FCC 15 SUBPART C

EMI MEASUREMENT AND TEST REPORT

For

TeLLUS Group Corp.

4F, No. 15, Industry E.Rd. IX,
Science-Based Industrial Park,
Hsinchu, Taiwan, R.O.C

FCC ID: PB6-01102

June 3, 2002

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

Test Engineer:	Jeff Lee
Report No.:	R0205135
Test Date:	March 10, 2002
Reviewed By:	Benjamin Jin
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TABLE OF CONTENTS

1 - GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Applicant:	TeLLUS Group Corp.
Product Description:	Wireless LAN
Product Name:	TWL-U11
FCC ID:	PB6-01102
Serial Number:	None
Transmitter Frequency:	2412~2462MHz
Maximum Output Power:	10.05dBm (0.0101mW)
Dimension:	4.25”L x 2.4”W x 1.0”W approximately
Power Supply:	5Vdc/500mA fed by desktop or notebook PC

** 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. *TeLLUS Group Corp.* 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)

No Related Submittal(s).

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 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 C63.4-1992.

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.

1.6 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 Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
Cyrix	Motherboard	None	B118B DL3 02934	DOC
NEC	Floppy Drive	None	1140001B6FX02Z	DOC
Fujitsu	Hard Drive	APG3102AT	VH34P0B00DR0	N/A
SAMSUNG	Power Supply	SFX-108C	ST38B-SS3 04035	DOC
SAMSUNG	CD-ROM	SCR-2432	ST48D-775-06770	DOC
eMachine	Chassis	eTower	QD38B-100-27852	DOC

1.8 Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	FCC ID
eMachine	PC System	eTower	QD38B-100-27852	DOC
Citizen	Printer	LSP-10	5047999-82	DLK66TLSP-10
Everex	Modem	EV-945	None	E3E5UVEV-945
Newmen	Mouse	MS-010	01234316	DOC
Keyboard	Dell	TR7D00	TH-025PGG-37171-22I-1659	AQ6-7D0080COB

1.9 External I/O Cabling List and Details

Cable Description	Length (M)	Port/From	To
Shielded Video Cable	1.8	VGA Port/Host	Monitor
Shielded KB Cable	1.8	PS/2 KB Port/Host	Keyboard
Shielded Mouse Cable	1.8	PS/2 Mouse Port/Host	Mouse
Shielded Parallel Cable	2.0	Parallel Port/Host	Printer
Shielded Serial Cable	1.8	Serial Port/Host	Modem
Shielded USB Cable	1.2	USB Port/Host	EUT

2 - SYSTEM TEST CONFIGURATION

2.1 Justification

The host system was configured for testing in a typical fashion (as 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 monitor.
2. The modem receives the Hs.
3. 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

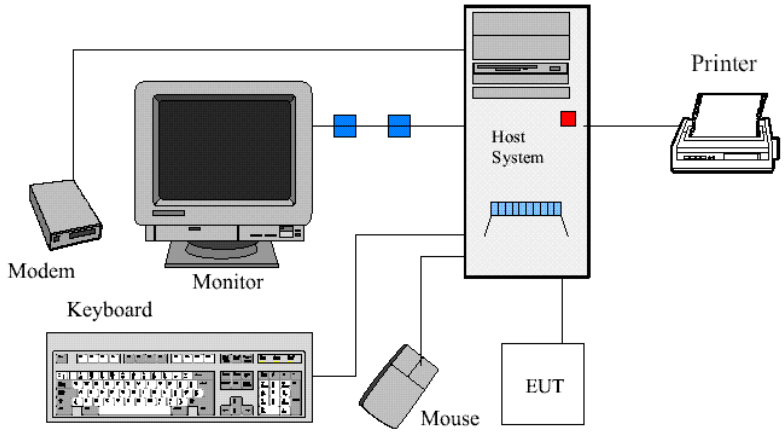
Please refer to Appendix D.

2.5 Equipment Modifications

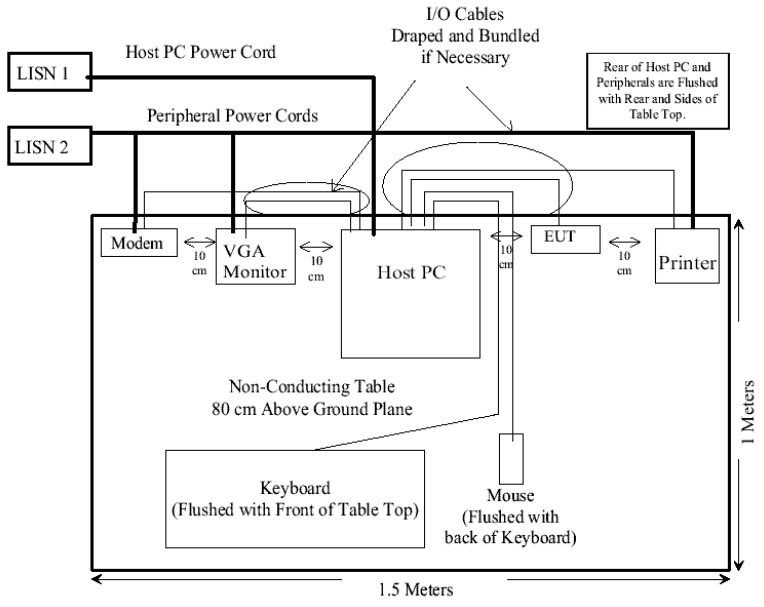
The following modifications were made by BACL Corporation to ensure the EUT to comply with the applicable limits and requirements:

1. Added ferrite (TDK ZCAT2017-0930) to the USB cable
2. Bridging the USB GND to board GND
3. Bridging the 44MHz crystal GND to board GND

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
§15.247 (e)	Processing Gain	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

4.3 Measurement Result

Please refer to the attached pictures for more information.

