

ENGINEERING STATEMENT

For Type Certification of

SECURICOR WIRELESS

Model No: 71-0150C

FCC ID: O6E710150C

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 Securicor Wireless to make type certification measurements on the 71-0150C 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: December 12, 2000

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the 71-0150C transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The 71-0150C is a VHF, frequency modulated transceiver intended for land mobile base station/repeater applications in the 40 - 50 MHz band. It operates from a 13.8 Vdc supply. Output power rating is 25 - 60 watts.

B. GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE  
(Paragraph 2.983 of the Rules)

1. Name of applicant: Securicor Wireless
2. Identification of equipment: O6E710150C
  - a. The equipment identification label is submitted as a separate exhibit.
  - b. Photographs of the equipment are submitted as a separate exhibit.
3. Quantity production is planned.
4. Technical description:
  - a. 16k0F3E emission
  - b. Frequency range: 40 - 50 MHz.
  - c. Operating power of transmitter is fixed at the factory at 60 watts and can be reduced to 25 watts.
  - d. Maximum power permitted under Part 90 of the FCC is 350 watts, and the 71-0150C fully complied with those power limitations.
  - e. The dc voltage and dc currents at final amplifier:  
  
Collector voltage: 13.5 Vdc  
Collector current: 8.9 A
  - f. Function of each active semiconductor device:  
See Appendix 1.
  - g. Complete circuit diagram is submitted as a separate exhibit.
  - h. A draft instruction book is submitted as a separate exhibit.
  - i. The transmitter tune-up procedure is submitted as a separate exhibit (see Operation Theory and

Alignment).

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B. GENERAL INFORMATION...(Continued)

- j. A description of circuits for stabilizing frequency is included in Operation Theory and Alignment.
- k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Operation Theory and Alignment.
- l. Not applicable.

5. Data for 2.985 through 2.997 follow this section.

C. 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 power attenuator as a 50 ohm dummy load. Maximum power measured was 60 watts; minimum 25 watts.

D. MODULATION CHARACTERISTICS

- 1. A curve showing frequency response of the transmitter is shown in Figure 1. Reference level was audio signal output from a Boonton 8220 modulation meter with one kHz deviation. Audio output was measured with a Audio Precision System One TRMS voltmeter and tracking generator.
- 2. Modulation limiting curves are shown in Figure 2 using a Boonton 8220 modulation meter. Signal level was established with a Audio Precision System One TRMS voltmeter. The curves show compliance with paragraphs 2.987(b), and 90.211(c).
- 3. Figure 3 is a graph of the post-limiter low pass filter which meets the requirements of paragraph 90.211(d)(1) in providing a roll-off of  $60\text{Log}f/3$  dB where  $f$  is audio frequency in kHz. Measurements were made following EIA RS-152B with an Audio Precision System One selective voltmeter on the Boonton 8220 modulation meter audio output.

