

# **FCC Test Report**

FCC ID : 2ACAHAC01

**Equipment** : AudioClip

: AC1A, AC1B Model No.

(Please refer to section 1.1.1 for more details)

**Applicant** : SBO Hearing A/S

**Address** : Kongebakken 9 DK-2765 Smoerum, Denmark

: 47 CFR FCC Part 15.247 Standard

**Received Date** : Sep. 04, 2017

**Tested Date** : Sep. 07 ~ Sep. 18, 2017

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 Chen / Assistant Manager Gary Chang / Manager

Page: 1 of 47

**Testing Laboratory** 2732

Report No.: FR790403AD



## **Table of Contents**

1	GENERAL DESCRIPTION	5
1.1	Information	5
1.2	Local Support Equipment List	8
1.3	Test Setup Chart	
1.4	The Equipment List	9
1.5	Test Standards	10
1.6	Measurement Uncertainty	10
2	TEST CONFIGURATION	11
2.1	Testing Condition	11
2.2	The Worst Test Modes and Channel Details	
3	TRANSMITTER TEST RESULTS	12
3.1	Conducted Emissions	12
3.2	Unwanted Emissions into Restricted Frequency Bands	15
3.3	Unwanted Emissions into Non-Restricted Frequency Bands	31
3.4	Conducted Output Power	36
3.5	Number of Hopping Frequency	38
3.6	20dB and Occupied Bandwidth	40
3.7	Channel Separation	42
3.8	Number of Dwell Time	44
4	TEST LABORATORY INFORMATION	47



## **Release Record**

Report No.	Version	Description	Issued Date
FR790403AD	Rev. 01	Initial issue	Oct. 16, 2017

Report No.: FR790403AD Page: 3 of 47



# **Summary of Test Results**

FCC Rules	Test Items	Measured	Result	
15.207	Conducted Emissions	[dBuV]: 0.585MHz 33.69 (Margin -12.31dB) - AV	Pass	
15.247(d)	Radiated Emissions	[dBuV/m at 3m]: 2324.00MHz	Pass	
15.209	Radiated Emissions	47.00 (Margin -7.00dB) - AV	F d 5 5	
15.247(d)	Band Edge	Meet the requirement of limit	Pass	
15.247(b)(1)	Conducted Output Power	Power [dBm]: 7.04	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.: FR790403AD Page: 4 of 47



## 1 General Description

#### 1.1 Information

#### 1.1.1 Product Details

The following models are provided to this EUT.

Model Name	Product Name	Description	
AC1A	AudiaClin	For different housing design	
AC1B	AudioClip	For different housing design.	

## 1.1.2 Specification of the Equipment under Test (EUT)

RF General Information						
Frequency Range (MHz)	Bluetooth Mode	Ch. Frequency (MHz)	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.

#### 1.1.3 Antenna Details

Ant. No.	Туре	Gain (dBi)	Connector	Remark
1	Inverted-F	5.8		

### 1.1.4 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	5Vdc from adapter 5Vdc from host 3.7Vec from battery
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Report No.: FR790403AD Page: 5 of 47



## 1.1.5 Accessories

	Accessories					
No.	Equipment	Description				
1	AC adapter	Brand: PHIHONG Model: AM05A-050A Power Rating: I/P: 100-240Vac, 50/60Hz, 0.2A O/P: 5Vdc, 1A Power Line: 1.8m non-shielded cable without core				
2	Battery	Brand: SYNERGY Model: AHB451730PC Power Rating: Rating: 3.7Vdc, 200mAh				
3	USB cable	1m shielded cable without core				

Report No.: FR790403AD Page: 6 of 47



## 1.1.6 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		

## 1.1.7 Test Tool and Duty Cycle

Test Tool	NebulaDeveloper, Version: 3.2.0.0

## 1.1.8 Power Setting

Modulation Mode		Test Frequency (MHz)	
Modulation Mode	2402	2441	2480
GFSK/1Mbps	0xff7f	0xff7f	0xff7f
л/4 QDPSK/2Mbps	0xff7f	0xff7f	0xff7f
8DPSK/3Mbps	0xff7f	0xff7f	0xff7f

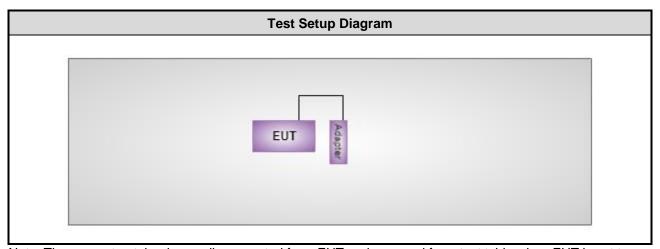
Report No.: FR790403AD Page: 7 of 47



## 1.2 Local Support Equipment List

Support Equipment List						
No. Equipment Brand			Model	FCC ID	Signal cable / Length (m)	
1	Notebook	DELL	Latitude E6430	DoC		

## 1.3 Test Setup Chart



Note: The support notebook was disconnected from EUT and removed from test table when EUT is set to transmit continuously.

Report No.: FR790403AD Page: 8 of 47



## 1.4 The Equipment List

Test Item	Conducted Emission							
Test Site	Conduction room 1 / (CO01-WS)							
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until			
Receiver	R&S	ESR3	101657	Dec. 21, 2016	Dec. 20, 2017			
LISN	SCHWARZBECK	Schwarzbeck 8127	8127-667	Nov. 08, 2016	Nov. 07, 2017			
RF Cable-CON	EMC	EMCCFD300-BM-B M-6000	50821	Dec. 20, 2016	Dec. 19, 2017			
Measurement Software	AUDIX	e3	6.120210k	NA	NA			
Note: Calibration Interval of instruments listed above is one year.								

