A Homebrew AUX-7 Board for the Drake TR7 and R7

Overview

OK, so you don't really *need* an AUX-7 board to be able to transmit and receive on all frequencies with the TR7. But, there are some advantages to using the AUX-7 and the board is easy to build using readily available parts. I was surprised to find that even the nylon connectors that fit over the motherboard pins are still available.

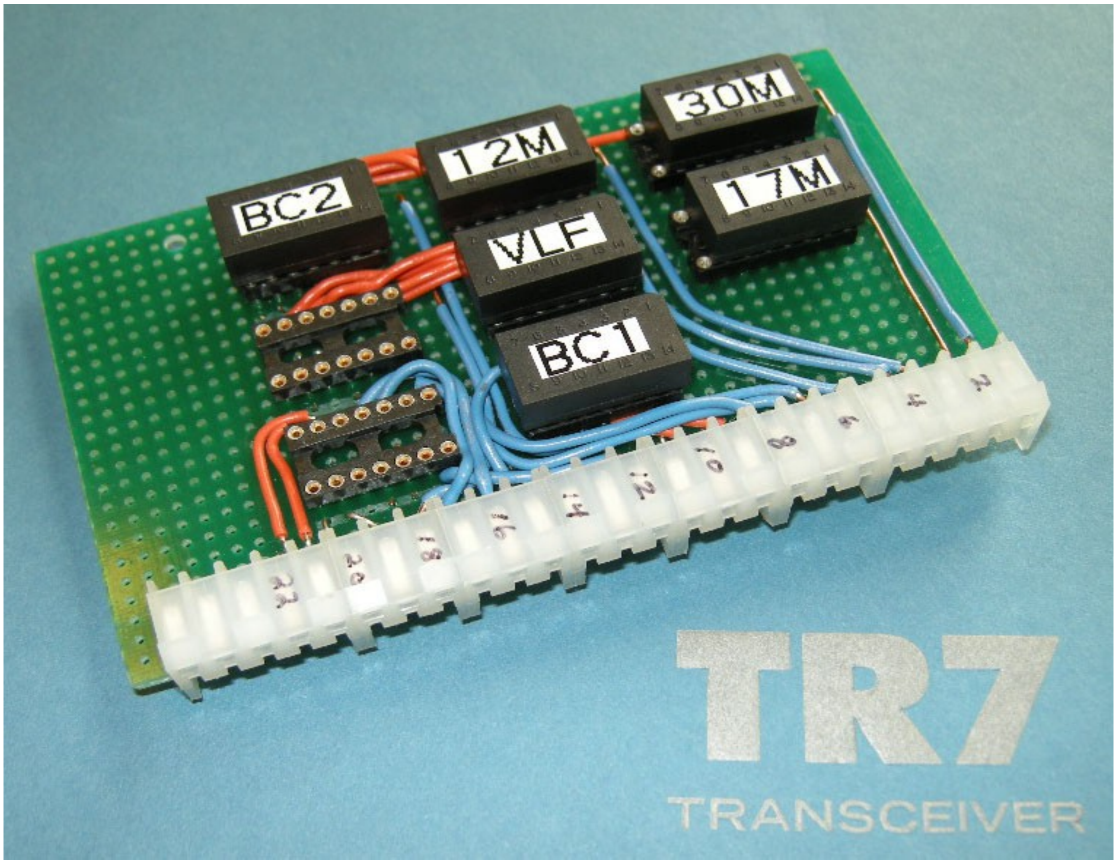
With the AUX-7 board installed, selecting the right 500 Khz band segment, say for the 30 meter band, is a matter of turning the AUX Program switch to the position corresponding to where you installed the module for that band and then setting the bandswitch to the right position. No more hitting the “down” button multiple times from the 20 meter band position in order to get to 30 meters. Furthermore, the “SETBAND” light to the right of the meter is illuminated until you set the band switch to the correct position for the band you selected with the AUX Program switch. Without the AUX board, turning the TR7 off loses the band segment information and you have to set it again using the up/down buttons when you power up again. With the AUX board, turning the TR7 off and on again returns you to the same frequency with no additional button presses required.

While a *real* AUX-7 board includes the ability use crystals to provide accurate selection of fixed frequencies, that was of no interest to me and so I elected not to include it on my board. I also decided to use an available piece of perf board made for prototyping IC circuits rather than etch and drill a new circuit board. The fiberglass board I used was easily cut to size and drilled to accept the proper connectors. If you're certain that you can select 8 frequency ranges and will NEVER want to change them, you can dispose of the IC sockets and just hardwire the programming diodes to the appropriate pins. I elected to go with the original design using plug-in modules, constructed on IC headers. For now, I have modules for 30, 17 and 12 meters and the 0-500 khz, 500-1000 khx, and 1000-1500 khz segments. The layout of the modules has been well documented in the past and I'll not repeat that here (see references below).

