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ENGINEERING STATEMENT

For Type Acceptance of

CATTRON INCORPORATED

**Model No: R1014T
FCC ID: CN275GR1014T-xNB**

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 acceptance measurements on the R1014T transceiver. These tests made by me or under my supervision in our Springfield laboratory.

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

92102



Rowland S. Johnson

Dated: October 6, 1998

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

The R1014T transmitter was tested for spurious emissions at the antenna terminals while the equipment was modulated with a 4800 baud signal.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through a Narda 765-20 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 12.5 volts throughout the tests.

Spurious emissions were measured throughout the RF spectrum from 9 (lowest frequency generated in the transmitter is 9.6 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, 12.5 Vdc Input, 0.330 W

<u>Spurious Frequency MHz</u>	<u>dB Below Carrier Reference</u>
920.000	68*
1380.000	104*
1840.000	100*
2300.000	100*
2760.000	100*
3220.000	101*
3680.000	102*
4140.000	101*
4600.000	102*

Required: $50 + 10\log(P)$ = 45 90.210(d)

All other emissions from 9 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 (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 95 dB or more below the reference level. Measurements were made from the lowest frequency generated within the unit (9 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

460.000 MHz, 12.5 Vdc, 0.330 watts

Spurious Frequency MHz	dB Below Carrier Reference ¹
920.000	51V
1380.000	54V
1840.000	90V*
2300.000	74V*
2760.000	72V*
3220.000	78H*
3680.000	84H*
4140.000	90V*
4600.000	63V
Required: $50+10\log(P) =$	45 90.210(d)

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

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

All other spurious from 9 MHz to 4.6 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 $+50^{\circ}\text{C}$. 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 $\pm 2^{\circ}$ 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 12.5 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. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY vs. TEMPERATURE

460.000 MHz; 12.5 Vdc; 0.330 W

<u>Temperature, $^{\circ}\text{C}$</u>	<u>Output Frequency, MHz</u>	<u>ppm</u>
-29.6	459.999577	-0.9
-19.6	459.999856	-0.3
-10.3	460.000107	0.2
- 0.1	460.000187	0.4
10.3	460.000072	0.2
20.8	459.999797	-0.4
29.8	459.999972	-0.1
40.3	459.999761	-0.5
50.4	459.999908	-0.2

Maximum frequency error: 459.999527
460.000000

- .000423 MHz

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

High Limit	455.001150 MHz
Low Limit	455.998850 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 $\pm 15\%$ above the nominal 12.5 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, 12.5 Volts Nominal, 0.330 W

<u>%</u>	<u>Supply Voltage</u>	<u>Output Frequency, MHz</u>	<u>ppm</u>
115	14.38	459.999811	-0.4
110	13.75	459.999811	-0.4
105	13.13	459.999804	-0.4
100	12.50	459.999797	-0.4
95	11.80	459.999790	-0.5
90	11.25	459.999786	-0.5
85	10.63	459.999783	-0.5
80	10.00	459.999783	-0.5

Maximum frequency error:	459.999783
	<u>460.000000</u>
	- .000217 MHz

*MFR rated battery end-point

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

High Limit	455.001150 MHz
Low Limit	454.998850 MHz

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

Plot identified as Figure 2 demonstrates TFB for 12.5 kHz channel operation.

Appendix 9 has Block Diagram and measurement description for TFB.

FIGURE 2
TRANSIENT FREQUENCY BEHAVIOR

(PLOTS FOLLOW THIS SHEET)

