

# TIMCO ENGINEERING INC.

849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: [sid@timcoengr.com](mailto:sid@timcoengr.com)

## Test Report

Product Name: VHF RADIO

FCC ID: MMAPL150

Applicant:

MIDLAND RADIO CORP.  
1120 CLAY STREET NORTH  
KANSAS CITY MISSOURI 64116  
USA

Date Receipt: 5/19/2006

Date Tested: 6/19/2006

APPLICANT: MIDLAND RADIO CORP.

FCC ID: MMAPL150

REPORT #: M\MIDLAND\_07K\1065UT6\1065UT6TestReport.doc

COVER SHEET

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### EXHIBITS CONTAINING:

BLOCK DIAGRAM  
SCHEMATIC  
PARTS LIST  
USERS MANUAL  
LABEL SAMPLE  
LABEL LOCATION  
EXTERNAL PHOTOGRAPHS  
INTERNAL PHOTOGRAPHS  
TUNING PROCEDURE  
OPERATIONAL DESCRIPTION  
TEST SET UP PHOTOGRAPH

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## GENERAL INFORMATION REQUIRED FOR CERTIFICATION OF A LICENSED TRANSMITTER

**Part 2.1033(c)(1)(2)** MIDLAND RADIO CORP. will manufacture the  
FCCID: MMAPL150 VHF TRANSCEIVER in quantity  
for use under FCC RULES PART 90.

MIDLAND RADIO CORP.  
1120 CLAY STREET NORTH  
KANSAS CITY, MISSOURI 64116 USA

This approval covers 2 radio models - Model PL2215 and PL2415 which  
are electronically the same except one is a 2 channel radio and one is  
a 4 channel radio.

**Part 2.1033(c)** TECHNICAL DESCRIPTION

**Part 2.1033(c)(3)** Instruction book. A copy of the instruction manual  
is included in the exhibits.

**Part 2.1033(c)(4) Type of Emission: 11K0F3E**

**Part 90.209**

**Part 90.207**

$B_n = 2M + 2DK$   
 $M = 3000$   
 $D = 2500$   
 $B_n = 2(3000) + 2(2500) = 11.0K$

**Type of Emissions: 16K0F3E**

$B_n = 2M + 2DK$   
 $M = 3000$   
 $D = 5000$   
 $B_n = 2(3000) + 2(5000) = 16.0K$

**Part 2.1033(c)(5) Frequency Range:** 148-174

**Part 90.209 (b)(5)**

**Part 2.1033(c)(6)(7)** Power Output shall not exceed 59 Watts into a 50 ohm  
**Part 90.205** resistive load. There are no user power controls.

**Part 2.1033(c)(8)** DC Voltages and Current into Final Amplifier:  
POWER INPUT:

FINAL AMPLIFIER ONLY  
INPUT POWER -  $(7.17V)(0.59A) = 4.23 \text{ Watts}$

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**Part 2.1033(c)(9) Tune-up procedure.** The tune-up procedure is included.

**Part 2.1033(c)(10) Complete Circuit Diagrams:** The circuit diagram is included. The block diagram is included.

**Part 2.1033(c)(10):** Description of all circuitry and devices provided for determining and stabilizing frequency is included in the circuit description.

**Part 2.1033(c)(11):** A photograph or drawing of the equipment identification label is included.

**Part 2.1033(c)(12):** Photographs of the equipment of sufficient clarity to reveal equipment construction and layout and label location are included.

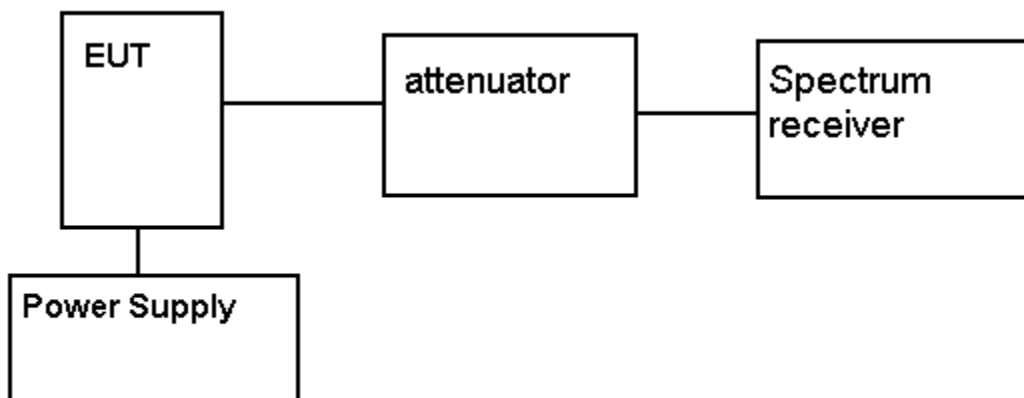
**Part 2.1033(c)(13):** Digital modulation is not allowed for voice devices.

