FCC 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

Z-Com, Inc.

7F-2, No. 9, Prosperity 1st Rd, Science-based Industrial Park,
Hsinchu, Taiwan, R.O.C.

Ricoh Co., Ltd.

3-6, Naka-magome 1-Chome Ohta-ku,
Tokyo 143-8555, Japan

FCC ID: M4Y-000325

October 15, 2002

This Report Concerns:	**Equipment Type:**
☒ Class II Permissive Change	Wireless Card & Antenna

Test Engineer:	Benjamin Jin
Report No.:	R0210011
Test Date:	October 1, 2002
Reviewed By:	Jeff Lee
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1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Applicant:	Z-Com, Inc. & Ricoh Co., Ltd.
Product Description:	Wireless Card & Antenna
Product Name:	XI-325
FCC ID:	M4Y-000325
Serial Number:	None
Transmitter Frequency:	2400-2483.5MHz
Maximum Output Power:	18.09dBm (64.4mW)
Dimension:	3.3"L x 2.1"W x 0.2"H approximately
Power Supply:	DC 5V from Printer

The Wireless PC Card designed with a transmitting method of direct sequence spread spectrum is for local area network operation, which operates at 2.4GHz ISM band and data rate up to 11Mbps.

** The test data in this test report was good for the test sample only. It may have deviation for other test samples.*

1.2 Objective

This type approval report is prepared on behalf of. *Z-Com, Inc.* and Ricoh Co., Ltd. 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 Requirements, 6 dB Bandwidth, power density, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Spurious Radiated Emission, and processing gain.

1.3 Related Submittal(s)/Grant(s)

This Class II permissive change device was originally granted on 8/20/2001. The manufacture did not make any modification on the EUT. The purpose of this permissive II change is to add the antenna (model: XI-XI 100) to the grant of equipment authorization.

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4 – 2000, 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 Corporation. 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 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, 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 C63.4-2000.

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.

1.6 Test Equipment List and Details

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

*** Statement of Traceability: Bay Area Compliance Laboratory Corp.** certifies that all calibration has been performed using suitable standards traceable to the NATIONAL INSTITUTE of STANDARDS and TECHNOLOGY (NIST).

1.7 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
Ricoh	Printer	AP2610N	N/A	None

1.8 Remote Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
Dell	Notebook	TS30H	32288	IIRTS30HT
Lucent	Wireless Card	PC24E	01UT25334217	IMRWLPCE24H

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, terminal.exe, provided by the customer, is started the Windows 98 terminal program under the Windows 98 operating system. Once loaded, the program sequentially exercises each system component.

The sequence used is as follows:

1. Lines of Hs scroll across the notebook monitor.
2. The printer output Hs.

This process is continuous throughout all tests.

2.3 Special Accessories

As shown in section 2.5, all interface cables used for compliance testing are shielded as normally supplied by INMAC and their respective support equipment manufacturers. The host pc and other peripherals featured shielded metal connectors.

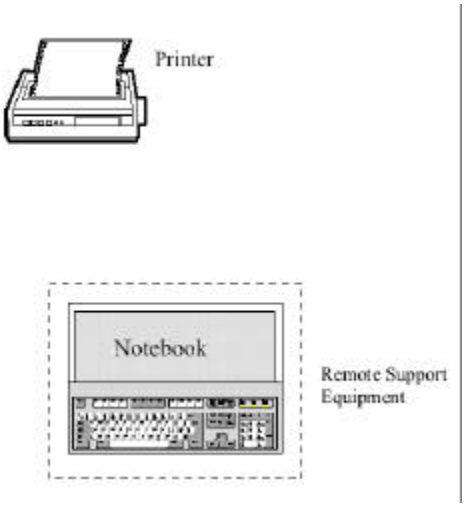
2.4 Schematics / Block Diagram

Please refer to Appendix D.

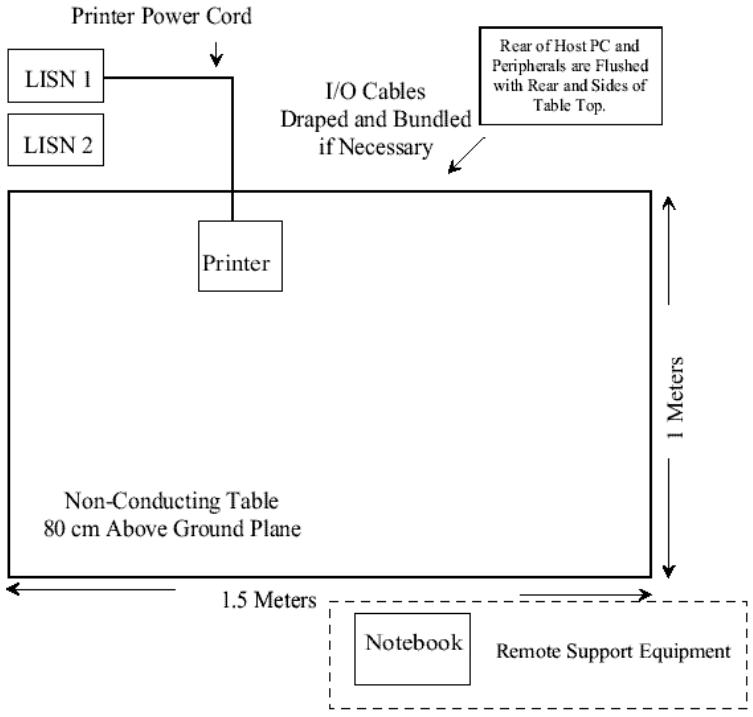
2.5 Equipment Modifications

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
§ 15.205	Restricted Bands	Compliant
§ 2.1091	RF Safety Requirements	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	Conducted Emission	Compliant
§15.209 (a)	Radiated Emission	Compliant
§15.209 (f)	Spurious Emission	Compliant
§15.247 (a) (2)	6 dB Bandwidth	Compliant
§15.247 (b) (2)	Peak Output Power	Compliant
§15.247 (b) (4)	RF Exposure	Compliant
§ 15.247 (c)	100 kHz Bandwidth of Frequency Band Edges	Compliant
§15.247 (d)	Peak Power Spectral Density	Compliant

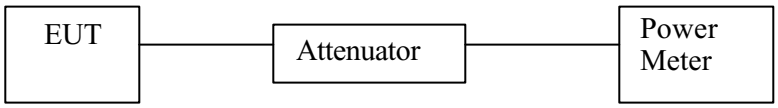
4 - PEAK OUTPUT POWER MEASUREMENT

4.1 Standard Applicable

According to §15.247(b) (2), for all direct sequence systems, the maximum peak output power of the intentional radiator 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 power meter.



4.3 Measurement Result

Port Description	Frequency (MHz)	Output Power in dBm	Output Power in W	Standard	Result
Port 1	Low	16.51	0.045	≤ 1W	Compliant
	Middle	15.26	0.034	≤ 1W	Compliant
	High	14.68	0.029	≤ 1W	Compliant
Port 2	Low	18.09	0.064	≤ 1W	Compliant
	Middle	17.77	0.059	≤ 1W	Compliant
	High	16.25	0.042	≤ 1W	Compliant

4.4 Test Equipment

Manufacturer	Description	Model No.	Serial No.	Calibration Due Date
HP	power meter	432A	1507A	8/16/03
HP	attenuator	BW-S15	/	/

5 - SPURIOUS EMISSION

5.1 Standard Applicable

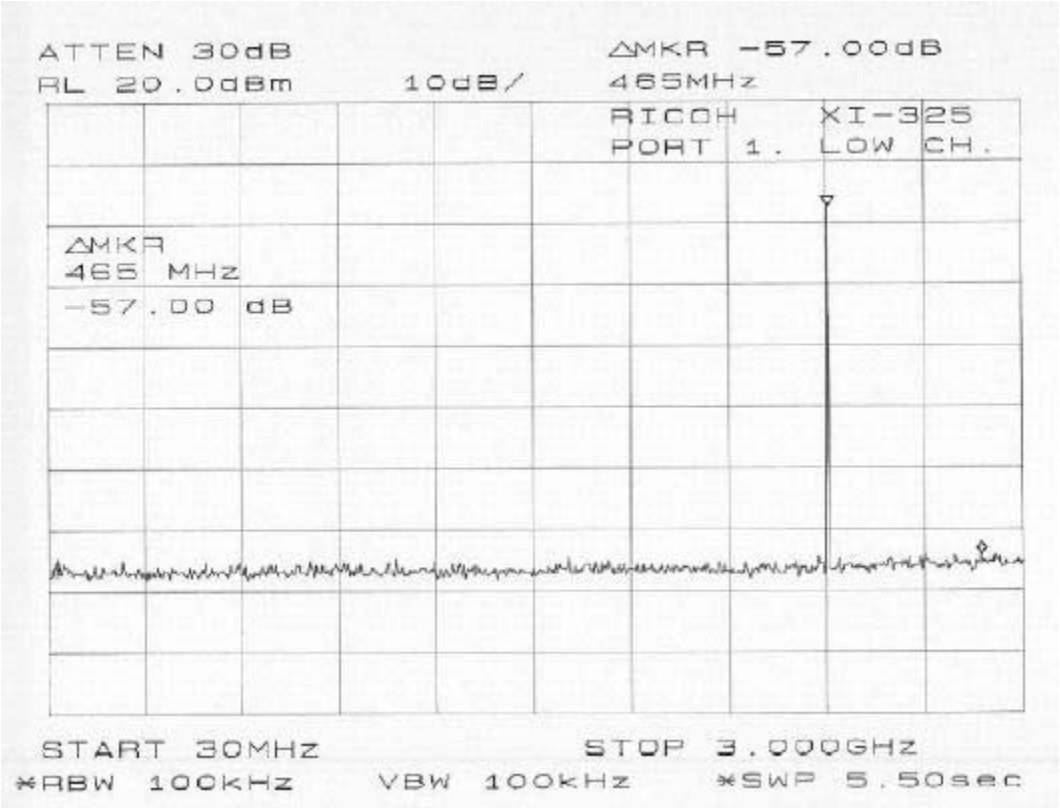
According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation f a digital device. If measurements above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

