

FCC Test Report

FCC ID : 2ALXJ-MTW200

Equipment : Meeting OWL™

Model No. : MTW200

Brand Name : OWLLabs™

Applicant : Owl Labs Inc

Address : 33-1/2 Union Sq

Somerville US 02143 United States Of America

Standard : 47 CFR FCC Part 15.247

Received Date : Jul. 17, 2019

Tested Date : Jul. 25 ~ Jul. 31, 2019

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by: Approved by:

Along Cheid/ Assistant Manager Gary Chang / Manager

Testing Laboratory

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Release Record

Report No.	Version	Description	Issued Date
FR971702AD	Rev. 01	Initial issue	Aug. 12, 2019

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Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 4.549MHz 50.14 (Margin -5.86dB) - QP	Pass
15.247(d)	Radiated Emissions	[dBuV/m at 3m]: 2483.50MHz	Pass
15.209	Radiated Emissions	42.54 (Margin -11.46dB) - AV	F d 3 3
15.247(d)	Band Edge	Meet the requirement of limit	Pass
15.247(b)(1)	Conducted Output Power	Power [dBm]: 11.26	Pass
15.247(a)(1)(iii)	Number of Hopping Channels	Meet the requirement of limit	Pass
15.247(a)(1)	Hopping Channel Separation	Meet the requirement of limit	Pass
15.247(a)(1)(iii)	Dwell Time	Meet the requirement of limit	Pass
15.203	Antenna Requirement	Meet the requirement of limit	Pass

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

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1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information						
Frequency Range (MHz) Bluetooth Ch. Frequency Channel Number Data Rate						
2400-2483.5	BR	2402-2480	0-78 [79]	1 Mbps		
2400-2483.5	EDR	2402-2480	0-78 [79]	2 Mbps		
2400-2483.5	EDR	2402-2480	0-78 [79]	3 Mbps		

Note 1: RF output power specifies that Maximum Peak Conducted Output Power.

Note 2: Bluetooth BR uses a GFSK.

Note 3: Bluetooth EDR uses a combination of $\pi/4$ -DQPSK and 8DPSK.

1.1.2 Antenna Details

Ant. No.	Model	Туре	Connector	Gain (dBi)	Remarks
1	SRF2W012-150	PCB	MHF IPEX	3.0dBi	

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	12Vdc from adapter
. one. cappiy Type	12 vae nem adapter

1.1.4 Accessories

	Accessories				
No.	Equipment	Description			
1	AC Adapter	Brand: HOLOTO Model: ADS-40SI-12-2 12036E Power Rating: I/P: 100-240Vac, 50/60Hz, 1A Max O/P: 12Vdc, 3A Power Line: DC 1.49m non-shielded without core AC 2.13m non-shielded without core			
2	USB Cable	1.97m non-shielded without core			

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1.1.5 Channel List

	Frequency band (MHz)				2400~2483.5			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	
0	2402	20	2422	40	2442	60	2462	
1	2403	21	2423	41	2443	61	2463	
2	2404	22	2424	42	2444	62	2464	
3	2405	23	2425	43	2445	63	2465	
4	2406	24	2426	44	2446	64	2466	
5	2407	25	2427	45	2447	65	2467	
6	2408	26	2428	46	2448	66	2468	
7	2409	27	2429	47	2449	67	2469	
8	2410	28	2430	48	2450	68	2470	
9	2411	29	2431	49	2451	69	2471	
10	2412	30	2432	50	2452	70	2472	
11	2413	31	2433	51	2453	71	2473	
12	2414	32	2434	52	2454	72	2474	
13	2415	33	2435	53	2455	73	2475	
14	2416	34	2436	54	2456	74	2476	
15	2417	35	2437	55	2457	75	2477	
16	2418	36	2438	56	2458	76	2478	
17	2419	37	2439	57	2459	77	2479	
18	2420	38	2440	58	2460	78	2480	
19	2421	39	2441	59	2461			

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1.1.6 Test Tool and Duty Cycle

Test Tool	QRCT, Version: 3.0	QRCT, Version: 3.0.298.0			
	Modulation Mode	Duty Cycle (%)	Duty Factor (dB)		
Duty Cycle and Duty Factor	DH5	77.61	1.10		
	3DH5	77.99	1.08		

1.1.7 Power Index of Test Tool

Modulation Mode	Test Frequency (MHz)			
Wodulation Wode	2402	2441	2480	
GFSK/1Mbps	9	9	9	
π/4-DQPSK /2Mbps	9	9	9	
8DPSK/3Mbps	9	9	9	

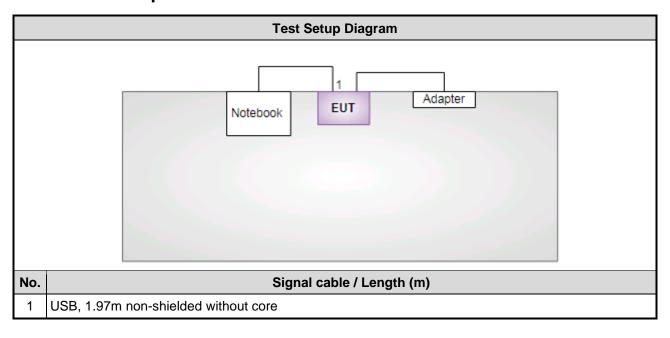
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1.2 Local Support Equipment List

	Support Equipment List					
No.	No. Equipment Brand Model FCC ID Remarks					
1	Notebook	DELL	Latitude E5470	DoC		

1.3 Test Setup Chart



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1.4 The Equipment List

Test Item	Conducted Emission								
Test Site	Conduction room 1 / (CO01-WS)								
Instrument	nt Manufacturer Model No. Serial No. Calibration Date Calibration Until								
Receiver	R&S	ESR3	101657	Jan. 08, 2019	Jan. 07, 2020				
LISN	R&S	ENV216	101579	Mar. 08, 2019	Mar. 07, 2020				
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Nov. 29, 2018	Nov. 28, 2019				
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Oct. 23, 2018	Oct. 22, 2019				
50 ohm terminal (Support Unit)	NA	50	04	May 28, 2019	May 27, 2020				
Measurement Software	AUDIX	e3	6.120210k	NA	NA				
	erval of instruments list		0.1202 TOR	IVA	IVA				

Test Item	Radiated Emission								
Test Site	966 chamber1 / (03Cl	H01-WS)							
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until				
Spectrum Analyzer	R&S	FSV40	101498	Dec. 27, 2018	Dec. 26, 2019				
Receiver	R&S	ESR3	101658	Dec. 11, 2018	Dec. 10, 2019				
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-522	Jul. 12, 2019	Jul. 11, 2020				
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1096	Dec. 18, 2018	Dec. 17, 2019				
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 15, 2018	Nov. 14, 2019				
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 09, 2018	Nov. 08, 2019				
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 08, 2018	Oct. 07, 2019				
Preamplifier	EMC	EMC02325	980225	Jul. 09, 2019	Jul. 08, 2020				
Preamplifier	Agilent	83017A	MY39501308	Oct. 04, 2018	Oct. 03, 2019				
Preamplifier	EMC	EMC184045B	980192	Aug. 09, 2018	Aug. 08, 2019				
RF Cable	EMC	EMC104-SM-SM-80 00	181106	Oct. 08, 2018	Oct. 07, 2019				
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16019/4	Oct. 08, 2018	Oct. 07, 2019				
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16014/4	Oct. 08, 2018	Oct. 07, 2019				
LF cable 1M	EMC	EMCCFD400-NM-N M-1000	160502	Oct. 08, 2018	Oct. 07, 2019				
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-001	Oct. 08, 2018	Oct. 07, 2019				
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-002	Oct. 08, 2018	Oct. 07, 2019				
Measurement AUDIX Software		e3 6.120210g		NA	NA				
Note: Calibration Inter	rval of instruments liste	d above is one year.							

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Test Item	RF Conducted									
Test Site	(TH01-WS)									
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until					
Spectrum Analyzer	R&S	FSV40	101063	Apr. 17, 2019	Apr. 16, 2020					
Spectrum Analyzer	R& S	FSV40	101499	Jan. 07, 2019	Jan. 06, 2020					
Power Meter	Anritsu	ML2495A	1241002	Oct. 09, 2018	Oct. 08, 2019					
Power Sensor	Anritsu	MA2411B	1207366	Oct. 09, 2018	Oct. 08, 2019					
DC POWER SOURCE	GW INSTEK	GPC-6030D	EM892433	Oct. 25, 2018	Oct. 24, 2019					
AC POWER SOURCE	APC	AFC-500W	F312060012	Nov. 29, 2018	Nov. 28, 2019					
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA					
Note: Calibration Inte	Note: Calibration Interval of instruments listed above is one year.									

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1.5 Test Standards

According to the specification of EUT, the EUT must comply with following standards and KDB documents.