- a) Turn-on
- b) Turn-off

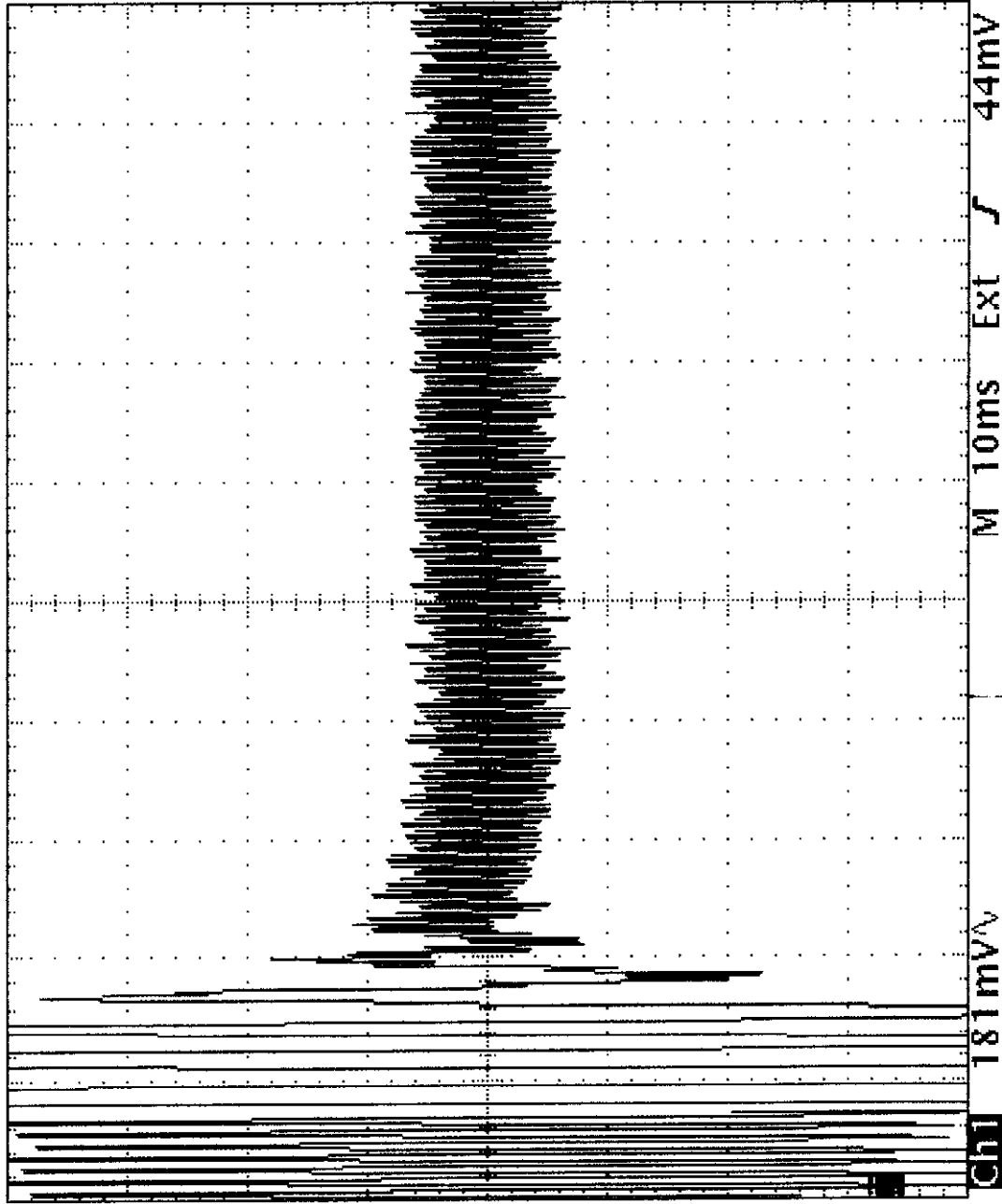
Tests performed with 4800 baud test pattern.

