2 KW Low Pass Filter for 160-6 Meters

After making various adjustments to the original LPF filter configuration and noting some of the changes which could be made to the board to make it easier to construct, tune, and re-configure (if necessary), I decided to modify the board layout itself. Here are all the changes made since the original generation 1 filter:

- All filter sections are now 7-pole Chebyshev, providing steep cut-off skirts and additional harmonic suppression.
- **The 15 meter section was moved** from the original 20-17 meter segment to the 12-10 meter segment. This made it easier to filter 20 and 17, so now these segments are 20-17, and 15-10. Larger ferrite cores are used in the 20-17 and 15-10 meter segments
- the pc board markings have been revised
- The core material used in the 20-10 meter segments was changed to type 10
- The 6m filter section elements were changed to air-core inductors (ferrite is not needed due to shorter wire lengths)
- all the chip capacitors are now mounted to the foil side of the PCB so one can make changes or correct installation errors without having to remove the inductors.
- extra space was allowed for mounting the capacitors; 160m uses a lot of them, and space was limited on generation 1 (they fit, but it was crowded).
- Provision was made for allowing either capacitive input or inductive input filters (first component), all 7-pole Chebyshev types. This would be important if one band was low in output due to interference from reflected harmonic energy, while the others were OK (keep in mind I'm attempting to make the filter universally useful with all the various RF deck designs out there)
- It is now even possible to have 5 of the 6 filter segments as 9-pole filters, though this is certainly overkill; harmonic suppression is more than enough with 7-pole filter segments for even the neediest RF decks.
- It is now possible to install segment-specific delay lines, should they be necessary, at the front of 5 of the 6 segments to minimize interference from reflected harmonic power coming back to the rf deck(s). This was useful in my own unit on 75m.

The configurations I'll be listing here are the ones I'm using in my own single and dual-deck amplifiers, but many more are possible…I stopped experimenting when I grew weary of trying to squeeze the last few watts out the amplifiers, but if you have the energy to continue experimenting, you may be able to discover even more efficient set-ups.

The following are recommended configurations for each type of amplifier deck

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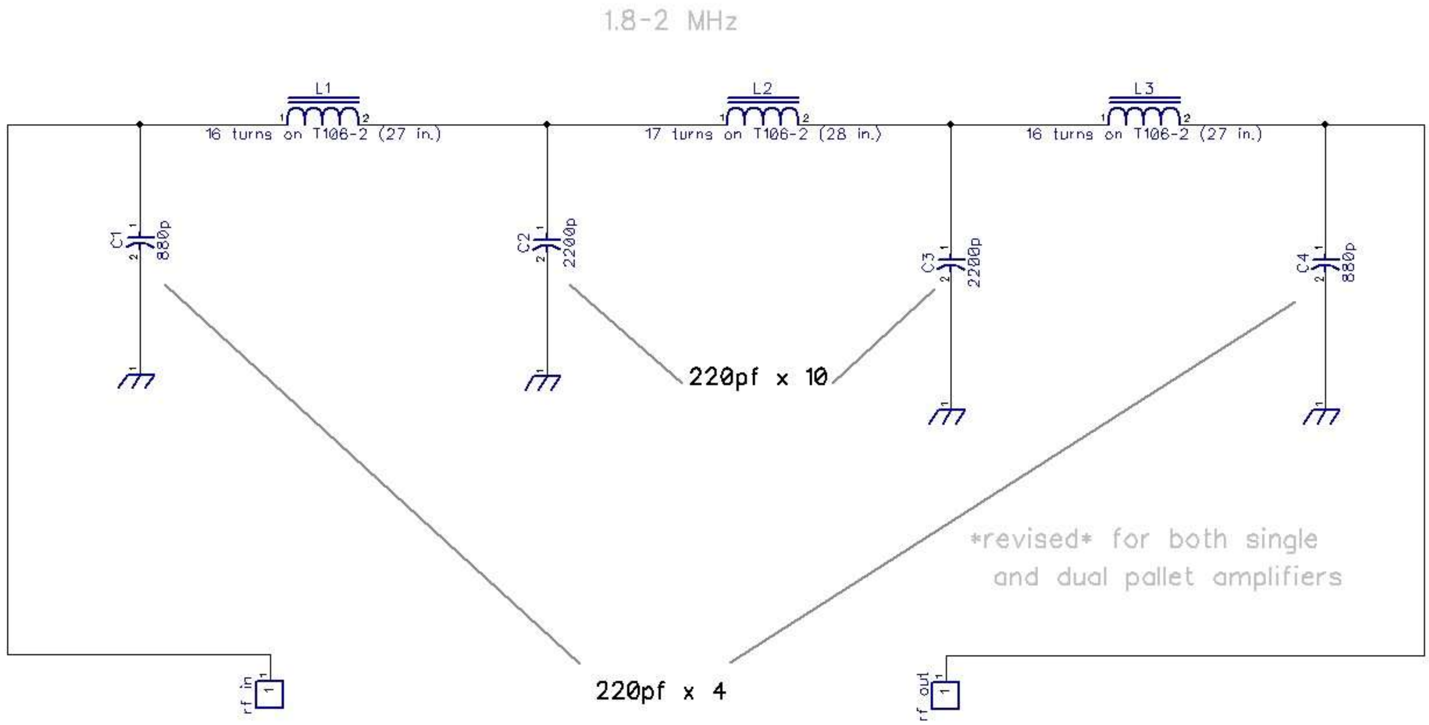

