

FCC Test Report

FCC ID : NKR-R40

Equipment : 11bgn+BT combo module

Model No. : DHSB-R40

Brand Name : RICOH

Applicant : Wistron Neweb Corporation

Address : 20 Park Avenue II, Hsinchu Science Park,

Hsinchu 308, Taiwan, R.O.C.

Standard : 47 CFR FCC Part 15.247

Received Date : Jul. 16, 2014

Tested Date : Aug. 25 ~ Aug. 29, 2014

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.

Approved & Reviewed by:

Gary Chang / Manager

Iac MRA



Report No.: FR471601AD Report Version: Rev. 01 Page : 1 of 46



Table of Contents

1	GENERAL DESCRIPTION	5
1.1	Information	5
1.2	Local Support Equipment List	
1.3	Test Setup Chart	7
1.4	The Equipment List	8
1.5	Test Standards	9
1.6	Measurement Uncertainty	9
2	TEST CONFIGURATION	10
2.1	Testing Condition	10
2.2	The Worst Test Modes and Channel Details	10
3	TRANSMITTER TEST RESULTS	11
3.1	Conducted Emissions	11
3.2	Unwanted Emissions into Restricted Frequency Bands	14
3.3	Unwanted Emissions into Non-Restricted Frequency Bands	30
3.4	Conducted Output Power	35
3.5	Number of Hopping Frequency	37
3.6	20dB and Occupied Bandwidth	39
3.7	Channel Separation	41
3.8	Number of Dwell Time	43
4	TEST LABORATORY INFORMATION	46



Release Record

Report No.	Version	Description	Issued Date
FR471601AD	Rev. 01	Initial issue	Sep. 05, 2014

Report No.: FR471601AD Page: 3 of 46



Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	[dBuV]: 0.156MHz 43.13 (Margin 12.56dB) - AV	Pass
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 79.47MHz 35.25 (Margin -4.75dB) - PK	Pass
15.247(d)	Band Edge	Meet the requirement of limit	Pass
15.247(b)(1)	Conducted Output Power	Power [dBm]: 10.91	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

Report No.: FR471601AD Page: 4 of 46



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.	Туре	Gain (dBi)	Connector	Remark
1	Printed	0.79		

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	3.3Vdc from host.

1.1.4 Accessories

N/A

Report No.: FR471601AD Page: 5 of 46



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		

Report No.: FR471601AD Page: 6 of 46



1.1.6 Test Tool and Duty Cycle

Test Tool	Blue Tool, version 2.5

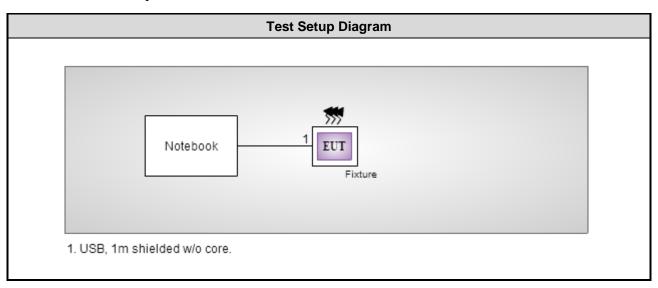
1.1.7 Power Setting

Madulation Mada	Test Frequency (MHz)				
Modulation Mode	2402	2441	2480		
GFSK/1Mbps	Default	Default	Default		
л/4 DQPSK/2Mbps	Default	Default	Default		
8DPSK/3Mbps	Default	Default	Default		

1.2 Local Support Equipment List

	Support Equipment List						
No.	No. Equipment Brand Model S/N FCC ID Signal cable / Length (m)						
1	Notebook	DELL	E6430		DoC	USB, 1m shielded w/o core.	

1.3 Test Setup Chart



Report No.: FR471601AD Page: 7 of 46



1.4 The Equipment List

Test Item	Conducted Emission	Conducted Emission								
Test Site	Conduction room 1 / (Conduction room 1 / (CO01-WS)								
Instrument	Manufacturer	Manufacturer Model No. Serial No. Calibration Date Calibration Until								
EMC Receiver	R&S	ESCS 30	100169	Oct. 15, 2013	Oct. 14, 2014					
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 23, 2013	Nov. 22, 2014					
LISN (Support Unit)	SCHWARZBECK	Schwarzbeck 8127	8127-666	Dec. 04, 2013	Dec. 03, 2014					
RF Cable-CON	Woken	CFD200-NL	CFD200-NL-001	Apr. 23, 2014	Apr. 22, 2015					
50 ohm terminal (Support Unit)	NA	50	04	Apr. 18, 2014	Apr. 17, 2015					
Note: Calibration Inte	Note: Calibration Interval of instruments listed above is one year.									

Test Item	Radiated Emission	Radiated Emission					
Test Site	966 chamber 3 / (03C	:H03-WS)					
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until		
Spectrum Analyzer	Agilent	N9010A	MY53400091	Oct. 07, 2013	Oct. 06, 2014		
Receiver	Agilent	N9038A	MY53290044	Jan. 08, 2014	Jan. 07, 2015		
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-562	Feb. 07, 2014	Feb. 06, 2015		
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Feb. 20, 2014	Feb. 19, 2015		
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Dec. 27, 2013	Dec. 26, 2014		
Preamplifier	EMC	EMC02325	980187	Nov. 22, 2013	Nov. 21, 2014		
Preamplifier	Agilent	83017A	MY53270014	Nov. 22, 2013	Nov. 21, 2014		
Preamplifier	WM	TF-130N-R1	923365	Oct. 23, 2013	Oct. 22, 2014		
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Feb. 19, 2014	Feb. 18, 2015		
RF cable-8M	HUBER+SUHNER	SUCOFLEX104	MY22601/4	Feb. 19, 2014	Feb. 18, 2015		
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22624/4	Feb. 19, 2014	Feb. 18, 2015		
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800 -001	Feb. 17, 2014	Feb. 16, 2015		
LF cable-3M	EMC	EMC8D-NM-NM-300	131103	Feb. 17, 2014	Feb. 16, 2015		
LF cable-13M	EMC	EMC8D-NM-NM-130 00	131104	Feb. 17, 2014	Feb. 16, 2015		
Note: Calibration Inter	Note: Calibration Interval of instruments listed above is one year.						

