FCC PART 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

Actiontec Electronics, Inc.

760 N. Mary Ave.
Sunnyvale, CA 94086

FCC ID: LNQBTM200B

2003-06-24

This Report Concerns:	**Equipment Type:**
☒ Original Report	USB Bluetooth Adapter

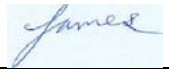
Test Engineer:	James Lee / 
Report No.:	R0306041
Test Date:	2003-06-13
Reviewed By:	Ling Zhang / 
Prepared By:	Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

TABLE OF CONTENTS

1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *Actiontec Electronics, Inc's* product, model no.:BTM200B or the "EUT" as referred to this report is a USB Bluetooth Adapter which is measured approximately 66.5 mm L x 18 mm W x 9 mm H. The EUT is designed to provide Bluetooth wireless function on a standard USB form factor. It is designed for a typical, well-defined environment, allowing it to be reused, without any retuning of the antenna. The Bluetooth wireless function is based on CSR BlueCore-02 chip, which fully compliance with Bluetooth version 1.1 standard. It has an USB interface to the host.

** The test data gathered are 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 15.247 rules for the bluetooth transmitter:

- Maximum Peak Output Power
- Hopping Channel Separation
- Number of Hopping Frequency Used
- 20 dB Bandwidth
- Dwell Time on Each Channel
- 100 kHz Bandwidth of Band Edge
- Conducted Emission
- Spurious Emission
- Radiated Emission
- Antenna Requirement
- RF Exposure Limit

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.

All radiated and conducted emissions measurement was performed at BACL. 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 15 - Digital Devices, CISPR 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	2517A01610	2003-10-30
HP	Amplifier	8447E	2944A07030	2003-06-28
HP	Quasi-Peak Adapter	85650A	2521A00718	2004-03-08
Com-Power	Biconical Antenna	AB-100	14012	2003-09-05
Com-Power	Log Periodic Antenna	AL-100	16005	2003-08-23
Com-Power	Log Periodic Antenna	AB-900	15049	2004-05-01
Agilent	Spectrum Analyzer (9KHz – 40GHz)	8564E	3943A01781	2003-08-01
Agilent	Spectrum Analyzer (9KHz – 50GHz)	8565EC	3946A00131	2004-05-03
HP	Amplifier (1-26.5GHz)	8449B	3147A00400	2004-03-14
A.H.System	Horn Antenna (700MHz-18GHz)	SAS-200/571	261	2003-05-31

*** 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
Toshiba	Notebook PC	PC8621ZAA000	J2N1500S1086	DOC

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The host system was configured for testing in a typical fashion (as a 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 exercising program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. The test software, bluetest, provided by the customer, is started the Windows 98 terminal program under the Windows 98 operating system. Once started, select USB from “choose a protocol”, select TXDATA1 from “bluetest” then click execute. The process is continuous throughout all tests.

2.3 Special Accessories

As shown in section 2.7, all interface cables used for compliance testing are shielded as normally supplied by their respective support equipment manufacturers.

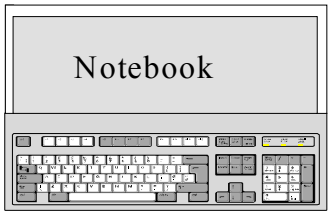
2.4 Schematics / Block Diagram

Please refer to Exhibit D.

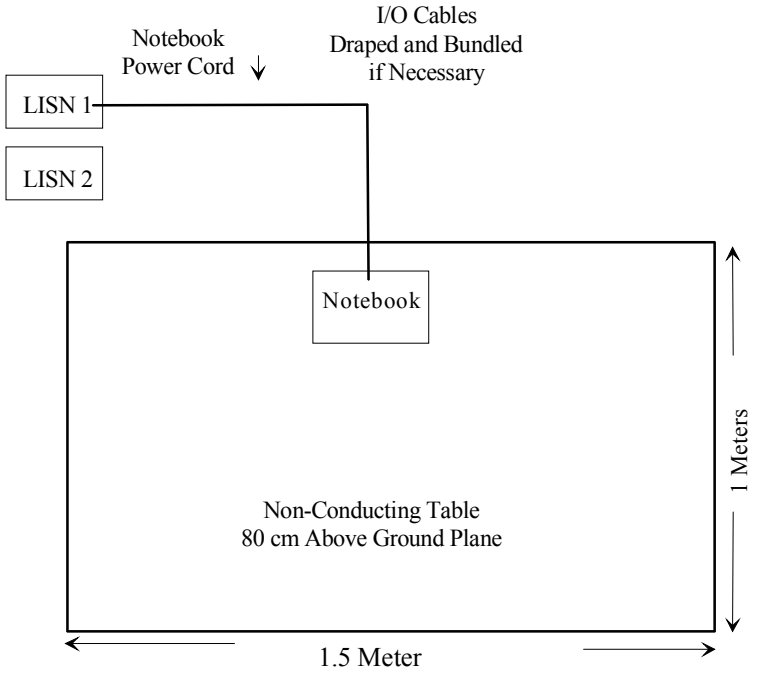
2.5 Equipment Modifications

No modifications were made by BACL Corporation 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
§ 2.1093	RF Safety Requirements	Compliant	User Manual
§15.203	Antenna Requirement	Compliant	Section 13
§15.207 (a)	Conducted Emission	Compliant	Section 12
§ 15.205	Restricted Bands	Compliant	Section 11
§15.247 (a) (1) (iii)	Number of Hopping Frequencies Used	Compliant	Section 6
§15.209	Radiated Emission	Compliant	Section 11
§15.247 (a) (1)	Hopping Channel Separation	Compliant	Section 7
§15.247 (a) (1) (iii)	Dwell Time of Each Frequency within a 10 Second Period of time (0.4 x Number of Channel)	Compliant	Section 9
§15.247 (a) (1) (iii)	20dB Bandwidth	Compliant	Section 5
§15.247 (b) (1)	Maximum Peak Output Power	Compliant	Section 4
§ 15.247 (c)	100 kHz Bandwidth of Frequency Band Edge	Compliant	Section 8
§ 15.247 (g)	Full and complete compliance with applicable requirements for FHSS. Compliance with the definition of frequency hopping system, distribute transmission over minimum number of hopping channel	Compliant	Technical Manual
§ 15.247 (h)	Limitation on avoidance on hopping on occupied channel	Compliant	Technical Manual

4 - MAXIMUM PEAK OUTPUT POWER

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.

4.3 Test Equipment

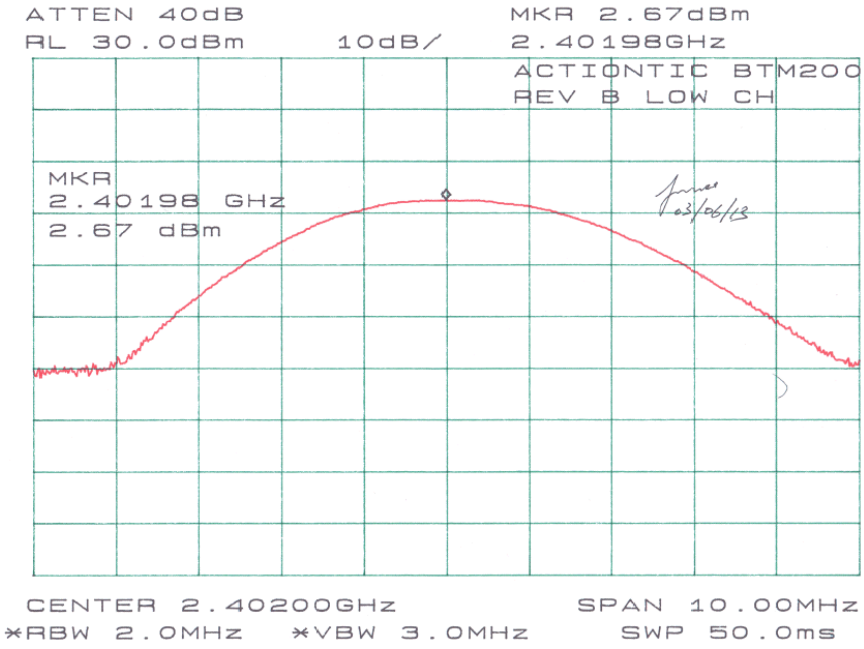
Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	8564E	3943A01781	2003-08-01

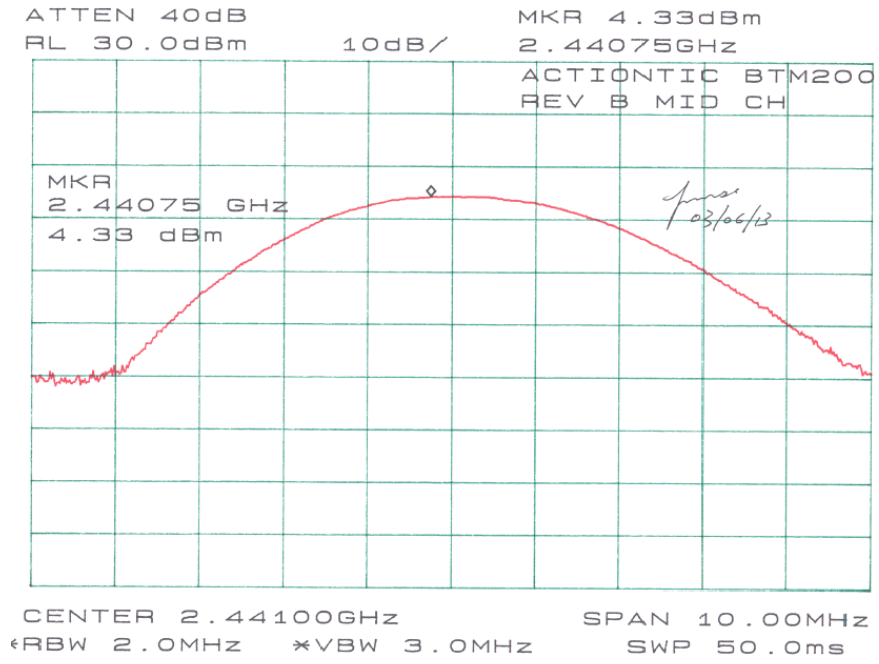
4.4 Measurement Result

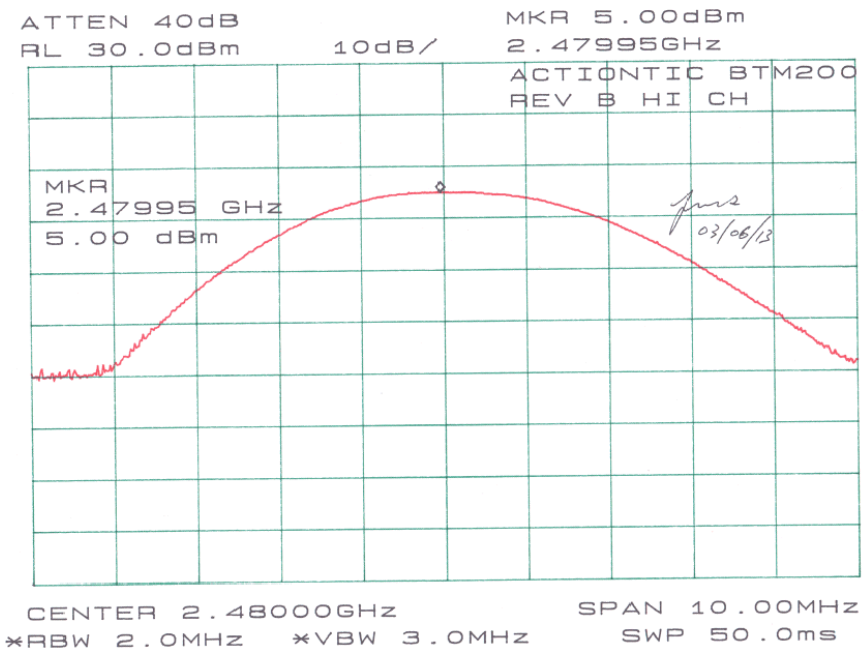
Channel	Frequency	Output Power in dBm	Output Power in W	Standard	Result
Low	2402	2.67	0.0018	≤ 1W	Compliant
Middle	2441	4.33	0.0027	≤ 1W	Compliant
High	2480	5.00	0.0032	≤ 1W	Compliant

4.5 Plots of Maximum Peak Output Power

Please refer to following plots.