**Part 2.1033(c)(14):** The data required for 2.1046 through 2.1057 is submitted below.

**Part 2.1046(a) RF POWER OUTPUT**

RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage, and the transmitter properly adjusted the RF output measures:

OUTPUT POWER: 2.3 WATTS



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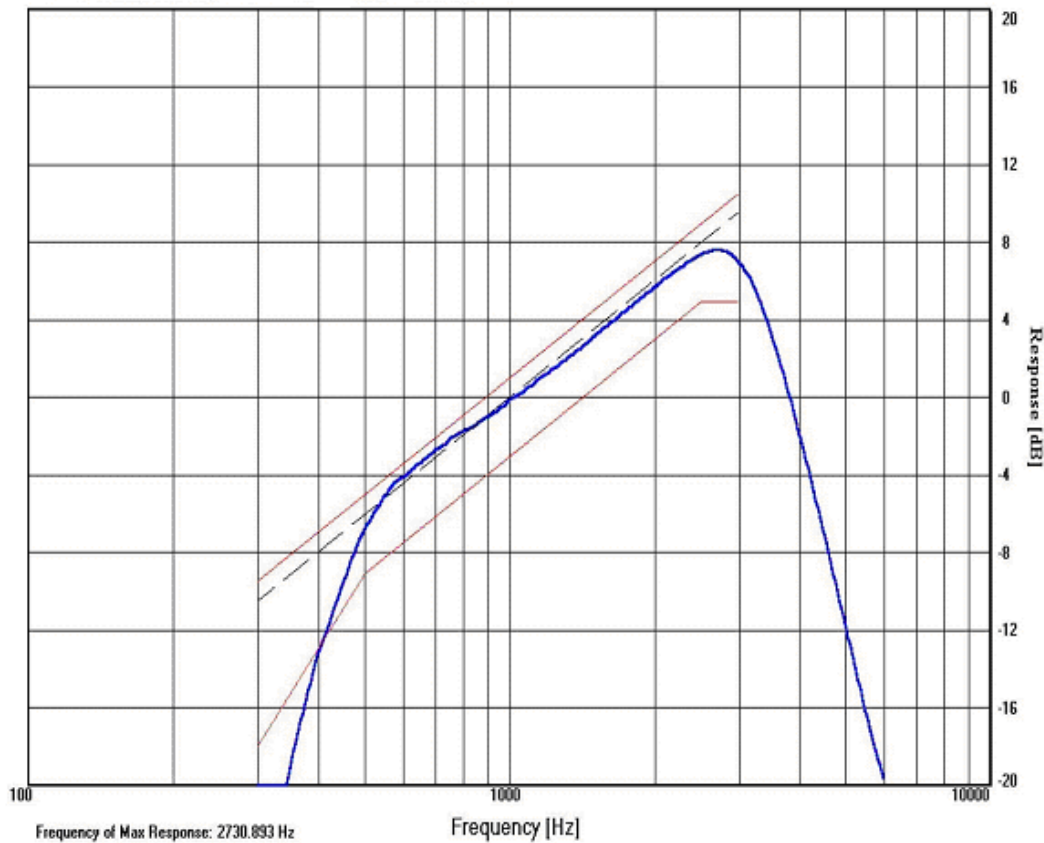
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## Part 2.1047(a)(b) Modulation characteristics:

### AUDIO FREQUENCY RESPONSE

The audio frequency response was measured in accordance with TIA/EIA Specification 603. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 - 5000Hz shall be submitted. The audio frequency response curve is shown below.

### MODULATION CHARACTERISTICS - Audio Frequency Response



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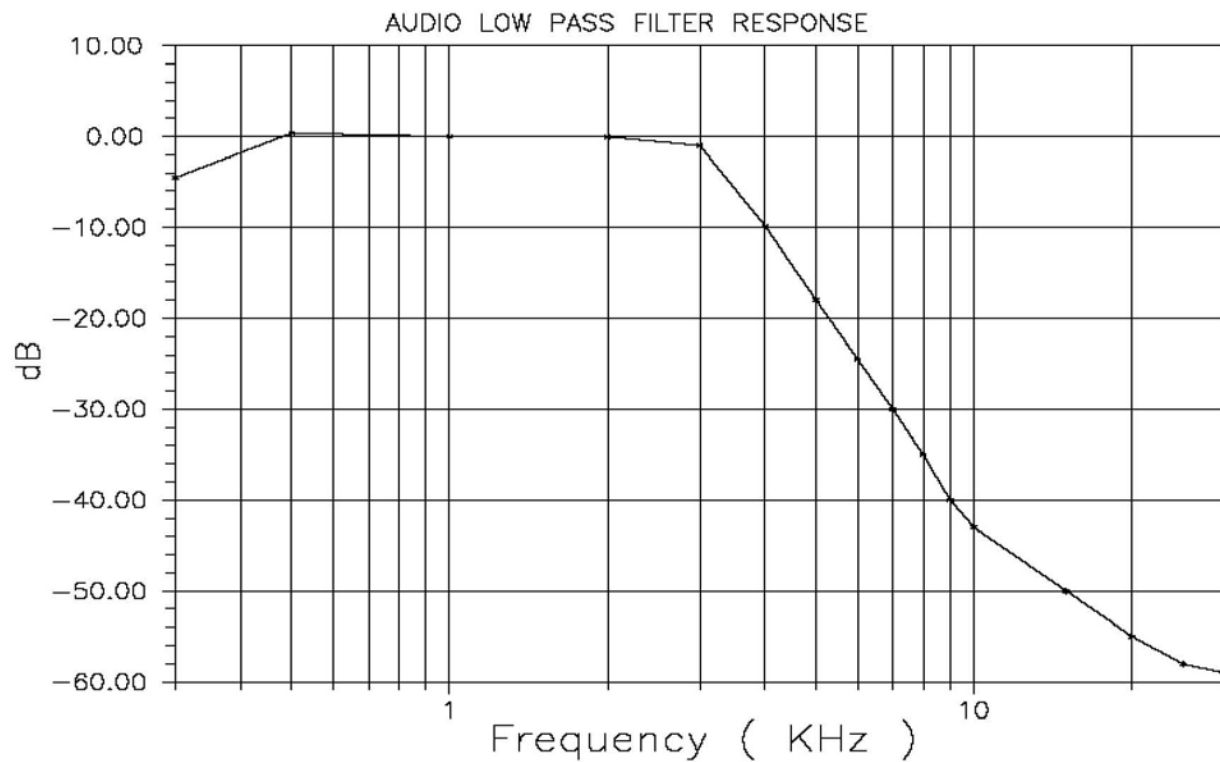
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**Part 2.1047(a) Voice modulated communication equipment:** For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all the circuitry installed between the modulation limiter and the modulated stage shall be submitted.

