FCC Test Report

FCC ID	:	**IPH-02324**
Equipment	:	**Head Unit**
Model No.	:	**884B**
Brand Name	:	**FUSION**
Applicant	:	**Garmin International**
Address	:	**1200 E. 151st Street Olathe, KS 66062**
Standard	:	**47 CFR FCC Part 15.247**
Received Date	:	**Feb. 02, 2016**
Tested Date	:	**Feb. 02 ~ Feb. 17, 2016**

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

Testing Laboratory
2732

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Release Record

Report No.	Version	Description	Issued Date
FR620201AD	Rev. 01	Initial issue	Mar. 11, 2016

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.207	Conducted Emissions	Note	N/A
15.247(d) 15.209	Radiated Emissions	[dBuV/m at 3m]: 60.07MHz 31.06 (Margin -8.94dB) - PK	Pass
15.247(d)	Band Edge	Meet the requirement of limit	Pass
15.247(b)(1)	Conducted Output Power	Power [dBm]: 9.3	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
Note: The EUT consumes DC power from battery, therefore this test is not required.			

1 General Description

1.1 Information

1.1.1 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 π/4-DQPSK and 8DPSK.				

1.1.2 Antenna Details

Ant. No.	Type	Gain (dBi)	Connector	Remark
1	Chip	2.5	NA	---

1.1.3 Power Supply Type of Equipment under Test (EUT)

Power Supply Type	DC 12V

1.1.4 Accessories & Support Units

Accessories	
No.	**Equipment**
1	GPS antenna, 0.6m
2	USB cable, 0.3m shielded without core
3	28 pin cable, 0.2m
4	16 pin cable, 0.2m
5	10 pin cable, 0.2m
6	6 pin cable, 0.2m
7	mounting bracket
Support Units	
1	DC cable, 3.25m non-shielded without core
2	FM antenna, 4.95m non-shielded without core
3	Audio cable, 1.63m (x4) non-shielded without core
4	HDMI cable, 1.48m shielded with two cores
5	Micro SD card (Brand: ADATA ; Capacity: 8GB)

Note: Support units were provided by applicant.

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	---	---

1.1.6 Test Tool and Duty Cycle

Test Tool	BT Test, V0.23

1.1.7 Power Setting

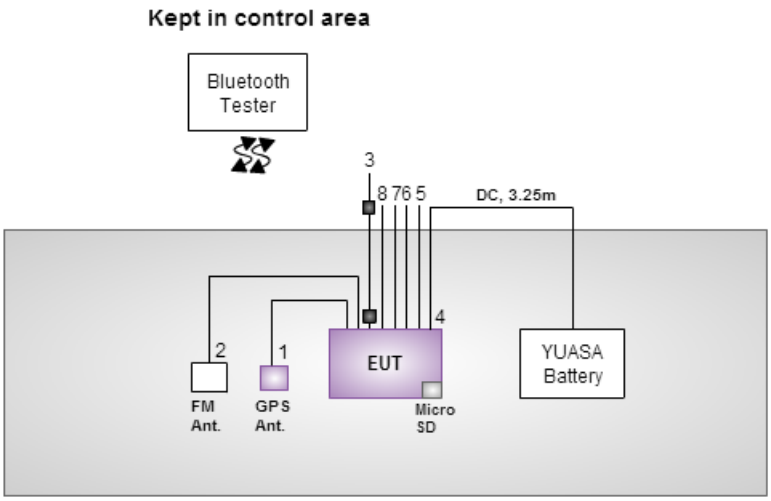
Modulation Mode	Test Frequency (MHz)		
	2402	2441	2480
GFSK/1Mbps	7	7	7
8DPSK/3Mbps	7	7	7

1.2 Local Support Equipment List

Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**FCC ID**	**Signal cable / Length (m)**
1	Battery	YUASA	115E41R	---	---
2	Bluetooth Tester	ROHDE&SCHWARZ	CBT	100959	---

1.3 Test Setup Chart

Test Setup Diagram



1. GPS Ant. cable, 0.6m non-shielded
2. RF cable, 4.95m non-shielded
3. HDMI cable, 1.48m shielded with 2 cores.
4. 10 pin cable, 0.2m (only use 3pin for DC cable connector)
5. 6 pin cable, 0.2m
6. 28 pin cable, 0.2m
7. 16 pin cable, 0.2m
8. USB, 0.3m shielded

1.4 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber 2 / (03CH02-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101499	Dec. 17, 2015	Dec. 16, 2016
Receiver	R&S	ESR3	101657	Jan. 12, 2016	Jan. 11, 2017
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-523	Nov. 09, 2015	Nov. 08, 2016
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1095	Oct. 07, 2015	Oct. 06, 2016
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Nov. 04, 2015	Nov. 03, 2016
Loop Antenna	R&S	HFH2-Z2	11900	Nov. 16, 2015	Nov. 15, 2016
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Dec. 10, 2015	Dec. 09, 2016
Preamplifier	Burgeon	BPA-530	100218	Nov. 03, 2015	Nov. 02, 2016
Preamplifier	Agilent	83017A	MY39501309	Sep. 22, 2015	Sep. 21, 2016
Preamplifier	EMC	EMC184045B	980192	Sep. 01, 2015	Aug. 31, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16140/4	Dec. 10, 2015	Dec. 09, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16018/4	Dec. 10, 2015	Dec. 09, 2016
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16015/4	Dec. 10, 2015	Dec. 09, 2016
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-003	Dec. 10, 2015	Dec. 09, 2016
LF cable 10M	EMCC	CFD400-E	CFD400-001	Dec. 10, 2015	Dec. 09, 2016
Bluetooth Tester	ROHDE&SCHWARZ	CBT	100959	Mar. 03, 2015	Mar. 02, 2016
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101498	Dec. 13, 2015	Dec. 12, 2016
Power Meter	Anritsu	ML2495A	1241002	Sep. 21, 2015	Sep. 20, 2016
Power Sensor	Anritsu	MA2411B	1207366	Sep. 21, 2015	Sep. 20, 2016
Bluetooth Tester	ROHDE&SCHWARZ	CBT	100959	Mar. 03, 2015	Mar. 02, 2016
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
FCC Public notice DA 00-705
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	±3.87 dB
Radiated emission > 1GHz	±5.60 dB

2 Test Configuration

2.1 Testing Condition

Test Item	Test Site	Ambient Condition	Tested By
Radiated Emissions	03CH02-WS	21°C / 65%	Aska Huang Brad Wu
RF Conducted	TH01-WS	21°C / 64%	Alex Huang

- FCC site registration No.: 657002
- IC site registration No.: 10807A-2

2.2 The Worst Test Modes and Channel Details

Test item	Mode	Test Frequency (MHz)	Data Rate (Mbps)	Test Configuration
Radiated Emissions ≤ 1GHz	GFSK	2480	1Mbps	---
Radiated Emissions > 1GHz	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	---
Conducted Output Power	GFSK π/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	GFSK 8DPSK	2402, 2441, 2480 2402, 2441, 2480	1Mbps 3Mbps	---
Dwell Time	GFSK 8DPSK	2402 2402	1Mbps 3Mbps	---

3 Transmitter Test Results

3.1 Unwanted Emissions into Restricted Frequency Bands

3.1.1 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.

3.1.2 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:

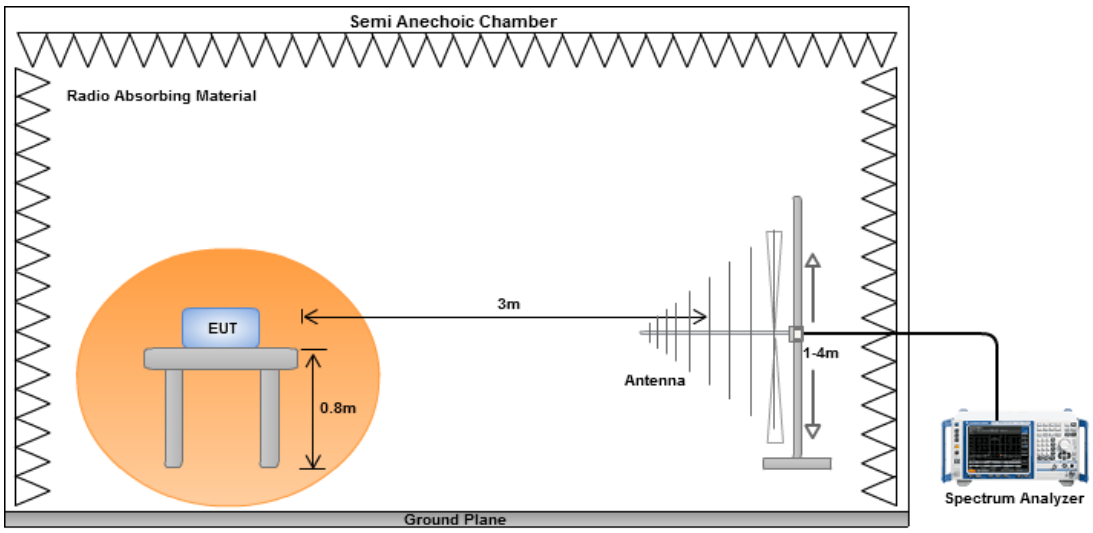
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. Radiated emission above 1GHz / Peak value
   RBW=1MHz, VBW=3MHz and Peak detector
3. Radiated emission above 1GHz / Average value for harmonics
   The average value is: Average = Peak value + 20log(Duty cycle) Where the duty factor is calculated from following formula for DH5 packet type which has worst duty factor:

