ENGINEERING STATEMENT

For Type Certification of

Hitec RCD, Inc.

Model: Eclipse
FCC ID: IFHHPF-M72

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 Eclipse 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: March 6, 2001

A. INTRODUCTION

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

The Eclipse is a low power, non-voice, transmitter intended for remote control of model aircraft in the 72 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: IFHHPF-M72

   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: 72.010 – 72.090 MHz.
   c. Operating power of transmitter is fixed at the factory at 0.170 Watt – ERP(d).
   d. Maximum power permitted under Paragraph 95.635(b) of the FCC Rules is 750 milliwatts, and the Eclipse fully complied with those power limitations.
   e. The dc voltage and dc currents at final amplifier:
      Collector voltage: 11.6 Vdc
      Collector current: 101 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 Eclipse 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) = 0.17 Watts.

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).

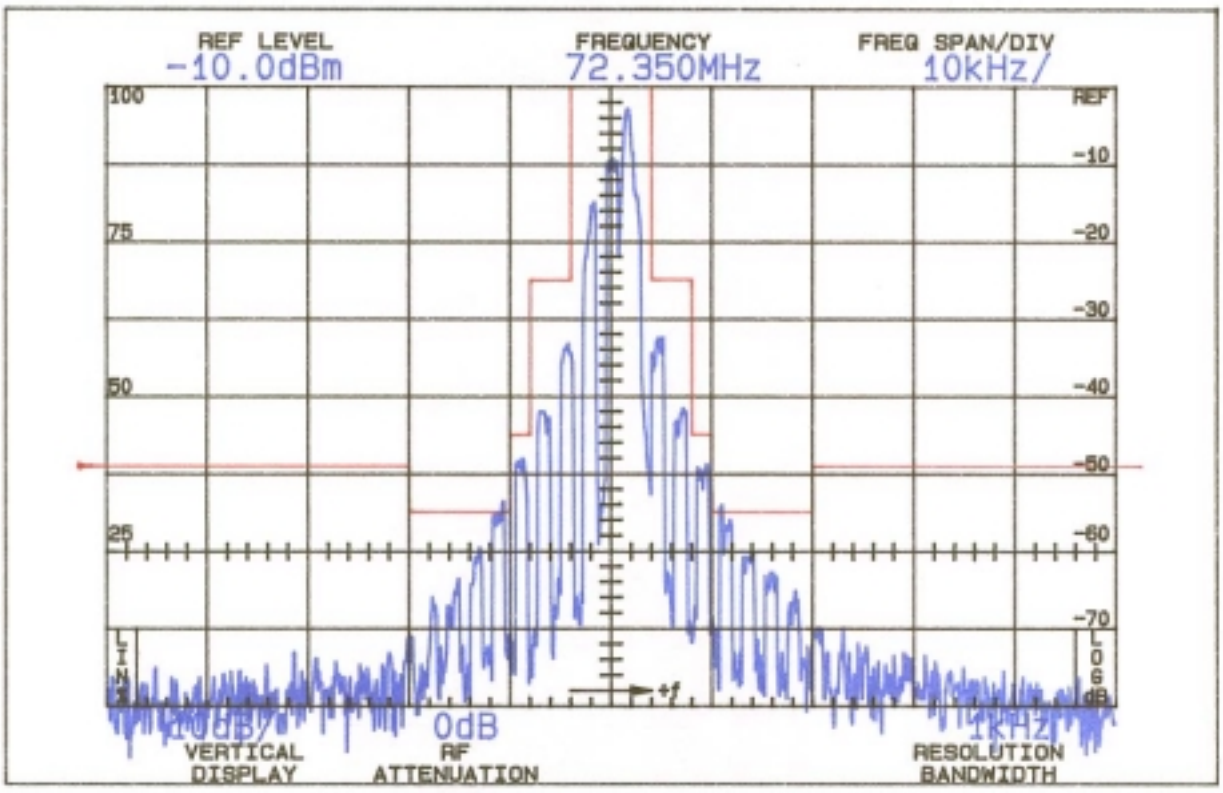
The horizontal scale (frequency) is **10** kHz per division and the vertical scale (Amplitude) is a logarithmic presentation equal to 10 dB per division.