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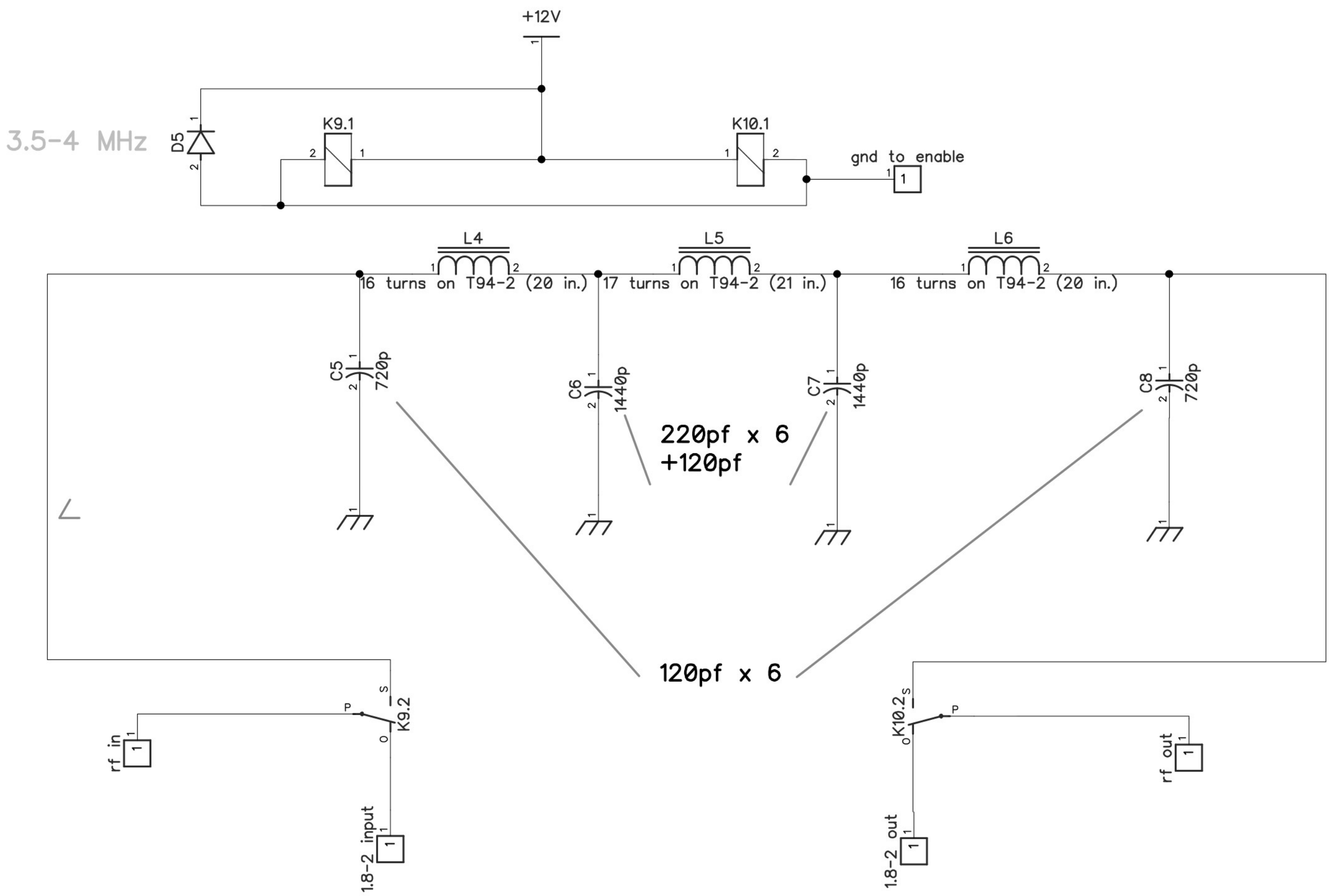

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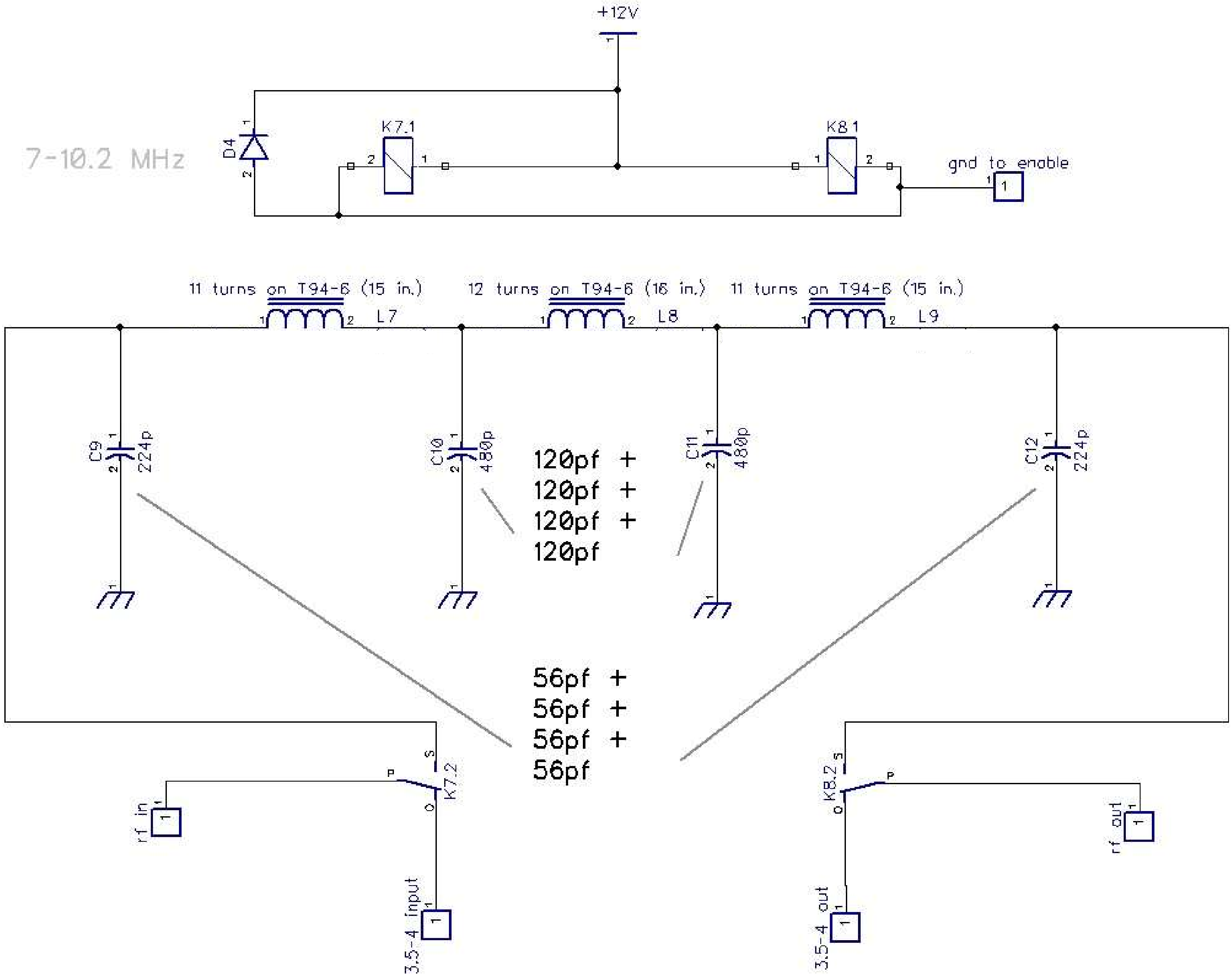

