



# Nemko

**Test Report:**

5W38277

**Applicant:**

Alutron Modules Inc.  
Power Excellence Ltd.  
420 Industrial Parkway South  
Aurora, Ontario L4G 3V7

**Equipment Under Test:  
(EUT)**

Vacuum Hose Handle RF Transmitter  
Models RFT-FB and RFT-FA  
RFT-PB and RFT-PA  
RFT-GB and RFT-GA  
Cen-Tec  
Alutron

**Accordance With:**

**FCC Part 15, Subpart C, 15.231**

**Tested By:**

Nemko Canada Inc.  
303 River Road, R.R. 5  
Ottawa, Ontario K1V 1H2

**Authorized By:**

Sim Jagpal, Resource Manager

**Date:**

5 May 2005

**Total Number of Pages:**

31

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**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 Part 15, Subpart C. All tests were conducted using measurement procedure ANSI C63.4-2003. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.

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".

TESTED BY:



DATE: February 18, 2005

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This report applies only to the items tested.

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter**Summary Of Test Data**

Name of Test	Para. Number	Results
Transmission Requirements	15.231(a)	Complies
Radiated Emissions	15.231(b)	Complies
Occupied Bandwidth	15.231(c)	Complies
Frequency Tolerance	15.231(d)	N/A
Periodic Alternate Field Strength Requirements	15.231(e)	N/A
Powerline Conducted Emissions	15.207	Complies

**Test Conditions:****Standard Test Voltage**      Battery Powered Units: 12 Volt Battery Type 23A  
AC Powered Units: 120 VAC, 60 Hz**Indoor**      Temperature: 21.4°C  
Humidity: 17.4%**Outdoor**      Temperature: 7.4°C  
Humidity: 27.3%

**Section 2. Equipment Under Test****General Equipment Information**

<b>Manufacturer:</b>	Alutron Modules Inc.
<b>Model No.:</b>	RFT-FB and RFT-FA RFT-PB and RFT-PA RFT-GB and RFT-GA Cen-Tec Alutron
<b>Date Received In Laboratory:</b>	Jan 31, 2005
<b>Transmitter:</b>	433.92 MHz $\pm$ 100 kHz
<b>Type of Transmission:</b>	On Off Keying using Pulse Width Modulation
<b>Primary Power Requirement:</b>	AC Units: 120 VAC, 60 Hz Battery Powered Units: Type 12 Volt Battery Type 23A
<b>Type of Equipment and Model Differences:</b>	The equipment tested is a vacuum hose handle RF transmitter used to remotely control a central vacuum cleaner system. All models are installed inside a vacuum hose handle and use a permanently attached antenna consisting of wire soldered to PCB. See attached list of model differences. All models use one of two basic types of PCB, PWB553 or PWB550. Both PCB's use identical RF and base band circuits with only minor differences in layout. The AC powered units use a separate AC power board with plug connector.
<b>Nemko Identification No.:</b>	Item 3 Unit 1 RFT-FB Item 8 Unit 2 RFT-FA Item 4 Unit 3 RFT-PB Item 9 Unit 4 RFT PA Item 5 Unit 5 RFT-GB Item 10 Unit 6 RFT-GA Item 12 Unit 7 Cen-Tec Item 13 Unit 8 Alutron

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter

## Model Differences

<b>Hose-handle Type</b>	<b>RF transmitter board</b>		<b>AC power board</b>	
B=battery; AC=line power	Layout gerber	schematic	Layout gerber	Schematic
Flextech B	PWB553	MCP553		
Flextech AC	PWB553	MCP553	PWB527	MCP527
Progression B	PWB550	MCP550		
Progression AC	PWB550	MCP550	PWB527	MCP527
Gas Pump B	PWB550	MCP550		
Gas Pump AC	PWB550	MCP550	PWB551	MCP551
Cen-Tec	PWB553	MCP553		
Alutron	PWB553	MCP553		

**Section 3.        Transmission Requirements****Para. No.: 15.231(a)**

<b>Test Performed By:</b> Russell Grant	<b>Date of Test:</b> Feb. 16, 05
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**Minimum Standard:** 15.231(a) Continuous transmissions such as voice, video or data transmissions are not permitted.

15.231(a)(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds after being released.

15.231(a)(2) A transmitter activated automatically shall cease transmission within 5 seconds of activation.

15.231(a)(3) Periodic transmissions at regular pre-determined intervals are not permitted. However polling or supervisory transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.

15.231(a)(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm.

**Test Results:** Complies.

**Test Data:** Compliance was determined by verification of technical specifications and a functional test on the equipment.

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter**Rationale for Compliance with Transmission Requirements**

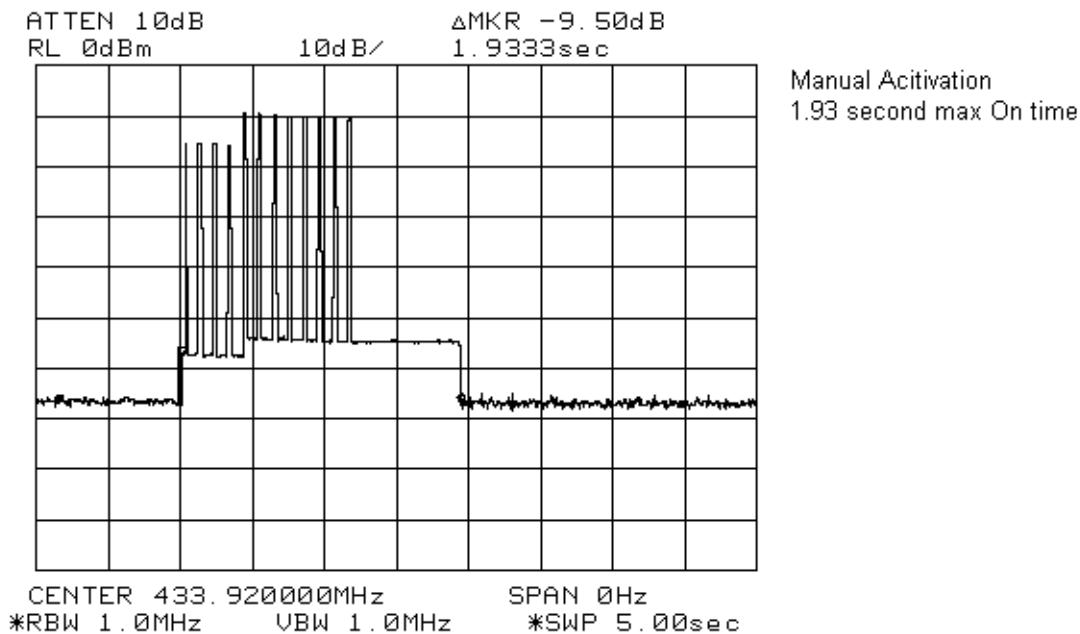
**15.231(a)** This equipment has no provision for continuous transmissions such as voice, video or data.

**15.231(a)(1) :** This equipment is manually activated. Holding down the push button results in a maximum on time of 1.93 seconds.

**15.231(a)(2) :** This equipment has no provision for automatic activation.

**15.231(a)(3) :** This equipment has no provision for periodic transmissions.

**15.231(a)(4) :** This equipment is not employed for radio control purposes during emergencies involving fire, security, and safety of life



*EQUIPMENT:* Vacuum Hose Handle RF Transmitter**Section 4. Radiated Emissions**

Para. No.: 15.231(b)

<b>Test Performed By:</b> Russell Grant	<b>Date of Test:</b> Feb. 17, 05
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**Minimum Standard:**

<b>Fundamental Frequency (MHz)</b>	<b>Field Strength of Fundamental (<math>\mu</math>V/m @ 3m)</b>	<b>Field Strength of Spurious Emissions (<math>\mu</math>V/m @ 3m)</b>
40.66 - 40.70	2,250	225
70-130	1, 250	125
130-174	1,250 to 3,750*	125 to 375
174-260 (note 1)	3,750	375
260-470 (note 1)	3,750 to 12,500*	375 to 1,250
Above 470	12,500	1,250

<b>Restricted Band Limits</b>		
<b>Frequency (MHz)</b>	<b>Field Strength (<math>\mu</math>V/m @ 3m)</b>	<b>Field Strength (dB<math>\mu</math>V/m @ 3m)</b>
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

**Test Results:** Complies**Test Data:** As per attached tabulated data.

Measured 3 m Open Area Test Site

The equipment was tested on 3 axis in order to maximize emissions.

