ENGINEERING STATEMENT

For Type Certification of

Hitec RCD, Inc.

Model: Laser 6
FCC ID: IFHLAS46-75

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 Laser 6 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.

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Rowland S. Johnson

Dated: October 5, 2001

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the Laser 6 transmitter in accordance with Part 2, Subpart J of the FCC Rules.

The Laser 6 is a low power, non-voice, transmitter intended for remote control of model surface craft 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: IFHLAS46-75

   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. 6k00F1D emission
   b. Frequency range: 75.41 – 75.99 MHz.
   c. Operating power of transmitter is fixed at the factory at 0.21 Watt – ERP(d).
   d. Maximum power permitted under Paragraph 95.635(b) of the FCC Rules is 750 milliwatts, and the Laser 6 fully complied with those power limitations.
   e. The dc voltage and dc currents at final amplifier:
      Collector voltage: 10.0 Vdc
      Collector current: 152 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 Laser 6 has an immediately attached, integral antenna, no antenna port exists. Power was determined by substitution comparison.

Assuming an ideal dipole (not the actual monopole)

ERP(d) = 0.21 Watts.

C. MODULATION CHARACTERISTICS

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

Figure 1 is a plot, with carrier at 0 dB Ref., of the sideband envelope of the transmitter taken with a 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).

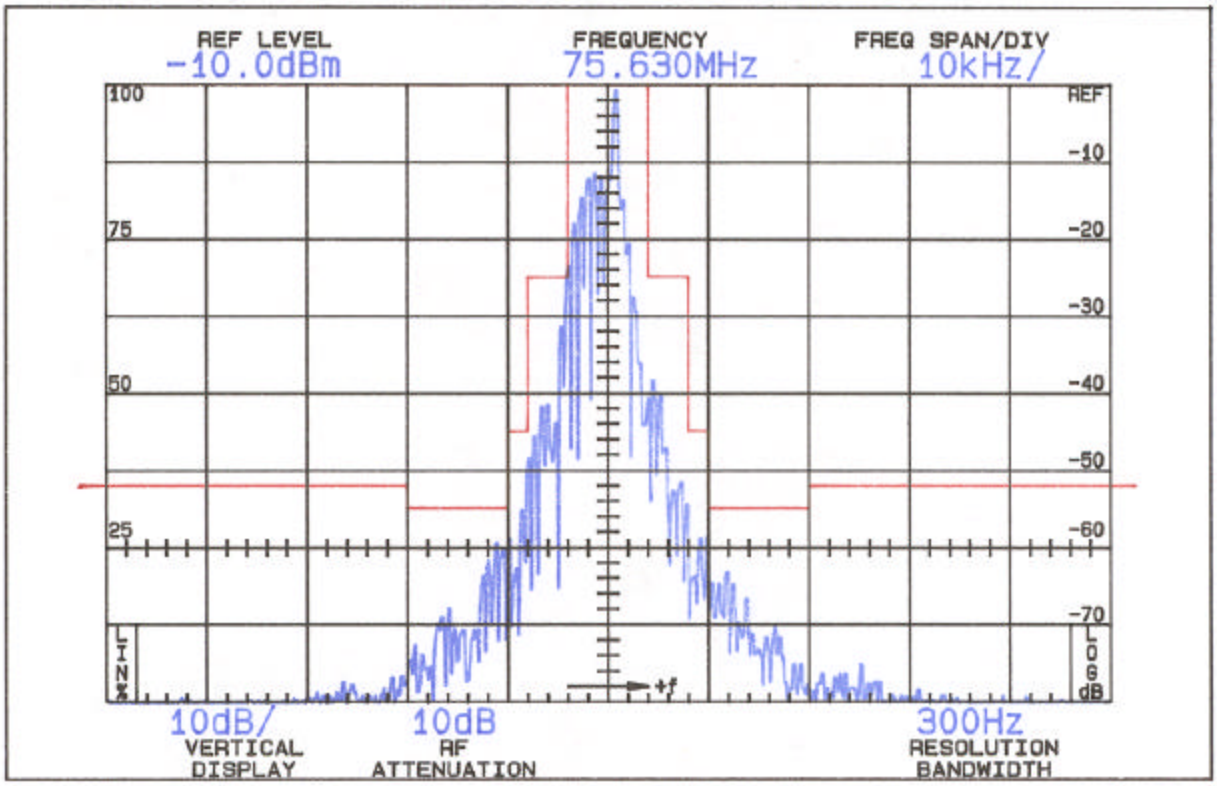
The horizontal scale (frequency) is 10 kHz per division and the vertical scale (Amplitude) is a logarithmic presentation equal to 10 dB per division.