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

Figure 2 is a plot from a Tektronix 494P spectrum analyzer with 2 mS/division sweep in the time domain of the modulated carrier. Modulation consisted of eight bursts with a nominal 0.8 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)

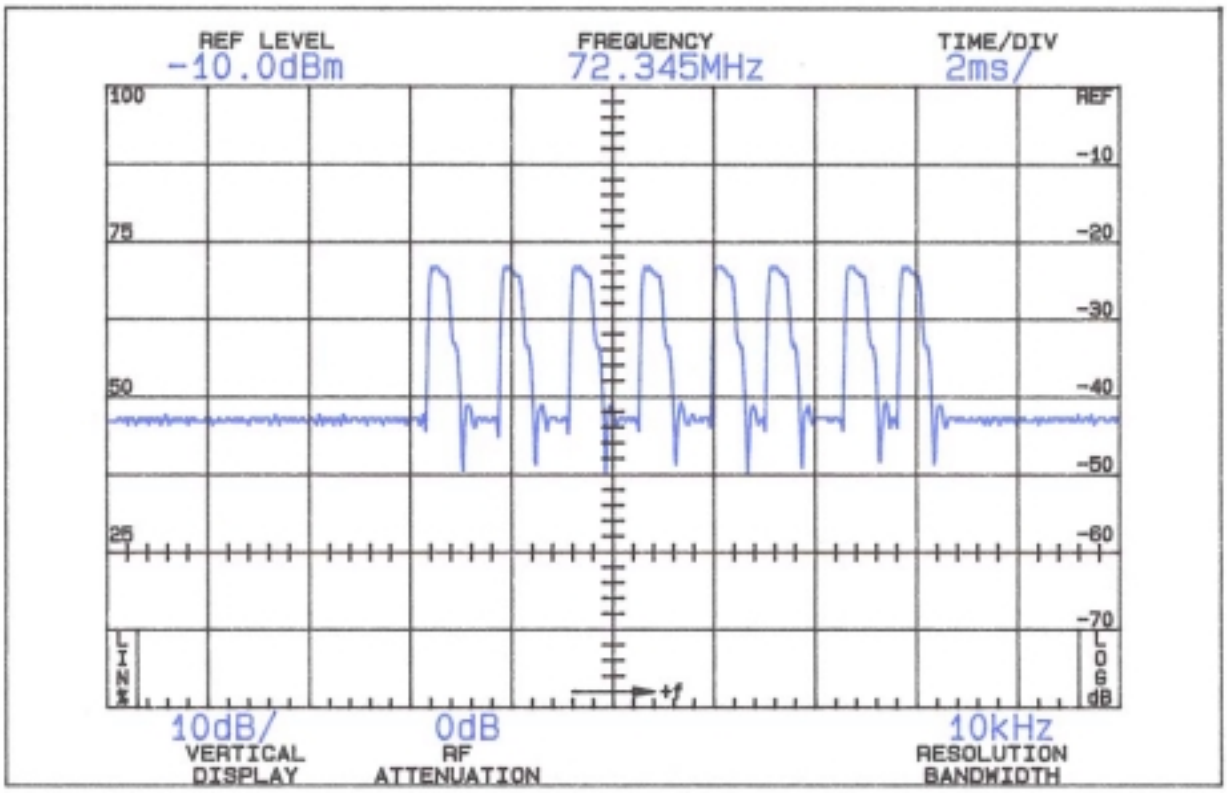
(12) At least $56+10 \log_{10}$ (TP) dB on any frequency removed from the center of the authorized bandwidth by more than 250%.

OCCUPIED BANDWIDTH
FCC ID: IFHHPF-M72

FIGURE 1

FIGURE 2

MODULATING WAVEFORM
TIME DOMAIN



2 millisecond/division sweep

OCCUPIED BANDWIDTH
(Modulating Waveform)
FCC ID: IFHHPF-M72

FIGURE 2

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

Since the Eclipse 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 Eclipse 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 fresh 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

72.35 MHz; 10.2 Vdc; 0.170 watt ERP

Emission Frequency MHz	dB Below Carrier Reference[1]
72.351	0
144.704	58
289.406	60
651.160	66
Required: **56**+10Log(0.170) =	48

All other spurious from 8 - 728 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 72.35 MHz. No transient keying effects were observed.

