

**Test Report  
From  
Netro Corporation**

**Test of Netro Corporation AirStar 28 GHz PMP 16 MHz**

**Radio Unit**

**Model Numbers BRU-F-2801-01  
and SRU-F-2802-01**

**To: CFR Title 47 Part 2 and Part 101**

**FCC ID: OZNRU28G**

**Information Provided in this Exhibit**

**Test Report – Data in these pages demonstrate conformance with the requirements of Title 47 Parts 2 and 101 for Certification.**

**12 December, 2000**

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

## Table of Contents

<b>Section 1. Identification &amp; Characteristics of Equipment Under Test.....</b>	<b>3</b>
1.1 Radio Unit Description .....	3
<b>Section 2. Technical Summary.....</b>	<b>4</b>
<b>Section 3. Tests Procedure .....</b>	<b>5</b>
3.1 Transmitter Output Power.....	5
3.2 Modulation Characteristics .....	5
3.3 Occupied Bandwidth.....	5
3.4 Spurious Emissions at Antenna Terminals .....	5
3.5 Field Strength of Spurious Emissions .....	5
3.6 Frequency Stability .....	7
<b>Section 4. Measurements, Examinations and Derived Results .....</b>	<b>7</b>
4.1 General Comments .....	7
4.2 Test Results.....	8
4.2.1 RF Power Output .....	8
4.2.2 Modulation Characteristics (Spectrum Mask).....	8
4.2.3 Occupied Bandwidth.....	8
4.2.4 Spurious Emissions at Antenna Terminals .....	9
4.2.5 Field Strength of Spurious Radiation.....	9
4.2.6 Frequency Stability .....	9
<b>Section 5. Summary of Test Results .....</b>	<b>10</b>
<b>Section 6. Test Equipment Used .....</b>	<b>10</b>
<b>Section 9. Graphs .....</b>	<b>10</b>
9.1 Modulation Characteristics and Emissions at Antenna Terminal <250% .....	11
9.2 Occupied Bandwidth.....	14
9.3 Spurious Emissions at Antenna Terminal > 250% B .....	15
9.4 Field Strength of Spurious Emissions .....	29
9.5 Frequency Stability .....	30
<b>Appendix A – 28 GHz PMP 1 GHz – 110 GHz Radiated Emissions Test Report .....</b>	<b>31</b>

**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

## **Section 1. Identification & Characteristics of Equipment Under Test**

### **1.1 Radio Unit Description**

The 28 GHz RU is part of a point to multipoint (PMP) digital radio relay system which utilizes TDMA protocol and provides up to 16 Mbps data rate operation. The radios operate full duplex frequency division multiplex (FDM) with a frequency pairing of 27.516-27.708 GHz for base stations and 27.932-28.124. GHz for subscriber stations. The RU accepts a 4 QAM digitally modulated 350 MHz IF signal from the indoor unit and produces the 28 GHz RF signal. The RU also accepts the RF signal via integral antenna from frequency duplexed radios and produces a 140 MHz IF signal that is fed to the indoor unit. All frequency conversion is accomplished using phase locked synthesizers that are capable of locking to a 14 MHz reference frequency provided by the indoor unit.

Base station antennas provide either 30 degree or 90 degree nominal azimuth beamwidth depending upon RU model. Subscriber radio antennas provide 7 degree nominal azimuth beamwidth.

The RU contains a central processor that provides communication to and from the indoor unit and control and status monitoring of the RU internal functions and a switching power supply to convert the -48 VDC prime power.

The 28 GHz RU is packaged in a weatherproof enclosure with integral antenna that provides for mounting, RF interface, cable interface connector, and RSL connector.

**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

## Section 2. Technical Summary

<b>Applicant:</b> Netro Corporation 3860 N. First St. San Jose, CA, 95134 USA	<b>Manufacturer:</b>  As Applicant
<b>Number of units submitted for test:</b>	One
<b>Equipment Category:</b>	Digital Microwave Fixed Link – Point to Multipoint TDMA
<b>Trade Name of Equipment:</b>	AirStar 28 GHz PMP
<b>Manufacturers Type Designation:</b>	Netro
<b>Specification:</b>	CFR Title 47, Part 2 and Part 101
<b>Type of Equipment:</b>	Transceiver
<b>Data Rate(s):</b>	16 Mbit/s
<b>Rated Output Power (dBm):</b>	+20 dBm
<b>BRU Frequency Characteristics (GHz):</b>	Transmit: 27.516 to 27.708
	Receive: 27.932 to 28.124
<b>SRU Frequency Characteristics (GHz):</b>	Transmit: 27.932 to 28.124
	Receive: 27.516 to 27.708
<b>Duplex Distance (MHz):</b>	416
<b>Channel Spacing (MHz):</b>	16.0
<b>Frequency Tolerance (ppm):</b>	Short Term: +/- 1
	Aging: +/-5
<b>Extreme Test Temperature Range (°C)</b>	Outdoor Unit: -33 to +55
	Indoor Unit: 0 to +40

**Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit to 47 CFR 2. and 47 CFR 101.**

---

### Section 3. Tests Procedure

The RU is subject to the requirements of CFR 47 Part 101 and Part 2 for FCC Certification. The following tests, as specified in CFR 47 Part 2 with limits defined in CFR 47 Part 101, are required. The transmitter was operated at the maximum rated output power, +20 dBm, for all tests. An active link with a subscriber unit was established to provide actual system operating conditions.

Test Parameter	CFR 47 Part 2 Paragraph	CFR 47 Part 101 Paragraph	CFR 47 Part 101 Limit
Transmitter Output Power	2.1046	101.113	+55 dBW maximum EIRP
Modulation Characteristics	2.1047	None	None
Occupied Bandwidth	2.1049	None	None
Spurious Emissions at Antenna Terminal	2.1051	101.111(a)(2)(ii) and (iii)	Refer to 47 CFR 101.111
Field Strength of Spurious Emissions	2.1053	101.111(a)(2)(ii) and (iii)	Refer to 47 CFR 101.111
Frequency Stability	2.1055	101.107	0.001%

#### 3.1 Transmitter Output Power

Transmitter output power at the antenna port was measured using a power meter. Power meter reading was corrected for the loss in the test set. EIRP is calculated using transmitter output power and antenna gain values. All measurements were made at the maximum rated output power of +20 dBm.

#### 3.2 Modulation Characteristics

Modulation characteristics were measured using a spectrum analyzer. The analyzer center frequency was set to the channel center frequency, resolution bandwidth to 1 MHz and video bandwidth to 30 kHz to provide video smoothing. All measurements were made at the maximum rated output power of +20 dBm.

#### 3.3 Occupied Bandwidth

Occupied bandwidth was measured using a spectrum analyzer and automated routine. All measurements were made at the maximum rated output power of +20 dBm.

#### 3.4 Spurious Emissions at Antenna Terminals

Conducted emissions at the antenna port were measured and plotted over a frequency range of 30 MHz to 110 GHz. The plotted transmit spectrum is given for low, middle, and high channel. Figure 3.4-1 shows the test limits for the full 850 MHz authorized bandwidth. All measurements were made at the maximum rated output power of +20 dBm. For spectrum mask tests the spectrum analyzer reference level is corrected for 1 MHz resolution bandwidth as follows and as shown in Figure 3.4-1:

Channel symbol rate = 11.856 MSps. In 1 MHz BW amplitude reduction is  $10 \text{ LOG}(11.856/1) = 10.7 \text{ dB}$ .  
Spectrum analyzer reference level = +20 dBm – 10.7 dB = 9.3 dBm nominal. Spectrum analyzer reference level was set to within 0.5 dB of actual measured peak envelope power level.

#### 3.5 Field Strength of Spurious Emissions

Radiated spurious emissions were measured over the frequency range of 1 GHz to 110 GHz in an anechoic chamber (25m x 14m x 9m). All measurements were made at the maximum rated output power of +20 dBm with the link operating. Measurements were made at a distance of 3 meters for all emissions. All four sides of the SRU were tested for maximum radiated levels in vertical polarization. The BABT report, report number A9177F02, detailing test method and limits, is attached as Appendix A of this report.

