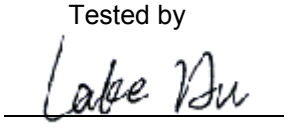
FCC CERTIFICATION TEST REPORT

For

FCC ID：2AAOY-2635986

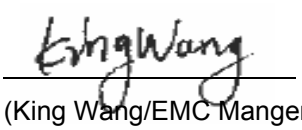
Report Reference No..... :	15FAS10064 11
FCC 2.948 No..... :	923232
Date of issue..... :	2015-11-09
Testing Laboratory..... :	ATT Product Service Co., Ltd.
Address..... :	No. 3, ChangLianShan Industrial Park, ChangAn Town, DongGuan City, GuangDong, China.
Applicant's name ..... :	Mitek Corp
Address..... :	1 Mitek Plaza Winslow,IL61089,United States
Manufacturer..... :	Mitek Corp
Test specification:	
Test item description..... :	Overhead Audio Unit
Trade Mark ..... :	--
Model/Type reference ..... :	2635986, 2881115 (Two models for the same product)
Ratings..... :	I/P: 12Vdc full battery is used to supply power

Tested by



(Rock Huang/Engineer)

Approved by



(King Wang/EMC Manger)

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TEST REPORT DECLARE

Applicant	:	Mitek Corp
Address	:	1 Mitek Plaza Winslow,IL61089,United States
Equipment under Test	:	Overhead Audio Unit
Model No	:	2635986, 2881115 (Two models for the same product)
FCC ID	:	2AAOY-2635986
Manufacturer	:	Mitek Corp
Address	:	1 Mitek Plaza Winslow,IL61089,United States

Test Standard Used: FCC Rules and Regulations Part 15 Subpart C: 2013

Test procedure used: ANSI C63.4: 2014, DA 00-705.

We Declare:

The equipment described above is tested by ATT Product Service Co., Ltd and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and ATT Product Service Co., Ltd is assumed of full responsibility for the accuracy and completeness of these tests.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC standards.

Report No:	15FAS10064 11		
Date of Test:	2015/10/29-2015/11/06	**Date of Report**:	2015/11/09

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of ATT Product Service Co., Ltd

1. SUMMARY OF TEST RESULTS

The EUT have been tested according to the applicable standards as referenced below.		
Description of Test Item	**Standard**	**Results**
20dB Bandwidth	FCC Part 15: 15.247 DA 00-705	N/A
Carrier Frequency Separation Test	FCC Part 15: 15.247 DA 00-705	PASS
Number Of Hopping Frequency	FCC Part 15: 15.247 DA 00-705	PASS
Dwell Time Test	FCC Part 15: 15.247 DA 00-705	PASS
Peak Output Power	FCC Part 15: 15.247 DA 00-705	PASS
Band Edge	FCC Part 15: 15.247	PASS
Spurious Emission	FCC Part 15.205/15.209	PASS
Antenna requirement	FCC Part 15: 15.203	PASS
Conducted Emission	FCC Part 15.207	N/A

2. GENERAL TEST INFORMATION

2.1. DESCRIPTION OF EUT

EUT* Name	:	Overhead Audio Unit
Model Number	:	2635986, 2881115 (Two models for the same product)
EUT function description	:	Please reference user manual of this device
Power supply	:	12Vdc full battery is used to supply power
Radio Technology	:	Bluetooth V3.0
Operation frequency	:	2402-2480MHz
Modulation	:	GFSK,8DPSK, π /4DQPSK
Antenna Type	:	printed antenna, maximum PK gain:0dBi
Date of Receipt	:	2015/10/29
Sample Type	:	Single production

Note1: EUT is the ab. of equipment under test.

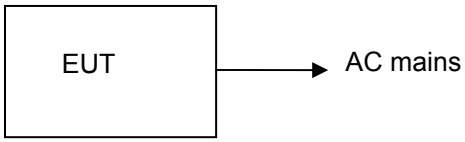
2.2. ACCESSORIES OF EUT

Description of Accessories	Manufacturer	Model number or Type	Output.
/	/	/	/

2.3. ASSISTANT EQUIPMENT USED FOR TEST

Description of Assistant equipment	Manufacturer	Model number or Type	EMC Compliance	SN
Notebook	acer	Aspire E1-472G	/	/
Battery Charge	Ao Neng	6-DZM-10	/	/

2.4. BLOCK DIAGRAM OF EUT CONFIGURATION FOR TEST



EUT was connected to control to a special test jig provided by manufacturer which has a Micro USB connector to connect to Notebook, and the Notebook will run a special test software to control EUT work in Continuous TX mode, and select test channel, wireless mode and data rate.

Remark: GFSK,8DPSK, π /4DQPSK all these modulation all have been tested , GFSK is found as worst case and only reported for radiated emission.

Tested mode, channel, and data rate information			
Mode	data rate (Mpbs) (see Note)	Channel	Frequency (MHz)
GFSK (Worst)	1	Low :CH0	2402
	1	Middle: CH39	2441
	1	High: CH78	2480
Note: According exploratory test, EUT will have maximum output power in those data rate, so those data rate were used for all test.			

2.5. TEST ENVIRONMENT CONDITIONS

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

Temperature range:	21-25℃
Humidity range:	40-75%
Pressure range:	86-106kPa

2.6. MEASUREMENT UNCERTAINTY

Test Item	Uncertainty
Uncertainty for Conduction emission test	2.44dB
Uncertainty for Radiation Emission test (9KHz-30MHz)	3.21dB
Uncertainty for Radiation Emission test (30MHz-200MHz)	3.42 dB (Polarize: V)
	3.52 dB (Polarize: H)
Uncertainty for Radiation Emission test (200MHz-1GHz)	3.52 dB (Polarize: V)
	3.54 dB (Polarize: H)
Uncertainty for Radiation Emission test (1GHz to 25GHz)	4.20 dB (Polarize: V)
	4.20 dB (Polarize: H)
Uncertainty for radio frequency	1×10-9
Uncertainty for conducted RF Power	0.65dB

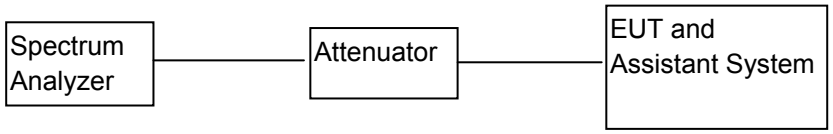
Note：This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3. 20dB BANDWIDTH

3.1. TEST EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Due.	Cal. Interval
1	Spectrum analyzer	R&S	FSU	1166.1660.26	2015/12/26	1 Year
2	Attenuator	Mini-Circuits	BW-S10W2	101109	2015/12/26	1 Year
3	RF Cable	Micable	C10-01-01-1	100309	2015/12/26	1 Year

3.2. BLOCK DIAGRAM OF TEST SETUP



3.3. LIMITS

For direct sequence systems, the minimum 20dB bandwidth shall be at least 500 KHz

3.4. TEST PROCEDURE

(1) Configure EUT and assistant system according clause 2.4 and 3.2

(2) Connect EUT's antenna output to spectrum analyzer by RF cable.

(3) Configure EUT work in test mode as stated in clause 2.4.

(4) Set the spectrum analyzer as follows:

RBW:	100KHz
VBW:	300KHz
Detector Mode:	Peak
Sweep time:	auto
Trace mode:	Max hold

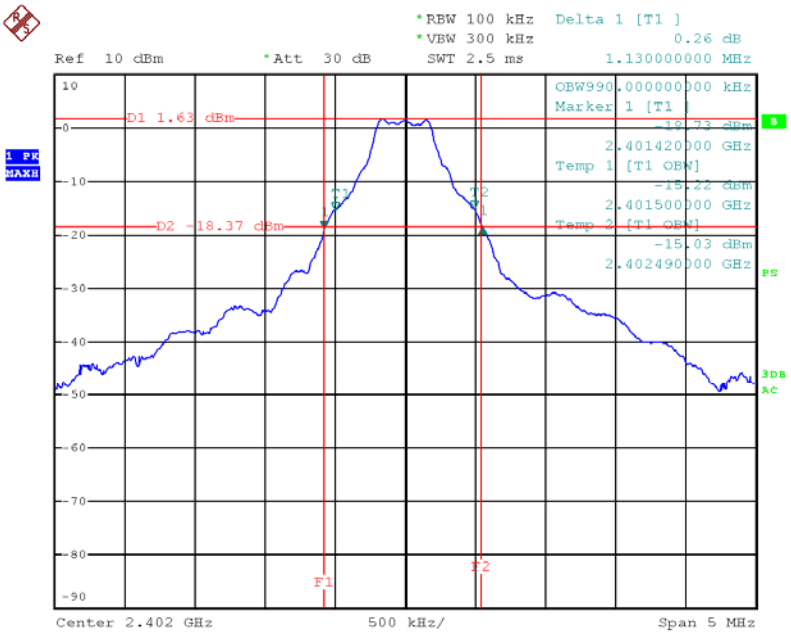
(5) Allow the trace to stabilize, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

3.5. TEST RESULT

Channel	Frequency (MHz)	GFSK 20dB Bandwidth (MHz)	π /4DQPSK 20dB Bandwidth (MHz)	8DPSK 20dB Bandwidth (MHz)	Result
Low	2402	1.13	1.32	1.33	Pass
Middle	2441	1.10	1.32	1.32	Pass
High	2480	1.09	1.32	1.33	Pass

3.6. ORIGINAL TEST DATA

GFSK



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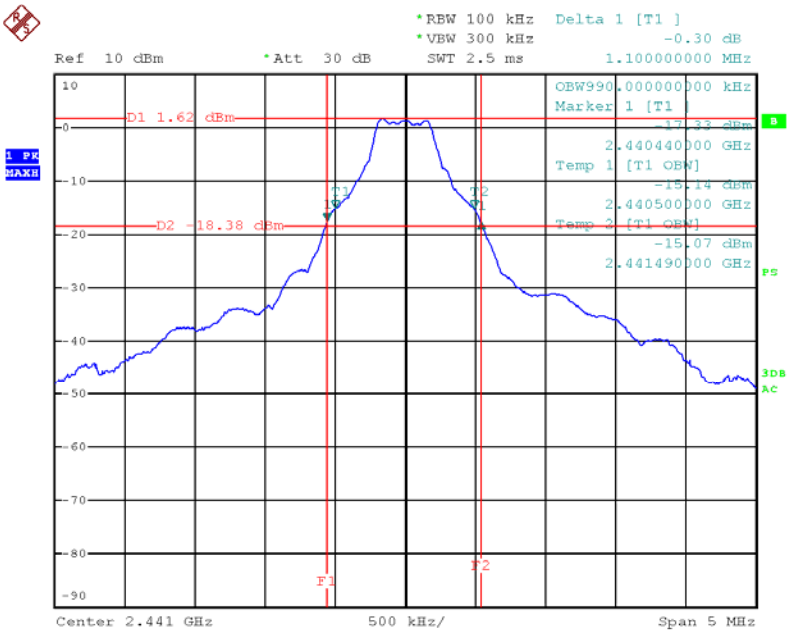

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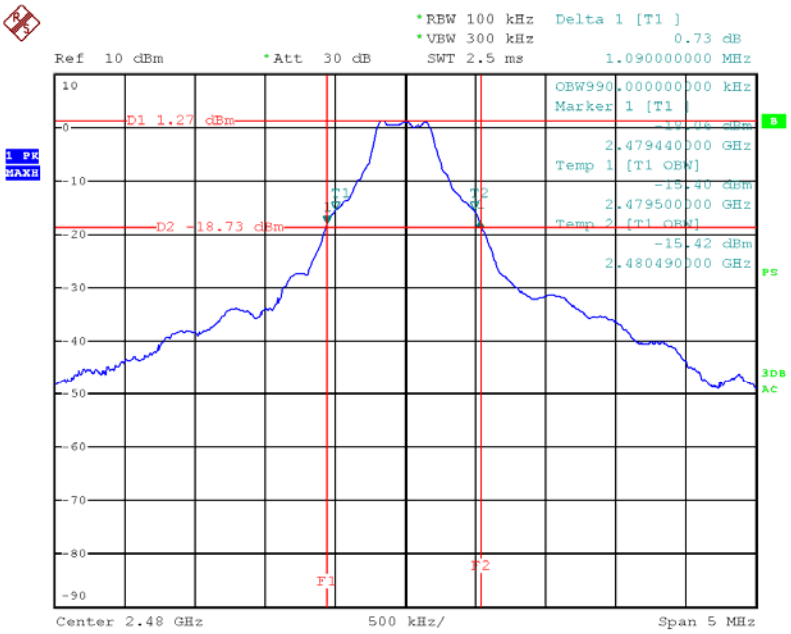

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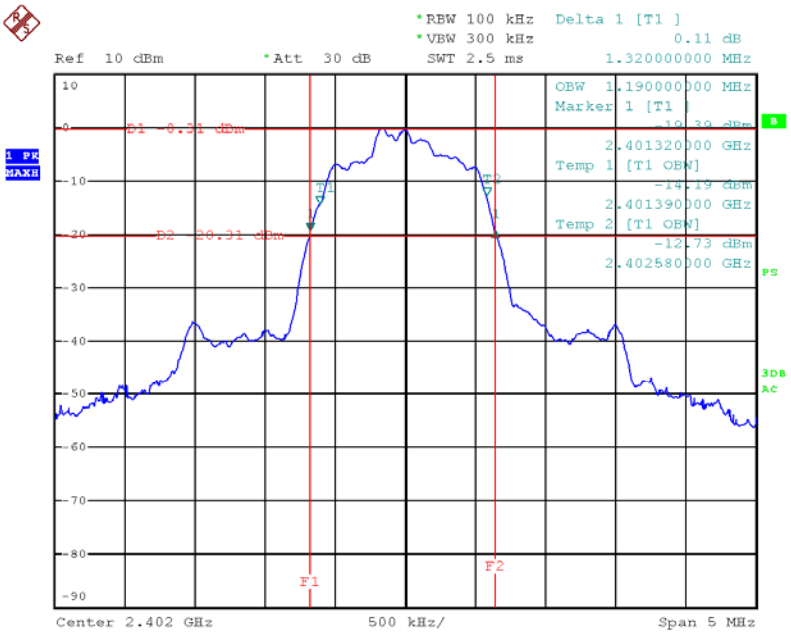
π /4DQPSK



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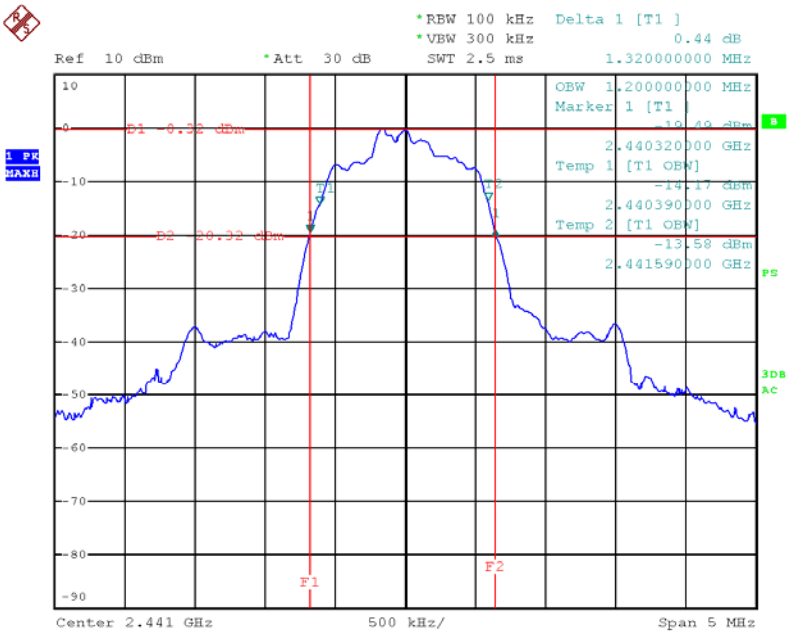

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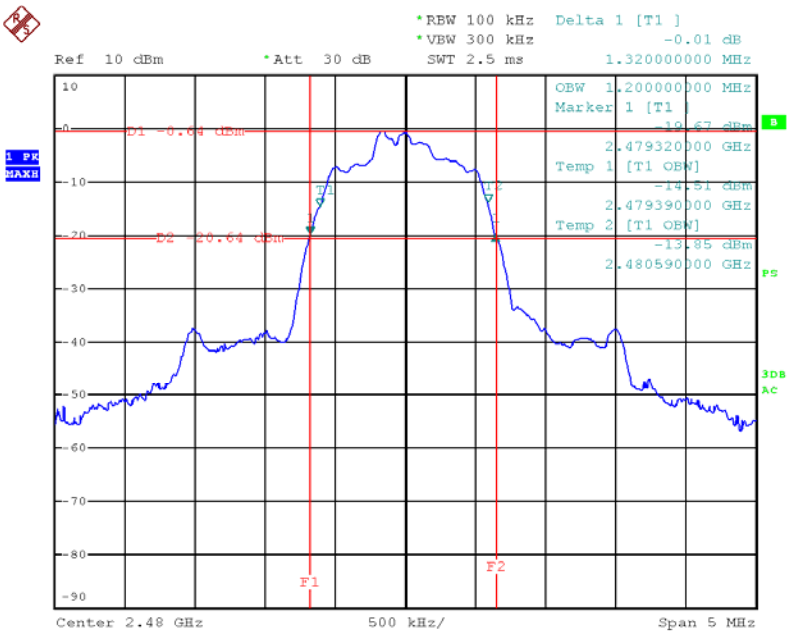

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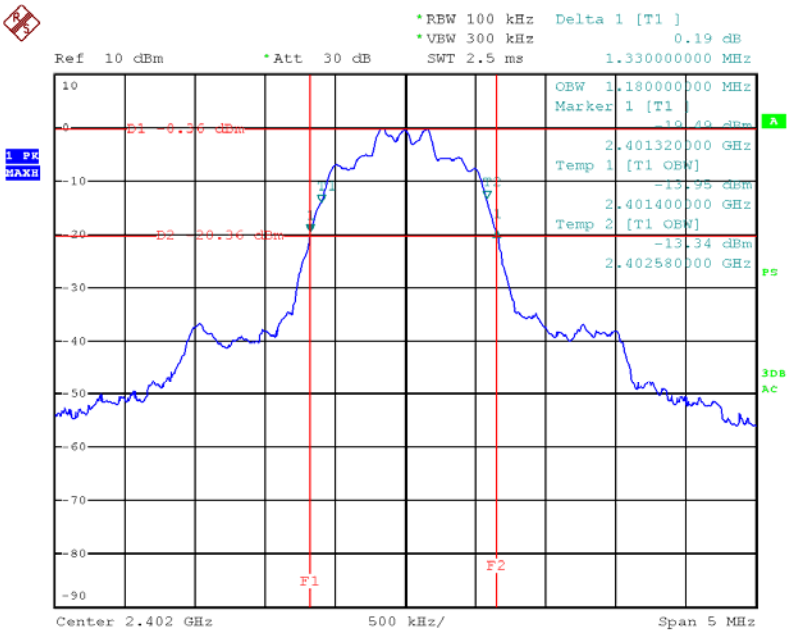
8DPSK



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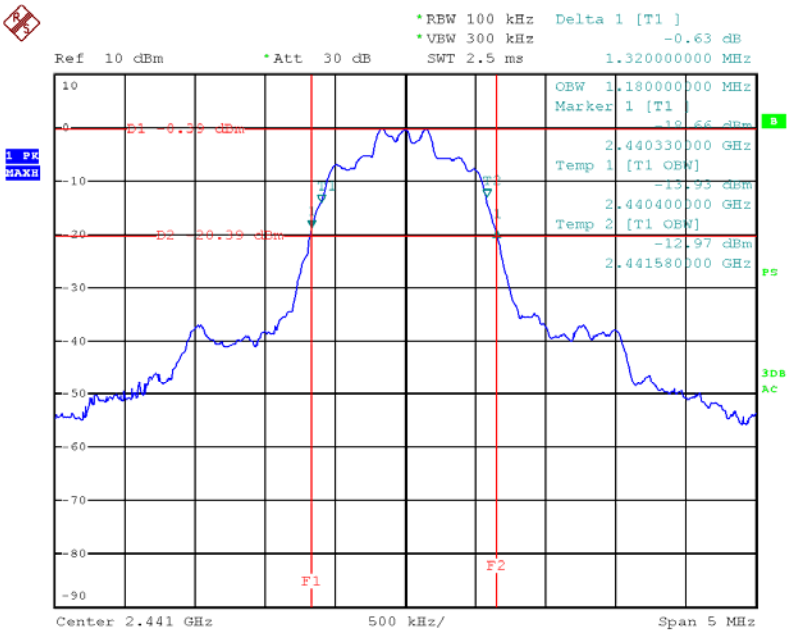

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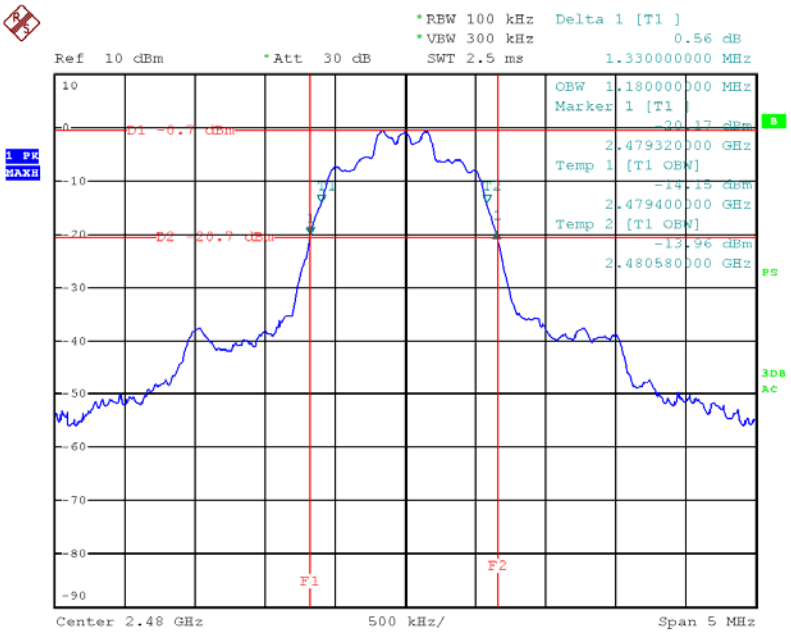

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4. CARRIER FREQUENCY SEPARATION TEST

4.1.THE REQUIREMENT FOR SECTION 15.247(A)(1)

Section 15.247(a)(1): 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 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly
ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

4.2.EUT CONFIGURATION ON MEASUREMENT

The equipment are installed on the emission measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

4.3.OPERATING CONDITION OF EUT

（1）Setup the EUT and simulator as shown as Section 6.1.

