THE ST. LOUIS TUNER

A QRP Transmatch Kit
Construction and Operation Guide

A Joint Project of the St. Louis QRP Society
And
The NorCal QRP Club

April 1996

By:
Dave Gauding, NF0R
Randy Miller, WA0OUI
Doug Hendricks, KI6DS

6/17: Interaction w/SL tuner. Parasitic oscillations after key up. Not with MFJ tuner; and not with SL tuner and OHR 400.
6/18: Bill Shaney suggests using a ferrite bead on the coax between the NC-40A and the St. Louis tuner. Could be a proximity, short-coax issue.

Foreward by Doug Hendricks, KI6DS

Thank you for purchasing the NorCal QRP Club's St Louis Tuner Kit. This was a cooperative effort between NorCal and The St. Louis QRP Society. This is a first for NorCal that I hope can be repeated many times. The two clubs have a common interest, QRP, yet are worlds apart in many ways. NorCal is a world wide club with 1700 members in all 50 states and 45 countries. The St. Louis QRP Society has 45 members, and by club rules, all must live within the St Louis Metropolitan area.

The guys in St. Louis are among the most prolific builders and experimenters in the world. They have produced 10 different kits, and all of them have been quality products. They chose to remain small, because they don't want the hassle of a large membership, with all that it entails. Yet, they are among the most willing to share ideas as any people I have ever met. These guys would probably give you the shirt off their back if you would just ask.

The St. Louis Tuner is an interesting story: Jim Cates and I are the founders of the NorCal Club, and we like our club to do kits. We have no rules in our club, but we do have a system of alternation on picking club projects. In the spring of 1995 we had just about finished with the Cascade project, a SSB transceiver designed by John Liebenrood, K7RO. The SSB kit was my idea, and I have to admit that it was one that I had always wanted to do. Jim mentioned that he thought that our members would enjoy a QRP antenna tuner some day. That is Jim's way of saying, "I'd like to do a tuner next."

I had met Pete Eaton, a member of the St. Louis Club on the phone when NorCal was getting started. He told me about the St. Louis Club doing an antenna tuner, but that it had been going on a couple of years. He said that when they were finished and produced kits, that he would see that I was able to buy one. The kit came in the fall of 1994, and it was a great kit, lots of fun to build. I modified mine by putting it into a spare Sierra case that I had.

So, when Jim mentioned the antenna tuner, the St. Louis kit came to mind immediately. I showed it to Jim and asked him if that was what he had in mind. He said that it was perfect and just what we needed. In fact, he said, why don't you contact the St. Louis group and see if we can make a deal to kit their kit, as there is no sense in reinventing the wheel. Jim and I are both very conservative and if we did their kit, we would save the usual time and effort on R & D.

I called Dave Gauding and we spoke several times over the phone. We agreed to meet in person at Dayton in 1995 and make the final agreement there. There was a picture published in June 1995 QRPp of Dave and I making those arrangements. Dave brought Keith Arns, another member of the St. Louis Club along and they had the entire history of the tuner with them. They had done 4 different prototypes before the final product was done.

Randy Miller, WA0OUI, was the project manager for the St. Louis work, and he deserves our thanks for a great job. We agreed that the kit would stay the same as much as possible. I then started to gather parts. The first problem we had was a huge one. We were not able to find the small square plastic transistor radio style polyethelyne variable capacitors that the St. Louis Club used. So, Jim and I decided to have custom capacitors made. We had them made (to the tune of $7 each!!) and waited 19 weeks for delivery. (We were promised 7 weeks delivery time). Then when the capacitors arrived, we had Dave Meacham, W6EMD, design the front panel. He did the drawings so we could get the cases made. Another member, Herb Vanderbeek told us that his son was in the sheetmetal fabrication business and would like to bid on our cases. He got the bid and I must say that he added to the design of the final product. He had the idea of using flanges on the bottom and sides to strengthen the case.

The guys in St. Louis helped get some parts that were hard to find. They found the meters and the 2 Watt resistors. Thank you Dave Gauding and Lee Johnson, KE0MC for your legwork. Dave Joseph, WA6BOY, helped find the connectors. My daughter Robbie and my wife JoAnne helped pack the kits. Thanks to all of you who helped. It is this sharing and helping that makes QRP so great.

I hope that in the future NorCal can do kits with other QRP clubs. It has been fun and I think it is a win-win situation for everyone. One last thing. When I asked Dave about doing the kit, I told him that we wanted to call it the St. Louis Tuner, to honor the guys who did the work of developing the kit. He agreed, and the rest is history. 72, Doug, KI6DS

THE ST. LOUIS TUNER HISTORY

by Randy Miller, WA0OUI

INTRODUCTION:

The original "St Louis Tuner", the St. Louis QRP Society's tenth homebrew kit, was released to our membership in August 1994. This project was quietly developed over a four year period by an SLQS design group. The club's goal was to produce a compact, full-featured, reasonably priced QRP antenna tuner kit. The project team headed by WA0OUI included N0ZZ, W0NVM, KE0MC, N0JFZ, WN9V, K0PFX and NF0R.

The St. Louis Tuner consolidates and builds upon the design work of fellow hams. The basic t-match circuit is from a "Miniature Antenna Tuner for 3.5 - 29 MHz" by W3TS as published in ARCI's *QRP Quarterly* (April 1985). The swr bridge circuit is based on two sources: the "Bi-Directional Wattmeter" by GM4ZNX in G-QRP's *Sprat* (No 61, Winter 1989/90) and an "RF Power Meter & SWR Bridge" in *W1FB's Design Notebook* (ARRL 1990). The low power 4:1 balun is drawn from "How to Build QRP Balun Transformers" in *W1FB's QRP Notebook* (ARRL 1991). We wish to acknowledge each author for helping make our club project a reality.

The tuner's features evolved from numerous planning sessions at monthly SLQS meetings and testing during portable outings. Four prototypes were eventually built. Development at a measured pace insured the final design met the collective expectations of our members. At the same time it presented an opportunity to confirm performance and long term reliability of the original dual-section polyethelyene-film variable capacitors, meters, bridge circuit and balun.

