

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

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EQUIPMENT: Hopper Plus 120-24

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



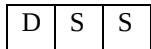
Production Unit



Class II Permissive Change



Pre-Production Unit



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

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This report applies only to the items tested.

EQUIPMENT: Hopper Plus 120-24

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 %

EQUIPMENT: Hopper Plus 120-24

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: $20 \text{ Log } \frac{1.2 \times 16 \text{ ms}}{100} = -14.3 \text{ dB}$

EQUIPMENT: Hopper Plus 120-24

Section 3. Powerline Conducted Emissions

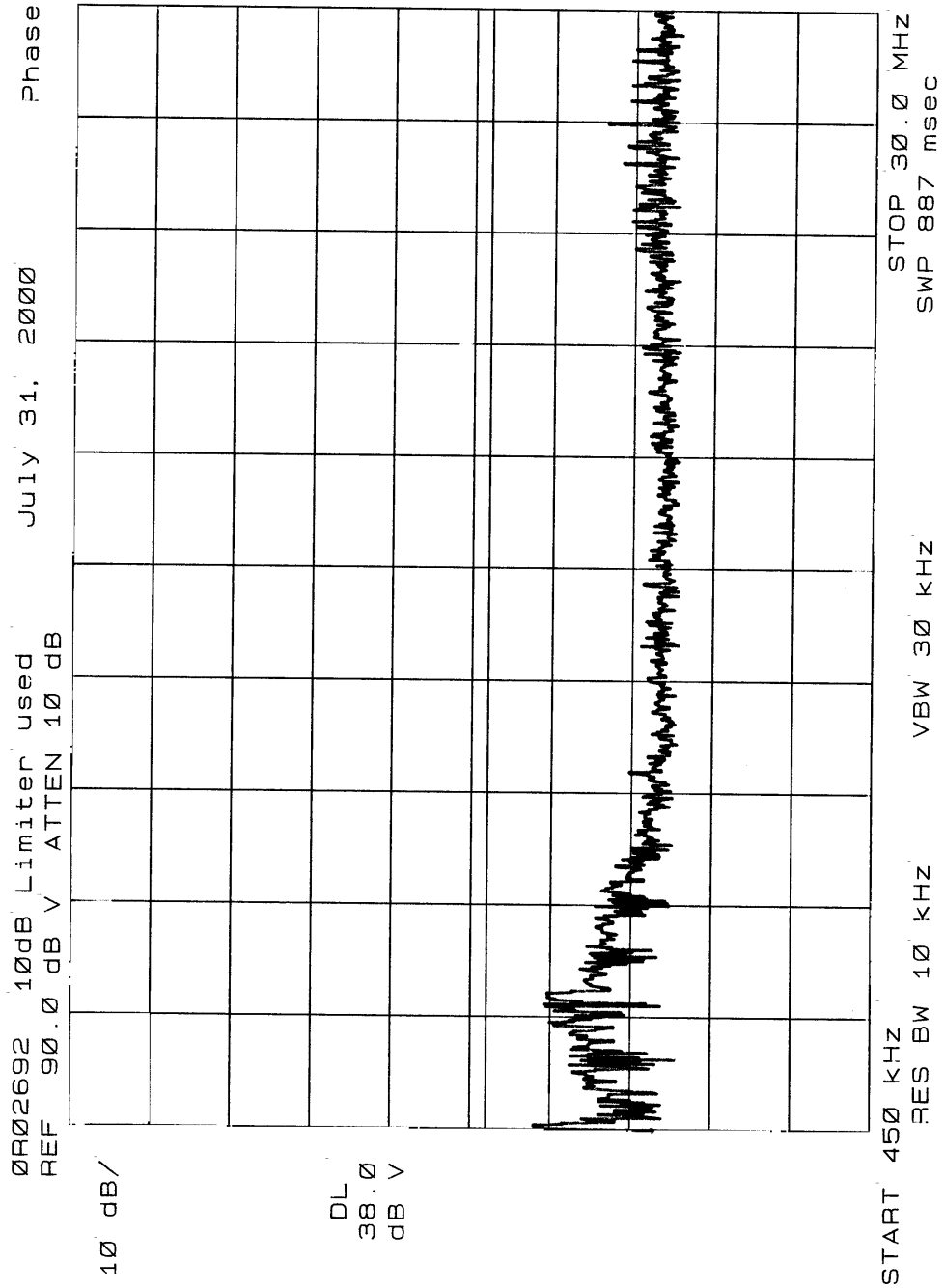
Para. No.: 15.207(a)

