ENGINEERING STATEMENT

For Type Certification of

MIDLAND USA INC.

Model No: 70-0511B
FCC ID: NCP700511B

I am an Electronics Engineer, a principal in the firm of Hyak Laboratories, Inc., Springfield, Virginia. My education and experience are a matter of record with the Federal Communications Commission.

Hyak Laboratories, Inc. has been authorized by Midland USA Inc. to make type certification measurements on the 70-0511B transceiver. These tests made by me or under my supervision in our Springfield laboratory.

Test data and documentation required by the FCC for Type Certification are included in this report. The data verifies that the above mentioned transceiver meets FCC requirements and Type Certification is requested.

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Rowland S. Johnson

Dated: October 28, 1999

A. INTRODUCTION

The following data are submitted in connection with this request for Type Certification of the 70-0511B transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The 70-0511B is a VHF, frequency modulated transceiver intended for 25 kHz land mobile applications in the 36 to 42 MHz band. It operates from a 13.8 vehicle supply. Nominal output power rating is 60 watts.

The transceiver is electrically identical, except for operating range, to the 70-0511C for which Type Certification is pending.

B. RF POWER OUTPUT (Paragraph 2.985(a) of the Rules)

RF power output was measured with a Bird 4421 RF power meter and a Bird 8325 attenuator as a 50 ohm dummy load. Maximum power measured was 64 watts.

C. MODULATION CHARACTERISTICS

Occupied_Bandwidth
(Paragraphs 2.989(c), 90.209(b)(5) and 90.210(b)of the Rules)

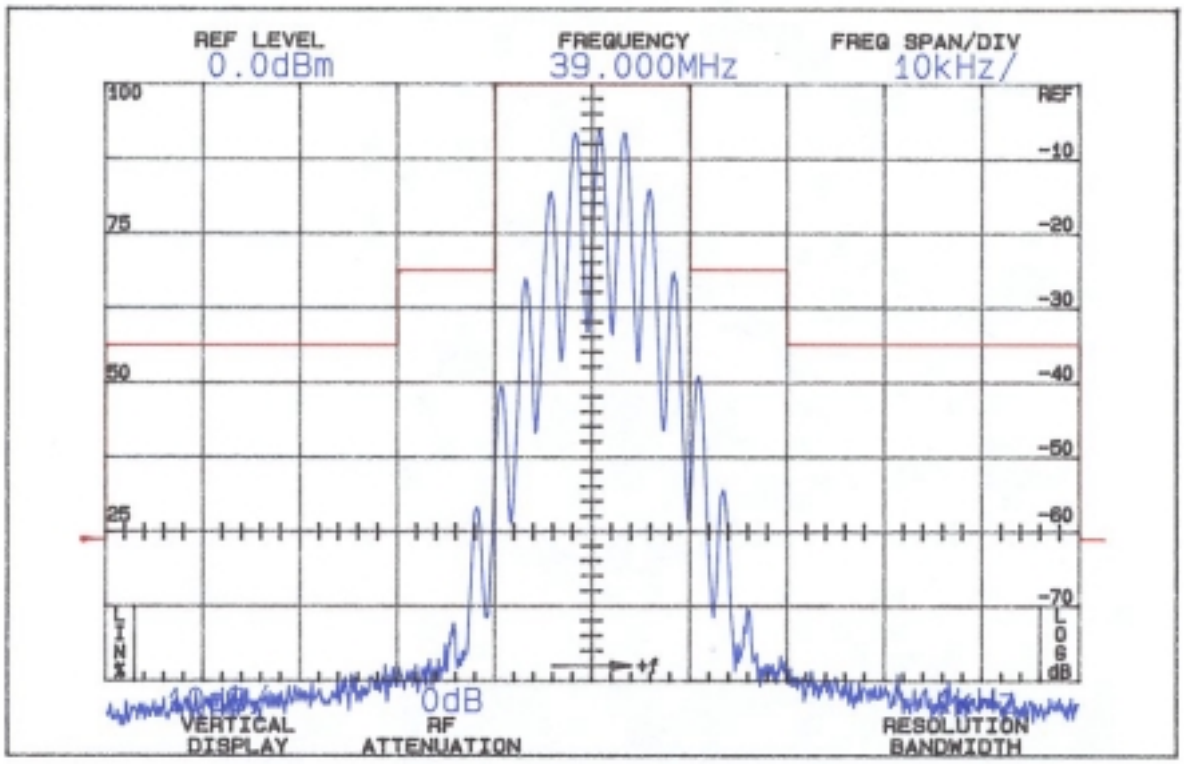
Figure 1 is a plot of the sideband envelope of the transmitter for 64 watt output taken with an Advantest R3361A spectrum analyzer. Modulation corresponded to conditions of 2.989(c)(1) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2639 Hz, the frequency of maximum response. Measured modulation under these conditions was 3.7 kHz.