TABLE 2

FREQUENCY STABILITY vs. TEMPERATURE
72.35 MHz; 10.2 Vdc; 0.170 watt

Temperature, °C	Output Frequency, MHz	ppm
-29.2	72.350484	6.7
-19.5	72.350618	8.5
- 9.6	72.350586	8.1
0.5	72.350462	6.4
10.4	72.350269	3.7
20.0	72.350006	0.1
29.7	72.349711	-4.0
40.4	72.349488	-7.1
50.1	72.349392	-8.4

Maximum frequency error: 72.350618
72.350000

+ .000618 MHz

Rule 95.623(c) specifies **0.002%** or a maximum of ±0.001447 MHz, which corresponds to:

High Limit	72.351447 MHz
Low Limit	72.348553 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
72.35 MHz; 10.2 Vdc; 0.170 watt

Supply Voltage	Output Frequency, MHz	ppm
11.73	72.350050	0.7
11.22	72.350037	0.5
10.71	72.350019	0.3
10.20	72.350006	0.1
9.69	72.349993	-0.1
9.18	72.349978	-0.3
8.67	72.349969	-0.4
8.16*	72.349957	-0.6

Maximum frequency error: 72.350050
72.350000

\+ .000050 MHz

* Manufacturer's battery end point.

FCC Rule 95.623(c) specifies **0.002%** or a maximum of ±0.001447 MHz, corresponding to:

High Limit	72.351447 MHz
Low Limit	72.348553 MHz

APPENDIX 1

FUNCTIONS OF ACTIVE SEMICONDUCTORS

Main Board Parts List

ITEM	QTY	COMP. NAM	REF. DESIGNATOR	DESCRIPTION
1	1	CHIP IC	U4	LM324D
2	1	U-COM IC	U1	MSM65524
3	1	EPROM	U5	X25330
4	1	RESET IC	U3	MC34064P (TO-92)
5	1	CHIP IC	U6	GD4066BD
6	1	TTL IC	U7	74HC573 (DIP)
7	1	CHIP IC	U2	NJM7201U50 (TO-89)
8	2	CHIP CAP	C35 C36	CS1608COG300J500NR
9	1		C48	CS1608COG471J500NR
10	1		C55	CS1608X7R102K500NR
11	53		C1-C3 C6 CC8 C1 C12-C34 C37 C3 C42 C44-C46 C4 C54 C58 C60-C6 C65	CS1608X7R103K500NR
12	1		C11	CS2012X7R104K500NR
13	1	CHIP RES	R35	RC1/16W 1M
14	26		R2 R8 R9 R10-R1 R17 R19 R21 R3 R34 R42 R44-R4 R57 R62	RC1/16W 47K
15	13		R7 RR31 R32 R37 R40 RR51 R52 R54 R5 R60 R63	RC1/16W 4.7K
16	1		R61	RC1/16W 100K
17	1		R4	RC1/16W 30K
18	4		R16 R18 R20 R22	RC1/16W 68K
19	1		R5	RC1/16W 120K

Main Board Continued

ITEM	QTY	COMP. NAM	REF. DESIGNATOR	DESCRIPTION
20	2	CHIP RES	R50 R56	RC 1/16W 10K
21	5		R36 R28 R25 R2 R26	RC 1/16W 100
22	5		R1 R23 R24 R2 R30	RC 1/16W 1K
23	1		R3	RC 1/16W 47
24	1		R53	RC 1/16W 470
25	1		R6	RC 1/16W 1.5K
26	1		R64	RC 1/16W 820
27	1		J1	RC 1/16W 0
28	3	ELEC CAP	C5 C7 C59	100µF 16V (SRA)
29	1		C9	220µF 6.3V (SRA)
30	2	CHIP TANTAL	C56 C4	ECSTICY 106K (10µF)
31	1	CRYSTAL	XTAL	8MHZ (49/S)
32	1	PIEZO	PIEZO	CB13PA-X5
33	1	CHIP TR	Q4	C3900
34	3		Q8 Q7 Q6	C1623
35	1		Q5	C3900
36	2		Q1 Q2	R1103
37	1		Q3	A812
38	1	TR	Q9	A928
39	1	CHIP DIOD	D2	RLS4148
40	1	DIODE	D1	IN4003
41	1	SEMI VR	VR1	PT-6KV 502 (5KB)
42	2	VR	VR6 VR7	18SN C4110SK B10K
43	4	GIMBAL VR	VR2-VR5	TR133N10.3F693Z 5K 1253
44	1	DC JACK	DC-JACK	DCP-20

Main Board Continued

ITEM	QTY	COMP. NAM	REF. DESIGNATO	DESCRIPTION
45	1	CHIP ZD	ZD1	RLZ5.1V
46	1	TOGGLE SW		MS-550CF
47	3			MS550AF
48	2			MS550AL
49	1			MS550BL
50	1	PIN ARRY		DH254D-115-32P
51	2			DH254D-115-6P
52	4	SHUNT		SHUNT
53	1	PCB		ECLM01
54	7	WAFER		8283-2P
55	8			8283-3P
56	2			8283-4P
57	2			8283-5P
58	2	WAFER		8283-8P
LCD BOARD				
59	1	CHIP IC	U9	UPD7225G
60	1	LCD	LCD1	KXN35190DEP
61	1	CHIP RES	R65	RC 1/16W 120K
62	1		R66	RC 1/16W 390
63	3		R67 R68 R69	RC 1/16W 10K
64	18		J1 - J18	RC 1/16W 0
65	2	CHIP CAP	C74 C75	CS1608X7R103K500NR
66	7		C67-C73	CS1608X7R102K500NR
67	1	WAFER		8283-8P ANGLE
68	2	PCB		ECL-L01
ANTENNA BOARD				
69	1	PIN	P1	PH01-1905A (GOLD)

