ENGINEERING STATEMENT

For Type Certification of

SECURICOR WIRELESS

Model No: 71-4050B
FCC ID: O6E714050B

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 71-4050B 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.

_____
Rowland S. Johnson

Dated: October 31, 2000

A. INTRODUCTION

The following data are submitted in connection with this request for Type Certification of the 71-4050B transceiver in

accordance with Part 2, Subpart J of the FCC Rules.

The 71-4050B is a multi-bandwidth, UHF, frequency modulated transceiver intended for fixed station applications in the 440 - 475 MHz band. It operates from a 13.8 volt vehicle supply. Output power rating is 25 to 70 watts. Both 25 kHz and 12.5 kHz channel operation is provided.

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

1. Name of applicant: Securicor Wireless

2. Identification of equipment: O6E714050B

   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; 11k0F3E emission
   b. Frequency range: 440-475 MHz.
   c. Operating power of transmitter is fixed at the factory at 70 watts and can be reduced to 25 watts under software control.
   d. Maximum power permitted under Part 90 of the FCC is 350 watts, and the 71-4050B fully complied with those power limitations.
   e. The dc voltage and dc currents at final amplifier:

      Collector voltage: 13.7 Vdc
      Collector current: 13.0 A

   f. Function of each active semiconductor device: See Appendix 1.
   g. Complete circuit diagram in included as a separate exhibit.
   h. A draft instruction book is submitted as a separate exhibit.

   i. The transmitter tune-up procedure is included as a separate exhibit.
   j. A description of circuits for stabilizing Frequency is included in Appendix 2.
   k. A description of circuits and devices employed For suppression of spurious radiation and for

Limiting modulation is included in Appendix 3.

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 attenuator as a 50 ohm dummy load. Maximum power measured was 70 watts; and with software programming minimum power was 25 watts. (The transmitter was tuned by the factory.)

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 Figures 2a and 2b for wide or narrow channel operation respectively, 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 60Logf/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.

D. MODULATION CHARACTERISTICS

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

Figures 4a, 4b, 4c and 4d are plots of the sideband envelope of the transmitter for both 70 and 25 watt output taken with a TEK 494P or 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

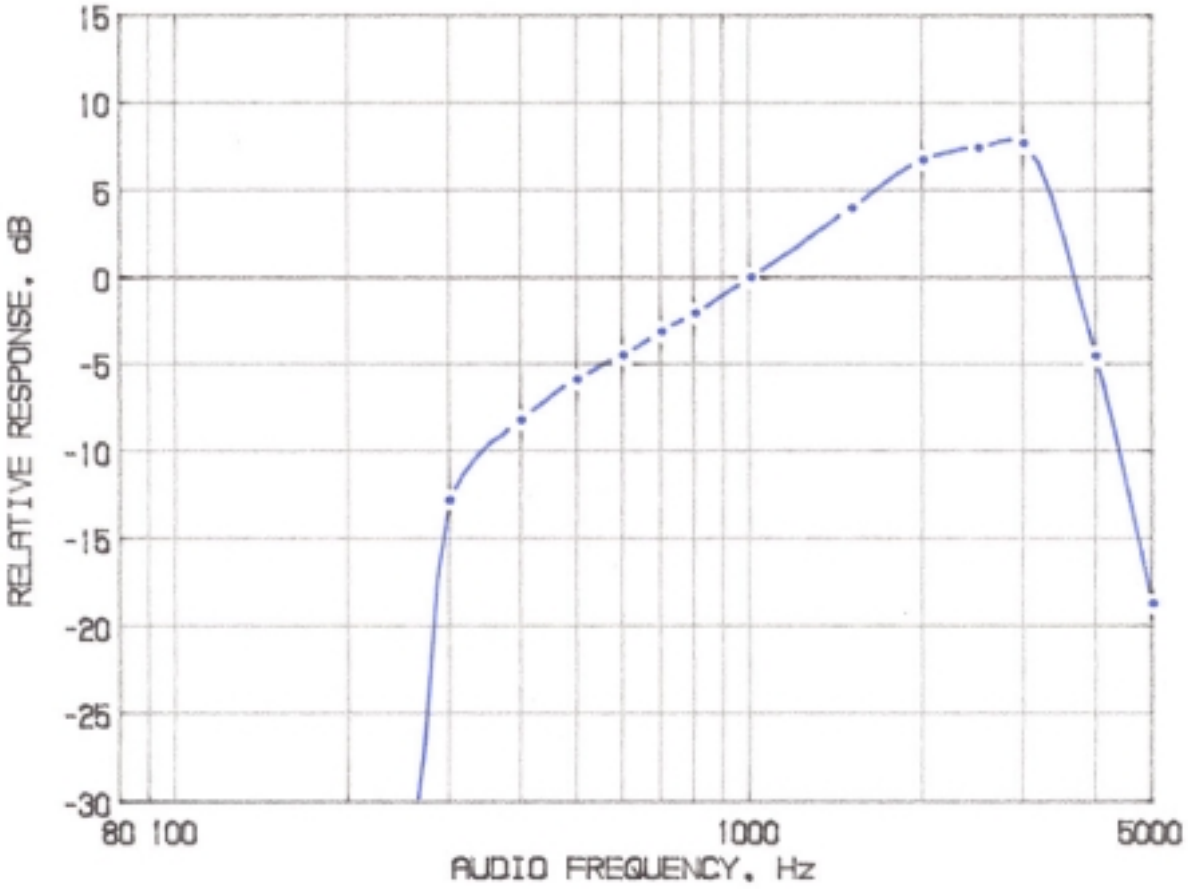
necessary to produce 50% modulation at 2379 Hz, the frequency of maximum response. Measured modulation under these conditions was 4.1 kHz, or 1.9 kHz for 25 or 12.5 kHz channelization respectively.