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

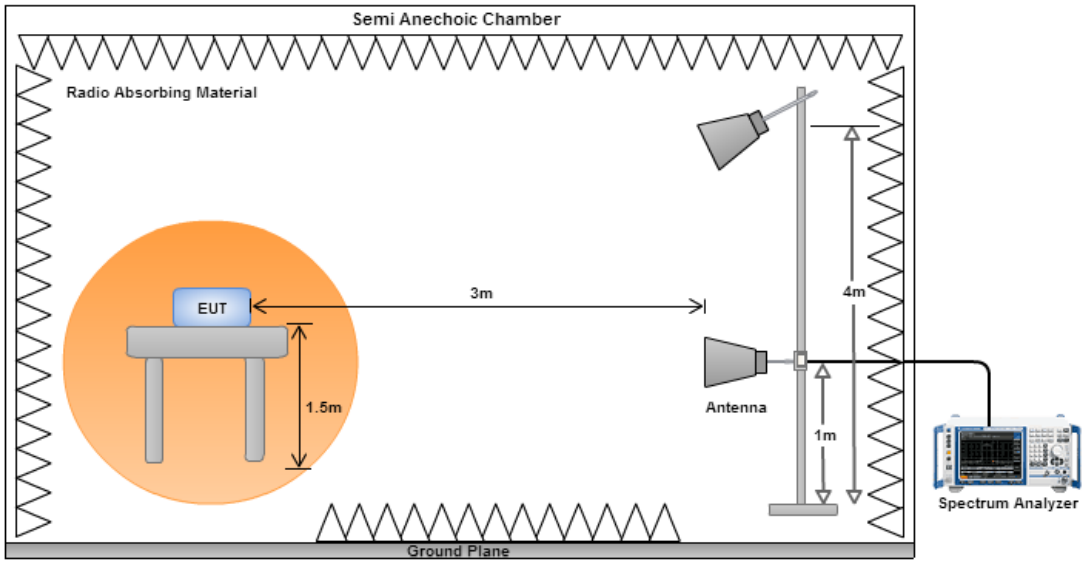
4. Radiated emission above 1GHz / Average value for other emissions
   RBW=1MHz, VBW=1/T and Peak detector

3.1.3 Test Setup

Radiated Emissions below 1 GHz

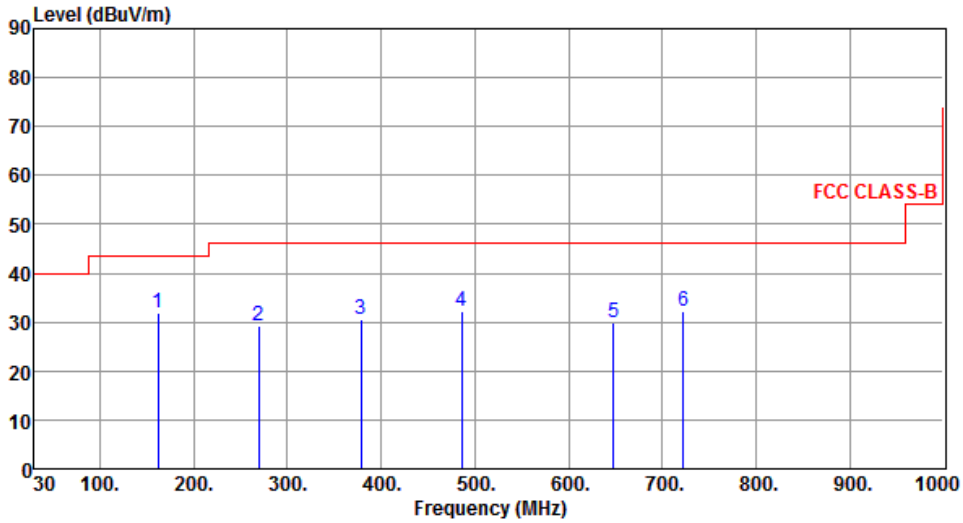


Radiated Emissions above 1 GHz



3.1.4 Transmitter Radiated Unwanted Emissions (Below 1GHz)

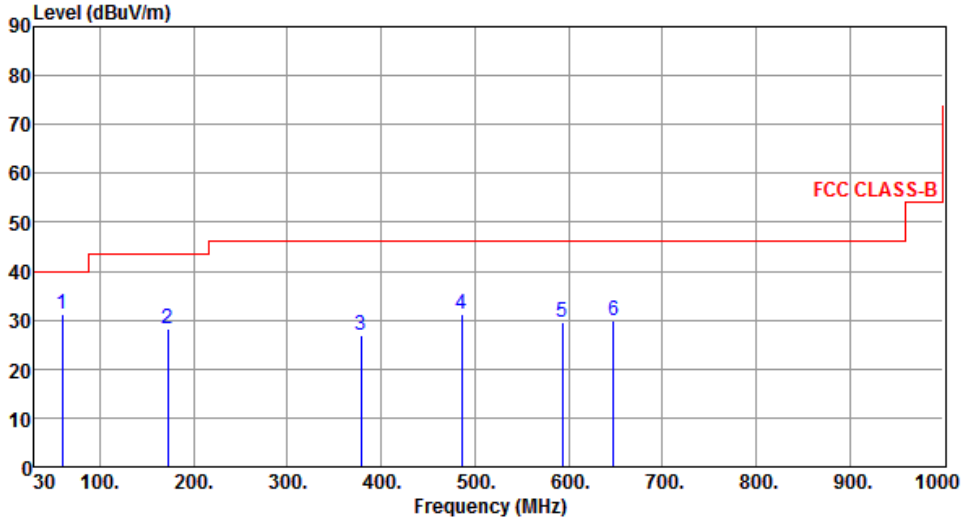
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	161.92	31.80	43.50	-11.70	43.56	-11.76	Peak	---	---
2	269.59	29.11	46.00	-16.89	41.13	-12.02	Peak	---	---
3	378.23	30.47	46.00	-15.53	39.72	-9.25	Peak	---	---
4	485.90	32.19	46.00	-13.81	38.99	-6.80	Peak	---	---
5	647.89	29.78	46.00	-16.22	33.79	-4.01	Peak	---	---
6	722.58	32.21	46.00	-13.79	35.03	-2.82	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.

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

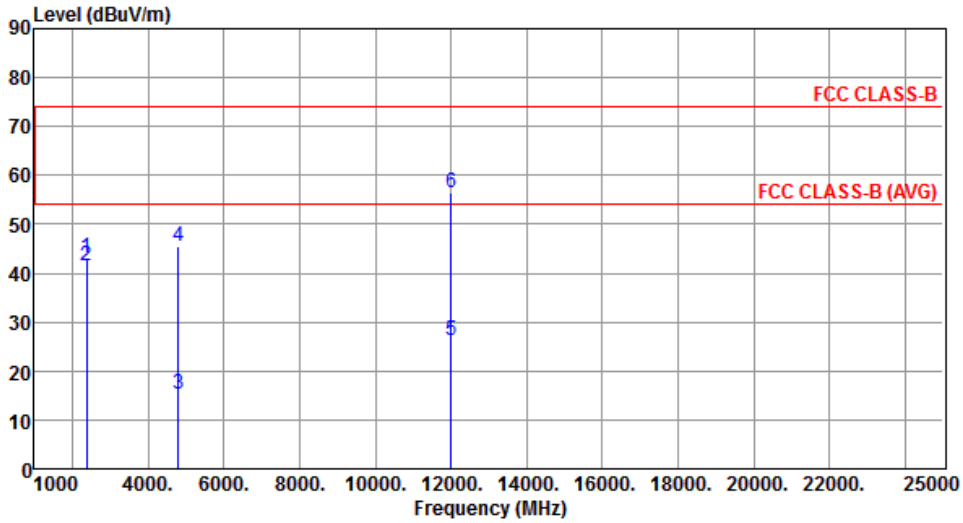


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	60.07	31.06	40.00	-8.94	43.81	-12.75	Peak	---	---
2	172.59	28.24	43.50	-15.26	40.55	-12.31	Peak	---	---
3	378.23	26.93	46.00	-19.07	36.18	-9.25	Peak	---	---
4	485.90	31.28	46.00	-14.72	38.08	-6.80	Peak	---	---
5	593.57	29.59	46.00	-16.41	34.30	-4.71	Peak	---	---
6	647.89	29.85	46.00	-16.15	33.86	-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.

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

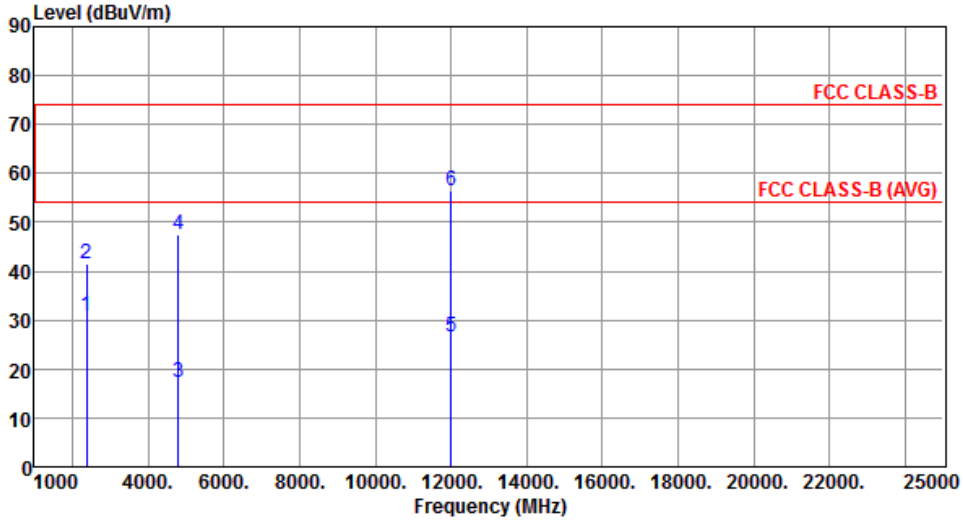
Modulation	GFSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	43.22	54.00	-10.78	46.28	-3.06	Average	105	56
2	2390.00	41.45	74.00	-32.55	44.51	-3.06	Peak	105	56
3	4804.00	15.30	54.00	-38.70	11.09	4.21	Average	154	29
4	4804.00	45.40	74.00	-28.60	41.19	4.21	Peak	154	29
5	12010.00	26.34	54.00	-27.66	12.47	13.87	Average	114	35
6	12010.00	56.44	74.00	-17.56	42.57	13.87	Peak	114	35

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).

