

FCC Part 15.247(Bluetooth) TEST REPORT

for

Pocket PC Mobile Phone

Model Name: V83
Trade Name: Inventec / Velocity
Report No.: SH08090014B02
FCC ID: DGIV83

prepared for

Inventec Corporation

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prepared by

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1 Test Report Certification

Equipment under Test: Pocket PC Mobile Phone

Model Name: V83

Trade Name: Inventec / Velocity

FCC ID: DGIV83

Applicant: Inventec Corporation

Inventec Building, 66 Hou-Kang St., Shih-Lin District, Taipei
11170, Taiwan, R.O.C

Manufacturer: Inventec Hi-tech Corporation

789 Puxing Road, Min Hang District Shanghai 201114, China

Test Standards: 47 CFR Part 15, Subpart C

EUT Received Date: Nov.08, 2008

Test Date(s): Nov,09 2008 –Nov,13, 2008

Test Result: PASS

* We Hereby Certify That:

The equipment under test was tested by Shenzhen Electronic Product Quality Testing Center Morlab Laboratory. The test data, data evaluation, test procedures and equipment configurations shown in this report were made in accordance with the requirement of related European Commission's standards.

The test results of this report only apply for the tested sample equipment identified above. The test report shall be invalid without all the signatures of the test engineer, the reviewer and the approver.

Tested by:

Huang Quanbo

Huang Quanbo

Dated:

2008.11.13

Reviewed by:

Zhang Jun

Zhang Jun

Dated:

2008.11.13

Approved by:

Su Feng

Su Feng

Dated:

2008.11.13



2 General Information

2.1 DESCRIPTION OF EUT

Product:	Pocket PC Mobile Phone
Trade Name:	Inventec / Velocity
Model Number:	V83
BT module Model name:	BC41B143A06-IRK-E4
BT module Brand name:	CSR
Frequency Range:	2402KHz-2480KHz
Modulation Technique:	FHSS
Number of Channels:	79 Channels
Antenna Specification:	Permanent attached
Temperature Range:	-40 ~ +105°C
Hardware Version:	DVT2.2
Software Version:	ver8227

NOTE:

1. The EUT is a model of GSM Mobile Station (MS). It supports Bluetooth function, operating at 2.4GHz ISM band. The Bluetooth modulation is Frequency Hopping Spread Spectrum (FHSS). The Channels and transmitter center frequencies are: $F(\text{MHz})=2401+1*n$, $1 \leq n \leq 79$.
2. Please refer to Appendix I for the photographs of the EUT. For a more detailed features description about the EUT, please refer to User's Manual.

2.2 Objective

Perform EMC test according to FCC Part 15 Subpart C (Bluetooth, 2.4GHz ISM band radiator).

2.3 Test Standards and Results

The EUT has been tested according to 47 CFR Part 15, Radio Frequency Devices.

Test items and the results are as bellow:

No	FCC Rules	Test Type	Result	Test Date
1	§15.207	Conducted Emission	PASS	2008.11.12
2	§15.209 §15.247(c)	Radiated Emission	PASS	2008.11.12
3	§15.247(a)	Bandwidth and Carrier Frequency Separation	PASS	2008.11.12
4	§15.247(a)	Hopping Sequence	PASS	2008.11.12
5	§15.247(a)	Equal Hopping Frequency Use	PASS	2008.11.12
6	§15.247(a)	Receiver Input Bandwidth and Hopping Capability	PASS	2008.11.12
7	§15.247(a)	Time of Occupancy(Dwell time)	PASS	2008.11.12
8	§15.247(b)	Peak Output Power	PASS	2008.11.12
9	§15.247(c)	Band Edge	PASS	2008.11.12
10	§15.247(c)	Conducted Spurious Emission	PASS	2008.11.12

2.4 List of Equipments Used

Description	Manufacturer	Model No.	Cal. Due Date	Serial No.
Test Receiver	Rohde & Schwarz	ESIB26	2009.06.05	A0304218
Test Receiver	Schwarzbeck	FCKL1528	2009.06.05	A0304230
Spectrum Analyzer	Rohde & Schwarz	FSP13	2009.01.15	M-030176
LISN	Schwarzbeck	NSLK8127	2009.06.05	A0304233
Loop Antenna	Rohde & Schwarz	HFH2-Z2	2009.06.05	A0304220
Ultra Broadband Ant.	Rohde & Schwarz	HL562	2009.06.05	A0304224
Horn Ant.	Rohde & Schwarz	HF906	2009.06.05	100150
Bluetooth Tester	Rohde & Schwarz	CBT	2009.09.26	100261
Shield Room	Nanbo Tech	Site 1	2009.01.04	A0304188
Anechoic Chamber	Albatross	EMC12.8×6.8× 6.4(m)	2009.04.10	A0304210

2.5 Test Facility

Shenzhen Electronic Product Quality Testing Center (SET) is a third party testing organization accredited by China National Accreditation Board for Laboratories (CNAL) according to ISO/IEC 17025. The accreditation certificate number is **L1659**.

The EMC chamber site No.1 (EMC12.8×6.8×6.4(m)), and the radiated and conducted Emission test equipments of SET are constructed and calibrated to meet the FCC requirements ANSI C63.4:2001 and CISPR 22/EN 55022. The FCC Registration Number is **261302**.

The EMC chamber site No.1 (EMC12.8×6.8×6.4(m)) also complies with Canada standard RSS 212, and acceptable to Industry Canada for the performance of radiated measurements. The Industry Canada Registration Number is **IC 5915**.

2.6 Environmental conditions

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

- Temperature: 15-35°C
- Humidity: 30-60 %
- Atmospheric pressure: 86-106 kPa

3 Conducted Emission Test

3.1 Limits of Conducted Emission

According to FCC §15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

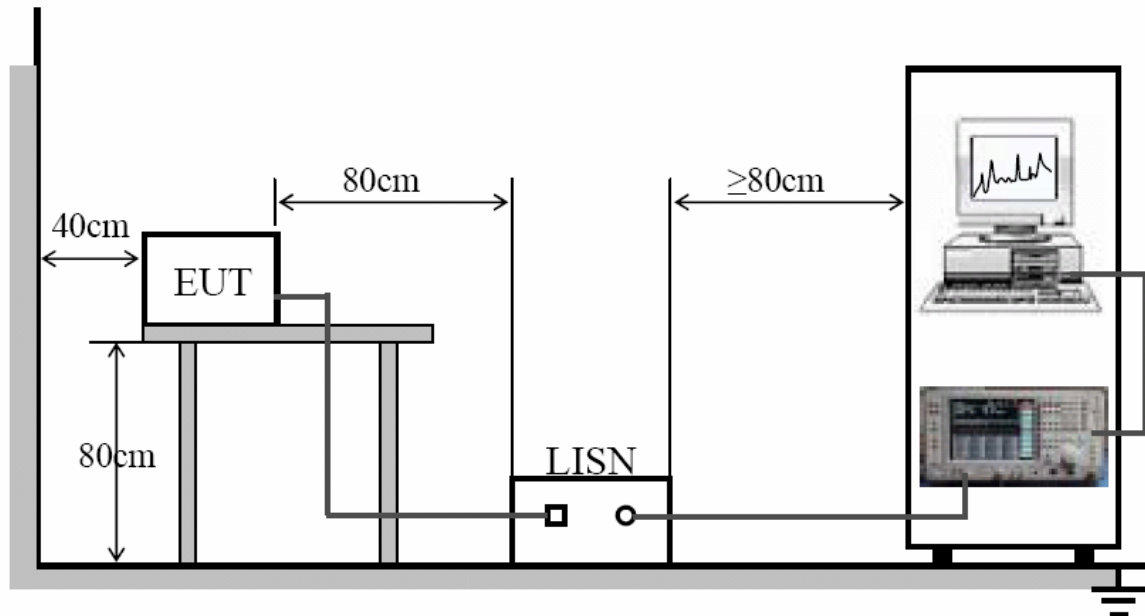
NOTE:

1. The lower limit shall apply at the band edges.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.50MHz.

3.2 Test Procedure

- a. The EUT was placed on a 0.8m high insulating table and kept 0.4 meters from the conducting wall of shielded room.
- b. The EUT was connected to the power mains through a line impedance stabilization network (LISN). The LISN provide 50 Ω /50 μ H of coupling impedance for the measuring instrument.
- c. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- d. The frequency range from 150 kHz to 30 MHz was searched using CISPR Quasi-Peak and Average detector.

3.3 Test Setup



For the actual test configuration, please refer to the related item - Photographs of the Test Configuration.

3.4 EUT Setup and Operating Conditions

The EUT configuration of the emission tests was MS + Battery + Charger.

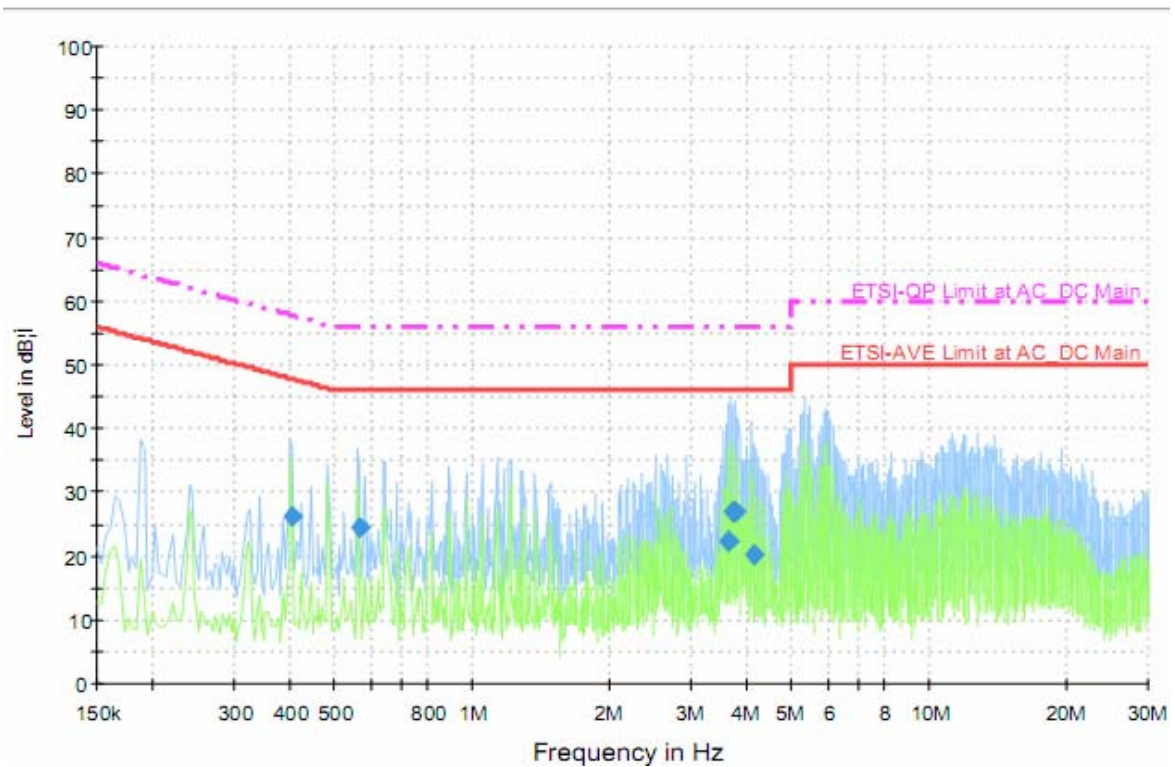
During the measurement, the EUT was charging empty battery. The charger was powered by 120V 60Hz AC mains supply.

The Bluetooth function was active and an audio link was established between the EUT and a Bluetooth tester.

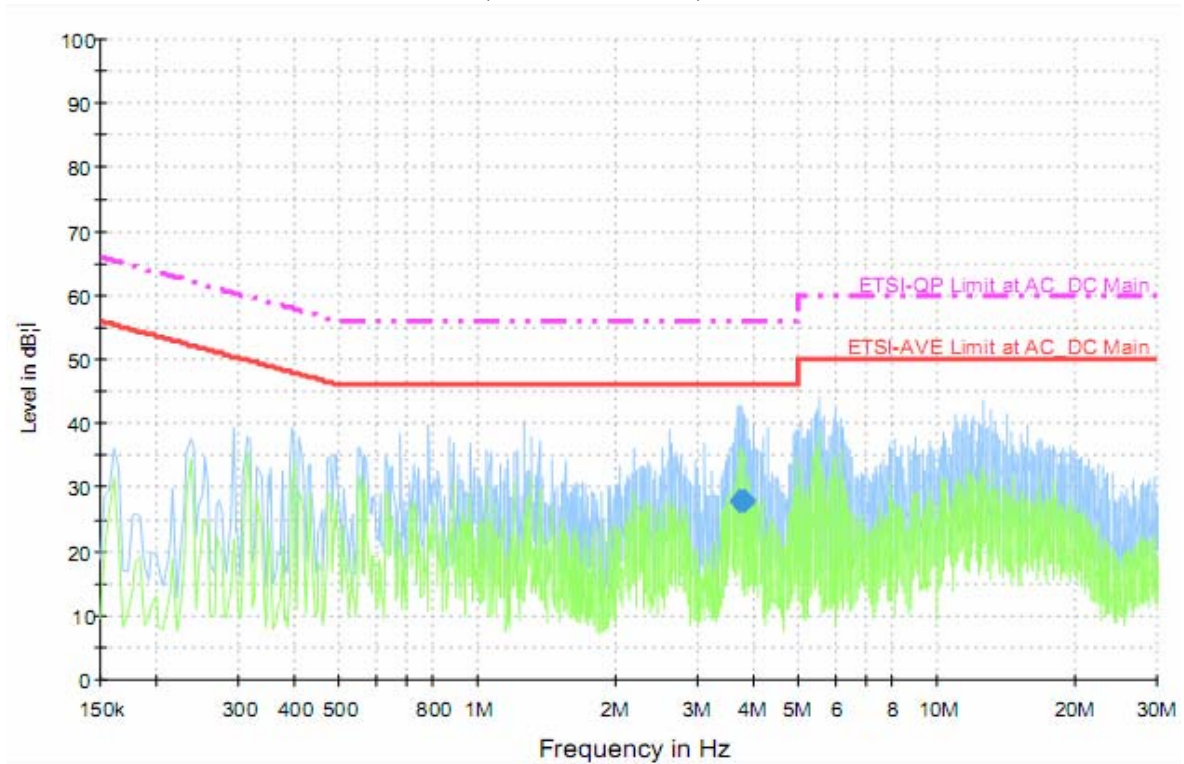
3.5 Test Results

No.	@Frequency (MHz)	Measured Emission Level (dBμV)				Limit (dBμV)		Verdict
		PK	QP	AV	Phase	QP	AV	
1	0.404156	38.9	35.2	26.3	N	58.0	48.0	PASS
2	0.564657	37.8	33.4	24.3	N	56.0	46.0	PASS
3	3.616298	44.2	36.8	22.2	N	56.0	46.0	PASS
4	3.691275	48.2	38.6	26.9	N	56.0	46.0	PASS
5	3.770359	47.8	38.8	26.9	N	56.0	46.0	PASS
6	4.121404	41.5	34.2	20.1	N	56.0	46.0	PASS
7	3.697620	46.2	36.7	27.9	L	56.0	46.0	PASS
8	3.698595	46.5	35.3	27.6	L	56.0	46.0	PASS
9	3.717971	47.1	36.4	28.0	L	56.0	46.0	PASS
10	3.783930	47.5	36.8	28.1	L	56.0	46.0	PASS
11	3.783941	46.6	36.2	27.9	L	56.0	46.0	PASS
12	3.787133	46.7	36.5	27.8	L	56.0	46.0	PASS

Test Plot:



(Plot A: N Phase)



(Plot B: L Phase)

4 Radiated Emission Test

4.1 Limits of Radiated Emission

According to FCC §15.247(c), radiated emission outside the frequency band attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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).