Test Item	Radiated Emission							
Test Site	966 chamber 3 / (03CH03-WS)							
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until			
Spectrum Analyzer	ROHDE&SCHWARZ	FSV40	101486	Nov. 15, 2016	Nov. 14, 2017			
Receiver	Agilent	N9038A	MY53290044	Oct. 06, 2016	Oct. 05, 2017			
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	Apr. 28, 2017	Apr. 27, 2018			
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Feb. 09, 2017	Feb. 08, 2018			
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 25, 2016	Oct. 24, 2017			
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 10, 2016	Nov. 09, 2017			
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Dec. 09, 2016	Dec. 08, 2017			
Preamplifier	EMC	EMC02325	980187	Sep. 04, 2017	Sep. 03, 2018			
Preamplifier	Agilent	83017A	MY53270014	Aug. 21, 2017	Aug. 20, 2018			
Preamplifier	EMC	EMC184045B	980192	Aug. 22, 2017	Aug. 21, 2018			
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Feb. 04, 2017	Feb. 03, 2018			
RF cable-8M	HUBER+SUHNER	SUCOFLEX104	MY22600/4	Feb. 04, 2017	Feb. 03, 2018			
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22624/4	Feb. 04, 2017	Feb. 03, 2018			
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800 -001	Feb. 04, 2017	Feb. 03, 2018			
LF cable-3M	EMC	EMC8D-NM-NM-300 0	131103	Feb. 04, 2017	Feb. 03, 2018			
LF cable-13M	EMC	EMC8D-NM-NM-130 00	131104	Feb. 04, 2017	Feb. 03, 2018			
Measurement Software	AUDIX	e3	6.120210g	NA	NA			
Note: Calibration Inter	Note: Calibration Interval of instruments listed above is one year.							

Report No.: FR790403AD Page: 9 of 47



Test Item	RF Conducted					
Test Site	(TH01-WS)					
Instrument	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Until	
Spectrum Analyzer	R&S	FSV40	101063	Mar. 15, 2017	Mar. 14, 2018	
Power Meter	Anritsu	ML2495A	1241002	Oct. 06, 2016	Oct. 05, 2017	
Power Sensor	Anritsu	MA2411B	1207366	Oct. 06, 2016	Oct. 05, 2017	
DC POWER SOURCE	GW INSTEK	GPC-6030D	EM892433	Oct. 20, 2016	Oct. 19, 2017	
AC POWER SOURCE	APC	AFC-500W	F312060012	Oct. 28, 2016	Oct. 27, 2017	
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA	
Note: Calibration Interval of instruments listed 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 ANSI C63.10-2013

## 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					
Power density	±0.463 dB					
Conducted emission	±2.670 dB					
AC conducted emission	±2.90 dB					
Radiated emission ≤ 1GHz	±3.66 dB					
Radiated emission > 1GHz	±5.37 dB					

Report No.: FR790403AD Page: 10 of 47



## 2 Test Configuration

## 2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
AC Conduction	CO01-WS	23°C / 57%	Alex Huang
Radiated Emissions	03CH03-WS	24-25°C / 64-65%	Aska Huang Brand Wu
RF Conducted	TH01-WS	25°C / 65%	Felix Sung

FCC Designation No.: TW0009
 FCC site registration No.: 207696
 IC 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 2Mbps 3Mbps	
Number of Hopping Channels	GFSK 8DPSK	2402~2480 2402~2480	1Mbps 3Mbps	
Hopping Channel Separation 20dB and Occupied bandwidth	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	
Dwell Time	GFSK 8DPSK	2402 2402	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.
- 2. S/N of test samples are as below 000016098300J2305570011 000016098300J2305570023 000016098300J2304263002
- 3. Two models AC1A and AC1B had been covered during the pretest. The worst model is AC1B, and only its data was record in this test report.

Report No.: FR790403AD Page: 11 of 47



## 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  $\Omega$  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



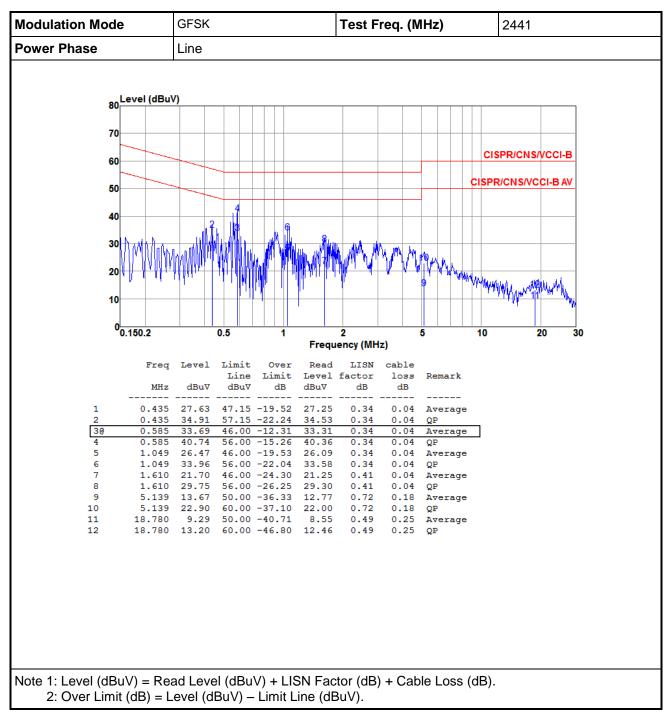
Note: 1. Support units were connected to second LISN.

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

Report No.: FR790403AD Page: 12 of 47

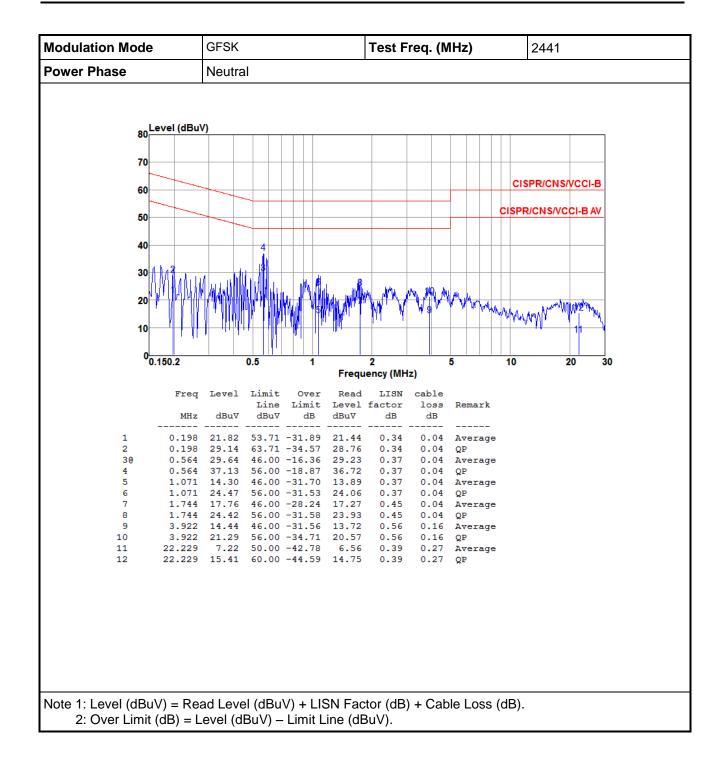


#### 3.1.4 Test Result of Conducted Emissions



Report No.: FR790403AD Page: 13 of 47





Report No.: FR790403AD Page: 14 of 47



### 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

- 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:

- 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:

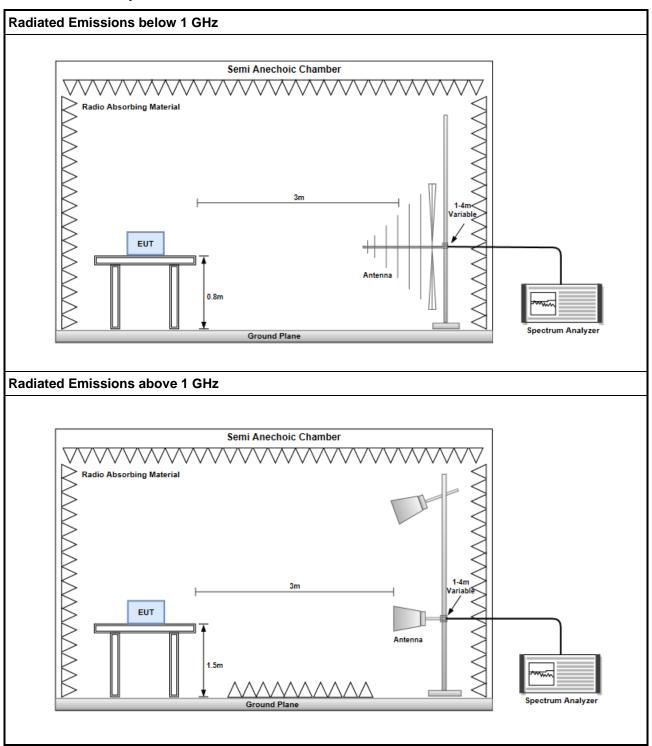
3. 
$$\frac{1s / 1600 * 5}{20 \log (\text{Duty cycle}) = 20 \log \frac{100 \text{ ms}}{100 \text{ ms}}} = -30.1 \text{dB}$$

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

Report No.: FR790403AD Page: 15 of 47



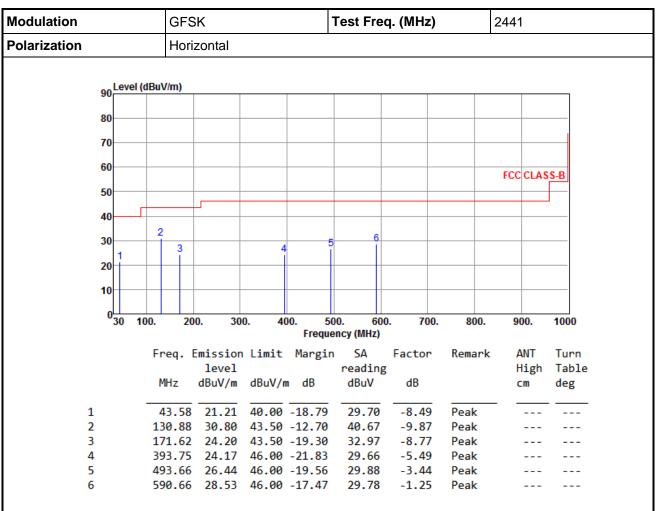
## 3.2.3 Test Setup



Report No.: FR790403AD Page: 16 of 47



### 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.: FR790403AD Page: 17 of 47



Modulation			GFS	K			Test Freq. (MHz)				2441	
Polarization			Verti	cal								
	90Le	evel (dB	uV/m)									
	80											
	70											
	60											
											FCC CLAS	S-B
	50											
	40			_								
	30-		2					, 6				
	1				3	4						
	20											
	10											
	0 <mark></mark>	100.	20	0. 30	0. 40		00. 60 ency (MHz)	0. 7	700.	800.	900.	1000
			rea F	mission	limit			Facto	ar l	Remark	ANT	Turn
			req	level	LIMIL	riai 81	reading			itemat k	High	Table
			MHz	dBuV/m	dBuV/r	n dB	dBuV	dB			cm	deg
1		_	45.52	23.00	40.00	-17.00	31.36	-8.	36	Peak		
2		1	130.88	32.69		-10.81	42.56	-9.8		Peak		
3			393.75			-22.01	29.48	-5.4		Peak		
4			193.66				29.99	-3.4		Peak		
5 6			505.21			-17.46		-0.9		Peak		
6		(	556.62	29.84	46.00	-16.16	30.17	-0.	55	Peak		

\*Factor includes antenna factor, cable loss and amplifier gain

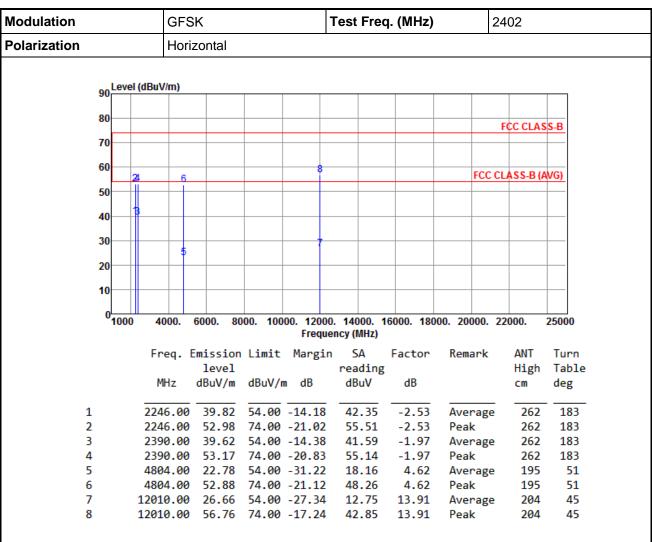
Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).

