

RF Measurement Report

Prepared by:

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In Support of:

FCC APPLICATION FOR CERTIFICATION

for

Young Design, Inc.

308 Hillwood Ave.

Falls Church, VA 22046

Model: WL2400-PCM Card with AMP2400 Amplifier

FCC ID: NM5WL2400-PCM

Demonstration of Compliance with FCC Rules Part 15.247

June 15, 1999

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1.0 Introduction

This report has been prepared on behalf of Young Design, Inc., to support the attached Application for Certification of a Part 15 Spread Spectrum Transmitter. The Equipment Under Test was the **Model WL2400-PCM Wireless LAN Adapter Card with Model AMP2440-250 Amplifier**.

Radio-Noise Emissions tests were performed according to *FCC Public Notice 54797, titled "Guidance on Measurements for Direct Sequence SST"*. The measuring equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

Testing was performed at National Certification Laboratory in Ellicott City, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch. FCC acceptance was granted on May 26, 1993.

1.1 Summary

The Young Design, Inc. **Model WL2400-PCM card with AMP2440-250** complies with the FCC limits (15.247) for a Direct Sequence SST.

2.0 Description of Equipment Under Test (EUT)

The **WL2400-PCM card** is actually the FCC Certified Samsung Model Magic Wave ISA, with FCCC ID: E2XSWL-1000N. Young Design, Inc. has not modified this product in any manner except for the addition of high gain antennas, and an external amplifier.

The EUT Features:

Direct Sequence Spread Spectrum Transceiver
+ 24 dBm RF Output Max.
2412 to 2452 MHz Freq. Range
10 MHz 6 dB Emission Bandwidth
9 Available Channels
5 MHz Channel Separation
2 Mbps Data Rate (Radio Link)
Differential DPSK Modulation

3.0 Test Program

This report contains measurement charts and data as evidence for the following tests performed:

1. (15.247 b) Peak RF output power.
2. (15.247 d) Power Spectral Density (3kHz Bandwidth).
3. (15.247 c) Field strength of harmonics and spurious out-of-band emissions.
4. (15.247 c) RF Antenna Conducted of harmonics and spurious out-of-band emissions.
5. (15.247 a) 6 dB Emission Bandwidth.
6. (15.207) Power Line Conducted Emissions.

4.0 Test Configuration

The PCM wireless LAN card was installed in a notebook computer for testing. A DOS program is used to control the transmitter. The external amplifier is connected in-line between the wireless LAN card and antenna via 50 feet of low loss cable. The 50 foot cable is the minimum length supplied with the system.

RF power output measurements were taken with an RF power meter at the amplifier antenna connector. RF antenna conducted output tests such as Bandwidth, Spurious/Harmonics, and Power Spectral Density were taken with the amplifier antenna connector feeding directly into the spectrum analyzer via external 30 dB attenuator. The analyzer's internal attenuator was adjusted to prevent overloading of the front end.

Field strength measurements were taken both with the amplifier in-line, and subsequently with just the wireless LAN card feeding a grid dish, panel, or omni antenna aimed at the measurement antenna. Testing was performed using the highest gain antenna from each design family (grid, panel, omni) in order to cover the worst-case range of combinations.

PEAK POWER TEST RESULTS

Limit: 0.250 watts (24 dBm)

Condition: Transmitter is set to a single modulated channel.
Measurement taken at amplifier antenna connector.

Readings from RF Peak Power Meter:

LAN Card w/ 250 mW Amp	2412 MHz	-	+23.8 dBm
LAN Card w/ 250 mW Amp	2432 MHz	-	+23.3 dBm
LAN Card w/ 250 mW Amp	2452 MHz	-	+24.1 dBm

POWER SPECTRAL DENSITY

Limit: 8 dBm

Resolution Bandwidth: 3 kHz

Average Time Interval: 1 second/3 kHz

Actual Time Interval used

for testing: 1.5 seconds/3 kHz

Condition: Transmitter is modulated at 24 dBm RF power.

Measurement taken at amplifier antenna connector.

Readings from spectrum analyzer:

