FCC PART 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

Actiontec Electronics, Inc.

760 N. Mary Ave.
Sunnyvale, CA 94086

FCC ID: LNQ802UI3B

December 9, 2002

This Report Concerns:	**Equipment Type:**
☒ Original Report	USB 802.11b Wireless LAN Adapter

Test Engineer:	Jeff Lee
Report No.:	R0211151
Test Date:	November 28, 2002
Reviewed By:	Hans Mellberg
Prepared By:	Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *Actiontec Electronics, Inc.'s*, model: *802UI3(B)*, or the "EUT" as referred to in this report is an USB 802.11b Wireless LAN Adapter which measures approximately 3.95"L x 2.0"W x 0.5"H. The EUT is designed to provide wireless LAN function on a small form factor with mini USB interface. The wireless LAN function is based on Interisl Prism3 chipset, which implements the full IEEE802.11b standard data rates up to 11 Mbps.

** The test data gathered is from typical production samples provided by the manufacturer.*

1.2 Objective

This type approval report is prepared on behalf of. *Actiontec Electronics, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules for Output Power, Antenna Requirements, 6 dB Bandwidth, power density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Spurious Radiated Emission.

1.3 Related Submittal(s)/Grant(s)

No Related Submittals.

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-1992, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz and FCC97114 for Direct Sequence SS.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.5 Test Facility

The Open Area Test site used by BACL to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-1992.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The scope of the accreditation covers the FCC Method – 47 CFR Part – Digital Devices, CISPER 22: 1997: Electromagnetic Interference – Limits and Methods of Measurement of Information Technology Equipment test methods.

1.6 Test Equipment List

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8568B	2610A02165	12/6/03
HP	Spectrum Analyzer	8593B	2919A00242	12/20/02
HP	Amplifier	8349B	2644A02662	12/20/02
HP	Quasi-Peak Adapter	85650A	917059	12/6/03
HP	Amplifier	8447E	1937A01046	12/6/03
A.H. System	Horn Antenna	SAS0200/571	261	12/27/02
Com-Power	Log Periodic Antenna	AL-100	16005	11/2/03
Com-Power	Biconical Antenna	AB-100	14012	11/2/03
Solar Electronics	LISN	8012-50-R-24-BNC	968447	12/28/02
Com-Power	LISN	LI-200	12208	12/20/02
Com-Power	LISN	LI-200	12005	12/20/02
BACL	Data Entry Software	DES1	0001	12/20/02

*** Statement of Traceability: Bay Area Compliance Laboratory Corp.** certifies that all calibration has been performed using suitable standards traceable to the NIST.

1.7 Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
IBM	Notebook PC	ThinkPad	11S02K68083BG 1BMKPE	NONE

1.8 Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
IBM	Notebook PC	ThinkPad	11S02K68083BG1B MKPE	NONE
Citizen	Printer	LSP-10	5047999-82	DLK66TLSP-10
EVEREX	Modem	EV-945	None	None

1.9 External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Shielded modem cable	1.8	Serial port/ Host	Everex modem
Shielded Printer Cable	2.0	Parallel Port/Host	Citizen Printer
Shielded USB cable	1.2	USB port/ Host	EUT

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The host system was configured for testing in a typical fashion (as normally used by a typical user).

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

2.2 EUT Exercise Software

The EUT exercise program used during radiated and conducted testing was designed to exercise the system components in a manner similar to a typical use. The test software, Prism Test Utility, provided by the customer, is started the Windows terminal program under the Windows 98/2000/ME/XP operating system.

Once loaded, the program sequentially exercises each system component, and the Prism Test Utility icon appears in the PC screen. Select the channel to be tested, select the 11 Mbps, and click the "Continuous TX" button for transmitting the RF power.

Repeat above steps for other channel to be tested.

2.3 Special Accessories

As shown in section 2.7, all interface cables used for compliance testing are shielded. The host pc and the peripherals featured shielded metal connectors.

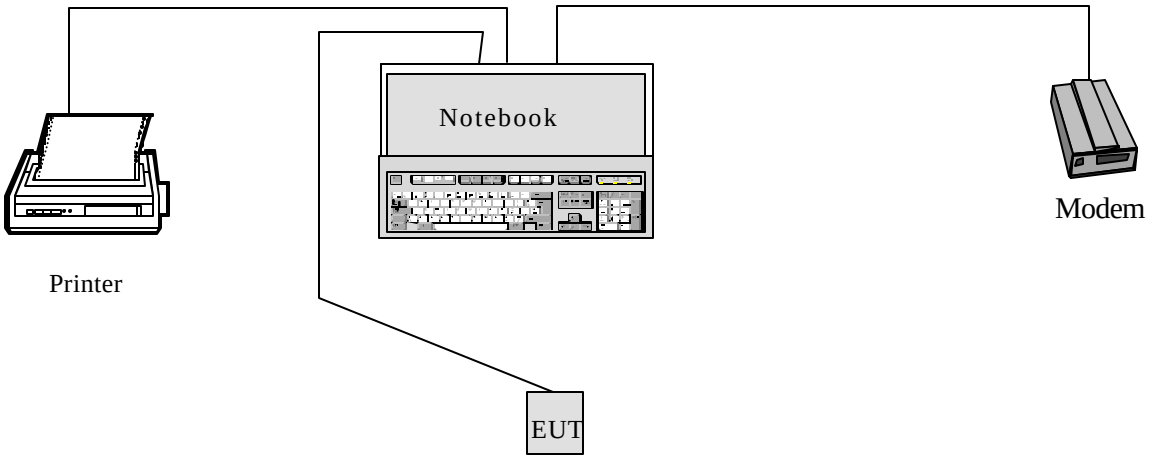
2.4 Schematics / Block Diagram

Please refer to Appendix A.

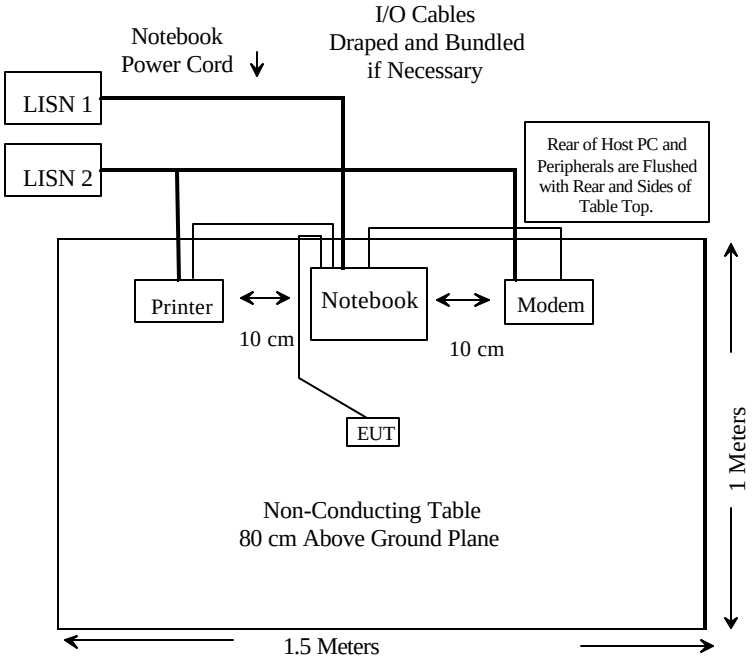
2.5 Equipment Modifications

No modifications were made by BACL to ensure the EUT to comply with the applicable limits and requirements.

2.6 Configuration of Test System



2.7 Test Setup Block Diagram



3 - SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT	REFERENCE
§15.203	Antenna Requirement	Compliant	Section 9
§ 15.205	Restricted Bands	Compliant	Section 10
§15.207 (a)	Conducted Emission	Compliant	Section 11
§15.209 (a)	Radiated Emission	Compliant	Section 10
§15.209 (f)	Spurious Emission	Compliant	Section 6
§15.247 (a) (2)	6 dB Bandwidth	Compliant	Section 5
§15.247 (b) (2)	Maximum Peak Output Power	Compliant	Section 4
§ 15.247 (c)	100 kHz Bandwidth of Frequency Band Edge	Compliant	Section 8
§15.247 (d)	Peak Power Spectral Density	Compliant	Section 7

4 - CONDUCTED OUTPUT POWER MEASUREMENT

4.1 Standard Applicable

According to §15.247(b) (1), for frequency hopping systems in the 2400-2483.5MHz band employing at least 75 hopping channels, and all direct sequence systems, the maximum peak output power of the transmitter shall not exceed 1 Watt.

4.2 Measurement Procedure

1. Place the EUT on the turntable and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Spectrum Analyzer.
3. The peak power will be obtained by adding the bandwidth correction factor, 10log(BW 6dB / RBW) to the peak power reading at RBW = 2.0 MHz of the spectrum analyzer.

