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Inside The Drake TR-7 Transceiver

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http://www.wb4hfn.com/DRAKE/DrakeArticles/InsideTheTR7/Inside_The_TR7-Menu.htm

Preference

The intent of this article is to help the semi-non-technical person understand what is inside the Drake TR-7(A) Transceiver, how it works, and discusses simple adjustment and modifications the end-user can perform. I start with a basic overview of the inside of the radio and how the signals flow. I show each plug-in circuit board with a brief description of its function or purpose. Towards the end of the article I go through several simple alignment procedures, discuss a few simple radio modifications to enhance the operation, and troubleshooting information. The last four pages is the Drake TR-7 color brochure published during the production of the radio.

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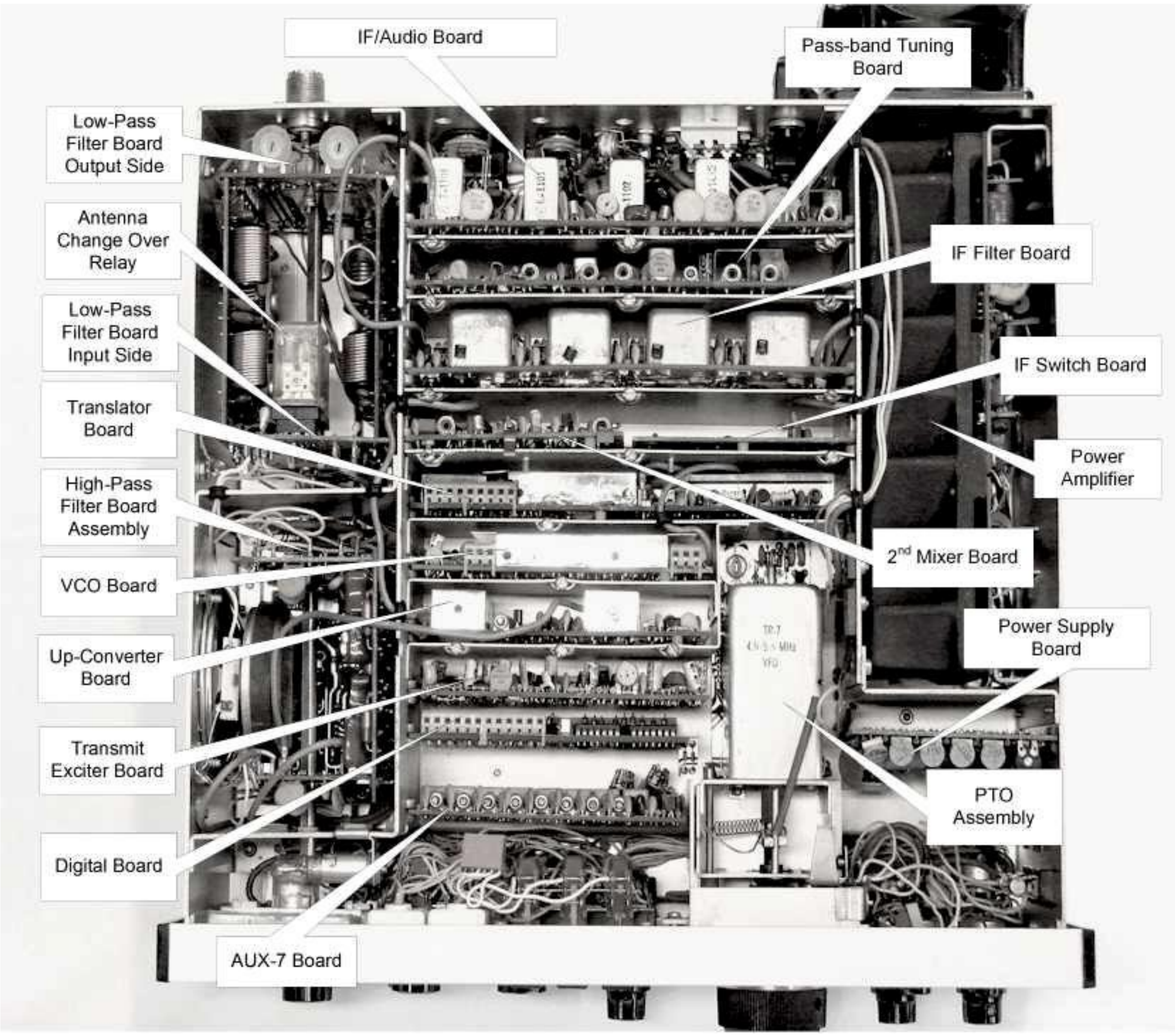
TR-7 Description

The Drake TR-7 Transceiver, designed by the R.L. Drake Company was considered the first all solid state commercially available transceivers. Being 100% solid state all the circuits were broadbanded so there was no need for preselector tuning or transmitter adjustments across the entire 1.5Mhz to 30Mhz operating range of the transceiver. The high performance frequency synthesizer and the Drake designed PTO provided smooth tuning with a 1Khz analog dial and 100Hz digital readout. The frequency synthesizer provided tuning ranges in 500Khz steps across the operating range of the transceiver selectable with the Band Switch and the "UP" and "DOWN" front panel pushbuttons. Drake was the first to introduce "Up-Conversion" for Amateur Radio transceivers. This was the process putting the 1st IF above the received frequency. Drake put the 1st IF at 48.05Mhz placing image frequencies well outside the tuning range of the receiver. The transmitter was designed to operate at 250 watts input power across the entire operating range of the radio. This netted a typical output power level between 130 and 150 watts on the lower bands and 90 and 100 watts on 15 and 10 meters. The transmitter being all solid state and designed to produce a flat frequency response across the entire operating range required no transmitter tuning or adjustment. The transmitter included VSWR protection which shut-down the power level when the antenna was not properly matched.

In the hay-days of Drake before the death of Bob Drake there was much discussion among the engineers on the TR-7. The discussions were on whether the new design should be a tube design, possibly a hybrid design, or forge into the new world of solid state. The more seasoned engineering leaned towards using the "tried & true" tube design. However, after the smoke cleared the younger college grad engineers won the debate for an all solid-state design. During the next couple of year the TR7 design went through several development phases and sometimes into yet uncharted waters. Along the way there were many all nighters, bar-room discussions, ruffled feathers, and impeded territories, but it all eventually came together. During it all, the Drake engineers overcame some insurmountable obstacles like the BFO signal that could be heard a block away until they realized the metal shield was acting like an antenna, or the power amplifier that self-destructed itself with design changes and a little SWR.

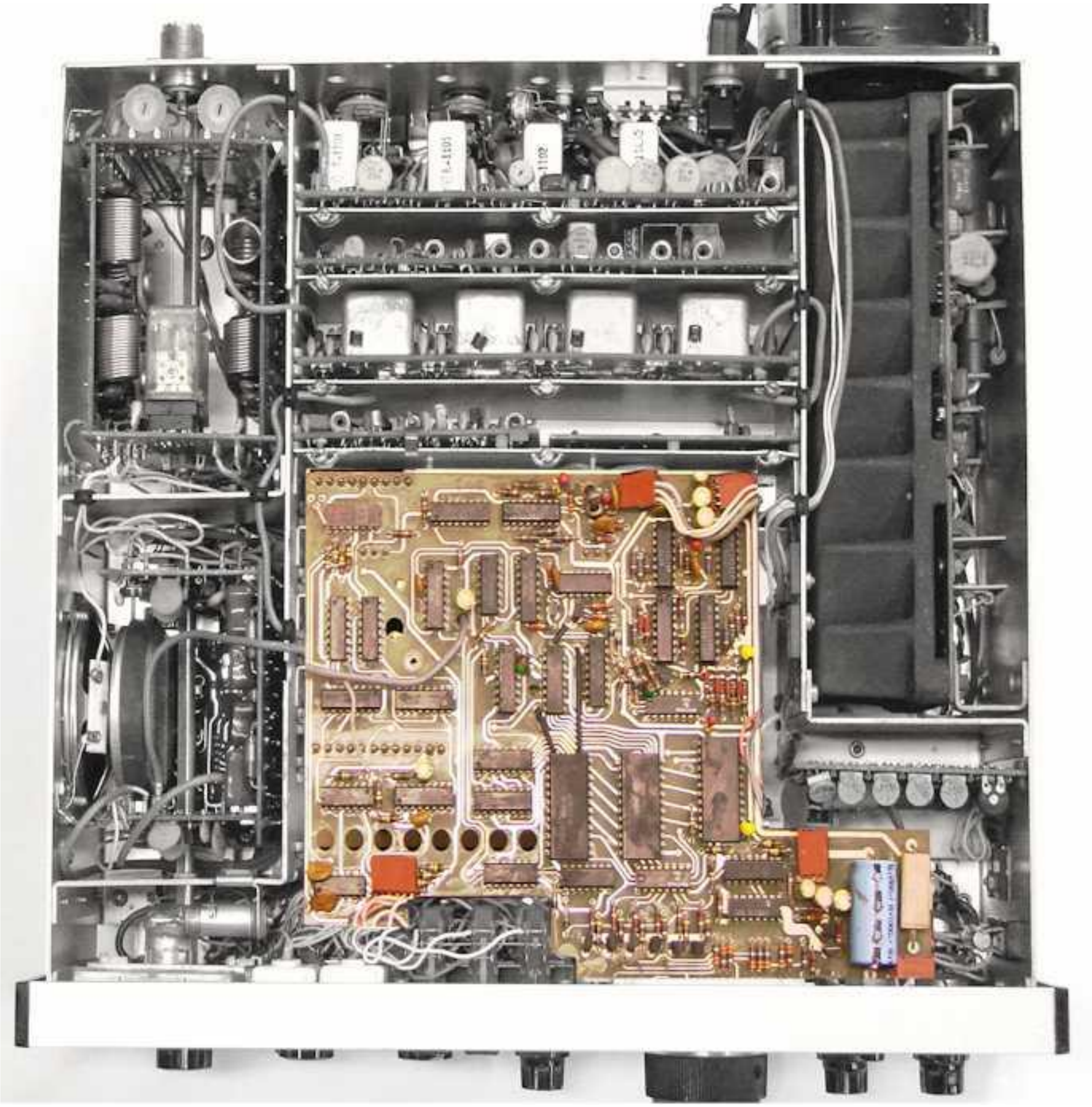
The TR-7 Board Layout

The basic layout of the TR-7 Transceiver is a modular design. Each section of the transceiver was built on individual circuit boards that plug into a mother board which Drake refers to as the Parent Board. The Parent Board was connectorized to except the smaller circuit boards and interconnect the boards carrying power, switching voltages and low frequency signals between the boards. The high frequency signals used small plug-in coax cables on the top side of the transceiver running between the circuit boards. The picture below shows the placement of each board and other major components in the transceiver. You can also see the small coax cables interconnecting the individual circuit boards.



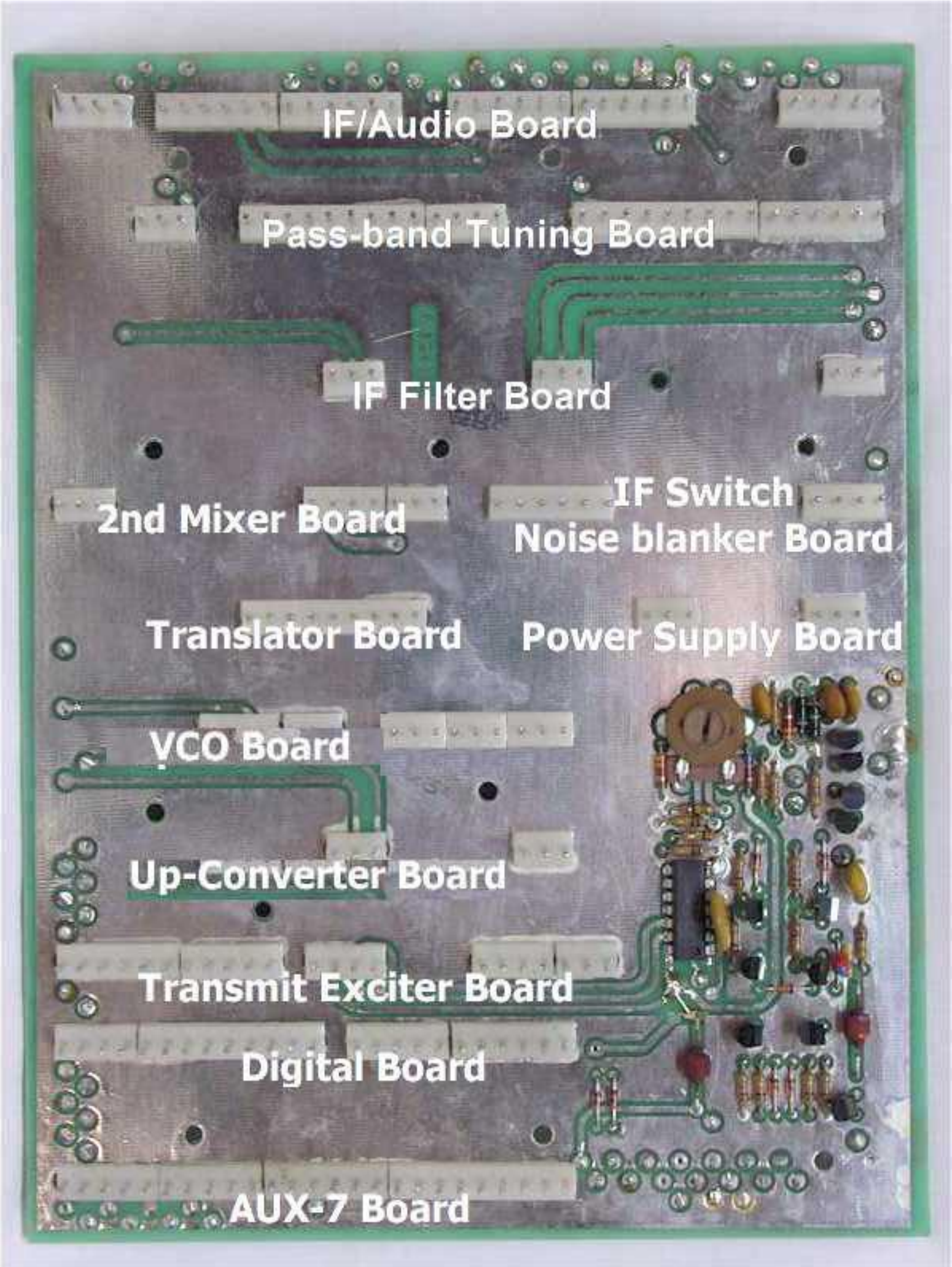
When the TR-7 Transceiver was first introduced, the Digital Display Board was an add-on option. After several months of production the digital display became a standard feature with all transceivers. As shown in the picture below, the digital display board mounted over the top of several circuit boards in the front half of the transceiver. The Digital Display Board also had connectors on the bottom side that plugged into the top side of the Digital Board, VCO Board and

Translator Board. On the top side of the Digital Display Board there are several small connectors for power and front panel switches. The Digital Display Board had a series of eight holes across the front which was to access the channel trim capacitors on the AUX-7 Board. On the back of the Transceiver there is a switch labeled "Normal - Ext" and a plug-in connector directly under the switch. In the "Normal" position the Digital Display showed the operating frequency of the transceiver. In the "Ext" position the Digital Display Board became an external frequency counter good to 150Mhz. The input connector for the frequency counter function was directly below the switch on the rear panel.



The Parent Board

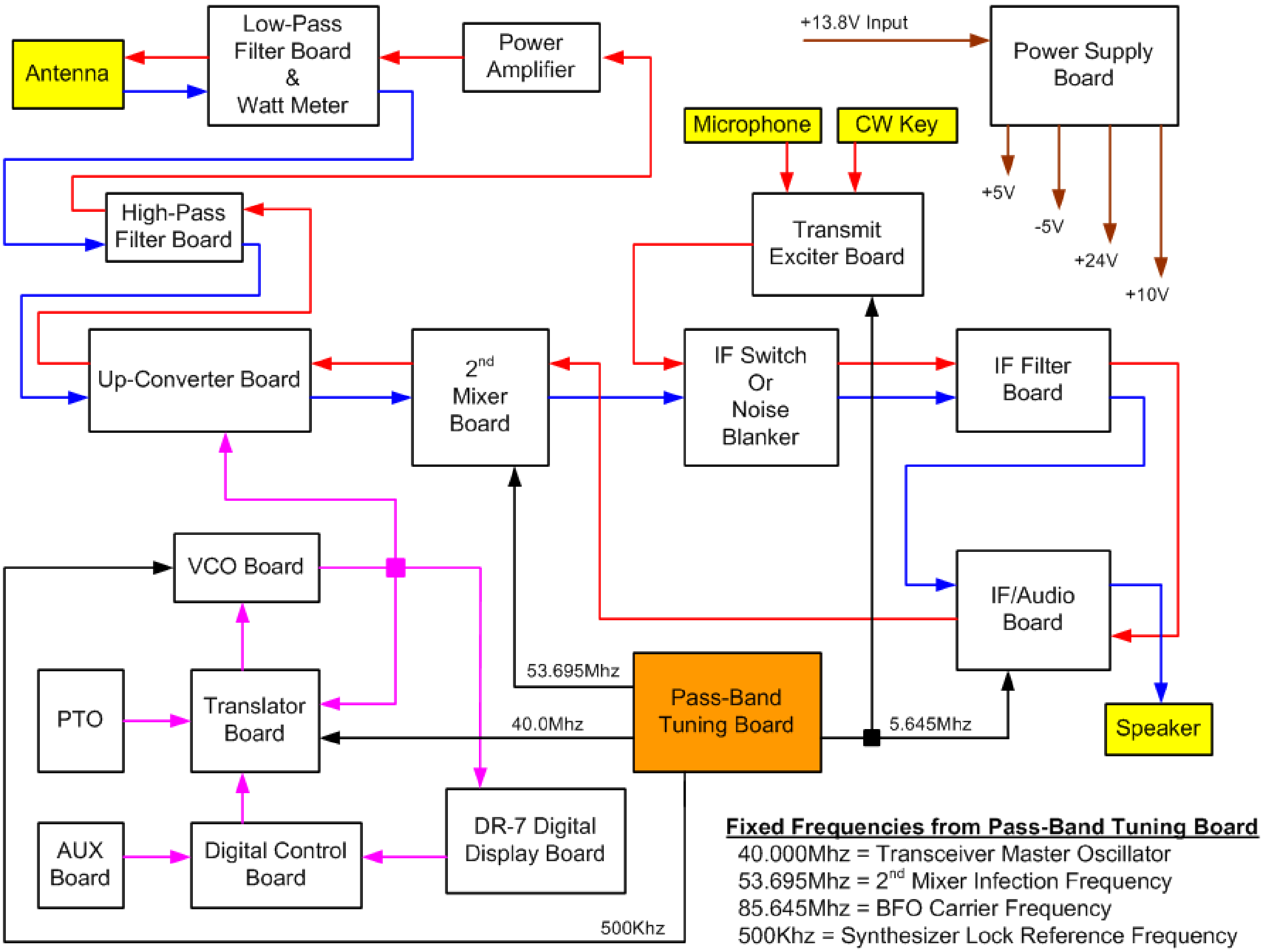
The Parent Board, is the transceiver's mother board on which all the other smaller individual circuit board plug into. Detailed below, each of the smaller boards has a particular place where they plug into the mother board. The mother board provides most of the interconnections between the smaller boards including switch and unswitched power, control voltages and signaling. Most of the critical RF signals are interconnected with separate coax cables from board to board. All the front panel controls and functions and the rear panel connectors all connect to the Parent Board along the front and rear edges of the board. The only active circuits on the Parent Board is shown in the bottom left corner in the picture. That circuit controls the RIT offset tuning, the PTO switching between transmit and receive and external devices such as the RV-7 remote VFO.



"The Road Map"

One of the best ways to understand what is inside the TR-7 Transceiver is to first understand how the signals flow. The transceiver operations is divided into four major functions, receiving, transmitting, frequency range synthesization, and fixed frequency generation. Each of those major functions are described in detail just below the Signal Flow Chart The Signal Flow Chart shows each function with separate colored lines and arrows showing the signal path. The one board common to every board and function in the transceiver is the Power Supply Board. This board provides all the proper voltages to the entire radio.