Test Performed By: Kevin Carr	Date of Test: July 31, 2000
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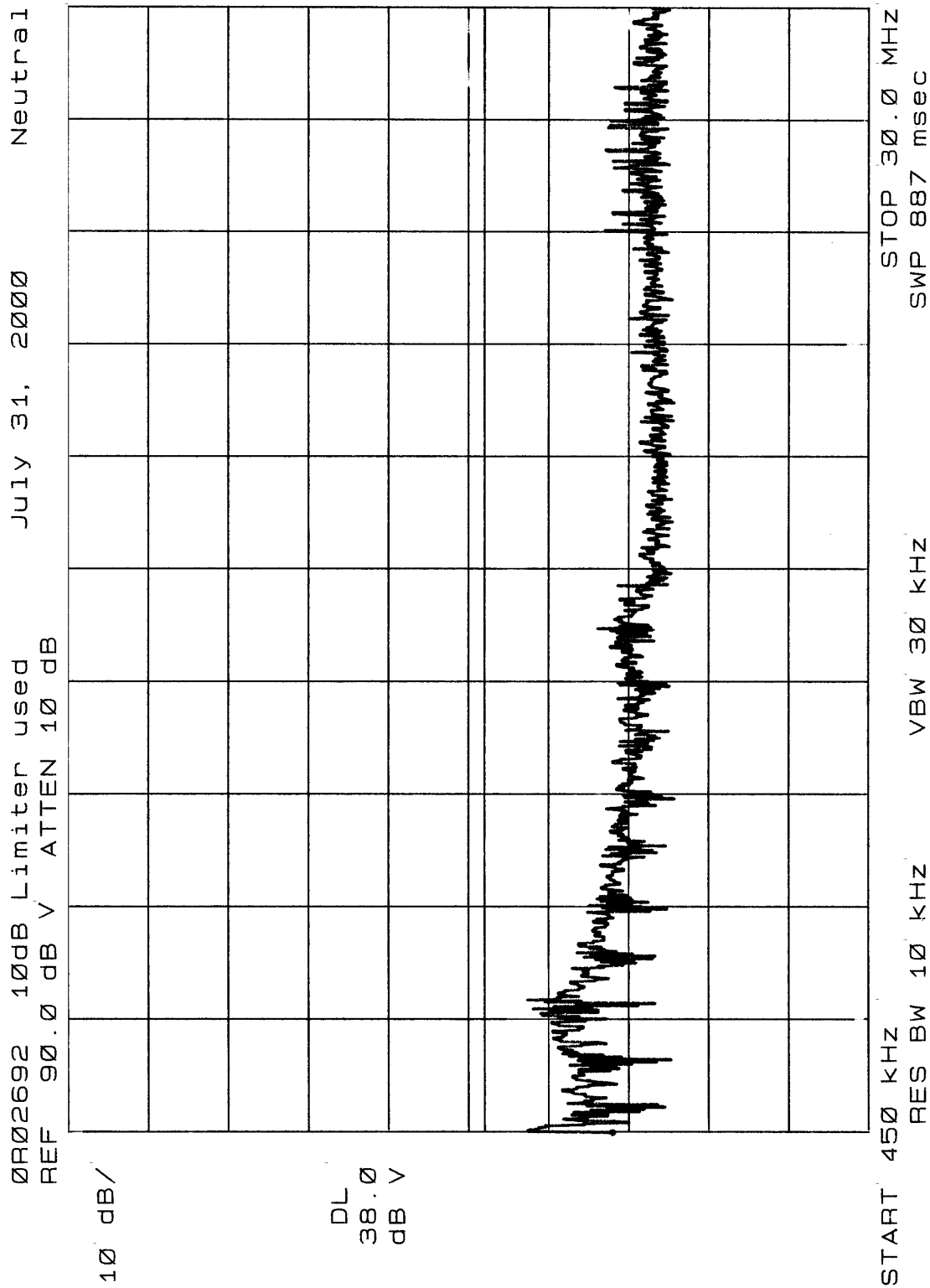
Test Results: Complies. See attached graph.

Measurement Data: See attached graph.

EQUIPMENT: Hopper Plus 120-24



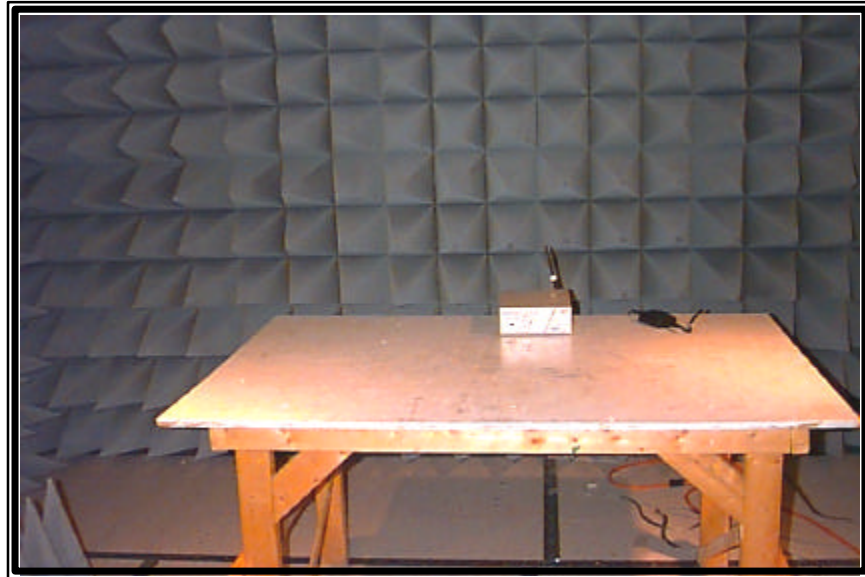
EQUIPMENT: Hopper Plus 120-24



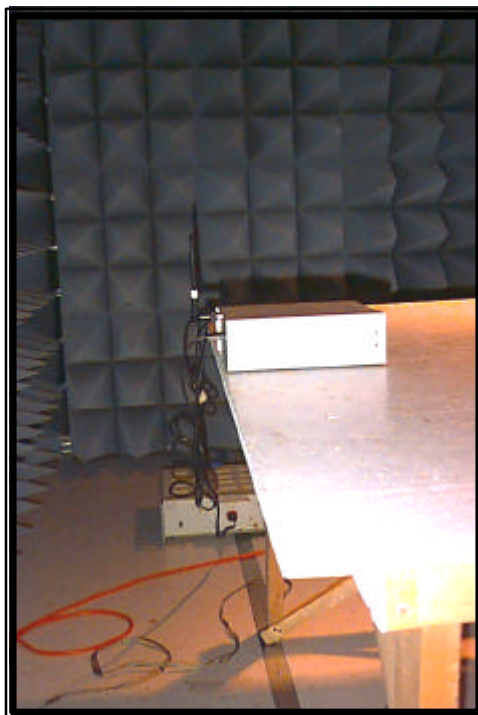
EQUIPMENT: Hopper Plus 120-24

Conducted Photographs (Worst Case Configuration)