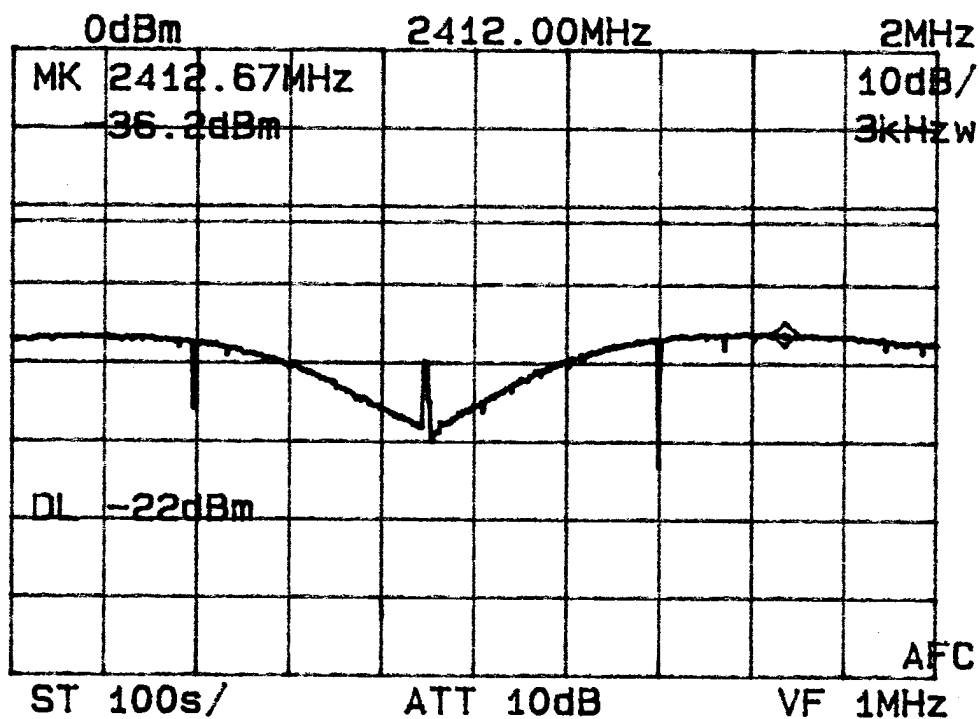
2412 MHz - -6.2 dBm

2432 MHz - -6.2 dBm

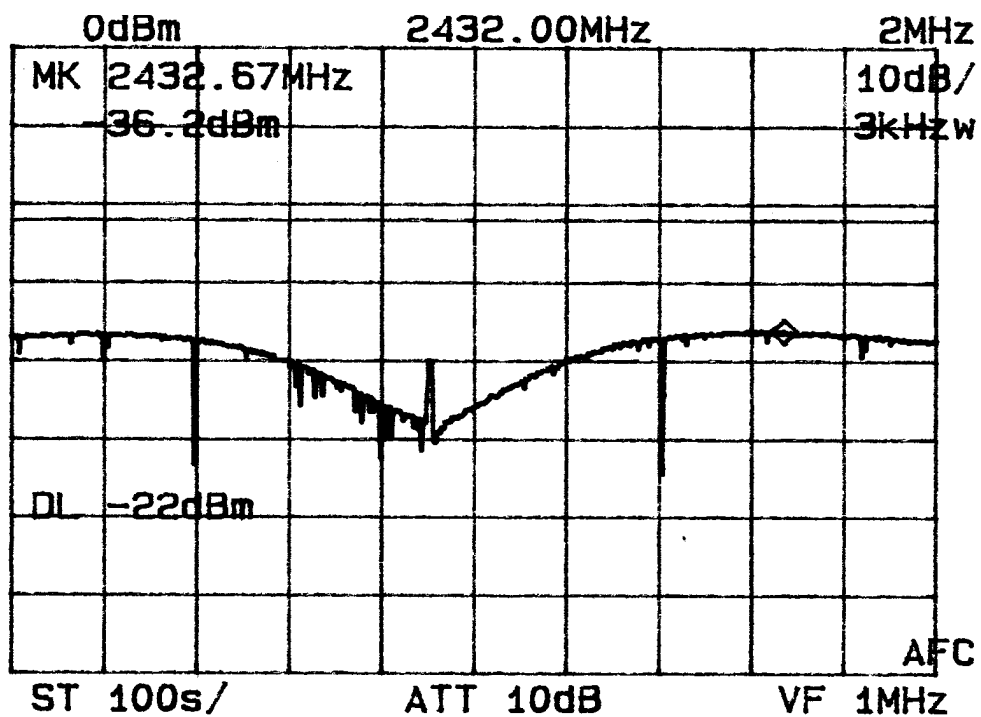
2452 MHz - -6.6 dBm

SEE FOLLOWING 3 PLOTS

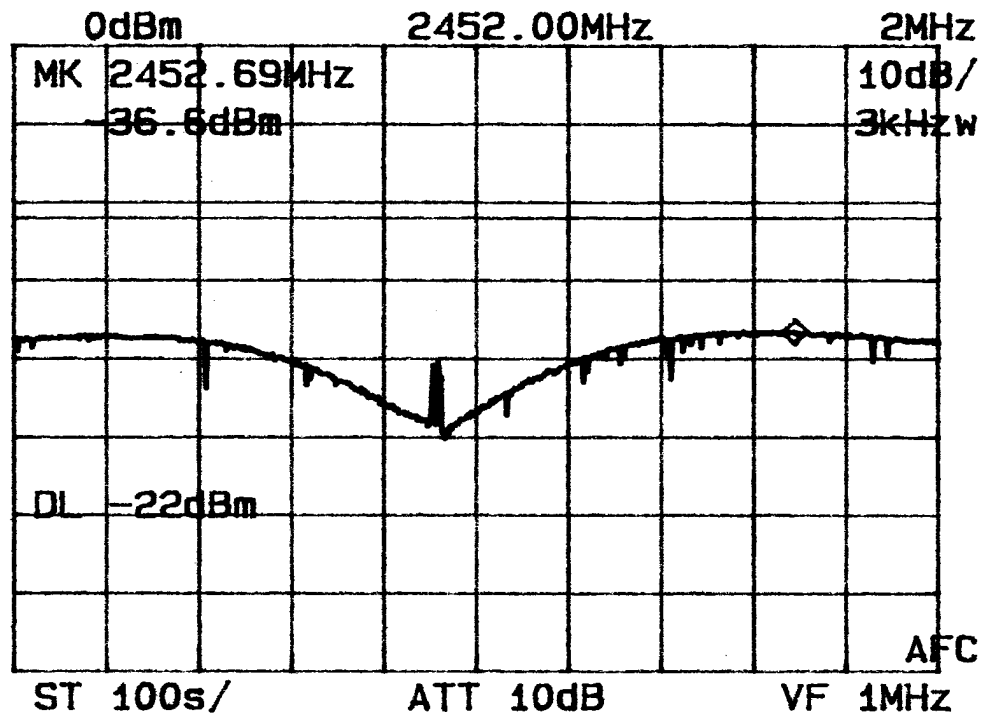
CHANNEL 1



CHANNEL 5



CHANNEL 9



6 dB EMISSION BANDWIDTH

Minimum 6 dB BW: 0.5 MHz
RBW Setting on S.A.: 100 kHz

Condition: Transmitter is set to a single FM modulated channel.
Measurement taken at amplifier antenna connector.

Readings from spectrum analyzer:

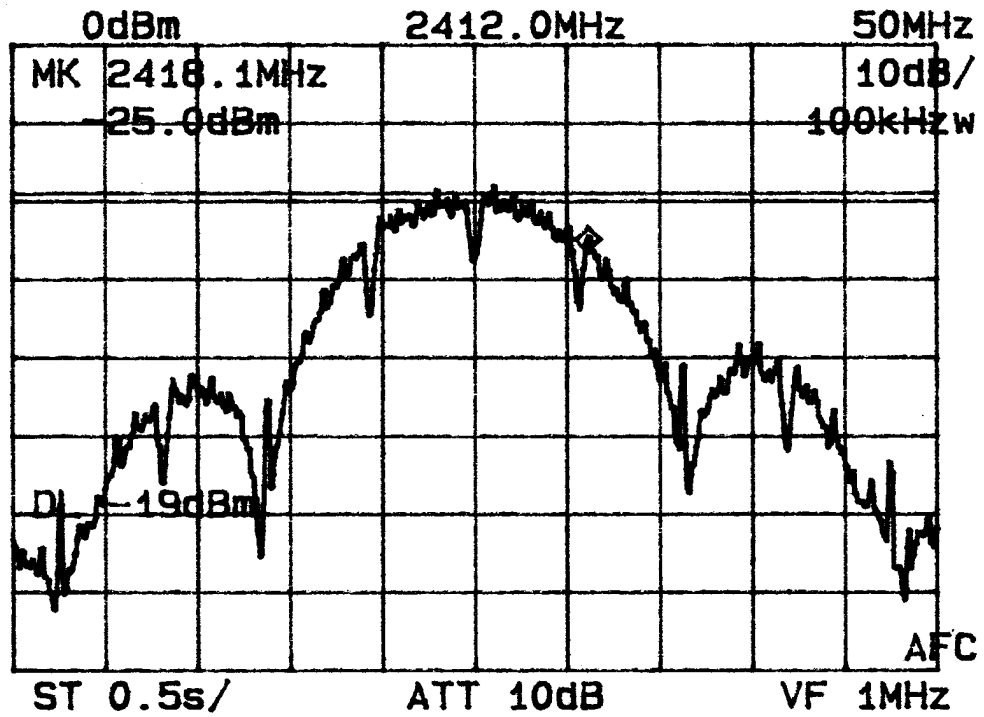
2412 MHz - 12.2 MHz Occupied BW

2432 MHz - 13.0 MHz Occupied BW

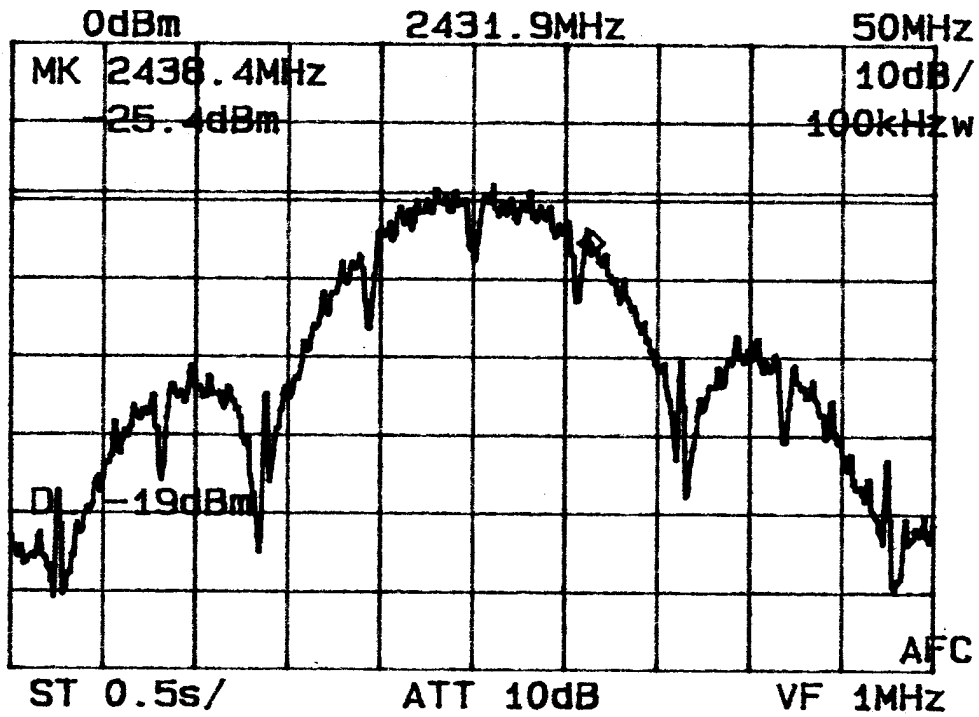
2452 MHz - 12.6 MHz Occupied BW

SEE FOLLOWING 3 PLOTS

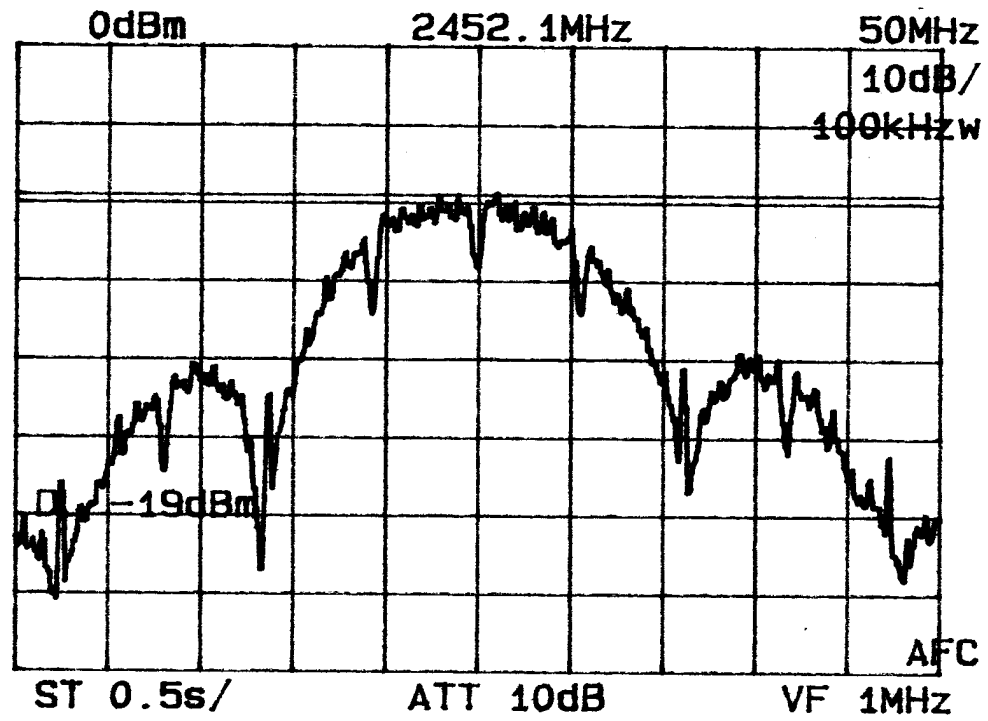
CHANNEL 1



CHANNEL 5



CHANNEL 9



RF ANTENNA CONDUCTED SPURIOUS/HARMONICS EMISSIONS

Limit: 20 dB below Carrier Level Measured with 100 kHz RBW
RBW Setting on S.A.: 100 kHz

Condition: Transmitter is set to a single FM modulated channel.
RF power = 24 dBm
Measurement taken at amplifier antenna connector.

Three separate Measurements are performed to show harmonic and spurious emissions generated with the transmitter tuned to low, middle, and high parts of the spectral range.

SEE FOLLOWING 3 DATA TABLES

FCC PART 15.247(c) - CONDUCTED SPURIOUS EMISSIONS

Frequency of Carrier = 2412 MHz

Limit = 20 dBc

Condition: Transmitter is set to a single modulated channel.