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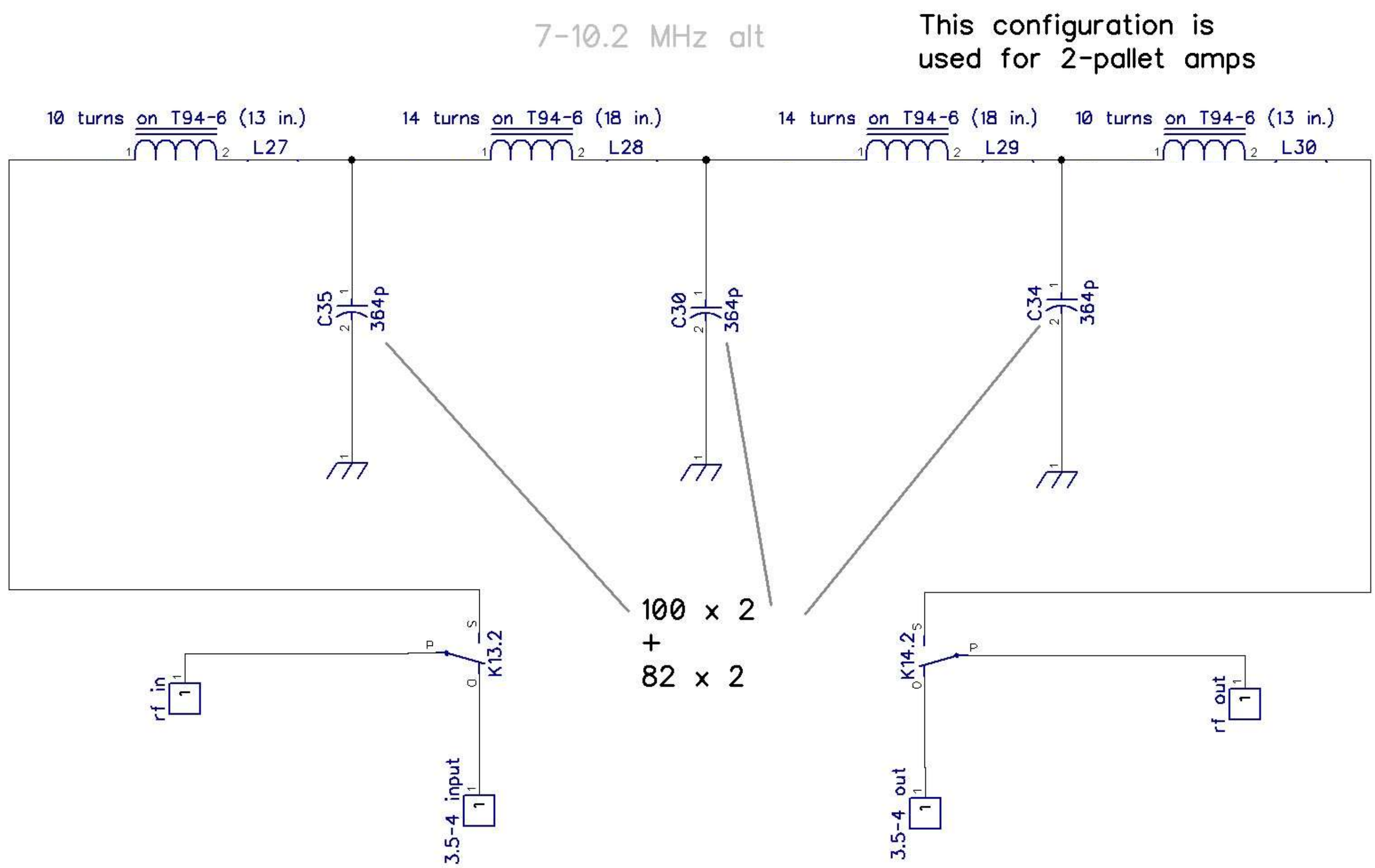