According to FCC §15.209 (a), Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency(MHz)	Field Strength(μ V/m)	Measurement Distance(m)
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

As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector. When average radiated emission measurements are specified in this part, including emission measurements below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules,

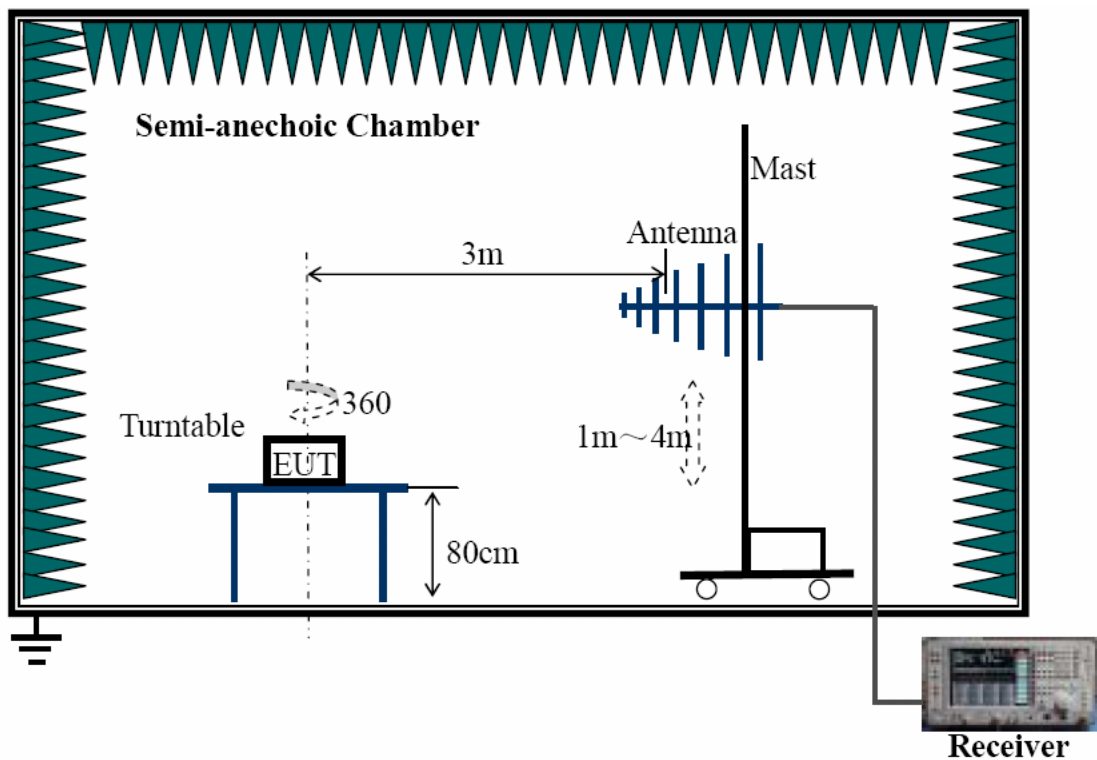
4.2 Test Procedure

- The EUT was placed on the top of a ratable 0.8 meters above the ground at a semi-anechoic chamber.
- In the frequency range of 9 kHz to 30 MHz, magnetic field was measured with loop antenna. The antenna was positioned with its plane vertical at 1 m distance from the EUT. The center of the loop was 1 m above the ground. During the measurement the loop antenna rotated about its vertical axis for maximum response at each azimuth about the EUT.
- In the frequency range above 30MHz, ultra-broadband bi-log antenna (30 MHz to 1 GHz) and horn antenna (above 1GHz) were used. Antenna was 3 meters away from the EUT. Antenna height was varied from one meter to four meter 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. The test-receiver system was set to Peak Detector Function and Specified Bandwidth with Maximum Hold Mode.
- e. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emission that did not have 10 dB margins would be retested one by one using the quasi-peak method.

4.3 Test Setup



For the actual test configuration, please refer to the related item-Photographs of the Test Configuration.

4.4 EUT Setup and Operating Conditions

A communication link was established between the EUT and a Bluetooth tester. The EUT set to test mode: transmitting 339 bytes DH5 packages with maximum power at low/mid/high channels.

4.5 Test Results

I. Fundamental Emissions

EUT Operating Freq. (MHz)	Antenna Polarization	Emission Level (dBμV/m)	
		PK	AV
2402.00	Vertical	90.98	77.23
	Horizontal	89.71	76.02

2441.00	Vertical	90.87	76.98
	Horizontal	89.23	75.33
2480.00	Vertical	89.80	76.19
	Horizontal	89.01	75.05

NOTE: Field strength of fundamental emissions were measured and record as a reference for calculation of the band edge emissions according to Marker-Delta Method DA 00-705. See chapter 11.5.

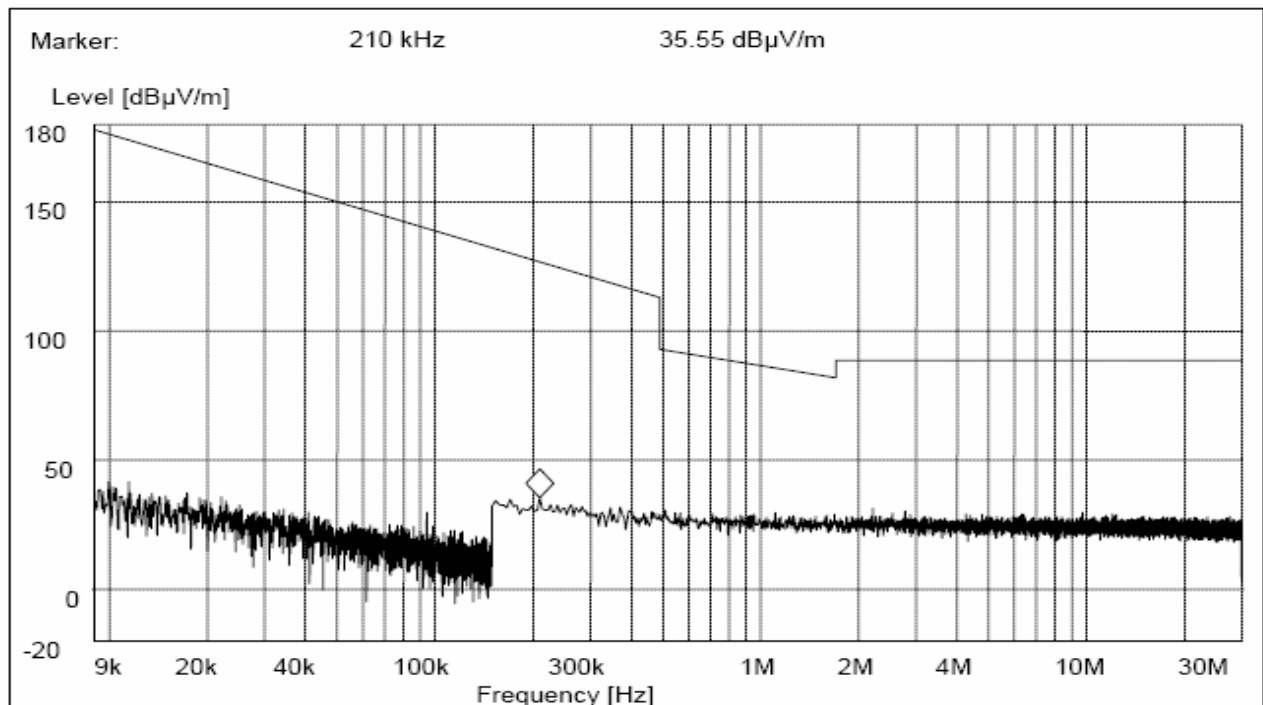
II. Spurious Emissions

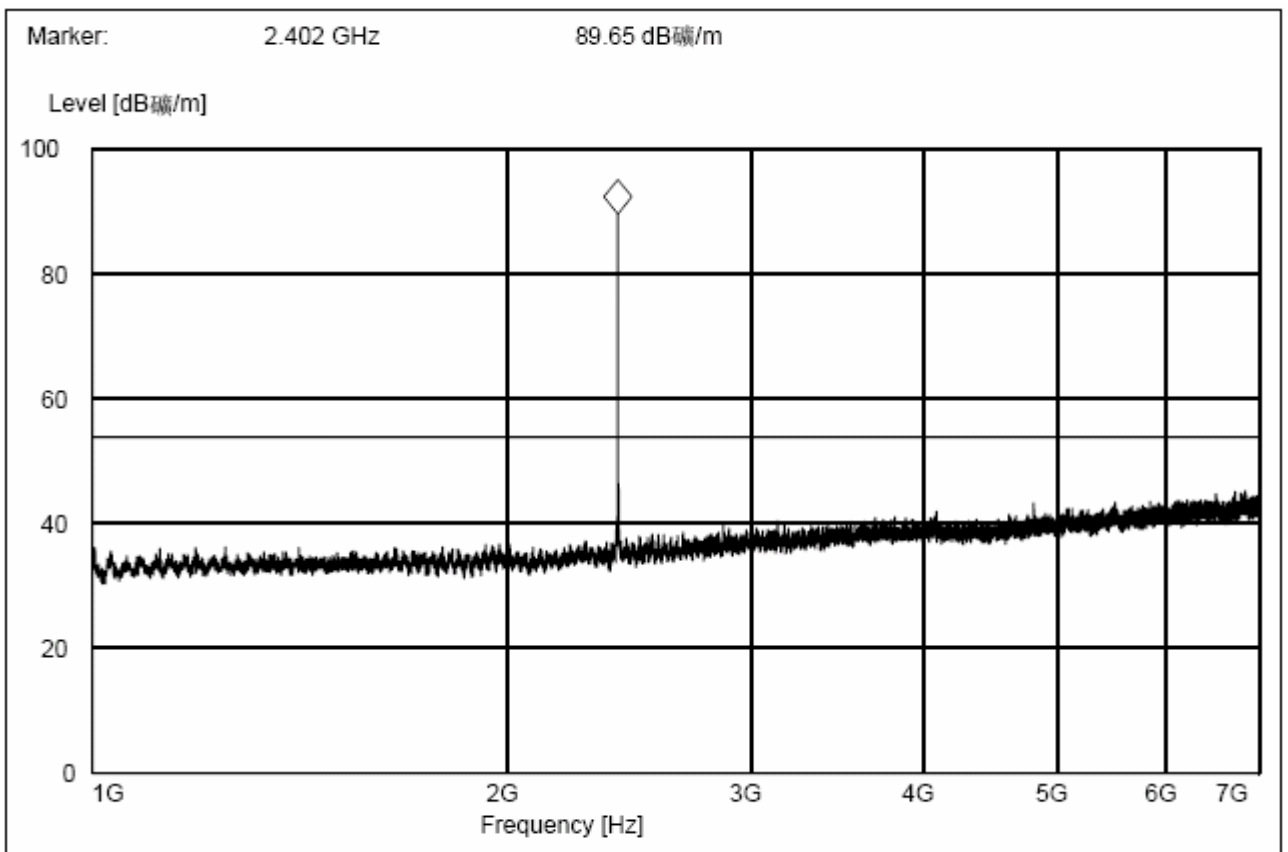
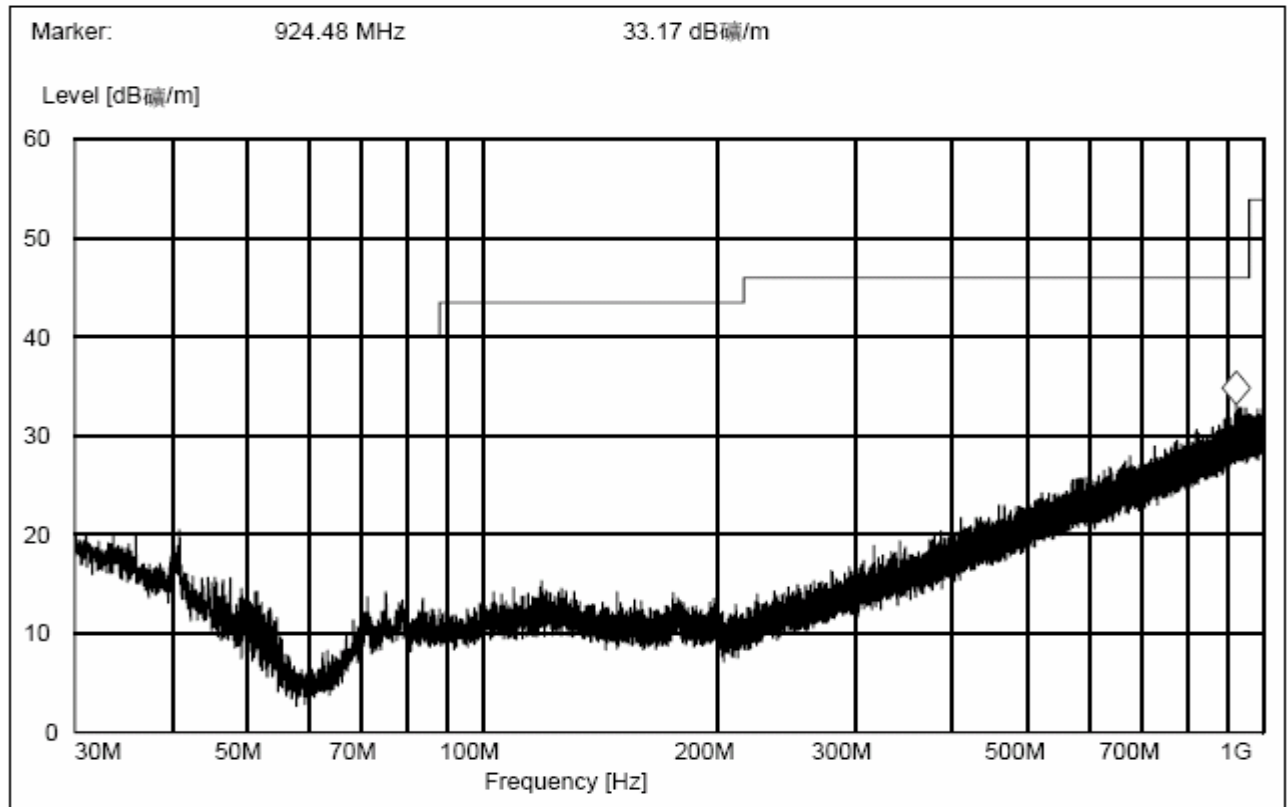
EUT Operating Freq. (MHz)	Emissions Falling in Restrict Bands (MHz)	Antenna Polarization	Emission Level (dB μ V/m)		QP Limits (dB μ V/m)	
			PK	AV	PK	AV
2402.00	No peak found	Vertical	--	--	74	54
	No peak found	Horizontal	--	--	74	54
2441.00	No peak found	Vertical	--	--	74	54
	No peak found	Horizontal	--	--	74	54
2480.00	No peak found	Vertical	--	--	74	54
	No peak found	Horizontal	--	--	74	54

