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## FCC PART 90 TEST REPORT

APPLICANT	MIDLAND RADIO CORPORATION
	5900 PARRETTA DRIVE KANSAS CITY MISSOURI 64116 USA
FCC ID	MMA701491B
MODEL NUMBER	70-1491B
PRODUCT DESCRIPTION	110W VHF RADIO
DATE SAMPLE RECEIVED	2/12/2008
DATE TESTED	2/28/2009
TESTED BY	NAM NGUYEN
APPROVED BY	MARIO DE ARANZETA
TIMCO REPORT NO.	312ZUT8TestReport.doc
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL  
WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**



Certificate # 0955-01

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## GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

The test results relate only to the items tested.

## Summary

The device under test does:

- fulfill the general approval requirements as identified in this test report  
 not fulfill the general approval requirements as identified in this test report

It is not meeting the radiated emissions requirements for the transient frequency response.

## Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025 requirements.



Testing Certificate # 0955-01

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.  
849 NW State Road 45  
Newberry, Fl 32669



## Authorized Signatory Name:

Mario de Aranzeta C.E.T.  
Compliance Engineer/ Lab. Supervisor

**Date:** 2/28/2008

Applicant: MIDLAND RADIO CORPORATION  
FCC ID: MMA701491B  
Report: X:\M\MidlandRadio\_MMA\312ZUT8\312ZUT8TestReport.doc

## GENERAL INFORMATION

### DUT Specification

<b>Description</b>	110 VHF RADIO
<b>FCC ID</b>	MMA701491B
<b>Model Number</b>	70-1491B
<b>Operating Frequency</b>	150-174 MHz
<b>No. of Channels</b>	120 OR 320 opt
<b>Type of Emission</b>	16K0F3E/11K0F3E
<b>Modulation</b>	FM
<b>DUT Power Source</b>	<input type="checkbox"/> 110-120Vac/50- 60Hz
	<input checked="" type="checkbox"/> DC Power 12V
	<input type="checkbox"/> Battery Operated Exclusively
<b>Test Item</b>	<input type="checkbox"/> Prototype
	<input checked="" type="checkbox"/> Pre-Production
	<input type="checkbox"/> Production
<b>Type of Equipment</b>	<input checked="" type="checkbox"/> Fixed
	<input type="checkbox"/> Mobile
	<input type="checkbox"/> Portable
<b>Test Conditions</b>	The temperature was 26°C with a relative humidity of 50%.
<b>Modification to the DUT</b>	None
<b>Test Exercise</b>	The DUT was placed in continuous transmit mode.
<b>Applicable Standards</b>	ANSI/TIA 603-C:2004, FCC CFR 47 Part 90
<b>Test Facility</b>	Timco Engineering Inc. at 849 NW State Road 45 Newberry, FL 32669 USA.

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## EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3-Meter OATS	TEI	N/A	N/A	Listed 1/11/06	1/10/09
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 11/30/07	11/30/09
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 11/30/07	11/30/09
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 11/30/07	11/30/09
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 11/30/07	11/30/09
Antenna: Biconnical	Electro- Metrics	BIA-25	1171	CAL 7/18/07	7/18/09
Antenna: Log- Periodic	Electro- Metrics	LPA-25	1122	CAL 12/1/06	12/1/08
Antenna: Double- Ridged Horn	Electro- Metrics	RGA-180	2319	CAL 7/18/07	7/18/09
LISN	Electro- Metrics	ANS-25/2	2604	CAL 10/5/06	10/5/08
Termaline Wattmeter	Bird Electronic Corporation	611	16405	CAL 3/15/07	3/15/09

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## TEST PROCEDURE

**Power Line Conducted Interference:** The procedure used was ANSI/TIA 603-C: 2004 using a 50uH LISN. Both lines were observed with the DUT transmitting. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

**Bandwidth 20 dB:** The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 1 MHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

**Power Output:** The RF power output was measured at the antenna feed point using a peak power meter.

**Antenna Conducted Emissions:** The RBW = 100 kHz, VBW = 300 kHz and the span set to 10.0 MHz and the spectrum was scanned from 30 MHz to the 10<sup>th</sup> harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz.

**Radiation Interference:** The test procedure used was ANSI/TIA 603-C: 2004 using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum ANSI/TIA 603-C: 2004 receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a microvolt at the output of the antenna.

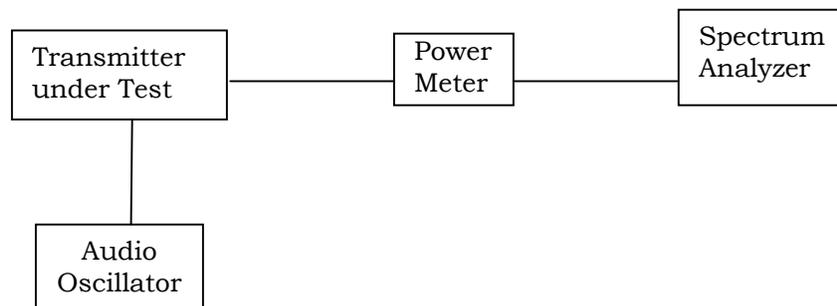
## RF POWER OUTPUT

**Rule Part No.:** Part 2.1046(a), Part 90

### Test Requirements:

**Method of Measurement:** 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:

### Test Setup Diagram:



### Test Data:

OUTPUT POWER: HIGH - 110 Watts  
 LOW - 50 Watts

### Part 2.1033 (C)(8) DC Input into the final amplifier

INPUT POWER:  $(13.6V)(16.2A) = 220.3$  Watts

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## MODULATION CHARACTERISTICS

