

# The Epiphyte 3, A 75 Meter SSB Transceiver

Designed by Derry Spittle, VE7QK  
A NorCal QRP Club Kit  
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*[The Epiphyte 3 is a remarkably simple, easy to build SSB transceiver for 75 Meters. It uses simple parts, which used to be easy to find. Sadly, some parts for this transceiver are very difficult to find in quantity, although it is possible to find them in lots of 1 or 2. NorCal kitted 100 of these transceivers in September, and they sold out in 1 day, less than 24 hours. We have been planning this kit for 4 years, and have had some parts for that long. We will not do another run of the kit, but present the manual here for those who might want to attempt to build their own, with salvaged parts from Epiphyte 1's and Epiphyte 2's. The club does have 40 PC Boards that are for sale for \$12 each. To order, send a check or money order for \$12 to Jim Cates, 3241 Eastwood Rd., Sacramento, CA 95821. Please enclose a self addressed mailing label to help Jim out. As always, please make checks and money order to Jim Cates, NOT NorCal. We do not have any parts available for the boards. You are on your own on that one. We hope you enjoy the article, as it has been a long time in development. Doug, KI6DS]*

## INTRODUCTION

### ***EPIPHYTE, a plant growing on another [f. EPI + Gk. phuton]O.E.D.***

The original Epiphyte was a simple transceiver designed to provide voice communication with the British Columbia Public Service Net on 3729KHz from wilderness areas of the province. It ran off AA batteries, was light enough to backpack, and had an output of one watt. Construction articles were published in both QRPp and SPRAT, circuit boards became available and fifty kits were produced. While only a few amateurs used it for the purpose for which it was originally intended it did succeed in introducing many of them to home construction of SSB equipment. It was fun to build and play with.

The Epiphyte-2 included a VFO and the power output was increased to five watts. Once again, construction articles were published and circuit boards became available. In 1996 the QRP Club of Northern California and the G QRP Club, as a joint project, donated fifty EP-2 kits to amateur operators in Third World Countries. It now features in the QRP section of the RSGB Radio Communication Handbook and feedback from amateurs around the world confirms that many have been and continue to be built and operated.

So how does the Epiphyte-3 differ from its predecessor?

- The circuit board has been re-designed and professionally manufactured with plated-through holes, solder resist and screened parts overlay.
- The antenna connector, power connector, switch, RF gain control and lowpass filter are now installed on the circuit board reducing the number of external connections.
- Audio-derived AGC has been added to the receiver.
- Polystyrene capacitors have been replaced with smaller and more readily available NPO/COG ceramic capacitors.
- The power amplifier has been heat sunked to the base of the enclosure. The improved the heat dissipation permits it to operate at higher power without overheating.

The NorCal kit includes the circuit board and all components which are directly mounted on it the 10-turn tuning pot and terminal housings for the Molex headers. You will need to find very few parts on your own to get your EP-3 on the air.

Assembly is not intended to be a “winter construction project”. Any amateur with some previous experience at building HF equipment and working with printed circuit boards will have little difficulty in assembling the EP-3 in a few evenings. Nor is it intended for the serious contester.

I hope you will have as much fun with it as I have. Feedback, suggestions and constructive criticism are always welcome,

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September, 2000

## **ACKNOWLEDGMENTS**

First and foremost to Doug Hendricks, KI6DS, and NorCal for funding most of the development costs and making the EP-3 available as a kit; to Ed Burke, KI7KW, Dave Meacham, W6EMD, and Graham Firth, G3MFJ for assembling and testing prototype boards. Their advice and suggestions led to a number of changes being made; to Wayne Burdick, N6KR, for allowing me to ‘borrow’ the AGC circuit from the SST transceiver; and Vern Wright, W6MMA, who assembled the final version without a manual, and has since worked me /M from Sacramento.

## **THE CIRCUIT**

Refer to the Block Diagram (Diag. C).

The EP-3 is based around a pair of NE602 double-balanced mixers U2 & 3 and a miniature 455KHz SSB filter F1. U6 (4066) switches the LF and HF oscillator between the mixers enabling them to be used for both transmitting and receiving.

The pre-amplifier U4 (LM741) is designed for an electret microphone and the audio amplifier U5 (LM386-4) will comfortably drive a small speaker.

The LF oscillator Q2 (MPF102) is tuned to 452.6KHz to produce an upper sideband signal at the output of the filter.

The HF oscillator Q4, or VFO, (MPF102) is tuned 452.6KHz higher than the output frequency to generate a lower sideband signal at the output frequency.

Conversely, when the oscillators are switched the receiver will demodulate a lower sideband signal in a similar.

The RF bandpass filter L3/L4 has a bandwidth of 200KHz and a steep cut-off to ensure adequate attenuation of the image frequency 900KHz higher. The filter terminates in a low resistive load at the input to U1.

The driver U1 (CA3020) is a high gain differential amplifier. A trifilar wound broadband transformer T2 matches the push-pull output to a resistive load at the gate of the Mosfet power amplifier Q1 (IRF510). Another broadband transformer T3 matches the power amplifier to a 50 ohm load.

L2/L3 is an elliptical lowpass filter. Both sections have been designed to afford maximum attenuation of the second harmonic of the output frequency.

Transmit/receive is accomplished with a miniature DPDT relay K1. One section of K1 switches B+ supplies. In the open position (receive) the voltage is removed from the microphone pre-amplifier U4 and the driver U1. Forward bias is removed from the power amplifier Q2. Closing the relay (transmit) removes B+ from the audio amplifier U5. At the same time this section provides the switching voltages to U6.

The other section of the relay connects the receiver input to the antenna via the lowpass filter when in the open position. It disconnects and grounds the receiver input when the relay is closed.

