Eclipse Series

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T220 Transmitter

Operation and Maintenance Manual

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Contents

WARNING

Changes or modifications not expressly approved by RF Technology could void your authority to operate this equipment. Specifications may vary from those given in this document in accordance with requirements of local authorities. RF Technology equipment is subject to continual improvement and RF Technology reserves the right to change performance and specification without further notice.

1 Operating Instructions

1.1 Front Panel Controls and Indicators

1.1.1 PTT

A front-panel push-to-talk (PTT) button is provided to facilitate bench and field tests and adjustments. The button is a momentary action type. When keyed, audio from the line input is disabled so that a carrier with subtone is transmitted. The front-panel microphone input is not enabled in this mode, but it is enabled when the PTT line on that socket is pulled to ground.

1.1.2 Line

The LINE trimpot is accessible by means of a small screwdriver from the front panel of the module. It is used to set the correct sensitivity of the line and direct audio inputs. It is factory preset to give 60% of rated deviation with an input of 0dBm (1mW on 600Ω equivalent to 775mV RMS or about 2.2V peak-to-peak) at 1kHz. The nominal 60% deviation level may be adjusted by measuring between pins 6 and 1 on the test socket, and adjusting the pot. By this means an input sensitivity from approximately -30dBm to +10dBm may be established.

An internal jumper provides a coarse adjustment step of 20dB. Between the jumper and the trimpot, a wide range of input levels may be accommodated.

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

Table 1: Interpretations of LED flash cadence

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

Table 2: Interpretations of LED flash speed, for early models

1.1.3 PWR LED

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

1.1.4 TX LED

The TX LED illuminates when the transmitter is keyed. It will not illuminate (and an ALARM cadence will be shown) if the synthesizer becomes unlocked, or the output amplifier supply is interrupted by the microprocessor.

1.1.5 ALARM LED

The ALARM LED can indicate several fault conditions if they are detected by the self test program. The alarm indicator shows the highest priority fault present. Receivers using software issue 5 and higher use the cadence of the LED flash sequence to indicate the alarm condition. Refer to table 1. Receivers using software issue 4 and lower use the LED flash rate to indicate the alarm condition. Refer to table 2.

2 Transmitter Internal Jumper Options

In the following subsections an asterisk (*) signifies the standard (Ex-Factory) configuration of a jumper.

2.1 JP2: EPROM Type

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

2.2 JP3: Dc Loop PTT

This jumper enables or disables the keying of the PTT function by means of a dc signal passed down the 600Ω line input pair. When enabled, JP9-JP11 control how the dc signal is configured with respect to an internal optocoupler.

Condition	Position
dc loop connected (enabled)	1-2 *
dc loop not connected (bypassed)	2-3

2.3 JP4: Audio Input Source

Either the 600Ω or the high-Z balanced inputs may be selected.

Condition	Position
600Ω Input	2-3 *
High-impedance Input	1-2

2.4 JP6: Input Level Attenuation

This jumper permits coarse input sensitivity to be set.

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

2.5 JP7: Audio Response

Condition	**Position**
750 uSec. pre-emphasis	1-2 *
Flat response	2-3

2.6 JP8: Sub-audible Tone Source

Condition	Position
Internal CTCSS	1-2, 4-5 *
External input	2-3, 5-6

2.7 JP9/10/11: dc Loop Configuration

These settings are only relevant when the PTT signal is to be used across the same wires as the audio. Refer to setting of JP3. They control the levels and connection into the audio balanced line circuitry.

Condition	JP9	JP10	JP11
Current Loop Input	ON	OFF	OFF *
12Vd Loop source	OFF	ON	ON

3 Transmitter I/O Connections

3.1 25 Pin Connector

The D-shell 25 pin connector is the main interface to the transmitter. The pin connections are described in table 3.

4. Channel and Tone Frequency Programming

Channel and tone frequency programming is most easily accomplished with RF Technology TecHelp software. This software can be run on an IBM compatible PC and provides a number of additional useful facilities. DOS and 32-bit versions are available.
TecHelp allows setting of the adaptive noise squelch threshold, provides a simple means of calibrating the forward and reverse power detectors, setting the power alarm preset levels, and enabling transmitter hang time and timeout time limits.

TecHelp can be supplied by your dealer, distributor or by contacting RF Technology directly.

Function	Signal	Pins	Specification
dc power	+12 Vdc -12 Vdc	1, 14 13, 25	+11.4 to 16 Vdc
Channel Select	1 2 4 8 10 20 40 80	21 9 22 10 23 11 24 12	BCD Coded 0 = Open Circuit or 0 Vdc 1 = +5 to +16 Vdc
RS232 Data	In Out	15 2	Test and Programming use 9600, 8 data 2 stop bits
600Ω Line	High Low	20 6	Transformer Isolated Balanced 0dBm Output
150Ω / Hybrid		7 19	
Direct PTT input		3	Ground to key PTT
T/R Relay driver output		16	Open collector, 250m /30V
Sub-Audible Tone Input	+	5	>10kΩ, AC coupled
		18	(1-250Hz)
High-Z Audio Input	+	4	>10kΩ, AC coupled
	-	17	(10Hz-3kHz)
External ALC input		8	<0.5V/1mA to obtain >30dB attenuation, O/C for maximum power

Table 3: Pin connections and explanations for the main 25-pin, D connector.

5 Circuit Description

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

5.1 VCO Section

The Voltage Controlled Oscillator uses a junction FET which oscillates at the required transmitter output frequency. A varactor diode is 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 monolithic amplifiers MA2 and MA3 before being fed to the PLL IC U6.

Amplifiers MA1, MA4 and MA5 increase the VCO output to approximately 4 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.

5.2 PLL Section

Temperature compensated crystal oscillator XO1 is the frequency reference source for the PLL Synthesizer. The frequency stability of XO1 is better than 1 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.

XO1 is frequency modulated by the processed transmit audio signal from U7b. 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 12.8~MHz output of XO1 is amplified by Q22 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) produces the tuning voltage which is smoothed by the loop filter components to bias the VCO varactor diode D3.

