Eclipse Series

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T350 / T500 Transmitter
Operation and Maintenance Manual

This manual is produced by RF Technology Pty Ltd
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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 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.

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 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.

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 synthesiser 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: 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 opto-coupler.

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 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 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 exciter 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 (pcb 30/9103/0009 or later)

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 truinking 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 (pcb 30/9103/0009 or later)

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 upon the type of trunking controller used, to add a 100K resistor in the place reserved for R157.

2.11 JP19: Alarm Output (pcb 30/9103/0009 or later)

The main audio transformer (T1), is connected to the Line IPI 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 inputs 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 centre 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 (pcb 30/9103/0009 or later)

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

2.13 JP23: Connection of DMTX Board (pcb 30/9103/0009 or later)

When the DMTX board is connected to an exciter, there is provision for digital or audio modulation of the reference oscillator and 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
N DMTX board	1-2, 5-6*
DMTX board connected	2-3, 4-5

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 onto spade connectors for these daughter boards. The spade connectors (2.1 x 0.6 x 7mm) are captive/soldered at the labelled points.

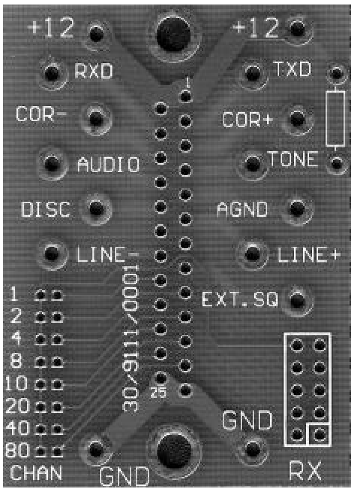

Fig 1
RX PCB

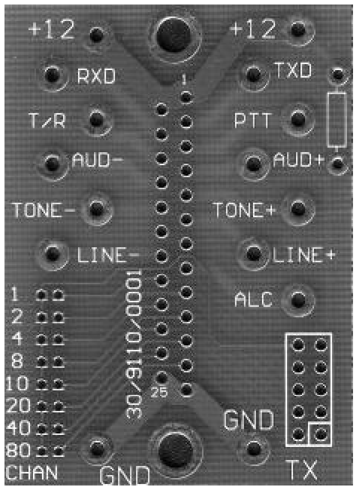

Fig 2
TX PCB

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

Table 4

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 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 5Ω coaxial cable.

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

U2 increases the power to 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 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 in turn reduces the outpower by 6-10dB.

5.5 600W 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. 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.

5.9 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*m*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 a 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 pin5 of JP5, 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 500Hz. 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 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.

A DMTX board can also cause the exciter to key up. When a 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 attempt to key the exciter up. It 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.

Jumper 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, 150-3000Hz 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.

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. 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 sub-tone (CTCSS) coding is not to be used, adjust RV3 fully CCW.

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.

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

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.

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.

[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.

7.1.3 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
330-365 MHz	T350C	T350CN
360-380 MHz	T350A	T350AN
375-400 MHz	T350B	T350BN
403-420 MHz	T500A	T500AN
430-450 MHz	T500D	T500DN
450-520 MHz	T500B	T500BN

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*m*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*ms*< $t_{r/f}$ <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 600W 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.

