

TEN - TEC

**OPERATOR'S  
MANUAL**

**JUPITER**

**MODEL 538**

**HF Transceiver**

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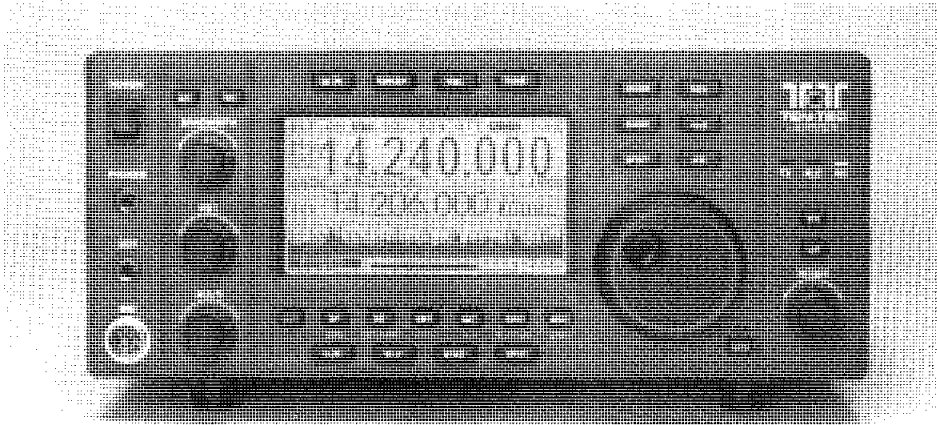
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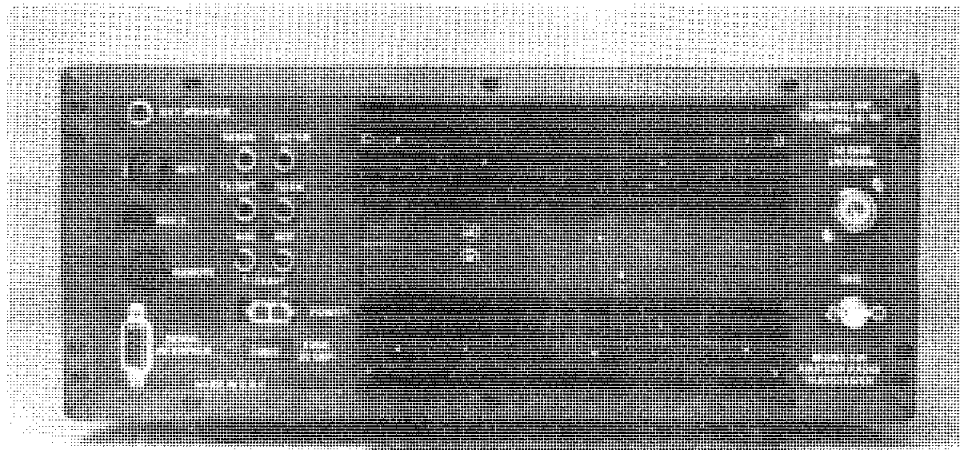
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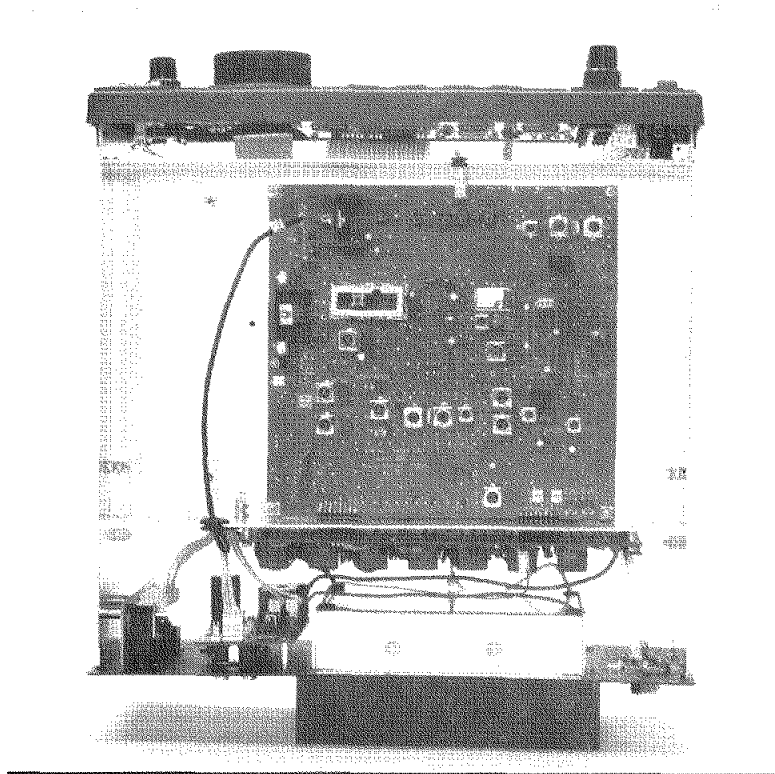
**Photo 1 Jupiter Front View**



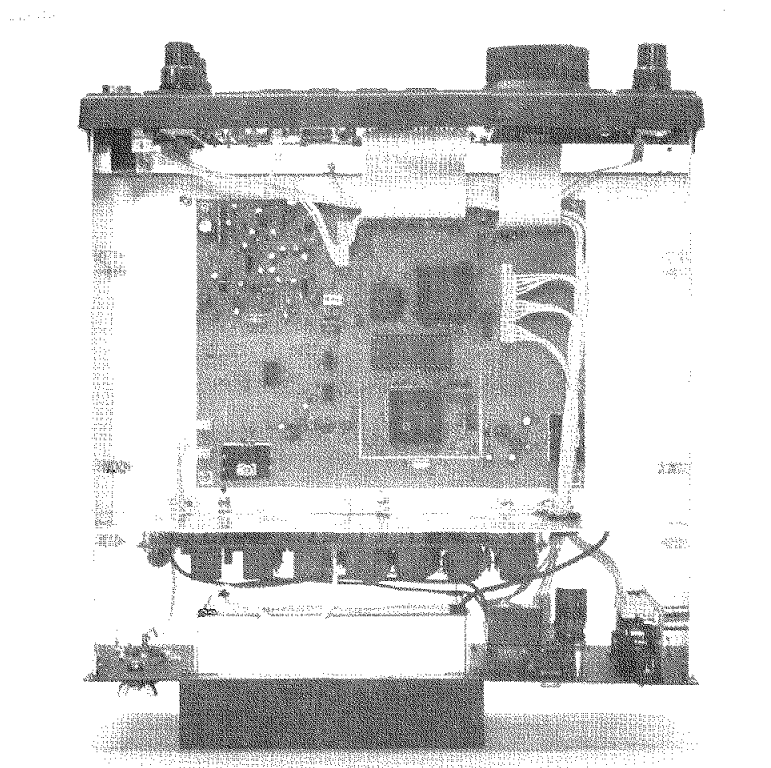
**Photo 2 Jupiter Rear View**



**Photo 3 Jupiter Top View**



**Photo 4 Jupiter Bottom View**



## SPECIFICATIONS

### GENERAL

MODULATION	LSB, USB, CW, AFSK, FM, AM.
FREQUENCY RANGE	Receive: 100 kHz – 30 MHz. Transmit: All amateur radio frequencies: 160 through 10 m.
DISPLAY	Multi-line text and graphic Liquid Crystal Display.
VFO	Dual VFOs with SPLIT transceive option.
OFFSET TUNING	+/- 10 kHz on receive and transmit.
MEMORIES	128 internal to Jupiter. - Virtually any PC will store thousands of memories in Pegasus Emulation Mode.
FREQUENCY ACCURACY	+/- 90 Hz at 25°C at 30 MHz for 1 year.
ANTENNA IMPEDANCE	50 ohms, SWR <2:1, unbalanced .
POWER REQUIRED	12-14 VDC @1.5 A receive, 20A transmit.
CONSTRUCTION	9 epoxy glass PC boards, molded front panel, aluminum chassis, textured painted steel cover.
DIMENSIONS	HWD = 5" x 12.125" x 13" (12.7 x 30.8 x 33 cm.) Depth includes heat sink on rear panel.
WEIGHT	12 lbs. (5.45 kg.)
<u>TRANSMITTER</u>	
RF OUTPUT	5 – 100 watts, ALC stabilized.
DC INPUT	Maximum 250 watts @ 14 VDC. 100% duty cycle for up to 10 minutes. Continuous duty with user-supplied air cooling of rear panel heat sink.
MICROPHONE	4-pin front panel connector accepts 200 ohm to 50K ohm impedance microphones with 5 mV (-67 dB) output and provides DC polarizing voltage (+9 V) for electret microphones.
LINE INPUT	1 mV p-p into 47k Ohms.
T/R SWITCHING	PTT or VOX on SSB, Adjustable QSK on CW.
CW OFFSET	DSP generated: programmable 0 to 1270 Hz. Sidetone automatically matches offset.
FM DEVIATION	5 kHz peak.
METERING	Selectable: Forward power or SWR.
SSB GENERATION	DSP implementation of Weaver method SSB.



CARRIER SUPPRESSION	> 50 dB.
UNWANTED SIDEBAND SUPPRESSION	> 60 dB at 1.5 kHz.
THIRD ORDER INTERMODULATION	25 dB below two tones @ 100 watts PEP.
SPURIOUS OUTPUT	Better than 40 dB below peak power output.
<b><u>RECEIVER</u></b>	
SENSITIVITY	0.35 $\mu$ V typical for 10 dB S+N/N @ 3 kHz bandwidth, SSB mode. Equivalent to 11.35 dB noise figure.
SELECTIVITY	34 filters built-in with 1.5:1 or better shape factors (-6 to -60 dB): 300 Hz, 330 Hz, 375 to 750 Hz in 75 Hz increments, 750 Hz to 3 kHz in 150 Hz increments, 3 kHz to 6 kHz in 300 Hz increments, and 8.0 kHz.
SPURIOUS FREE DYNAMIC RANGE	90 dB @ 3 kHz bandwidth at 50 kHz tone spacing.
THIRD ORDER INTERCEPT	+10 dBm.
NOISE FLOOR	-126 dBm @ 3 kHz bandwidth.
S-METER	S9 calibrated to 50 $\mu$ V standard.
ATTENUATOR	20 dB, selectable by operator
PASSBAND TUNING	+/- 2 kHz.
I-F FREQUENCIES	1 <sup>st</sup> I-F 45 MHz, 2 <sup>nd</sup> I-F 455 kHz, 3 <sup>rd</sup> I-F 12 kHz.
I-F REJECTION>	60 dB typical.
IMAGE REJECTION	> 60 dB typical.
RECEIVE RECOVERY TIME	less than 20 ms, including SPLIT mode.
AUDIO	Speaker: 1 watts @ 4 ohms. Line out: > 1 V p-p into 600 ohms.
SPECTRUM SWEEP DISPLAY	8 widths from 240 Hz to 2.4 MHz, with tuning cursor and selectable Autosweep function.

## INTRODUCTION

The Model 538 JUPITER is a conventional front-panel version of Ten-Tec's notable PEGASUS HF transceiver, designed in response to our customers who want PEGASUS performance without requiring a computer to operate the radio. Apart from the changes necessary to include hardware controls, JUPITER uses the same IF DSP technology and RF circuitry, building on our years of engineering HF DSP receivers for government, commercial and amateur radio use.

JUPITER's "brain" is an Analog Devices™ AD2181 Digital Signal Processor (DSP). The DSP and control software implements many functions formerly performed by dedicated signal and control components. Digital Signal Processing provides JUPITER with features that would otherwise be too expensive or impractical for amateur equipment. The extensive repertoire of receive and transmit filter bandwidths is an example of a feature that would be too costly and space consuming without DSP. Automatic Notch (**AN**) and Noise Reduction (**NR**) are examples of functions which are not practical to include in amateur equipment without DSP.

Many new features and upgrades to DSP equipment require only new computer code rather than electronic components. Since introducing JUPITER, Ten-Tec has added firmware for AM transmit, a noise blanker, and speech processing. Internet downloads can quickly upgrade firmware in the Flash memory.

Because JUPITER is a traditional front panel transceiver, all features and functions are available without need of

computer skills and a computer. In keeping with modern trends and its PEGASUS heritage, however, the JUPITER design offers a built-in **PEGASUS Emulation Mode** that allows computer control for those who wish the best of both worlds. Using this mode, described later in this manual, makes all controls and functions visible on your computer screen and controllable by the computer keyboard, mouse, and optional Model 302J remote encoder/keypad.

JUPITER covers all amateur bands, 160 through 10 meters, using CW (full break-in – a Ten-Tec tradition!), SSB (with adjustable DSP generated transmit bandwidth filtering), digital modes (AFSK, PSK), FM and AM. JUPITER provides continuous receiver coverage from 100 kHz to 30 MHz.

## **OVERVIEW OF THIS MANUAL**

Chapter 1 of the manual is the JUPITER installation guide.

Chapter 2 contains the steps for getting JUPITER operational right out of the box.

Chapter 3 is a detailed operation guide that will help you take full advantage of the transceiver's capabilities.

Chapter 4 has the schematics and parts lists for JUPITER.

Chapter 5 covers JUPITER's theory of operation.

Chapter 6 contains the glossary of terms used in this manual. We recommend that you refer to it if you come across an unfamiliar descriptive term.

Chapter 7 is a troubleshooting guide, should you have difficulty with transceiver operation.

Chapter 8 describes PEGASUS EMULATION MODE of computer-controlled operation at the operator's option.

## UNPACKING

Examine your transceiver carefully for signs of shipping damage. Should any damage be apparent, notify the delivering carrier immediately, stating the full extent of the damage.

Retain all damaged cartons. Liability for shipping damage rests with the carrier. We recommended you keep the shipping carton and fillers in the event that storage, moving or re-shipment becomes necessary.

The following hardware and accessories come standard with your JUPITER. Make sure that you have not overlooked anything.

Qty	Part #	Description
1	#74269	User's manual
1	#74020	Warranty Card
1	#46176	5-pin DIN male to 4 phono plugs
1	#86095	DC power cord
2	#41020	Female terminal pins
1	#35165	2 pin power connector shell
1	#35017	¼ in. stereo plug
1	#35003	Male phono plug
1	#35057	4-pin mic. connector

If any of the previous items are missing, contact the repair department at Ten-Tec for replacements.

Repair Department (865) 428-0364  
 Switchboard (865) 453-7172  
 FAX (865) 428-4483

## ACCESSORIES

There are several Ten-Tec station accessory items that are suitable for use with JUPITER. Contact the Ten-Tec sales department for pricing and availability information.

Part #	Description
#963	+13.8 VDC, 25 amp power supply
#302J	Remote tuning encoder/keypad
#306	4 pin to 2 pin power supply cable adapter
#701	hand microphone
#705	desk microphone
#35057	4-pin microphone connector
#80573	2-pin DC connector with pins

## 1. INSTALLATION

### 1.1. POWER SUPPLY

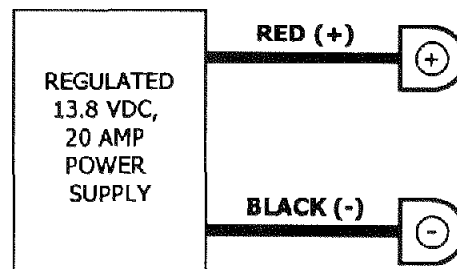
JUPITER requires a source of well-filtered and regulated DC voltage. The supply voltage can range from +12.0 to +15.0 VDC but +13.8 VDC is optimum and recommended. The power source must be capable of 20-ampere peaks. If you wish to run JUPITER to its full capability on digital modes, the current capacity must apply at 100% duty cycle, and you will need to direct a cooling air stream (from a fan) at the heat sink.

**NOTE: ALWAYS ENABLE THE POWER SOURCE *FIRST* AND *THEN* THE TRANSCEIVER. IF THE DC SOURCE IS SUPPORTED BY A GENERATOR OR ALTERNATOR, ALWAYS TURN OFF THE TRANSCEIVER BEFORE THE EQUIPMENT IS STARTED OR SHUT OFF. THESE RECHARGING DEVICES OFTEN GENERATE LARGE VOLTAGE SPIKES THAT CAN DAMAGE THE TRANSCEIVER.**

The TEN-TEC Model 963 power supply is specifically designed for this service. This supply has built-in overcurrent protection and all the necessary RF bypassing.

The 2-pin DC connector on the rear panel of JUPITER is polarized to permit attaching the mating plug in only the correct way. Determine the correct orientation and plug the power cable into JUPITER. If you plan to use a power source other than Model 963, we recommend the pre-assembled DC power cord (#86095) that we supply with the 963. Older model Ten-Tec power supplies with 4-pin connectors

require the model 306 4-pin to 2 pin adapter.



**Figure 1-1 Power Supply Connections**

We have also included two spare connector pins (#41020) and a connector shell (#35165) for building your own cord. Be sure to use no less than 14 gauge stranded wire for these connections because of the high current demand on transmit.

### 1.2. ANTENNA

The transmitter is protected against damage from *brief* load impedance mismatches ranging from a dead short to an open circuit. Operation at or near full power is possible with an unbalanced (coax feed) load impedance between 25 and 100 ohms (approximately 2:1 SWR). Antennas with higher SWR require an external antenna tuner, as do single wire and balanced feedline types.

An SO-239 connector on the rear panel connects the antenna to the transceiver.

### 1.3. EXTERNAL SPEAKER

Note: JUPITER provides a connection for an *ungrounded* external speaker. JUPITER's audio power amplifier IC uses a full-bridge circuit. This connects the speaker terminals as a balanced load between two amplifiers driven in push-pull. While the circuit floats both sides of the speaker off ground, it maximizes the undistorted output power from a single-ended supply.

**Be sure to keep both speaker leads ungrounded if you connect them to any station accessories.**

#### 1.4. FRONT PANEL CONNECTORS AND INDICATORS

Three front panel jacks connect the operator's microphone, key or keyer, and headphones to the transceiver. Four LEDs provide the operator with transceiver status information.

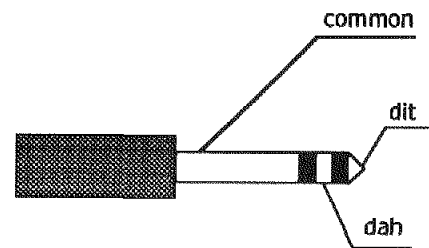
##### 1.4.1. PHONES

This is a standard jack used for connecting 8-ohm stereo or mono headphones. However, because dropping resistors reduce the output to headphone level at this jack, it cannot provide sufficient audio level to drive an external speaker. Use the rear panel **EXT SPEAKER** jack for that purpose.

##### 1.4.2. KEY

Two methods are available for keying the transceiver in CW mode. The front panel **KEY** jack provides CW with a straight key, bug, or external keyer. To use JUPITER's internal keyer with your iambic or single lever paddle, refer to Figure 3 and use the 1/4" stereo plug (#35017) supplied in the packing kit. A front panel **MENU** function allows the operator to configure the jack to accept either a monaural (2-circuit - "mono") input (like a straight key, bug, or external keyer), or a "stereo" paddle input. The factory value on power-up (or RESET) is to accept a "mono" input.

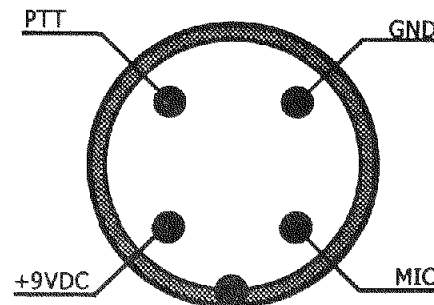
Older Ten-Tec keyers with a phono plug output will work with JUPITER via a RadioShack™ part #274-320 (or equivalent) male phono plug to 1/4" mono male adapter. Refer to paragraph 3.2 for more information on **MENU** functions.



**Figure 1-2 Paddle Wiring for Built-in Keyer**

##### 1.4.3. MICROPHONE

The Ten-Tec standard 4-pin **MIC** jack accommodates a low impedance microphone and provides a polarizing voltage of +9 VDC to power an electret microphone. Any Ten-Tec microphone, using our 4-pin connector, works without change. Most dynamic, ceramic, crystal, or electret microphones also work with this transceiver. When adapting another microphone for use with JUPITER, please refer to the wiring diagram in Figure 1-3. The JUPITER packing kit includes a spare 4-pin microphone plug (#35057). Be sure to use shielded cable to prevent any RF interference. Electret microphones and some with built-in preamplifiers will require the +9 VDC available at pin 4.



Front View of 538

**Figure 1-3 Microphone Connections**

#### 1.4.4. RX LED

The green **RX** LED is lit when JUPITER's receiver is operational.

#### 1.4.5. TX LED

The red **TX** LED is lit when JUPITER is transmitting.

#### 1.4.6. AUTOMATIC LEVEL CONTROL LED

The red **ALC** LED lights when transmit power peaks reach the proper level. Use it for adjustment of **MIC** gain. The LED will flash when JUPITER is transmitting at proper ALC level for CW or SSB.

### 1.5. REAR PANEL CONNECTIONS

There are several rear panel connections on JUPITER, to interface other station equipment with the transceiver.

#### 1.5.1. 50-OHM ANTENNA

This SO-239 jack connects to a suitable (SWR < 2:1) 50-ohm coax-fed antenna.

#### 1.5.2. GROUND

A wing nut connector provides the means to connect JUPITER to your station ground. A good ground system is essential for optimum operation of any transmitter. The best solution is to connect all the station equipment chassis together using a heavy flat ground braid. Use another length of braid to connect to a ground rod. Keep all connections as short as possible. If you are not using a linear amplifier a less ideal ground will suffice. A short ground connection to the copper cold water plumbing pipe is usually acceptable.

Antenna type and proximity to the station are also factors in choosing ground methods. With good resonant antennas located away from the station, the AC ground in your house wiring may be adequate.

#### 1.5.3. DC POWER

This is a 2-pin MOLEX™ connector for connection of a suitable 13.8 VDC power supply with 20-ampere capacity. See paragraph 1.1 for details.

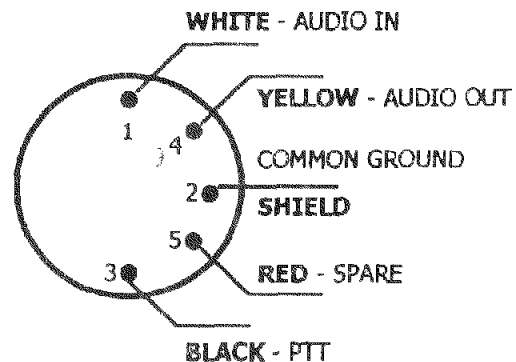
**Please observe correct polarity when using this jack or damage will result.**

#### 1.5.4. FUSE

A 25-ampere blade fuse protects JUPITER's transceiver wiring if an internal fault should occur. JUPITER's packing kit includes a spare fuse (#27074). These fuses are commonly available at automotive supply stores.

#### 1.5.5. ACCESSORY JACK

The **ACC1** jack is for interfacing equipment requiring audio in/out connections, like a TNC or phone patch. These connections also provide for digital mode operation. For information on using JUPITER in digital modes, see section 2.6.4. Figure 1-4 shows wiring information. Use the supplied cable (#46176) or an equivalent to connect accessories.



Looking at Rear Panel

Figure 1-4 Accessory Jack Connections

#### 1.5.6. TX ENABLE / TX OUT

These phono jacks are the input (**TX EN**) and output (**TX OUT**) for a QSK (full break-in) linear amplifier-keying loop. They are operational only when enabled via the **MENU** screen.

For operation without an amplifier, the default setting is **OFF**. See sections 3.5 and 3.15 for details.

#### **1.5.7. EXTERNAL T/R**

The **EXT T/R** connector provides for keying a non-QSK external linear amplifier. This connection does not use a relay. It is an open-collector transistor switch rated for a maximum of +24 volts and 200 mA at the amplifier key line.

**Do not connect EXT T/R to a circuit that will impose higher voltage, higher current or negative polarity.**

Please see section 3.15 of this manual for more information on connecting an amplifier.

#### **1.5.8. AUXILIARY +13.5V**

These two phono connectors provide 13.5 VDC power for connecting accessory equipment. They are in parallel. The maximum current available for both jacks combined is 2 amperes.

#### **1.5.9. REMOTE**

The **REMOTE** jack is for connection of the optional Model 302J (or 302) remote encoder/keypad via its included cable. The difference between the two models is only the paint color.

#### **1.5.10. SERIAL INTERFACE**

The **SERIAL INTERFACE** provides for connection of JUPITER to a COM port on your personal computer, via a standard 9-pin serial port cable. This connection allows electronic updates of

the firmware in JUPITER's flash ROM, and operation in the Pegasus Emulation Mode of remote control. Chapter 3, paragraph 3.18 describes optional operation by computer control.

#### **1.5.11. SPARE**

This phono connector has no connection as supplied from the factory, and is available for custom applications.

#### **1.5.12. ACC - 2 JACK**

This connector is for future use.

#### **1.5.13. AMPLIFIER DUTY CYCLE**

JUPITER has a thermostat sensor on the Power Amplifier module that disconnects DC power from the entire transceiver when the heat sink temperature exceeds 85°C (about 180°F). The transceiver will not power on until the heat sink cools to 80°C (about 170°F).

Our testing has established that the heat sink temperature will reach 85°C after approximately 15 minutes of continuous transmitting at 100 watts output without a cooling fan. The time to shutdown will vary with band and load impedance. We recommend that you always employ a cooling fan to blow air across the heat sink when operating key down digital modes such as RTTY, PSK31, and SSTV.

## 2. GETTING STARTED

### 2.1. INTRODUCTION

Some JUPITER controls are constantly in use, and some need changing only occasionally according to your operating preferences. The default settings listed below will allow you to get started with JUPITER. You can customize the operation to more closely fit your preferences, as you become familiar with the transceiver.

When approximately 5 seconds of inactivity occur after a control change, JUPITER saves your settings in non-volatile memory. This happens automatically and does not require a standby battery as older technology did. A pound sign (#) appears in the lower right-hand corner of the screen to verify the automatic store. If you power down the radio with the # in place, your current settings will return the next time you apply power.

### 2.2. POWERING JUPITER FOR THE FIRST TIME

Connect a suitable resonant antenna (SWR less than 2:1) to the rear panel **50 OHM ANTENNA** connector. Connect a suitable **DC** power source to the transceiver (see paragraph 1-1). Turn on your power supply first, then JUPITER.

At power-on, you will see the firmware version message briefly on the display, after which the screen will resemble Figure 2-1.

All functions on the transceiver have buttons or rotary knobs for control, and are also controllable by pointing, clicking, and/or "dragging" with your computer mouse in **Pegasus Emulation Mode** (See chapter 8). JUPITER constantly displays key functions and will show any other

setting in response to pressing the appropriate front panel key(s).

### 2.3. INITIAL RADIO SETTINGS

As supplied from the factory, JUPITER's firmware includes a number of default settings to allow the operator to quickly start using the transceiver. Please note that we recommend reading **ALL** the operating instructions before operating the transceiver.

The top row of JUPITER's graphic display screen (see Figure 2-1) shows the status of eight alternate-action controls starting with **AN** and **NR**. Black letters on the colored background indicate that the function is off and colored letters on a black background (reverse video) mean that the function is active. Initially, these controls should be **off**.

### 2.4. A BRIEF TOUR OF THE FRONT PANEL CONTROLS

The following paragraphs will provide some familiarity with the controls, after which more details follow in chapter 3.

#### 2.4.1. Left Edge

Along the left edge of the panel are the **POWER** switch and three self-explanatory connectors: **PHONES**, **KEY**, and **MIC**.

#### 2.4.2. Second Column

The next column to the right on the panel has the **AN** and **NR** buttons which enable the DSP functions, **Automatic Notch** and **Noise Reduction**. Below those buttons are three rotary knobs labeled **BANDWIDTH**, **PBT**, and **MULTI**.

Rotating the **BANDWIDTH** knob chooses the receiver selectivity from among JUPITER's 34 built-in DSP filters. After a reset operation, **BANDWIDTH** defaults to **2400** hertz, the normal SSB setting, and a good place to start. That indication appears just above the horizontal line near the



middle of the display. The **BANDWIDTH** control is always available.

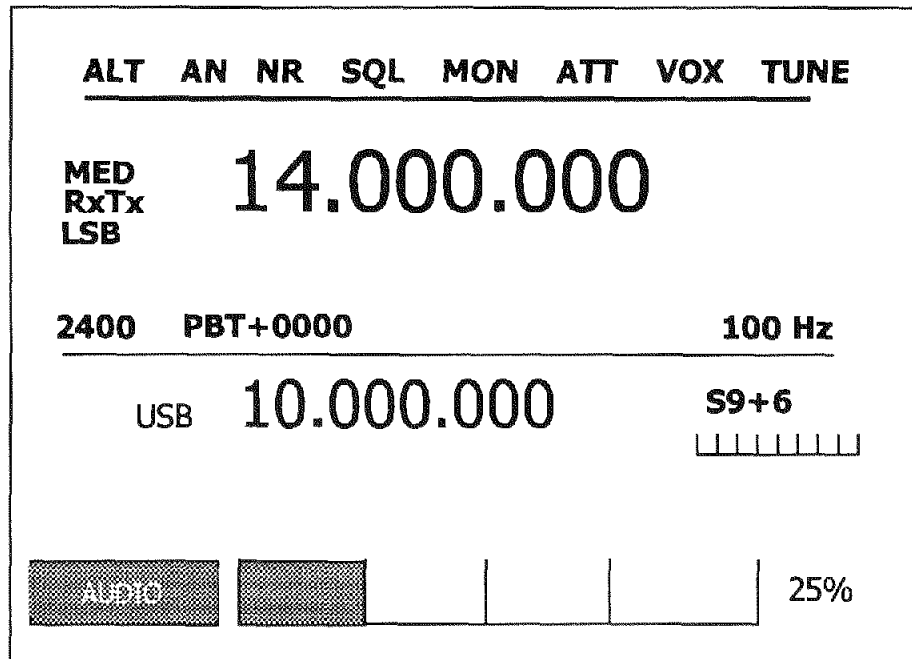


Figure 2-1 - JUPITER Screen in MULTI mode

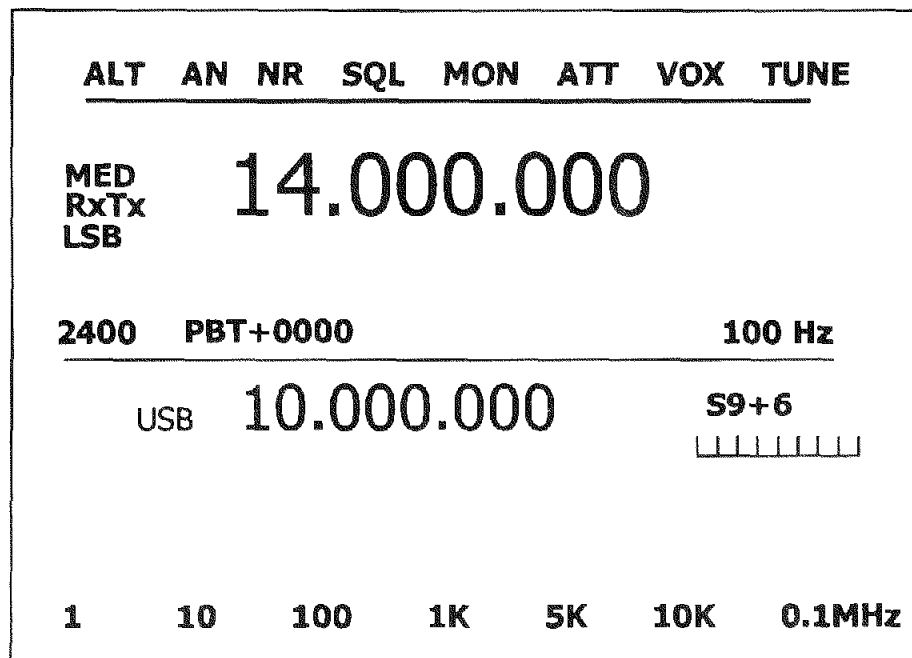


Figure 2-2 - JUPITER Screen in Tuning Step Mode

**PBT** (Passband Tuning) shifts the receiver's passband up or down with respect to the tuned frequency when the **PBT** button is **on**. **JUPITER** displays the **PBT** setting just below the first two digits of **VFO A**. Start with **PBT** off.