Front View



Side View



EQUIPMENT: Hopper Plus 120-24

Section 4. Occupied Bandwidth

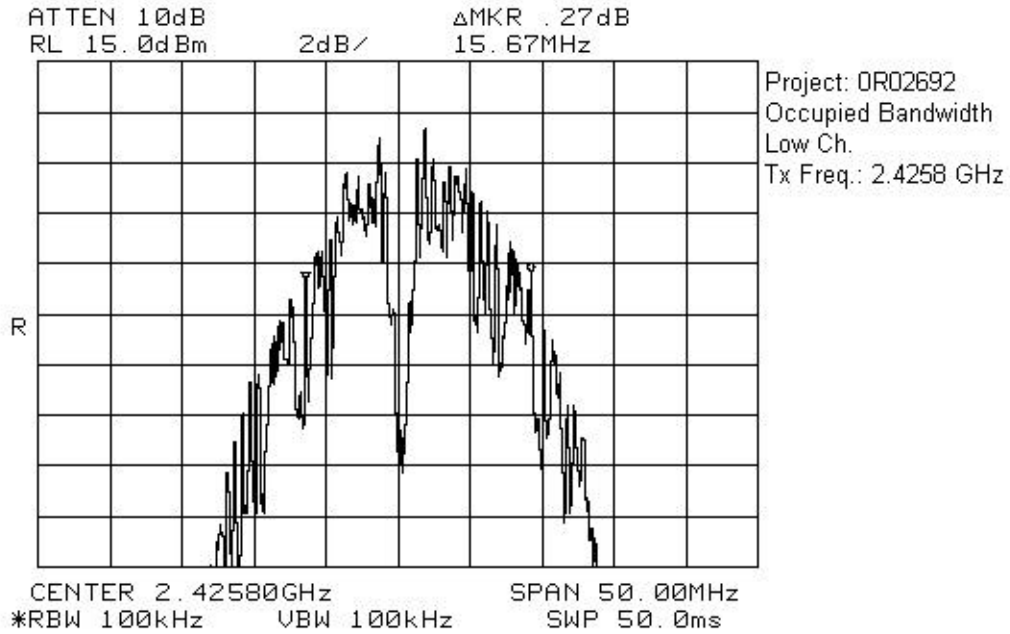
Para. No.: 15.247(a)(2)

Test Performed By: Kevin Carr	Date of Test: July 31, 2000
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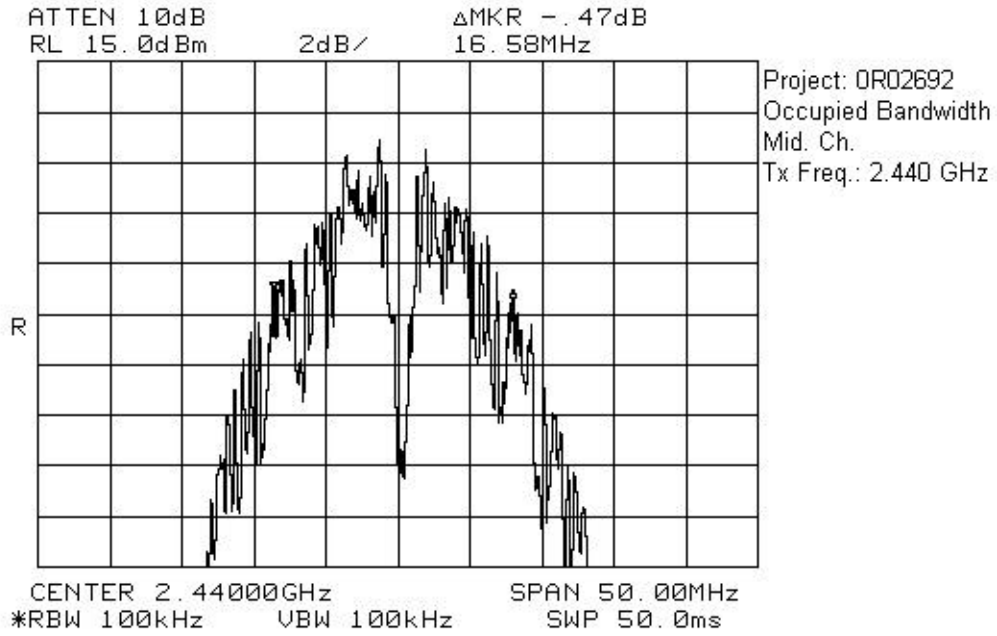
Test Results: Complies. The 6 dB bandwidth is 18.0 MHz.
See attached graph.

Measurement Data: See attached graph.

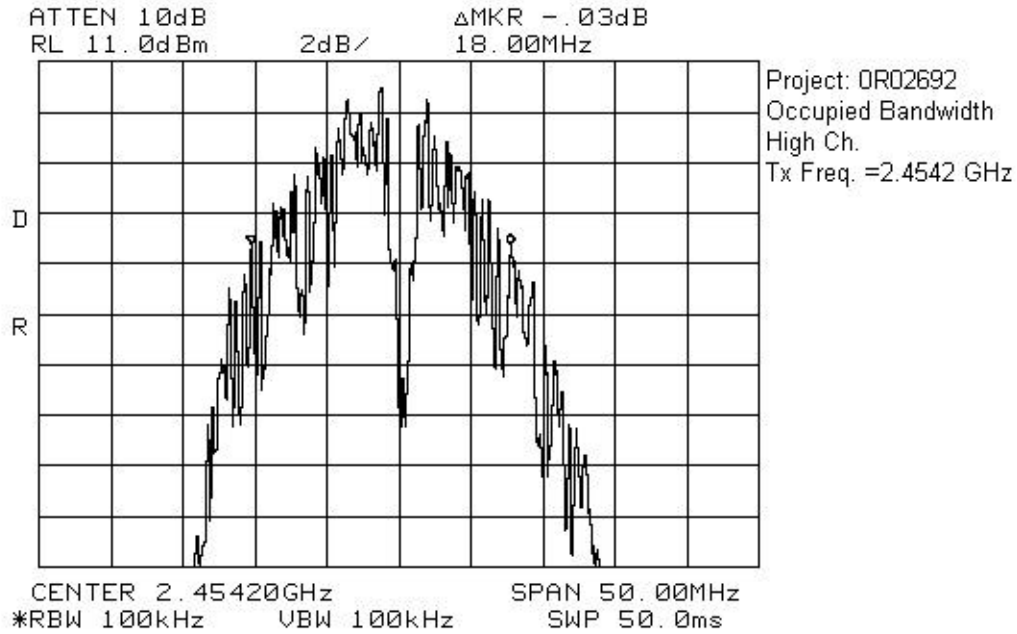
EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24