Resolution bandwidth was 300 Hz; video bandwidth was 100 kHz.

Figure 2 is a plot from a Tektronix 494P spectrum analyzer with 2 mS/division sweep in the time domain of the modulated carrier. Modulation consisted of seven bursts with a nominal 0.9 mS duration at a nominal 50 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)

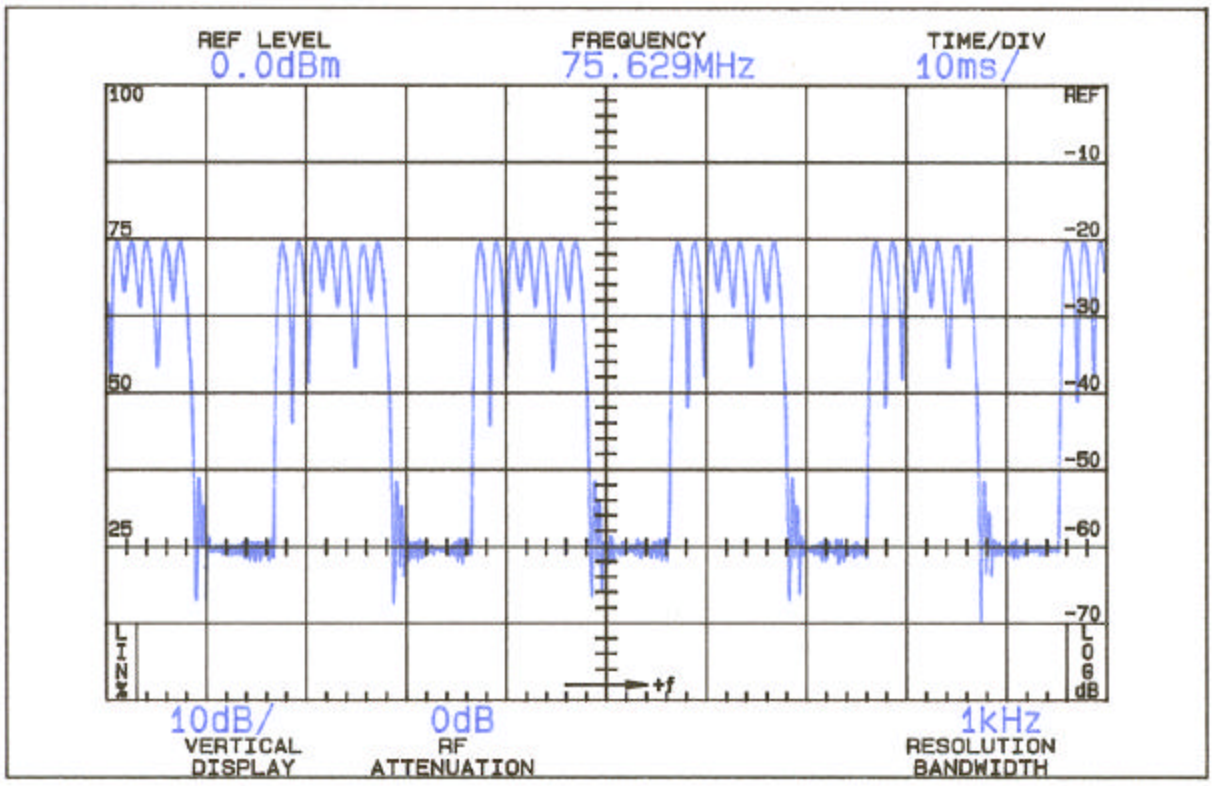
(12) At least $56+10 \log_{10}$ (TP) dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