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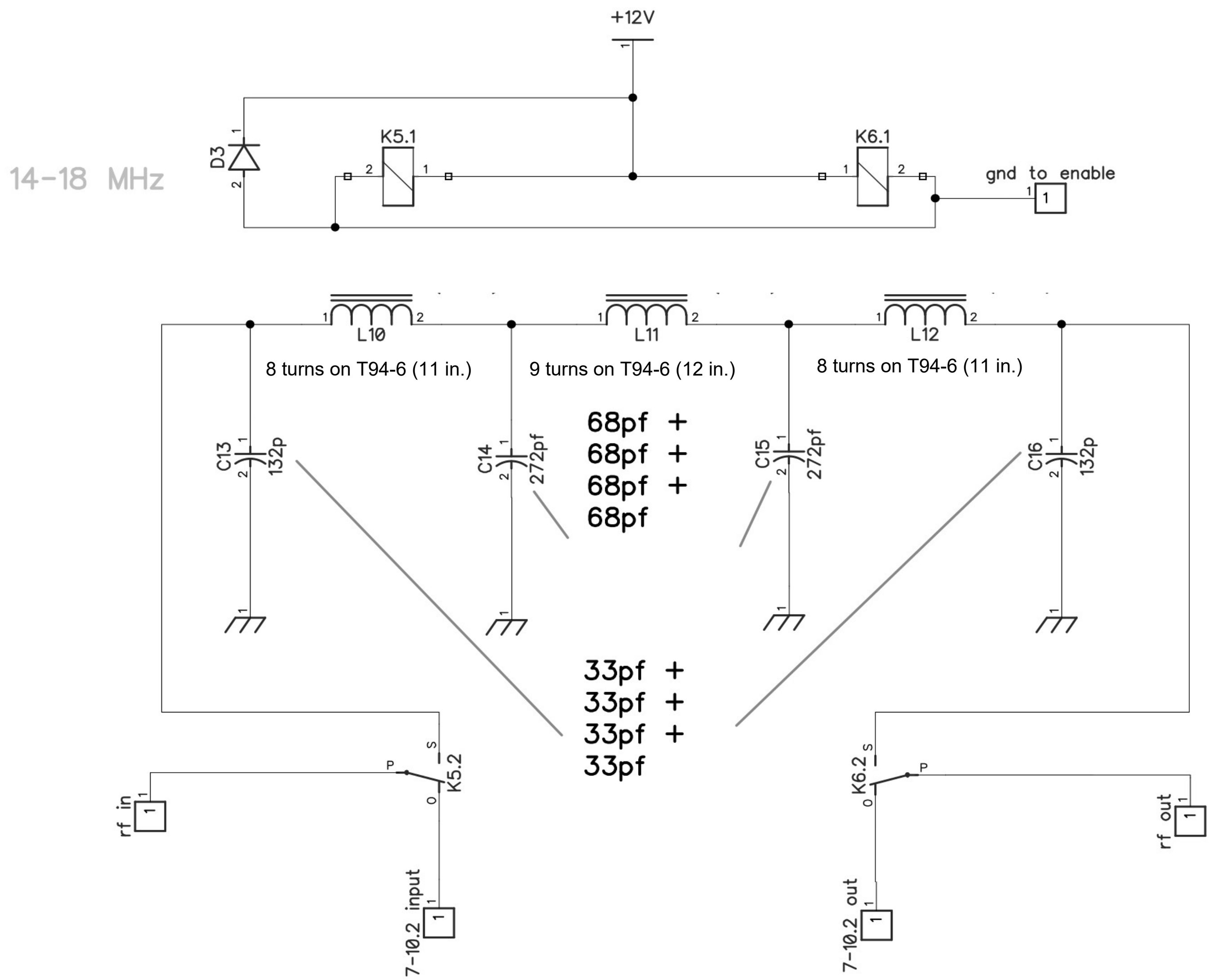

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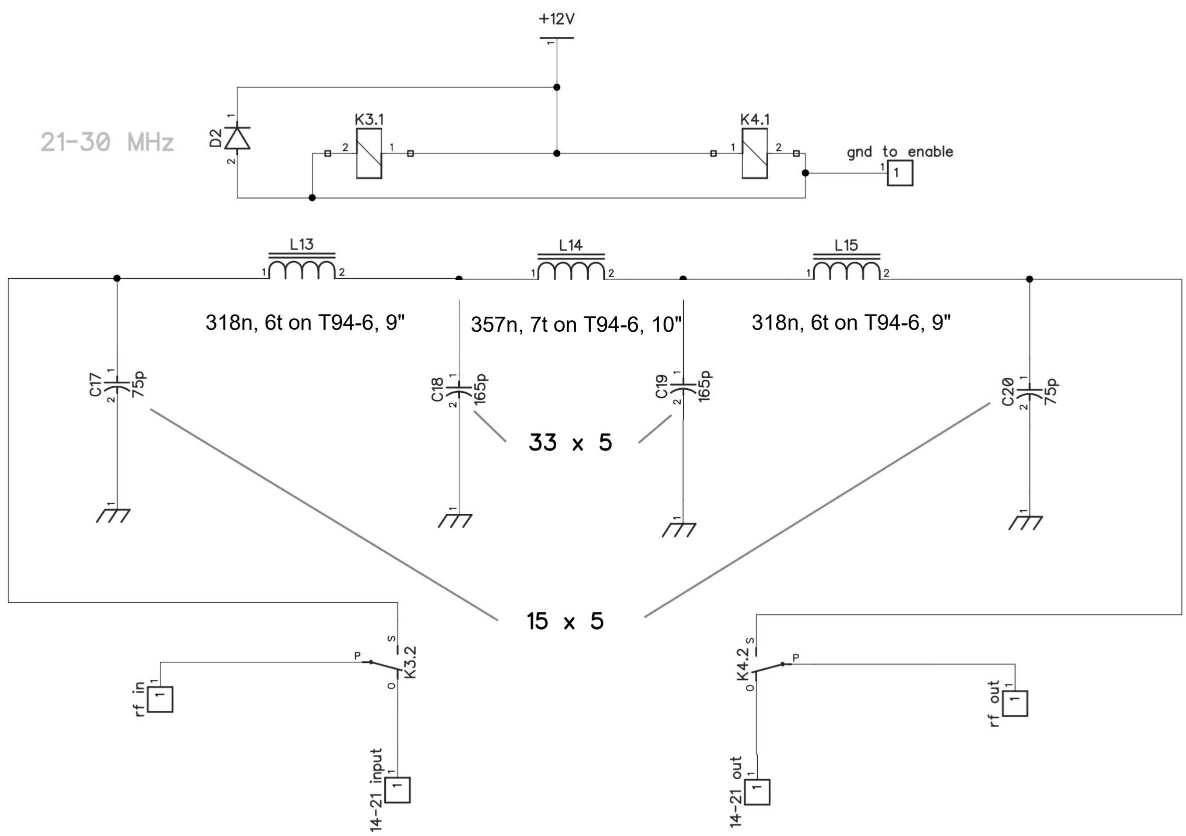