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

Report No.: FR790403AD Page: 18 of 47



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



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

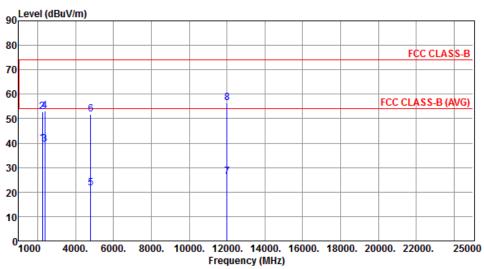
\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR790403AD Page: 19 of 47



Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		

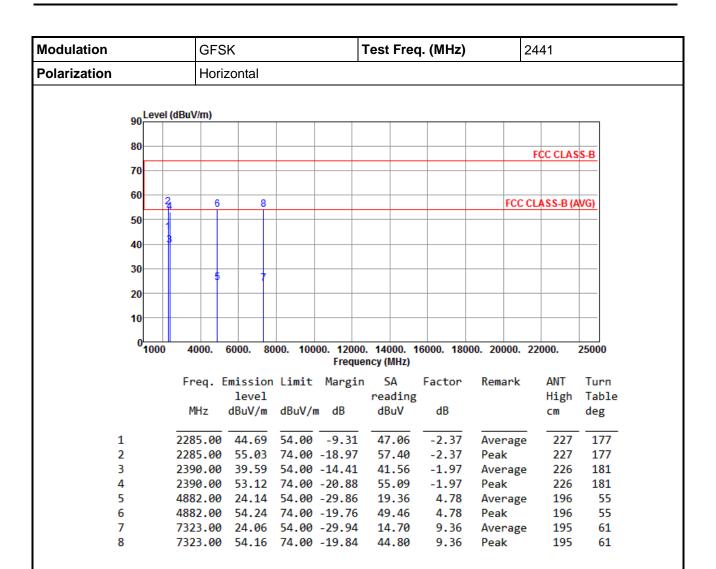


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2246.00	39.75	54.00	-14.25	42.28	-2.53	Average	238	241
2	2246.00	52.86	74.00	-21.14	55.39	-2.53	Peak	238	241
3	2390.00	39.54	54.00	-14.46	41.51	-1.97	Average	238	241
4	2390.00	53.06	74.00	-20.94	55.03	-1.97	Peak	238	241
5	4804.00	21.55	54.00	-32.45	16.93	4.62	Average	209	214
6	4804.00	51.65	74.00	-22.35	47.03	4.62	Peak	209	214
7	12010.00	26.35	54.00	-27.65	12.44	13.91	Average	211	212
8	12010.00	56.45	74.00	-17.55	42.54	13.91	Peak	211	212

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

Report No.: FR790403AD Page: 20 of 47





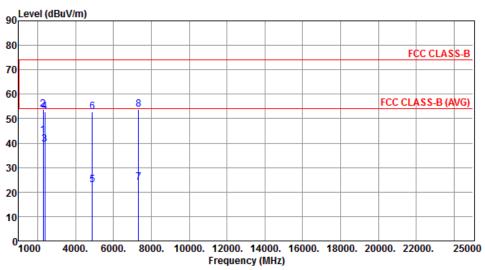
\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR790403AD Page: 21 of 47



Modulation	GFSK	Test Freq. (MHz)	2441
Polarization	Vertical		

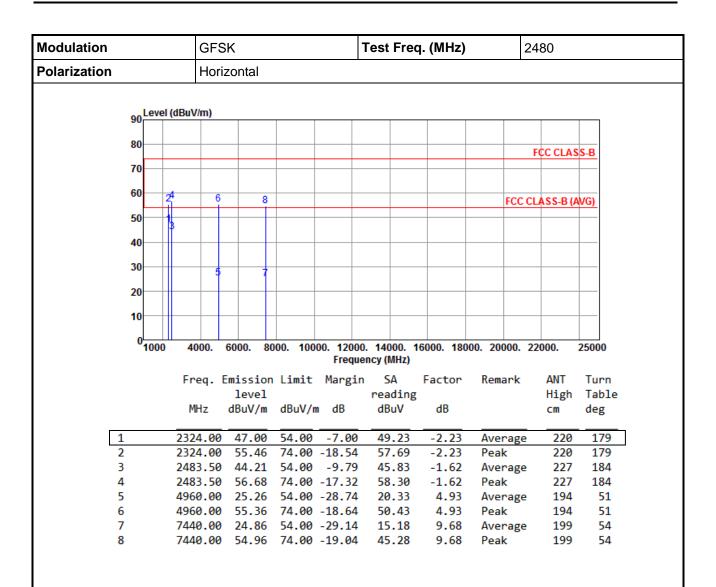


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Ū	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2285.00	43.25	54.00	-10.75	45.62	-2.37	Average	238	241
2	2285.00	53.84	74.00	-20.16	56.21	-2.37	Peak	238	241
3	2390.00	39.48	54.00	-14.52	41.45	-1.97	Average	238	241
4	2390.00	52.96	74.00	-21.04	54.93	-1.97	Peak	238	241
5	4882.00	22.83	54.00	-31.17	18.05	4.78	Average	210	211
6	4882.00	52.93	74.00	-21.07	48.15	4.78	Peak	210	211
7	7323.00	23.85	54.00	-30.15	14.49	9.36	Average	208	195
8	7323.00	53.95	74.00	-20.05	44.59	9.36	Peak	208	195

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

Report No.: FR790403AD Page: 22 of 47





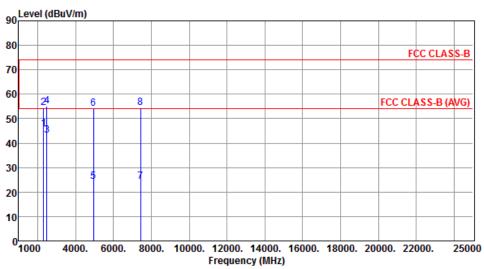
\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR790403AD Page: 23 of 47



Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		



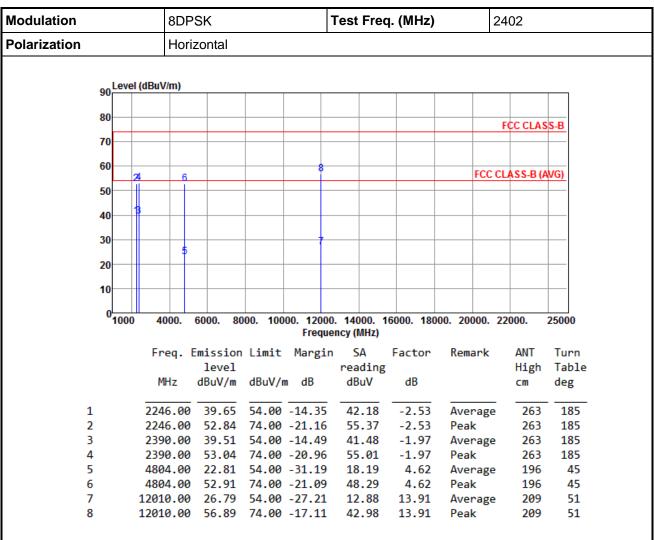
	Freq. MHz	Emission level dBuV/m	Limit dBuV/m		SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2324.00	45.92	54.00	-8.08	48.15	-2.23	Average	235	246
2	2324.00	54.31	74.00	-19.69	56.54	-2.23	Peak	235	246
3	2483.50	43.05	54.00	-10.95	44.67	-1.62	Average	235	246
4	2483.50	55.21	74.00	-18.79	56.83	-1.62	Peak	235	246
5	4960.00	24.14	54.00	-29.86	19.21	4.93	Average	205	224
6	4960.00	54.24	74.00	-19.76	49.31	4.93	Peak	205	224
7	7440.00	24.29	54.00	-29.71	14.61	9.68	Average	202	199
8	7440.00	54.39	74.00	-19.61	44.71	9.68	Peak	202	199

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

Report No.: FR790403AD Page: 24 of 47



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



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

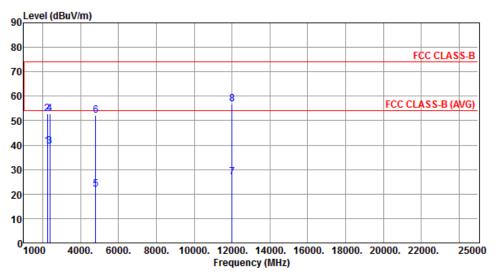
\*Factor includes antenna factor, cable loss and amplifier gain

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

Report No.: FR790403AD Page: 25 of 47



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	2246.00	39.61	54.00	-14.39	42.14	-2.53	Average	235	244
2	2246.00	52.73	74.00	-21.27	55.26	-2.53	Peak	235	244
3	2390.00	39.46	54.00	-14.54	41.43	-1.97	Average	235	244
4	2390.00	52.95	74.00	-21.05	54.92	-1.97	Peak	235	244
5	4804.00	21.88	54.00	-32.12	17.26	4.62	Average	210	219
6	4804.00	51.98	74.00	-22.02	47.36	4.62	Peak	210	219
7	12010.00	26.82	54.00	-27.18	12.91	13.91	Average	207	218
8	12010.00	56.92	74.00	-17.08	43.01	13.91	Peak	207	218

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

Report No.: FR790403AD Page: 26 of 47



Modulation			8	3DPS	SK				٦	est	Free	q. (M	Hz)		2	2441	
Polarization			ŀ	Horizontal													
	90	Level	(dBuV/r	n)													
	80																
	00															FCC CLAS	SS-B
	70																
	60			_		_									ļ		
		2		6		8									FCC C	CLASS-B (	AVG)
	50	1															
	40																+
	30																
	30			\$		7											
	20																
	10																
	0	1000	400	00. 6	6000.	800	0. 100		12000. Freque			6000.	180	00. 2	0000. 2	22000.	25000
			Fre	a F	missi	on	Limit					Fac	tor	Rer	nark	ANT	Tur
				4	leve				a. 6±		 ding			1101	iidi it	High	
			MH	Z	dBuV/	m	dBuV/	m (	dB	dB	uV	dl	В			cm	deg
	1		2285	.00	44.1	3	54.00		9.87	46	.50	-2	.37	Ave	erage	228	18
	2		2285	.00			74.00				.63		.37	Pea	_	228	
	3						54.00				.42		.97		erage	228	
	4						74.00				.05		.97	Pea		228	
	5						54.00				.81		.78		erage	199	
	6		4882	.00	54.6	9	74.00	-13	9.31	49	.91	4	.78	Pea	aK	199	6

9.36

9.36

Average

Peak

187

187

53

53

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

7323.00 24.86 54.00 -29.14 15.50

7323.00 54.96 74.00 -19.04 45.60

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

Report No.: FR790403AD Page: 27 of 47

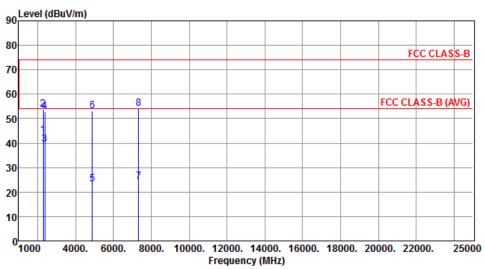
Report Version: Rev. 01

7

8



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



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m		SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2285.00	43.12	54.00	-10.88	45.49	-2.37	Average	234	245
2	2285.00	53.69	74.00	-20.31	56.06	-2.37	Peak	234	245
3	2390.00	39.36	54.00	-14.64	41.33	-1.97	Average	234	245
4	2390.00	52.81	74.00	-21.19	54.78	-1.97	Peak	234	245
5	4882.00	23.15	54.00	-30.85	18.37	4.78	Average	202	194
6	4882.00	53.25	74.00	-20.75	48.47	4.78	Peak	202	194
7	7323.00	24.16	54.00	-29.84	14.80	9.36	Average	202	199
8	7323.00	54.26	74.00	-19.74	44.90	9.36	Peak	202	199

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

Report No.: FR790403AD Page: 28 of 47



1

2

3

4

5

6

7

8

Modulation				8D	PSK	(				-	Γest	Fred	դ. (M	Hz)		2	480	
Polarization				Но	rizor	ntal												
	اء	Level	(dBu\	V/m)														
	90			Ť														
	80						+										FCC CLA	SS-B
	70																100 0231	
	60	1	4		6	8										FCC C	LASS-B (	AVG)
	50																	
	40		-				_											
	30				5	_												-
	20						_											
	10																	
	0,	1000	4	1000.	600	00. 8	3000.	100			. 140 ncy (l		6000.	180	00. 20	000. 2	2000.	25000
					1	ssio evel			Ма	rgin	S	A ding			Rem	ark	ANT High	
			M	ИHz	dB	uV/m	dl	BuV/ı	m d	В	dB	uV	d	В			cm	deg

