

FCC/IC - TEST REPORT

Report Number	: 68.950.17.721	.01	Date of Issue:	January 09, 2018
Model	: SP005			
Product Type	: Sonic Rider			
Applicant	: Binatone Elect	ronics Interr	national Ltd.	
Address	: Floor 23A, 9 D	es Voeux R	oad West, Sheur	ig Wan Hong Kong China
Production Facility	: ATI Electronics	s (Shenzher	n) Co., LTD.	
Address	: 1/F, B Tower, S	Shengdelan	Industrial Park, I	Kukeng Village,
	: Guanglan Tow	n, Shenzhe	n, China.	
Test Result	: n Positive	O Negativ	ve	
Total pages including Appendices	: 51	_		

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

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:	Sonic Rider
Model no.:	SP005
FCC ID:	VLJ-SP005
IC:	4522A-SP005
Options and accessories:	Car Charger
Ratings:	DC3.7V, 2600mAh (Supplied by rechargeable Li-ion Polymer) 5VDC, 1.0A (Charged by Car Charger)
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 Equipment Under Test (EUT) is a Sonic Rider operated at 2.4GHz



4 Summary of Test Standards

Test Standards				
FCC Part 15 Subpart C	PART 15 – RADIO FREQUENCY DEVICES			
10-1-2016 Edition	Subpart C – Intentional Radiators			
RSS-Gen Issue 4 General Requirements for the Certification of Radio Apparatus				
November 2014				
RSS-247lssue 2	Digital Transmission Systems (DTSS), Frequency Hopping Systems			
February 2017	(FHSS) and License-Exempt Local Area Network (LE-LAN) Devices			

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

FCC Dert 45 Sub		echnical Requirements			
Test Condition	part C/R55-247 IS	sue 2/RSS-Gen Issue 4	Pages	Test Result	Test Site
§15.207	RSS-GEN 8.8	10	Pass	Site 1	
§15.247(b)(1)	RSS-247 Clause 5.4(d)	Conducted peak output power	15	Pass	Site 1
§15.247€	RSS-247 Clause 5.2(b)	Power spectral density*		N/A	
§15.247(a)(2)	RSS-247 Clause 5.2(a)	6dB bandwidth		N/A	
§15.247(a)(1)	RSS-247 Clause 5.1(a) & RSS-Gen 6.6	20dB bandwidth and 99% Occupied Bandwidth	22	Pass	Site 1
§15.247(a)(1)	RSS-247 Clause 5.1(b)	Carrier frequency separation	29	Pass	Site 1
§15.247(a)(1)(iii)	RSS-247 Clause 5.1(d)	Number of hopping frequencies	32	Pass	Site 1
§15.247(a)(1)(iii)	RSS-247 Clause 5.1(d)	Dwell Time	34	Pass	Site 1
§15.247(d)	RSS-247 Clause 5.5	Spurious RF conducted emissions	37	Pass	Site 1
§15.247(d)	RSS-247 Clause 5.5	Band edge	41	Pass	Site 1
§15.247(d) & §15.209 &	RSS-247 Clause 5.5 & RSS-GEN 6.13	Spurious radiated emissions for transmitter and receiver	46	Pass	Site 1
§15.203	RSS-GEN 8.3	Antenna requirement	See note 1	Pass	

Note 1: N/A=Not Applicable.

Note 2: The EUT uses a 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: VLJ-SP005, IC: 4522A-SP005 complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C, RSS-247 and RSS-Gen rules.

SUMMARY:

All tests according to the regulations cited on page 5 were

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

Sample Received Date:

November 10, 2017

Testing End Date:

Testing Start Date:

December 4, 2017

November 10, 2017

Reviewed by:

how

Phoebe Hu EMC Section Manager

Prepared by:

Tested by:

Mark chen

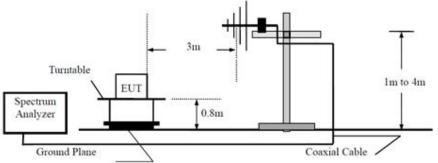
Mark Chen EMC Project Engineer

Tree Zhan EMC Test Engineer

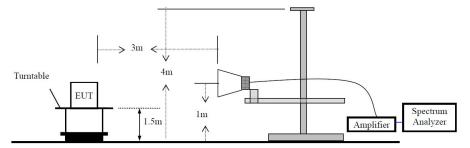
Tree them

7 Test Setups

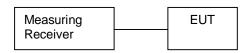
7.3 Radiated test setups Below 1GHz



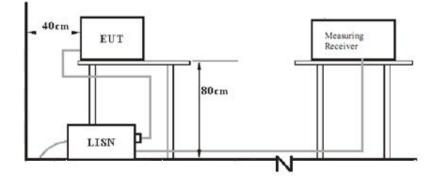
Above 1GHz

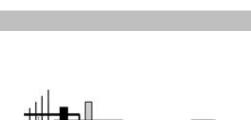


7.2 Conducted RF test setups



7.3 AC Power Line Conducted Emission test setups









8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Mobile Phone			
Car Charger		PGCB0500150W1EU	

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

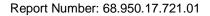
Test Method

- 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

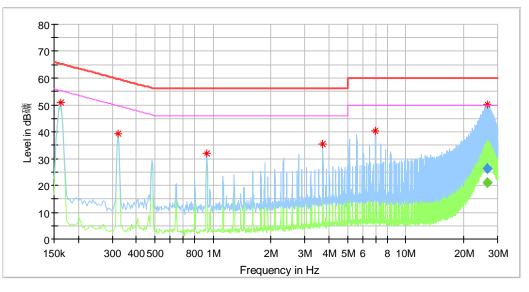
Frequency	QP Limit	AV Limit
MHz	dBµV	dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.