A simple audio-derived AGC is used to control the gain of the second mixer. For this to work effectively the gain of the audio amplifier must remain high. A manual AF gain control has been omitted. The RF attenuator at the input sets the audio level and only requires adjustment if an extremely strong signal overloads the first mixer. If headphones are used an attenuator in the lead will reduce the output to a comfortable level along with mixer noise.

An LED, inductively coupled to the antenna lead provides a simple modulation/power indicator

### **Specifications:**

Output	8 watts PEP
Input voltage	12 - 14 voltage DC
Band	3.5 - 4.0 MHz
Coverage	Set to any 200KHz section
Sideband	Lower
Circuit board	2.9in x 6.0in
Total current drain	Receive: 50 - 100mA with speaker Transmit: 150 - 900mA with normal speech
Power supply	2.5 amp AC power supply or 5Ah gel-cell

### **ASSEMBLY**

A small clamp-on table vise great help. Cover the jaws with plastic tape and always grip the circuit board by its edges.

I recommend that you make a temporary chassis from a 6" x 6" (minimum) piece aluminum for testing and alignment rather than use your final enclosure. Bend one side to form a 2" panel and mount the circuit board along the rear edge on the four threaded metal spacers provided. Use long screws and fasten it to the chassis with nuts on the underside. Screws and metal spacers may be left attached to the board throughout assembly.

All holes in the circuit board are plated-through. Never attempt to enlarge or drill them out. Adequate clearance has been allowed to permit the components to drop into place. If you have to unsolder and remove any component, avoid applying force. If a capacitor or resistor costing pennies does not come out easily, clip it in half and unsolder each piece separately.

The component layout is screened on the circuit board but bear in mind that the part number will often be obscured once the component has been installed. Refer then to the printout (Diag. E).

You can, of course "empty the bag, populate the board and smoke test". The following approach reduces the chance of mistakes and time-consuming trouble shooting later.

- Start with the BNC antenna connector J1. Make sure that it sits both flush with the face and square with the edge of the circuit board. Avoid applying too much heat as this will melt the connector housing.
- Install the power connector. Again, make sure that it is flush and square with the edge. One or more of the tabs might require filing down as their width appears to vary between manufacturers.
- Install the on/off switch SW1. Solder the mounting tabs first and make sure that it is vertical before soldering the leads.

- Install the five IC sockets. Check that each is correctly oriented, flush with the board and that all the pins protrude through the hole. If you start by soldering two diagonally opposite pins it will allow you to square up the socket before soldering the remainder.

- Splay the twelve leads of the driver amplifier U1 out about 30 degrees over a piece of 3/8" round material such as cap of a pen and then straighten the ends. Commence by inserting lead #12 (located beneath the tab) into the corresponding hole on the board. Working clockwise you will be able to insert four or five leads without any problem. Do not insert them any more than is necessary to keep them in the holes. Then use a pointed Xacto knife to guide each of the remainder into place. With luck you will reach pin #1 before pin #12 slips out! Centre U1 about 1/4 inch above the board. Double-check to be absolutely sure that it is correctly oriented before soldering in place.

Install the antenna current sensor T3. This is difficult to install once surrounding components are in place. The single turn primary winding passes once through the core and does not wrap around it. Tighten this as you solder in and it will hold the core in place. The secondary winding is a 470 ohm resistor R24 which limits the current in the D7. Center the body of the resistor through the core and form the leads as necessary to reach the pads. Make sure they do not contact the ferrite core.

- Install the Molex headers CON1 - 5. D5 will be mounted in a terminal housing (to permit disconnecting AGC). Install CON5 in it's place on the board.

Install the headers for the metering jumpers J3 & 4.

Turn now to the capacitors and refer to the parts list which lists them in groups by size and type. I recommend that you install them one at a time, trimming the leads as you go and striking them off on the parts list. Mount axial capacitors so that the markings remains visible after installation.

- Commence with the 470mF and three 100mF electrolytic capacitors. Make sure that they are correctly polarized and flush with the board.

- Install the two 10mF and five 1mF tantalum capacitors. Again, be absolutely sure that they are correctly polarized.

- Install the 1mF non-polarized ceramic capacitor C10. Re-form the pins to fit the hole spacing if necessary and try not to damage any molded stand-offs.

- Install the fourteen 100nF (0.1mF) ceramic capacitors.

- Install the four 10nF (0.01mF) capacitors.

- You will have noticed that C32 appears twice in the parts list. 5600pF, despite being a standard value, was unavailable. 4700pF in parallel with 1000pF has been substituted. Stack the caps above one another and feed two leads through each hole. They fit easily providing you don't twist them together.

- Install C33A 1200pF polystyrene cap. This is in parallel with C33 but this time separately mounted.

- Install the three 2200pF ceramic caps.

- Install the four remaining 1000pF caps

- Now sort out the seven 680pF caps. Install the two COG caps C40 & 41 in the VFO before installing the remainder. Why two types? COG caps were not available with the 100V rating for the lowpass filter.

- Sort out and install the remaining fifteen ceramic caps.

- Finally, install the trimmer cap C56

- Verify that all caps are accounted for both on the board and out of the bag.

**Turn now to the resistors.**

- Install the 21 fixed resistors. For those mounted vertically, form one lead into a 0.1”D semicircle close to the body using the tapered end of a pencil.
- Install the multi-turn trimpots R19 & 20 and orient the adjusting screws as in the parts layout and photograph.
- Insert the shaft in R22 and install. Make sure the pot is square and the shaft horizontal before soldering in place.
- Install the 10-turn precision pot R24 in the center of the panel of the temporary chassis.
- Install the voltage regulators U7 & 8. U7 is the 8V regulator and U8 is the 9V regulator.
- Install the reverse polarity protection diode D6.
- Install the SSB filter F1 flush with the board. Avoid overheating and do not trim the pins.
- Install the relay K1 flush with the board.
- Install the ceramic resonator X1.

