

## TEST REPORT



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Manufacturer or Supplier	ZONDA HOBBY TECHNOLOGIES ELECTRONIC LIMITED
Address	Workshop No.1, 1/F, Kam Hon industrial Building, No.8 Wang Kwun Road, Kowloon Bay, Kowloon, Hong Kong.
Product	2.4GHz Transmitter
Brand Name	GWY
Model	GWY005451
Additional Model & Model Difference	N/A
Date of tests	Sep. 10, 2013 ~ Oct. 09, 2013

the tests have been carried out according to the requirements of the following standards:

☒ **FCC Part 15, Subpart C, Section 15.247(2012-10)**

**CONCLUSION: The submitted sample was found to COMPLY with the test requirement**

Tested by Venless long Project Engineer / EMC Department	Approved by Glyn He Supervisor / EMC Department
	  Date: Oct. 29, 2013

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Test Report No.: RF130910N013R1

## RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF130507N003	Original release	Jun. 10, 2013
RF130910N013	Based on the original report RF130507N003 change model number and product appearance.	Oct. 11, 2013
RF130910N013R1	Revise model number	Oct. 29, 2013

## 1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart C			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is -12.48dB at 0.18147MHz
15.247(a)(1) (iii)	Number of Hopping Frequency Used	PASS	Meet the requirement of limit.
15.247(a)(1) (iii)	Dwell Time on Each Channel	PASS	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	PASS	Meet the requirement of limit.
15.247(b)	Maximum Peak Output Power	PASS	Meet the requirement of limit.
15.247(d)	Transmitter Radiated Emissions	PASS	Meet the requirement of limit. Minimum passing margin is -1.2dB at 4952MHz
15.247(d)	Band Edge Measurement	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used.

**NOTE:** If The Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of hopping channel whichever is greater.

## 2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	FREQUENCY	UNCERTAINTY
Conducted emissions	9kHz~30MHz	2.94dB
Radiated emissions	9KHz ~ 30MHz	2.74dB
	30MHz ~ 1GMHz	3.64dB
	1GHz ~ 18GHz	2.2dB
	18GHz ~ 40GHz	1.94dB

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

### 3 GENERAL INFORMATION

#### 3.1 GENERAL DESCRIPTION OF EUT

<b>PRODUCT</b>	2.4GHz Transmitter
<b>MODEL NO.</b>	GWY005451
<b>FCC ID</b>	2AAB6-HK0003
<b>POWER SUPPLY</b>	DC 3.7V By Battery (wireless controller)
<b>MODULATION TECHNOLOGY</b>	FHSS
<b>MODULATION TYPE</b>	GFSK
<b>OPERATING FREQUENCY</b>	2406MHz ~ 2476MHz
<b>NUMBER OF CHANNEL</b>	71
<b>MAX. OUTPUT POWER</b>	18.98dBm
<b>ANTENNA TYPE</b>	Integral external omni antenna; 2.0dBi gain
<b>I/O PORTS</b>	Refer to user's manual
<b>DATA CABLE</b>	N/A

**NOTE:**

1. This report cancels and replaces the previous one with No. RF130910N013, and the model number was revised from GWY5451 to GWY005451 in the new report.
2. This report is issued based on the previous report with report number RF130507N003, the model GWY005451 is the same as the test model GWY004539 except the model number and transmitter appearance for marketing purpose, Partial test item were performed for the Model GWY005451.
3. GWY005451 as the main product includes controller and receiver. The model of the wireless module in the controller is GWY004540.
4. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
5. For the test results, the EUT had been tested within transmitter controller conditions. And only the worst case was shown in test report.
6. The data connection port on the device is for charging purposes when connected to a computer and can not carry data.

### 3.2 DESCRIPTION OF TEST MODES

71 channels are provided for GFSK

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



### 3.2.1. TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. The worst case was found when positioned on X axis for radiated emission. Following modes were tested as listed below.

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE $\geq$ 1G	RE<1G	PLC	APCM	
A	√	√	-	√	Tx controller + Battery mode
B	-	-	√	-	Tx controller + USB charging mode

Where **RE $\geq$ 1G**: Radiated Emission above 1GHz  
**PLC**: Power Line Conducted Emission

**RE<1G**: Radiated Emission below 1GHz  
**APCM**: Antenna Port Conducted Measurement

### POWER LINE CONDUCTED EMISSION TEST:

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, antenna ports (if EUT with antenna diversity architecture), and packet types.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
B	1 to 71	71	FHSS	GFSK

### RADIATED EMISSION TEST (BELOW 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
A	1 to 71	71	FHSS	GFSK

#### RADIATED EMISSION TEST (ABOVE 1 GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
A	1 to 71	1, 36, 71	FHSS	GFSK

#### ANTENNA PORT CONDUCTED MEASUREMENT:

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, antenna ports (if EUT with antenna diversity architecture), and packet types.
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
A	1 to 71	1, 36, 71	FHSS	GFSK

#### TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (SYSTEM)	TESTED BY
RE $\geq$ 1G	23deg. C, 56%RH	3.7Vdc	Yuqiang Yin
RE<1G	23deg. C, 56%RH	3.7Vdc	Yuqiang Yin
PLC	23deg. C, 40%RH	3.7Vdc	Bin Wei
APCM	25deg. C, 60%RH	3.7Vdc	Venless Long

### 3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**FCC Part 15, Subpart C, Section 15.247(2012-10)**  
**ANSI C63.10-2009**

All test items have been performed and recorded as per the above standards.

### 3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Notebook	Dell	5P2PM2X	12400120329	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1.	N/A

**NOTE:** All power cords of the above support units are non shielded (1.8m).

## 4 TEST TYPES AND RESULTS

### 4.1 CONDUCTED EMISSION MEASUREMENT

#### 4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB $\mu$ V)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56	56 to 46
0.5 ~ 5	56	46
5 ~ 30	60	50

**NOTE:** 1. The lower limit shall apply at the transition frequencies.

- The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.
- All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

#### 4.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESU 26	100005	May 14,13	May 13,14
Artificial Mains Network	Rohde&Schwarz	ENV216	101173	May 14,13	May 13,14
Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	100317	May 14,13	May 13,14
Test software	ADT	ADT_Conc_ V7.3.7	N/A	N/A	N/A

- NOTE:** 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA and NIM/CHINA
- The test was performed in Dongguan Shielded Room 553.

#### 4.1.3 TEST PROCEDURES

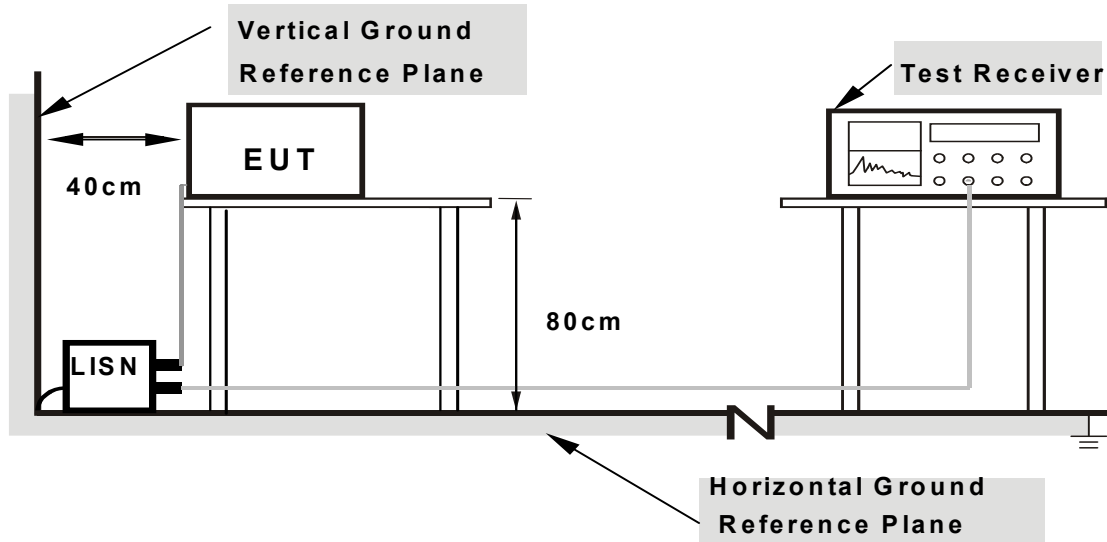
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

**NOTE:** All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

#### 4.1.5 TEST SETUP



**Note: 1. Support units were connected to second LISN.**

**2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes**

For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.1.6 EUT OPERATING CONDITIONS