**Rule Part No.:** Part 2.1047(a)(b)

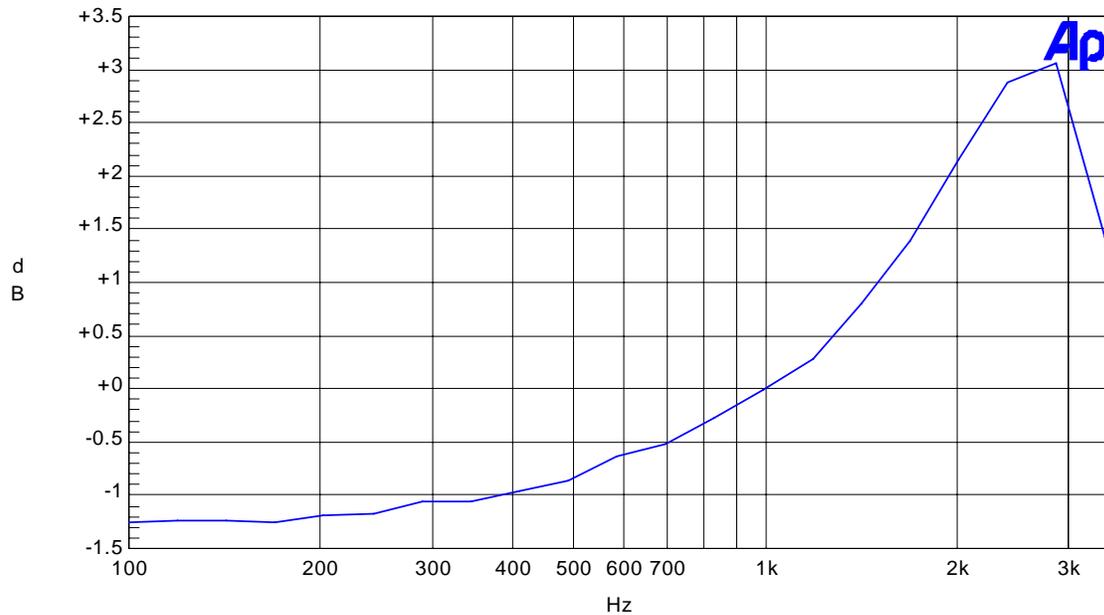
**Test Requirements:**

**Method of Measurement:**

*Audio frequency response*

The audio frequency response was measured in accordance with TIA/EIA Specification 603 with no exception. 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.

Audio Frequency Response Plot



Color	Line Style	Thick	Data	Axis
Blue	Solid	1	Anlr.Level A!Normalize	Left

MaxFreq.at1

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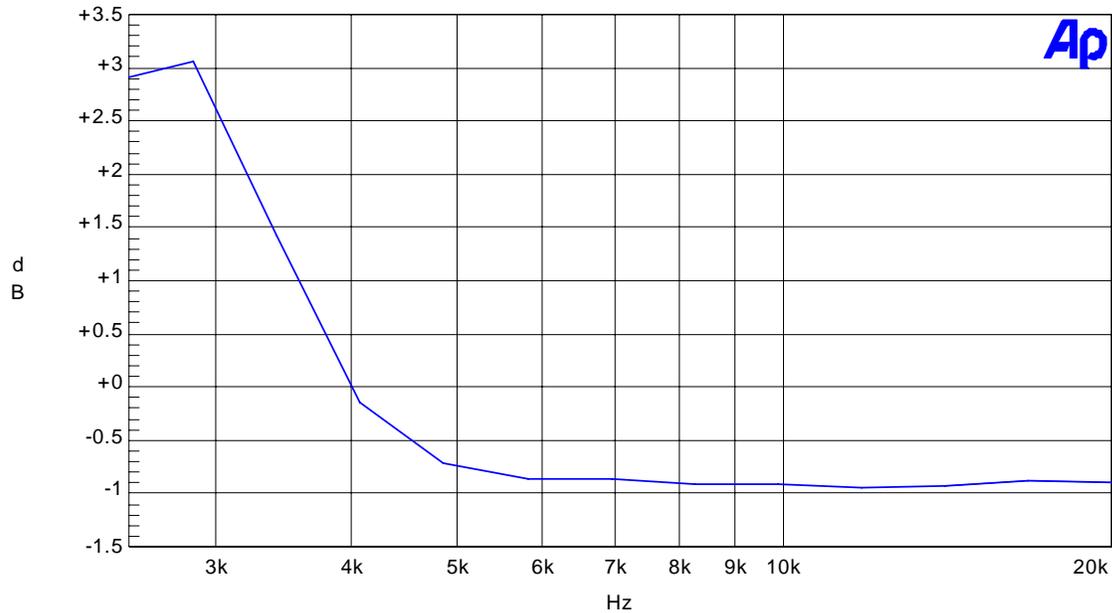
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**VOICE MODULATED COMMUNICATION EQUIPMENT**

