

FCC REPORT (Bluetooth)

Applicant: MAT GLOBAL SOLUTIONS,SL.

Address of Applicant: C/ Sant Sebastià, 202 bis 1a-E08223 TERRASSA (Barcelona)
- Spain

Equipment Under Test (EUT)

Product Name: Bluetooth hands free kit

Model No.: in3

Trade Mark: Twiins

FCC ID: DDOTWIN3

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.247:2011

Date of sample receipt: 28 Jan., 2013

Date of Test: 29 Jan., 2013

Date of report issued: 29 Jan., 2013

Test Result : PASS *

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Bruce Zhang
Laboratory Manager

This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product and does not permit the use of the CCIS product certification mark. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards.

This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only."

2 Version

Version No.	Date	Description
00	29 Jan., 2013	Original

Prepared By:

Lisa chen

Report Clerk

Date:

29 Jan., 2013

Check By:

Joe. Zhou

Project Engineer

Date:

29 Jan., 2013

3 Contents

	Page
1 COVER PAGE	1
2 CONTENTS.....	3
3 TEST SUMMARY.....	4
4 GENERAL INFORMATION	5
4.1 CLIENT INFORMATION.....	5
4.2 GENERAL DESCRIPTION OF E.U.T.	5
4.3 TEST MODE.....	7
4.4 TEST FACILITY	7
4.5 TEST LOCATION	7
4.6 OTHER INFORMATION REQUESTED BY THE CUSTOMER.....	7
4.7 TEST INSTRUMENTS LIST	8
5 TEST RESULTS AND MEASUREMENT DATA.....	9
5.1 ANTENNA REQUIREMENT:	9
5.2 CONDUCTED EMISSIONS.....	10
5.3 CONDUCTED PEAK OUTPUT POWER.....	13
5.4 20dB OCCUPY BANDWIDTH.....	17
5.5 CARRIER FREQUENCIES SEPARATION.....	21
5.6 HOPPING CHANNEL NUMBER	26
5.7 DWELL TIME	28
5.8 PSEUDORANDOM FREQUENCY HOPPING SEQUENCE.....	32
5.9 BAND EDGE	33
5.9.1 Conducted Emission Method	33
5.9.2 Radiated Emission Method.....	37
5.10 SPURIOUS EMISSION	39
5.10.1 Conducted Emission Method.....	39
5.10.2 Radiated Emission Method.....	43
6 TEST SETUP PHOTO.....	48
7 EUT CONSTRUCTIONAL DETAILS	50

4 Test Summary

Test Item	Section in CFR 47	Result
Antenna Requirement	15.203/15.247 (c)	Pass
AC Power Line Conducted Emission	15.207	Pass
Conducted Peak Output Power	15.247 (b)(1)	Pass
20dB Occupied Bandwidth	15.247 (a)(1)	Pass
Carrier Frequencies Separation	15.247 (a)(1)	Pass
Hopping Channel Number	15.247 (a)(1)	Pass
Dwell Time	15.247 (a)(1)	Pass
Pseudorandom Frequency Hopping Sequence	15.247(b)(4)&TCB Exclusion List (7 July 2002)	Pass
Radiated Emission	15.205/15.209	Pass
Band Edge	15.247(d)	Pass

Pass: The EUT complies with the essential requirements in the standard.

5 General Information

5.1 Client Information

Applicant:	MAT GLOBAL SOLUTIONS,SL.
Address of Applicant:	C/ Sant Sebastià, 202 bis 1a-E08223 TERRASSA (Barcelona) - Spain
Manufacturer:	ETHER ELECTRONICS CO.,LTD.
Address of Manufacturer:	4F,5Building,DongFangMing Industrial Park,NO.83,DaBao Road, Bao an District, ShenZhen City, China.

5.2 General Description of E.U.T.

Product Name:	Bluetooth hands free kit
Model No.:	in3
Trade Mark:	Twins
Operation Frequency:	2402MHz~2480MHz
Transfer rate:	1/2/3 Mbits/s
Number of channel:	79
Modulation type:	GFSK, $\pi/4$ -DQPSK, 8DPSK
Modulation technology:	FHSS
Bluetooth Version:	2.1+EDR
Antenna Type:	PCB Antenna
Antenna gain:	2.5 dBi
AC adapter:	Model NO.:VTC0500500 Input:100-240V AC,50/60Hz Output:5V DC 500mA
Power supply:	Rechargeable Li-ion Battery DC3.7V/20mAh

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

5.3 Test mode

Transmitting mode:	Keep the EUT in transmitting mode with worst case data rate.
Remark	GFSK were the worst case mode.

5.4 Test Facility

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

● FCC —Registration No.: 817957

China Certification & Inspection Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 817957, February 27, 2012

● Industry Canada (IC)

The 3m Semi-anechoic chamber of China Certification & Inspection Services Co., Ltd. Has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

5.5 Test Location

All tests were performed at:
China Certification & Inspection Services Co., Ltd. Address: 1st Floor, Block No.2, Laodong Industrial Zone, Xixiang Road Baoan District, Shenzhen, China Tel: 0755-23118282 Fax: 0755-23116366

5.6 Other Information Requested by the Customer

None.

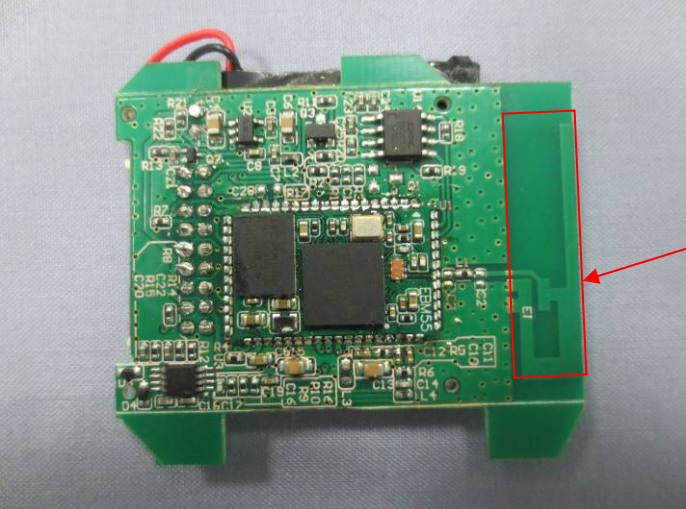
5.7 Test Instruments list

Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (dd-mm-yy)	Cal.Due date (dd-mm-yy)
1	3m Semi- Anechoic Chamber	SAEMC	9(L)*6(W)* 6(H)	CCIS0001	June 09 2012	June 08 2013
2	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	CCIS0005	June 04 2012	June 03 2013
3	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA9120D	CCIS0006	May 30 2012	May 29 2013
4	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
5	Coaxial Cable	CCIS	N/A	CCIS0016	Apr. 01 2012	Mar. 31 2013
6	Coaxial Cable	CCIS	N/A	CCIS0017	Apr. 01 2012	Mar. 31 2013
7	Coaxial cable	CCIS	N/A	CCIS0018	Apr. 01 2012	Mar. 31 2013
8	Coaxial Cable	CCIS	N/A	CCIS0019	Apr. 01 2012	Mar. 31 2013
9	Coaxial Cable	CCIS	N/A	CCIS0087	Apr. 01 2012	Mar. 31 2013
10	Amplifier(10kHz-1.3GHz)	HP	8447D	CCIS0003	Apr. 01 2012	Mar. 31 2013
11	Amplifier(1GHz-18GHz)	Compliance Direction Systems Inc.	PAP-1G18	CCIS0011	June 09 2012	June 08 2013
12	Pre-amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	Apr. 01 2012	Mar. 31 2013
13	Horn Antenna	ETS-LINDGREN	3160	GTS217	Mar. 30 2012	Mar. 29 2013
14	Printer	HP	HP LaserJet P1007	N/A	N/A	N/A
15	Positioning Controller	UC	UC3000	CCIS0015	N/A	N/A
16	Spectrum analyzer 9k-30GHz	Rohde & Schwarz	FSP	CCIS0023	May. 29 2012	May. 28 2013
17	EMI Test Receiver	Rohde & Schwarz	ESPI	CCIS0022	Apr 01 2012	Mar. 31 2013
18	Loop antenna	Laplace instrument	RF300	EMC0701	Aug. 12 2012	Aug. 11 2013

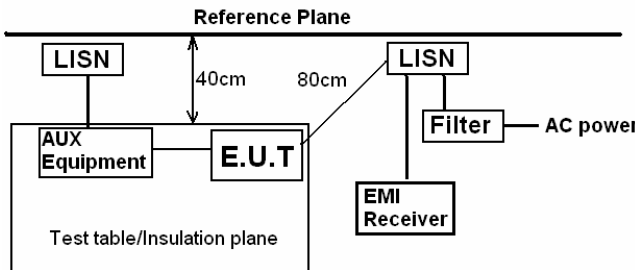
Conducted Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (dd-mm-yy)	Cal. Due date (dd-mm-yy)
1	Shielding Room	ZhongShuo Electron	11.0(L)x4.0(W)x3.0(H)	CCIS0061	June 09 2012	June 08 2013
2	EMI Test Receiver	Rohde & Schwarz	ESCI	CCIS0002	May 25 2012	May 24 2013
3	LISN	CHASE	MN2050D	CCIS0074	Apr 01 2012	Mar. 31 2013
4	Coaxial Cable	CCIS	N/A	CCIS0086	Apr. 01 2012	Mar. 31 2013
5	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A

6 Test results and Measurement Data

6.1 Antenna requirement:

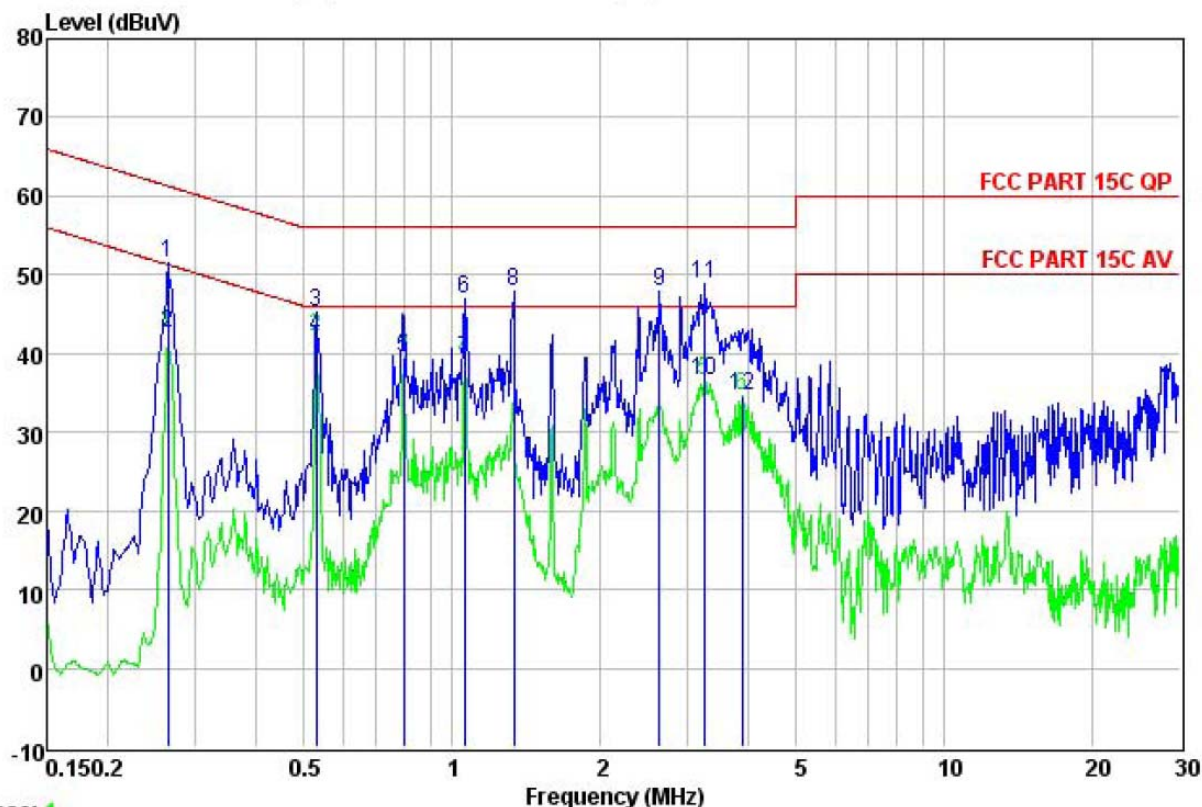
Standard requirement:	FCC Part15 C Section 15.203 /247(c)
<i>15.203 requirement:</i> <i>An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, 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.</i> <i>15.247(c) (1)(i) requirement:</i> <i>(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.</i>	
E.U.T Antenna:	
The antenna is a PCB antenna, and the best case gain of the antenna is 2.5 dBi.	
 Bluetooth Antenna	