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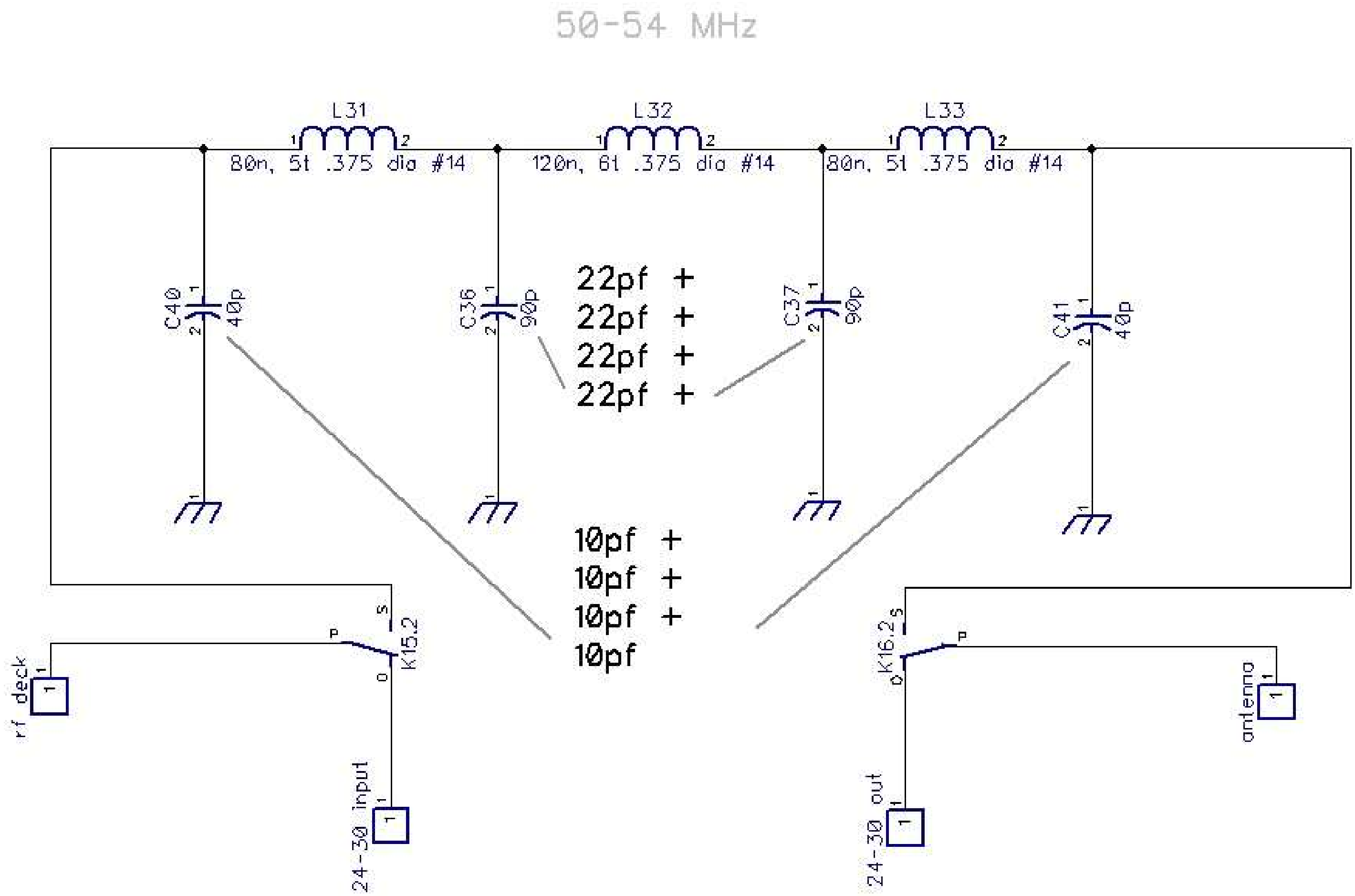

