

# Design Note

From: DEMI R & D Dept.

DN#: 034

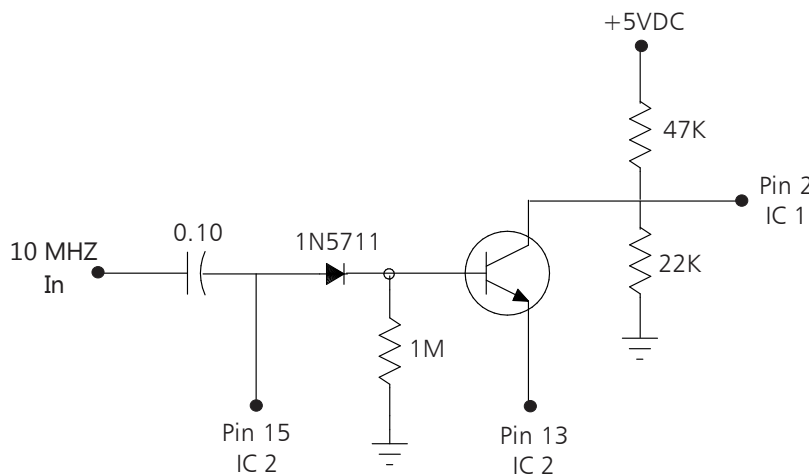
Date: July 19, 2012

Re: Positive Loc Modification for A32 and VHF ApoLO synthesizer

**PREFACE:** On occasion, all A-32 and VHF ApoLO synthesizers may have a false “LOC” detect if the 10 MHz reference is not connected at start up. This is because the Si413X series of synthesizer chips assumes that a Reference signal is always available. The false LOC may occur if the board (Both A-32 and VHF ApoLO) is powered up without the Reference connected. The LOC indication will light fully instead of blink. If the Reference is then connected, the synthesizer will lock with only a slight flicker of the LOC detect light. If then the reference is removed after locking, the LOC indicator light will go out as it should showing that a normal locked state did occur.

The reason for this is the Si413X series chip has no way of making a determination if the reference signal is the correct level or connected at all. In the complete board design, an auxiliary output port of the Synthesizer chip was configured to either be high or Low depending on its locking status. If the Synthesizer chip receives the correct programming, it will send a Loc signal to the Micro processor enabling the LOC detect light. But since it has no feedback to determine an actual lock, it can show a false “LOC” on occasion when started without the 10 MHz. reference source connected

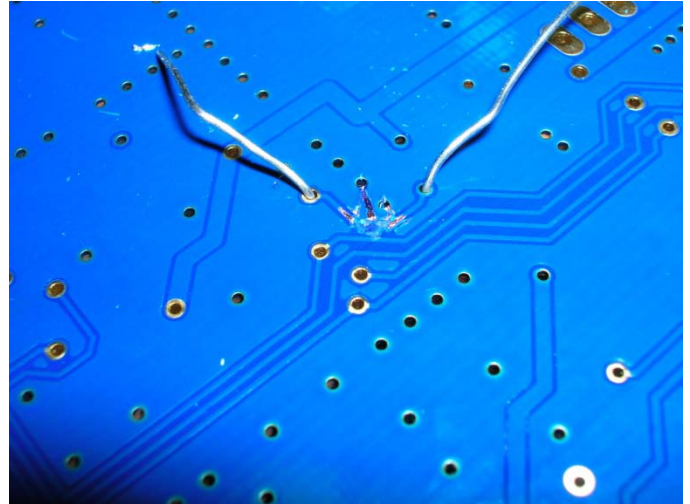
**CIRCUIT DESCRIPTION and REASONING:** The circuit shown below is placed between the AUX out pin of the Synthesizer chip IC2, Pin 13 and the RAD/ANG pin of the microprocessor IC1, Pin 2. Both pins are responsible for the “LOC” detection signal. Pin 2 on the microprocessor needs to be pulled “Low” to enable the LOC signal (the LED lights). If left “High” the LOC signal will be disabled. (No light)



