Eclipse Series

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T800 Transmitter
Operation and Maintainance Manual

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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 sub-tone 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.

1.1.3 POWER 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.

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

1.1.6 ALC LED

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

1.1.7 REF LED

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

1.1.8 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.

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: 600 Ohm Line Dc Loop PTT Input

By default, Eclipse exciters can be keyed up by pulling the PTT signal low, or by dc loop signalling on the audio pair.

This jumper enables or disables this second method.

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

2.3 JP4: Audio Input Source Selection

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 JP5: 600 ¿ Termination

Normally the Line Input is terminated in 600 ¿ . The 600 ohm termination can be removed by choosing the alternate position.

Condition	Position
600¿ Termination	1-2*
No Termination	2-3

2.5 JP6: Input Level Attenuation

This jumper permits coarse input sensitivity to be set. In the default position, the unit expects a line level of 0dBm (nominal) at its Line Input. In the alternate position, levels of +20dBm(nominal) can be accepted.

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

2.6 JP7: Audio Frequency Response

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

2.7 JP8: Sub-audible Tone Source

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

2.8 JP9/10/11: dc Loop Configuration

Dc loop current on the audio pair is normally sourced externally. The Eclipse exciters loop the current through an opto-isolator. When the current flows the exciter keys up.

An alternative arrangement is possible. The exciters can source the current and an external device can provide the dc loop.

These three jumpers select the appropriate mode.

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

2.9 JP16: Direct Digital Input (Rev 4 or Higher)

Some trunking controllers have digital encoding schemes which operate to very low frequencies. The elliptical filter, used as a 250Hz low pass filter in the tone section, can cause excessive pulse edge distortion of the trunking controller's digital signals. In such circumstances, JP16 allows a user to bypass the low and high pass filters in the tone input section. See also 2.12 - JP22: If direct tone input is selected, then JP22 should be removed (open)

Condition	**Position**
Normal Tone Input	1-2*
Direct Tone Input	2-3

2.10 JP17: Bypass Low Pass Filter (Rev 4 or higher)

Some trunking controllers have digital encoding schemes that require the low pass filter in the tone input section to be bypassed. JP17 allows this. Normally JP17 is open circuit. Placing a link across it will bypass the low pass filter.

In conjunction with this change, it sometimes may be necessary, depending on the type of trunking controller used, to add a 100K resistor in the place reserved for R157.

2.11 JP19: Alarm Output (Rev 4 or higher)

The main audio transformer (T1), is connected to the Line IP1 and Line IP4 pins on P3.

These two pins constitute the main audio input for the exciter. The centre taps of the audio transformer, though, are brought out on Line IP2, and Line IP3. These can be used as alternate audio pins for larger signals, or to directly access the dc loop sense circuitry. JP19 allows an alternate use for Line IP2 (pin 7 of P3). In the alternate position for JP19, the ALARM signal (the signal that drives the ALARM LED itself) is connected to pin 7 of P3. The ALARM signal when asserted is low active; when unasserted, it pulls high to +9.4V through an LED and a 680 ohm resistor.

Condition	**Position**
P3, pin 7 connects to center tap of transformer T1	1-2*
P3, pin 7 connects to ALARM signal	2-3

2.12 JP22: Use Tone- as a Direct Digital Input (Rev 4 or higher)

JP22 is normally shunted with a jumper, which connects Tone- on P3 (pin 18), as the negative leg of the Tone input pair. Removing this jumper disconnects Tone- from this path and allows the use of the Tone- pin to be used as a direct digital input. See also 2.9 - JP16: If this jumper is removed, then JP16 should be in the alternative position (Direct Tone Input).

2.13 JP23: Connection of DMTX Board (Rev 4 or higher)

When a DMTX board is connected to an exciter, there is provision for digital or audio modulation of the reference osciallator and the VCO. The digital signal is input via the DB9 rear connector and the audio input signal is via the Line inputs on the standard DB25 rear panel connector.

Condition	Position
No DMTX board	1-2, 5-6*
DMTX board connected	2-3, 4-5

In addition to the jumper changes, a wire link or zero ohm resistor must be connected in the place marked for R159.

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.

Function	Signal	Pins	Specification
DC power	+12 Vdc 0 Vdc	1, 14 13, 25	+11.4 to 16 Vdc Ground
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,250mA/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.

3.2 Rear Panel Connectors

The exciter and receiver can be supplied with optional rear panel connectors that bring out the more important signals available on P1, the rear panel DB25 connector.

Figures 1 and 2 show the rear panel connectors, and Table 4 shows the signals that are brought out to the spade connectors. The spade connectors (2.1x0.6x7mm) are captive/soldered at the labelled points.