5.3 Power Amplifier

The 4 mW output from the main board connects to the power amplifier board through a short miniature 50Ω 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 levelling circuitry to adjust the drive to the output module U2.

U2 increases the power to 10--30 watts (depending upon options) 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.

5.4 600ΩLine Input

The 600Ω balanced line input connects to line isolation transformer T1. T1 has two 150Ω primary windings which are normally connected in series for 600Ω 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 600Ω load through JP5 or left unterminated in high impedance applications.

5.5 Direct Coupled Audio Input

A high impedance (10kΩ) 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.

5.6 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.

5.7 CTCSS and Tone Filter

The CTCSS encoder module H1, under control of the main microprocessor U13, can encode all 38 E.I.A.\ tones and (on some models) 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.

5.8 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 (for 750μs pre-emphasis) and C61, R55 (for flat response). 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 a flat frequency response relative to the desired characteristic.

5.9 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 4.8kΩ 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. The microphone line also enables that audio input.

5.10 Microprocessor Controller

The microprocessor controller circuit uses an single-chip eight bit processor and several support chips. The processor U13 includes non-volatile 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.

5.11 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.

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

6 Field Alignment Procedure

The procedures given below may be used to align the transmitter in the field. Normally, alignment is only required when changing operating frequencies, or after component replacement.

The procedures below do not constitute an exhaustive test or a complete alignment of the module, but if successfully carried out are adequate in most circumstances.

TCXO calibration may be periodically required owing to normal quartz crystal aging. A drift of 1ppm/year is to be expected.

Each alignment phase assumes that the preceding phase has been successfully carried out, or at least that the module is already in properly aligned state with respect to preceding conditions.

6.1 Standard Test Condition

The following equipment and conditions are assumed unless stated otherwise:

- AF signal generator with 600Ω impedance, 150--3000Hz frequency range, with level set to 387mV RMS.
- Power supply set to 13.8Vdc, with a current capability of >5A.
- RF 50Ω load, 30W rated, return loss <-20dB.
- Jumpers set to factory default positions.

6.2 VCO Alignment

1. Select a channel at the centre frequency (half way between the highest and lowest frequencies for the model in question).
2. Disconnect the Audio input (no signal input).
3. Key the PTT line.
4. Measure the voltage between pins 9 and 1 of the test socket (TUNEV), and adjust C99 to obtain 4.5±0.2V, while the TX LED is ON and the ALARM LED is OFF.

6.3 TCXO Calibration

1. Select a channel at the centre frequency (half way between the highest and lowest frequencies for the model in question).
2. Disconnect the Audio input (no signal input).
3. Key the PTT line.

4 Measure the carrier frequency at the output connector, and adjust XO1 until the correct carrier frequency is measured, ±50Hz.

6.4 Modulation Balance

1. Set RV3 fully CCW (subtone off).
2. Set RV1 fully CW (maximum deviation)
3. Set RV2 mid-position
4. Set JP7 for flat response
5. Key the transmitter on
6. Set the audio input to 150Hz, 0dBm.
7. Measure deviation and adjust RV4 (line Level) for a deviation of 5kHz (2.5kHz for narrow band transmitters).
8. Set the audio input to 1.5kHz, 0dBm.
9. Adjust RV2 (Mod. Bal.) for a deviation of 5kHz (2.5kHz for narrow band transmitters).
10. Repeat steps 6-9 until balance is achieved.
11. Key the transmitter off.
12. Return JP7 to its correct setting.
13. Carry out the Deviation (section 6.6) and Tone Deviation (section 6.5) alignment procedures.

6.5 Tone Deviation

1. Remove the audio input.
2. Key the transmitter on.

3. Adjust RV3 for the desired deviation in the range 0-1kHz.[1] If subtone (CTCSS) coding is not to be used, adjust RV3 fully CCW.

[1] The factory default is 500Hz for wide band (5kHz maximum deviation) and 250Hz for narrow band channels.

6.6 Deviation

1. Set RV4 (Line Level) fully clockwise (CW).

2. Set the audio to 1kHz, 0dBm, on the line input.

3. Key the transmitter on..

4. Adjust RV1 (Set Max. Deviation) for a deviation of 2.5kHz.

5. Key the transmitter off.

6. Carry out the Line Input Level alignment procedure (section 6.7)

6.7 Line Input Level

1. Set the audio to 1kHz, 0dBm, on the line input, or use the actual signal to be transmitted.

2. Key the transmitter on.

3. Adjust RV4 (line level) for 60% of system deviation (1.5kHz)

4. If the test signal is varying, RV4 may be adjusted to produce a level of 234mV RMS or 660m$V_{p\text{-}p}$ at the audio voltage test connector pin 6 to pin 1.

5. Key the transmitter off.

6.8 Output Power

1. No audio input is required

2. Key the transmitter on.

3. Adjust RV1 on the power amplifier PCB for the desired power level *at the output connector*. [2]

4. Key the transmitter off.

---

2 Be sure to set the power below the rated maximum for the model of transmitter. If in doubt, allow 1.0dB cable and connector losses, and assume that the maximum rated power is 30W. This means no more than 24W at the end of a 1m length of test cable. This pessimistic procedure is safe on all models manufactured at the time of writing.

7 SPECIFICATIONS

7.1 Overall Description

The transmitter is a frequency synthesized, narrow band FM unit, normally used to drive a 100 watt amplifier. It can also be used alone in lower power applications from 2 to 25W. All necessary control and 600 ohm line interface circuitry is included.

7.1.1 Channel Capacity

Although most applications are single channel, it can be programmed for up to 100 channels, numbered 0--99. This is to provide the capability of programming all channels into all of the transmitters used at a given site. Where this facility is used in conjunction with channel-setting in the rack, exciter modules may be ``hot-jockeyed" or used interchangeably. This can be convenient in maintenance situations.

7.1.2 CTCSS

Full EIA subtone capability is built into the modules. The CTCSS tone can be programmed for each channel. This means that each channel number can represent a unique RF and tone frequency combination.

7.1.3 Channel Programming

The channel information is stored in non-volatile memory and can be programmed via the front panel test connector using a PC and RF Technology software.