Product Type:Sonic RiderM/N:SP005Operating Condition:Charging+ BT Link+ Phone FunctionTest Specification:LineComment:DC12V



Critical_Freqs

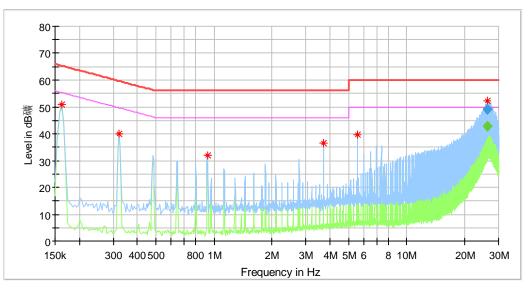
Frequency	MaxPeak	Average	Limit	Margin	Line	Corr.
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)		(dB)
0.162000	50.88		65.36	14.48	L1	10.2
0.322000	39.29		59.66	20.37	L1	10.2
0.930000	31.83		56.00	24.17	L1	10.2
3.714000	35.31		56.00	20.69	L1	10.3
6.966000	40.22		60.00	19.78	L1	10.5
26.385500	50.24		60.00	9.76	L1	11.4

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
26.385500		21.17	50.00	28.83	L1	11.4
26.385500	26.35		60.00	33.65	L1	11.4



Product Type:Sonic RiderM/N:SP005Operating Condition:Charging+ BT Link+ Phone FunctionTest Specification:NeutralComment:DC12V



Critical_Freqs

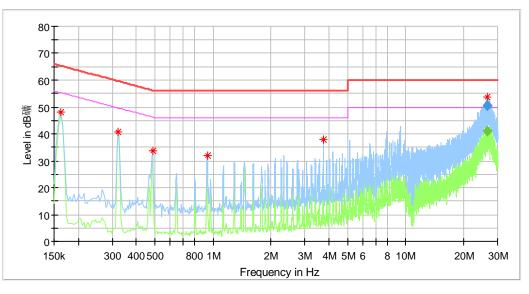
Frequency	MaxPeak	Average	Limit	Margin	Line	Corr.
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)		(dB)
0.162000	50.80		65.36	14.56	Ν	10.3
0.322000	39.83		59.66	19.83	Ν	10.3
0.926000	31.95		56.00	24.05	Ν	10.4
3.702000	36.52		56.00	19.48	Ν	10.5
5.554000	39.73		60.00	20.27	Ν	10.6
26.241500	52.20		60.00	7.80	Ν	11.9

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
26.241500		42.95	50.00	7.05	Ν	11.9
26.241500	48.97		60.00	11.03	Ν	11.9



Product Type:Sonic RiderM/N:SP005Operating Condition:Charging+ BT Link+ Phone FunctionTest Specification:LineComment:DC24V



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.162000	48.18		65.36	17.19	L1	10.2
0.322000	40.70		59.66	18.96	L1	10.2
0.486000	33.59		56.24	22.64	L1	10.4
0.934000	31.86		56.00	24.14	L1	10.2
3.734000	37.90		56.00	18.10	L1	10.3
26.525500	53.78		60.00	6.22	L1	11.4

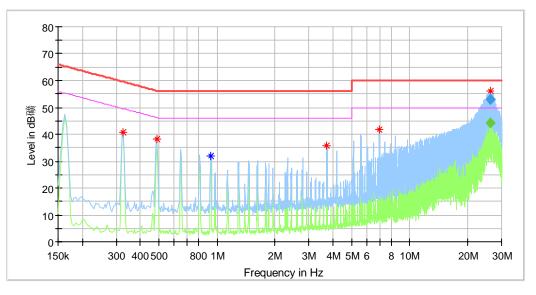
Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
26.525500		41.17	50.00	8.83	L1	11.4
26.525500	50.56		60.00	9.44	L1	11.4

Report Number: 68.950.17.721.01



Product Type:Sonic RiderM/N:SP005Operating Condition:Charging+ BT Link+ Phone FunctionTest Specification:NeutralComment:DC24V



Critical_Freqs

	-					
Frequency	MaxPeak	Average	Limit	Margin	Line	Corr.
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)		(dB)
0.326000	40.79		59.55	18.77	Ν	10.3
0.486000	38.25		56.24	17.98	Ν	10.3
0.930000		31.86	46.00	14.14	Ν	10.4
3.718000	35.81		56.00	20.19	Ν	10.5
6.974000	41.75		60.00	18.25	Ν	10.7
26.218500	56.04		60.00	3.96	Ν	11.9

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
26.218500		44.38	50.00	5.62	Ν	11.9
26.218500	52.96		60.00	7.04	Ν	11.9

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.

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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

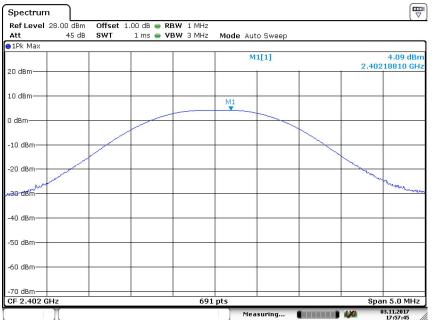
Frequency Range	Limit	Limit
MHz	W	dBm
2400-2483.5	≤1	≤30





Conducted peak output power

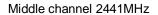
Bluetooth Mode GFSK modulation Test Result						
	Conducted Peak					
Frequency	Output Power	Result				
MHz	dBm					
Low channel 2402MHz	4.09	Pass				
Middle channel 2441MHz	4.03	Pass				
High channel 2480MHz	3.69	Pass				

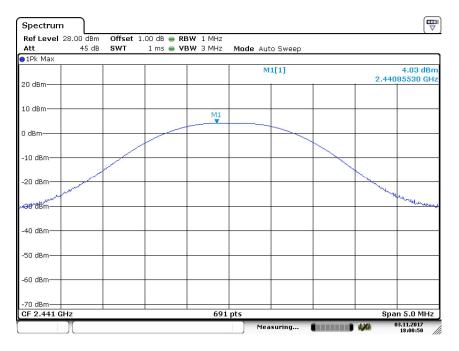


Low channel 2402MHz

EMC_SZ_FR_21.00FCC Release 2014-03-20











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

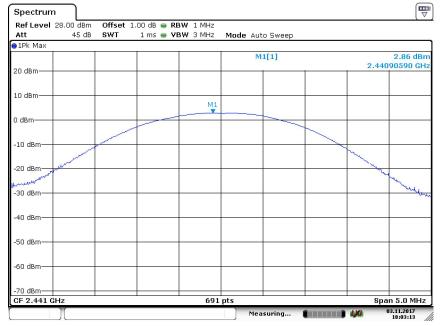
Frequency	Output Power	Result
MHz	dBm	
Low channel 2402MHz	2.97	Pass
Middle channel 2441MHz	2.86	Pass
High channel 2480MHz	2.43	Pass

