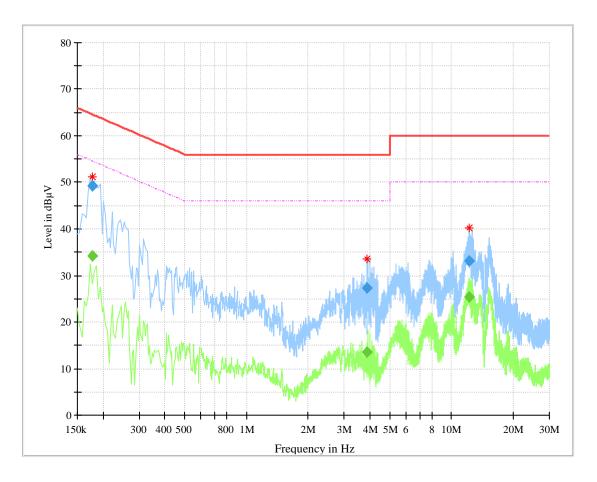
Frequency	QP Limit	AV Limit
MHz	dBµV	dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50
Decreasing linearly with	logarithm of the freq	liency

Decreasing linearly with logarithm of the frequency



#### **Conducted Emission**

Product Type:SING-A-LONG Bluetooth & MP3 Player with Dual MicrophonesM/N:0509Operating Condition:BT Playing & MIC ONTest Specification:LiveComment:AC 120V/60Hz (powered by Micro USB port from PC)



## Final\_Result

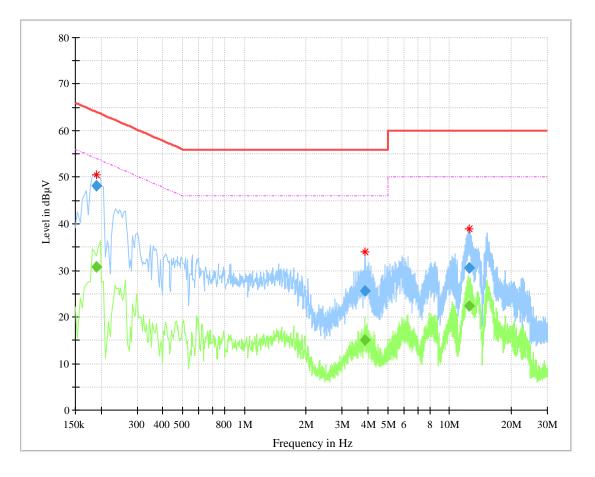
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line
0.178500		34.29	54.56	20.27	L1
0.178500	49.22		64.56	15.34	L1
3.889500		13.63	46.00	32.37	L1
3.889500	27.31		56.00	28.69	L1
12.230500		25.36	50.00	24.64	L1
12.230500	33.08	-	60.00	26.92	L1

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#### **Conducted Emission**



## Final\_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line
0.189500		30.74	54.06	23.32	Ν
0.189500	48.20		64.06	15.86	Ν
3.893500		14.95	46.00	31.05	Ν
3.893500	25.53		56.00	30.47	Ν
12.541500		22.32	50.00	27.68	Ν
12.541500	30.50		60.00	29.50	Ν

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## 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

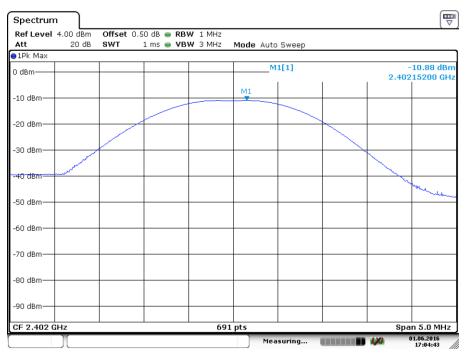
Frequency Range	Limit	Limit
MHz	W	dBm
2400-2483.5	≤1	≤30



#### Conducted peak output power

Bluetooth Mode GFSK modulation Test Result					
Frequency					
MHz Low channel 2402MHz	<u>dBm</u> -10.88	Pass			
Middle channel 2441MHz	-10.80	Pass			
High channel 2480MHz	-11.22	Pass			

#### Low channel 2402MHz



Date: 1.JUN.2016 17:04:43

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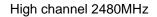
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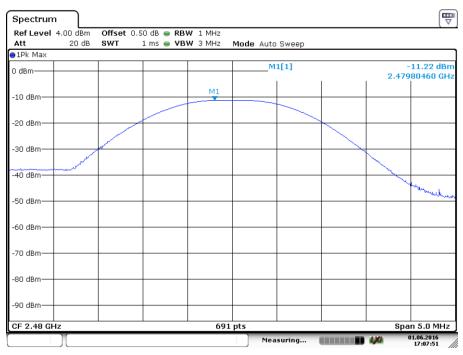






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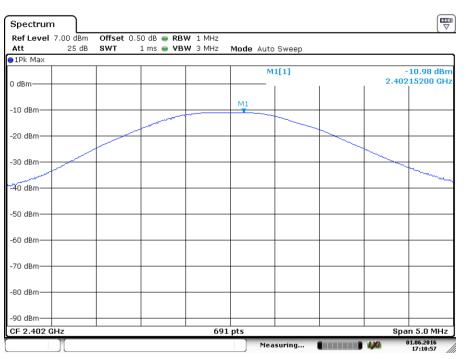
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# Bluetooth Mode $\pi$ /4-DQPSK modulation Test Result Conducted Peak