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 2.67dBm
2.40198GHz
ACTIONTIC BTM200
REV B LOW CH
MKR
2.40198 GHz
2.67 dBm
03/06/13
CENTER 2.40200GHz
SPAN 10.00MHz
*RBW 2.0MHz
*VBW 3.0MHz
SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 4.33dBm
2.44075GHz
ACTIONTIC BTM200
REV B MID CH
MKR
2.44075 GHz
4.33 dBm
03/06/13
CENTER 2.44100GHz
SPAN 10.00MHz
*RBW 2.0MHz
*VBW 3.0MHz
SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 5.00dBm
2.47995GHz
ACTIONTIC BTM200
REV B HI CH
MKR
2.47995 GHz
5.00 dBm
03/06/13
CENTER 2.48000GHz
SPAN 10.00MHz
*RBW 2.0MHz
*VBW 3.0MHz
SWP 50.0ms

5 - CHANNEL BANDWIDTH

5.1 Standard Applicable

According to §15.247(a)(l), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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 20 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 Test Equipment

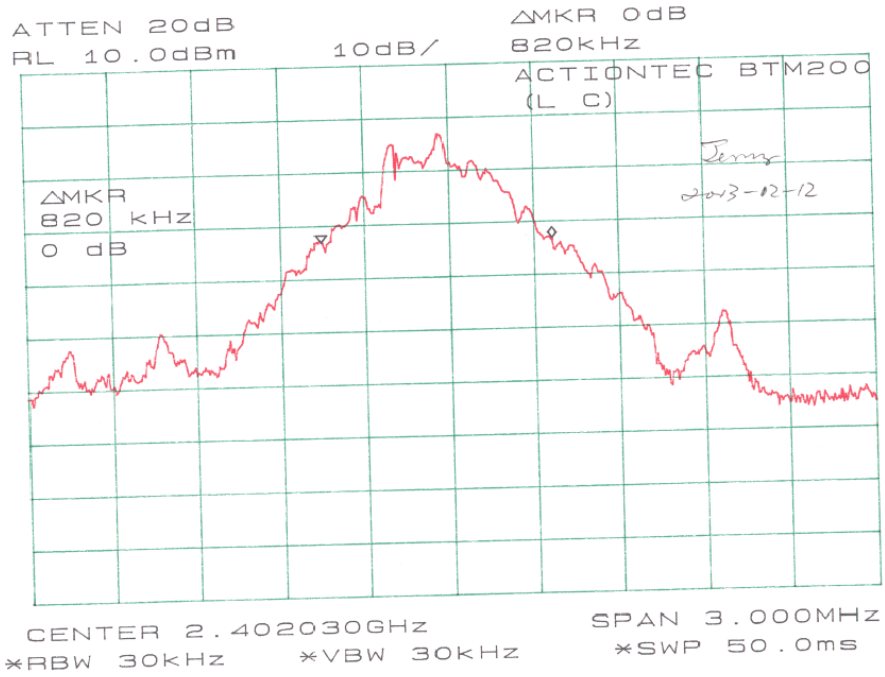
Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	8564E	3943A01781	2003-08-01

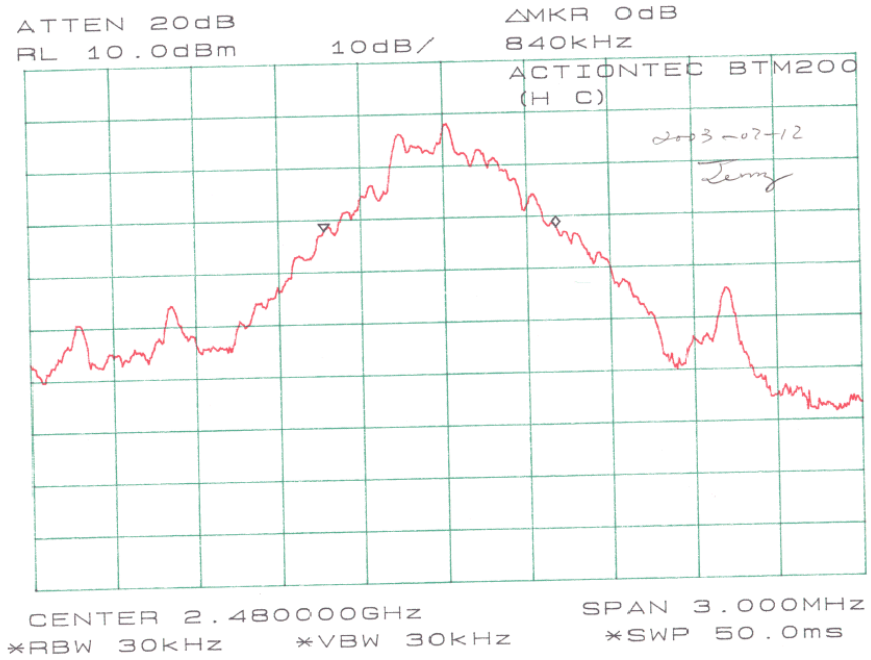
5.4 Measurement Result

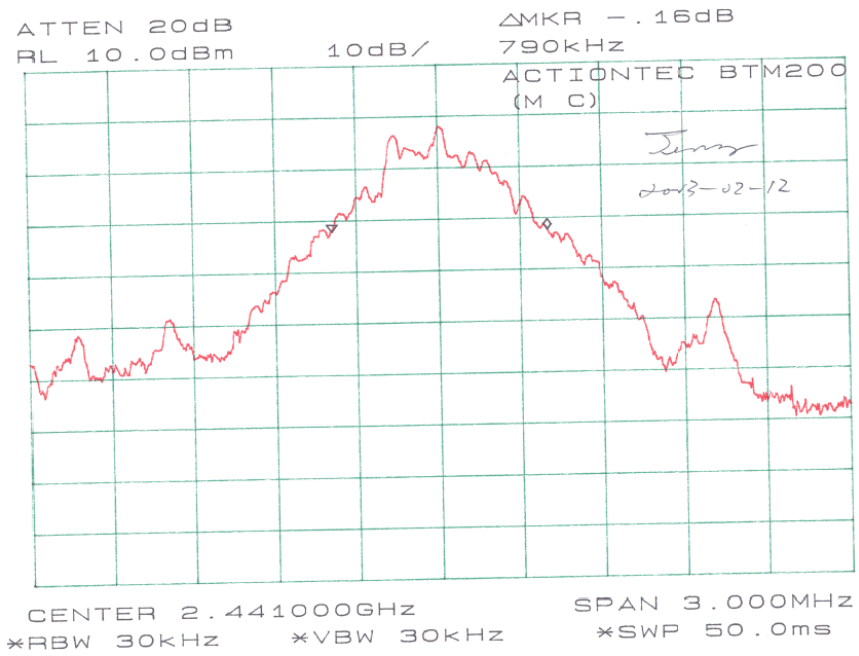
Frequency	Measurement (kHz)	Standard	Result
Low	820	≤ 1MHz	Compliant
Middle	790	≤ 1MHz	Compliant
High	840	≤ 1MHz	Compliant

5.5 Plot of Channel Bandwidth

Please refer to following plots.


ATTEN 20dB
RL 10.0dBm
10dB/
ΔMKR 0dB
820kHz
ACTIONTEC BTM200
(L C)
Jerry
2003-12-12
ΔMKR
820 kHz
0 dB
CENTER 2.402030GHz
SPAN 3.000MHz
*RBW 30kHz
*VBW 30kHz
*SWP 50.0ms


ATTEN 20dB
RL 10.0dBm
10dB/
ΔMKR 0dB
840kHz
ACTIONTEC BTM200
(H C)
2003-07-12
Jerry
CENTER 2.480000GHz
SPAN 3.000MHz
*RBW 30kHz
*VBW 30kHz
*SWP 50.0ms


ATTEN 20dB
RL 10.0dBm
10dB/
ΔMKR -.16dB
790kHz
ACTIONTEC BTM200
(M C)
2003-02-12
CENTER 2.441000GHz
SPAN 3.000MHz
*RBW 30kHz
*VBW 30kHz
*SWP 50.0ms

6 - NUMBER OF HOPPING FREQUENCY USED

6.1 Standard Applicable

According to §15.247(a)(1)(iii), frequency hopping systems operating in the 2400-2483.5Mhz band shall use at least 75 hopping frequencies.

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 on the bench 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 hopping 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 Test Equipment

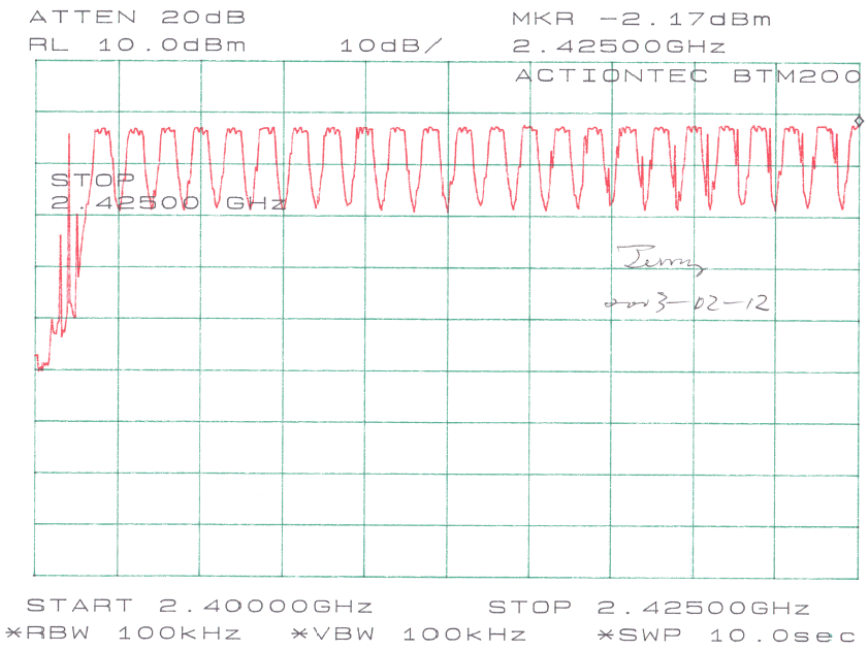
Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	8564E	3943A01781	2003-08-01

