FCC Part 15 Subpart C

EMI MEASUREMENT AND TEST REPORT

For

Arescom, Inc.

3541 Gateway Blvd.
Fremont, CA 94538

FCC ID: PT2ND1760

August 17, 2001

This Report Concerns:	**Equipment Type:**
☒ Original Report	ADSL Wireless LAN Router

Test Engineer: Jeff Lee

Test Date: July 24, 2001

Reviewed By: John Y. Chan – Engineering Manager

Prepared By: Bay Area Compliance Laboratory Corporation
230 Commercial Street, Suite 2
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)

Arescom, Inc.'s product, model: *ND176x-XXX (*x is Arabic number from 0 to 9 and XXX is a combination of 2 or 3 alphabets and or Arabic numbers) or the "EUT" as referred to in this report is an ADSL wireless LAN router which measures approximately 9.5"L x 6.1' W x 1.5"H.

1.2 Objective

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

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

1.3 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 Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.4 Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Suite 2, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation 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, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, IEC/CISPR 22: 1998, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167-0.

1.5 Test Equipment List

Manufacturer	Description	Model	Serial Number	Cal. Due Date
HP	Spectrum Analyzer	8564E	08303	12/6/01
HP	Spectrum Analyzer	8593B	2919A00242	12/20/01
HP	Amplifier	8349B	2644A02662	12/20/01
HP	Quasi-Peak Adapter	85650A	917059	12/6/01
HP	Amplifier	8447E	1937A01046	12/6/01
A.H. System	Horn Antenna	SAS0200/571	261	12/27/01
Com-Power	Log Periodic Antenna	AL-100	16005	11/2/01
Com-Power	Biconical Antenna	AB-100	14012	11/2/01
Solar Electronics	LISN	8012-50-R-24-BNC	968447	12/28/01
Com-Power	LISN	LI-200	12208	12/20/01
Com-Power	LISN	LI-200	12005	12/20/01
BACL	Data Entry Software	DES1	0001	12/20/01
Rohde & Schwarz	Signal Generator	SMIQ03B	1125.5555.03	7/10/02
Rohde & Schwarz	I/Q Modulation Generator	AMIQ	1110.2003.02	8/10/02

1.6 Equipment Under Test (EUT)

Manufacturer	Description	Model	Serial Number	FCC ID
Arescom, Inc.	ADSL Wireless LAN Router	ND176x-XXX	None	PT2ND1760

Note: "x" stands for Arabic number from 0 to 9. 'XXX' stands for a combination of 2 or 3 alphabets or Arabic numbers.

1.7 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
SONY	Laptop	PCG-9241	28309431, 33920662	DOC

1.8 External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Shielded RJ11 Cable	1.0	DSL Port/EUT	Terminator
Shielded RJ45 Cable	1.5	Ethernet Port/EUT	Laptop

2 - SYSTEM TEST CONFIGURATION AND REQUIREMENT

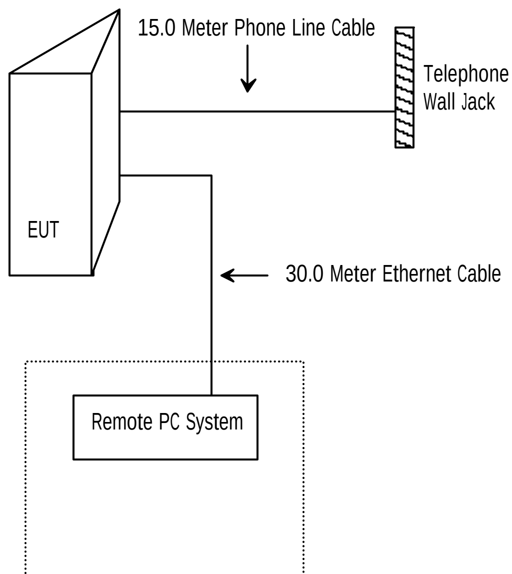
2.1 Description of Test Configuration

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

The test software, provided by the customer, was used to exercise during conducted and radiated testing. No other test data as transmitted to the EUT during testing.

The EUT was tested with GF power adapter (M/N: GI12-US0520) during the final testing.

2.2 Configuration of Test System



2.3 Equipment Modification

No modification(s) was made by BACL Corp. to ensure EUT comply with applicable limits.

3 - SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT	Page
§15.247 (b) (2)	Conducted of Output Power Emission	Passed	P8-11
§15.247 (a) (2)	6 dB Bandwidth	Passed	P12-15
§ 15.205, §15.209 (a), §15.209 (f)	Spurious Emission, Radiated Emission, Restricted Bands	Passed	P16-20
§ 15.247 (c)	100 kHz Bandwidth of Frequency Band Edges	Passed	P21-24
§15.247 (d)	Peak Power Spectral Density	Passed	P25-28
§15.203	Antenna Requirement	Passed	P29
§ 2.1091	RF Safety Requirements	Passed	P30
§15.247 (e)	Processing Gain	Passed	P31-34
§15.207 (a)	Conducted Emission	Passed	P36-38

4 - Conducted Output Power Measurement

4.1 Standard Applicable

For frequency hopping, according to §15.247(b) (2), the maximum peak output power of the transmitter shall not exceed 1 Watt.