4. Occupied Bandwidth

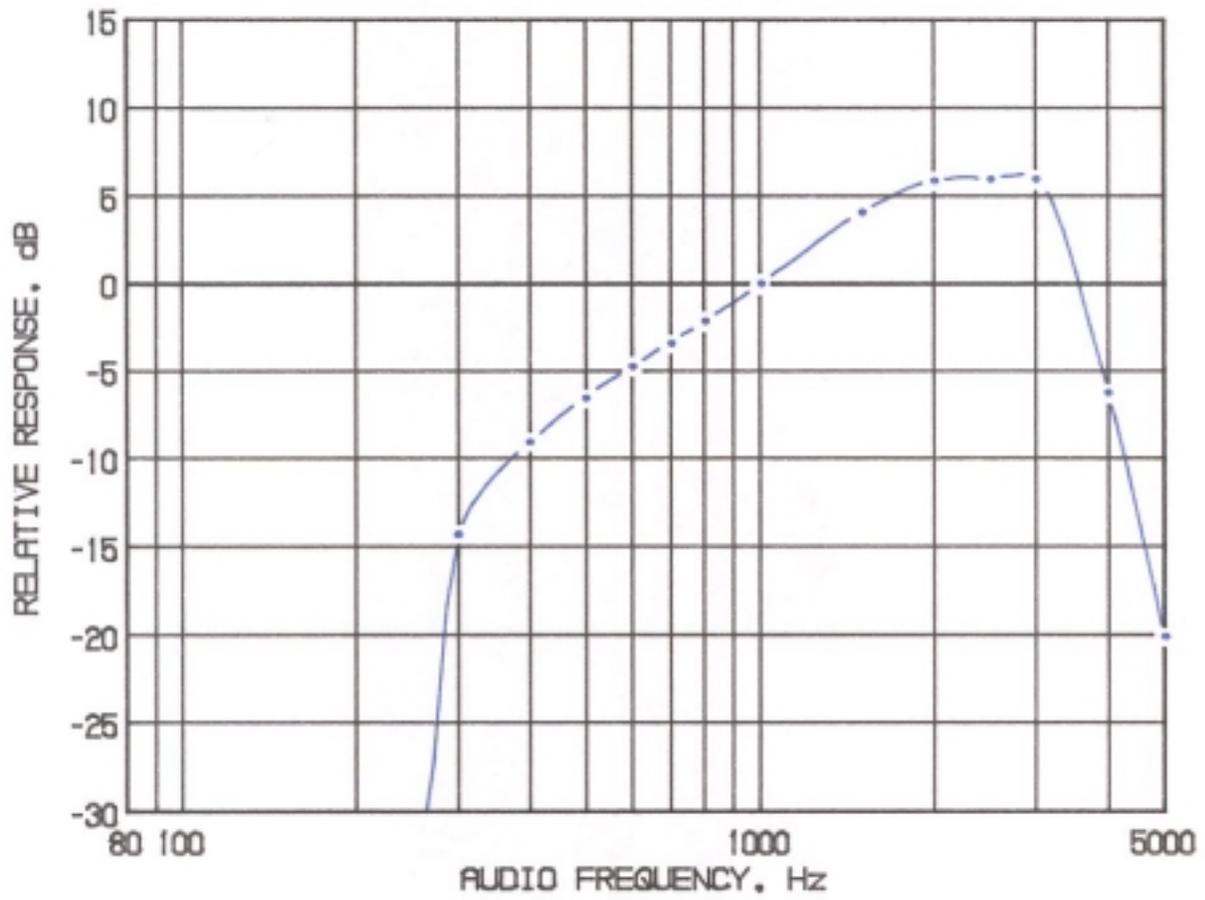
(Paragraphs 2.989(c), 90.209(b)(4) and 90.210(d) of the Rules)

Figures 4a and 4b are plots of the sideband envelope of the transmitter taken with a TEK 494P 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 2272 Hz, the frequency of maximum response. Measured modulation under these conditions was 4.3 kHz.

**All plots have unmodulated carrier as 0 dBm reference.**

FIGURE 1

## MODULATION FREQUENCY RESPONSE



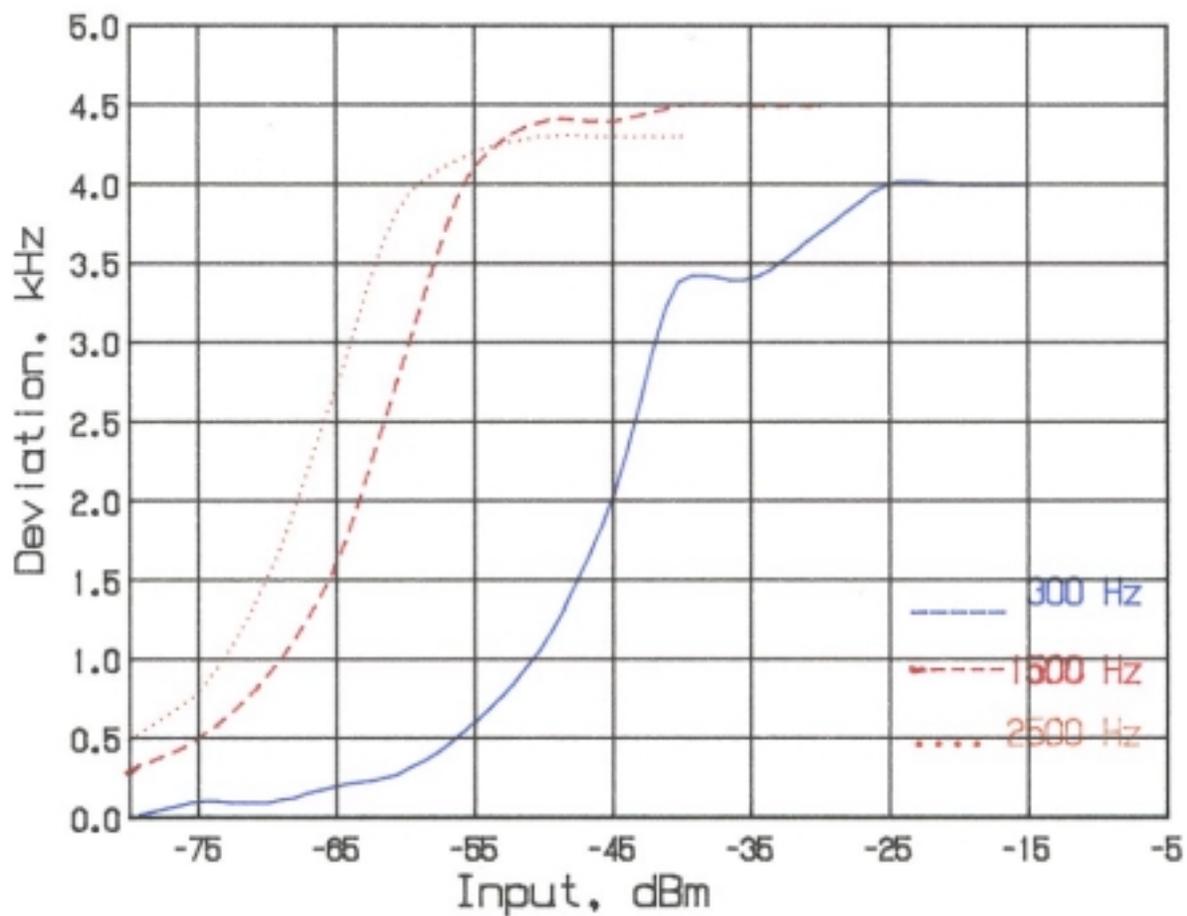
MODULATION FREQUENCY RESPONSE  
FCC ID: O6E710150C

