

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

Test Report

Product Name: MARINE MOBILE TRANSCEIVER

FCC ID: MMARG1

Applicant:

**MIDLAND RADIO CORPORATION
5900 PARRETTA DRIVE
KANSAS CITY MISSOURI 64120
USA**

Date Receipt: 3/9/2007

Date Tested: 4/4/2007

APPLICANT: MIDLAND RADIO CORPORATION
FCC ID: MMARG1
REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

TABLE OF CONTENTS LIST

APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

TEST REPORT:

PAGE 1.....	GENERAL INFORMATION & TECHNICAL DESCRIPTION
PAGE 2.....	TECHNICAL DESCRIPTION CONTINUED
	RF POWER OUTPUT
PAGE 3.....	TECHNICAL DATA
PAGE 4.....	VOICE MODULATION CHARACTERISTICS
	AUDIO FREQUENCY RESPONSE
PAGE 5.....	AUDIO LOW PASS FILTER
PAGE 6.....	MODULATION LIMITING
PAGE 7.....	OCCUPIED BANDWIDTH
PAGE 8.....	OCCUPIED BANDWIDTH PLOT
PAGE 9.....	OCCUPIED BANDWIDTH PLOT - DSC
PAGE 10.....	SPURIOUS EMISSIONS AT ANTENNA TERMINALS
PAGE 11.....	METHOD OF MEASURING CONDUCTED SPURIOUS EMISSIONS
PAGE 12.....	FIELD STRENGTH OF SPURIOUS EMISSIONS
PAGE 13.....	METHOD OF MEASURING RADIATED SPURIOUS EMISSIONS
PAGE 14.....	FREQUENCY STABILITY
PAGE 15.....	LIST OF TEST EQUIPMENT

EXHIBITS INCLUDING:

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

APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

GENERAL INFORMATION

2.1033(c) MIDLAND RADIO CORPORATION will sell the FCC ID: MMARG1 VHF Marine transmitter in quantity, for use under FCC RULES PART 80.

2.1033(c) TECHNICAL DESCRIPTION

(4) Type of Emission: 16K0G3E/16K0F3E

Bn = 2M + 2DK
M = 3000
D = 4.6kHz (Peak Deviation)
K = 1
Bn = 2(3.0k) + 2(4.6k)(1) = 6.0k + 9.2k = 15.2k

80.205 (a) ALLOWED AUTHORIZED BANDWIDTH = 20.00kHz.

(5) Type of Emission: 16K0G3E/16K0F3E

Bn = 2M + 2DK
M = 3000
D = 4.6kHz (Peak Deviation)
K = 1
Bn = 2(3.0k) + 2(4.6k)(1) = 6.0k + 9.1 = 15.2.0k

80.205 (a) ALLOWED AUTHORIZED BANDWIDTH = 20.00kHz.

2.1033(c)(6) Frequency Range: 156.025 - 157.425 MHz

2.1033(c)(7) Power Range and Controls: There is a user Power switch for High/Low Power. Maximum Output Power Rating: High (25) Watts, (1) Watt into a 50 ohm resistive load.

2.1033(c)(8) DC Voltages and Current into Final Amplifier:

POWER INPUT	
FINAL AMPLIFIER ONLY	
High	Low
Vce = 13.6 Volts	Vce = 13.6 VDC
Ice = 5.66 A.	Ice = 1.51
Pin = 76.97 Watts	Pin = 20.53 Watts

APPLICANT: MIDLAND RADIO CORPORATION
FCC ID: MMARG1
REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: tei@timcoengr.com

2.1033(c)(9) Complete Circuit Diagrams: The circuit and block diagrams are included.

2.1033(c)(10) Instruction book. The instruction manual is included.

2.1033(c)(11) Tune-up procedure. The tune-up procedure is included.

Description of all circuitry and devices provided for determining and stabilizing frequency is included in the circuit description

2.1033(c)(11) Digital modulation. This unit does NOT use digital modulation.

