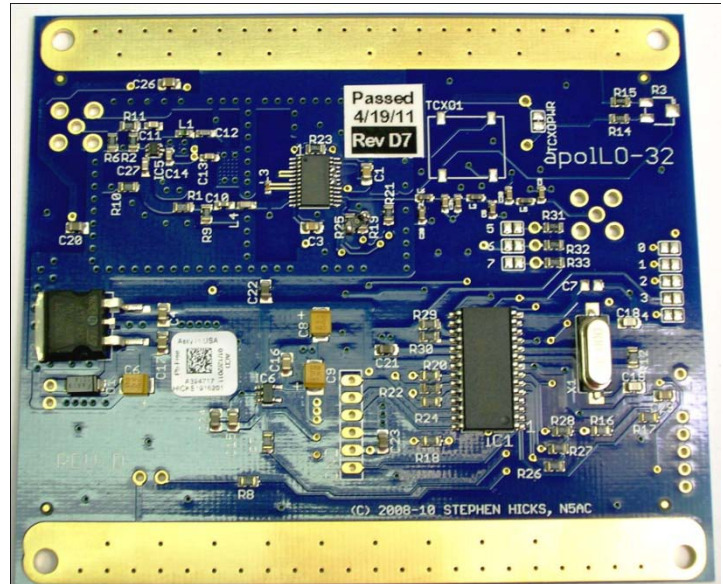


DEM A32 RFK

The DEM A-32RFK (Retro-Fit Kit) is comprised of the apoLO 32 pre-programmed frequency synthesizer designed by N5AC and all of the necessary hardware to make a complete retrofit installation of the standard MICRO-LO in any DEMI 2.3 thru 10 GHz transverter. This kit will utilize the existing hardware and wiring when possible, but does include the 10 MHz connection, lock indicator LED, dual frequency switch, extra wire and coax with complete installation and operation instructions. You will need to drill two holes in the front panel (if you desire the dual frequency option) and depending on the IF configuration, maybe add an extra hole for the 10 MHz input signal.



This kit is only recommended for any DEMI 2.3, 3.4, 5.7 and 10 GHz transverter that has the DEM MICRO-LO 1 GHz range oscillator. The A-32 may be retrofit for older model transverters that utilize the original KK7B 500 MHz LO with a few modifications to the transverter but the use of this particular kit and instructions would be invalid. The KK7B designs will be covered in a DEMI Design Note and found on our web site in the future.

The A-32 is provided with 32 pre-programmed synthesized frequencies that include the basic RF and IF combinations required to allow any DEMI 2.3 GHz through 10 GHz transverter to operate in the standard band plans. These pre-set frequencies are selectable by jumpers and allow you (if you install the dual frequency switch) to change the LO injection frequency on the fly. For instance, if you desire to operate on 2304 and 2320 or if you desire to have the ability to change your IF on 10368 from 144 to 145 MHz as a precaution to eliminate interference from another portable station operating from the same location. Simply select and install the appropriate jumpers and wire to the switch. No more "re-crystalling" a second oscillator and adding it as an outboard unit when you need to change frequencies.