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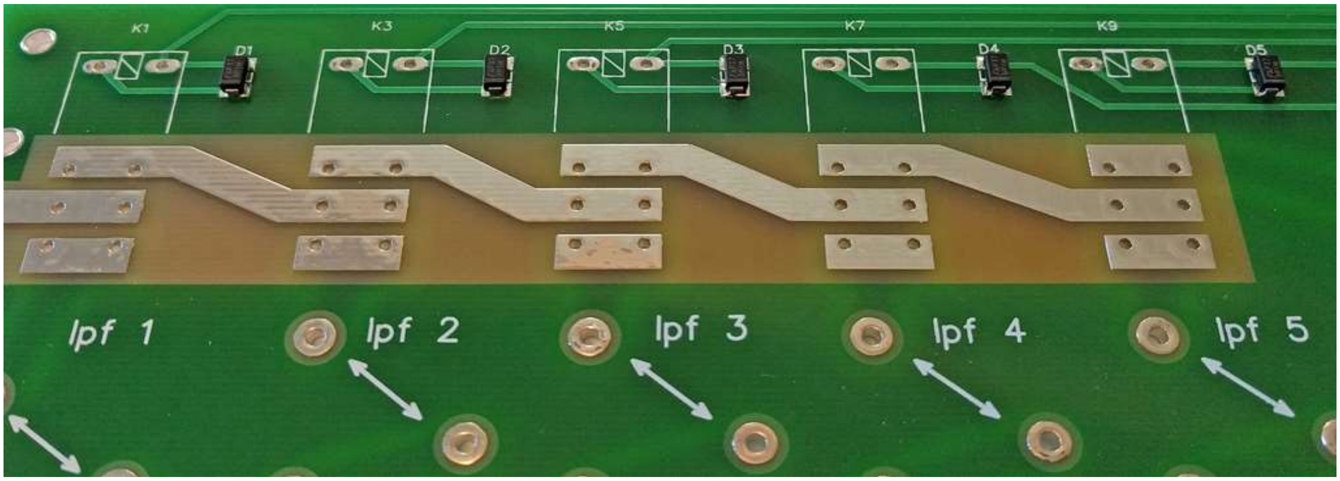
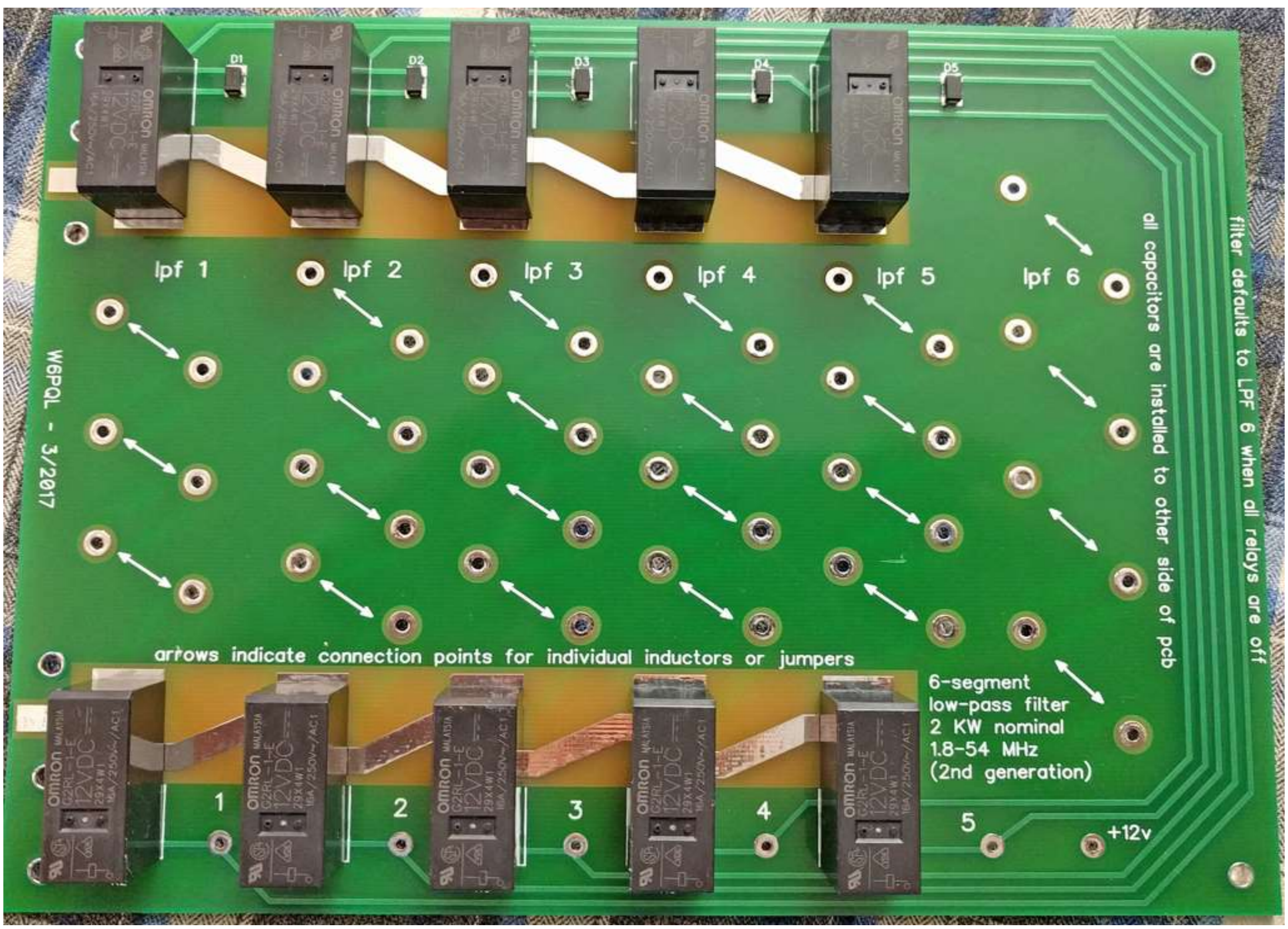
2 KW Low Pass Filter for 160-6 Meters

Begin construction of your filter by installing the diodes first. This will prevent soldering iron damage to the plastic relay cases (which can get in the way of diode installation if done later).



Now it’s safe to install the relays.