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

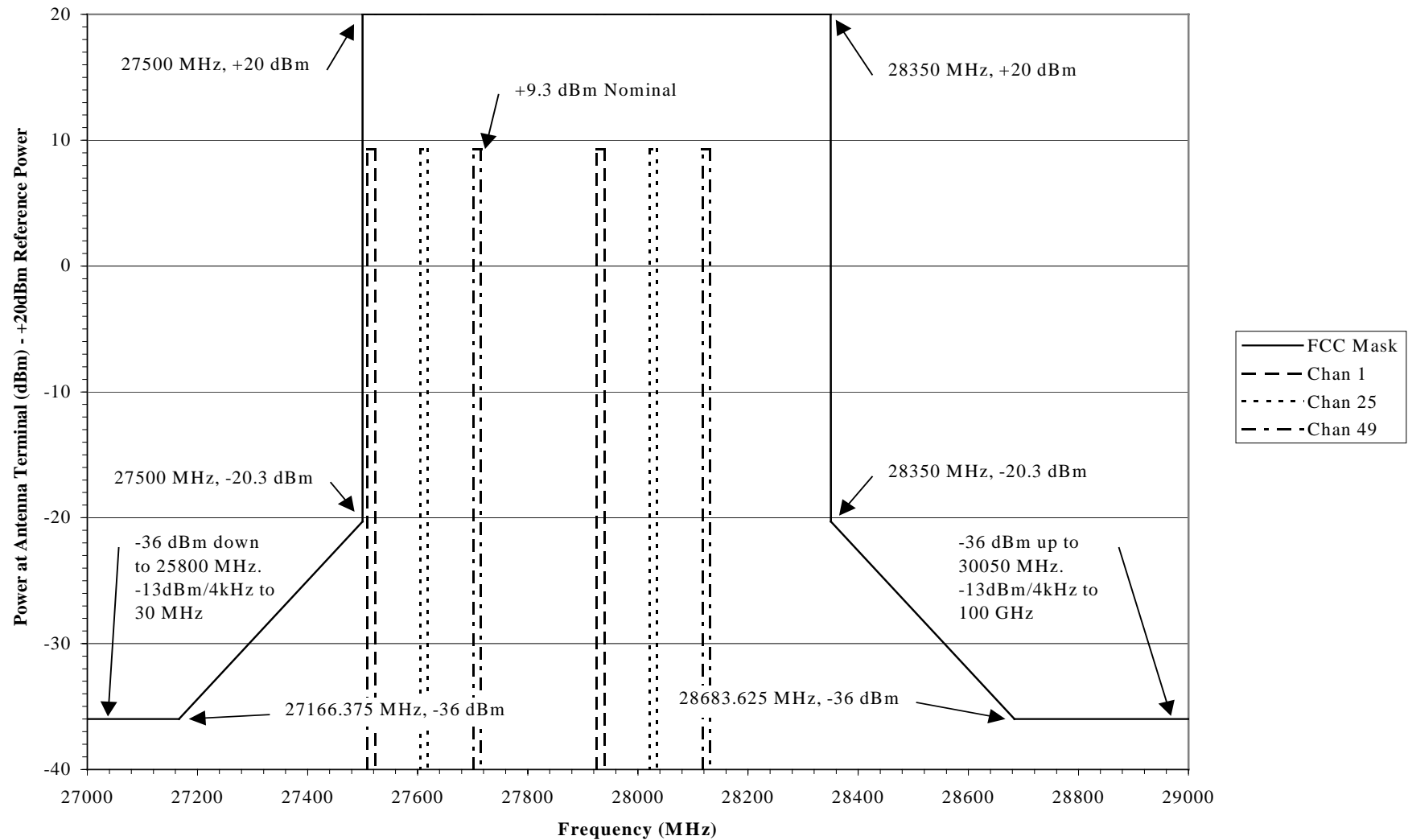


Figure 3.4-1 – Spurious Emissions at the Antenna Port, Spectrum Mask Test Limits

**Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit to 47 CFR 2. and 47 CFR 101.**

---

### 3.6 Frequency Stability

The RU frequency stability was measured using the frequency counter function of a spectrum analyzer connected to the 140 MHz receiver IF output. A 350 MHz CW test tone was injected into the subscriber transmitter IF input to produce the 140 MHz test tone output at the RU. The spectrum analyzer and CW signal source reference frequencies were connected together to eliminate differential frequency drift between the generation and measurement equipment.

NOTE: The actual frequency accuracy of the radio is determined by an external network reference frequency injected into the indoor unit. This external reference frequency is fed to the RU via the IF cable interface and all phase lock loops are locked to this reference. The reference frequency is distributed to the subscriber unit via the data symbol rate that is also synchronized with the external network reference frequency.

## Section 4. Measurements, Examinations and Derived Results

### 4.1 General Comments

4.1.1. This section contains test results only. Details of test methods used are available from Netro. Wherever possible the test methods described in 47 CFR 2 and 47 CFR 101 have been used.

4.1.2. The measurement uncertainties stated were calculated in accordance with the requirements of ETSI document ETR 028 with a confidence level of 95%.

4.1.3. The purpose of the tests was to demonstrate compliance with the test specification.

4.1.4. Data of receipt of test sample(s): 23 February 2000

4.1.5. Measurements were performed between the following date(s):

Start Date: 23 February 2000

Finish Date: 21 April 2000

4.1.6. All measurements described in this report were performed at Netro Corporation, San Jose, CA, USA unless otherwise noted. All radiated emissions measurements were performed at BABT Laboratory, Santa Clara, CA, USA. BABT has provided a full report that is included as Appendix A of this report. Report number is A9177F02.

4.1.7. For full duplex equipment the spurious emissions tests need only be performed once in duplex (transmit/receive) mode of operation for transmit and receive spurious.

4.1.8. The extremes of test voltage were taken as -42VDC and -56VDC.

4.1.9. The extremes of temperature were taken as -35°C and +55°C for the outdoor unit. The indoor unit was at +25°C ambient temperature.

4.1.10. Antenna port conducted and radiated measurements were performed by removing the integral antenna and packaging the radio unit in the non-integral antenna housing.

4.1.11. Frequency Allocation:

	Channel Transmitter Frequencies					
	Low Channel		Middle Channel		High Channel	
	Frequency (GHz)	Channel Number	Frequency (GHz)	Channel Number	Frequency (GHz)	Channel Number
Base Radio	27.516	1	27.612	25	27.708	49
Subscriber Radio	27.932	1	28.028	25	28.124	49

**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

## 4.2 Test Results

### 4.2.1 RF Power Output

47 CFR 2.1046

Rated RF Output Power at Antenna Terminal = +20.0 dBm

Test Conditions		Transmitter Power at Antenna Terminal (dBm)		
		Low Channel	Middle Channel	High Channel
BRU	T nominal +25C	19.56	18.23	18.63
SRU	V nom -48VDC	19.44	20.01	20.32

Base Radio Unit antenna gain is 15 dBi nominal. Subscriber Radio Unit antenna gain is 30 dBi nominal.  
Calculate EIRP (dBW) = Tx power (dBm) + antenna gain (dBi) -30 dBW/dBm.

Test Conditions		EIRP (dBW)		
		Low Channel	Middle Channel	High Channel
BRU	T nominal +25C	4.56	3.23	3.63
SRU	V nom -48VDC	19.44	20.01	20.32

Limits: 47 CFR 101.113

Maximum Mean Power – EIRP (dBW)	+55
---------------------------------	-----

Calculate SRU EIRP (dBW/MHz) = Tx power (dBm/MHz) + antenna gain (dBi) -30 dBW/dBm.

Test Conditions		Power Density (dBW/MHz)		
		Low Channel	Middle Channel	High Channel
T nominal +25C	V nom -48VDC	8.27	7.53	8.63

Limits: 47 CFR 101.113

Maximum RF Power Density (dBW/MHz)	+42
------------------------------------	-----

### 4.2.2 Modulation Characteristics (Spectrum Mask)

47 CFR 2.1047

Test Conditions		RF Spectrum Mask (Refer to Plots)		
		Low Channel	Middle Channel	High Channel
BRU	T nominal +25C	BRU 2.987-4	BRU 2.987-5	BRU 2.987-6
SRU	V nom -48VDC	SRU 2.987-4	SRU 2.987-5	SRU 2.987-6

Limits: None

### 4.2.3 Occupied Bandwidth

47 CFR 2.1049

Test Conditions		99% Occupied Bandwidth (MHz) (Refer to Plot)		
			Middle Channel	
BRU	T nominal +25C		14.13 MHz	
	V nom -48VDC		BRU 2.989-2	
SRU			14.13 MHz	
			SRU 2.989-2	

Limits: None



Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

#### 4.2.4 Spurious Emissions at Antenna Terminals

47 CFR 2.1051

##### Frequency $\leq \pm 250\%$ Removed from Band Center

Test Conditions		RF Spectrum Mask (Refer to Plots)		
		Low Channel	Middle Channel	High Channel
BRU	T nominal +25C	BRU 2.987-4	BRU 2.987-5	BRU 2.987-6
SRU	V nom -48VDC	SRU 2.987-4	SRU 2.987-5	SRU 2.987-6

Limits: 47 CFR 101.111(a)(2)(ii)

Spectrum Mask (P = % removed from carrier, B = Authorized Bandwidth = 850 MHz)	Attenuation = $11 + 0.4 * (P-50) + 10 * \text{LOG}_{10}(B)$ or Attenuation = $40.3 + 0.4*(P-50)$
--	---

##### Frequency $\geq \pm 250\%$ Removed from Band Center

Test Conditions		Spurious Emissions (Refer to Plots)		
		IF Bandwidth	Middle Channel	Pass/Fail
T nominal +25C V nom -48VDC	.030-1 GHz	100 kHz	BRU 2.991-1	Pass
	1-21.2 GHz	1 MHz	BRU 2.991-2 to -6	Pass
	21.2-27.572 GHz	1 MHz	BRU 2.991-7 to -9	Pass
	27.652-110GHz	1 MHz	BRU 2.991-10 to -28	Pass

Limits: 47 CFR 101.111(a)(2)(iii)

Attenuation in 4 kHz band, >250% B away from carrier B= Authorized Bandwidth (MHz), $P_{out}$ = Mean Output Power in Watts	Attenuation = $43+10*\text{LOG}_{10}(P_{out})$ or 80 dB whichever is lesser Attenuation = -33 dB in 4 kHz band = -13 dBm/4 kHz
---	--

#### 4.2.5 Field Strength of Spurious Radiation

47 CFR 2.1053

Limits: 47 CFR 101.111(a)(2)(ii)

All radiated emissions testing was performed at BABT Laboratory, Santa Clara, CA, USA. The BABT test report, report number A9177F02, is submitted as Appendix A of this report. Refer to the BABT report for all information.

#### 4.2.6 Frequency Stability

47 CFR 2.1055

Note: Frequency stability is determined by external network clock.