TEST RESULTS

LIMIT: -20 dB FROM PEAK CARRIER

<u>COMPONENT</u>	<u>FREQUENCY (MHZ)</u>	<u>RESULT (dB FROM PEAK)</u>
HARMONIC	4824.00	- 42.0
HARMONIC	7236.00	- 45.0
HARMONIC	9648.00	- 55.0
HARMONIC	12060.00	- 63.0
HARMONIC	14472.00	- 64.0
HARMONIC	16884.00	- 69.0
HARMONIC	19296.00	- 71.0
HARMONIC	21708.00	- 77.0
HARMONIC	24120.00	- 77.0

FCC PART 15.247(c) - CONDUCTED SPURIOUS EMISSIONS

Frequency of Carrier = 2432 MHz

Limit = 20 dBc

Condition: Transmitter is set to a single modulated channel.

TEST RESULTS

LIMIT: -20 dB FROM PEAK CARRIER

<u>COMPONENT</u>	<u>FREQUENCY (MHZ)</u>	<u>RESULT (dB FROM PEAK)</u>
HARMONIC	4864.00	- 44.0
HARMONIC	7296.00	- 47.0
HARMONIC	9728.00	- 55.0
HARMONIC	12160.00	- 60.0
HARMONIC	14592.00	- 66.0
HARMONIC	17024.00	- 70.0
HARMONIC	19456.00	- 74.0
HARMONIC	21888.00	- 77.0
HARMONIC	24320.00	- 77.0

FCC PART 15.247(c) - CONDUCTED SPURIOUS EMISSIONS

Frequency of Carrier = 2452 MHz

Limit = 20 dBc

Condition: Transmitter is set to a single modulated channel.

TEST RESULTS

LIMIT: -20 dB FROM PEAK CARRIER

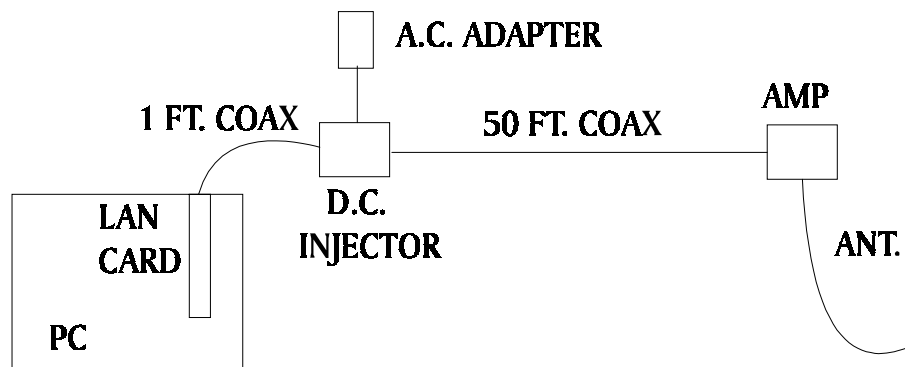
<u>COMPONENT</u>	<u>FREQUENCY (MHZ)</u>	<u>RESULT (dB FROM PEAK)</u>
HARMONIC	4904.00	- 42.0
HARMONIC	7356.00	- 47.0
HARMONIC	9808.00	- 56.0
HARMONIC	12260.00	- 62.0
HARMONIC	14712.00	- 69.0
HARMONIC	17164.00	- 72.0
HARMONIC	19616.00	- 75.0
HARMONIC	22068.00	- 77.0
HARMONIC	24520.00	- 77.0

4.0 Test Configuration

RADIATED EMISSIONS

The EUT was set up on the center of the test table, in a manner which follows the general guidelines of ANSI C63.4, Section 6 "General Operating Conditions and Configurations". Two sets of measurements were taken: First set with amplifier, second set without amplifier.

This is described below:



5.0 Conducted Emissions Scheme

The EUT is placed on an 80 cm high 1 X 1.5 m non-conductive table. Power to the RF modem is provided through a Solar Corporation 50 Ω /50 μ H Line Impedance Stabilization Network bonded to a 2.2 X 2 meter horizontal ground plane, and a 2.2 X 2 meter vertical ground plane. The LISN has its AC input supplied from a filtered AC power source. A separate LISN provides AC power to the peripheral equipment. I/O cables are moved about to obtain maximum emissions.

The 50 Ω output of the LISN is connected to the input of the spectrum analyzer and emissions in the frequency range of 450 kHz to 30 MHz are searched. The detector function is set to quasi-peak and the resolution bandwidth is set at 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth for final measurements. All emissions within 20 dB of the limit are recorded in the data tables.

FCC CLASS B CONDUCTED EMISSIONS DATA

CLIENT: YOUNG DESIGN
EUT: WL2400-PCM WITH 2440 AMP

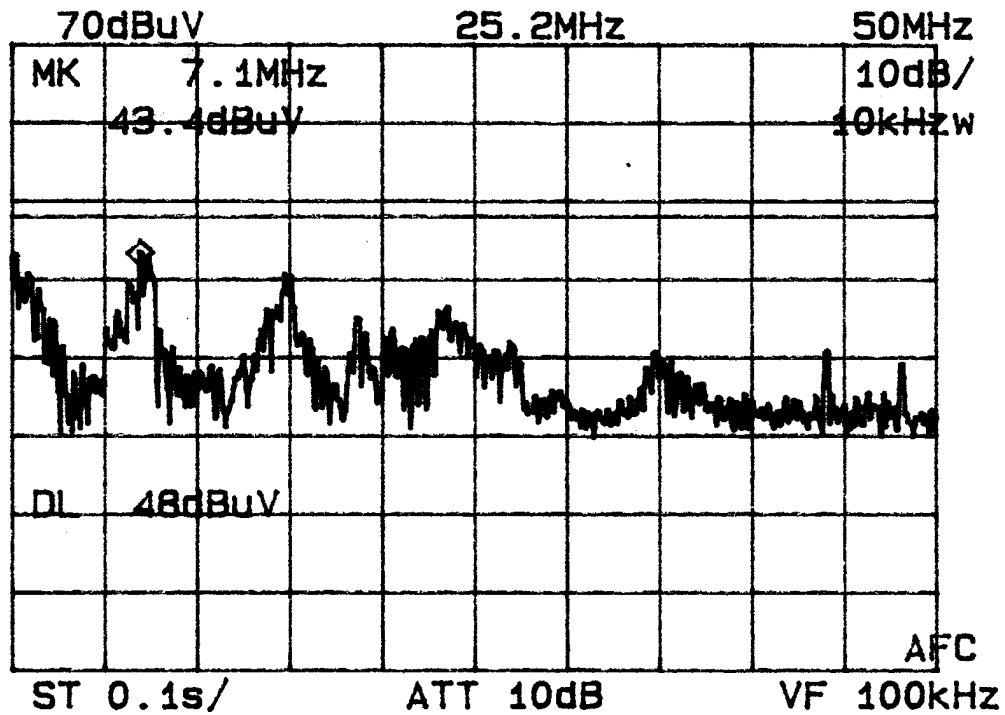
LINE 1 - NEUTRAL

FREQ MHz	VOLTAGE dBuV	VOLTAGE uV	FCC LIMIT uV	MARGIN dB
1.1	40.6	107	250	-7.4
7.1	43.4	148	250	-4.6
15.1	40.4	105	250	-7.6
18.9	35.2	58	250	-12.8
23.8	36.4	66	250	-11.6