7.1.4 Channel Selection

Channel selection is by eight channel select lines. These are available through the rear panel connector. Internal presetting is also possible. The default (open-circuit) state is to select channel 00.

A BCD active high code applied to the lines selects the required channel. This can be supplied by pre-wiring the rack connector so that each rack position is dedicated to a fixed channel. Alternatively, thumb-wheel switch panels are available.

7.1.5. Microprocessor

A microprocessor is used to control the synthesizer, tone squelch, PTT function and facilitate channel frequency programming. With the standard software, RF Technology modules also provide fault monitoring and reporting.

7.2 Physical Configuration

The transmitter is designed to fit in a 19 inch rack mounted sub-frame. The installed height is 4 RU (178 mm) and the depth is 350 mm. The transmitter is 63.5 mm or two Eclipse modules wide.

7.3 Front Panel Controls, Indicators, and Test Points

7.3.1 Controls

Transmitter Key - Momentary Contact Push Button

Line Input Level - screwdriver adjust multi-turn pot

7.3.2 Indicators

Power ON - Green LED

Tx Indicator - Yellow LED

Fault Indicator - Flashing Red LED

External ALC - Green LED

External Reference - Green LED

7.3.3 Test Points

Line Input - 6 + Ground (pin 1)

Forward Power - 8 + Ground (pin 1)

Reverse Power - 4 + Ground (pin 1)

Tuning Voltage - 9 + Ground (pin 1)

Serial Data (RS-232) - 2/3 + Ground (pin 1)

7.4 Electrical Specifications

7.4.1 Power Requirements

Operating Voltage - 10.5 to 16 Vdc with output power reduced below 12 Vdc

Current Drain - 5A Maximum, typically 0.25A Standby

Polarity - Negative Ground

7.4.2 Frequency Range and Channel Spacing

215 to 240 MHz
12.5KHz spacing

7.4.3 Frequency Synthesizer Step Size

Step size is 5 or 6.25kHz, fixed

7.4.4 Frequency Stability

±2.5 ppm over 0 to +60 C, standard

±1ppm over -20 to +60 C, optional

7.4.5 Number of Channels

100, numbered 00 - 99

7.4.6 Antenna Impedance

50Ω

7.4.7 Output power

Preset for 2-25 Watts

7.4.8 Transmit Duty Cycle

100% to 40C, derating to zero at 60C.
100% to 5000ft altitude, derating to zero at 15,000ft.

7.4.9 Spurious and Harmonics

Less than 0.25μW

7.4.10 Carrier and Modulation Attack Time

Less than 20ms. Certain models have RF envelope attack and decay times controlled in the range 200μs< $t_{r/f}$ <2ms according to regulatory requirements.

7.4.11 Modulation

Type - Two point direct FM with optional pre-emphasis

Frequency Response - ±1 dB of the selected characteristic from 300--3000~Hz

Maximum Deviation - Maximum deviation preset to 2.5 KHz

7.4.12 Distortion

Modulation distortion is less than 3% at 1 KHz and 60% of rated system deviation.

7.4.13 Residual Modulation and Noise

The residual modulation and noise in the range 300 - 3000 Hz is typically less than -50dB referenced to rated system deviation.

7.4.14 600Ω Line Input Sensitivity

Adjustable from -30 to +10 dBm for rated deviation

7.4.15HI-Z Input

Impedance - 10KΩ Nominal, balanced input

Input Level - 25mV to 1V RMS

7.4.16 Test Microphone Input

200Ω dynamic, with PTT

7.4.17 External Tone Input

Compatible with R220 tone output

7.4.18 External ALC Input

Output will be reduced 20dB by pulling the input down to below 1V. (Typically more than 40dB attenuation is available.) The input impedance is ≅10kΩ, internally pulled up to rail.

The external ALC input can be connected to the power control circuit in Eclipse external power amplifiers.

7.4.19 T/R Relay Driver

An open collector transistor output is provided to operate an antenna change over relay or solid state switch. The transistor can sink up to 250mA.

7.4.20 Channel Select Input/Output

Coding - 8 lines, BCD coded 00 - 99

Logic Input Levels - Low for <1.5V, High for >3.5V

Internal 10K pull down resistors select channel 00 when all inputs are O/C.

7.4.21 DC Remote Keying

An opto-coupler input is provided to enable dc loop keying over balanced lines or local connections. The circuit can be connected to operate through the 600Ω line or through a separate isolated pair.

7.4.22 Programmable No-Tone Period

A No-Tone period can be appended to the end of each transmission to aid in eliminating squelch tail noise which may be heard in mobiles with slow turn off decoders. The No-Tone period can be set from 0--5 seconds in 0.1 second increments. The No Tone period operates in addition to the reverse phase burst at the end of each transmission.[3]

7.4.23 Firmware Timers

The controller firmware includes some programmable timer functions.

Repeater Hang Time - A short delay or ``Hang Time" can be programmed to be added to the end of transmissions. This is usually used in talk through repeater applications to prevent the repeater from dropping out between mobile transmissions. The Hang Time can be individually set on each channel for 0 - 15 seconds.

Time Out Timer - A Time-Out or transmission time limit can be programmed to automatically turn the transmitter off. The time limit can be set from 0-254 minutes in increments of one minute. The timer is automatically reset when the PTT input is released.

7.4.24 CTCSS

CTCSS tones can be provided by an internal encoder or by an external source connected to the external tone input. The internal CTCSS encoding is provided by a subassembly PCB module. This provides programmable encoding of all EIA tones. Some models encode certain extra tones.

Tone frequencies are given in table 4.

7.5 Connectors

7.5.1 Antenna Connector

Type N Female Mounted on the module rear panel

[3] The reverse phase burst is usually sufficient to eliminate squelch tail noise in higher-quality mobiles.