Drake TR-7 Transceiver Signal Flow Chart



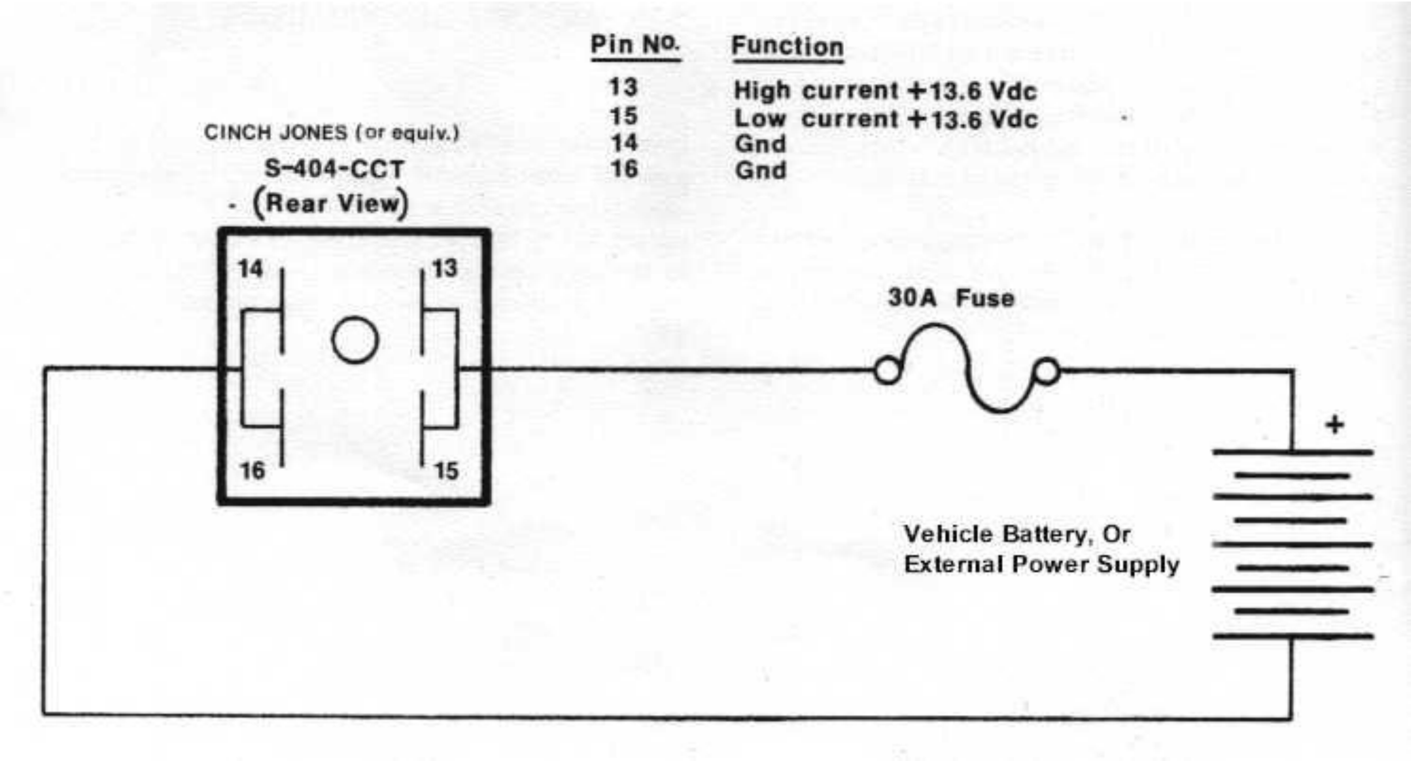
The most important board in the entire radio is the Pass-Band Tuning Board. This board is considered the "heart-beat" of the radio because it generates several fixed frequencies and reference signal needed to operate the radio. Those signals are indicated with the **black arrow lines** going from the Pass-Band Tuning Board. This board generates the 40.0Mhz master oscillator frequency from which the entire operations of the radio depend on. From that master oscillator frequency this board derives several other fixed frequencies which are supplied to several other boards.

The receive function signal flow is shown with the **blue arrow lines**. Starting at the antenna the receive signal flows through a high pass and low pass filter to limit the broad range of incoming frequencies to a narrower tuning range set by the band switch. The signal then travels to the UP-Converter board where its mixed with the VCO frequency to produce the 1st IF frequency. From there it travels to the 2nd Mixer Board where the signal is mixed with the injection signal from the Pass Band Tuning Board to produce the 2nd IF signal at 5.645Mhz. From there the signal is sent to the IF Switch Board where in the receive mode is sent to the IF Filter board. The Filter Board limits the bandwidth of the receive signal with selectable filters according to the selected mode of operation. The output of the Filter Board goes the IF/Audio Board where the signal is AGC controlled, demodulated with the audio then amplified to drive the speaker.

The transmit function signal flow is shown with the **red arrow lines.** Starting at the microphone or key, these devices are attached to the Transmit Exciter Board. This board takes the audio from the microphone amplifies it and mixes that with the BFO frequency to create the 1st transmit IF frequency. This board also controls the VOX functions of the transceiver. Next the signal goes to the IF Switch Board where in the transmit mode that board switches it to the Filter Board where the signal only passes through the SSB filter to limit the signal bandwidth of the signal to 2.3Khz. From there the signal passes to the IF/Audio board which contains a variable attenuator used to control the output power level of the transmitter. The transmit signal then is sent through the 2nd Mixer board and the UP-converter Board to produce the operating transmit frequency. Through each of these boards the input signal is mixed with a fixed frequency to create the operating frequency at the output of the Up-Converter board. From there the low level transmit signal goes through the high pass filter board to eliminate all harmonics of the actual frequency. The filtered signal then goes to the power amplifier where up to 150 watts of RF power output can be created depending on the drive level set by the variable attenuator. The high power signal then goes through the low pass filter to further eliminate all harmonic frequencies generated by the power amplifier to produce a clean signal which is sent to the antenna connector.

The frequency synthesizer function produces the correct injection signal frequency to the Up-Converter Board, refer to the **violet arrow lines** for signal flow. This injection signal is mixed with the incoming signal to the Up-Converter to produce a correctly tuned output frequency. In the receive mode this frequency would be the 1st IF signal going to the 2nd Mixed Board, and in the transmit mode the output is the actual transmit frequency which goes to the High-Pass Filter Board and PA Amplifier. The Synthesizer has three major interdependent boards. The VCO Board produces the actual injection frequency from the data supplied from the other boards. The Translator Board takes signal inputs from the PTO, Pass-Band Tuning Board, and VCO Board, mixed those signals together, then divides that signal in frequency to produce an varying output reference signal proportionate to the VCO frequency. That varying reference signal is sent back to the VCO Board to the phase detector circuit. The Phase Detector compares that varying reference signal to the 500Khz reference signal from the Pass-Band Tuning Board. When the Phase Detector determines both frequencies exactly match the detector locks the VCO frequency. When the VCO frequency is locked, that VCO frequency is set to the correct injection frequency to operate the transceiver. In this process of producing a locked frequency the Digital Board determines the actual VCO frequency tuning range from data supplied from the band switch. The Digital Display Board determines the actual operating frequency and displays that frequency at the front panel.

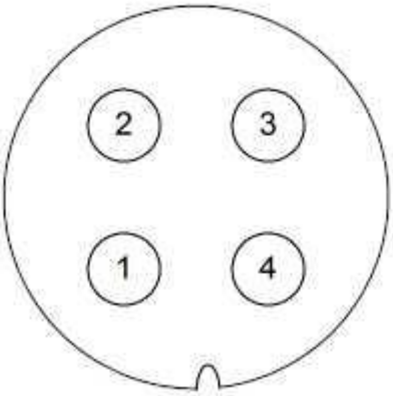
Power Cable Wiring



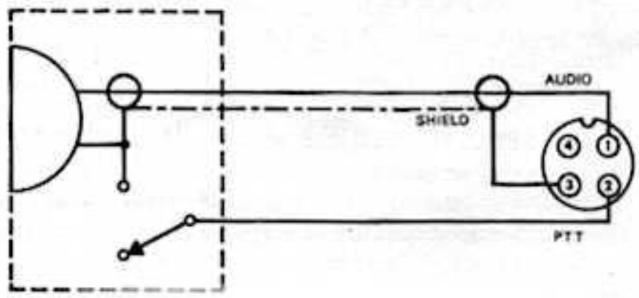
The power cable wiring is a simple wiring project. The power connector is a Cinch Jones connector number S-404-CCT. Pins 13 & 15 are wired to the positive or +13.8VDC side, and pins 14 & 16 is wired to the negative or ground side of the power supply. When making the cable don't for get to put a 30 amp fuse holder in series with the positive lead. This will give you good power load protection even if the power supply has it own protection circuit or fuse. Make sure the wire or cable you use is at least a #12 or larger conductor to properly handle the current load.

Wiring A Microphone

TR-7 Microphone
Connector



Pin #1 = Low Level Audio
Pin #2 = TX PTT
Pin #3 = Ground
Pin #4 = High Level Audio

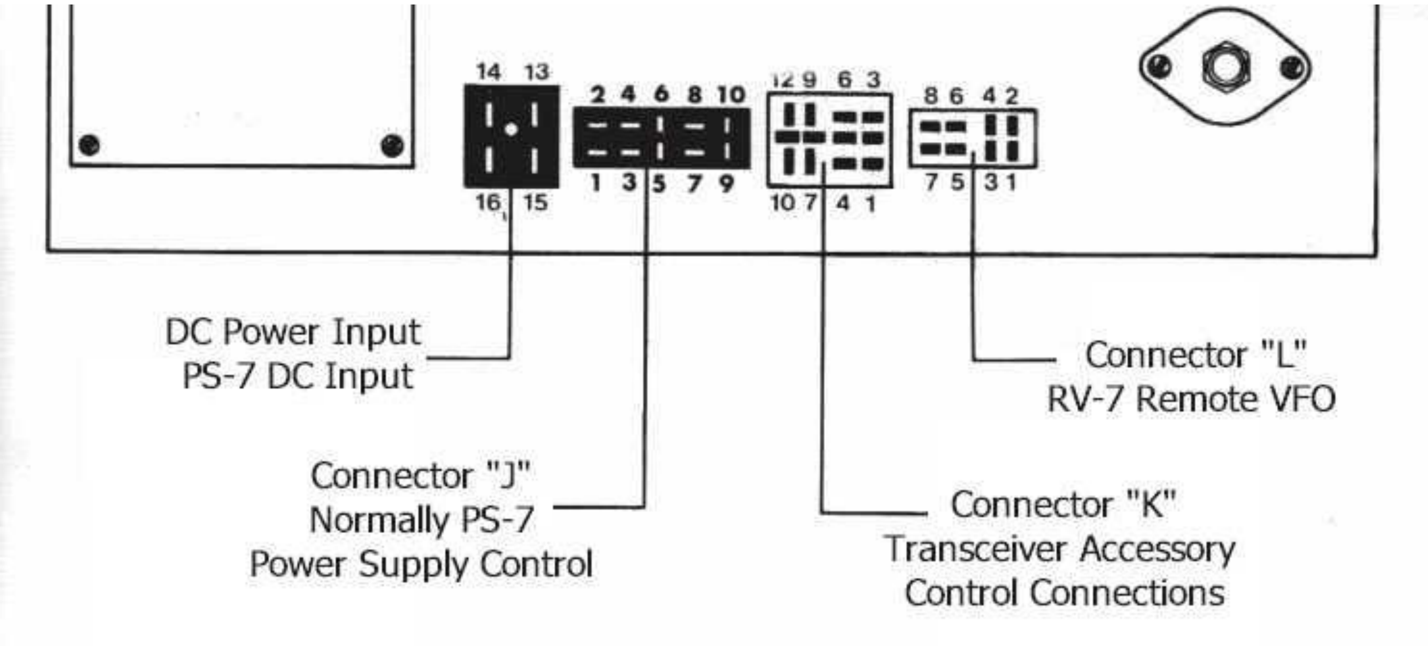


The TR7 requires a Hi-Z (high impedance) type microphone, either dynamic, crystal or ceramic type microphone elements will work fine. The microphone should have a good audio response between 300 and 5000hz with an output level of -48dB or better at 1000Hz. The microphone connector is wired with microphone audio lead to pin #1 and the shield side to pin #3 which is chassis ground. Transmitter keying lead goes to pin #2 with the other side of the switch is grounded to the chassis either through the microphone or as a separate lead connected to Pin #3. The TR7 microphone connector has an internal 1000 ohm resistor between pins #1 and #4. Pin #4 is used for high level audio inputs and should be used with amplified microphones over using pin #1. Pin #4 would also be used as the audio input from other devices such as the output from a tape recorder having high audio output.

Some microphones also internally switch the microphone element with the transmitter keying switch. This method works fine for the PTT keying mode but will not work for VOX mode operation. If the microphone does switch the microphone element, to operate VOX mode that side of the switch the contacts must be shorted together or bypassed to allow the microphone element to be active all the time for microphone audio to key the transmitter.

The Drake "7" Line matching Drake Model 7077 microphone, pictured on the left, was wired for VOX operation as shown the diagram above. Most of the newer desk microphones available today have a switch on the bottom or inside to select whether the microphone element is switched on not.

The Rear Panel Accessory Connectors



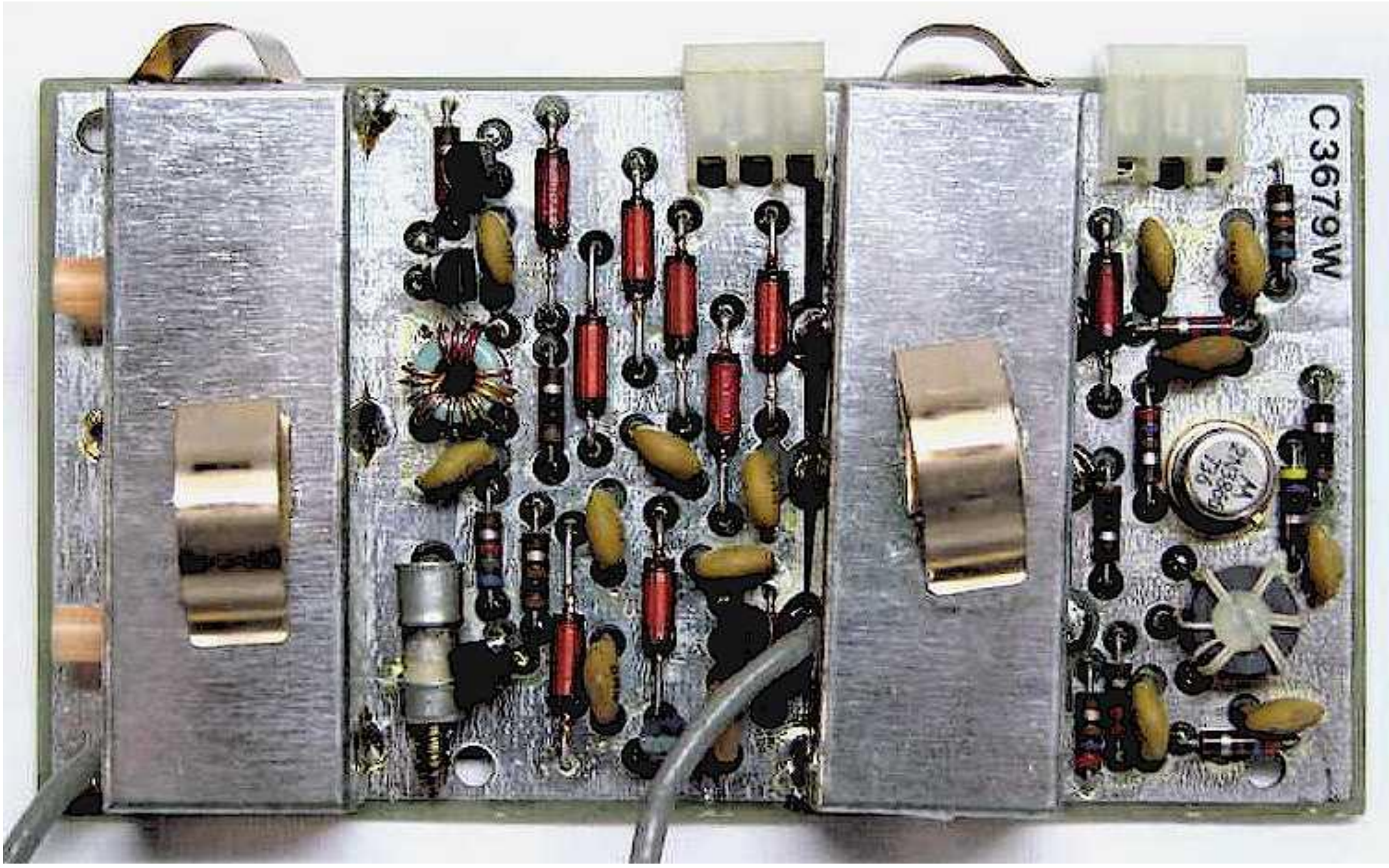
The four large Cinch Jones plugs across the back of the transceiver accommodate various accessories for the radio. The pin-out connections of each plug is listed in the manual, but here I will discuss a few other options to consider beyond the standard accessories.

Starting with connector "J" this connector is the AC switch and control functions for the PS-7 matching Power Supply. For those not using the PS-7, pin #8 is used to key an external amplifier, this pin goes to ground, Pin 10, when the transmitter is keyed. On this connector, pin #9 is the ALC input for the external amplifier, ground is pin #10. The internal power switch comes out to pins #1 and #2, this can be used to switch any external power supply for the radio.

Connector "K" supports the use for several station accessories. Some of the more useful functions include, switched +10VDC on transmit is found at pin #1, continuous +13.8VDC is found on pin #9, transmitter key is pin #10, (transmitter keyed when grounded), and pin #3 is chassis ground. On this connector pin #7 is the antenna input for the VLF bands, ground is pin #3. This is the antenna input for receiving frequencies below 1.5Mhz. As noted in the manual the SO-239 antenna connector does not support the VLF input to the receiver.

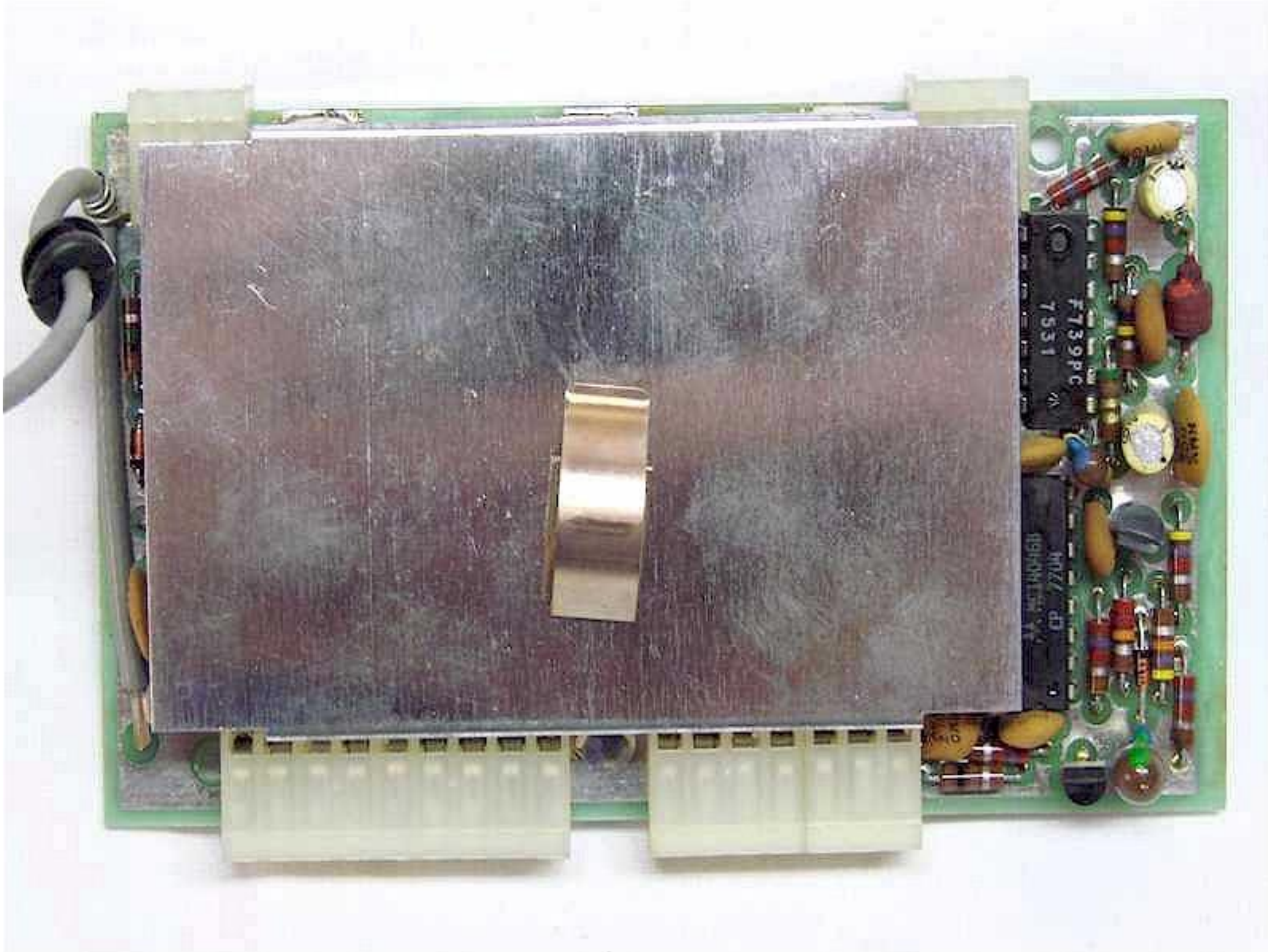
Connector "L" is specific to the RV-7 remote VFO and only provides signal and switching functions for that accessory. Not much useful functions outside its intended use with the RV-7.