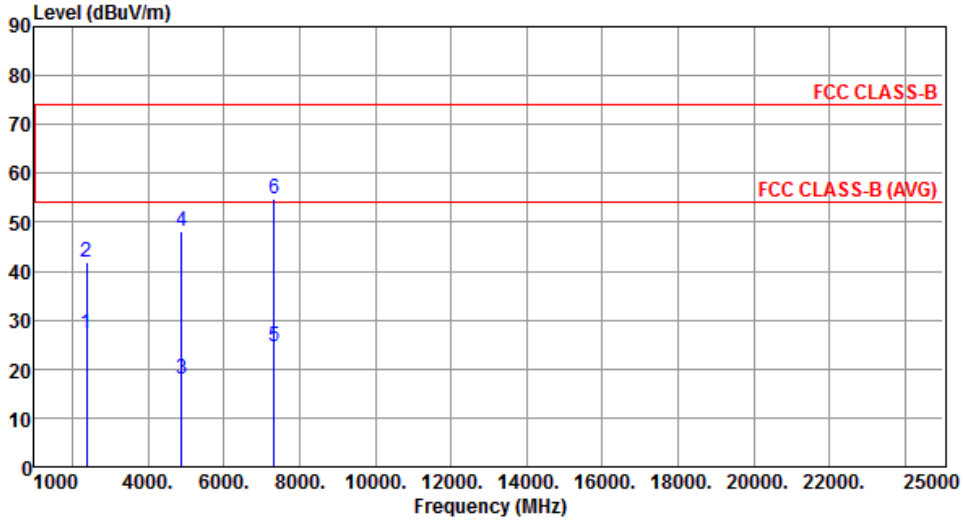
Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	31.04	54.00	-22.96	34.10	-3.06	Average	318	169
2	2390.00	41.39	74.00	-32.61	44.45	-3.06	Peak	318	169
3	4804.00	17.36	54.00	-36.64	13.15	4.21	Average	119	64
4	4804.00	47.46	74.00	-26.54	43.25	4.21	Peak	119	64
5	12010.00	26.46	54.00	-27.54	12.59	13.87	Average	145	34
6	12010.00	56.56	74.00	-17.44	42.69	13.87	Peak	145	34

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).

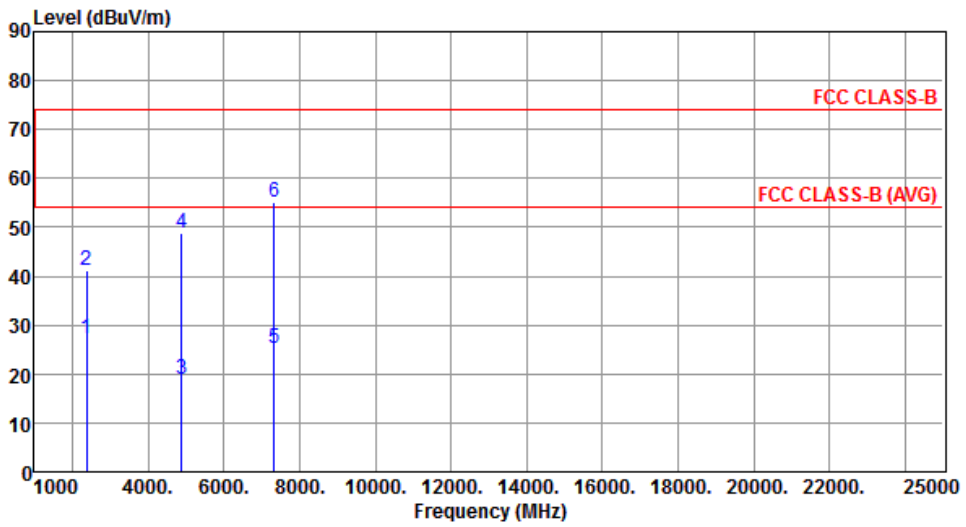
Modulation	GFSK	Test Freq. (MHz)	2441
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2385.00	27.38	54.00	-26.62	30.45	-3.07	Average	125	43
2	2385.00	41.83	74.00	-32.17	44.90	-3.07	Peak	125	43
3	4882.00	18.07	54.00	-35.93	13.66	4.41	Average	100	44
4	4882.00	48.17	74.00	-25.83	43.76	4.41	Peak	100	44
5	7323.00	24.66	54.00	-29.34	15.42	9.24	Average	115	68
6	7323.00	54.76	74.00	-19.24	45.52	9.24	Peak	115	68

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).

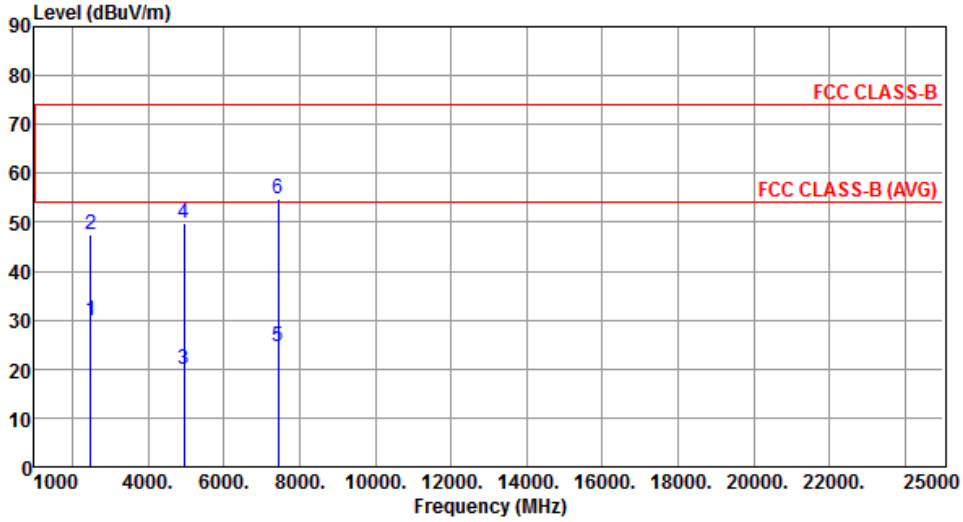
Modulation	GFSK	Test Freq. (MHz)	2441
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2385.00	27.18	54.00	-26.82	30.25	-3.07	Average	315	171
2	2385.00	41.18	74.00	-32.82	44.25	-3.07	Peak	315	171
3	4882.00	18.88	54.00	-35.12	14.47	4.41	Average	139	254
4	4882.00	48.98	74.00	-25.02	44.57	4.41	Peak	139	254
5	7323.00	25.10	54.00	-28.90	15.86	9.24	Average	236	55
6	7323.00	55.20	74.00	-18.80	45.96	9.24	Peak	236	55

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).

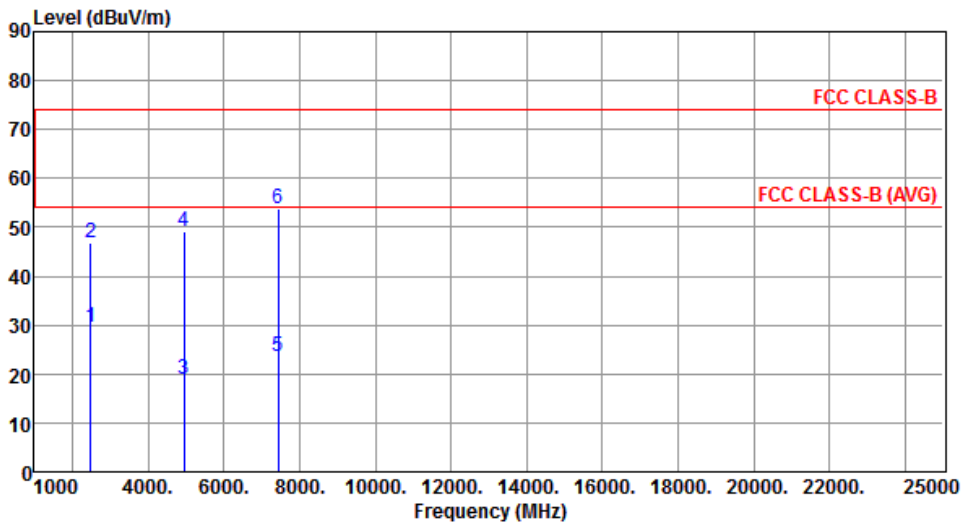
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	29.86	54.00	-24.14	32.55	-2.69	Average	125	44
2	2483.50	47.51	74.00	-26.49	50.20	-2.69	Peak	125	44
3	4960.00	19.79	54.00	-34.21	15.17	4.62	Average	169	148
4	4960.00	49.89	74.00	-24.11	45.27	4.62	Peak	169	148
5	7440.00	24.57	54.00	-29.43	15.10	9.47	Average	113	96
6	7440.00	54.67	74.00	-19.33	45.20	9.47	Peak	113	96

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).

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

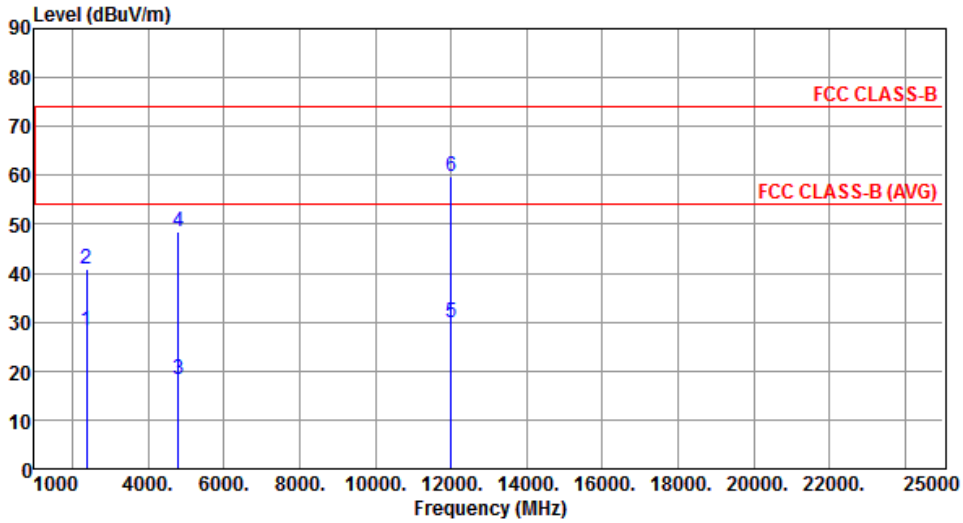


	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	29.70	54.00	-24.30	32.39	-2.69	Average	328	168
2	2483.50	46.85	74.00	-27.15	49.54	-2.69	Peak	328	168
3	4960.00	19.05	54.00	-34.95	14.43	4.62	Average	244	306
4	4960.00	49.15	74.00	-24.85	44.53	4.62	Peak	244	306
5	7440.00	23.61	54.00	-30.39	14.14	9.47	Average	118	69
6	7440.00	53.71	74.00	-20.29	44.24	9.47	Peak	118	69

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).