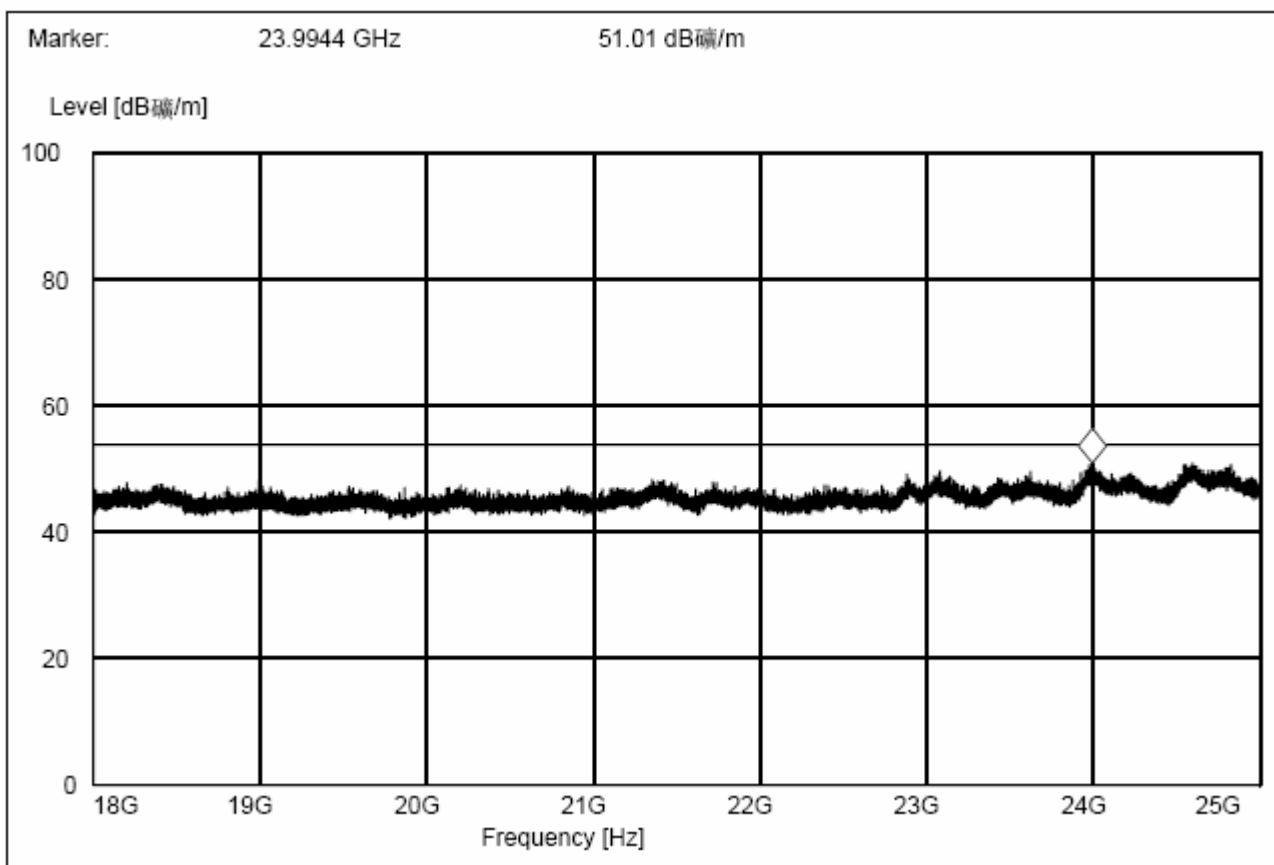
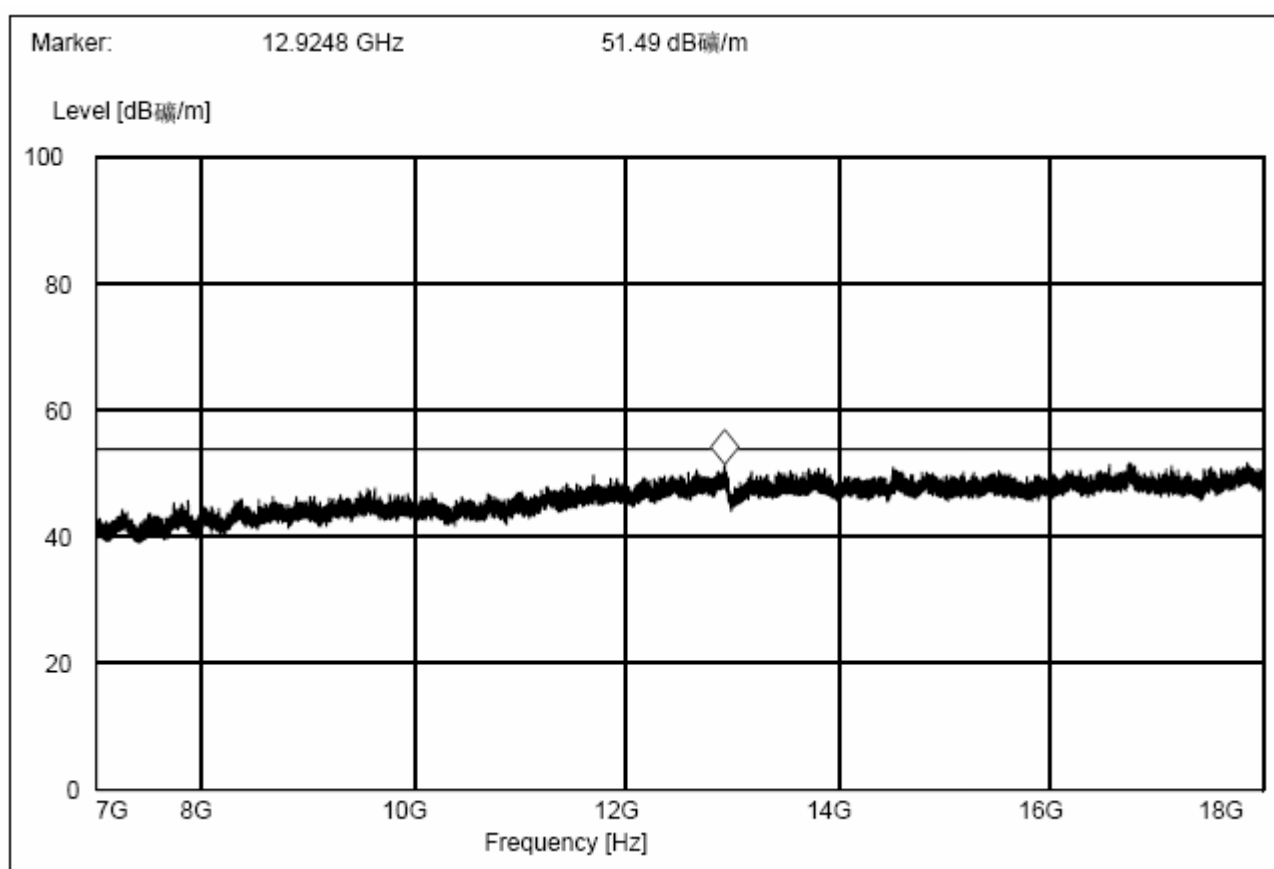
NOTE: The spurious Emissions from 9 kHz to 10th harmonic of the fundamental frequency were researched. Refer to following test plots.

Test Plots

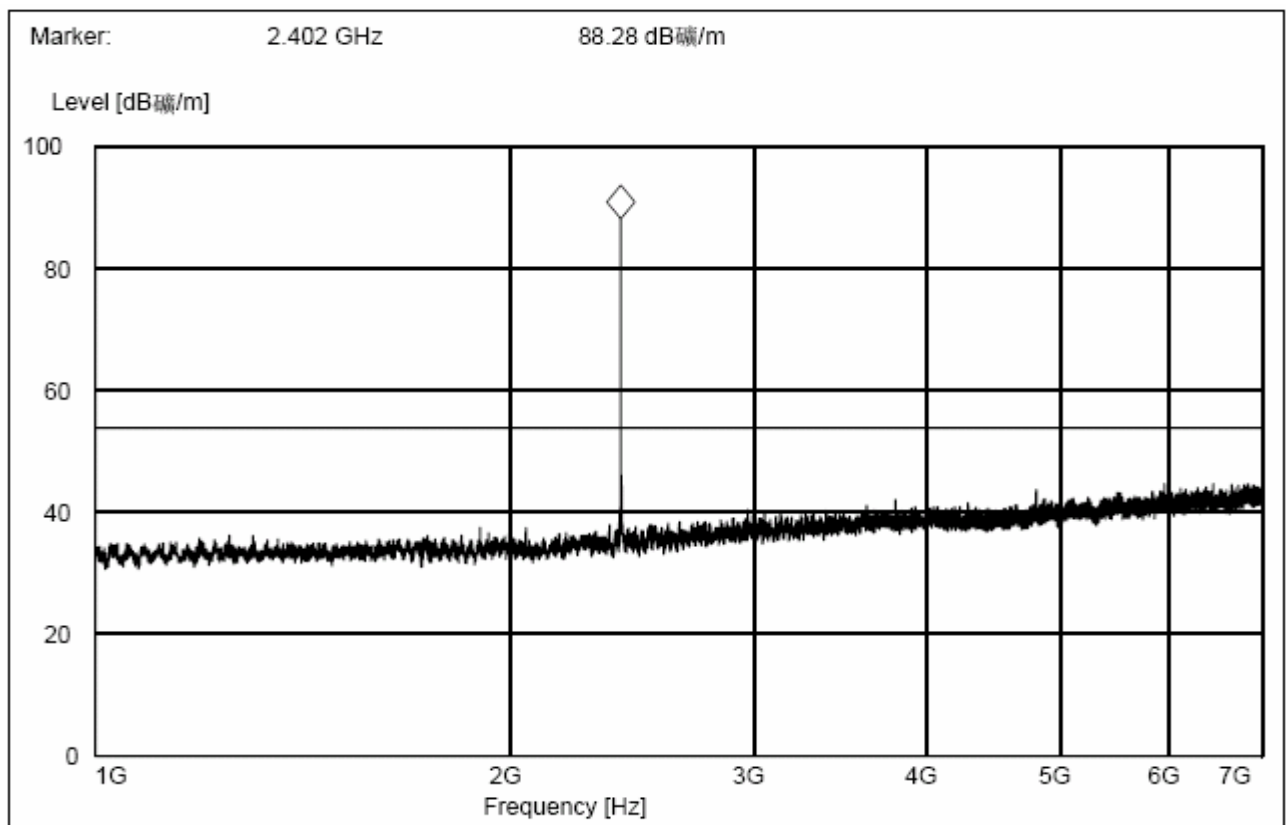
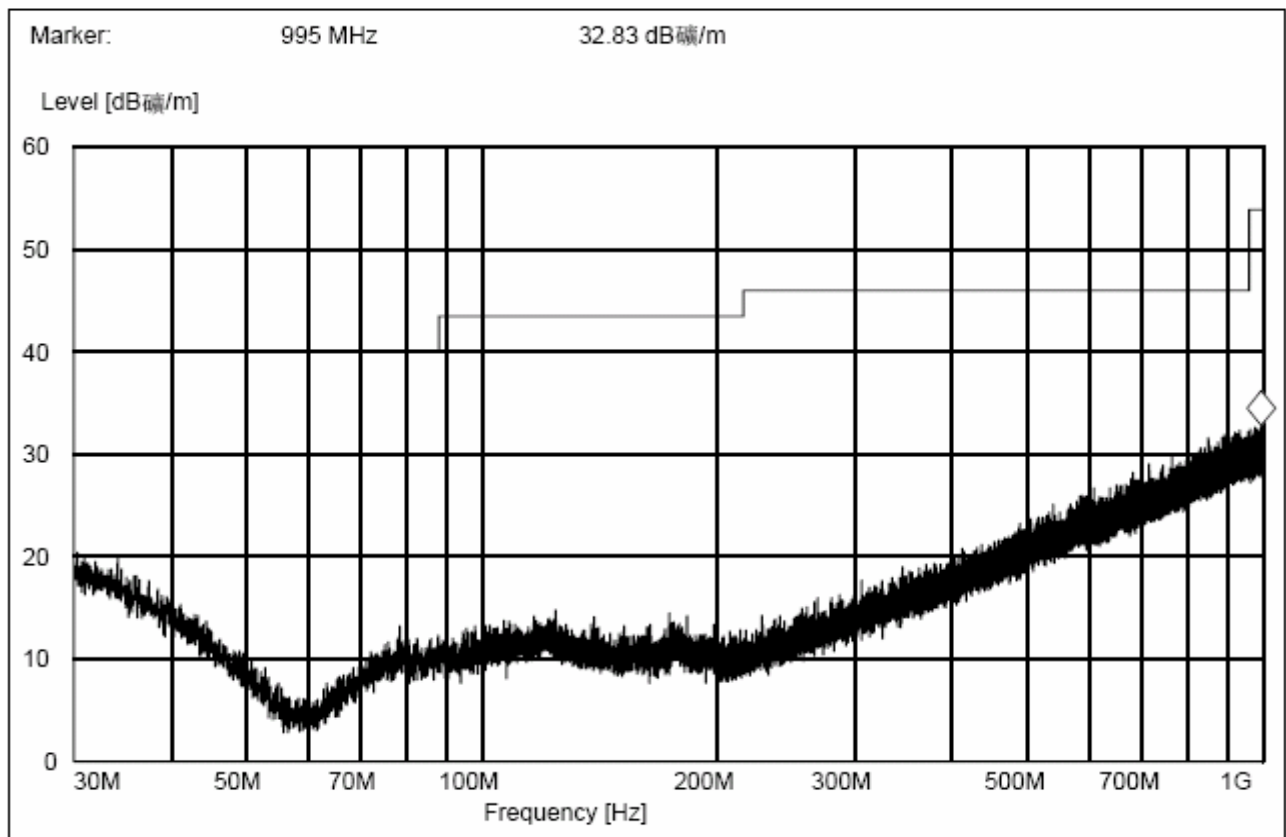
1. Lowest channel 2402MHz, Vertical

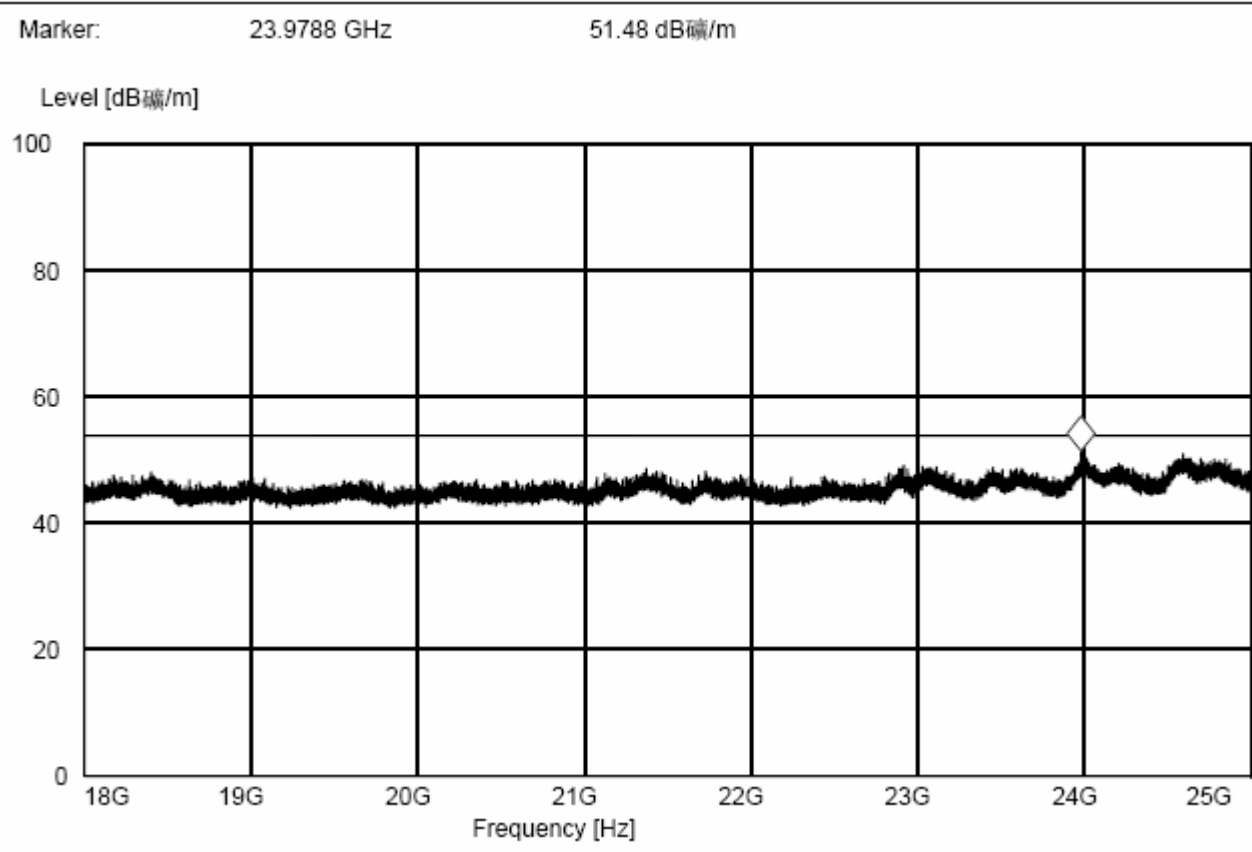
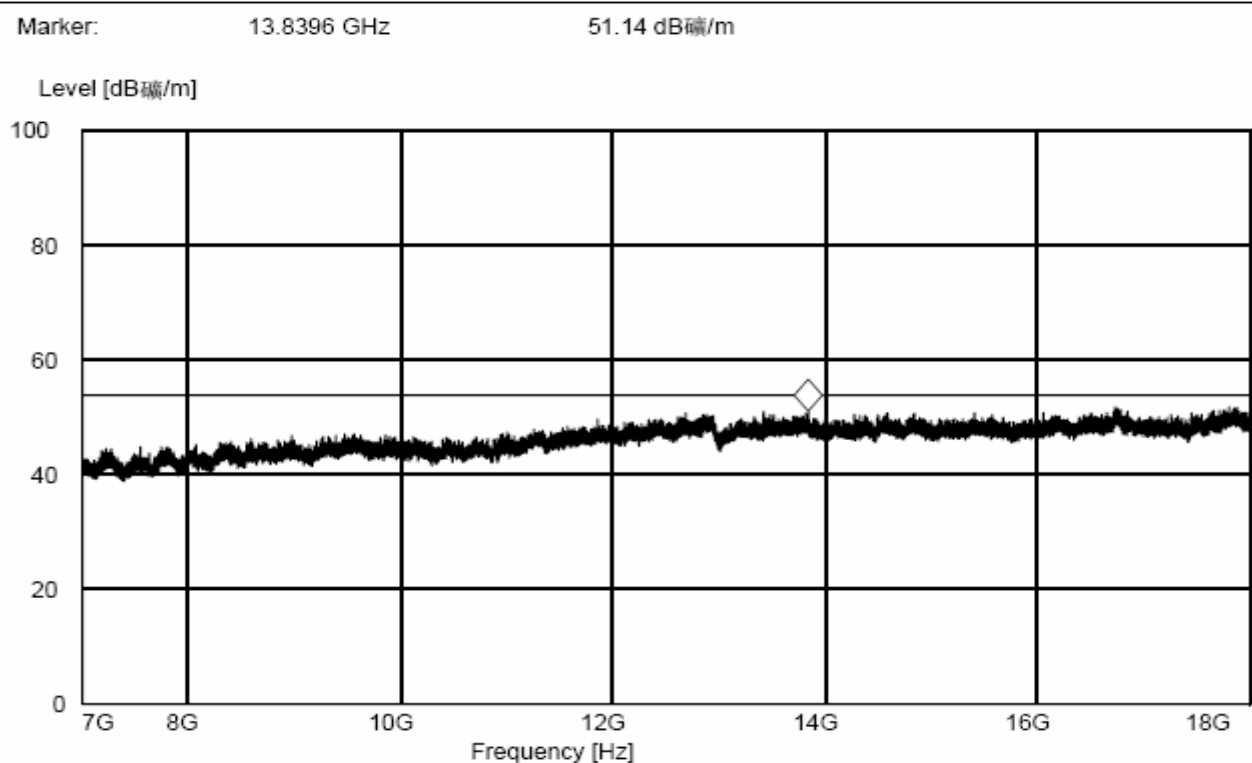




