ENGINEERING STATEMENT

For Type Certification of

CATTRON-THEIMEG, INC.

Model No: PS
FCC ID: CN2PS90

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 Cattron Inc. to make type certification measurements on the PS 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: March 14, 2001

A. INTRODUCTION

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

The PS is a UHF, 12.5 kHz channel, non-voice, frequency

modulated transmitter intended for hand-held, industrial remote control applications in the 447 - 473 MHz band. It operates from a 2.4 volt battery pack. Output power rating is 3 milliwatts, (90.217 applies).

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

1. Name of applicant: Cattron Inc.

2. Identification of equipment: CN2PS90

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. 9k0F1D emission
b. Frequency range: 447-473 MHz.
c. Operating power of transmitter is fixed at the factory at 0.003 watts.
d. Maximum power permitted under Part 90.217 of the FCC is 120 mW, and the PS fully complied with those power limitations.
e. The dc voltage and dc currents at final amplifier:

Collector voltage: 2.3 Vdc
Collector current: 0.011 A

f. Function of each active semiconductor device is submitted as a separate exhibit.
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

B. GENERAL INFORMATION . . .(Continued)

j. A description of circuits for stabilizing frequency is included in Appendix 1
k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is submitted as a separate exhibit.
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)

a. Conducted RF power output was measured with a HP 432A power meter with HP 478A sensor and a HP8491B (6 dB) attenuator as a 50 ohm dummy load. Maximum power measured was 0.003 watts. (The transmitter was tuned by the factory.)

b. ERP(d) using the supplied antenna was 400 uW.

D. MODULATION CHARACTERISTICS

1. Occupied Bandwidth (Paragraphs 2.989(c), 90.209(b)(4) and 90.217(b) of the Rules)

Figure 1 is a plot of the sideband envelope of the transmitter output taken with an Advantest R3361A spectrum analyzer. Modulation consisted of a 4000 baud test pattern. Measured modulation under these conditions was 2.5 kHz for 12.5 kHz channelization.

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

The plot has unmodulated carrier as 0 dBm reference.

The plot is within the limits imposed by Paragraph 90.217(b). The horizontal scale (frequency) is 10 kHz per division and the vertical scale (amplitude) is a logarithmic presentation equal to 10 dB per division.

NOTE: The transmitter has a power output of under 500 milliwatts and is not required to meet the spectrum efficiency provisions of Para 90.203(j)(3).

D. MODULATION CHARACTERISTICS (continued)

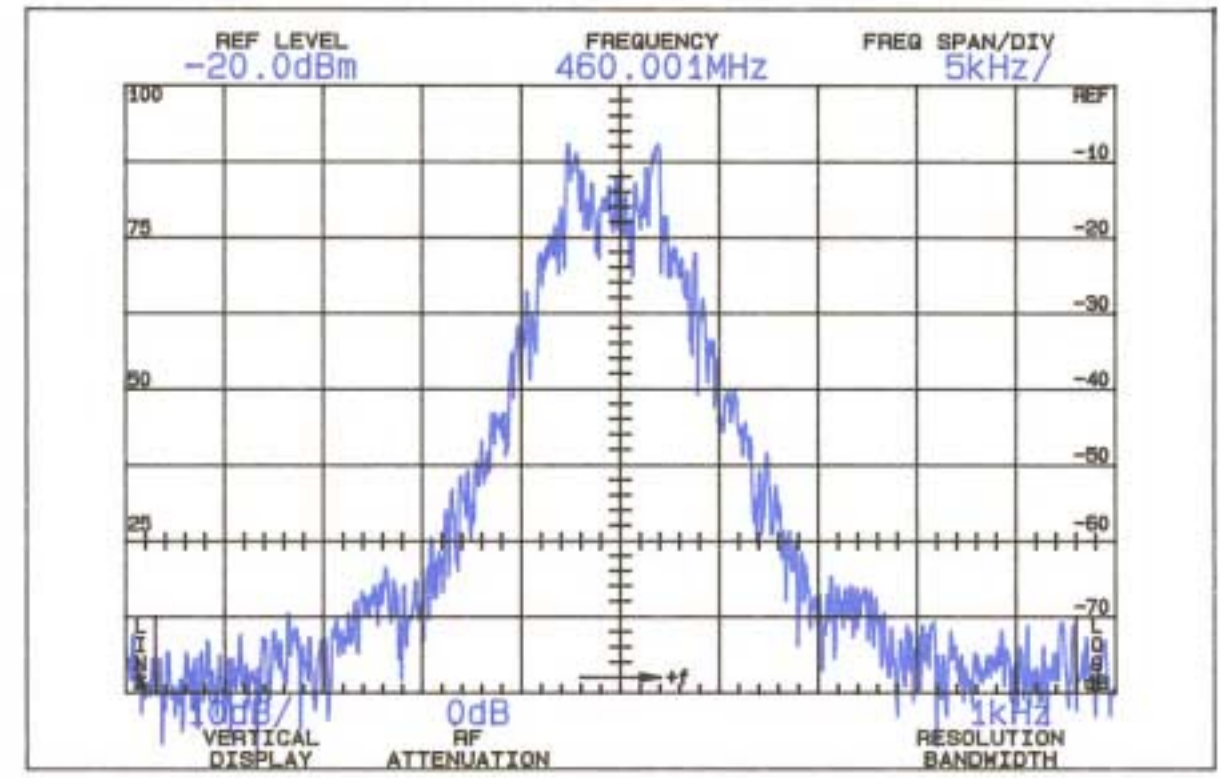
2. Digital Signal Description (Submitted as a separate exhibit for Confidentiality purposes.)

