KTL Test Report:	0R02692.3
Applicant:	Wi-Lan Inc. 300-801 Manning Road, NE Calgary, Alberta T2E 8J5
Equipment Under Test: **(E.U.T.)**	Hopper Plus 120-24
In Accordance With:	**FCC Part 15, Subpart C** Direct Sequence Transmitters
Tested By:	KTL Ottawa Inc. 3325 River Road, R.R. 5 Ottawa, Ontario K1V 1H2
Authorized By:	 R. Grant, Wireless Group Manager
Date:	August 8, 2000
Total Number of Pages:	35
Authorized Copy:	E-Mail

Table Of Contents

Section 1. Summary Of Test Results 3

Section 2. General Equipment Specification 5

Section 3. Powerline Conducted Emissions 6

Section 4. Occupied Bandwidth 10

Section 5. Peak Power Output 14

Section 6. Spurious Emissions (Antenna Conducted) 16

Section 7. Spurious Emissions (Radiated) 20

Section 8. Transmitter Power Density 27

Section 9. Processing Gain 31

Section 10. Test Equipment List 32

Annex A Block Diagrams A1

Section 1. Summary Of Test Results

General

All measurements are traceable to national standards.

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15, Subpart C, Paragraph 15.247 for Direct Sequence Spread Spectrum devices.

☒	New Submission	☒	Production Unit
☐	Class II Permissive Change	☐	Pre-Production Unit
D S S	Equipment Code	☐	Family Listing

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.
See " Summary of Test Data".

NVLAP LAB CODE: 100351-0

TESTED BY: Kevin Carr, Technologist DATE: August 8, 2000

Summary Of Test Data

Name Of Test	Para. No.	Result
Powerline Conducted Emissions	15.207 (a)	Complies
Occupied Bandwidth	15.247 (a)(2)	Complies
Peak Power Output	15.247 (b)	Complies
Spurious Emissions (Antenna Conducted)	15.247 (c)	Complies
Spurious Emissions (Radiated)	15.247 (c)	Complies
Transmitter Power Density	15.247 (d)	Complies
Processing Gain	15.247 (e)	Exhibit To Be Supplied By Customer

Footnotes For N/A's:

Test Conditions:

Indoor	Temperature:	27 °C
	Humidity:	50 %
Outdoor	Temperature:	27 °C
	Humidity:	50 %

Section 2. General Equipment Specification

Manufacturer:	Wi-Lan Inc.
Model No.:	Hopper Plus 120-24
Date Received In Laboratory:	July 11, 2000
KTL Identification No.:	Item #1

Transmitter

Power Input:	120 VAC, 60 Hz
Frequency Range:	2425.8 MHz to 2454.2 MHz
Tunable Bands:	1
6 dB Bandwidth:	18.0 MHz
Output Impedance:	50 ohm
Power Output Adjustment Capability:	None. Available to end user.
Duty Cycle Calculation:	$20 \text{ Log } \frac{1.2x16)ms}{100} = -14.3 \text{ dB}$

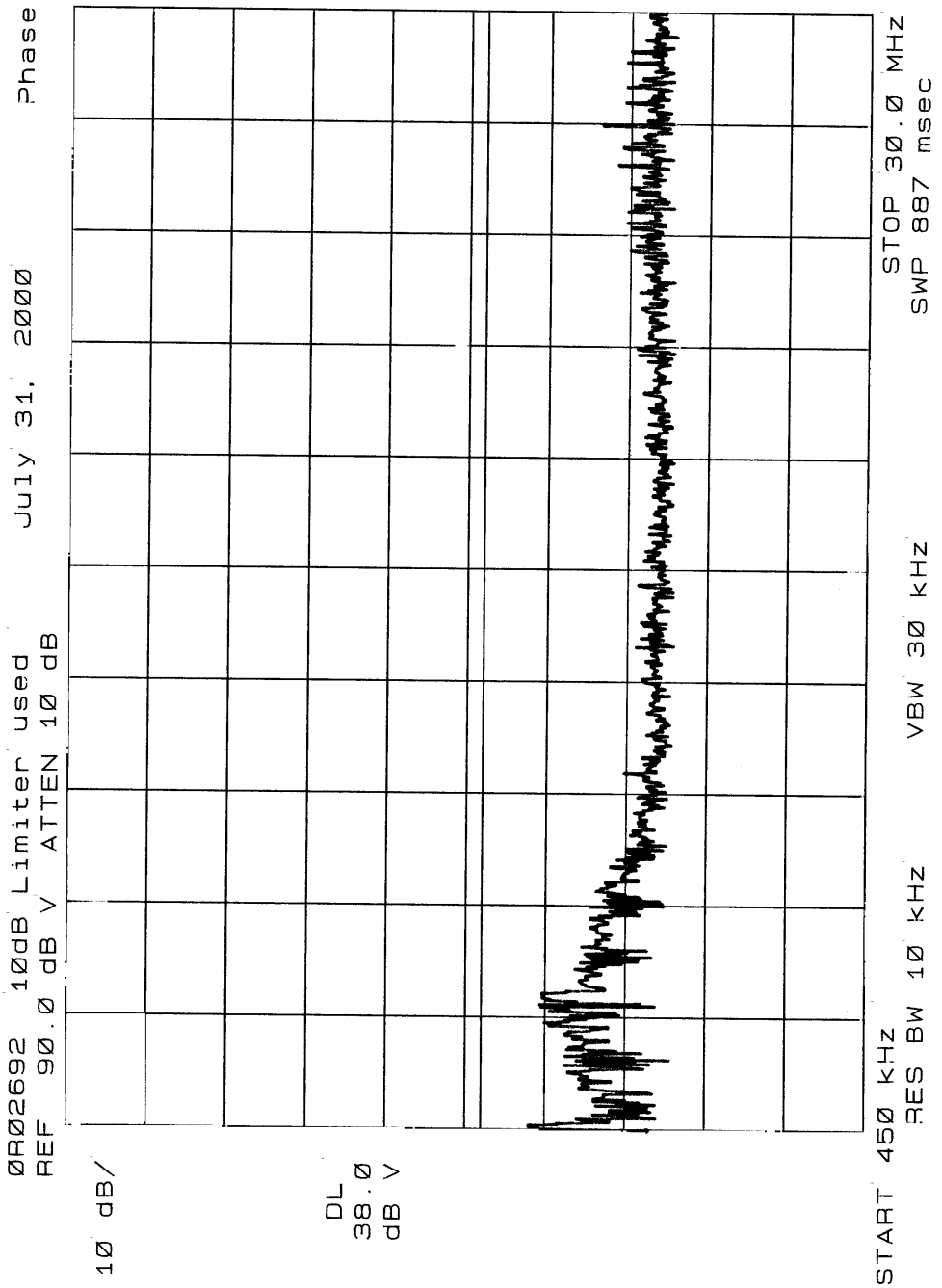
Section 3. Powerline Conducted Emissions