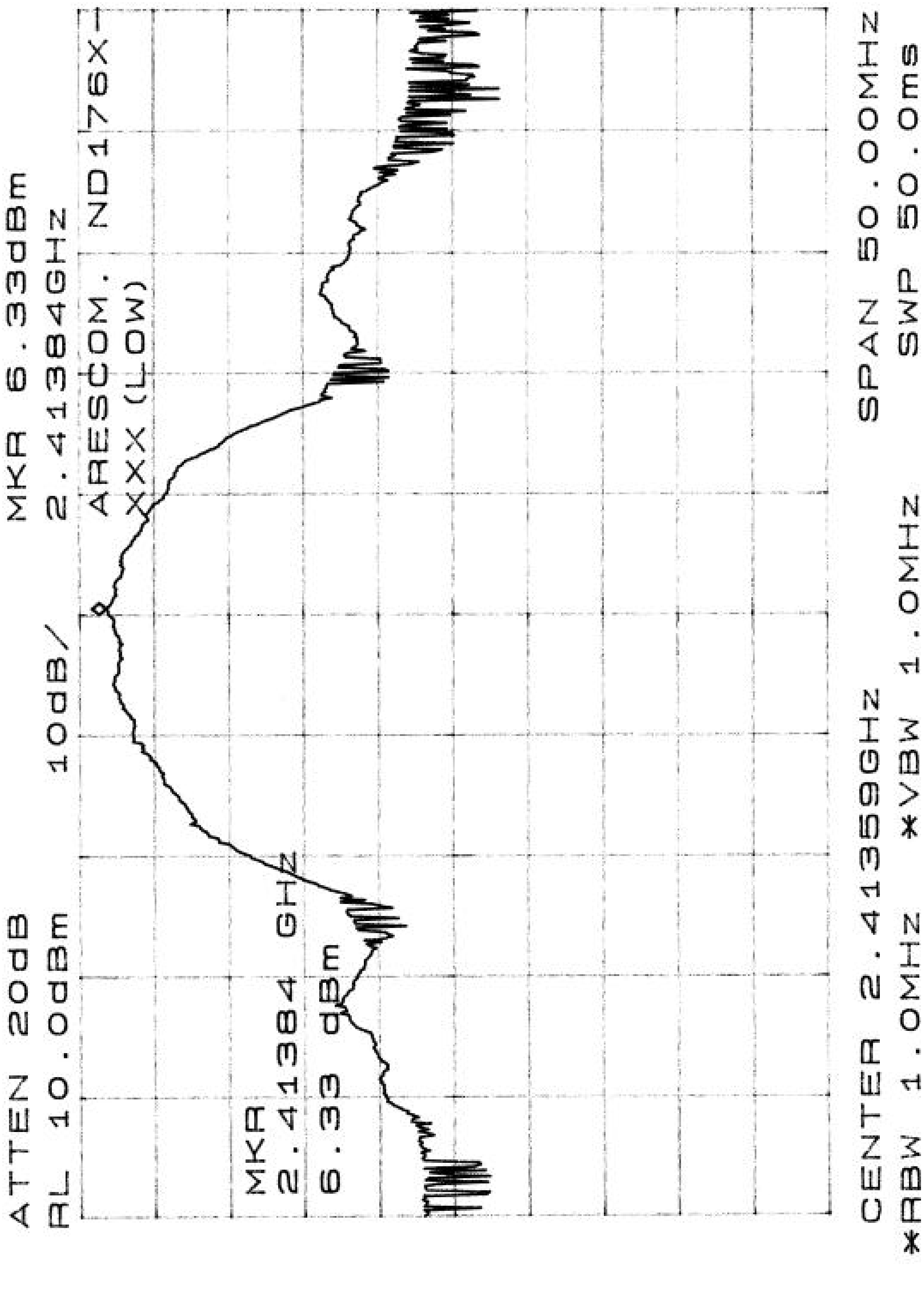
4.2 Measurement Procedure

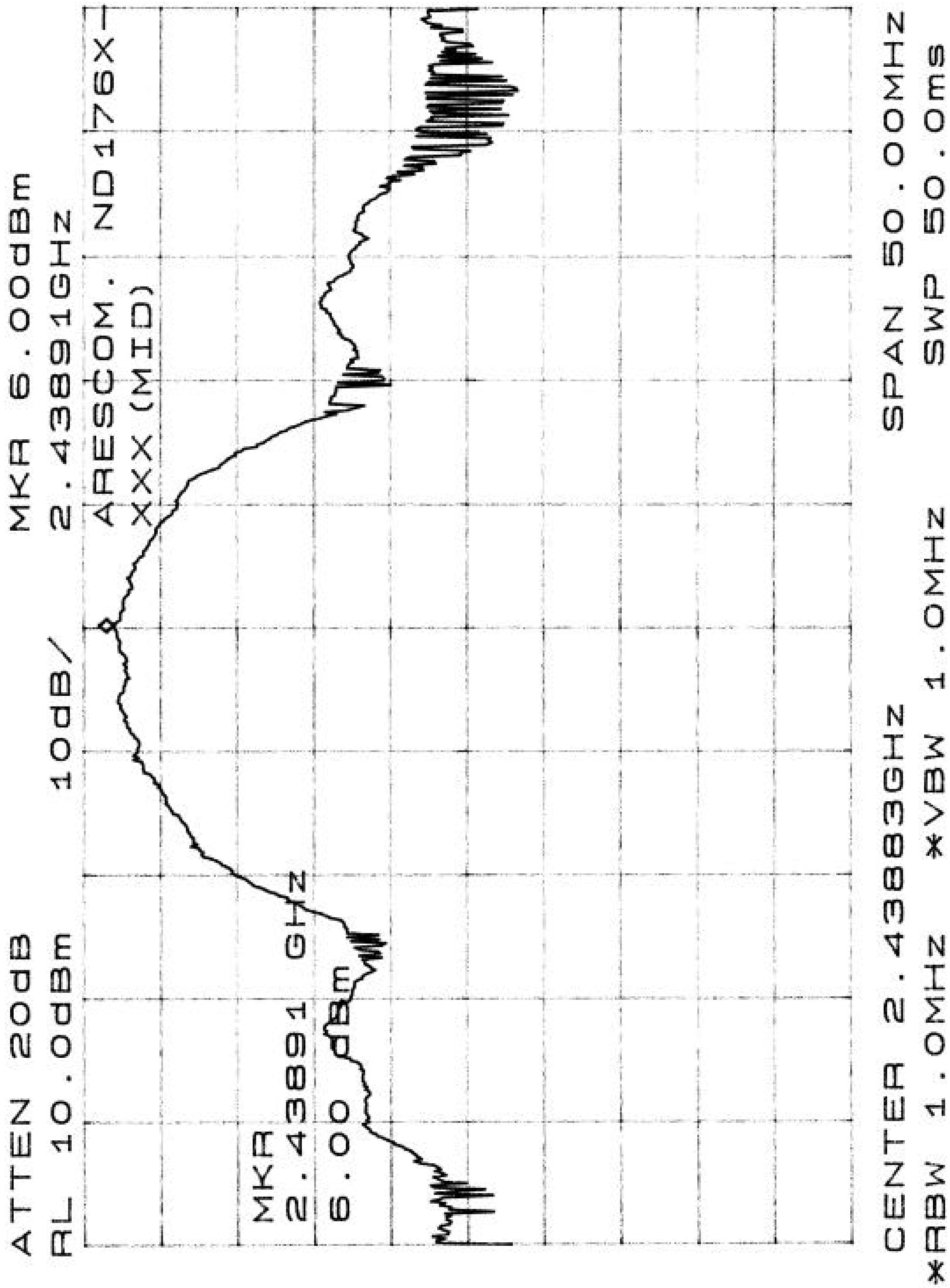
1. Place the EUT on the turntable and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

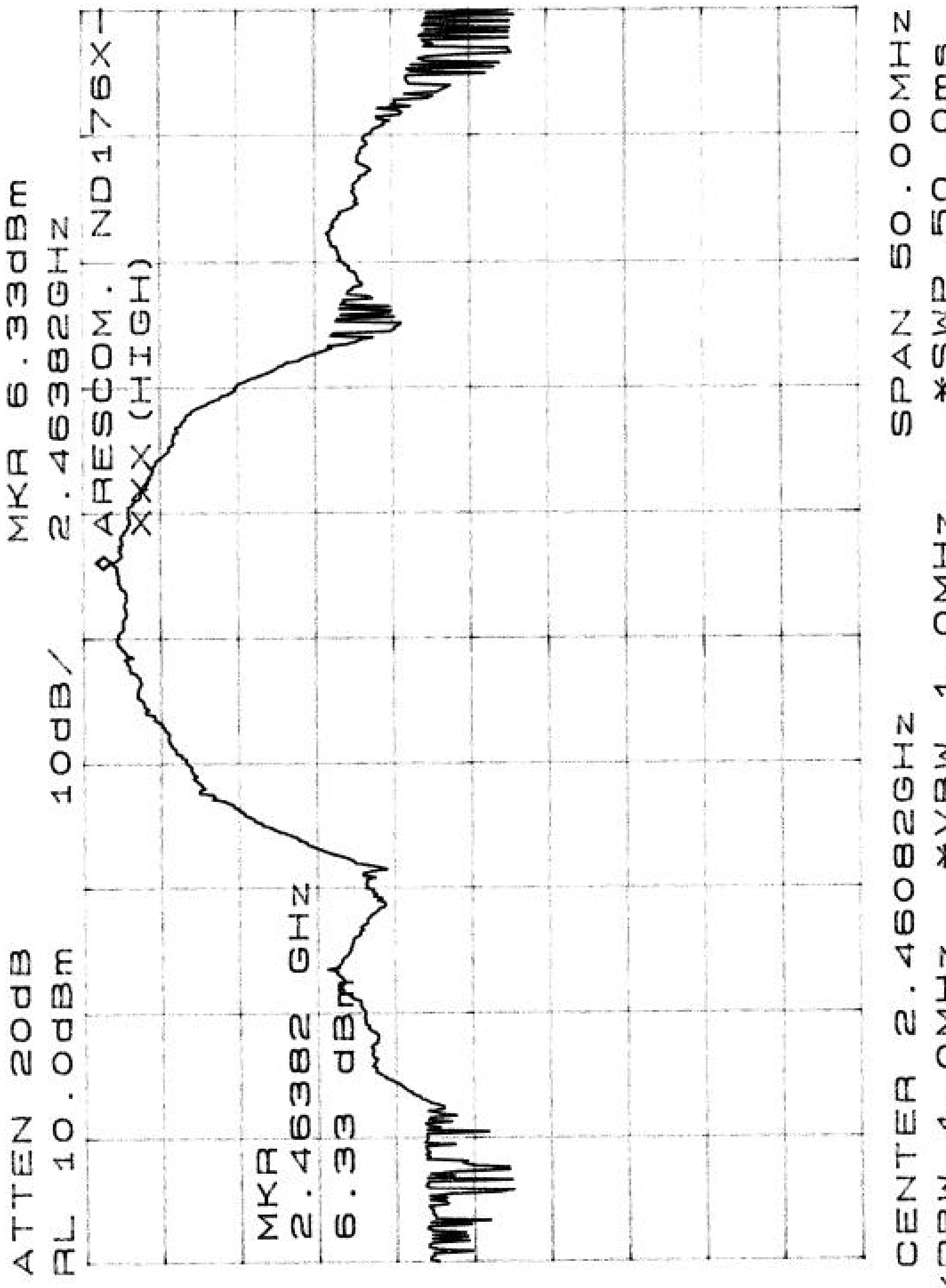
4.3 Measurement Result

Test Result: Pass. The maximum peak output power does not exceed 1 watt.

Please refer to the attached plots for more details.


ATTEN 20dB
RL 10.0dBm
10dB/
MKR 6.33dBm
2.41384GHz
ARESCOM. ND176X-
XXX (LOW)
MKR
2.41384 GHz
6.33 dBm
CENTER 2.41359GHz
SPAN 50.00MHz
*RBW 1.0MHz
*VBW 1.0MHz
SWP 50.0ms


ATTEN 20dB
RL 10.0dBm
10dB/
MKR 6.00dBm
2.43891GHz
ARESCOM. ND176X-
XXX (MID)
MKR
2.43891 GHz
6.00 dBm
CENTER 2.43883GHz
SPAN 50.00MHz
*RBW 1.0MHz
*VBW 1.0MHz
SWP 50.0ms


ATTEN 20dB
RL 10.0dBm
10dB/
MKR 6.33dBm
2.46382GHz
ARESCOM. ND1176X
XXX (HIGH)
MKR
2.46382 GHz
6.33 dBm
CENTER 2.46082GHz
SPAN 50.00MHz
*RBW 1.0MHz
*VBW 1.0MHz
*SWP 50.0ms