47 CFR FCC Part 15.247 ANSI C63.10-2013 FCC KDB 558074 D01 15.247 Meas Guidance v05r02

1.6 Deviation from Test Standard and Measurement Procedure

None

1.7 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty								
Parameters	Uncertainty							
Bandwidth	±34.130 Hz							
Conducted power	±0.808 dB							
Power density	±0.583 dB							
Conducted emission	±2.715 dB							
AC conducted emission	±2.92 dB							
Radiated emission ≤ 1GHz	±3.41 dB							
Radiated emission > 1GHz	±4.59 dB							

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2 Test Configuration

2.1 Testing Condition

Test Item Test Site		Ambient Condition	Tested By		
AC Conduction	CO01-WS	24°C / 58%	Alex Tsai		
Radiated Emissions	03CH01-WS	25-27°C / 65-66%	Akun Chung		
RF Conducted	TH01-WS	24°C / 65%	Brad Wu		

FCC Designation No.: TW2732FCC site registration No.: 181692

➤ ISED#: 10807A

➤ CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate (Mbps)	Test Configuration
Conducted Emissions	GFSK	2402	1Mbps	
Radiated Emissions ≤ 1GHz	GFSK	2402	1Mbps	
Radiated Emissions > 1GHz	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	
Conducted Output Power	GFSK л/4 DQPSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480 2402, 2441, 2480	1Mbps 2Mbps 3Mbps	
Number of Hopping Channels	GFSK л/4 DQPSK 8DPSK	2402~2480 2402~2480 2402~2480	1Mbps 2Mbps 3Mbps	
Hopping Channel Separation 20dB and Occupied bandwidth	GFSK л/4 DQPSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480 2402, 2441, 2480	1Mbps 2Mbps 3Mbps	
Dwell Time	GFSK л/4 DQPSK 8DPSK	2441 2441 2441	1Mbps 2Mbps 3Mbps	

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3 Transmitter Test Results

3.1 Conducted Emissions

3.1.1 Limit of Conducted Emissions

Conducted Emissions Limit							
Frequency Emission (MHz)	Quasi-Peak	Average					
0.15-0.5	66 - 56 *	56 - 46 *					
0.5-5	56	46					
5-30	60	50					
Note 1: * Decreases with the logarithm of the frequency.							

3.1.2 Test Procedures

- 1. The device is placed on a test table, raised 80 cm above the reference ground plane. The vertical conducting plane is located 40 cm to the rear of the device.
- 2. The device is connected to line impedance stabilization network (LISN) and other accessories are connected to other LISN. Measured levels of AC power line conducted emission are across the 50 Ω LISN port.
- 3. AC conducted emission measurements is made over frequency range from 150 kHz to 30 MHz.
- 4. This measurement was performed with AC 120V/60Hz

3.1.3 Test Setup



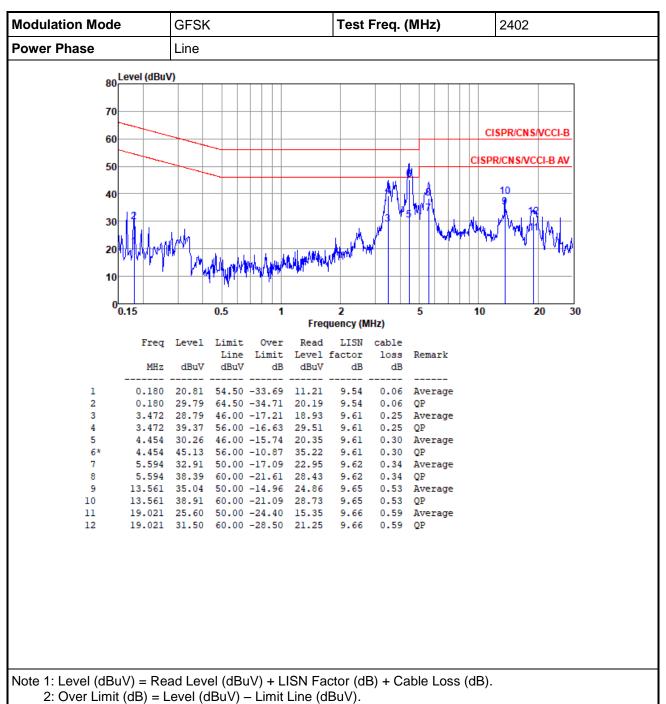
Note: 1. Support units were connected to second LISN.

Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

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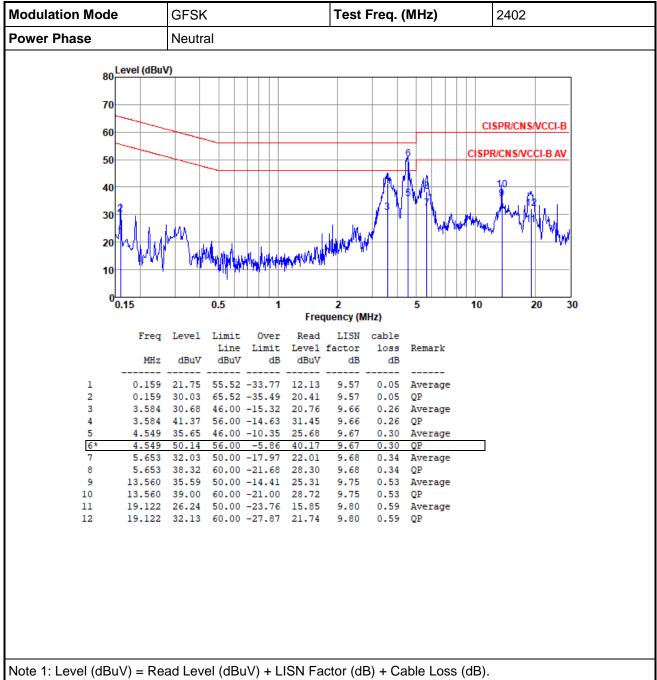


3.1.4 Test Result of Conducted Emissions



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2: Over Limit (dB) = Level (dBuV) - Limit Line (dBuV).

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3.2 Unwanted Emissions into Restricted Frequency Bands

3.2.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit									
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)						
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300						
0.490~1.705	24000/F(kHz)	33.8 - 23	30						
1.705~30.0	30	29	30						
30~88	100	40	3						
88~216	150	43.5	3						
216~960	200	46	3						
Above 960	500	54	3						

Note 1:

Qusai-Peak value is measured for frequency below 1GHz except for 9–90 kHz, 110–490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit **Note 2**:

Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

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3.2.2 Test Procedures

- 1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m
- 2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
- 3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

3.

- 1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
- 2. Radiated emission above 1GHz / Peak value RBW=1MHz, VBW=3MHz and Peak detector

Radiated emission above 1GHz / Average value for harmonics
The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula for DH5 packet type which has worst duty factor:

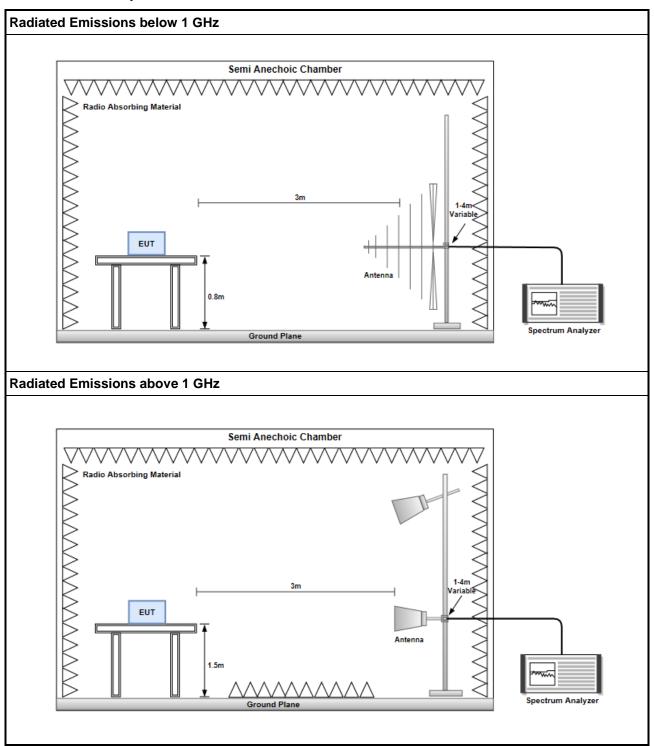
20log (Duty cycle) = 20log
$$\frac{1s / 1600 * 5}{100 \text{ ms}}$$
 = -30.1dB

4. Radiated emission above 1GHz / Average value for other emissions RBW=1MHz, VBW=1/T and Peak detector

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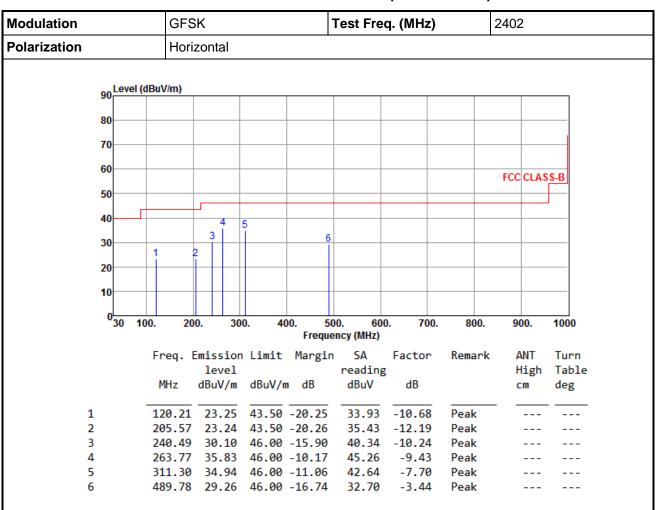
3.2.3 Test Setup



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3.2.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

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Modulation			GFSK T				Test Freq. (MHz)			2402	
Polarization			Vertical								
	90 Le	vel (dBu	V/m)								
	00										
	80										
	70										
	60										
										FCC CLA	SS-B
	50										
	40			_							
	30-			4	5	6					
	30	1 2	2 3 1								
	20										
	10										
	030	100.	20	0. 30	0. 40	00. 50 Freque	0. 600 ncy (MHz)	0. 700.	800.	900.	1000
		F	rea. I	mission	limit	Margin		Factor	Remark	ANT	Turn
			4	level		1101 6211	reading		ricinar ic	High	
		ı	MHz	dBuV/m	dBuV/r	n dB	dBuV	dB		cm	deg
	1	_	67.83	24.61	40.00	-15.39	34.70	-10.09	Peak		
	2		30.88			-18.30	34.86	-9.66	Peak		
	3		59.01	26.30		-17.20	34.73	-8.43	Peak		
	4		63.77	28.60		-17.40	38.03	-9.43	Peak		
	5		11.30	31.18		-14.82	38.88	-7.70	Peak		
•	6	4	55.83	30.06	40.00	-15.94	34.07	-4.01	Peak		

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain

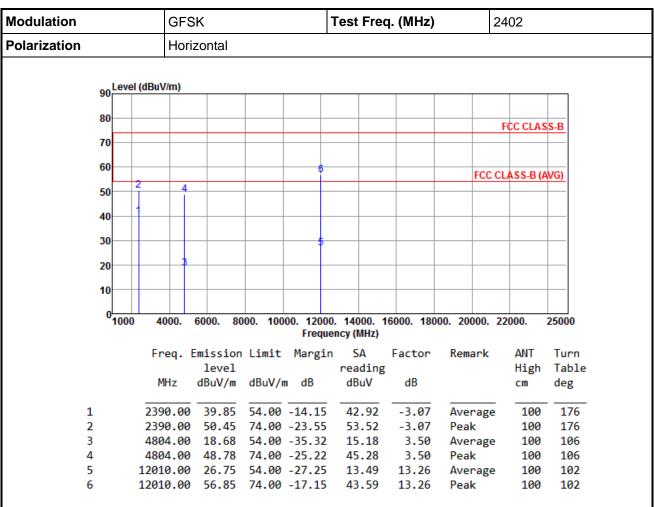
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.