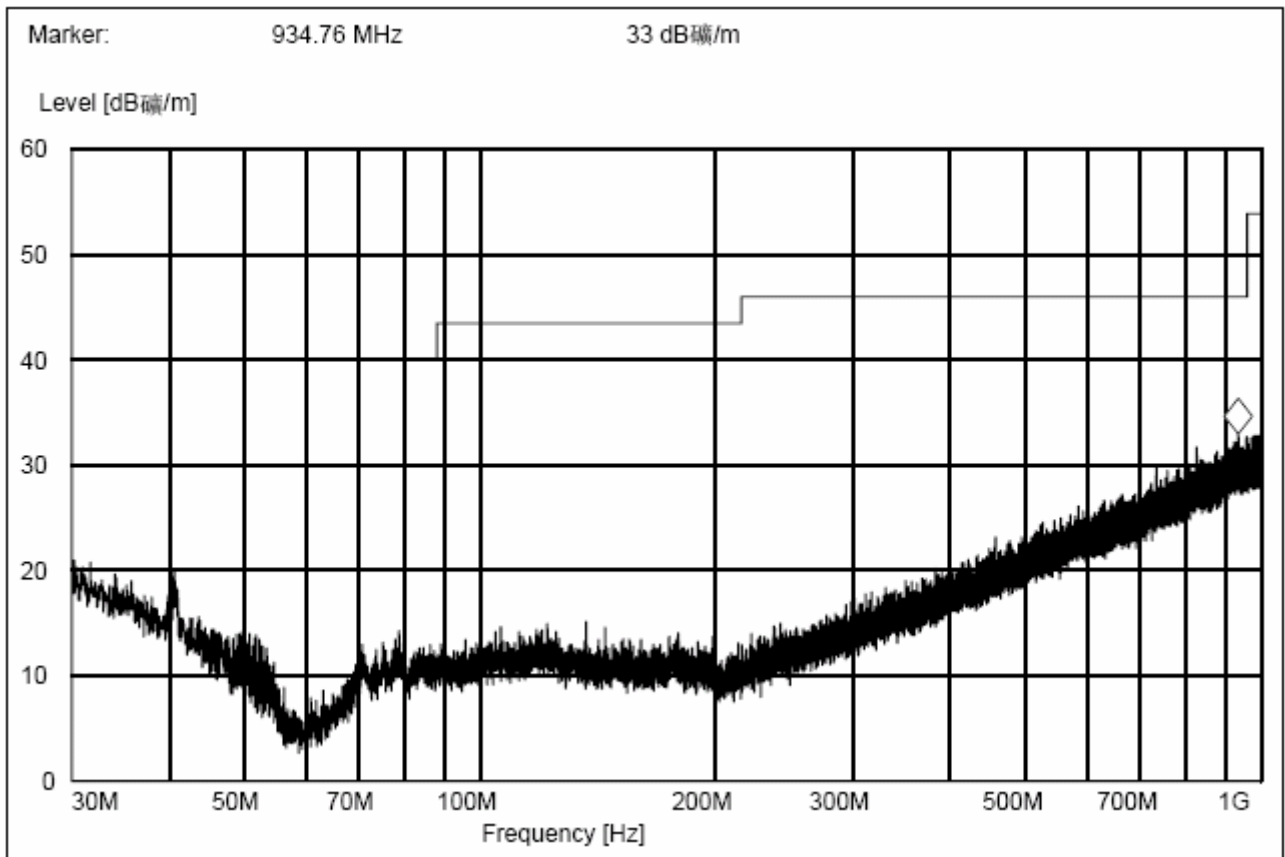
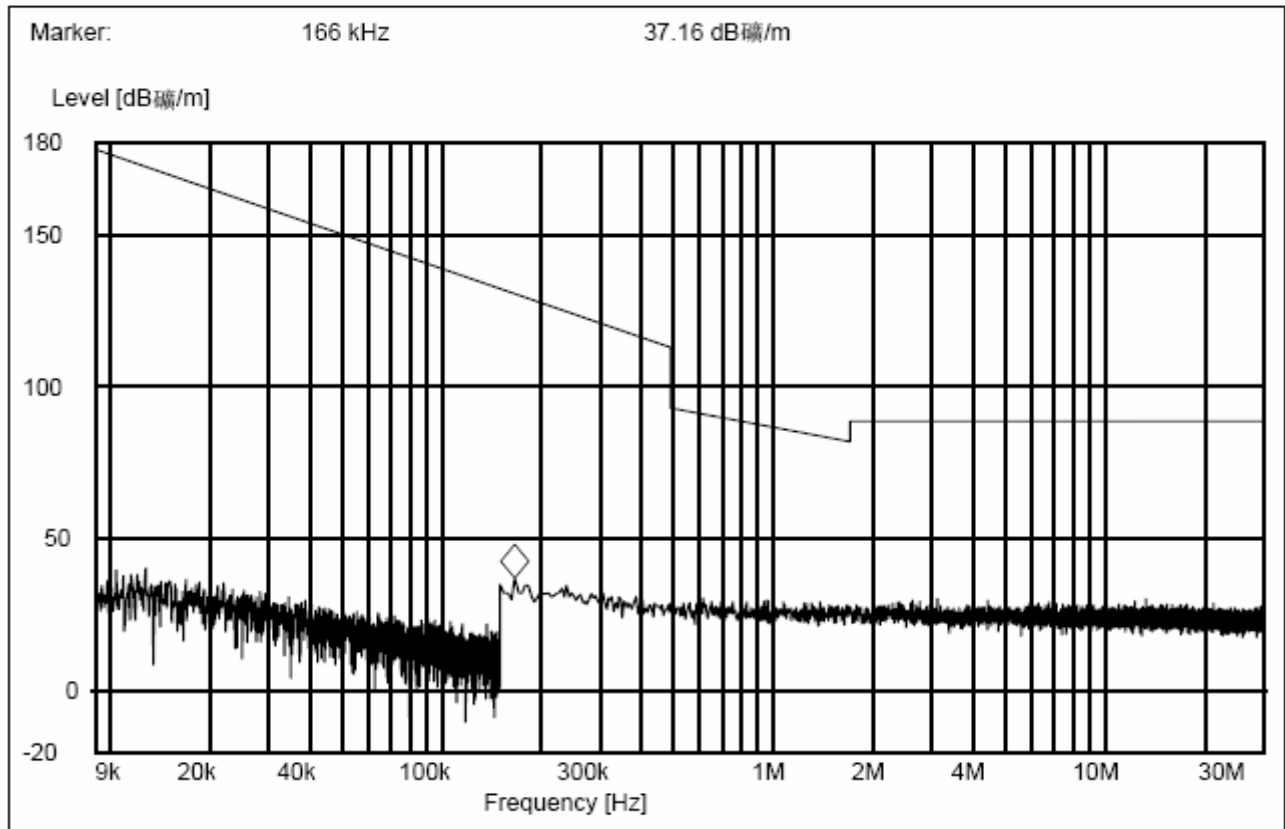


2. Lowest channel 2402MHz, Horizontal



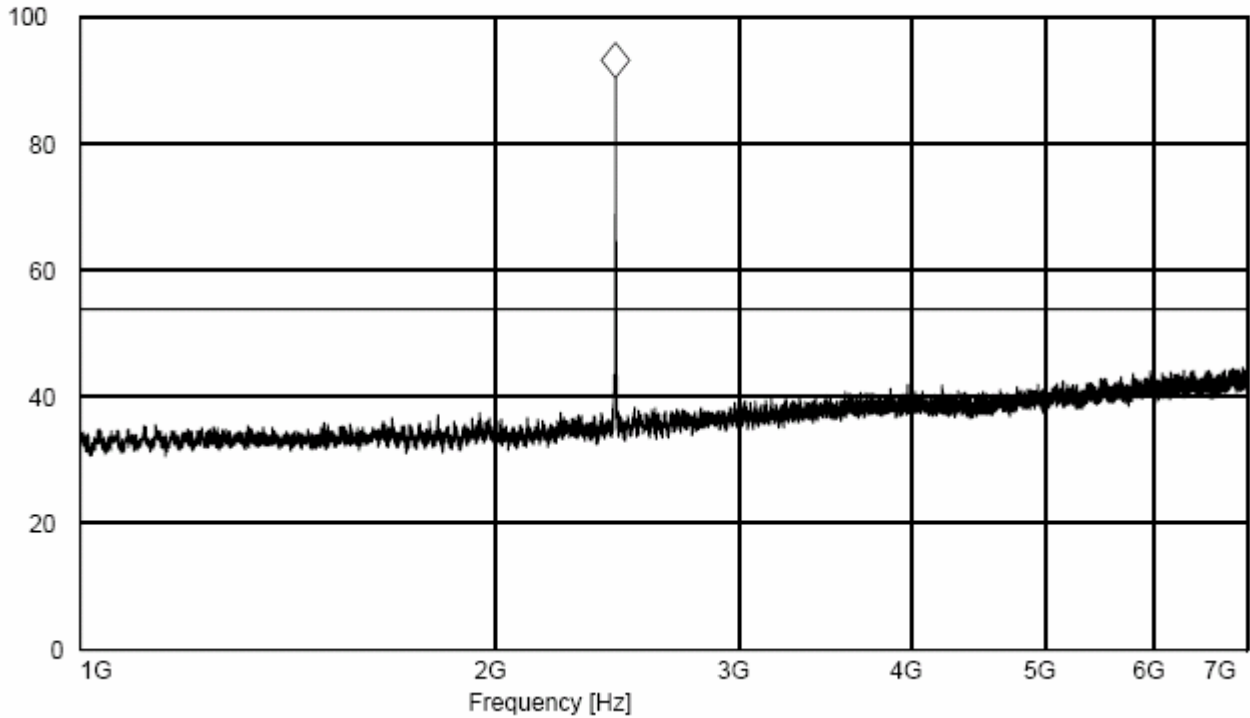


3. Middle channel 2441MHz, Vertical



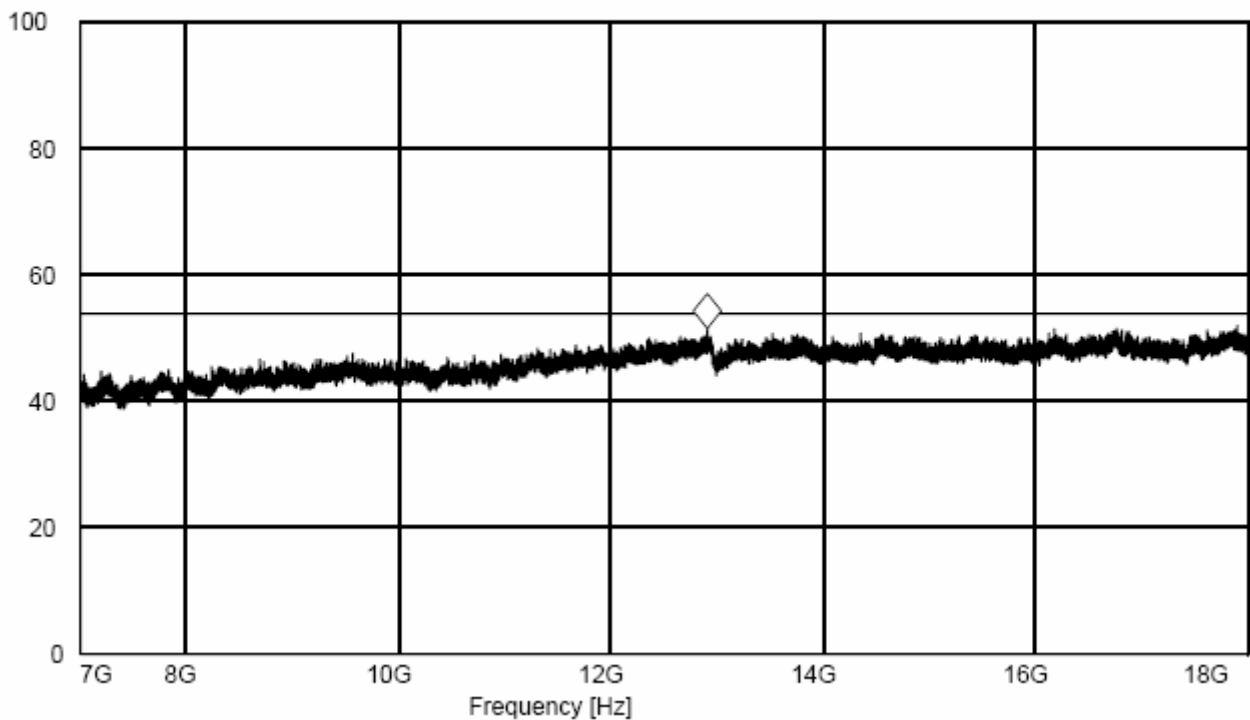
Marker: 2.4412 GHz 90.52 dB μ /m

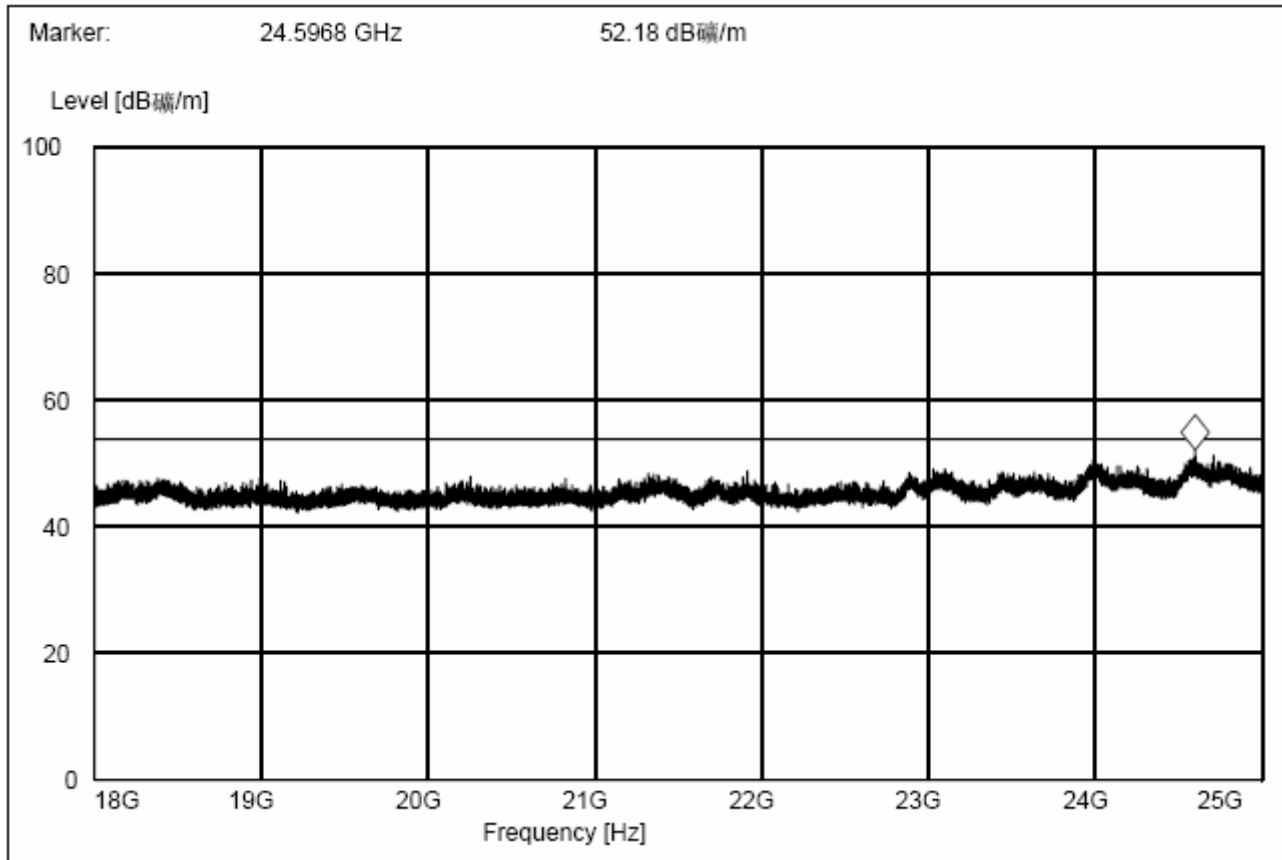
Level [dB μ /m]