5 – 6 dB Bandwidth of Emissions

5.1 Standard Applicable

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

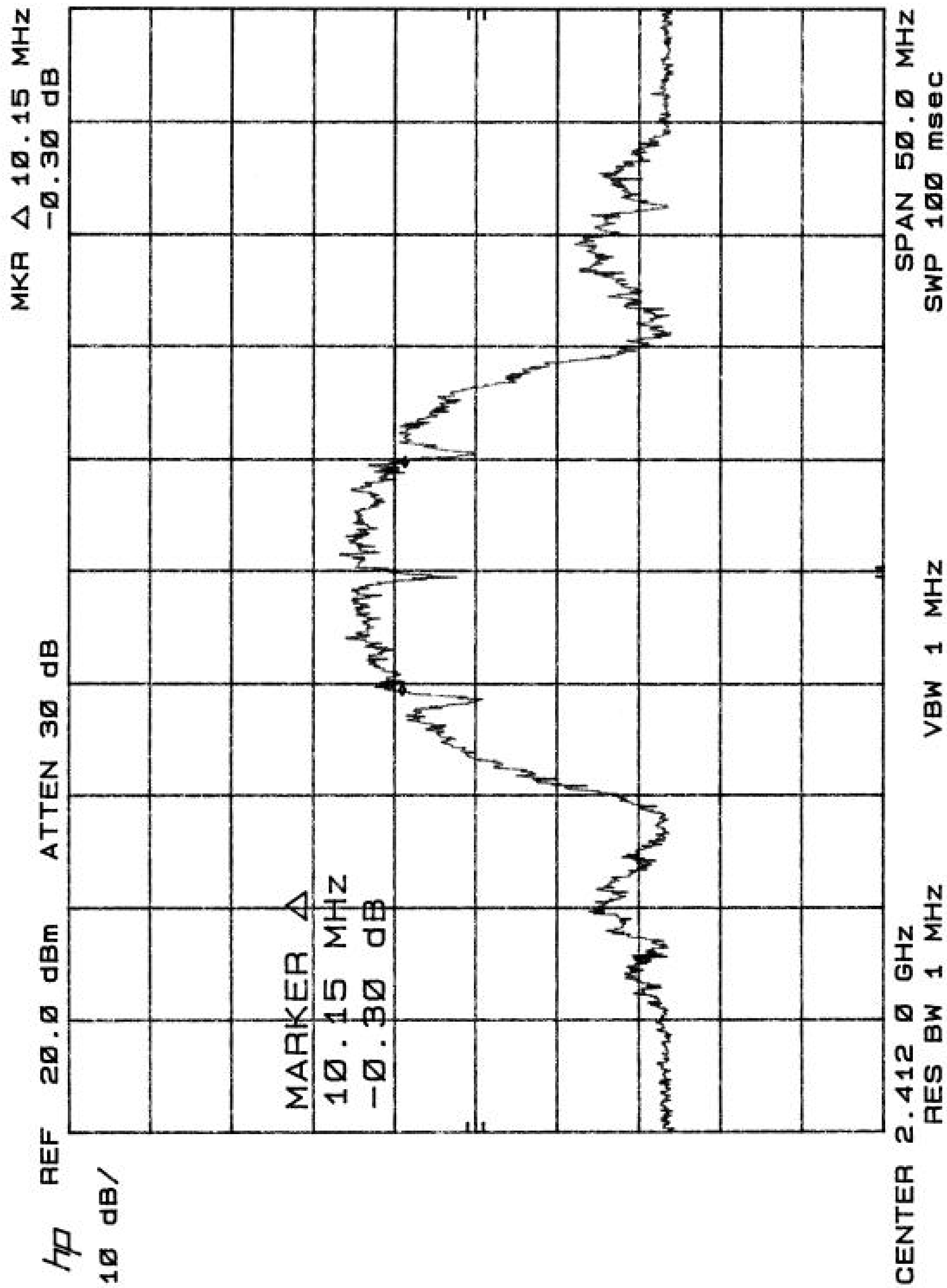
5.2 Measurement Procedure

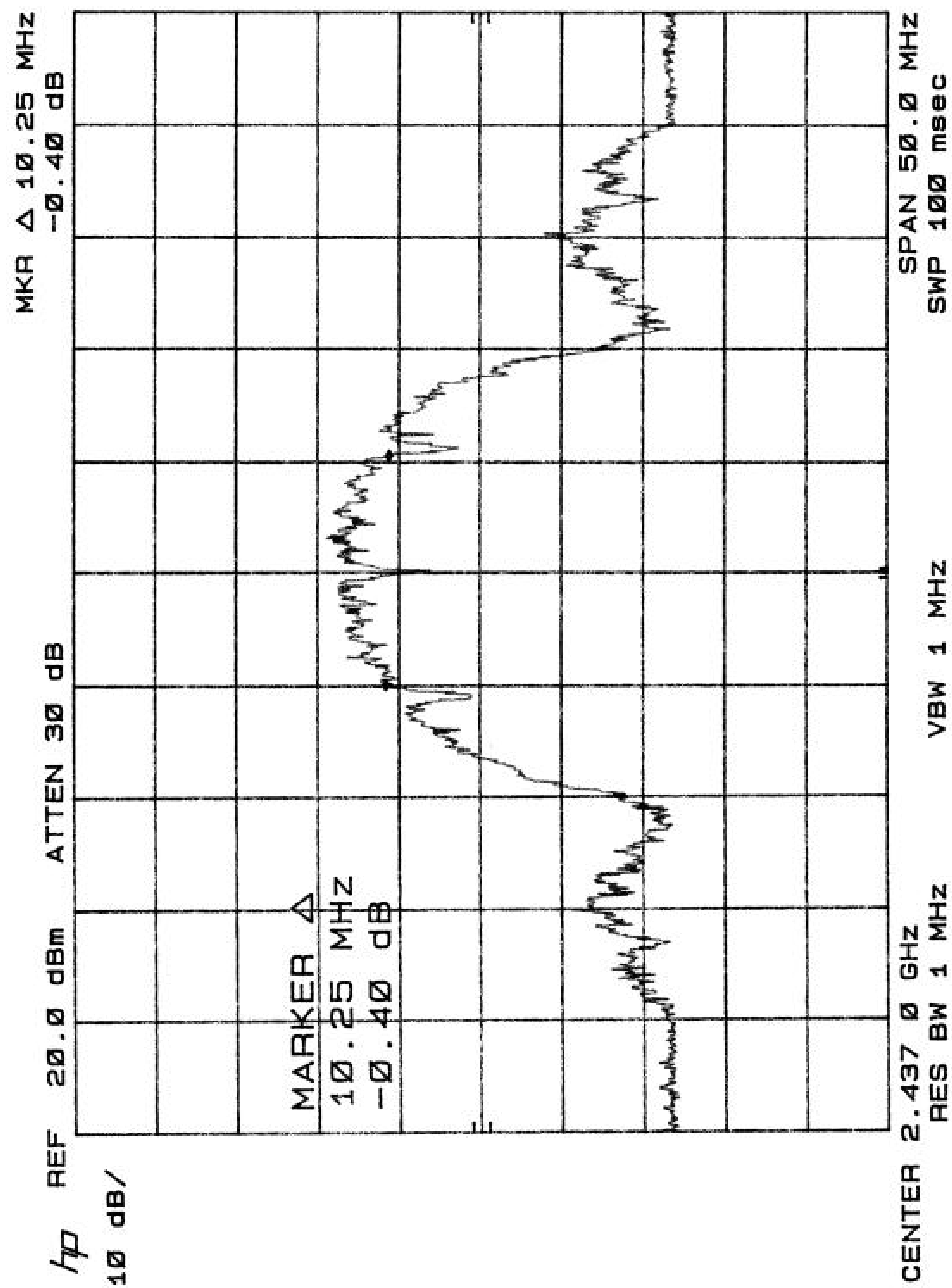
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency 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 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

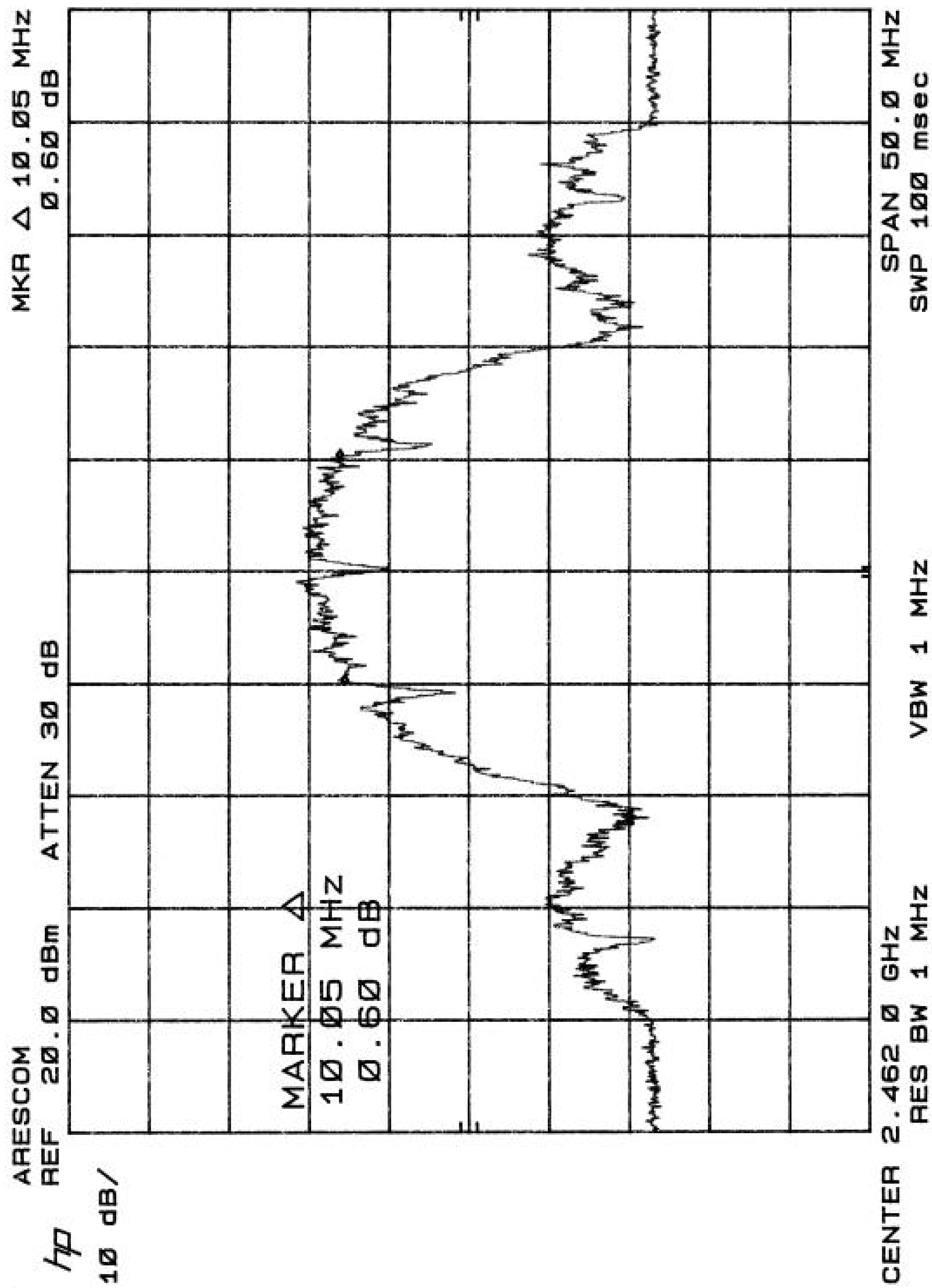
5.3 Measurement Data

Test Result: Pass. According to §15.247(a)(2), for direct sequence systems, the minimum 6dB bandwidth was greater than 500 kHz.