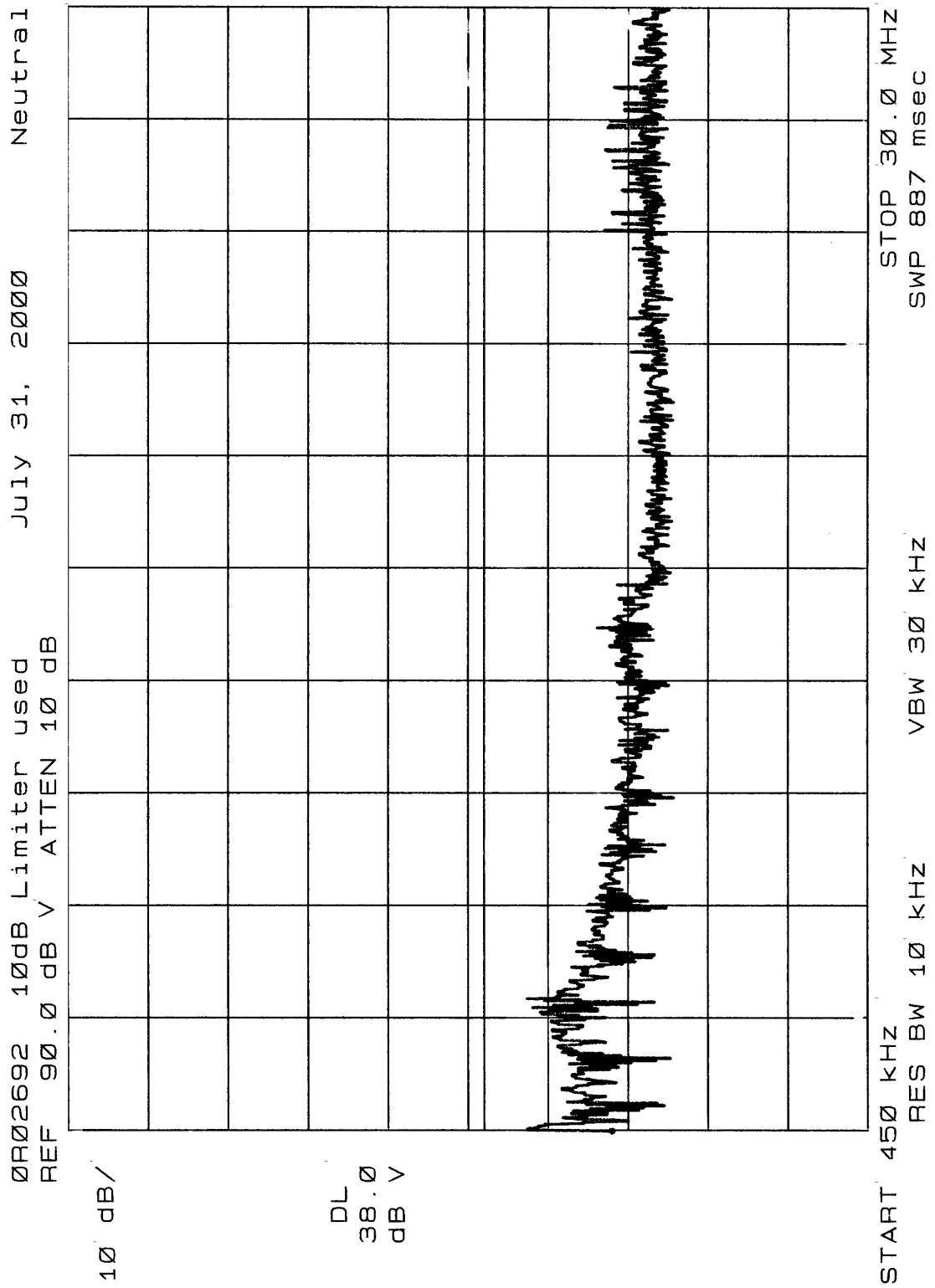
Para. No.: 15.207(a)

Test Performed By: Kevin Carr	**Date of Test:** July 31, 2000

Test Results: Complies. See attached graph.

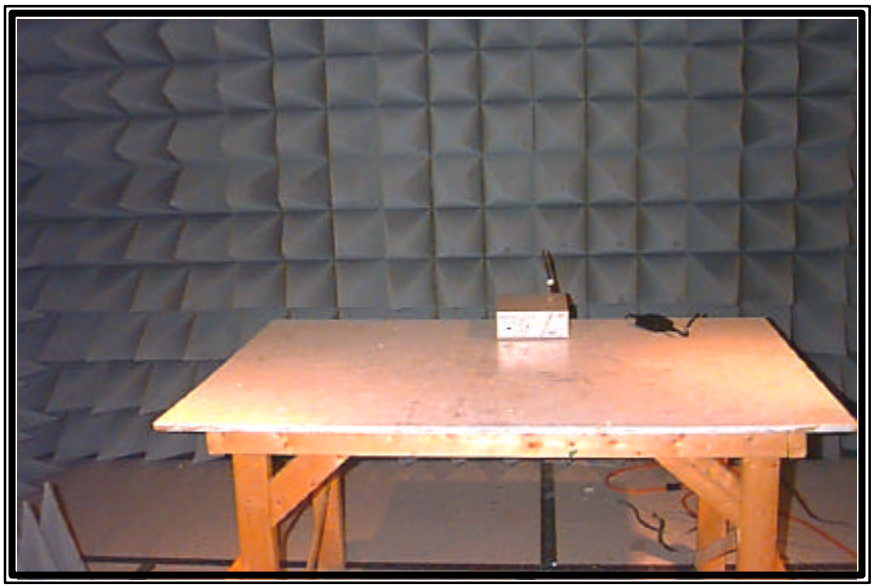
Measurement Data: See attached graph.


Phase
July 31, 2000
0R02692 10dB Limiter used
REF 90.0 dB V ATTEN 10 dB
10 dB/
DL
38.0
dB V
START 450 kHz
RES BW 10 kHz
VBW 30 kHz
STOP 30.0 MHz
SWP 887 msec

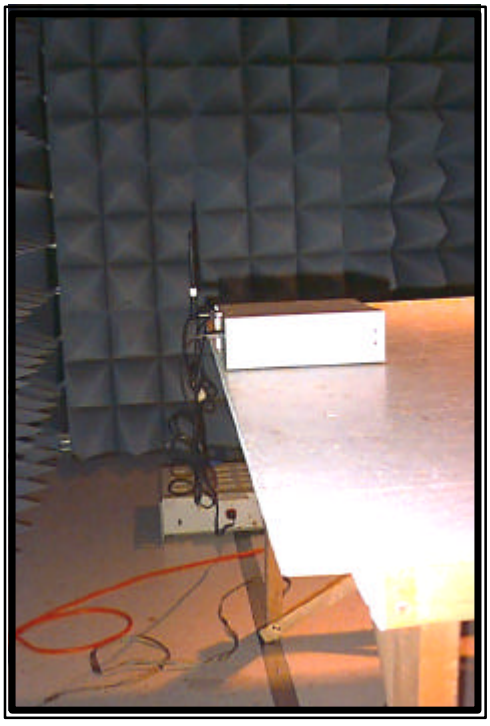

ØR02692 10dB Limiter used July 31, 2000 Neutral
REF 90.0 dB V ATTEN 10 dB
10 dB/
DL
38.0
dB V
START 450 kHz
RES BW 10 kHz
VBW 30 kHz
STOP 30.0 MHz
SWP 887 msec

Conducted Photographs (Worst Case Configuration)