6.2 Conducted Emissions

Test Requirement:	FCC Part15 C Section 15.207		
Test Method:	ANSI C63.4:2003		
Test Frequency Range:	150KHz to 30MHz		
Class / Severity:	Class B		
Receiver setup:	RBW=9kHz, VBW=30kHz, Sweep time=auto		
Limit:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	Average
	0.15-0.5	66 to 56*	56 to 46*
	0.5-5	56	46
	5-30	60	50
* Decreases with the logarithm of the frequency.			
Test setup:	 Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m		
Test procedure:	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2003 on conducted measurement.		
Test Instruments:	Refer to section 5.7 for details		
Test mode:	Charging+ transmitting mode		
Test results:	Pass		

Measurement Data

Line:

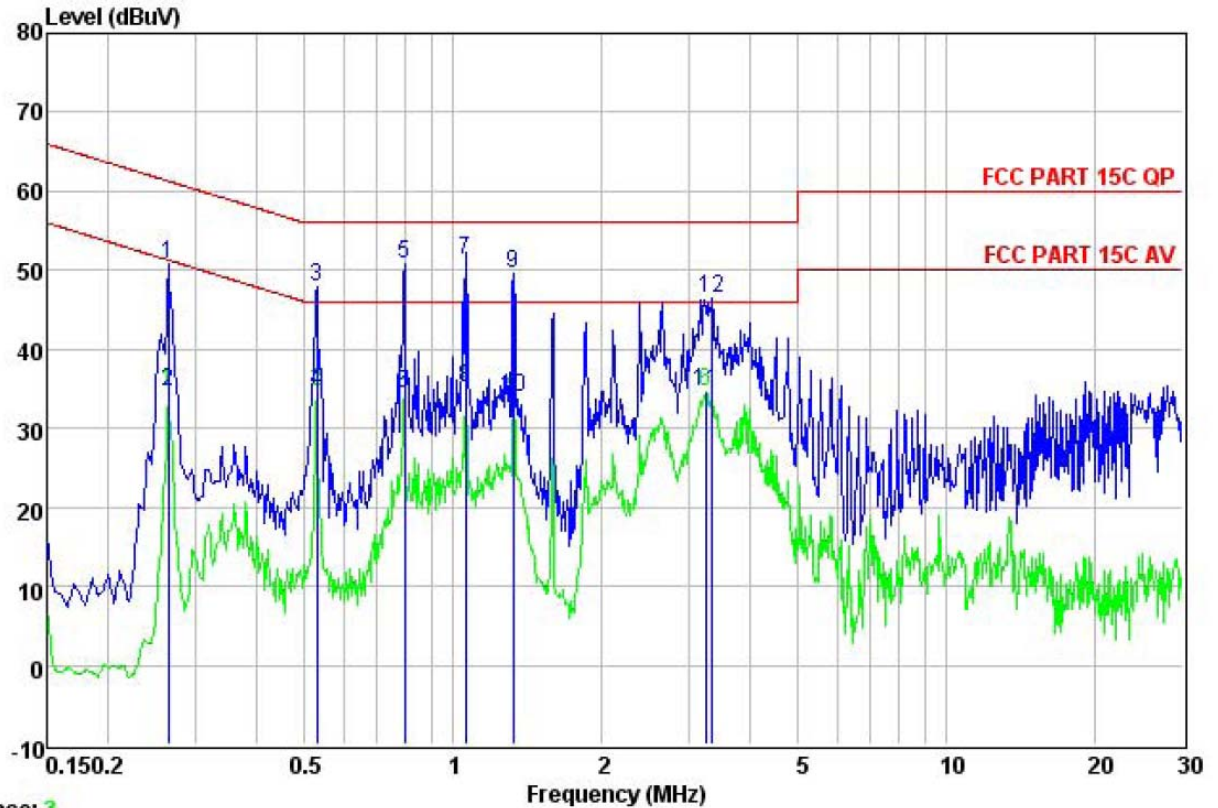


Trace: 1

Site : CCIS Conducted Test Site
 Condition : FCC PART 15C QP LISN LINE
 Job NO. : 028RF
 Test Mode : Charge+transmitting mode
 Power Rating : AC 120V/60Hz
 Environment : Temp: 23 °C Humi:56% Atmos:101KPa
 Test Engineer: Joe

	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.264	40.54	10.24	0.74	51.52	61.29	-9.77	QP
2	0.264	31.60	10.24	0.74	42.58	51.29	-8.71	Average
3	0.529	34.17	10.26	0.76	45.19	56.00	-10.81	QP
4	0.529	31.06	10.26	0.76	42.08	46.00	-3.92	Average
5	0.796	28.50	10.19	0.80	39.49	46.00	-6.51	Average
6	1.060	35.82	10.22	0.83	46.87	56.00	-9.13	QP
7	1.060	28.09	10.22	0.83	39.14	46.00	-6.86	Average
8	1.331	37.03	10.24	0.59	47.86	56.00	-8.14	QP
9	2.636	36.70	10.28	0.94	47.92	56.00	-8.08	QP
10	3.241	25.36	10.29	0.90	36.55	46.00	-9.45	Average
11	3.258	37.59	10.29	0.90	48.78	56.00	-7.22	QP
12	3.881	23.51	10.29	0.89	34.69	46.00	-11.31	Average

Neutral:



Trace: 3

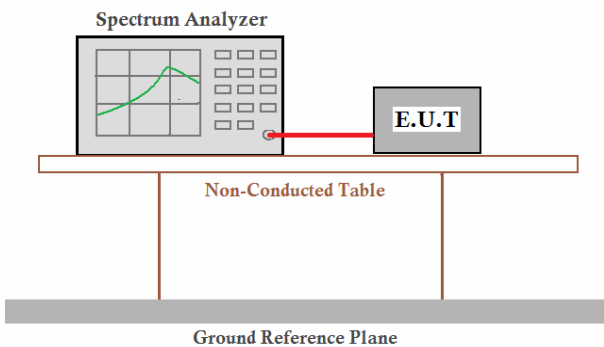
Site : CCIS Conducted Test Site
Condition : FCC PART 15C QP LISN NEUTRAL
Job NO. : 028RF
Test Mode : Charge+transmitting mode
Power Rating : AC 120V/60Hz
Environment : Temp: 23 °C Humi:56% Atmos:101KPa
Test Engineer: Joe

	Freq	Read	LISN	Cable	Level	Limit	Over	
	MHz	Level	Factor	Loss	Level	Line	Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.264	39.73	10.24	0.74	50.71	61.29	-10.58	QP
2	0.264	23.75	10.24	0.74	34.73	51.29	-16.56	Average
3	0.529	36.91	10.26	0.76	47.93	56.00	-8.07	QP
4	0.529	23.51	10.26	0.76	34.53	46.00	-11.47	Average
5	0.796	39.80	10.17	0.80	50.77	56.00	-5.23	QP
6	0.796	23.37	10.17	0.80	34.34	46.00	-11.66	Average
7	1.060	40.16	10.21	0.83	51.20	56.00	-4.80	QP
8	1.060	24.05	10.21	0.83	35.09	46.00	-10.91	Average
9	1.324	38.80	10.23	0.60	49.63	56.00	-6.37	QP
10	1.324	23.20	10.23	0.60	34.03	46.00	-11.97	Average
11	3.241	23.35	10.28	0.90	34.53	46.00	-11.47	Average
12	3.346	35.17	10.28	0.90	46.35	56.00	-9.65	QP

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss

6.3 Conducted Peak Output Power

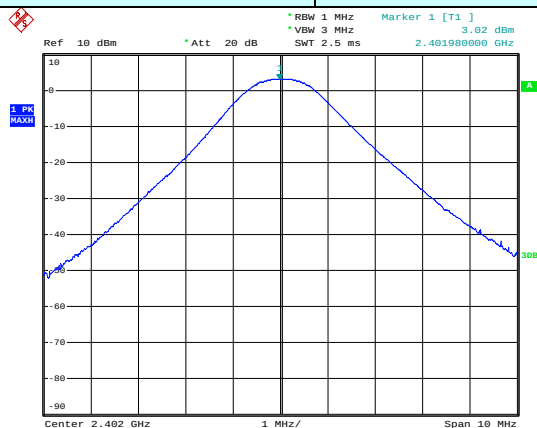
Test Requirement:	FCC Part15 C Section 15.247 (b)(3)
Test Method:	ANSI C63.4:2003 and DA00-705
Receiver setup:	RBW=1MHz, VBW=3MHz, Detector=Peak (20dB BW≤1MHz) RBW=3MHz, VBW=10MHz, Detector=Peak (20dB BW≥1MHz)
Limit:	125mW(21dBm)
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 5.7 for details
Test mode:	Non-hopping mode
Test results:	Pass

Measurement Data

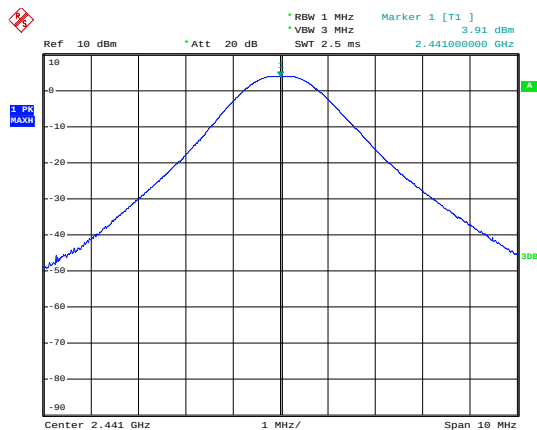
GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	3.02	21.00	Pass
Middle	3.91	21.00	Pass
Highest	3.84	21.00	Pass
$\pi/4$ -DQPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	2.28	21.00	Pass
Middle	3.10	21.00	Pass
Highest	2.71	21.00	Pass
8DPSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	2.25	21.00	Pass
Middle	3.38	21.00	Pass
Highest	3.07	21.00	Pass

Test plot as follows:

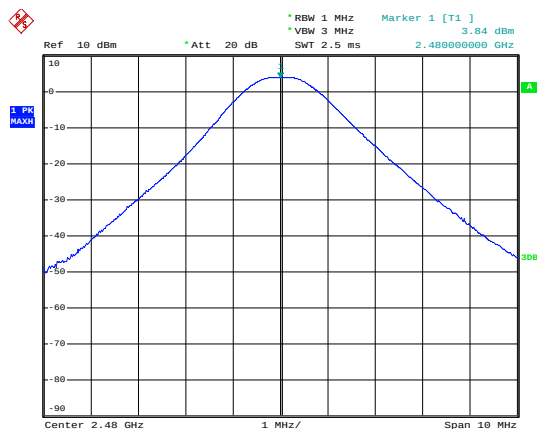
Modulation mode:	GFSK
------------------	------



Lowest channel

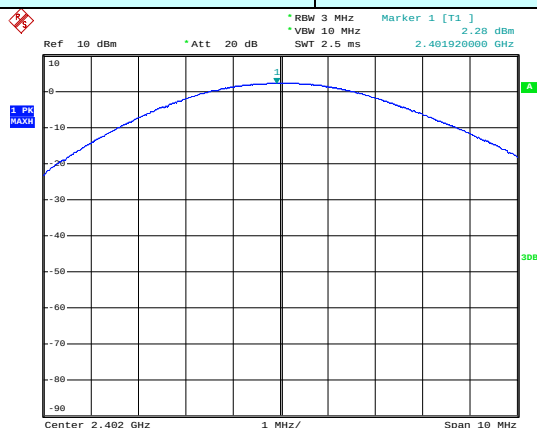


Middle channel

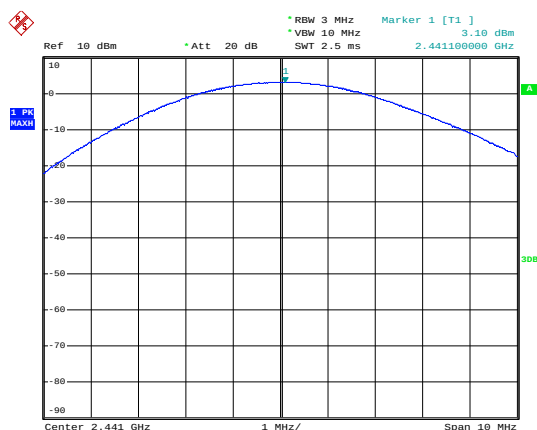


Highest channel

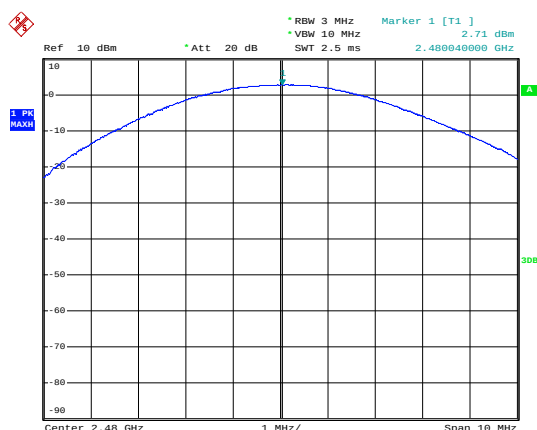
Modulation mode:	$\pi/4$ -DQPSK
------------------	----------------



Lowest channel

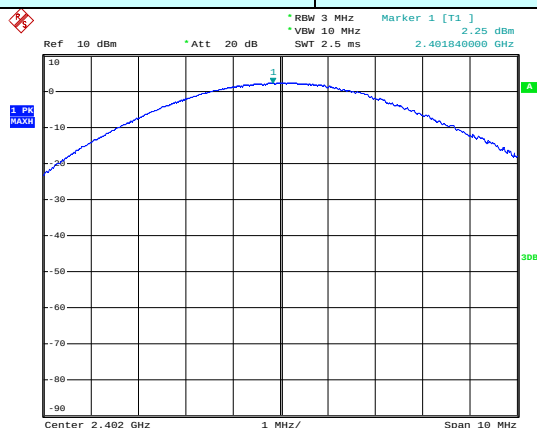


Middle channel

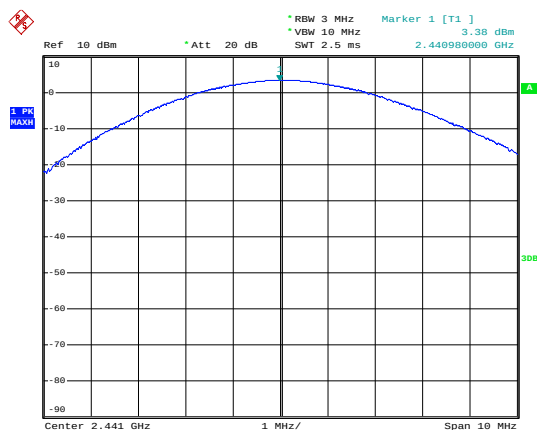


Highest channel

Modulation mode:	8DPSK
------------------	-------

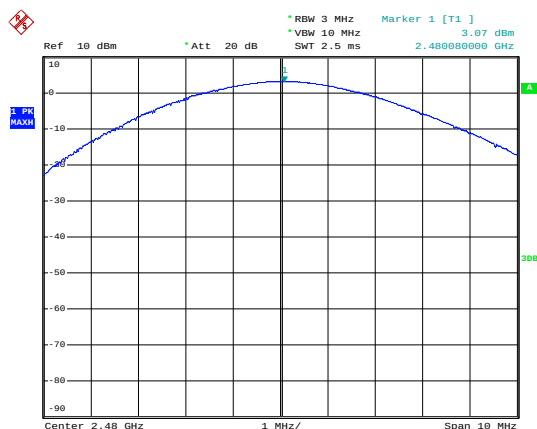


Lowest channel



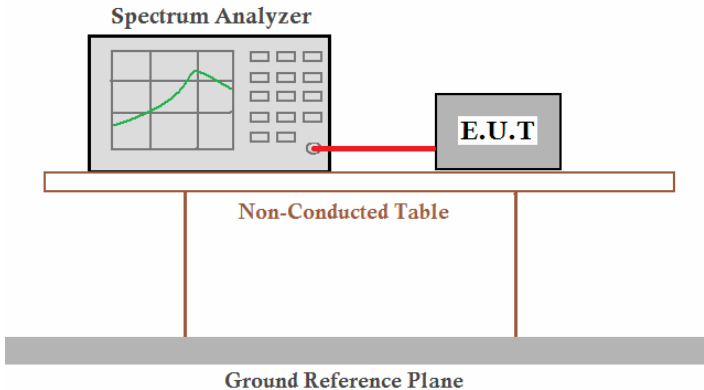
Date: 2018/01/13 07:28:21

Middle channel



Highest channel

6.4 20dB Occupy Bandwidth

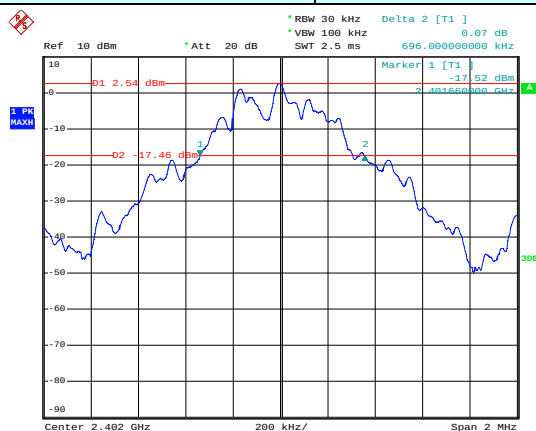
Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.4:2003 and DA00-705
Receiver setup:	RBW=30kHz, VBW=100kHz,detector=Peak
Limit:	NA
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 5.7 for details
Test mode:	Non-hopping mode
Test results:	Pass

Measurement Data

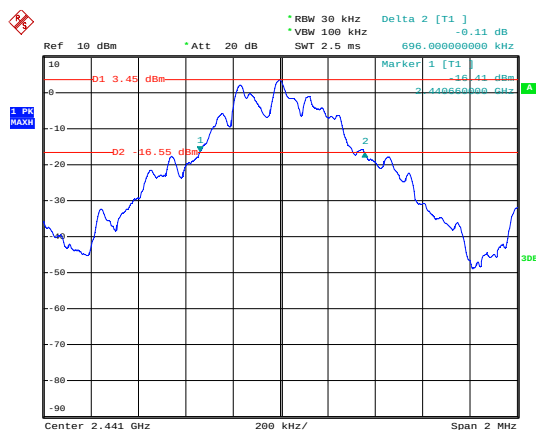
Test channel	20dB Occupy Bandwidth (kHz)		
	GFSK	$\pi/4$ -DQPSK	8DPSK
Lowest	696	1288	1220
Middle	696	1284	1216
Highest	696	1284	1216

Test plot as follows:

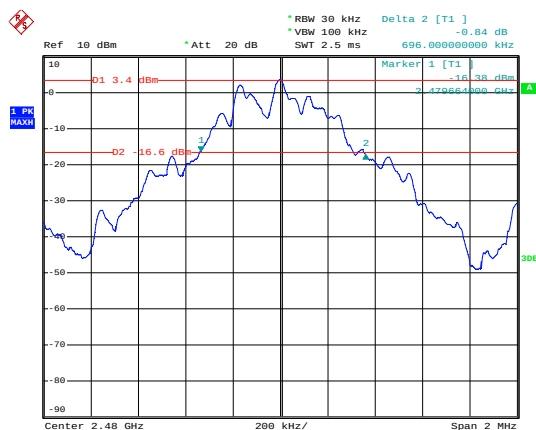
Modulation mode:	GFSK
------------------	------



Lowest channel

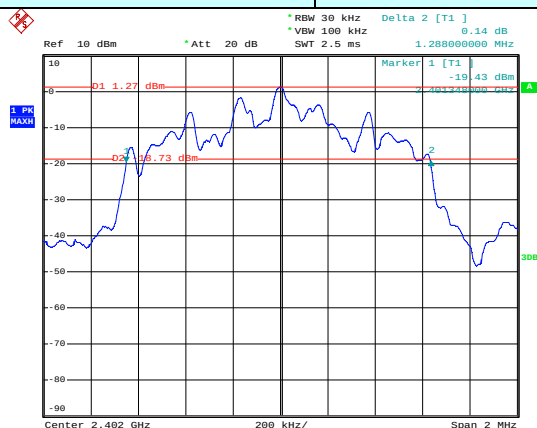


Middle channel

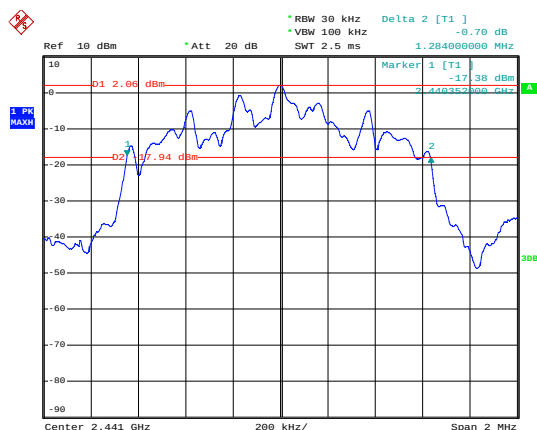


Highest channel

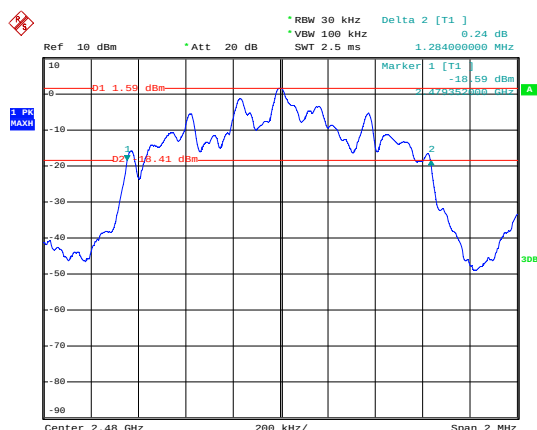
Modulation mode:	$\pi/4$ -DQPSK
------------------	----------------