The Up-Converter Board



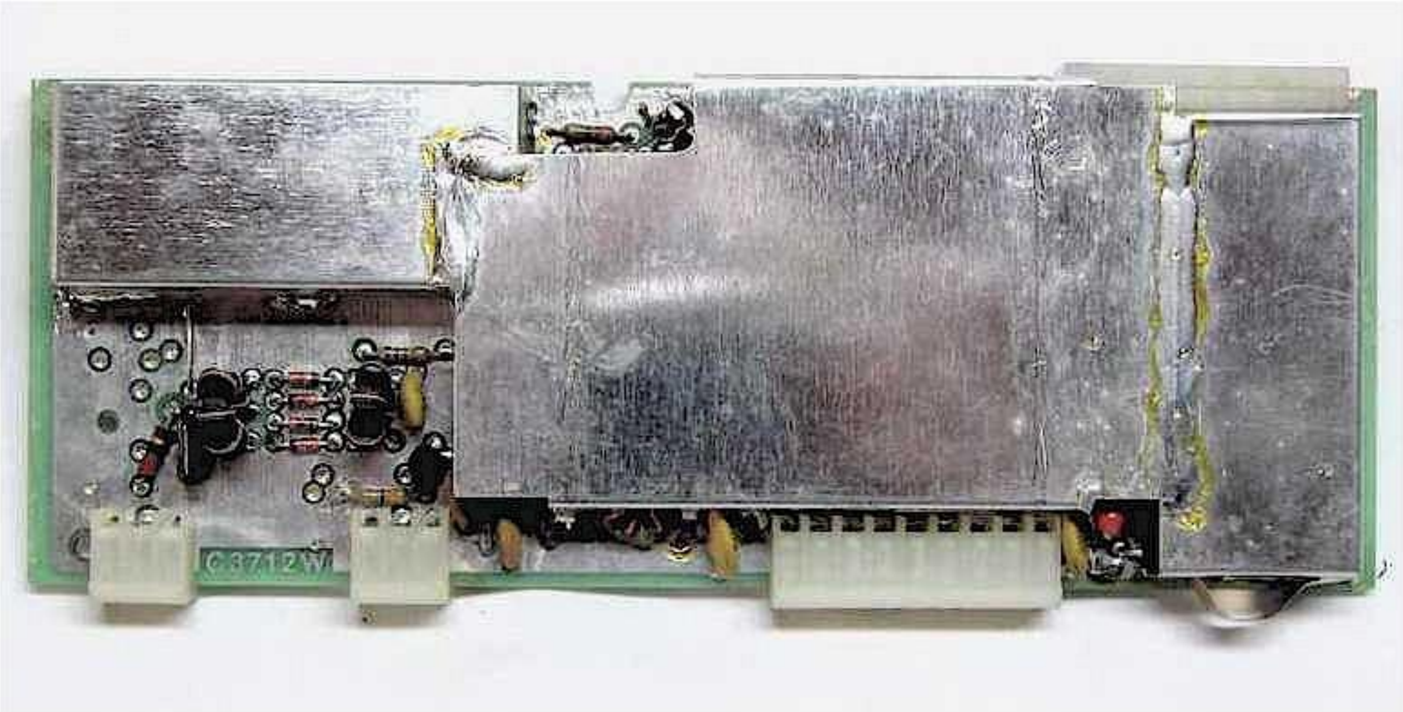
The Up-Converter Board serves a dual function. In the receive mode the incoming signal from the antenna passes through High Pass Filter Board to the input of the Up-Converter board. The Up-Converter board samples the locked frequency from the Translator Board, mixes that with the incoming signal to produce the 1st IF frequency with an output at 48.05Mhz. In the transmit mode the input to this board is the 48.05Mhz transmit IF frequency. This IF signal is mixed with the same locked frequency from the Translator Board, to produce an output signal on the operating transmit frequency. The transmit output of this board travels back through the High-pass Filter Board and the pin-diode switch to the transmit pre-driver stage.

The VCO Board



The VCO Board (Voltage Controlled Oscillator) function is to generate the final mixing frequency, (Injection Frequency), which is sent to the Up-Converter Board to produce the actual receive and transmit operating frequencies. This board has two voltage controlled oscillators, one for the lower band range of 0 to 15Mhz, and a 2nd for the higher band range of 15 to 30Mhz. Other than the actual operating frequency range both oscillators operate in the same manner and are selected according to the operating band selected. This board also contains the phase detector and loop filter portion of the synthesizer used to produce a "locked" frequency condition when the VCO is tuned to the correct injection frequency.

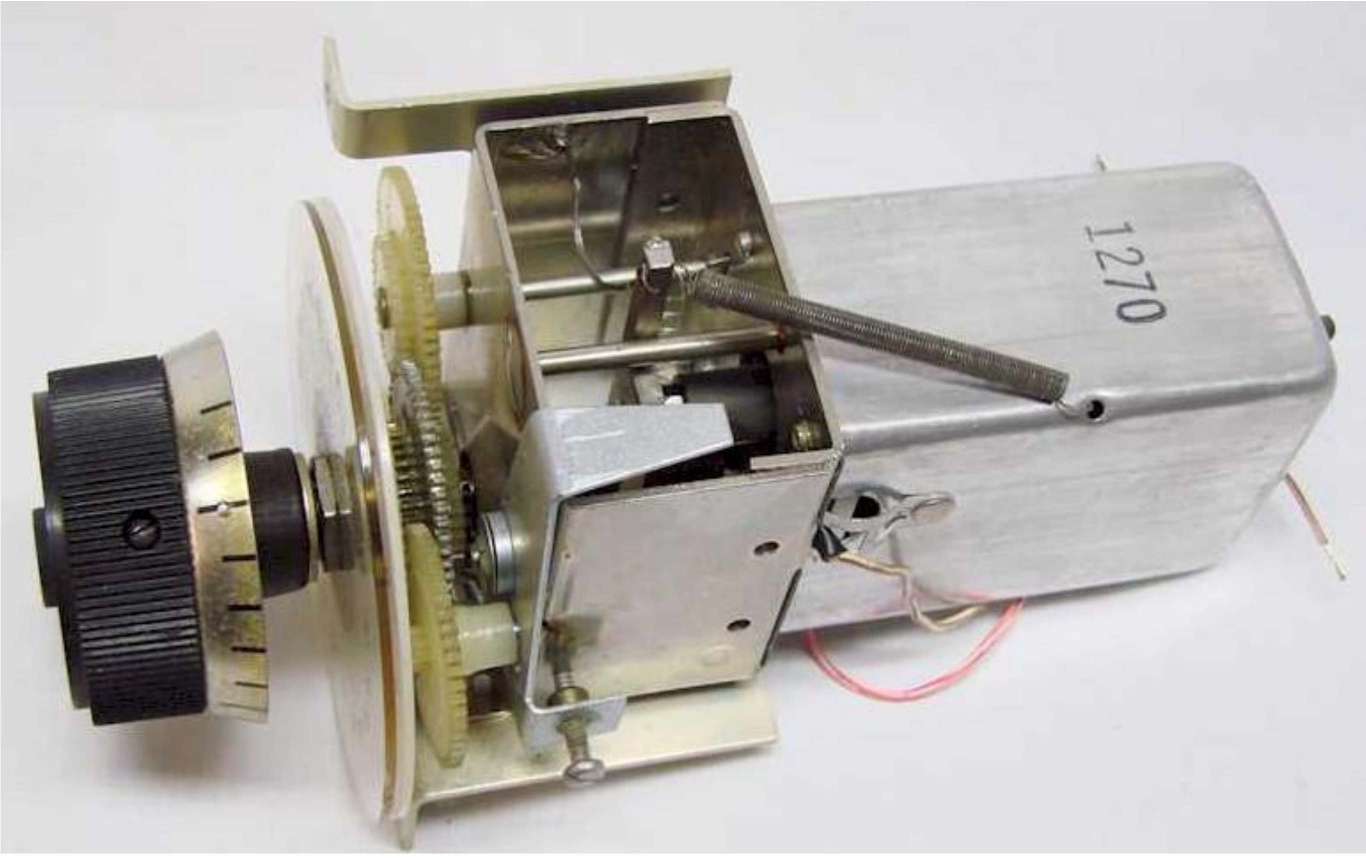
The Translator Board



The Translator Board combines signal inputs from three sources which produces a output signal between 3 and 32.5Mhz, exact frequency depending on the set tuning range of the transceiver. This output signal is then sent to a programmable divider network which produces a 500Khz signal used to phase lock the VCO master oscillator.

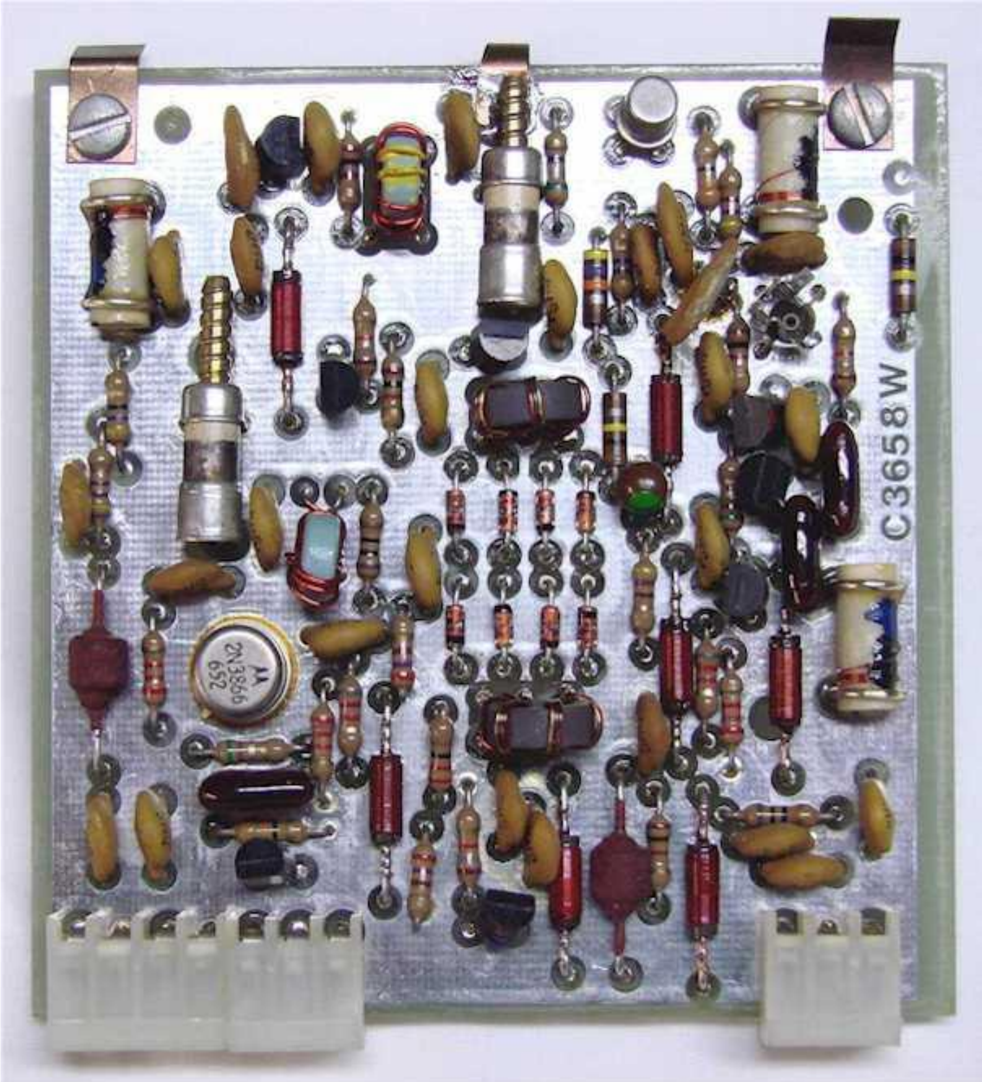
The first two signal inputs, the PTO signal, 5.05 to 5.55Mhz, and the 40Mhz reference from the Pass-Band Tuning Board, are mixed together to produce a signal between 45.05 to 45.55Mhz. This signal is filtered and applied to a 2nd mixer stage where its mixed with the master VCO signal between 48.05 to 78.05Mhz. The output of the 2nd mixing stage, a signal between 3 to 32.5Mhz, is applied to a programmable divider network. The programmable divider is programmed by the Digital Board to divide the input frequency between 6 to 65, depending on the 500Khz selected tuning range of the transceiver. The output of the programmable divider is a constant 500Khz signal when the synthesizer is phased locked to the VCO tuning frequency.

The PTO Assembly



The PTO (Permeability-Tuned Oscillator) provides a 5.05Mhz to 5.55Mhz injection signal to the frequency synthesizer circuit. The VCO Board tracks the frequency of the PTO to provide an overall 500Khz tuning range for the radio. The PTO is calibrated and temperature compensating to provide a highly stable signal with a minimal drift. The PTO includes a set of tuning dials calibrated to the PTO to provide a very accurate frequency display at the front panel.

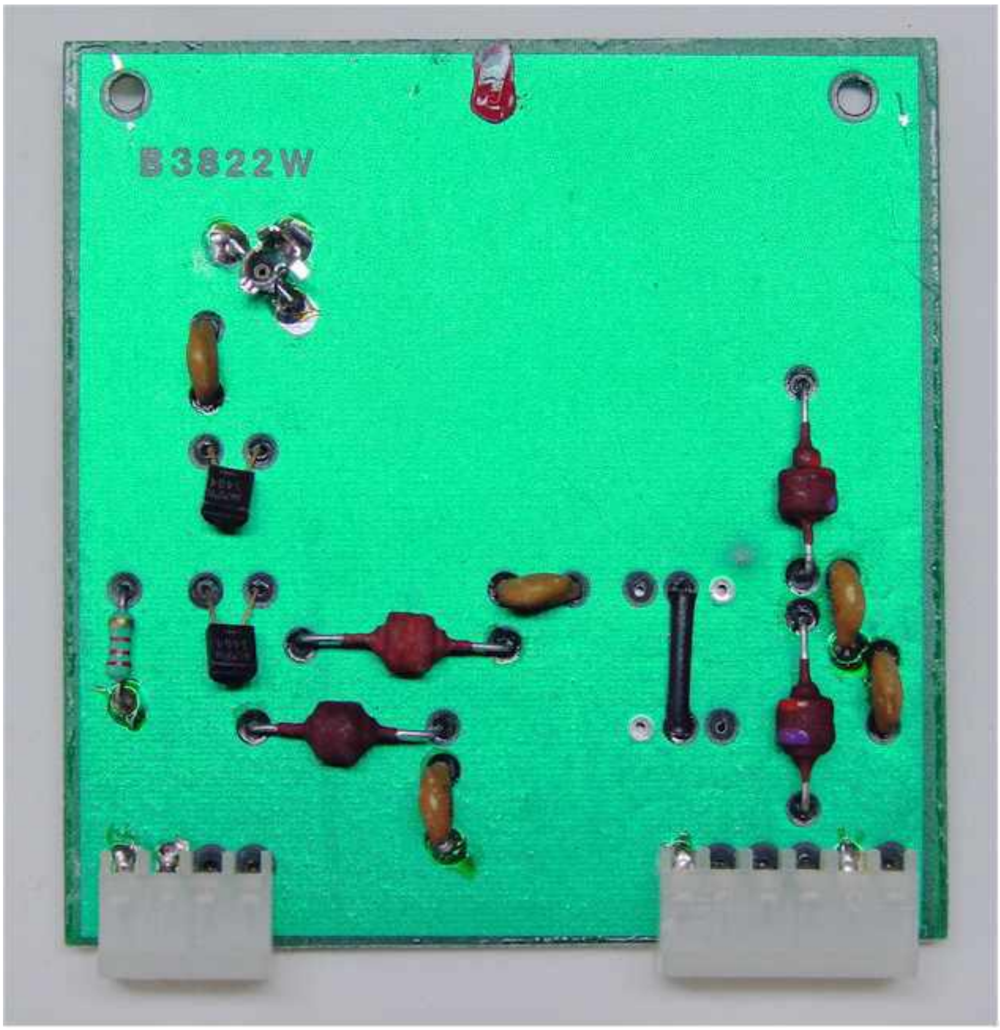
The Second Mixer Board



The 2nd Mixer Board serves a dual function depending on transmit or receive. In the receive mode the 48.05Mhz IF signal from the Up-Converter Board is applied to the input of the 2nd Mixer Board. The injection signal for the mixer is the 53.696Mhz signal developed on the Pass-Band Tuning Board. The output of the mixer takes the difference of the two signals, the 5.645Mhz IF signal, filters and amplifies that signal and sends it to the Filter Board.

In the transmit mode the process is reversed. The Mixer Board takes the 5.645Mhz transmit IF signal and mixes that with the 53.696Mhz injection signal from the Pass-Band Tuning Board. The board filters the difference of those two frequencies, and outputs the 48.05Mhz IF signal to the Up-Converter Board.

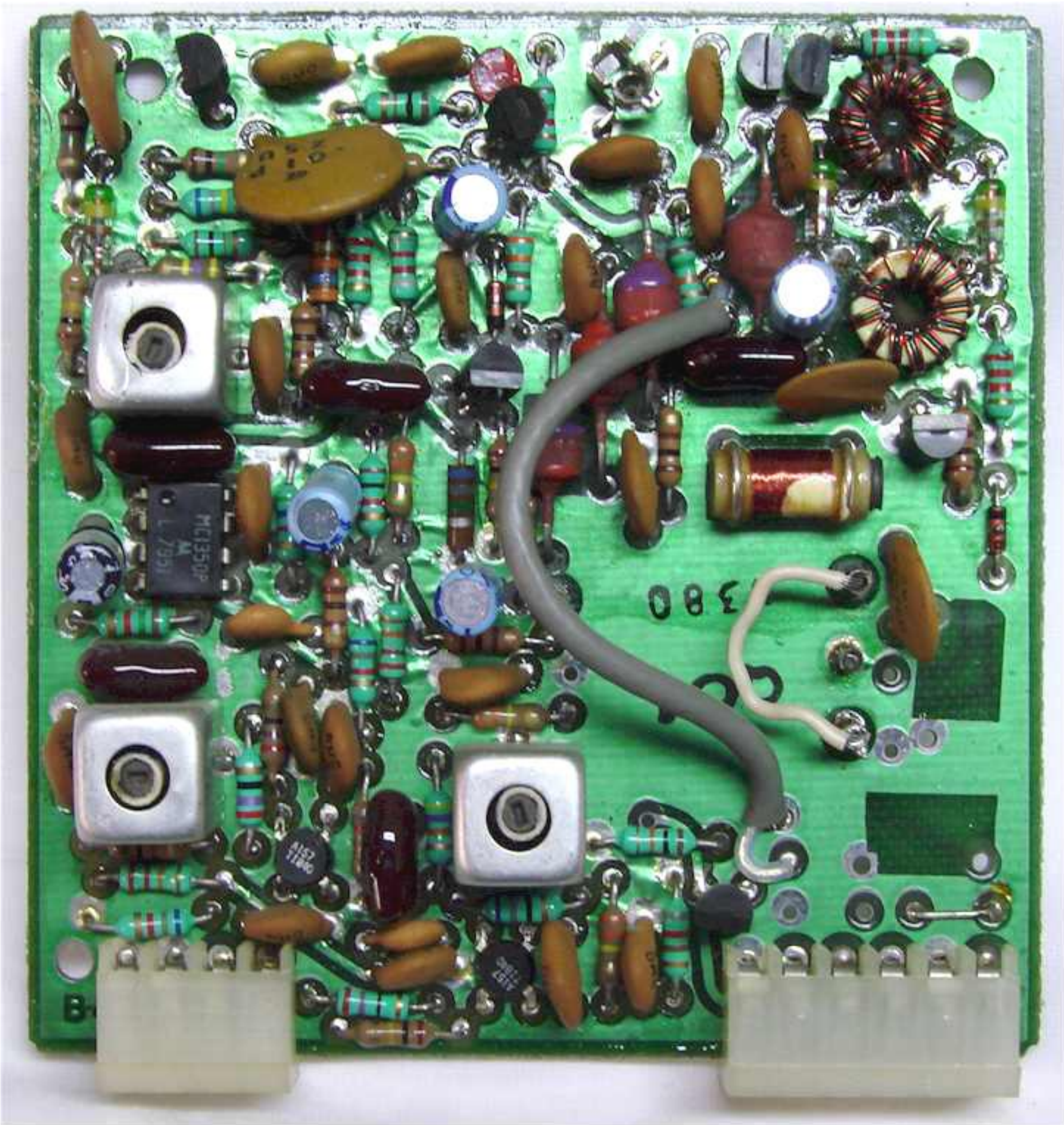
The IF Switching Board



This slot on the transceiver Parent Board accommodates two boards. If the accessory Noise Blanker Board is installed it provided both the IF switching function described here and performs the noise blanking function, described below.