Spectrum Ref Level 28.00 dBm	Offset 1	.00 dB 🔵 RB	W 1 MHz					(\(\neq \)
Att 45 dB	SWT	1 ms 😑 VE	SW 3 MHz	Mode Au	uto Sweep			
∋1Pk Max								
				P	41[1]		0.405	2.97 dBm 216640 GHz
20 dBm							2.402	10040 GHz
10 dBm								
				M1				
0 dBm					-	~		
10 10-		1						
-10 dBm							m	
-20 dBm							- mark	Su
in the second state								Munum
dBm								
-40 dBm								
-50 dBm					-			
co in-								
-60 dBm								1
-70 dBm								
CF 2.402 GHz			691	pts				on 5.0 MHz

Low channel 2402MHz



Middle channel 2441MHz





High channel 2480MHz

-



Bluetooth Mode 8DI	PSK modulation Tes	t Result
	Conducted Peak	
Frequency	Output Power	Result
MU	dDm	

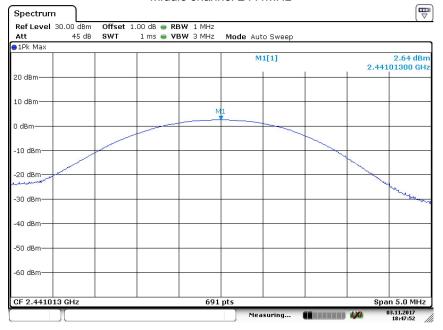
MHz	dBm	
Low channel 2402MHz	3.14	Pass
Middle channel 2441MHz	2.64	Pass
High channel 2480MHz	2.57	Pass

Spectrum			
Ref Level 28.00 dBm	Offset 1.00 dB 👄 RBW 11	MHz	
Att 45 dB	SWT 1 ms 🔵 VBW 3 f		
●1Pk Max			
		M1[1]	3.14 dBm
20 dBm			2.40202890 GHz
20 UBIII-			
10 dBm		M11	
0 dBm			
-10 dBm			
	f I I		
-20 dBm			and a second sec
-20 UBIII			manulun
-40 dBm			
-50 dBm			
-60 dBm			
70 -0			
-70 dBm CF 2.402 GHz		691 pts	Span 5.0 MHz
		Measuring	03.11.2017 18:04:07

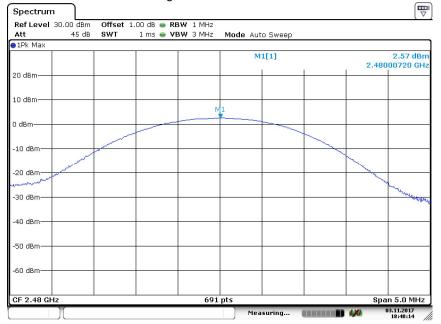
Low channel 2402MHz



Middle channel 2441MHz



High channel 2480MHz



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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	929.1	863.97		Pass
2441	924.7	859.62		Pass
2480	924.7	855.28		Pass

	LOW					_
Spectrum						
RefLevel 23.00 dBm Att 40 dB			Iode Auto FFT			
1Pk Max						
20 dBm			D2[1] Occ Bw			-0.02 dE 929.10 kHz 67728 kHz
10 dBm			M1[1]			16.27 dBm 53980 GHz
0 dBm	dBm	~~~~~	\wedge			
-10 dBm	MH /	A	Mr32			
-20 dBm	6.460 dBm		- K			
-30 dBm				2	Λ	
-40 gent				5		
-50 dBm						~~~~
-60 dBm						
-70 dBm						
CF 2.402 GHz		691 pts		1	Spa	n 3.0 MHz
			Measuring		1/0 0	3.11.2017 19:04:22

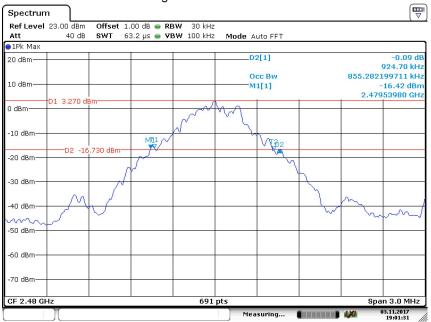
Low channel 2402MHz



Middle channel 2441MHz



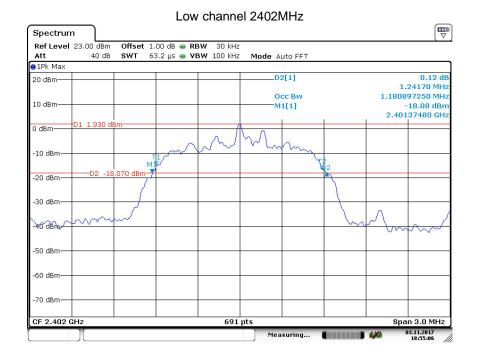
High channel 2480MHz





20 dB bandwidth and 99% Occupied Bandwidth

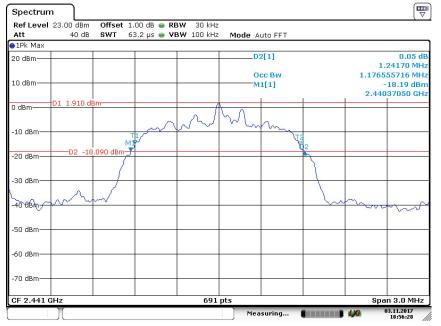
Bluetooth Mode $\pi/4$ -DQPSK Modulation test result							
	Frequency	20 dB Bandwidth	99% Bandwidth	Limit	Result		
	MHz	kHz	kHz	kHz			
	2402	1241.7	1180.89		Pass		
	2441	1241.7	1176.56		Pass		
	2480	1241.7	1172.21		Pass		