The data required by 2.1046 through 2.1055 is submitted below.

2.1046(a)
80.215 (e)(1) **RF power output.**

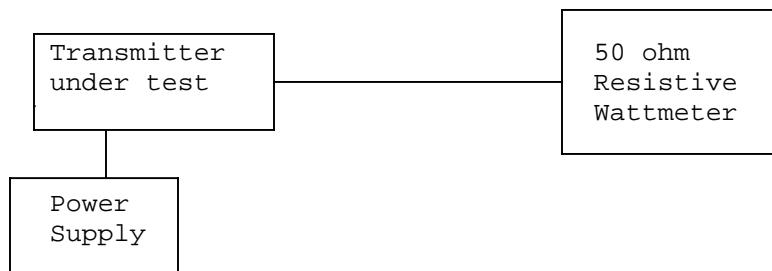
RF power is measured by connecting a 50 ohm, resistive wattmeter to the RF output connector. With a nominal battery voltage, and the transmitter properly adjusted the RF output measures:

OUTPUT POWER: HIGH: 25 W CONDUCTED
LOW: 1 W CONDUCTED

80.911 (d)(5) For primary supply voltages, measured in accordance with the procedures in this paragraph, greater than 11.5 volts, but less than 12.6 volts, the required transmitter output power shall be equal or greater than the value calculated below

$$P = 4.375(v) - 35.313 \text{ (For 12V this equals 17.2W)}$$

METHOD OF MEASURING RF POWER OUTPUT



APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

TECHNICAL DATA:

80.203 (b) **External Controls:** The transmitter is capable of changing frequency between 156.05 - 157.425 MHz by external control. The available channels are shown in the User Manual description Channel List. These channels are preprogrammed by the manufacturer and change of frequency is inaccessible to the station operator.

80.203 (c) Five minutes continuous transmission test. The antenna was connected to a dummy load and the radio was locked in a transmit PTT mode. An external timer digital clock was used to observe the duration of the un-modulated transmission. The transmitter turned off and the radio went to receive mode at 4 minutes, 58 seconds as displayed by the external digital clock.

80.203 (n) This radio complies with the requirement for DSC capability in the 156 - 162 MHz band and in accordance with 80.225.

80.873; 80.956 Transmitter G3E emission capability: The transmitter was connected to 50 ohm resistive wattmeter and the frequency was set to 156.300 and to 156.800 MHz. With normal modulation, the output power displayed was 25 Watts at the high power setting and 1 watt at low power setting, consistent with previous measurements.

The transmitter has been demonstrated to be capable, with normal operating voltages applied, of delivering 25 watts of carrier power into a 50 ohm resistive load over the specified frequencies.

80.911 (a) 80.956 G3E Transmissions: This radio is capable of G3E emission on 156.300 and 156.800 MHz

80.911 (c) With 13.6 VDC applied and with the radio connected to a 50 ohm resistive wattmeter, the output power was measured at 156.300 and 156.800 MHz with a measured reading of 25 Watts under normal speech modulation.

80.911 (d)(2) 80.959 With the power supply set to 13.6 VDC, and the output of the transmitter terminated in a 50 ohm matching artificial load, the transmitter output power was monitored over a 10 minute continuous operational period while in full power. The output power varied from the nominal 25 Watts output power to 24.8 Watts output power

APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: tei@timcoengr.com

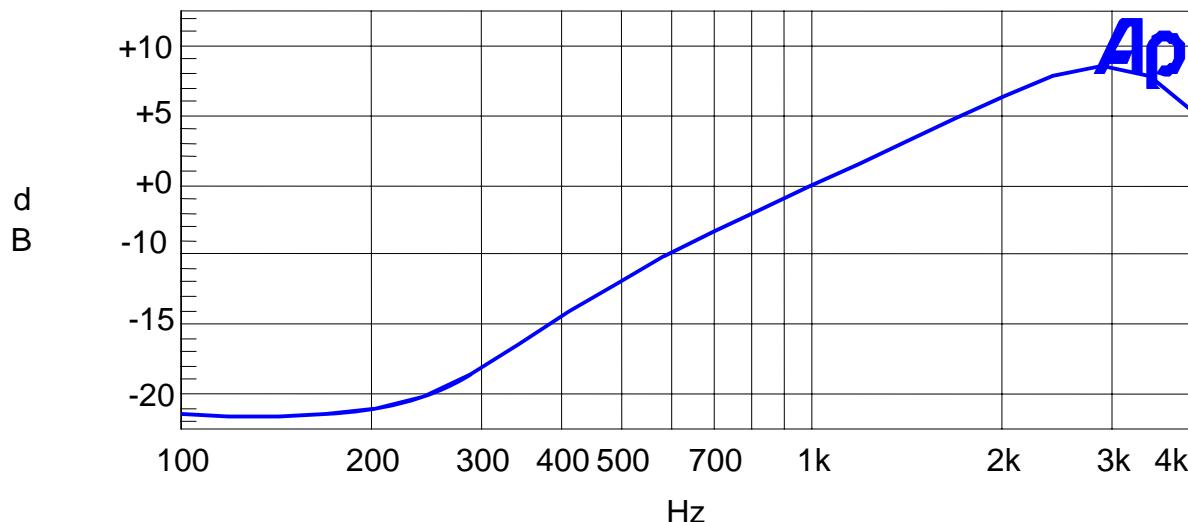
2.1047(a)

Voice Modulation characteristics:

(b)

AUDIO_FREQUENCY_RESPONSE See the following plot.

AUDIO FREQUENCY RESPONSE PLOT MIDLAND RADIO CORP -- FCC ID: MMARG1



APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: tei@timcoengr.com

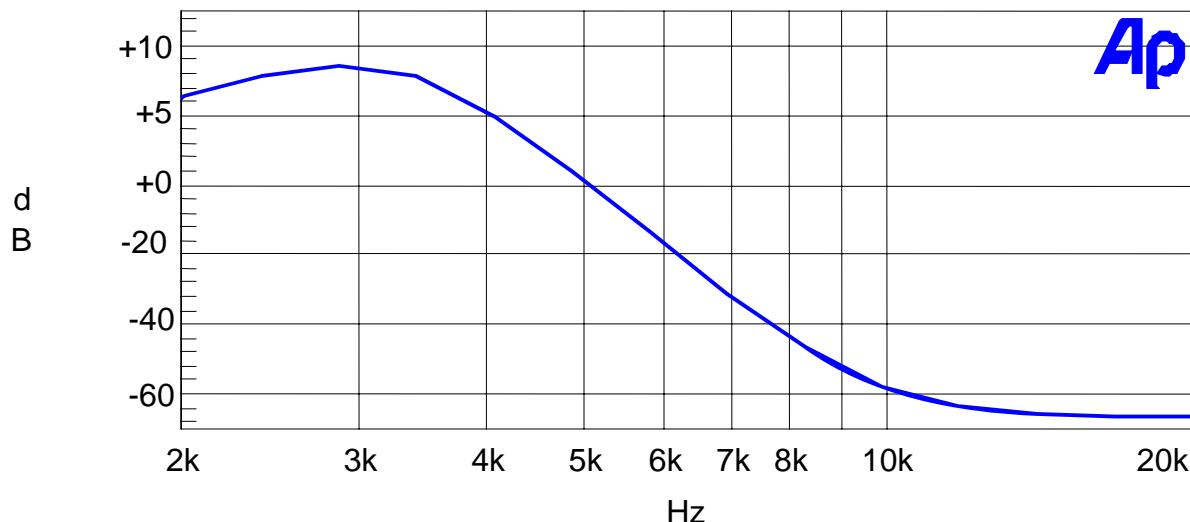
2.1047(a)

80.213

AUDIO_LOW_PASS_FILTER

The audio low pass filter shown in the following plot.

