



SPORTON International Inc.

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FCC RADIO TEST REPORT

Applicant's company	SYMBOL Technologies, INC.
Applicant Address	One Symbol Plaza Holtsville, New York, 11742-1300 U.S.A
FCC ID	H9PWT4070
Manufacturer's company	Universal Scientific Industrial CO., LTD.
Manufacturer Address	141, Lane 351, Taiping Road, Sec. 1, Tsao Tuen, Nan-Tou, Taiwan

Product Name	Mobile computer
Brand Name	Symbol
Model Name	WT4070
Test Rule	47 CFR FCC Part 15 Subpart C § 15.247
Test Freq. Range	2402 ~ 2480MHz for Bluetooth 2412 ~ 2462 for WLAN
Received Date	Jul. 24, 2006
Final Test Date	Aug. 4, 2006
Submission Type	Original Equipment



Statement

The collocation effect of Bluetooth and WLAN are evaluated in this test report.

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.4-2003** and **47 CFR FCC Part 15 Subpart C**.

The test equipment used to perform the test is calibrated and traceable to NML/ROC.

NVLAQ®

Lab Code: 200079-0

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History of This Test Report

Original Issue Date: Aug. 4, 2006

Report No.: FR672115-AF

☒ No additional attachment.

☐ Additional attachment were issued as following record:

Attachment No.	Issue Date	Description

1. CERTIFICATE OF COMPLIANCE

Product Name : Mobile computer
Brand Name : Symbol
Model Name : WT4070
Applicant : SYMBOL Technologies, INC.
Test Rule Part(s) : 47 CFR FCC Part 15 Subpart C § 15.247

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on Jul. 24, 2006 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.



Prepared By:

Tina Jao / Specialist



Tested By:

Carl Lee / Engineer



Reviewed By:

Roger Sheng / Manager

2. SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart C				
Part	Rule Section	Description of Test	Result	Under Limit
4.7	15.247(d)	Band Edge Emissions	Complies	3.65 dB

Test Items	Uncertainty	Remark
Radiated Emissions / Band Edge Emissions	$\pm 3.72\text{dB}$	Confidence levels of 95%

3. GENERAL INFORMATION

3.1. Product Details

EUT is a Mobile computer with IEEE 802.11b/g, Bluetooth radio functions. Only the radio detail of Bluetooth and IEEE 802.11b/g is shown in the table below. For more detailed features description, please refer to the manufacturer's specifications or user's manual.

The radio detail of Bluetooth is shown in the table below:

Items	Description
Power Type	12V DC from adapter; 3.7V DC from battery
Modulation	FHSS (GFSK)
Data Rate (Mbps)	1
Frequency Range	2402 ~ 2480MHz
Channel Number	79
Channel Band Width (99%)	856 kHz
Conducted Output Power	3.18 dBm

The radio detail of WLAN is shown in the table below:

Items	Description
Power Type	12V DC from adapter; 3.7V DC from battery
Modulation	DSSS for IEEE 802.11b ; OFDM for IEEE 802.11g
Data Modulation	DSSS (BPSK / QPSK / CCK) ; OFDM (BPSK / QPSK / 16QAM / 64QAM)
Data Rate (Mbps)	DSSS (1/ 2/ 5.5/11) ; OFDM (6/9/12/18/24/36/48/54)
Frequency Range	2412 ~ 2462MHz
Channel Number	11
Channel Band Width (99%)	11b: 15.32 MHz ; 11g: 16.32 MHz
Conducted Output Power	11b: 18.10 dBm ; 11g: 17.30 dBm

3.2. Accessories

Power	Brand	Model	Rating
Adapter	HIPRO	HP-O2040D43	INPUT: 100 ~ 240V AC OUTPUT: 12V DC
Battery	Symbol	-	3.7V DC
Others			
Cradle, scanner RS-409, scanner RS-309, Headset (MIC + Earphone)			

3.3. Table for Filed Antenna

Ant.	Antenna Type	Connector	Gain (dBi)	Remark
1	Chip Antenna	NA	2.70	Bluetooth
2	PIFA Antenna	UFL	-1.11	WLAN

3.4. Table for Carrier Frequencies

Frequency Band	Channel No.		Frequency	
2400 ~ 2483.5MHz Bluetooth	0		2402 MHz	
	1		2403 MHz	
	:		:	
	38		2440 MHz	
	39		2441 MHz	
	40		2442 MHz	
	:		:	
	77		2479 MHz	
	78		2480 MHz	
Frequency Band	Channel No.	Frequency	Channel No.	Frequency
2400 ~ 2483.5MHz IEEE 802.11b/g	1	2412 MHz	7	2442 MHz
	2	2417 MHz	8	2447 MHz
	3	2422 MHz	9	2452 MHz
	4	2427 MHz	10	2457 MHz
	5	2432 MHz	11	2462 MHz
	6	2437 MHz		

3.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel	Antenna
Band Edge Emissions	11b/CCK;	11 Mbps(11b)	1(11b)	1&2
	Bluetooth/GFSK	1 Mbps(Bluetooth)	0(Bluetooth)	
	11g/BPSK;	6 Mbps(11g)	11(11g)	1&2
	Bluetooth/GFSK	1 Mbps(Bluetooth)	78(Bluetooth)	

Band Edge Emissions test mode is Bluetooth+WLAN mode

During radiated and band edge emissions test, WLAN was turned on to evaluated the collocation effect.