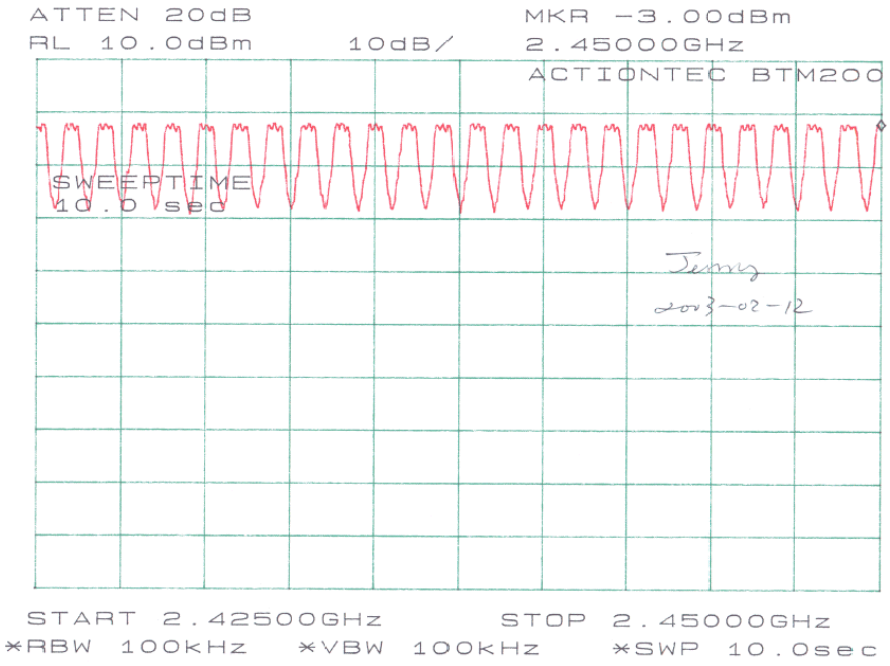
6.4 Measurement Procedure

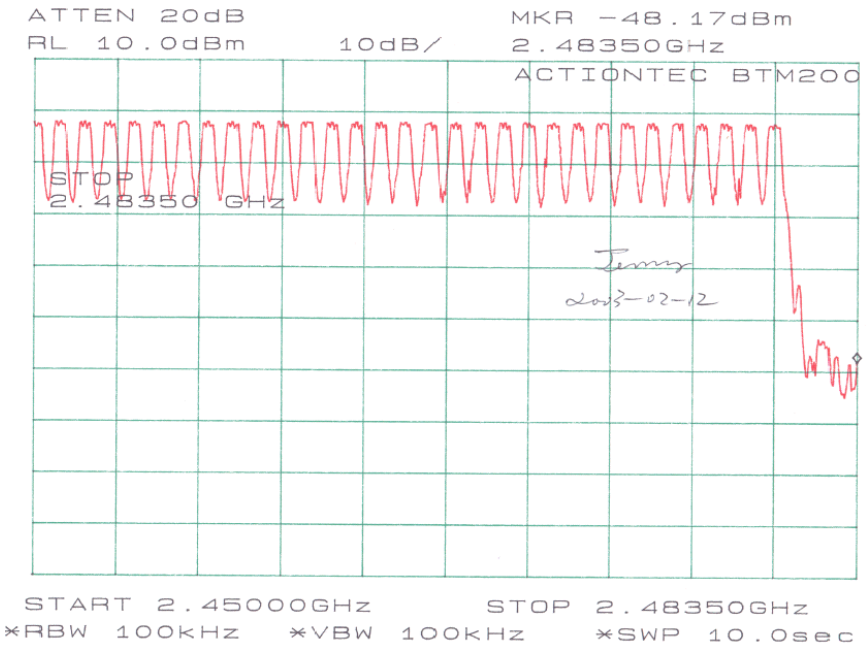
Measurement	Standard	Result
79	75	Compliant

6.5 Plots of Number of Hopping Frequency

Please refer to the attached plots.


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -2.17dBm
2.42500GHz
ACTIONTEC BTM200
STOP
2.42500 GHz
Jenny
2003-02-12
START 2.40000GHz
STOP 2.42500GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -3.00dBm
2.45000GHz
ACTIONTEC BTM200
SWEEPTIME
10.0 sec
Jenny
2003-02-12
START 2.42500GHz
STOP 2.45000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -48.17dBm
2.48350GHz
ACTIONTEC BTM200
STOP
2.48350 GHz
Jimmy
2003-02-12
START 2.45000GHz
STOP 2.48350GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec

7 - HOPPING CHANNEL SEPARATION

7.1 Standard Applicable

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

7.2 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 on a bench 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.
3. By using the Max-Hold 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.

7.3 Test Equipment

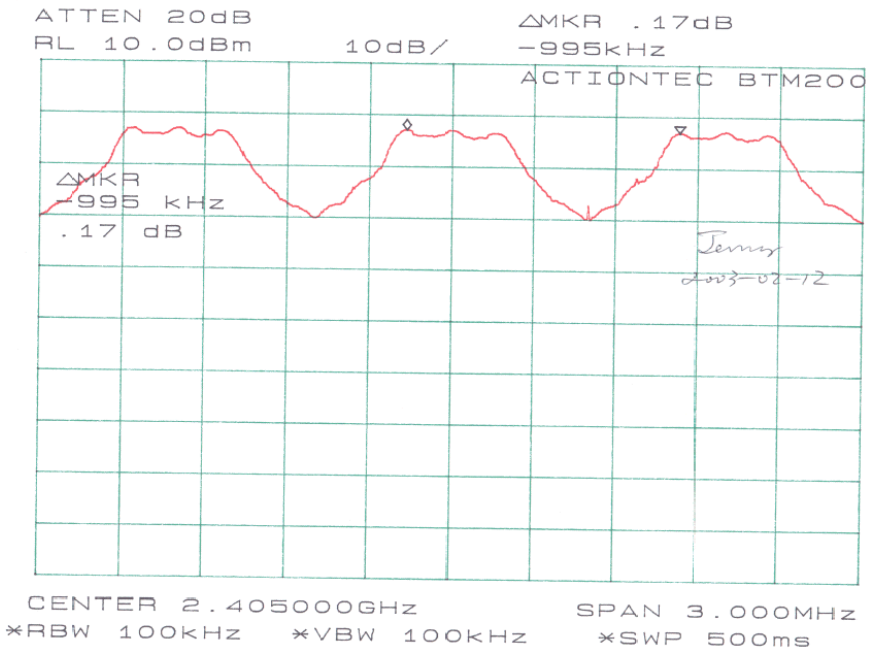
Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	8564E	3943A01781	2003-08-01

7.4 Measurement Results

Measurement (kHz)	Result
995	Compliant

7.5 Plots of Hopping Channel Separation

Please refer to the following plots.


ATTEN 20dB
RL 10.0dBm
10dB/
△MKR .17dB
-995kHz
ACTIONTEC BTM200
△MKR
-995 kHz
.17 dB
Jenny
2003-02-12
CENTER 2.405000GHz
SPAN 3.000MHz
*RBW 100kHz
*VBW 100kHz
*SWP 500ms

8 - 100 KHZ BANDWIDTH OF BAND EDGES

8.1 Standard Applicable

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

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 300 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 Test Equipment

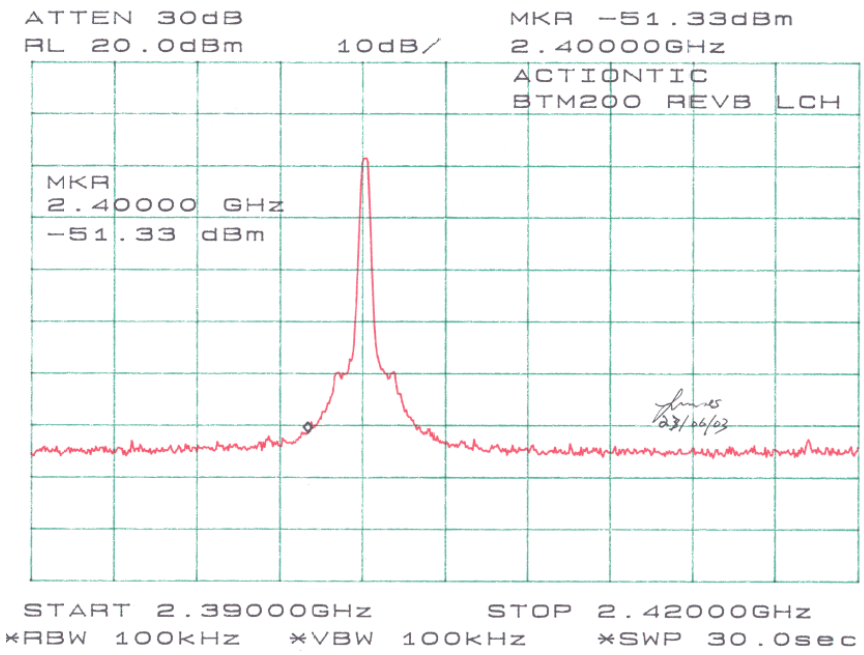
Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	8564E	3943A01781	2003-08-01

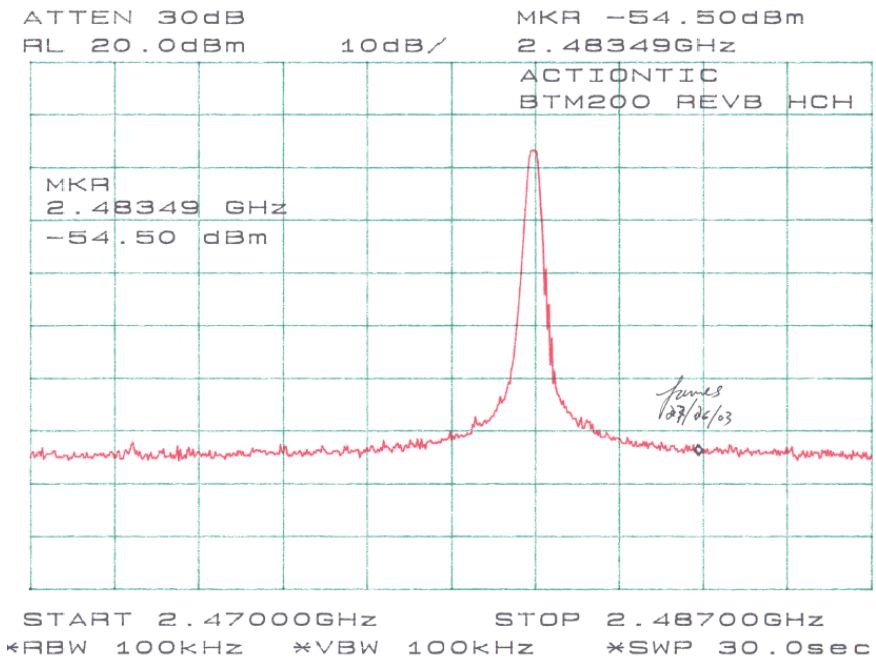
8.4 Measurement Results

Channel	Measurement (dBm)	Standard	Result
Low	51.33	≥ 20dB	Compliant
High	54.50	≥ 20dB	Compliant

8.5 Plots of 100kHz Bandwidth of Band Edge

Please refer the following plots.


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -51.33dBm
2.40000GHz
ACTIONTIC
BTM200 REVB LCH
MKR
2.40000 GHz
-51.33 dBm
START 2.39000GHz
STOP 2.42000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 30.0sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -54.50dBm
2.48349GHz
ACTIONTIC
BTM200 REVB HCH
MKR
2.48349 GHz
-54.50 dBm
START 2.47000GHz
STOP 2.48700GHz
*RBW 100kHz
*VBW 100kHz
*SWP 30.0sec

9 - DWELL TIME

9.1 Standard Applicable

According to §15.247 (a)(1)(iii), 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.

