ENGINEERING STATEMENT

In Connection With

CATTRON, INC.

Model No. MK CONTROLLER

FCC ID: CN2MK

Hyak Laboratories, Inc. has been retained to perform radiated and conducted spurious measurements on the MK Controller transmitter in accordance with Section 15.231 of the FCC rules.

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, having submitted numerous applications for equipment authorization.

All tests were made by me or under my supervision in accordance with the rules and regulations of the Federal Communications Commission.

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Rowland S. Johnson

Dated: April 18, 2000

A. INTRODUCTION

Hyak Laboratories Inc. has been authorized by Cattron, Inc., to perform measurements on the MK Controller transmitter to determine compliance with FCC Rules, Subpart C, Para. 15.231(a).

The MK Controller is a low powered, battery operated transmitter designed for industrial remote control systems. It operates on a single-channel in the 447 - 473 MHz band. The transmitter, constructed on an etched circuit card, is powered from an internal battery. An internal antenna is used.

Data are presented for units with internal antenna at operating frequencies of 447.000, 457.000 and 472.9875 MHz.

The device meets the provisions of Para. 15.231(a)(4) since it is only activated when a control button is activated. Transmission stops immediately when the control is released.

B. DESCRIPTION OF MEASUREMENT FACILITIES

A description of the Hyak Laboratories Inc. radiation test facility is a matter of record with the FCC. The facility was accepted for radiation measurements on October 1, 1976, and is currently listed as an acceptable site.

C. DESCRIPTION OF MEASUREMENT PROCEDURE: RADIATED MEASUREMENTS

Measurements of transmitter radiation field strength were made using ANSI 63.4 (1992) as the test procedure. Measurements were made with 3 meter spacing between the transmitter under test and the test equipment antenna.

The transmitter under test was placed on a rotatable table approximately one meter in height.

The power supply was a fresh set of batteries.

Measurement of field strength was made through use of a HP 8596E or Tek 494P spectrum analyzer in conjunction with a HP 8447D and Avantek wide band, low noise preamplifiers.

Singer DM-105A series calibrated dipoles were used as the test antennas in the 30-1000 MHz range. An Emco 3115 calibrated horn antenna was used between 1 and 5 GHz.

An analysis of time domain measurements (see plot in Figure 1, submitted as a separate exhibit.) was made to determine average field intensity of the emissions. Sample calculations are included in Figure 2.

C. DESCRIPTION OF MEASUREMENT PROCEDURE: RADIATED MEASUREMENTS (Continued)

Based on time domain observations, and using the procedures of Figure 2, a correction factor for a nominal 100 mS averaging interval was computed, and is included in the data, submitted as a separate exhibit.

Data for radiated emissions in Tables 1a through 1c includes this correction factor. For emissions that fell in forbidden bands below 1 GHz the CISPR quasi-peak detector was used.

Below 1 GHz, a 100 kHz RBW with 100 kHz VBW was used; above 1 GHz a 1 MHz RBW was used which was reduced to 100 kHz when a CW signal was confirmed. Above 3 GHz, measurements were made at 1 meter spacing extrapolated to 3 meters.

For each spurious emission identified between 30 to the tenth harmonic the test assembly was rotated for maximum pickup, the test antenna varied in elevation and the test antenna polarization shifted between horizontal to vertical in order to maximize observed signals.

The measurement procedure included recording the worst-case field strength for receiving antenna polarization, test antenna height variation from 3 feet to 10 feet and test sample rotation.

The spectrum was checked from 30 MHz to the tenth harmonic. All emissions not reported were more than 20 dB below the permitted level or below FCC limits but in the ambient/system noise floor. Tabulation of the measurements are shown in Tables 1a, 1b and 1c.

Specific forbidden band scans were made per Paragraph 15.205.

D. REPORT OF RADIATED MEASUREMENTS

Tables 1a through 1c list the frequency and amplitude of all signals observed from 30 MHz to the tenth harmonic that were within 20 dB of the limits of FCC Rules. The averaging factor is included as noted.

TIME DOMAIN PLOT AND CALCULATIONS (FIGURES 1 AND 2) ARE SUBMITTED AS A SEPARATE EXHIBIT.