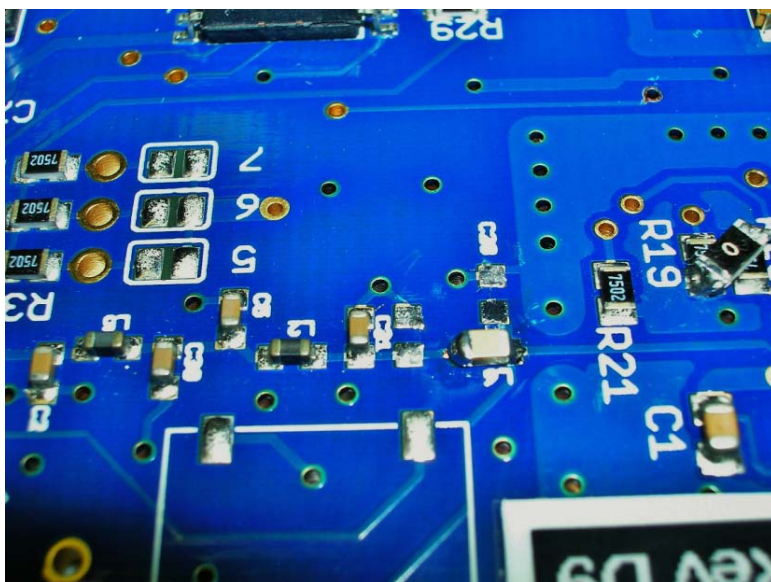
This new add on circuit acts as an AND Gate. The NPN transistor breaks the path between the synthesizers' AUXOUT pin 13 and the Microprocessor's RAD/ANG input pin 2. First, the NPN transistor will not conduct unless the 10 MHz reference is sampled then rectified to drive its base junction. The signal is sampled from the signal that is present at the synthesizer chip's Pin 15. Second, the emitter of the NPN transistor needs to be pulled low by pin 13 of the synthesizer chip. This will only occur if it receives the correct programming at start up. Only if both conditions exist, the conduction of the NPN transistor will pull the voltage low on the Microprocessor's pin 2 through a voltage divider and a LOC detect signal will occur. If one or the other doesn't happen, synthesizer LOC will not occur nor will the LOC signal be present. In our opinion, if the A32 or the VHF Apollo is functioning normally, this new LOC detect circuit will be 100% accurate.

