

FCC PART 15 SUBPART C
EMI MEASUREMENT AND TEST REPORT

For

Actiontec Electronics, Inc.

760 N. Mary Ave.
Sunnyvale, CA 94086

FCC ID: LNQBTM200

February 26, 2003

This Report Concerns: <input checked="" type="checkbox"/> Original Report	Equipment Type: USB Bluetooth Wireless Module
Test Engineer: <u>Jerry Wang</u>	
Report No.: <u>R0302101</u>	
Test Date: <u>February 12, 2003</u>	
Reviewed By: <u>Hans Mellberg</u>	
Prepared By: Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164	

Note: This test report is specially limited to the above client company and product model only. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

TABLE OF CONTENTS

1 - GENERAL INFORMATION.....	4
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	4
1.2 OBJECTIVE	4
1.3 RELATED SUBMITTAL(S)/GRANT(S).....	4
1.4 TEST METHODOLOGY	4
1.5 TEST FACILITY	5
1.6 TEST EQUIPMENT LIST	5
1.7 HOST SYSTEM CONFIGURATION LIST AND DETAILS	6
1.8 EXTERNAL I/O CABLING LIST AND DETAILS	6
2 - SYSTEM TEST CONFIGURATION.....	7
2.1 JUSTIFICATION	7
2.2 EUT EXERCISE SOFTWARE	7
2.3 SPECIAL ACCESSORIES.....	7
2.4 SCHEMATICS / BLOCK DIAGRAM	7
2.5 EQUIPMENT MODIFICATIONS	7
2.6 CONFIGURATION OF TEST SYSTEM.....	8
2.7 TEST SETUP BLOCK DIAGRAM	8
3 - SUMMARY OF TEST RESULTS.....	9
4 - MAXIMUM PEAK OUTPUT POWER.....	10
4.1 STANDARD APPLICABLE	10
4.2 MEASUREMENT PROCEDURE.....	10
4.3 TEST EQUIPMENT	10
4.4 MEASUREMENT RESULT	10
4.5 PLOTS OF MAXIMUM PEAK OUTPUT POWER	10
5 - CHANNEL BANDWIDTH	14
5.1 STANDARD APPLICABLE	14
5.2 MEASUREMENT PROCEDURE.....	14
5.3 MEASUREMENT RESULT	14
5.4 PLOT OF CHANNEL BANDWIDTH	14
6 - NUMBER OF HOPPING FREQUENCY USED	18
6.1 STANDARD APPLICABLE	18
6.2 MEASUREMENT PROCEDURE.....	18
6.3 MEASUREMENT PROCEDURE.....	18
6.4 PLOTS OF NUMBER OF HOPPING FREQUENCY	18
7 - HOPPING CHANNEL SEPARATION	22
7.1 STANDARD APPLICABLE	22
7.2 MEASUREMENT PROCEDURE.....	22
7.3 MEASUREMENT RESULTS.....	22
7.4 PLOTS OF HOPPING CHANNEL SEPARATION	22
8 - 100 KHZ BANDWIDTH OF BAND EDGES	24
8.1 STANDARD APPLICABLE	24
8.2 MEASUREMENT PROCEDURE.....	24
8.3 MEASUREMENT RESULTS.....	24
8.4 PLOTS OF 100kHz BANDWIDTH OF BAND EDGE	24
9 - DWELL TIME	29
9.1 STANDARD APPLICABLE	29
9.2 MEASUREMENT PROCEDURE.....	29
9.3 MEASUREMENT RESULTS.....	29
9.4 PLOTS OF DWELL TIME	29
10 - SPURIOUS EMISSION AT ANTENNA PORT.....	34

10.1 STANDARD APPLICABLE	34
10.2 MEASUREMENT PROCEDURE.....	34
10.3 MEASUREMENT RESULTS.....	34
11 - RADIATED EMISSION.....	38
11.1 MEASUREMENT UNCERTAINTY	38
11.2 TEST SETUP.....	38
11.3 SPECTRUM ANALYZER SETUP	38
11.4 TEST PROCEDURE	39
11.5 CORRECTED AMPLITUDE & MARGIN CALCULATION	39
11.6 SUMMARY OF TEST RESULTS	39
11.7 RADIATED EMISSION TEST DATA.....	40
12 - CONDUCTED EMISSION	42
12.1 MEASUREMENT UNCERTAINTY	42
12.2 TEST SETUP.....	42
12.3 SPECTRUM ANALYZER SETUP	42
12.4 TEST PROCEDURE	42
12.5 SUMMARY OF TEST RESULTS	43
12.6 CONDUCTED EMISSIONS TEST DATA	43
12.7 PLOT OF CONDUCTED EMISSIONS TEST DATA	43
13 - ANTENNA REQUIREMENT.....	46
EXHIBIT A - FCC ID LABEL INFORMATION	47
PROPOSED FCC ID LABEL.....	47
PROPOSED LABEL LOCATION ON EUT	47
EXHIBIT B - TEST SETUP PHOTOGRAPHS	48
CONDUCTED EMISSION - FRONT VIEW.....	48
CONDUCTED EMISSION - REAR VIEW	48
RADIATED EMISSION - FRONT VIEW	49
RADIATED EMISSION - REAR VIEW	49
RADIATED EMISSION - REAR VIEW 2	50
EXHIBIT C - EUT PHOTOGRAPHS.....	51
EUT – FRONT VIEW	51
EUT – REAR VIEW	51
EUT – COMPONENT VIEW	52
EXHIBIT D - BLOCK DIAGRAM /SCHEMATICS.....	53
EXHIBIT E - OPERATIONAL DESCRIPTION.....	54
EXHIBIT F - USERS MANUAL.....	55

1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

The *Actiontec Electronics, Inc*'s product, model no.:BTM200 or the "EUT" as referred to this report is a USB Bluetooth Wireless Module which is measured approximately 1.1"L x 0.5"W x 0.2"H. The EUT is a standalone complete Bluetooth module with an built-in antenna on it. The module is capable of receiving FCC Part 15 Unlicensed Modular Transmitter approval as a standalone transmitter. It has its own metal shield to cover the RF transmitter. There is an internal regulator to supply power for the transmitter for this purpose.

** 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 C108.8 & RSS-210 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	2610A02165	12/6/03
HP	Spectrum Analyzer	8593B	2919A00242	12/20/03
HP	Amplifier	8349B	2644A02662	12/20/03
HP	Quasi-Peak Adapter	85650A	917059	12/6/03
HP	Amplifier	8447E	1937A01046	12/6/03
A.H. System	Horn Antenna	SAS0200/571	261	12/27/03
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	12/28/03
Com-Power	LISN	LI-200	12208	12/20/03
Com-Power	LISN	LI-200	12005	12/20/03
BACL	Data Entry Software	DES1	0001	12/20/03

* **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
SamSung	Notebook PC	Sapphire	J2N1500S1182	DOC

1.8 External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Cable	1.0	DC Port/ EUT	DC/AC Adapter
USB Cable	0.15	EUT	Notebook

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.

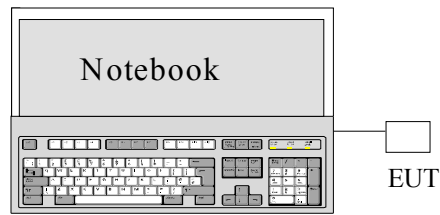
2.4 Schematics / Block Diagram

Please refer to Exhibit D.

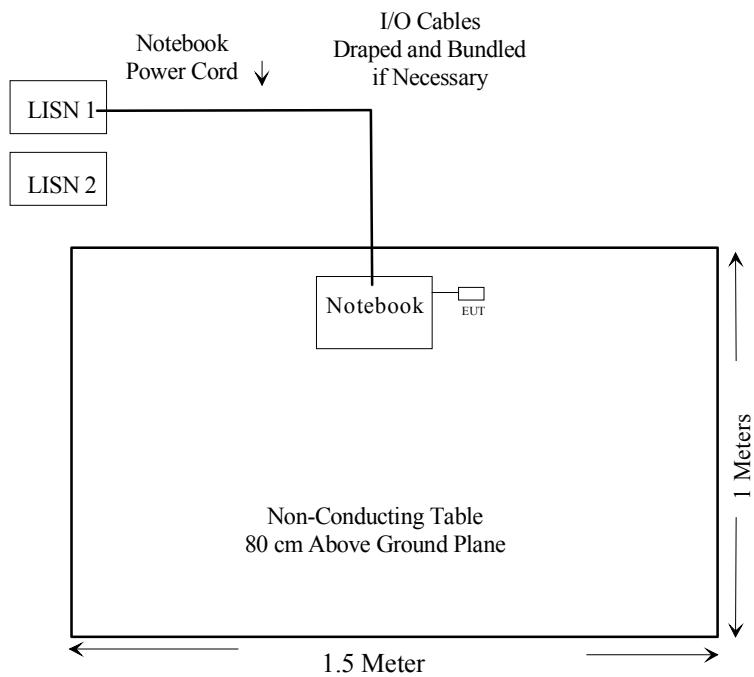
2.5 Equipment Modifications

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

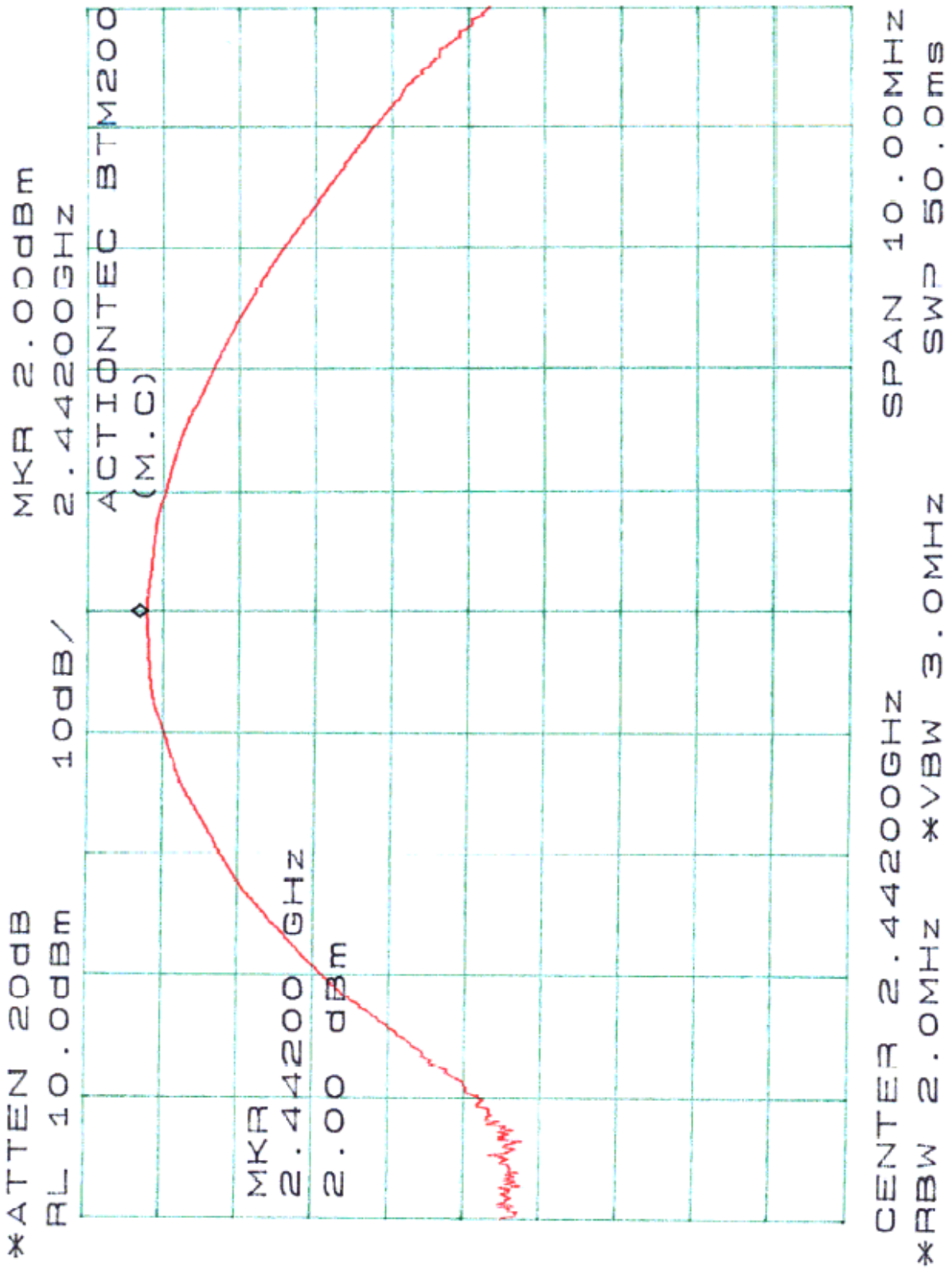
Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	8565EC	648492	5/3/03