Loop Antenna	R&S	HFH2-Z2	100330	Nov. 15, 2012	Nov. 14, 2014	
Note: Calibration Inter	rval of instruments liste	d above is two year.				

Report No.: FR471601AD Page: 8 of 46



Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101063	Feb. 17, 2014	Feb. 16, 2015
Power Meter	Anritsu	ML2495A	1241002	Oct. 24, 2013	Oct. 23, 2014
Power Sensor	Anritsu	MA2411B	1207366	Oct. 24, 2013	Oct. 23, 2014
Note: Calibration Inter	rval of instruments listed	d above is one year.			

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 FCC Public notice DA 00-705 ANSI C63.10-2009

1.6 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	±34.134 Hz						
Conducted power	±0.808 dB						
Frequency error	±34.134 Hz						
Temperature	±0.6 °C						
Conducted emission	±2.670 dB						
AC conducted emission	±2.92 dB						
Radiated emission ≤ 1GHz	±3.26 dB						
Radiated emission > 1GHz	±4.94 dB						

Report No.: FR471601AD Page: 9 of 46



2 Test Configuration

2.1 Testing Condition

Test Item Test Site		Ambient Condition	Tested By
AC Conduction	CO01-WS	22°C / 68%	Skys Huang
Radiated Emissions	03CH03-WS	20-21°C / 60-61%	Haru Yang Aska Huang
RF Conducted	TH01-WS	24°C / 63%	Brad Wu

FCC site registration No.: 390588IC site registration No.: 10807C-1

2.2 The Worst Test Modes and Channel Details

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

NOTE: The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Z-plane** results were found as the worst case and were shown in this report.

Report No.: FR471601AD Page: 10 of 46



3 Transmitter Test Results

3.1 Conducted Emissions

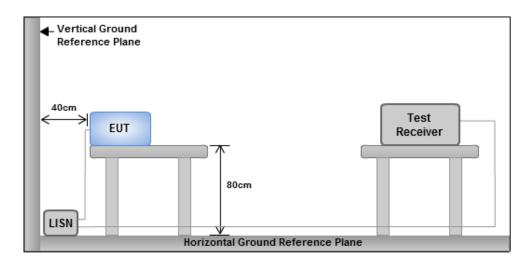
3.1.1 Limit of Conducted Emissions

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



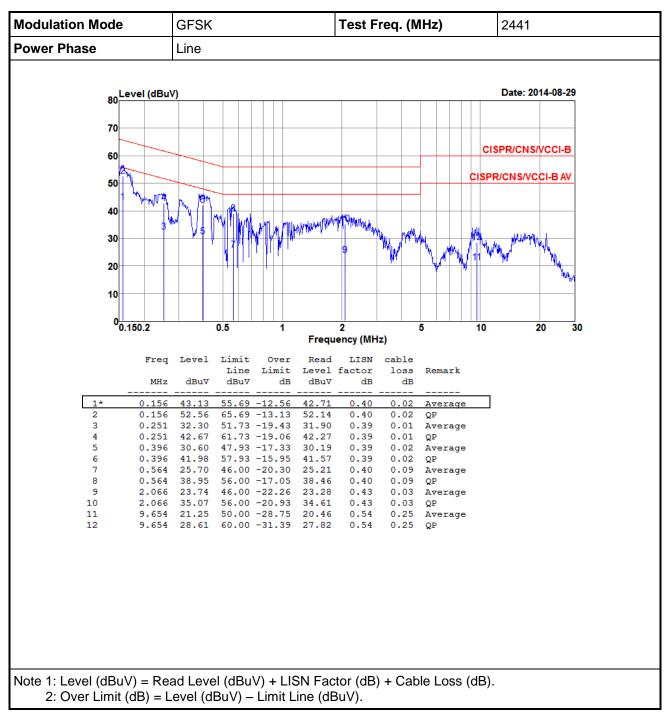
Note: 1. Support units were connected to second LISN.

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

Report No.: FR471601AD Page: 11 of 46

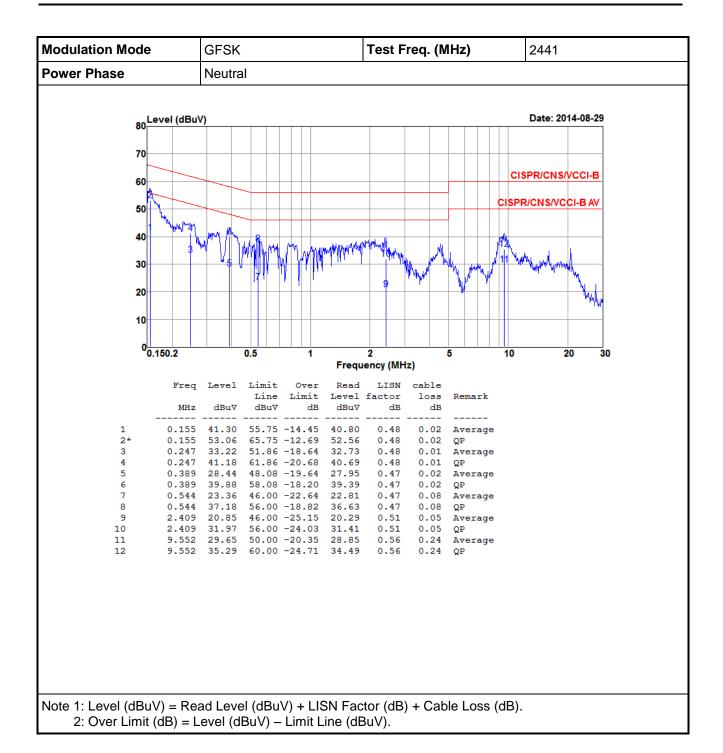


3.1.4 Test Result of Conducted Emissions



Report No.: FR471601AD Page: 12 of 46





Report No.: FR471601AD Page : 13 of 46



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.