TRANSIENT FREQUENCY BEHAVIOR
FCC ID: F3J130-142U2

FIGURE 2

Tek Run: 10KS/s Sample 11168

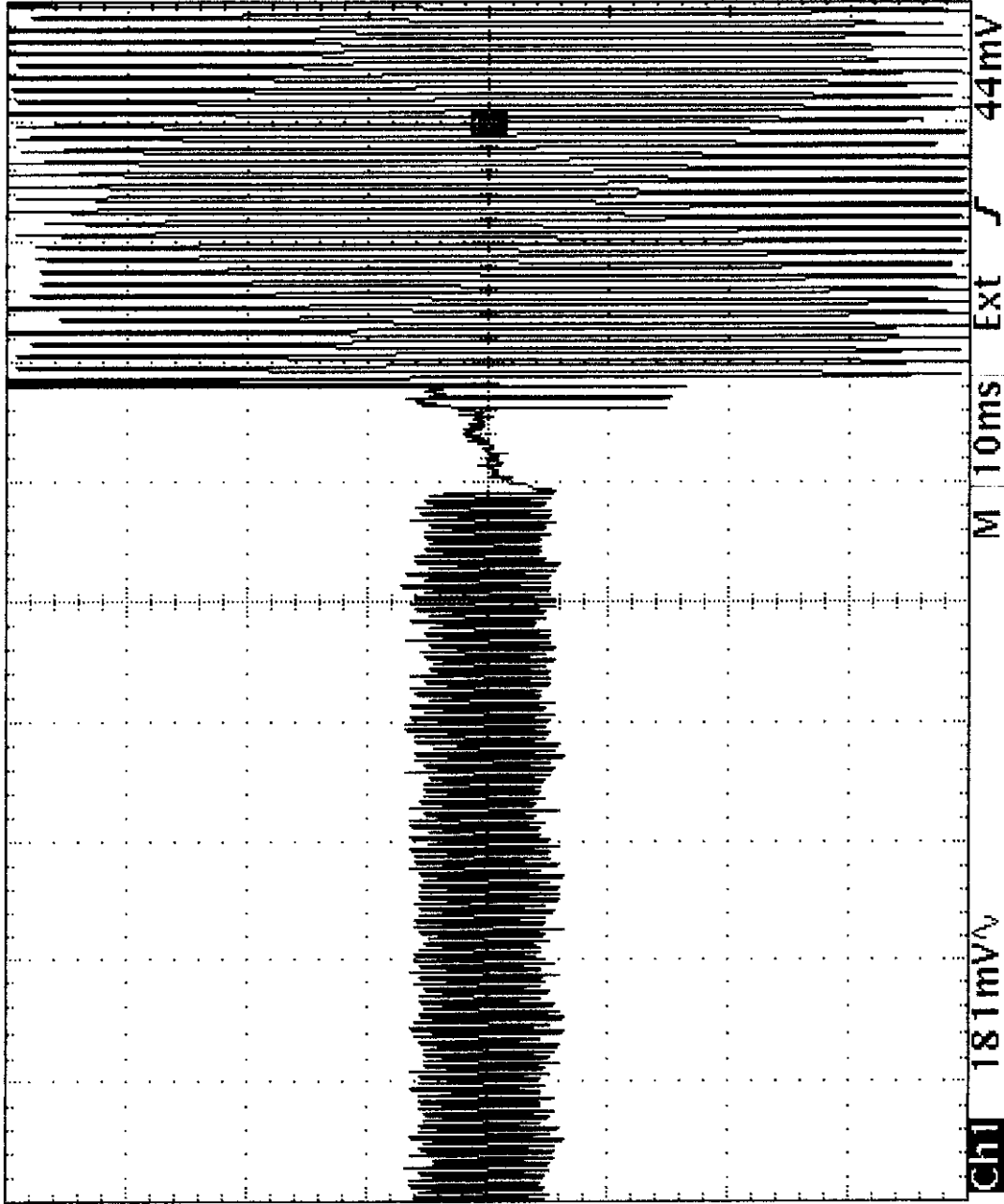
1



1

Tek Run: 10kS/s Sample

[-----]