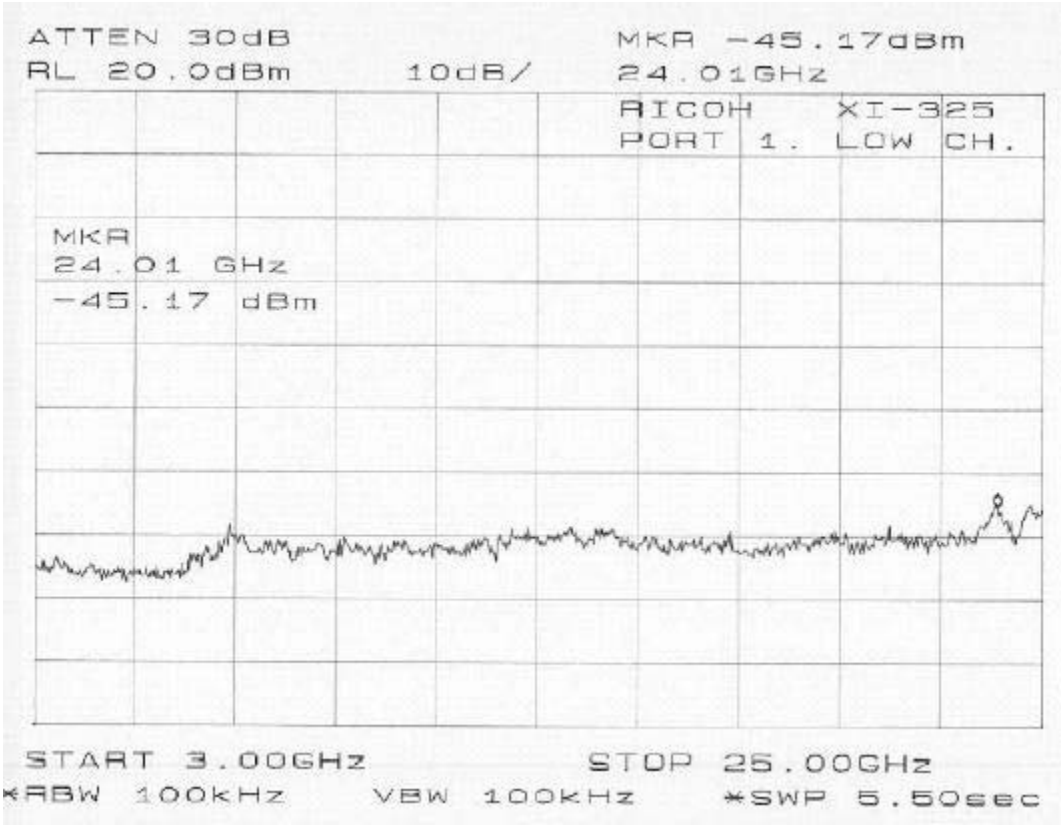
5.2 Measurement Procedure

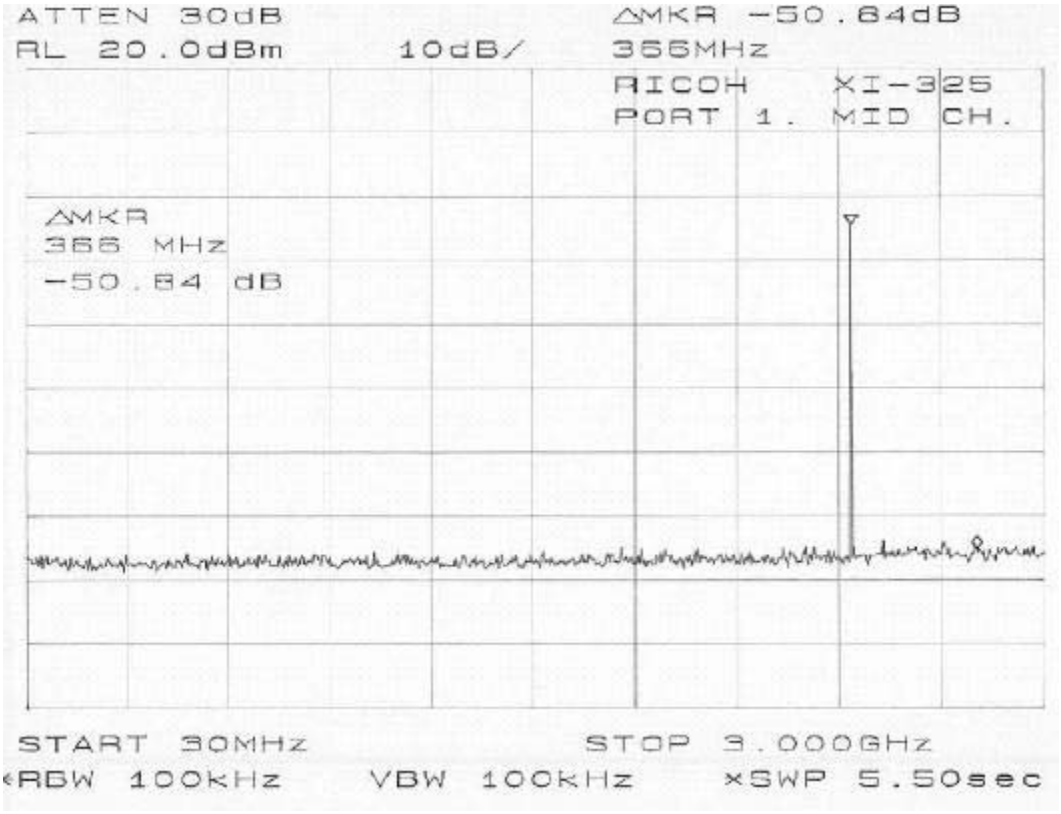
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument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

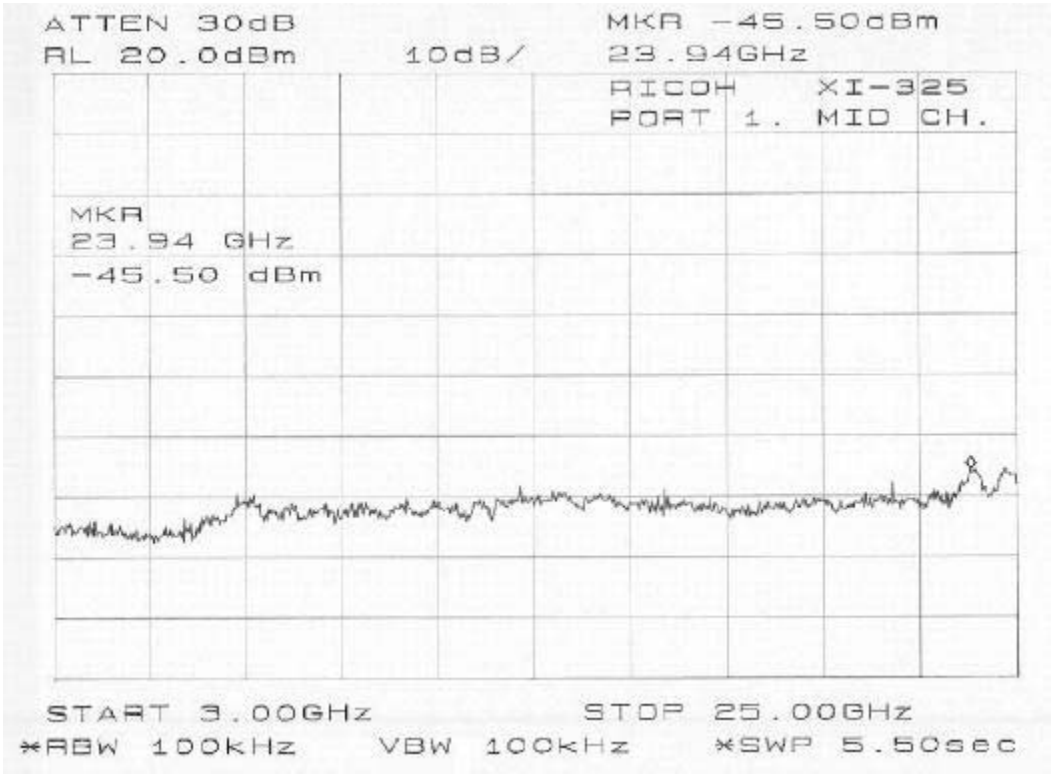
5.3 Measurement Data

Please refer to the appending for more information.