3.2.2 Test Procedures

- 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 a height of 0.8 m test table above the ground plane.
- 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:

- 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:

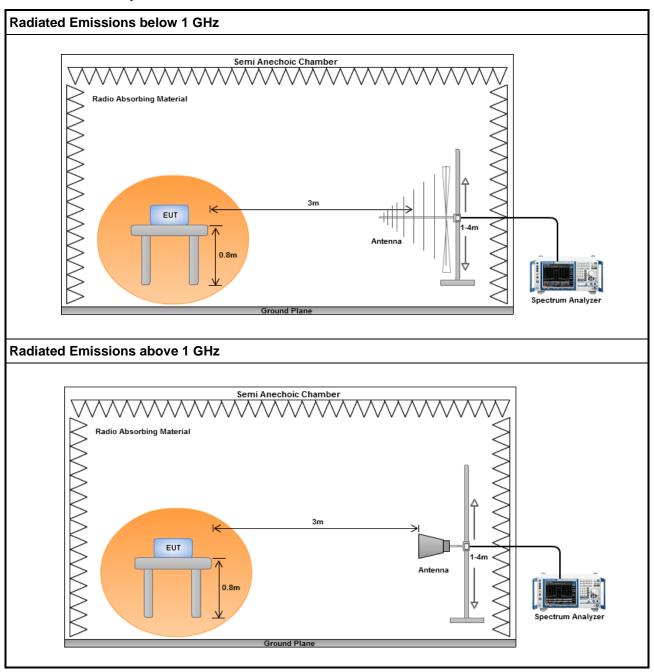
3.
$$20\log \text{ (Duty cycle)} = 20\log \frac{1\text{s} / 1600 * 5}{100 \text{ ms}} = -30.1 \text{dB}$$

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

Report No.: FR471601AD Page: 14 of 46



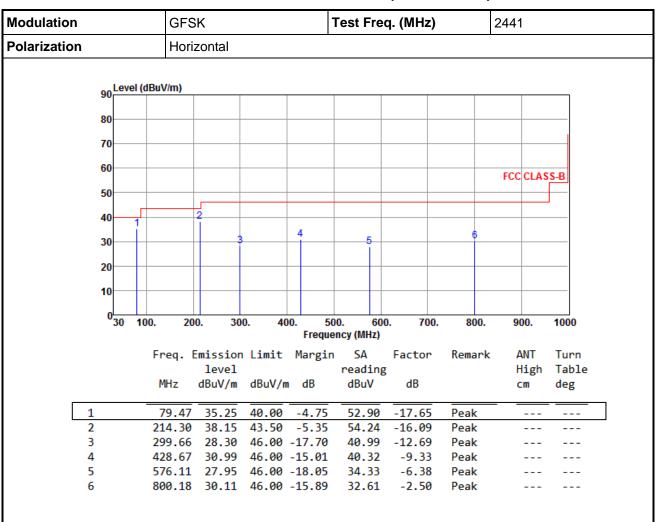
3.2.3 Test Setup



Report No.: FR471601AD Page: 15 of 46



3.2.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)



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

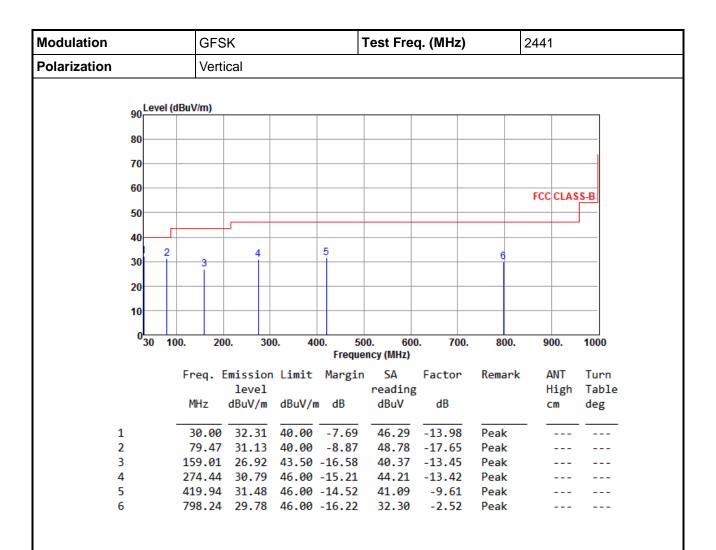
*Factor includes antenna factor, cable loss and amplifier gain

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.

Report No.: FR471601AD Page: 16 of 46





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

*Factor includes antenna factor, cable loss and amplifier gain

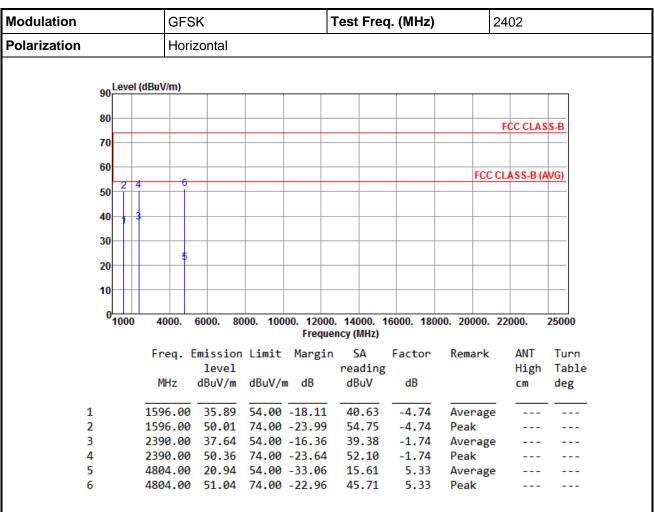
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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

Report No.: FR471601AD Page: 17 of 46



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).