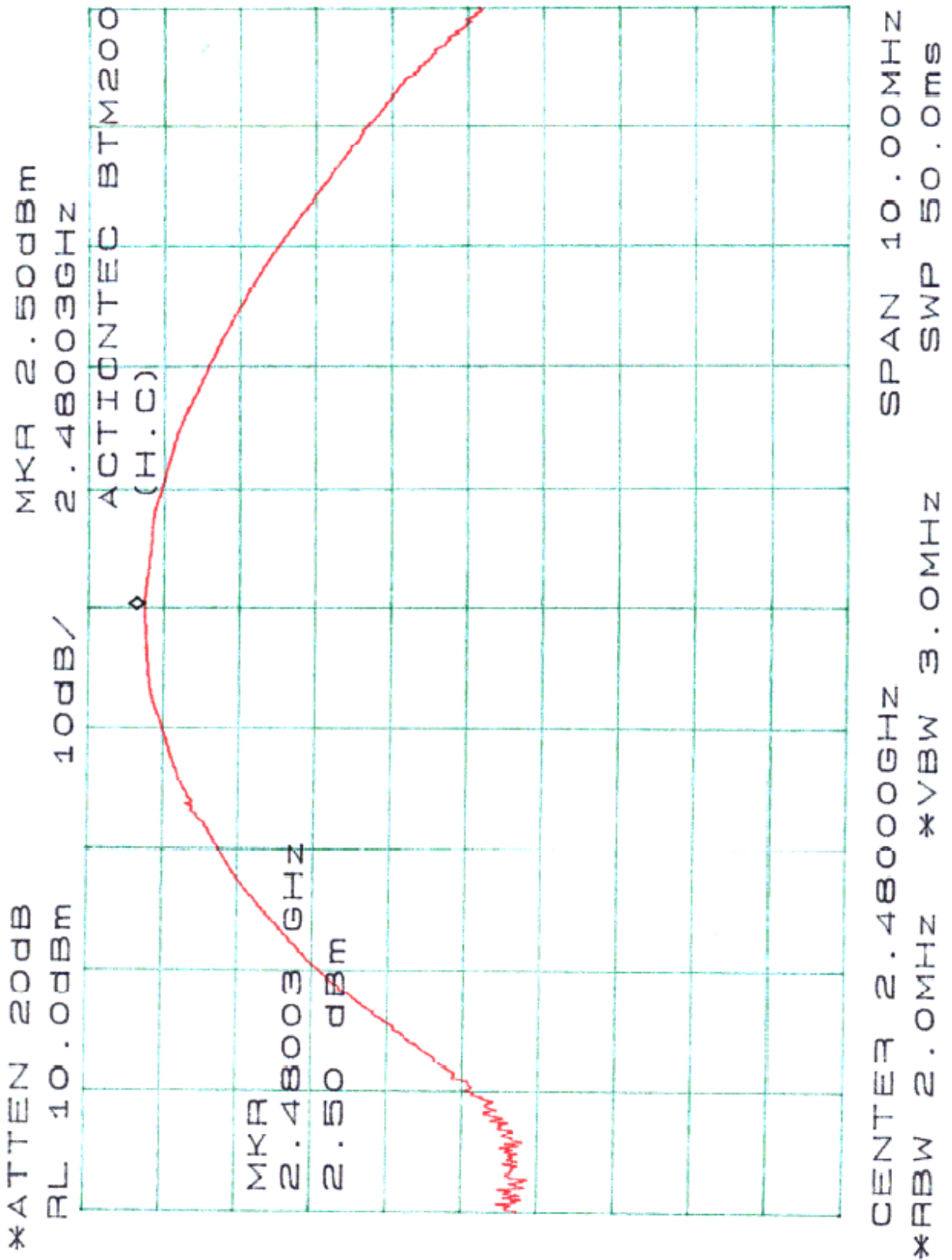
4.4 Measurement Result

Frequency	Output Power in dBm	Output Power in mW	Standard	Result
Low	2.33	1.71	≤ 1W	Compliant
Middle	2.00	1.58	≤ 1W	Compliant
High	2.50	1.78	≤ 1W	Compliant

4.5 Plots of Maximum Peak Output Power

Please refer to following plots.





5 - CHANNEL BANDWIDTH

5.1 Standard Applicable

According to §15.247(a)(1), 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

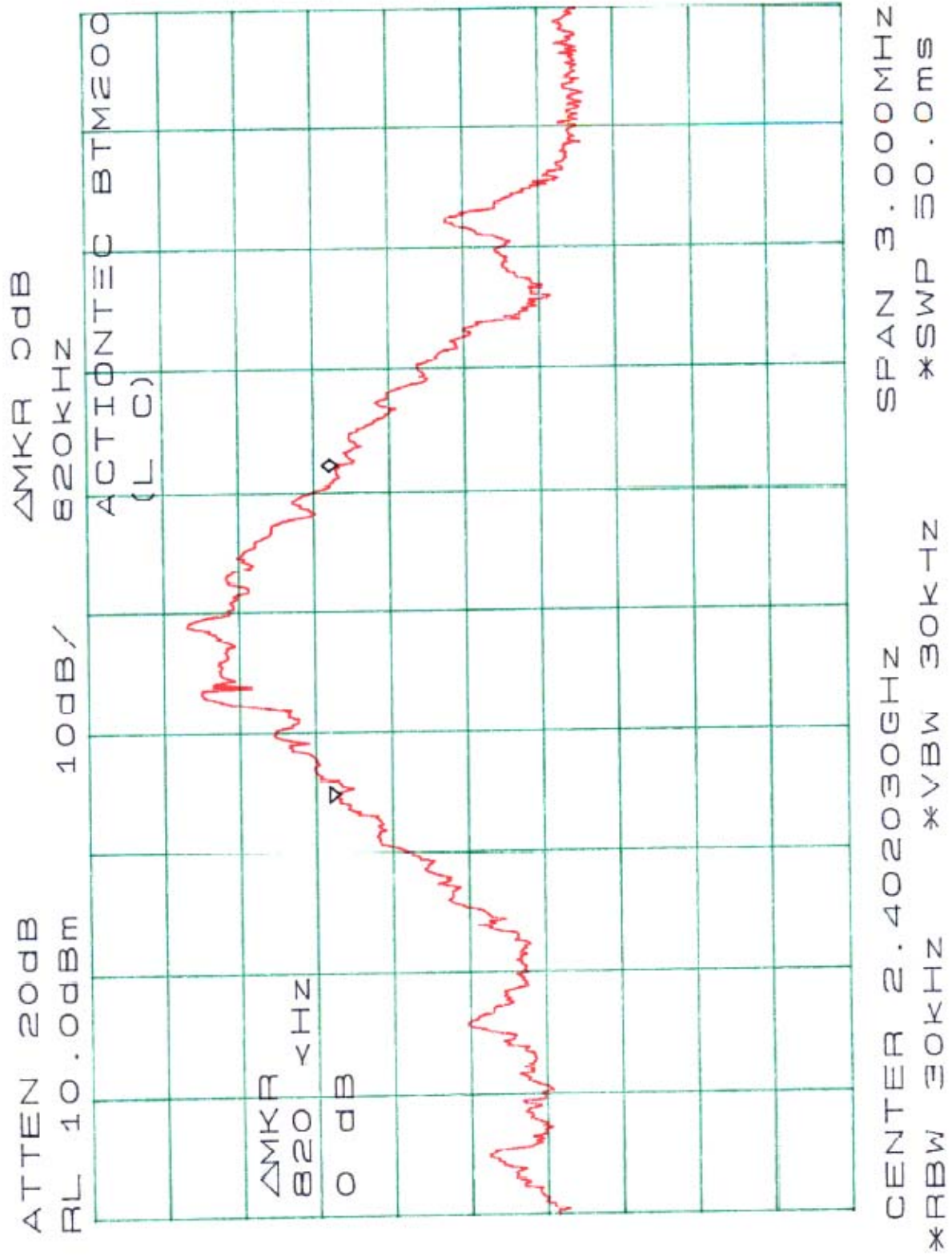
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency 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.