3.6. Table for Testing Locations

Test Site No.	Site Category	Location	FCC Reg. No.	IC File No.	VCCI Reg. No
03CH03-HY	SAC	Hwa Ya	101377	IC 4088	-
CO04-HY	Conduction	Hwa Ya	101377	IC 4088	-
TH01-HY	OVEN Room	Hwa Ya	-	-	-

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC); Fully Anechoic Chamber (FAC).

Please refer section 6 for Test Site Address.

3.7. Table for Supporting Units

Support Unit	Brand	Model	FCC ID
Bar code	-	-	Provide by Customer
Headset (MIC + Earphone)	-	-	
AP (Remote workstation)	VSI	AP-B-AG-01	
PDA (Remote workstation)	SYMBOL	MC3090BT	
Scanner RS-309 with long cable	-	-	
Scanner RS-309 with short cable	-	-	
Scanner RS-409 with long cable	-	-	
Scanner RS-409 with short cable	-	-	
Notebook	DELL	D400	DoC
Mouse	Microsoft	1004	DoC
Modem	ACEEX	DM-1414	IFAXDM1414

3.8. Table for Parameters of Test Software Setting

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

Power Parameters of Bluetooth

Test Software Version	Bluetest		
Frequency	2402 MHz	2441 MHz	2480 MHz
Power Parameters	7	7	7

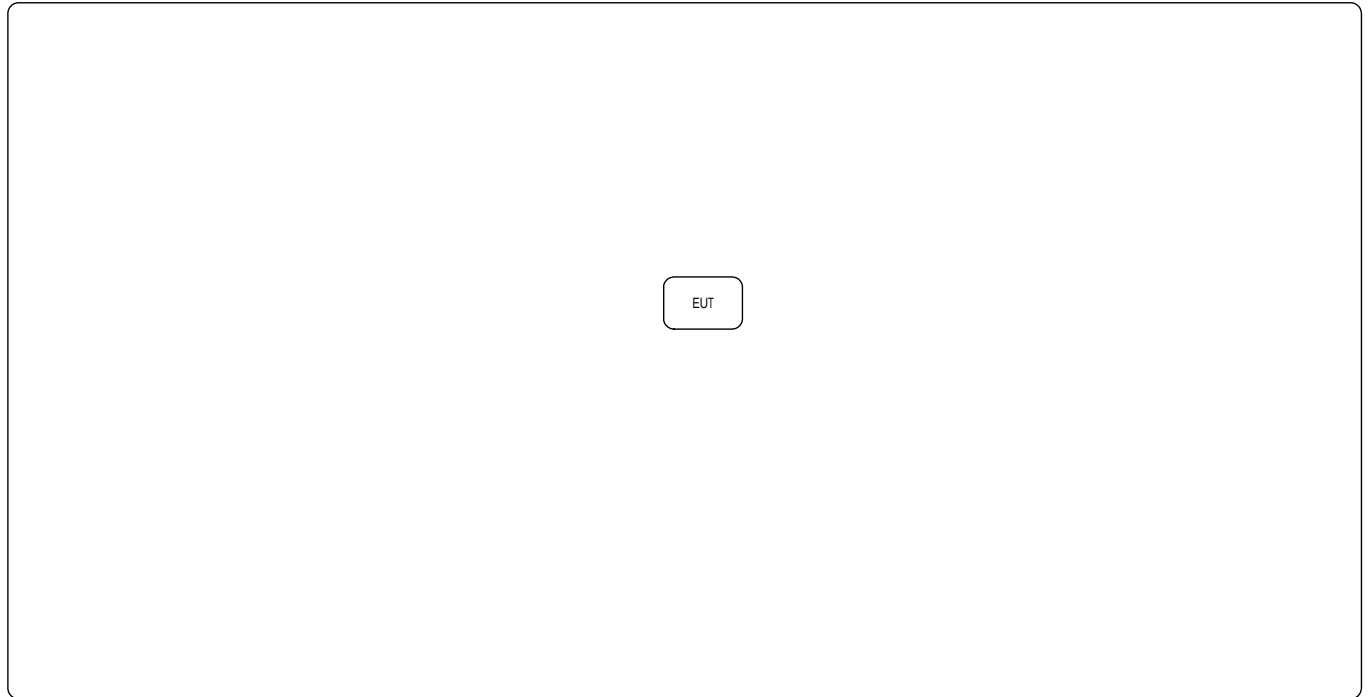
Power Parameters of IEEE 802.11b/g

Test Software Version	CECTXRX		
Frequency	2402 MHz	2441 MHz	2480 MHz
IEEE 802.11b	13	15.25	13
IEEE 802.11g	13	14.5	13

3.9. Test Configurations

3.9.1. Radiation Emissions Test Configuration

Above 1GHz



4. TEST RESULT

4.1. Band Edge Emissions Measurement

4.1.1. Limit

Frequencies (MHz)	Field Strength (microvolt/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

4.1.2. Measuring Instruments and Setting

Please refer to section 5 in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	100 KHz /100 KHz for Peak