**Part 2.1047(a)** 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.

Audio Low Pass Filter



Color	Line Style	Thick	Data	Axis
Blue	Solid	1	Anlr.Level A!Normalize	Left

MaxFreq.at1

## AUDIO INPUT VERSUS MODULATION

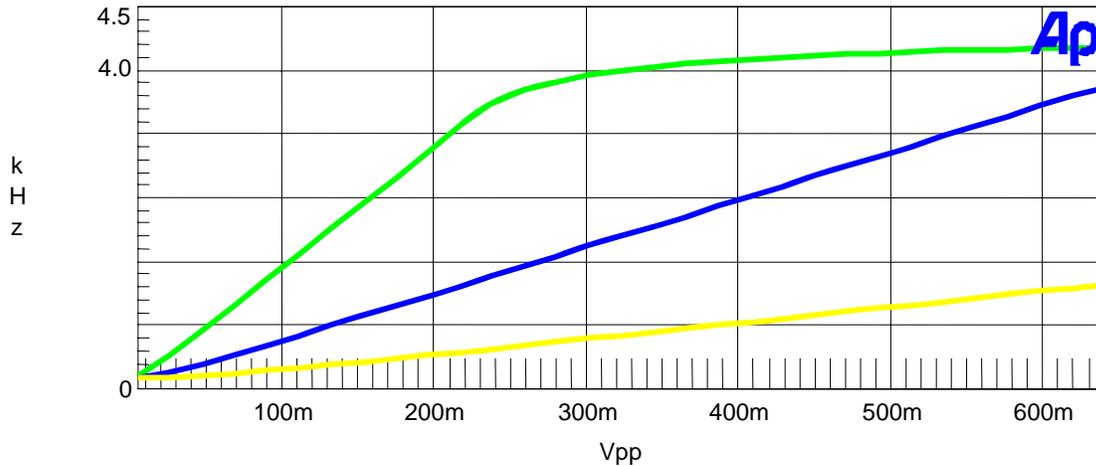
**Rule Part No.:** Part 2.1047(b) & 90

### Test Requirements:

**Method of Measurement:** **Modulation cannot exceed 100%**, 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 2500 Hz.

**Test data: Wideband**

Modulation Limiting Plots:  
2.5 KHz (Green), 1.0 KHz (Blue), and 300 Hz (Yellow)



Color	Line Style	Thick	Data	Axis
Green	Solid	3	Anlr.Level A	Left
Blue	Solid	3	Anlr.Level A	Left
Yellow	Solid	3	Anlr.Level A	Left

modulation limiting.at2

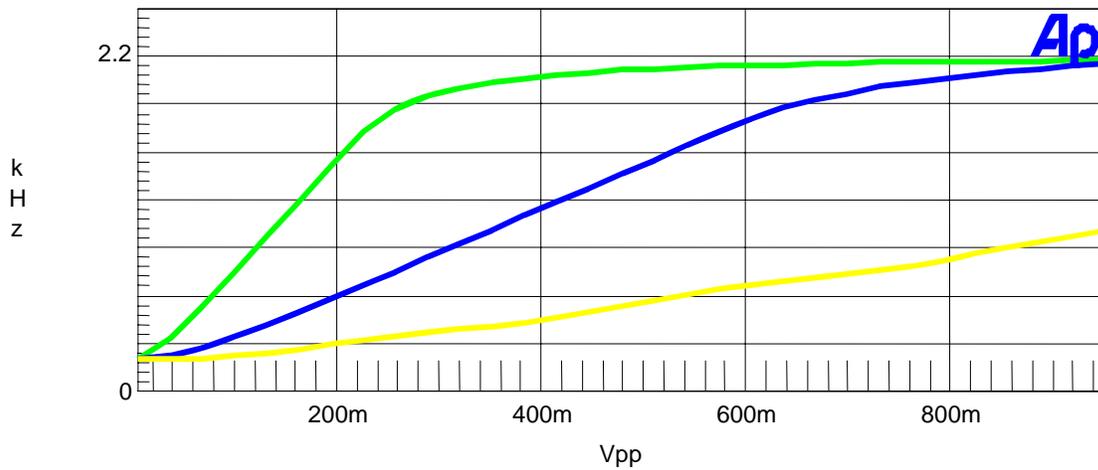
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**Test data: Narrow Band**

Modulation Limiting Plots:  
2.5 KHz (Green), 1.0 KHz (Blue), and 300 Hz (Yellow)



