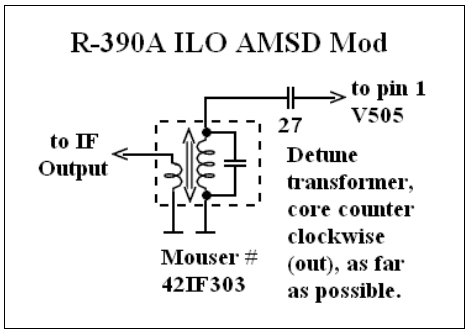
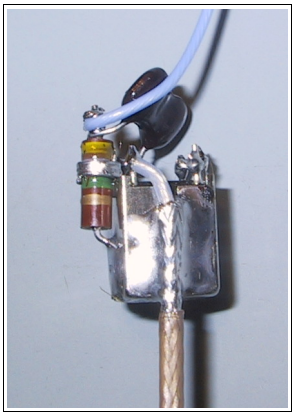
R-390A ILO AM Synchronous Detector Mod

Dallas Lankford, 6/1/06

Here is a simple but effective AM synchronous detector for the R-390A which reduces fading and flutter distortion about as good as the best of them. It converts the R-390A BFO to an injection locked oscillator (ILO). The injection source is the R-390A IF output. The injection source is stepped up to a higher voltage with a sub miniature IF transformer, 5K to 20K, black core, 3rd IF type, unloaded Q of 70, loaded Q of 35, fixed tuning capacitor of 180 pF, slot adjust core, Mouser catalog no. 42IF303. The stepped up source is injected via a 27 pF capacitor into pin 1 of V505, the 5749 BFO tube. For widest lock range the IF transformer should be adjusted by detuning the core counter clockwise (out) as far as possible. This ILO also works equally well with my product detector mod which uses a 5750 tube. A 500 volt silver mica is suggested for the 27 pF capacitor. My ILO AMSD was motivated by Graham Maynard's ILO AMSD which was published in Issue # 17 of The Hollow State Newsletter, Fall 1987 (more information may be found in subsequent issues). Back issues can be downloaded at http://www.hollowstatenews.com/ . My ILO has a wider lock range than Graham's ILO, about 200 Hz vs. 75 Hz. The R-390A ILO BFO can be offset to either side of 455 kHz to provide single sideband synchronous AM detection if desired. This, of course, requires that the R-390A be off tuned so that one or the other sideband fallse within the IF filter in use. When the signal is off tuned as far as possible consistent with good lock and good audio, you will observe that by turning the BFO off and on (and hence the ILO AMSD off and on) that there is little or no fading distortion in either case. This is because maximum off tuning with an ordinary AM detector gives about the same amount of fading distortion reduction as center tuning with an AMSD. In other words, you can hear for yourself that selectable sideband AMSD is of little or no value. Nevertheless, some may wish to use selectable sideband AMSD anyway just in case it helps a little. With strongly fading SW signals these ILO type AM synchronous detectors ***will*** occasionally lose lock briefly during deep fades, manifested by a brief growl, ***if*** the AM carrier is not tuned precisely so that it is very close to the BFO frequency in the IF passband. Neither the main nor the BFO R-390A tuning has enough resolution to do such precise tuning reliably. My BFO vernier fine tuning mod with about 200 Hz per turn resolution is recommended to provide the fine tuning necessary to adjust the main tuning and BFO so that the ILO does not lose lock. With the BFO vernier fine tuning mod installed in your R-390A, adjust the BFO tuning, or the main tuning, or both so that lock is maintained throughout the BFO fine tuning range, and then set the BFO fine tuning pot to mid range. The R-390A BFO vernier fine tuning mod can be downloaded from The Dallas Files at http://www.kongsfjord.no/ .



One way to implement this R-390A ILO is shown here. The braid of miniature Teflon coax was soldered directly to the IF transformer shield, and the center conductor was soldered to the appropriate link coupling input. Do not use excessive heat; it can melt internal parts of the IF transformer. The two appropriate grounded pins of the IF transformer were connected to one of the IF transformer shield lugs with #24 solid tinned copper wire and soldered. A 4.7 Meg ohm resistor was attached to the IF transformer shield as shown. One lead was soldered to the IF transformer shield. Three (3) turns of #24 solid tinned copper wire were wrapped around the resistor and one lug of the IF transformer shield and soldered. This provided an insulated standoff for attaching one lead of the 27 pF capacitor and a short length of #22 stranded insulated (blue color here) silver plated Teflon wire which was connected to pin 1 of the V505 tube socket as will be shown below. The other lead of the 27 pF capacitor was soldered to the appropriate IF transformer pin. The finished IF transformer



assembly should be insulated with heat shrink tubing or some other good quality insulating material. The assembly should be tested before insulation is applied. If heat shrink tubing is used, be careful not to apply too much heat. There are several options for connecting the miniature coax to the IF output. If you have a (used) miniature BNC connector like those used to connect to the IF output connector on the R-390A IF module, then you can attach it to the end of the miniature coax and connect to the IF output connector on the R-390A IF module (after detaching the miniature BNC connector with the miniature coax which goes to the IF output connector on the inside of the rear panel). If not, then you may use a regular size BNC connector and connect the end of the miniature coax to the BNC IF output connector on the outside of the rear panel. The BNC connector is small enough to pass through the hole in the rear panel for aligning the oscillator shaft.

Below is a photo of the connection of the insulated stranded wire from the 4.7 meg ohm insulated standoff to pin 1 of the V505 tube socket. First, the V505 tube was removed. Next, about 5/16 inch (8 mm) of insulation was removed, a right angle in the strands was formed, the end of the wire with the right angle strands was inserted through a small hole in the base of the tube shield support, and the end of the strands inserted into the 1 position of the tube socket. Finally, if the strands are not twisted too tigtly, the V505 tube can be re-inserted. The ILO can also be installed underneath the chassis of the IF module because the only alignment required is the BFO frequency. After the R-390A has warmed up for an hour, select the 2 kHz BW and tune a steady AM signal so that it is in the center of the passband. Turn on the BFO and adjust the BFO tuning shaft so that zero beat occurs when the tuning knob is at 12 o'clock (0). The BFO is now re-aligned and you are ready to play with your ILO. When tuning selectable sideband AMSD you should set the BFO frequency (+ or -) to a little less than half the filter bandwidth. For example, when using the 4 kHz BW filter, single AMSD sideband is gottten by setting the BFO frequency to about + or – 1.75 as shown on the front panel, and then tuning AM signals without changing the BFO frequency, except slightly as necessary to adjust the ILO lock range. Of course, as I said above, with offset tuning like this, you will not hear much fading distortion, if any, in either case, with the BFO on (AMSD) and the BFO off (ordinary AM diode detection). The case where AMSD will give substantial reduction in fading distortion is when the signal is tuned near the center of the passband and the BFO is set near 0.