

**RELM Wireless Corporation  
FCC Certification Application  
RPV516A**

**October 23, 2001**

# MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **RELM Wireless Corporation**

MODEL: **RPV516A**

FCC ID: **ARURPV516A**

DATE: **October 23, 2001**

This report concerns (check one): Original grant  X  
Class II change  \_\_\_\_\_

Equipment type: **VHF FM Transceiver**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes \_\_\_\_\_ No  X

If yes, defer until: \_\_\_\_\_  
date

N.A. agrees to notify the Commission by N.A.  
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

United States Technologies, Inc.  
3505 Francis Circle  
Alpharetta, GA 30004

Phone Number: (770) 740-0717

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# **SECTION 1**

## **GENERAL INFORMATION**

## GENERAL INFORMATION

### 1.1 Product Description

The Equipment Under Test (EUT) is a RELM Wireless Corporation, Model RPV516A. The EUT is a VHF FM Portable transceiver which operates on 16 programmable channels (25 kHz and/or 12.5 kHz) within the 150.0 to 174.0 MHz range.

The unit is manufactured by the following company:

Shenzhen HYT Science & Technology Co., Ltd.  
R2-A 1/F  
Shenzhen High-Tech Industrial Park  
Shennan Road  
Shenzhen China Postcode: 518057

## **1.2 Related Submittal(s)/Grant(s)**

The EUT will be used with part of a system to send/receive data. The transceiver presented in this report will be used with other like transceivers.

The EUT is subject to the following authorizations:

- a) Certification as a transmitter as specified by Parts 22, 74, 80, and 90.

The information contained in this report is presented for the certification authorization(s) for the EUT.

# **SECTION 2**

## **TESTS AND MEASUREMENTS**



## **TEST AND MEASUREMENTS**

### **2.1 Configuration of Tested System**

Prepared in accordance with the requirements of the FCC Rules and Regulations Part 2. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious emissions are shown in Figure 2.

The sample used for testing was received by U.S. Technologies on September 10, 2001 in good condition.

### **2.2 Test Facility**

Unless otherwise stated, testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

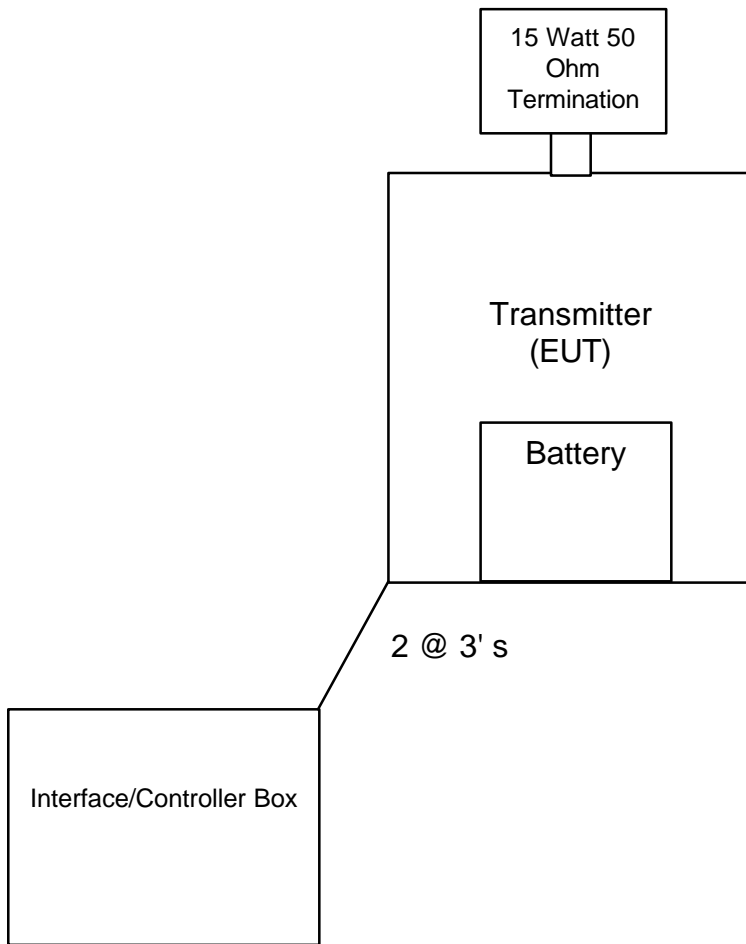
### **2.3 Test Equipment**

Table 2 describes test equipment used to evaluate this product.

### **2.4 Modifications**

No modifications were made by US Tech to bring the EUT into compliance with FCC limits for the transmitter portion of the EUT.