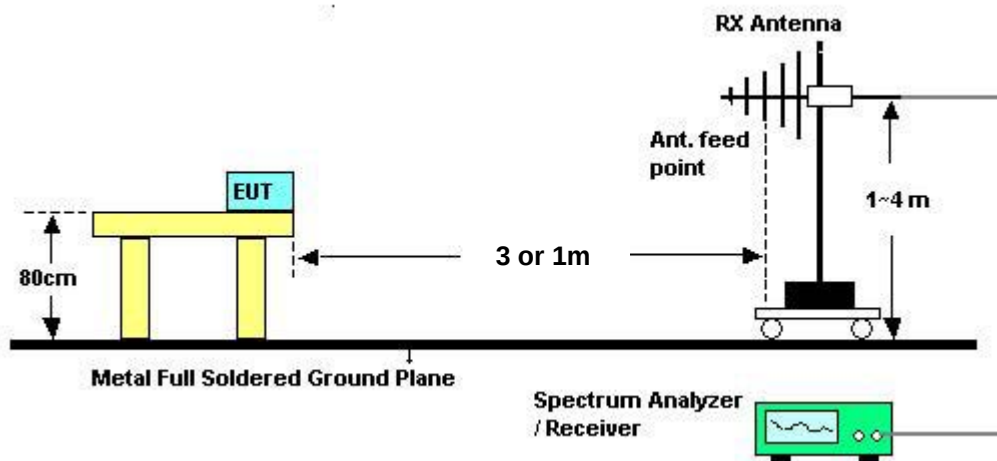
4.1.3. Test Procedures

1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging

over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.
11. In case the emission is fail due to the used RB/VB is too wide, marker-delta method of FCC Public Notice DA00-705 will be followed.

4.1.4. Test Setup Layout



4.1.5. Test Deviation

There is no deviation with the original standard.

4.1.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.1.7. Test Result of Band Edge and Fundamental Emissions

Temperature	29	Humidity	62%
Test Engineer	Vic Hsiao	Configurations	802.11b: CH 1, 11 Bluetooth: CH 0, 78

Channel 1

	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamplifier Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	2390.000	58.05	-15.95	74.00	27.87	28.29	1.88	0.00	Peak
2 #	2401.770	96.80				28.29	1.88	0.00	Peak
3 #	2413.170	102.31				28.33	1.88	0.00	Peak
1	2390.000	43.77	-10.23	54.00	13.59	28.29	1.88	0.00	Average
2 #	2402.340	88.42				28.29	1.88	0.00	Average
3 @	2412.410	93.83				28.33	1.88	0.00	Average

Item 1 is Band Edge.

Channel 11

	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamplifier Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1 #	2463.330	102.86				28.43	1.94	0.00	Peak
2 #	2480.050	95.74				28.47	1.94	0.00	Peak
3	2483.500	60.46	-13.54	74.00	30.06	28.47	1.94	0.00	Peak
1 @	2462.570	94.65				28.43	1.94	0.00	Average
2 #	2480.050	87.36				28.47	1.94	0.00	Average
3	2483.500	50.35	-3.65	54.00	19.95	28.47	1.94	0.00	Average

Item 3 is Band Edge.

Temperature	29	Humidity	62%
Test Engineer	Vic Hsiao	Configurations	802.11g: CH 1, 11 Bluetooth: CH 0, 78

Channel 1

	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1	2390.000	58.08	-15.92	74.00	27.90	28.29	1.88	0.00	Peak
2 #	2401.770	97.85				28.29	1.88	0.00	Peak
3 #	2413.930	100.53				28.33	1.88	0.00	Peak
1	2390.000	45.00	-9.00	54.00	14.82	28.29	1.88	0.00	Average
2 #	2402.530	89.47				28.33	1.88	0.00	Average
3 #	2413.930	90.67				28.33	1.88	0.00	Average

Item 1 is Band Edge.

Channel 11

	Freq	Level	Over Limit	Limit Line	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp Factor	Remark
	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	
1 #	2464.090	101.25				28.43	1.94	0.00	Peak
2 #	2480.050	94.27				28.47	1.94	0.00	Peak
3	2483.500	59.87	-14.13	74.00	29.47	28.47	1.94	0.00	Peak
1 @	2457.060	91.48				28.43	1.91	0.00	Average
2 #	2480.050	85.89				28.47	1.94	0.00	Average
3	2483.500	49.02	-4.98	54.00	18.62	28.47	1.94	0.00	Average

Item 3 is Band Edge.

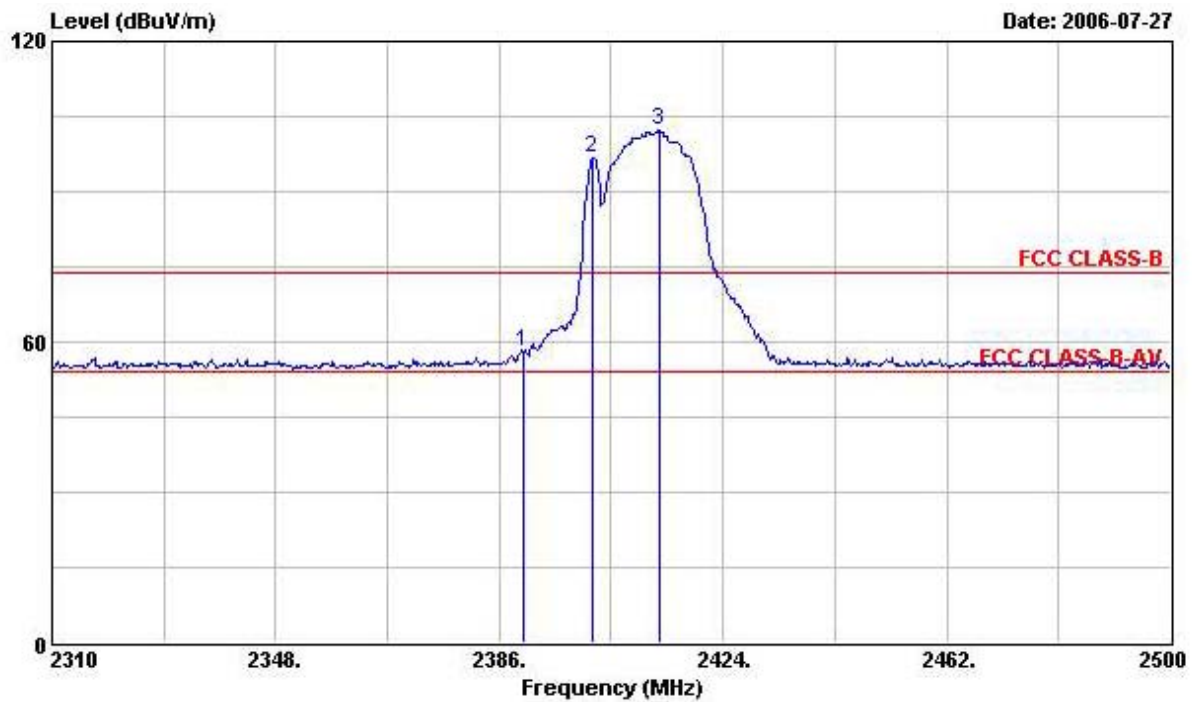
Note:

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

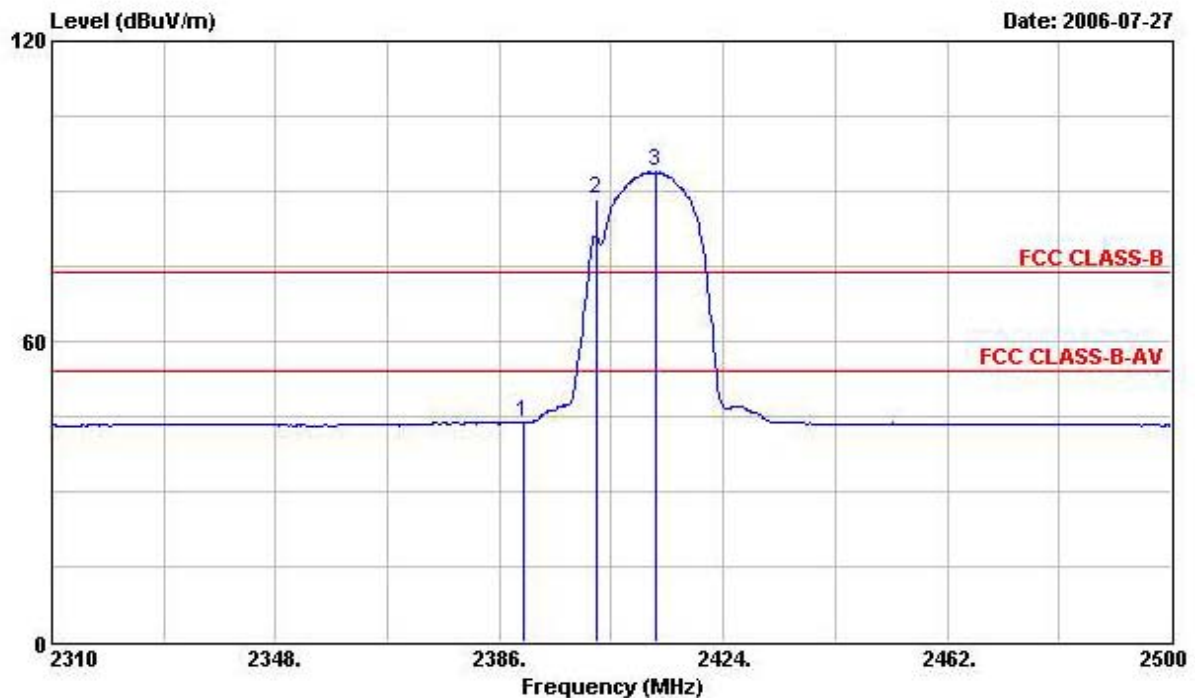
Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

For Band edge Emission, radiated Measurement

Low Band Edge Plot on Configuration IEEE 802.11b / 2412 MHz and Bluetooth / 2402 MHz (Peak reading)