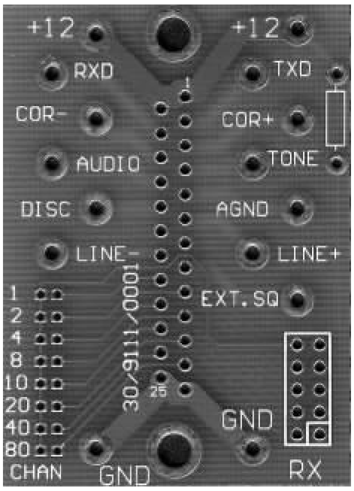

Fig 1
RX PCB

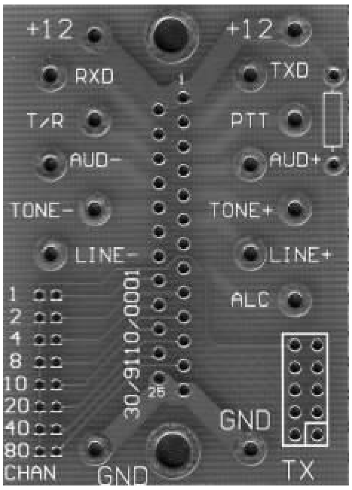

Fig 2
TX PCB

The Receiver and Transmitter modules plug into the back plane DB25/F connectors

To configure: Solder wire connections between appropriate points.

Receiver DB25/F	**RX PCB**	DESCRIPTION		**TX PCB**	**Transmitter DB25/F**
1, 14	+12V	+12V DC SUPPLY		+12V	1, 14
2	TXD	TX Data		TXD	2
15	RXD	RX Data		RXD	15
3	COR+	Carrier Operate Sw+	PressToTalk input	PTT	3
16	COR-	Carrier Operate Sw-	Tx/Rx output	T/R	16
4	TONE	Subtone output	Hi Z audio input+	AUD+	4
17	AUDIO	Audio output	Hi Z audio input-	AUD-	17
5	AGND	Audio Ground	Ext tone input+	TONE+	5
18	DISC	Discriminator output	Ext tone input-	TONE-	18
6	LINE+	Line output+	Line input+	LINE+	6
20	LINE-	Line output-	Line input-	LINE-	20
8	EXT SQ	Ext Squelch input	Auto Level Control	ALC	8
13, 25	GND	Ground, 0V		GND	13, 25
21	BCD 1	Channel select 1’s digit		BCD 1	21
9	BCD 2	Channel select 1’s digit		BCD 2	9
22	BCD 4	Channel select 1’s digit		BCD 4	22
10	BCD 8	Channel select 1’s digit		BCD 8	10
23	BCD 10	Channel select 10’s digit		BCD 10	23
11	BCD 20	Channel select 10’s digit		BCD 20	11
24	BCD 40	Channel select 10’s digit		BCD 40	24
12	BCD 80	Channel select 10’s digit		BCD 80	12

4 Channel and Tone Frequency Programming

Channel and tone frequency programming is most easily accomplished with RF Technology TecHelp software or the Service Monitor 2000 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.

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 bipolar 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. A second varactor diode D3 is used to frequency modulate the VCO. 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 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.

5.2 PLL Section

The frequency reference for the synthesiser is a crystal oscillator using transistors Q26 and Q27 and crystal Y3. The temperature stability is better than 5 ppm and it can be synchronised 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 12.8 MHz output of Q27 is amplified by Q28 and Q29 to drive the reference input of the PLL synthesiser IC U6. This IC is a single chip synthesiser which includes a 1.1 GHz pre-scaler, programmable divider, reference divider and phase/frequency detector. The frequency data for U6 is supplied via a serial data link by the microcontroller.

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.

5.3 Power Amplifier

The 10 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 approximately200mW. The bias of Q2 is controlled by Q1 and the power leveling circuitry to adjust the drive to the output module U2.

U2 increases the power from the driver 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 power voltage from U1a and U1b are compared to the present 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 levelling control loop.

5.4 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 6-10dB.

5.5 600 t Line 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 provide DC loop PTT signaling 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 un-terminated in high impedance applications.

5.6 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.

5.7 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 analogue 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

5.8 CTCSS and Tone Filter

The CTCSS encoder module H1, under control of the main microprocessor U13, can encode all 38 EIA 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.

On Rev 4 or later revisions, the low pass filter can be by passed by inserting a jumper onto JP17.

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.

The subtone amplifier, filter and limiter can be bypassed on Rev 4 or later exciters by removing the link from JP22 and moving the link in JP16 to the alternate position.

5.9 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 voltage gain of ten before connecting to the input of analogue switch U10c.

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

The audio signal is further amplified 100 times by U7d. U7d also provides the symmetrical 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. When the links on JP23 are in their default state, the filtered audio is coupled to the TCXO voltage tuning input and the modulation balance trimmer RV2. RV2, R99 and R98 attenuate the modulation signal before applying it to the VCO via varactor D3.