**FIGURE 1**  
**TEST CONFIGURATION**



**Test Date:** September 10, 2001  
**UST Project:** 01-0504  
**Customer:** RELM Wireless Corporation  
**Model:** RPV516A

**FIGURE 2a**

**Photograph(s) for Spurious Emissions (Front)**



**Test Date:** September 10, 2001  
**UST Project:** 01-0504  
**Customer:** RELM Wireless Corporation  
**Model:** RPV516A

**FIGURE 2b**

**Photograph(s) for Spurious Emissions (Back)**



**TABLE 1****EUT and Peripherals**

<b>PERIPHERAL MANUFACTURER</b>	<b>MODEL NUMBER</b>	<b>SERIAL NUMBER</b>	<b>FCC ID:</b>	<b>CABLES P/D</b>
Transmitter (EUT) RELM Wireless Corporation	RPV516A	01705A1007	ARURPV516A (Pending)	
Interface/Controller Box RELM Wireless Corporation	None	None	None	2 @ 3' S
Termination Component General, Inc.	CFT-15 BM	None	None	

**TABLE 2  
TEST INSTRUMENTS**

<b>TYPE</b>	<b>MANUFACTURER</b>	<b>MODEL</b>	<b>SN.</b>
SPECTRUM ANALYZER	HEWLETT-PACKARD	8593E	3205A00124
SPECTRUM ANALYZER	HEWLETT-PACKARD	8558B	2332A09900
S A DISPLAY	HEWLETT-PACKARD	853A	2404A02387
COMB GENERATOR	HEWLETT-PACKARD	8406A	1632A01519
RF PREAMP	HEWLETT-PACKARD	8447D	1937A03355
RF PREAMP	HEWLETT-PACKARD	8449B	3008A00480
HORN ANTENNA	EMCO	3115	3723
BICONICAL ANTENNA	EMCO	3110	9307-1431
LOG PERIODIC ANTENNA	EMCO	3146	9110-3600
MULTIMETER	FLUKE	85	53710469
PLOTTER	HEWLETT-PACKARD	7475A	2325A65394

## 2.5 Antenna Description

Manufacturer: Unknown at this time

Type: Helical Wound Molded Rubber Flex (1/4 Wave)

Model Number: Unknown at this time

Gain: Not specified by Relm Communications, Inc.

Connector: SMA

## **2.6 RF Power Output (FCC Section 2.1046)**

Information regarding this requirement has been supplied by RELM Communications. The EUT was directly connected to an HP 8901A Modulation Analyzer (Cal Due 04/11/02). The measured results are shown in Table 3 and Figure 3.

### **FCC Minimum Standard**

#### FCC Part 22

<150 Watts

#### FCC Part 74.461

Power delivered to antenna must be < 100 Watts

#### FCC Part 80.215

Maximum power at the input terminal to the antenna is 50 Watts

#### FCC Part 90.205

Power dependent upon station's antenna HAAT and required service area and may be from 1 to 500 Watts.



**TABLE 3  
RF POWER OUTPUT**

**Test Date:** July 17, 2001  
**UST Project:** 01-0504  
**Customer:** RELM Wireless Corporation  
**Model:** RPV516A

Frequency of Fundamental (MHz)	Measurement (Watt)	FCC Limit (Watt)
150.05	5.3	Varies
162.50	5.3	Varies
173.95	5.2	Varies

Note: The power output may depend upon the intended use of the EUT. For all tests, the EUT was set to near maximum conditions. The EUT requires a FCC license and is programmed for use by local RELM Radio Dealers.

**Test Results****Reviewed By****Signature:****Name:** Timothy R. Johnson

**Figure 3**  
**RF Power Output**

**Figures Not Provided**

## **Modulation Characteristics (FCC Section 2.1047)**

Where applicable, the modulation characteristics of the EUT have been supplied by RELM Wireless Corporation as stipulated by the following FCC requirements:

- a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. For equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

## **FCC Minimum Standard**

### FCC Part 22

None

### FCC Part 74.463

Each new remote pickup broadcast station with a power output in excess of 3 watts shall be equipment with a device which will automatically prevent modulation in excess of the limits. If frequency modulation is employed, the emissions shall conform to the emission requirements of 74.462.