The **MULTI** knob provides a means to adjust any of a number of settings selected by pressing a particular button. For example, pressing **AF** allows the **MULTI** knob to adjust the audio (speaker or headphones) volume, while pressing **PWR** causes **MULTI** to adjust the transmit power level. The selected function appears in the lower left-hand corner of the screen as reverse-video (light lettering on a dark background) and a bar graph illustrates the setting as a percentage of full-scale. Settings made using the **MULTI** control persist after switching to another function, and after you switch off the transceiver. Start with **MULTI** controlling **AF**.

#### 2.4.3. Top Row

Along the top of the panel, above the radio display, are four push-on push-off buttons.

**ATTN** (attenuator) reduces the RF gain of the receiver by 20 dB in case of overload by very strong signals. The attenuator is normally off.

Pushing **SWEEP** paints a snapshot of the activity either side of the tuned frequency. **JUPITER** mutes the audio for a few seconds while painting the screen. The horizontal dimension signifies relative frequency and the vertical dimension signifies relative strength of the signals. The width of the frequency scan is selectable as an item on the **MNU** screen. A vertical cursor on the display follows the main tuning frequency as a

aid for tuning to signals or clear spots as desired. **SWEEP** is an alternate-action key. See chapter 3 for more details on this function.

The **VOX** key switches the control of receive and transmit states between push-to-talk and Voice-Operated-Xmit. Three adjustments to this function are available on the **MENU** screen, discussed in chapter 3. Its operation is conventional.

The **TUNE** button keys the transmitter steadily in **CW** mode, regardless of the selected operating mode. This produces a steady RF carrier, useful for observing the output power setting or adjusting an external antenna coupler. Because **JUPITER** will automatically shut down if a badly mismatched load causes excessive power supply current, it is prudent to reduce power before activating **TUNE**.

**Be certain that a proper antenna or dummy load is connected before pressing TUNE, and avoid causing interference to others.**

Push the **TUNE** button to activate or deactivate. When activated, the **TUNE** legend will change to reverse video, the S-meter reading will change to **PWR**, or **SWR**, and the red **TX** LED on **JUPITER**'s front panel will light.

#### 2.4.4. Middle Row

Immediately below the display is a row of 7 buttons, starting with the yellow lettered **ALT** (alternate) button. Each of the next six buttons has a primary function, marked in white letters on the button, and an alternate function marked in yellow on the panel below. Tapping the **ALT** button (no need to hold it) temporarily re-assigns a selected button

in that row to its alternate (yellow) function.

**ALT+AGC** (automatic gain control) steps the **AGC** hold time among its **SLOW**, **MEDIUM**, and **FAST** settings. Tap **ALT+AGC** each time you wish to change the **AGC** speed. **MEDIUM** is a good starting point. The **AGC** setting appears to the left of the **VFO A** display.

Pushing **RF** (RF gain) assigns the **MULTI** rotary control to the RF gain control function. **RF** appears at the bottom of the display in reverse video. A bar graph and a numeric readout show the setting as a function of full-scale. The initial (and usual) setting is **100%**.

**ALT+ KEY SPD** (keyer speed) connects the **MULTI** control to set the speed of JUPITER's internal electronic keyer. **KEYER** appears at the bottom of the display in reverse video with a bar graph and readout to show the setting as a function of full-scale. A function on the **MNU** screen enables either the internal keyer or an external device. JUPITER's keyer speed ranges from 1 to 63 words per minute. See paragraph 3.3 for **MENU** functions.

Pushing **PBT** alternately enables or disables the passband tuning function, described in paragraph 2.5.2. **PBT** is initially off.

Pushing **ALT+SQL** (squelch) controls the normally off squelch function (via the **MULTI** knob). See paragraph 2.5.8. The **SQUELCH** legend appears at the bottom of the display in reverse video. A bar graph and numeric value show its setting as a fraction of full-scale. The **SQL** indicator in the top row of the screen shows reverse video when the signal level is below the threshold setting and squelch mutes the receiver.

**SQL** works in all modes. Start out with **SQL** at **0%**.

The **MIC** (microphone) button assigns the **MULTI** rotary control to the microphone gain function. **MIC** appears at the bottom of the display in reverse video, and a bar graph with a numeric readout shows the setting as a fraction of full-scale. Try an initial setting of **30%**.

**ALT+S-T** (sidetone volume) controls the CW sidetone volume with the **MULTI** knob. Sidetone volume defaults to **23%**. A sidetone pitch adjustment is another function of the **MENU** screen. Both are effective only in **CW** mode.

**PWR** (power) assigns the **MULTI** rotary control to set the RF power level at which **ALC** regulates. **PWR** appears at the bottom of the display in reverse video, and a bar graph shows the setting as a function of full-scale.

**ALT+M-LVL** adjusts the audio **MONITOR** volume in the operator's speaker or headphones. The control interacts with the **AF** control, and some adjustment of both will be required. **MONITOR** appears at the bottom of the display in reverse video and a bar graph shows the setting as a function of full-scale. See **ALT+MON** below.

**MNU** (menu) switches the display to show text for 21 "set-and-forget" settings for JUPITER functions. Rotating the main tuning knob moves the reverse video highlight to select a function. Turning the **MULTI** control changes the displayed state of the selected function, e.g. **ON** or **OFF**. See paragraph 3.3 for a description of the **MNU** functions. To return to the operating display, push **MNU** again.

**ALT+MON** enables or disables the **MONITOR** function by which the operator can hear his microphone audio for purposes of equipment adjustment. The default setting is **off**.

#### 2.4.5. Bottom Row

**V>M** (VFO-to-Memory) prompts the operator to select one of the 128 memory channels (with the **MULTI** control). A second push of the button stores the frequency and mode data from **VFO A** in the selected memory channel.

**M>V** (Memory-to-VFO) recalls the frequency and mode data from a memory channel selected by the **MULTI** control and *copies* it to VFO A, switching JUPITER to that setting. Rotating the **MULTI** control after pushing **M>V** steps JUPITER to the frequency and mode of each stored channel in sequence. Using any control except **M>V** or **MULTI** at this point returns JUPITER to the screen before the **M>V** operation. A second push of the **M>V** button writes the stored channel data into VFO A allowing full use of all controls on the recalled setting.

Tapping **STEP** (tuning step size) briefly replaces any bar graph currently showing on the bottom of the display with a horizontal "soft menu". The screen temporarily redefines the 7 buttons below it as tuning step sizes ranging from very fine (**1 Hz**) to coarse (**0.1 MHz**). Pushing any of the buttons sets the resolution of the Tuning knob and returns the display to its state before **STEP** was pushed, but with the new step size in effect. **STEP** returns JUPITER to the **MULTI** screen in about 3 seconds if no step size key is pressed.

Pushing and holding the **SPOT** button switches in an audio tone at the selected **SIDETONE** frequency to aid in tuning

the receiver exactly to the frequency of an incoming CW signal. **SPOT** and **SIDETONE** adjustments appear on the **MNU** function, covered in paragraph 3.3.

#### 2.4.6. Cluster Above Tuning Knob

The six buttons in this group control JUPITER's **BAND**, **MODE**, **VFO A** and **VFO B** functions.

**MODE** steps sequentially through JUPITER's five demodulation modes: **USB**, **LSB**, **CW**, **FM**, & **AM**. Initially, JUPITER sets the **MODE** to **USB** on 10 through 20 meters, to **CW** on 30 meters, and to **LSB** on 40 through 160 meters. These settings are conventional and popular on those bands, but stored operator settings can override them. JUPITER returns to the last mode used on a given band.

**BAND** steps sequentially through JUPITER's 9 amateur radio band allocations: **28**, **24**, **21**, **18**, **14**, **10.1**, **7.0**, **3.5**, & **1.8** Megahertz. The receiver coverage is continuous from 0.1 to 30 Megahertz with automatic band changing.

The **SPLIT** key switches between transceiving on the **VFO A** frequency (normal state) and receiving on the **VFO A** frequency but transmitting on the **VFO B** frequency (**SPLIT** state). **SPLIT** is normally **off**. See paragraph 2.4.11.

The **REV** (reverse) key works while **SPLIT** operation is active. While you push and hold the **REV** key, JUPITER tunes and receives on the frequency and mode from **VFO B** (the *transmit* VFO). Though **REV** defaults to **off**, it is convenient in particular operating situations. See paragraph 2.4.12 below for an example of **REV** use.

To switch the active VFO, tap the **A/B** button above the tuning knob. The **VFO**

**A** and **VFO B** displays will now exchange contents, each transferring its frequency and mode to the other one.

**A=B** copies the **VFO A** frequency and mode to the **VFO B** register.

#### 2.4.7. Lock Button

Pushing the **LCK** button locks the main tuning to prevent disturbing JUPITER's frequency by inadvertent movement of the knob. A nearby red LED lights when the frequency is locked. Push **LOCK** again to re-activate the tuning knob.

#### 2.4.8. RIT & XIT Buttons

Alternate presses of the **RIT** button activate or disable the **RIT/XIT** (Receiver / Transmitter Incremental Tuning) control. In the active **RIT** state, the control offsets the receiver frequency from that in the **VFO A** display without changing the transmit frequency. The control has a +/- 10 kHz range. The setting appears at the right of the display under the **VFO A** frequency range. **RIT** is normally off.

**XIT** offsets the transmit frequency from that in the **VFO A** display without changing the receive frequency. Otherwise it works the same as **RIT** and is normally off.

JUPITER will activate only one of the Incremental Tuning modes at a time.

#### 2.4.9. Mode Selection

JUPITER transceives in **USB**, **LSB**, **CW**, **AM** and **FM** modes within the 160 through 10-meter amateur bands. Use either **USB** or **LSB** as appropriate for the digital modulation modes (**RTTY**, **AMTOR**, **PSK31**, **FACTOR**, et cetera). Select the modulation mode by repeated presses of the **MODE** button until the desired mode shows on the display to the left of the **VFO A** readout.

#### 2.4.10. VFO Operation

JUPITER has two tuning registers or "VFOs", each of which displays and holds an operating frequency and mode. The larger (main) display is **VFO A**. **VFO B** is the smaller (alternate) display. To the left of each VFO readout is one of the following legends: **RxTx**, **Rx**, **Tx**, or a blank. They keep the operator aware of which VFO is active in receive and transmit states.

Before transmitting, it is wise to note which frequency the active transmit VFO holds.

#### 2.4.11. Split Operation Example

When the **SPLIT** mode is active, the receiving frequency and mode are in the **A** display (marked **Rx**) and the transmitting frequency and mode are in the **B** display (marked **Tx**). Pressing **SPLIT** again restores the **RxTx** designator to **VFO A** and leaves **VFO B** with inactive status.

For example: a DX station is transmitting on 14.195 and listening for calls around 14.200. Tune the **VFO A** display frequency to the calling frequency near 14.200. Tap the **A=B** button to equalize both VFOs at 14.200. Tap the **SPLIT** key. Now retune **VFO A** to the DX at 14.195. **VFO A** now controls the receive frequency. **VFO B** controls your transmit frequency and you are ready to join the action.

#### 2.4.12. Reverse-Split Example

With JUPITER in **SPLIT**-frequency operation, the momentary-action **REV** key exchanges the frequency and mode between **VFOs A** and **B** while you press it. **REV** is a convenient operating aid in situations such as the one below.

For example: a DX station is transmitting on 14.195 MHz and listening for calls around 14.200. Tune the main display frequency to the DX at 14.195. Tap the **A=B** key to set both VFOs at 14.195. Select **SPLIT** operation, then press and hold **REV**. **VFO A** tunes the receiver on the split (transmit) frequency while you hold the button. Tune and listen around 14.200 to determine where to transmit. (You might choose a relatively clear frequency or you might choose to use the same frequency as a successful caller). When you release **REV**, the receiver is back on the DX station's frequency and the transmitter is ready on the **SPLIT** frequency you chose by monitoring in **REV**.

The optional Model 302J remote encoder/keypad can also control **REV**. **RIT** and **XIT** provide yet another way to split frequencies in this versatile radio. See paragraph 2.4.8.

## 2.5. RECEIVER OPERATION

JUPITER's receiver provides general coverage reception from below 500 kHz to 30.0 MHz. The **BAND** key cycles through the amateur bands, but the receiver will tune over its entire range from any starting frequency, automatically switching band filters as necessary. All receiver features are functional throughout the range.

### 2.5.1. Receive Filter Selection

JUPITER comes with 34 built-in receive filters. To choose any filter, rotate the **BANDWIDTH** knob (which is always active). This updates the filter bandwidth legend to the left of the frequency display. Except for **FM**, where JUPITER's selectivity is fixed at

15 kHz, all filter choices are independent of mode.

### 2.5.2. Passband Tuning (PBT)

This is perhaps the most useful of all of the receiver controls, especially in a crowded band. Use the alternate action **PBT** button to enable or reset passband tuning. The **PBT** knob allows you to move the receiver passband back and forth across the desired signal. It can "drop QRM off one side or the other" of the passband. Adjusting it can often improve the quality and intelligibility of a signal. Note the **PBT** offset reading below the first two digits of **VFO A**.

### 2.5.3. Audio and RF Gain Controls

Use the **AF** button and the **MULTI** control to the left side of the graphic display to adjust audio level. Push the **RF** button to assign the **MULTI** control to the **RF** gain function.

JUPITER's receiver design provides good selectivity and dynamic range. Under most conditions, leave **RF** gain at 100%. Should you experience receiver overload, the **RF** gain control can limit receiver distortion and/or overload response in the presence of extremely strong signals. There is also a switchable 20 dB front-end attenuator (see paragraph 2.4.3).

### 2.5.4. Automatic Gain Control (AGC)

The **AGC** button selects the decay time constant of the **AGC** circuit. It steps through **FAST**, **MEDIUM**, or **SLOW** settings by pushing the **ALT+AGC** buttons. The current **AGC** setting appears just above and to the right of the **VFO A** readout.

### 2.5.5. DSP Noise Reduction

Pushing the **NR** (noise reduction) button activates or deactivates JUPITER's DSP noise reduction algorithm. This system identifies desired signals mathematically

and tracks them with a set of adaptive filters. **NR** suppresses broadband noise by as much as 15 dB depending upon the noise statistics.

#### 2.5.6. **AN (Automatic Notch)**

Pushing the alternate action **AN** button enables this sophisticated DSP algorithm and puts its indicator in reverse video at the top of the screen. There is no frequency adjustment for the automatic notch. It seeks out and nulls all constant carriers in the receiver passband. This notch works well for SSB modes but is not useful in CW nor digital modes because it tends to notch out the desired signal as well as the QRM.

#### 2.5.7. **S Meter**

While JUPITER is receiving, the "meter" at the right of the **VFO B** display shows received signal strength in S-units. Each S-unit represents a 6-dB change in signal level. S9 occurs at the standard 50  $\mu$ V level. The meter has a numeric readout and a bar graph.

In transmit, the same meter displays either forward power (**PWR**) or standing wave ratio (**SWR**) based on its **MNU** setting.

#### 2.5.8. **Squelch**

This control is operational in all modes. To adjust, push the **SQL** button to bring up the **SQUELCH** bar graph and legend which shows that the **MULTI** control is connected to that function. **SQUELCH** mutes the receiver audio unless a signal greater in strength than the control setting is present. To set **SQL** properly, tune to a clear frequency and adjust the **SQUELCH** (via **MULTI**) control just into the threshold for receiver muting.

#### 2.5.9. **RF Attenuator**

This function, useful when very strong signals overload the receiver, introduces 20-dB attenuation to all signals. To

enable or disable the attenuator, push the **ATTN** button.

#### 2.5.10. **Lock**

The **LOCK** button on the front panel disables the **VFO A** tuning knob and the optional Model 302J tuning knob. With **LOCK** enabled all other JUPITER functions including direct frequency entry from the serial port or Model 302J keypad remain available. A red LED above the button indicates the locked condition.

### 2.6. **TRANSMITTER AND TRANSCEIVER OPERATION**

#### 2.6.1. **CW Operation**

Attach an appropriate CW keying device to the front panel **KEY** jack (see paragraph 1.4.2). Select **CW** mode. The default value of JUPITER's firmware is to accept input from a straight key, bug, or external keyer through the key jack via a "mono" (2-circuit) plug. JUPITER's CW keying is full break-in by default. Adjustable timing via the **MNU** screen, detailed in paragraph 3.2, can provide much longer switching times between transmit and receive to suit operator taste. **MNU** can also enable JUPITER to accept input to the internal keyer from your paddles. The red **ALC** and **TX** LEDs on the front panel will light during CW transmission.

#### 2.6.2. **Push-to-Talk USB/LSB Operation**

Select either **USB** or **LSB** and key the transceiver by pressing the microphone's **PTT** (push-to-talk) button. The red **TX** LED on JUPITER's front panel will light to indicate you are now transmitting. While speaking into the microphone, advance the **MIC** control until the red **ALC** LED on the front panel begins to flash. The **ALC** LED indicates that the transceiver is generating full

output power relative to the setting of the **POWER** control. See paragraph 3.6.3 for operation with **VOX**.

18 distinct DSP generated transmit bandwidths are available for use via the **MNU** screen. 3000 Hertz is the default setting. See paragraph 3.6.1 for more information.

### 2.6.3. Monitor

The **MON** button enables you to monitor your transmitter audio in any **MODE**. See paragraph 3.6.7 for information on adjusting the monitor.

### 2.6.4. Operation in Digital Modes

The rear panel **ACC 1** jack provides a direct connection for digital mode operation via SSB. JUPITER's 5-pin DIN connector has pins for **Audio In**, **Audio Out**, **PTT**, and **Ground**. The fifth pin on the **ACCESSORY** jack is available for future assignment. You can easily interface a TNC to JUPITER by using the supplied multi conductor ribbon cable, (#46176). See **Figure 1-4** for the proper DIN plug connections.

The ends of the 46176 cable bear color codes as follows:

**White = Audio In**

**Yellow = Audio Out**

**Black = PTT**

**Red = (Spare)**

Connect an appropriate TNC or modem to the **ACC 1** jack using the #46176 cable provided, or an equivalent. To accept input from the accessory jack, you must turn on the **MNU** screen, select **AUDIO SOURCE** by highlighting it with the tuning knob, and select **LINE** with the **MULTI** knob.

### 2.6.5. FM Operation

**NOTE:** The FCC currently authorizes this mode for HF use only on the 10 meter 'phone band. National band plans call for FM only above 29.0 MHz.

Select the **FM** mode on the radio screen. Press the microphone PTT button to transmit. The receive filters have a fixed setting in **FM** mode and the **PBT** control is not active. The **MIC** gain control acts as a deviation control in **FM** mode.

### 2.6.6. AM Operation

Previous to firmware version 1.09 JUPITER's **AM** mode was receive-only, but this version added **AM** transmit operation with 100 watts peak envelope power (which corresponds to 25 watts of carrier power). See paragraph 3.2 for details.

### 2.6.7. Control Summary

Table 2-1 and Table 2-2 below summarize JUPITER's front panel controls. The **DESCRIPTION** field explains the abbreviated panel and key markings. The **ACTION** field deals with the several types of control action that JUPITER employs.

- Rotary controls have the familiar "analog" action.
- Alternate-action controls operate in a push-on – push-off fashion.
- The controls listed as **MULTIPLE** in the **ACTION** column are push-button keys that temporarily assign the designated function to the multi-purpose rotary control and display the control name and setting at the bottom of the screen.
- Alternate action one-shot is a special case for the **SWEEP** control. Alternate key pushes cause JUPITER to display a frequency-spectrum



snapshot and then to clear the display.

- Push & **MULTI** action requires selecting the function with a key press and controlling it via the **MULTI** control, as is the case with the **M>V** and **V>M** keys.
- A momentary-action control is active only while its key is pushed. **SPOT** and **REV** are examples.

The **AVAILABILITY** field differentiates between “continuous” and “select-with-key” functions. Continuous controls are active full-time and status always appears on the screen. Select-with-key controls require a keystroke before they appear on the screen. Their setting remains effective until changed, but the display changes when the operator pushes another select-with-key button.

**Table 2-1 Jupiter Front Panel Controls**

<b>MARKED</b>	<b>DESCRIPTION</b>	<b>ACTION</b>	<b>AVAILABILITY</b>	<b>COMMENT</b>
<b>AN</b>	Automatic Notch	Alternate action	Continuous	NOT for CW nor data!
<b>NR</b>	Automatic Noise Reduction	Alternate action	Continuous	
<b>BANDWIDTH</b>	Receiver Bandwidth	Rotary	Continuous	Independent of mode.
<b>PBT</b>	Passband Tuning	Rotary	When PBT KEY is on	Setting Displayed On Screen
<b>MULTIPLE</b>	Adjusts any function selected by pushing a FCN key.	Rotary	Continuous	Function & Setting Displayed On Screen
<b>ATTN</b>	20 dB RF Attenuator	Alternate action	Continuous	
<b>SWEEP</b>	Spectral Display	Alternate action one-shot	Continuous. & Menu	Snapshot Function
<b>VOX</b>	Voice Operated Xmit	Alternate action	Continuous - See Menu Functions	See Menu
<b>TUNE</b>	Key-down CW	Alternate action	Continuous in Ham Bands	Always Key-down CW
<b>ALT</b>	Enable Alternate (Yellow) Function	Alternate action	Continuous	
<b>AF</b>	Audio Gain	MULTIPLE	Select-with-key	Setting Displayed On Screen
<b>RF</b>	RF Gain	MULTIPLE	Select-with-key	Usually 100%
<b>PBT</b>	PBT Enable	Alternate action	Select-with-key	Setting Displayed On Screen
<b>MIC</b>	Microphone Level	MULTIPLE	Select-with-key	Setting Displayed On Screen
<b>PWR</b>	RF Power Control	MULTIPLE	Select & See Menu	Setting Displayed On Screen
<b>MNU</b>	Menu Screen	Alternate action	Select-with-key	Scroll with Main Tuning Knob
<b>ALT+AGC</b>	AGC Speed	Alternate action	Select One Step with key	Fast/Medium /Slow
<b>ALT+KEY SPD</b>	Keyer Speed	MULTIPLE	Select-with-key	1 to 63 wpm
<b>ALT+SQL</b>	Squelch	MULTIPLE	Select-with-key	All Modes
<b>ALT+S-T</b>	CW Sidetone Volume	MULTIPLE	Select-with-key	Active only in CW See Menu
<b>ALT+MON</b>	Xmit Audio Monitor	MULTIPLE	Select. See M-LEVEL	Active only in Phone & Data

<b>MARKED</b>	<b>DESCRIPTION</b>	<b>ACTION</b>	<b>PRESENCE</b>	<b>COMMENT</b>
<b>V &gt; M</b>	Store VFO to Memory	Push & MULTIPLE	Continuous	Select 128 Memory Channels with MULTI
<b>M &gt; V</b>	Recall Memory to VFO	Push & MULTIPLE	Continuous	See above
<b>STEP</b>	Select Tuning Rate	Push to select tuning step on soft key menu	Continuous	302J option adds more tuning steps
<b>SPOT</b>	CW tuning-aid tone	Momentary	Select-with-key	Active only in CW
<b>BAND</b>	Select Band	Push to step through amateur bands	Continuous	10/12/15/17/20/30/40/80/160M ; Stores last frequency used
<b>SPLIT</b>	Tx on VFO B	Alternate action	Continuous	Receive on VFO A
<b>REV</b>	Monitor with VFO B	Momentary	Continuous	See Detailed Instructions
<b>A = B</b>	Copy VFO A contents to B	Momentary	Continuous	See Indicators on screen
<b>A / B</b>	Swap VFO Contents	Momentary	Continuous	See Indicators on screen
<b>LCK</b>	Lock Tuning Knob	Alternate action	Continuous	Red LED Indicator
<b>RIT</b>	RIT Enable/Disable	Alternate action	Continuous	Setting Displayed On Screen
<b>XIT</b>	XIT Enable/Disable	Alternate action	Continuous	Setting Displayed On Screen
<b>RIT/XIT</b>	Incremental Offset Tuning: Receiver OR Transmitter	Rotary	Enable with RIT or XIT Key	Setting Displayed On Screen

**Table 2-2 Jupiter Front Panel Controls, (continued)**

### 3. DETAILED OPERATING INSTRUCTIONS

#### 3.1. INTRODUCTION

Chapter 2 of this manual describes many of JUPITER's basic transmit and receive functions in sufficient detail to get started quickly. This chapter provides more detailed operating instructions to permit taking full advantage of the transceiver's capabilities. Customize these settings to your operating preferences. JUPITER will retain them in non-volatile memory if you wait approximately five seconds without adjusting any controls before you remove power from the radio. When you next turn on the radio your custom settings will remain until you change them.

#### 3.2. AM OPERATION

Double-sideband-AM-with-carrier was once the predominant mode of voice modulation in amateur radio. Because **AM** remains popular with some of our customers, Ten-Tec has added DSP firmware to JUPITER to enable that mode.

Two of JUPITER's controls operate differently when **AM** is the selected mode. The **TUNE** control activates the **AM-AUTO-SET** function. Pushing that key with the **MODE** in **AM** causes JUPITER to automatically adjust carrier power to 25 watts in order to keep the peak modulated RF output to 100 watts.

**CAUTION:** the RF output will pulse to 100 watts during this operation. Be certain that no amplifier is inline and active. We recommend using a dummy load rather than an antenna for setting up **AM**.

The **PWR** control becomes an **AM DRIVE** control to permit reducing the carrier level after the **AM-AUTO\_SET** function has done its work. Adjust this control for 25 watts or less of carrier.

#### 3.3. JUPITER's MENU SCREEN

JUPITER's menu screen, shown in Table 3-1 collects the "set-and-forget" controls in a convenient format.

MENU ITEM	CHOICES
TX METER	PWR/SWR
TRANSMITTER	ON/OFF
TX FILTER BW	See BW LIST below
KEYING LOOP	ON/OFF
AUDIO SOURCE	MIC/LINE
EXT T/R DELAY	0 - 100%
SIDETONE FREQUENCY	10 - 1270 Hz IN 10 Hz STEPS
SIDETONE VOL	0 - 100%
SPOT VOLUME	0 - 100%
CW QSK DELAY	0 - 100%
CW WEIGHTING	0 - 100%
CW KEYS	OFF - ON
AUTOSWEEP	OFF/ON
SWEEP RANGE	SELECT RANGE FROM LIST
VOX GAIN	0 - 100%
ANTI-VOX	0 - 100%
VOX HANG	0 - 100%
REMOTE F1	SELECT FUNCTION FROM LIST
REMOTE F2	SELECT FUNCTION FROM LIST
REMOTE F3	SELECT FUNCTION FROM LIST
HIGH BOOST	ENHANCES VOLUME OF HIGH AUDIO FREQUENCIES
CONTRAST	0 - 100%
NOISE BLANKER	OFF/ON
NB SELECTION	0/1/...../7
SPEECH PROC	0 - 100%

Table 3-1 JUPITER's Menu Screen

To access them, press **MNU** and use the main tuning knob to move the reverse-video highlight to any of the items on the menu. To the right of each listed

function its current setting appears. At each position of the highlight you may rotate the **MULTI** control to step the stored setting through its range of choices. You will find the **MULTI** control less sensitive in this mode than with other uses, so turn it until you have seen its range of choices.

### 3.4. TRANSMITTER SETTINGS

#### 3.4.1. Transmitter On/Off

A responsible amateur radio operator takes steps, per FCC regulations, to prevent accidental or unauthorized transmission when he is not in the shack. To disable or enable JUPITER's transmitter, push **MNU** and select the **TRANSMITTER** item by turning the main tuning knob to highlight it. Rotate the **MULTI** control to select **ON** or **OFF** as required. Push **MNU** again to return to the previous screen.

#### 3.4.2. Transmitter Meter

JUPITER's meter display always indicates signal strength in the receive state, but you may choose to display either output power or standing wave ratio while transmitting. Turn on the **MNU** screen and set the highlight on **TX METER**. Turning the **MULTI** control will select either **PWR** or **SWR**.

#### 3.4.3. Output Power

This controls JUPITER's transmitter output power. Push the **PWR** button and use the **MULTI** control to adjust forward output power from approximately 5 to 100 watts. The control is nearly linear in indicated percentage versus actual RF power.

### 3.5. CW SETTINGS

#### 3.5.1. Tx Enable Keying Loop

The **TX EN** and **TX OUT** connectors on JUPITER's rear panel will form a keying loop to operate a QSK (full break-in

CW) linear amplifier with proper T/R sequencing. See 3.15 below for information on connecting an amplifier.

#### 3.5.2. CW QSK Delay

Ten-Tec transceivers have always offered the full break-in operation that many (but not all) CW operators prefer. For reasons of particular preferences and possible limitations of external equipment, JUPITER's transmit-to-receive switching time is another **CW** set-and-forget item on the Menu screen. Select **CW QSK DELAY** from the Menu and adjust the timing with the **MULTI** control. The range of adjustment is from nearly instantaneous to 2.6 seconds.

#### 3.5.3. CW Keyer

This function can accept direct connection of keyer paddles to JUPITER's built-in keyer via the front panel **KEY** jack. JUPITER's default setting is to accept a 1/4" mono key plug from a straight key, bug, or external keyer. To enable the internal keyer, for use with your paddle, select **CW KEYER** on the **MNU** and use the **MULTI** knob to turn on the keyer.

The keyer will default to **OFF** when power is removed. This prevents inadvertent transmission if a 2-circuit plug is in the **KEY** jack as power is applied to the transceiver. Figure 3 in chapter 1 shows proper wiring of keyer paddles and a 1/4-inch stereo plug for use with the internal keyer.

#### 3.5.4. Keyer Speed

The **KEYER SPD** button enables control of JUPITER's internal keyer speed. Activate the button by pressing **ALT + RF**, and set the speed with the **MULTI** control. The range is from 1 to 63 WPM.

#### 3.5.5. CW Weighting

This control adjusts the ratio of dit-to-space timing to suit operator preference

and possible effects of an amplifier. The factory-default setting of 1:1 at 50% will suffice for most purposes. **CW** with extreme values of weighting may sound “distinctive”, but it can be hard to copy!

### 3.5.6. Sidetone Volume

**S.T. VOL** controls **CW** sidetone volume as a separate adjustment from the main radio volume control. These two controls do interact and as main radio volume is increased, sidetone volume will increase. Some experimentation with sidetone volume vs. main volume will result in a comfortable setting.

### 3.5.7. Sidetone Frequency

The most usual pitch setting of beat-frequency oscillator (BFO) offset and monitoring sidetone is 700 Hertz, JUPITER’s default value, but some operators prefer a different pitch. This Menu item assigns the **MULTI** control to adjust the BFO and sidetone together in 10 Hertz steps from 0 to 1270 Hertz.

### 3.5.8. Spot Volume

This **MNU** item adjusts the volume of the **CW** spotting tone aid (see paragraph 2.4.5). The **SPOT** tone occurs only while the front panel **SPOT** button is depressed while in **CW** mode.

## 3.6. SSB AND DIGITAL MODE SETTINGS

### 3.6.1. Transmitter Filter Bandwidth - **IMPORTANT!**

The JUPITER operator should be aware of the implications of using wide SSB filtering while transmitting.

Audio fidelity generally improves with the use of wider SSB transmit filtering. A 3.0 kHz transmit bandwidth has a more “well-rounded” audio response than a narrower bandwidth. Wider transmit bandwidth, however, increases the potential for interference with stations using adjacent frequencies.