Frequency	EIA Number
No Tone	
67.0	A1
69.4	
71.9	B1
74.4	C1
77.0	A2
79.7	C2
82.5	B2
85.4	C3
88.5	A3
91.5	C4
94.8	B3
97.4	
100.0	A4
103.5	B4
107.2	A5
110.9	B5
114.8	A6
118.8	B6
123.0	A7
127.3	B7
131.8	A8
136.5	B8
141.3	A9
146.2	B9
151.4	A10
156.7	B10
159.8	
162.2	A11
165.5	
167.9	B11
171.3	
173.8	A12
177.3	
179.9	B12
183.5	
186.2	A13
189.9	
192.8	B13
196.6	
199.5	
203.5	A14
206.5	
210.7	B14
218.1	A15
225.7	B15
229.1	
233.6	A16
241.8	B16
250.3	A17
254.1	

Table 4: Tone Squelch Frequencies

7.5.2 Power & I/O Connector

25-pin ``D'' Male Mounted on the rear panel

7.5.3 Test Connector

9-pin ``D'' Female mounted on the front panel

A Engineering Diagrams

Most Eclipse transmitter modules contain two PCBs, a motherboard with the control and signal generation circuitry (the exciter board), and an RF Power Amplifier board. Certain models are equipped with optional functions on piggyback PCBs atop the exciter motherboard. The exciter PCB typically has a few components whose values vary from model to model depending upon operating frequency and local regulatory constraints. The RF PA PCB varies from model to model but to a greater extent. At least two different PCB layouts, and numerous variations, exist. This manual presents the circuits and parts lists for two representative variants. When ordering spare parts be sure to specify the model exactly, in case the part you require is different in value from that specified in this manual.

Older models (predating this manual) may not be covered by this manual. However, advances are evolutionary, and the information in this manual will be sufficient in most cases to permit understanding and servicing of all models, past and present.

Versions of more detailed circuit schematics, printed on A3 paper, may be inserted or bound with this manual towards the end. It is sometimes easier to work with these fold-out diagrams because of their larger format. In case the inserts/fold-outs are missing or damaged, the reader is advised that information in the figures included with the text should be identical.

A.1 Block Diagram

Figure 1 shows the block signal flow diagram.

A.2 Circuit Diagrams

Figure 2 shows the detailed circuit diagram with component numbers and values for the main (exciter) PCB. Figure 3 shows the detailed circuit diagram with component numbers and values for the higher-power PA variation. Figure 4 shows the detailed circuit diagram with component numbers and values for the lower-power PA variation.

A.3 Component Overlay Diagrams

Figure 5 shows the PCB overlay guide with component positions for the main (exciter) PCB. Figure 6 shows the detailed circuit diagram with component numbers and values for the higher-power PA variation. Figure 7 shows the detailed circuit diagram with component numbers and values for the lower power PA variation.

APPENDIX B – T220 Parts List

Main PCB Assembly Parts

Ref.	Description	Part Number
C1	CAP 10U 35V RAD ELECTRO	41/2001/010U
C10	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C100	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C102	CAP 10N 10% 63V X7R 1206	46/3310/010N
C103	CAP 47N 20% 50V X7R RD.2	46/2001/047N
C104	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C105	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C106	CAP 100N 10% 63V X7R 1206	46/3310/100N
C107	CAP 47N 20% 50V X7R RD.2	46/2001/047N
C108	CAP 1UO 10% 63V MKT RAD.2	47/2007/01U0
C109	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C11	CAP 10U 35V RAD ELECTRO	41/2001/010U
C110	CAP 47P 2% 100V NPO RAD.1	45/2680/047P
C111	CAP 100N 10% 63V X7R 1206	46/3310/100N
C112	CAP 100U 25V RB ELECTRO	41/1025/100U
C113	CAP 1UO 10% 63V MKT RAD.2	47/2007/01U0
C114	CAP 1UO 10% 63V MKT RAD.2	47/2007/01U0
C115	CAP 100U 25V RB ELECTRO	41/1025/100U
C116	CAP 1UO 10% 63V MKT RAD.2	47/2007/01U0
C117	CAP 100U 25V RB ELECTRO	41/1025/100U
C118	CAP 10U 35V RAD ELECTRO	41/2001/010U
C119	CAP 10U 35V RAD ELECTRO	41/2001/010U
C12	CAP 47N 20% 50V X7R RD.2	46/2001/047N
C13	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C14	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C15	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C16	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C17	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C18	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C19	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C2	CAP 18P 2% 100V NPO RAD.1	45/2680/018P
C20	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C21	CAP 100N 10% 63V X7R 1206	46/3310/100N
C22		
C23	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C24	CAP 4P7 5% 63V NP0 SM1206	46/3300/04P7
C25	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C26	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C27	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C28	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C29	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C3	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C30	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C31	CAP 2U2 10% 100V MKT RD.2	47/2010/02U2
C32	CAP 10U 35V RAD ELECTRO	41/2001/010U
C33	CAP 1UO 10% 63V MKT RAD.2	47/2007/01U0
C34	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C35	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C36	CAP 10U 35V RAD ELECTRO	41/2001/010U
C37	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C38	CAP 10U 35V RAD ELECTRO	41/2001/010U

Ref.	Description	Part Number
C39	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C4	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C40	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C41	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C42	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C43	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C44	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C45	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C46	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C47	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C48	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C49	CAP 22N 5% 63V MKT RAD.2	47/2010/022N
C5	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C50	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C51	CAP 1N2 5% NPO RAD.2	46/2000/01N2
C52	CAP 1N5 10% 50V COG RAD.2	46/2000/01N5
C53	CAP 1U 35V RAD ELECTRO	41/2001/001U
C54	CAP 10U 35V RAD ELECTRO	41/2001/010U
C55	CAP 10N 10% 63V X7R SM1206	46/3310/010N
C56	CAP 1N2 5% NPO RAD.2	46/2000/01N2
C57	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C58	CAP 22N 5% 63V MKT RAD.2	47/2010/022N
C59	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C6	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C60	CAP 1UO 10% 63V MKT RAD.2	47/2007/01U0
C61	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C62	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C63	CAP 10U 35V RAD ELECTRO	41/2001/010U
C64	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C65	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C66	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C67	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C68	CAP 470U 25V RB ELECTRO	41/2001/470U
C69	CAP 470U 25V RB ELECTRO	41/2001/470U
C7	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C70	CAP 10U 35V RAD ELECTRO	41/2001/010U
C71	CAP 10U 35V RAD ELECTRO	41/2001/010U
C72	CAP 10U 35V RAD ELECTRO	41/2001/010U
C73	CAP 10U 35V RAD ELECTRO	41/2001/010U
C74	CAP 10U 35V RAD ELECTRO	41/2001/010U
C75	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C76	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C77	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C78	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C79	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C8	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C80	CAP 10U 35V RAD ELECTRO	41/2001/010U
C81	CAP 18P 2% 100V NPO RAD.1	45/2680/018P
C82	CAP 10U 35V RAD ELECTRO	41/2001/010U
C83	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C84	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C85	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C86	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C87	CAP 100N 10% 63V X7R 1206	46/3310/100N
C88	CAP 10P 5% 63V NPO SM1206	46/3300/010P
C89	CAP 100N 10% 63V X7R 1206	46/3310/100N
C9	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C90	CAP 10P 5% 63V NPO SM1206	46/3300/010P
C91	CAP 100N 10% 63V X7R 1206	46/3310/100N