**Before proceeding you can carry out some DC voltage checks.**

- Install the PC board on the temporary chassis. Leave the switch in the off position (down). Do not install any ICs or shorting jumpers.
- Obtain the parts to make up a power lead. Include an inline 5A fuse. The reverse polarity protection is a shunt diode so do not omit the fuse.
- Connect to a 12V DC power supply. If the fuse blows, then either the polarity of the supply is reversed or the protection diode was installed backwards. Rectify this before going any further.
- Place the switch in the on position and check out some voltages with a multimeter. You should be reading 8V at pin 8 of U2 and 12V at pin 6 of U5. No voltage should appear at J4 and pin 7 of U4.
- Ground pin 1 of CON1 to close the relay. You should read 8V at pin 8 of U2, 9V at J4 and 12V at pin 7 of U4. No voltage should appear at pin 6 of U5.

**This completes the test. Refer now to the list of semiconductors.**

- Install Q2, 3 and 4 (MPF102).
- Install D1, 2, & 3 (1N914) observing the polarity. The cathode end is marked with a black band. D1 is mounted horizontally and the cathode end is identified in the parts layout. D2 & D3 are mounted vertically and their cathodes grounded. Form the cathode leads into a 0.1” semicircle. The grounded traces on the board are easy to locate if you are uncertain.
- Install the varactor diode D4.
- Install LEDs D5 & 7 in 2-pin polarized Molex housings but do mount them on the headers at this stage. It is essential to observe the polarity of D5 or the AGC won’t operate. While the polarity of D7 is unimportant you should polarize it the same way as it is unable to tell them apart later!

**Refer to the list of inductors**

- Identify and install the 1000mH choke L11 (epoxy-coated). If you have any doubt measure its DC resistance with an ohmmeter. It should read around 12 ohms.
- Install the three 1000mH chokes L7, 8 & 9 (molded). Form the leads of L7 & 8 as you would for a vertically mounted resistor. Avoid sharp bends near the body as the internal connections are quite fragile.
- Install the four Toko variable inductors L3, 4, 5, & 6. Install L 6 (VFO) first. The remaining three are identical. Use a small solder fillet on each of the mounting lugs to ground and fasten them to the circuit board. It is unnecessary to solder any of pins other than the 2 outside pins of the 3-pin row. The remainder do not connect to anything.

- Identify the iron powder toroid cores for L1 & 2 (red). Wind each with 20 turns of #24g enameled wire leaving half inch leads. Scrape clean and tin the leads close to the core before installing.

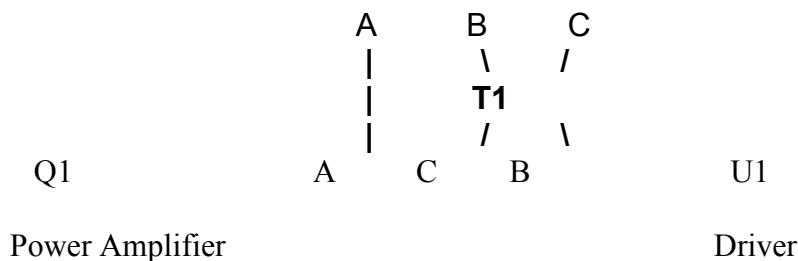
- Identify the ferrite core for L10 (black). The manufacturer lists this as a “bead”. Wind with 12 turns of #24g enameled wire leaving one inch leads. Leave the leads long enough for the core to mount in line with the pads clear of adjacent components.

**Refer now to the list of transformers.**

- Start with the power amplifier output transformer T2 which is wound on the ferrite binocular core. The primary winding (connected to U1) comprises 2 turns of #24g enameled wire. Pass the wire through each holes twice which leaves both leads projecting from the same end of the core. The secondary winding comprises 5 turns of #26g wire and starts from and finishes at the opposite end of the core. Trim the leads to half inch, tin and install.

- T3, the antenna sensor was installed at the beginning.

- Turn now to the driver output transformer T1 which comprises 5 trifilar turns wound on the remaining ferrite bead. For those of you who have a problem with trifilar windings the following may help. Take three 10 inch lengths of #26g enameled wire and knot them together at each end. Clamp one end in the chuck of a small hand drill and the other in a vise. Keep the wires taut and twist to about 10 turns per inch. Cut off the damaged ends and wind 5 evenly spaced turns on the core. Unravel (rather than untwist) the ends back to the core, straighten and trim each of the 6 leads back to one inch. Clean and tin back the first half inch only or they may short together or against the core. Identify each of the three windings with an ohmmeter. Referring to them as “AA”, “BB” & “CC” install T1 on the circuit board as below. Pull each lead through leaving a small portion of the tinned section visible above the top pad before soldering.



## TESTING AND ALIGNMENT

Most of the testing can now be carried out before the power amplifier is installed. The IRF510 pins are brittle and easily bent when the circuit board is removed. It is better to delay installation until you are satisfied that everything else is functioning correctly.

The antenna and power jack are mounted on the circuit board and Molex connectors are used for all other attachments. The terminals are made to be crimped onto wire. Few amateurs have access to a proper crimping tool and pliers make a poor job. Form the terminals into a cylinder around the shank of a small drill and solder the leads. To remove a terminal, hold the housing in a vise and extract it with a pointed Xacto blade. It takes a little practice and terminals can be re-cycled several times. Use thin stranded hook-up wire or ribbon cable.