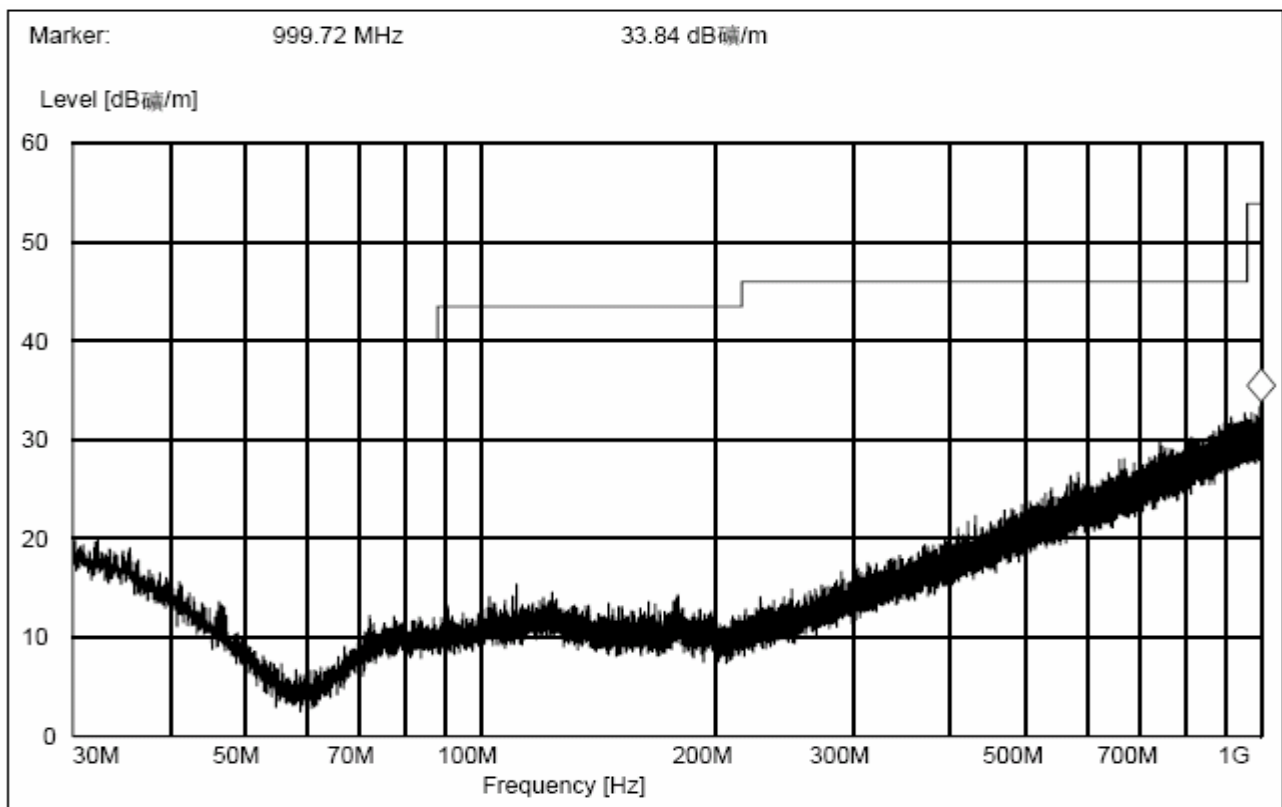
Marker: 12.9068 GHz 51.58 dB μ /m

Level [dB μ /m]



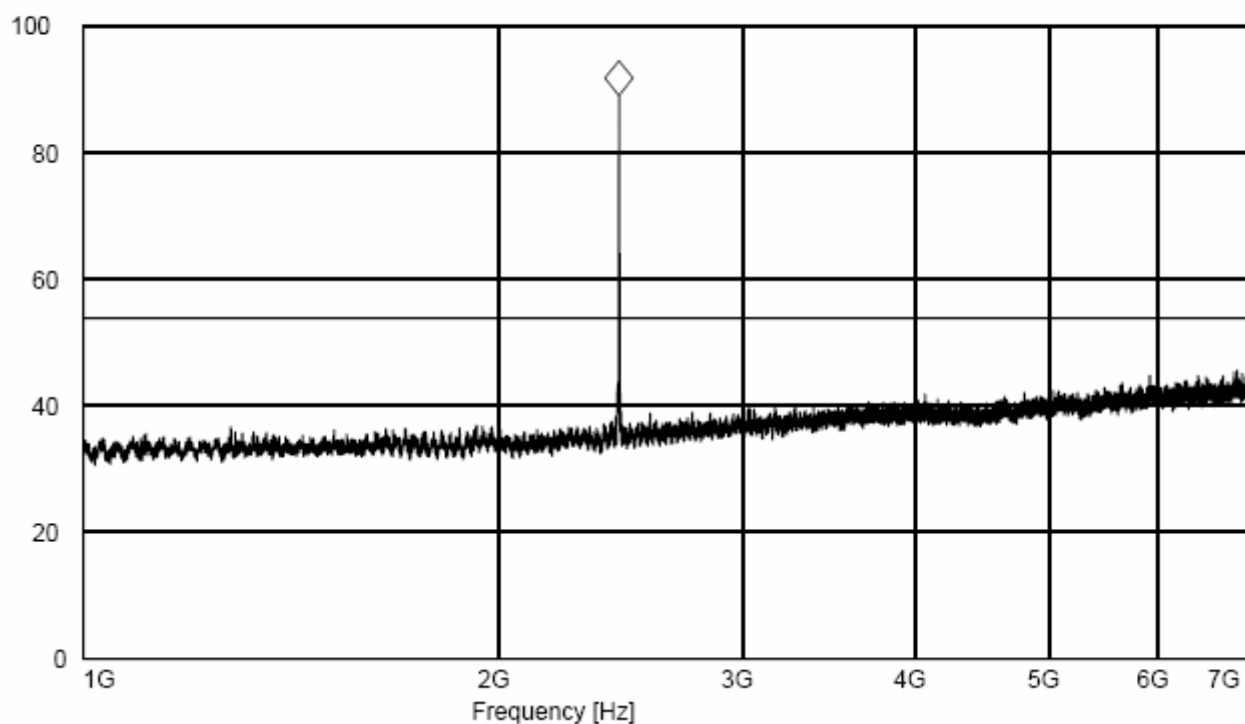


4. Middle channel 2441MHz, Horizontal



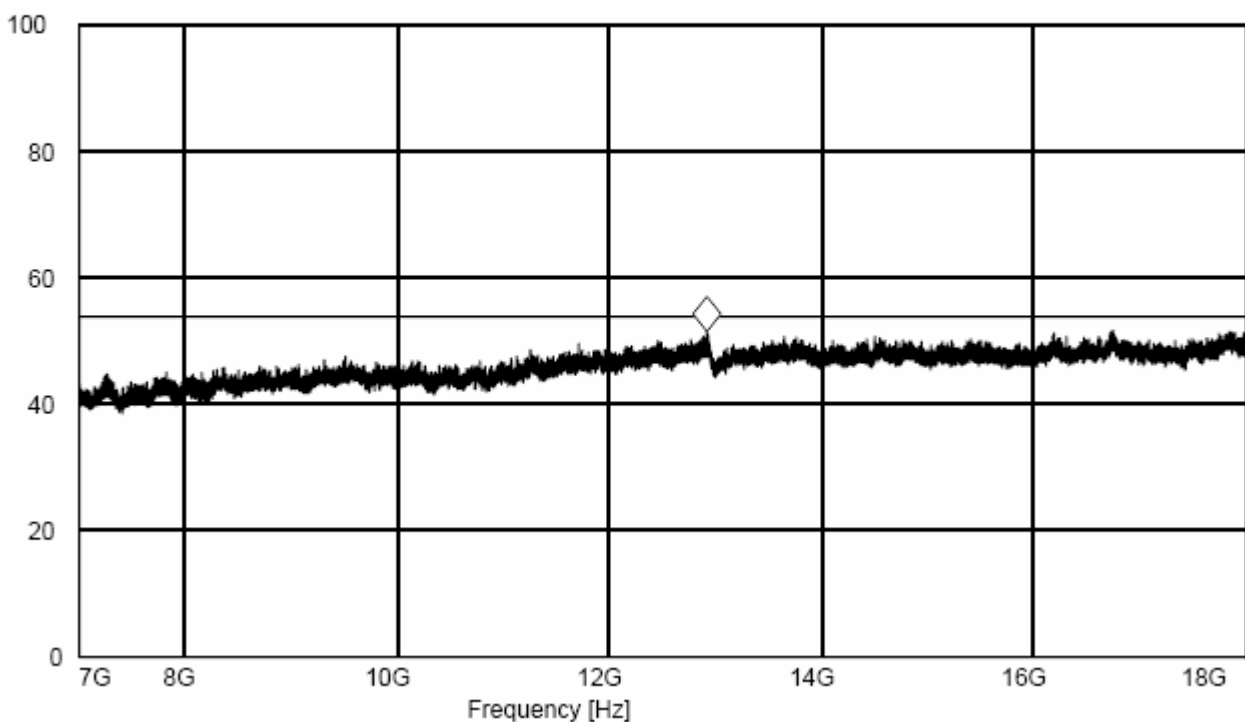
Marker: 2.4412 GHz 89.1 dB_{μV/m}

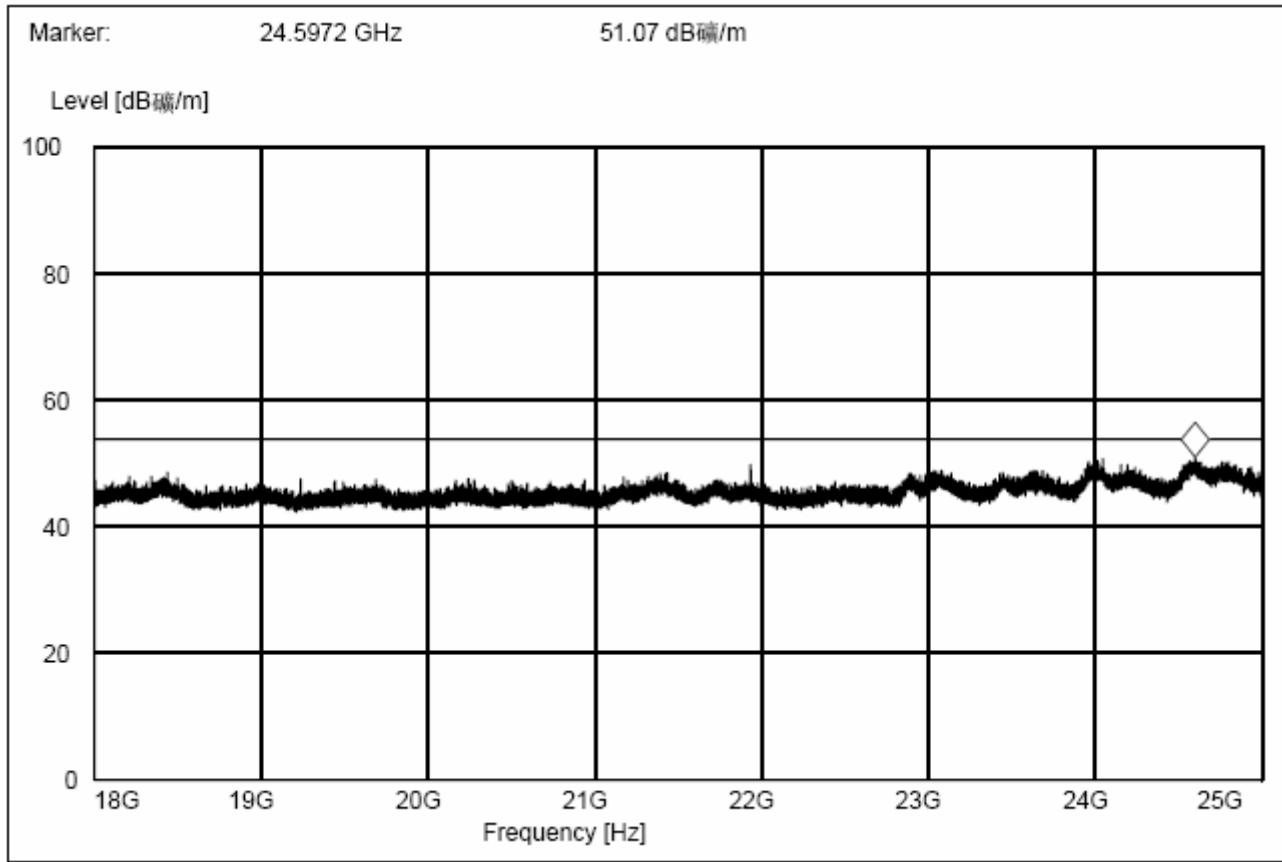
Level [dB_{μV/m}]