Test Conditions		Frequency Stability (%) (Refer to Plot)		
			Middle Channel	
BRU	T nominal +25C V nom -48VDC		.00004 BRU 2.995-5	
SRU			.00003 SRU 2.995-5	

Limits: 47 CFR 101.107

Frequency Tolerance, percent	0.001
------------------------------	-------

**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

## Section 5. Summary of Test Results

The summary of the test results is as follows:

	<u>BRU</u>	<u>SRU</u>
Transmitter Output Power	Pass	Pass
Modulation Characteristics– Spectrum Mask	N/A	N/A
Occupied Bandwidth	N/A	N/A
Spurious Emissions at Antenna Terminal	Pass	Pass
Field Strength of Spurious Emissions	Pass	Pass
Frequency Stability	Pass	Pass

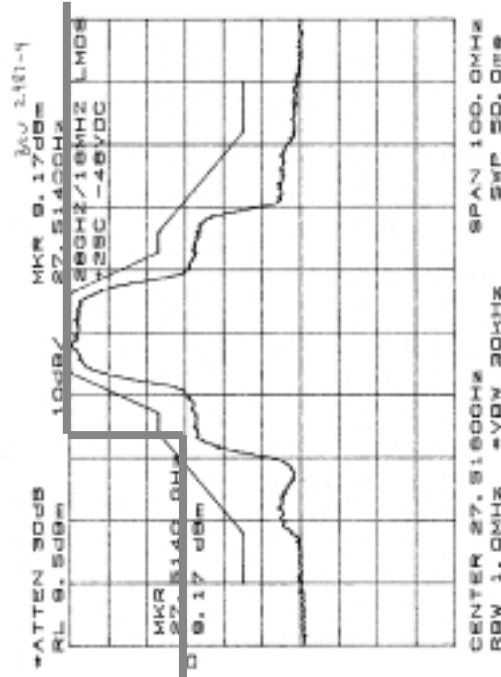
## Section 6. Test Equipment Used

Instrument	Mfr.	Model No.	Serial No.
DVM	Fluke	79	54940691
BER Test Set	HP	3784A	2918U00732
BER Test Set	HP	3784A	3117U01512
RF Power Meter	HP	438A	3048U03885
Power Sensor	HP	8485A	2703A05209
Spectrum Analyzer	HP	8565E	3804A00884
Spectrum Analyzer	HP	8564E	3425A00185
Harmonic Mixer	HP	11970U	3003A01395
Harmonic Mixer	HP	11970V	2521A01172
Harmonic Mixer	HP	11970W	2521A01336
Harmonic Mixer	HP	11970U	3003A01553
Harmonic Mixer	HP	11970V	2521A01055
Harmonic Mixer	HP	11970W	2521A01210
Signal Generator	HP	83650A	3420A00683
Signal Generator	HP	8648D	3642U00278
Temperature Chamber	Lunaire Tenney	T10S	26833-02
Variable Power Supply	Kepco	ATE 100-10M	F54572
Directional Coupler	Flann	22130-10	1106
Directional Coupler	Flann	22130-10	1117
Rotary Vane Attenuator	Flann	22110	717
Rotary Vane Attenuator	Flann	22110	718
Antenna, 40-60 GHz	Aerowave	19-7025	2918
Antenna, 50-75 GHz	Aerowave	15-7025	2917
Antenna, 75-110 GHz	Aerowave	10-7025	2916

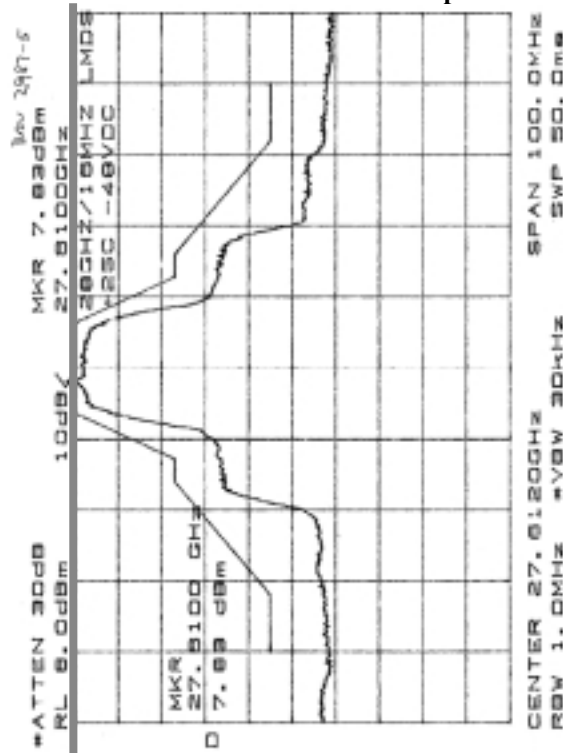
## Section 9. Graphs

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

## 9.1 Modulation Characteristics and Emissions at Antenna Terminal <250%

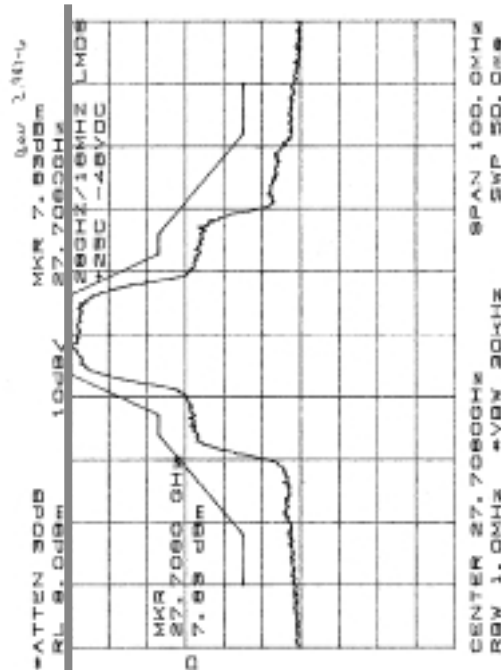


Spurious Emission < 250% Limit Line per 47 CFR 101.111(a)(2)(ii)  
Figure BRU 2.987-4 – Modulation Characteristics and Spurious Emissions <250% B

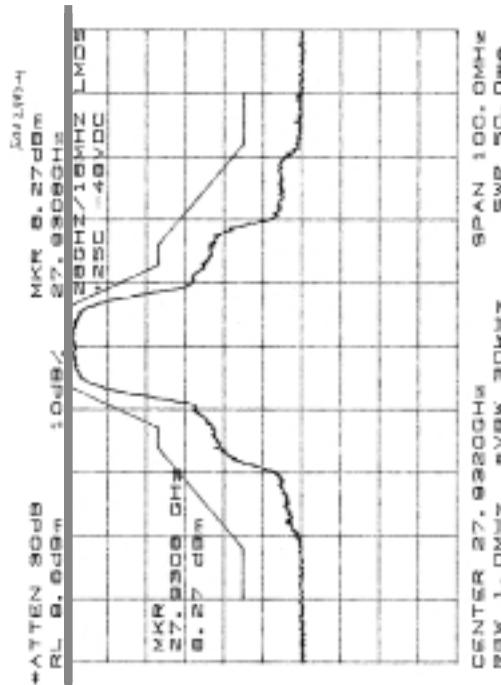


Spurious Emission < 250% Limit Line per 47 CFR 101.111(a)(2)(ii)  
Figure BRU 2.987-5 – Modulation Characteristics and Spurious Emissions <250% B

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

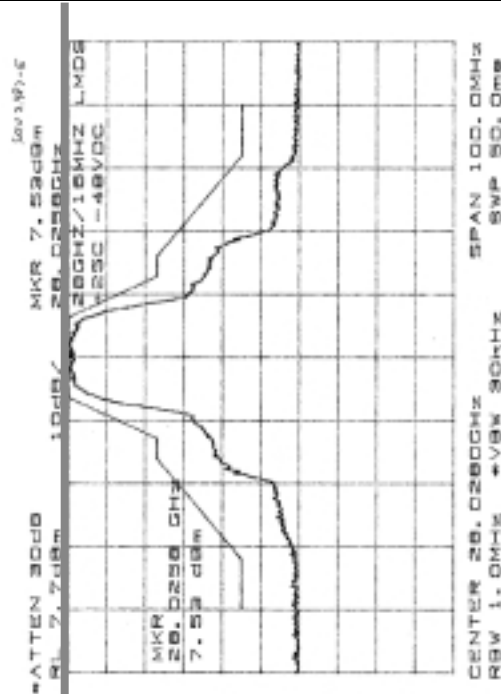


Spurious Emission < 250% Limit Line per 47 CFR 101.111(a)(2)(ii)  
Figure BRU 2.987-6 – Modulation Characteristics and Spurious Emissions <250% B

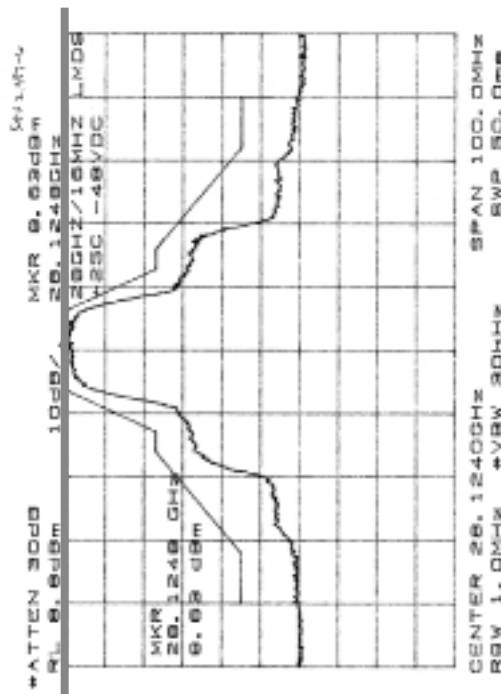


Spurious Emission < 250% Limit Line per 47 CFR 101.111(a)(2)(ii)  
Figure SRU 2.987-4 – Modulation Characteristics and Spurious Emissions <250% B

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.