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3.2.5 Transmitter Radiated Unwanted Emissions (Above 1GHz) for GFSK



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

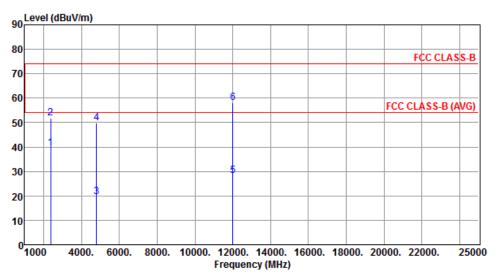
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		



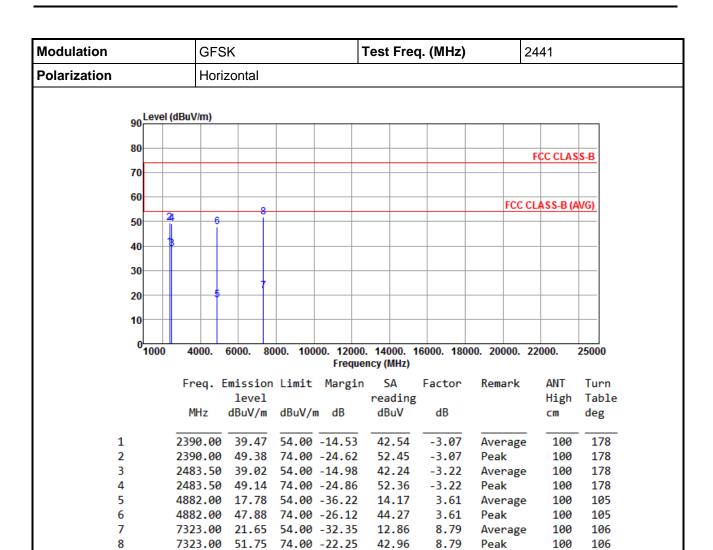
	Freq. MHz	Emission level dBuV/m		Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	39.63	54.00	-14.37	42.70	-3.07	Average	262	81
2	2390.00	51.88	74.00	-22.12	54.95	-3.07	Peak	262	81
3	4804.00	19.56	54.00	-34.44	16.06	3.50	Average	100	158
4	4804.00	49.66	74.00	-24.34	46.16	3.50	Peak	100	158
5	12010.00	28.15	54.00	-25.85	14.89	13.26	Average	100	150
6	12010.00	58.25	74.00	-15.75	44.99	13.26	Peak	100	150

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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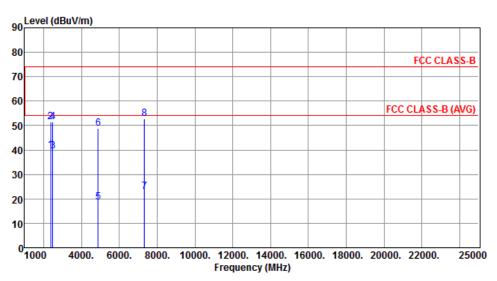
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation	GFSK	Test Freq. (MHz)	2441
Polarization	Vertical		



	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	2390.00	39.93	54.00	-14.07	43.00	-3.07	Average	271	85
2	2390.00	51.45	74.00	-22.55	54.52	-3.07	Peak	271	85
3	2483.50	39.47	54.00	-14.53	42.69	-3.22	Average	271	85
4	2483.50	51.60	74.00	-22.40	54.82	-3.22	Peak	271	85
5	4882.00	18.72	54.00	-35.28	15.11	3.61	Average	105	144
6	4882.00	48.82	74.00	-25.18	45.21	3.61	Peak	105	144
7	7323.00	22.79	54.00	-31.21	14.00	8.79	Average	100	142
8	7323.00	52.89	74.00	-21.11	44.10	8.79	Peak	100	142

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation			GFS	K		-	Test Fred	ղ. (MHz)	2	2480	
Polarization			Horizontal								
	90¦	Level	(dBuV/m)								
	80										
	00									FCC CLAS	S-B
	70										
	60		2								
	•	L .		6					FCC (CLASS-B (A	WG)
	50		1 1								
	40										
	30										
	20	_	3								
	10										
	0	1000	4000.	6000. 80	00. 100	00 12000	14000 1	6000 100	00. 20000.	22000	25000
		1000	4000.	0000. 80	00. 100		ncy (MHz)	0000. 100	00. 20000.	22000.	23000
			Freq. E	mission	Limit	Margin	SA	Factor	Remark	ANT	Turn
				level		_	reading			High	Table
			MHz	dBuV/m	dBuV/r	n dB	dBuV	dB		cm	deg
1	1		2483.50	38.03	54.00	-15.97	41.25	-3.22	Average	100	177
	2		2483.50				59.54	-3.22	Peak	100	177
3	3		4960.00	18.18	54.00	-35.82	14.32	3.86	Average	110	103
			40.00	40 00	74 00	05 70	44 40	3 00	D 1	440	400

74.00 -25.72

44.42

14.05

44.15

3.86

8.54

8.54

Peak

Peak

Average

110

100

100

103

108

108

Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

4960.00 48.28

7440.00 22.59 54.00 -31.41

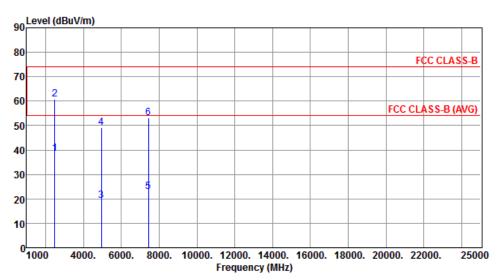
7440.00 52.69 74.00 -21.31

5

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Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	2483.50	38.67	54.00	-15.33	41.89	-3.22	Average	268	84
2	2483.50	60.73	74.00	-13.27	63.95	-3.22	Peak	268	84
3	4960.00	19.18	54.00	-34.82	15.32	3.86	Average	110	154
4	4960.00	49.28	74.00	-24.72	45.42	3.86	Peak	110	154
5	7440.00	22.96	54.00	-31.04	14.42	8.54	Average	100	144
6	7440.00	53.06	74.00	-20.94	44.52	8.54	Peak	100	144

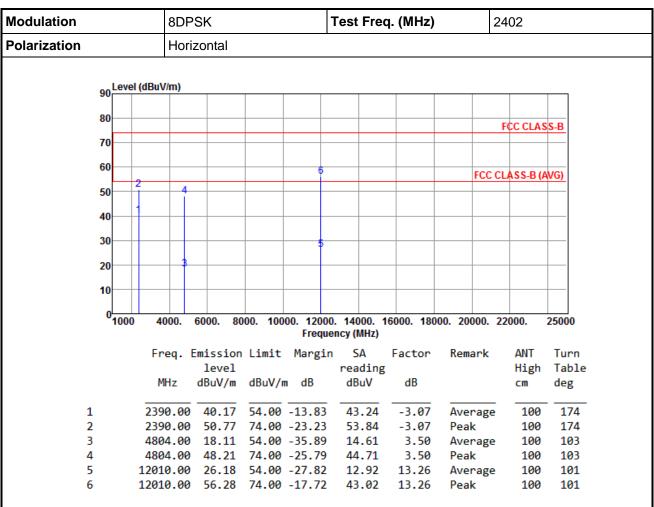
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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3.2.6 Transmitter Radiated Unwanted Emissions (Above 1GHz) for 8DPSK



Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

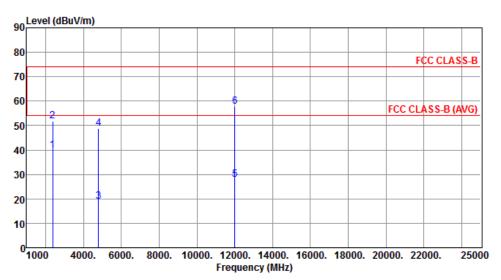
*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) - Limit (dBuV/m).