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

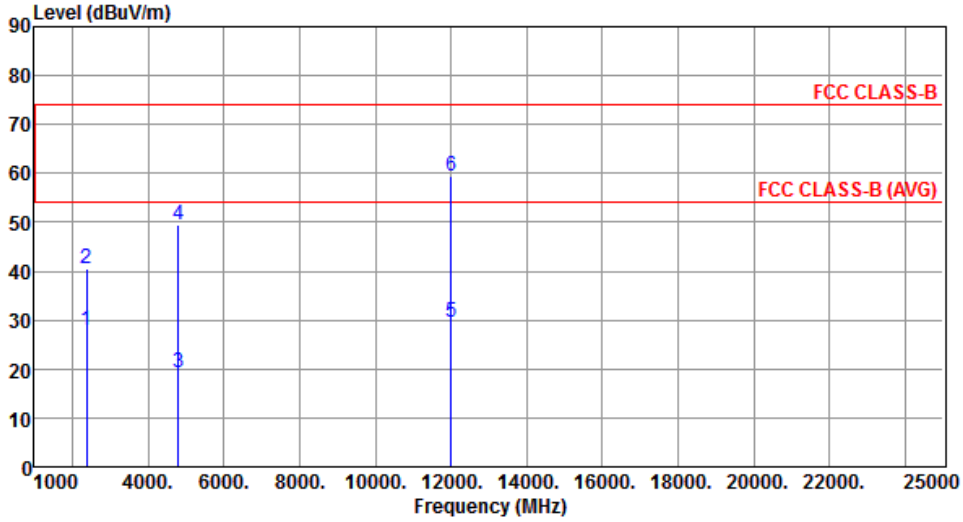
Modulation	8DPSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	28.19	54.00	-25.81	31.25	-3.06	Average	134	31
2	2390.00	40.81	74.00	-33.19	43.87	-3.06	Peak	134	31
3	4804.00	18.37	54.00	-35.63	14.16	4.21	Average	119	65
4	4804.00	48.47	74.00	-25.53	44.26	4.21	Peak	119	65
5	12010.00	29.75	54.00	-24.25	15.88	13.87	Average	125	96
6	12010.00	59.85	74.00	-14.15	45.98	13.87	Peak	125	96

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).

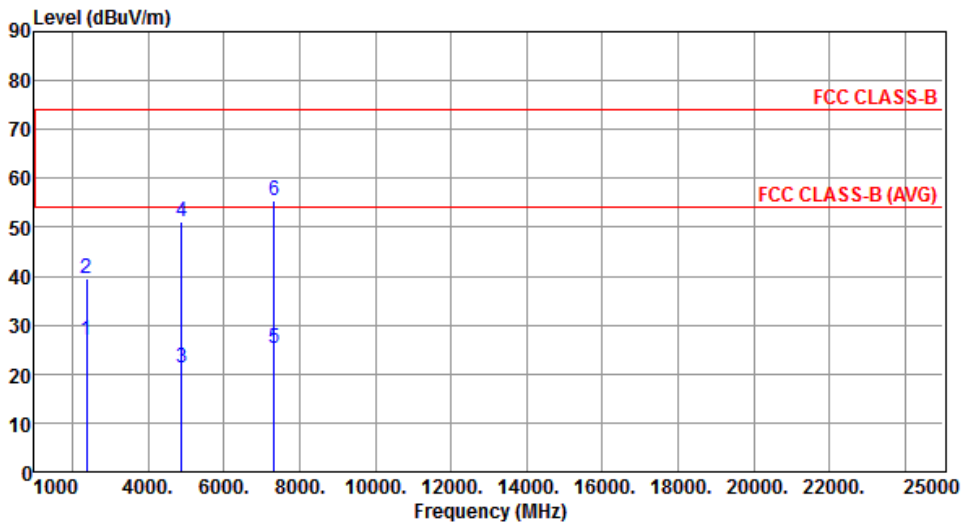
Modulation	8DPSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2390.00	27.95	54.00	-26.05	31.01	-3.06	Average	315	166
2	2390.00	40.66	74.00	-33.34	43.72	-3.06	Peak	315	166
3	4804.00	19.26	54.00	-34.74	15.05	4.21	Average	154	220
4	4804.00	49.36	74.00	-24.64	45.15	4.21	Peak	154	220
5	12010.00	29.43	54.00	-24.57	15.56	13.87	Average	238	99
6	12010.00	59.53	74.00	-14.47	45.66	13.87	Peak	238	99

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).

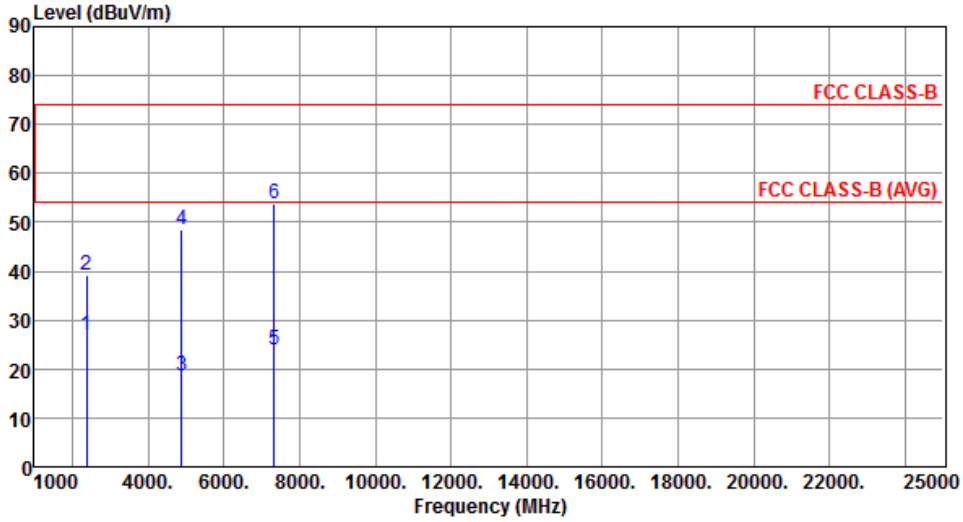
Modulation	8DPSK	Test Freq. (MHz)	2441
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2385.00	27.07	54.00	-26.93	30.14	-3.07	Average	128	42
2	2385.00	39.38	74.00	-34.62	42.45	-3.07	Peak	128	42
3	4882.00	21.17	54.00	-32.83	16.76	4.41	Average	114	145
4	4882.00	51.27	74.00	-22.73	46.86	4.41	Peak	114	145
5	7323.00	25.32	54.00	-28.68	16.08	9.24	Average	135	27
6	7323.00	55.42	74.00	-18.58	46.18	9.24	Peak	135	27

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).

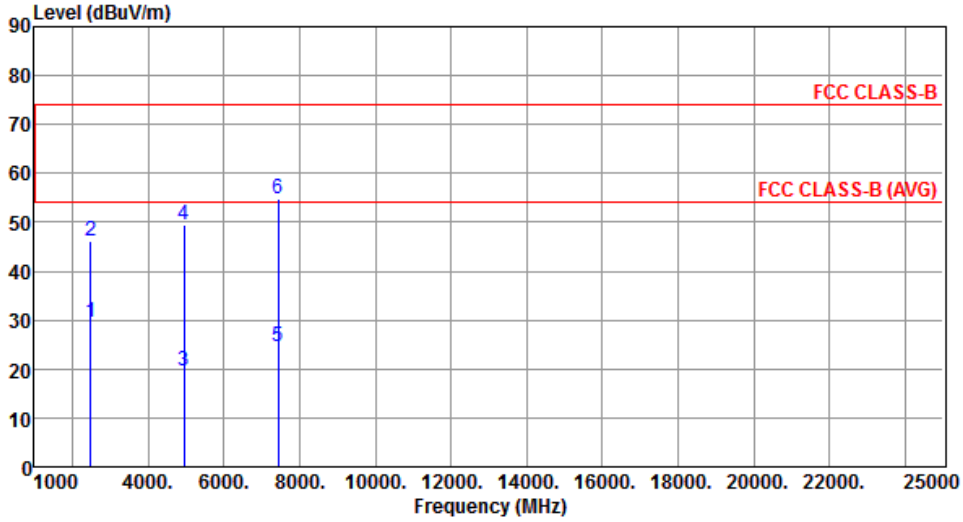
Modulation	8DPSK	Test Freq. (MHz)	2441
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2385.00	26.85	54.00	-27.15	29.92	-3.07	Average	328	151
2	2385.00	39.22	74.00	-34.78	42.29	-3.07	Peak	328	151
3	4882.00	18.50	54.00	-35.50	14.09	4.41	Average	145	158
4	4882.00	48.60	74.00	-25.40	44.19	4.41	Peak	145	158
5	7323.00	23.76	54.00	-30.24	14.52	9.24	Average	101	77
6	7323.00	53.86	74.00	-20.14	44.62	9.24	Peak	101	77

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).