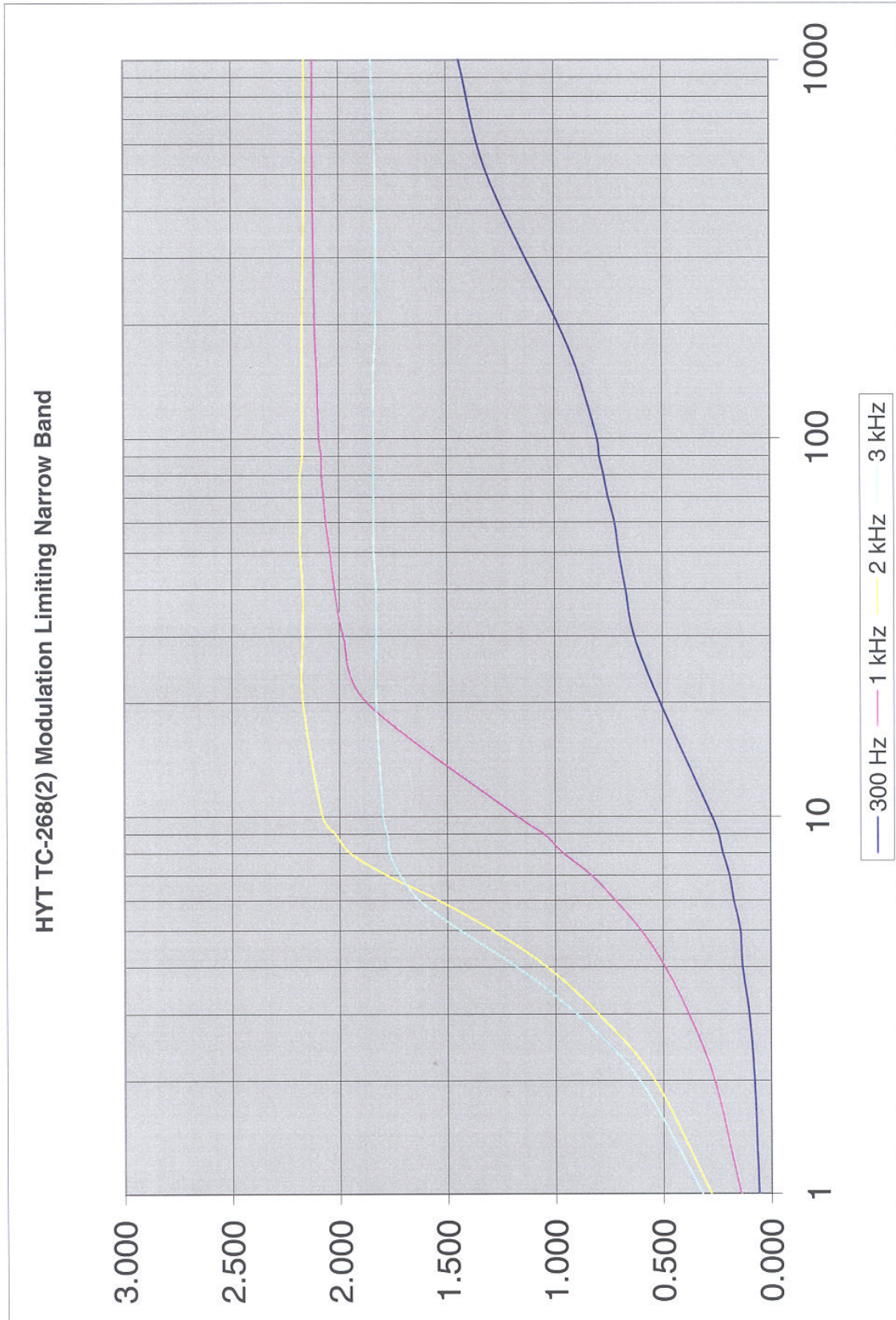
### FCC Part 80.213

- (a) When phase of frequency modulation is used in the 156-162 MHz and 216-220 MHz bands, the peak modulation must be maintained between 75 and 100 percent. A frequency deviation of  $\pm 5$  kHz is defined as 100 percent peak modulation.
- (b) Transmitters using F3E emission must have a modulation limiter to prevent any modulation over 100 percent
- (d) Ship and coast station transmitters operating in the 156-162 MHz and 216-220 MHz bands must be capable of proper operation with a frequency deviation of  $\pm 5$  kHz.
- (e) Coast station transmitters operated in the 156-162 MHz band must be equipped with an audio low-pass filter. The filter must be installed between the modulation limiter and the modulated radio frequency stage. At frequencies between 3 kHz and 20 kHz it must have an attenuation greater than at 1 kHz by at least  $60 \log(f/3)$  db. At frequencies above 20 kHz the attenuation must be at least 50 dB greater than at 1 kHz.