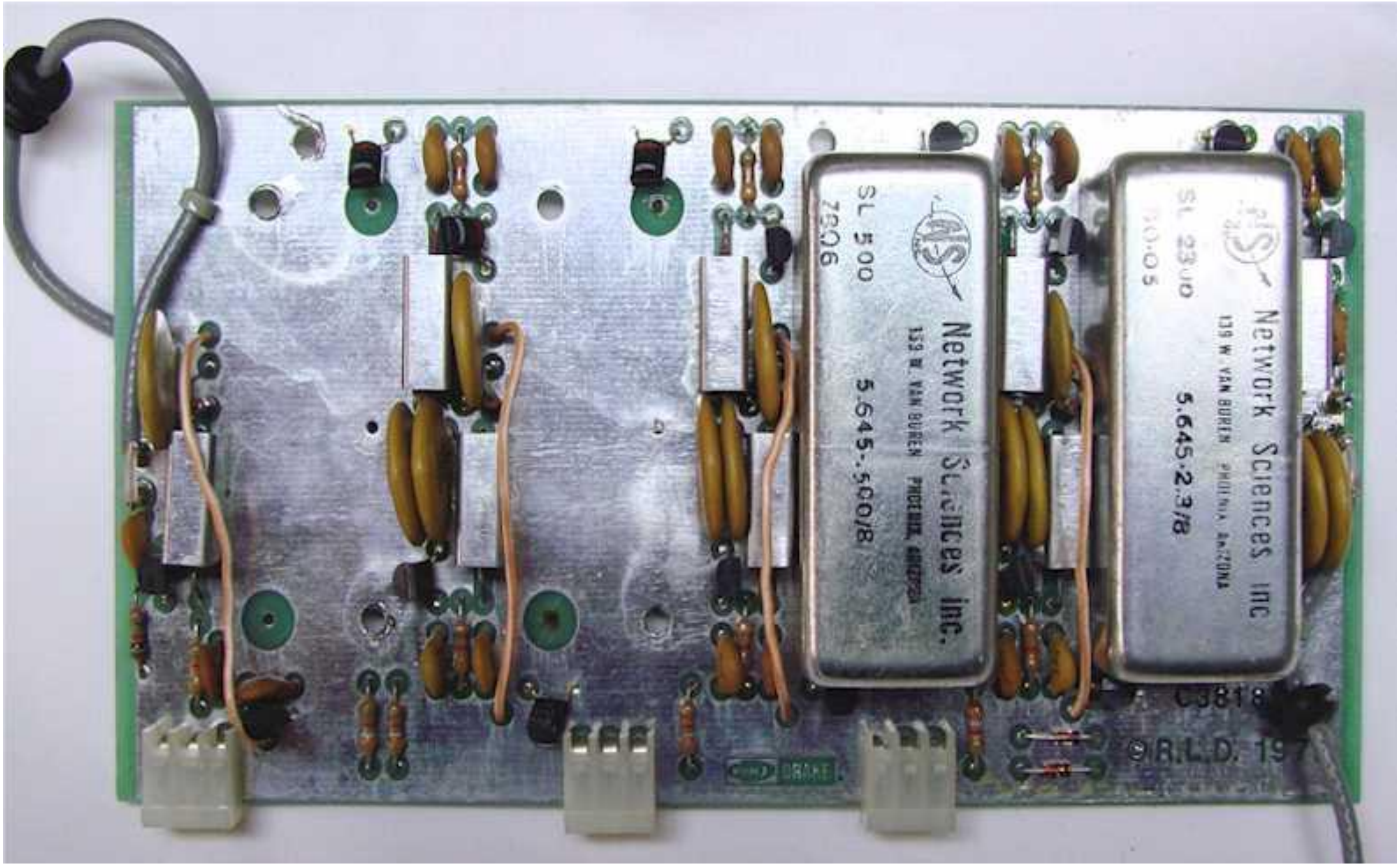
Pictured here is the IF Switching Board which is used if the Noise Blanker accessory in not installed in the radio. This board provides the transmit/receive switching for the 5.645Mhz IF signal. In the receive mode the 5.645Mhz from the 2ND Mixer Board is switched through this board to the IF Selectable Filter Board. In the transmit mode it takes the 5.645Mhz transmit IF signal from the Transmit Exciter Board and switches that to the 2nd Mixer Board.

Noise Blanker Board



The Noise Blanker Board is an accessory which is a plug-in replacement for the IF Switch Board and also provides signal noise processing during receive mode. This board provides the same signal switching functions as detailed in the IF Switch Board description. In addition, in the receive mode this board samples the 5.645Mhz IF signal to detect pulsing type noise spikes such as ignition noise generated from a automobile engine. When the noise processor detects noise peaks it turns off the IF amplifier during the spike to eliminate the pulse noise. The noise processor is very effective for short duration noise spikes in the range of 50 milliseconds or less in duration.

The Filter Board

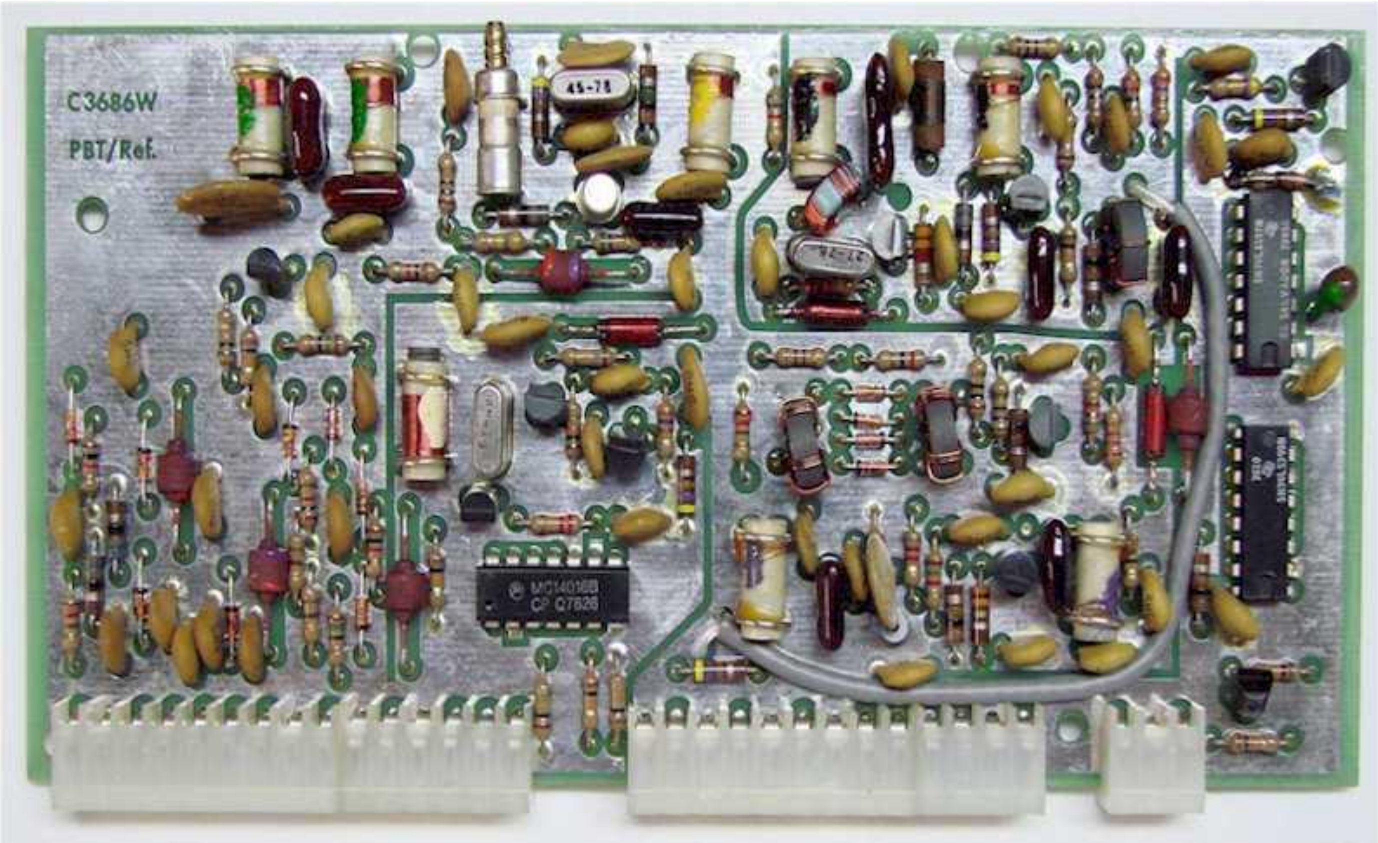


The IF Selectivity Board servers a dual function depending on transmit or receive. The board is designed to accommodate up to four different crystal filter bandwidths. The board comes standard with the 2.3Khz SSB filter mounted in the first position. The other three positions are for accessory filters which were purchased separately and installed by the end-user. The other filters available include a 6Khz or 4Khz AM filter, 1.8Khz RTTY filter (also used for a narrow SSB filter), 1000Hz RTTY filter, 500Hz CW filter and a 250Hz CW filter. Each of the accessory filters were mounted to the board and soldered in place. In the receive mode each of the filters is independently selectable from the front panel push button switches. Pictured above this board has mounted to it the SSB filter, far left, and the 500Hz CW Filter in the second position.

In the receive mode the board routes the 5.645Mhz IF signal through the selected filter to limit the bandwidth of the received signal according to the mode of operation. In the transmit mode the board was hard wired to only select the SSB filter for all transmitting modes of operation.

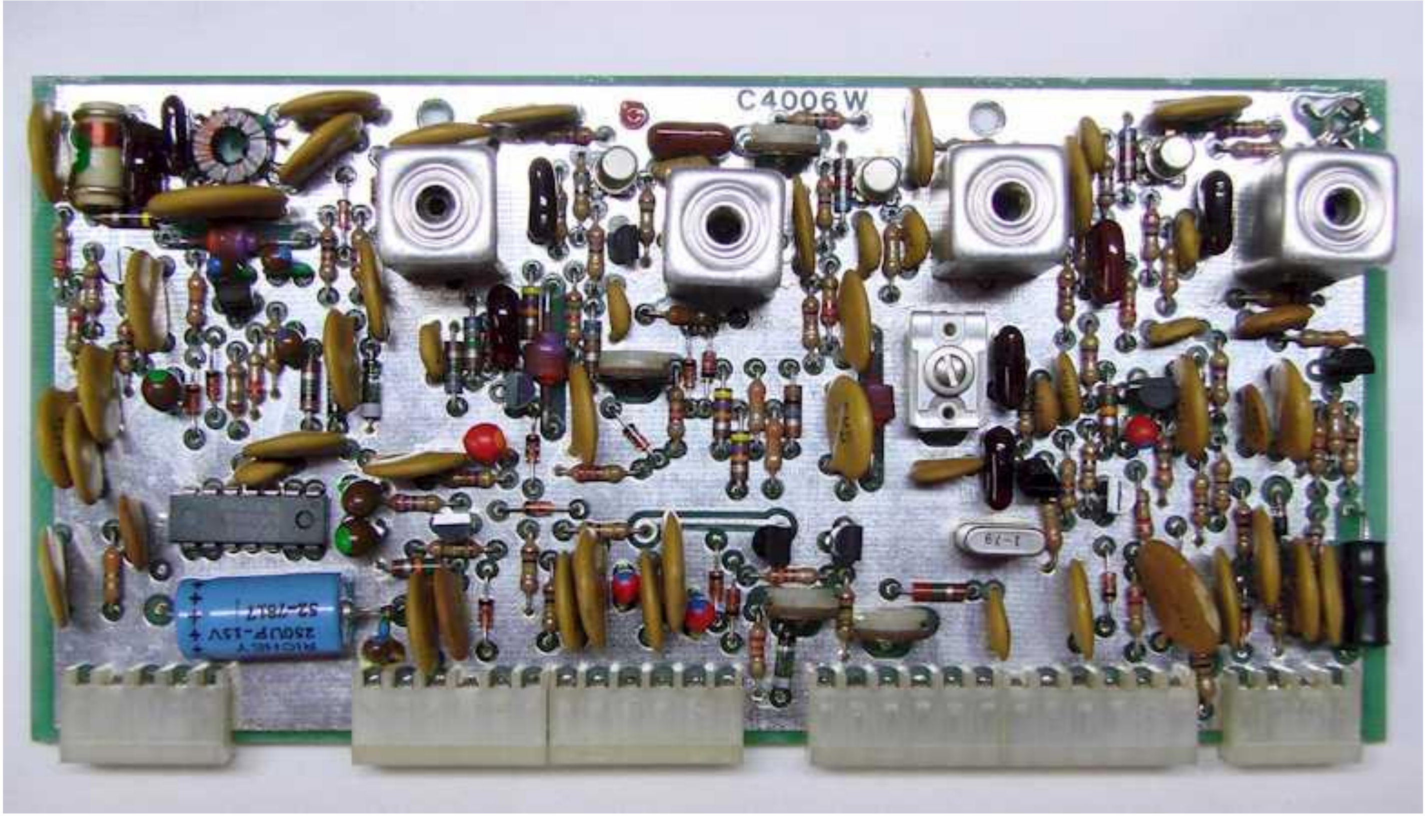
Note, that went removing the top cover shield, ultimate selectivity of the crystal filter is somewhat compromised due to outside signals leaking around the filter. Make sure the top shield cover is in place for normal operations.

The Pass-Band Tuning Board



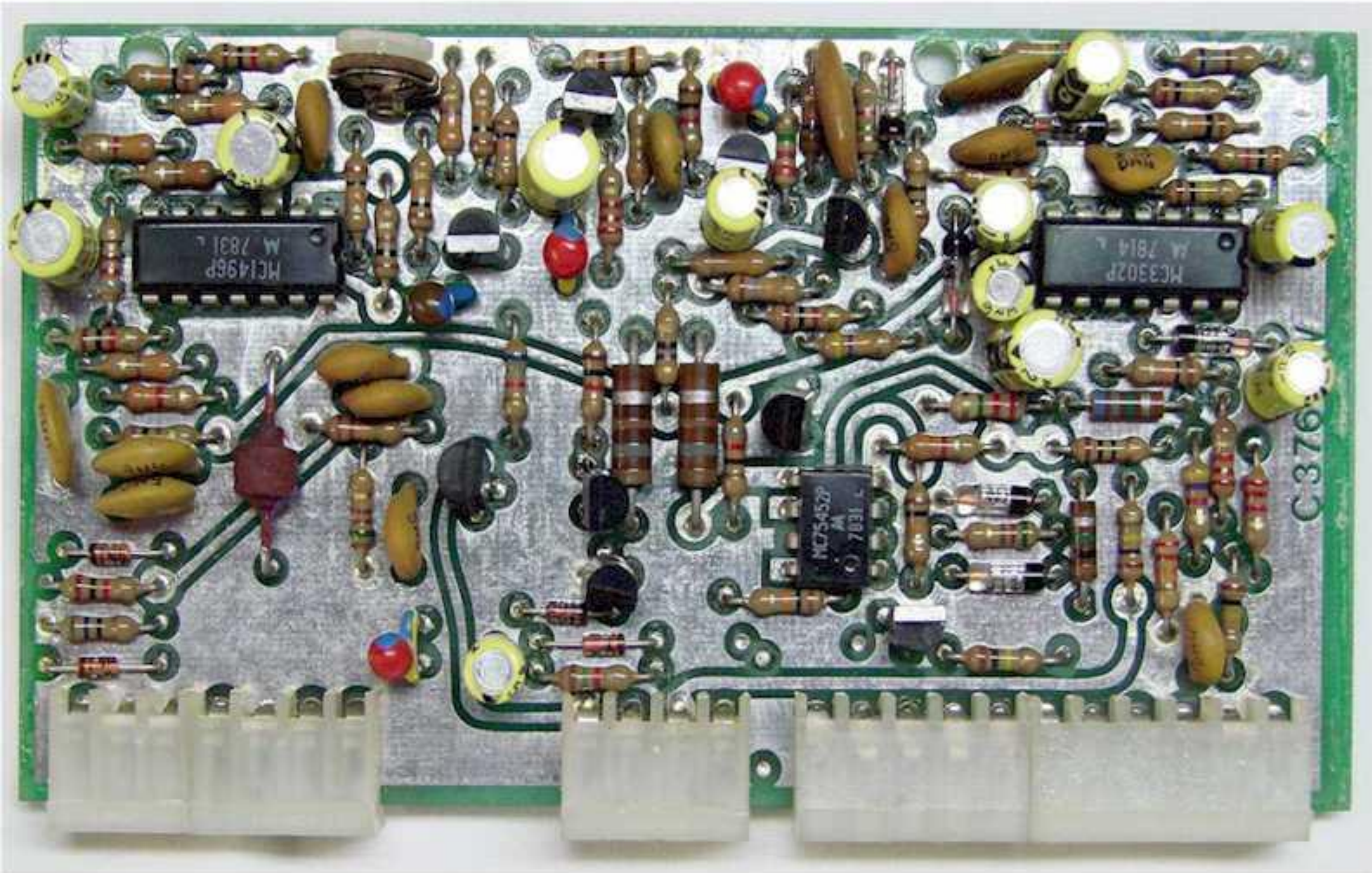
The Pass-Band Tuning Board is a multi-function board which generates the master oscillator frequency, mixer injection signals and secondary signals through a frequency divider network. In addition the board does the "Mode" function switching and controls the manual pass-band tuning adjustment. Of the many functions, this board generates the 40Mhz master oscillator signal of which most every part and function of the radio is connected to. This 40Mhz high stability crystal oscillator signal source is considered the heart beat of the radio, problems here affects all other parts and functions of the radio in some way. One output of this signal is sent to the frequency divider network which outputs the 500Khz signal for the synthesizer lock reference and a 25Khz signal used for the receiver "25Khz Calibrator" function. This boards also feeds the mixer circuits to produce the 53.696Mhz injection signal to the 2nd Mixer Board and the 5.645Mhz BFO signal to the Transmit Exciter Board. For the Pass-band Tuning function this board contains a 13.696Mhz VCXO, or Voltage Controlled Crystal Oscillator, which is capable of pulling the crystal oscillator frequency +/- 3Khz depending in the bias voltage applied. Preset bias voltages for each Mode of Operation of the radio is switched through a quad IC switch which is controlled by the front panel "Mode" switch. These voltages are preset with individual "Mode" adjustment controls located on the Power Supply Board. These preset voltages set the VCXO to the exact offset frequency for the "Mode" selected from the front panel. When the Pass-Band Tuning is set to the manual tuning mode, the front panel "Pass-Band" control varies this bias voltage controlling the VCXO frequency. This allows the receiver to be manually adjusted from the low side of the crystal filter (LSB) through the high side (USB) of the crystal filter pass-band range.