Ref.	Description	Part Number
C92	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C93	CAP 100N 10% 63V X7R 1206	46/3310/100N
C94	CAP 1P8 5% 63V NPO SM1206	46/3300/01P8
C95	CAP 100N 10% 63V X7R 1206	46/3310/100N
C96	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C97	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C98	CAP 1P8 5% 63V NPO SM1206	46/3300/01P8
C99	CAP TRIM 5-25P	49/3000/025P
D1	DIODE LED RED T1 3/4	21/1010/LEDR
D10	DIODE SILICON 1N4148	21/1010/4148
D11	DIODE SILICON 1N4148	21/1010/4148
D12	DIODE LED YELLOW T1 3/4	21/1010/LEDY
D13	DIODE SILICON 1N4148	21/1010/4148
D14	DIODE SIL GP	21/1010/4002
D15	DIODE SILICON 1N4148	21/1010/4148
D16	DIODE SILICON 1N4148	21/1010/4148
D17	DIODE SILICON 1N4148	21/1010/4148
D18	DIODE LED GREEN T1 3/4	21/1010/LEDG
D19	DIO SHTKY BAT17 SOT23	21/3030/0017
D2	DIODE 3AMP 1KV RECTIFIER	21/1080/5408
D20	DIODE 8V2 ZENER	21/1040/B8V2
D21	DIODE LED GREEN T1 3/4	21/1010/LEDG
D22	DIODE LED GREEN T1 3/4	21/1010/LEDG
D23	DIODE SILICON 1N4148	21/1010/4148
D24	DIO ZEN 1N4751 30V 1W AXI	21/1040/4751
D3	DIO VCAP MMBV105G SOT23	21/3060/105G
D4	DIODE SILICON 1N4148	21/1010/4148
D5	DIODE SILICON 1N4148	21/1010/4148
D6	DIODE SIL GP	21/1010/4002
D7	DIO ZEN 1N4751 30V 1W AXI	21/1040/4751
D8	DIODE SIL GP	21/1010/4002
D9	DIODE SIL GP	21/1010/4002
H1	HYBRED CTCSS	17/1000/1752
ISO1	IC OPTO-ISOLATOR 4N35	25/1010/4N35
J1	CON COAX SKT SMB VERT PCB	35/2004/0001
JP10	CON 2WAY HEADER	35/2501/0002
JP11	CON 2WAY HEADER	35/2501/0002
JP13	CON 2WAY HEADER	35/2501/0002
JP14	CON 16WAY SHR'D HEADER	35/2502/0016
JP15	CON 10WAY HEADER	35/2501/0010
JP2	CON 3WAY HEADER	35/2501/0003
JP3	CON 3WAY HEADER	35/2501/0003
JP4	CON 3WAY HEADER	35/2501/0003
JP5	CON 3WAY HEADER	35/2501/0003
JP6	CON 3WAY HEADER	35/2501/0003
JP7	CON 3WAY HEADER	35/2501/0003
JP8	CON 6WAY HEADER	35/2501/0006
JP9	CON 2WAY HEADER	35/2501/0002
L1	FERRITE BEAD SMD	37/3321/LM31
L10	IND 6 HOLE FERRITE RFC	37/1021/0001
L11	IND 220N 10% CHOKE SM1206	37/3320/220N
L12	IND 220N 10% CHOKE SM1206	37/3320/220N
L13	IND 220N 10% CHOKE SM1206	37/3320/220N
L14	IND 220N 10% CHOKE SM1206	37/3320/220N
L2	INDUCTOR 1uH AXIAL	37/2021/001U
L3	FERRITE BEAD SMD	37/3321/LM31
L4	FERRITE BEAD SMD	37/3321/LM31
L5	INDUCTOR 150mH 10RBH	37/2021/1RBH
L6	IND 220N 10% CHOKE SM1206	37/3320/220N
L7	FERRITE BEAD SMD	37/3321/LM31