TABLE 1a

RADIATED FIELD INTENSITY
Measured at 3 meters
15.231(b)

Frequency _MHz)	Meter[1] Reading (dBm)	Antenna Factor (dB)	Field[2] Intensity uV/m @ 3m	Calc. Field[3] Intensity uV/m @ 3m	FCC Limit uV/m @ 3m	dB to Limit
447.002	-39.2	25.2	44668.4	11167.1	11541	- 0.3
894.004	-95.6	32.0	147.0	37.0	1154	-29.9
1341.002	-99.2	25.3	45.2	11.3	500*	-32.9
1788.006	-103.2	27.2	35.5	8.9	1154	-42.3
2235.010	-99.2	28.9	68.4	17.1	500*	-29.3
2682.012	-100.8	30.0	64.6	16.2	500*	-29.8
3129.014	-102.0	31.2	64.6	16.2	1154	-37.1
3576.016	-102.4	32.5	71.6	17.9	1154	-36.2
4023.018	-101.6	33.7	90.2	22.6	500*	-26.9
4470.020	-102.0	32.9	78.5	19.6	1154	-35.4

Note 1: Peak detector reading without averaging.

Note 2: $uV/m = Log^{-1}\frac{dBu/m}{20}$

dBu = dBm + antenna factor + 107

Note 3: Field Intensity calculated from peak value and –12 dB peak/average factor.

*Forbidden Band

All other emissions to the tenth harmonic were below FCC limits.

(Unit was measured on 3 major planes)

RBW 100 kHz < 1 GHz; 1 MHz > 1 GHz; VBW 100 kHz.

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TABLE 1a (447.000 MHz)

TABLE 1b

RADIATED FIELD INTENSITY
Measured at 3 meters
15.231b

Frequency (MHz)	Meter[1] Reading (dBm)	Antenna Factor (dB)	Field[2] Intensity uV/m @ 3m	Calc. Field[3] Intensity uV/m @ 3m	FCC Limit uV/m @ 3m	dB to Limit
457.000	-39.8	25.4	42658.0	10664.5	11958	- 1.0
914.000	-93.6	32.3	192.8	48.2	1196	-27.9
1371.000	-101.2	25.4	36.3	9.1	500*	-34.8
1828.000	-90.8	27.4	151.4	37.9	1196	-30.0
2285.002	-94.8	29.0	114.8	28.7	500*	-24.8
2742.000	-99.6	30.2	75.9	19.0	500*	-28.4
3199.000	-99.2	31.4	91.2	22.8	1196	-34.4
3656.000	-101.6	32.7	80.4	20.1	500*	-27.9
4113.000	-100.4	33.5	101.2	25.3	500*	-25.9
4670.000	-101.6	33.1	84.1	21.0	500*	-27.5

Note 1: Peak detector reading without averaging.

Note 2: $uV/m = \text{Log}^{-1}\frac{dBu/m}{20}$

dBu = dBm + antenna factor + 107

Note 3: Field Intensity calculated from peak value and -12 dB peak/average factor.

*Forbidden Band

All other emissions to the tenth harmonic were below FCC limits.

(Unit was measured on 3 major planes)

RBW 100 kHz < 1 GHz; 1 MHz > 1 GHz; VBW 100 kHz.

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TABLE 1b (457.000 MHz)

TABLE 1c

RADIATED FIELD INTENSITY
Measured at 3 meters
15.231(b)

Frequency (MHz)	Meter[1] Reading (dBm)	Antenna Factor (dB)	Field[2] Intensity uV/m @ 3m	Calc. Field[3] Intensity uV/m @ 3m	FCC Limit uV/m @ 3m	dB to Limit
472.990	-32.9	25.7	47315.1	11828.8	12500	- 0.5
945.979	-98.8	32.6	109.6	27.4	1250	-33.2
1418.967	-101.2	25.5	36.7	9.2	500*	-34.7
1891.958	-101.2	27.7	47.3	11.8	1250	-40.5
2364.948	-102.8	29.2	46.8	11.7	500*	-32.6
2837.937	-99.2	30.4	81.3	20.3	500*	-27.8
3310.927	-101.2	31.7	75.0	18.8	1250	-36.5
3783.916	-100.0	33.1	101.2	25.3	500*	-25.9
4256.906	-101.2	33.2	89.1	22.3	500*	-27.0
4729.895	-100.4	33.7	103.5	25.9	500*	-25.7

Note 1: Peak detector reading without averaging.