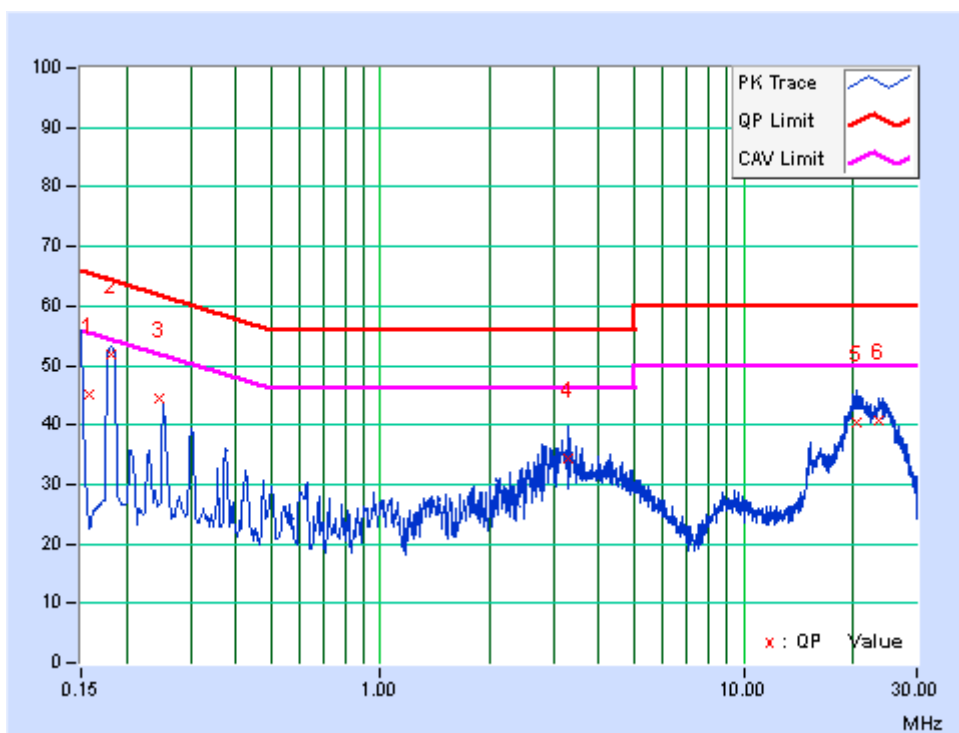
- a. Turned on the power and connected of all equipment.
- b. EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

#### 4.1.7 TEST RESULTS

PHASE	Line	6dB BANDWIDTH	9kHz
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No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15728	10.52	34.54	20.17	45.06	30.69	65.61	55.61	-20.55	-24.92
2	<b>0.18147</b>	<b>10.47</b>	<b>41.47</b>	<b>25.11</b>	<b>51.94</b>	<b>35.58</b>	<b>64.42</b>	<b>54.42</b>	<b>-12.48</b>	<b>-18.84</b>
3	0.24541	10.32	34.06	19.26	44.38	29.58	61.91	51.91	-17.53	-22.33
4	3.30146	9.79	24.44	17.57	34.23	27.36	56	46	-21.77	-18.64
5	20.3647	10.1	30.26	21.86	40.36	31.96	60	50	-19.64	-18.04
6	23.70384	10.24	30.39	22.72	40.63	32.96	60	50	-19.37	-17.04

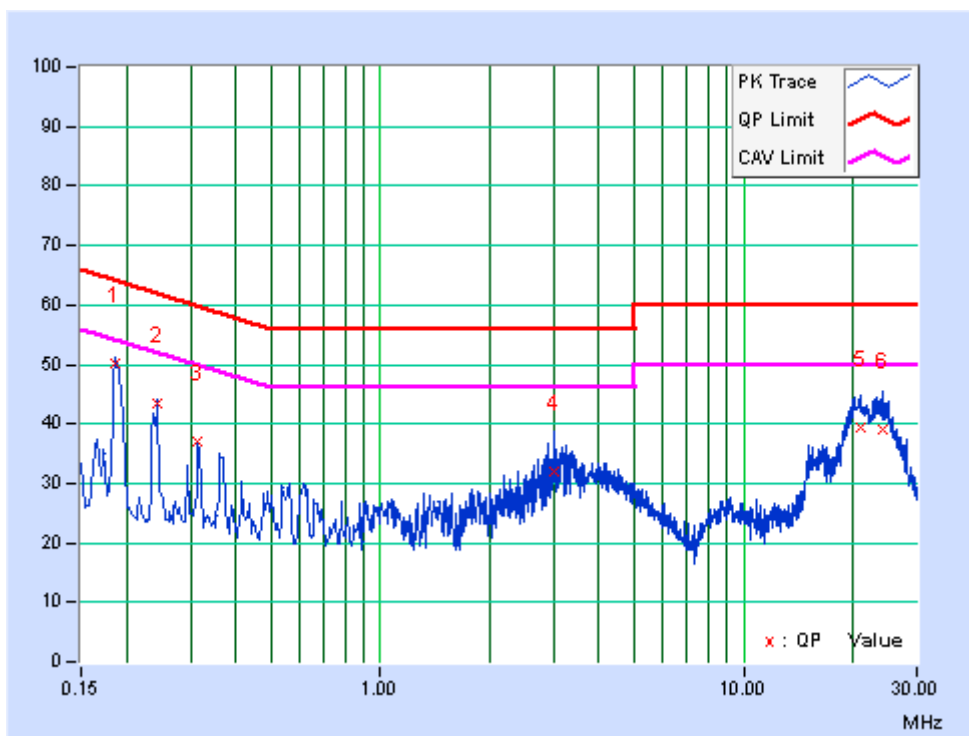
- REMARKS:**
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
  2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
  3. The emission levels of other frequencies were very low against the limit.
  4. Margin value = Emission level - Limit value
  5. Correction factor = Insertion loss + Cable loss
  6. Emission Level = Correction Factor + Reading Value.



PHASE	Neutral	6dB BANDWIDTH	9kHz
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No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.18557	10.42	39.74	24.97	50.16	35.39	64.23	54.23	-14.08	-18.85
2	0.24384	10.27	33	18.91	43.27	29.18	61.96	51.96	-18.7	-22.79
3	0.31432	10.36	26.76	11.39	37.12	21.75	59.86	49.86	-22.74	-28.11
4	3.02385	9.46	22.43	15.93	31.89	25.39	56	46	-24.11	-20.61
5	21.04504	10.05	29.24	21.78	39.29	31.83	60	50	-20.71	-18.17
6	24.05965	10.23	28.72	21.15	38.95	31.38	60	50	-21.05	-18.62

- REMARKS:**
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
  2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
  3. The emission levels of other frequencies were very low against the limit.
  4. Margin value = Emission level - Limit value
  5. Correction factor = Insertion loss + Cable loss
  6. Emission Level = Correction Factor + Reading Value.





## 4.2 RADIATED EMISSION AND BANDEDGE MEASUREMENT

### 4.2.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a). Other emissions shall be at least 20dB below the highest level of the desired power.

FREQUENCIES (MHz)	FIELD STRENGTH (microvolts/meter)	MEASUREMENT DISTANCE (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

**NOTE:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

## 4.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Spectrum Analyzer	Agilent	E4446A	MY46180622	April 24,13	April 23,14
EMI Test Receiver	Rohde&Schwarz	ESVD	847398/003	May 14,13	May 13,14
Loop antenna (9kHz~30MHz)	Daze	ZN30900A	0708	Nov. 28,12	Nov. 27,13
Bilog Antenna (20M-2GHz)	Teseq	CBL 6111D	25757	Nov. 22,12	Nov. 21,13
Horn Antenna (1GHz -18GHz)	EMCO	3117	00062558	Oct.18,12	Oct.17,13
Horn Antenna (15GHz-40GHz)	SCHWARZBECK	BBHA 9170	BBHA9170242	Jan. 04,11	Jan. 03,14
Pre-Amplifier (9kHz~1GHz)	SONOMA	310D	186955	Mar. 06,13	Mar. 05,14
Pre-Amplifier (20MHz-3GHz)	EMCI	EMC 330	980095	Nov. 02,12	Nov.01,13
Pre-Amplifier (100MHz-26.5GHz)	Agilent	8449B	3008A00409	May 14,13	May 13,14
Pre-Amplifier (18GHz-40GHz)	EMCI	EMC 184045	980102	Nov. 04,12	Nov. 03,13
10m Semi-anechoic Chamber	CHANGLING	21.4m*12.1m*8 .8m	NSEMC006	Mar. 24,13	Mar. 23,14
Digital Multimeter	FLUKE	15B	A1220010DG	Oct. 31,12	Oct. 30,13
Test Software	ADT	ADT_Radiated _V7.6.15	N/A	N/A	N/A
Spectrum Analyzer	Agilent	E4446A	MY46180622	April 24,13	April 23,14

- NOTE:**
1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GREGT/CHINA and NIM/CHINA.
  2. The test site was performed in Dongguan Chamber.
  3. The horn antenna are used only for the measurement of emission frequency above 1GHz if tested.
  4. The FCC Site Registration No. is 502831.