Frequency (MHz)	Output Power in dBm	Output Power in W	Standard	Result
Low	10.05	0.0101	≤ 1W	Compliant
Middle	9.86	0.0097	≤ 1W	Compliant
High	9.25	0.0084	≤ 1W	Compliant

4.4 Test Equipment

Manufacturer	Model No.	Serial No.	Calibration Due Date
Agilent	E4419b	GB40202891	4/8/03
Agilent	E4412a	US38486529	4/8/03


Agilent
E4419B EPM Series Power Meter
10.05dBm
POWER REF
CHANNEL


Agilent
E4419B EPM Series Power Meter
9.86dBm
POWER REF
CHANNEL


Agilent
E4419B EPM Series Power Meter
9.25dBm
POWER REF
CHANNEL

5 - SPURIOUS EMISSION

5.1 Standard Applicable

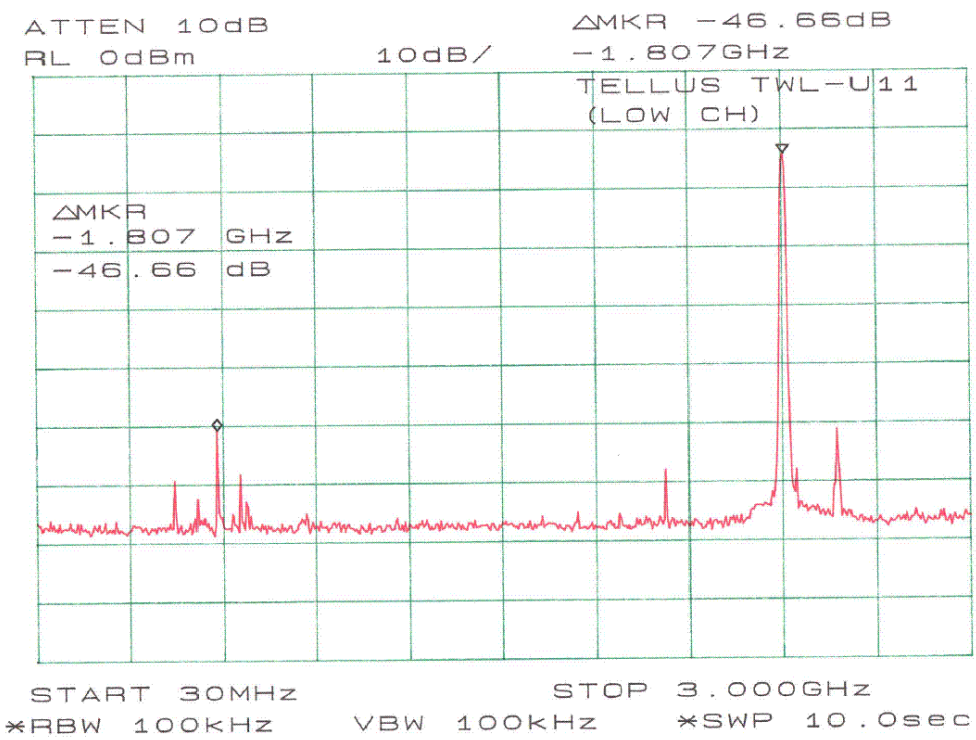
According to §15.209 (f) and §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation f a digital device. If measurements above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

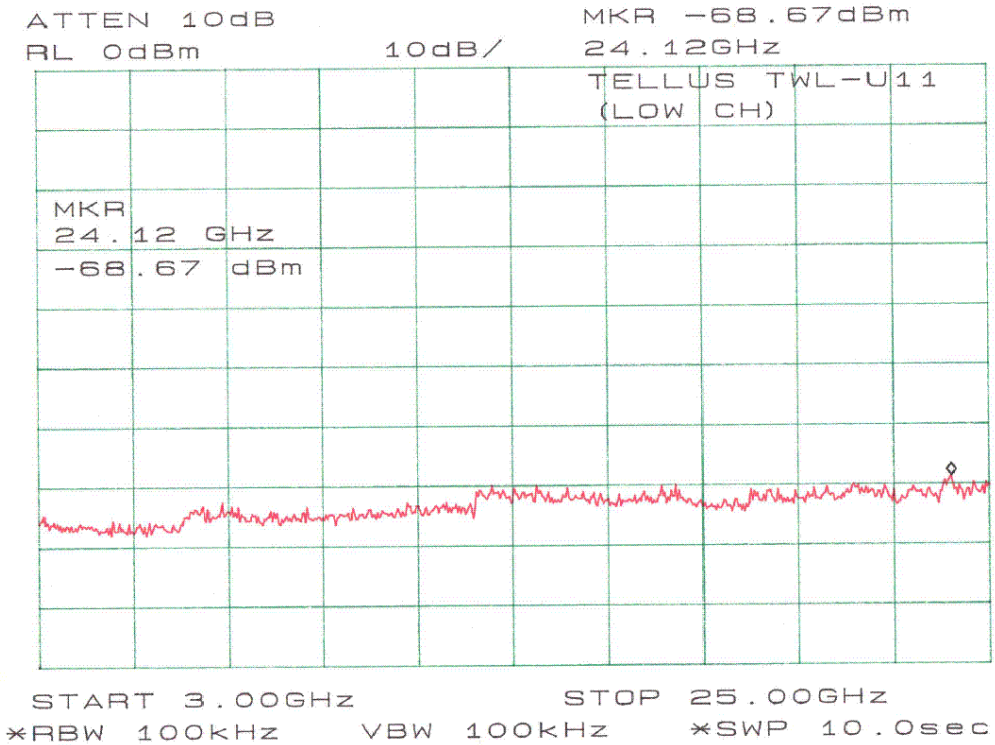
5.2 Measurement Procedure

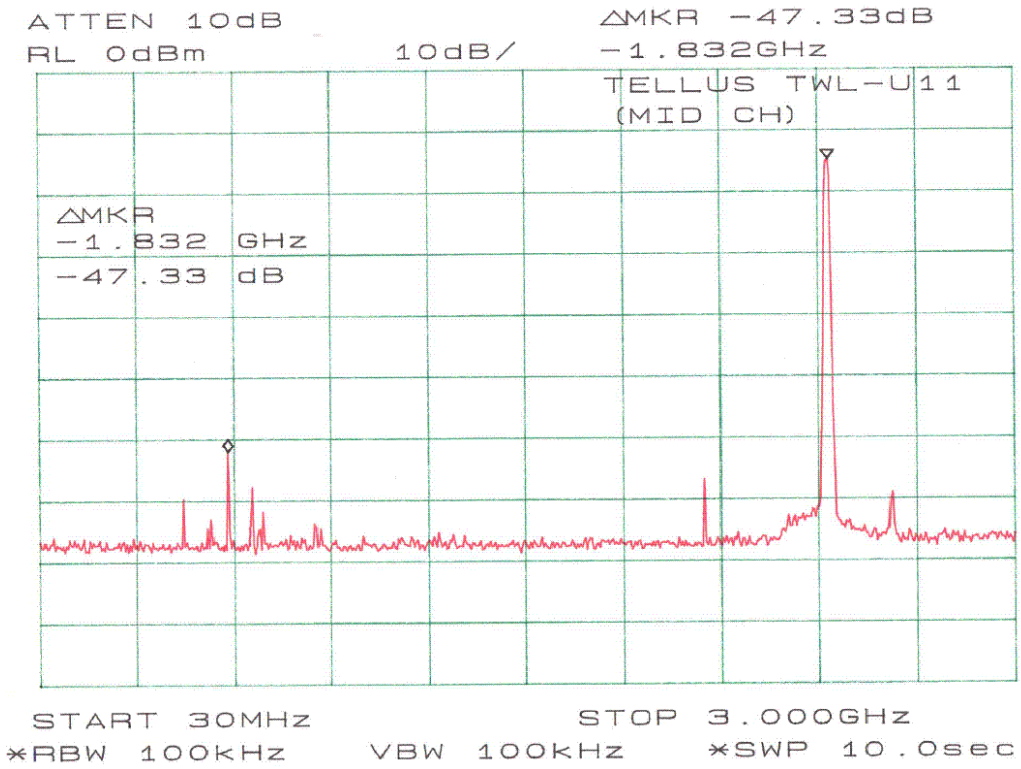
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument 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.