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -57.00dB
465MHz
RICOH XI-325
PORT 1. LOW CH.
ΔMKR
465 MHz
-57.00 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -45.17dBm
24.01GHz
RICOH XI-325
PORT 1. LOW CH.
MKR
24.01 GHz
-45.17 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -50.64dB
366MHz
RICOH XI-325
PORT 1. MID CH.
ΔMKR
366 MHz
-50.64 dB
START 30MHz
STOP 3.000GHz
#RBW 100kHz
VBW 100kHz
xSWP 5.50sec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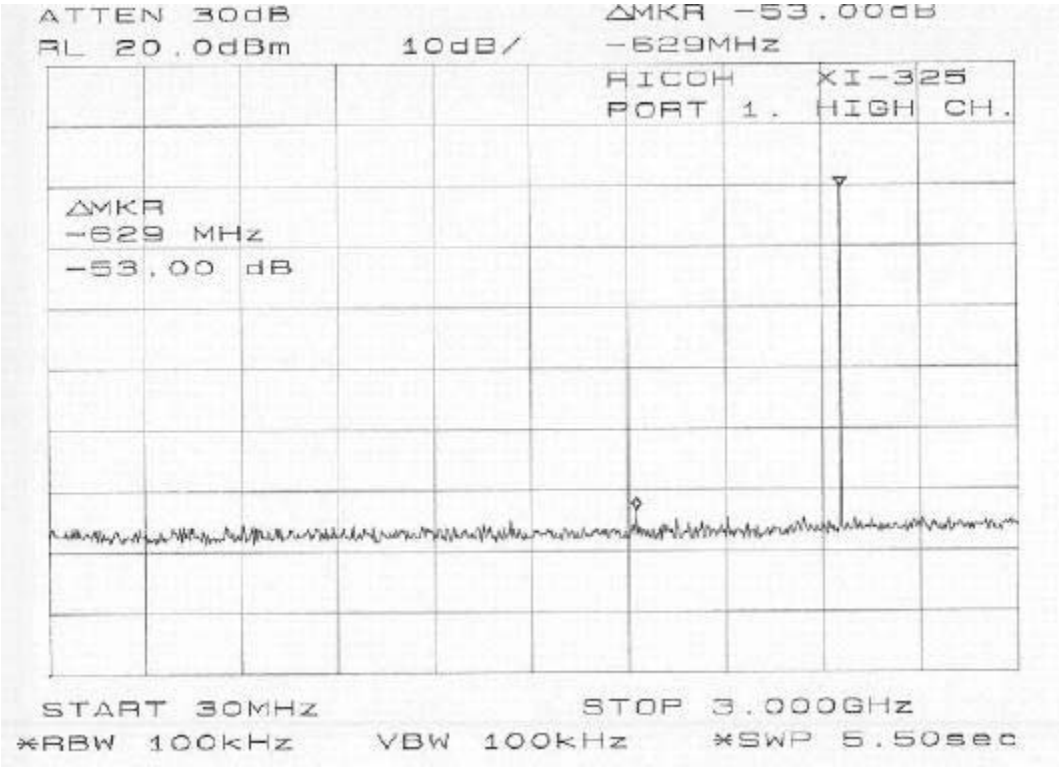
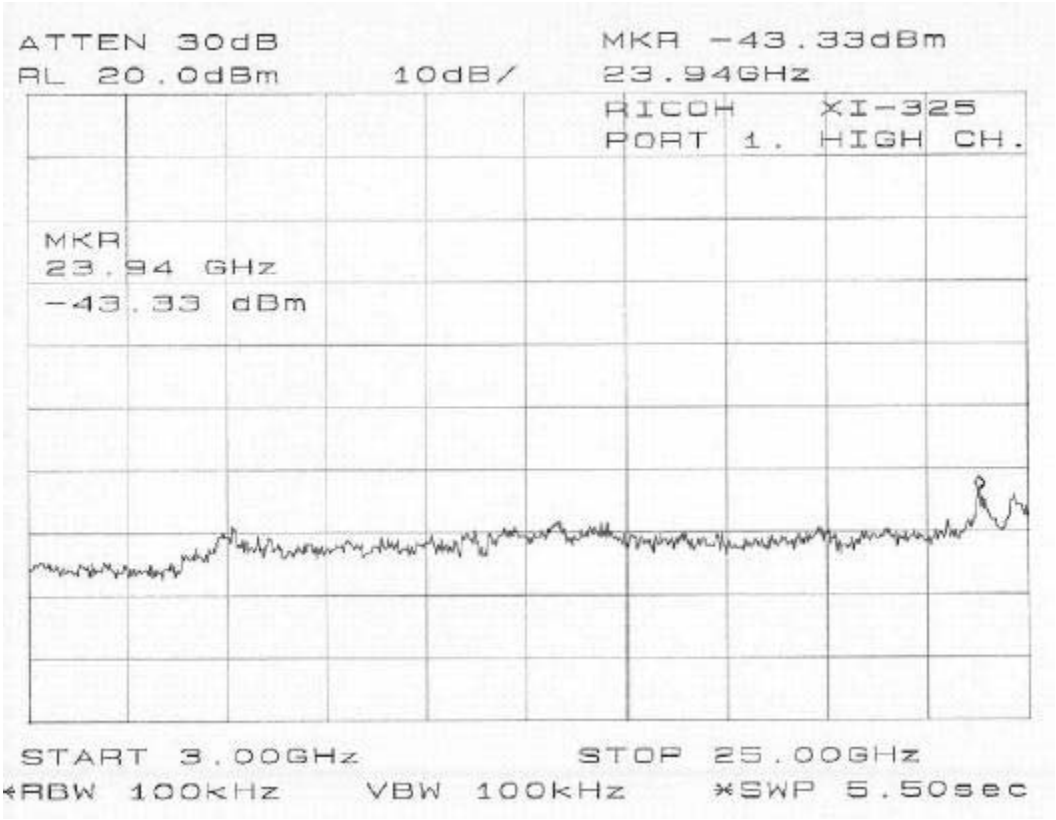
10dB/
MKR -45.50dBm
23.94GHz
RICOH XI-325
PORT 1. MID CH.
MKR
23.94 GHz
-45.50 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -53.00dB
-629MHz
RICOH XI-325
PORT 1. HIGH CH.
ΔMKR
-629 MHz
-53.00 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec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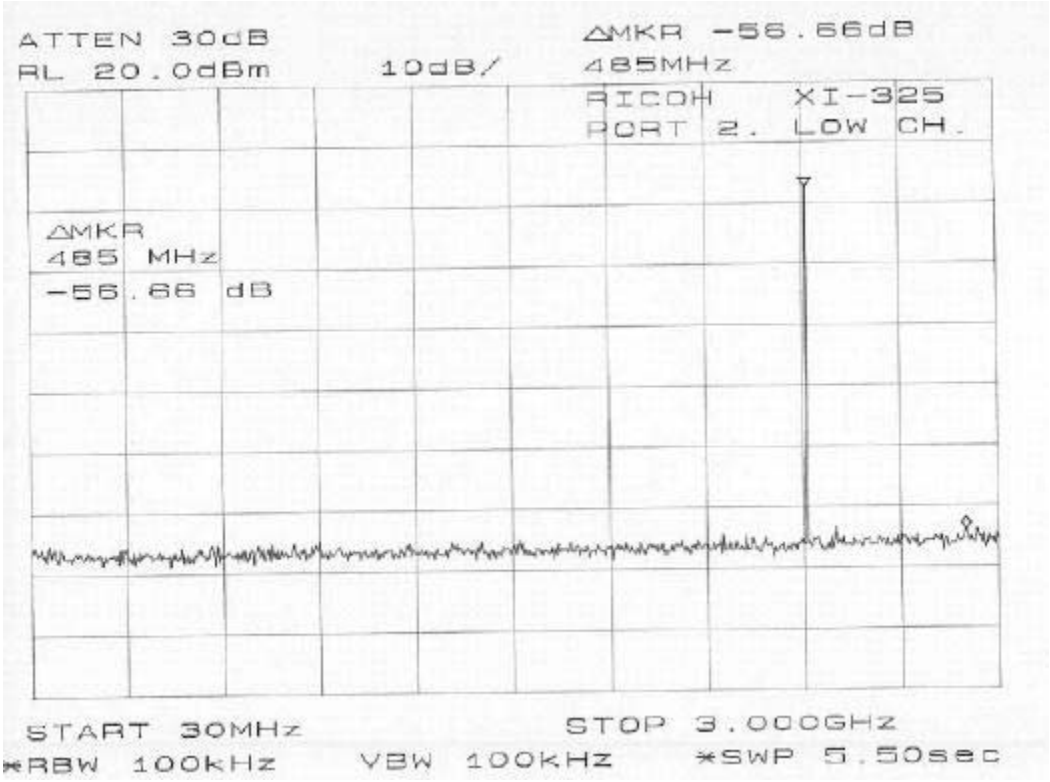
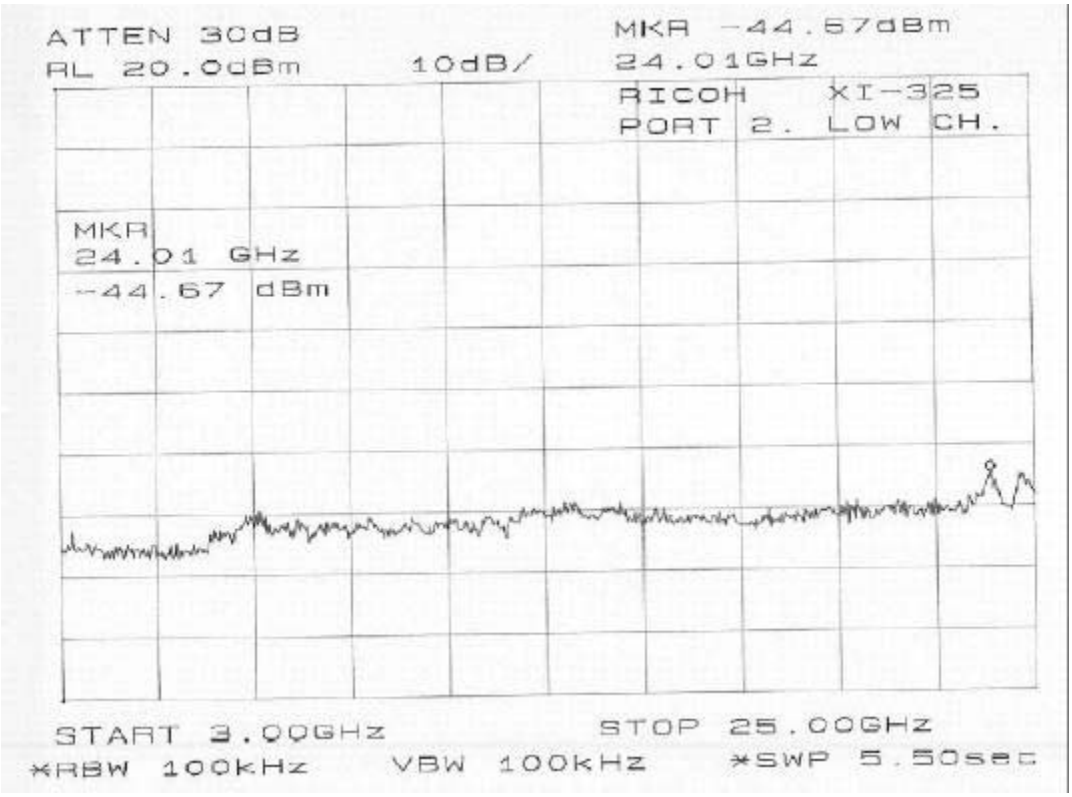
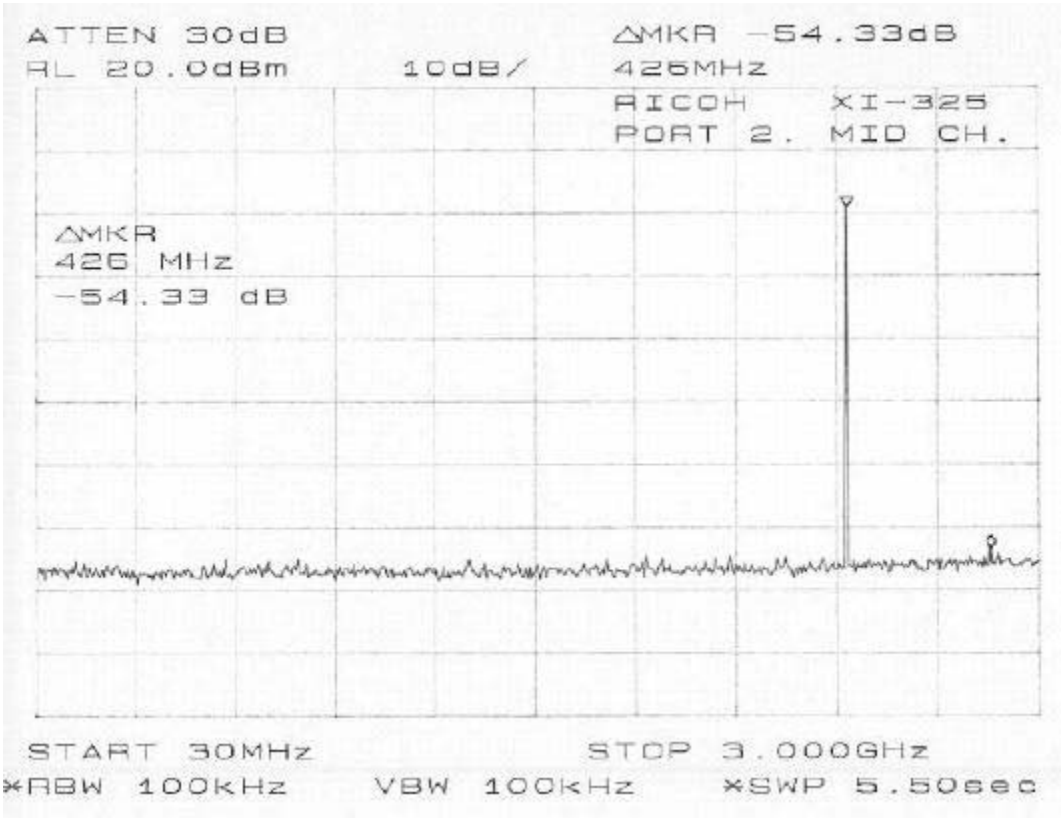
10dB/
MKR -43.33dBm
23.94GHz
RICOH XI-325
PORT 1. HIGH CH.
MKR
23.94 GHz
-43.33 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -56.66dB
485MHz
RICOH XI-325
PORT 2. LOW CH.
ΔMKR
485 MHz
-56.66 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -44.67dBm
24.01GHz
RICOH XI-325
PORT 2. LOW CH.
MKR
24.01 GHz
-44.67 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec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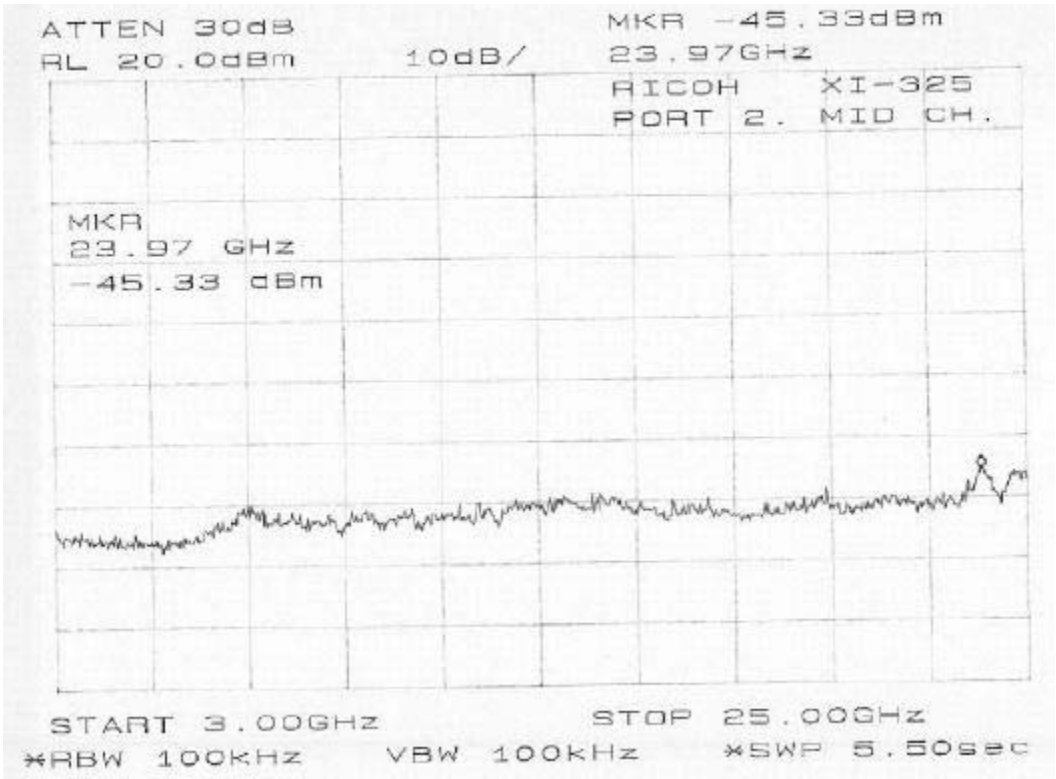
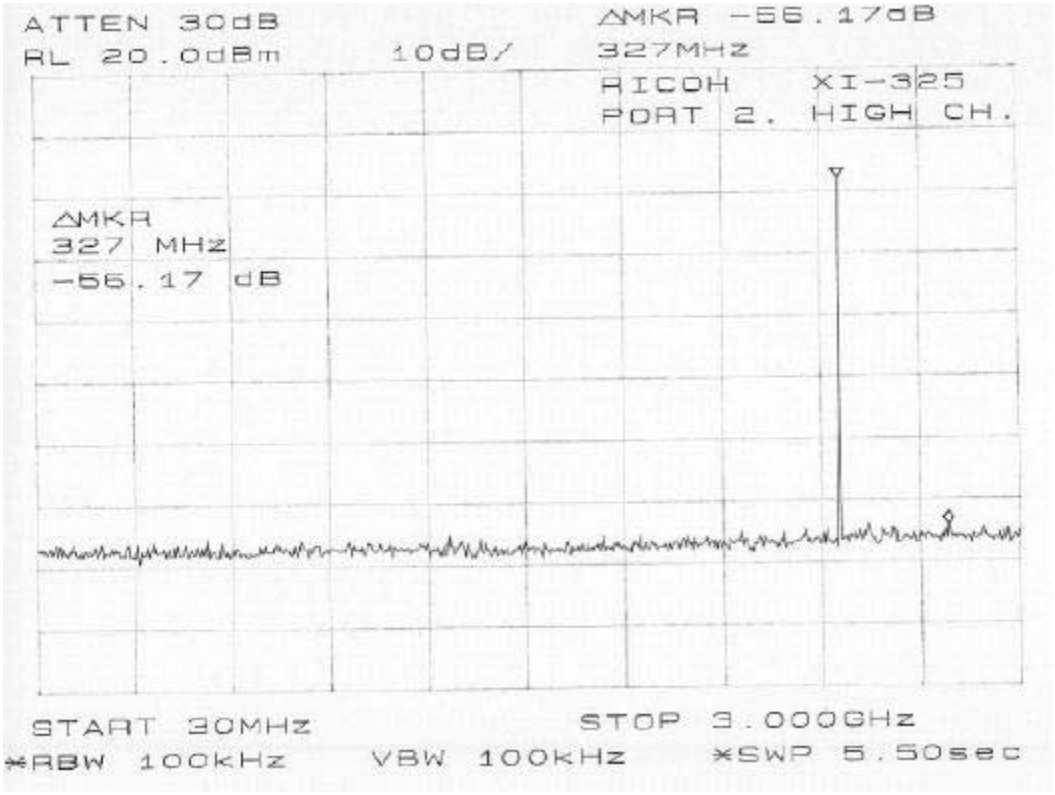
RL 20.0dBm
10dB/
ΔMKR -54.33dB
426MHz
RICOH XI-325
PORT 2. MID CH.
ΔMKR
426 MHz
-54.33 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -45.33dBm
23.97GHz
RICOH XI-325
PORT 2. MID CH.
MKR
23.97 GHz
-45.33 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec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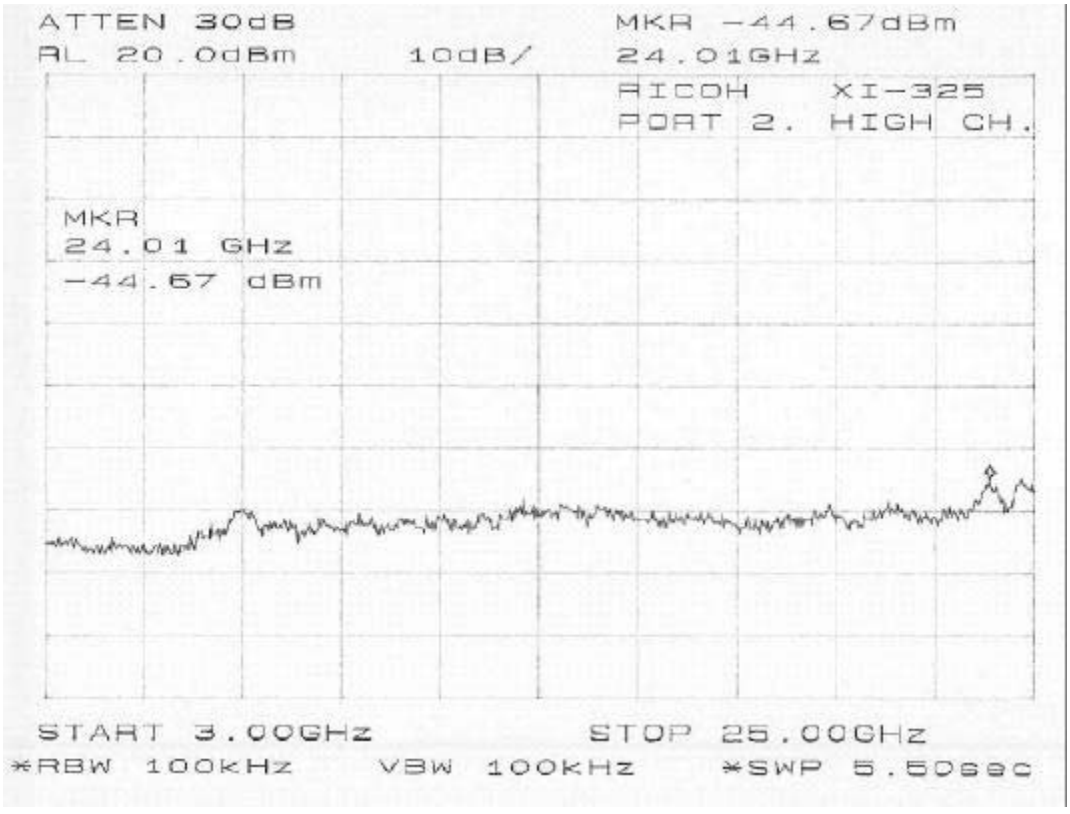
RL 20.0dBm
10dB/
ΔMKR -56.17dB
327MHz
RICOH XI-325
PORT 2. HIGH CH.
ΔMKR
327 MHz
-56.17 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -44.67dBm
24.01GHz
RICOH XI-325
PORT 2. HIGH CH.
MKR
24.01 GHz
-44.67 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 5.50sec