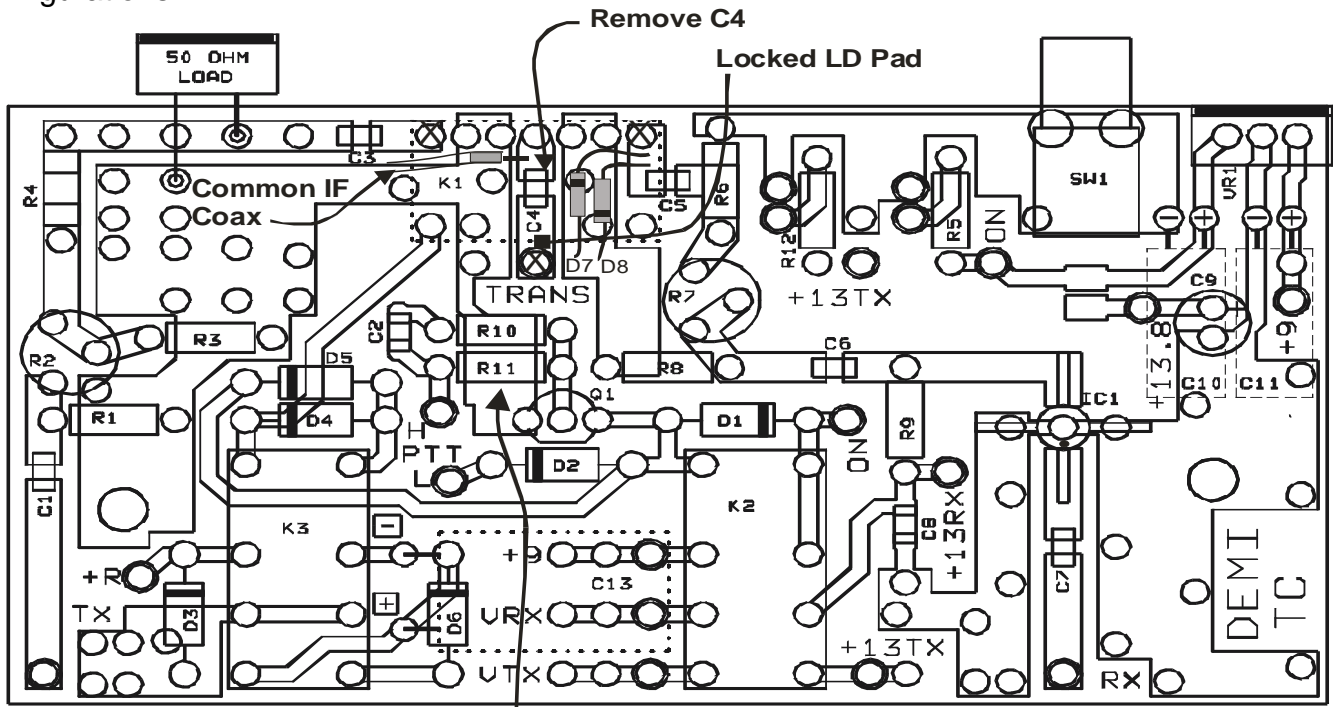
Start the Retrofit:

Before starting the Retrofit, you may want to review a sample of the final unit pictured in our on line "Photo Gallery". You may also want to download and/or read the complete apoLO-32 document produced by Hicks Consulting found in our "Product Manuals" section of our web site. This document has excerpts of the Hicks manual at the end that pertain to the retrofit only.

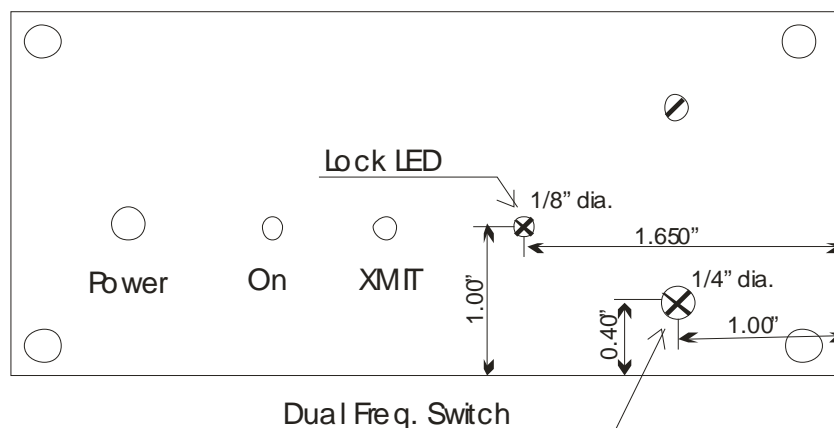
So, when you are ready, start by opening the transverter by removing the top four screws (2 on the front, 2 on the back). Carefully separate the upper half from the bottom half of the enclosure. The MICRO-LO will be in the top half on the enclosure. Make a note of how the top half of the enclosure lines up with the bottom. This is important for the positioning of the A-32 unit in the transverter. Now follow the steps in order.

1. Unsolder the coax and DC wire on the MICRO-LO. Leave the coax connected to the transverter and the wire connected to the TC board. Remove the MICRO-LO from the enclosure half by removing the four 4-40 screws and save. If there is static foam and RTV holding it in place, it may be completely removed and discarded.

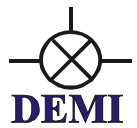
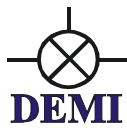
2. Remove the front panel from the transverter by first removing the 4-40 screws holding the Regulator and the 50 ohm load if you have it installed. Then remove the two front panel screws holding the panel to the bottom half of the enclosure. Save all of the hardware and the panel.
3. The TC board requires a placement modification and assumes that your transverter is configured for PTT-L and you do not have +DC voltage applied to the IF coax for PTT-H switching. Remove C4 and reposition the COM IF coax as shown. Do not reposition the IF coaxes if you have a SPLIT IF. If your transverter requires DC on the coax and PTT-H switching, please consult DEMI with your situation. As our retrofits progress here in the factory, we will have an answer for all configurations.