The IF/Audio Board



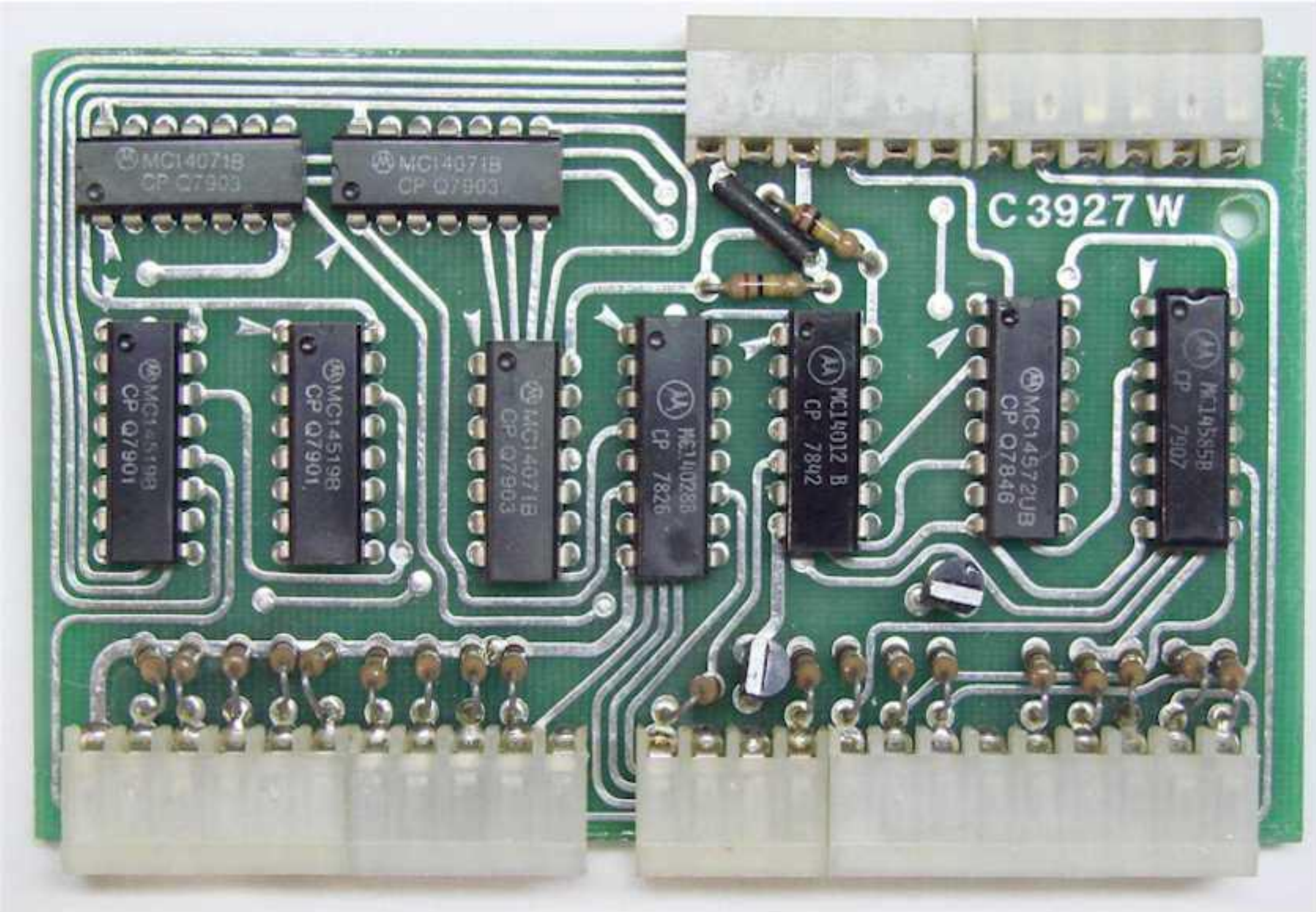
The IF/Audio Board supports multiple functions in receive and transmit modes. In the receive mode the board takes the 5.645Mhz IF signal from the Filter Board, provides additional gain and AGC control and produces a signal level voltage for the S-Meter functions. The function of the AGC (Automatic Gain Control) is to provide a constant level signal to the detector stage with varying input signal level to the receiver. The resulting output of the detector stage is demodulated receiver audio which is then sent to the audio amplifier and speaker. In the transmit mode the board uses a crystal oscillator to generated the 5.645Mhz transmit IF carrier signal. In the AM and CW modes this signal is sent directly to the Filter Board, and in the SSB and RTTY modes the signal also includes the mode frequency off-set before going to the Filter Board.

Transmit Exciter Board



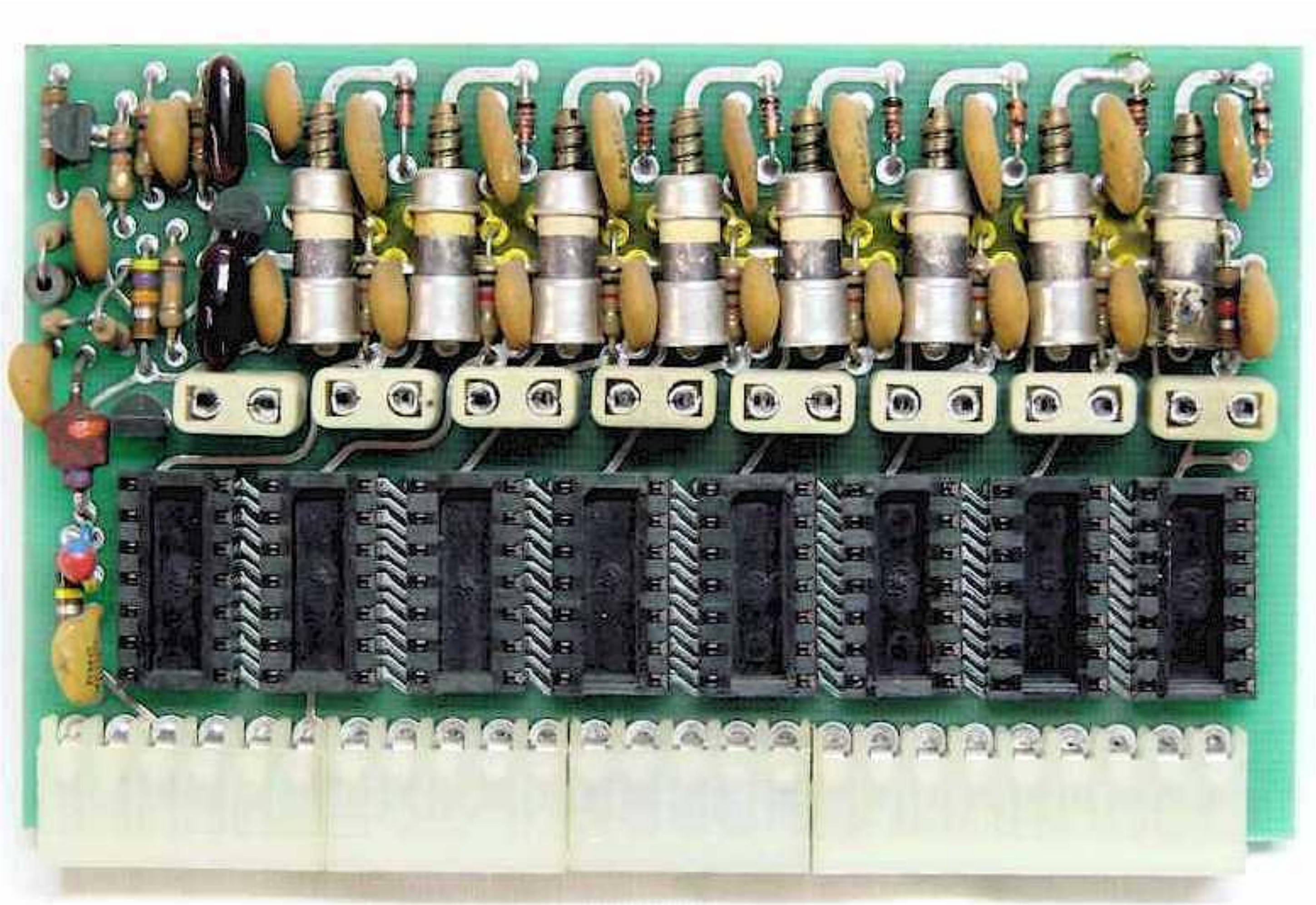
The Transmit Exciter Board provides microphone audio amplification, controls the transmitter VOX functions, produces the modulated transmit IF frequency, and provides the +10 volt transmit/receive switching. Microphone audio from the front panel connector is sent to this board where the audio is amplified and sent to the balanced modulator input and the VOX circuits. The VOX circuit is controlled through the setting of three front panel controls, VOX Gain, VOX Delay and Anti-VOX. With these adjustment the VOX circuit is adjusted to key the transmitter with signal input from the microphone, controls the transmit delay, and prevents the receiver audio from keying the transmitter. The amplifier microphone audio feeds the balance modulator and mixed with the 5.645Mhz transmit IF carrier signal from the IF/Audio board to produce a modulated transmit IF signal. The output of the balanced modulator is then sent back to the Filter Board and through the 2.3Khz SSB filter to limit the signal bandwidth of the transmit signal.

The Digital Board



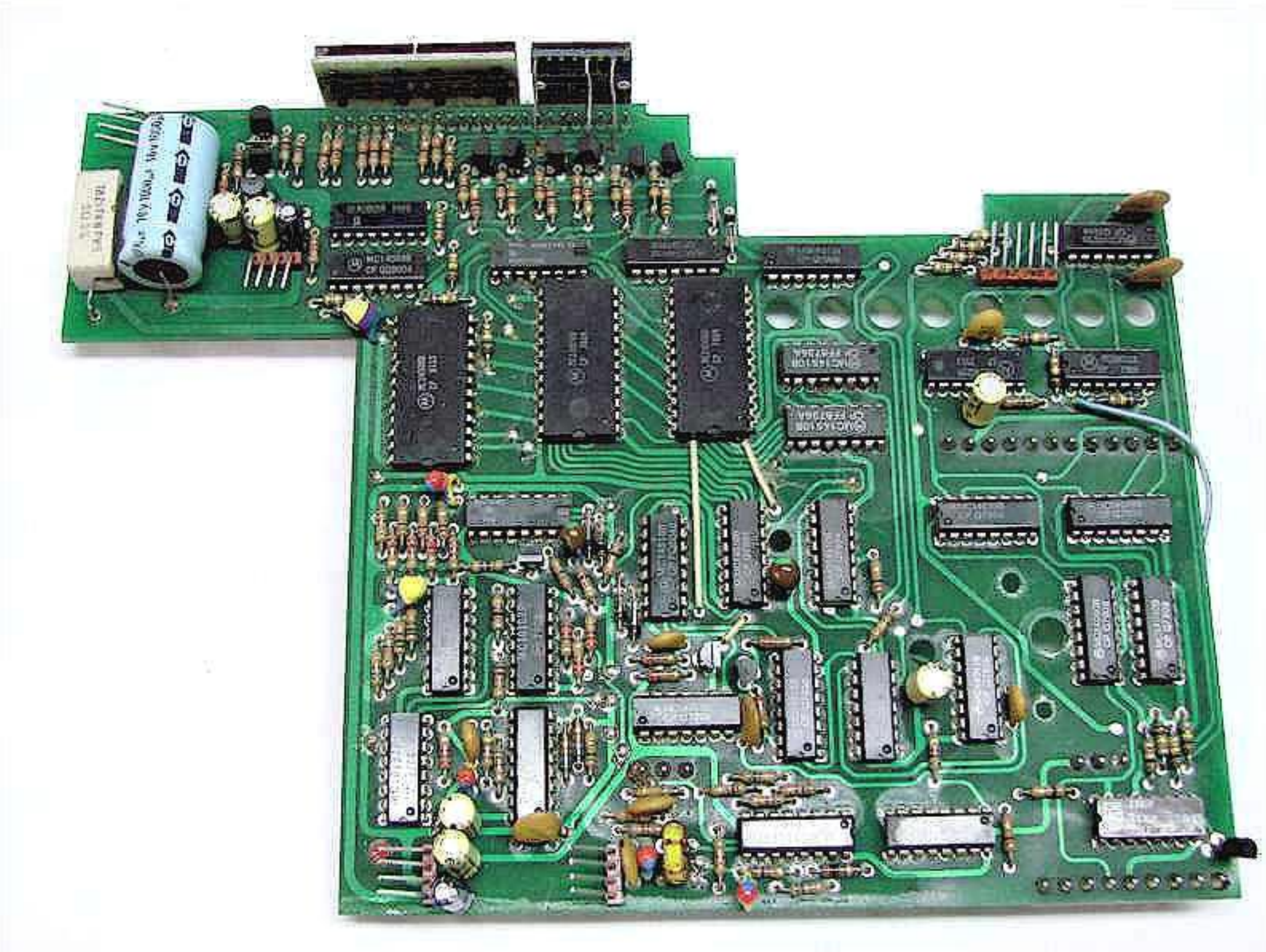
The function of the Digital Board is to decode the data from the band switch and produce the frequency range data which is then sent to the frequency synthesizer. The frequency synthesizer takes this data and produces the corresponding tuning range of the transceiver as determined from the band switch setting. This board also controls the switching between the "Normal" tuning ranges and the tuning range input from the AUX Program Board.

The AUX-7 Board



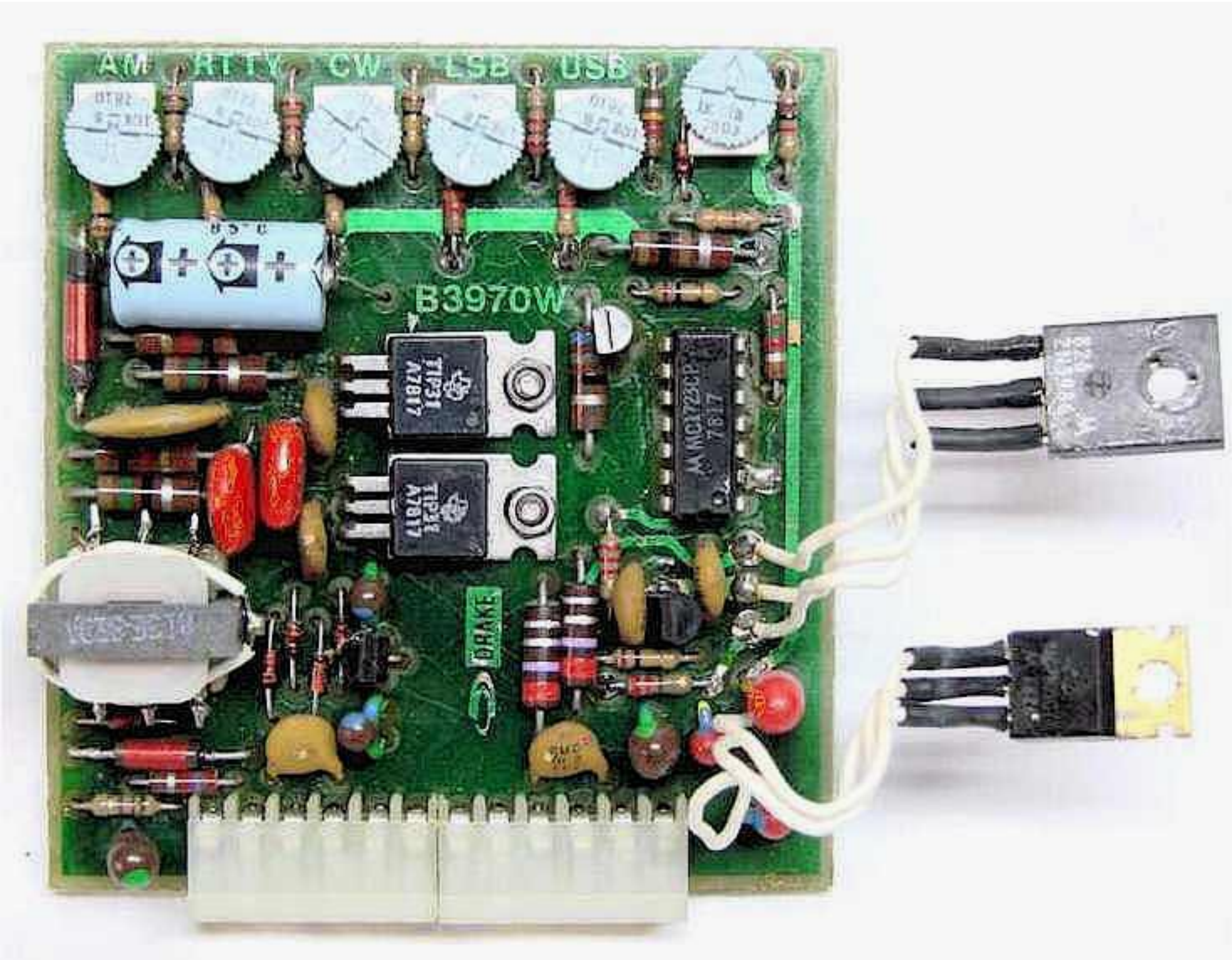
The AUX-7 Board is an accessory board that accommodates the programming for up to eight additional 500Khz tuning ranges for transmit and receive functions. The board also supports up to eight channels for fixed frequency operation. All tuning ranges and fixed channels are selectable from the front panel "AUX Programming" switch. The eight 500Khz tuning ranges are programmable using the plug-in diode array modules. Each of the eight fixed frequencies are crystal controlled by installing the appropriate crystal on the board. Each crystal position has an individual trim capacitor to zero in the correct frequency.

The Digital Display Board



The Digital Display Board provides two major functions for the transceiver. First it provides full frequency coverage for all frequencies from 500Khz to 30Mhz and generates the frequency range data beyond the Amateur Radio bands. Second, the board displays the operating frequency in a digital format. Both functions work independently of each other, a failure in one section does not affect the other. This board mounts over the top of other circuit boards plugged into the Parent Board. Because of the board size and mounting makes this board very difficult to remove and replace. The board must be precisely placed to fit the front panel display and align the pins on the bottom side. Take care when removing or installing this board, its very easy to misalign the bottom side pins. Applying power with this board not properly installed could cause significant damage to the board and the transceiver.

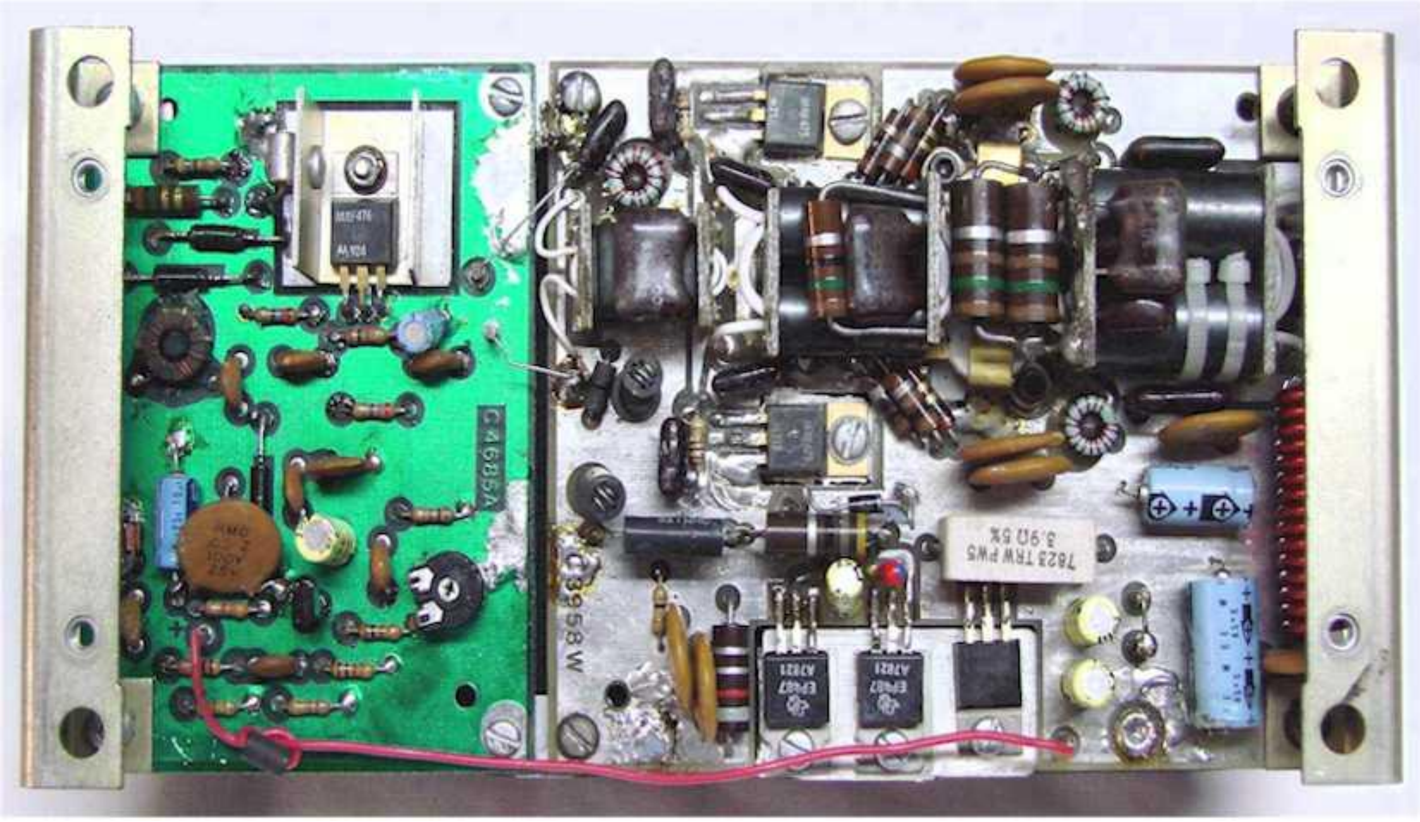
The Power Supply Board



The Power Supply Board takes the primary input power, typically 13.8VDC, and outputs four different voltage levels. The +10VDC and +5VDC outputs are internally regulated on the board. The +24VDC and the -5VDC are unregulated and are produced from a DC to DC inverter circuit running at 23Khz. This DC inverter circuit included the two board mounted transistors in the center of the board and the small transformer on the right side near the bottom.

The Power Supply Board also contains the voltage divider adjustments for the fixed pass-band tuning control lines. These adjustments are the transceiver mode fixed frequency off-set adjustments that fine-tune the offset to the exact frequency. There are separate frequency adjustments for the AM, RTTY, CW, LSB, and USB modes.