Front View



Side View



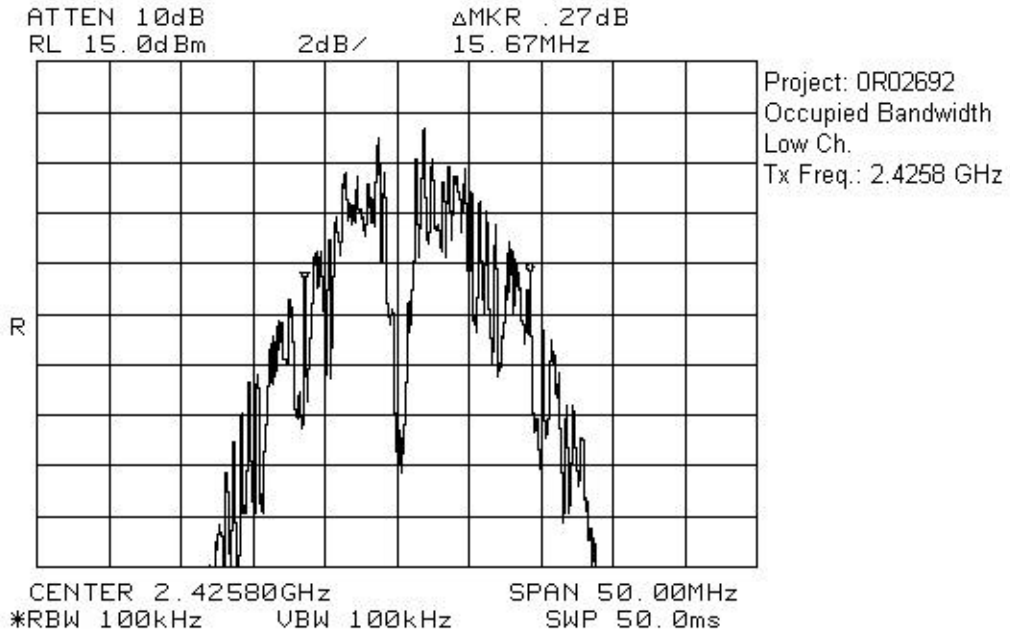
Section 4. Occupied Bandwidth

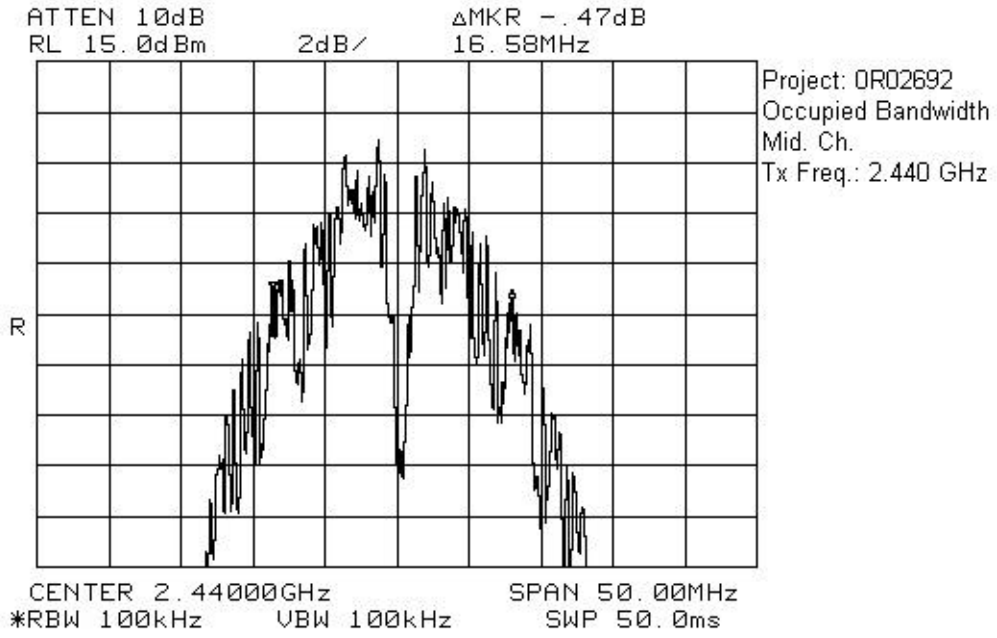
Para. No.: 15.247(a)(2)

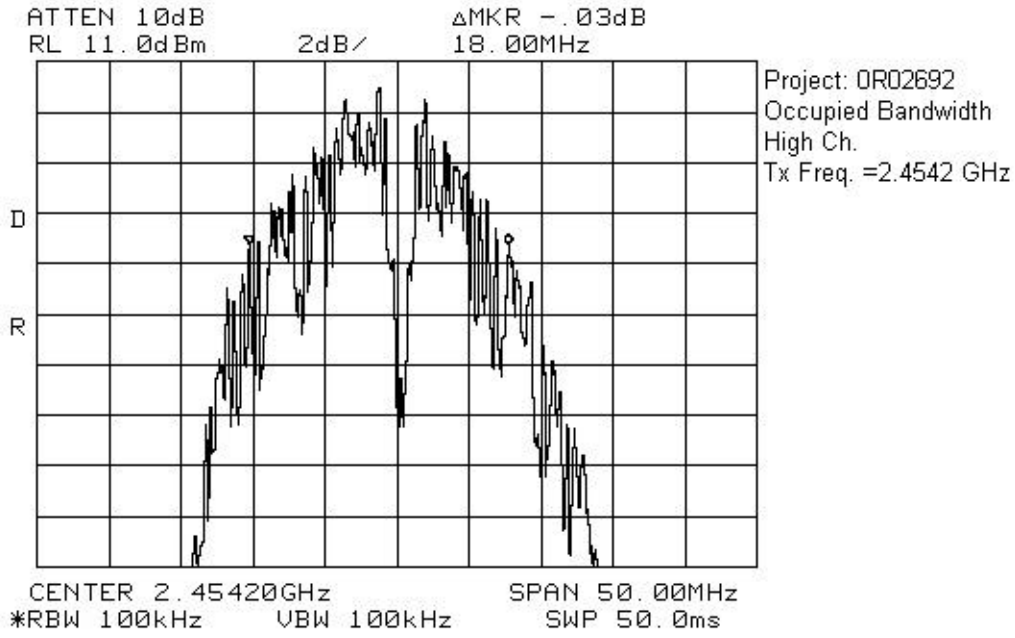
Test Performed By: Kevin Carr	**Date of Test:** July 31, 2000

Test Results: Complies. The 6 dB bandwidth is 18.0 MHz.
See attached graph.

Measurement Data: See attached graph.


ATTEN 10dB
RL 15.0dBm
2dB/
ΔMKR .27dB
15.67MHz
Project: 0R02692
Occupied Bandwidth
Low Ch.
Tx Freq.: 2.4258 GHz
R
CENTER 2.42580GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 15.0dBm
2dB/
ΔMKR -.47dB
16.58MHz
Project: 0R02692
Occupied Bandwidth
Mid. Ch.
Tx Freq.: 2.440 GHz
R
CENTER 2.44000GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 11.0dBm
2dB/
ΔMKR -.03dB
18.00MHz
Project: 0R02692
Occupied Bandwidth
High Ch.
Tx Freq. =2.4542 GHz
D
R
CENTER 2.45420GHz
SPAN 50.00MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms

Section 5. Peak Power Output

Para. No.: 15.247(b)

Test Performed By: Kevin Carr	**Date of Test:** July 31, 2000

Test Results: Complies. The maximum peak power output of the transmitter is 0.170 watts

Measurement Data: Detachable antenna? ☒ Yes ☐ No

If yes, state the type of non-standard connector used at the antenna port: Reverse TNC.