Lowest channel



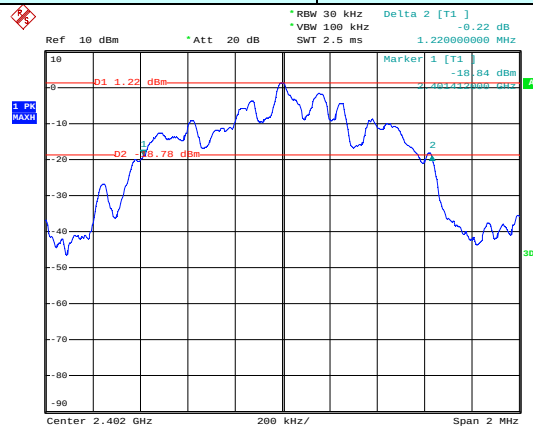
Middle channel



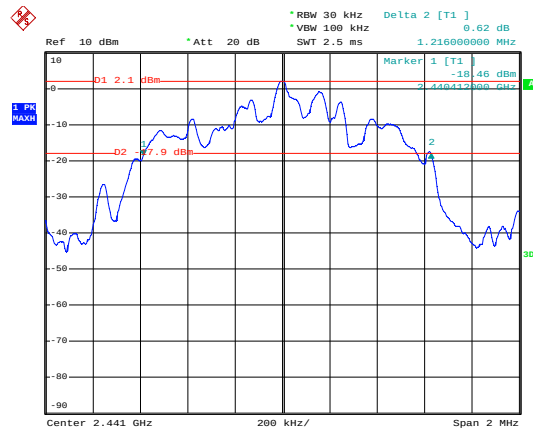
Highest channel

Modulation mode:

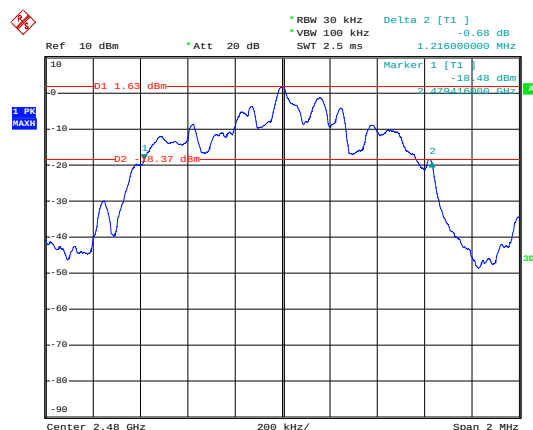
8DPSK



Lowest channel

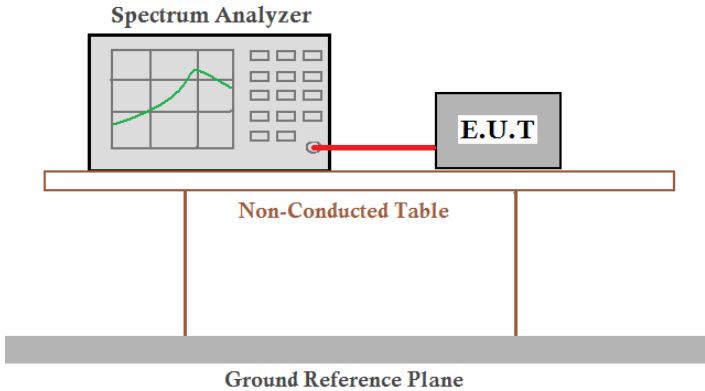


Middle channel



Highest channel

6.5 Carrier Frequencies Separation

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.4:2003 and DA00-705
Receiver setup:	RBW=100kHz, VBW=300kHz, detector=Peak
Limit:	0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater)
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer, shown with a green trace on its screen, is connected to an E.U.T. (Equipment Under Test) by a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a table labeled 'Non-Conducted Table'. Below this table is a 'Ground Reference Plane', represented by a thick grey bar.
Test Instruments:	Refer to section 5.7 for details
Test mode:	Hopping mode
Test results:	Pass

Measurement Data

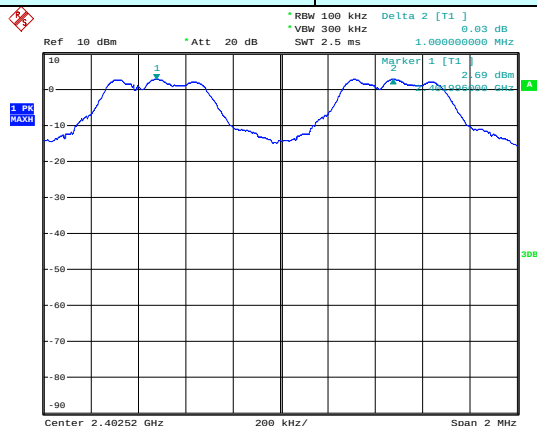
GFSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	1000	464.000	Pass
Middle	1000	464.000	Pass
Highest	1000	464.000	Pass
$\pi/4$ -DQPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	1012	858.667	Pass
Middle	1020	858.667	Pass
Highest	1000	858.667	Pass
8DPSK mode			
Test channel	Carrier Frequencies Separation (kHz)	Limit (kHz)	Result
Lowest	1168	813.333	Pass
Middle	1008	813.333	Pass
Highest	1000	813.333	Pass

Note: According to section 5.4

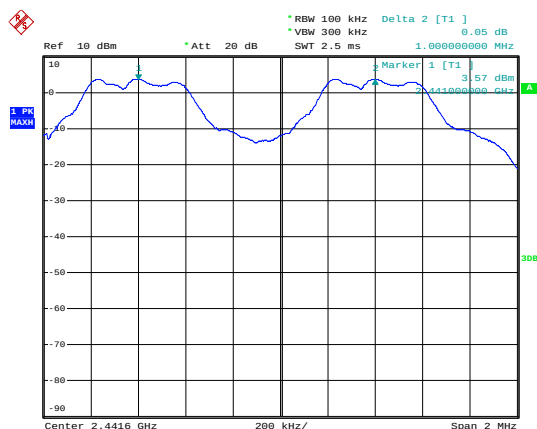
Mode	20dB bandwidth (kHz) (worse case)	Limit (kHz) (Carrier Frequencies Separation)
GFSK	696	464.000
$\pi/4$ -DQPSK	1288	858.667
8DPSK	1220	813.333

Test plot as follows:

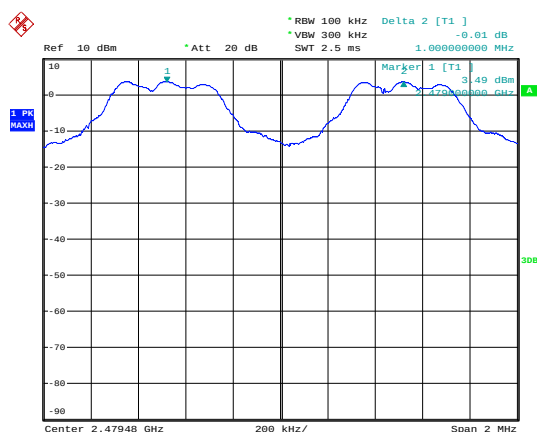
Modulation mode:	GFSK
------------------	------



Lowest channel

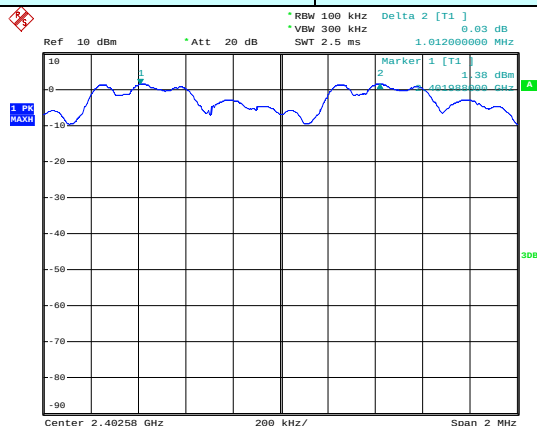


Middle channel

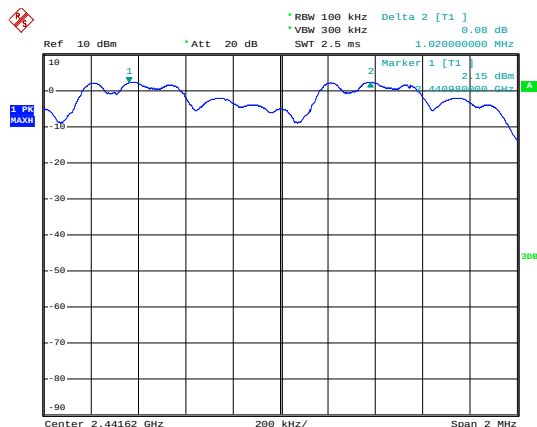


Highest channel

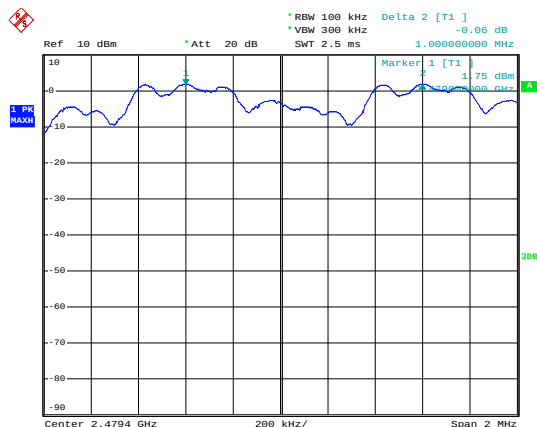
Modulation mode:	$\pi/4$ -DQPSK
------------------	----------------



Lowest channel

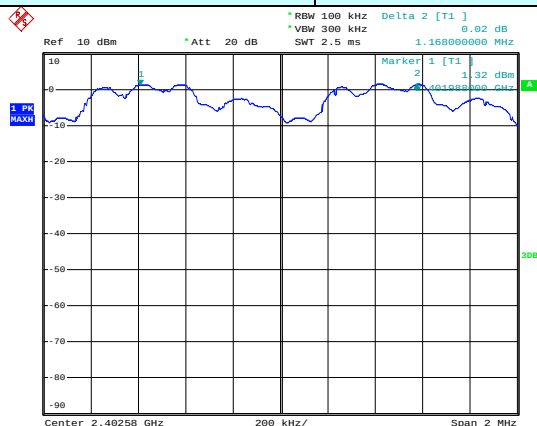


Middle channel

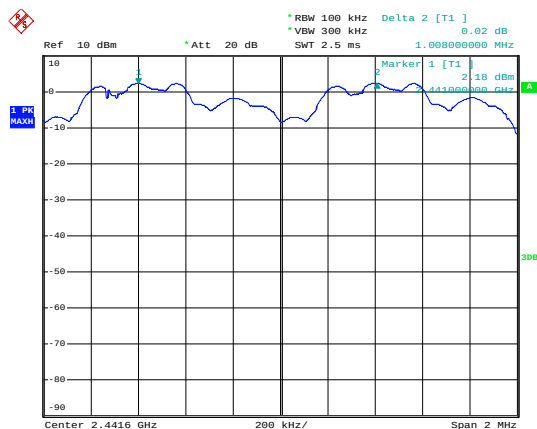


Highest channel

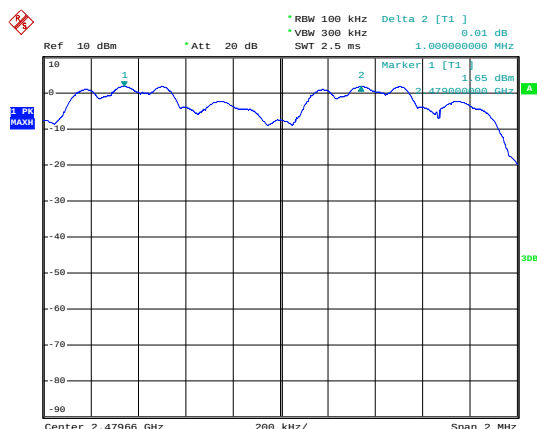
Modulation mode:	8DPSK
------------------	-------