The spectrum was searched from 13.56 MHz up to 4339.2 MHz and all emissions greater than 20 dB below the specification limit were measured and reported.

All emissions were measured using a spectrum analyzer set to positive peak max hold detector function with 100 kHz RBW/VBW for emissions < 1 GHz and 1 MHz RBW/VBW for emissions > 1 GHz. Average reading were obtained by applying a 19.5 dB duty cycle correction factor. See attached time domain plots and duty cycle calculation. There was no change in the fundamental field strength due to  $\pm$  15% change in standard test voltage of 120 VAC.

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter**Unit 1 Flextech B**

Frequency of Emission (MHz)		Received Signal (dBuV)	Antenna Factor (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Cables Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	V	73.0	16.1		-19.5	2.7	72.3	80.8	8.5
433.920	H	76.3	16.8		-19.5	2.7	76.3	80.8	4.5
867.840	V	35.2	22.1		-19.5	3.9	41.7	60.8	19.1
867.840	H	41.5	23.1		-19.5	3.9	49.0	60.8	11.8
1301.760	V	77.0	25.1	46.5	-19.5	3.2	39.2	54.0	14.8
1301.760	H	71.8	25.1	46.5	-19.5	3.2	34.0	54.0	20.0
1735.680	V	64.0	27.2	46.6	-19.5	4.2	29.3	60.8	31.5
1735.680	H	59.2	27.3	46.6	-19.5	4.2	24.6	60.8	36.2
2169.600	V	63.0	28.7	55.3	-19.5	5.1	21.9	60.8	38.9
2169.600	H	64.0	28.7	55.3	-19.5	5.1	22.9	60.8	37.9

**Unit 2 Flextech AC**

Frequency of Emission (MHz)		Received Signal (dBuV)	Antenna Factor (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Cables Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	V	60.5	16.1		-19.5	2.7	59.8	80.8	21.0
433.920	H	60.5	16.8		-19.5	2.7	60.5	80.8	20.3
867.840	V	38.5	22.1		-19.5	3.9	45.0	60.8	15.8
867.840	H	39.7	23.1		-19.5	3.9	47.2	60.8	13.6
1301.760	V	65.7	25.1	46.5	-19.5	3.2	27.9	54.0	26.1
1301.760	H	70.0	25.1	46.5	-19.5	3.2	32.2	54.0	21.8
1735.680	V	63.0	27.2	46.6	-19.5	4.2	28.3	60.8	32.5
1735.680	H	61.0	27.3	46.6	-19.5	4.2	26.4	60.8	34.4
2169.600	V	68.0	28.7	55.3	-19.5	5.1	26.9	60.8	33.9
2169.600	H	66.0	28.7	55.3	-19.5	5.1	24.9	60.8	35.9

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter

## Unit 3 Progression B

Frequency of Emission (MHz)	Received Signal (dBuV)	Antenna Factor (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Cables Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	V 71.8	16.1		-19.5	2.7	71.1	80.8	9.7
433.920	H 73.2	16.8		-19.5	2.7	73.2	80.8	7.6
867.840	V 41.5	22.1		-19.5	3.9	48.0	60.8	12.8
867.840	H 49.7	23.1		-19.5	3.9	57.2	60.8	3.6
1301.760	V 72.5	25.1	46.5	-19.5	3.2	34.7	54.0	19.3
1301.760	H 75.5	25.1	46.5	-19.5	3.2	37.7	54.0	16.3
1735.680	V 64.5	27.2	46.6	-19.5	4.2	29.8	60.8	31.0
1735.680	H 65.7	27.3	46.6	-19.5	4.2	31.1	60.8	29.7
2169.600	V 76.8	28.7	55.3	-19.5	5.1	35.7	60.8	25.1
2169.600	H 73.8	28.7	55.3	-19.5	5.1	32.7	60.8	28.1

## Unit 4 Progression AC

Frequency of Emission (MHz)	Received Signal (dBuV)	Antenna Factor (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Cables Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	V 77.0	16.1		-19.5	2.7	76.3	80.8	4.5
433.920	H 73.8	16.8		-19.5	2.7	73.8	80.8	7.0
867.840	V 38.0	22.1		-19.5	3.9	44.5	60.8	16.3
867.840	H 44.7	23.1		-19.5	3.9	52.2	60.8	8.6
1301.760	V 77.2	25.1	46.5	-19.5	3.2	39.4	54.0	14.6
1301.760	H 75.0	25.1	46.5	-19.5	3.2	37.2	54.0	16.8
1735.680	V 65.0	27.2	46.6	-19.5	4.2	30.3	60.8	30.5
1735.680	H 62.5	27.3	46.6	-19.5	4.2	27.9	60.8	32.9
2169.600	V 73.5	28.7	55.3	-19.5	5.1	32.4	60.8	28.4
2169.600	H 74.8	28.7	55.3	-19.5	5.1	33.7	60.8	27.1

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter**Unit 5 Gas Pump B**

Frequency of Emission (MHz)		Received Signal (dBuV)	Antenna Factor (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Cables Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	V	69.0	16.1		-19.5	2.7	68.3	80.8	12.5
433.920	H	67.7	16.8		-19.5	2.7	67.7	80.8	13.1
867.840	V	34.8	22.1		-19.5	3.9	41.3	60.8	19.5
867.840	H	38.5	23.1		-19.5	3.9	46.0	60.8	14.8
1301.760	V	77.0	25.1	46.5	-19.5	3.2	39.2	54.0	14.8
1301.760	H	71.3	25.1	46.5	-19.5	3.2	33.5	54.0	20.5
1735.680	V	65.5	27.2	46.6	-19.5	4.2	30.8	60.8	30.0
1735.680	H	59.7	27.3	46.6	-19.5	4.2	25.1	60.8	35.7
2169.600	V	68.0	28.7	55.3	-19.5	5.1	26.9	60.8	33.9
2169.600	H	68.3	28.7	55.3	-19.5	5.1	27.2	60.8	33.6

**Unit 6 Gas Pump AC**

Frequency of Emission (MHz)		Received Signal (dBuV)	Antenna Factor (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Cables Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	V	77.3	16.1		-19.5	2.7	76.6	80.8	4.2
433.920	H	75.0	16.8		-19.5	2.7	75.0	80.8	5.8
867.840	V	30.7	22.1		-19.5	3.9	37.2	60.8	23.6
867.840	H	36.0	23.1		-19.5	3.9	43.5	60.8	17.3
1301.760	V	82.0	25.1	46.5	-19.5	3.2	44.2	54.0	9.8
1301.760	H	81.0	25.1	46.5	-19.5	3.2	43.2	54.0	10.8
1735.680	V	65.8	27.2	46.6	-19.5	4.2	31.2	60.8	29.6
1735.680	H	66.0	27.3	46.6	-19.5	4.2	31.4	60.8	29.4
2169.600	V	73.2	28.7	55.3	-19.5	5.1	32.0	60.8	28.8
2169.600	H	72.0	28.7	55.3	-19.5	5.1	30.9	60.8	29.9

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter**Unit 7 Cen-Tec**

Frequency of Emission (MHz)		Received Signal (dBuV)	Antenna Factor (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Cables Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	V	72.5	16.1		-19.5	2.7	71.8	80.8	9.0
433.920	H	72.5	16.8		-19.5	2.7	72.5	80.8	8.3
867.840	V	30.0	22.1		-19.5	3.9	36.5	60.8	24.3
867.840	H	43.0	23.1		-19.5	3.9	50.5	60.8	10.3
1301.760	V	78.8	25.1	46.5	-19.5	3.2	41.0	54.0	13.0
1301.760	H	73.5	25.1	46.5	-19.5	3.2	35.7	54.0	18.3
1735.680	V	62.0	27.2	46.6	-19.5	4.2	27.3	60.8	33.5
1735.680	H	57.2	27.3	46.6	-19.5	4.2	22.6	60.8	38.2
2169.600	V	74.0	28.7	55.3	-19.5	5.1	32.9	60.8	27.9
2169.600	H	68.3	28.7	55.3	-19.5	5.1	27.2	60.8	33.6