6 - PEAK POWER SPECTRAL DENSITY

6.1 Standard Applicable

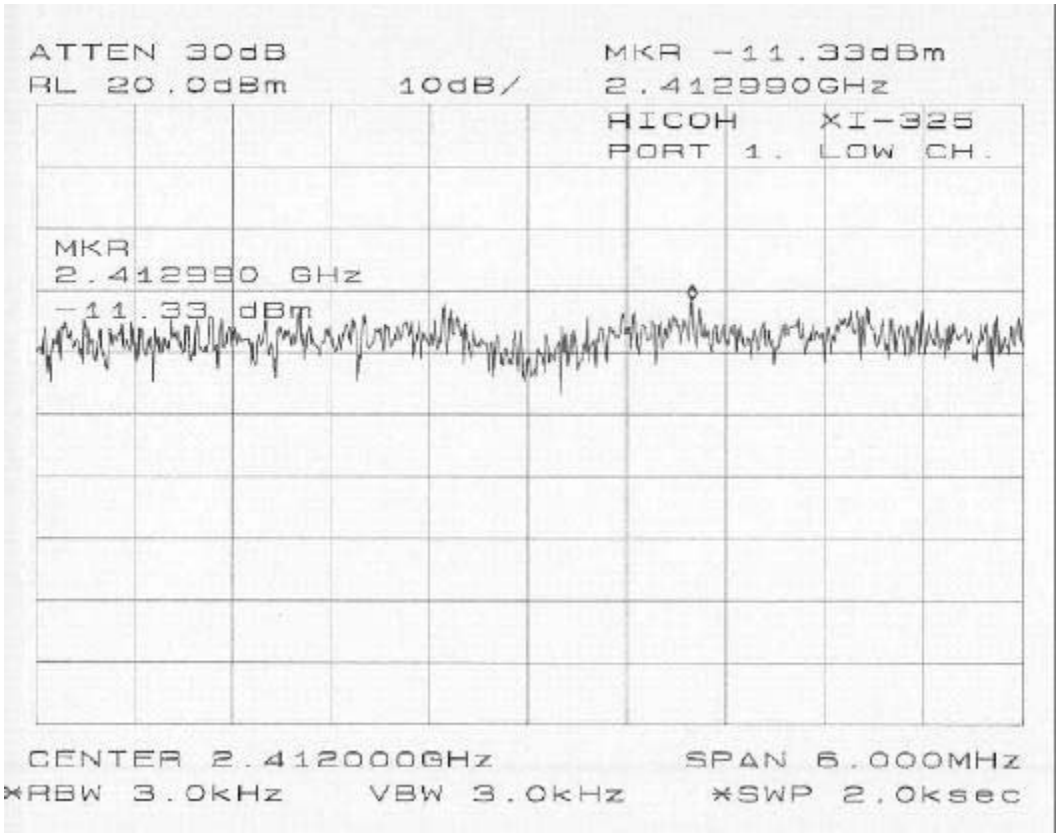
According to §15.247 (d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

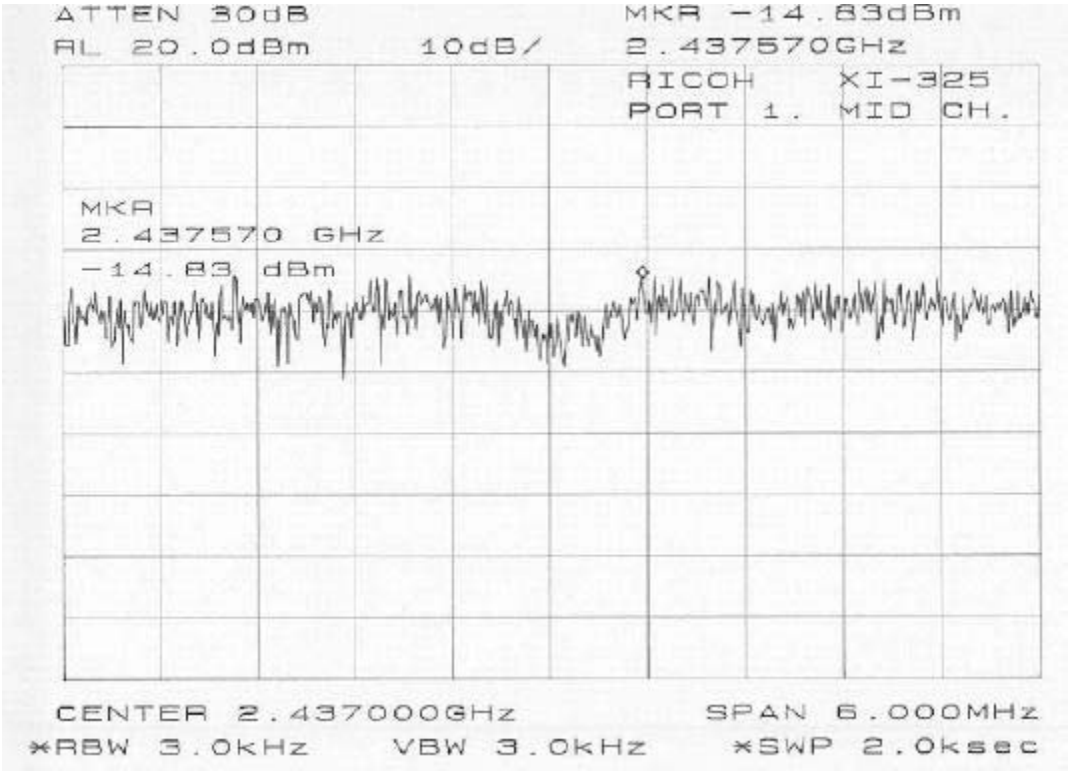
6.2 Measurement Procedure

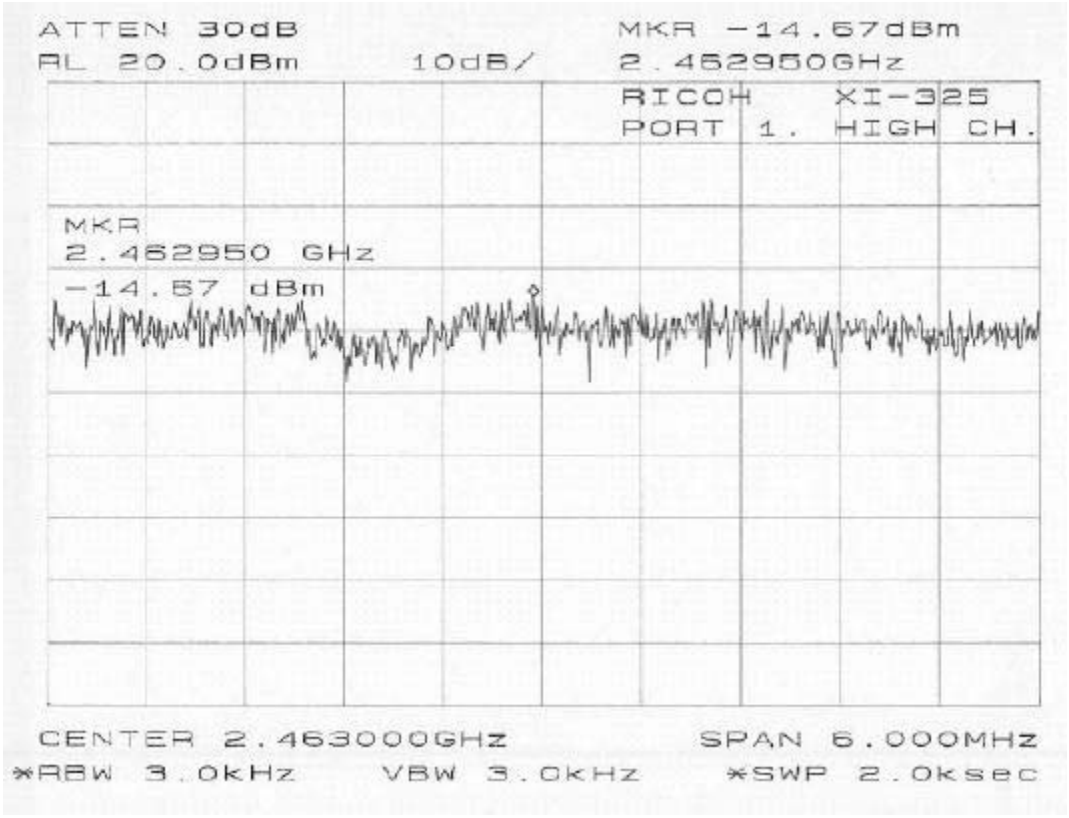
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable.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

6.3 Test Results

Please refer to the attached plot(s).