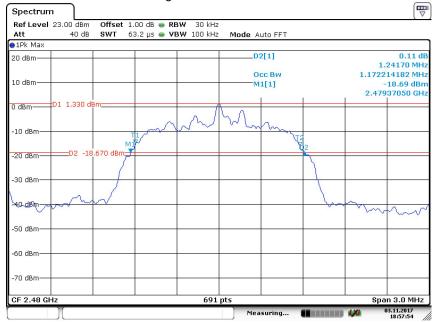
EMC_SZ_FR_21.00FCC Release 2014-03-20



Middle channel 2441MHz



High channel 2480MHz





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	1263.4	1172.21		Pass
2441	1263.4	1172.21		Pass
2480	1254.7	1172.21		Pass

	2		LOW	channe	JI 24021	VINZ			
Spectrum	ı)								
Ref Level				SW 30 kHz					
Att	40 dB	SWT 63	3.2 μs 👄 VE	3W 100 kHz	Mode A	uto FFT			
●1Pk Max									0.04.10
20 dBm					D;	2[1]		1	0.04 dB 26340 MHz
					0	cc Bw			14182 MHz
10 dBm					M	1[1]		-18.36 dBm	
		ID				1		2.401	35750 GHz
0 dBm	D1 1.920 c	JBM		$ \land f$					
-10 dBm			m	~ / ~	とて	m			
-10 0.011	100 10	M1	1			1 VI	2		
-20 dBm	D2 -1	8.080 dBm							
-30 dBm							\backslash		
	han	\sim							~
-40 d8m	~~							m	M.
-50 dBm									
-60 dBm									
-70 dBm									
CF 2.402 G	Hz			691	pts			Sna	in 3.0 MHz
)(suring			03.11.2017
						Surfight			18:53:37

Low channel 2402MHz

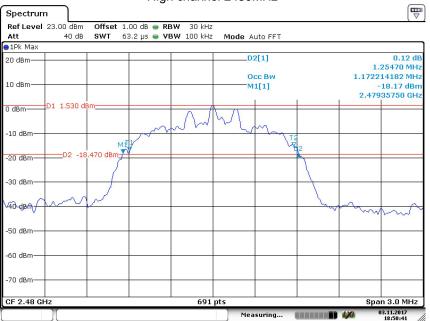
EMC_SZ_FR_21.00FCC Release 2014-03-20

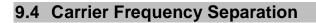


Spectrum Ref Level 23.00 dBm Att 40 dB Offset 1.00 dB ● RBW 30 kHz SWT 63.2 µs ● VBW 100 kHz Mode Auto FFT ●1Pk Max 20 dBm D2[1] -0.26 df 1.26340 MHz Occ Bw 1.172214182 MH 10 dBm -18.40 dBm 2.44035310 GHz M1[1] 01 1.880 dB 0 dBm -10 dBm D2 -18.120 dBm -20 dBm -30 dBm 40-dBA--50 dBm -60 dBm -70 dBm CF 2.441 GHz 691 pts Span 3.0 MHz 03.11.2017 18:52:29 Measuring...

Middle channel 2441MHz







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	2/3 of 20 dB Bandwidth		
MHz	kHz		
2402	619.4		
2441	616.5		
2480	616.5		



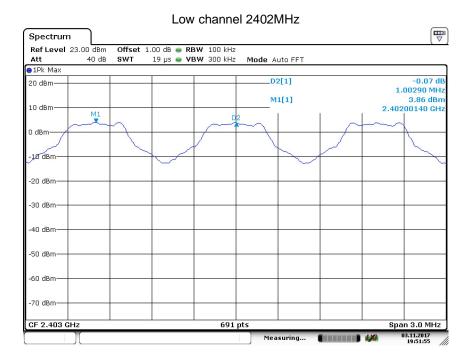


Carrier Frequency Separation

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

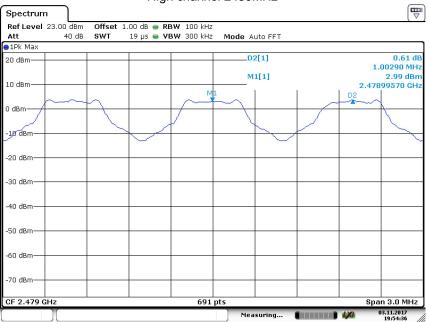




Spectrum Ref Level 23.00 dBm Att 40 dB Offset 1.00 dB ● RBW 100 kHz SWT 19 µs ● VBW 300 kHz Mode Auto FFT ●1Pk Max 20 dBm D2[1] -0.01 dE 1.00290 MHz 3.83 dBm 2.44100000 GHz M1[1] 10 dBm D2 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm CF 2.441 GHz 691 pts Span 3.0 MHz 03.11.2017 19:53:21 Measuring... 11



High channel 2480MHz



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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.

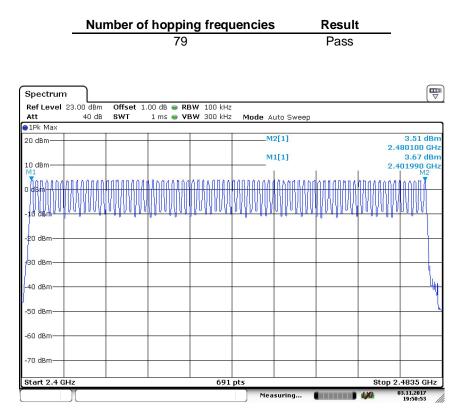
Limit

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.





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];

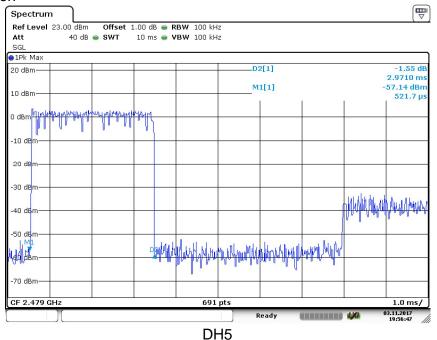
The burst width, which is directly measured, refers to the duration on one channel hop.