Please refer to the hereinafter plots for more details.


MKR Δ 10.15 MHz
-0.30 dB
REF 20.0 dBm
ATTEN 30 dB
10 dB/
MARKER Δ
10.15 MHz
-0.30 dB
CENTER 2.412 0 GHz
SPAN 50.0 MHz
RES BW 1 MHz
VBW 1 MHz
SWP 100 msec


MKR Δ 1Ø.25 MHz
-Ø.4Ø dB
REF 2Ø.Ø dBm ATTEN 3Ø dB
10 dB/
MARKER Δ
1Ø.25 MHz
-Ø.4Ø dB
CENTER 2.437 Ø GHz
SPAN 5Ø.Ø MHz
RES BW 1 MHz
VBW 1 MHz
SWP 1ØØ msec


ARESCOM
REF 20.0 dBm
ATTEN 30 dB
MKR Δ 10.05 MHz
0.60 dB
10 dB/
MARKER Δ
10.05 MHz
0.60 dB
CENTER 2.462 0 GHz
SPAN 50.0 MHz
RES BW 1 MHz
VBW 1 MHz
SWP 100 msec

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 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 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 ±4.0 dB.

6.4 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 connected to a 110 VAC / 60 Hz power source and it was placed center and the back edge of the test table. The rear of the EUT was placed flushed with the rear of the tabletop.

The spacing between the peripherals was 10 centimeters.

External Input / Output cables were draped along the edge of the test table and bundled if necessary.

6.5 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 24000 MHz.

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

Start Frequency ....30 MHz
Stop Frequency ....24000 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

6.6 Test Procedure

For the radiated emissions test, both the EUT and all support equipment power cords were 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.

6.7 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

6.8 Summary of Test Results

According to the data in section 6.9, 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:

-7.1 dBmV at **4824.00 MHz** in the **Vertical** polarization at Low Channel, **30 to 24000MHz, 3 meters.**

-8.1 dBmV at **4874.00 MHz** in the **Vertical** polarization at Middle Channel, **30 to 24000MHz, 3 meters.**

-12.4 dBmV at **4924.00 MHz** in the **Vertical** polarization at High Channel, **30 to 24000MHz, 3 meters.**

-2.8 (Peak) dBmV at **216.00 MHz** in the **Horizontal** polarization at local unintentional used, **30 to 1000MHz, 3 meters.**

6.9 Test Data

6.9.1 Final Test Data, Low Channel.

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart C		
Frequency	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	
2412.00	100.2	180	1.2	V3	28.1	3.4	30.0	101.7			
2412.00	100.0	90	1.6	H3	28.1	3.4	30.0	101.5			
4824.00	59.5	45	1.2	V	32.5	4.9	30.0	66.9	74	-7.1	Peak
4824.00	38.0	45	1.2	V	32.5	4.9	30.0	45.4	54	-8.6	Ave.
4824.00	28.8	45	1.6	H	32.5	4.9	30.0	36.2	54	-17.8	Ave.
7236.00	22.6	90	1.2	V	35.1	5.6	30.0	33.3	54	-20.7	Ave.
7236.00	21.1	45	1.6	H	35.1	5.6	30.0	31.8	54	-22.2	Ave.
7236.00	37.2	90	1.2	V	35.1	5.6	30.0	47.9	74	-26.1	Peak
7236.00	34.2	90	1.6	H	35.1	5.6	30.0	44.9	74	-29.1	Peak

6.9.2 Final Test Data, Middle Channel.

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart C		
Frequency	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	
2437.00	100.0	45	1.2	V3	28.1	3.4	30.0	101.5			
2437.00	98.9	90	1.4	H3	28.1	3.4	30.0	100.4			
4874.00	38.5	45	1.2	V	32.5	4.9	30.0	45.9	54	-8.1	Ave.
4874.00	46.2	45	1.2	V	32.5	4.9	30.0	53.6	74	-20.4	Peak
7311.00	22.4	90	1.2	V	35.1	5.6	30.0	33.1	54	-20.9	Ave.
7311.00	18.8	145	1.4	H	35.1	5.6	30.0	29.5	54	-24.5	Ave.
4874.00	22.1	145	1.4	H	32.5	4.9	30.0	29.5	54	-24.5	Ave.
4874.00	38.0	90	1.4	H	32.5	4.9	30.0	45.4	74	-28.6	Peak
7311.00	32.0	90	1.2	V	35.1	5.6	30.0	42.7	74	-31.3	Peak
7311.00	30.0	145	1.4	H	35.1	5.6	30.0	40.7	74	-33.3	Peak

6.9.3 Final Test Data, High Channel.

Indicated			Table	Antenna		Correction Factor			FCC 15 Subpart C		
Frequency	Ampl.	Direction	Height	Polar	Antenna	Cable Loss	Amp.	Corr. Ampl.	Limit	Margin	Mode
MHz	dBmV/m	Degree	Meter	H/V	dBmV/m	dBmV/m	dB	dBmV/m	dBmV/m	dB	
2462.00	103.3	45	1.4	V3	28.1	3.4	30.0	104.8			
2462.00	98.4	90	1.6	H3	28.1	3.4	30.0	99.9			
4924.00	34.2	90	1.4	V	32.5	4.9	30.0	41.6	54	-12.4	Ave.
4924.00	32.6	45	1.6	H	32.5	4.9	30.0	40.0	54	-14.0	Ave.
4924.00	47.5	90	1.4	V	32.5	4.9	30.0	54.9	74	-19.1	Peak
7386.00	20.6	45	1.4	V	35.1	5.6	30.0	31.3	54	-22.7	Ave.
7386.00	18.9	90	1.6	H	35.1	5.6	30.0	29.6	54	-24.4	Ave.
4924.00	40.0	45	1.6	H	32.5	4.9	30.0	47.4	74	-26.6	Peak
7386.00	34.3	45	1.4	V	35.1	5.6	30.0	45.0	74	-29.0	Peak
7386.00	32.0	90	1.6	H	35.1	5.6	30.0	42.7	74	-31.3	Peak

6.9.4 Final Test Result, Local Unintentional Unit, 30 MHz – 10000 MHz

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 SUBPART C	
Frequency MHz	Ampl. dBmV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBmV/m	Cable dB	Amp. dB	Corr. Ampl. dBmV/m	Limit dBmV/m	Margin dB
216.00	48.5(Q)	180	1.0	H	12.5	4.7	25.0	40.7	43.5	-2.8
280.02	47.0	360	1.3	H	14.6	5.8	25.0	42.4	46.0	-3.6
168.00	49.5	90	1.2	H	13.3	2.1	25.0	39.9	43.5	-3.6
384.01	46.7(Q)	270	1.0	H	16.2	3.9	25.0	41.8	46.0	-4.2
227.09	50.7(Q)	180	1.0	H	12.1	3.9	25.0	41.7	46.0	-4.3
528.04	43.7	90	2.0	H	19.8	2.9	25.0	41.4	46.0	-4.6
336.02	48.6	225	3.0	H	15.0	2.6	25.0	41.2	46.0	-4.8
288.02	45.2(Q)	315	2.0	H	14.6	5.8	25.0	40.6	46.0	-5.4
264.00	46.9	90	1.8	H	13.3	4.9	25.0	40.1	46.0	-5.9
240.00	48.2	180	1.7	H	12.6	2.3	25.0	38.1	46.0	-7.9
224.00	46.3	90	1.5	H	12.1	3.9	25.0	37.3	46.0	-8.7
211.99	42.3	90	1.0	H	12.5	4.7	25.0	34.5	43.5	-9.0
352.00	42.0	90	1.0	H	15.5	4.3	25.0	36.8	46.0	-9.2
960.00	29.7	225	1.0	H	25.2	4.8	25.0	34.7	46.0	-11.3

7 - 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

7.1 Standard Applicable

According to §15.247(c), if *any* 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in § 15.209(a), whichever results in the lesser attenuation.