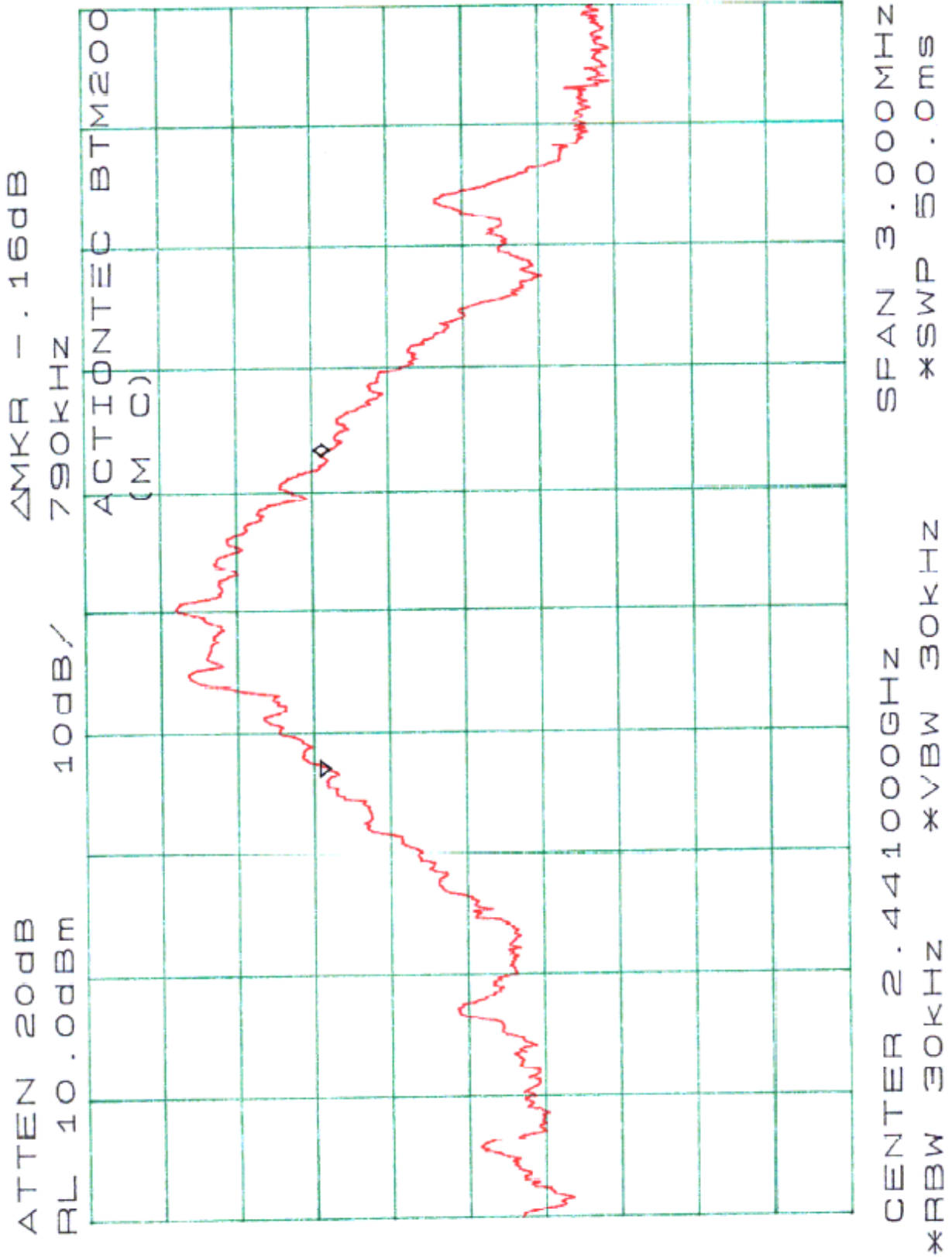
5.3 Measurement Result

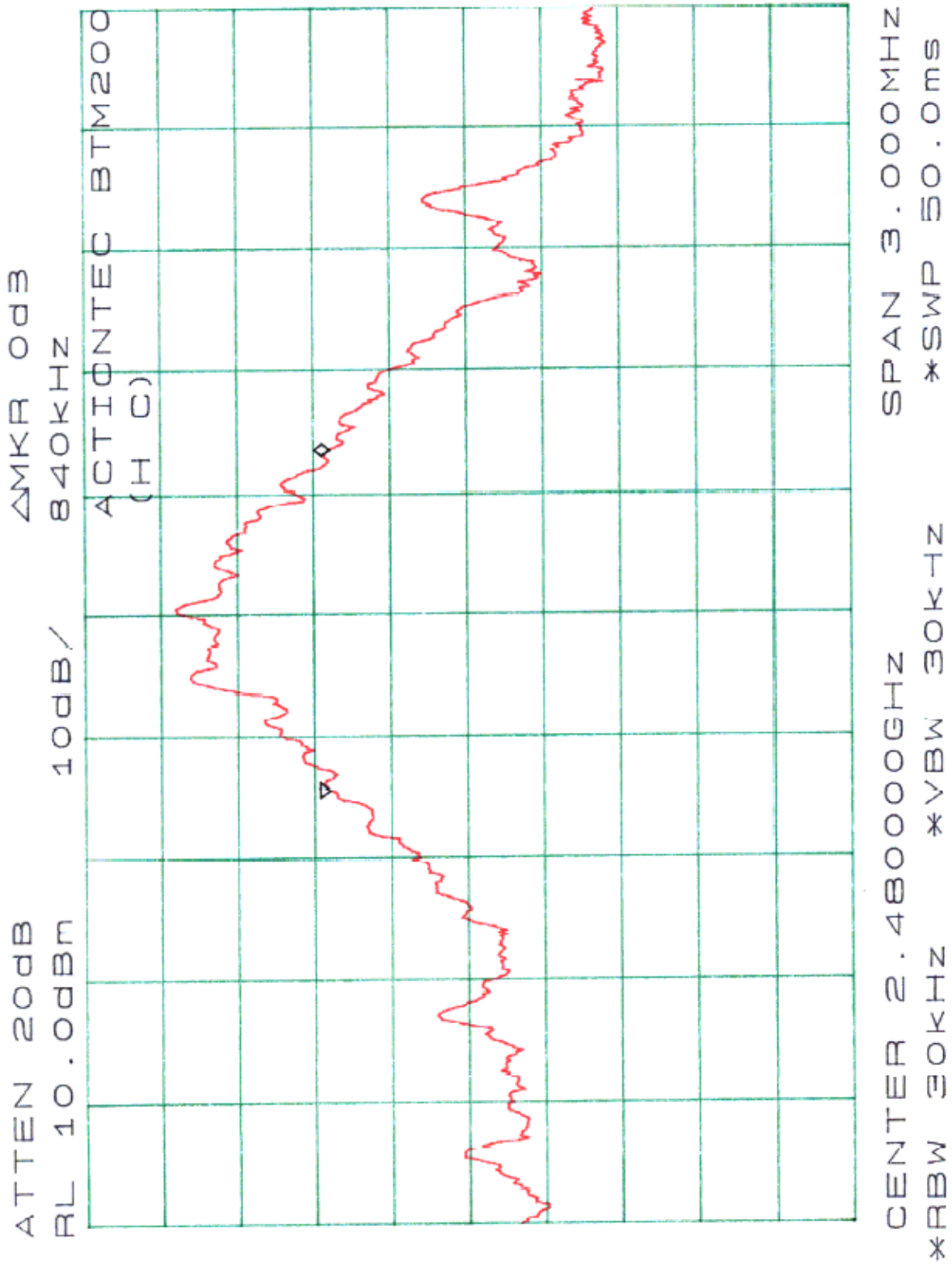
Frequency	Measurement (kHz)	Standard	Result
Low	820	$\leq 1\text{MHz}$	Compliant
Middle	790	$\leq 1\text{MHz}$	Compliant
High	840	$\leq 1\text{MHz}$	Compliant

5.4 Plot of Channel Bandwidth

Please refer to following plots.







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

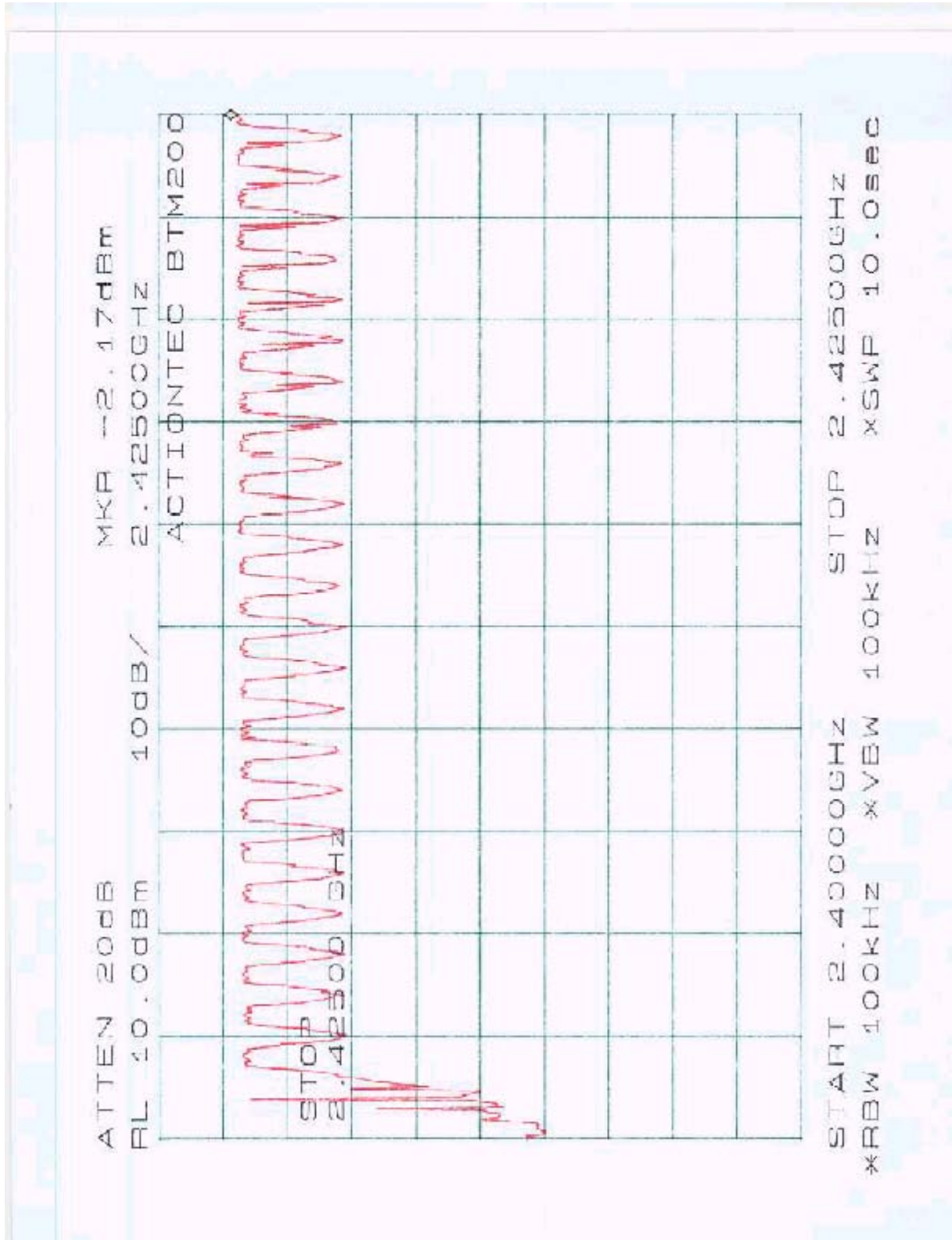
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the bench without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low 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.