The design will match any reasonable load at QRP power levels from 10M to 80M. It accepts both balanced and unbalanced antennas and provides a five watt dummy load. The bridge circuit with dual-meters is very sensitive. Tuning for maximum output is quick and easy. Several popular types of connectors are provided and insures that the tuner is compatible with most commercial and homebrew equipment. Details on additional operating conveniences are covered in the manual.

In the spring of 1995, our club was pleased to learn the Northern California QRP Club was interested in developing a tuner kit for its membership. Further, that the proposed project would continue the highly creative kit concepts established with the NorCal 40, Sierra and Cascade projects. After informal discussions concluding at the 1995 Dayton Hamvention both organizations looked forward to seeing the St. Louis Tuner design in widespread use. Looking to the future, NorCal has thoughtfully chosen to replace the original poly-caps with custom dual-section air variable capacitors while upgrading the cabinetry and connector selection.

NorCal is offering to underwrite research and development costs for promising homebrew designs submitted by individual hams or clubs. SLQS strongly supports this proposal knowing first-hand that it can improve the long term outlook for homebrew, QRP and amateur radio in general. Such progressive thinking reflects well upon the low power community and helps make our hobby very special indeed!

Finally, after much research and budget considerations, SLQS chose "laboratory quality" poly-caps featuring brass rotors and copper stators for our prototypes and kits. When used sensibly these inexpensive devices work quite well in low-power tuner applications. Contrary to ham folklore signal loss is negligible and they are remarkably reliable. We recommend that homebrewers give the lowly poly-cap favorable consideration when designing new projects.

The St. Louis QRP Society was organized 1987 as a local amateur radio club. We have an average membership of forty-five low power enthusiasts and homebrewers from the Metropolitan St. Louis area and Metro East. Our club meets on the third Wednesday of every month, at 7:30 p.m., in the Engineering Building of Florissant Valley Community College. Visitors are most welcome! Please join us for a meeting when you are in the St. Louis area and bring along your tuner.

TOURING NORCAL's "ST. LOUIS TUNER"

By Dave Gauding, NF0R

Metering and SWR Bridge:

The bridge circuit, configured as a bi-directional wattmeter, is perfectly balanced. Each meter's sensitivity setting is totally independent of the other. Calibration is simple and fully explained in the operating section.

In this design both **FWD** and **REF** 200 microamp meters are in-line at all times. Tuning for maximum rf output at minimum swr is quick and accurate using this system.

The **REF** meter is adjusted for maximum sensitivity. It will achieve full-scale deflection at approximately 1W input.

The **FWD** meter indicates milliwatts to 5 Watts and is adjusted for 5 Watts rf output. At a 1:1 match this meter offers dependable output readings across the tuner's frequency range.

Matching Circuit:

The classic t-match circuit will handle any reasonable antenna load from 3.5 to 29 MHz. Custom dual-gang air variable capacitors were specified for this kit.

Antenna matching procedures are fully explained in the operating manual. In the interim here is some preliminary information for experienced operators. We trust all builders will find these comments both interesting and informative.

The tuner's matching capabilities are optimized by switching sections of the capacitors in and out. The dual-sections help compensate for twelve coarse inductor taps with two separate capacitance ranges. The capacitance available to each band falls into a favorable range for producing a 50 ohm match at the tuner input.

During antenna matching, a smaller capacitor section is placed in parallel with the larger section by switching to **LOW** position. The **LOW** setting will normally be selected for 80M, 40M and 30M. A match on 20M may call for either the **LOW** or **HIGH** setting depending upon the antenna. The **HIGH** setting disengages the smaller capacitor section and is normally used for 17M and higher bands.

Individual homebrewing techniques require that each tuner kit's initial inductor and capacitor settings be selected by experimentation. An accompanying table in the operating manual will place operators in the ballpark. Once a band's optimum inductor setting is determined it will generally hold true for similar antenna types, i.e. unbalanced or balanced.

Dummy Load:

Switching in the 50-Ohm dummy load removes the tuner section and all external antenna inputs from the line. The bridge and meters continue to function.

The four non-inductive 200 Ohm carbon resistors are purposely air-spaced. They will handle a full 5 Watt output for a maximum of 20 seconds.

Maximum time key-down for the dummy load is virtually continuous at 1 Watt output, approximately one minute at 2 Watts and progressively shorter duration as power increases to 5 Watts output.

Antenna Switching:

The front panel rotary antenna switch has three settings. **TUNER** is the normal operating position. **OUT** removes the matching circuit from the line and permits direct forward and reflected power readings. **DUM** selects the dummy load.

The rear panel switch toggles between **UNBALANCED** and **BALANCED** antennas. When the latter is selected a 4:1 balun is engaged to accept balanced feeders of various impedance such as open wire, window line, twinlead or zip cord.

The tuner will accept one balanced and one unbalanced antenna at the same time. The operator can switch quickly between a manually tuned antenna and an externally matched antenna such as a yagi, vertical or dipole. 73 de St. Louis QRP Society

L Brackets
Vertically on the Left
Side

Building The St. Louis Tuner

by Doug Hendricks, KI6DS

Construction:

You are now ready to start building your kit. NorCal is pleased that you chose to build the St. Louis Tuner. To insure the success of your kit, we hope that you will follow the directions we have included in this section.

The first step is to inventory the parts. Take all of the parts that are in your parts bag and dump them into a container, such as a cake pan. Then, separate and match the parts with the parts list. If you are missing ~~any parts, please notify Doug Hendricks.~~ You may phone (evenings after 5 PM Pacific Time) 209-392-3522. Email ki6ds@telis.org or send me a letter. Doug Hendricks, 862 Frank Ave. Dos Palos, CA 93620. NorCal will replace any missing parts without question for 30 days after mailing.

If you are planning to paint your tuner, you should do it at this time. But, do not paint the inside of the case. The tuner uses the case as a ground plane, and all parts must make good electrical contact with the case. If you paint the inside, you will have problems.

When you have the parts inventoried, you are ready to begin. We provided a custom case that is made from .060"& aluminum and is prepunched and drilled for all parts except for one. We decided to let you position the circuit board in the case. This was done because many will want to add accessories to their tuner. Some will want to put in a battery, others a keyer or other accessories. By letting you position the board, it gives you much more latitude to plan the addition of accessories. And, there are only 4 holes to drill.