For the 12.5 kHz channelization, RBW was 100 Hz, VBW 100 Hz, max hold, multiple scan per 90.210(d)(4).

All plots have unmodulated carrier as 0 dBm reference.

FIGURE 1

MODULATION FREQUENCY RESPONSE

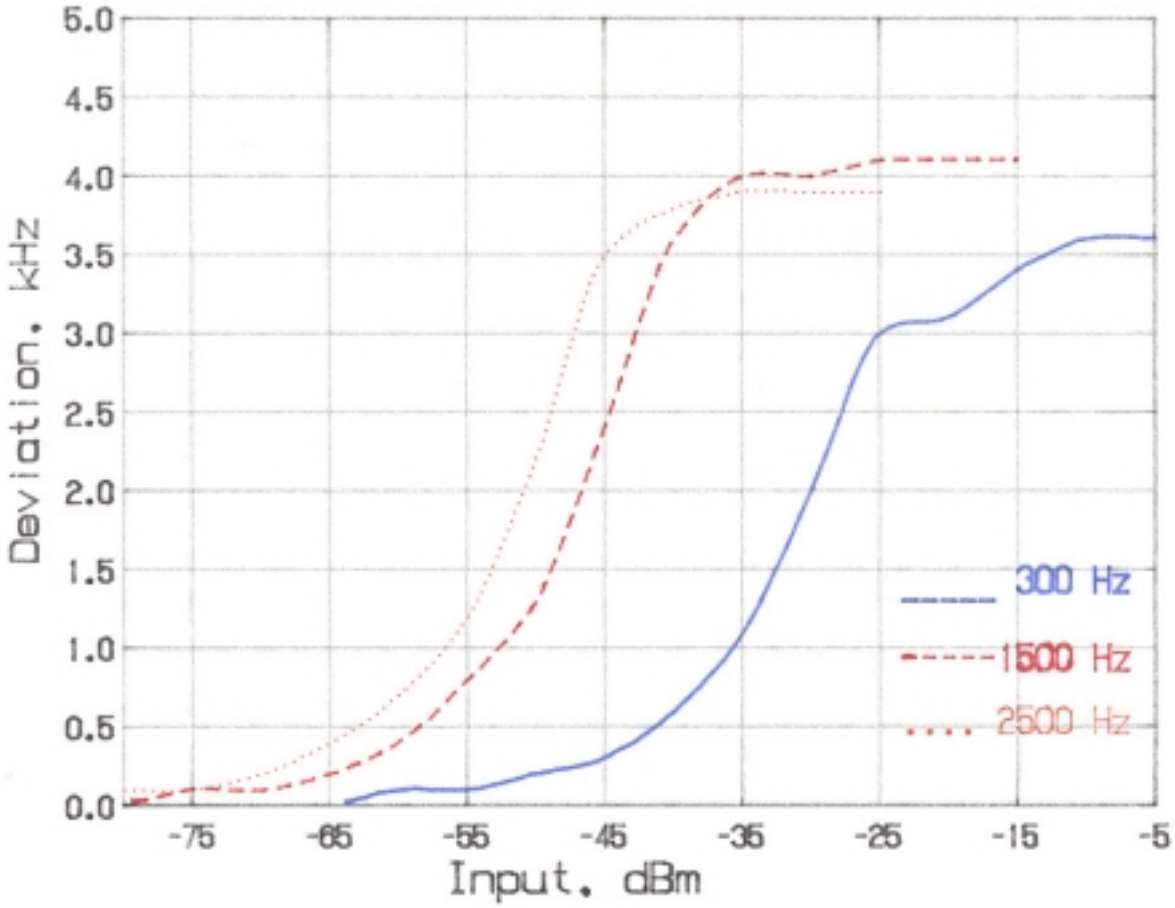


MODULATION FREQUENCY RESPONSE
FCC ID: O6E714050B

FIGURE 1

FIGURE 2a