Color	Line Style	Thick	Data	Axis
Green	Solid	3	Anlr.Level A	Left
Blue	Solid	3	Anlr.Level A	Left
Yellow	Solid	3	Anlr.Level A	Left

modulation limiting.at2

## **OTHER MODULATION CHARACTERISTICS**

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

**Part 90.209**

**Part 90.207**  $B_n = 2M + 2DK$

$M = 3000$

$D = 2200$

$K=1$

$B_n = 2(3000)+2(2200) = 10.4k$

**Part 2.1033(c) (4)** Type of Emission: 16K0F3E

**Part 90.209**

**Part 90.207**  $B_n = 2M + 2DK$

$M = 3000$

$D = 4500$

$K=1$

$B_n = 2(3000)+2(4500) = 15.0k$

## OCCUPIED BANDWIDTH

### Part 2.1049(c)

#### 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(c) 12.5kHz Channel Spacing Not Equipped with a Low Pass Filter

For transmitters that are not equipped with an audio low pass filter pursuant to S90.211 (b), the power of any emission must be attenuated below the un-modulated carrier output power as follows; (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 5 kHz but not more than 10 kHz: At least  $83 \log(f_d/5)$  dB; (2) ON any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 10 kHz, but not more than 250% of the authorized bandwidth: At least  $29 \log(f_d/11)$ dB or 50 dB, whichever is the lesser attenuation; (3) On any frequency removed from the center of the authorized bandwidth by more than 250% of the authorized bandwidth: At least  $43 + 10 \log(P_o)$ 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.

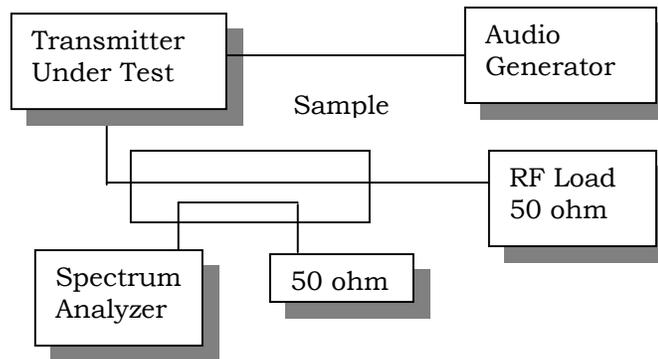
#### Part 90.210(e) Emission Mask E - 6.25 kHz channel BW equipment.

For transmitters designed to operate with a 6.25 kHz 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 3.0 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 3.0 kHz but no more than 4.6 kHz: At least  $30 + 16.67(f_d - 3.0 \text{ kHz})$  or  $55 + 10 \log(P)$  or 65, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6kHz: At least  $55 + 10\log(P)$  dB or 65 dB, whichever is the lesser attenuation.