#### 4.2.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

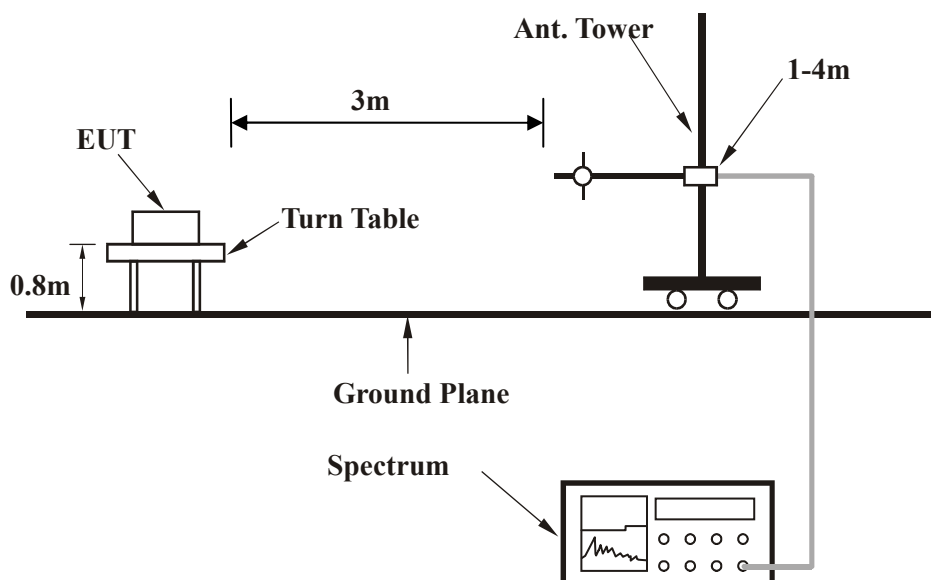
**NOTE:**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 10Hz for Average detection at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.2.4 DEVIATION FROM TEST STANDARD

No deviation.

#### 4.2.5 TEST SETUP



For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.2.6 EUT OPERATING CONDITIONS

- Set the EUT under full load condition and placed them on a testing table.
- Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.
- The necessary accessories enable the EUT in full functions.

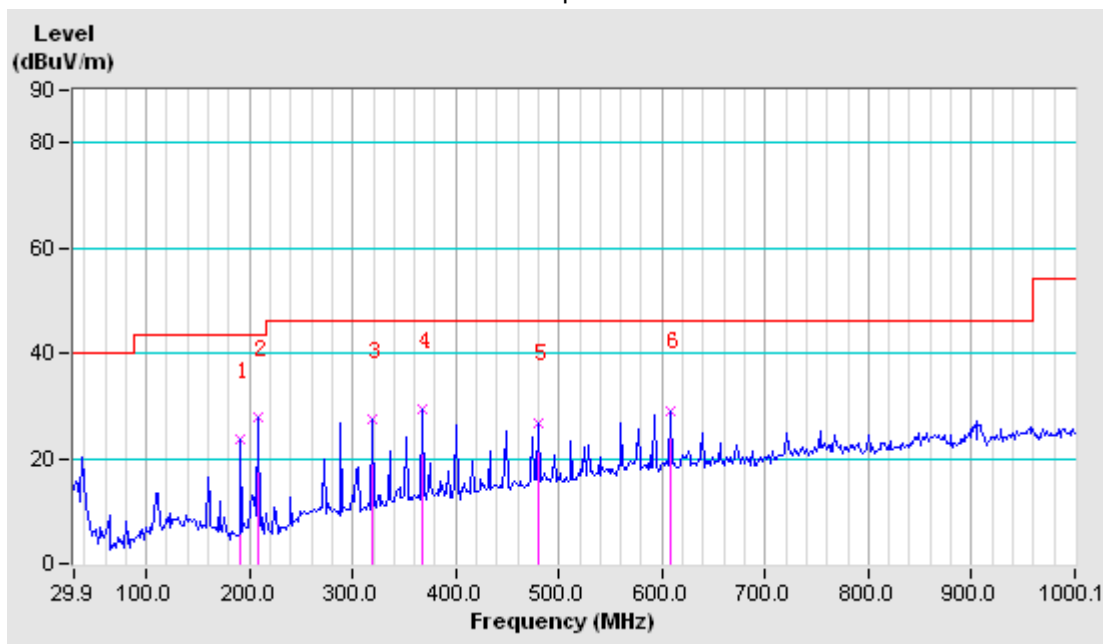
## 4.2.7 TEST RESULTS

### BELOW 1GHz DATA

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 71	FREQUENCY RANGE	Below 1000MHz
INPUT POWER (SYSTEM)	3.7Vdc	DETECTOR FUNCTION	Quasi-Peak

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	191.6	23.63	43.5	-19.87	1.01 H	281	13.17	10.46
2	207.77	27.9	43.5	-15.6	1.08 H	298	17.09	10.81
3	319.34	27.59	46	-18.41	1.63 H	359	11.81	15.78
4	367.85	29.24	46	-16.76	1.00 H	252	12	17.24
5	479.43	26.85	46	-19.15	1.22 H	316	6.38	20.47
6	608.79	29.16	46	-16.84	1.46 H	347	5.76	23.4

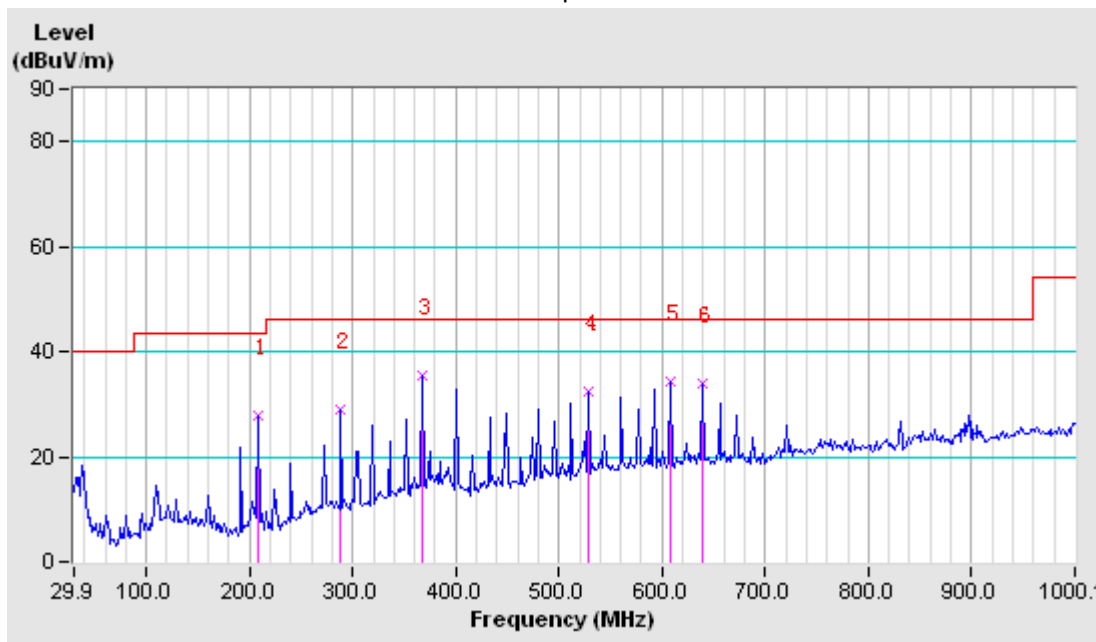
- REMARKS:**
1. Emission level (dBuV/m) = Reading (dBuV) + Factor (dB/m).
  2. Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
  3. The other emission levels were very low against the limit.
  4. Margin value = Emission level – Limit value.
  5. For the test results, the EUT had been tested from 9KHz ~25GHz. But only the worst case was shown in test report.



EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 71	FREQUENCY RANGE	Below 1000MHz
INPUT POWER (SYSTEM)	3.7Vdc	DETECTOR FUNCTION	Quasi-Peak

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	207.77	27.82	43.5	-15.68	1.00 V	244	17.01	10.81
2	288.62	29.11	46	-16.89	1.00 V	172	13.95	15.16
3	367.85	35.54	46	-10.46	1.00 V	222	18.3	17.24
4	527.94	32.46	46	-13.54	1.00 V	262	11.09	21.37
5	607.17	34.32	46	-11.68	1.00 V	142	10.95	23.37
6	639.51	33.84	46	-12.16	1.00 V	194	9.99	23.85

- REMARKS:**
1. Emission level (dBuV/m) = Reading (dBuV) + Factor (dB/m).
  2. Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
  3. The other emission levels were very low against the limit.
  4. Margin value = Emission level – Limit value.
  5. For the test results, the EUT had been tested from 9KHz ~25GHz. But only the worst case was shown in test report.