4.3 Test Equipment

Manufacturer	Model No.	Serial No.	Calibration Due Date
HP	8568B	2610A02165	12/6/03

4.4 Measurement Result

Frequency (MHz)	Peak Output Power (dBm)	Output Power (mW)	Standard (W)	Result
2412	16.01	39.90	≤ 1W	Compliant
2437	16.17	41.40	≤ 1W	Compliant
2462	16.17	41.40	≤ 1W	Compliant

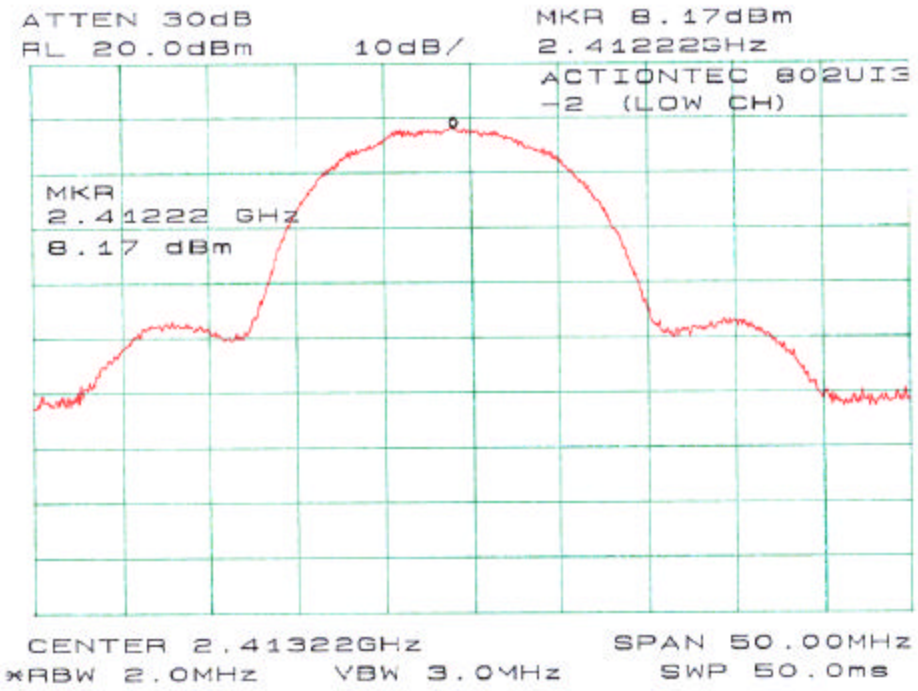
Factor = 10 log (BW6dB/RBW) = 10 log (12.17/2) = 7.84

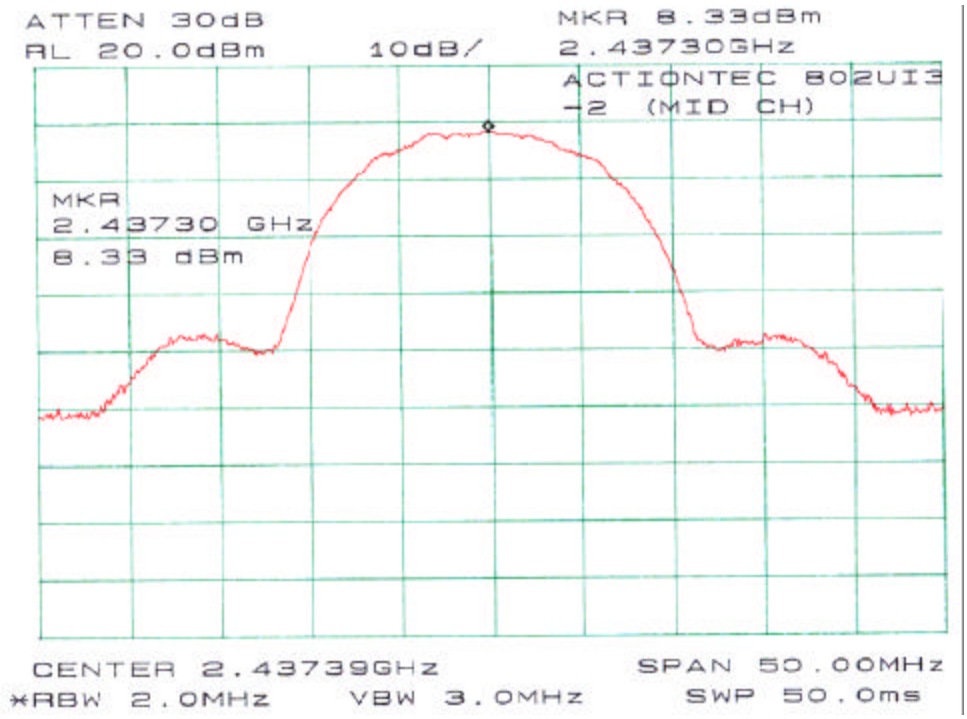
Peak output power

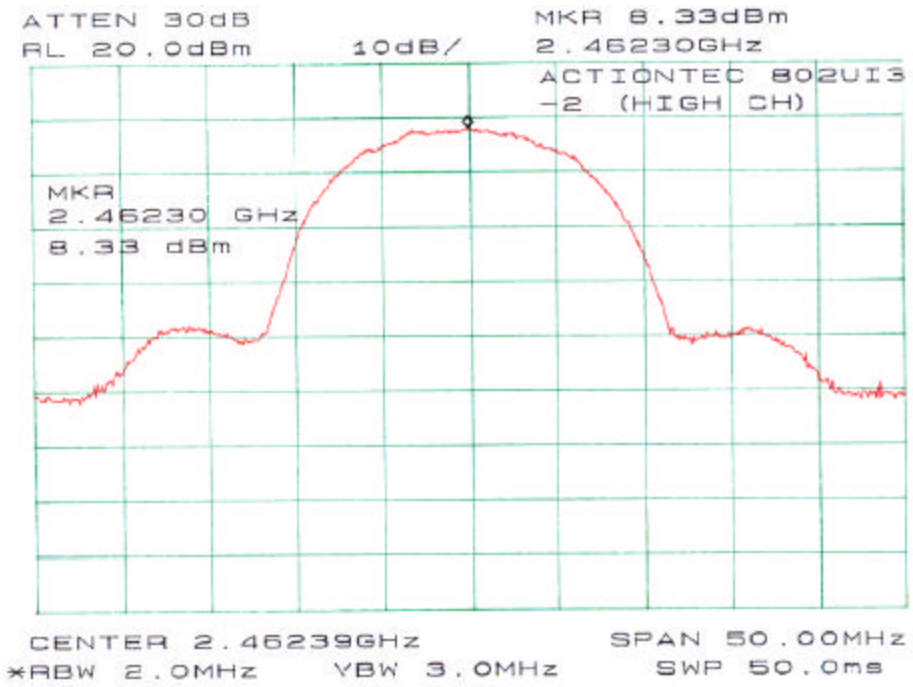
Low channel = 8.17 + 7.84 = 16.01 dBm

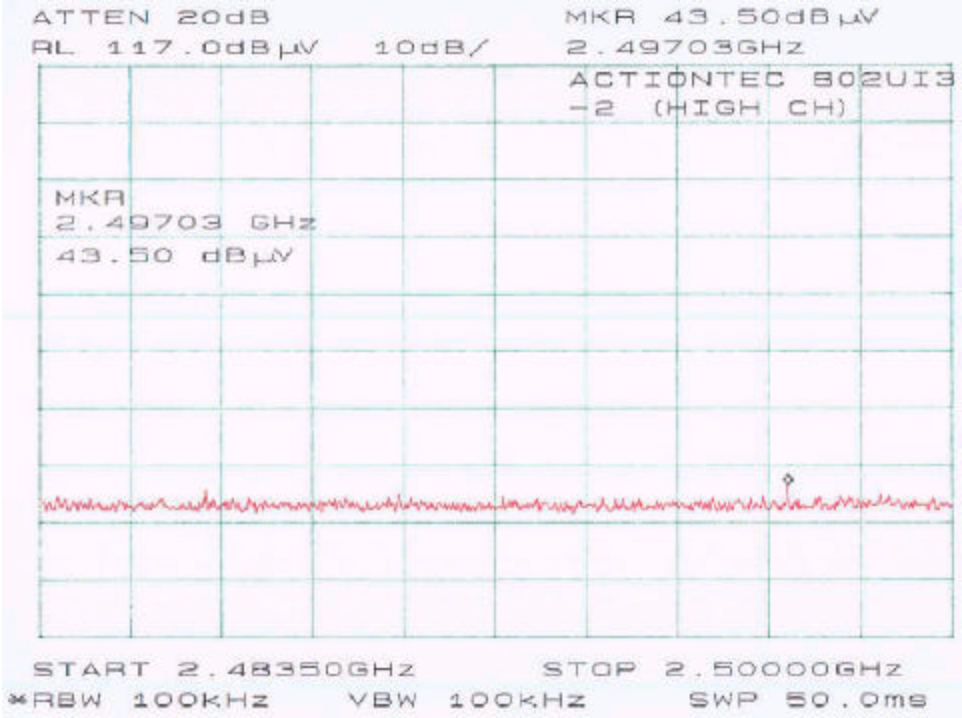
Middle channel = 8.33 + 7.84 = 16.17 dBm