Peak Power Output

Frequency (MHz)	Average Power (dBm)	Duty Cycle (dB)	Peak Power Output (dBm)	Peak Output Power (Watts)
2425.8	15.1	7.2	22.3	0.170
2440.0	14.5	7.2	21.7	0.148
2454.2	11.9	7.2	19.1	0.081

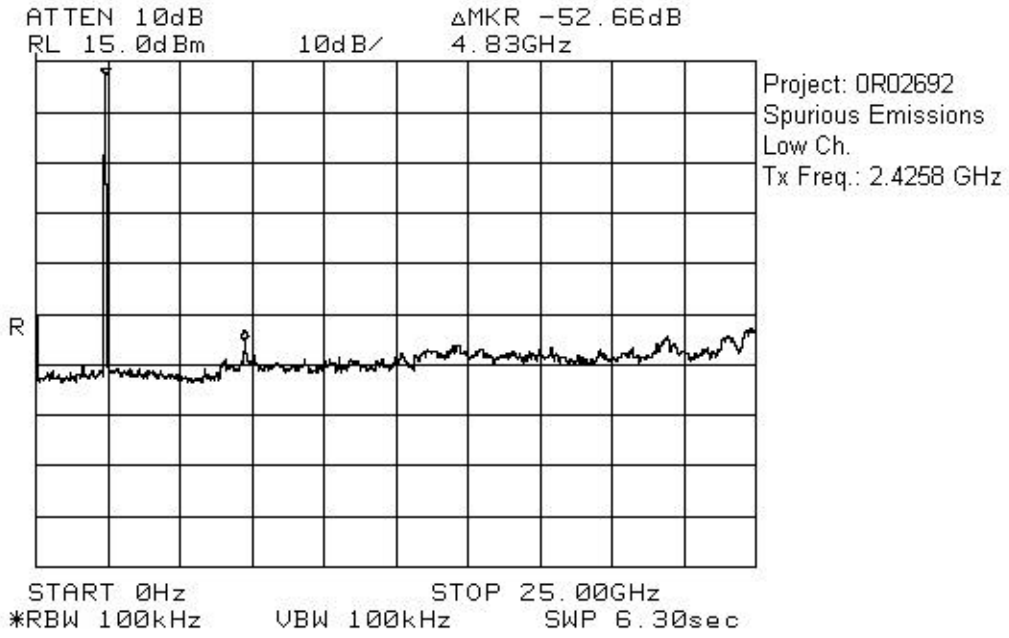
Section 6. Spurious Emissions (Antenna Conducted)

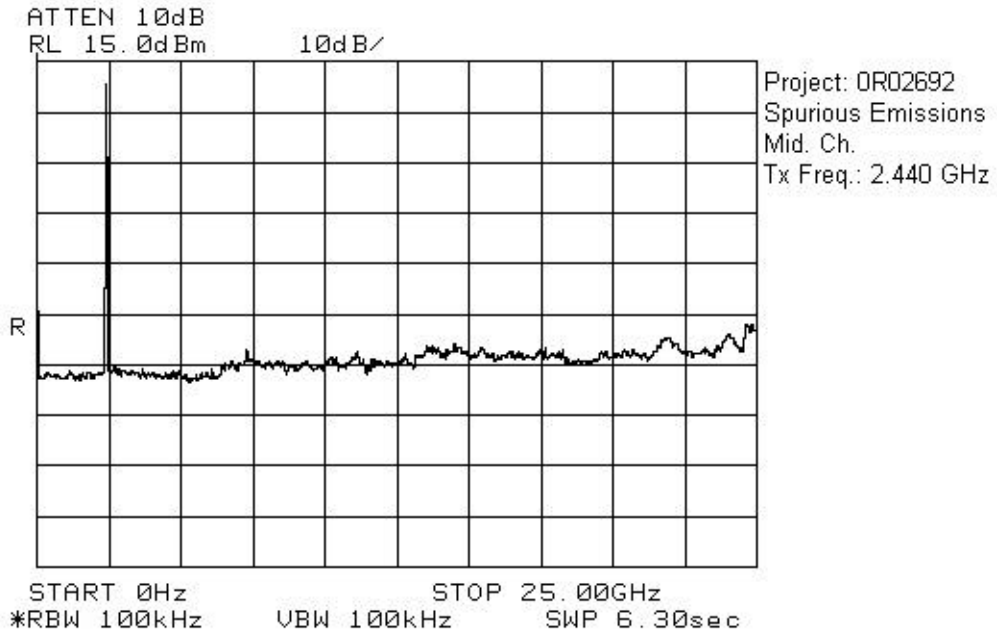
Para. No.: 15.247

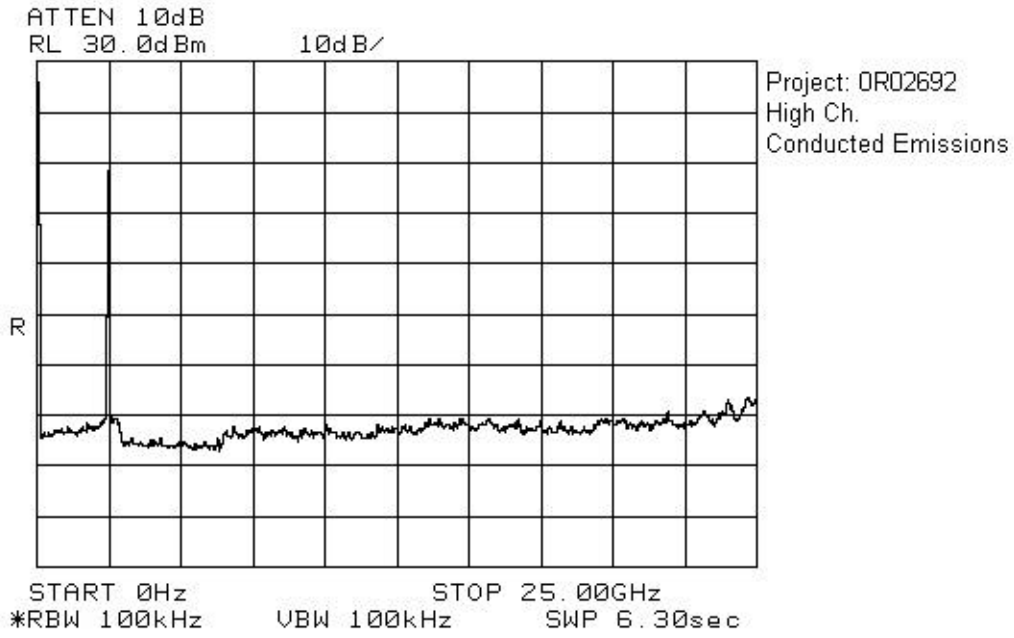
Test Performed By: Kevin Carr	**Date of Test:** July 31, 2000

Test Results: Complies.

Measurement Data: See attached graphs.


ATTEN 10dB
RL 15.0dBm
10dB/
ΔMKR -52.66dB
4.83GHz
Project: 0R02692
Spurious Emissions
Low Ch.
Tx Freq.: 2.4258 GHz
R
START 0Hz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
SWP 6.30sec


ATTEN 10dB
RL 15.0dBm
10dB/
R
Project: 0R02692
Spurious Emissions
Mid. Ch.
Tx Freq.: 2.440 GHz
START 0Hz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
SWP 6.30sec


ATTEN 10dB
RL 30.0dBm
10dB/
Project: 0R02692
High Ch.
Conducted Emissions
R
START 0Hz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
SWP 6.30sec

Section 7. Spurious Emissions (Radiated)

Para. No.: 15.247(c)

Test Performed By: Kevin Carr	**Date of Test:** July 31, 2000

Test Results: Complies. The worst-case emission level is 46.0 dBµV/m @ 3m at 7277.4 MHz. This is 8.0dB below the specification limit.

Measurement Data: See attached graphs.