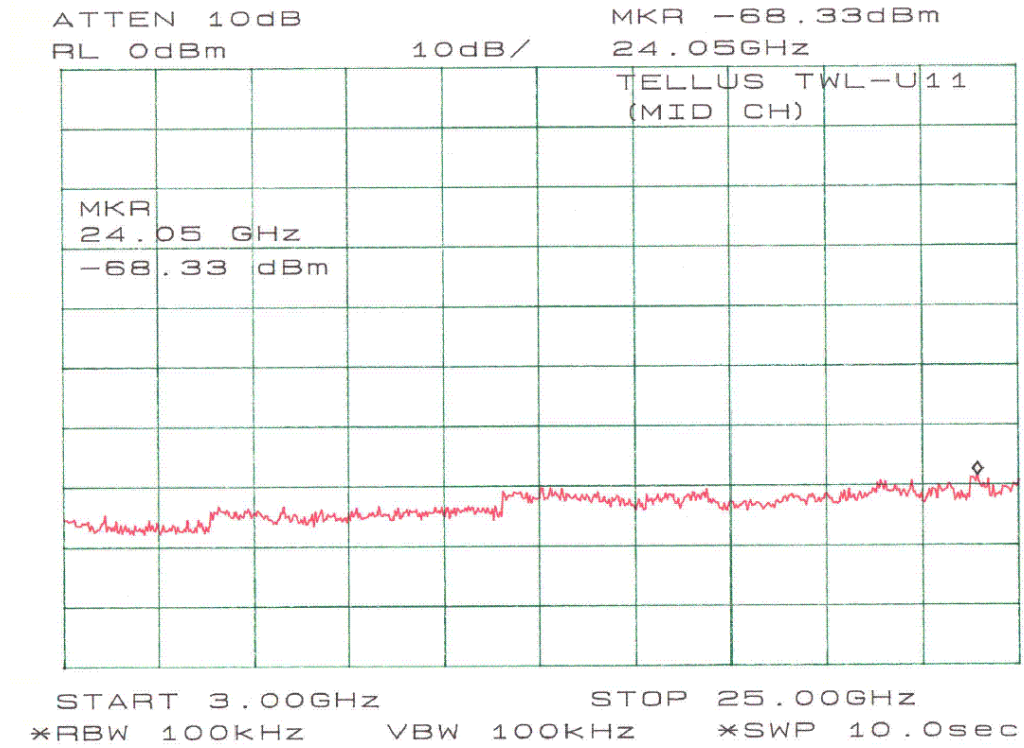
5.3 Measurement Data

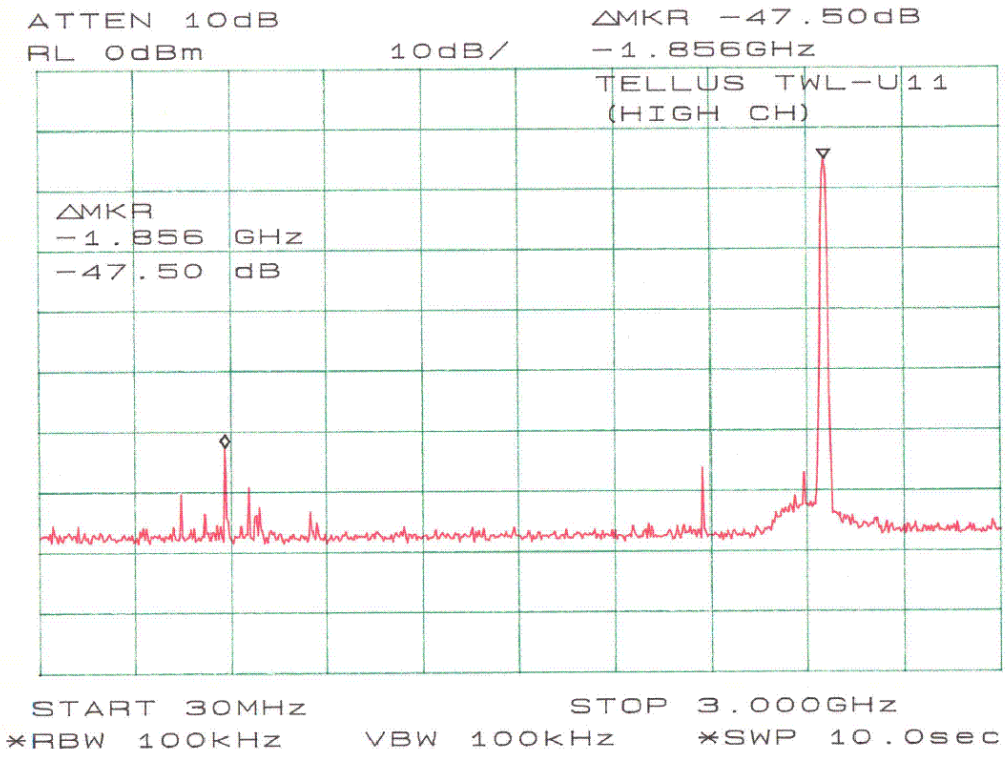
Please refer to the appending for more information.