OCCUPIED BANDWIDTH
FCC ID: IFHLAS46-75

FIGURE 1

FIGURE 2

MODULATING WAVEFORM
TIME DOMAIN



10 millisecond/division sweep

OCCUPIED BANDWIDTH
(Modulating Waveform)
FCC ID: IFHLAS46-75

FIGURE 2

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

Since the Laser 6 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. MEASUREMENTS OF SPURIOUS RADIATION
(Paragraph 2.993(a) (b) (2) of the Rules)

Measurements of radiated spurious emissions from the Laser 6 were made with a Tektronix 494P spectrum analyzer using EMCO 3121C calibrated test antennas using substitution comparison.

The transmitter and its integral vertical antenna were located in an open field 3 meters from the test antenna. Supply voltage was from a fully charged set of batteries with a terminal voltage under load of 10.2 Vdc. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

Reference was power at the carrier frequency.

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.

TABLE 1

TRANSMITTER RADIATED EMISSION

75.630 MHz; 10.2 Vdc; 0.21 watt ERP(d)

Emission Frequency MHz	dB Below Carrier_Reference
75.632	0
151.262	67V
453.786	60V
529.416	63V
605.048	64V
756.310	70V
Required: **56**+10Log(0.21) =	49

All other spurious from 8 - 757 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 10.2 volts. Frequency was measured with a HP 5385A digital frequency counter connected to the transmitter through a power attenuator. Measurements were made at 75.630 MHz. No transient keying effects were observed.

TABLE 2

FREQUENCY STABILITY vs. TEMPERATURE
75.630 MHz; 10.2 Vdc; 0.21 watt ERP(d)

Temperature, °C	Output Frequency, MHz	ppm
-29.9	75.630309	4.1
-20.1	75.630669	8.8
- 9.7	75.630918	12.1
0.2	75.630904	12.0
10.1	75.630735	9.7
20.3	75.630594	7.9
30.1	75.630504	6.7
40.5	75.629458	- 7.2
50.2	75.629369	- 8.3

Maximum frequency error: 75.630918
75.630000

+ .000918 MHz

Rule 95.623(c) specifies **0.002%** or a maximum of ±0.001513 MHz, which corresponds to:

High Limit	75.631513 MHz
Low Limit	75.628487 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 10.2 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
75.630 MHz; 10.2 Vdc; 0.21 watt

Supply Voltage	Output Frequency, MHz	ppm
11.73	75.630683	9.0
11.22	75.630631	8.3
10.71	75.630615	8.1
10.20	75.630594	7.9
9.69	75.630590	7.8
9.18	75.630604	8.0
8.67	75.630624	8.3
8.16*	75.630626	8.3

Maximum frequency error: 75.630683
75.630626

+ .000683 MHz

* Manufacturer's battery end point.

FCC Rule 95.623(c) specifies **0.002%** or a maximum of ±0.001513 MHz, corresponding to:

High Limit	75.631513 MHz
Low Limit	75.628487 MHz

APPENDIX 1

FUNCTIONS OF ACTIVE SEMICONDUCTORS/PARTS LIST

Reference	Type	Function
Q7	C1623	Buffer
Q8	C1623	Varicap Driver
Q9	C2223	XTAL Oscillator
Q10	C2223	Driver
Q11	C4910	Final RF Amplifier
IC1		CPU/Encoder

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

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

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
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APPENDIX 2

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION,

Final RF amplifier spurious emissions are attenuated by a matching network consisting of L2, C95, C96, T4, C98, C97, T5, C99, C100, and L3.