## ABOVE 1GHz DATA

### GFSK

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 1	FREQUENCY RANGE	1 ~ 25GHz
INPUT POWER (SYSTEM)	3.7Vdc	DETECTOR FUNCTION	Peak (PK) Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	67.5 PK	74.0	-6.5	1.00 H	261	30.25	37.25
2	2390.00	48.2 AV	54.0	-5.8	1.00 H	261	10.95	37.25
3	*2406.00	104.8 PK			1.00 H	261	67.52	37.28
4	*2406.00	99.3 AV			1.00 H	261	62.02	37.28
5	4812.00	65.2 PK	74.0	-8.8	1.12 H	258	23.58	41.62
6	4812.00	49.8 AV	54.0	-4.2	1.12 H	258	8.18	41.62
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	67.3 PK	74.0	-6.7	1.13 V	325	30.05	37.25
2	2390.00	48.6 AV	54.0	-5.4	1.13 V	325	11.35	37.25
3	*2406.00	103.9 PK			1.13 V	325	66.62	37.28
4	*2406.00	98.1 AV			1.13 V	325	60.82	37.28
5	4812.00	56.5 PK	74.0	-17.5	1.08 V	236	14.88	41.62
6	4812.00	49.5 AV	54.0	-4.5	1.08 V	236	7.88	41.62

### REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. " \* ": Fundamental frequency.

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 36	FREQUENCY RANGE	1 ~ 25GHz
INPUT POWER (SYSTEM)	3.7Vdc	DETECTOR FUNCTION	Peak (PK) Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	105.6 PK			1.00 H	168	68.26	37.34
2	*2441.00	99.8 AV			1.00 H	168	62.46	37.34
3	4882.00	56.4 PK	74.0	-17.6	1.12 H	235	14.70	41.70
4	4882.00	50.7 AV	54.0	-3.3	1.12 H	235	9.00	41.70
5	7323.00	57.4 PK	74.0	-16.6	1.00 H	228	11.61	45.79
6	7323.00	50.9 AV	54.0	-3.1	1.00 H	228	5.11	45.79
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	105.1 PK			1.14 V	321	67.76	37.34
2	*2441.00	99.7 AV			1.14 V	321	62.36	37.34
3	4882.00	56.5 PK	74.0	-17.5	1.07 V	286	14.80	41.70
4	4882.00	50.3 AV	54.0	-3.7	1.07 V	286	8.60	41.70
5	7323.00	58.2 PK	74.0	-15.8	1.23 V	152	12.41	45.79
6	7323.00	50.1 AV	54.0	-3.9	1.23 V	152	4.31	45.79

**REMARKS:**

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. " \* ": Fundamental frequency.



EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 71	FREQUENCY RANGE	1 ~ 25GHz
INPUT POWER (SYSTEM)	3.7Vdc	DETECTOR FUNCTION	Peak (PK) Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2476.00	105.5 PK			1.13 H	312	68.10	37.40
2	*2476.00	100.2 AV			1.13 H	312	62.80	37.40
3	2483.50	57.6 PK	74.0	-16.4	1.13 H	312	20.19	37.41
4	2483.50	39.8 AV	54.0	-14.2	1.13 H	312	2.39	37.41
5	4952.00	57.6 PK	74.0	-16.4	1.28 H	215	15.81	41.79
6	4952.00	52.4 AV	54.0	-1.6	1.28 H	215	10.63	41.79
7	7428.00	58.5 PK	74.0	-15.5	1.00 H	311	12.68	45.82
8	7428.00	52.0 AV	54.0	-2.0	1.00 H	311	6.18	45.82
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2476.00	116.9 PK			1.00 V	5	79.50	37.40
2	*2476.00	111.8 AV			1.00 V	5	74.41	37.40
3	2483.50	68.1 PK	74.0	-5.9	1.00 V	5	30.69	37.41
4	2483.50	49.2 AV	54.0	-4.8	1.00 V	5	11.79	37.41
5	4952.00	58.3 PK	74.0	-15.7	1.00 V	114	16.51	41.79
6	4952.00	52.8 AV	54.0	-1.2	1.00 V	114	11.01	41.79
7	7428.00	55.3 PK	74.0	-18.7	1.00 V	189	9.48	45.82
8	7428.00	46.9 AV	54.0	-7.1	1.00 V	189	1.08	45.82

**REMARKS:**

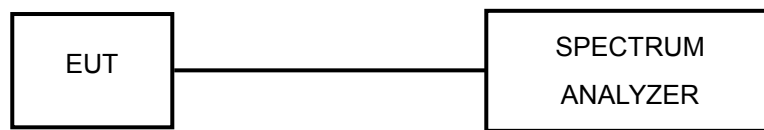
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. " \* ": Fundamental frequency.

### 4.3 NUMBER OF HOPPING FREQUENCY USED

#### 4.3.1. LIMIT OF HOPPING FREQUENCY USED

At least 15 channels frequencies, and should be equally spaced.

#### 4.3.2. TEST SETUP



#### 4.3.3. TEST INSTRUMENTS

Refer to section 4.1.2 to get information of above instrument.

#### 4.3.4. TEST PROCEDURES

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- d. Set the SA on View mode and then plot the result on SA screen.
- e. Repeat above procedures until all frequencies measured were complete.

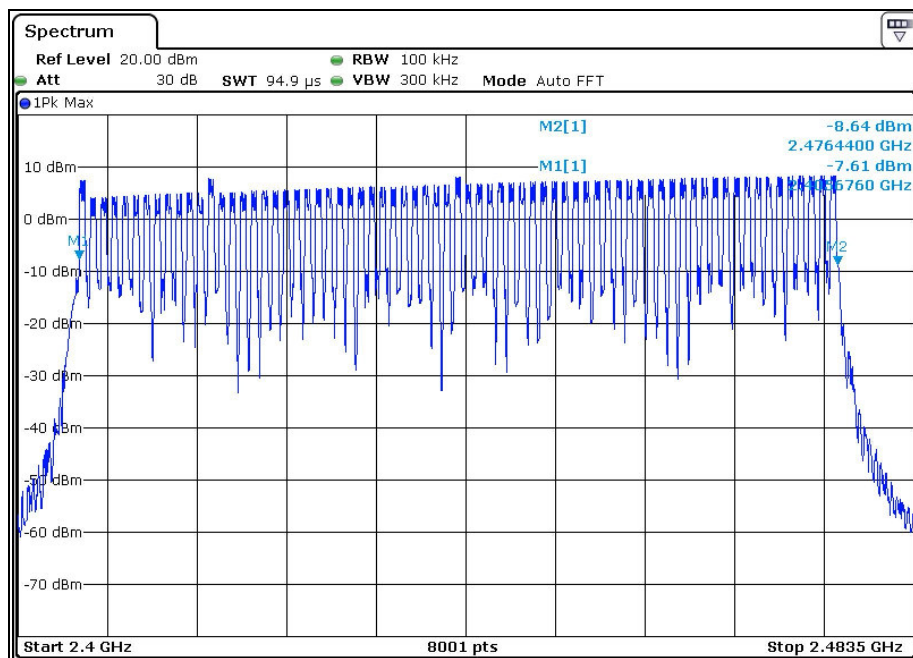
#### 4.3.5. DEVIATION FROM TEST STANDARD

No deviation.

#### 4.3.6. TEST RESULTS

There are 71 hopping frequencies in the hopping mode. Please refer to next two pages for the test result. On the plots, it shows that the hopping frequencies are equally spaced.

#### GFSK

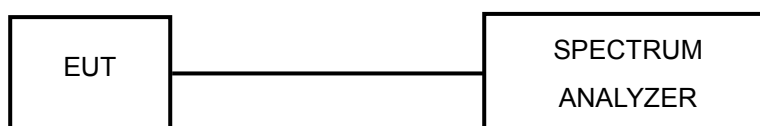


## 4.4 DWELL TIME ON EACH CHANNEL

### 4.4.1 LIMIT OF DWELL TIME USED

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.

### 4.4.2 TEST SETUP



### 4.4.3 TEST INSTRUMENTS

Refer to section 4.1.2 to get information of above instrument.

### 4.4.4 TEST PROCEDURES

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- c. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- e. Repeat above procedures until all different time-slot modes have been completed.

#### 4.4.5 DEVIATION FROM TEST STANDARD

No deviation.