**Unit 8 Alutron**

Frequency of Emission (MHz)		Received Signal (dBuV)	Antenna Factor (dB)	Amplifier Gain (dB)	Duty Cycle (dB)	Cables Loss (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
433.920	V	77.0	16.1		-19.5	2.7	76.3	80.8	4.5
433.920	H	79.7	16.8		-19.5	2.7	79.7	80.8	1.1
867.840	V	32.8	22.1		-19.5	3.9	39.3	60.8	21.5
867.840	H	37.3	23.1		-19.5	3.9	44.8	60.8	16.0
1301.760	V	82.0	25.1	46.5	-19.5	3.2	44.2	54.0	9.8
1301.760	H	81.0	25.1	46.5	-19.5	3.2	43.2	54.0	10.8
1735.680	V	63.0	27.2	46.6	-19.5	4.2	28.3	60.8	32.5
1735.680	H	59.5	27.3	46.6	-19.5	4.2	24.9	60.8	35.9
2169.600	V	66.3	28.7	55.3	-19.5	5.1	25.2	60.8	35.6
2169.600	H	68.3	28.7	55.3	-19.5	5.1	27.2	60.8	33.6

**Description of Type of Modulation and Duty Cycle**

Transmission method is ON/OFF keying with transmission periods or "alphas" of 50 microseconds duration. "Hi" is carrier transmission for 50 microseconds and "Lo" is no carrier for 50 microseconds.

- Each digital bit comprises 16 alphas.
- digital **0** consists of 4Hi and 12 Lo; digital **1** consists of 12Hi and 4 Lo.
- Within the "Data" period of 18mS referred to in my last email:
  - 10 bits of preamble all **0**
  - 1 synchronization bit of 16Hi and 4Lo
  - 10 Address code bits
  - 2 bit command code
  - 1 stop bit (**0** or **1**)

**Duty Cycle Calculation****On Time**

$$10 \text{ bits all 0} = 10 \times 4 \times 50 \text{ us} = 2000 \text{ us}$$

$$1 \text{ sync pulse} = 16 \times 50 \text{ us} = 800 \text{ us}$$

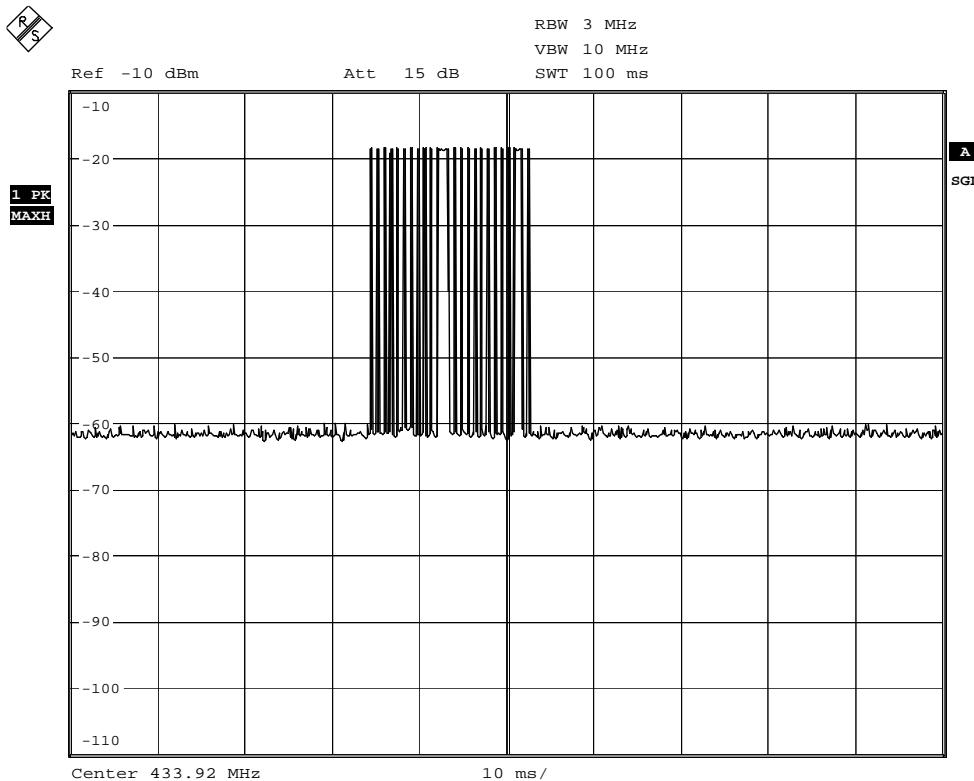
$$10 \text{ address bits using all 1's} = 10 \times 12 \times 50 \text{ us} = 6000 \text{ us}$$

$$2 \text{ bit command code all 1's} = 2 \times 12 \times 50 \text{ us} = 1200 \text{ us}$$

$$1 \text{ stop bit "1"} = 1 \times 12 \times 50 \text{ us} = 600 \text{ us}$$

$$\text{Total on time per packet} = 2000 + 800 + 6000 + 1200 + 600 = 10600 \text{ us} = 10.6 \text{ ms}$$

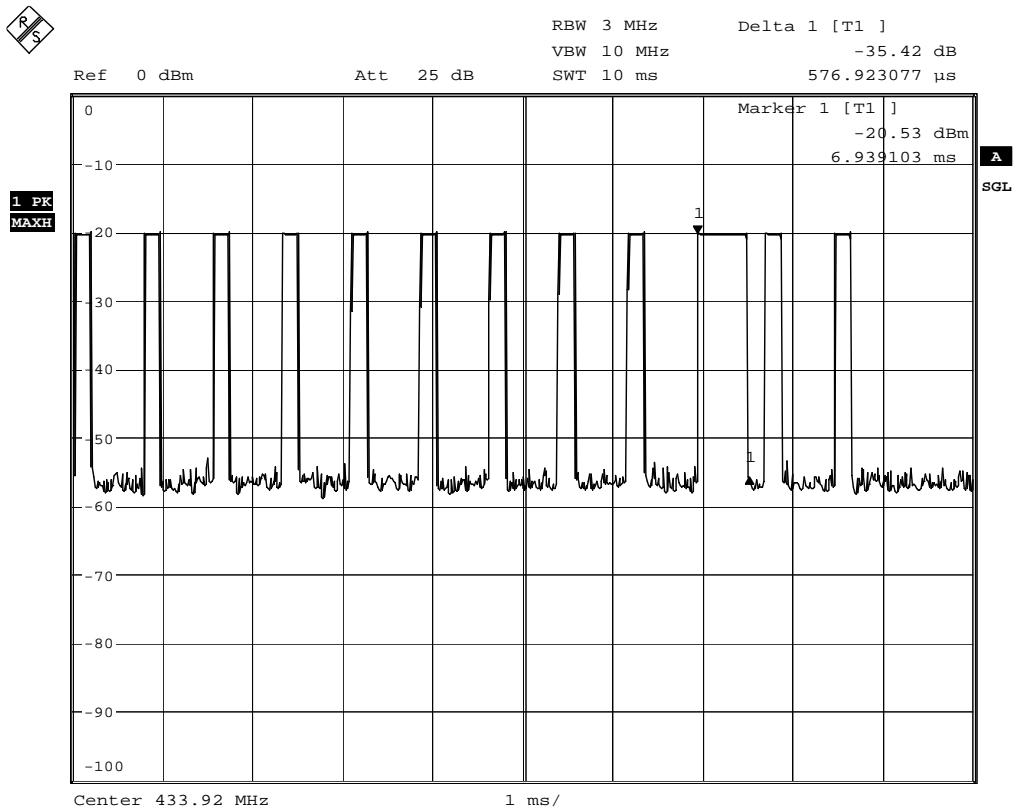
$$\text{Duty Cycle} = 20 \text{ Log} (10.6/100) = -19.5 \text{ dB}$$