The maximum number of hopping channels in 31.6s for DH5=1600 / 6 / 79 *31.6=106.67

Modulation	Mode	Reading (us)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	DH5	2971	106.67	316.92	< 400	Pass
π/4-DQPSK	2DH5	2971	106.67	316.92	< 400	Pass
8-DPSK	3DH5	2971	106.67	316.92	< 400	Pass

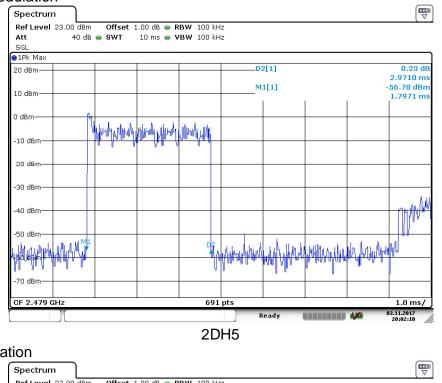
Test Result

GFSK Modulation

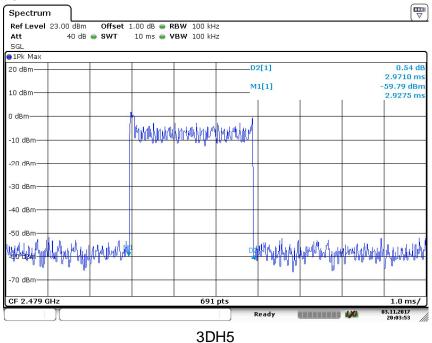




$\pi/4$ -DQPSK Modulation



8-DPSK Modulation





9.7 Spurious RF conducted emissions

Test Method

- 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

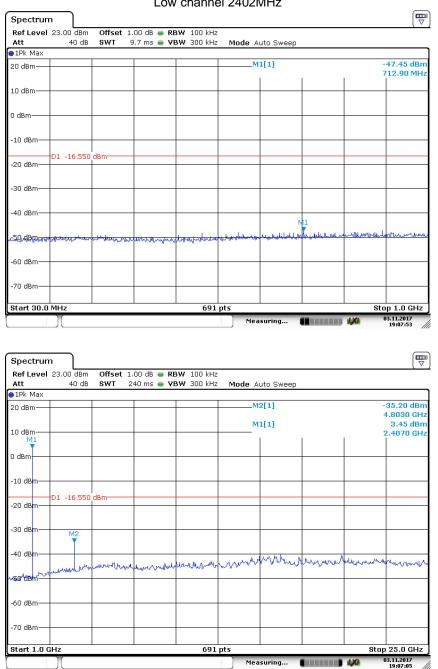
Frequency Range MHz	Limit (dBc)
30-25000	-20



Spurious RF conducted emissions

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

BT3.0 GFSK Modulation:



Low channel 2402MHz



Middle channel 2441MHz

Att	23.00 dBm 40 dB	Offset SWT				100 kHz					
Att 1Pk Max	40 aB	SWI	9.7 ms	5 • Y	BW .	300 kHz	Mode /	Auto Sweep			
20 dBm							N	11[1]			-46.97 dBn
20 0011								1	1		909.50 MH
10 dBm			_								
) dBm			_								
-10 dBm			_								
	D1 -16.330	I dBm									
-20 dBm		-	-		-						
-30 dBm											
-40 dBm											M1
	0 353	75						in the second	www.enthallent	Manushan	V
a SQLOBING	altanartulter	an mouth	human	trenter	www	Humarchal	ىرىغى ھەربىيا ئايلىكىنى مەربىي	International Sector	VIII - VIII - VIII		and collection to the .
-60 dBm											
70 d0											
-70 dBm											
Start 30.0	MUTA					691	nte				top 1.0 GHz
Spectrun								asuring		4,70	_
Ref Level	23.00 dBm		1.00 dB				Ме			1 424	19:09:11
Ref Level Att		Offset SWT				100 kHz 300 kHz	Ме	asuring Auto Sweep		1 424	19:09:11
Ref Level Att 1Pk Max	23.00 dBm						Mode ,			1/2 0	19:09:11
Ref Level Att 1Pk Max	23.00 dBm						Mode ,	Auto Sweep 11[1]			19:09:11 (▼ 3.67 dBn 2.4410 GH:
Ref Level Att 1Pk Max 20 dBm	23.00 dBm						Mode ,	Auto Sweep			19:09:11
Ref Level Att 1Pk Max 20 dBm	23.00 dBm						Mode ,	Auto Sweep 11[1]			19:09:11 ∠ 3.67 dBn 2.4410 GH: -33.89 dBn
Ref Level Att 1Pk Max 20 dBm- 10 dBm- M1	23.00 dBm						Mode ,	Auto Sweep 11[1]			19:09:11 ∠ 3.67 dBn 2.4410 GH: -33.89 dBn
Ref Level Att) 1Pk Max 20 dBm	23.00 dBm						Mode ,	Auto Sweep 11[1]			19:09:11 (
Ref Level Att 1Pk Max 20 dBm 10 dBm M1 0 dBm	23.00 dBm						Mode ,	Auto Sweep 11[1]			19:09:11 (
Ref Level Att 1Pk Max 20 dBm 10 dBm 0 dBm 10 dBm 10 dBm	23.00 dBm	SWT					Mode ,	Auto Sweep 11[1]			19:09:11 ∠ 3.67 dBn 2.4410 GH: -33.89 dBn
Ref Level Att 1Pk Max 20 dBm 10 dBm 0 dBm 10 dBm 10 dBm	23.00 dBm 40 dB	SWT					Mode ,	Auto Sweep 11[1]			19:09:11 ∠ 3.67 dBn 2.4410 GH: -33.89 dBn
Ref Level Att 1Pk Max 20 dBm 10 dBm 	23.00 dBm 40 dB	SWT					Mode ,	Auto Sweep 11[1]			19:09:11 (
Ref Level Att 1Pk Max 20 dBm 10 dBm 	23.00 dBm 40 dB	SWT					Mode ,	Auto Sweep 11[1]			19:09:11 (
Ref Level Att) IPk Max 20 dBm 10 dBm -10 dBm -20 dBm -30 dBm	23.00 dBm 40 dB	SWT					Mode ,	Auto Sweep 11[1]			19:09:11 ∠ 3.67 dBn 2.4410 GH: -33.89 dBn
Ref Level Att) IPk Max 20 dBm 10 dBm -10 dBm -20 dBm -30 dBm	23.00 dBm 40 dB	SWT	240 ms				Mode /	Auto Sweep 11[1]			3.67 dBn 2.4410 GH: -33.89 dBn 4.8730 GH:
Ref Level Att 1Pk Max 20 dBm 10 dBm -10 dBm -20 dBm -30 dBm -40 dBm	23.00 dBm 40 dB	SWT				300 kHz	Mode ,	Auto Sweep			3.67 dBn 2.4410 GH: -33.89 dBn 4.8730 GH:
Att 1Pk Max 20 dBm	23.00 dBm 40 dB	SWT	240 ms			300 kHz	Mode /	Auto Sweep			3.67 dBn 2.4410 GH: -33.89 dBn 4.8730 GH:
Ref Level Att 1Pk Max 20 dBm 10 dBm M1 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	23.00 dBm 40 dB	SWT	240 ms			300 kHz	Mode /	Auto Sweep			3.67 dBn 2.4410 GH: -33.89 dBn 4.8730 GH:
Ref Level Att 1Pk Max 20 dBm 10 dBm -10 dBm -20 dBm -30 dBm -40 dBm	23.00 dBm 40 dB	SWT	240 ms			300 kHz	Mode /	Auto Sweep			3.67 dBn 2.4410 GH: -33.89 dBn 4.8730 GH:
Ref Level Att 1Pk Max 20 dBm 10 dBm M1 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm	23.00 dBm 40 dB	SWT	240 ms			300 kHz	Mode /	Auto Sweep			3.67 dBn 2.4410 GH -33.89 dBn 4.8730 GH
Ref Level Att 11Pk Max 20 dBm 10 dBm -10 dBm -10 dBm -30 dBm -30 dBm -40 dBm -60 dBm	23.00 dBm 40 dB	SWT	240 ms			300 kHz	Mode /	Auto Sweep			3.67 dBn 2.4410 GH: -33.89 dBn 4.8730 GH:



High channel 2480MHz

Att	23.00 dBm 40 dB				♥ 100 kH ♥ 300 kH		uto Sweep			
1Pk Max				-		, iouo ,				
20 dBm			-			N	11[1]			-46.29 dBr 731.20 MH
10 dBm			_							
) dBm——			-							
-10 dBm—			_					-		
-20 dBm—	D1 -17.120) dBm	_							
-20 ubiii										
-30 dBm			-					-		
-40 dBm			_							
								M1	www.mudwu	number
. <u>59.08m-</u>	the second when the	4 Arm Provel	And Hillinger	AUGHUMA	and the second	the second s	(A Think of Provider	and the second		1 OQ 1 II I I I I I I I I I I I I I I I I I
-60 dBm—			_							
-70 dBm—										
, o abiii										
Start 30.0	MH ₂				601	pts				Stop 1.0 GHz
Spectru	 n					Mei	asuring		490	03.11.2017 19:10:04
Spectrur Ref Level	n				V 100 kH	Me4			4 90	19:10:04
Spectrur Ref Level Att	 n					Me4	asuring Auto Sweep		1,4 4	19:10:04
Spectrur Ref Leve Att 1Pk Max	n				V 100 kH	2 2 2 3 3 4 3 4 4 4 4 4 4 4 4 4 4 4 4 4			1,4 4	19:10:04
Spectrur Ref Level Att 1Pk Max 20 dBm	n				V 100 kH	2 2 2 Mode A	auto Sweep			03.11.2017 19:10:04 2.88 dBr 2.4760 GH -32.55 dBr
Spectrur Ref Leve Att 1Pk Max	n				V 100 kH	2 2 2 Mode A	luto Sweep			19:10:04 ,
Spectrur Ref Level Att 1Pk Max 20 dBm	n				V 100 kH	2 2 2 Mode A	luto Sweep			19:10:04 / ▼ 2.88 dBr 2.4760 GH -32.55 dBr
Spectrui Ref Level Att) IPk Max 20 dBm- 10 dBm-) dBm-	n				V 100 kH	2 2 2 Mode A	luto Sweep			19:10:04 / ▼ 2.88 dBr 2.4760 GH -32.55 dBr
Spectrui Ref Level Att) IPk Max 20 dBm- 10 dBm-) dBm-	n				V 100 kH	2 2 2 Mode A	luto Sweep			19:10:04 / ▼ 2.88 dBr 2.4760 GH -32.55 dBr
Spectrui Ref Level Att 1PIPk Max 20 dBm	n	SWT			V 100 kH	2 2 2 Mode A	luto Sweep			19:10:04 / ▼ 2.88 dBr 2.4760 GH -32.55 dBr
Spectrui Ref Level Att 9 IPk Max 20 dBm	n	SWT			V 100 kH	2 2 2 Mode A	luto Sweep			19:10:04 / ▼ 2.88 dBr 2.4760 GH -32.55 dBr
Spectrui Ref Level Att 9 IPk Max 20 dBm	n 23.00 dBm 40 dB	SWT			V 100 kH	2 2 2 Mode A	luto Sweep			19:10:04 / ▼ 2.88 dBr 2.4760 GH -32.55 dBr
Spectrui Ref Level Att 20 dBm	n 123.00 dBm 40 dB	SWT	240 ms		V 100 kH V 300 kH	2 Mode A	uto Sweep 11[1] 12[1]			19:10:04 (
Spectrur Ref Level Att IPk Max 20 dBm	n 23.00 dBm 40 dB	SWT			V 100 kH V 300 kH	2 2 2 Mode A	uto Sweep 11[1] 12[1]			19:10:04 (
Spectrui Ref Level Att 10 IPk Max 20 dBm 10 dBm -10 dBm -10 dBm -20 dBm -30 dBm -40 dBm -40 dBm	n 123.00 dBm 40 dB	SWT	240 ms		V 100 kH V 300 kH	2 Mode A	uto Sweep 11[1] 12[1]			19:10:04 / ▼ 2.88 dBr 2.4760 GH -32.55 dBr
Spectrui Ref Level Att 19 IPk Max 20 dBm	n 123.00 dBm 40 dB	SWT	240 ms		V 100 kH V 300 kH	2 Mode A	uto Sweep 11[1] 12[1]			19:10:04 (
Spectrui Ref Level Att 10 IPk Max 20 dBm 10 dBm -10 dBm -10 dBm -20 dBm -30 dBm -40 dBm -40 dBm	n 123.00 dBm 40 dB	SWT	240 ms		V 100 kH V 300 kH	2 Mode A	uto Sweep 11[1] 12[1]			19:10:04 (



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 ≥ 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.