Ref.	Description	Part Number
L8	FERRITE BEAD SMD	37/3321/LM31
L9	FERRITE BEAD SMD	37/3321/LM31
MA1	AMP MMIC MWA0211L SOT143	24/3010/211L
MA2	AMP MMIC MWA0211L SOT143	24/3010/211L
MA3	AMP MMIC MWA0211L SOT143	24/3010/211L
MA4	AMP MMIC MWA0211L SOT143	24/3010/211L
MA5	AMP MMIC MWA0211L SOT143	24/3010/211L
P1	FILT D RT AGL 9W F FERRIT	35/5012/009F
P3	FILT D RT AGL 25W M FERRI	35/5012/025M
Q1	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q10	TRSTR GP NPN 2N3904 TO92	27/3020/3904
Q11	TRSTR GP NPN MPS2369 TO92	27/2010/2369
Q12	TRSTR GP PNP 2N3906 TO92	27/2010/3906
Q13	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q14	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q15	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q16	TRSTR GP PNP 2N3906 TO92	27/2010/3906
Q17	FET NJ 2N5459 TO92M	27/2030/5459
Q18	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q19	FET NJ MMBFJ309 SOT23	27/3030/J309
Q2	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q20	TRSTR GP NPN MMBT3904 SOT23	27/3020/3904
Q21	TRSTR GP PNP MPS3640	27/2010/3640
Q22	TRSTR GP NPN MPS2369 TO92	27/2010/2369
Q23	TRSTR PNP MJF6107 TO22O	27/2010/6107
Q24	TRSTR GP PNP 2N3906 TO92	27/2010/3906
Q25	TRSTR NPN GP MPSA06 TO92	27/2010/PA06
Q3	TRSTR GP PNP 2N3906 TO92	27/2010/3906
Q4	TRSTR GP PNP MPS3640	27/2010/3640
Q5	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q6	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q7	TRSTR GP PNP 2N3906 TO92	27/2010/3906
Q8	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q9	FET NJ 2N5459 TO92M	27/2030/5459
R1	RES 5K11 1% 0.25W AXIAL	51/1010/5K11
R10	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R100	RES 47R 5% 0.25W SM1206	51/3380/0047
R101	RES 4K32 1% 0.25W AXIAL	51/1010/4K32
R102	RES 4K32 1% 0.25W AXIAL	51/1010/4K32
R103	RES 4K32 1% 0.25W AXIAL	51/1010/4K32
R104	RES 470K 5% 0.25W AXIAL	51/1040/470K
R105	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R106	RES 560 5% 0.25W AXIAL	51/1040/0560
R107	RES 3K3 5% 0.25W AXIAL	51/1040/03K3
R108	RES 560 5% 0.25W AXIAL	51/1040/0560
R109	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R11	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R110	RES 100 5% 0.25W AXIAL	51/1040/0100
R111	RES 2K2 5% 0.25W AXIAL	51/1040/02K2
R112	RES 220K 5% 0.25W AXIAL	51/1040/220K
R113	RES 68 5% 0.25W AXIAL	51/1040/0068
R114	RES 47K 5% 0.25W AXIAL	51/1040/047K
R115	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R116	RES 10K 5% 0.25W AXIAL	51/1040/010K
R117	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R119	RES 22 5% O.25W AXIAL	51/1040/0022
R12	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R120	RES 220 5% 0.25W AXIAL	51/1040/0220
R121	RES 120K 5% 0.25W AXIAL	51/1040/120K
R123	RES 150K 5% 0.25W AXIAL	51/1040/150K

Ref.	Description	Part Number
R124	RES 150K 5% 0.25W AXIAL	51/1040/150K
R125	RES 680K 5% 0.25W AXIAL	51/1040/680K
R126	RES 680K 5% 0.25W AXIAL	51/1040/680K
R127	RES 470K 5% 0.25W AXIAL	51/1040/470K
R128	RES 680K 5% 0.25W AXIAL	51/1040/680K
R129	RES 470K 5% 0.25W AXIAL	51/1040/470K
R13	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R130	RES 470 5% 0.25W SM1206	51/3380/0470
R131	RES 47R 5% 0.25W SM1206	51/3380/0047
R132	RES 47R 5% 0.25W SM1206	51/3380/0047
R133	RES 510K 5% 0.25W AXIAL	51/1040/510K
R134	RES 270 5% 0.25W AXIAL	51/1040/0270
R135	RES 470 5% 0.25W AXIAL	51/1040/0470
R136	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R137	RES 10K 5% 0.25W AXIAL	51/1040/010K
R138	RES 22K 5% 0.25W AXIAL	51/1040/022K
R139	RES 4K7 5% 0.25W AXIAL	51/1040/04K7
R14	RES 680 5% 0.25W AXIAL	51/1040/0680
R140	RES 100K 5% 0.25W AXIAL	51/1040/100K
R141	RES 10R 5% 0.25W AXIAL	51/1040/0010
R15	RES 6K8 5% 0.25W AXIAL	51/1040/06K8
R16	RES 680 5% 0.25W AXIAL	51/1040/0680
R17	RES 270 5% 0.25W SM1206	51/3380/0270
R18	RES 10K 5% 0.25W AXIAL	51/1040/010K
R19	RES 47K 5% 0.25W AXIAL	51/1040/047K
R2	RES 4K7 5% 0.25W AXIAL	51/1040/04K7
R20	RES 1M0 5% 0.25W AXIAL	51/1040/01M0
R21	RES 10K 5% 0.25W AXIAL	51/1040/010K
R22	RES 10K 5% 0.25W AXIAL	51/1040/010K
R23	RES 10K 5% 0.25W AXIAL	51/1040/010K
R24	RES 330 5% 0.25W AXIAL	51/1040/0330
R25	RES 330 5% 0.25W AXIAL	51/1040/0330
R26	RES 18K 5% 0.25W AXIAL	51/1040/018K
R27	RES 10K0 1% 0.25W AXIAL	51/1010/010K
R28	RES 10K 5% 0.25W AXIAL	51/1040/010K
R29	RES 2K2 5% 0.25W AXIAL	51/1040/02K2
R3	RES 100 5% 0.25W SM1206	51/3380/0100
R30	RES 470K 5% 0.25W AXIAL	51/1040/470K
R31	RES 10K 5% 0.25W AXIAL	51/1040/010K
R32	RES 10K 5% 0.25W AXIAL	51/1040/010K
R33	RES 10K 5% 0.25W AXIAL	51/1040/010K
R34	RES 100K 5% 0.25W AXIAL	51/1040/100K
R35	RES 100K 5% 0.25W AXIAL	51/1040/100K
R36	RES 5K11 1% 0.25W AXIAL	51/1010/5K11
R37	RES 10K 5% 0.25W AXIAL	51/1040/010K
R38	RES 91K 5% 0.25W AXIAL	51/1040/091K
R39	RES 22 5% O.25W AXIAL	51/1040/0022
R4	RES 100 5% 0.25W SM1206	51/3380/0100
R40	RES 4K7 5% 0.25W AXIAL	51/1040/04K7
R41	RES 2K2 5% 0.25W AXIAL	51/1040/02K2
R42	RES 100 5% 0.25W SM1206	51/3380/0100
R43	RES 100K 5% 0.25W AXIAL	51/1040/100K
R44	RES 18K 5% 0.25W AXIAL	51/1040/018K
R45	RES 10K 5% 0.25W AXIAL	51/1040/010K
R46	RES 10K 5% 0.25W AXIAL	51/1040/010K
R47	RES 64K9 1% 0.25W AXIAL	51/1010/64K9
R48	RES 64K9 1% 0.25W AXIAL	51/1010/64K9
R49	RES 7K50 1% 0.25W AXIAL	51/1010/07K5
R5	RES 100 5% 0.25W SM1206	51/3380/0100
R50	RES 1M0 5% 0.25W AXIAL	51/1040/01M0