Frequency	Output Power	Result
MHz	dBm	
Low channel 2402MHz	-10.98	Pass
Middle channel 2441MHz	-10.82	Pass
High channel 2480MHz	-11.21	Pass



#### Low channel 2402MHz

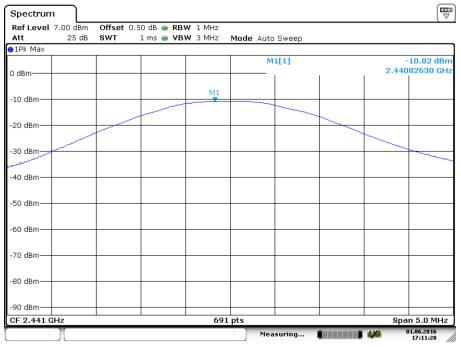
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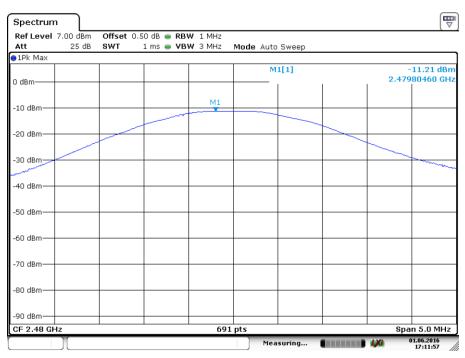






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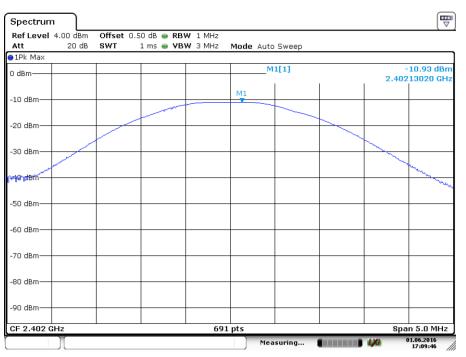
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#### Bluetooth Mode 8DPSK modulation Test Result Conducted Peak Frequency Output Power Result

Output Power	Result	
dBm		
-10.93	Pass	
-10.78	Pass	
-11.20	Pass	
	<b>dBm</b> -10.93 -10.78	dBm -10.93 Pass -10.78 Pass



Low channel 2402MHz

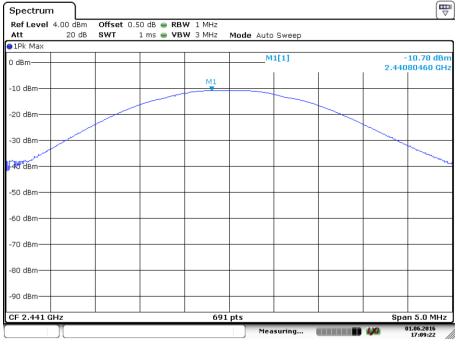
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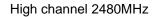
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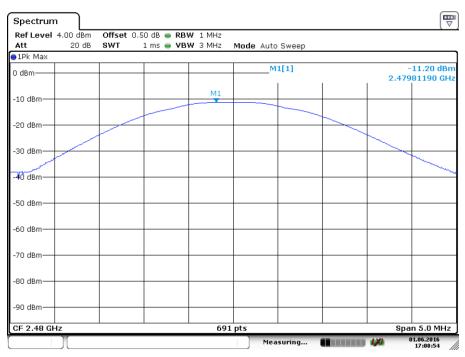






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## 9.3 20 dB bandwidth and 99% Occupied Bandwidth

#### **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

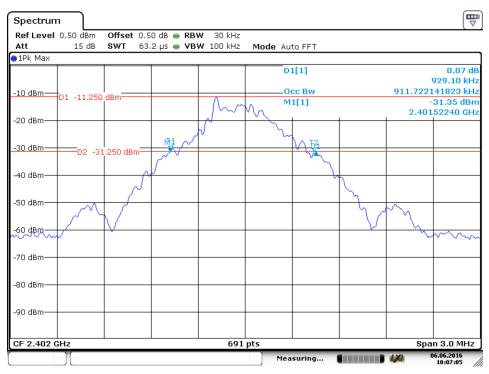


#### 20 dB bandwidth and 99% Occupied Bandwidth

#### Bluetooth Mode GFSK Modulation test result

	Frequency	20 dB Bandwidth	99% Bandwidth	Limit	Result
_	MHz	kHz	kHz	kHz	
-	2402	929.10	911.72		Pass
	2441	942.10	907.38		Pass
	2480	933.40	907.38		Pass