4. Modify the front panel (as shown below) by measuring and marking the required holes, (two maximum) then drill to the correct size as indicated. If you do not require the dual frequency switch, do not mark and drill the 1/4" hole.

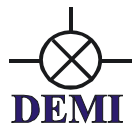
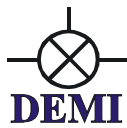


5. Skip this step if you do not desire dual frequency operation. If you do desire a dual frequency set up, (such as 2304/2320 or 3456/3400) remove R11 then un-bolt the TC board from the housing by removing the two 4-40 screws. Save the screws. Then install one 3" multiple stripe



wire on the bottom side of the TC, in the PTT-H via hole and another 3" multiple stripe wire in any ground via on the bottom side near the PTT-H Via. After the wires are installed, reinstall the TC board being careful not to pinch any wires and have the ends of the wires just installed protruding out the front of the transverter. Now, install the switch in the ¼" hole and mount it horizontal with it's hardware. Then connect the ground wire to the center and the other wire on either pin.

6. Reinstall the front panel to the transverter using the mounting hardware and re-attach the regulator and the 50-ohm load if required. Then install the LOCK LED in the 1/8" hole similar to the ON and TX LED. Solder the short lead of the led to any ground connection close to the panel. Trim as required to fit. This will hold the LED in position. Then solder the long lead (after trimming) to the pad labeled TRANS that C4 was removed from.
7. If you have a Common IF configuration, install the supplied BNC connector in the extra 3/8" hole in the back panel and use the IF connector as an example of how to install one end of the supplied coax. This will now be the 10 MHz input connection. If you have a separate TX and RX IF connections, the 10 MHz connection is more difficult to locate. If your plans are to use a SMA type relay as a TR switch mounted to the transverter, you cannot place the hole for the 10 MHz input above the RXRF and TX RF SMA connectors except on the Low power versions of the 2304 and 3456 transverters. If you do not mount the relay on the transverter, you can drill a 3/8" hole in the connector panel anywhere it won't interfere. Other possibilities for the 2304 and 3456 high power and all 5760 and 10 GHz transverters are to add it to the front panel or in the top half of the enclosure avoiding the A-32 mounting location.
8. Verify that the coax connecting the old MICRO-LO and the transverter is in good shape. Look for a broken shield on the transverter side or a loose rivet in the 5760 and 10 GHz units. If anything looks bad, fix it now. It can only get worse.
9. Review the frequency selection chart found at the end of this document and select which jumper(s) you require for your desired frequency. Also note the other selections within the desired band. If you desire a dual frequency, such as 2304 and 2320 with a 144 MHz IF, you will see that for 2304, the A-32 should have "0" and "1" strapped. Then to switch to 2320, you need to strap the "2" in addition. So, add solder jumpers to the "0" and "1" on the component side of the A-32. The "2" position will be wired to the switch. The same can be done on the other bands. Some "Not Normal" combinations may require a little thought before assembly. This may all be tested before assembly in the transverter if desired, but will be much simpler if just installed.
10. Install the A-32 in the enclosure with the following procedure:
 - a. Align the top and bottom halves of the enclosure. Trial fit if necessary because of the interlocking groves will only allow a one way fit. Now, open the halves up and position side by side, even front to back.
 - b. Position the A-32 in the top half with the components down and the exposed ground plane resting on the rails of the top half of the enclosure. The RF OUT must be towards the front of the transverter. Then, install it with the four 4-40 screws from the MICRO-LO.
 - c. Connect the DC wire from the TC board (+9) to the 6-12V input on the A-32. The wire should be long enough. If not, replace it.
 - d. Connect the LO INPUT coax to the RF OUT of the A-32. It should be long enough. Again be sure that the shield connection to the transverter is of good quality. The shields become brittle after soldering.



e. Trial fit the 10 MHz coax, cut to size and solder to the A-32 REF IN position. If you needed to use a different hole for the BNC connector than specified, be sure that when the enclosure is closed, the coax does not drape on any active circuitry or especially come near the TXIF drive section of the TC board or in contact with the Common IF or TXIF coax. If excessive IF energy is applied to the 10 MHz input, it will produce spurs on your TX output signal.

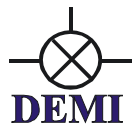
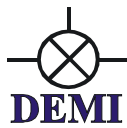
f. Connect one end of the supplied blue/white wire to the +LOCK via on the A-32. Loosely wrap the wire along the +DC wire up to the TC board and then extend the wire to the TRANS pad of the TC board where the LOCK LED is soldered. Trim the wire and solder.

