FCC Part 15C Test Report

FCC ID:2AITM-IOT3288E

Product Name:	IoT-3288E
Trademark:	N/A
Model Name :	IoT-3288E IoT-3288B, IoT-3288D
Prepared For : **Address :**	Shenzhen Smart Device Technology Co., LTD SSMEC Building, Gao Xin Nan First Avenue Hi-Tech Park South, Nanshan, Shenzhen, China
Prepared By : **Address :**	Shenzhen BCTC Testing Co., Ltd. BCTC Building & 1-2F, East of B Building, Pengzhou Industrial, Fuyuan 1st Road, Qiaotou Community, Fuyong Street, Bao'an District, Shenzhen, China
Test Date:	Jun. 28, 2018 - Jul. 09, 2018
Date of Report :	Jul. 09, 2018
Report No.:	BCTC-LH180601548-2E

TEST RESULT CERTIFICATION

Applicant's name ..... :	Shenzhen Smart Device Technology Co., LTD
Address ..... :	SSMEC Building,Gao Xin Nan First Avenue Hi-Tech Park South, Nanshan,Shenzhen, China
Manufacture's Name..... :	Shenzhen Smart Device Technology Co., LTD
Address ..... :	SSMEC Building,Gao Xin Nan First Avenue Hi-Tech Park South, Nanshan,Shenzhen, China
Product description	
Product name ..... :	IoT-3288E
Trademark ..... :	N/A
Model and/or type reference ..... :	IoT-3288E IoT-3288B, IoT-3288D
Standards ..... :	FCC Part15.247 ANSI C63.10:2013

This device described above has been tested by BCTC, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.
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Prepared by(Engineer):	Lake Xie	Lake Xie
Reviewer(Supervisor):	Rita Xiao	Rita Xiao
Approved(Manager):	Carson Zhang	Carson Zhang

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(Note: N/A means not applicable)

1. TEST SUMMARY

Test procedures according to the technical standards:

FCC Part15 (15.247) , Subpart C			
Standard Section	Test Item	Judgment	Remark
15.205(a) 15.209 15.247(d)	Radiated Spurious Emissions	PASS	
15.247(d)	Conducted Spurious emissions	PASS	
15.247(d) 15.205(a)	Band edge	PASS	
15.207	Conducted Emission	PASS	
15.247(a)	20dB Bandwidth	PASS	
15.247(b)	Maximum Peak Output Power	PASS	
15.247(a)	Frequency Separation	PASS	
15.247(a)	Number of Hopping Frequency	PASS	
15.247(a)	Dwell time	PASS	
15.203	Antenna Requirement	PASS	
Note: (1)" N/A" denotes test is not applicable in this Test Report			

2. TEST FACILITY

Shenzhen BCTC Testing Co., Ltd.
Add. : BCTC Building & 1-2F, East of B Building, Pengzhou Industrial, Fuyuan 1st Road, Qiaotou Community, Fuyong Street, Bao'an District, Shenzhen, China
Test Firm Registration Number: 712850
IC Registered No.: 23583

3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ± U，where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2，providing a level of confidence of approximately 95 %。

No.	Item	Uncertainty
1	Conducted Emission Test	±1.38dB
2	RF power,conducted	±0.16dB
3	Spurious emissions,conducted	±0.21dB
4	All emissions,radiated(<1G)	±4.68dB
5	All emissions,radiated(>1G)	±4.89dB
6	Temperature	±0.5°C
7	Humidity	±2%

4. GENERAL INFORMATION

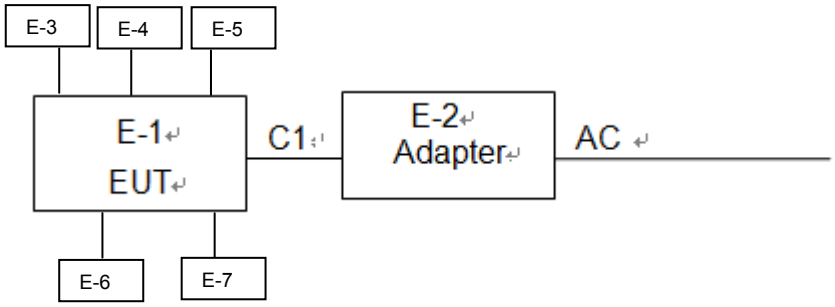
4.1 GENERAL DESCRIPTION OF EUT

Equipment	IoT-3288E
Trade Name	N/A
Model Name	IoT-3288E
Serial Model	IoT-3288B, IoT-3288D
Model Difference	All the model are the same circuit and RF module,except the model names.
Product Description	The EUT is a IoT-3288E Operation Frequency: 2402-2480 MHz Modulation Type: GFSK, Pi/4DQPSK, 8DPSK Number Of Channel 79CH Antenna Designation: External Antenna , 2 dBi Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User's Manual.
Channel List	Please refer to the Note 2.
Ratings	DC 12V,3A
Adapter	N/A
Connecting I/O Port(s)	Please refer to the User's Manual
Hardware Version:	N/A
Software Version:	N/A

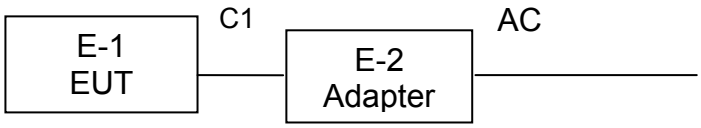
4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP Photographs for the actual

Conducted Emission Test



Radiated Spurious Emission



4.3 Support Equipment

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	IoT-3288E	N/A	IoT-3288E	N/A	EUT
E-2	SWITCHING POWER SUPPLY	N/A	BSYF120200C W	N/A	Peripherals
E-3	Earphone	N/A	2688	N/A	Peripherals
E-4	LED Light	N/A	1547	N/A	Peripherals
E-5	ANT	N/A	ANT01	N/A	Peripherals
E-6	LCD Display	AOC	002	N/A	Peripherals
E-7	SD	N/A	8GB	N/A	Peripherals

Item	Shielded Type	Ferrite Core	Length	Note
C-1	NO	NO	1.0M	DC cable unshielded

Note:
(1) The support equipment was authorized by Declaration of Confirmation.
(2) For detachable type I/O cable should be specified the length in cm in『Length』column.

4.4 Channel List

CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)
0	2402	1	2403	2	2404	3	2405
4	2406	5	2407	6	2408	7	2409
8	2410	9	2411	10	2412	11	2413
12	2414	13	2415	14	2416	15	2417
16	2418	17	2419	18	2420	19	2421
20	2422	21	2423	22	2424	23	2425
24	2426	25	2427	26	2428	27	2429
28	2430	29	2431	30	2432	31	2433
32	2434	33	2435	34	2436	35	2437
36	2438	37	2439	38	2440	39	2441

CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)
40	2442	41	2443	42	2444	43	2445
44	2446	45	2447	46	2448	47	2449
48	2450	49	2451	50	2452	51	2453
52	2454	53	2455	54	2456	55	2457
56	2458	57	2459	58	2460	59	2461
60	2462	61	2463	62	2464	63	2465
64	2466	65	2467	66	2468	67	2469
68	2470	69	2471	70	2472	71	2473
72	2474	73	2475	74	2476	75	2477
76	2478	77	2479	78	2480	79	/

4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

The EUT is Continue Transmitting.

The software is installed in operation system, named “RFTestTool.apk” ,Version 1.0.

Test Mode	Test mode	Low channel	Middle channel	High channel
1	Transmitting(GFSK)	2402MHz	2441MHz	2480MHz
2	Transmitting(Pi/4DQPSK)	2402MHz	2441MHz	2480MHz
3	Transmitting(8DPSK)	2402MHz	2441MHz	2480MHz
4	Transmitting (conducted emission and Radiated emission)			

5. TEST FACILITY AND TEST INSTRUMENT USED

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at BCTC Building & 1-2F, East of B Building, Pengzhou Industrial, Fuyuan 1st Road, Qiaotou Community, Fuyong Street, Bao'an District, Shenzhen, China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

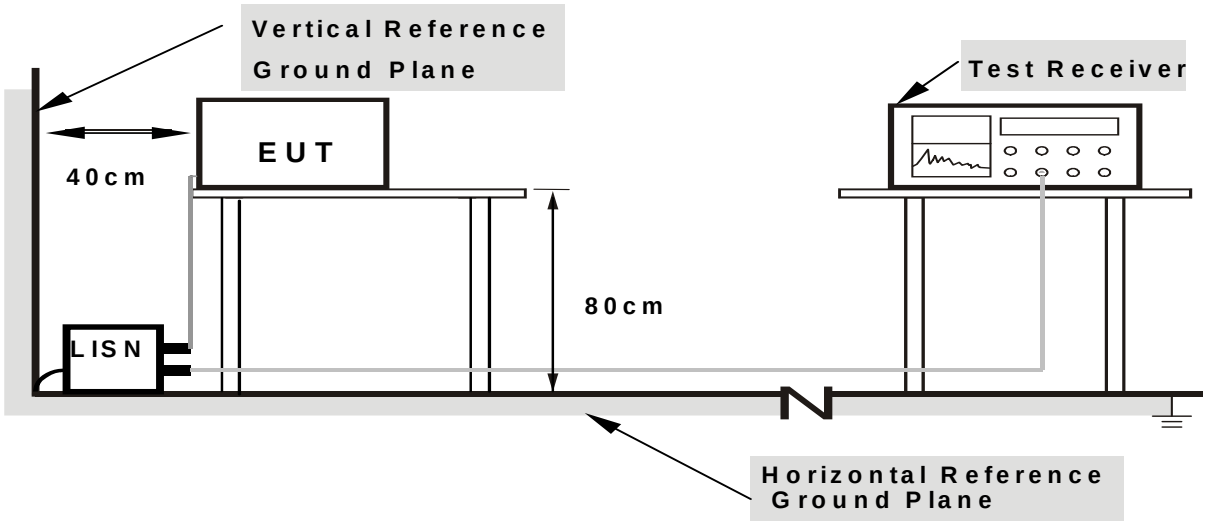
5.2 Test Instrument Used

Radiation Test						
Item	Equipment	Manufacturer	Type No.	Serial No.	Cal.Date	Cal.Due date
1	Spectrum Analyzer (9kHz-26.5GHz)	Agilent	E4407B	MY45108040	Aug. 27, 2017	Aug.26, 2018
2	Test Receiver (9kHz-7GHz)	R&S	ESPI	101318	Aug. 27, 2017	Aug.26, 2018
3	Bilog Antenna (30MHz-1GHz)	R&S	VULB 9168	VULB91 68-438	Aug. 27, 2017	Aug.26, 2018
4	Horn Antenna (1GHz-18GHz)	SCHWARZBECK	BBHA9120D	1201	Sep.03, 2017	Sep.02,2018
5	Horn Antenna (14GHz-40GHz)	SCHWARZBECK	BBHA 9170	9170-181	Sep.03, 2017	Sep.02,2018
6	Amplifier (9KHz-6GHz)	SCHWARZBECK	BBV9744	9744-0037	Aug. 27, 2017	Aug.26, 2018
7	Amplifier (1GHz-18GHz)	SCHWARZBECK	BBV9718	9718-309	Aug. 27, 2017	Aug.26, 2018
8	Amplifier (18GHz-40GHz)	SCHWARZBECK	BBV 9721	9721-205	Aug. 27, 2017	Aug.26, 2018
9	Loop Antenna (9KHz-30MHz)	SCHWARZBECK	FMZB1519B	00014	Sep.03, 2017	Sep.02,2018
10	RF cables1 (9kHz-1GHz)	R&S	R203	R20X	Aug. 27, 2017	Aug.26, 2018
11	RF cables2 (1GHz-40GHz)	R&S	R204	R21X	Aug. 27, 2017	Aug.26, 2018
12	Antenna connector	Florida RF Labs	N/A	RF 01#	Aug. 27, 2017	Aug.26, 2018
13	Power Metter	ANRITSU	ML2487A	6K00001568	Aug. 27, 2017	Aug.26, 2018
14	Power Sensor (AV)	ANRITSU	ML2491A	030989	Aug. 27, 2017	Aug.26, 2018
15	Signal Analyzer 9kHz-26.5GHz	Agilent	N9010A	MY48030494	Aug. 27, 2017	Aug.26, 2018
16	Test Receiver 20kHz-40GHz	R&S	ESU 40	100376	Aug. 27, 2017	Aug.26, 2018
17	D.C. Power Supply	LongWei	PS-305D	010964729	Aug. 27, 2017	Aug.26, 2018

Conduction Test						
Item	Equipment	Manufacturer	Type No.	Serial No.	Cal.Date	Cal.Due date
1	Test Receiver	R&S	ESCI	1166.5950K03-101165-ha	Aug. 27, 2017	Aug.26, 2018
2	LISN	SCHWARZBECK	NSLK8127	8127739	Aug. 27, 2017	Aug.26, 2018
3	LISN	R&S	NSLK8126	8126487	Aug. 27, 2017	Aug.26, 2018
4	RF cables	R&S	R204	R20X	Sep.03, 2017	Sep.02,2018
5	Attenuator	R&S	ESH3-Z2	143206	Sep.03, 2017	Sep.02,2018

6. CONDUCTED EMISSIONS

6.1 Block Diagram Of Test Setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

6.2 Limit

FREQUENCY (MHz)	Limit (dBuV)		Standard
	Quasi-peak	Average	
0.15 -0.5	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	56.00	46.00	FCC
5.0 -30.0	60.00	50.00	FCC

6.3 Test procedure

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

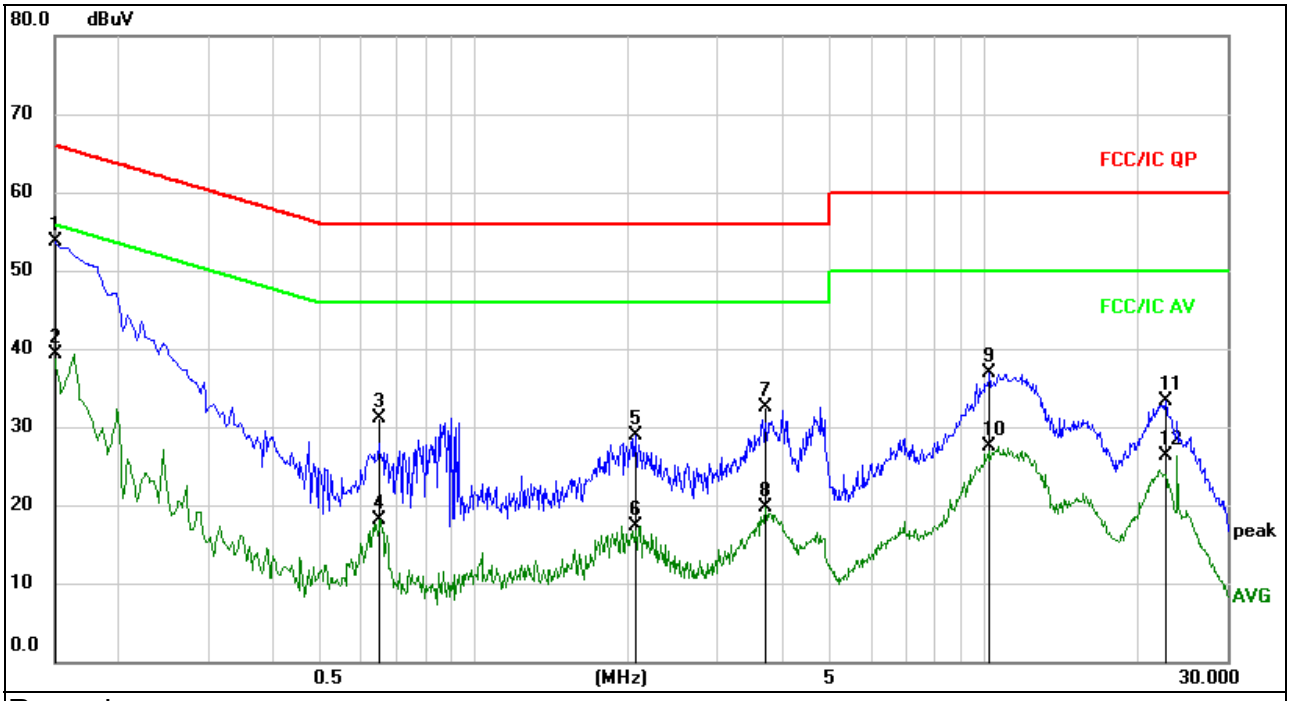
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

d. LISN at least 80 cm from nearest part of EUT chassis.

e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

6.4 Test Result

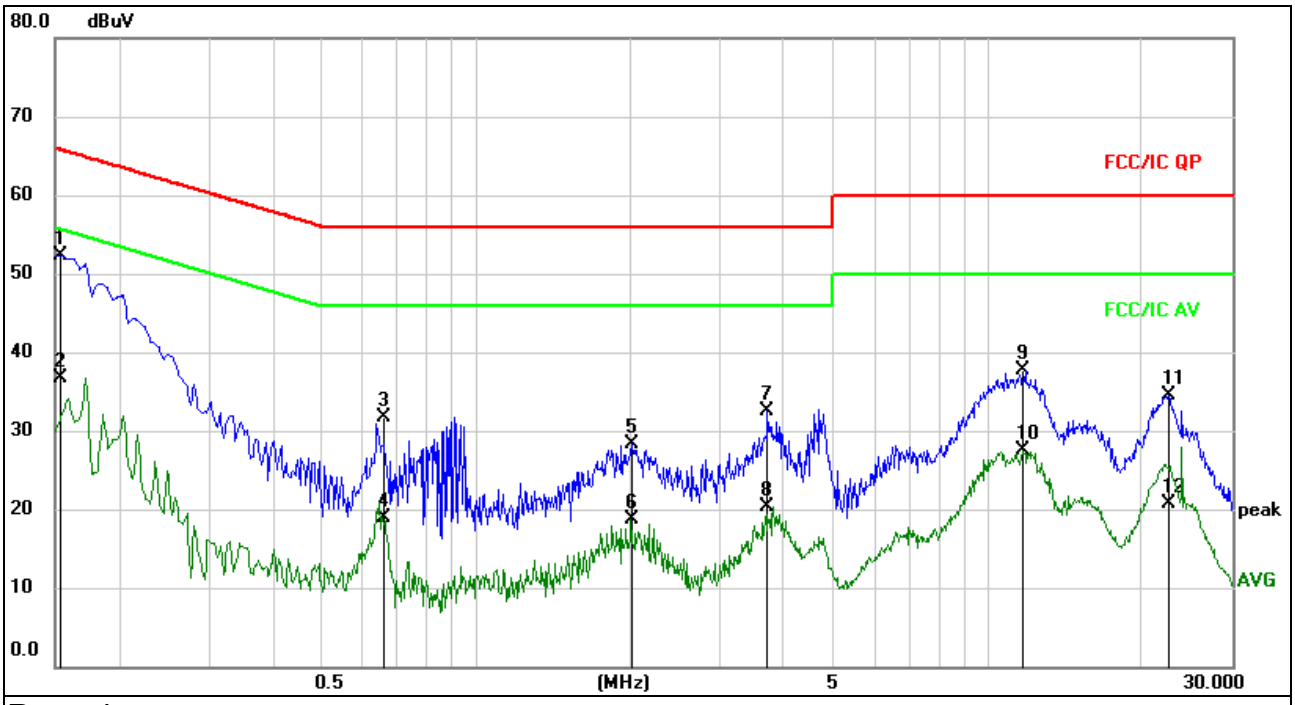
Temperature：	24 ℃	Relative Humidity：	54%
Pressure：	101kPa	Phase：	L
Test Voltage ：	AC 120V/60Hz	Test Mode：	Mode 4



Remark:
1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1500	43.90	9.77	53.67	66.00	-12.33	QP	
2		0.1500	29.60	9.77	39.37	56.00	-16.63	AVG	
3		0.6540	21.09	10.01	31.10	56.00	-24.90	QP	
4		0.6540	8.16	10.01	18.17	46.00	-27.83	AVG	
5		2.0715	19.19	9.79	28.98	56.00	-27.02	QP	
6		2.0715	7.51	9.79	17.30	46.00	-28.70	AVG	
7		3.7275	22.68	9.85	32.53	56.00	-23.47	QP	
8		3.7275	9.78	9.85	19.63	46.00	-26.37	AVG	
9		10.2390	27.01	9.90	36.91	60.00	-23.09	QP	
10		10.2390	17.58	9.90	27.48	50.00	-22.52	AVG	
11		22.7400	23.10	10.11	33.21	60.00	-26.79	QP	
12		22.7400	16.27	10.11	26.38	50.00	-23.62	AVG	

Temperature：	24 ℃	Relative Humidity：	54%
Pressure：	101kPa	Phase：	N
Test Voltage ：	AC 120V/60Hz	Test Mode：	Mode 4



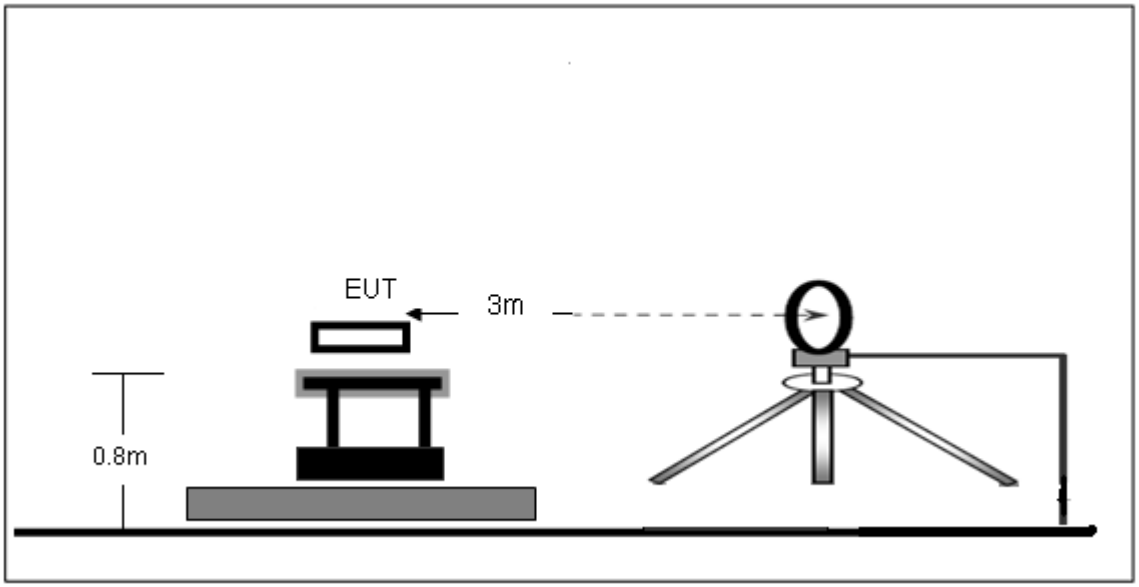
Remark:
1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1545	42.57	9.77	52.34	65.75	-13.41	QP	
2		0.1545	27.03	9.77	36.80	55.75	-18.95	AVG	
3		0.6543	21.61	10.01	31.62	56.00	-24.38	QP	
4		0.6543	8.88	10.01	18.89	46.00	-27.11	AVG	
5		2.0085	18.43	9.79	28.22	56.00	-27.78	QP	
6		2.0085	8.83	9.79	18.62	46.00	-27.38	AVG	
7		3.7140	22.56	9.85	32.41	56.00	-23.59	QP	
8		3.7140	10.54	9.85	20.39	46.00	-25.61	AVG	
9		11.7015	27.77	9.93	37.70	60.00	-22.30	QP	
10		11.7015	17.52	9.93	27.45	50.00	-22.55	AVG	
11		22.5600	24.45	10.11	34.56	60.00	-25.44	QP	
12		22.5600	10.57	10.11	20.68	50.00	-29.32	AVG	