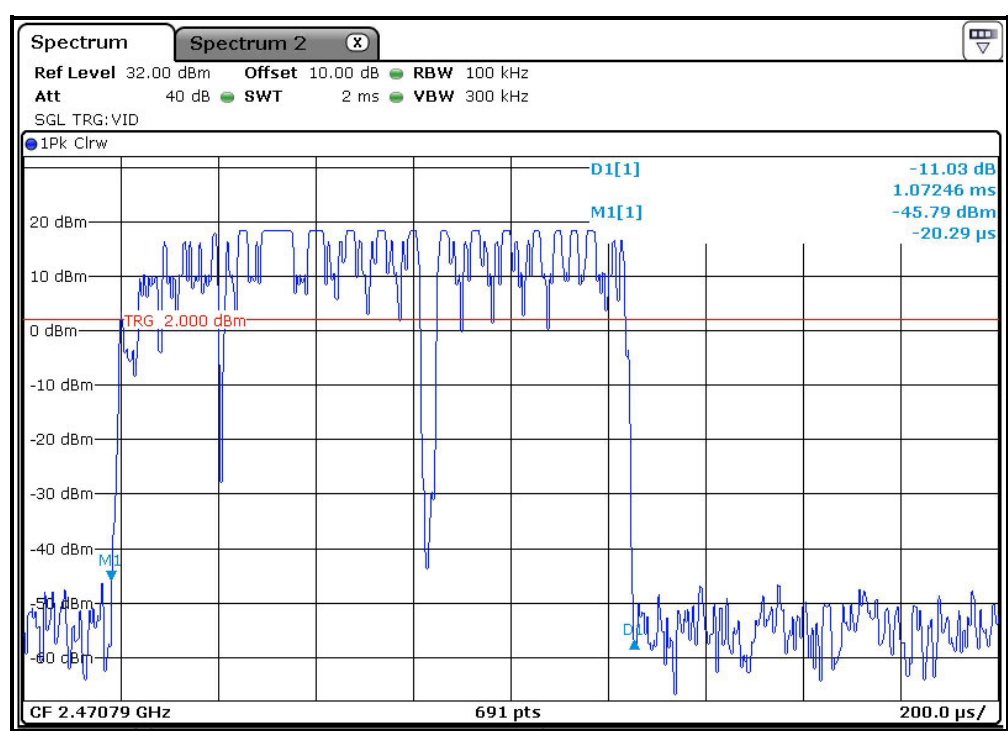
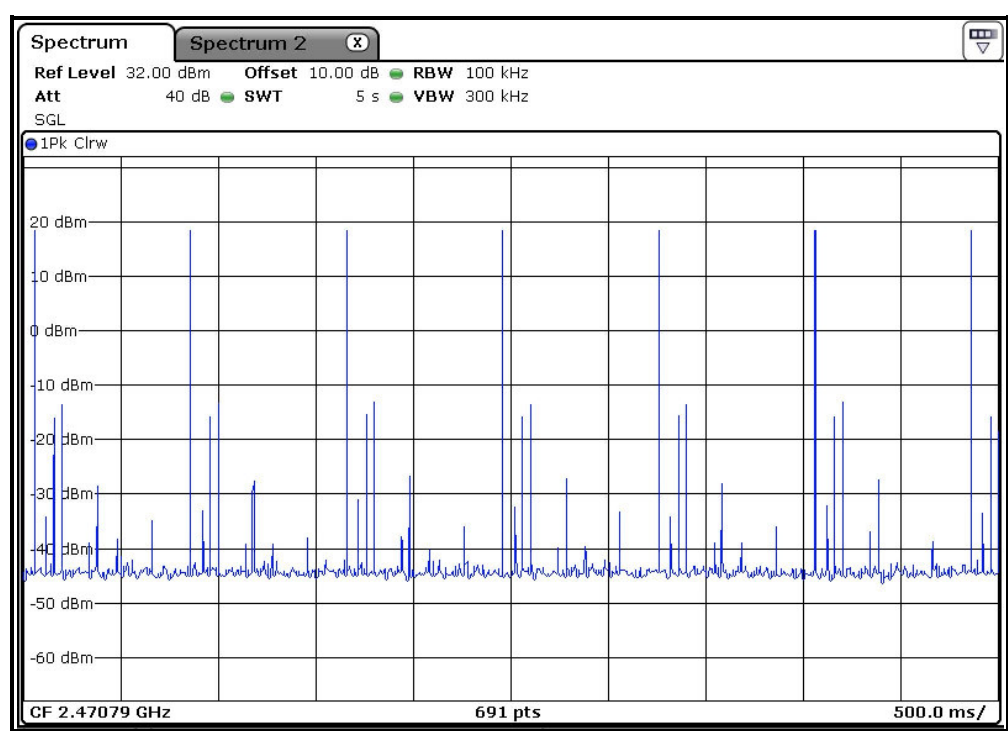
#### 4.4.6 TEST RESULTS

##### GFSK

Mode	Number of Hopping Channel	Number of transmission in a period(channel number*0.4 sec)				Length of transmission time (msec)	Result (msec)	Limit (msec)	PASS / FAIL
		period (sec)	sweep time (sec)	times in a sweep	times in a period				
GFSK	71	28.4	5	7	39.76	1.072	42.623	400	PASS

**NOTE:** Test plots of the transmitting time slot are shown on next pages.

GFSK

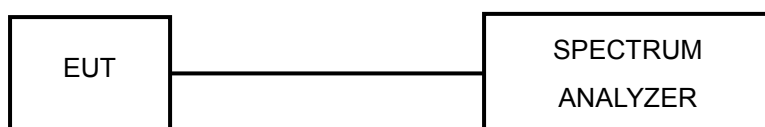


## 4.5 CHANNEL BANDWIDTH

### 4.5.1 LIMITS OF CHANNEL BANDWIDTH

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

### 4.5.2 TEST SETUP



### 4.5.3 TEST INSTRUMENTS

Refer to section 4.1.2 to get information of above instrument.

### 4.5.4 TEST PROCEDURE

- a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- d. Repeat above procedures until all frequencies measured were complete.

#### 4.5.5 DEVIATION FROM TEST STANDARD

No deviation.

#### 4.5.6 EUT OPERATING CONDITION

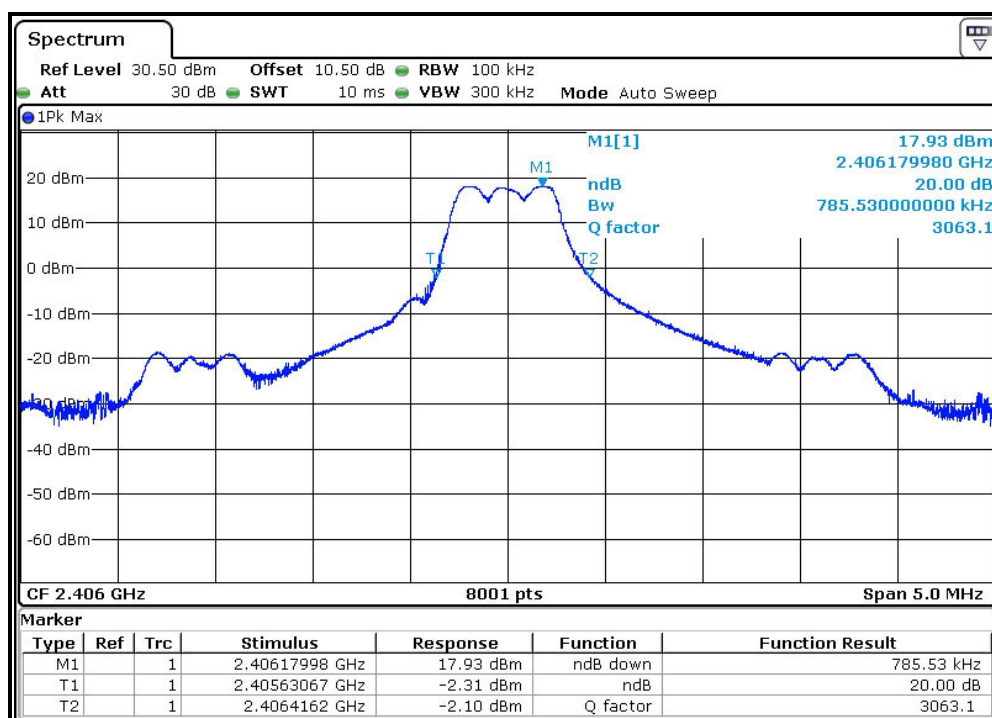
Same as item 4.2.6

#### 4.5.7 TEST RESULTS

GFSK

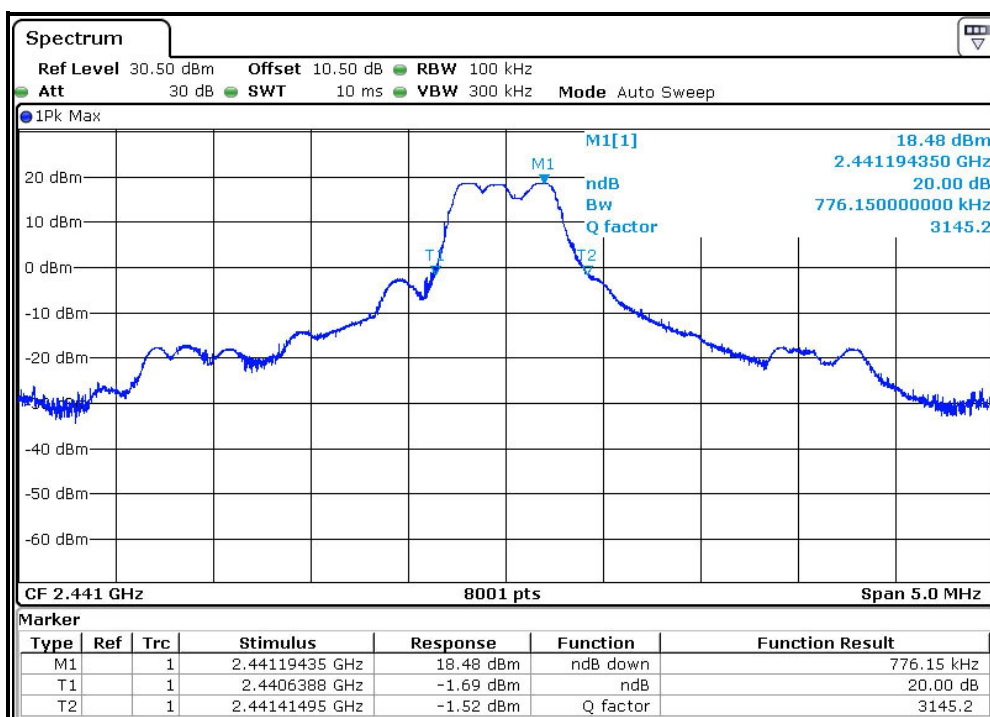
CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BANDWIDTH (MHz)
1	2406	0.785
36	2441	0.776
71	2476	1.126