The FCC regulations (Part 97) governing amateur radio operation do not specify a maximum transmit bandwidth for SSB communication. However, FCC regulation 97.307(a) requires amateur stations to occupy no more bandwidth than is necessary for the emission type in accordance with good amateur practice. In amateur practice, SSB radio transceivers use **between 2.4 and 2.8 kHz**, and this range is the de facto standard for a communications-grade SSB transmit signal. Regulation 97.307(b) requires that emissions outside the “necessary bandwidth” must not cause splatter interference to operations on adjacent frequencies.

While these are broad regulations subject to interpretation, the responsibility for complying with the regulations rests with the operator. Using a SSB transmit bandwidth wider than necessary for communications and causing interference to adjacent stations while doing so is specifically what these regulations are addressing. In summary, what may be an acceptable bandwidth on a given band at a given time may not be acceptable on another band, or at another time.

SSB transmission on JUPITER is DSP generated. There are 18 available transmit bandwidth filters to suit your individual taste for transmit audio or data. The factory setting is 3000 Hertz.

The available transmit bandwidths are 900, 1050, 1200, 1350, 1500, 1650, 1800, 1950, 2100, 2250, 2400, 2550, 2700, 2850, 3000, 3300, 3600, and 3900 Hertz.

### 3.6.2. Microphone Gain:

The **MIC** button adjusts microphone gain with the ever-versatile **MULTI** control. While speaking into the microphone, advance the **MIC (MULTI)**

control until the **ALC** LED on JUPITER's front panel begins to flash. The LED indicates that the transceiver is generating full power relative to the output PWR setting.

This control provides approximately 22 dB of adjustment, which should accommodate most microphones. In the unlikely event your microphone requires more or less gain, there is a trim potentiometer (R72) on the logic board to provide further adjustment.

### 3.6.3. VOX Controls

To use the **VOX** (voice operated transmit) mode, access the **MNU** and move the highlight to the **VOX** items. To set the **VOX GAIN**, **ANTI-VOX**, and **VOX DELAY** controls, select the required control using the main tuning knob and adjust it using the **MULTI** knob. Once set, these controls should not require adjustment unless operator, microphone, or operating position changes.

### 3.6.4. VOX Gain

Adjust the **VOX GAIN** for desired transmitter action while speaking into the microphone. Avoid making the setting so sensitive that ambient noise will cause unintentional transmission.

### 3.6.5. VOX Delay

After setting **VOX GAIN**, adjust **VOX DELAY** for desired transmitter hang time.

### 3.6.6. ANTI VOX

Adjust **ANTI-VOX** to a level where the receiver audio does not trip the transmitter.

### 3.6.7. MONITOR VOLUME:

JUPITER includes a monitor function for listening to the sound of your microphone audio signal in speaker or headphones. To adjust the monitor volume, activate the **ALT+MON** keys on

the front panel. Proceed by pushing **ALT+M-LVL** and use the **MULTI** knob. The **M-LVL** setting interacts with the **AF** volume control, so work with both adjustments to set a comfortable volume. If you monitor with a speaker, place it carefully to avoid acoustic feedback.

### 3.6.8. MICROPHONE/ SPEAKER vs. ACCESSORY INPUT/OUTPUT:

By selecting either **MIC** or **LINE** at the **AUDIO SOURCE** Menu item, you can instruct JUPITER to route transmit audio from either the microphone jack or the **ACC 1** DIN connector located on the rear panel of the radio. This can facilitate switching the transceiver between voice and digital modes of SSB communication without moving cables.

## 3.7. SWEEP FUNCTION

The **SWEEP** control enables JUPITER's spectral display. It provides a way to view active frequencies in the visual format of a spectrum analyzer. It can help locate activity (or inactivity) on a given range of frequencies. Pressing the button mutes the audio for a few seconds while JUPITER quickly scans a range of frequencies below and above the frequency set by **VFO A**. A vertical dashed-line cursor follows the movement of the **MAIN TUNING** knob to show the tuned frequency in relation to the **SWEEP** display.

See the **SWEEP RANGE MNU** function, Table 3-2, to set the **SWEEP** range with the **MULTI** control.

## 3.8. AUTOSWEEP FUNCTION

Enabling this menu function will cause JUPITER to perform another spectrum sweep as soon as the operator tunes the receiver outside the existing sweep range.

### 3.9. SWEEP RANGE

This **MNU** item uses the **MULTI** control to select one of JUPITER's eight sweep ranges listed below. They range from quite narrow spans suitable for a look either side of a narrow CW or digital mode passband to wide survey sweeps past ham band edges.

Sweep Widths
240 Hz
2.4 kHz
12 kHz
24 kHz
120 kHz
240 kHz
1.2 MHz
2.4 MHz

Table 3-2 JUPITER Sweep Ranges

### 3.10. High Boost

**HIGH BOOST** increases the relative level of higher frequencies in the receiver audio as an aid to operators whose hearing has some loss at those frequencies.

### 3.11. Contrast

This **MNU** item adjusts the contrast of the front panel display to suit ambient lighting conditions and operator taste.

### 3.12. Noise Blanker

This position provides **OFF/ON** control of the DSP Noise Blanker via the **MULTI** control.

### 3.13. NB Selection

In this position of the **MNU** highlight, **MULTI** sets the Noise Blanker to one of seven threshold levels.

### 3.14. Speech Processor

When you select **SPEECH PROC** in the **MNU**, **MULTI** sets the relative level of transmit speech processing from 0 to

100%. A moderate amount of speech processing increases the "punch" of your signal, but too high a setting impairs intelligibility.

### 3.15. Using External Amplifiers

#### 3.15.1. OPERATION WITH A NON - QSK AMPLIFIER

The **EXT T/R** phono connector provides an open collector output for keying a non-QSK linear amplifier. The **EXT T/R DELAY** menu function uses the **MULTI** knob to control the transmit-to-receive changeover (hang) time on the **EXT T/R** output. It is useful for keying a non- Ten-Tec external linear amplifier. The range of adjustment runs from *very short* to a maximum of 2.6 seconds. This guards against hot-switching your amplifier.

Refer to Figure 3-1 for required connections and use shielded cable for the keying line. The **EXT T/R** connection is *not* a relay similar to those found on many older transceivers. It is a transistor switch rated for a **maximum of 24 volts and 200 mA** on the keying line of your amplifier.

Many vacuum tube linear amplifiers such as those formerly manufactured by Collins, Drake, and Heathkit use keying voltages of 100 volts or higher. Further, some older amplifiers have a negative keying voltage instead of positive.

**You cannot connect these *directly* to JUPITER. Please check your linear amplifier operator's manual before connecting the equipment to JUPITER.**

If your amplifier does use negative keying polarity or a higher keying voltage or current value than JUPITER can tolerate, you must use an isolation relay or equivalent level-shifting circuit in the control line between your linear



amplifier and JUPITER. QST and other amateur radio publications have published articles on such devices. The Code Transmission, Digital Communications, or Station Setup chapters in recent ARRL Handbooks have some suitable circuits.

### 3.15.2. OPERATION WITH A TEN-TEC QSK AMPLIFIER

To use a Ten-Tec (or similar) QSK amplifier to greatest advantage on **CW**, cable these connectors to corresponding input and output jacks on the amplifier and enable this loop. See Figure 3-2 for a connection guide. To enable the keying loop, select the **KEYING LOOP** item on the Menu screen by first pushing **MNU** and then turning the main tuning knob to highlight **KEYING LOOP**. Next, rotate the **MULTI** knob until **ON** appears opposite **TRANSMITTER**. Pushing **MNU** again returns you to the previous screen.

The connectors should run in shielded cables to corresponding **KEY IN** and

**KEY OUT** jacks on the rear panel of a Ten-Tec linear amplifier, as shown in Figure 3-2. These connections ensure that proper timing is maintained between the transceiver and amplifier during QSK operation.

Note: The default setting (in the **MNU**) from the factory requires no connection between the **TX EN** and **TX OUT** jacks to operate JUPITER without an amplifier. This is unlike other Ten-Tec transceivers that use a jumper cable for “barefoot” operation with the Ten-Tec keying loop. The keying loop uses hardware “handshaking” between the amplifier and JUPITER to provide timing for full break-in that makes **CW** more efficient for experienced operators. This circuit takes advantage of the fast switching time of a well-designed QSK amplifier.

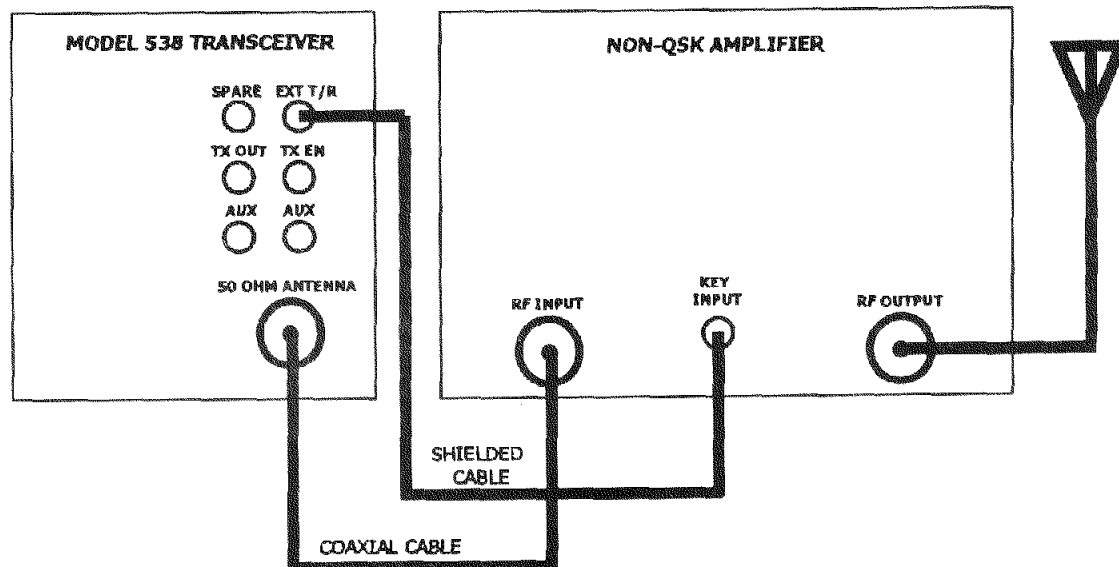


Figure 3-1-Connecting a Non-QSK Amplifier

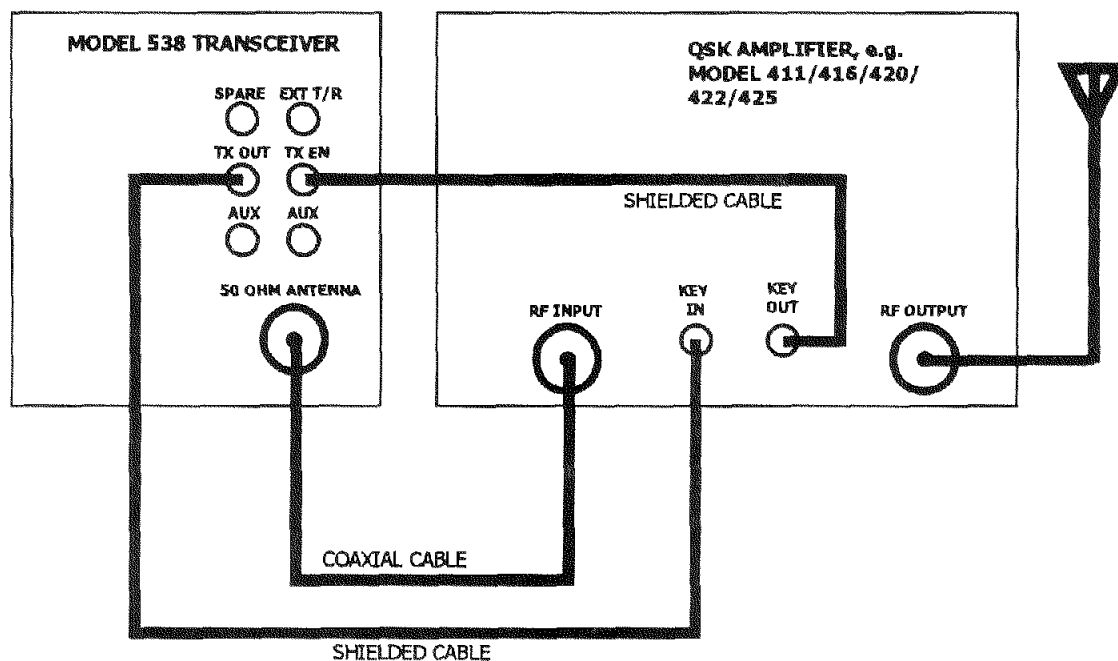


Figure 3-2 - Connecting a Ten-Tec Compatible QSK Amplifier

### 3.16. Control Via 302J Pod

The optional Model 302J remote tuning/keypad control features an “armchair” or “laptop” tuning knob and a numeric keypad for entering specific frequencies into the tuning register.

It also provides three function buttons (labeled **F1**, **F2**, and **F3**) that can bring specific radio functions, as assigned from the **MNU** screen, to a convenient location. A list of these choices appears as Table 3-3 below.

<b>(F1, F2, F3)</b>
<b>STEP</b>
<b>MODE</b>
<b>REV</b>
<b>A/B</b>
<b>SWEEP</b>

Table 3-3 302J Remote Function Keys

### 3.17. Firmware Updates

JUPITER will accept firmware updates via its **SERIAL INTERFACE** on the rear panel. This requires a Windows-based computer with the Ten-Tec update software installed. Use a standard serial port cable to connect the computer to JUPITER’s 9-pin **SERIAL**

**INTERFACE**, and run the software to perform the update. The software is free via a connection to the Ten-Tec page on the Internet World Wide Web.

### **3.18. Pegasus Emulation Mode**

In Emulation mode, JUPITER operates as though it were a Pegasus. When the operator exits the computer program, JUPITER operation reverts to its normal mode. See chapter 8 for details.

### **3.19. Resetting the JUPITER Processor**

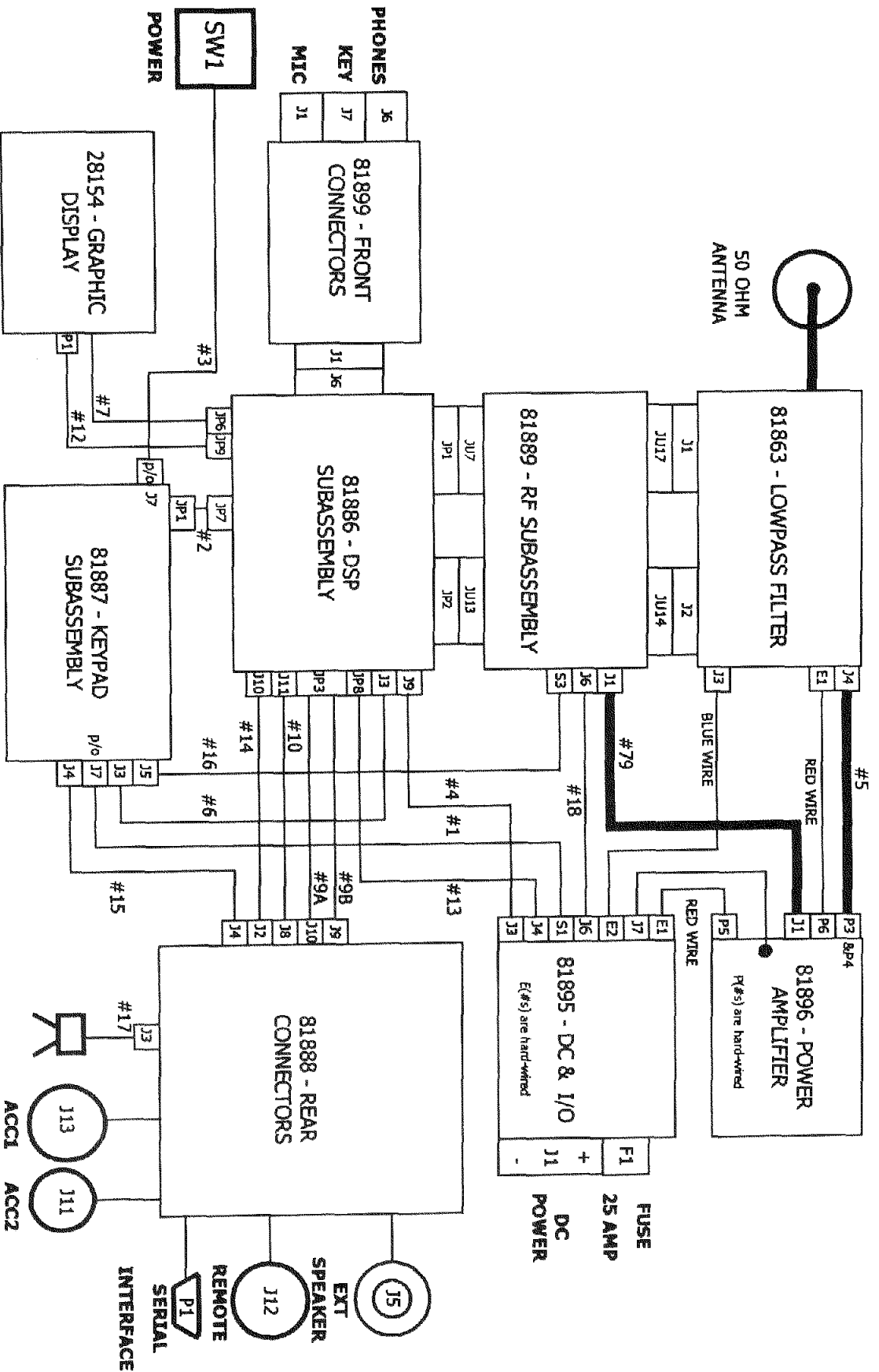
On rare occasions, it may be desirable to return to factory-default memory settings or to “rescue” JUPITER’s processor from a “glitch”. Holding down any control button while switching on the POWER will reset the processor and restore factory settings in memory. This operation is familiar to personal computer users and provides an “escape-hatch” when things go wrong!

#### 4. Jupiter Schematic Diagrams

The following Ten-Tec drawings provide a guide to the JUPITER wiring and parts for maintenance purposes.

DRAWING TITLE	DWG No.	SH #	
INTERCONNECTION DIAGRAM – JUPITER TRANSCEIVER	538.SCH	SH 1/1	Figure 4-1
<b>MODEL 538: RF BOARD 81889</b>	538RF.SCH	SH 1/6	Figure 4-2
MODEL 538: LOCAL OSCILLATORS p/o 81889	81889LO.SCH	SH 2/6	Figure 4-3
MODEL 538: RECEIVER1 p/o 81889	81889RX1.SCH	SH 3/6	Figure 4-4
MODEL 538: RECEIVER2 p/o 81889	81889RX2.SCH	SH 4/6	Figure 4-5
MODEL 538: TRANSMITTER1 p/o 81889	81889TX1.SCH	SH 5/6	Figure 4-6
MODEL 538: TRANSMITTER2 p/o 81889	81889TX2.SCH	SH 6/6	Figure 4-7
ASSY 81889 TOP VIEW COMPONENT MAP	81889TOP	SH 1/1	Figure 4-8
ASSY 81889 BOTTOM VIEW COMPONENT MAP	81889BOT	SH 1/1	Figure 4-8A
ASSY 81889 BILL OF MATERIALS	81889.BOM	4	Table 4-2
<b>MODEL 538: DSP BOARD 81886</b>	538DSP.SCH	SH 1/6	Figure 4-9
MODEL 538: POWER/CONTROL p/o 81886	81886CTL.SCH	SH 2/6	Figure 4-10
MODEL 538: AUDIO I/O p/o 81886	81886ANG.SCH	SH 3/6	Figure 4-11
MODEL 538: CODEC p/o 81886	81886COD.SCH	SH 4/6	Figure 4-12
MODEL 538: LOGIC/DSP p/o 81886	81886CPU.SCH	SH 5/6	Figure 4-13
MODEL 538: PLD p/o 81886	81886PLD.SCH	SH 6/6	Figure 4-14
ASSY 81886 TOP VIEW COMPONENT MAP	81886TOP	SH 1/1	Figure 4-15
ASSY 81886 BILL OF MATERIALS	81889.BOM	3	Table 4-3
No figure 4-16			Figure 4-16
<b>JUPITER ASSY 81863: 538LPF</b>	538LPF.SCH	SH 1/1	Figure 4-17
ASSY 81863 BILL OF MATERIALS	81863.BOM	1	Table 4-4
<b>JUPITER ASSY 81877: 538KEY PAD</b>	538PANEL.SCH	SH 1/1	Figure 4-18
ASSY 81877 BILL OF MATERIALS	81877.BOM	1	Table 4-5
ASSY 78213 PANEL JACKS BILL OF MATERIALS	78312.BOM	1	Table 4-5A
<b>JUPITER ASSY 81888: REAR CONNECTORS</b>	538REAR.SCH	SH 1/1	Figure 4-19
ASSY 81888 BILL OF MATERIALS	81888.BOM	SH 1/1	Table 4-6
<b>JUPITER DCIN: ASSY 81895</b>	81895.SCH	SH 1/1	Figure 4-20
ASSY 81895 BILL OF MATERIALS	81895.BOM	SH 1/1	Table 4-7
<b>100 WATT RF AMPLIFIER: ASSY 81897</b>	81897.SCH	SH 1/1	Figure 4-21
ASSY 81897 BILL OF MATERIALS	81897.BOM	SH 1/1	Table 4-8

Table 4-1 SCHEMATICS & BILLS of MATERIAL



7420 JUPITER  
 Model 538

Figure 4-1 INTERCONNECTION DIAGRAM  
 JUPITER TRANSCIVER

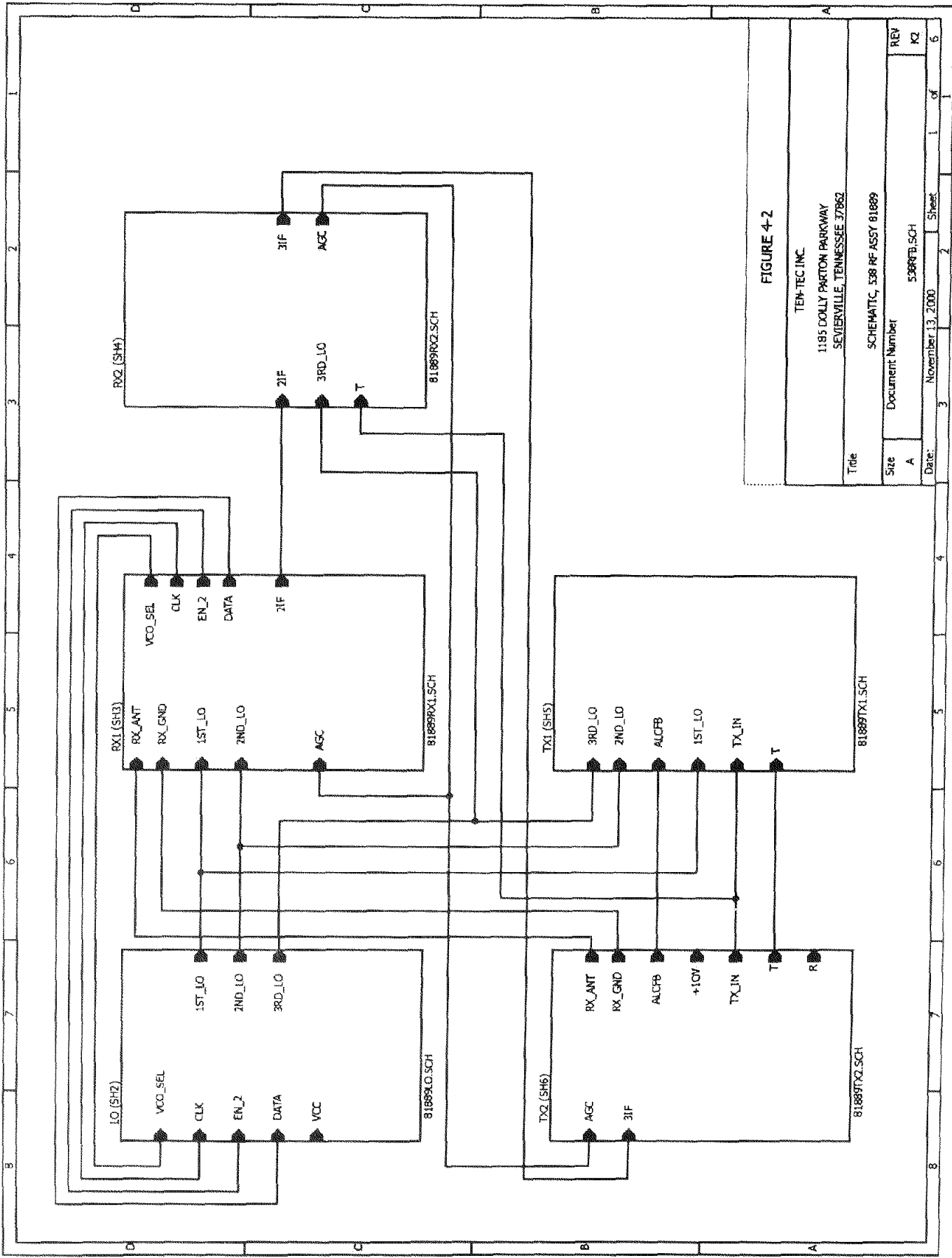


FIGURE 4-2

TEM-TEC INC.  
 1185 DOLLY PARTON PARKWAY  
 SEVIERVILLE, TENNESSEE 37862

Title		SCHEMATIC, 538 RF ASSY 81889	
Size	Document Number	REV	PQ
A	538RF.SCH		
Date:	November 13, 2000	Sheet	6