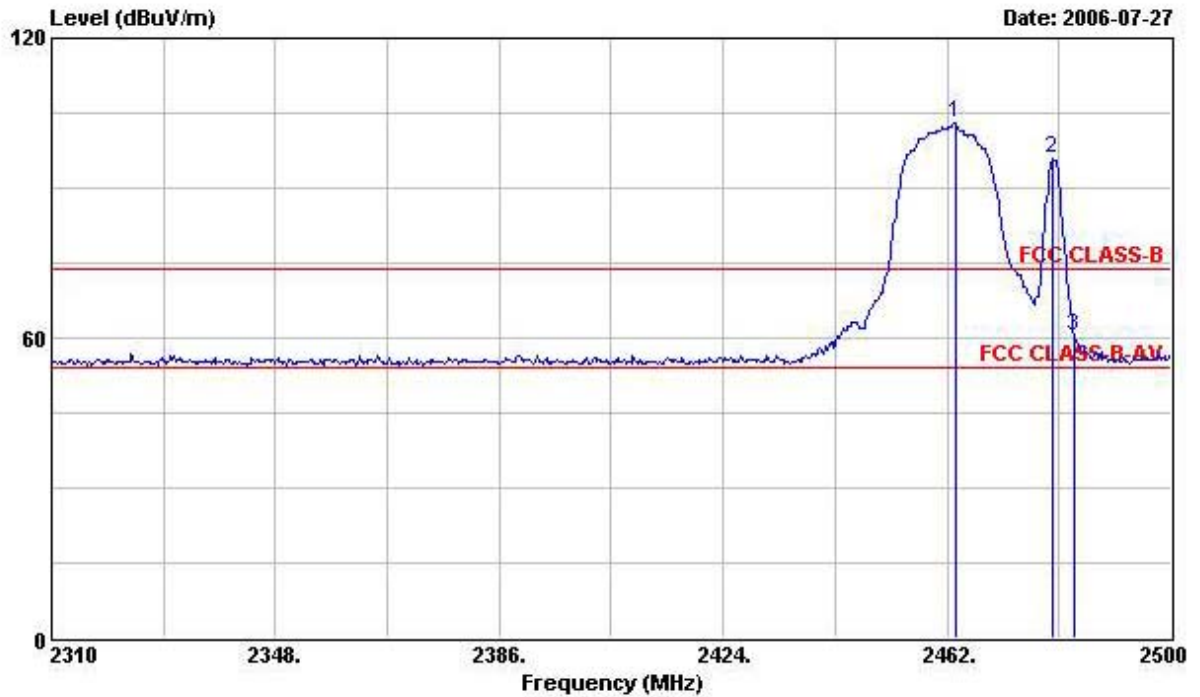


Low Band Edge Plot on Configuration IEEE 802.11b / 2412 MHz and Bluetooth / 2402 MHz (AVG reading)

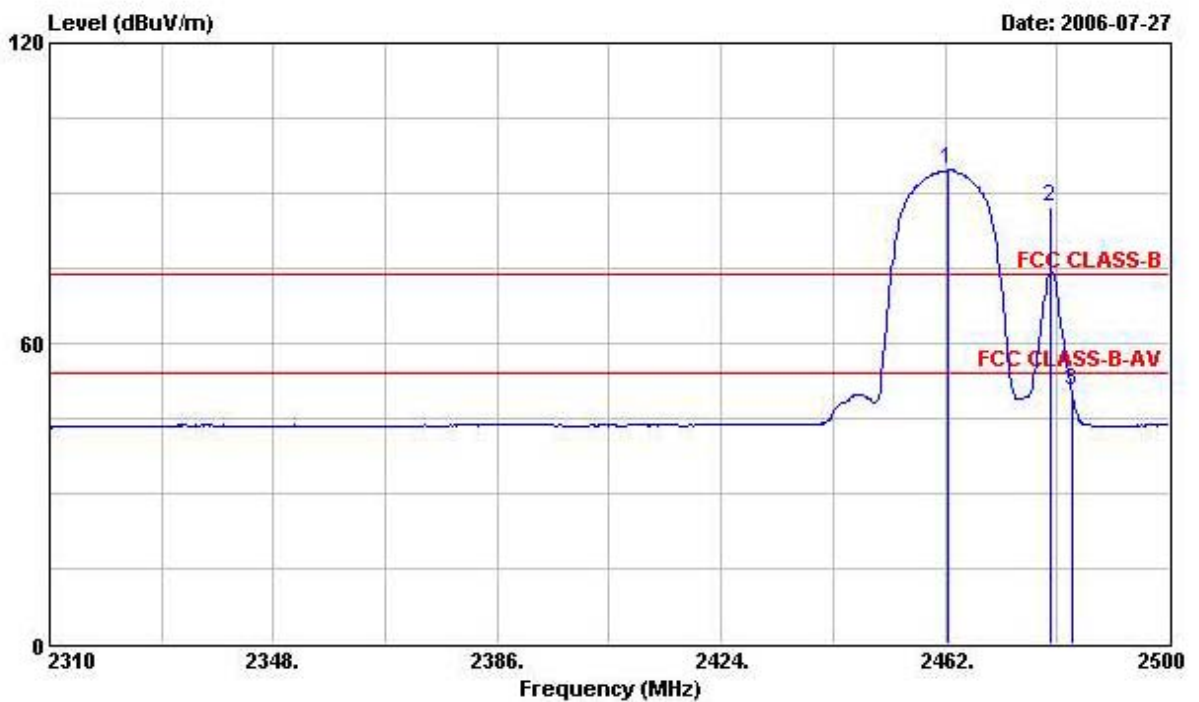


For Band edge Emission, radiated Measurement

High Band Edge Plot on Configuration IEEE 802.11b / 2462 MHz and Bluetooth / 2480 MHz (Peak reading)