AUDIO LOW PASS FILTER PLOT MIDLAND RADIO CORP -- FCC ID: MMARG1



APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: tei@timcoengr.com

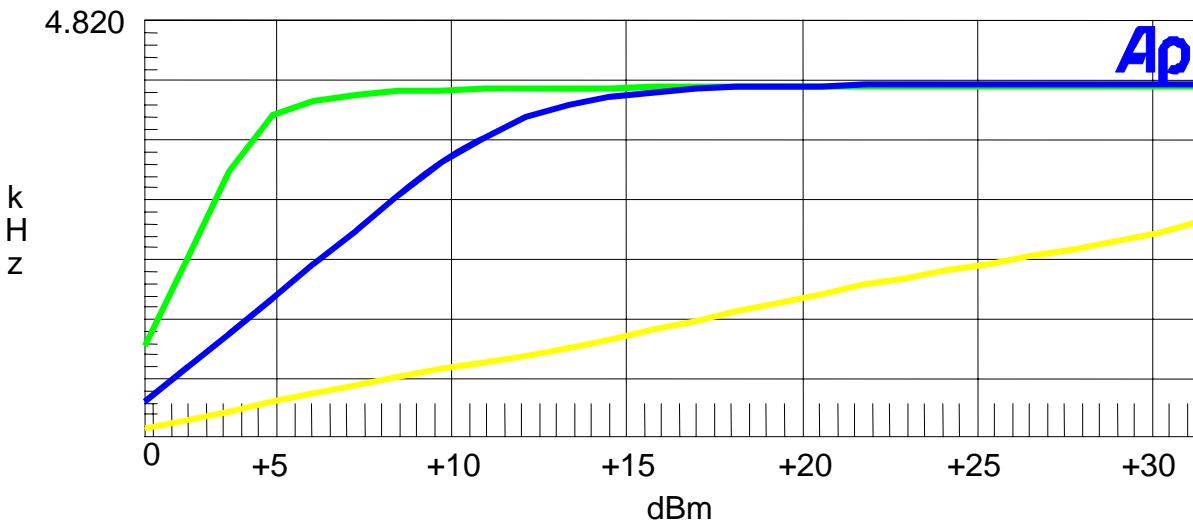
2.1047(b)

80.213 (d)

Audio_input_versus_modulation

A plot of the audio input versus deviation is shown in the following plots.

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



APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

2.1049(c)

Occupied bandwidth:

80.213 (b)

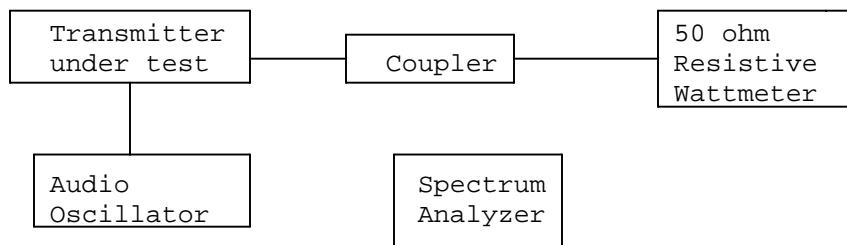
Data in the plots shows that on any frequency removed from the assigned frequency by more than 50%, but not more than 100%: At least 25dB. On any frequency removed from the assigned frequency by more than 100%, but not more than 250%: At least 35dB. On any frequency removed from the assigned frequency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

Radiotelephone transmitter with modulation limiter.

Test procedure: ANSI/TIA 603-C: 2004 Para. 2.2.11,
with the exception that various tones were used.