Test equipment does not have to be elaborate. If you do not have an oscilloscope you can make a simple RF probe to use with a multimeter; if you do not have a frequency counter you

can get by using a calibrated receiver; if you do not have an audio signal generator you can whistle and groan into the microphone (don't overdo this or your family become concerned about you); if you do not have a spectrum analyzer you can have the amateur next door check your signal quality.

- Mount the circuit board on the temporary chassis. It is assumed that you have already made up a fused power lead and carried out the DC voltage checks described on p. 5. Do not install jumpers at J3 & 4.

- Connect the "wiper" terminal of the tuning pot R24 to pin 6 of CON2. Connect the "bottom" end of R24 to ground (or chassis) via a 4k7 resistor (not provided). Connect the "top" end R24 to pin 3 of CON2. The connections are usually shown on the pot but easy to determine with an ohmmeter. Verify that the DC voltage on the wiper terminal varies from c. +3V to +8V as R24 is tuned. Leave this set to c. 5V

- With an RF probe verify that both oscillators are functioning. Set the LF oscillator to 452.6KHz with the trimmer cap. Tune for the 9th harmonic at 4.074MHz on a closely coupled receiver. Most amateur band receivers tune 100KHz beyond the band edge.

- Adjust L6 until the VFO frequency (measured at pin 4 of CON2) is approximately 4.2MHz. To avoid having the slug protrude screw it deep into the can and tune upwards (anti-clockwise) to lower the frequency.

- Now install the mixers U2 & 3, and the switch U6 in their sockets. With an RF probe verify that pin 6 on each shows a reading of at least 140mV RMS. These readings are unlikely to be identical. Close the relay by grounding pin 1 of CON1 and the readings should then "switch" indicating that U6 is functioning. A counter will, of course, display the frequency change.

- Install the audio amplifier U5 and connect an 8 ohm speaker between pins 1 & 2 of CON2. Touching pin 1 or pin 2 of U5 with your finger should produce a loud hum in the speaker.

- Connect an 80M antenna at J1 (the receiver is quite sensitive but will not function using a non-resonant piece of wire). Advance the RF gain pot R22 fully clockwise, tune across the band to find a SSB station and tune L5. Install D5 to establish that the AGC circuit is functioning. **Do not commence testing and aligning the transmitter until you are first satisfied that the receiver is functioning properly.**

- Connect an electret microphone element (2-lead type) to pins 2 & 3 of CON1. For testing this may be mounted directly into the terminal housing or through a piece of screened cable. Pin 3 is the ground. At the same time install a wire to pin 1 for closing the relay. You can add push-button switch or just ground the wire to the chassis for testing.

- Install the pre-amplifier U4. Place a probe on pin 4 of the 2nd mixer U3 to act as a radiator, PTT (close the relay) and speak into the microphone. Monitor the signal on a receiver using headphones. Any problem at this stage is most likely to be in the speech amplifier or microphone since the mixers and oscillators function in the receive mode.

- Set R20 (RF drive) to minimum. This will be fully clockwise if R20 is oriented as shown in the parts layout. Bear in mind that multi-turn trimpots do not have end stops. Install a milliammeter at J4. (use the 2-pin Molex housing supplied for attaching a frequency display and make up a cable). Close the relay and verify that the standing current in the driver U1 is c. 25mA. Open R20 three or four turns, speak into the microphone while monitoring the signal on a receiver using headphones. No radiator should be required.

- Replace the meter with a shorting jumper at J4. PTT and measure the voltage at the gate pad of (yet to be installed) Q1. This is the right-hand pad nearest the driver. Adjust R19 to set this to c. 3.0V. Verify that this drops to zero when the PTT is released. Remove the jumper from J4 and install it on J3. Verify that the drain (center) pad for Q1 reads +12V.

- **Refer to the Diag. D and install Q1. From now on you must make sure that the circuit board is fully grounded to the chassis at all five mounting points.**
- Install a 50 ohm dummy load at J1 and LED D7 at CON4.
- Remove the jumper from J4 (driver current) and install a milliammeter at J3 (PA current). PTT and adjust R19 to set the idling current to 45mA.
- Re-install the jumper at J4, PTT, and modulate with a level tone. The current at J3 will increase and D7 will light. Now tune both sections of the bandpass filter L3 & L4 for maximum current. Do not “stagger tune” the coils. Adjust R20 so that the current at J3 does not exceed 900mA on peaks with normal speech. Verify that the current rapidly drops to the idling level with no modulation.
- Re-check the driver current at J3. Similarly, this should rise to 60 - 70mA with modulation and drop to 25mA.
- You are now ready to go! Connect the antenna and have another amateur check your signal.

**Frequency display:** Several designs were published for LED digital frequency displays for the EP-2. These generated a lot of noise and consumed a lot of current. Today there are several DFD kits available with LCD displays, programmable offsets and none of these disadvantages. K1MG's (Blue Sky Engineering Co.) Digital Clock/ Counter is perhaps least expensive, simplest to build and install.

**Enclosure:** There is nothing to prevent you operating from the test chassis but sooner or later you will want to install it in a professional-looking package. The Ten-Tec TG-26 enclosure should accommodate the EP-3 circuit board and a K1MG DFD nicely. I believe this was used by W6MMA to house the prototype he assembled. The low-profile circuit board is also ideal for installation in a “slim-line” enclosure with the display on top and thumb-wheel tuning.

**Bandspread:** The 4k7 ohm resistor from the 10-turn tuning to ground serves to prevent the voltage at tuning diode dropping to zero. Below one volt it becomes very unstable. So long as this limitation is observed it's value may be changed to set the band spread.