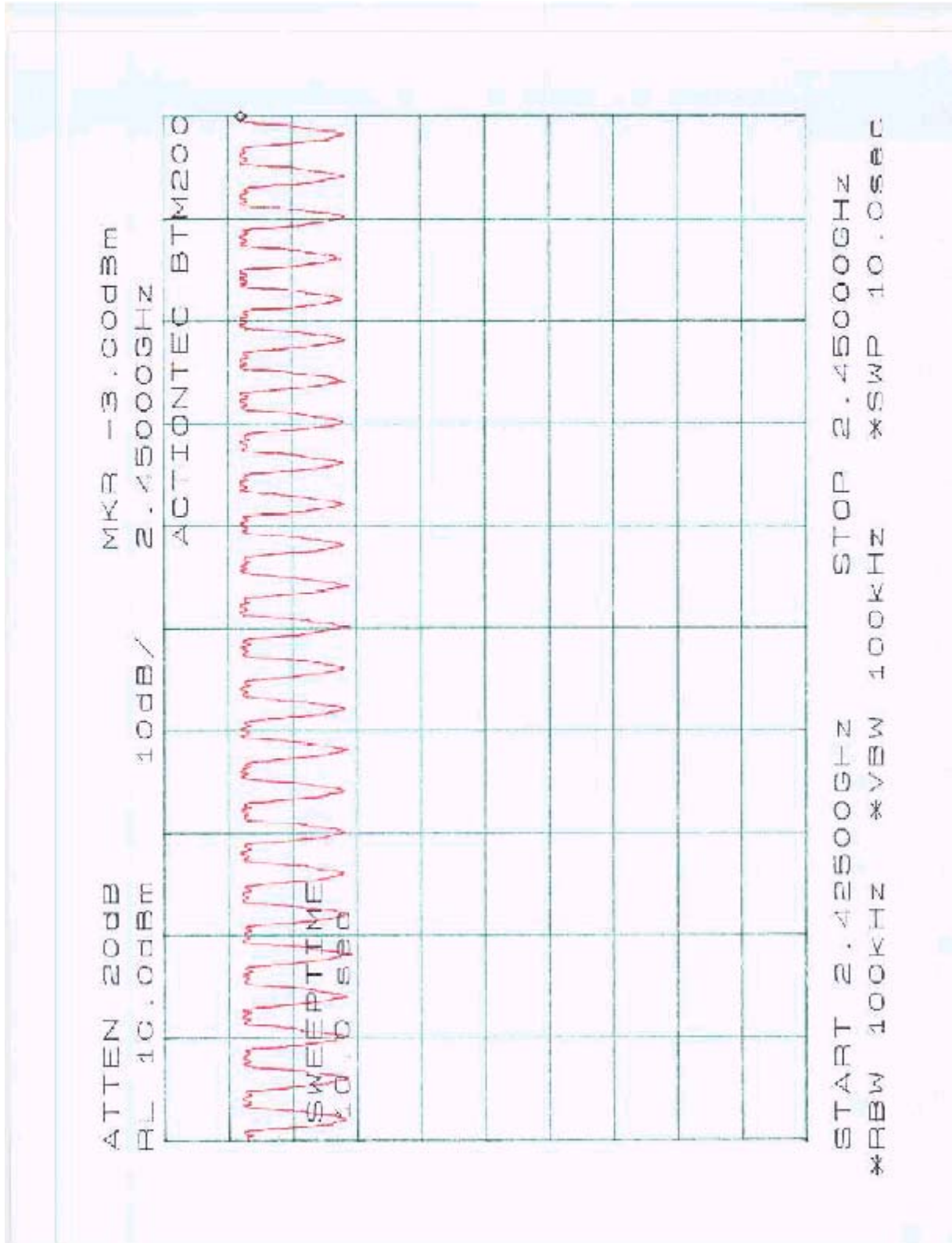
6.3 Measurement Procedure

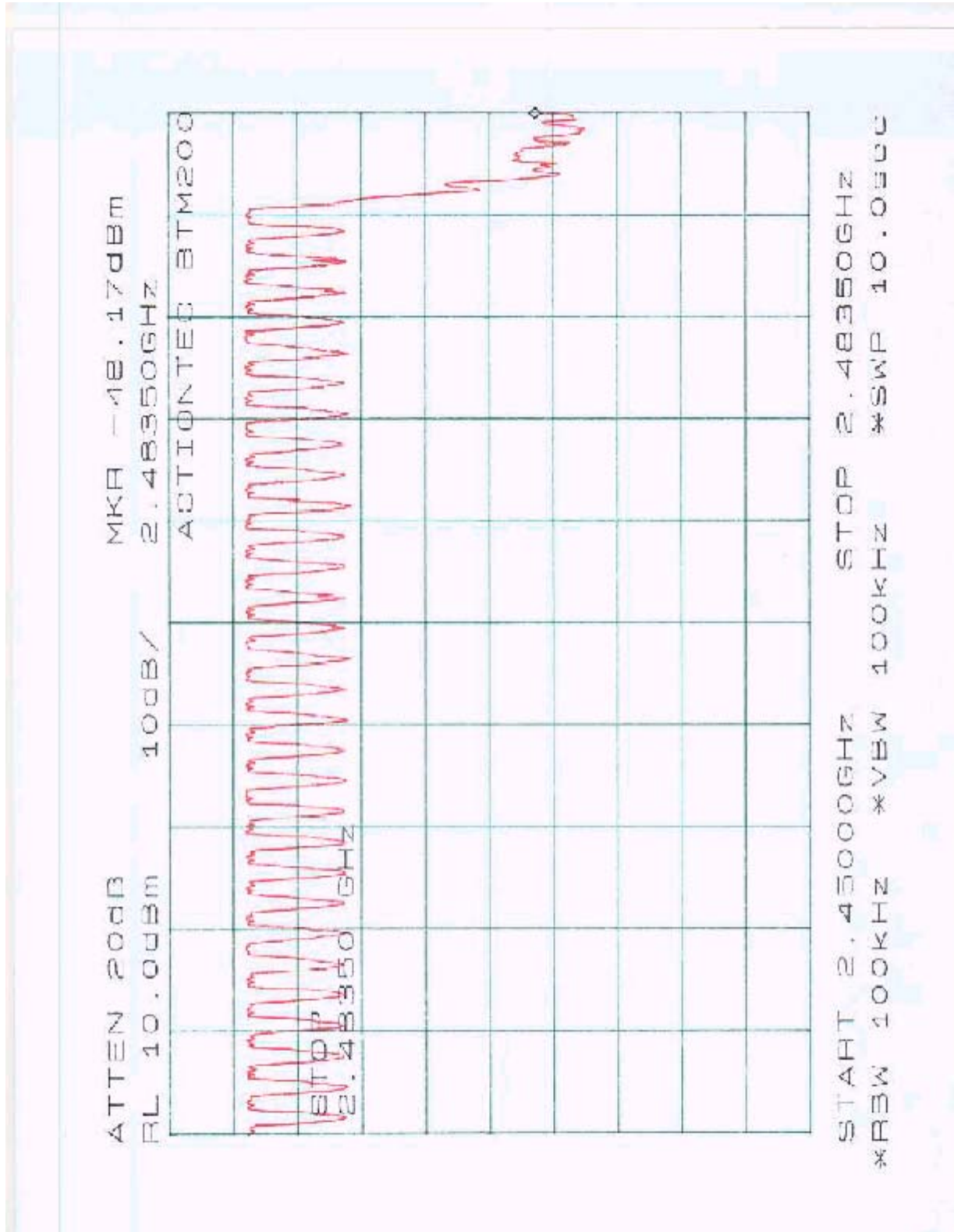
Measurement	Standard	Result
79	75	Compliant

6.4 Plots of Number of Hopping Frequency

Please refer to the attached plots.







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

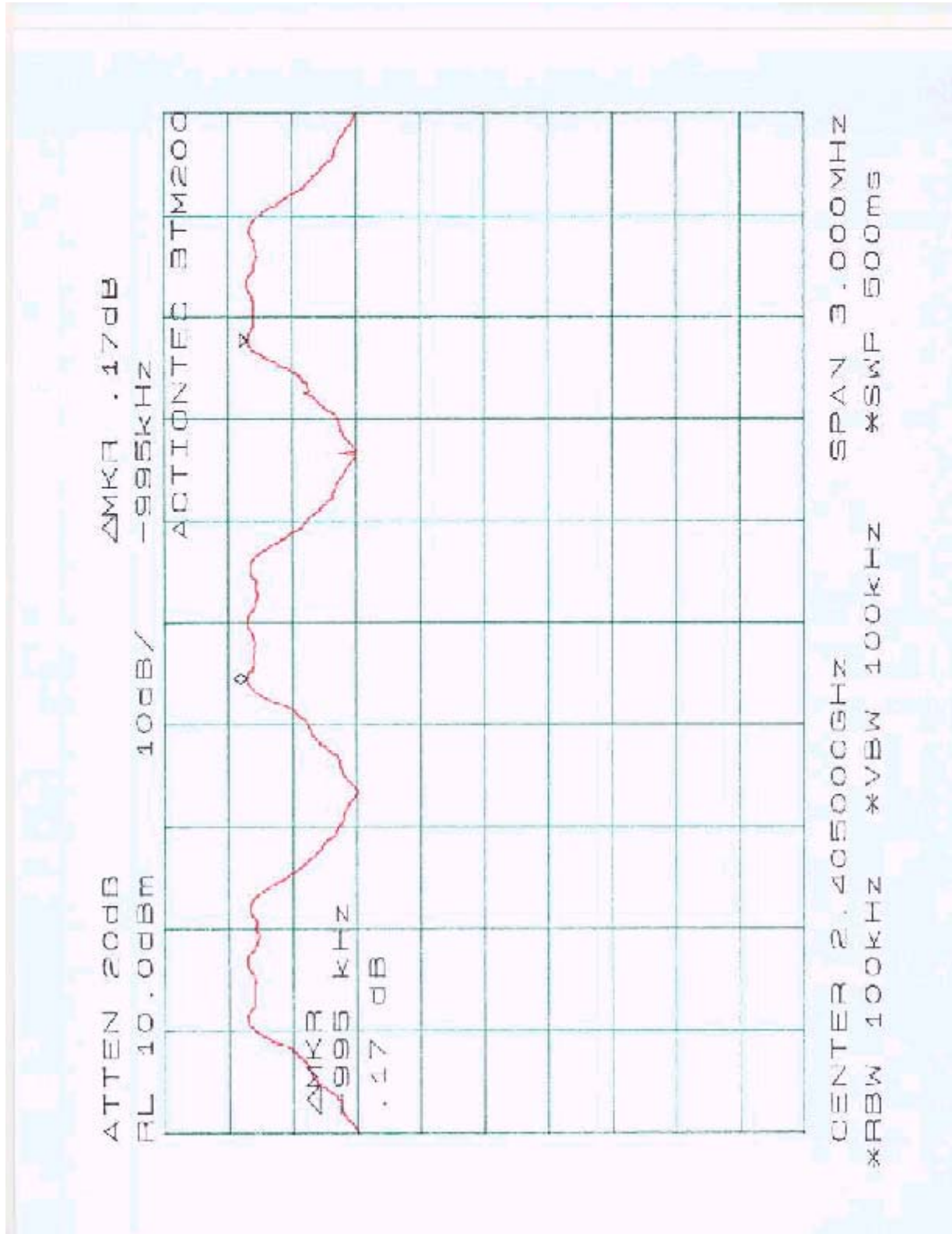
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient 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 Measurement Results

Measurement (kHz)	Result
995	Compliant

7.4 Plots of Hopping Channel Separation

Please refer to the following plots.



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

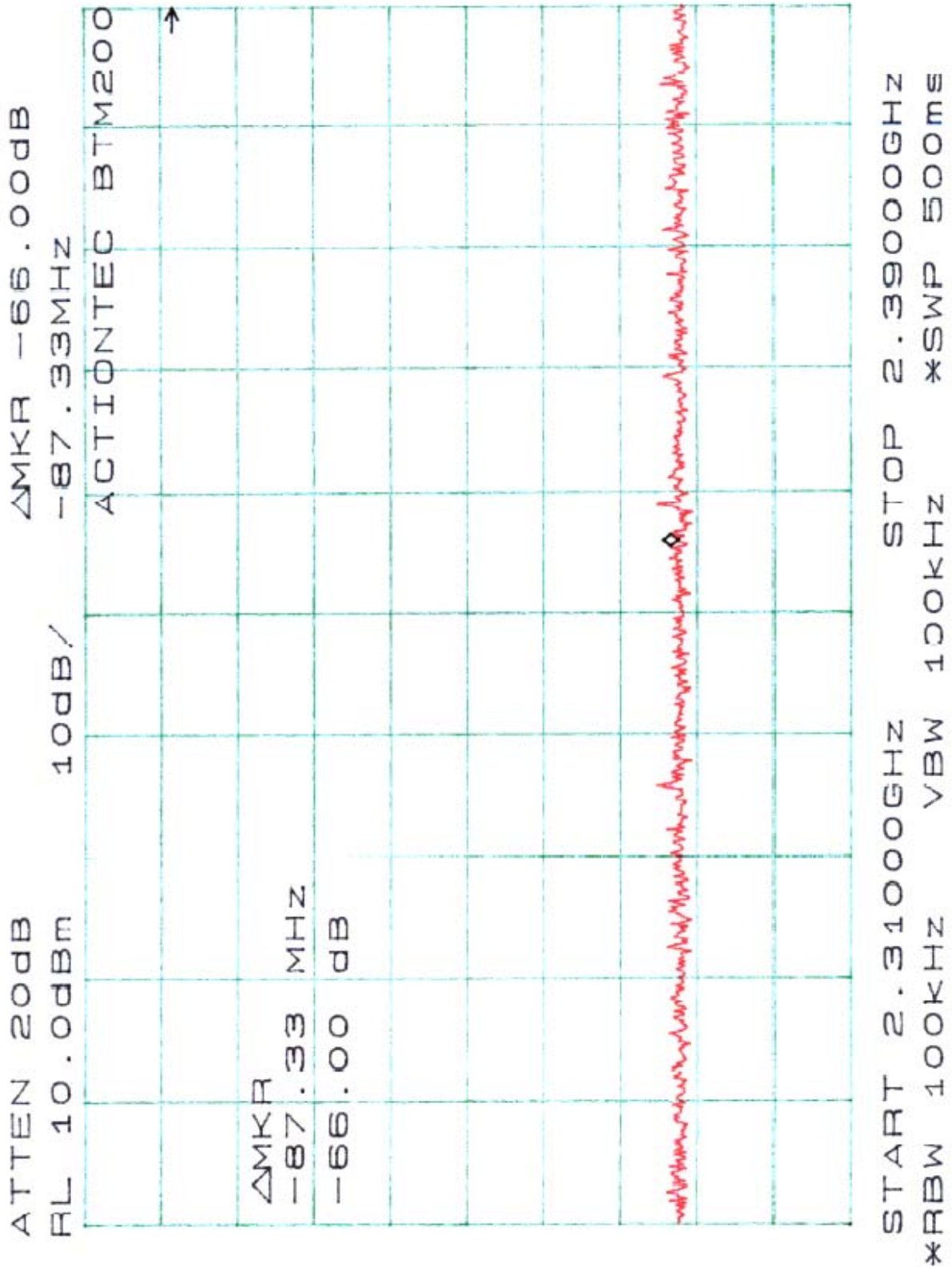
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then 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.