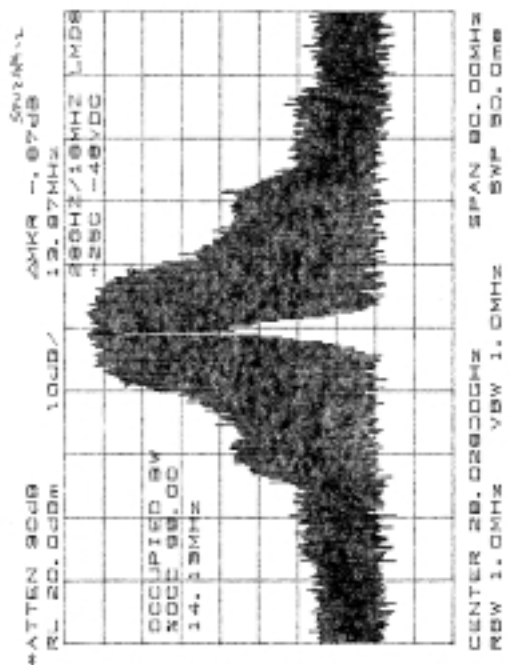
Spurious Emission < 250% Limit Line per 47 CFR 101.111(a)(2)(ii)  
Figure SRU 2.987-5 – Modulation Characteristics and Spurious Emissions <250% B



Spurious Emission < 250% Limit Line per 47 CFR 101.111(a)(2)(ii)  
Figure SRU 2.987-6 – Modulation Characteristics and Spurious Emissions <250% B

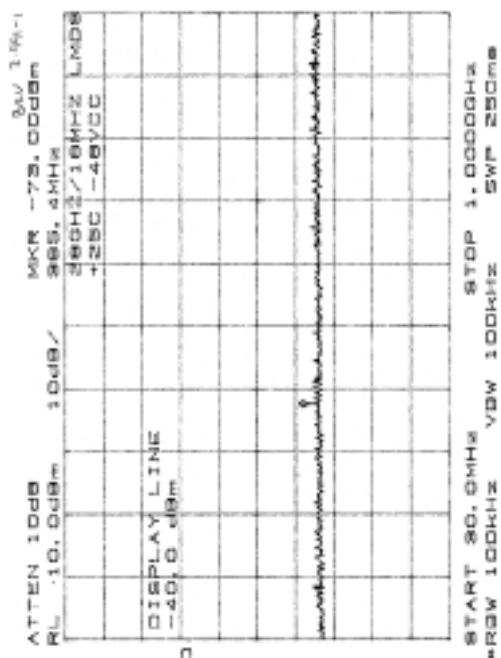
**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit to 47 CFR 2. and 47 CFR 101.

**No Limit Defined**  
**Figure BRU 2.989-2 – Occupied Bandwidth**

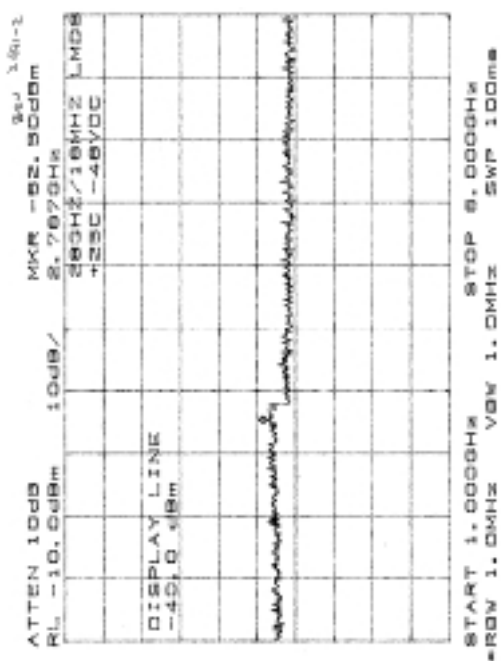


**No Limit Defined**  
**Figure SRU 2.989-2 – Occupied Bandwidth**

### 9.3 Spurious Emissions at Antenna Terminal > 250% B

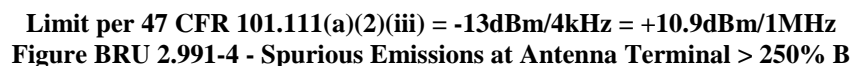
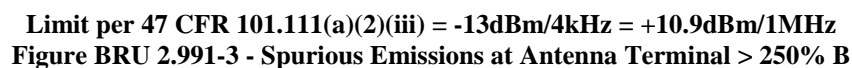


**Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +1.9dBm/100kHz**  
**Figure BRU 2.991-1 - Spurious Emissions at Antenna Terminal > 250% B**



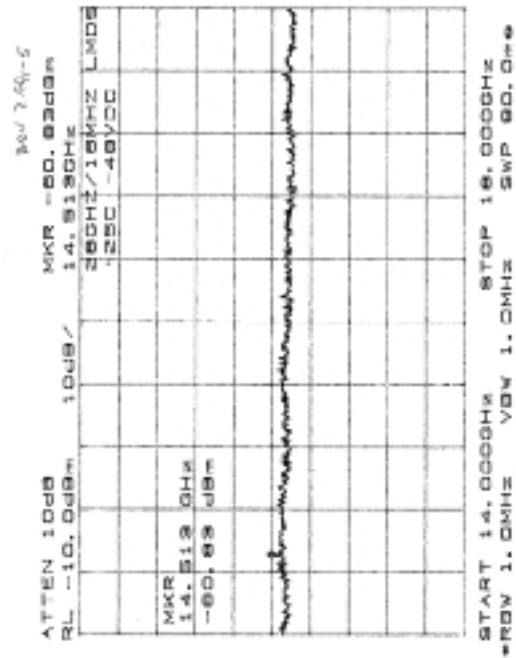
**Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz**  
**Figure BRU 2.991-2 - Spurious Emissions at Antenna Terminal > 250% B**

**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit to 47 CFR 2. and 47 CFR 101.

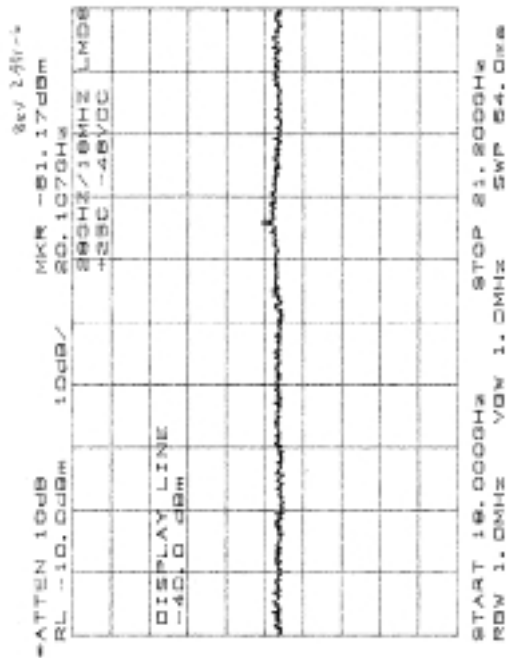




Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

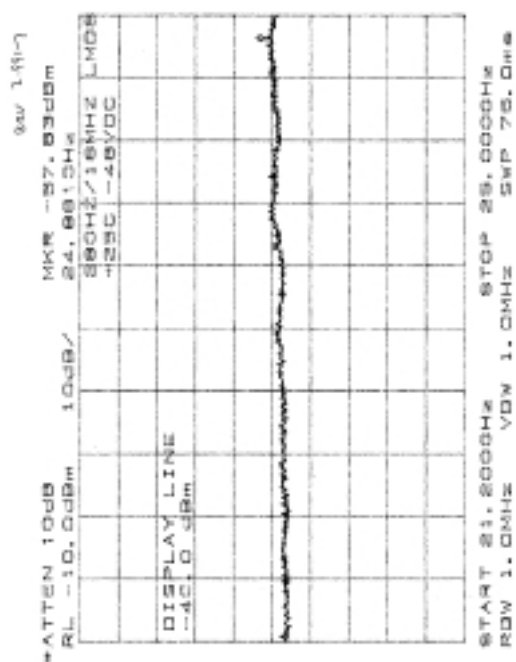


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-5 - Spurious Emissions at Antenna Terminal > 250% B

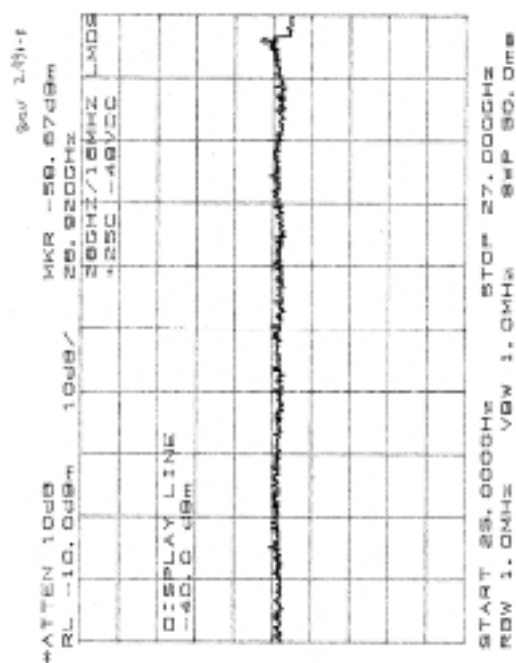


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-6 - Spurious Emissions at Antenna Terminal > 250% B