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

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

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

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

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

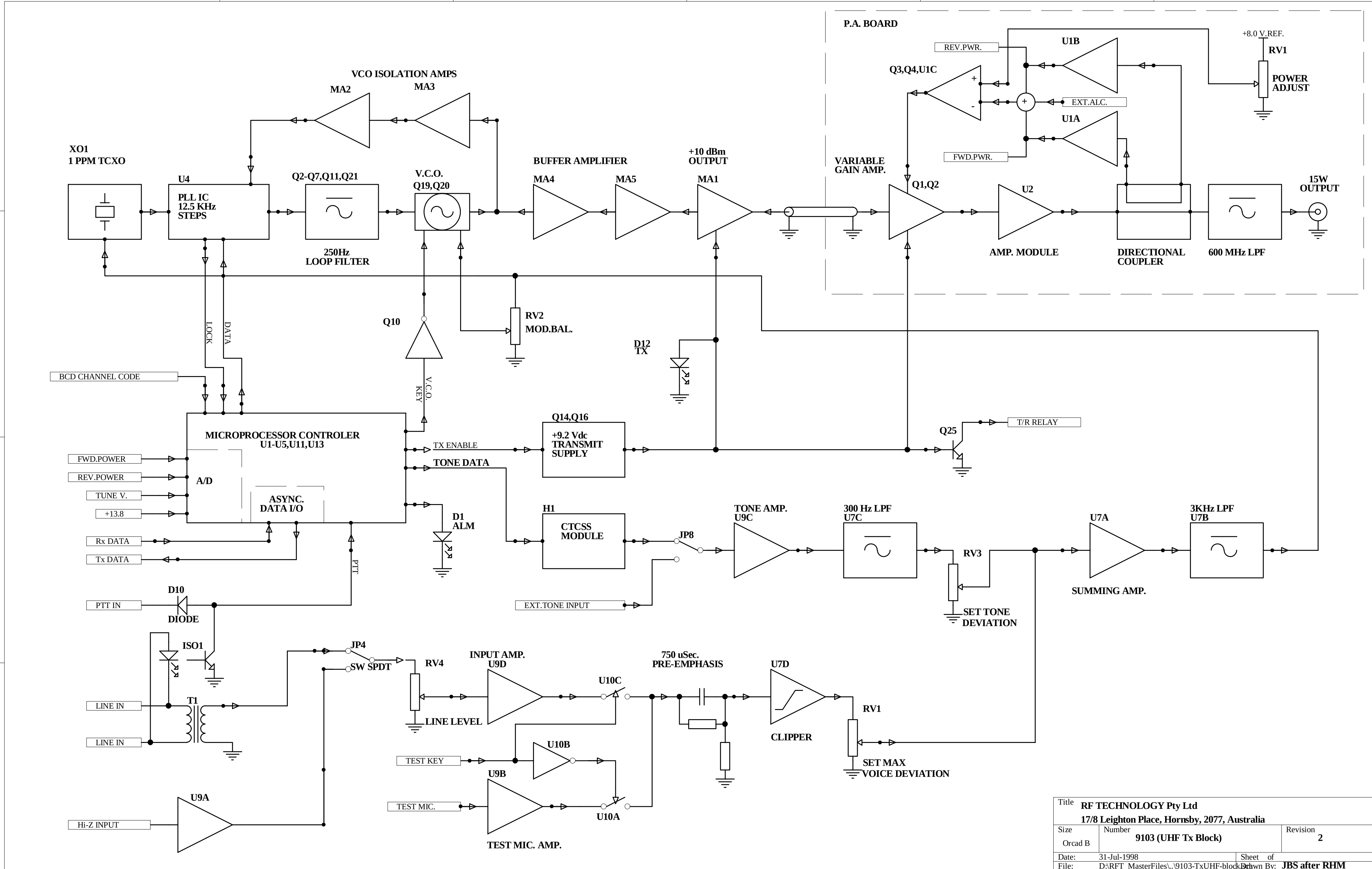
Figure 1 shows the block signal flow diagram.

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.



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Size Orcad B	Number 9103 (UHF Tx Block)		Revision 2
Date:	31-Jul-1998	Sheet of	
File:	D:\RFT_MasterFiles\..\9103-TxUHF-block.sch	Drawn By:	JBS after RHM