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -11.33dBm
2.412990GHz
RICOH XI-325
PORT 1. LOW CH.
MKR
2.412990 GHz
-11.33 dBm
CENTER 2.412000GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -14.83dBm
2.437570GHz
RICOH XI-325
PORT 1. MID CH.
MKR
2.437570 GHz
-14.83 dBm
CENTER 2.437000GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec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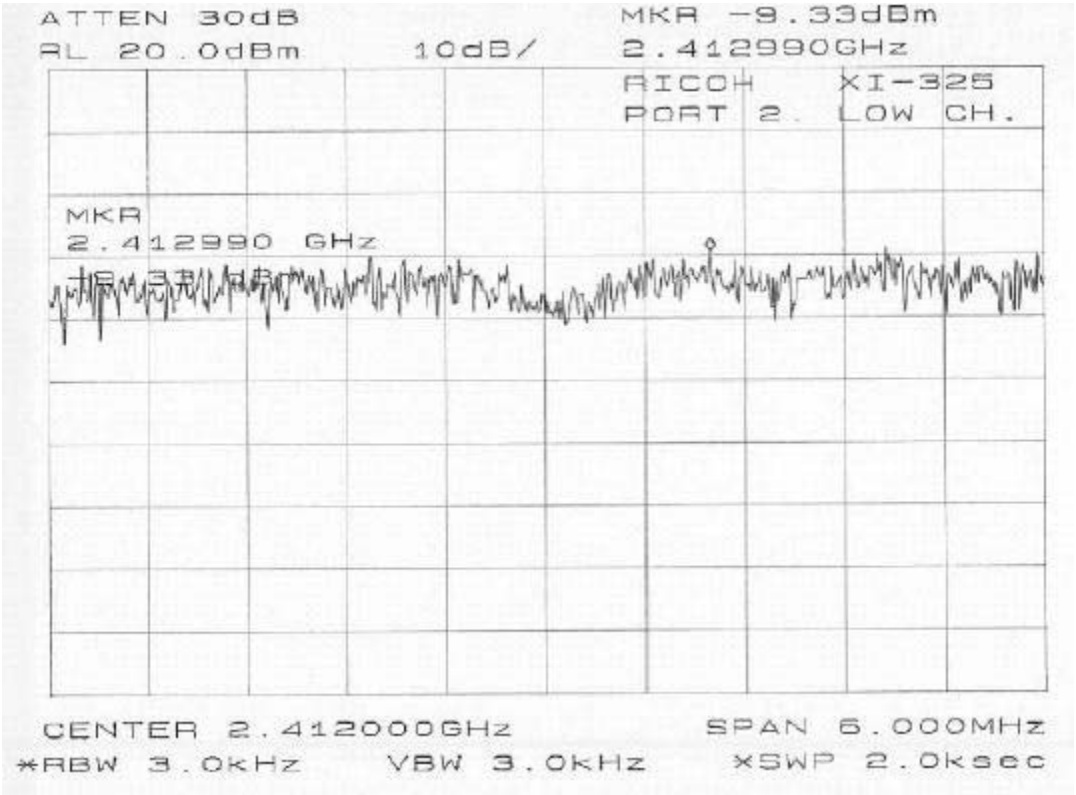
10dB/
MKR -14.67dBm
2.462950GHz
RICOH XI-325
PORT 1. HIGH CH.
MKR
2.462950 GHz
-14.57 dBm
CENTER 2.463000GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec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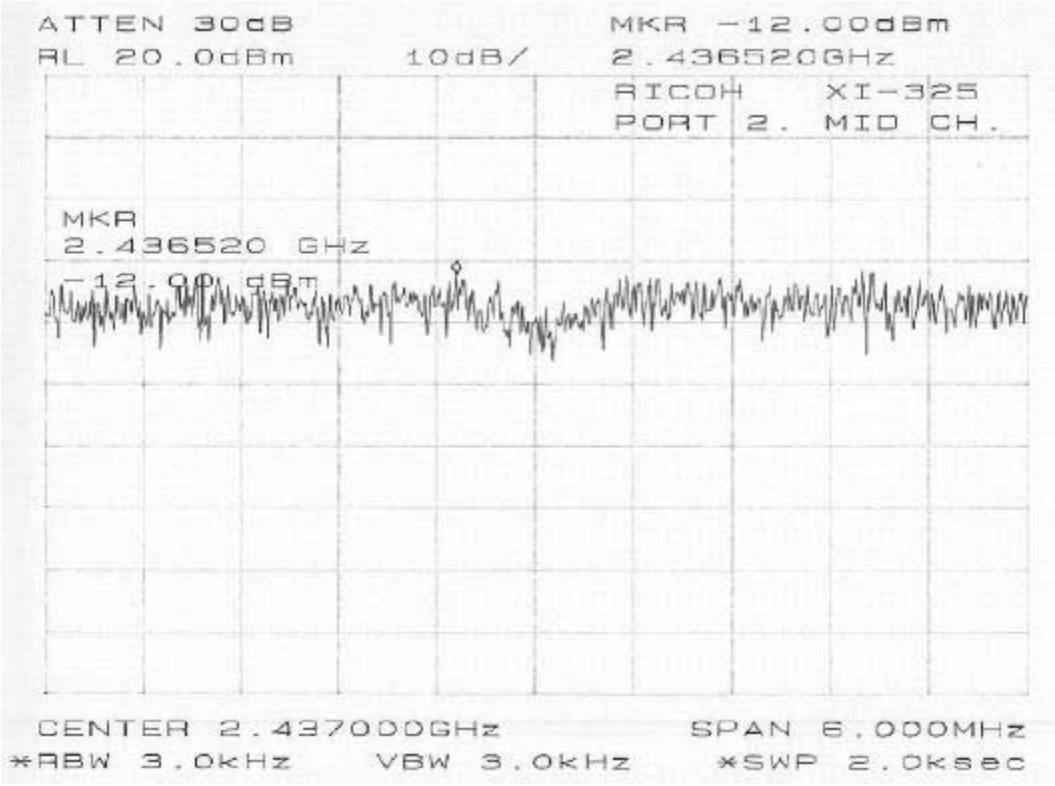
10dB/
MKR -9.33dBm
2.412990GHz
RICOH XI-325
PORT 2. LOW CH.
MKR
2.412990 GHz
CENTER 2.412000GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec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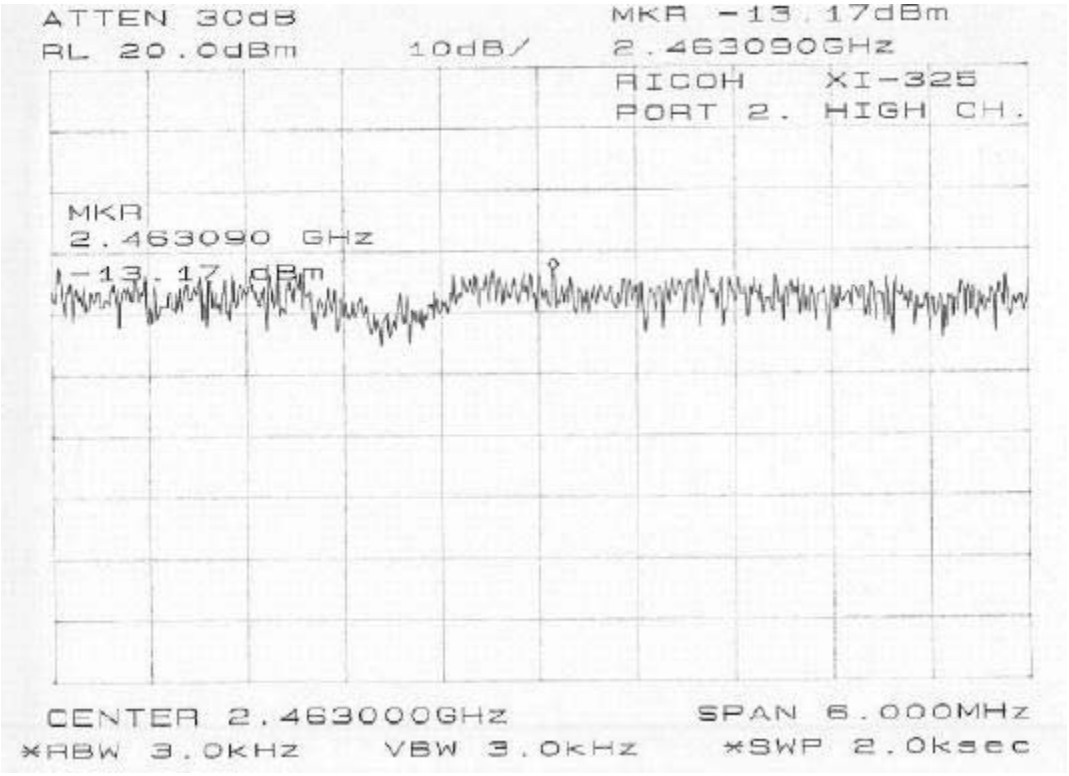
10dB/
MKR -12.00dBm
2.436520GHz
RICOH XI-325
PORT 2. MID CH.
MKR
2.436520 GHz
-12.00 dBm
CENTER 2.437000GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec


ATTEN 30dB
RL 20.0dBm
10dB/
MKR -13.17dBm
2.463090GHz
RICOH XI-325
PORT 2. HIGH CH.
MKR
2.463090 GHz
-13.17 dBm
CENTER 2.463000GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec

7 - 6 DB BANDWIDTH

7.1 Standard Applicable

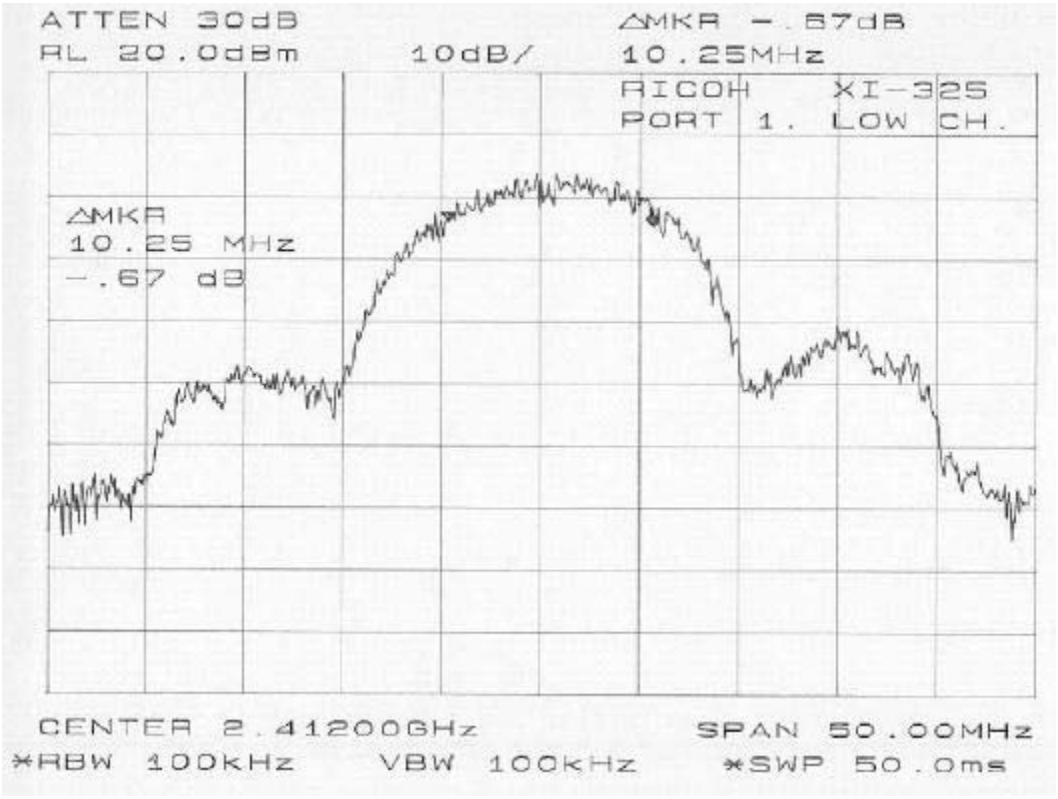
According to §15.247(a)(2), for direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz.

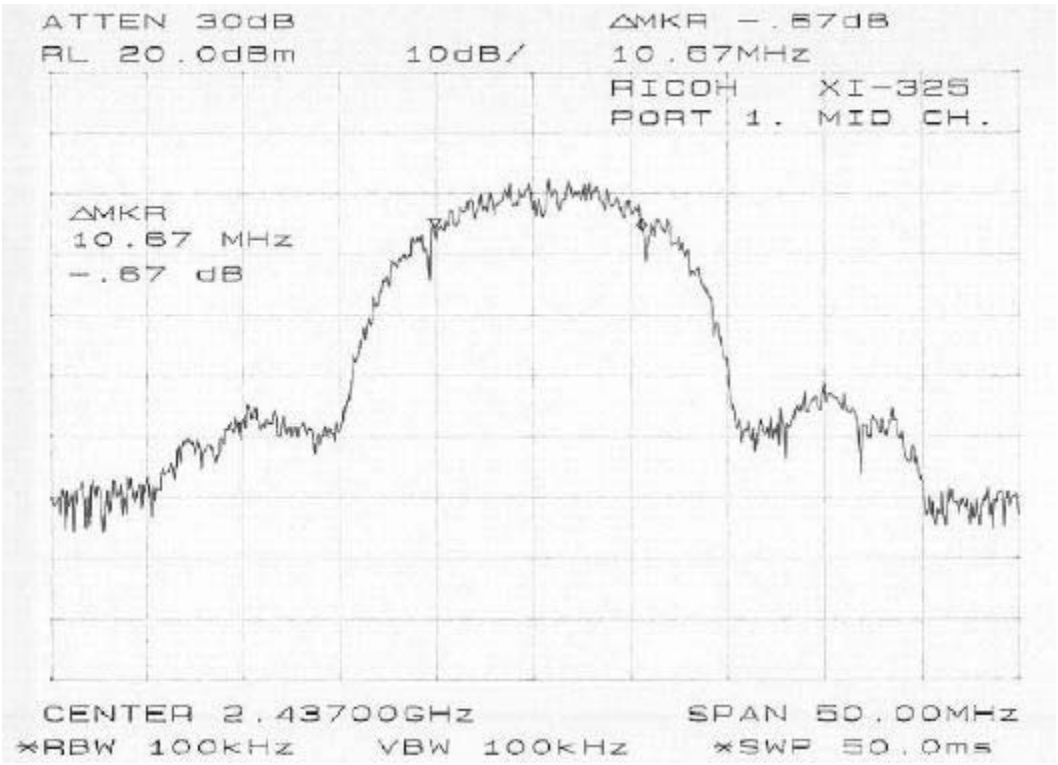
7.2 Measurement Procedure

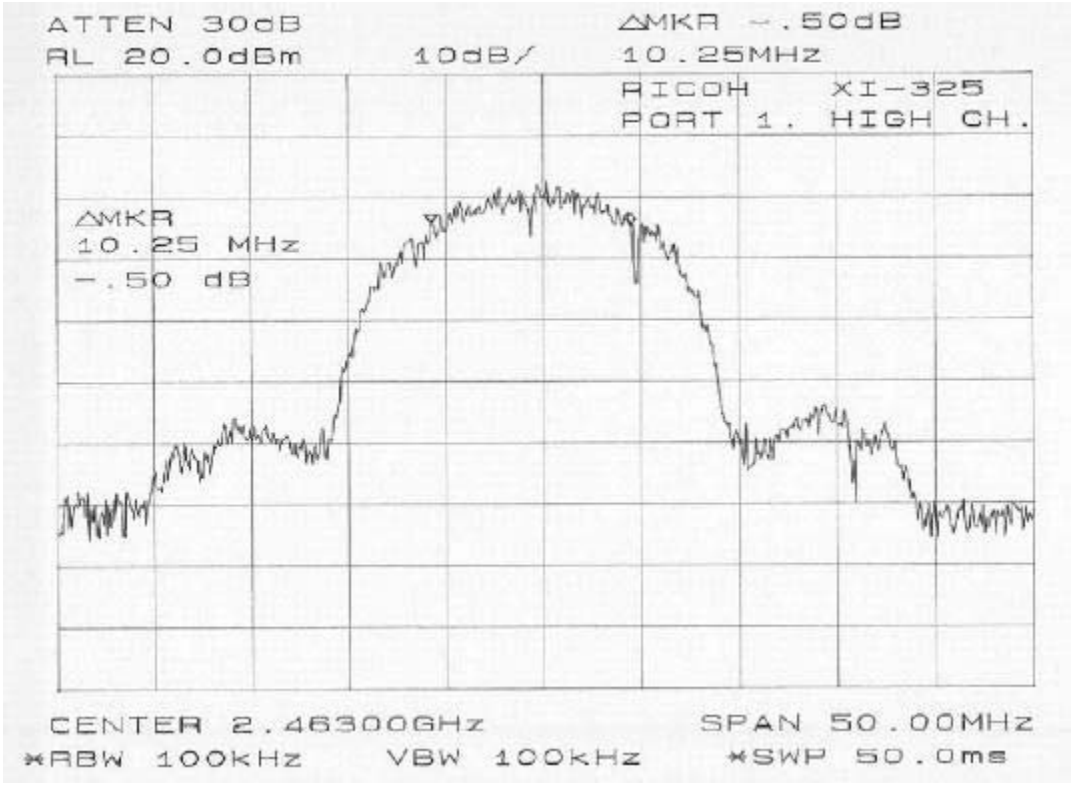
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency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