Note 2: $uV/m = \text{Log}^{-1}\frac{dBu/m}{20}$

dBu = dBm + antenna factor + 107

Note 3: Field Intensity calculated from peak value and -12 dB peak/average factor.

*Forbidden Band

All other emissions to the tenth harmonic were below FCC limits.

(Unit was measured on 3 major planes)

RBW 100 kHz < 1 GHz; 1 MHz > 1 GHz; VBW 100 kHz.

RADIATED FIELD INTENSITY
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TABLE 1c (472.9875 MHz)

D. FORBIDDEN BAND MEASUREMENTS

Any spurious signals from the transmitter that fell in a forbidden band are identified in Table 1. All forbidden bands, per Paragraph 15.205, from 30 MHz to the tenth harmonic were searched and any applicable emissions above noise or interference levels are shown in Tables 1a through 1c.

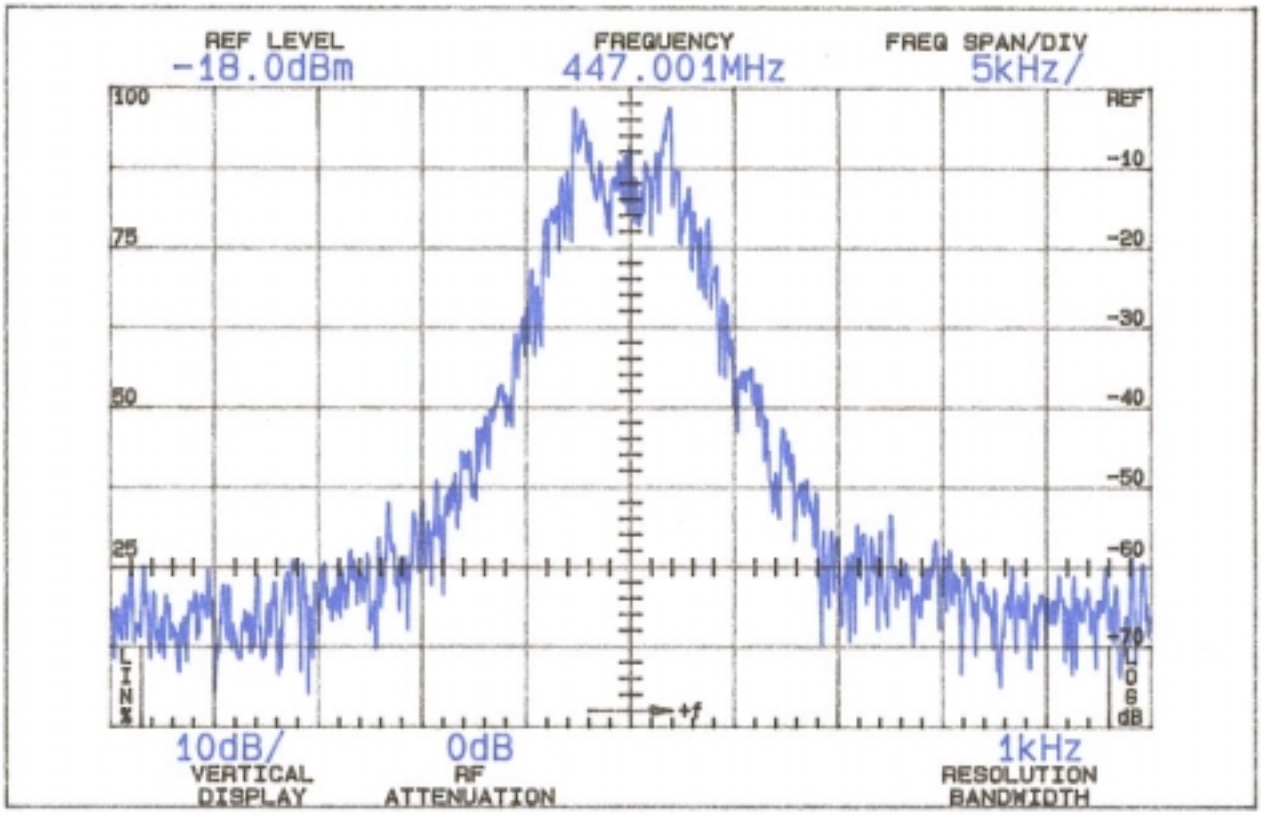
E. OCCUPIED BANDWIDTH

Plots of occupied bandwidth are shown in Figures 3a, 3b and 3c. The device meets bandwidth restriction of Paragraph 15.231(c); 10 dB points are less than 20 kHz with worst-case modulation. (Worst-case Limit is 0.25% of 473 MHz or 1.18 MHz).