#### 2402MHz



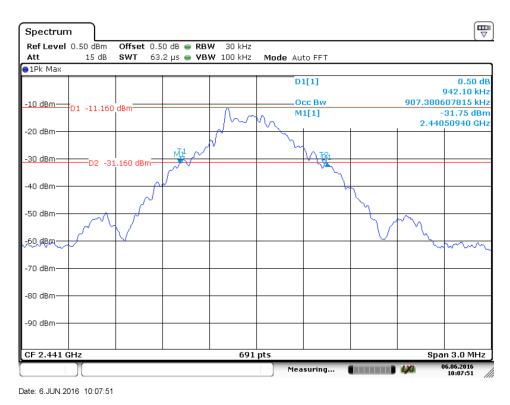
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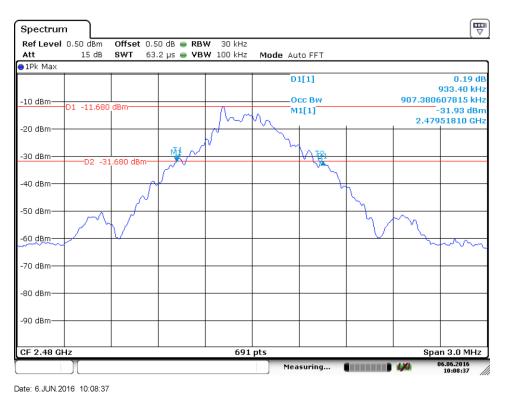
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2441MHz



#### 2480MHz



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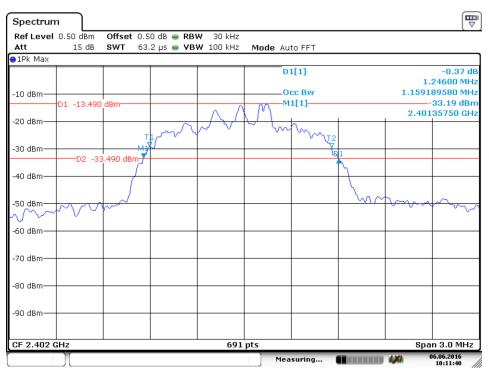


#### 20 dB bandwidth and 99% Occupied Bandwidth

#### Bluetooth Mode $\pi$ /4-DQPSK Modulation test result

Frequency	20 dB Bandwidth	99% Bandwidth	Limit	Result
MHz	kHz	kHz	kHz	
2402	1246.0	1159.19		Pass
2441	1250.4	1198.26		Pass
2480	1250.4	1206.95		Pass

#### 2402MHz



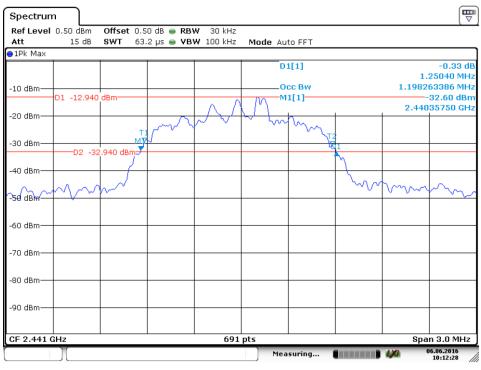
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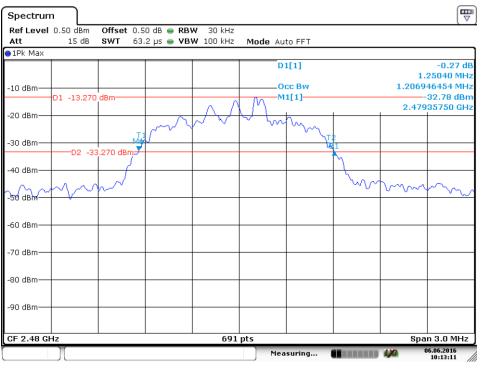


2441MHz



Date: 6.JUN.2016 10:12:28

#### 2480MHz



Date: 6.JUN.2016 10:13:11



#### 20 dB bandwidth and 99% Occupied Bandwidth

#### Bluetooth Mode 8DPSK Modulation test result

Frequency	20 dB Bandwidth	99% Bandwidth	Limit	Result
MHz	kHz	kHz	kHz	
2402	1259.0	1172.21		Pass
2441	1259.0	1211.29		Pass
2480	1263.4	1224.31		Pass

#### 2402MHz



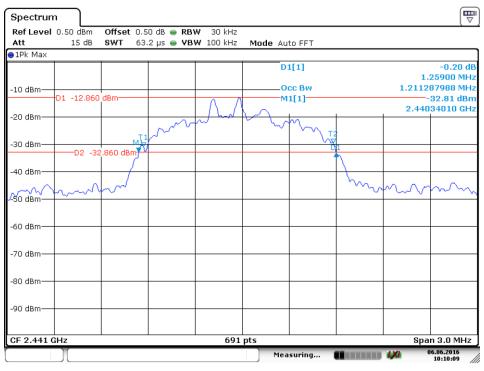
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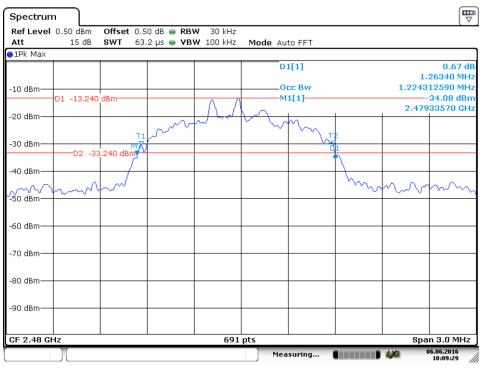