49.04

57.51

45.71

58.13

21.18

51.28

15.43

45.53

-2.23

-2.23

-1.62

-1.62

4.93

4.93

9.68

9.68

Average

Average

Average

Average

Peak

Peak

Peak

Peak

229

229

229

229

199

199

195

195

185

185

185

185

43

43

48

48

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

2324.00 46.81 54.00 -7.19

56.51

26.11

56.21

25.11

7440.00 55.21 74.00 -18.79

55.28 74.00 -18.72

54.00 -9.91

74.00 -17.49

54.00 -27.89

74.00 -17.79

54.00 -28.89

2324.00

2483.50

4960.00

4960.00

7440.00

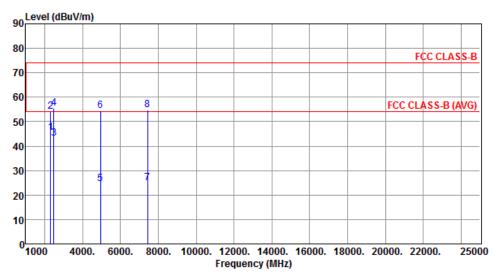
2483.50 44.09

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

Report No.: FR790403AD Page: 29 of 47



Modulation	8DPSK	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	2324.00	45.66	54.00	-8.34	47.89	-2.23	Average	238	245
2	2324.00	54.18	74.00	-19.82	56.41	-2.23	Peak	238	245
3	2483.50	43.15	54.00	-10.85	44.77	-1.62	Average	238	245
4	2483.50	55.36	74.00	-18.64	56.98	-1.62	Peak	238	245
5	4960.00	24.49	54.00	-29.51	19.56	4.93	Average	208	224
6	4960.00	54.59	74.00	-19.41	49.66	4.93	Peak	208	224
7	7440.00	24.78	54.00	-29.22	15.10	9.68	Average	203	206
8	7440.00	54.88	74.00	-19.12	45.20	9.68	Peak	203	206

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

Report No.: FR790403AD Page: 30 of 47



## 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

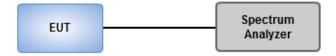
#### **Reference Level Measurement**

- Set the RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
- 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**

- 1. 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

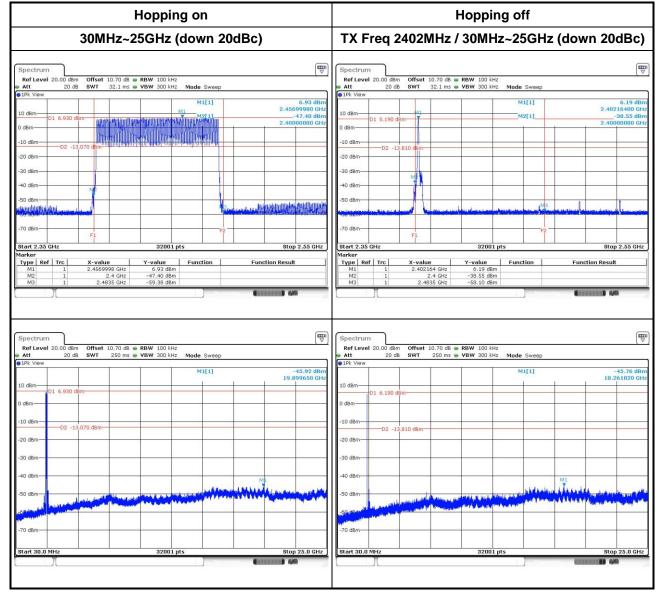


Report No.: FR790403AD Page: 31 of 47



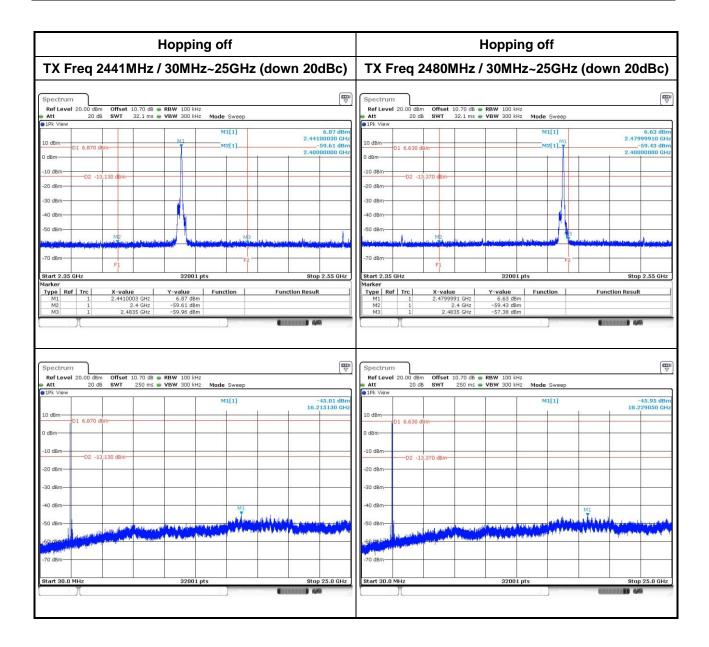
## 3.3.4 Unwanted Emissions into Non-Restricted Frequency Bands