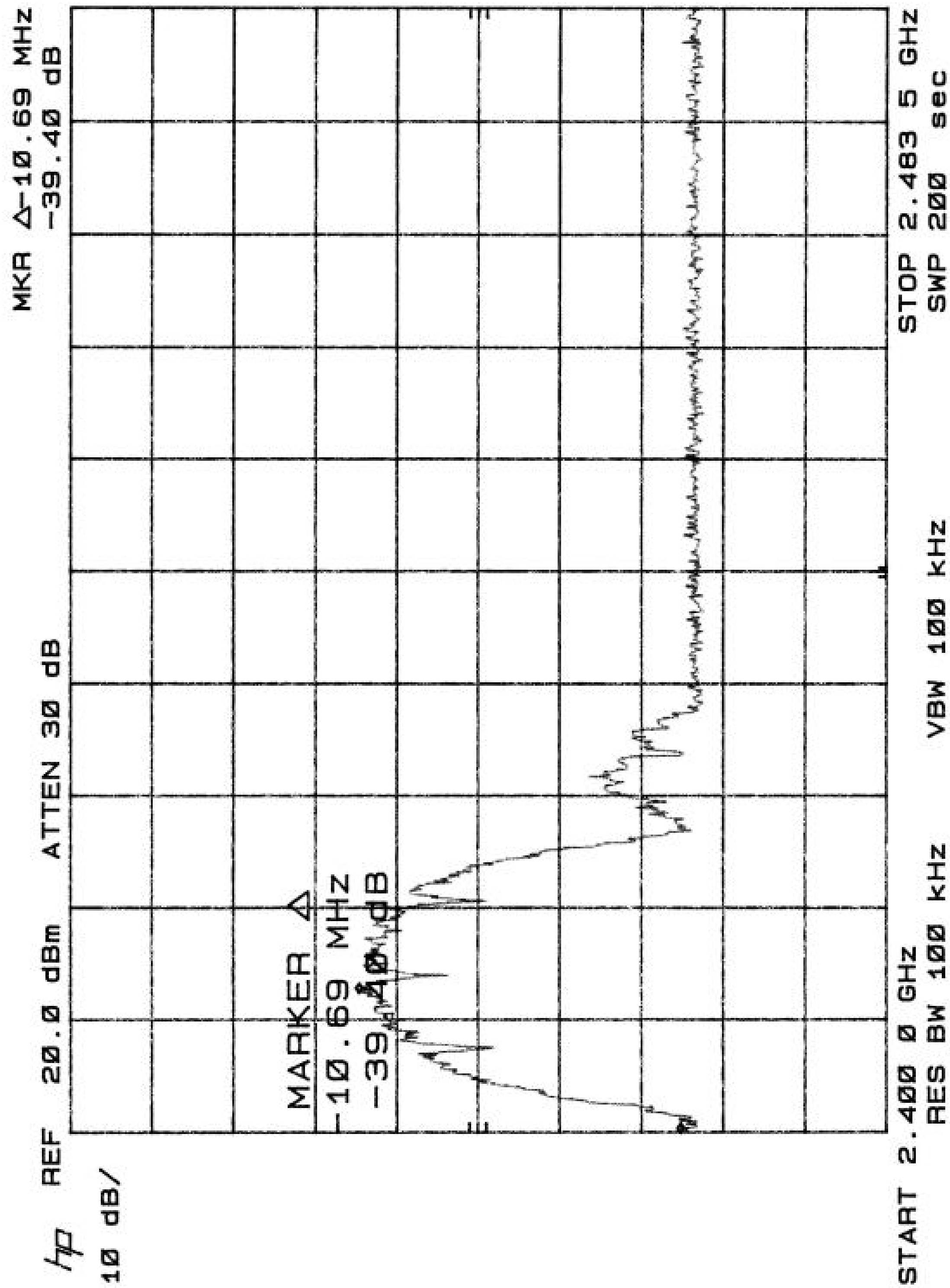
7.2 Measurement Procedure

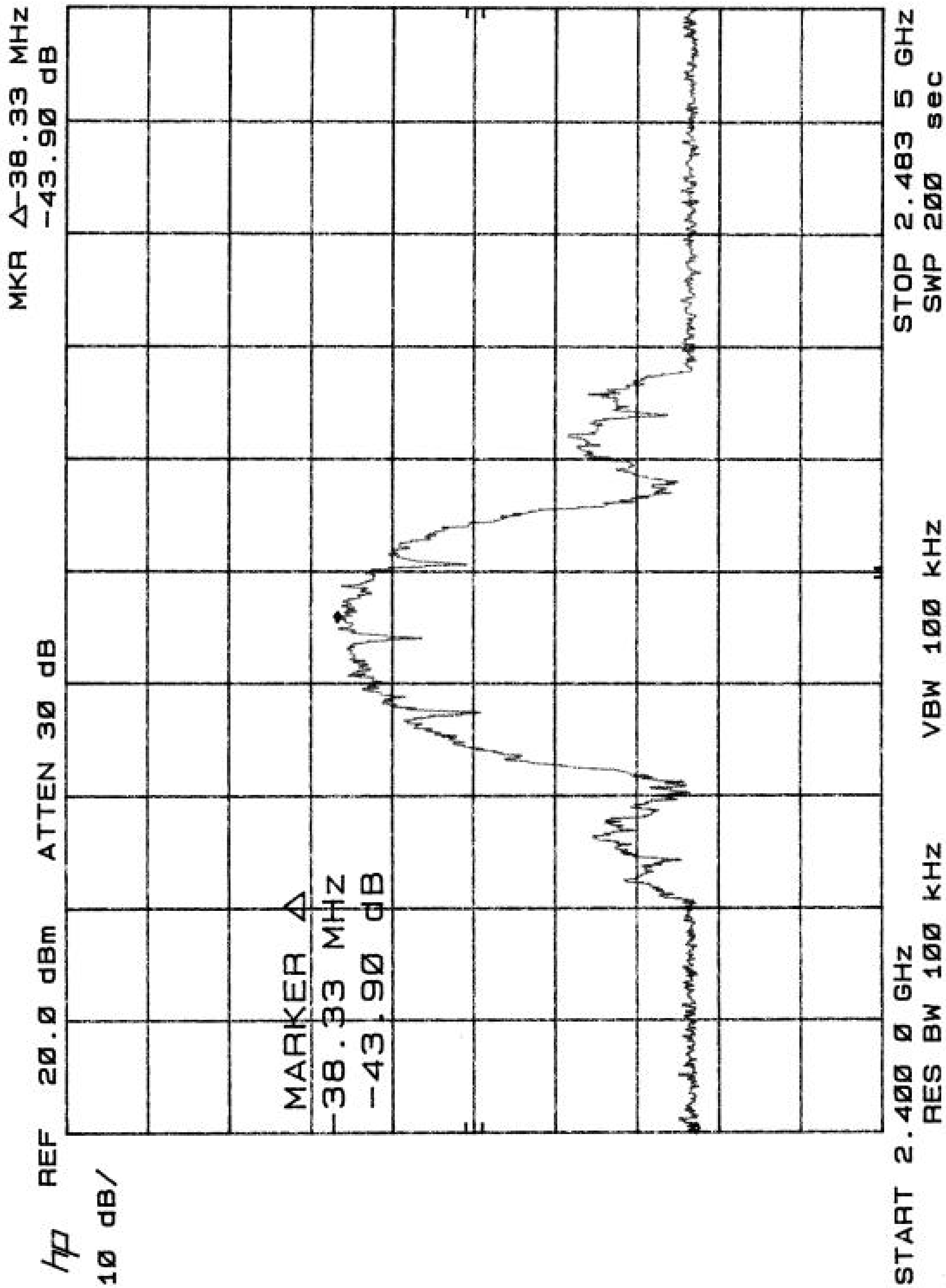
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then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

7.3 Test Results

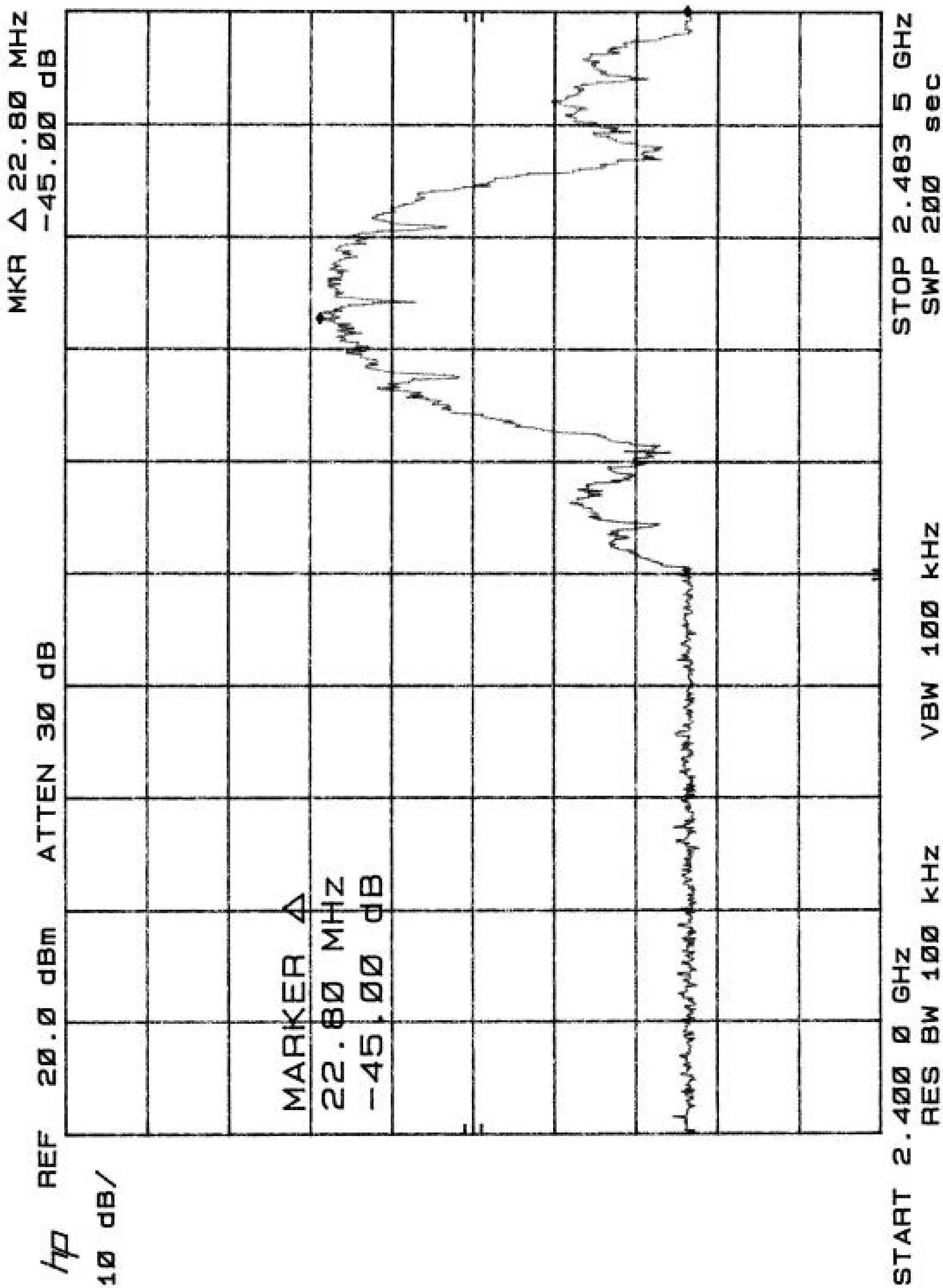
Test Result: pass.