The plot has unmodulated carrier as 0 dBm reference.

The plots are within the limits imposed by Paragraph 90.210(b) for frequency modulation. The horizontal scale (frequency) is 10 kHz per division and the vertical scale (amplitude) is a logarithmic presentation equal to 10 dB per division.

FIGURE 1

OCCUPIED BANDWIDTH



	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 20 kHz (10-20 kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (20-50 kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth (over 50 kHz)	43+10LogP = 61 (P = 64 W)

OCCUPIED BANDWIDTH
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FIGURE 1

C. MODULATION CHARACTERISTICS (Continued)

The plot is within the limits imposed by Paragraph 90.210(b) for frequency modulation. The horizontal scale (frequency) is 10 kHz per division and the vertical scale

(amplitude) is a logarithmic presentation equal to 10 dB per division.

D. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS
(Paragraph 2.991 of the Rules)

The 70-0511B transmitter was tested for spurious emissions at the antenna terminals while the equipment was modulated with a 2500 Hz signal, 16 dB above minimum input signal for 50% (2.5 kHz deviation) modulation at 2639 Hz, the frequency of highest sensitivity.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through a Bird 8325 power attenuator. A notch filter was used to attenuate the carrier.

During the tests, the transmitter was terminated in the 50 ohm attenuator. Power was monitored on a Bird 43 Thru-Line wattmeter; dc supply was 13.8 volts throughout the tests.

Spurious emissions were measured at 64 watts output throughout the RF spectrum from 12 (lowest frequency generated in the transmitter is 12.8 MHz) to the tenth harmonic of the carrier.

Any emissions that were between the required attenuation and the noise floor of the spectrum analyzer were recorded. Data are shown in Table 1.

E. DESCRIPTION OF RADIATED SPURIOUS MEASUREMENT FACILITIES

A description of the Hyak Laboratories' radiation test facility is a matter of record with the FCC. The facility meets ANSI 63.4-1992 and was accepted for radiation measurements from 25 to 1000 MHz on October 1, 1976 and is currently listed as an accepted site.

TABLE 1

TRANSMITTER CONDUCTED SPURIOUS
39.000, 13.8 Vdc Input, 64 W

Spurious Frequency MHz	dB Below Carrier Reference

	78.000	87
	117.000	98
	156.000	85
	195.000	98
	234.000	86
	273.000	88
	312.000	>100
	351.000	>100
	390.000	>100
Required:	43+10Log(P)	61

All other emissions from 12 MHz to the tenth harmonic were 20 dB or more below FCC limit.

*Reference data only, more than 20 dB below FCC limit.

NOTE: Carrier notch filter used to increase dynamic range.

F. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Field intensity measurements of radiated spurious emissions from the Midland 70-0511B were made with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated dipole antennas.

The transmitter and dummy load were located in an open field 3 meters from the test antenna. Supply voltage was a power supply with a terminal voltage under load of 13.8 Vdc.

Output power was 64 watts at 39.000 MHz operating frequency. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antennae polarization were employed.

Reference level for the spurious radiation was taken as an ideal dipole excited by 64 watts, the output power of the transmitter according to the following relationship:*

$$E = \frac{(49.2P_t)^{1/2}}{R}$$

where E = electric-field intensity in volts/meter

P_t = transmitter power in watts

R = distance in meters

for this case $E = \frac{(49.2 \times 64.0)^{1/2}}{3} = 18.7$ V/m

Since the spectrum analyzer is calibrated in decibels above one milliwatt (dBm), a conversion, for convenience, was made from dBu to dBm.

18.7 volts/meter = 18.7×10^6 uV/m

dBu/m = $20 \log_{10}(18.7 \times 10^6)$

= 145 dBu/m

Since 1 uV/m = -107 dBm, the reference becomes

148 - 107 = 38 dBm

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*Reference Data for Radio Engineers, Fourth Edition, International Telephone and Telegraph Corp., p. 676.

F. FIELD STRENGTH MEASUREMENTS (Continued)

The transmitter and test antennae were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

The measurement system was capable of detecting signals 100 dB below the reference level. Measurements were made from the lowest frequency generated within the unit (12 MHz), to 10 times operating frequency. Data after application of antenna factors and line loss corrections are shown in Table 2.

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS

39.000 MHz, 13.8 Vdc, 64 watts

Spurious Frequency MHz	dB Below Carrier Reference[1]
78.000	91V*
117.000	89H*

156.000	88H*
195.000	89H*
234.000	85H*
273.000	75H
312.000	97H*
351.000	88V*
390.000	83V
Required:	61

[1]Worst-case polarization, H-Horizontal, V-Vertical.

* Reference data only, more than 20 dB below FCC limit.

All other spurious from 12 MHz to 390 GHz were 20 dB or more below FCC limit.