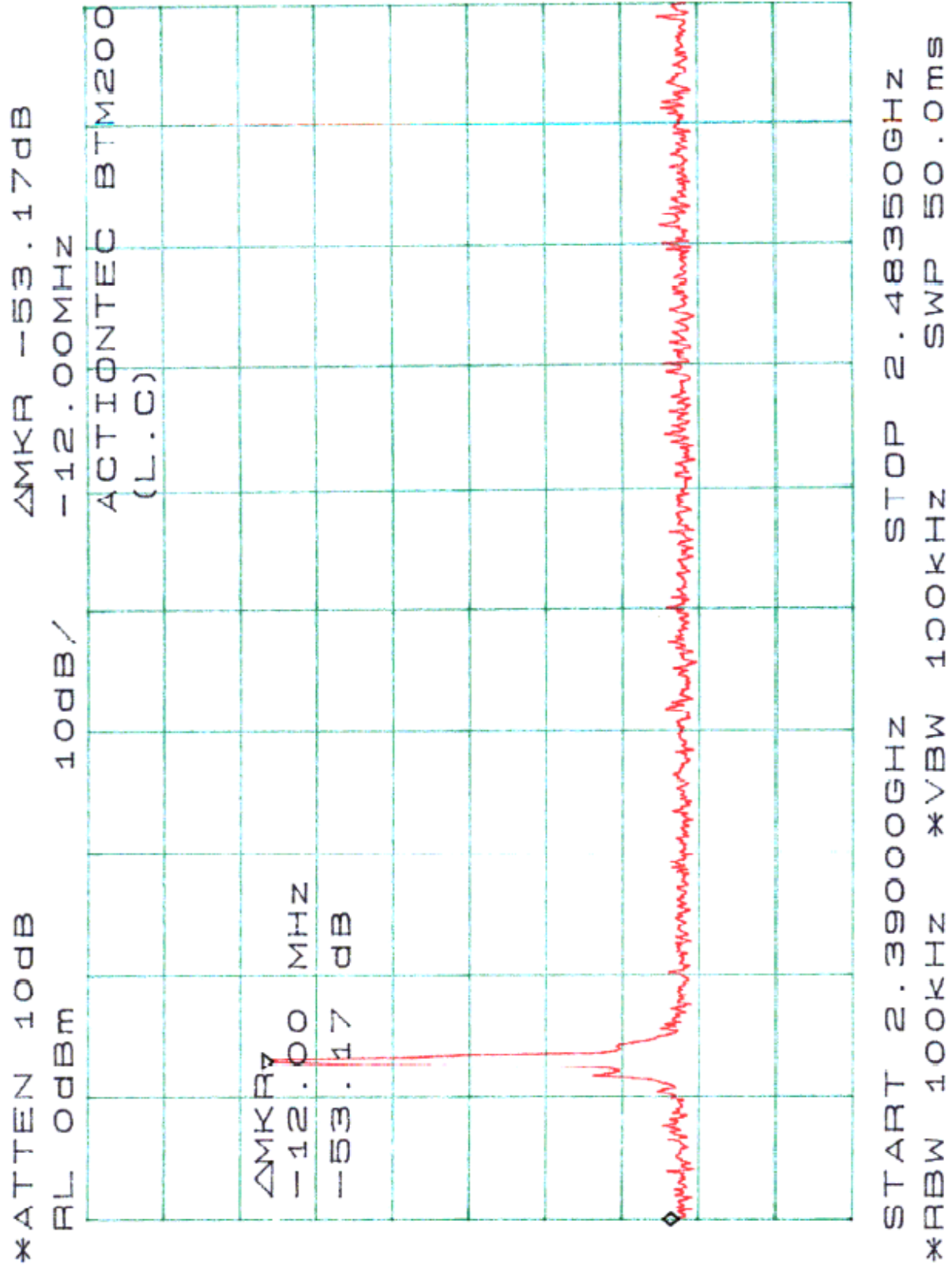
8.3 Measurement Results

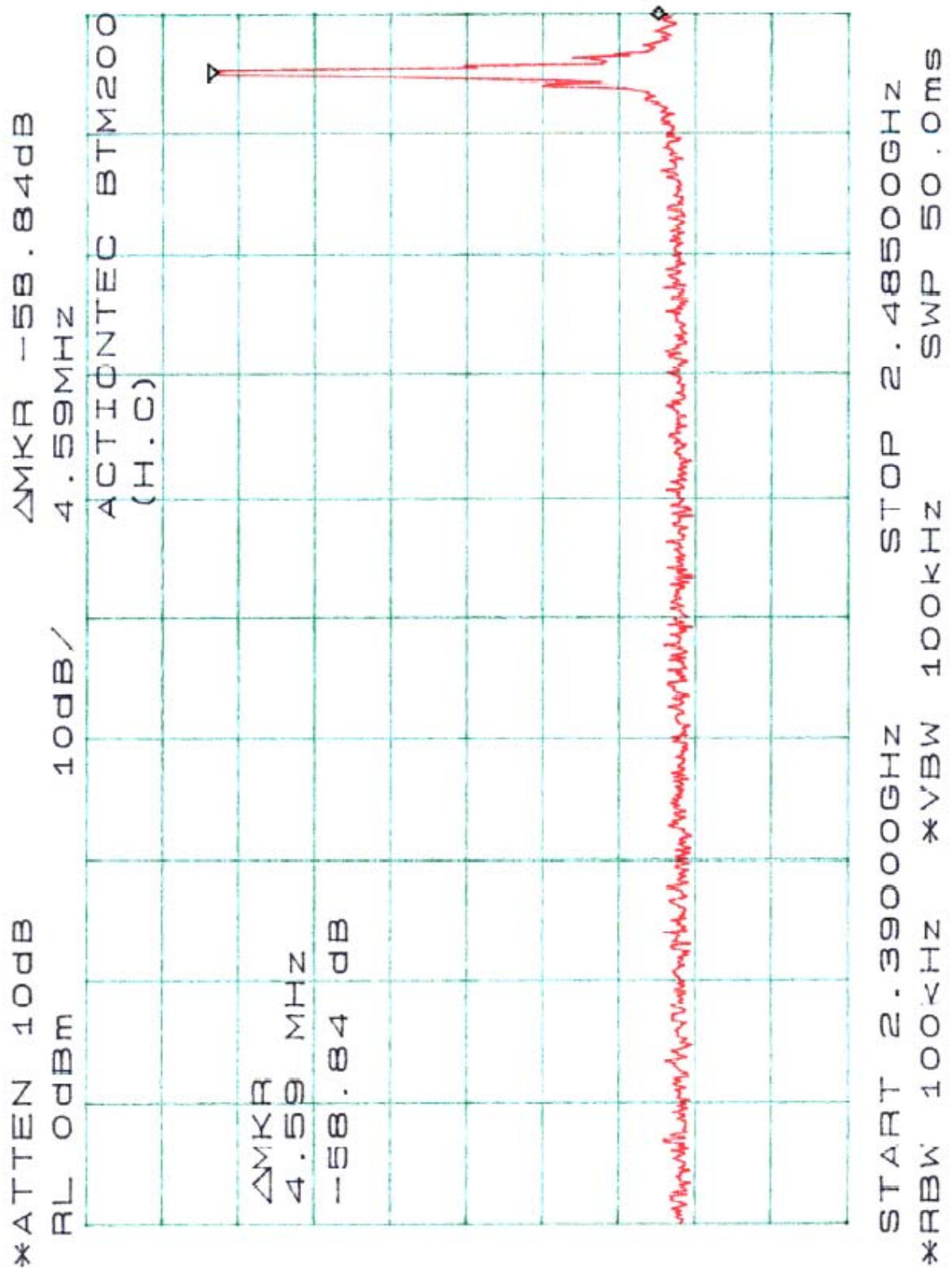
Frequency	Measurement (dBm)	Standard	Result
Low	53.17	$\geq 20\text{dB}$	Compliant
High	58.84	$\geq 20\text{dB}$	Compliant

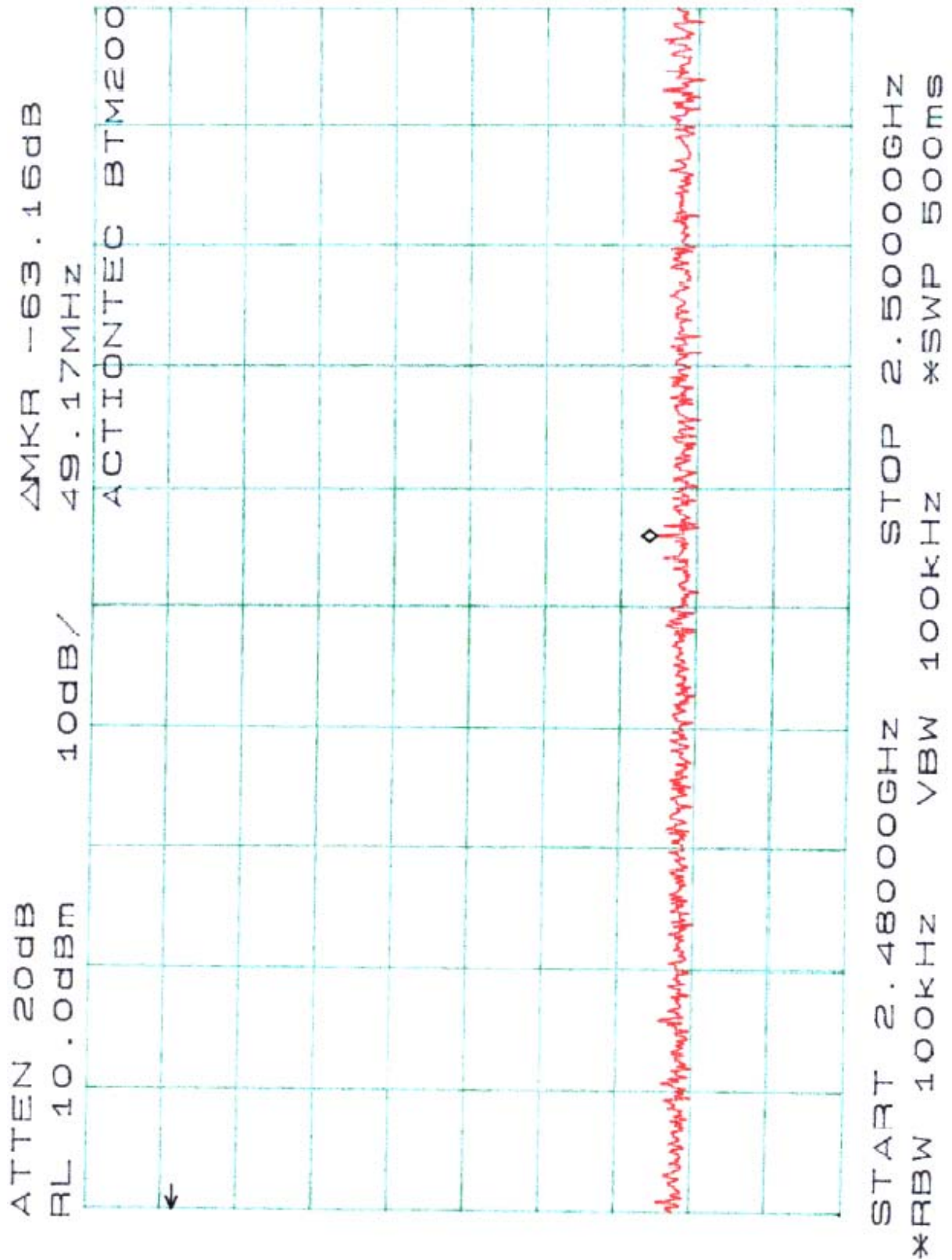
8.4 Plots of 100kHz Bandwidth of Band Edge

Please refer the following plots.









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.

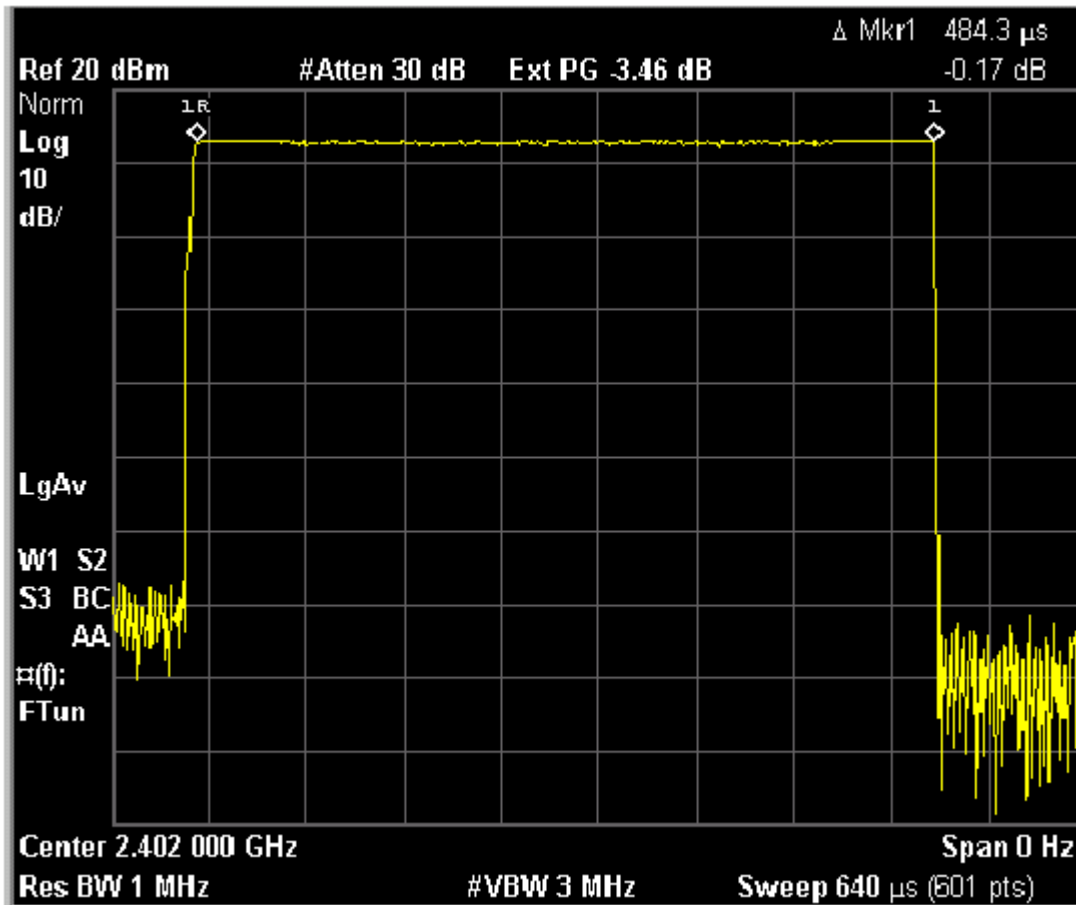
9.3 Measurement Results

The worst case dwell time is (DH5 packet) $(4 \times 2.952 \text{ ms})$ (dwell time in 1 sec) $\times 30 \text{ seconds} = 354.24 \text{ ms} < 0.4 \times 79$