9.2 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 zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

9.3 Test Equipment

Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	8564E	3943A01781	2003-08-01

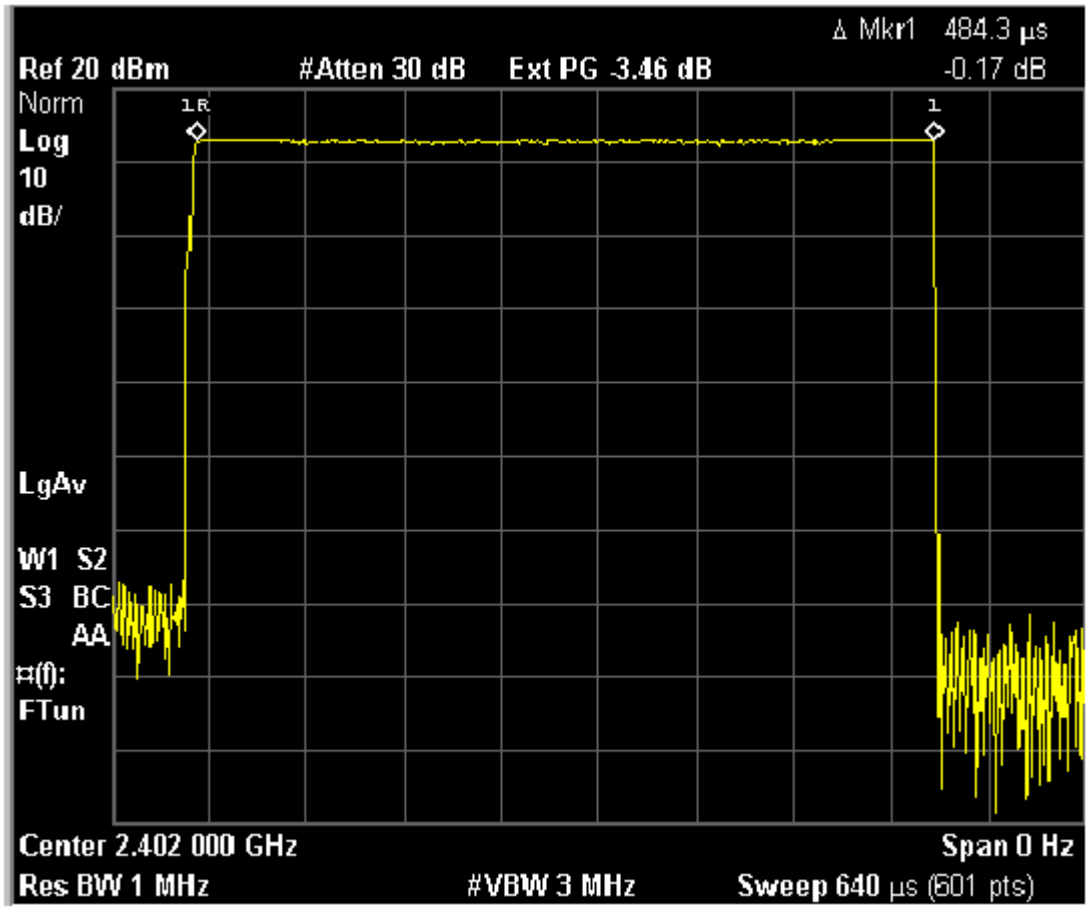
9.4 Measurement Results

The worst case dwell time is (DH5 packet) (4 x 2.952 ms) (dwell time in 1 sec) x 30 seconds = 354.24 ms <0.4 x 79

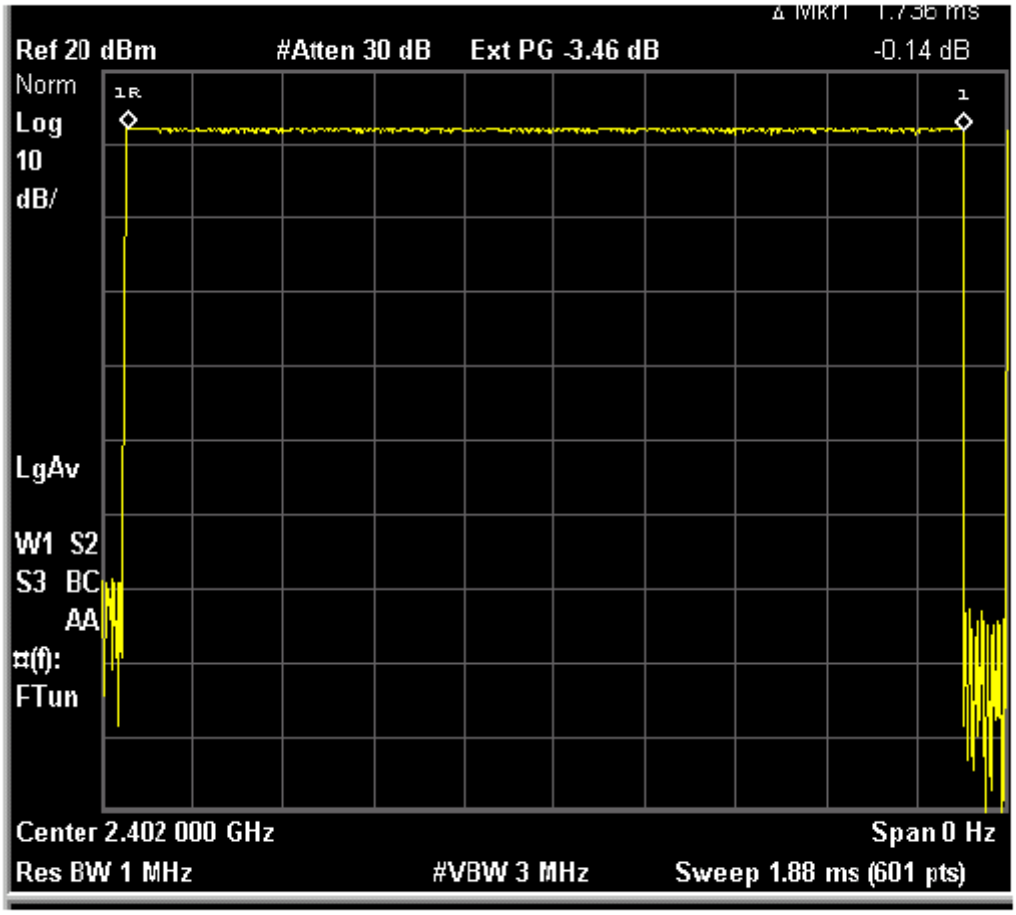
9.5 Plots of Dwell Time

Please refer the following plots.

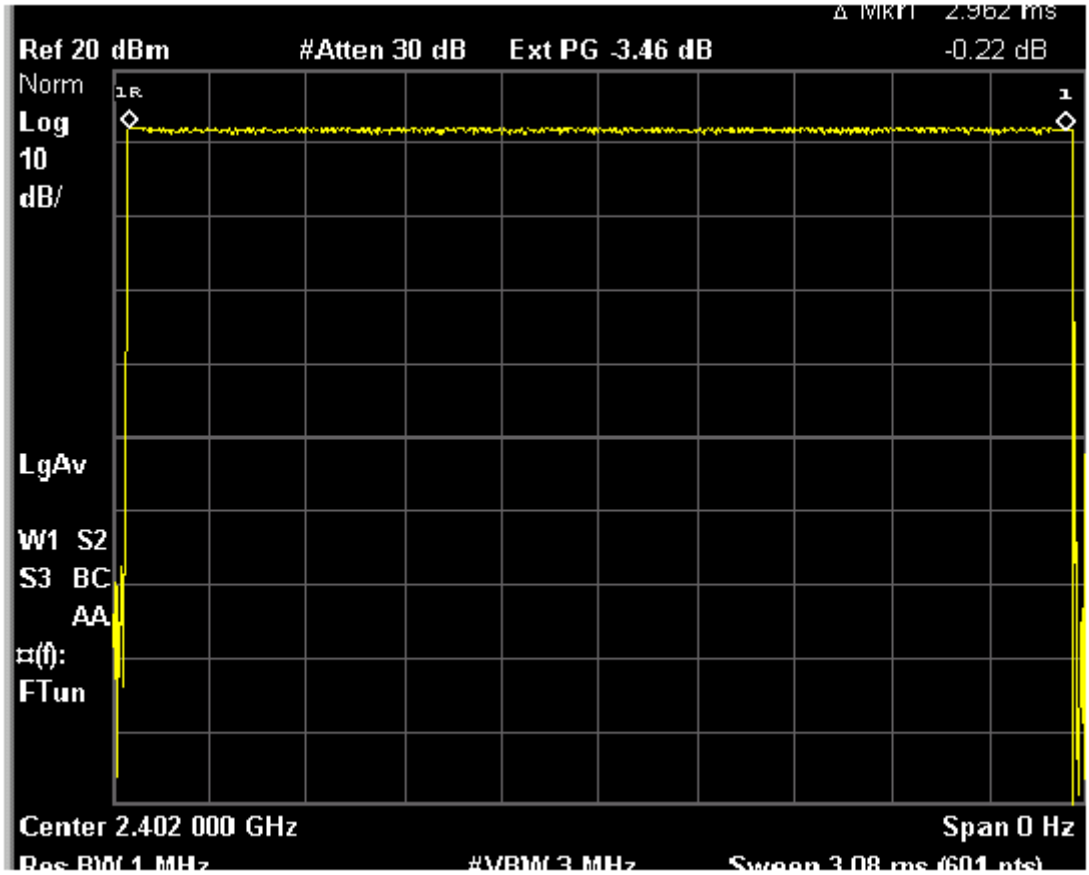
DH1 Mode Dwell Time: DH1 Data Packet – Dwell Time = 484.3 µsec