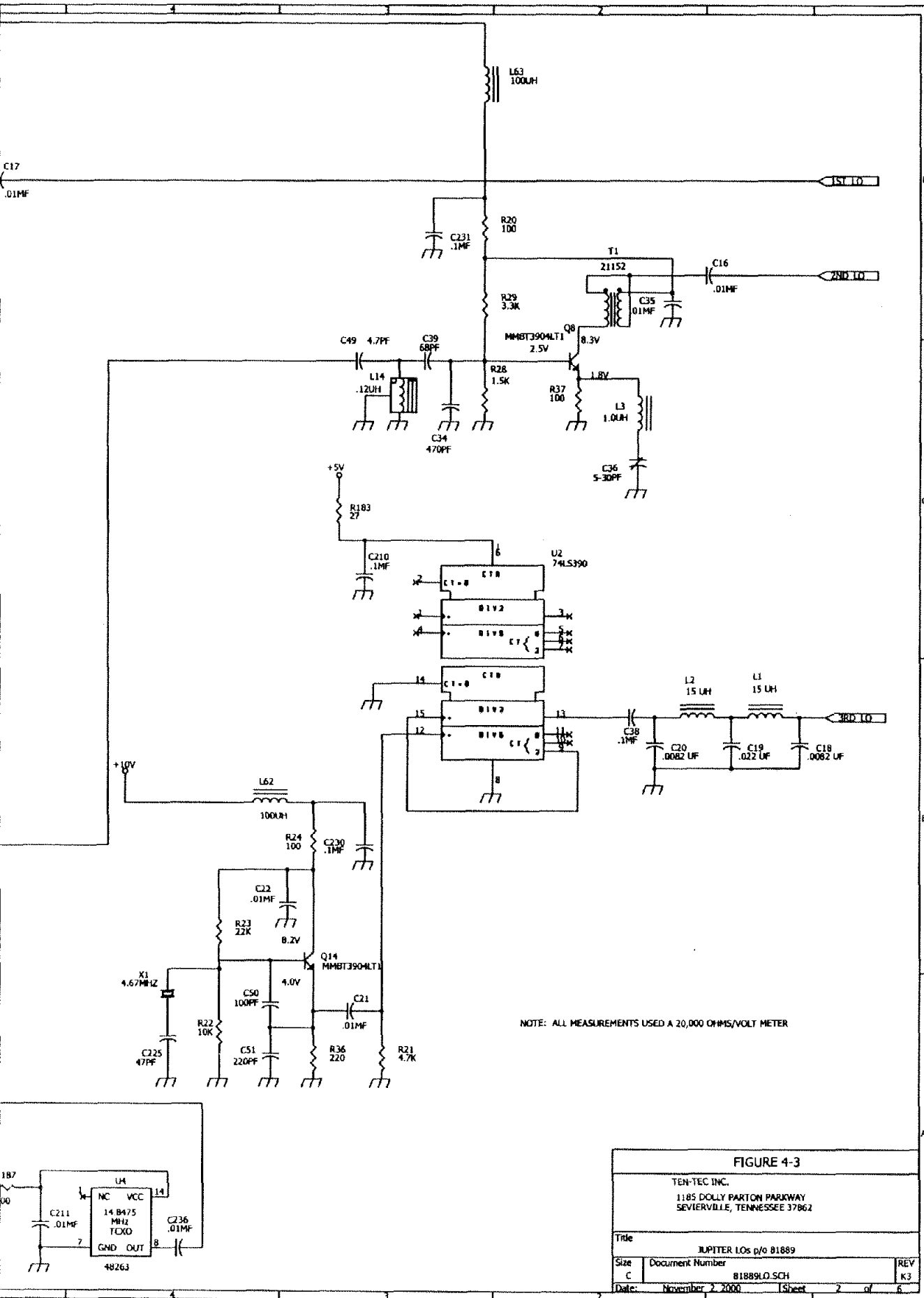


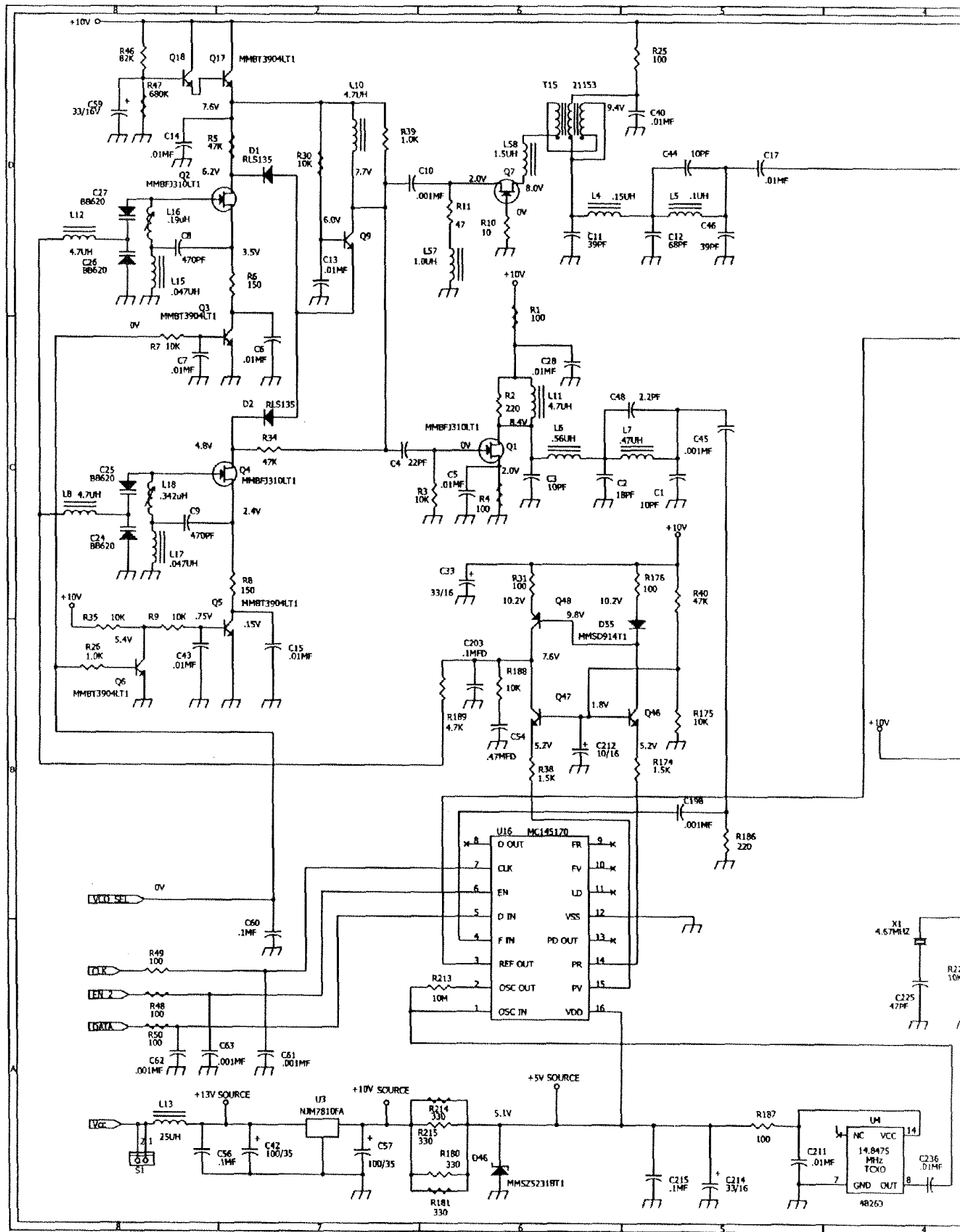
FIGURE 4-3

TEN-TEC INC.  
1185 DOLLY PARTON PARKWAY  
SEVIERVILLE, TENNESSEE 37862

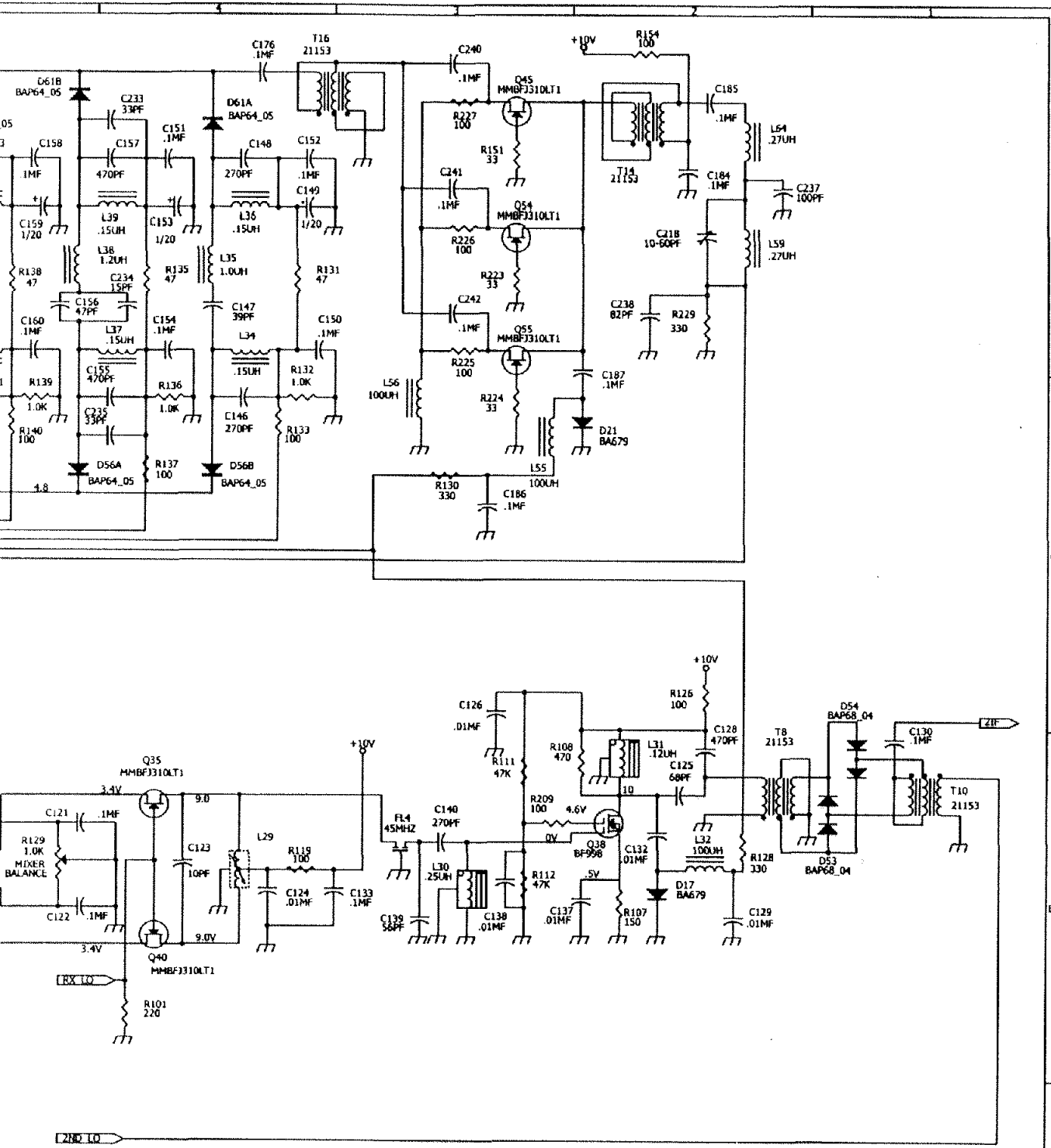
Title JUPITER LOs p/o 81889

Size C Document Number 81889LO.SCH REV K3

Date: November 3, 2000 Sheet 2 of 6







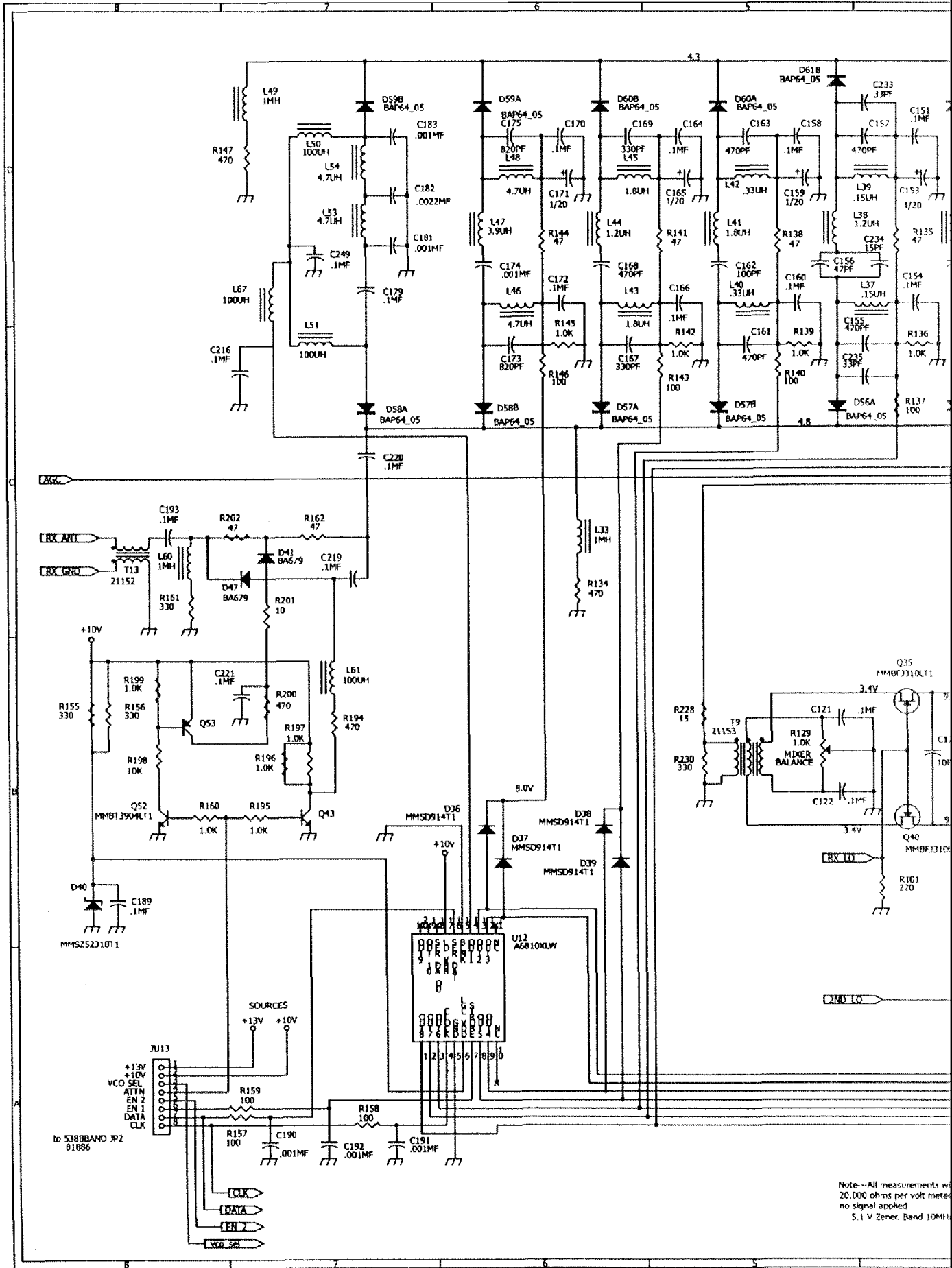
ZIN LO

JU14

TO 53BLOPAS: 81883-32

Note:-- All measurements with a 20,000 ohms per volt meter and no signal applied.  
5.1 V Zener: Band 10MHz

FIGURE 4-4		
TEN-TEC, INC 1185 DOLLY PARTON PKY SEVIERTVILLE, TN 37862		
Title 81889RX1 p/o 538RF3		
Size C	Document Number 81889RX1.SCH	REV KS
Date: October 26, 2000	Sheet 3	of 6



Note--All measurements w/ 20,000 ohms per volt meter no signal applied.  
5.1 V Zener, Band 10MHz

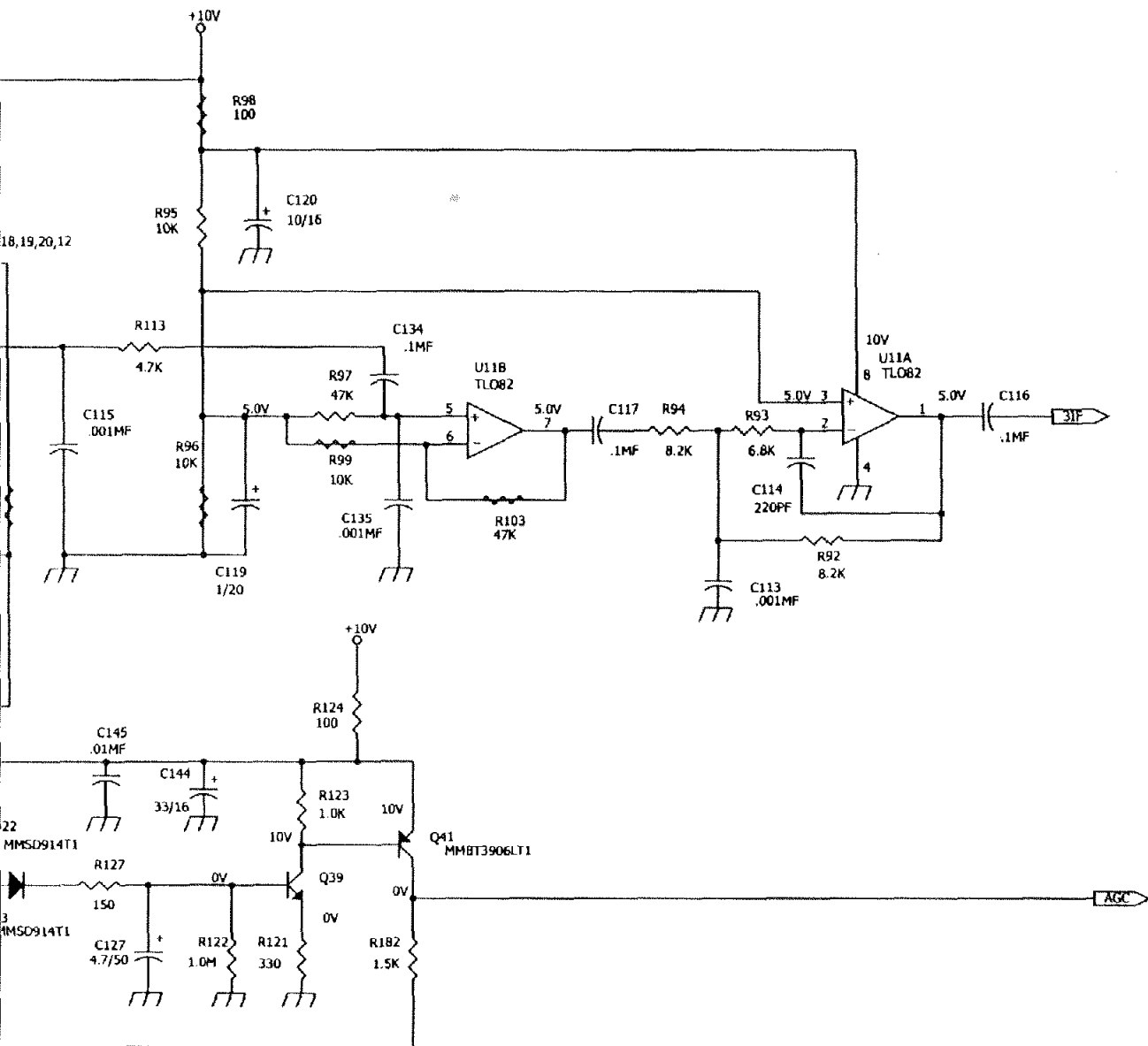
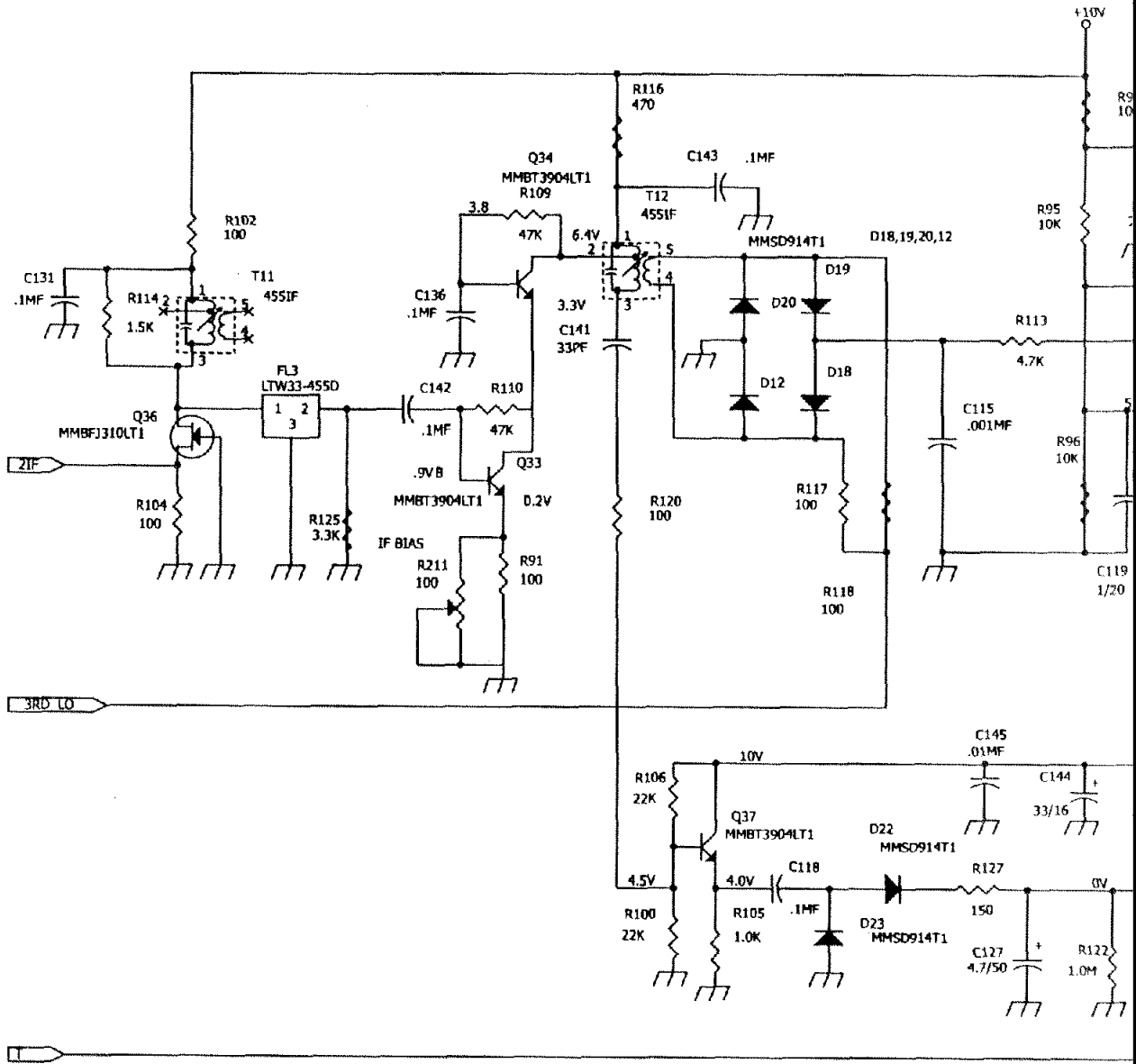
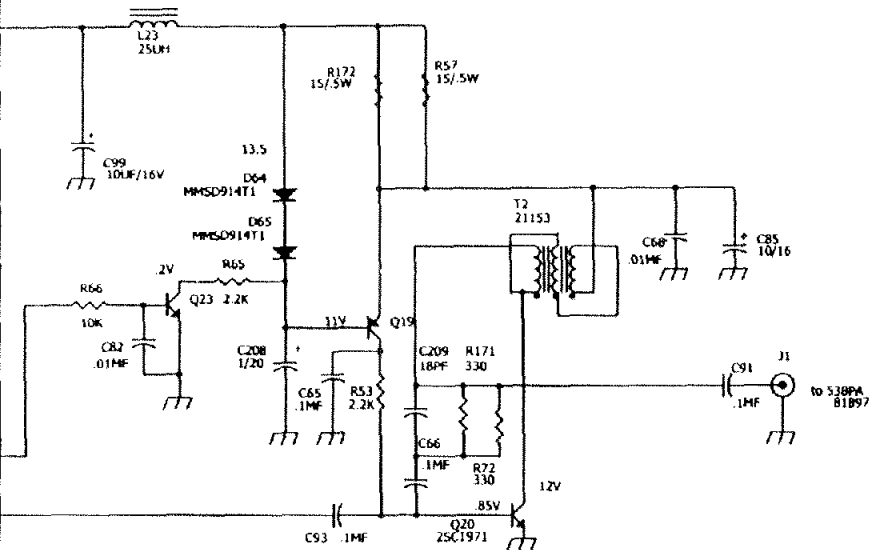
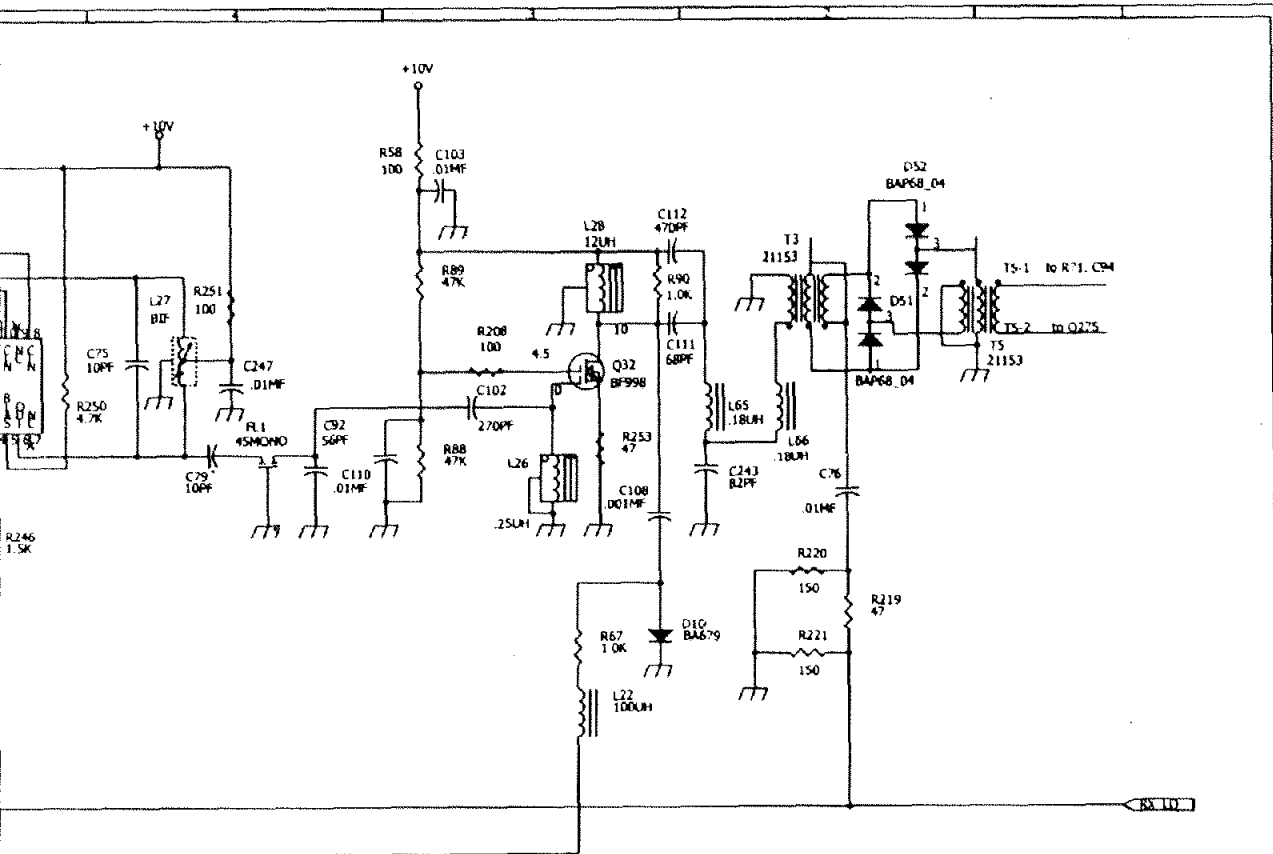


FIGURE 4-5  
 TEN-TEC, INC  
 1185 DOLLY PARTON PKY  
 SEVIERVILLE, TN 37862

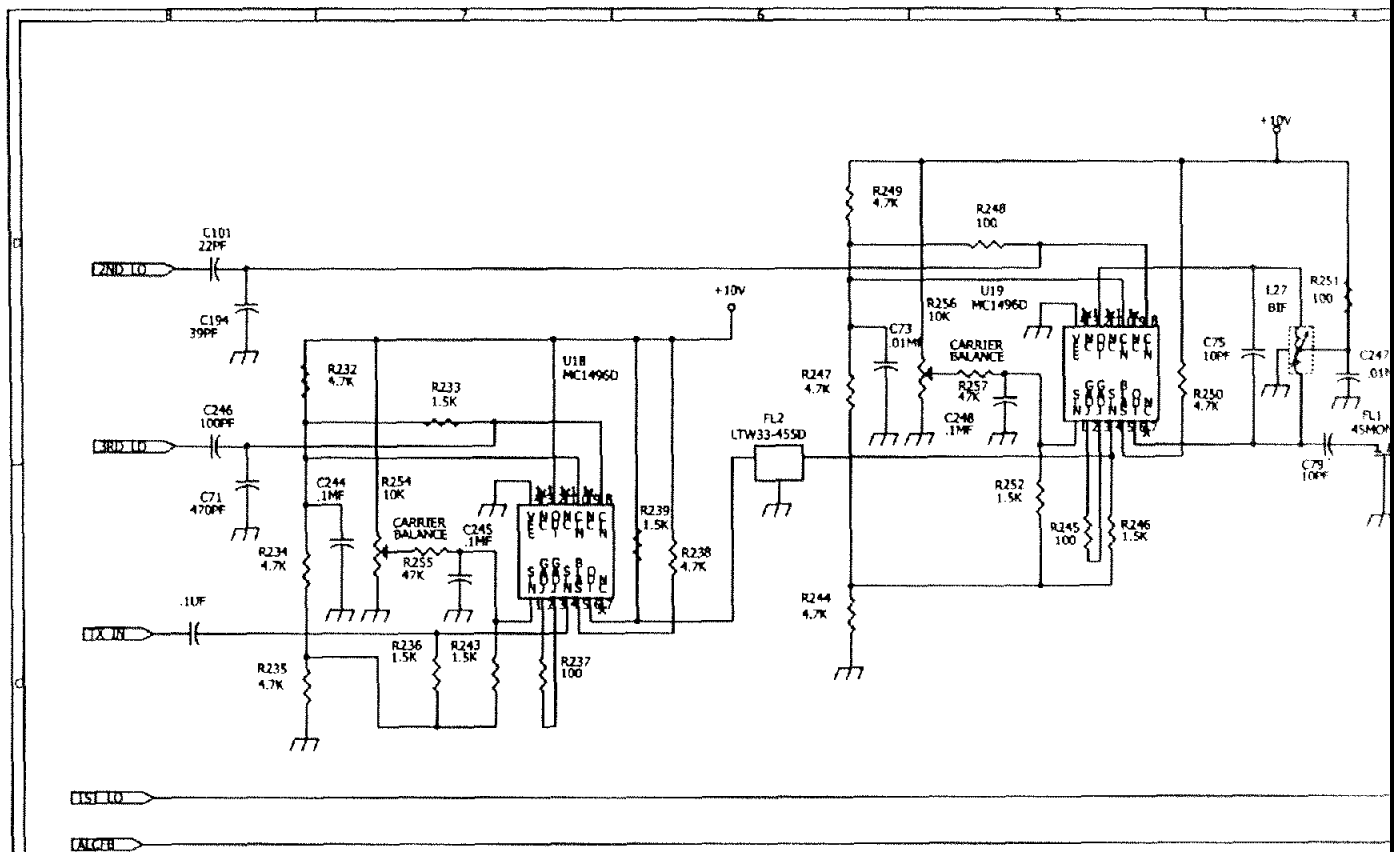
Title	81889RX2 p/o 538RFB	
Size	Document Number	REV
C	81889RX2.SCH	K6
Date:	November 13, 2000	1 Sheet 4 of 6





**FIGURE 4-6**  
 TEN-TEC, INC.  
 1185 DOLLY PARTON PKY  
 SEVIERVILLE, TN 37862

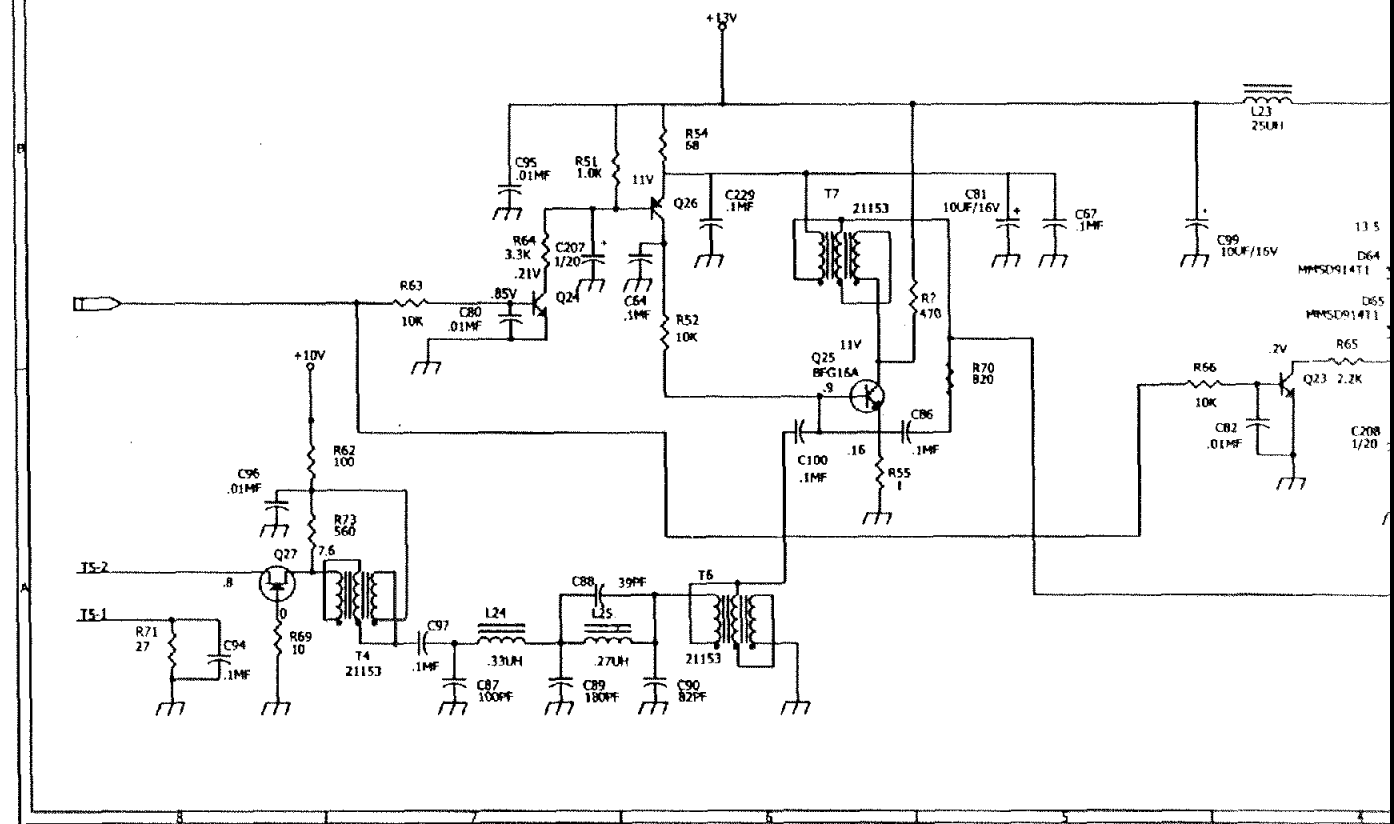
Title	JUPITER LL TX1 p/o 81889	
Size	Document Number	REV
C	81889TX1.SCH1	K5
Date:	November 2, 2000	Sheet 5 of 6