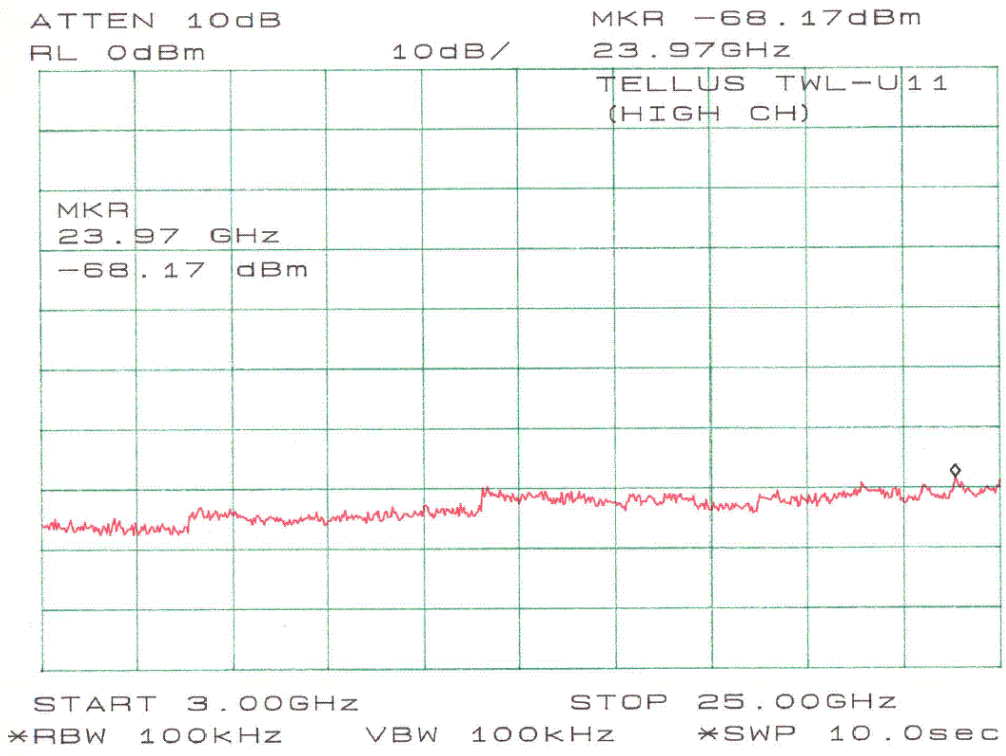

ATTEN 10dB
RL 0dBm
10dB/
ΔMKR -46.66dB
-1.807GHz
TELLUS TWL-U11
(LOW CH)
ΔMKR
-1.807 GHz
-46.66 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 10.0sec


ATTEN 10dB
RL 0dBm
10dB/
MKR -68.67dBm
24.12GHz
TELLUS TWL-U11
(LOW CH)
MKR
24.12 GHz
-68.67 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 10.0sec


ATTEN 10dB
RL 0dBm
10dB/
△MKR -47.33dB
-1.832GHz
TELLUS TWL-U11
(MID CH)
△MKR
-1.832 GHz
-47.33 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 10.0sec


ATTEN 10dB
RL 0dBm
10dB/
MKR -68.33dBm
24.05GHz
TELLUS TWL-U11
(MID CH)
MKR
24.05 GHz
-68.33 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 10.0sec


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR -47.50dB
-1.856GHz
TELLUS TWL-U11
(HIGH CH)
ΔMKR
-1.856 GHz
-47.50 dB
START 30MHz
STOP 3.000GHz
*RBW 100kHz
VBW 100kHz
*SWP 10.0sec


ATTEN 10dB
RL 0dBm
10dB/
MKR -68.17dBm
23.97GHz
TELLUS TWL-U11
(HIGH CH)
MKR
23.97 GHz
-68.17 dBm
START 3.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
*SWP 10.0sec

6 - PEAK POWER SPECTRAL DENSITY

6.1 Standard Applicable

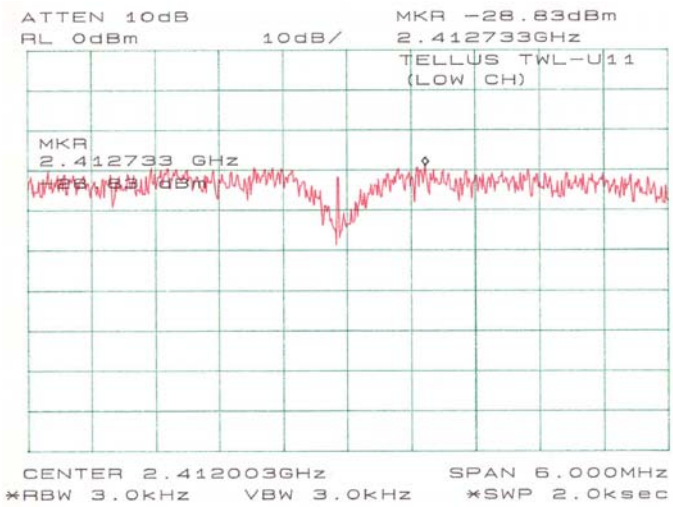
According to §15.247 (d), for direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

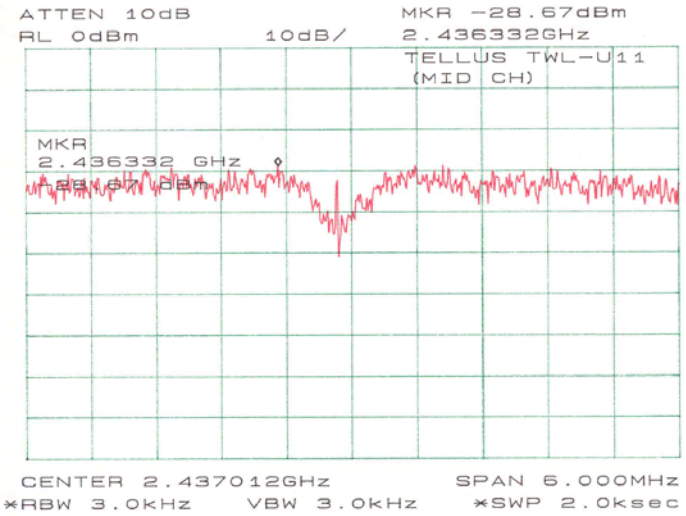
6.2 Measurement Procedure

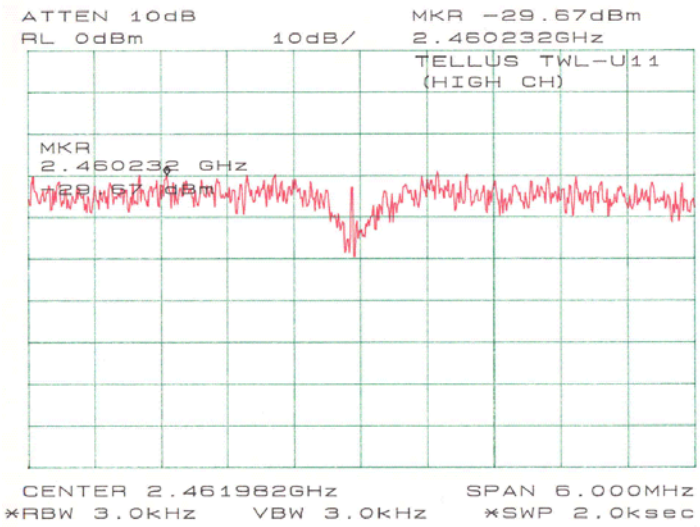
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. 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 10dB
RL 0dBm
10dB/
MKR -28.83dBm
2.412733GHz
TELLUS TWL-U11
(LOW CH)
MKR
2.412733 GHz
CENTER 2.412003GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec


ATTEN 10dB
RL 0dBm
10dB/
MKR -28.67dBm
2.436332GHz
TELLUS TWL-U11
(MID CH)
MKR
2.436332 GHz
CENTER 2.437012GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec


ATTEN 10dB
RL 0dBm
10dB/
MKR -29.67dBm
2.460232GHz
TELLUS TWL-U11
(HIGH CH)
MKR
2.460232 GHz
CENTER 2.461982GHz
SPAN 6.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 2.0ksec

7 - 6 DB BANDWIDTH

7.1 Standard Applicable

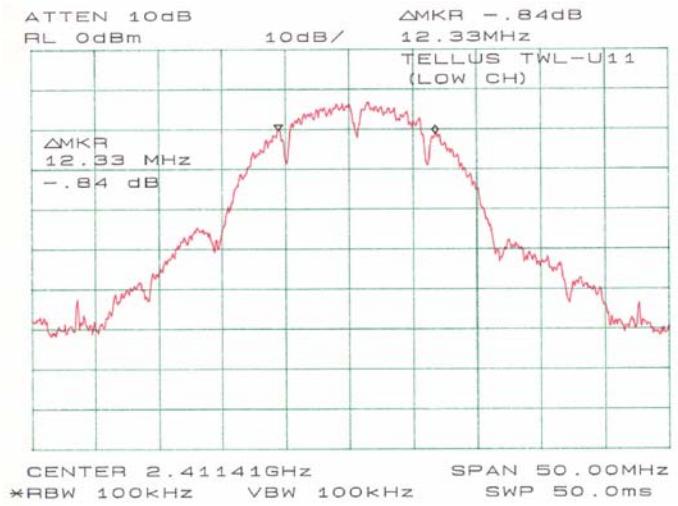
According to §15.247(a)(2), for direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz.

7.2 Measurement Procedure

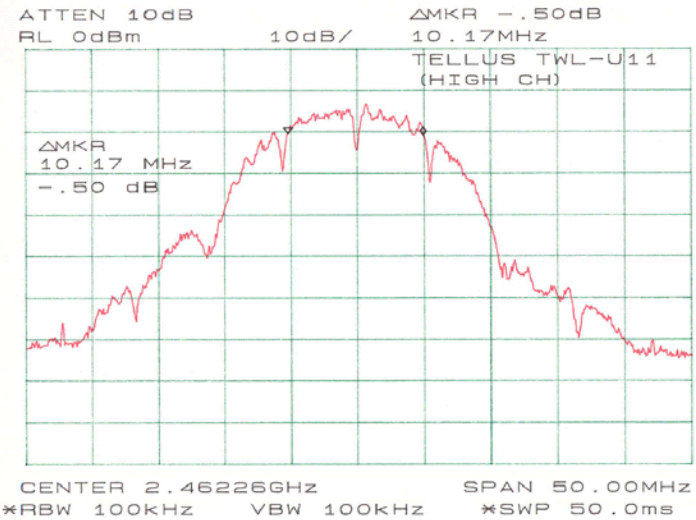
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency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

Please refer to appending plot for more information.


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR -.84dB
12.33MHz
TELLUS TWL-U11
(LOW CH)
ΔMKR
12.33 MHz
-.84 dB
CENTER 2.41141GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR -.83dB
12.50MHz
TELLUS TWL-U11
(MID CH)
ΔMKR
12.50 MHz
-.83 dB
CENTER 2.43710GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR -.50dB
10.17MHz
TELLUS TWL-U11
(HIGH CH)
ΔMKR
10.17 MHz
-.50 dB
CENTER 2.46226GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
*SWP 50.0ms

8 -100 KHZ BANDWIDTH OF BAND EDGES MEASUREMENT

8.1 Standard Applicable

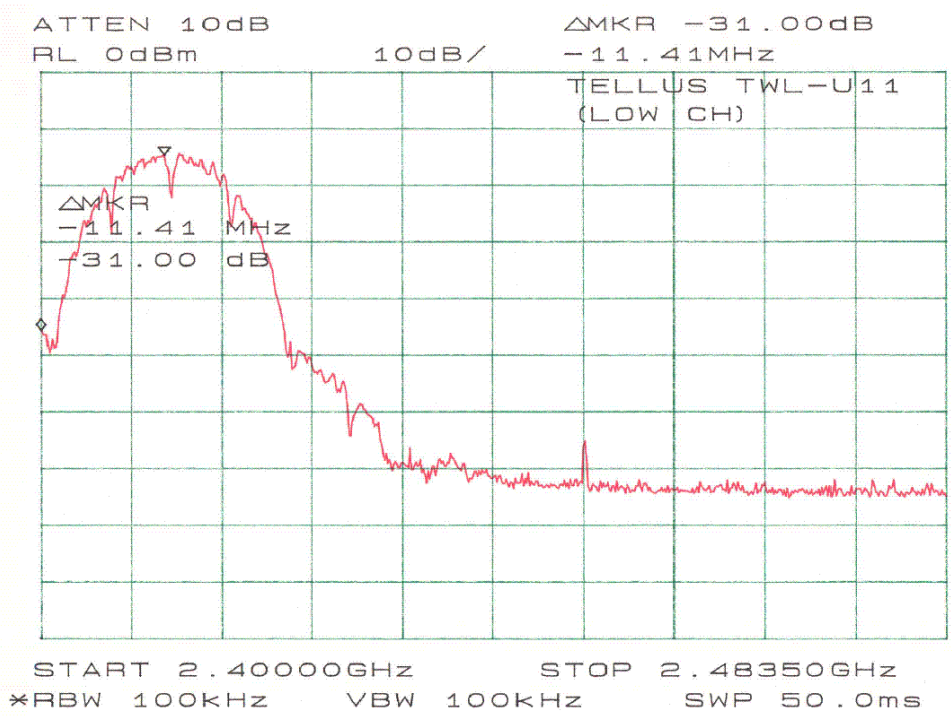
According to §15.247(c), in *any* 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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)).