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Modulation	8DPSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	2390.00	39.89	54.00	-14.11	42.96	-3.07	Average	251	86
2	2390.00	51.91	74.00	-22.09	54.98	-3.07	Peak	251	86
3	4804.00	18.83	54.00	-35.17	15.33	3.50	Average	100	153
4	4804.00	48.93	74.00	-25.07	45.43	3.50	Peak	100	153
5	12010.00	27.74	54.00	-26.26	14.48	13.26	Average	100	148
6	12010.00	57.84	74.00	-16.16	44.58	13.26	Peak	100	148

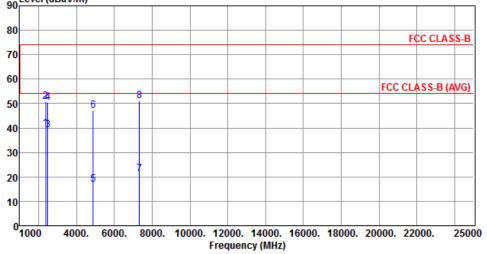
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation	8DPSK	8DPSK			Test Freq. (MHz)				2441		
Polarization	Horizonta	Horizontal									
0	Level (dB	ıV/m)									
	Level (dB	uV/m)									



	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	2390.00	39.74	54.00	-14.26	42.81	-3.07	Average	100	172
2	2390.00	50.73	74.00	-23.27	53.80	-3.07	Peak	100	172
3	2483.50	39.33	54.00	-14.67	42.55	-3.22	Average	100	172
4	2483.50	50.42	74.00	-23.58	53.64	-3.22	Peak	100	172
5	4882.00	16.95	54.00	-37.05	13.34	3.61	Average	100	106
6	4882.00	47.05	74.00	-26.95	43.44	3.61	Peak	100	106
7	7323.00	21.21	54.00	-32.79	12.42	8.79	Average	100	107
8	7323.00	51.31	74.00	-22.69	42.52	8.79	Peak	100	107

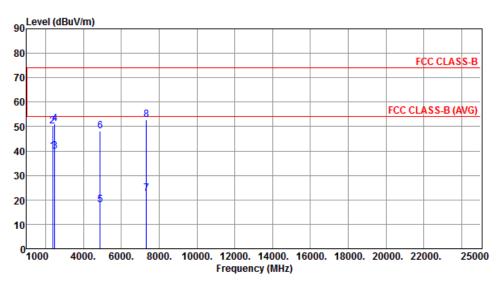
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Modulation	8DPSK	Test Freq. (MHz)	2441
Polarization	Vertical		



	Freq.	Emission level	Limit	Margin	SA reading	Factor	Remark	ANT High	Turn Table
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB		cm	deg
1	2390.00	39.80	54.00	-14.20	42.87	-3.07	Average	278	82
2	2390.00	50.14	74.00	-23.86	53.21	-3.07	Peak	278	82
3	2483.50	39.99	54.00	-14.01	43.21	-3.22	Average	278	82
4	2483.50	51.03	74.00	-22.97	54.25	-3.22	Peak	278	82
5	4882.00	18.00	54.00	-36.00	14.39	3.61	Average	100	142
6	4882.00	48.10	74.00	-25.90	44.49	3.61	Peak	100	142
7	7323.00	22.64	54.00	-31.36	13.85	8.79	Average	100	140
8	7323.00	52.74	74.00	-21.26	43.95	8.79	Peak	100	140

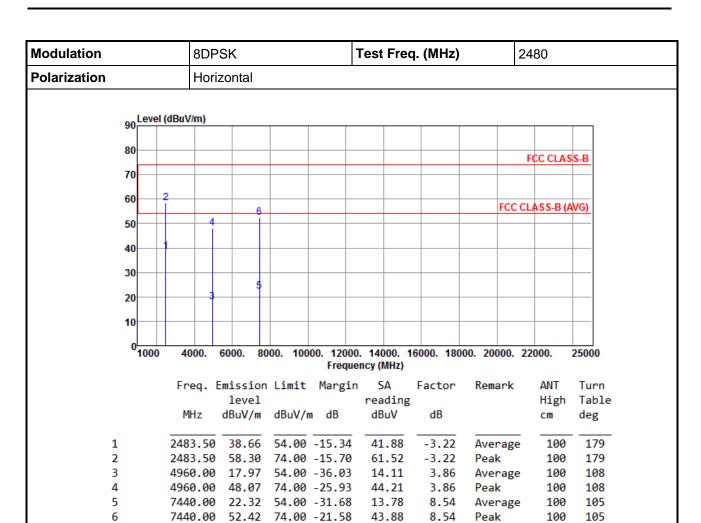
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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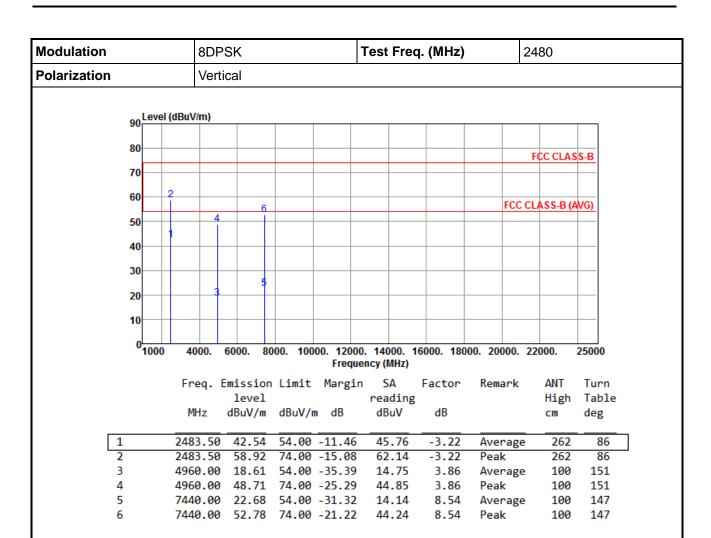


Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor, cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor , cable loss and amplifier gain

Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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3.3 Unwanted Emissions into Non-Restricted Frequency Bands

3.3.1 Limit of Unwanted Emissions into Non-Restricted Frequency Bands

Peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

3.3.2 Test Procedures

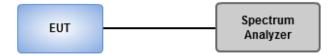
Reference level measurement

- 1. Set RBW=100kHz, VBW = 300kHz, Detector = Peak, Sweep time = Auto
- Trace = max hold , Allow Trace to fully stabilize
- 3. Use the peak marker function to determine the maximum PSD level

Emission level measurement

- 1. Set RBW=100kHz, VBW = 300kHz, Detector = Peak, Sweep time = Auto
- 2. Trace = max hold, Allow Trace to fully stabilize
- 3. Scan Frequency range is up to 25GHz
- 4. Use the peak marker function to determine the maximum amplitude level

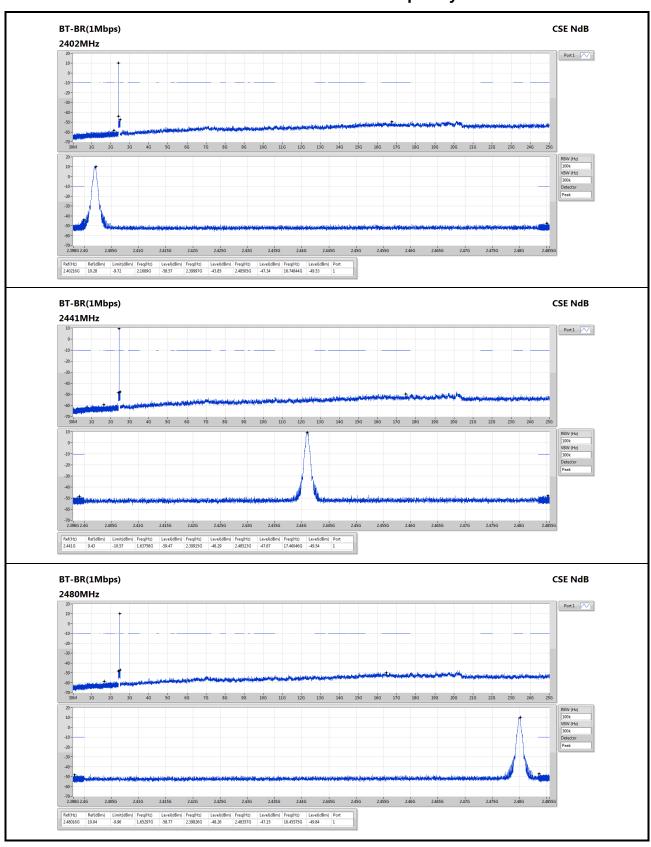
3.3.3 Test Setup



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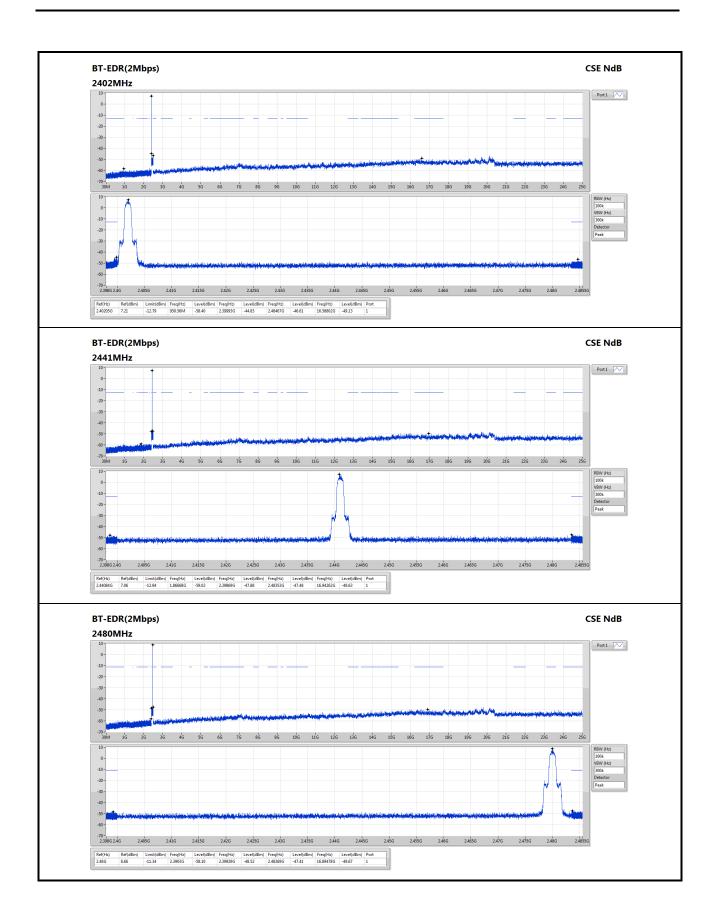