ZND LO  
BRD LO  
LX IN

ZND LO  
BRD LO  
LX IN

ZND LO  
BRD LO  
LX IN



TS-2  
TS-1

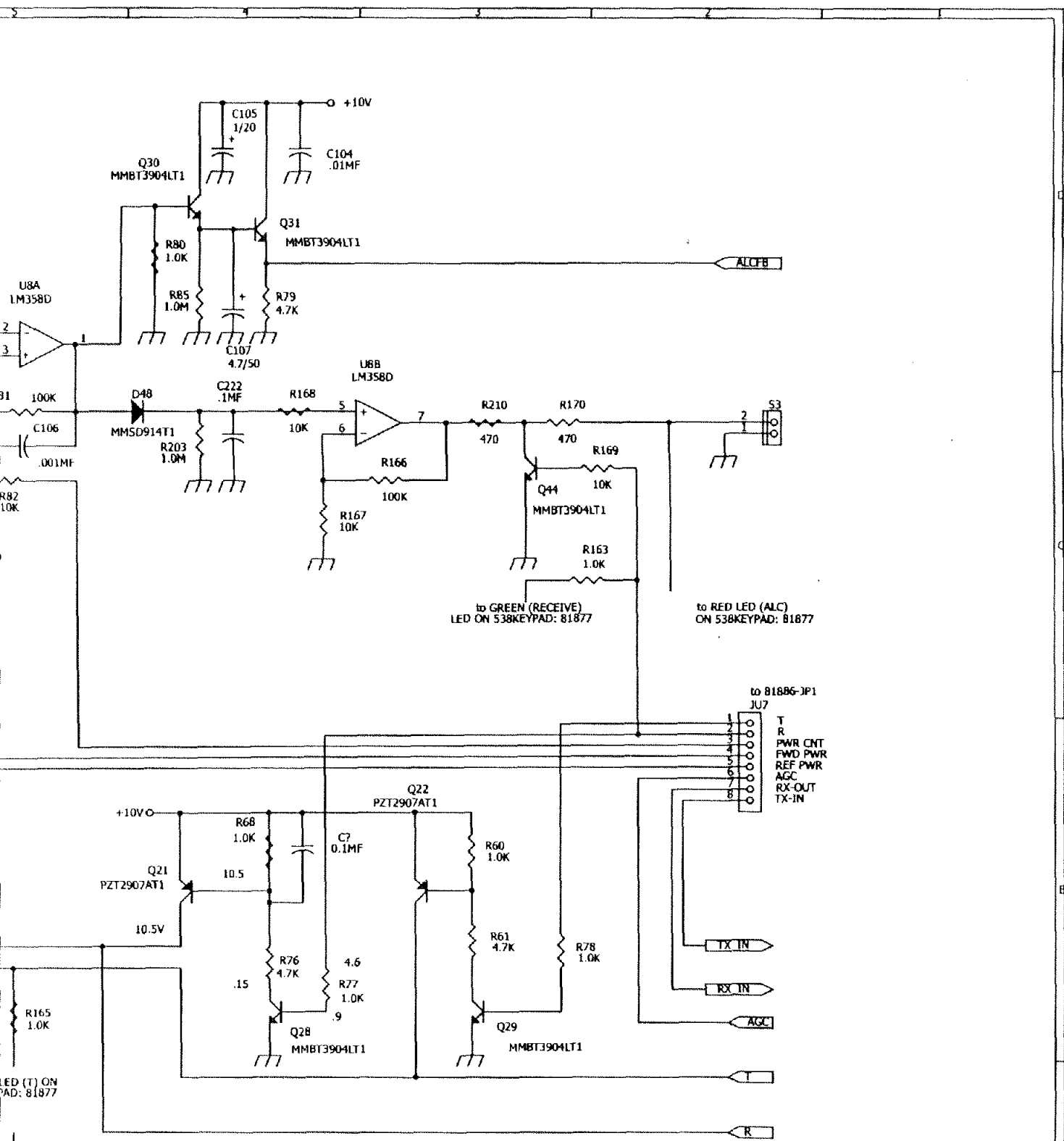
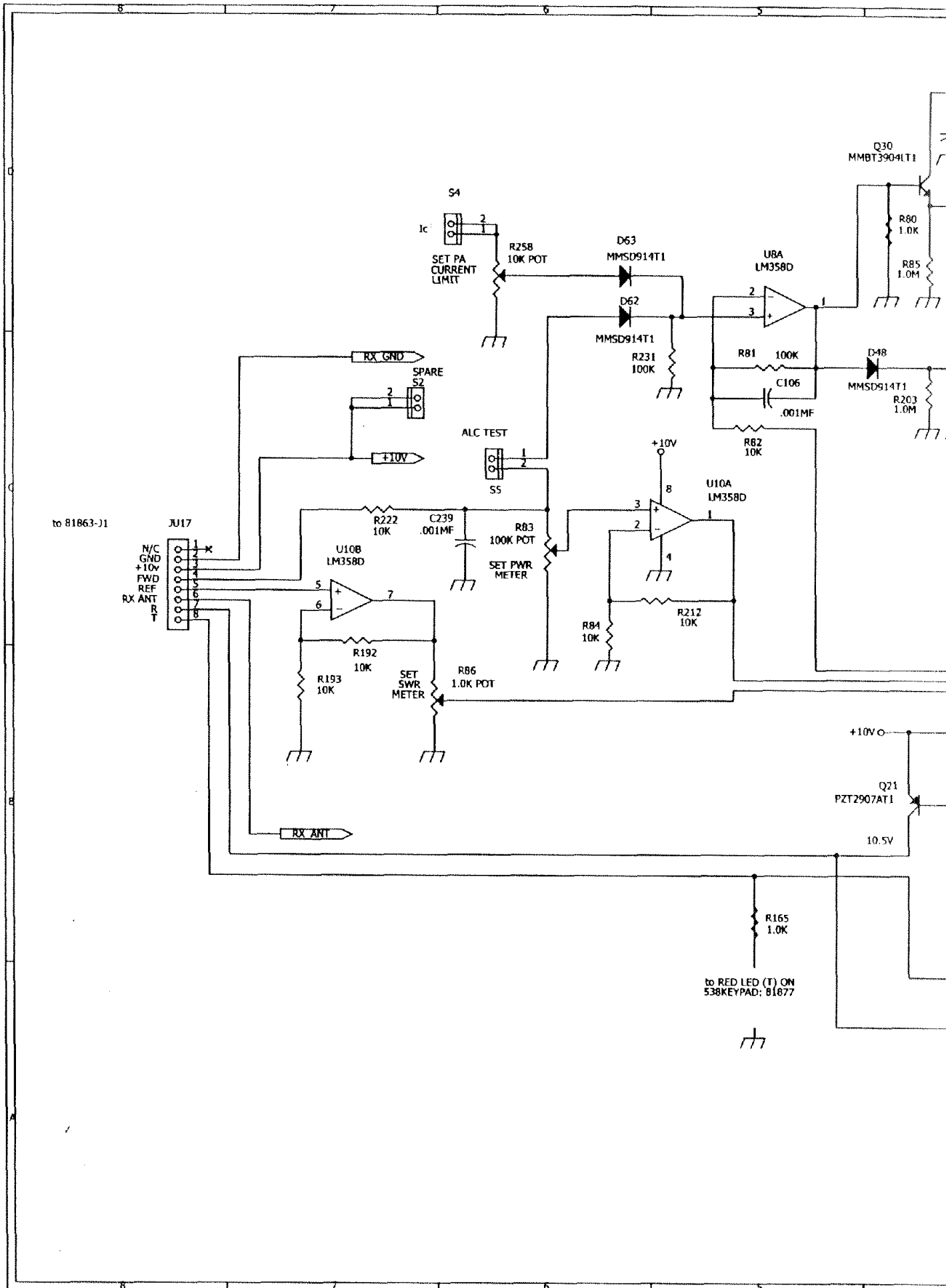


FIGURE 4-7  
 TEN TEC INC.  
 1185 DOLLY PARTON PARKWAY  
 SEVIERVILLE, TENNESSEE 37862  
 AMERICA'S BEST!

Title	JUPITER LL TX2 p/o 81889		
Size	Document Number	REV	
C	81889TX2.SCH	K3	
Date:	November 13, 2000	1 Sheet	6 of 6



to 81863-J1

JU17  
N/C  
GND  
+10V  
REF  
RX ANT  
R  
T

S4  
Ic  
SET PA  
CURRENT  
LIMIT

ALC TEST

SET PWR  
METER

SET SWR  
METER

to RED LED (T) ON  
538KEYPAD: 81677

+10V

10.5V



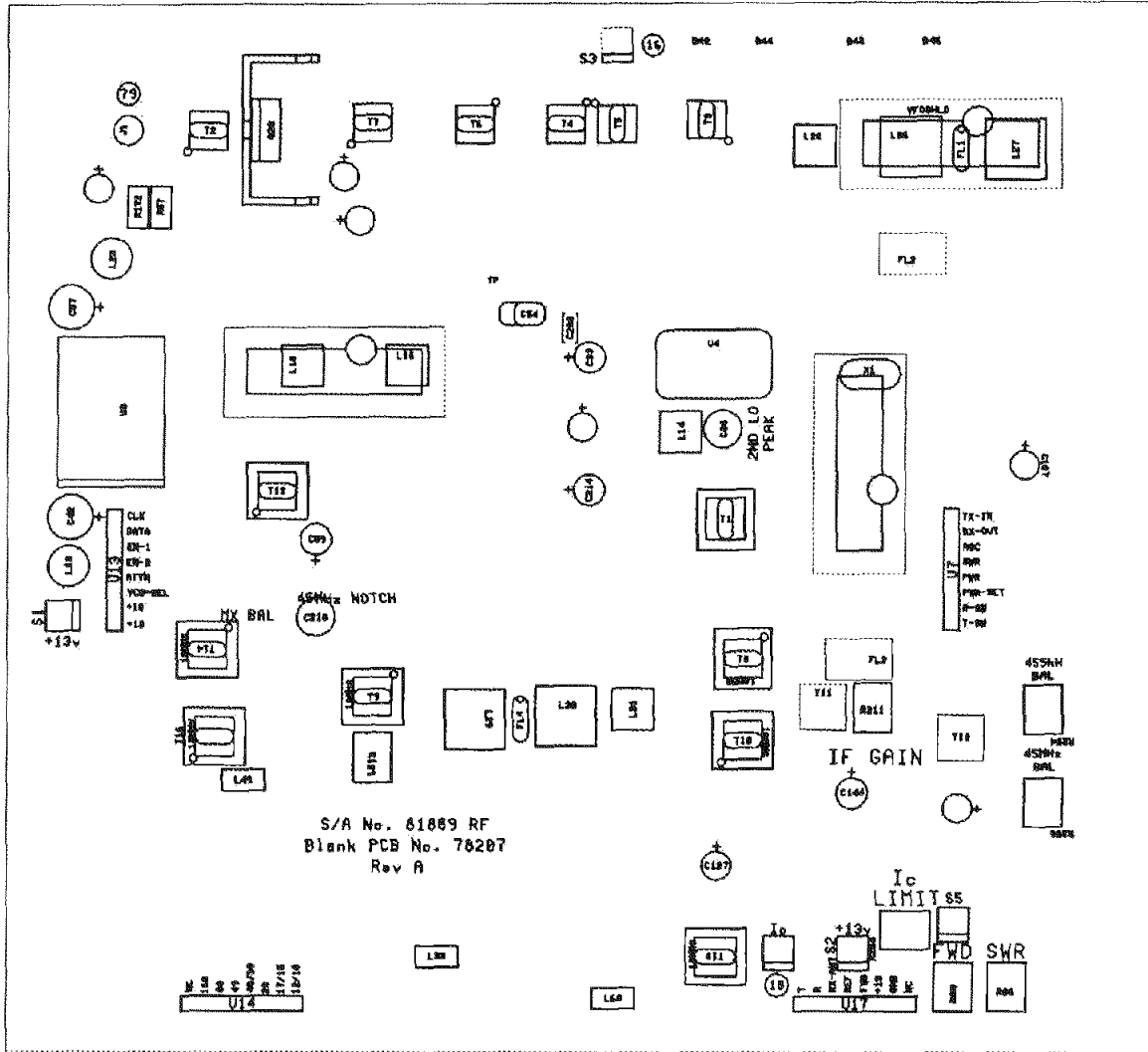


FIGURE 4-8 81889 TOP VIEW,  
COMPONENT MAP

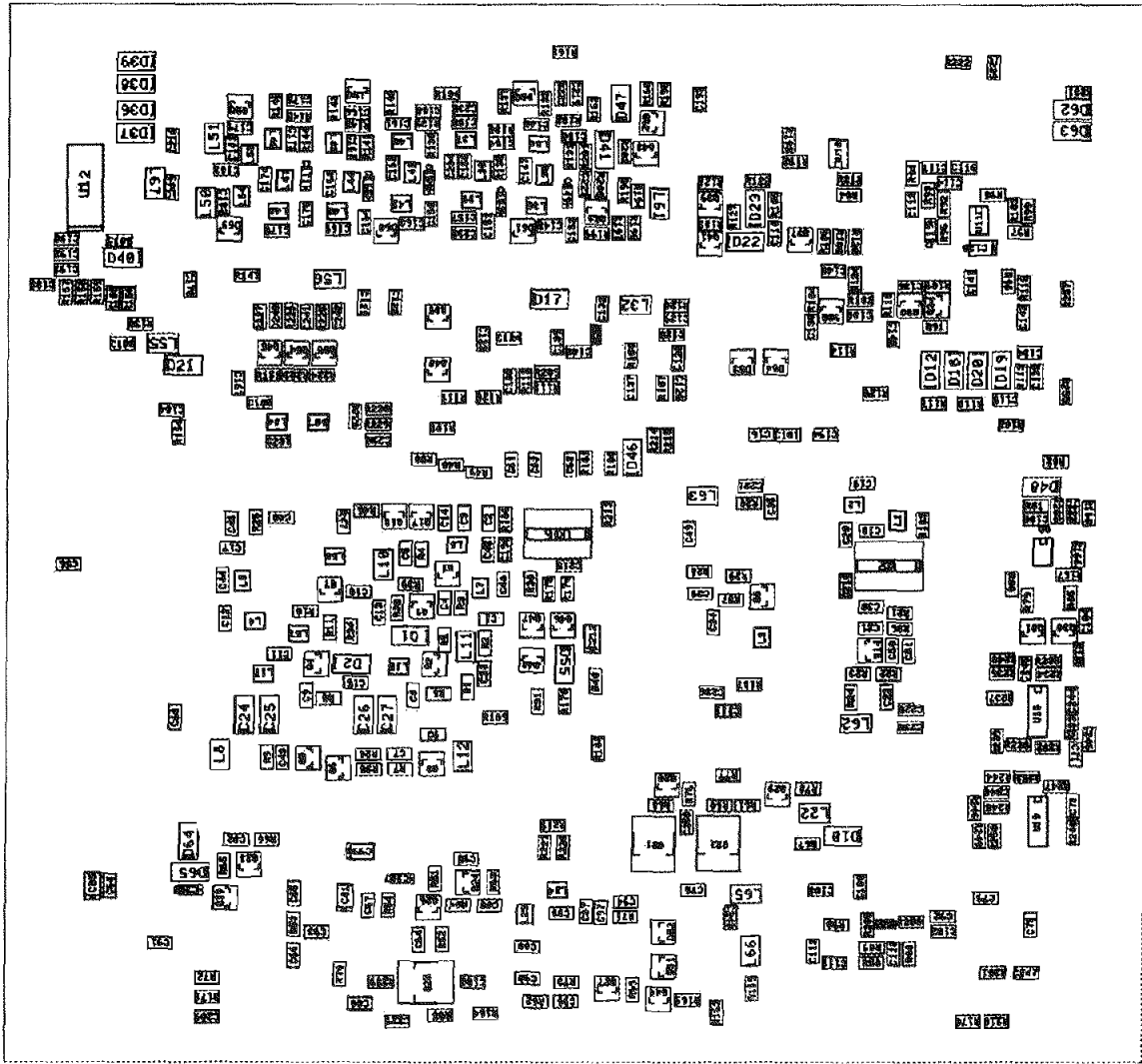


FIGURE 4-8A 81889 BOTTOM  
COMPONENT MAP

Bill Of Materials 538RFB			TABLE 4-2 Sheet 1/4	
PWB ASSY 81889			Revised: 2-Nov-00 16:16	
Item	Qty	Reference	Description	TEN TEC Part Number
1	1	C48	2.2PF	23454
2	2	C49,C232	4.7PF	23458
3	6	C1,C3,C44,C75,C79,C123	10PF	23462
4	1	C234	15PF	23464
5	2	C2,C209	18PF	23465
6	2	C101,C4	22PF	23466
7	4	C141,C147,C233,C235	33PF	23468
8	4	C11,C46,C88,C194	39PF	23469
9	2	C225,C156	47PF	23470
10	2	C92,C139	56PF	23471
11	4	C12,C39,C111,C125	68PF	23472
12	2	C90,C217	82PF	23473
13	4	C50,C78,C87,C162	100PF	23474
14	1	C89	180PF	23477
15	2	C51,C114	220PF	23478
16	2	C102,C140	270PF	23479
17	2	C167,C169	330PF	23480
18	2	C148,C146	390PF	23481
19	11	C8,C9,C34,C71,C112,C128,C155,C157,C161,C163,C168	470PF	23482
20	2	C173,C175	820PF	23485
21	1	C182	.0022MF	23498
22	39	C5,C6,C7,C13,C14,C15,C16,C17,C21,C22,C28,C35,C40,C43,C68,C69,C70,C73,C74,C76,C80,C82,C95,C96,C103,C104,C109,C110,C124,C126,C129,C132,C137,C138,C145,C211,C226,C227,C236	.01MF	23487
23	54	C38,C56,C60,C64,C65,C66,C67,C72,C86,C91,C93,C94,C97,C100,C116,C117,C118,C121,C122,C130,C131,C133,C134,C136,C142,C143,C150,C151,C152,C154,C158,C160,C164,C166,C170,C172,C176,C179,C184,C185,C186,C187,C189,C193,C210,C215,C216,C219,C220,C221,C222,C229,C230,C231	.1MF	23488
24	18	C10,C45,C61,C62,C63,C106,C108,C113,C115,C135,C174,C181,C183,C190,C191,C192,C198,C228	.001MF	23486
25	2	C18,C20	.0082MF	23523
26	1	C19	.022MF	23510
27	2	L1,L2	15UH	21236
28	1	L6	.56UH	21219
29	1	L7	.47UH	21218

Bill Of Materials			TABLE 4-2 Sheet 2/4	
538RFB PWB ASSY 81889			Revised: 2-Nov-00 16:16	
Item	QTY	Reference	Description	Part Number
30	2	L15, L17	.047UH	21247
31	1	L16	.19uH	21248
32	1	L18	.342uH	21249
33	12	L22, L32, L33, L49, L50, L51, L55, L56, L60, L61, L62, L63	100UH	21192
34	4	L24, L37, L40, L42	.33UH	21216
35	1	L25	.27UH	21215
36	2	L39, L4	.15UH	21212
37	3	L3, L35, L57	1.0UH	21222
38	2	L44, L38	1.2UH	21223
39	3	L41, L43, L45	1.8UH	21225
40	1	L58	1.5UH	21224
41	8	L8, L10, L11, L12, L46, L48, L53, L54	4.7UH	21197
42	1	C203	.1MFD	23328
43	1	C54	.47MFD	23330
44	25	Q3, Q5, Q6, Q8, Q9, Q14, Q17, Q18, Q23, Q24, Q28, Q29, Q30, Q31, Q33, Q34, Q37, Q39, Q43, Q44, Q46, Q47, Q50, Q51, Q52	MMBT3904 LT1	25375
45	6	Q19, Q26, Q41, Q48, Q49, Q53	MMBT3906 LT1	25376
46	1	R55	1	30630
47	4	R10, R69, R151, R201	10	30638
48	2	R183, R71	27	30643
49	9	R11, R131, R135, R138, R141, R144, R152, R162, R202	47	30646
50	1	R54	68	30648
51	34	R1, R4, R20, R24, R25, R31, R37, R48, R49, R58, R62, R91, R98, R102, R104, R117, R118, R119, R120, R124, R126, R133, R137, R140, R143, R146, R154, R157, R158, R159, R176, R187, R208, R209	100	30650
52	5	R6, R8, R87, R107, R127	150	30652
53	7	R2, R36, R53, R74, R101, R184, R186	220	30654
54	10	R72, R121, R128, R130, R155, R156, R161, R171, R180, R181	330	30656
55	9	R56, R108, R116, R134, R147, R170, R194, R200, R210	470	30658
56	1	R73	560	30659
57	1	R70	820	30661
58	25	R26, R39, R51, R60, R67, R68, R77, R78, R80, R90, R105, R123, R132, R136, R139, R142, R145, R160, R163, R164, R165, R195, R196, R197, R199	1.0K	30662
59	6	R28, R38, R114, R174, R182, R190	1.5K	30664
60	1	R65	2.2K	30666
61	3	R29, R64, R125	3.3K	30668

		Bill Of Materials	Revised:	TABLE 4-2
		538RFB RF PWB ASSY 81889	17-Nov-00	Sheet 3/4
Item	Qty	Reference	Description	TEN-TEC Part Number
62	7	R21, R61, R76, R79, R113, R189, R191	4.7K	30670
63	1	R93	6.8K	30672
64	2	R92, R94	8.2K	30673
65	24	R3, R7, R9, R22, R30, R35, R52, R50, R63, R66, R82, R84, R95, R96, R99, R167, R168, R169, R175, R188, R192, R193, R198, R212	10K	30674
66	4	R23, R27, R100, R106	22K	30678
67	11	R5, R34, R40, R88, R89, R97, R103, R109, R110, R111, R112	47K	30682
68	1	R46	82K	30685
69	2	R81, R166	100K	30686
70	1	R47	680K	30696
71	3	R85, R122, R203	1.0M	30698
72	1	R213	10M	30704
73	1	J1	TMP	35225
74	1	S1	2AMP	35065
75	9	Q1, Q2, Q4, Q7, Q27, Q35, Q36, Q40, Q45	MMBFJ310LT1	25377
76	2	Q21, Q22	PZT2907AT1	25379
77	11	D12, D18, D19, D20, D22, D23, D36, D37, D38, D39, D48	MMSD914T1	28124
78	2	C107, C127	4.7/50V	23310
79	5	C33, C59, C144, C213, C214	33/16V	23308
80	1	R211	100 TRIM	30617
81	2	T1, T13	2BAL	21152
82	11	T2, T3, T4, T5, T6, T7, T8, T9, T10, T14, T15	3BAL	21153
83	14	D1, D2, D24, D25, D26, D27, D28, D29, D30, D31, D32, D33, D34, D35	RLS135	28130
84	1	C218	10-60PF	23268
85	3	D11, D40, D46	MMSZ5231BT1	28127
86	2	T11, T12	455IF	21093
87	4	C24, C25, C26, C27	BB620	28131
88	1	C36	5-30PF	23236
89	2	C42, C57	100/35V	23189
90	1	C202	.047MFD	23291
91	1	C55	.01MFD	23340
92	5	D10, D17, D21, D41, D47	BA679	28133
93	1	Q25	BFG16A	25431
94	1	R83	100K PCPOT	30620
95	2	R86, R129	1.0K PCPOT	30618
96	2	U5, U6	NE612A	25441
97	2	U8, U10	LM358D	25383
98	1	U12	A6810XLW	25407
99	2	L26, L30	.25UH	21059
100	2	Q32, Q38	BF998	25387

		Bill Of Materials	Revised:	TABLE 4-2
		538RFB RF PWB ASSY 81889	17-Nov-00	Sheet 4/4
Item	Qty	Reference	Description	TEN-TEC Part Number
101	1	U16	MC145170	25405
102	1	U2	74LS390	25396
103	1	U3	NJM7810FA	25400
104	1	U11	TLO82	25406
105	5	C81, C85, C99, C120, C212	10/16V	23525
106	9	C105, C119, C149, C153, C159, C165, C171, C207, C208	1/20V	23524
107	1	X1	4.67 MHz	48240
108	2	L27, L29	BIF	21194
109	2	L13, L23	25UH	21179
110	3	L14, L28, L31	.12UH	21180
111	2	FL1, FL4	45MONO	48227
112	1	Q20	2SC1971	25337
113	2	FL2, FL3	LTW33-455D	48257
114	4	L5, L34, L36, L59	.1UH	21210
115	2	R57, R172	10/.5W	30022
116	4	D51, D52, D53, D54	BAP68 04	28156
117	1	L47	3.9UH	21229
118	1	U4	TCXO, 14.8475 MHz	48263
119	4	JU7, JU13, JU14, JU17	8PIN	35316

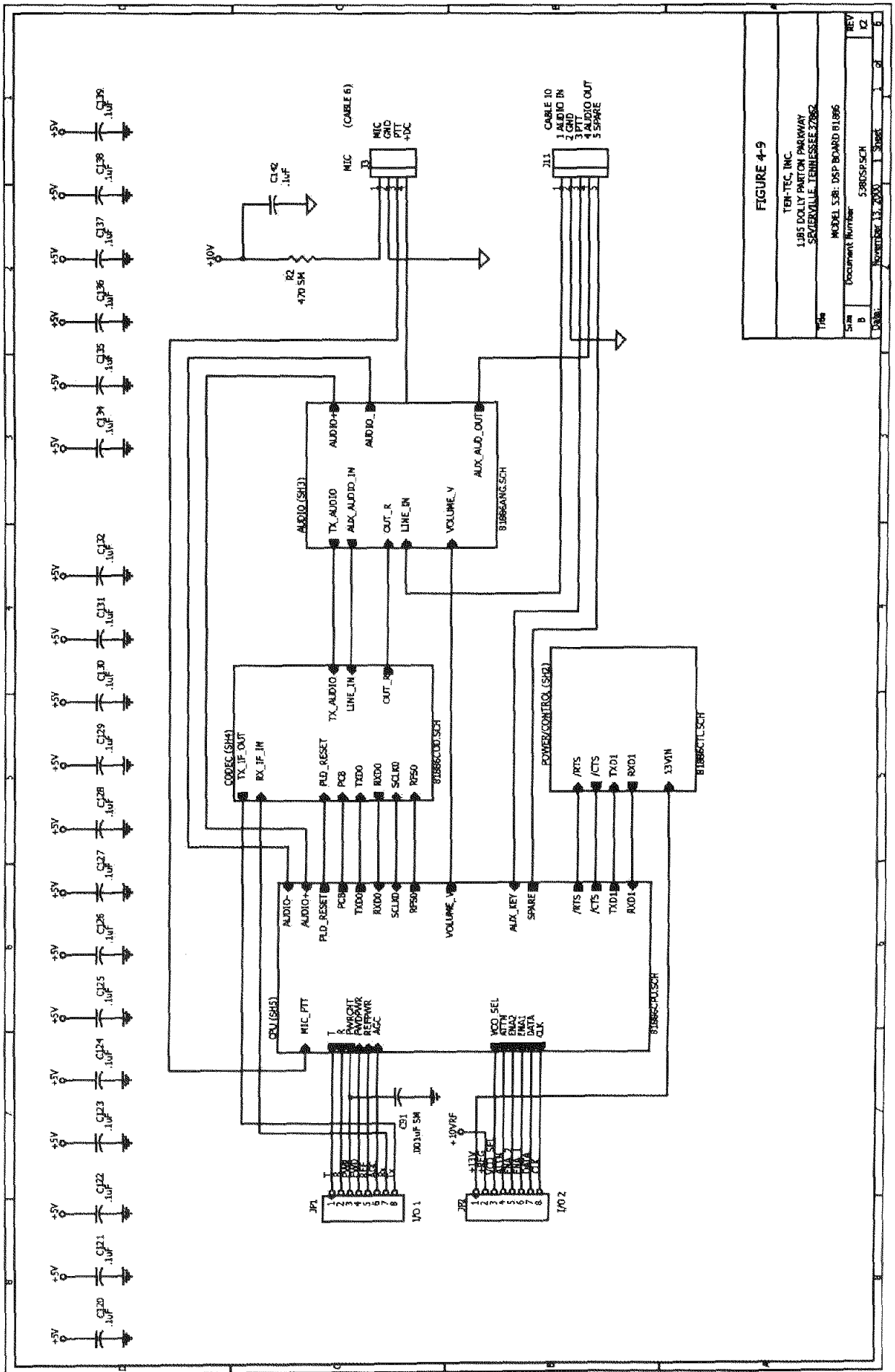


FIGURE 4-9  
 TEN-TEC, INC.  
 1385 DOLLY PARTON PARKWAY  
 SPRINGVILLE, TENNESSEE 37282

Model	538	DSP BOARD	61896
Rev	B	Document Number	53805P.SCH
Date	NOVEMBER 13, 2003	Sheet	2
REV	12		

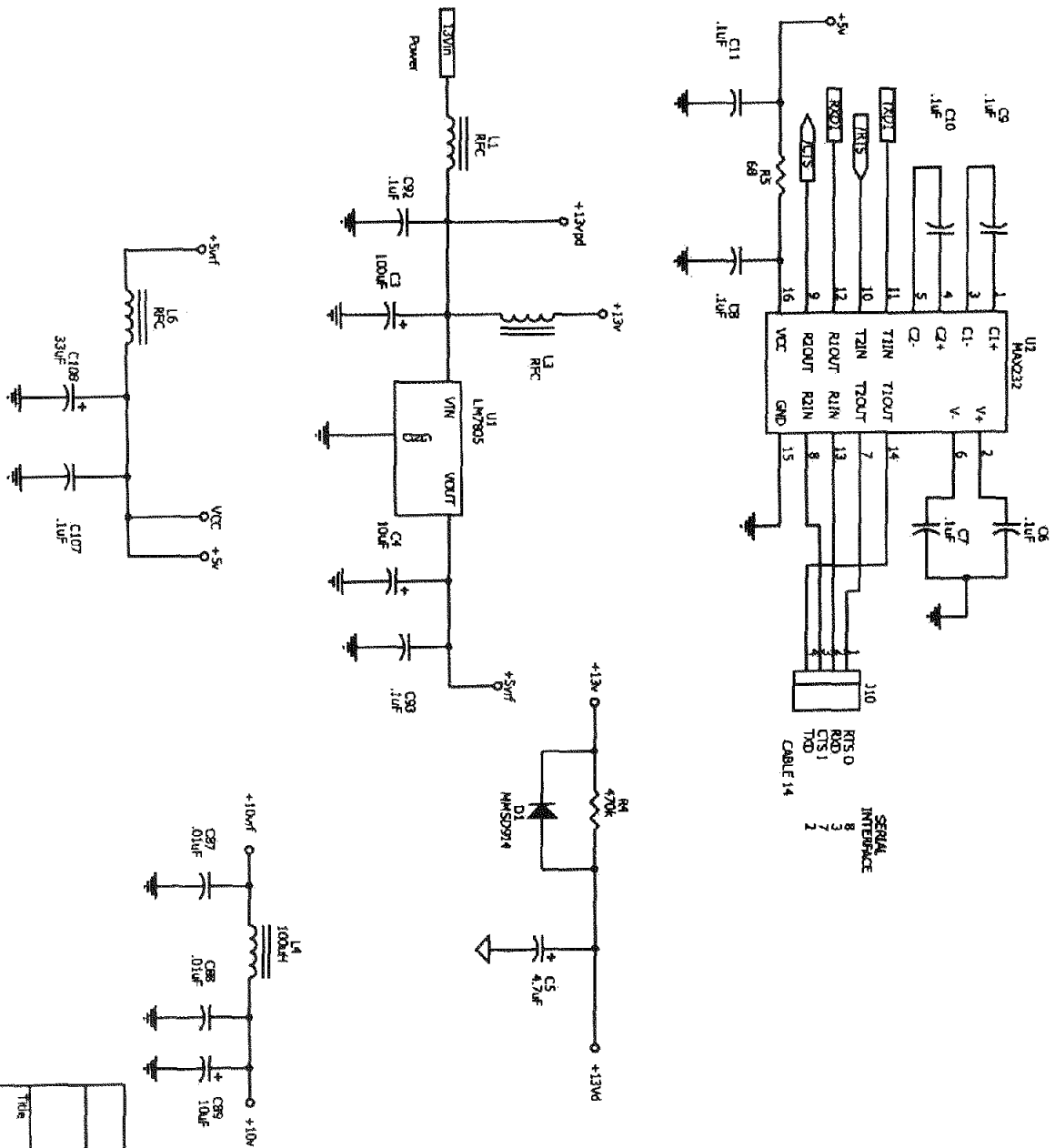


Figure 4-10

TEN-TEC, INC.	
1185 DOLLY PARKWAY	
SEVERVILLE, IN 47582	
MODEL 538 POWER/CONTROL y/o 81886	
Site	Document Number
8	81886CTL1SCH
Date:	November 1, 2000
Drawn:	STW
Checked:	STW
Approved:	STW