When DMTX board option is required, Jumper JP23 allows the audio paths to be re-routed. The DMTX board provides for an external digital modulation input signal. When the two links on JP23 are positioned in the middle of the 6 pin header, the audio from the exciter is passed to the DMTX board via pin 5 of JP15, where the signal is conditioned and then returned from the DMTX board via pin 2 of JP15, and passed to the two modulation points.

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.

5.10 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 of ISO1. Any low voltage current source capable of providing 2mA at 4V or switching circuit with less than 4.8k¿ 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.

A DMTX board can also cause the exciter to key up. When TX (or TTL_TX) signal is received by the DMTX board, it pulls pin 6 of JP15 low, which in turn asserts the PTT_WIRE-OR signal, causing the microprocessor (U13) to key the exciter up.

5.11 Microprocessor Controller

The microprocessor controller circuit uses a 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 analogue 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 analogue to digital converter is used to measure the forward and reverse power, tuning voltage and dc supply voltage.

If the processor detects that the PTT_WIRE_OR signal is asserted low, it will attempts to key the exciter up. If will first attempt to key the VCO through Q10, and if the LD pin goes high, it will switch the 9.2 Volt transmit line through Q14 and Q16. asserting Q16 has the effect of also asserting the yellow Tx LED (D12) on the front panel, enabling the local 25W power amplifier, and causing the T/R Relay output to be pulled low. D24 is 30 volt zener which protects Q25 from both excessive voltages or reverse voltages.

Should there be a problem with either the tuning volts, or the battery voltage, the VCO locking, the forward power, or the reverse power, the microprocessor will assert the ALARM LED, through Q1. Depending on the setting of Jumper JP19, the ALARM signal can be brought out on pin 7 of P3.

5.12 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.

Jumper JP18 is not normally fitted to the board, and is bridged with a 12mil track on the component side of the board. It is provided so that the 9.4V load can be isolated from the supply by the service department to aid in fault finding.

Jumpers JP20 and JP21 are also not normally fitted on the board, and are usually bridged with a 12mil track on the component side. They allow U14 to be isolated from its input, or its output or both.

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

Alignment Frequency		
Model	**Range**	**Align F**
T800A	806-830	818MHz
T800B	850-870	860MHz
T800C	928-942	935MHz

6.2 VCO Alignment

1. Select a channel at the center 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 (TUNE V), and adjust C99 to obtain 4.5±0.25V, while the TX LED is ON and the ALARM LED is OFF.

6.3 TCXO Calibration

1. Select a channel at the center 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 counter clockwise (CCW) (sub-tone off).
2. Set RV1 fully clockwise (CW) (maximum deviation)
3. Set RV2 mid-position
4. Set JP7 for flat response
5. Set JP4 for Hi-Z input
6. Key the transmitter on
7. Set the audio input to 150Hz, 0dBm.(387mV)
8. Measure deviation and adjust RV4 (line Level) for a deviation of 5kHz (2.5kHz for narrow band transmitters).
9. Set the audio input to 1.5kHz, 0dBm.
10. Adjust RV2 (Mod. Bal.) for a deviation of 5kHz (2.5kHz for narrow band transmitters).
11. Repeat steps 6-9 until balance is achieved.
12. Key the transmitter off.
13. Return JP7 to its correct setting.
14. 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 sub-tone (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 5kHz (2.5kHz for narrow band transmitters).
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 (3kHz or 1.5kHz for narrow band systems).
4. If the test signal is varying, RV4 may be adjusted to produce a level of 234mV RMS or 660mV_{p-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 1.5dB cable and connector losses, and assume that the maximum rated power is 15W. This means no more than 10W 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 50 watt amplifier. It can also be used alone in lower power applications.
Various models allow 2-25W of output power to be set across a number of UHF frequency bands. All necessary control and 600Ω 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 sub-tone 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 –	Pin 6 + Ground (pin 1)
Forward Power –	Pin 8 + Ground (pin 1)
Reverse Power –	Pin 4 + Ground (pin 1)
Tuning Voltage –	Pin 9 + Ground (pin 1)

Serial Data (RS-232) – Pins 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

Frequency	25 kHz	12.5 kHz
806-830 MHz	T800A	T800AN
850-870 MHz	T800B	T800BN
928-942 MHz	T800C	T800CN

7.4.3 Frequency Synthesizer Step Size

Step size is 10 / 12.5kHz or 5 / 6.25kHz, fixed, depending upon model

7.4.4 Frequency Stability

±1 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 2-15 or 2-25W depending upon model

7.4.8 Transmit Duty Cycle

100% to 40C, de-rating to zero at 60C.
100% to 5000ft altitude, de-rating to zero at 15,000ft.