AUDIO LIMITER CHARACTERISTICS

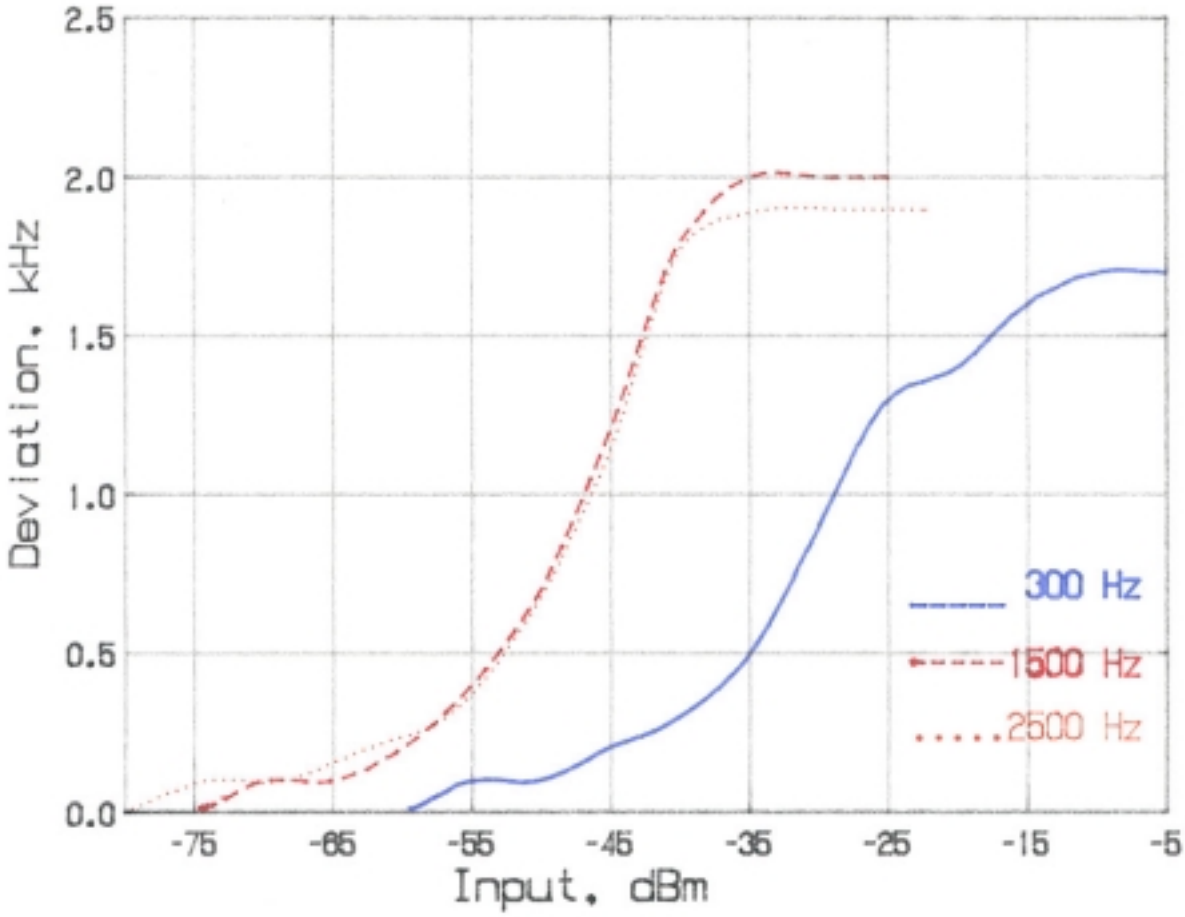


AUDIO LIMITER CHARACTERISTICS
FCC ID: O6E714050B

FIGURE 2a Wideband (5 kHz)

FIGURE 2b

AUDIO LIMITER CHARACTERISTICS

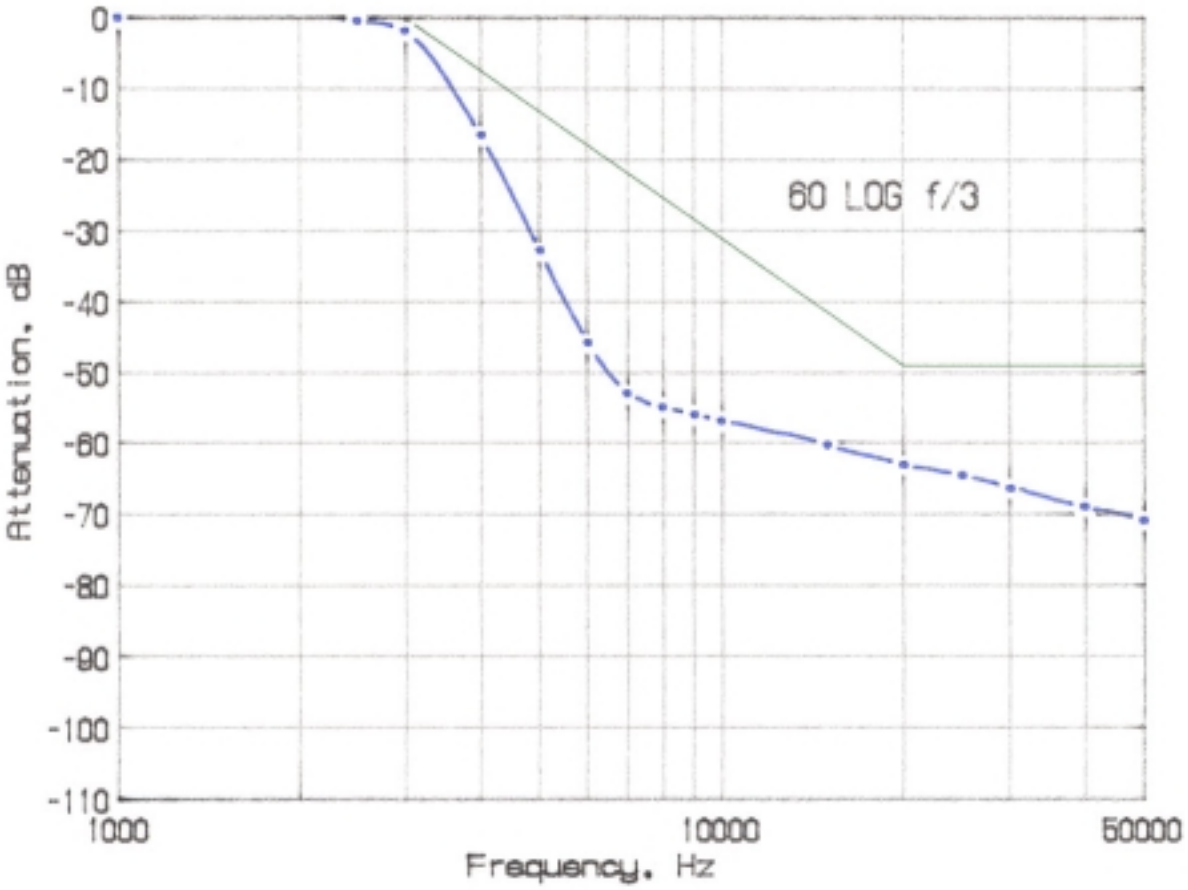


AUDIO LIMITER CHARACTERISTICS
FCC ID: O6E714050B

FIGURE 2b Narrow band (2.5 kHz)