Report No.: FR471601AD Page: 18 of 46



3

4

5

6

Modulation			GFS	K			Test Free	q. (MHz)		2402	
Polarization			Verti	Vertical							
	90	Level	(dBuV/m)								
	80										
	00									FCC CLAS	S-B
	70										
	60								ECC	CLASS-B (A	WG)
	50	2 4	6						rcc	, CLA33-D (A	woj
	40	1 3									
	30										
	20		5_								
	40										
	10										
	0	1000	4000.	6000. 80	00. 100		0. 14000. 1 ency (MHz)	16000. 180	00. 20000.	22000.	25000
			Freq. E	mission	Limit	Margi	n SA	Factor	Remark	ANT	Turn
				level		_	reading			High	Tabl
			MHz	dBuV/m	dBuV/r	n dB	dBuV	dB		cm	deg
	1		1596.00	35.70	54.00	-18.30	40.44	-4.74	Averag	e	
	2		1596.00					-4.74	Peak		

39.04

-1.74

-1.74

5.33

5.33

Average

Average

Peak

Peak

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

2390.00 37.30 54.00 -16.70

2390.00 49.90 74.00 -24.10 51.64 4804.00 18.74 54.00 -35.26 13.41 4804.00 48.84 74.00 -25.16 43.51

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

Report No.: FR471601AD Page: 19 of 46



Modulation	GFSK	Ι.	est Freq. (N	ИHz)	2441	
Polarization	Horizontal	•				
90 Level (d	IBuV/m)					\neg
80					500 01 400	_
70					FCC CLASS-	<u>R</u>
60	4 6			FC	C CLASS-B (AVG	G)
50 2						
40						
30	3 5					
20						
10						_
0						
1000	4000. 6000. 80		. 14000. 16000 ncy (MHz)	0. 18000. 20000	. 22000. 25	000
	Freq. Emission	Limit Margin	SA Fac	ctor Remark	c ANT T	Turn
	level		reading		_	Γable
	MHz dBuV/m	dBuV/m dB	dBuV d	dB	Cm C	deg
1	1596.00 35.95	54.00 -18.05	40.69	4.74 Averag	ge	
	1596.00 49.72	74.00 -24.28		4.74 Peak		
	4882.00 22.11			5.54 Averag	ge	
		74.00 -21.79 54.00 -28.97		5.54 Peak 1.32 Averag	 IP	
	7323.00 25.03			1.32 Peak		

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

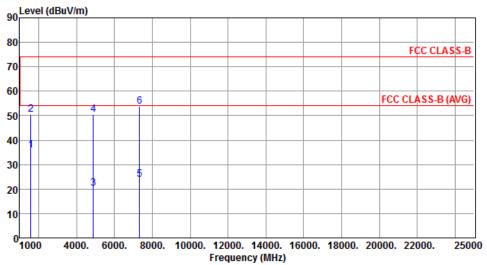
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR471601AD Page: 20 of 46

Report Version: Rev. 01



Modulation		GFSK		Test	Freq.	(MHz)	24	41		
Polarization		Vertical								
00	Level (dBu	V/m)								
90										



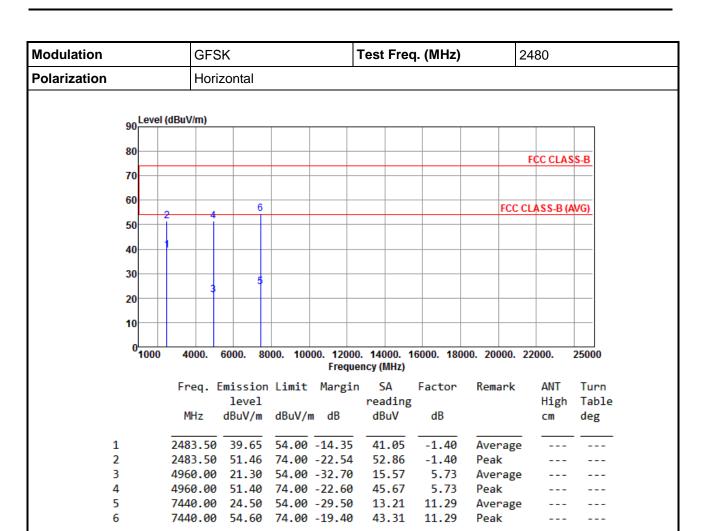
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ü	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
	4506.00	75.03		40.07	40.67				
1	1596.00	35.93	54.00	-18.0/	40.67	-4.74	Average		
2	1596.00	50.38	74.00	-23.62	55.12	-4.74	Peak		
3	4882.00	20.22	54.00	-33.78	14.68	5.54	Average		
4	4882.00	50.32	74.00	-23.68	44.78	5.54	Peak		
5	7323.00	23.79	54.00	-30.21	12.47	11.32	Average		
6	7323.00	53.89	74.00	-20.11	42.57	11.32	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).

Report No.: FR471601AD Page: 21 of 46





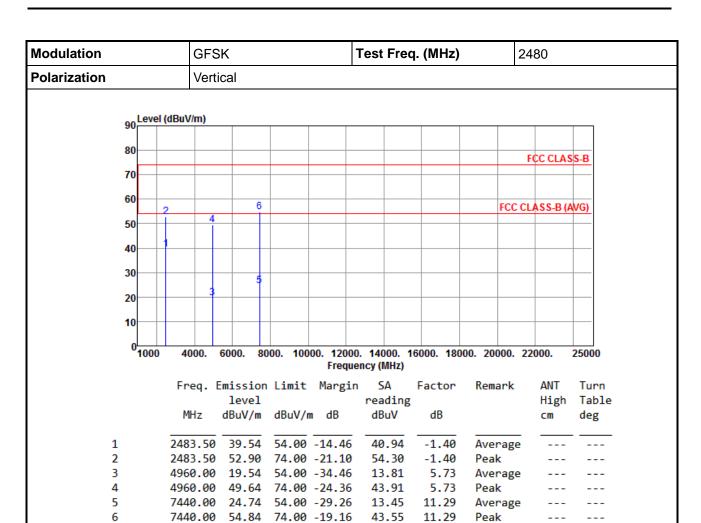
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB)

*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR471601AD Page: 22 of 46





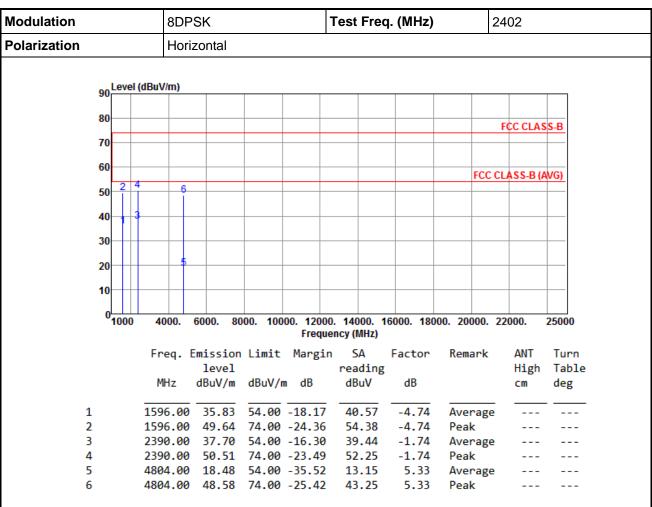
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB) *Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR471601AD Page: 23 of 46



