
Mark Connelly - WA1ION DX Labs - 30 JAN 1984

A passive tuner has preselection as its primary function. Preselection is of increasing importance as few DXers live in areas with no strong local stations capable of spur/image production. Preselection is especially useful to DXers using lower-priced solid-state receivers having wideband input RF amplification. Such receivers do not offer the 'crunch-proof' operation of some of the 'top-buck' solid-state gear and of many of the old tube-type stalwarts such as the HQ-180A & the R390A. With any decent length of wire capable of capturing weak DX, many receivers crumple up like an accordion and give urban & suburban DXers headache-producing local-station images & spurs instead of the desired DX.

Use of a tuner can go a long way towards solving such problems. One must remember that the gain of a passive tuner is generally about unity: the received signal is about the same as if the wire were connected directly to the receiver -- BUT, with the important consideration that, in general, spurs will be removed (thereby allowing longer-than-previously-useful wires to be utilised).

For those wanting actual gain, use either an active tuner such as APT-2 or APT-3, or use a Broadband Amplifier module between a passive tuner's output and the receiver's input. Figure 8 of the 'Modular Phasing Systems' article gives a schematic for a broadband amplifier card which may be readily mounted in a mini-box. Changing R5 of that card from 100 ohms to 33 ohms will beef up the gain a bit more. The amplifier's output should be routed out through a low-value resistor (about 33 ohms) in series with a DC-blocking capacitor (.1 uF).

The seven tuners to follow fall into two overall groups: Passive Series-L-C Tuners (PST's) and Passive Parallel-L-C Tuners (PPT's).

PST's have been the traditional favourite as phasing-unit input tuners. As they are tightly coupled to the antenna, tuning ranges are influenced greatly by antenna length: if many different length aerials are to be used, this may be perceived as a disadvantage, as the difficulty in memorising or looking up a whole batch of frequency-range switch position tables would tend to slow down tuning agility in a good-opening fast-frequency-hopping type operation. The advantage of the PST, because of tighter coupling, is somewhat more signal coupled to the receiver, phaser output module, or broadband amplifier input.

PPT's offer somewhat looser coupling. The critical factor is how much antenna-to-tank coupling capacitance will produce maximum tuner output consistent with spur-rejection & good Q. In PPT designs, 47 pF generally is best throughout the MW broadcast band, although for short aerials operated on the lower half of the band, better results could be obtained with greater coupling capacitance, in the order of 100 pF or more. Similarly, if Beverage-length aerials are being used, tuning sharpness above 1 MHz could be improved somewhat by decreasing the coupling capacitor to approximately 27 pF. In general, 47 pF does well for the vast majority of medium-wave PPT situations encountered.

A big advantage of the PPT is much more reliable frequency range switch settings, settings less influenced by antenna length than those of PST-style tuners. Furthermore, PPT's often provide sharper tuning (when not Q-spoiled) than PST's.

It has been found that use of inductive voltage divider schemes has been of great value in making the tuners 'work into' a wide variety of output impedances.

A big problem with many tuner designs heretofore published in DX magazines is that a given tuner will work well with some receivers and yet be useless with others.

Some receivers have a very low input impedance. A portable receiver using a ferrite rod antenna often uses a coupling coil of as few as 3 turns on the rod. That coil is usually grounded on one end; the other end goes to the external antenna jack. The input impedance of such a configuration may be less than an ohm DC resistance in series with a small inductance, perhaps less than 10 uH.

Many communications receivers have input impedances in the order of 50 to 75 ohms, primarily resistive.

Car radios may have very high input impedances, sometimes principally reactive.

The inductive voltage divider principle permits tuner operation with most conceivable receiver, amplifier, or phaser-output-module input impedances. Some signal is wasted in this process, but by careful design ,loss can be minimised. Using an inductance-division ratio of between 8:1 and 16:1 has proved to offer optimal performance.

Passive tuners, in general, are to be used with aerials of minimum length approximately 1/16 of a wavelength (e. g. 18.8 m. / 61.5 ft at 1 MHz). Use of a broadband amplifier module after the tuner may allow somewhat shorter wires to be tuned. Really short wires, car whips, bedsprings, etc. should be tuned with an FET-input active tuner such as APT-2 or APT-3.