TRANSMITTER Jumper Options

JP2- EPROM Type

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

JP3 - 600 Ohm Line dc Loop PTT Input

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

JP4 - Audio Input Source Selection

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

JP5 - 600 ohm Audio Terminator

	Position
Terminated 600 Ohm	1-2 *
Not terminated	2-3

JP6 - Input Level Attenuation

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

JP7 - Audio Frequency Response

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

JP8 - Subaudible Tone Source

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

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

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

THE FOLLOWING JUMPERS ARE VALID ON
TX PCB VERSION 30/9103/0009 OR LATER

JP16 –(see also JP22) DCS and low frequency Digital Data Input

	Position
DCS Not selected JP16	1-2 *
Select DCS input JP16	2-3

JP22 – (see also JP16) Tone input or DCS Digital Data Input

	Position
Tone- input JP22 fitted	1-2 *
DCS input JP22 removed	open

JP17 – Bypass Tone circuit 250Hz low pass filter

	Position
Default - Link not fitted JP17	open*
Bypass active JP17 fitted	1-2

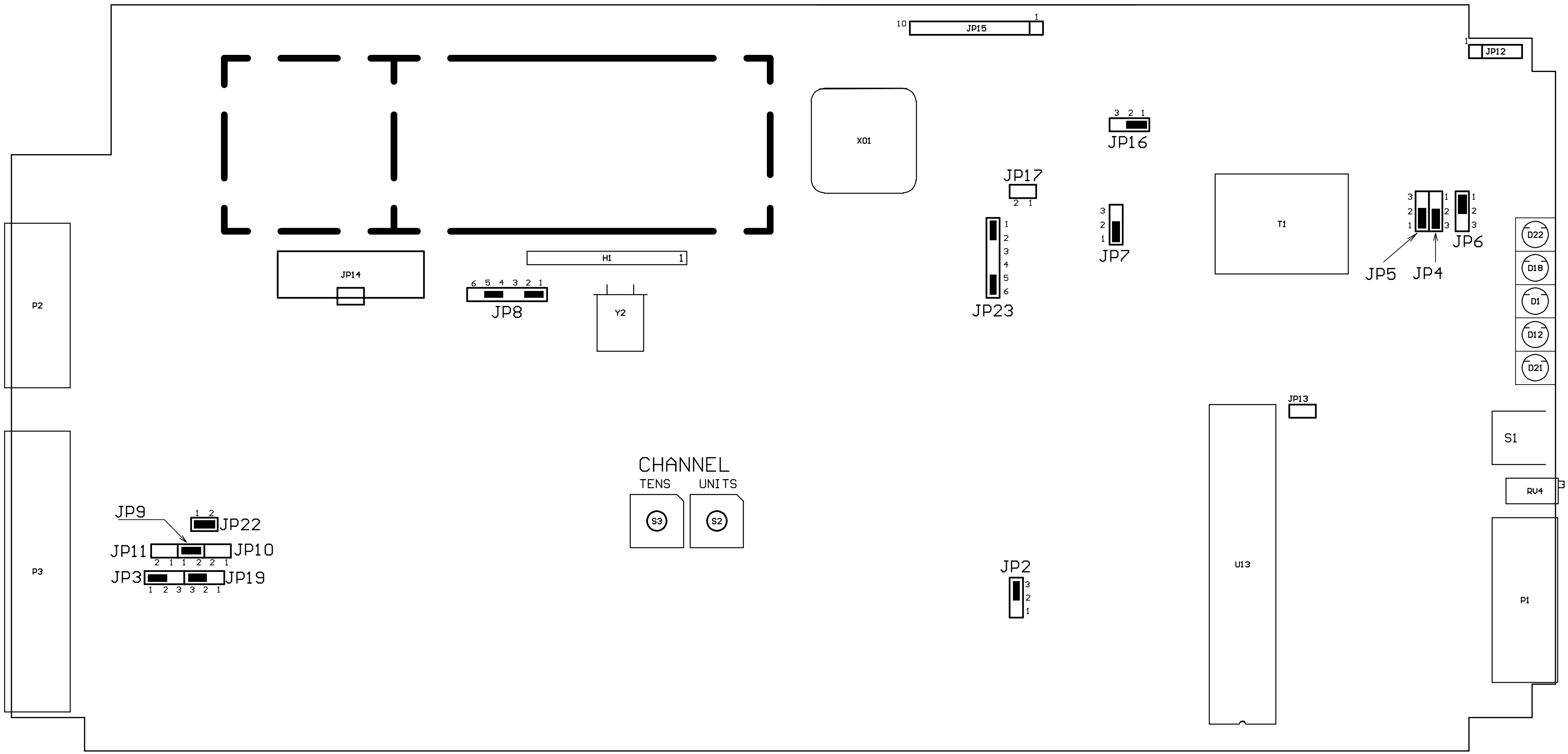
JP19 – LED Alarm output

	Position
No alarm output	2-3 *
Alarm - active low output at DB25 pin 7	1-2

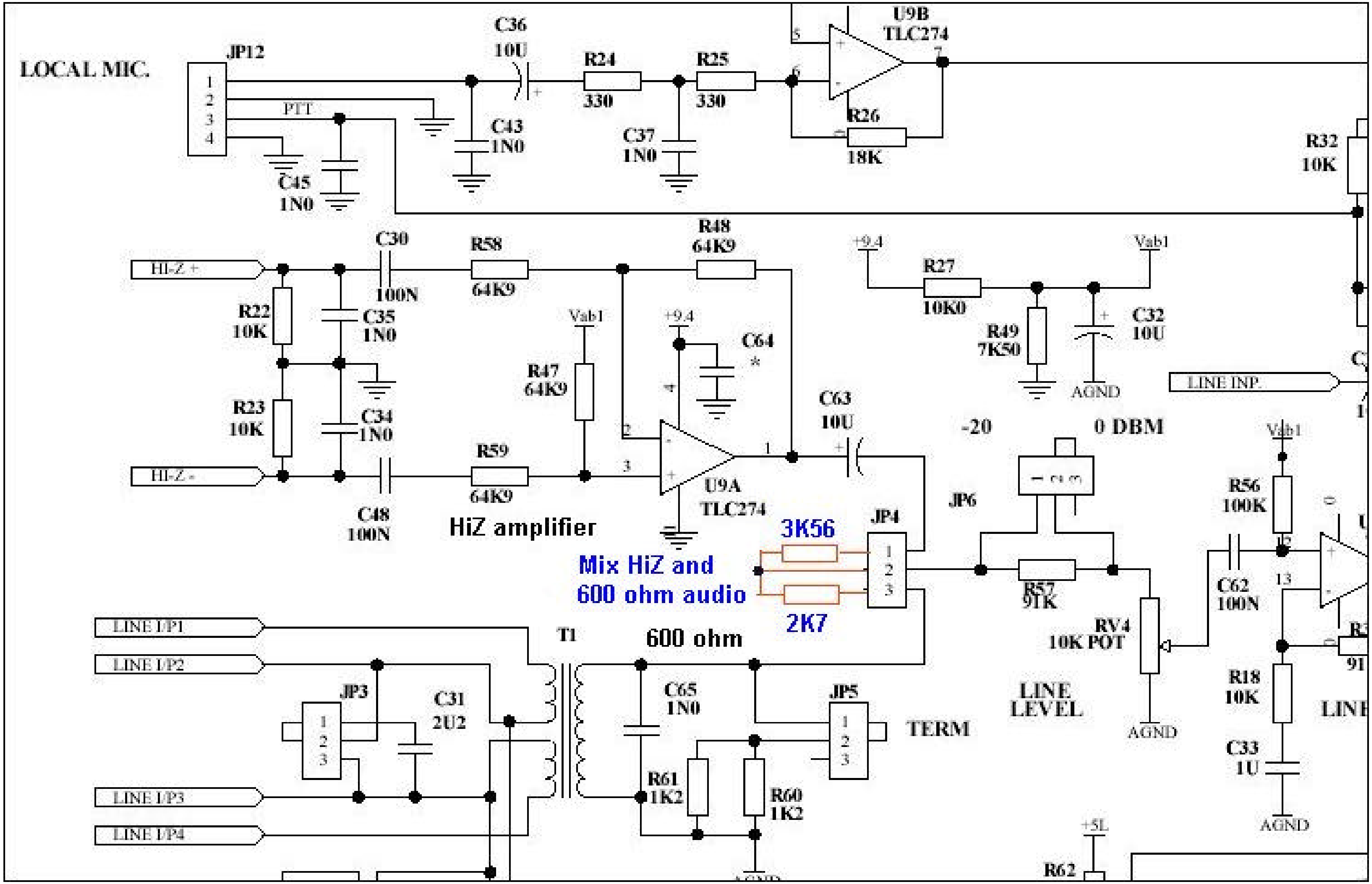
JP23 – DMTX Digital and audio modulation option

	Position
Audio modulation only	1-2, 5-6 *
DMTX fitted for Digital and Audio modulation	2-3, 4-5