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



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

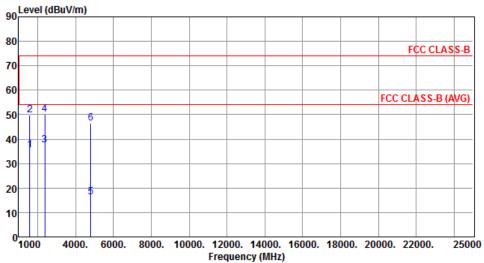
*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR471601AD Page: 24 of 46



Modulation	8DPSK	Tes	st Freq. (MHz)	240)2	
Polarization	Vertical					
90 Leve	l (dBuV/m)					



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1596.00	35.69	54.00	-18.31	40.43	-4.74	Average		
2	1596.00	49.82	74.00	-24.18	54.56	-4.74	Peak		
3	2390.00	37.69	54.00	-16.31	39.43	-1.74	Average		
4	2390.00	50.19	74.00	-23.81	51.93	-1.74	Peak		
5	4804.00	16.40	54.00	-37.60	11.07	5.33	Average		
6	4804.00	46.50	74.00	-27.50	41.17	5.33	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).

Report No.: FR471601AD Page: 25 of 46



Modulation	8DPSK	-	Test Freq	. (MHz)	2	2441	
Polarization	Horizontal						
90 Level (di	BuV/m)						
80							
70						FCC CLAS	S-B
60	. 6				FCC (CLASS-B (A	WG)
50 2	4						
40							
30							
20							
10							
0 1000	4000. 6000. 8	000. 10000. 12000 Freque	. 14000. 16 ency (MHz)	5000. 1800	00. 20000.	22000.	25000
	Freq. Emission	n Limit Margin		Factor	Remark	ANT	Turn
	level	_	reading			High	Table
	MHz dBuV/m	dBuV/m dB	dBuV	dB		cm	deg
1 1	596.00 36.19	54.00 -17.81	40.93	-4.74	Average		
	596.00 50.02		54.76	-4.74	Peak		
	1882.00 19.79		14.25	5.54	Average		
		74.00 -24.11 54.00 -31.41	44.35 11.27	5.54 11.32	Peak Average		
	7323.00 52.69		41.37	11.32	Peak		

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

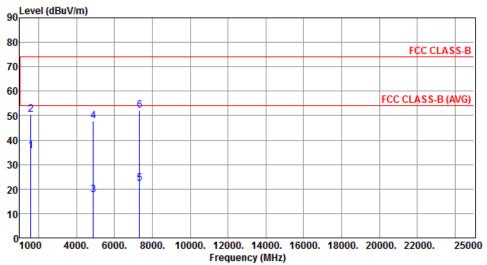
*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR471601AD Page: 26 of 46

Report Version: Rev. 01



Modulation	8DPSK	Test Freq. (MHz)	2441				
Polarization	Vertical						
Loyal (dPul/m)							



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	1596.00	35.54	54.00	-18.46	40.28	-4.74	Average		
2		50.57			55.31	-4.74	Peak		
3	4882.00	17.65	54.00	-36.35	12.11	5.54	Average		
4	4882.00	47.75	74.00	-26.25	42.21	5.54	Peak		
5	7323.00	22.18	54.00	-31.82	10.86	11.32	Average		
6	7323.00	52.28	74.00	-21.72	40.96	11.32	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).

Report No.: FR471601AD Page: 27 of 46



Modulation	8DPSK	Ι.	est Freq. (MH	<u>z</u>)	2480	
Polarization	Horizontal	-		1		
90 Level (dE	BuV/m)					_
80						
					FCC CLASS	<u>-B</u>
70						
60				FCC	CLASS D (AV	(C)
50	4 1			FCC	CLASS-B (AV	(6)
50						
40						
30						
	5					
20						
10						_
0						
1000	4000. 6000. 8	000. 10000. 12000. Frequei	14000. 16000. 1 ncy (MHz)	8000. 20000.	22000. 2	5000
	Frea. Emission	n Limit Margin	SA Facto	r Remark	ANT	Turn
	level		reading		High	Tabl
	MHz dBuV/m	dBuV/m dB	dBuV dB		CM	deg
1 2	483.50 40.84	54.00 -13.16	42.24 -1.4	Average		
	483.50 52.46	74.00 -21.54	53.86 -1.4			
	960.00 18.85		13.12 5.7			
		74.00 -25.05	43.22 5.7			
	440.00 22.54 440.00 52.64	54.00 -31.46	11.25 11.29 41.35 11.29			

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

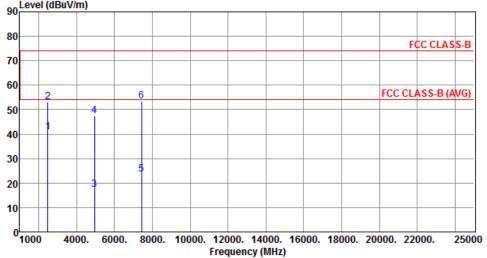
*Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

Report No.: FR471601AD Page: 28 of 46

Report Version: Rev. 01



Modulation		8DPSk)PSK Te		Test	Test Freq. (MHz)			248	2480			
Polarization			Vertica	ıl									
Q	n Leve	el (dBuV	/m)										
8													
	٧										E/	CLIVE	C D



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ü	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
									_
1	2483.50	40.84	54.00	-13.16	42.24	-1.40	Average		
2	2483.50	53.02	74.00	-20.98	54.42	-1.40	Peak		
3	4960.00	17.37	54.00	-36.63	11.64	5.73	Average		
4	4960.00	47.47	74.00	-26.53	41.74	5.73	Peak		
5	7440.00	23.43	54.00	-30.57	12.14	11.29	Average		
6	7440.00	53.53	74.00	-20.47	42.24	11.29	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).