**Frequency stability:** The VFO frequency drops c. 400Hz during the first five minutes after switching on from cold. So long as the temperature within the enclosure remains constant it is quite stable. If you are transmitting for long periods on a net frequency, occasional adjustments are necessary. To compensate for this you can play with the values of C33 and C33A (which have differing thermal characteristics) and install a diode in series with the tuning pot, or make your next project a “huff and puff”!

**Microphone:** The simplest and most foolproof is an electret mic in which the PTT switch directly grounds the relay coil. If the switch is in the mic lead itself (as is the case with most spkr/mics) you will have to install a transistor to switch the relay. If you use a dynamic mic remove the bias resistor R13.

### EPIPHYTE 3 PARTS LIST

#### CAPACITORS

No.	Cap	Type	Source	Stock No.
1	470uF	elect/16V	MOUSER	140-XRL16V470
3	100uF	elect/50V	MOUSER	140-XRL50V100
2	10uF	tant/25V	MOUSER	74-199D25V10



6	1uF	tant/35V	MOUSER	74-199D35V1.0
1	1uF	cer/50V	DIGI-KEY	P4968-ND
14	100nF	cer/50V	DIGI-KEY	1210PHCT-ND
5	10nF	cer/50V	DIGI-KEY	1103PHCT-ND
1	4700pF	cer/50V	DIGI-KEY	1102PHCT-ND
1	1200pF	polystyrene	MOUSER	23PS212
3	2200pF	cer/50V	DIGI-KEY	119PHCT-ND
5	1000pF	cer/100V	DIGI-KEY	116PHCT-ND
5	680pF	cer/100V	DIGI-KEY	1114PHCT-ND
2	680pF	cer/50V	DIGI-KEY	1009PHCT-ND
6	470pF	cer/50V	DIGI-KEY	1007PHCT-ND
2	270pF	cer/100V	DIGI-KEY	1111PHCT-ND
1	100pF	cer/50V	DIGI-KEY	1001PHCT-ND
1	47pF	cer/100V	DIGI-KEY	1017PHCT-ND
4	33pF	cer/100V	DIGI-KEY	1016PHCT-ND
2	15pF	cer/100V	DIGI-KEY	1012PHCT-ND
1	5 - 65pF	trim cap	DIGI-KEY	SG3009-ND

**RESISTORS** (All Resistors 0.25W & vertically mounted unless otherwise specified)

2	100k	
1	47K	
1	15k	
4	10K	
3	4k7	
2	2k2	
1	1k5	
1	1k	
1	470	
1	330	
1	100	
2	47	
1	10	
1	10k	3/8" multi-turn square Cermet trimpot 0.1" in-line pin sp.
1	100	Multi-turn carbon trimpot 0.1" in-line pin sp.
1	2k5	PHIER Trimpot extension shaft
1	10k	10-turn precision tuning pot

**INDUCTORS**

L1,L2	1.68uH Iron powder core 20/T #24g enam T-37-2
L3,4,5	4.7uH TOKO tunable coil 154AN-T1005 TK1203-ND
L6	3.3uH TOKO tunable coil BTKANS9445 DIGI-KEYTK1414-ND
L7,8,9	1000uH Molded choke MOUSER 43HH103
L10	40uH Ferrite Bead 12-turns #24g enam FB-43-2401
L11	1000mH Epoxy Coated Choke Low Res (12 ohms) MOUSER 43LS103

## **TRANSFORMERS**

T1 RF Trans Ferrite Bead 5 trifilar t. #26g enam FB-43-2401  
T3 Prim. 1 t. #24g enam Sec. see text FB-43-2401  
T2 RF Transf Binocular Prim. 2 t. #24g enam Sec. 5 t. #26g enam BN-75-202

## **CONNECTORS**

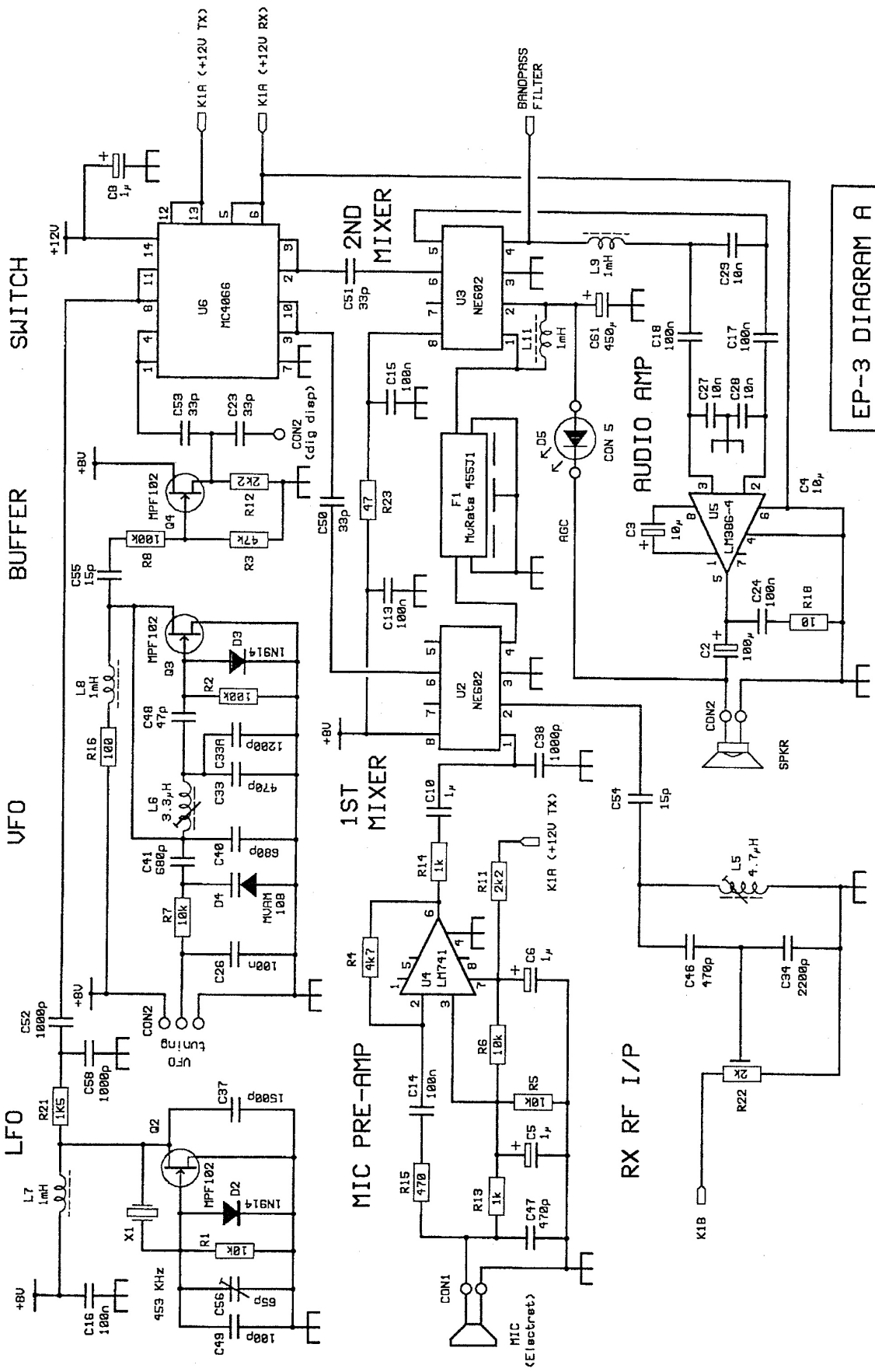
J1 PCB Mount BNC  
J2 PCB Mount DC Power Jack  
J3,4 2 Pin Header & Jumper