**Method of Measurement: ANSI/TIA 603-C:2004**

**Test Setup Diagram:**



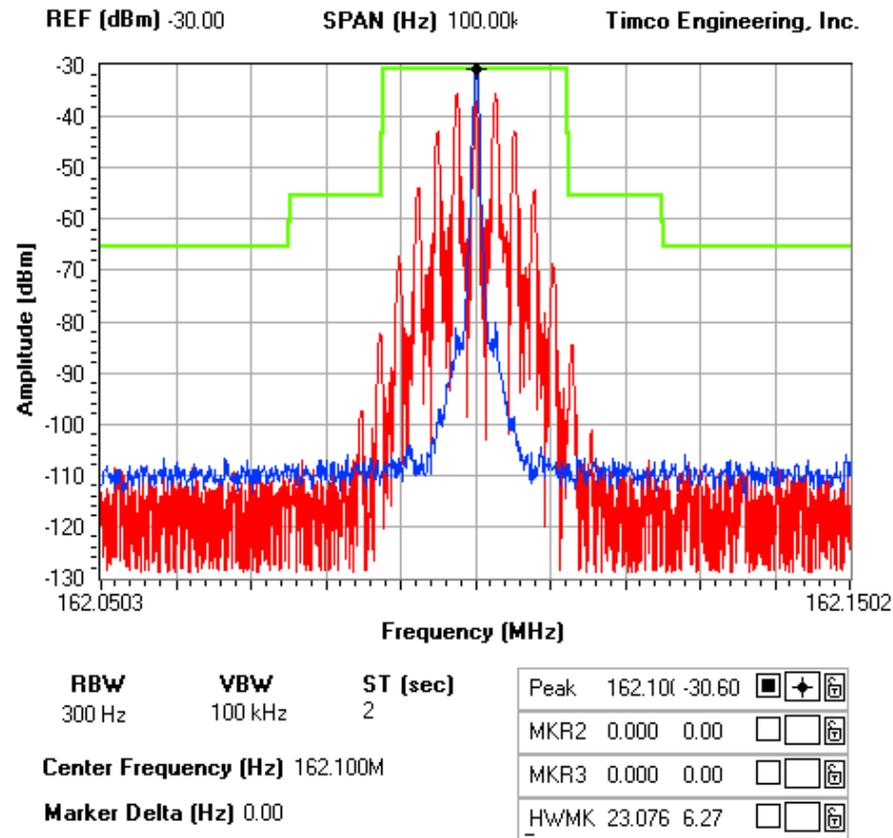
**Test Data:** See the plots below

## OCCUPIED BANDWIDTH PLOTS

**NOTES:**

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 OCCUPIED BANDWIDTH PLOT

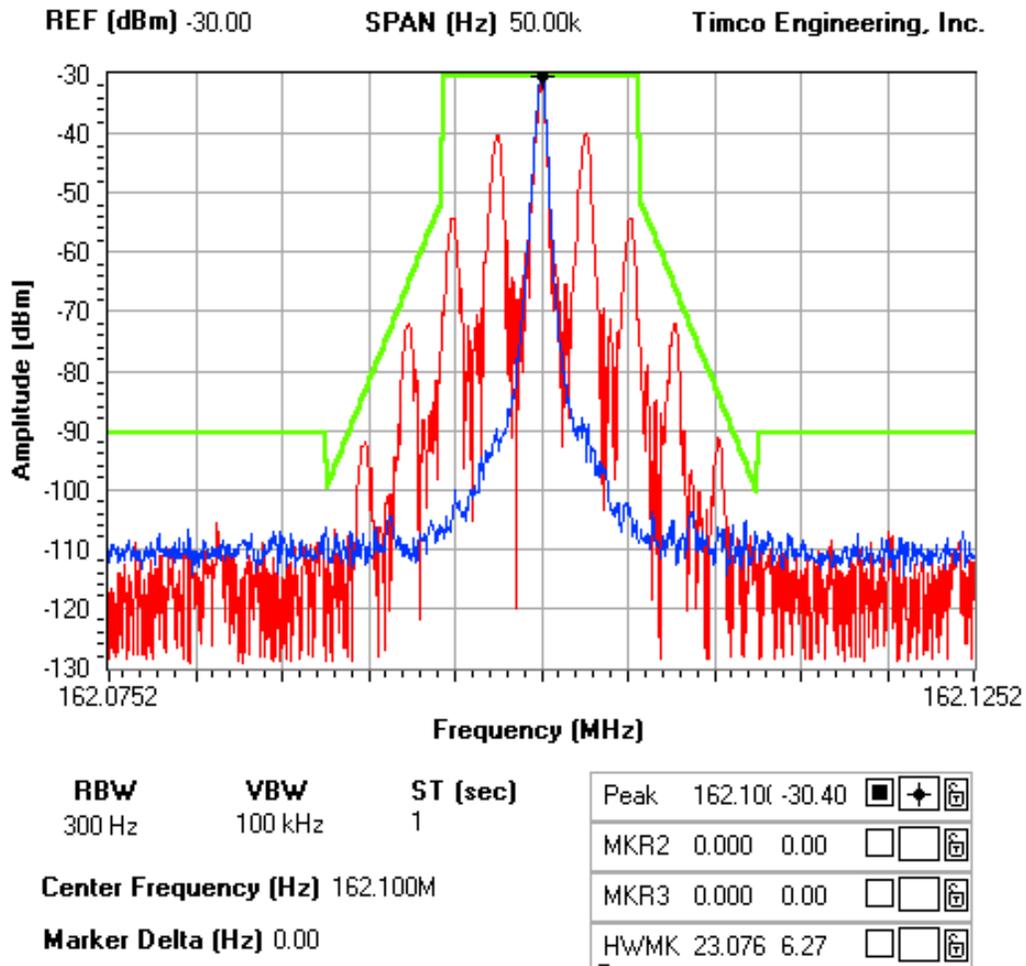
**FCC 90.210 Mask B**



**NOTES:**

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 OCCUPIED BANDWIDTH PLOT

**FCC 90.210 Mask D**



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**SPURIOUS EMISSIONS AT ANTENNA TERMINALS (CONDUCTED)**

**Rule Part No.:** Part 2.1051(a)

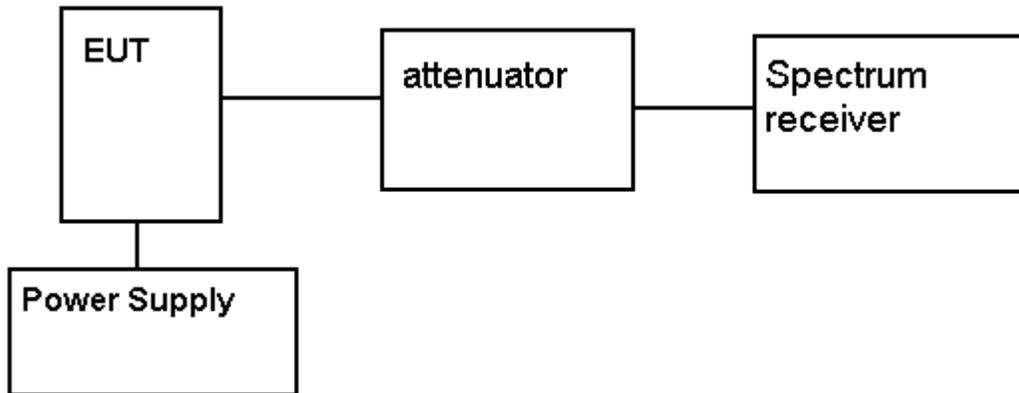
**Requirements:** 25kHz Channel Spacing =  $43+10\log(110W) = 63$  dBc  
 12.5kHz Channel Spacing =  $50+10\log(110W) = 70$  dBc