**EQUIPMENT:** Vacuum Hose Handle RF Transmitter

100 ms Span

Date: 7.FEB.2005 14:02:24

One Packet per 100 ms

**EQUIPMENT:** Vacuum Hose Handle RF Transmitter

Date: 14.FEB.2005 10:28:33

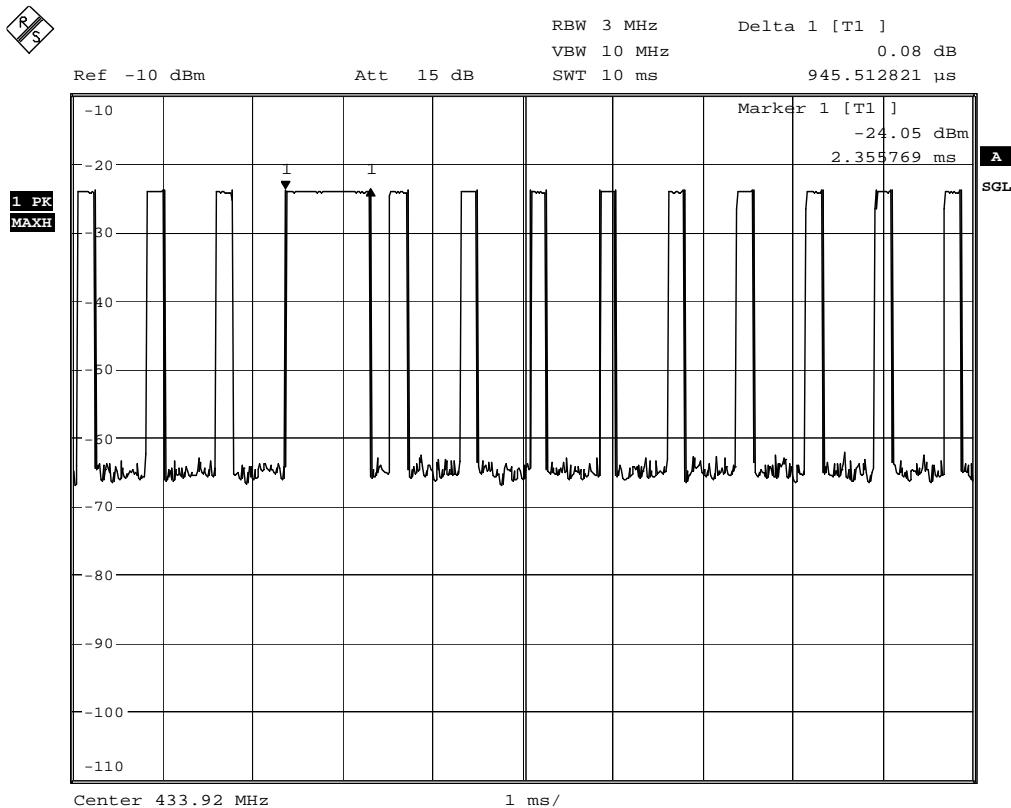
Digital "1"

## Nemko Canada Inc.

## FCC PART 15, SUBPART C, 15.231

PROJECT NO.: 5W38277

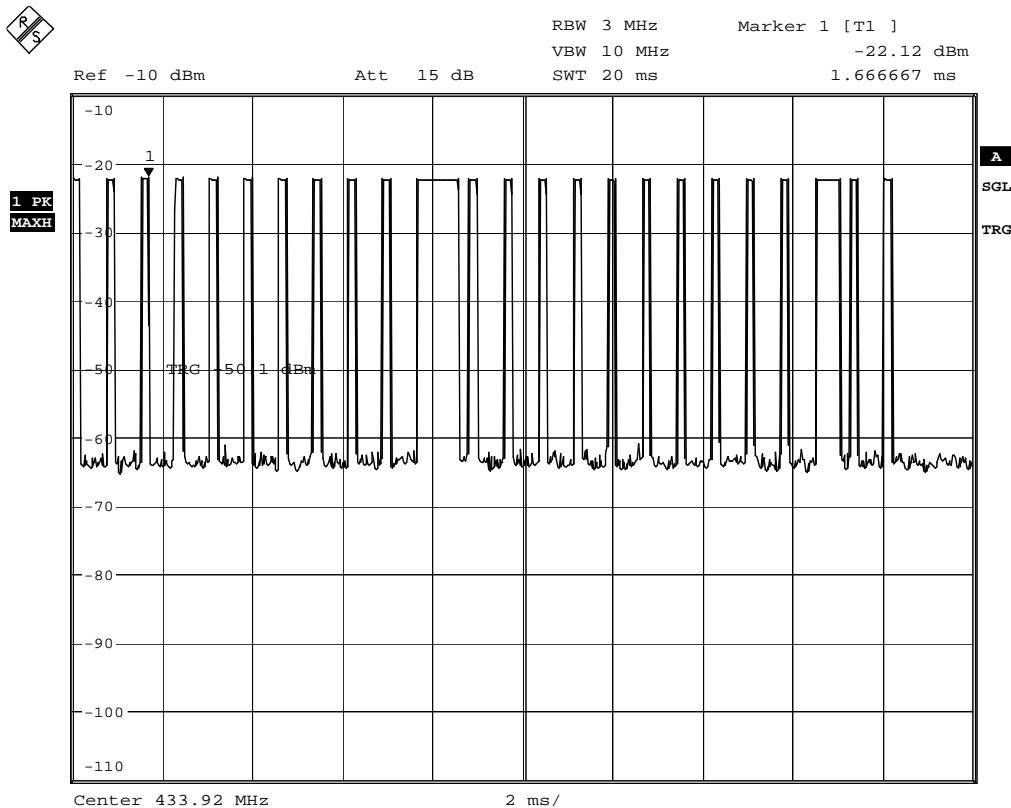
*EQUIPMENT:* Vacuum Hose Handle RF Transmitter



0.945 ms Long Pulse

Date: 7.FEB.2005 13:50:34

## Sync Pulse

**EQUIPMENT:** Vacuum Hose Handle RF Transmitter

Date: 7.FEB.2005 13:57:04

10 bits "0" + 1 sync pulse + 10 address bits + 2 bit command code + stop bit

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter

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Radiated Emission Test Set Up Photograph

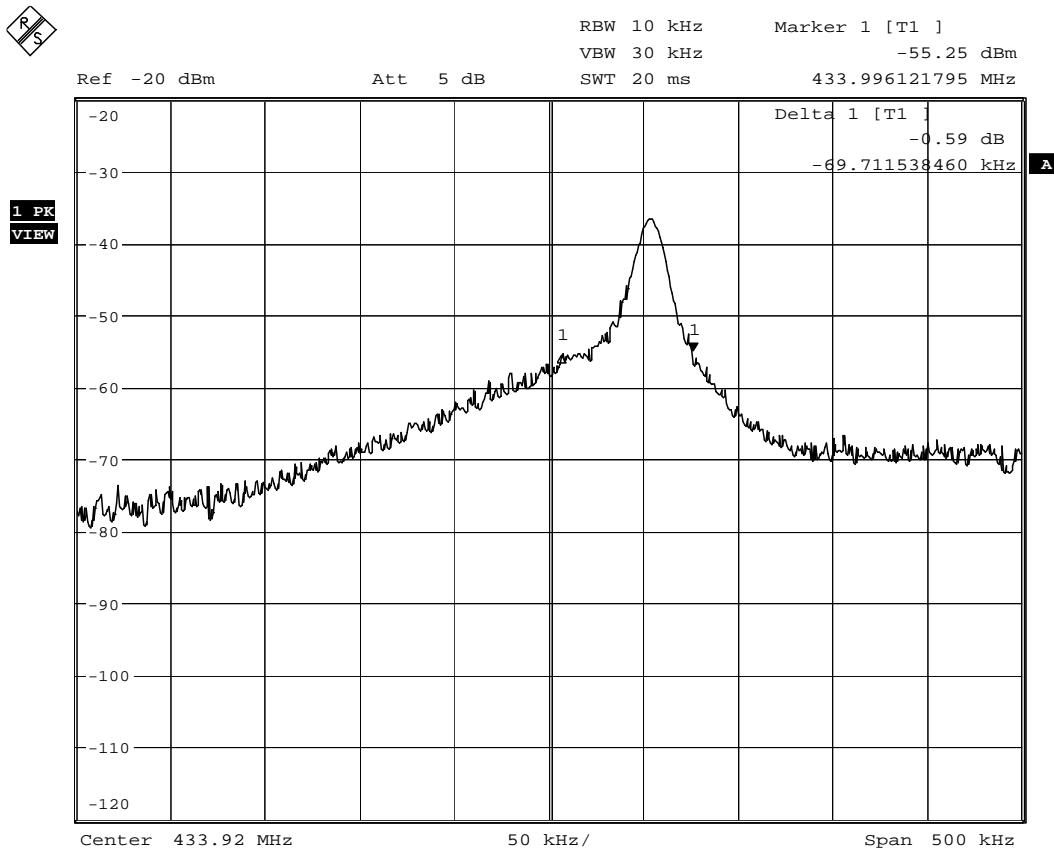
**Section 5.        Occupied Bandwidth****Para. No.: 15.231(c)**

