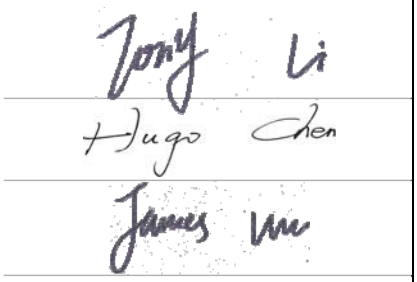
FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.....:	**TZ170100238-EDR**
FCC ID..... :	**2ALGP-VJB-105**
Compiled by (position+printed name+signature)..:	File administrators Tony Li
Supervised by (position+printed name+signature)..:	Technique principal Hugo Chen
Approved by (position+printed name+signature)..:	Manager James Wu
Date of issue.....:	2017/3/13



Representative Laboratory Name ....:	Shenzhen Tongzhou Testing Co.,Ltd
Address .....:	1th floor, building 1, Haomai High-tech park, Huating Road 387, Dalang street, Longhua, Shenzhen, China
Testing Laboratory Name.....:	Dongguan Dongdian Testing Service Co.,Ltd
Address .....:	No.17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China
Applicant's name.....:	**Innovative Technology Electronics LLC**
Address .....:	No.1 Channel Drive, Port Washington, NY 11050, USA
Test specification .....**:**	
Standard .....:	**FCC Part 15.247: Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz**
TRF Originator.....:	Shenzhen Tongzhou Testing Co.,Ltd
Master TRF.....:	Dated 2012-06

Test item description .....:	Large Full Size Vinyl Turntable Jukebox
Trade Mark .....:	Victoria
Model/Type reference.....:	VJB-105
Listed Models .....:	/
Manufacturer .....:	**Innovative Technology Electronics LLC**
Modulation Type.....:	GFSK,Π/4DQPSK,8DPSK
Operation Frequency.....:	From 2402MHz to 2480MHz
Rating .....:	DC 18.0V Adapter from AC 100V~240V-50/60Hz
Result.....:	**PASS**

T E S T R E P O R T

Test Report No. :	TZ170100238-EDR	2017/3/13 Date of issue

Equipment under Test	:	Large Full Size Vinyl Turntable Jukebox
Model /Type	:	VJB-105
Listed Models	:	/
Applicant	:	**Innovative Technology Electronics LLC**
Address	:	No.1 Channel Drive, Port Washington, NY 11050, USA
Manufacturer	:	**Jin shun yan Electronic processing factory**
Address	:	Xin xu Town,hui yang,Guangdong,China

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Contents

1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	2017/1/18
Testing commenced on	:	2017/1/18
Testing concluded on	:	2017/3/13

2.2. Product Description

The **Innovative Technology Electronics LLC**'s Model: VJB-105 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

Name of EUT	Large Full Size Vinyl Turntable Jukebox
Model/Type reference	VJB-105
Listed Models	/
FCC ID	2ALGP-VJB-105
Bluetooth	Supported BT 4.0+EDR
Antenna Type	Internal
Bluetooth FCC Operation frequency	2402MHz-2480MHz
Bluetooth Modulation	EDR(GFSK,8DPSK,π/4DQPSK)/BLE(GFSK)

2.3. Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	120V / 60 Hz	○	115V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 18.0V Adapter from AC 100V~240V-50/60Hz

2.4. Short description of the Equipment under Test (EUT)

2.4GHz (Large Full Size Vinyl Turntable Jukebox (M/N: VJB-105))

For more details, refer to the user's manual of the EUT.

2.5. EUT operation mode

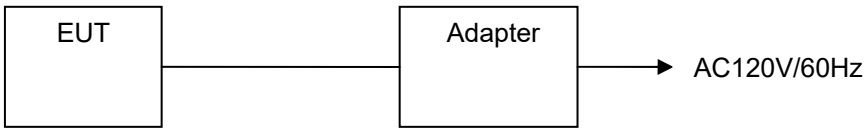
The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continous transmitting and receiving mode for testing. There are 79 channels of EUT, and the test carried out at the lowest channel, middle channel and highest channel .

Channel	Frequency(MHz)	Channel	Frequency(MHz)
00	**2402**	40	2442
01	2403	41	2443
02	2404	42	2444
03	2405	43	2445
04	2406	44	2446
05	2407	45	2447
06	2408	46	2448

07	2409	47	2449
08	2410	48	2450
09	2411	49	2451
10	2412	50	2452
11	2413	51	2453
12	2414	52	2454
13	2415	53	2455
14	2416	54	2456
15	2417	55	2457
16	2418	56	2458
17	2419	57	2459
18	2420	58	2460
19	2421	59	2461
20	2422	60	2462
21	2423	61	2463
22	2424	62	2464
23	2425	63	2465
24	2426	64	2466
25	2427	65	2467
26	2428	66	2468
27	2429	67	2469
28	2430	68	2470
29	2431	69	2471
30	2432	70	2472
31	2433	71	2473
32	2434	72	2474
33	2435	73	2475
34	2436	74	2476
35	2437	75	2477
36	2438	76	2478
37	2439	77	2479
38	2440	**78**	**2480**
39	**2441**		

2.6. Block Diagram of Test Setup

Fig. 2-1 Configuration of Tested System



Adapter:

Model: BX1800-7000 Input:AC 100~240V 50/60Hz 2A Output: DC 18V/7A

◇ Shielded ◆ Unshielded

Other Support Unit(s):

Type Name	Manufacturer	Model Name	Series
PC	ASUS	X454L	15105-0038A100
Software	CSR	BlueTest	--

2.7. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: 2ALGP-VJB-105** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8. Modifications

No modifications were implemented to meet testing criteria.

2.9. NOTE

1. The EUT is a Large Full Size Vinyl Turntable Jukebox with WLAN and Bluetooth function,The functions of the EUT listed as below:

	Test Standards	Reference Report
Bluetooth-EDR	FCC Part 15 Subpart C	TZ170100238-EDR
Bluetooth-BLE	FCC Part 15 Subpart C	TZ170100238-BLE
MPE	FCC Per 47 CFR 2.1091(b)	TZ170100238-MPE

2. The frequency bands used in this EUT are listed as follows:

Frequency Band(MHz)	2400-2483.5	5150-5350	5470-5725	5725-5850
EUT	√	—	—	—

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

Dongguan Dongdian Testing Service Co.,Ltd

No.17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 (2014) and CISPR Publication 22.

3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

IC Registration No.: 10288A-1

The 3m alternate test site of Dongguan Dongdian Testing Service Co.,Ltd EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 10288A-1 on May, 2012.

FCC-Registration No.: 270092

Dongguan Dongdian Testing Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 270092, Mar, 2015.

3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 ° C
Humidity:	30-60 %
Atmospheric pressure:	950-1050mbar

3.4. Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Pass	Fail	NA	NP	Remark
§15.247(b)(4)	Antenna gain	GFSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.247(e)	Power spectral density	-/-	-/-	-/-	-/-	☐	☐	☒	☐	Not applicable for FHSS!
§15.247(a)(1)	Carrier Frequency separation	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Middle	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Number of Hopping channels	GFSK 8DPSK	☒ Full	GFSK 8DPSK	☒ Full	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Time of Occupancy (dwell time)	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Middle	☒ ☒	☐	☐	☐	complies
§15.247(a)(1)	Spectrum bandwidth of a FHSS system 20dB bandwidth	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(b)(1)	Maximum output power	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK Π/4DQPSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒ ☒	☐	☐	☐	complies

§15.247(d)	Band edge compliance conducted	GFSK 8DPSK	☒ Lowest ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.205	Band edge compliance radiated	GFSK 8DPSK	☒ Lowest ☒ Highest	GFSK	☒ Lowest ☒ Highest	☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions conducted	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	☒ ☒	☐	☐	☐	complies
§15.247(d)	TX spurious emissions radiated	GFSK 8DPSK	☒ Lowest ☒ Middle ☒ Highest	GFSK	☒ Lowest ☒ Middle ☒ Highest	☒	☐	☐	☐	complies
§15.109	RX spurious emissions radiated	-/-	-/-	-/-	-/-	☒	☐	☐	☐	complies
§15.209(a)	TX spurious Emissions radiated < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	GFSK	-/-	GFSK	-/-	☒	☐	☐	☐	complies

Remark:
1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. We tested all test mode and recorded worst case in report
4. **For π/4 QPSK its same modulation type with 8-DPSK, and based exploratory test, there is no significant difference of that two types test result, so except output power, all other items final test were only performed with the worse case 8-DPSK and GFSK.**

3.5. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Dongguan Dongdian Testing Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.
Hereafter the best measurement capability for Dongguan Dongdian Testing Service Co.,Ltd laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	3.16 dB	(1)
Radiated Emission	1~18GHz	2.56 dB	(1)
Radiated Emission	18-40GHz	2.56 dB	(1)
Conducted Disturbance	0.15~30MHz	2.44 dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.6. Equipments Used during the Test

Radiated Method Test						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Ultra-Broadband Antenna	ShwarzBeck	VULB9163	462	2016/04/12	3 years
2	EMI TEST Receiver	Rohde&Schwarz	ESU8	100316	2016/10/25	1 years
3	EMI TEST Software	Audix	E3	6.111111	N/A	N/A
4	Horn Anternna	EMCO	3116	00060095	2016/04/12	3 years
5	Pre-Amplifer	Rohde&Schwarz	SCU-01	10049	2016/10/25	1 years
6	Pre-Amplifer	A.H.	PAM0-0118	360	2016/10/25	1 years
7	Pre-Amplifer	A.H.	PAM-1840VH	562	2016/10/25	1 years

8	Double Ridged Horn Antenna	Rohde&Schwarz	HF907	100265	2016/04/12	3 years
9	Active Loop Antenna	Schwarz beck	FMZB1519	0.38	2016/04/12	3 years
11	TURNTABLE	MATURO	TT2.0	----	N/A	N/A
12	ANTENNA MAST	MATURO	TAM-4.0-P	----	N/A	N/A
13	Spectrum Analyzer	R&S	FSU26	1166.1660.26	2016/10/25	1 years
14	Horn Antenna	SCHWARZBECK	BBHA 9170	1123	08/19/2016	08/18/2017

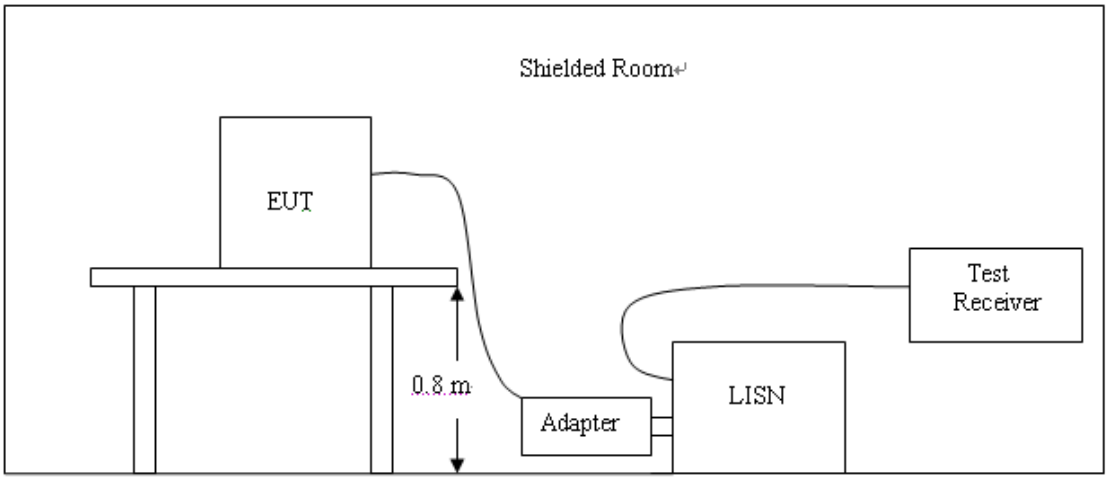
Conducted Method Test						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Power Sensor	Rohde&Schwarz	NRP-Z81	102638	2016/11/02	1 years
2	Spectrum Analyzer	Agilent	N9030A	MY49430428	2016/11/02	1 years
3	Spectrum Analyzer	R&S	FSU26	1166.1660.26	2016/10/25	1 years

AC Power Conducted Emission						
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1	Artificial Mains	Rohde&Schwarz	ENV216	101109	2016/10/25	1 years
2	Artificial Mains	Rohde&Schwarz	ESH3-Z5	100309	2016/10/25	1 years
3	EMI Test Receiver	Rohde&Schwarz	ESU8	100316	2016/10/25	1 years
4	Pulse Limiter	Rohde&Schwarz	ESH3-Z2	101242	2016/10/25	1 years

4. TEST CONDITIONS AND RESULTS

4.1. AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a standfloor system and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013;
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013;
4 The EUT received DC18V power from the adapter, the adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

AC Power Conducted Emission Limit

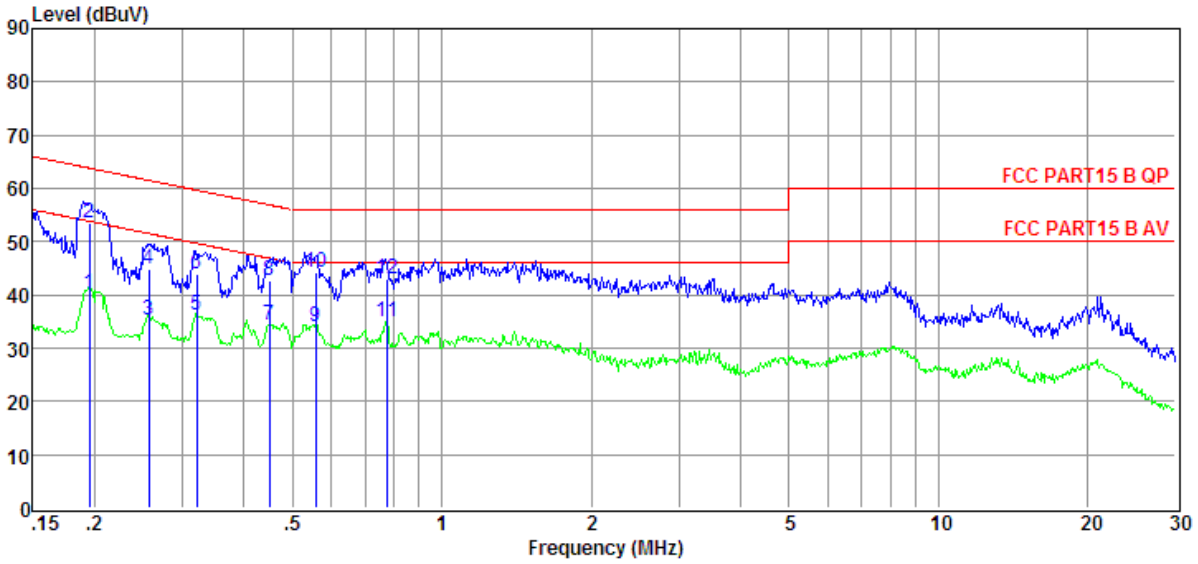
For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

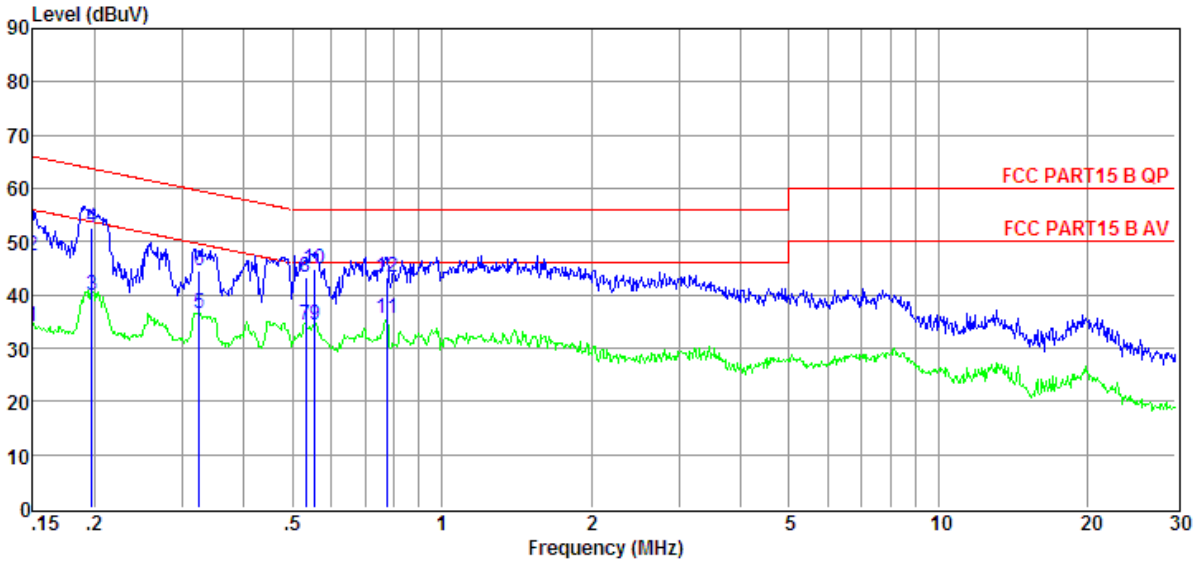
* Decreasing linearly with the logarithm of the frequency

TEST RESULTS

Pre-scan all mode and recorded the worst case results in this report (BT Link @120VAC).



Item	Freq	Read Level	LISN Factor	Cable Loss	Pulse Limiter Factor	Result Level	Limit Line	Over Limit	Detector	Phase
(Mark)	(MHz)	(dBµV)	(dB)	(dB)	(dB)	(dBµV)	(dBµV)	(dB)		
1	0.20	20.62	9.59	0.02	9.85	40.08	53.80	-13.72	Average	NEUTRAL
2	0.20	34.01	9.59	0.02	9.85	53.47	63.80	-10.33	QP	NEUTRAL
3	0.26	15.87	9.60	0.02	9.85	35.34	51.51	-16.17	Average	NEUTRAL
4	0.26	25.24	9.60	0.02	9.85	44.71	61.51	-16.80	QP	NEUTRAL
5	0.32	16.63	9.60	0.02	9.85	36.10	49.66	-13.56	Average	NEUTRAL
6	0.32	24.57	9.60	0.02	9.85	44.04	59.66	-15.62	QP	NEUTRAL
7	0.45	14.82	9.61	0.03	9.87	34.33	46.89	-12.56	Average	NEUTRAL
8	0.45	23.22	9.61	0.03	9.87	42.73	56.89	-14.16	QP	NEUTRAL
9	0.56	14.66	9.61	0.04	9.86	34.17	46.00	-11.83	Average	NEUTRAL
10	0.56	24.67	9.61	0.04	9.86	44.18	56.00	-11.82	QP	NEUTRAL
11	0.78	15.55	9.61	0.08	9.86	35.10	46.00	-10.90	Average	NEUTRAL
12	0.78	23.45	9.61	0.08	9.86	43.00	56.00	-13.00	QP	NEUTRAL



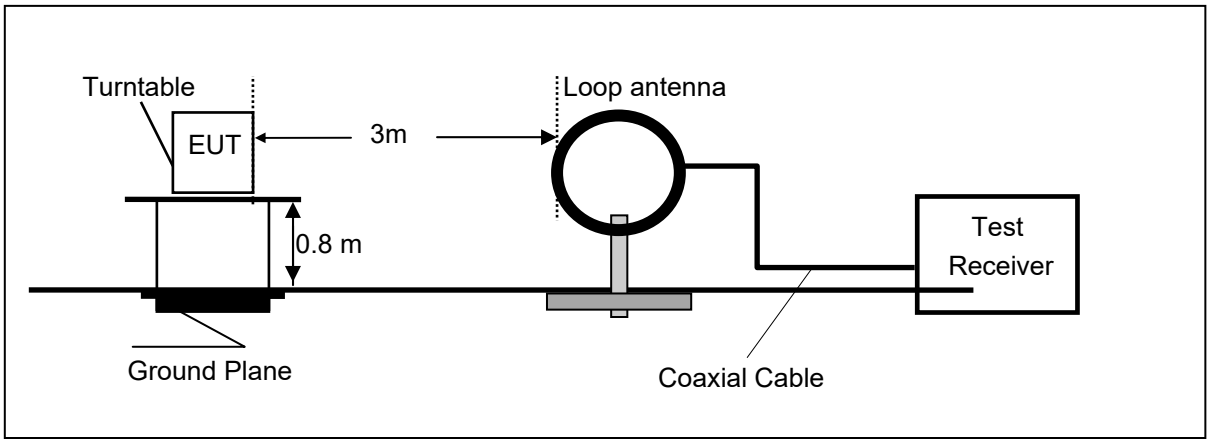
Item	Freq	Read Level	LISN Factor	Cable Loss	Pulse Limiter Factor	Result Level	Limit Line	Over Limit	Detector	Phase
(Mark)	(MHz)	(dBµV)	(dB)	(dB)	(dB)	(dBµV)	(dBµV)	(dB)		
1	0.15	14.71	9.61	0.01	9.84	34.17	56.00	-21.83	Average	LINE
2	0.15	27.99	9.61	0.01	9.84	47.45	66.00	-18.55	QP	LINE
3	0.20	20.34	9.62	0.02	9.85	39.83	53.71	-13.88	Average	LINE
4	0.20	33.13	9.62	0.02	9.85	52.62	63.71	-11.09	QP	LINE
5	0.33	16.97	9.63	0.02	9.85	36.47	49.57	-13.10	Average	LINE
6	0.33	25.09	9.63	0.02	9.85	44.59	59.57	-14.98	QP	LINE
7	0.53	14.72	9.63	0.04	9.87	34.26	46.00	-11.74	Average	LINE
8	0.53	23.84	9.63	0.04	9.87	43.38	56.00	-12.62	QP	LINE
9	0.56	14.83	9.63	0.04	9.86	34.36	46.00	-11.64	Average	LINE
10	0.56	25.34	9.63	0.04	9.86	44.87	56.00	-11.13	QP	LINE
11	0.78	16.08	9.62	0.08	9.86	35.64	46.00	-10.36	Average	LINE
12	0.78	23.87	9.62	0.08	9.86	43.43	56.00	-12.57	QP	LINE

Note:
1. Result Level = Read Level +LISN Factor + Pulse Limiter Factor + Cable loss.
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz), Step size: 4 kHz, Scan time: auto.

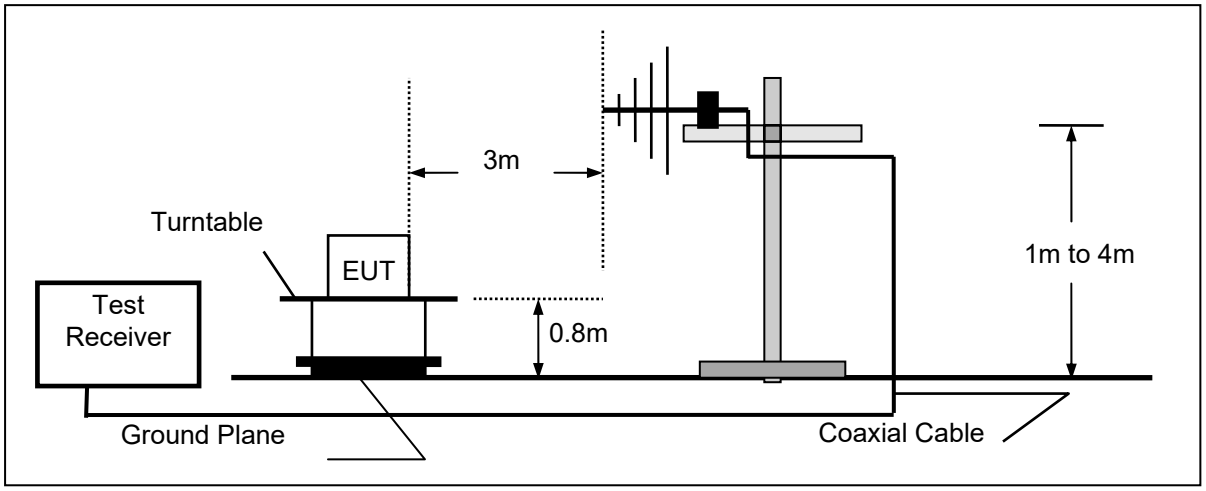
4.2. Radiated Emission

TEST CONFIGURATION

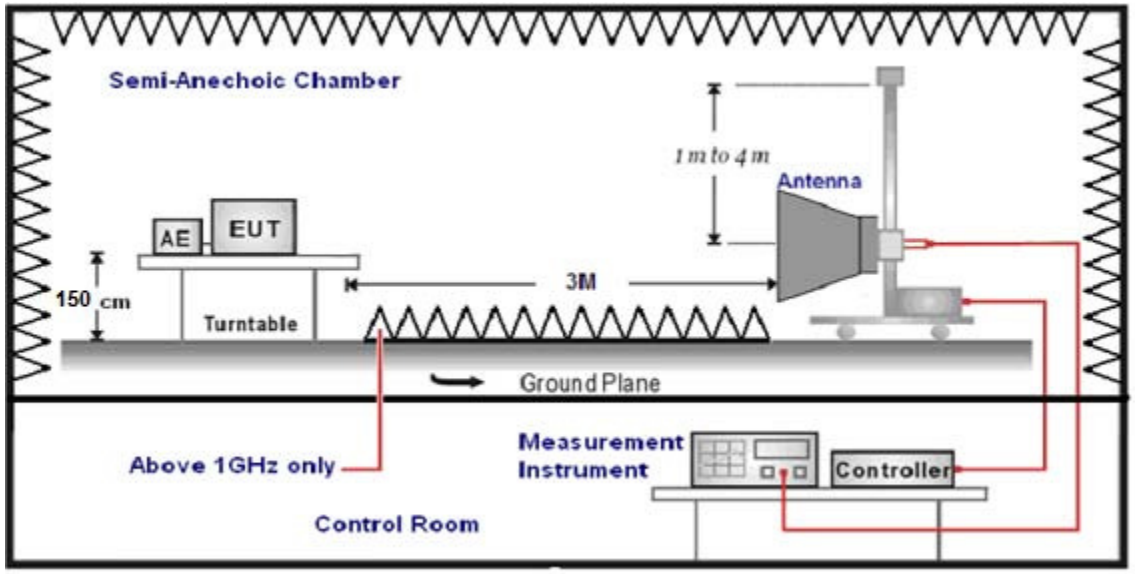
Frequency range 9KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1) Sequence of testing 9 kHz to 30 MHz
Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.
Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna height is 0.8 meter.
--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions
Final measurement:
--- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz
Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.
Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna is polarized vertical and horizontal.
--- The antenna height changes from 1 to 3 meter.
--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.
Final measurement:
--- The final measurement will be performed with minimum the six highest peaks.
--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter.
--- The final measurement will be done with QP detector with an EMI receiver.
--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz
Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 3 meter.
--- The EUT was set into operation.
Premeasurement:
--- The turntable rotates from 0° to 315° using 45° steps.
--- The antenna is polarized vertical and horizontal.
--- The antenna height scan range is 1 meter to 2.5 meter.
--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.
Final measurement:
--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (± 45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz
Setup:
--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
--- Auxiliary equipment and cables were positioned to simulate normal operation conditions
--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
--- The measurement distance is 1 meter.
--- The EUT was set into operation.
Premeasurement:
--- The antenna is moved spherical over the EUT in different polarisations of the antenna.
Final measurement:
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

Instruments Setting

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=330kHz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

For example

Frequency (MHz)	FS (dBµV/m)	RA (dBµV/m)	AF (dB)	CL (dB)	AG (dB)	Transd (dB)
300.00	40	58.1	12.2	1.6	31.90	-18.1