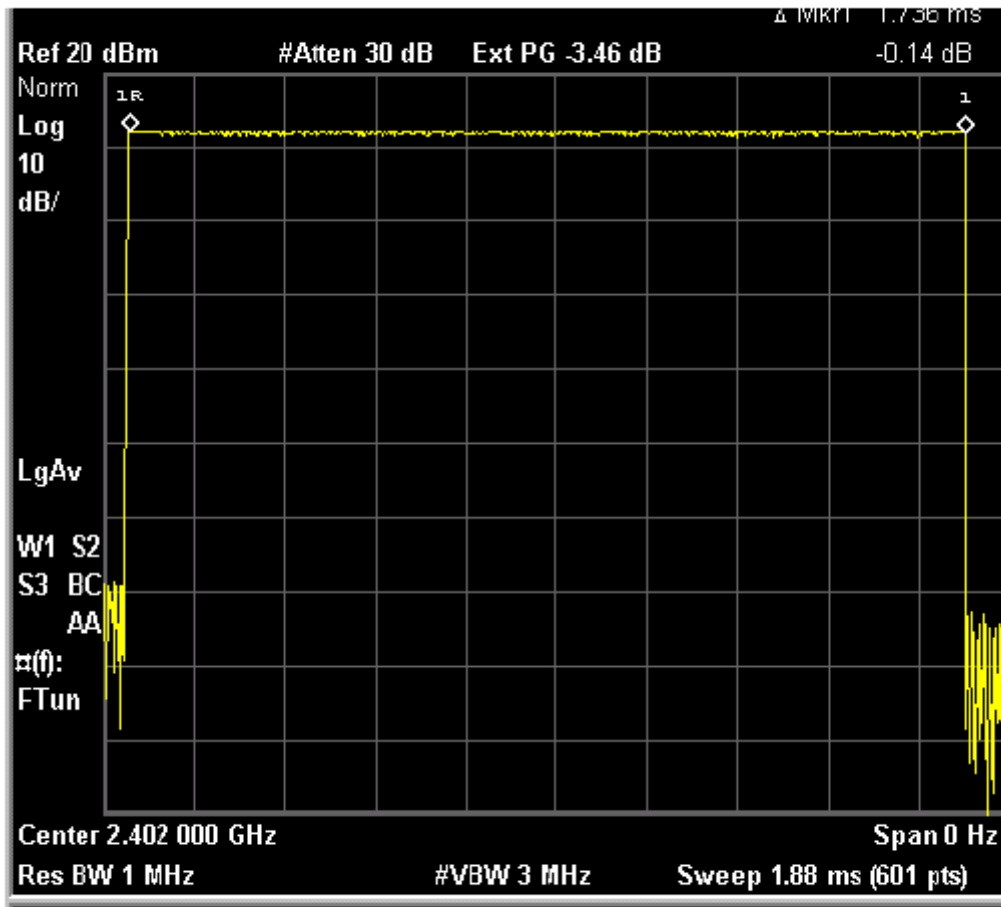
9.4 Plots of Dwell Time

Please refer the following plots.

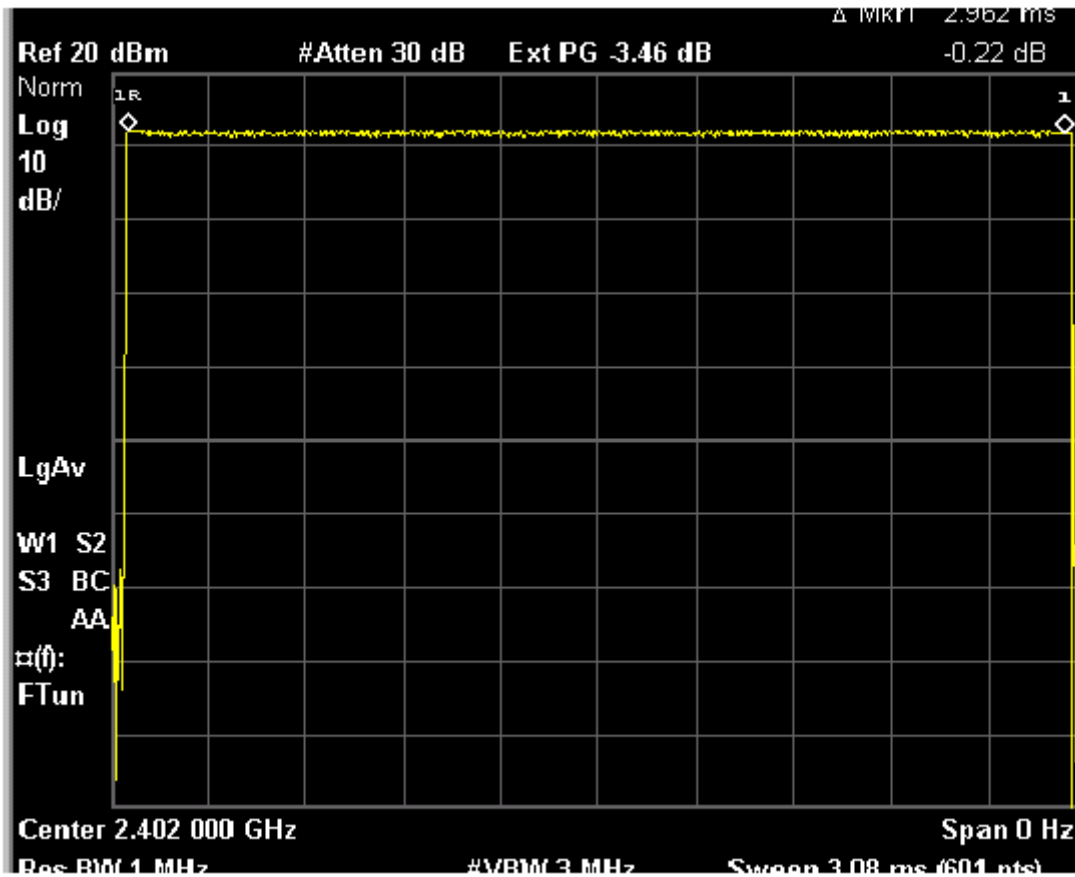
DH1 Mode Dwell Time: DH1 Data Packet – Dwell Time = 484.3 μ sec



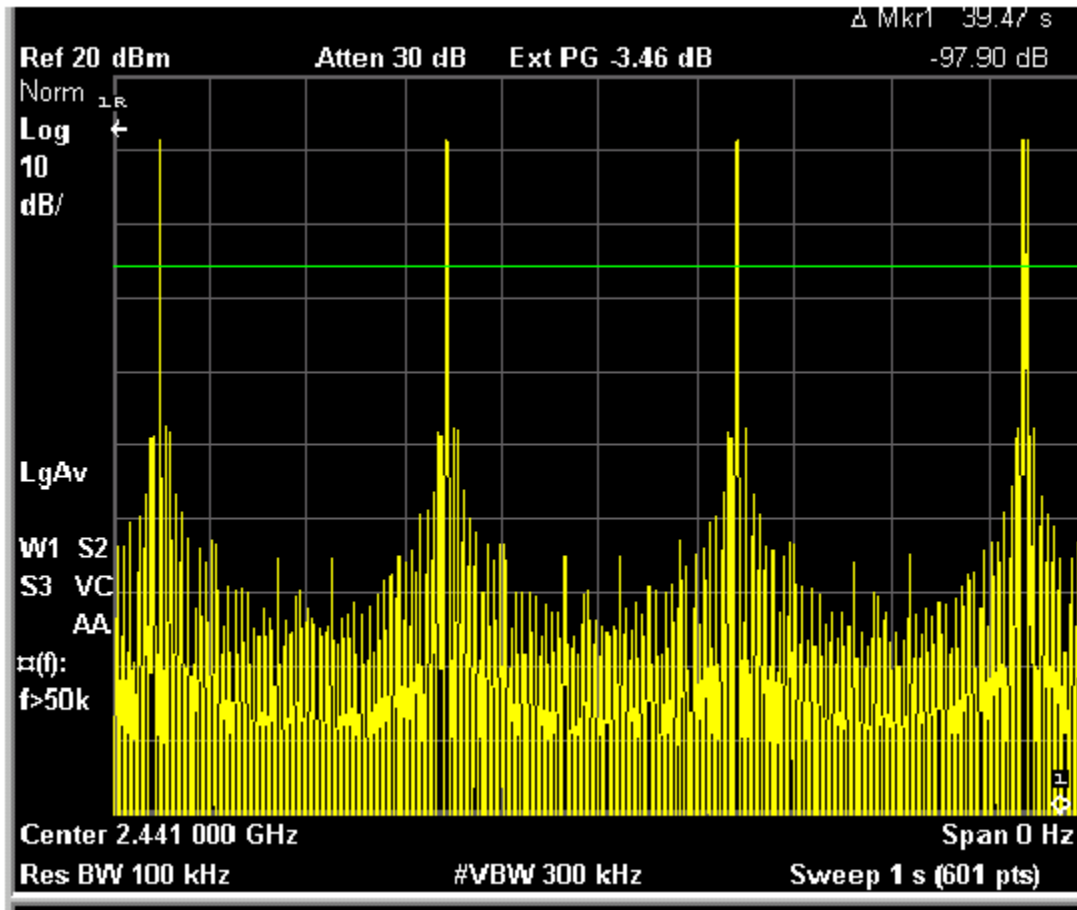
DH3 Mode Dwell Time: DH3 Data Packet – Dwell Time = 1.736 msec



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

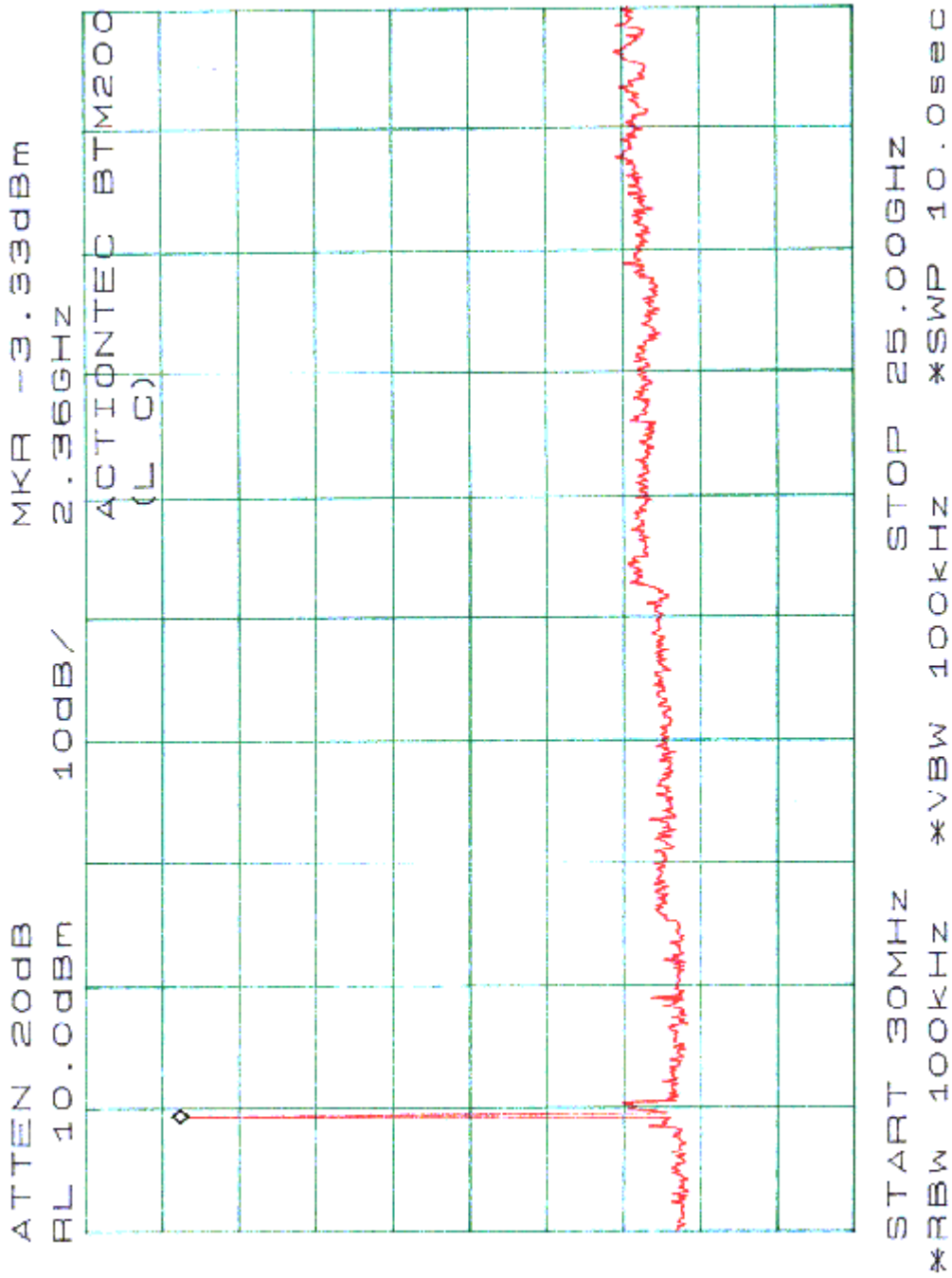
According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above 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.