## **IC's, DIODES & TRANSISTORS**

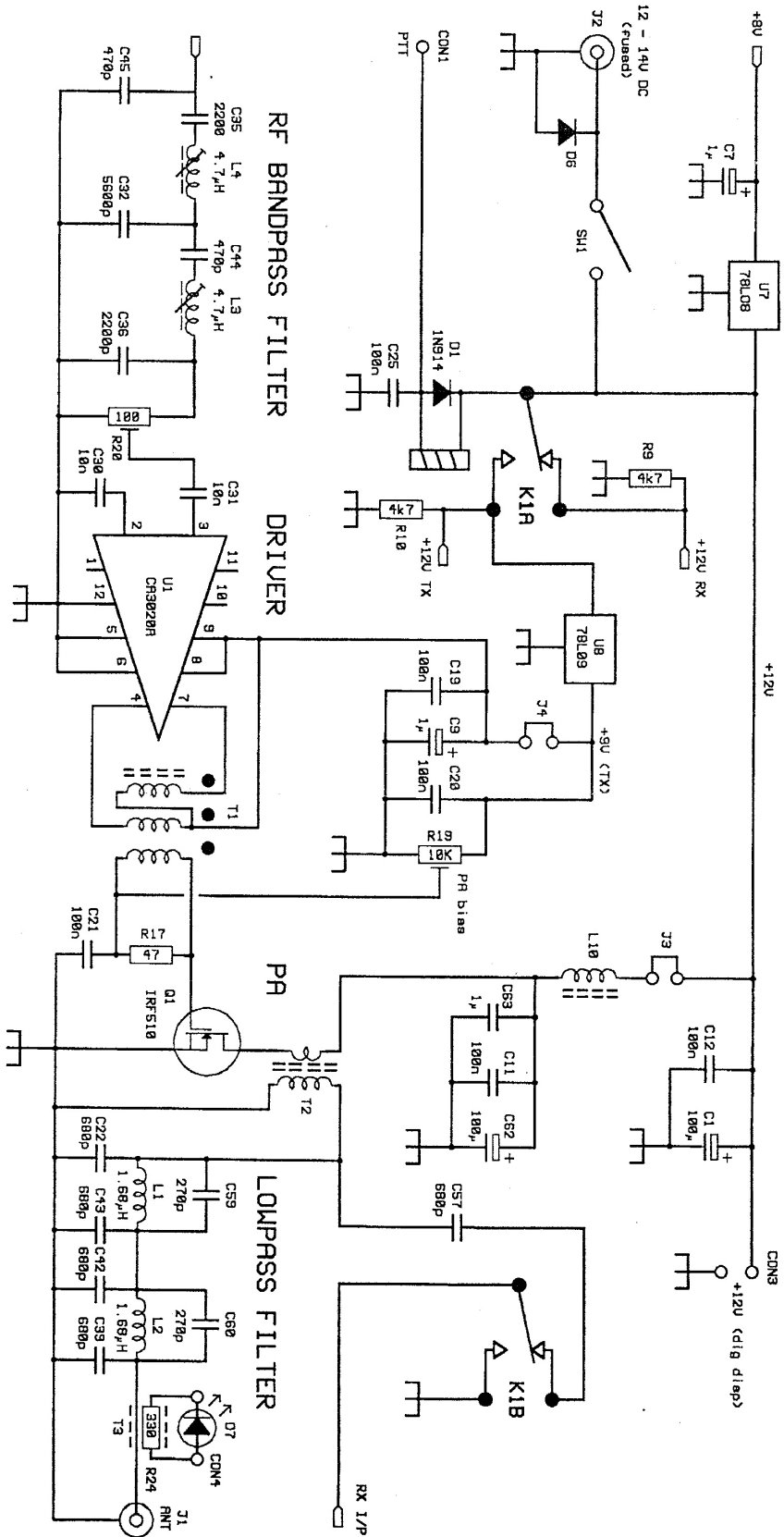
Q1 IRF510  
Q2 MPF102  
Q3 MPF102  
Q4 MPF102  
U1 CA3020 or CA3020A  
U2 NE602, NE612, SA602, SA612  
U3 NE602, NE612, SA602, SA612  
U4 LM741  
U5 LM386-4  
U6 MC4066  
U7 78L08  
U8 78L09  
D1 1N914  
D2 1N914  
D3 1N914  
D4 MVAM108, 1SV149  
D5 Red or Green LED, High Eff. 2.1Vf  
D6 1N4005  
D7 Red or Green LED

