FCC Certification Test Report

FCC Certification Test Report for Cattron-Theimeg Inc. FCC ID: CN2R3A

February 5, 2004

Prepared for:

Cattron-Theimeg Inc.
58 West Shenango St.
Sharpsville, PA 16150-1198

Prepared By:

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7560 Lindbergh Drive
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FCC Certification Test Program

FCC Certification Test Report
for the
Cattron-Theimeg Inc.
R3A

February 5, 2004

WLL JOB# 7769

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Abstract

This report has been prepared on behalf of Cattron-Theimeg Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Transceiver under Part 90 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Cattron-Theimeg Inc. R3A Transceiver.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Cattron-Theimeg Inc. R3A Transceiver complies with the limits for a Transceiver device under Part 90 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Cattron-Theimeg Inc. R3A Transceiver complies with the limits for a Transceiver device under Part 90 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2001 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer: Cattron-Theimeg Inc.
58 West Shenango St.
Sharpsville, PA 16150-1198

Purchase Order Number: 127902

Quotation Number: 61087

1.4 Test Dates

Testing was performed from October 1, 2003 to December 30, 2003.

1.5 Test and Support Personnel

Washington Laboratories, LTD James Ritter

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	decibel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The Cattron-Theimeg Inc. R3HNXX Transceiver is housed in the Cattron-Theimeg MP96GIIRCR EMI/RFI shielding enclosure. This enclosure contains three individual compartments that house the encoder/decoder circuit board, R3HNX-007 transceiver circuit board and CPA-0387-006 RF Power Amplifier, and power supply.

The encoder/decoder contains the electronic circuits and microprocessors that control system functions. This includes checking the address of incoming signals, interpreting the RCT (Remote Controlled Transmitter) commands, and controlling the status of various output relays.

The R3H transceiver board is a multichannel, UHF-synthesized, narrowband RF receiver with an LCD display. Additionally it also encompasses an integral RF transmitter for polling data transmission. This transceiver has a frequency range of 447 MHz thru 473 MHz, and operates on a single radio frequency (simplex channel), or a pair of radio frequencies (half duplex channel) when a repeater is require for extended range. Through the use of an RF power amp external to transceiver board the power out is factory set at 1.4 watts + or – 200mw.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Cattron-Theimeg Inc.
FCC ID Number	CN2R3A
EUT Name:	Remote Controlled Transceiver (RCT)
Model:	R3A
FCC Rule Parts:	§90
Frequency Range:	447 - 473MHz
Maximum Output Power:	1.6W
Modulation:	FM
Necessary Bandwidth:	12.5 kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	16
Power Output Level	Fixed
Antenna Type	BNC Connector
Frequency Tolerance:	1.5 ppm %
Emission Type(s):	F1D
Interface Cables:	Antenna In/Out
Power Source & Voltage:	120Vac

2.2 Test Configuration

The R3A was configured with a dummy load connected via an RG-58 cable from the TX/RX port. A test program was flash transmitted into the transceiver board, allowing setting of channels and modulation modes.

2.3 Testing Algorithm

The R3A was provided with flash software in the EUT to allow receive mode, CW mode, and modulated modes on three (3) channels: 447MHz, 460MHz, and 473MHz.

Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 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

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Manufacturer	Model/Type	Function	Identification	Cal. Due
HP	8568B	Spectrum Analyzer	2634A02888	7/07/04
HP	85650A	Quasi-Peak Adapter	3303A01786	7/08/04
Solar	8012-50-R-24BNC	LISN	8379493	6/20/04
ARA	LPB-2520	BiconiLog Antenna	1044	6/20/04
EMCO	3146A	Log Periodic Antenna	8912-1129	6/20/04
HP	85685A	RF Preselector	3221A01395	7/03/04
ARA	DRG-118/A	Horn Antenna	1010	1/30/04
ARA	DRG-118/A	Horn Antenna	1236	9/27/04
HP	8563A	Spectrum Analyzer	3003A00168	4/4/04
HP	8593A	Spectrum Analyzer	3009A00739	6/25/04
HP	8449B	Pre-Amplifier	3008A00729	2/11/04
HP	8672A	Signal Generator	2311A03131	3/17/04
Racal-Dana		Frequency Counter	2806	4/30/04
Kikusui	PCR200L	AC/DC Power Supply	15030820	8/6/04
TekTronics	TDS220	Oscilloscope	B025304	8/18/04
HP	8648C	Signal Generator	3347A00242	4/30/04
Agilent	8474B	Crystal Detector	2905A04196	NCR

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046)

The output from the transmitter was connected to an attenuator and then to the input of an HP 438A RF power meter. The transmitter was set to transmit a constant carrier for the test and the RF output power was recorded.

Table 3. RF Power Output

Frequency	Level (Watts)
Low Channel 447MHz	1.413
Mid Channel 460MHz	1.469
High Channel 473MHz	1.648

4.2 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

FCC Part 90.210 states that the 20 dB bandwidth of the modulated carrier must comply with emissions mask D

Frequency Range (MHz)	Occupied Bandwidth Limit
421 - 512 MHz	12.5 kHz

The FM Direct FSK modulation consisted of a 4000 baud random data test pattern and the peak deviation measured 2.94 kHz on a Boonton 82AD modulation analyzer.

Bandwidth computation at 4000 bps:

Bn = 2M + 2DK (K = 1)

Bn = 4000 + 5880 = 9.8kHz

Emission designator: 9K80F1D

At full modulation, the occupied bandwidth was measured as shown:

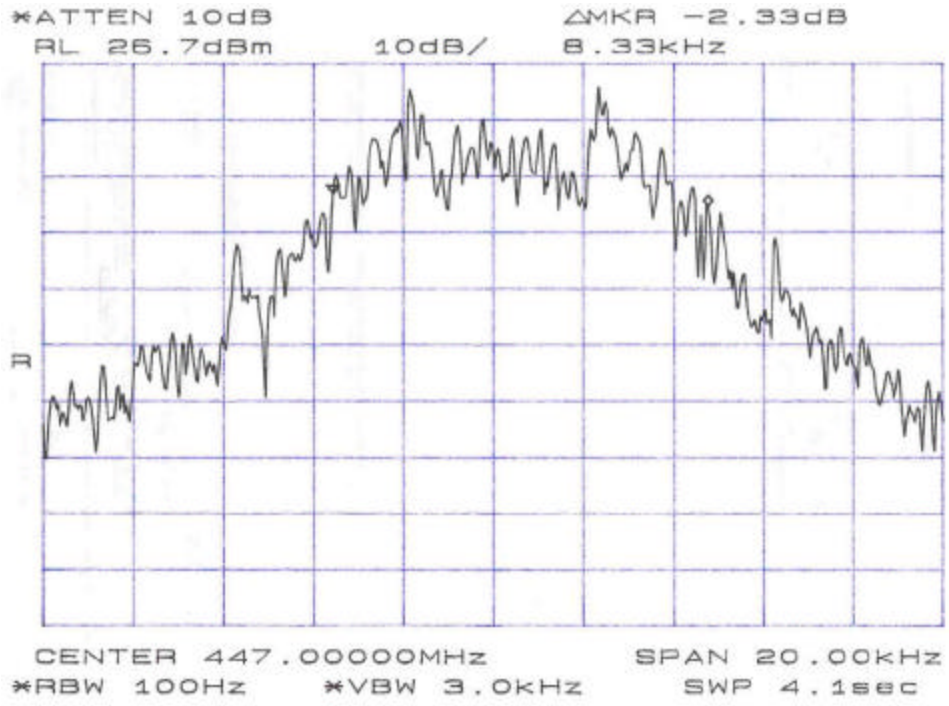

Figure 1. Occupied Bandwidth, Low Channel: 447MHz

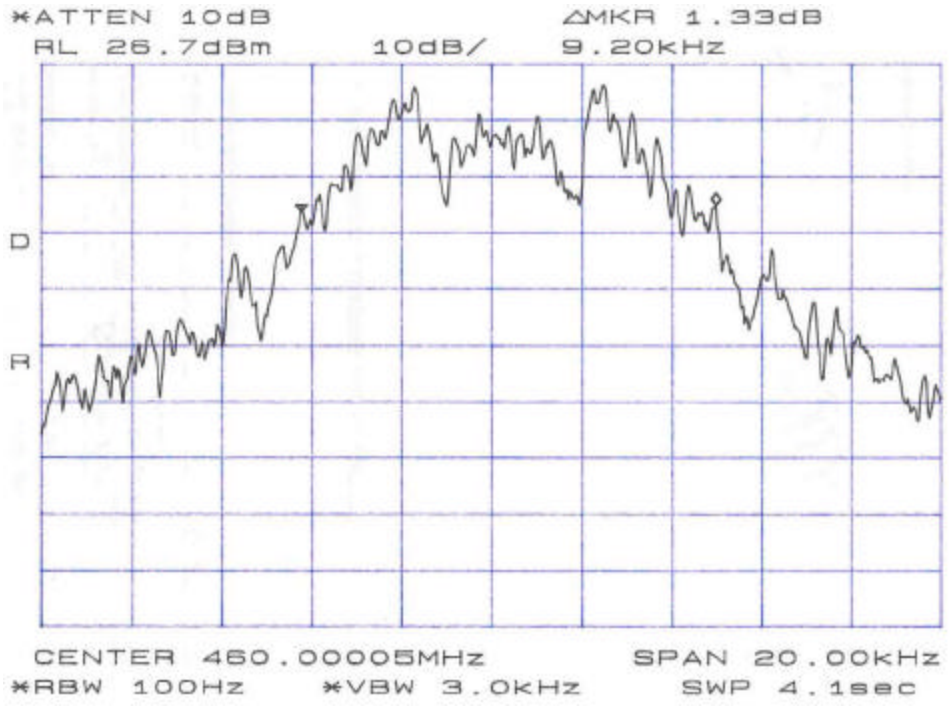

Figure 2. Occupied Bandwidth, Mid Channel: 460MHz

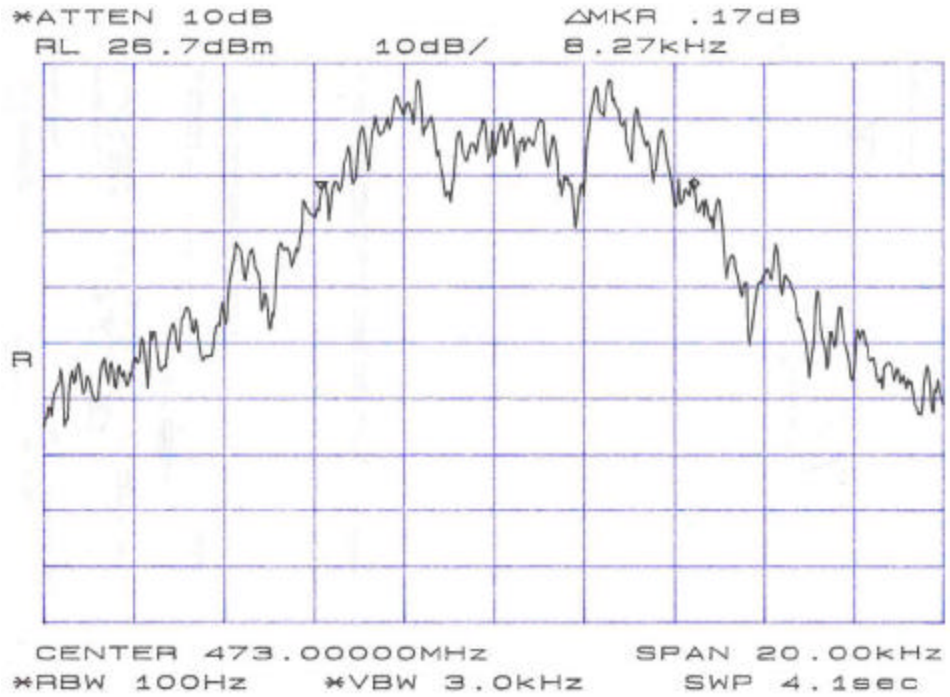

Figure 3. Occupied Bandwidth, High Channel: 473MHz

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel 447MHz	8.33kHz	12.5 kHz	Pass
Mid Channel 460MHz	9.20kHz	12.5 kHz	Pass
High Channel 473MHz	8.27kHz	12.5 kHz	Pass

4.3 Spurious Emissions at Antenna Terminals (FCC Part §2.1051

The EUT must comply with requirements for spurious emissions at antenna terminals. The limits are shown in the following table.