**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit to 47 CFR 2. and 47 CFR 101.

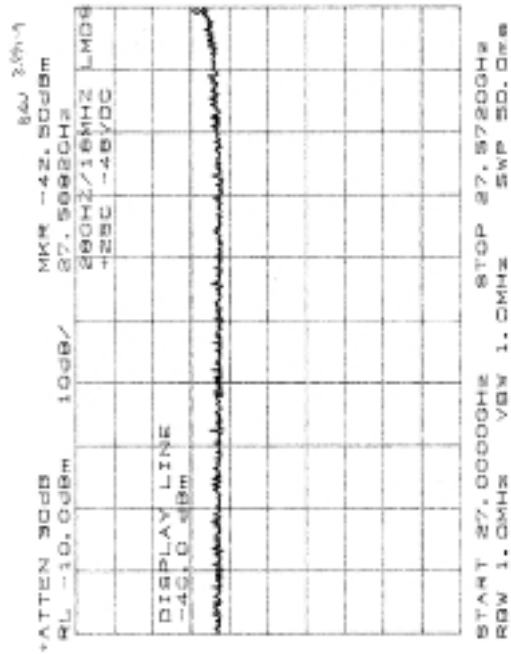


**Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz**  
**Figure BRU 2.991-7 - Spurious Emissions at Antenna Terminal > 250% B**

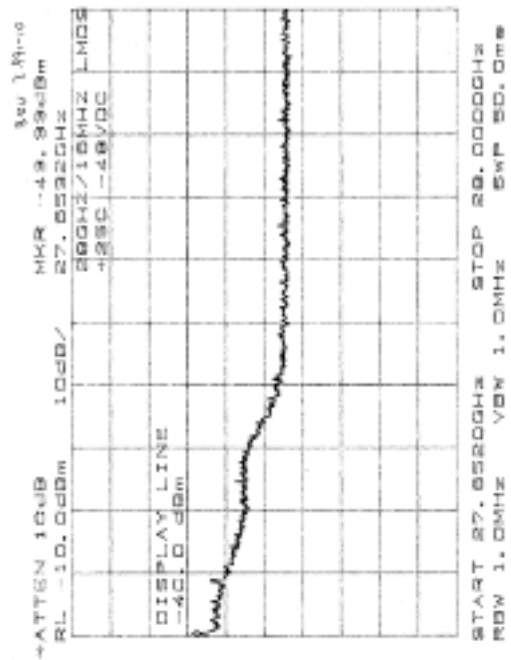


**Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz**  
**Figure BRU 2.991-8 - Spurious Emissions at Antenna Terminal > 250% B**

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

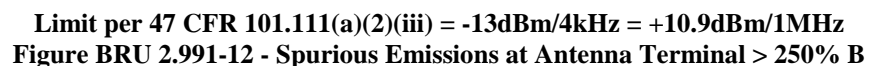
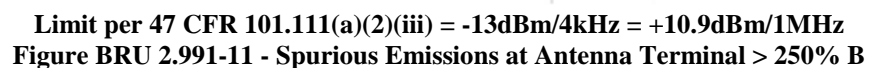


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-9 - Spurious Emissions at Antenna Terminal > 250% B

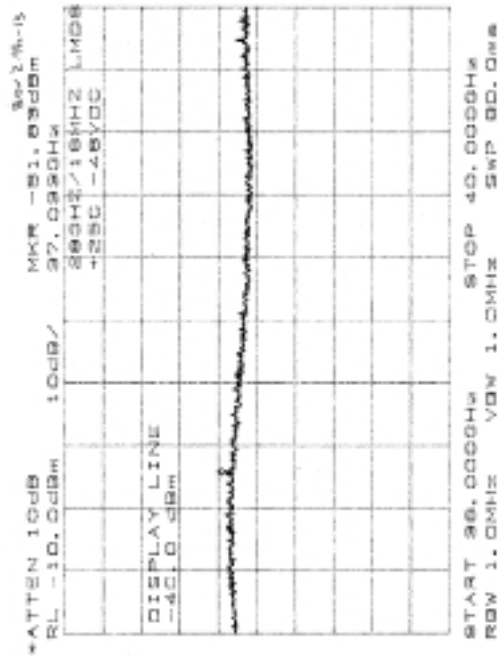


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-10 - Spurious Emissions at Antenna Terminal > 250% B

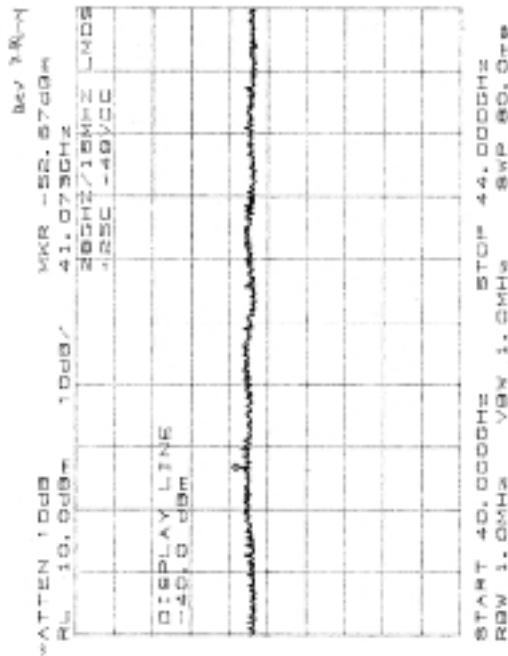
**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit to 47 CFR 2. and 47 CFR 101.



Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

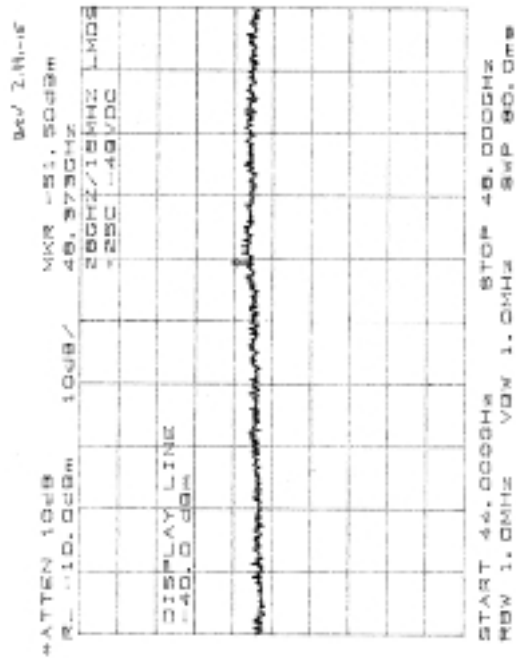


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-13 - Spurious Emissions at Antenna Terminal > 250% B

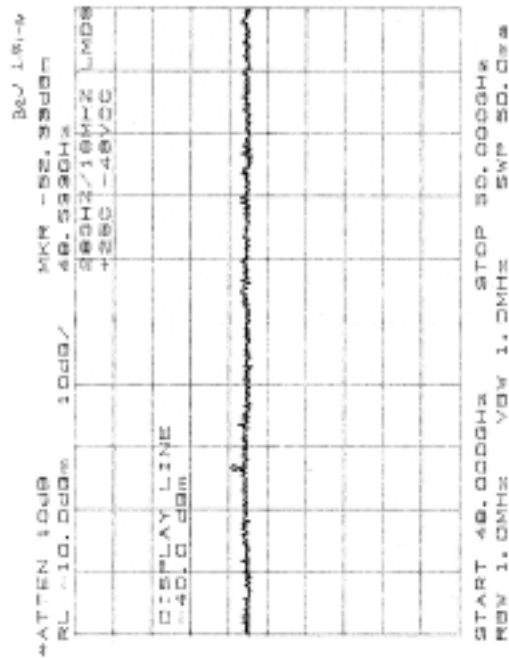


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-14 - Spurious Emissions at Antenna Terminal > 250% B

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

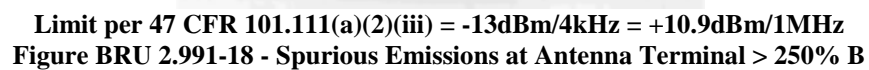
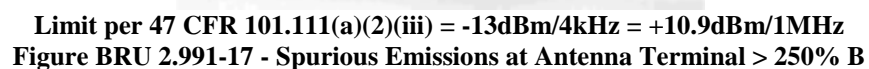


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-15 - Spurious Emissions at Antenna Terminal > 250% B

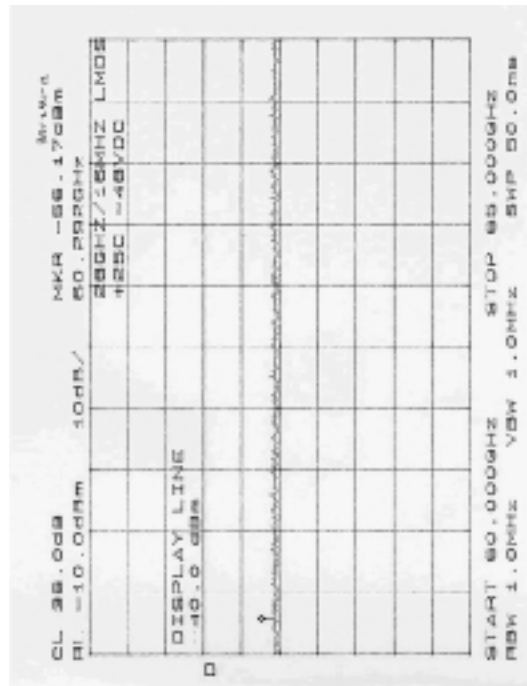


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-16 - Spurious Emissions at Antenna Terminal > 250% B