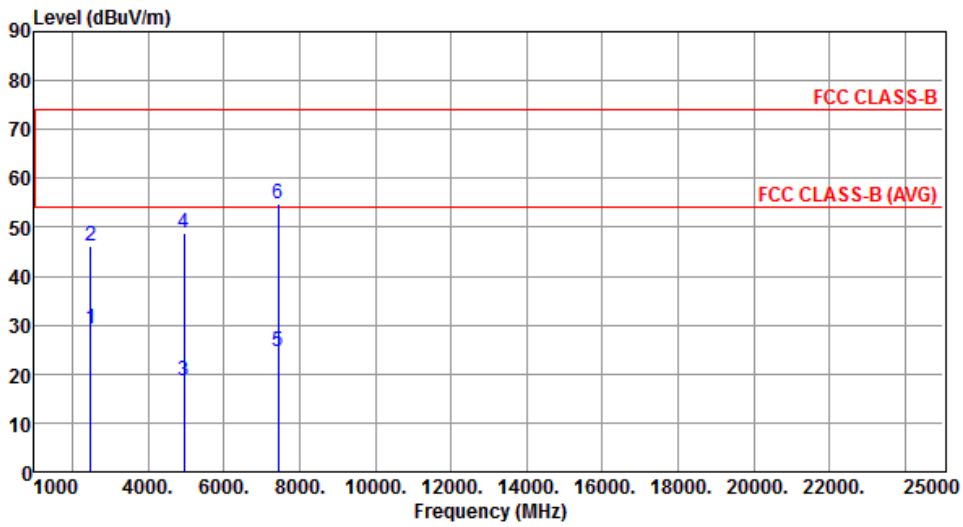
Modulation	8DPSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	29.46	54.00	-24.54	32.15	-2.69	Average	100	44
2	2483.50	46.21	74.00	-27.79	48.90	-2.69	Peak	100	44
3	4960.00	19.48	54.00	-34.52	14.86	4.62	Average	106	247
4	4960.00	49.58	74.00	-24.42	44.96	4.62	Peak	106	247
5	7444.00	24.73	54.00	-29.27	15.26	9.47	Average	285	63
6	7444.00	54.83	74.00	-19.17	45.36	9.47	Peak	285	63

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).

Modulation	8DPSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq. MHz	Emission level dBuV/m	Limit dBuV/m	Margin dB	SA reading dBuV	Factor dB	Remark	ANT High cm	Turn Table deg
1	2483.50	29.31	54.00	-24.69	32.00	-2.69	Average	325	144
2	2483.50	46.05	74.00	-27.95	48.74	-2.69	Peak	325	144
3	4960.00	18.76	54.00	-35.24	14.14	4.62	Average	119	52
4	4960.00	48.86	74.00	-25.14	44.24	4.62	Peak	119	52
5	7440.00	24.72	54.00	-29.28	15.25	9.47	Average	111	206
6	7440.00	54.82	74.00	-19.18	45.35	9.47	Peak	111	206

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).

3.2 Unwanted Emissions into Non-Restricted Frequency Bands

3.2.1 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.

3.2.2 Test Procedures

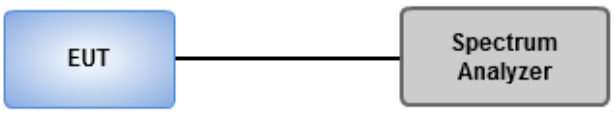
Reference Level Measurement

1. 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

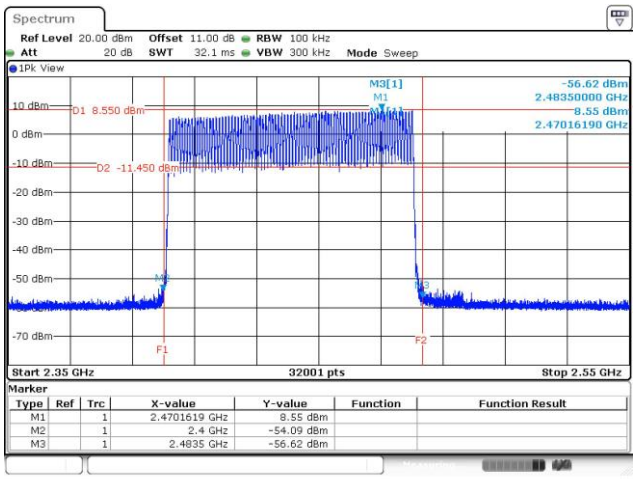
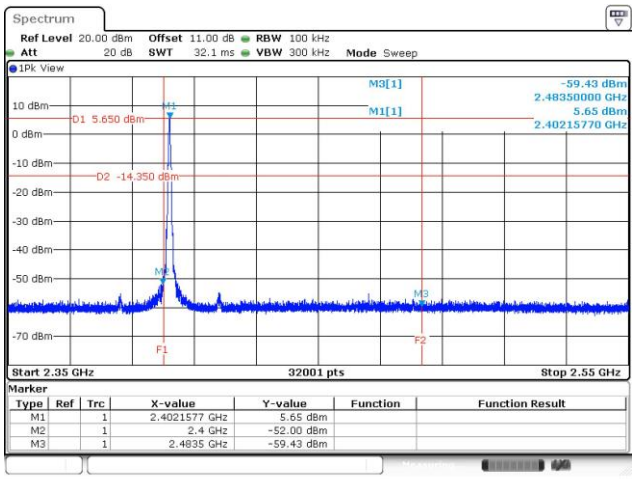
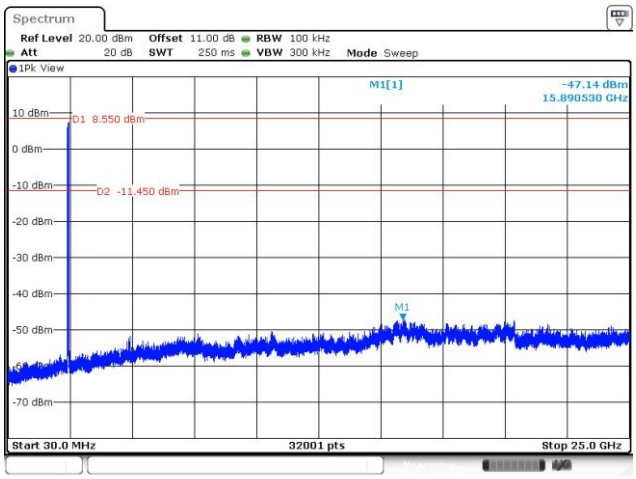
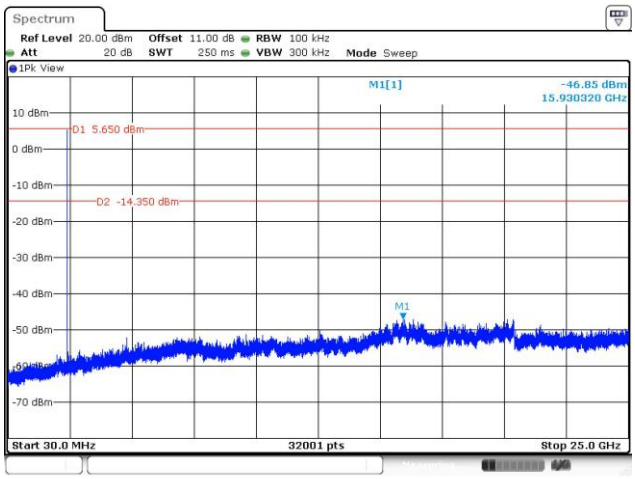
1. Set RBW = 100 kHz, VBW = 300 kHz, Detector = peak.
2. Trace Mode = max hold, Sweep = auto couple.
3. Allow the trace to stabilize.
4. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

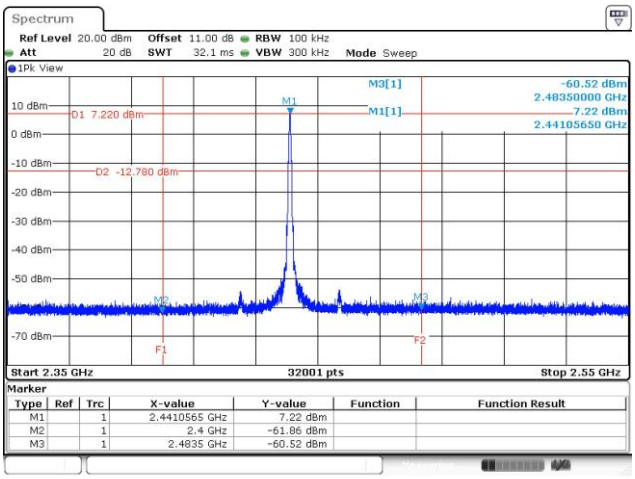
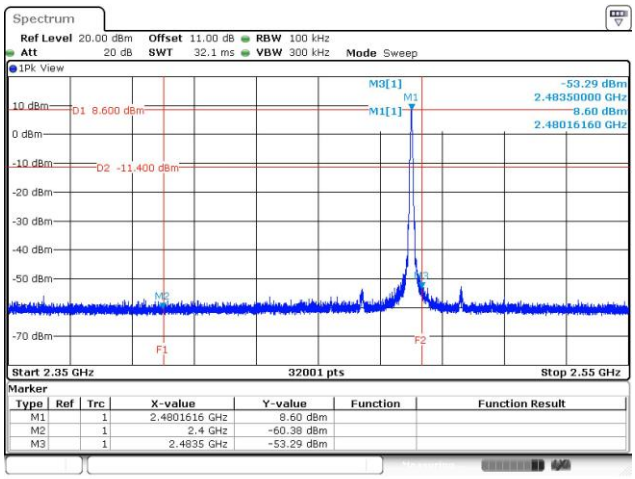
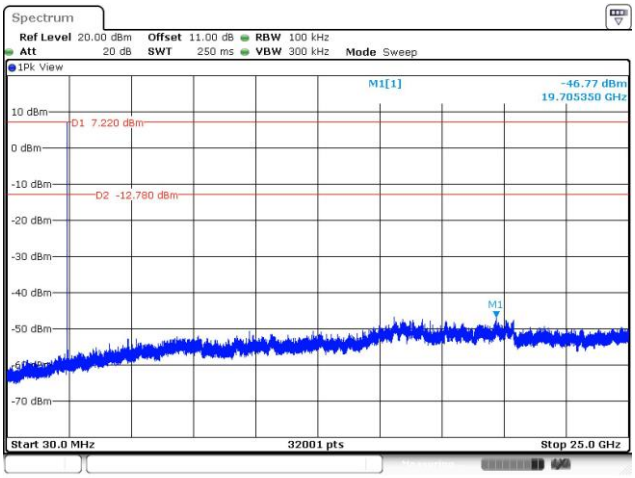
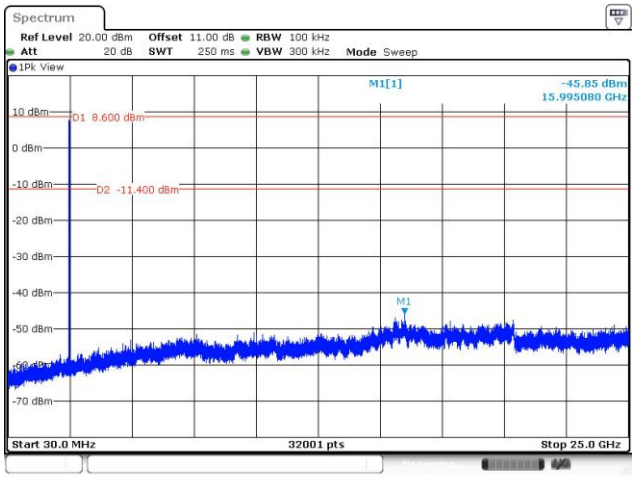
3.2.3 Test Setup