FIGURE 1

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FIGURE 2

AUDIO LIMITER CHARACTERISTICS



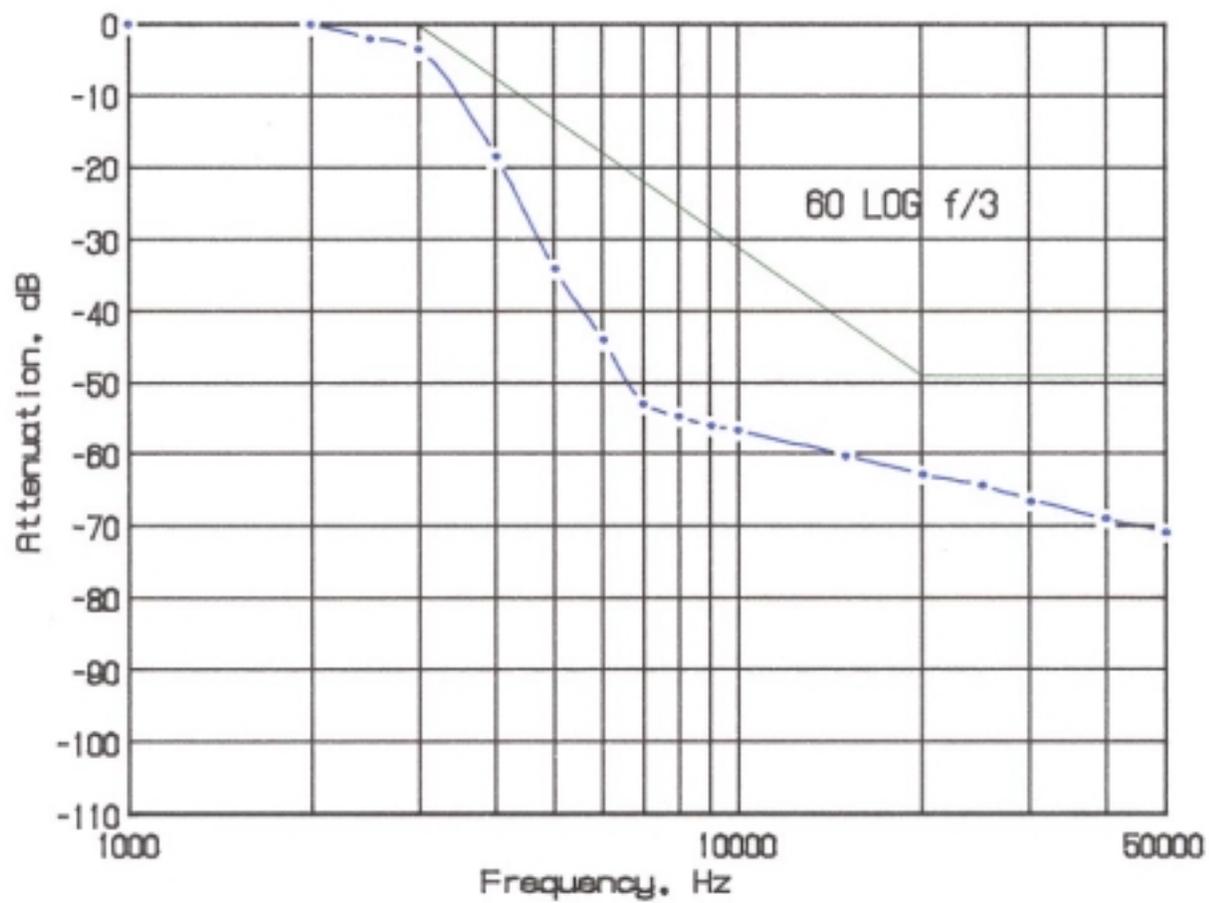
AUDIO LIMITER CHARACTERISTICS  
FCC ID: O6E710150C