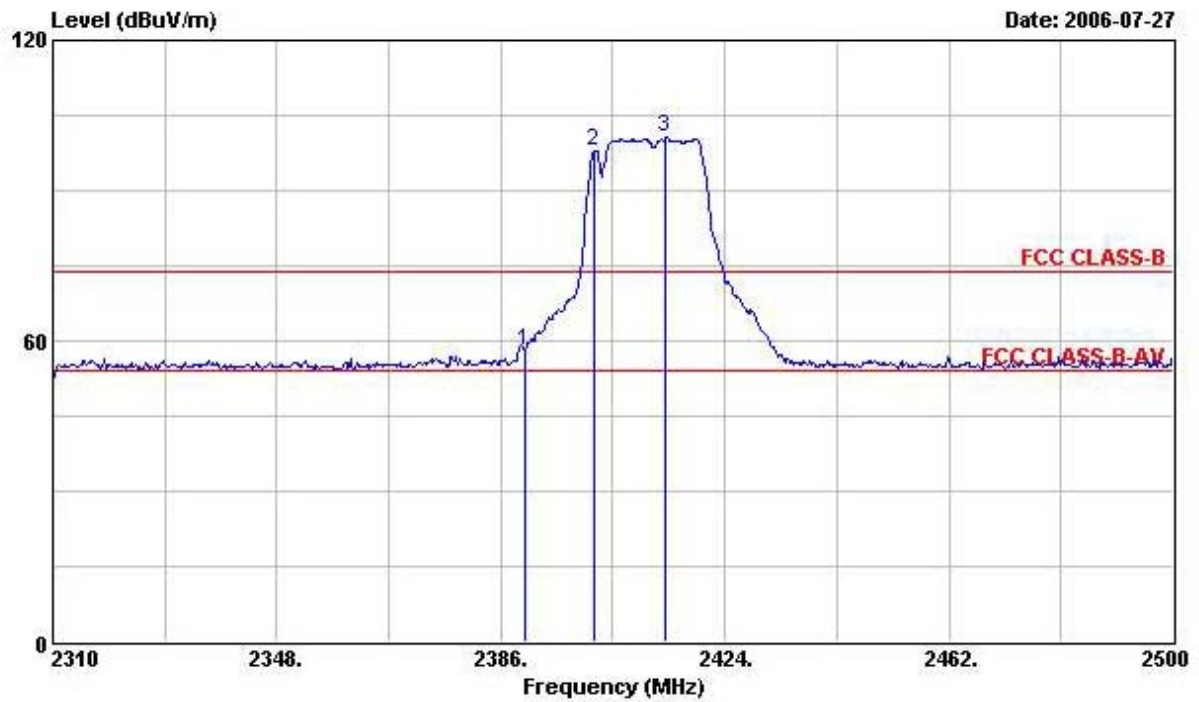


High Band Edge Plot on Configuration IEEE 802.11b / 2462 MHz and Bluetooth / 2480 MHz (AVG reading)

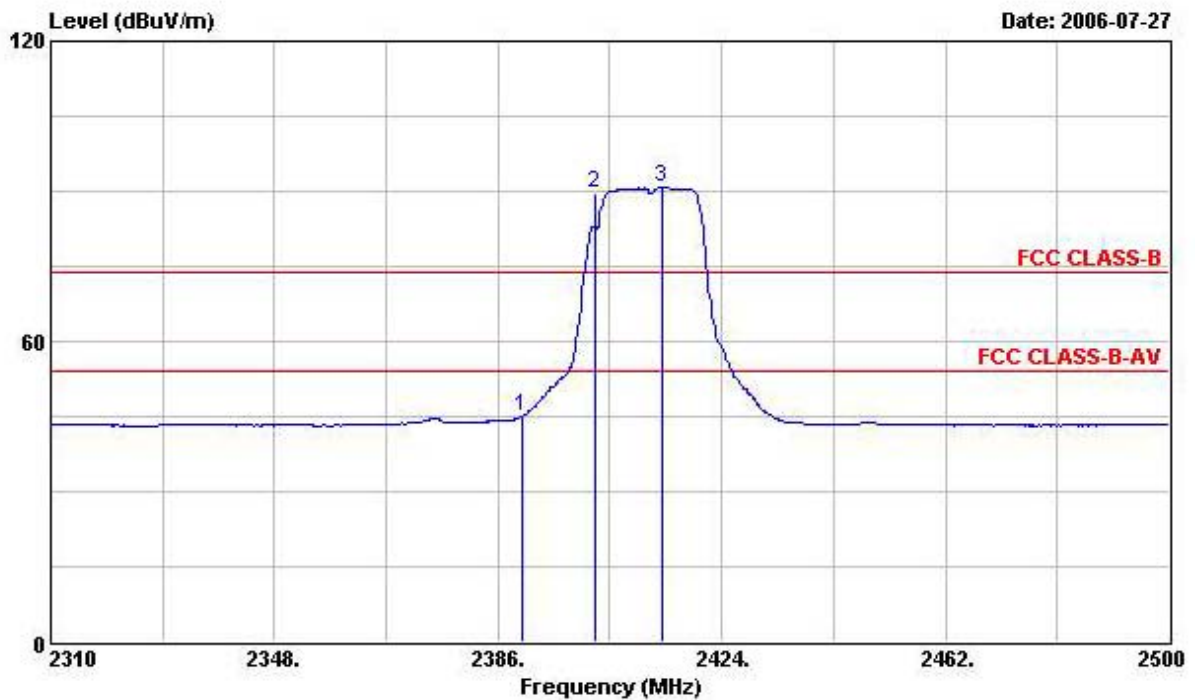


For Band edge Emission, radiated Measurement

Low Band Edge Plot on Configuration IEEE 802.11g / 2412 MHz and Bluetooth / 2402 MHz (Peak reading)