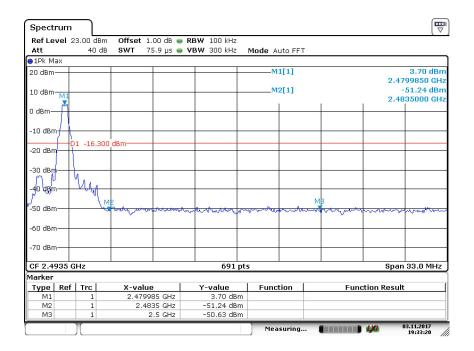
Limit:

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: Hopping OFF

Ref Le	rum	L	Den Officiat	1.00 40 -	RBW 100 k	ll a						(V
RET LE	ver 2		dB SWT		• KBW 100 ki • VBW 300 ki		Mode A	uto Swe	ep			
1Pk M	ах								F			
20 dBm							M	1[1]				3.54 dBn
												02040 GH
10 dBm						_	M	2[1]				-42.26 dBn 100000 CH:
								1	1	1	2.4	HUUUUU GH.
0 dBm–												
-10 dBn	-											
10 000	·	1 16	.460 dBm									
-20 dBn	ע	1 -10.	400 UBIII	_								
-30 dBn	+-י					+						1 14
-40 dBn												M2
	'										M3	J V
se abin	men	newla	une many	monthem	and a second and a second and	enne	minuna	wantere	menodinen	manne	une the deally	mound
-60 dBn	<u>ו</u> רי					+						
-70 dBn	–ר											
Start 2	.31 G	Hz			69	1 pts					Stop	2.405 GHz
1arker												
Туре	Ref	Trc	X-val		Y-value		Func	tion		Funct	ion Result	:
M1		1	2.40	0204 GHz	3.54							
M2 M3		1		2.4 GHz 2.39 GHz	-42.26 -48.98							





GFSK mode: Hopping ON

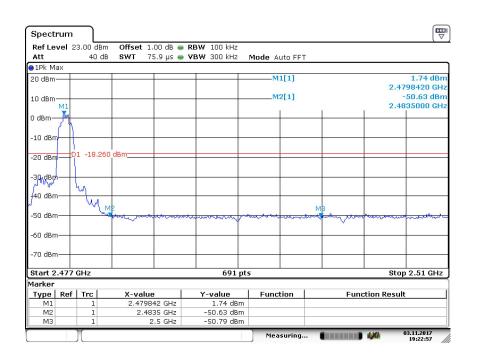
Ref Level Att	23.00 dBr 40 d			Mode Auto Swa	зер	
1Pk Max						
20 dBm				M1[1]		3.49 dBn
						2.403970 GH
10 dBm				M2[1]		-46.12 dBn 2.400000 GA
0 dBm				1	1	2.40000 Gr
-10 dBm						
	D1 -16.51					
-20 dBm	DI -10.51		_			
-30 dBm						
-40 dBm						
-40 ubiii						M2 M3
-50.dBpg	معانية والمعارية والعار		Rugan and and and		Harris Harrison and the	Man up the way
		- 545 578 - 1574	10 A 10 A			
-60 dBm						
-70 dBm						
Start 2.31	GHz		691 pts			Stop 2.405 GHz
larker						
Type Re	Trc	X-value	Y-value	Function	Fun	ction Result
M1	1	2.40397 GHz	3.49 dBm			
M2 M3	1	2.4 GHz 2.39 GHz	-46.12 dBm -49.94 dBm			

Spect	rum									
Ref Le	vel 2				RBW 100 kHz					
Att		40	dB SWT 7:	5.9 µs 👄	VBW 300 kHz	Mode A	uto FFT			
●1Pk M										
20 dBm	-					M	1[1]		0.47	3.70 dBm 99850 GHz
						54	2[1]			99850 GHZ 50.60 dBm
10 dBm	M1						2[1]			35000 GHz
o BemA	M						1	1	1	
h heut-										
Voltes	M									
[†] to ββ⊓										
-20 dBr		1 -16.	300 dBm							
20 000	" []									
-30 dBr	n									
	·	Чла.								
-40 dBn	n-+-	VU								
		V	M2					MB		
-50 dBn	n		how have all and	howard	and more thank		mark	and the second	www.www.	our theme
			- Contraction Section 1997							
-60 dBn	∩———						-			
-70 dBn	∩—†									
CF 2.4	025.0	-11-7			691	nt c				33.0 MHz
Marker	900 0	1112			091				əpun	00.0 1112
Type	Pof	Trc	X-value	, 1	Y-value	Fund	tion	Eun	ction Result	1
M1	Kei	1	2,4799		3.70 dBr			run	ction Result	
M2		1		35 GHz	-50.60 dBr					
MЗ		1	2	.5 GHz	-50.63 dBr	1				
	-	1				Mea	suring.			3.11.2017
		Л					isuring.		140	19:33:58