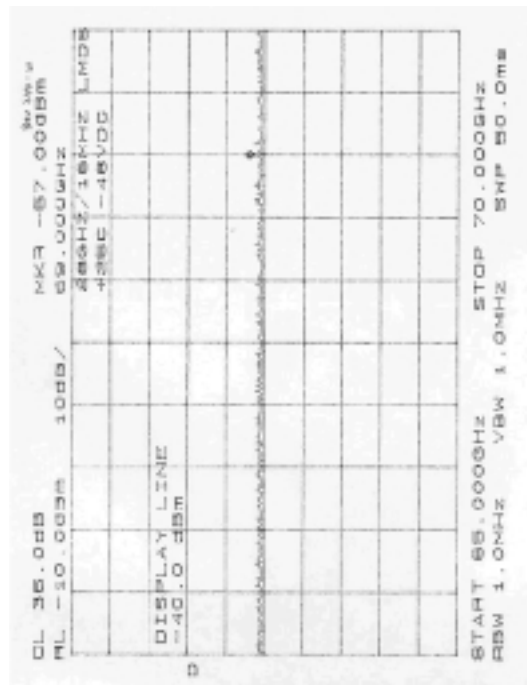
**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit to 47 CFR 2. and 47 CFR 101.



Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.



Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-19 - Spurious Emissions at Antenna Terminal > 250% B



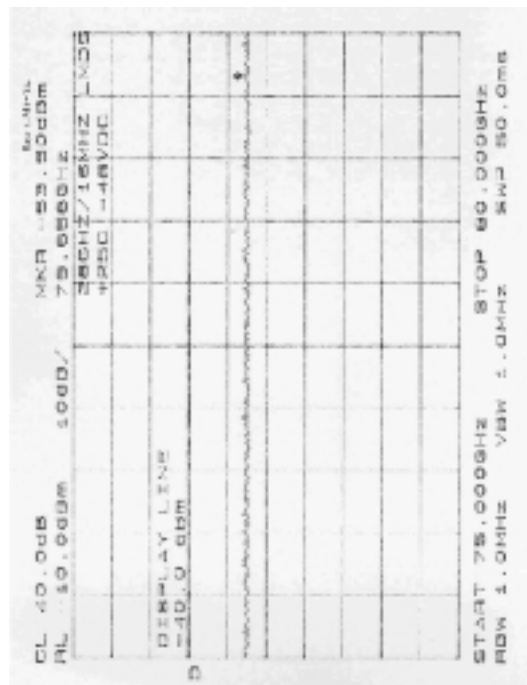
Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-20 - Spurious Emissions at Antenna Terminal > 250% B



Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

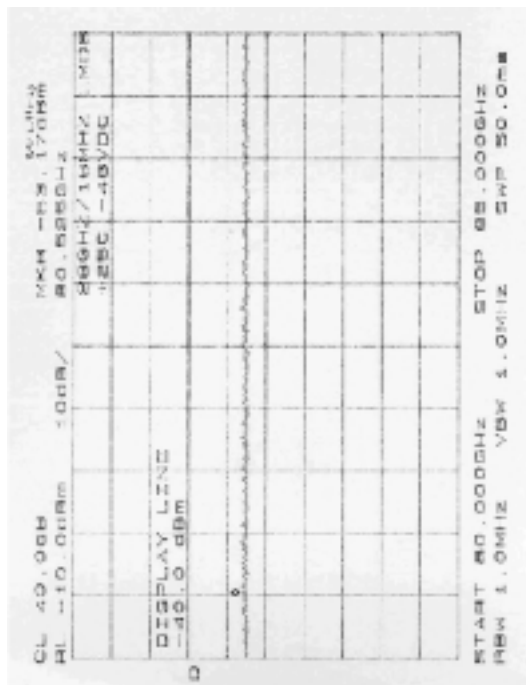


Limit per 47 CFR 101.111(a)(2)(iii) =  $-13\text{dBm}/4\text{kHz} = +10.9\text{dBm}/1\text{MHz}$   
Figure BRU 2.991-21 - Spurious Emissions at Antenna Terminal > 250% B

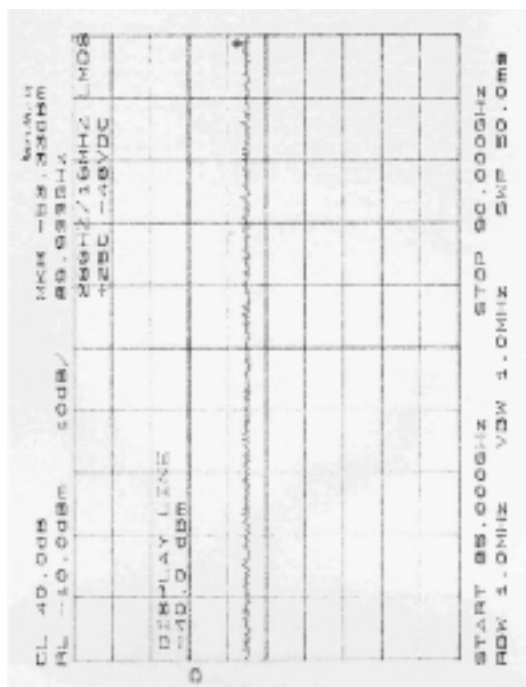


Limit per 47 CFR 101.111(a)(2)(iii) =  $-13\text{dBm}/4\text{kHz} = +10.9\text{dBm}/1\text{MHz}$   
Figure BRU 2.991-22 - Spurious Emissions at Antenna Terminal > 250% B

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

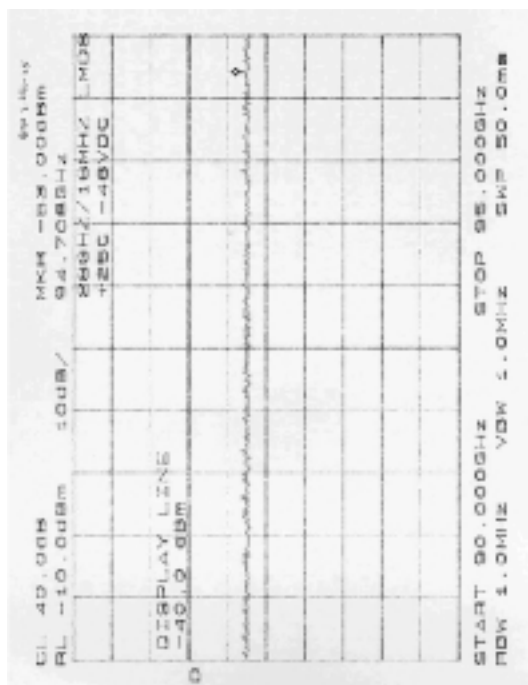


Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-23 - Spurious Emissions at Antenna Terminal > 250% B



Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz  
Figure BRU 2.991-24 - Spurious Emissions at Antenna Terminal > 250% B

**Title:** Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit to 47 CFR 2. and 47 CFR 101.



Page 2 of 4

CL 40.0dB  
RL -10.0dBm 50dB/ 95.700GHz  
MM -55.550dBm

STOP 50.000GHz  
ROW 1.0MHz VSW 1.0MHz SWR 50.0dB

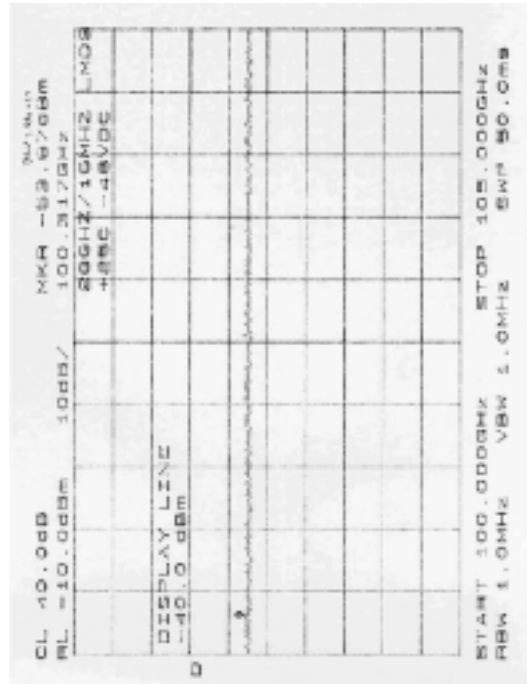
DISPLAY LINE  
-40.0 dBm

200MHz/10MHz  
+250 -10VDC

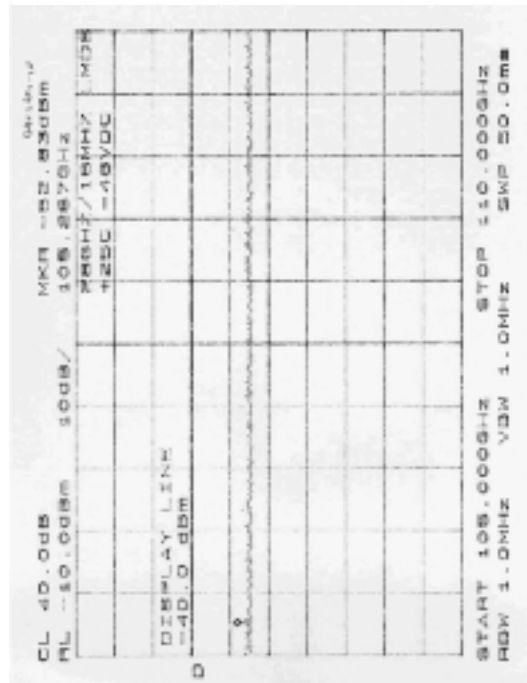
0

**Limit per 47 CFR 101.111(a)(2)(iii) = -13dBm/4kHz = +10.9dBm/1MHz**  
**Figure BRU 2.991-26 - Spurious Emissions at Antenna Terminal > 250% B**

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.