（2）Turn on the power of all equipment.

（3）Let the EUT work in TX (Hopping on) modes measure it. The transmit frequency are 2402-2480MHz. We select 2402MHz, 2441MHz, and 2480MHz TX frequency to transmit.

4.4.TEST PROCEDURE

（1）The transmitter output was connected to the spectrum analyzer through a low loss cable.

（2）.Set RBW of spectrum analyzer to 30 kHz and VBW to 100 kHz. Adjust Span to 3 MHz.

（3）Set the adjacent channel of the EUT maxhold another trace.

（4）Measurement the channel separation

4.5.TEST RESULT

GFSK

Channel	Frequency (MHz)	Channel Separation(MHz)	Limit (MHz)	Result
Low	2402	1.005	>(25KHz or 2/3*20dB Bandwidth)	PASS
Middle	2441	1.026	>(25KHz or 2/3*20dB Bandwidth)	PASS
High	2479	1.014	>(25KHz or 2/3*20dB Bandwidth)	PASS

π /4DQPSK

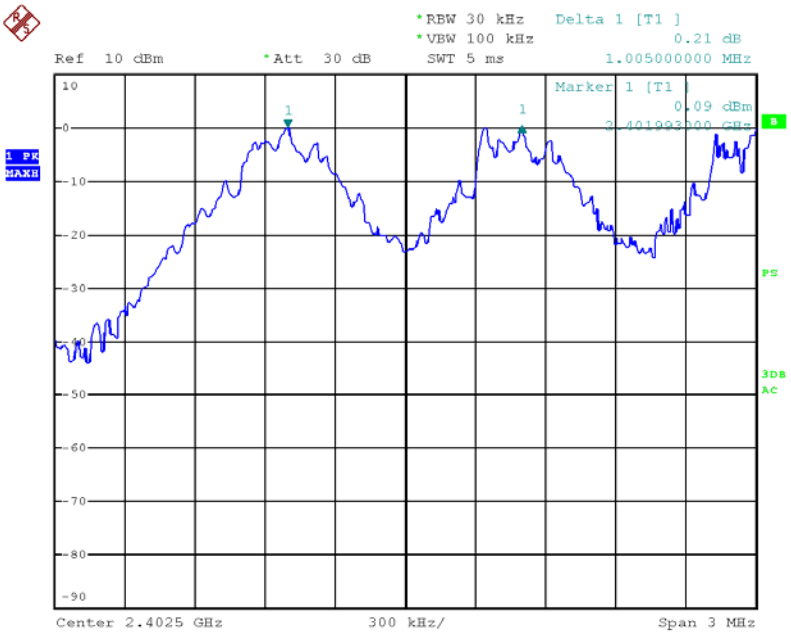
Channel	Frequency (MHz)	Channel Separation(MHz)	Limit (MHz)	Result
Low	2402	1.002	>25KHz or 2/3*20dB bandwidth	PASS
Middle	2441	1.002	>25KHz or 2/3*20dB bandwidth	PASS
High	2479	1.002	>25KHz or 2/3*20dB bandwidth	PASS

8DPSK

Channel	Frequency (MHz)	Channel Separation(MHz)	Limit (MHz)	Result
Low	2402	1.014	>25KHz or 2/3*20dB bandwidth	PASS
Middle	2441	1.020	>25KHz or 2/3*20dB bandwidth	PASS
High	2479	1.002	>25KHz or 2/3*20dB bandwidth	PASS

The spectrum analyzer plots are attached as below.

GFSK



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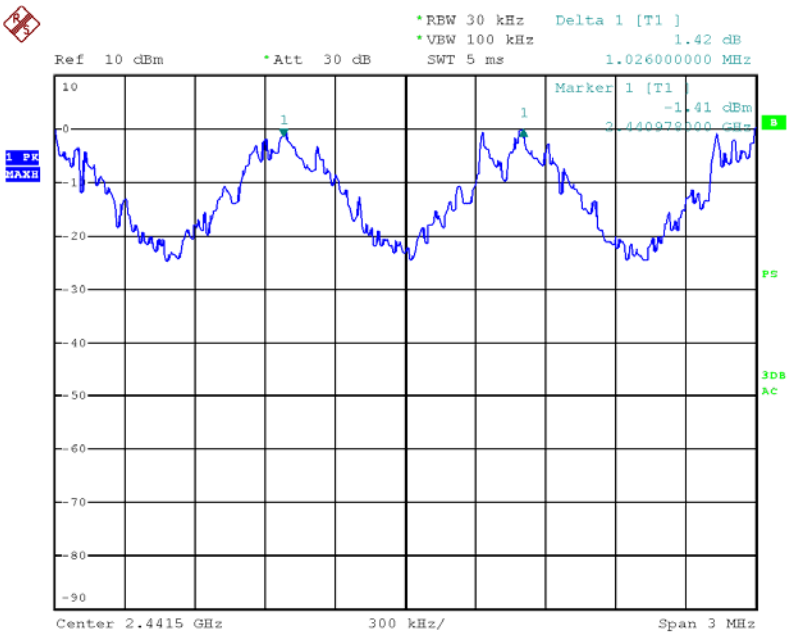

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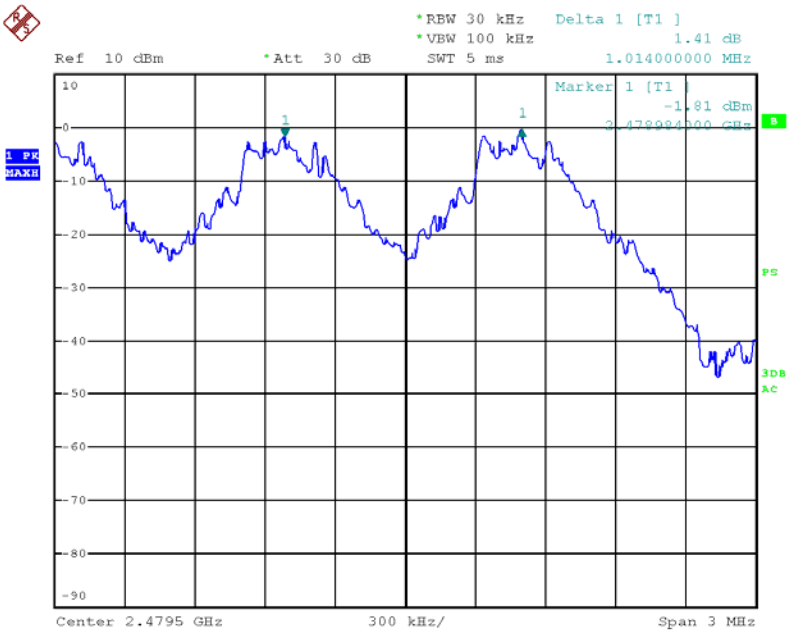

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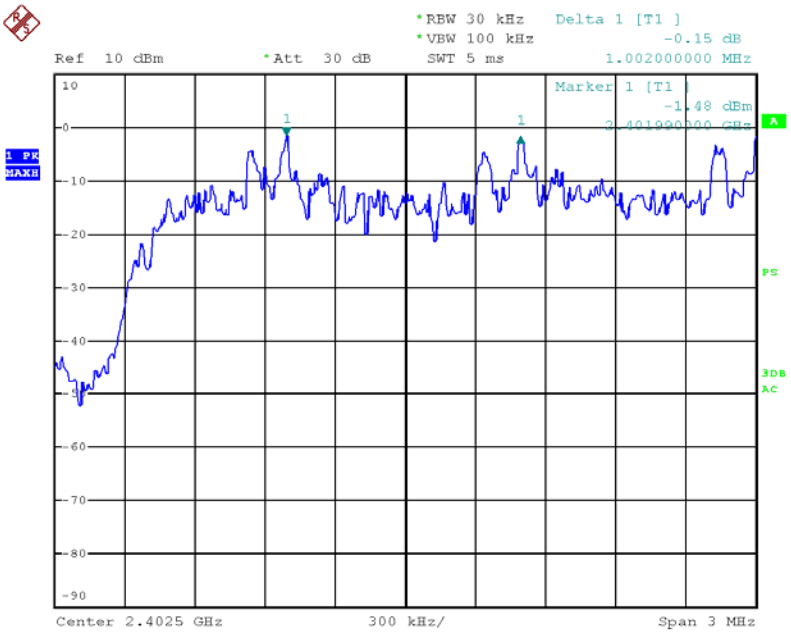
Ⅱ/4-DQPSK



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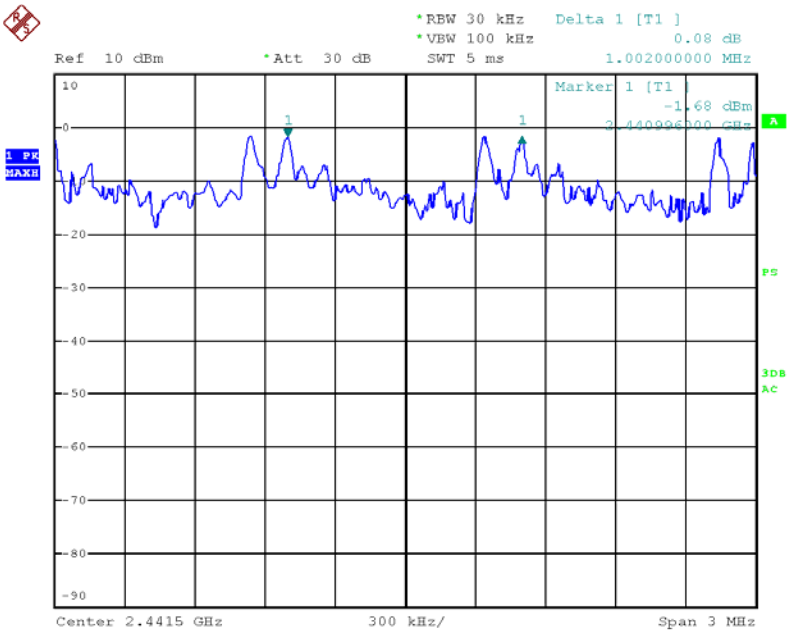

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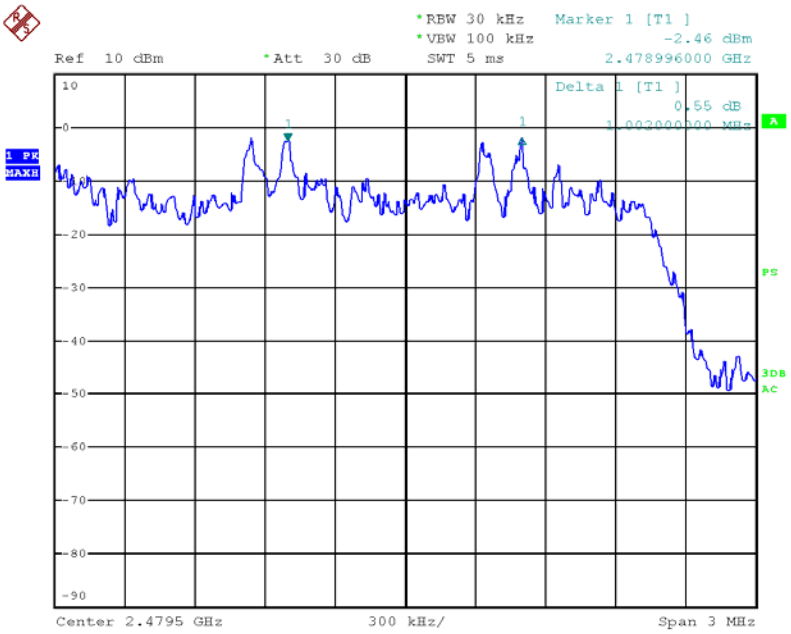

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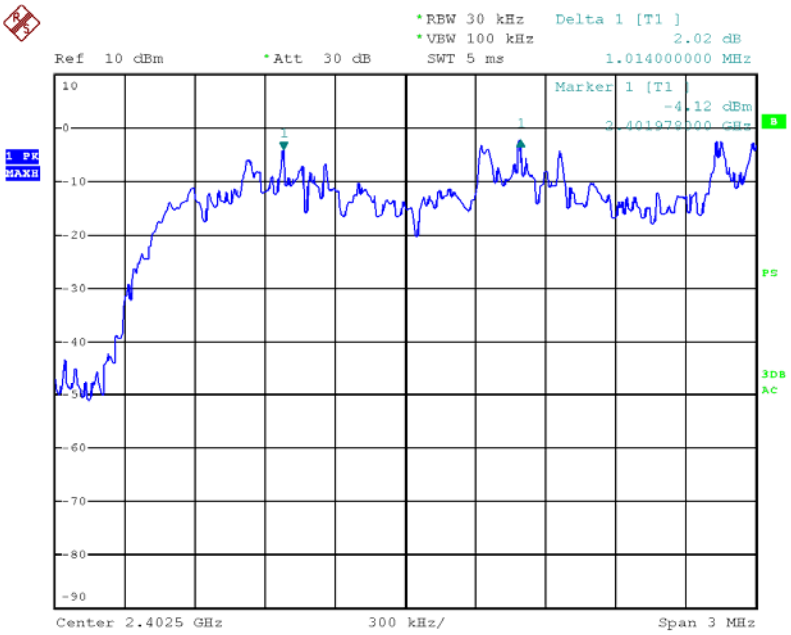
8DPSK



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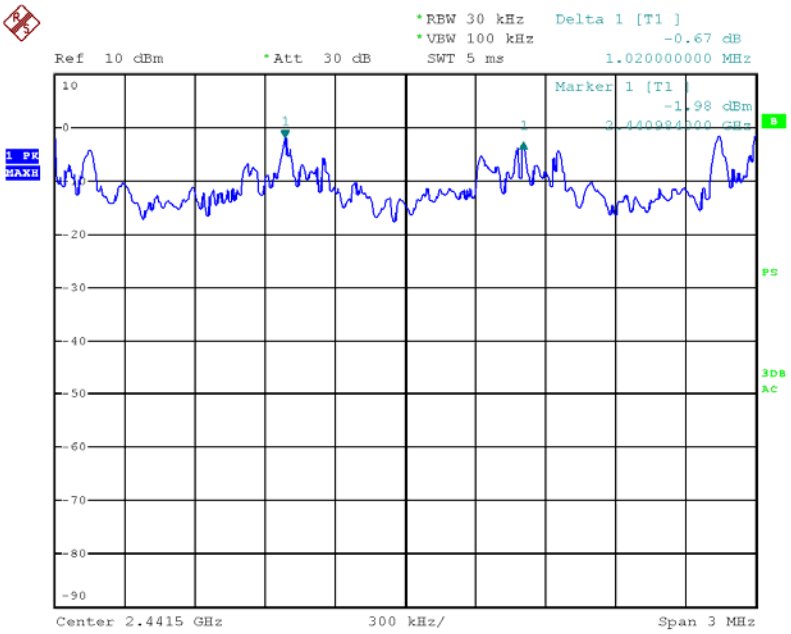

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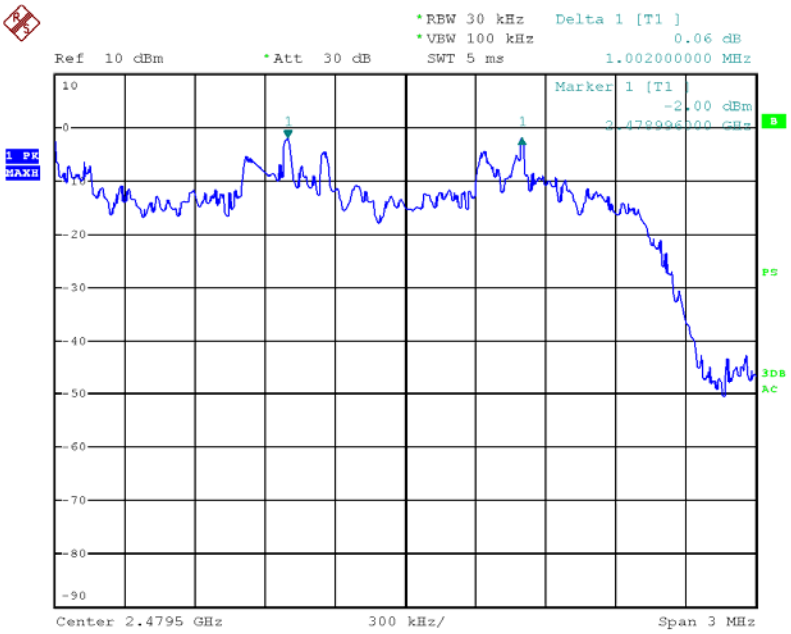

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5. NUMBER OF HOPPING FREQUENCY TEST

5.1. THE REQUIREMENT FOR SECTION 15.247(a)(1)(iii)

Section 15.247(a)(1)(iii): Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

5.2. EUT CONFIGURATION ON MEASUREMENT

The equipment are installed on the emission measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

5.3. OPERATING CONDITION OF EUT

（1）Setup the EUT and simulator as shown as Section 7.1.

（2）Turn on the power of all equipment.

（3）Let the EUT work in TX (Hopping on) modes measure it.

5.4. TEST PROCEDURE

（1）The transmitter output was connected to the spectrum analyzer through a low loss cable.