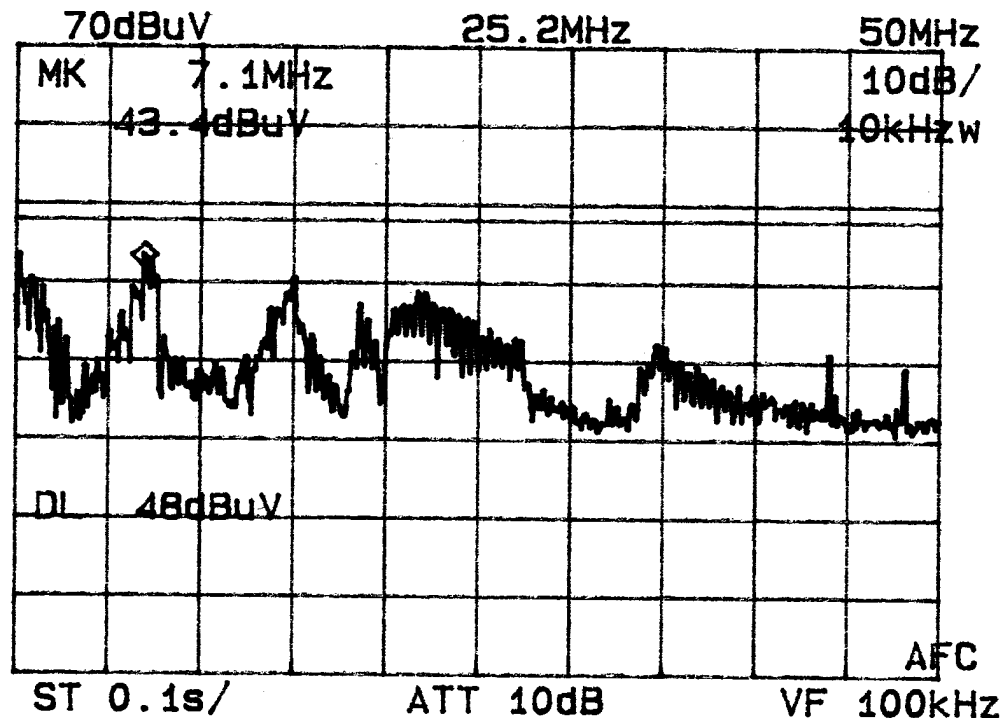
LINE 2 - PHASE

FREQ MHz	VOLTAGE dBuV	VOLTAGE uV	FCC LIMIT uV	MARGIN dB
1.1	40.4	105	250	-7.6
7.1	43.4	148	250	-4.6
15.3	40.6	107	250	-7.4
18.9	37.2	72	250	-10.8
22.4	38.6	85	250	-9.4

A.C. LINE-CONDUCTED - L1



A.C. LINE-CONDUCTED - L2



6.0 Radiated Emissions Scheme

The EUT is placed on an 80 cm high 1 X 1.5 meter non-conductive motorized turntable for radiated testing on the 3-meter open area test site. The emissions from the EUT are measured continuously at every azimuth by rotating the turntable. Guided horn and log periodic broadband antennas are mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna is varied between 1 and 4 meters. Both the horizontal and vertical field components are measured.

The RF spectrum is searched from 30 MHz - 25.000 GHz.

The output from the antenna is connected to the input of the preamplifier. The preamp out is connected to the spectrum analyzer. The detector function is set to **Peak**. The resolution bandwidth of the spectrum analyzer is set at 120 kHz, for the frequency range of 30-1000 MHz, and 1 MHz for the range of 1 GHz-25 GHz. A 10 Hz video BW setting is used to average readings above 1 GHz. All emissions within 20 dB of the limit are recorded in the data tables.

To convert the spectrum analyzer reading into a quantified E-field level to allow comparison with the FCC limits, it is necessary to account for various calibration factors. These factors include cable loss (CL) and antenna factors (AF). The AF/CL in dB/m is algebraically added to the Spectrum Analyzer Voltage in dB μ V to obtain the Radiated Electric Field in dB μ V/m. This level is then compared with the FCC limit.

Example:

Spectrum Analyzer Volt: VdB μ V

Composite Factor: AF/CLdB/m

Electric Field: EdB μ V/m = VdB μ V + AF/CLdB/m
Linear Conversion: EuV/m = Antilog (EdB μ V/m/20)

	FCC 15.209 RADIATED EMISSIONS DATA						
	FCC ID:	NM5WL2400-PCM					
CLIENT:		YOUNG DESIGN					
EUT:		WL2400/2440 AMP					
CARRIER:		2412 MHZ @ 250 mW					
ANTENNA		12 DBi OMNI					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	36.0	35.0	-25	46.0	199.5	500.0
12060.00	V	30.0	40.0	-25	45.0	177.8	500.0
14472.00	H	21.0	43.0	-25	39.0	89.1	500.0
19296.00	H	20.0	36.0	-25	31.0	35.5	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	38.0	35.0	-25	48.0	251.2	5000.0
12060.00	V	32.0	40.0	-25	47.0	223.9	5000.0
14472.00	H	23.0	43.0	-25	41.0	112.2	5000.0
19296.00	H	22.0	36.0	-25	33.0	44.7	5000.0

CARRIER:		2432 MHZ @ 250 mW					
ANTENNA:		12 DBi OMNI					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	35.0	35.0	-25	45.0	177.8	500.0
7296.00	H	30.0	37.0	-25	42.0	125.9	500.0
12160.00	H	25.0	40.0	-25	40.0	100.0	500.0
19456.00	H	19.0	36.0	-25	30.0	31.6	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	37.0	35.0	-25	47.0	223.9	5000.0
7296.00	H	32.0	37.0	-25	44.0	158.5	5000.0
12160.00	H	27.0	40.0	-25	42.0	125.9	5000.0
19456.00	H	21.0	36.0	-25	32.0	39.8	5000.0