I didn't draw a diagram for the board since it's identical to that documented in the TR7 or R7 Service Manual. In those diagrams, the pertinent items are labeled “Channel x Module” and the wiring connecting the modules to the connector pins 1-22 at the bottom of the page. Ignore the circuitry associated with the crystals, and everything on the right side of the diagram connected to pins 24 and 25.

Note that this board will work in either the TR7 or R7 in place of a real AUX-7 board (but provides no fixed frequency function).

Here's what the new board looks like:



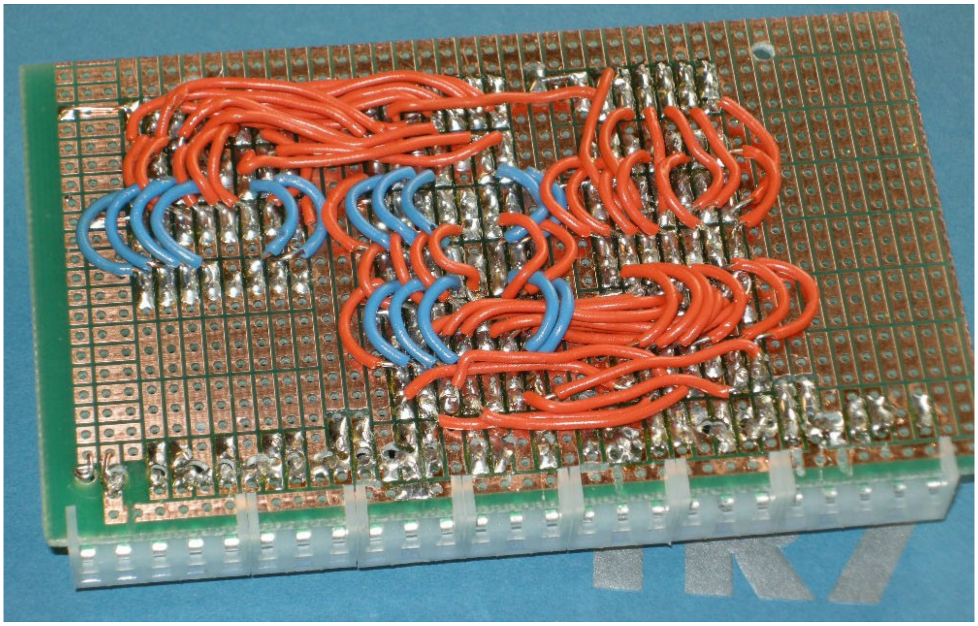
The modules require 14 pin DIP sockets, but I ran out and had to use a couple of 16 pin sockets, hence the extra socket pin positions seen on the 30 and 17M positions. Note that the overhang of the board past the connectors on the left side in the photo is not correct. I had to remove .1 inches of that so the card would fit the available clearance to the PTO housing.

Here's a brief description of how the board works:

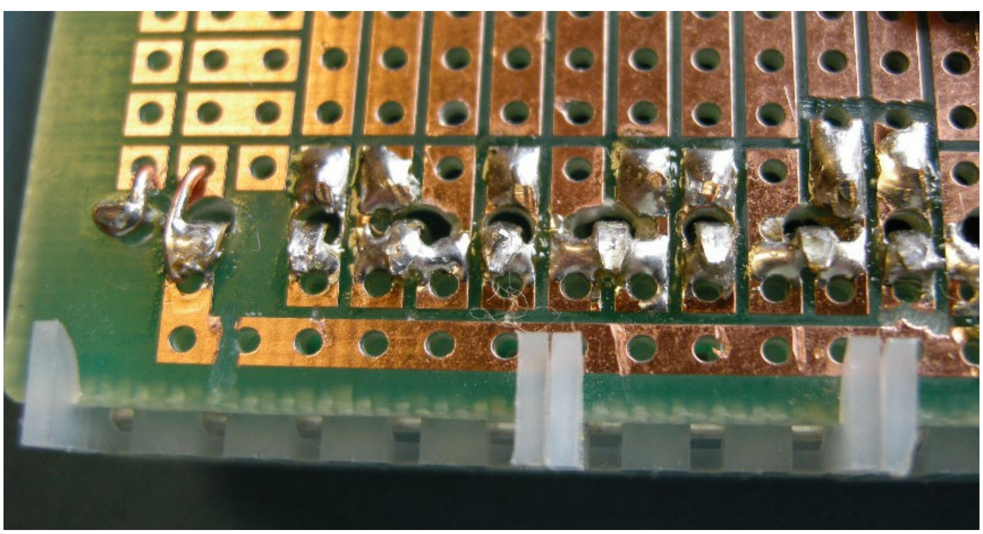
The AUX Program switch applies 5 VDC to pin 1 of the selected module (8 in total) and the first 8 pins of the board are used to route that voltage to the proper module socket. An array of diodes on each plug in module applies that 5 VDC to combinations of pins 9, 10, 11 and 12 which represent Bands A, B, C and D. That coded representation of the band to be used works in conjunction with the bandswitch to set the SETBAND light on or off. Pins 15 through 22 are used to specify which of the 8 possible 500 Khz frequency ranges are to be set for each module. That's what allows the proper segment to be selected automatically when you set the AUX Program switch position. Pin 14 on the board is the TX Enable line and a positive voltage there enables transmit in that selected band segment. It's much simpler to just cut the well-documented motherboard land pattern to enable transmit on all frequencies rather than install the diodes to enable transmit on each plug-in module. That was the approach I took with this board.