Test Data - Radiated Emissions (PEAK)

Test Distance (meters) : 3		Range: A Tower		Receiver: HP 8564E		RBW: 1 MHz		Detector: Peak	
Freq. (MHz)	**Ant. ***	**Pol. (V/H)**	**RCVD Signal (dBµV/m)**	**Ant. Factor (dB)****	**Amp. Gain (dB)*****	**Dist. Corr. (dB)**	**Field Strength (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**
Peak Power Measurements – Low Channel – Tx Freq.: 2.4258 GHz									
4851.6	H2	V	63.5	44.8	-55.5		52.8	74.0	-21.2
4851.6	H2	H	65.4	44.8	-55.5		54.7	74.0	-19.3
7277.4	H2	V	64.0	52.0	-55.7		60.3	74.0	-13.7
7277.4	H2	H	60.0	52.0	-55.7		56.3	74.0	-17.7
Peak Power Measurements – Mid. Channel – Tx Freq.: 2.440 GHz									
4880.0	H2	V	60.4	45.0	-55.4		50.0	74.0	-24.0
4880.3	H2	H	62.8	45.0	-55.4		52.4	74.0	-21.6
7320.0	H2	V	63.0	52.1	-55.7		59.4	74.0	-14.6
7320.0	H2	H	59.4	52.1	-55.7		55.8	74.0	-18.2
Peak Power Measurements – High Channel – Tx Freq.: 2.4542 GHz									
4908.4	H2	V	58.2	45.0	-55.3		47.9	74.0	-26.1
4908.4	H2	H	60.8	45.0	-55.3		50.5	74.0	-23.5
7362.6	H2	V	60.5	52.2	-55.7		57.0	74.0	-17.0
7362.6	H2	H	60.0	52.2	-55.7		56.5	74.0	-17.5

Notes:

B/C = Biconical, B/L = Biconilog, L/P = Log-Periodic, H = Horn, D/P = Dipole
* Re-measured using dipole antenna.
** Includes cable loss when amplifier is not used.
*** Includes cable loss.
( ) Denotes failing emission level.
N.D. = Not Detected

Test Data - Radiated Emissions (AVERAGE)

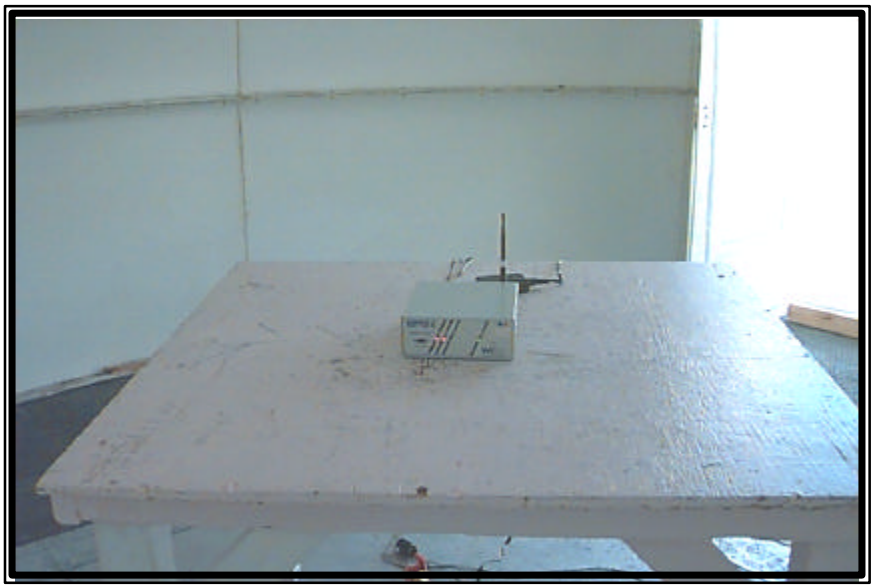
Test Distance (meters) : 3		**Range: A Tower**		**Receiver: HP 8564E**			**RBW: 1 MHz**		**Detector: Peak**	
Freq. (MHz)	**Ant. ***	**Pol. (V/H)**	**RCVD Signal (dBµV/m)**	**Ant. Factor (dB)****	**Amp. Gain (dB)* ****	**Duty Cycle Corr. (dB)**	**Dist. Corr. (dB)**	**Field Strength (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**
Average Power Measurements – Low Channel – Tx Freq.: 2.4258 GHz										
4851.6	H2	V	63.5	44.8	-55.5	-14.3		38.5	54.0	-15.5
4851.6	H2	H	65.4	44.8	-55.5	-14.3		40.4	54.0	-13.6
7277.4	H2	V	64.0	52.0	-55.7	-14.3		46.0	54.0	-8.0
7277.4	H2	H	60.0	52.0	-55.7	-14.3		42.0	54.0	-12.0
Average Power Measurements – Mid. Channel – Tx Freq.: 2.440 GHz										
4880.0	H2	V	60.4	45.0	-55.4	-14.3		35.7	54.0	-18.3
4880.3	H2	H	62.8	45.0	-55.4	-14.3		38.1	54.0	-15.9
7320.0	H2	V	63.0	52.1	-55.7	-14.3		45.1	54.0	-8.9
7320.0	H2	H	59.4	52.1	-55.7	-14.3		41.5	54.0	-12.5
Average Power Measurements – High Channel – Tx Freq.: 2.4542 GHz										
4908.4	H2	V	58.2	45.0	-55.3	-14.3		33.6	54.0	-20.4
4908.4	H2	H	60.8	45.0	-55.3	-14.3		36.2	54.0	-17.8
7362.6	H2	V	60.5	52.2	-55.7	-14.3		42.7	54.0	-11.3
7362.6	H2	H	60.0	52.2	-55.7	-14.3		42.2	54.0	-11.8

Notes:

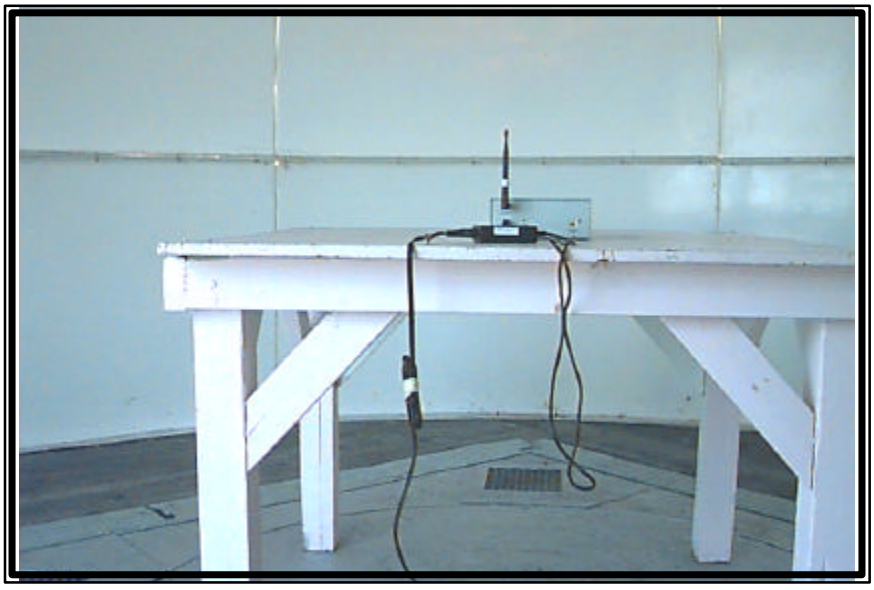
B/C = Biconical, B/L = Biconilog, L/P = Log-Periodic, H = Horn, D/P = Dipole
* Re-measured using dipole antenna.
** Includes cable loss when amplifier is not used.
*** Includes cable loss.
( ) Denotes failing emission level.
N.D. = Not Detected