CH 1

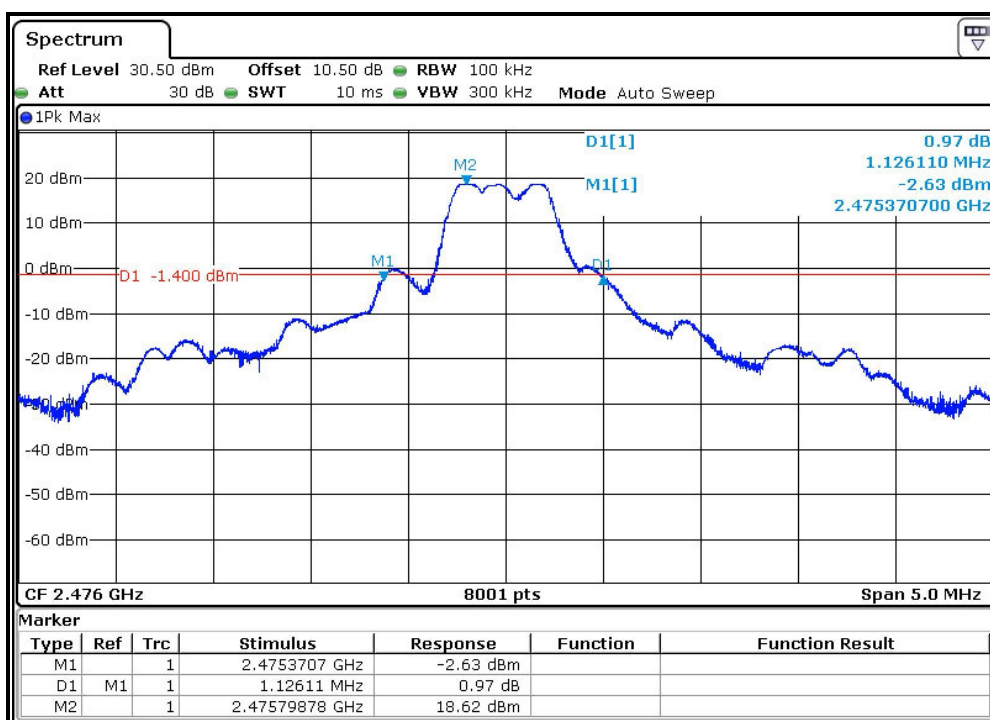




CH 36



CH 71

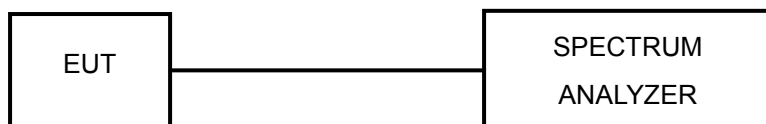


## 4.6 HOPPING CHANNEL SEPARATION

### 4.6.1. LIMIT OF HOPPING CHANNEL SEPARATION

At least 25kHz or two-third of 20dB hopping channel bandwidth (whichever is greater).

### 4.6.2. TEST SETUP



### 4.6.3. TEST INSTRUMENTS

Refer to section 4.1.2 to get information of above instrument.

### 4.6.4. TEST PROCEDURES

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the MaxHold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

### 4.6.5. DEVIATION FROM TEST STANDARD

No deviation.

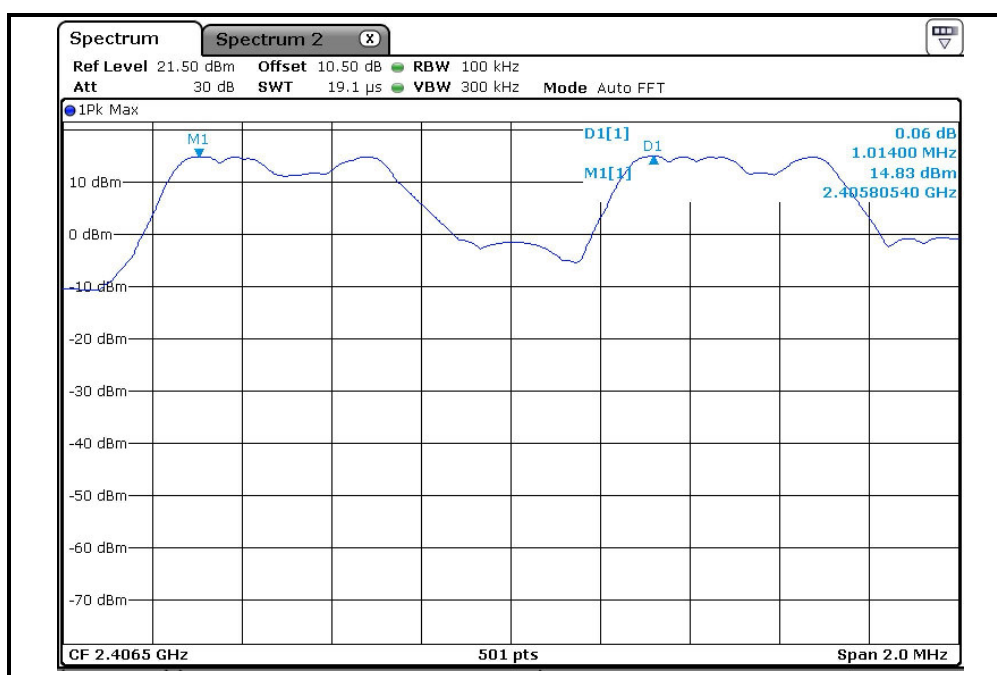
#### 4.6.6. TEST RESULTS

##### GFSK

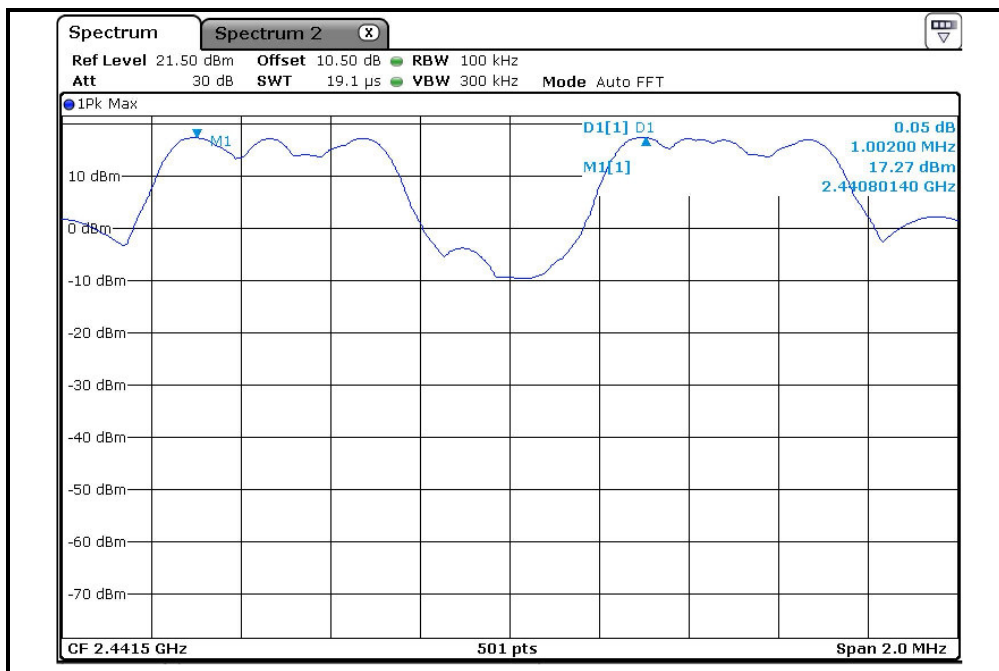
CHANNEL	FREQUENCY (MHz)	ADJACENT CHANNEL SEPARATION (MHz)	20dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
1	2406	1.01	0.846	0.56	PASS
36	2441	1.00	0.853	0.57	PASS
71	2476	1.00	1.027	0.68	PASS