Table 5. Conducted Spurious Emission Limits

Frequency	Fundamental	Harmonic Limit (-dBc)

Low Channel		
Fundamental	447MHz	
Harmonics		Mask D
Mid Channel		
Fundamental	460MHz	
Harmonics		Mask D
High Channel		
Fundamental	473MHz	
Harmonics		Mask D

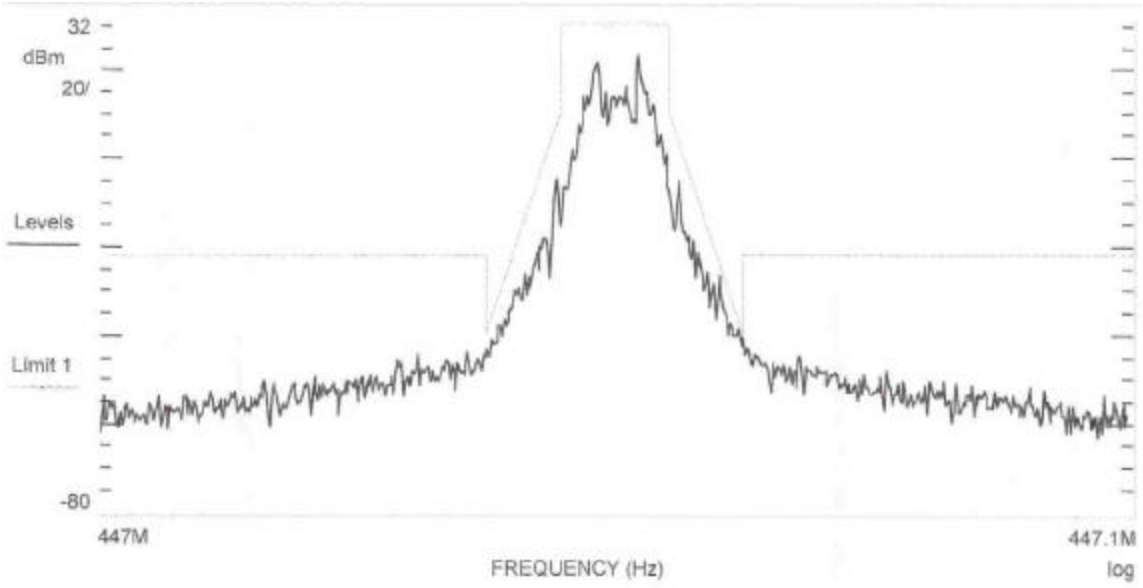

Figure 4. Emission Mask, Low Channel, 447 MHz

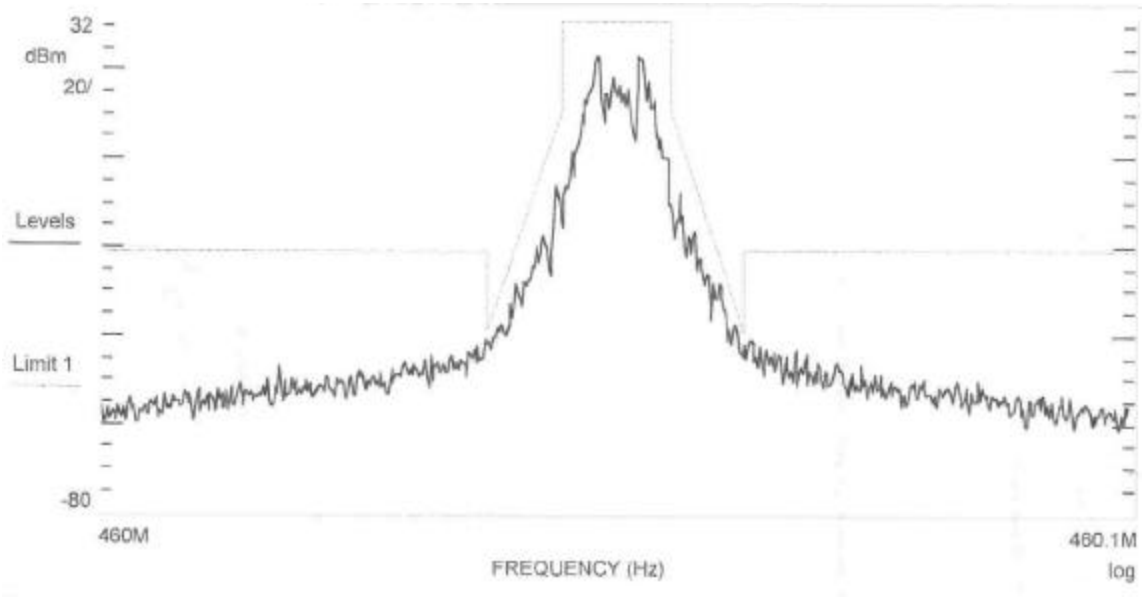

Figure 5. Emissions Mask, Mid Channel, 460 MHz

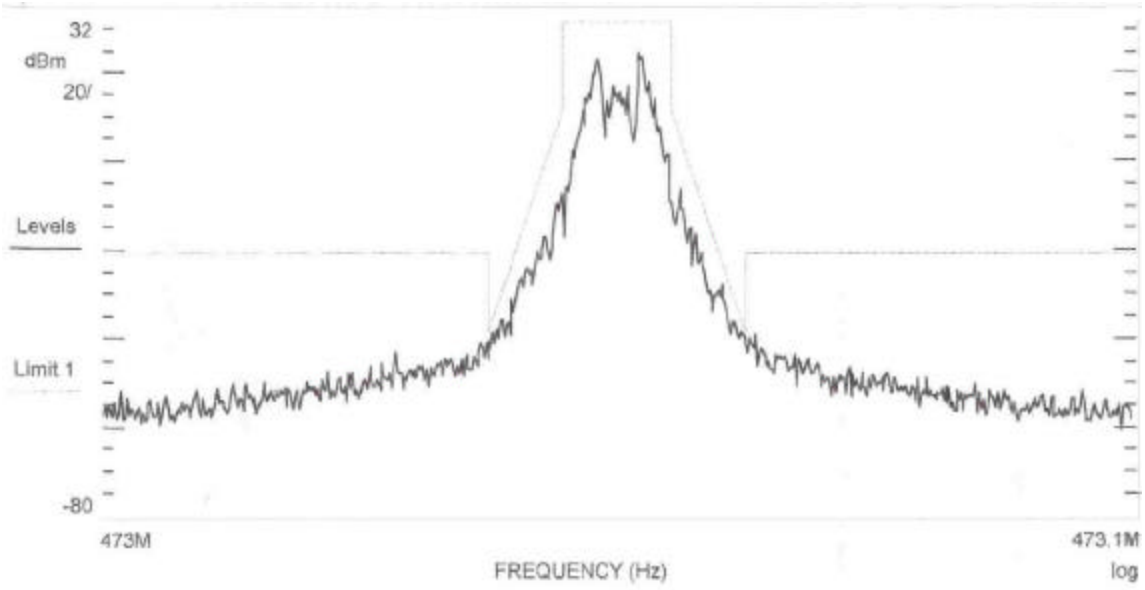

Figure 6. Emissions Mask, High Channel, 473 MHz

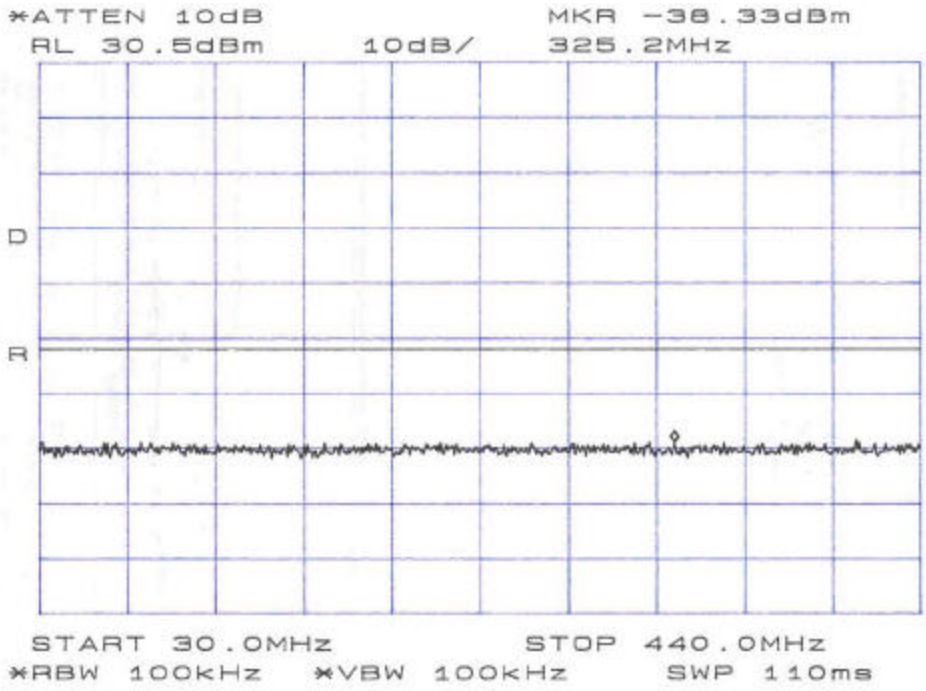

Figure 7. Conducted Spurious Emissions, 447MHz Low Channel: 30 - 440MHz

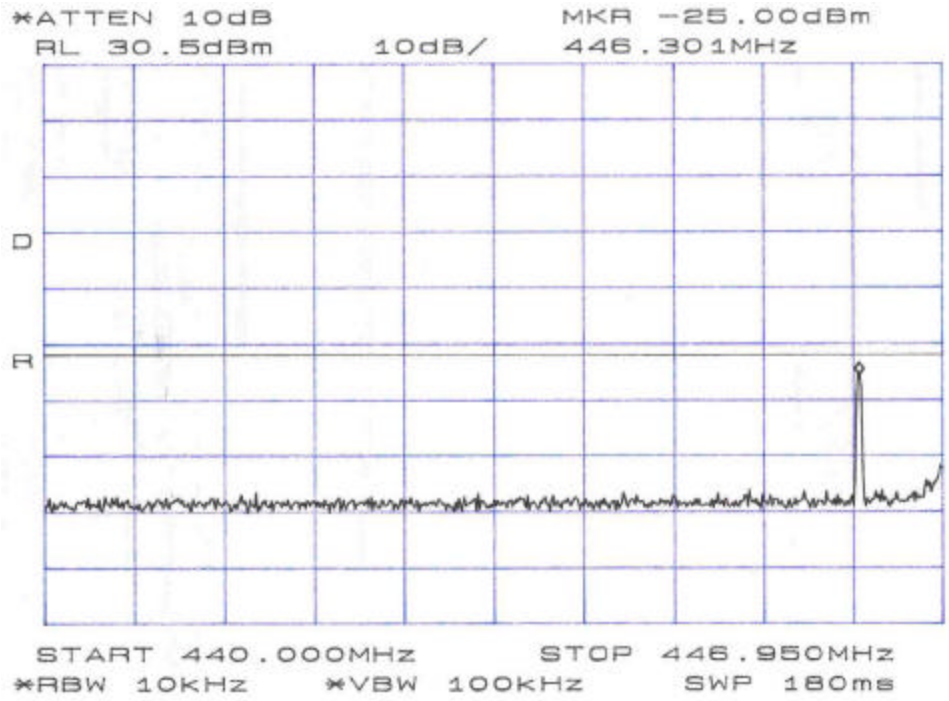

Figure 8. Conducted Spurious Emissions, 447MHz Low Channel: 440 - 446.95MHz

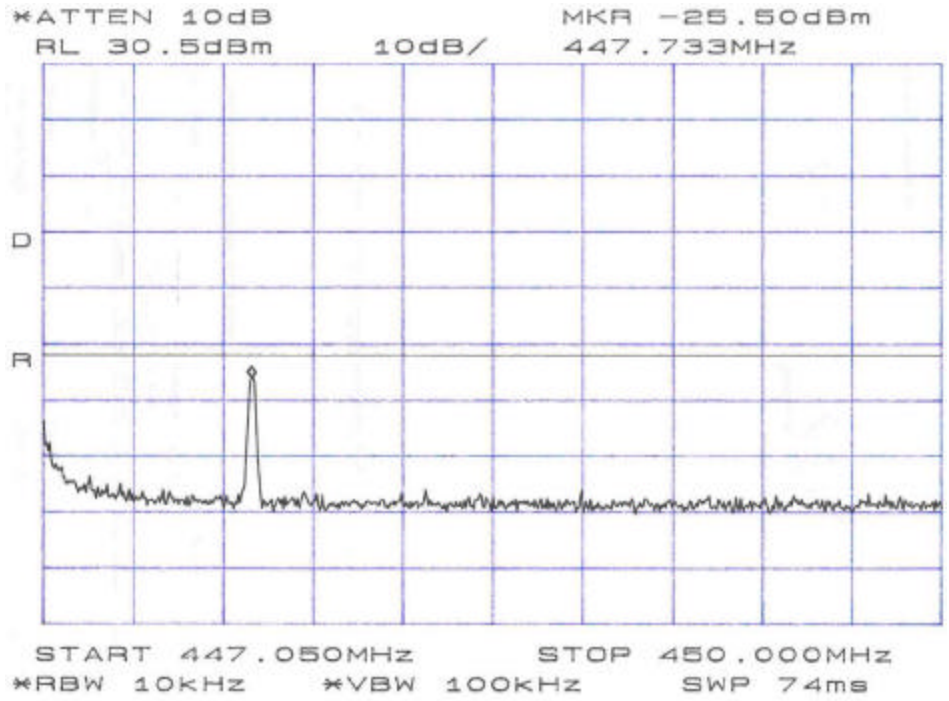

Figure 9. Conducted Spurious Emissions, 447MHz Low Channel: 447.05 - 450MHz

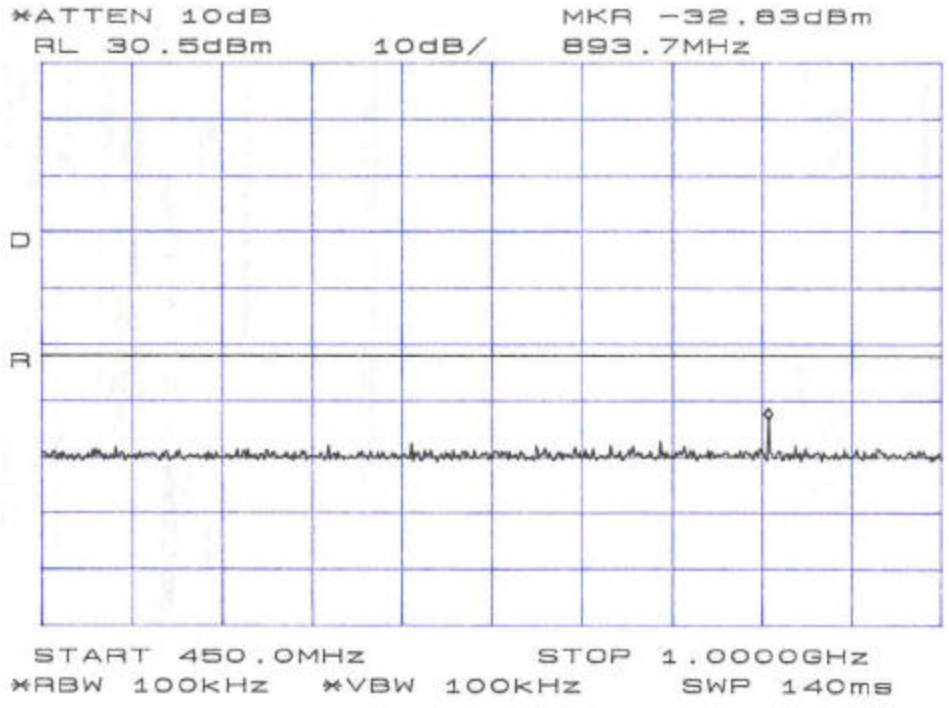

Figure 10. Conducted Spurious Emissions, 447MHz Low Channel: 450MHz - 1GHz

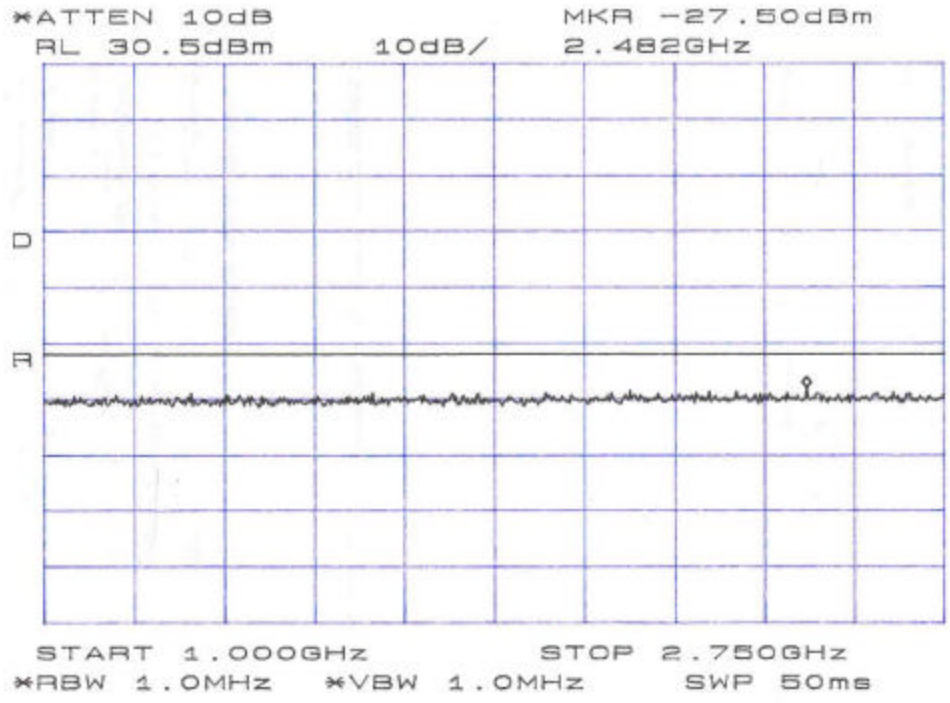

Figure 11. Conducted Spurious Emissions, 447MHz Low Channel: 1GHz - 2.75GHz

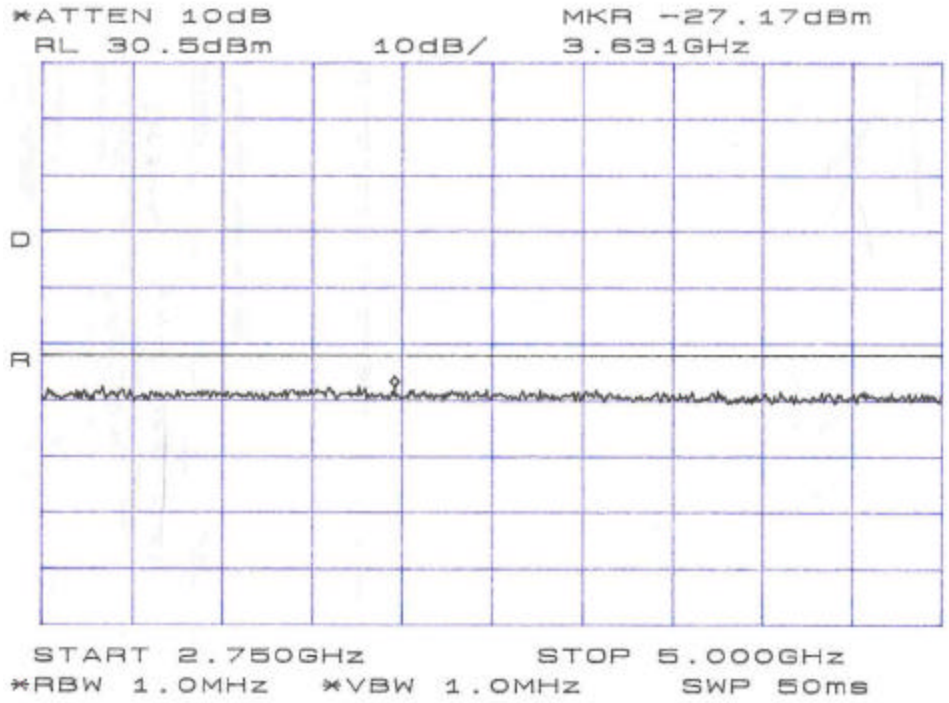

Figure 12. Conducted Spurious Emissions, 447MHz Low Channel: 2.75GHz - 5GHz

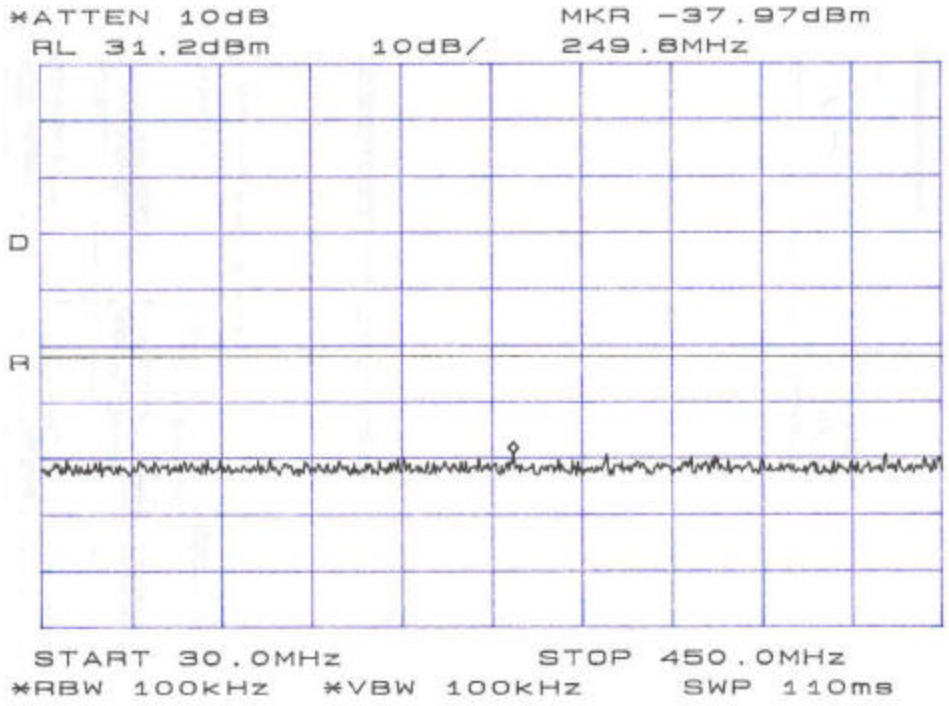

Figure 13. Conducted Spurious Emissions, 460MHz Mid Channel: 30 - 450MHz

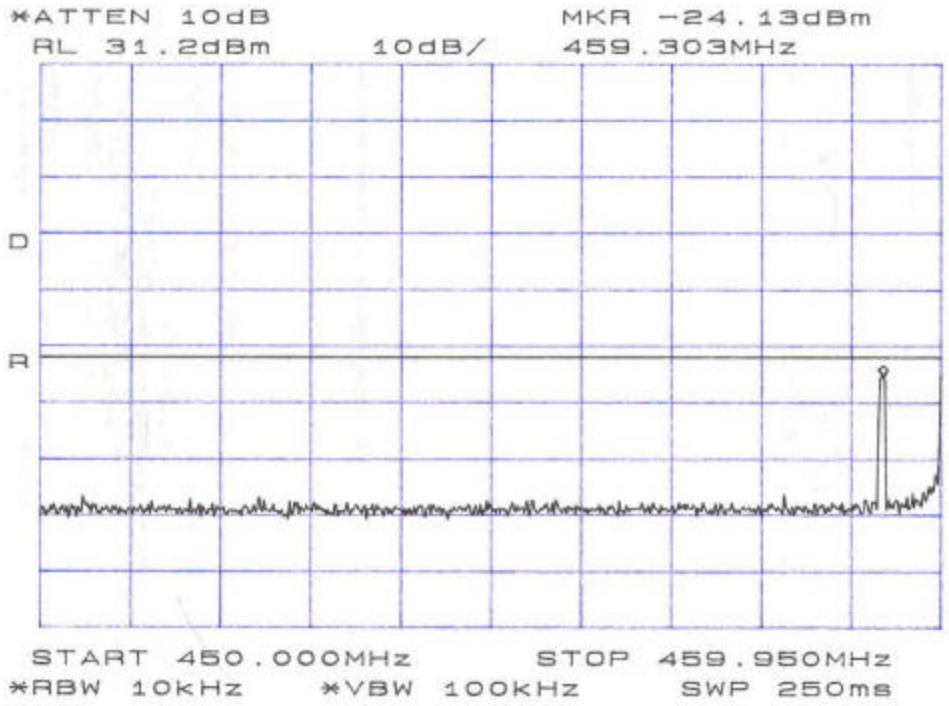

Figure 14. Conducted Spurious Emissions, 460MHz Mid Channel: 450 - 459.95MHz