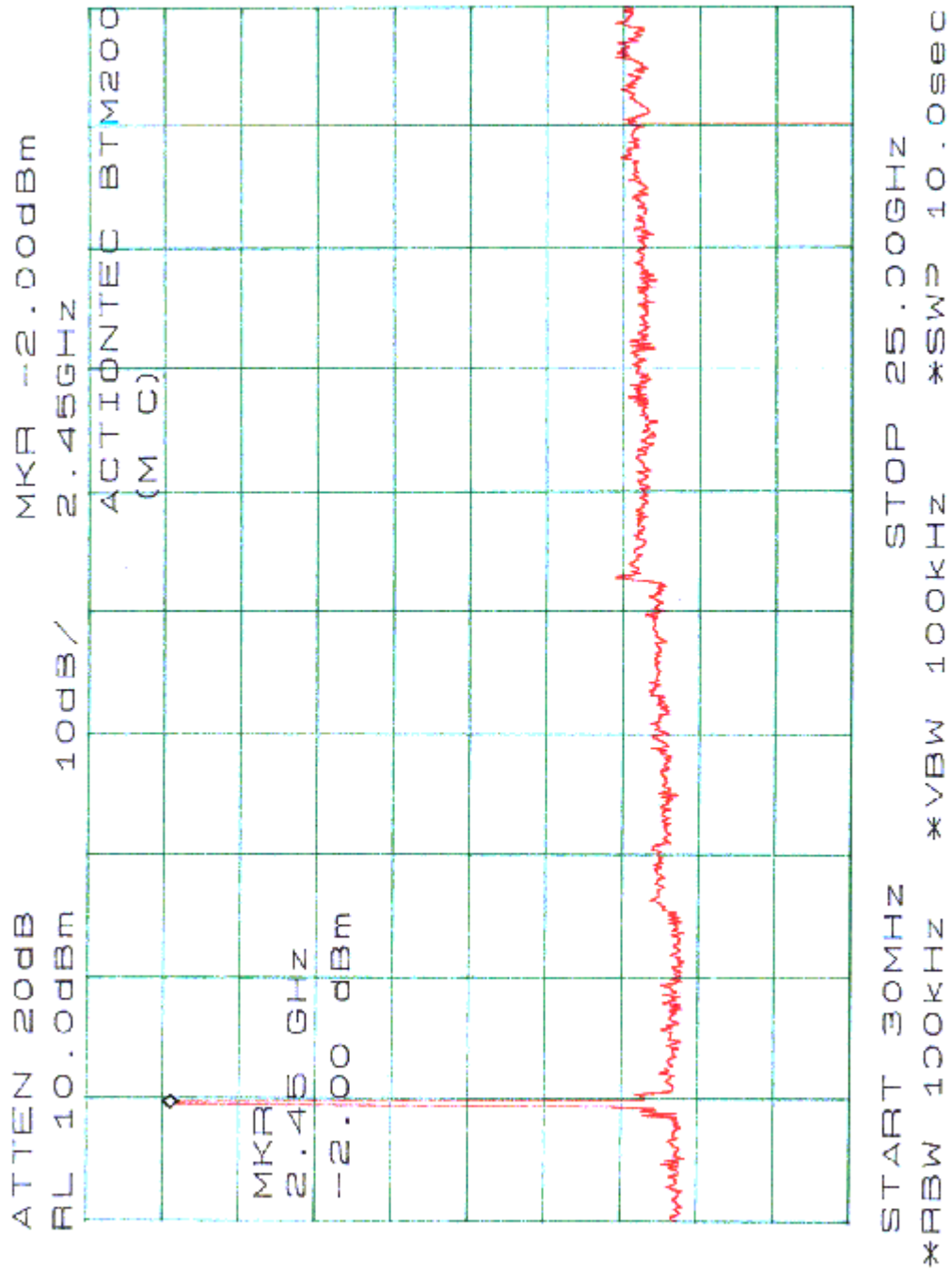
10.2 Measurement Procedure

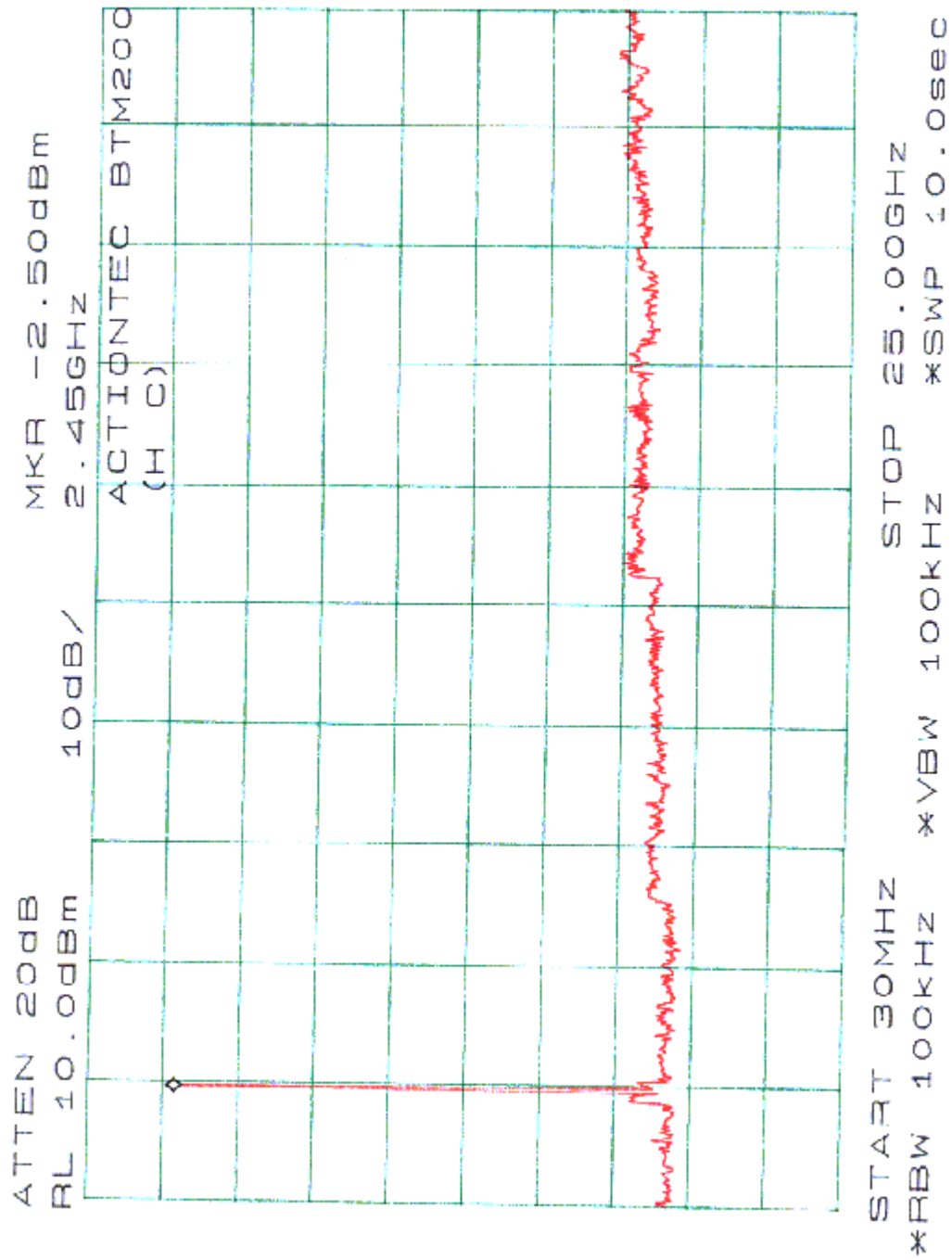
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low 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 Measurement Results

Please refer to the following plots.







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 BAEL is ± 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 its right.

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 dB μ V 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:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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

$$\text{Margin} = \text{Corr. Ampl.} - \text{Class B Limit}$$

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:

-9.6 dB at **7206 MHz** in the **Horizontal** polarization, Low Channel.

-9.4 dB at **7323 MHz** in the **Vertical** polarization, Middle Channel.

-9.4dB at **7440 MHz** in the **Horizontal** polarization, High Channel.

-6.7 dB at **389.80 MHz** in the **Horizontal** polarization, Unintentional Emission

11.7 Radiated Emission Test Data**30MHz ~ 25 GHz, 3 Meters**

Frequency MHz	Indicated		Table Height Meter	Antenna		Correction Factor			FCC 15 Subpart C		
	Ampl. dB μ V/m	Direction Degree		Polar H/V	Antenna dB μ V/m	Cable Loss dB μ V/ m	Amp. dB	Corr. Ampl. dB μ V/m	Limit dB μ V/m	Margin dB	Mode
Low Channel											
2402.00	91.7	250	1.2	V	28.1	3.4	30	93.1			PEAK, FUND
2402.00	90.2	250	1.2	V	28.1	3.4	30	91.6			AVE, FUND
2402.00	95.5	180	1.5	H	28.1	3.4	30	96.9			PEAK, FUND
2402.00	94.7	180	1.5	H	28.1	3.4	30	96.1			AVE, FUND
7206.00	33.7	200	1.5	H	35.1	5.6	30	44.4	54.0	-9.6	AVE
7206.00	33.5	90	1.2	V	35.1	5.6	30	44.2	54.0	-9.8	AVE
4804.00	32.5	180	1.5	H	32.5	4.9	30	39.9	54.0	-14.1	AVE
4804.00	31.6	270	1.2	V	32.5	4.9	30	39.0	54.0	-15.0	AVE
7206.00	45.0	200	1.5	H	35.1	5.6	30	55.7	74.0	-18.3	PEAK
7206.00	44.7	90	1.2	V	35.1	5.6	30	55.4	74.0	-18.6	PEAK
4804.00	43.3	180	1.5	H	32.5	4.9	30	50.7	74.0	-23.3	PEAK
4804.00	42.7	270	1.2	V	32.5	4.9	30	50.1	74.0	-23.9	PEAK
Middle Channel											
2441.00	97.5	180	1.8	H	28.1	3.4	30	98.9			PEAK, FUND
2441.00	94.7	180	1.8	H	28.1	3.4	30	96.1			AVE, FUND
2441.00	98.3	120	1.2	V	28.1	3.4	30	99.8			PEAK, FUND
2441.00	97.3	120	1.2	V	28.1	3.4	30	98.8			AVE, FUND
7323.00	33.8	330	1.5	V	35.1	5.6	30	44.6	54.0	-9.4	AVE
7323.00	33.7	0	1.2	H	35.1	5.6	30	44.4	54.0	-9.6	AVE
4882.00	32.2	200	1.5	H	32.5	4.9	30	39.6	54.0	-14.4	AVE
4882.00	30.8	30	2.0	V	32.5	4.9	30	38.2	54.0	-15.8	AVE
1079.00	39.3	280	2.0	V	23.7	4.2	30	37.2	54.0	-16.8	AVE
1079.00	39.3	270	1.8	H	23.7	4.2	30	37.2	54.0	-16.8	AVE
7323.00	45.0	0	1.2	H	35.1	5.6	30	55.7	74.0	-18.3	PEAK
7323.00	45.0	330	1.5	V	35.1	5.6	30	55.7	74.0	-18.3	PEAK
4882.00	43.7	200	1.5	H	32.5	4.9	30	51.1	74.0	-22.9	PEAK
4882.00	42.2	30	2.0	V	32.5	4.9	30	49.6	74.0	-24.4	PEAK