Test procedure diagram

OCCUPIED BANDWIDTH MEASUREMENT



APPLICANT: MIDLAND RADIO CORPORATION

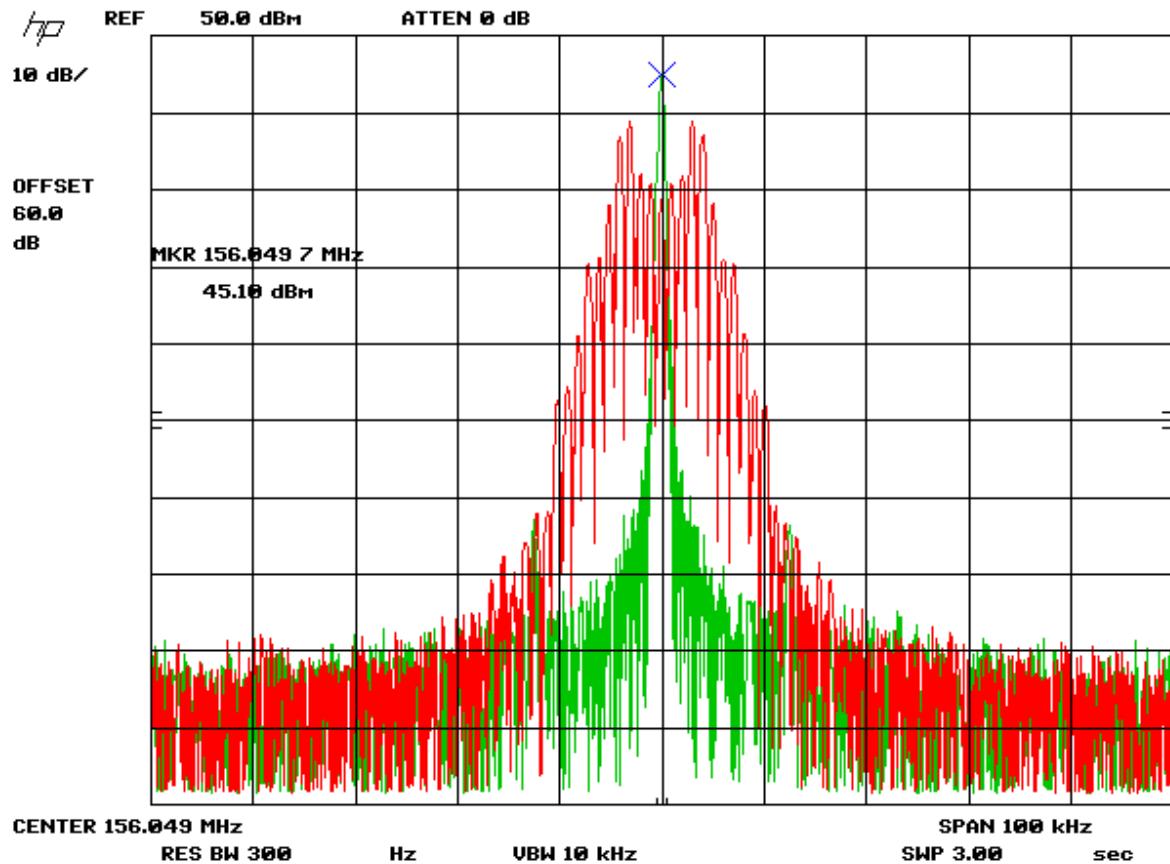
FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