The Power Amplifier

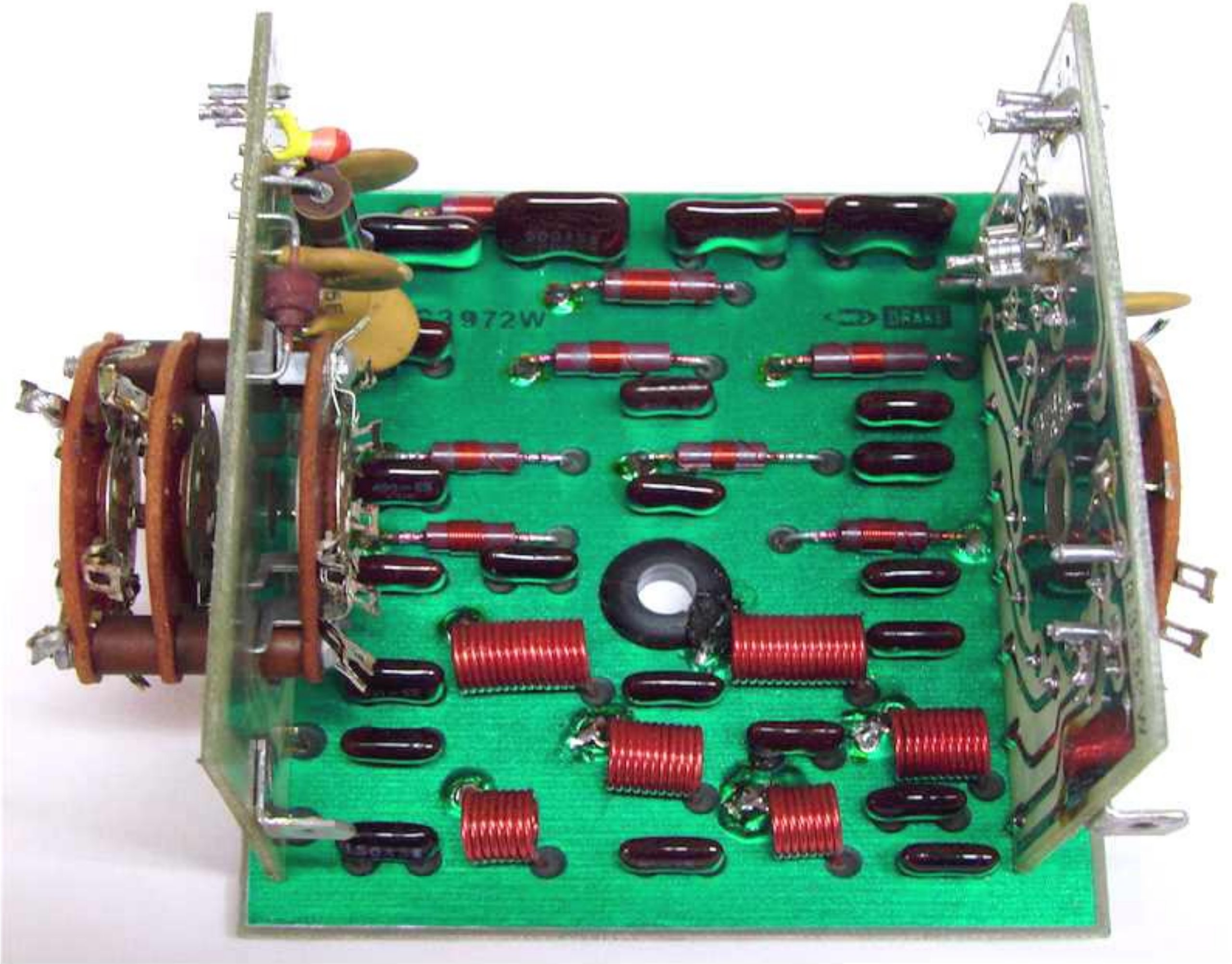


The Power Amplifier Board consists of two separate circuit boards mounted to a large heat sink. The Pre-driver Board on the left side of the picture amplifies the transmit signal to a sufficient level to drive the power amplifier board. The output drive level is controlled from the on-board drive level control. This board operated at 13.8VDC and is switched on during the transmit mode through the relay mounted on the Low-Pass Filter Board.

The power amplifier board, right side in picture, has a pair of driver and final amplifier transistors. Each transistor pair operates in push-pull to provide a good balance for proper circuit gain and flatness across all frequencies from 1.8 to 30Mhz. The 13.8VDC supply voltage for the amplifier is connected directly to primary power and is not switched. The bias circuit, transistors across the bottom of the board in the picture, provide sufficient bias to to hold the amplifier transistors in cut-off during receive mode.

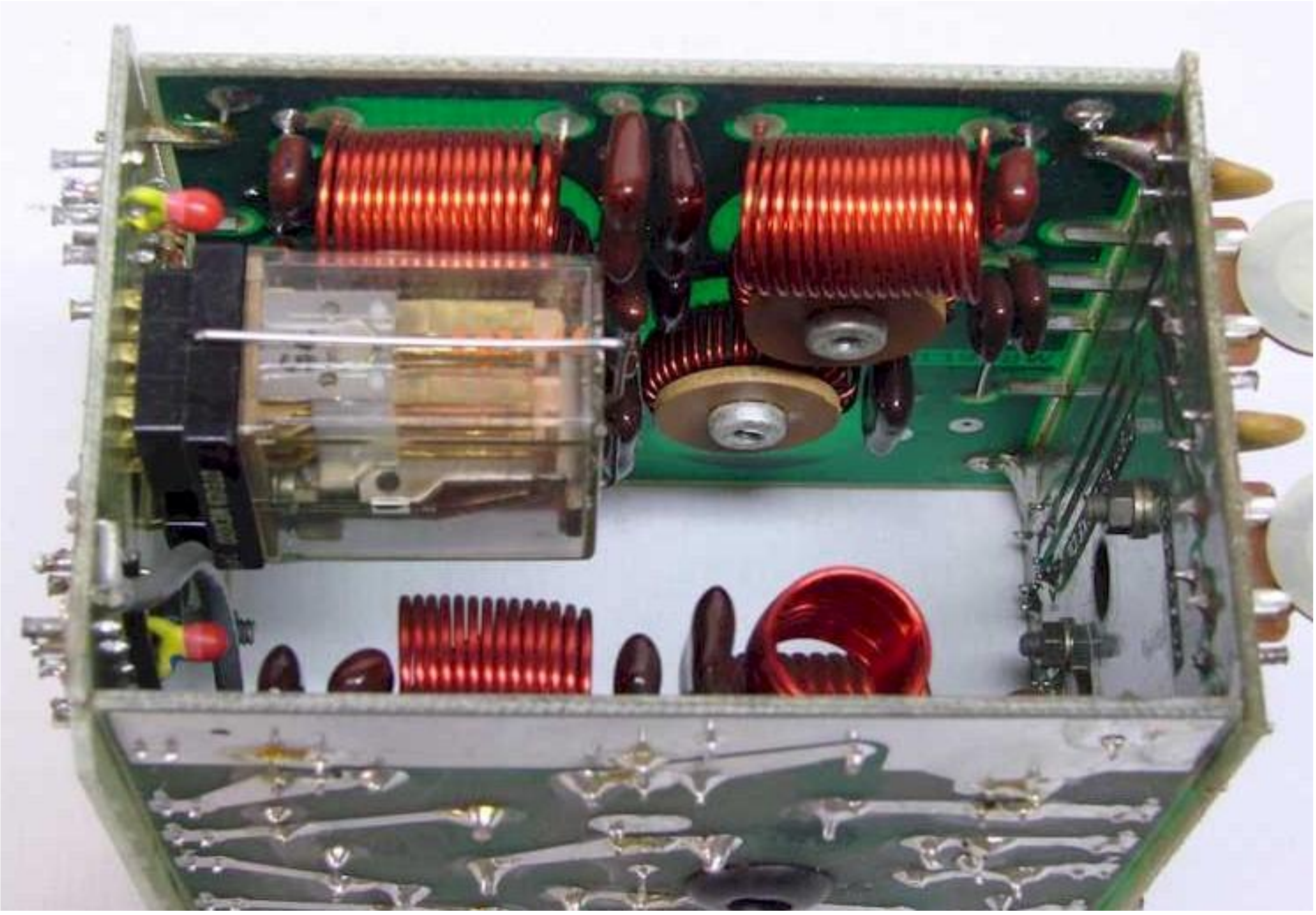
The Power Amplifier Board takes a very low level signal, typically between 100 and 200 millivolts, from the radio and amplifies that to well over 100 watts of output power. The ALC circuit, located on the High-Pass Filter Board controls the overall gain of the Pre-driver Board to limit the output power to around 100-120 watts output. Even though this amplifier is capable of producing power levels greatly exceeding 100 watts, its not recommended. Running higher power levels over time will significantly shorten the life of the transistors. Typical output power levels of the transceiver are 110-125 watts on all bands below 15 meters, and 80 to 100 watts on all bands 15 meters and above.

High-Pass Filter Boards

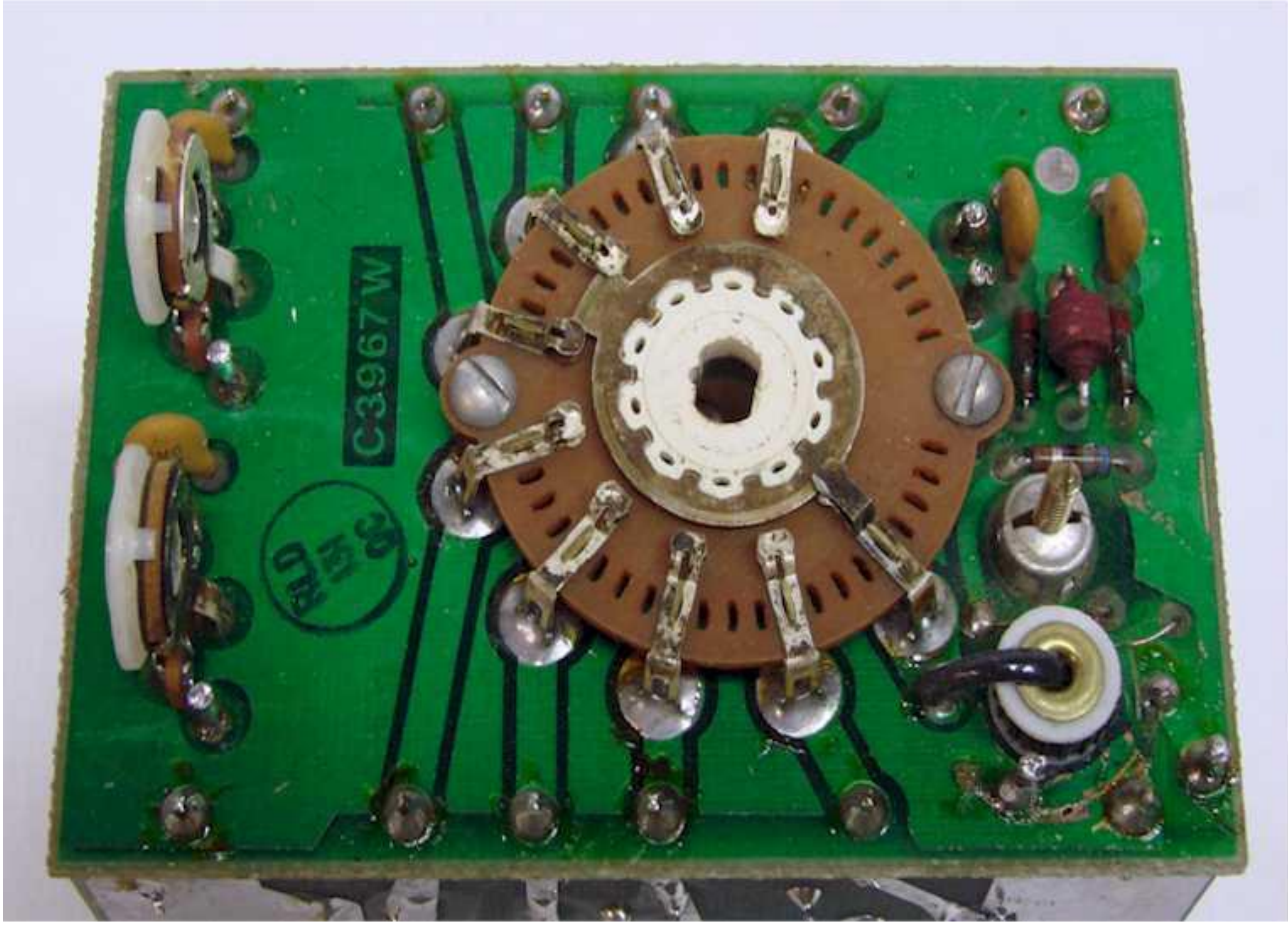


The High-Pass Filter Board consists of three separated boards. The front and rear boards form seven different pass-band filter circuits which are switched into the signal path with the Band Switch. There is a separate filter for each of the major band segments except for the two lowest bands which are switched straight-through. In the receive mode this filter board connects the antenna to the Up-Converter Board and controls the pin-diode signal switching for the 25Khz Calibrator signal insertion. In the transmit mode the signal from the Up-Converter Board is pin-diode signal switched to the Power Amplifier Module.

Low-Pass Filter Boards



The Low-Pass Filter is a 4 board configuration, T/R Relay on the left.



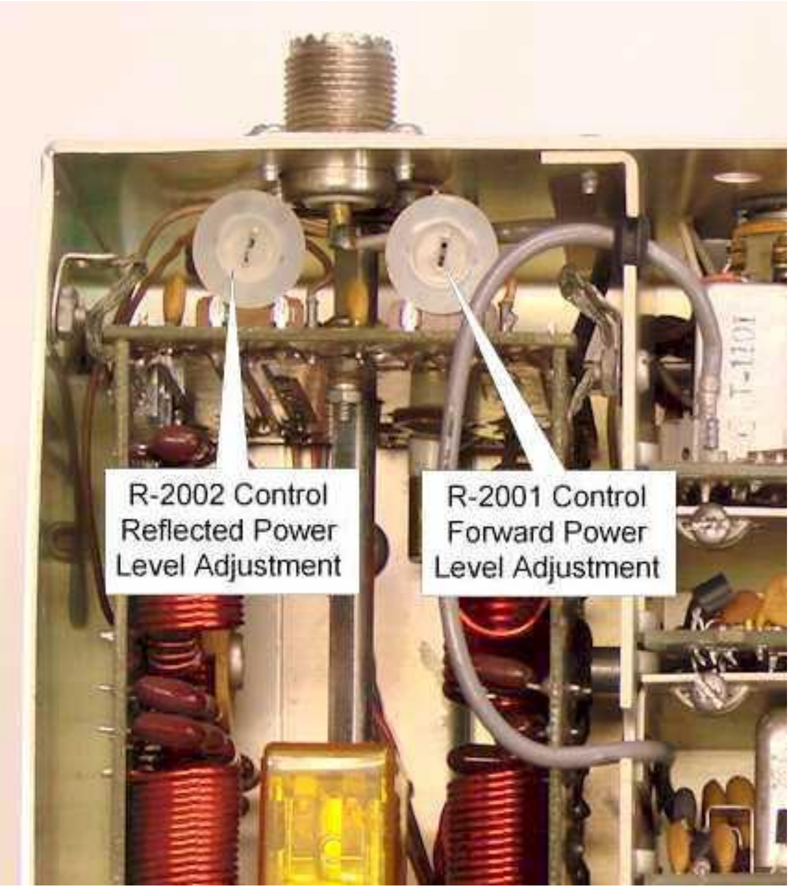
The Low-Pass Filter output side showing the Watt Meter adjustments on the left.

The Low-Pass Filter Board consists of four separated boards. The front and rear boards are switching boards ganged to the Band Switch and selects one of eight filters and routes the signal through the transmit/receive (T/R) relay to the watt meter circuit and antenna connector. The T/R relay provides antenna switching, linear amplifier key switching and external receiver muting. The other two boards form the eight individual low-pass filters which are switched into the signal path by the front and rear switch boards.

The ALC Board

The ALC Board (Automatic Level Control) takes inputs from the forward and reflected wattmeter and the linear amplifier and provides an output that controls the variable attenuator on the 2nd IF/Audio Board. The purpose of this board is to control the drive level of the Power Amplifier to prevent signal flat-topping and provide high VSWR protection caused by an antenna mismatch. This board also lights the green front panel LED when the ALC circuit is operating.

Making Basic Adjustments To The TR-7 Transceiver Power Meter Calibration

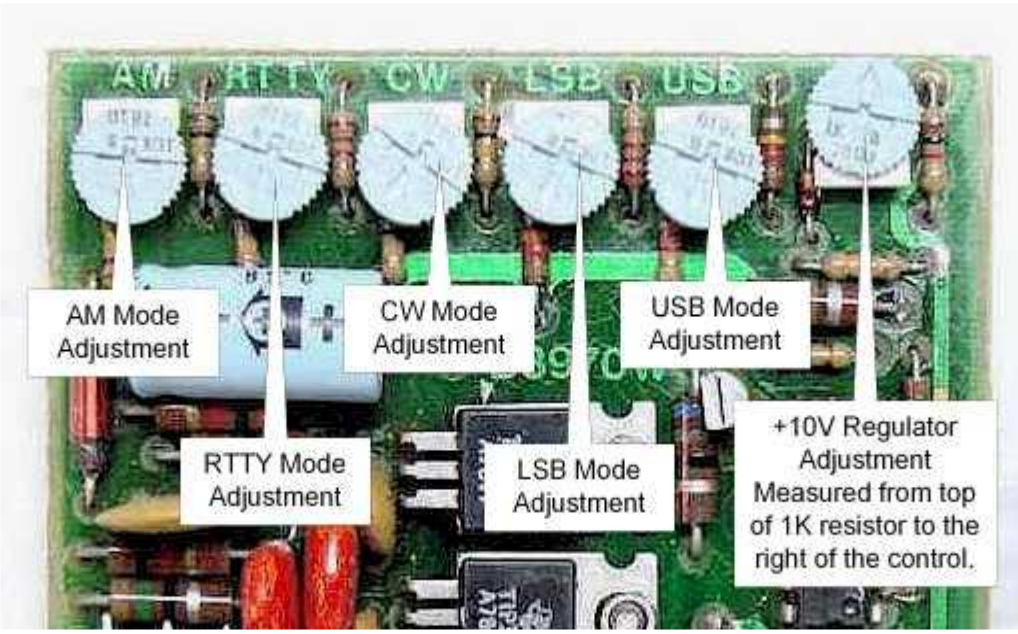


To calibrate the internal Watt Meter you will need an external Watt Meter with know accuracy like a Bird Model 43 Watt Meter with a 100 watt or higher element for the 3-30Mhz range. Connect your known accurate watt meter to the antenna connector and a 50 ohm dummy load to the other side of the watt meter. Set the transceiver to the 14Mhz band and select the CW mode. Next key the transmitter and using the front panel Carrier Level control adjust the power output to exactly 100 watts as indicated on the external watt meter. While the transmitter is still keyed adjust R2001 on the Low-Pass Filter Board until the internal transceiver watt meter indicates 100 watts. Make sure the front panel watt meter switch is set to the "Forward" position before making the adjustment. Do not keep the transmitter keyed for more that a few seconds at a time to prevent over heating the power amplifier. Next remove the antenna connection to the external watt meter. Quickly key the transmitter and turn down the power level using the Carrier Level control until the green ALC lamp goes out. At that point take note where the internal watt meter in indicating with the "Forward" position. Next select the "Reflected" position and set R-2002 on the Low-Pass Filter Board to the same internal watt meter indication as noted in the "Forward" position.

RIT Centering Adjustment

To calibrate the front panel RIT control, first turn "ON" the RIT function and set the RIT knob pointer to the center, or straight-up position. Then zero-beat the receiver to the internal calibrator signal and the nearest 25khz increments. Once you set the zero-beat, then turn "OFF" the RIT function and adjust control R-24 on the Parent Board to zero-beat with the internal calibrator signal. R-24 is located on the Parent Board just behind the PTO as shown in the picture with the Display Board removed. There is also an access hole on the Parent Board from the bottom side to access R-24 with the Display Board mounted in position.