11. If you desire the dual frequency version, connect the multiple stripe wire to whatever numbered via/vias you chose (0-4 or any multiples of). Then run the wire up to the +DC and LOCK wires loosely wrapping them all the way up to the TC board. Continue on to the open via on the TC board between the PTT-H and the C2 capacitor where R11 was removed, and connect.

12. This is when you recheck your wiring and do a "trial fit" of the complete assembly. Be sure the enclosure will close and that all excess wire and coax is remove if possible. If the wires are long and sloppy, shorten them. If they seem short and tight, exchange them for new. The transverter is now ready to test.

Testing the assembly:

1. All of the A-32's are pretested for output level and lock on all frequencies. This board, unless mishandled, should just fire up and work. When the test is complete, you may perform a complete transverter test to verify its performance. Start off by connecting the DC supply.
2. Power on the transverter. The ON led should light up and the lock LED should be blinking. If it is not, check the wiring, and the polarity of the LOCK LED. You can use a voltmeter to check for a slow pulse. If no voltage present at the LED, check the DC voltage input of the A-32 and if OK check the two vias marked 3.3 and 5 for voltage. If no voltage, remove and check for loose debris on the circuit board. If a simple problem is not found, please consult DEMI.
3. After you obtain a slow blinking LOCK light, connect the 10 MHz source and the LOCK led should light up steady indicating solid lock. If you have installed the dual frequency switch, you may switch it to verify lock or not. You may also verify the frequency change if you have a frequency counter of the desired LO frequency or at the A-32 level. Remember, the frequency is dependent on your 10 MHz source. If you transverter's source is different than the frequency meters source, chances are you will see some "Error". Which source is the problem is up to you to find out, but, a suggestion is if you attempt to adjust the source that is used with the transverter by measuring it against your frequency meter, it is best for the greatest accuracy, to measure the LO frequency of the transverter while adjusting the 10 MHz source. If you use the same 10 MHz source with the transverter and the frequency meter, it will never measure any error. So again, frequency accuracy depends on the quality of your 10 MHz source.
4. If you are finished" playing" with the A-32, you may want to test the transverter but if you have not changed the RXIF and the TXIF controls, you should be able to close up the enclosure and start making contacts. Test it as you would any other transverter.



Considerations and Cautions:

When choosing operating frequencies of the A-32, it is easy to just pick one and switch it if you desire. But please understand that if your transverter was not designed for a 432 or 1296 IF frequency, you should not select LO frequencies that are specified for 432 and 1296 MHz IF range. Any DEMI transverter with a 2M IF will operate anywhere within the 2M band and a bit wider but will not operate correctly with an 432 MHz. IF! The 5760 and 10 GHz transverters may be “retuned” to operate with 432 and 1296 IF’s but it is not possible in our 2.3 and 3.4 GHz transverters.

Only attempt re-tuning the LO multipliers of the 5.7 and 10 GHz transverters if you have the proper test equipment. Other considerations if you do change IF frequency specifications of the transverter are that the TC board may not have the correct TXIF attenuation or exhibit more RX IF loss. Again, this will need to be tested thoroughly before use. It has been done and can be done with any 5.7 and 10 GHz transverter. If you desire more than two frequencies of operation, a small rotary switch may be incorporated in place of the SPDT switch. You may also utilize a DPDT center open switch for the use of 3 frequencies. This would be a great option for our 10 GHz transverter using 144, 145 and 147 MHz as IF frequencies. There are many possible options including a digital switching control if desired. Only caution is if you have wired exiting the enclosure, be sure to RF bypass them.

The last consideration is when the unit is tower mounted, can an remote LOC Led be installed. The belief is yes, but it has not been done yet. A future design note will follow.

Retrofit Conclusion:

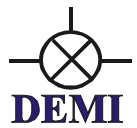
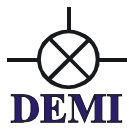
We hope you had fun with this simple upgrade and enjoy the frequency accuracy the A-32 was designed for. Please consider this for all of your DEMI transverters 2.3 GHz and up. If you have multiple transverters, you may consider our DEM10-4 that will allow you to utilize one 10 MHz source for all of your 10 MHz referenced equipment. This is handy if you only have one expensive source or even a source off a lesser quality. If you combine all of your transverters to the same source that has some frequency error, you can make a frequency calibration on any band after you make a contact with someone that may have a higher quality source. Then, note the frequency error and calculate it on up to 10 GHz by keeping track of the multiplication factor of the multiplier stages in the transverters. If you have 4 separate inexpensive sources, they will not be on the same frequency. Remember, your frequency is only as accurate as your 10 MHz source. It can be made more accurate if calibrated against a better source. Have fun and see you on frequency!