Report No.: FR471601AD Page: 29 of 46



3.3 Unwanted Emissions into Non-Restricted Frequency Bands

3.3.1 Limit of Unwanted Emissions into Non-Restricted Frequency Bands

The peak output power measured 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

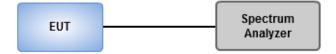
Reference Level Measurement

- Set the RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
- 2. Set Sweep time = auto couple, Trace mode = max hold.
- 3. Allow trace to fully stabilize.
- 4. Use the peak marker function to determine the maximum amplitude level.

Unwanted Emissions Level Measurement

- Set RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
- 2. Trace Mode = max hold, Sweep = auto couple.
- 3. Allow the trace to stabilize.
- 4. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

3.3.3 Test Setup

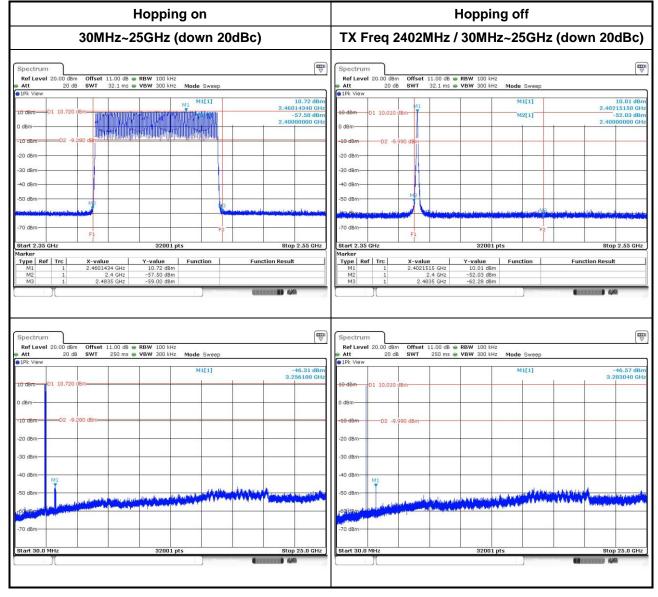


Report No.: FR471601AD Page: 30 of 46



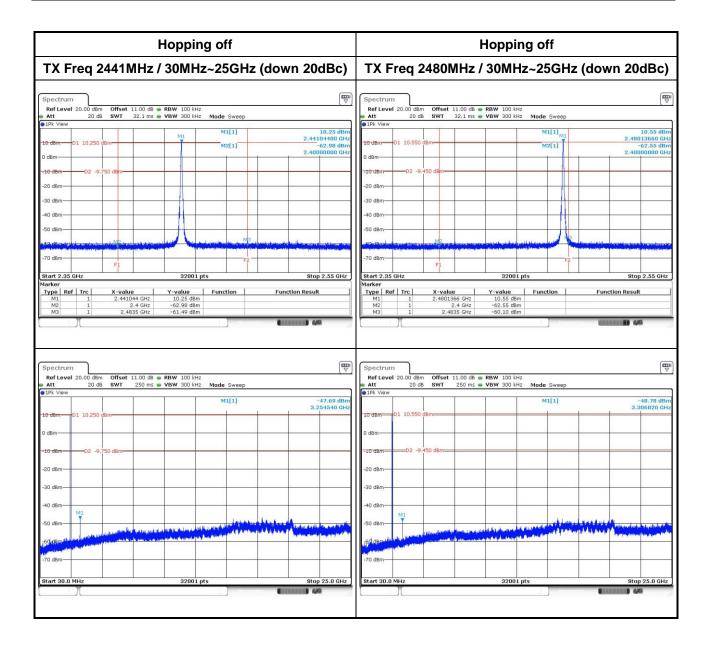
3.3.4 Unwanted Emissions into Non-Restricted Frequency Bands