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EQUIPMENT: Hopper Plus 120-24

Section 5. Peak Power Output

Para. No.: 15.247(b)

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

EQUIPMENT: Hopper Plus 120-24

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

EQUIPMENT: Hopper Plus 120-24

Section 6. Spurious Emissions (Antenna Conducted)

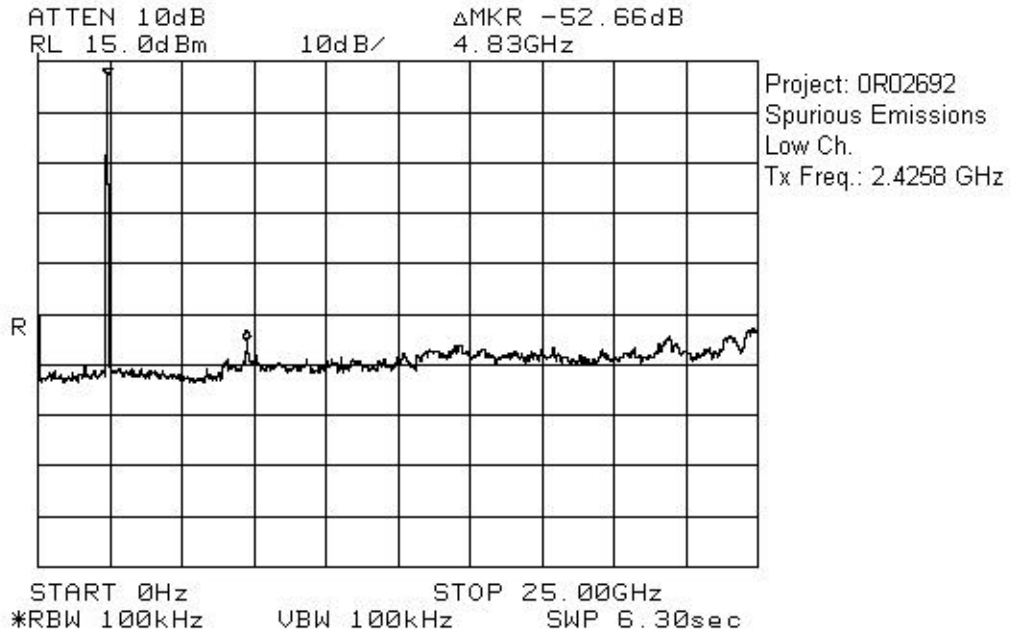
Para. No.: 15.247

Test Performed By: Kevin Carr	Date of Test: July 31, 2000
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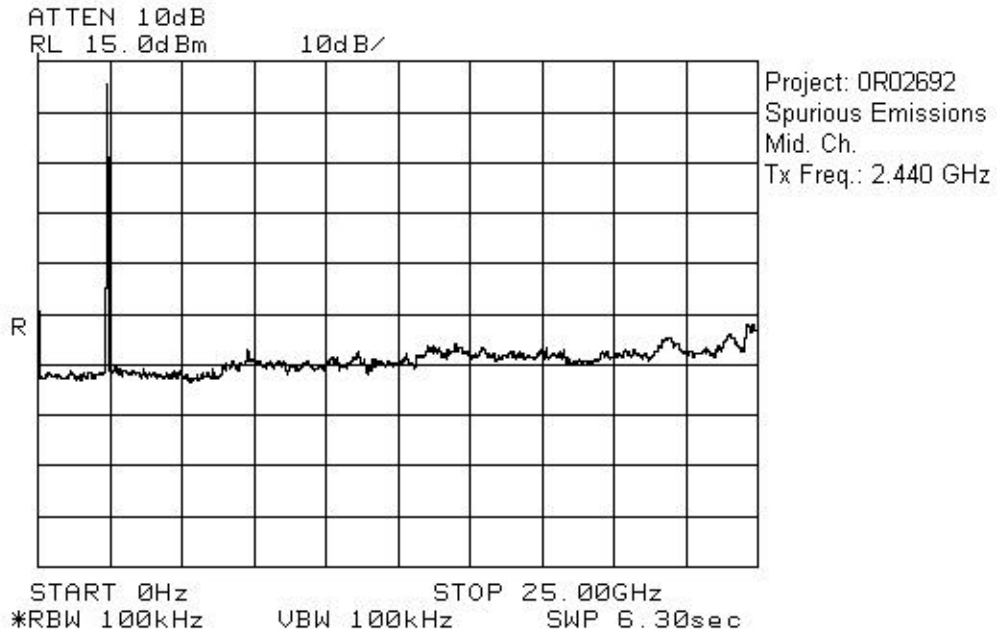
Test Results: Complies.

Measurement Data: See attached graphs.