（2）Set the spectrum analyzer as Span=83.5MHz, RBW=100 kHz, VBW=300 kHz.

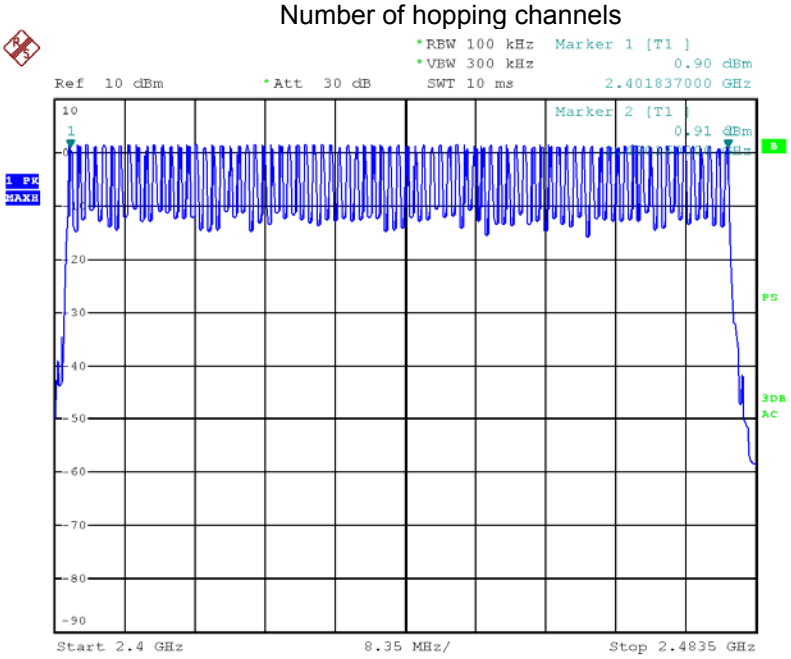
（3）Max hold, view and count how many channel in the band.

5.5. TEST RESULT

Total number of hopping channel	Measurement result(CH)	Limit(CH)
	79	≥15

The spectrum analyzer plots are attached as below

Number of hopping channels



Channle information									
CH	Frequency	CH	Frequency	CH	Frequency	CH	Frequency	CH	Frequency
0	2402	16	2418	32	2434	48	2450	64	2466
1	2403	17	2419	33	2435	49	2451	65	2467
2	2404	18	2420	34	2436	50	2452	66	2468
3	2405	19	2421	35	2437	51	2453	67	2469
4	2406	20	2422	36	2438	52	2454	68	2470
5	2407	21	2423	37	2439	53	2455	69	2471
6	2408	22	2424	38	2440	54	2456	70	2472
7	2409	23	2425	39	2441	55	2457	71	2473
8	2410	24	2426	40	2442	56	2458	72	2474
9	2411	25	2427	41	2443	57	2459	73	2475
10	2412	26	2428	42	2444	58	2460	74	2476
11	2413	27	2429	43	2445	59	2461	75	2477
12	2414	28	2430	44	2446	60	2462	76	2478
13	2415	29	2431	45	2447	61	2463	77	2479
14	2416	30	2432	46	2448	62	2464	78	2480
15	2417	31	2433	47	2449	63	2465	-	-

6. DWELL TIME TEST

6.1. THE REQUIREMENT FOR SECTION 15.247(a)(1)(iii)

Section 15.247(a)(1)(iii): 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.

6.2. EUT CONFIGURATION ON MEASUREMENT

The equipment are installed on the emission measurement to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

6.3. OPERATING CONDITION OF EUT

（1）Setup the EUT and simulator as shown as Section 8.1.

（2）Turn on the power of all equipment.

（3）Let the EUT work in TX (Hopping on) modes measure it. The transmit frequency are 2402-2480MHz. We select 2402MHz, 2441MHz, and 2480MHz TX frequency to transmit.

6.4. TEST PROCEDURE

（1）The transmitter output was connected to the spectrum analyzer through a low loss cable.

（2）Set center frequency of spectrum analyzer = operating frequency.

（3）Set the spectrum analyzer as RBW=1MHz, VBW=1MHz, Span=0Hz, Adjust Sweep=5ms, 10ms, 20ms. Get the pulse time.

6.5. TEST RESULT

GFSK Mode

Mode	Channel Frequency (MHz)	Pulse Time (ms)	Dwell Time (ms)	Limit (ms)
DH1	2402	0.43	137.6	400
	2441	0.44	140.8	400
	2480	0.43	137.6	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(2*79)) ×31.6				
DH3	2402	1.70	272	400
	2441	1.70	272	400
	2480	1.70	272	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(4*79)) ×31.6				
DH5	2402	2.98	317.9	400
	2441	3.00	320	400
	2480	3.00	320	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(6*79)) ×31.6				

Π/4-DQPSK Mode

Mode	Channel Frequency (MHz)	Pulse Time (ms)	Dwell Time (ms)	Limit (ms)
DH1	2402	0.44	140.8	400
	2441	0.44	140.8	400
	2480	0.44	140.8	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(2*79)) ×31.6				
DH3	2402	1.72	275.2	400
	2441	1.72	275.2	400
	2480	1.70	272	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(4*79)) ×31.6				
DH5	2402	3.00	320	400
	2441	3.00	320	400
	2480	3.00	320	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(6*79)) ×31.6				

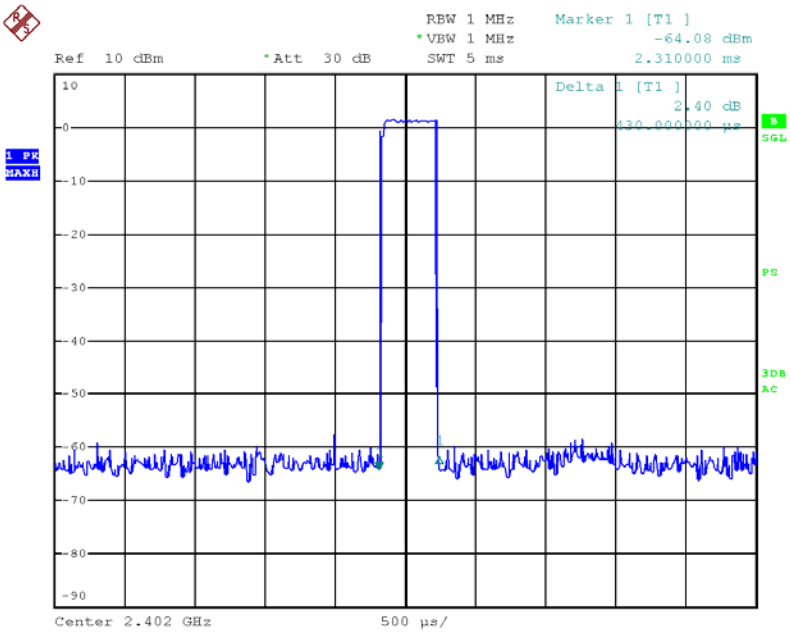
8DPSK Mode

Mode	Channel Frequency (MHz)	Pulse Time (ms)	Dwell Time (ms)	Limit (ms)
DH1	2402	0.44	140.8	400
	2441	0.44	140.8	400
	2480	0.44	140.8	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(2*79)) ×31.6				
DH3	2402	1.70	272	400
	2441	1.70	272	400
	2480	1.72	275.2	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(4*79)) ×31.6				
DH5	2402	3.00	320	400
	2441	3.04	324.3	400
	2480	3.00	320	400
A period transmit time = 0.4 × 79 = 31.6 Dwell time = pulse time × (1600/(6*79)) ×31.6				

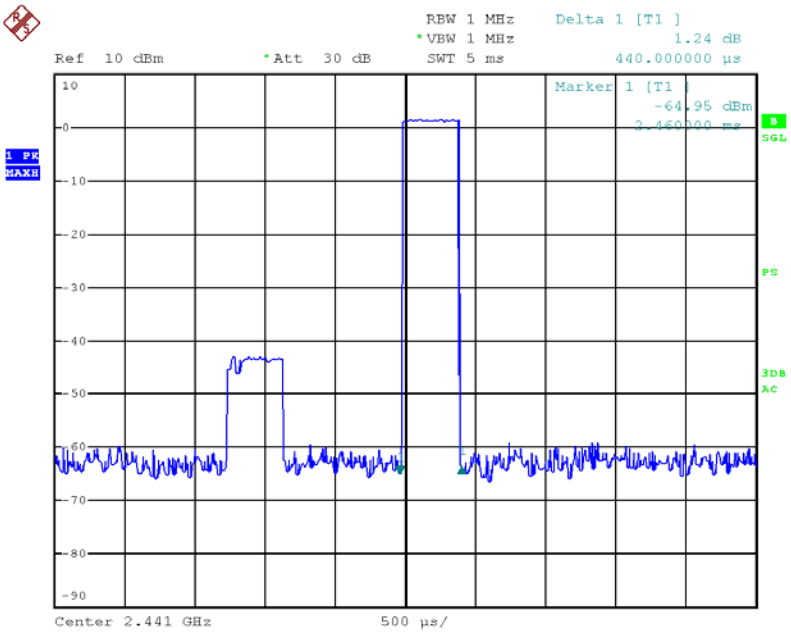
The spectrum analyzer plots are attached as below:

GFSK Mode

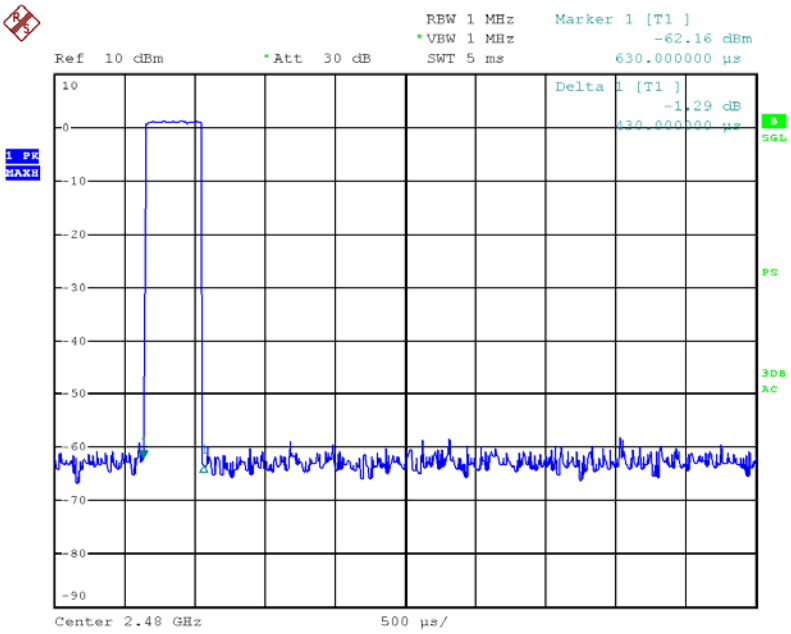
DH1



Date: 1.NOV.2015 11:00:57

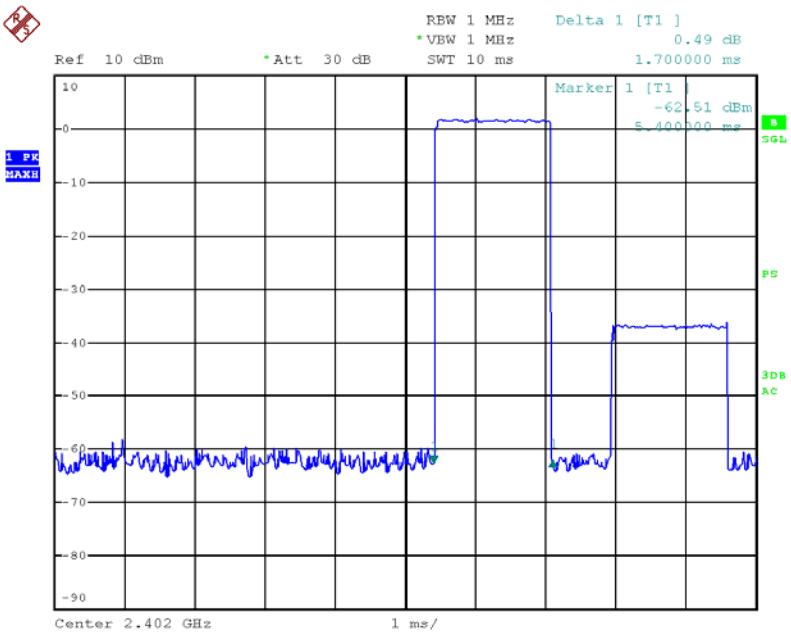


Date: 1.NOV.2015 11:01:13

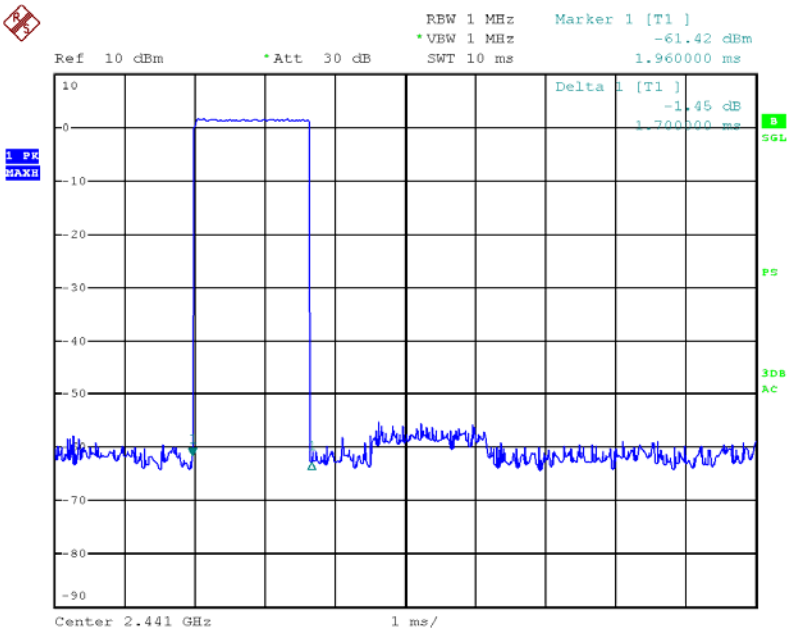


Date: 1.NOV.2015 11:01:32

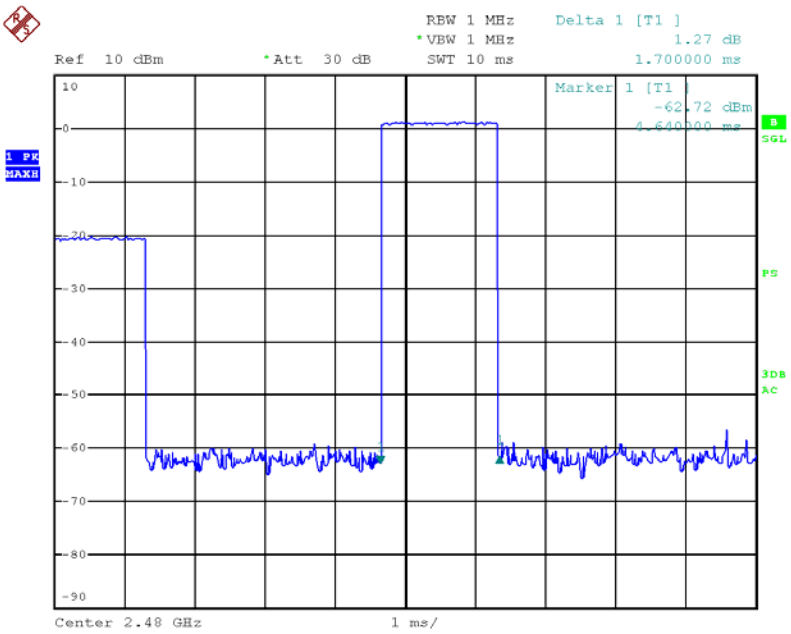
DH3



Date: 1.NOV.2015 11:02:10

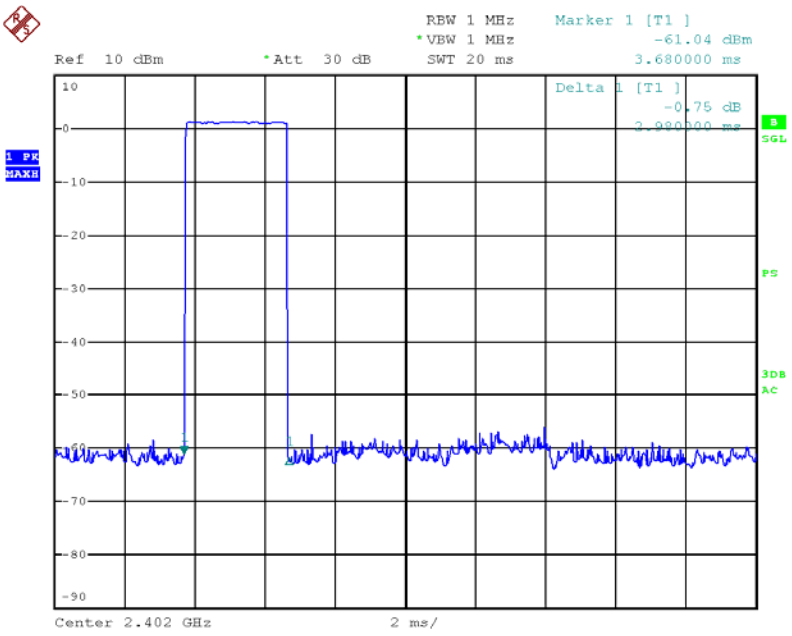


Date: 1.NOV.2015 11:02:26

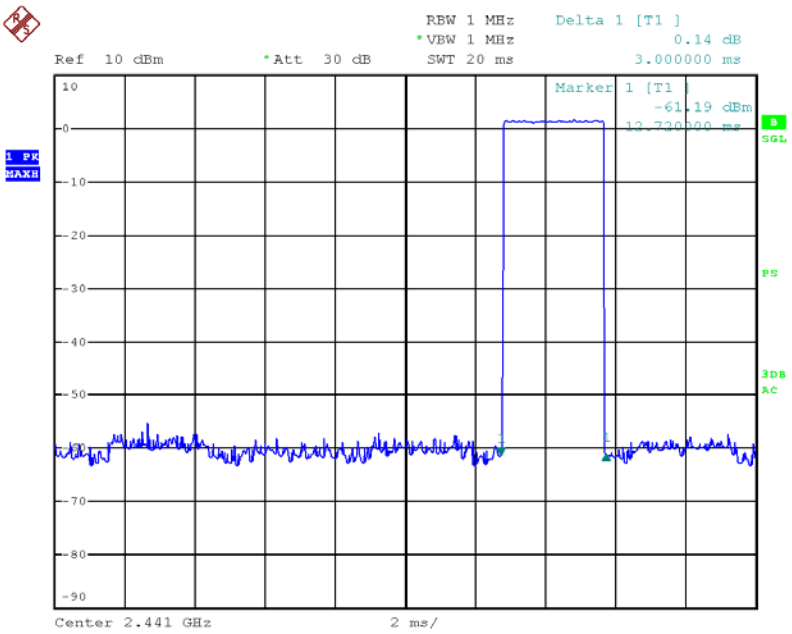


Date: 1.NOV.2015 11:02:41

DH5



Date: 1.NOV.2015 11:03:12



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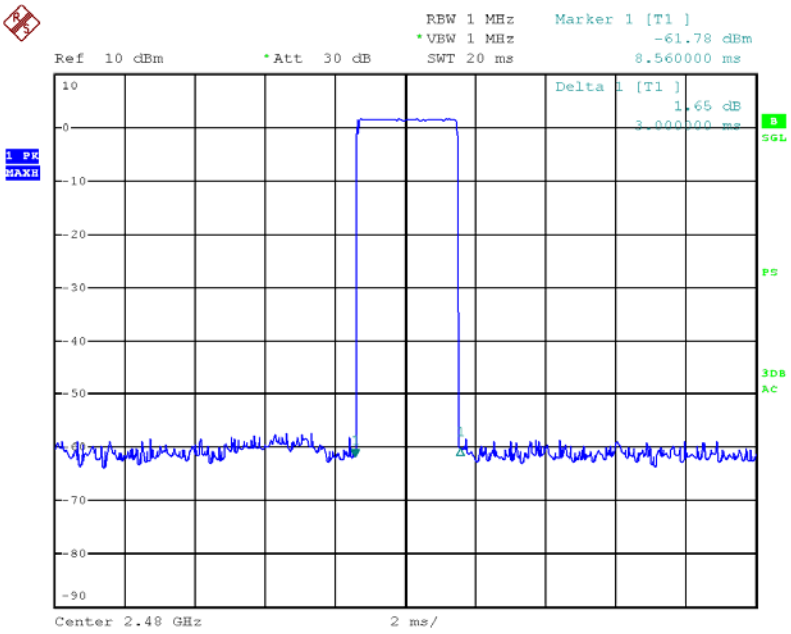
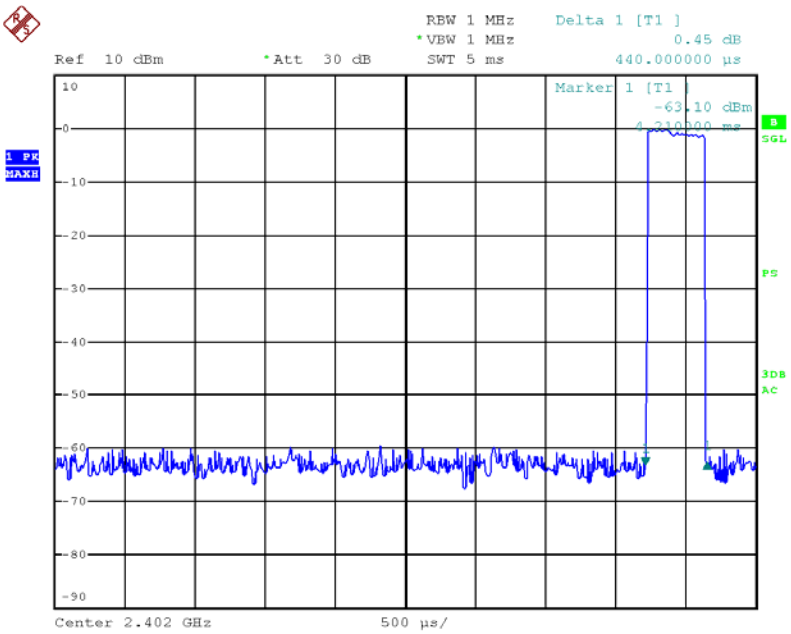