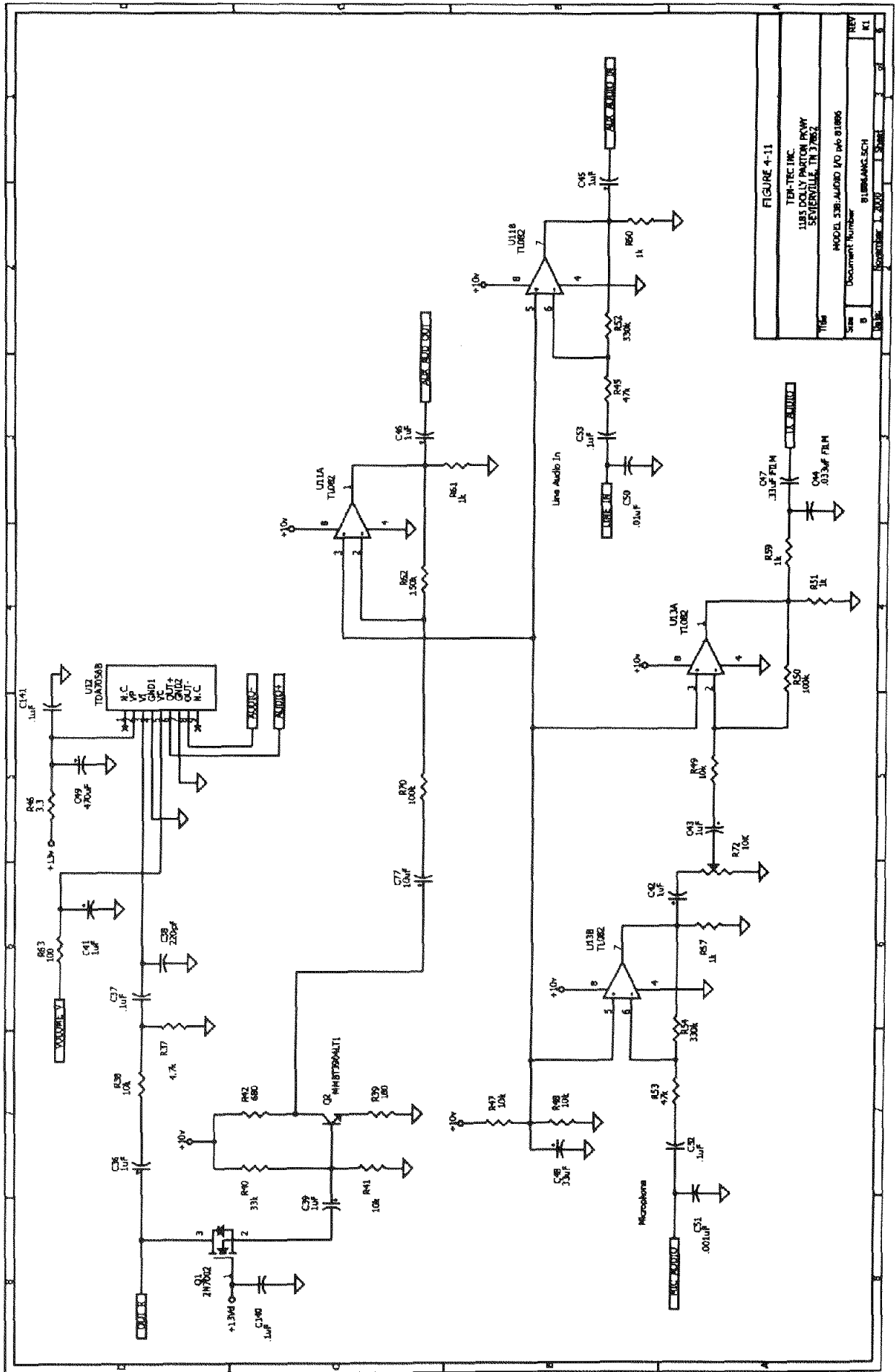


FIGURE 4-11  
 TEB-TEC INC.  
 1185 DOLLY PRATION PKWY  
 SEVENVILLE, TN 37867  
 Model 3B-AUDIO (O part 81895  
 Document Number  
 81895A001SCH  
 REV  
 K1

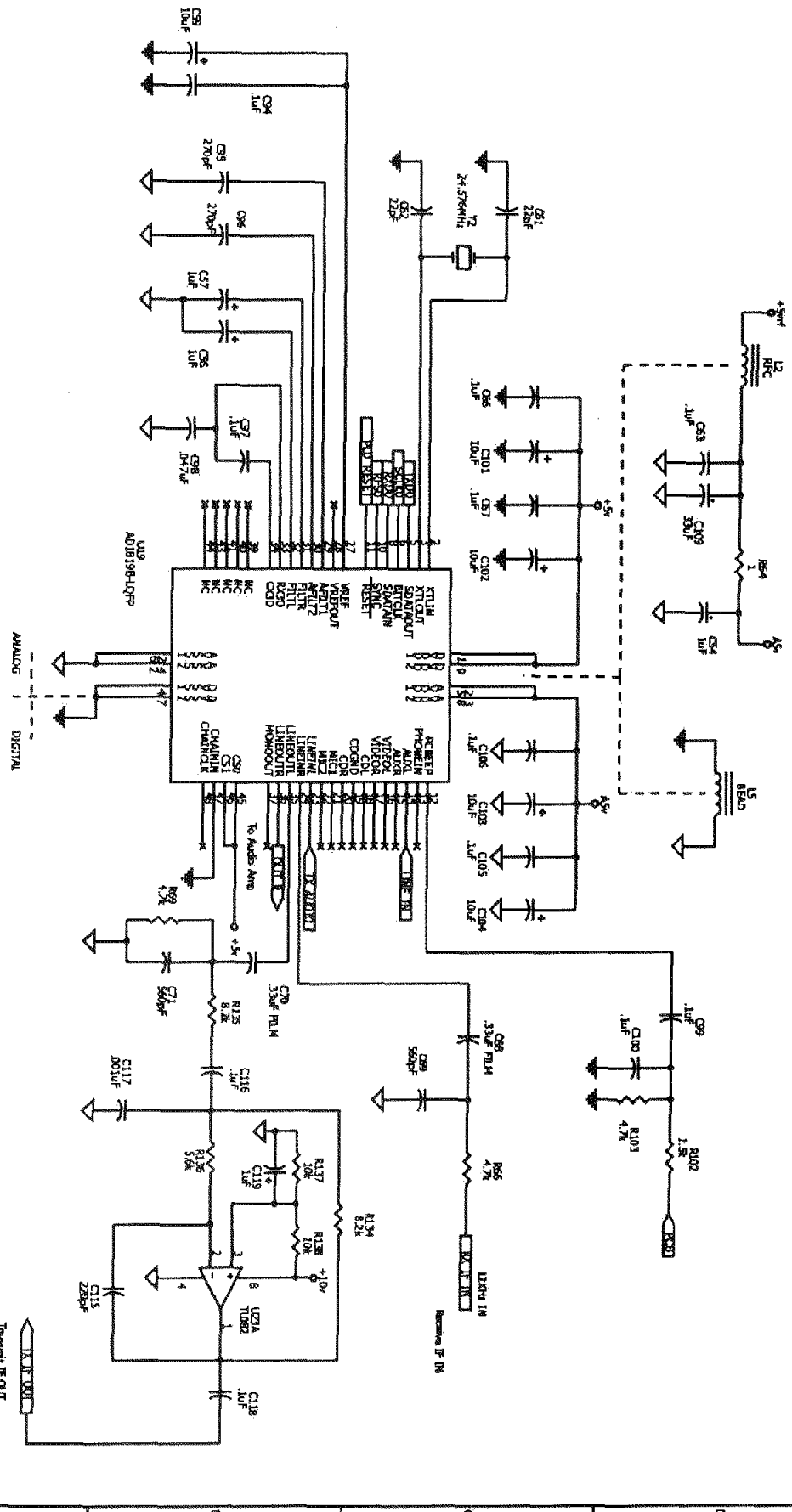


FIGURE 4-12

TEN-TEC INC.  
 1185 COLLYERSON PARK  
 SEASIDEVILLE, TN 37862

Model 538 CONEC 40-81866  
 Document Number 81886COO SCH 1

REV	DATE	DESCRIPTION
1	NOVEMBER 2000	ISSUE

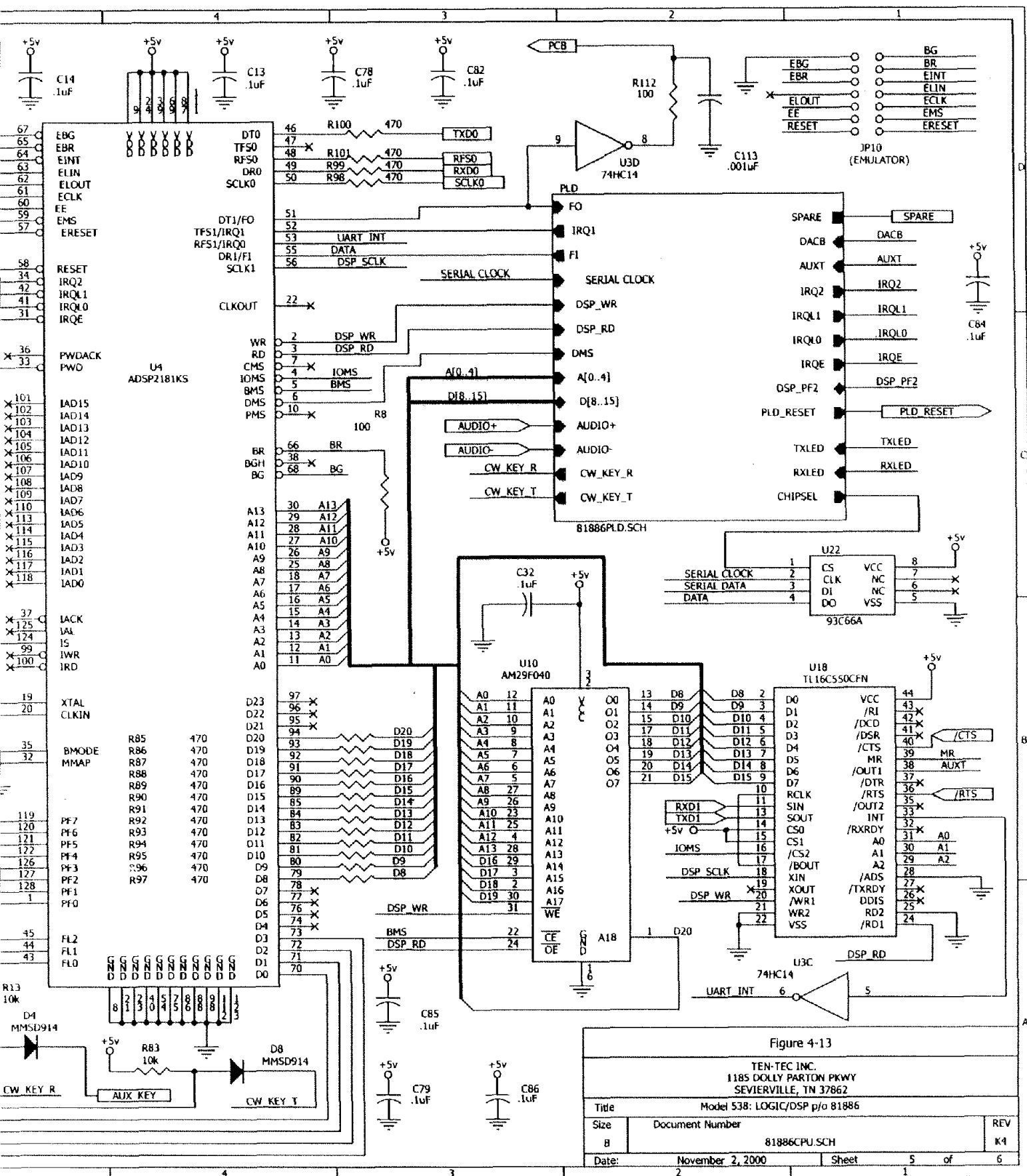
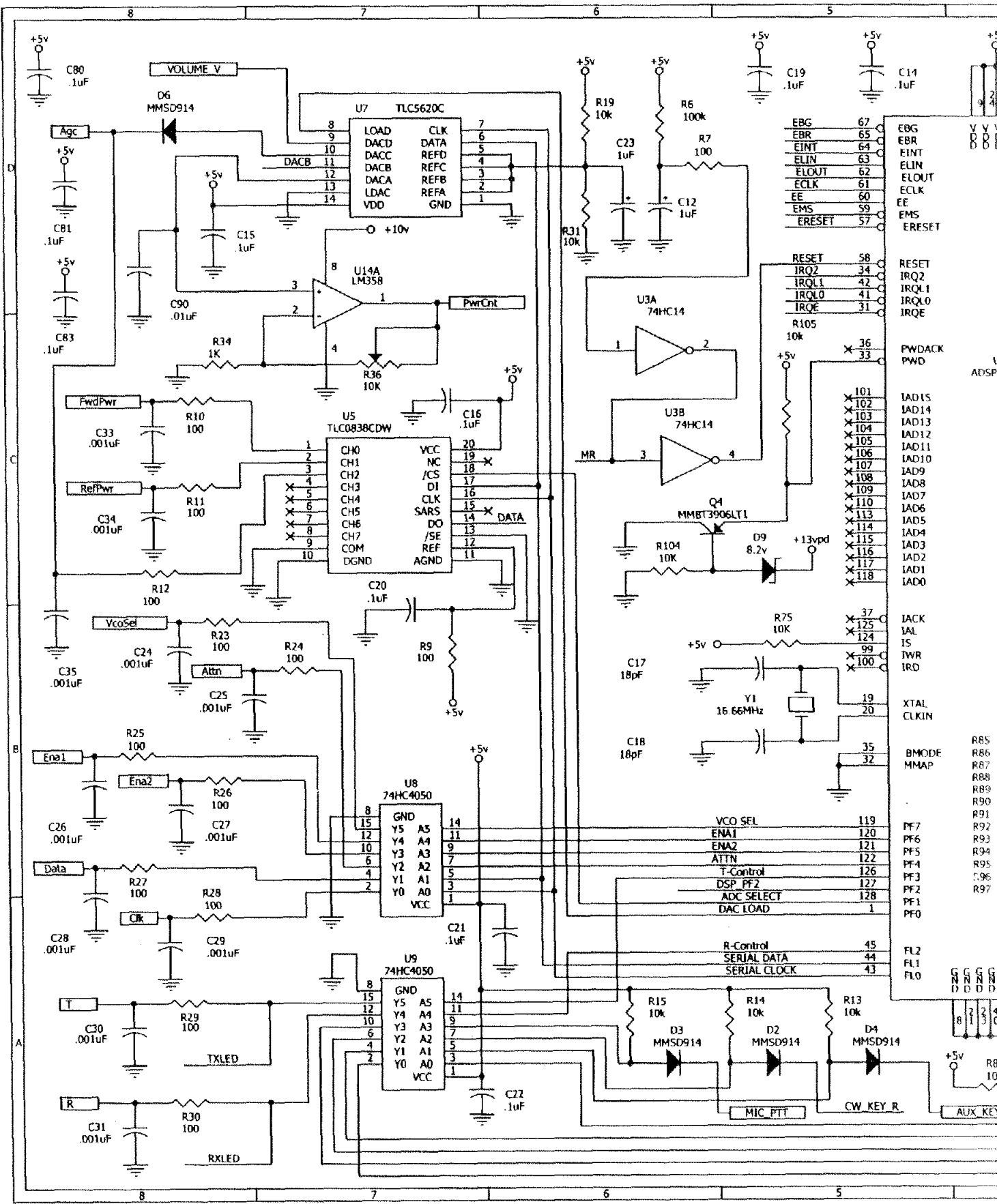


Figure 4-13  
 TEN-TEC INC.  
 1185 DOLLY PARTON PKWY  
 SEVIERVILLE, TN 37862

Title	Model 538: LOGIC/DSP p/o 81886		
Size	Document Number	REV	
B	81886CPU.SCH	K4	
Date:	November 2, 2000	Sheet	5 of 6



EBG	67	EBG	67
EBR	65	EBR	65
EINT	64	EINT	64
ELIN	63	ELIN	63
ELOUT	62	ELOUT	62
ECLK	61	ECLK	61
EE	60	EE	60
EMS	59	EMS	59
ERESET	57	ERESET	57

RESET	58	RESET	58
IRQ2	34	IRQ2	34
IRQ1	42	IRQ1	42
IRQ0	41	IRQ0	41
IRQE	31	IRQE	31

R105	10k	PWDACK	36
		PWD	33

X101	IAD15
X102	IAD14
X103	IAD13
X104	IAD12
X105	IAD11
X106	IAD10
X107	IAD9
X108	IAD8
X109	IAD7
X110	IAD6
X113	IAD5
X114	IAD4
X115	IAD3
X116	IAD2
X117	IAD1
X118	IAD0

X37	JACK
X125	IAL
X124	IS
X99	TWR
X100	IRD

Y1	16.66MHz	XTAL	19
		CLKIN	20

X35	BMODE
X32	MMAP

VCO SEL	119
ENA1	120
ENA2	121
ATTN	122
T-Control	126
DSP PF2	127
ADC SELECT	128
DAC LOAD	1

R-Control	45
SERIAL DATA	44
SERIAL CLOCK	43

D3	MMSD914
D2	MMSD914
D4	MMSD914

MIC PTT	
CW KEY R	
AUX KEY	

R8	10k
----	-----



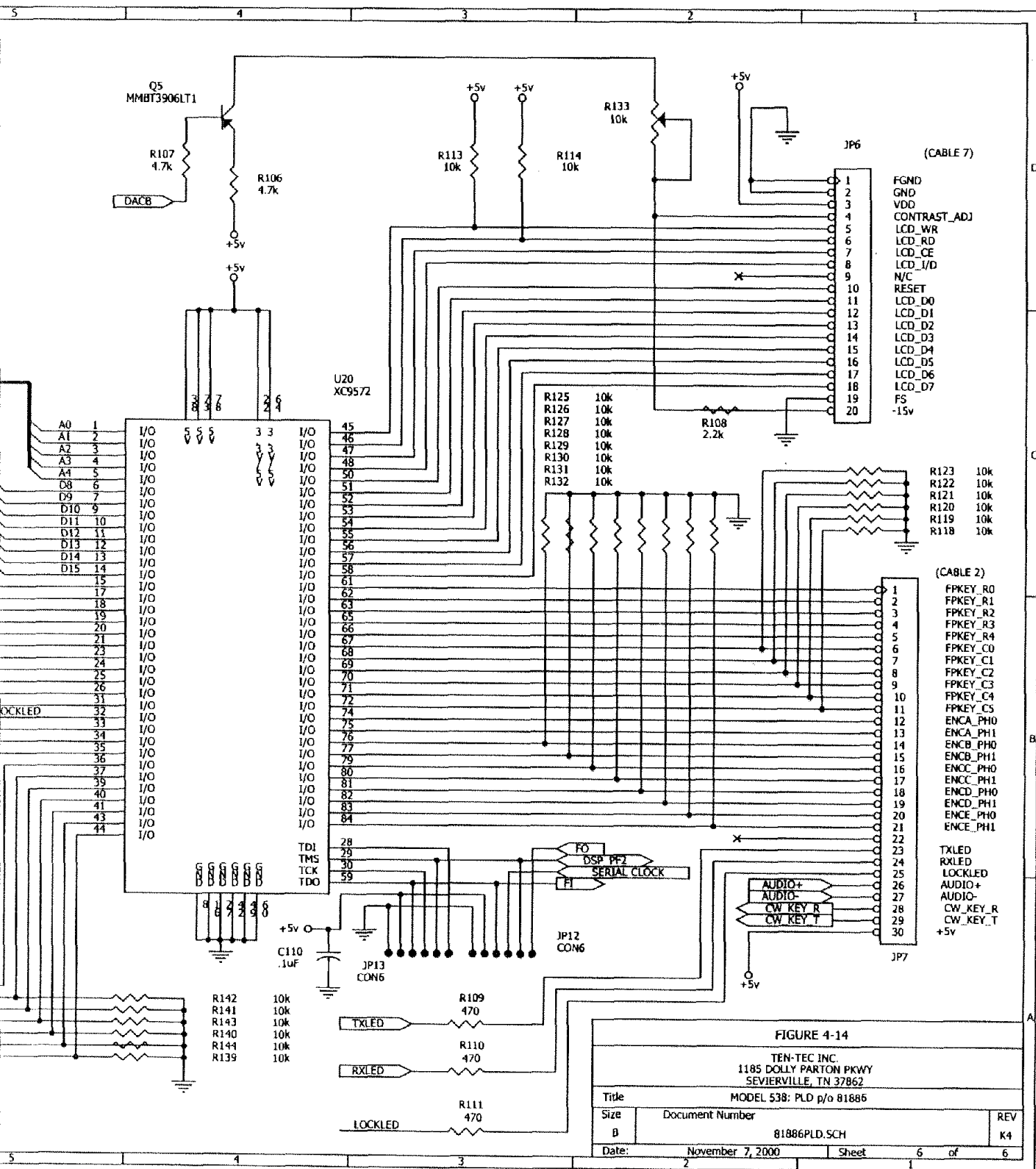
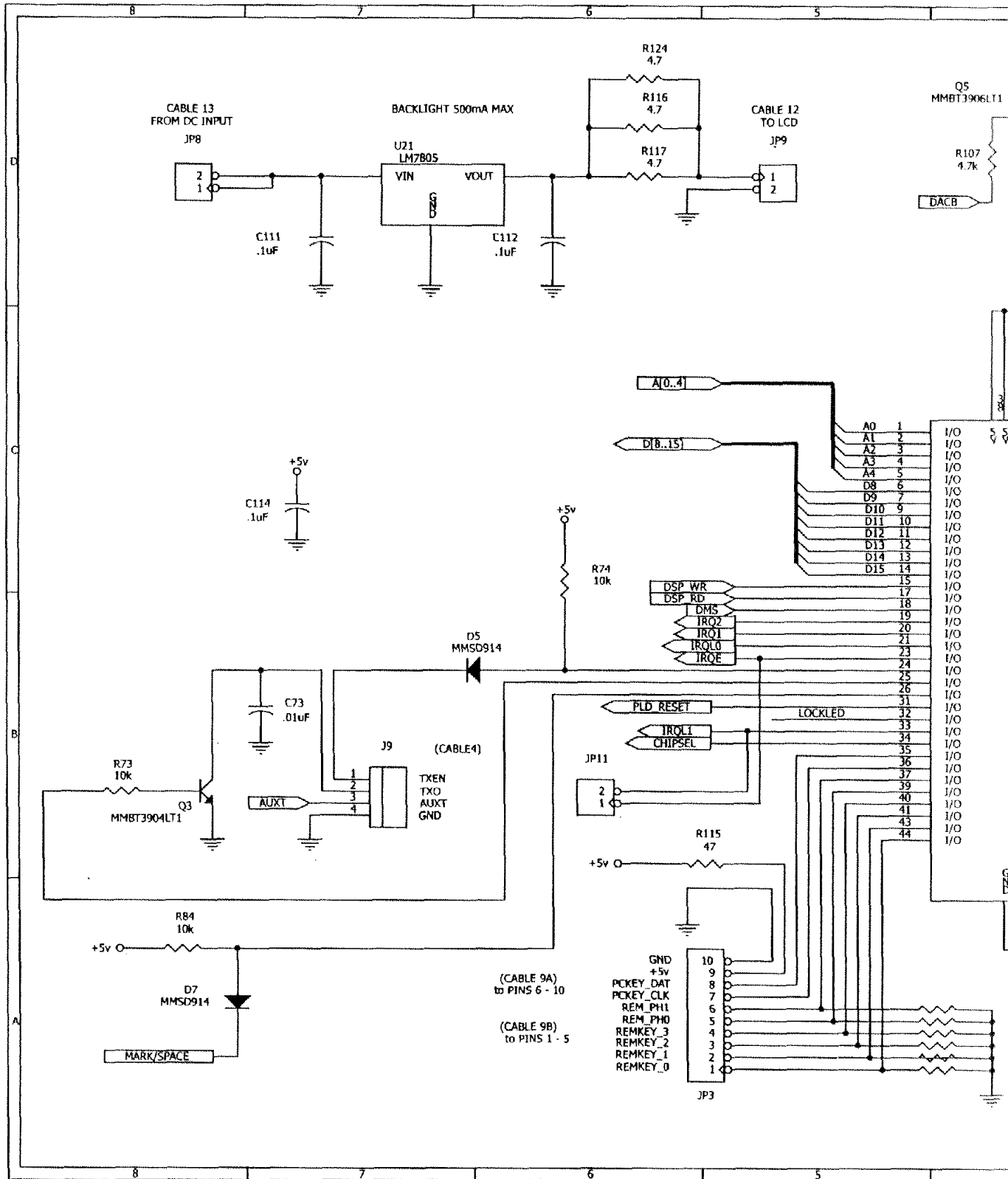
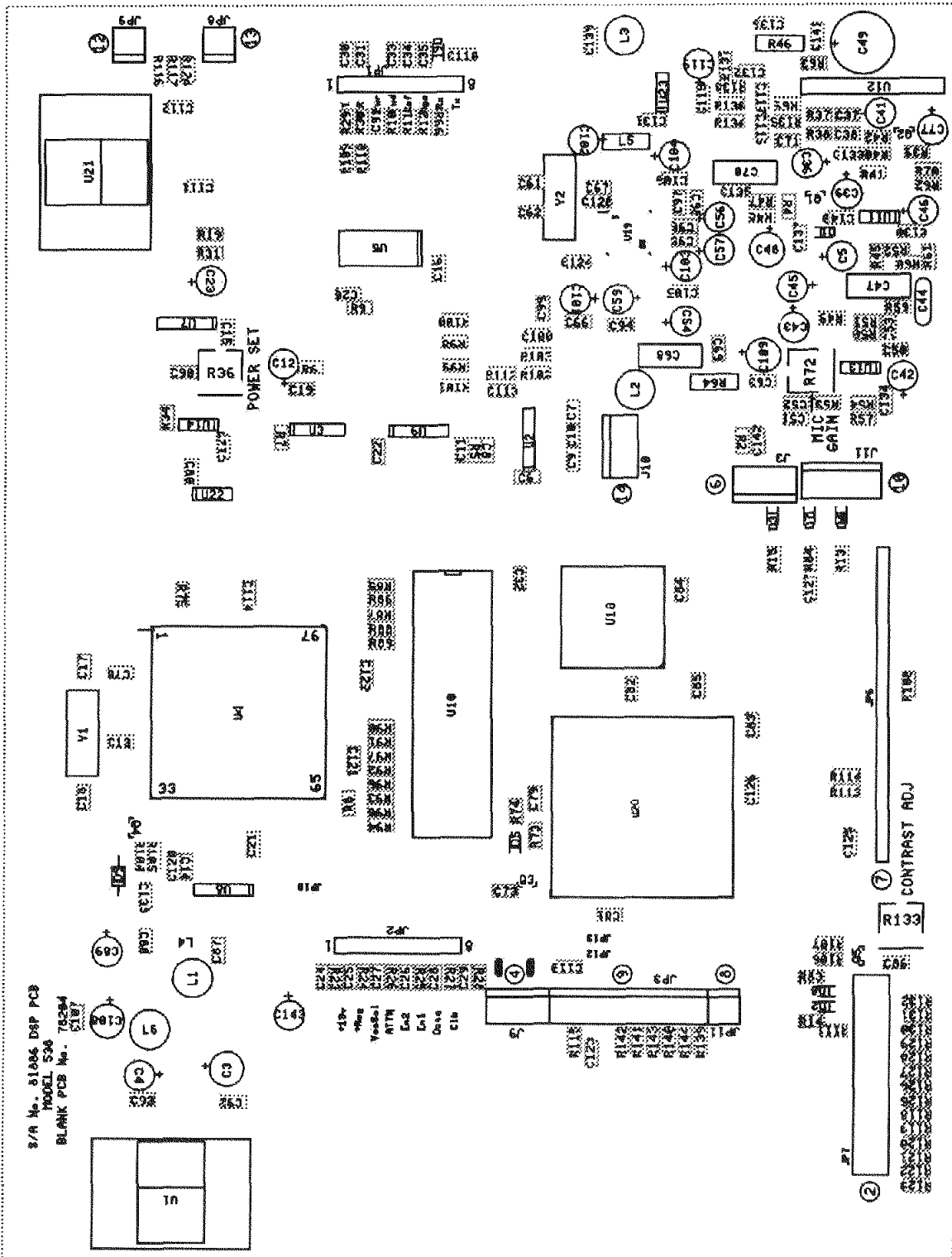


FIGURE 4-14

TEN-TEC INC.  
1185 DOLLY PARTON PKWY  
SEVIERVILLE, TN 37862

Title			MODEL 538: PLD p/o 81886
Size	Document Number	REV	
B	81886PLD.SCH	K4	
Date:	November 7, 2000	Sheet	6 of 6





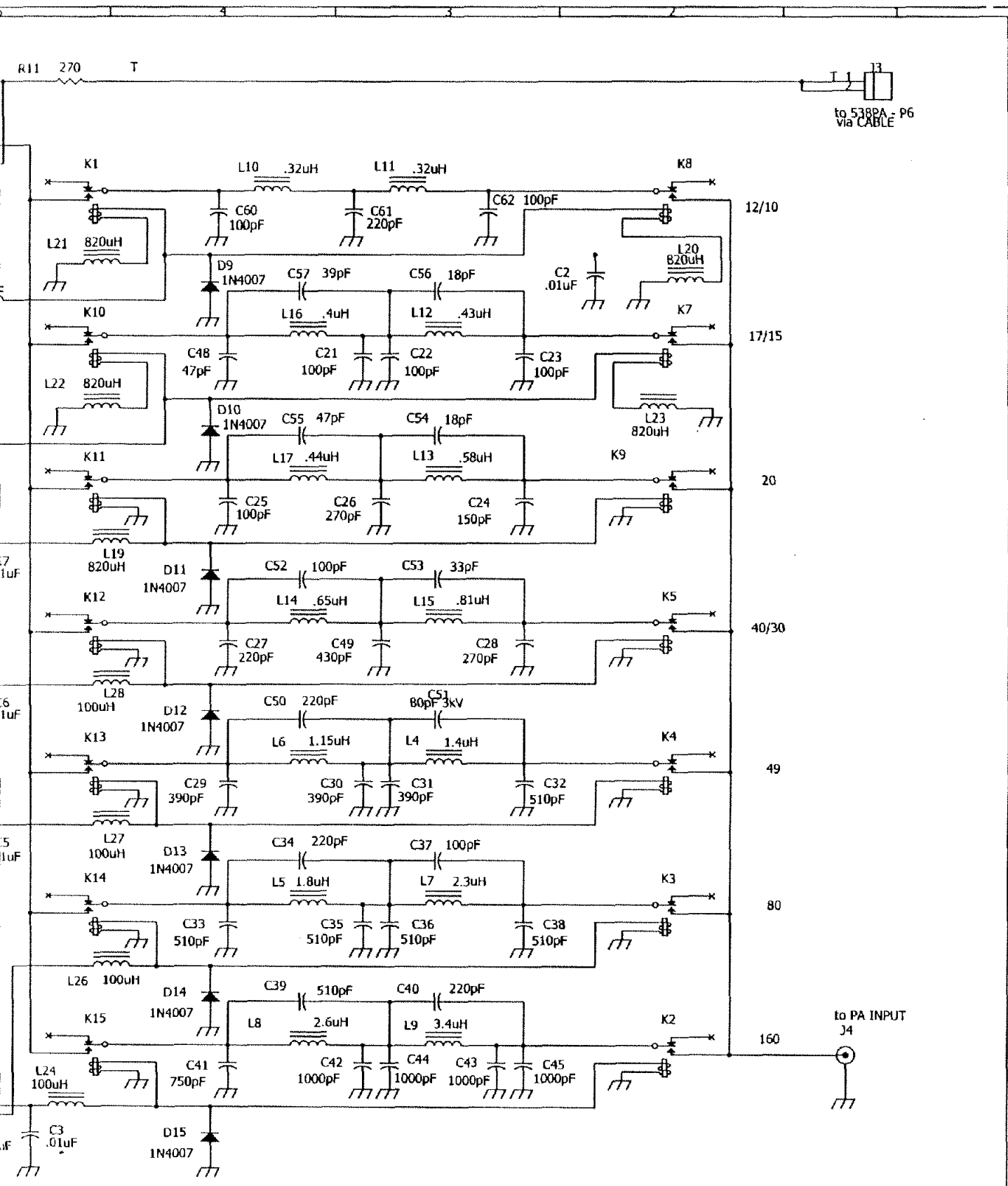
Model 538:DSP BOARD (S/A 81886)		Revised: 21 November, 2000		
TABLE 4-3 Bill Of Materials		Sheet 1/2		
Item	Qty	Reference	Description	TEN TEC Part Number
1	1	C3	100uF	23189
2	8	C4,C59,C77,C89,C101,C102, C103,C104	10uF	23266
3	1	C5	4.7uF	23310
4	68	C6,C7,C8,C9,C10,C11,C13,C14, C15,C16,C19,C20,C21,C22,C32, C37,C52,C53,C63,C66,C67,C78, C79,C80,C81,C82,C83,C84,C85, C86,C92,C93,C94,C97,C99,C100, C105,C106,C107,C110,C111,C112C114,C1 16,C118,C120,C121,C122C123,C124,C125 ,C126,C127,C128C129,C130,C131,C132,C 133,C134C135,C136,C137,C138,C139,C14 0 C141,C142	.1uF SM	23488
5	13	C12,C23,C36,C39,C41,C42,C43, C45,C46,C54,C56,C57, C119	1uF	23264
6	2	C17,C18	18pF SM	23465
7	15	C24,C25,C26,C27,C28,C29,C30, C31,C33,C34,C35,C51,C91,C113,C117	1000pF SM	23486
8	2	C115,C38	220pF SM	23478
9	1	C44	.033uF FILM	23290
10	3	C47,C68,C70	.33uF FILM	23329
11	3	C48,C108,C109	33uF	23308
12	1	C49	470uF	23228
13	5	C50,C73,C87,C88,C90	.01uF SM	23487
14	2	C61,C62	22pF SM	23466
15	2	C69,C71	560pF SM	23483
16	2	C95,C96	270pF SM	23479
17	1	C98	.047uF SM	23513
18	8	D1,D2,D3,D4,D5,D6,D7,D8	MMSD914	28124
19	1	D9	8.2v	28019
20	1	JP1	I/O 1	35277
21	1	JP2	I/O 2	35277
22	1	JP3	10 HEADER	35xxx
23	1	JP6	20 HEADER	35270
24	1	JP7	30 HEADER	32328
25	3	JP8,JP9,JP11	MT2	35065
26	1	JP10	(EMULATOR)	N/A
27	2	JP12,JP13	CON6	35277
28	1	J3	MIC	35xxx
29	2	J10,J9	MT4	35067
30	1	J11	MT5	35068
31	4	L1,L2,L3,L6	REC	21179
32	1	L4	100uH SM	21246
33	1	L5	BEAD	21027
34	1	Q1	2N7002	25412
35	2	Q2,Q3	MMBT3904LT1	25375
36	2	Q4,Q5	MMBT3906LT1	25376