Limit per 47 CFR 101.111(a)(2)(iii) =  $-13\text{dBm}/4\text{kHz} = +10.9\text{dBm}/1\text{MHz}$   
Figure BRU 2.991-27 - Spurious Emissions at Antenna Terminal > 250% B



Limit per 47 CFR 101.111(a)(2)(iii) =  $-13\text{dBm}/4\text{kHz} = +10.9\text{dBm}/1\text{MHz}$   
Figure BRU 2.991-28 - Spurious Emissions at Antenna Terminal > 250% B

**Title:           Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
                  to 47 CFR 2. and 47 CFR 101.**

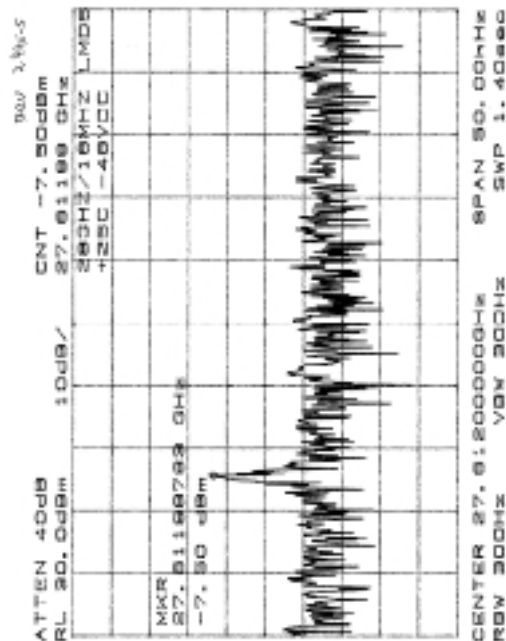
---

## **9.4 Field Strength of Spurious Emissions**

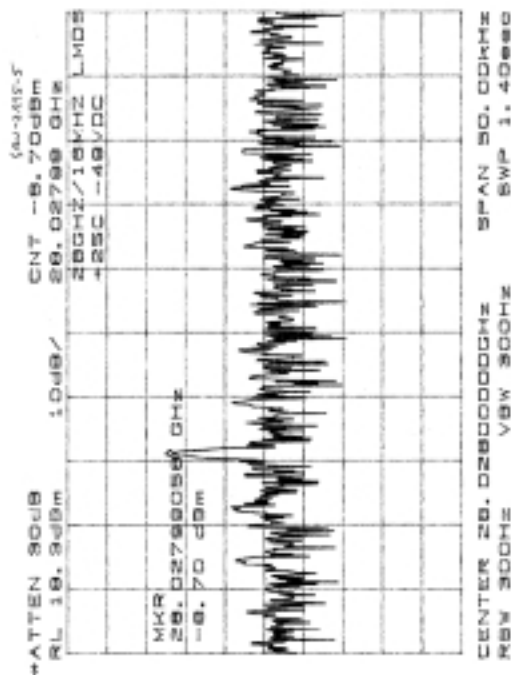
Refer to the BABT test report, report number A9177F02 for all test methods, results, and graphs. This report is submitted as Appendix A of this document.

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

## 9.5 Frequency Stability



Limit per 47 CFR 101.107 = .001% = 27612MHz +/- 276.12kHz  
Figure BRU 2.995-5 – Frequency Stability



Limit per 47 CFR 101.107 = .001% = 28028MHz +/- 280.28kHz  
Figure SRU 2.995-5 – Frequency Stability

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

**Appendix A – 28 GHz PMP 1 GHz – 110 GHz Radiated Emissions Test Report**

Report No. A9177F02

## TEST RESULT SUMMARY

### UNITED STATES STANDARD 47 CFR PART 101

MANUFACTURER NAME	Netro Corporation
NAME OF EQUIPMENT	Microwave fixed link
MODEL NUMBER	AirStar PMP 28
MANUFACTURER ADDRESS	3860 N. First Street San Jose, CA 95134
TEST REPORT NUMBER	A9177F02
TEST DATE	20 April 2000

According to testing performed at BABT Product Service, the above-mentioned unit is in compliance with the electromagnetic compatibility requirements defined in United States Standard 47 CFR Part 101, section 101.111

BABT Product Service reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. BABT Product Service shall have no liability for any deductions, inferences or generalizations drawn by the client or others from BABT Product Service issued reports.

As the responsible EMC Project/Division Managers, we hereby declare that the equipment tested at BABT Product Service as specified above conforms to the requirements of United States Standard 47 CFR Part 101, Fixed Microwave Services.

Date: 26 April, 2000

Location: Santa Clara, California  
USA



Frank Ibrahim  
Engineer In Charge



Dave Wilson  
EMC Manager



Certificate No: 1212-01

Not Transferable

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

Report No. A9177F02

## EMC EMISSION - TEST REPORT

### UNITED STATES STANDARD 47 CFR PART 15, SUBPART B

Test Report File No. : A9177F02 Date of Issue: 26 April, 2000

Model / Serial No. : AirStar PMP 28 / N/A

Product Type : Microwave fixed link

Applicant : Netro Corporation

Manufacturer : Netro Corporation

License holder : Netro Corporation

Address : 3860 N. First Street  
San Jose, CA 95134

Test Result : ☒ Positive ☐ Negative

Test Project Number  
Reference(s) : A9177F02

Total pages - Test Report : 13

*BABT Product Service is a joint venture between TÜV Product Service, Inc. and BABT.*

*BABT Product Service reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. BABT Product Service shall have no liability for any deductions, inferences or generalizations drawn by the client or others from BABT Product Service issued reports.*

*This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval.*

Page 1 of 13

BABT PRODUCT SERVICE INC 4855 Patrick Henry Drive/ Santa Clara CA 95054 USA Tel: 408 748 3585 Fax: 408 919 0585 Rev. No 1.0  
Building # 6



Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

Report No. A9177F02

**EMISSIONS TEST REGULATIONS :**

The emissions tests were performed according to the following regulations:

- |  |   |  |
|--|---|--|
| <input type="checkbox"/> - EN 50081-1 : 1992                           |   |  |
| <input type="checkbox"/> - EN 55011 : 1991                             | <input type="checkbox"/> - Group 1              | <input type="checkbox"/> - Group 2     |
| <input type="checkbox"/> - EN 55013 : 1990                             | <input type="checkbox"/> - Class A              | <input type="checkbox"/> - Class B     |
| <input type="checkbox"/> - EN 55014-1 : 1993                           | <input type="checkbox"/> - Household appliances |  |
|  | <input type="checkbox"/> - Electric tools       |  |
|  | <input type="checkbox"/> - Similar apparatus    |  |
| <input type="checkbox"/> - EN 55014-1 : 1993 / Amendment A1 : 1997     |   |  |
| <input type="checkbox"/> - EN 55015 : 1993                             |   |  |
| <input type="checkbox"/> - EN 55015 : 1996                             |   |  |
| <input type="checkbox"/> - EN 55015 : 1996 / Amendment A1 : 1997       |   |  |
| <input type="checkbox"/> - EN 55022 / 1987                             | <input type="checkbox"/> - Class A              | <input type="checkbox"/> - Class B     |
| <input type="checkbox"/> - EN 55022 / 1994                             | <input type="checkbox"/> - Class A              | <input type="checkbox"/> - Class B     |
| <input type="checkbox"/> - Amendment A1 : 1995 to EN 55022 : 1994      |   |  |
| <input type="checkbox"/> - Amendment A2 : 1997 to EN 55022 : 1994      |   |  |
| <input type="checkbox"/> - EN 55022 : 1998                             | <input type="checkbox"/> - Class A              | <input type="checkbox"/> - Class B     |
| <input type="checkbox"/> - BS  |   |  |
| <input type="checkbox"/> - VCCI  | <input type="checkbox"/> - Class A ITE          | <input type="checkbox"/> - Class B ITE |
| <input checked="" type="checkbox"/> - 47 CFR Part 101, section 101.111 |   |  |
| <input type="checkbox"/> - AS/NZS 3548: 1995                           | <input type="checkbox"/> - Class A              | <input type="checkbox"/> - Class B     |
| <input type="checkbox"/> - CISPR 11 (1997)                             | <input type="checkbox"/> - Group 1              | <input type="checkbox"/> - Group 2     |
|  | <input type="checkbox"/> - Class A              | <input type="checkbox"/> - Class B     |
| <input type="checkbox"/> - CISPR 22 (1997)                             | <input type="checkbox"/> - Class A              | <input type="checkbox"/> - Class B     |

Page 3 of 13

BABT PRODUCT SERVICE INC 4855 Patrick Henry Drive/  
Building # 6

Santa Clara CA 95054 USA

Tel: 408 748  
3585Fax: 408 919  
0585

Rev. No 1.0

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

Report No. A9177F02

#### Environmental Conditions In The Laboratory:

	<u>Actual</u>
Temperature:	: 23 °C
Relative Humidity:	: 50 %
Atmospheric Pressure:	: 100.0 kPa

#### Power Supply Utilized:

Power supply system : -48 VDC , 10 Amp

#### Symbol Definitions:

- - Applicable
- - Not Applicable

#### Description of EUT:

AirStar is a wireless point-to-multipoint telecommunication system that provides broadband local loop access. AirStar is a complete product family that is built on advanced ATM and digital microwave technology. Based on a sectorized cellular topology an AirStar Network is composed of one or more cells which may overlap. Each AirStar cell provides a point-to-multipoint wireless communications network consisting of a Base Station and a number of Subscriber Terminals. Each cell can be split into sectors to allow efficient reuse of the allocated spectrum and to increase the capacity available to Subscriber Terminals.