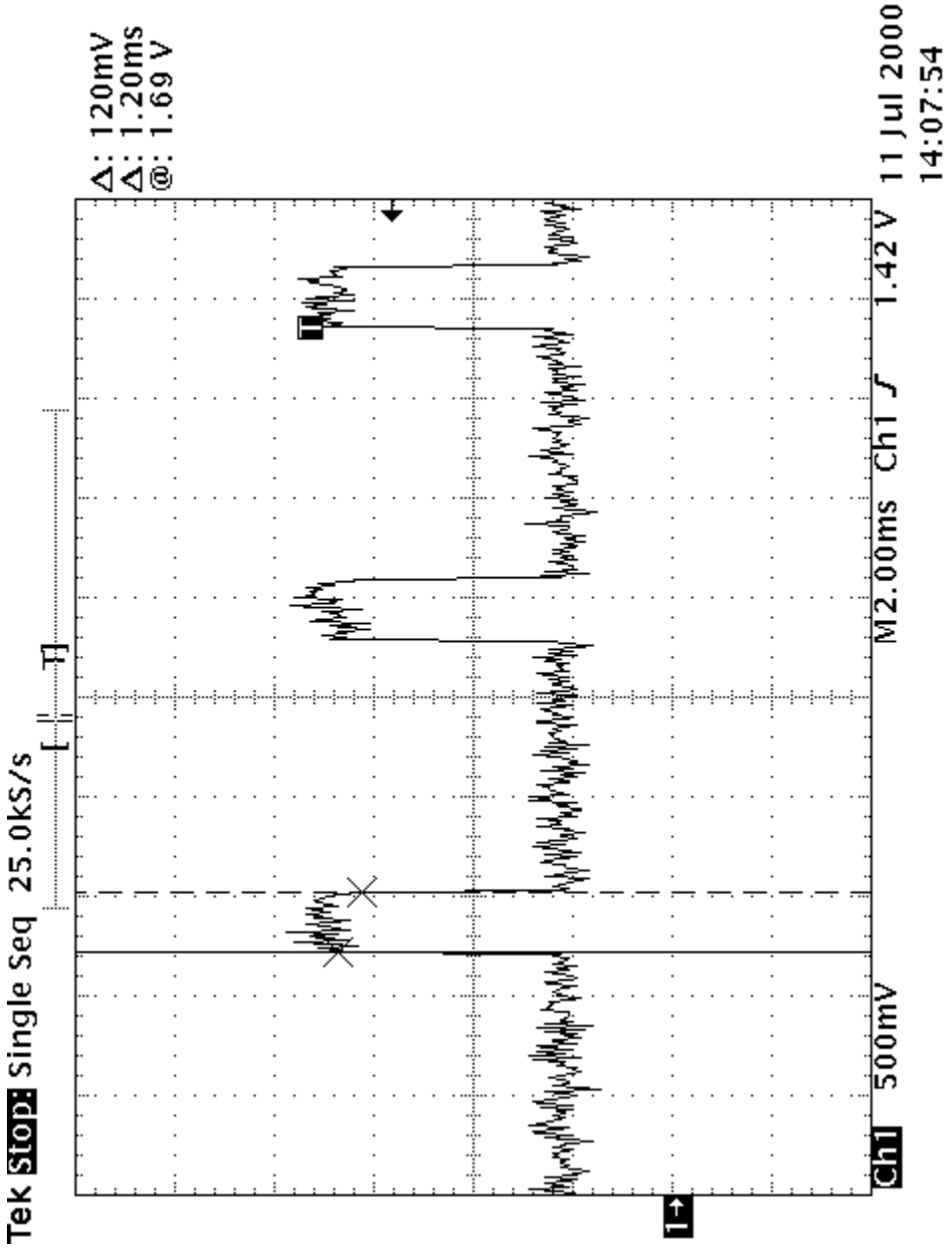
Radiated Photographs (Worst Case Configuration)

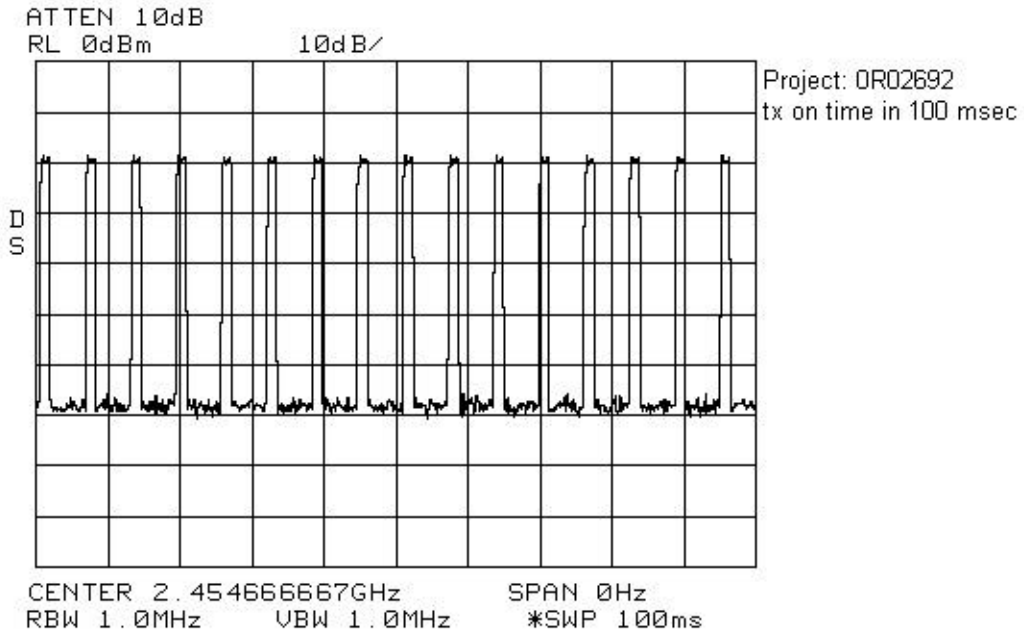
Front View

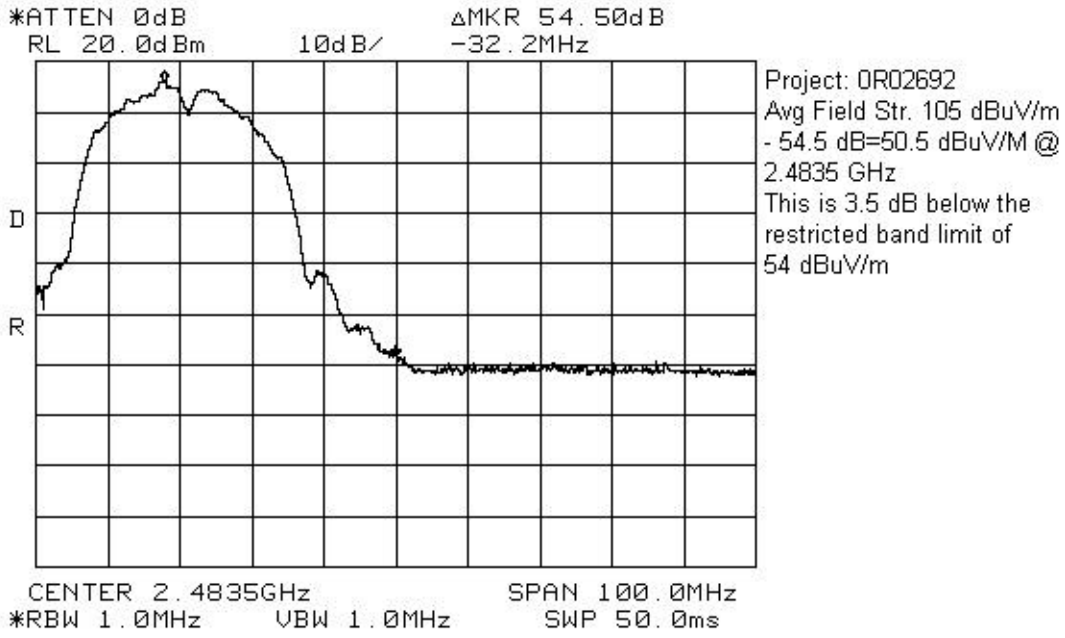


Rear View




Δ: 120mV
Δ: 1.20ms
@: 1.69 V
11 Jul 2000
14:07:54
1.42 V
M2.00ms Ch1 ƒ
Tek Stop: Single Seq 25.0kS/s
500mV
Ch1


ATTEN 10dB
RL 0dBm
10dB/
Project: 0R02692
tx on time in 100 msec
D
S
CENTER 2.454666667GHz
SPAN 0Hz
RBW 1.0MHz
VBW 1.0MHz
*SWP 100ms