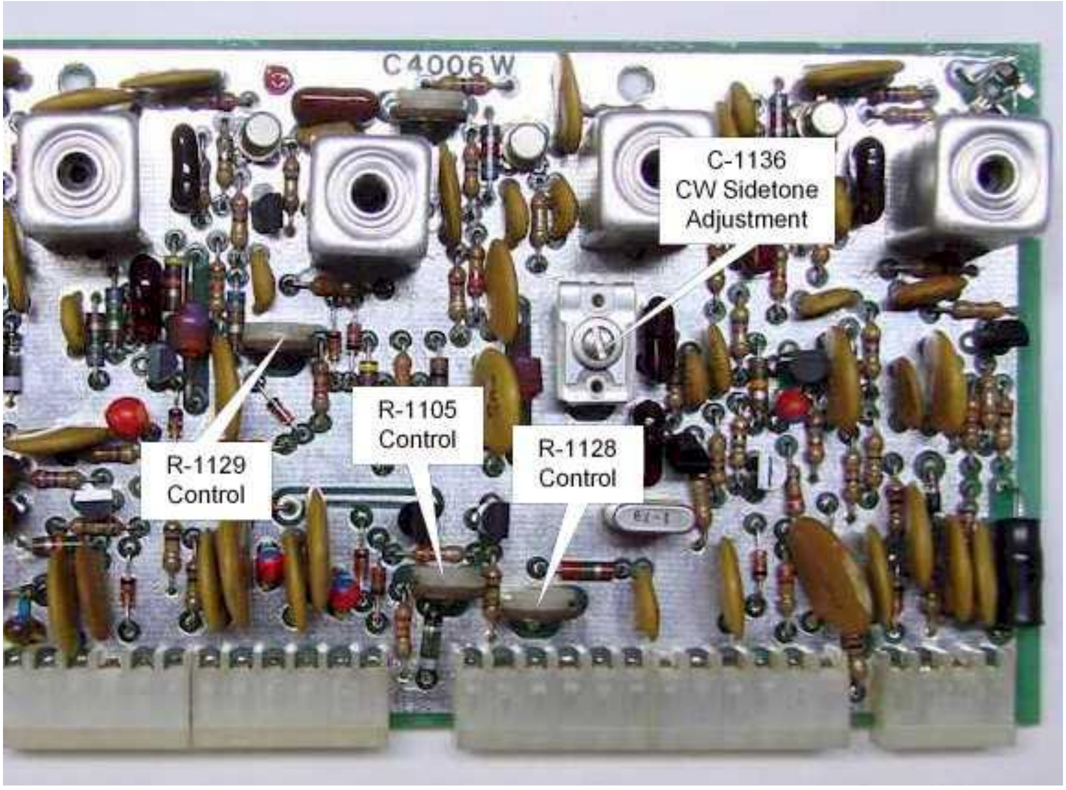
Mode Frequency Adjustments



Each of the mode adjustments is a voltage adjustment which is sent to the Pass-Band Tuning Board to fine tune the radio to the exact offset. Since all these voltages are derived from the +10 volt regulator, before making these mode adjustments, first make sure the +10 volt regulator is set to exactly 10 volts. To set the +10 volt regulator use a digital volt meter attached to the 1K resistor lead at the top right corner of the board adjacent to the regulator circuit adjustment. Next adjust the mode controls, first select the desired mode with the front panel switch, and make sure the PBT button is released. Next tune the receiver to the exact frequency which corresponds with the selected mode as shown below. As the receiver approaches the desired frequency a beat note will be heard. The beat note should be set to zero when the receiver is on the right frequency. It may be necessary to turn up the audio to hear the beat note when it approaches "zero-beat" because the tuning will be on the edge of the filters bandwidth. Selecting a wide bandwidth filter like the AM mode filter will increase your ability to hear the beat note.

AM = 13,695.0Mhz RTTY=13,697.5Mhz CW=13,694.2Mhz LSB=13,696.4Mhz USB=13,693.6Mhz

S-Meter, IF gain, and CW Mode Off-Set Adjustments



To make the S-Meter adjustments first remove the rear cage area top cover. Next select the AM mode and remove the antenna connection. The AM mode is used to prevent the BFO signal leakage from interfering with the adjustment. Next turn R-1128 (Meter Zero) fully clockwise. Next turn R-1129 (AGC Pedestal) fully clockwise. Next turn R-1129 counter-clockwise until the S-Meter level increase by two S-Units. Next adjust R-1128 for an S-Meter reading between 0 and 1 S-Unit, make sure its at least slightly above the zero. Next turn the front panel RF gain control fully counter-clockwise. Then adjust R-1105 (Meter Sensitivity) for a full scale S-Meter reading of 80dB. Now turn the RF Gain control fully clockwise and make sure the S-Meter reading is still between 0 and 1 S-Unit. If it is not, repeat the alignment procedure again. Because of the interaction between the controls it may be necessary to go through the alignment procedure a couple of times.

To adjust the CW side-tone offset select the CW mode and key the transmitter, make sure the power level is turned to a low level setting so not to damage the Power Amplifier. While the transmitter is keyed adjust C-1136 for an 800Hz side-tone. The C-1136 is accessible through the CW jack on the rear panel. Using a small metal screwdriver you can key the transmitter and make this adjustment through the CW key jack.

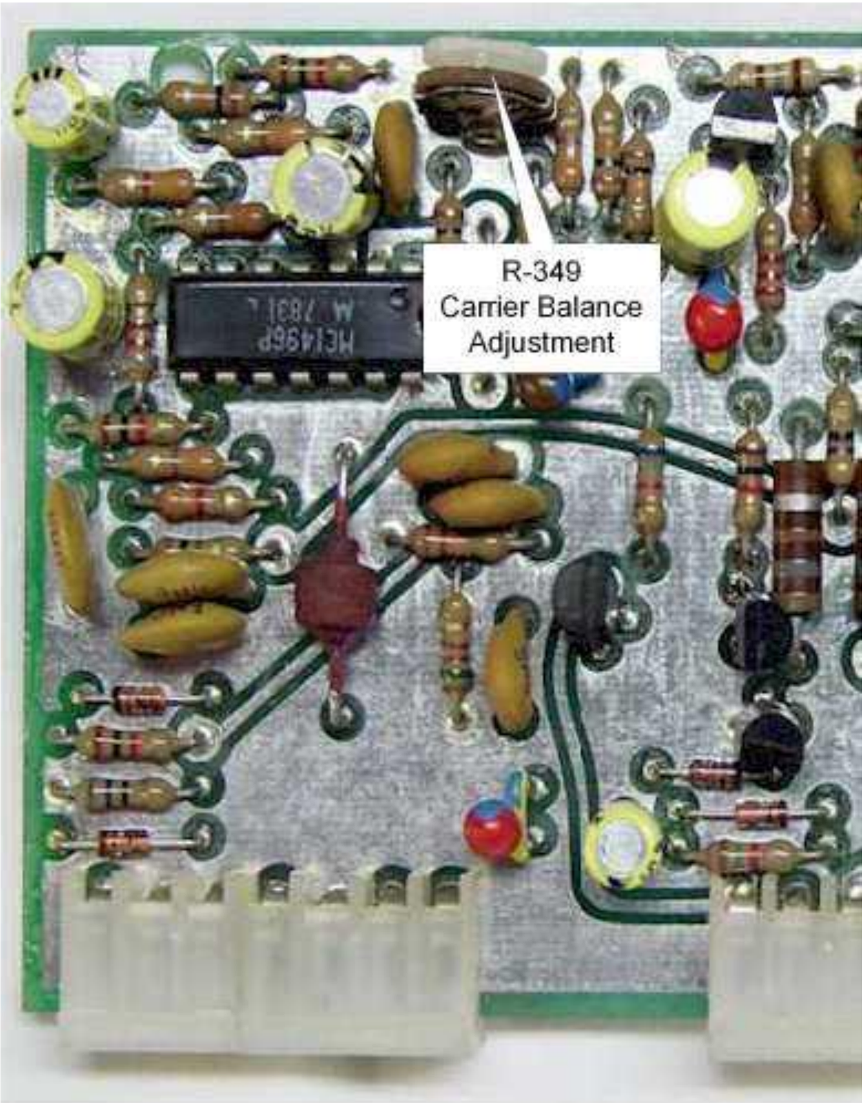
ALC Adjustment

To adjust the transmitter ALC, select the 14Mhz band, and select the CW mode. Connect a 50 ohm dummy load to the antenna connector. Next key the transmitter and turn the Carrier Level control to maximum output. Next adjust R-1613 on the ALC Board, which is mounted to the Low-Pass Filter Board, to between 140 and 150 watts output. Un-key the transmitter and set the Band Switch to the 28.5Mhz band. With the Carrier Level control still at maximum, adjust the R-2227 control on the power amplifier Predriver Board to a point where the front panel green ALC light just goes out. Do not adjust R-2227 beyond this point or transmitter instability will result. The picture shows the R-1613 on the ALC Board. Refer to the Power Amplifier section on page 7 of this article for the location of the R-2227 control on the Predriver Board of the Power Amplifier.

Transmit Carrier Balance Adjustment

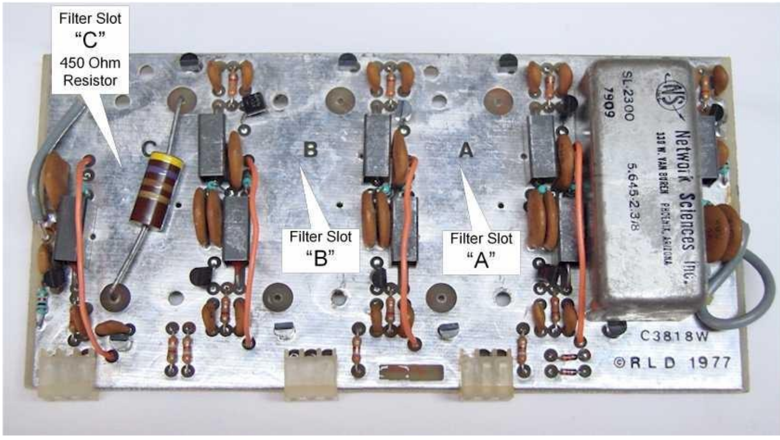
This adjustment minimizes the transmitter carrier level signal in the LSB and USB modes. The best way to make this adjustment is by using an external receiver tuned to the transceiver's transmit frequency. To make the adjustment first select the USB mode and turn the Microphone Gain control to minimum or counter-clockwise. Next key the transmitter and listen to the signal with the other receiver. If the Carrier Balance needs adjustment you will hear a low level signal. Adjust R-349, located on the Transmit Exciter Board, for minimum signal level. Even after this adjustment has been set to minimum in some cases a small amount of signal still may be detectable.

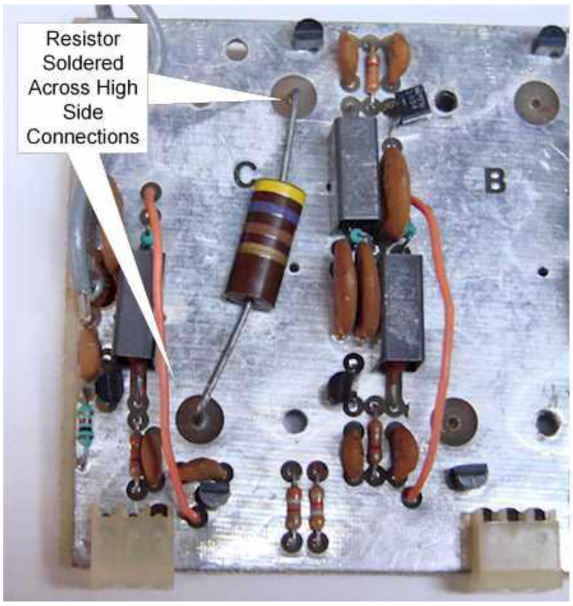
This adjustment can also be made by sampling the transmit signal at the antenna connection with a RF Voltmeter or oscilloscope. If you use this method make sure the transmitter is properly terminated into a 50 ohm load.



Poor Man's AM Filter Modification

The TR-7 Filter Board comes standard with only the 2.3Khz filter installed. The board has three additional slot to add additional filters. The slots are labeled "A", "B", and "C" which are selected with the front panel Bandwidth Switches. The accessory filter options include a 250Hz and 500Hz CW filter, 1000Hz and 1800Hz RTTY filter and a 4Khz and 6Khz AM filter. The AM filters are hard to find and expensive when you do find them. One option called the "Poor Man's AM Filter" is simply adding a 450 ohm resistor across the filter high side connections of any open slot. With this modification and the filter slot selected, allows the receiver to pass a wide band signal for AM reception. The downside to this modification, the bandwidth is somewhat wider than the 6Khz AM filter and has significantly less ability to reject adjacent frequency interference. One the positive side it provides wide band high quality AM reception, and provide excellent audio when using the 500Khz to 1.5Mhz AM broadcast bands.

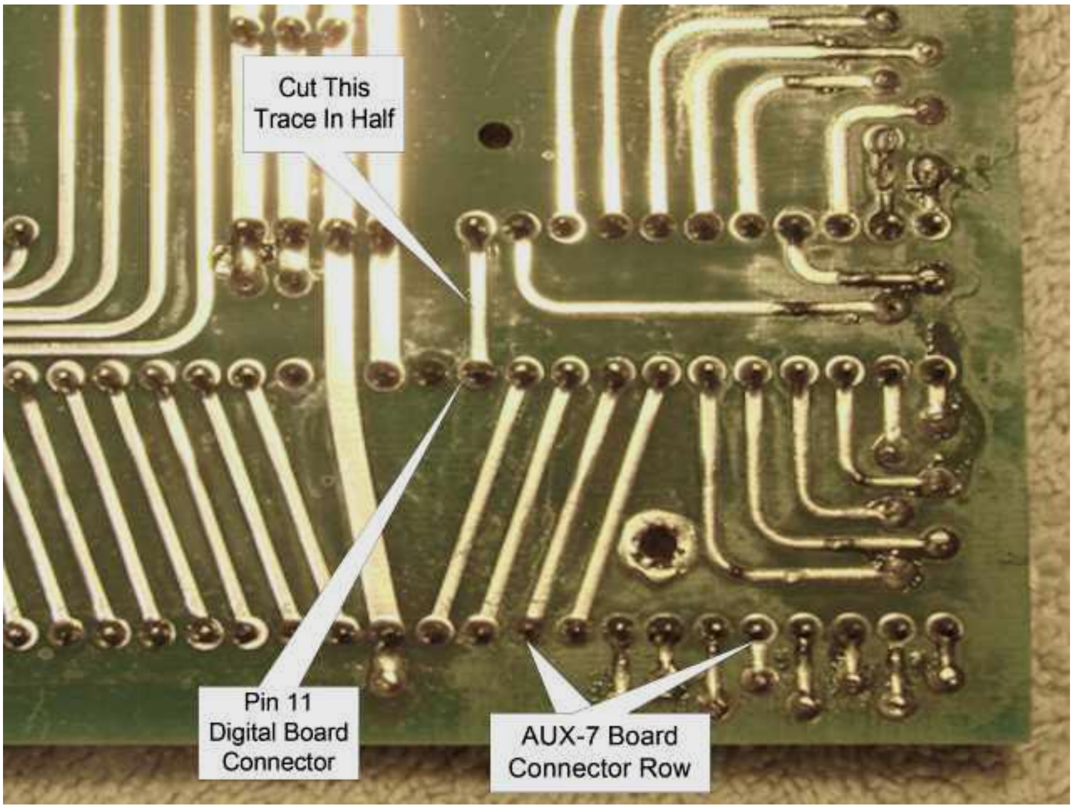


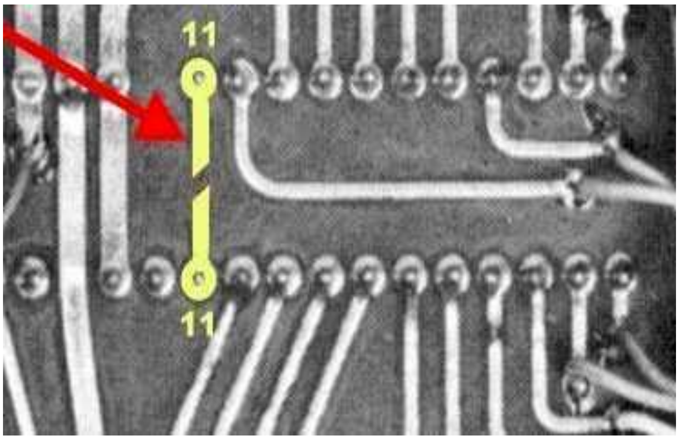


The picture on the left is a close-up of the wide band AM mode modification. Shown here is a 450 ohm resistor, but a lower value such as a 150 ohm resistor will also work fine. In some cases the lower value will allow a little more signal to pass but may be more prone to overloading the receiver with a strong signal. The larger value will pass less signal and is less susceptible to receiver overloading. The higher value would be better choice for radios which exhibits high signal gain or considered a 'Hot" receiver. In this picture a 2 watt, 450 ohm resistor installed in slot "C". Any wattage resistor will work since the power rating is not a factor, and can be installed in any open slot. The 2 watt resistor is typically used because the lead size is approximately the same size as the filter pins which makes a nice fit.

All Band Transmit Modification

The TR-7 transceiver was originally designed to transmit on all bands between 1.8Mhz to 30Mhz. However the transmitter was disabled from transmitting outside the established Amateur Radio bands with an inhibit circuit on the Digital Board. To work around the inhibit circuit Drake produced the AUX-7 Board accessory. This board would allow out of band transmitting with a programmable IC module setup for the proper band. Out of band 500Khz segments was then accessible by selecting the programmed module using the front panel "AUX Program" switch. The band programmable module plugged into one of eight IC sockets along the bottom of the board. Shortly after the transceiver was on the market the ham community discovered a simple work-around modification to disable the inhibit circuit allowing all-band transmission capability without the need for the AUX-7 Board or the programmable modules.





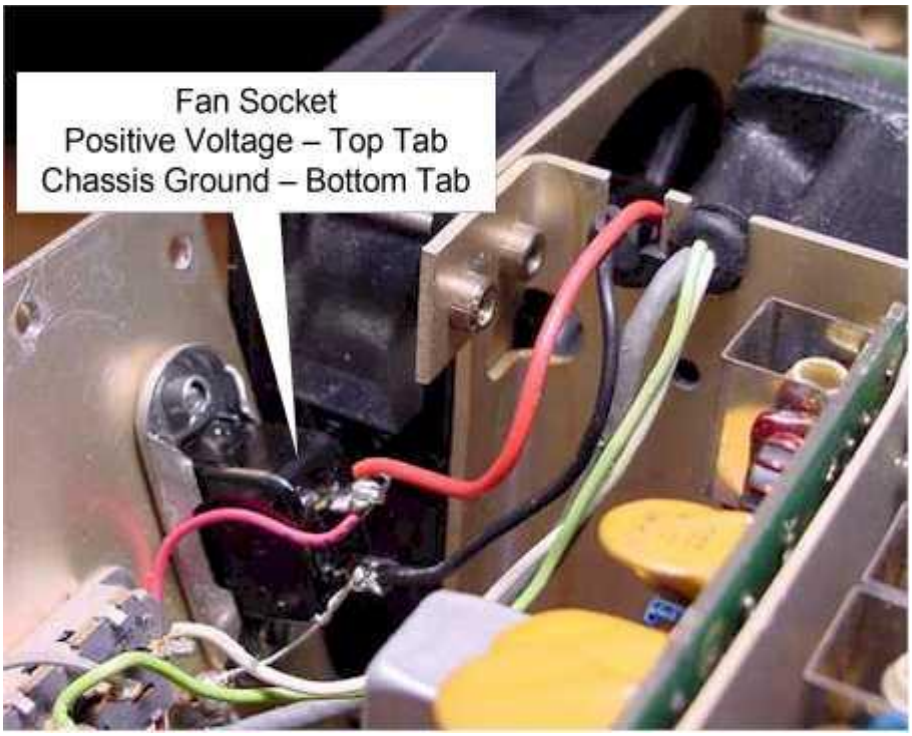
The modification is as simple as cutting one circuit trace on the Parent Board. The trace you cut runs between pin 11 of the Digital Board connector and pin 11 of the Transmit Exciter Board. From the bottom of the transceiver locate the copper trace as shown in the picture. The location is along the the front edge, right corner, looking at the radio bottom side up. Using a razor blade cut the trace halfway between the board connectors as shown in the picture. Once this trace is cut the TR-7 transceiver is capable of transmitting on any frequency tuned on the display or VFO setting. This modification will now allow you to operate on all the new WARC bands. Just remember, "KEEP IT LEGAL", operate only in the approved Amateur Radio bands. The TR-7 in not FCC type-accepted to operate outside the Amateur Radio bands.

TR-7 Quiet Fan Modification

The original Drake FA-7 Fan option was intended to be used for the extended transmit mode like RTTY and AM. Under normal SSB and CW operations the fan option wasn't required, though possibly needed for heavy "contesting" type of use. When the Drake FA-7 fan accessory was installed it did a good job keeping the radio cool, however it was a noisy fan. The constant roaring noise level was objectionable in an otherwise quiet ham shack. Several modification surfaced which seemed to help but required modifying the radio, adding parts and in some cases an entire circuit board to control the fan. Though effective in reducing the noise most were not simple installation. The basic problem was the fan ran from 110VAC which being an AC motor made it harder to electronically control or switch. Also, the FA-7 fan ran the entire time the transceiver was powered on whether cooling was needed or not.