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

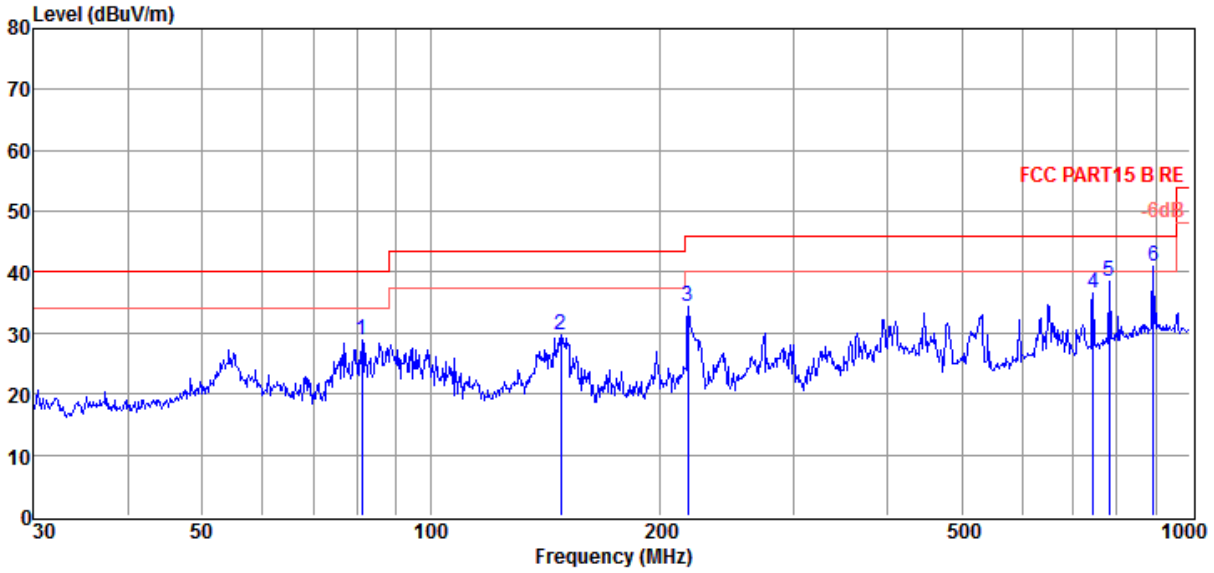
TEST RESULTS

For 9KHz to 30MHz

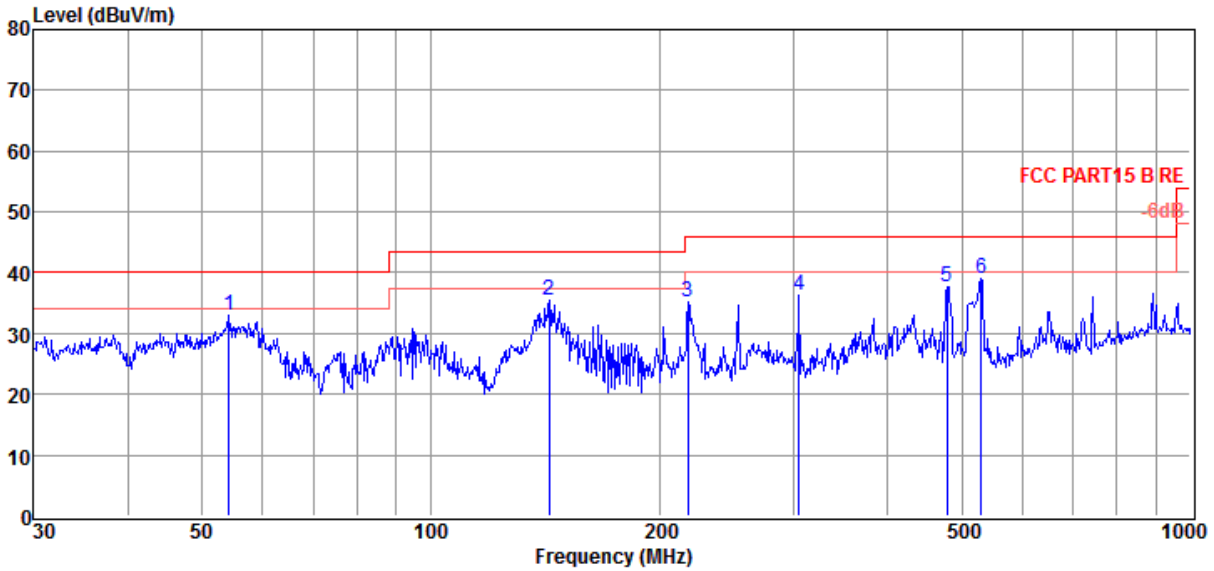
Frequency (MHz)	Corrected Reading (dBμV/m)@3m	FCC Limit (dBμV/m) @3m	Over Limit (dB)	Detector
---	---	---	---	***QP***

Remark:
1. Over Limit = Emission level - Limit value
2. "---" states emission level at least lower than limit 20dB, so without recorded any values;

For 30MHz to 1000MHz



Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	81.21	18.41	9.15	1.36	28.92	40.00	-11.08	QP	HORIZONTAL
2	148.44	19.35	8.67	1.79	29.81	43.50	-13.69	QP	HORIZONTAL
3	218.31	21.36	10.90	2.20	34.46	46.00	-11.54	QP	HORIZONTAL
4	744.87	12.62	19.33	4.52	36.47	46.00	-9.53	QP	HORIZONTAL
5	782.35	13.59	20.17	4.66	38.42	46.00	-7.58	QP	HORIZONTAL
6	893.86	14.02	22.03	4.95	41.00	46.00	-5.00	QP	HORIZONTAL



Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	54.26	17.69	14.20	1.09	32.98	40.00	-7.02	QP	VERTICAL
2	143.33	24.96	8.83	1.72	35.51	43.50	-7.99	QP	VERTICAL
3	218.31	22.21	10.90	2.20	35.31	46.00	-10.69	QP	VERTICAL
4	305.68	20.16	13.50	2.72	36.38	46.00	-9.62	QP	VERTICAL
5	478.85	18.18	15.98	3.62	37.78	46.00	-8.22	QP	VERTICAL
6	530.10	18.87	16.51	3.73	39.11	46.00	-6.89	QP	VERTICAL

Remark:
1. Over Limit = Emission level - Limit value
2. "---" states emission level at least lower than limit 20dB, so without recorded any values;
3. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
4. Pre-scan all mode and recorded the worst case results in this report (TX-Low Channel(1Mbps)).

For 1GHz to 25GHz
(Only record worst case at GFSK mode)

Low Channel @ Channel 00 @ 2402 MHz

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4804	45.46	35.40	29.13	12.07	63.8	74	-10.2	Peak	Horizontal
1	4804	22.88	35.40	29.13	12.07	41.22	54	-12.78	AV	Horizontal
2	7206	43.65	37.20	30.03	15.29	66.11	74	-7.89	Peak	Horizontal
2	7206	23.43	37.20	30.03	15.29	45.89	54	-8.11	AV	Horizontal

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4804	47.09	35.40	29.13	12.07	65.43	74	-8.57	Peak	Vertical
1	4804	16.2	35.40	29.13	12.07	34.54	54	-19.46	AV	Vertical
2	7206	44.1	37.20	30.03	15.29	66.56	74	-7.44	Peak	Vertical
2	7206	21.71	37.20	30.03	15.29	44.17	54	-9.83	AV	Vertical

Middle Channel @ Channel 39 @ 2441 MHz

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4882	33.78	35.46	29.16	12.17	52.25	74	-21.75	Peak	Horizontal
1	4882	27.47	35.46	29.16	12.17	45.94	54	-8.06	AV	Horizontal
2	7323	44.6	37.28	30.08	15.44	67.24	74	-6.76	Peak	Horizontal
2	7323	21.73	37.28	30.08	15.44	44.37	54	-9.63	AV	Horizontal

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4882	46.37	35.46	29.16	12.17	64.84	74	-9.16	Peak	Vertical
1	4882	29.29	35.46	29.16	12.17	47.76	54	-6.24	AV	Vertical
2	7323	43.57	37.28	30.08	15.44	66.21	74	-7.79	Peak	Vertical
2	7323	23.68	37.28	30.08	15.44	46.32	54	-7.68	AV	Vertical

High Channel @ Channel 78 @ 2480 MHz

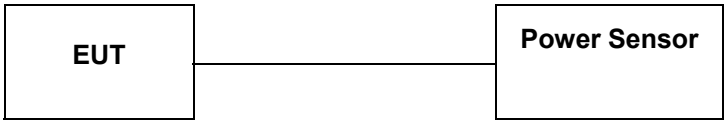
Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4960	44.27	35.52	29.19	12.28	62.88	74	-11.12	Peak	Horizontal
1	4960	19.7	35.52	29.19	12.28	38.31	54	-15.69	AV	Horizontal
2	7440	43.41	37.37	30.12	15.60	66.26	74	-7.74	Peak	Horizontal
2	7440	22.98	37.37	30.12	15.60	45.83	54	-8.17	AV	Horizontal

Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor dB	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	4960	39.56	35.52	29.19	12.28	58.17	74	-15.83	Peak	Vertical
1	4960	16.53	35.52	29.19	12.28	35.14	54	-18.86	AV	Vertical
2	7440	43.22	37.37	30.12	15.60	66.07	74	-7.93	Peak	Vertical
2	7440	21.66	37.37	30.12	15.60	44.51	54	-9.49	AV	Vertical

REMARKS:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. Over Limit=Emission Level - Limit.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=330kHz/Sweep time=Auto/Detector=Peak;

4.3. Maximum Peak Output Power

TEST CONFIGURATION



TEST PROCEDURE

According to ANSI C63.10:2013 Maximum peak conducted output power for HFSS devices:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the HFSS bandwidth and shall utilize a fast-responding diode detector.

LIMIT

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: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

TEST RESULTS

4.3.1 GFSK Test Mode

A. Test Verdict

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limits (dBm)	Verdict
0	2402	4.65	30	PASS
39	2441	4.79	30	PASS
78	2480	4.26	30	PASS

4.3.2 π/4DQPSK Test Mode

A. Test Verdict

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limits (dBm)	Verdict
0	2402	4.82	21	PASS
39	2441	5.26	21	PASS
78	2480	4.12	21	PASS

4.3.3 8DPSK Test Mode

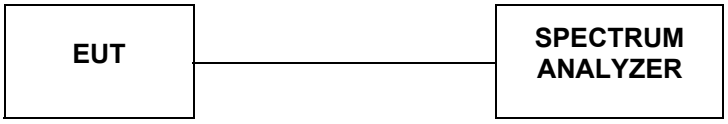
A. Test Verdict

Channel	Frequency (MHz)	Measured Output Peak Power (dBm)	Limits (dBm)	Verdict
0	2402	4.92	21	PASS
39	2441	5.97	21	PASS
78	2480	5.39	21	PASS

Note: 1.The test results including the cable lose.
2.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, provided the systems operate with an output power no greater than 125 mW.

4.4. 20dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30 KHz and VBW=100KHz.
The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

LIMIT

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwith.

TEST RESULTS

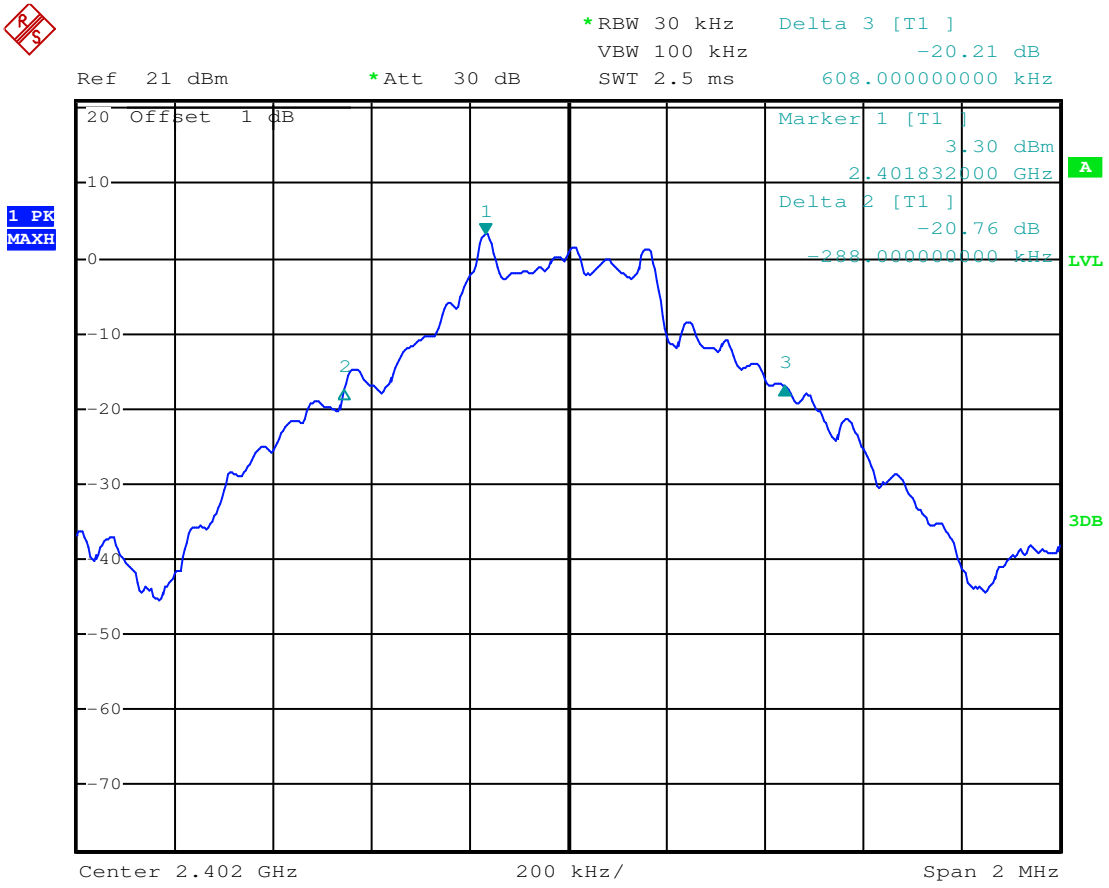
4.4.1 GFSK Test Mode

A. Test Verdict

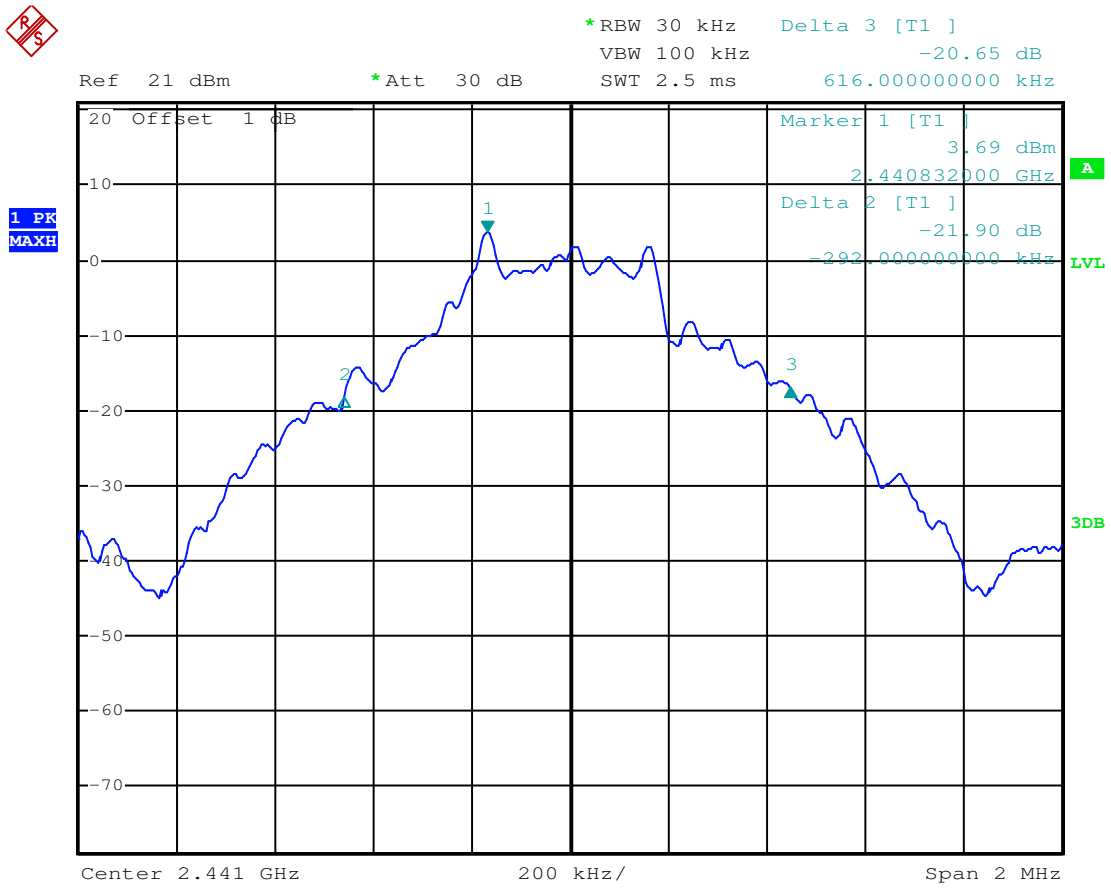
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Refer to Plot	Limits (MHz)	Verdict
00	2402	0.896	Plot 4.4.1 A	/	PASS
39	2441	0.908	Plot 4.4.1 B	/	PASS
78	2480	0.904	Plot 4.4.1 C	/	PASS

Note: 1.The test results including the cable lose.

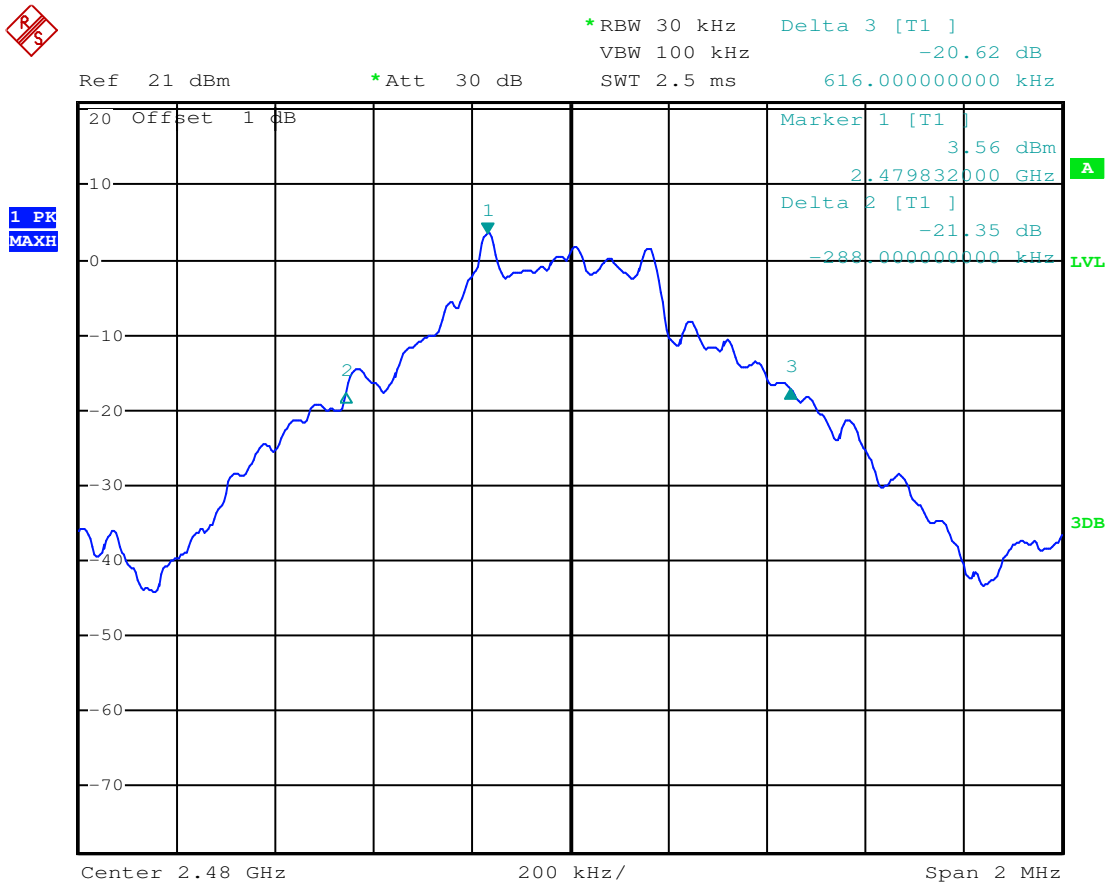
B. Test Plots



(Plot 4.4.1 A: Channel 00: 2402MHz @ GFSK)



(Plot 4.4.1 B: Channel 39: 2441MHz @ GFSK)



(Plot 4.4.1 C: Channel 78: 2480MHz @ GFSK)

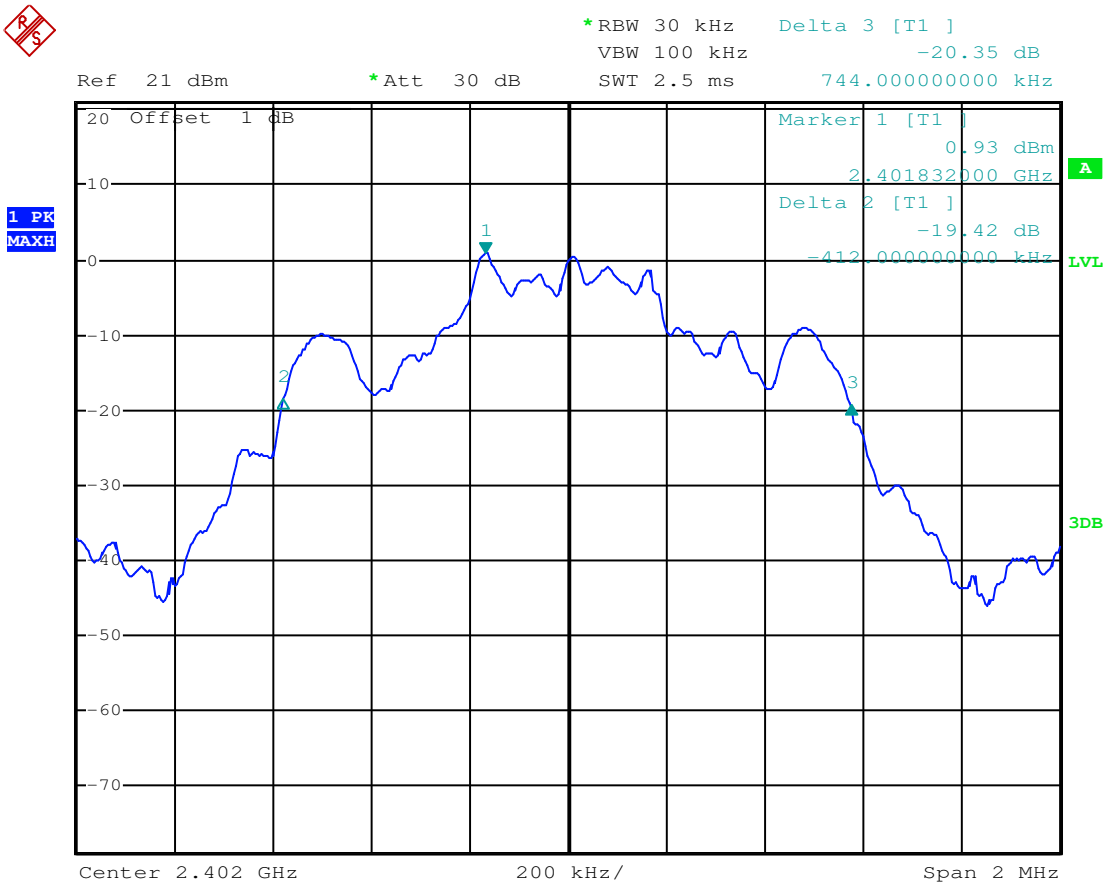
4.4.2 8DPSK Test Mode

A. Test Verdict

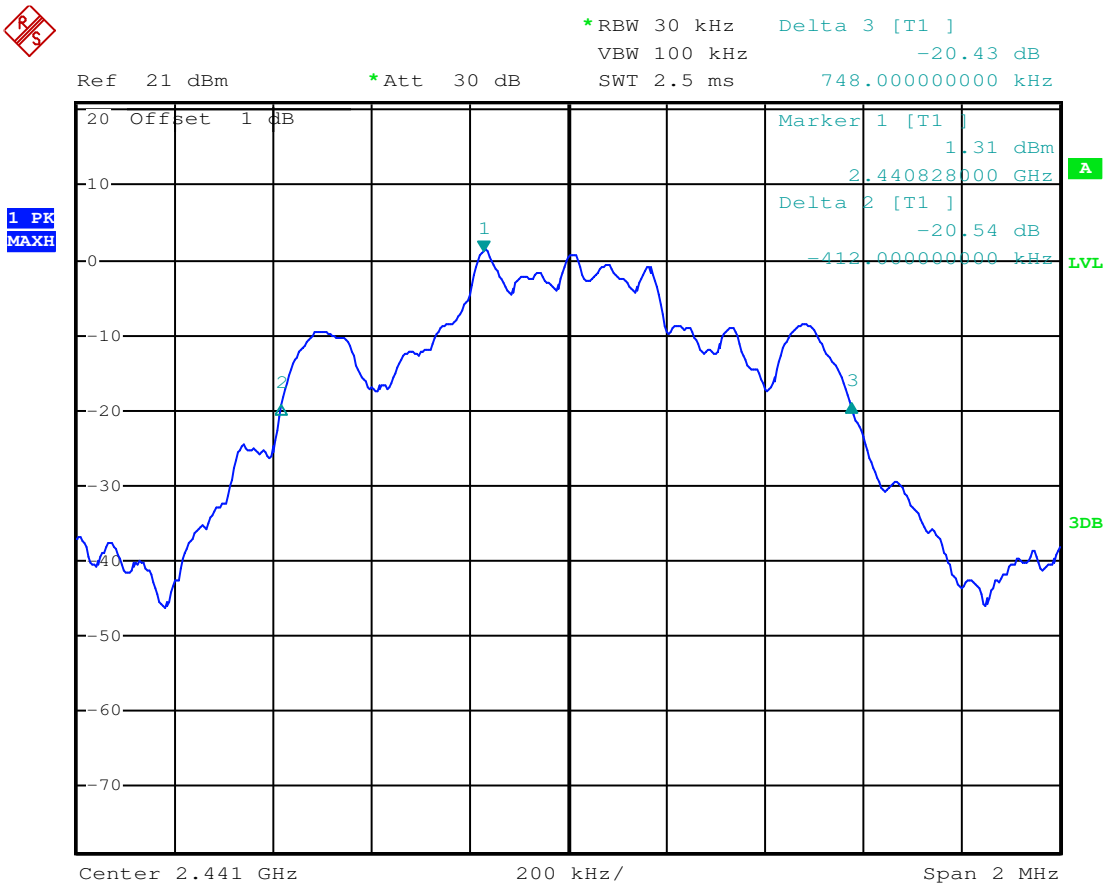
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Refer to Plot	Limits (MHz)	Verdict
00	2402	1.156	Plot 4.4.2 A	/	PASS
39	2441	1.160	Plot 4.4.2 B	/	PASS
78	2480	1.160	Plot 4.4.2 C	/	PASS

Note: 1.The test results including the cable lose.

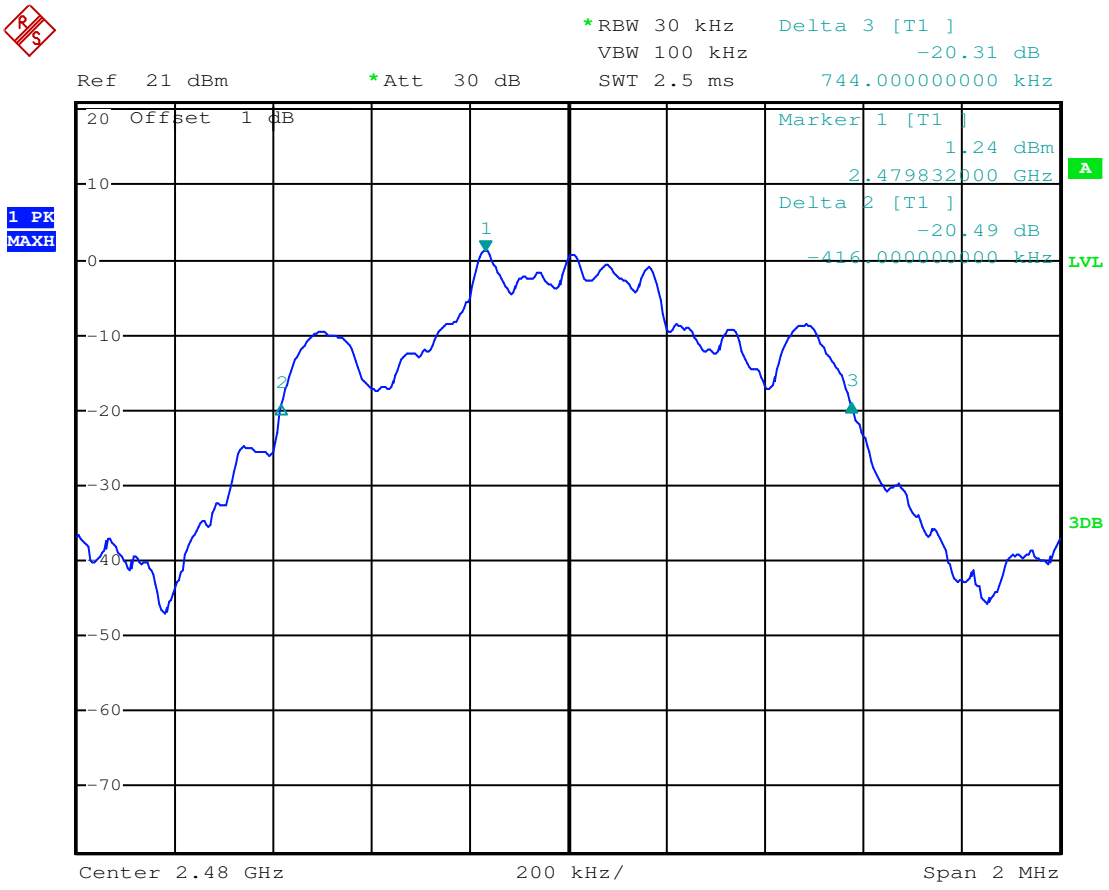
B. Test Plots



(Plot 4.4.2 A: Channel 00: 2402MHz @ 8DPSK)



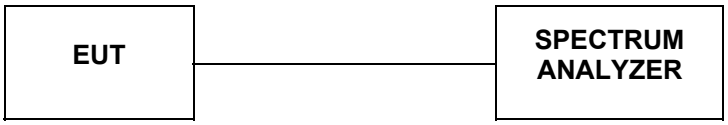
(Plot 4.4.2 B: Channel 39: 2441MHz @ 8DPSK)



(Plot 4.4.2 C: Channel 78: 2480MHz @ 8DPSK)

4.5. Frequency Separation

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30 KHz and VBW=100KHz.