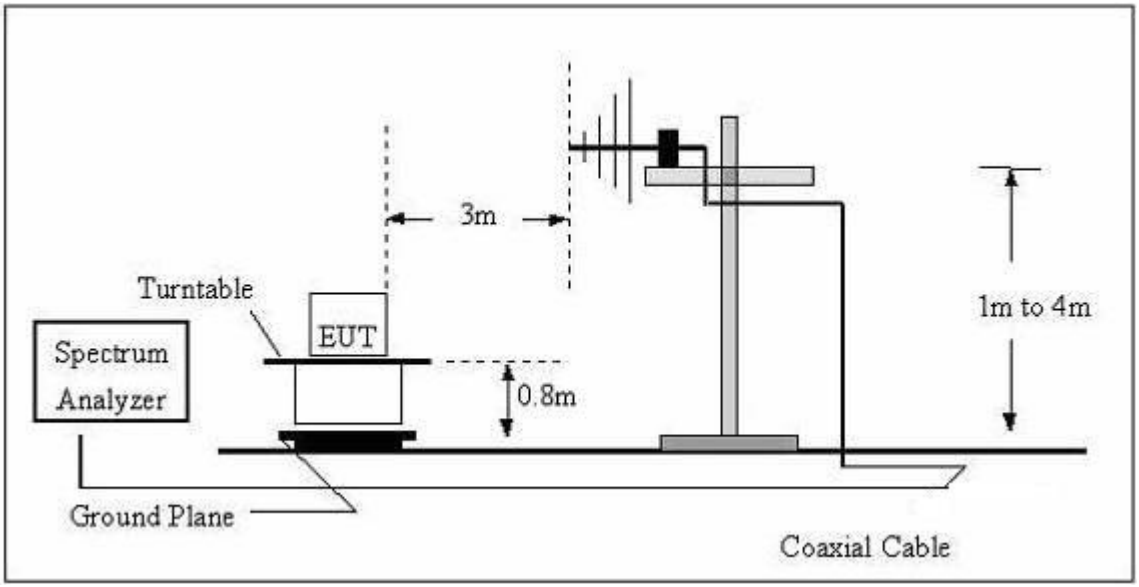
7. RADIATED EMISSIONS

7.1 Block Diagram Of Test Setup

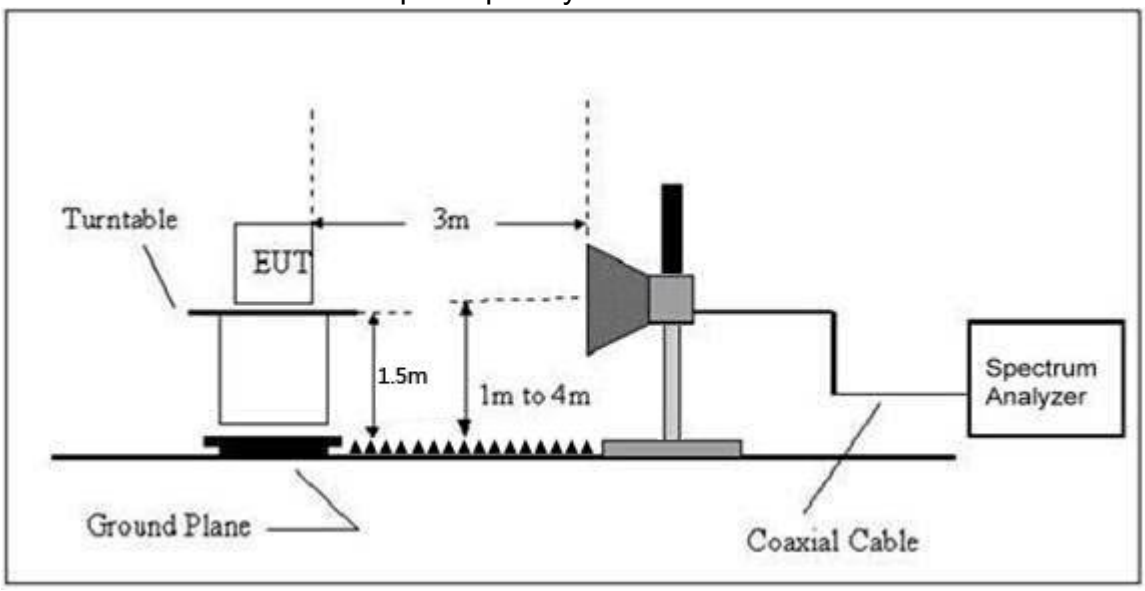
（A）Radiated Emission Test-Up Frequency Below 30MHz



（B）Radiated Emission Test-Up Frequency 30MHz~1GHz



（C）Radiated Emission Test-Up Frequency Above 1GHz



7.2 Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency	Field Strength	Distance	Field Strength Limit at 3m Distance	
(MHz)	uV/m	(m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))}$ + 80
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))}$ + 40
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)}$ + 40
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

7.3 Test procedure

Receiver Parameter	Setting
Attenuation	Auto
9kHz~150kHz	RBW 200Hz for QP
150kHz~30MHz	RBW 9kHz for QP
30MHz~1000MHz	RBW 120kHz for QP

Spectrum Parameter	Setting
1-25GHz	RBW 1 MHz /VBW 1 MHz for Peak, RBW 1 MHz / VBW 10Hz for Average

Below 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Above 1GHz test procedure as below:

g. Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 metre to 1.5 metre(Above 18GHz the distance is 1 meter and table is 1.5 metre).

h. Test the EUT in the lowest channel ,the middle channel ,the Highest channel.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

7.4 Test Result

Below 30MHz

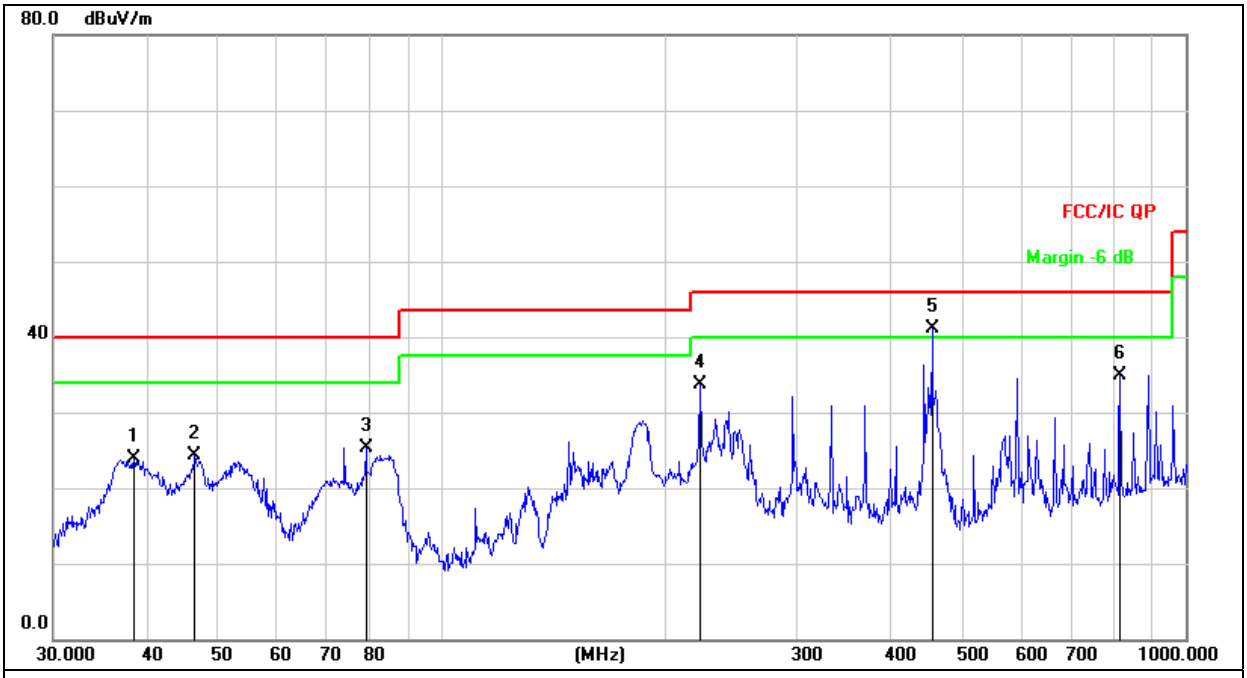
Temperature：	24℃	Relative Humidtity：	54%
Pressure：	101 kPa	Test Voltage ：	AC 120V/60Hz
Test Mode ：	Mode 4	Polarization :	--

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	PASS
--	--	--	--	PASS

Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits(dBuv) + distance extrapolation factor.

Between 30MHz – 1GHz

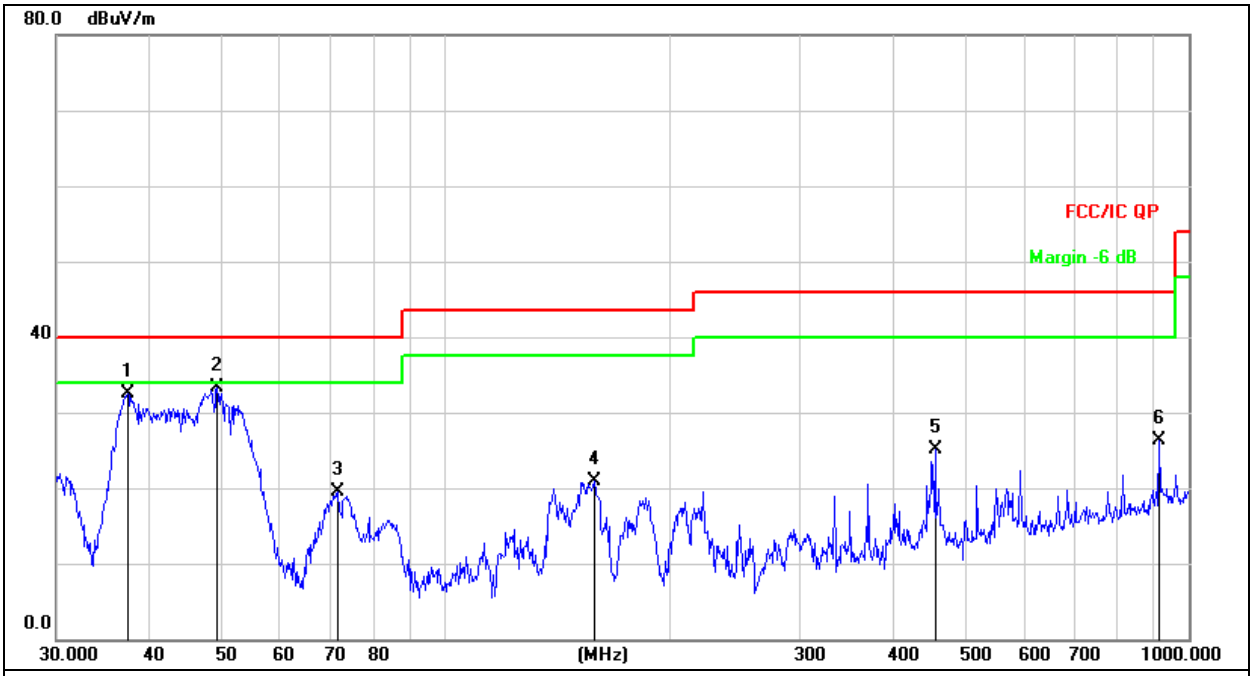
Temperature：	24℃	Relative Humidtity：	54%
Pressure：	101kPa	Test Voltage ：	AC 120V/60Hz
Test Mode ：	Mode 4	Polarization :	Horizontal



Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		38.4809	39.15	-15.26	23.89	40.00	-16.11	QP			
2		46.5030	38.36	-14.01	24.35	40.00	-15.65	QP			
3		78.9652	44.66	-19.41	25.25	40.00	-14.75	QP			
4		222.1698	49.90	-16.16	33.74	46.00	-12.26	QP			
5	*	455.9058	51.64	-10.59	41.05	46.00	-4.95	QP			
6		815.9678	38.92	-4.07	34.85	46.00	-11.15	QP			

Temperature：	26℃	Relative Humidtity：	54%
Pressure：	101kPa	Test Voltage ：	AC 120V/60Hz
Test Mode ：	Mode 4	Polarization :	Vertical



Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector	cm	degree	Comment
1		37.4165	48.19	-15.64	32.55	40.00	-7.45	QP			
2	*	49.3594	47.21	-13.96	33.25	40.00	-6.75	QP			
3		71.8320	37.50	-17.96	19.54	40.00	-20.46	QP			
4		158.6677	40.03	-19.06	20.97	43.50	-22.53	QP			
5		455.9058	35.70	-10.59	25.11	46.00	-20.89	QP			
6		912.8620	28.53	-2.28	26.25	46.00	-19.75	QP			

Between 1-25GHz

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
GFSK Low Channel:2402MHz									
V	4804.00	67.63	39.55	7.85	25.66	61.59	74.00	-12.41	PK
V	4804.00	47.37	39.55	7.85	25.66	41.33	54.00	-12.67	AV
V	7206.00	68.98	38.33	7.52	24.55	62.72	74.00	-11.28	PK
V	7206.00	49.13	38.33	7.52	24.55	42.87	54.00	-11.13	AV
V	15450.00	48.01	35.23	6.75	26.59	46.12	74.00	-27.88	PK
H	4804.00	66.15	39.55	7.85	25.66	60.11	74.00	-13.89	PK
H	4804.00	49.30	39.55	7.85	25.66	43.26	54.00	-10.74	AV
H	7206.00	70.53	38.33	7.52	23.55	63.27	74.00	-10.73	PK
H	7206.00	46.34	38.33	7.52	23.22	38.75	54.00	-15.25	AV
H	15450.00	45.48	35.45	6.75	27.88	44.66	74.00	-29.34	PK

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
GFSK Middle Channel:2441MHz									
V	4882.00	64.05	39.55	7.85	25.66	58.01	74.00	-15.99	PK
V	4882.00	52.54	39.55	7.85	25.66	46.50	54.00	-7.50	AV
V	7323.00	68.23	38.33	7.52	24.55	61.97	74.00	-12.03	PK
V	7323.00	47.44	38.33	7.52	24.55	41.18	54.00	-12.82	AV
V	15450.00	43.63	35.23	6.75	26.59	41.74	74.00	-32.26	PK
H	4882.00	70.57	39.55	7.85	25.66	64.53	74.00	-9.47	PK
H	4882.00	53.06	39.55	7.85	25.66	47.02	54.00	-6.98	AV
H	7323.00	66.76	38.33	7.52	23.55	59.50	74.00	-14.50	PK
H	7323.00	43.87	38.33	7.52	23.22	36.28	54.00	-17.72	AV
H	15450.00	45.08	35.45	6.75	27.88	44.26	74.00	-29.74	PK

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
GFSK High Channel:2480MHz									
V	4960.00	69.67	39.55	7.85	25.66	63.63	74.00	-10.37	PK
V	4960.00	47.54	39.55	7.85	25.66	41.50	54.00	-12.50	AV
V	7440.00	66.80	38.33	7.52	24.55	60.54	74.00	-13.46	PK
V	7440.00	48.73	38.33	7.52	24.55	42.47	54.00	-11.53	AV
V	15450.00	47.76	35.23	6.75	26.59	45.87	74.00	-28.13	PK
H	4960.00	69.97	39.55	7.85	25.66	63.93	74.00	-10.07	PK
H	4960.00	50.13	39.55	7.85	25.66	44.09	54.00	-9.91	AV
H	7440.00	68.21	38.33	7.52	23.55	60.95	74.00	-13.05	PK
H	7440.00	43.43	38.33	7.52	23.22	35.84	54.00	-18.16	AV
H	15450.00	47.28	35.45	6.75	27.88	46.46	74.00	-27.54	PK

Remark:

1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier,
   Margin= Emission Level - Limit
2. If peak below the average limit, the average emission was no test.
3. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
4. All the Modulation are test, the worst mode is GFSK, the data recording in the report.

7.5 RADIATED Band EMISSION MEASUREMENT

Test Requirement:

FCC Part15 C Section 15.209 and 15.205

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Limit (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	2300MHz
Stop Frequency	2520
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

TEST PROCEDURE

Above 1GHz test procedure as below:

a. 1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. Test the EUT in the lowest channel,the Highest channel

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

TEST RESULT

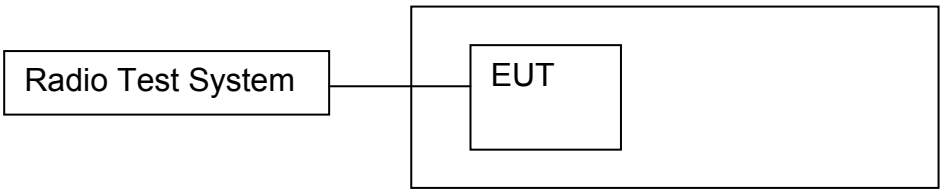
	Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Pre-amplifier (dB)	Cable Loss (dB)	Antenna Factor (dB/m)	Emission evel (dBuV/m)	Limits (dBuV/m)		Result
							PK	PK	AV	
GFSK	**Low Channel 2402MHz**									
	H	2390.00	54.23	38.06	7.42	20.15	43.74	74.00	54.00	PASS
	H	2400.00	55.32	38.06	7.42	20.15	44.83	74.00	54.00	PASS
	V	2390.00	56.65	38.06	7.42	20.15	46.16	74.00	54.00	PASS
	V	2400.00	55.27	38.06	7.42	20.15	44.78	74.00	54.00	PASS
	High Channel 2480MHz									
	H	2483.50	56.85	38.17	7.45	20.54	46.62	74.00	54.00	PASS
	H	2485.50	55.57	38.17	7.45	20.54	45.37	74.00	54.00	PASS
	V	2483.50	56.72	38.20	7.45	20.54	46.50	74.00	54.00	PASS
	V	2485.50	56.58	38.20	7.45	20.54	46.51	74.00	54.00	PASS
Pi/4DQPSK	**Low Channel 2402MHz**									
	H	2390.00	58.96	38.06	7.42	20.15	48.47	74.00	54.00	PASS
	H	2400.00	57.77	38.06	7.42	20.15	47.28	74.00	54.00	PASS
	V	2390.00	56.29	38.06	7.42	20.15	45.80	74.00	54.00	PASS
	V	2400.00	57.30	38.06	7.42	20.15	46.81	74.00	54.00	PASS
	High Channel 2480MHz									
	H	2483.50	55.86	38.17	7.45	20.54	45.68	74.00	54.00	PASS
	H	2485.50	56.74	38.17	7.45	20.54	46.56	74.00	54.00	PASS
	V	2483.50	56.52	38.2	7.45	20.54	46.31	74.00	54.00	PASS
	V	2485.50	56.23	38.2	7.45	20.54	46.02	74.00	54.00	PASS
8DPSK	**Low Channel 2402MHz**									
	H	2390.00	56.37	38.06	7.42	20.15	45.88	74.00	54.00	PASS
	H	2400.00	59.87	38.06	7.42	20.15	49.38	74.00	54.00	PASS
	V	2390.00	58.74	38.06	7.42	20.15	48.25	74.00	54.00	PASS
	V	2400.00	57.32	38.06	7.42	20.15	46.83	74.00	54.00	PASS
	High Channel 2480MHz									
	H	2483.50	58.97	38.17	7.45	20.54	48.79	74.00	54.00	PASS
	H	2485.50	57.33	38.17	7.45	20.54	47.15	74.00	54.00	PASS
	V	2483.50	56.40	38.2	7.45	20.54	46.19	74.00	54.00	PASS
	V	2485.50	57.05	38.2	7.45	20.54	46.84	74.00	54.00	PASS

Remark:

1. Emission Level = Meter Reading + Antenna Factor + Cable Loss – Pre-amplifier, Margin= Emission Level - Limit
2. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.

8. CONDUCTED EMISSION

8.1 Block Diagram Of Test Setup



8.2 Limit

Regulation 15.247 (d),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)).