*ATTEN 0dB
RL 20.0dBm
10dB/
ΔMKR 54.50dB
-32.2MHz
D
R
Project: 0R02692
Avg Field Str. 105 dBuV/m
- 54.5 dB=50.5 dBuV/M @
2.4835 GHz
This is 3.5 dB below the
restricted band limit of
54 dBuV/m
CENTER 2.4835GHz
SPAN 100.0MHz
*RBW 1.0MHz
VBW 1.0MHz
SWP 50.0ms

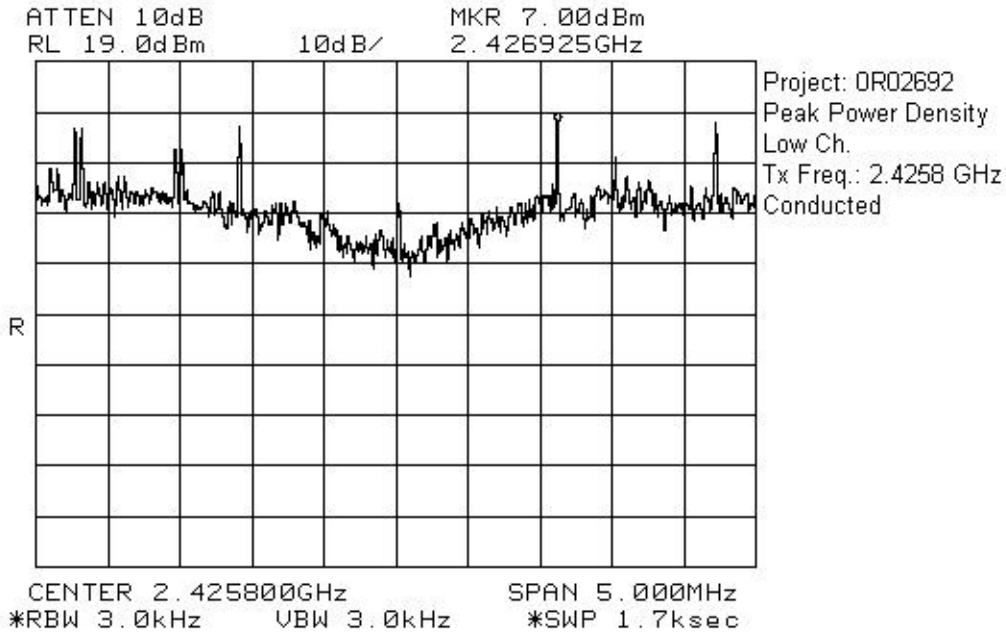
Section 8. Transmitter Power Density

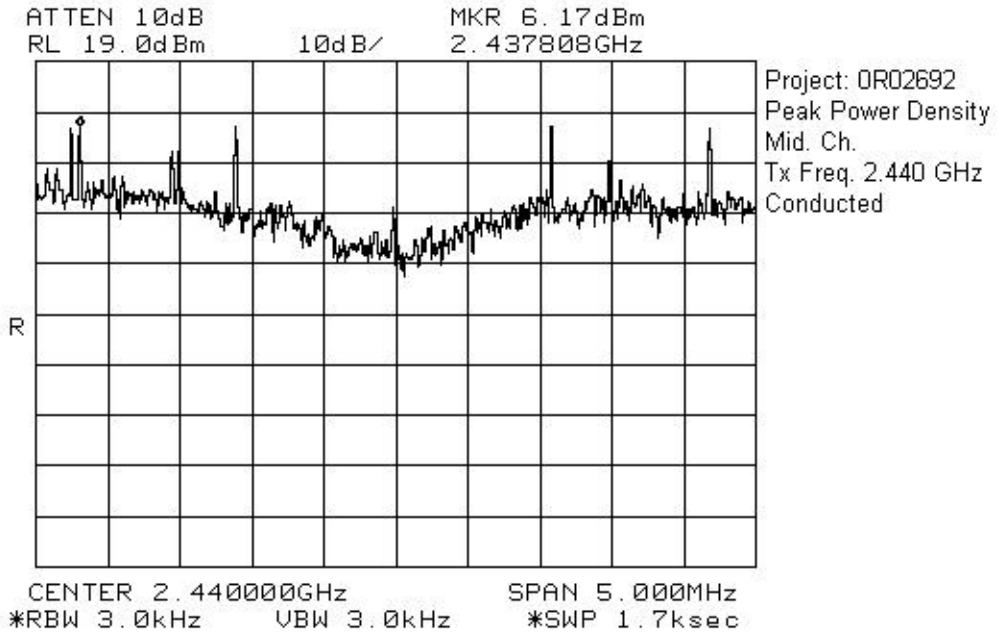
Para. No.: 15.247(d)

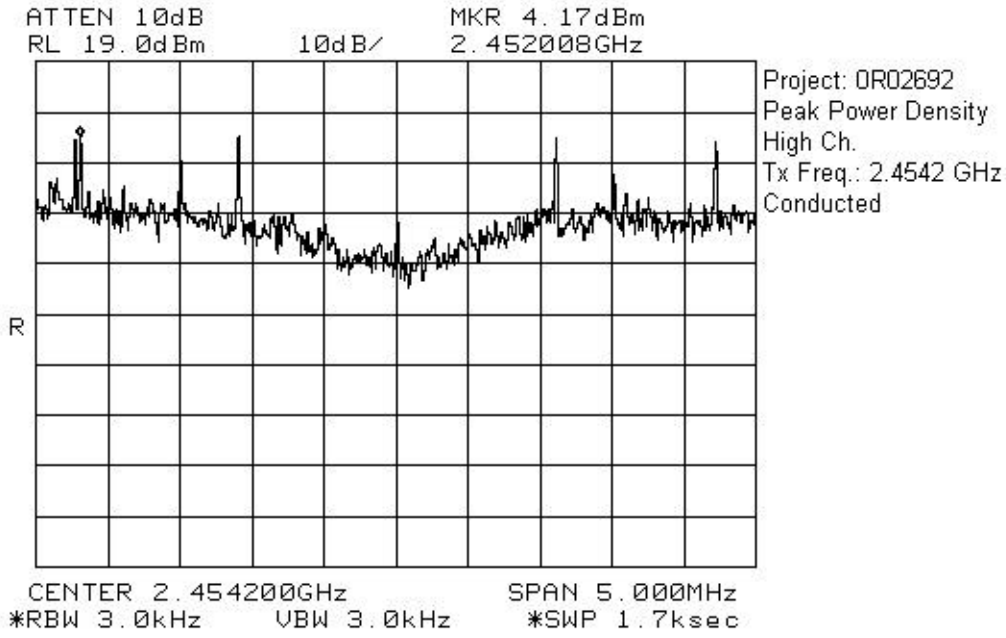
Test Performed By: Kevin Carr	**Date of Test:** July 31, 2000

Test Results: Complies.

Measurement Data: See attached graphs.


ATTEN 10dB
RL 19.0dBm
10dB/
MKR 7.00dBm
2.426925GHz
Project: 0R02692
Peak Power Density
Low Ch.
Tx Freq.: 2.4258 GHz
Conducted
R
CENTER 2.425800GHz
SPAN 5.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 1.7ksec


ATTEN 10dB
RL 19.0dBm
10dB/
MKR 6.17dBm
2.437808GHz
Project: 0R02692
Peak Power Density
Mid. Ch.
Tx Freq. 2.440 GHz
Conducted
R
CENTER 2.440000GHz
SPAN 5.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 1.7ksec


ATTEN 10dB
RL 19.0dBm
10dB/
MKR 4.17dBm
2.452008GHz
Project: 0R02692
Peak Power Density
High Ch.
Tx Freq.: 2.4542 GHz
Conducted
R
CENTER 2.454200GHz
SPAN 5.000MHz
*RBW 3.0kHz
VBW 3.0kHz
*SWP 1.7ksec

Section 9. Processing Gain

Para. No.: 15.247(e)

Test Performed By: Exhibit To Be Supplied By Client	**Date of Test:** July 31, 2000

Test Results: Complies. The processing gain of the system is ____ dB.