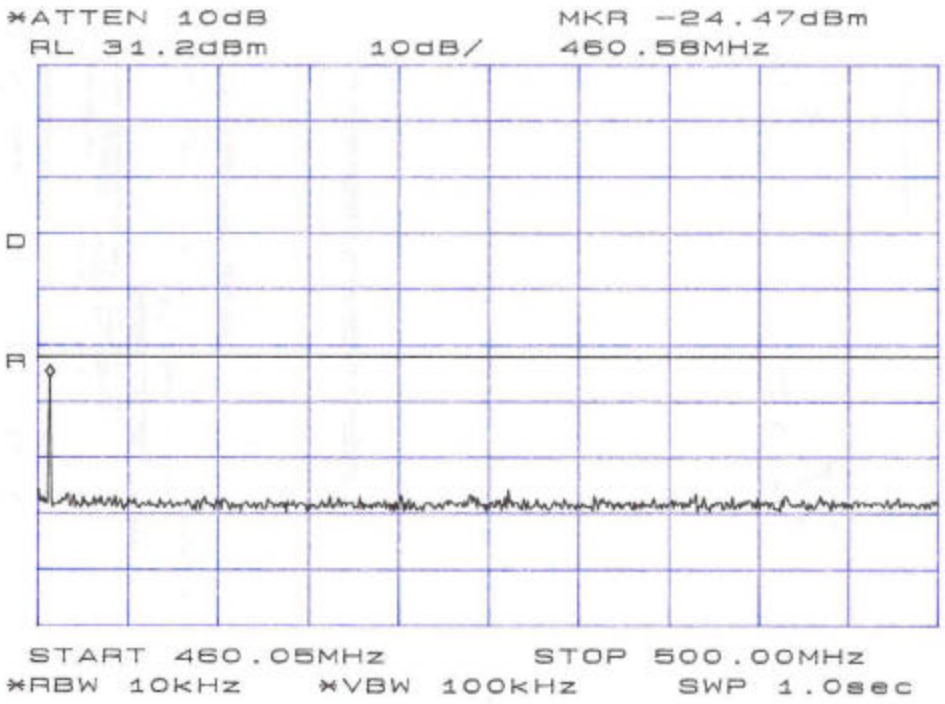

Figure 15. Conducted Spurious Emissions, 460MHz Mid Channel: 460 - 500MHz

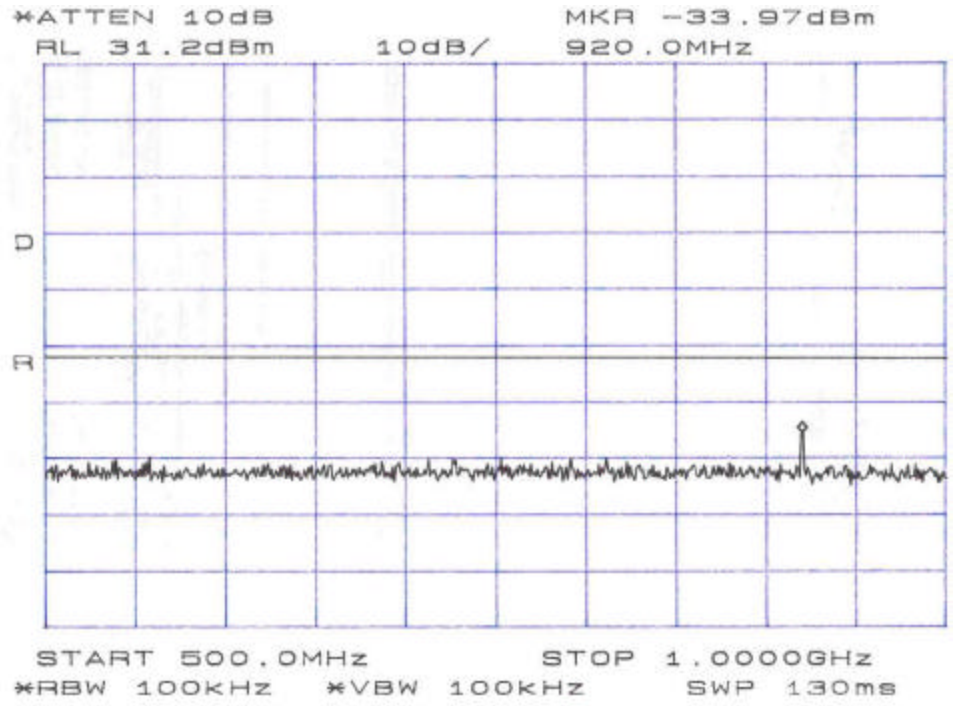

Figure 16. Conducted Spurious Emissions, 460MHz Mid Channel: 500MHz - 1GHz

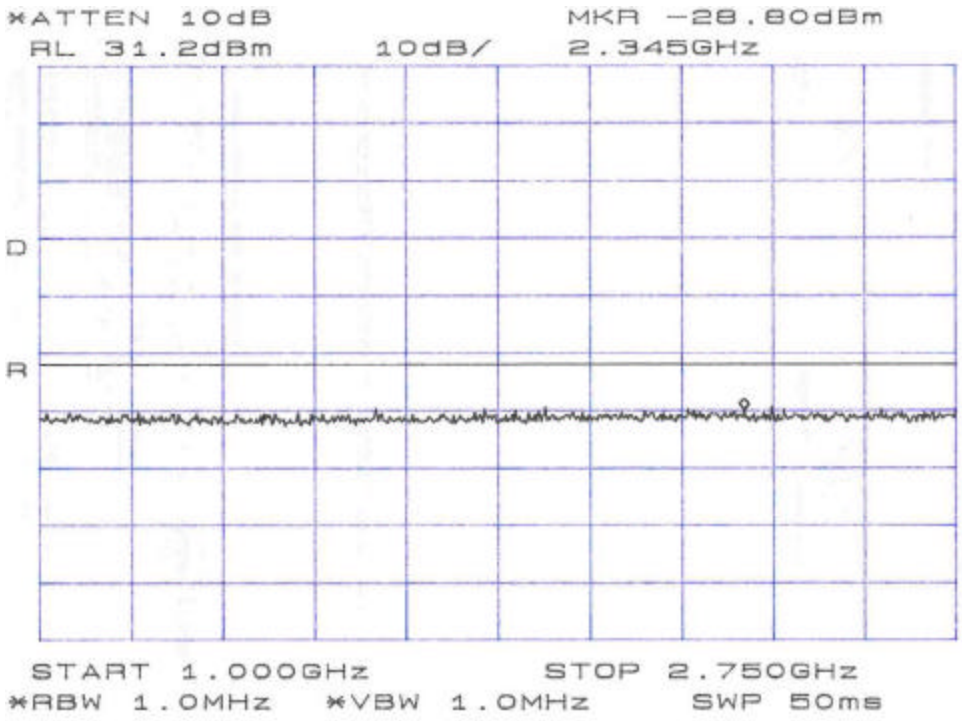

Figure 17. Conducted Spurious Emissions, 460MHz Mid Channel: 1GHz - 2.75GHz

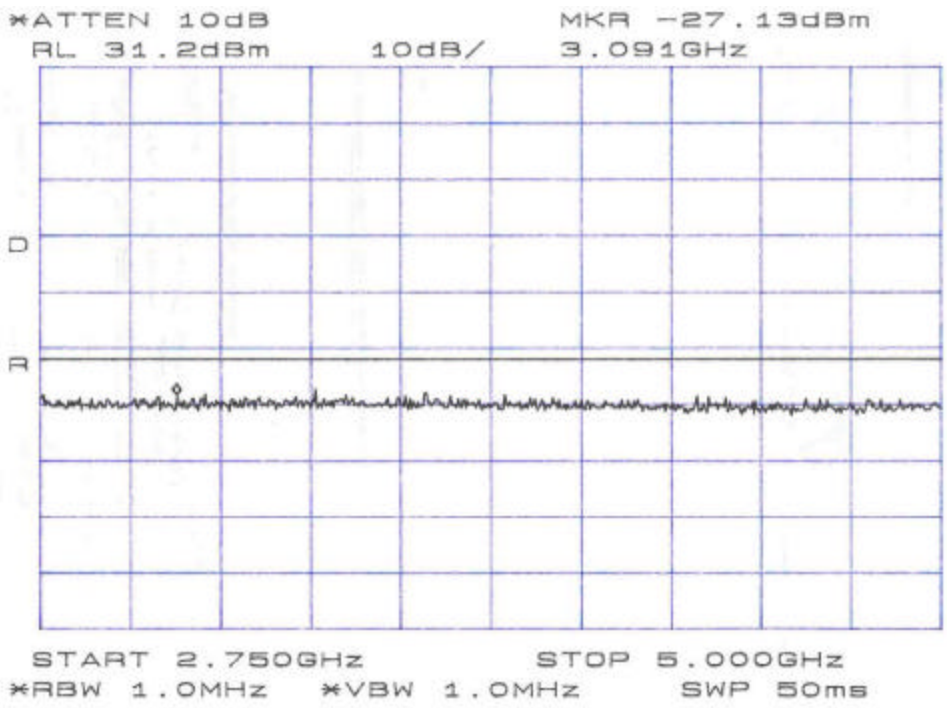

Figure 18. Conducted Spurious Emissions, 460MHz Mid Channel: 2.75GHz - 5GHz

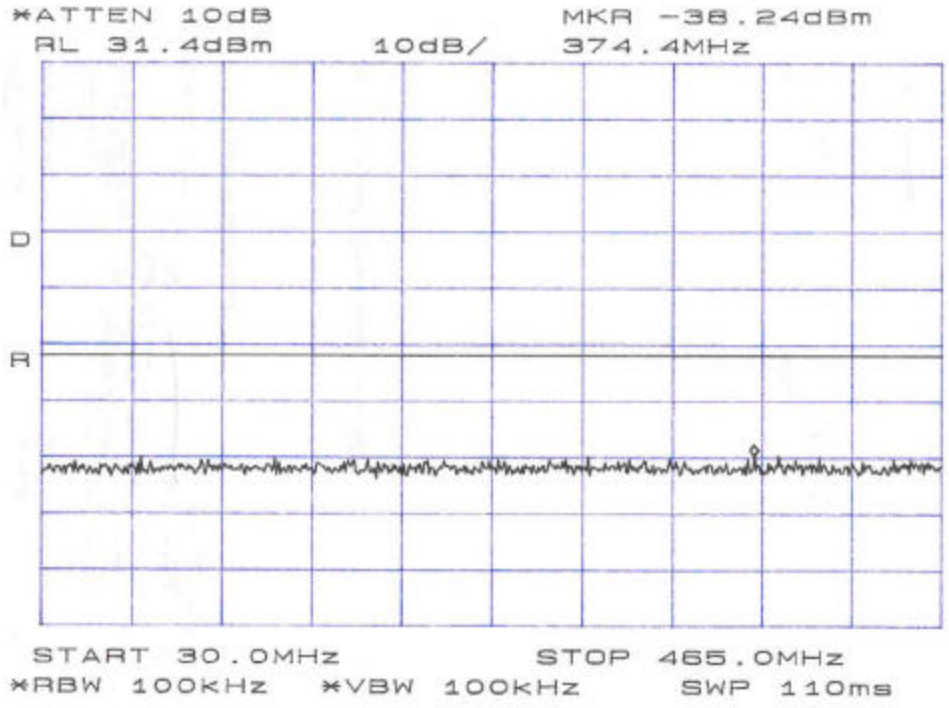

Figure 19. Conducted Spurious Emissions, 473MHz High Channel: 30 - 455MHz

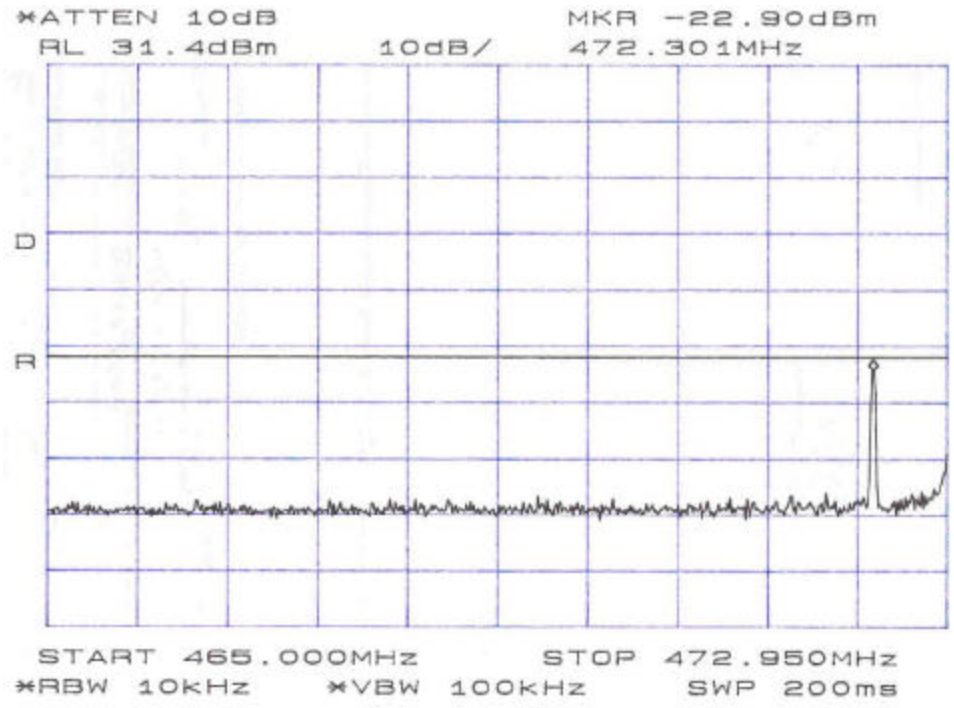

Figure 20. Conducted Spurious Emissions, 473MHz High Channel: 455 - 472.95MHz

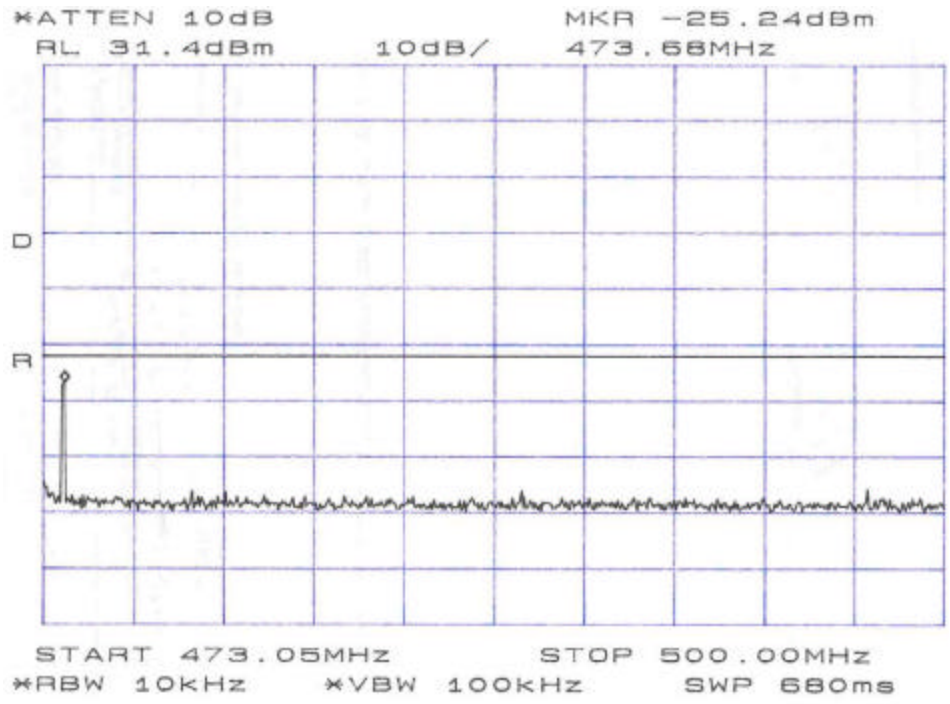

Figure 21. Conducted Spurious Emissions, 473MHz High Channel: 473 - 500MHz

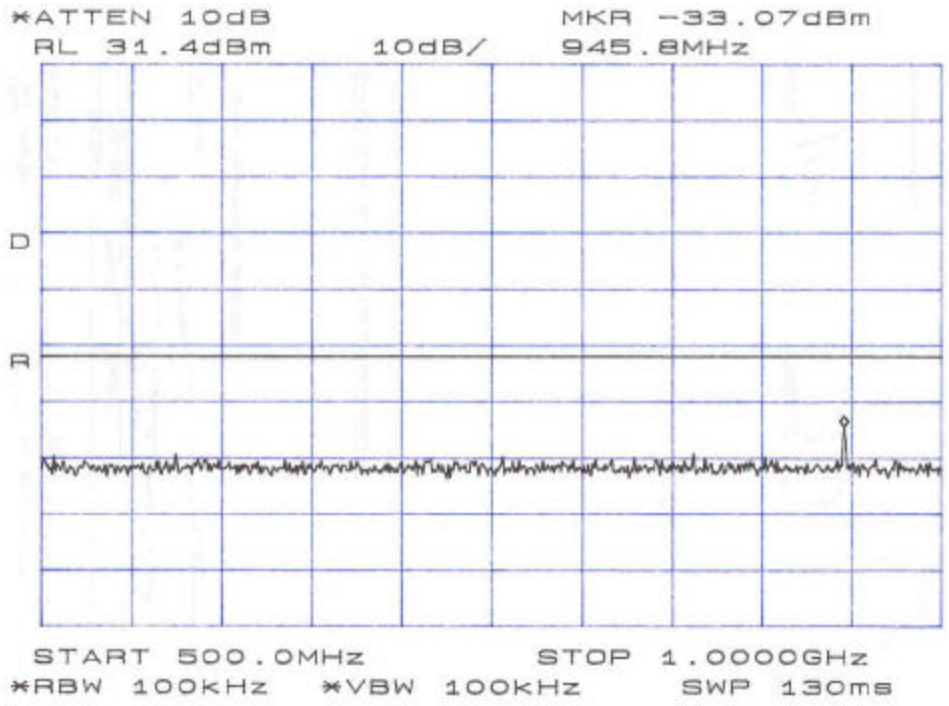

Figure 22. Conducted Spurious Emissions, 473MHz High Channel: 500MHz - 1GHz

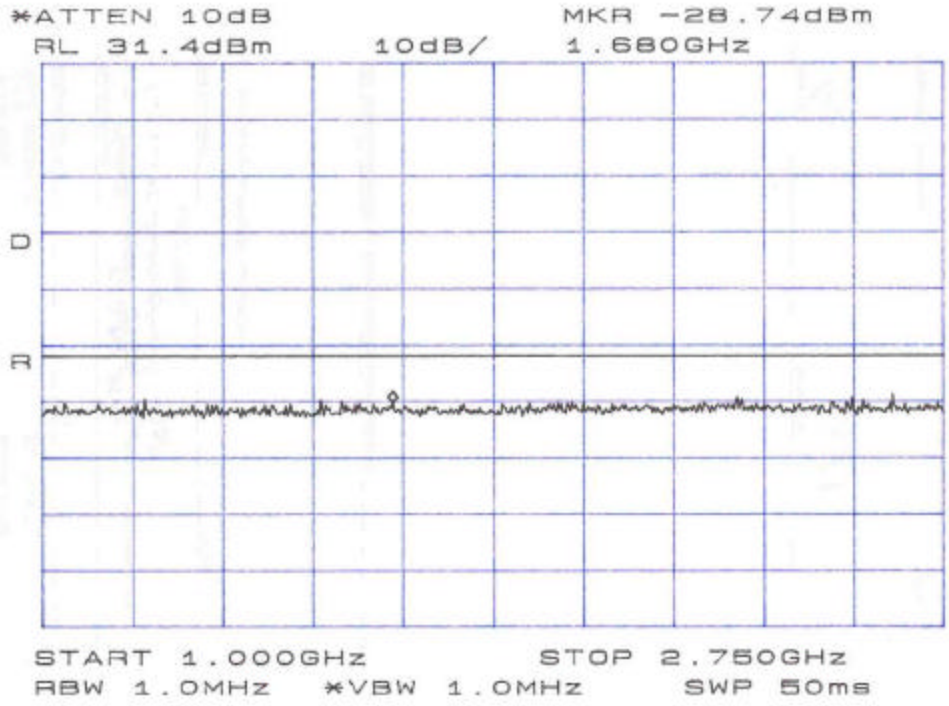

Figure 23. Conducted Spurious Emissions, 473MHz High Channel: 1GHz - 2.75GHz

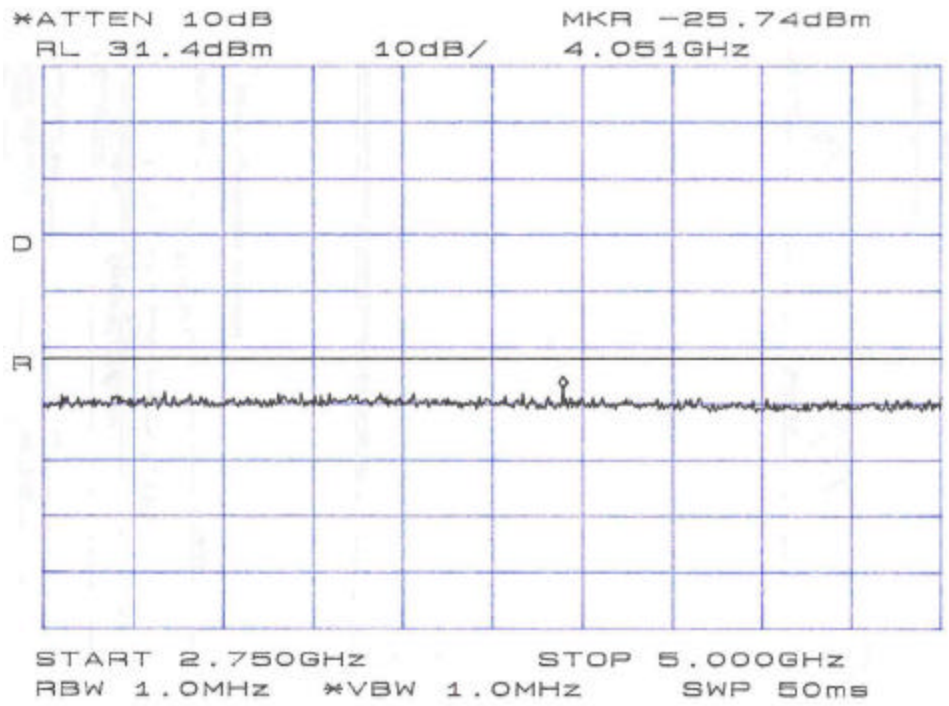

Figure 24. Conducted Spurious Emissions, 473MHz High Channel: 2.75GHz - 5GHz

4.4 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with requirements for radiated spurious emissions. The limits are as shown in the following table.

Table 6. Radiated Spurious Emissions Limits

Frequency	Fundamental	Harmonic Level (-dBc or E-Field)