## PL 2215P



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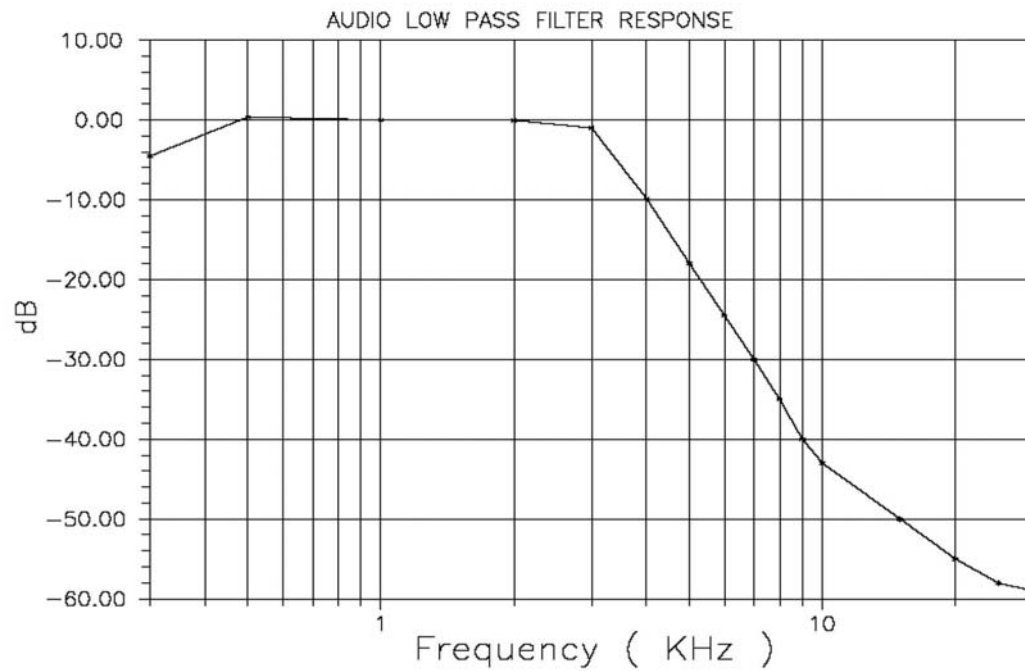
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## PL 2415



