ENGINEERING STATEMENT

For Type Certification of

Hitec RCD, Inc.

Model: Lynx Sport AM 75
FCC ID: IFHLYNXSP2A75

I am an Electronics Engineer, a principal 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 Hitec RCD, Inc., to make type certification measurements on the Lynx Sport AM 75 transmitter. These tests were made by me or under my supervision in our Springfield laboratory.

Test data and other documentation required by the FCC for type certification are included in this report. It is submitted that the above mentioned transmitter meets FCC requirements and type certification is requested.

Rowland S. Johnson

Dated: November 8, 1999

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the Lynx Sport AM 75 transmitter in accordance with Part 2, Subpart J of the FCC Rules.

The Lynx Sport AM 75 is a low power, non-voice, transmitter intended for remote control of model vehicles in the 75 MHz band.

The equipment employs a vertical polarized antenna directly mounted on the unit and meets Paragraphs 95.645, 95.647, 95.649, and the technical requirements established in the Report & Order in PR Docket 90-222.

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

1. Name of applicant: Hitec RCD, Inc.

2. Identification of equipment: IFHLYNXSP2A75

   a. The equipment identification label is submitted as a separate exhibit.
   b. Photographs of the equipment are submitted as separate exhibits.

3. Quantity production is planned.

4. Technical description:

   a. 6k00A1D emission
   b. Frequency range: 75.41-75.99 MHz.
   c. Operating power of transmitter is fixed at the factory at 0.305 Watt.
   d. Maximum power permitted under Paragraph 95.635(b) of the FCC Rules is 750 milliwatts, and the Lynx Sport AM 75 fully complied with those power limitations.
   e. The dc voltage and dc currents at final amplifier:
      Collector voltage: 11.6 Vdc
      Collector current: 93 mA
   f. Function of each active semiconductor device: See Appendix 1.
   g. Complete schematic diagram is submitted as a separate exhibit.
   h. Draft instruction book is submitted as a separate exhibit.

B. GENERAL INFORMATION (continued)

- i. The transmitter tune-up procedure is submitted 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.

6. RF_Power_Output (Paragraph 2.985(a) of the Rules)

Since the Lynx Sport AM 75 has an immediately attached, integral antenna, no antenna port exists. Power was determined by calculation:

$$P = \frac{(E + D)^2}{30\ G} \qquad (1)$$

Where

P = Power input (same as power radiated assuming 100% efficient antenna)

E = Electric Field in V/M

D = Distance in meters

G = Gain of the antenna over isotropic. (For a 75 MHz monopole, gain = 0.8)

$$P = \frac{(0.901571 \times 3)^2}{30 \times 0.8} \text{ (from Table 1)}$$

P = 0.305 watts

(1) Kraus, J.D., Antennas p.55.

C. MODULATION CHARACTERISTICS

Occupied_Bandwidth
(Paragraphs 2.989(i), and 95.635(b) of the Rules)

Figure 1 is a plot of the sideband envelope of the transmitter taken with an Tektronix 494P spectrum analyzer. Modulation corresponded to conditions of 2.989(i) and consisted of the multiple pulses and synchronizing space normally used in radio control applications. Operator controls were adjusted for worst-case emission.

The plot is within the limits imposed by paragraph 95.635(c).