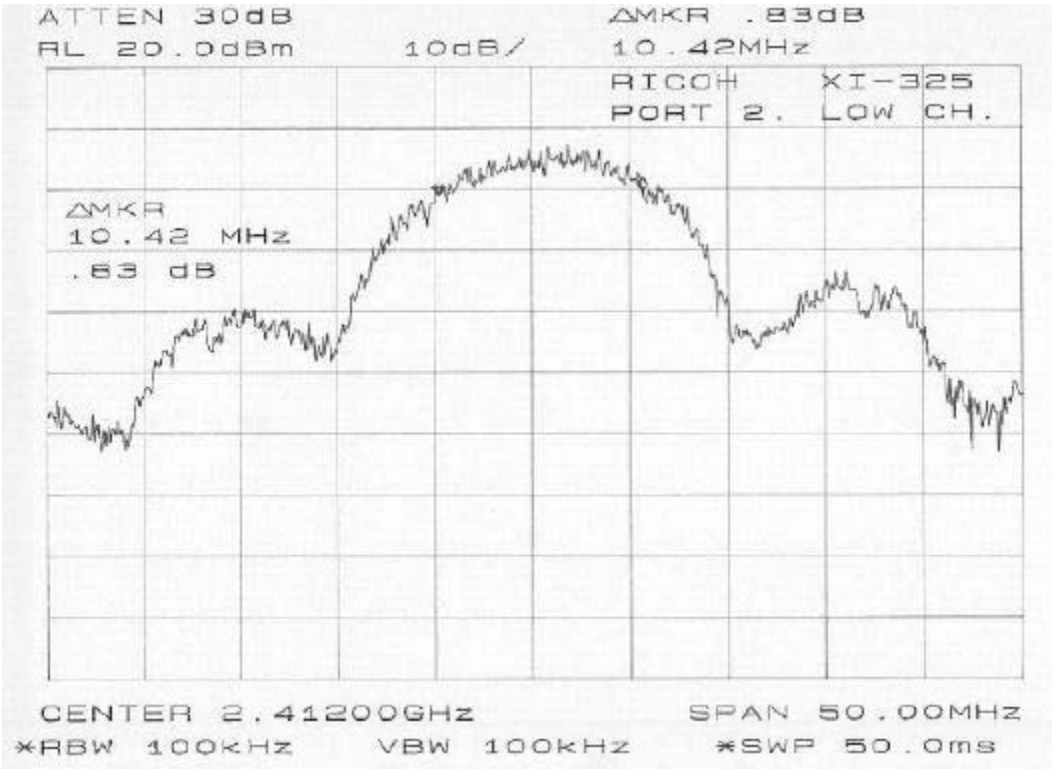
7.3 Measurement Data

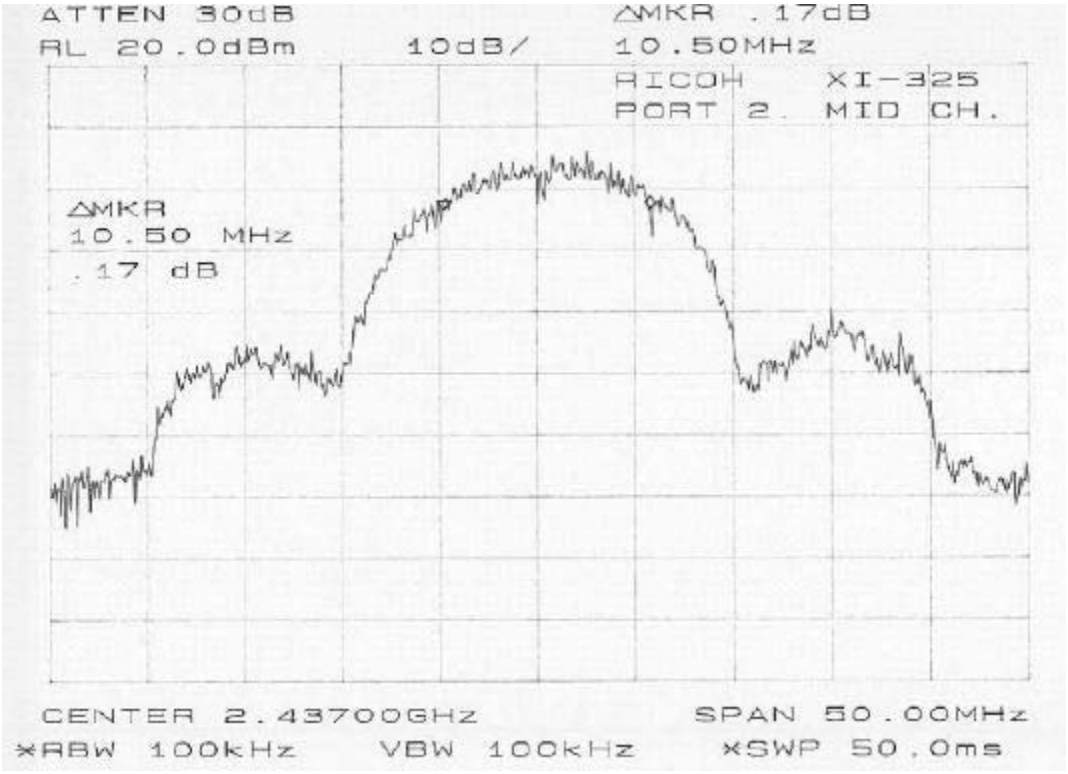
The minimum 6dB bandwidth was 10.17MHz, which was greater than 500 kHz standard limit. Please refer to appending plot for more information.

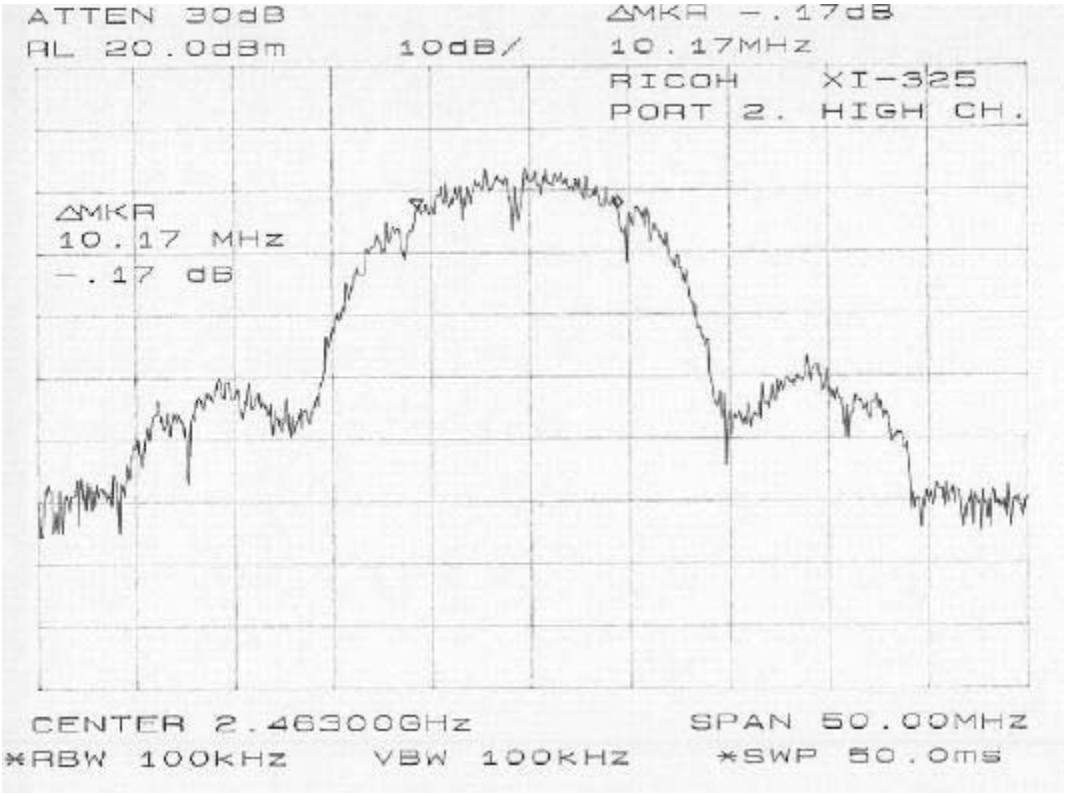

ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.67dB
10.25MHz
RICOH XI-325
PORT 1. LOW CH.
ΔMKR
10.25 MHz
-.67 dB
CENTER 2.41200GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.67dB
10.67MHz
RICOH XI-325
PORT 1. MID CH.
ΔMKR
10.67 MHz
-.67 dB
CENTER 2.43700GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.50dB
10.25MHz
RICOH XI-325
PORT 1. HIGH CH.
ΔMKR
10.25 MHz
-.50 dB
CENTER 2.46300GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR .83dB
10.42MHz
RICOH XI-325
PORT 2. LOW CH.
ΔMKR
10.42 MHz
.83 dB
CENTER 2.41200GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR .17dB
10.50MHz
RICOH XI-325
PORT 2. MID CH.
ΔMKR
10.50 MHz
.17 dB
CENTER 2.43700GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -.17dB
10.17MHz
RICOH XI-325
PORT 2. HIGH CH.
ΔMKR
10.17 MHz
-.17 dB
CENTER 2.46300GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100KHz
*SWP 50.0ms

8 - 100 KHZ BANDWIDTH OF BAND EDGES MEASUREMENT

8.1 Standard Applicable

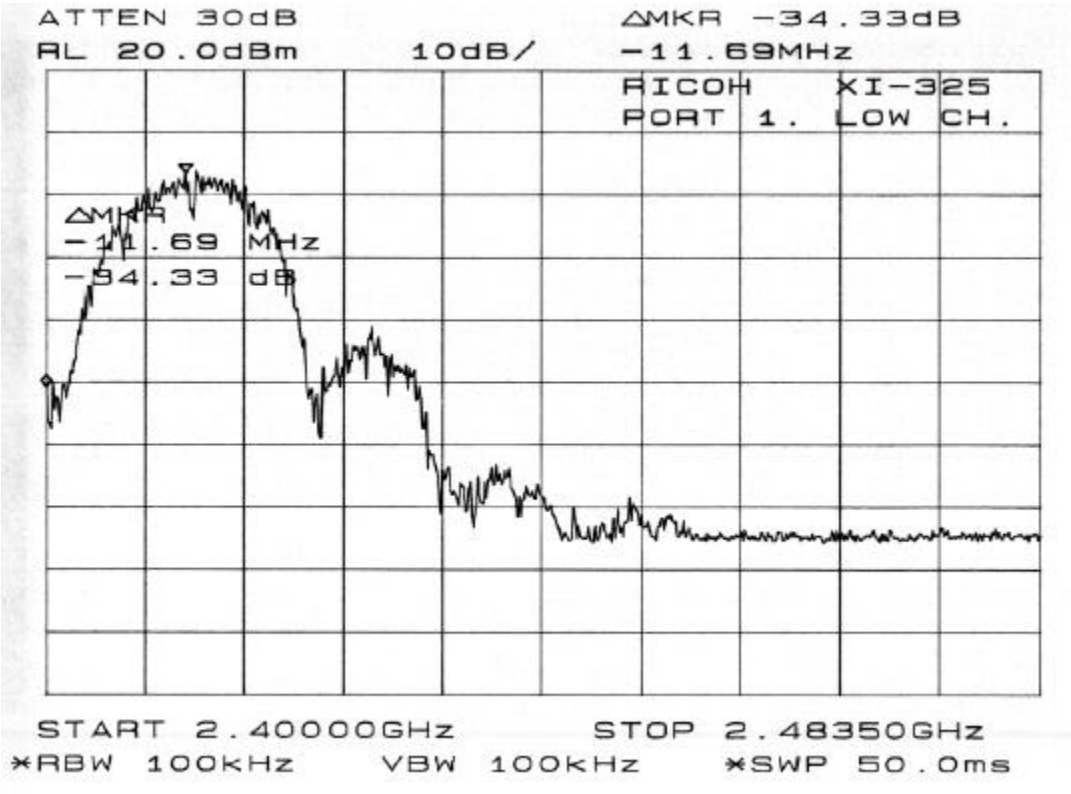
According to §15.247(c), in *any* 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) see §15.2057(c)).