F. POWER LINE CONDUCTED MEASUREMENTS

AC line conducted spurious measurements were not made since the device does not use the public power supply system.

FIGURE 3a


REF LEVEL
-18.0dBm
FREQUENCY
447.001MHz
FREQ SPAN/DIV
5kHz/
100
75
50
25
REF
-10
-20
-30
-40
-50
-60
-70
LIN %
LOG dB
10dB/
VERTICAL DISPLAY
0dB
RF ATTENUATION
1kHz
RESOLUTION BANDWIDTH

Center Frequency 447 MHz

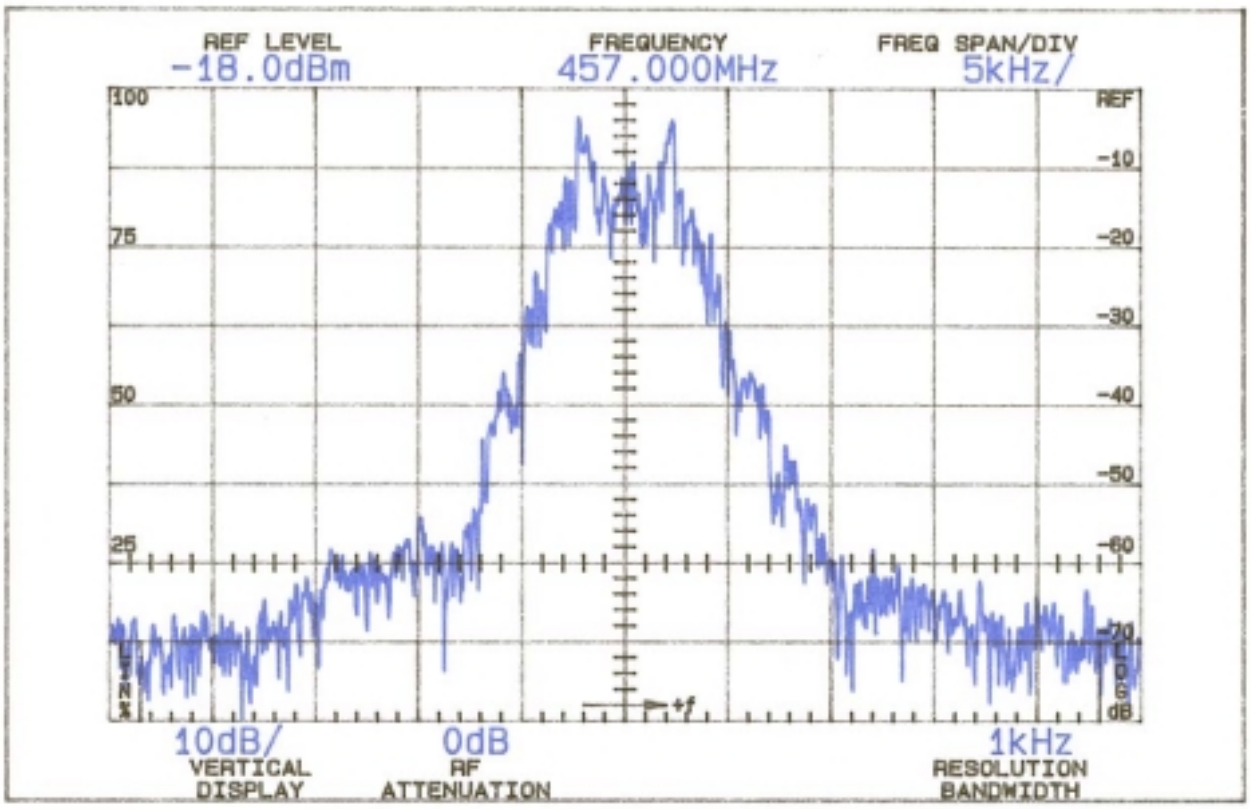
Horizontal: 5 kHz
Vertical: 10 dB/Div.
Resolution: 1 kHz

No video filtering.