3.3.4 Unwanted Emissions into Non-Restricted Frequency Bands



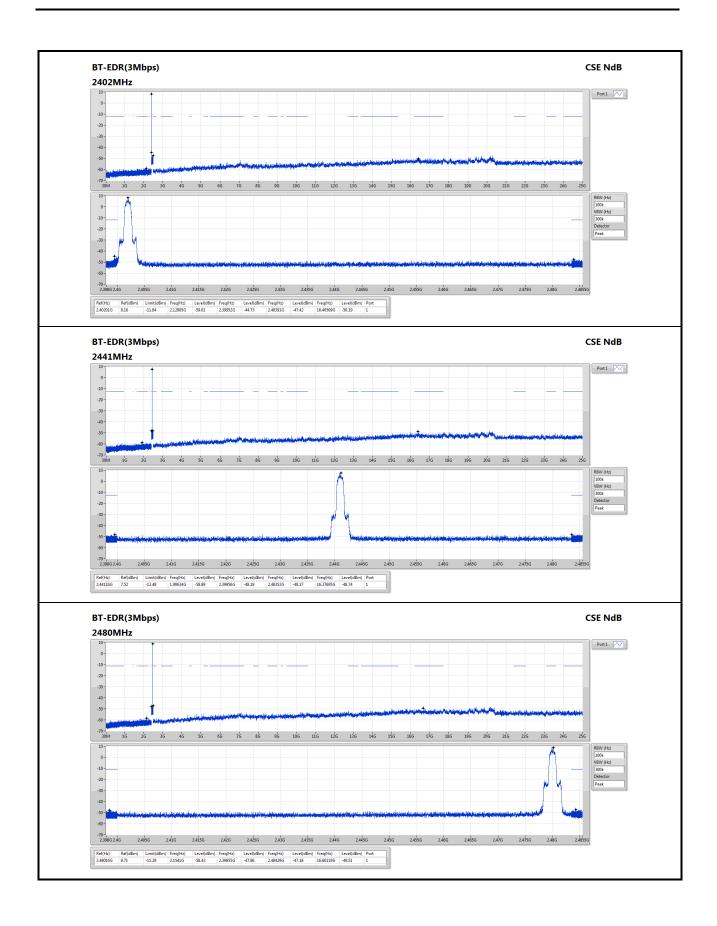
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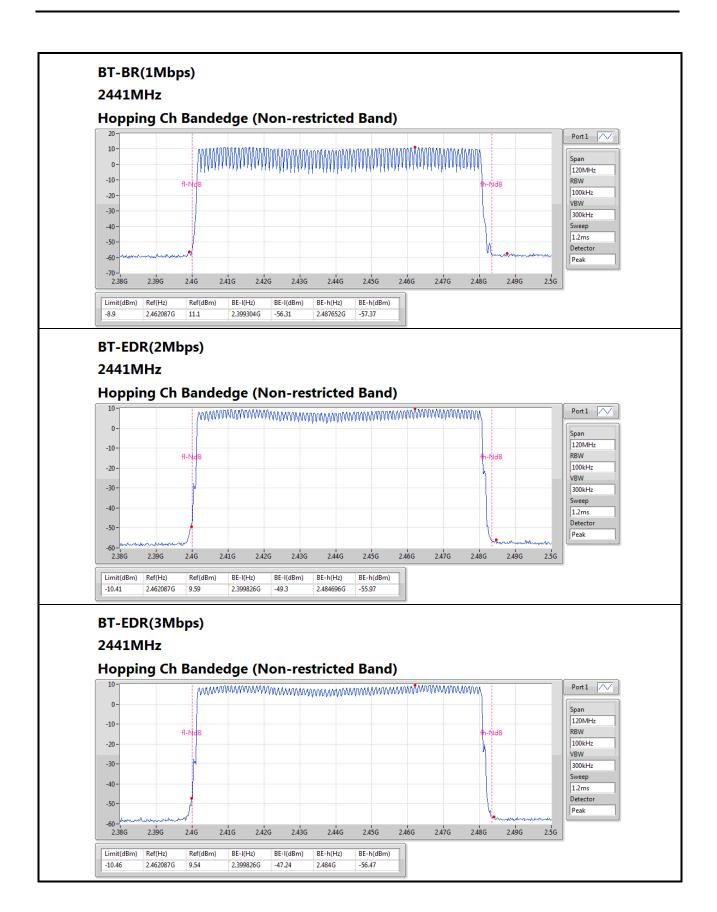
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3.4 Conducted Output Power

3.4.1 Limit of Conducted Output Power

1 Watt For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band.
0.125 Watt For all other frequency hopping systems in the 2400–2483.5 MHz band.
0.125 Watt For Frequency hopping systems operating in the 2400–2483.5 MHz band have hopping channel carrier frequencies that are separated by two-thirds of the 20 dB bandwidth of the hopping channel.

3.4.2 Test Procedures

- 1. A wideband power meter is used for power measurement. Bandwidth of power senor and meter is 50MHz
- 2 If duty cycle of test signal is not 100 %, trigger and gating function of power meter will be enabled to capture transmission burst for measuring output power

3.4.3 Test Setup



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3.4.4 Test Result of Conducted Output Power

Peak Power

Summary

Mode	Power	Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
BT-BR(1Mbps)	11.26	0.01337
BT-EDR(2Mbps)	10.81	0.01205
BT-EDR(3Mbps)	11.02	0.01265

Result

Mode	Result	Gain	Power	Power Limit
		(dBi)	(dBm)	(dBm)
BT-BR(1Mbps)	-	-	-	-
2402MHz	Pass	3.00	11.26	21.00
2441MHz	Pass	3.00	10.84	21.00
2480MHz	Pass	3.00	11.18	21.00
BT-EDR(2Mbps)	-	-	-	-
2402MHz	Pass	3.00	10.75	21.00
2441MHz	Pass	3.00	10.26	21.00
2480MHz	Pass	3.00	10.81	21.00
BT-EDR(3Mbps)	-	-	-	-
2402MHz	Pass	3.00	11.01	21.00
2441MHz	Pass	3.00	10.55	21.00
2480MHz	Pass	3.00	11.02	21.00

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Average Power

Summary

Mode	Power	Power
	(dBm)	(W)
2.4-2.4835GHz	-	-
BT-BR(1Mbps)	11.16	0.01306
BT-EDR(2Mbps)	9.16	0.00824
BT-EDR(3Mbps)	9.16	0.00824

Result

Mode	Result	Gain	Power	Power Limit
		(dBi)	(dBm)	(dBm)
BT-BR(1Mbps)	-	-	-	-
2402MHz	Pass	3.00	11.16	-
2441MHz	Pass	3.00	10.74	-
2480MHz	Pass	3.00	11.09	-
BT-EDR(2Mbps)	-	-	-	-
2402MHz	Pass	3.00	8.56	-
2441MHz	Pass	3.00	8.02	-
2480MHz	Pass	3.00	9.16	-
BT-EDR(3Mbps)	-	-	-	-
2402MHz	Pass	3.00	8.56	-
2441MHz	Pass	3.00	8.01	-
2480MHz	Pass	3.00	9.16	-

Note: Average power is for reference only.

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3.5 Number of Hopping Frequency

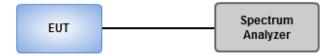
3.5.1 Limit of Number of Hopping Frequency

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

3.5.2 Test Procedures

- 1. Set RBW = 100kHz, VBW = 300kHz, Sweep time = Auto, Detector = Peak Trace max hold.
- 2 Allow trace to stabilize.

3.5.3 Test Setup



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3.5.4 Test Result of Number of Hopping Frequency

Summary

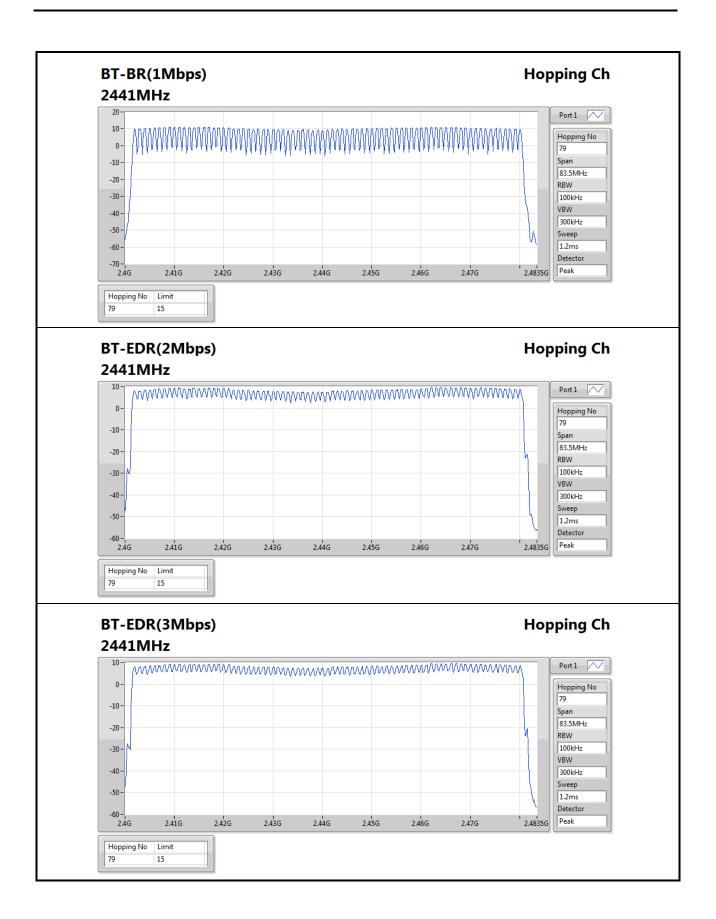
Mode	Max-Hop No
2.4-2.4835GHz	-
BT-BR(1Mbps)	79
BT-EDR(2Mbps)	79
BT-EDR(3Mbps)	79