CARRIER:		2452 MHZ @ 250 mW					
ANTENNA:		12 DBi OMNI					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	35.0	35.0	-25	45.0	177.8	500.0
7356.00	H	32.0	37.0	-25	44.0	158.5	500.0
12260.00	H	30.0	40.0	-25	45.0	177.8	500.0
19616.00	H	25.0	36.0	-25	36.0	63.1	500.0
22068.00	V	21.0	37.0	-25	33.0	44.7	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	37.0	35.0	-25	47.0	223.9	5000.0
7356.00	H	34.0	37.0	-25	46.0	199.5	5000.0
12260.00	H	32.0	40.0	-25	47.0	223.9	5000.0
19616.00	H	27.0	36.0	-25	38.0	79.4	5000.0
22068.00	V	23.0	37.0	-25	35.0	56.2	5000.0

		FCC 15.209 RADIATED EMISSIONS DATA					
		FCC ID:	NM5WL2400-PCM				
CLIENT:		YOUNG DESIGN					
EUT:		WL2400 CARD					
CARRIER:		2412 MHZ					
ANTENNA:		12 DBi OMNI					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	33.0	35.0	-25	43.0	141.3	500.0
12060.00	V	28.0	40.0	-25	43.0	141.3	500.0
14472.00	H	21.0	43.0	-25	39.0	89.1	500.0
19296.00	H	20.0	36.0	-25	31.0	35.5	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	35.0	35.0	-25	45.0	177.8	5000.0
12060.00	V	30.0	40.0	-25	45.0	177.8	5000.0
14472.00	H	23.0	43.0	-25	41.0	112.2	5000.0
19296.00	H	22.0	36.0	-25	33.0	44.7	5000.0

CARRIER:		2432 MHZ					
ANTENNA:		12 DBi OMNI					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	34.0	35.0	-25	44.0	158.5	500.0
7296.00	H	25.0	37.0	-25	37.0	70.8	500.0
12160.00	H	22.0	40.0	-25	37.0	70.8	500.0
19456.00	H	19.0	36.0	-25	30.0	31.6	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	36.0	35.0	-25	46.0	199.5	5000.0
7296.00	H	27.0	37.0	-25	39.0	89.1	5000.0
12160.00	H	24.0	40.0	-25	39.0	89.1	5000.0
19456.00	H	21.0	36.0	-25	32.0	39.8	5000.0

CARRIER:		2452 MHZ					
ANTENNA:		12 DBi OMNI					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	34.0	35.0	-25	44.0	158.5	500.0
7356.00	H	31.0	37.0	-25	43.0	141.3	500.0
12260.00	H	23.0	40.0	-25	38.0	79.4	500.0
19616.00	H	21.0	36.0	-25	32.0	39.8	500.0
22068.00	V	19.0	37.0	-25	31.0	35.5	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	36.0	35.0	-25	46.0	199.5	5000.0
7356.00	H	33.0	37.0	-25	45.0	177.8	5000.0
12260.00	H	25.0	40.0	-25	40.0	100.0	5000.0
19616.00	H	23.0	36.0	-25	34.0	50.1	5000.0
22068.00	V	21.0	37.0	-25	33.0	44.7	5000.0

		FCC 15.209 RADIATED EMISSIONS DATA					
		FCC ID:	NM5WL2400-PCM				
CLIENT:		YOUNG DESIGN					
EUT:		WL2400/2440 AMP					
CARRIER:		2412 MHZ @ 250 mW					
ANTENNA		17 DBi LPANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	34.0	35.0	-25	44.0	158.5	500.0
12060.00	V	29.0	40.0	-25	44.0	158.5	500.0
14472.00	H	21.0	43.0	-25	39.0	89.1	500.0
19296.00	H	23.0	36.0	-25	34.0	50.1	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	36.0	35.0	-25	46.0	199.5	5000.0
12060.00	V	31.0	40.0	-25	46.0	199.5	5000.0
14472.00	H	23.0	43.0	-25	41.0	112.2	5000.0
19296.00	H	25.0	36.0	-25	36.0	63.1	5000.0

CARRIER:		2432 MHZ @ 250 mW					
ANTENNA:		17 DBi LPANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	34.0	35.0	-25	44.0	158.5	500.0
7296.00	H	29.0	37.0	-25	41.0	112.2	500.0
12160.00	H	23.0	40.0	-25	38.0	79.4	500.0
19456.00	H	19.0	36.0	-25	30.0	31.6	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	36.0	35.0	-25	46.0	199.5	5000.0
7296.00	H	31.0	37.0	-25	43.0	141.3	5000.0
12160.00	H	25.0	40.0	-25	40.0	100.0	5000.0
19456.00	H	21.0	36.0	-25	32.0	39.8	5000.0

CARRIER:		2452 MHZ @ 250 mW					
ANTENNA:		17 DBi LPANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	33.0	35.0	-25	43.0	141.3	500.0
7356.00	H	30.0	37.0	-25	42.0	125.9	500.0
12260.00	H	27.0	40.0	-25	42.0	125.9	500.0
19616.00	H	21.0	36.0	-25	32.0	39.8	500.0
22068.00	V	20.0	37.0	-25	32.0	39.8	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	35.0	35.0	-25	45.0	177.8	5000.0
7356.00	H	32.0	37.0	-25	44.0	158.5	5000.0
12260.00	H	29.0	40.0	-25	44.0	158.5	5000.0
19616.00	H	23.0	36.0	-25	34.0	50.1	5000.0
22068.00	V	22.0	37.0	-25	34.0	50.1	5000.0

		FCC 15.209 RADIATED EMISSIONS DATA					
		FCC ID:	NM5WL2400-PCM				
CLIENT:		YOUNG DESIGN					
EUT:		WL2400 CARD					
CARRIER:		2412 MHZ					
ANTENNA		17 DBi LPANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	33.0	35.0	-25	43.0	141.3	500.0
12060.00	V	23.0	40.0	-25	38.0	79.4	500.0
14472.00	H	22.0	43.0	-25	40.0	100.0	500.0
19296.00	H	20.0	36.0	-25	31.0	35.5	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	35.0	35.0	-25	45.0	177.8	5000.0
12060.00	V	25.0	40.0	-25	40.0	100.0	5000.0
14472.00	H	24.0	43.0	-25	42.0	125.9	5000.0
19296.00	H	22.0	36.0	-25	33.0	44.7	5000.0