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE

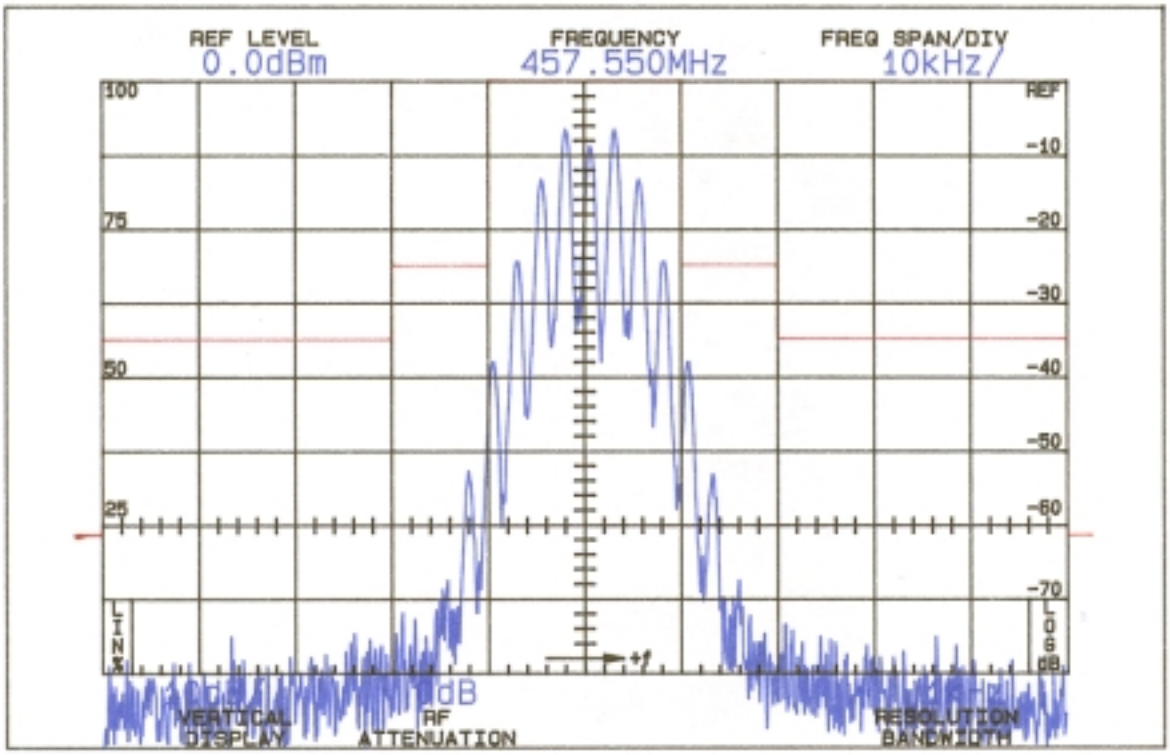


AUDIO LOW PASS FILTER RESPONSE
FCC ID: O6E714050B

FIGURE 3

FIGURE 4a

OCCUPIED BANDWIDTH



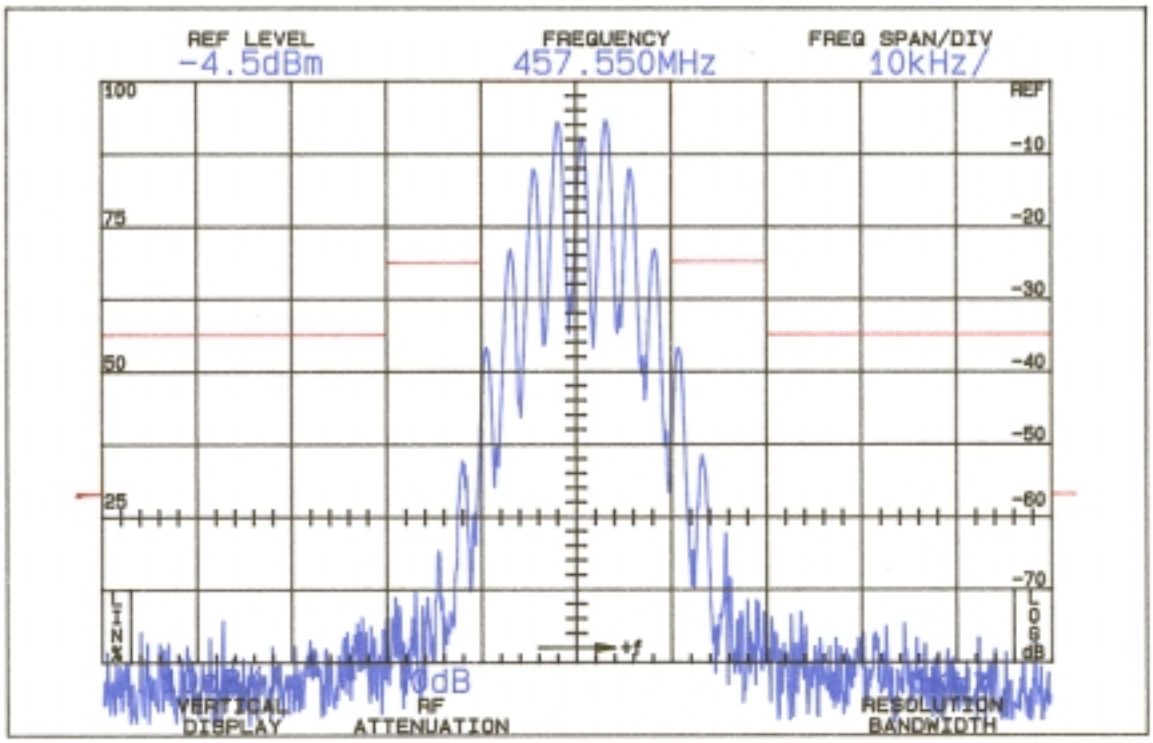
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 20 kHz (10-20 kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (20-50 kHz)	35
On any frequency removed from the assigned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

OCCUPIED BANDWIDTH (70 W)
FCC ID: O6E714050B

FIGURE 4a (5 kHz)