Position the board where you want it, making sure that you have clearance to avoid shorting out on the sides of the case if you mount it vertical with angle brackets. Mark and drill the 4 holes. Be sure to use a center punch to give the bit a place to start without walking. Drill four .125 holes to be used to mount the circuit board.

The next step is to prepare the toroids. There are 4 to wind, and they are not hard, just time consuming. Relax and enjoy this part. You will be able to proudly say that "Yes I wound the toroids myself!" when your buddies look in your tuner and admire your work.

Transformers T1 and T2: DARK

Winding the transformers is the easiest part so we will start with it. Remember that every time a wire goes through a toroid, it counts as 1 turn. Find the roll of #24 enameled wire and cut off a piece 12" long. Take the FT50-61 toroid, (it is the black one without the orange dot) and the wire. Wind 12 turns and leave leads that are about 1" long. Strip the enamel from the leads by burning, then scraping the enamel with an exacto knife or use a piece of sandpaper to clean off the wire. It should be bright and shiny back to the edge of the toroid. Tin the wires with solder. Set this assembly aside for now. Find the other black toroid without an orange dot and wind another coil just like the first one.

The next step is to prepare the Faraday shield. We use coax for this and it must be prepared carefully. Cut 2 pieces exactly 1.75" long. Get out the circuit board and follow closely. Lay one piece of RG58 coax on the board directly over the layout for T1. Position it so that one end is even with the holes for C1 and the other is even with the holes for C2. You will use the pattern on the board as a template to prepare the coax. Trim the coax so that you have the outer covering as long as the inside two lines on the silkscreen. Be careful not to nick the copper foil. Then trim the foil back to the second set of lines, then trim the insulation of the inner conductor so that it matches the third set of lines. It sounds a lot harder than it is and when you lay the coax on the board you will not have any problem. Prepare the second piece exactly like the first. Lay these assemblies aside for now.

T3 - 1:4 Balun

We are ready to wind the 1:4 balun for T3. It will be a bifilar winding, but it is not hard. Take the #26 wire and cut off two pieces 18" long. Put one end of the wires together in a vise and the other two ends in a hand drill (must be variable speed). Turn it very slowly and twist the two wires until they have about 8 turns per inch. You will use this "bifilar"

 Light

12 → Doug info 5/24/96

wire to wind the toroid. Wind 10 turns on the FT50-43 toroid (the black one with the orange dot). You will have two ends on one side of the toroid and two ends on the other when you finish. Take an ohmmeter and determine which wires are which. Or you can mark one of the wires with a black felt marker. Call one wire A and the other wire B. You will take the start of wire A and twist and connect it to the end of wire B, the other wire.

Now, strip the ends of the two different wires (start of wire A and the end of wire B) and twist them together and solder. Leave a lead of about 1". Then strip the ends of the other two wires so that you have a length of 1" stripped lead from the edge of the toroid. Set this assembly to the side. See Fig. 1 below

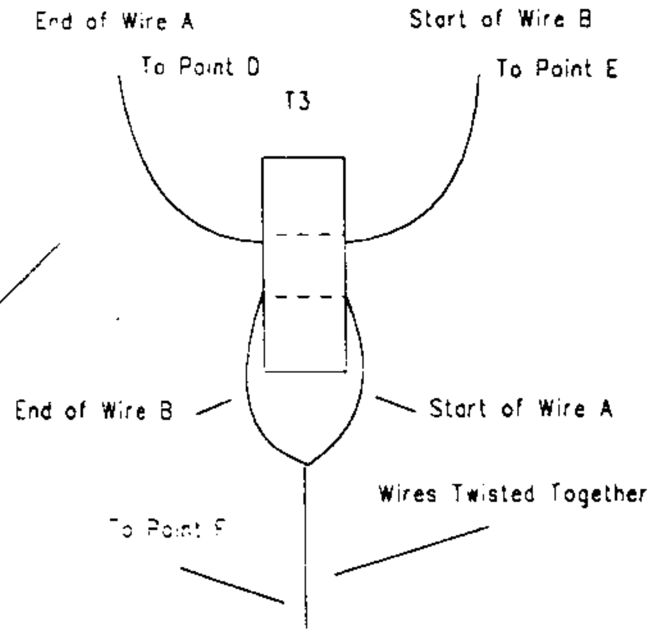


Fig. 1

L1 : Main Coil

This coil is wound on the large red toroid, and it must be built as described, as it is a tight fit for the front panel and case. It mounts on the back of the contacts for S2, the 1 pole - 12 position switch that mounts in the lower right hand hold of the front panel. You will use #24 enamel wire to wind this coil, and you will need a piece about 8 feet long to wind it. Take the #24 wire and start winding the coil. You will tap the inductor at turn numbers 3, 6, 10, 15, 20, 25, 30, 37, 44, 52, and 60. Leave plenty of wire to make your taps. I usually leave a loop about one inch long, secure each loop with a twist or two and wind the whole coil with these one inch loops sticking out the edge. Remember to not have the twists on the curved side of the coil but on the flat side, or your coil will not fit. See Fig. 2. This is extremely important. Then I go back and strip each loop in the

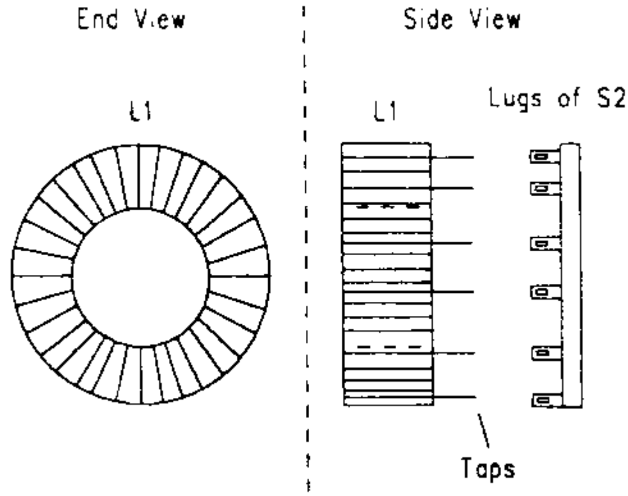


Fig. 2

following manner. I cut the loop at the end, and have two wires. I scrape each wire carefully, and then twist and solder them together. I make sure that each wire is about 1 inch long at this point. Set L1 aside. Believe me it will take longer to wind this coil than any you have ever done, but it is not hard, just slow and tedious. Be patient and be careful not to kink your wire.

