A104-1-1

LIL-3

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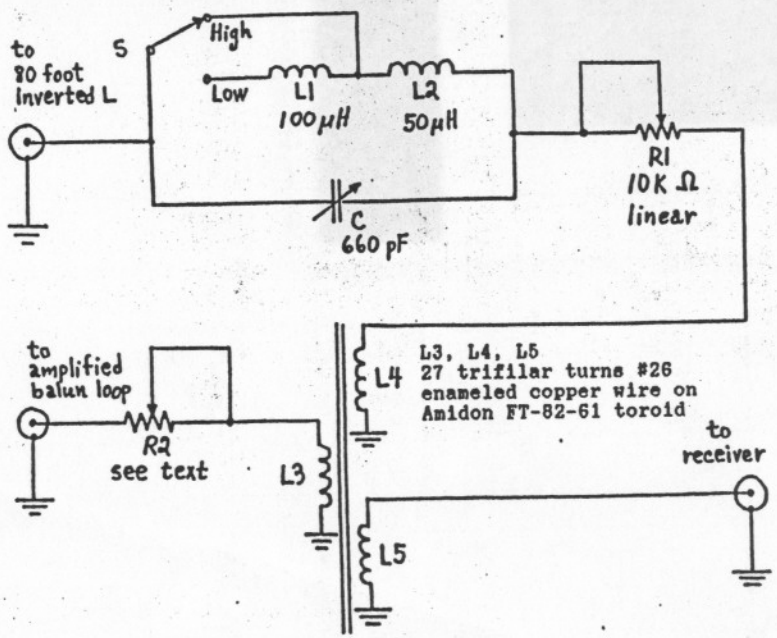
April 1991

LIL-3 is a new phasing circuit for generating cardioid patterns by combining the signals from a long wire and a loop antenna. It was designed specifically for use with an 80 foot inverted L antenna and the two foot air core high dynamic range balun loop described in my article "High Dynamic Range Balun Loops." It may work well with other long wire antennas and other loop antennas, but I make no claims in that regard. The inductors L1 and L2 may be any reasonably high Q inductors, such as Mouser chokes #s 43HH104 and 43HH475. I have also used a Radio Shack 100 uH choke, # 273-102, and a home brewed 50 uH choke made by removing the wire from a Radio Shack # 273-102 and winding 38 turns of # 26 enameled copper wire on the choke form, close spaced. The switch S is a SPDT toggle switch, which determines the tuning range. While testing the breadboarded version of LIL-3, I found that cardioid patterns could not be generated throughout the entire MW band with a single inductor and 660 pF capacitor. I chose to switch in additional inductance because that provides a wider two band tuning range than switching in additional capacitance. For nighttime signals, in the High range a cardioid pattern can be generated from about 920 KHz to beyond 1600 KHz, while in the Low range tuning is from below 540 KHz to about 1000 KHz. The resistor R2 is not required for use with the balun loop, and should only be included if you plan to try the phasing unit with other loop antennas. The resistor R1 is a 10 K ohm linear composition potiometer, and should be a high quality 2 watt mil spec type. You can use a Radio Shack pot, but it will not last long before it develops scratchiness. For R2 try 10 K ohms (the correct value will depend on your loop). The tuning capacitor C should be a straight line frequency air variable of good quality, cf. my article "What's Wrong With Present-Day Loop Antennas."



LIL-3 was developed because the amplified balun loop described previously had excessive loss when used with LIL-1. LIL-3 is similar to the phasing circuits described in "LSCA-1" by Ron Schatz and "A Loop/Longwire Combined Antennae" by Paul Swain. But there are important differences from those two circuits. Schatz's circuit used a single inductor instead of the two band parallel LC tuned circuit I used in LIL-3. The nulls generated by LSCA-1 are neither as easy to generate nor as deep as the nulls obtained with LIL-3. Swain's circuit used a wide range variable inductor (in place of my switched L1 and L2), but he did not describe the wide range inductor in enough detail to reproduce it. Neither of them used the trifilar transformer.

Sturdy construction should be used when building LIL-3. The 660 pF air variable capacitor should not be a flimsey miniature air variable. No reduction tuning is needed for the air variable capacitor C of LIL-3, which makes it simpler to build than LIL-1. However, a dual speed 6:1/30:1 Jackson Brothers planetary vernier drive must be used for tuning the high dynamic range balun loop. The components of LIL-3 should be mounted inside a metal box. As I said before, R2 should not be used unless you want to try LIL-3 with other loop antennas. Note that the capacitor C must be isolated from ground and from the tuning knob. I used a flexible insulated coupler and panel bushing to bring the shaft out to the tuning knob.

To generate a cardioid pattern for nighttime signals, set R1 for maximum resistance, C for minimum capacitance, and S for the desired tuning range. Point the loop at a strong signal (maximum pickup). Tune the signal so that peak response is at the center of the JB 30:1 range. Detune the signal slightly to one side (about half the 30:1 range). Slowly adjust R1 and the loop tuning until a dip is found (keeping the loop tuning on the same side of loop tuning peak). If no dip is found, detune the loop to the other side of peak, and repeat the procedure. When a dip is found, make the dip as deep as possible using R1 and the loop tuning (there is some interaction between controls). Finally, use the LIL-3 tuning capacitor C to make the dip deeper. The effect of C is quite subtle. As C is tuned away from minimum capacitance there will normally be little effect on the dip. However, at some point the dip will suddenly become much less deep (signal level will increase sharply). The deepest dip (null) will occur just before this point. If you are not observant, you will not notice any change in dip depth. After the correct initial setting of C is found, readjust R1, loop tuning, and C for the deepest possible dip. Finally, rotate the loop through 180 degrees to confirm that you have a cardioid pattern. If not, go through the adjustment sequence again. With practice, it will become easier to generate the cardioid pattern. For nighttime signals the dip (null) depth will often need to be readjusted from time to time. Long term stability of the null varies widely from one signal to another, and may be as short as a few seconds to as long as 30 minutes. Lower frequency signals tend to have better long term stability.

To generate daytime cardioid patterns, follow the same procedure above, but it may be necessary to start with C at some value of capacitance other than minimum capacitance. If minimum capacitance does not work, then try 10% capacitance, and of that does not work, try 20% capacitance, and so on.

Sometimes a deeper null can be obtained with the loop rotated through 180 degrees. A phase reversing switch could be added for this purpose, but it is easier to rotate the loop.

There is no LIL-2 because LIL-2 was identical to LIL-3 except for the parallel LC tuned circuit. LIL-2 actually worked quite well, except that null depths were not quite as deep as I expected based on experience with LIL-1. Thus I added the parallel LC tuned circuit to have independent control over the phase shift. Since the loop tuning and R1 alone can generate quite good nulls, the effect of the tuning capacitor C is quite subtle. You might wish to build LIL-2 first (by omitting C and L1 and L2) to gain some experience with a simpler (but not quite as good) phasing circuit.