<b>Test Performed By:</b> Russell Grant	<b>Date of Test:</b> Feb 17, 05
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**Minimum Standard:** 15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

**Test Results:** Complies. The 20 dB bandwidth is 69.7 kHz. This is 0.016% of the center frequency of operation.

**Test Data:** See attached graph.

**EQUIPMENT:** Vacuum Hose Handle RF Transmitter

20 dB Bandwidth

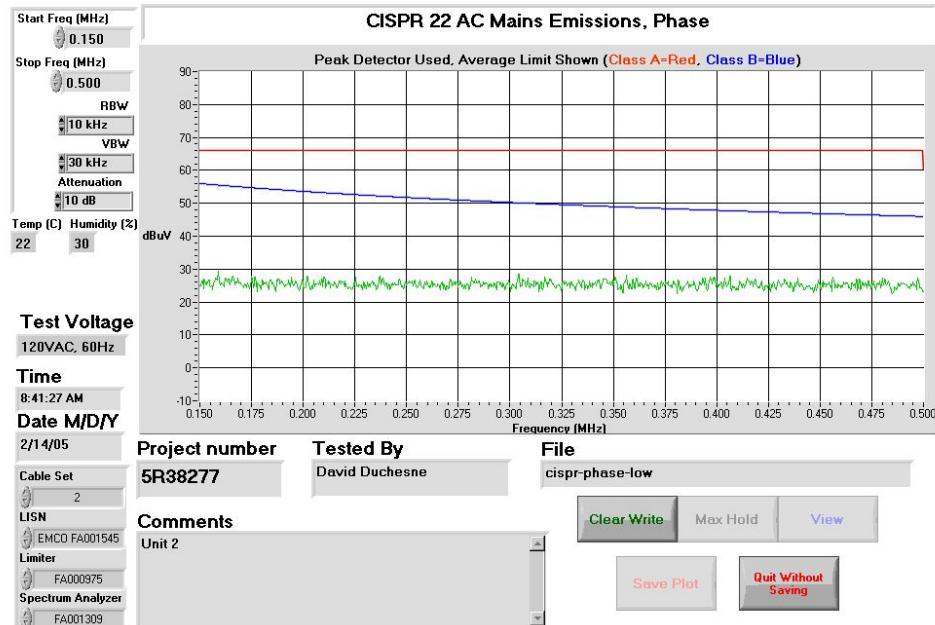
Date: 16.FEB.2005 13:08:26

**Section 6. Powerline Conducted Emissions****Para. No.: 15.207****Test Performed By: David Duchesne****Date of Test: 14-Feb-05****Minimum Standard:**

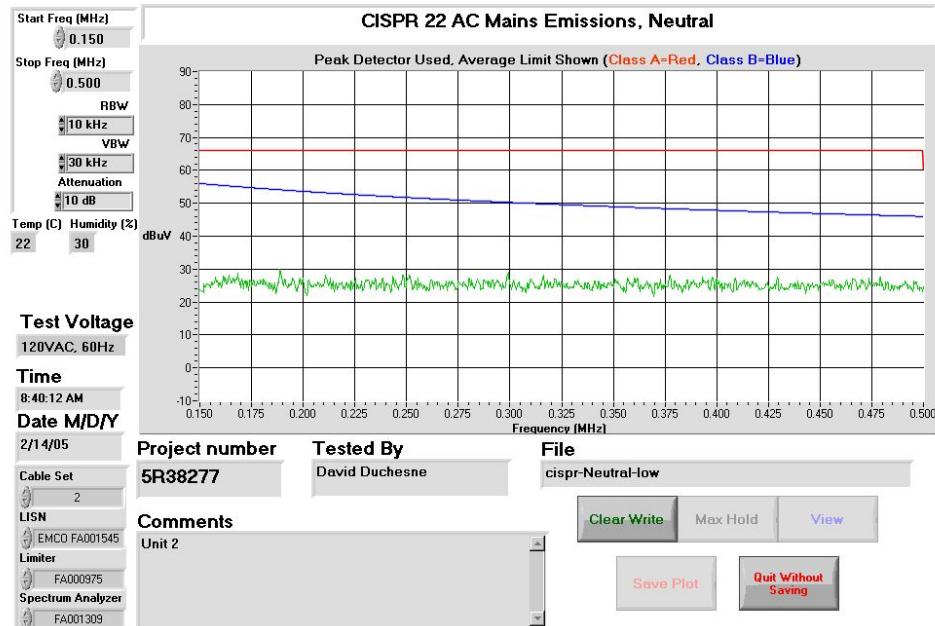
Frequency(MHz)	Maximum Powerline Conducted RF Voltage	
	µV	dBµV
0.45 - 30.0	250	48