FIGURE 4b

OCCUPIED BANDWIDTH



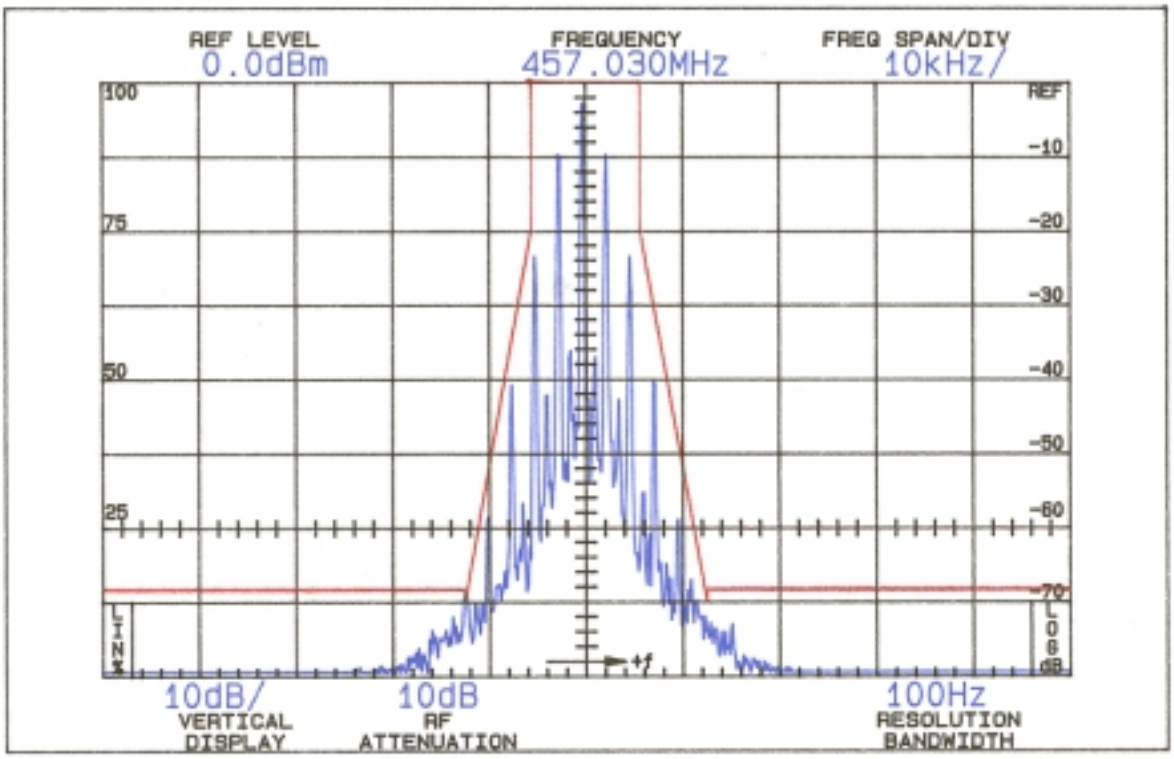
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 20 kHz (10-20 kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (20-50 kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth (over 50 kHz)	43+10LogP = 57

OCCUPIED BANDWIDTH (25 W)
FCC ID: O6E714050B

FIGURE 4b (5 kHz)

FIGURE 4c

OCCUPIED BANDWIDTH



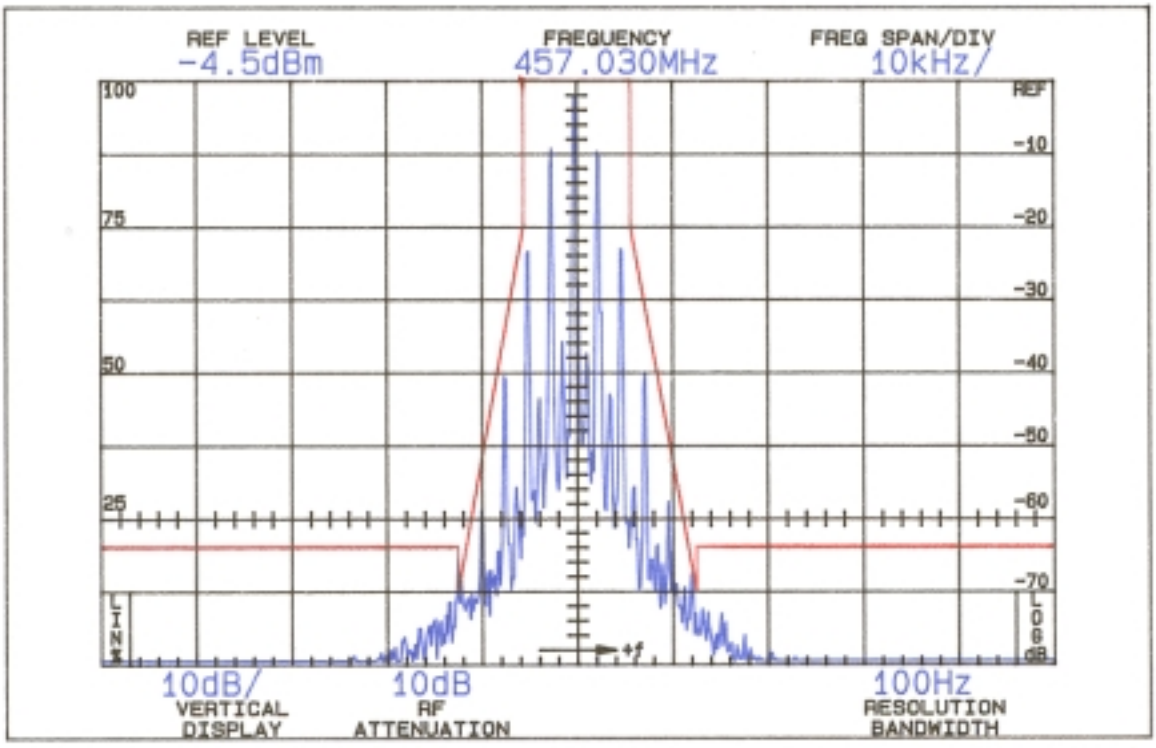
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from f_o.	0 (>5.625 kHz)
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: at least 7.27 (f_d - 2.88 kHz) dB.	70 (@ 12.5 kHz)
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.	50+10LogP = 68 (>12.5 kHz)