**NOTE:** The minimum limit is two-third 20dB bandwidth.

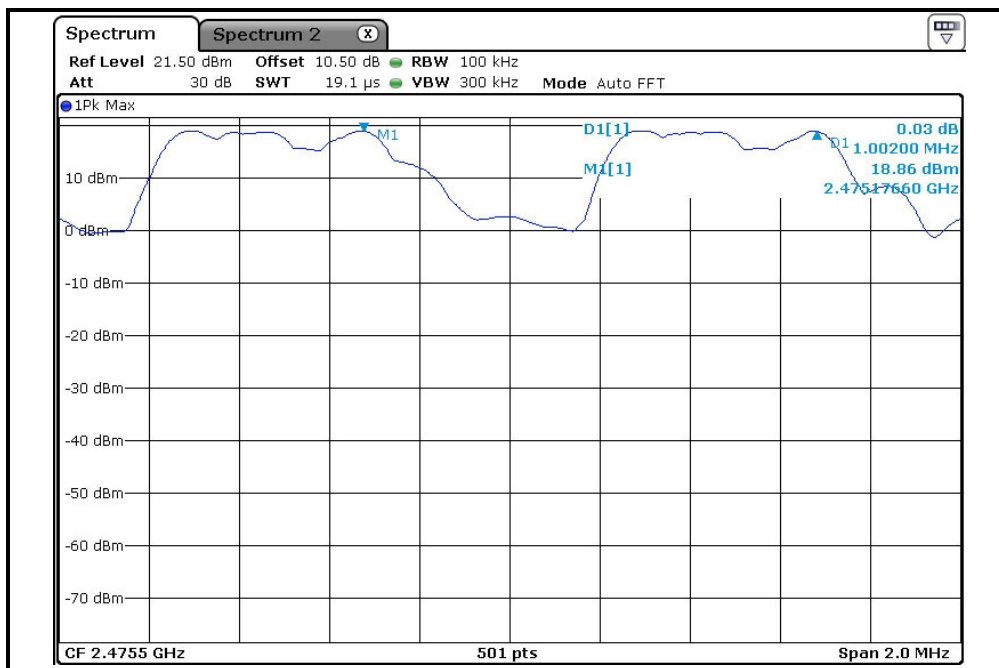
##### GFSK CH 1



GFSK CH 36



GFSK CH 71

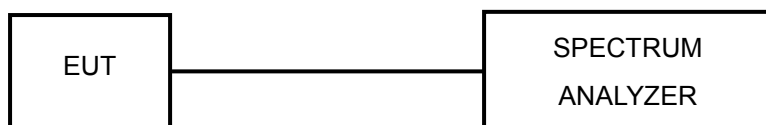


## 4.7 MAXIMUM OUTPUT POWER

### 4.7.1 LIMITS OF MAXIMUM OUTPUT POWER MEASUREMENT

The Maximum Output Power Measurement is 125mW.

### 4.7.2 TEST SETUP



### 4.7.3 TEST INSTRUMENTS

Refer to section 4.1.2 to get information of above instrument.

### 4.7.4 TEST PROCEDURES

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3MHz RBW and 10 MHz VBW.
- Measure the captured power within the band and recording the plot.
- Repeat above procedures until all frequencies required were complete.

#### 4.7.5 DEVIATION FROM TEST STANDARD

No deviation.

#### 4.7.6 EUT OPERATING CONDITION

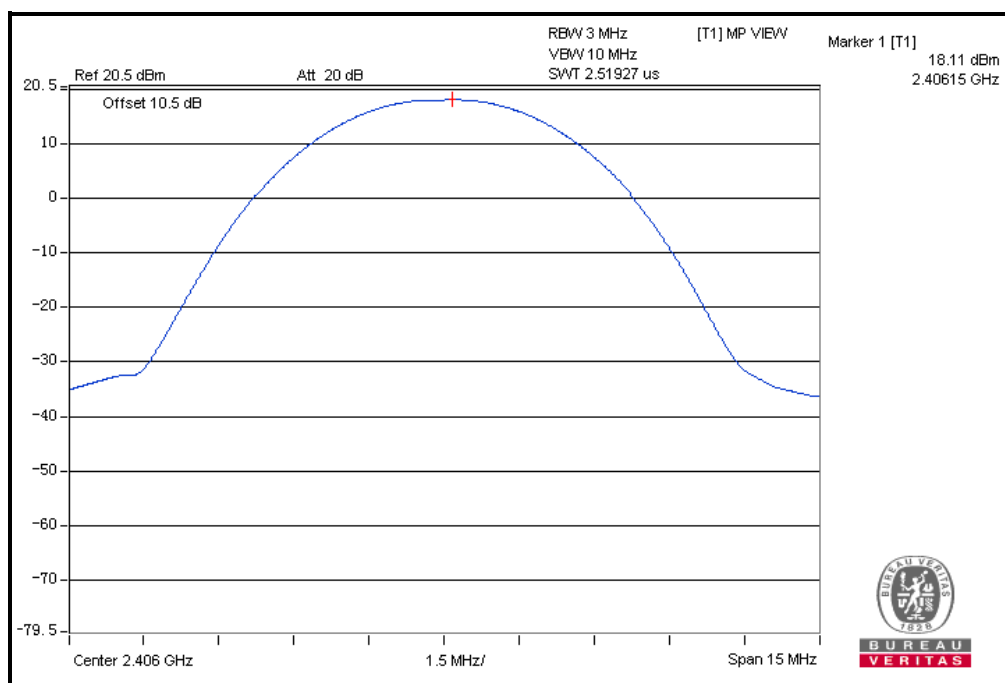
Same as item 4.1.6.

#### 4.7.7 TEST RESULTS

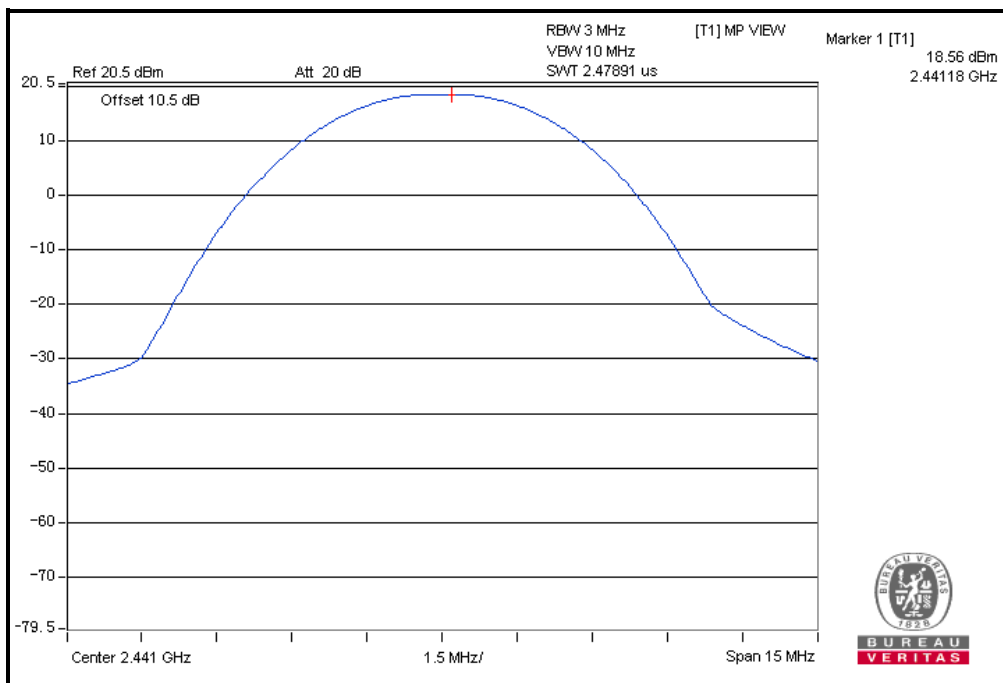
##### GFSK

CHANNEL	CHANNEL FREQUENCY (MHz)	POWER OUTPUT (dBm)	POWER OUTPUT (mW)	POWER LIMIT (mW)	PASS/FAIL
1	2406	18.11	64.714	125	PASS
36	2441	18.56	71.779	125	PASS
71	2476	18.98	79.068	125	PASS