CARRIER:		2432 MHZ					
ANTENNA:		17 DBi LPANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	35.0	35.0	-25	45.0	177.8	500.0
7296.00	H	32.0	37.0	-25	44.0	158.5	500.0
12160.00	H	21.0	40.0	-25	36.0	63.1	500.0
19456.00	H	19.0	36.0	-25	30.0	31.6	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	37.0	35.0	-25	47.0	223.9	5000.0
7296.00	H	34.0	37.0	-25	46.0	199.5	5000.0
12160.00	H	23.0	40.0	-25	38.0	79.4	5000.0
19456.00	H	21.0	36.0	-25	32.0	39.8	5000.0

CARRIER:		2452 MHZ					
ANTENNA:		17 DBi LPANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	36.0	35.0	-25	46.0	199.5	500.0
7356.00	H	32.0	37.0	-25	44.0	158.5	500.0
12260.00	H	21.0	40.0	-25	36.0	63.1	500.0
19616.00	H	22.0	36.0	-25	33.0	44.7	500.0
22068.00	V	21.0	37.0	-25	33.0	44.7	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	38.0	35.0	-25	48.0	251.2	5000.0
7356.00	H	34.0	37.0	-25	46.0	199.5	5000.0
12260.00	H	23.0	40.0	-25	38.0	79.4	5000.0
19616.00	H	24.0	36.0	-25	35.0	56.2	5000.0
22068.00	V	23.0	37.0	-25	35.0	56.2	5000.0

		FCC 15.209 RADIATED EMISSIONS DATA					
		FCC ID:	NM5WL2400-PCM				
CLIENT:		YOUNG DESIGN					
EUT:		WL2400/2440 AMP					
CARRIER:		2412 MHZ @ 250 mW					
ANTENNA		18 DBi PANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	35.0	35.0	-25	45.0	177.8	500.0
12060.00	V	30.0	40.0	-25	45.0	177.8	500.0
14472.00	H	22.0	43.0	-25	40.0	100.0	500.0
19296.00	H	21.0	36.0	-25	32.0	39.8	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	37.0	35.0	-25	47.0	223.9	5000.0
12060.00	V	32.0	40.0	-25	47.0	223.9	5000.0
14472.00	H	24.0	43.0	-25	42.0	125.9	5000.0
19296.00	H	23.0	36.0	-25	34.0	50.1	5000.0

CARRIER:		2432 MHZ @ 250 mW					
ANTENNA:		18 DBi PANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	35.0	35.0	-25	45.0	177.8	500.0
7296.00	H	32.0	37.0	-25	44.0	158.5	500.0
12160.00	H	22.0	40.0	-25	37.0	70.8	500.0
19456.00	H	23.0	36.0	-25	34.0	50.1	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	37.0	35.0	-25	47.0	223.9	5000.0
7296.00	H	34.0	37.0	-25	46.0	199.5	5000.0
12160.00	H	24.0	40.0	-25	39.0	89.1	5000.0
19456.00	H	25.0	36.0	-25	36.0	63.1	5000.0

CARRIER:		2452 MHZ @ 250 mW					
ANTENNA:		18 DBi PANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	32.0	35.0	-25	42.0	125.9	500.0
7356.00	H	33.0	37.0	-25	45.0	177.8	500.0
12260.00	H	24.0	40.0	-25	39.0	89.1	500.0
19616.00	H	25.0	36.0	-25	36.0	63.1	500.0
22068.00	V	21.0	37.0	-25	33.0	44.7	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	34.0	35.0	-25	44.0	158.5	5000.0
7356.00	H	35.0	37.0	-25	47.0	223.9	5000.0
12260.00	H	26.0	40.0	-25	41.0	112.2	5000.0
19616.00	H	27.0	36.0	-25	38.0	79.4	5000.0
22068.00	V	23.0	37.0	-25	35.0	56.2	5000.0

		FCC 15.209 RADIATED EMISSIONS DATA					
		FCC ID:	NM5WL2400-PCM				
CLIENT:		YOUNG DESIGN					
EUT:		WL2400 CARD					
CARRIER:		2412 MHZ					
ANTENNA		18 DBi PANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	32.0	35.0	-25	42.0	125.9	500.0
12060.00	V	30.0	40.0	-25	45.0	177.8	500.0
14472.00	H	22.0	43.0	-25	40.0	100.0	500.0
19296.00	H	20.0	36.0	-25	31.0	35.5	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	34.0	35.0	-25	44.0	158.5	5000.0
12060.00	V	32.0	40.0	-25	47.0	223.9	5000.0
14472.00	H	24.0	43.0	-25	42.0	125.9	5000.0
19296.00	H	22.0	36.0	-25	33.0	44.7	5000.0

CARRIER:		2432 MHZ					
ANTENNA:		18 DBi PANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	33.0	35.0	-25	43.0	141.3	500.0
7296.00	H	27.0	37.0	-25	39.0	89.1	500.0
12160.00	H	25.0	40.0	-25	40.0	100.0	500.0
19456.00	H	20.0	36.0	-25	31.0	35.5	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	35.0	35.0	-25	45.0	177.8	5000.0
7296.00	H	29.0	37.0	-25	41.0	112.2	5000.0
12160.00	H	27.0	40.0	-25	42.0	125.9	5000.0
19456.00	H	22.0	36.0	-25	33.0	44.7	5000.0

CARRIER:		2452 MHZ					
ANTENNA:		18 DBi PANEL					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	34.0	35.0	-25	44.0	158.5	500.0
7356.00	H	30.0	37.0	-25	42.0	125.9	500.0
12260.00	H	22.0	40.0	-25	37.0	70.8	500.0
19616.00	H	21.0	36.0	-25	32.0	39.8	500.0
22068.00	V	19.0	37.0	-25	31.0	35.5	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	36.0	35.0	-25	46.0	199.5	5000.0
7356.00	H	32.0	37.0	-25	44.0	158.5	5000.0
12260.00	H	34.0	40.0	-25	49.0	281.8	5000.0
19616.00	H	23.0	36.0	-25	34.0	50.1	5000.0
22068.00	V	21.0	37.0	-25	33.0	44.7	5000.0