**Method of Measurement:** 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 ANSI/TIA 603-C:2004.

**Test Data:**

TF	EF	dB below carrier		TF	EF	dB below carrier		TF	EF	dB below carrier
150.10	150.10			162.10	162.10			173.90	173.90	
	300.20	91.11			324.20	96.39			347.80	91.32
	450.30	85.81			486.30	88.9			521.70	95.31
	600.40	88.25			648.40	93.04			695.60	93.24
	750.50	92.17			810.50	86.72			869.50	88.27
	900.60	94.17			972.60	86.53			1043.40	88.03
	1050.70	88.64			1134.70	85.02			1217.30	87.78
	1200.80	88.96			1296.80	89.7			1391.20	90.98
	1350.90	91.95			1458.90	NE			1565.10	NE
	1501.00	91.48			1621.00	NE			1739.00	90.38

### Method of Measuring Conducted Spurious Emissions



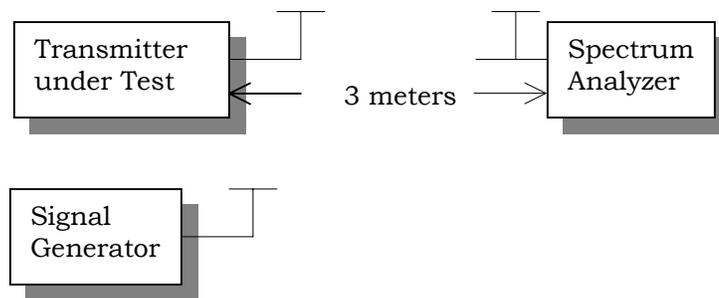
## FIELD STRENGTH OF SPURIOUS EMISSIONS

**Rule Parts. No.:** Part 2.1053

**Requirements:** 25kHz Channel Spacing =  $43 + 10\log(110W) = 63$  dBc  
 12.5kHz Channel Spacing =  $50 + 10\log(110W) = 70$  dBc

**METHOD OF MEASUREMENT:** 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 ANSI/TIA 603-C:2004. using the substitution method. Measurements were made at the test site of TIMCO ENGINEERING, INC. located at 849 NW State Road 45, Newberry, FL 32669.

### Test Setup Diagram:



### Test Data:

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
151.60	0	0
303.20	H	84.55
454.80	H	77.21
606.40	H	82.67
758.00	H	84.56
909.60	H	78.52
1061.20	H	73.28
1212.80	H	71.59
1364.40	H	71.10
1516.00	H	76.76

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
162.10	0	0
324.20	H	81.85
486.30	H	90.31
648.40	H	80.77
810.50	H	83.06
972.60	H	80.92
1134.70	H	77.78
1296.80	H	78.49
1458.90	H	75.90
1621.00	H	84.26

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
173.90	0	0
347.80	H	74.87
521.70	H	86.75
695.60	H	74.27
869.50	H	75.39
1043.40	H	83.14
1217.30	H	73.17
1391.20	H	75.01
1565.10	H	77.15
1739.00	H	84.44

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## FREQUENCY STABILITY

**Rule Parts. No.:** Part 2.1055, Part 90.213

**Requirements:** Temperature range requirements: -30 to +50° C.  
Voltage Variation +, -15%  
±2.5 PPM

**Method of Measurements:** ANSI/TIA 603-C:2004.

**Test Data:**

<b>Assigned Frequency (Ref. Frequency) (MHz)</b>		
<b>Temperature (°C)</b>	<b>Frequency (MHz)</b>	<b>Frequency Stability (PPM)</b>
-30	150.099996	-0.17
-20	150.100165	0.95
-10	150.100125	0.69
0	150.100039	0.11
+10	150.100014	-0.05
+20	150.100022	0.00
+30	150.100041	0.13
+40	150.100065	0.29
+50	150.100050	0.19

<b>Assigned Frequency (Ref. Frequency) (MHz)</b>		
<b>% Battery</b>	<b>Frequency (MHz)</b>	<b>Frequency Stability (PPM)</b>
-15%	150.100023	0.01
0		
+15%	150.100022	0.00