LIMIT

According to 15.247(a)(1),frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

TEST RESULTS

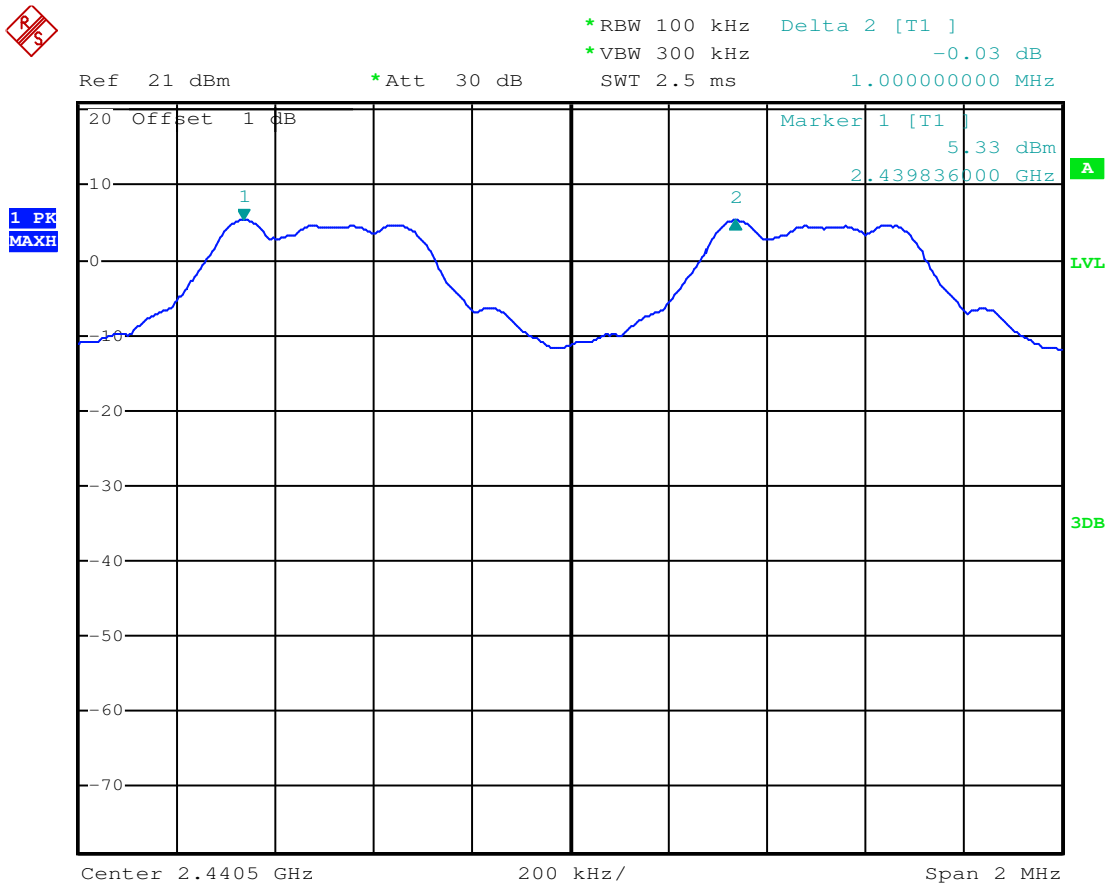
Remark: 1. We test Frequency Separation at difference Packet Type (DH1, DH3 and DH5) and all test channels, recorded worst case at DH5 and middle channel.

4.5.1 GFSK Test Mode

A. Test Verdict

Channel	Frequency (MHz)	Channel Separation (MHz)	Refer to Plot	Limits (MHz)	Verdict
38	2440	1.000	Plot 4.5.1 A	25KHz or 20dB bandwidth	PASS
39	2441				

B. Test Plots



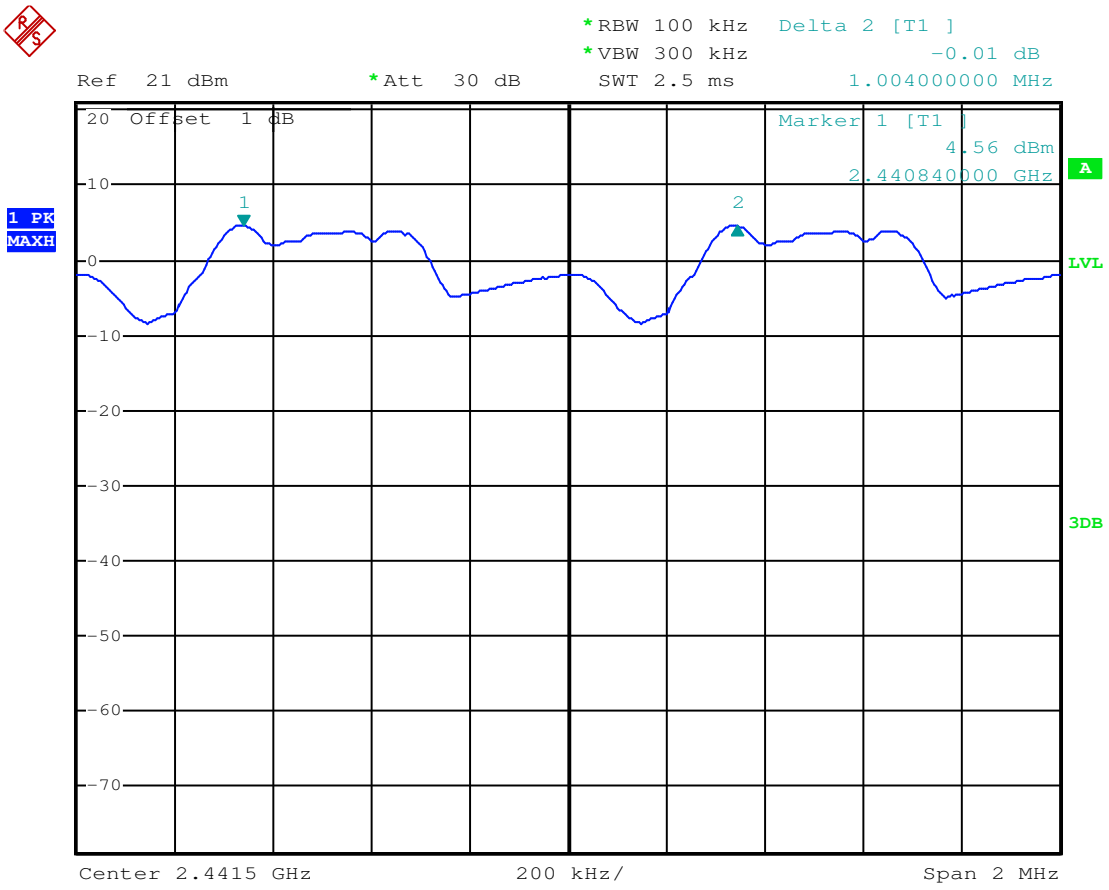
(Plot 4.5.1 A: Channel 39: 2441MHz @ GFSK)

4.5.2 8DPSK Test Mode

A. Test Verdict

Channel	Frequency (MHz)	Channel Separation (MHz)	Refer to Plot	Limits (MHz)	Verdict
38	2440	1.004	Plot 4.5.2 A	25KHz or 2/3*20dB bandwidth	PASS
39	2441				

B. Test Plots



(Plot 4.5.2 A: Channel 39: 2441MHz @ 8DPSK)

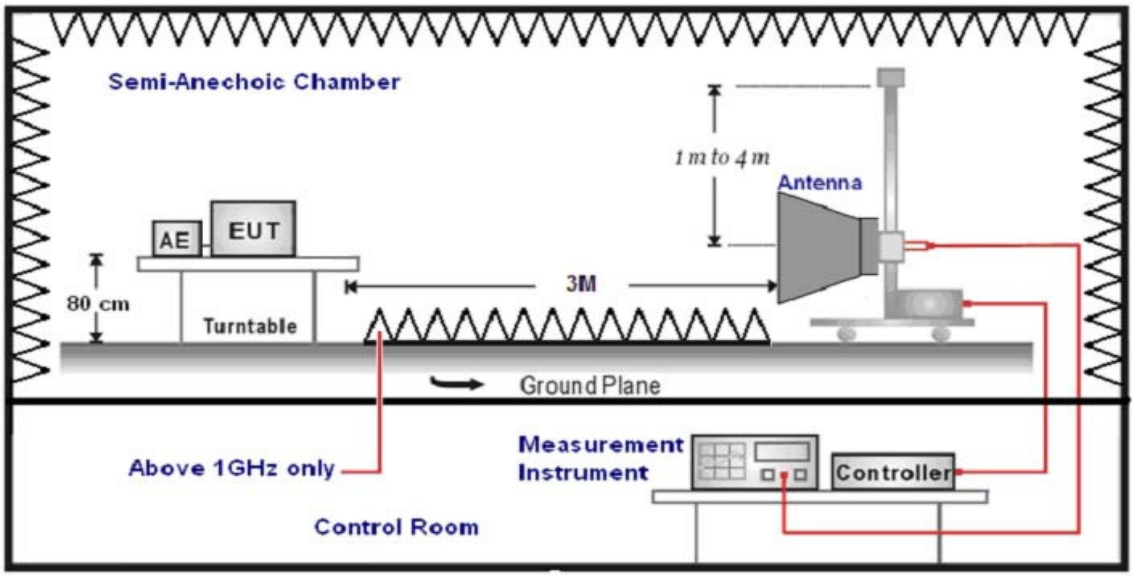
4.6. Band Edge Compliance of RF Emission

TEST REQUIREMENT

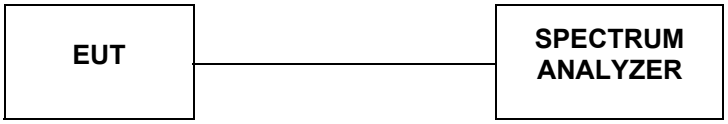
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST CONFIGURATION

For Radiated



For Conducted



TEST PROCEDURE

1. The EUT was placed on the ground.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT was 3 meter:
6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=330kHz, Sweep time=Auto	Peak

LIMIT

Below -20dB of the highest emission level in operating band.
Radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a)

TEST RESULTS

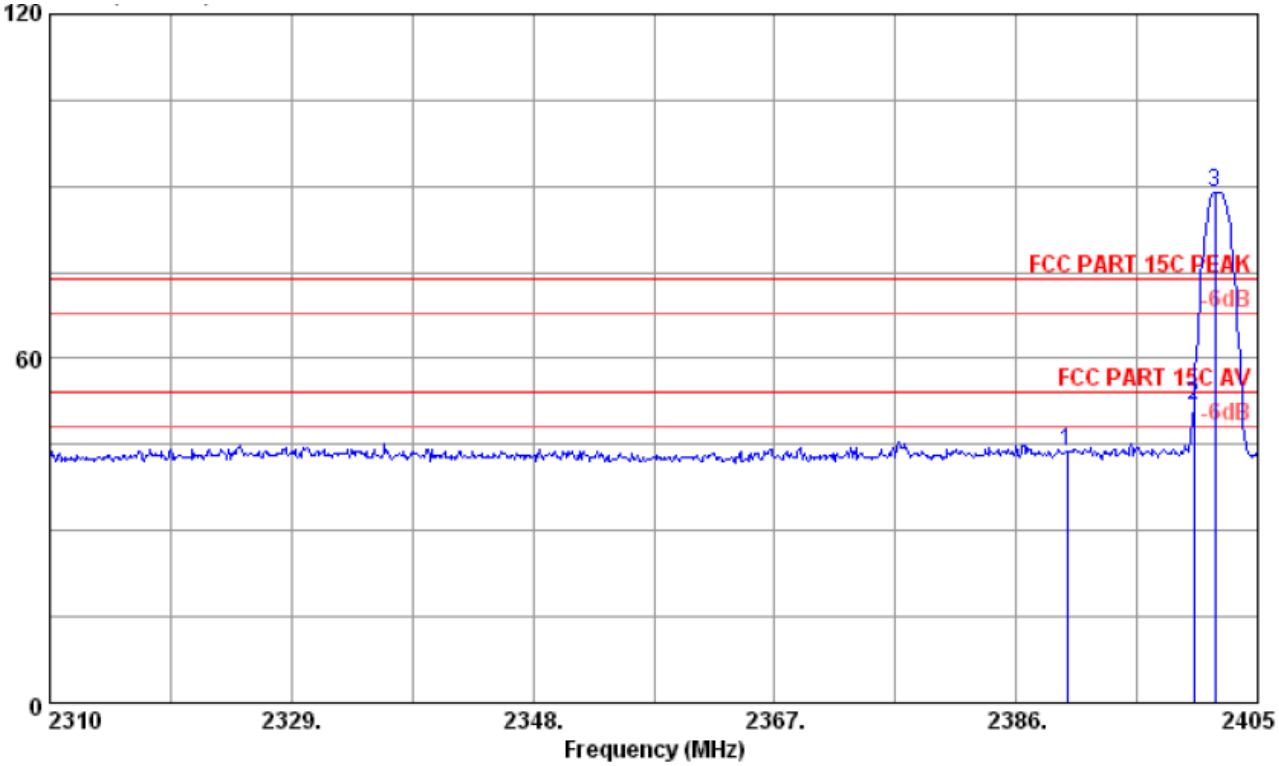
Remark: we measured all conditions(DH1,DH3,DH5) and recorded worst case at DH1

4.6.1 For Radiated Bandedge Measurement

Remark: we tested radiated bandedge at both hopping and no-hopping modes,recorded worst case at no-hopping mode

4.6.1.1 GFSK Test Mode

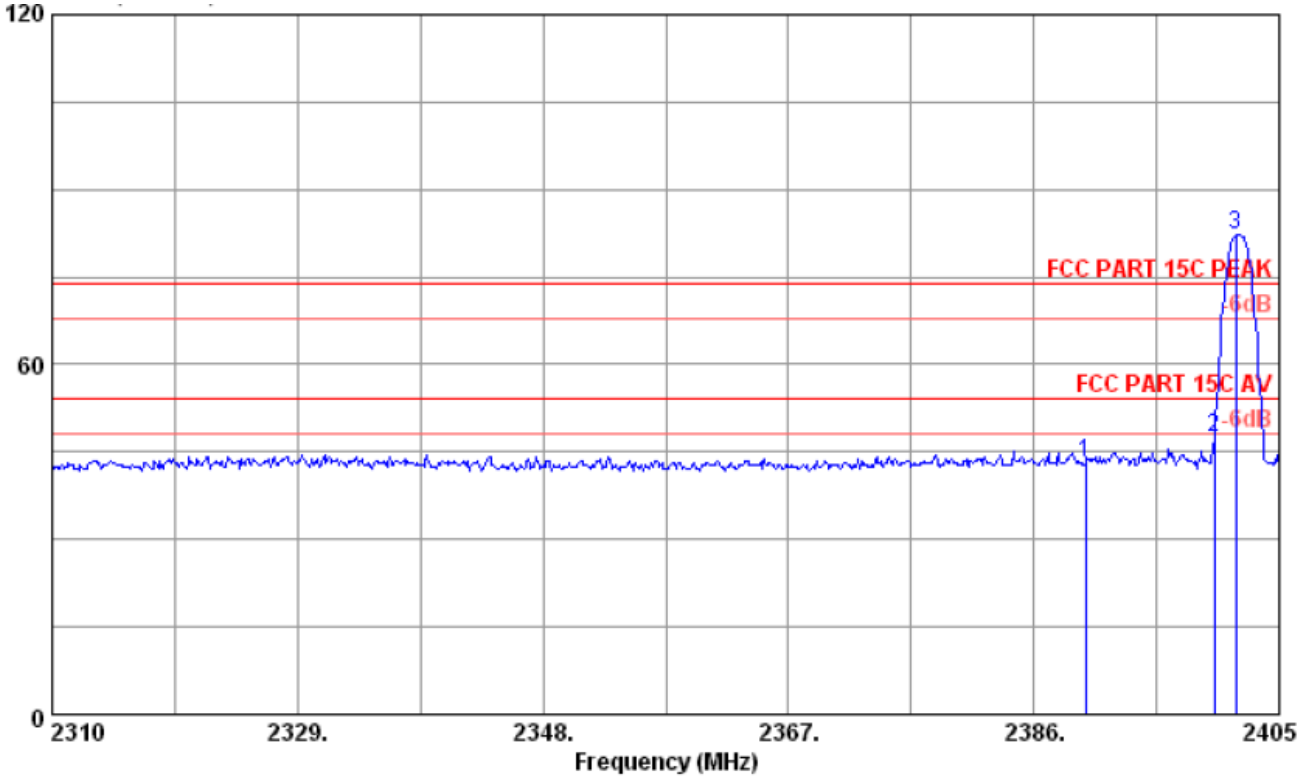
Low Channel/Horizontal:



Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	2390.00	35.68	29.99	30.21	8.35	43.81	54	-30.19	Peak	Horizontal
2	2400.00	43.58	29.99	30.21	8.35	51.71	---	---	Peak	Horizontal
3	2401.67	80.94	29.99	30.21	8.35	89.07	---	---	Peak	Horizontal

REMARKS:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. Over Limit=Emission Level - Limit.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=330kHz/Sweep time=Auto/Detector=Peak;

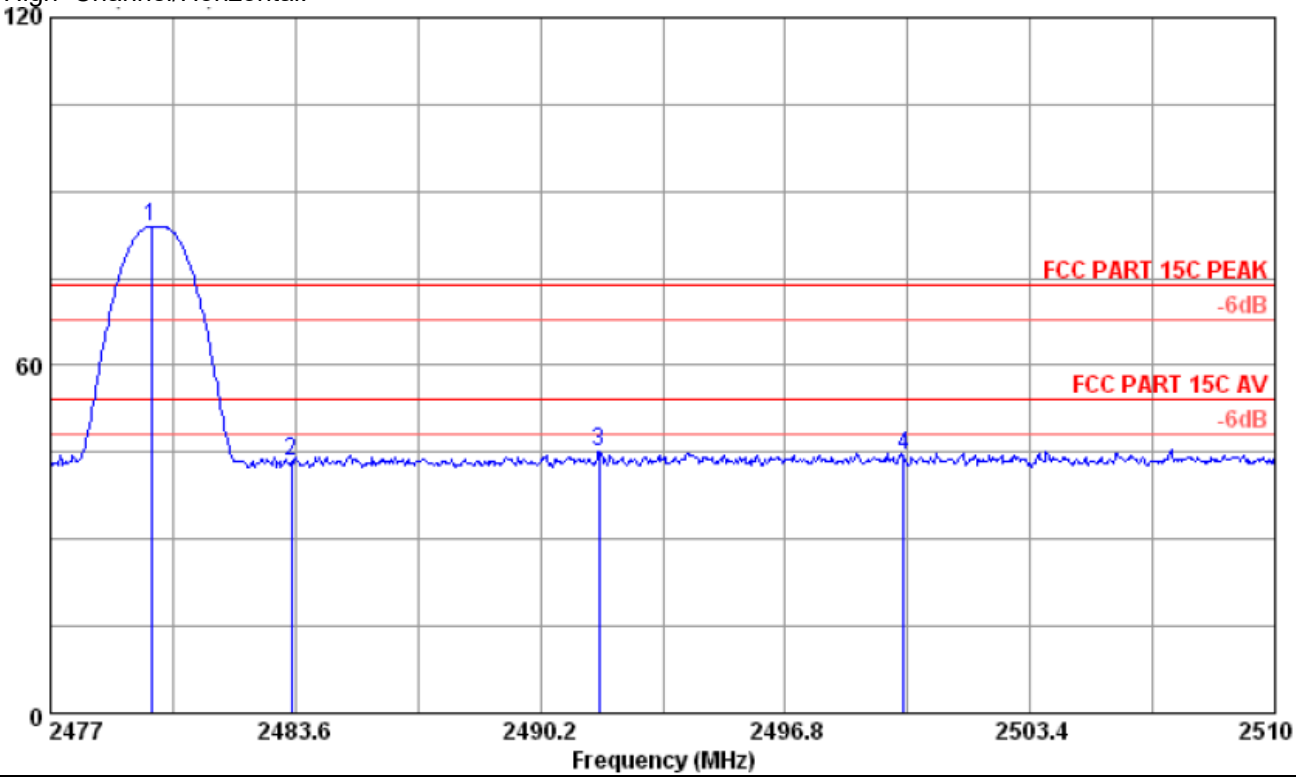
Low Channel/Vertical:



Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	2390.00	35.02	29.99	30.21	8.35	43.15	54	-30.85	Peak	Vertical
2	2400.00	39.35	29.99	30.21	8.35	47.48	---	---	Peak	Vertical
3	2401.67	73.99	29.99	30.21	8.35	82.12	---	---	Peak	Vertical

REMARKS:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. Over Limit=Emission Level - Limit.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=330kHz/Sweep time=Auto/Detector=Peak;

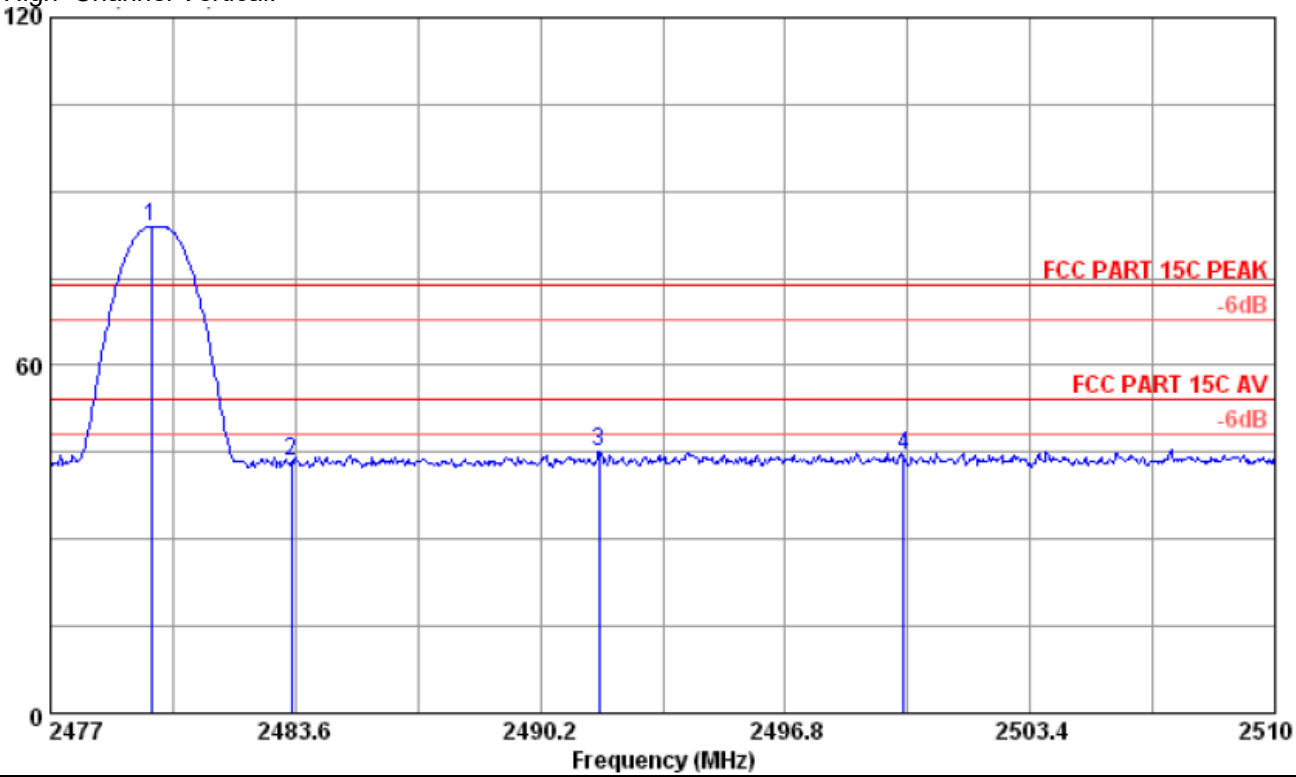
High Channel/Horizontal:



Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	2479.7	75.38	30.25	30.25	8.5	83.88	---	---	Peak	Horizontal
2	2483.5	34.92	30.25	30.25	8.5	43.42	54	-30.58	Peak	Horizontal
3	2491.72	36.64	30.25	30.25	8.5	45.14	54	-28.86	Peak	Horizontal
4	2500	35.99	30.25	30.25	8.5	44.49	54	-29.51	Peak	Horizontal

REMARKS:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. Over Limit=Emission Level - Limit.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=330kHz/Sweep time=Auto/Detector=Peak;

High Channel Vertical:



Item (Mark)	Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	2479.73	67.3	30.25	30.25	8.5	75.8	---	---	Peak	Vertical
2	2483.50	34.48	30.25	30.25	8.5	42.98	54	-31.02	Peak	Vertical
3	2494.59	37.41	30.25	30.25	8.5	45.91	54	-28.09	Peak	Vertical
4	2500.00	35.2	30.25	30.25	8.5	43.7	54	-30.3	Peak	Vertical

REMARKS:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. Over Limit=Emission Level - Limit.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=330kHz/Sweep time=Auto/Detector=Peak;

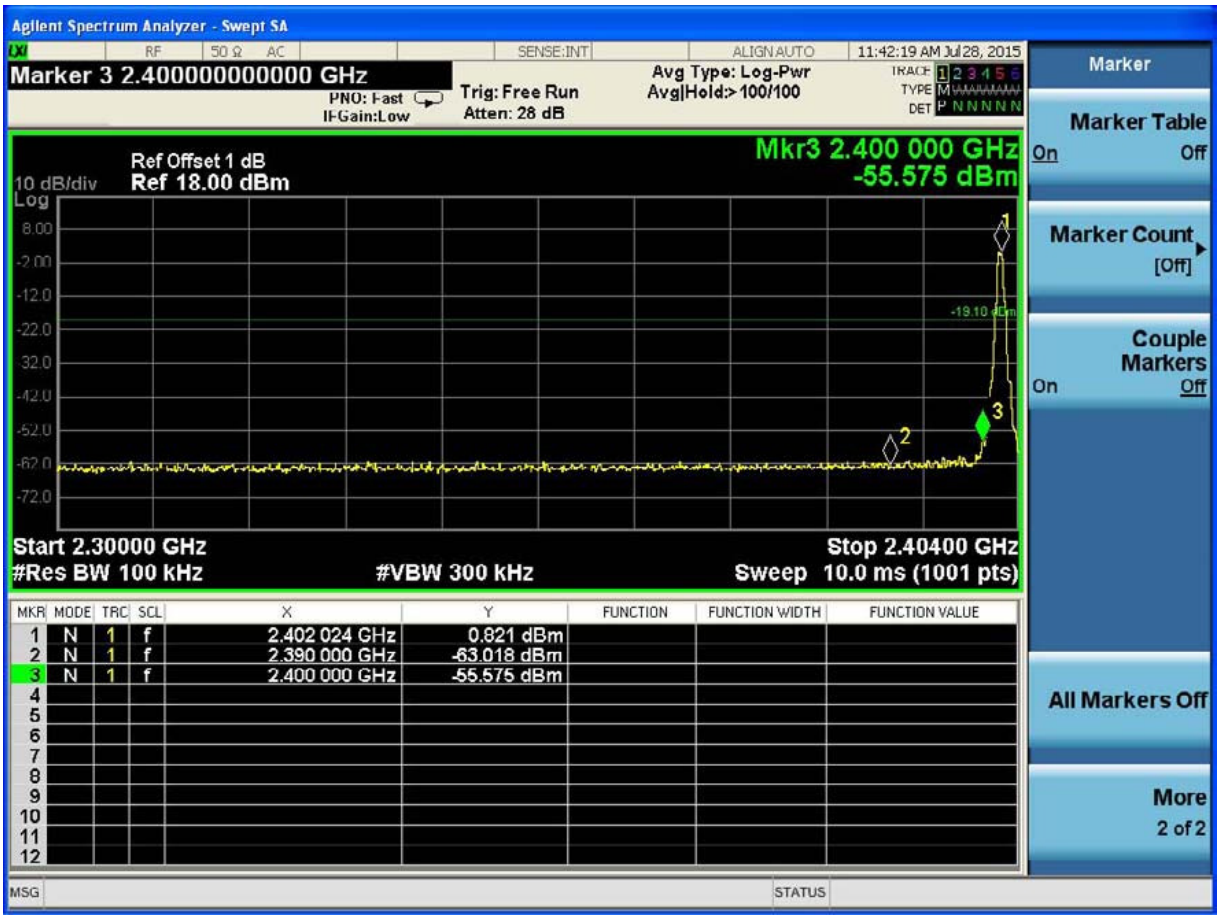
4.6.2 For Conducted Bandedge Measurement