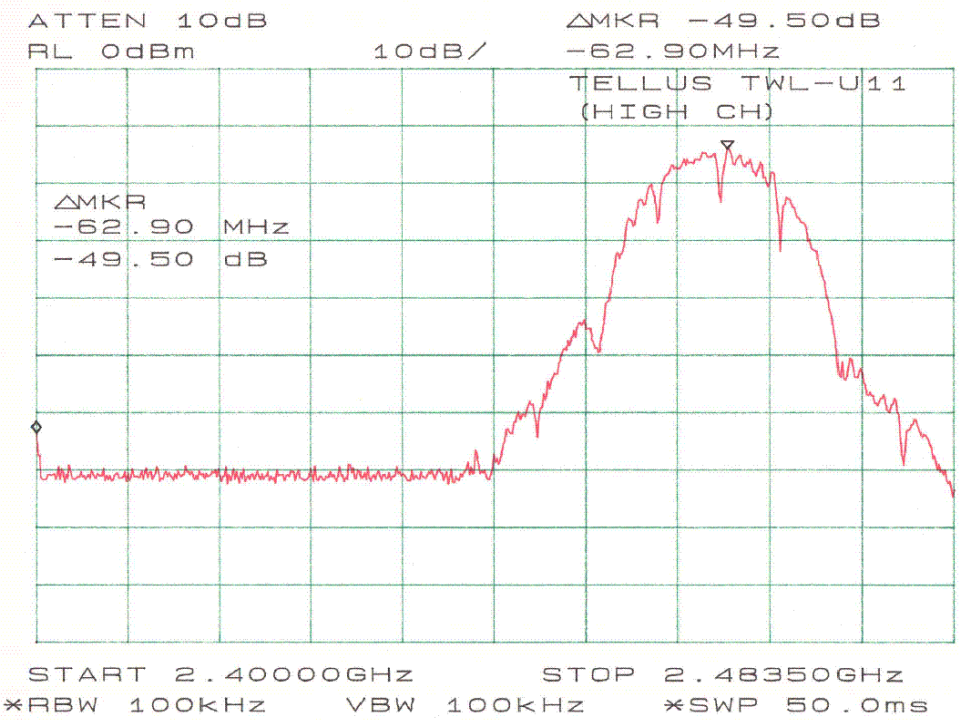
8.2 Measurement Procedure

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 10dB
RL 0dBm
10dB/
ΔMKR -31.00dB
-11.41MHz
TELLUS TWL-U11
(LOW CH)
ΔMKR
-11.41 MHz
-31.00 dB
START 2.40000GHz
STOP 2.48350GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR -49.50dB
-62.90MHz
TELLUS TWL-U11
(HIGH CH)
ΔMKR
-62.90 MHz
-49.50 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: 10.05 (dBm)
Maximum peak output power at antenna input terminal: 10.12 (mW)
Antenna Gain (typical): 2 (dBi)
Maximum antenna gain: 1.58 (numeric)
Prediction distance: 3 (cm)
Predication frequency: 2400 (MHz)
MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm^2)
Power density at predication frequency: 0.14 (mW/cm^2)
Maximum allowable antenna gain: 11.17 (numeric)
Maximum allowable antenna gain: 10.48 (dBi)

Test Result

The predicted power density level at 3 cm is 0.14mW/cm². This is below the uncontrolled exposure limit of 1mW/cm² at 2400 MHz.

This EUT is 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 - 1992. The specification used was the FCC 15 Subpart C limits.

The EUT was put in the front of the test table. The host PC system was placed on the center of the back edge on the test table. The modem and the monitor were placed on the left side of the host PC system, and the printer was placed on the left side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.

The keyboard was placed directly in front of the monitor, flushed with the front of tabletop. The mouse was placed next to the keyboard, flushed with the back of keyboard.

The spacing between the peripherals was 10 centimeters.

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

The host PC system was connected with 110 Vac/60Hz power source.

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:

-1.2 (AVG) dBµV at 4824.34 MHz in the Vertical polarization, 30 MHz to 26GHz, Low Channel, 3 meters

-1.3 (AVG) dBµV at 4873.71 MHz in the Vertical polarization, 30 MHz to 26GHz, Middle Channel, 3 meters

-2.1 (AVG) dBµV at 4923.90 MHz in the Vertical polarization, 30 MHz to 26GHz, High Channel, 3 meters

-1.2 dBµV at 44.00 MHz in the Vertical polarization, *Unintentional Emission*, 30 MHz to 1000MHz, 3 meters

Unintentional Emission, 30MHz to 26GHz, 3 meters

INDICATED			TABLE	ANTENNA		CORRECTION FACTOR			CORRECTED AMPLITUDE	FCC 15 Subpart C	
Frequency MHz	Ampl. dBμV/m	Comments	Angle Degree	Height Meter	Polar H/ V	Antenna dBμV/m	Cable DB	Amp. DB	Corr. Ampl. dBμV/m	Limit dBμV/m	Margin dB
Low Channel											
4824.34	45.4	AVG	180	1.5	V	32.5	4.9	30.0	52.8	54	-1.2
4824.34	43.2	AVG	225	1.0	H	32.5	4.9	30.0	50.6	54	-3.4
7234.04	37.0	AVG	180	1.3	V	35.1	5.6	30.0	47.7	54	-6.3
7234.04	34.6	AVG	225	1.0	H	35.1	5.6	30.0	45.3	54	-8.7
Middle Channel											
4873.71	45.3	AVG	180	1.4	V	32.5	4.9	30.0	52.7	54	-1.3
4873.71	42.9	AVG	225	1.3	H	32.5	4.9	30.0	50.3	54	-3.7
7306.95	35.2	AVG	225	1.2	H	35.1	5.6	30.0	45.9	54	-8.1
7306.95	34.5	AVG	180	1.4	V	35.1	5.6	30.0	45.2	54	-8.8
High Channel											
4923.90	44.5	AVG	180	1.5	V	32.5	4.9	30.0	51.9	54	-2.1
4923.90	43.4	AVG	225	1.4	H	32.5	4.9	30.0	50.8	54	-3.2
7383.99	38.9	AVG	225	1.4	H	35.1	5.6	30.0	49.6	54	-4.4
7383.99	34.8	AVG	180	1.5	V	35.1	5.6	30.0	45.5	54	-8.5

* There was no apparent emission after the 3rd harmonics.

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
44.00	51.0	90	1.0	V	12.1	0.7	25.0	38.8	40	-1.2
48.00	51.4	45	1.0	V	11.3	0.5	25.0	38.2	40	-1.8
168.01	51.2	135	1.2	V	13.3	2.1	25.0	41.6	43.5	-1.9
672.07	43.2	360	1.0	H	21.7	3.4	25.0	43.3	46	-2.7
83.84	49.3	270	1.0	V	9.6	1.4	25.0	35.3	40	-4.7
131.99	48.5	45	1.0	V	12.6	2.0	25.0	38.1	43.5	-5.4
767.94	40.0	180	1.8	H	22.7	2.6	25.0	40.3	46	-5.7
216.01	48.0	270	1.2	H	12.5	4.7	25.0	40.2	46	-5.8
240.01	49.0	270	1.0	H	12.6	2.3	25.0	38.9	46	-7.1
144.01	46.5	315	1.0	V	13.2	1.0	25.0	35.7	43.5	-7.8
528.10	40.2	135	1.0	H	19.8	2.9	25.0	37.9	46	-8.1
912.20	32.8	270	1.8	H	24.6	4.2	25.0	36.6	46	-9.4
120.01	44.8	45	1.2	V	12.1	2.2	25.0	34.1	43.5	-9.4

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 ±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 15 Subpart C limits.