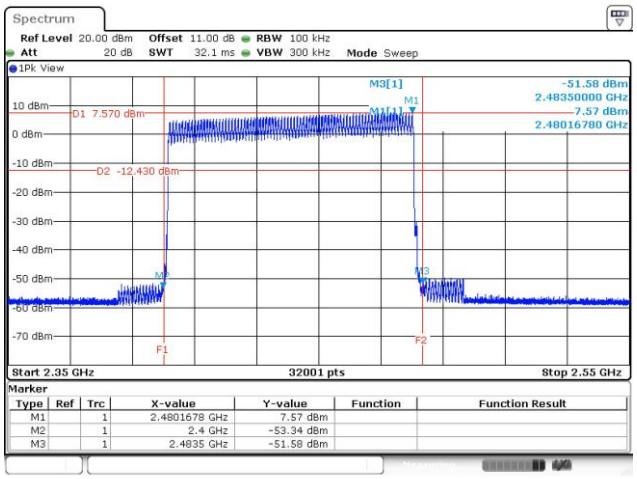
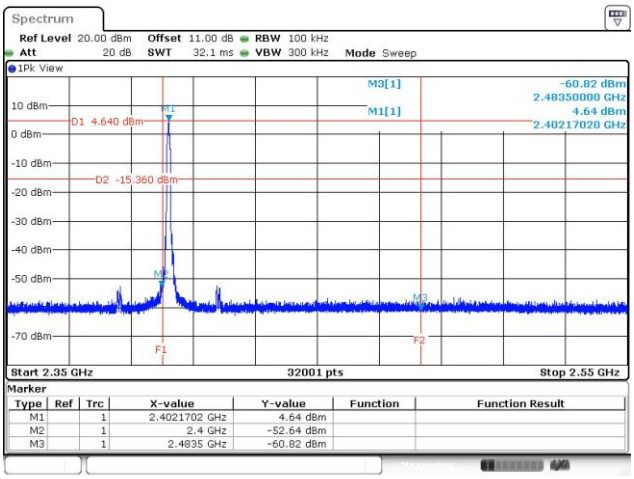
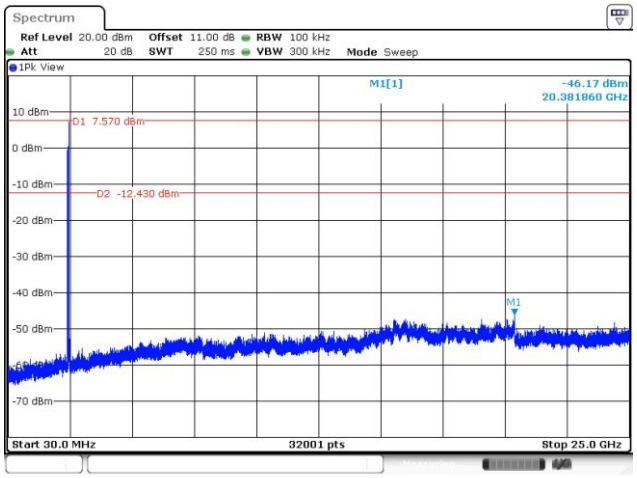
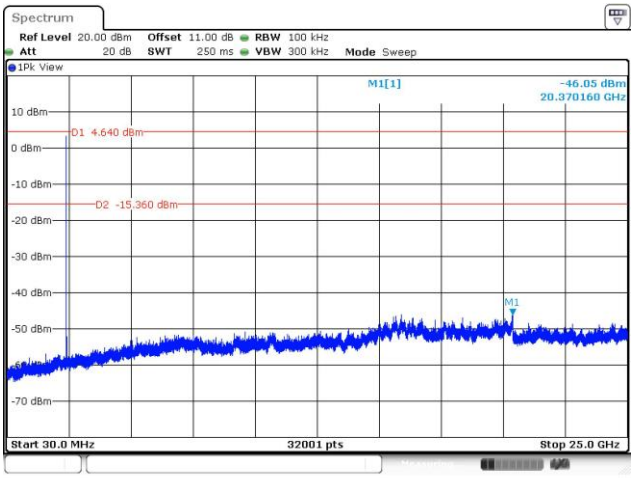
3.2.4 Unwanted Emissions into Non-Restricted Frequency Bands

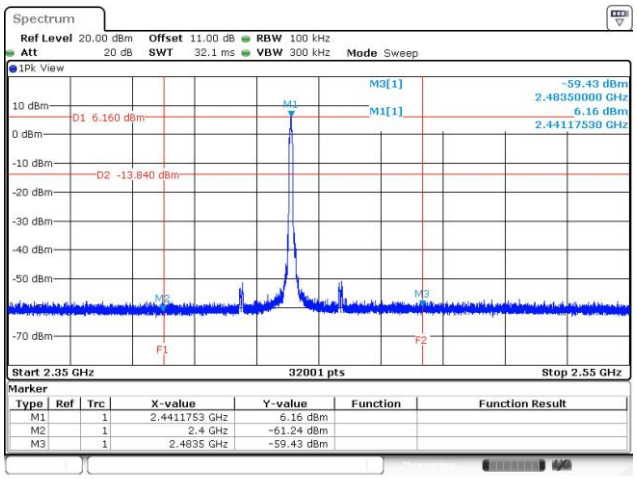
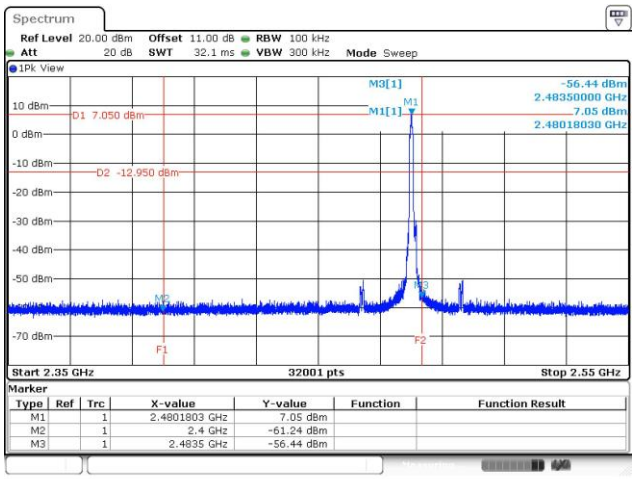
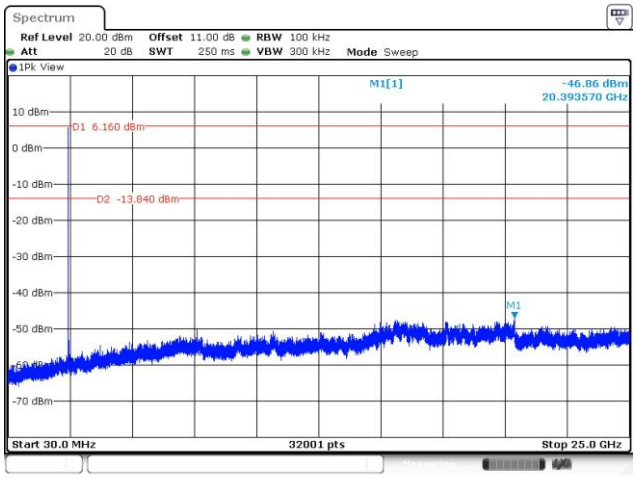
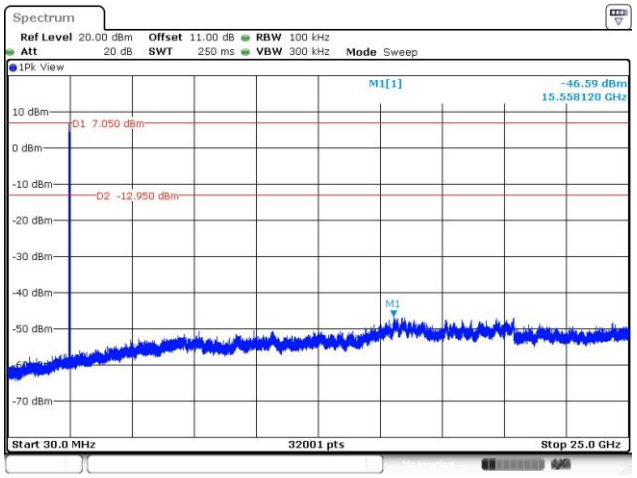
GFSK

Hopping on	Hopping off
30MHz~25GHz (down 20dBc)	**TX Freq 2402MHz / 30MHz~25GHz (down 20dBc)**
	
	

Hopping off	Hopping off
TX Freq 2441MHz / 30MHz~25GHz (down 20dBc)	**TX Freq 2480MHz / 30MHz~25GHz (down 20dBc)**
	
	

8DPSK

Hopping on	Hopping off
30MHz~25GHz (down 20dBc)	**TX Freq 2402MHz / 30MHz~25GHz (down 20dBc)**
	
	

Hopping off	Hopping off
TX Freq 2441MHz / 30MHz~25GHz (down 20dBc)	**TX Freq 2480MHz / 30MHz~25GHz (down 20dBc)**
	
	

3.3 Conducted Output Power

3.3.1 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.

3.3.2 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

3.3.3 Test Setup

3.3.4 Test Result of Conducted Output Power

Modulation Mode	Freq. (MHz)	Output Power (mW)	Output Power (dBm)	Limit (mW)
GFSK	2402	4.17	6.2	125
GFSK	2441	6.31	8.0	125
GFSK	2480	8.51	**9.3**	125
π/4 DQPSK	2402	3.55	5.5	125
π/4 DQPSK	2441	5.37	7.3	125
π/4 DQPSK	2480	7.33	8.65	125
8DPSK	2402	3.57	5.53	125
8DPSK	2441	5.40	7.32	125
8DPSK	2480	7.36	8.67	125

Modulation Mode	Freq. (MHz)	AV Output Power (mW)	AV Output Power (dBm)
GFSK	2402	3.94	5.95
GFSK	2441	5.98	7.77
GFSK	2480	8.07	**9.07**
π/4 DQPSK	2402	2.74	4.37
π/4 DQPSK	2441	4.14	6.17
π/4 DQPSK	2480	5.73	7.58
8DPSK	2402	2.74	4.38
8DPSK	2441	4.15	6.18
8DPSK	2480	5.75	7.60

Note: Average power is for reference only.