8DPSK mode: Hopping OFF

Spectru	ım								
Ref Leve	al 23.00 (dBm Offset	1.00 dB 🧉	RBW 100 kHz					
Att	40	db SWT	1.1 ms 🥃	VBW 300 kHz	Mode Auto	Sweep			
⊖1Pk Max									
20 dBm-					M1[1]				1.72 dBm
									402180 GHz
10 dBm—	-				M2[1]	2			-42.80 dBm
					1		1	2.	400000/GHz
0 dBm	-								1
									1 0
-10 dBm-									+ ++
		0000							1 11
-20 dBm-	-01 -18	.280 dBm							
-30 dBm-	-						-		
									M2
-40 dBm-	-						-		INIE -
						7		MB	N
-58-88m-	and and and and	have for the second	and the second second	and a free the state of the second states and a second states and the second states and	and the second	ndun kun te	where a reference	when the starter	a and a second
1000 mil									
-60 dBm-	-		_						-
-70 dBm-									
Start 2.3				601 nt				Pton	2.405 GHz
	or GHZ			691 pt	>			stup	2.403 GHZ
Marker	- 6 T-	1 1		M	1	1	-		
Type F M1	Ref Trc	X-va	HUE 40218 GHz	Y-value 1.72 dBm	Function		Fun	ction Resu	π
M1 M2	1	2.4	2.4 GHz	-42.80 dBm					
M3	1		2.39 GHz	-50.16 dBm					
1.104		1		serve dom	<u></u>		-		03.11.2017
	1 11				Measuri	ng		LXI	19:23:51

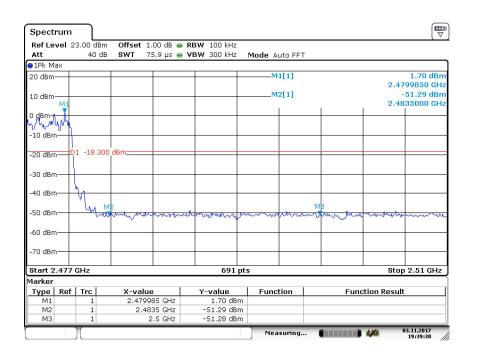


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8DPSK mode: Hopping ON

Refle	vel 2	3.00 dB	m Offset 1	00 dB 👄	RBW 100	kHz						(🛛
Att	101 2	40 0		_	VBW 300		Mode Au	uto Swe	ер			
)1Pk M	ax											
20 dBm	-		_				M:	1[1]				1.60 dBn
												02180 GH: 47.66 dBn
10 dBm	-		-			-	IMD	2[1]				47.66 dBn 00000 (GH:
0 dBm-							1		1	1	2.1	
u ubiii-												/w
-10 dBn	1											
-20 dBn	ק	1 -18.4	00 dBm		_	_						
-30 dBn	ר ו											
-40 dBn												P .
-10 001	'										МЗ	MP
-50'd8a	autor a	مر الغاريب	the all and the second second	-	-	-	and the second	-	-	mantour	L. T.A. mark	A way a way
-60 dBn	י											
70 10												
-70 dBn	די											
Start 2	.31 G	Hz		1	- 6	i91 pts				- 1	Stop 2	2.405 GHz
/larker												
Туре	Ref		X-valu		Y-valu		Funct	ion		Functio	n Result	
M1		1		18 GHz) dBm						
M2 M3		1		2.4 GHz 39 GHz	-47.66							





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, $VBW \ge RBW$ 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 100kHz 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
	MHz	dBuV/m		dBµV/m		dBuV/m	(dB)	
30-	941.42	27.27	Н	46	QP	18.73	-15.4	Pass
1000MHz	440.31	26.41	V	46	QP	19.59	-22.0	Pass
	4804	51.18	Н	74	PK	22.82	2.5	Pass
1000-			Н	54	AV			Pass
25000MHz	4804	50.82	V	74	PK	23.18	2.6	Pass
			V	54	AV			Pass

BT3.0 GFSK Modulation 2402MHz Test Result

BT3.0 GFSK Modulation 2441MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBuV/m		dBµV/m		dBuV/m	(dB)	
30-			Н	43.5	QP			Pass
1000MHz			Н	46	QP			Pass
	4882	49.96	Н	74	PK	24.04	2.5	Pass
1000-			Н	54	AV			Pass
25000MHz	4882	44.80	V	74	PK	29.20	2.6	Pass
			V	54	AV			Pass



BT3.0 GFSK Modulation 2480MHz Test Result

Frequency Band	Frequency	Emission Level	Polarization	Limit	Detector	Margin	Correct factor	Result
	MHz	dBuV/m		dBµV/m		dBuV/m	(dB)	
30-			Н	43.5	QP			Pass
1000MHz			Н	46	QP			Pass
	4960	46.56	Н	74	PK	27.44	2.7	Pass
1000-			Н	54	AV			Pass
25000MHz	4960	46.81	V	74	PK	27.19	2.8	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

Conducted RF tests

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Generator	Rohde & Schwarz	SMB100A	108272	2018-7-7
Signal Analyzer	Rohde & Schwarz	FSV40	101030	2018-7-7
Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2018-7-7
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2018-7-7

Radiated Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2018-7-14
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2018-7-14
Horn Antenna	Rohde & Schwarz	HF907	102294	2018-7-14
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2018-7-14
Signal Generator	Rohde & Schwarz	SMY01	839369/005	2018-7-7
Attenuator	Agilent	8491A	MY39264334	2018-7-7
3m Semi-anechoic chamber	TDK	9X6X6		2020-7-7
Test software	Rohde & Schwarz	EMC32	Version 9.15.00	N/A

Conducted Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2018-7-14
LISN	Rohde & Schwarz	ENV4200	100249	2018-7-14
LISN	Rohde & Schwarz	ENV432	101318	2018-7-14
LISN	Rohde & Schwarz	ENV216	100326	2018-7-14
ISN	Rohde & Schwarz	ENY81	100177	2018-7-14
ISN	Rohde & Schwarz	ENY81-CA6	101664	2018-7-14
High Voltage Probe	Rohde & Schwarz	TK9420(VT94 20)	9420-584	2018-7-14
RF Current Probe	Rohde & Schwarz	EZ-17	100816	2018-7-14
Attenuator	Shanghai Huaxiang	TS2-26-3	080928189	2018-7-7
Test software	Rohde & Schwarz	EMC32	Version9.15.00	N/A

Conducted RF tests

- · Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Band edge



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		
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.99dB; Vertical: 4.97dB;		
Uncertainty for Radiated Emission in 3m chamber 1000MHz-18000MHz	Horizontal: 4.96dB; Vertical: 4.95dB;		
Uncertainty for Conducted RF test with TS 8997	Power level test involved: 1.05dB Frequency test involved: 1.16×10 ⁻⁷		