## **MISC.**

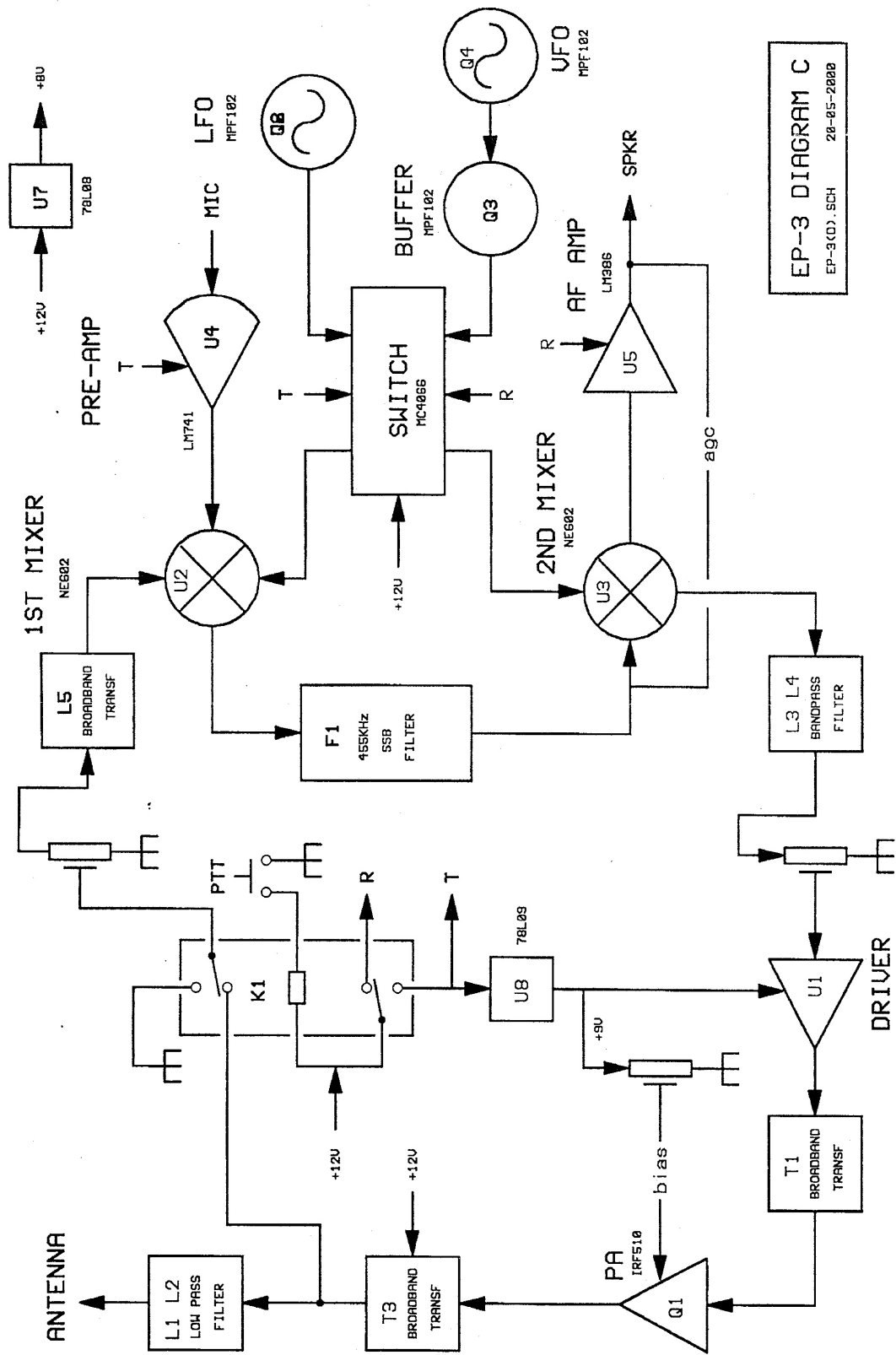
F1 MuRata M455J1 Ceramic SSB Filter  
X1 455 kHz Ceramic Resonator  
K1 Miniature 12V DPDT Relay  
SW1 PCB Mount SPDT Switch  
4 8 pin IC Sockets (Optional)  
1 14 pin IC Socket (Optional)  
1 TO220 Thermal Mounting Kit  
1 Nylon Bushing  
1 1/4 x 4-40 Machine Screw and Nut  
4 PCB Standoffs, 1/4" x 4-40



EP-3 DIAGRAM A  
 EP-3(R).SCH 20-65-2888



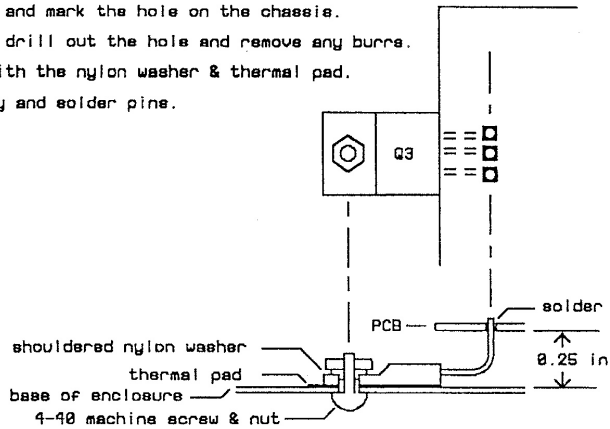
**EP-3 DIAGRAM B**  
EP-3(B).SCH 28-85-2088