**Test Results:** Complies. See attached spectral plots.**Test Data:** As per attached graphs.

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter

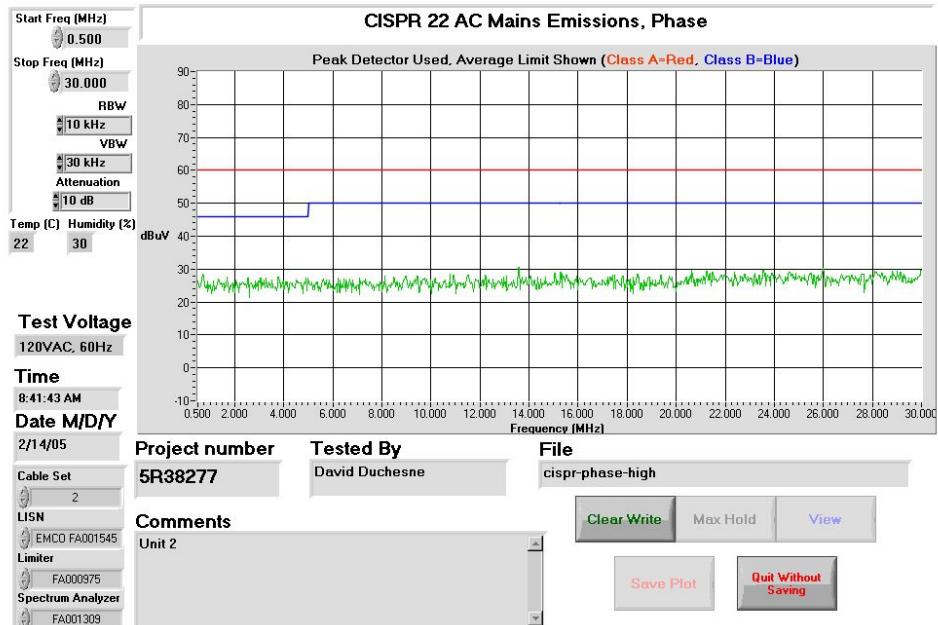


Unit 2 Model RFT-FA

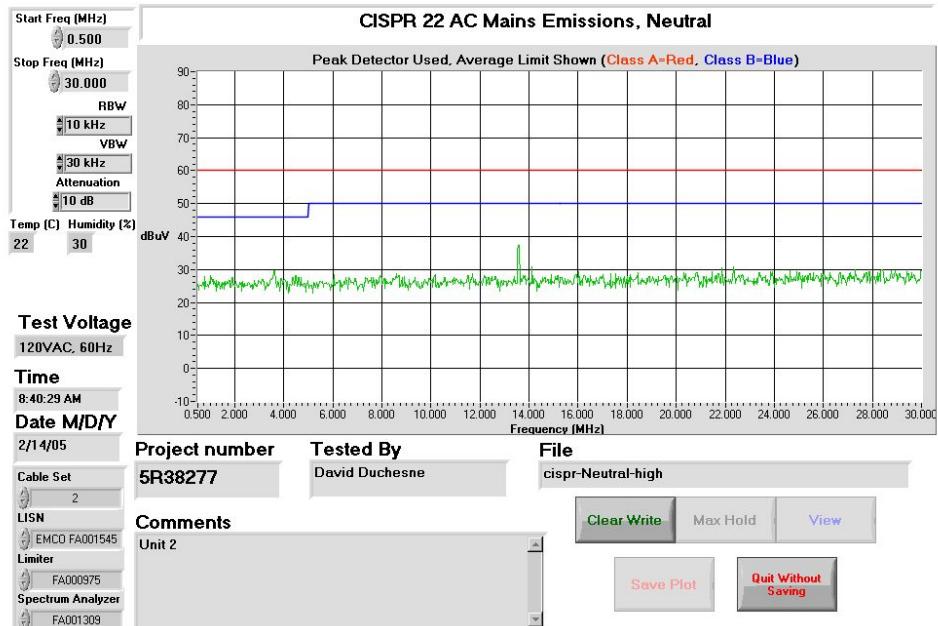


Unit 2 Model RFT-FA

**EQUIPMENT:** Vacuum Hose Handle RF Transmitter

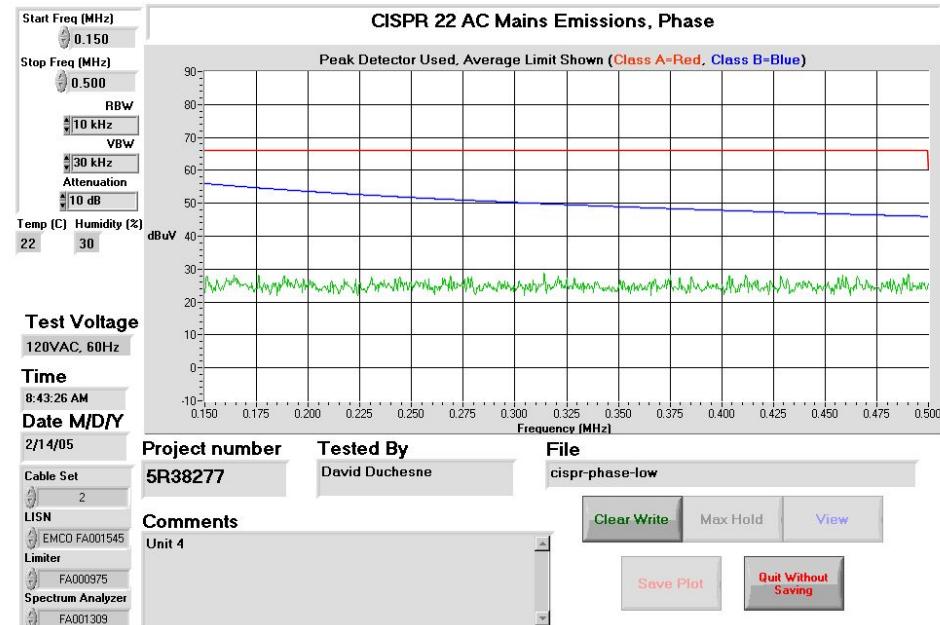


**Unit 2 Model RFT-FA**

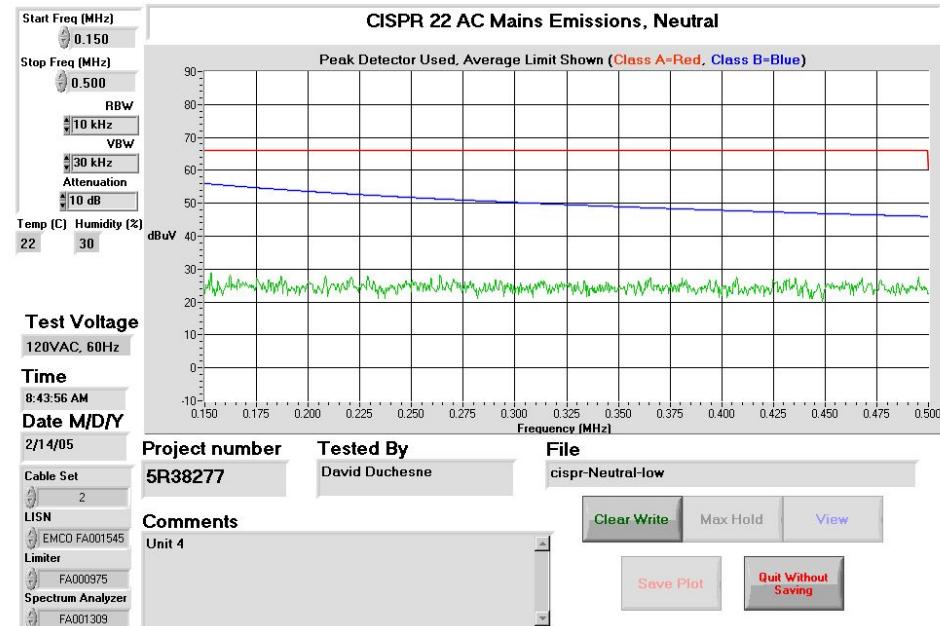


**Unit 2 Model RFT-FA**

EQUIPMENT: Vacuum Hose Handle RF Transmitter

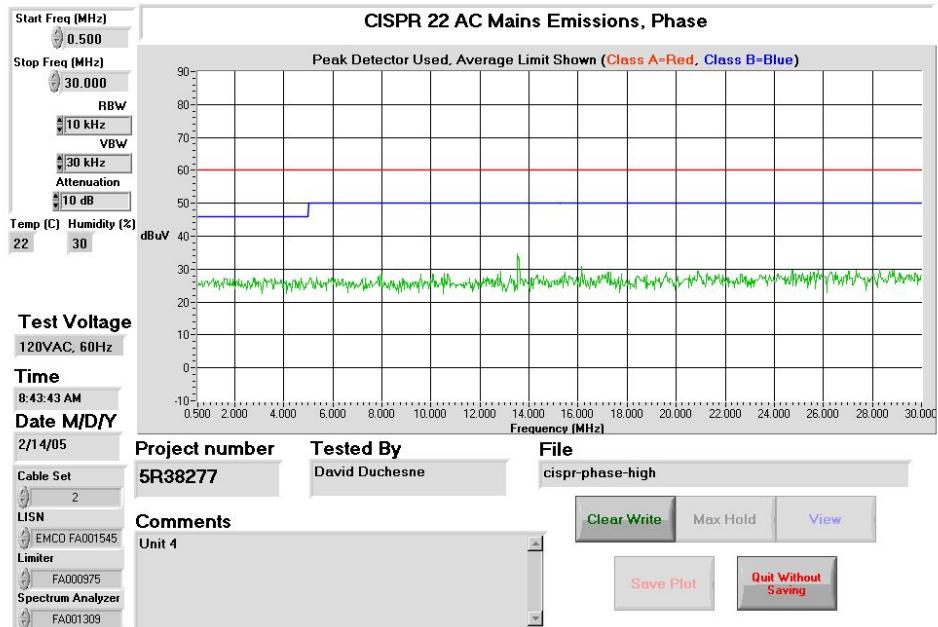


Unit 4 Model RFT-PA

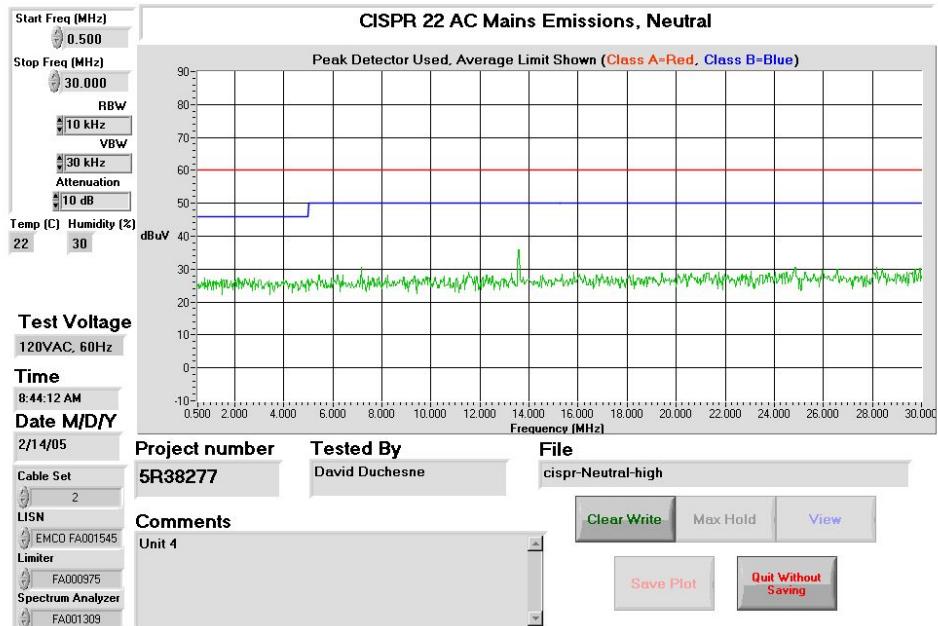


Unit 4 Model RFT-PA

EQUIPMENT: Vacuum Hose Handle RF Transmitter

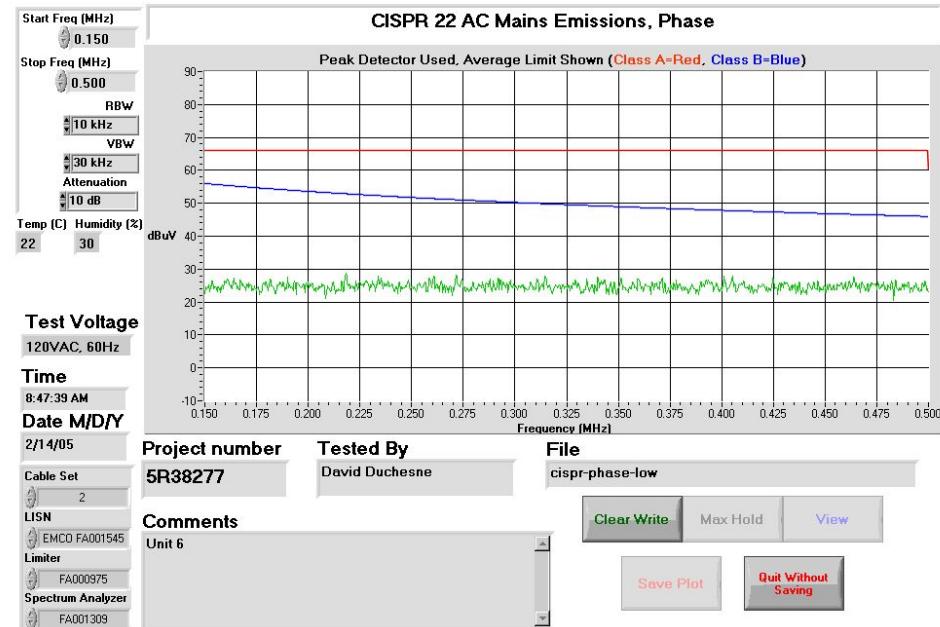


Unit 4 Model RFT-PA

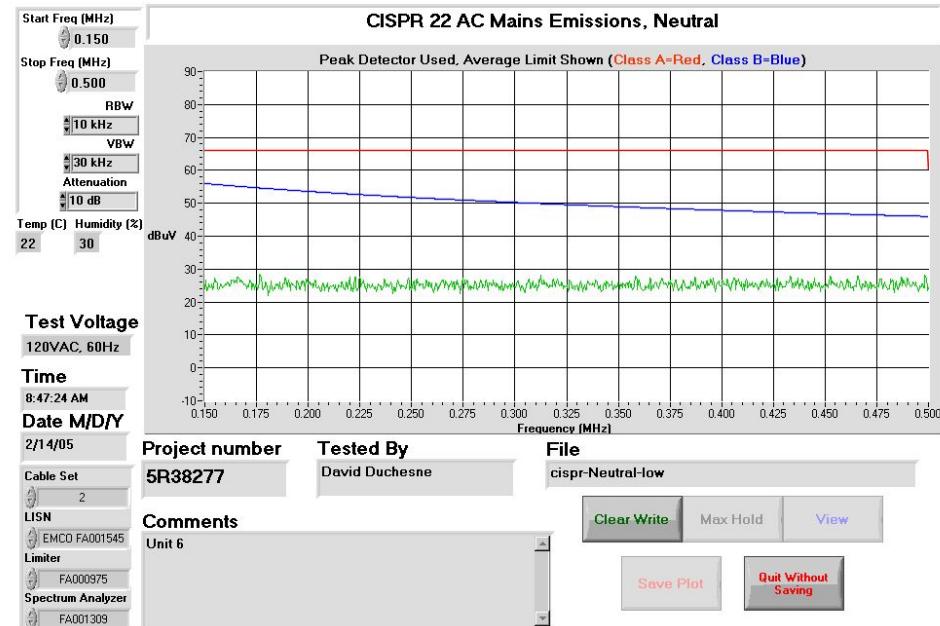