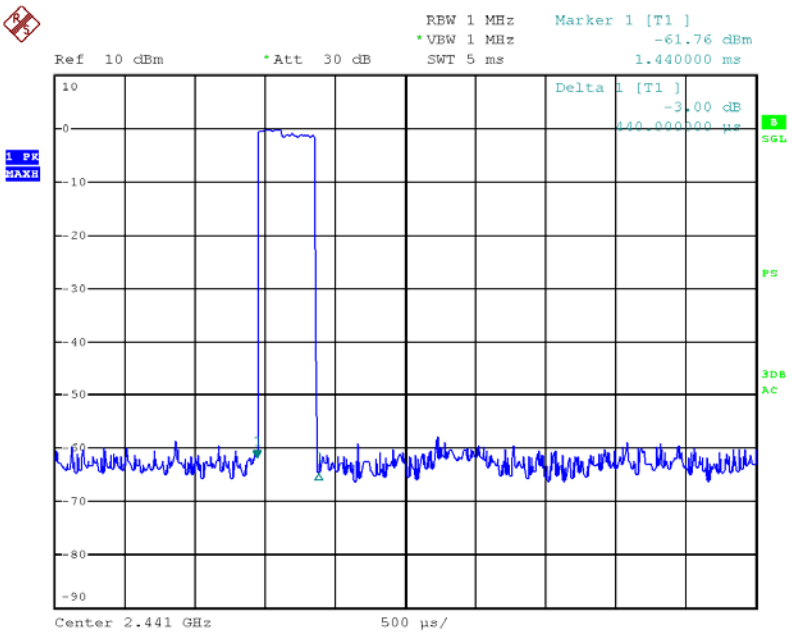
Date: 1.NOV.2015 11:03:41

Π/4-DQPSK Mode

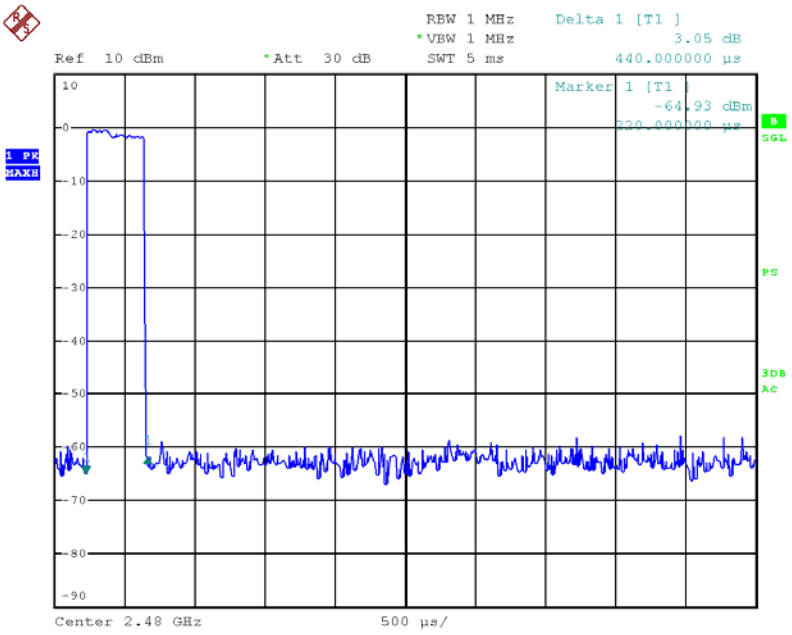
DH1



Date: 1.NOV.2015 11:04:57

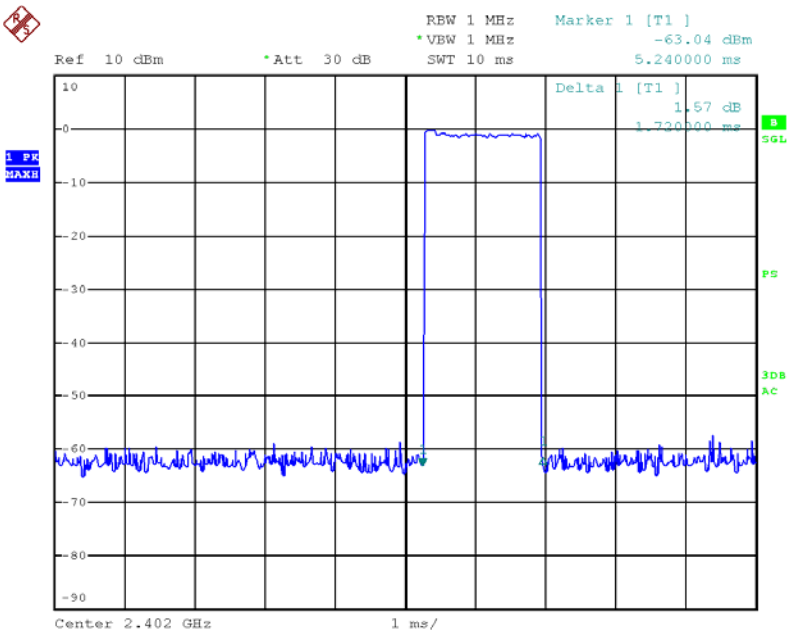


Date: 1.NOV.2015 11:05:22

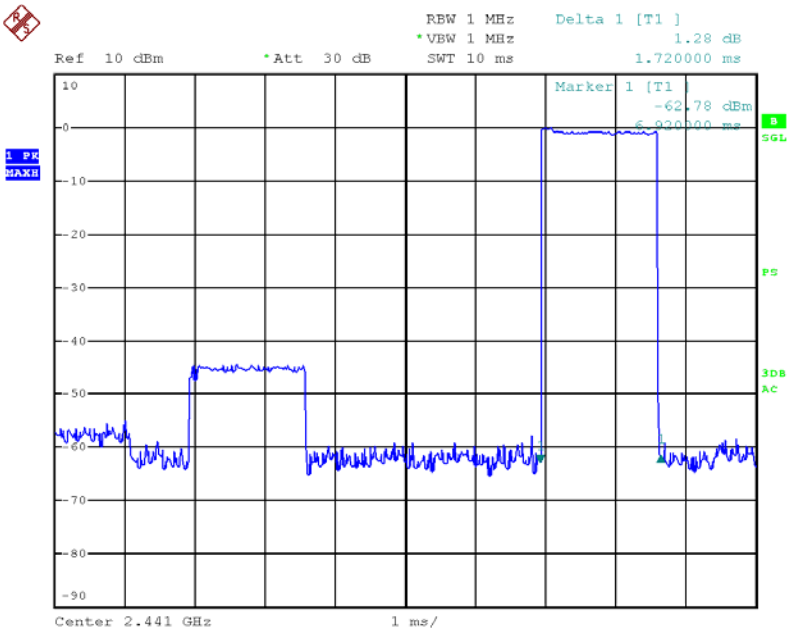


Date: 1.NOV.2015 11:05:40

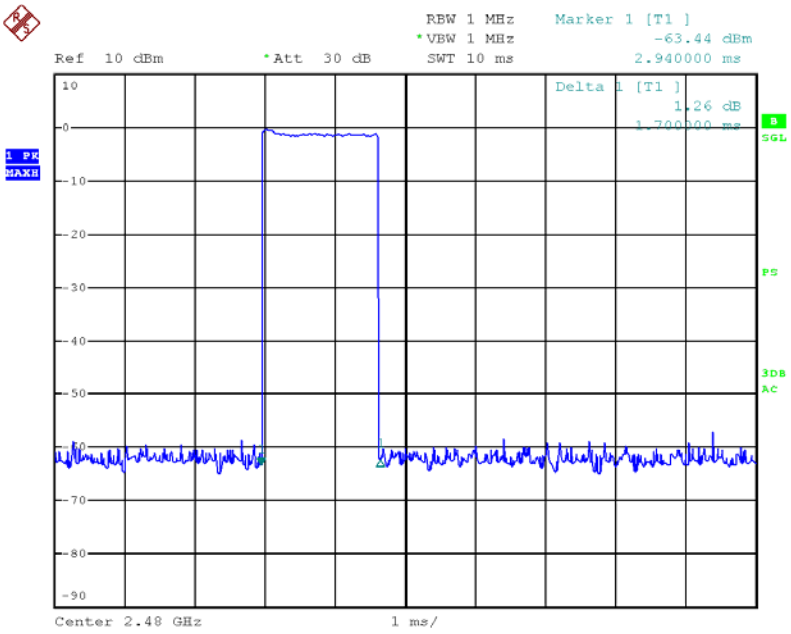
DH3



Date: 1.NOV.2015 11:06:23

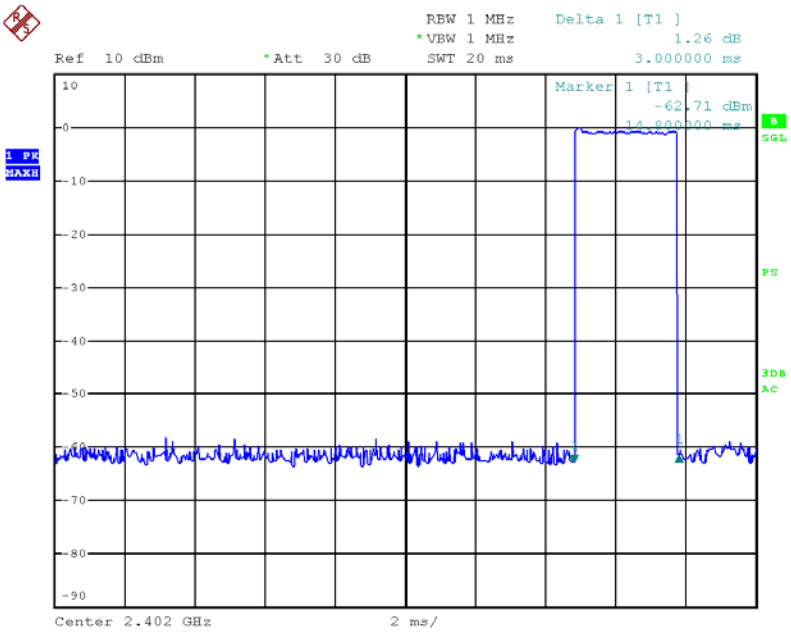


Date: 1.NOV.2015 11:06:39



Date: 1.NOV.2015 11:07:21

DH5



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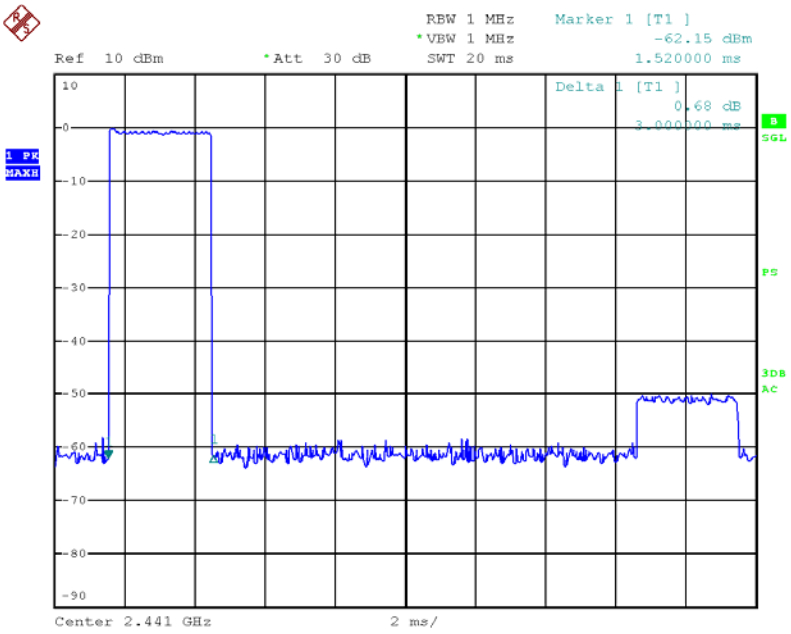
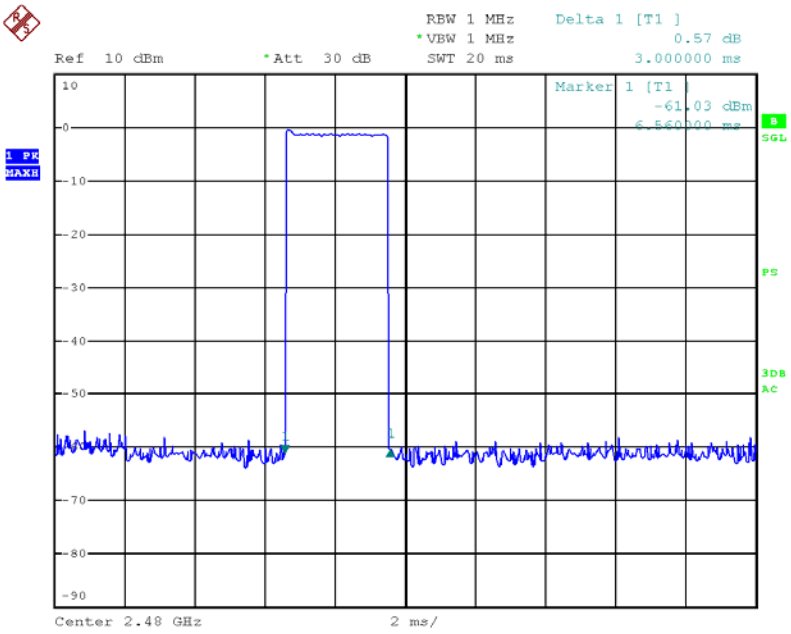