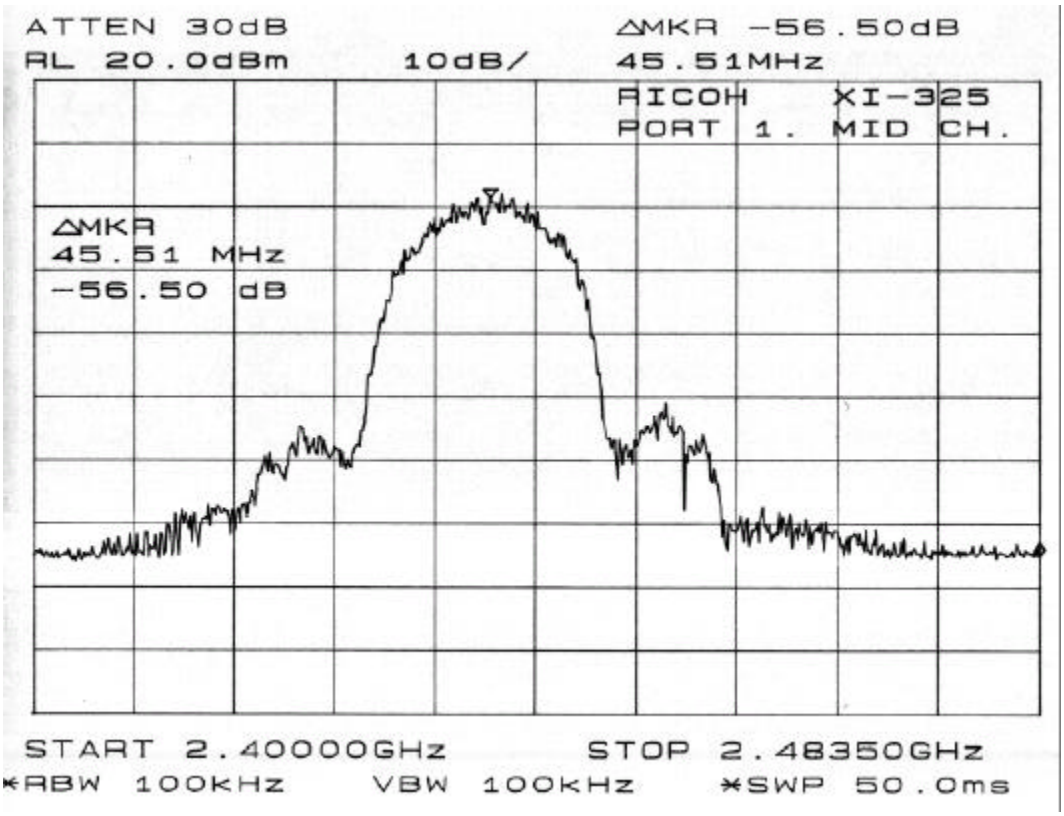
8.2 Measurement Procedure

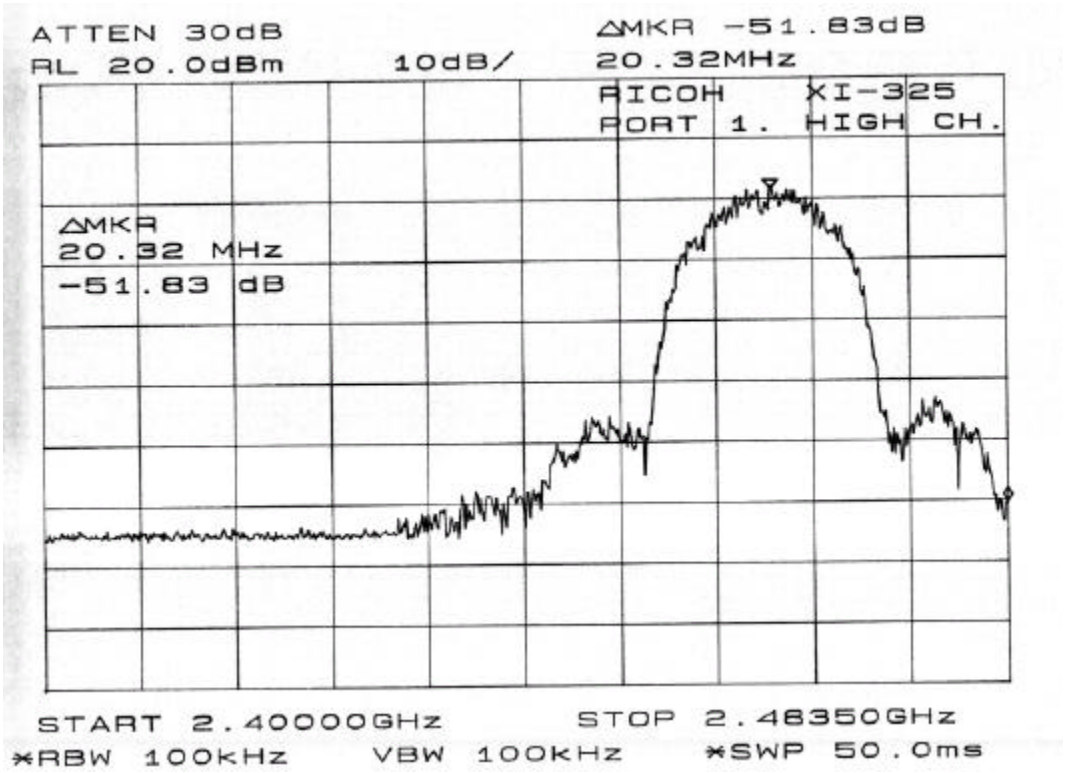
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 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 Results

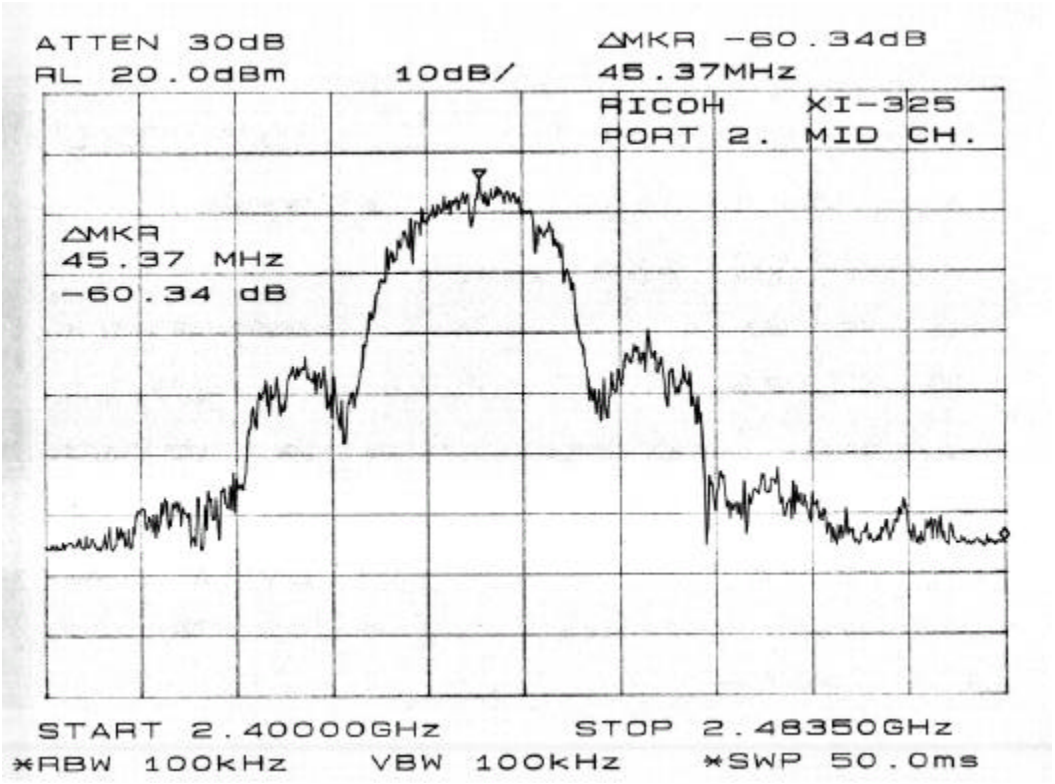
Please refer to the appending plot for more information.

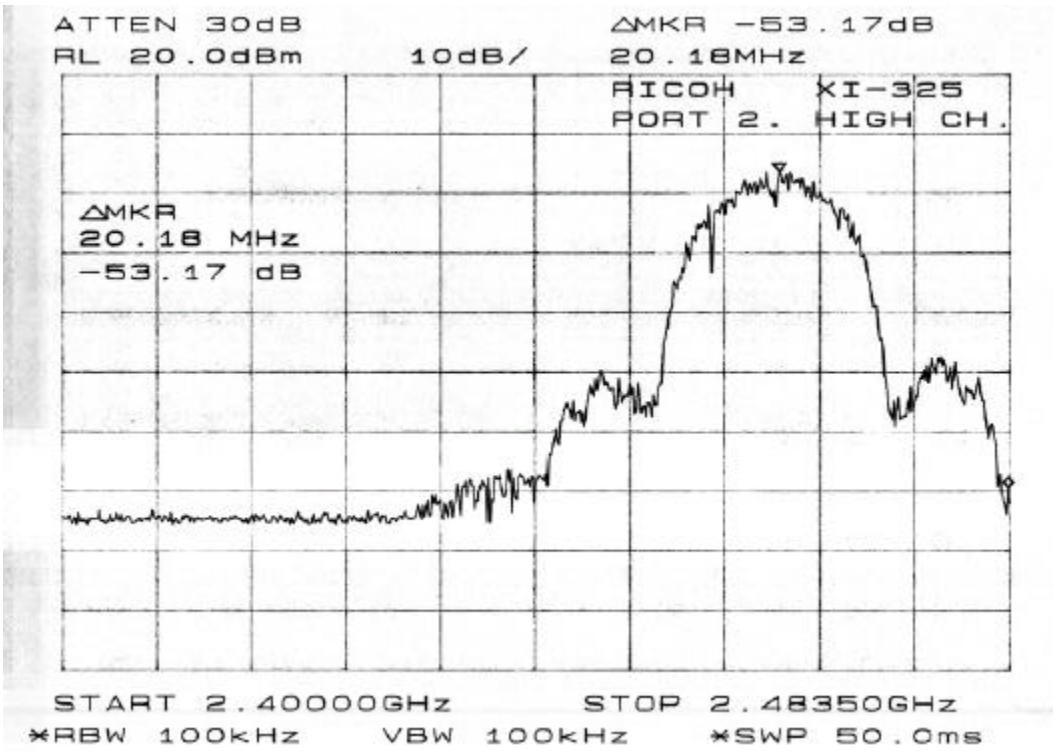

ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -34.33dB
-11.69MHz
RICOH XI-325
PORT 1. LOW CH.
ΔMKR
-11.69 MHz
-34.33 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -56.50dB
45.51MHz
RICOH XI-325
PORT 1. MID CH.
ΔMKR
45.51 MHz
-56.50 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -51.83dB
20.32MHz
RICOH XI-325
PORT 1. HIGH CH.
ΔMKR
20.32 MHz
-51.83 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -37.83dB
-12.53MHz
RICOH XI-325
PORT 2 LOW CH.
ΔMKR
-12.53 MHz
-37.83 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -60.34dB
45.37MHz
RICOH XI-325
PORT 2. MID CH.
ΔMKR
45.37 MHz
-60.34 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 30dB
RL 20.0dBm
10dB/
ΔMKR -53.17dB
20.18MHz
RICOH XI-325
PORT 2. HIGH CH.
ΔMKR
20.18 MHz
-53.17 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms

9 - ANTENNA REQUIREMENT

9.1 Standard Applicable

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

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

9.2 Antenna Connected Construction

The directional gain of antenna used for transmitting is 2 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

10 - 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: 18.09 (dBm)
Maximum peak output power at antenna input terminal: 64.4 (mW)
Antenna Gain (typical): 2 (dBi)
Maximum antenna gain: 1.58 (numeric)
Prediction distance: 20 (cm)
Predication frequency: 2400 (MHz)
MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm^2)
Power density at predication frequency: 0.025 (mW/cm^2)
Maximum allowable antenna gain: 18.62 (numeric)
Maximum allowable antenna gain: 12.70 (dBi)

Test Result

The predicted power density level at 20 cm is 0.025 mW/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2400 MHz.

This EUT is intended to be installed in printer and is thus classed as mobile equipment.

11 - SPURIOUS RADIATED EMISSION DATA

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 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 - 2000. The specification used was the FCC 15 Subpart C limits.

The EUT was inserted into the printer. The printer was connected with a remote support notebook.

The printer was connected 110Vac/60Hz power source.

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

11.3 Spectrum Analyzer Setup

According to FCC Rules, 47 CFR §15.33 (a) (1), the system was tested to 26GHz.

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

Start Frequency	30 MHz
Stop Frequency	26GHz
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, the Host PC system 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.