2441MHz



Date: 6.JUN.2016 10:10:10

#### 2480MHz



Date: 6.JUN.2016 10:09:29

## 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	619.4
2441	628.1
2480	622.3





#### **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

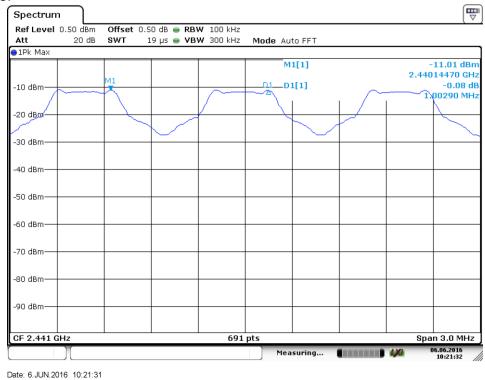
Frequency	Carrier Frequency Separation	Result
MHz	kHz	
2402	1002.9	Pass
2441	1002.9	Pass
2480	1002.9	Pass

#### Low Channel ₩ Spectrum Ref Level 0.50 dBm Offset 0.50 dB 👄 RBW 100 kHz 20 dB SWT 19 µs 👄 **VBW** 300 kHz Mode Auto FFT Att ⊖1Pk Max M1[1] 11.16 dBn 2.40281330 GHz M1 0.04 dE D1[1] D1 -10 dBm 00290 MHz -20 dBm -30 dBm 40 dBm -50 dBm -60 dBm 70 dBm -80 dBm -90 dBm CF 2.403 GHz 691 pts Span 3.0 MHz 5.06.2016 10:22:18 Measuring... LXI

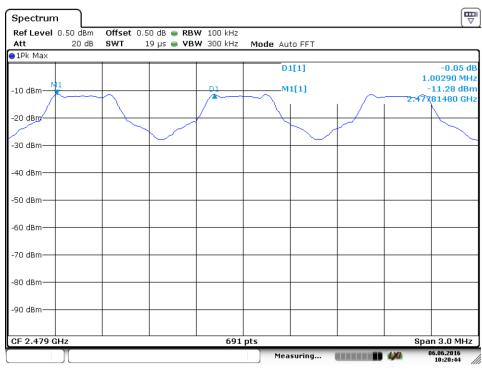
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#### Middle channel



## High Channel



Date: 6.JUN.2016 10:20:44

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## 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.

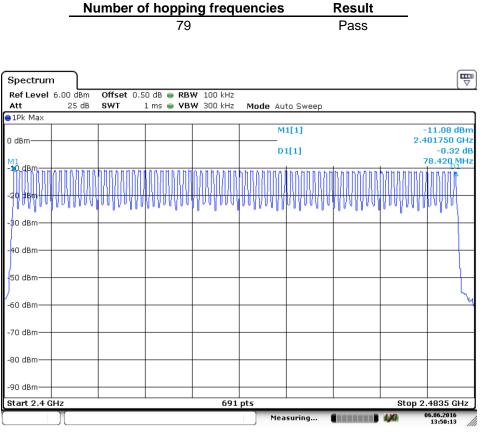
### Limit

Limit number ≥ 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: 6.JUN.2016 13:50:12



## 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.

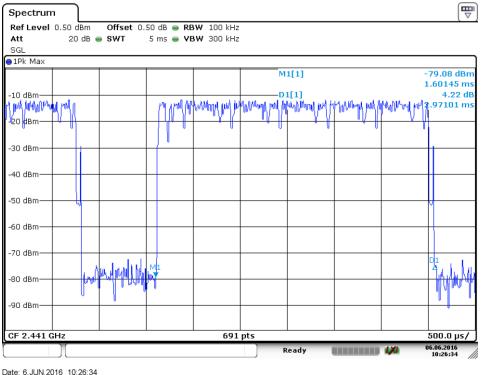
According to the Bluetooth Core Specification, the worse result (DH5 mode) was reported to show compliance.

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

# Test Result

Modulation	Mode	Reading (us)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	DH5	2971.01	106.67	319.70	< 400	Pass
π/4-DQPSK	2DH5	2963.77	106.67	316.06	< 400	Pass
8-DPSK	3DH5	2978.26	106.67	317.66	< 400	Pass

#### **GFSK Modulation**

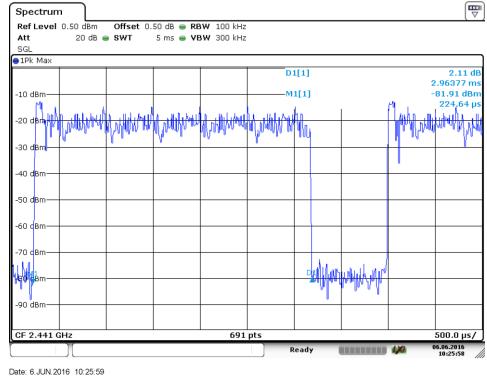


DH5

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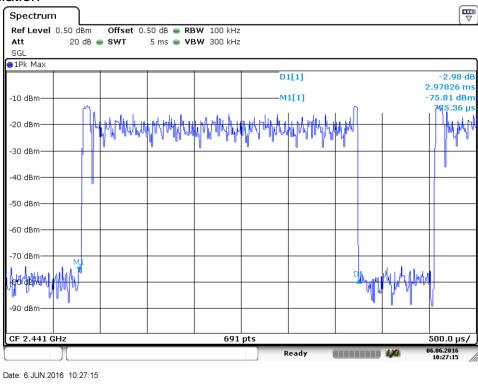


#### π/4-DQPSK Modulation





# 8-DPSK Modulation



3DH5

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## 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 10<sup>th</sup> 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