8.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer:

Blow 30MHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

Above 30MHz:

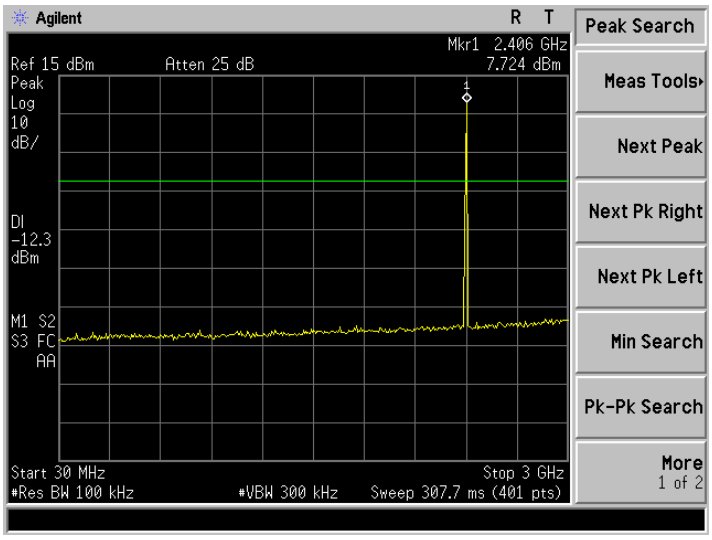
RBW = 100KHz, VBW = 300KHz, Sweep = auto

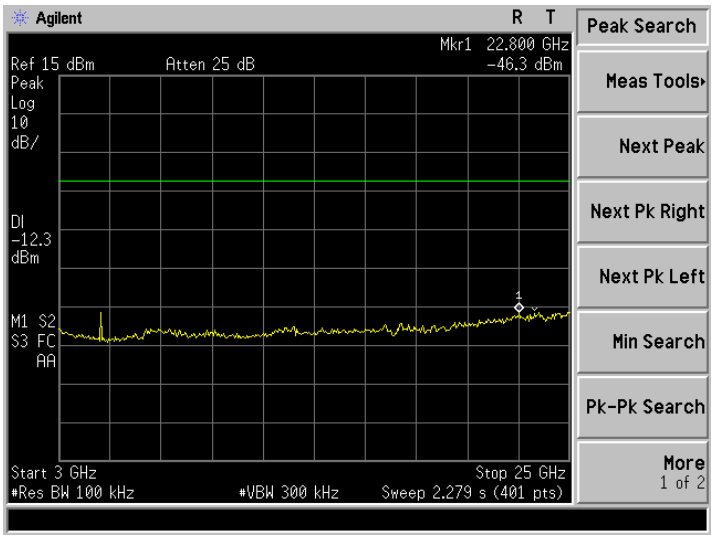
Detector function = peak, Trace = max hold