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 Subpart C. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – Subpart C 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:

-5.3 dBµV at **4824.60 MHz** in the **Horizontal** polarization, intentional emission, Port1

-5.5 dBµV at **4874.40 MHz** in the **Horizontal** polarization, intentional emission, Port1

-5.8 dBµV at **4924.20 MHz** in the **Horizontal** polarization, intentional emission, Port1

-6.0 dBµV at **4824.20 MHz** in the **Horizontal** polarization, intentional emission, Port2

-5.5 dBµV at **4874.60 MHz** in the **Horizontal** polarization, intentional emission, Port2

-5.5 dBµV at **4924.40 MHz** in the **Horizontal** polarization, intentional emission, Port2

-7.6 dBµV at **879.66 MHz** in the **Horizontal** polarization, u*nintentional emission*

Intentional Emission, 30MHz to 26GHz, 3 meters, Port1

INDICATED			TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. dBµV/m	Comments	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable DB	Amp. DB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
Low Frequency and Local Frequency 2038MHz											
2412.30	94.6	Fund.	220	1.5	H	28.1	3.4	30.0	96.1		
2412.30	95.8	Fund.	310	1.5	V	28.1	3.4	30.0	97.3		
4824.60	41.3	Avg.	60	1.2	H	32.5	4.9	30.0	48.7	54	-5.3
4824.60	40.8	Avg.	90	1.2	V	32.5	4.9	30.0	48.2	54	-5.8
4076.00	41.7	Avg.	190	1.2	V	31.4	4.7	30.0	47.8	54	-6.2
4076.00	40.5	Avg.	210	1.5	H	31.4	4.7	30.0	46.6	54	-7.4
2038.00	43.5	Avg.	270	1.0	V	28.1	3.4	30.0	45.0	54	-9.1
2038.00	42.1	Avg.	160	2.0	H	28.1	3.4	30.0	43.6	54	-9.3
2038.00	45.4	Peak	160	2.0	H	28.1	3.4	30.0	46.9	74	-9.3
7236.90	31.8	Avg.	0	1.2	V	35.1	5.6	30.0	42.5	54	-11.5
7236.90	29.4	Avg.	310	1.2	H	35.1	5.6	30.0	40.1	54	-13.9
4824.60	43.9	Peak	60	1.2	H	32.5	4.9	30.0	51.3	74	-22.7
4076.00	44.9	Peak	190	1.2	V	31.4	4.7	30.0	51.0	74	-23.0
4824.60	43.5	Peak	90	1.2	V	32.5	4.9	30.0	50.9	74	-23.1
4076.00	43.7	Peak	210	1.5	H	31.4	4.7	30.0	49.8	74	-24.2
2038.00	46.1	Peak	270	1.0	V	28.1	3.4	30.0	47.6	74	-26.5
7236.90	34.1	Peak	0	1.2	V	35.1	5.6	30.0	44.8	74	-29.2
7236.90	32.8	Peak	310	1.2	H	35.1	5.6	30.0	43.5	74	-30.5
Middle Frequency and Local Frequency 2063MHz											
2437.20	97.70	Fund.	90.00	1.50	V	28.1	3.4	30.0	99.2		
2437.20	96.4	Fund.	120	1.2	H	28.1	3.4	30.0	97.9		
4874.40	41.1	Avg.	30	1.5	H	32.5	4.9	30.0	48.5	54	-5.5
4874.40	40.9	Avg.	0	1.5	V	32.5	4.9	30.0	48.3	54	-5.7
2063.00	44.10	Avg.	310	1.20	H	28.1	3.4	30.0	45.6	54	-8.5
2063.00	43.5	Avg.	270	1.5	V	28.1	3.4	30.0	45.0	54	-9.1
7311.60	32.5	Avg.	90	1.5	V	35.1	5.6	30.0	43.2	54	-10.8
4126.00	42.6	Avg.	180	1.2	V	31.4	4.7	30.0	48.7	54	-12.7
4126.00	45.7	Peak	180	1.2	V	31.4	4.7	30.0	51.8	74	-12.7
4126.00	41.1	Avg.	150	1.2	H	31.4	4.7	30.0	47.2	54	-13.2
4126.00	43.6	Peak	150	1.2	H	31.4	4.7	30.0	49.7	74	-13.2
7311.60	28.7	Avg.	110	1.5	H	35.1	5.6	30.0	39.4	54	-14.6
4874.40	44.7	Peak	30	1.5	H	32.5	4.9	30.0	52.1	74	-21.9
4874.40	44.1	Peak	0	1.5	V	32.5	4.9	30.0	51.5	74	-22.5
2063.00	47.30	Peak	310	1.20	H	28.1	3.4	30.0	48.8	74	-25.3
2063.00	46.2	Peak	270	1.5	V	28.1	3.4	30.0	47.7	74	-26.4
7311.60	35.2	Peak	90	1.5	V	35.1	5.6	30.0	45.9	74	-28.1
7311.60	31.9	Peak	110	1.5	H	35.1	5.6	30.0	42.6	74	-31.4
High Frequency and Local Frequency 2088 MHz											
2462.10	93.2		60	1.5	H	28.1	3.4	30.0	94.7		
2462.10	95.5		0	1.2	V	28.1	3.4	30.0	97.0		
4924.20	40.8	Avg.	130	1.2	H	32.5	4.9	30.0	48.2	54	-5.8
4924.20	40.2	Avg.	90	1.2	V	32.5	4.9	30.0	47.6	54	-6.4

2088.00	43.2	Avg.	180	1.5	V	28.1	3.4	30.0	44.7	54	-9.3
2088.00	42.7	Avg.	120	1.2	H	28.1	3.4	30.0	44.2	54	-9.8
7386.30	30.7	Avg.	0	1.2	V	35.1	5.6	30.0	41.4	54	-12.6
4176.00	41.5	Avg.	210	1.5	V	31.4	4.7	30.0	47.6	54	-12.8
4176.00	43.7	Peak	210	1.5	V	31.4	4.7	30.0	49.8	74	-12.8
4176.00	39.4	Avg.	270	1.5	H	31.4	4.7	30.0	45.5	54	-13.5
4176.00	42.6	Peak	270	1.5	H	31.4	4.7	30.0	48.7	74	-13.5
7386.30	28.2	Avg.	350	1.2	H	35.1	5.6	30.0	38.9	54	-15.1
4924.20	44.1	Peak	130	1.2	H	32.5	4.9	30.0	51.5	74	-22.5
4924.20	43.5	Peak	90	1.2	V	32.5	4.9	30.0	50.9	74	-23.1
2088.00	46.5	Peak	180	1.5	V	28.1	3.4	30.0	48.0	74	-26.1
2088.00	45.8	Peak	120	1.2	H	28.1	3.4	30.0	47.3	74	-26.8
7386.30	33.8	Peak	0	1.2	V	35.1	5.6	30.0	44.5	74	-29.5
7386.30	31.4	Peak	350	1.2	H	35.1	5.6	30.0	42.1	74	-31.9

Intentional Emission, 30MHz to 26GHz, 3 meters, Port2

INDICATED			TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. dBµV/m	Comments	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable DB	Amp. DB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
Low Frequency and Local Frequency 2038MHz											
2412.10	95.6	Fund.	210	1.2	H	28.1	3.4	30.0	97.1		
2412.10	97.9	Fund.	320	1.5	V	28.1	3.4	30.0	99.4		
4824.20	40.6	Avg.	60	1.2	H	32.5	4.9	30.0	48.0	54	-6.0
4076.00	41.5	Avg.	190	1.2	V	31.4	4.7	30.0	47.6	54	-6.4
4824.20	39.8	Avg.	30	1.2	V	32.5	4.9	30.0	47.2	54	-6.8
4076.00	40.7	Avg.	210	1.5	H	31.4	4.7	30.0	46.8	54	-7.2
2038.00	45.3	Avg.	250	1.0	V	28.1	3.4	30.0	46.8	54	-7.3
2038.00	43.2	Avg.	160	2.0	H	28.1	3.4	30.0	44.7	54	-9.3
2038.00	46.3	Peak	160	2.0	H	28.1	3.4	30.0	47.8	74	-9.3
7236.90	31.3	Avg.	150	1.2	V	35.1	5.6	30.0	42.0	54	-12.0
7236.90	27.9	Avg.	180	1.2	H	35.1	5.6	30.0	38.6	54	-15.4
4824.20	43.5	Peak	60	1.2	H	32.5	4.9	30.0	50.9	74	-23.1
4076.00	44.7	Peak	190	1.2	V	31.4	4.7	30.0	50.8	74	-23.2
4076.00	43.9	Peak	210	1.5	H	31.4	4.7	30.0	50.0	74	-24.0
2038.00	48.1	Peak	250	1.0	V	28.1	3.4	30.0	49.6	74	-24.5
7236.90	34.6	Peak	150	1.2	V	35.1	5.6	30.0	45.3	74	-28.7
7236.90	31.1	Peak	180	1.2	H	35.1	5.6	30.0	41.8	74	-32.2
4824.20	32.9	Peak	30	1.2	V	32.5	4.9	30.0	40.3	74	-33.7
Middle Frequency and Local Frequency 2063MHz											
2437.30	97.40	Fund.	30.00	1.20	V	28.1	3.4	30.0	98.9		
2437.30	96.9	Fund.	90	1.0	H	28.1	3.4	30.0	98.4		
4874.60	41.1	Avg.	60	1.5	H	32.5	4.9	30.0	48.5	54	-5.5
4874.60	40.3	Avg.	90	1.5	V	32.5	4.9	30.0	47.7	54	-6.3
2063.00	43.80	Avg.	150	1.20	H	28.1	3.4	30.0	45.3	54	-8.8
2063.00	42.4	Avg.	120	1.5	V	28.1	3.4	30.0	43.9	54	-10.2
7311.60	32.4	Avg.	160	1.5	V	35.1	5.6	30.0	43.1	54	-10.9
4126.00	41.7	Avg.	210	1.2	V	31.4	4.7	30.0	47.8	54	-12.7
4126.00	44.9	Peak	210	1.2	V	31.4	4.7	30.0	51.0	74	-12.7
4126.00	42.6	Avg.	250	1.0	H	31.4	4.7	30.0	48.7	54	-13.2
4126.00	45.8	Peak	250	1.0	H	31.4	4.7	30.0	51.9	74	-13.2
7311.60	28.2	Avg.	110	1.5	H	35.1	5.6	30.0	38.9	54	-15.1
4874.60	44.2	Peak	60	1.5	H	32.5	4.9	30.0	51.6	74	-22.4
4874.60	43.6	Peak	90	1.5	V	32.5	4.9	30.0	51.0	74	-23.0
2063.00	47.10	Peak	150	1.20	H	28.1	3.4	30.0	48.6	74	-25.5
2063.00	45.5	Peak	120	1.5	V	28.1	3.4	30.0	47.0	74	-27.1
7311.60	35.7	Peak	160	1.5	V	35.1	5.6	30.0	46.4	74	-27.6
7311.60	31.9	Peak	110	1.5	H	35.1	5.6	30.0	42.6	74	-31.4
High Frequency and Local Frequency 2088MHz											
2462.20	93.4	Fund.	60	1.5	H	28.1	3.4	30.0	94.9		
2462.20	95.7	Fund.	90	1.2	V	28.1	3.4	30.0	97.2		
4924.40	41.1	Avg.	250	1.5	H	32.5	4.9	30.0	48.5	54	-5.5

4924.40	40.3	Avg.	270	1.8	V	32.5	4.9	30.0	47.7	54	-6.3
2088.00	42.9	Avg.	180	1.5	V	28.1	3.4	30.0	44.4	54	-9.7
2088.00	42.9	Peak	180	1.5	V	28.1	3.4	30.0	44.4	54	-9.7
2088.00	41.6	Avg.	120	1.2	H	28.1	3.4	30.0	43.1	54	-11.0
4176.00	41.8	Avg.	60	1.5	V	31.4	4.7	30.0	47.9	54	-12.8
4176.00	44.6	Peak	60	1.5	V	31.4	4.7	30.0	50.7	74	-12.8
7386.30	30.1	Avg.	320	1.2	V	35.1	5.6	30.0	40.8	54	-13.2
4176.00	40.6	Avg.	45	1.5	H	31.4	4.7	30.0	46.7	54	-13.5
4176.00	43.8	Peak	45	1.5	H	31.4	4.7	30.0	49.9	74	-13.5
7386.30	27.3	Avg.	0	1.2	H	35.1	5.6	30.0	38.0	54	-16.0
4924.40	44.2	Peak	250	1.5	H	32.5	4.9	30.0	51.6	74	-22.4
4924.40	43.4	Peak	270	1.8	V	32.5	4.9	30.0	50.8	74	-23.2
2088.00	44.7	Peak	120	1.2	H	28.1	3.4	30.0	46.2	74	-27.9
7386.30	33.5	Peak	320	1.2	V	35.1	5.6	30.0	44.2	74	-29.8
7386.30	30.4	Peak	0	1.2	H	35.1	5.6	30.0	41.1	74	-32.9

Unintentional Emission, 30MHz to 1000MHz, 3 meters

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Class B	
Frequency MHz	Ampl. dBµV/m	Angle Degree	Height Meter	Polar H/ V	Antenna dBµV/m	Cable dB	Amp. dB	Corr. Ampl. dBµV/m	Limit dBµV/m	Margin dB
879.66	33.5	140	2.2	H	24.1	5.8	25.0	38.4	46	-7.6
659.97	36.1	0	1.5	V	20.7	3.4	25.0	35.2	46	-10.8
748.52	34.2	90	2.0	H	22.4	2.9	25.0	34.5	46	-11.5
528.05	35.3	350	2.5	H	19.8	2.9	25.0	33.0	46	-13.0
439.62	32.8	80	3.5	V	17.5	2.9	25.0	28.2	46	-17.8
440.12	31.4	30	2.0	V	17.4	2.7	25.0	26.5	46	-19.5
352.17	31.6	60	1.2	H	15.5	4.3	25.0	26.4	46	-19.6
396.88	30.5	110	3.0	V	16.5	2.8	25.0	24.8	46	-21.2
264.25	31.4	230	1.2	H	13.3	4.9	25.0	24.6	46	-21.4

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 $\pm$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 - 2000 measurement procedure. The specification used was FCC 15 Subpart C limits.

The EUT was inserted into the printer. The printer was connected with a remote support notebook.

The printer was connected 110Vac/60Hz power source.

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

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	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:

-1.3 dBµV at **0.710 MHz** in the **Line** mode, 450kHz~30MHz

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
0.710	46.7	Qp	Line	48	-1.3
0.690	46.2	Qp	Neutral	48	-1.8
1.180	34.8	Qp	Line	48	-13.2
13.450	33.6	Qp	Neutral	48	-14.4
12.960	31.7	Qp	Line	48	-16.3
1.290	27.9	Qp	Neutral	48	-20.1

12.7 Plot of Conducted Emissions Test Data

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