Main Board Continued

ITEM	QTY	COMP. NAM	REF. DESIGNATO	DESCRIPTION
70	1	WAFER	WF1	8283-5P ANGLE
71	1	WAFER	WF2	8263-2P ANGLE
72	1	BRACKET	JACK 1	
73	1	ANT		HT-4N
74	1	PCB		ECL-A01
POWER BOARD				
75	1	SWITCH	SW1	KSK2202
ROM BOARD				
76	1	SND IC	U8	SST39VF512-904CNH (QFP)
77	1	SOCKET		DSAD25432P
78	1	PCB		ECL-ROM
SWITCH MATERIAL				
79	9	TACT SW	T SW1-SW9	DPT-1105
80	1	WAFER		8283-8P ANGLE
81	1	PCB		ECLSW01
TRAINER JACK				

82	1	TRAIN JAC	T-JACK	D6733A11
83	1	WAFER		8283-5P ANGLE
84	1	PCB		ECL-TR01
TRIM LEFT				
85	4	TACT SW	SW1-SW4	DPT1105
86	1	PCB		ECL-TL01
TRIM RIGHT				
87	4	TACT SW	SW1-SW4	DPT-1105
88	1	PCB		ECL-TR01

72MHz Band Module Parts List

ITEM	QTY	COMP. NAM	REF. DESIGNATOR	DESCRIPTION
1		CHIP TR	Q1 Q2	2SC1623
2			Q3 Q4	2SC2223
3		DIP TR	Q5	2SC4910
4		RFT COIL	T1	HDR01S
5			T2	HDR01S
6			T3	HDR05S
7			T4 T5	HDR04S
8		SEMI VR	VR1	RVM637AO B200
9			VR2	RVM637AO B2K
10		CHIP DIOD	D1	MA152K
11		CHIP ZD	D2	5.1V
12		V-DIODE	VD1	BB535G
13		CHIP COIL	L1	LK2125 1R2K
14		INDUCTOR	L3	HDQ02 10µH
15		THERMISTO	R12	LNSV20G332JE
16		CHIP RES	R1	18K
17			R11	2.2K
18			R2 R14	470
19			R7	150
20			R8 R17	820
21			R22	270
22			R3	12K
23			R4 R6 R19	1.2K
24			R5 R25 R26 R28	0
25			R9	2.7K
26			R15	10K

ITEM	QTY	COMP. NAM	REF. DESIGNATOR	DESCRIPTION
27		CHIP RES	R13	8.2K
28			R10	22
29			R16	220K
30			R18	4.7K
31			R20	100
32			R27	330
33			R24 R23	4.7

34		CHIP CAP	C9 C26 C2 C6 C1 C19 C24 C13 C2 C8 C25	CS2012 103
35			C1 C7	CS2012 102
36			C4	CS2012 470P
37			C11 C12	CS2012 68P
38			C17	CS2012 0.5P
39			C34	CS2012 10P
40			C14 C18	CS2012 5P
41			C37	CS2012 30P
42			C23	CS2012 47P
43			C20	CS2012 56P
44			C27	CS2012 75P
45			C29	CS2012 22P
46			C31	CS2012 27P
47			C30	CS2012 120P
48			C32	CS2012 36P
49		MYLAR CAP	C3	103J
50		XTAL	X-1	72MHZ BAND
51		HOUSING		5124-05
52		PCB		RFM-I72

FUNCTION OF ACTIVE
SEMICONDUCTORS
FCC ID: IFHHPF-M72

APPENDIX 1

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
FCC ID: IFHHPF-M72

APPENDIX 2

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION,

Final RF amplifier spurious emissions are attenuated by a matching network consisting of L3, C27, C28, C29, T4, C30, T5, C31, C32 and C37.

CIRCUITS TO SUPPRESS SPURIOUS RADIATION, LIMIT MODULATION AND CONTROL POWER
FCC ID: IFHHPF-M72

APPENDIX 3