Result

result				
Mode	Result	Hopping No	Limit	
BT-BR(1Mbps)	-	-	-	
2441MHz	Pass	79	15	
BT-EDR(2Mbps)	-	-	-	
2441MHz	Pass	79	15	
BT-EDR(3Mbps)	-	-	-	
2441MHz	Pass	79	15	

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3.6 20dB and Occupied Bandwidth

3.6.1 Test Procedures

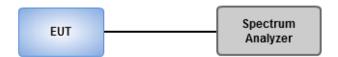
20dB Bandwidth

- Set RBW=10kHz VBW= 30kHz for BT BR mode, RBW=20kHz, VBW=100kHz for other modes, Sweep time = Auto, Detector=Peak, Trace max hold
- 2 Allow trace to stabilize
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Occupied Bandwidth

- Set RBW=10kHz VBW= 30kHz for BT BR mode, RBW=20kHz, VBW=100kHz for other modes, Sweep time = Auto, Detector=Sample, Trace max hold
- 2 Allow trace to stabilize
- 3. Use Occupied bandwidth function of spectrum analyzer to measuring 99% occupied bandwidth

3.6.2 Test Setup



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3.6.3 Test result of 20dB and Occupied Bandwidth

Summary

Mode	Max-N dB	Max-OBW	ITU-Code	Min-N dB	Min-OBW
	(Hz)	(Hz)		(Hz)	(Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-BR(1Mbps)	916.667k	828.509k	829KF1D	876.812k	828.509k
BT-EDR(2Mbps)	1.351M	1.212M	1M21G1D	1.283M	1.179M
BT-EDR(3Mbps)	1.341M	1.212M	1M21G1D	1.268M	1.183M

Max-N dB = Maximum 20dB down bandwidth; **Max-OBW** = Maximum 99% occupied bandwidth; **Min-N dB** = Minimum 20dB down bandwidth; **Min-OBW** = Minimum 99% occupied bandwidth;

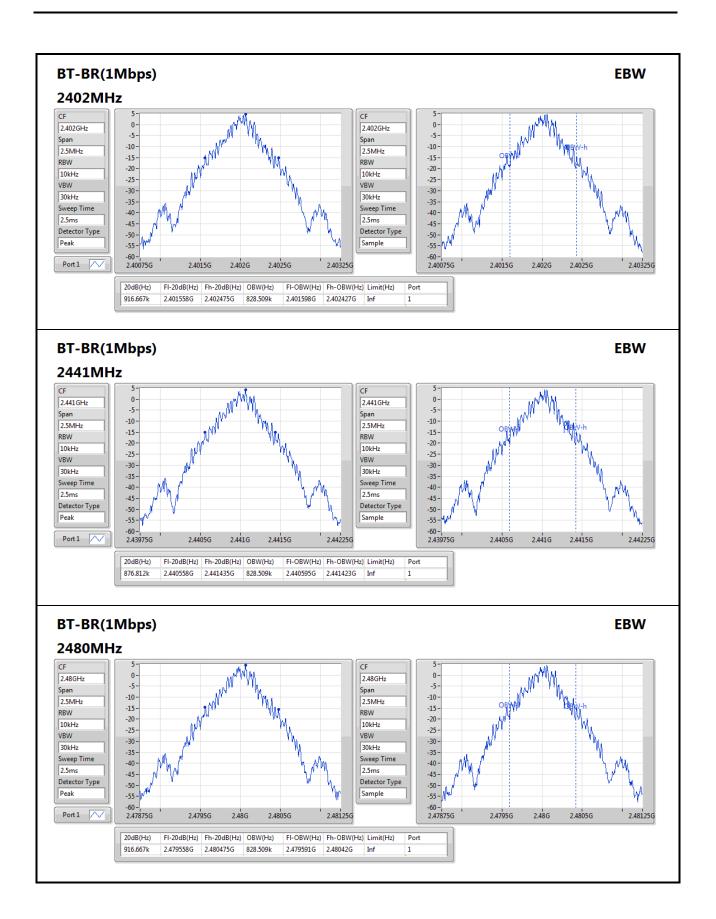
Result

Mode	Result	Limit	Port 1-N dB	Port 1-OBW
		(Hz)	(Hz)	(Hz)
BT-BR(1Mbps)	-	-	-	-
2402MHz	Pass	Inf	916.667k	828.509k
2441MHz	Pass	Inf	876.812k	828.509k
2480MHz	Pass	Inf	916.667k	828.509k
BT-EDR(2Mbps)	-	-	-	-
2402MHz	Pass	Inf	1.283M	1.179M
2441MHz	Pass	Inf	1.326M	1.179M
2480MHz	Pass	Inf	1.351M	1.212M
BT-EDR(3Mbps)	-	-	-	-
2402MHz	Pass	Inf	1.268M	1.183M
2441MHz	Pass	Inf	1.341M	1.19M
2480MHz	Pass	Inf	1.341M	1.212M

Port X-N dB = Port X 20dB down bandwidth; Port X-OBW = Port X 99% occupied bandwidth;

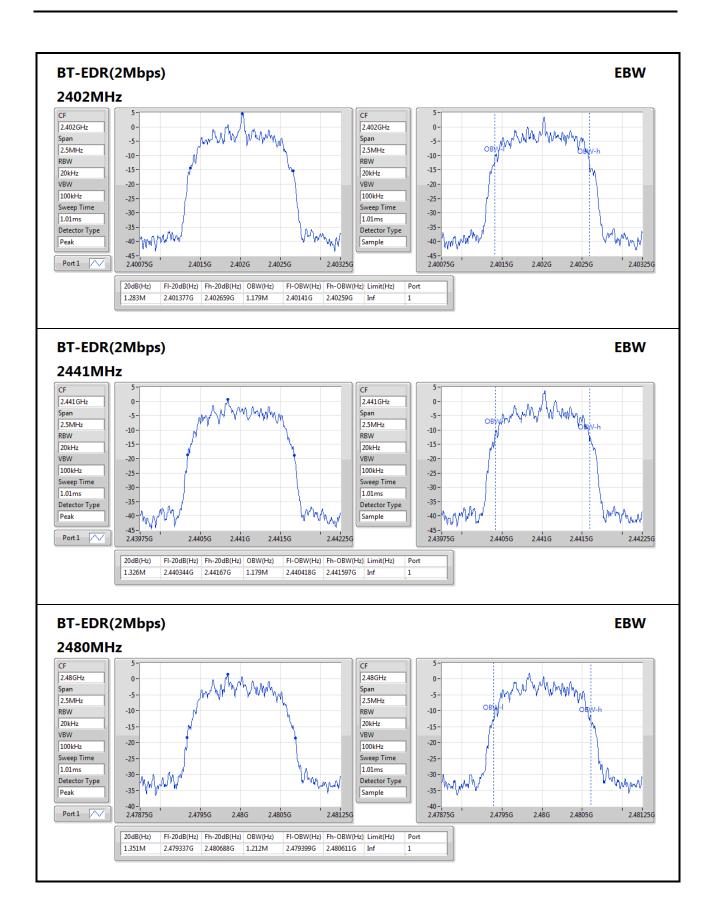
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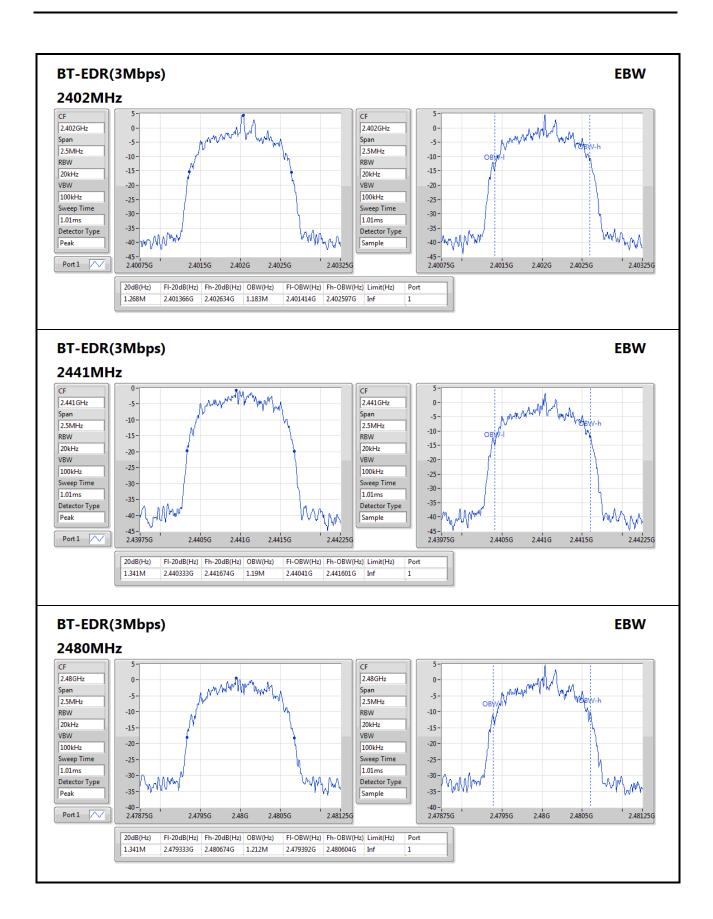
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3.7 Channel Separation

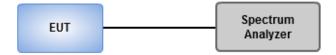
3.7.1 Limit of Channel Separation

- Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
- Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

3.7.2 Test Procedures

- 1. Set RBW=30kHz, VBW=100kHz, Sweep time = Auto, Detector=Peak Trace max hold
- 2 Allow trace to stabilize
- 3 Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The EUT shall show compliance with the appropriate regulatory limit