EP-3 DIAGRAM C  
EP-3(K) SCH 28-05-2008

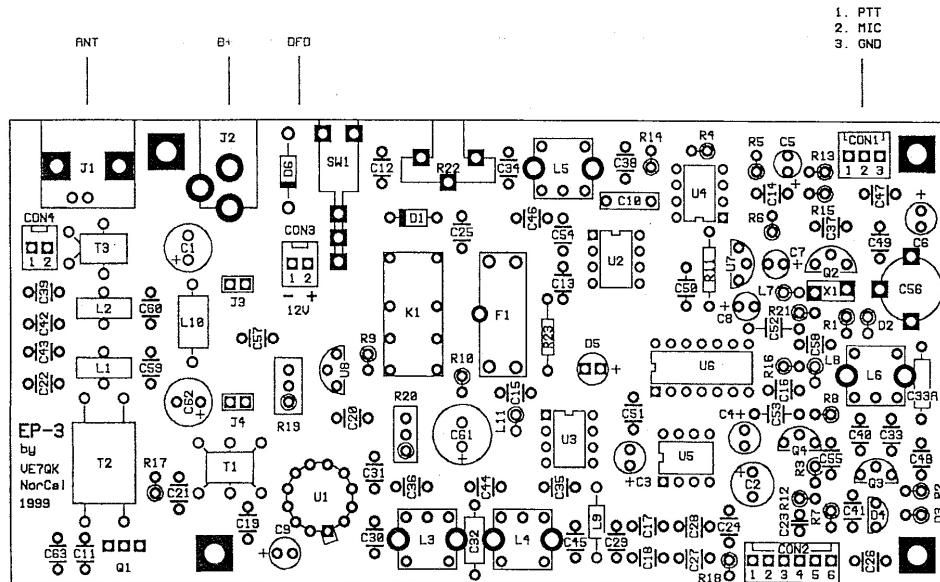
## MOUNTING THE POWER AMPLIFIER

1. Form pins around a drill shank in a smooth curve.
2. Install the PCB on 4 metal spacers.
3. Align square and mark the hole on the chassis.
4. Disassemble, drill out the hole and remove any burrs.
5. Reassemble with the nylon washer & thermal pad.
6. Fasten firmly and solder pins.



## PARTS LAYOUT

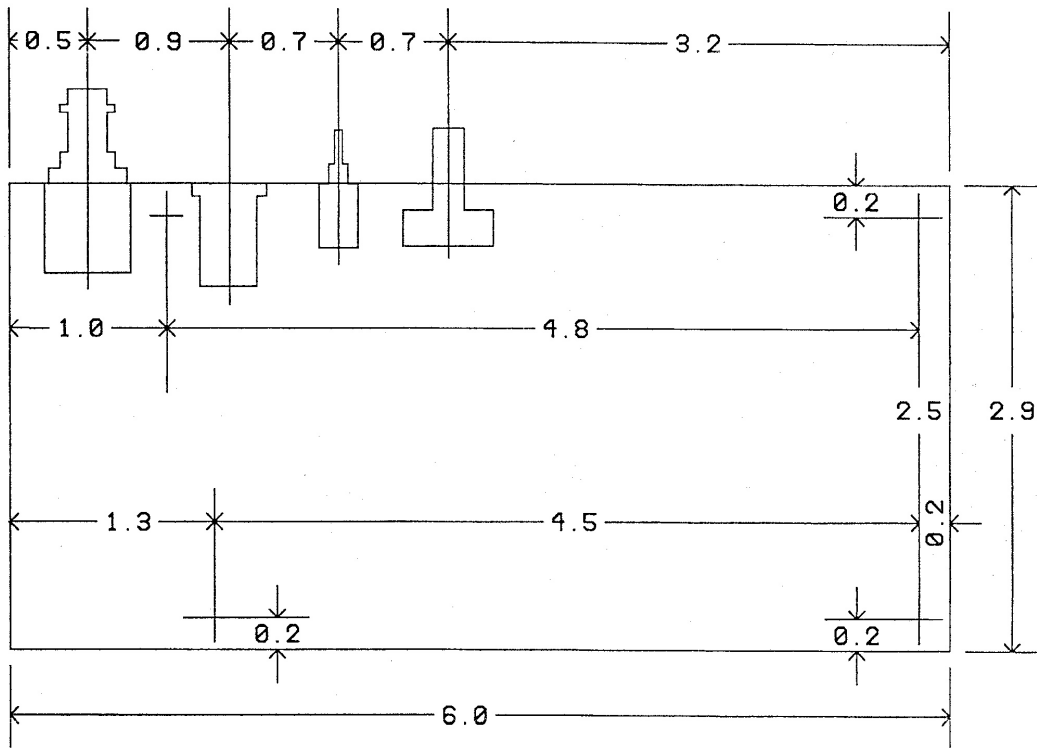
EP-3 DIAGRAM D  
EP3-PA.PCB 30-09-2000



1. SPKR
2. GND
3. +8V
4. DFD
5. GND
6. TUN

EP-3 DIAGRAM E  
EP3\_PL.PCB 30-09-2000

# CIRCUIT BOARD DIMENSIONS



EP-3 DIAGRAM F  
EP3\_DIM.PCS 20.05.2000