7.4.9 Spurious and Harmonics

Less than 0.25«W

7.4.10 Carrier and Modulation Attack Time

Less than 20ms. Certain models have RF envelope attack and decay times controlled in the range 200«s< $t_{r/f}$ <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 or 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.

7.4.14 600 t Line Input Sensitivity

Adjustable from -30 to +10 dBm for rated deviation

7.4.15 HI-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 R500 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

Eclipse Series

RF Technology
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February 2005 Revision 2

R800 Receiver
Operation and Maintainance Manual

This Manual is produced by RF Technology Pty Ltd
10/8 Leighton Place, Hornsby NSW 2077 Australia

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 Mon Volume

The Mon. Volume control is used to adjust the volume of the internal loudspeaker and any external speaker connected to the test socket. It does not effect the level of the 600 Ohm line or direct audio output.

1.1.2 Mon. SQ.

The Mon. SQ. switch allows the normal squelch functions controlling the monitor output to be disabled. When the switch is in the Mon. SQ. position the audio at the monitor speaker is controlled by the noise detector. The CTCSS, carrier and external squelch functions are disabled. This can be useful when you are trying to trace the source of on-channel interference or when setting the noise squelch threshold. the audio from the 600Ω line and direct outputs is not effected by the switch position.

1.1.3 N.SQ

The N.SQ trimpot is used to set the noise squelch sensitivity. Use the following procedure to set the noise squelch to maximum sensitivity.

1. Set the toggle switch to the Mon. Sq. position and set the Mon. Volume control to 9 o'clock.

2. Turn the N.SQ adjustment counter clockwise until the squelch opens and noise is heard from the speaker. Adjust the volume to a comfortable listening level.

3. In the absence of any on channel signal, turn the NSQ screw clockwise until the noise in the speaker is muted. Then turn the screw one additional turn in the clockwise direction.

1.1.4 C.SQ

The C.SQ trimpot is used to set the carrier squelch sensitivity. Carrier squelch is useful at higher signal levels than noise squelch and can be used from 1-200µV input

It is provided mainly for use in fixed link applications where a high minimum signal to noise ratio is required or where very fast squelch operation is required for data transmission. The carrier squelch will open and close in less than 2 mSec.

In most base station applications the carrier squelch is disabled by turning the adjustment counter clockwise until the screw clicks.

The carrier squelch may be set to a predetermined level with the Techelp/ Service Monitor 2000 Software or by using the following procedure.

1. First turn the adjustment fully counter-clockwise. Then set the noise squelch as above.

2. Connect a source of an on channel signal with the desired threshold level to the receiver's RF input.

3. Turn the screw clockwise until the SQ LED goes OFF. Then turn the screw back until the LED just comes ON.

1.1.5 LINE

The LINE trimpot is used to set the line and direct audio output level. It is normally set to give 0dBm (775mV) to line with a standard input signal equal to 60% of maximum deviation at 1 KHz. The level can be measured between test socket pins 6 and 1 and set as desired.

1.1.6 PWR LED

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

1.1.7 SQ LED

The SQ LED comes on when the audio to the line and direct outputs is un-squelched. The LED and squelch function are controlled by noise, carrier and tone squelch circuits.

1.1.8 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. In order of priority the alarms are.

Indication Cadence	Fault Condition
Flashing 5 times, pause	Synthesizer unlocked
Flashing 4 times, pause	Tuning voltage outside limits
Flashing 3 times, pause	Signal level below preset threshold (for fixed links)

Flashing 1 time, pause	dc supply voltage low or high
LED ON continuously	External squelch is active

2 Receiver Internal Jumper Options

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

2.1 JP1 - 240 Hz Notch Filter

Condition	Position
Notch filter In	1-2*
Notch Filter Out	2-3

2.2 JP2 Audio Response

Condition	Position
750µSec de-emphasis	1-2*
Flat response	2-3

2.3 JP3 Audio Filter In/Out

Condition	Position
Hi-pass & Notch In	2-3*
Flat response to 3 KHz	1-2

2.4 JP4 600 Ohm Line dc Loop COS

Condition	Position
dc Loop Configured by JP7, JP8, JP9	1-2*
dc Loop Not connected	2-3

2.5 JP6 COS Polarity

Condition	Position
Active on Signal	1-2*
Active on No Signal	2-3

2.6 JP7, JP8, JP9 - dc Loop COS Configuration (JP4 1-2)

Condition	JP7	JP8	JP9
Source +12 Vdc Loop	2-3	ON	2-3*
Free Switch Output	1-2	ON	1-2