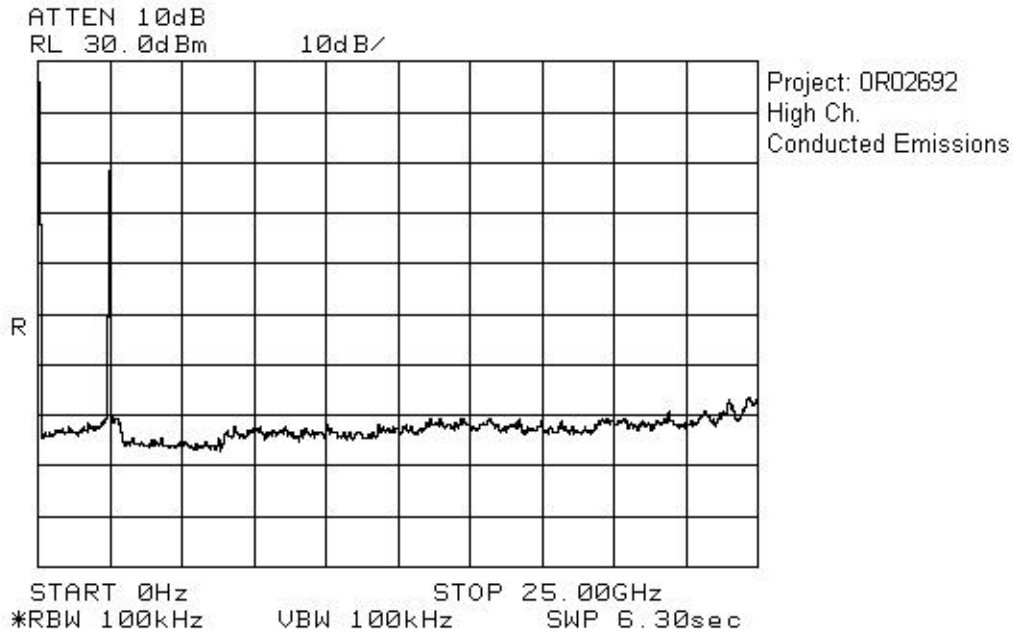
EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24

Section 7. Spurious Emissions (Radiated)

Para. No.: 15.247(c)

Test Performed By: Kevin Carr	Date of Test: July 31, 2000
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Test Results: Complies. The worst-case emission level is 46.0 dB μ V/m @ 3m at 7277.4 MHz. This is 8.0dB below the specification limit.

Measurement Data: See attached graphs.

EQUIPMENT: Hopper Plus 120-24

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									

EQUIPMENT: Hopper Plus 120-24

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										

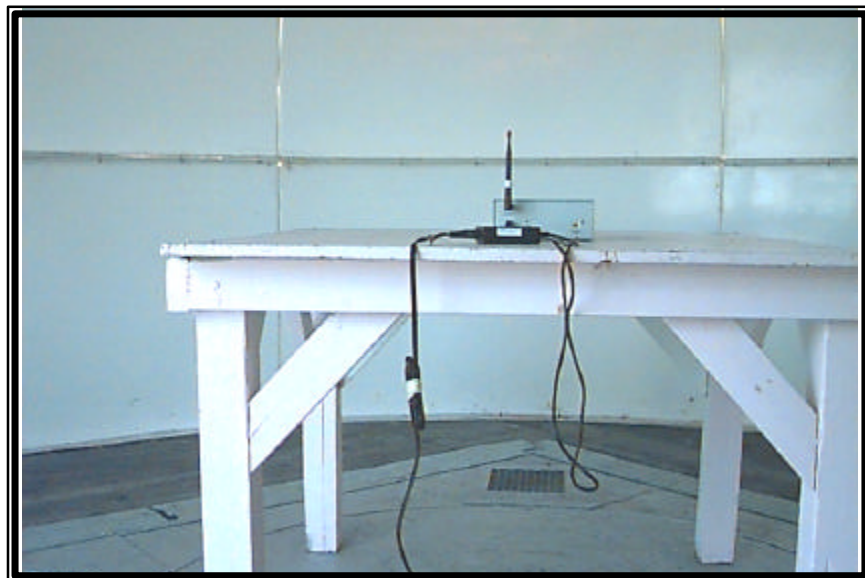
EQUIPMENT: Hopper Plus 120-24

Radiated Photographs (Worst Case Configuration)