4.6.2.1 GFSK Test Mode

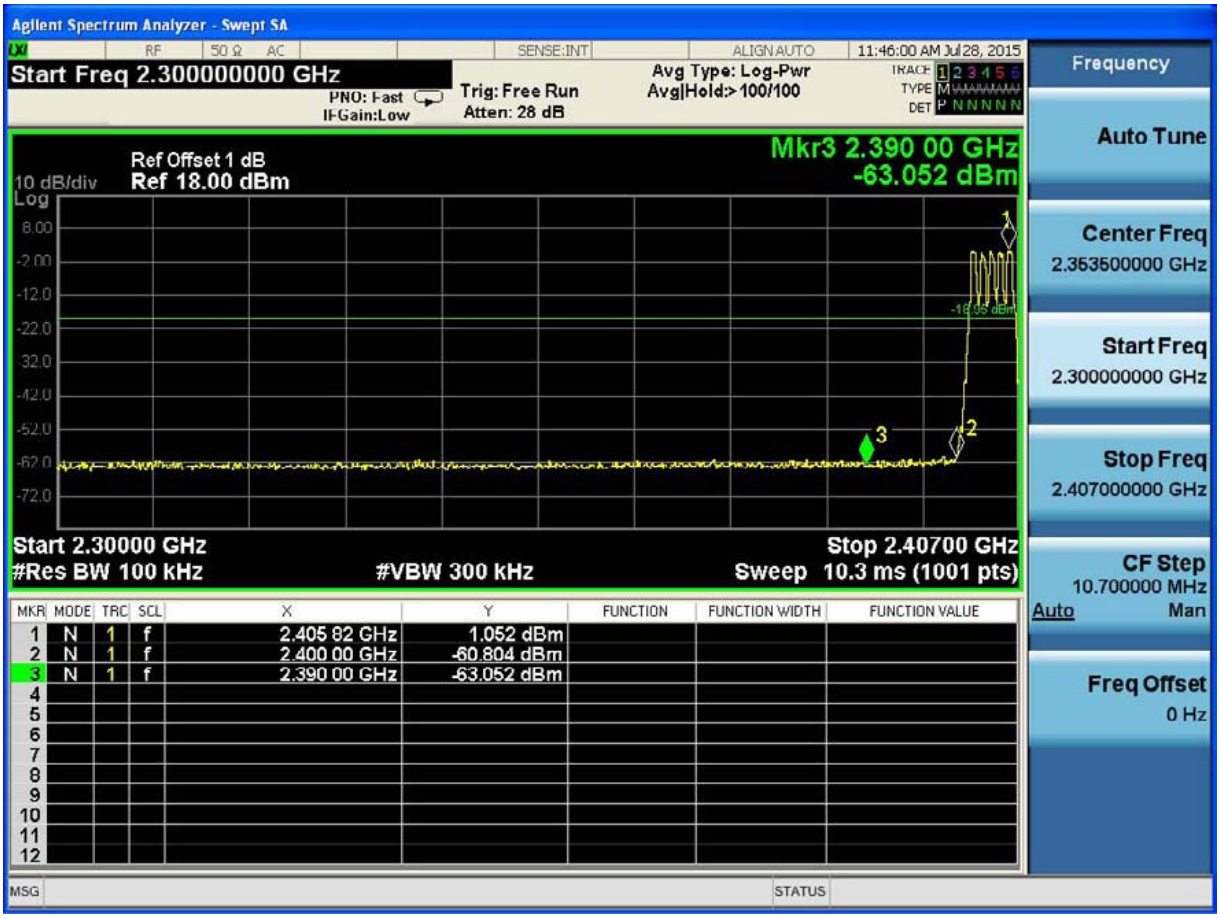
A. Test Verdict

Frequency (MHz)	Delta Peak to Band emission (dBc)	Hoping Mode	Detector	Limit (dBc)	Refer to Plot	Verdict
2400.00	-56.396	OFF	Peak	-20	Plot 4.6.2.1 A	PASS
2400.00	-61.856	ON	Peak	-20	Plot 4.6.2.1 B	PASS
2483.50	-63.045	OFF	Peak	-20	Plot 4.6.2.1 C	PASS
2483.50	-63.839	ON	Peak	-20	Plot 4.6.2.1 D	PASS

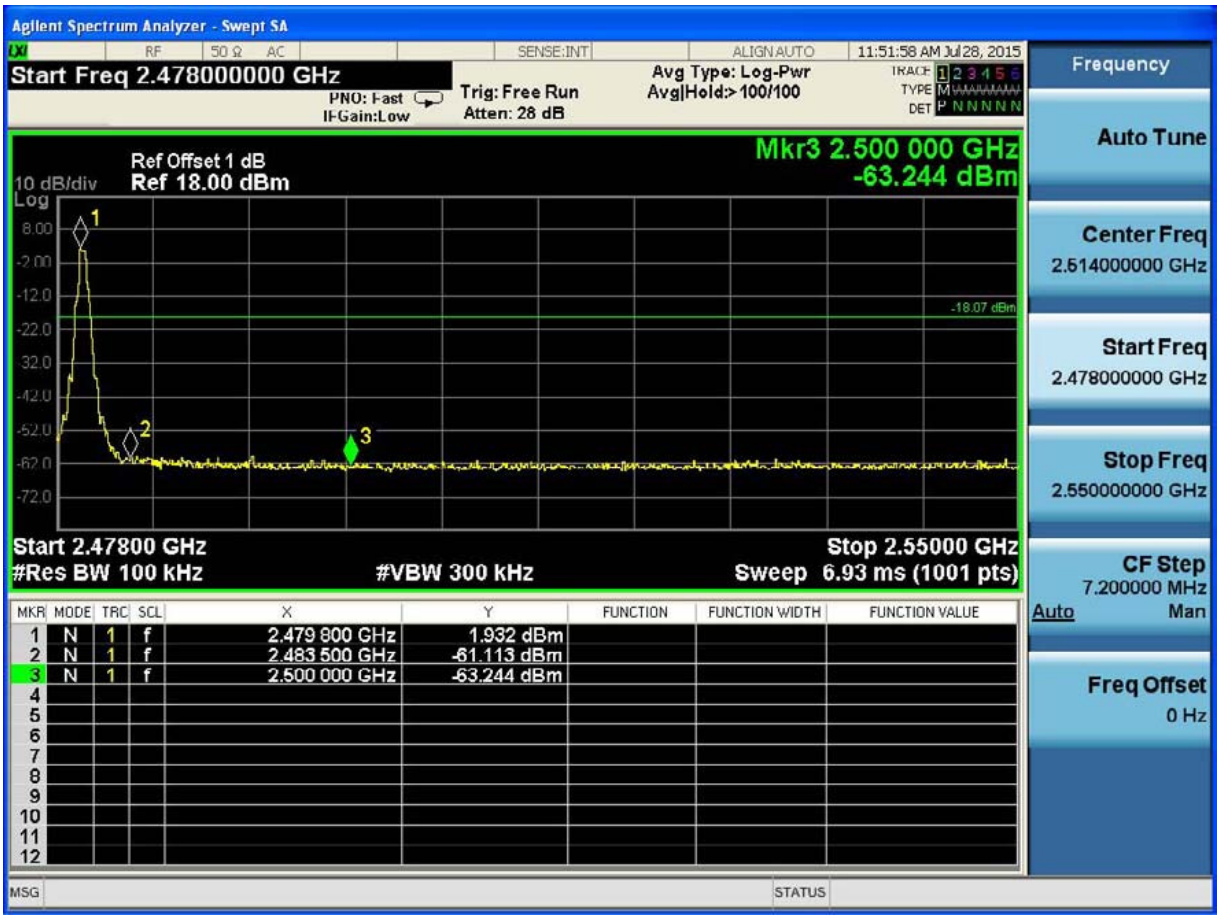
B. Test Plots



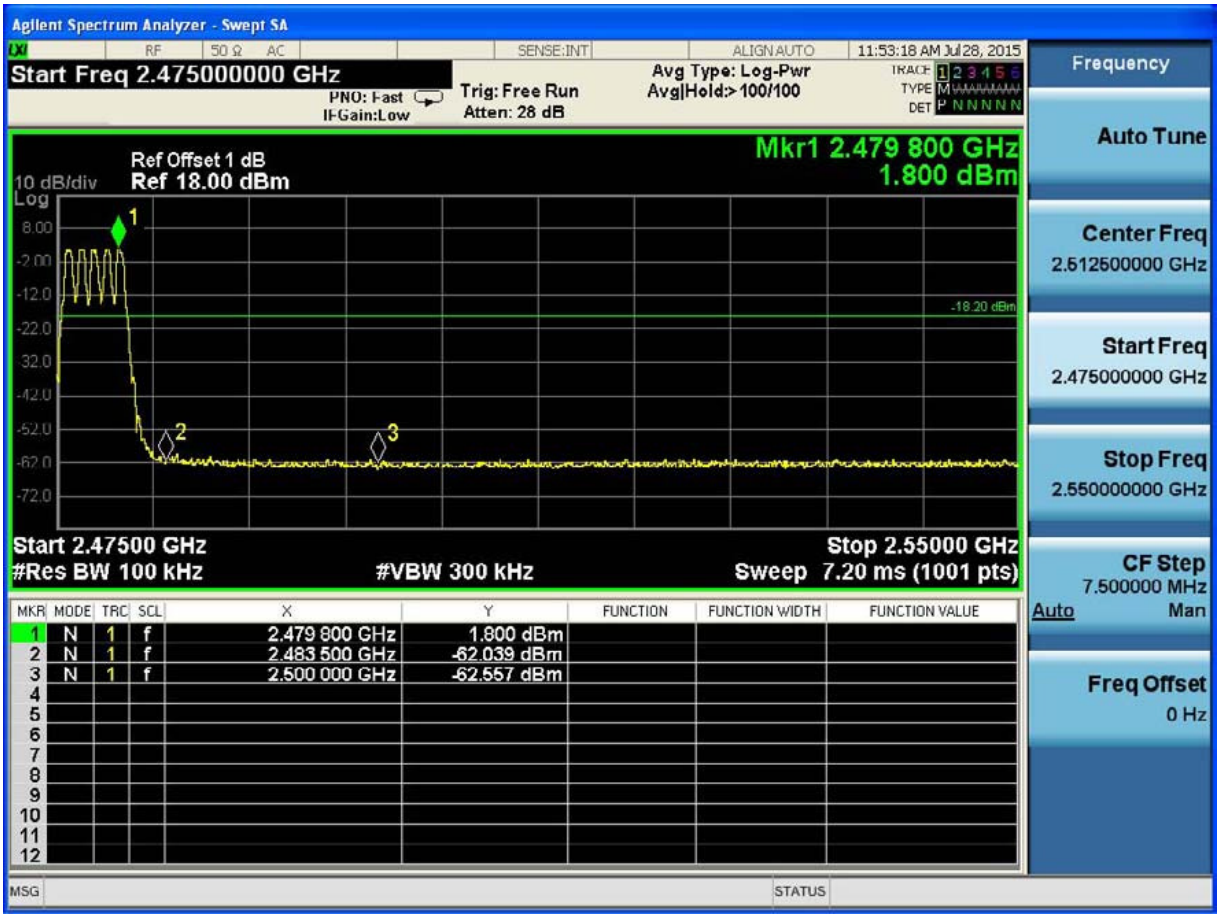
(Plot 4.6.2.1 A: Channel 00: 2402MHz @ GFSK)



(Plot 4.6.2.1 B: Hopping Mode @ GFSK)



(Plot 4.6.2.1 C: Channel 78: 2480MHz @ GFSK)



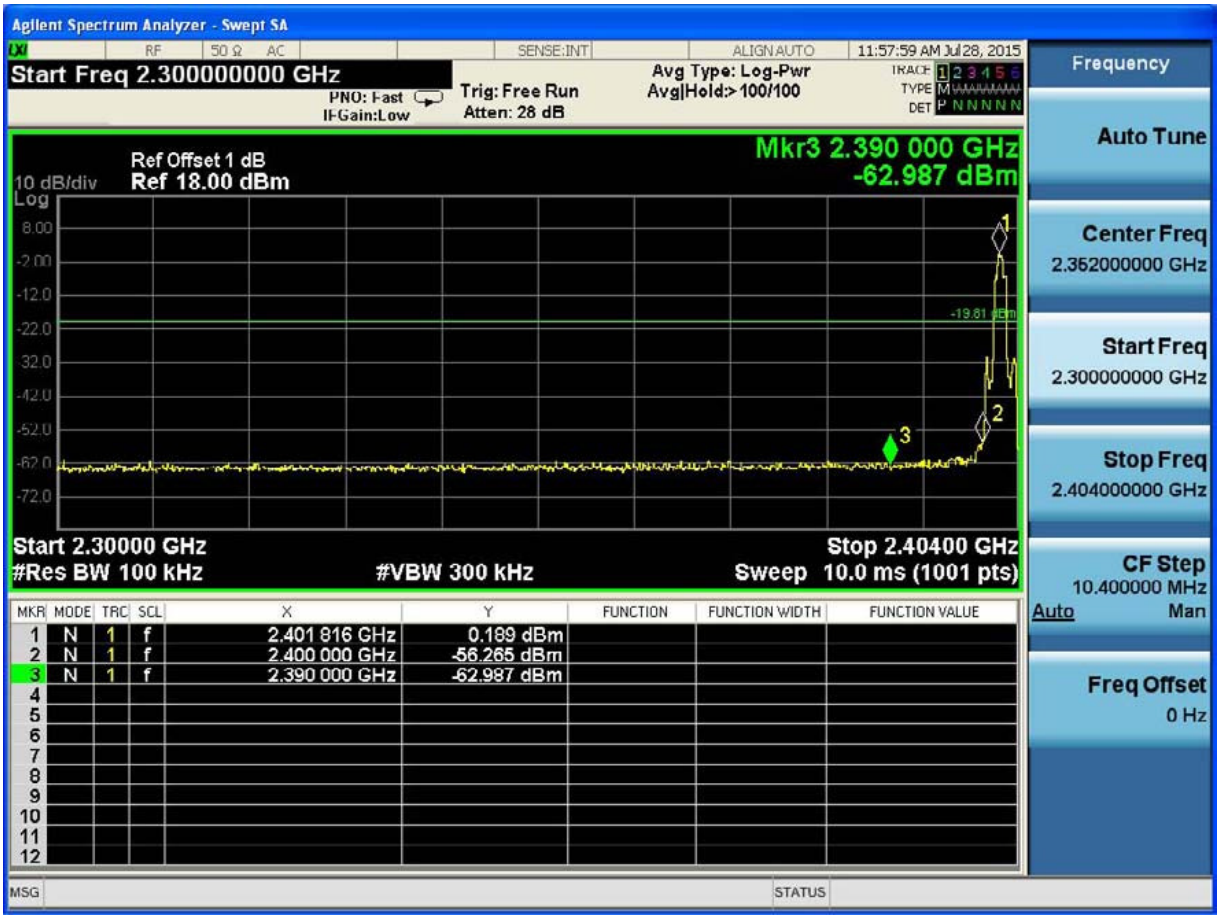
(Plot 4.6.2.1 D: Hopping Mode @ GFSK)

4.6.2.2 8DPSK Test Mode

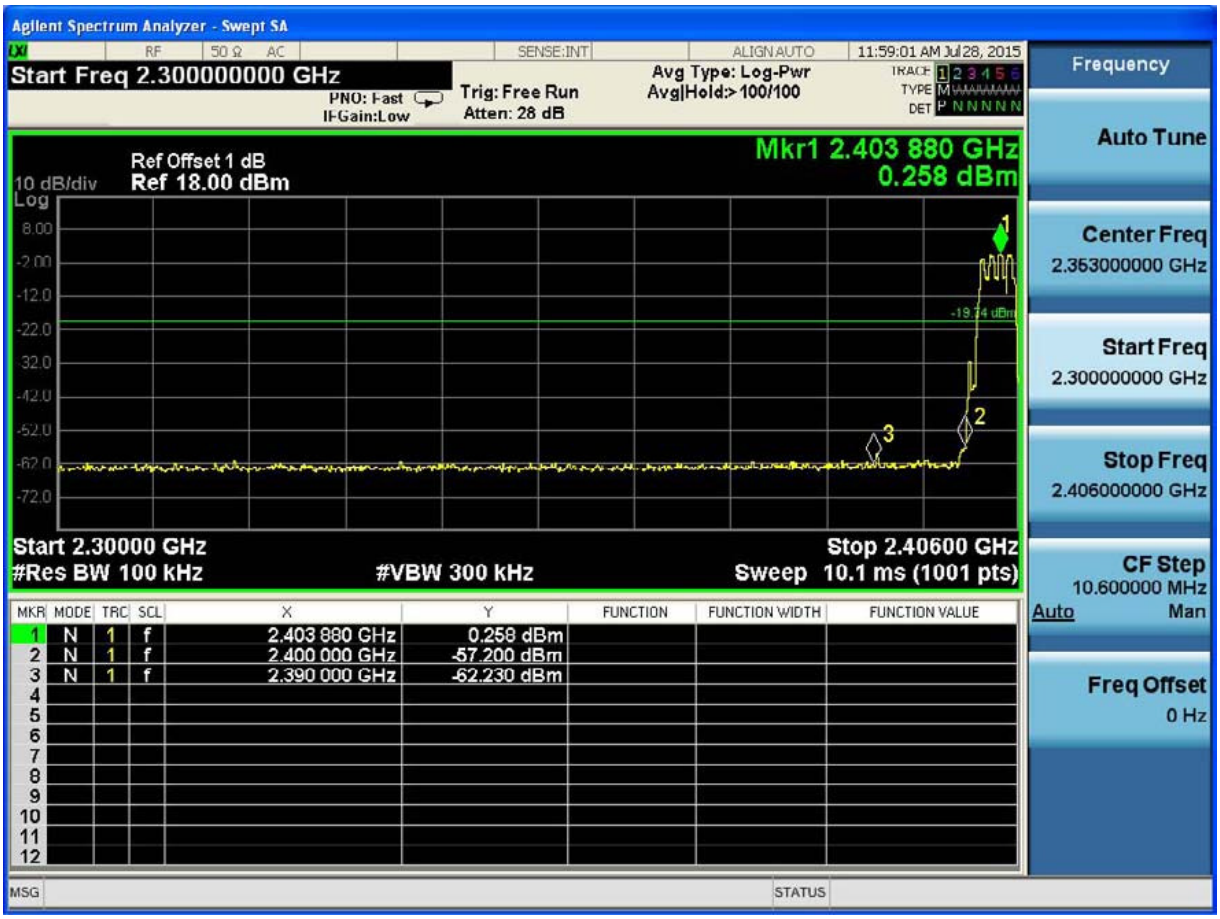
A. Test Verdict

Frequency (MHz)	Delta Peak to Band emission (dBc)	Hoping Mode	Detector	Limit (dBc)	Refer to Plot	Verdict
2400.00	-56.454	OFF	Peak	-20	Plot 4.6.2.2 A	PASS
2400.00	-57.458	ON	Peak	-20	Plot 4.6.2.2 B	PASS
2483.50	-61.194	OFF	Peak	-20	Plot 4.6.2.2 C	PASS
2483.50	-58.907	ON	Peak	-20	Plot 4.6.2.2 D	PASS

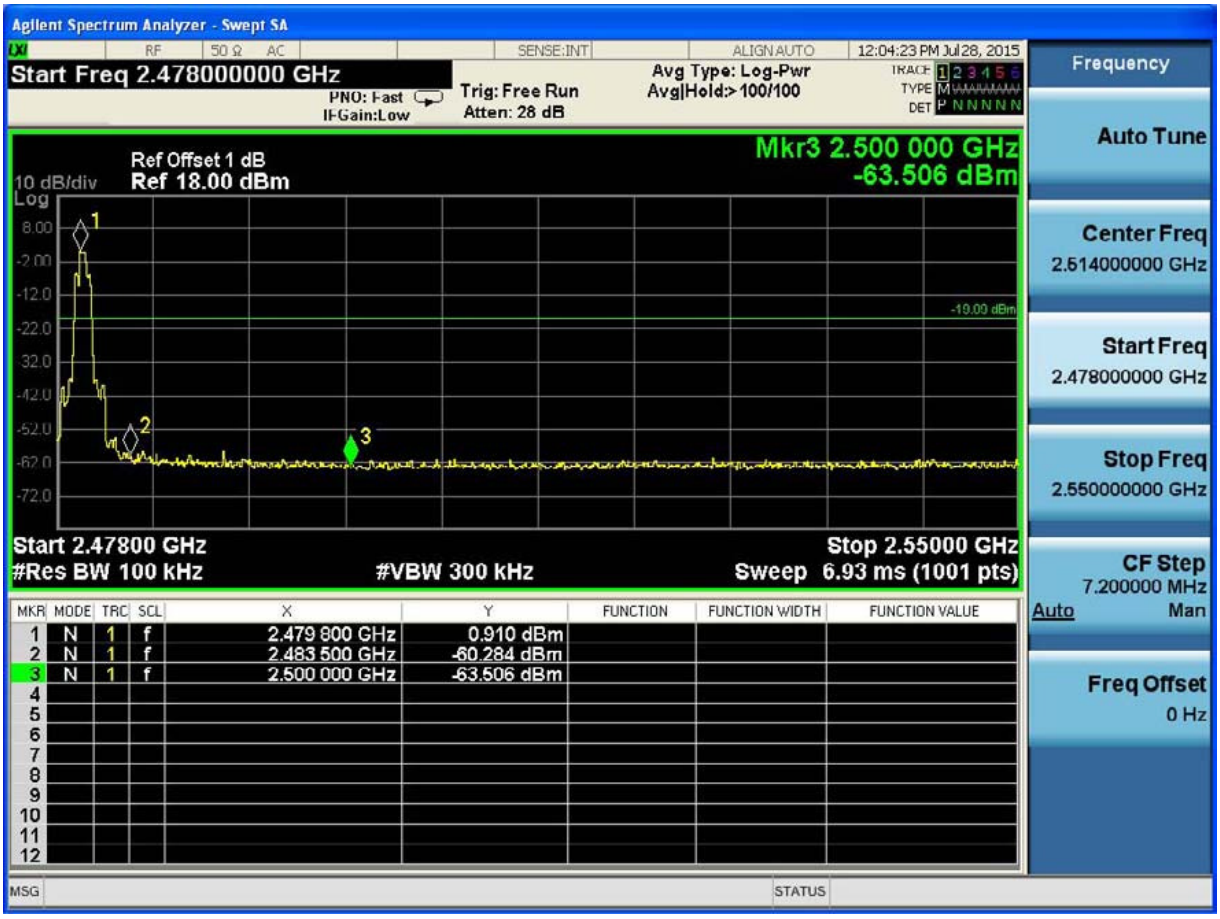
B. Test Plots



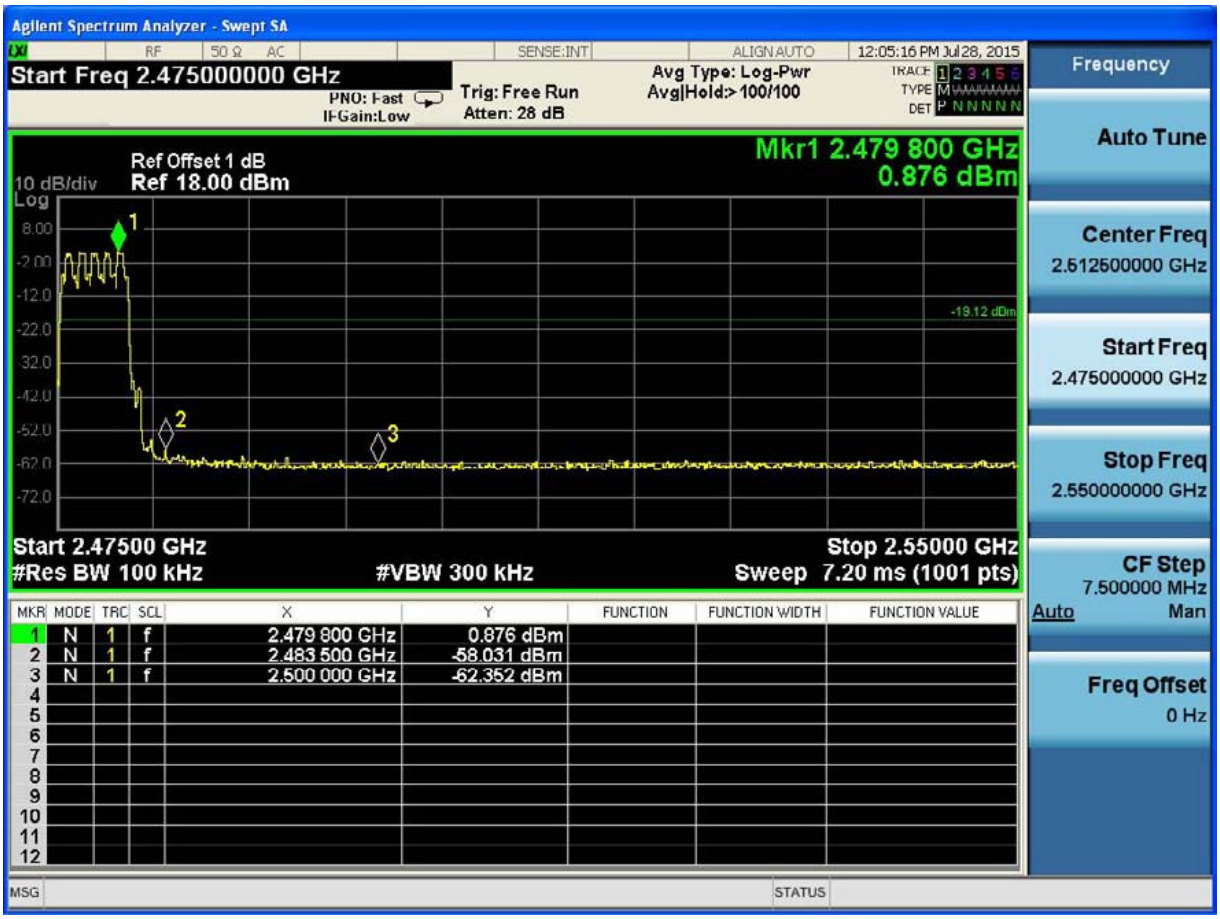
(Plot 4.6.2.2 A: Channel 00: 2402MHz @ 8DPSK)



(Plot 4.6.2.2 B: Hopping Mode @ 8DPSK)



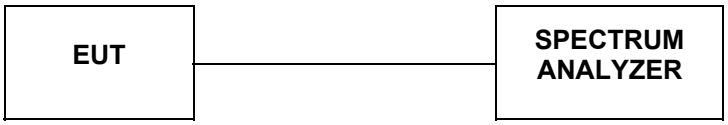
(Plot 4.6.2.2 C: Channel 78: 2480MHz @ 8DPSK)



(Plot 4.6.2.2 D: Hopping Mode @ 8DPSK)

4.7. Spurious RF Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100kHz and VBW= 300KHz to measure the peak field strength , and mwasure frequeny range from 9KHz to 26.5GHz.

LIMIT

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

TEST RESULTS

Remark: The measurement frequency range is from 9KHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandege measurement data.