ApoLO-32 Theory of Operation- (excerpts from the Hicks manual)

ApoLO is a frequency synthesizer designed to operate in the 1.0—1.2GHz range for use as a local oscillator (LO). Whereas the apoLO 1’s frequency is programmable via PC software and a USB port, the apoLO-32 is programmed via a set of solder jumpers or switches. The PCB consists of four main sections.

The power supply (section #1 in Figure 1) produces supply voltages required by the board. The board will actually run off of up to 20V if necessary (more if higher voltage caps are used on the input of the voltage regulator – up to 35V). The power supply produces two supply voltages, 4.5-5.0V used for the microprocessor and RF amplifier and 3.3V used for the synthesizer. Both supplies may also be used to power a TCXO.

The second major section of the board is the microprocessor (μ P) (section #2 in Figure 1). The microprocessor’s main purpose is to read jumpers and switches to determine which frequency the LO should use and to program the synthesizer with this information. The PIC 18F2550 was chosen because of its ability to interface directly to USB without other components and because of its low cost, but the USB port is not used on the apoLO-32 design. The μ P uses a 20MHz clock



Understanding the synthesizer and lock

The apollo-32 is preprogrammed to lock on to each of the 32 frequencies selected. Situations could occur that would cause a loss-of-lock, however. The included LED should be placed on the front panel of the transverter and wired to the LOCK LED holes in the PCB (one hole is actually ground and this side of the LED could be connected to ground directly instead of the PCB hold if preferred). This LED can be used as a diagnostic aid to determine if any lock problems occur. The LED indication is derived from the LDET output of the on-board synthesizer. Under normal conditions, the blue LED will light solid indicating a good lock. If, however, you are on the edge of the synthesizer range or there is another problem, the synthesizer may not be able to lock. Unfortunately, this is not always a “black and white” situation. Sometimes, the synthesizer will gradually lose lock. In this situation, the Blue LED would normally begin to very slowly dim in intensity as the lock weakened. Because we felt that this was an unacceptable way to report a lock failure (we can't seem to make our eyes detect a 1% loss of light in an LED), we have devised a better method for providing lock information.

It works like this. The apollo microprocessor samples the LDET (lock detect) line of the synthesizer about 10,000 times a second. After 1000 samples, the software examines the number of times that a lock was detected. If there was a lock detect signal present in every sample (100%), then the lock detect LED is lit solid and the Setup Utility reports the message “LOCKED.”

If, on the other hand, it detects a 0-10% failure of lock detect, “Weak Lock” is reported and the LED will blink fast. In this situation, we can guarantee that the resulting signal is not pure carrier. You do not want to run the synthesizer in this mode, but we have setup the board to give you an indication of the type of problem encountered for aid in setup and troubleshooting. When lock is lost, the PLL will be operating open loop until lock is reestablished and the resulting carrier will be wandering around. For a weak lock, this can result in significant phase noise or even choppy reception as the LO wanders around. Again, we recommend not using the LO in this situation.

The moment that the microprocessor detects a lock failure, it first tries to reestablish lock by forcing the synthesizer to implement its internal auto-tune software. This software attempts to compensate for inductor values on the part, temperature variations and the like to get the oscillator back on channel. If a temperature drift is the cause of the lock loss, initially the auto-tune algorithm in the synthesizer will be successful. This is designed to automatically compensate for changes in temperature of the LO and the like. If you are watching the LO when this happens, the software forces the lock LED to go dark for approximately 20ms which appears as a short off blink. We tested this software in the lab by rapidly cooling and heating the PCB and watching a series of retunes occur successfully. In the field, these retunes generally would only occur with large temperature swings (> 30° C) which might happen over a series of hours in a rover or on a tower.

If the lock detect is lost for 10%-90% of the time, a “poor lock” is reported. A spectrum plot of the carrier during an example period is shown in Figure 3 for information—again you would not want to use the LO in this situation and with the pre-programmed values, the synthesizer should never end up in this position. A lock detect percentage of <10% is reported as UNLOCKED and you would not want to use the LO in this situation either.