Unit 4 Model RFT-PA

**EQUIPMENT:** Vacuum Hose Handle RF Transmitter

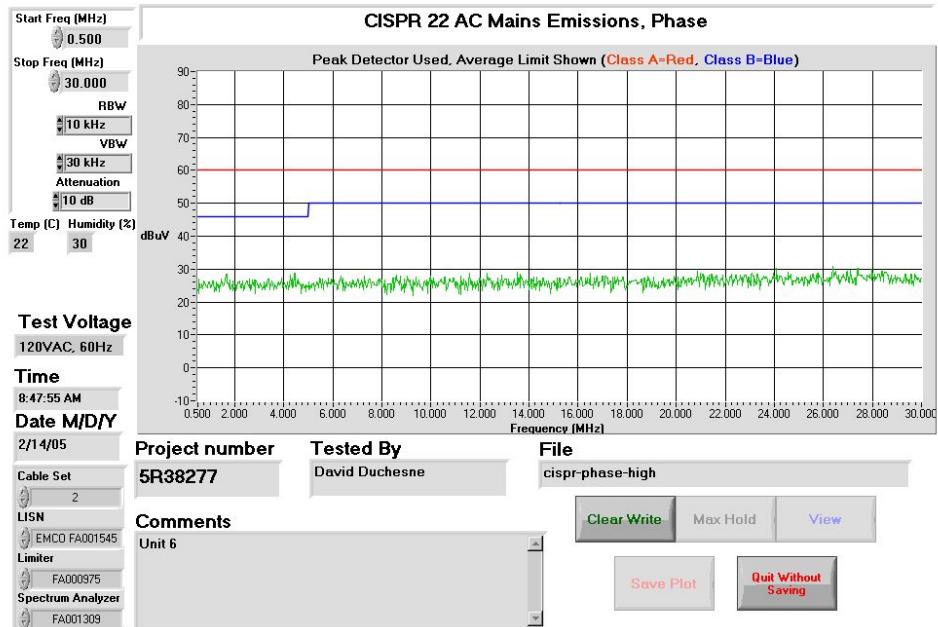


**Unit 6 Model RFT-GA**

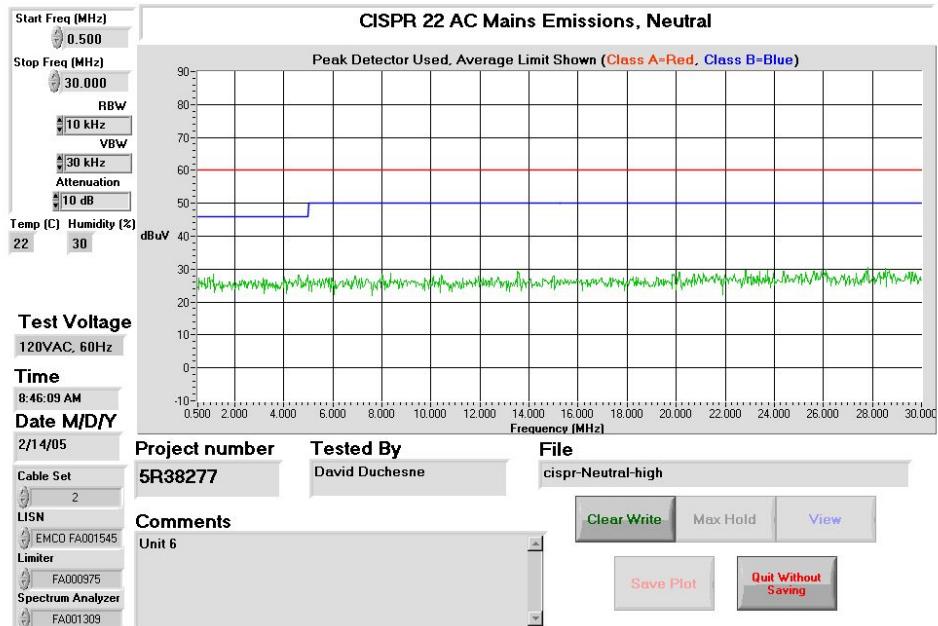


**Unit 6 Model RFT-GA**

**EQUIPMENT:** Vacuum Hose Handle RF Transmitter



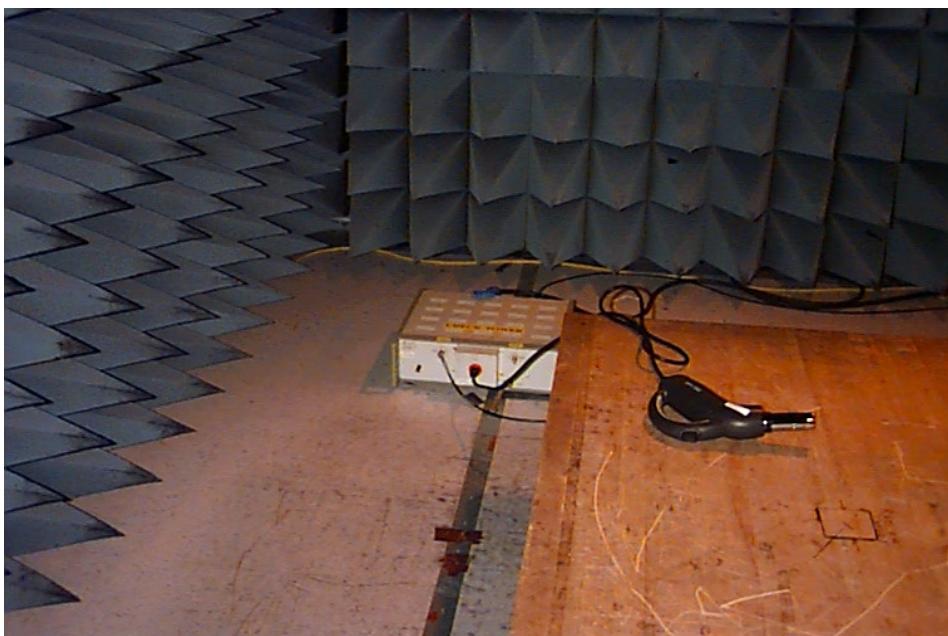
Unit 6 Model RFT-GA



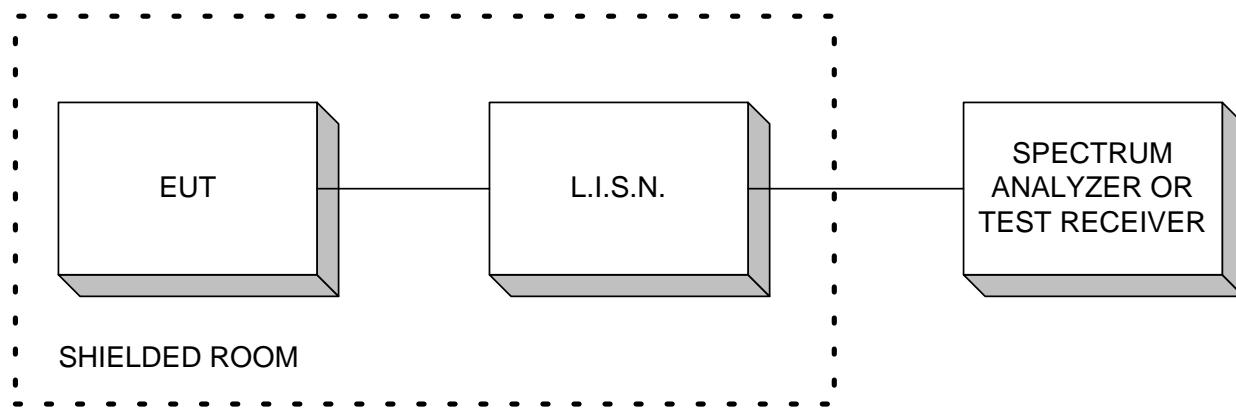
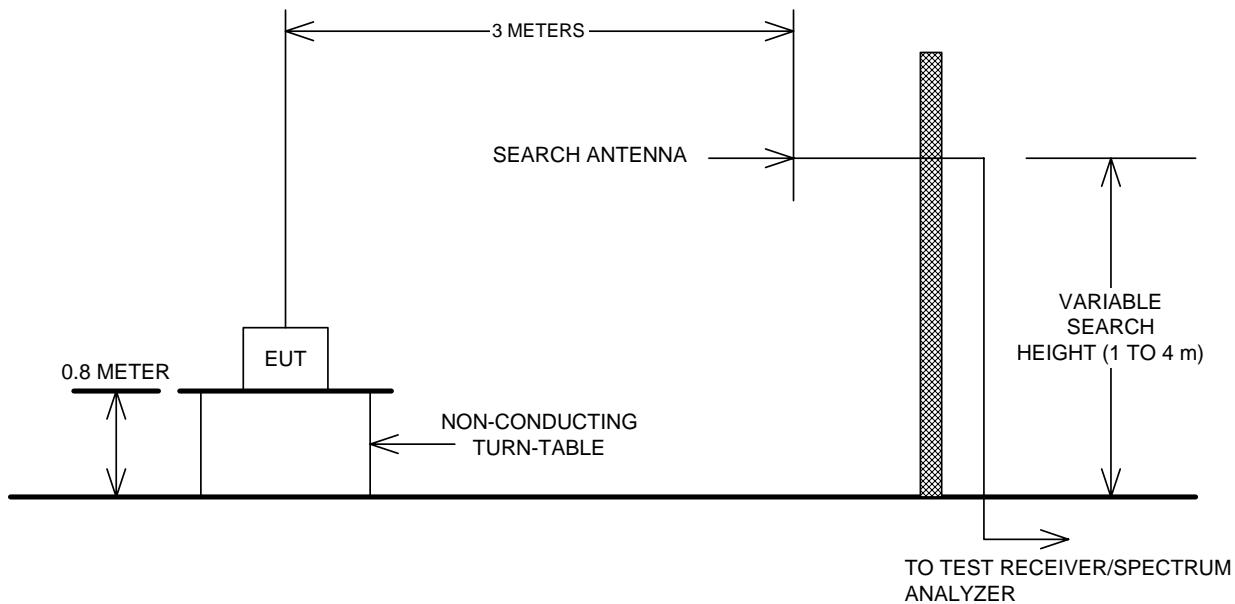
Unit 6 Model RFT-GA

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter

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Conducted Emission Test Setup

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter**Section 7. Block Diagrams****Conducted Emissions****Outdoor Test Site For Radiated Emissions**

The spectrum was searched up to the 10th harmonic of the fundamental frequency of operation.

*EQUIPMENT:* Vacuum Hose Handle RF Transmitter**Section 8. Test Equipment List**

Equipment	Manufacturer	Model	Asset/Serial No.	Last Cal	Cal Due Date
Spectrum Analyzer	Hewlett-Packard	8566B	FA001309	May 28/04	May 28/05
Spectrum Analyzer	Hewlett Packard	8564E	1158844B	12/22/04	12/22/05
Bilog	Schaffner	CBL6112B	FA001504	NCR	NCR
LISN	EMCO	4825/2	FA001545	Jan. 13/05	Jan. 13/06
Transient Limiter	Hewlett-Packard	1194 7A	FA000975	June 10/04	June 10/05
Log Periodic Antenna #1	EMCO	LPA-25	FA000477	Aug. 26/04	Aug. 26/05
Horn Antenna #1	EMCO	3115	FA000649	Dec. 22/04	Dec. 22/05
1.0 – 2.0 GHz Amplifier	JCA	12-400	FA001498	June 18/04	June 18/05
2.0 – 4.0 GHz Amplifier	JCA	24-600	FA001496	June 18/04	June 18/05
Spectrum Analyzer	Rohde & Schwarz	FSU	FA001877	May 26/04	May 26/05