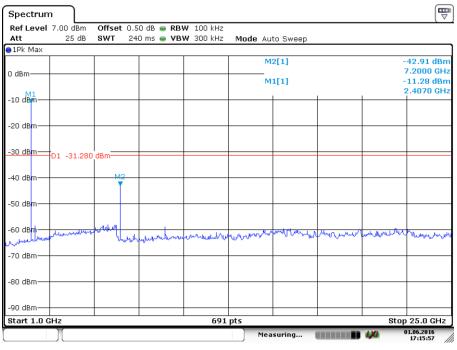


#### **Spurious RF conducted emissions**

Only the worse case (which is subject to the maximum EIRP, GFSK mode) test result is listed in the report. BT3.0 GFSK Modulation: 2402MHz

> **T** Spectrum Ref Level 7.00 dBm Offset 0.50 dB 👄 RBW 100 kHz Att 25 dB SWT 9.7 ms 👄 **VBW** 300 kHz Mode Auto Sweep ●1Pk Ma> M1[1] -62.50 dBn 548.70 MH 0 dBm -10 dBm -20 dBm -30 dBm-D1 -31.280 dBm -40 dBm -50 dBm -60 dBm unterna when المالكين -70 dBm -80 dBm -90 dBm-691 pts Stop 1.0 GHz Start 30.0 MHz Measuring... 01.06.2016 17:16:23

Date: 1.JUN.2016 17:16:23



Date: 1.JUN.2016 17:15:56

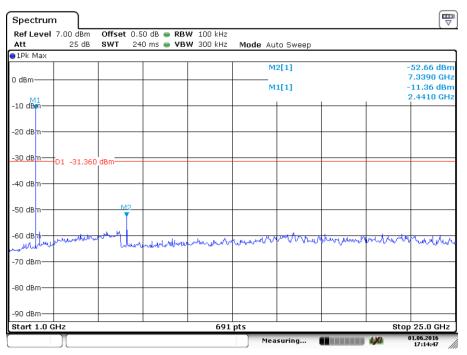
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#### 2441MHz

SWT 9.7 ms (				
0 HT 5.7 115 (	<b>&gt; VBW</b> 300 kHz	Mode Auto Sweep		
		M1[1]		-61.80 dBi 947.40 MH 
0 dBm				
				M1
and and the second	www.www.horderal.ville	der og her vider og det det som	multer when the	nuhaltarihad
			Image: second	

Date: 1.JUN.2016 17:15:12



Date: 1.JUN.2016 17:14:47

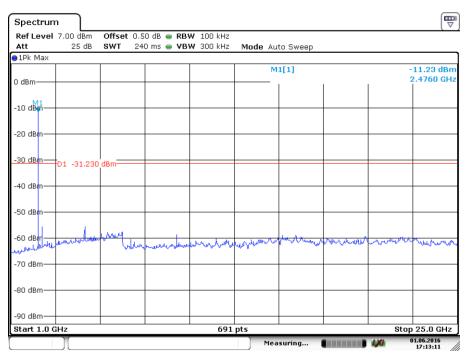
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#### 2480MHz

**T** Spectrum Offset 0.50 dB 🖷 RBW 100 kHz Ref Level 7.00 dBm 25 dB SWT 9.7 ms 😑 VBW 300 kHz Att Mode Auto Sweep ●1Pk Ma> M1[1] -62.56 dBm 735.40 MHz 0 dBm -10 dBm -20 dBm -30 dBm-D1 -31.230 dBm--40 dBm -50 dBm -60 dBm riturn og the help when when waterallist monut mili halle المل -70 dBm -80 dBm -90 dBm-Stop 1.0 GHz Start 30.0 MHz 691 pts 01.06.2016 17:13:53 Measuring... ------ *U* 

Date: 1.JUN.2016 17:13:52



Date: 1.JUN.2016 17:13:12

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## 9.8 Band edge testing

#### **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 RBW = 100 kHz, VBW  $\ge$  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.



## **Band edge testing**

BT3.0 GFSK Modulation Test Result: Hopping on mode:

Ref Le <sup>.</sup> Att	vel O	.50 dBm 20 dB	Offset 0.50 dB 👄 F SWT 1.1 ms 👄 V	<b>(BW</b> 100 kHz <b>/BW</b> 300 kHz	Mode Au	to Swee	p		
∋1Pk Ma	ах								
					M	1[1]			11.37 dB
-10 dBm					M	2[1]			04790 GI ∙68.61 dB
						2[1]			90000 G
-20 dBm								1	1 1
-30 dBm									[
-30 UBIT	D	1 -31.37	0 dBm						
-40 dBm				_					L
-50 dBm									
-60 dBm									M3
-ou ubii								M2 IN	rt.
-70-d8m	-	<del>,,</del>				ەقىيەمىسىلىپ	allowed an apple of the	M2 JAK	
-80 dBm									
-90 dBm									
-90 UBII									
Start 2	31.6	<b>H</b> 7		691 p	te			Ston	 2.405 GH
1arker	UT U	112		0,11				0.00	2.100 011
Type	Ref	Trc	X-value	Y-value	Func	tion	Fui	nction Result	:
M1		1	2.40479 GHz	-11.37 dBn	1				
M2		1	2.39 GHz	-68.61 dBn					
MЗ		1	2.4 GHz	-58.81 dBn	ו ו				