Please refer to the hereinafter plots for more details.


MKR Δ-10.69 MHz
-39.40 dB
REF 20.0 dBm
ATTEN 30 dB
10 dB/
MARKER Δ
-10.69 MHz
-39.40 dB
START 2.400 0 GHz
STOP 2.483 5 GHz
RES BW 100 kHz
VBW 100 kHz
SWP 200 sec



hp
REF 20.0 dBm ATTEN 30 dB
10 dB/
MKR Δ-38.33 MHz
-43.90 dB
MARKER Δ
-38.33 MHz
-43.90 dB
START 2.400 0 GHz
RES BW 100 kHz
VBW 100 kHz
STOP 2.483 5 GHz
SWP 200 sec


MKR Δ 22.80 MHz
-45.00 dB
REF 20.0 dBm
ATTEN 30 dB
10 dB/
MARKER Δ
22.80 MHz
-45.00 dB
START 2.400 0 GHz
STOP 2.483 5 GHz
RES BW 100 kHz
VBW 100 kHz
SWP 200 sec

8 – POWER DENSITY

8.1 Standard Applicable

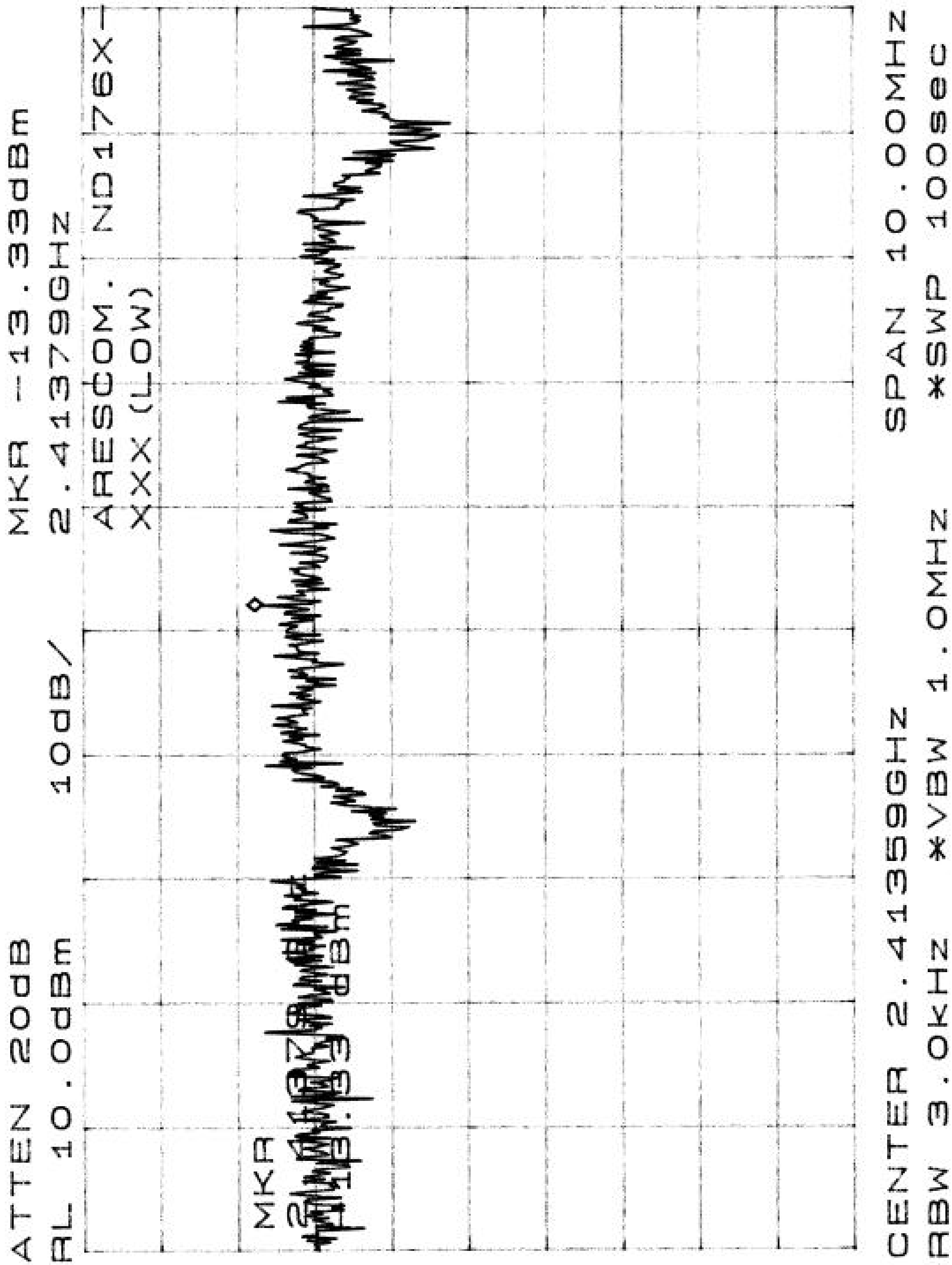
According to §15.247 (d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