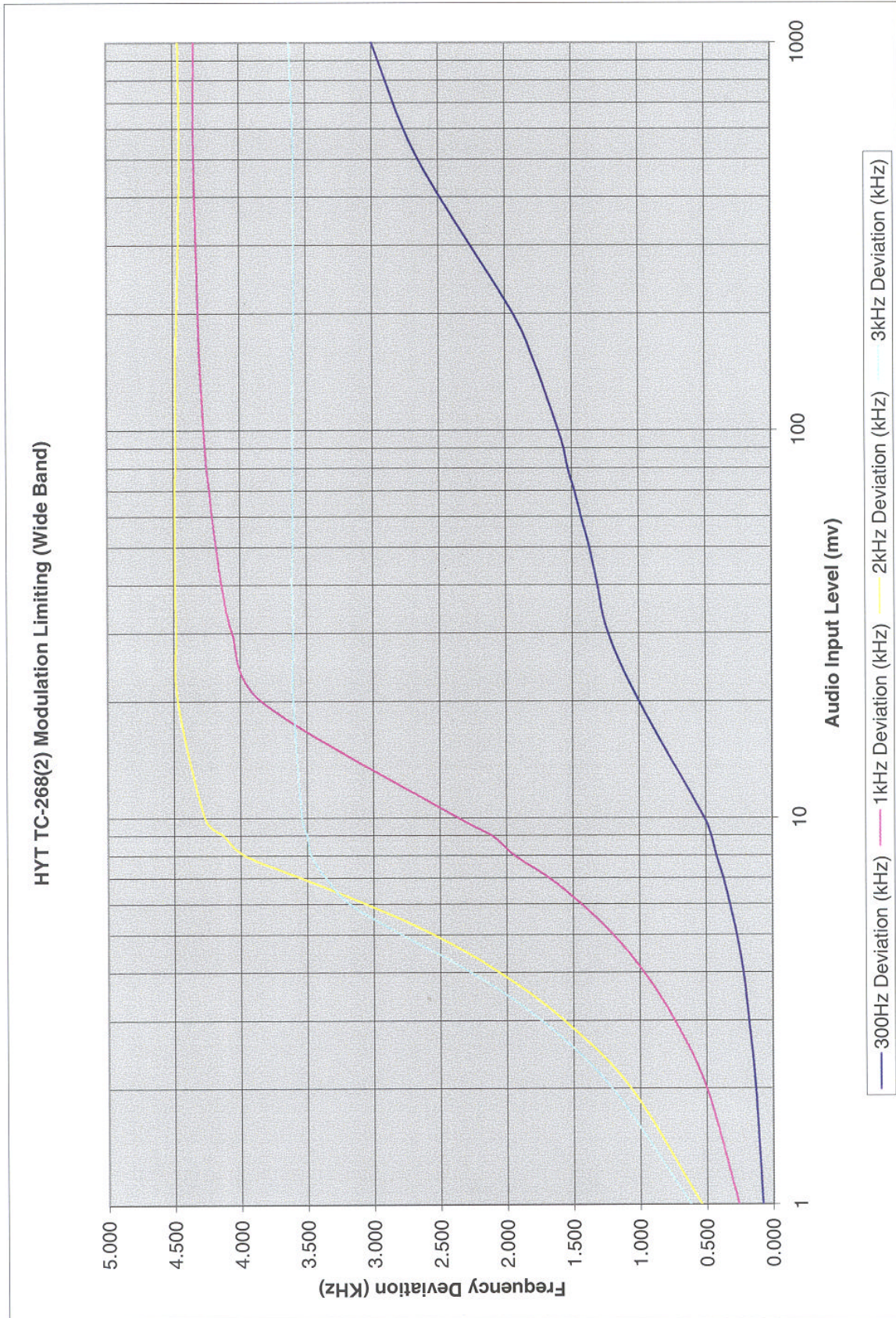
### FCC Part 90.205

Transmitters utilizing analog emissions that are equipped with an audio low-pass filter must meet the emission limitations must meet proper emissions mask of 90.210.

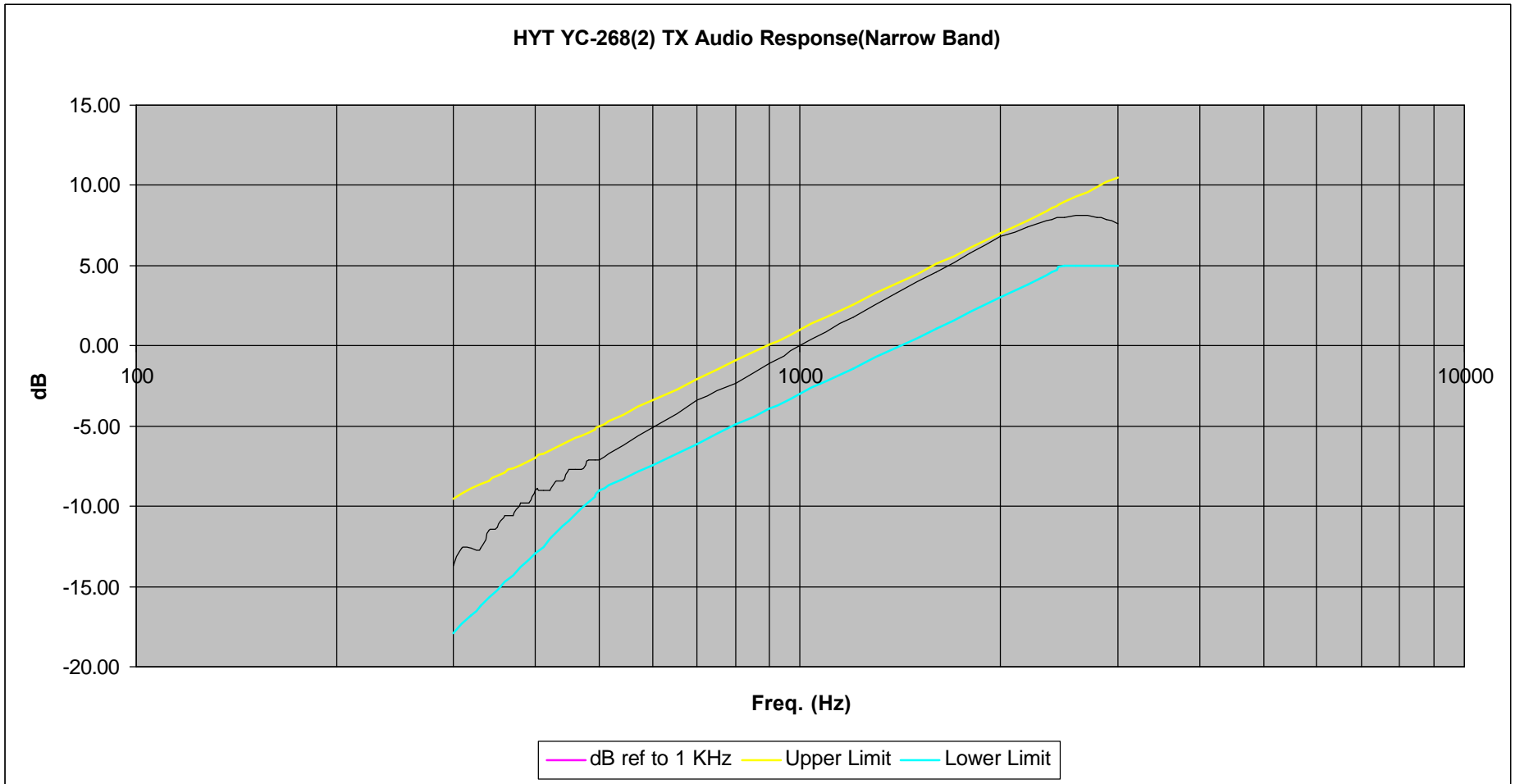
**Figure 4a.**  
**Modulation Characteristics**