8.4 Test Result

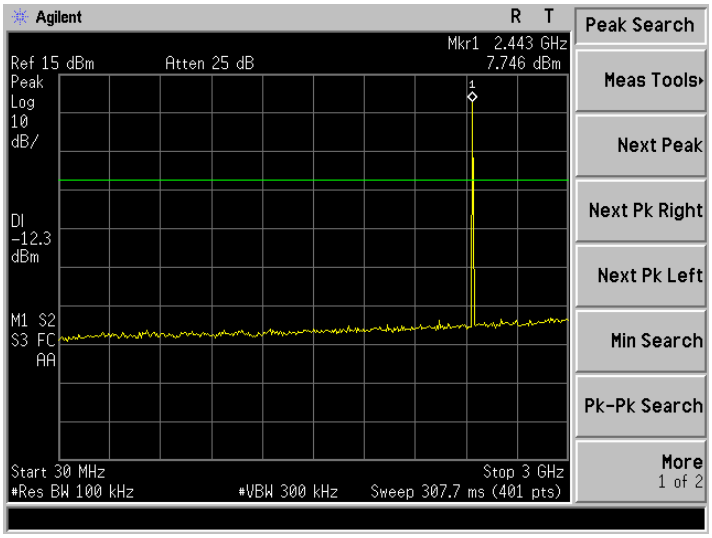
30MHz – 25GHz

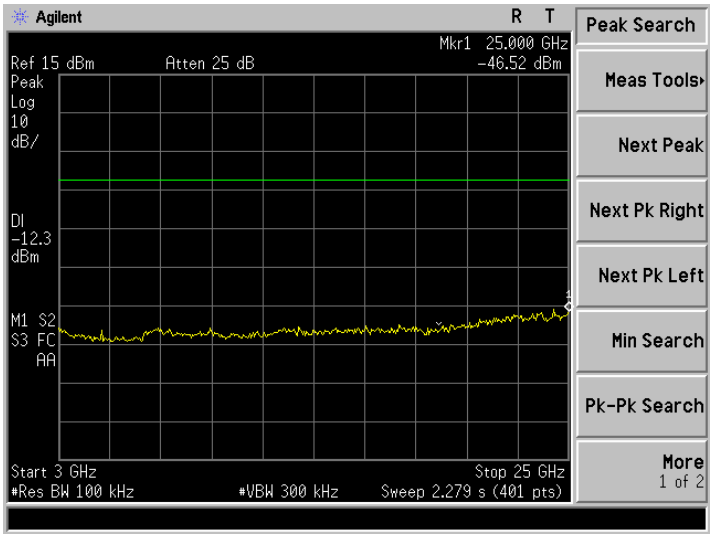
GFSK Low Channel



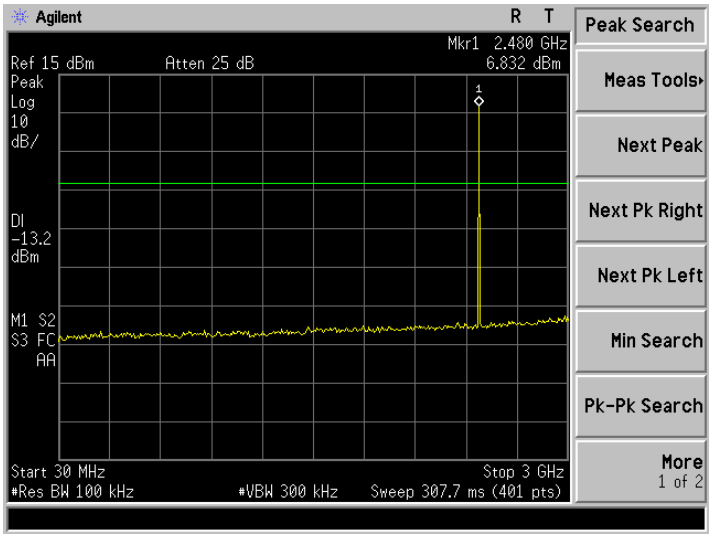


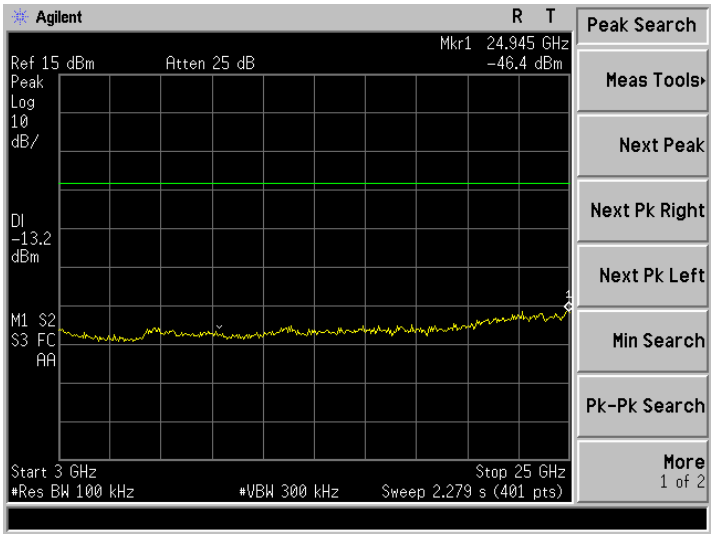
GFSK Middle Channel



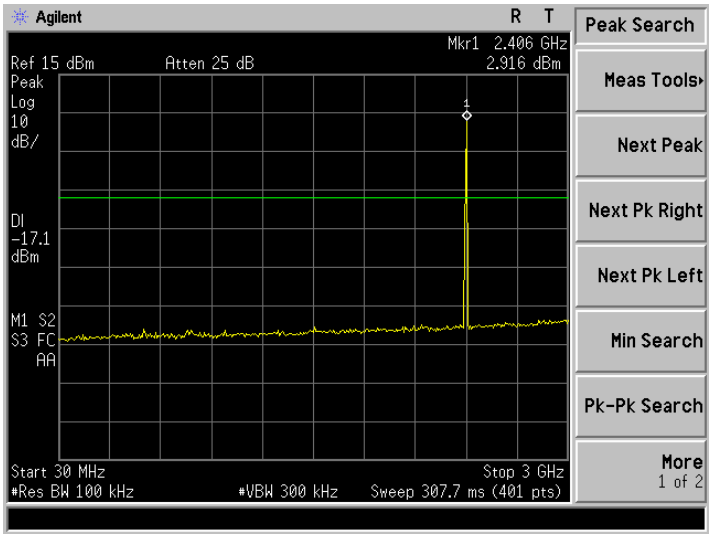


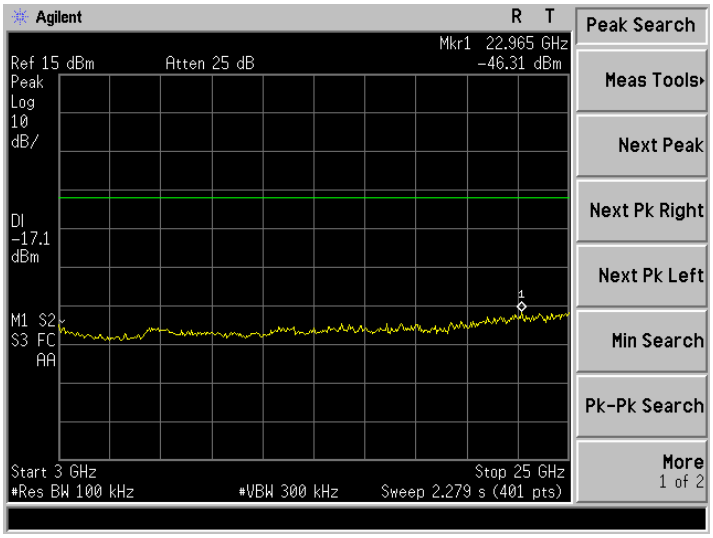
GFSK High Channel



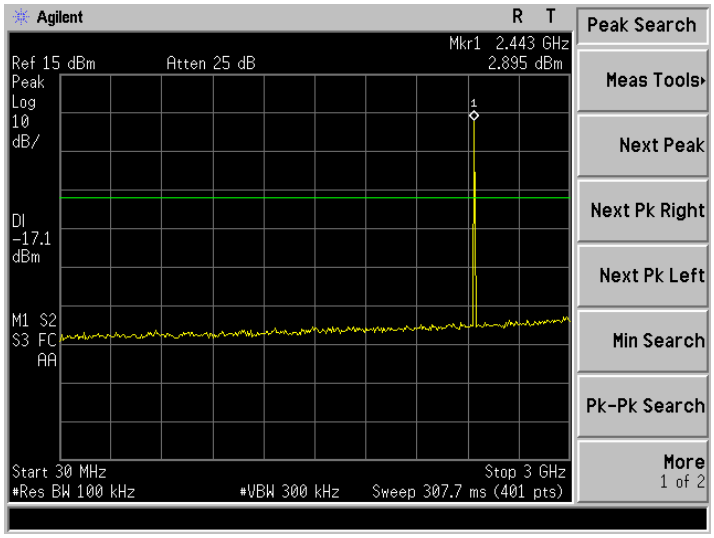


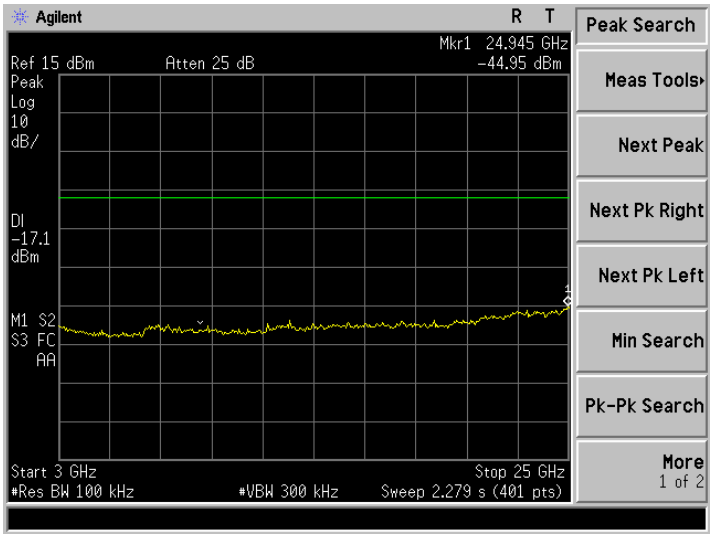
Pi/4 DQPSK Low Channel



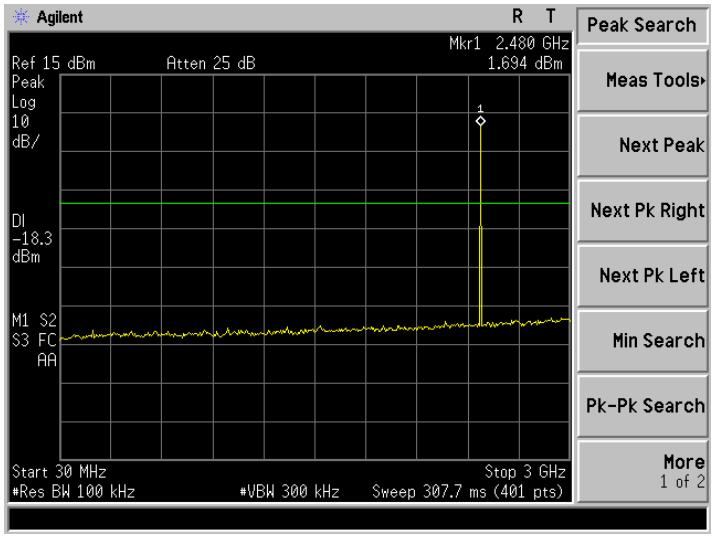


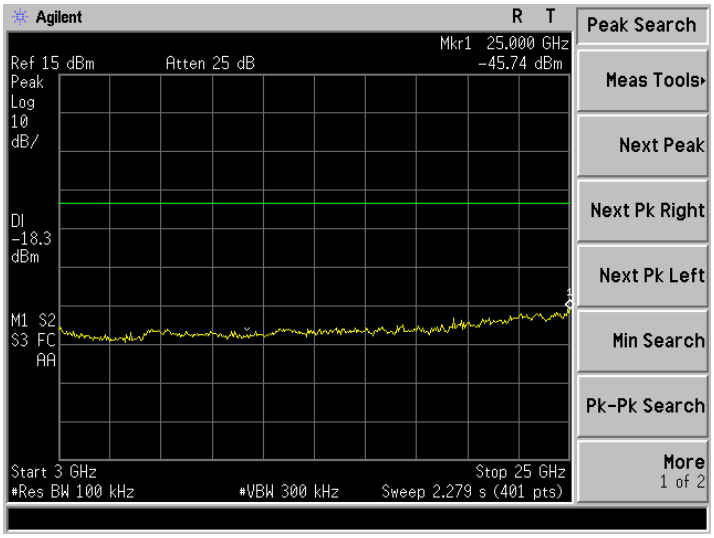
Pi/4 DQPSK Middle Channel



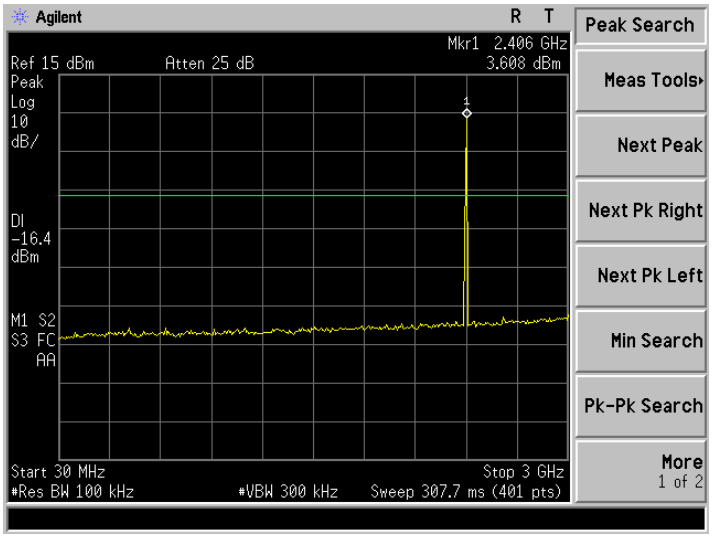


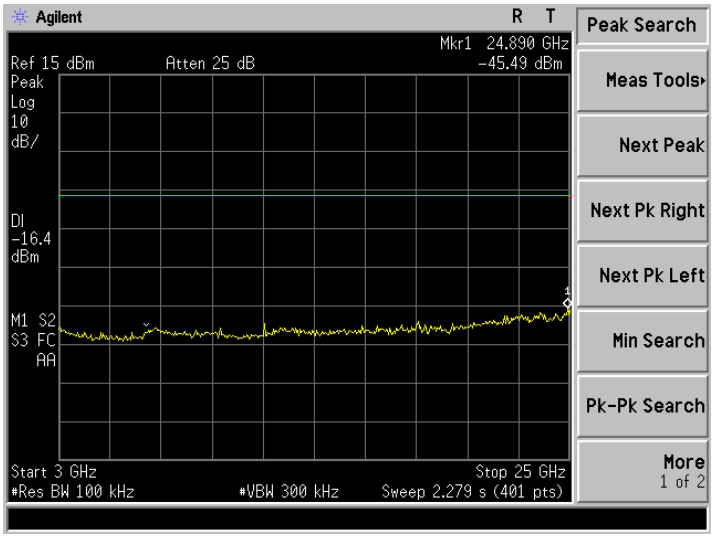
Pi/4 DQPSK High Channel



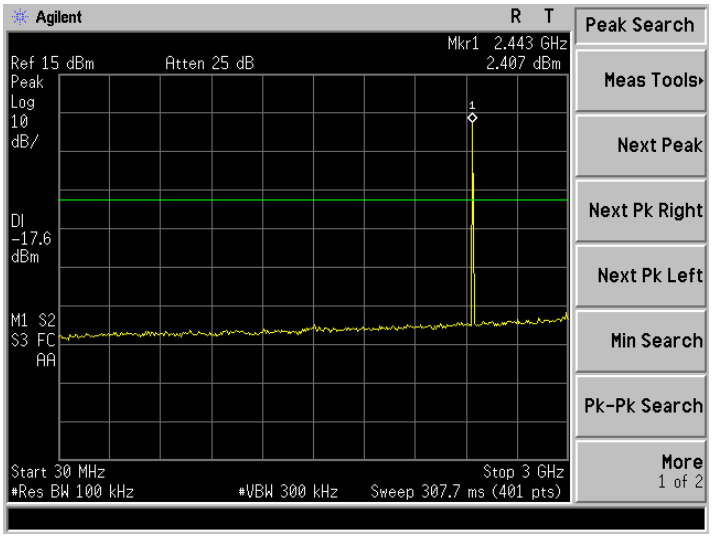


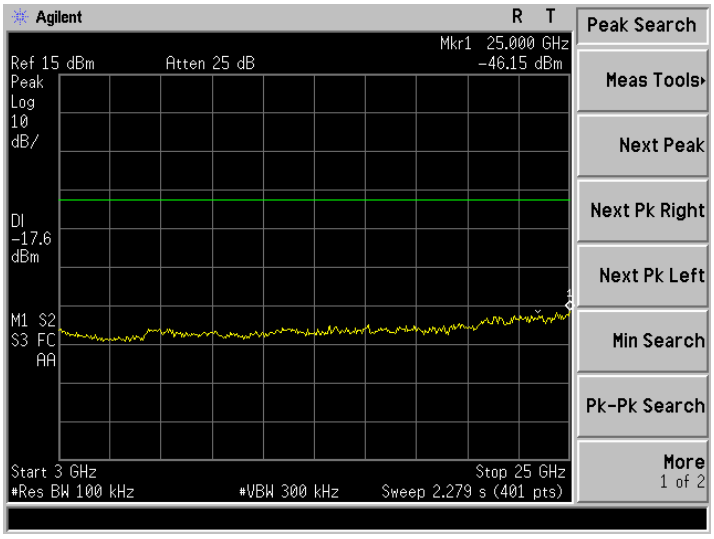
8DPSK Low Channel



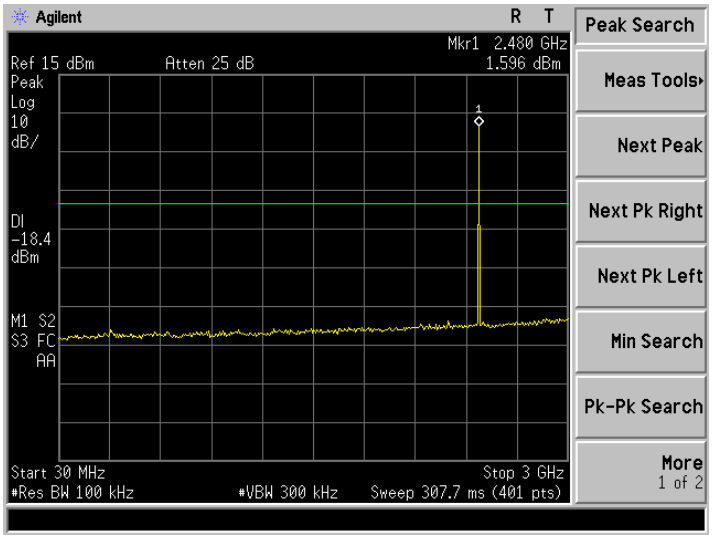


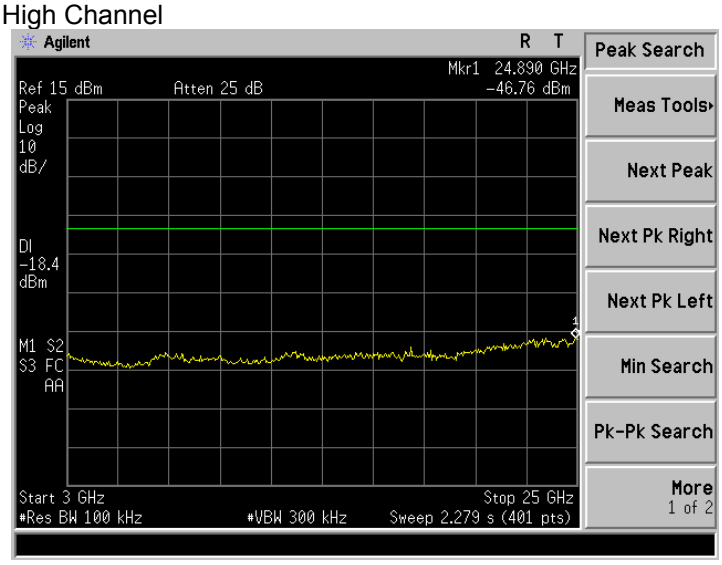
8DPSK Middle Channel



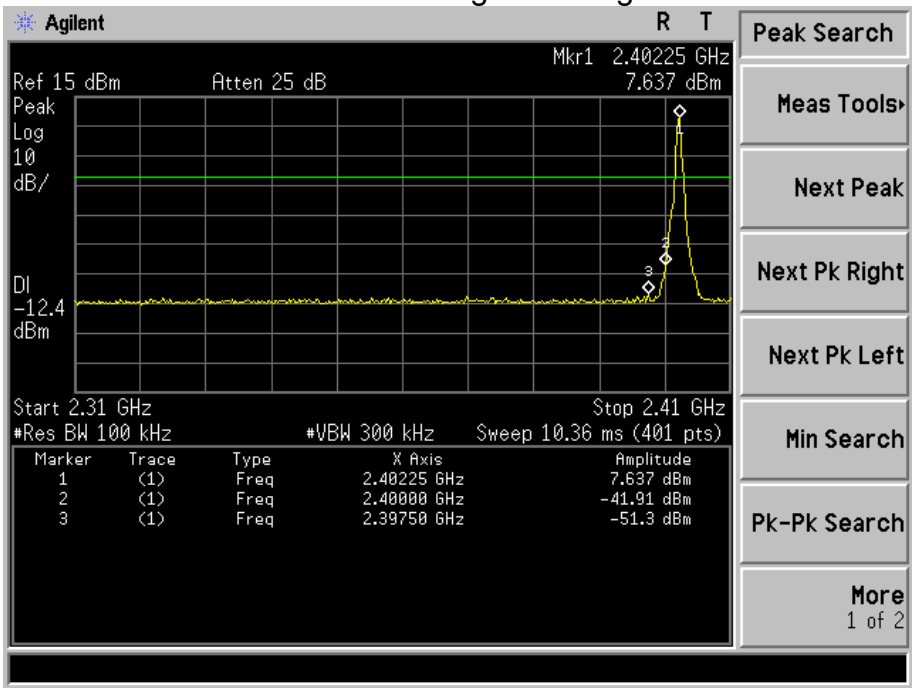


8DPSK High Channel

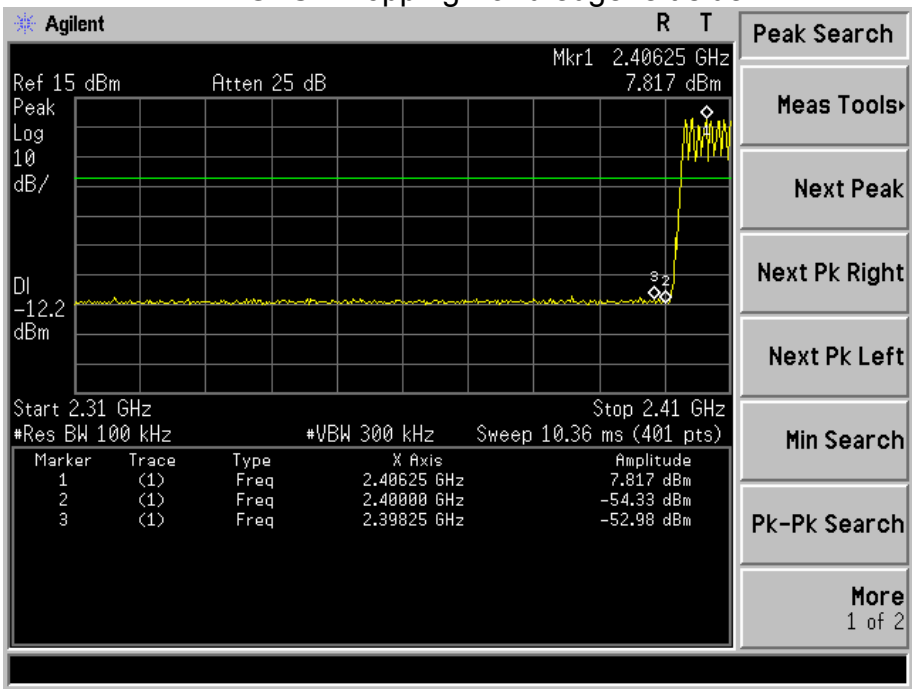




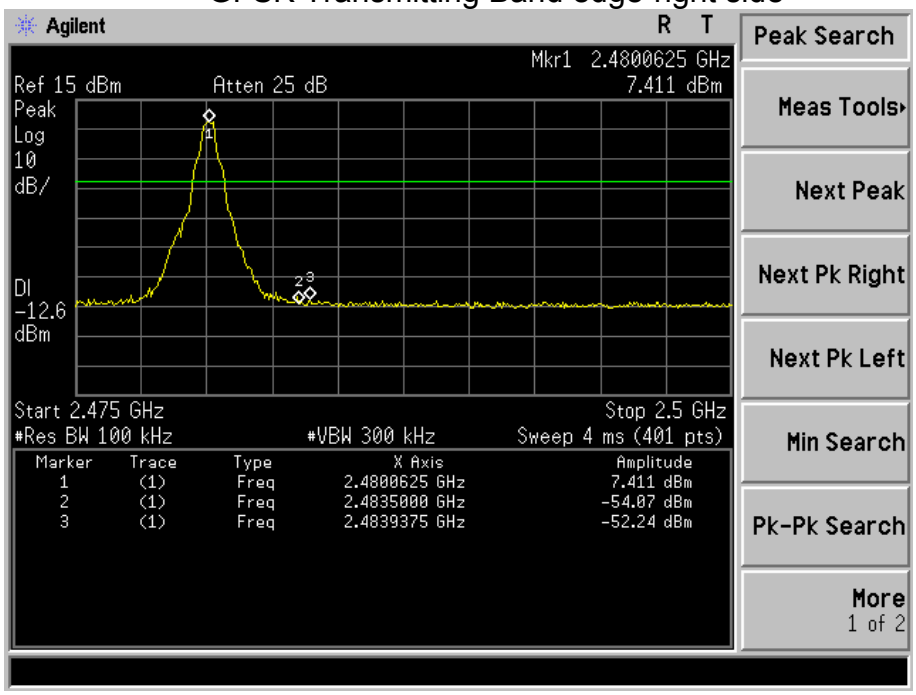
GFSK Transmitting Band edge-left side



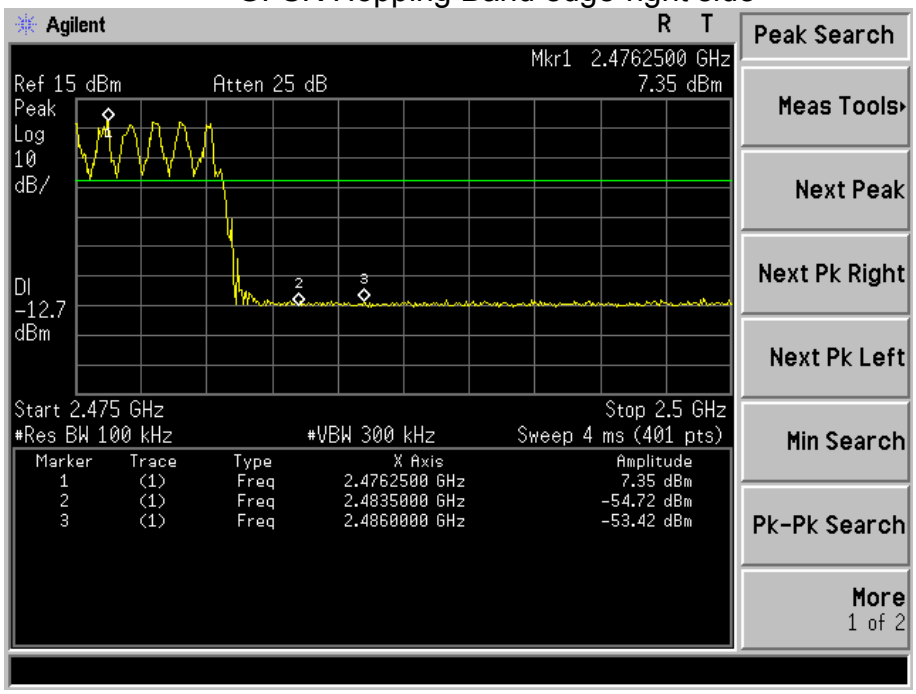
GFSK Hopping Band edge-left side



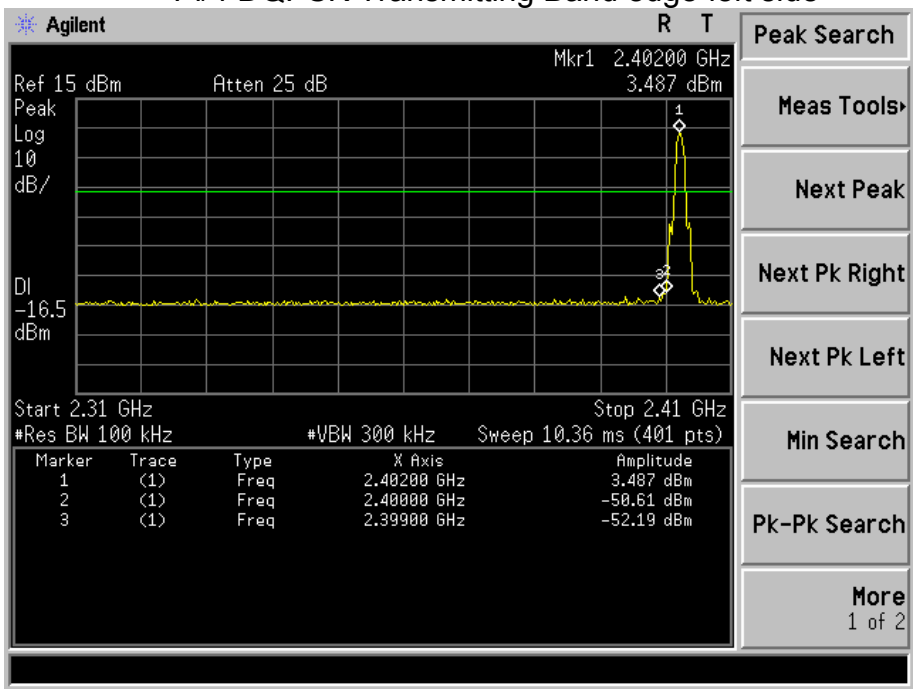
GFSK Transmitting Band edge-right side



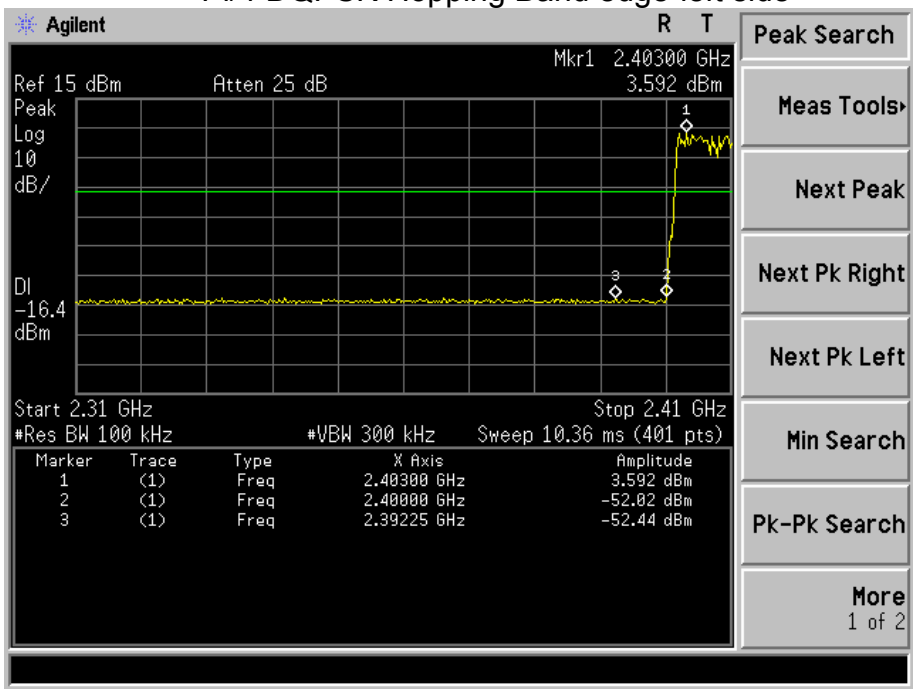
GFSK Hopping Band edge-right side



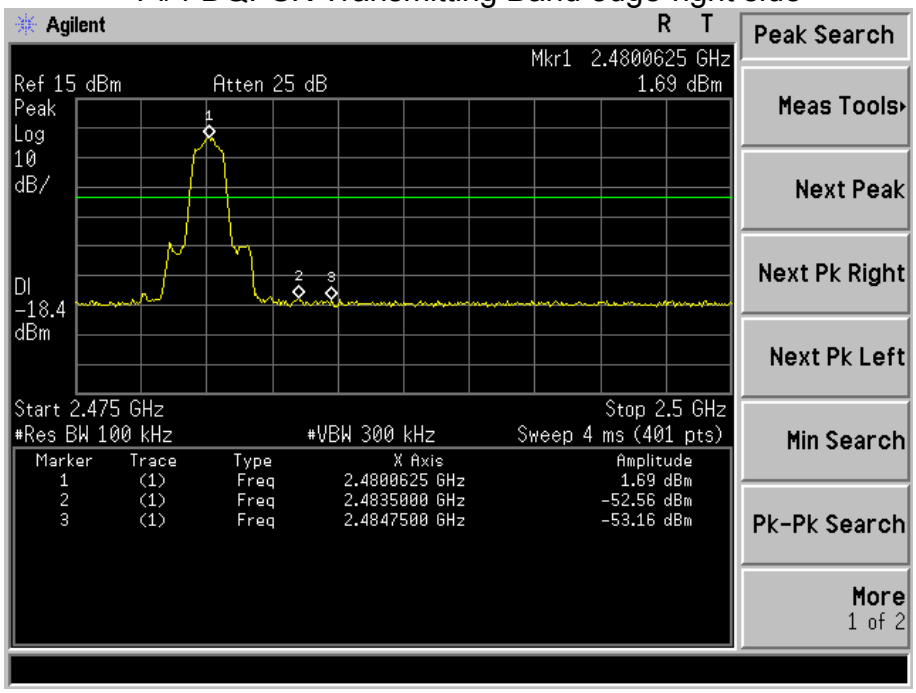
Pi/4 DQPSK Transmitting Band edge-left side



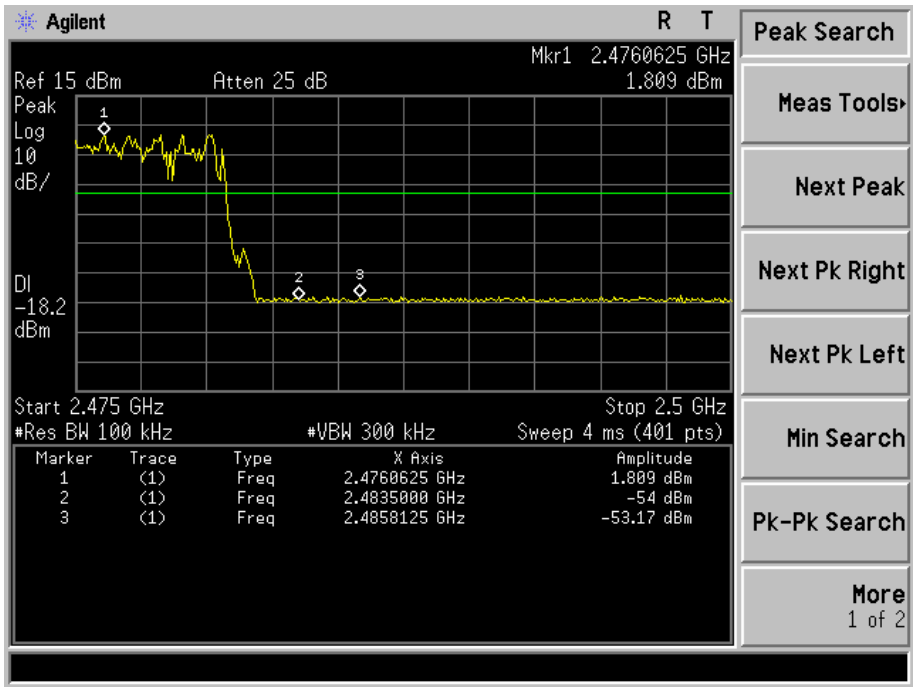
Pi/4 DQPSK Hopping Band edge-left side



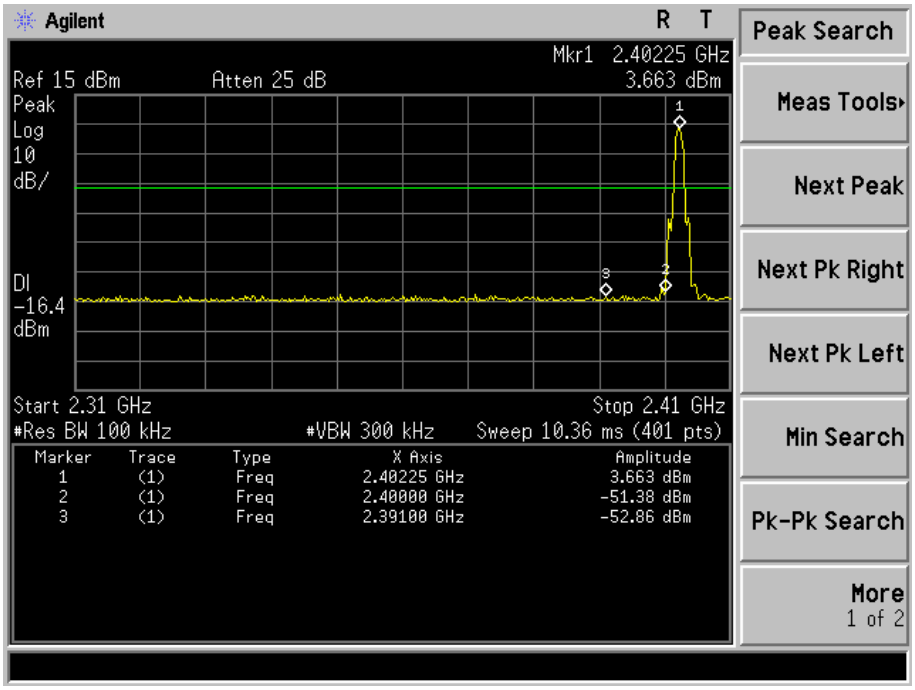
Pi/4 DQPSK Transmitting Band edge-right side



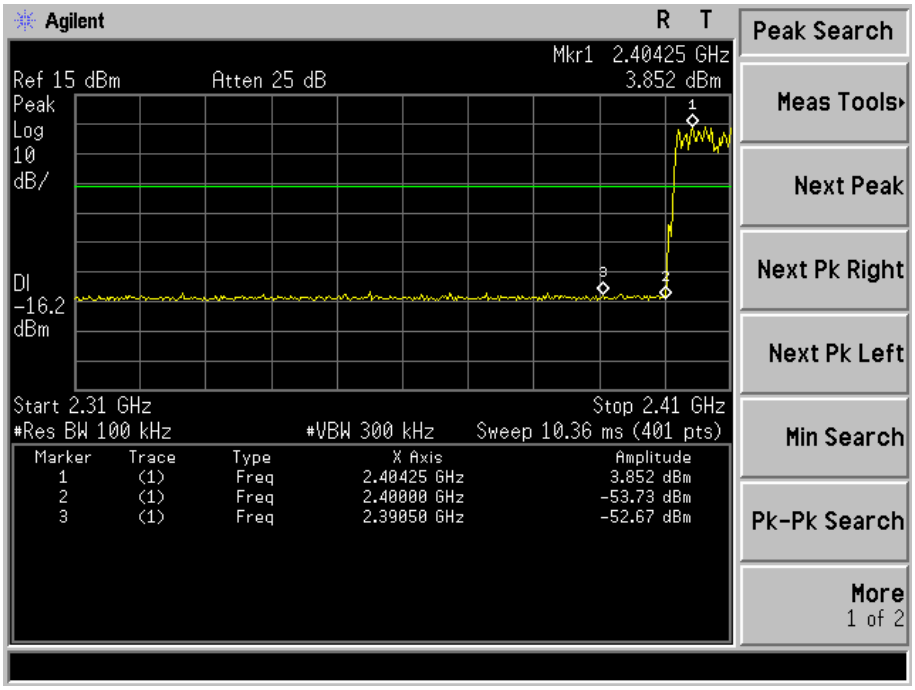
Pi/4 DQPSK Hopping Band edge-right side



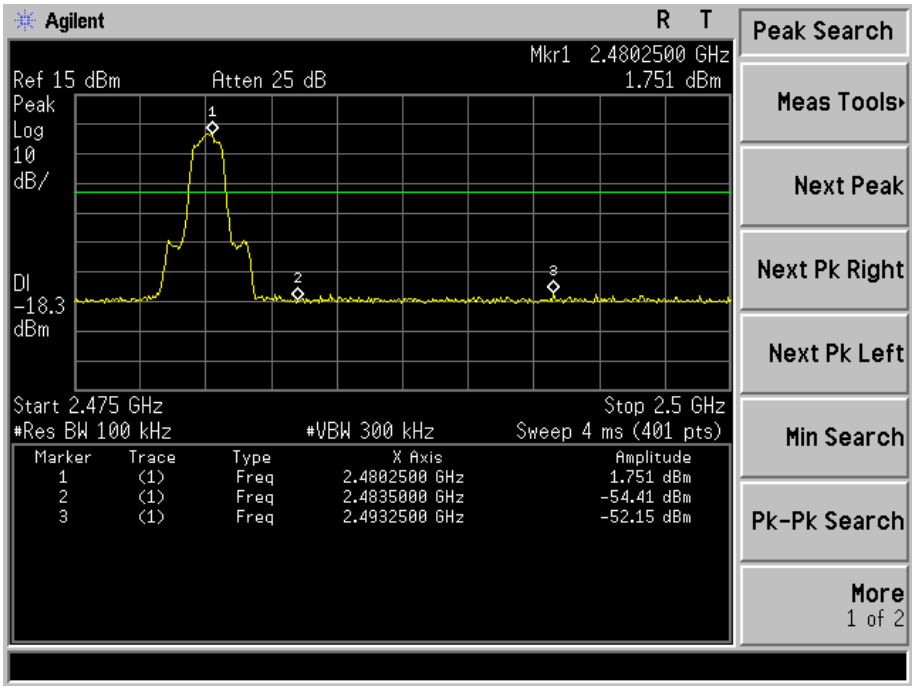
8DPSK Transmitting Band edge-left side



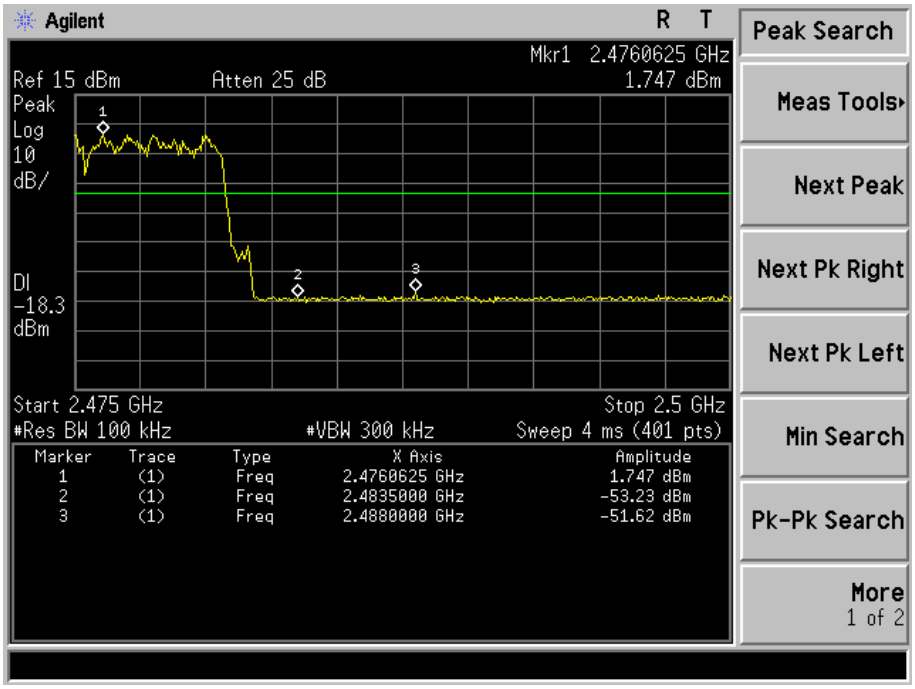
8DPSK Hopping Band edge-left side



8DPSK Transmitting Band edge-right side

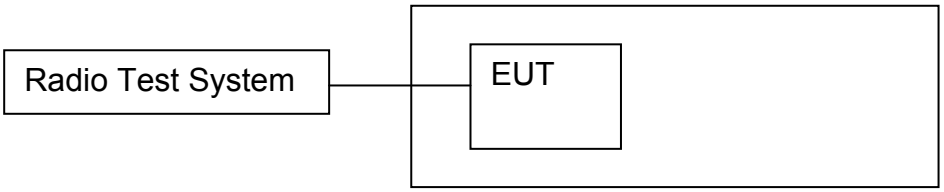


8DPSK Hopping Band edge-right side



9. 20 DB BANDWIDTH

9.1 Block Diagram Of Test Setup



9.2 Limit

N/A

9.3 Test procedure

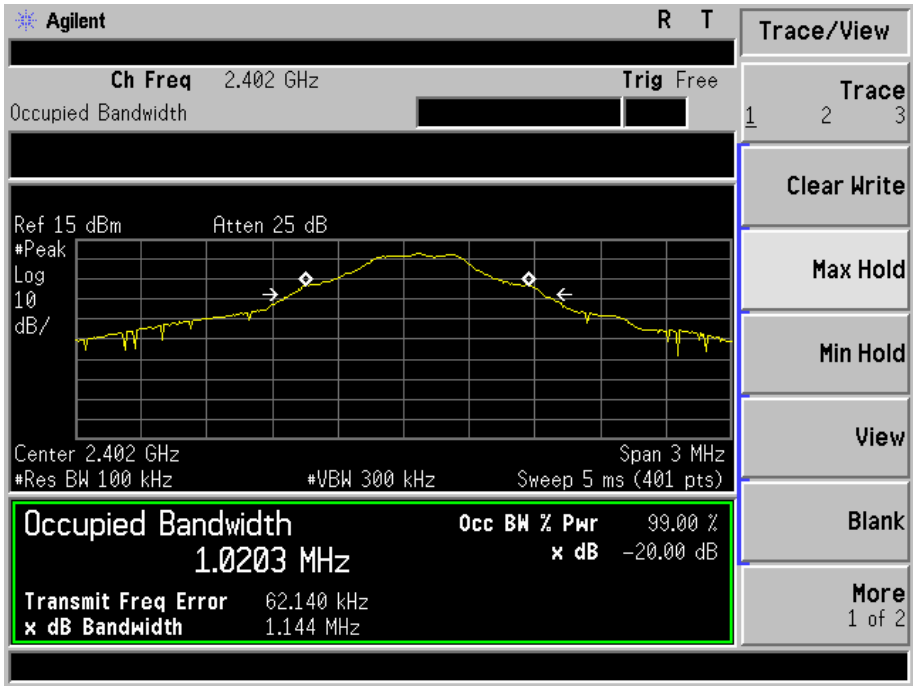
1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