#### **GFSK**



Report No.: FR790403AD Page: 32 of 47

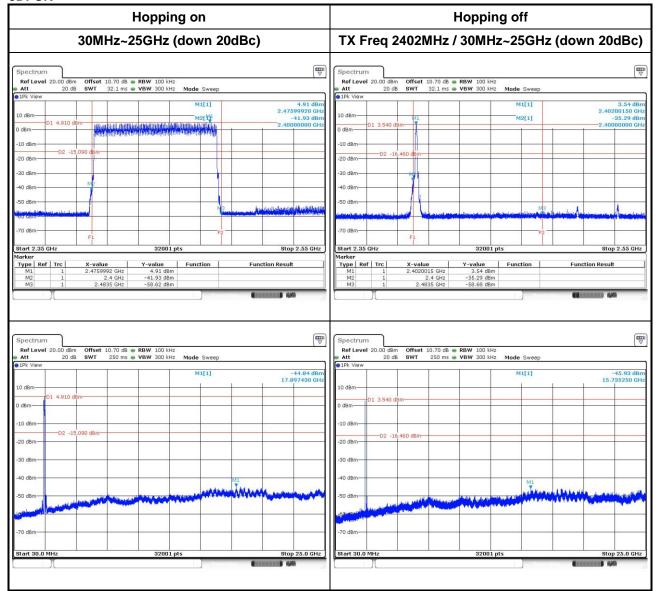




Report No.: FR790403AD Page: 33 of 47

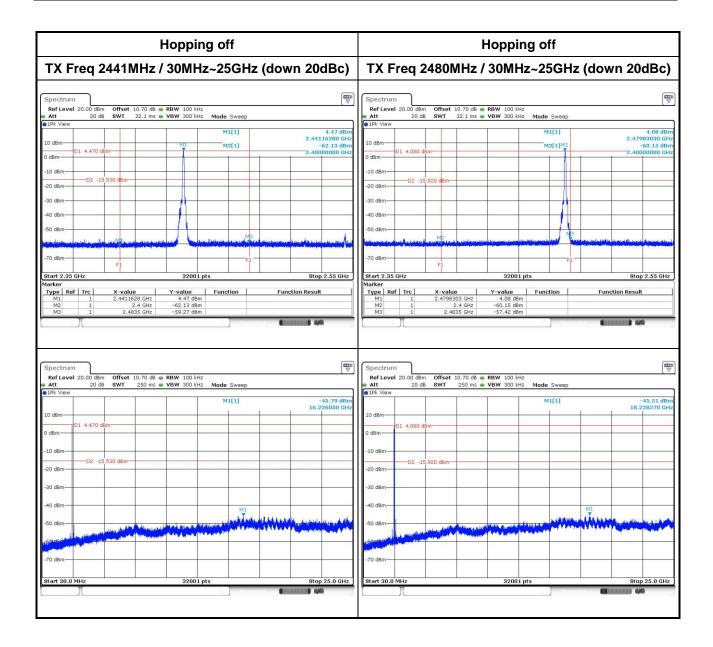


#### 8DPSK



Report No.: FR790403AD Page: 34 of 47





Report No.: FR790403AD Page: 35 of 47



## 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

- 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.: FR790403AD Page: 36 of 47



## 3.4.4 Test Result of Conducted Output Power

Modulation Mode	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (mW)
GFSK	2402	4.25	6.28	125
GFSK	2441	5.06	7.04	125
GFSK	2480	4.84	6.85	125
л/4 DQPSK	2402	3.06	4.86	125
л/4 DQPSK	2441	3.77	5.76	125
л/4 DQPSK	2480	3.22	5.08	125
8DPSK	2402	3.32	5.21	125
8DPSK	2441	4.13	6.16	125
8DPSK	2480	3.66	5.64	125

Modulation Mode	Freq. (MHz)	AV Output Power (mW)	AV Output Power (dBm)
GFSK	2402	4.02	6.04
GFSK	2441	4.83	6.84
GFSK	2480	4.60	6.63
л/4 DQPSK	2402	1.82	2.59
л/4 DQPSK	2441	2.30	3.61
л/4 DQPSK	2480	1.91	2.81
8DPSK	2402	1.82	2.60
8DPSK	2441	2.31	3.63
8DPSK	2480	2.05	3.11

Note: Average power is for reference only.

Report No.: FR790403AD Page: 37 of 47



## 3.5 Number of Hopping Frequency

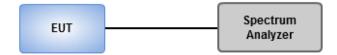
## 3.5.1 Limit of Number of Hopping Frequency

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.

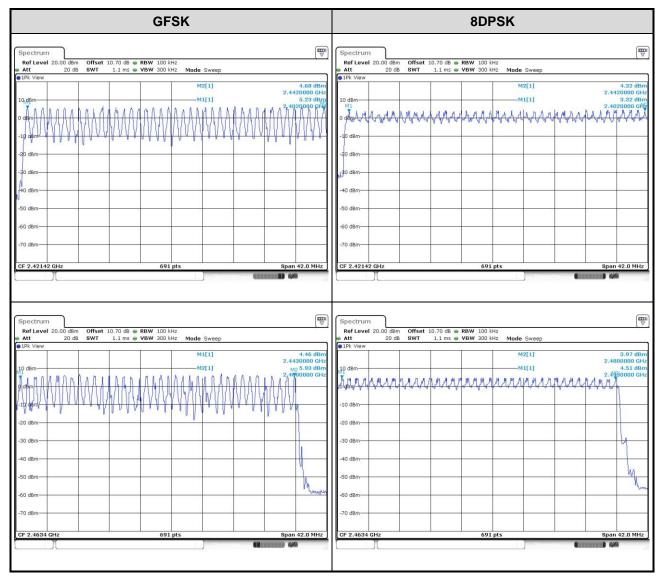
#### 3.5.3 Test Setup



Report No.: FR790403AD Page: 38 of 47



## 3.5.4 Test Result of Number of Hopping Frequency



Report No.: FR790403AD Page: 39 of 47



## 3.6 20dB and Occupied Bandwidth

#### 3.6.1 Test Procedures

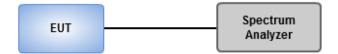
#### 20dB Bandwidth

- 1. Set RBW=30kHz, VBW=100kHz, Sweep time = Auto, Detector=Peak, Trace max hold
- 2 Allow trace to stabilize
- 3 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**

- 1. Set RBW=30kHz, VBW=100kHz, 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

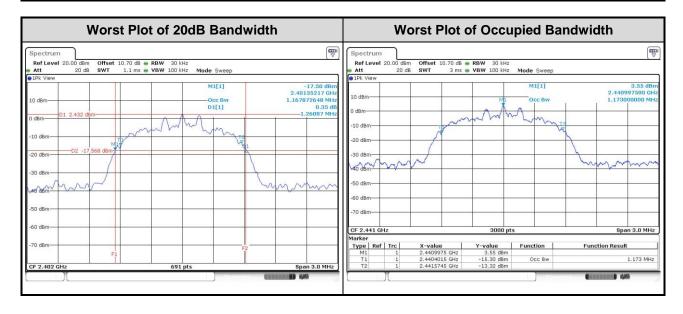


Report No.: FR790403AD Page: 40 of 47



## 3.6.3 Test result of 20dB and Occupied Bandwidth

Modulation Mode	Freq. (MHz)	20dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
GFSK	2402	0.943	0.868
GFSK	2441	0.935	0.858
GFSK	2480	0.935	0.860
8DPSK	2402	1.261	1.168
8DPSK	2441	1.257	1.173
8DPSK	2480	1.257	1.172