FIGURE 2

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FIGURE 3

AUDIO LOW PASS FILTER RESPONSE



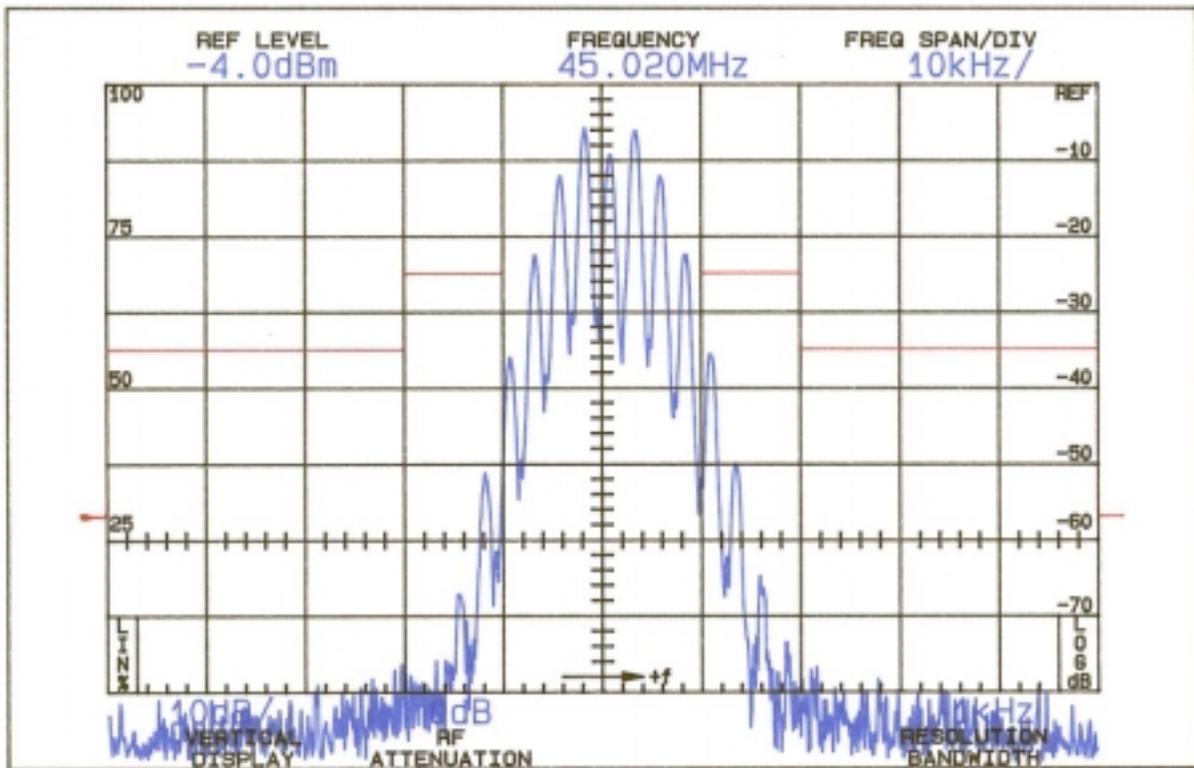
AUDIO LOW PASS FILTER RESPONSE  
FCC ID: O6E710150C

FIGURE 3

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FIGURE 4a

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)

