Eclipse Series
T70/T150 Transmitter
Operation and Maintenance

RF TECHNOLOGY PTD. LTD.
FCC ID: KRET70A
JOB #: 182U0
EXHIBIT #: 7A

CONTENTS

	Page
Operating Instructions	5
Internal Jumper Options	7
I/O Connections	8
Programming	9
Circuit Description	10
Alignment Procedures	15
Specifications	18
Appendix A - Parts List	24
Block Diagram	30
Schematic Diagrams	
Exciter	31
66 - 88 MHz Power Amplifier	32
136 -174 Mhz Power Amplifier	33
Board Layout	
Exciter	34
66 - 88 MHz Power Amplifier	35
136 -174 Mhz Power Amplifier	36

Operating Instructions

Front Panel Controls and Indicators

PTT -

The PTT button is used to key the transmitter during system test and adjustment. Audio from the line input is automaticaly disabled so that an unmodulated carrier with subaudible tone is transmitted.

LINE -

The LINE trimpot is used to set the line and direct audio input level. It is normally set to give 60% of system deviation with 0 dBm (775 mV) input at 1 KHz. The level can be measured between test socket pins 6 & 1 and adjusted for inputs of -30 to +10 dBm.

An internal jumper provides a coarse adjustment step of 20 dB. This, in conjunction with the trimpot, allows the level to be accurately set over a wide range.

PWR LED -

The PWR LED shows that the dc supply is connected to the transmitter.

TX LED -

The TX LED indicates that the transmitter is being keyed, the synthesizer is locked and the output amplifier is enabled.

ALARM LED -

The ALARM LED can indicate the detection of several different fault conditions by the self test circuits. The alarm indicator shows the highest priority fault present.

For transmitters using software issue number 5 and higher the alarm condition is indicated by the cadence of the LED flash.

LED Cadence	Fault Condition
Flash 5 times, pause	Synthesizer unlocked
Flash 4 times, pause	Tuning voltage range
Flash 3 times, pause	Low forward power
Flash 2 times, pause	High reverse power
Flash 1 times, pause	Low dc supply voltage
LED ON continuously	Transmitter timed out

For transmitters using issue number 4 or lower the alarm condition is indicated by the flash rate.

LED Indication	Fault Condition
Flashing, 8 per second	Synthesizer unlocked
Flashing, 4 per second	Tuning voltage range
Flashing, 2 per second	Low forward power
Flashing, 1 per second	High reverse power
Continuous	dc supply voltage low or high

ALC LED -

The ALC LED indicates that the transmitter output power is being controlled by an external amplifier through the external ALC input.

REF LED -

The REF LED indicates that the synthesizer frequency reference is locked to an external reference.

TEST MIC.

The TEST MIC. DIN socket is provided for use with a standard mobile or handset 200 Ohm dynamic microphone. The external audio inputs are disabled when the TEST MIC.'s PTT is on.

Transmitter Internal Jumper Options

JP2 - EPROM Type

	Position
27C256	2-3 *
27C64	1-2

JP3 - 600 Ohm Line dc Loop PTT Input

	Position
dc Loop Connected	1-2 *
dc Loop Not Connected	2-3

JP4 - Audio Input Source Selection

	Position
600 Ohm Line Input	2-3 *
Hi-Z Balanced Input	1-2

JP6 - Input Level Attenuation

	Position
0 dB	2-3 *
20 dB	1-2

JP7 - Audio Frequency Response

	Position
750 uSec. Pre-emphasis	1-2 *
Flat Response	2-3

JP8 - Subaudible Tone Source

	Position
Internal CTCSS	2-3 5-6 *
External Input	1-2 4-5

JP9, JP10, JP11 dc Loop PTT Input Configuration (JP3 1-2)

	JP9	JP10	JP11
Current Loop Input	ON	OFF	OFF *
+12 Vdc Loop Source	OFF	ON	ON

* = Standard Ex-Factory Configuration

RF TECHNOLOGY PTD. LTD.
FCC ID: KRET70A
JOB #: 182U0
EXHIBIT #: 7E

T70/T150 Transmitter I/O Connections

25 Pin Connector

Function/Signal		Pins	Specification
dc Power +12 Vdc		1,14	+11.4 to 16 Vdc
-12 Vdc		13,25	
Channel Selection	1	21	BCD Code
	2	9	0 = Open Circuit
	4	22	or 0 Vdc
	8	10	
	10	23	1 = +5 to +16 Vdc
	20	11	
	40	24	
	80	12	
RS232 Serial Data	Input	15	Test & Programming
	Output	2	9600, 8 data 2 stop bits
600 Ohm Line	High	20	Transformer Isolated
	Low	6	Balanced 0 dBm Input
150 Ohm/Hybrid Connections		7,19	
Direct PTT Input		3	Switch to ground to key the transmitter
T/R Relay Driver Output		16	Open collector switch, 250mA, 30V
Hi-Z Audio Input	+	4	High impedance AC coupled direct input
	-	17	
Sub-Audible Tone Input	+	5	1 - 250 Hz Input
	-	18	
External ALC Input		8	ALC input for Power amplifiers.Decreases from 7V with increasing power

RF TECHNOLOGY PTD. LTD.
FCC ID: KRET70A
JOB #: 182U0
EXHIBIT #: 7F

Channel and Tone Frequency Programming

Channel and tone frequency programming is most easily acomplished with R.F.Technology TecHelp software. This software can be run on any IBM compatible PC and provides a number of additional useful facillities.