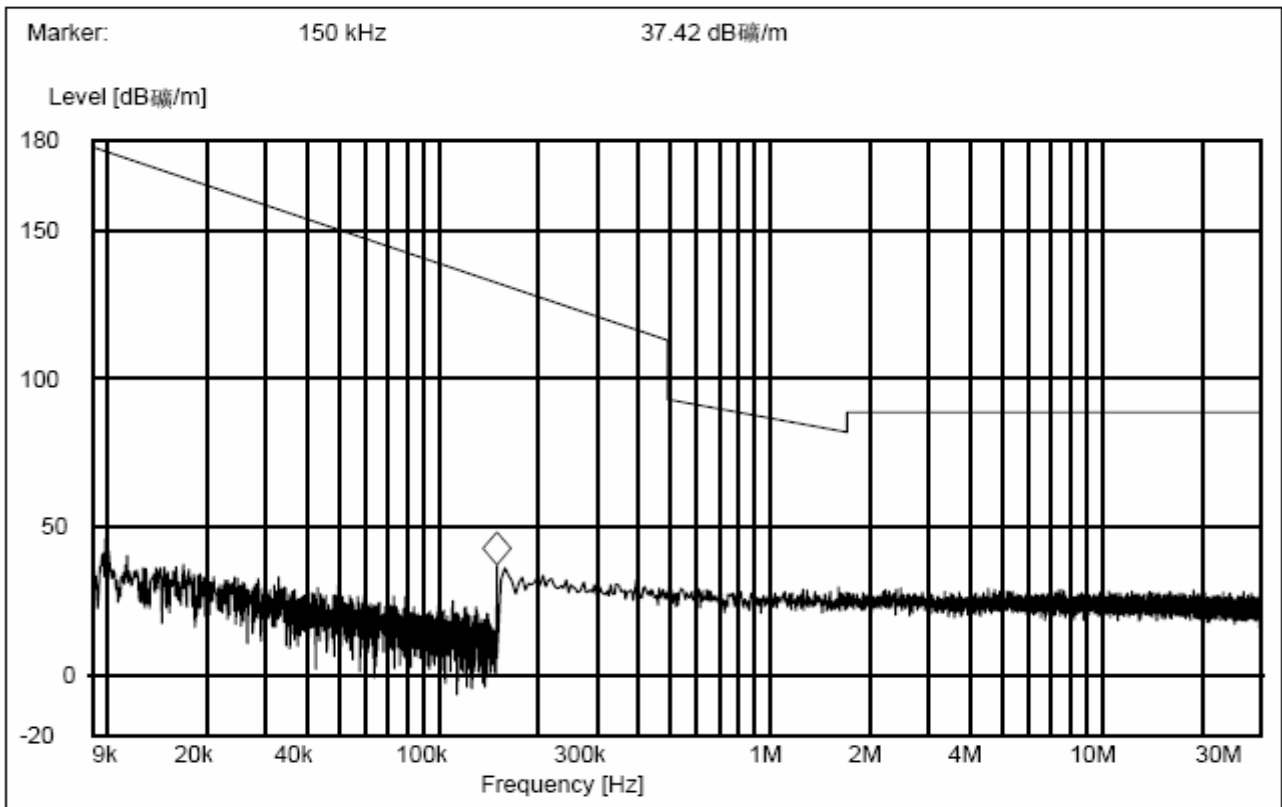
Marker: 12.9184 GHz 51.55 dB_{μV/m}

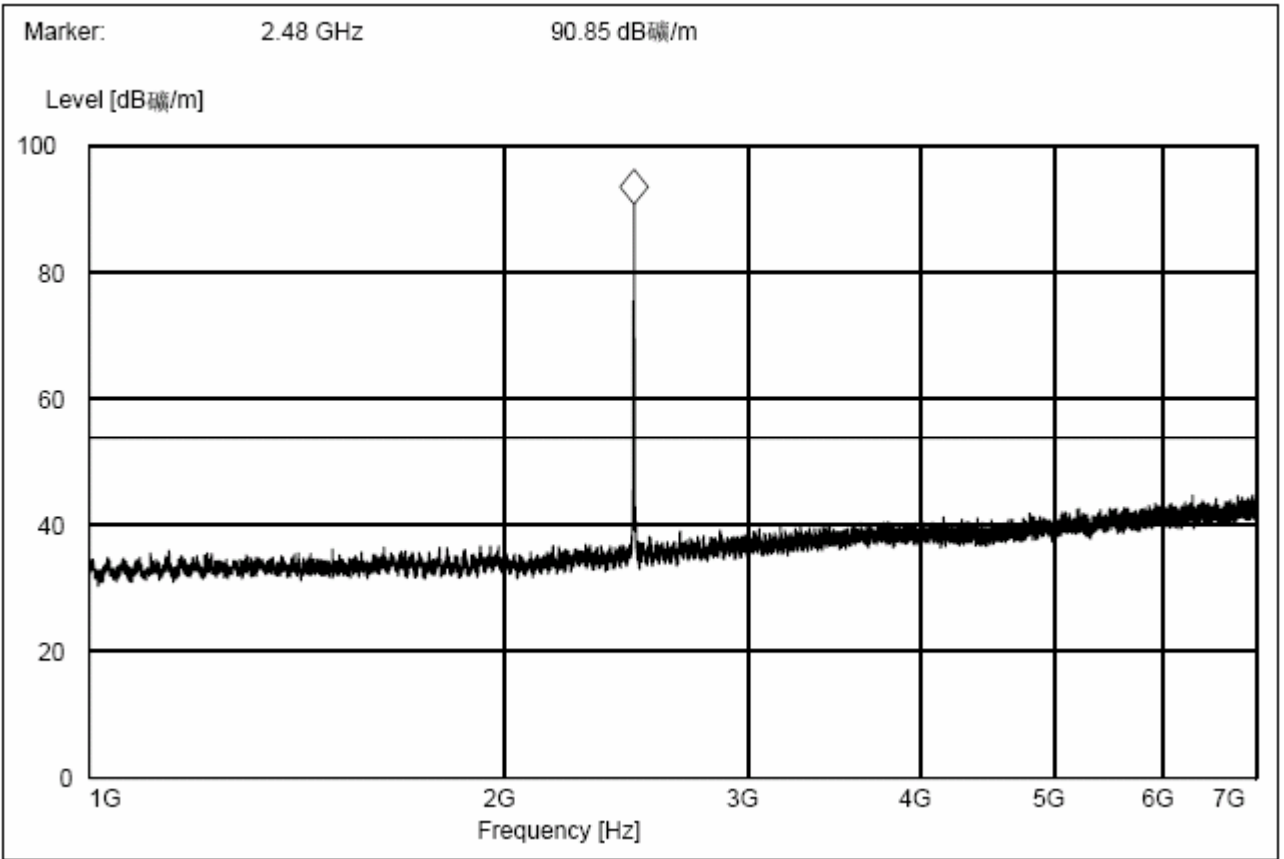
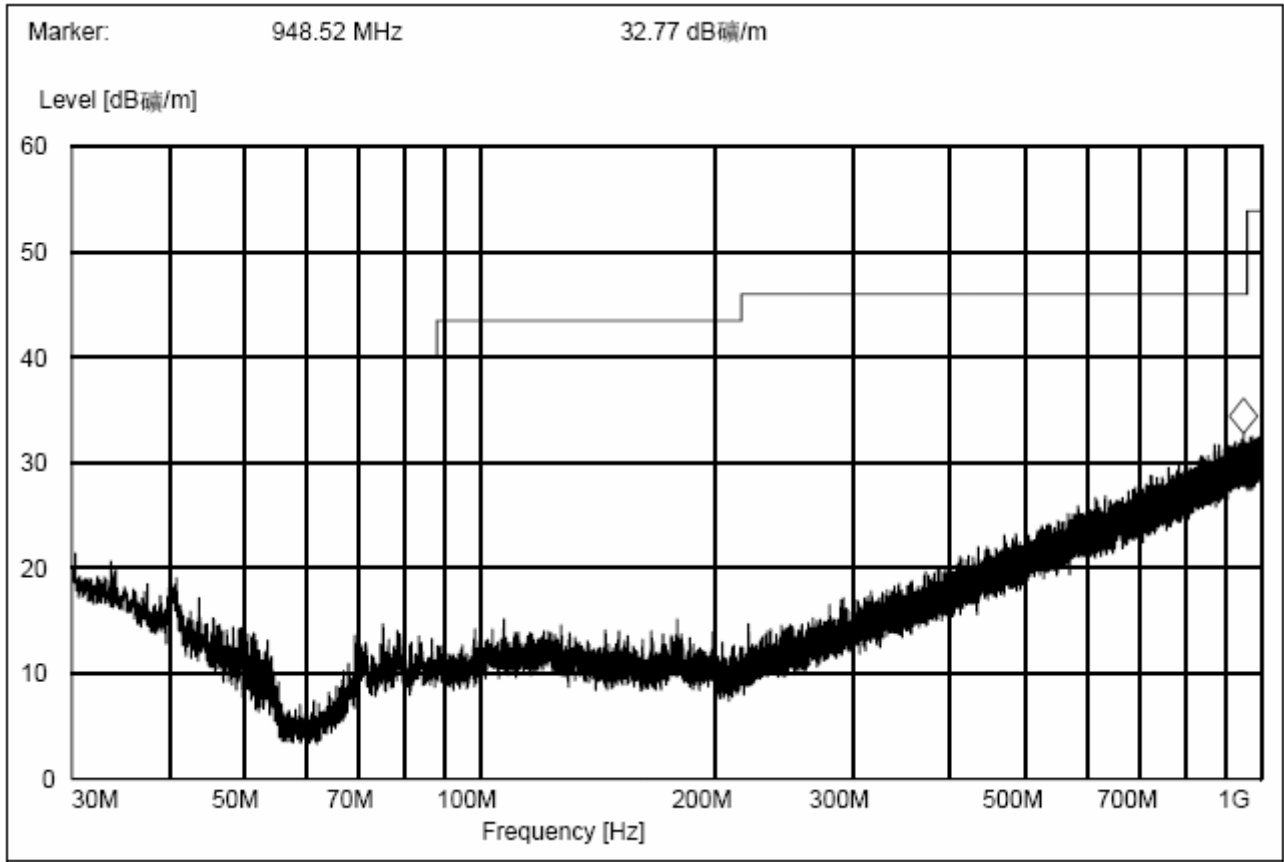
Level [dB_{μV/m}]

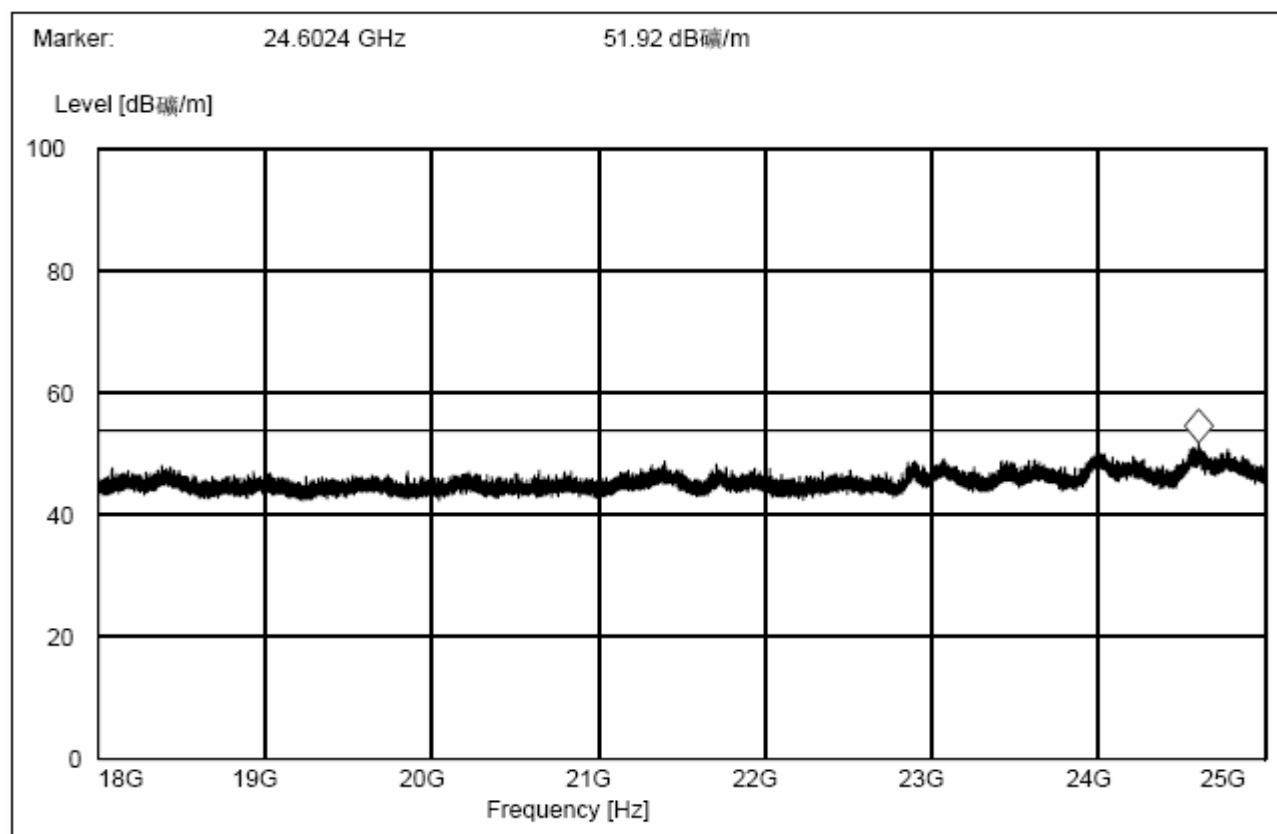
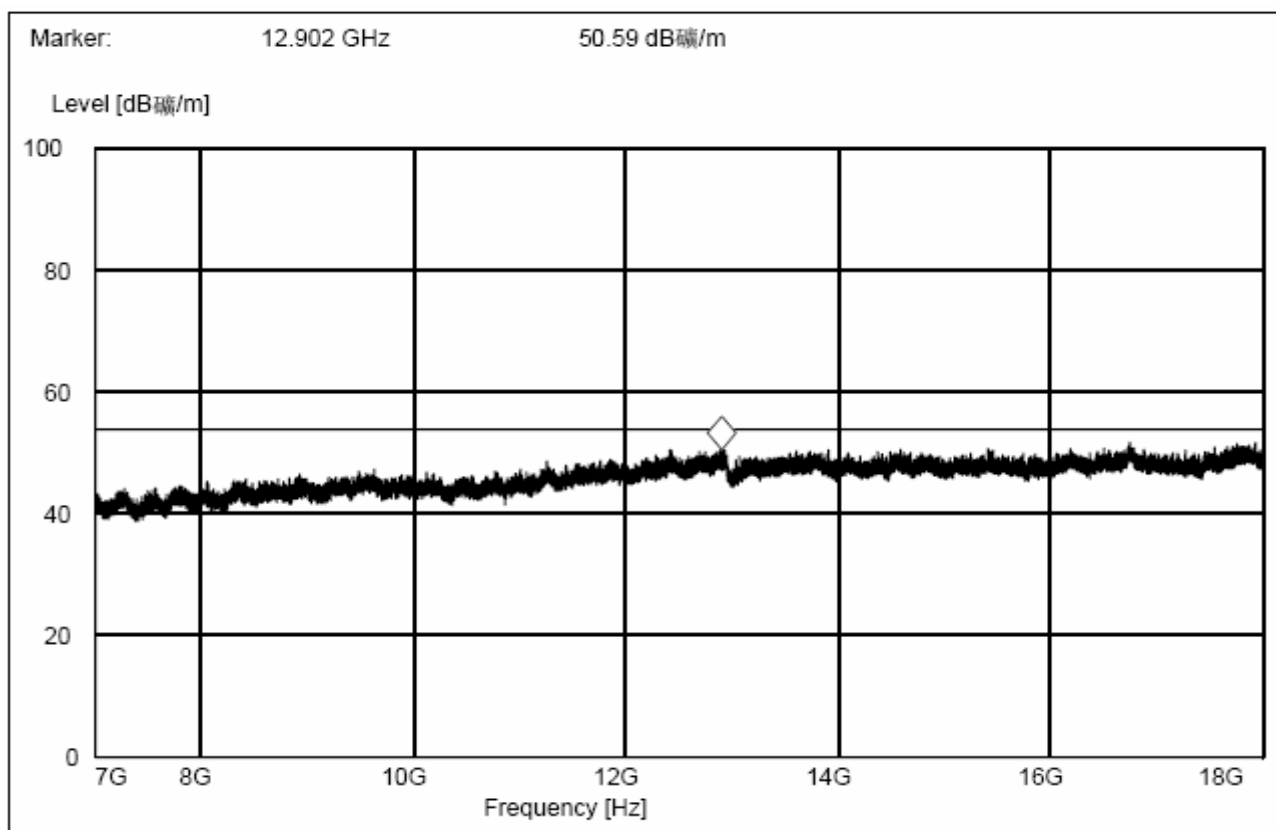




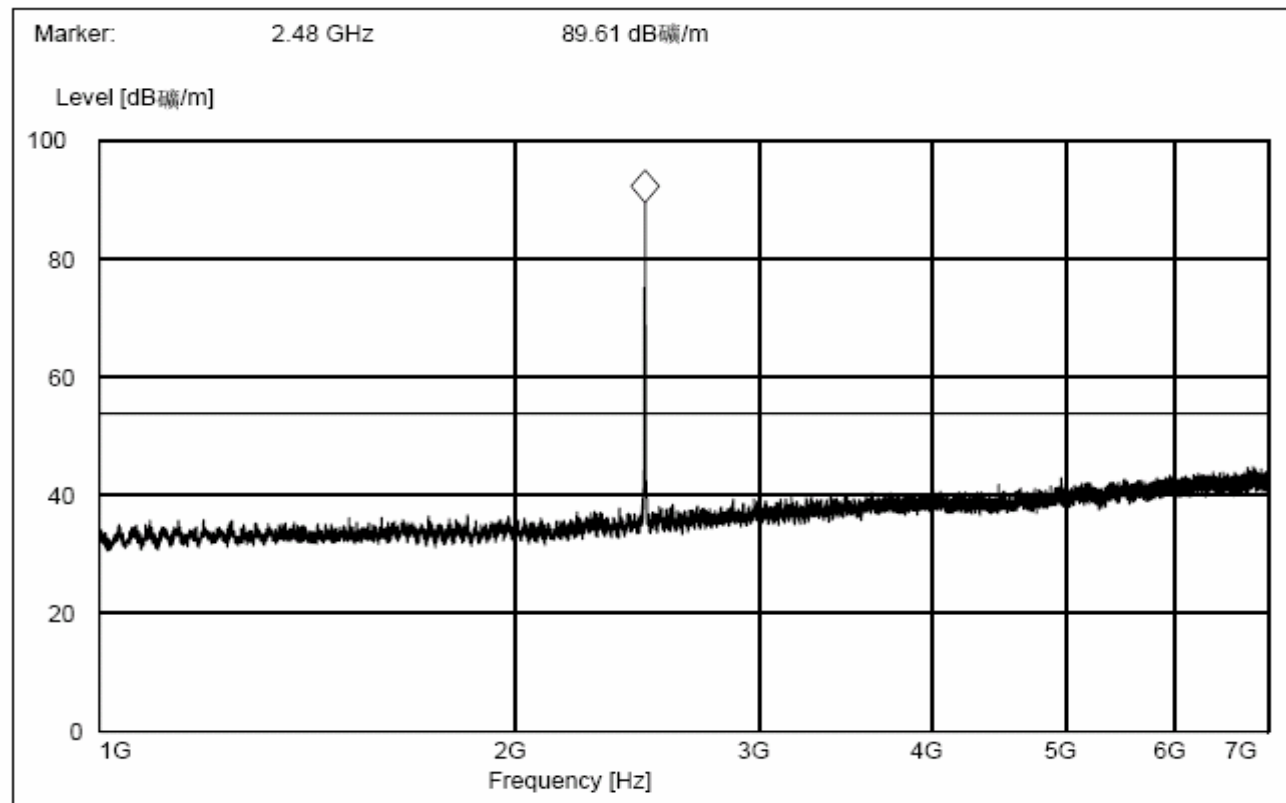
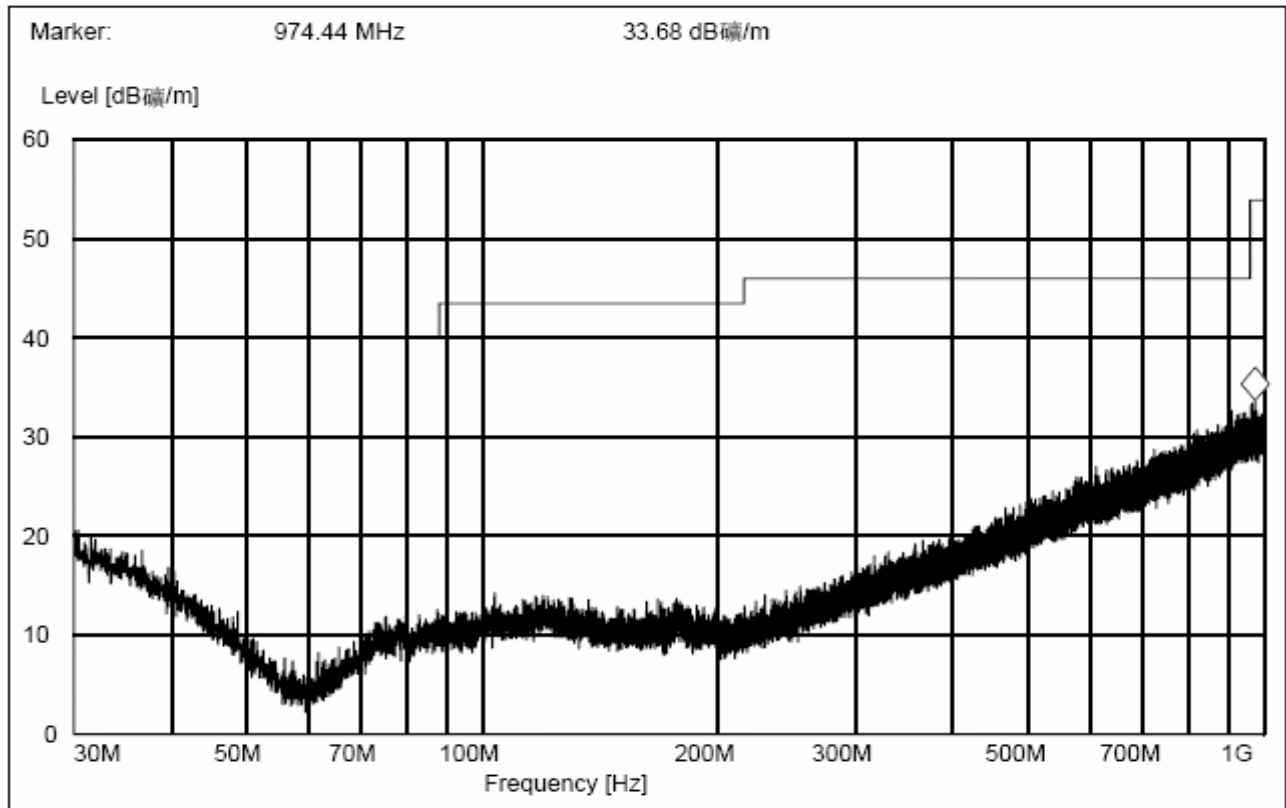
5. Highest channel 2480MHz, Vertical