OCCUPIED BANDWIDTH (F3E 70W)
FCC ID: O6E714050B

FIGURE 4c (2.5 kHz)

FIGURE 4d

OCCUPIED BANDWIDTH



ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required

On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from f_o.	0 (>5.625 kHz)
On any frequency removed 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 kHz) dB.	70 (@ 12.5 kHz)
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.	50+10LogP = 64 (>12.5 kHz)

OCCUPIED BANDWIDTH (F3E 25W)
FCC ID: O6E714050B

FIGURE 4d (2.5 kHz)

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.

Resolution bandwidth was 100 Hz; video bandwidth 1 kHz; max store display; 20 second scan time.

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

The 71-4050B 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 2379 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 70 and 25 watts output throughout the RF spectrum from (lowest frequency generated in the transmitter is 14.95 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
457.030, 13.8 Vdc Input

Spurious	dB Below

Frequency MHz	Carrier Reference	
70 W		
914.062	97	
1371.093	>100	
1828.124	>100	
2285.155	>100	
2742.186	>100	
3199.217	>100	
3656.248	>100	
4113.279	>100	
4570.310	>100	
Required:	60	(67) 90.210(d)
25 W		
914.062	92	
1371.093	>100	
1828.124	>100	
2285.155	>100	
2742.186	>100	
3199.217	>100	
3656.248	>100	
4113.279	>100	
4570.310	>101	
Required:	57	(64) 90.210(d)

All other emissions from 14.95 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.

G. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Field intensity measurement of radiated spurious emissions from the 71-4050B were made with a Tektronix 494P spectrum analyzer using Singer DM-105A or Emco 3121 calibrated dipole antennas below 1 GHz, and Polarad CA-L, and CA-S or EMCO 3115 from 1-5.0 GHz based on the procedures of EIA/TIA 603 (1992).

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 70 watts at 457.030 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 taken as 70 watts, the output power of the transmitter.

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 95 dB or more below the reference level. Measurements were made from the lowest frequency generated within the unit (14.95 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

457.030 MHz, 13.8 Vdc, 70 watts

Spurious Frequency MHz	dB Below Carrier Reference[1]	
1371.093	85V	
1828.124	85V	
4570.310	84H	
Required:	60	(67) 90.210(d)

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

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

All other spurious from 14.95 MHz to 4.7 GHz were 20 dB or more below FCC limit.

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.

A Thermotron S1.2 temperature chamber was used. 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 457.030 MHz. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY vs. TEMPERATURE
457.030 MHz; 13.8 Vdc; 70 W

Temperature, °C	Output_Frequency,_MHz	p.p.m.
-29.6	457.030069	0.2
-19.3	457.030114	0.2
-10.0	457.030113	0.2
- 0.1	457.030246	0.5
9.9	457.030070	0.2
19.9	457.029993	0.0
30.5	457.030025	0.1
40.3	457.029878	-0.3
50.1	457.029834	-0.4

Maximum frequency error: 457.030246
457.030000

+ .000246 MHz

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001143 MHz, which corresponds to:

High Limit	457.031143 MHz
Low Limit	457.028857 MHz

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
457.030 MHz, 13.8 Volts Nominal, 70 W

%	Supply_Voltage	Output_Frequency,_MHz	p.p.m.

115	15.87	457.029990	0.0
110	15.18	457.029992	0.0
105	14.49	457.029993	0.0
100	13.80	457.029993	0.0
95	13.11	457.029994	0.0
90	12.42	457.029994	0.0
85	11.73	457.029993	0.0

Maximum frequency error: 457.029990
457.030000

\- .000010 MHz

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001143 MHz, corresponding to:

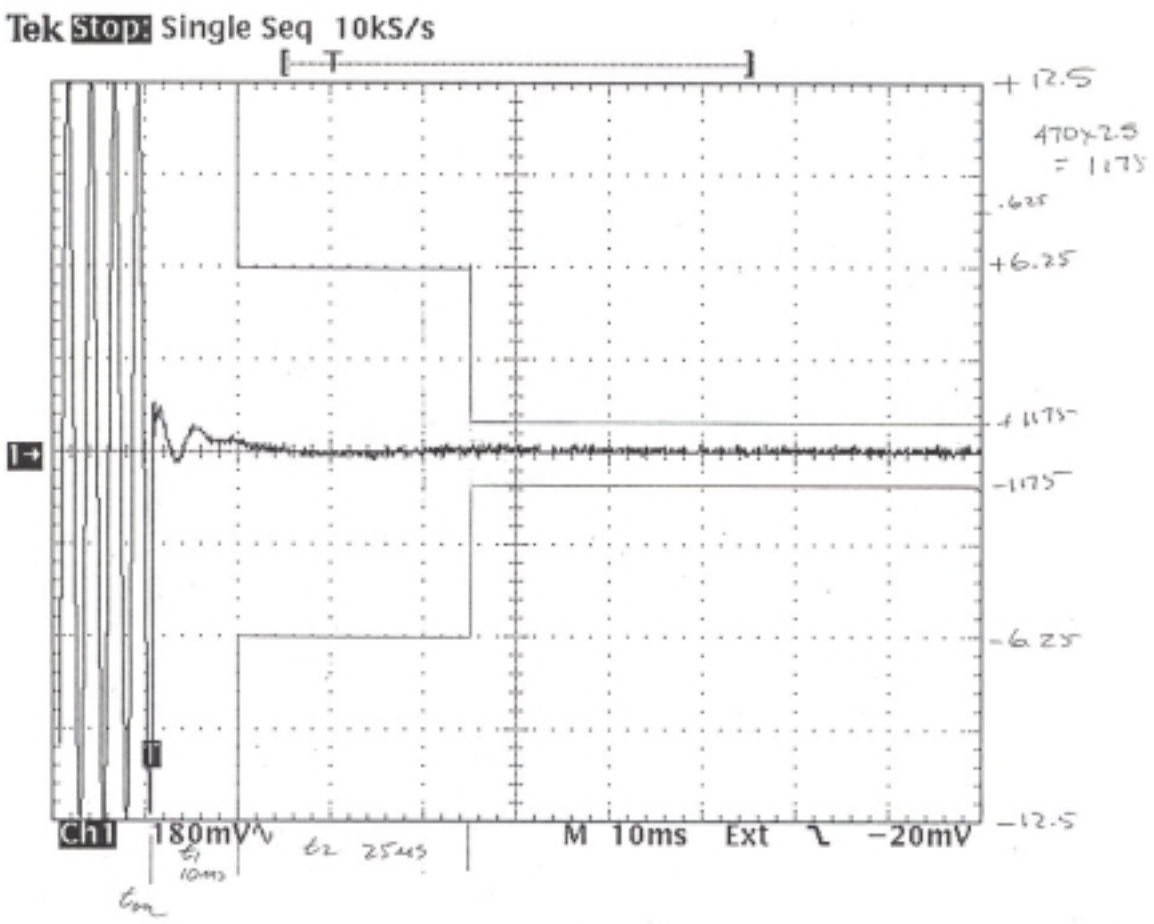
High Limit	457.031143 MHz
Low Limit	457.028857 MHz