Fundamental	N/A	
Harmonics		-52 dBc (Limit = -20dBm)
FCC Mask	Mask D	

4.4.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The RF output of the EUT was terminated by a suitable 50-ohm dummy load. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2001. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured up to the 10th harmonic of the fundamental.

The received levels of any detected spurious emissions are recorded in the data sheet. The EUT is then replaced with a transmit antenna and signal generator. Output power of the signal generator was increased until the same received level was indicated on the spectrum analyzer for the emission under investigation. Radiated power of the emission was then determined by adding the power supplied to the substitution antenna with the gain of the substitution antenna and comparing the result to the limit.

Table 7: Radiated Emission Test Data

CLIENT:	Cattron	DATE:	10/3/03
TESTER:	James Ritter	JOB #:	7769
EUT Information:		**Test Requirements:**	
EUT:	RCR Transceiver	TEST STANDARD:	FCC Part 90
CONFIGURATION:	Transmit at 460 MHz into dummy load Ch2		
DISTANCE:	3m		
Test Equipment/Limit:			
ANTENNA:	A_00007		
LIMIT: -20dBm (52dBc)			
CABLE:	CSITE2_3m		
AMPLIFIER (dB)	#66 for above 1 GHz		

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Gain dBi	Sig. Gen. Level dBm	EIRP Level dBm	Limit (dBm)	Margin dB
460.00	H	270.0	1.2	56.7	6.8	-22.0	-15.2	Fundamental	