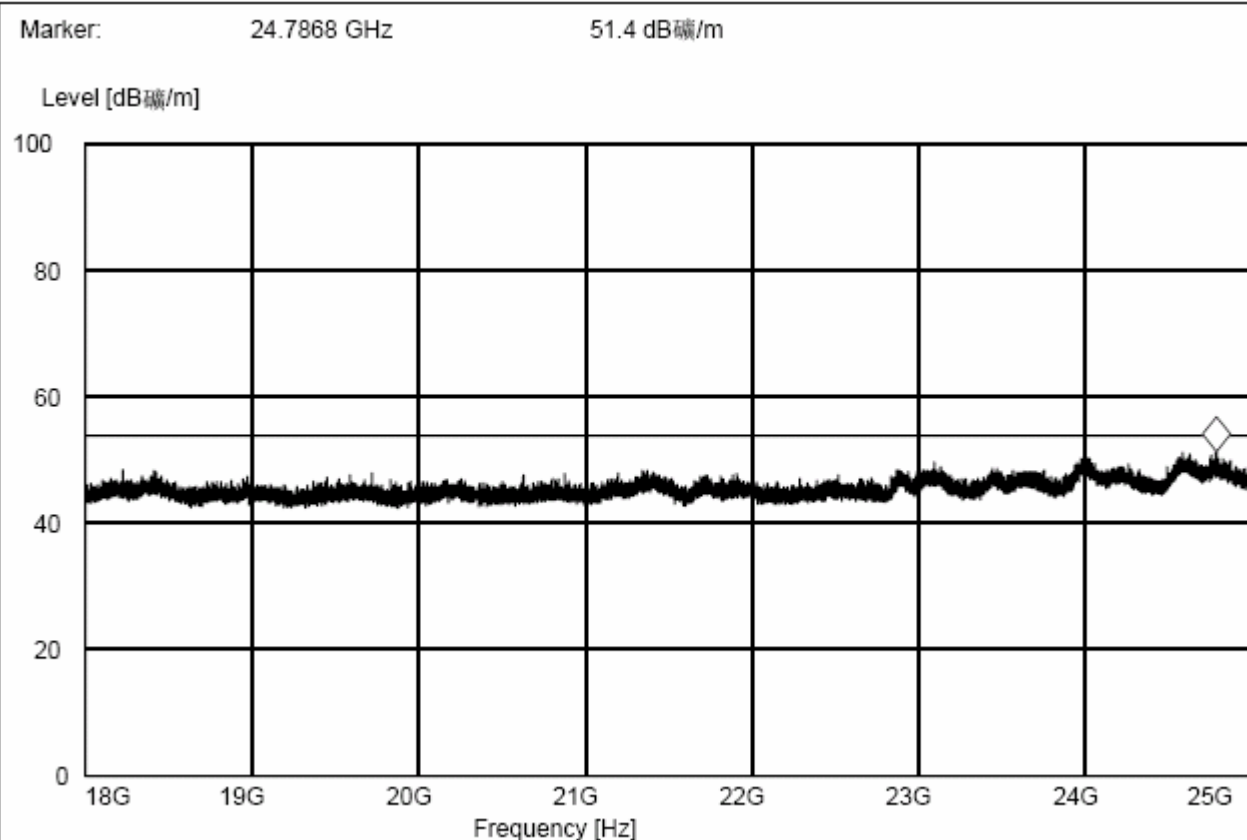
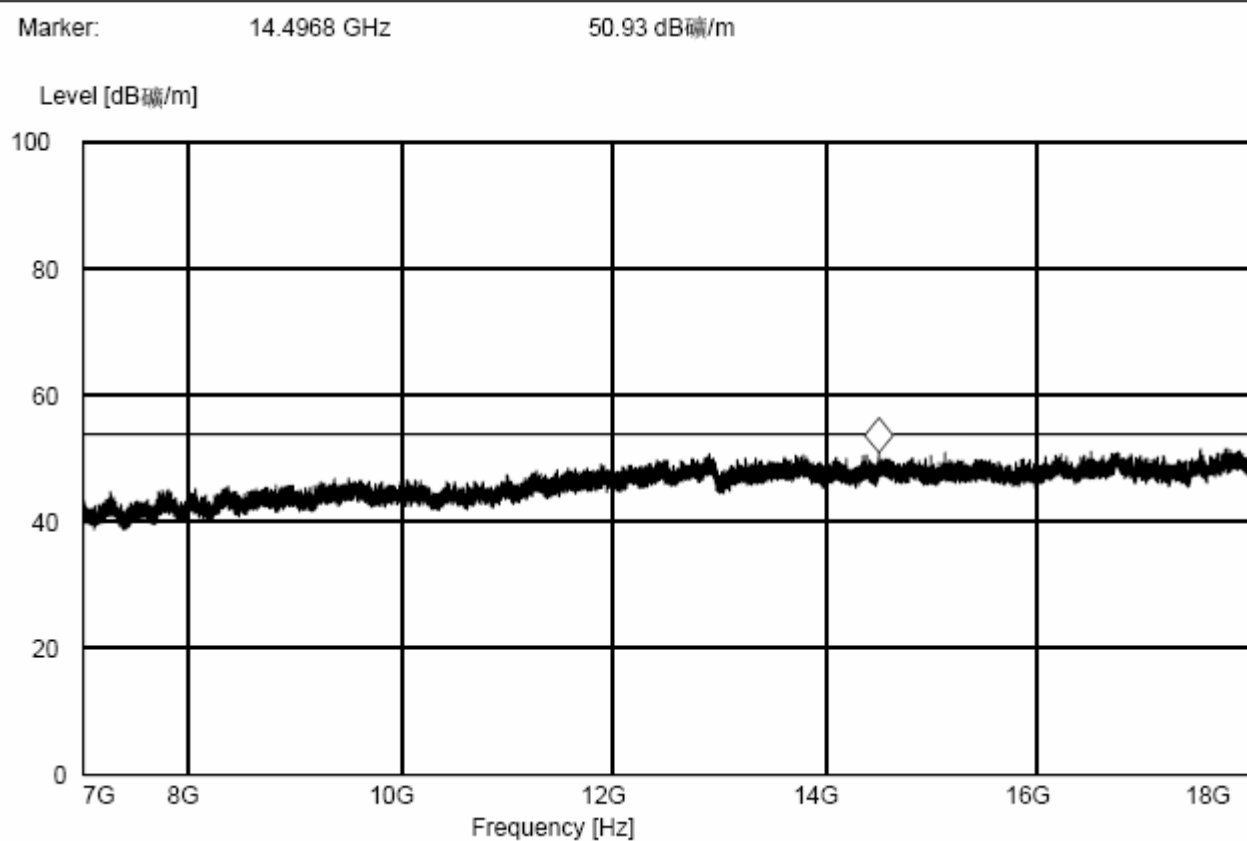






6. Highest channel 2480MHz, Horizontal





5 Bandwidth and Carried Frequency Separation

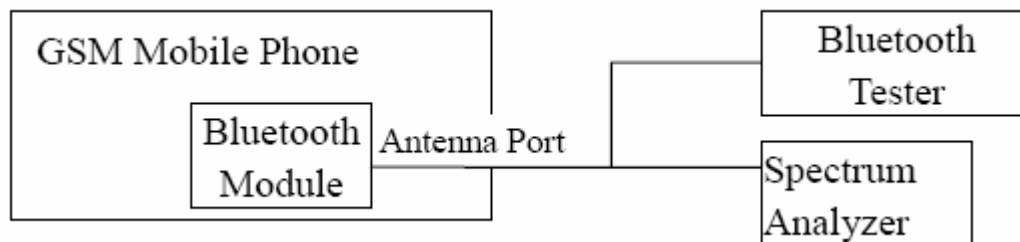
5.1 Definition

According to FCC §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.

5.2 Test Procedure

- The EUT temporary antenna port was coupled to the spectrum analyzer. The lost of the cables the test system is calibrated to correct the reading.
- The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- The resolution bandwidth of the spectrum analyzer was set to at least 1% of the EUT emission bandwidth. RBW=10 kHz, VBW=30 kHz.

5.3 Test Setup



For the actual test configuration, please refer to the related item-Photographs of the Test Configuration.

5.4 EUT Setup and Operating Conditions

A communication link was established between the EUT and a Bluetooth tester. The EUT set to test mode: transmitting 339 bytes DH5 packages with maximum power at low/mid/high channels.

5.5 Test Results

Operating Frequency (MHz)	20dB Bandwidth(MHz)	Channel Separation
2402	0.951	1.00MHz
2441	0.954	
2480	0.955	

The EUT had hopping channel carrier frequencies separated by the 20 dB bandwidth of the hopping channel.

6 Hopping Sequence

6.1 Requirement of the standard

According to FCC §15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudorandomly ordered list of hopping frequencies.

6.2 Test Results

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master. For details refer to the Bluetooth standard.

7 Equal Hopping Frequency Use

7.1 Requirement of the standard

According to FCC §15.247(a)(1), Each frequency must be used equally on the average by each transmitter.

7.2 Test Results

The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth Standard

8 Receiver Input Bandwidth and Hopping Capability

8.1 Requirement of the standard

According to FCC §15.247(a)(1), 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

8.2 Test Results

The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.

9 Time of Occupancy (Dwell Time)

9.1 Requirement of the Standard

According to FCC §15.247(a)(1)(iii), Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping 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 which use fewer than 75 hopping frequencies may employ intelligent hopping techniques to avoid interference to other transmissions. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 non-overlapping channels are used.

9.2 Test Procedure

- The EUT temporary antenna port was coupled to the spectrum analyzer. The loss of the cables the test system is calibrated to correct the reading.
- The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- The resolution bandwidth of the spectrum analyzer was comparable to the EUT emission bandwidth. RBW=1 MHz, VBW=3 MHz.

9.3 Test Setup

Same as 5.3

9.4 EUT Setup and Operating Conditions

Refer to 5.4. The Bluetooth module was operating at maximum power output and hopping-on mode.

9.5 Test Results

Number of hopping channels is 79.

A channel was used 109 times within $0.4 \times 79 = 31.6$ S.

Dwell time of each occupation in this channel is 2.93mS.

$2.94\text{mS} \times 109 = 0.320 \text{ S} < 0.4 \text{ S}$

10 Peak Output Power

10.1 Requirement of the standard

According to FCC §15.247(b)(1), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band, the maximum peak output power of the intentional radiator shall not exceed 1 Watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts.

10.2 Test Procedure

- The EUT was coupled to the spectrum analyzer and the base station simulator through a power divider. The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.
- The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- The resolution bandwidth of the spectrum analyzer was comparable to the EUT emission bandwidth. RBW=1 MHz, VBW=3 MHz.

10.3 Test Setup

Same as 5.3

10.4 EUT Setup and Operating Conditions

Same as 5.4

10.5 Test Results

Operating Frequency (MHz)	Peak Output Power		Limit (W)
	(dBm)	(W)	
2402	-1.5	0.7×10^{-3}	1
2441	-0.1	1.0×10^{-3}	1
2480	0.6	1.2×10^{-3}	1

11 Band Edge

11.1 Requirement of the standard

According to FCC §15.247(c), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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).

11.2 Test Procedure

- a. The EUT was coupled to the spectrum analyzer and the base station simulator through a power divider. The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.
- b. The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- c. According to the standard requirement, the resolution bandwidth of the spectrum analyzer was set to RBW=100 kHz, VBW=300 kHz.

11.3 Test Setup

Same as 5.3

11.4 EUT Setup and Operating Conditions

Same as 5.4. Tests were also repeated in hopping mode.

11.5 Test Results

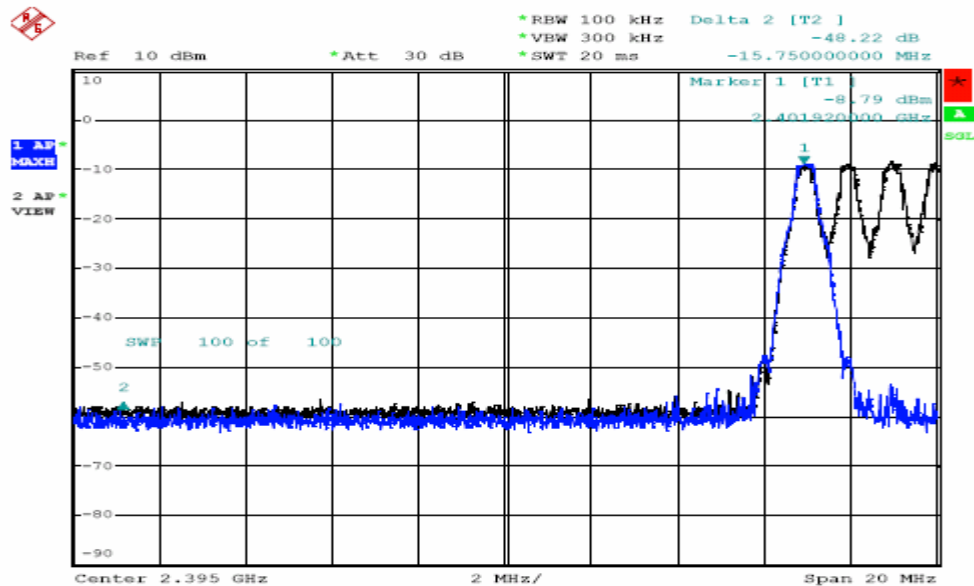
The radio frequency power beyond the band edges was 20dB below the peak output power, measured with 100 kHz resolution bandwidth. Refer to the following test plots.

Field strength of band edge emission falling in adjacent restricted bands (2310MHz-2390MHz and 2483.5MHz-2500MHz) per section 15.205(a) was calculated according to Marker-Delta Method DA 00-705. Refer to chapter 4.5 for step 1 in-band field strength measurement. The following test plots gave the “Delta Marker” of maximum band edge emissions falling in restricted bands relevant to the fundamental emissions. Calculation results in the following table shows compliance with the radiated emission limits specified in Section 15.209(a).

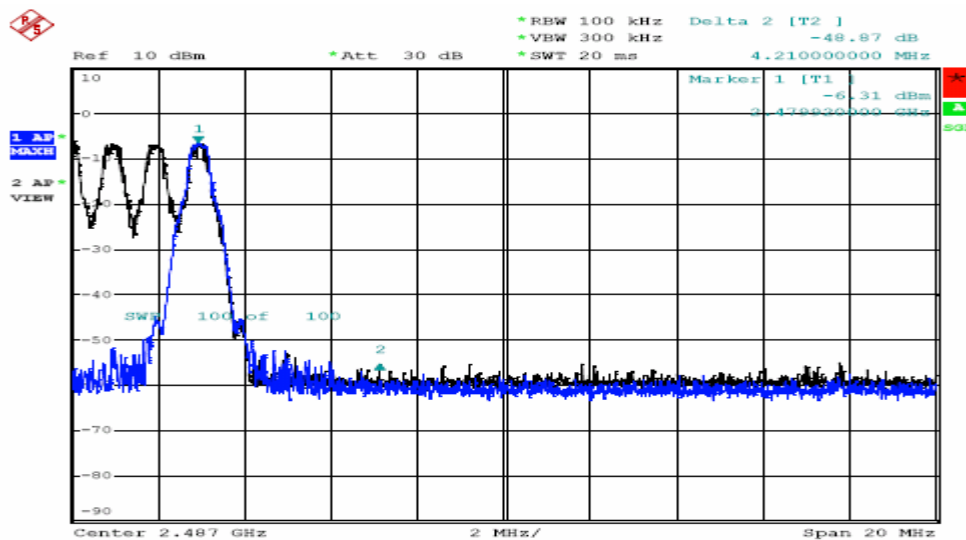
Fundamental Emission			Freq. of Max. Band Edges Emission (MHz)	Freq. of Max. Band Edges Emission (MHz)	Calculated Max. Band Edges Emission Level (dB μ V/m)	Limit (dB μ V/m)
Freq.	Field Strength (dB μ V/m)	Detector				
2402.00	90.98	PK	2386.17	48.22	42.76	74
2402.00	77.23	AV	2386.17	48.22	29.01	54
2480.00	89.80	PK	2484.13	48.87	40.93	74
2480.00	76.19	AV	2484.13	48.87	27.32	54

Band Edge Test Plots

1. Lowest channel, 2402MHz



2. Highest channel, 2480MHz



12 Conducted Spurious Emission

12.1 Requirement of the standard

According to FCC §15.247(c), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement..