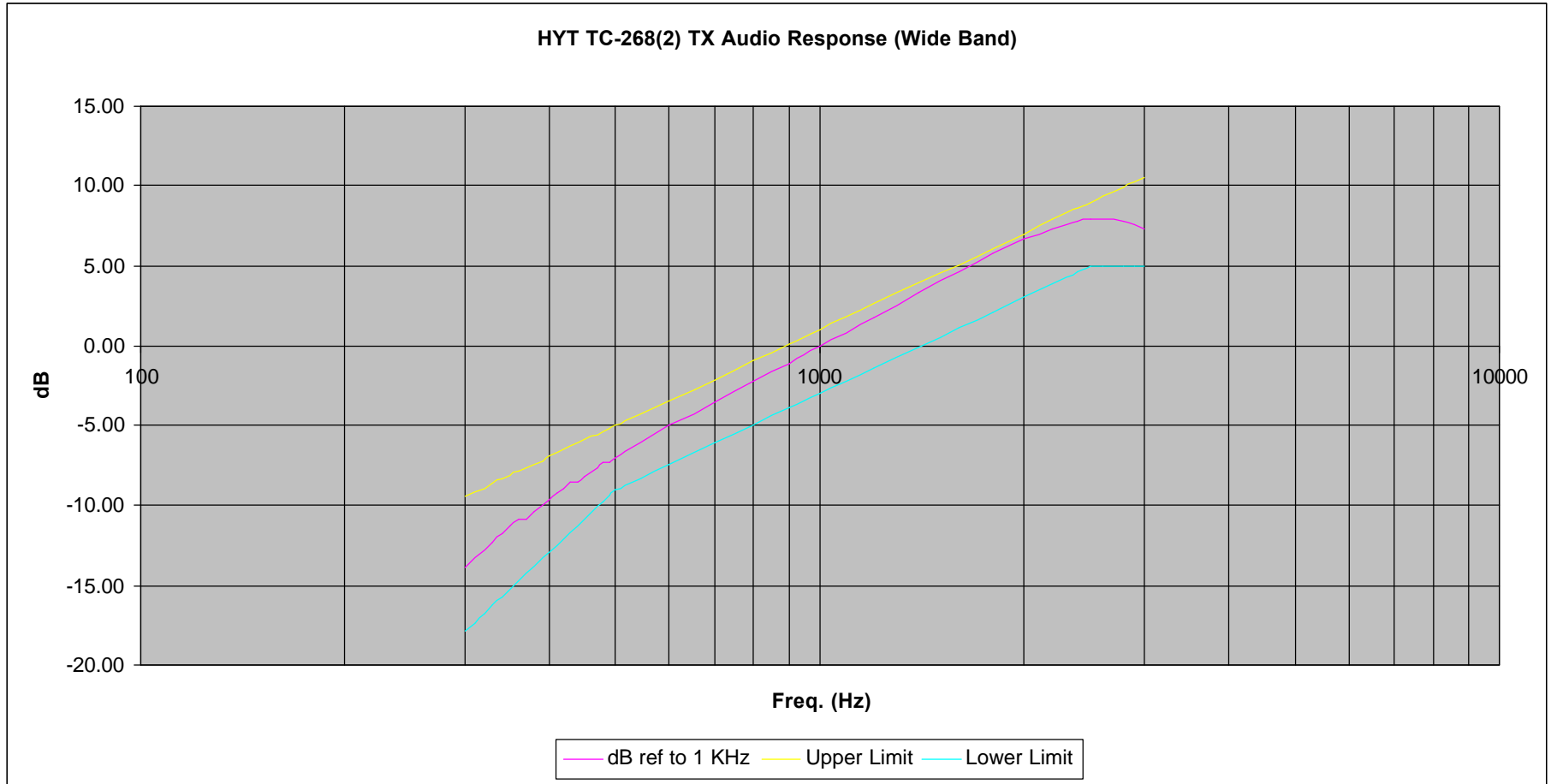
**Figure 4b.**  
**Modulation Characteristics**



**Figure 4c.**  
**Modulation Characteristics**



**Figure 4d.**  
**Modulation Characteristics**



## 2.8 Occupied Bandwidth (FCC Section 2.1049)

EUT was modulated by a 2500 Hz signal. The bandwidth of the fundamental was measured by RELM Wireless Corporation using a spectrum analyzer, as shown in Figure 5a through Figure 5b.