OCCUPIED BANDWIDTH PLOT



APPLICANT: MIDLAND RADIO CORPORATION
FCC ID: MMARG1
REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

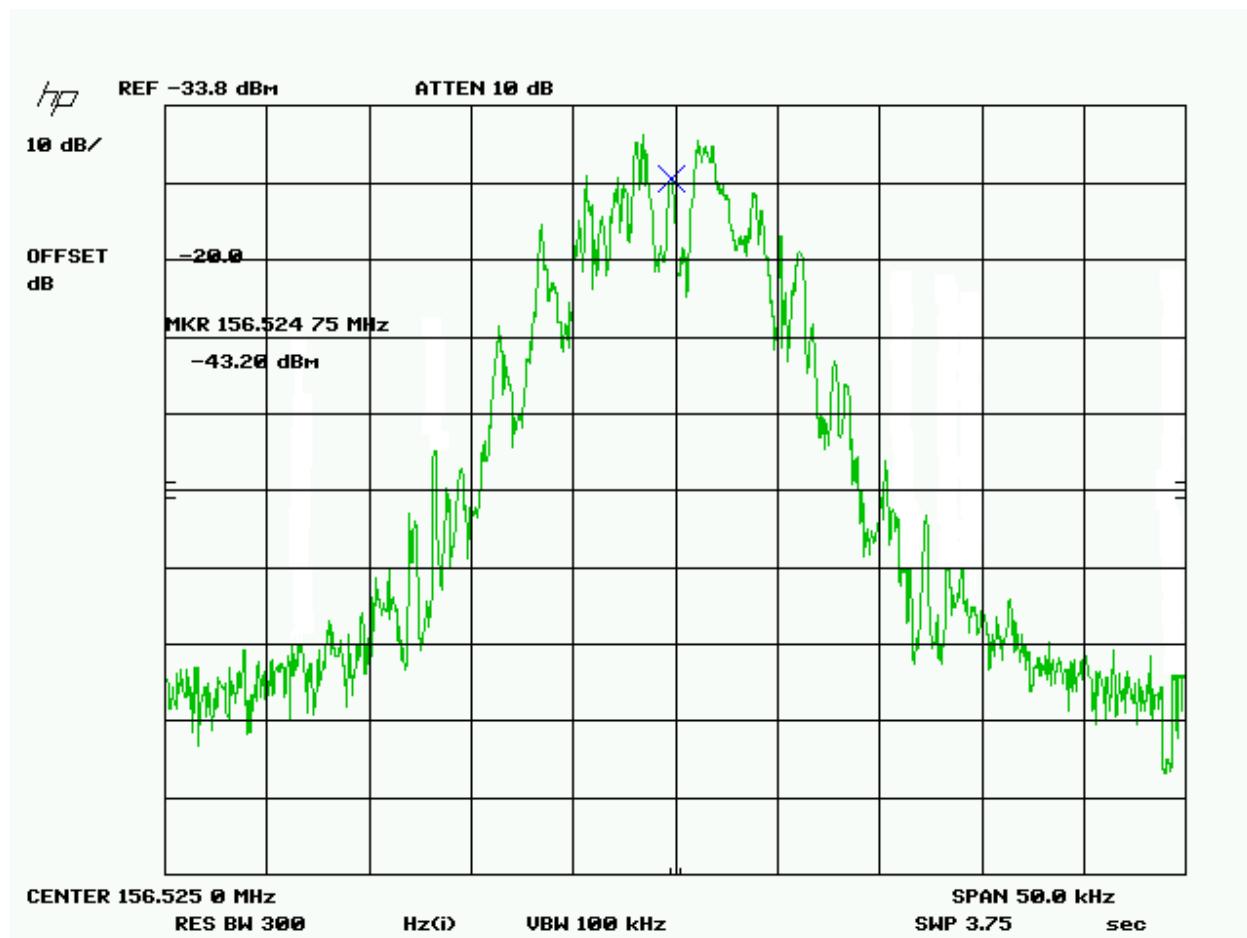
849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: tei@timcoengr.com

OCCUPIED BANDWIDTH PLOT
DSC



APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: tei@timcoengr.com

2.1051
80.211

Spurious emissions at antenna terminals (conducted):

The data on the following page shows the level of conducted spurious responses. The carrier was modulated 100% using a 2500Hz 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.

REQUIREMENTS: Emissions must be $43 + 10\log(Po)$ dB below the mean power output of the transmitter.