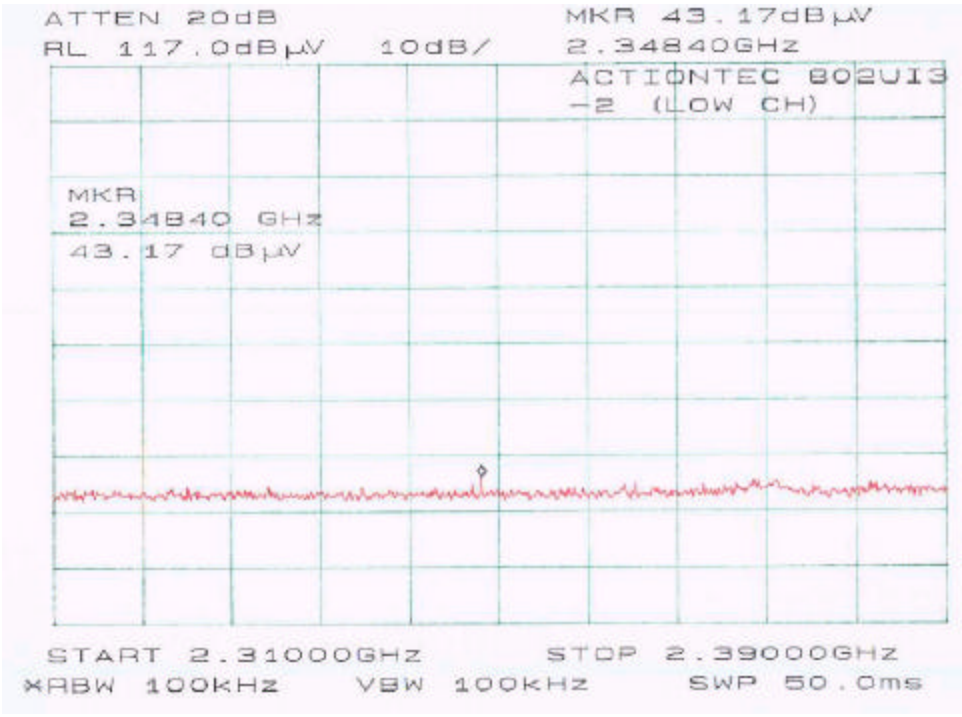
High channel = 8.33 + 7.84 = 16.17 dBm


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 8.17dBm
2.41222GHz
ACTIONTEC 802UI3
-2 (LOW CH)
MKR
2.41222 GHz
8.17 dBm
CENTER 2.41322GHz
SPAN 50.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 8.33dBm
2.43730GHz
ACTIONTEC 802UI3
-2 (MID CH)
MKR
2.43730 GHz
8.33 dBm
CENTER 2.43739GHz
SPAN 50.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 8.33dBm
2.46230GHz
ACTIONTEC 802UI3
-2 (HIGH CH)
MKR
2.46230 GHz
8.33 dBm
CENTER 2.46239GHz
SPAN 50.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms


ATTEN 20dB
RL 117.0dBµV 10dB/
MKR 43.50dBµV
2.49703GHz
ACTIONTEC 802UI3
-2 (HIGH CH)
MKR
2.49703 GHz
43.50 dBµV
START 2.48350GHz
STOP 2.50000GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 20dB
RL 117.0dBµV 10dB/
MKR 43.17dBµV
2.34840GHz
ACTIONTEC 802UI3
-2 (LOW CH)
MKR
2.34840 GHz
43.17 dBµV
START 2.31000GHz
STOP 2.39000GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms

5 – 6 DB BANDWIDTH

5.1 Standard Applicable

According to §15.247(a)(2), for direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz.

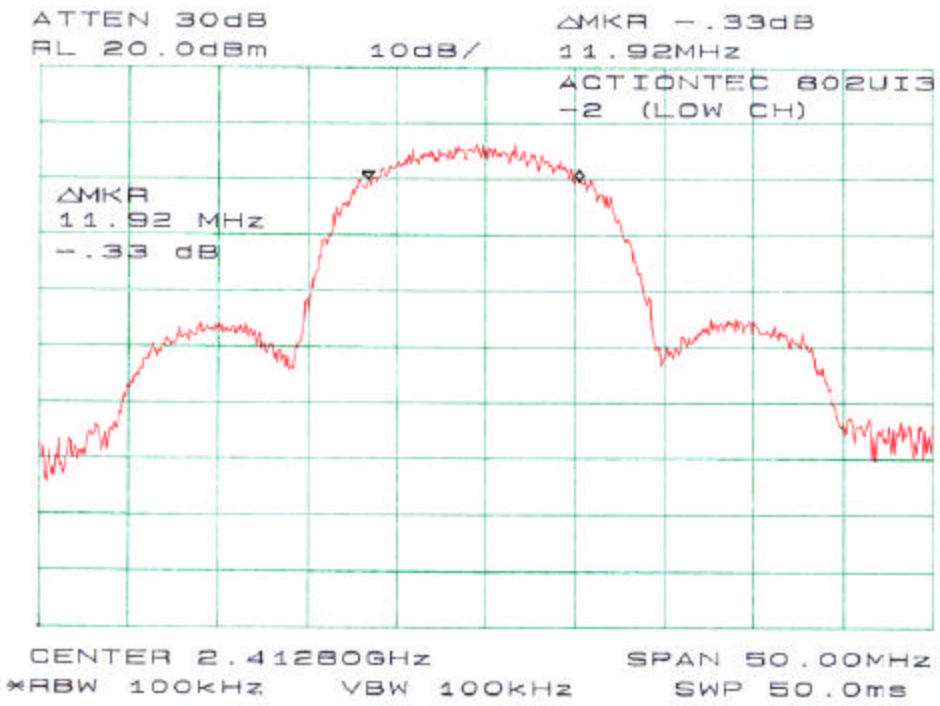
5.2 Measurement Procedure

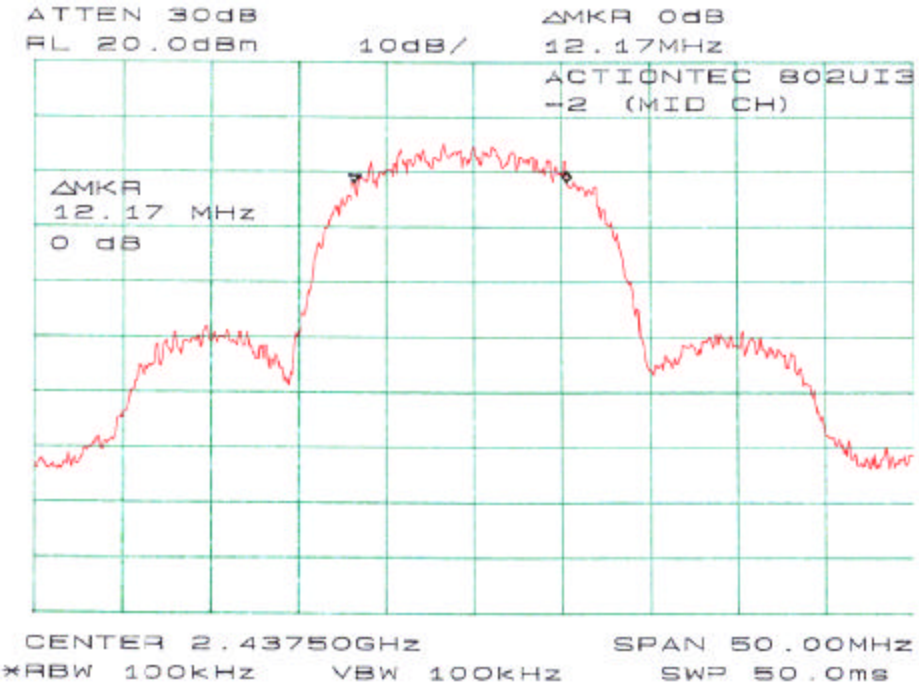
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

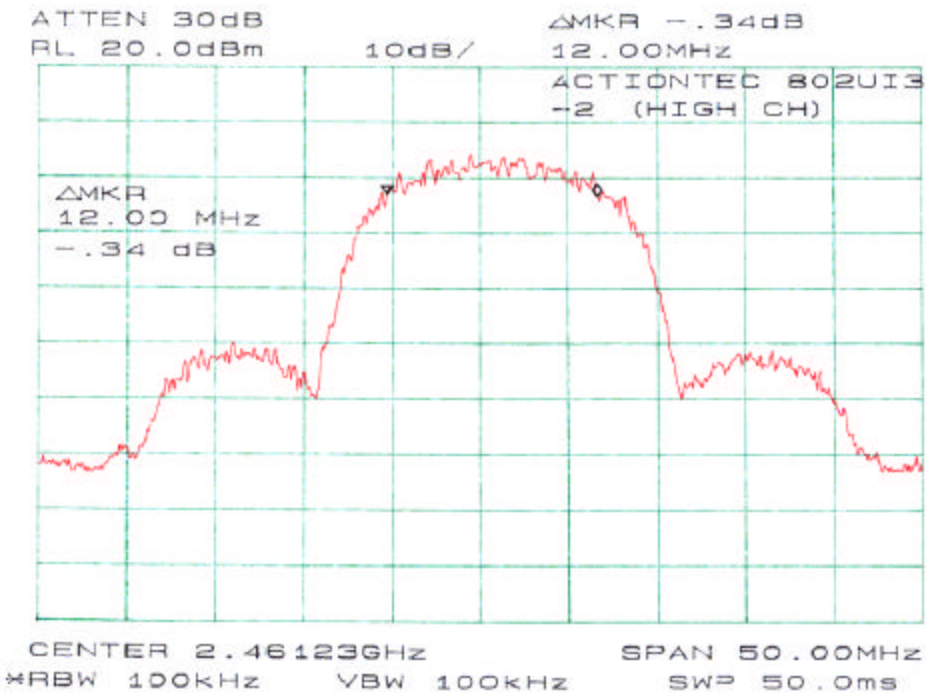
5.3 Measurement Result

Please refer to following pages for plots of 6 dB Bandwidth.