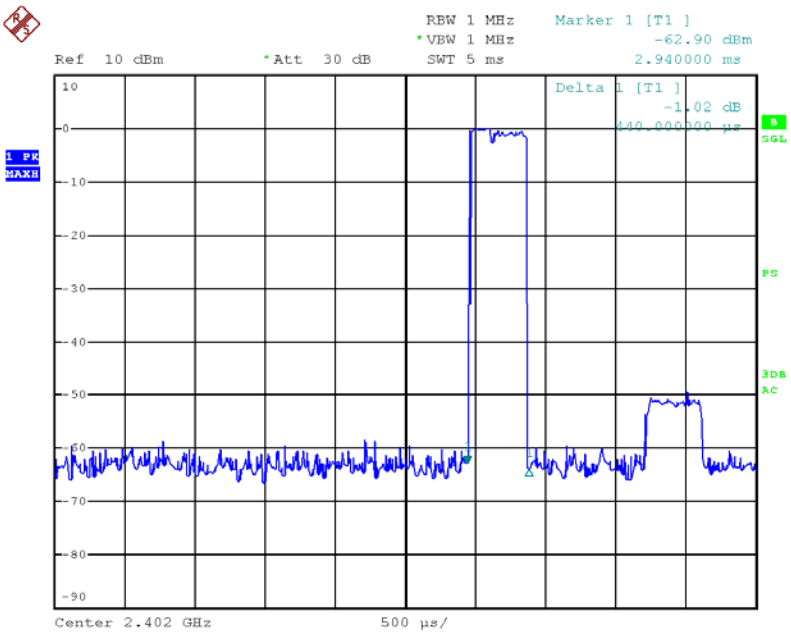
Date: 1.NOV.2015 11:08:19

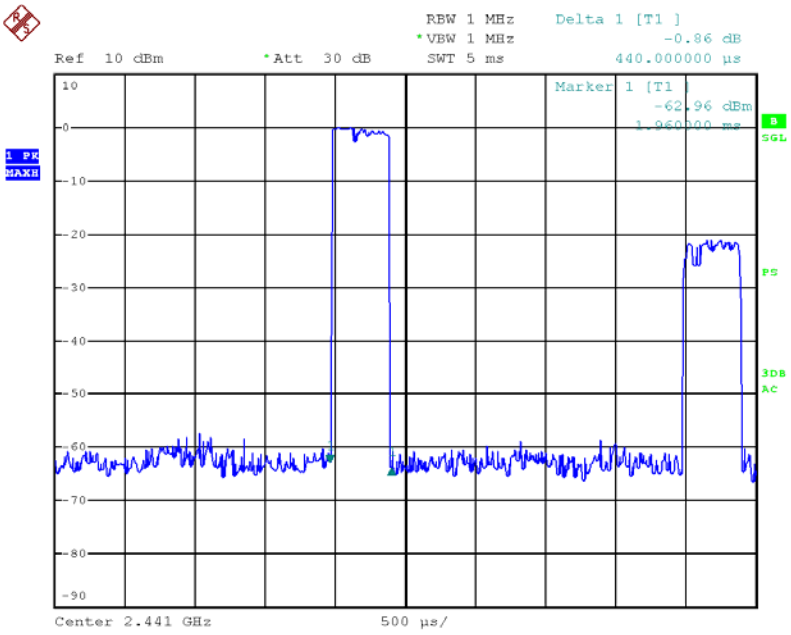


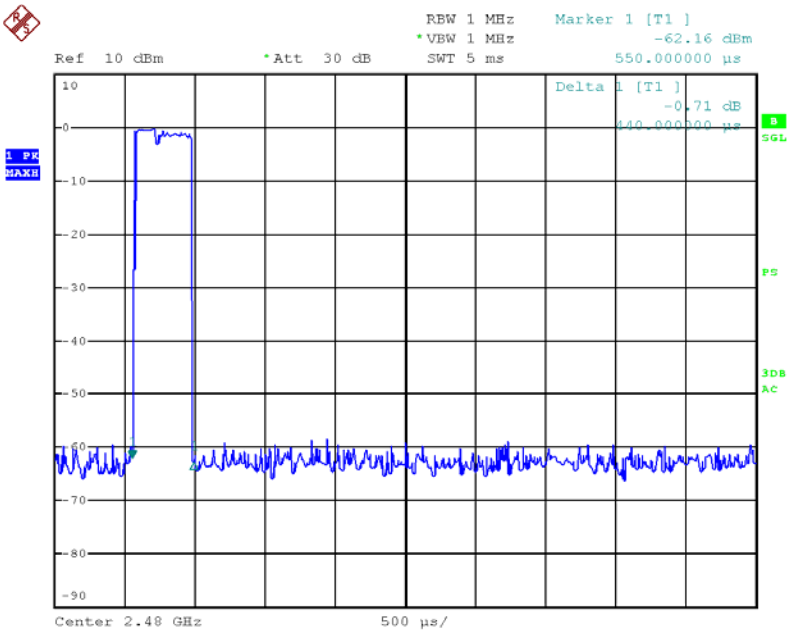
Date: 1.NOV.2015 11:08:32

8DPSK Mode

DH1

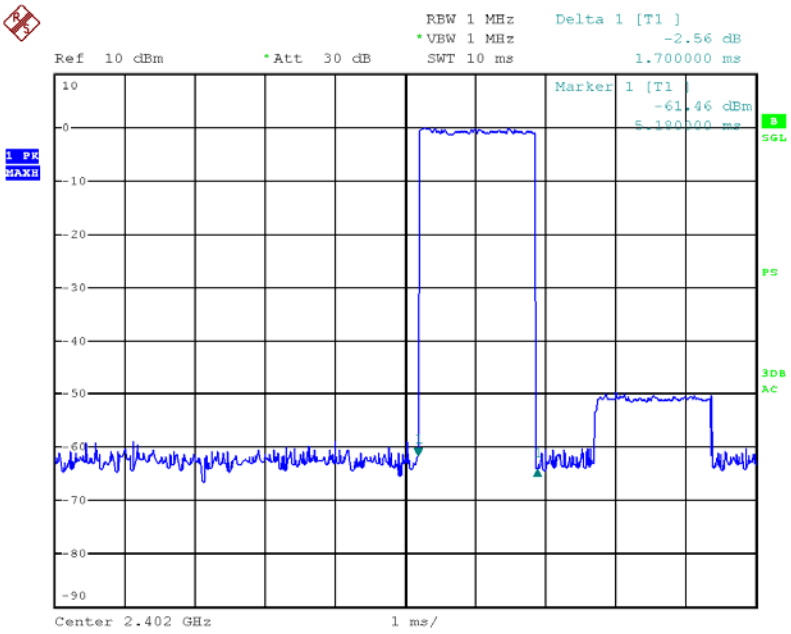






Date: 1.NOV.2015 11:10:12

DH3



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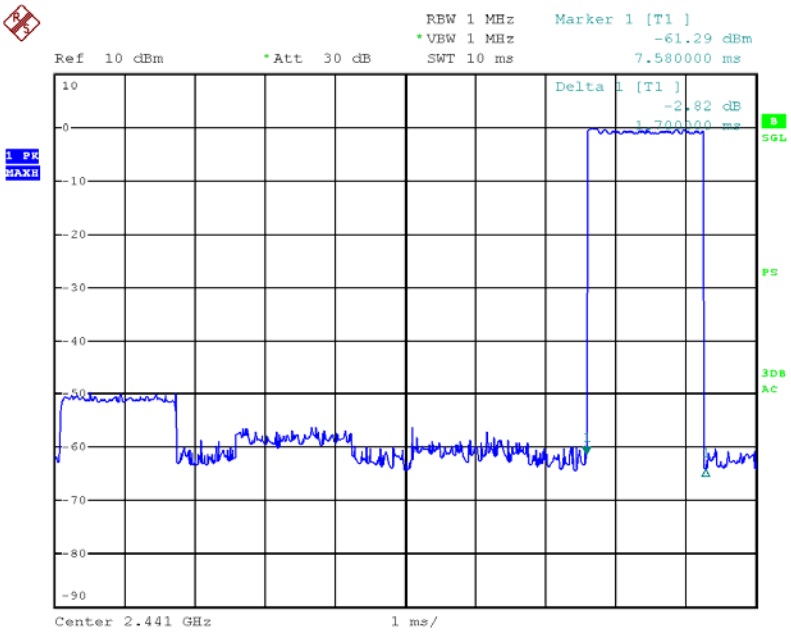

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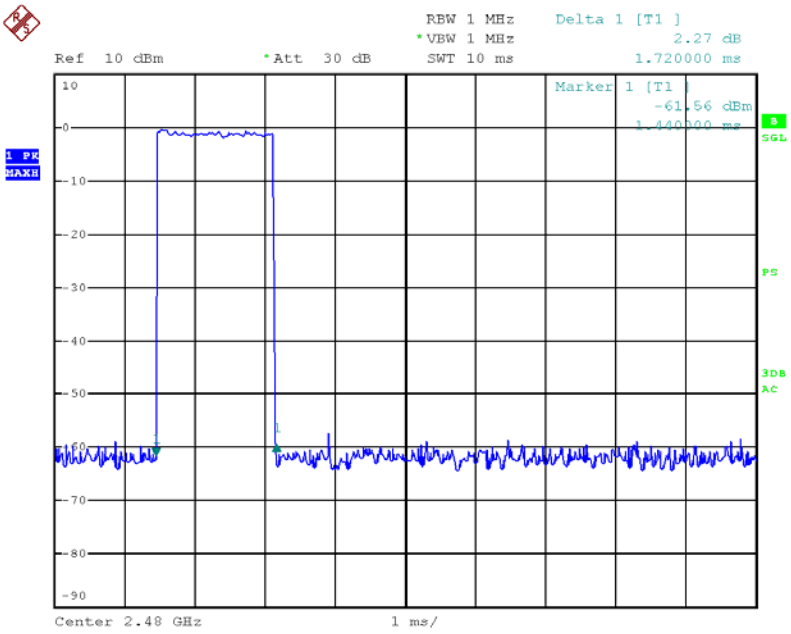

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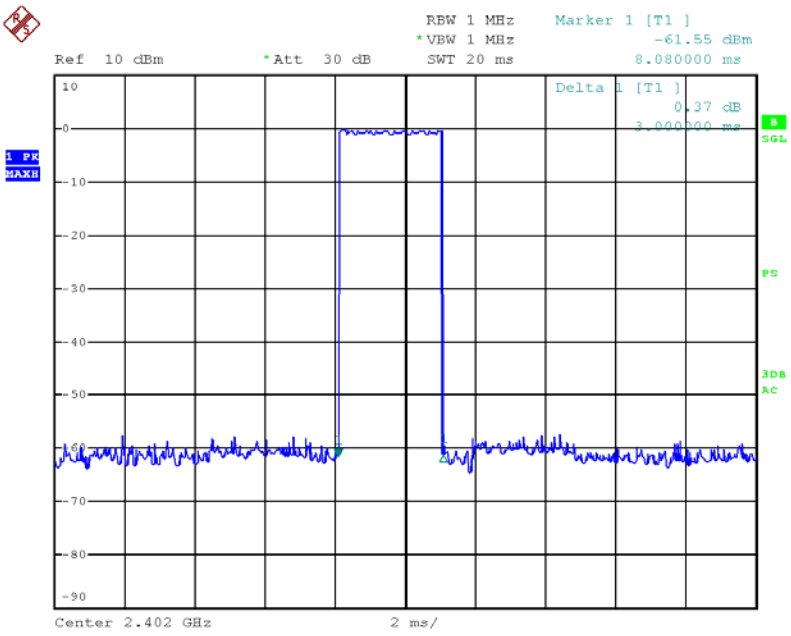
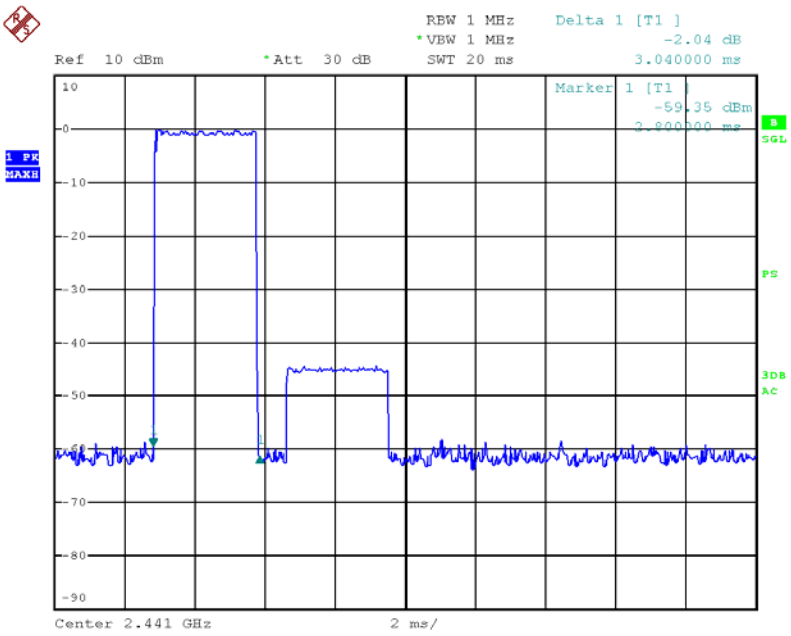
DH5



Date: 1.NOV.2015 11:12:13



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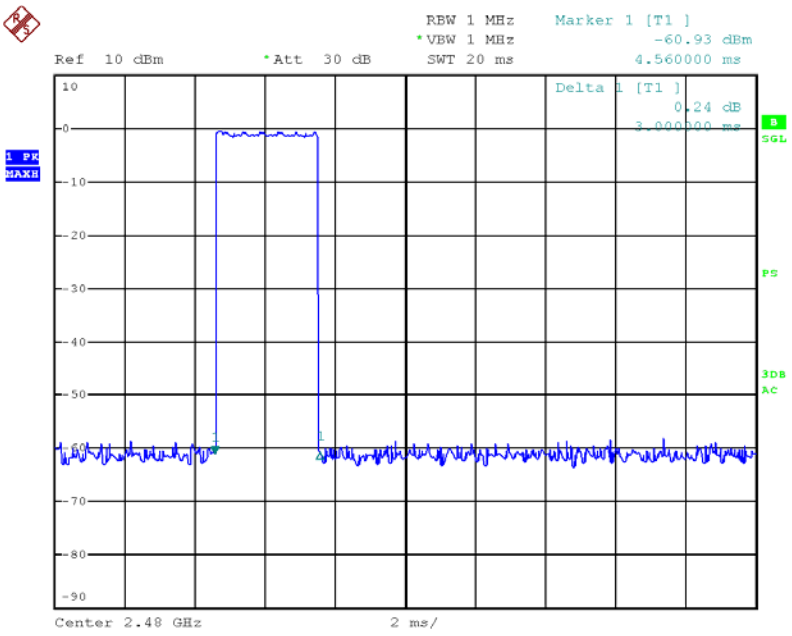


Date: 1.NOV.2015 11:13:06

8. MAXMUM OUTPUT POWER

8.1. TEST EQUIPMENT

Same with 3.1

8.2. BLOCK DIAGRAM OF TEST SETUP

Same with 3.2

8.3. LIMITS

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz bands: 0.125 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.4. TEST PROCEDURE

(1) Configure EUT and assistant system according clause 2.4 and 3.2

(2) Connect EUT's antenna output to spectrum analyzer by RF cable.

(3) Configure EUT work in test mode as stated in clause 2.4.

(4) Set the spectrum analyzer as follows:

RBW:	1MHz
VBW:	3MHz
Span	>1.5x 20dB bandwidth
Detector Mode:	Peak
Sweep time:	auto
Trace mode	Max hold

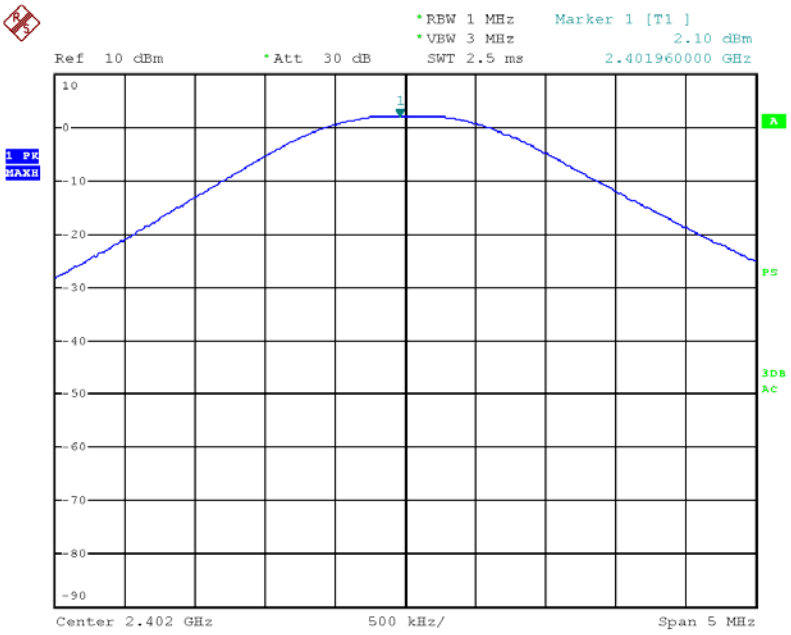
(5) Allow the trace to stabilize, Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges measure out the Average and PK output power.

8.5. TEST RESULT

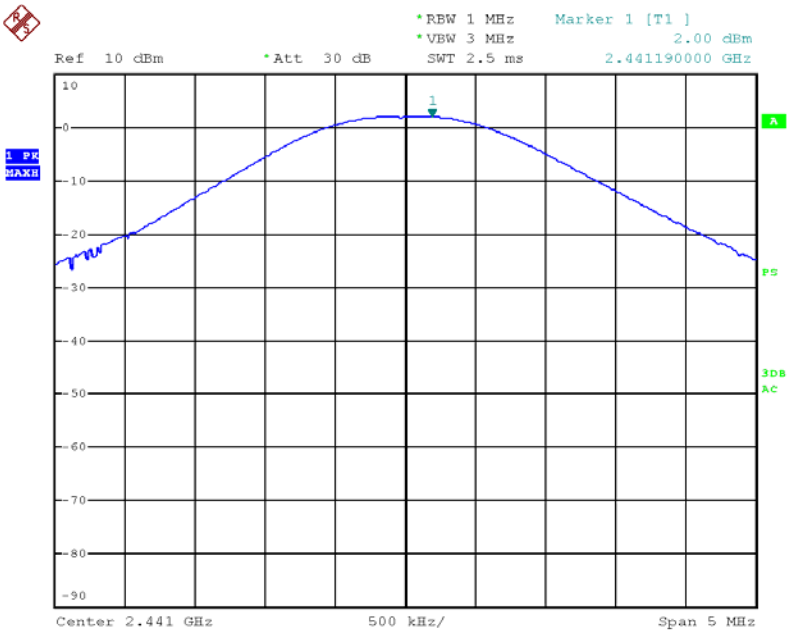
EUT Set Mode	Data Rate (Mbp/s)	Frequency (MHz)	Result(dBm)
			Peak
GFSK	1	2402	2.10
		2441	2.00
		2480	1.71
π /4DQPSK	1	2402	0.29
		2441	0.26
		2480	-0.01
8DPSK	1	2402	0.42
		2441	0.42
		2480	0.08
Limit: 21dBm		Conclusion: PASS	