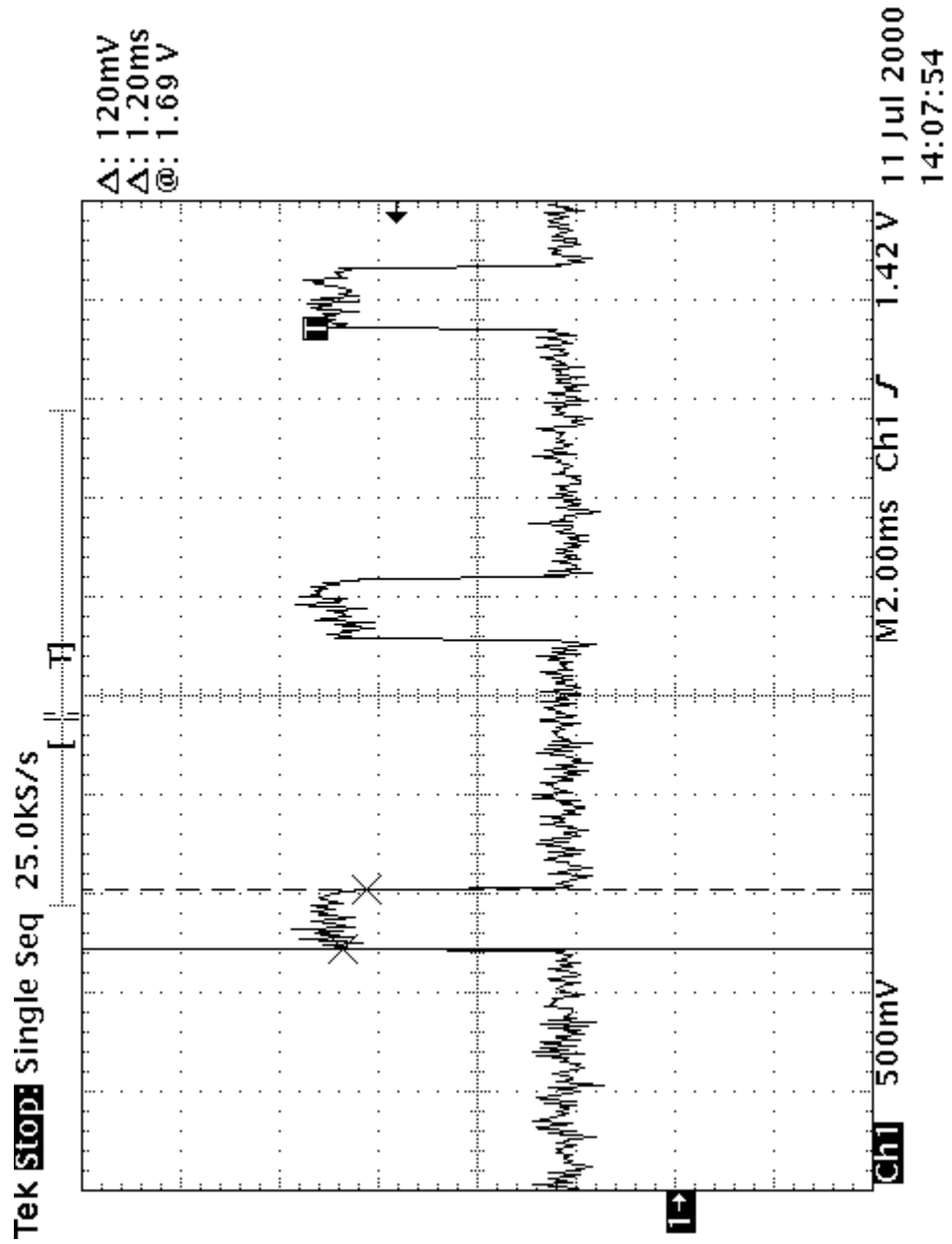
Front View



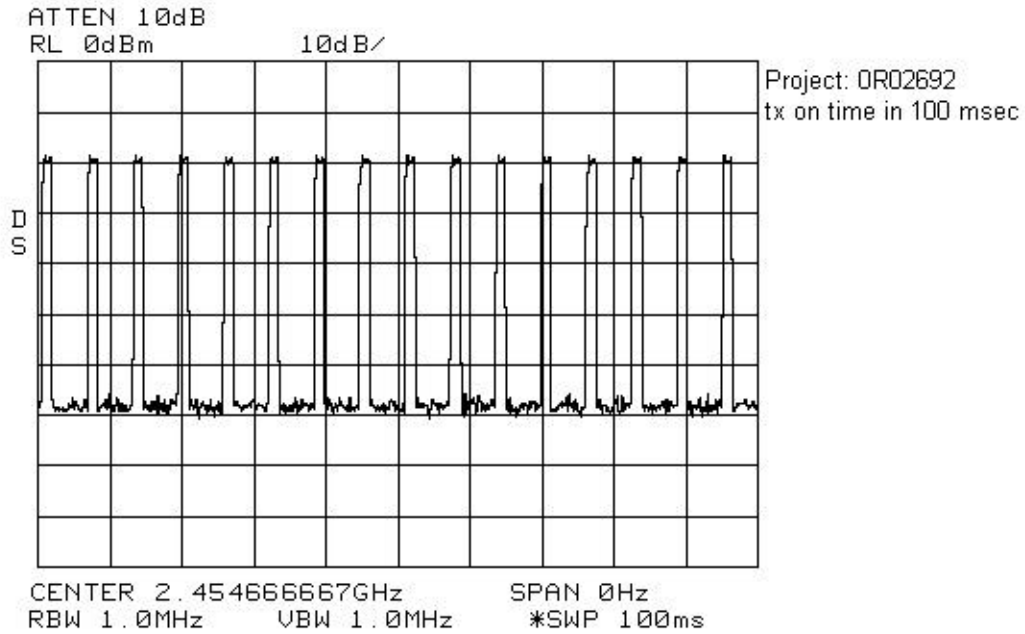
Rear View



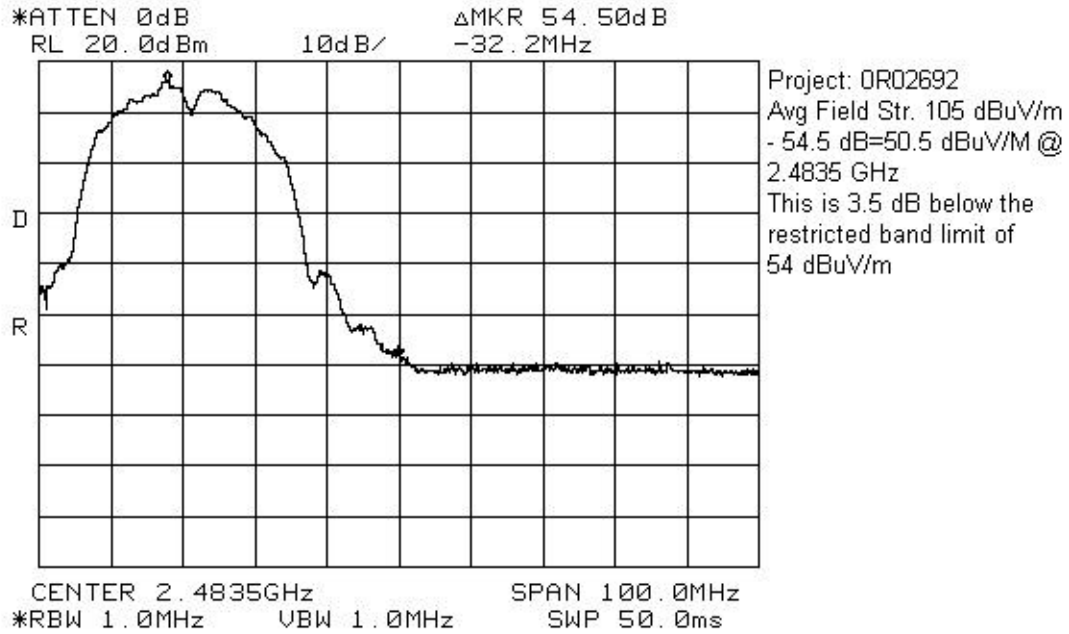
EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24