### FCC Minimum Standard

#### FCC Part 22.359, 74.462, 80.211 and 90.210 (25 kHz bandwidth only)

For any frequency removed from the center of the assigned channel by more than 50 percent up to and including 100 percent of the authorized bandwidth, at least 25 dB.

On any frequency removed from the center of the assigned channel by more than 100 percent up to and including 250 percent, at least 35 dB.

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

$$\text{Low: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.3) = 50.2 \text{ dB}$$

$$\text{Middle: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.3) = 50.2 \text{ dB}$$

$$\text{High: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.2) = 50.2 \text{ dB}$$

The resolution bandwidth was 300 Hz or greater for measuring up to 250 kHz from the edge of the authorized frequency segment, and 30 kHz or greater for measuring more than 250 kHz from the authorized frequency segment.

#### FCC Part 90.210 (12.5 kHz Bandwidth only)

For any frequency removed from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ , 0 dB.

On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.626 kHz but no more than 12.5 kHz, at least 7.27 ( $f_d - 2.88$  kHz) dB.

On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz at least:

$$\text{Low: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.3) = 57.2 \text{ dB}$$

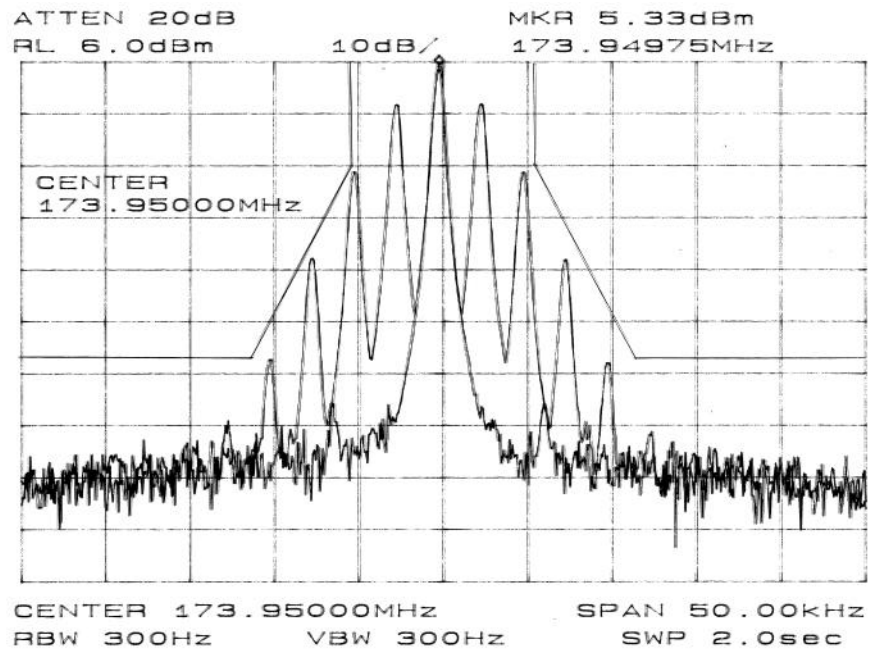
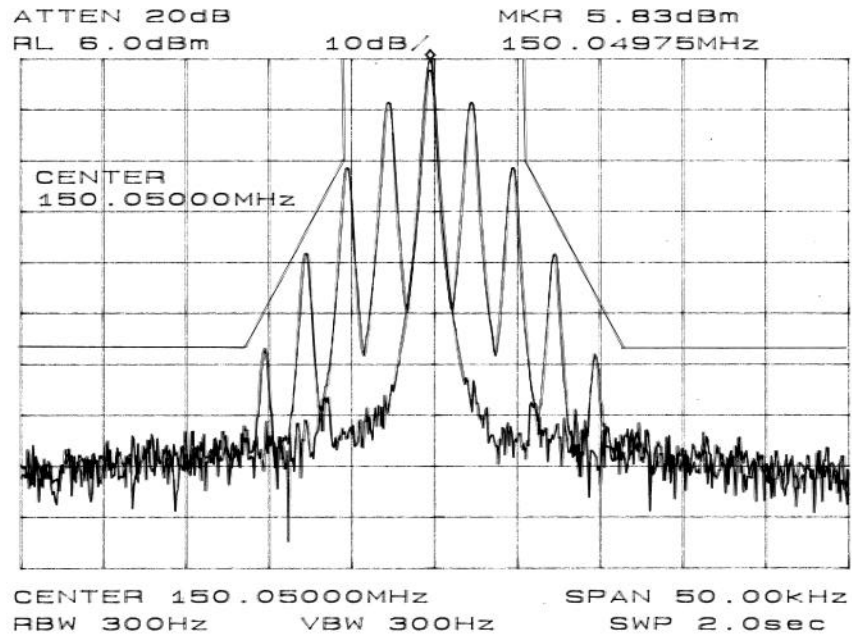
$$\text{Middle: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.3) = 57.2 \text{ dB}$$

$$\text{High: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.2) = 57.2 \text{ dB}$$





**Figure 5b.**  
**Occupied Bandwidth (Narrow Bandwidth)**



## 2.9 Spurious Emissions at Antenna Terminals (FCC Section 2.1051)

Spurious emissions appearing at the antenna terminals were measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable to the antenna output terminals or across the antenna leads on the PCB as specified by the manufacturer. Results are shown in Figure 6.