That's all there is to it. The board will work in a TR7 or R7 and can be built for less than $38 if you buy everything new. If you have a well-stocked parts cabinet, your total could be quite a bit less than that.

Here's what the backside of the board looks like. The board has three hole pads, providing holes in which to place the jumpers, but there are a lot of jumpers required.



The hole spacing on the perfboard is .1” and the pin spacing on the connectors is .156”. So, every other connector pin roughly lines up with one of the board holes, but even those holes had to be increased in size with a tapered diamond Dremel bit. For the pins that didn't line up with existing holes, new holes were drilled between land patterns as you see here.



Construction Notes

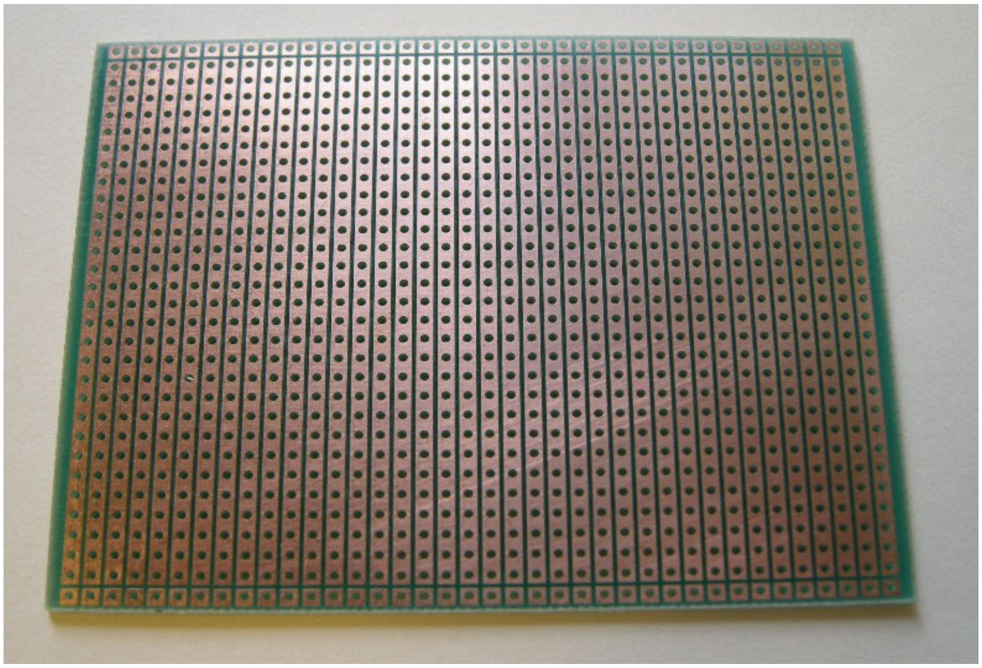
1. The board that I used is fiberglass and I cut it to size using a nibbling tool. I then filed the edges smooth with a flat file.
2. I drilled two holes in the top edge of the board to allow my board removal tool (fashioned from a piece of coat hanger) to be used when removing the board.
3. The IC headers I used for the plug-in modules have fairly high U-shaped pin tops making it easier to mount the diodes. I was able to stack 4 leads on pin 1 easily. You can also buy plastic caps that fit over the finished module and you can see those in the photos. When soldering the diodes to the IC headers, it's a good idea to plug the header into an IC socket to prevent pin misalignment in the event you overheat the pins.
4. The typical perf board today has holes spaced at .1". The connectors used to plug the board into the motherboard have a spacing of .156". I found that every 4th hole lined up pretty well with every other connector pin and I drilled a new hole in the board for the 2nd, 4th etc. connector pins. I used a tapered diamond tip bit in my Dremel tool and was able to increase the existing hole diameters a bit and drill the new holes fairly easily. The connector pins are too large to fit the board holes without increasing their diameter. See the accompanying photograph showing the details of how the connectors mate with the board.
5. When I was finished with the board, it was impossible to push it in over the connecting pins. I ended up putting a thin coating of De-Oxit on the pins and that made it possible to push the board into place, but it wasn't easy.
6. The connectors come in many sizes, from three pin to nine pin. You can use whatever combination you choose to add up to 25 pins. I used (2) five pin and (5) three pin. Since pins 23, 24 and 25 are not used on my board, you could leave off the connector for those pins and that would make it a bit easier to insert and remove the board from the TR7.
7. There's no need to make the board wide enough to fit into the card guide on the left side of the board position. The board that I recommend later is not quite wide enough to reach the board guide anyway, but that's of no concern. The 25 pin connector count holds the board in a perfectly vertical position very snuggly and it's much easier to get the board in and out without the guide interfering.
8. All of the board wiring carries low voltage DC – there is no RF present, so, there's no real concern about lead dressing or routing.