Dave Gaulding, NF0R, suggests using a shuttle. The shuttle can be made from cardboard, fiberglass, metal or plastic and should be no more than 3/16" wide by 2 1/2" long so it can pass easily through the center of the toroid core. A plastic straw makes a nifty shuttle and is cheap! Cut a piece about 2 1/2 inches long. Cut a 1/4" slit in each end and wind your magnet wire between the two slits.

Circuit Board Assembly:

We are now ready to stuff the parts on the pc board. Install the components in the following order:

1 W resistors R1, 2, 3, 4 — 100 Ω
Trimpots R5 and R6 — 25K
2 W resistors R7, 8, 9, 10 — 200 Ω
RFC 1 & 2 DIODES
D1 and D2. Make sure banded end is towards R1-4.
C1, 2, 3, 4. .01 mf DISK

Take the Faraday shield that you made from the pieces of coax and insert them in the FT50-61 toroids that you have wound. Then, solder the leads of the coax of T1 where they go on the board to hold the transformer in place. The toroid will fit in the cut out of the pc board. Repeat for T2. Refer to the circuit board assembly diagram on page 11 and connect the ends of the magnet wire on the toroids where they go on the board. Next, cut a piece of the #18 tinned bus wire 2 inches long. Bend the end around so that it makes a loop about 1/4 inch in diameter and will fit over the coax shield. It will look like a candy cane or letter J. Use this to ground the shield of the coax on T1. Repeat for T2.. Be careful when soldering to the shield that you don't overheat it. When connecting the Faraday shield to the board, be sure to ground them only on 1 end, NOT BOTH ENDS!! If you wish you may replace the coax braid with the appropriately sized copper or brass tubing, but the braid will work fine.

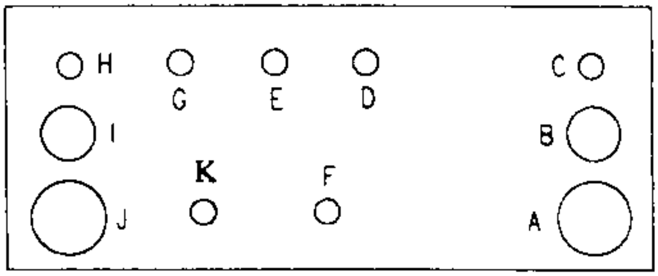
Attach the standoffs to the pc board at this time. Now cut a piece of small insulated stranded hookup wire 6" long and connect to M1 hole on the board. Repeat for M2. Cut another piece of different colored wire and flip the board over. Solder to the ground plane on the side nearest the resistors R1-R4 so that the wire can come out the bottom. These wires will attach to the meters, but not at this time.

BLK
YEL

Use the #18 tinned copper wire to prepare the following: Cut a wire 4" long. Solder one end in the Input hole. Cut another wire 6" long and solder to the "To S1" hole near C2, but install it from the bottom side of the board and run it towards the front of the tuner. Finally, cut a wire 4" long and solder to the "To S1" hole near R10. This wire is stiff and hard to work with, but it is excellent for increasing tuner effectiveness. You will be glad you used it when you finish. Set the circuit board assembly aside at this time.

Back Panel:

The next step is to install the connectors on the back panel. One of the features of the tuner is the wide array of connectors. Start with the right side and install top to bottom the following: RCA, BNC and SO239. Be sure to tighten securely. Next do the same thing with the connectors for the left side. The two holes at the top middle take the 5-way binding posts. Install them next. The single pole toggle switch goes in the hole between the RCA jack and the 5-Way binding posts. The bottom middle hole is for the ground 5-way binding post and the hole next to it (K) is for the single wire output binding post. You should have all of the holes on the back panel filled at this time.



Rear Panel / Rear View

Lay the panel on its back so the inside is facing up. Make the following connections using the #18 tinned bus wire. Looking at the inside of the panel connect the center conductor of the 3 incoming terminals on your left. The terminals are RCA, BNC and SO239. I suggest that you start with a "hooked" wrap on the RCA and solder it to hold in place. Then wrap the wire around the BNC center conductor and solder. Then make a final hook around the SO239. This will allow us to simply insert the #18 wire from the pc board input point when it is time to do so, but not now.

Fig. 3

A = S0239	**B = BNC**	**C = RCA**
D = 5Way	**E = 5Way**	**F = 5Way**
G = SPST Toggle	**H = RCA**	**I = BNC**
J = SO239		

***ABC = Input Side**

Next cut a piece of the #18 tinned wire 2" long. Make a 1/4" hook on one end. Place the hook around the center conductor of the 5Way binding post that is on the bottom row and in the center (ground termi-

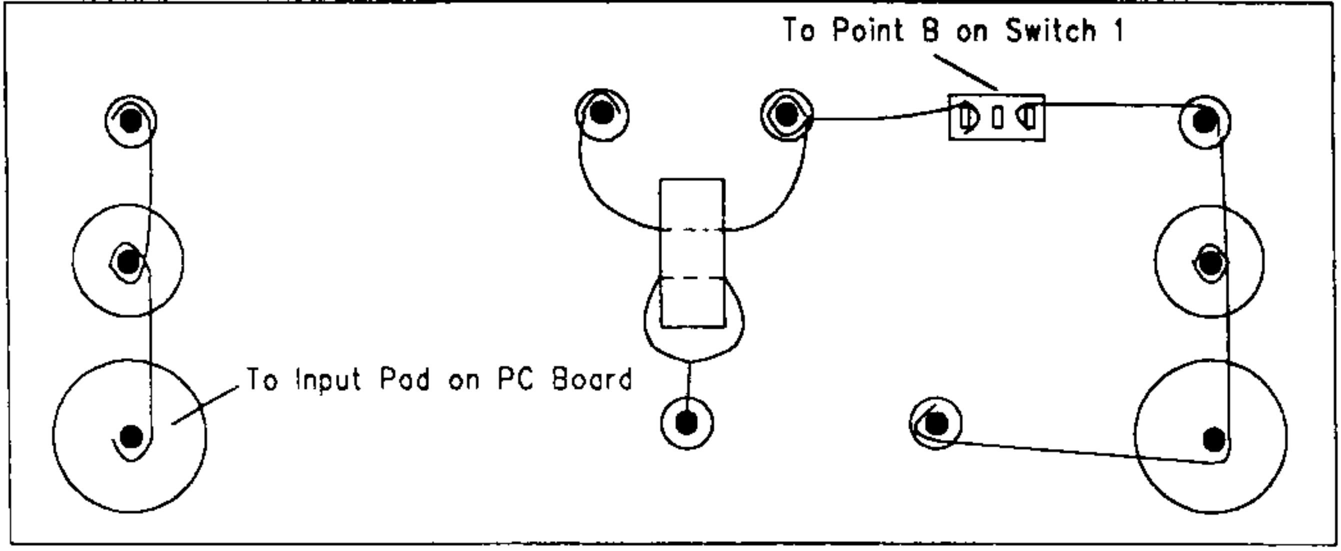


Fig. 4: Inside View Back Panel wiring diagram.