9.4 Test Result

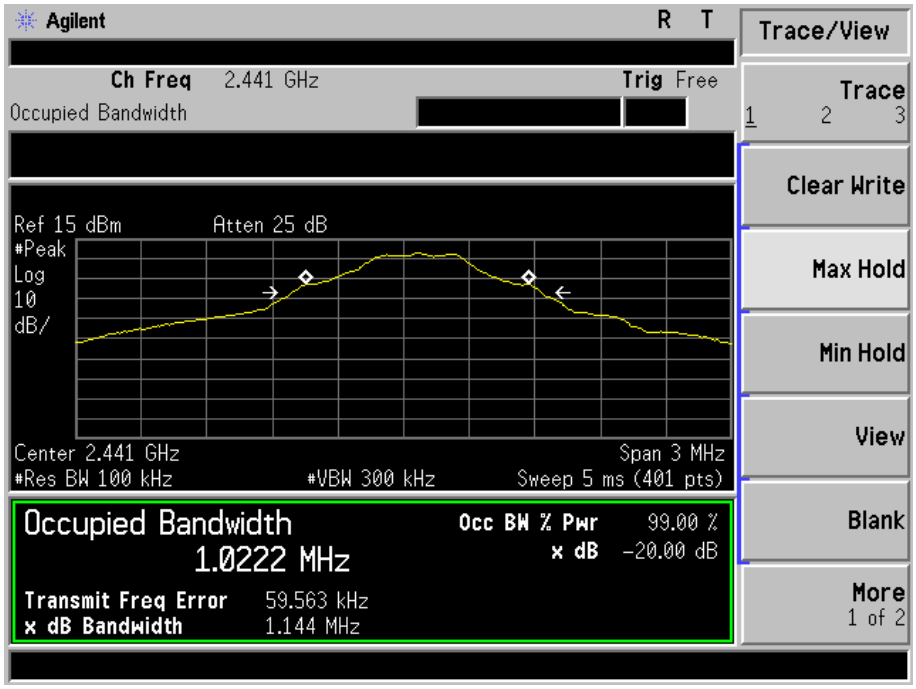
Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	1.144
GFSK	Middle	1.144
GFSK	High	1.139
Pi/4 DQPSK	Low	1.433
Pi/4 DQPSK	Middle	1.428
Pi/4 DQPSK	High	1.430
8DPSK	Low	1.411
8DPSK	Middle	1.427
8DPSK	High	1.419

Test plots

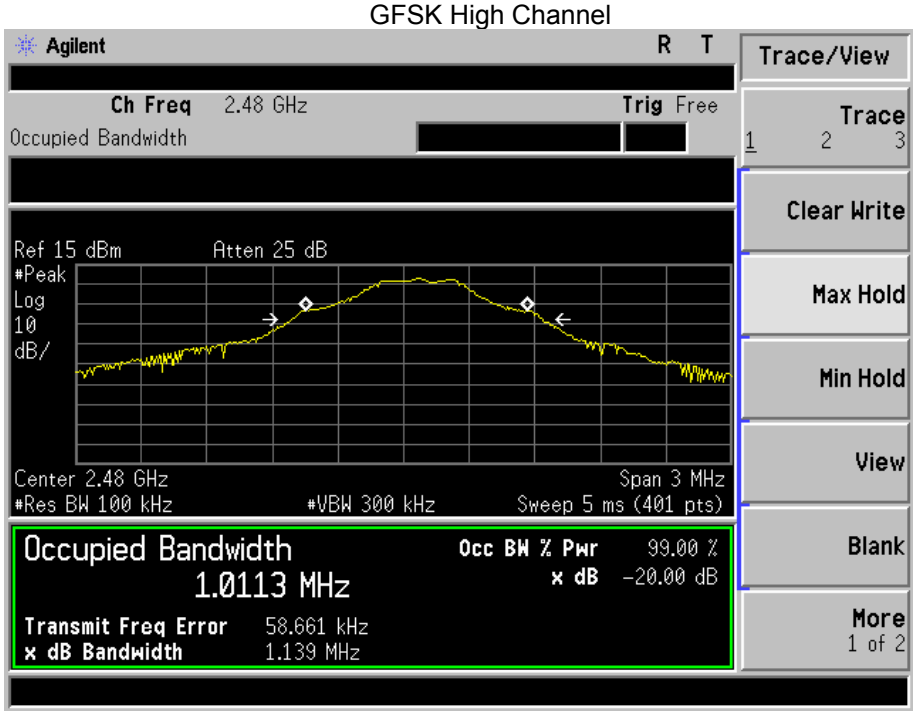
GFSK Low Channel



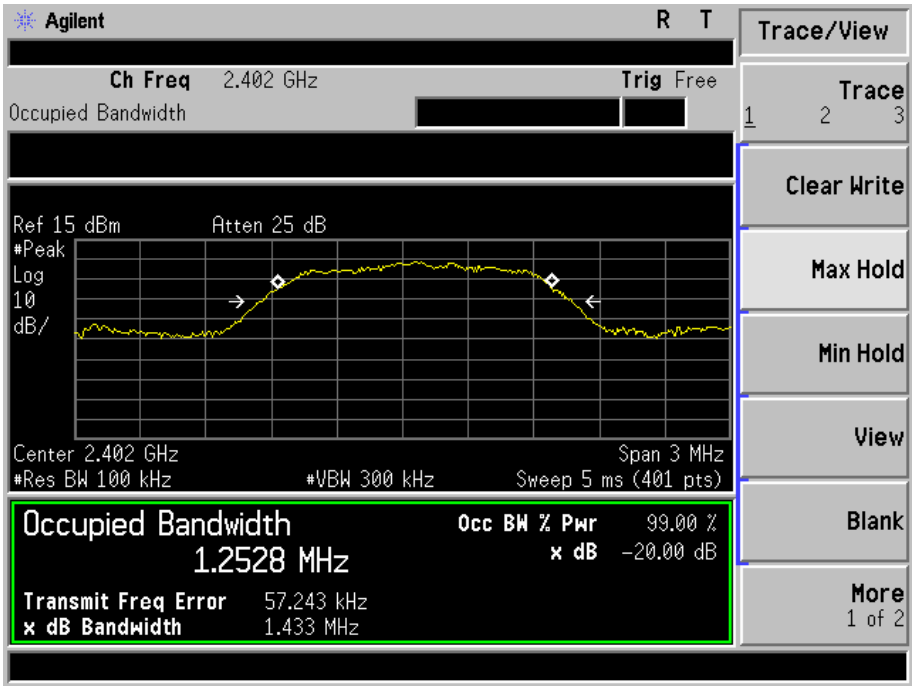
GFSK Middle Channel



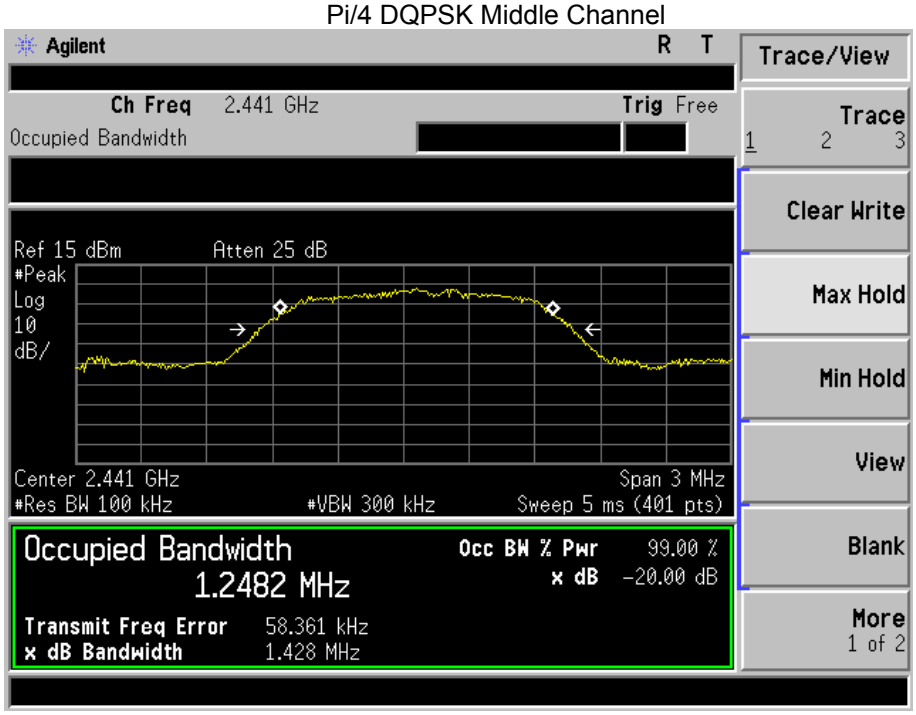
GFSK High Channel



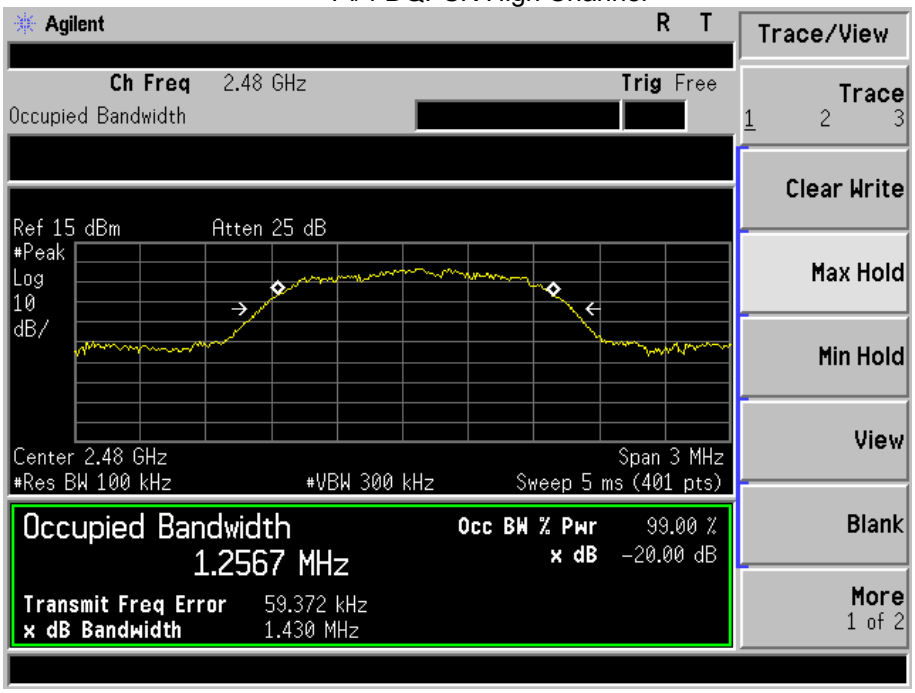
Pi/4 DQPSK Low Channel



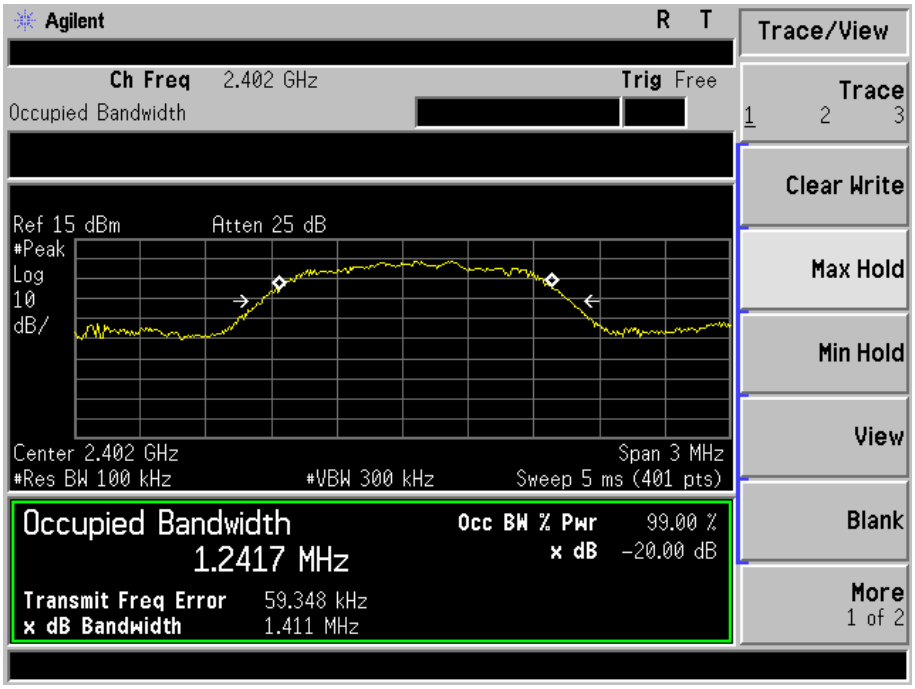
Pi/4 DQPSK Middle Channel



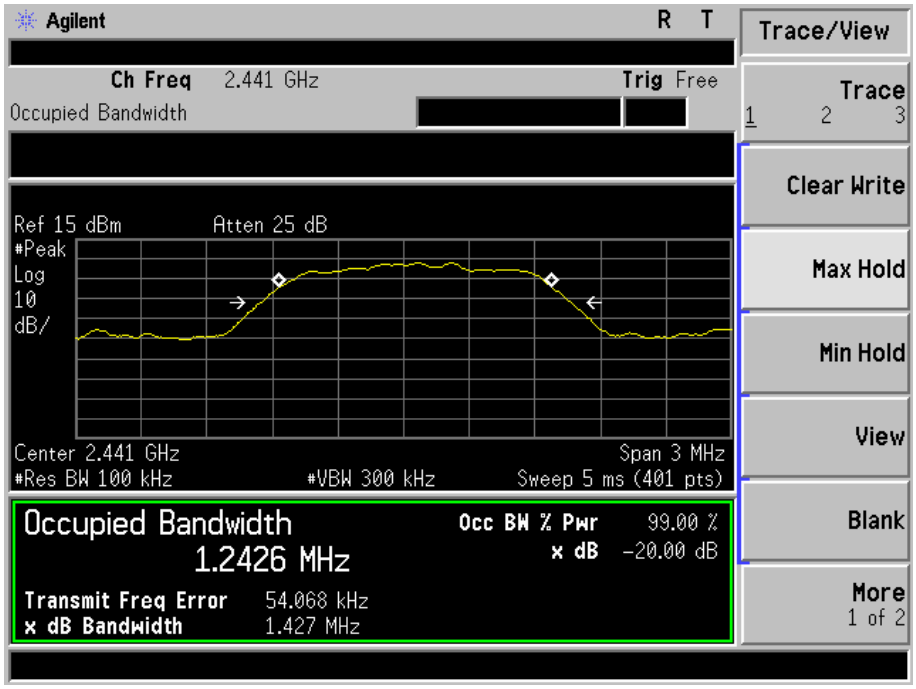
Pi/4 DQPSK High Channel



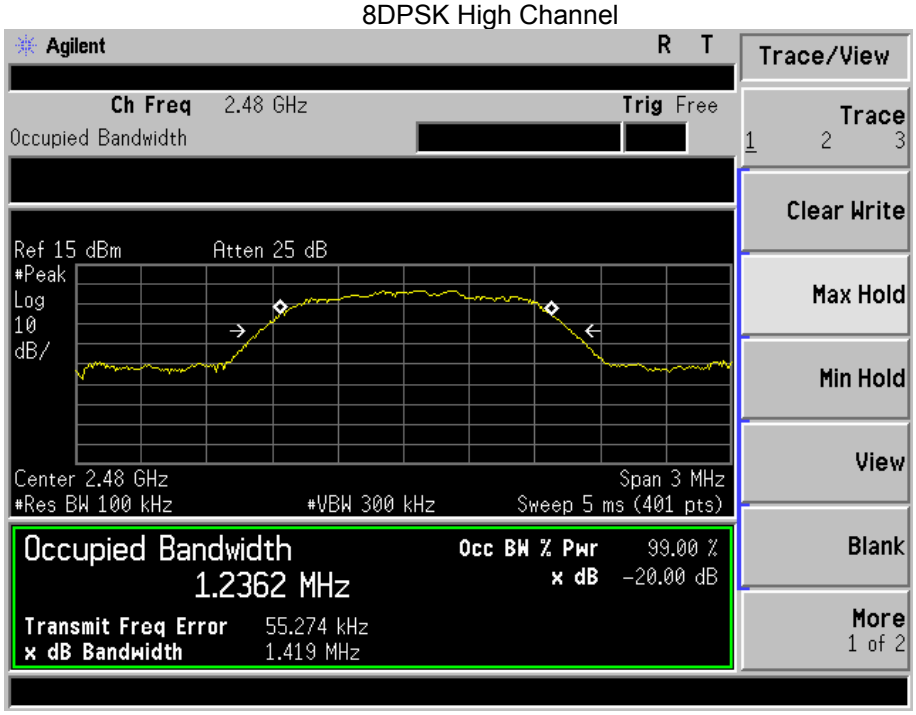
8DPSK Low Channel



8DPSK Middle Channel

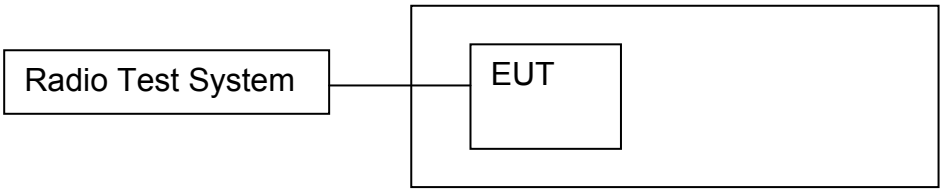


8DPSK High Channel



10. MAXIMUM PEAK OUTPUT POWER

10.1 Block Diagram Of Test Setup



10.2 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.

10.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.

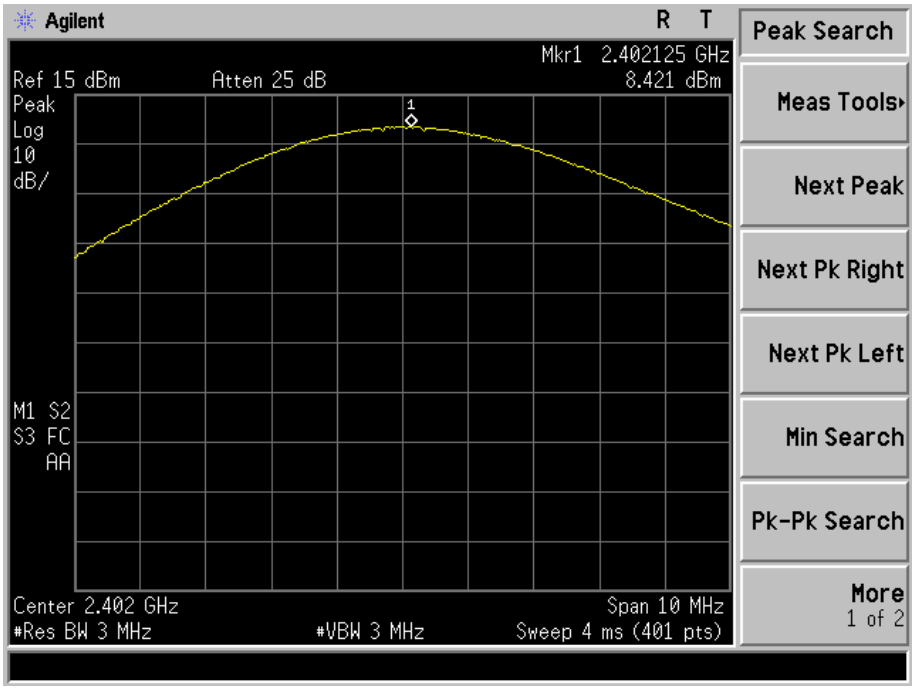
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

10.4 Test Result

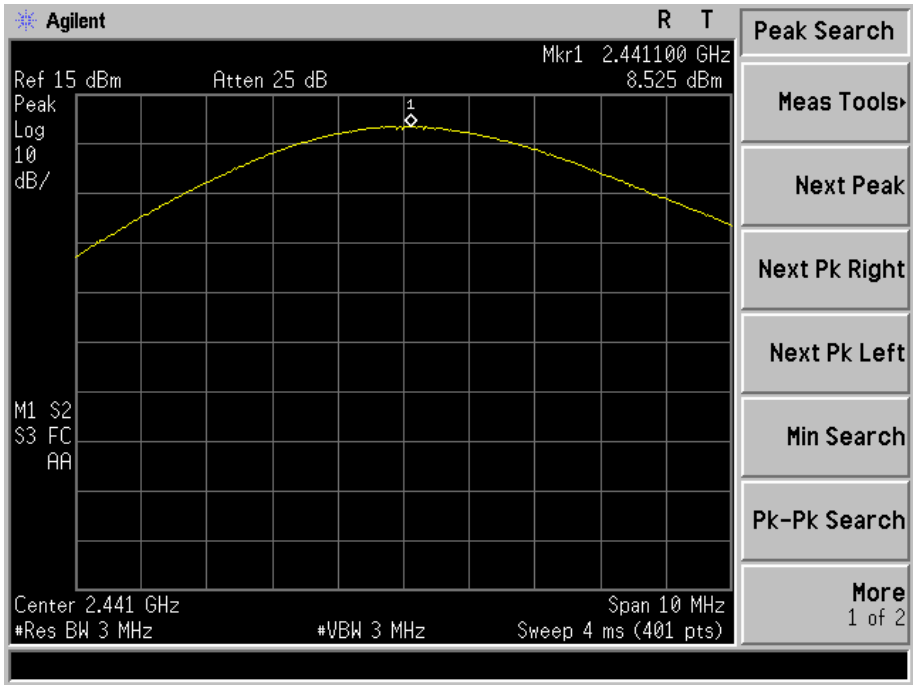
Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	8.421	21
GFSK	Middle	8.525	21
GFSK	High	8.557	21
Pi/4 DQPSK	Low	5.860	21
Pi/4 DQPSK	Middle	5.036	21
Pi/4 DQPSK	High	4.150	21
8DPSK	Low	6.395	21
8DPSK	Middle	5.467	21
8DPSK	High	4.724	21