8.6. ORIGINAL TEST DATA

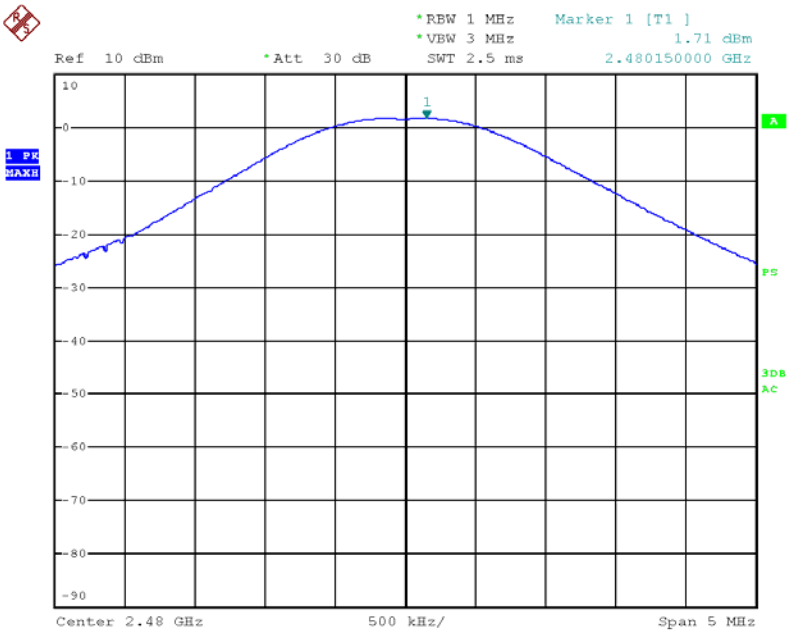
GFSK



Date: 1.NOV.2015 10:39:23

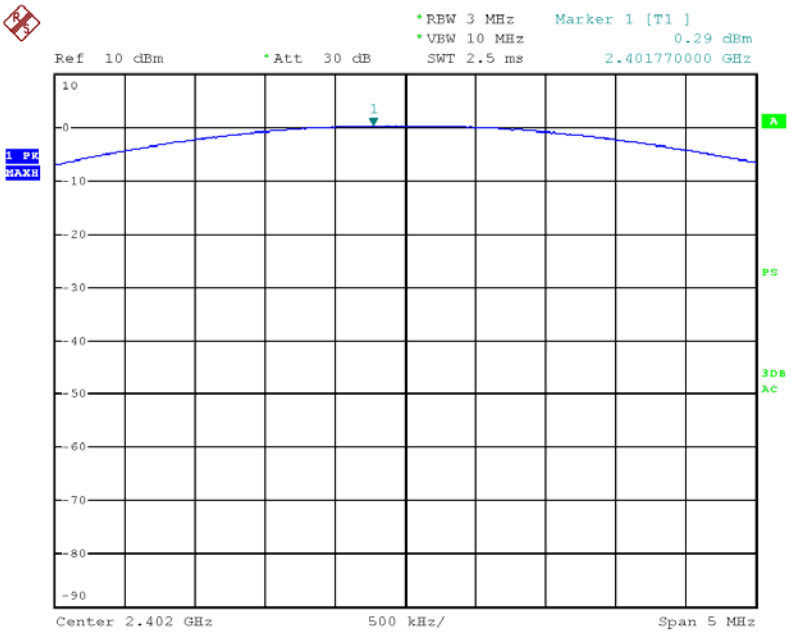


Date: 1.NOV.2015 10:42:47

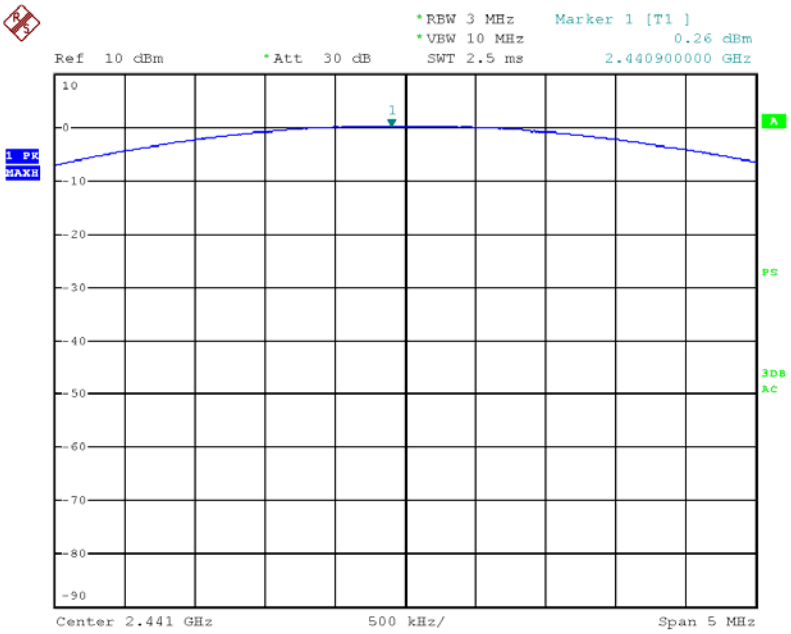


Date: 1.NOV.2015 10:43:26

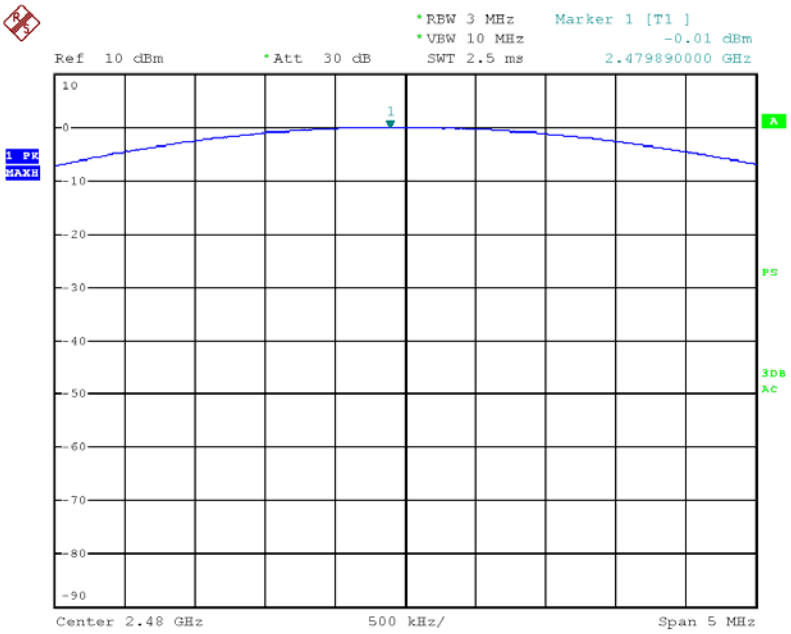
π /4DQPSK



Date: 1.NOV.2015 11:19:15

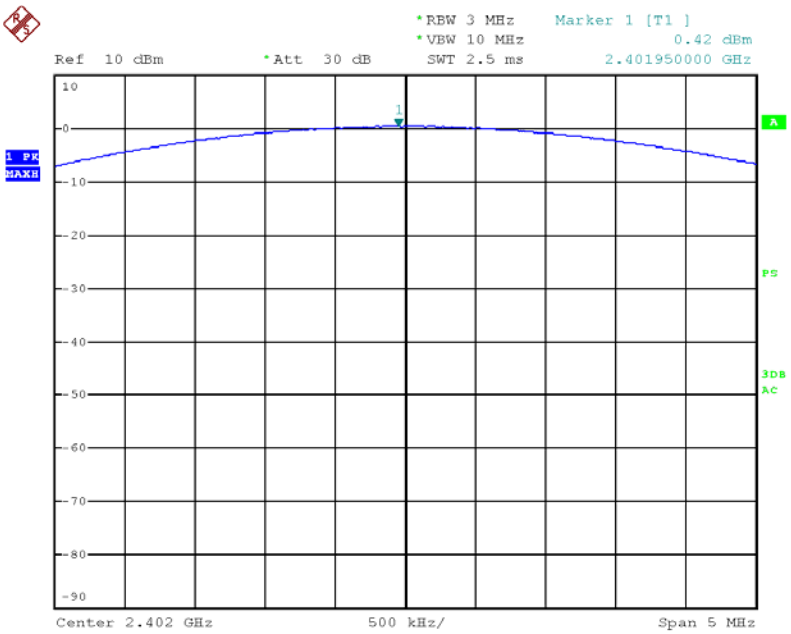


Date: 1.NOV.2015 11:19:39



Date: 1.NOV.2015 11:22:03

8DPSK



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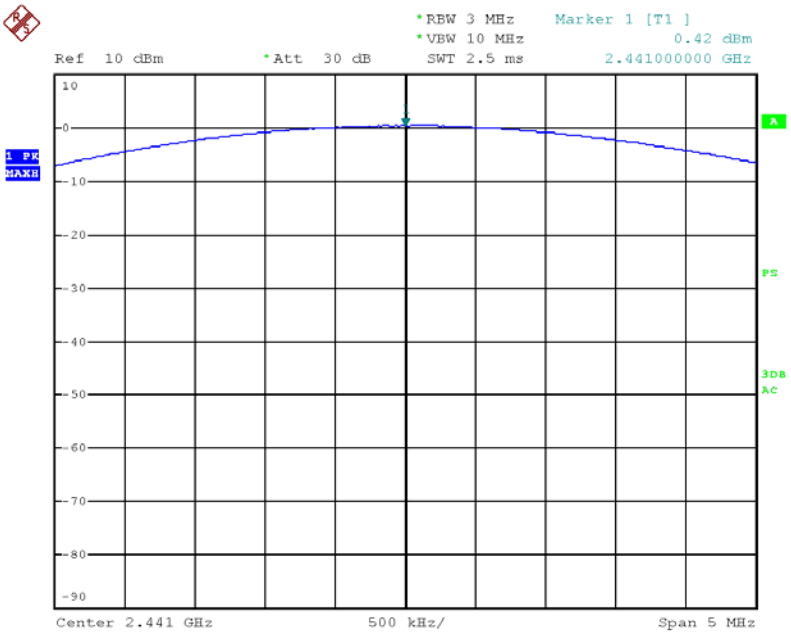
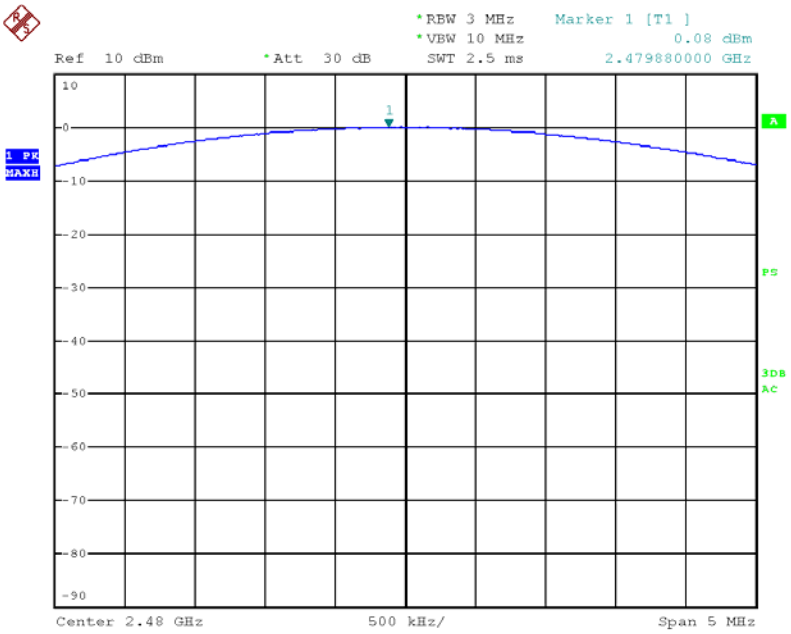


Date: 1.NOV.2015 11:40:34



Date: 1.NOV.2015 11:41:59

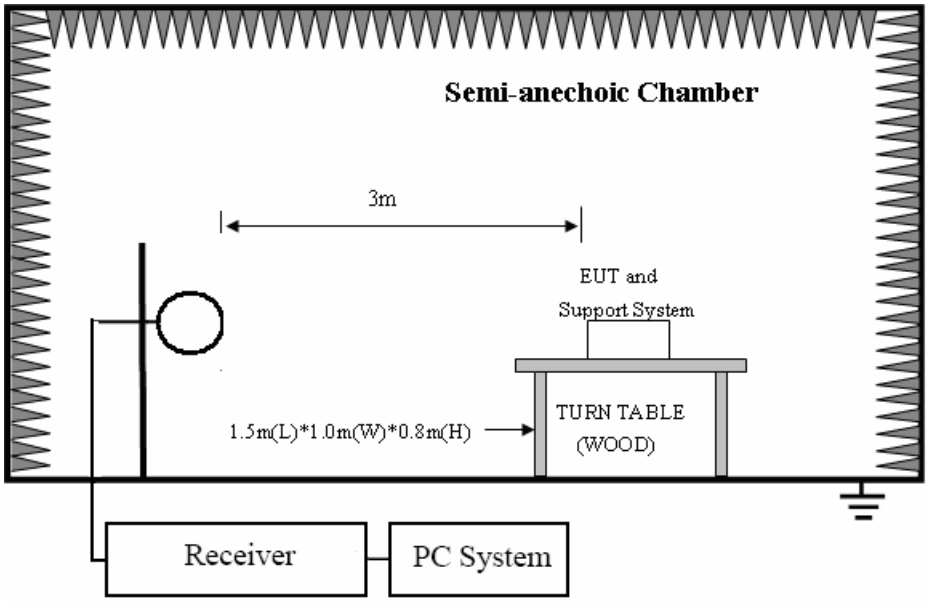
9. SPURIOUS EMISSION

9.1. TEST EQUIPMENT

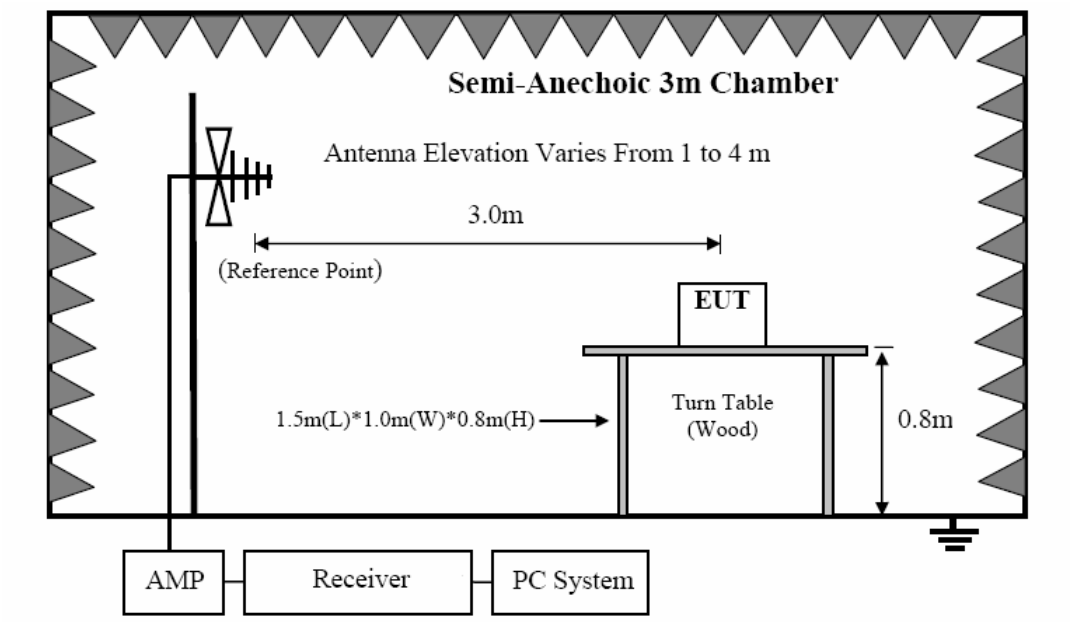
Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Due.	Cal. Interval
1	EMI Test Receiver	R&S	ESU8	100316	2015/12/26	1 Year
2	Spectrum analyzer	R&S	FSU	1166.1660.26	2015/07/11	1 Year
3	Loop antenna	TESEQ	HLA6120	20129	2015/12/26	1 Year
4	Trilog Broadband Antenna	Schwarzbeck	VULB9163	9163-462	2015/12/26	1 Year
5	Double Ridged Horn Antenna	R&S	HF907	100276	2015/12/26	1 Year
6	Horn Antenna	EMCO	3116	00060095	2015/12/26	1 Year
7	Pre-amplifier	A.H.	PAM-1840VH	562	2015/12/26	1 Year
8	Pre-amplifier	R&S	AFS33-18002 650-30-8P-44	SEL0080	2015/12/26	1 Year
9	RF Cable	R&S	R01	10403	2015/12/26	1 Year
10	RF Cable	R&S	R02	10512	2015/12/26	1 Year

9.2. BLOCK DIAGRAM OF TEST SETUP

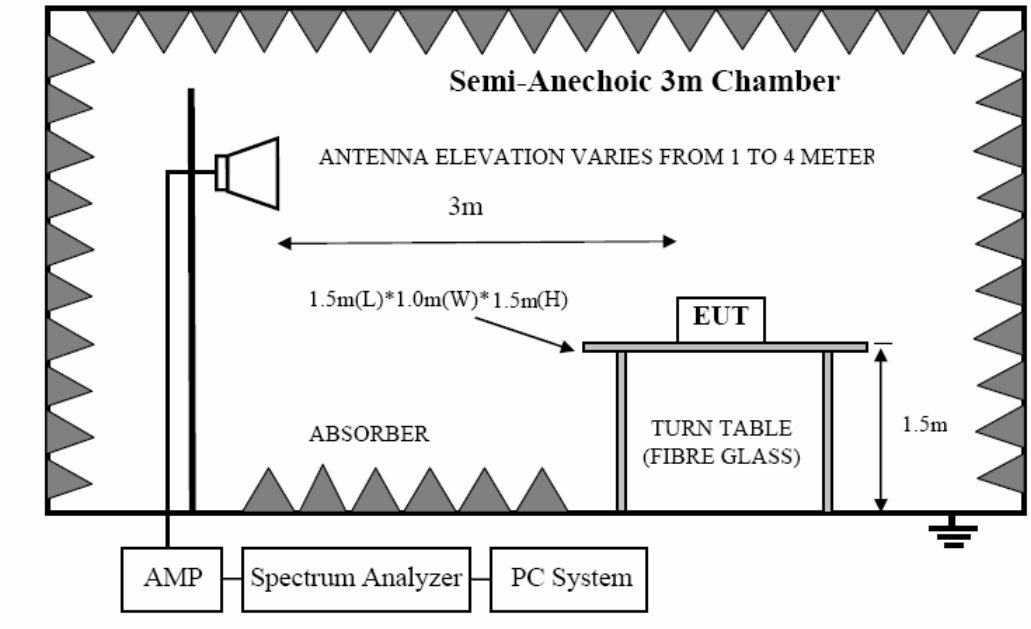
In 3m Anechoic Chamber Test Setup Diagram for 9KHz-30MHz



In 3m Anechoic Chamber Test Setup Diagram for 30MHz-1GHz



In 3m Anechoic Chamber Test Setup Diagram for frequency above 1GHz



Note: For harmonic emissions test a appropriate high pass filter was inserted in the input port of AMP.

9.3. LIMIT

9.3.1 FCC 15.205 Restricted frequency band

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

9.3.2. FCC 15.209 Limit.

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μV/m	dB(μV)/m
0.009 ~ 0.490	300	2400/F(KHz)	67.6-20log(F)
0.490 ~ 1.705	30	24000/F(KHz)	87.6-20log(F)
1.705 ~ 30.0	30	30	29.54
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

Note: (1) The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz and above 1000MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) At frequencies below 30MHz, measurement may be performed at a distance closer then that specified, and the limit at closer measurement distance can be extrapolated by below formula:

$Limit_{3m}(dBuV/m) = Limit_{30m}(dBuV/m) + 40Log(30m/3m)$

9.3.3. Limit for this EUT

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 30dB below the fundamental emissions, or comply with 15.209 limits.

9.4. TEST PROCEDURE

(1) EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber.

(2) Setup EUT and assistant system according clause 2.4 and 7.2

(3) Test antenna was located 3m from the EUT on an adjustable mast, and the antenna used as below table.

Test frequency range	Test antenna used
9KHz-30MHz	Active Loop antenna
30MHz-1GHz	Trilog Broadband Antenna
1GHz-18GHz	Double Ridged Horn Antenna(1GHz-18GHz)
18GHz-40GHz	Horn Antenna(18GHz-40GHz)

According ANSI C63.10:2013 clause 6.4.4.2 and 6,5.3, for measurements below 30 MHz, the loop antenna was positioned with its plane vertical from the EUT and rotated about its vertical axis for maximum response at each azimuth position around the EUT. And the loop antenna also be positioned with its plane horizontal at the specified distance from the EUT. The center of the loop is 1 m above the ground. for measurement above 30MHz, the Trilog Broadband Antenna or Horn Antenna was located 3m from EUT, Measurements were made with the antenna positioned in both the horizontal and vertical planes of Polarization, and the measurement antenna was varied from 1 m to 4 m. in height above the reference ground plane to obtain the maximum signal strength.

(4) Below pre-scan procedure was first performed in order to find prominent frequency spectrum radiated emissions from 9KHz to 25GHz:

(a) Scanning the peak frequency spectrum with the antenna specified in step (3), and the EUT was rotated 360 degree, the antenna height was varied from 1m to 4m(Except loop antenna, it's fixed 1m above ground.)

(b) Change work frequency or channel of device if practicable.

(c) Change modulation type of device if practicable.

(d) Change power supply range from 85% to 115% of the rated supply voltage

(e) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions.

Spectrum frequency from 9KHz to 25GHz (tenth harmonic of fundamental frequency) was investigated, and no any obvious emission were detected from 18GHz to 25GHz, so below final test was performed with frequency range from 9KHz to 18GHz.

(5) For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10 2013 on Radiated Emission test.

(6) The emissions from 9KHz to 1GHz were measured based on CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz, for emissions from 9KHz-90KHz,110KHz-490KHz and above 1GHz were measured based on average detector, for emissions above 1GHz, peak emissions also be measured and need comply with Peak limit.

(7) The emissions from 9KHz to 1GHz, QP or average values were measured with EMI receiver with below RBW

Frequency band	RBW
9KHz-150KHz	200Hz
150KHz-30MHz	9KHz
30MHz-1GHz	120KHz

（8）For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1MHz, VBW is set at 3MHz for Peak measure; RBW is set at 1MHz, VBW is set at 10Hz for Average measure(according ANSI C63.10:2013 clause 4.2.3.2.3 procedure for average measure). Peak detector is used for Peak and AV measurement both.

9.5. TEST RESULT

PASS. (See below detailed test result)

All the emissions except fundamental emission from 9KHz to 25GHz were comply with 15.209 limit.

Note1: According exploratory test no any obvious emission were detected from 9KHz to 30MHz and 18GHz to 25GHz, so the final test was performed with frequency range from 30MHz to 18GHz and recorded in below.

Note2: For below test data, when the limit tabular marked "/" means this frequency point is the fundamental emission and no need comply with this limit.