All passive tuners described hereafter offer an output-level 'gain' potentiometer (R2 of Figures 1-4,6,7; R1 of Figure 5). This pot is necessary so that the tuner can be operated into a receiver or amplifier without overloading it with potentially-spur-causing signals on frequencies other than that of operation. This pot adjusts the level of RF out of the tuner without noticeably influencing tank circuit Q or the peak-yielding settings of the tuning capacitor & frequency range switch.

All tuners except the Mini-MWPPT (Figure 5) provide a second pot [R1] which is used to spoil Q as well as to adjust 'gain'. This pot is generally used only in PHASING applications: set it to CCW (max. Q) otherwise.

The main tuning capacitor (C1 of all tuners) can be either a miniature mica-dielectric type (e. g. Mouser 24TR210 or GC/Calectro A1-232) or the larger air-dielectric type of metal construction (e. g. Mouser 524-A1-227 or GC/Calectro A1-227). If the miniature type is used, the tuner can be constructed in Radio Shack's largest mini-box, the 270-238 (approx. 5.25 X 3 X 2.125 in.). Use of the air-variable capacitor will mandate a larger chassis: the Bud CU-3005A / Mouser 537-TF-779 (5 X 4 X 3 in.) would then be the preferred box.

Note that PST's require C1 to be 'floated above ground' (= isolated from contact with chassis). See the recent MWDX-2 article on ideas of how to accomplish this.

The vernier, or fine, tuning capacitor (C2 of Figures 1-4,6,7) is used primarily in phasing applications. It, and its series fixed capacitor, may be eliminated from the tuner if no phasing is to be done.

Choices of vernier capacitors include the Mouser 530-189-0565-1 (no series cap. needed) and the GC/Calectro A1-225. The A1-225 is larger than the Mouser unit (it also costs more), but it is easier to mount in a secure fashion; it also turns more easily.

Inductors greater than 1 mH (1000 uH) should be Mouser 43LH or 43LJ series. Those of 1000 uH or less can be Mouser 43HH, 43LR, or 43LS series; or equivalent units made by J.W. Miller, Nytronics, Delevan, Caddell-Burns, Dale, Krystinel, or other vendors.

Function switches (S1, all tuners) are simple DPDT (on/off/on) toggle types (e. g. Radio Shack 275-620). S2 of Figures 5 & 7 can be the same type switch. The 6-position / 2-pole frequency range switches (S3 of Figures 1-4,6,7) are Radio Shack 275-1386. Pots, fixed resistors, & fixed capacitors may be obtained from a variety of sources.

The antenna-input jack (J1) and the ground-input jack (J2) are Radio Shack 274-662 insulated binding-post banana jacks: use the red one for J1 & the black one for J2. Space J1 & J2 0.75 in. apart to permit the use of double-plug connectors & adapters.

RF-output connector J3 (all tuners) can be female BNC, UHF, RCA phono, N, SMA, F, or other coaxial type. J4 (Figures 3, 4, & 5) is Radio Shack 274-712 car jack.

Initial setup of a completed tuner entails setting length switch to normal, all pots to fully counterclockwise, and the tuning & vernier capacitors to centre (half-meshed). Running the frequency-range switch through its positions will help to ascertain the proper range: that with the strongest wanted-frequency signal. The DXer should make a 'look-up table' for frequency-range switch settings (similar to Table 1 of the recent APT-2 article). If wires of considerably-different lengths will be used, more than one such table may be needed - especially with PST's.

Of interest to beginners is Figure 5, the 'Mini-MWPPT'. This tuner is about the simplest design possible. Anyone should be able to throw this thing together in an hour or less. Parts expenditure should be under $ 25. Every MW-DXer who uses a longwire antenna should make one of these boxes. This is meant to be a 'bare-bones' type module

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designed for easy operation. The Mini-MWPPT is not meant to be an input to a phasing system: the Q-pot & several other phasing-oriented features have been omitted for the sake of simplicity.