J. TRANSIENT FREQUENCY BEHAVIOR
(Paragraph 90.214 of the Rules)

Plots identified as Figures 5 and 6 demonstrate TFB.

FIGURE 5

TRANSIENT FREQUENCY BEHAVIOR

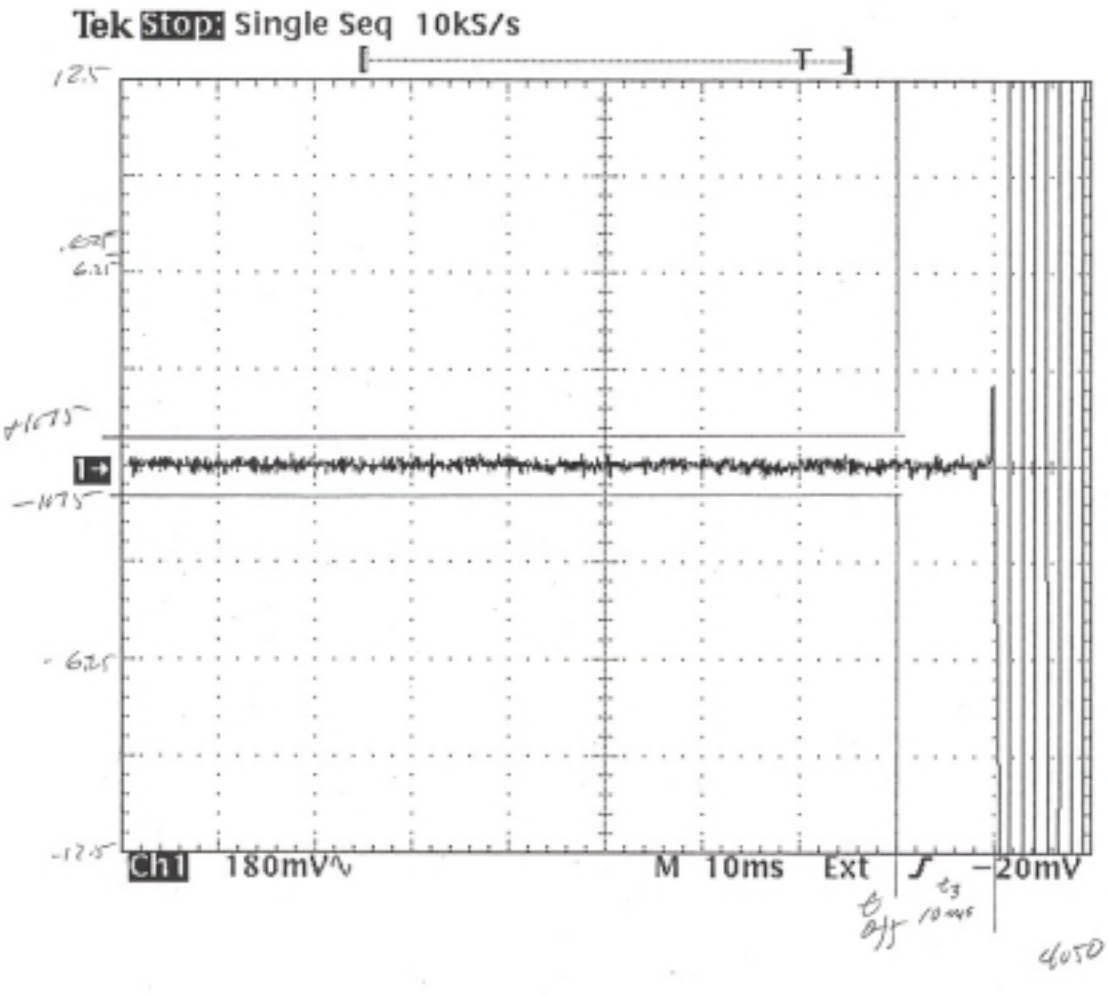


TRANSIENT FREQUENCY BEHAVIOR
FCC ID: O6E714050B

FIGURE 5 (12.5 kHz Turn-on)