Section 8. Transmitter Power Density

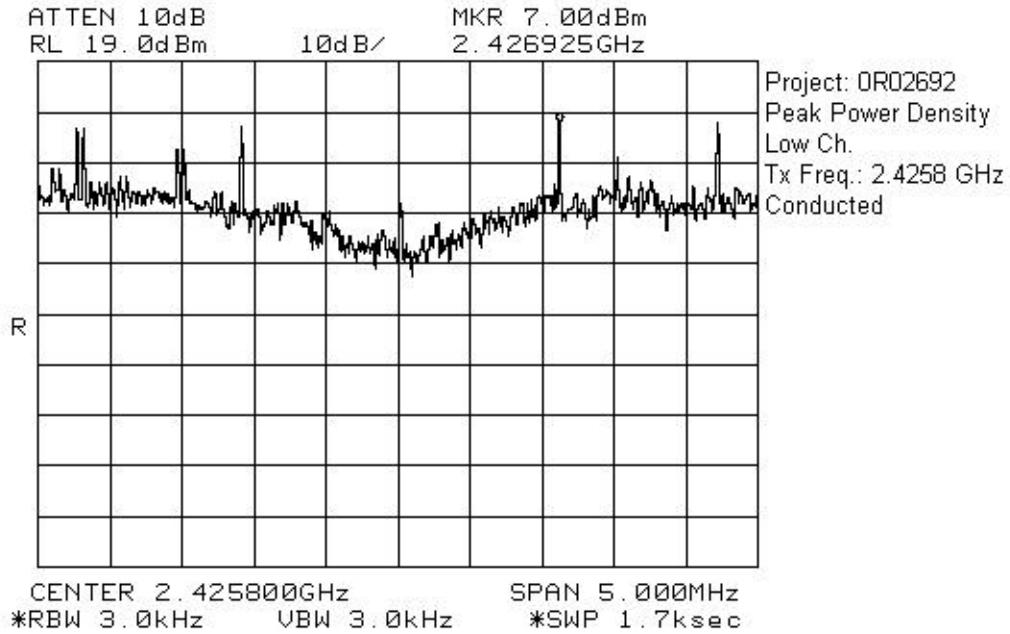
Para. No.: 15.247(d)

Test Performed By: Kevin Carr	Date of Test: July 31, 2000
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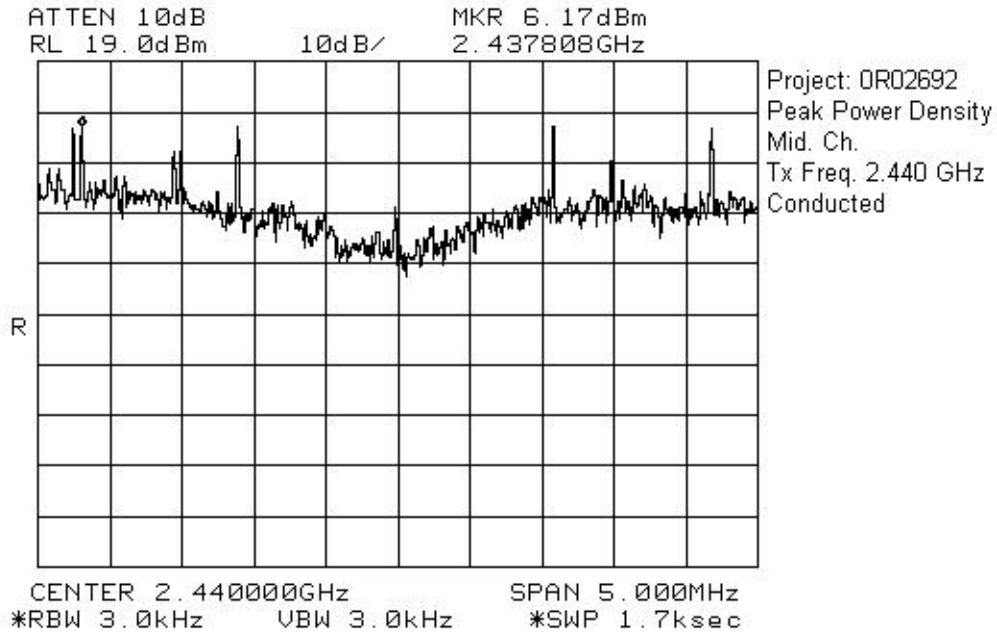
Test Results: Complies.

Measurement Data: See attached graphs.

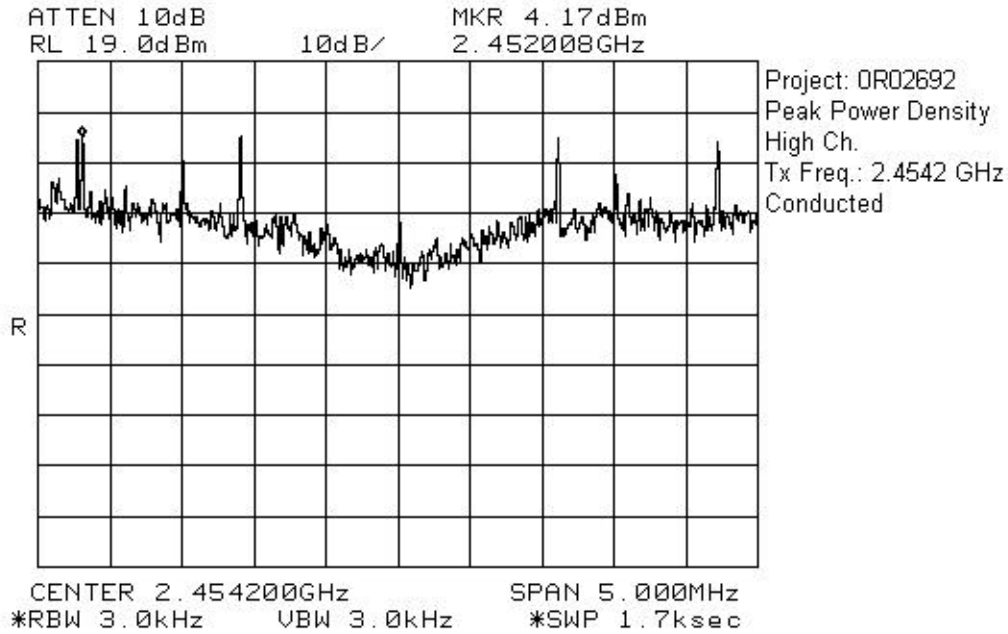
EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24