nal). You should have a ground lug attached to it pointing towards the top of the panel. Thread the wire up through the ground lug and leave the extra to form a tie point for the Balun. Solder the wire to the center conductor and the ground lug. You should have about 1" of wire sticking up. Now, take the balun, T3 which you have already wound, and install like this. The two wires that are twisted together go to the wire that you have just installed. The other two wires, one coming out of each side of the toroid will attach to the two binding posts in the center of the panel on the top row. You now have the Balun attached by the "Y" shaped yoke, with the balun being in the center of the "Y".

We will now connect the center conductors of all the output terminals of the tuner. Use the #18 tinned bus wire, and start with a loop on the single wire binding post, then go to the SO239, wrap a loop around the center conductor and solder both connections. Don't cut the wire. Run the wire to the BNC center conductor, wrap a loop and solder. Next go to the RCA, wrap a loop around the center conductor and solder. Then go to the right terminal of

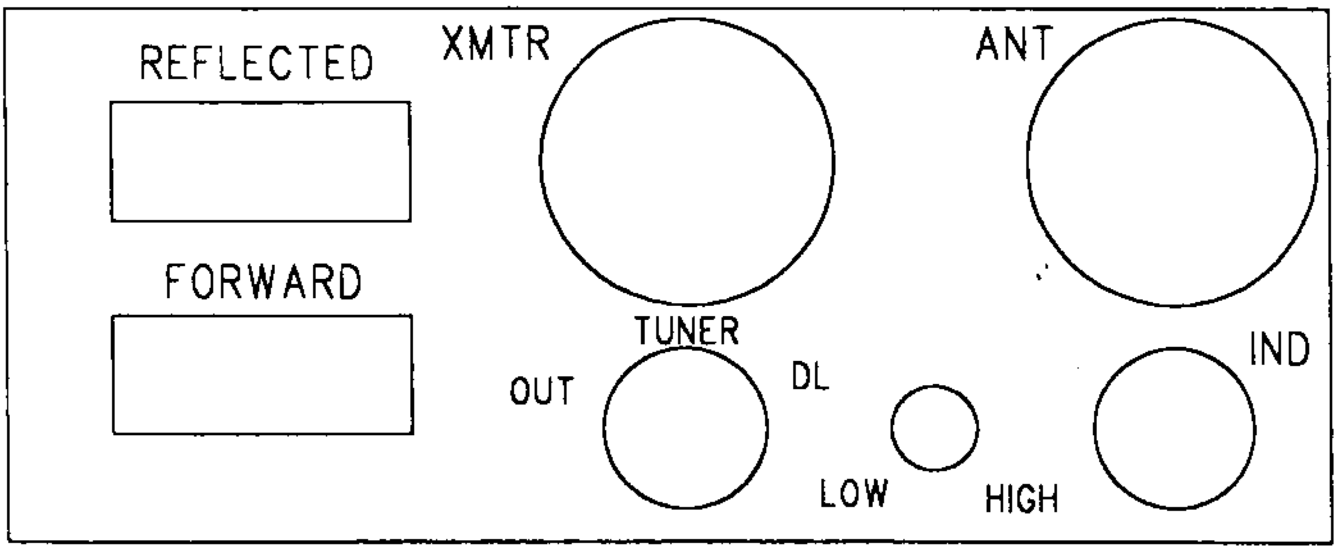


FIG 5 Front Panel Assembly (Front View)

the single pole toggle switch. Use a light iron here, and don't heat the switch contacts any more than you have to. They melt easily. Solder another wire from the left conductor of the toggle switch to the right 5-way binding post on the top (inside view). This will connect the balanced line input to the tuner. This switch will allow you to switch from a balanced line input to a coax input antenna. The back panel is finished at this time. Set it aside.

Front Panel Assembly:

We will now install the parts on the front panel. First, place two meters in the rectangular holes and attach with the 2-56 hardware. You will have to use a pair of needle nose pliers or hemostats to hold the nuts so you can install them. Make sure that you do not over tighten the screws. You will break the meters and there are no extras. If the meter doesn't fit in the holes you may have to dress the hole with a file, but it should fit in most cases. Do not force the meter. Use a piece of resistor or capacitor lead that was left over from the pcboard installation and connect the right terminals of the two meters together. The small insulated ground wire from the pcboard will attach here, but not at this time.

Our next task is to attach the custom variable capacitors to the front panel. Dave Meacham, W6EMD did the front panel layout and it was a tight squeeze but he figured out how to do it. We all owe Dave a big thank you for his layout work. The variable caps must be insulated from ground, so we will use the #6 nylon screws and washers to hold them. Take 3 nylon screws and put through the panel from the front side. Then put 3 nylon washers on the screws. They will hold the caps away from the panel. Carefully place the capacitor on the screws and tighten them. Make sure than none of the washers fall off. They must all be in place. Repeat this operation with the other capacitor. Take an ohm meter and check the frame of the capacitors and the case to make sure there is no connection. If you find a short, you must correct it. Use an exacto knife to trim the excess thread portion of the top two nylon screws so the plates of the capacitor will miss them. I did this with the screws installed and it was easy. Be care to not cut yourself.

Install the double pole toggle switch in the middle hole on the bottom row of the front panel. Be sure to tighten securely.

Prepare the 3 pole / 3 position rotary switch as follows. Place it in the front panel. You will see that the phenolic part of the switch hits the pem nut that is on the bottom of the panel. Take a small file and file off the phenolic until the switch will set flat against the front panel.