## THE MODIFICATION:

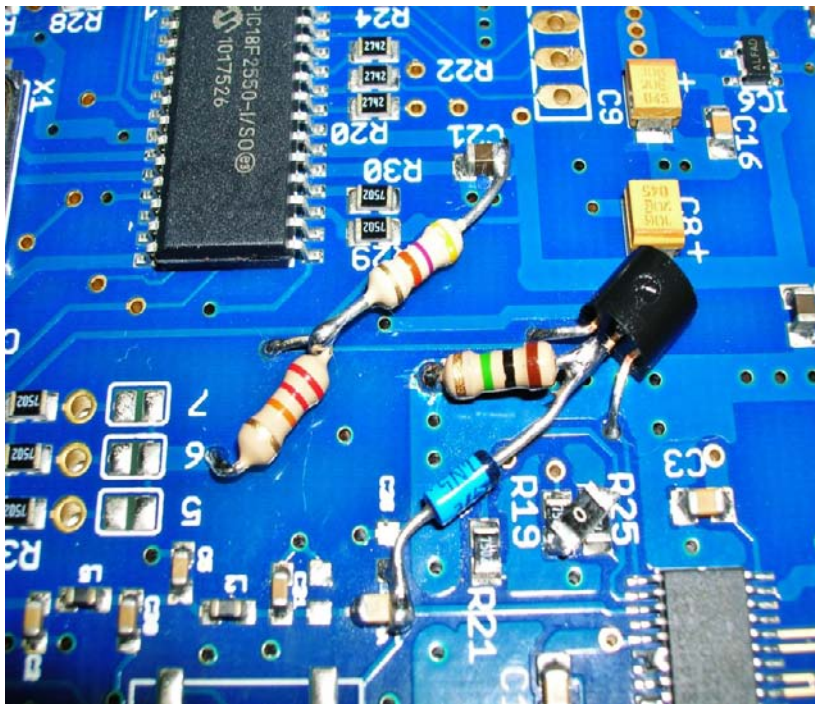
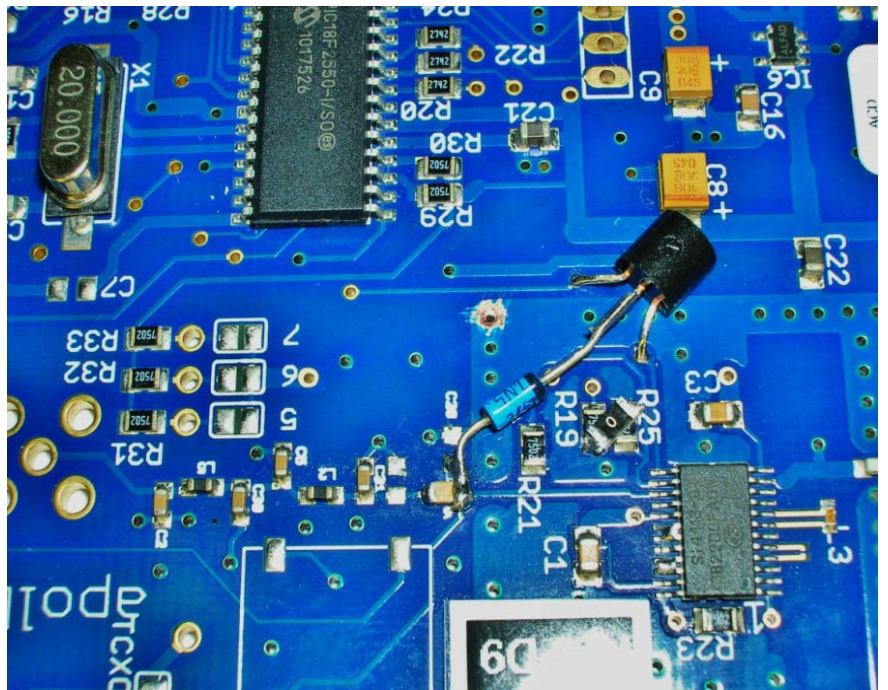
**A-32:** The prep of the board requires a circuit trace cut. The NPN transistor needs to be placed between both pins of both chips in the LOC signal line. For the A-32, the trace is on the back side of the board. Find pin IC2, Pin13, then follow the short trace to the via hole. Use a small wire or resistor lead and place it through the via hole so it sticks out the back side of the board. Flip the board over as shown in the picture to the right and follow the short curved trace to the next via hole. This is the trace that needs to be cut. Do not drill through the vias! Just remove a section of the trace between the vias as shown in the picture. You may also remove any solder mask by scraping it with a sharp knife to ease the soldering of the transistor



Various revisions have been made to the A32 to keep track of programmed frequencies. BUT- along the way, a couple of changes have been made to the 10 MHz low pass filter. The first rev. did not have a filter, and then there was a 3 pole filter and finally, a multipole filter. The positive Loc Mod requires isolating the voltage on Pin 15 of IC2. This requires a .1uF capacitor placed somewhere between the reference input connector and Pin 15. Without it, the detector diode may not be able to rectify enough RF to bias the NPN transistor if the input connector is loaded down with a particular source. On the filter less board, just cut the line and place a chip cap across the cut. With the three pole filter, make the cut after the large chip inductor. On the multi-pole filter board, remove the last 3 poles in the filter, L4, C31 and C28. Then place a .1uF chip cap in the L4 position as shown the picture to the left.