30MHz ~ 25 GHz, 3 Meters (Continued)

Frequency MHz	Indicated		Table Height Meter	Antenna		Correction Factor			FCC 15 Subpart C		
	Ampl. dB μ V/m	Direction Degree		Polar H/V	Antenna dB μ V/m	Cable Loss dB μ V/ m	Amp. dB	Corr. Ampl. dB μ V/m	Limit dB μ V/m	Margin dB	Mode
High Channel											
2480.00	97.5	120	1.8	V	28.1	3.4	30	98.9			PEAK, FUND
2480.00	93.8	120	1.8	V	28.1	3.4	30	95.3			AVE, FUND
2480.00	92.7	90	1.5	H	28.1	3.4	30	94.1			PEAK, FUND
2480.00	92.3	90	1.5	H	28.1	3.4	30	93.8			AVE, FUND
7440.00	33.9	300	1.5	H	35.1	5.7	30	44.6	54	-9.4	AVE
7440.00	33.9	200	1.5	V	35.1	5.7	30	44.6	54	-9.4	AVE
4960.00	31.0	330	1.5	V	32.5	4.9	30	38.4	54	-15.6	AVE
4960.00	30.8	270	1.2	H	32.5	4.9	30	38.2	54	-15.8	AVE
1230.50	39.8	270	1.8	H	23.7	4.1	30	37.7	54	-16.3	AVE
7440.00	44.8	200	1.5	V	35.1	5.6	30	55.6	74	-18.4	PEAK
7440.00	44.8	300	1.5	H	35.1	5.6	30	55.6	74	-18.4	PEAK
4960.00	42.7	270	1.2	H	32.5	4.9	30	50.1	74	-23.9	PEAK
4960.00	42.0	330	1.5	V	32.5	4.9	30	49.4	74	-24.6	PEAK

Unintentional Emission

Frequency MHz	Indicated		Table Height Meter	Antenna		Correction Factor			FCC 15 Subpart C	
	Ampl. dB μ V/m	Direction Degree		Polar H/V	Antenna dB μ V/m	Cable Loss dB μ V/ m	Amp. dB	Corr. Ampl. dB μ V/m	Limit dB μ V/m	Margin dB
389.80	46.3	120	2.5	H	15.6	2.4	25	39.3	46.0	-6.7
663.24	40.2	0	3	H	20.8	3.0	25	39.0	46.0	-7.0
240.00	47.8	270	2	H	13.8	2.2	25	38.8	46.0	-7.2
389.83	44.7	330	2.0	V	15.6	2.4	25	37.7	46.0	-8.3
60.04	45.7	180	1.2	V	9.4	1.3	25	31.5	40.0	-8.5
572.73	39.8	270	2.5	H	19.3	3.0	25	37.2	46.0	-8.8
670.60	36.9	30	2.0	H	21.2	3.2	25	36.3	46.0	-9.7
389.84	42.5	90	2	V	15.6	2.4	25	35.5	46.0	-10.5
663.24	36.5	330	2	V	20.8	3.0	25	35.3	46.0	-10.7
120.09	44.2	30	2	H	11.7	1.6	25	32.5	43.5	-11.0
389.84	40.9	300	1.5	H	15.6	2.4	25	33.9	46.0	-12.1
80.03	42.1	300	1.2	V	9.5	1.2	25	27.8	40.0	-12.2
300.07	42.1	90	1.2	V	14.4	2.3	25	33.8	46.0	-12.2
840.00	31.8	30	1.2	V	22.7	3.8	25	33.3	46.0	-12.7
572.73	35.9	90	1.2	V	19.3	3.0	25	33.2	46.0	-12.8
220.17	42.8	0	2.0	H	11.8	2.1	25	31.8	46.0	-14.2
250.00	41.0	270	1.2	V	13.3	2.2	25	31.5	46.0	-14.5

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

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 dB μ V 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:

-1.2 dB μ V at 3.460 MHz in the Line mode

12.6 Conducted Emissions Test Data

LINE CONDUCTED EMISSIONS				FCC CLASS B	
Frequency MHz	Amplitude dB μ V	Detector Qp/Ave/Peak	Phase Line/Neutral	Limit dB μ V	Margin dB
3.460	54.8	QP	Line	56	-1.2
0.810	42.1	Ave	Line	46	-3.9
0.215	54.4	QP	Neutral	63	-8.6
3.460	37.4	Ave	Line	46	-8.6
0.810	45.3	QP	LIne	56	-10.7
0.150	54.3	QP	Line	66	-11.7
0.810	40.8	QP	Neutral	56	-15.2
0.150	39.6	Ave	Line	56	-16.4
0.810	39.4	Ave	Neutral	56	-16.6
10.080	41.2	QP	Neutral	60	-18.8
0.215	40.8	Ave	Neutral	63	-22.2
10.080	36.4	Ave	Neutral	60	-23.6

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
CISPR CLASS B

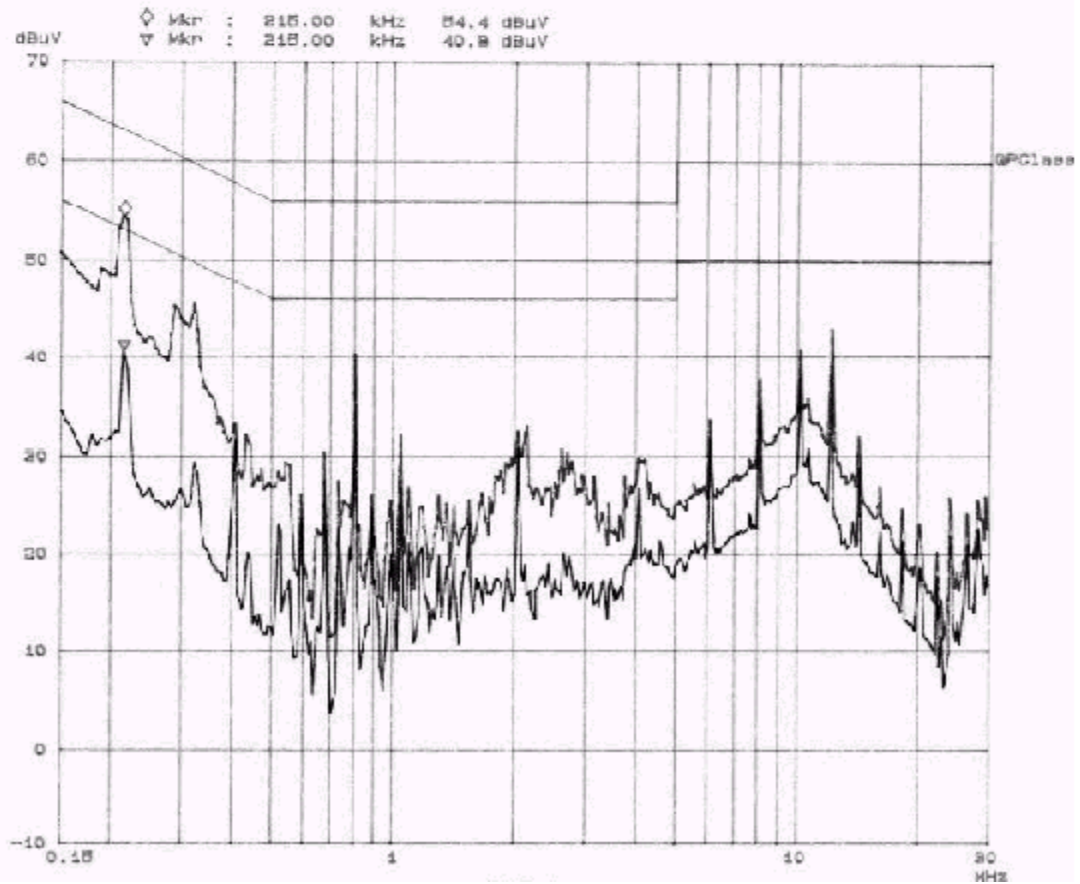
18. Apr 03 09:49

EUT: BTM200
Manuf: ACTIONTEC
Op Cond: Normal
Operator: JERRY
Comment: NEUTRAL
File name: ACTIONTC.RES

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
500K	20M	5K	5K	QP+AV	20ms	100dB	OFF

Final Measurement: x QP / + AV
Meas Time: 1 s
Overrange: 00
Acc Margin: 6dB



Bay Area Compliance Corporation
CISPR CLASS B

18. Apr 03 18:51

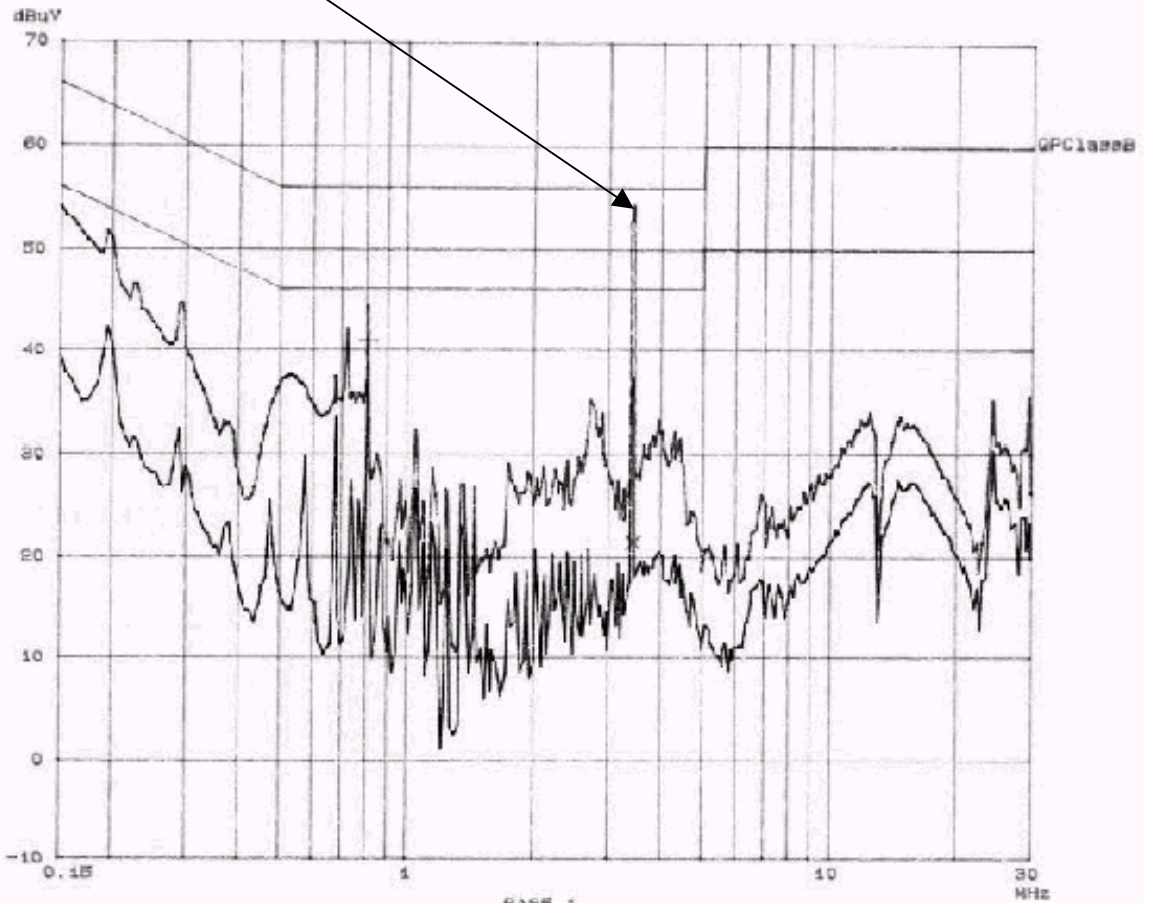
EUT: BTK200
Manuf: ACTIONTEC
Op Cond: NORMAL
Operator: JERRY
Comment: LINE
File name: ACTION_L.REB

Ambient

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150K	30M	5K	5K	QP+AV	20ms	100dBm	OFF

Final Measurement: x 50 / + AV
Meas Time: 1 s
Subranges: 20
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.