Date: 6.JUN.2016 10:30:39

Spectrum Ref Level (		Offset 0.50 dB 👄				
Att	20 dB	SWT 1.1 ms 👄	<b>VBW</b> 300 kHz M	lode Auto Swee	p	
1Pk Max				M1[1] M2[1]		-11.43 dBr 2.479800 GH -61.84 dBr 2.483500 GH
08	)1 -31.43	0 dBm				
50 dBm		M3				
70 dBm	hardenach	and and the second		ut-ntonp <sup>rof</sup> -i-datan	And the second second	میروند میکنمیمیک آمد
90 dBm						
Start 2.477	GHz		691 pts	5	I	Stop 2.55 GHz
larker Type   Ref	Trc	X-value	Y-value	Function	Funct	ion Result
M1 M2 M3	1 1 1	2.4798 GHz 2.4835 GHz 2.5 GHz	-11.43 dBm -61.84 dBm -68.23 dBm			
	1			Measuring		06.06.2016 10:33:18

Date: 6.JUN.2016 10:33:19

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## Hopping off mode:

₽ Spectrum Ref Level 0.50 dBm Offset 0.50 dB 👄 RBW 100 kHz 1.1 ms 👄 **VBW** 300 kHz 20 dB Att SWT Mode Auto Sweep ⊖1Pk Max M1[1] 11.48 dBn 2.401770<sub>M</sub>QHz -68.62 dBm 2.390000 GHz -10 dBm· M2[1] -20 dBm--30 dBm— D1 -31.510 dBm--40 dBm -50 dBm M3 -60 dBm M2 70 dBo -80 dBm -90 dBm-Stop 2.405 GHz Start 2.31 GHz 691 pts Marker Type M1 Ref | Trc X-value 2.40177 GHz Y-value -11.48 dBm Function Function Result 1 M2 2.39 GHz -68.62 dBm 1 МЗ 1 2.4 GHz -58.42 dBm 06.06.2016 10:05:58 Measuring... 🚺 🚺 🚧

Date: 6.JUN.2016 10:05:58

Spect	rum													
Ref Le	vel (	0.50 dBm	Offset 0.5	0 dB 😑	RBW	100 kHz								
Att		20 dB	SWT 1.	1 ms 👄	VBW	300 kHz	Moe	de Aut	to Swee	р				
😑 1Pk M	ax													
								M	1[1]				-	11.43 dBm
														79800 GHz
-10,980	n							M:	2[1]					62.53 dBm
-20 dBn												_	2.4	83500 GHz
-20 001														
-30 dBn	n		l											
		01 -31.430	dBm											
-40 dBn	n													
-50 den	n —													
-60 dBn	M2													
	- M	un when here a		мз										
-70 dBn	n —	man	muno	man	NAM	martha	Julian	Wattrach-	mense	1 min	പകപ്പപ്പകം	مرت المؤون المغ	يعلمكمك والم	ولتعديك والمحافظ والمحافظ
-80 dBn	n –											-		
-90 dBn	n													
Start 2	.477	GHz				691	pts						Stop	2.55 GHz
Marker														
Туре	Ref	Trc	X-value	.	Y	-value		Func	tion		Fur	nction R	esult	
M1		1		98 GHz		-11.43 dE								
M2		1		35 GHz		-62.53 dE								
M3		1	2	.5 GHz		-69.50 dE	3m							
		Π						Mea	suring			1,70	0	6.06.2016 10:03:06

Date: 6.JUN.2016 10:03:07

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## BT3.0 $\pi$ /4-DQPSK Modulation Test Result: Hopping on mode:

₽ Spectrum Offset 0.50 dB 🖷 RBW 100 kHz Ref Level 0.50 dBm 20 dB 1.1 ms 👄 **VBW** 300 kHz Att S₩T Mode Auto Sweep ●1Pk Max M1[1] 11.37 dBn 2.404240 GH -10 dBm -69.45 dBn 2.390000 0Ht M2[1] -20 dBm -30 dBm— D1 -31.370 dBm-40 dBm -50 dBm м -60 dBm M2 70.dBm -80 dBm -90 dBm-Start 2.31 GHz 691 pts Stop 2.405 GHz Marker Y-value -11.37 dBm -69.45 dBm Ref | Trc 2.40424 GHz Function Function Result Туре M1 M2 1 2.39 GHz МЗ 1 2.4 GHz -57.47 dBm 6.06.2016 10:31:28 Measuring...

Date: 6.JUN.2016 10:31:28

Ref Level		Offset 0.50 dB 👄	DDW 100 kUz			( \
Att	20 dB			ode Auto Swe	en	
1Pk Max					-P	
				M1[1]		-11.43 dBr
11						2.478110 GH
10 dBm				M2[1]		-64.14 dBr
20 dBm-				1	- 1	2.483500 GH
20 00111						
30 dBm-	01 -31.43	0. d0 m				
	JI -31.43					
40 dBm						
1						
50 dBm						
60 dBm 🙀						
Y	mound	M3	he an annument	mar mar and mar mar and	والمراجع والمراجع والمراجع	A American Hill margins
70 dBm						
80 dBm						
oo abiii						
90 dBm						
Start 2.477	GHz		691 pts			Stop 2.55 GHz
arker						
Type   Ref	Trc	X-value	Y-value	Function	Fund	ction Result
M1	1	2.47811 GHz	-11.43 dBm			
M2	1	2.4835 GHz	-64.14 dBm			
M3	1	2.5 GHz	-69.18 dBm			