GFSK



Report No.: FR471601AD Page: 31 of 46

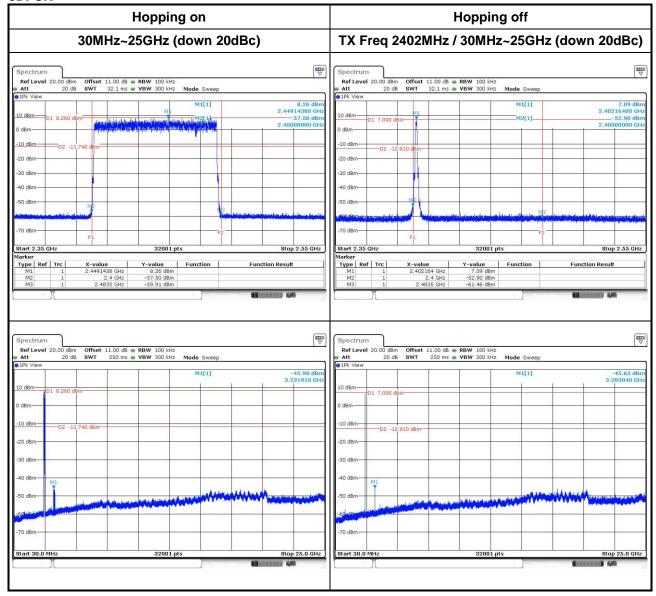




Report No.: FR471601AD Page: 32 of 46

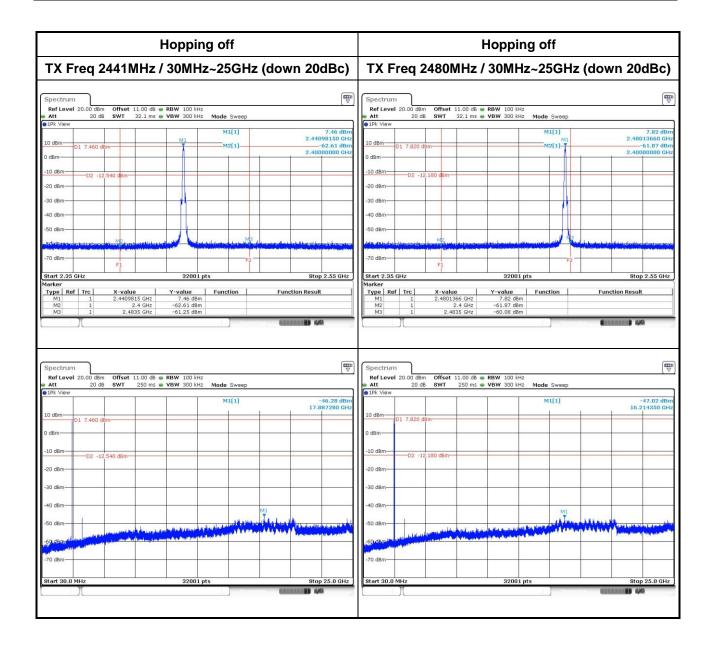


8DPSK



Report No.: FR471601AD Page: 33 of 46





Report No.: FR471601AD Page: 34 of 46



3.4 Conducted Output Power

3.4.1 Limit of Unwanted Emissions into Non-Restricted Frequency Bands

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

- 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



Report No.: FR471601AD Page: 35 of 46



3.4.4 Test Result of Conducted Output Power

Modulation Mode	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (mW)
GFSK	2402	10.69	10.29	125
GFSK	2441	12.33	10.91	125
GFSK	2480	12.16	10.85	125
л/4 DQPSK	2402	10.02	10.01	125
л/4 DQPSK	2441	11.64	10.66	125
л/4 DQPSK	2480	11.04	10.43	125
8DPSK	2402	10.52	10.22	125
8DPSK	2441	12.25	10.88	125
8DPSK	2480	11.53	10.62	125

Modulation Mode	Freq. (MHz)	AV Output Power (mW)	AV Output Power (dBm)
GFSK	2402	10.50	10.21
GFSK	2441	12.13	10.84
GFSK	2480	11.94	10.77
л/4 DQPSK	2402	5.87	7.69
л/4 DQPSK	2441	7.10	8.51
л/4 DQPSK	2480	6.58	8.18
8DPSK	2402	5.87	7.69
8DPSK	2441	7.03	8.47
8DPSK	2480	6.52	8.14

Note: Average power is for reference only.

Report No.: FR471601AD Page: 36 of 46



3.5 Number of Hopping Frequency

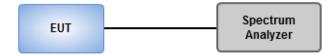
3.5.1 Limit of Number of Hopping Frequency

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.

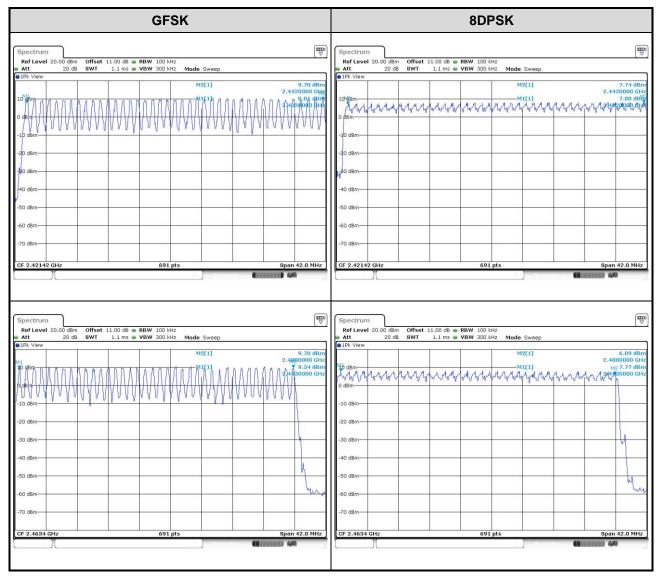
3.5.3 Test Setup



Report No.: FR471601AD Page: 37 of 46



3.5.4 Test Result of Number of Hopping Frequency



Report No.: FR471601AD Page: 38 of 46

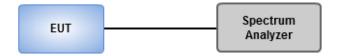


3.6 20dB and Occupied Bandwidth

3.6.1 Test Procedures

- 1. Set RBW=30kHz, VBW=100kHz, Sweep time = Auto, Detector=Peak Trace max hold
- 2 Allow trace to stabilize
- 3 Use N dB function of spectrum analyzer to measuring 20 dB bandwidth
- 4. Use Occupied bandwidth function of spectrum analyzer to measuring 99% occupied bandwidth

3.6.2 Test Setup

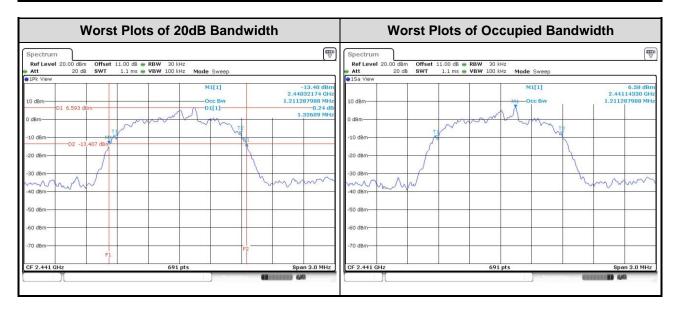


Report No.: FR471601AD Page: 39 of 46



3.6.3 Test result of 20dB and Occupied Bandwidth

Modulation Mode	Freq. (MHz)	20dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
GFSK	2402	0.952	0.903
GFSK	2441	0.948	0.907
GFSK	2480	0.948	0.899
8DPSK	2402	1.322	1.207
8DPSK	2441	1.326	1.211
8DPSK	2480	1.322	1.207



Report No.: FR471601AD Page: 40 of 46



3.7 Channel Separation

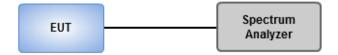
3.7.1 Limit of Channel Separation

- 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=100kHz, VBW=300kHz, 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