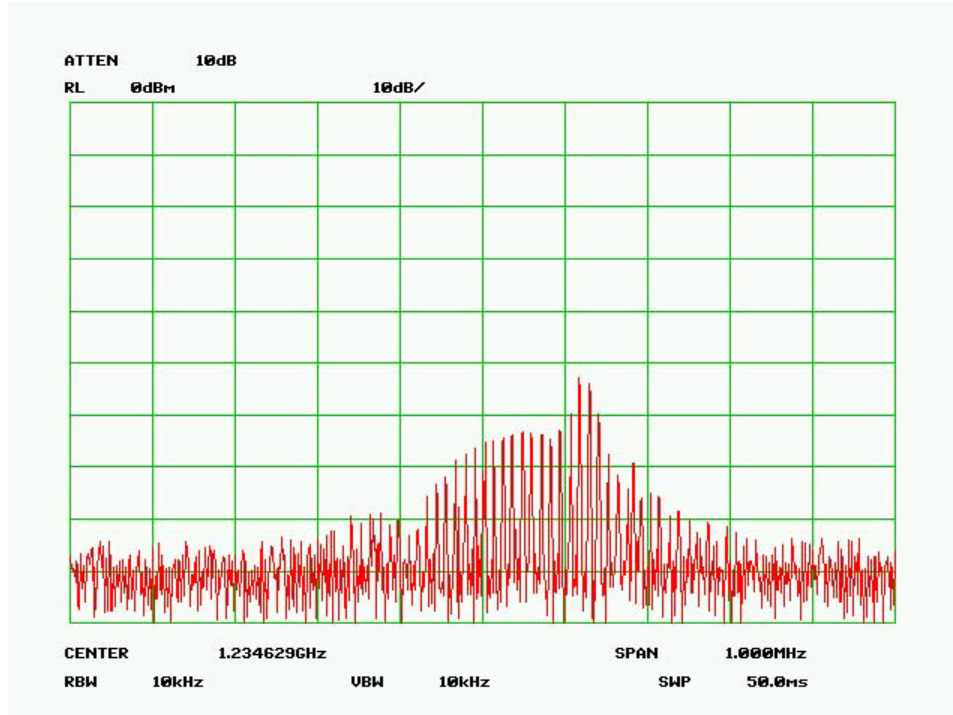
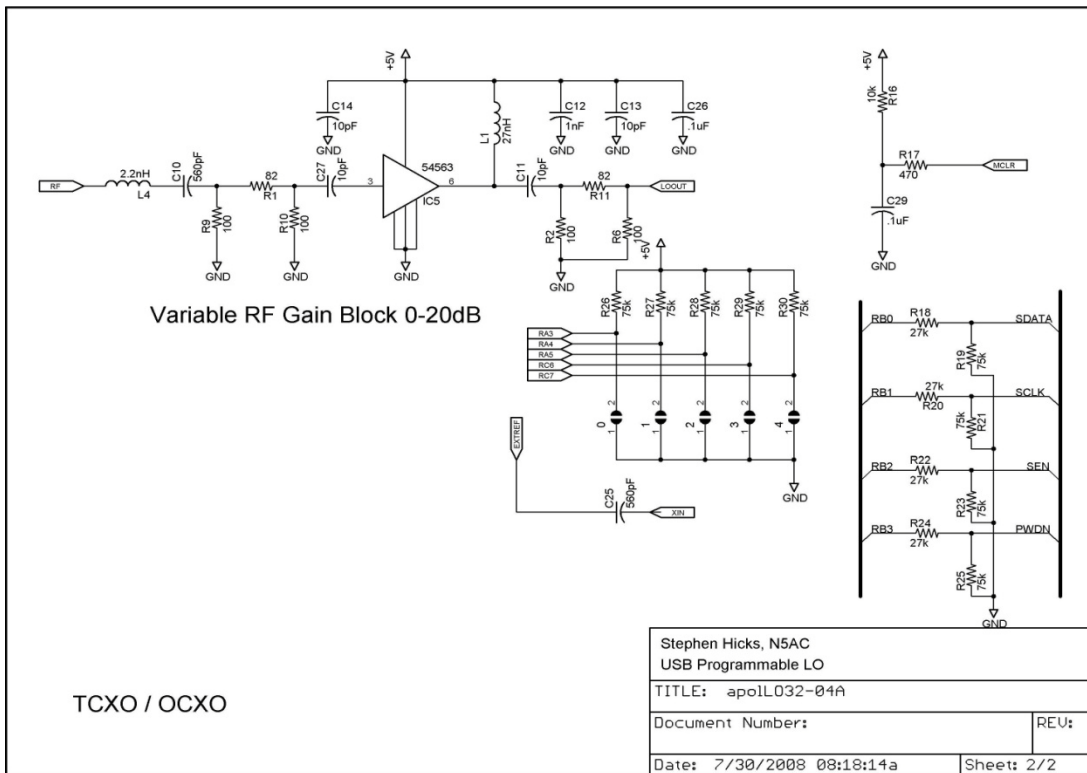