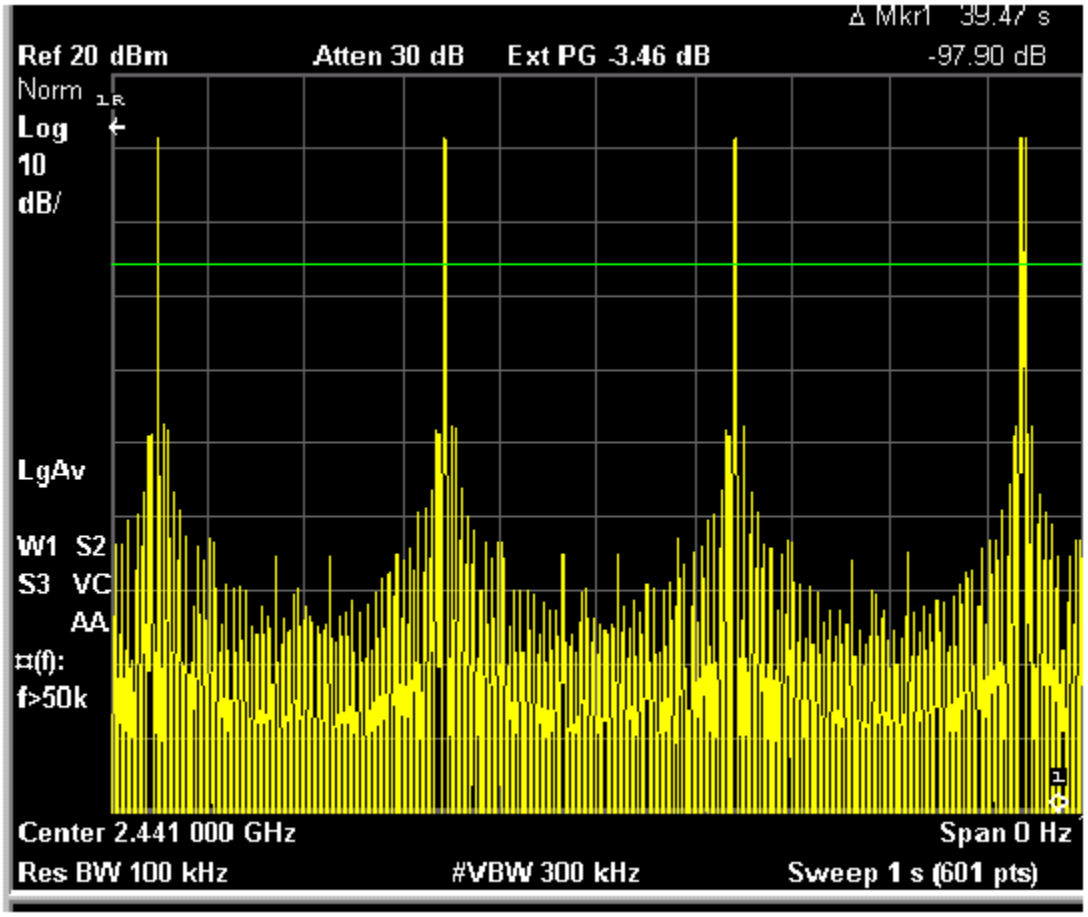
DH3 Mode Dwell Time: DH3 Data Packet – Dwell Time = 1.736 msec



DH5 Mode Dwell Time: DH5 Data Packet – Dwell Time = 2.952 msec



Plot Showing numbers of pulses in 1 second in DH5 Mode: 4 peaks of DH5 packets in 1 second



10 - SPURIOUS EMISSION AT ANTENNA PORT

10.1 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.

10.2 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 on a bench 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.

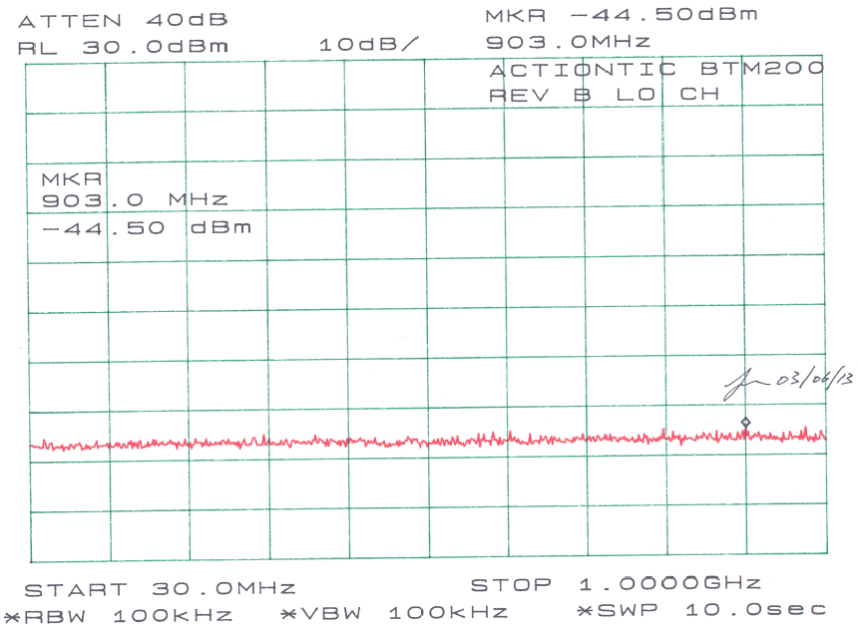
5. Repeat above procedures until all frequencies measured were complete.

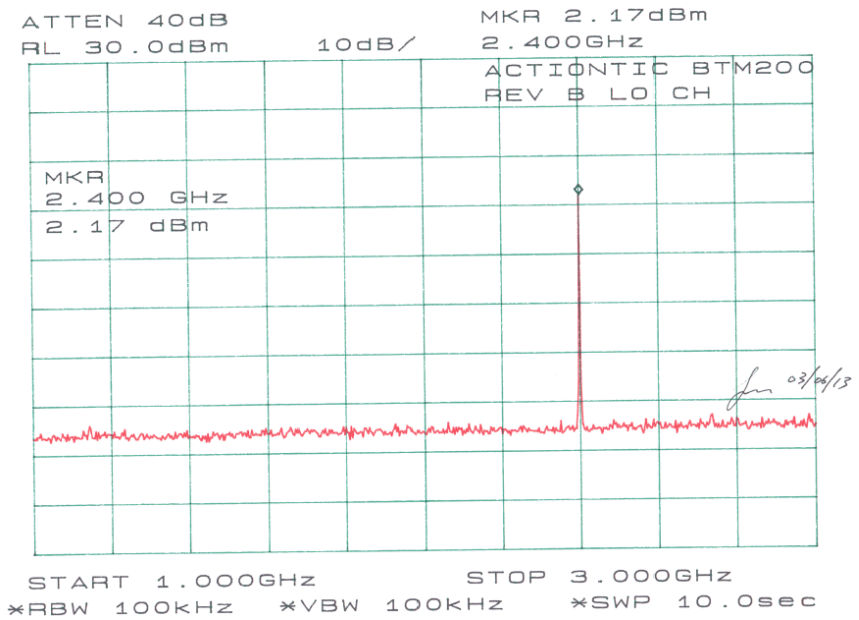
10.3 Test Equipment

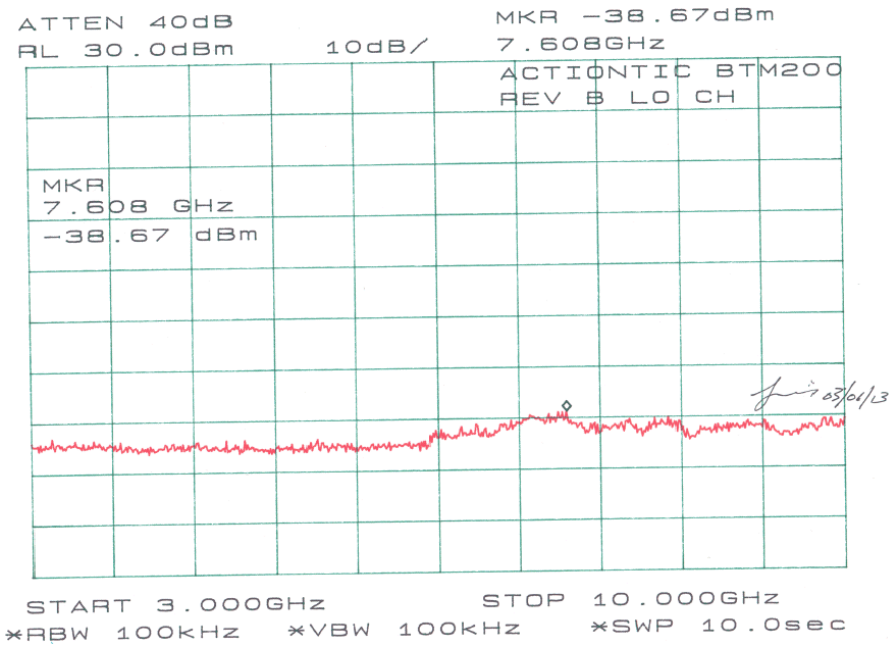
Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	8564E	3943A01781	2003-08-01

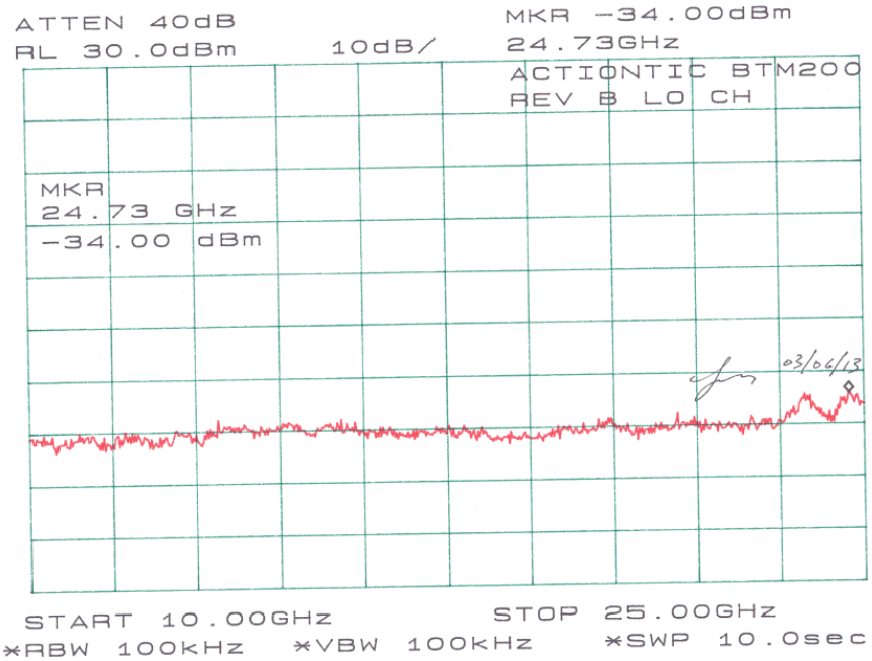
10.4 Measurement Results

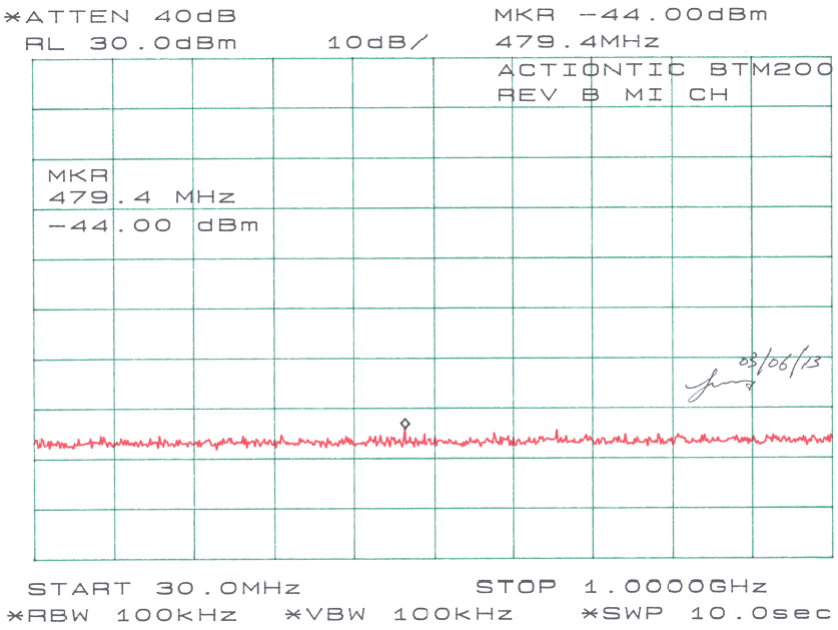
Please refer to the following plots.