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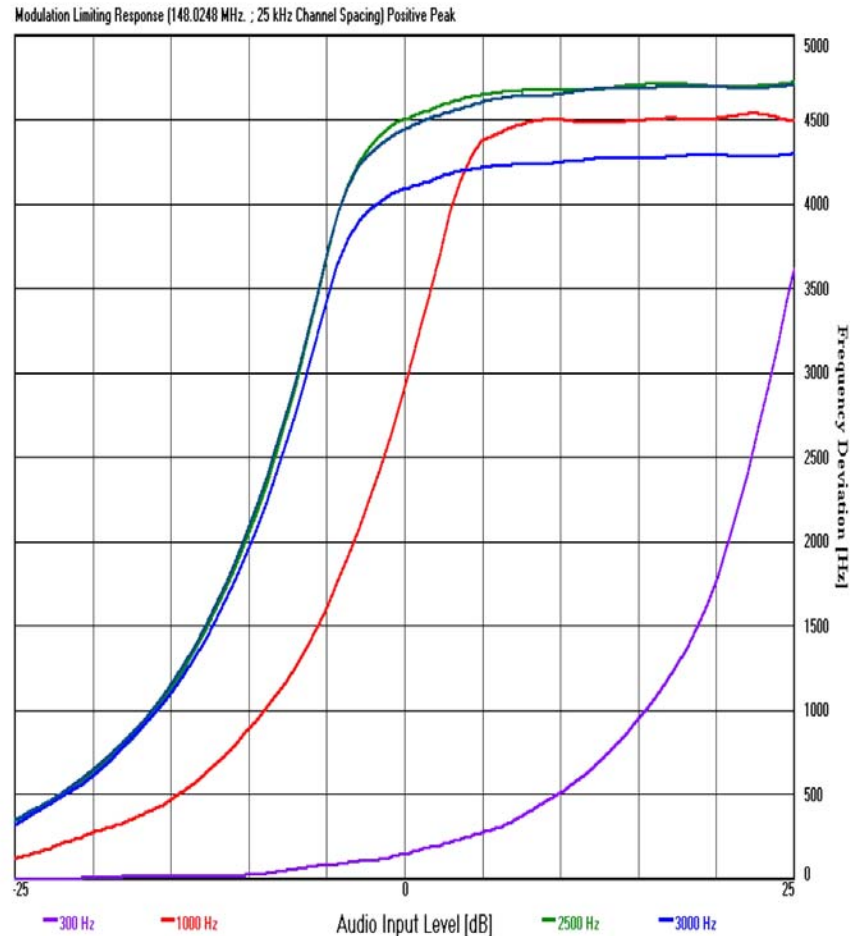
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## Part 2.1047(b) Audio input versus modulation

The audio input level needed for a particular percentage of modulation was measured in accordance with TIA/EIA Specification 603. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 3000 Hz.

### MODULATION CHARACTERISTICS – MODULATION LIMITING: WIDE BAND POSITIVE PEAK



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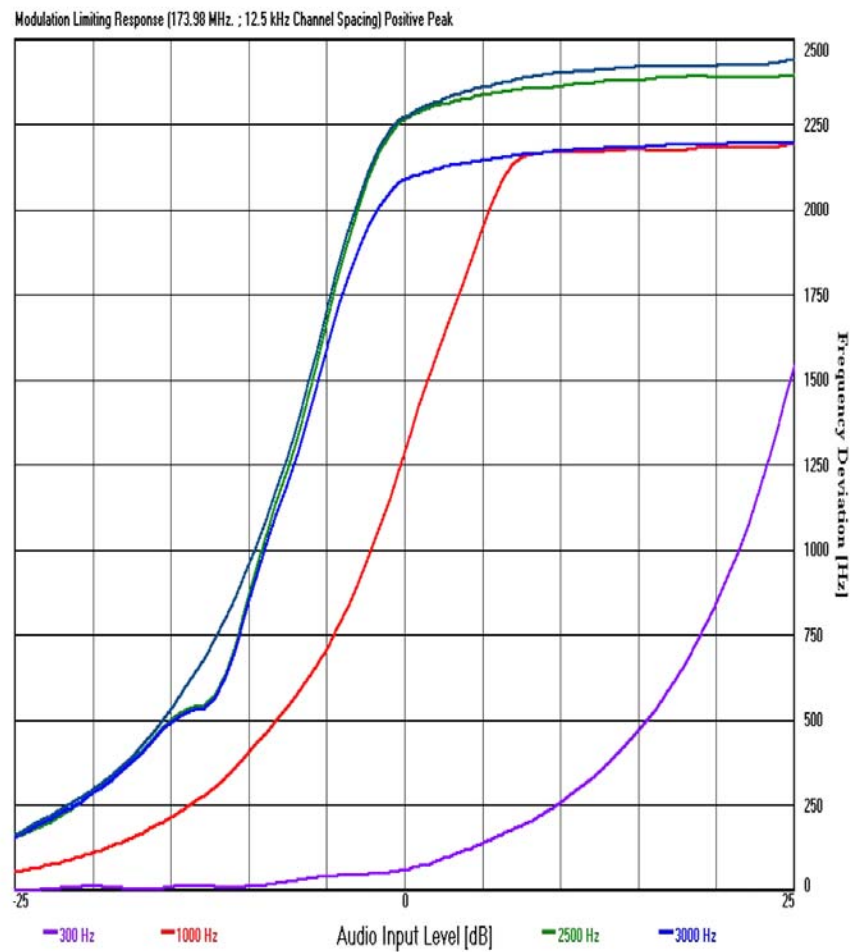
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## MODULATION CHARACTERISTICS – MODULATION LIMITING: NARROW BAND POSITIVE PEAK



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## **Part 2.1049      Occupied bandwidth:**

### **Part 2.1049(c)      EMISSION BANDWIDTH:**

#### **Part 90.210(b) 25kHz Channel Spacing**

Data in the plots show that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35 dB. On any frequency removed from the assigned frequency by more than 250%, of the authorized bandwidth: At least  $43 + 10\log(P)$ dB.