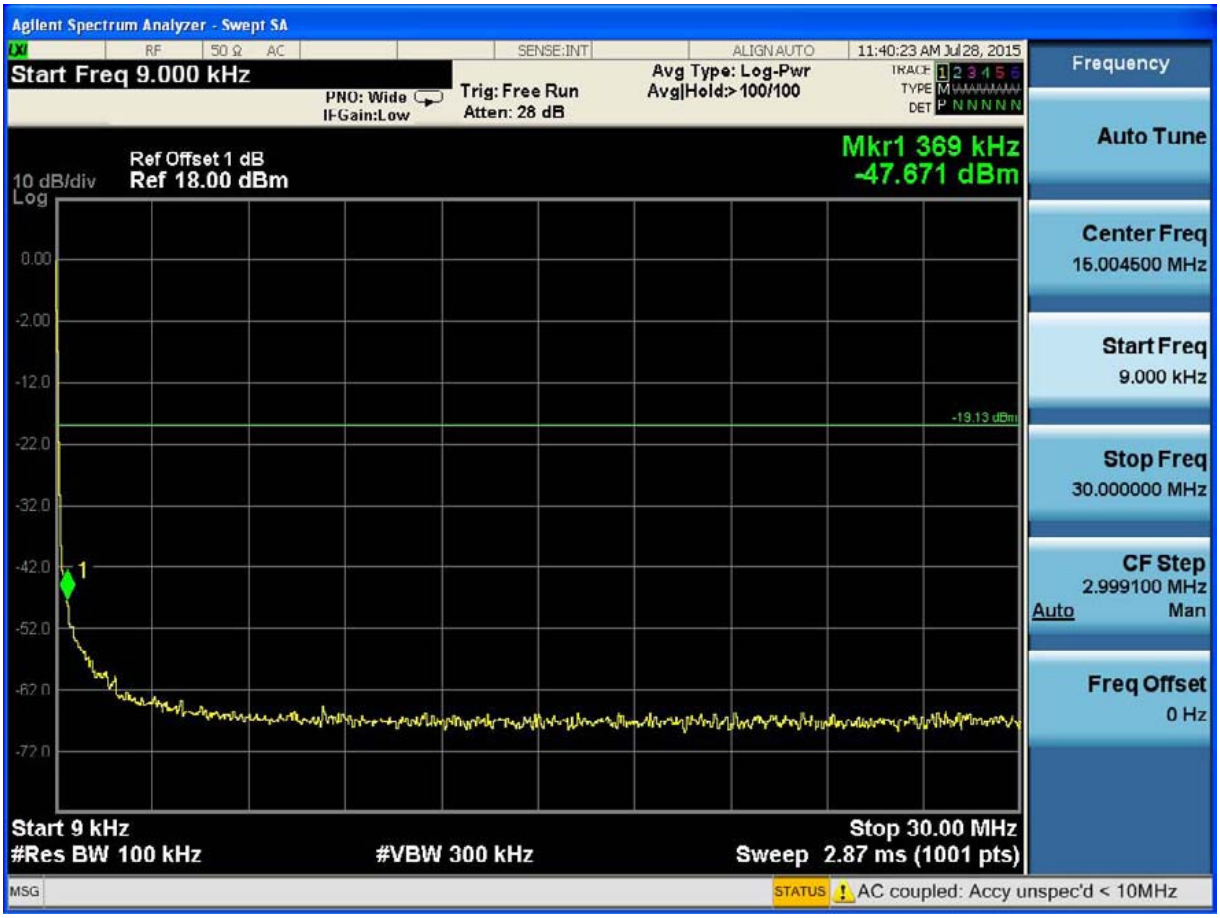
4.7.1 GFSK Test Mode

A. Test Verdict

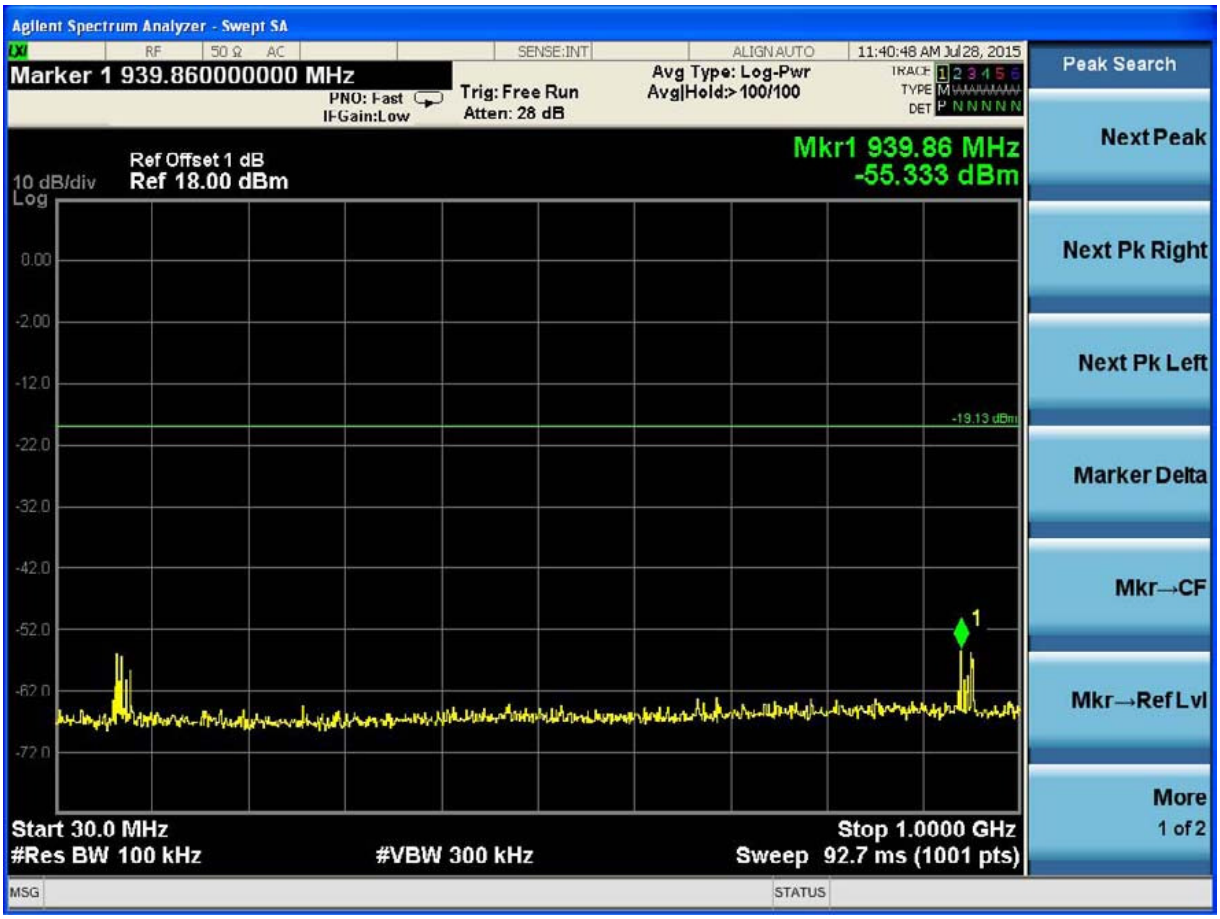
Channel	Frequency (MHz)	Frequency Range	Refer to Plot	Limit (dBc)	Verdict
00	2402	2402MHz	Plot 4.7.1 A1	N/A	PASS
		9KHz-30MHz	Plot 4.7.1 A2	-20	PASS
		30MHz-1GHz	Plot 4.7.1 A3	-20	PASS
		1GHz-8GHz	Plot 4.7.1 A4	-20	PASS
		8GHz-16GHz	Plot 4.7.1 A5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.1 A6	-20	PASS
39	2441	2440MHz	Plot 4.7.1 B1	N/A	PASS
		9KHz-30MHz	Plot 4.7.1 B2	-20	PASS
		30MHz-1GHz	Plot 4.7.1 B3	-20	PASS
		1GHz-8GHz	Plot 4.7.1 B4	-20	PASS
		8GHz-16GHz	Plot 4.7.1 B5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.1 B6	-20	PASS
78	2480	2480MHz	Plot 4.7.1 C1	N/A	PASS
		9KHz-30MHz	Plot 4.7.1 C2	-20	PASS
		30MHz-1GHz	Plot 4.7.1 C3	-20	PASS
		1GHz-8GHz	Plot 4.7.1 C4	-20	PASS
		8GHz-16GHz	Plot 4.7.1 C5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.1 C6	-20	PASS

B. Test Plots

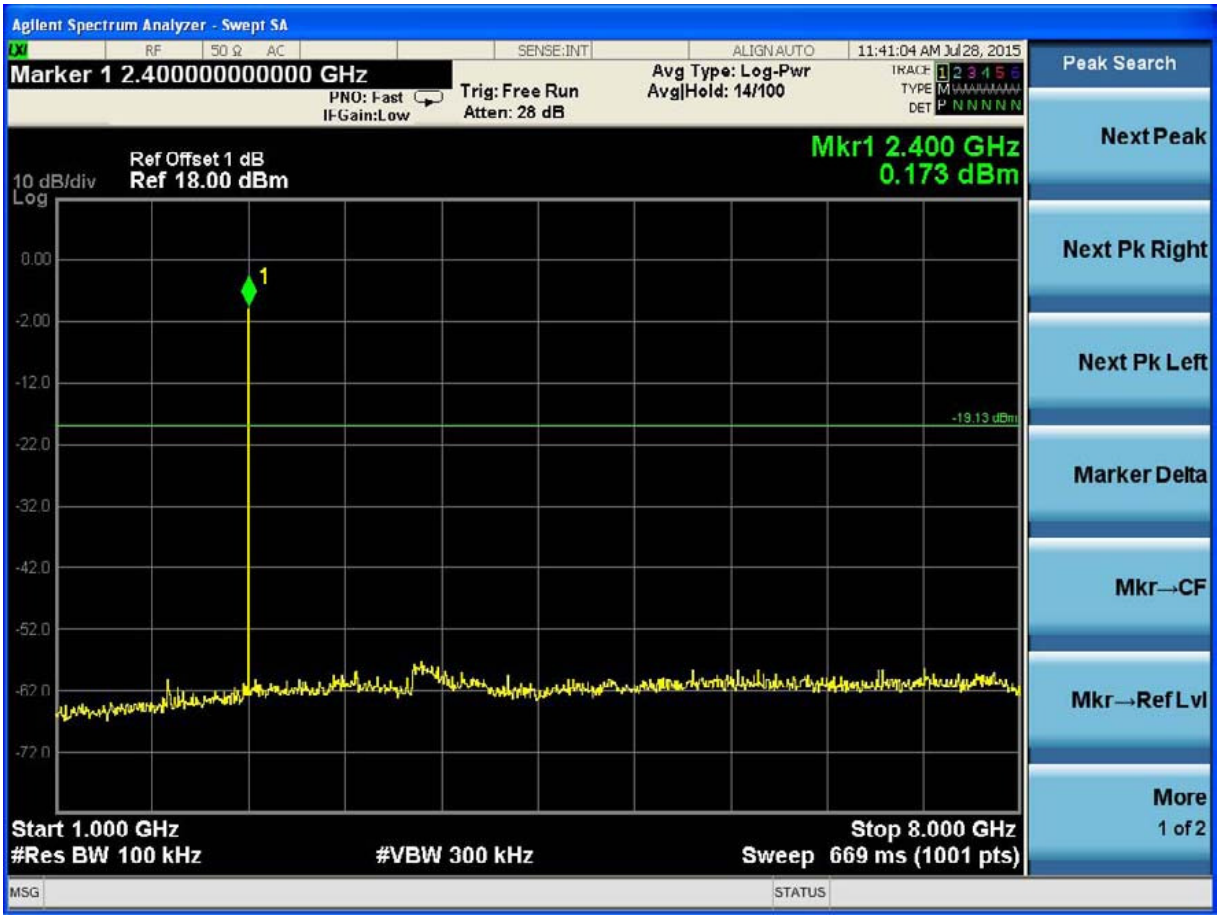
(Plot 4.7.1 A1: Channel 00: 2402MHz @ GFSK)



(Plot 4.7.1 A2: Channel 00: 2402MHz @ GFSK)



(Plot 4.7.1 A3: Channel 00: 2402MHz @ GFSK)

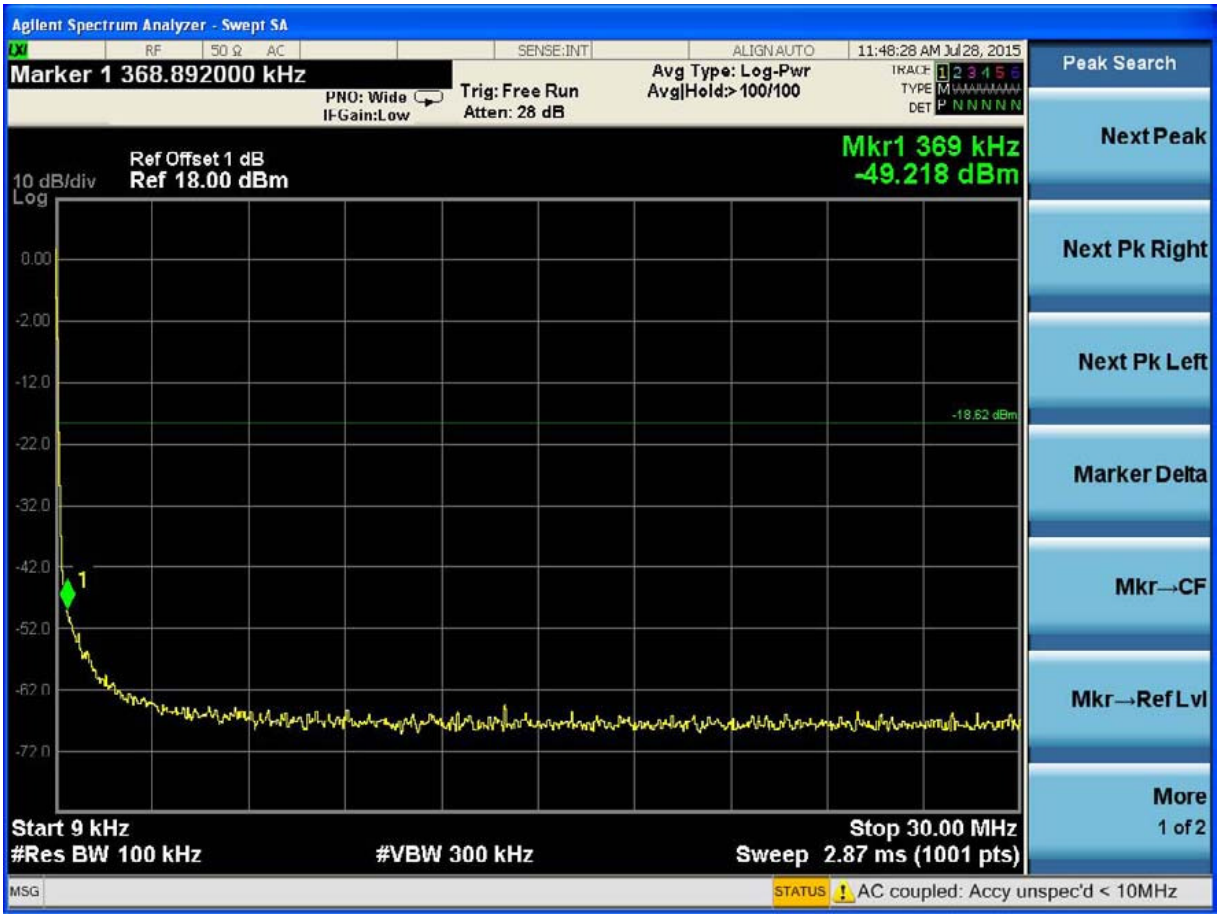


(Plot 4.7.1 A4: Channel 00: 2402MHz @ GFSK)

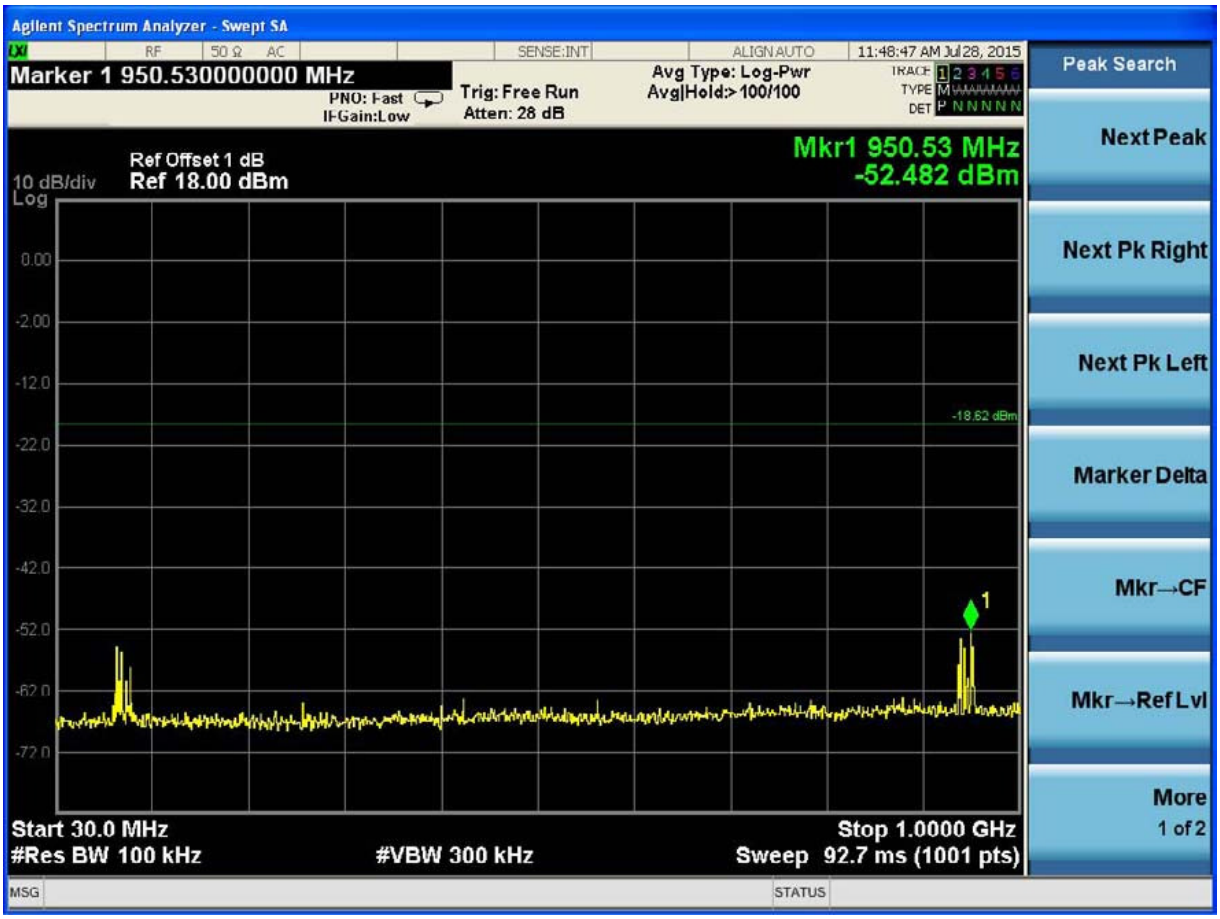
(Plot 4.7.1 A5: Channel 00: 2402MHz @ GFSK)

(Plot 4.7.1 A6: Channel 00: 2402MHz @ GFSK)

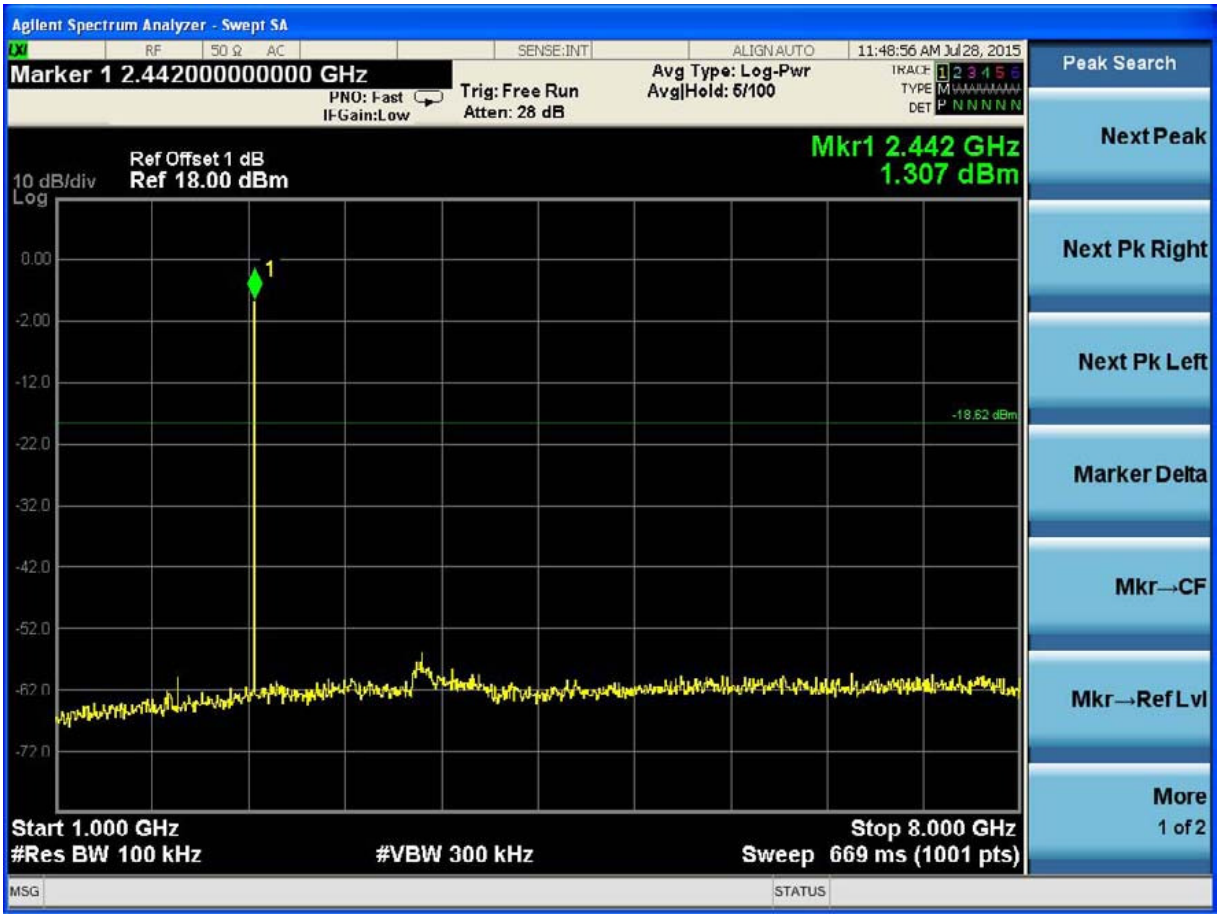
(Plot 4.7.1 B1: Channel 39: 2441MHz @ GFSK)



(Plot 4.7.1 B2: Channel 39: 2441MHz @ GFSK)



(Plot 4.7.1 B3: Channel 39: 2441MHz @ GFSK)

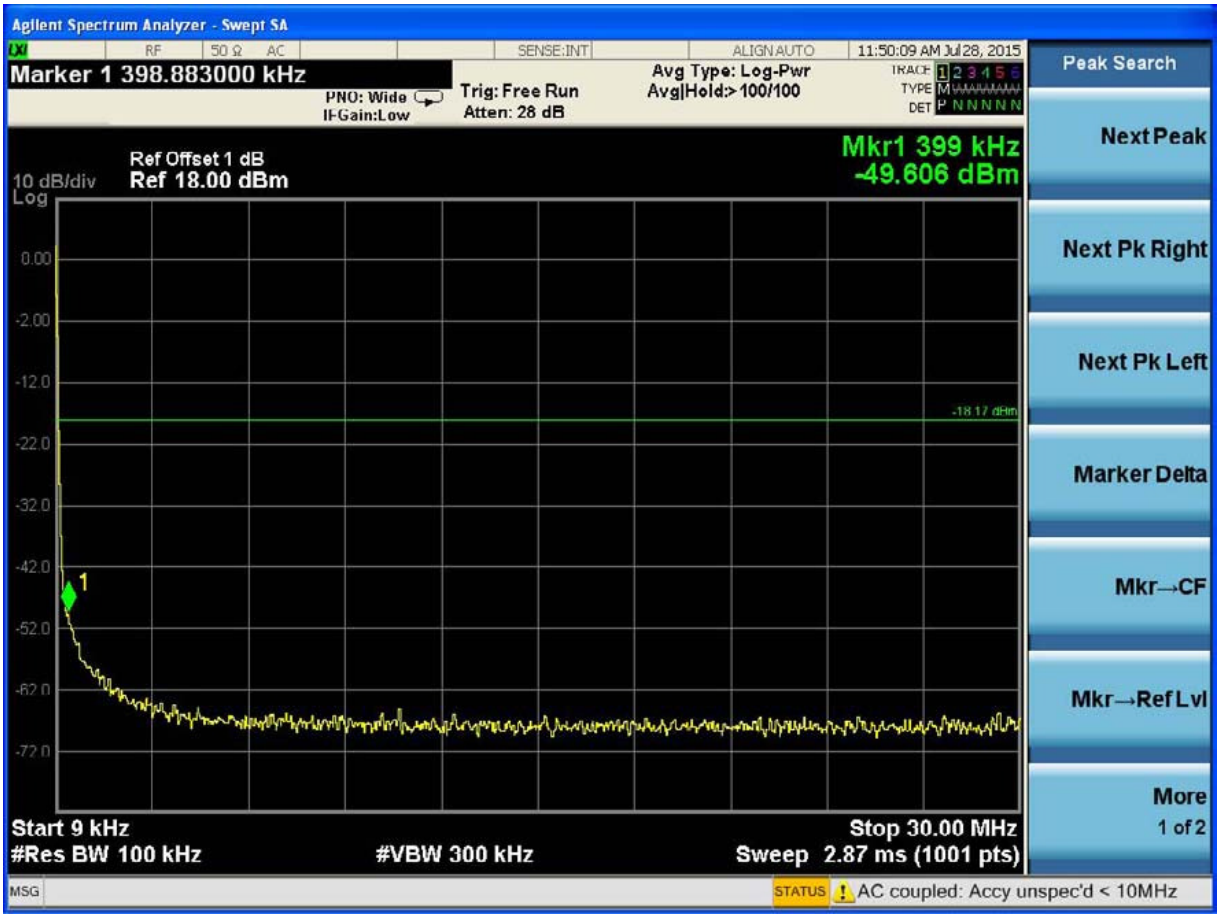


(Plot 4.7.1 B4: Channel 39: 2441MHz @ GFSK)

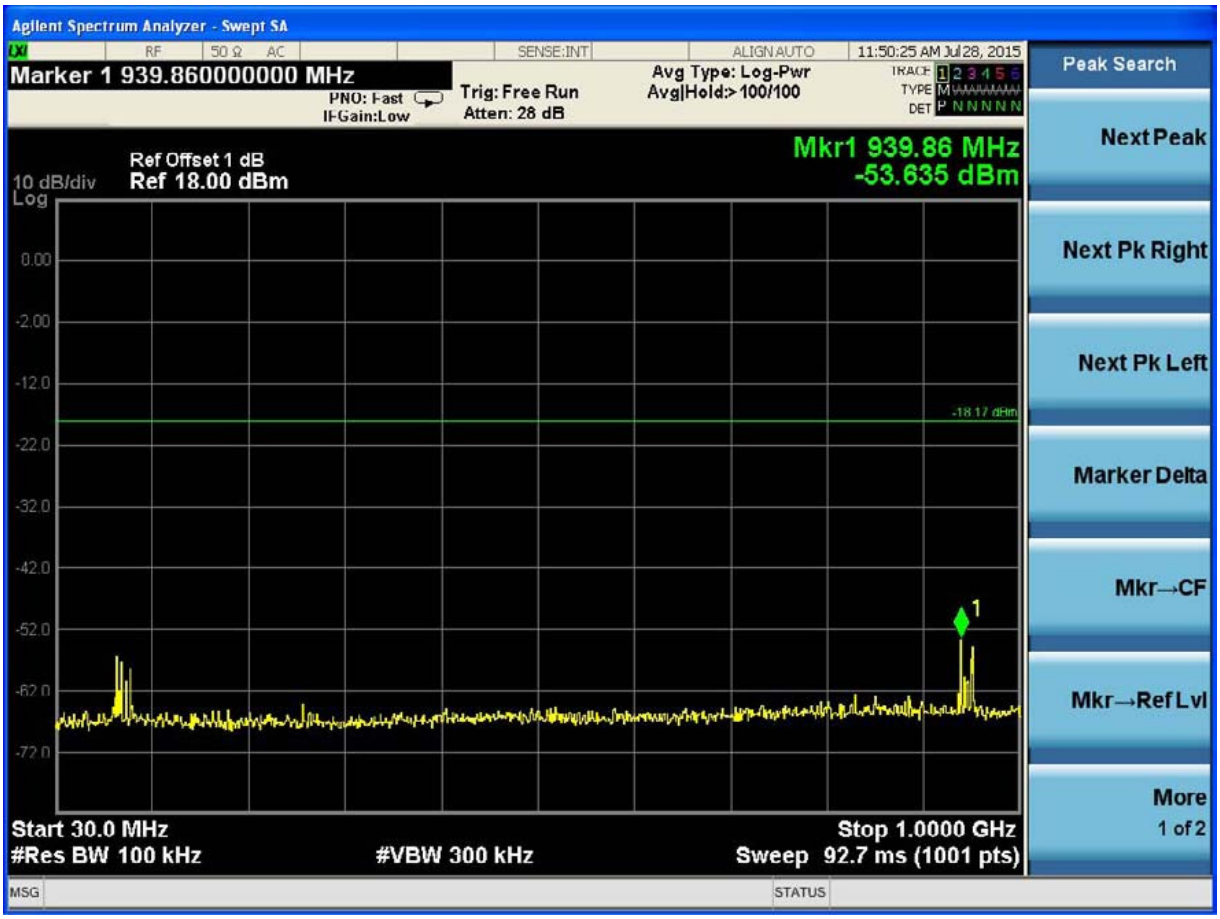
(Plot 4.7.1 B5: Channel 39: 2441MHz @ GFSK)