Frequency	Measured (MHz)	Standard (kHz)	Result
Low	11.92	≥ 500	Compliant
Mid	12.17	≥ 500	Compliant
High	12.00	≥ 500	Compliant


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.33dB
11.92MHz
ACTIONTEC 802UI3
-2 (LOW CH)
ΔMKR
11.92 MHz
-.33 dB
CENTER 2.412800GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR 0dB
12.17MHz
ACTIONTEC 802UI3
-2 (MID CH)
ΔMKR
12.17 MHz
0 dB
CENTER 2.437500GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.34dB
12.00MHz
ACTIONTEC 802UI3
-2 (HIGH CH)
ΔMKR
12.00 MHz
-.34 dB
CENTER 2.461236Hz
SPAN 50.00MHz
*RBW 100KHz
VBW 100KHz
SWP 50.0ms

6 - SPURIOUS EMISSION

6.1 Standard Applicable

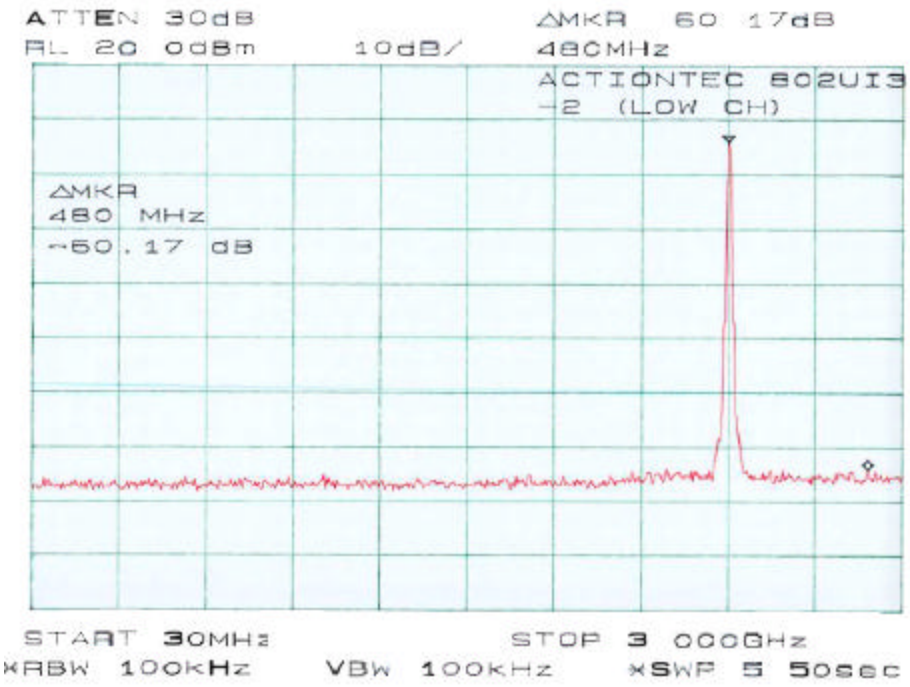
According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation f a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit.

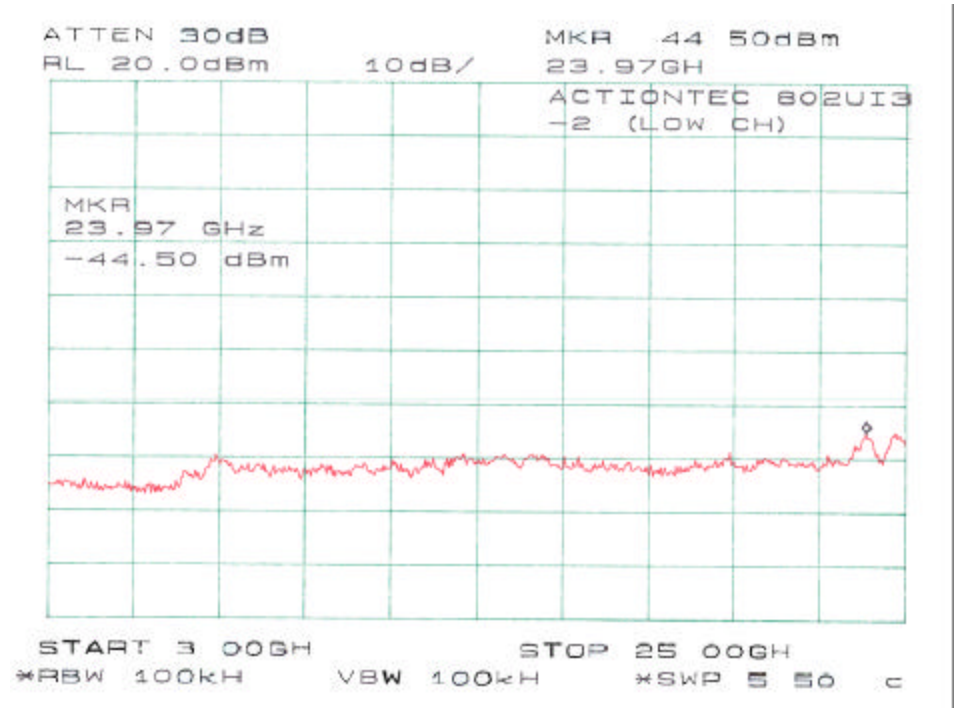
6.2 Measurement Procedure

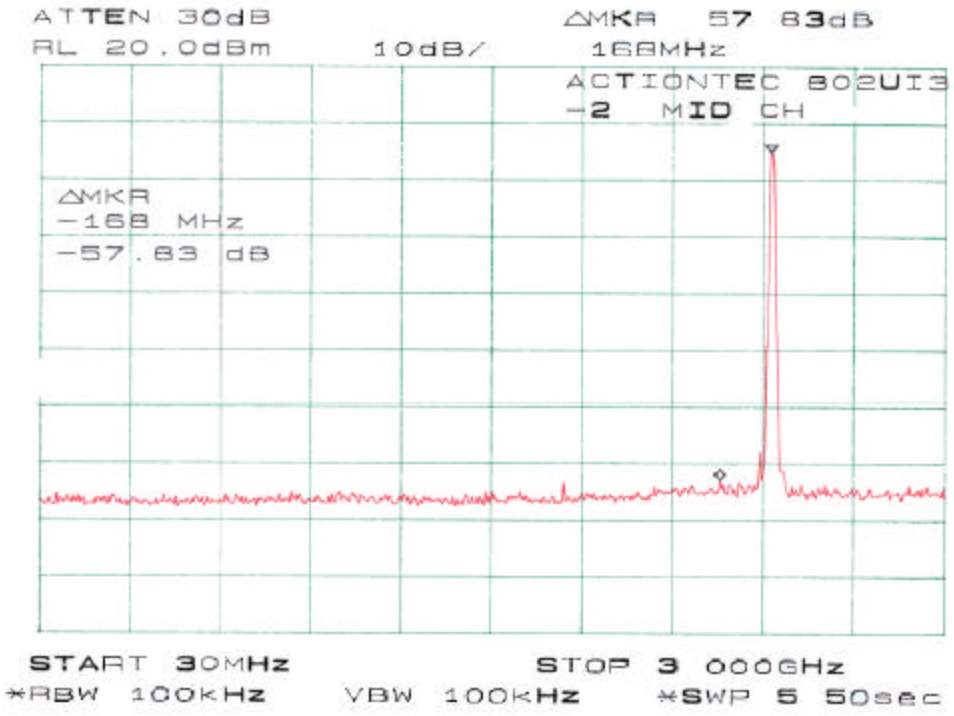
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument 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.
3. Set the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