Test Result

Test Site : 3m Chamber

EUT : Overhead Audio Unit **Tested By** : Lake

Power Supply : 12Vdc full battery is used to supply power **Model Number** : 2635986, 2881115

Condition : Temp:24.5'C,Humi:55%, Press:100.1kPa **Test Mode** : Tx mode

Memo : GFSK (worst case) **Antenna/Distance** : VULB 9163 /3m

Frequency	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	FCC 15.247	
(MHz)	Reading (dBμV)	PK/QP/AV	Polar (H/V)	Factor (dB)				Limit (dBμV/m)	Margin (dB)
Low Channel (2402)									
2400	26.42	PK	H	28	3.57	0	57.99	74	-16.01
2400	14.11	AV	H	28	3.57	0	45.68	54	-8.32
2400	22.76	PK	V	28	3.57	0	54.33	74	-19.67
2400	12.38	AV	V	28	3.57	0	43.95	54	-10.05
4804	47.11	PK	H	32.3	5.91	31.78	53.54	74	-20.46
4804	34.27	AV	H	32.3	5.91	31.78	40.7	54	-13.3
4804	41.93	PK	V	32.3	5.91	31.78	48.36	74	-25.64
4804	30.04	AV	V	32.3	5.91	31.78	36.47	54	-17.53
7206	32.52	PK	H	36.3	6.34	30.97	44.19	74	-29.81
7206	22.13	AV	H	36.3	6.34	30.97	33.8	54	-20.2
7206	32.25	PK	V	36.3	6.34	30.97	43.92	74	-30.08
7206	20.48	AV	V	36.3	6.34	30.97	32.15	54	-21.85
9608	30.52	PK	H	37.9	8.01	30.86	45.57	74	-28.43
9608	18.69	AV	H	37.9	8.01	30.86	33.74	54	-20.26
9608	28.7	PK	V	37.9	8.01	30.86	43.75	74	-30.25
9608	19.34	AV	V	37.9	8.01	30.86	34.39	54	-19.61
239.99	51.12	QP	H	14.2	2.74	27.6	40.46	46	-5.54
256.52	49.54	QP	V	14.2	2.74	27.6	38.88	46	-7.12
Middle Channel (2441)									
4882	47.03	PK	H	32.9	6.34	31.78	54.49	74	-19.51
4882	33.47	AV	H	32.9	6.34	31.78	40.93	54	-13.07
4882	42.29	PK	V	32.9	6.34	31.78	49.75	74	-24.25
4882	30.03	AV	V	32.9	6.34	31.78	37.49	54	-16.51
7323	32.44	PK	H	37.1	6.72	30.97	45.29	74	-28.71
7323	19.35	AV	H	37.1	6.72	30.97	32.2	54	-21.8
7323	31.61	PK	V	37.1	6.72	30.97	44.46	74	-29.54
7323	19.79	AV	V	37.1	6.72	30.97	32.64	54	-21.36

9764	28.01	PK	H	38.6	8.43	30.86	44.18	74	-29.82
9764	17.56	AV	H	38.6	8.43	30.86	33.73	54	-20.27
9764	28.74	PK	V	38.6	8.43	30.86	44.91	74	-29.09
9764	18.39	AV	V	38.6	8.43	30.86	34.56	54	-19.44
256.52	51.56	QP	H	14.2	2.74	27.6	40.9	46	-5.1
324.45	50.78	QP	V	14.2	2.74	27.6	40.12	46	-5.88
High Channel (2480)									
4960	44.44	PK	H	33.1	6.39	31.78	52.15	74	-21.85
4960	31.89	AV	H	33.1	6.39	31.78	39.6	54	-14.4
4960	40.02	PK	V	33.1	6.39	31.78	47.73	74	-26.27
4960	27.71	AV	V	33.1	6.39	31.78	35.42	54	-18.58
7440	32.59	PK	H	37.2	6.77	30.97	45.59	74	-28.41
7440	21.32	AV	H	37.2	6.77	30.97	34.32	54	-19.68
7440	31.46	PK	V	37.2	6.77	30.97	44.46	74	-29.54
7440	18.57	AV	V	37.2	6.77	30.97	31.57	54	-22.43
9920	28.21	PK	H	38.7	8.48	30.86	44.53	74	-29.47
9920	16.36	AV	H	38.7	8.48	30.86	32.68	54	-21.32
9920	28.07	PK	V	38.7	8.48	30.86	44.39	74	-29.61
9920	17.89	AV	V	38.7	8.48	30.86	34.21	54	-19.79
327.88	51.55	QP	H	14.2	2.74	27.6	40.89	46	-5.11
256.52	50.43	QP	V	14.2	2.74	27.6	39.77	46	-6.23

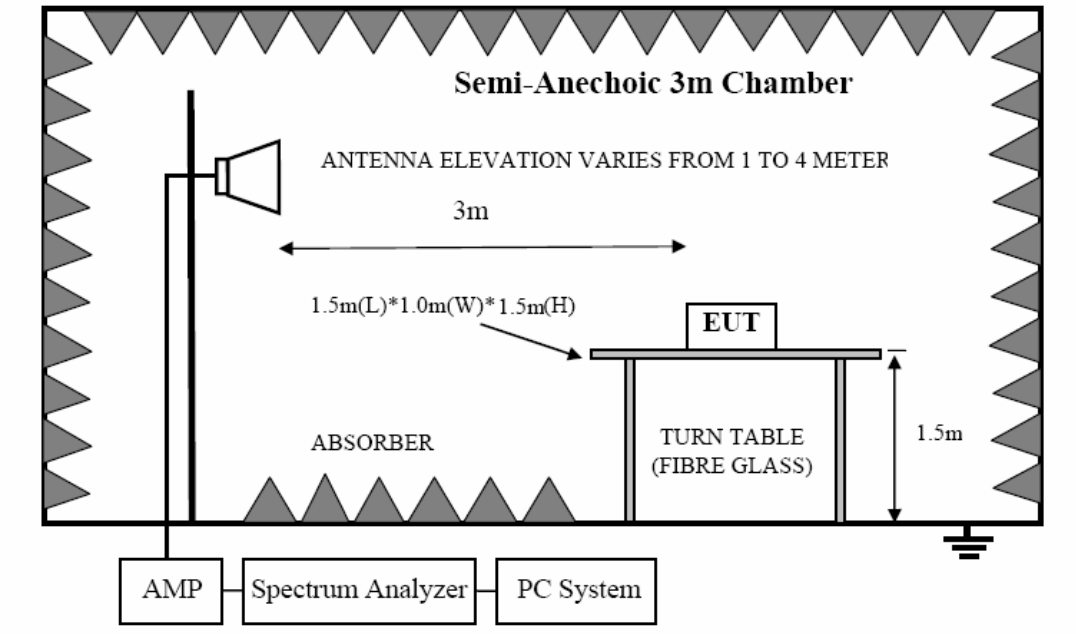
Note: 1. Result Level = Read Level + Antenna Factor + Cable loss
2. If Peak Result comply with QP limit, QP Result is deemed to comply with QP limit

10. BAND EDGE

10.1. TEST EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Due.	Cal. Interval
1	EMI Test Receiver	R&S	ESU8	100316	2015/12/26	1 Year
2	Spectrum analyzer	R&S	FSU	1166.1660.26	2015/07/11	1 Year
3	Trilog Broadband Antenna	Schwarzbeck	VULB9163	9163-462	2015/12/26	1 Year
4	Double Ridged Horn Antenna	R&S	HF907	100276	2015/12/26	1 Year
5	Pre-amplifier	A.H.	PAM0-0118	360	2015/12/26	1 Year
6	RF Cable	R&S	R01	10403	2015/12/26	1 Year
7	RF Cable	R&S	R02	10512	2015/12/26	1 Year

10.2. BLOCK DIAGRAM OF TEST SETUP



10.3. LIMIT

All the lower and upper band-edges emissions appearing within 2310MHz to 2390MHz and 2483.5MHz to 2500MHz restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions outside operation frequency band 2400MHz to 2483.5MHz shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

10.4. TEST PROCEDURE

Same with clause 8.4 except change investigated frequency range from 2100MHz to 2450MHz and 2450MHz to 2500MHz.

Remark: All restriction band have been tested, and only the worse case is shown in report.

10.5. TEST RESULT

Frequency	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	FCC 15.247	
(MHz)	Reading (dBμV)	PK/QP/AV	Polar (H/V)	Factor (dB)				Limit (dBμV/m)	Margin (dB)
Lowest Channel (GFSK)									
2390	23.05	PK	H	27.8	3.57	0	54.42	74	-19.58
2390	9.96	AV	H	27.8	3.57	0	41.33	54	-12.67
2390	23.32	PK	V	27.8	3.57	0	54.69	74	-19.31
2390	9.98	AV	V	27.8	3.57	0	41.35	54	-12.65
2400	34.02	PK	H	28	3.57	0	65.59	74	-8.41
2400	14.17	AV	H	28	3.57	0	45.74	54	-8.26
2400	30.08	PK	V	28	3.57	0	61.65	74	-12.35
2400	11.25	AV	V	28	3.57	0	42.82	54	-11.18
Highest Channel (GFSK)									
2483.5	23.02	PK	H	28.7	3.72	0	55.44	74	-18.56
2483.5	10.48	AV	H	28.7	3.72	0	42.9	54	-11.10
2483.5	22.46	PK	V	28.7	3.72	0	54.88	74	-19.12
2483.5	9.63	AV	V	28.7	3.72	0	42.05	54	-11.95
Lowest Channel (π/4DQPSK)									
2390	22.89	PK	H	27.8	3.57	0	54.26	74	-19.74
2390	9.92	AV	H	27.8	3.57	0	41.29	54	-12.71
2390	22.91	PK	V	27.8	3.57	0	54.28	74	-19.72
2390	9.94	AV	V	27.8	3.57	0	41.31	54	-12.69
2400	32.03	PK	H	28	3.57	0	63.6	74	-10.40
2400	12.15	AV	H	28	3.57	0	43.72	54	-10.28
2400	29.31	PK	V	28	3.57	0	60.88	74	-13.12

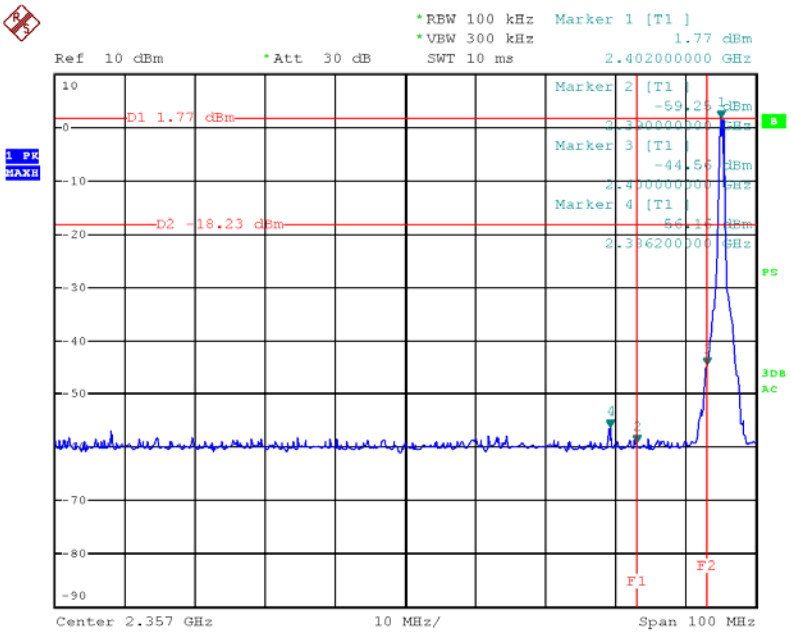
2400	10.24	AV	V	28	3.57	0	41.81	54	-12.19
Highest Channel (π /4DQPSK)									
2483.5	22.04	PK	H	28.7	3.72	0	54.46	74	-19.54
2483.5	9.69	AV	H	28.7	3.72	0	42.11	54	-11.89
2483.5	21.51	PK	V	28.7	3.72	0	53.93	74	-20.07
2483.5	9.67	AV	V	28.7	3.72	0	42.09	54	-11.91

Lowest Channel (8DBSK)									
2390	22.76	PK	H	27.8	3.57	0	54.13	74	-19.87
2390	9.98	AV	H	27.8	3.57	0	41.35	54	-12.65
2390	23.05	PK	V	27.8	3.57	0	54.42	74	-19.58
2390	9.91	AV	V	27.8	3.57	0	41.28	54	-12.72
2400	30.89	PK	H	28	3.57	0	62.46	74	-11.54
2400	11.48	AV	H	28	3.57	0	43.05	54	-10.95
2400	28.73	PK	V	28	3.57	0	60.3	74	-13.70
2400	10.23	AV	V	28	3.57	0	41.8	54	-12.20
Highest Channel (8DBSK)									
2483.5	21.24	PK	H	28.7	3.72	0	53.66	74	-20.34
2483.5	9.61	AV	H	28.7	3.72	0	42.03	54	-11.97
2483.5	22.43	PK	V	28.7	3.72	0	54.85	74	-19.15
2483.5	9.66	AV	V	28.7	3.72	0	42.08	54	-11.92

Note: 1. Result Level = Read Level + Antenna Factor + Cable Loss- Amplifier Gain

2. After test and evaluation hopping off mode and hopping on mode, will record worst case (hopping off mode) in this report.

GFSK



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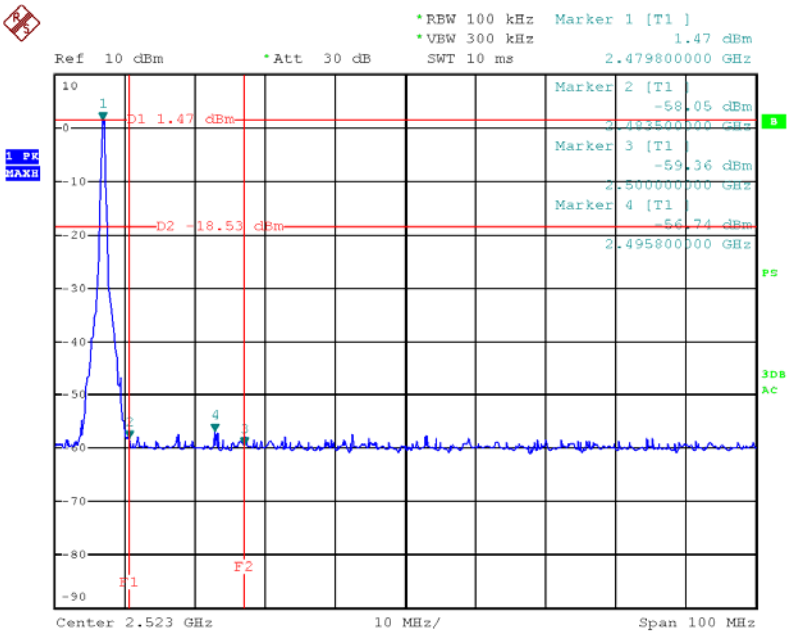

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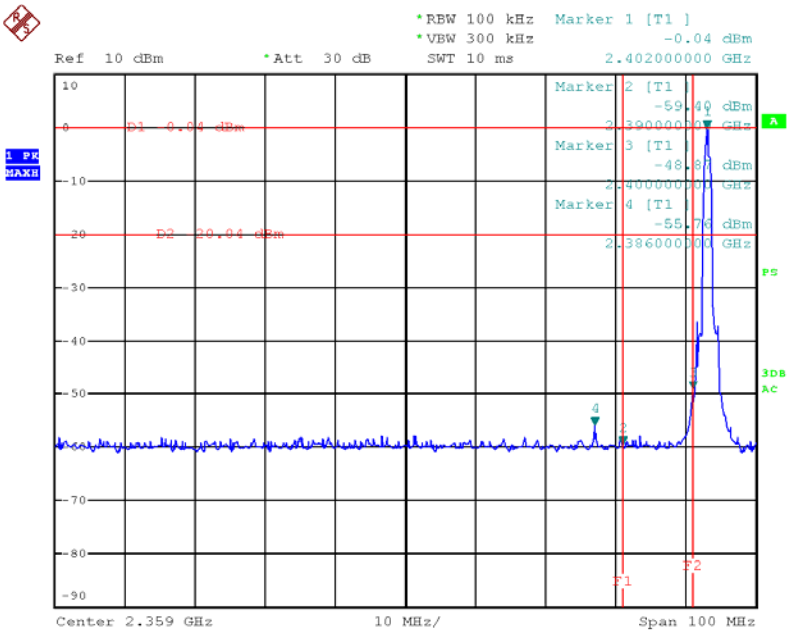
π /4DQPSK



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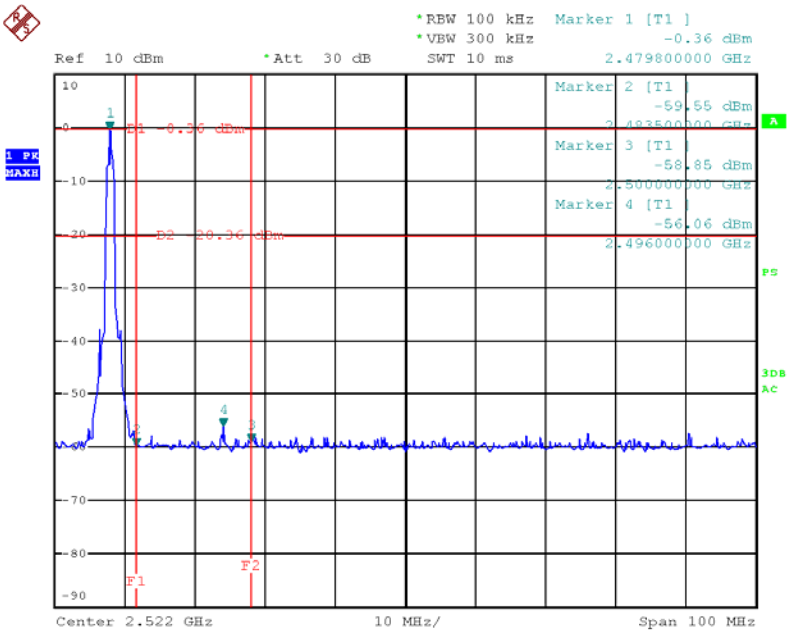

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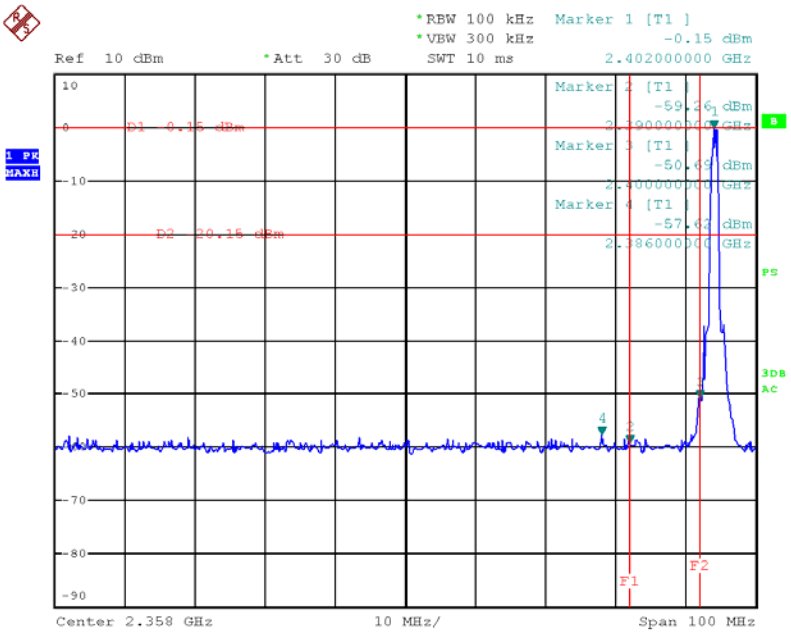
8DPSK



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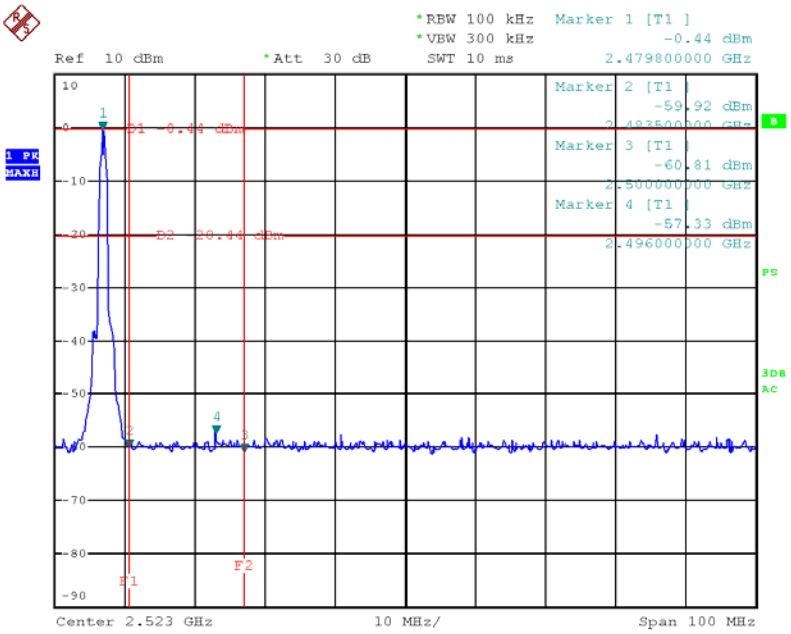