43 + 10log(25) = 57

43 + 10log(1) = 43

TF HIGH POWER	EF	dB below carrier	TF LOW POWER	EF	dB below carrier
156.050	156.050	0.0	156.050	156.050	0.0
	312.100	80.1		312.100	72.6
	468.150	84.0		468.150	75.9
	624.200	83.6		624.200	75.8
	780.250	88.6		780.250	73.8
	936.300	89.7		936.300	75.1
	1092.350	89.7		1092.350	75.5
	1248.400	89.5		1248.400	75.7
	1404.450	90.2		1404.450	74.6
	1560.500	88.6		1560.500	75.2

TF HIGH POWER	EF	dB below carrier	TF LOW POWER	EF	dB below carrier
157.475	157.475	0.0	157.475	157.475	0.0
	314.950	81.9		314.950	78.1
	472.425	85.3		472.425	84.1
	629.900	85.3		629.900	83.5
	787.375	93.3		787.375	85.0
	944.850	93.1		944.850	83.6
	1102.325	95.8		1102.325	83.1
	1259.800	97.9		1259.800	83.0
	1417.275	97.6		1417.275	84.0
	1574.750	97.0		1574.750	83.0

APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

Method of Measuring Conducted Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI/TIA 603-C: 2004. The measurements were made using the test sites located at TIMCO ENGINEERING INC. 849 STATE ROAD 45, NEWBERRY FLORIDA 32669.

APPLICANT: MIDLAND RADIO CORPORATION
FCC ID: MMARG1
REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

2.1053(a)

Field strength of spurious emissions:

NAME OF TEST: RADIATED SPURIOUS EMISSIONS

REQUIREMENTS: Emissions must be $43 + 10\log(P_o)$ dB below the mean power output of the transmitter.

TEST DATA:

25W		
Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
156.05	0	0
312.10	H	80.05
468.15	H	82.42
624.20	V	77.36
780.25	H	78.93
936.30	H	83.19
1092.35	H	85.8
1248.40	H	89.51
1404.45	V	93.31
1560.50	V	91.22

Emission Frequency MHz	Ant. Polarity	dB Below Carrier (dBc)
157.48	0	0
314.95	H	75.65
472.43	V	74.82
629.90	V	71.46
787.38	V	74.13
944.85	H	84.59
1102.33	H	86.1
1259.80	V	86.21
1417.28	V	92.11
1574.75	V	89.82

APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

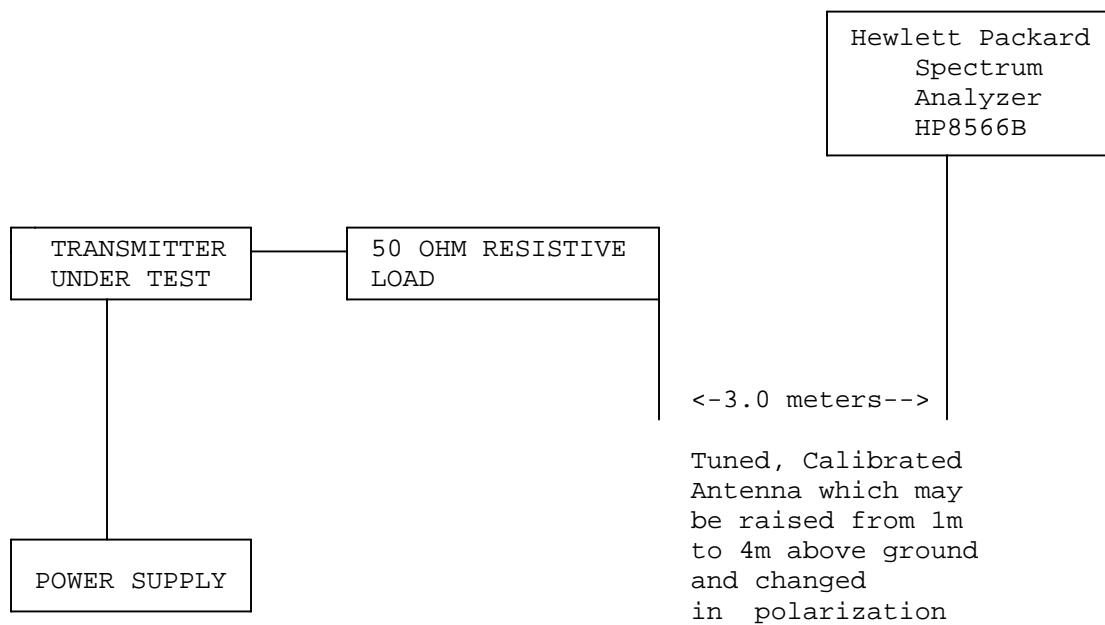
REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
Newberry, Florida 32669
<http://www.timcoengr.com>
888.472.2424 F 352.472.2030 email: tei@timcoengr.com