OCCUPIED BANDWIDTH
FCC ID: CN2MK

FIGURE 3a (447.000 MHz)

FIGURE 3b



Center Frequency 457 MHz

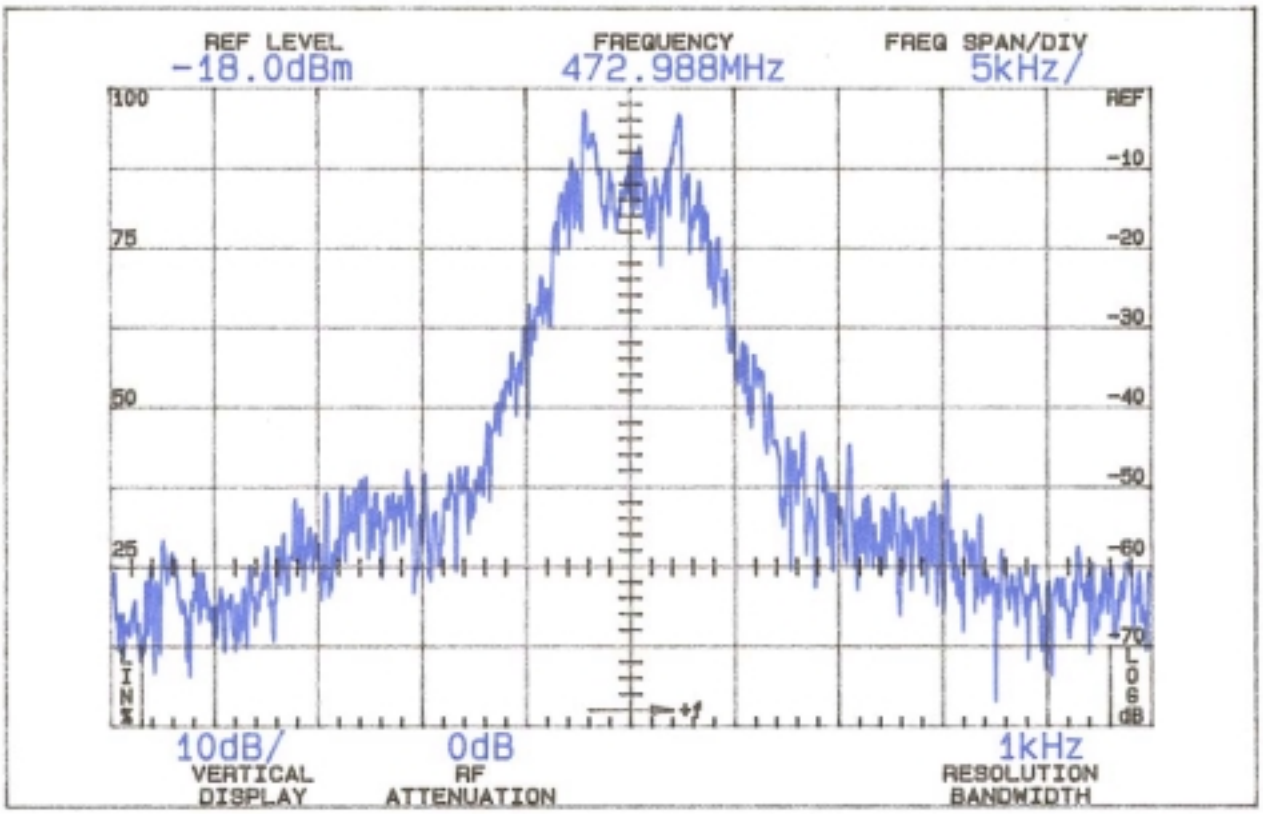
Horizontal: 5 kHz
Vertical: 10 dB/Div.
Resolution: 1 kHz

No video filtering.

OCCUPIED BANDWIDTH
FCC ID: CN2MK

FIGURE 3b (457.000 MHz)

FIGURE 3c



Center Frequency 472.9875 MHz

Horizontal: 5 kHz
Vertical: 10 dB/Div.
Resolution: 1 kHz

No video filtering.

OCCUPIED BANDWIDTH
FCC ID: CN2MK

FIGURE 3c (472.9875 MHz)