919.97	H	190.0	1.0	3.8	6.1	-68.0	-61.9	-20.0	-41.9
1380.10	H	270.0	1.0	44.5	6.4	-72.5	-66.1	-20.0	-46.1
1840.17	H	0.0	1.0	50.3	7.4	-63.1	-55.7	-20.0	-35.7
2300.14	H	180.0	1.0	50.8	8.0	-55.3	-47.3	-20.0	-27.3
2760.05	H	270.0	1.0	50.0	8.8	-55.6	-46.8	-20.0	-26.8
3220.07	H	180.0	1.0	48.0	9.5	-53.0	-43.5	-20.0	-23.5
3680.07	H	180.0	1.0	44.3	10.2	-65.5	-55.3	-20.0	-35.3
4140.07	H	270.0	1.0	49.3	10.7	-57.8	-47.1	-20.0	-27.1
4600.07	H	180.0	1.0	42.7	11.0	-66.5	-55.5	-20.0	-35.5
460.00	V	180.0	1.5	53.2	6.8	-16.5	-9.7		
919.97	V	270.0	3.4	7.3	6.1	-64.0	-57.9	-20.0	-37.9

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Gain dBi	Sig. Gen. Level dBm	EIRP Level dBm	Limit (dBm)	Margin dB
1380.10	V	90.0	1.0	49.2	6.4	-68.3	-61.9	-20.0	-41.9
1840.17	V	0.0	1.0	57.3	7.4	-56.5	-49.1	-20.0	-29.1
2300.14	V	0.0	1.0	55.3	8.0	-51.5	-43.5	-20.0	-23.5
2760.05	V	180.0	1.0	51.5	8.8	-57.3	-48.5	-20.0	-28.5
3220.07	V	165.0	1.0	51.3	9.5	-55.6	-46.1	-20.0	-26.1
3680.07	V	270.0	1.0	48.2	10.2	-58.8	-48.6	-20.0	-28.6
4140.07	V	0.0	1.0	53.5	10.7	-57.3	-46.6	-20.0	-26.6
4600.07	V	90.0	1.0	44.8	11.0	-60.8	-49.8	-20.0	-29.8
446.99	H	290.0	1.5	56.6	6.3	-7.0	-0.7	Fundamental	
894.00	H	180.0	1.0	4.8	6.5	-65.0	-58.5	-20.0	-38.5
1341.12	H	45.0	1.0	46.7	6.3	-67.3	-61.0	-20.0	-41.0
1788.08	H	90.0	1.0	46.2	7.1	-67.0	-59.9	-20.0	-39.9
2235.08	H	0.0	1.0	44.5	7.9	-64.3	-56.4	-20.0	-36.4
2682.08	H	90.0	1.0	45.3	8.6	-64.5	-55.9	-20.0	-35.9
3129.08	H	180.0	1.0	44.2	9.3	-64.8	-55.5	-20.0	-35.5