Test plots

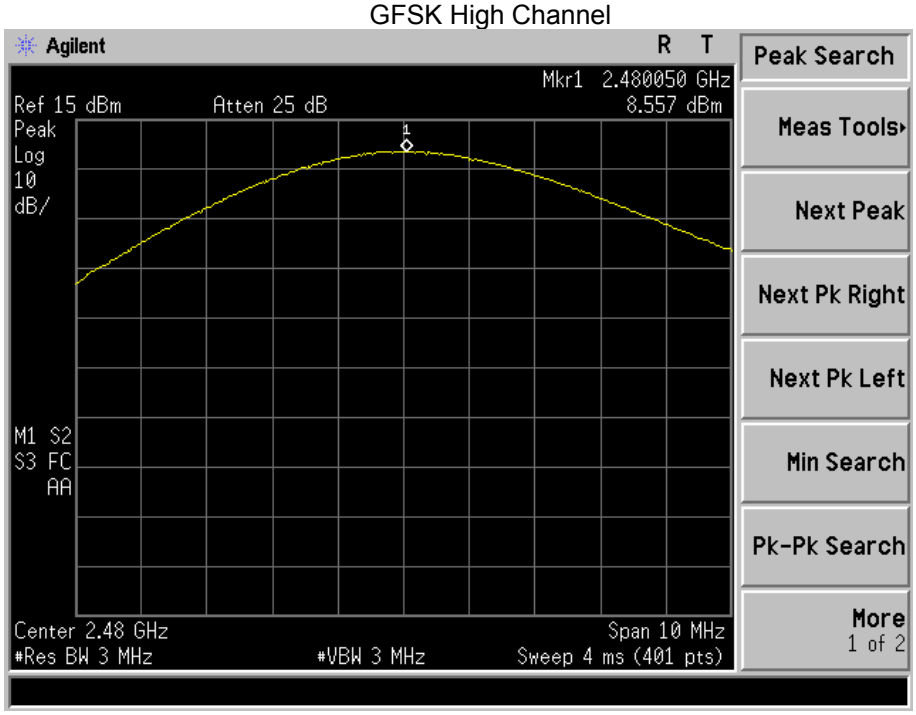
GFSK Low Channel



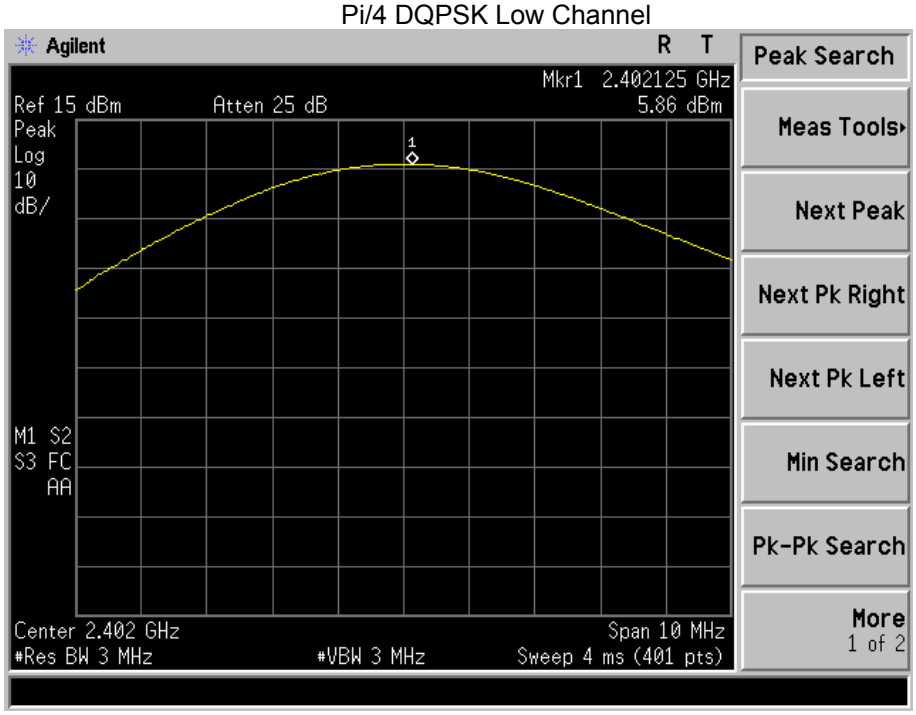
GFSK Middle Channel



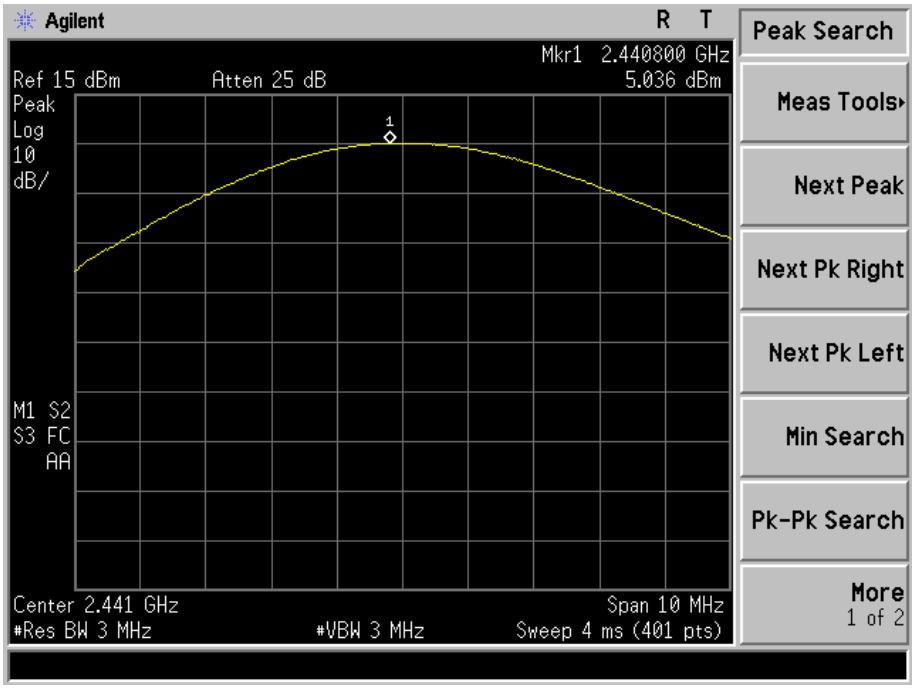
GFSK High Channel



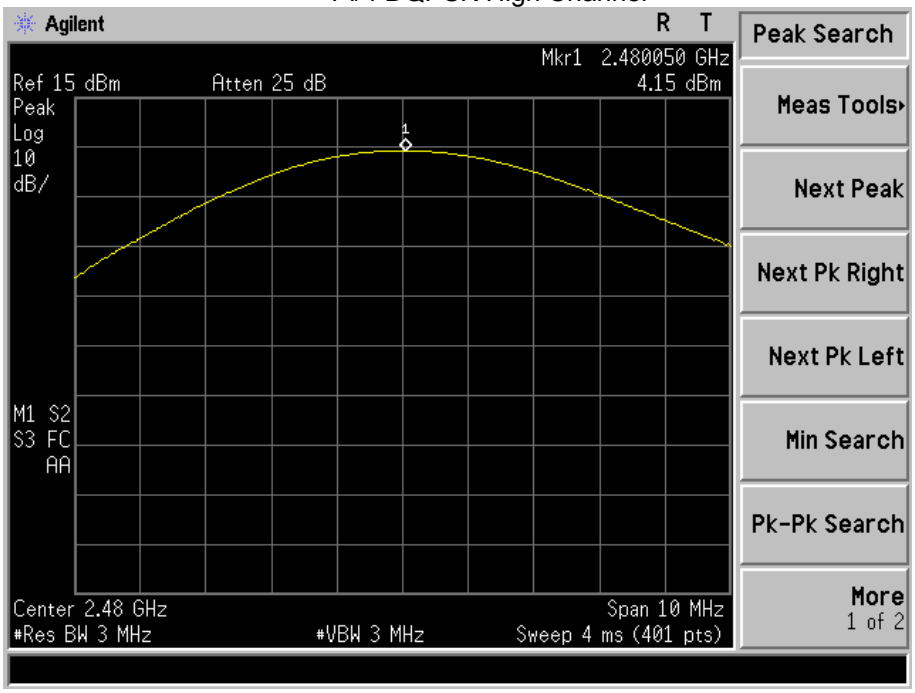
Pi/4 DQPSK Low Channel



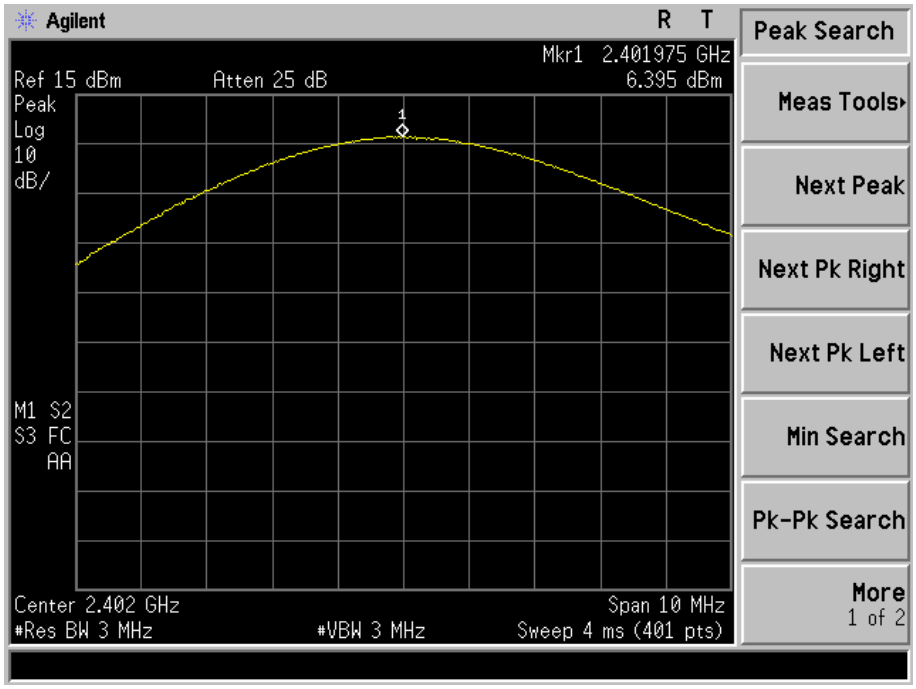
Pi/4 DQPSK Middle Channel



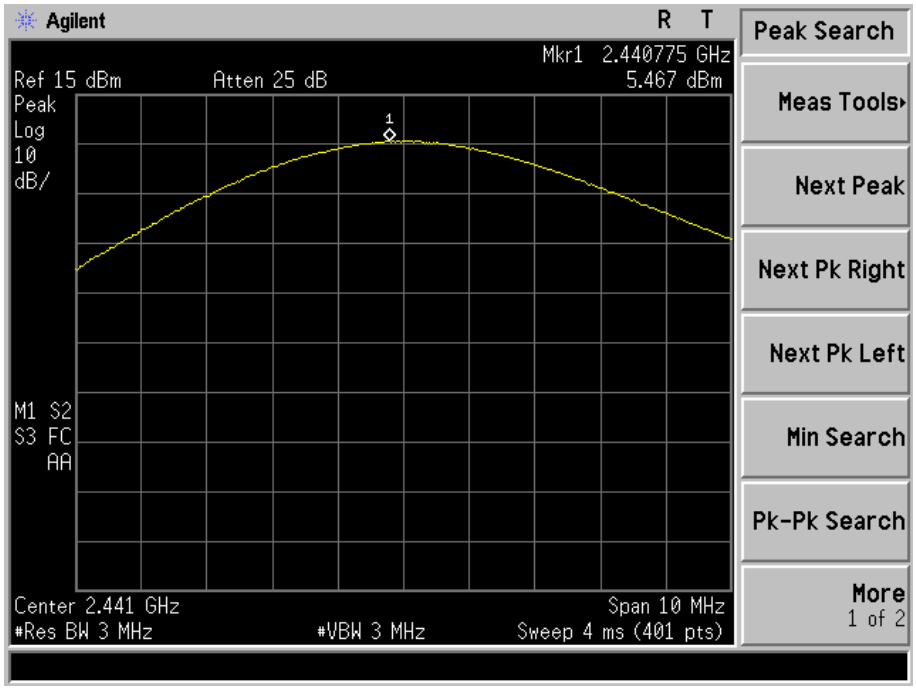
Pi/4 DQPSK High Channel



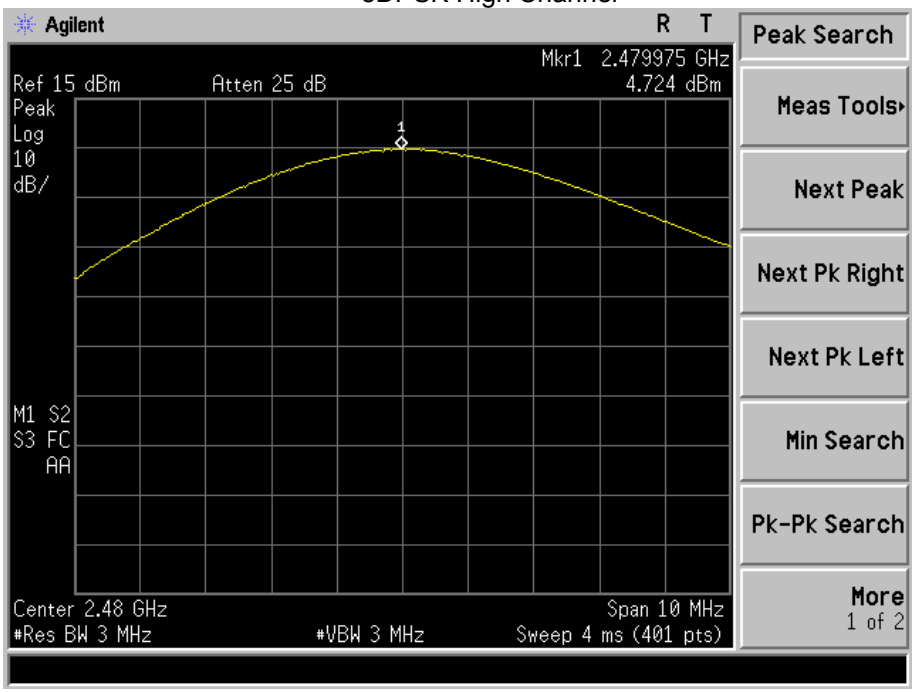
8DPSK Low Channel



8DPSK Middle Channel

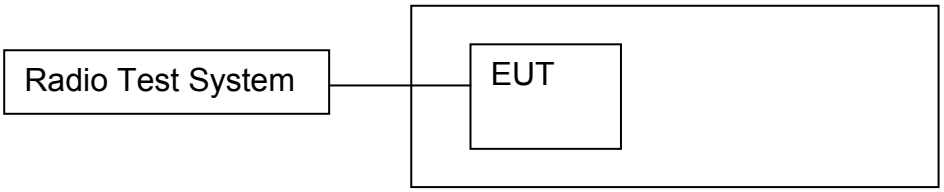


8DPSK High Channel



11. HOPPING CHANNEL SEPARATION

11.1 Block Diagram Of Test Setup



11.2 Limit

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. Alternatively, 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 0.125W.

11.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 3.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

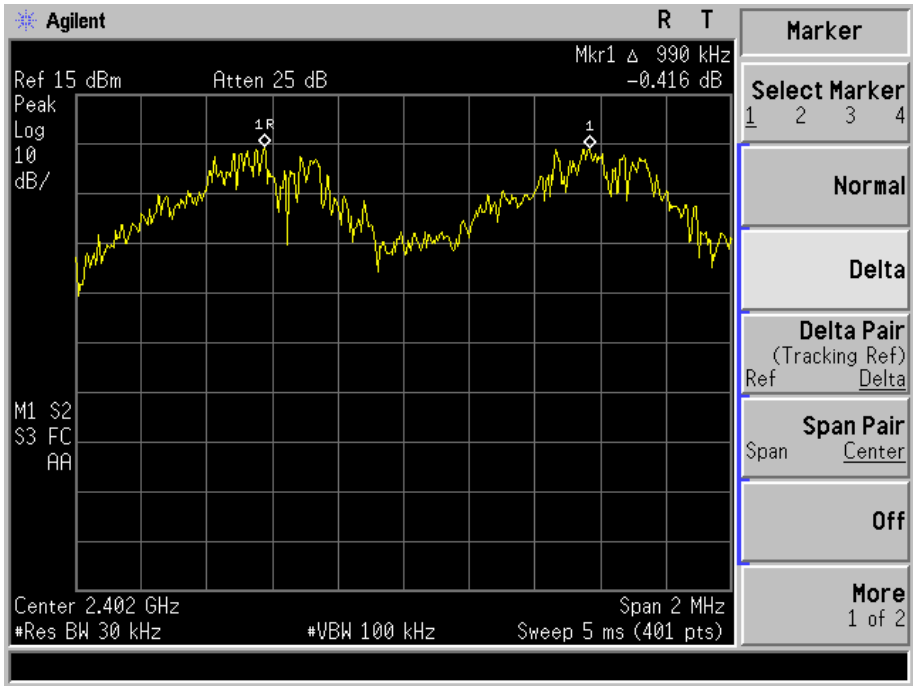
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

11.4 Test Result

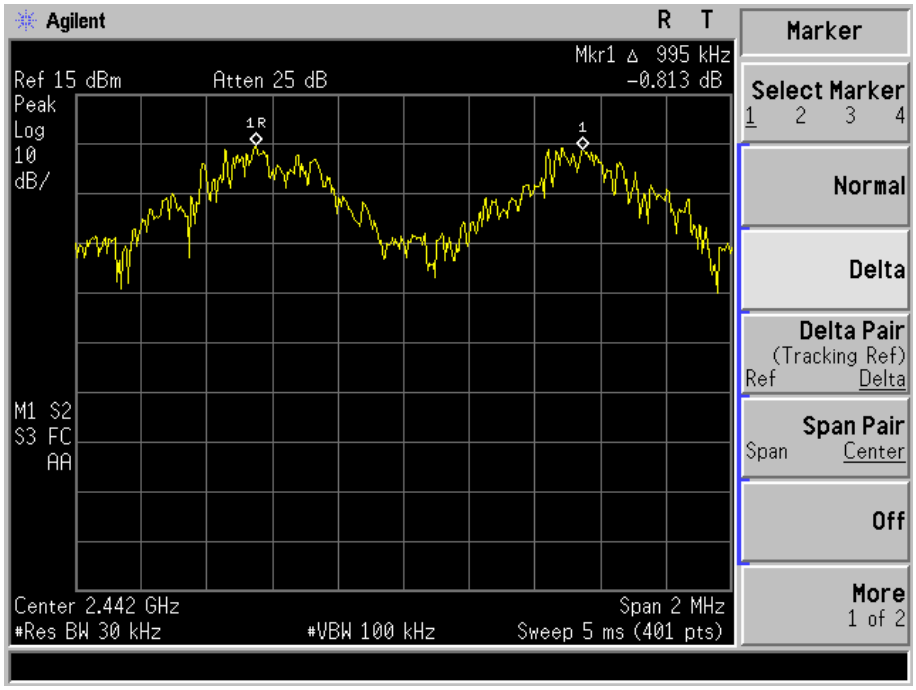
Modulation	Test Channel	Separation (MHz)	Limit(MHz)	Result
GFSK	Low	0.990	0.763	PASS
GFSK	Middle	0.995	0.763	PASS
GFSK	High	1.000	0.759	PASS
Pi/4 DQPSK	Low	1.025	0.955	PASS
Pi/4 DQPSK	Middle	1.005	0.952	PASS
Pi/4 DQPSK	High	0.965	0.953	PASS
8DPSK	Low	1.000	0.941	PASS
8DPSK	Middle	1.005	0.951	PASS
8DPSK	High	1.005	0.946	PASS