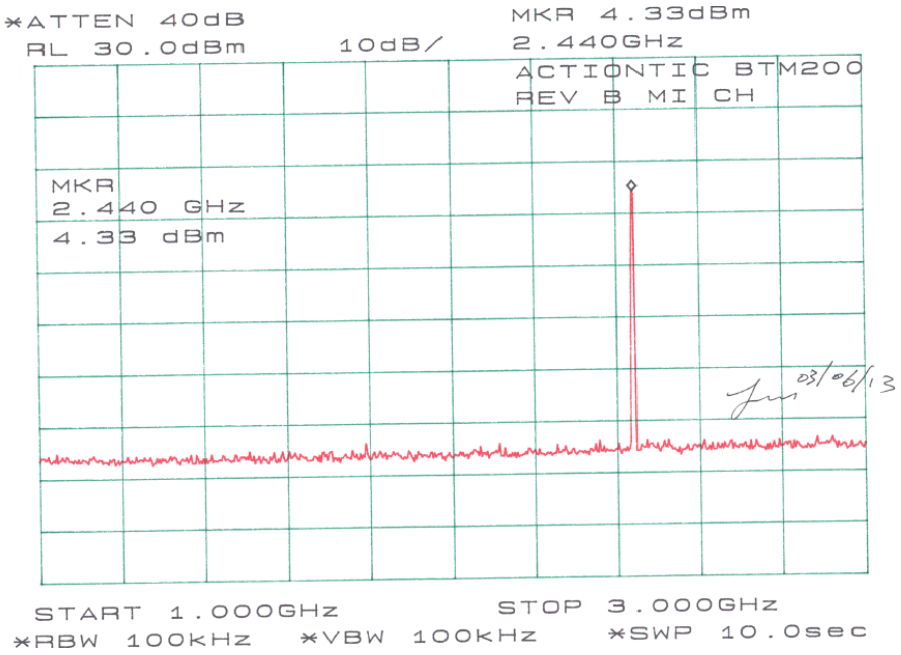

ATTEN 40dB
RL 30.0dBm
10dB/
MKR -44.50dBm
903.0MHz
ACTIONTIC BTM200
REV B LO CH
MKR
903.0 MHz
-44.50 dBm
03/04/13
START 30.0MHz
STOP 1.0000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec

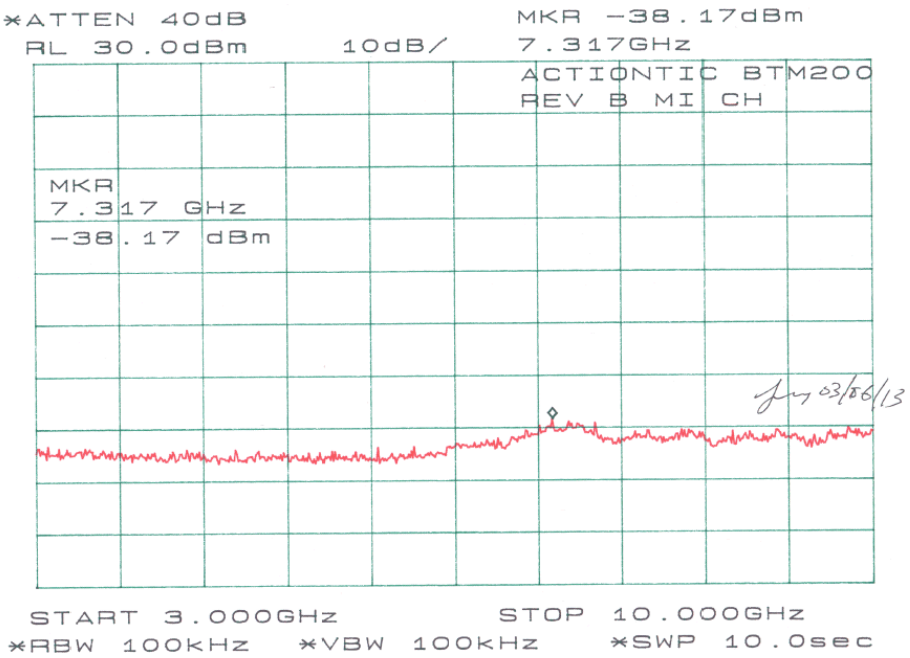

ATTEN 40dB
RL 30.0dBm
10dB/
MKR 2.17dBm
2.400GHz
ACTIONTIC BTM200
REV B LO CH
MKR
2.400 GHz
2.17 dBm
03/04/13
START 1.000GHz
STOP 3.000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec

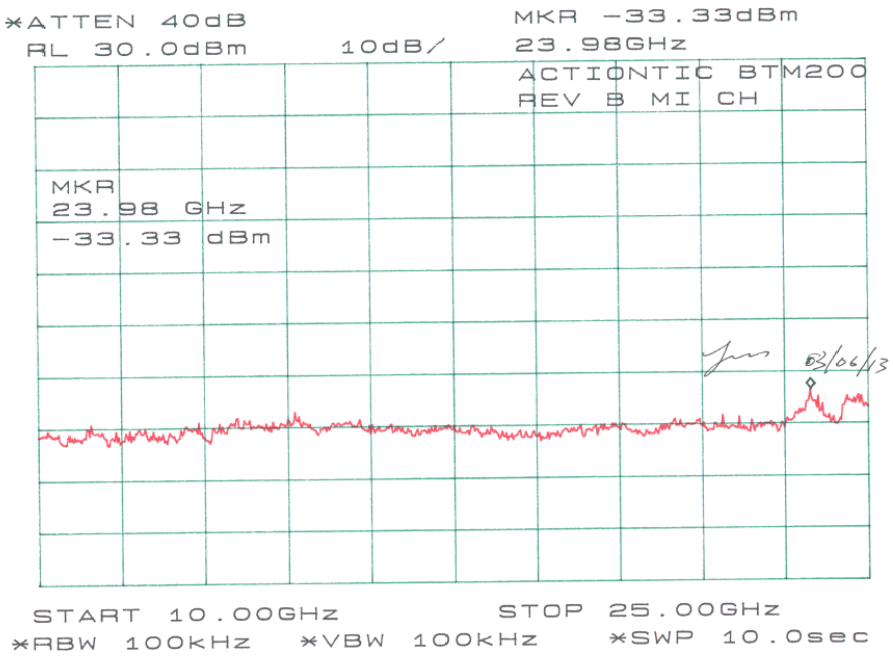

ATTEN 40dB
RL 30.0dBm
10dB/
MKR -38.67dBm
7.608GHz
ACTIONTIC BTM200
REV B LO CH
MKR
7.608 GHz
-38.67 dBm
03/04/13
START 3.000GHz
STOP 10.000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec

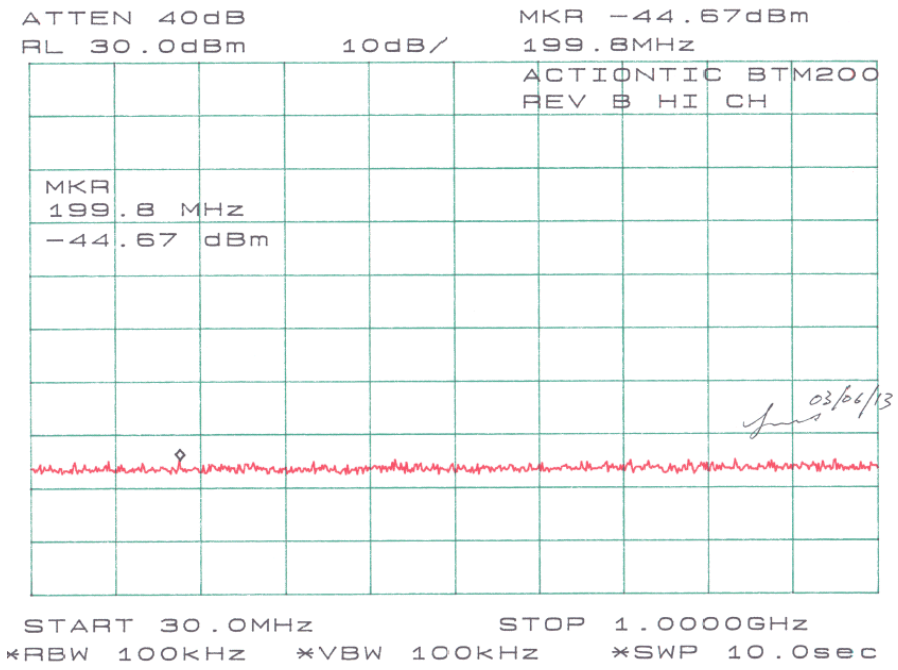

ATTEN 40dB
RL 30.0dBm
10dB/
MKR -34.00dBm
24.73GHz
ACTIONTIC BTM200
REV B LO CH
MKR
24.73 GHz
-34.00 dBm
03/04/13
START 10.00GHz
STOP 25.00GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec

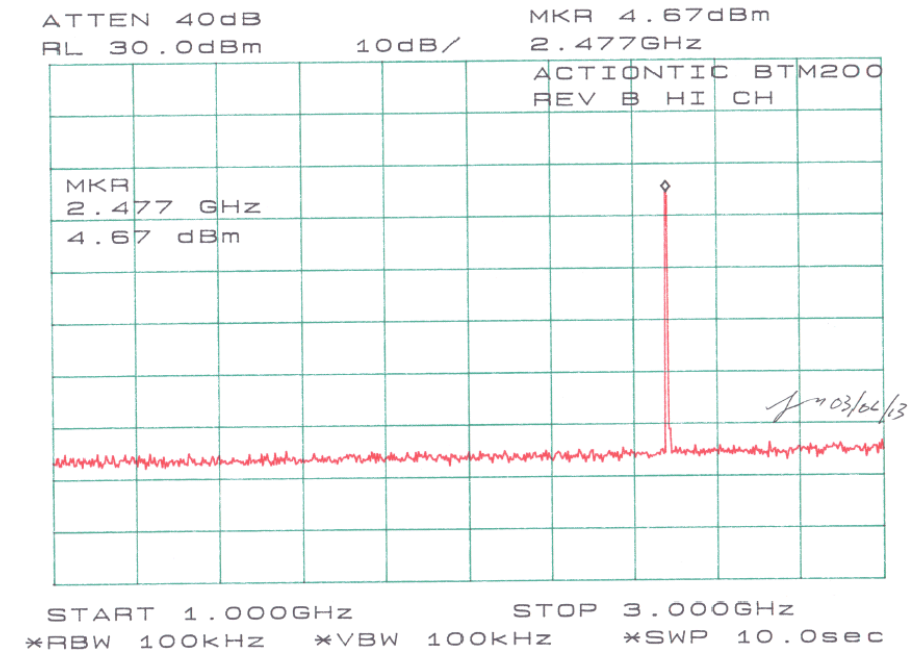

*ATTEN 40dB
RL 30.0dBm
10dB/
MKR -44.00dBm
479.4MHz
ACTIONTIC BTM200
REV B MI CH
MKR
479.4 MHz
-44.00 dBm
03/06/13
START 30.0MHz
STOP 1.0000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec

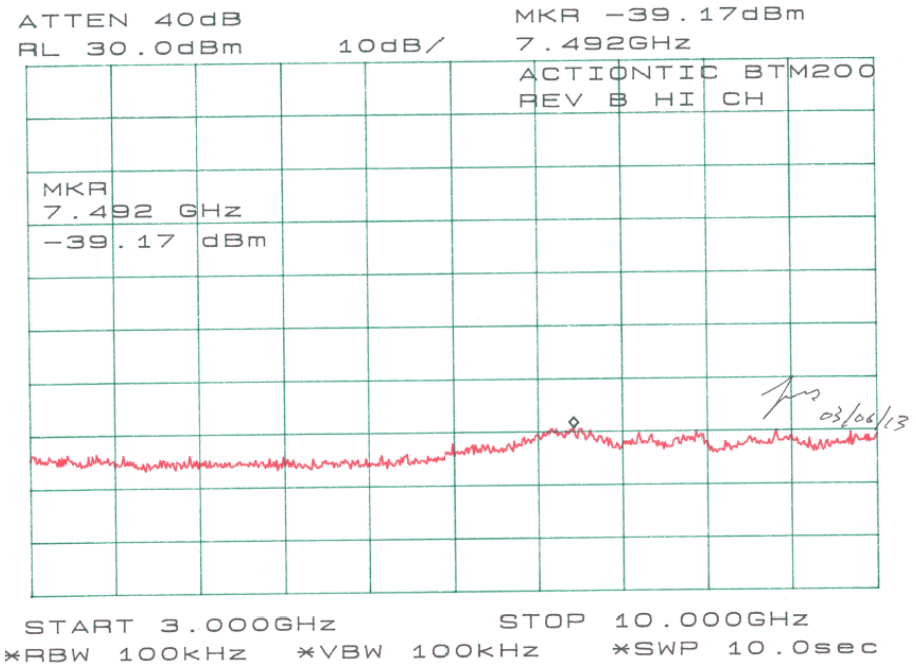

*ATTEN 40dB
RL 30.0dBm
10dB/
MKR 4.33dBm
2.440GHz
ACTIONTIC BTM200
REV B MI CH
MKR
2.440 GHz
4.33 dBm
03/06/13
START 1.000GHz
STOP 3.000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec

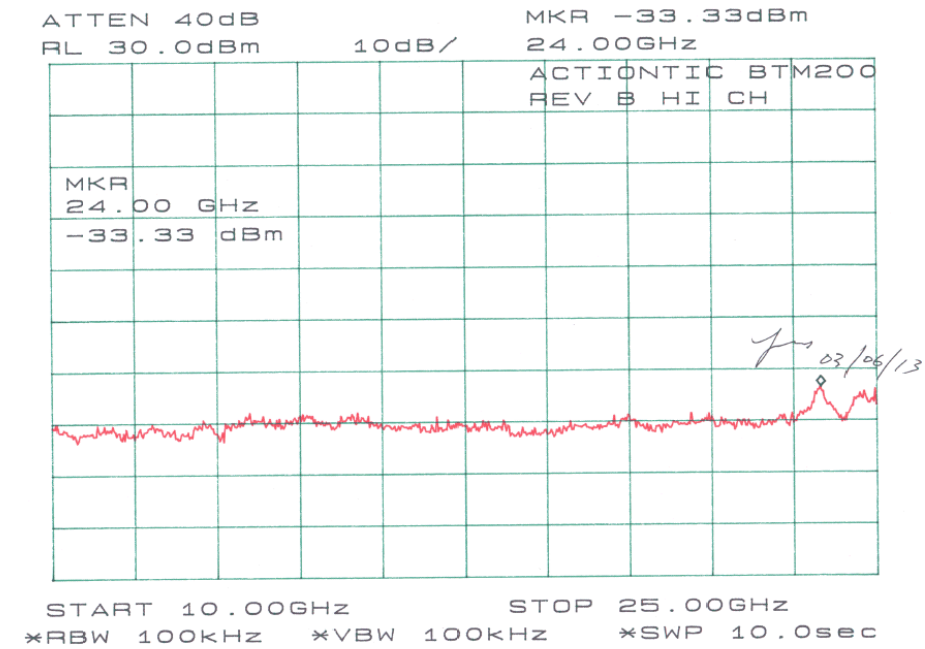

*ATTEN 40dB
RL 30.0dBm
10dB/
MKR -38.17dBm
7.317GHz
ACTIONTIC BTM200
REV B MI CH
MKR
7.317 GHz
-38.17 dBm
03/06/13
START 3.000GHz
STOP 10.000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec


*ATTEN 40dB
RL 30.0dBm
10dB/
MKR -33.33dBm
23.98GHz
ACTIONTIC BTM200
REV B MI CH
MKR
23.98 GHz
-33.33 dBm
03/06/13
START 10.00GHz
STOP 25.00GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -44.67dBm
199.8MHz
ACTIONTIC BTM200
REV B HI CH
MKR
199.8 MHz
-44.67 dBm
03/06/13
START 30.0MHz
STOP 1.0000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 4.67dBm
2.477GHz
ACTIONTIC BTM200
REV B HI CH
MKR
2.477 GHz
4.67 dBm
03/06/13
START 1.000GHz
STOP 3.000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -39.17dBm
7.492GHz
ACTIONTIC BTM200
REV B HI CH
MKR
7.492 GHz
-39.17 dBm
03/06/13
START 3.000GHz
STOP 10.000GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec


ATTEN 40dB
RL 30.0dBm
10dB/
MKR -33.33dBm
24.00GHz
ACTIONTIC BTM200
REV B HI CH
MKR
24.00 GHz
-33.33 dBm
03/06/13
START 10.00GHz
STOP 25.00GHz
*RBW 100kHz
*VBW 100kHz
*SWP 10.0sec

11 - RADIATED EMISSION

11.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. 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.

11.2 Test 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 laptop notebook was placed on the center of the back edge on the test table with the EUT connected to it.

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 laptop was connected with 120Vac/60Hz power source.

11.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 25000 MHz.

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

Start Frequency	30 MHz
Stop Frequency	25000 MHz
Sweep Speed	Auto
IF Bandwidth	1 MHz
Video Bandwidth	1 MHz
Quasi-Peak Adapter Bandwidth	120 kHz
Quasi-Peak Adapter Mode	Normal
Resolution Bandwidth	1MHz

11.4 Test Procedure

For the radiated emissions test, both the laptop and all peripheral power cords were connected to the AC floor outlet since the power supply used in the laptop 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.

11.5 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 Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. - Class B Limit

11.6 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:

-8.4 dB at **7206 MHz** in the **Vertical** polarization, Low Channel.

-6.7 dB at **4882 MHz** in the **Vertical** polarization, Middle Channel.

-6.6 dB at **4960 MHz** in the **Vertical** polarization, High Channel.

-51.8 dB at **660.10 MHz** in the **Horizontal** polarization, Unintentional Emission

11.7 Radiated Emission Test Data

Indicated			Antenna	Antenna		Correction Factor			FCC 15 Subpart C		
Freqency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin	Mode
MHz	dBμV/m	Degree	Meter	H/V	dBμV/m	dBμV/m	dB	dBμV/m	dBμV/m	dB	
Low Channel											
2402.00	97.17	140	1.6	V	28.1	3.4	35.2	93.4			FUND/PEAK
2402.00	90.00	180	1.8	H	28.1	3.4	35.2	86.3			FUND/PEAK
2402.00	96.84	140	1.6	V	28.1	3.4	35.2	93.1			FUND/AVE
2402.00	89.34	180	1.8	H	28.1	3.4	35.2	85.6			FUND/AVE
7206.00	38.37	140	1.5	V	35.1	5.6	33.5	45.6	54	-8.4	AVE
7206.00	38.34	185	1.5	H	35.1	5.6	33.5	45.6	54	-8.4	AVE
4804.00	36.05	130	1.7	V	32.5	4.9	33.0	40.5	54	-13.5	AVE
4804.00	35.90	170	1.7	H	32.5	4.9	33.0	40.3	54	-13.7	AVE
7206.00	50.06	140	1.5	V	35.1	5.6	33.5	57.3	74	-16.7	PEAK
7206.00	49.84	185	1.5	H	35.1	5.6	33.5	57.1	74	-16.9	PEAK
4804.00	49.10	130	1.7	V	32.5	4.9	33.0	53.5	74	-20.5	PEAK
4804.00	47.73	170	1.7	H	32.5	4.9	33.0	52.1	74	-21.9	PEAK
Middle Channel											
2441.00	96.67	80	1.0	V	28.1	3.4	35.2	92.9			FUND/PEAK
2441.00	88.34	30	1.7	H	28.1	3.4	35.2	84.6			FUND/PEAK
2441.00	95.84	80	1.0	V	28.1	3.4	35.2	92.1			FUND/AVE
2441.00	87.50	30	1.7	H	28.1	3.4	35.2	83.8			FUND/AVE
4882.00	42.90	70	1.1	V	32.5	4.9	33.0	47.3	54	-6.7	AVE
4882.00	42.56	40	1.8	H	32.5	4.9	33.0	47.0	54	-7.0	AVE
7323.00	39.27	60	1.2	V	35.1	5.6	33.5	46.5	54	-7.5	AVE
7323.00	39.07	20	1.7	H	35.1	5.6	33.5	46.3	54	-7.7	AVE
4882.00	53.90	70	1.1	V	32.5	4.9	33.0	58.3	74	-15.7	PEAK
4882.00	53.23	40	1.8	H	32.5	4.9	33.0	57.6	74	-16.4	PEAK
7323.00	49.27	60	1.2	V	35.1	5.6	33.5	56.5	74	-17.5	PEAK
7323.00	49.15	20	1.7	H	35.1	5.6	33.5	56.4	74	-17.6	PEAK
High Channel											
2480.00	102.15	160	1.0	V	28.1	3.4	35.2	98.4			FUND/PEAK
2480.00	87.50	170	1.6	H	28.1	3.4	35.2	83.8			FUND/PEAK
2480.00	100.82	160	1.0	V	28.1	3.4	35.2	97.1			FUND/AVE
2480.00	86.50	170	1.6	H	28.1	3.4	35.2	82.8			FUND/AVE
4960.00	42.98	150	1.5	V	32.5	4.9	33.0	47.4	54	-6.6	AVE
7440.00	39.00	160	1.2	V	35.1	5.6	33.5	46.2	54	-7.8	AVE
7440.00	38.50	180	1.6	H	35.1	5.6	33.5	45.7	54	-8.3	AVE
4960.00	37.23	175	1.7	H	32.5	4.9	33.0	41.6	54	-12.4	AVE
4960.00	53.90	150	1.5	V	32.5	4.9	33.0	58.3	74	-15.7	PEAK
7440.00	49.00	160	1.2	V	35.1	5.6	33.5	56.2	74	-17.8	PEAK
7440.00	48.67	180	1.6	H	35.1	5.6	33.5	55.9	74	-18.1	PEAK
4960.00	48.40	175	1.7	H	32.5	4.9	33.0	52.8	74	-21.2	PEAK

Unintentional Emission

Indicated			Antenna	Antenna		Correction Factor			FCC 15 Subpart C	
Frequency MHz	Ampl. dBμV/m	Direction Degree	Height Meter	Polar H/V	Antenna dBμV/m	Cable Loss dBμV/m	Amp. dB	Corr. Ampl. dBμV/m	Limit dBμV/m	Margin dB
660.10	37.38	30	1.8	H	20.8	3.0	25.0	36.2	74	-37.8
850.20	34.81	160	1.7	V	22.4	3.8	25.0	36.1	74	-38.0
295.60	43.61	90	1.7	V	13.7	2.3	25.0	34.6	74	-39.4
385.60	40.22	150	1.0	V	15.6	2.4	25.0	33.2	74	-40.8
235.20	43.19	180	1.6	H	12.6	2.2	25.0	33.0	74	-41.0
118.40	42.50	30	1.7	V	11.5	1.6	25.0	30.6	74	-43.4
79.50	40.32	270	1.7	V	9.4	1.2	25.0	25.8	74	-48.2

12 - CONDUCTED EMISSION

12.1 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. 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.