3.7.3 Test Setup



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3.7.4 Test result of Channel Separation

Summary

Mode	Max-N dB	Max-OBW	ITU-Code	Min-N dB	Min-OBW
	(Hz)	(Hz)		(Hz)	(Hz)
2.4-2.4835GHz	-	-	-	-	-
BT-BR(1Mbps)	916.667k	828.509k	829KF1D	876.812k	828.509k
BT-EDR(2Mbps)	1.351M	1.212M	1M21G1D	1.283M	1.179M
BT-EDR(3Mbps)	1.341M	1.212M	1M21G1D	1.268M	1.183M

Max-N dB = Maximum 20dB down bandwidth; **Max-OBW** = Maximum 99% occupied bandwidth; **Min-N dB** = Minimum 20dB down bandwidth; **Min-OBW** = Minimum 99% occupied bandwidth;

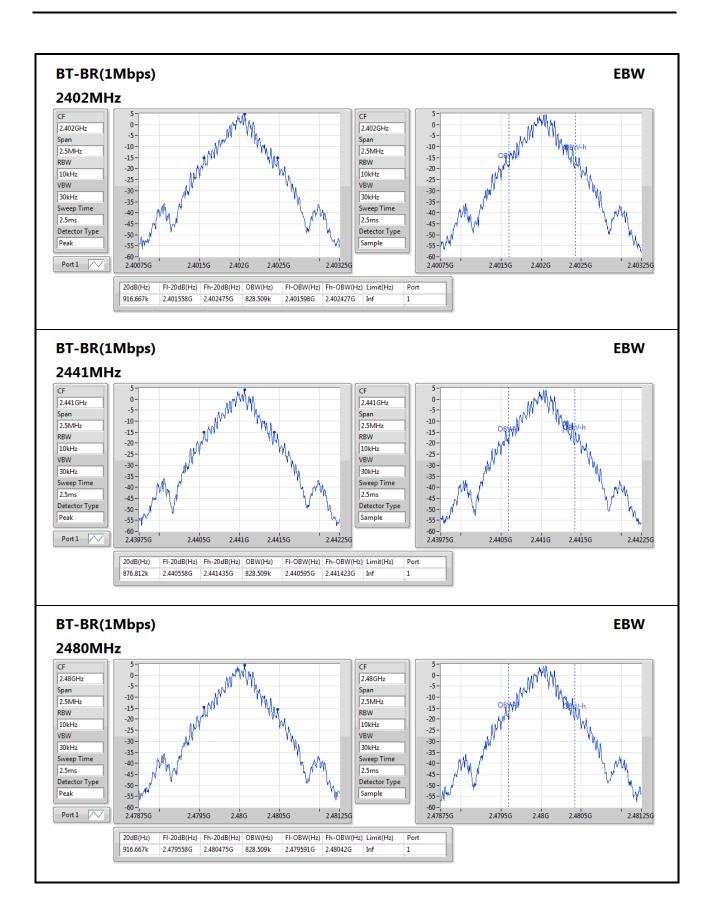
Result

Mode	Result	Limit	Port 1-N dB	Port 1-OBW
		(Hz)	(Hz)	(Hz)
BT-BR(1Mbps)	-	-	-	-
2402MHz	Pass	Inf	916.667k	828.509k
2441MHz	Pass	Inf	876.812k	828.509k
2480MHz	Pass	Inf	916.667k	828.509k
BT-EDR(2Mbps)	-	-	-	-
2402MHz	Pass	Inf	1.283M	1.179M
2441MHz	Pass	Inf	1.326M	1.179M
2480MHz	Pass	Inf	1.351M	1.212M
BT-EDR(3Mbps)	-	-	-	-
2402MHz	Pass	Inf	1.268M	1.183M
2441MHz	Pass	Inf	1.341M	1.19M
2480MHz	Pass	Inf	1.341M	1.212M

Port X-N dB = Port X 20dB down bandwidth; Port X-OBW = Port X 99% occupied bandwidth;

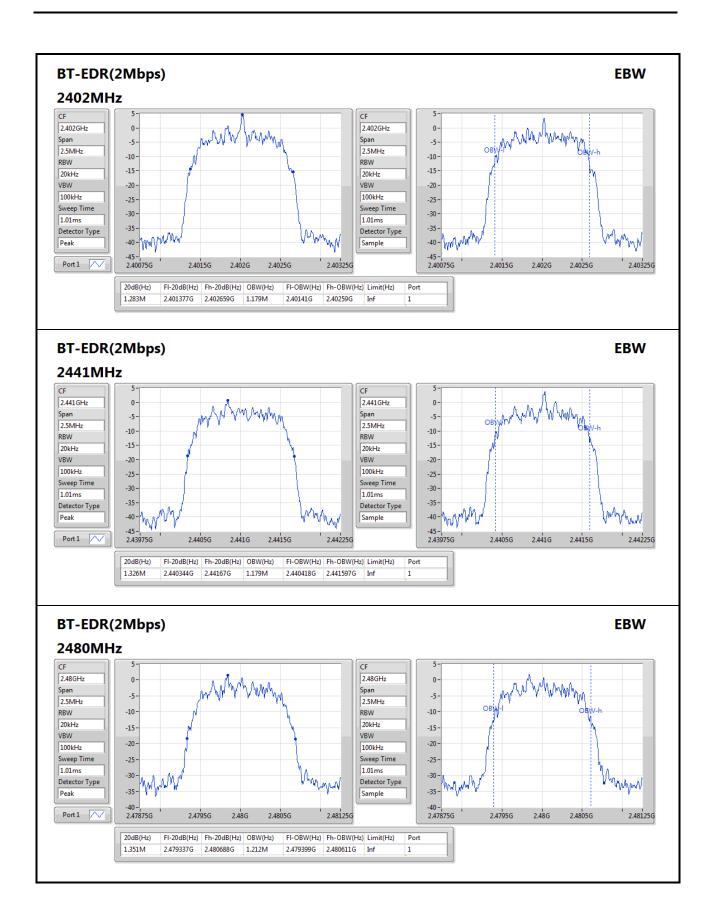
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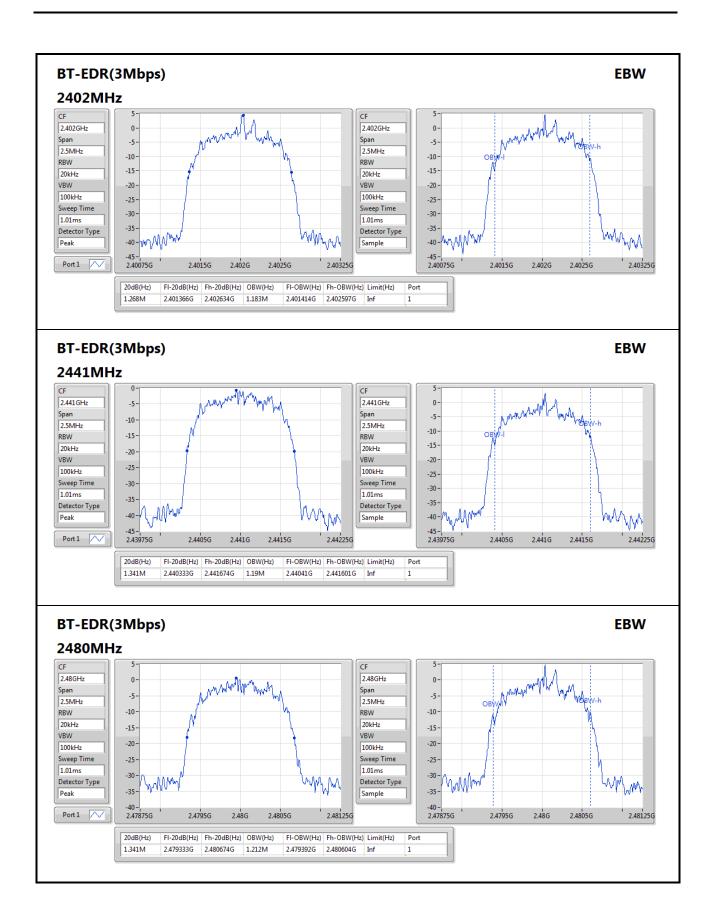
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3.8 Number of Dwell Time

3.8.1 Limit of Dwell time

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

3.8.2 Test Procedures

- Set RBW=300kHz,VBW=1MHz,Sweep time = 10 ms, Detector=Peak, Span=0Hz,Trace max hold
- 2 Enable gating and trigger function of spectrum analyzer to measure burst on time.
- The DH1 packet can cover a single time slot. A maximum length packet has duration of 1 time slots. Non AFH mode

The hopping rate is 1600 hops/second so the maximum dwell time is 1/1600 seconds. DH1 Packet permit maximum 1600 / 79 / 2 = 10.12 hops per second in each channel (1 time slot TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $10.12 \times 31.6 = 320$ within 31.6 seconds. AFH mode

The hopping rate is 800 hops/second so the maximum dwell time is 1/800 seconds. DH1 Packet permit maximum 800/20/2 = 20 hops per second in each channel (1 time slot TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $20 \times 8 = 160$ within 8 seconds.

4. The DH3 packet can cover up to 3 time slots. A maximum length packet has duration of 3 time slots. Non AFH mode

The hopping rate is 1600 hops/second so the maximum dwell time is 3/1600 seconds. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $5.06 \times 31.6 = 160 \text{ within } 31.6 \text{ seconds}$. AFH mode

The hopping rate is 800hops/second so the maximum dwell time is 3/800 seconds. DH3 Packet permit maximum 800 / 20 / 4 = 10 hops per second in each channel (3 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $10 \times 8 = 80$ within 8 seconds.

The DH5 packet can cover up to 5 time slots. Operate DH5 at maximum dwell time and maximum duty cycle. A maximum length packet has duration of 5 time slots.