#### **Part 90.210(d)      Emission Mask D - 12.5 kHz channel BW equipment.**

For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

- (1) On any frequency from the center of the authorized bandwidth  $f_0$  to 5.625 kHz removed from  $f_0$ : Zero dB.
- (2) On any frequency from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least  $7.27 (f_d - 2.88 \text{ kHz})$  dB.
- (3) 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  $50 + 10\log(P)$  dB or 70 dB, whichever is the lesser attenuation.

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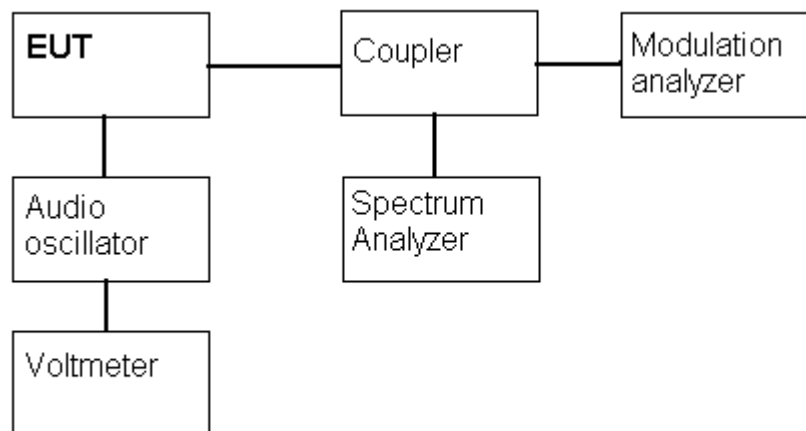
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**Test procedure:** TIA/EIA-603 para 2.2.11.

Test setup diagram

## OCCUPIED BANDWIDTH MEASUREMENT



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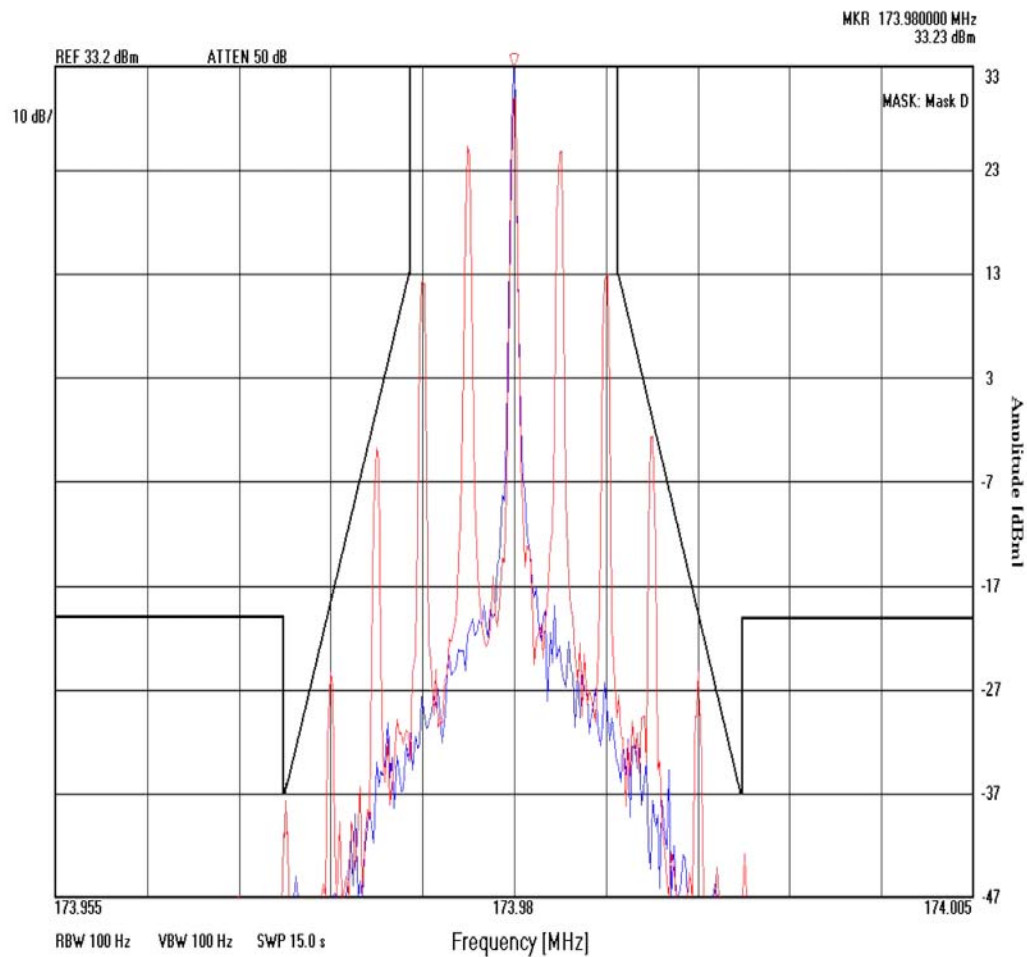
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## OCCUPIED BANDWIDTH PLOT