Ch1 181mV 10ms Ext 44mV

63 10ms 100%

1 →

APPENDIX 3

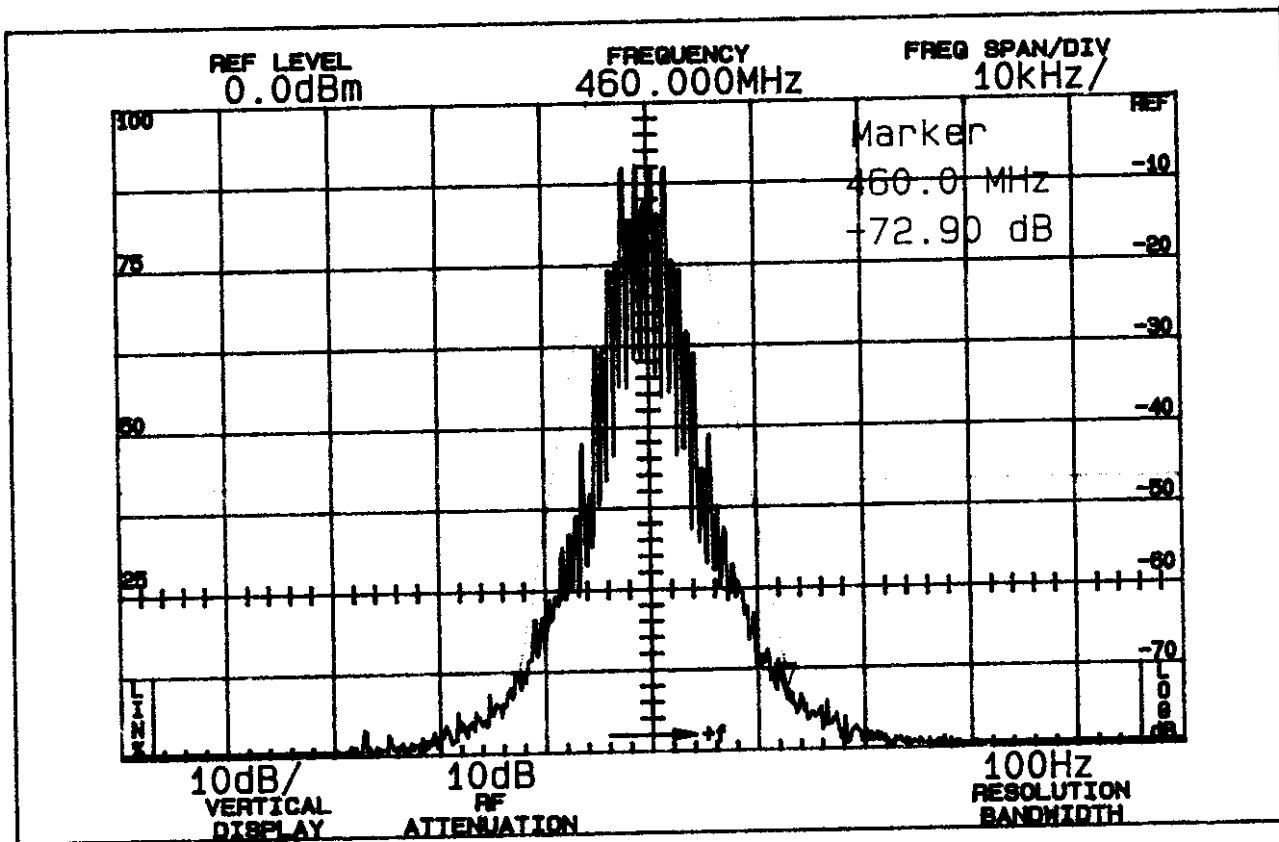
FUNCTION OF DEVICES
R1014T

<u>REFERENCE NUMBER</u>	<u>TYPE NUMBER</u>	<u>FUNCTION</u>
U3	UMA-1014T	PLL Synthesizer IC
U6	LVCO-2966T	VCO
Y4	01C-0322	9.6 MHz TCXO
U5	MAR-3SM	TX Buffer Amp
Q3	NE85639	Pre-Driver
Q4	NE85639	Driver for Final Amp
Q7	48-80225C09	Final Amplifier
U106	4066D	Modulation Waveform Generator
U108, U110	TLC274D	Modulation Low Pass Filter Network and Driver to VCO and Reference OSC.

FUNCTION OF DEVICES
FCC ID: CN275GR1014T-xNB

FIGURE 1

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.

$50 + 10 \log P = 45$ (>12.5 kHz)
($P = 0.33W$)

OCCUPIED BANDWIDTH
FCC ID: CN275GR1014T-xNB

FIGURE 1

A. INTRODUCTION

The following data are submitted in connection with this request for Type Acceptance of the R1014T transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The R1014T is a UHF, non-voice, frequency modulated transceiver intended for hand-held, industrial remote control applications in the 447 - 473 MHz band. It operates from a 12.5 volt battery pack. Output power rating is 0.330 watts. Narrow band, 12.5 kHz channel, operation is provided.

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

1. Name of applicant: Cattron Inc.
2. Identification of equipment: CN275GR1014T-xNB
 - a. The equipment identification label is shown in Appendix 1.
 - b. Photographs of the equipment are included in Appendix 2.
3. Quantity production is planned.
4. Technical description:
 - a. 9k8F1D emission
 - b. Frequency range: 447-473 MHz.
 - c. Operating power of transmitter is fixed at the factory at 0.330 watts.
 - d. Maximum power permitted under Part 90 of the FCC is 350 watts, and the R1014T fully complied with those power limitations.
 - e. The dc voltage and dc currents at final amplifier:

Collector voltage: 12.3 Vdc
Collector current: 0.069 A
 - f. Function of each active semiconductor device:
See Appendix 3.
 - g. Complete circuit diagram is included in Appendix 4.
 - h. A draft instruction book is submitted as Appendix 5.
 - i. The transmitter tune-up procedure is included in Appendix 6.
 - j. A description of circuits for stabilizing frequency is included in Appendix 7.
 - k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 8.
 - l. Not applicable.

B. GENERAL INFORMATION...(Continued)

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 an HP 432A power meter with HP 478A sensor and a Narda 765-20 attenuator as a 50 ohm dummy load. Maximum power measured was 0.330 watts. (The transmitter was tuned by the factory according to the procedure of Exhibit 4.)

D. MODULATION CHARACTERISTICS

Occupied Bandwidth

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

Figure 1 is a plot of the sideband envelope of the transmitter output taken with a Advantest R3361A spectrum analyzer. Modulation consisted of a 4800 baud test pattern. Measured modulation under these conditions was 2.0 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 Paragaph 90.210(d). 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).

Bandwidth computation: @ 4800 baud

$$2D + 2F = 5 + 4.8$$

$$= 9K8F1D$$