## 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:

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

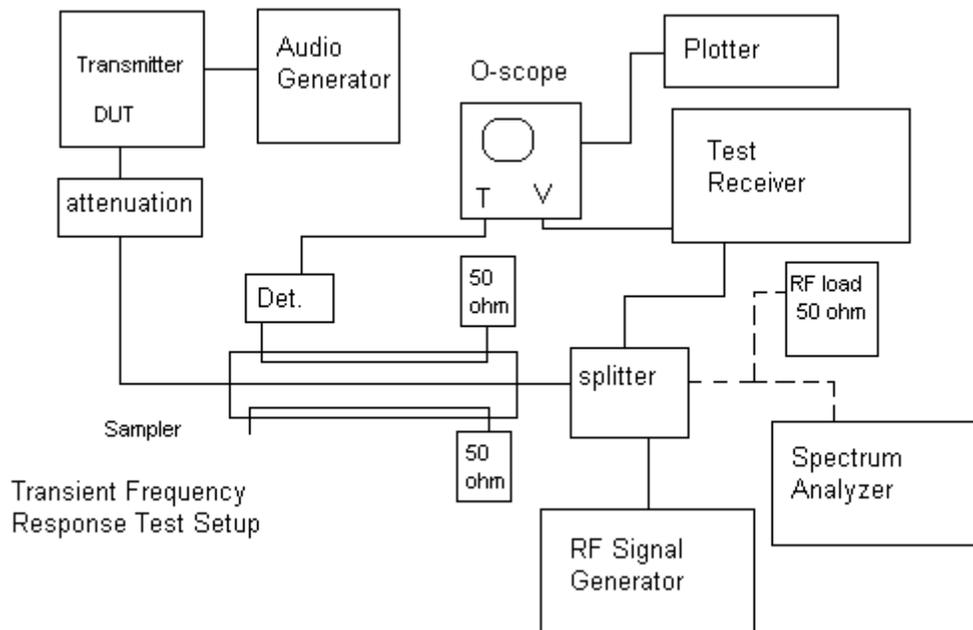
$t_1^4$	$\pm 12.5$ kHz	5.0 ms	10.0 ms
$t_2$	$\pm 6.25$ kHz	20.0 ms	25.0 ms
$t_3^4$	$\pm 12.5$ kHz	5.0 ms	10.0 ms

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

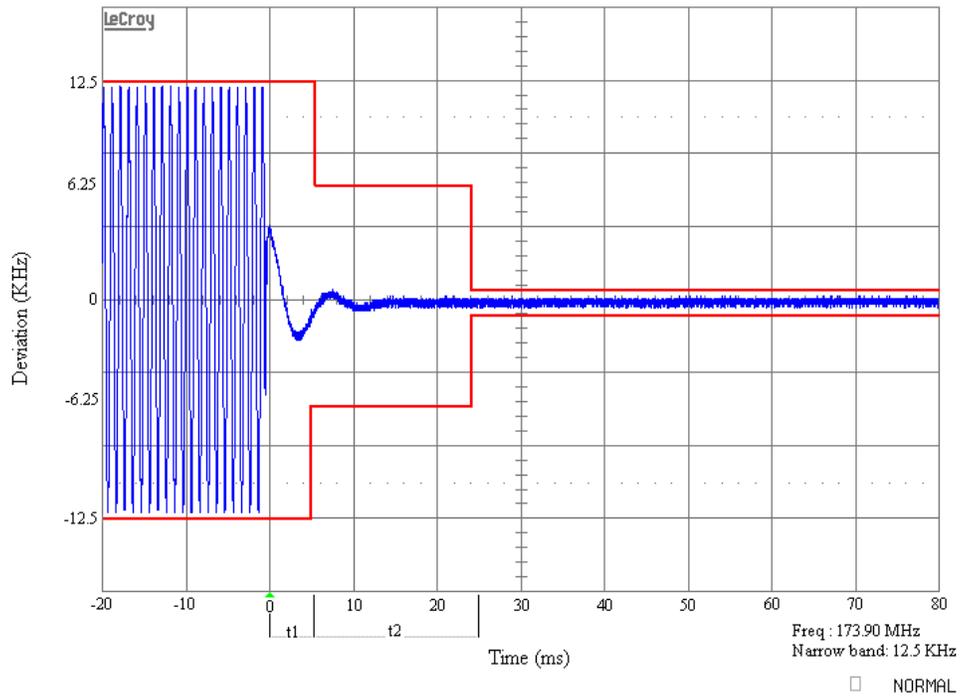
$t_1^4$	$\pm 6.25$ kHz	5.0 ms	10.0 ms
$t_2$	$\pm 3.125$ kHz	20.0 ms	25.0 ms
$t_3^4$	$\pm 6.25$ kHz	5.0 ms	10.0 ms

**TEST PROCEEDURE:** ANSI/TIA 603-C:2004, the levels were set as follows:

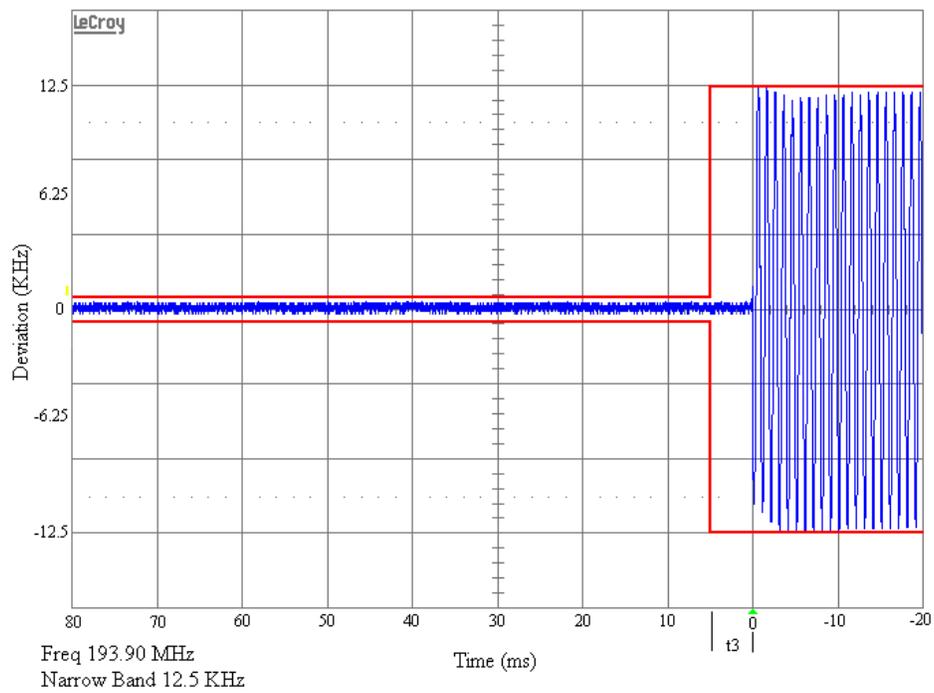
1. Using the variable attenuator the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.
2. With the transmitter off the signal generator was set 20dB below the level of the transmitter in the above step, this level will be maintained 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 and recorded.