TecHelp provides a simple means of calibrating the forward and reverse power detectors and alarms.

TecHelp can be supplied by your dealer, distributor or by contacting R.F. Technology direct.

Circuit Description

The following descriptions should be read as an aid to understanding the block and schematic diagrams at the rear of this manual.

VCO Section -

The Voltage Controlled Oscillator uses a junction FET Q19 which oscillates at the required transmitter output frequency. Varactor diodes D25 and D26 are used by the PLL circuit to keep the oscillator on the desired frequency. Transistor Q20 is used as an active filter to reduce the noise on the oscillator supply voltage.

The VCO is keyed ON by the microcontroller through Q10. It is keyed ON when any of the PTT inputs are active and OFF at all other times.

The VCO output is amplified and buffered by monolythic amplifiers MA2 and MA3 before being fed to the PLL IC U6.

Amplifiers MA1, MA4 and MA5 increase the VCO output to approximately 10 mW to drive the power amplifier. MA1 is not switched on until the PLL has locked and had time to settle. This prevents any momentary off channel transmission when the transmitter is keyed.

PLL Section -

The frequency reference for the synthesizer is a crystal oscillator using transistors Q26 and Q27 and crystal Y3. The temperature stability is better than 5 ppm and it can be synchronized to an external reference for improved stability. External reference option board 11/9119 is required when using an external reference.

A positive temperature coefficient thermistor, XH1, is used in versions intended for operation down to -30 degrees Celsius. The thermistor heats the crystal's case to maintain its temperature above -10 degrees thus extending the oscillator stability of 5 ppm down to -30 degrees ambient.

Varactor diodes D27-30 are used to frequency modulate the oscillator. The processed transmit audio signal from U7b varies the diodes bias voltage to modulate the reference frequency. This extends the modulation capability down to a few Hz for sub-audible tones and digital squelch codes. A two point modulation scheme is used with the audio also being fed to the VCO to modulate the higher audio frequencies.

The the 12.8 MHz output of Q27 is amplified by Q28and Q29 to drive the reference input of the PLL synthesizer IC U6. This IC is a single chip synthesizer which includes a 1.1 GHz pre-scaler, programmable divider, reference divider and phase/frequency detector. The frequency data for U6 is supplied through serial data link by the microprocessor.

The phase detector output signals of U6 are used to control two switched current sources. The output of the positive and negative sources' Q3 and Q6, produce the tuning voltage which is smoothed by the loop filter components to bias the V.C.O. varactor diode D3.

Power Amplifier -

The 10 mW output from the main board connects to the power amplifier board through a short miniature 50 Ohm coaxial cable.

Q2 on the power amplifier board increases the signal to approximately 200 mW. The bias current of Q2 is controlled by Q1 and the power leveling circuitry to adjust the drive to the output module U2.

U2 increases the power to 30 watts before it is fed to the directional coupler, low pass filter and output connector. The directional coupler detects the forward and reverse power components and provides proportional dc voltages which are amplified by U1a and U1b.

The forward and reverse voltages from U1a and U1b are compared to the DC reference voltage from RV1. The difference is amplified by U1c, Q3 and Q4. The resulting control voltage supplies Q2 through R10, R12 and completes the power leveling control loop.

Temperature Protection -

Thermistor RT1 on the power amplifier board is used to sense the case temperature of the output module U2. If the case temperature rises above 90 degrees C., the voltage across RT1 will increase and transistor Q5 will be turned on. This reduces the dc reference voltage to the power regulator which inturn reduces the outpower by 6-10 dB.

600 Ohm Line Input -

The 600 Ohm balanced line input connects to line isolation transformer T1. T1 has two 150 Ohm primary windings which are normally connected in series for 600 Ohm lines. The dual primary windings can be used to privide DC loop PTT signalling or a 2/4 wire hybrid connection. All four leads are available at the rear panel system connector.

The secondary of T1 can be terminated with an internal 600 Ohm load through JP5 or left unterminated in high impedance applications.

Direct Coupled Audio Input -

A high impedance (10k) direct AC coupled input is available at the system connector. The direct coupled input connects to U9a which is configured as a unity gain bridge amplifier.

The bridge configuration allows audio signal inversion by interchanging the positive and negative inputs and minimizes ground loop problems. Both inputs should be connected, with one lead going to the source output pin and the other connected to the source audio ground.