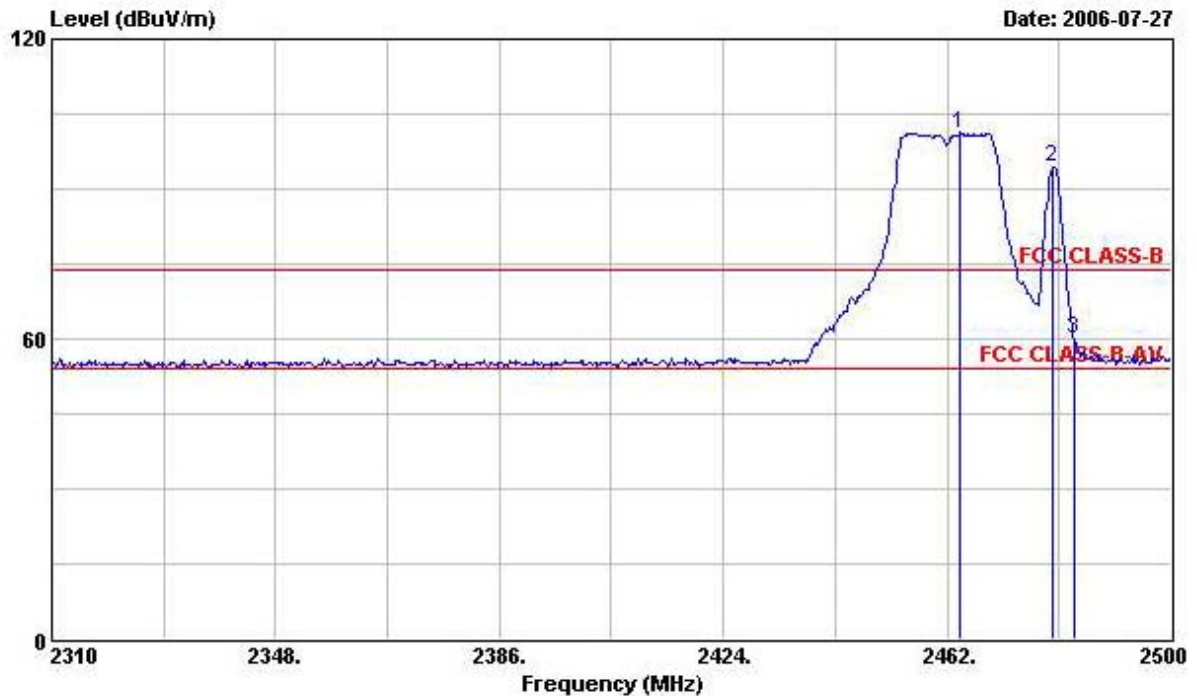


Low Band Edge Plot on Configuration IEEE 802.11g / 2412 MHz and Bluetooth / 2402 MHz (AVG reading)

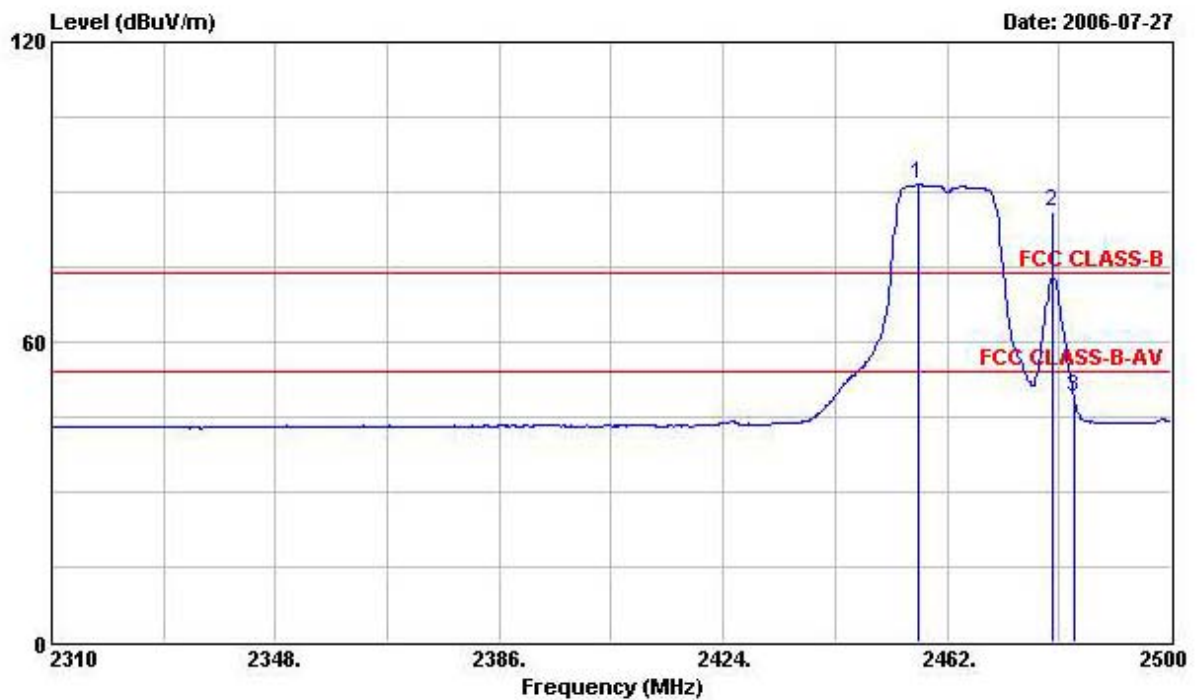


For Band edge Emission, radiated Measurement

High Band Edge Plot on Configuration IEEE 802.11g / 2462 MHz and Bluetooth / 2480 MHz (Peak reading)



High Band Edge Plot on Configuration IEEE 802.11g / 2462 MHz and Bluetooth / 2480 MHz (AVG reading)



5. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMC Receiver	R&S	ESCS 30	100174	9kHz – 2.75GHz	Feb. 22, 2006	Conduction (CO04-HY)
LISN	MessTec	NNB-2/16Z	99079	9kHz – 30MHz	Dec. 19, 2005	Conduction (CO04-HY)
LISN (Support Unit)	EMCO	3810/2NM	9708-1839	9kHz – 30MHz	Mar. 18, 2006	Conduction (CO04-HY)
RF Cable-CON	UTIFLEX	3102-26886-4	CB049	9kHz – 30MHz	Apr. 20, 2006	Conduction (CO04-HY)
EMI Filter	LINDGREN	LRE-2030	2651	< 450 Hz	N/A	Conduction (CO04-HY)
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30 MHz - 1 GHz 3m	Jun. 15, 2006	Radiation (03CH03-HY)
Amplifier	SCHAFFNER	CPA9231A	3565	9 kHz - 2 GHz	Jan. 18, 2006	Radiation (03CH03-HY)
Amplifier	Agilent	8449B	3008A02120	1 GHz - 26.5 GHz	May 29, 2006	Radiation (03CH03-HY)
Spectrum Analyzer	R&S	FSP40	100004/040	9 kHz - 40 GHz	Sep. 30, 2005	Radiation (03CH03-HY)
Bilog Antenna	SCHAFFNER	CBL 6112D	22237	30 MHz – 1 GHz	Jul. 24, 2006	Radiation (03CH03-HY)
Horn Antenna	EMCO	3115	6903	1GHz ~ 18GHz	Mar. 15, 2006	Radiation (03CH03-HY)
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA9170154	15 GHz - 40 GHz	NCR	Radiation (03CH03-HY)
RF Cable-R03m	Jye Bao	RG142	CB021	30 MHz - 1 GHz	Dec.02, 2005	Radiation (03CH03-HY)
RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	1 GHz - 40 GHz	Dec.02, 2005	Radiation (03CH03-HY)
Turn Table	HD	DS 420	420/650/00	0 – 360 degree	N/A	Radiation (03CH03-HY)
Antenna Mast	HD	MA 240	240/560/00	1 m - 4 m	N/A	Radiation (03CH03-HY)
Spectrum Analyzer	R&S	FSP30	100023	9kHz ~ 30GHz	Nov. 26, 2005	Conducted (TH01-HY)
Power Meter	R&S	NRVS	100764	DC ~ 40GHz	Jul. 20, 2006	Conducted (TH01-HY)
Power Sensor	R&S	NRV-Z51	100666	DC ~ 40GHz	Jul. 19, 2006	Conducted (TH01-HY)
Power Sensor	R&S	NRV-Z32	100057	30MHz ~ 6GHz	Jun. 10, 2006	Conducted (TH01-HY)
DC Power Source	G.W.	GPC-6030D	C671845	DC 1V ~ 60V	Dec. 28, 2005	Conducted (TH01-HY)
Temp. and Humidity Chamber	KSON	THS-C3L	612	N/A	Oct. 01, 2005	Conducted (TH01-HY)
RF CABLE-1m	Jye Bao	RG142	CB034-1m	20MHz ~ 7GHz	Dec. 30, 2005	Conducted (TH01-HY)
RF CABLE-2m	Jye Bao	RG142	CB035-2m	20MHz ~ 1GHz	Dec. 30, 2005	Conducted (TH01-HY)
Oscilloscope	Tektronix	TDS1012	CO38515	100MHz / 1GS/s	Jun. 20, 2006	Conducted (TH01-HY)
Signal Generator	R&S	SMR40	100116	10MHz ~ 40GHz	Dec. 30, 2005	Conducted (TH01-HY)
Data Generator	Tektronix	DG2030	063-2920-50	0.1Hz~400MHz	Jun. 16, 2006	Conducted (TH01-HY)

Note: Calibration Interval of instruments listed above is one year. NCR: Non-Calibration required.

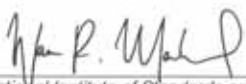
Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Amplifier	MITEQ	AMF-6F-260400	923364	26.5 GHz - 40 GHz	Jan. 24, 2006*	Radiation (03CH03-HY)
Loop Antenna	R&S	HFH2-Z2	860004/001	9 kHz - 30 MHz	May 23, 2006*	Radiation (03CH03-HY)
AC Power Source	HPC	HPA-500W	HPA-9100024	AC 0 ~ 300V	Apr. 21, 2005*	Conducted (TH01-HY)

Note: Calibration Interval of instruments listed above is two year.

6. TEST LOCATION

SHIJR	ADD : 6Fl., No. 106, Sec. 1, Shintai 5th Rd., Shijr City, Taipei, Taiwan 221, R.O.C. TEL : 886-2-2696-2468 FAX : 886-2-2696-2255
HWA YA	ADD : No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL : 886-3-327-3456 FAX : 886-3-318-0055
LINKOU	ADD : No. 30-2, Dingfu Tsuen, Linkou Shiang, Taipei, Taiwan 244, R.O.C TEL : 886-2-2601-1640 FAX : 886-2-2601-1695
DUNGHU	ADD : No. 3, Lane 238, Kangle St., Neihu Chiu, Taipei, Taiwan 114, R.O.C. TEL : 886-2-2631-4739 FAX : 886-2-2631-9740
JUNGHE	ADD : 7Fl., No. 758, Jungjeng Rd., Junghe City, Taipei, Taiwan 235, R.O.C. TEL : 886-2-8227-2020 FAX : 886-2-8227-2626
NEIHU	ADD : 4Fl., No. 339, Hsin Hu 2 nd Rd., Taipei 114, Taiwan, R.O.C. TEL : 886-2-2794-8886 FAX : 886-2-2794-9777
JHUBEI	ADD : No.8, Lane 728, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C. TEL : 886-3-656-9065 FAX : 886-3-656-9085

7. NVLAP CERTIFICATE OF ACCREDITATION

United States Department of Commerce National Institute of Standards and Technology		
		
Certificate of Accreditation to ISO/IEC 17025:1999		
NVLAP LAB CODE: 200079-0		
Sporton International, Inc. Hwa Ya EMC Laboratory Tao Yuan Hsien 333 TAIWAN		
<i>is recognized by the National Voluntary Laboratory Accreditation Program for conformance with criteria set forth in NIST Handbook 150:2001 and all requirements of ISO/IEC 17025:1999. Accreditation is granted for specific services, listed on the Scope of Accreditation, for:</i>		
ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS		
2006-01-01 through 2006-12-31 <i>Effective dates</i>		 <i>For the National Institute of Standards and Technology</i>

NVLAP-01C (REV. 2005-05-19)