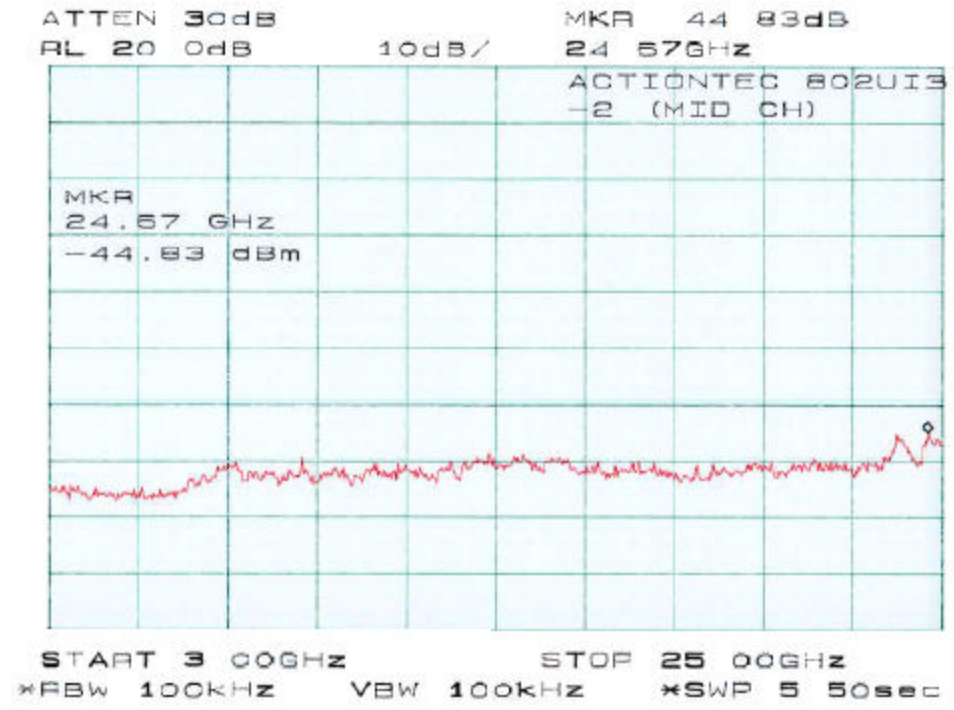
6.3 Measurement Result

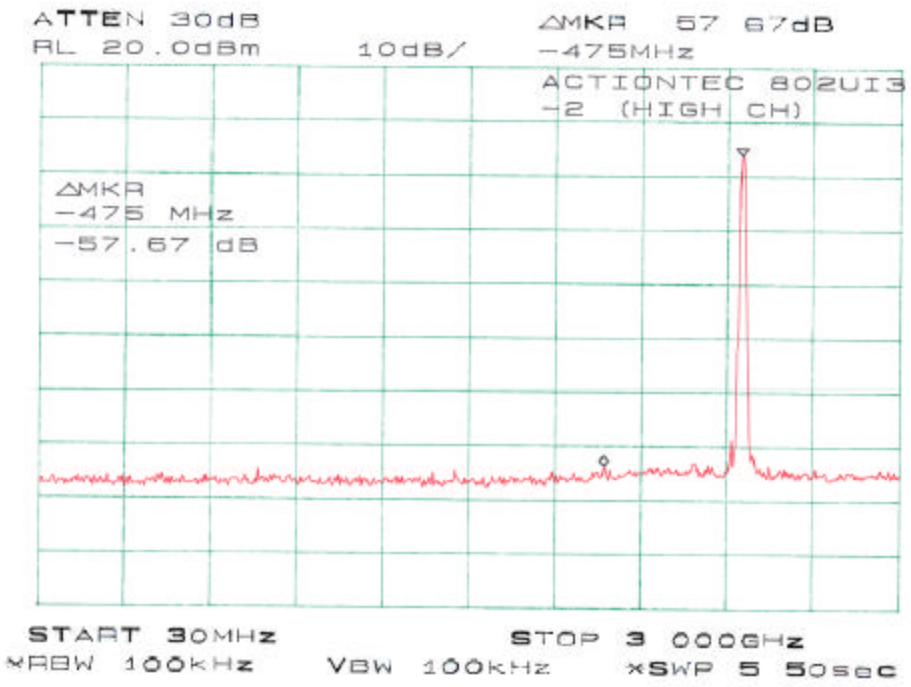
Please refer to following pages for plots of spurious emission.

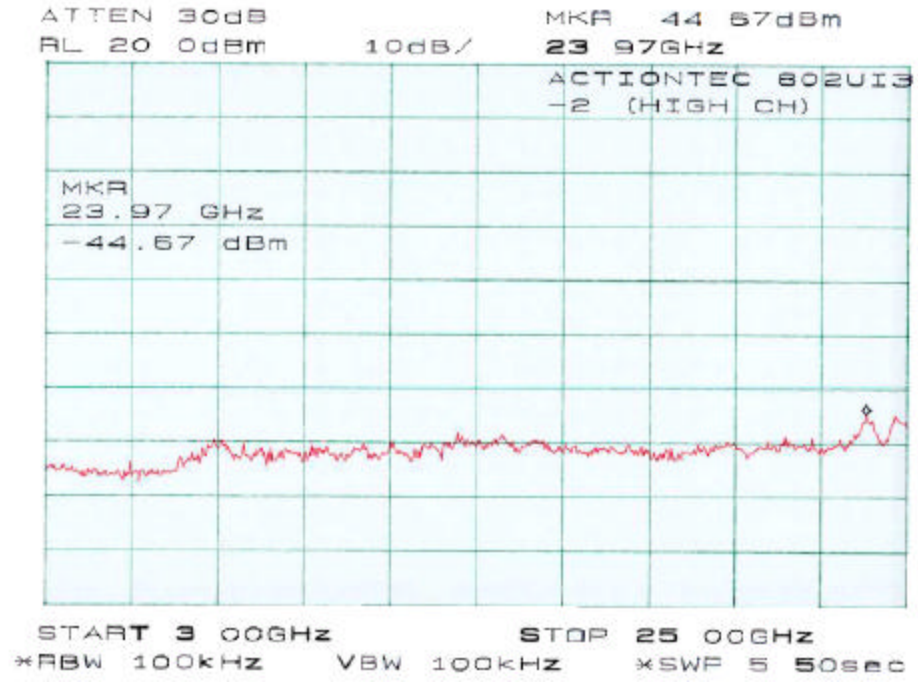

ATTEN 30dB
RL 20 0dBm
10dB/
ΔMKR 60 17dB
480MHz
ACTIONTEC 802UI3
-2 (LOW CH)
ΔMKR
480 MHz
-60.17 dB
START 30MHz
STOP 3 000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5 50sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 44 50dBm
23.97GH
ACTIONTEC 802UI3
-2 (LOW CH)
MKR
23.97 GHz
-44.50 dBm
START 3 00GH
STOP 25 00GH
*RBW 100kH
VBW 100kH
*SWP 5 50


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR 57.83dB
168MHz
ACTIONTEC 802UI3
-2 MID CH
ΔMKR
-168 MHz
-57.83 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dB
10dB/
MKR 44.83dB
24.670GHz
ACTIONTEC 802UI3
-2 (MID CH)
MKR
24.67 GHz
-44.83 dBm
START 3.000GHz
STOP 25.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR 57.67dB
-475MHz
ACTIONTEC 802UI3
-2 (HIGH CH)
ΔMKR
-475 MHz
-57.67 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 44.67dBm
23.97GHz
ACTIONTEC 802UI3
-2 (HIGH CH)
MKR
23.97 GHz
-44.67 dBm
START 3.000GHz
STOP 25.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec

7 - PEAK POWER SPECTRAL DENSITY

7.1 Standard Applicable

According to §15.247 (d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

7.2 Measurement Procedure

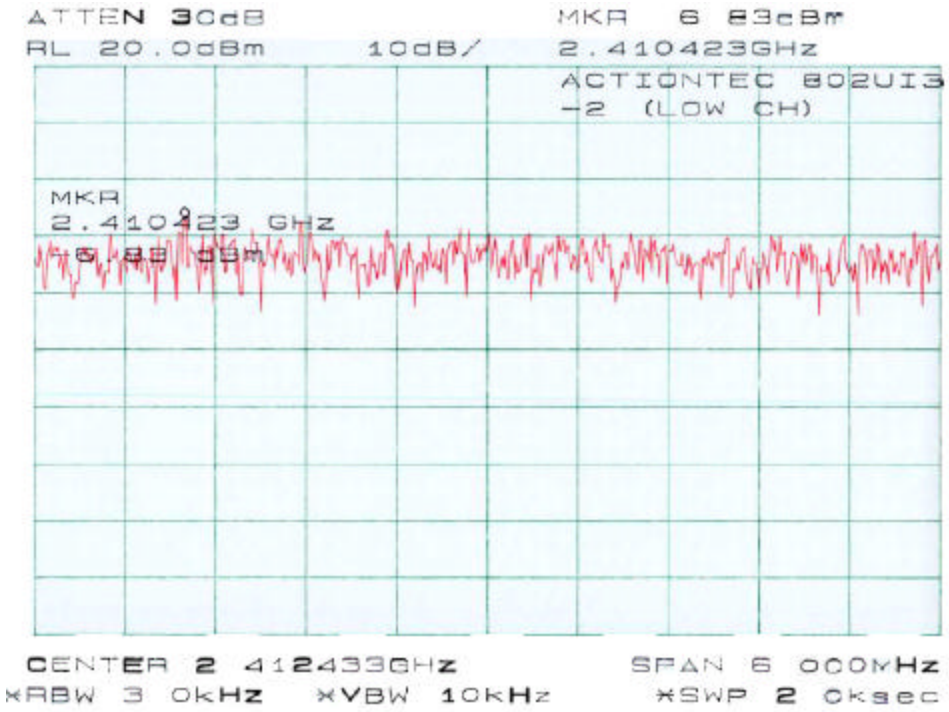
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 6MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Repeat above procedures until all frequencies measured were complete.