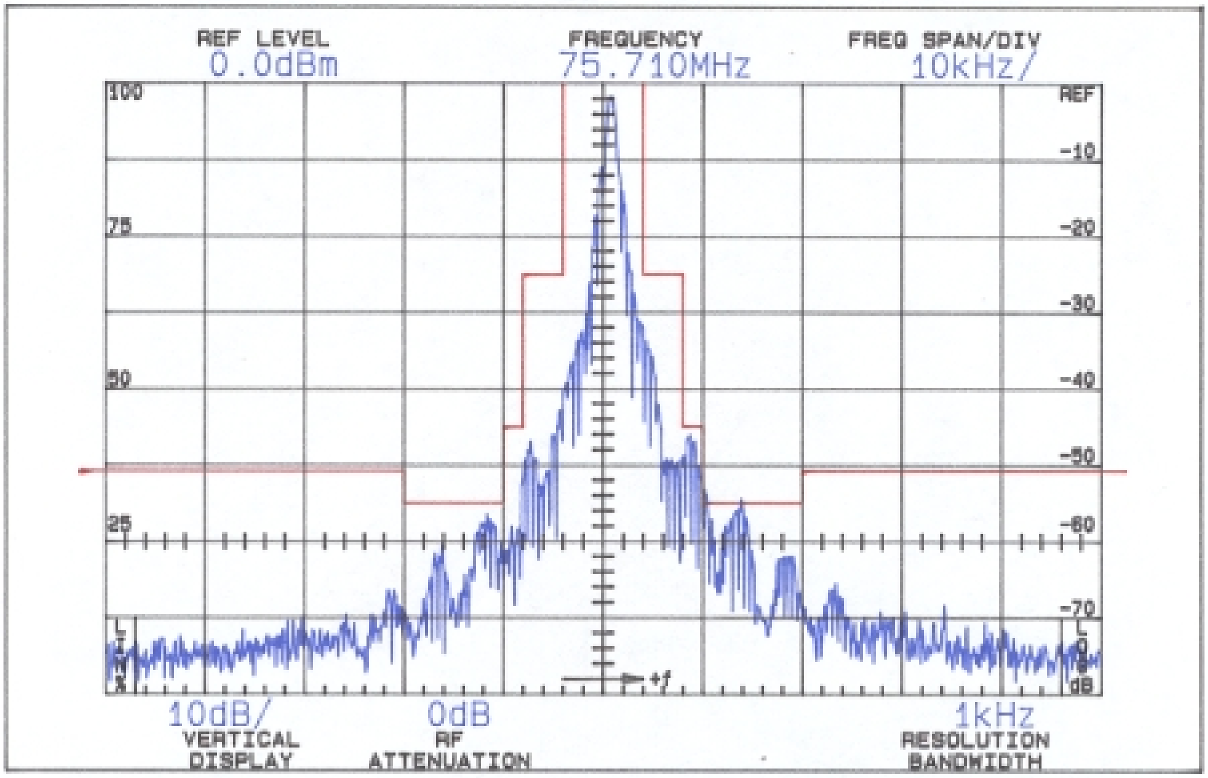
The horizontal scale (frequency) is **10** kHz per division and the vertical scale (Amplitude) is a logarithmic presentation equal to 10 dB per division.

Resolution bandwidth was 1 kHz; video bandwidth was 100 kHz.

Figure 2 is a plot from a Tektronix 494P spectrum analyzer with 5 mS/division sweep in the time domain of the modulated carrier. Modulation consisted of two bursts with a nominal 2 mS duration at a nominal 60 Hz repetition rate.

FIGURE 1

OCCUPIED BANDWIDTH



95.635:

(3) At least 25 dB on any frequency removed from the center of the authorized bandwidth by more than 50% up to and including 100% of the authorized bandwidth (4 to 8 kHz).

(10) At least 45 dB on any frequency removed from the center of the authorized bandwidth by more than 100% up to and including 125% of the authorized bandwidth. (8 to 10 kHz)

(11) At least 55 dB on any frequency removed from the center of the authorized bandwidth by more than 125% up to and including 250% of the authorized bandwidth. (10 to 20 kHz)