Test plots

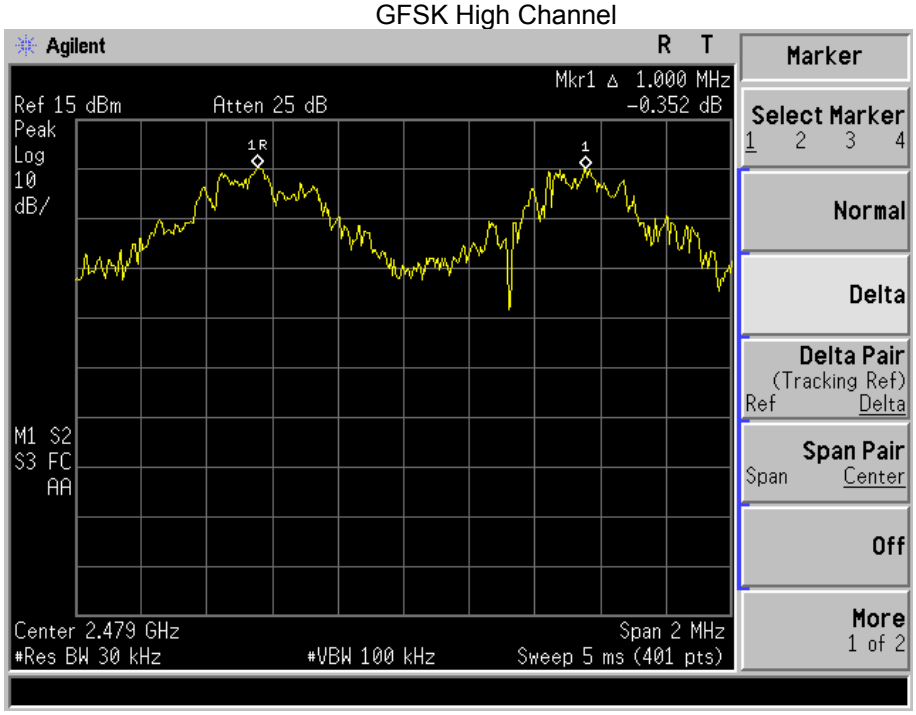
GFSK Low Channel



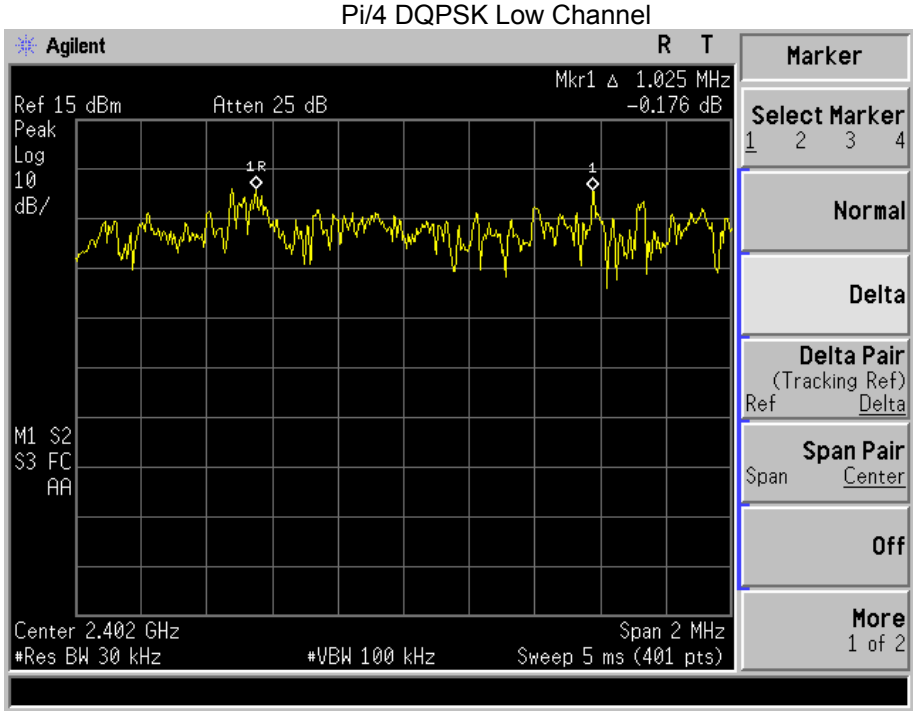
GFSK Middle Channel



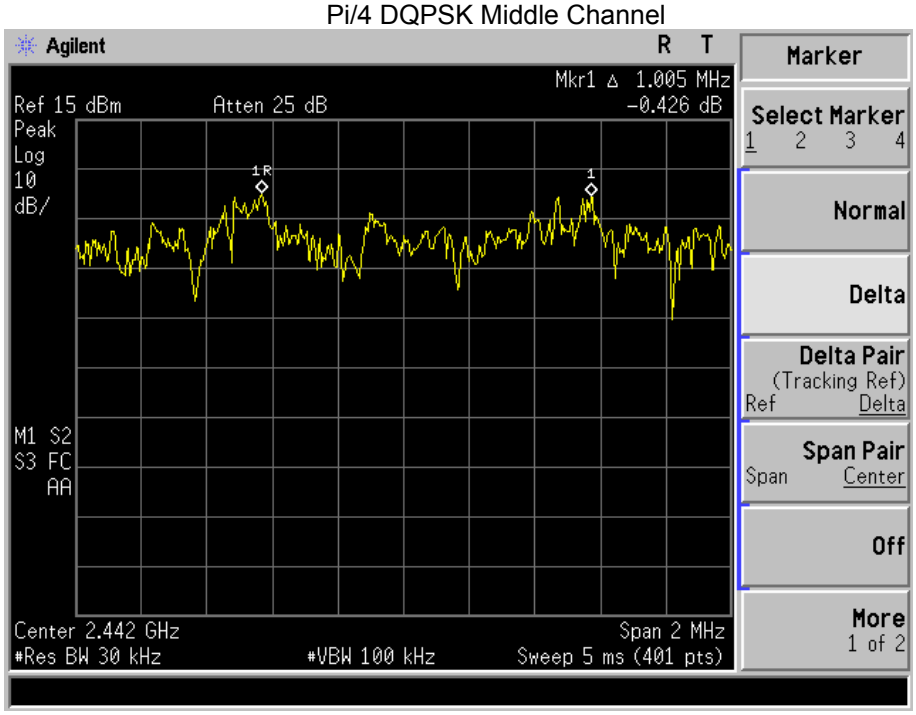
GFSK High Channel



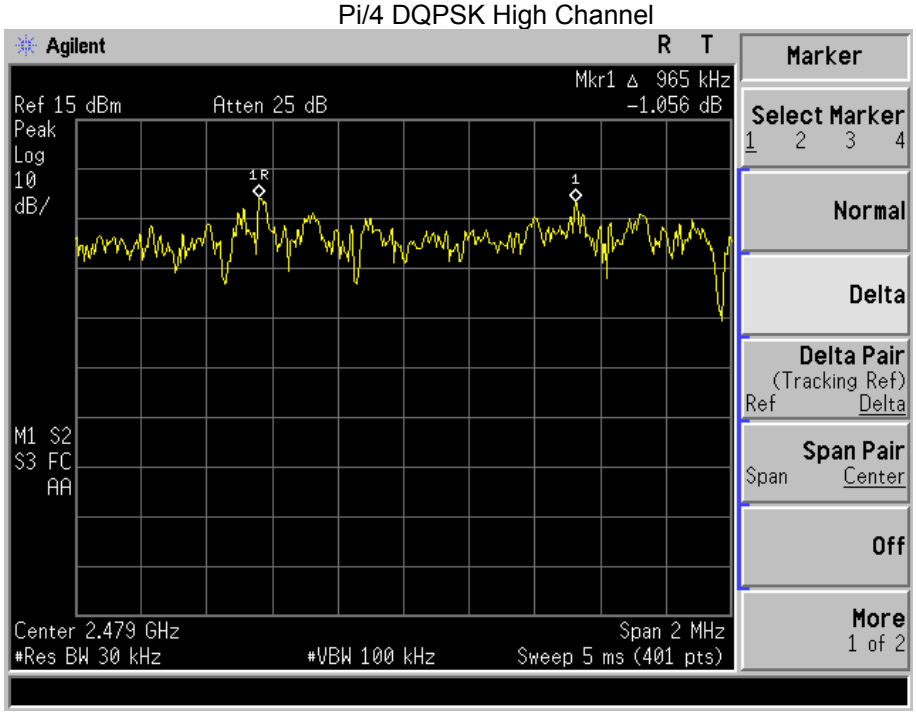
Pi/4 DQPSK Low Channel



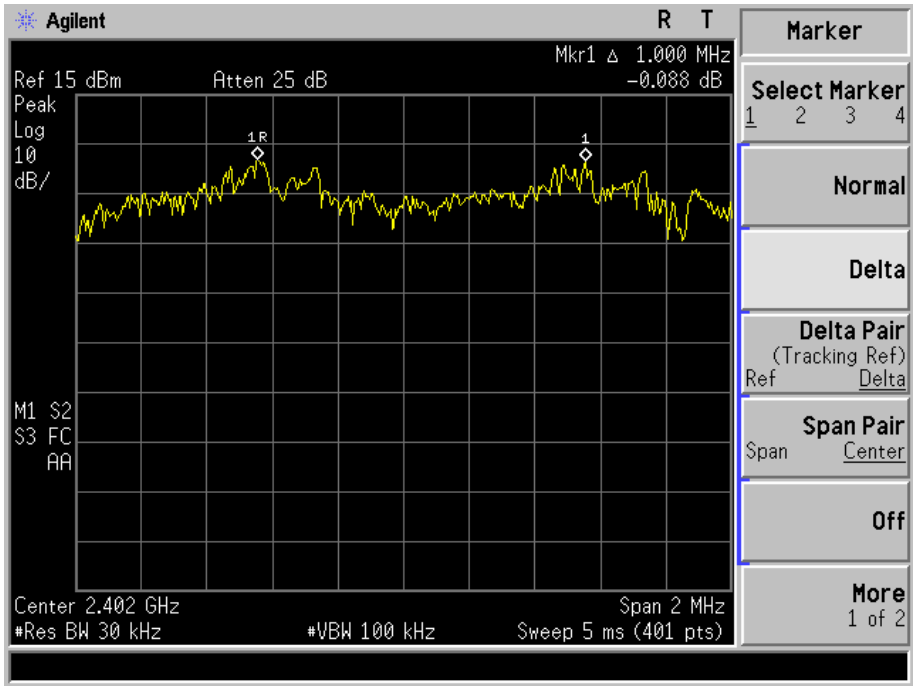
Pi/4 DQPSK Middle Channel



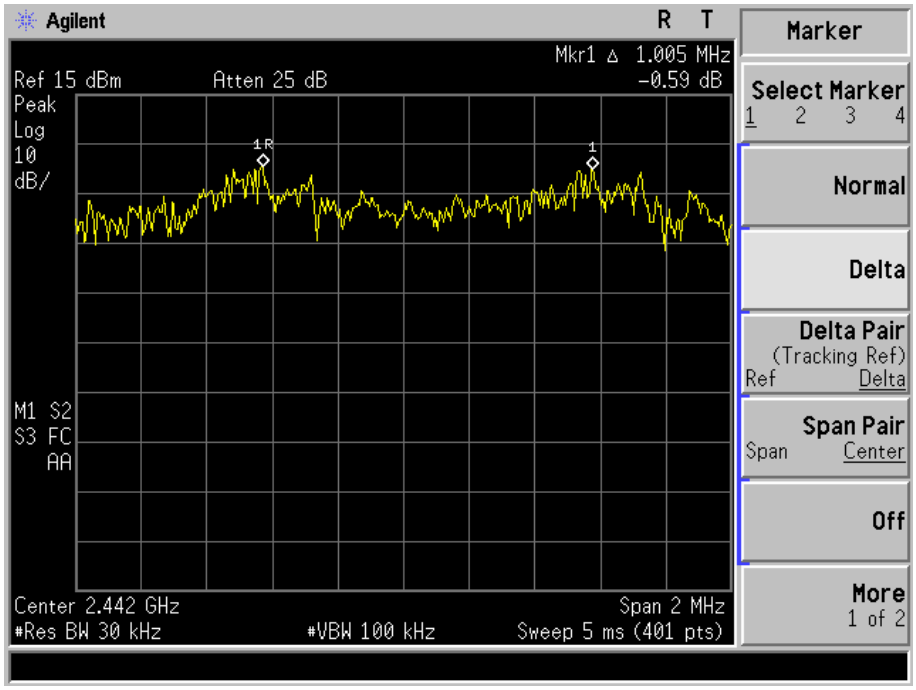
Pi/4 DQPSK High Channel



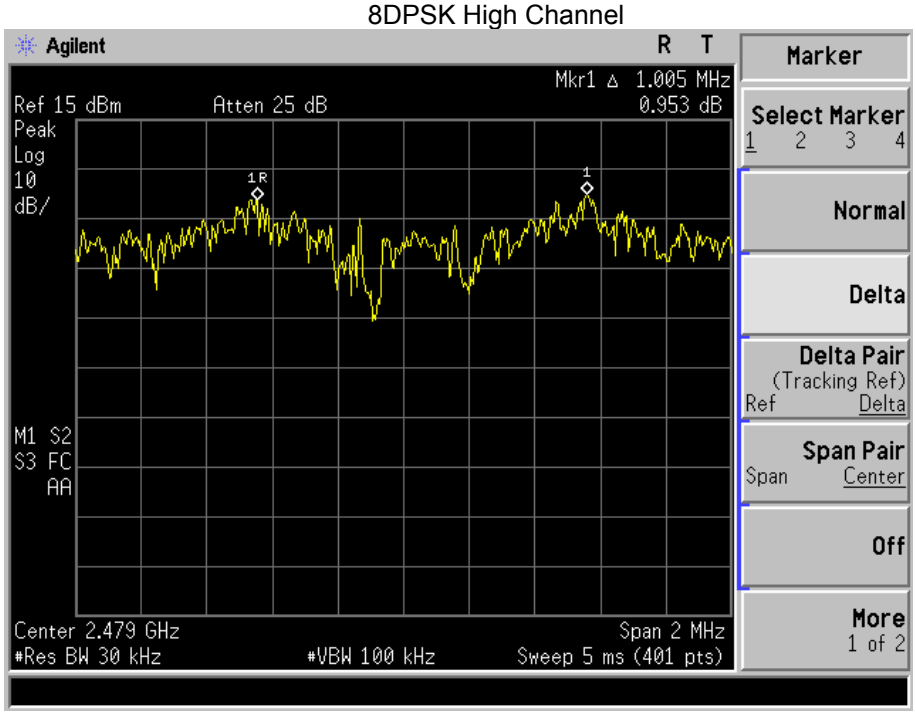
8DPSK Low Channel



8DPSK Middle Channel

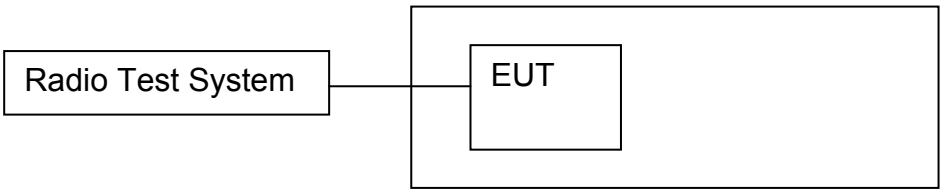


8DPSK High Channel



12. NUMBER OF HOPPING FREQUENCY

12.1 Block Diagram Of Test Setup



12.2 Limit

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

12.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

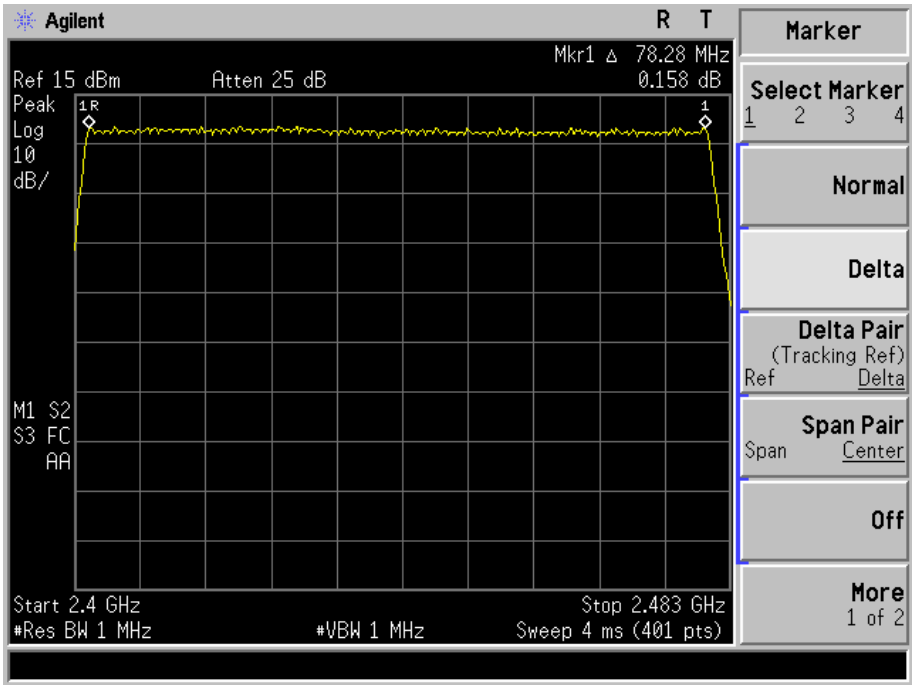
2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.

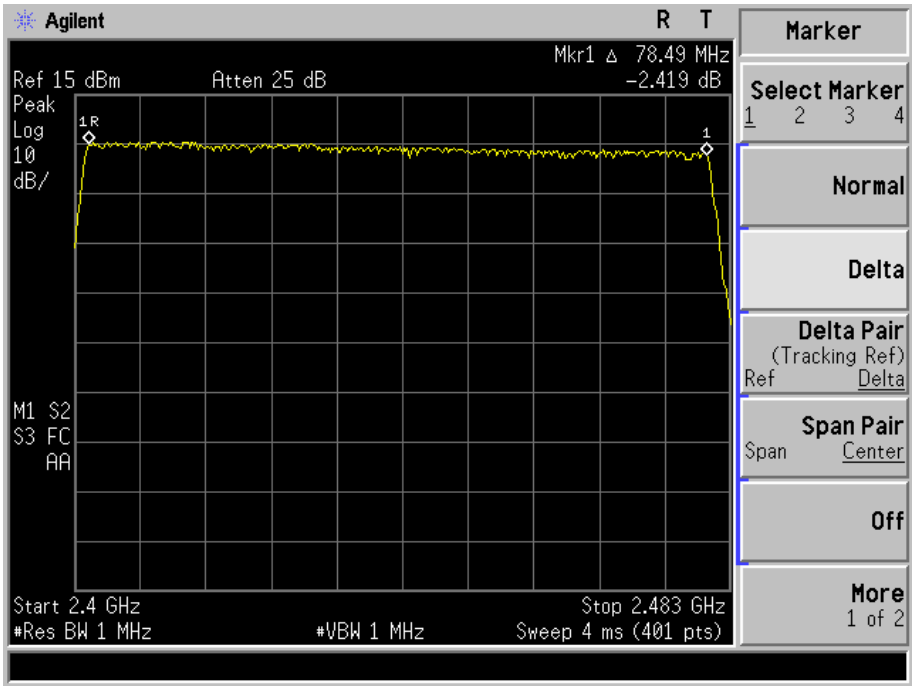
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

12.4 Test Result

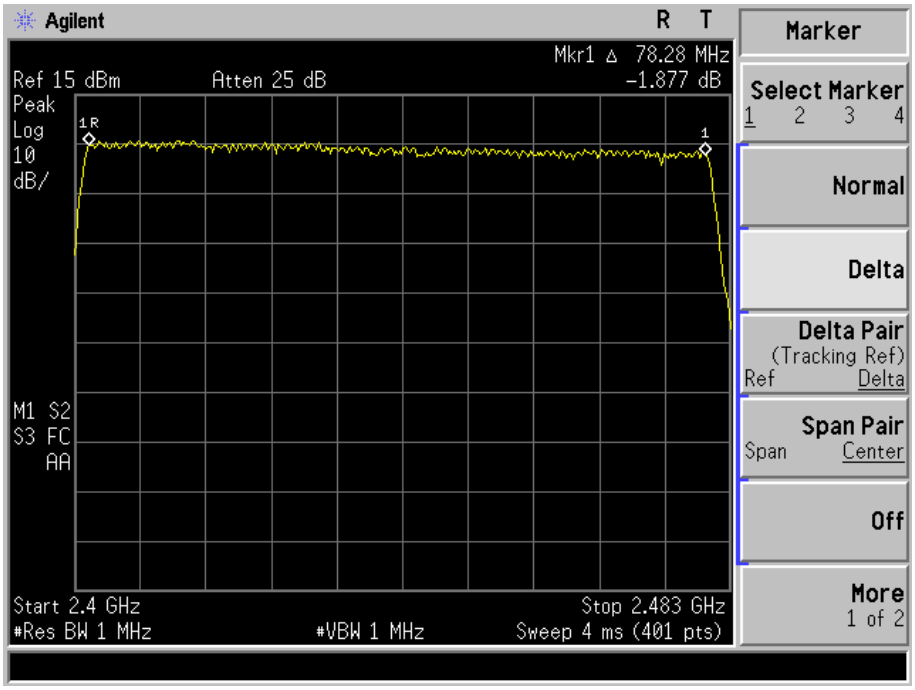
Test Plots:
79 Channels in total
GFSK



Pi/4 DQPSK

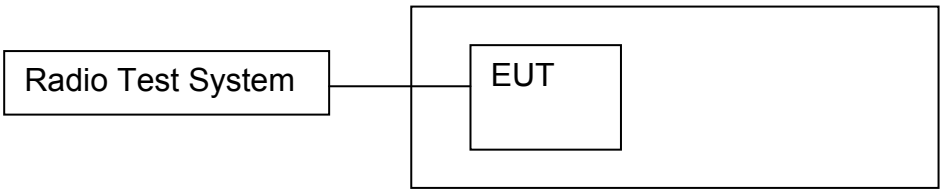


8DPSK


Agilent
R T
Mkr1 Δ 78.28 MHz
-1.877 dB
Ref 15 dBm
Atten 25 dB
Peak
Log
10
dB/
1R
1
M1 S2
S3 FC
AA
Start 2.4 GHz
#Res BW 1 MHz
#VBW 1 MHz
Stop 2.483 GHz
Sweep 4 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

13. DWELL TIME

13.1 Block Diagram Of Test Setup



13.2 Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

13.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set spectrum analyzer span = 0. Centred on a hopping channel;

3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.

4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

13.4 Test Result

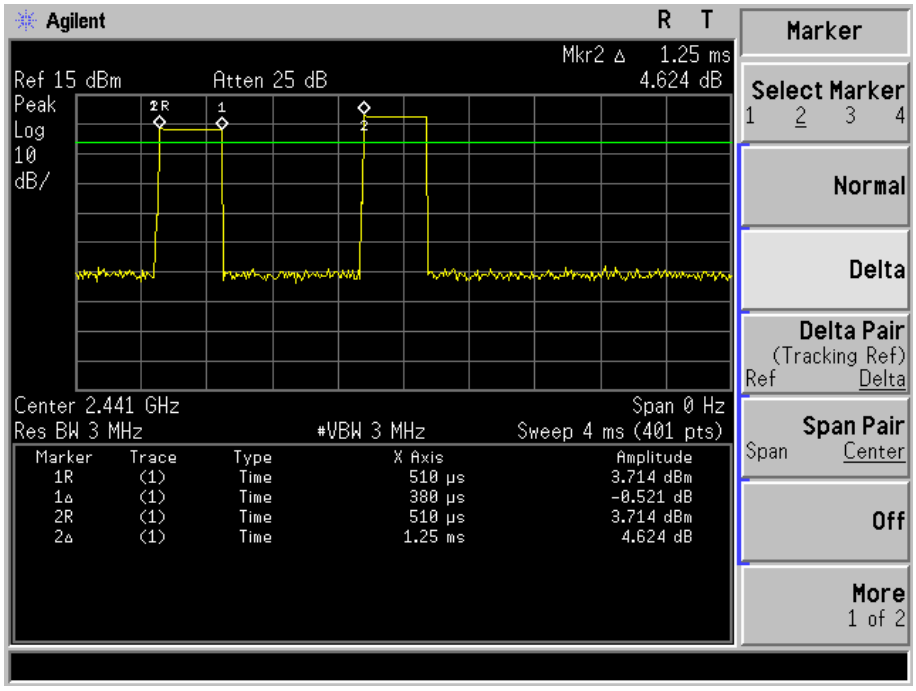
DH5 Packet permit maximum 1600 / 79 / 6 hops per second in each channel (5 time slots RX, 1 time slot TX).
DH3 Packet permit maximum 1600 / 79 / 4 hops per second in each channel (3 time slots RX, 1 time slot TX).
DH1 Packet permit maximum 1600 / 79 /2 hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

DH5:1600/79/6*0.4*79*(MkrDelta)/1000
DH3:1600/79/4*0.4*79*(MkrDelta)/1000
DH1:1600/79/2*0.4*79*(MkrDelta)/1000
Remark: Mkr Delta is once pulse time.