Part 90.210(d) Emission Mask D - 12.5 kHz channel

OCCUPIED BANDWIDTH {12.5 kHz CHANNEL BANDWIDTH: MASK D (AUDIO MODULATION: 2,500 Hz)}



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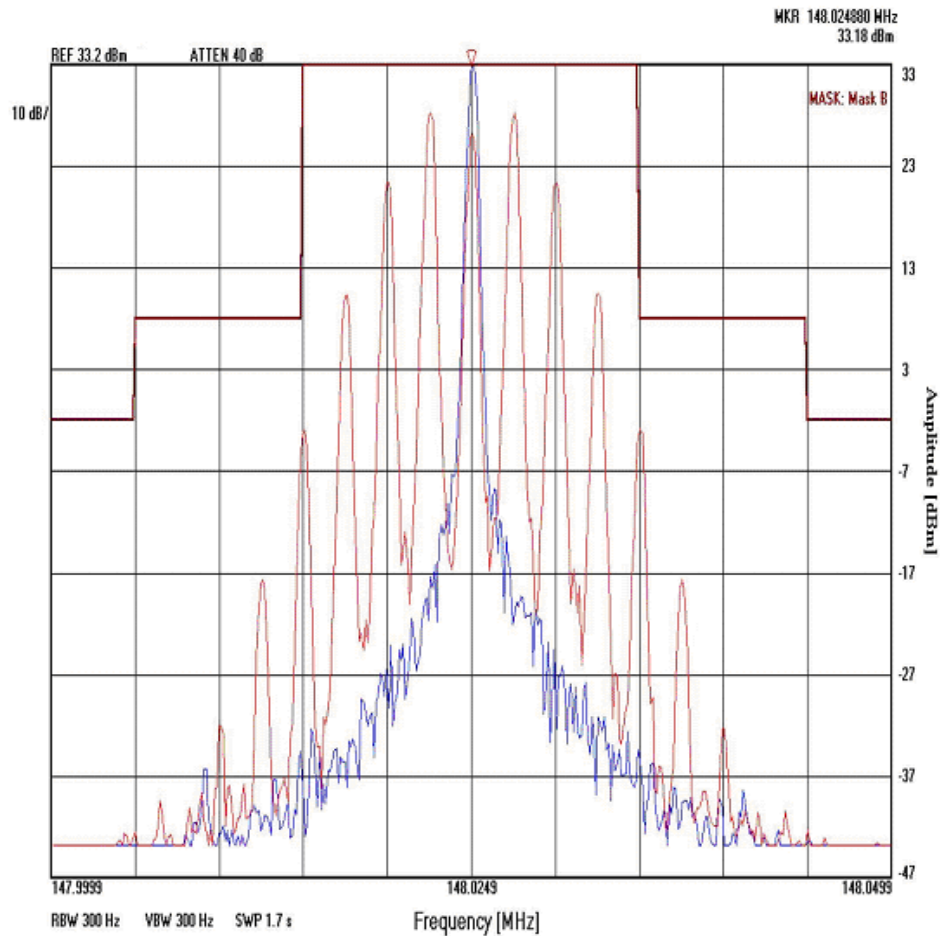
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## Part 90.210(b) Emission Mask B - 25 kHz channel

OCCUPIED BANDWIDTH {25 kHz CHANNEL BANDWIDTH: MASK B (AUDIO MODULATION: 2,500 Hz)}



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## **Part 2.1051(a) Spurious emissions at antenna terminals (conducted):**

Data below shows the level of conducted spurious responses. The carrier was modulated 100% using a 2500 Hz tone. The spectrum was scanned from 0.4 to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard TIA/EIA-603.

FCC Limit for:

25kHz Channel Spacing =  $43+10(\log)2.29 = 46.60$

12.5kHz Spacing =  $50+10(\log)2.29 = 53.60$

TF HIGH POWER	EF	dB below carrier
148.025	296.050	53.7
148.025	444.075	70.3
148.025	592.100	85.3
148.025	740.125	88.1
148.025	888.150	95.5
148.025	1036.175	98.2
148.025	1184.200	97.7
148.025	1332.225	98.6
148.025	1480.250	99.1
162.025	324.050	95.1
162.025	486.075	84.6
162.025	648.100	88.6
162.025	810.125	94.7
162.025	972.150	95.1
162.025	1134.175	104.0
162.025	1296.200	103.4
162.025	1458.225	107.3
162.025	1620.250	100.0
173.975	347.950	82.9
173.975	521.925	89.8
173.975	695.900	93.5
173.975	869.875	98.7
173.975	1043.850	107.3
173.975	1217.825	106.5
173.975	1391.800	106.2
173.975	1565.775	100.0
173.975	1739.750	100.3