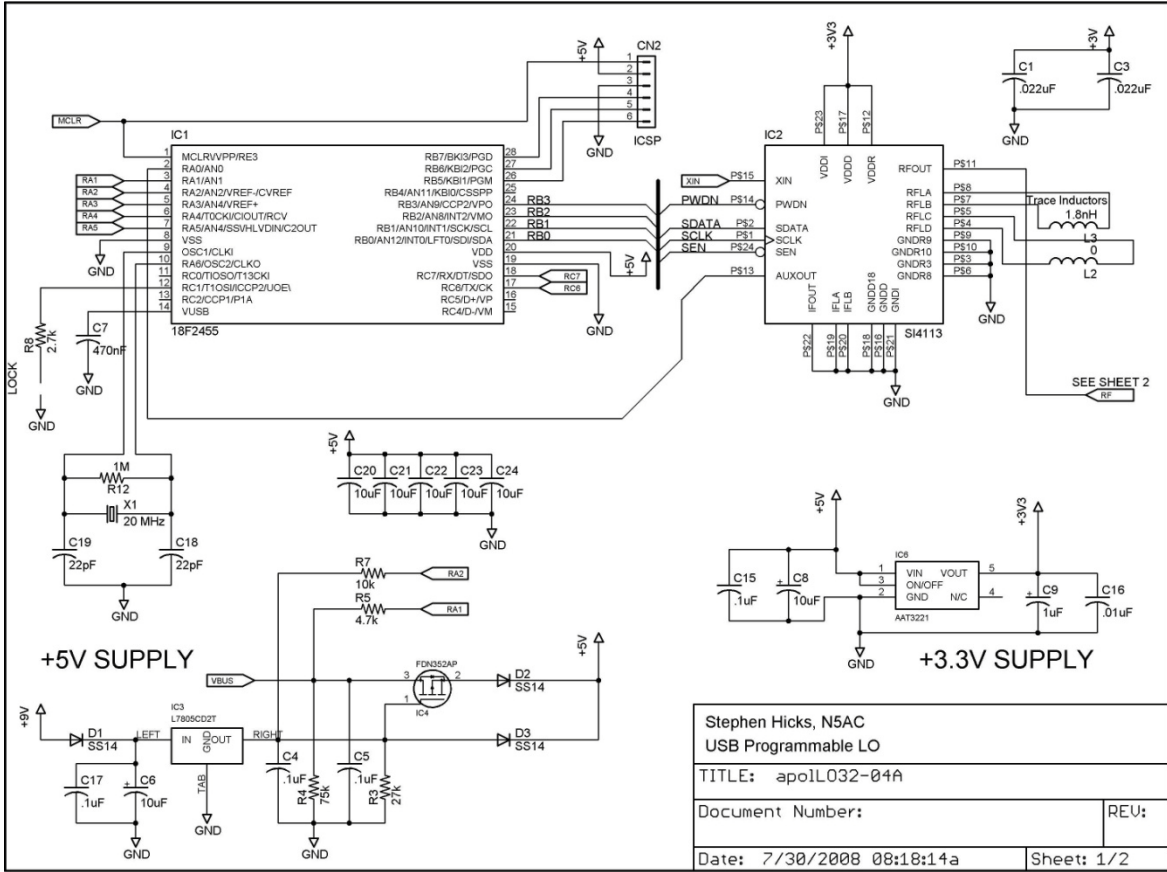