### FCC Minimum Standard

#### FCC Part 22.359, 74.462, 80.211 and 90.210 (25 kHz bandwidth only)

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

$$\text{Low: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.3) = 50.2 \text{ dB}$$

$$\text{Middle: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.3) = 50.2 \text{ dB}$$

$$\text{High: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.2) = 50.2 \text{ dB}$$

#### FCC Part 90.210 (12.5 kHz Bandwidth only)

On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz at least:

$$\text{Low: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.3) = 57.2 \text{ dB}$$

$$\text{Middle: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.3) = 57.2 \text{ dB}$$

$$\text{High: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.2) = 57.2 \text{ dB}$$

**NOTE: In general, the worse case attenuation requirement shown above was applied.**

**Figure 6  
Spurious Emissions at Antenna Terminals**

**HYT TC-268 Conducted Spurious Emissions Wide Band**

**150.05 MHz**

Freq.(MHz)	144.75	300.10	450.15	600.20	750.25	900.30	1050.35	1200.40	1350.45	1500.50	1650.55
step f.(without notch)	-80	-39.6	-37.6	-73	-72.5	n/a	-80	-80	n/a	n/a	n/a
step k.(with notch)	n/a	61	n/a	n/a	n/a	n/a	n/a	-80	n/a	n/a	n/a
step l.(sig. Gen. w/o notch from step f.)											
step l.(sig. Gen. w/ notch from step k.)		-28.7						-45.5			

Power = 5.2 watts  
 $43 + 10\log(P) = \text{dB} = 50.160033 \text{ dB}$   
 Power(dbm)= 37.160033 dBm  
 Reference Line = -13 dBm

**162.5 MHz**

Freq.(MHz)	141	157.13	325	487.5	650	812.5	975	1137.5	1300	1462.5	1625	1787.5
step f.(without notch)	-79	-79	-41.5	-39.5	-70	-74	n/a	n/a	n/a	n/a	n/a	n/a
step k.(with notch)	n/a	n/a	-75	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
step l.(sig. Gen. w/o notch from step f.)												
step l.(sig. Gen. w/ notch from step k.)			-42									

Power = 5.4 watts  
 $43 + 10\log(P) = \text{dB} = 50.323938 \text{ dB}$   
 Power(dbm)= 37.323938 dBm  
 Reference Line = -13 dBm

**173.95 MHz**

Freq.(MHz)	152.52	168.58	347.9	521.85	674.37	826.89	979.41	1131.93	1284.45	1436.97	1589.49	1742.01
step f.(without notch)	-79.5	-77	-43	-44	-77.5	-77	n/a	n/a	n/a	n/a	n/a	n/a
step k.(with notch)			-81									
step l.(sig. Gen. w/o notch from step f.)												
step l.(sig. Gen. w/ notch from step k.)			-50.4									

Power = 5.2 watts  
 $43 + 10\log(P) = \text{dB} = 50.160033 \text{ dB}$   
 Power(dbm)= 37.160033 dBm  
 Reference Line = -13 dBm

## 2.10 Field Strength of Spurious Radiation (FCC Section 2.1053)

Spurious emissions were evaluated from 30 MHz to 1.8 GHz at an EUT to antenna distance of 3 meters. The EUT was tested modulated by its own internal sources. The EUT was placed on an open area test site and the spurious emissions tested as stipulated by EIT/TIA-603:1992 section 2.2.12. Measurements for 30 to 1000 MHz were made with the analyzer's bandwidth set to 120 kHz. Measurements above 1 GHz were made with the analyzer's bandwidth set to 1 MHz.

### FCC Minimum Standard

#### FCC Part 22.359, 74.462, 80.211 and 90.210 (25 kHz bandwidth only)

On any frequency removed from the center of the assigned channel by more than 250 percent at least:

$$\text{Low: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.3) = 50.2 \text{ dB}$$

$$\text{Middle: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.3) = 50.2 \text{ dB}$$

$$\text{High: } 43 + 10 \log (P_{\text{Watts}}) = 43 + 10 \log (5.2) = 50.2 \text{ dB}$$

#### FCC Part 90.210 (12.5 kHz Bandwidth only)

On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz at least:

$$\text{Low: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.3) = 57.2 \text{ dB}$$

$$\text{Middle: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.3) = 57.2 \text{ dB}$$

$$\text{High: } 50 + 10 \log (P_{\text{Watts}}) = 50 + 10 \log (5.2) = 57.2 \text{ dB}$$

**NOTE: In general, the worse case attenuation requirement shown above was applied.**

## FIELD STRENGTH OF SPURIOUS RADIATION

Test Date: September 10, 2001  
 UST Project: 01-0504  
 Customer: ReIm  
 Model: TC-268