When you use the #18 tinned wire, you will find that it won't fit in the solder lug holes of the switches. You will have to carefully flatten the ends of the wire to get them to fit into the solder terminals. I used a small ball pean hammer and a flat piece of steel. I tapped it lightly and tried to flatten it about 1/4" long. I then inserted the wire, soldered and trimmed the excess.

Now comes the fun part of the kit. We will install L1 on the back of Switch 2. But first we have to attach a #18 tinned bus wire. Cut a piece that is 8" long. Bend a 90 degree bend on one end with about 1" sticking out. Flatten the end of the short end and solder to the inner solder tab on the switch. Run the wire out between the two solder tabs so that the wire will go around the toroid when it is attached. It must not run through it. You might want to slip a piece of heatshrink on the wire to assure that there are no shorts. You just need about an inch or so.

Take L1 and position the starting and ending wires over the two taps that are on either side of the wire that you have just installed. They are labeled 1 and 12 on Fig. 7. Carefully start inserting the taps into the solder lugs. Take your time and work around the toroid as you go. I was able to get mine within an eighth inch of the solder lugs on the switch. The important thing is to make the coil as close as possible and be "square with the world" when you are done. Solder the wires in to the lugs, and then solder a #18 tinned bus wire 4" long to the first lug (the one that has the1 turn tap on it). Install switch 2 at this time. Make sure that the coil does not touch any part of the frame.

Front Panel Wiring:

Make sure that you have the meters, switches and capacitors installed on the front panel. Flip it over so that the inside of the panel is facing up and oriented to match Fig. 7.

The wiring is complicated, but if you follow the step by step instructions you will be successful.

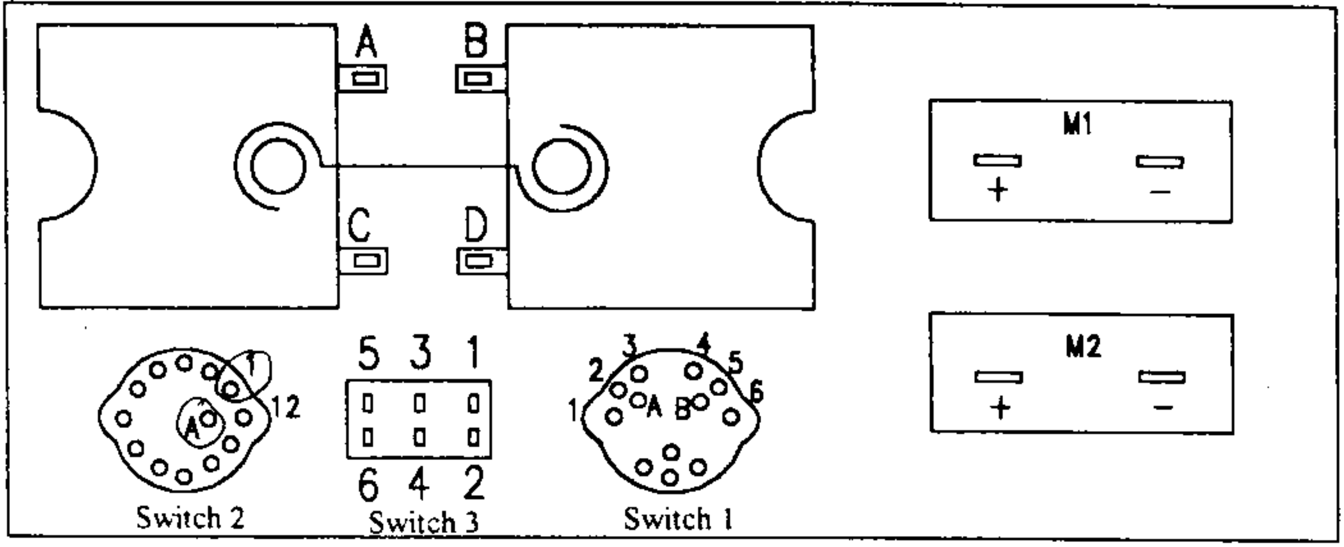


Fig. 7 Front Panel Wiring Diagram (Inside View)

Refer to Fig. 7 as you go though the following steps.

Step 1: Attach solder lugs with #6 screws to frame of capacitors. Orient lugs so they are close to each other. Take a piece of the #18 tinned bus wire and connect the two lugs. You are effectively tying the frames of the two variable capacitors together.

Step 2: Run a #18 tinned bus wire from tap 12 of switch 2 to the wire installed between the two capacitor lugs in step 1. Solder to the lug and the wire between the caps.

Step 3: Run a #18 tinned bus wire from Point A, which is the connection closest to the front panel on the left capacitor and tab 1 of the DPDT toggle switch. Again, be very careful to not apply too much heat when soldering to the toggle switch.

Step 4: Run a #18 tinned bus wire from Point B, which is the connection closest to the front panel on the right capacitor and tab 2 of the DPDT toggle switch.

Step 5: Run a #18 tinned bus wire from Point C, which is the other connector on the left variable capacitor, and tab 3 of the DPDT toggle switch. Do not solder the connection to the capacitor at this time, just the toggle switch connection.

Step 6: Run a #18 tinned bus wire from Point D, the other connector of the right variable capacitor and tab 4 of the DPDT toggle switch. Again, solder only the toggle switch connection at this time.

Step 7: Run a #18 tinned bus wire jumper from Point 6 to Point 3 on Rotary Switch 1, the 3 Pole/3 Position switch. Note that 1 section of this switch is not used. You may want to use heat shrink here to insulate the wire. Solder both ends.

Step 8: Run a #18 tinned bus wire from Point 5 of Switch 1 to Point C of the left variable capacitor. You already have 1 wire going to this connection from step 5. Solder Point C and Point 5 on Switch 1 at this time.

Step 9: Cut a piece of the #18 tinned bus wire 6" long and connect one end to **Point B of Switch** 1. Solder this end. We will attach the other end during final assembly.

Step 10: Connect a #18 tinned bus wire from Point 2 of Switch 1 and Point D of the right variable capacitor. Again, note that there is already 1 wire attached to Point D from Step 6. Solder both Point D and Point 2 of Switch 1 at this time.