Date: 6.JUN.2016 10:32:35



## Hopping off mode:

₽ Spectrum Ref Level 0.50 dBm Offset 0.50 dB 👄 RBW 100 kHz 1.1 ms 👄 **VBW** 300 kHz 20 dB Att SWT Mode Auto Sweep ⊖1Pk Max M1[1] 11.52 dBn 2.401770<sub>M</sub>QHz -68.50 dam 2.390000 QHz -10 dBm· M2[1] -20 dBm--30 dBm— D1 -31.520 dBm--40 dBm -50 dBm -60 dBm M2 ZO de -80 dBm -90 dBm Stop 2.405 GHz Start 2.31 GHz 691 pts Marker Ref | Trc Y-value -11.52 dBm -68.50 dBm Type M1 X-value 2.40177 GHz Function Result Function 1 M2 2.39 GHz 1 МЗ 1 2.4 GHz -55.22 dBm 06.06.2016 10:04:42 Measuring... 

Date: 6.JUN.2016 10:04:41

Spectr	um										
Ref Lev	vel O	.50 dBm	Offset	0.50 dB 🔵	RBW 100 kHz						
Att		20 dB	SWT	1.1 ms 👄	<b>VBW</b> 300 kHz	М	ode Au	to Swe	ер		
⊖1Pk Ma	эх										
-10 Bm								1[1] 2[1]		2.	-11.44 dBm 480120 GHz -62.39 dBm
-20 dBm						_				2.4	483500 GHz
-30 dBm		1 -31.440									
-40 dBm		1 -51.440									
-50 dBra -60 dBm											
-70 dBm		Whitehall Marine	Burrand	M3	1944	<b></b>	markanst	us alamen			
-80 dBm						+					
-90 dBm						+					
Start 2	.477	GHz			69	 1 pts				Sto	p 2.55 GHz
Marker											
Туре	Ref	Trc	X-va		Y-value		Func	tion	Fu	nction Resul	t 🔤
M1		1		48012 GHz	-11.44 c						
M2 M3		1	2	.4835 GHz 2.5 GHz	-62.39 d -70.21 d						
							) Mea	suring.		1,00	06.06.2016 10:03:42

Date: 6.JUN.2016 10:03:42

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## BT3.0 8-DPSK Modulation Test Result: Hopping on mode:

₽ Spectrum Offset 0.50 dB 🖷 RBW 100 kHz Ref Level 0.50 dBm 20 dB 1.1 ms 👄 **VBW** 300 kHz Att S₩T Mode Auto Sweep ●1Pk Max M2[1] -69.21 dBn 2.390000 GH -10 dBm -11.37 dBn 2.404790 gHz M1[1] -20 dBm -30 dBm— D1 -31.370 dBm-40 dBm -50 dBm -60 dBm M2 79 d8n -80 dBm -90 dBm-Start 2.31 GHz 691 pts Stop 2.405 GHz Marker Y-value -11.37 dBm -69.21 dBm Ref | Trc 2.40479 GHz Function Function Result Туре M1 M2 1 2.39 GHz МЗ 1 2.4 GHz -54.32 dBm 06.06.2016 10:29:36 Measuring... 

Date: 6.JUN.2016 10:29:37

Spectrum						(
Ref Level (	20 dBm 20 dBm	Offset 0.50 dB				
Att	20 dB	SWI 1.1 ms 🖷	VBW 300 kHz M	ode Auto Swe	ер	
1Pk Max			_			-11.44 dBn
				M1[1]		-11.44 dBr 2.478850 GH
M1 10 dBm				M2[1]		-56.41 dBr
WUL				mz[1]		2.483500 GH
20 d <mark>8</mark> m						21100000 dii
1 1						
30 d <mark>8m</mark> [	01 -31.44	0 dBm	_			
40 dBm —						
50 dBr						
্ প্						
60 dBm 🕌						
``	Unen	M3	14 diamandaha	او بریانی در در در در		
70 dBm				- analysis and the second		C C C & a C C C & a C C C & A C A C & A C
80 dBm						
80 dBm						
90 dBm						
90 uBm						
Start 2.477	GHz		691 pts			Stop 2.55 GHz
larker						
Type Ref		X-value	Y-value	Function	Functi	on Result
M1 M2	1	2.47885 GHz	-11.44 dBm -56.41 dBm			
M2 M3	1	2.4835 GHz 2.5 GHz	-69.32 dBm			
110		2.5 6/12	05.52 dbm			06.06.2016

Date: 6.JUN.2016 10:34:11



## Hopping off mode:

₽ Spectrum Ref Level 0.50 dBm Offset 0.50 dB 👄 RBW 100 kHz 1.1 ms 👄 **VBW** 300 kHz 20 dB Att SWT Mode Auto Sweep ⊖1Pk Max M1[1] 11.48 dBn 2.401770<sub>M</sub>QHz -69.38 dam 2.390000 gHz -10 dBm· M2[1] -20 dBm--30 dBm— D1 -31.480 dBm--40 dBm -50 dBm -60 dBm M2 Land ZOrd -80 dBm -90 dBm Stop 2.405 GHz Start 2.31 GHz 691 pts Marker Ref | Trc Type M1 X-value 2.40177 GHz Y-value -11.48 dBm Function Result Function 1 M2 2.39 GHz -69.38 dBm 1 МЗ 1 2.4 GHz -54.40 dBm 06.06.2016 10:05:29 Measuring... 🚺 🚺 🚧