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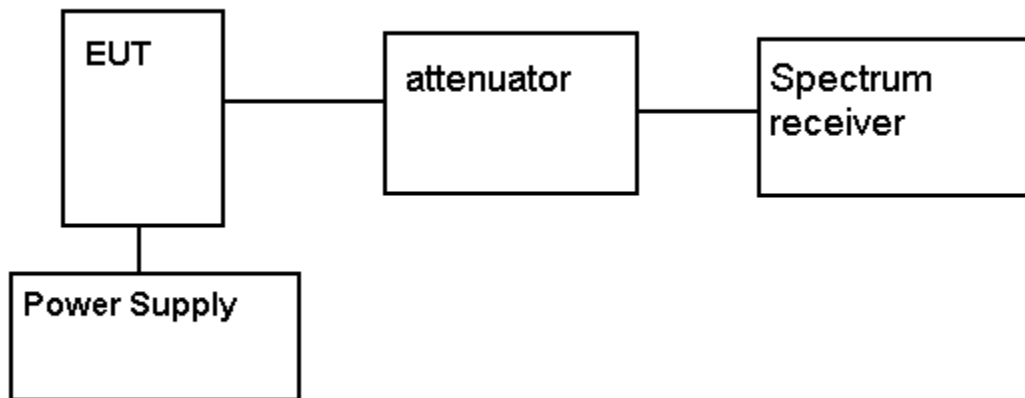
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## Method of Measuring Conducted Spurious Emissions



**METHOD OF MEASUREMENT:** The procedure used was TIA/EIA-603 STANDARD without any exceptions. The measurements were made at TIMCO ENGINEERING INC. 849 N.W. State Road 45, Newberry, Florida 32669.

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## Part 2.1053

## Field strength of spurious emissions:

NAME OF TEST: RADIATED SPURIOUS EMISSIONS

**REQUIREMENTS:** 25kHz Channel Spacing =  $43+10(\log)2.29 = 46.60$   
12.5kHz Spacing =  $50+10(\log)2.29 = 53.60$

### TEST DATA:

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
148.025		0
296.050	V	96.99
444.075	V	81.57
592.100	H	97.77
740.125	H	90.75
888.150	V	90.16
1036.175	H	93.28

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
162.025		0
324.050	V	87.05
486.075	V	89.27
648.100	H	92.99
810.125	V	87.45
972.150	H	87.47
1134.175	H	90.99
1296.200	H	90.89
1458.225	H	81.08

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<b>Emission Frequency MHz</b>	<b>Ant. Polarity</b>	<b>dB Below Carrier (dBc)</b>
<b>173.975</b>		<b>0</b>
<b>347.950</b>	<b>V</b>	<b>83.95</b>
<b>521.925</b>	<b>H</b>	<b>84.56</b>
<b>695.900</b>	<b>H</b>	<b>91.97</b>
<b>869.875</b>	<b>V</b>	<b>86.59</b>
<b>1217.825</b>	<b>H</b>	<b>88.32</b>
<b>1565.775</b>	<b>H</b>	<b>86.92</b>
<b>1739.750</b>	<b>H</b>	<b>86.96</b>

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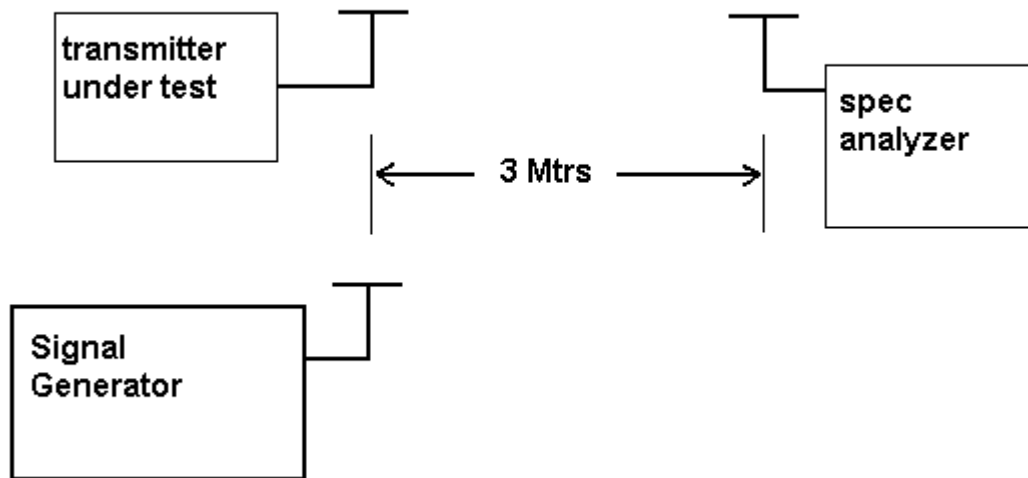
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## Method of Measuring Radiated Spurious Emissions



**METHOD OF MEASUREMENTS:** The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. This test was conducted per TIA/EIA STANDARD 603 using the substitution method. Measurements were made at the open field test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.

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## Part 2.1055 Frequency stability:

Part 90.213(a)(1) 90.266(b)(3)

Frequency Stability Requirement:

Temperature range requirements: -30 to +50° C.

Voltage Variation +, - 15%.

Measurement procedure per TIA/EIA 603.

### MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 162.025 000 MHz

<u>TEMPERATURE_°C</u>	<u>FREQUENCY_MHz</u>	<u>PPM</u>
REFERENCE_____	162.025 258	00.0
-30_____	162.025 284	+01.59
-20_____	162.025 118	+01.75
-10_____	162.025 006	+00.73
0_____	162.025 011	+00.04
+10_____	162.024 997	+00.07
+20_____	162.024 965	-00.02
+30_____	162.024 913	-00.22
+40_____	162.024 839	-00.54
+50_____	162.024 786	-00.99

<u>BATT</u>	<u>%BATT.</u>	<u>DATA</u>	<u>PPM</u>
	-15%	162.024 964	-0.22
	+15%	162.024 965	-0.22

**RESULTS OF MEASUREMENTS:** The test results indicates that the EUT meets the requirements.

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**Part 2.1055(a)(1) Frequency stability:**  
**Part 90.214** Transient Frequency Behavior

**REQUIREMENTS:** Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum transient frequencies within the maximum frequency difference limits during the time intervals indicated:

**Please note: the plots are included in a separate report exhibit.**

Time Intervals	Maximum frequency difference	All Equipment	
		150-174 MHz	421-512 MHz

Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels

$t_1^4$	$\pm 25.0$ kHz	5.0 mS	10.0 mS
$t_2$	$\pm 12.5$ kHz	20.0 mS	25.0 mS
$t_3^4$	$\pm 25.0$ kHz	5.0 mS	10.0 mS

Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels

$t_1^4$	$\pm 12.5$ kHz	5.0 mS	10.0 mS
$t_2$	$\pm 6.25$ kHz	20.0 mS	25.0 mS
$t_3^4$	$\pm 12.5$ kHz	5.0 mS	10.0 mS

Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels

$t_1^4$	$\pm 6.25$ kHz	5.0 mS	10.0 mS
$t_2$	$\pm 3.125$ kHz	20.0 mS	25.0 mS
$t_3^4$	$\pm 6.25$ kHz	5.0 mS	10.0 mS

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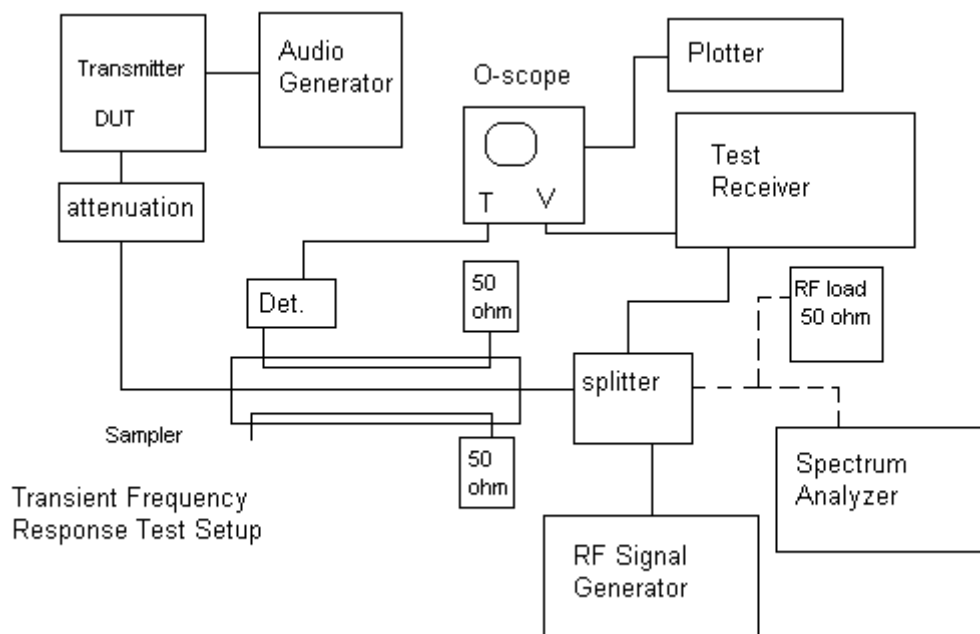
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**TEST PROCEEDURE:** TIA/EIA TS603 PARA 2.2.19, the levels were set as follows;

1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.
2. With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained with the signal generator through-out the test.
3. Reduce the attenuation between the transmitter and the RF detector by 30 dB.
4. With the levels set as above the transient frequency behavior was observed & recorded.



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# TIMCO ENGINEERING INC.

849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: [sid@timcoengr.com](mailto:sid@timcoengr.com)

## EMC Equipment List

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 12/7/05	12/7/07
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 12/7/05	12/7/07
Analyzer Tan Tower Quasi- Peak Adapter	HP	85650A	3303A01690	CAL 12/8/05	12/8/07
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 12/8/05	12/8/07
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	CAL 4/29/05	4/29/07
Antenna: Log- Periodic	Electro-Metrics	LPA-25	1122	CAL 8/26/04	8/26/06
Antenna: Double-Ridged Horn	Electro-Metrics	RGA-180	2319	CAL 12/29/04	12/29/06
LISN	Electro-Metrics	ANS-25/2	2604	CAL 8/27/04	8/27/06
Termaline Wattmeter	Bird Electronic Corporation	611	16405	CAL 7/16/04	7/16/06

APPLICANT: MIDLAND RADIO CORP.

FCC ID: MMAPL150

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