Step 11: This one is a little bit tricky, as the #18 wire is hard to handle. Attach the front panel to the case with the undercut flathead 4-40 screws and the pem nuts on the panel. Attach the circuit board to the case using the 4-40 pan head screws and the holes that you have previously drilled. Now connect the wire from the S1 pad nearest R10 on the PC Board to Point 1 on Switch 1. You may not be able to get the wire into the lug, and may have to lay it on the lug and solder. The important thing is to make sure that you have a good connection.

Step 12: Connect the wire from the S1 pad nearest C2 on the PC board to Point A on Switch 1.

Step 13: Install the rear panel to the bottom of the case. Use the flat head undercut #4 screws. Connect the wire from Point A of Switch 2 to the ground lug on the output SO239 on the lower right side of the rear panel (as you look at the rear panel from the inside.)

Step 14: Connect the wire from the input pad to the center conductor of the SO239 on the lower left hand side (looking from the inside of the case).

Step 15: Connect the small insulated wire running from the M1 pad on the PC board to the positive (+) terminal of M1

Step 17: Connect the small insulated wire running from the M2 pad on the PC Board to the positive (+) terminal of M2

Step 18: Connect the wire from the ground plane of the PC Board to the negative terminals of M1 and M2 tied together with the resistor lead. When you finish with the wiring of the front panel it is time for final assembly.

Final Assembly:

Install the latches on the sides of the case. Use the #4-40 x 5/16" flat head screws and 4-40 nuts. Place the Knobs on the capacitors and switches as required. Your tuner is finished. Congratulations.

Calibration:

Calibration of the meters is quite simple. The top meter, the reflected power is set to be as sensitive as you can get it, using R5 to set the adjustment. The forward power meter needs to be calibrated. I used a known calibrated meter, an OHR WM-1. I set my Icom 735 for 5 W on the OHR. Then without changing the output of the Icom, I set the Power Meter to the full scale position on my St. Louis Tuner using R6 to adjust for forward power. If you don't have a calibrated meter, Dave Gauding found that the B on the meter face is 5 Watts. If you want to set it for 1 Watt, 3 on the meter face is approximately 1 watt. Each meter will be a little different, but these examples will get you in the ball park.

Operation:

Front panel controls consist of three switches, (Mode, Inductor and high/low Capacitance) and two variable capacitors for transmitter and antenna adjustment.

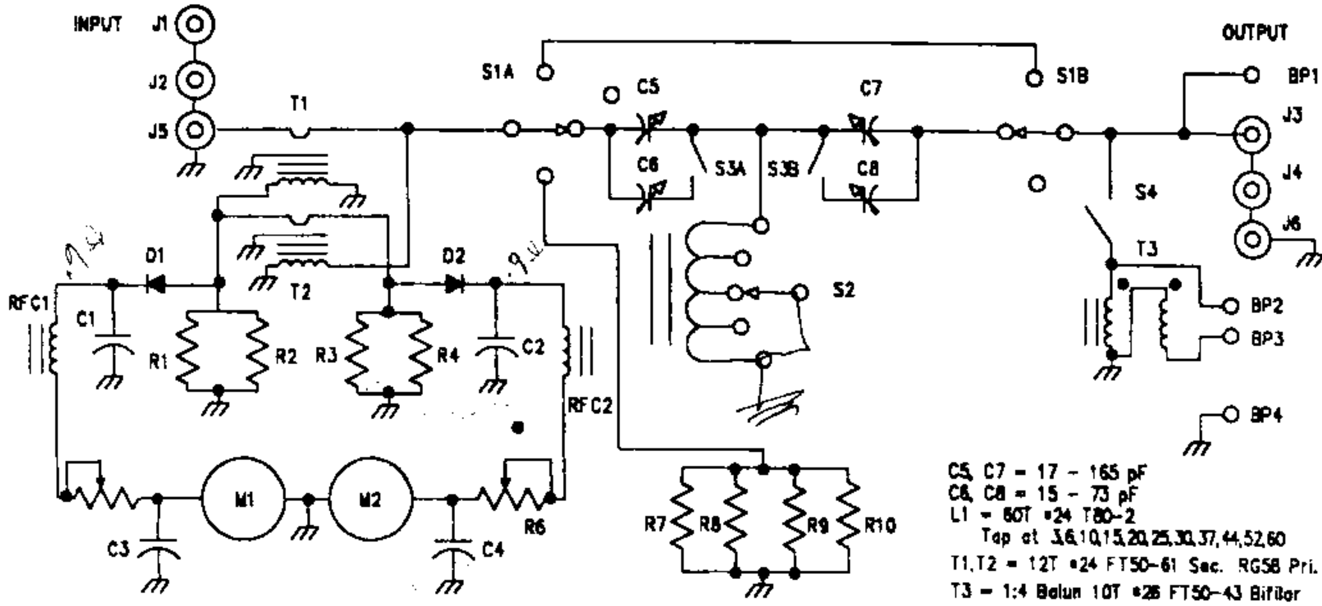
The mode switch has three settings, OUT, TUNER, and DL. OUT means the tuner is not in the circuit; however, the power meters are still active. In the Tuner position, the power meters are used with the tuner to match the transmitter to the antenna. The DL position removes the tuner and connects the Dummy Load following the power meters for transmitter adjustment.

The inductor switch has twelve positions that change the tap point on the tapped inductor (L1) so a match may be obtained over a wide range of frequencies.

The Transmitter and Antenna controls are two-section variable capacitors which are used to obtain a match between the transmitter and antenna. The high/low capacitance switch allows the two sections of the variable capacitors to be paralleled (high) or operated separately (low).