Lowest channel

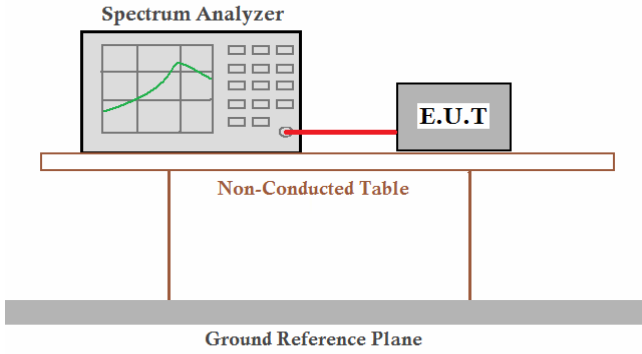


Middle channel



Highest channel

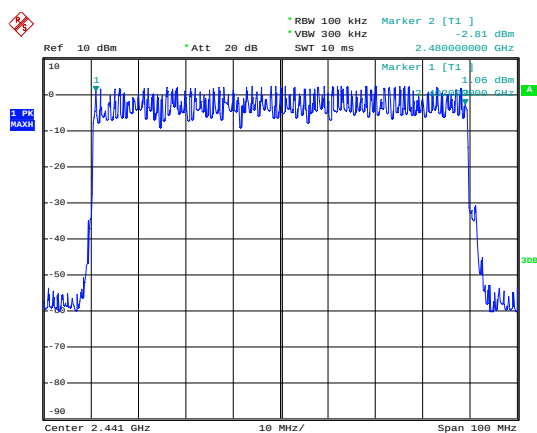
6.6 Hopping Channel Number

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.4:2003 and DA00-705
Receiver setup:	RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak
Limit:	15 channels
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 5.7 for details
Test mode:	Hopping mode
Test results:	Pass

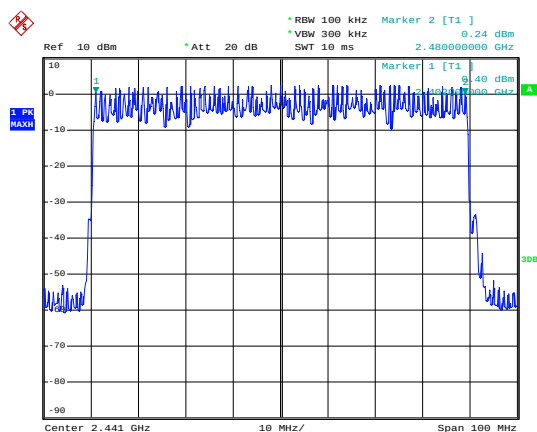
Measurement Data:

Mode	Hopping channel numbers	Limit	Result
GFSK, $\pi/4$ -DQPSK, 8DPSK	79	15	Pass

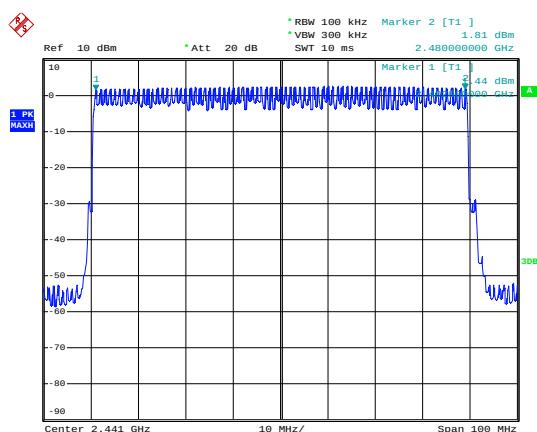
GFSK



$\pi/4$ -DQPSK

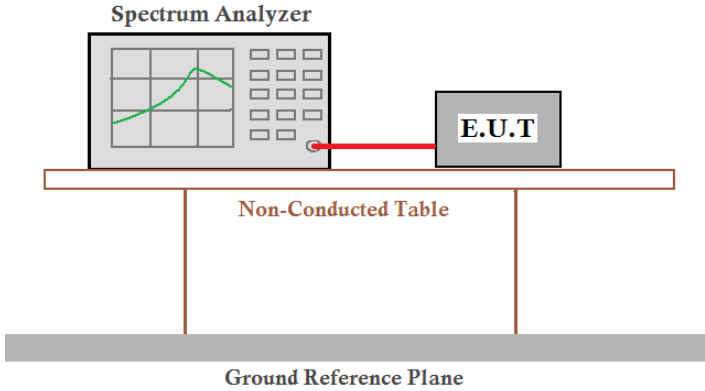


8DPSK



2.441 GHz 2.441 GHz 2.441 GHz

6.7 Dwell Time

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)
Test Method:	ANSI C63.4:2003 and DA 00-705
Receiver setup:	RBW=1MHz, VBW=1MHz, Span=0Hz, Detector=Peak
Limit:	0.4 Second
Test setup:	
Test Instruments:	Refer to section 5.7 for details
Test mode:	Hopping mode
Test results:	Pass

Measurement Data (Worse case)

Mode	Packet	Dwell time (second)	Limit (second)	Result
GFSK	DH1	0.17664	0.4	Pass
	DH3	0.28608		
	DH5	0.32939		
$\pi/4$ -DQPSK	2-DH1	0.17792	0.4	Pass
	2-DH3	0.28896		
	2-DH5	0.33046		
8DPSK	3-DH1	0.18432	0.4	Pass
	3-DH3	0.29472		
	3-DH5	0.33046		

For GFSK, $\pi/4$ -DQPSK and 8DPSK:

The test period: $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$

The lowest channel (2402MHz), middle channel (2441MHz), highest channel (2480MHz) as below

DH1 time slot = $0.552(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 176.64\text{ms}$

DH3 time slot = $1.788(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 286.08\text{ms}$

DH5 time slot = $3.090(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 329.39\text{ms}$

2-DH1 time slot = $0.556(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 177.92\text{ms}$

2-DH3 time slot = $1.806(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 288.96\text{ms}$

2-DH5 time slot = $3.100(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 330.46\text{ms}$

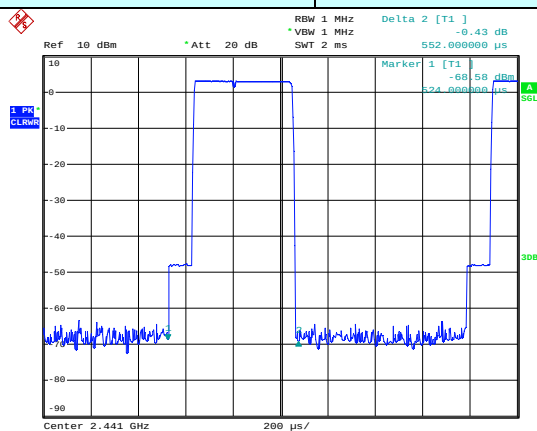
3-DH1 time slot = $0.576(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 184.32\text{ms}$

3-DH3 time slot = $1.842(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 294.72\text{ms}$

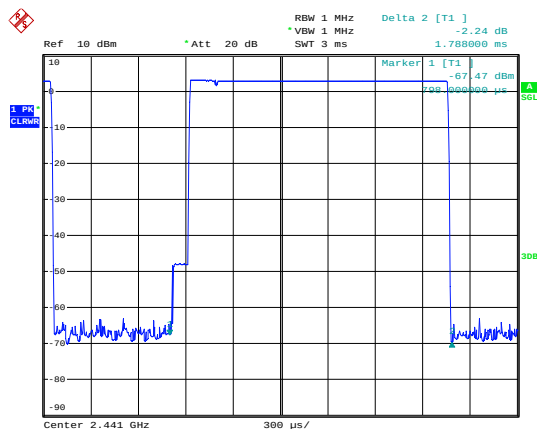
3-DH5 time slot = $3.100(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 330.46\text{ms}$

Test plot as follows:

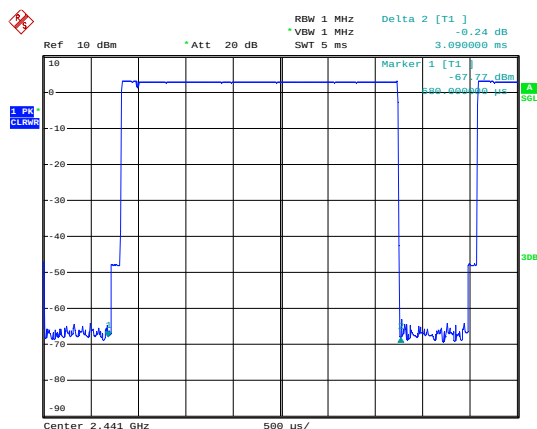
Modulation mode:	GFSK
------------------	------



DH1

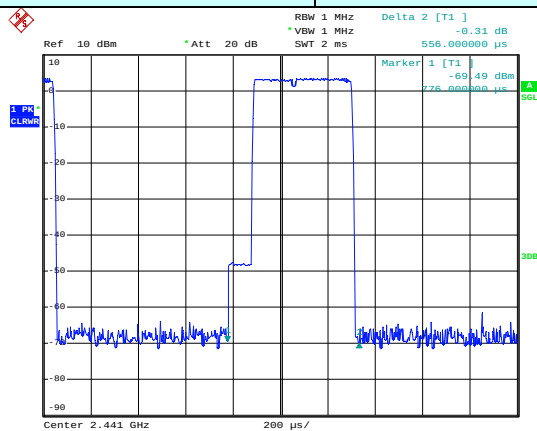


DH3

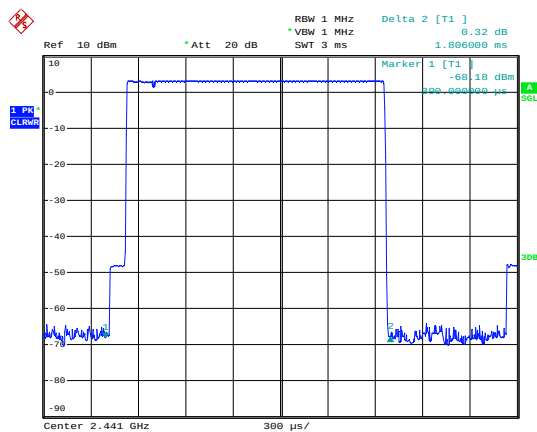


DH5

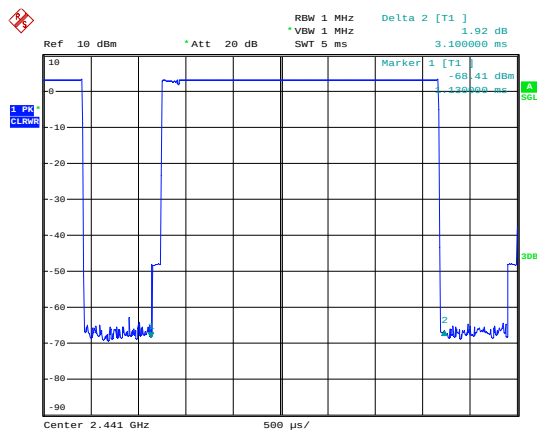
Modulation mode:	$\pi/4$ -DQPSK
------------------	----------------