2.7 JP7, JP8, JP9 Direct Output COS (JP4 2-3)

Condition	JP7	JP8	JP9
+12 Vdc Direct Output	2-3	OFF	OFF
Free Switch Output	1-2	OFF	OFF

2.8 JP11 EPROM Type

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

*= Standard Ex-Factory Configuration

3 Receiver I/O Connections

3.1 25 Pin Connector

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

Function	Signal	Pins	Specification
DC Power	+12Vdc 0 Vdc	1,14 13,25	+11.4 to 16Vdc
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 +16Vdc
RS232 Data	In Out	15 2	Test and Programming use 9600, 8 data 2 stop
600 Ohm Line	High Low	20 6	Transformer Isolated Balanced 0 dBm Output
150 Ohm/Hybrid Access		7 19	
Discriminator Audio	Disc	18	AC coupled, unsquelched
Direct Audio Output	Audio	17	Direct AC Coupled Audio
Audio Ground	Agnd	5	Direct Audio Ground
Sub-Audible Audio Output	Tone	4	Unsquelched, 1-250 Hz
Carrier Operated Switch	COS+ COS-	3 16	Opto-coupled Transistor Switch (10mA)
External Squelch	Ext Sq	8	<1 Vdc to Squelch >2 Vdc or open ckt to unsquelch

Table 3: Pin connections and explanations for the main, 25-pin D-shell Connector

4 Frequency Programming

Channel and tone frequency programming is most easily accomplished with RF Technology TecHelp/ Service Monitor 2000 Software. This software can be run on any IBM compatible PC and provides a number of additional useful facilities.

TecHelp/ Service Monitor 2000 allows setting of the adaptive noise squelch threshold, provides a simple means of calibrating the signal strength output and minimum signal alarm

.
TecHelp/ Service Monitor 2000 can be supplied by your dealer, distributor or by contacting RF Technology direct.

5 Circuit Description

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

5.1 RF Section

A two section helical filter FL1 is used to limit the R.F. bandwidth prior to the R.F. amplifier transistor Q1. The output impedance of FL1 is matched to the input of Q1 by C177, C178 and a microstrip line on the printed circuit board. Q1 is a very low noise device with good intermodulation performance.

A four section filter consisting of FL2 and FL3 is used between Q1 and the mixer MX1. This filter provides additional image and spurious frequency rejection.

MX1 is a high level double balanced diode ring mixer with excellent intermodulation performance. It has a conversion loss of approximately 7dB. The gain between the receiver input and the mixer input is approximately 10dB so that the total gain between the antenna input and the I.F. input is 3-4dB.

Monolithic amplifiers MA1, MA2 and transistor Q5 amplify the VCO output to the necessary L.O. level for MX1 approximately +13dBm.

The network C8, C9, L1-3 and R6 passes the 45MHz I.F. frequency to the I.F. amplifier and terminates the R.F. and L.O. frequency components.

5.2 I.F. Section

The first I.F. amplifier uses two parallel connected JFET transistors Q2 and Q3 to obtain 8-10dB gain. The two transistors provide improved dynamic range and input matching over a single transistor.
A two pole 45MHz crystal filter XF1 is used between the first and second I.F. amplifiers. The second I.F. amplifier Q4 provides additional gain of 6-10dB. A two pole crystal filter is used between Q4 and the 2nd oscillator mixer. These two crystal filters provide some adjacent channel rejection and all of the second I.F. image frequency rejection.

U1 is a monolithic oscillator and mixer I.C. It converts the 45MHz I.F. signal down to 455KHz. The second oscillator frequency or 45.455MHz is controlled by crystal Y1. The 455KHz output of the second mixer is fed through the ceramic filter CF1 to the 2nd I.F. amplifier transistor Q27. Q27 provides an additional 15dB gain ahead of the limiter and discriminator I.C. U3.

CF1 provides additional adjacent channel selectivity for 25KHz versions and all of the adjacent channel selectivity for 12.5KHz versions. CF1 and termination resistors R15 and R24 are the only component differences between the 12.5 and 25KHz versions.

The limiter/discriminator I.C. U3 further amplifies the signal and passes it through CF2. CF2 does not contribute to the adjacent channel rejection but is used to reduce the wide band noise input to the limiter section U3.

The limiter section of U3 drives the quadrature detector discriminator. C31 and I.F. tuned circuit L10 comprise the discriminator phase shift network.

U3 also has a received signal strength indicator output (RSSI). The RSSI voltage connects to the test socket for alignment use. The RSSI voltage is also used by the microprocessor for the adaptive noise squelch, carrier squelch and low signal alarm functions.

Dual op-amp U2 is used to amplify and buffer the discriminator audio and RSSI outputs.