The EUT was put in front of the test table. The host PC system was placed on the center of the back edge on the test table. The modem and the monitor were placed on the left side of the host PC system, and the printer was placed on the left side of the host PC system. The rear of the EUT and peripherals were placed flushed with the rear of the tabletop.

The keyboard was placed directly in front of the monitor, flushed with the front of tabletop. The mouse was placed next to the keyboard, flushed with the back of keyboard.

The spacing between the peripherals was 10 centimeters.

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

The host PC system utilized 110 Vac/60Hz power source.

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:

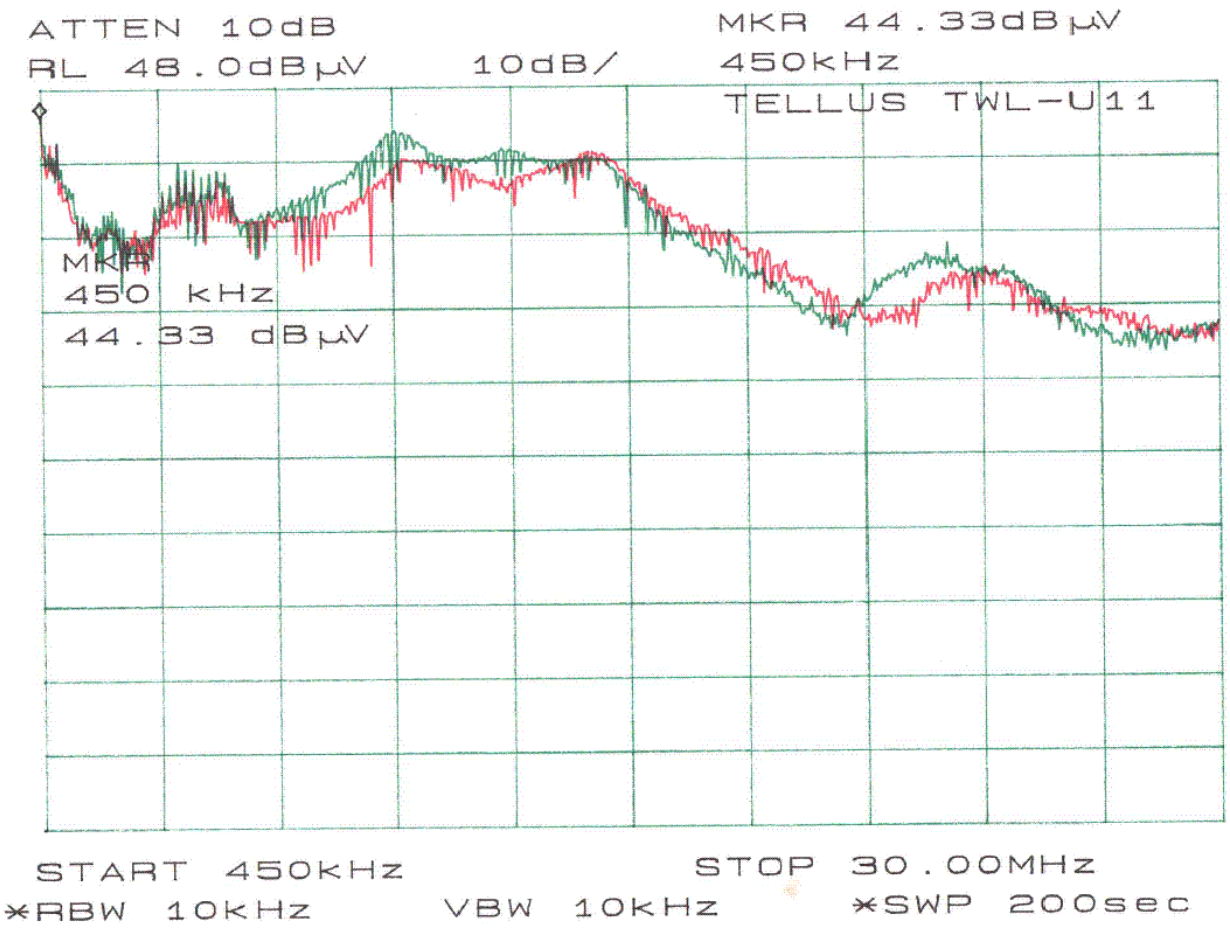
-3.7 dBμV at 0.450 MHz in the Neutral mode, 450kHz~30MHz

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
0.450	44.3	QP	Neutral	48	-3.7
0.450	43.5	QP	Line	48	-4.5
8.790	42.5	QP	Neutral	48	-5.5
12.300	41.0	QP	Line	48	-7.0
14.300	39.2	QP	Neutral	48	-8.8
8.900	38.5	QP	Line	48	-9.5

12.7 Plot of Conducted Emissions Test Data

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



13 - PROCESSING GAIN

According to §15.247(e), the processing gain of a direct sequence system shall be at least 10 dB. The processing gain represents the improvement to the received signal-to-noise ratio, after filtering to the information bandwidth, from the spreading/dispreading function.

13.1 Brief Explanations on Processing Gain Data

Please see the attached file.

13.2 Test Data for Processing Gain

Please see the attached file.

13.3 Test Setup - Processing Gain

Please see the attached file.

Test Report: RF3000 Processing Gain

Tested on RFMD RD0314 reference design board S/N 0229022F with RF3000 rev 10 Baseband Processor.

Scope: This report presents the test setup and measured data for a FCC Part 15.247 (e) Jamming Margin test for the indirect measurement of processing gain.