3576.08	H	0.0	1.0	48.3	10.0	-58.5	-48.5	-20.0	-28.5
4023.08	H	0.0	1.0	45.2	10.6	-62.3	-51.7	-20.0	-31.7
4470.08	H	180.0	1.0	44.3	10.9	-64.3	-53.4	-20.0	-33.4
446.99	V	0.0	1.3	48.9	6.3	-22.0	-15.7	Fundamental	
894.00	V	0.0	1.0	8.2	6.5	-62.0	-55.5	-20.0	-35.5
1341.12	V	90.0	1.0	51.2	6.3	-64.8	-58.5	-20.0	-38.5
1788.08	V	90.0	1.0	50.5	7.1	-64.6	-57.5	-20.0	-37.5
2235.08	V	180.0	1.0	45.8	7.9	-61.6	-53.7	-20.0	-33.7
2682.08	V	0.0	1.0	48.2	8.6	-58.6	-50.0	-20.0	-30.0
3129.08	V	180.0	1.0	51.5	9.3	-52.1	-42.8	-20.0	-22.8
3576.08	V	280.0	1.0	52.0	10.0	-51.8	-41.8	-20.0	-21.8
4023.08	V	270.0	1.0	50.8	10.6	-54.0	-43.4	-20.0	-23.4
4470.08	V	270.0	1.0	46.8	10.9	-60.1	-49.2	-20.0	-29.2
473.00	H	270.0	1.5	62.0	6.7	-4.0	2.7	Fundamental	
946.00	H	0.0	1.5	3.2	6.0	-69.0	-63.0	-20.0	-43.0
1418.90	H	90.0	1.0	42.2	6.5	-68.0	-61.5	-20.0	-41.5
1892.02	H	180.0	1.0	52.3	7.2	-55.6	-48.4	-20.0	-28.4
2365.02	H	0.0	1.0	51.5	8.1	-55.3	-47.2	-20.0	-27.2
2838.02	H	180.0	1.0	46.8	8.9	-59.8	-50.9	-20.0	-30.9
3311.02	H	0.0	1.0	40.0	9.6	-68.0	-58.4	-20.0	-38.4
3784.02	H	90.0	1.0	43.7	10.3	-64.3	-54.0	-20.0	-34.0
4257.00	H	0.0	1.0	47.5	10.8	-57.6	-46.8	-20.0	-26.8
4730.02	H	0.0	1.0	43.2	11.1	-64.5	-53.4	-20.0	-33.4
473.00	V	45.0	2.0	54.0	6.7	-17.0	-10.3	Fundamental	
946.00	V	0.0	1.3	4.1	6.0	-67.5	-61.5	-20.0	-41.5
1418.90	V	0.0	1.0	44.0	6.5	-69.6	-63.1	-20.0	-43.1
1892.02	V	45.0	1.0	60.0	7.2	-51.8	-44.6	-20.0	-24.6
2365.02	V	90.0	1.0	55.2	8.1	-52.6	-44.5	-20.0	-24.5