Ref.	Description	Part Number
R51	RES 10K 5% 0.25W SM1206	51/3380/010K
R52	RES 10K 5% 0.25W SM1206	51/3380/010K
R53	RES 7K50 1% 0.25W AXIAL	51/1010/07K5
R54	RES 10K0 1% 0.25W AXIAL	51/1010/010K
R55	RES 91K 5% 0.25W AXIAL	51/1040/091K
R56	RES 100K 5% 0.25W AXIAL	51/1040/100K
R57	RES 91K 5% 0.25W AXIAL	51/1040/091K
R58	RES 64K9 1% 0.25W AXIAL	51/1010/64K9
R59	RES 64K9 1% 0.25W AXIAL	51/1010/64K9
R6	RES 15R 5% 0.25W SM1206	51/3380/0015
R60	RES 1K2 5% 0.25W AXIAL	51/1040/01K2
R61	RES 1K2 5% 0.25W AXIAL	51/1040/01K2
R62	RES 10K 5% 0.25W AXIAL	51/1040/010K
R63	RES 4K7 5% 0.25W AXIAL	51/1040/04K7
R64	RES 390 5% 0.25W AXIAL	51/1040/0390
R65	RES 47K 5% 0.25W AXIAL	51/1040/047K
R66	RES 47K 5% 0.25W AXIAL	51/1040/047K
R67	RES 10K 5% 0.25W AXIAL	51/1040/010K
R68	RES 680 5% 0.25W AXIAL	51/1040/0680
R69	RES 1K5 5% 0.25W AXIAL	51/1040/01K5
R7	RES 68 5% 0.25W AXIAL	51/1040/0068
R70	RES 680 5% 0.25W AXIAL	51/1040/0680
R71	RES 4K7 5% 0.25W AXIAL	51/1040/04K7
R72	RES 47 5% 0.25W AXIAL	51/1040/0047
R73	RES 1M0 5% 0.25W AXIAL	51/1040/01M0
R74	RES 4K7 5% 0.25W AXIAL	51/1040/04K7
R75	RES 4K7 5% 0.25W AXIAL	51/1040/04K7
R76	RES 10K 5% 0.25W AXIAL	51/1040/010K
R77	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R78	RES 6K49 1% 0.25W AXIAL	51/1010/6K49
R79	RES 28K7 1% 0.25W AXIAL	51/1010/28K7
R8	RES 3K3 5% 0.25W AXIAL	51/1040/03K3
R80	RES 5K11 1% 0.25W AXIAL	51/1010/5K11
R81	RES 5K11 1% 0.25W AXIAL	51/1010/5K11
R82	RES 5K11 1% 0.25W AXIAL	51/1010/5K11
R83	RES 5K11 1% 0.25W AXIAL	51/1010/5K11
R84	RES 100K 5% 0.25W AXIAL	51/1040/100K
R85	RES 2K2 5% 0.25W AXIAL	51/1040/02K2
R86	RES 680 5% 0.25W AXIAL	51/1040/0680
R87	RES 2K2 5% 0.25W SM1206	51/3380/02K2
R88	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R89	RES 10K 5% 0.25W AXIAL	51/1040/010K
R9	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R90	RES 180 5% 0.25W AXIAL	51/1040/0180
R91	RES 100 5% 0.25W SM1206	51/3380/0100
R92	RES 180 5% 0.25W SM1206	51/3380/0180
R93	RES 100 5% 0.25W SM1206	51/3380/0100
R94	RES 1K8 5% 0.25W AXIAL	51/1040/01K8
R95	RES 2K7 5% 0.25W AXIAL	51/1040/02K7
R96	RES 15R 5% 0.25W SM1206	51/3380/0015
R97	RES 47R 5% 0.25W SM1206	51/3380/0047
R98	RES 47R 5% 0.25W SM1206	51/3380/0047
R99	RES 10K 5% 0.25W SM1206	51/3380/010K
RN1	RES PACK 100K X8 DIP16	52/2002/100K
RN2	RES PACK 10K SIP10	52/2002/010K
RV1	TRIMPOT 10K 1 TURN VERT	53/1020/010K
RV2	TRIMPOT 10K 1 TURN VERT	53/1020/010K
RV3	TRIMPOT 10K 1 TURN VERT	53/1020/010K
RV4	TRIMPOT 10K MULTITURN HOR	53/2060/010K
S1	SWITCH PSH BTN SPDT & CAP	31/0005/E121

Ref.	Description	Part Number
S2	SWITCH BCD PRE-SET	31/4001/0BCD
S3	SWITCH BCD PRE-SET	31/4001/0BCD
T1	TRANSFORMER LINE 600 OHM	37/2040/5065
U1	IC RS232 INTER MAX232C	26/2001/232C
U10	IC ANALOGE GATE MC14066B	26/2040/4066
U11	IC QUAD NAND 74C00 DIP14	26/2031/4C00
U13	IC MICRO 68HC11A1P	26/2000/HC11
U14	IC VOLT REGULATOR LM7805	25/2040/7805
U2	IC 3 STATE BUF 74HC244N	26/2030/244N
U3	IC MICRO SUPER MC34064P-5	26/2000/064P
U4	IC 8 BIT LATCH 74HC573N	26/2030/C573
U5	IC EPROM 27C256	26/2090/C256
U6	IC FREQ SYN MB1501 SO16X	26/2000/1501
U7	IC QUAD OP AMP TLC274	25/2050/274C
U8	IC DUAL FET OP AMP DIP8	25/1050/272C
U9	IC QUAD OP AMP TLC274	25/2050/274C
XO1	TCXO 12.8 MHz O91/143-2	32/2030/12.8
Y1	CRYSTAL 8.0MHz	32/2049/08M0
Y2	CRYSTAL 5.0MHz	32/2049/05M0