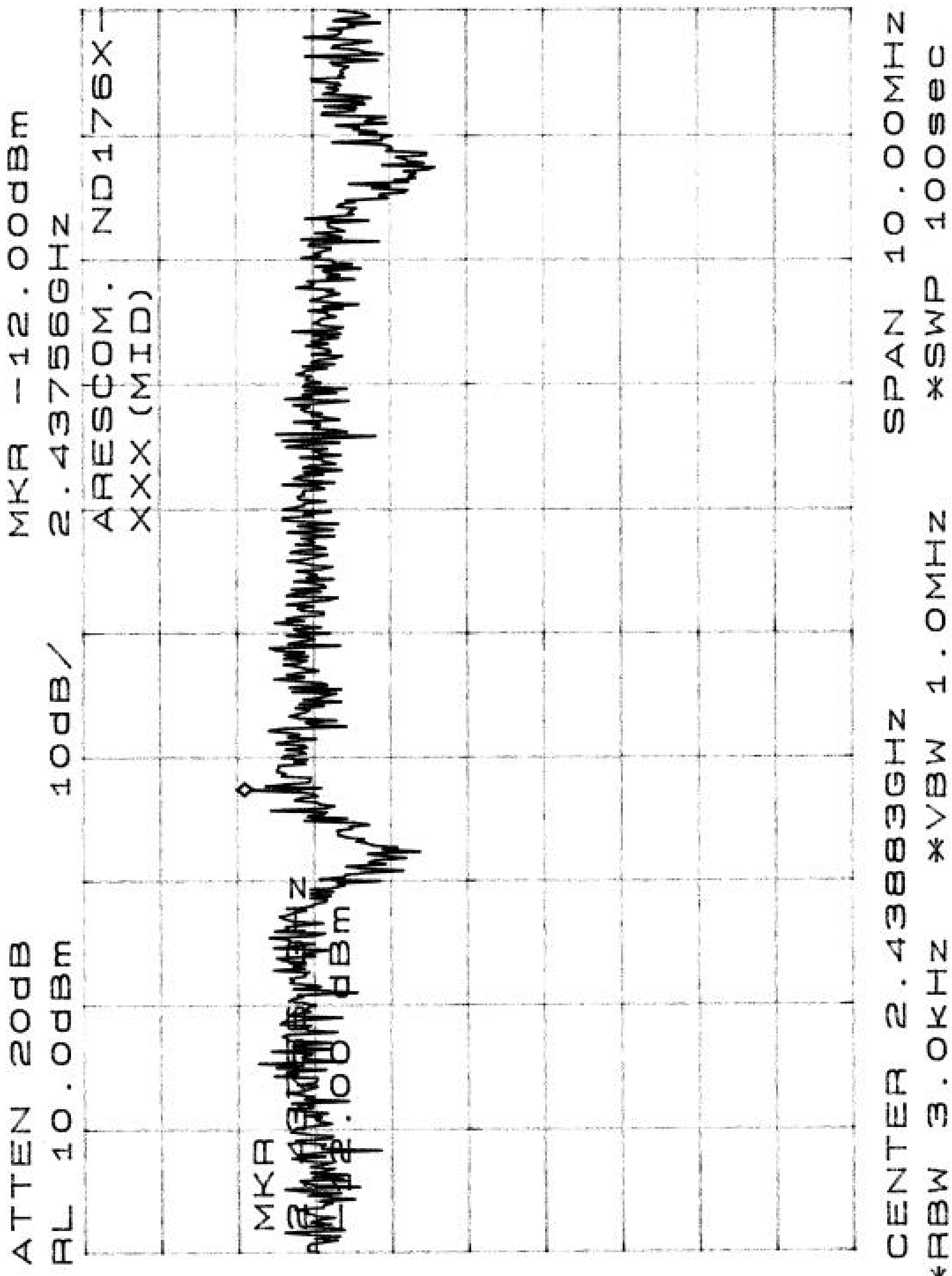
8.2 Measurement Procedure

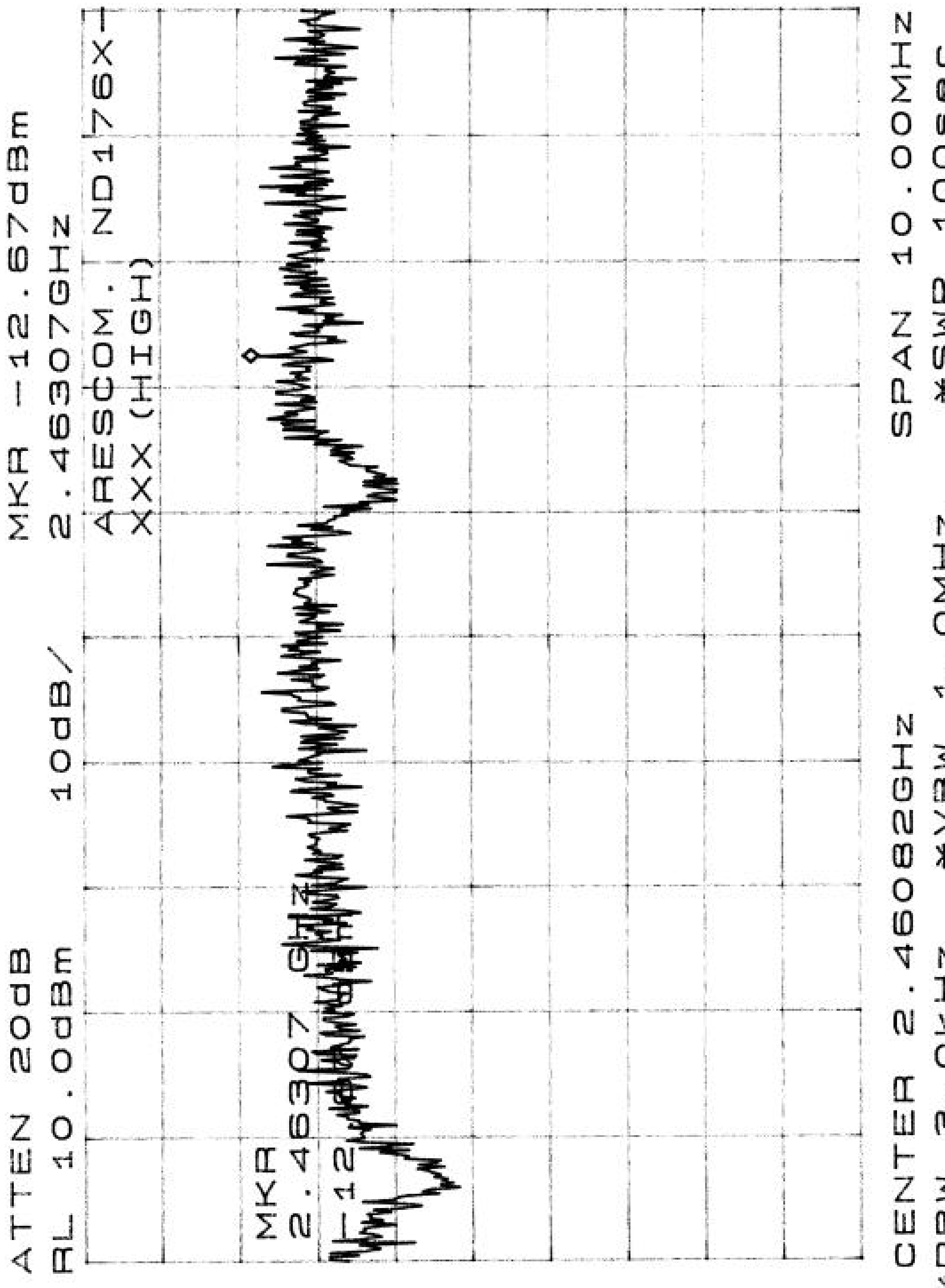
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. 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. Repeat above procedures until all frequencies measured were complete.

8.3 Test Results

Please refer to the following plot(s) for more details.


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -13.33dBm
2.413779GHz
ARESCOM. ND176X
XXX (LOW)
MKR
CENTER 2.41359GHz
SPAN 10.00MHz
*RBW 3.0kHz
*VBW 1.0MHz
*SWP 100sec


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -12.00dBm
2.43756GHz
ARESCOM. ND176X-
XXX (MID)
CENTER 2.43883GHz
SPAN 10.00MHz
*RBW 3.0kHz
*VBW 1.0MHz
*SWP 100sec


ATTEN 20dB
RL 10.0dBm
10dB/
MKR -12.67dBm
2.46307GHz
ARESCOM. ND1176X-
XXX (HIGH)
MKR
2.46307 GHz
-12
CENTER 2.46082GHz
SPAN 10.00MHz
*RBW 3.0kHz
*VBW 1.0MHz
*SWP 100sec

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 0 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

10 – RF SAFETY REQUIREMENTS TO 2.1091

According to 15.247(b)(4), RF exposure is calculated.

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: 6.3 (dBm)
Maximum peak output power at antenna input terminal: 4.27 (mW)
Antenna Gain (typical): 2.5 (dBi)
Maximum antenna gain: 1.78 (numeric)
Prediction distance: 3 (cm)
Predication frequency: 2400(MHz)
MPE limit for uncontrolled exposure at prediction frequency: 1.0(mW/cm^2)
Power density at predication frequency: 0.067(mW/cm^2)
Maximum allowable antenna gain: 14.23(dBi)

Test Result

The predicted power density level at 3 cm is 0.067mW/cm^2. This is below the uncontrolled exposure limit of 1mW/cm^2 at 2400 MHz.

This radio is intended to be installed in laptop PC only and is thus classed as mobile equipment.

11 – Processing Gain of Direct Sequence Spread Spectrum Measurement

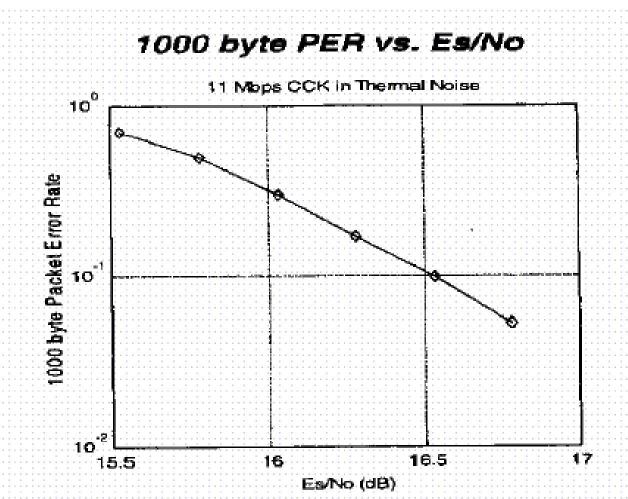
11.1 Test Instruments and Support Unit

Description & Manufacturer	Model No.	Serial No.
Anritsu Spectrum Analyzer, 9kHz to 30GHz	MS2667C	M10281
Anritsu Signal Generator, 10kHz to 20GHz	68247B	984703
Hewlett Packard Power Meter,	HP438A	2743A04416
Hewlett Packard Power Sensor, -30 to 20dBm	8485A	2942A08387
Hewlett Packard Step Attenuator, 10dB steps	HP8496B	3247A18505
Mini-Circuits Power Splitter	ZN2PD-9G	NA
DELL Laptop Computer	Inspiron 5000e	NA
Campaq Laptop Computer	PPX	99125

11.2 Method of Measurement

The processing gain may be measured using the CW jamming margin method. Section 4.7.4 shows the test configuration. The test consists of stepping a signal generator in 50 kHz increments across the passband of the system. At each point, the generator level required to produce the recommended Bit Error Rate (BER) is recorded. This level is jammer level. The output power of the transmitting unit is measured at the same point. The jammer to Signal (J/S) ratio is then calculated. Discard the worst 20% of the J/S data points. The lowest remaining J/S ratio is used when calculating the Process Gain.

The reference PER is specified as 8%. The corresponding Es/No (signal to noise ratio per symbol) is 16.4 dB. The curve is attached as below.



This value and the measured J/S ratio are used in the following equation to calculate the Process Gain (Gp) of the system.

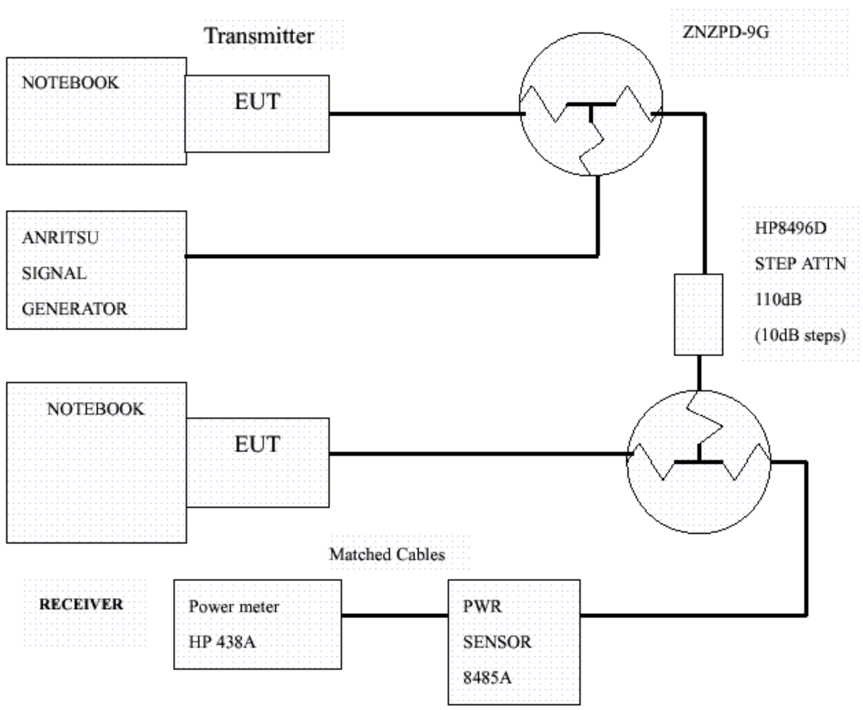
$$Gp = (S/N)o + Mj + Lsys$$

Where:

(S/N)o: Signal to noise ratio for the chosen BER.
Mj: Maximum jammer to Signal Ratio recorded at the detected BER.
Lsys: System losses. For the purpose of this processing gain calculation, we assume Lsys at its minimum value of 2 dB.

TEST SETUP

Mini-Circuits 15542



11.3 Test Procedures

Obtain the simplex link shown. Perform all independent instrumentation calibrations prior to this procedure. Set operating power levels using fixed and variable attenuators in system to meet the following objectives:

Signal Power at receiver approximately –55dBm (above thermal sensitivity such that thermal noise does not cause bit errors.