2-DH1

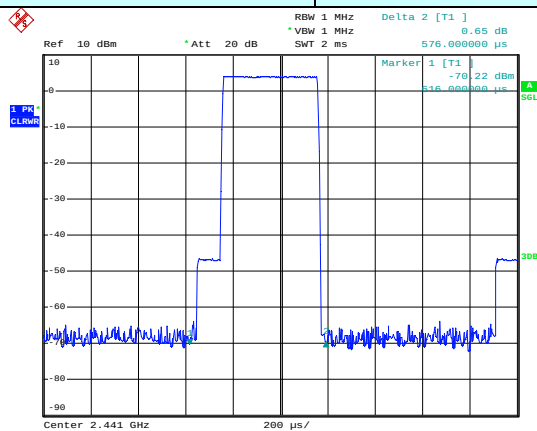


2-DH3

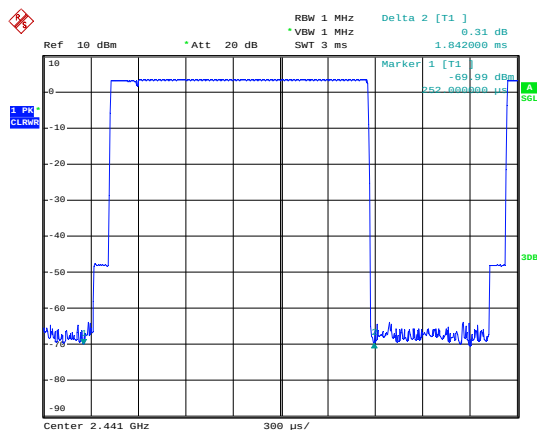


2-DH5

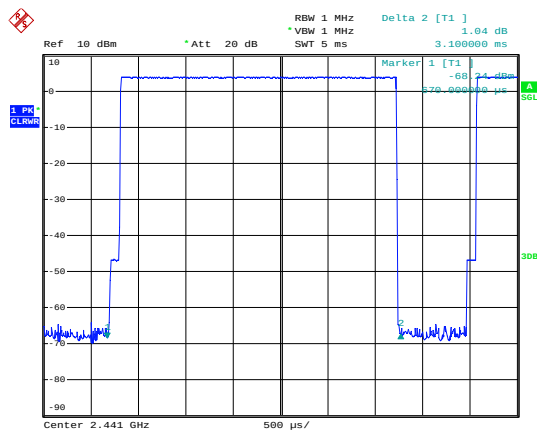
Modulation mode:	8DPSK
------------------	-------



3-DH1



3-DH3



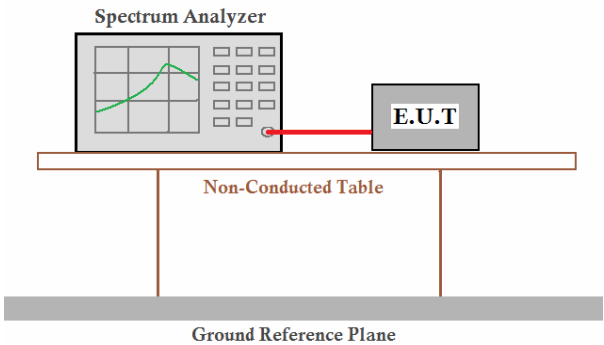
3-DH5

6.8 Pseudorandom Frequency Hopping Sequence

Test Requirement:	FCC Part15 C Section 15.247 (a)(1) requirement:
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 Pseudorandom 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.	
EUT Pseudorandom Frequency Hopping Sequence	
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones. • Number of shift register stages: 9 • Length of pseudo-random sequence: $2^9 - 1 = 511$ bits • Longest sequence of zeros: 8 (non-inverted signal) <i>Linear Feedback Shift Register for Generation of the PRBS sequence</i> An example of Pseudorandom Frequency Hopping Sequence as follow: Each frequency used equally on the average by each transmitter. The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.	

6.9 Band Edge

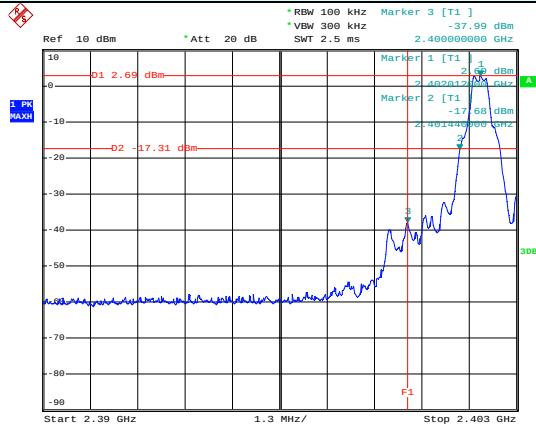
6.9.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.4:2003 and DA00-705
Receiver setup:	RBW=100kHz, VBW=300kHz, Detector=Peak
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 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.
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T. (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table. The table is supported by a Ground Reference Plane.
Test Instruments:	Refer to section 5.7 for details
Test mode:	Non-hopping mode and hopping mode
Test results:	Pass

Test plot as follows:

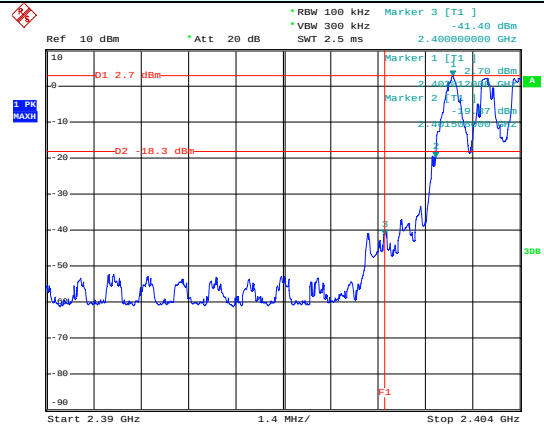
GFSK

Test channel:	Lowest channel
---------------	----------------



Date: 28.JAN.2013 06:52:23

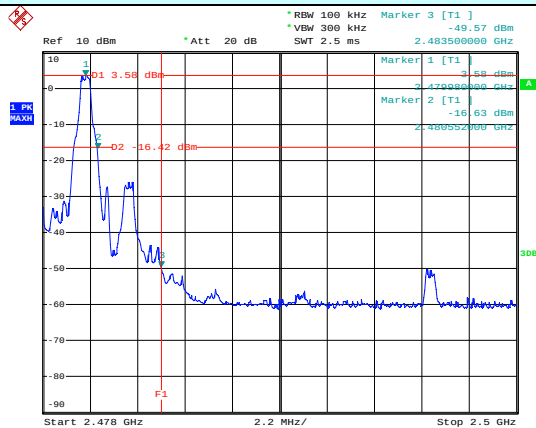
No-hopping mode



Date: 28.JAN.2013 08:14:54

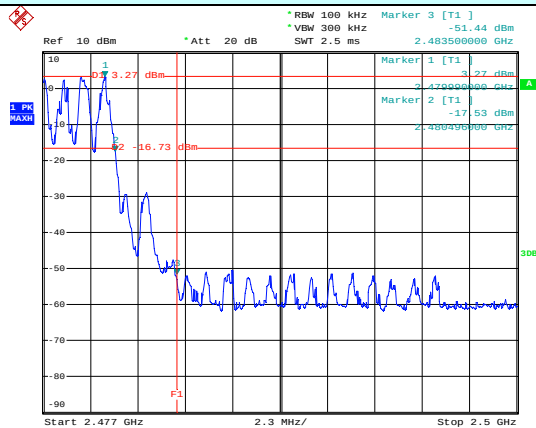
Hopping mode

Test channel:	Highest channel
---------------	-----------------



Date: 28.JAN.2013 07:02:26

No-hopping mode

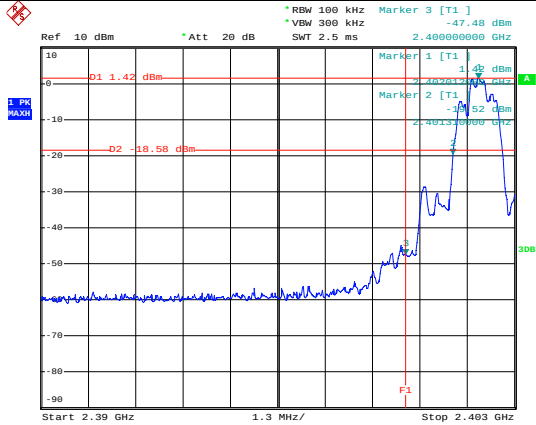


Date: 28.JAN.2013 08:16:13

Hopping mode

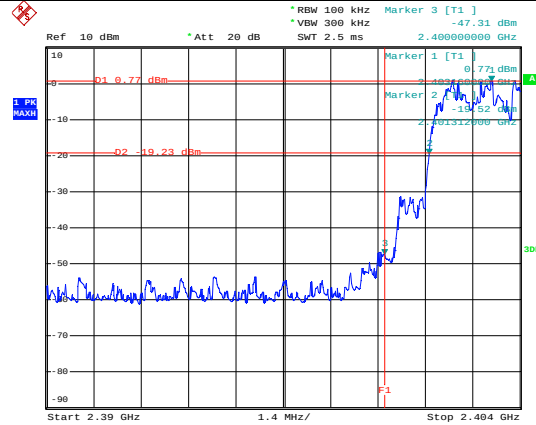
$\pi/4$ -DQPSK

Test channel:	Lowest channel
---------------	----------------



Date: 28.JAN.2013 07:08:06

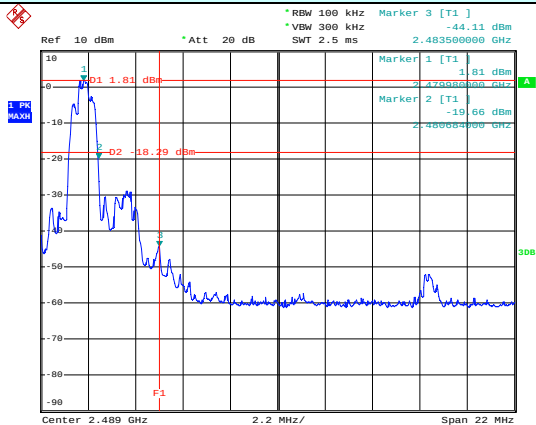
No-hopping mode



Date: 28.JAN.2013 08:13:49

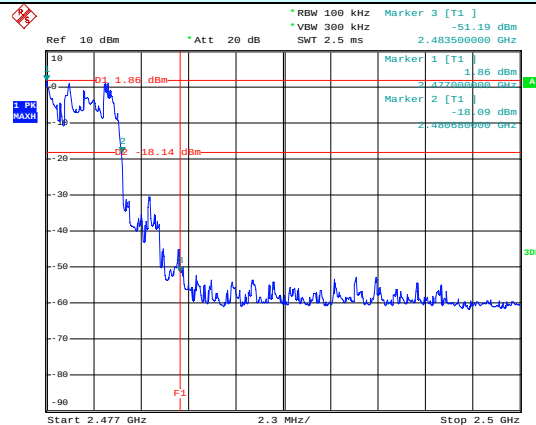
Hopping mode

Test channel:	Highest channel
---------------	-----------------



Date: 28.JAN.2013 07:17:24

No-hopping mode

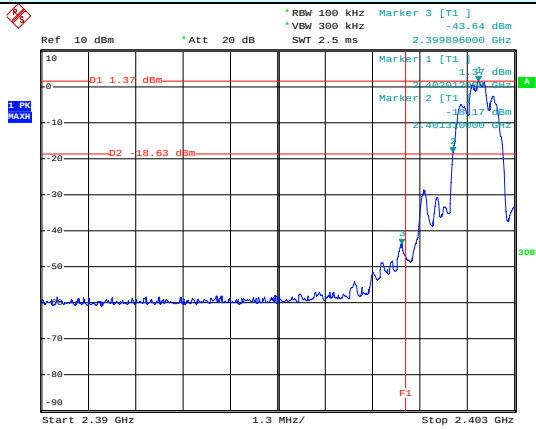


Date: 28.JAN.2013 08:12:45

Hopping mode

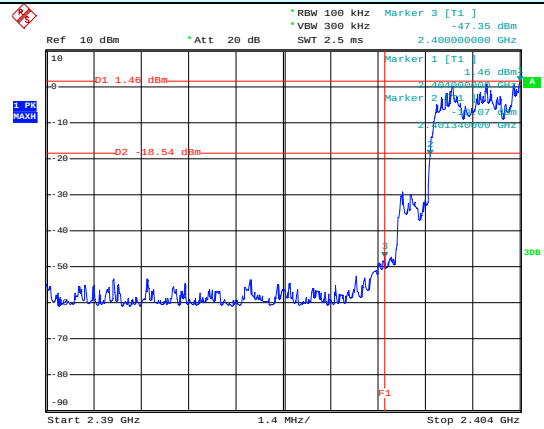
8DPSK

Test channel:	Lowest channel
---------------	----------------



Date: 28.JAN.2013 07:22:51

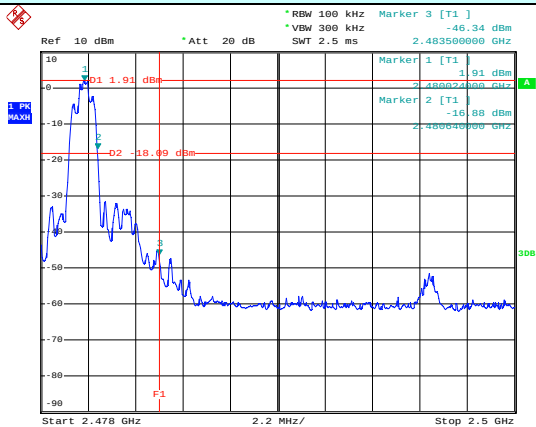
No-hopping mode



Date: 28.JAN.2013 08:18:28

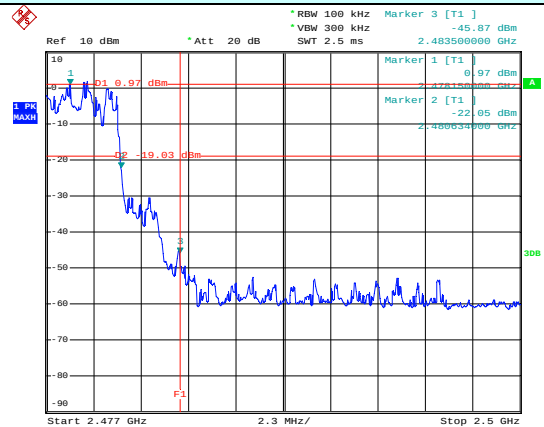
Hopping mode

Test channel:	Highest channel
---------------	-----------------



Date: 28.JAN.2013 08:07:22

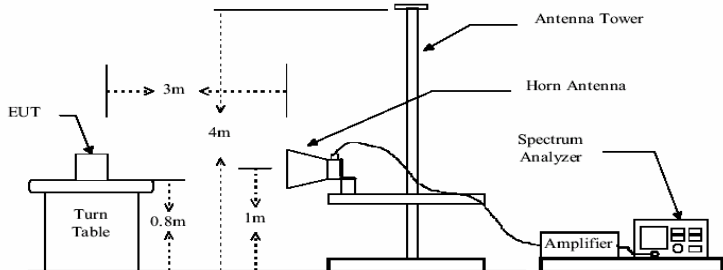
No-hopping mode



Date: 28.JAN.2013 08:17:35

Hopping mode

6.9.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209 and 15.205				
Test Method:	ANSI C63.4: 2003				
Test Frequency Range:	2.3GHz to 2.5GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Remark
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		Peak	1MHz	10Hz	Average Value
Limit:	Frequency		Limit (dBuV/m @3m)		Remark
	Above 1GHz		54.00		Average Value
			74.00		Peak Value
Test setup:					
Test Procedure:	1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. 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. 4. 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. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. 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.				
Test Instruments:	Refer to section 5.7 for details				
Test mode:	Non-hopping mode				
Test results:	Passed				

Remark:

1. During the test, pre-scan the GFSK, π /4-DQPSK, 8DPSK, and found the GFSK modulation is the worst case.
2. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis is the worst case.

Test channel:		Lowest			Level:		Peak	
Frequency (MHz)	Read Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2390.00	62.32	27.58	3.81	34.83	58.88	74.00	-15.12	Horizontal
2390.00	61.35	27.58	3.81	34.83	57.91	74.00	-16.09	Vertical

Test channel:		Lowest			Level:		Average	
Frequency (MHz)	Read Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2390.00	48.35	27.58	3.81	34.83	44.91	54.00	-9.09	Horizontal
2390.00	47.26	27.58	3.81	34.83	43.82	54.00	-10.18	Vertical

Test channel:		Highest			Level:		Peak	
Frequency (MHz)	Read Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	64.25	27.52	3.89	34.86	60.80	74.00	-13.20	Horizontal
2483.50	62.38	27.52	3.89	34.86	58.93	74.00	-15.07	Vertical

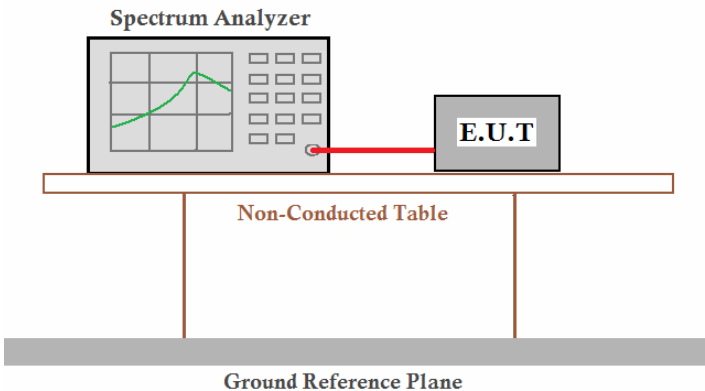
Test channel:		Highest			Level:		Average	
Frequency (MHz)	Read Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
2483.50	49.36	27.52	3.89	34.86	45.91	54.00	-8.09	Horizontal
2483.50	48.82	27.52	3.89	34.86	45.37	54.00	-8.63	Vertical

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. The emission levels of other frequencies are very lower than the limit and not show in test report.

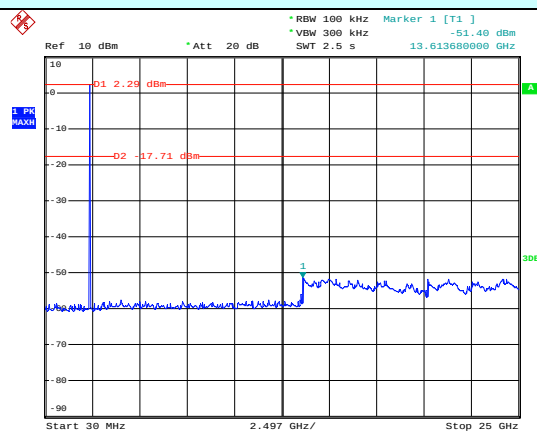
6.10 Spurious Emission

6.10.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.4:2003 and DA00-705
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.
Test setup:	 The diagram illustrates the test setup for conducted emission measurement. A Spectrum Analyzer is connected via a red cable to an E.U.T (Equipment Under Test). Both are placed on a Non-Conducted Table, which is supported by two vertical legs. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 5.7 for details
Test mode:	Non-hopping mode
Test results:	Pass