Power Amplifier Assembly

C1	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C12	CAP 10U 35V RAD ELECTRO	41/2001/010U
C13	CAP 10U 35V RAD ELECTRO	41/2001/010U
C14	CAP 4N7 5% 400V MKT RAD.2	47/2040/04N7
C15	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C18	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C19	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C2	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C20	CAP 10U 35V RAD ELECTRO	41/2001/010U
C21	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C22	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C23	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C24	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C27	CAP 100N 10% 63V X7R 1206	46/3310/100N
C28	CAP 100N 10% 63V X7R 1206	46/3310/100N
C29	CAP 10U 35V RAD ELECTRO	41/2001/010U
C3	CAP 18P 2% 100V NPO RAD.1	45/2680/018P
C30	CAP 1N0 5% 63V NPO SM1206	46/3300/01N0
C31	CAP 100N 10% 50V X7R RD.2	46/2001/100N
C32	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C4	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C5	CAP 10N 10% 50V X7R RAD.2	46/2001/010N
C6	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
C7	CAP 1N0 5% 100V NPO RAD.2	46/2000/01N0
D1	DIO SHTKY BAT17 SOT23	21/3030/0017
D2	DIO SHTKY BAT17 SOT23	21/3030/0017
D3	DIODE SILICON 1N4148	21/1010/4148
D4	DIODE SILICON 1N4148	21/1010/4148
J2	CON COAX SMB PCB HORZ	35/2001/0001
L5	IND 3U3 10% CHOKE SM1008	37/3320/03U3
L6	IND 6 HOLE FERRITE RFC	37/1021/0001
L7	IND 6 HOLE FERRITE RFC	37/1021/0001
P1	CON 16 WAY HORZ SHR'D HDR	35/2503/0016
Q2	TRSTR RF NPN MRF5812 SO8	27/3020/5812
Q3	TRSTR GP PNP 1A MPSW51,A	27/2010/PW51
Q4	TRSTR GP NPN 2N3904 TO92	27/2020/3904
Q5	TRSTR GP NPN 2N3904 TO92	27/2020/3904

R1	RES 220 5% 0.25W SM1206	51/3380/0220
R10	RES 10R 5% 0.25W AXIAL	51/1040/0010
R11	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R12	RES 10R 5% 0.25W AXIAL	51/1040/0010
R13	RES 470 5% 0.25W AXIAL	51/1040/0470
R14	RES 10K 5% 0.25W AXIAL	51/1040/010K
R15	RES 470 5% 0.25W AXIAL	51/1040/0470
R16	RES 470 5% 0.25W SM1206	51/3380/0470
R18	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R19	RES 100K 5% 0.25W AXIAL	51/1040/100K
R2	RES 100K 5% 0.25W AXIAL	51/1040/100K
R20	RES 100 5% 0.25W AXIAL	51/1040/0100
R22	RES 1K0 5% 0.25W AXIAL	51/1040/01K0
R23	RES 47K 5% 0.25W SM1206	51/3380/047K
R24	RES 47K 5% 0.25W SM1206	51/3380/047K
R25	RES 220 5% 0.25W SM1206	51/3380/0220
R26	RES 220 5% 0.25W SM1206	51/3380/0220
R27	RES 100K 5% 0.25W AXIAL	51/1040/100K
R28	RES 1M0 5% 0.25W AXIAL	51/1040/01M0
R29	RES 10K 5% 0.25W AXIAL	51/1040/010K
R30	RES 4K7 5% 0.25W AXIAL	51/1040/04K7
R33	RES 33R 5% 0.25W AXIAL	51/1040/0033
R4	RES 100 5% 0.25W AXIAL	51/1040/0100
R5	RES 220 5% 0.25W SM1206	51/3380/0220
R7	RES 47K 5% 0.25W AXIAL	51/1040/047K
RT1	THERMISTOR	54/0400/0080
RV1	TRIMPOT 10K 1 TURN VERT	53/1020/010K
U1	IC QUAD OP AMP MC3403P	25/1050/3403
C8	CAP 8P 500V MICA SM1210	48/3003/008P
C9	CAP 27P 500V MICA SM1210	48/3003/027P
C10	CAP 27P 500V MICA SM1210	48/3003/027P
C11	CAP 8P 500V MICA SM1210	48/3003/008P
C16	CAP 100P 5% 63V NPO 1206	46/3300/100P
C17	CAP 100P 5% 63V NPO 1206	46/3300/100P
C25	CAP 10P 5% 63V NPO SM1206	46/3300/010P
C26	CAP 10P 5% 63V NPO SM1206	46/3300/010P
L1	IN MOLDED 3.5 TURN	37/2021/0003
L2	IN MOLDED 3.5 TURN	37/2021/0003
L3	IN MOLDED 3.5 TURN	37/2021/0003
L4	FERRITE BEADS (4)	37/1022/0001
L8	IND MOLDED 1.5 TURN	37/2021/0001
L9	IND MOLDED 2.5 TURN	37/2021/0002
L10	IND MOLDED 2.5 TURN	37/2021/0002
L11	IND MOLDED 2.5 TURN	37/2021/0002
R3	RES 100K 5% 0.25W AXIAL	51/1040/100K
R6	RES 15K 5% 0.25W AXIAL	51/1040/015K
R17	RES 7K5 1% 0.25W AXIAL	51/1010/07K5
R21	RES 100K 5% 0.25W AXIAL	51/1040/100K
R31	RES 100 5% 0.25W SM1206	51/3380/0100
R32	RES 47R 5% 0.25W SM1206	51/3380/0047
CR1	47nH Coilcraft midispring	37/AC52/047N
U2	AMP 20W 220-245MHz	18/M687/0029