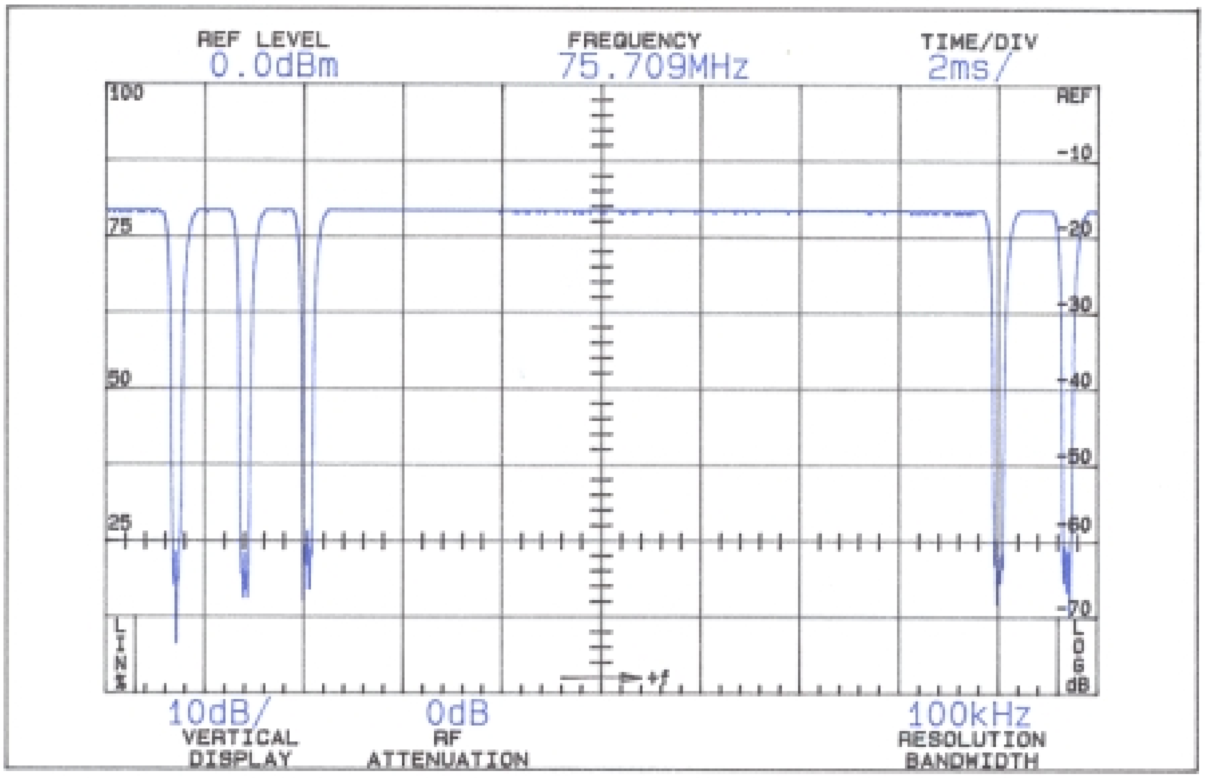
(12) At least 56+10 $\log_{10}$ (TP) dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

OCCUPIED BANDWIDTH
FCC ID: IFHLYNXSP2A75

FIGURE 1

FIGURE 2

MODULATING WAVEFORM
TIME DOMAIN



5 millisecond/division sweep

OCCUPIED BANDWIDTH
(Modulating Waveform)
FCC ID: IFHLYNXSP2A75

FIGURE 2

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

Since the Lynx Sport AM 75 transmitter meets FCC Rules 95.645, there are no provisions for antenna terminal output measurements.

Substitution of a suitable matching network and retuning to permit observations at 50 ohms would not be representative of normal operation.

Accordingly data on radiated spurious emissions are included in lieu of antenna terminal conducted spurious emissions.

E. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION
(Paragraph 2.993(a) (b) (2) of the Rules)

Field intensity measurements of radiated spurious emissions from the Lynx Sport AM 75 were made with a Tektronix 494P spectrum analyzer using EMCO 3121C calibrated test antennas.

The transmitter and its integral vertical antenna were located in an open field 3 meters from the test antenna. Supply voltage was from a fresh set of batteries with a terminal voltage under load of 12.0 Vdc. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

Reference was measured emission at the carrier frequency, 75.71 MHz, expressed in uV/m @ 3m.