Date: 6.JUN.2016 10:05:29

Spect	rum									
Ref Le	vel 0	1.50 dBm	Offset 0.50 d	ib 😑 RBW	100 kHz					
Att		20 dB	SWT 1.1 m	ns 👄 VBW	300 kHz	Mode	Auto Swe	ер		
😑 1Pk M	ax									
-10 dBn	n						M3[1] M1[1]		2.5	68.78 dBm 00000 GHz 11.43 dBm
-20 dBn	n								2.4	79800 GHz
20,001										
-30 d3n		1 -31.430	dBm				_			
-40 dBh										
-\$0 dBn	M2									
-60 dBn -70 dBn	T	white the shares	M3		Maran	um	horam	hannananananana	- Want Burn and	anothe mar
70 abri										
-80 dBn	n						_			
-90 dBn	n									
Start 2	.477	GHz			691	pts		I	Stop	2.55 GHz
Marker						•			•	
Туре	Ref	Trc	X-value		Y-value	Fu	nction	Fur	nction Result	
M1		1	2.4798 (		-11.43 dB					
M2		1	2.4835		-56.52 dB					
M3		1	2.5	GHz	-68.78 dB	m				
		)[]				<b>۱</b>	leasuring.		• 4/4 •	6.06.2016 10:01:45

Date: 6.JUN.2016 10:01:45

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# 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  $\ge$  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	Field Strength	Field Strength	Detector
MHz	uV/m	dBµV/m	
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
	MHz 30-88 88-216 216-960 960-1000 Above 1000	MHzuV/m30-8810088-216150216-960200960-1000500Above 1000500	MHzuV/mdBμV/m30-881004088-21615043.5216-96020046960-100050054Above 100050054



## 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	Result
Dallu	MHz	dBuV/m		dBµV/m		dBuV/m	
30-	277.40	41.84	Н	46	QP	5.16	Pass
1000MHz	286.35	42.72	V	46	QP	4.28	Pass
	*1535.200000	47.20	Н	74	PK	26.80	Pass
1000-	*4803.500000	48.49	Н	74	PK	25.51	Pass
25000MHz	*1535.200000	42.95	V	74	PK	31.05	Pass
200011112	*4803.500000	42.98	V	74	PK	31.02	Pass

BT3.0 GFSK Modulation 2402MHz Test Result

## BT3.0 GFSK Modulation 2441MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
Dallu	MHz	dBuV/m		dBµV/m		dBuV/m	
30-	277.40	41.54	Н	46	QP	5.46	Pass
1000MHz	286.35	42.61	V	46	QP	4.39	Pass
	*1535.200000	47.18	Н	74	PK	26.82	Pass
1000	*4881.500000	50.43	Н	74	PK	23.57	Pass
1000- 25000MHz	*1535.200000	43.19	V	74	PK	30.81	Pass
2300011112	*4881.500000	44.25	V	74	PK	29.75	Pass

#### BT3.0 GFSK Modulation 2480MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Result
Danu	MHz	dBuV/m		dBµV/m		dBuV/m	
30-	277.40	41.23	Н	46	QP	5.77	Pass
1000MHz	286.35	42.67	V	46	QP	4.33	Pass
	*1535.133333	47.28	Н	74	PK	26.72	Pass
1000	*4959.500000	48.23	Н	74	PK	25.77	Pass
1000- 25000MHz	*1535.133333	43.31	V	74	PK	30.69	Pass
2000000	*4959.500000	45.94	V	74	PK	28.06	Pass
							-

Remark: 1) Data of measurement within this frequency range shown "-" in the table above means the reading of emissions are attenuated more than 20db below the permissible limits or the field strength is too small to be measured.

2) "\*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.



# **10 Test Equipment List**

#### **Conducted Emission Test**

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2016-7-24
LISN	Rohde & Schwarz	ENV216	100326	2016-7-24

## Conducted RF test (TS8997 Test System)

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Generator	Rohde & Schwarz	SMB100A	108272	2016-7-24
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2016-7-24
Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2016-7-24
RF Switch Module	Rohde & Schwarz	OSP120/OSP-	101226/1008	2016-7-24
		B157	51	2010-7-24

#### **Radiated Spurious Emission Test**

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	101031	2016-7-24
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	708	2016-7-31
Horn Antenna	Rohde & Schwarz	HF907	102295	2016-7-24
Wideband Horn Antenna	Q-PAR	QWH-SL-18- 40-K-SG	12827	2017-10-21
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2016-7-24
Pre-amplifier	Rohde & Schwarz	SCU 40A	100432	2016-7-24
Fully Anechoic Chamber	TDK	8X4X4		2019-5-29



# **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 Uncertainty						
Items	Extended Uncertainty					
Conducted Emission	150 kHz to 30 MHz	±3.46 dB				
Radiated Spurious Emission	25MHz-3000MHz	Horizontal: 4.98dB; Vertical: 5.06dB;				
	3000MHz-18000MHz	Horizontal: 4.95dB; Vertical: 4.94dB;				
Conducted RF Test		Power level test involved: 2.06dB Frequency test involved: 1.16x10-7				