EQUIPMENT: Hopper Plus 120-24

Section 9. Processing Gain

Para. No.: 15.247(e)

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

*EQUIPMENT: Hopper Plus 120-24***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

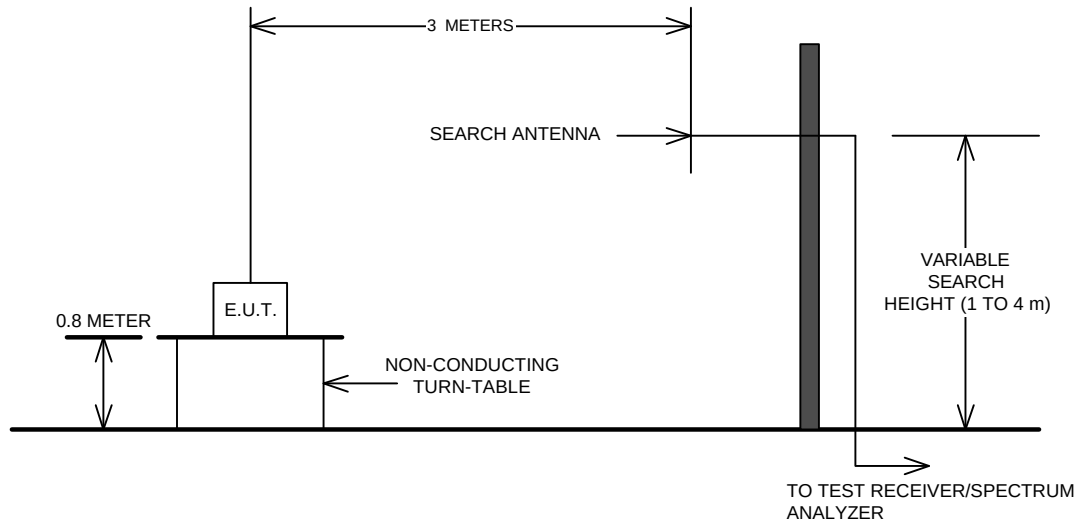
NA: Not Applicable
NCR: No Cal Required
COU: CAL On Use

EQUIPMENT: Hopper Plus 120-24

Annex A
Block Diagrams

EQUIPMENT: *Hopper Plus 120-24*

Test Site For Radiated Emissions



Below 1 GHz

Peak detector.
RBW = 100 kHz

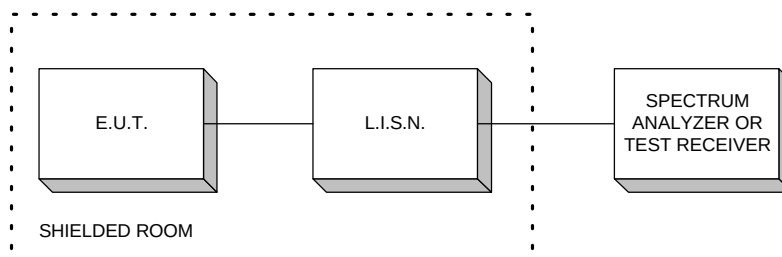
Above 1 GHz For Peak Emission Levels

Peak detector
RBW = 1 MHz
VBW = >RBW

Above 1 GHz For Average Emission Levels

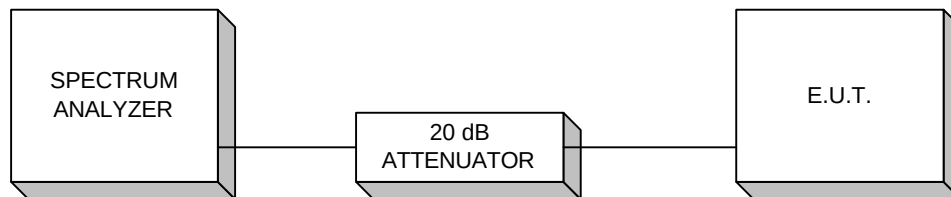
Peak detector
RBW = 1 MHz
VBW = 10 Hz

Conducted Emissions



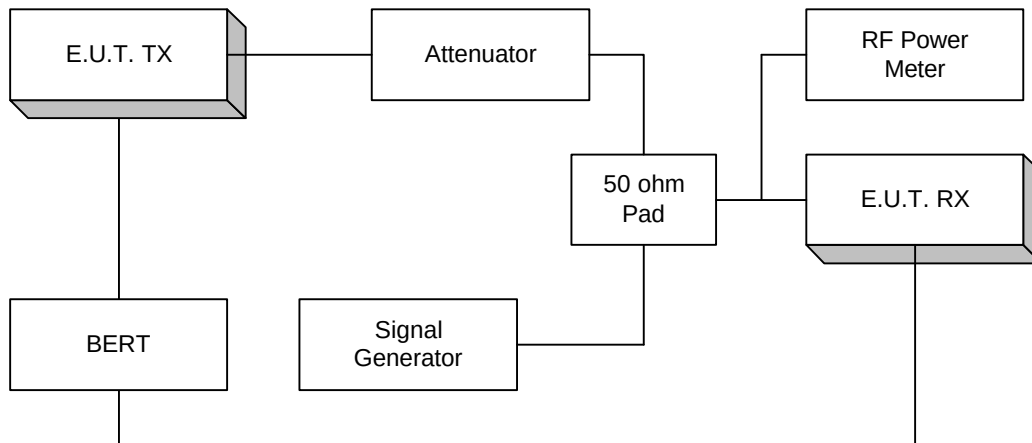
EQUIPMENT: Hopper Plus 120-24

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.