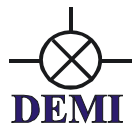
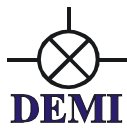
Figure 3, Example Poor Lock Plot

If you encounter a lock issues with the apollo-32, there are a few things to try. First, verify that your 10 MHz reference is successfully making it to the synthesizer board. Without the reference, there is nothing to lock to and you will always get a lock failure. The next item to consider is a tuning issue. Although the software is designed to auto-retune in the event of a lock failure, it seems reasonable to reset the LO with a power cycle. Again, this is not likely to solve the problem, but it is easy to test.

Lastly, the lock problem may be caused by a out-of-range error. The VCO inside of the synthesizer chip has an adjustable range that is set by the external inductors (L2 and L3) on the part. These have been pre-selected to cover a broad range of frequencies (902-1296). The range covered by the LO is, in fact, beyond the specifications of the synthesizer. Because we were able to successfully obtain lock with a number of different parts outside of the normal range, the circuit was built around the chip's actual capabilities.

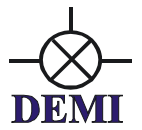
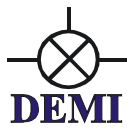
There are some caveats, however. Both synthesizers in the Si4113 are employed to cover the range. RF1 covers the low end of the range (903-1088) and RF2 covers the high-end (1103-1296). The frequencies at either end of both of these ranges are on the edge of performance for the part. Under temperature stresses, it is possible the synthesizer might have difficulty at one end of the other. If you believe this is the failure mode you are in, the simplest solution is to slightly alter the position of the inductor in question responsible for the VCO tuning range. In general, movement of about 1mm will move the center frequency of the VCO by 50MHz or so. You may move the inductors a small amount to try to re-achieve lock if a particular frequency is giving you trouble at a temperature extreme. Moving the inductor towards the synthesizer raises the frequency and moving it away from the synthesizer lowers the frequency. (DEMI Note: Understand that the A-32's in production are only tested at room temperature. The positions of the two inductors were determined from a small sample of correctly operating units over temperature. AND, adjusting the position of any inductor will alter the lock specifications of other frequencies.)





Below is the frequency selection chart. "X" indicates a jumper in that position.

Band	IF	Frequency	REV	7	6	5	4	3	2	1	0	Predicted PN, dBc/Hz @ 1 kHz
2304	144	1080								X	X	-81
"	145	1079.5							X		X	-79
"	147	1078.5						X			X	-79
2320	144	1088							X	X	X	-81
2424	144	1140						X		X	X	-81
3456	144	1104							X	X		-81
"	145	1103.6667						X		X		-78
"	147	1103					X	X	X	X		-81
3400	144	1085.3333						X	X	X		-80
"	145	1085					X	X		X		-81
5760	144	1123.2						X	X			-78
"	145	1123						X	X		X	-81
"	147	1122.6						X	X	X	X	-76
"	432	1065.6					X			X		-78
"	435	1065					X				X	-81
10368	144	1136										-81
"	145	1135.8889					X			X	X	-74
"	147	1135.6667					X		X			-78
"	432	1104							X	X		-81
"	435	1103.6667						X		X		-78
"	1296	1008					X		X		X	-81
24192	144	1002					X		X	X		-81
"	147	1001.875					X	X				-80
"	432	990					X	X		X	X	-81
"	435	989.875					X	X	X			-75
24048	144	996					X		X	X	X	-81
"	147	995.875					X	X			X	-75
"	432	984					X	X	X	X	X	-81
"	435	983.875					X	X	X		X	-75
903.1	WSS	903.1									X	-74
915	WSS	915								X		-81
1296.1	WSS	1296.1							X			-74
1152.02	WSS	1152.022						X				-74
2401	WSS	1200.5					X					-79
902.1	WSS	902.1	C2			X						-74
1275	WSS	1275	C2		X							-81
1420	WSS	1420	C2	X								-81
1296	144	1152	C2			X					X	-81
2400	144	1128	C2			X				X		-81
5760	1296	1116	C2			X			X			-81
1296	28	1268	C2			X		X				-81
1296	145	1151	C3			X				X	X	-81
2300	145	1077.5	C3			X			X		X	-79
2300	144	1078	C3			X			X	X		-81
2400	145	1127.5	C3			X			X	X	X	-81
10368	145	1022.3	C3			X		X			X	-74
10368	144	1022.4	C3			X		X		X		-78
1296	147	1149	C3			X		X		X	X	-81



1296	29	1267	C3			X		X	X			-81
1420	144	1276	C3			X		X	X		X	-81
10368	144	1278 G3WDG	C4			X		X	X	X		-81
10450	144	1288.28 G3WDG	C5			X		X	X	X	X	-77
10450	144	1145.111	C5			X	X					-76
10450	145	1145	C5			X	X				X	-81
10450	432	1113.111	C5			X	X			X		-76
10450	433	1113	C5			X	X			X	X	-81
10450	1296	1144.25	C5			X	X		X			-77
10450	0	1116.111	C5			X	X		X		X	-76
3400	0	1133.333	C5			X	X		X	X		-78
2320	145	1087.5	C5			X	X		X	X	X	-79
2424	145	1139.5	C5			X	X	X				-79
10368	432	1242	C6			X	X	X			X	-81
10450	432	1252.25	C6			X	X	X		X		-77
1296	50	1246	D7			X	X	X		X	X	-81
2304	50	1127	D7			X	X	X	X			-81
3456	51	1135	D7			X	X	X	X		X	-81
5760	50	1142	D7			X	X	X	X	X		-81
10368	51	1146.333	D7			X	X	X	X	X	X	-78