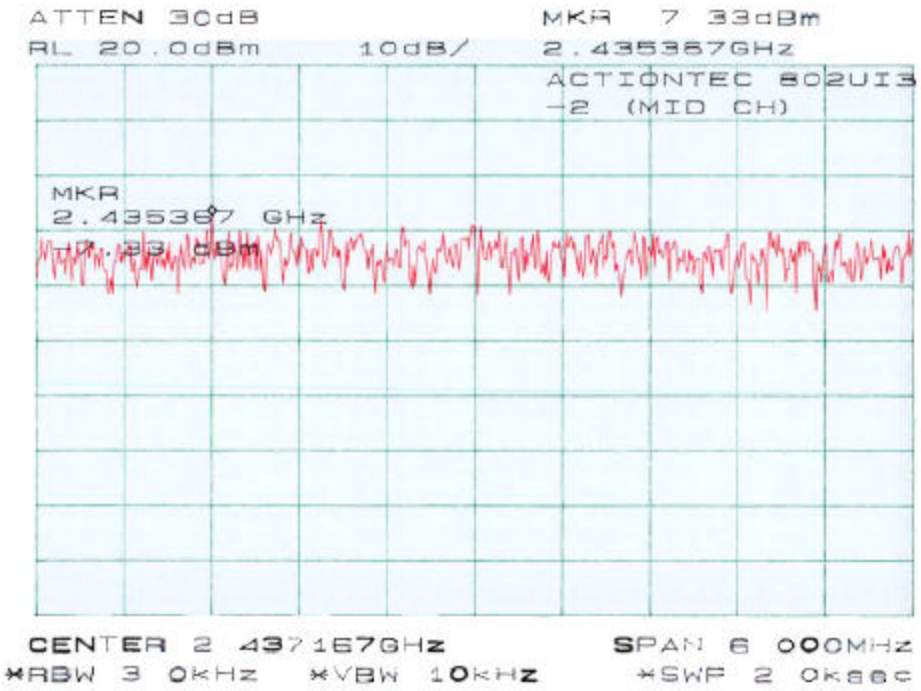
7.3 Measurement Results

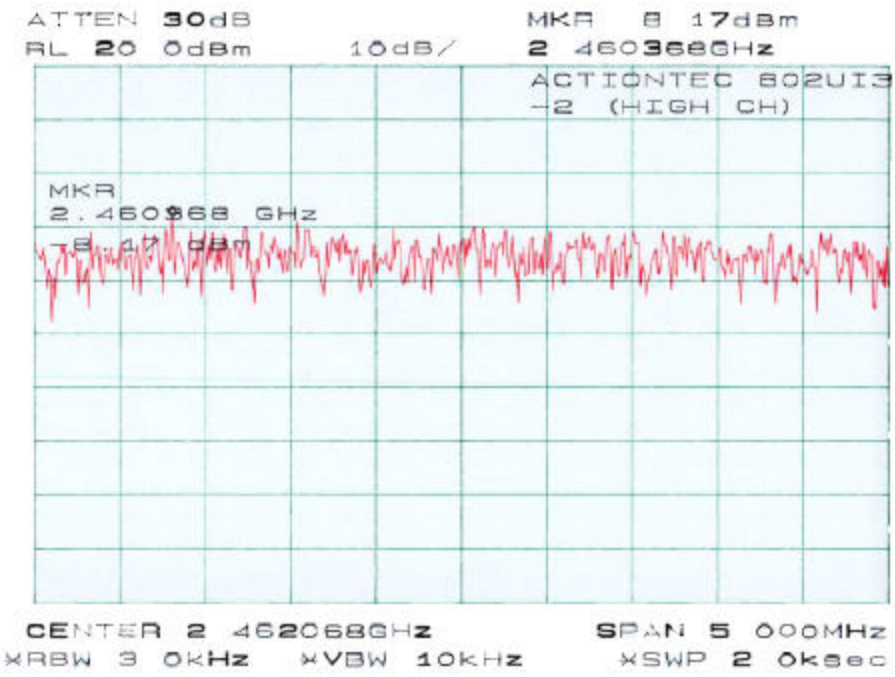
Frequency	Peak Power Spectral Density (dBm)	Standard (dBm)	Result
Low	-6.83	≤ 8	Compliant
Mid	-7.33	≤ 8	Compliant
High	-8.17	≤ 8	Compliant

7.4 Plot of Peak Power Spectral Density

Please refer to following pages for plots of peak power spectral density.


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 6.83dBm
2.410423GHz
ACTIONTEC 802UI3
-2 (LOW CH)
MKR
2.410423 GHz
CENTER 2.412433GHz
SPAN 6.000MHz
*RBW 3.0kHz
*VBW 10kHz
*SWP 2.0ksec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR 7.33dBm
2.435367GHz
ACTIONTEC 802UI3
-2 (MID CH)
MKR
2.435367 GHz
CENTER 2.437167GHz
SPAN 6.000MHz
*RBW 3.0kHz
*VBW 10kHz
*SWP 2.0ksec


ATTEN 30dB
RL 20 0dBm
10dB/
MKR 8 17dBm
2 460368GHz
ACTIONTEC 802UI3
-2 (HIGH CH)
MKR
2.460368 GHz
CENTER 2 462068GHz
SPAN 5 000MHz
*RBW 3 0kHz
*VBW 10kHz
*SWP 2 0ksec

8 - 100 KHZ BANDWIDTH OF BAND EDGES

8.1 Standard Applicable

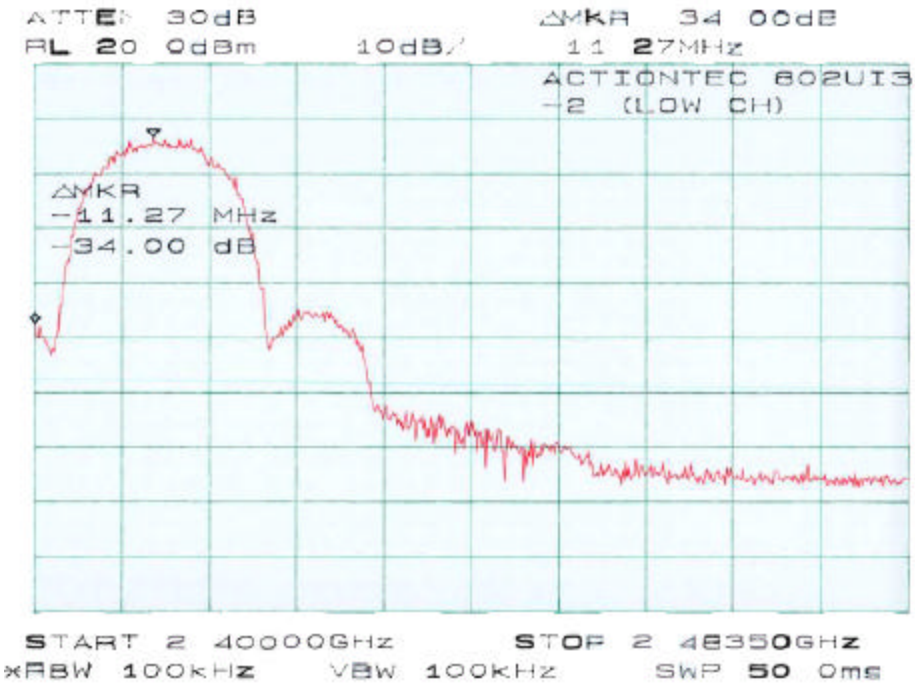
According to §15.247(c), in *any* 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) see §15.205(c)).

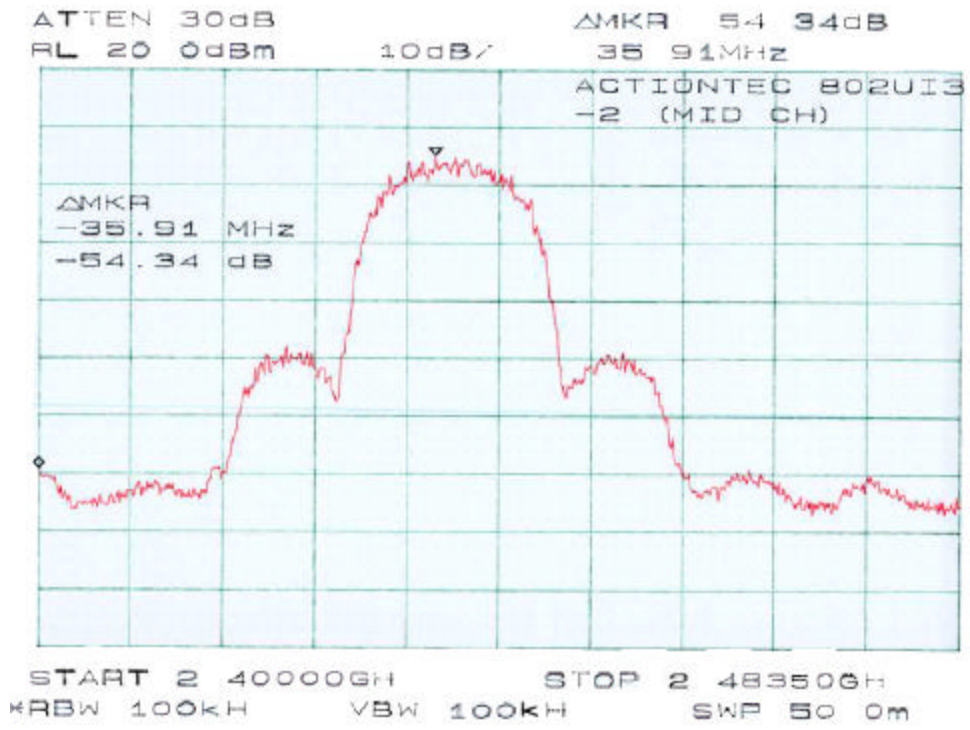
8.2 Measurement Procedure

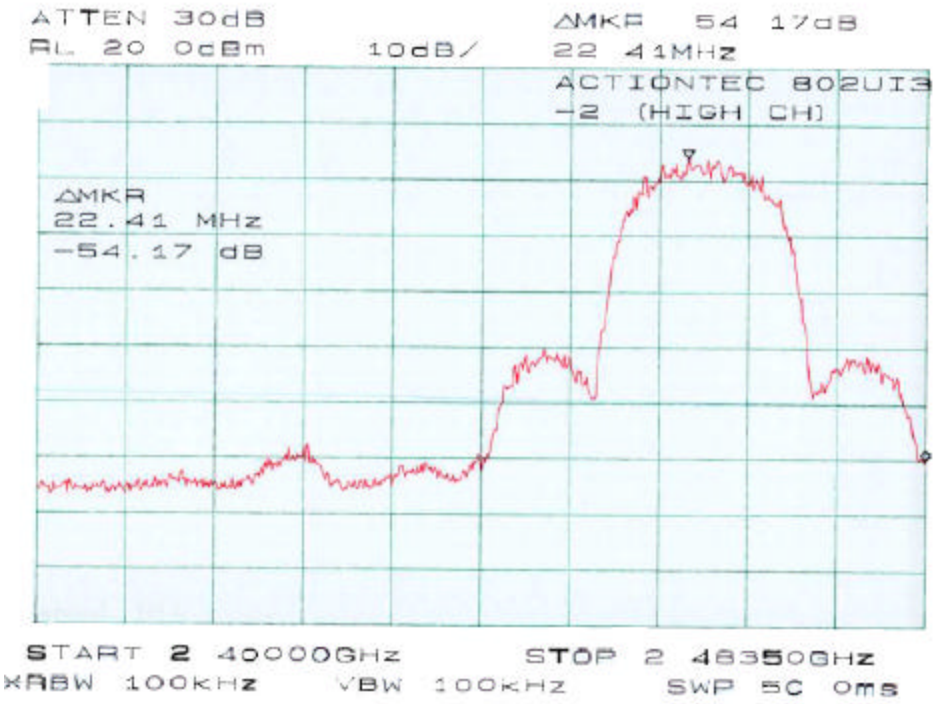
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

8.3 Measure Results

Please refer to following pages for plots of band edge.