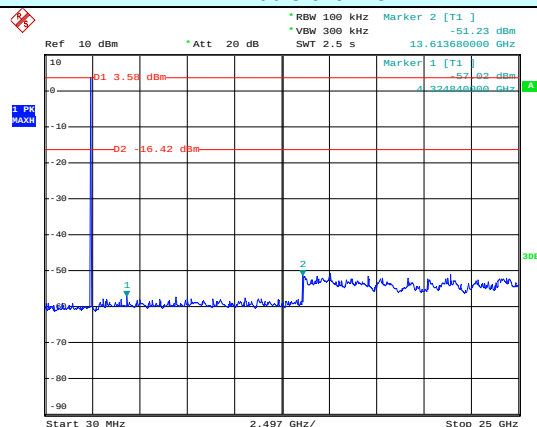
GFSK

Lowest channel



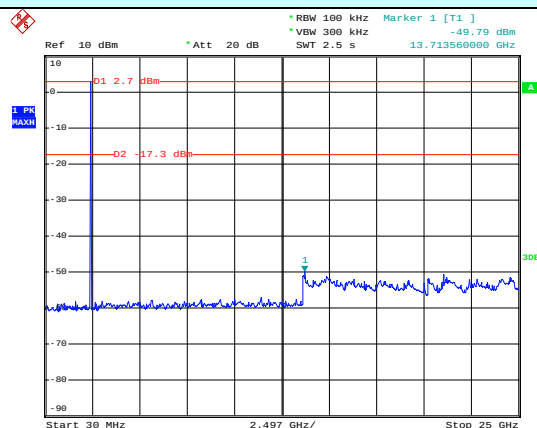
30MHz~25GHz

Middle channel



30MHz~25GHz

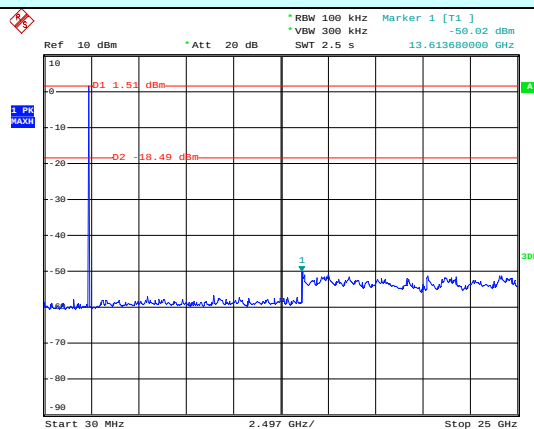
Highest channel



30MHz~25GHz

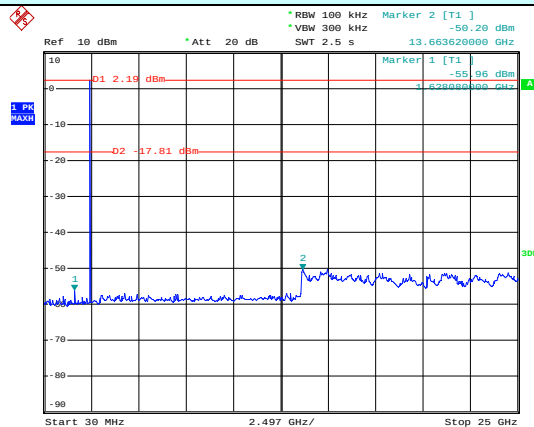
$\pi/4$ -DQPSK

Lowest channel



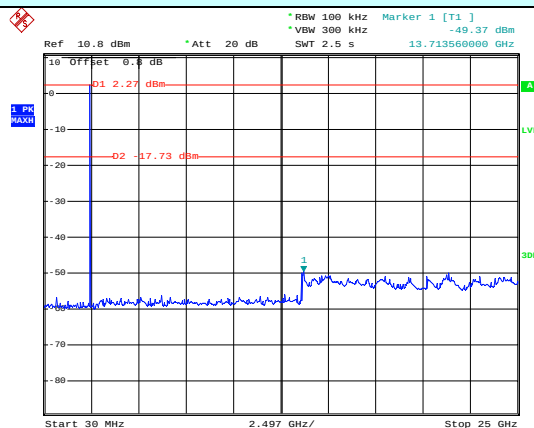
30MHz~25GHz

Middle channel



30MHz~25GHz

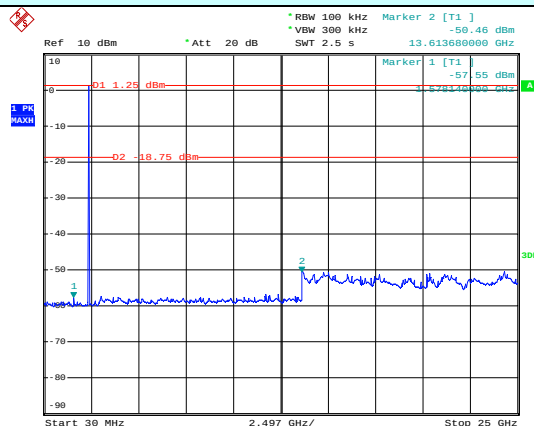
Highest channel



30MHz~25GHz

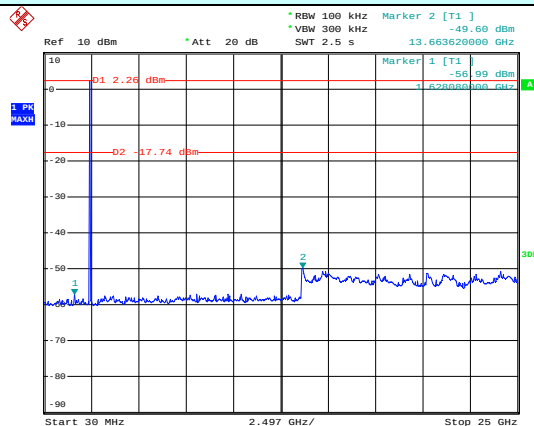
8DPSK

Lowest channel



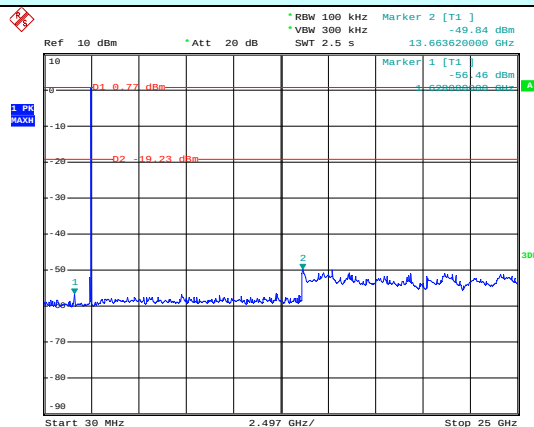
30MHz~25GHz

Middle channel



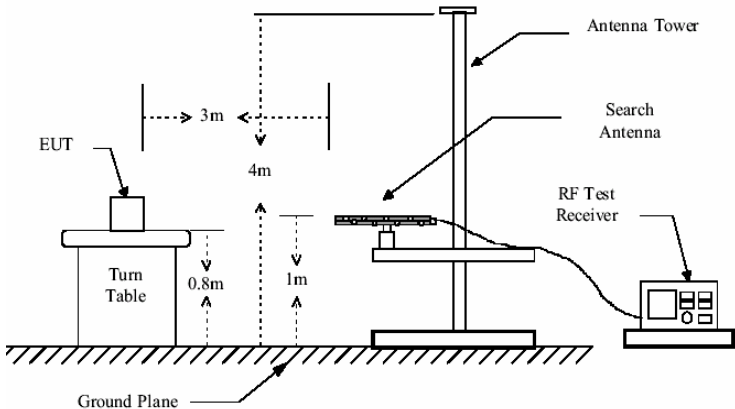
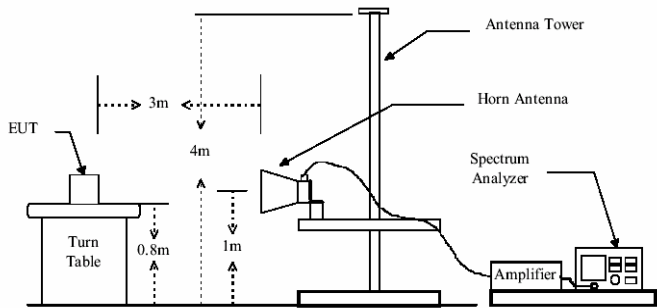
30MHz~25GHz

Highest channel



30MHz~25GHz

6.10.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.4: 2003				
Test Frequency Range:	9KHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Remark
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		Peak	1MHz	10Hz	Average Value
Limit:	Frequency		Limit (dBuV/m @3m)		Remark
	30MHz-88MHz		40.0		Quasi-peak Value
	88MHz-216MHz		43.5		Quasi-peak Value
	216MHz-960MHz		46.0		Quasi-peak Value
	960MHz-1GHz		54.0		Quasi-peak Value
	Above 1GHz		54.0		Average Value
			74.0		Peak Value
Test setup:	Below 1GHz				
					
Test setup:	Above 1GHz				
					

Test Procedure:	1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. 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. 4. 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. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. 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.
Test Instruments:	Refer to section 5.7 for details
Test mode:	Non-hopping mode
Test results:	Pass

Remark:

1. During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8DPSK modulation, and found the GFSK modulation is the worst case.
2. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis is the worst case.
3. The test data of below 30MHz is too low, so only shows the data of above 30MHz in this report.

Measurement data:

Below 1GHz

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
31.843	45.89	12.32	0.85	26.47	32.59	40	-7.41	Vertical
44.275	36.64	13.55	1.28	27.72	23.75	40	-16.25	Vertical
65.343	37.23	10.57	1.38	29.73	19.45	40	-20.55	Vertical
100.934	38.81	13.06	1.95	30.07	23.75	43.5	-19.75	Vertical
143.83	39.51	8.22	2.44	29.32	20.85	43.5	-22.65	Vertical
174.424	34.23	9.29	2.69	27.72	18.49	43.5	-25.01	Vertical
45.058	33.95	13.55	1.29	27.81	20.98	40	-19.02	Horizontal
93.44	41.83	12.58	2.02	30.08	26.35	43.5	-17.15	Horizontal
99.878	40.68	13.16	1.94	30.09	25.69	43.5	-17.81	Horizontal
142.824	41.17	8.21	2.43	29.33	22.48	43.5	-21.02	Horizontal
176.269	38.61	9.42	2.7	27.42	23.31	43.5	-20.19	Horizontal
207.123	38.88	10.8	2.86	29.78	22.76	43.5	-20.74	Horizontal

Above 1GHz

Test channel:	Lowest	Level:	Peak
---------------	--------	--------	------

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4804	40.36	31.78	5.32	24.09	53.37	74	-20.63	Vertical
7206	36.25	36.15	6.87	26.38	52.89	74	-21.11	Vertical
9608	31.46	37.95	8.94	25.4	52.95	74	-21.05	Vertical
4804	38.26	31.78	5.32	24.09	51.27	74	-22.73	Horizontal
7206	31.12	36.15	6.87	26.38	47.76	74	-26.24	Horizontal
9608	22.35	37.95	8.94	25.4	43.84	74	-30.16	Horizontal

Test channel:	Lowest	Level:	Average
---------------	--------	--------	---------

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4804	26.35	31.78	5.32	24.09	39.36	54	-14.64	Vertical
7206	24.23	36.15	6.87	26.38	40.87	54	-13.13	Vertical
9608	16.35	37.95	8.94	25.4	37.84	54	-16.16	Vertical
4804	30.24	31.78	5.32	24.09	43.25	54	-10.75	Horizontal
7206	12.35	36.15	6.87	26.38	28.99	54	-25.01	Horizontal
9608	10.36	37.95	8.94	25.4	31.85	54	-22.15	Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “*”, means average level is not recorded when its peak level is less than average limit.
3. The emission levels of other frequencies are very lower than the limit and not show in test report.

Test channel:	Middle	Level:	Peak
---------------	--------	--------	------

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4882	43.26	31.85	5.4	24.01	56.5	74	-17.5	Vertical
7323	31.25	36.37	6.91	26.62	47.91	74	-26.09	Vertical
9764	20.35	38.35	9.01	25.29	42.42	74	-31.58	Vertical
4882	45.32	31.85	5.4	24.01	58.56	74	-15.44	Horizontal
7323	31.92	36.37	6.91	26.62	48.58	74	-25.42	Horizontal
9764	26.18	38.35	9.01	25.29	48.25	74	-25.75	Horizontal

Test channel:	Middle	Level:	Average
---------------	--------	--------	---------

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4882	25.35	31.85	5.4	24.01	38.59	54	-15.41	Vertical
7323	21.35	36.37	6.91	26.62	38.01	54	-15.99	Vertical
9764	15.36	38.35	9.01	25.29	37.43	54	-16.57	Vertical
4882	26.35	31.85	5.4	24.01	39.59	54	-14.41	Horizontal
7323	22.35	36.37	6.91	26.62	39.01	54	-14.99	Horizontal
9764	15.32	38.35	9.01	25.29	37.39	54	-16.61	Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “*”, means average level is not recorded when its peak level is less than average limit.
3. The emission levels of other frequencies are very lower than the limit and not show in test report.

Test channel:	Highest	Level:	Peak
---------------	---------	--------	------

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4960	39.32	31.93	5.47	23.93	52.79	74	-21.21	Vertical
7440	35.28	36.59	6.95	26.95	51.87	74	-22.13	Vertical
9920	30.48	38.81	9.07	25.22	53.14	74	-20.86	Vertical
4960	38.26	31.93	5.47	23.93	51.73	74	-22.27	Horizontal
7440	31.25	36.59	6.95	26.95	47.84	74	-26.16	Horizontal
9920	24.36	38.81	9.07	25.22	47.02	74	-26.98	Horizontal

Test channel:	Highest	Level:	Average
---------------	---------	--------	---------

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4960	28.32	31.93	5.47	23.93	41.79	54	-12.21	Vertical
7440	23.35	36.59	6.95	26.95	39.94	54	-14.06	Vertical
9920	15.35	38.81	9.07	25.22	38.01	54	-15.99	Vertical
4960	30.23	31.93	5.47	23.93	43.7	54	-10.3	Horizontal
7440	25.35	36.59	6.95	26.95	41.94	54	-12.06	Horizontal
9920	18.69	38.81	9.07	25.22	41.35	54	-12.65	Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “*”, means average level is not recorded when its peak level is less than average limit.
3. The emission levels of other frequencies are very lower than the limit and not show in test report.