The AirStar system design is based on Asynchronous Transport Mode (ATM) switching technology which provides a generic transport vehicle for carrying voice, data and video with quality of services. AirStar provides local access for all types of traffic, such as analog voice, digital voice, TDM, Frame Relay, ATM, and IP.

#### Measurement Methods

Measurements were made in accordance with ANSI C63.4:1992. All emissions measurements are fully automated.

For conducted emissions, the receiver is swept over the frequency range 450kHz to 30MHz using detector functions as specified in CISPR 16. The measured levels from the receiver are then re-calculated taking into account the LISN and coax cable loss to derive the corrected level. This is then compared with the limits specified in FCC 47 CFR Part 15.107 to determine the compliance of the EUT.

Page 4 of 13

BABT PRODUCT SERVICE INC	4855 Patrick Henry Drive/ Building # 6	Santa Clara CA 95054 USA	Tel: 408 748 3585	Fax: 408 919 0585	Rev. No 1.0
--------------------------	---	--------------------------	----------------------	----------------------	-------------

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

Report No. A9177F02

For radiated emissions, the receiver is swept over the frequency range 1GHz to 110GHz, while the turntable is rotated through 360° and the antenna height is varied between 1m and 4m. The worst-case emission level is recorded for each frequency and recorded for the full frequency range. The measured levels from the receiver are then re-calculated taking into account the antenna gain, mast amplifier gain and coax cable loss to derive the corrected level. All peak emissions over the limit are re-measured using the CISPR 16 quasi-peak detector, in any case the highest 15 peaks are re-measured. These are then compared with the limits specified in FCC 47 CFR Part 101 to determine the compliance of the EUT.

### Sample Calculations

These calculations are performed automatically by the control software prior to display. For radiated emissions the corrected level is derived by taking into account the antenna gain, antenna mast amplifier and coax cable loss.

For example, assuming a receiver measurement of 50.0dBμV. Allowing for an antenna factor of 10.0dB/m, a mast amplifier gain of 25dB and a cable loss of 0.64dB, the resultant corrected field strength would be calculated as follows:-

Receiver level = field strength - antenna factor + amplifier gain - cable factor

Corrected field strength = (Receiver level) + (Cable factor) - (Amp gain) + (Antenna factor)

$$= 50.0 + 10.0 + 0.64 - 25$$

$$= 35.64\text{dB}\mu\text{V/m}$$

FCC limits are specified in μV for conducted emissions and μV/m for radiated emissions. These are converted to dBμV and dBμV/m respectively by the control software before results are displayed, limits being converted accordingly. The conversion factor is  $20 \log_{10}(\mu\text{V}) = \text{dB}\mu\text{V}$ .

Page 5 of 13

BABT PRODUCT SERVICE INC	4855 Patrick Henry Drive/ Building # 6	Santa Clara CA 95054 USA	Tel: 408 748 3585	Fax: 408 919 0585	Rev. No 1.0
--------------------------	---	--------------------------	----------------------	----------------------	-------------

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

Report No. A9177F02

**Emissions Test Conditions: RADIATED EMISSIONS (Electric Field)**

The *EQUIVALENT RADIATED EMISSIONS* measurements in the frequency range 1 GHz - 110 GHz were performed in a horizontal and vertical polarization at the following test location :

☐ - Test not applicable

- - Test area no. 1 – Semi - anechoic absorber – lined chamber (80' x 44' x 28')
- ☐ - Test area no. 2 – Shielded room (19' x 19' x 8' )
- ☐ - Test area no. 3 – Fully – anechoic ferrite – lined chamber (24' x 16' x 11' )

Testing was performed at a test distance of:

- ☐ - 1 meters
- - 3 meters
- ☐ - 10 meters

**Test Equipment Used :**

Model No.	Description	Manufacturer	Serial No.	Due Calib. Date
■ - 19-7025	Horn Antenna	Microwave Inc.	-----	-----
■ - 15-7025	Horn Antenna	Microwave Inc.	-----	-----
■ - 10-7025	Horn Antenna	Microwave Inc.	-----	-----
■ - 11970V	Harmonic Mixer 50-75 GHz	Hewlett Packard	-----	-----
■ - 11970A	Harmonic Mixer 26.5-40 GHz	Hewlett Packard	-----	-----
■ - 11970U	Harmonic Mixer 40-60 GHz	Hewlett Packard	-----	-----
■ - 11970W	Harmonic Mixer 75-110 GHz	Hewlett Packard	-----	-----
■ - 11970K	Harmonic Mixer 18-26.5 GHz	Hewlett Packard	-----	-----
■ - 121674G	Pre Amplifier	Miteq	-----	-----
■ - 3115	Horn Antenna	Emco	-----	-----

Page 10 of 13

BABT PRODUCT SERVICE INC 4855 Patrick Henry Drive/  
Building # 6

Santa Clara CA 95054 USA

Tel: 408 748  
3585

Fax: 408 919  
0585

Rev. No 1.0

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

Report No. A9177F02

**Equipment Under Test (EUT) Test Operation Mode - Emissions Tests :**

The equipment under test was operated under the following conditions during emissions testing:

- ☐ - Standby
- ☐ - Test Program (H - Pattern)
- ☐ - Test Program (Color Bar)
- ☐ - Test Program (Customer Specified)
- ☐ - Practice Operation
- ☒ - Normal Operating Mode, (Refer to appendix B)
- ☐ - \_\_\_\_\_

**Configuration of the equipment under test:**

- ☐ - See Constructional Data Form in Appendix B - Page B2
- ☒ - See Product Information Form(s) in Appendix B - Page B2

The following peripheral devices and interface cables were connected during the testing: (Refer to appendix B)

- |   |                |
|---|----------------|
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - _____                    | Type : _____   |
| <input type="checkbox"/> - Unshielded power cable   |                |
| <input type="checkbox"/> - Unshielded cables        |                |
| <input type="checkbox"/> - Shielded cables          | MPS.No.: _____ |
| <input type="checkbox"/> - Customer specific cables |                |
| <input type="checkbox"/> - _____                    |                |
| <input type="checkbox"/> - _____                    |                |

Page 11 of 13

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

Report No. A9177F02

**Emissions Test Results:****Conducted Emissions, 10/150/450 kHz - 30 MHz**☐ - PASS☐ - FAIL☒ - NOT APPLICABLE

Minimum limit margin \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Maximum limit exceeding \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Remarks: \_\_\_\_\_  
\_\_\_\_\_

**Radiated Emissions (Magnetic Field), 10 kHz - 30 MHz**☐ - PASS☐ - FAIL☒ - NOT APPLICABLE

Minimum limit margin \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Maximum limit exceeding \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Remarks: \_\_\_\_\_  
\_\_\_\_\_

**Radiated Emissions (Electric Field), 30 MHz - 1000 MHz**☐ - PASS☐ - FAIL☒ - NOT APPLICABLE

Minimum limit margin \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Maximum limit exceeding \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Remarks: \_\_\_\_\_  
This part was done previously and a separate report was issued, report number A9242F01

**Interference Power at the Mains and Interface Cables, 30 MHz - 300 MHz**☐ - PASS☐ - FAIL☒ - NOT APPLICABLE

Minimum limit margin \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Maximum limit exceeding \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Remarks: \_\_\_\_\_  
\_\_\_\_\_

**Equivalent Radiated Emissions, 1 GHz - 110 GHz**☒ - PASS☐ - FAIL☐ - NOT APPLICABLE

Minimum limit margin \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Maximum limit exceeding \_\_\_\_\_ dB at \_\_\_\_\_ MHz

Remarks: No RF noise of significant value was noticed in this range.

Page 12 of 13

Title: Test of Netro Corporation AirStar 28 GHz PMP 16 MHz Radio Unit  
to 47 CFR 2. and 47 CFR 101.

---

Report No. A9177F02

#### GENERAL REMARKS:

No modifications were necessary in order for the EUT to meet the emissions requirements.

#### SUMMARY:

All tests according to the regulations cited on page 3 were

☒ - Performed

☐ - Not Performed

The Equipment Under Test

☒ - **Fulfills** the general approval requirements cited on page 3.

☐ - **Does not** fulfill the general approval requirements cited on page 3.

#### Statement of Measurement Uncertainty

The data and results referenced in this document are true and accurate. There may be some degree or level of measurement uncertainty. As EN 45001 does not allow recommendations to be included in the test report, the reader is encouraged to request a copy of the BABT Product Service policy concerning pass or fail judgment with respect to possible measurement uncertainties.

Equipment Received Date: On file

Testing Start Date: 20 April 2000

Testing End Date: 20 April 2000

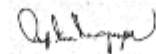
#### - BABT PRODUCT SERVICE -

Engineer In Charge:



Frank Ibrahim  
(EMC Engineer)

Tester:



Kim Nguyen  
(EMC Technician)

Page 13 of 13

BABT PRODUCT SERVICE INC 4855 Patrick Henry Drive/  
Building # 6

Santa Clara CA 95054 USA

Tel: 408 748  
3585

Fax: 408 919  
0585

Rev. No 1.0