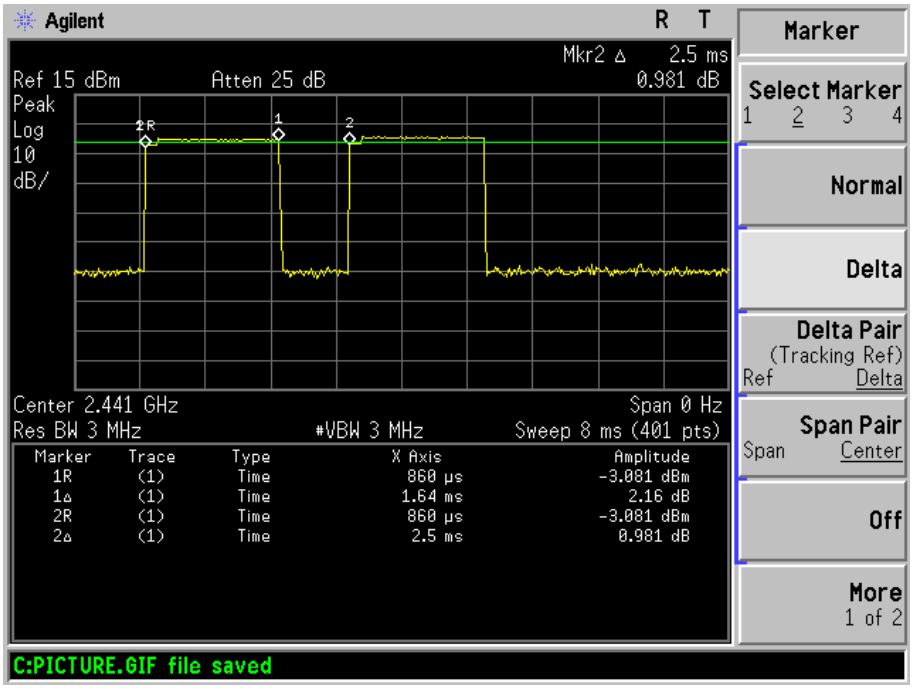
Modulation	Channel Data	Packet	pulse time(ms)	Dwell Time(s)	Limits(s)
GFSK	Middle	DH1	0.380	0.122	0.4
		DH3	1.640	0.262	0.4
		DH5	2.880	0.307	0.4
Pi/4DQPSK	Middle	DH1	0.380	0.122	0.4
		DH3	1.620	0.259	0.4
		DH5	2.880	0.307	0.4
8DPSK	Middle	DH1	0.390	0.125	0.4
		DH3	1.640	0.262	0.4
		DH5	2.910	0.310	0.4

Test Plots

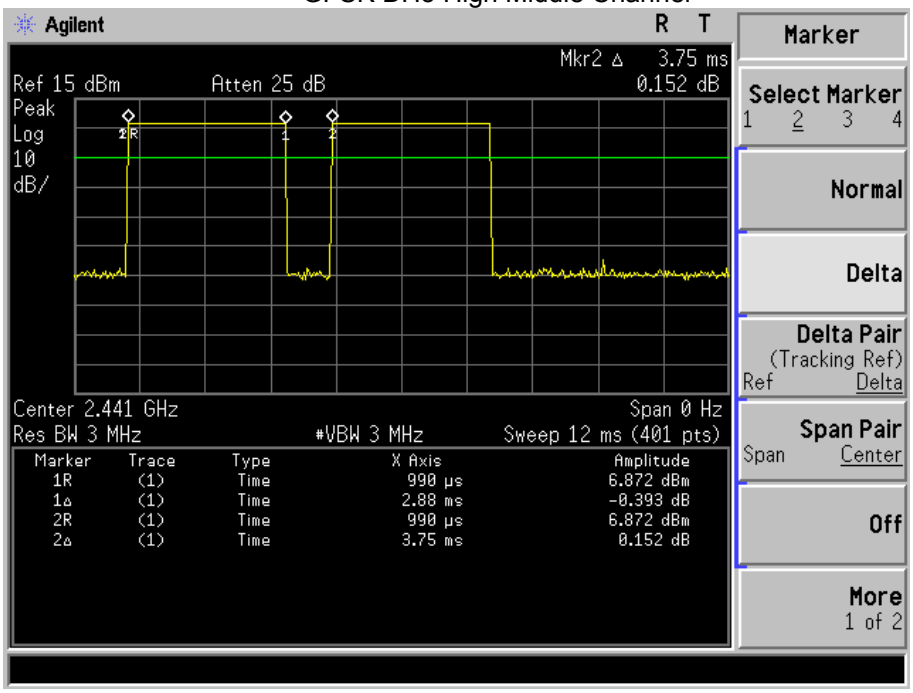
GFSK DH1 Middle Channel



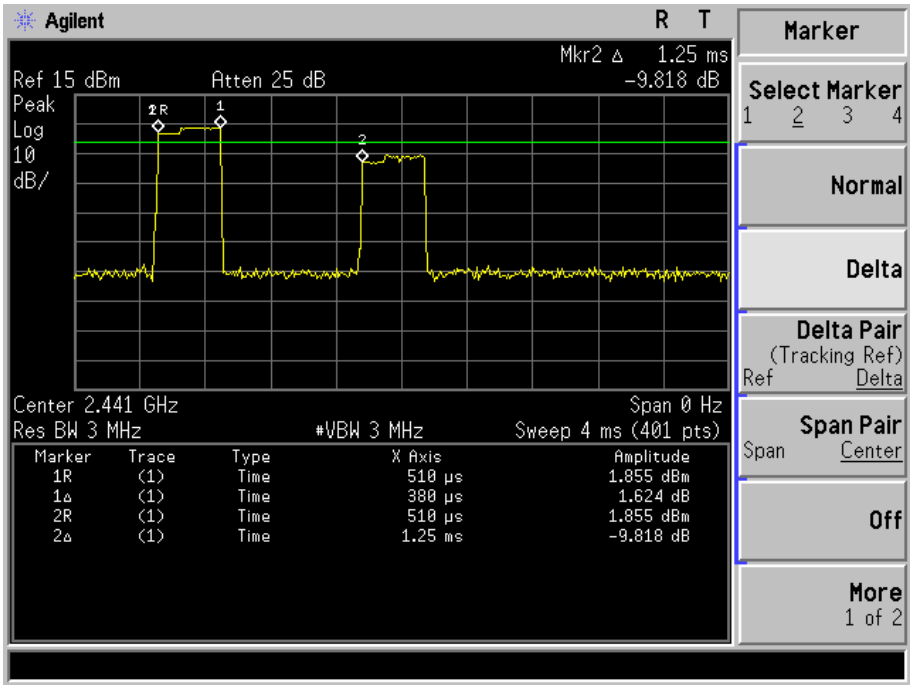
GFSK DH3 Middle Channel



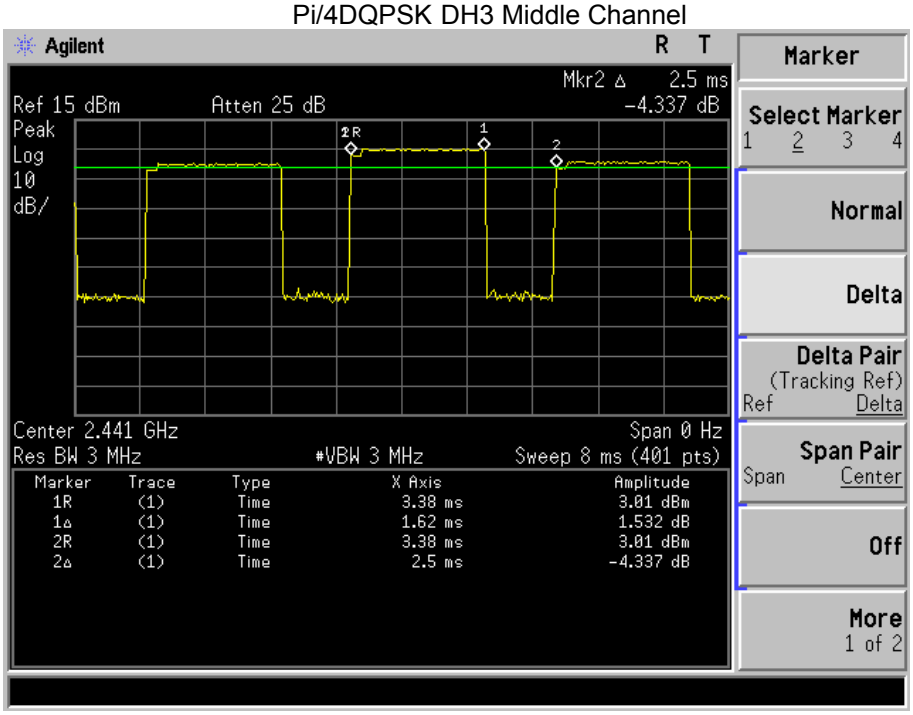
GFSK DH5 High Middle Channel



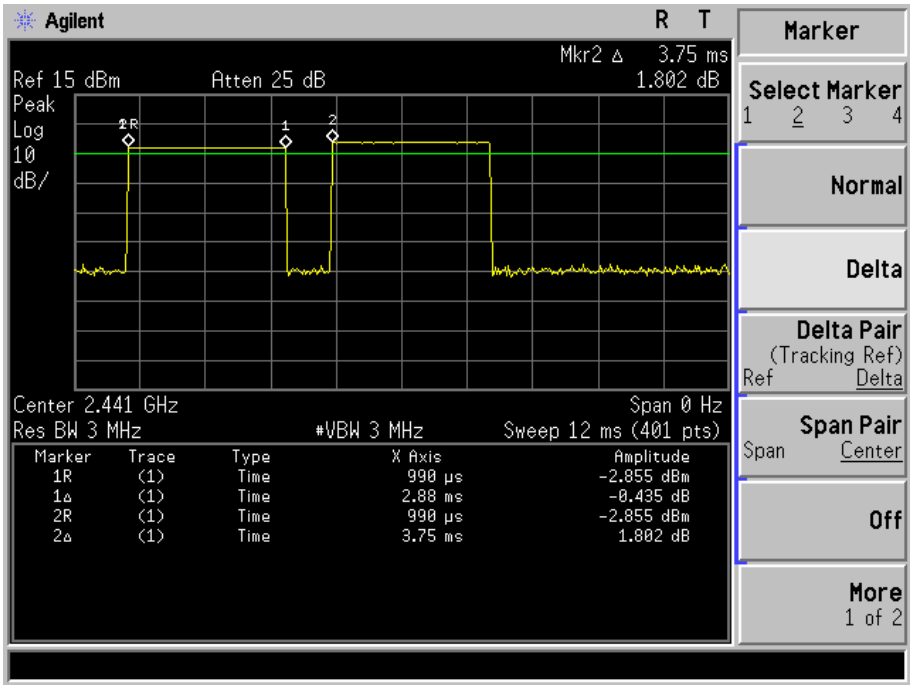
Pi/4DQPSK DH1 Middle Channel



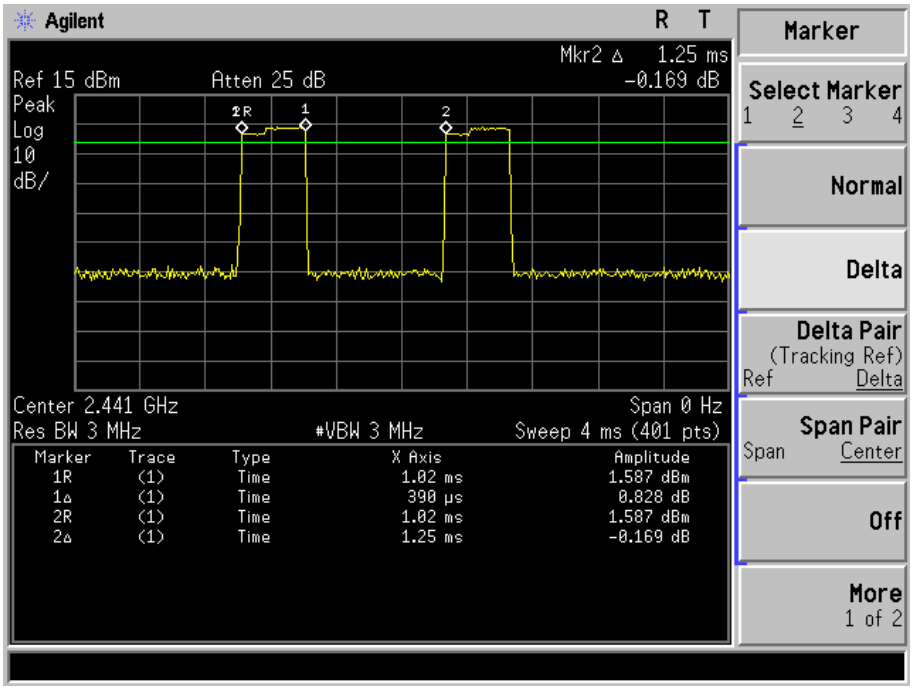
Pi/4DQPSK DH3 Middle Channel



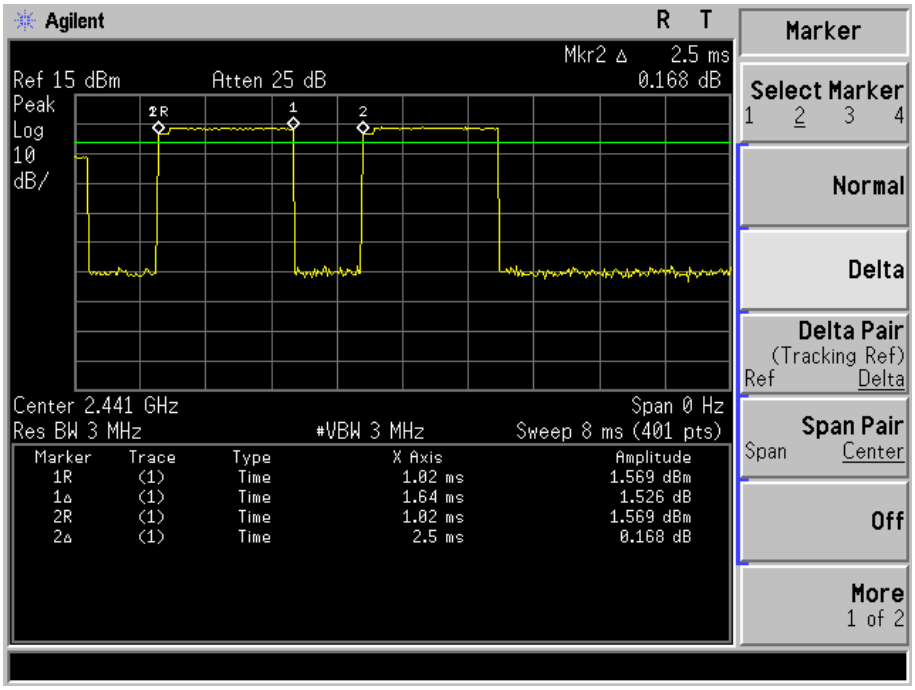
Pi/4DQPSK DH5 Middle Channel



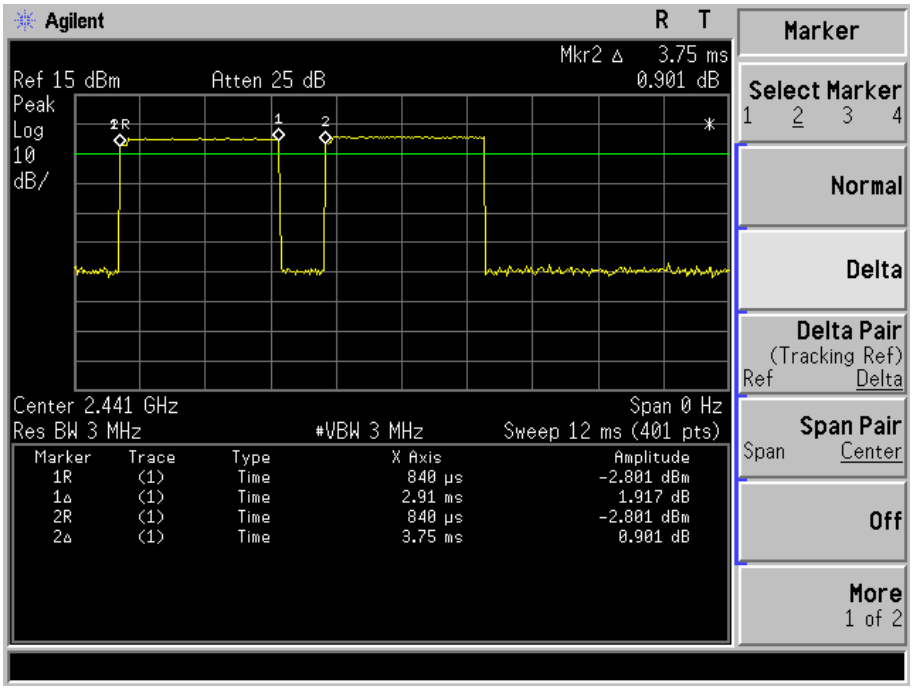
8DPSK DH1 Middle Channel



8DPSK DH3 Middle Channel



8DPSK DH5 Middle Channel



14. ANTENNA REQUIREMENT

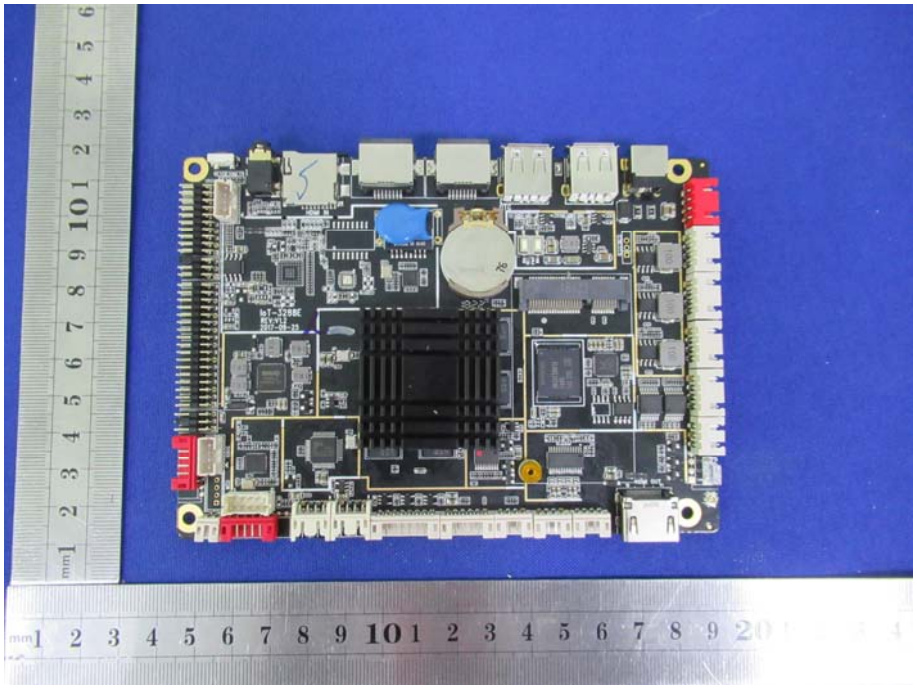
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

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.

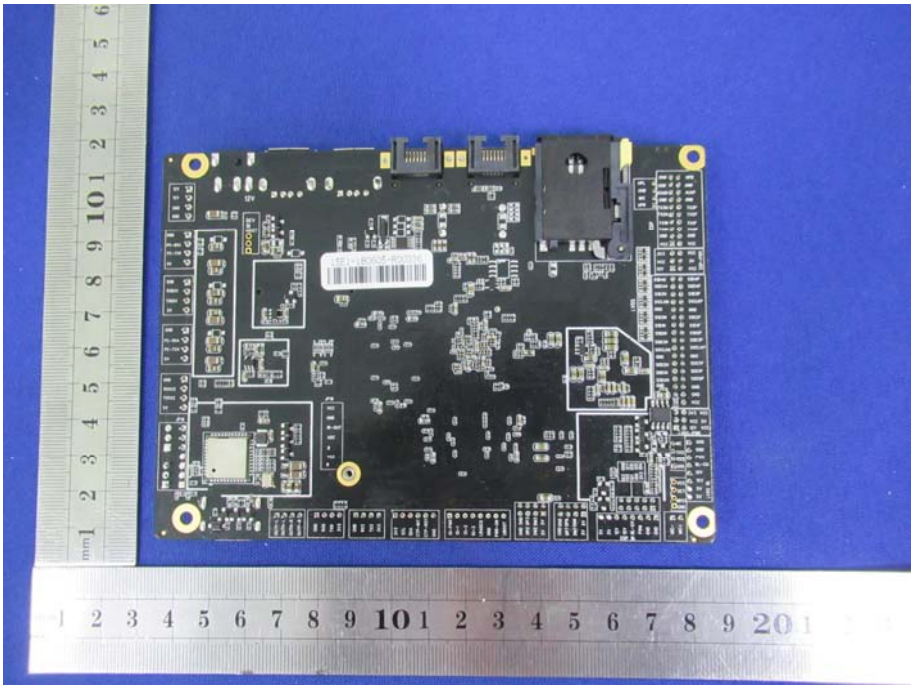
The EUT antenna is external antenna, through card buckle connect to board, external antenna is plastic, antenna Gain 2dBi, impedance 50Ω. It comply with the standard requirement of FCC 15.203.

15. EUT PHOTOGRAPHS

EUT Photo 1

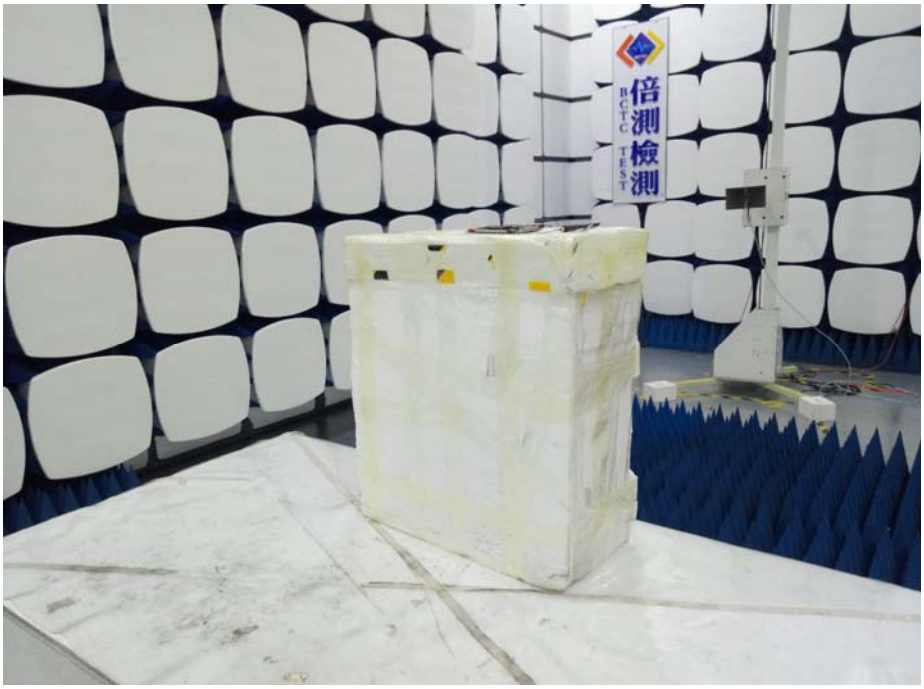


EUT Photo 2

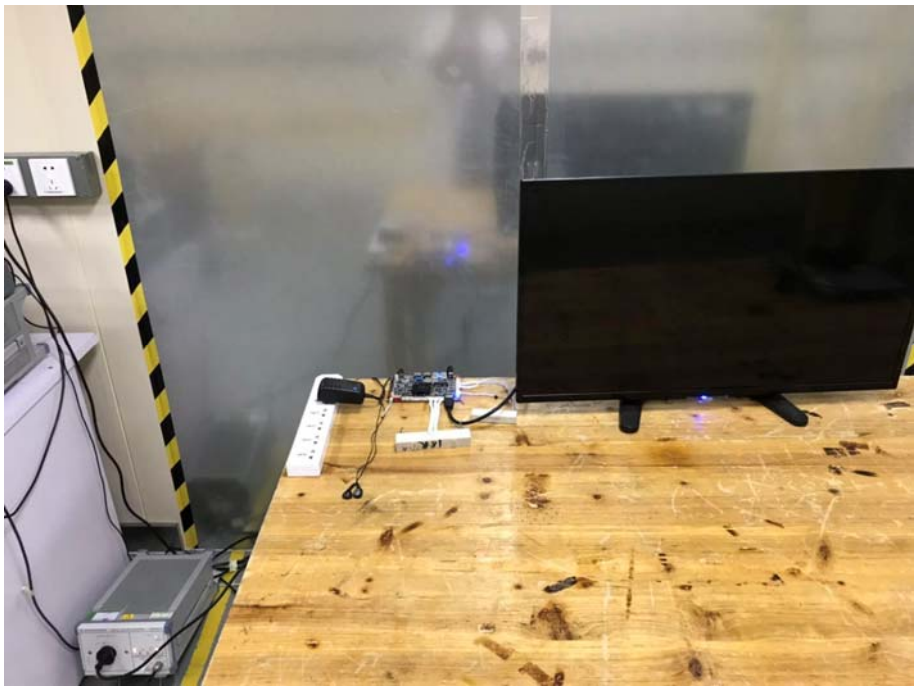


16. EUT TEST SETUP PHOTOGRAPHS

Spurious emissions



Conducted emissions



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