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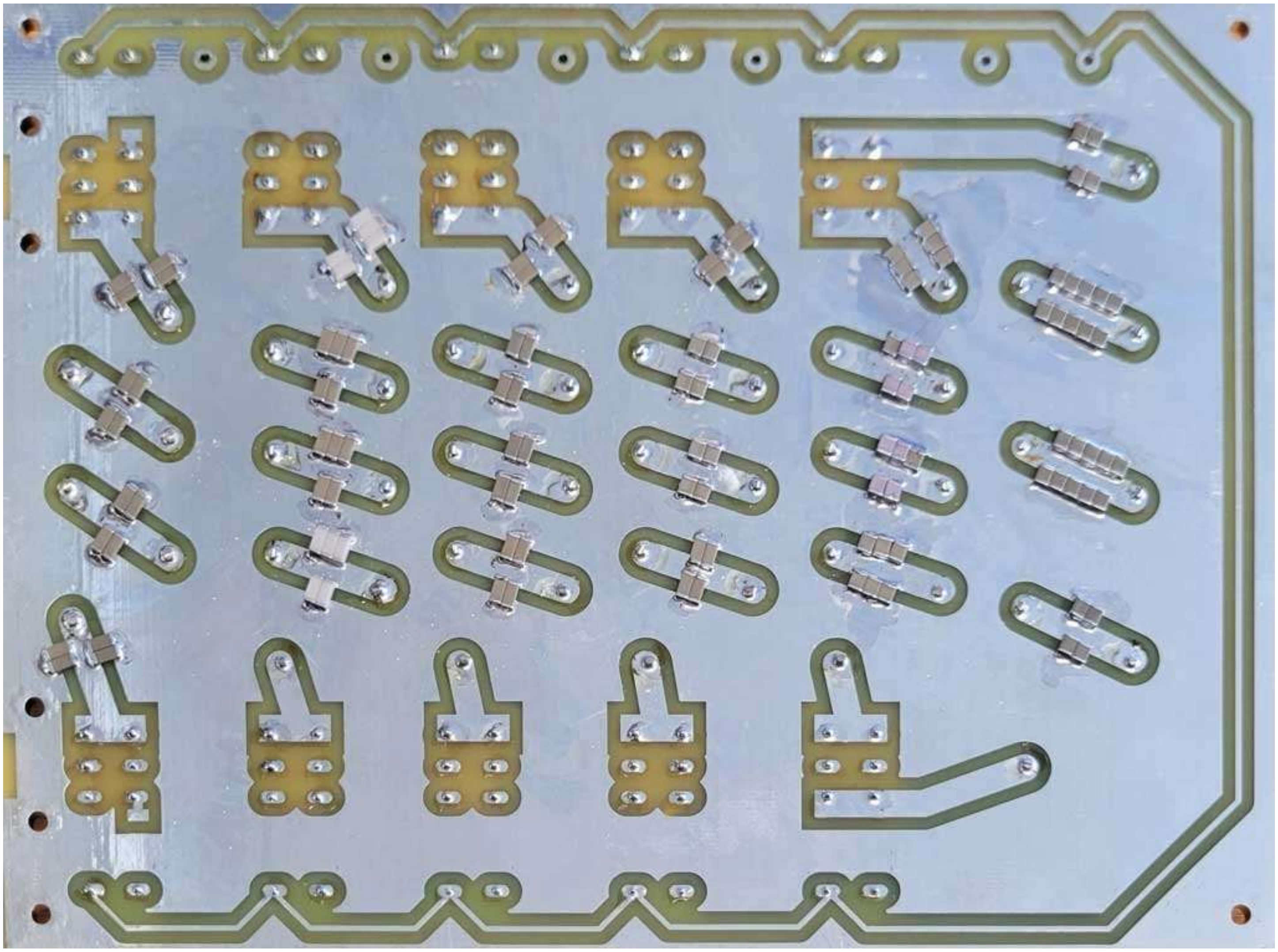
Turn the board over and install the chip capacitors. The 6m segment is on the left, 160m on the right. The photo is for the single-pallet configuration; the dual pallet will be similar.



Finally, wind the toroid inductors:

Some earlier kits were provided with pre-cut and tinned wires; this worked OK, but when winding the cores, quite often the wires needed trimming...so the tinning process was abandoned for this one:

Cut the wires to the specified length one inductor at a time, starting with the 160m segment. The number of turns is counted by the number of times the wire passes through the center of the core.If you cannot get the specified number of turns on the toroid, you must unwind it, straighten out the wire and rewind tighter around the core.
Once you have the core wound, trim the wire so that each lead is about 1 inch long...then scrape the insulation away so at least 3/4" of the copper wire is exposed for soldering. Install and solder the inductor into place.
There is about 26 inches of extra wire provided in case you make a mistake (it happens).

One last note...remember to install jumper wires at the inputs to the individual filters. You will need these jumpers when you opt not to use individual delay lines.

A photo of the completed filter is here: https://www.w6pql.com/images/hf/gen2single.jpg