3.4 Number of Hopping Frequency

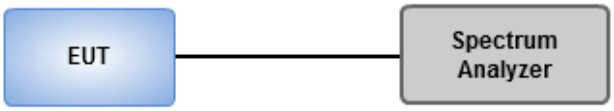
3.4.1 Limit of Number of Hopping Frequency

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

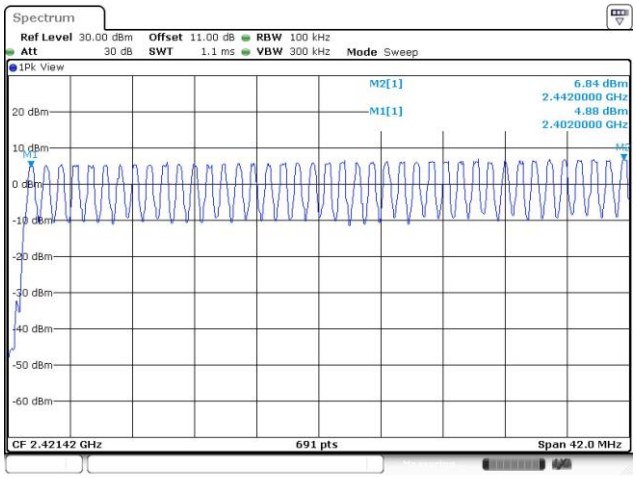
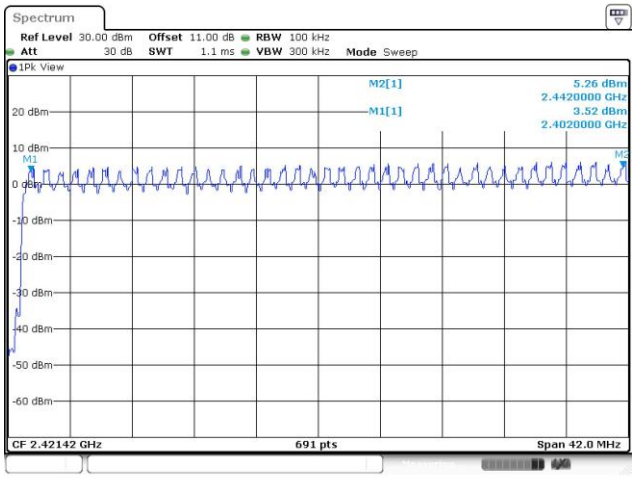
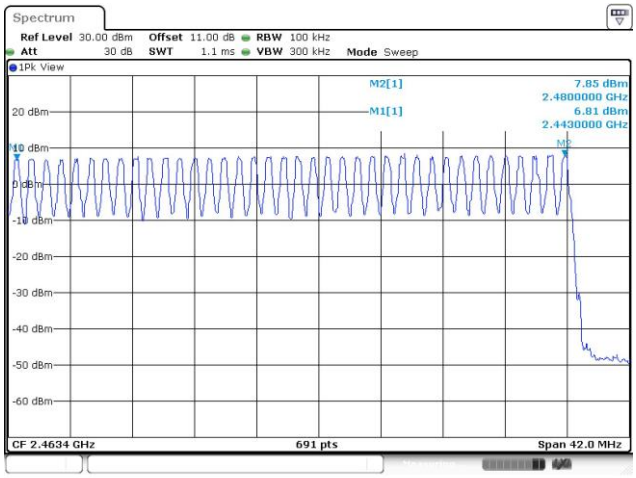
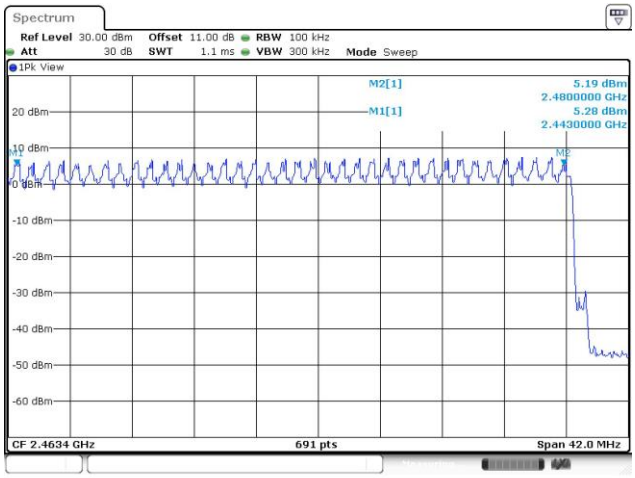
3.4.2 Test Procedures

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

3.4.3 Test Setup



3.4.4 Test Result of Number of Hopping Frequency

GFSK	8DPSK
	
	

3.5 20dB and Occupied Bandwidth

3.5.1 Test Procedures

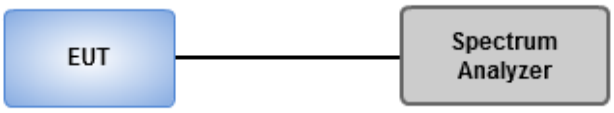
20dB Bandwidth

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

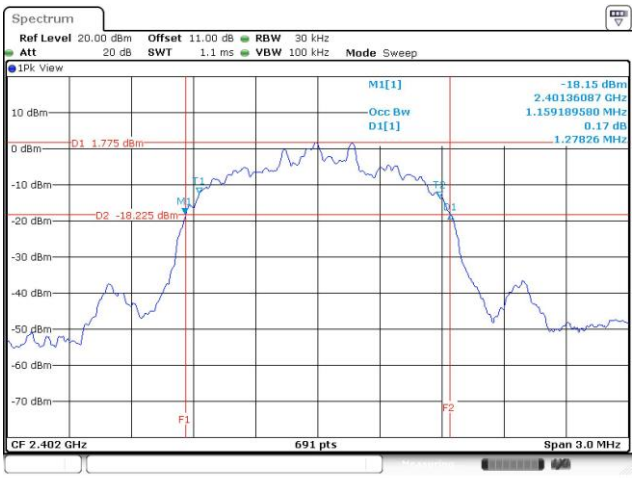
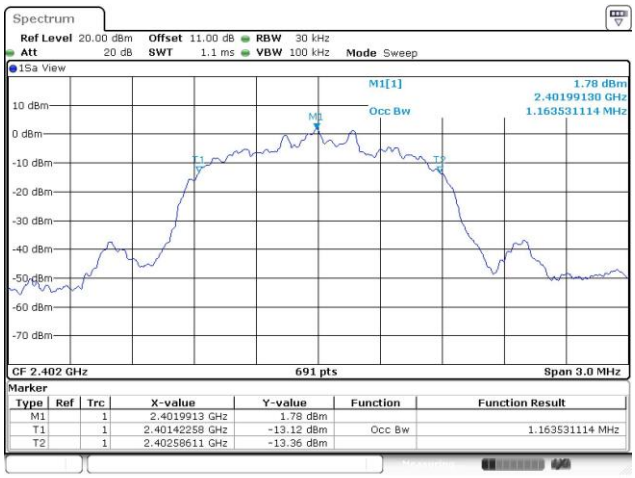
1. Set RBW=30kHz, VBW=100kHz,Sweep time = Auto, Detector=Sample, Trace max hold
2 Allow trace to stabilize
3. Use Occupied bandwidth function of spectrum analyzer to measuring 99% occupied bandwidth

3.5.2 Test Setup



3.5.3 Test result of 20dB and Occupied Bandwidth

Modulation Mode	Freq. (MHz)	20dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
GFSK	2402	0.965	0.886
GFSK	2441	0.965	0.890
GFSK	2480	0.974	0.894
8DPSK	2402	1.278	1.164
8DPSK	2441	1.278	1.155
8DPSK	2480	1.278	1.164

Worst Plot of 20dB Bandwidth	Worst Plot of Occupied Bandwidth
	

3.6 Channel Separation

3.6.1 Limit of Channel Separation

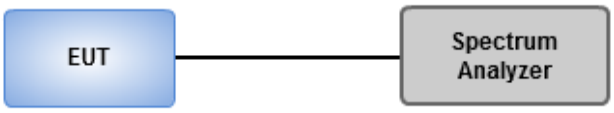
☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

☒ 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.