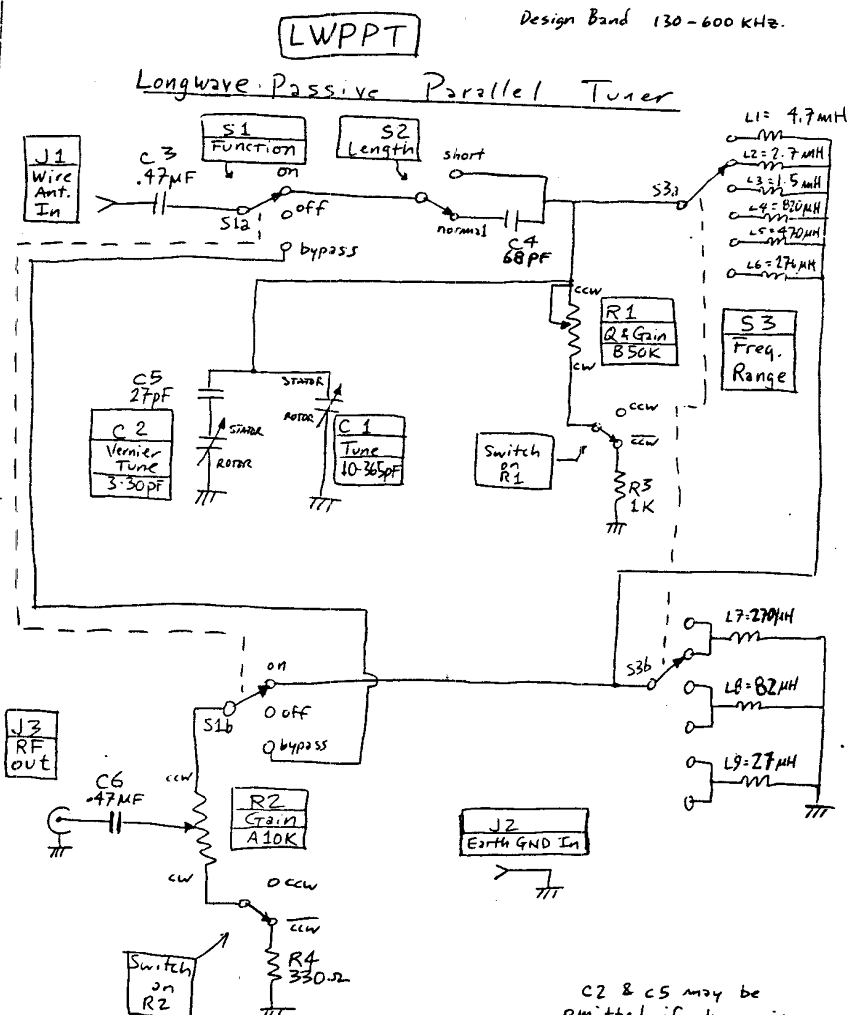
All tuners described work best when operated into a receiver having a metal chassis shielding internal receiver components. Operation with portables using ferrite rod aerials may be influenced somewhat by the direct pickup of the ferrite rod. Sometimes offsetting a tuner's tuning capacitor from peak can cause a dip - this is a crude sort of phasing whereby the tuner's output is phased against the ferrite rod's direct pickup. Such phasing is usually a hit-or-miss proposition, not something as dependable as the operation of a dual-tuner phasing unit.

Good grounding is important, especially for the proper operation of PST type tuners. The metal chassis of communications receivers plugged into mains is often a sufficient ground. Otherwise, use a pipe, mains, rod, vehicle chassis or other suitable ground connection. An otherwise-unused longwire or Beverage can sometimes be used as a 'dummy ground' at poor-conductivity DXpedition sites lacking other readily-available grounds.

The figures to follow should provide good starting points for experimenters -- these include:

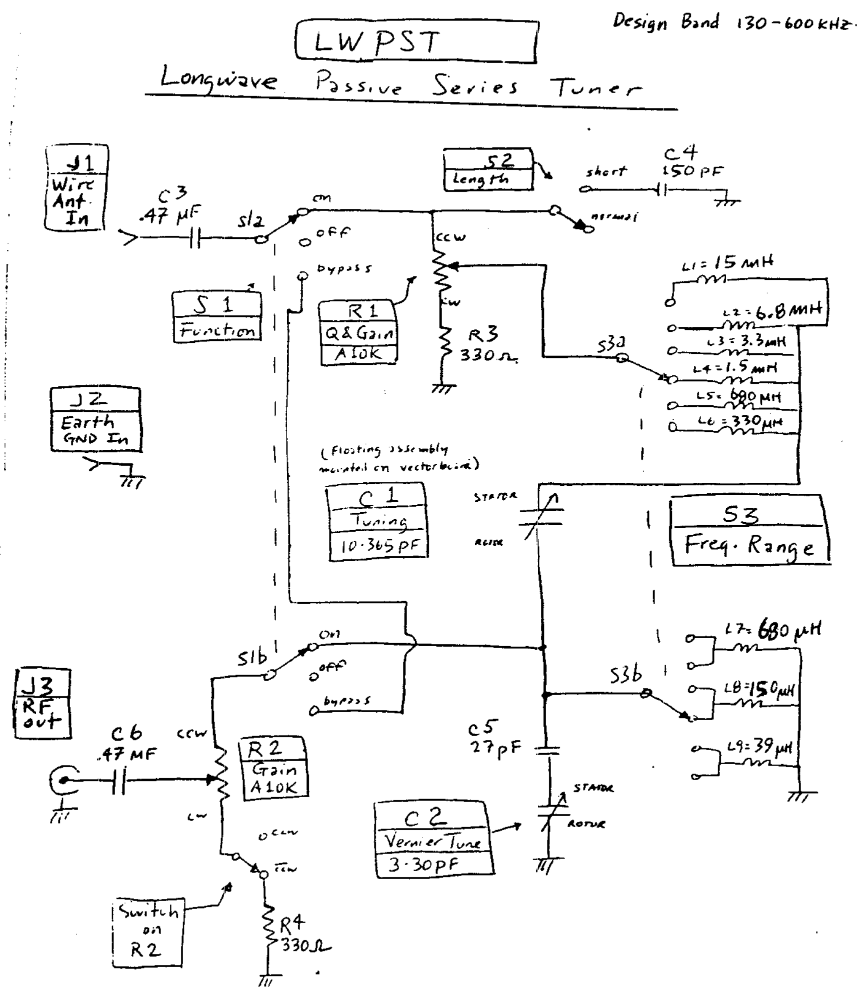
Figure 1 LWPPT (Longwave Passive-Parallel-L-C Tuner)
Figure 2 LWPST (Longwave Passive-Series-L-C Tuner)
Figure 3 MWPPT (Medium-wave Passive-Parallel-L-C Tuner)
Figure 4 MWPST (Medium-wave Passive-Series-L-C Tuner)
Figure 5 Mini-MWPPT (Miniature MW Passive-Parallel-L-C Tuner)
Figure 6 TBPPT (Tropical-Band Passive-Parallel-L-C Tuner)
Figure 7 TBPST (Tropical-Band Passive-Series-L-C Tuner)

FIGURE 1



C2 & C5 may be omitted if tuner is not to be used as an input module in a phasing system.

FIGURE 2



C2 & C5 may be omitted if tuner is not to be used as an input module in a phasing system