12.2 Test Procedure

- a. The EUT was coupled to the spectrum analyzer and the base station simulator through a power divider. The radio frequency load attached to the EUT antenna terminal was 50 Ohm. The loss of the cables the test system is calibrated to correct the reading.
- b. The spectrum analyzer was set to Maxpeak Detector function and Maximum Hold mode.
- c. The spurious Emissions from 9 KHz to 10th harmonic of the fundamental frequency were researched.
- d. According to the standard requirement, the resolution bandwidth of the spectrum analyzer was set to RBW=100 kHz, VBW=300 kHz.

12.3 Test Setup

Same as 5.3

12.4 EUT Setup and Operating Conditions

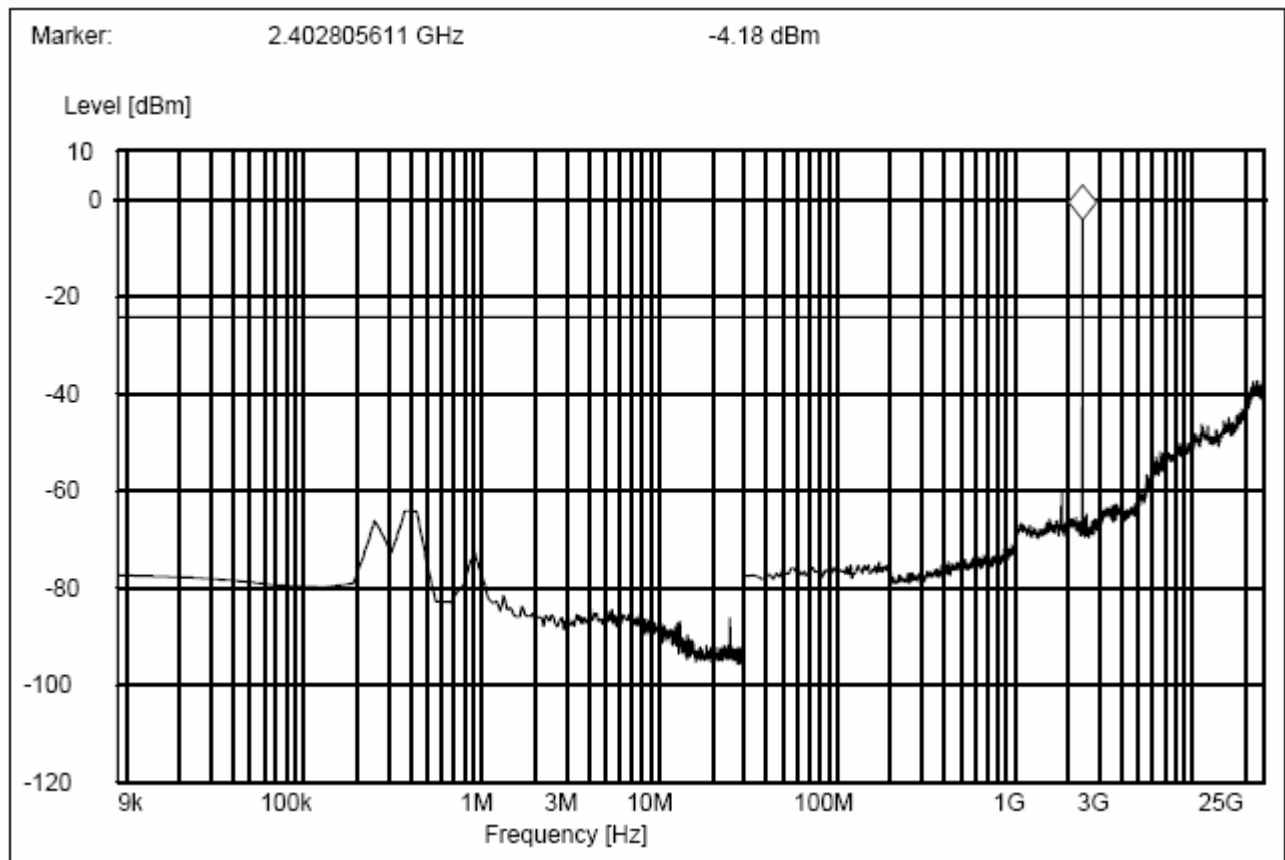
Same as 5.4

12.5 Test Results

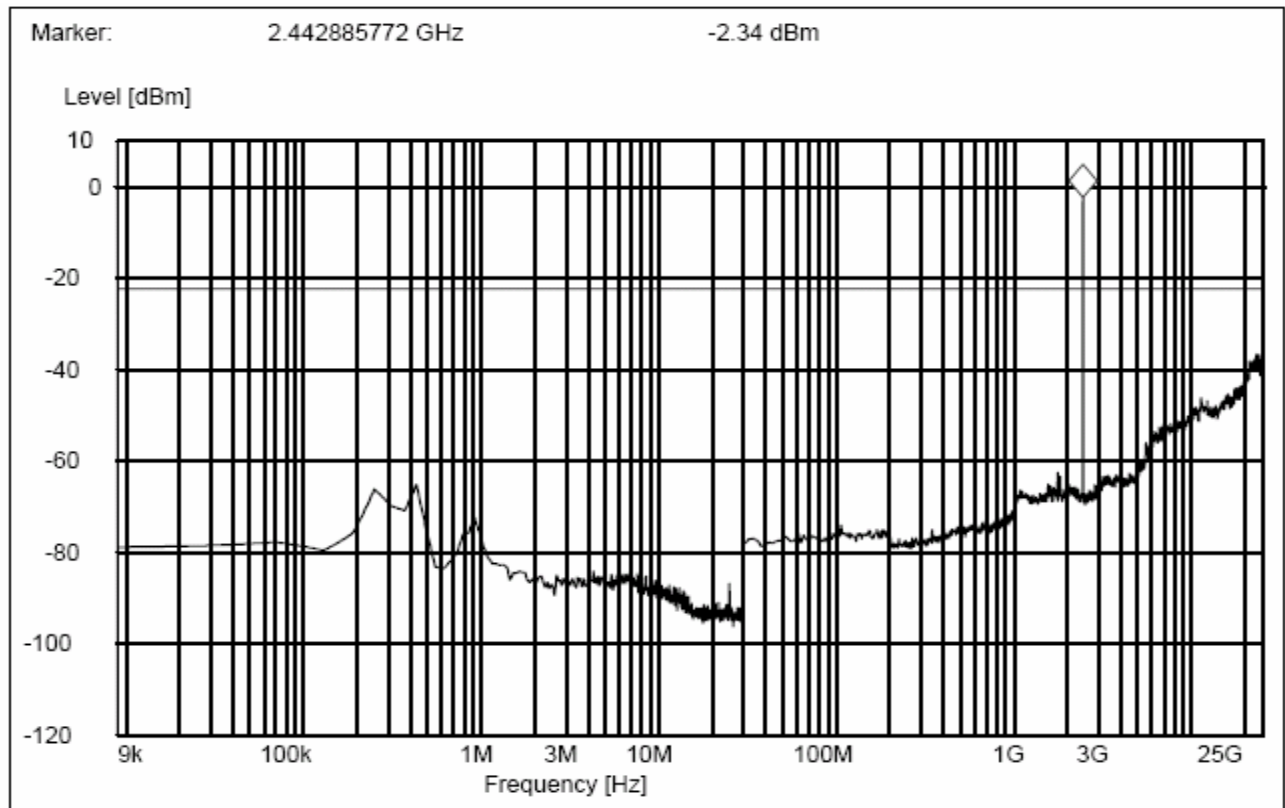
The following test plots shows that spurious emissions in the whole frequency range were below the 20dBc limit line.

Conducted Spurious Emission Test Plots

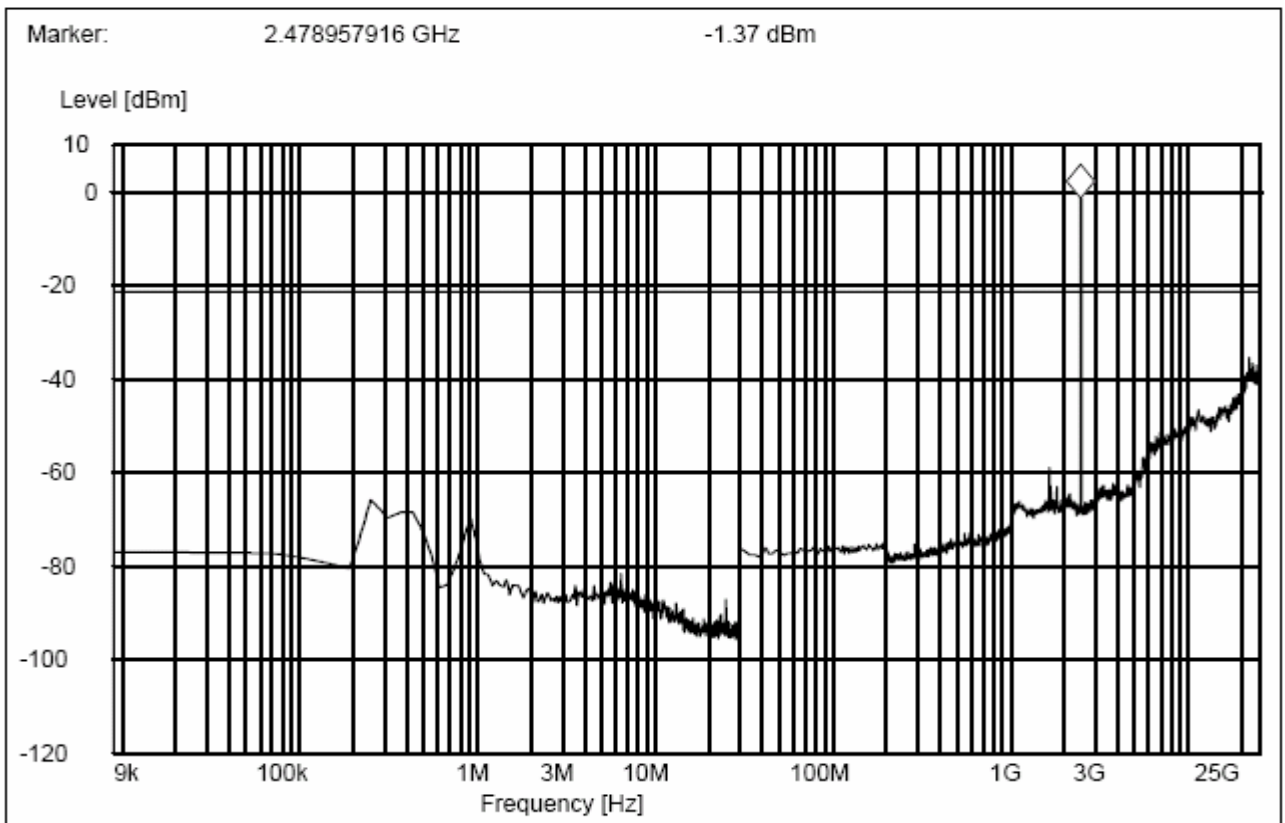
1. Lowest channel, 2402MHz



2. Middle channel, 2441MHz



3. Highest channel, 2480MHz



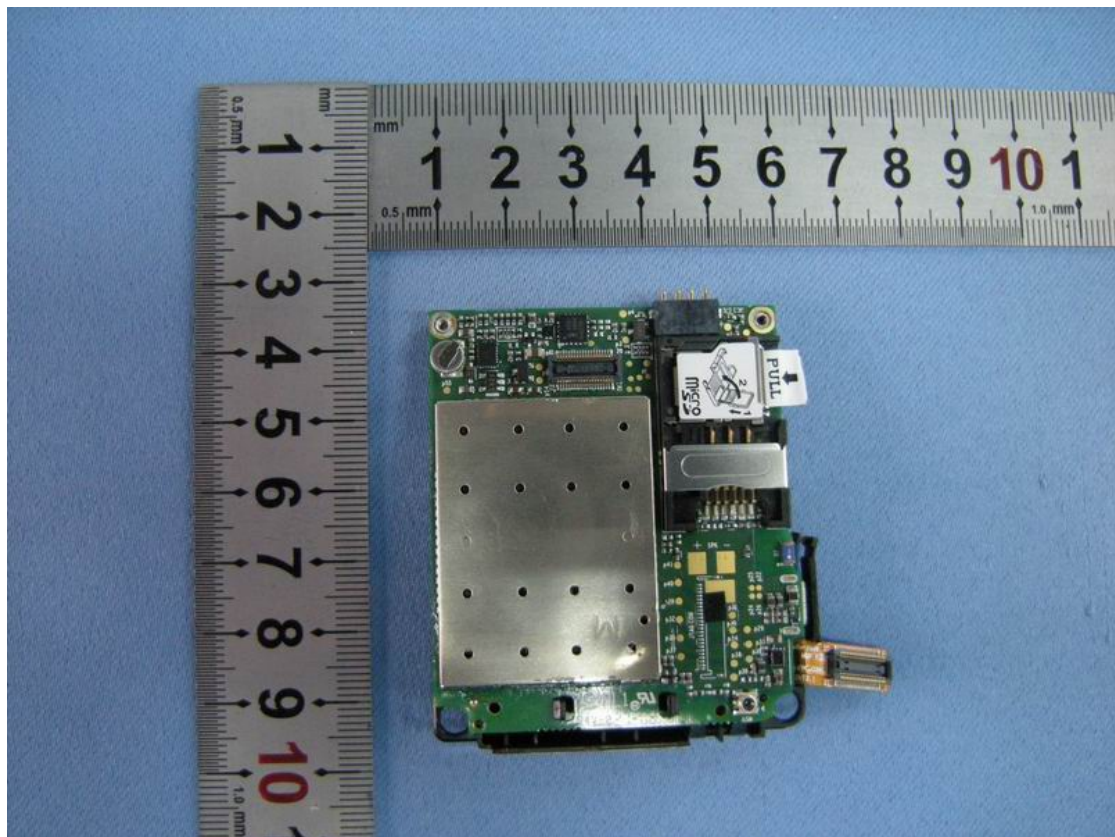
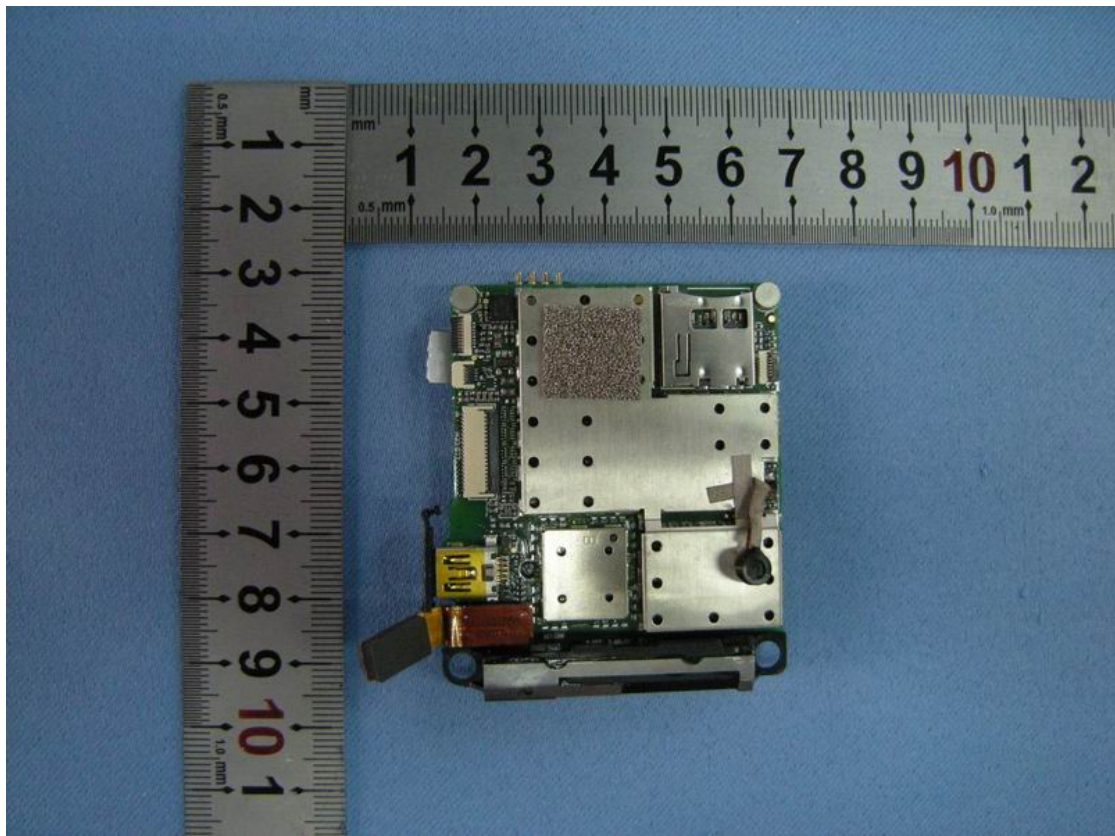
Appendix I: Photographs of the EUT











Appendix II: Photographs of Test Configuration