Measurement Data: See attached data.

BER:
S/N_{out}:
J/S Ratio:
L_{sys}:

Section 10. Test Equipment List

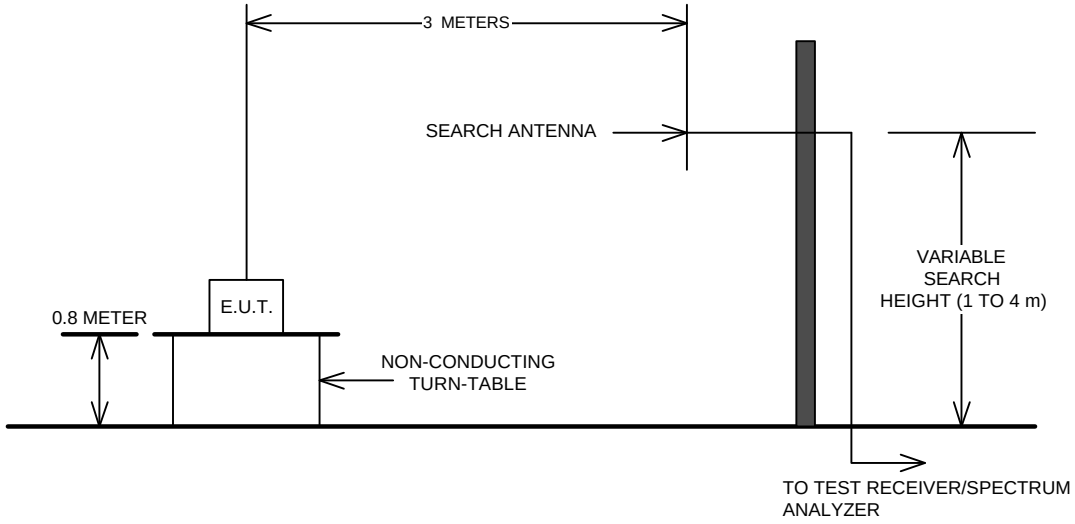
CAL CYCLE	EQUIPMENT	MANUFACTURER	MODEL	SERIAL	LAST CAL.	NEXT CAL.
1 Year	Spectrum Analyzer	Hewlett Packard	8565E	FA000981	June 16/00	June 16/01
1 Year	Spectrum Analyzer-**1**	Hewlett Packard	8566B	2311A02238	Nov. 6/99	Nov. 6/00
1 Year	Spectrum Analyzer Display-**1**	Hewlett Packard	8566B	2314A04759	Nov. 6/99	Nov. 6/00
1 Year	Quasi-peak adapter-**1**	Hewlett-Packard	85650A	2043A00302	Nov. 11/99	Nov. 11/00
	Power Supply	Astron	VS-50M	8405071	NCR	NCR
1 Year	Attenuator	Narda	768-20	9507	Oct. 12/99	Oct. 12/00
1 Year	Attenuator	Narda	768-10	9707	Aug. 23/99	Aug. 23/00
1 Year	LISN	Tegam	95300-50	T-12855/56	Aug. 24/99	Aug. 24/00
1 Year	Receiver	Rohde & Schwarz	ESVP	892661/014	April 5/00	April 5/01
1 Year	Horn Antenna	EMCO #2	3115	4336	Nov. 11/99	Nov. 11/00
3 Year	Standard Gain Horn	Electro-Metrics	SH-50/60-1	FA000479	July 7/00	July 7/01
1 Year	RF AMP	JCA	4-8 GHz	FA001497	May 31/00	May 31/01
	High Pass Filter	K&L	11SH10-4000	FA001340	COU	COU

NA: Not Applicable
NCR: No Cal Required
COU: CAL On Use

Annex A

Block Diagrams

Test Site For Radiated Emissions

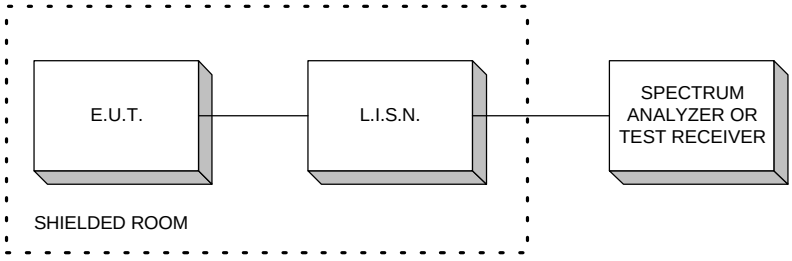


Below 1 GHz
Peak detector.
RBW = 100 kHz

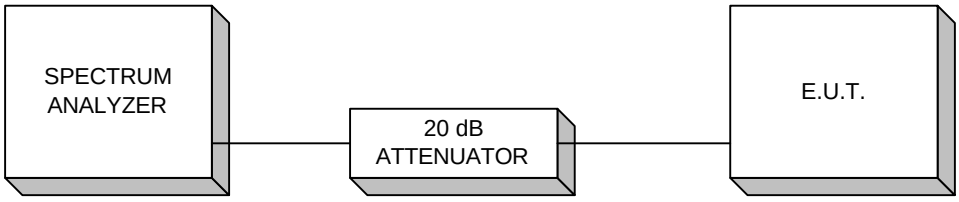
Above 1 GHz For Peak Emission Levels
Peak detector
RBW = 1 MHz
VBW = >RBW

Above 1 GHz For Average Emission Levels
Peak detector
RBW = 1 MHz
VBW = 10 Hz

Conducted Emissions

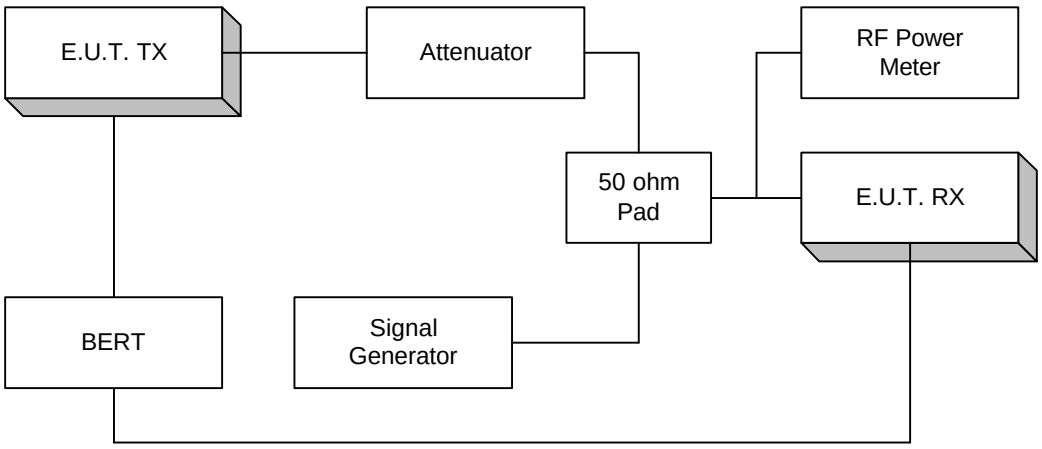


Transmitter Power Density & Peak Power At Antenna Terminals



If the E.U.T. has an integral (non-detachable) antenna, the above test is performed as a radiated measurement and the result is reported as EIRP.

Processing Gain



NOTE: This is a typical setup. The setup may vary slightly since many devices have BER test functions built into the device.