On any frequency more than 100%,  
up to and including 250% of the  
authorized bandwidth (20-50 kHz)

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On any frequency removed from  
the assigned frequency by more  
than 250% of the authorized  
bandwidth (over 50 kHz)

$$43 + 10 \log P = 61$$

(P = 60 W)

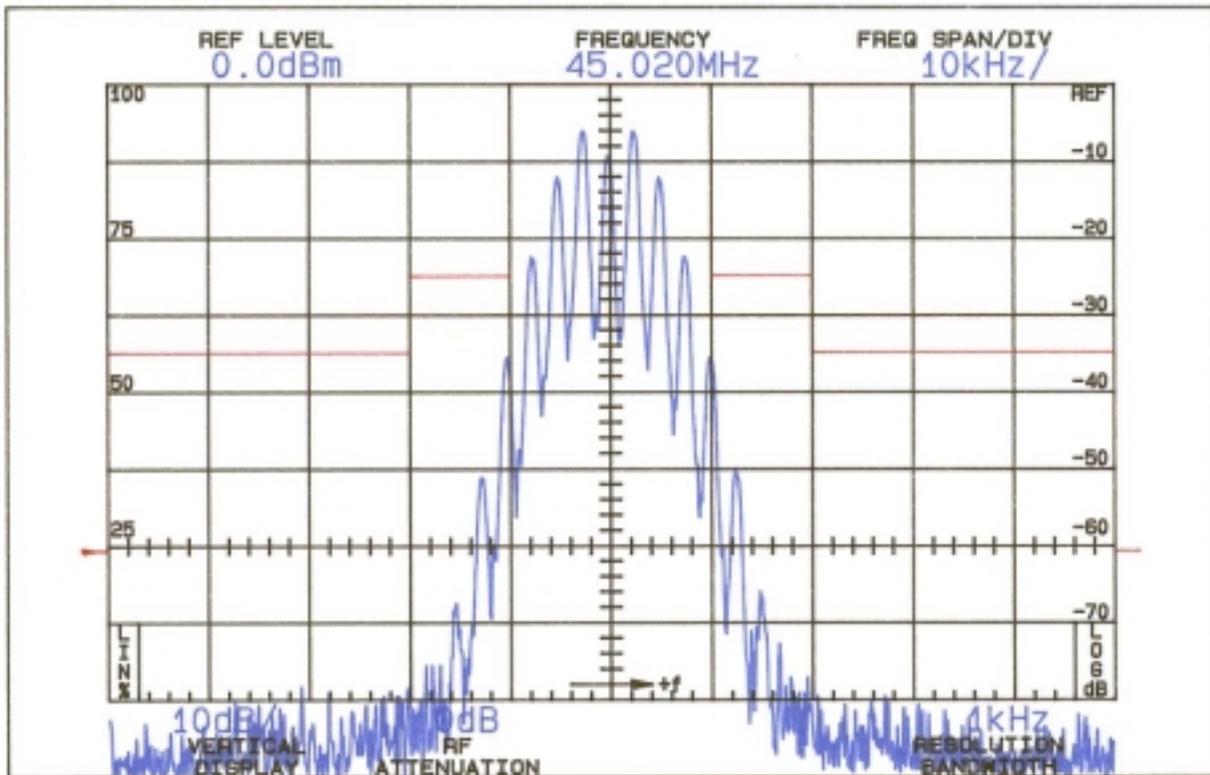
OCCUPIED BANDWIDTH  
FCC ID: O6E710150C

FIGURE 4a (60 W)

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FIGURE 4b

OCCUPIED BANDWIDTH



ATTENUATION IN dB BELOW  
MEAN OUTPUT POWER  
Required

On any frequency more than 50%  
up to and including 100% of the

25

authorized bandwidth, 20 kHz  
(10-20 kHz)

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)

$$43+10\text{Log}P = 71$$

(P = 25 W)

OCCUPIED BANDWIDTH  
FCC ID: O6E710150C

FIGURE 4b (25 W)

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D. MODULATION CHARACTERISTICS (Continued)

The plots are within the limits imposed by Paragraph 90.211(c) 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.

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

The 71-0150C 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 2272 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 116 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.