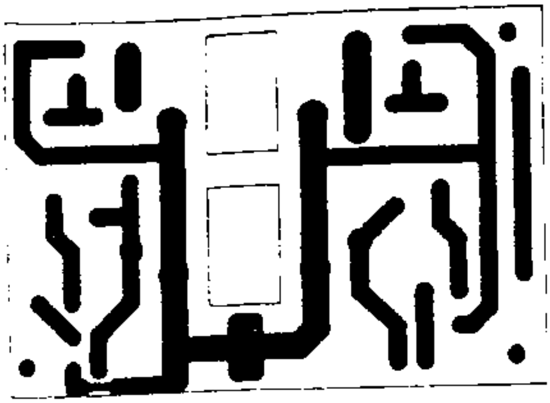
This tuner operates much like those sold by MFJ and TenTec. Begin by setting the mode switch to "Tuner", both capacitors approximately mid scale and the paralleling switch in the separate position (low). Make sure the balun switch is set for the type of feed line you are using, either balanced or unbalanced. Set the inductor switch at either end of its range and apply transmitter power to the unit. Quickly note the reading of the reflected power meter. If not less than full scale, quickly turn off the transmitter, select the next setting of the inductor and again check the reflected power. continue this procedure until a null in reflected is observed. then adjust the "transmitter" and "antenna" capacitors on the transmatch to reduce the reflected power further, hopefully to zero. If unable to find a match with the capacitor switch in the separate setting, try the procedure again using the parallel position. There may be times when a perfect match (zero reflected power) cannot be achieved but some value less than full scale reflected power can. Depending on how critical SWR is to your transmitter, you may decide to operate with some reflected power showing if that is the best match you can obtain.

ST. LOUIS TUNER

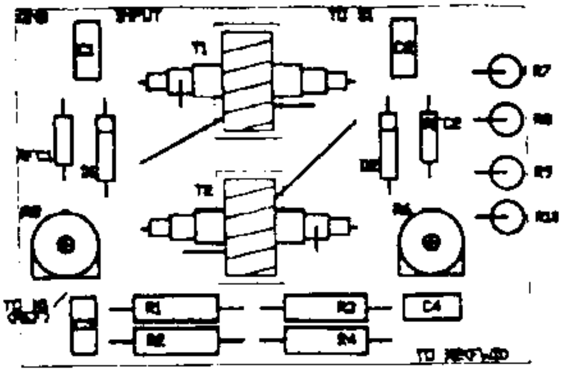


PARTS LIST

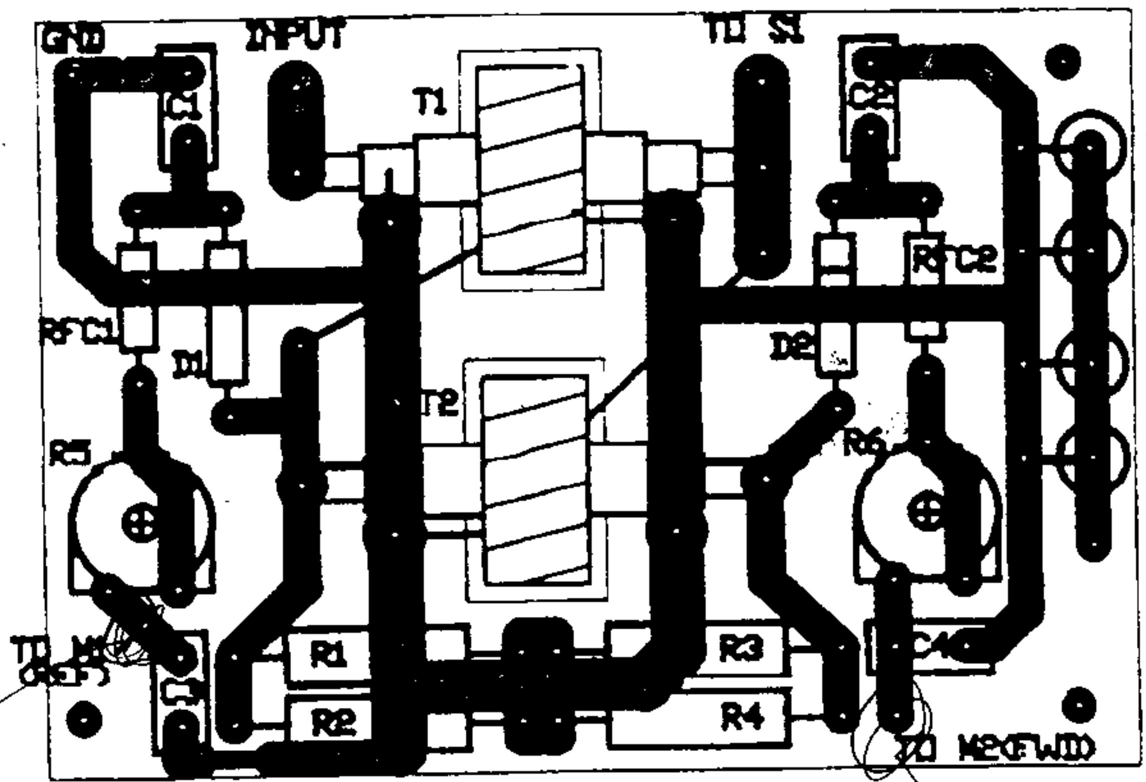
1	Cabinet	1	PC Board
C1-C4	.01uF Disc	4'	#18 Tinned Bus Wire
C5-C8	Dual Gang Variable Capacitors (2)	10'	#24 Magnet Wire
RFC1,2	1mH RF Choke	3'	#26 Magnet Wire
BP1-3	Binding Post Connector 5 Way	4	Rubber Feet
J1,J3	SO239	6	4-40 x 1/4" FH Undercut Screws
BP4	Binding Post Connector, 5 Way	4	4-40 x 5/16" FH Screws
J2, J4	RCA Jack	8	4-40 x 1/4" PH Screws
J5, J6	BNC Jack	4	4-40 x 1/2" Spacers
D1, D2	1N34A Diode	4	4-40 Nuts
M1, M2	200uA Meter	4	2-56 x 1/4" PH Screws
R1-R4	100 Ohm, 1 Watt	4	2-56 Nuts
R5, R6	25K Trimpot	2	Southco Latch Assemblies
R7-R10	200 Ohm, 2 Watt	6	6-32 x 1/4" PH Nylon Screws
S1	3P/3Pos Rotary Switch	6	6-32 Nylon Washers
S2	1P/12Pos Rotary Switch	2	6-32 x 1/8" PH Screws
S3	DPDT Toggle Switch	2	Solder Lugs
S4	SPST Toggle Switch	2	1 - 3/8" Knobs
T1, T2	FT50-61 Toroid	2	3/4" Knobs
T3	FT50-43 Toroid (Orange Dot)		
L1	T80-2 Toroid (Red)		



Circuit Board



Components



M1

Circuit Board Assembly

M2