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Figure 3

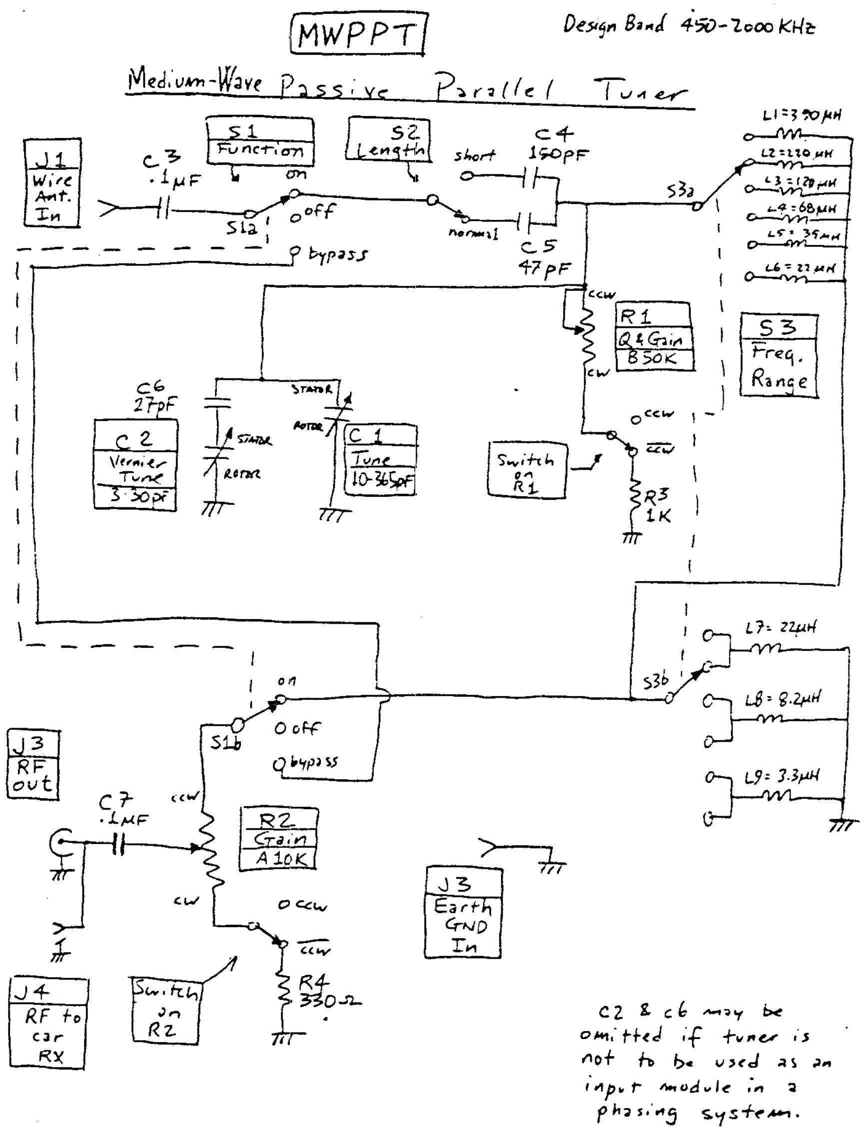


Figure 4

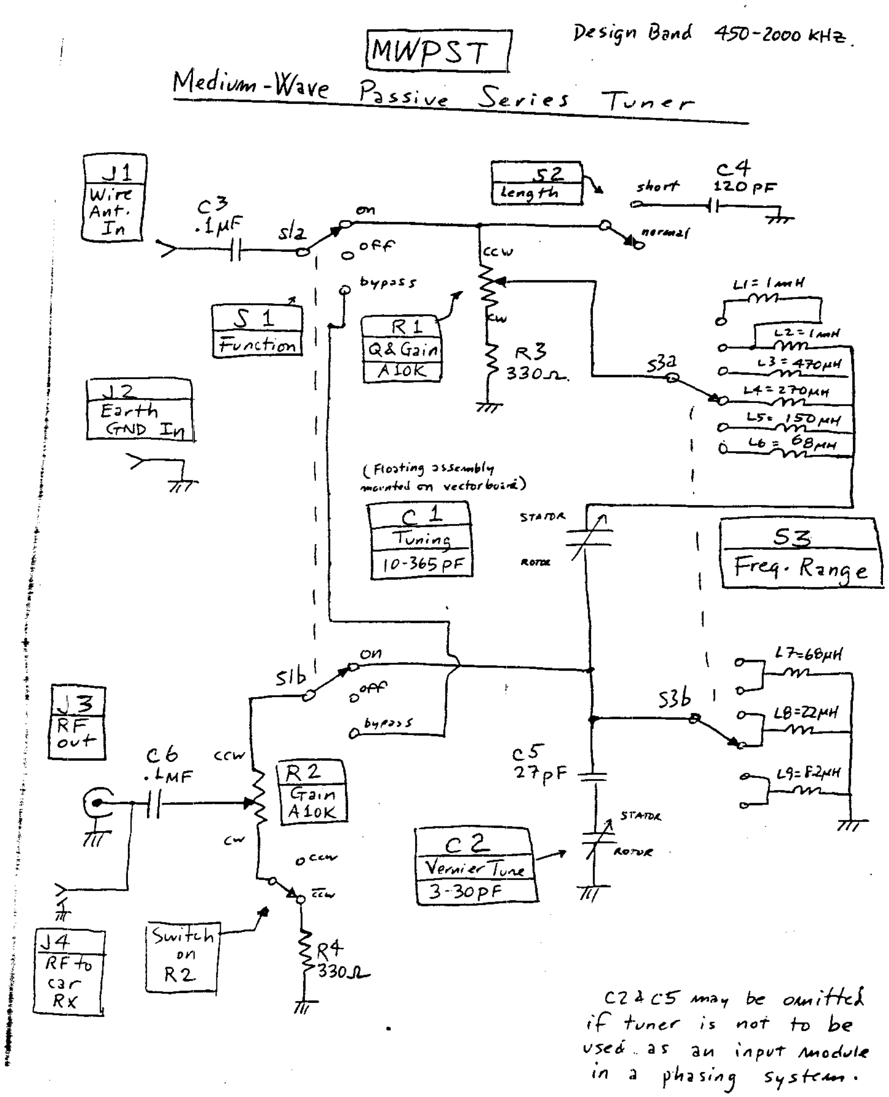


FIGURE 5