		FCC 15.209 RADIATED EMISSIONS DATA					
		FCC ID:	NM5WL2400-PCM				
CLIENT:		YOUNG DESIGN					
EUT:		WL2400/2440 AMP					
CARRIER:		2412 MHZ @ 250 mW					
ANTENNA:		24 DBi GRID					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	37.0	35.0	-25	47.0	223.9	500.0
12060.00	V	33.0	40.0	-25	48.0	251.2	500.0
14472.00	H	24.0	43.0	-25	42.0	125.9	500.0
19296.00	H	22.0	36.0	-25	33.0	44.7	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	39.0	35.0	-25	49.0	281.8	5000.0
12060.00	V	35.0	40.0	-25	50.0	316.2	5000.0
14472.00	H	26.0	43.0	-25	44.0	158.5	5000.0
19296.00	H	24.0	36.0	-25	35.0	56.2	5000.0

CARRIER:		2432 MHZ @ 250 mW					
ANTENNA:		24 DBi GRID					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	38.0	35.0	-25	48.0	251.2	500.0
7296.00	H	34.0	37.0	-25	46.0	199.5	500.0
12160.00	H	25.0	40.0	-25	40.0	100.0	500.0
19456.00	H	28.0	36.0	-25	39.0	89.1	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	40.0	35.0	-25	50.0	316.2	5000.0
7296.00	H	36.0	37.0	-25	48.0	251.2	5000.0
12160.00	H	27.0	40.0	-25	42.0	125.9	5000.0
19456.00	H	30.0	36.0	-25	41.0	112.2	5000.0

CARRIER:		2452 MHZ @ 250 mW					
ANTENNA:		24 DBi GRID					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	38.0	35.0	-25	48.0	251.2	500.0
7356.00	H	33.0	37.0	-25	45.0	177.8	500.0
12260.00	H	30.0	40.0	-25	45.0	177.8	500.0
19616.00	H	28.0	36.0	-25	39.0	89.1	500.0
22068.00	V	20.0	37.0	-25	32.0	39.8	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	40.0	35.0	-25	50.0	316.2	5000.0
7356.00	H	35.0	37.0	-25	47.0	223.9	5000.0
12260.00	H	32.0	40.0	-25	47.0	223.9	5000.0
19616.00	H	30.0	36.0	-25	41.0	112.2	5000.0
22068.00	V	22.0	37.0	-25	34.0	50.1	5000.0

		FCC 15.209 RADIATED EMISSIONS DATA					
		FCC ID:	NM5WL2400-PCM				
CLIENT:		YOUNG DESIGN					
EUT:		WL2400 CARD					
CARRIER:		2412 MHZ					
ANTENNA:		24 DBi GRID					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	34.0	35.0	-25	44.0	158.5	500.0
12060.00	V	31.0	40.0	-25	46.0	199.5	500.0
14472.00	H	20.0	43.0	-25	38.0	79.4	500.0
19296.00	H	19.0	36.0	-25	30.0	31.6	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4824.00	V	36.0	35.0	-25	46.0	199.5	5000.0
12060.00	V	33.0	40.0	-25	48.0	251.2	5000.0
14472.00	H	22.0	43.0	-25	40.0	100.0	5000.0
19296.00	H	21.0	36.0	-25	32.0	39.8	5000.0

CARRIER:		2432 MHZ					
ANTENNA:		24 DBi GRID					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	35.0	35.0	-25	45.0	177.8	500.0
7296.00	H	30.0	37.0	-25	42.0	125.9	500.0
12160.00	H	20.0	40.0	-25	35.0	56.2	500.0
19456.00	H	22.0	36.0	-25	33.0	44.7	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4864.00	V	37.0	35.0	-25	47.0	223.9	5000.0
7296.00	H	32.0	37.0	-25	44.0	158.5	5000.0
12160.00	H	22.0	40.0	-25	37.0	70.8	5000.0
19456.00	H	24.0	36.0	-25	35.0	56.2	5000.0

CARRIER:		2452 MHZ					
ANTENNA:		24 DBi GRID					
		AVRG					AVRG
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	35.0	35.0	-25	45.0	177.8	500.0
7356.00	H	26.0	37.0	-25	38.0	79.4	500.0
12260.00	H	31.0	40.0	-25	46.0	199.5	500.0
19616.00	H	22.0	36.0	-25	33.0	44.7	500.0
22068.00	V	20.0	37.0	-25	32.0	39.8	500.0
		PEAK					PEAK
FREQ	POL	SPEC A	AF/CL	PREAMP	E-FIELD	E-FIELD	LIMIT
MHz	H/V	dBuV	dB/m	GAIN	dBuV/m	uV/m	uV/m
4904.00	V	37.0	35.0	-25	47.0	223.9	5000.0
7356.00	H	28.0	37.0	-25	40.0	100.0	5000.0
12260.00	H	33.0	40.0	-25	48.0	251.2	5000.0
19616.00	H	24.0	36.0	-25	35.0	56.2	5000.0
22068.00	V	22.0	37.0	-25	34.0	50.1	5000.0

Table 1
EUT Accessories

24 dBi Grid Dish Antenna - Model PT2424 - 2150-2700 MHz

18 dBi Panel Antenna - Antenna America Model M2.45FP - 2.4-2.5 GHz

17 dBi Long Panel Antenna - Model ISM-1009-0081-401 - 2.4-2.5 GHz

12 dBi Omni Antenna - Model A2412 - 2.4-2.5 GHz

Bidirectional amp module

D.C. power injector module

120 VAC adapter to 12 VDC

50 feet of low-loss flex coaxial cable used to connect the EUT to the antenna.

Table 2
Support Equipment

MANUFACTURER	FCC ID #	SERIAL #
MONITOR:		
COMPUTER Kapok Computers Notebook	L4PK5000T2	NISDC17017853
KEYBOARD:		
MOUSE:		

Table 3

Measurement Equipment Used

The following equipment is used to perform measurements:

HP 435A RF Peak Power Meter	- Serial No. 1527A0284
EMCO Model 3110 Biconical Antenna	- Serial No. 1619
Antenna Research MWH-1825B Horn Antenna	- Serial No. 1005
EMCO Model 3115 Ridged Horn Antenna	- Serial No. 3007
HP 8348A Preamplifier	- Serial No. 197-2564A
Solar 8012-50-R-24-BNC LISN	- Serial No. 924867
Bird 8306-300-N 30dB Attenuator	- S/N: 29198391515
Tektronix R3272 Spectrum Analyzer	- Serial No. 6-95-1124
4 Meter Antenna Mast	
Motorized Turntable	
Heliax FSJ1-50A 1/4" Superflex Coax Cable (12 Ft.)	