### 12.5k ON



### 12.5k OFF

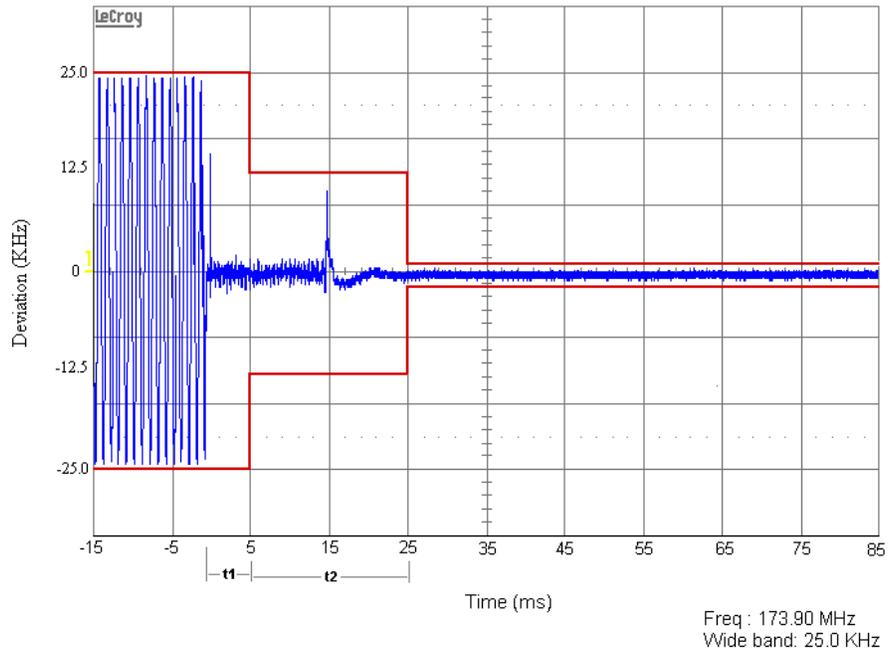


Applicant: MIDLAND RADIO CORPORATION

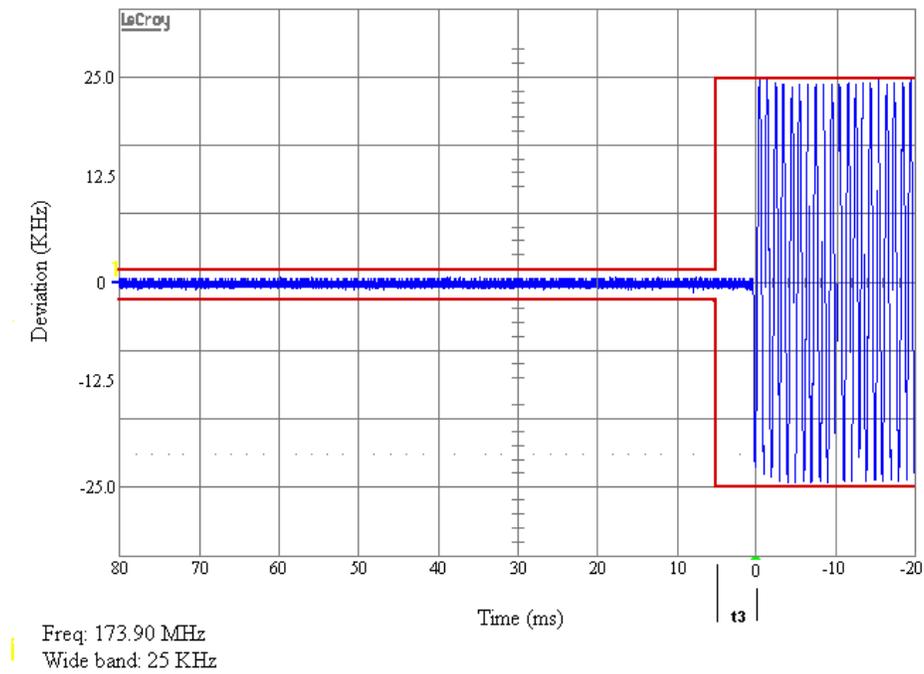
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### 25k ON



### 25k OFF



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