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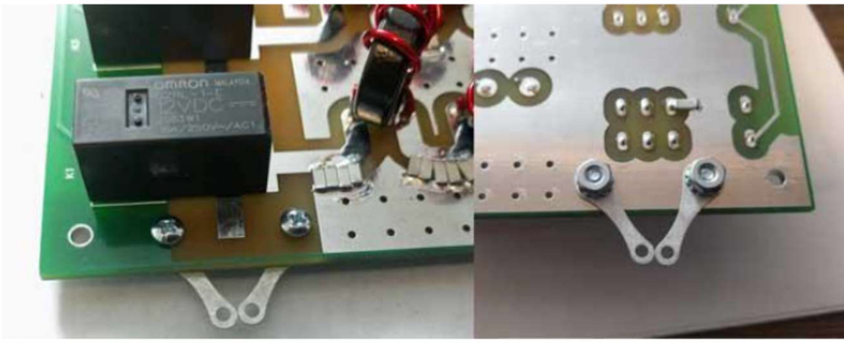
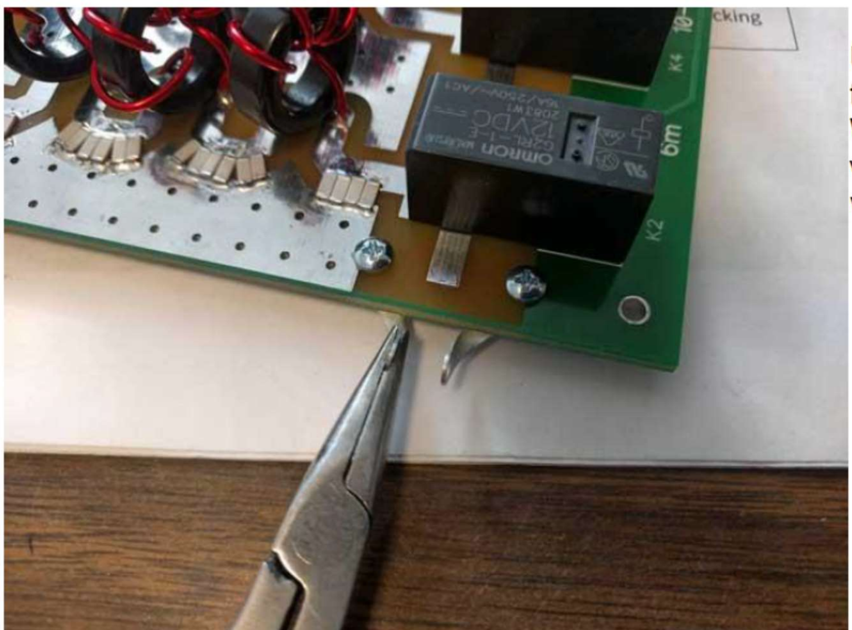
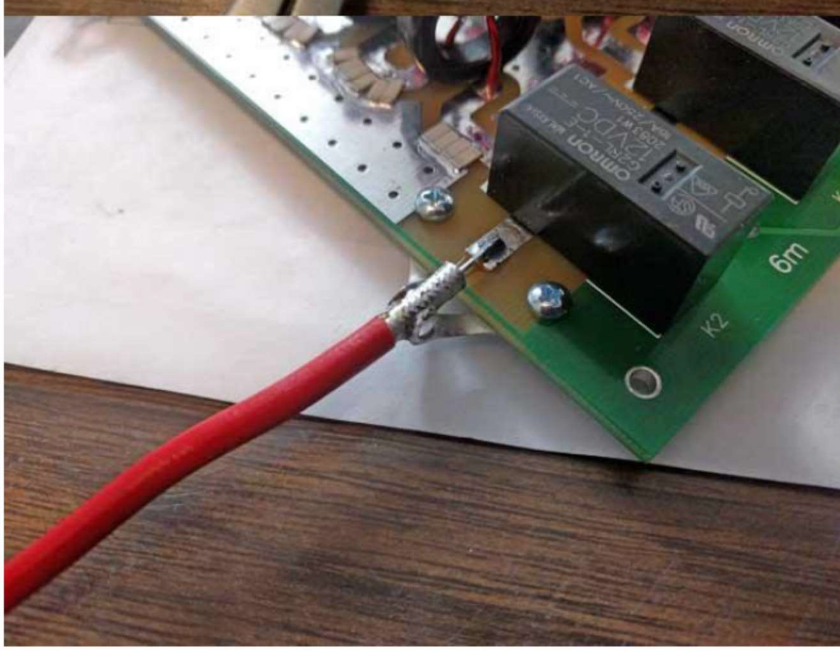
Coax fastener installation instructions



Secure two solder lugs as shown here using the 4-40 machine screws provided; leftmost photo is top side, rightmost photo shows the two locking nuts on the other side securing the lugs.



Using a pair of needle-nose pliers, bend the ends of the lugs vertical as shown. With the lugs formed in this way, there will be considerable strength in both the vertical and horizontal planes.



Shown here is RG402 coax, though you can use any coax (such as RG142) capable of handling the power.

Prepare your coax by removing 20mm insulation covering the outer conductor. Next, remove 10mm insulation covering the center conductor. With the center conductor laying on top of the board and soldered to the board trace, taking care not to move the coax, position the lugs against the sides of the outer conductor and solder them to the outer. Repeat this procedure for the other RF connection.

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2 KW Low Pass Filter for 160-6 Meters

Bill of Materials

# 14 tinned wire, bare 5 turns	2	.375 ID
# 14 tinned wire, bare 6 turns	1	.375 ID
#16 magnet wire, 200C, 10"	**3**	7 turns
#16 magnet wire, 200C, 11"	**1**	8 turns
#16 magnet wire, 200C, 12"	**5**	9 turns
#16 magnet wire, 200C, 13"	**3**	10 turns
#16 magnet wire, 200C, 15"	**1**	11 turns
#16 magnet wire, 200C, 17"	**2**	13 turns
#16 magnet wire, 200C, 20"	**2**	16 turns
#16 magnet wire, 200C, 21"	**1**	17 turns
#16 magnet wire, 200C, 27"	**2**	16 turns
#16 magnet wire, 200C, 28"	**1**	17 turns
2kv ceramic		
220pf	40	
120pf	22	
100pf	6	
3kv ceramic		
82pf	6	
68pf	8	
33pf	18	
22pf	8	
15pf	10	
10pf	8	
G2RL-1-E-12V Relay	10	
GF1M diode	5	
#6 long solder lug	4	
4-40 k/l	4	
4-40 x .25	4	
PC Board	1	
T106-2 toroid core	3	
T94-2 toroid core	7	
T94-10 toroid core	6	

The filter must be tuned after it is assembled, and this is best done with the use of a VNA.

These days a mini-VNA is not expensive...you can find them on Amazon for as little as $50.

To tune the individual segments, the wire turns are spread apart from one another on their ferrite core, or squeezed closer together.

A return loss of at least 20db is the goal to achieve (this translates to SWR of about 1.2 to 1). Most segments can be tuned to achieve a return loss of greater than 25db.

If this cannot be achieved, the problem is usually a misplaced or improperly soldered chip capacitor.

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