The measurement system was capable of detecting signals 100 dB or more below the reference level. Measurements were made from the lowest frequency generated within the unit, 8 MHz, to 10 times operating frequency. Data after application of antenna factors and line loss corrections are shown in Table 1.

TABLE 1

TRANSMITTER RADIATED EMISSION

75.71 MHz; 12.0 Vdc; 0.305 watt ERP

Emission Frequency MHz	Radiated Emission uV/m	dB Below Carrier Reference[1]
75.710	901571.1	0.0
151.424	1870.3	53.7
227.132	595.7	63.6
302.840	93.7	79.7
378.552	152.1	75.5
454.260	127.6	77.0
529.970	220.9	72.2
605.680	110.5	78.2
681.390	94.3	79.6
757.098	204.6	72.9

Required: **56**+10Log(0.305) = **50.8**

1. Worst-case polarization, H-horizontal, V-vertical.

All other spurious from 8 - 758 MHz were 20 dB or more below FCC limit.

F. FREQUENCY STABILITY
(Paragraph 2.995(a) and 95.623(c) 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 our 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 2, starting with -30°C.

A Thermotron S1.2 temperature chamber was used. Temperature was monitored with a Keithley 177 DVM and Fluke 150-30 temperature probe. The transmitter output stage was terminated in a dummy load. Primary supply was 12.0 volts. Frequency was measured with a HP 5385A digital frequency counter connected to the transmitter through a power attenuator. Measurements were made at 75.71 MHz. No transient keying effects were observed.

TABLE 2

FREQUENCY STABILITY vs. TEMPERATURE
75.71 MHz; 12.0 Vdc; 0.305 watt

Temperature, °C	Output Frequency, MHz	p.p.m.
-29.4	75.709921	-1.0
-19.4	75.710385	5.1
-10.4	75.710497	6.6
0.5	75.710699	9.2
10.6	75.710537	7.1
20.4	75.710236	3.1
30.1	72.709950	-0.7
39.7	72.709698	-4.0
50.2	72.709516	-6.4

Maximum frequency error: 75.710699
75.710000

+ .000699 MHz

Rule 95.623(c) specifies **0.002%** or a maximum of ±0.001514 MHz, which corresponds to:

High Limit	75.511514 MHz
Low Limit	75.508486 MHz

G. 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 an HP 5385A digital frequency counter as supply voltage provided by an HP 6264B variable dc power supply was varied ±15% from the nominal 12.0 volt rating. A Keithley 197 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient.

TABLE 3

FREQUENCY STABILITY vs. SUPPLY VOLTAGE
75.51 MHz; 12.0 Vdc; 0.305 watt

Supply_Voltage	Output_Frequency,_MHz	p.p.m.
13.80	75.710284	3.8
13.20	75.710265	3.5
12.60	75.710250	3.3
12.00	75.710236	3.1
11.40	75.710234	3.1
10.80	75.710233	3.1
10.20	75.710233	3.1
9.60*	75.710240	3.2

Maximum frequency error: 75.710584
75.710000

\+ .000584 MHz

* Manufacturer's battery end point.

FCC Rule 95.623(c) specifies **0.002%** or a maximum of ±0.001514 MHz, corresponding to:

High Limit	75.511514 MHz
Low Limit	75.508486 MHz

APPENDIX 1

FUNCTIONS OF ACTIVE SEMICONDUCTORS

Reference	Type	Function
Q2	2SC2223	XTAL Oscillator
Q3	2SA812	AM Modulator
Q4	2SC2223	Driver
Q5	2SC4735	Final amplifier
IC1	M52460P	Encoder

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

Transmitter output frequency is determined and stabilized by crystal controlled oscillator.

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION,

Final RF amplifier spurious emissions are attenuated by a "PI" matching network consisting of L1, C63, T4, C64, T5, C65, C66 and L2.