Recommendations

Unless you really need the ability to modify the frequencies covered by replacing modules in the future, I strongly recommend that you don't use the same construction technique that I used. As you can see in the photographs, you must install *many* jumpers to connect all the socket pins to the board connector pins and that's not fun. For example, pin 14 of every socket must be connected to pin x on the board connector.

When your board is completely wired, use a VOM to ensure that each of the pins is connected to the appropriate connector source pin (and no others).

The alternate approach is to hardwire the diodes to the board, saving a lot of unnecessary parts and time.   Here's the board I'd use for that approach (see parts list for ordering info):



The connectors would be mounted along the bottom edge, and the diodes would run horizontally across the board. This would eliminate the need for all the jumpers I used in the DIP socket version of the board and would reduce the overall price of parts.

Parts list and sources

(prices listed were good as of 4/20/08)

1. **Boards** – See www.Electronics123.com for high quality Velleman Eurocard fiberglass boards. I used the ECI (IC pattern, 3.9" x 6.3") card, priced at $5.30, and cut it down to 4 3/16" x 2 1/2".   To build the board without IC sockets, use the ECL1/2 (full line pattern, 3.9" x 3.1"), priced at $2.91.
2. **Connectors** – The board connectors are made by Molex and are identical to those used on the TR7 boards. They're available from www.Mouser.com and are known as "Molex KK Series (.156")". The connectors you want are labeled as ".156" PCB Receptacles" and the "Side Entry" type is the one we want. The Mouser part number for the 3 pin connector is: 538-09-52-3031 and they're available in 2 to 12 pin models. It's probably easier to use the 3 and 5 pin models here for ease of attachment to the board. Total price for (5) 3 pin and (2) 5 pin connectors is $4.04.
3. **Diodes** – You'll need an average of 7-8 diodes for each plug-in module, the actual number depending upon the frequency ranges you select. I purchased (100) of the 1N4148 diodes from Mouser (p/n 512-1N4148) for only $1.10!

4. **IC sockets** – (8 needed) These are 14 pin DIP sockets and I generally buy the ones with machined sleeves (Mouser 575-11044314), but any type will do. The less expensive types are usually easier to insert the IC headers into and they work just fine. Total price of (8) of the part number I used is: $6.32.
5. **IC headers** – (Quantity needed depends on the number of modules you need). I used p/n 535-14-600-10 from Mouser, rather expensive at $2.17 each, but well suited for installing lots of diodes. Total price for (8) is: $17.36.
6. **IC header caps** – (Quantity depends upon number of modules) – These are really not required, but give you a nice surface on which to place module labels. They pop on and off fairly easily and are made to fit the headers listed above. The p/n is 535-14-650-10 from Mouser and they're priced at 72 cents each. Total price for (8) is $5.76.
7. **Wire** – I made all my jumpers from junkbox #22 solid wire. #24 would be a much better choice.

The total price for building a board with (8) IC sockets using the parts shown above is $37.49. As of yesterday, the AUX-7 cards (with NO modules) on eBay had buy-it-now prices of $150-$179.

Module building references

1. "Programming Modules for the AUX-7 Board", Gary Poland, W8PU,

   http://www.wb4hfn.com/DRAKE/DrakeArticles/AUX7_Modules/AUX7_Modules.htm
2. "Drake Mods – TR7 to the TR7", April 3, 1998, Wayne Montague, VE3EFJ,

   http://www.dproducts.be/DRAKE_MUSEUM/DrakeMods2005.pdf
3. "GW4ALG's Drake TR7 Pages", Steve Rawlings, GW4ALG,

   http://www.alg.myzen.co.uk/radio/tr7/mods.htm#20

   http://www.alg.myzen.co.uk/radio/tr7/mods.htm#22