FCC Minimum Standard:  $50 + 10 \log (5.3) = 57.2 \text{ dB}$

TABLE 4a

NOTE: Low Channel

Frequency (MHz)	Polarity (H or V)	Substitution Antenna Level (dBm)	Antenna Correction for Reference to Dipole (dB)	Corrected Substitution Level (dBm)	Attenuated Level Below Carrier Power (dB)
300.0	V	-49.3	N/A	-49.3	86.5
300.0	H	-44.3	N/A	-44.3	81.5
450.0	V	-50.3	N/A	-50.3	87.5
1050.0	V	-56.3	9.1	-47.2	93.5
1200.0	V	-57.7	9.5	-48.2	85.4
1300.0	V	-71.3	9.3	-62.0	99.2

## SAMPLE CALCULATION:

Attenuated Level Below Carrier Power =  
 $10 \log (\text{TX Power in mW}) - \text{Corrected Substitution Level (dBm)}$   
 $10 \log (5300) - 49.3 = 86.5$

Test Results

Reviewed By: Name: Brian Parks

## FIELD STRENGTH OF SPURIOUS RADIATION

**Test Date:** September 10, 2001  
**UST Project:** 01-0504  
**Customer:** Relm  
**Model:** TC-268

FCC Minimum Standard:  $50 + 10 \log (5.3) = 57.2 \text{ dB}$

TABLE 4b

NOTE: Mid Channel

Frequency (MHz)	Polarity (H or V)	Substitution Antenna Level (dBm)	Antenna Correction for Reference to Dipole (dB)	Corrected Substitution Level (dBm)	Attenuated Level Below Carrier Power (dB)
325.0	H	-44.3	N/A	-44.3	81.5
650.0	V	-43.3	N/A	-43.3	80.5
650.0	H	-43.3	N/A	-43.3	80.5
1137.0	V	-65.4	9.1	-56.3	93.5
1625.0	V	-68.8	9.7	-59.1	96.3

## SAMPLE CALCULATION:

**Attenuated Level Below Carrier Power =**  
 $10 \log (\text{TX Power in mW}) - \text{Corrected Substitution Level (dBm)}$   
 $10 \log (5300) - -44.3 = 81.5$

**Test Results**  
**Reviewed By:**



**Name:** Brian Parks

## FIELD STRENGTH OF SPURIOUS RADIATION

**Test Date:** September 10, 2001  
**UST Project:** 01-0504  
**Customer:** Relm  
**Model:** TC-268

FCC Minimum Standard:  $50 + 10 \log (5.2) = 57.2 \text{ dB}$

TABLE 4c

NOTE: High Channel

Frequency (MHz)	Polarity (H or V)	Substitution Antenna Level (dBm)	Antenna Correction for Reference to Dipole (dB)	Corrected Substitution Level (dBm)	Attenuated Level Below Carrier Power (dB)
348.0	H	-41.3	N/A	-41.3	78.5
522.0	V	-45.8	N/A	-45.8	83.0
1043.0	V	-67.4	9.2	-58.2	95.4
1217.0	H	-61.4	8.3	-53.1	90.3
1565.0	H	-69.5	8.0	-61.5	98.7
1739.0	H	-66.6	8.3	-58.3	95.5

## SAMPLE CALCULATION:

**Attenuated Level Below Carrier Power =**  
 **$10 \log (\text{TX Power in mW}) - \text{Corrected Substitution Level (dBm)}$**   
 **$10 \log (5200) - 41.3 = 78.5$**

Test Results

Reviewed By: \_\_\_\_\_


Name: Brian Parks



## 2.11 Frequency Stability (FCC Section 2.1055)

Information regarding this requirement has been supplied by RELM Communications. The frequency tolerance of the carrier signal was measured by while ambient temperature was varied from -30 to 50 degrees centigrade. The frequency tolerance was verified at 10 degree increments. The EUT was tested while powered from 9.6 VDC. Additionally, the supply voltage was varied from 85% to 115% of the nominal value (except for hand carried, battery powered equipment which was additionally measured at battery endpoint). The data is shown in the following tables and figures.

### FCC Minimum Standard

#### FCC Part 22.355

5.0 ppm for Mobile > 3 Watts, 50 ppm for  $\leq$  3 Watts

#### FCC Part 74.464

0.0005% (5 ppm) for > 3 Watts, 0.005% (50 ppm) for  $\leq$  3 Watts

#### FCC Part 80.209

5.0 ppm for Coast Stations > 3 Watts, 10 ppm for  $\leq$  3 Watts

#### FCC Part 90.213

5.0 ppm for > 2 Watts

Temperature (C)	Frequency Error (PPM)
65	
60	-.24
55	
50	-.04
45	
40	0.05
35	
30	
25	-.03
20	
15	
10	0.20
5	
0	0.40
-5	
-10	0.75
-15	
-20	1.10
-25	
-30	0.80
-35	



## **2.12 Transient Frequency Behavior (FCC Section 90.214)**

Information regarding this requirement has been supplied by RELM Communications. Plots are provided in the following figures.