5.3 V.C.O Section

The Voltage controlled Oscillator uses a bipolar junction transistor Q6 which oscillates at the required mixer injection frequency. A fixed tuned ceramic coaxial resonator CR1 is used to set the tuning range. Varactor diode D18 is used by the P.L.L. circuit to keep the oscillator locked on the desired frequency. Transistor Q7 is used as a filter to reduce the noise on the oscillator supply voltage.

5.4 P.L.L. Section

The synthesizer frequency reference is supplied by a temperature compensated crystal oscillator (XO1). the frequency stability of the TCXO is better than 1ppm over the operating temperature range.

The 12.8MHz output of XO1 is amplified by Q8 to drive the reference input of the P.L.L. synthesizer I.C. U4. This I.C. is a single chip synthesizer which includes a 1.1GHz pre-scaler, programmable divider, reference divider and phase/frequency detector. The frequency data is entered by a serial data link from the microprocessor.

The phase detector output signals from U4 are used to control two switched current sources. The output of the positive and negative sources Q10 and Q15, produce the tuning voltage which is smoothed by the loop filter components to bias the V.C.O. varactor diode D18.

5.5 Audio Signal Processing

A 4KHz low pass filter (U27b) is used to remove high frequency noise from the signal. A 300Hz high pass filter (Y26a,b) then removes the sub-audible tones. A 240Hz notch filter (U26c,d) is used to improve the rejection of tones above 200Hz. The high pass and notch filters can be bypassed by internal jumpers JP1 and JP3.

The audio frequency response can be set for either a 750uS de-emphasis or flat characteristic by JP2. JP2 switches the feedback networks of amplifier U27c to achieve the desired response.
After de-emphasis and filtering, the audio signal is applied to the inputs of two analog switches (U17a,b). These switches are controlled by the microcontroller and squelch or mute

the audio to the line and monitor output circuits. The monitor output can be set for noise squelch only operation by S1.

The audio from U17a is adjusted by the volume control before connecting to the monitor output amplifier U5. U5 drives the internal speaker and can also supply 3-5 watts to an external loudspeaker.

The audio from U17b is adjusted by RV3 before connecting to the line output I.C. (U22a,b). U22 is a dual amplifier connected in a bridge configuration to drive the 600 Ohm line output transformer T1.

5.6 Noise Filter, Amplifier and Detector

The unfiltered audio from the discriminator is fed to trimpot RV4 which is used to set the noise squelch threshold. From RV4 the audio goes to the noise filter (U27a). This is a 10KHz high pass filter and is used to eliminate voice frequency components.

The noise signal is then amplified by U27d and fed to the noise detector. The noise detector consists of D6, Q17 and U26c. D6 and Q17 are a charge pump detector and pull the input to U26c low as the noise increases. U26c has positive feedback and acts like a schmidt trigger. The output of U26c goes high when noise is detected. It connects to the microcontroller and to analog switch U17d. U17d varies the gain of the noise amplifier to provide approximately 2dB hysteressis.

5.7 Subtone Filter and C.T.C.S.S.

The discriminator audio is fed through cascaded low pass filters U28a and U28b to filter out the voice frequency components. The filtered sub-tone audio is supplied to the C.T.C.S.S. hybrid and the rear panel system connector. The filtered output can be used for re-transmission of C.T.C.S.S. or D.C.S.

The C.T.C.S.S. decoder module is a microcontroller base hybrid module. Under control of the main microprocessor U15 it can decode all 38 E.I.A. tones and 12 additional commonly used tones. The decode bandwidth is set to 1% but may be changed to 2% by a jumper on the printed circuit board.

5.8 External Squelch

The audio output can be muted through pin 8 of the receiver system connector P1. When pin 8 is pulled to less than 1 Volt above ground, the microcontroller U15 will mute the audio output.

This facility can be used to mute the audio during transmission, as is required in single frequency systems, by simply connecting pin 8 of the receiver to the transmitter T/R relay driver output (pin 16 on Eclipse transmitters).

5.9 Microprocessor Controller

The microprocessor controller circuit uses an advanced eight bit processor and several support chips. The processor U15 includes EE memory for channel frequencies, tones and other information. It also has an asynchronous serial port, a synchronous serial port and an analog to digital convertor.

The program is stored in U12, a CMOS EPROM. U13 is an address latch for the low order address bits. U11 is used to read the channel select lines onto the data bus. U7 is an address decoder for U11 and U12. U14 is a supervisory chip which keeps the processor reset unless the +5 Volt supply is within operating limits. U16 translates the asynchronous serial port data to standard RS232 levels.

The analog to digital converter is used to measure the received signal strength, tuning voltage, dc supply voltage and the carrier squelch setting.

5.10 Carrier Operated Switch

The carrier operated switch is an opto-coupled (IS01) output. Internal jumpers (JP4,7,8,9) can be connected to provide loop source, loop switch, free switch and various other configurations.