3.6.2 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

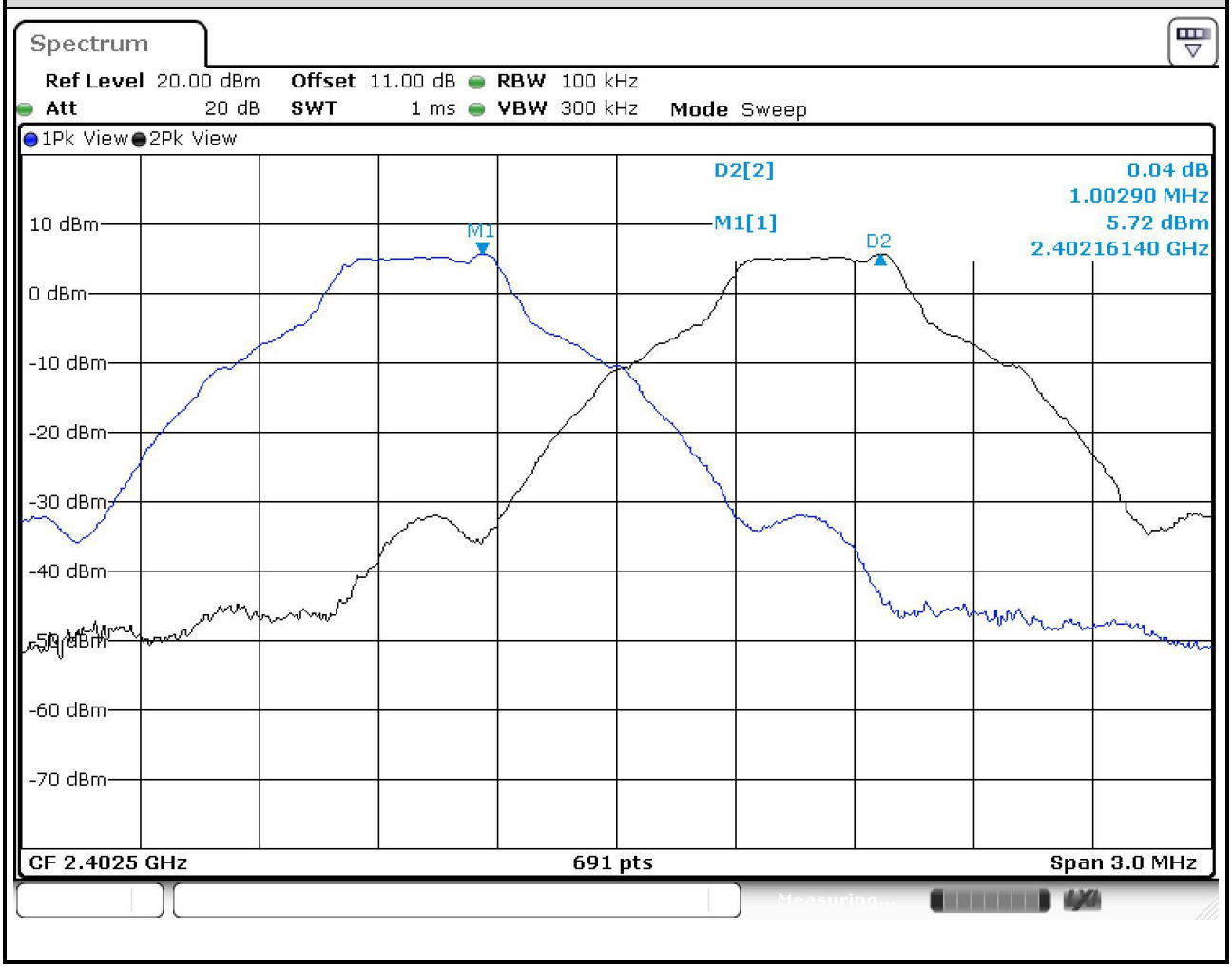
3.6.3 Test Setup



3.6.4 Test result of Channel Separation

Modulation Mode	Freq. (MHz)	Channel Separation (MHz)	20dB Bandwidth (MHz)	Minimum Limit (MHz)
GFSK	2402	1.003	0.965	0.643
GFSK	2441	1.003	0.965	0.643
GFSK	2480	1.003	0.974	0.649
8DPSK	2402	1.003	1.278	0.852
8DPSK	2441	1.003	1.278	0.852
8DPSK	2480	1.003	1.278	0.852

Worst Plot



3.7 Number of Dwell Time

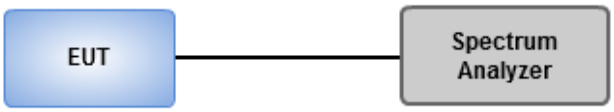
3.7.1 Limit of Dwell time

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.

3.7.2 Test Procedures

1. 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.
5 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

3.7.3 Test Setup

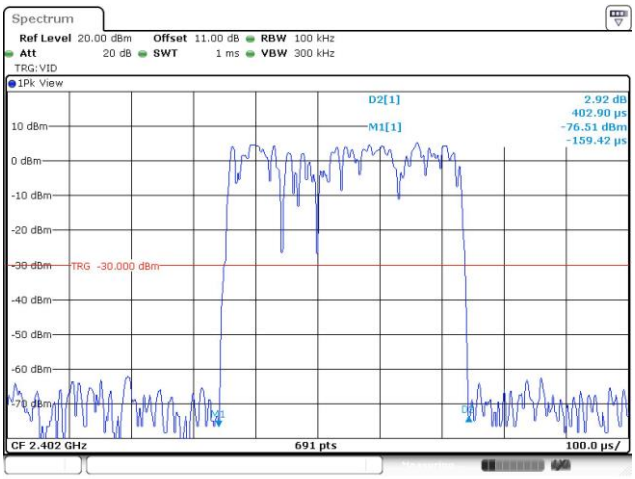


3.7.4 Test Result of Dwell Time

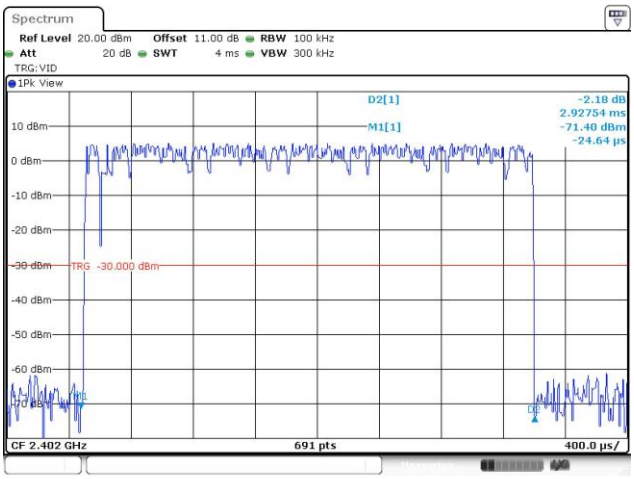
Modulation Mode	Freq. (MHz)	Length of Transmission Time (msec)	Number of Transmission in a 31.6 (79 Hopping*0.4)	Result (s)	Limit (s)
GFSK-DH1	2402	0.40290	320	0.129	0.4
GFSK-DH3	2402	1.66377	160	0.266	0.4
GFSK-DH5	2402	2.92754	106.6	0.312	0.4
8DPSK-DH1	2402	0.41449	320	0.133	0.4
8DPSK-DH3	2402	1.66812	160	0.267	0.4
8DPSK-DH5	2402	2.94928	106.6	0.314	0.4

GFSK

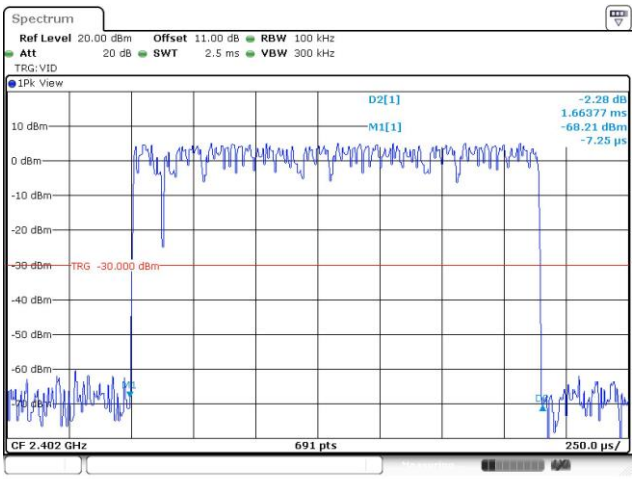
DH1



DH5



DH3



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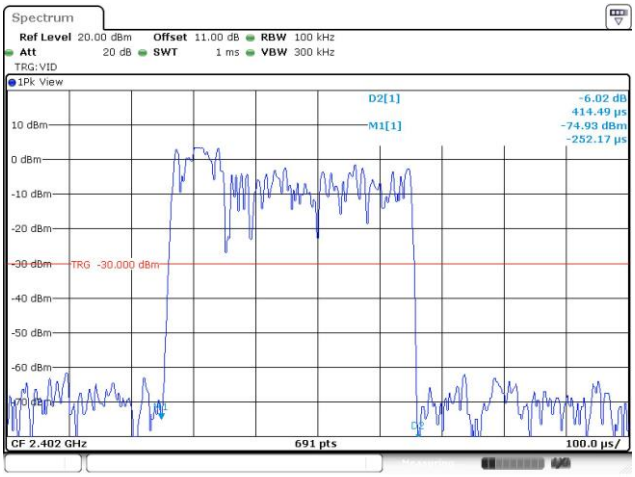
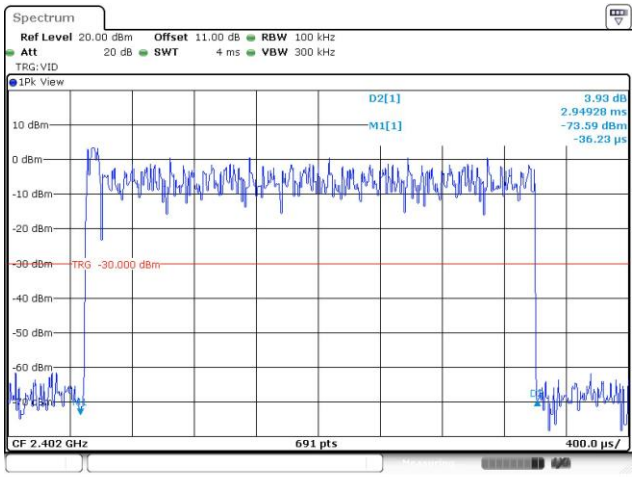
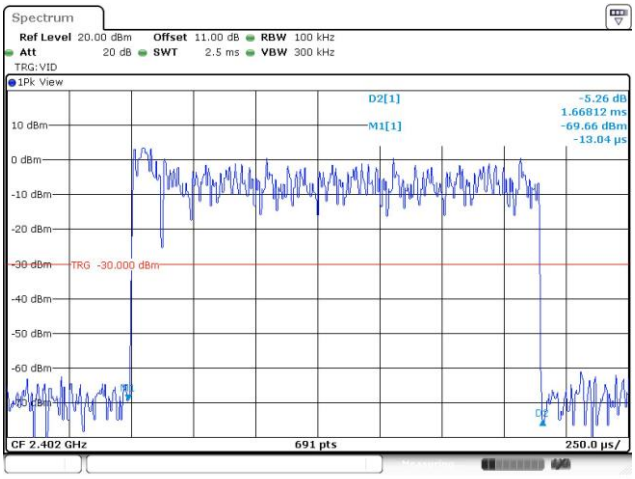
8DPSK	
3DH1	**3DH5**
	
3DH3	**--**
	--

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	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan Hsiang, Tao Yuan Hsien 333, Taiwan, R.O.C.	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

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