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11. Conducted Spurious Emissions

11.1. Test Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Due.	Cal. Interval
1	Spectrum analyzer	R&S	FSU	1166.1660.26	2015/12/26	1 Year
2	Attenuator	Mini-Circuits	BW-S10W2	101109	2015/12/26	1 Year
3	RF Cable	Micable	C10-01-01-1	100309	2015/12/26	1 Year

11.2. Limit

In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

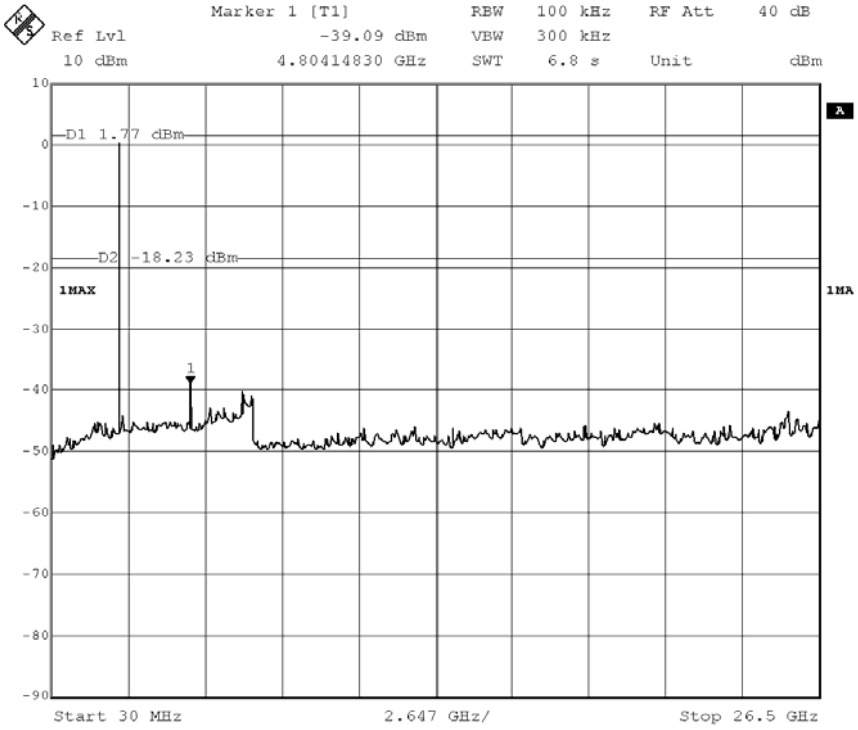
11.3. Test Procedure

The transmitter output was connected to a spectrum analyzer, The resolution bandwidth is set to 100 kHz, The video bandwidth is set to 300 kHz and measure all the emissions detected.

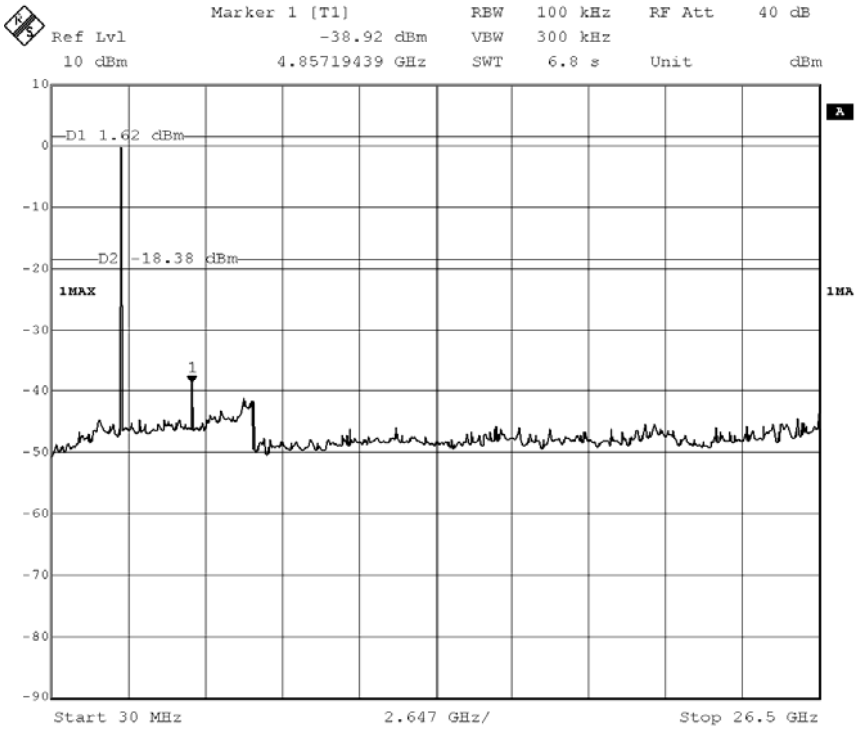
11.4. Test result

PASS (**See below detailed test result**.)

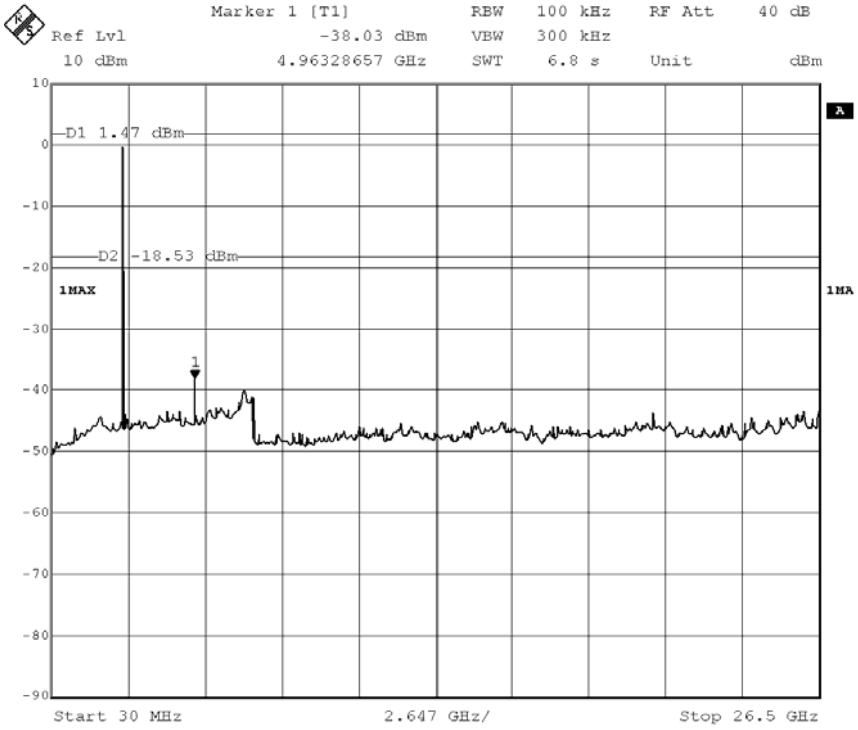
GFSK 2402MHz



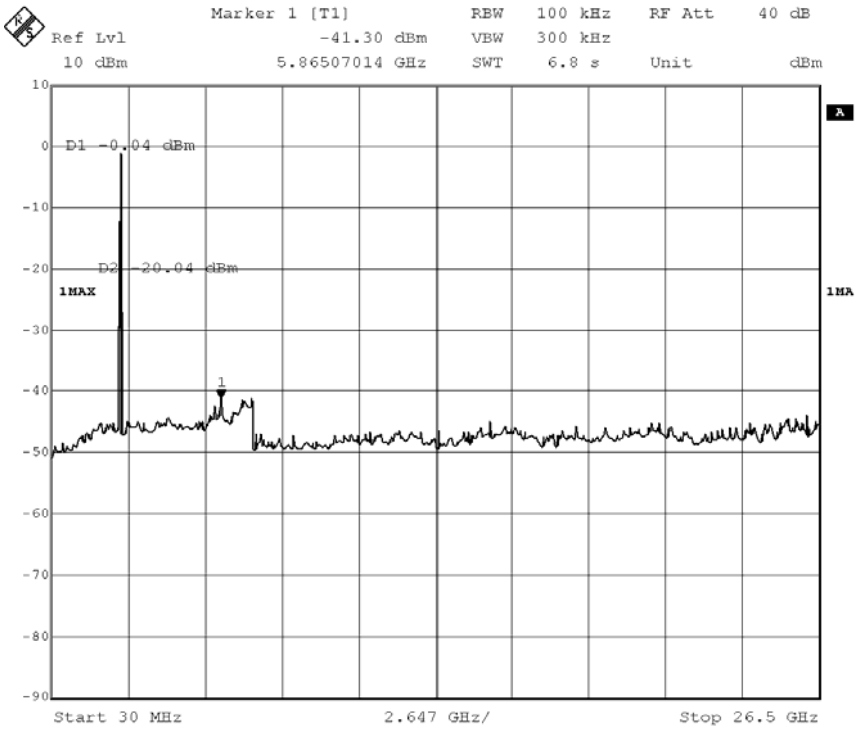
GFSK 2441MHz



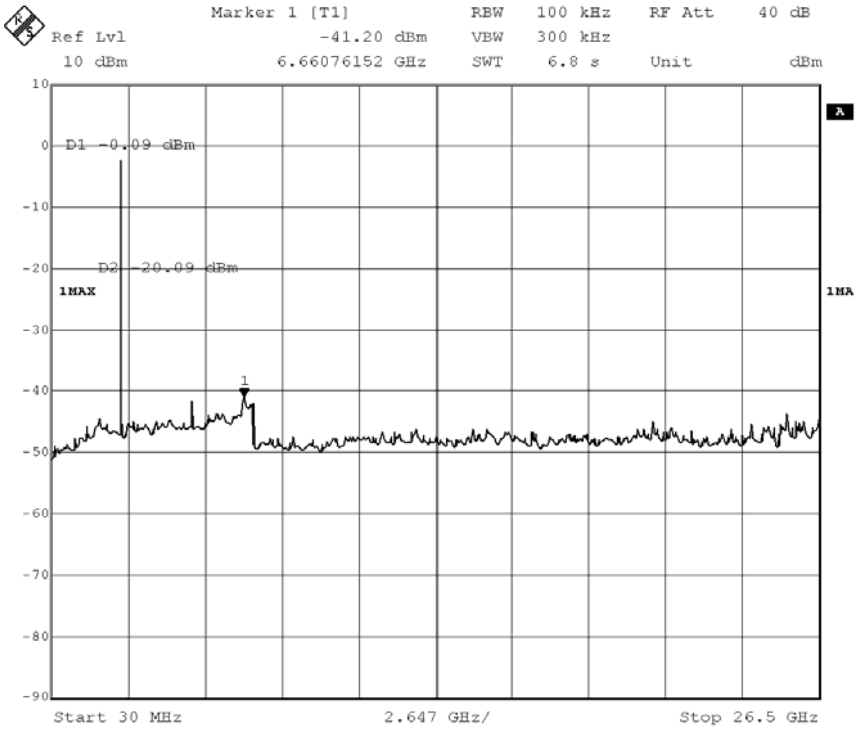
GFSK 2480MHz



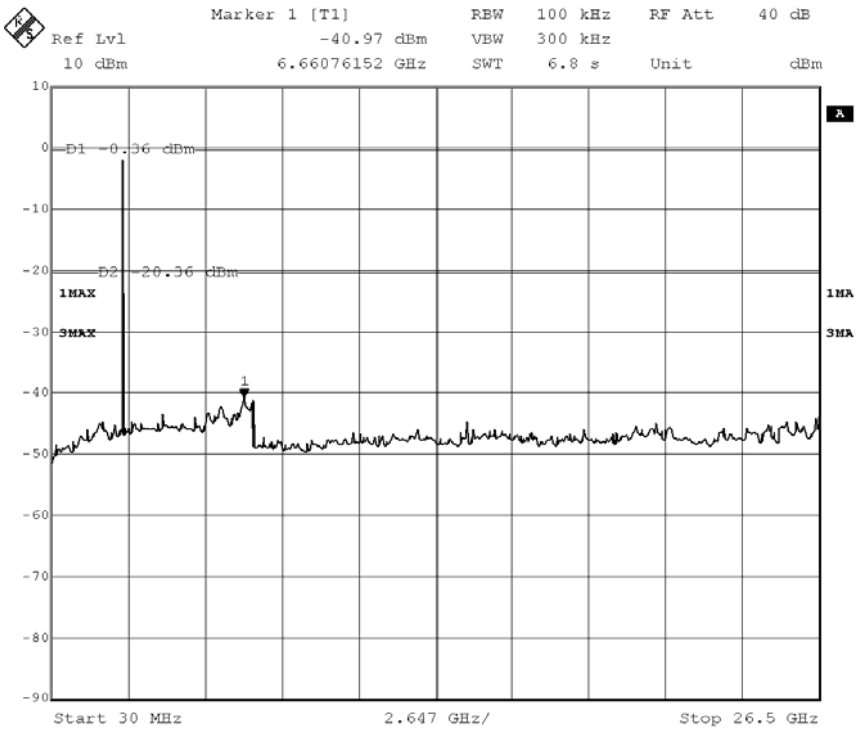
π /4DQPSK 2402MHz



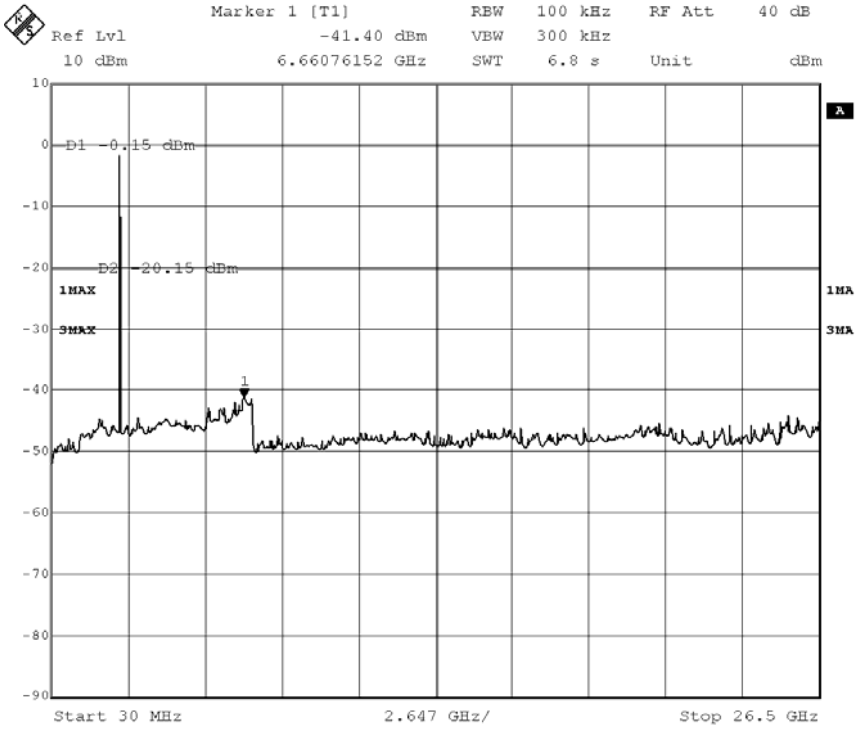
π /4DQPSK 2441MHz



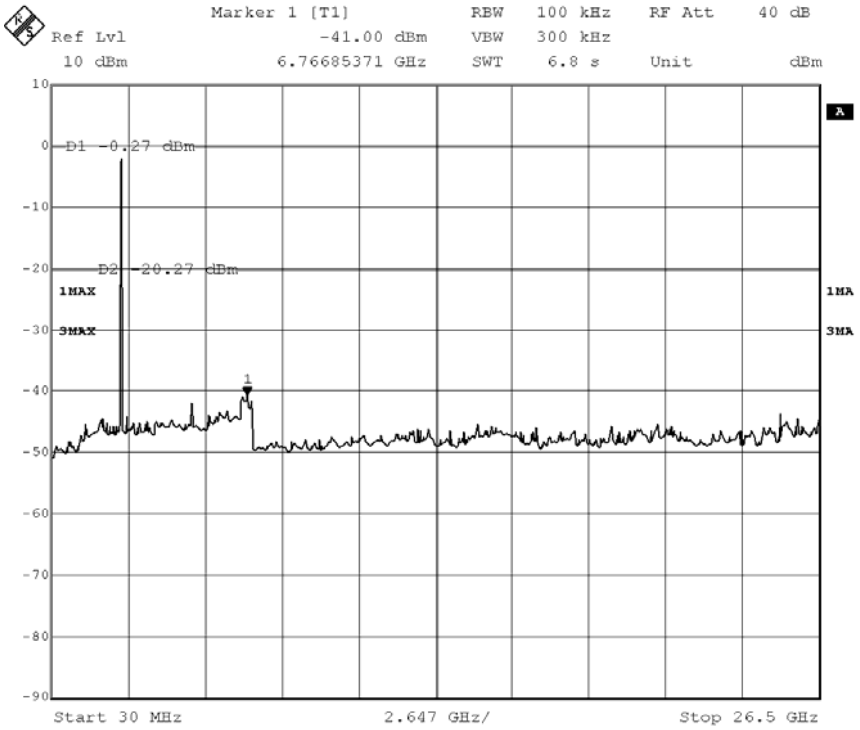
π /4DQPSK 2480MHz



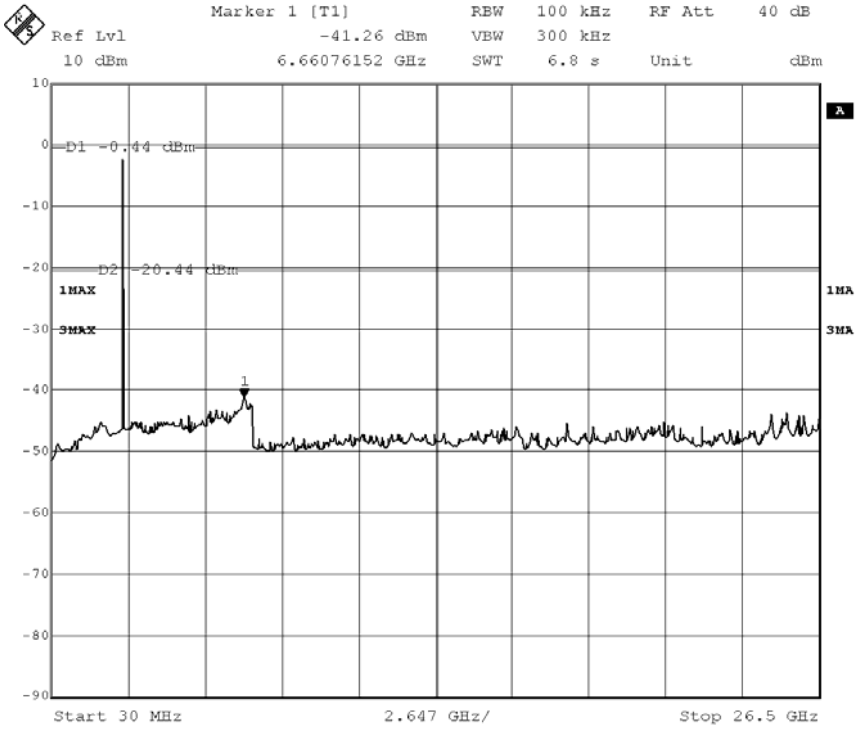
8DPSK 2402MHz



8DPSK 2441MHz



8DPSK 2480MHz



12. ANTENNA REQUIREMENTS

12.1. Limit

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 (b), 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.

12.2. RESULT

The antennas used for this product are dipole antenna and other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 0dBi. The EUT has an internal antenna, the directional gain of antenna is 0dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.

END OF REPORT