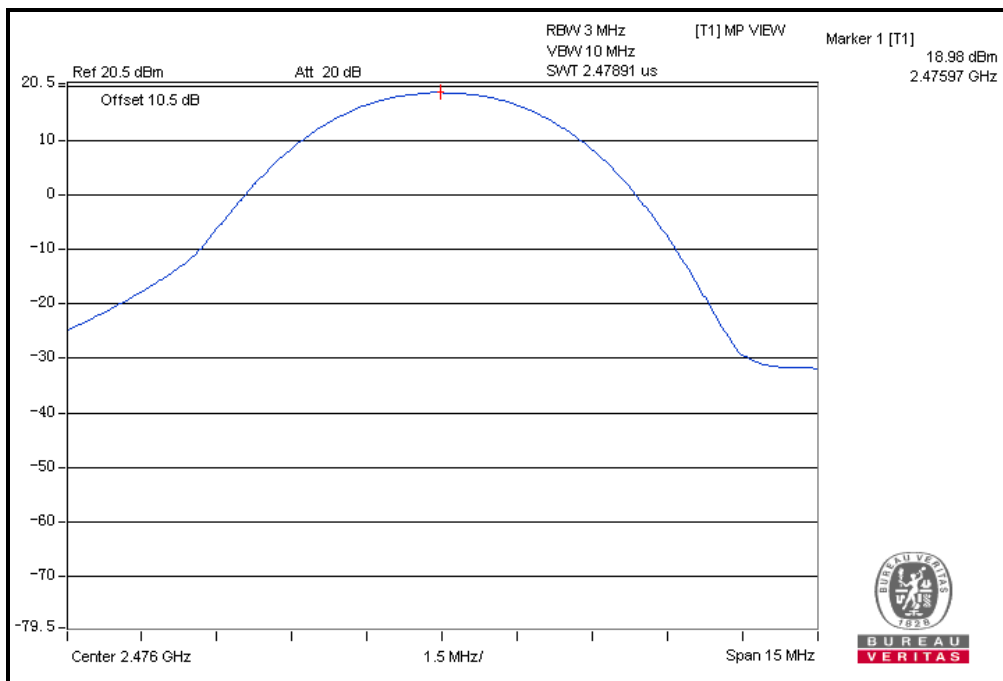
##### CH 1



CH 36



CH 71



## 4.8 BAND EDGES MEASUREMENT

### 4.8.1 LIMITS OF BAND EDGES MEASUREMENT

Below -20dB of the highest emission level of operating band (in 100KHz RBW).

### 4.8.2 TEST INSTRUMENTS

Refer to section 4.1.2 to get information of above instrument.

### 4.8.3 TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100 kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

### 4.8.4 DEVIATION FROM TEST STANDARD

No deviation.

### 4.8.5 EUT OPERATING CONDITION

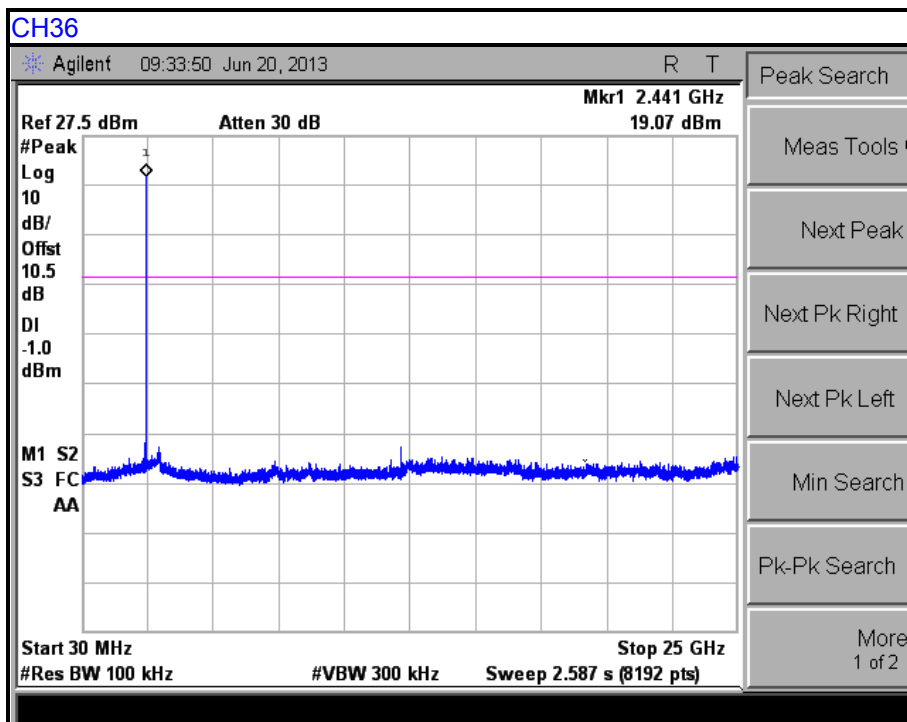
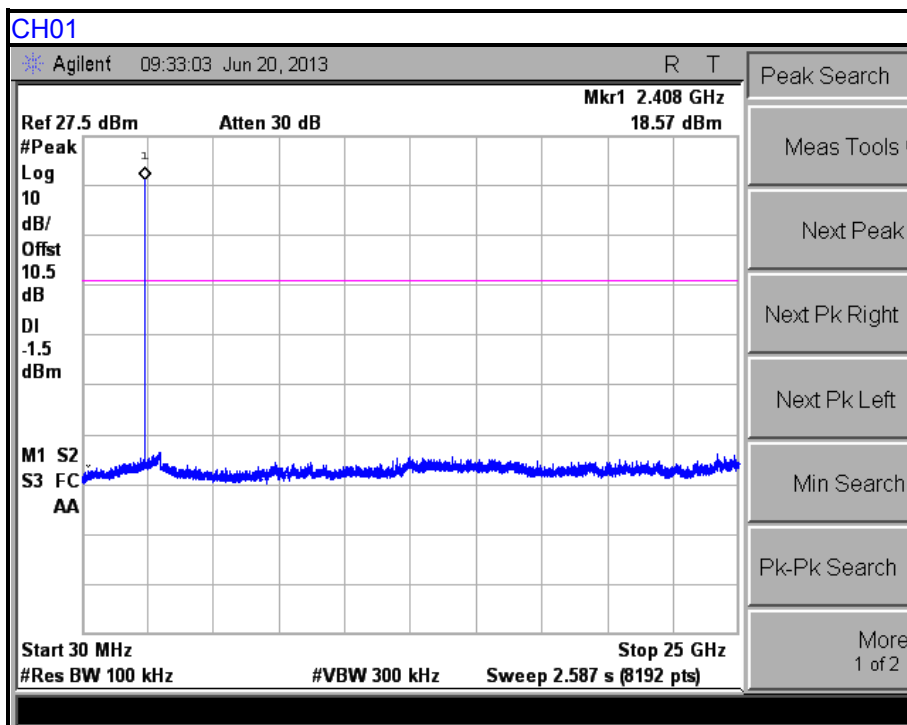
Same as item 4.2.6

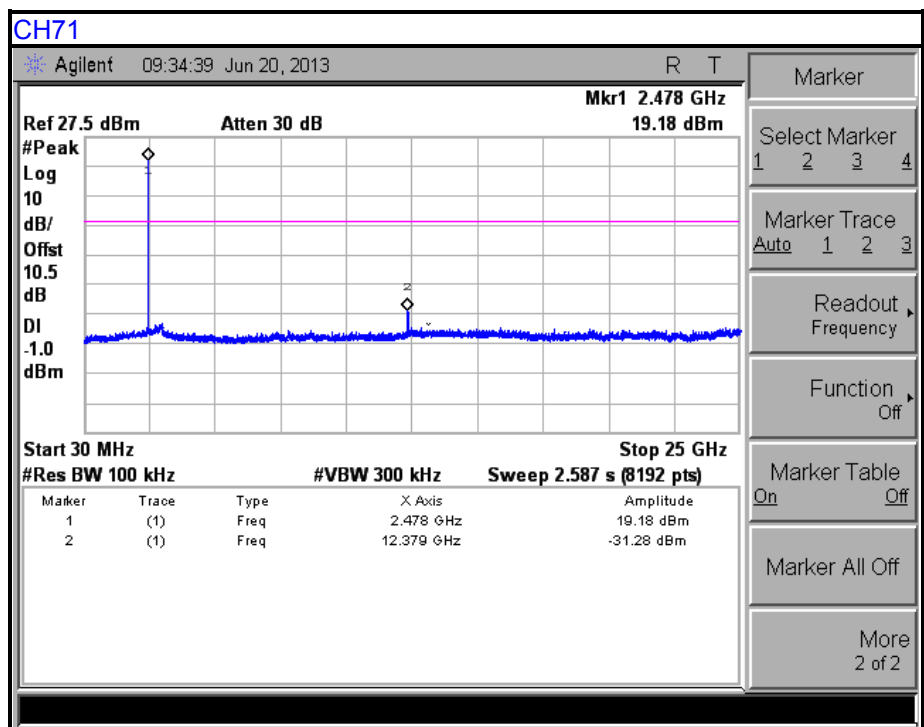
### 4.8.6 TEST RESULTS

The spectrum plots are attached on the following images., D1 line indicates the 20dB offset below D1.



GFSK







Test Report No.: RF130910N013R1

## 5. PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).

## 6. APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---