Report No.: FR790403AD Page: 41 of 47



## 3.7 Channel Separation

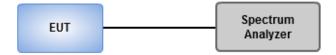
#### 3.7.1 Limit of Channel Separation

- 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

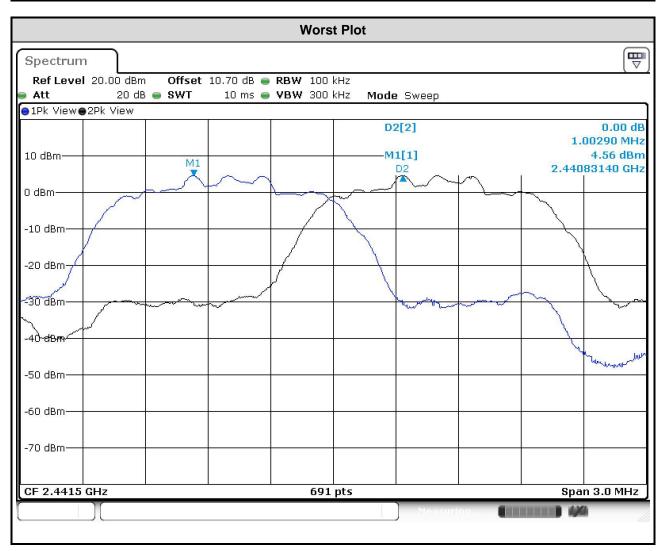


Report No.: FR790403AD Page: 42 of 47



## 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	0.943	0.629
GFSK	2441	1.003	0.935	0.623
GFSK	2480	1.003	0.935	0.623
8DPSK	2402	1.003	1.261	0.841
8DPSK	2441	1.003	1.257	0.838
8DPSK	2480	1.003	1.257	0.838



Report No.: FR790403AD Page: 43 of 47



#### 3.8 Number of Dwell Time

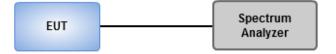
#### 3.8.1 Limit of Dwell time

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 TX, 1 time slot RX). 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 TX, 1 time slot RX). 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 TX, 1 time slot RX). 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

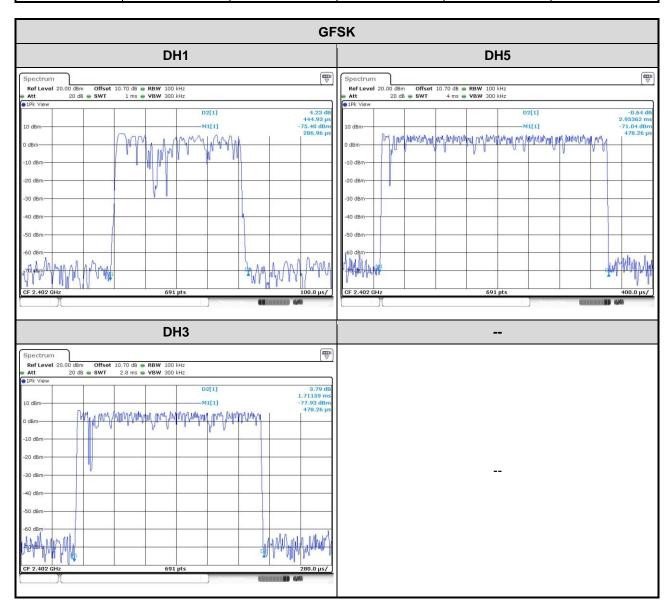


Report No.: FR790403AD Page: 44 of 47



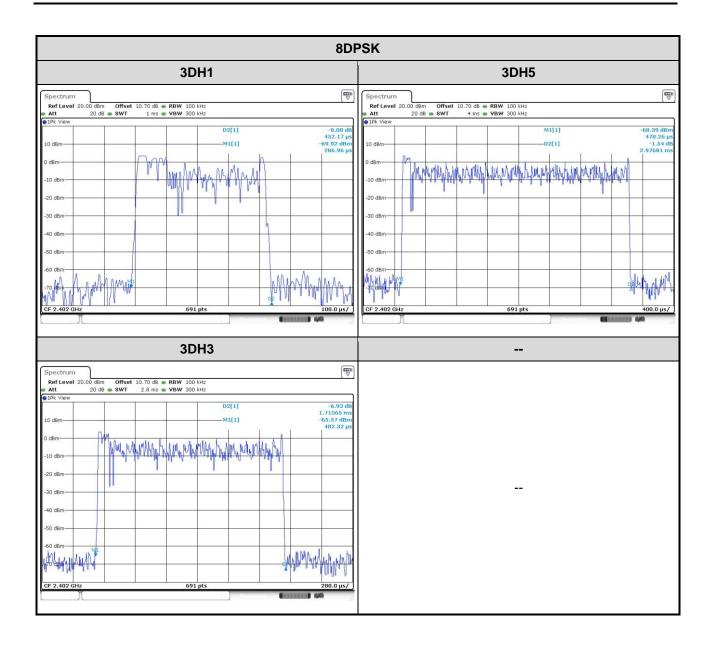
#### 3.8.4 Test Result of Dwell Time

Modulation Mode	Freq. (MHz)	Length of Transmission Time (msec)	Number of Transmission in a 31.6 (79 Hopping*0.4)	Result (s)	Limit (s)
GFSK-DH1	2402	0.44493	320	0.142	0.4
GFSK-DH3	2402	1.71159	160	0.274	0.4
GFSK-DH5	2402	2.95362	106.6	0.315	0.4
8DPSK-DH1	2402	0.45217	320	0.145	0.4
8DPSK-DH3	2402	1.71565	160	0.275	0.4
8DPSK-DH5	2402	2.97681	106.6	0.317	0.4



Report No.: FR790403AD Page: 45 of 47





Report No.: FR790403AD Page: 46 of 47



## 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 <a href="http://www.icertifi.com.tw">http://www.icertifi.com.tw</a>.

#### 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

<u>==END</u>==

Report No.: FR790403AD Page: 47 of 47