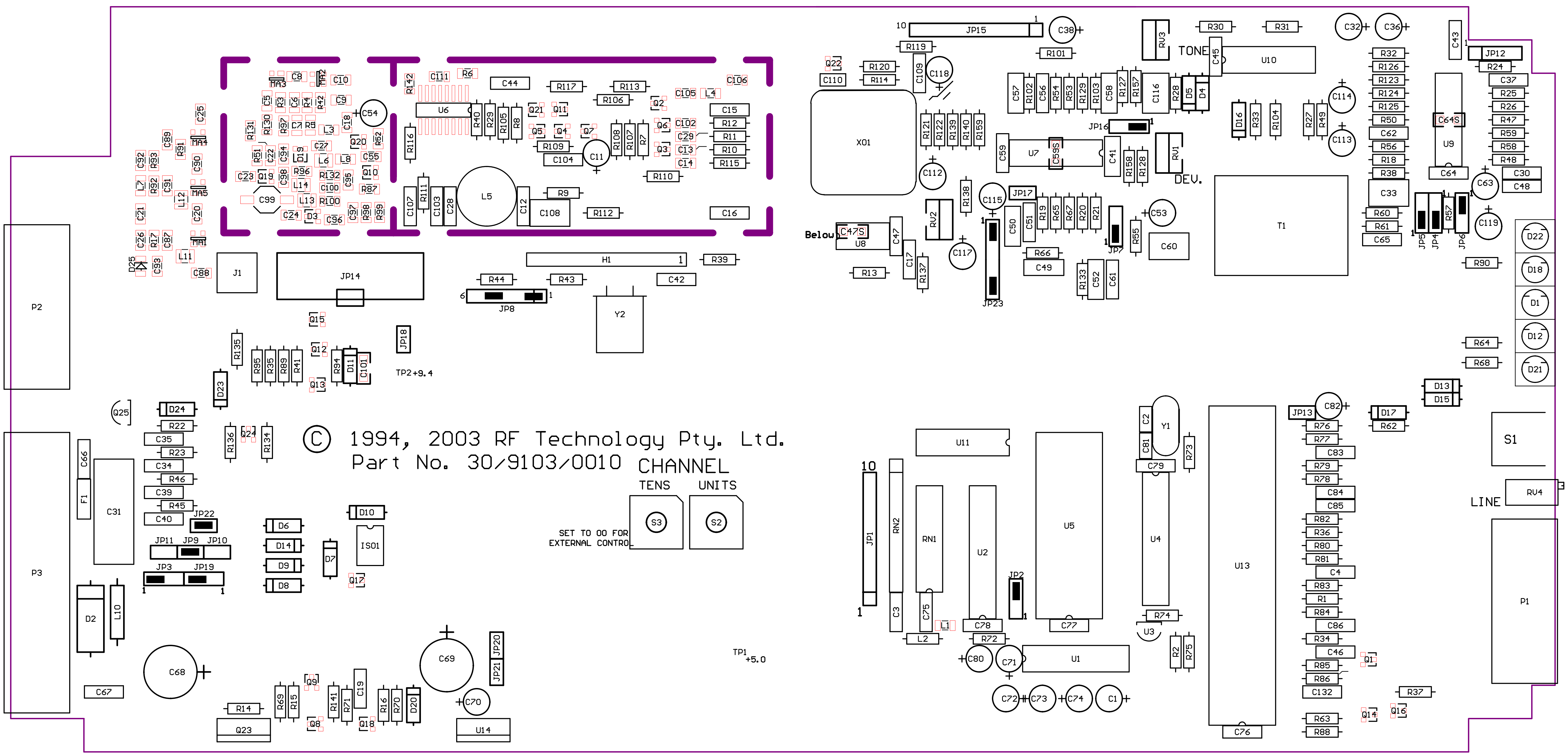
* = Standard Factory Configuration



STANDARD EXCITER JUMPER CONFIGURATION



LOCAL MIC.
JP12
PTT
C45
1N0
C36
10U
C43
1N0
R24
330
R25
330
C37
1N0
U9B
TLC274
R26
18K
R32
10K
HI-Z +
HI-Z -
R22
10K
R23
10K
C30
100N
C35
1N0
C34
1N0
C48
100N
R58
64K9
R59
64K9
R47
64K9
R48
64K9
Vab1
+9.4
C64
U9A
TLC274
HiZ amplifier
R27
10K0
R49
7K50
C32
10U
AGND
LINE INP.
C63
10U
-20
0 DBM
JP6
JP4
3K56
2K7
Mix HiZ and
600 ohm audio
R57
91K
RV4
10K POT
LINE
LEVEL
R56
100K
C62
100N
R18
10K
C33
1U
LINE I/P1
LINE I/P2
LINE I/P3
LINE I/P4
JP3
C31
2U2
T1
600 ohm
C65
1N0
R61
1K2
R60
1K2
JP5
TERM
+5L
R62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Part No. 30/9103/0010
CHANNEL
TENS
UNITS
SET TO 00 FOR
EXTERNAL CONTROL
TONE
DEV.
LINE
TP2+9.4
TP1 +5.0