(Plot 4.7.1 B6: Channel 39: 2441MHz @ GFSK)

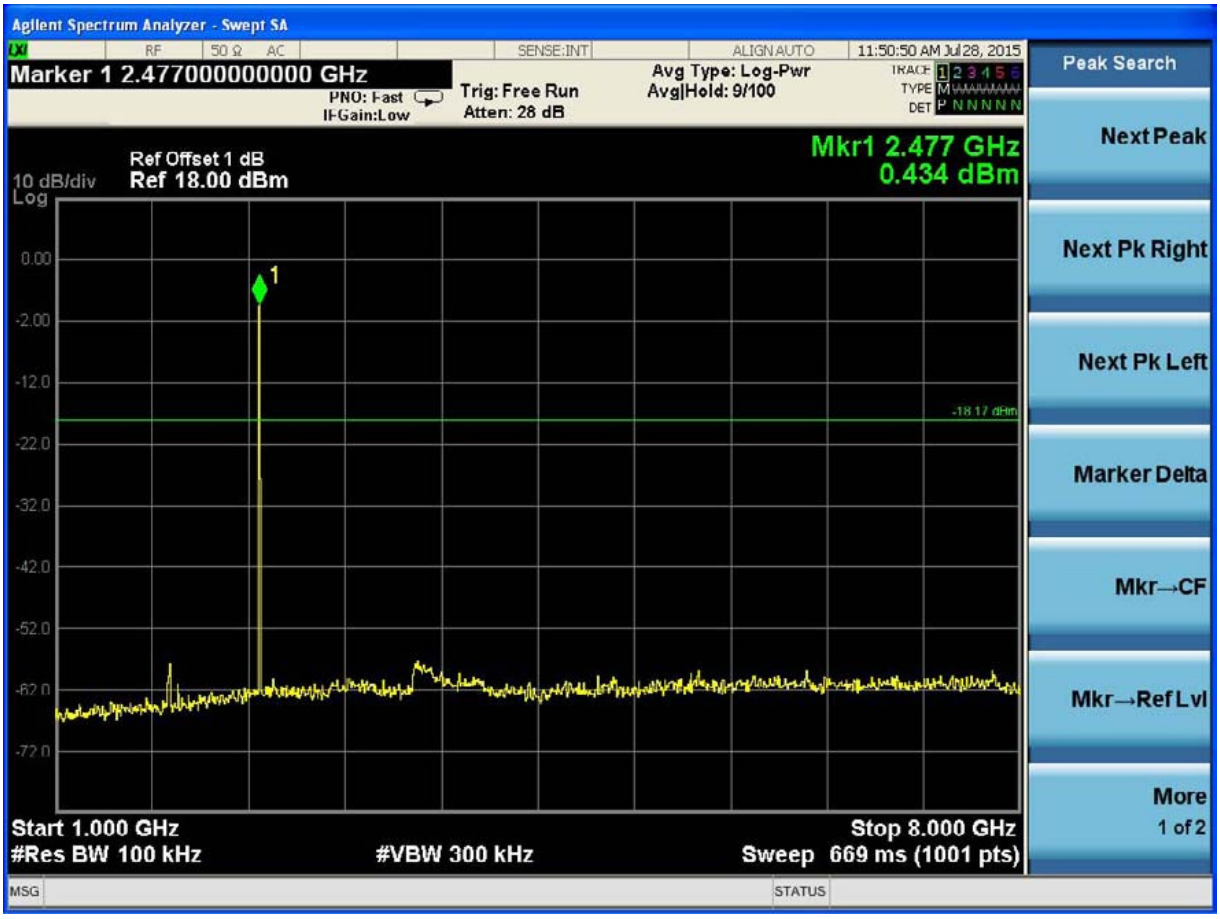
(Plot 4.7.1 C1: Channel 78: 2480MHz @ GFSK)



(Plot 4.7.1 C2: Channel 78: 2480MHz @ GFSK)

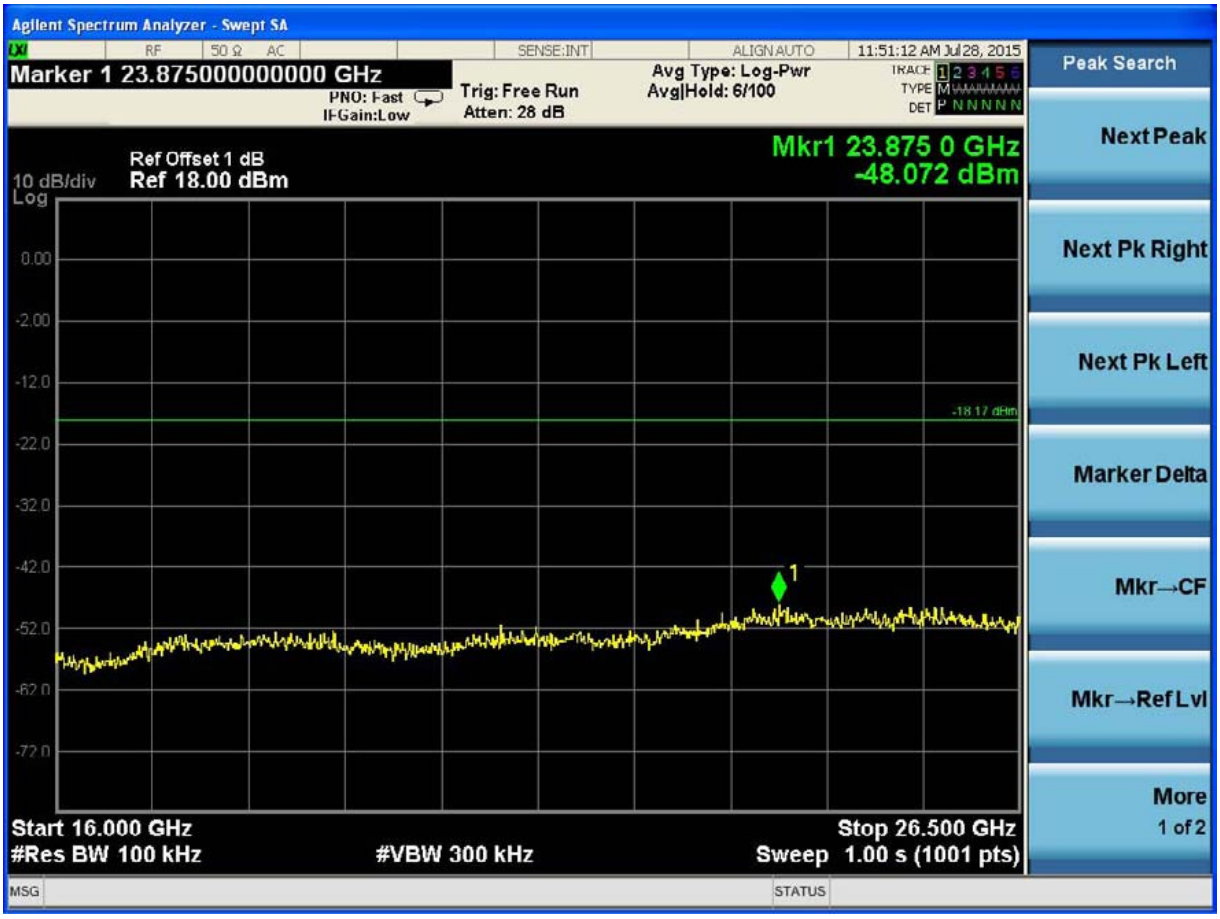


(Plot 4.7.1 C3: Channel 78: 2480MHz @ GFSK)



(Plot 4.7.1 C4: Channel 78: 2480MHz @ GFSK)

(Plot 4.7.1 C5: Channel 78: 2480MHz @ GFSK)



(Plot 4.7.1 C6: Channel 78: 2480MHz @ GFSK)

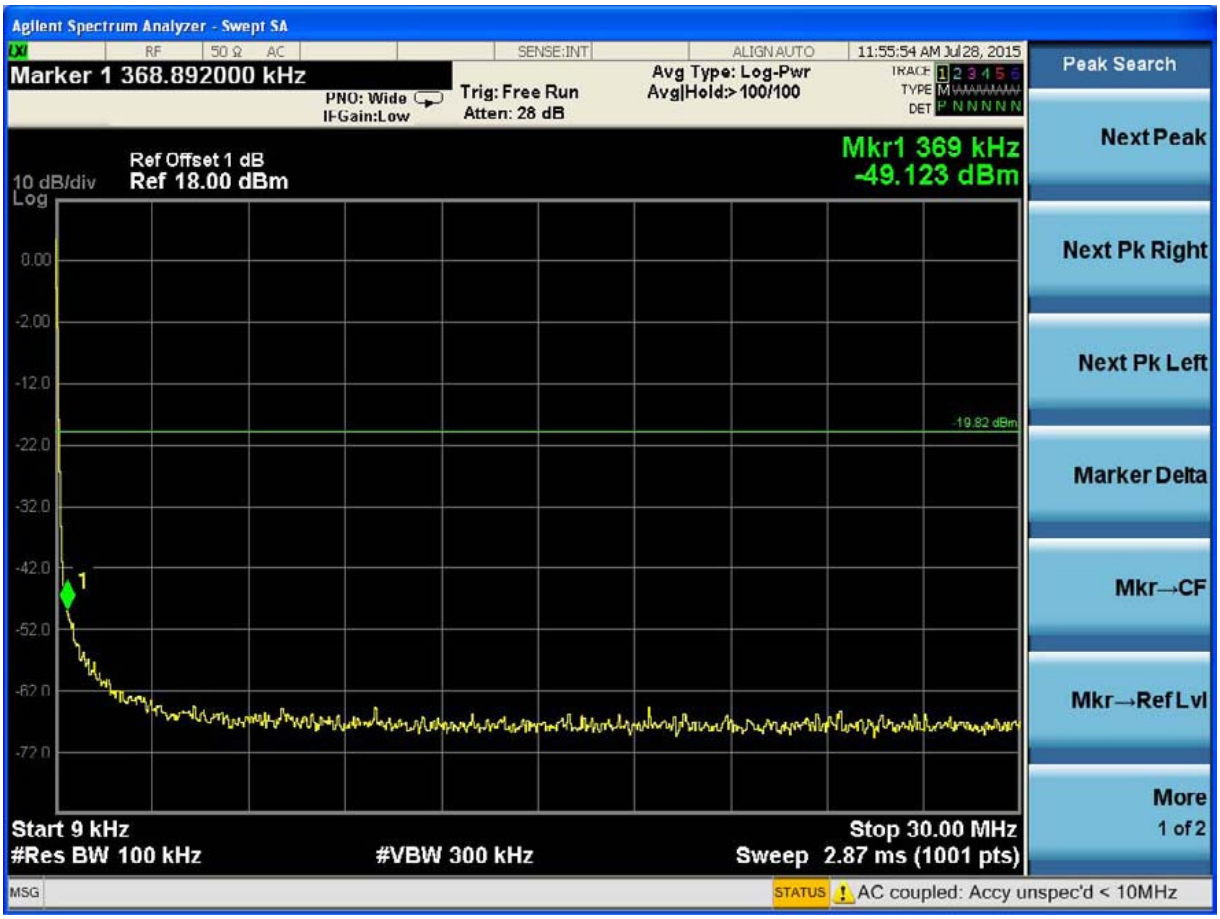
4.7.2 8DPSK Test Mode

A. Test Verdict

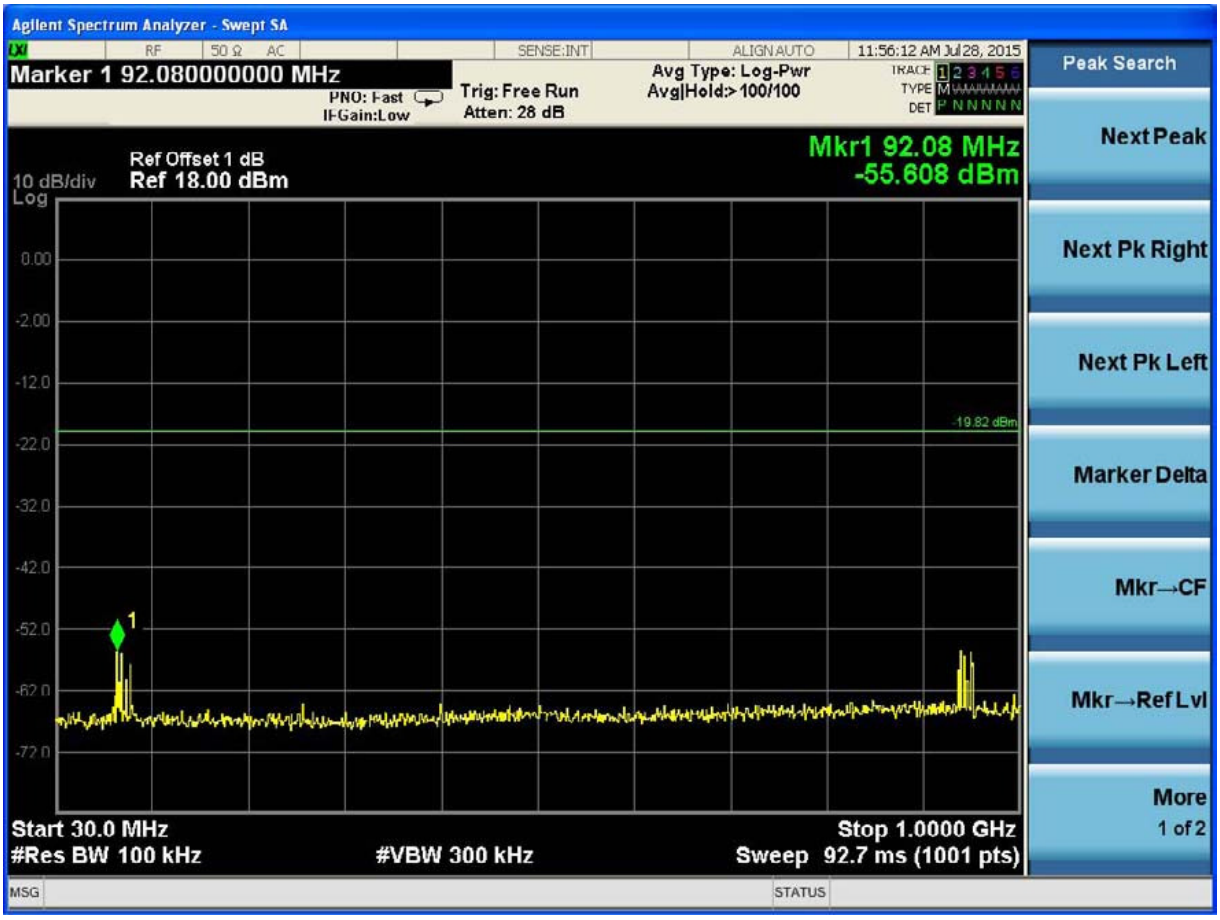
Channel	Frequency (MHz)	Frequency Range	Refer to Plot	Limit (dBc)	Verdict
00	2402	2402MHz	Plot 4.7.2 A1	N/A	PASS
		9KHz-30MHz	Plot 4.7.2 A2	-20	PASS
		30MHz-1GHz	Plot 4.7.2 A3	-20	PASS
		1GHz-8GHz	Plot 4.7.2 A4	-20	PASS
		8GHz-16GHz	Plot 4.7.2 A5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.2 A6	-20	PASS
19	2440	2440MHz	Plot 4.7.2 B1	N/A	PASS
		9KHz-30MHz	Plot 4.7.2 B2	-20	PASS
		30MHz-1GHz	Plot 4.7.2 B3	-20	PASS
		1GHz-8GHz	Plot 4.7.2 B4	-20	PASS
		8GHz-16GHz	Plot 4.7.2 B5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.2 B6	-20	PASS
39	2480	2480MHz	Plot 4.7.2 C1	N/A	PASS
		9KHz-30MHz	Plot 4.7.2 C2	-20	PASS
		30MHz-1GHz	Plot 4.7.2 C3	-20	PASS
		1GHz-8GHz	Plot 4.7.2 C4	-20	PASS
		8GHz-16GHz	Plot 4.7.2 C5	-20	PASS
		16GHz-26.5GHz	Plot 4.7.2 C6	-20	PASS

B. Test Plots

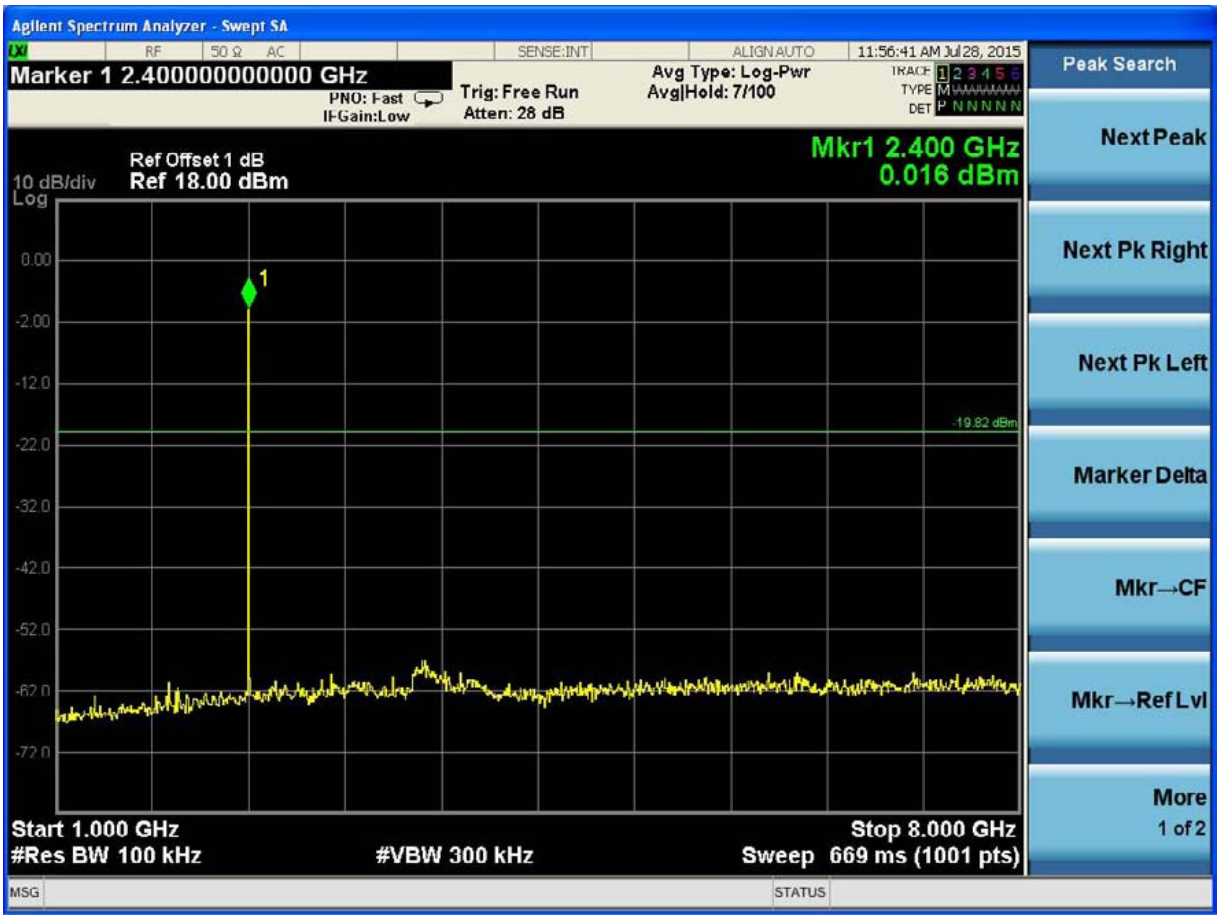
(Plot 4.7.2 A1: Channel 00: 2402MHz @8DPSK)



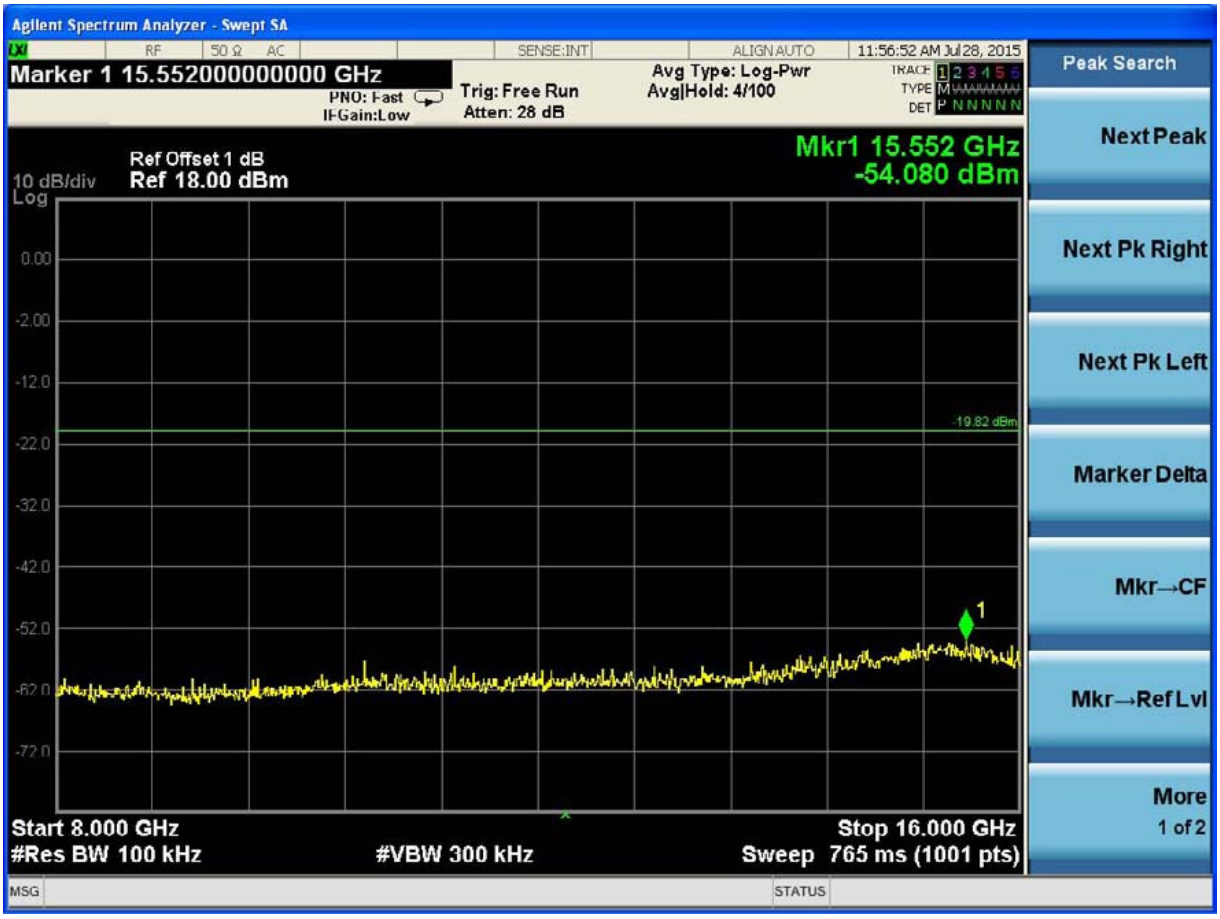
(Plot 4.7.2 A2: Channel 00: 2402MHz @8DPSK)



(Plot 4.7.2 A3: Channel 00: 2402MHz @8DPSK)



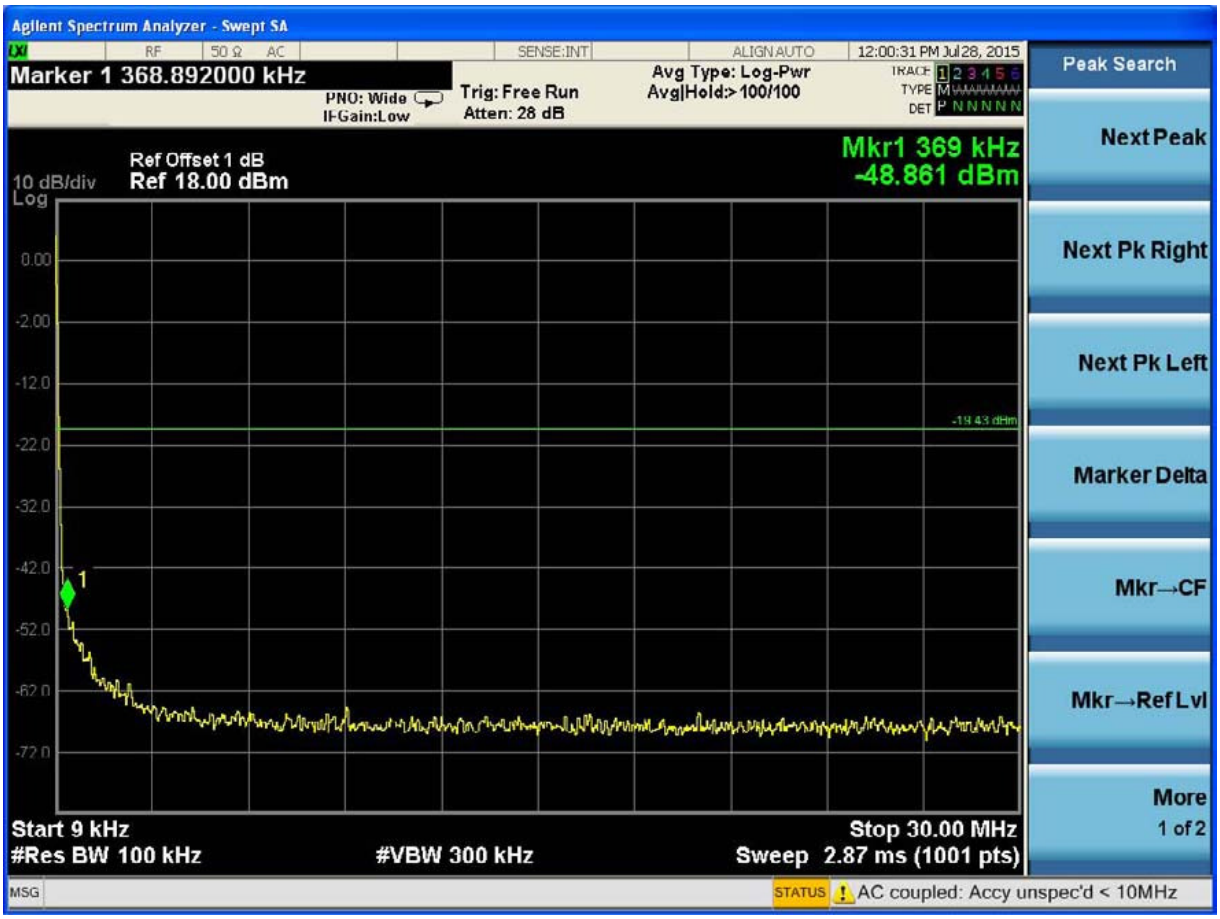
(Plot 4.7.2 A4: Channel 00: 2402MHz @8DPSK)