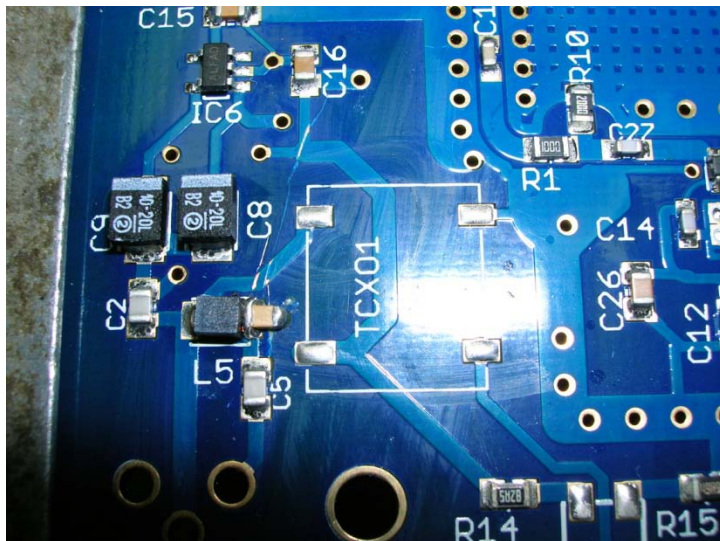
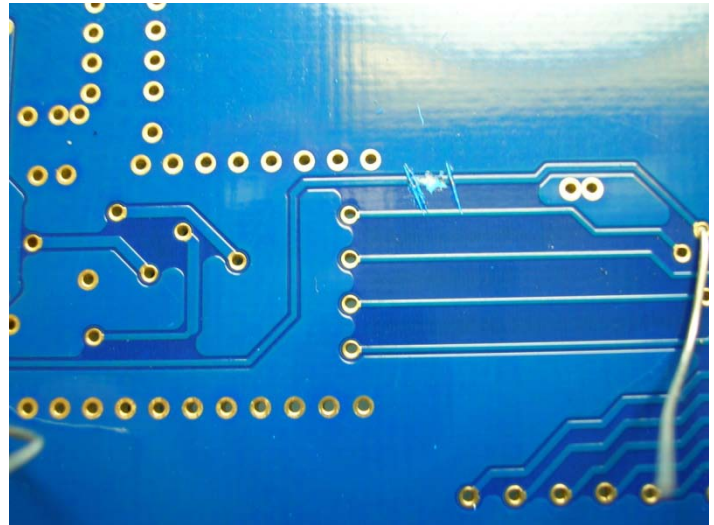
Now, using a NPN transistor, (PN2222, 3904, or others) place it with the emitter and collector leads in the vias where the trace was cut as indicated in the schematic. The picture shows a PN2222. Position the body of the transistor so the leads are as short as possible and close to the board. The base lead should be positioned extending toward the .1uF capacitor placed in the 10 MHz line. Again, this is a multipole 10 MHz filter board. Then, attach the signal diode as shown to the added .1uF capacitor, You may also use the one pad from L28 that was removed for attachment. Then, remove the solder mask (by scraping with a sharp tool) from the via hole located above the body of the diode as shown in the ground plane part of the circuit board.



Next, attach the 22K, 47 K and 1 Meg resistors as shown. If the via holes are covered with solder mask, scrape them clean before component insertion. Make short lead connections as shown.

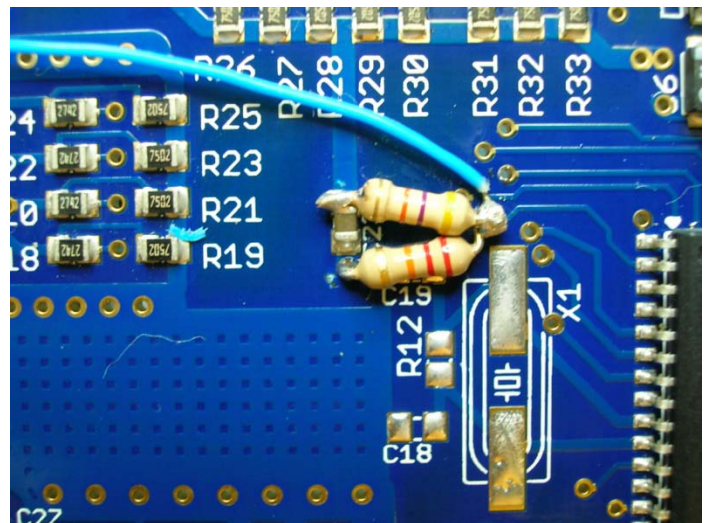
The 22K is attached to ground (by the #6 via) and connected to the via on the Loc signal line. That point is also connected to the +5VDC rail through a 47K resistor. Simply, wrap the lead of the 47K around the soldered lead of the 22K. Then the DC return of the forward biased diode (the 1 MEG resistor) on the base of the NPN is connected to ground. The modification is now complete. Remove the excess leads from the bottom of the board and it is ready to test. This mod will be included in future revisions of the A-32 board.