ATTEN 30dB
RL 20 0dBm
10dB/
ΔMKR 34 00dB
11 27MHz
ACTIONTEC 802UI3
-2 (LOW CH)
ΔMKR
-11.27 MHz
-34.00 dB
START 2 40000GHz
STOP 2 48350GHz
#RBW 100kHz
VBW 100kHz
SWP 50 0ms


ATTEN 30dB
RL 20 0dBm
10dB/
ΔMKR 54 34dB
35 91MHz
ACTIONTEC 802UI3
-2 (MID CH)
ΔMKR
-35.91 MHz
-54.34 dB
START 2 40000GH
STOP 2 48350GH
#RBW 100kH
VBW 100kH
SWP 50 0m


ATTEN 30dB
RL 20 0dBm
10dB/
ΔMKR 54 17dB
22 41MHz
ACTIONTEC 802UI3
-2 (HIGH CH)
ΔMKR
22.41 MHz
-54.17 dB
START 2 40000GHz
STOP 2 48350GHz
RBW 100KHz
VBW 100KHz
SWP 50 0ms

9 - ANTENNA REQUIREMENT

9.1 Standard Applicable

For intentional device, according to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

And according to § 15.247 (1), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

9.2 Antenna Connected Construction

The directional gain of antenna used for transmitting is 3 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement.

10 - SPURIOUS RADIATED EMISSION

10.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is $\pm$4.0 dB.

10.2 EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup in accordance with the ANSI C63.4-1992. The specification used was the FCC 15 Subpart C limits.

The EUT was installed in the notebook. The notebook was put on the center back edge of the test table with the printer and modem on each side.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 120Vac/60Hz power source.

10.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 25GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Frequency Range	***RBW***	***Video B/W***
Below 30MHz	10kHz	10kHz
30 – 1000MHz	100kHz	100kHz
Above 1000MHz	1MHz	1MHz

10.4 Test Procedure

For the radiated emissions test, the Host PC system power cord was connected to the AC floor outlet since the power supply used in the EUT did not provide an accessory power outlet.

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations. All data was recorded in the peak detection mode. Quasi-peak readings was performed only when an emission was found to be marginal (within -4 dBµV of specification limits), and are distinguished with a "**Qp**" in the data table.

10.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dBµV means the emission is 7dBµV below the maximum limit for Subpart C. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Subpart C Limit

10.6 Summary of Test Results

According to the data in section 11.7, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.207 and 15.247, and had the worst margin of:

-1.0 dB at **2384.53 MHz** in the **Vertical** polarization, Low Channel

-0.5 dB at **4876.82 MHz** in the **Horizontal** polarization, Middle Channel

-0.3 dB at **4926.40 MHz** in the **Horizontal** polarization, High Channel

-4.0 dB at **40.00 MHz** in the **Vertical** polarization, Unintentional Emission

10.7.1 Final test data, 1,000 – 25,000 MHz

Indicated			Table	Antenna		Correction Factor			Corrected Amplitude	FCC 15 Subpart C	
Frequency MHz	Ampl. dBµV/m	Comments	Angle Degree	Height Meter	Polar H/V	Antenna dBµV/m	Cable DB	Amp. DB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
Low Channel											
2412	110.50	90	1.4	H	28.1	3.4	30.0	112.0			AVG
2412	110.6	0	1.5	V	28.1	3.4	30.0	112.1			AVG
2384.53	51.6	90	1.3	V	28.1	3.4	30.0	53.1	54	-1.0	AVG RB
2384.53	71.3	90	1.3	V	28.1	3.4	30.0	72.8	74	-1.3	PEAK RB
4824.00	65.2	270	1.3	H	32.5	4.9	30.0	72.6	74	-1.4	PEAK
2384.53	70.7	90	1.0	V	28.1	3.4	30.0	72.2	74	-1.8	PEAK RB
4824.00	63.2	0	1.5	V	32.5	4.9	30.0	70.6	74	-3.4	PEAK
2384.53	47.8	90	1.0	V	28.1	3.4	30.0	49.3	54	-4.8	AVG RB
7236.00	38.2	0	1.5	V	35.1	5.6	30.0	48.9	54	-5.1	AVG
4824.00	41.0	90	1.4	H	32.5	4.9	30.0	48.4	54	-5.6	AVG
4824.00	40.0	0	1.5	V	32.5	4.9	30.0	47.4	54	-6.6	AVG
7236.00	35.7	90	1.4	H	35.1	5.6	30.0	46.4	54	-7.6	AVG
9648.00	33.3	0	1.5	V	35.1	5.6	30.0	44.1	54	-9.9	AVG
9648.00	31.0	90	1.4	H	35.1	5.6	30.0	41.7	54	-12.3	AVG
7236.00	51.0	270	1.3	H	35.1	5.6	30.0	61.7	74	-12.3	PEAK
7236.00	50.7	0	1.5	V	35.1	5.6	30.0	61.4	74	-12.6	PEAK
12060.00	29.0	0	1.5	V	35.1	5.6	30.0	39.7	54	-14.3	AVG
1968.80	41.7	360	1.0	H	25.3	2.6	30.0	39.6	54	-14.4	AVG
12060.00	28.5	90	1.4	H	35.1	5.6	30.0	39.2	54	-14.8	AVG
1968.80	58.5	225	1.2	V	25.3	2.6	30.0	56.4	74	-17.6	PEAK
1968.80	37.5	225	1.2	V	25.3	2.6	30.0	35.4	54	-18.6	AVG
9648.00	41.7	270	1.3	H	35.1	5.6	30.0	52.4	74	-21.6	PEAK
1968.80	53.7	360	1.0	H	25.3	2.6	30.0	51.6	74	-22.4	PEAK
9648.00	40.2	0	1.5	V	35.1	5.6	30.0	50.9	74	-23.1	PEAK
12060.00	40.1	0	1.5	V	35.1	5.6	30.0	50.8	74	-23.2	PEAK
12060.00	40.0	270	1.3	H	35.1	5.6	30.0	50.7	74	-23.3	PEAK

Middle Channel											
2437.41	108.3	315	1.4	V	28.1	3.4	30.0	109.8			AVG
2437.41	110.8	270	1.6	H	28.1	3.4	30.0	112.3			AVG
4876.82	66.1	270	1.6	H	32.5	4.9	30.0	73.5	74	-0.5	PEAK
4876.82	43.8	315	1.4	V	32.5	4.9	30.0	51.2	54	-2.8	AVG
4876.82	43.0	270	1.6	H	32.5	4.9	30.0	50.4	54	-3.6	AVG
7315.23	36.5	270	1.6	H	35.1	5.6	30.0	47.2	54	-6.8	AVG
2637.50	43.7	90	1.3	H	29.0	3.7	30.0	46.3	54	-7.7	AVG
4876.82	57.8	315	1.4	V	32.5	4.9	30.0	65.2	74	-8.8	PEAK
2637.50	41.7	135	1.0	V	29.0	3.7	30.0	44.3	54	-9.7	AVG
2637.50	61.0	90	1.3	H	29.0	3.7	30.0	63.7	74	-10.3	PEAK
7315.23	32.70	315	1.4	V	35.1	5.6	30.0	43.4	54	-10.6	AVG
9753.64	31.3	270	1.6	H	35.1	5.6	30.0	42.0	54	-12.0	AVG
9753.64	30.20	315	1.4	V	35.1	5.6	30.0	40.9	54	-13.1	AVG
12192.05	29.5	270	1.6	H	35.1	5.6	30.0	40.2	54	-13.8	AVG
12192.05	28.50	315	1.4	V	35.1	5.6	30.0	39.2	54	-14.8	AVG
2637.50	55.5	135	1.0	V	29.0	3.7	30.0	58.2	74	-15.8	PEAK
7315.23	44.17	315	1.4	V	35.1	5.6	30.0	54.9	74	-19.1	PEAK
9753.64	43.20	315	1.4	V	35.1	5.6	30.0	53.9	74	-20.1	PEAK
9753.64	42.8	270	1.6	H	35.1	5.6	30.0	53.5	74	-20.5	PEAK
12192.05	42.3	270	1.6	H	35.1	5.6	30.0	53.1	74	-20.9	PEAK
12192.05	40.10	315	1.4	V	35.1	5.6	30.0	50.8	74	-23.2	PEAK
7315.23	38.2	270	1.6	H	35.1	5.6	30.0	48.9	74	-25.1	PEAK