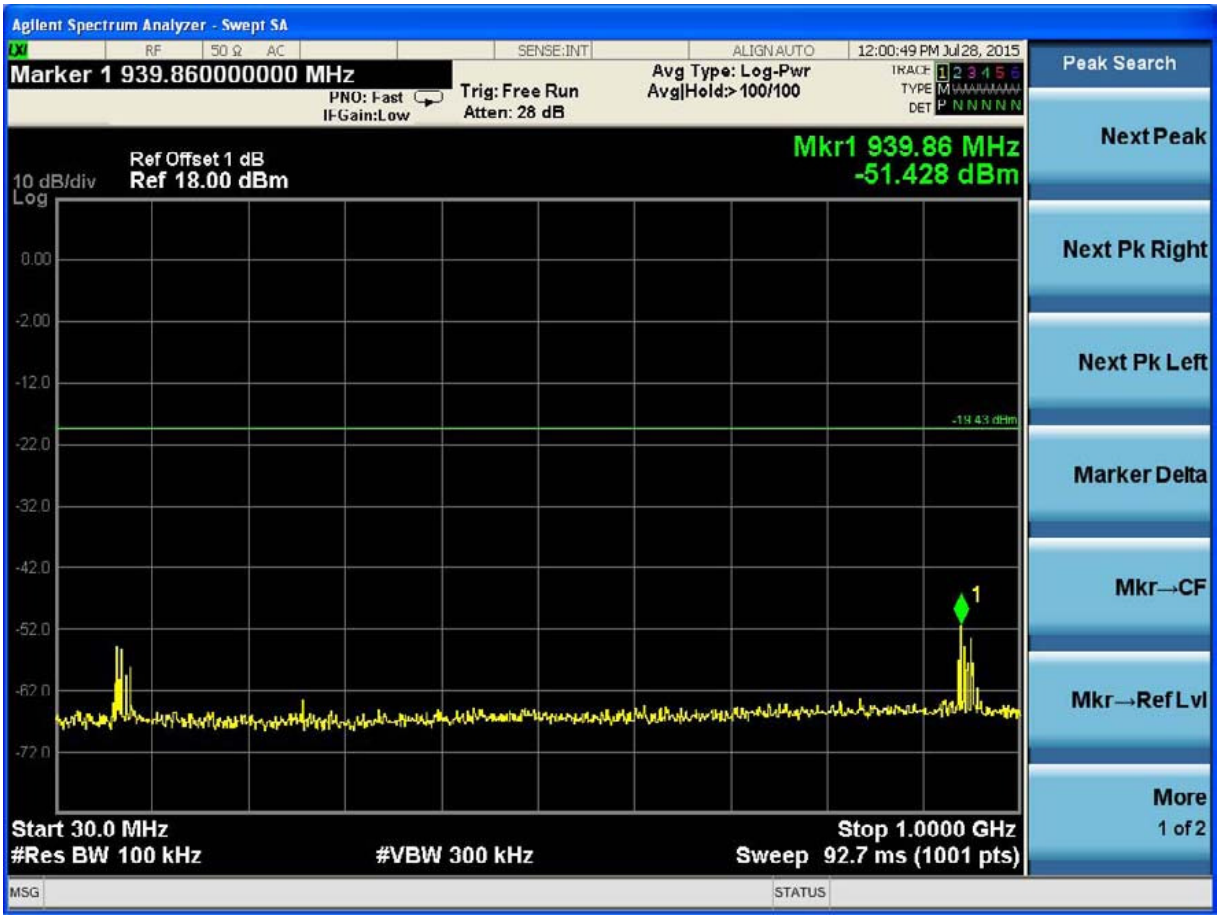
(Plot 4.7.2 A5: Channel 00: 2402MHz @8DPSK)

(Plot 4.7.2 A6: Channel 00: 2402MHz @8DPSK)

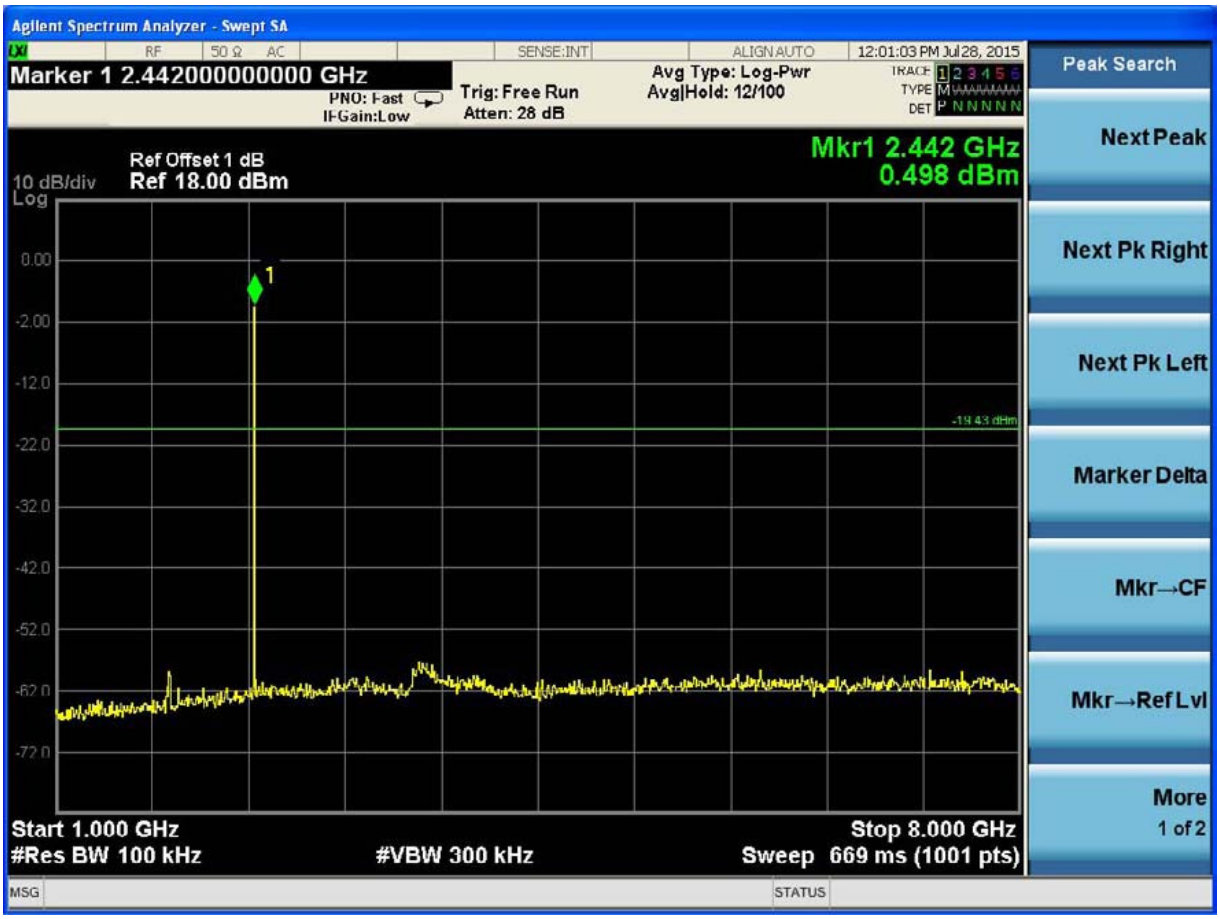
(Plot 4.7.2 B1: Channel 39: 2441MHz @8DPSK)



(Plot 4.7.2 B2: Channel 39: 2441MHz @8DPSK)

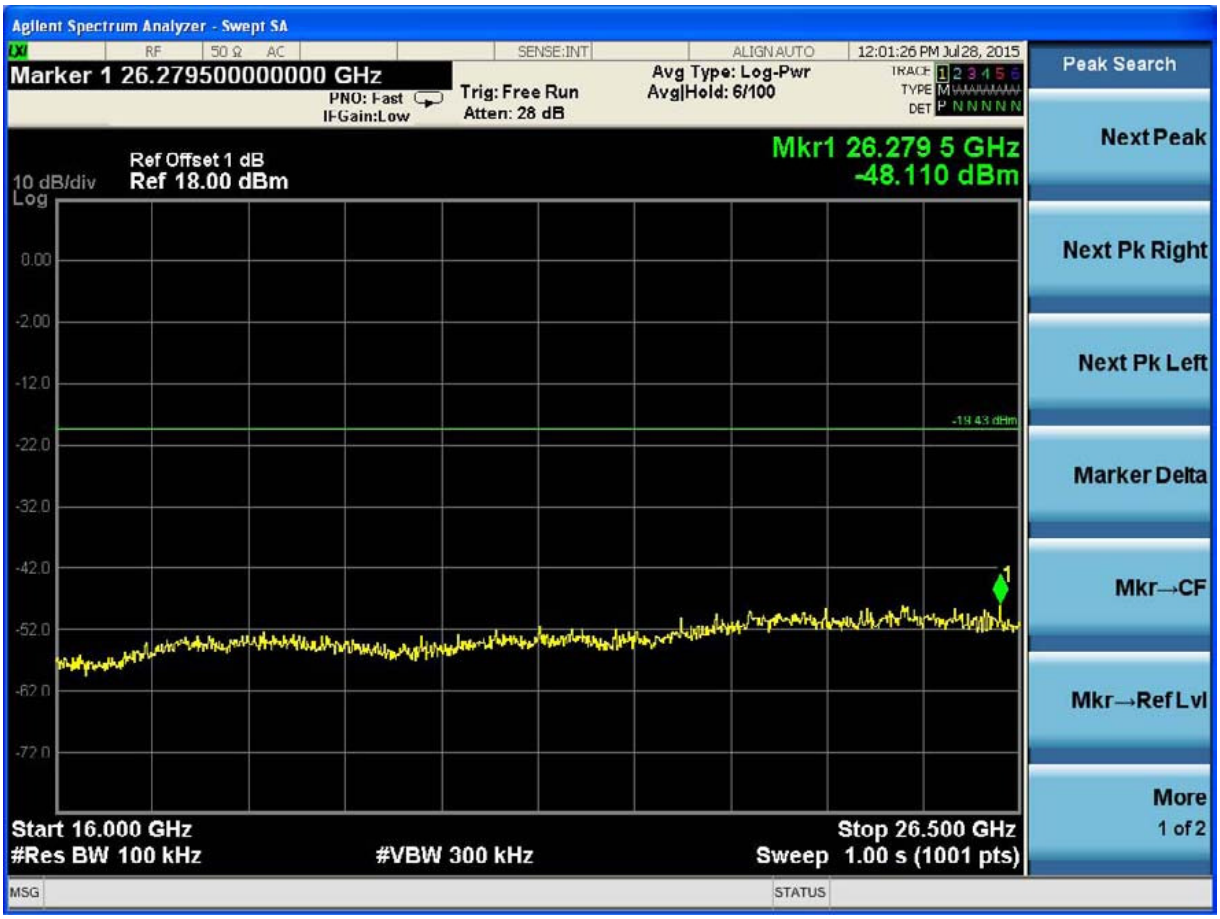


(Plot 4.7.2 B3: Channel 39: 2441MHz @8DPSK)



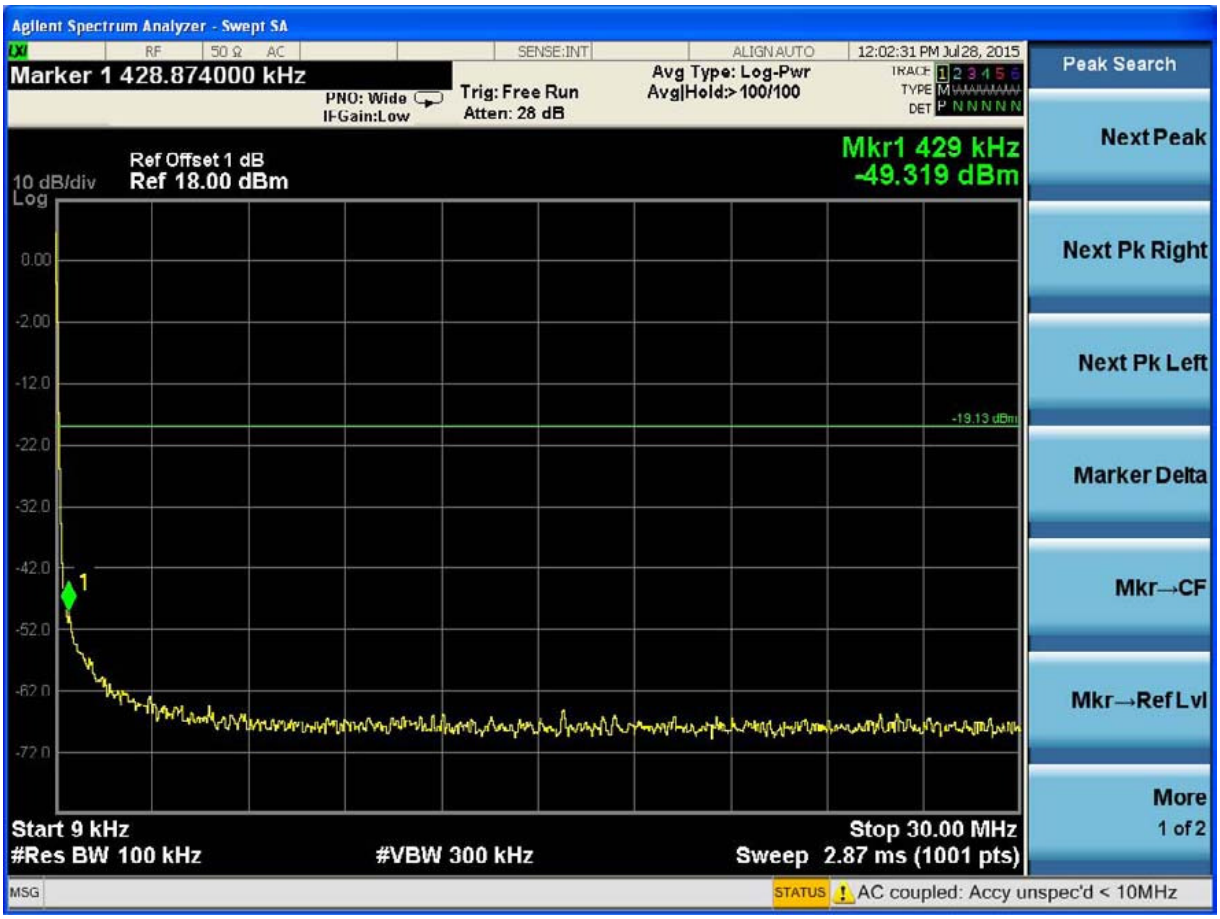
(Plot 4.7.2 B4: Channel 39: 2441MHz @8DPSK)

(Plot 4.7.2 B5: Channel 39: 2441MHz @8DPSK)

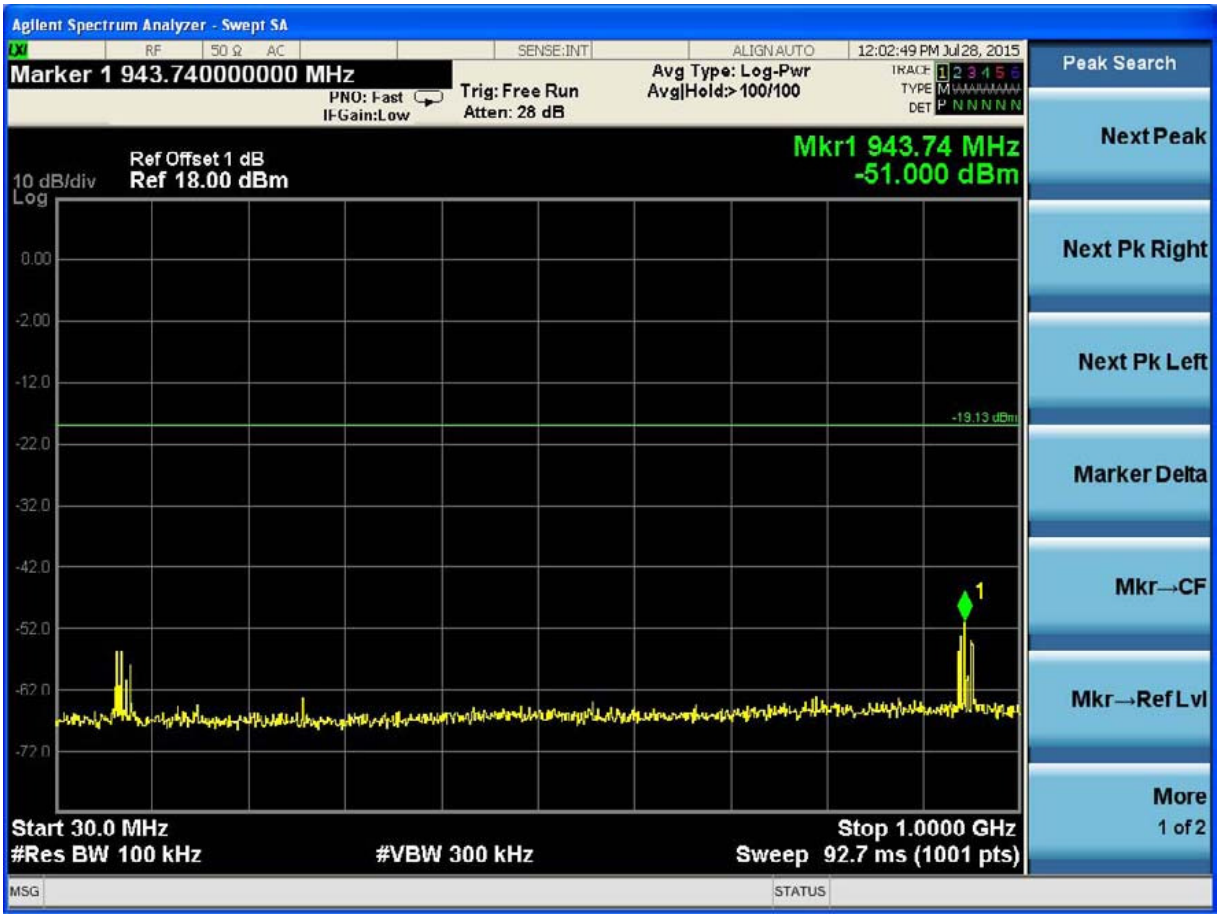


(Plot 4.7.2 B6: Channel 39: 2441MHz @8DPSK)

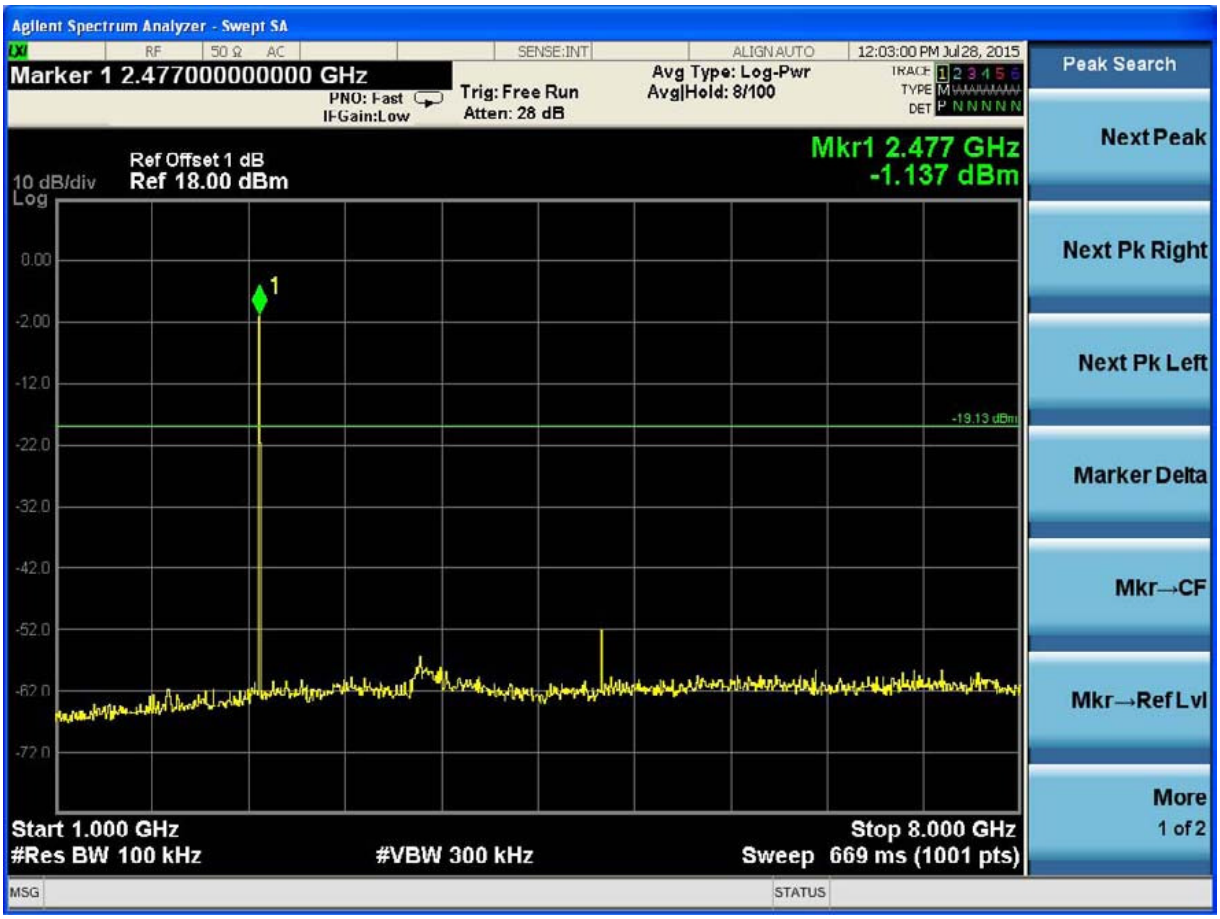
(Plot 4.7.2 C1: Channel 78: 2480MHz @8DPSK)



(Plot 4.7.2 C2: Channel 78: 2480MHz @8DPSK)

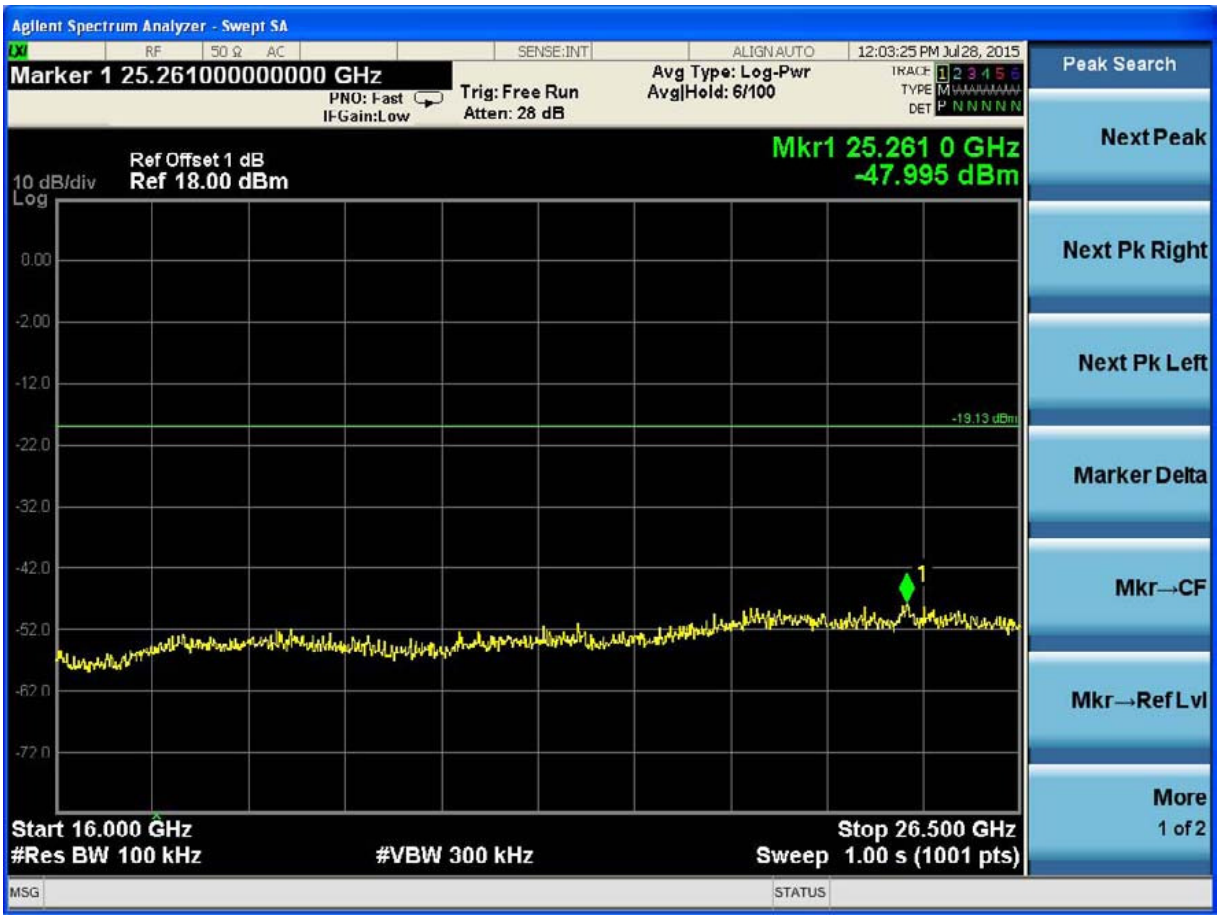


(Plot 4.7.2 C3: Channel 78: 2480MHz @8DPSK)



(Plot 4.7.2 C4: Channel 78: 2480MHz @8DPSK)

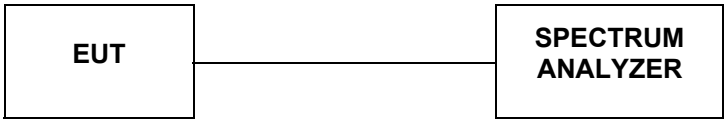
(Plot 4.7.2 C5: Channel 78: 2480MHz @8DPSK)



(Plot 4.7.2 C6: Channel 78: 2480MHz @8DPSK)

4.8. Number of hopping frequency

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator.Set spectrum analyzer start 2400MHz to 2483.5MHz with RBW=30 KHz and VBW=100KHz.