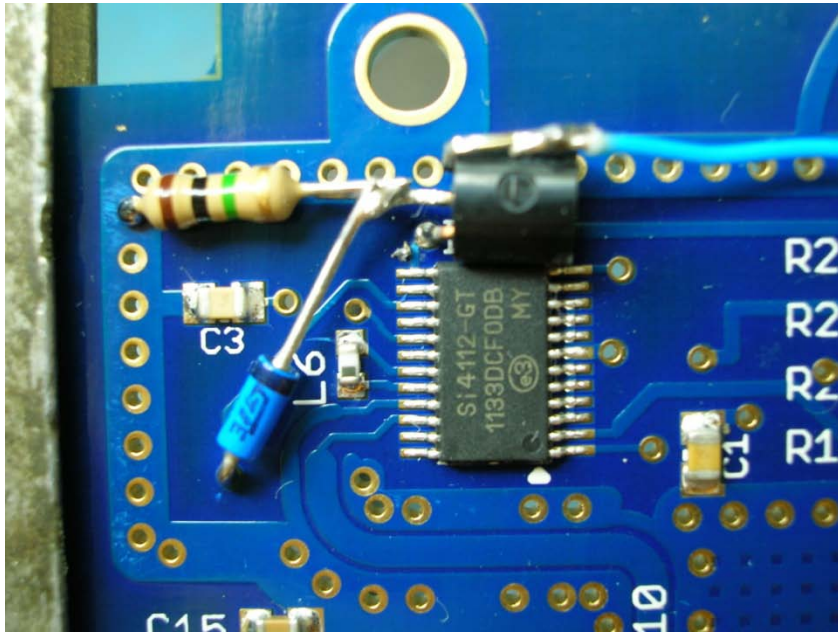
**VHF APOLLO:** On the VHF ApoILO, it is a similar modification. Find the screen printed text "IC2" on the top side of the board on the end of IC2. The via that is closest to the "I" in IC2 is connected to Pin 13. Again use a wire or resistor lead and pass it through the via. Flip the board over and follow the trace. It is long! It will route to Pin 2 of IC1 through yet another via. Cut and remove a section of trace anywhere on the back side of the board as shown in the picture to the right. This spot was chosen for ease of cutting but any where will work. Just do not drill through the vias or attempt to peel the trace off the board. The vias need to remain intact.



The VHF ApoILO requires a second circuit board modification. Find L5. It is after the REF IN connection but near the TCXO1 screen printing. Between L5 and C5, there is a via that has a very small length of trace between it and the Pad of L5. This trace, maybe .030" long, needs to be removed so a small 0805 size chip capacitor as shown in the picture to the left , can be soldered between L5 and the via. Be careful not to damage the via or L5. It may be helpful to solder wick some of the solder away from the L5 connection before attempting the cut. Be sure that C5 is not removed from the circuit and L5 is still connected when finished. Check L5 with an ohm meter. The install a .01 uF or larger value 0805 chip capacitor.

The rest of the work is just assembly. The order of component placement is semi important in that certain component leads are chosen to be inserted in certain vias to add strength to the "Dead Bug" style of modification. Start with the 22K and 47K. The common connection is connected to Pin2 of IC1. Again, find the via connected to Pin 2 of IC1 and insert one lead of the 47K. Solder then bend the second lead around the +voltage side of C23. Snip short and solder to C23. Then insert one lead of the 22K in the via on the other side of C23 (ground) Solder then wrap the second lead around the 47K lead connect to Pin2 of IC1, The wire shown is a #30 and runs back towards the components that will be installed near IC2.





To finish the circuit modification, use a NPN transistor and insert its Emitter lead in the via hole that is connected to Pin 13 of IC2. It is the via closest to the "I" screen printing of "IC2". Cut the other two leads short as shown in the picture and bend the collector lead up and in the direction shown. Now, insert the 1 MEG resistor lead in the ground via. Solder, and then trim the other lead to fit so it can be soldered to the Base lead of the NPN transistor. The Hot carrier diode (1N5711 or similar) is installed as shown in the via. This via has a trace on the bottom side of the board that runs back to via by L5 and the new capacitor. Verify with an ohm meter in necessary. Now make the solder

connection to the base lead with the 1MEG lead. To finish, connect the wire from Pin2 of IC1 to the collector lead of the NPN. When complete, you may tack the wire down to the circuit board with an adhesive or tape but in most cases, if the wire is stiff enough, it will not be a problem. When finished, its ready to be installed or tested. Below, is a complete overview, of the completed board showing all connections with top side circuit modifications. This complete modification will be included in the next VHF Apollo revision.