High Channel											
2462.20	110.8	270	1.6	H	28.1	3.4	30.0	112.3			AVG
2462.20	109.0	135	1.0	V	28.1	3.4	30.0	110.5			AVG
4926.40	66.3	270	1.6	H	32.5	4.9	30.0	73.7	74	-0.3	PEAK
2591.37	50.5	315	1.3	V	29.0	3.7	30.0	53.2	54	-0.8	AVG
2483.75	70.7	135	1.0	V	28.1	3.4	30.0	72.2	74	-1.8	PEAK RB
2483.75	50.6	90	1.3	H	28.1	3.4	30.0	52.1	54	-2.0	AVG RB
4926.40	44.2	270	1.6	H	32.5	4.9	30.0	51.6	54	-2.4	AVG
2483.75	49.9	135	1.0	V	28.1	3.4	30.0	51.4	54	-2.7	AVG RB
4926.40	62.7	135	1.0	V	32.5	4.9	30.0	70.1	74	-3.9	PEAK
2483.75	67.5	90	1.3	H	28.1	3.4	30.0	69.0	74	-5.1	PEAK RB
7389.60	38.1	270	1.6	H	35.1	5.6	30.0	48.8	54	-5.2	AVG
4926.40	41.1	135	1.0	V	32.5	4.9	30.0	48.5	54	-5.5	AVG
7389.60	34.80	135	1.0	V	35.1	5.6	30.0	45.5	54	-8.5	AVG
12316	34.5	270	1.6	H	35.1	5.6	30.0	45.2	54	-8.8	AVG
2591.37	42.2	135	1.5	V	29.0	3.7	30.0	44.9	54	-9.1	AVG
9852.8	34.00	270	1.6	H	35.1	5.6	30.0	44.7	54	-9.3	AVG
12316	32.50	135	1.0	V	35.1	5.6	30.0	43.2	54	-10.8	AVG
9852.8	31.7	135	1.0	V	35.1	5.6	30.0	42.4	54	-11.6	AVG
7389.60	50.3	270	1.6	H	35.1	5.6	30.0	61.1	74	-12.9	PEAK
9852.8	45.70	270	1.6	H	35.1	5.6	30.0	56.4	74	-17.6	PEAK
7389.60	44.83	135	1.0	V	35.1	5.6	30.0	55.6	74	-18.4	PEAK
12316	44.30	270	1.6	H	35.1	5.6	30.0	55.0	74	-19.0	PEAK
12316	43.7	135	1.0	V	35.1	5.6	30.0	54.4	74	-19.6	PEAK
9852.8	41.5	135	1.0	V	35.1	5.6	30.0	52.2	74	-21.8	PEAK
2591.37	49.0	135	1.5	V	29.0	3.7	30.0	51.7	74	-22.3	PEAK
2591.37	46.3	315	1.3	V	29.0	3.7	30.0	49.0	74	-25.0	PEAK

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart C	
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin
MHz	dBµV/m	Degree	Meter	H/V	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB
40.00	48.2	180	1.0	V	12.1	0.7	25.0	36.0	40	-4.0
79.95	49.5	225	1.2	V	9.5	1.6	25.0	35.6	40	-4.4
144.00	48.7	270	1.5	V	13.2	1.0	26.0	36.9	43.5	-6.6
512.50	37.7	180	1.5	H	19.3	3.5	25.0	35.5	46	-10.5
113.91	44.7	315	1.0	V	11.7	1.3	25.0	32.7	43.5	-10.8
225.77	42.3	45	1.8	H	12.1	3.9	25.0	33.3	46	-12.7
324.26	39.8	270	1.0	H	15.5	2.8	25.0	33.1	46	-12.9
828.60	30.8	270	1.0	H	22.9	3.7	25.0	32.4	46	-13.6
458.94	35.8	0	1.0	H	17.8	3.2	25.0	31.8	46	-14.2
243.46	39.8	225	1.8	H	12.6	2.3	25.0	29.7	46	-16.3

Note 1.

AVG = average
RB = Restricted Band

Note 2.

Only spurious emissions below the limits of 15.209 are permitted in the restricted band. The EUT was tested and had the worst margin in the restricted bands is –0.5 dBuV/m at 4876.82 MHz.

11 - CONDUCTED EMISSIONS

11.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is ±2.4 dB.

11.2 EUT Setup

The measurement was performed at the **O**pen **A**rea **T**est **S**ite, using the same setup per ANSI C63.4-1992 measurement procedure. The specification used was FCC 15 Subpart C limits.

The EUT was installed in the notebook. The notebook was put on the center back edge of the test table.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The host PC system was connected with 120Vac/60Hz power source.

11.3 Spectrum Analyzer Setup

The spectrum analyzer was set with the following configurations during the conduction test:

Start Frequency	450 kHz
Stop Frequency	30 MHz
Sweep Speed	Auto
IF Bandwidth	10 kHz
Video Bandwidth	10 kHz
Quasi-Peak Adapter Bandwidth	9 kHz
Quasi-Peak Adapter Mode	Normal

11.4 Test Procedure

During the conducted emission test, the power cord of the host system was connected to the auxiliary outlet of the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of each modes tested to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings were only performed when an emission was found to be marginal (within -4 dBµV of specification limits). Quasi-peak readings are distinguished with a "**Qp**".

11.5 Summary of Test Results

According to the data in section 12.6, the EUT complies with the FCC Conducted margin for a Class B device, with the *worst* margin reading of:

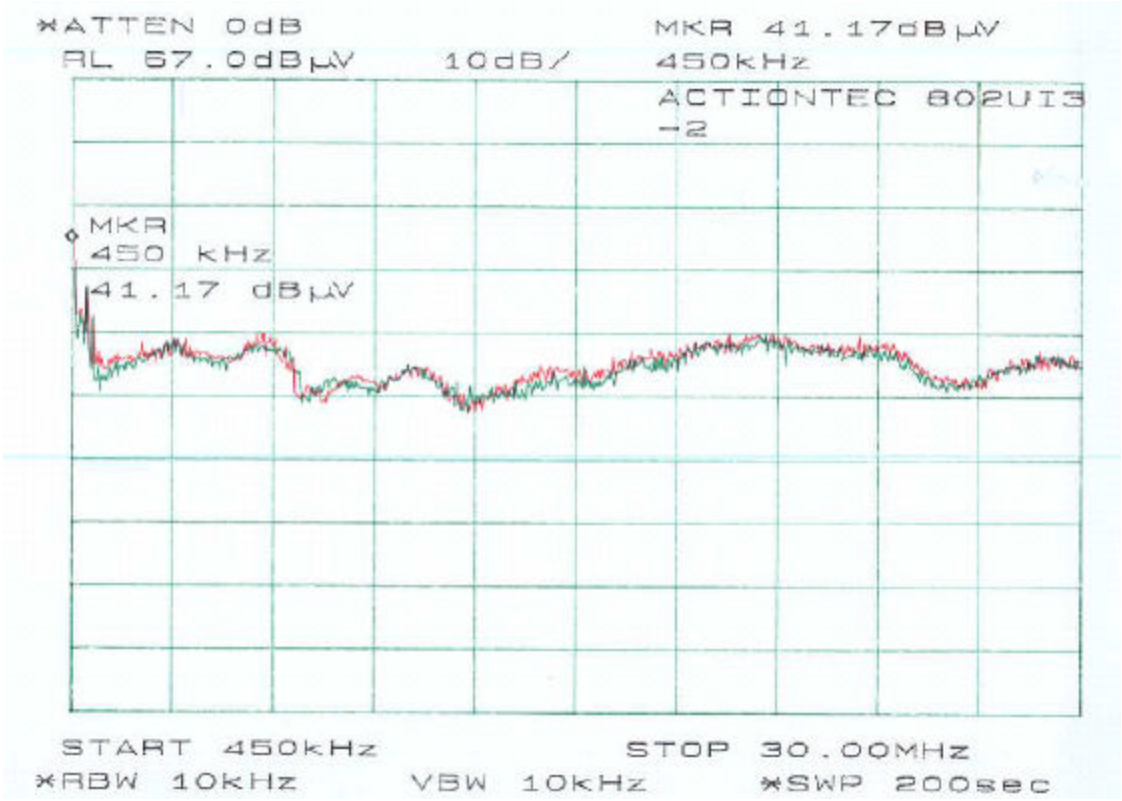
-6.8 dBµV at 0.450 MHz in the Line mode

11.6 Conducted Emissions Test Data

LINE CONDUCTED EMISSIONS				FCC PART 15 CLASS B	
Frequency MHz	Amplitude dBµV	Detector Qp/Ave/Peak	Phase Line/Neutral	Limit dBµV	Margin dB
0.450	41.2	QP	Line	48	-6.8
0.450	37.0	QP	Neutral	48	-11.0
0.890	34.3	QP	Line	48	-13.7
0.890	34.0	QP	Neutral	48	-14.0
20.940	27.0	QP	Line	48	-21.0
20.190	26.8	QP	Neutral	48	-21.2

11.7 Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented hereinafter as reference.



12 - RF EXPOSURE

According to §15.247(b)(4) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1093 RF exposure is calculated.

Limits for Maximum Permissive Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-15000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

MPE Prediction

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S = PG/4\pi R^2$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal: 16.17 (dBm)
Maximum peak output power at antenna input terminal: 41.40 (mW)
Prediction distance: 20 (cm)
Predication frequency: 2400 (MHz)
Antenna Gain (typical): 13 (dBi)
Maximum antenna gain: 2.00(numeric)
Power density at predication frequency at 20 cm: 0.016 (mW/cm^2)
MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm^2)
MPE distance at maximum power density (1mW/cm^2) is 6.59 cm

Test Result

The predicted power density level at 20 cm is 0.016 mWcm^2. This is below the uncontrolled exposure limit of 1mW/cm^2 at 2400 MHz. The EUT is used at least 20cm away from user's body, so it is determined as mobile equipment.