Tested by Dan Habecker and Chris Irwin, RFMD

Report written by Chris Irwin, RFMD

Test Date: January 4, 2002

Report Date: March 20, 2002

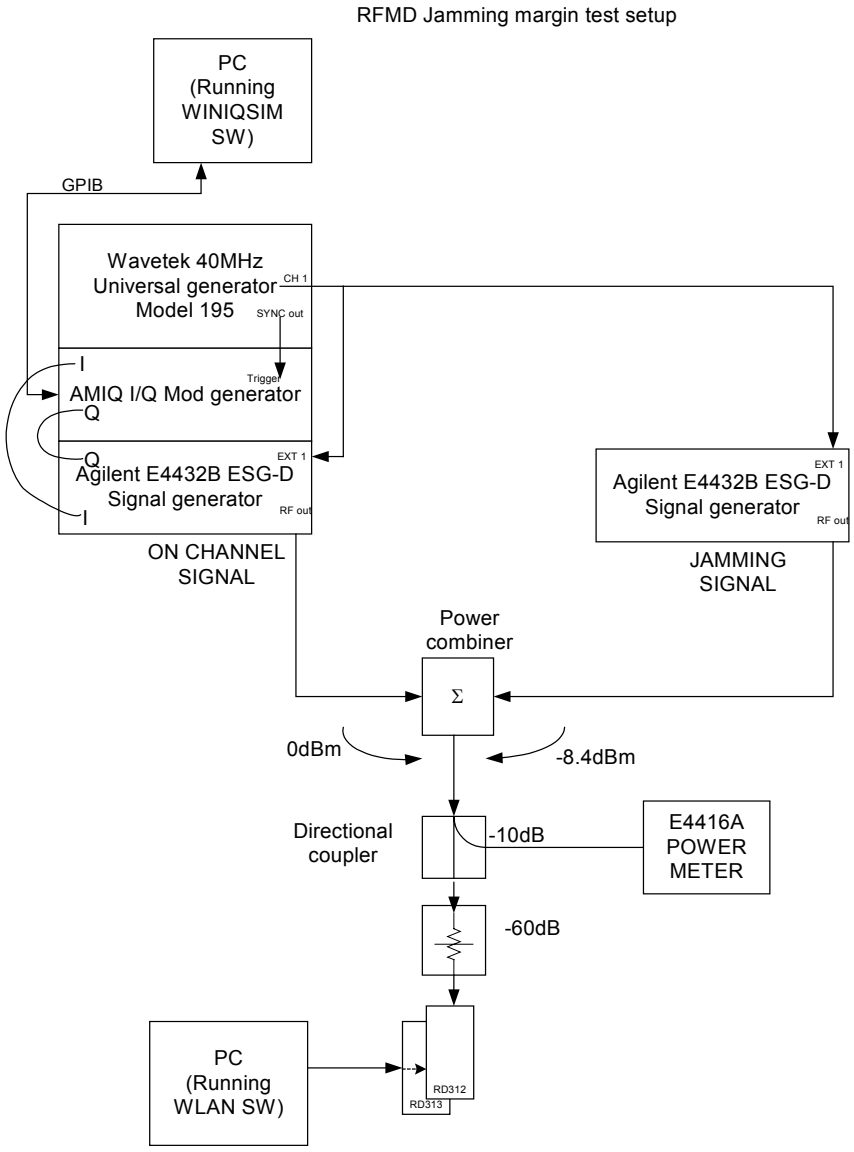
Test Background and Procedure

Material has been previously published, by other organizations supplying Integrated Circuits to implement IEEE802.11b compliant systems, that provides background theoretical calculations and test methods for measuring Jamming Margin, and using the results to infer Processing Gain. As that material, in conjunction with test results, has already been accepted by the FCC as sufficient proof that the systems comply with FCC Part 15.247(e) Processing Gain requirements, no attempt to reproduce that material in another form will be made in this report. The result of those theoretical calculations will be used here, and the same test method (in principle) will be applied.
This method can be summarized as follows:
The Signal-to-Jammer ratio is fixed at 8.4dB, with the Jammer frequency swept through the receiver pass-band (17MHz in this case) in 50kHz increments, and if the number of points at which the PER exceeds 8% is less than 20% of the total points then the test is passed. Otherwise, the test is failed.

This is repeated on each of the following channels:

Channel 1: 2412 MHz
Channel 7: 2442 MHz
Channel 11: 2462 MHz

Test setup


RFMD Jamming margin test setup
PC
(Running
WINIQSIM
SW)
GPIB
Wavetek 40MHz
Universal generator
Model 195
CH 1
SYNC out
I
Trigger
AMIQ I/Q Mod generator
Q
Q
EXT 1
Agilent E4432B ESG-D
Signal generator
RF out
I
ON CHANNEL
SIGNAL
EXT 1
Agilent E4432B ESG-D
Signal generator
RF out
JAMMING
SIGNAL
Power
combiner
Σ
0dBm
-8.4dBm
Directional
coupler
-10dB
E4416A
POWER
METER
-60dB
PC
(Running
WLAN SW)
RD312
RD313

Wavetek setup:
CH 1: Amplitude 2.5Vpp, Load = 50OHM
Pulse waveform, period 40ms
Pulse delay 12us, pulse width 1290 us
DC offset -1.8VDC, Mode - continuous
Sync ON

AMIQ settings:
Run WinIQSim. Requires PC and GPIB cable for control.
Mod Settings -->Sequence length = 72000.
Mod Settings-->Filter-->User-->file-->LPF9REC.IFL
Set AMIQ Rem-->HW settings-->Type=Single Output
Set AMIQ Rem-->HW settings-->Tracking=OFF
Set AMIQ Rem-->HW settings-->CH I Level = 0.3
Set AMIQ Rem-->HW settings-->CH Q Level = 0.3
Set AMIQ Rem-->HW settings-->Filter=OFF
Set AMIQ Rem-->HW settings-->OFF state = High Z
Set AMIQ Rem-->HW settings-->Output Resolution=14bit
Set AMIQ Rem-->HW settings-->Source/Trigger=GATED
RFMD can provide the following files. Open Settings.IQS (this sets all above settings as listed) then click on Source Data, File 11MbRD0312.DBI

Agilent signal generator setup:
MOD ON, I/Q ON, I/Q source = EXT I/Q, BURST ENVLP ON, High Crest mode OFF, I/Q adjustments OFF, EXT I/Q Polarity NORMAL, ALC OFF
Set Amplitude Offset to calibrate output level to 0dB for On Channel signal and –8.4dBm for Jamming signal (use Agilent E4416A).

Test Results

Jamming Margin test results.	Jammer level: -8.4dB	relative to On channel 11Mbps modulated signal
Tested on RD0314 S/N 0229022F	1/4/2002	Chris Irwin

	Channel 1 2412 MHz	Channel 7 2442 MHz	Channel 11
Number of jammer frequencies exceeding 8%:	14	15	19
Percentage of frequencies exceeding 8%:	4.0%	4.3%	5.4%
Max allowed:	20%	20%	20%
Result:	PASS	PASS	PASS

Conclusion

This data confirms that the device tested complied with FCC Part 15.247(e) requirements that minimum Processing Gain be 10dB.