12.2 Test Setup

The measurement was performed at shield room, using the same setup per ANSI C63.4 – 1992 measurement procedure. The specification used was FCC Class B limits.

The laptop notebook was placed on the center of the back edge on the test table with the EUT connected to it.

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

The laptop was connected with 120Vac/60Hz power source.

12.3 Spectrum Analyzer Setup

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

Start Frequency	150 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

12.4 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**".

12.5 Summary of Test Results

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

-10.0 dBµV at 0.17 MHz in the Line mode

12.6 Conducted Emissions Test Data

LINE CONDUCTED EMISSIONS				FCC CLASS B	
Frequency MHz	Amplitude dBµV	Detector Qp/Ave/Peak	Phase Line/Neutral	Limit dBµV	Margin dB
0.17	54.00	QP	Line	64	-10.0
0.17	38.20	AVG	Line	54	-15.8
0.15	46.10	QP	Neutral	64	-17.9
0.23	42.60	QP	Neutral	62	-19.4
0.23	31.50	AVG	Neutral	52	-20.5
0.37	35.30	QP	Line	57	-21.7
0.27	39.50	QP	Line	62	-22.5
0.28	27.60	AVG	Neutral	51	-23.4
0.28	36.70	QP	Neutral	61	-24.3
0.27	26.90	AVG	Line	52	-25.1
0.37	21.00	AVG	Line	47	-26.0
0.15	26.60	AVG	Neutral	54	-27.4

12.7 Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented in the following page as reference.

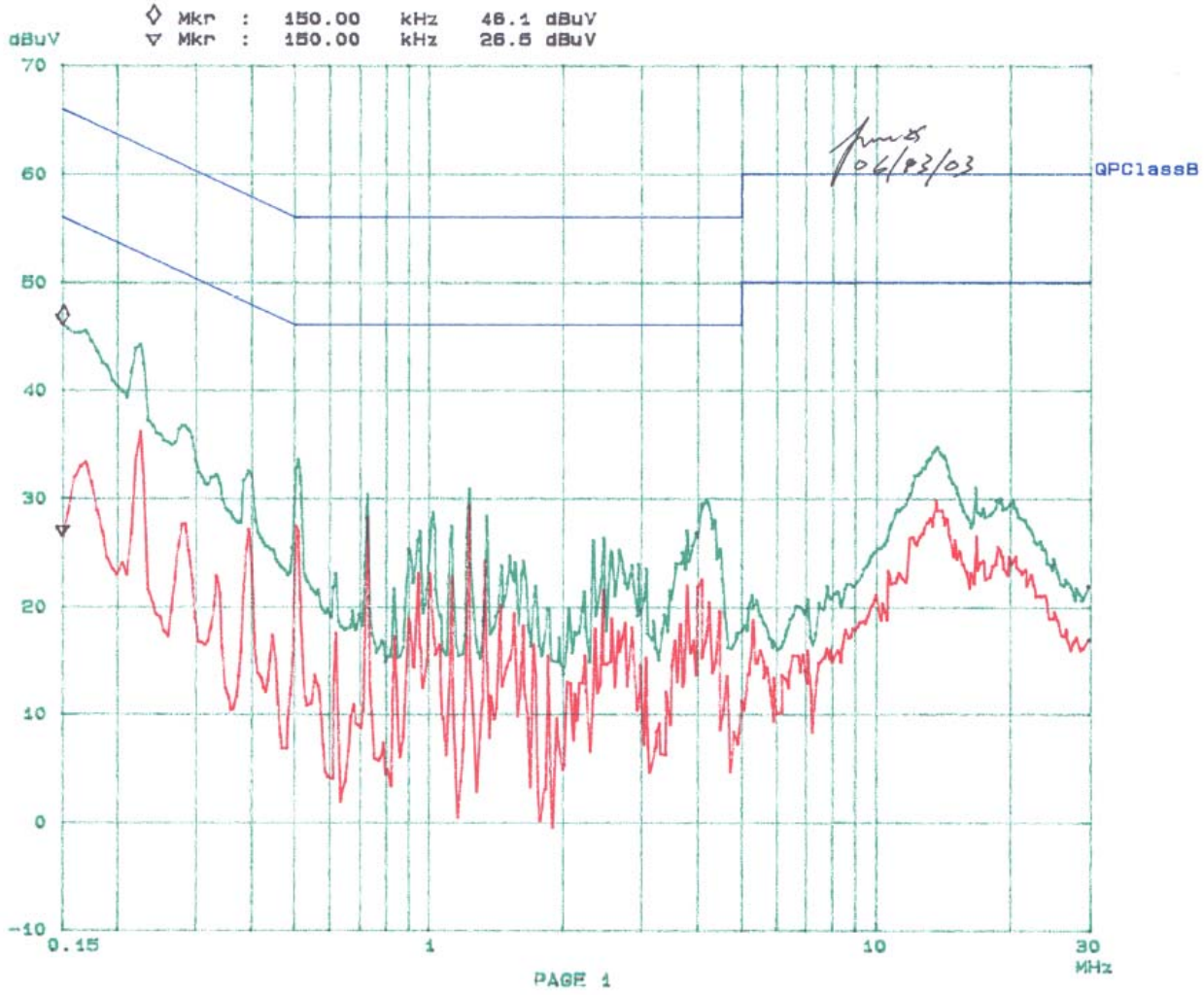
Bay Area Compliance Corporation 13. Jun 03 09:32
CISPR CLASS B

EUT: btm 200 rev B
Manuf: Actiontec
Op Cond: Normal
Operator: James
Comment: Neutral
File name: SEANIXL.RES

Scan Settings (3 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	1M	5k	9k	QP+AV	20ms	10dBLN	OFF
1M	10M	10k	9k	QP+AV	1ms	10dBLN	OFF
10M	30M	100k	9k	QP+AV	1ms	10dBLN	OFF

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 6dB



PAGE 1

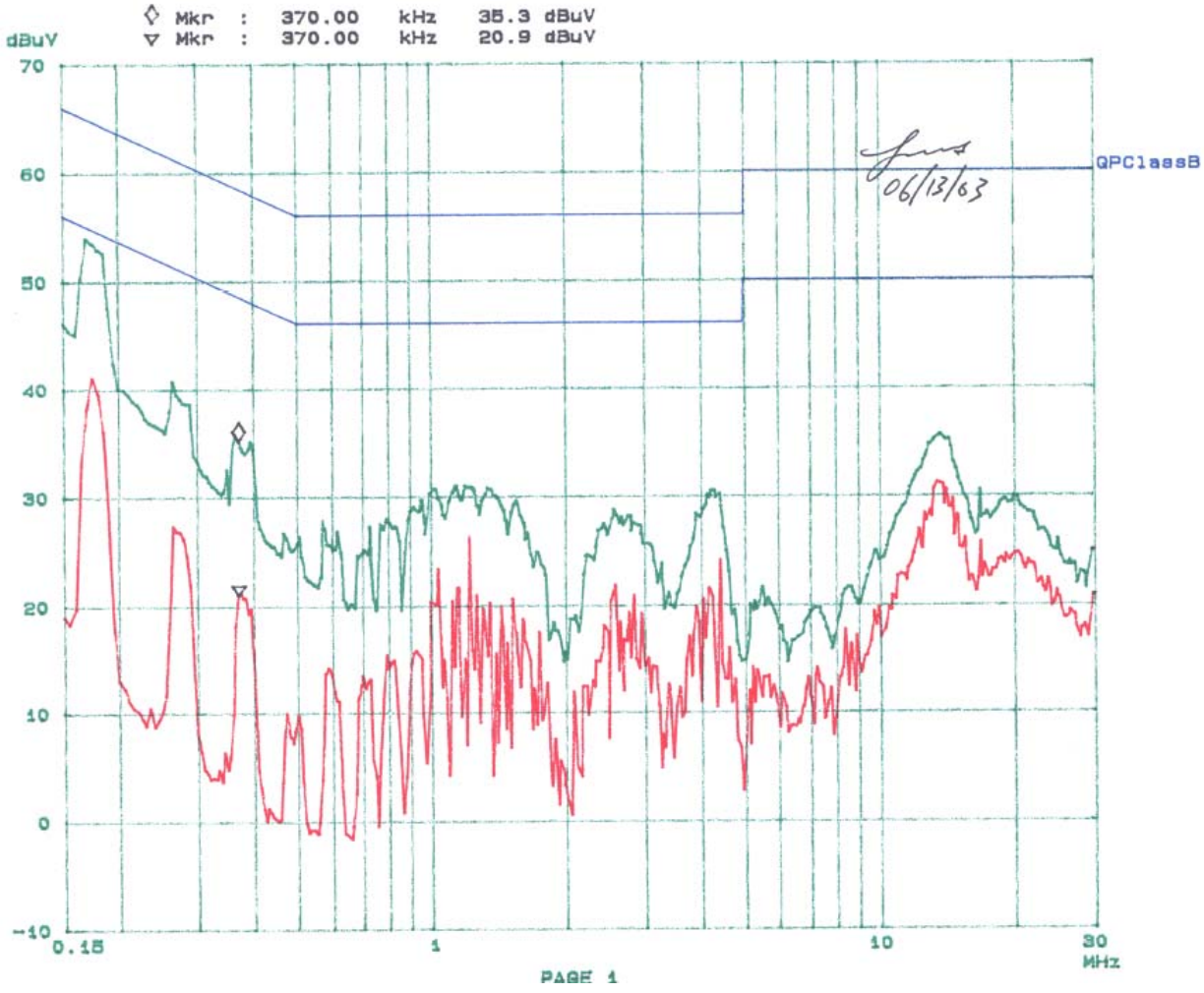
Bay Area Compliance Corporation 13. Jun 03 09:04
CISPR CLASS B

EUT: btm 200 rev B
Manuf: Actiontec
Op Cond: Normal
Operator: James
Comment: Line
File name: SEANIXL.RES

Scan Settings (3 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	1M	5k	9k	QP+AV	20ms	10dBLN	OFF
1M	10M	10k	9k	QP+AV	1ms	10dBLN	OFF
10M	30M	100k	9k	QP+AV	1ms	10dBLN	OFF

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 25
Acc Margin: 6dB



13 - ANTENNA REQUIREMENT

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.

The gain of antenna used for transmitting is 1 dBi by default, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

14 - 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: 5.00 (dBm)
Maximum peak output power at antenna input terminal: 3.16 (mW)
Prediction distance: 20 (cm)
Predication frequency: 2400 (MHz)
Antenna Gain (typical): 1 (dBi)
Maximum antenna gain: 1.26(numeric)
Power density at predication frequency at 20 cm: 0.0008(mW/cm^2)
MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm^2)

Test Result

The predicted power density level at 20 cm is 0.0008 mW/cm^2. This is below the uncontrolled exposure limit of 1mW/cm^2 at 2400 MHz. The EUT is used at least 3cm away from user's body, so it is determined as portable equipment.