TABLE 4-3 Bill Of Materials

Sheet 2/2

Item	Qty	Reference	Description	TEN TEC Part Number
37	21	R2,R85,R86,R87,R88,R89,R90, R91,R92,R93,R94,R95,R96,R97, R98,R99,R100,R101,R109,R110, R111	470 SM	30658
38	1	R4	470k SM	30694
39	1	R5	68 SM	30648
40	3	R6,R50,R70	100k SM	30686
41	16	R7,R8,R9,R10,R11,R12,R23, R24,R25,R26,R27,R28,R29, R30,R63,R112	100 SM	30650
42	41	R13,R14,R15,R19,R31,R38, R41, R47,R48,R49,R73,R74, R75, R83,R84,R104,R105,R113,R114,R118,R11 9,R120,R121,R122,R123,R125,R126,R127 ,R128,R129,R130R131,R132,R137,R138,R 139,R140 R141,R142,R143,R144	10k SM	30674
43	6	R34,R51,R57,R59,R60,R61	1k SM	30662
44	3	R36,R72,R133	10K POT	30619
45	6	R37,R66,R69,R103,R106,R107	4.7k SM	30670
46	1	R39	180 SM	30653
47	1	R40	33k SM	30680
48	1	R42	680 SM	30660
49	2	R53,R45	47k SM	30682
50	1	R46	3.3	30109
51	1	R52	330k SM	30692
52	2	R54,R62	150k SM	30688
53	1	R64	1	30103
54	1	R102	1.5k SM	30664
55	1	R108	2.2k SM	30666
56	1	R115	47 SM	30646
57	3	R116,R117,R124	4.7 SM	30634
58	2	R134,R135	8.2k SM	30673
59	1	R136	5.6k SM	30671
60	2	U1,U21	LM7805	25095
61	1	U2	MAX232 SM	25410
62	1	U3	74HC14 SM	25043
63	1	U4	ADSP2181KS	25362
64	1	U5	TLC0838CDW	25450
65	1	U7	TLC5620C	25451
66	2	U8,U9	74HC4050 SM	25414
67	1	U10	AM29F040	25363
68	3	U11,U13,U23	TL082 SM	25406
69	1	U12	TDA7056B	25444
70	1	U14	LM358 SM	25383
71	1	U18	TL16C550CFN	25452
72	1	U19	AD1819B-LQFP	25459
73	1	U20	KC9572	25460
74	1	U22	93C66A	25465
75	1	Y1	16.66MHz	48209
76	1	Y2	24.576MHZ	48239



to 538PA - P6  
via CABLE

12/10

17/15

20

40/30

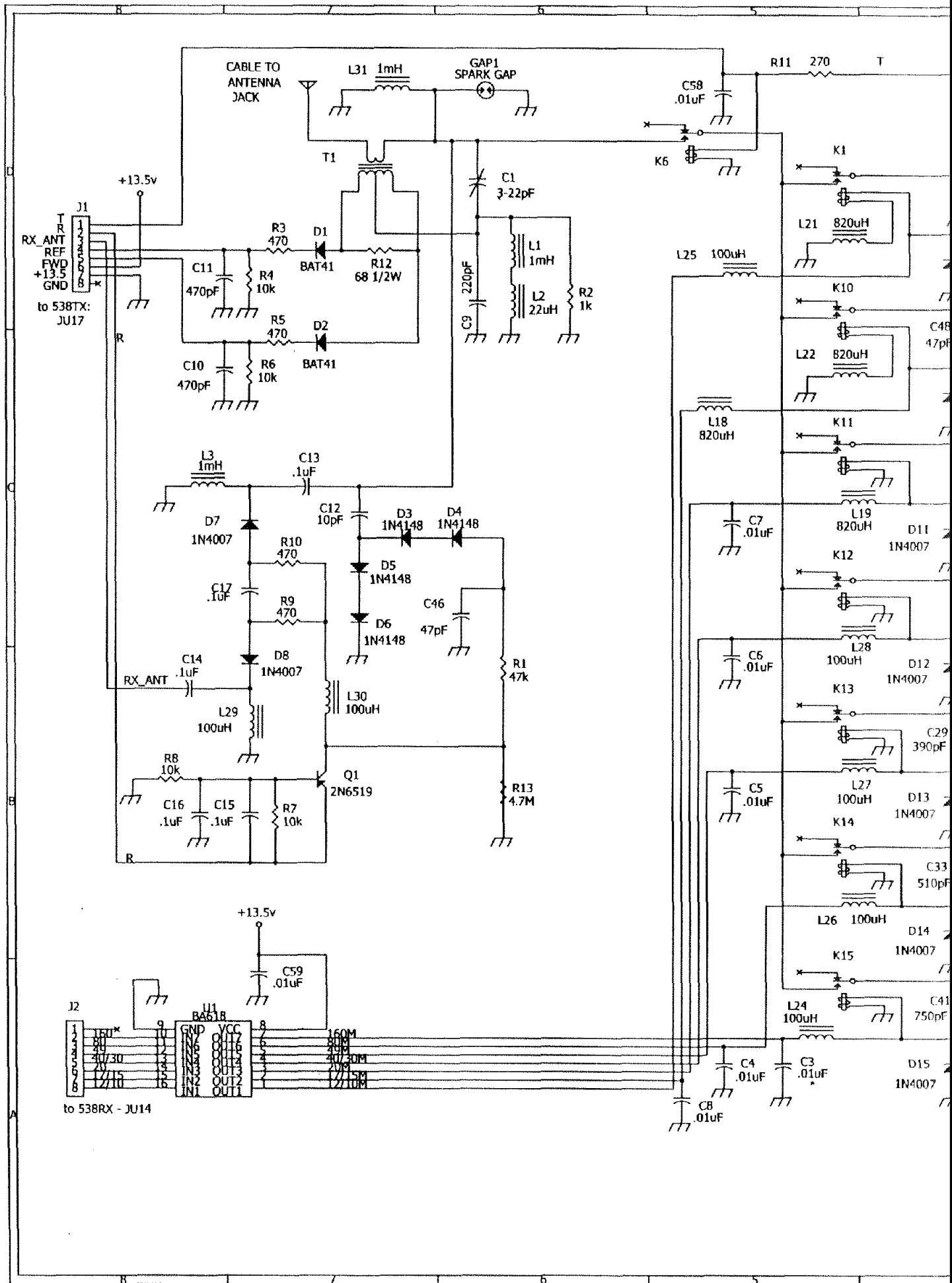
49

80

160

to PA INPUT  
J4

FIGURE 4-17			
TEN-TEC, INC. 1185 DOLLY PARTON PARKWAY SEVIERVILLE, TN 37862			
Title	JUPITER ASSY 81863: 538LPF		
Size	Document Number	REV	
C	538LPF.SCH	KS	
Date:	October 11, 2000	Sheet	1 of 1



**TABLE 4-4 Bill Of Materials**

**Sheet 1/2**

Item	Qty	Reference	Description	Ten-Tec Part Number
1	1	C1	3-22pF	
2	9	C2,C3,C4,C5,C6,C7,C8,C58,C59	.01 $\eta$ F	
3	1	C9	220pF	
4	2	C10,C11	470pF	
5	1	C12	10pF	
6	5	C13,C14,C15,C16,C17	.1 $\eta$ F	
7	8	C21,C22,C23,C25,C37,C52,C60, C62	100pF 1kV	
8	1	C24	150pF 1kV	
9	2	C26,C28	270pF 2kV	
10	5	C27,C34,C40,C50,C61	220pF 1kV	
11	3	C29,C30,C31	390pF 2kV	
12	6	C32,C33,C35,C36,C38,C39	510pF 1kV	
13	1	C41	750pF 1kV	
14	4	C42,C43,C44,C45	1000pF	
15	3	C46,C48,C55	47pF	
16	1	C49	430pF 1kV	
17	1	C51	80pF 3kV	
18	1	C53	33pF	
19	2	C54,C56	18pF	
20	1	C57	39pF	
21	2	D1,D2	BAT41	
22	4	D3,D4,D5,D6	1N4148	
23	9	D7,D8,D9,D10,D11,D12,D13,D14,D15	1N4007	
24	1	GAP1	SPARK GAP	
25	2	J2,J1	CON8	
26	1	J3	MT2	
27	1	J4	TMP	

JUPITER ASSY 81863: 538LPF		Revised: November 13, 2000		
TABLE 4-4 Bill Of Materials		Sheet 2/2		
Item	Qty	Reference	Description	Ten-Tec Part Number
28	14	K1,K2,K3,K4,K5,K7,K8,K9, K10,K11,K12,K13,K14,K15	RELAY SPDT H500F12-1-C	
29	1	K6	RELAY REED	
30	2	L1,L3	1mH	
31	1	L2	22uH	
32	1	L4	1.4uH TOROID	
33	1	L5	1.8uH TOROID	
34	1	L6	1.15uH TOROID	
35	1	L7	2.3uH TOROID	
36	1	L8	2.6uH TOROID	
37	1	L9	3.4uH TOROID	
38	2	L10,L11	.32uH AIR	
39	1	L12	.43uH TOROID	
40	1	L13	.58uH TOROID	
41	1	L14	.65uH TOROID	
42	1	L15	.81uH TOROID	
43	1	L16	.4uH TOROID	
44	1	L17	.44uH TOROID	
45	6	L18,L19,L20,L21,L22,L23	820uH	
46	7	L24,L25,L26,L27,L28,L29,L30	100uH /.1"	
47	1	L31	1mH PC	
48	1	Q1	2N6519	
49	1	R1	47k	
50	1	R2	1k	
51	4	R3,R5,R9,R10	470	
52	4	R4,R6,R7,R8	10k	
53	1	R11	270	
54	1	R12	68 1/2W	
55	1	R13	4.7M	
56	1	T1	1:2 XFMR CT	
57	1	U1	BA618	

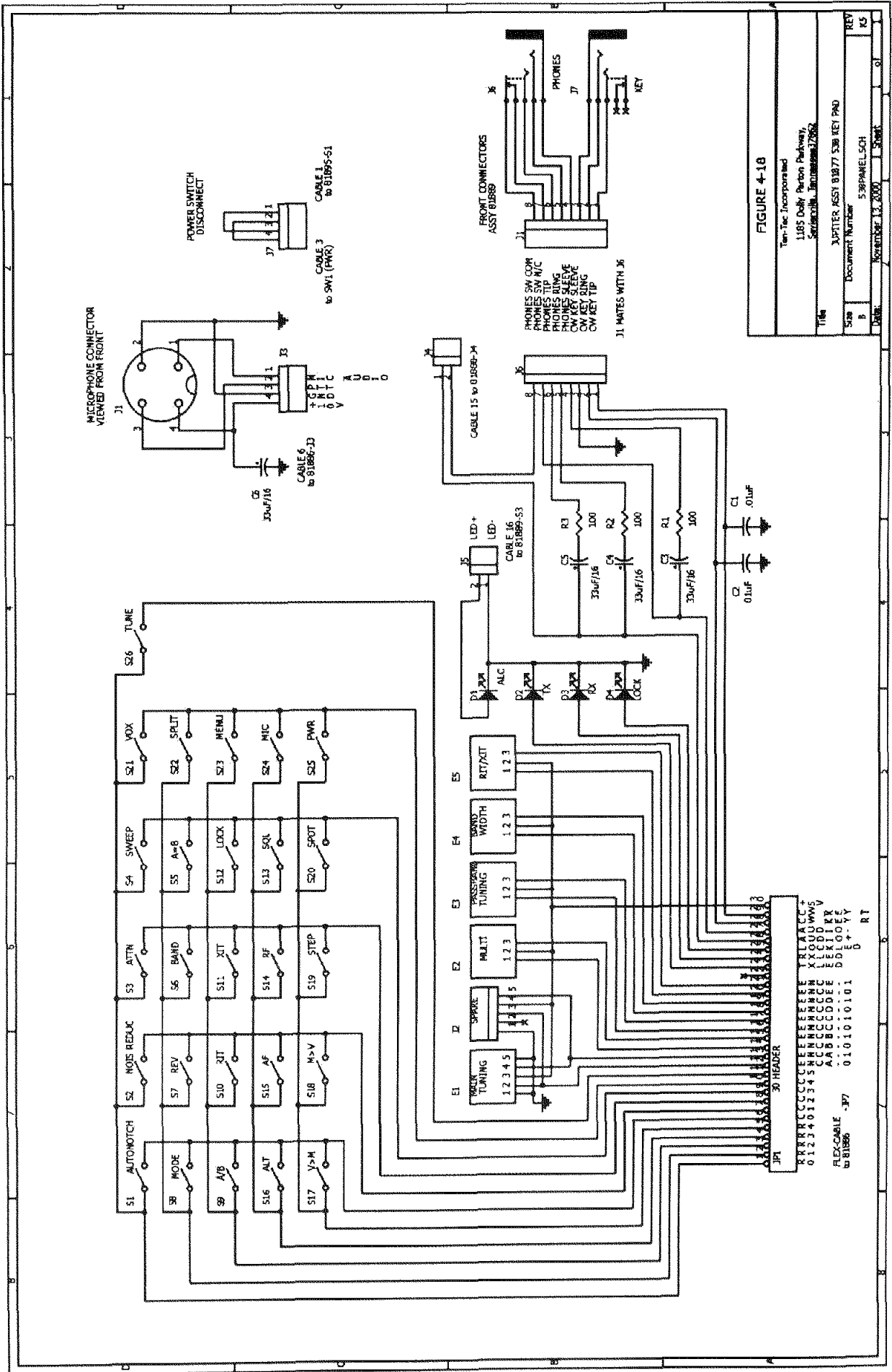


FIGURE 4-18

Ten-Tec Incorporated  
 1185 Dally Parkway,  
 Southfield, Michigan 48034

Model  
 30PTER, KS1 8187, 538 KEY PAD

Document Number 538PANELSCH

Date November 13, 2000

Sheet 1 of 1

JUPITER KEYPAD ASSY 81877			Revised: 17 November, 2000	
TABLE 4-4 Bill Of Materials			TABLE 4-5	Sheet 2/2
Item	Qty	Reference	Description	Ten-Tec Part Number
1	2	C1,C2	.01uF	23260
2	4	C3,C4,C5,C6	33uF/16V	23308
3	4	D1,D2, D4	LED, RED	28040
4	1	D3	LED, GREEN	28067
5	1	E1	ENCODER, HRPG	32127
6	4	E2,E3,E4,E5	ENCODER	32122
7	1	JP1	30 PIN HEADER	35328
8	1	J1	4PIN MIC CONN	35056
9	1	J2	MT5 CONN	35068
10	1	J3	MT4 CONN	35062
11	2	J4,J5	MT2 CONN	35065
12	1	J6	MT8 CONN	35277
13	3	R1,R2,R3	RESISTOR 100	30126
14	26	S1 through S26, inclusive	KEYSWITCH SPST	32113

TABLE 4-5 KEYPAD BOM

JUPITER PANEL JACKS KEYPAD ASSY 78213			Revised: 17 November, 2000	
Bill Of Materials			TABLE 4-5A	Sheet 1/1
Item	Qty	Reference	Description	Ten-Tec Part Number
1	0.2	J1	MT8	35276
2	1	J6	HEADPHONE JACK	35309
3	1	J7	CW KEY JACK	35309

TABLE 4-5A PANEL JACKS BOM





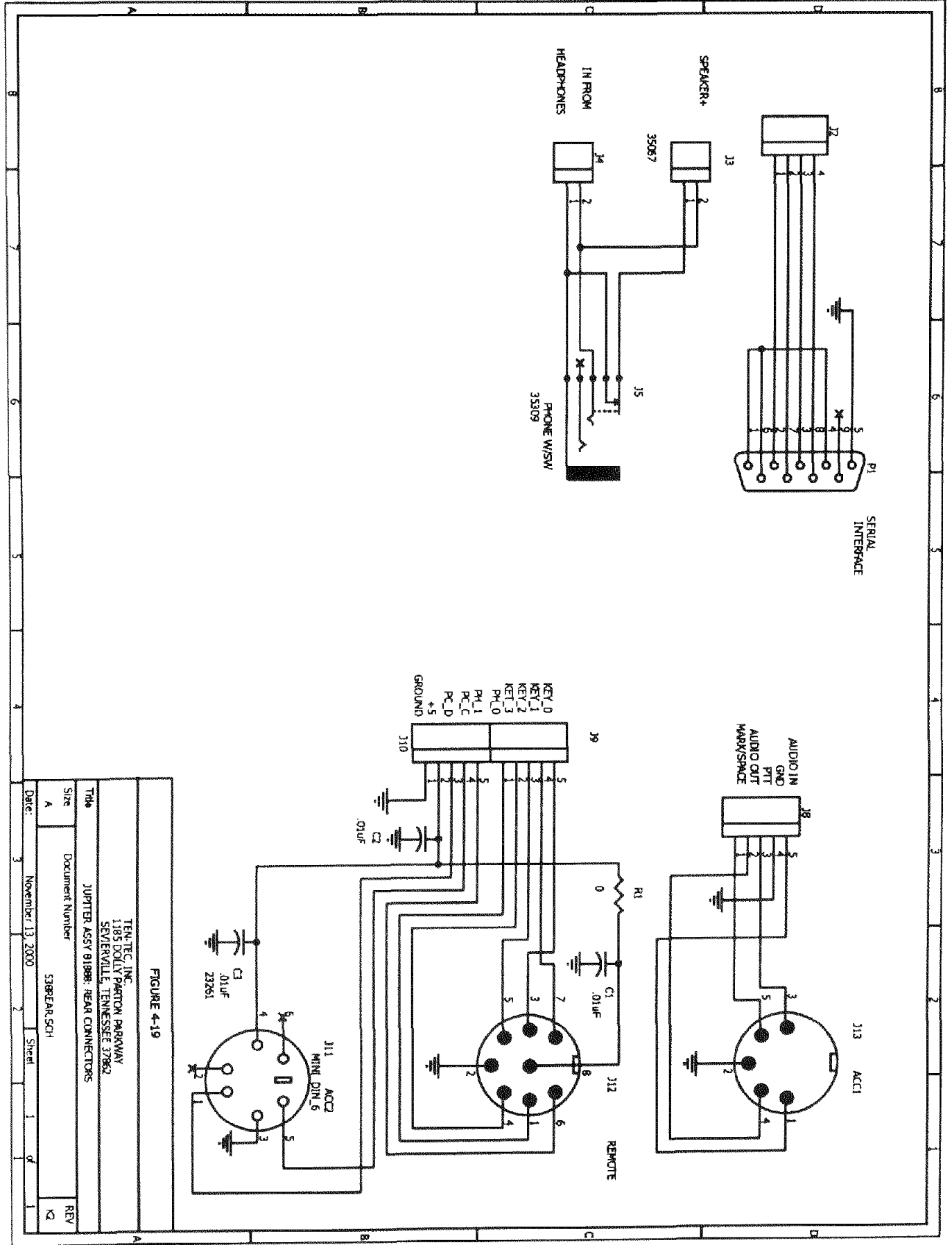


FIGURE 4-19

TEA, INC.	
1185 DOLLY PARTON PARKWAY	
SEVIERVILLE, TENNESSEE 37962	
JUPITER AGSY 81988: REAR CONNECTORS	
Document Number	538REAR.SCH
Date:	November 13, 2000
Size	A
REV	K2

538REAR\_CONN ASSY 81888 Revised: 17 November, 2000

Bill Of Materials Table 4-6 Sheet 1/1

Item	Quantity	Reference	Description	TEN-TEC Part No
1	3	C1,C2,C3	.01uF	
2	1	J2	MT4	
3	2	J3,J4	MT2	
4	1	J5	PHONE JACK W/SW	
5	3	J8,J9,J10	MT5	
6	1	J11	CONNECTOR, MINI_DIN_6	
7	1	J12	CONNECTOR, DIN_8	
8	1	J13	CONNECTOR, DIN 5	
9	1	P1	CONNECTOR, DB9S	
10	1	R1	0 ohm resistor	

**TABLE 4-6 REAR CONNECTORS BOM**

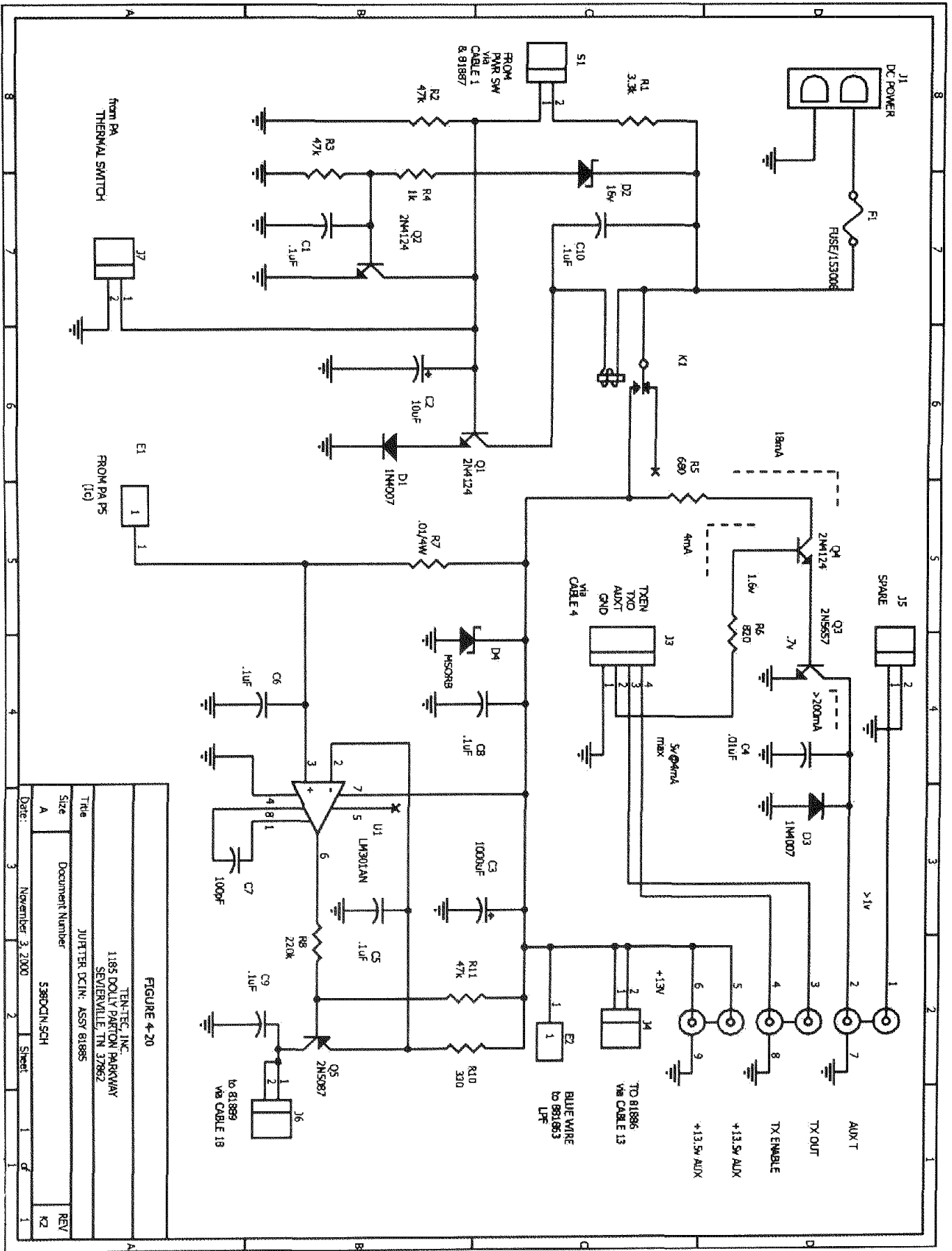


FIGURE 4-20

TELETEC, INC.  
 1185 DOLLY PARTON PARKWAY  
 SEVENSVILLE, TN 37862  
 JUPITER DCIN. ASSY 81885

Size	Document Number	REV
A	580DCIN.SCH	K2
Date:	November 3, 2000	Sheet
		1 of 1

## Bill Of Materials

## TABLE 4-7 sheet 1/1

Item	Qty	Reference	Description	Ten-Tec Part Number
1	6	C1,C5,C6,C8,C9,C10	.1uF	
2	1	C2	10uF	
3	1	C3	1000uF	
4	1	C4	.01uF	
5	1	C7	100pF	
6	2	D3,D1	1N4007	
7	1	D2	16v	
8	1	D4	MSORB	
9	2	E2,E1	TERMINAL	
10	1	F1	25A FUSE	
11	1	J1	DC POWER	
12	1	J2	6 POS'N RCA	
13	1	J3	MT4	
14	5	S1,J4,J5,J6,J7	MT2	
15	1	K1	RELAY/T90	
16	3	Q1,Q2,Q4	2N4124	
17	1	Q3	2N5657	
18	1	Q5	2N5087	
19	1	R1	3.3k	
20	3	R2,R3,R11	47k	
21	1	R4	1k	
22	1	R5	680	
23	1	R6	820	
24	1	R7	.01/4W	
25	1	R8	220k	
26	1	R10	330	
27	1	U1	LM301AN	

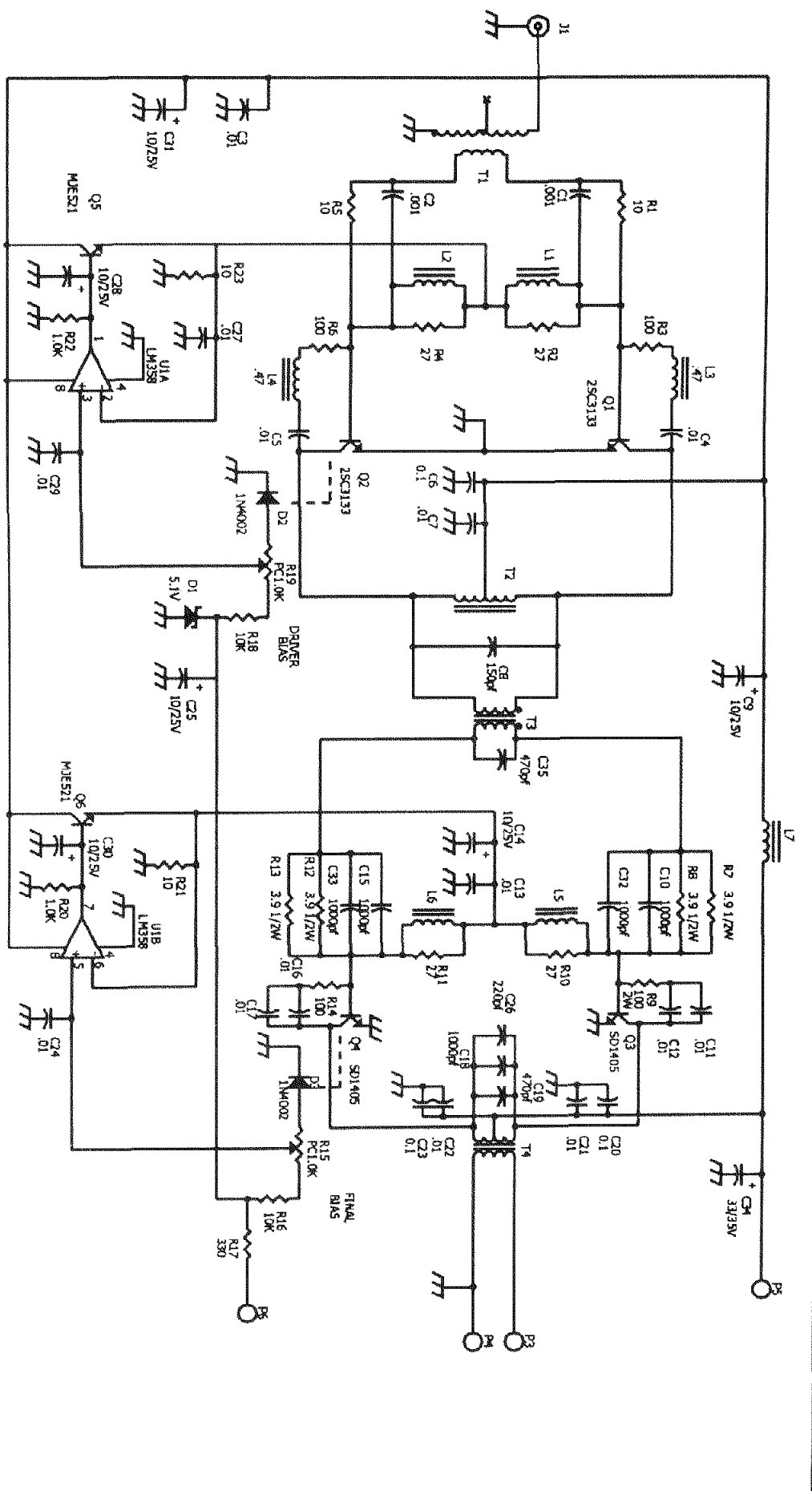


FIGURE 4-21

TEN-TEC, INC.	
1185 DOLLY PARTON PARKWAY	
SEVIERVILLE, TENNESSEE 37862	
Title	100W RF AMPLIFIER CRT BOARD
Doc. No.	41897
Rev.	B
Date	OCTOBER 9, 2000
Drawn	SWP
Checked	
Approved	

538 AMP: ASSY 81896

Revised: 9 October, 2000

## 81896 Bill Of Materials

## TABLE 4-8 Sheet 1/1

Item	Qty	Reference	Description	Ten-Tec Part Number
1	2	C1,C2	.001 uF	23133
2	14	C3,C4,C5,C7,C11,C12,C13,C16, C17,C21,C22,C24,C27,C29	.01 uF	23260
3	3	C6,C20,C23	0.1 uF	23006
4	1	C8	150 pF	23127
5	6	C9,C14,C25,C28,C30,C31	10 uF /25V	23226
6	5	C10,C15,C18,C32,C33	1000pf	23535
7	2	C19,C35	470 pF	23536
8	1	C26	220 pF	23129
9	1	C34	33 uF /35V	23407
10	1	D1	ZENER 5.1V	28041
11	2	D3,D2	1N4002	28000
12	1	J1	TMP	35225
13	5	L1,L2,L5,L6,L7	RF CHOKE	21179
14	2	L4,L3	.47 uH	21108
16	2	Q1,Q2	2SC3133	25463
17	2	Q4,Q3	SD1405	25080
18	2	Q5,Q6	MJE521	25002
19	4	R1,R5,R21,R23	10	30115
20	4	R2,R4,R10,R11	27	30119
21	4	R3,R6,R9,R14	100	30219
22	4	R7,R8,R12,R13	3.9 1/2W	30224
23	2	R15,R19	VAR RES 1.0K	30070
24	2	R18,R16	10K	30150
25	1	R17	330	30132
26	2	R22,R20	1.0K	30138
27	1	T1	INPUT X- FMR	21153
28	1	T2	TOROID_2C T	85085
29	1	T3	INTERSTAG E XFMR	85425-2
30	1	T4	OUTPUT XFMR	85425-1
31	1	UI	LM358	25117

## 5. THEORY OF OPERATION

This chapter introduces interested users to a brief explanation of what goes on behind JUPITER's front panel

### 5.1. Product Composition

JUPITER's basic design derives from the Ten-Tec Model 550, but a number of changes were necessary to replace PEGASUS' personal computer functions with front panel controls. Apart from the software, physical, and cosmetic changes, Ten-Tec engineers designed several new electronic circuit board subassemblies to transform PEGASUS to JUPITER. Model 538 comprises the following electronic subassemblies:

Ten-Tec Subassembly #	Subassembly Description
81886	Logic
81889	RF
81896	RF Power Amplifier
81863	Low-Pass Filter
81887	Keypad
28154	Graphic Display
81899	Front Connectors
81888	Rear Connectors
81895	DC & I/O

**Table 5-1 Jupiter Subassemblies**

Chapter 5 contains schematic diagrams and parts lists for these assemblies. Refer to them as necessary to follow the explanations in this chapter.