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Gain dBi	Sig. Gen. Level dBm	EIRP Level dBm	Limit (dBm)	Margin dB
2838.02	V	180.0	1.0	49.7	8.9	-59.6	-50.7	-20.0	-30.7
3311.02	V	0.0	1.0	43.0	9.6	-65.0	-55.4	-20.0	-35.4
3784.02	V	45.0	1.0	48.3	10.3	-57.0	-46.7	-20.0	-26.7
4257.00	V	180.0	1.0	48.8	10.8	-55.6	-44.8	-20.0	-24.8
4730.02	V	180.0	1.0	45.7	11.1	-60.8	-49.7	-20.0	-29.7

4.5 AC Line Conducted Emissions (FCC Part 15.107)

4.5.1 Requirements

Compliance Limits		
Frequency	Quasi-peak	Average
0.15-0.5MHz	79dBµV	66dBµV
0.5-30MHz	73dBµV	60dBµV

4.5.2 Test Procedure

The EUT was placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 µH Line Impedance Stabilization Network bonded to a 3 X 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4-2001. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth.

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed.

4.5.3 Test Data

Table 8 provides the test results for phase and neutral line power line conducted emissions.

Table 8. AC Line Conducted Emissions Test Data

CLIENT:	Cattron	DATE:	12/23/03
MODEL:	MP96GIIRCR	TEST STANDARD:	FCC Part 15
TESTER:	James Ritter	JOB #:	7770
CONFIGURATION:	Freq: 460MHz	CLASS:	FCC_B
TEST VOLTAGE:	120 VAC	TEST SITE:	CSITE2_CE

LINE 1 - NEUTRAL

Frequency MHz	Level QP dBuV	Cable Loss dB	Limit QP dBuV	Margin QP dB	Level AVG dBuV	Cable Loss dB	Limit AVG dBuV	Margin AVG dB
0.186	42.4	10.7	64.2	-11.1	35.8	10.7	54.2	-7.7
0.239	37.5	10.7	62.1	-13.9	30.9	10.7	52.1	-10.5
0.472	23.5	10.7	56.5	-22.2	23.5	10.7	46.5	-12.2
0.952	24.8	11.0	56.0	-20.2	24.8	11.0	46.0	-10.2
3.720	17.9	11.5	56.0	-26.6	17.9	11.5	46.0	-16.6
10.468	15.8	12.0	60.0	-32.2	15.8	12.0	50.0	-22.2
21.681	17.1	12.7	60.0	-30.2	17.1	12.7	50.0	-20.2
24.575	23.7	12.8	60.0	-23.5	23.7	12.8	50.0	-13.5

LINE 2 - PHASE

Frequency MHz	Level QP dBuV	Cable Loss dB	Limit QP dBuV	Margin QP dB	Level AVG dBuV	Cable Loss dB	Limit AVG dBuV	Margin AVG dB
0.186	50.1	10.7	64.2	-3.4	41.2	10.7	54.2	-2.3
0.239	49.0	10.7	62.1	-2.4	39.1	10.7	52.1	-2.3
0.472	37.8	10.7	56.5	-7.9	32.8	10.7	46.5	-2.9
0.952	40.0	11.0	56.0	-5.0	32.1	11.0	46.0	-2.9
3.720	21.5	11.5	56.0	-23.0	21.5	11.5	46.0	-13.0
10.468	20.3	12.0	60.0	-27.7	20.3	12.0	50.0	-17.7
21.676	18.2	12.7	60.0	-29.1	18.2	12.7	50.0	-19.1
24.575	24.8	12.8	60.0	-22.4	24.8	12.8	50.0	-12.4

4.6 Frequency Stability: (FCC Part §2.1055)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances.

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The EUT is powered by AC voltage supplied externally. Testing was performed at 115% (132.25 VAC) and 85% (97.75 VAC) of the nominal (115 VAC) AC input voltage. Table 9 shows the results of this test.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter. The following are the reference frequencies at ambient for the Middle channel.

Mid Channel: 460MHz

Table 9. Frequency Deviation as a Function of Temperature

Temperature (Celsius)	Frequency (MHz)	Deviation (Hz)	Limit (Hz)
Mid Channel			
Ambient	459.999700	0.0	
-30	460.000054	354.0	± 690
-20	459.999941	241.0	± 690
-10	459.999680	-20.0	± 690
0	459.999586	-114.0	± 690
10	459.999351	-349.0	± 690
20	459.999429	-271.0	± 690
30	459.999650	-50.0	± 690
40	460.000085	385.0	± 690
50	460.000208	508.0	± 690

Table 10. Frequency Deviation as a Function of Voltage

Voltage Volts	Frequency MHz	Difference Hz	Difference PPM	Voltage Volts

At rated	459.999572	0	0.0	115VAC
At 85%	459.999581	-9	-0.02	97.75VAC
At 115%	459.999586	-14	-0.03	132.25VAC

Notes: PPM Deviation = ((Ambient Freq/Freq at test time) -1) *1000000

Limit= 1.5PPM (+/- 690Hz) as per FCC 90.213 footnote 7 for 12.5 KHz channels at 460 MHz

4.7 Transient Frequency Response (Part 90.214)

The transient frequency behavior of the transmitter was measured per the method describe in TIA/EIA 603.

The spectrum analyzer was tuned to the carrier frequency of the transmitter. The demodulated AUX Video Output of the spectrum analyzer was connected to the Channel 1 of the oscilloscope to provide a signal that is proportional to the frequency deviation of the input from the RF combiner.

The transmitter was keyed on and the waveform was captured on the oscilloscope. This procedure was repeated while turning off the transmitter and capturing the turn-off waveform.

The following plots depict the “turn-off” and “turn-on” time intervals for the unit under test. During the transient frequency behavior testing the EUT was in full modulation. The transmitter meets the requirements for transient frequency behavior.

Figure 3 shows the “turn-on” time of the transmitter depicting the transmitter behavior during t_1, t_2 and t_3. The frequency deviation for the time following t_2 to the beginning of t_3 must meet the requirements of Part 90.213.