Local Microphone Input -

The local microphone input is provided for use with a standard low impedance dynamic microphone. The microphone output is amplified by U9a before connecting to analog switch U10a. U10b inverts the local microphone PTT input to switch U10a ON when the microphone PTT button is pressed. U10a is OFF at all other times.

The local microphone audio has priority over the other inputs. Activation of the local microphone PTT input switches OFF the audio from the line or direct inputs through D16 and U10c.

CTCSS and Tone Filter -

The CTCSS encoder module H1 is a microcontroller based hybrid module. Under control of the main microprocessor U13 it can encode all 38 E.I.A. tones and 12 additional commonly used tones.

The tone output of H1 connects to jumper JP8 which is used to select either H1 or an external tone source. The selected source is coupled to U9c which is a balanced input unity gain amplifier. The buffered tone from U9c is fed to 300 Hz low pass filter U7c. RV3, the tone deviation trimmer, is used to adjust the level of the tone from U7c before it is combined with the voice audio signal in the summing amplifier U7a.

Back to back diodes D4 and D5 limit the maximum tone signal amplitude to prevent excessive tone deviation when external tone sources are used.

Audio Signal Processing -

Jumper JP4 selects either the line or direct input source. The selected source is then connected to JP6. JP6 can be removed to provide 20 dB attenuation when the input level is above 10 dBm to expand the useful range of the line level trimmer RV4.
The wiper of RV4 is coupled to the input of the input amplifier U9d. U9d provides a votlage gain of ten before connecting to the input of analog switch U10c.

The outputs of U10a and U10c are connected to the frequency response shaping networks C52, R133 (750 uSec. pre-emphasis) and C61,R55 (flat). JP7 selects the pre-emphasised or flat response.

The audio signal is further amplified 100 times by U7d. U7d also provides the symetrical clipping required to limit the maximum deviation. The output level from U7d is adjusted by RV1, the deviation adjustment, before being combined with the tone audio signal in the summing amplifier U7a.

The composite audio from U7a is fed through the 3Khz low pass filter U7b. The filtered audio is coupled to the TCXO voltage tuning input and the modulation balance trimmer RV2.

RV2 adjusts level of the audio used to modulate the VCO. This primarily effects the deviation of audio frequencies above 500 Hz. RV2 is used to balance the high and low frequency deviation to obtain an flat frequency response relative to the desired characteristic.

PTT and DC Remote Control -

Two main PTT inputs are provided. The first, a direct logic level input, is connected to pin 3 of the system connector. The transmitter can be keyed by applying a logic low or ground on pin 3. Pin 3 connects to the PTT logic and microprocessor through D10.

DC current loop control can be used for remote PTT operation. The current loop can be configured by JP9, JP10 and JP11 for use with either a remote free switch or a remote switched source.

Opto-isolator ISO1 is used to isolate the loop current signal from the transmitter PTT logic. The loop current passes through the input of ISO1 and the output of ISO1 connects to the PTT logic.

A bridge consisting of diodes D6, D8, D9 and D14 ensures correct operation regardless of the current polarity. Q17 limits the current and D7 limits the voltage input to ISO1.

Any low voltage current source capable of providing 2 mA at 4 V or switching circuit with less than 4.8k Ohms loop resistance can be used to switch the DC loop.

The test PTT button on the front panel and the local microphone PTT button will also key the transmitter. Both of these also mute the line audio input.

Microprocessor Controller -

The microprocessor controller circuit uses an advanced eight bit processor and several support chips. The processor U13 includes non-volitile EE memory for channel frequencies, tones, and other information. It also has an asynchronous serial port, a synchronous serial port and an eight bit analog to digital converter.

The program is stored in U5, a CMOS EPROM. U4 is an address latch for the low order address bits. U2 is used to read the channel select lines onto the data bus. U11 is an address decoder for U5 and U2. U3 is a supervisory chip which keeps the processor reset unless the +5 Volt supply is within operating limits. U1 translates the asynchronous serial port data to standard RS232 levels.

The analog to digital converter is used to measure the forward and reverse power, tuning voltage and dc supply voltage.

The processor keys the VCO through Q10, switches the 9.2 Volt transmit line through Q14 and Q16, and the alarm LED D1 through Q1.

Voltage Regulator -

The dc input voltage is regulated down to 9.4 Vdc by a discrete regulator circuit. The series pass transistor Q23 is driven by error amplifiers Q8 and Q18. Q9 is used to start up the regulator and once the circuit turns on, it plays no further part in the operation.

This circuit is short circuit and overload proof by virtue of the component current and power ratings. The maximum current and dissipation rating of the pass transistor can not be exceeded under any load condition.

The descrete component circuit provides much better line isolation and lower dropout voltage than can be obtained with current integrated circuit regulators.

The +5 Volt supply for the logic circuits is provided by an integrated circuit regulator U14 which is run off of the regulated 9.4 Volt supply.

RF TECHNOLOGY PTD. LTD.
FCC ID: KRET70A
JOB #: 182U0
EXHIBIT #: 7L