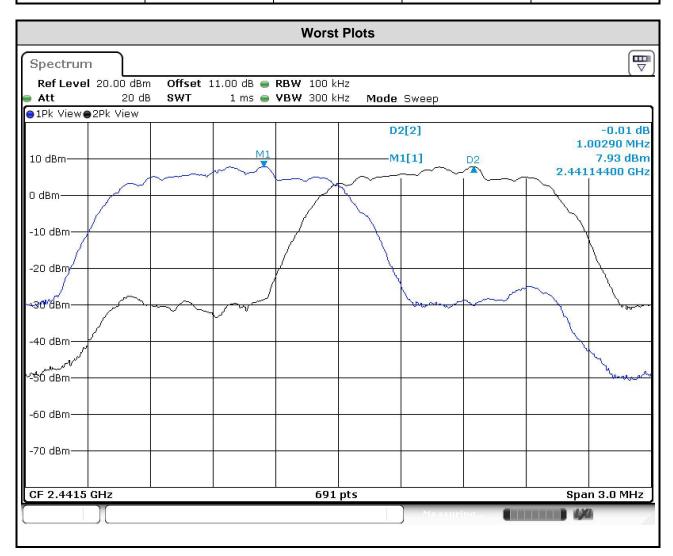


Report No.: FR471601AD Page: 41 of 46



3.7.4 Test result of Channel Separation

Modulation Mode	Freq. (MHz)	Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)
GFSK	2402	1.003	0.952	0.635
GFSK	2441	1.003	0.948	0.632
GFSK	2480	1.003	0.948	0.632
8DPSK	2402	1.003	1.322	0.881
8DPSK	2441	1.003	1.326	0.884
8DPSK	2480	1.003	1.322	0.881



Report No.: FR471601AD Page: 42 of 46



3.8 Number of Dwell Time

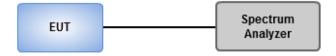
3.8.1 Limit of Dwell time

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=100kHz,VBW=300kHz,Sweep time = 500us(DH1),2ms(DH3),4ms(DH5), Detector=Peak, Span=0Hz,Trace max hold
- 2 Enable gating and trigger function of spectrum analyzer to measure burst on time.
- 3. The DH1 packet can cover a single time slot. A maximum length packet has duration of 1 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 1/1600 seconds, or 0.625ms. DH1 Packet permit maximum 1600 / 79 /2 = 10.12 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 10.12 x 31.6 = 320 within 31.6 seconds.
- 4. The DH3 packet can cover up to 3 time slots. A maximum length packet has duration of 3 time slots. The hopping rate is 1600 hops/second so the maximum dwell time is 3/1600 seconds, or 1.875ms. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 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. 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 RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds

3.8.3 Test Setup

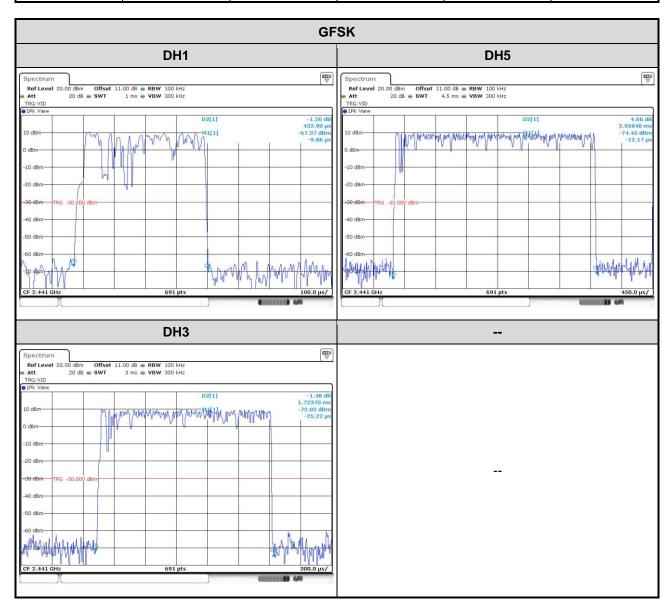


Report No.: FR471601AD Page: 43 of 46



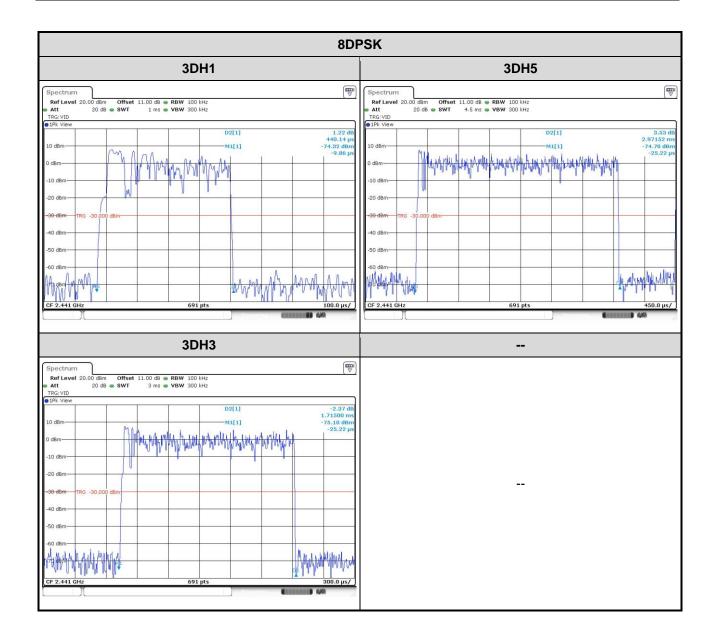
3.8.4 Test Result of Dwell Time

Modulation Mode	Freq. (MHz)	Length of Transmission Time (msec)	Number of Transmission in a 31.6 (79 Hopping*0.4)	Result (msec)	Limit (msec)
GFSK-DH1	2480	0.43290	320	138.53	400
GFSK-DH3	2480	1.72370	160	275.79	400
GFSK-DH5	2480	2.95848	106.6	315.37	400
8DPSK-DH1	2480	0.44014	320	140.84	400
8DPSK-DH3	2480	1.71500	160	274.40	400
8DPSK-DH5	2480	2.97152	106.6	316.76	400



Report No.: FR471601AD Page: 44 of 46





Report No.: FR471601AD Page: 45 of 46



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, 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 Hsiang. 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 Hsiang, Tao Yuan

Hsien 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 Hsiang, Tao Yuan Hsien 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

==END==

Report No.: FR471601AD Page: 46 of 46