The C.O.S. can be set to active (switch closed) on carrier or active in the absence of carrier. The generic term “Carrier Operated Switch” may be misleading in this case. If a sub-audible tone has been programmed for the channel current channel, the C.O.S. will be controlled by carrier and tone detection.

5.11 Voltage Regulator

The dc input voltage is regulated down to 9.4Vdc by a discrete regulator circuit. The series pass transistor Q20 is driven by error amplifiers Q21 and Q22. Q23 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 protected. It provides much better line isolation and lower dropout voltage than can be obtained with current integrated circuit regulators.

5.12 Tuning Voltage Supply

U18 is an astable multivibrator. The output from pin 3 of U18 is a rectangular 8 volt waveform with a frequency of approximately 200KHz. This output is connected to a voltage tripler circuit consisting of C170-C173, D13 and D14 to produce +20Vdc. This is used by the frequency synthesizer to provide tuning voltages up to +18Vdc.

6 Alignment Procedure

The following procedures may be used to align the receiver for optimum performance. Normally alignment should only be necessary after repairs on that part of the circuit.

TCXO calibration may be required periodically due to crystal aging. The aging should be less than 1ppm/year.

6.1 Standard Input Signal

RF Signal Generator
50? output impedence Frequency range 806-950MHz FM modulation at 1KHz 1.5KHz peak for 12.5KHz channel spacing 3.0KHz peak for 25KHz channel spacing

6.2 RF Alignment

Step	**Input**	**Measure**	**Adjust**
1	Select alignment frequency channel	dc Volts on TP3 (next to FL4)	FL4 for maximum dc volts
2	Signal generator on centre frequency channel to J1. Modulation off.	dc Volts on test socket pin 7 to pin 1	Generator level to read 2-3Vdc
3	As above	As above	FL1,FL2,FL3 for maximum reading. Reduce generator output to keep below 3Vdc.

6.3 IF Alignment

Step	Input	Measure	Adjust
1	Signal generator on centre frequency channel to J1. Modulation OFF.	dc Volts on test socket pin 7 to pin 1	Generator level to read 2-3Vdc.
2	As above	As above	L5,L6,L7,L8 For max. Reduce generator output to keep below 3Vdc
3	Set generator level to 10uV	Frequency U3 pin 9	L9 to read 455KHz +/- 10Hz
4	Set generator level to 1 millivolt. Modulation ON	Audio level test socket pin 6 to pin 1	Line level (RV3) to obtain approx. 1Vrms
5	As Above	As Above	L10 for maximum
6	As above	Audio level P1 pin 18 to pin 5	RV1 for .5Vrms
7	Set generator level to approx 0.25uV	SINAD on test socket pin 6 to pin 1	Reduce generator level to obtain 12dB SINAD. Carefully adjust L5,L6,L7,L8 to obtain the best SINAD. Reduce the generator output to maintain 12dB SINAD.

6.4 Line Level Adjustment

Step	Input	Measure	Adjust
1	Signal generator on centre frequency channel to J1. Modulation ON. Level 1 millivolt	Audio level test socket pin 6 to pin 1	RV3 for 775mV rms

6.5 Reference Oscillator Calibration

Step	Input	Measure	Calibration
1	None required	Frequency Junction of R69 and R26 on the top of the PCB. (L.O. input to the mixer)	X01 for L.O. +/- 100Hz L.O. =Fc+45MHz

7 Specifications

7.1 General Description

The receiver is a high performance, frequency synthesized, narrow band FM unit which can be used in conjunction with transmitter and power supply modules as a base station or as a stand alone receiver. 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 receivers used at a given site.

7.1.2 CTCSS

The CTCSS tone or no tone can also be programmed for each channel. Each channel number can represent a unique RF and tone frequency combination.

7.1.3 Channel Programming

The channelling information is stored in a non-volatile memory chip and can be programmed via the front panel test connector using a PC and RF Technology supplied TecHelp/ Service Monitor 2000 software.

7.1.4 Channel Selection

Channel selection is by eight channel select lines. These are available through the rear panel connector.

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.

BCD switches inside the receiver can be used to pre-set any desired channel. These eliminate the need to externally select the channel.

7.1.5 Microprocessor

A microporcessor is used to control the synthesizer and squelch functions and facilitate the channel frequency programming. With the standard software it also can provide some rudimentary fault monitoring and reporting.

7.2 Physical Configuration

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

7.3 Front Panel Controls, Indicators and Test Points

7.3.1 Controls

Mute Defeat Switch - toggle (Overrides CTCSS and carrier squelch at the monitor output).