2.1053(a) Continued Field_strength_of_spurious_emissions:

Method of Measuring Radiated Spurious Emissions



Equipment placed 80 cm above ground on a rotatable platform.

METHOD OF MEASUREMENT: The tabulated data shows the results of the radiated field strength emissions test. The spectrum was scanned from 30 to at least the tenth harmonic of the fundamental. This test was conducted per ANSI/TIA 603C: 2004 using the substitution method. Measurements were made test sites of TIMCO ENGINEERING, INC. located at 849 N.W. State Road 45, Newberry, FL 32669.

APPLICANT: MIDLAND RADIO CORPORATION
FCC ID: MMARG1
REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45

Newberry, Florida 32669

<http://www.timcoengr.com>

888.472.2424 F 352.472.2030 email: tei@timcoengr.com

Frequency stability:

2.1055(a)(2)

80.209 (a)

Temperature and voltage tests were performed to verify that the frequency remains within the .0010%, 10.0ppm specification limit, for 20kHz spacing. The test was conducted as follows: The transmitter was placed in the temperature chamber at 25° C and allowed to stabilize for one hour. The transmitter was keyed ON for one minute during which four frequency readings were recorded at 15 second intervals. The worse case number was taken for temperature plotting. The assigned channel frequency was considered to be the reference frequency. The temperature was then reduced to -20°C for one hour. The transmitter was keyed ON for one minute, and again frequency readings were noted at 15 sec intervals. The worst-case number was recorded for temperature plotting. This procedure was repeated in 10-degree increments up to + 50°C.

Readings were also taken at minus 15% of the battery voltage, which we estimate to be the battery endpoint.

MEASUREMENT DATA:

Assigned Frequency (Ref. Frequency): 156.050 000 MHz

TEMPERATURE °C	FREQUENCY_MHz	PPM
REFERENCE_____	156.049 500	00.0
-20_____	156.050 966	+9.39
-10_____	156.050 926	+9.14
0_____	156.050 754	+8.04
+10_____	156.050 456	+6.13
+20_____	156.050 182	+4.37
+30_____	156.049 501	+0.01
+40_____	156.049 178	-2.06
+50_____	156.049 014	-3.11
		<u>Batt. PPM</u>
-15%	<u>VOLTS</u> 11.56	156.049 435 -0.42
+15%	15.64	156.049 406 -0.60

APPLICANT: MIDLAND RADIO CORPORATION

FCC ID: MMARG1

REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc

TIMCO ENGINEERING INC.

849 NW State Road 45
 Newberry, Florida 32669
<http://www.timcoengr.com>
 888.472.2424 F 352.472.2030 email: tei@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	HP	8449B-H02	3008A00372	CAL 12/8/05	12/8/07
Preamplifier					
Antenna: Biconnical	Electro-Metrics	BIA-25	1171	CAL 4/29/05	4/29/07
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 12/29/04	12/29/06
LISN	Electro-Metrics	ANS-25/2	2604	CAL 10/5/06	10/5/08
Termaline Wattmeter	Bird Electronic Corporation	611	16405	CAL 7/16/04	7/16/06

APPLICANT: MIDLAND RADIO CORPORATION
 FCC ID: MMARG1
 REPORT #: M\MidlandRadio_MMA\569AUT7\569AUT7TestReport.doc