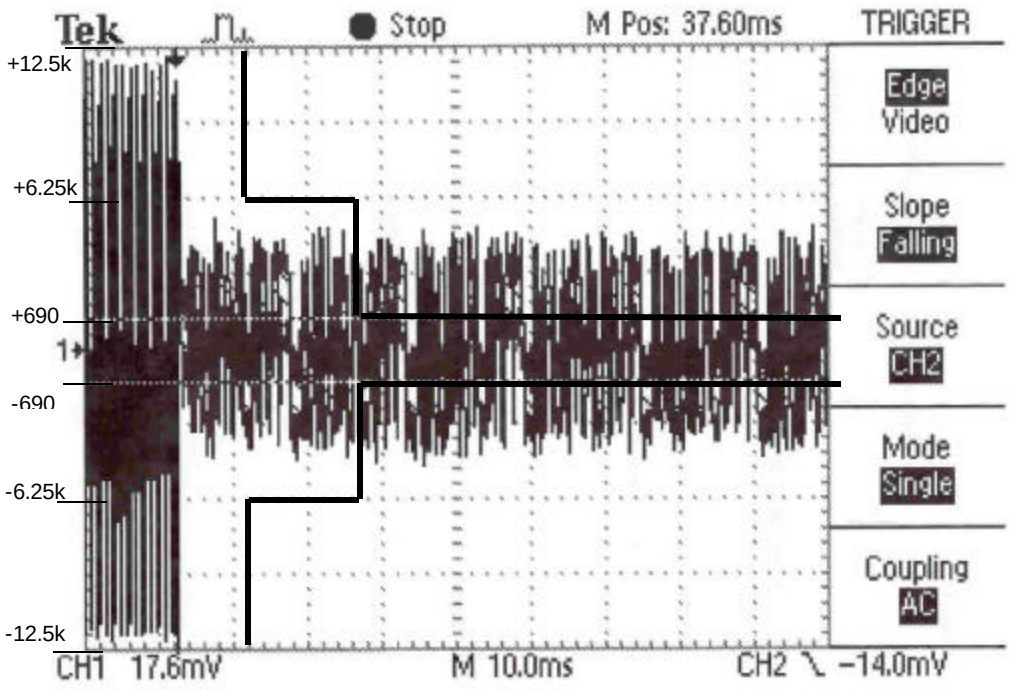

Figure 25. Transient Frequency Response: 447MHz ON Time

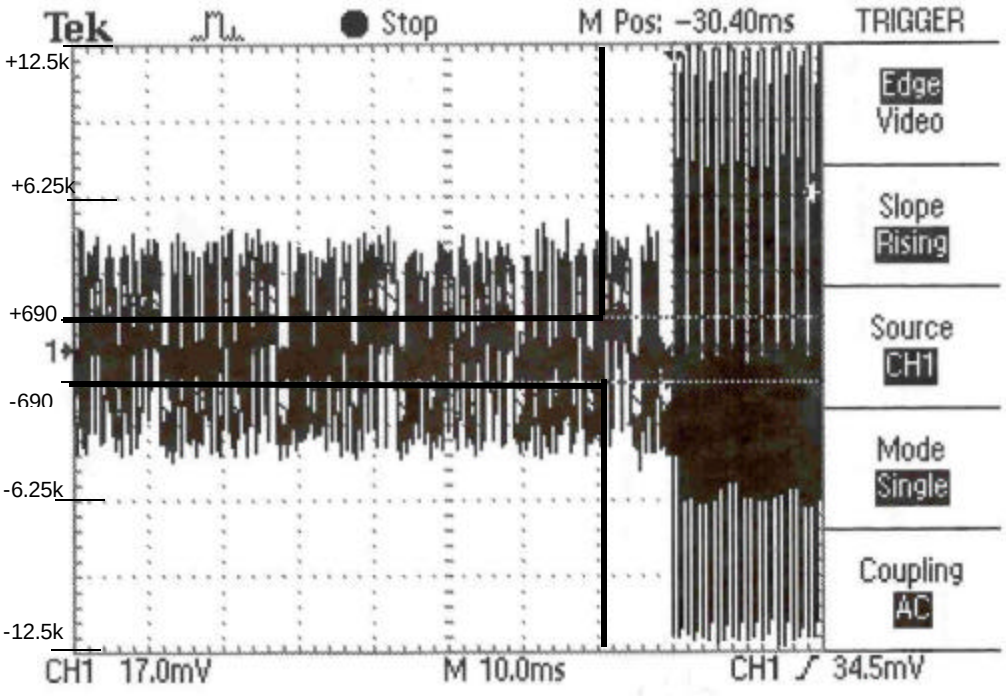

Figure 26. Transient Frequency Response: 447MHz OFF Time

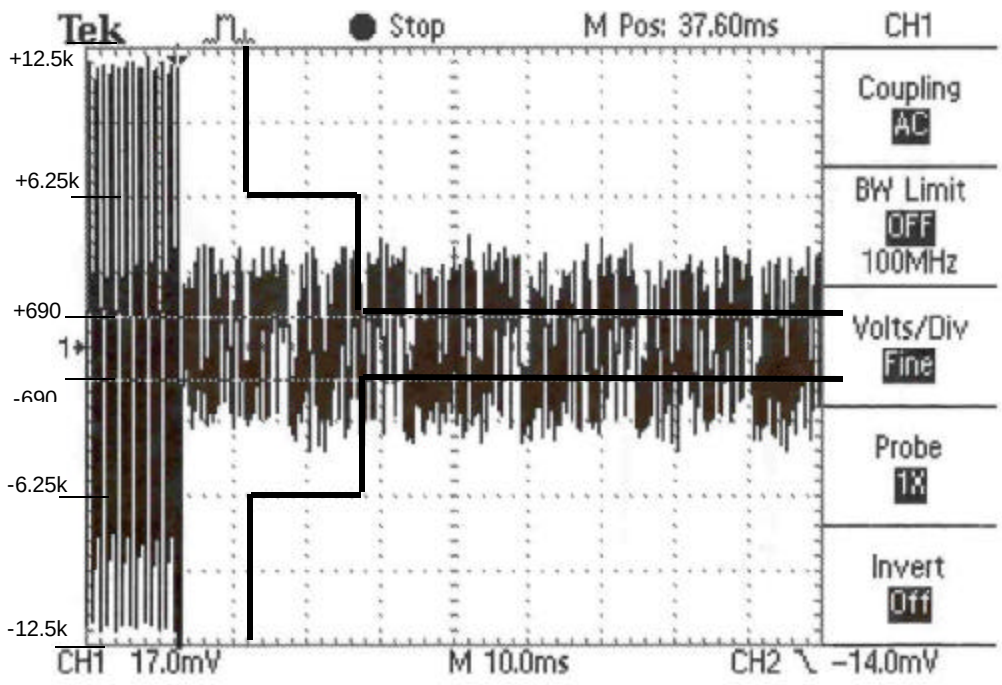

Figure 27. Transient Frequency Response: 460MHz ON Time

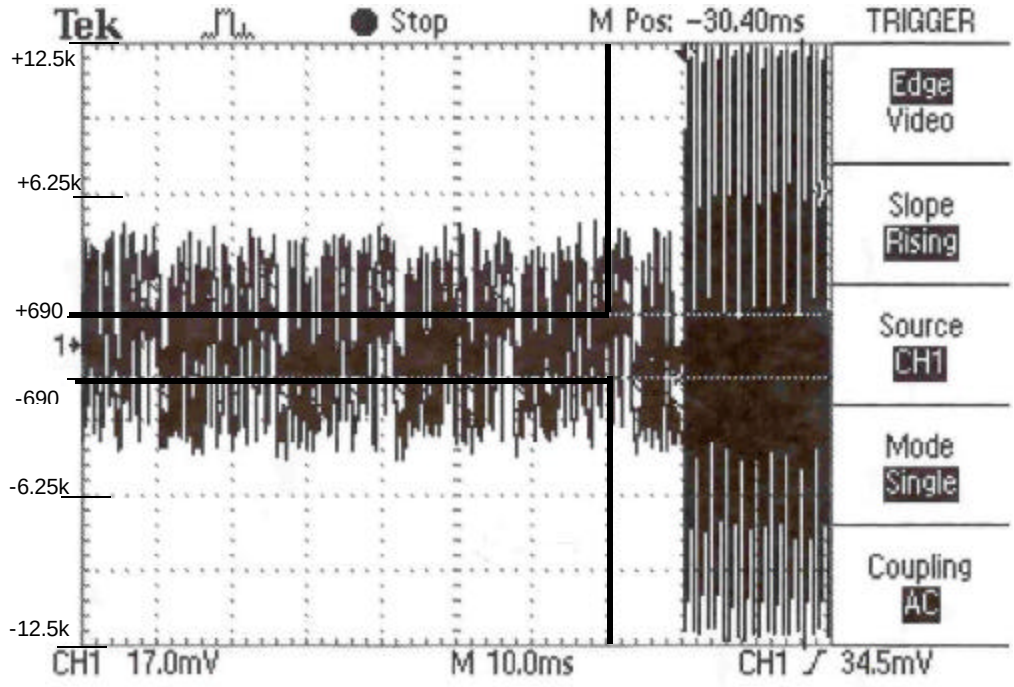

Figure 28. Transient Frequency Response: 460MHz OFF Time

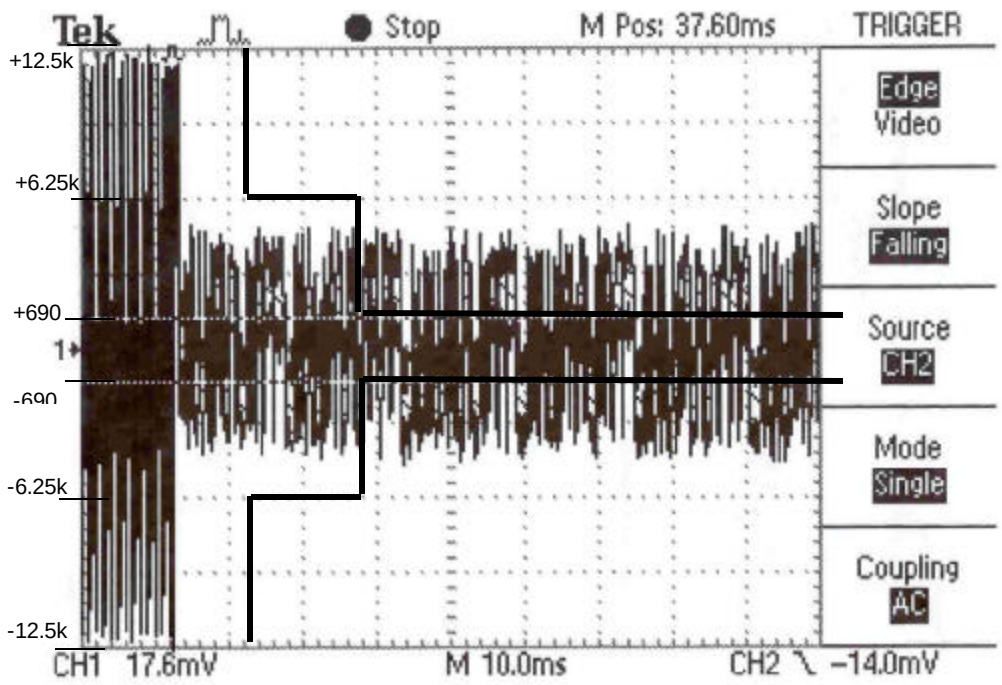

Figure 29. Transient Frequency Response: 473MHz ON Time

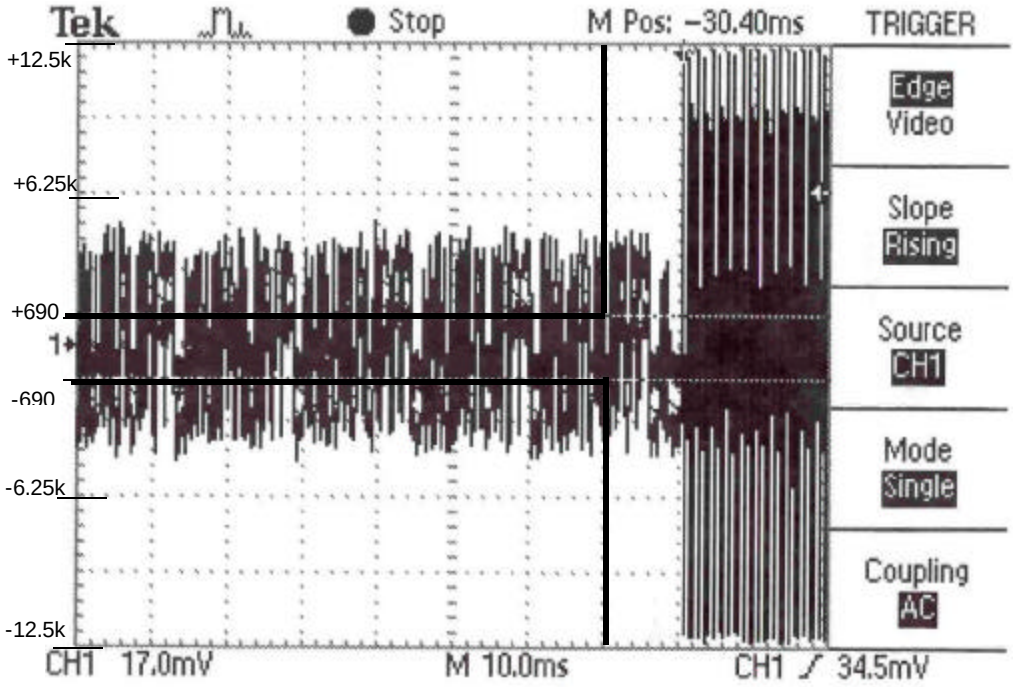

Figure 30. Transient Frequency Response: 473MHz OFF Time