F. 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  
45.02 MHz, 13.8 Vdc Input

Spurious Frequency <u>    MHz    </u>	dB Below Carrier <u>Reference</u>	
	25W	60W
90.402	84	80
135.062	>100	94
180.080	>100	>100
225.100	>100	>100
270.120	>100	>100
315.140	>100	>100
360.160	>100	>100
405.180	>100	>100
450.200	>100	>100

Required:  $43+10\text{Log}(P)$

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

NOTE: Carrier notch filter used to increase dynamic range.

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#### G. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Measurements of radiated spurious emissions were made by substitution 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 60 watts at 45.02 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 radiations was 60 watts.

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

Measurements were made from the lowest frequency generated within the unit 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

45.02 MHz, 13.8 Vdc, 60 watts

<u>Spurious Frequency MHz</u>	<u>dB Below Carrier Reference<sup>1</sup></u>
90.042	>81
135.062	>81
180.080	>81
225.100	>81
270.120	>81
315.140	>81
360.160	>81
405.180	>81
450.200	>81
Required: $43+10\text{LogP} =$	61

All other spurious from 12 MHz to 451 MHz were 20 dB or more below FCC limit.

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H. FREQUENCY STABILITY  
(Paragraph 2.995(a)(2) and 90.213 of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -30°C to +50°C. At each temperature, the unit was exposed to test chamber ambient a minimum of 60 minutes after indicated chamber temperature ambient had stabilized to within ±2° of the desired test temperature. Following the 1 hour soak at each temperature, the unit was turned on, keyed and frequency measured within 2 minutes. Test temperature was sequenced in the order shown in Table 3, starting with -30°C.

Temperature was monitored with a Keithley 871 digital thermometer. The transmitter output stage was terminated in a dummy load. Primary supply was 13.8 volts. Frequency was measured with a HP 5385A frequency counter connected to the transmitter through a power attenuator. Measurements were made at 45.02 MHz. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY vs. TEMPERATURE

45.02 MHz; 13.8 Vdc; 60 W

<u>Temperature, °C</u>	<u>Output Frequency, MHz</u>	<u>p.p.m.</u>
-29.7	45.020161	3.6
-20.0	45.020269	6.0
- 9.3	45.020182	4.0
- 0.1	45.020106	2.4
10.0	45.020052	1.2
20.2	45.020011	0.2
30.5	45.019977	-0.5
40.5	45.019915	-1.9
50.5	45.019832	-3.7

Maximum frequency error: 45.020269  
45.020000  
+ .000269 MHz

The device met a stability of .002% (20 ppm) or a maximum of ±.000900 MHz

High Limit 45.020900 MHz  
Low Limit 45.019100 MHz

FCC Rule 90.213(a) specifies .002%.

I. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE  
(Paragraph 2.995(d)(2) of the Rules)

Oscillator frequency as a function of power supply voltage was measured with a HP 5385A frequency counter as supply voltage provided by an HP 6264B variable dc power supply was varied from ±15% above the nominal 13.8 volt rating. A Fluke 197 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient.

TABLE 4

FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE

45.02 MHz, 13.8 Volts Nominal, 60 W

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<u>%</u>	<u>Supply_Voltage</u>	<u>Output_Frequency,_MHz</u>	<u>p.p.m.</u>
115	15.87	45.020012	0.3
110	15.18	45.020013	0.3
105	14.49	45.020012	0.3
100	13.80	45.020011	0.2
95	13.11	45.020010	0.2
90	12.42	45.020011	0.2
85	11.73	45.020010	0.2

Maximum frequency error: 45.020013  
45.020000  
+ .000013 MHz

The device met a stability of .002% (20 ppm) or a maximum of ±.000900 MHz.

High Limit 45.020900 MHz  
Low Limit 45.019100 MHz

FCC Rule 90.213(a) specifies .002%

APPENDIX 1

FUNCTION OF DEVICES  
71-0150C

**TITAN LOW BAND BASE/REPEATER**

Commercial type numbers for all active circuit devices in the audio and RF circuitry of the transmitter:

TCVXO : VT50P14  
Audio IC : AK2344  
VCO unit

VCO oscillator : 2SK-508  
Tuning vari-cap diode : 1SV239, 1SV232  
Buffer amplifier : 2SC-4250  
Pre-amplifier : Upc-1688  
Post-amplifier : 2SC3583  
Tx unit  
Younger amplifier : 2SC2945  
Prescaller : MB1511  
Synthesizer : MB1511  
PA unit  
Semi Driver : 2SC-1947  
Driver : 2SC-1729  
50w amplifier : M68702

FUNCTION OF DEVICES  
FCC ID: O6E710150C

APPENDIX 1