Mini-MWPPT

Design Band 500-1700 KHz

"Mini" Medium-Wave Passive Parallel Tuner

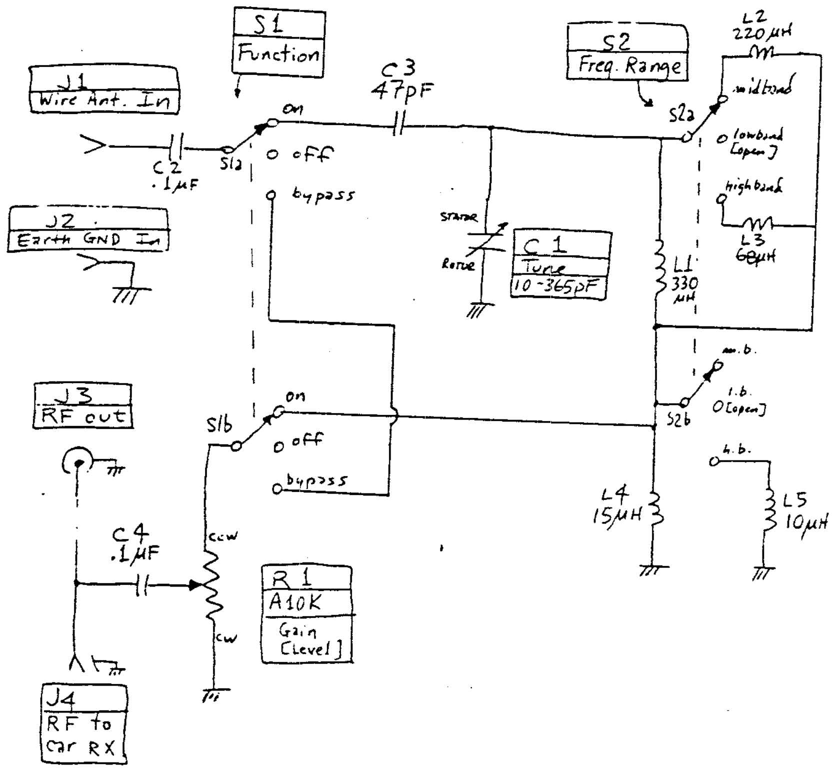
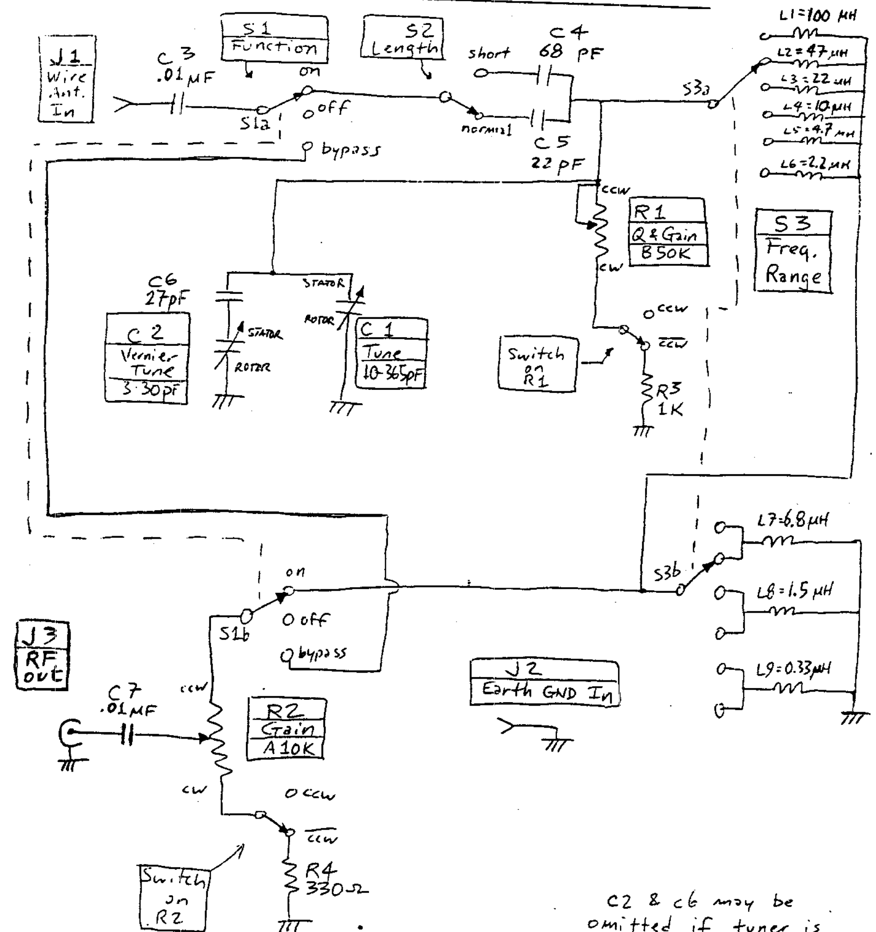