Monitor Speaker Volume - Knob

Line Output Level - Screwdriver adjust multiturn pot

Noise Sq. Setting - Screwdriver adjust multiturn pot

Carrier Sq. Setting - Screwdriver adjust multiturn pot

7.3.2 Indicators

Power On - Green LED

Squelch Open - Yellow LED

Fault Indicator - Flashing Red LED

7.3.3 Test Points

Line Output Level - 6 + Gnd (pin 1)

Receive Signal Strength - 7 + Gnd (pin 1)

Tuning Voltage - 9 + Gnd (pin 1)

Serial data (RS232) - 2/3 + Gnd (pin 1)

7.4 Electrical Specifications

7.4.1 Power Requirements

Operating Voltage - 10.5 to 16Vdc

Current Drain - 500mA Max

Polarity - Negative Ground

7.4.2 Frequency Range and Channel Spacing

Model No.		
Frequency	**25KHz**	**12.5KHz**
800-830MHz	R800A	R800AN
850-870MHz	R800B	R800BN
896-930MHz	R800C	R800CN

7.4.3 Frequency Synthesizer Step Size

-10.0 or 12.5KHz

7.4.4 Frequency Stability

+/- 1ppm, 0 to +60C, Standard

7.4.5 Nominal Antenna Impedance

50 Ohms

7.4.6 IF Frequencies

1st IF Frequency 45MHz

2nd IF Frequency 455KHz

7.4.7 Sensitivity

0.25uV (-119dBm) for 12dB SINAD

0.35uV (-116dBm) for 20dB Quieting

7.4.8 Selectivity

25KHz spacing - 80dB per EIA-603

12.5KHz spacing - 70dB per EIA-603

7.4.9 Spurious and Image Rejection

90dB

7.4.10 Intermodulation

80dB per RS204C

7.4.11 Modulation Acceptance BW

25KHz spacing - 7.5KHz per EIA-603
12.5KHz spacing - 3.75KHz per EIA-603

7.4.12 Noise Squelch

Adjustment Range 6-26dB SINAD, 25KHz Versions
6-18dB SINAD, 12.5KHz Versions

Attack Time 20mSec. above 20dB Quieting

Release Time 150mSec. at 20dB quieting decreasing to 20mSec. above 2uV present threshold

Hysteresis Hysteresis is equal to approximately 2dB change in noise quieting.

7.4.13 Carrier Level Squelch

Carrier level squelch can be used when it is necessary to set the opening point above 26dB SINAD as may be required in link applications. The minimum adjustment range is 1 to 200uV.

7.4.14 Receiver Frequency Spread

Less than 1dB change in sensitivity over 10MHz

7.4.15 Receiver Conducted Spurious Emissions

Less than -57dBm from 1 to 2900MHz

7.4.15.1 Audio Frequency Response

600 Ohm Line and Direct Output: +1/-3dB 300-3000Hz relative to either a flat response or 750uSec. de-emphasis with the high pass and notch filters bypassed.

Sub Audio Output: +1/-3dB 67-250Hz

7.4.15.2 Audio Output Level

600 Ohm Line: Adjustable -10 to +10dBm

Monitor Loudspeaker: 5watts with external speaker. 0.3watt with internal speaker.

Discriminator and Sub-Audio Level:
Nominally equal to 1 volt peak at rated system deviation.

7.4.16 Audio Distortion

With 750uSec. De-Emphasis: Less than 3% at 1KHz and 60% of rated system deviation.

With Flat Response: Less than 5% at 1KHz and 60% of rated system deviation.

7.4.17 Channel Select Input/Output

Coding: 8 Lines BCD coded 00-99

Logic Input Levels: 0=<0.4Volts
1=>3.5Volts
Internal 10K pull down resistors selects Ch.00 when all inputs are O/C.

7.4.20 Carrier Operated Switch Output

Floating Opto-Coupler Output: The carrier operated switch output is via an opto-coupler. Collector and emitter connections are available to allow connection for source or sink.

The opto-coupler can be linked inside the receiver to be on when a carrier is detected or to be on in the absence of carrier.

Connection to Remote Switch via 600? Line: Internal connections are provided so that the opto-coupler can be connected to the 600? line for use over a single pair.

Current Source/Sink, Collector Voltage: Ic = 10mA Maximum
Vc = 30Volts Maximum.

7.4.21 CTCSS

The CTCSS decoding is provided by a hybrid module. This provides programmable decoding of all 38 EIA and 12 other common tones.

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

7.4.22 External Squelch Input

An external input is provided to squelch or mute the receiver audio output. This may be used in conjunction with an external decoder or to mute the receiver during transmissions.

The External Squelch Input can be connected to the T/R Relay pin on Eclispe transmitters to mute the receiver during transmission.

7.5 Connectors

7.5.1 Antenna Connector

Type N Female Mounted on the module rear panel

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.