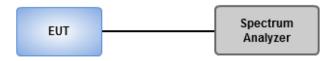
Non AFH mode

The hopping rate is 1600 hops/second so the maximum dwell time is 5/1600 seconds, or 3.125ms. DH5 Packet permit maximum 1600/79/6 = 3.37 hops per second in each channel (5 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $3.37 \times 31.6 = 106.6$ within 31.6 seconds

AFH mode

The hopping rate is 800 hops/second so the maximum dwell time is 5/800 seconds. DH5 Packet permit maximum 800/20 / 6 = 6.667 hops per second in each channel (5 time slots TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times $6.667 \times 8 = 53.33$ within 8 seconds

3.8.3 Test Setup



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3.8.4 Test Result of Dwell Time

Summary

Mode	Max-Dwell			
	(s)			
2.4-2.4835GHz	-			
BT-BR(1Mbps)	310.530435m_DH5			
BT-EDR(2Mbps)	310.530435m_DH5			
BT-EDR(3Mbps)	310.530435m_DH5			

Result/ Non AFH mode

Mode	Result	Period	Dwell	Limit	Tx On
		(s)	(s)	(s)	(s)
BT-BR(1Mbps)	-	-	-	-	-
2441MHz	Pass	31.6	310.530435m_DH5	400m	2.913043m
2441MHz	Pass	31.6	264.347826m_DH3	400m	1.652174m
2441MHz	Pass	31.6	129.855072m_DH1	400m	405.797101u
BT-EDR(2Mbps)	-	-	-	-	-
2441MHz	Pass	31.6	310.530435m_DH5	400m	2.913043m
2441MHz	Pass	31.6	264.347826m_DH3	400m	1.652174m
2441MHz	Pass	31.6	129.855072m_DH1	400m	405.797101u
BT-EDR(3Mbps)	-	-	-	-	-
2441MHz	Pass	31.6	310.530435m_DH5	400m	2.913043m
2441MHz	Pass	31.6	264.347826m_DH3	400m	1.652174m
2441MHz	Pass	31.6	134.492754m_DH1	400m	420.289855u

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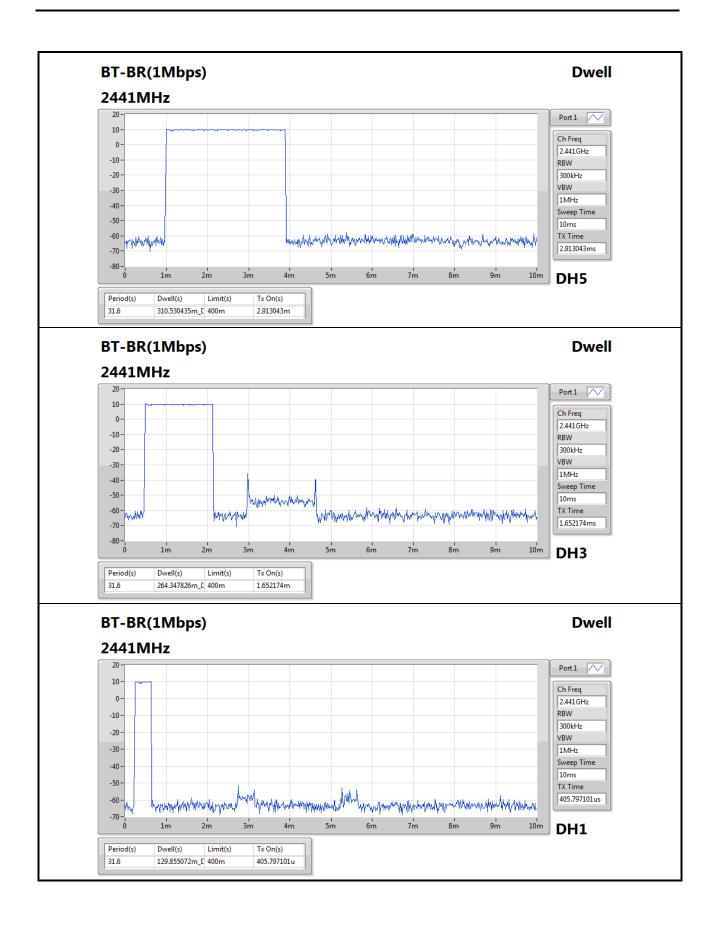


Result/ AFH mode

Mode	Result	Period	Dwell	Limit	Tx On
		(s)	(s)	(s)	(s)
BT-BR(1Mbps)	-	-	-	-	-
2441MHz	Pass	8	155.3526m_DH5	400m	2.913043m
2441MHz	Pass	8	132.1739m_DH3	400m	1.652174m
2441MHz	Pass	8	64.92754m_DH1	400m	405.797101u
BT-EDR(2Mbps)	-	-	-	-	-
2441MHz	Pass	8	155.3526m_DH5	400m	2.913043m
2441MHz	Pass	8	132.1739m_DH3	400m	1.652174m
2441MHz	Pass	8	64.92754m_DH1	400m	405.797101u
BT-EDR(3Mbps)	-	-	-	-	-
2441MHz	Pass	8	155.3526m_DH5	400m	2.913043m
2441MHz	Pass	8	132.1739m_DH3	400m	1.652174m
2441MHz	Pass	8	67.24638m_DH1	400m	420.289855u

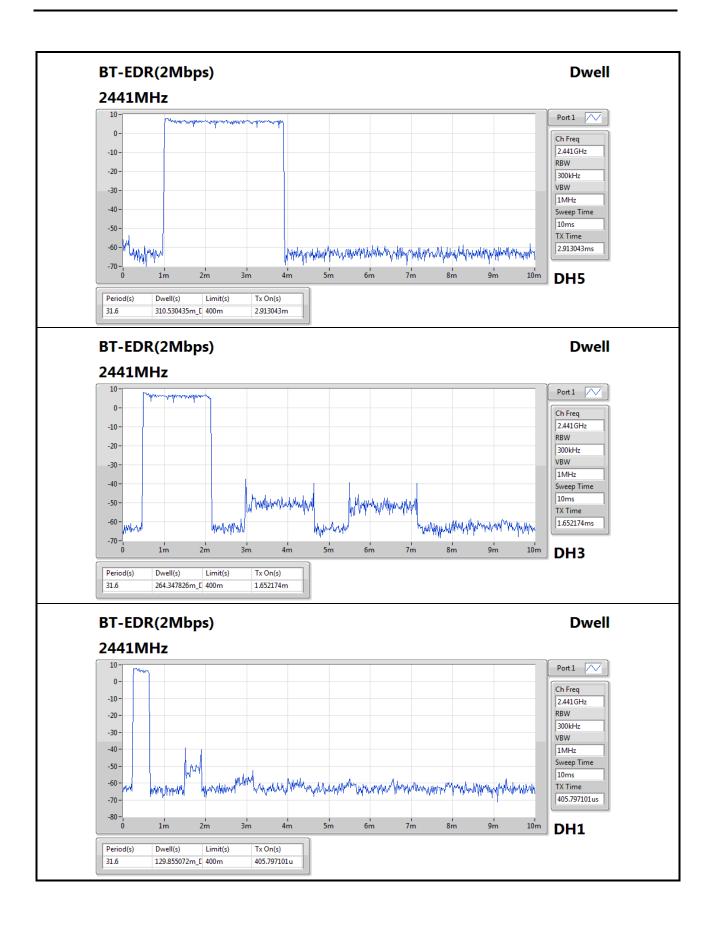
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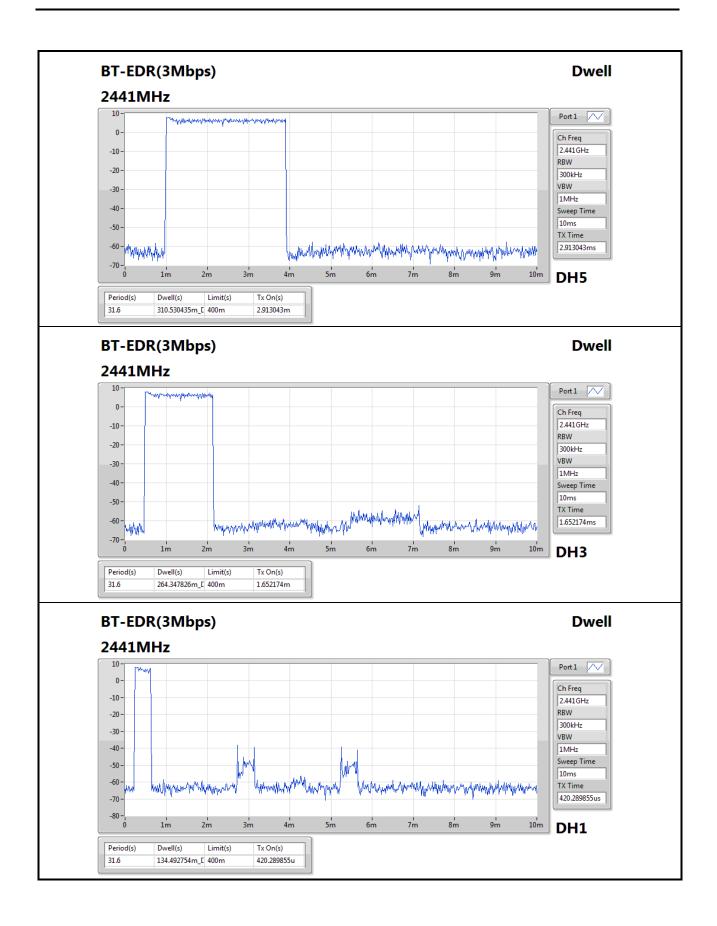
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4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou

Tel: 886-2-2601-1640 No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.

Kwei Shan

Tel: 886-3-271-8666 No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.

Kwei Shan Site II

Tel: 886-3-271-8640 No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666 Fax: 886-3-318-0155

Email: ICC_Service@icertifi.com.tw

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