FIGURE 6

TRANSIENT FREQUENCY BEHAVIOR



TRANSIENT FREQUENCY BEHAVIOR
FCC ID: O6E714050B

FIGURE 6 (12.5 kHz Turn-off)

APPENDIX 1

FUNCTION OF DEVICES
71-4050B

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

TCVXO	: VT20P8
Audio IC	: AK2344
VCO unit	
VCO oscillator	: 2SK508
Tuning vari-cap diode	: 1SV229
Buffer amplifier	: 2SC4325
Pre-amplifier	: uPC1688
Post-amplifier	: 2SC3583
Tx unit	
Younger amplifier	: 2SC2131
Prescaller	: MB1511
Synthesizer	: MB1511
PA unit	
10w amplifier	: M57704
50w amplifier	: 2SC3102

FUNCTION OF DEVICES
FCC ID: O6E714050B

APPENDIX 1

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

A 14.95 MHz referenced TCXO PLL circuit establishes and stabilizes output frequency.

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
FCC ID: O6E714050B

APPENDIX 2

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION,
LIMIT MODULATION AND CONTROL POWER

1) VCO section

The oscillator circuit formed by L303, D305 and D306 generates transmitter frequencies. Then this signal is fed to the 3-stage of amplifiers, buffer amplifier Q302, pre,-ampufler IC301 and post amplifier Q303 and lead to the final amplifier.

2) PLL section

Basically, the circuit description is the same as Rx. PLL IC inclusive with pre-scaller IC205 compares the phase between the VCO signal and reference oscillator frequency (12.00NMz) by method of dividing the frequency, and produces VCO control signal. Then this VCO control signal is fed to the charge pump, consisting of Q206, Q207 and Q208, and fed to the LPF. The supply voltage of charge pump is amplified by IC206 (approx. 15V) to achieve greater C/N ratio.

3) Modulator section

The modulation signal is fed to both VCO and the reference oscillator (TCVXO), this permits a very flat modulation characteristics against low frequency (DC). This is the advantage when KG510 is used for POCSAG transmitter.

4) Tx younger section

The VCO signal is amplified by Q215 and Q216 to achieve 250mW. But VHF bands (136-174MHz) has only stage of amplifier Q215 to achieve l00mW.

5) PA section

The signal from younger stage is fed to PM510 and Q510 (VHF bands have no Q501) to achieve 70W output power. Then, signal is fed to the LPF to eliminate the harmonics spurious frequencies. An APC circuit formed by IC502, IC503, Q504 and Q505 stabilizes the output power at the set level. An IC501 protects PM501 and Q501 from the reverse power caused by the unmatched aerials.

CIRCUITS TO SUPPRESS SPURIOUS RADIATION, LIMIT MODULATION- AND CONTROL POWER

FCC ID: O6E713050B

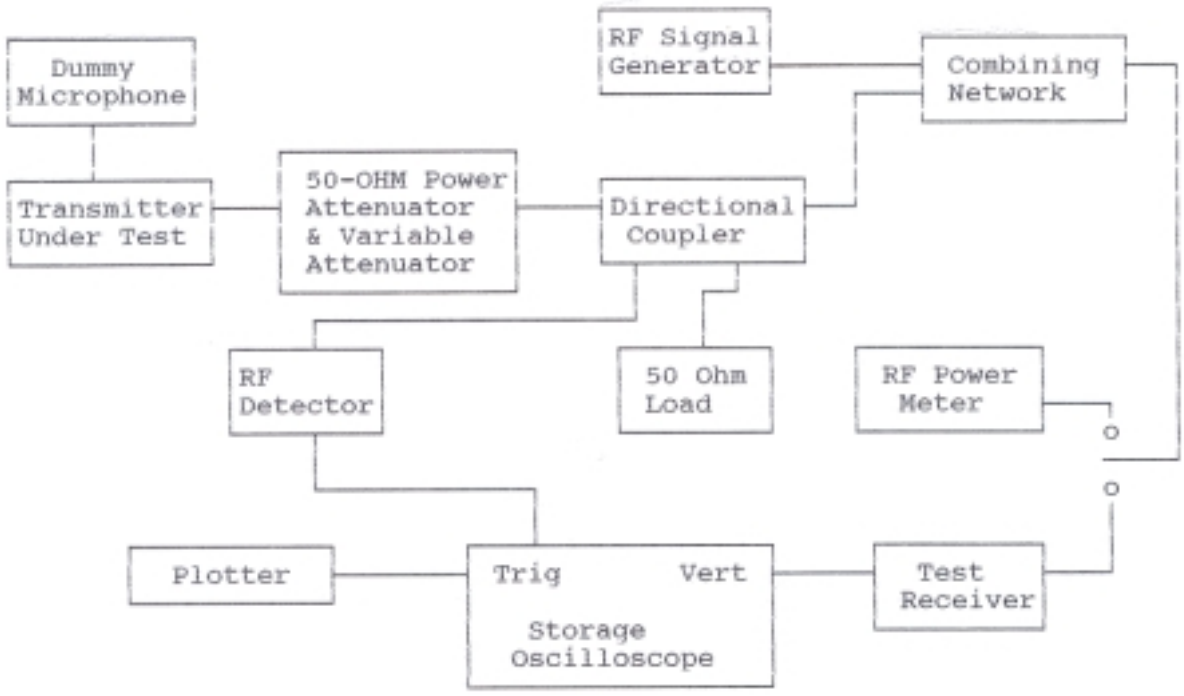
APPENDIX 3

APPENDIX 4

TRANSIENT FREQUENCY BEHAVIOR (90.214) TEST PROCEDURE

Para. 2.995(a)(b)(d) Frequency stability

90.214 Transient Frequency Behavior
(continued)



TRANSIENT FREQUENCY BEHAVIOR
TEST PROCEDURE
FCC ID: O6E713050B

APPENDIX 4