FIGURE 6

TBPPT

Design Band 1500-6200 KHz

Tropical Bands Passive Parallel Tuner



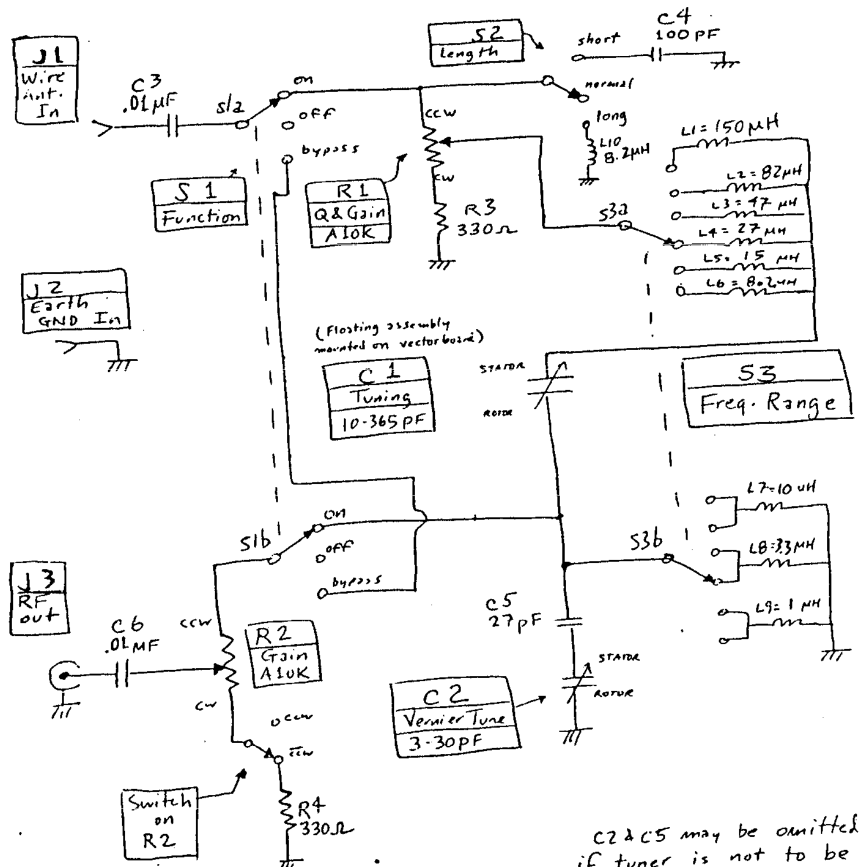
C2 & C6 may be omitted if tuner is not to be used as an input module in a phasing system.

FIGURE 7

Design Band 1500-6200 KHz.

TBPST

Tropical Bands Passive Series Tuner



C2 & C5 may be omitted if tuner is not to be used as an input module in a phasing system.