Signal Power at power meter between –20 and –30dBm for optimal linearity.

Use spectrum analyzer to monitor test.

Ensure that CW Jammer generator RF output is disabled and measure the power at the power meter port using the power meter. This is the relative signal power, Sr.

Disable Transmitter, and set CW Jammer generator RF output frequency equal to the carrier frequency and enable generator output. Set reference CW Jammer power level at power meter port 8.4dB below Sr (minimum J/S, or 10dB processing gain reference level). Note the power level setting on the generator, this is the reference CW Jammer power setting, Jr.

Disable CW Jammer, re-establish link. PER test should be operating essentially error -free.

Enable CW Jammer at the reference power level and verify that the PER test indicates a PER of less than 8%.

Alternatively, adjust the CW Jammer level to that which causes 8% PER and verify that the S/J is less than 8.4dB.

Repeat step 7 for uniform steps in frequency increments of 50 kHz across the receiver passband with the CW Jammer. In this case the receiver passband is +/- 8.5 MHz.

The numerical data associated with the following radio channel is tabulated and presented for Channel 1,6, and 11.

Note: Since the jamming signal will be blocked by the IF filter if the jamming frequency is far form the center of the carrier frequency. So, only those frequencies around carrier frequency are shown here.

11.4 EUT Operating Condition

The software provided by client to set the EUT to transmit at lowest, middle and highest channel.

11.5 Test Results

Environmental Conditions: 20°C, 60%RH

Although the theoretical processing gain is lower than 10 dB, but the CCK coding provides an extra coding gain of 2.2dB.

11Mbps CHANNEL 1 Processing Gain				
Frequency (GHz)	Gp (dB)	(S/N) (dB)	Mj = J/S (dB)	Lsys (dB)
2.40800	13.0	16.4	-4.4	1
2.40805	13.6	16.4	-3.8	1
2.40810	13.1	16.4	-4.3	1
2.40815	13. 2	16.4	-4.2	1
2.40820	13.0	16.4	-4.4	1
2.40825	12.9	16.4	-4.5	1
2.40830	12.8	16.4	-4.6	1
2.40835	12.3	16.4	-5.1	1
2.40840	13.0	16.4	-4.4	1
2.40845	13.1	16.4	-4.3	1
2.40850	12.4	16.4	-5.0	1
2.40855	12.0	16.4	-5.4	1
2.40860	12.3	16.4	-5.1	1
2.40865	12.2	16.4	-5.2	1
2.40870	12.5	16.4	-4.9	1
2.40875	11.8	16.4	-5.6	1
2.40880	12.1	16.4	-5.3	1
2.40885	12.3	16.4	-5.1	1

11Mbps CHANNEL 1 Processing Gain				
Frequency	Gp	(S/N)	Mj = J/S	Lsys
(GHz)	(dB)	(dB)	(dB)	(dB)
2.40890	12.1	16.4	-5.3	1
2.40895	12.5	16.4	-4.9	1
2.40900	12.2	16.4	-5.2	1
2.40950	12.0	16.4	-5.4	1
2.40955	11.4	16.4	-6.0	1
2.40960	11.3	16.4	-6.1	1
2.40965	11.0	16.4	-6.4	1
2.40970	11.6	16.4	-5.8	1
2.40975	10.9	16.4	-6.5	1
2.40980	11.4	16.4	-6.0	1
2.40985	11.0	16.4	-6.4	1
2.40990	11.6	16.4	-5.8	1
2.40995	10.3	16.4	-7.1	1
2.41000	10.6	16.4	-6.8	1
2.41005	11.2	16.4	-6.2	1
2.41010	10.5	16.4	-6.9	1
2.41015	11.4	16.4	-6.0	1
2.41020	10.8	16.4	-6.6	1
2.41025	10.6	16.4	-6.8	1
2.41030	10.2	16.4	-7.2	1
2.41035	11.6	16.4	-5.8	1
2.41040	11.2	16.4	-6.2	1
2.41045	12.7	16.4	-4.7	1
2.41050	11.4	16.4	-6.0	1
2.41055	13.1	16.4	-4.3	1
2.41060	12.5	16.4	-4.9	1
2.41065	12.4	16.4	-5.0	1
2.41070	11.6	16.4	-5.8	1
2.41075	11.4	16.4	-6.0	1
2.41080	11.3	16.4	-6.1	1
2.41085	12.0	16.4	-5.4	1
2.41090	11.8	16.4	-5.6	1
2.41095	12.0	16.4	-5.4	1
2.41100	12.1	16.4	-5.3	1
2.41105	11.4	16.4	-6.0	1
2.41110	11.6	16.4	-5.8	1
2.41115	11.5	16.4	-5.9	1
2.41120	11.3	16.4	-6.1	1

12 - CONDUCTED EMISSIONS TEST DATA

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 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 Class B limits.

12.3 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..100 kHz
Video Bandwidth..100 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 EUT 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 and these test results is deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations, with the *worst* margin reading of:

-14.9 dBmV at **0.660 MHz** in the **Line** mode.

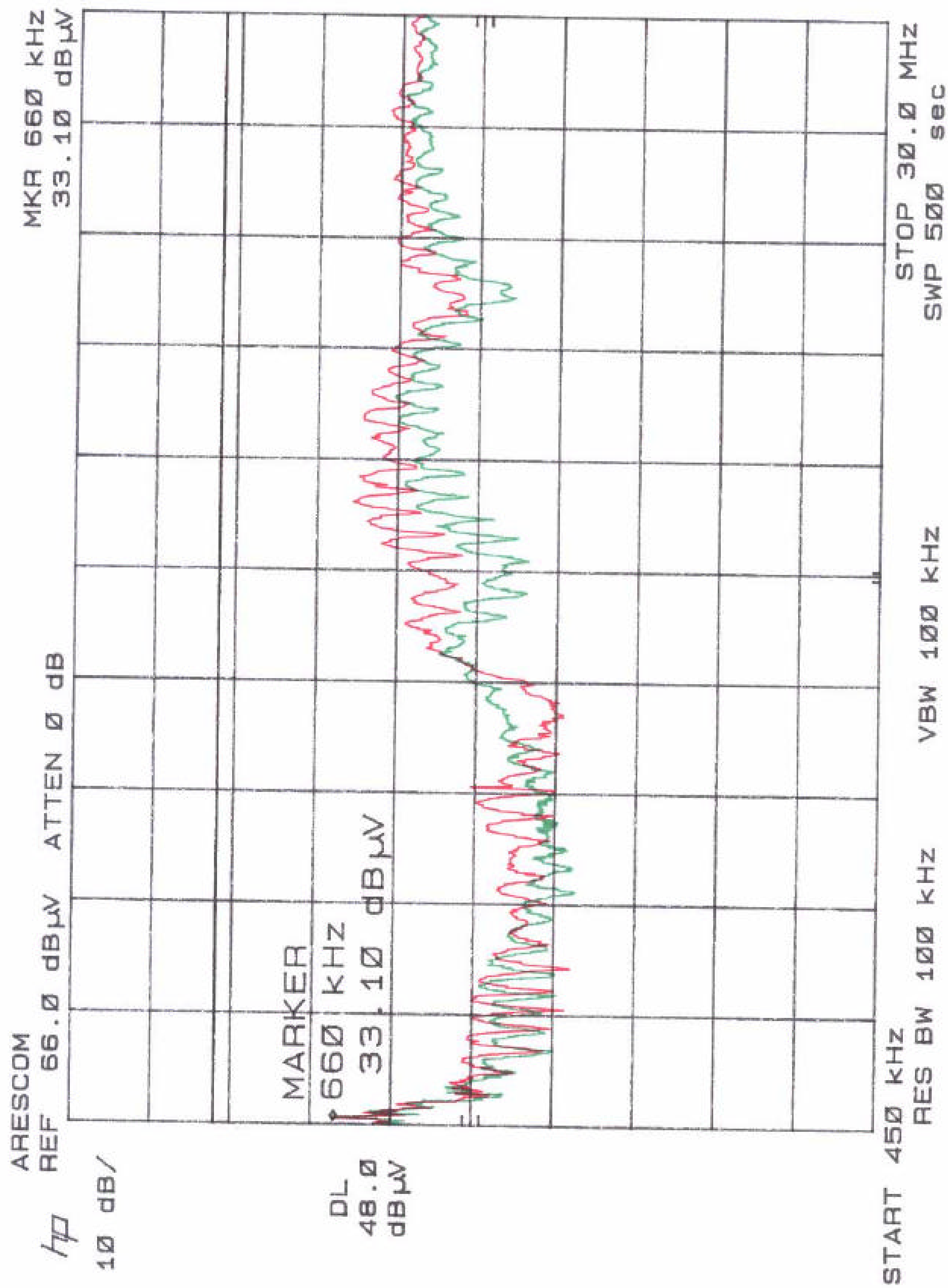
12.6 Conducted Emissions Test Data

11.6.1 Test Data, 0.45 - 30 MHz.

LINE CONDUCTED EMISSIONS				FCC CLASS B	
Frequency	Amplitude	Detector	Phase	Limit	Margin
MHz	dBµV	Qp/Ave/Peak	Line/Neutral	dBµV	dB
0.660	33.1	Qp	Line	48	-14.9
0.660	32.6	Qp	Neutral	48	-15.4
17.340	30.4	Qp	Line	48	-17.6
19.050	30.2	Qp	Line	48	-17.8
19.730	26.2	Qp	Neutral	48	-21.8
17.370	24.9	Qp	Neutral	48	-23.1

12.7 Plot of Conducted Emissions Test Data

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


MKR 660 kHz
33.10 dBµV
ARESCOM
REF 66.0 dBµV ATTEN 0 dB
10 dB/
DL
48.0
dBµV
MARKER
660 kHz
33.10 dBµV
START 450 kHz
RES BW 100 kHz
VBW 100 kHz
STOP 30.0 MHz
SWP 500 sec