### 5.2. Functional Overview

The **81886 Logic** board connects directly or indirectly to all other JUPITER boards. Its principal functions are:

- All receiver and transmitter signal processing, including multi-mode modulation, demodulation and filtering, between audio/data baseband and the 3<sup>rd</sup> IF stages;
- Control of all tuning operations, including **SPLIT, PBT, RIT/XIT**;
- Non-volatile storage and recall of control settings and VFO memories;
- Constant monitoring of all operator controls to capture their status and any changes for conversion to transceiver control signals;
- Generation and control of all information on the front panel display;
- Monitoring of several significant analog signals from the transmitter and receiver circuitry.

The **81889 RF** board provides level control and three frequency conversions between HF and the 3<sup>rd</sup> IF for the receiver and 1-watt transmitter driver. It also hosts the three local oscillators shared by the receiver and transmitter.

The **81896 Power Amplifier** works exclusively in the transmit path where it raises the low power level of the exciter signal to as much as 100 watts output.

The primary function of the **81863 Low-pass Filter** board is to suppress harmonics and mixer image products from the transmitted signal, but it also includes the high-speed transmit/receive switches and detectors for monitoring forward and reflected power to feed control functions.

The **81887 Keypad** board hosts JUPITER's front panel controls and the 28154 Graphics Display. Five rotary shaft-to-digital encoders provide multiple control functions with a traditional analog feel. Twenty-six push-button keys selectively activate or disable one-at-a-

time functions. The display screen provides the operator with status and feedback for the principal and subsidiary controls, and a selectable menu screen displays the set-and-forget controls.

The 81895 DC & I/O board primarily distributes DC power to the other boards and to rear panel receptacles.

### 5.3. Overall Schematic

Figure 4-1 shows the interconnection of JUPITER's 9 printed wiring board subassemblies. The five principal boards, **Power Amplifier**, **Lowpass Filter**, **RF**, **Logic**, and **DC&IO**, evolved from the Ten-Tec Pegasus design. The **Graphic Display**, **Keypad**, **Front Connectors**, and **Rear Connectors** are entirely new. There are 18 numbered cables and 2 soldered wires interconnecting the boards. Board-to-board header plugs in a manner similar to Pegasus couple the **Lowpass Filter**, **RF**, and **Logic** boards.

### 5.4. RF Board – P/N 81889

For the following, refer to Figures 4-2 through 4-8 in the Schematics chapter. The RF board schematic comprises an overall diagram, Figure 4-2, and five detail parts – Figures 4-3 through 4-7.

#### 5.4.1.1. Local Oscillator Section

Jupiter's receiver and transmitter are triple-conversion superheterodyne designs sharing three local oscillators – Figure 4-3. The following description of the frequency plan takes the receiver point-of-view, but applies in reverse order to the transmitter.

The first local oscillator is a phase-locked loop that tunes 45.1 – 75 MHz to convert the signal frequency to the 45 MHz first IF. Tuning data comes from the Logic board via **CLK**, serial **DATA**, and **EN\_2** lines. The **VCO\_SEL** line switches from the Q4 VCO to the Q2 VCO at a

transceiver frequency of 13.03 MHz. U10 processes the control signals, the reference signal from TCXO U4, and the VCO samples from the loop buffer, Q1. The circuit surrounding Q54–Q48 is the charge-pump and loop filter, while Q7 buffers the **1st\_LO** output to the receiver and transmitter first mixers.

The 14.8475 MHz TCXO reference also feeds the Q8 frequency tripler to develop the 44.5425 MHz **2nd\_LO** for the second mixers.

Crystal, X1, at 4.76 MHz drives a divide-by-ten counter at U2 to develop the 476 kHz **3rd\_LO**.

#### 5.4.1.2. Receiver Section

Figures 4-4 and 4-5 show Jupiter's receiver schematic. The antenna signal from the Lowpass board encounters a common-mode choke at T13 followed by a PIN diode switched attenuator, R152, R201 and R202. Q43, Q52, and Q53 condition the attenuator control signal from the Logic board to levels suited to switches, D41 and D47. Common control signals, **DATA** and **CLK**, plus **EN\_1** control driver, U17, which sources the band-select lines to PIN diode switched sub-octave filters between C181 and C148.

Q45, Q54, and Q55, form a parallel-connected high dynamic range RF amplifier with D21 as a gain control element. Q35 and Q40, with associated parts, comprise the balanced first mixer, fed by the first LO to develop a 45 MHz first IF. Monolithic crystal filter, FL4 feeds the dual-gate MOSFET (Q38) first IF amplifier. The **2<sup>nd</sup>\_LO** signal drives the double-balanced mixer formed by T8, T10, and the diode pairs. The **2<sup>nd</sup> IF** centered at approximately 454 kilohertz results.



Common-gate buffer, Q35 and T11 feed this signal to FL3, a ceramic bandpass filter, followed in turn by the Q33 and Q34 cascode amplifier. The IF signal proceeds to the third mixer, D12 and D18 – D20, via T12, which also feeds the amplified AGC detector between Q37 and Q41. The **T** (transmit) control voltage at R162 mutes the receiver during transmit times. Following the third mixer, dual op-amp U11 and associated components apply a combination of active and passive filtering to condition the signal for circuitry on the Logic board.

#### 5.4.1.3. Transmitter Section

See Figures 4-5 and 4-6 for the transmitter section schematic of JUPITER's RF board. From its source on the Logic board, the modulated **TX\_IN** signal feeds the 3<sup>rd</sup> IF mixer at U18 where the **3<sup>rd</sup>\_LO** converts the signal from its 13 kHz center frequency to 454 kHz. FL2 defines the 2<sup>nd</sup> IF passband and feeds U19, the 2<sup>nd</sup> mixer. The **2<sup>nd</sup>\_LO** causes frequency translation to 45 MHz. The monolithic crystal filter, FL1, and Q32 filter and amplify the 2<sup>nd</sup> IF signal for the final mixer, which uses the first LO to shift the signal to the required amateur frequency.

Q25 and Q19 are broadband HF amplifiers that develop input for the Power Amplifier board. Q23, Q24, and Q26 use the **T** control signal to apply operating bias for transmitting and to mute the amplifiers during receive periods.

The two sections of U10 condition forward and reflected power signals from the Lowpass Filter board for use by the Logic metering functions. R86 and R83 set the meter calibration for those functions. The forward power signal and the PA current signal combine in R231 (via D62 and D63) to produce input for U8a. This op amp and the low-pass

filtered buffer, Q30 and Q31, generate the **ALCFB** (Automatic Level Control Feedback) to D10 to perform transmitter ALC. U8a also sums in a front panel power control signal from the Logic board to allow a range of RF power adjustments below the factory set point.

The U8a output also drives a peak detector (D46, R203, and C222) and U8b which supply a signal for the ALC indicator on the front panel. The **R** (receive) control voltage feeds Q44 to extinguish the ALC indicator as soon as JUPITER switches to receive. The **R** voltage feeds a buffer amplifier at Q21 and Q28 to distribute that control signal to the 81863 board. In similar manner, Q22 and Q28 buffer the **T** signal.

#### 5.4.2. Logic Board - P/N 81889

Figure 4-9 is the overall schematic diagram for the Logic board. Five subordinate sheets (Figures 4-10 through 4-14) cover the detailed diagrams.

##### 5.4.2.1. Power/Control Section

Figure 4-10 shows the circuitry of the Power/Control section, comprised of a voltage regulator to condition the RF board 5 volt supply, networks to condition the **10vrf** distribution point, the RS232 integrated circuit level converter for the **Serial Interface** connector on the rear panel, and two distinct 13 volt paths. **13vpd** is a power-down signal to the CPU. **13vdc** supplies voltage to Q1, an FET anti-pop switch on the Auxiliary Audio Output section of the Logic board.

##### 5.4.2.2. Audio I/O Section

Refer to Figure 4-11. Signal **OUT\_R** brings received audio from U19 on the Codec section to the audio output amplifier, U12 **VOLUME\_V** is a DC volume control voltage from one channel

of U7 on the CPU section (Figure 4-13) of the Logic board. The **AUDIO-** and **AUDIO+** signals are the balanced output. They exit the board via JP7 to the 81887 Keypad board. Q2 and U11a are audio amplifiers that provide the **AUX\_AUD\_OUT** path to the **REAR CONNECTORS** board via J11 and Cable 10. **MIC\_AUDIO** comes from the Keyboard Board via Cable 6 and J3. U13a and U13b provide amplification of the signal and R72 provides an internal control for setting the range of the operator's **MIC** control on the front panel. From U13a the amplified signal goes to an input of the codec IC, U19.

The codec section of the Logic schematic, Figure 4-12, is the bridge between JUPITER's analog and DSP circuitry, providing the two-way conversion between 3<sup>rd</sup> IF and audio signals for both receiver and transmitter. In the transmit path, the U19 IC converts analog audio input to digital data for the CPU and converts digital-signal-processed CPU data to analog 3<sup>rd</sup> IF. In the receive path it converts analog 3<sup>rd</sup> IF signals to digital data for the DSP and converts the processed data to audio for receiver output.

U4, an Analog Devices ADSP2181 processor clocked at 16.66 MHz by Y1, provides much of JUPITER's functionality. See Figure 4-13. Here the selectivity-critical filtering, multiple-mode modulation and demodulation, and interpretation of operator input to the radio controls takes place. Buffers, U8 and U9, are the drivers for discrete control signals to the RF board and U9 also conditions digital lines from such external control inputs as **MIC\_PTT** (push-to-talk) and **CW\_KEY\_R** (Ring) and **CW\_KEY\_T** (Tip). U5 digitizes analog control signals from the transmitter and receiver. These include **FwdPwr** and **RefPwr** from the

transmitter and **AGC** from the receiver. U4 processes these inputs and returns analog control outputs via the D/A converter at U7 output. U22 is a serial Read-Only Memory that stores configuration data for the processor. U10 is the Flash Random-Access-Memory that holds the operating data and control settings. U18 performs parallel-to-serial and serial-to-parallel data conversion between the CPU and Jupiter's **SERIAL INTERFACE** connector.

Subsidiary to the Sheet5 CPU schematic diagram is the Sheet 6 PLD schematic. The Programmable Logic Device, U20, uses a single IC to replace many smaller-scale digital ICs. It communicates with the processor via 5 address lines and 8 data lines, and its internal logic handles six I/O connectors that serve the:

- 28154 GRAPHIC DISPLAY (JP6);
- 881887 KEYPAD (JP7);
- ACC2 Connector (JP3);
- Amplifier Control Connectors (J9); and
- Factory Test Connectors (JP12) & (JP11);

The PLD section of the Logic board schematic (Figure 4-14) shows the voltage regulator, U21, dedicated to the GRAPHIC DISPLAY and Q5, the driver for its contrast signal.

#### 5.4.3. Lowpass Filter - P/N 81863

This circuit board (Figure 4-17) accepts band-selection signals from the CPU via driver, U1, in order to interpose the appropriate low-pass filter between the broadband 81896 Power Amplifier and the antenna. These filters suppress transmitter harmonics and undesired mixer products to levels that satisfy FCC requirements for signal purity and make JUPITER a good RF neighbor.

Reed relay, K6, switches the 100-watt RF amplifier output to the antenna at CW-keying speed. Transmitter RF feeds a voltage-doubler (D4 through D6, C12 and C46) to develop cut-off bias for the series diode switch (D7 and D8) to protect the receiver. On receive, the R control voltage (from the Logic board) turns on Q1, thereby biasing D7 and D8 on and restoring the RF path from the antenna to the receiver input. The directional coupler, T1, D1, and D2, supplies low-voltage DC signals proportional to forward and reflected power for metering and control by the processor. L31 establishes a static-electricity drain at the antenna jack, while GAP1 provides a protective-shunt path to transient energy pulses that might otherwise damage receiver components. J3 carries T control voltage to control the PA.

#### **5.4.4. Keypad - P/N 81887**

JUPITER's operator controls, rotary encoders and key-switches, connect via digital logic on the 81887 KEYPAD board (Figure 4-18). Located immediately behind the molded front panel, this board also carries the L.E.D. indicators for **ALC**, **TX**, **RX**, and **LOCK**. The KEYPAD board is a mechanical host for the 28154 GRAPHICS DISPLAY, the MIC connector, and for the 81899 board which mounts the **KEY** and **PHONES** jacks.

#### **5.4.5. Rear connectors - P/N 81888**

Figure 4-20 shows the REAR CONNECTOR board, a simple mounting means and junction site for rear panel connectors and several cables.

#### **5.4.6. DCIN - P/N 81895**

The external DC power supply connects to JUPITER via the 81895 circuit board which controls, and filters it for distribution throughout the transceiver. It hosts circuitry at Q1 and Q2 for the master power control, and PA protection circuitry.

Cable 4 carries keying control signals via J3 and the Q3, Q4 switch circuit. U1 and Q5 condition the PA current signal, developed across the R7 shunt and fed back to the RF board via J6 and Cable 18.

#### **5.4.7. 100 watt Amplifier - P/N 81897**

Refer to Figure 4-21, the schematic of JUPITER's 100-watt Power Amplifier. The amplifier comprises two transformer-coupled broadband push-pull bipolar transistor stages of amplification that are effective from 1.8 to 30 MHz. P5, a hard-wired terminal carries supply current to the PA from the current-sensing circuitry on the DCIN board. T control voltage, hardwired to P6 from E1 on the Lowpass Filter board, activates the bias circuits for driver and final stages during transmit periods and shuts down the stages during receive periods. R17 and D1 stabilize the control voltage, which provides a fixed reference to bias setting controls R19 (Driver Bias) and R15 (Final Bias). Diodes D2 and D3, coupled to the driver and final transistors reduce the set-point as device temperature rises. This is a precaution against thermal runaway. Collector-to-Base networks at each device provide increasing negative feedback with rising frequency to partially offset the inherent response of the transistors. Solder terminals, P3 and P4 at the output transformer, connect the coax output cable leading to the Lowpass Filter board.

## 6 GLOSSARY

Many of the definitions in this glossary are specific to JUPITER, and may not be strictly accurate in other contexts. For explanations in greater detail than is

practical here, we recommend consulting The ARRL Handbook for Radio Amateurs.

adaptive filter	An "intelligent" filter which changes its characteristics to optimize an output property.
<b>AF</b>	(Audio Frequency) JUPITER's volume control
<b>AGC</b>	(Automatic Gain Control) holds receiver output fairly constant with a wide range of input signals.
<b>AGC</b> hold time	During this period the automatic gain setting does not change.
<b>ALC</b>	(Automatic Level Control) holds transmitter output constant with changing loads.
algorithm	A method of problem solution, especially in computer programs.
alternate action	Example: push <b>ON</b> , then push <b>OFF</b>
<b>AM</b>	Amplitude Modulation of an RF signal.
AMTOR,	A digital mode that improves radioteletype performance.
<b>AN</b>	(Automatic Notch) A DSP function that removes steady tones from interfering with a voice signal.
attenuator	A device to reduce signal strength.
balanced feedline	A (low-loss) ungrounded two-wire feedline.
<b>BANDWIDTH</b> (BW)	The frequency space required (or allowed) to pass a signal.
BFO (beat-frequency oscillator)	Converts an IF signal to an audio tone.
break-in	Ability to receive CW between transmitted letters (or even dits).
bug	A semi-automatic telegraph key that forms dits automatically and dahs manually.
built-in preamplifiers	Included in some microphones to increase output, but makes problems if not used carefully.
codec	A combined analog-to-digital and digital to analog converter used with DSPs.
<b>CW</b>	"Continuous-wave", formerly used to distinguish electronic RF signals from older spark signals, became synonymous with Morse radiotelegraphy.
dB	(Decibel) a logarithmic unit of power <i>change</i> related to human hearing.
dead short	A usually unintentional electrical bypass of all current limiting elements in a circuit.
deviation control	Adjusts the level of modulation in an FM transmitter.

digital modes	Modulation methods, such as RTTY, AMTOR, PSK31, and others that use digital codes on RF.
direct frequency entry	Setting the operating frequency by using JUPITER's optional keypad.
DSP	Digital Signal Processor (processing).
duty cycle	Ratio of <b>ON</b> time to <b>OFF</b> time.
dynamic range	Ratio between strongest and weakest signals handled with acceptable performance.
dynamic, ceramic, crystal, or electret microphones	Commonly available methods of converting voice to electrical signals. Only the electret requires a power source.
external T/R	This control signal usually keys an external amplifier.
firmware	Computer instructions or data in a non-volatile medium.
flash RAM	A form of non-volatile Random-Access-Memory that accepts electronic updates without physical removal from its host circuit.
FM	(Frequency Modulation) impresses information on an RF carrier by varying its instantaneous frequency.
forward power	The component of RF power flowing in a transmission line from the generator towards the load. See reflected power and SWR.
front-end	The portion of receiver circuitry ahead of the main selectivity filtering.
heat sink	A metallic mass used to convey heat from JUPITER's power amplifier components to the air.
iambic	Alternating formation of dits and dahs in some automatic keyers.
IC	Integrated Circuit.
impedance mismatches	Discrepancies between inherent voltage-to-current ratios of connected components, especially transmitter and antenna.
<b>KEY SPD</b>	(Keyer Speed), the rate at which JUPITER's keyer forms Morse code dits and dahs. See WPM.
keyer	JUPITER's internal means of automatic dit and dah formation from the user's paddle input.
<b>LCK (LOCK)</b>	This key prevents accidental disturbance of JUPITER's tuning knob from moving the operating frequency of the transceiver.

<b>LEDs</b>	(Light Emitting Diodes) used as indicators on the control panel.
linear amplifier	External amplifier used to increase transmitted power with minimal distortion to SSB or AM signals.
low impedance	Usually below a thousand ohms for microphones or below 50 ohms for antennas.
<b>61.1..1.1 LSB</b>	(Lower sideband) AM without carrier or upper sideband. See USB.
<b>M-LVL (MONITOR volume)</b>	JUPITER's adjustment for listening to transmitted audio via speaker or headphones.
<b>MODE</b>	The method of impressing or recovering information on a radio signal, also called modulation. JUPITER uses five modes.
Model 302J	JUPITER's optional remote tuning/control device.
MOLEX™ connector	Brand name of JUPITER's power connector.
monaural (2-circuit – “mono”)	A jack or plug (of telephone origin) carrying “tip” (signal) and “sleeve” (ground) circuits. See stereo, below.
<b>MULTI</b>	JUPITER's (multiple-purpose control) operates many functions that used to require individual knobs and occupy more panel space.
non-QSK	An RF device lacking Ten -Tec's traditional break-in capability. See QSK.
non-volatile memory	Computer memory that retains its contents without electrical power.
<b>NR (Noise Reduction)</b>	JUPITER's DSP function that diminishes random noise on received signals.
open circuit	Electrical circuit having a disconnected load. A common antenna fault.
open-collector	A transistor circuit requiring external connection of a power source and a load.
overcurrent protection	Prevents many commonly occurring conditions from overloading JUPITER's wiring or power amplifier components.
<b>PACTOR</b>	A popular amateur radio digital mode.
paddles	The form of telegraph hand key that controls an automatic keyer.
<b>PBT</b>	(Passband Tuning) tunes the receiver's selective filter across the signal without moving the apparent receiver tuning.

PEGASUS Emulation Mode	JUPITER's built-in remote control function uses existing PEGASUS software.
personal computer	As used here, this means IBM™-compatible and Windows™ operating system.
phono plug	A common connector for shielded cables. RCA introduced them in the 30's for phonograph connections to radio sets.
polarized	A connector whose design prevents mating with incorrect orientation.
polarizing voltage	The necessary power to operate an electret microphone.
PSK31	A very popular form of digital modulation compatible with SSB transceivers.
push-pull	An amplifier circuit in which pairs of devices handle signal excursions above and below the static bias current to increase the range of operation.
<b>PWR</b>	(Power) usually RF power; sometimes primary power.
QRM	Radio "Q-code" for interference.
receiver overload	An extremely strong signal can cause distortion in the receiver even when it is on a different frequency.
Reflected (reverse) power	The component of RF power returned towards the generator from a load whose impedance is not matched to that of the transmission line.
Regulated	Usually a power supply whose output voltage is constant with changing load current.
remote encoder/keypad	See 302J, above.
RESET	To restore factory settings, press a front panel button while applying power to JUPITER.
resonant	The condition of being tuned to the operating frequency maximizes power transfer.
reverse-video	(Light lettering on a dark background) shows that a particular JUPITER function is selected and active.
RTTY	Radio Teletypewriter operation, a digital mode of long standing, still popular in amateur contesting.
<b>Rx</b>	(Receiver)
Selectivity	Ability separate signals close in frequency.
serial port	Connector (on rear) and circuitry for connecting JUPITER to a personal computer.
shielded cable	One or more wires inside a metallic shield to prevent signal leakage.

single lever paddle	A non-iambic keyer paddle.
SO-239 connector	Old military name for JUPITER's <b>50 OHM ANTENNA</b> coaxial connector. It mates with a PL-259 cable plug.
<b>SQUELCH</b>	This function will mute the receiver audio until a signal exceeds the threshold setting.
<b>S-T</b> (sidetone volume)	A tone which provides audio feedback to a CW operator while he is transmitting.
station ground	The common connection of equipment chassis to earth ground.
status	Information on the state of JUPITER's controls, settings, and operating conditions.
<b>STEP</b>	(Tuning step size) is the selectable smallest amount by which JUPITER will change frequency in response to the tuning knob.
Stereo	A jack or plug (of telephone origin) carrying "tip" (signal A), "ring" (signal B), and "sleeve" (ground) circuits. See Figure 1-2.
straight key	The traditional manual telegraph key.
SWR (standing wave ratio)	On RF transmission lines, the ratio between line and load impedance. An indicator of mismatch.
TNC or phone patch	A (Terminal Node Controller) for packet radio and a phone patch for interconnection of radio and telephone are two examples of equipment served by JUPITER's <b>ACC-1</b> connector.
transmit power peaks	Usually, the maximum levels of SSB voice signals.
<b>TX</b>	(Transmitter)
unbalanced	Characteristic of coaxial cable, a transmission line having one side connected to ground.
USB	(Upper SideBand). AM without carrier or upper sideband. See LSB.
$\eta$ V	(Microvolt) one-millionth of a volt. Unit of measure for RF at the receiver's antenna.
<b>VFO A, VFO B</b>	JUPITER's two Variable Frequency Oscillator functions that control and store the transceiver operating frequency.
Weighting	The ratio of dit to space timing in Morse code.
WPM	(Words per Minute) see <b>KEY SPD</b> .



## 7 – TROUBLESHOOTING

While we cannot cover every possible problem, here are hints for dealing with some potential difficulties.

### 7.1 Check the Obvious!

- Is DC **PWR** okay?
- Check power supply, cable and connector(s).
- Is 25 ampere fuse loose or missing.
- Antenna Problems?
  - Is the proper antenna connected?
  - Is the antenna switch connected and properly set?

#### Control Settings?

- Have you double-checked JUPITER's many control settings, including those on the **MNU** screen, for your intended mode of operation?

### 7.1 Reset the Processor.

See paragraph 3.19. We have learned that this can cure a multitude of "bugs" in a few seconds.

### 7.2 No audio from receiver.

- Frequency controls act normally;
- S-meter seems to be reacting to signals.
  - Receiver squelched. Push **SQL** key to check setting.
  - Check settings of **AF** and **RF** gain controls.
  - Try a set of headphones in case the speaker has failed.
  - Check inside the cabinet for cable connectors that may have loosened in shipment or rough handling.

### 7.3 Symptom: distorted SSB

- Be certain the ALC is set properly in accordance with paragraph 2.6.2.

The ALC LED should flash briefly on voice peaks.

- A frequent cause of a distorted SSB signal is inadequate RF grounding resulting in feedback. Common RF grounding problems are:
  - No ground connection: or
  - Too long a lead to a good ground.
- Another potential cause of distorted SSB arises when the station is in the near field of the antenna. This is a problem many apartment dwellers face.

### 7.4 Diagnosing RF feedback problems

- Every amateur station should have access to a well-shielded 50-ohm dummy load. Start troubleshooting by disconnecting all RF accessory equipment from the transceiver output. Likewise disconnect all accessories from other radio connectors, leaving only the microphone. Be certain your microphone cable is well shielded. Connect the dummy load to the Antenna receptacle with a short coaxial cable.
- A nearby HF receiver (or a local ham friend's station) will likely have little trouble hearing your very low power RF signal when you transmit 100 watts into the dummy load. If the distortion problem does *not* disappear under these conditions, your rig may well have a problem and you should call Ten-Tec's service department. If the problem goes away, as is likely, you can begin the process of re-connecting accessories one-at-a-time to isolate the problem.

## 7.5 RF Grounding

- Many problems relate to the lack of an RF station ground, as contrasted with a safety ground connection. We recommend bonding all equipment chassis together with short heavy metal braid or strap. Make these connections from chassis ground lug to chassis ground lug and connect the last piece in the chain feeding the antenna to a good earth ground. This lead needs to be as short as possible. Lengths near  $\frac{1}{4}$  wavelength on any band used can be particularly troublesome when the far end is connected to earth.
- Ten-Tec recommends following the good advice in the ARRL Handbook for dealing with RF grounds and safety grounds.

## 7.6 No Transmit, but Receiver works

- Check the following items on JUPITER's **MNU** screen to decide if the setting is right for the operating mode you plan to use:
  - Is the **AUDIO SOURCE** set to **MIC** or **LINE** as appropriate?
  - Is the **TRANSMITTER ENABLE ON?**
  - Is the **KEYER ENABLE ON?**
  - Is the **KEYING LOOP** set properly for your mode of operation? With no amplifier or with a non-QSK amplifier the **MNU** should indicate

**KEYING LOOP** off. See paragraph 3.15.

## 7.7 No Receiver, but JUPITER Transmits

- Check the **PBT** setting or turn it off. It may be set outside the passband.
- Disconnect any external equipment that might be pulling the **PTT** line to ground.
- Is the internal **KEYER** enabled with a mono plug in the **KEY** jack? That would cause a constant stream of dits when you apply power.
- Check settings of the **SQL**, **AF**, and **RF** controls.

## 7.8 No operation in VOX

- Check the switch on the bottom of the Model 705 microphone.
- Check JUPITER's screen to see if the **MNU** items for **VOX** are active and set properly. If any of the three settings is at zero, **VOX** will not operate.

## 7.9 When All Else Fails...

- If the measures above do not fix the problem, please consult with our service department.

## **8 PEGASUS EMULATION MODE**

JUPITER's **SERIAL INTERFACE** and built-in PEGASUS Emulation Mode provide the transceiver with remote control from a computer RS-232 port. JUPITER uses PEGASUS software in this mode. Upon detection of PEGASUS commands, JUPITER's display screen shows the legend **PEGASUS EMULATION MODE** and the normal front panel controls go inactive. JUPITER then responds much as a PEGASUS does. Using this mode makes all JUPITER's controls and functions visible on your computer screen and controllable by the computer keyboard, mouse, and optional Model 302J remote encoder/keypad. JUPITER reverts to front-panel operation when you quit the PEGASUS program.

JUPITER's Pegasus Emulation Mode allows a PEGASUS graphical user interface (GUI) computer program to operate the transceiver in a manner quite similar to the PEGASUS. This requires connecting a Windows computer to JUPITER's serial interface via a 9-pin serial port cable. The computer runs PEGASUS software (available by download from the [www.tentec.com](http://www.tentec.com) website). When JUPITER detects PEGASUS commands, the firmware responds by disabling the panel controls and displaying "Version x.xx PEGASUS EMULATION" in place of the JUPITER screen. "X.xx" will be the PEGASUS software version. The website provides a text help file for those unfamiliar with PEGASUS operation.

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### LIMITED WARRANTY AND SERVICE POLICY, U.S.A.

TEN-TEC, Inc. warrants this product to be free from defects in material and workmanship for a period of one year from the date of purchase, under these conditions:

1. THIS WARRANTY APPLIES ONLY TO THE ORIGINAL OWNER. It is important that the warranty registration card be sent to us promptly to establish you as the owner of record. This will also insure that any bulletins pertaining to this equipment will be sent to you.
2. READ THE MANUAL THOROUGHLY. This warranty does not cover damage resulting from improper operation. Developing a thorough understanding of this equipment is your responsibility.
3. IF TROUBLE DEVELOPS we recommend that you contact our customer service group direct. The selling dealer is not obligated by us to perform service in or out of warranty. It has been our experience that factory direct service is expeditious and usually results in less down-time on the equipment. Some dealers do offer warranty service and of course, have our complete support.
4. WE ENCOURAGE SELF HELP. Taking the covers off does not void the warranty. In many cases our customer service technicians, with your help, can identify a faulty circuit board. In these cases we will send you a replacement board which you can change out. This will be shipped on a 30 day memo billing and when the defective board is returned, we will issue credit.
5. EQUIPMENT RETURNED TO THE FACTORY must be properly packaged, preferably in the original shipping carton. You pay the freight to us and we prepay surface freight back to you.
6. EXCLUSIONS. This warranty does not cover damage resulting from misuse, lightning, excess voltages, polarity errors or damage resulting from modifications not recommended or approved by Ten-Tec. In the event of transportation damage a claim must be filed with the carrier. Under no circumstances is Ten-Tec liable for consequential damages to persons or property caused by the use of this equipment.
7. TEN-TEC RESERVES the right to make design changes without any obligation to modify equipment previously manufactured.
8. THIS WARRANTY is given in lieu of any other warranty, expressed or implied.

### SERVICE OUTSIDE OF THE U.S.A.

Many of our dealers provide warranty service on the equipment they sell. Many of them also provide out of warranty service on all equipment whether they sold it or not. If your dealer does not provide service or is not conveniently located, follow the procedure outlined above. Equipment returned to us will be given the same attention as domestic customers but all freight expense, customs and broker fees will be paid by you.