LIMIT

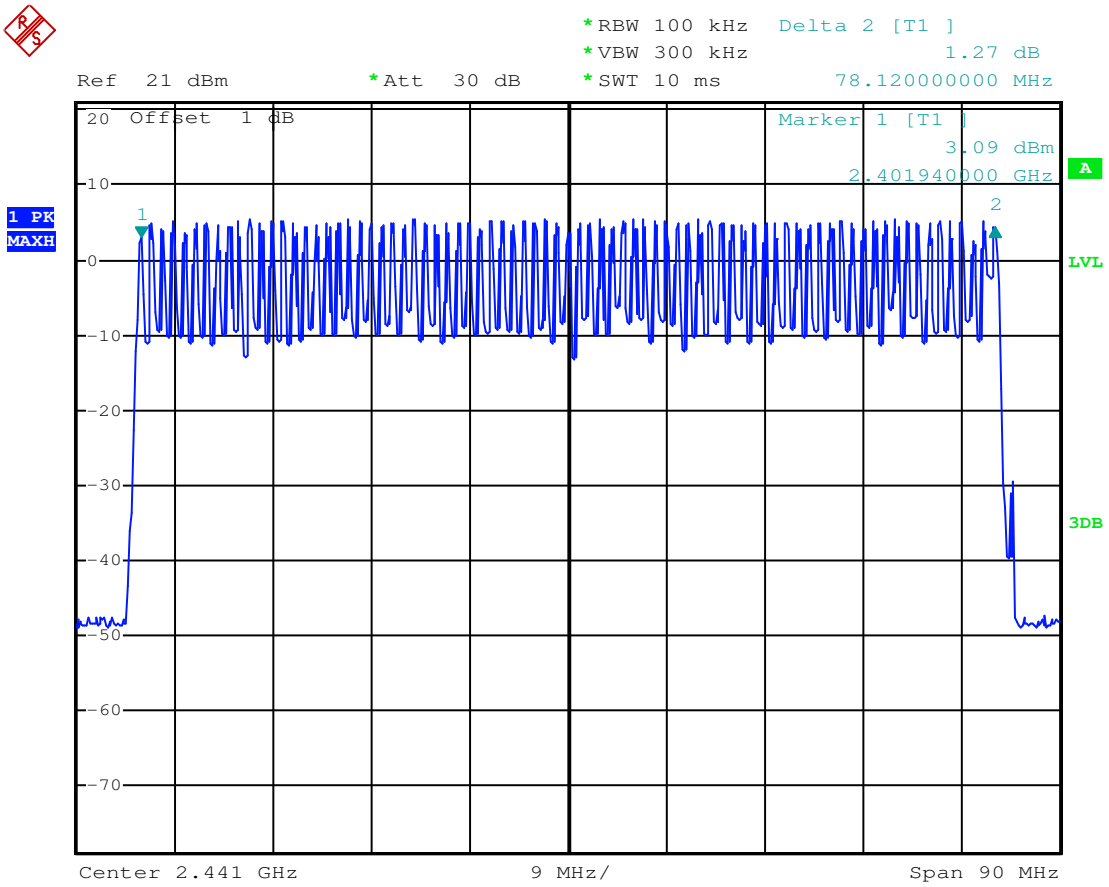
Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

4.8.1 GFSK Test Mode

A. Test Verdict

Hopping Channel Frequency Range (MHz)	Number of Hopping Channel	Refer to Plot	Limit	Verdict
2400-2483.5	79	Plot 4.8.1 A1	≥15	PASS

B. Test Plots



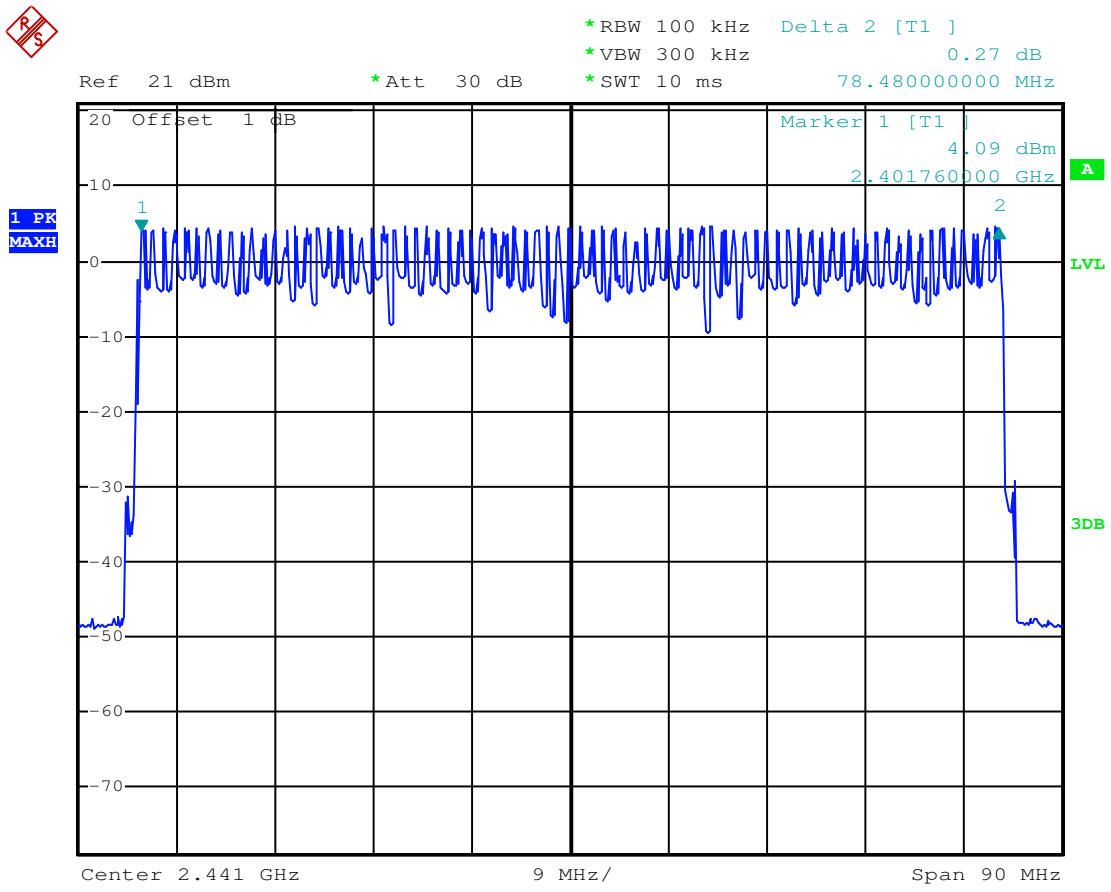
(Plot 4.8.1 A: @ GFSK)

4.8.2 8DPSK Test Mode

A. Test Verdict

Hopping Channel Frequency Range (MHz)	Number of Hopping Channel	Refer to Plot	Limit	Verdict
2400-2483.5	79	Plot 4.8.2 A1	≥15	PASS

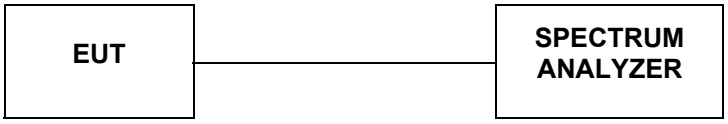
B. Test Plots



(Plot 4.7.2 A1: @ 8DPSK)

4.9. Time Of Occupancy(Dwell Time)

TEST CONFIGURATION



TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with RBW=1MHz and VBW=3MHz,Span=0Hz.

LIMIT

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

TEST RESULTS

The Dwell Time=Burst Width*Total Hops. The detailed calculations are showed as follows:
The duration for dwell time calculation:0.4[s]*hopping number=0.4[s]*79[ch]=31.6[s*ch];
The burst width [ms/hop/ch], which is directly measured, refers to the duration on one channel hop.
The hops per second for all channels: The selected EUT Conf uses a slot type of 5-Tx&1-Rx and a hopping rate of 1600 [ch*hop/s] for all channels. So the final hopping rate for all channels is 1600/6=266.67 [ch*hop/s]
The hops per second on one channel: 266.67 [ch*hops/s]/79 [ch]=3.38 [hop/s];
The total hops for all channels within the dwell time calculation duration: 3.38 [hop/s]*31.6[s*ch]=106.67 [hop*ch];
The dwell time for all channels hopping: 106.67 [hop*ch]*Burst Width [ms/hop/ch].

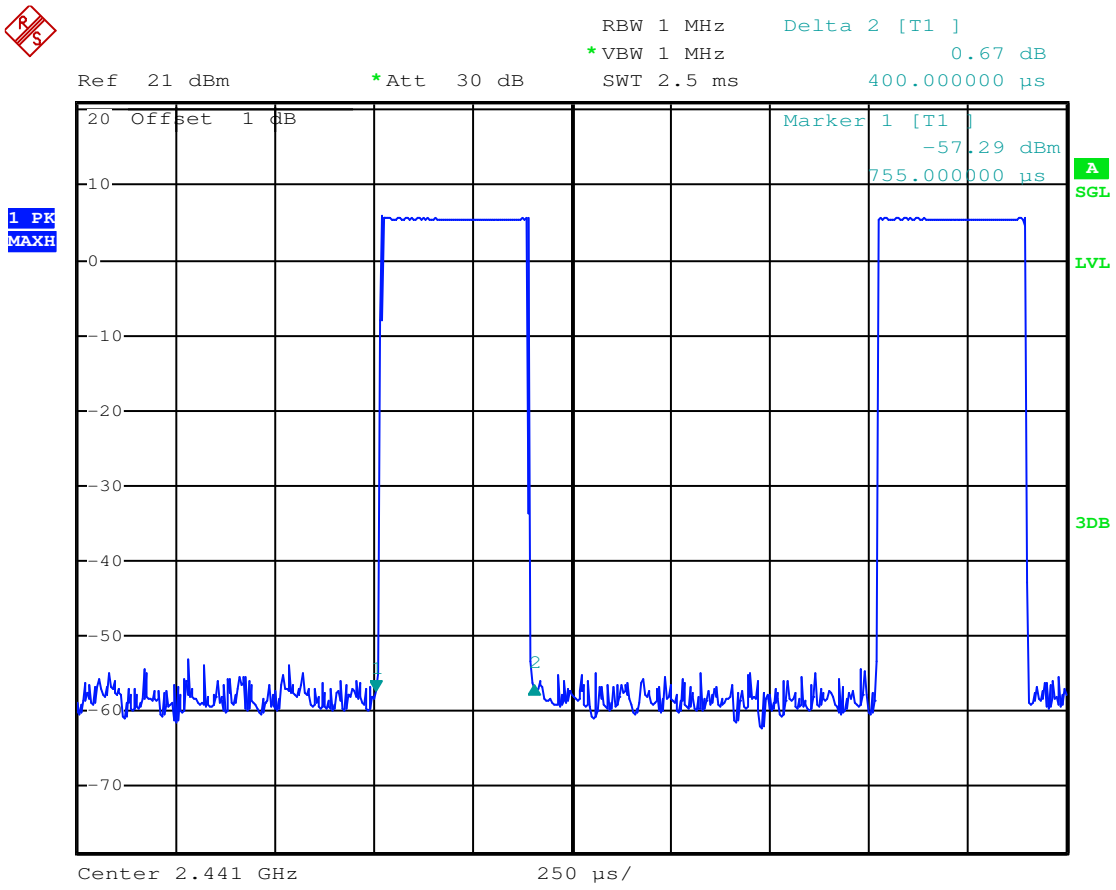
Remark: 1. We test Frequency Separation at all test channels, recorded worst case at middle channel.

4.9.1 GFSK Test Mode

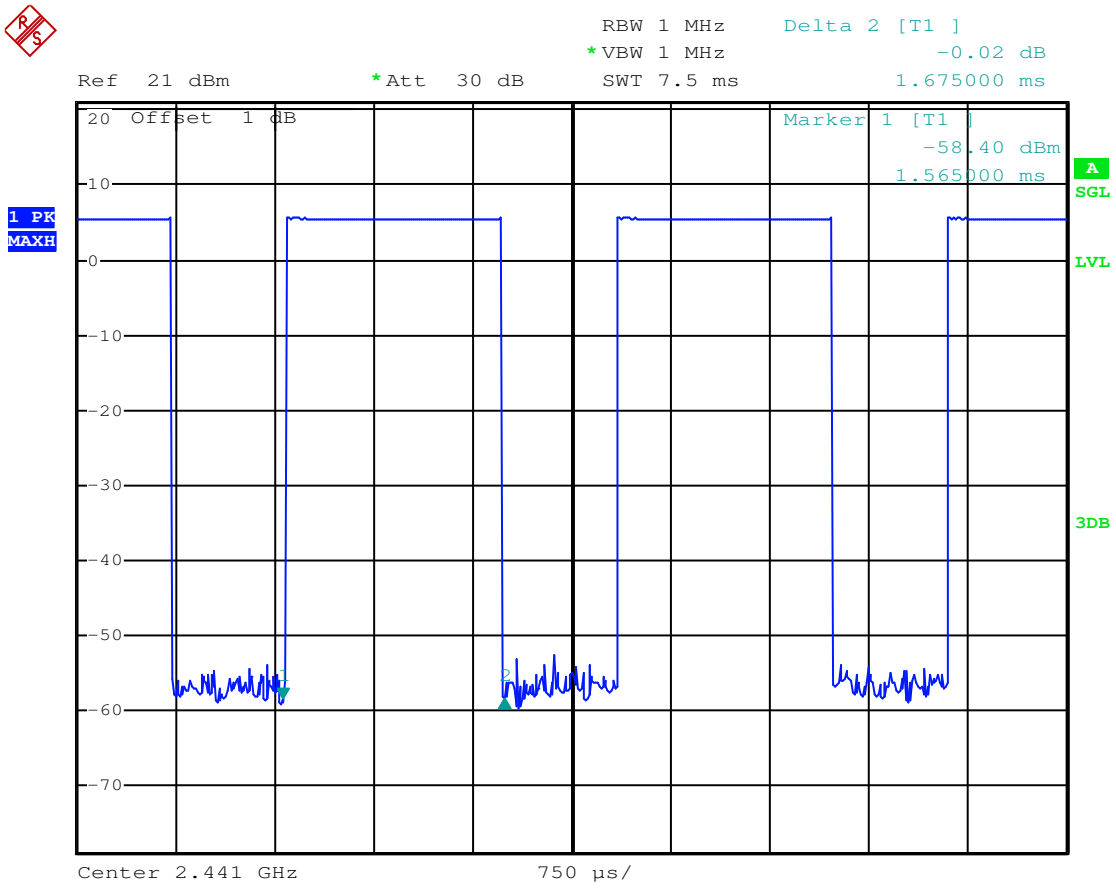
A. Test Verdict

Mode	Frequency (MHz)	Pulse Width (ms)	Dwell Time (S)	Limit (S)	Refer to Plot	Verdict
DH 1	2441	0.4000	0.1280	0.4	Plot 4.9.1 A1	PASS
	Note: Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second					
DH 3	2441	1.6750	0.2680	0.4	Plot 4.9.1 B1	PASS
	Note: Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second					
DH 5	2441	2.9400	0.3136	0.4	Plot 4.9.1 C1	PASS
	Note: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second					

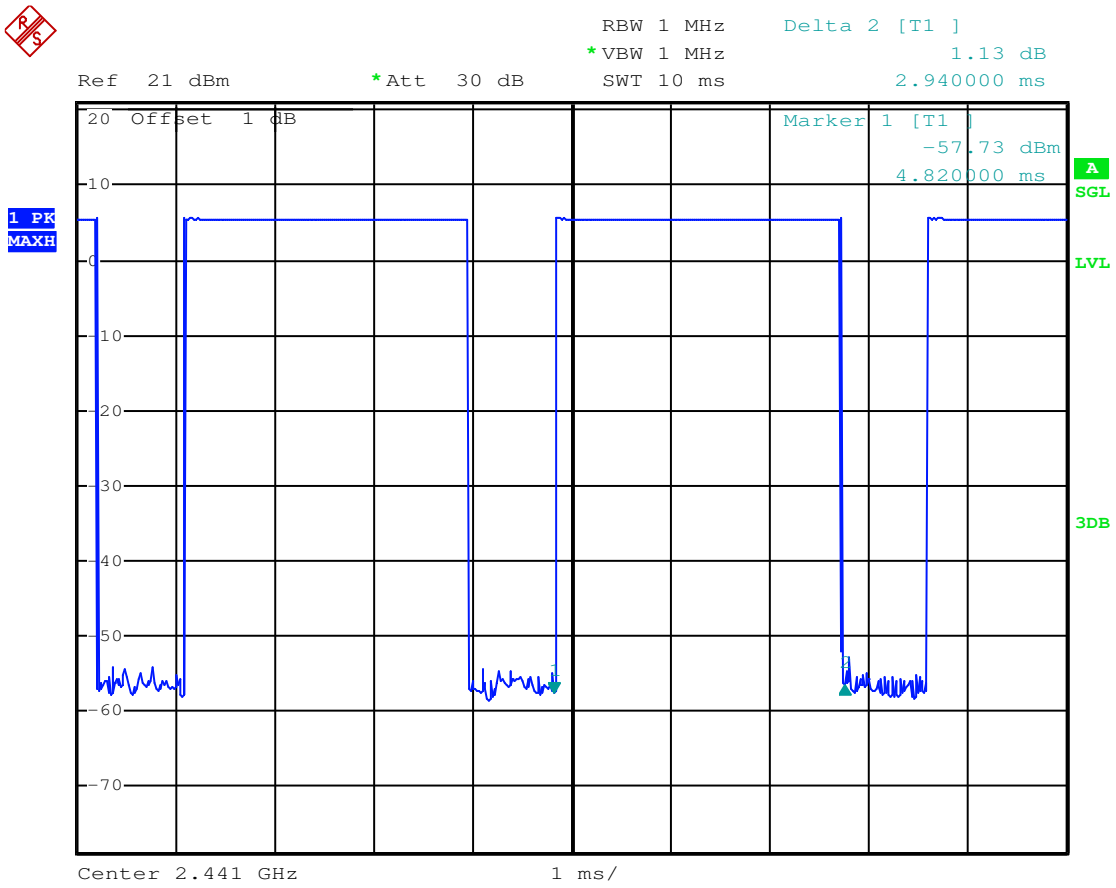
B. Test Plots



(Plot 4.9.1.A1: Channel 39: 2441MHz @ GFSK @ DH1)



(Plot 4.9.1.B1: Channel 39: 2441MHz @ GFSK @ DH3)



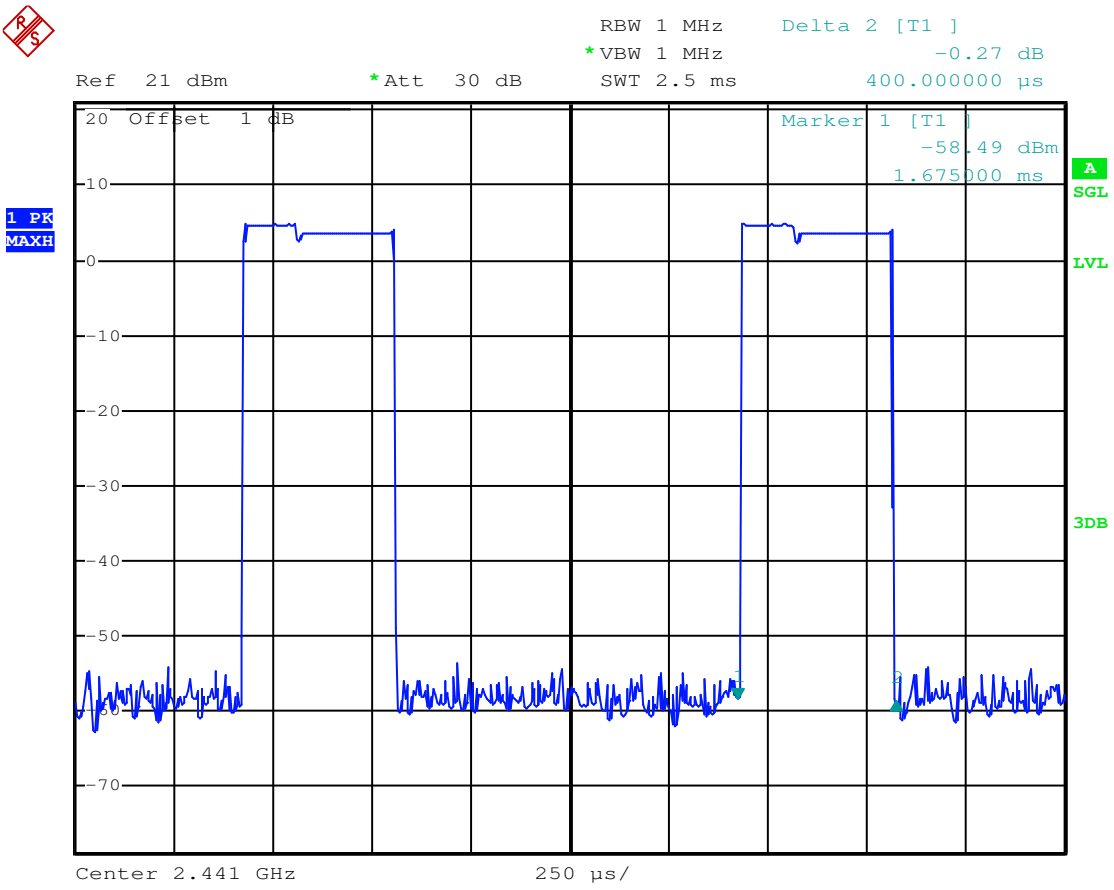
(Plot 4.9.1.C1: Channel 39: 2441MHz @ GFSK @ DH5)

4.8.2 8DPSK Test Mode

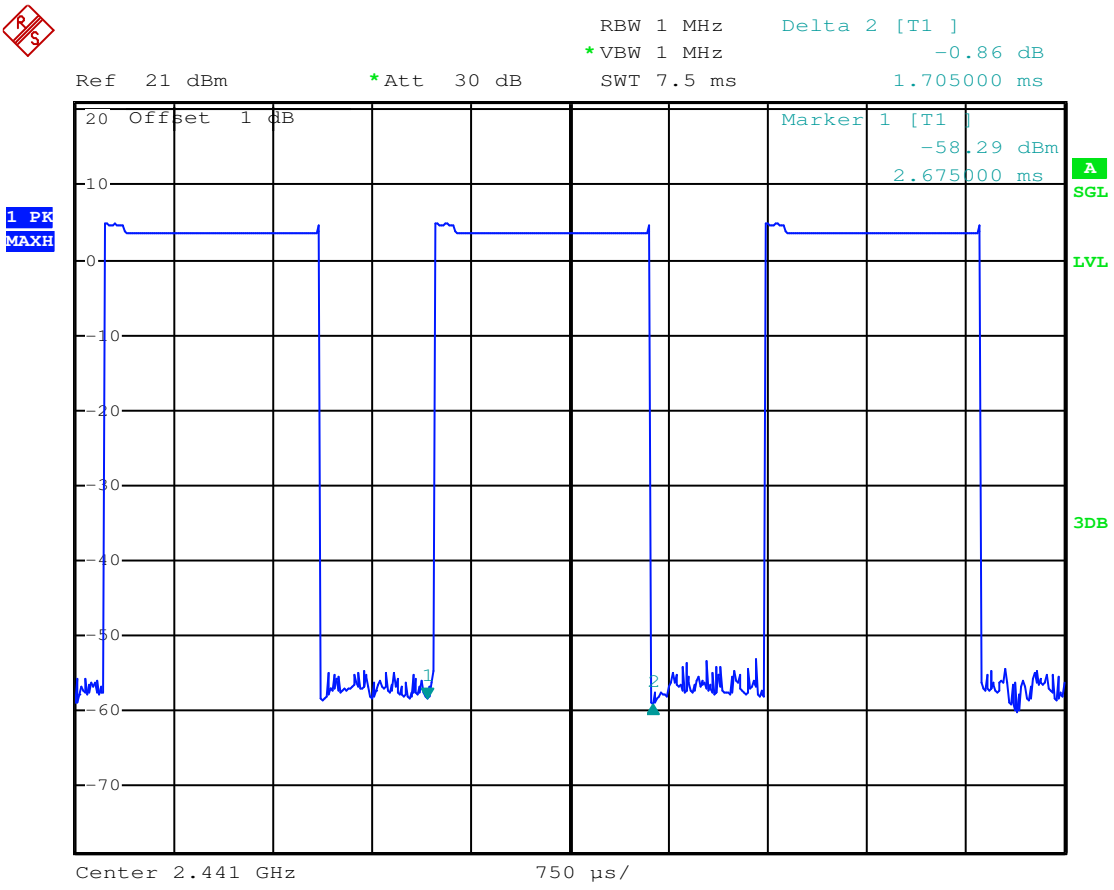
A. Test Verdict

Mode	Frequency (MHz)	Pulse Width (ms)	Dwell Time (S)	Limit (S)	Refer to Plot	Verdict
DH 1	2441	0.4000	0.1280	0.4	Plot 4.9.2 A1	PASS
	Note: Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second					
DH 3	2441	1.7050	0.2728	0.4	Plot 4.9.2 B2	PASS
	Note: Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second					
DH 5	2441	2.9650	0.3163	0.4	Plot 4.9.2 C2	PASS
	Note: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second					

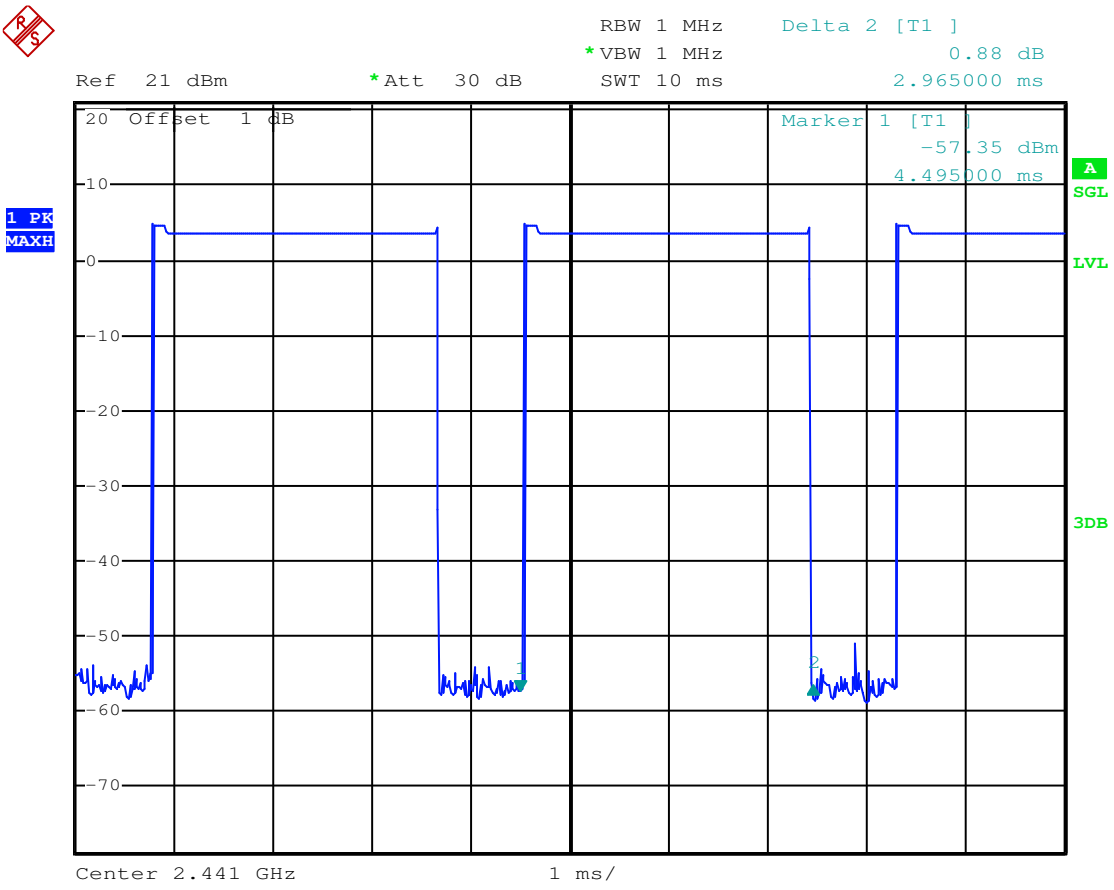
B. Test Plots



(Plot 4.9.2.A1: Channel 39: 2441MHz @ 8DPSK @ DH1)



(Plot 4.9.2.B1: Channel 39: 2441MHz @ 8DPSK @ DH3)



(Plot 4.9.2.C1: Channel 39: 2441MHz @ 8DPSK @ DH5)

4.10. Pseudorandom Frequency Hopping Sequence

TEST APPLICABLE

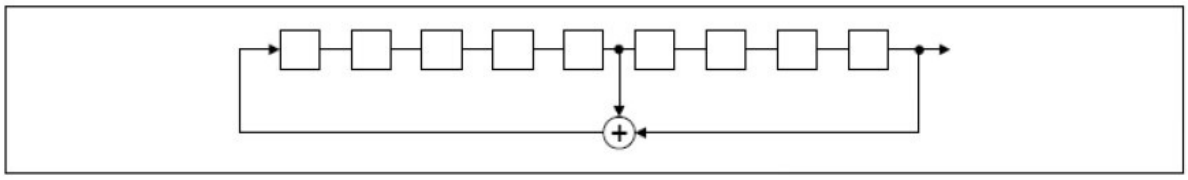
For 47 CFR Part 15C section 15.247 (a)(1) requirement:

Frequency hopping systems shall have hopping channel carrier fre-quencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hop-ping channel, whichever is greater. Al-ternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier fre-quencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to chan-nel frequencies that are selected at the system hopping rate from a pseudo ran-domly ordered list of hopping fre-quencies. Each frequency must be used equally on the average by each trans-mitter. The system receivers shall have input bandwidths that match the hop-ping channel bandwidths of their cor-responding transmitters and shall shift frequencies in synchronization with the transmitted signals.

EUT Pseudorandom Frequency Hopping Sequence Requirement

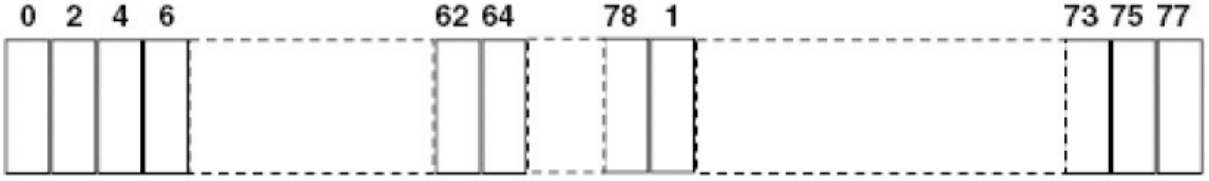
The pseudorandom frequency hopping sequence may be generated in a nice-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage.And the result is fed back to the input of the frist stage.The sequence begins with the frist one of 9 consecutive ones,for example:the shift register is initialized with nine ones.

- Number of shift register stages:9
- Length of pseudo-random sequence:29-1=511 bits
- Longest sequence of zeros:8(non-inverted signal)



Linear Feedback Shift Register for Generation of the PRBS sequence

An explame of pseudorandom frequency hopping sequence as follows:



Each frequency used equally one the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitter and shift frequencies in synchronization with the transmitted signals.

4.11. Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to FCC 47 CFR Section 15.247 (c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Refer to statement below for compliance

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

Measurement

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module.For normal BT devices, the GFSK mode is used.

Measurement parameters

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1MHz
Video bandwidth:	3MHz
Trace-Mode:	Max hold

Limits

FCC	IC
Antenna Gain	
6 dBi	

Results

T_{nom}	V_{nom}	Lowest Channel 2402 MHz	Middle Channel 2440 MHz	Highest Channel 2480 MHz
Conducted power [dBm] Measured with GFSK modulation		4.65	4.79	4.26
Radiated power [dBm] Measured with GFSK modulation		3.01	3.29	3.17
Gain [dBi] Calculated		-1.64	-1.5	-1.09
Measurement uncertainty		± 0.6 dB (cond.) / ± 2.56 dB (rad.)		

.....End of Report.....