Bandwidth computation:

$$2D + 2F = 5.0 + 4$$
$$= 9k0F1D$$

FIGURE 1

OCCUPIED BANDWIDTH



ATTENUATION IN dB BELOW
MEAN OUTPUT POWER
Required

For equipment designed to operate with a 12.5 kHz channel band width, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.

OCCUPIED BANDWIDTH
FCC ID: CN2PS90

FIGURE 1

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

The PS transmitter was tested for spurious emissions at the antenna terminals while the equipment was modulated with a random 4000 baud signal.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through

a HP 8491B (6 dB) 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 2.4 volts throughout the tests.

Spurious emissions were measured throughout the RF spectrum from 21 (lowest frequency generated in the transmitter is 21.855 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
460.000, 2.4 Vdc Input, 3 mW (conducted)

Spurious Frequency MHz	dB Below Carrier Reference
919.994	77*
1379.988	>100*
1839.984	>100*
2299.980	>100*

2759.976	>100*
3219.972	>100*
3679.968	>100*
4139.964	>100*
4599.960	>100*

Required: 50+10Log(P) = 25 90.210(d)

All other emissions from 21.855 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. MEASUREMENTS OF SPURIOUS RADIATION

Measurements of radiated spurious emissions from the PS were made with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated dipole antennas below 1 GHz, and Polarad CA-L, and CA-S or EMCO 3115 from 1-5.0 GHz.

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 2.4 Vdc.

Output power was 3 mW conducted at 460.000 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 3 mW

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

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS

460.000 MHz, 2.4 Vdc, 3 mW (conducted)

Spurious Frequency MHz	dB Below Carrier Reference[1]
919.994	30V

Required: 50+10Log(P) = 25 90.210(d)

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

All other spurious from 21.855 MHz to 4.6 GHz were more than 20 dB 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 2.4 volts. Frequency was measured with a HP 5385A frequency counter connected to the transmitter through a power attenuator. Measurements were made at 460.000 MHz.

TABLE 3

FREQUENCY STABILITY vs. TEMPERATURE

460.000 MHz; 2.4 Vdc; 3 mW (conducted)

Temperature, °C	Output Frequency, MHz	ppm
-29.7	460.000623	1.4
-20.1	460.000303	0.7
- 9.4	460.000062	0.1
0.3	459.999937	-0.1
9.9	459.999850	-0.3
19.9	459.999850	-0.3
30.4	460.000098	0.2
40.5	460.000364	0.8
50.4	460.000681	1.5

Maximum frequency error: 460.000681
460.000000

\+ .000681 MHz

FCC Rule 90.213(a) specifies .00025% or a maximum of ±.001150 MHz, which corresponds to:

High Limit	460.001150 MHz
Low Limit	459.998850 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 2.4 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
460.000 MHz, 2.4 Volts Nominal, 3 mW (conducted)

%	Supply_Voltage	Output_Frequency,_MHz	ppm
115	2.76	459.999853	-0.3
110	2.64	459.999851	-0.3
105	2.52	459.999848	-0.3
100	2.40	459.999850	-0.3
95	2.28	459.999857	-0.3
90	2.16	459.999846	-0.3
85	2.04	459.999845	-0.3
80*	1.92	459.999841	-0.3

Maximum frequency error:	459.999841	
	460.000000	
	- .000159	MHz

*MFR rated battery end-point

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001150 MHz, corresponding to:

High Limit	460.001150 MHz
Low Limit	459.998850 MHz

J. TRANSIENT FREQUENCY BEHAVIOR

Operation under 90.217 does not require TFB compliance.

APPENDIX 1

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

A 14.4 MHz reference TCXO and a PLL circuit establishes and stabilizes output frequency.

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
FCC ID: CN2PS90

APPENDIX 1