I wanted to come up with a fan modification that cooled, was quiet and easy to install without modifying the transceiver. This way the modification could be quickly removed putting the radio back into its original condition. First I decided to use a DC powered fan and it had to be the same size as the FA-7 for mounting purposes. The fan itself is a standard 5" box fan available in a wide variety of operating voltages. I first tried using a 12VDC fan but found the noise level to be about the same as the original FA-7 fan. For 90% of all transmitting conditions the high velocity fan was an over-kill, so I went with a 24VDC fan operating at 12VDC to lower the RPM's. The 24VDC fan starts up and runs fine on 12VDC. It also runs slower and much quieter and still provided sufficient air flow to keep the radio cool under extended transmitting modes.

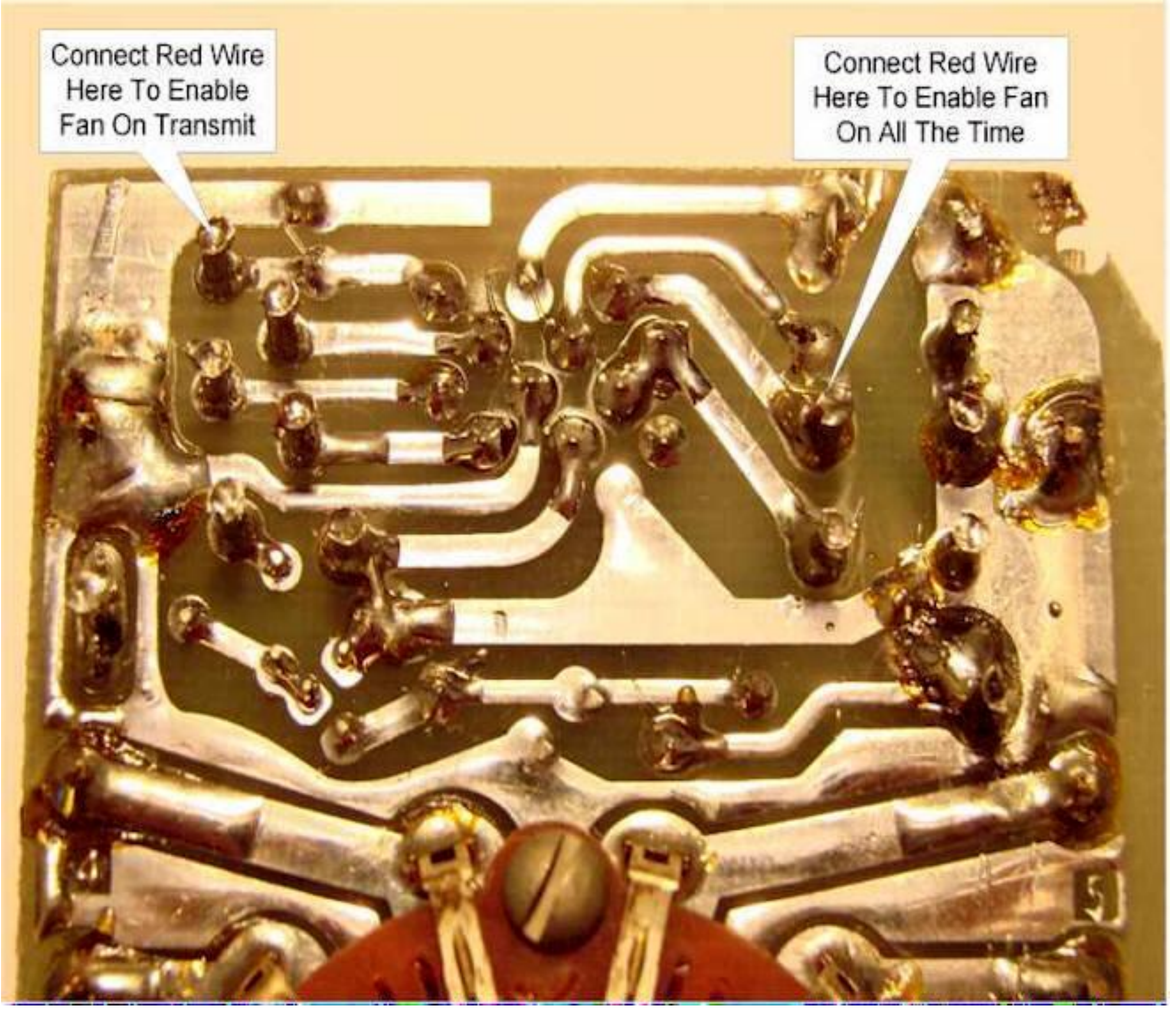
Now there at two different thoughts on two different subjects around the installation and operation of the fan. Should the fan blow inward or outward, and should it run all the time or just during transmit. Blowing in or out is more a personal choice and everyone has an opinion on that subject. Since the fan mounts either way, that choice is your decision. Powering the fan you will need to decide whether you want it on all the time or on only during transmit, the wiring difference is where you place the red positive power lead. I choose to have the fan blow inward and to run all the time because the fan noise is just a whisper, and virtually undetectable. The constant air flow keeps the radio at a more even temperature for better operating stability.



This picture shows the back side of the fan connector This show the tight area behind the antenna relay

Before starting make sure the radio is completely disconnected from all power. In this modification I used the "FAN" receptacle next to the fan. First I cut back and tape both of the existing wires connected to the two terminals. Tape well because there is 110VAC across those wires when using the PS-7 Power Supply. Next route the red & black fan power leads through the fan blade opening and over the divider as shown in the picture. Next cut the leads to length leaving some slack and solder the black wire to the lower terminal and the red wire to the upper terminal. Next take a small length of wire and solder one end to the lower terminal where the black wire is attached. Solder the other end to the chassis ground terminal just to the left of the fan connector. Next take a long length of red wire and solder that to the upper connection where the red fan lead wire is soldered. Route the length of wire across the back of the panel to the other side bringing the end in front of the low pass filter, input board, where the antenna relay is mounted.

On the back side of the antenna relay board you have two terminals providing switched and unswitched +12VDC. Solder the red wire to the unswitched voltage terminal for continuous fan operation and to the switched voltage terminal to operate the fan during transmit only. See close-up picture of this area for the exact terminal. Working in this area is very tight and can be difficult to access.

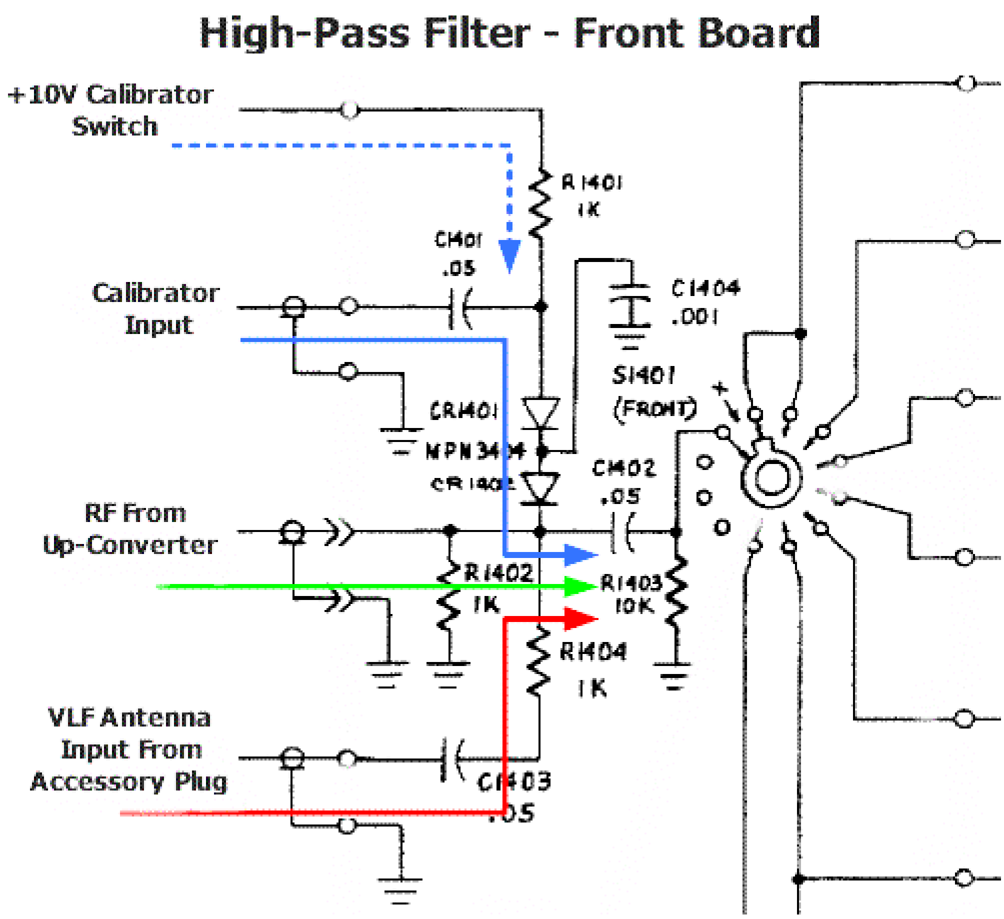


After this connection is made, recheck the installation and reassemble the radio. The fan connector now also serves as a +12DVC low current power source with continuous or switched +12VDC depending on how the fan was wired.

The TR-7 "Pin Diode" Dilemma

The infamous and ever eluding TR-7 "pin diode" problem is probably the single most difficult repair to make in the radio. Troubleshooting and finding the pin diodes is the easy part, getting at then to replace is a definite challenge. The pin diodes are found on the High-Pass Filter assembly, just behind the S-meter and in the same compartment with the internal speaker. The pin diodes are used for low level signal switching for the 25Khz Calibrator on the front board of the filter assembly, and on the rear board, low level signal switching to and from the Up-Converter. The front board is the board closest to the front of the radio directly behind the S-Meter. The rear board is located on the other end of the filter assembly.

High-Pass Filter - Front Board

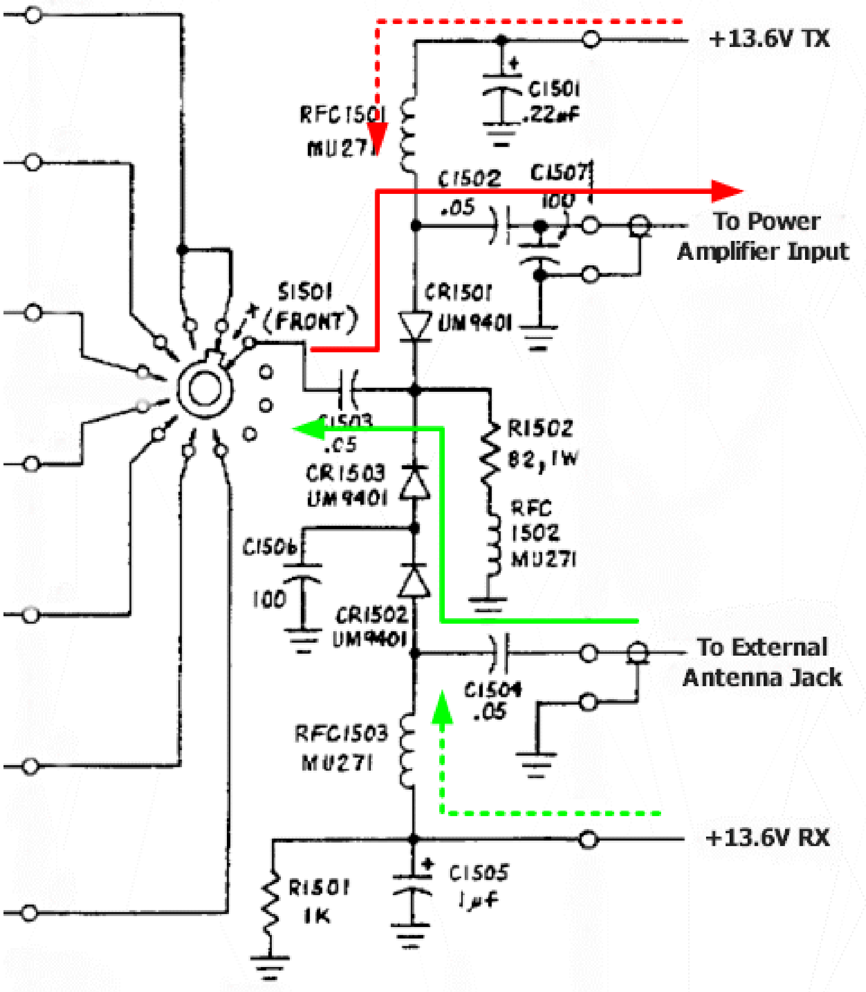


The High-Pass Filter, front board, switches the Calibrator signal to the Up-Converter through CR1401 and CR1402, (MPN3404 Diodes). Referring to the front board diagram to the right, you see there are three input signals going to the input switch side of the filter. The VLF Antenna input, (Red Arrow Line), transmit & receive signals to the Up-Converter (Green Arrow Line), and the Calibrator signal, (Blue Solid Arrow Line). When the front panel Calibrator switch is selected, that sends +10VDC through resistor R1401, (Blue Dash Arrow Line), which forward biases the two pin diodes creating a low resistive signal path for the calibrator signal to flow to the Up-Converter input. When the Calibrator switch is de-selected this removes the voltage, reverse biasing the pin diodes, which stops the Calibrator signal from going through the pin diodes.

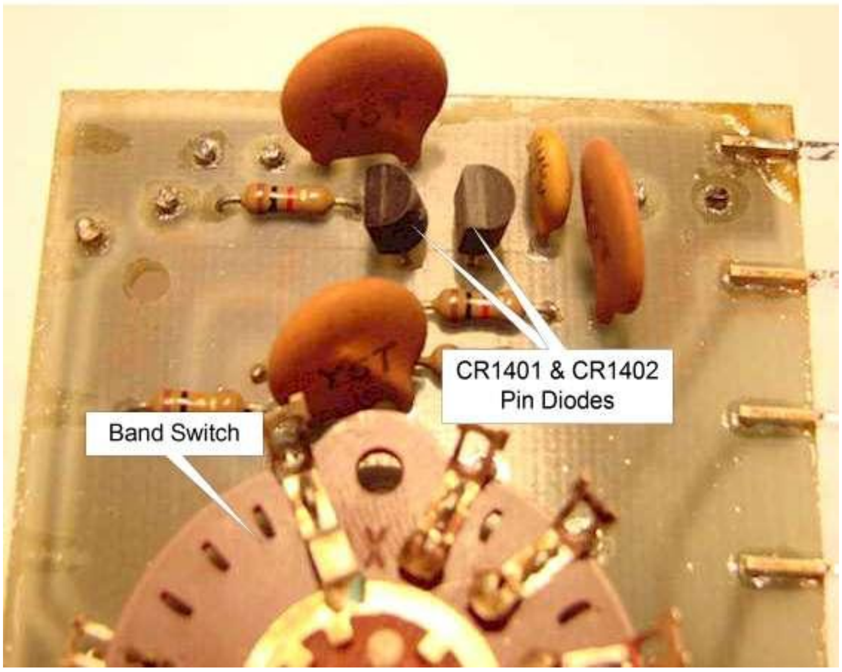
Accessing these pin diodes and soldering is very difficult and requires a certain amount of skill and patience getting them replaced. The best method I can recommend is to follow the disassembly procedure detailed in the TR-7 Service manual.

The picture below shows the location of the two pin diodes on the High Pass Filter - Front Board.

High-Pass Filter - Rear Board



High-Pass Filter - Input Board



High-Pass Filter - Rear Board

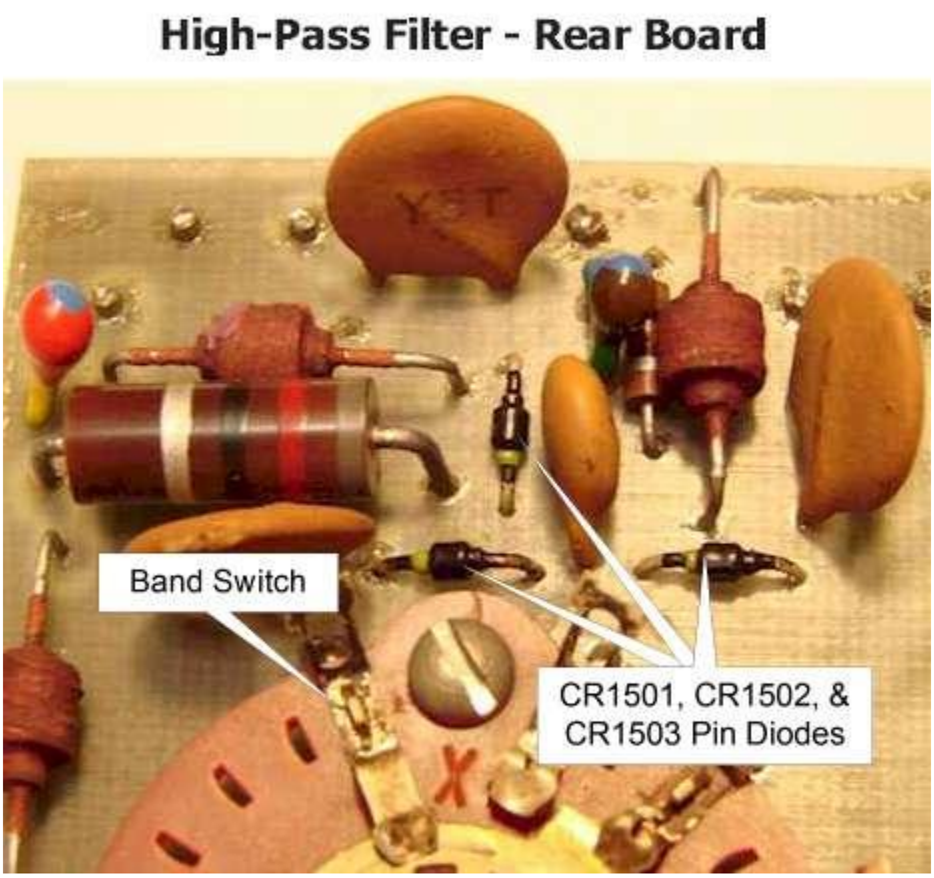
The High-Pass Filter - Rear Board switches the low level signal to the Up-Converter from the antenna connector in the receive mode and the signal from the Up-Converter to the Power Amplifier module in the transmit mode.   On this board the pin diodes are a high frequency switching diode, number UM9401. The 13.6VDC switch control voltage to turn on and off the pin diodes comes from the a set of relay contacts in the antenna relay.

In receive mode a 13.6VDC control voltage is applied through RFC1504, (Green Dash Arrow Line) which forward biases pin diodes CR1502 and CR1503, allowing the input signal from the antenna connector to pass though to the input selector switch, (Green Solid Arrow Line), and the filter assembly.

In the transmit mode a +13.6VDC control voltage is applied to RFC1501, (Red Dash Arrow Line), forward biasing pin diode CR1501, allowing the low level transmit signal to flow to the Power Amplifier, (Red Solid Arrow Line).

Some of the more common problems with the pin diodes on this board is when they short or start leaking.   When this occurs low power output and low receiver sensitivity will both be noticeable and having a greater affect as you go higher in frequency.

Pictured below is the High Pass Filter - Rear Board showing
the physical location of the three pin diodes, CR1501,
CR1502, and CR 1503



Troubleshooting Pin Diode Problems

Troubleshooting a pin diode problem will be a bit tricky from the standpoint of getting to them to take measurements. On the Front Board, when the Calibrator switch is selected that puts a positive voltage on the anodes of both CR1401 and CR1402. As you go from the anode to the cathode you will see a small reduction in voltage, typically a .6 to 1 volt drop across each diode. If a total loss of voltage is found across one or both pin diodes, that diode is probably open, and with measurable voltage but no voltage difference across them, the pin diode is shorted. In either case the defective diode is preventing the signal from reaching in band switch input. When the Calibrator switch is deselected all voltage should be removed. One common problem caused by one or both of these diodes going bad or leaking is poor receiver sensitivity and low power output on 10 meters. Typically CR1402 shorts and causes the input signal to be grounded through capacitor C1404. This effect is most noticeable on 10 meters.

Troubleshooting the Rear Board will be more difficult since there is a switched voltage to deal with on transmit and receive. In either mode there will be a measurable voltage at the input of the band switch, but with the voltage source coming in from two different directions. The best way to check these pin diodes is to lift the cathode of the pin diode opposite to the mode being tested at the input to the band switch. This way the receiver pin diodes will not induce any effect on the transmitter side being tested, and vise-versa. In either the transmit or receive mode you should be able to follow the voltage from anode to cathode to the band switch. If the positive voltage is not measurable at the cathode, the diode is defective. Before replacing the pin diode cathode you previously lifted from the board, measure the receiver sensitivity or power output. After replacing the the pin diode cathode you should still see approximately the same results. If the result is noticeably different one of the pin diodes on the opposite side is probably leaking pulling down the input signal. Following this procedure on both the receive and transmit modes will detect open and leaking pin diodes.

Replacing The Internal Fuse

Front & Side views of 5A fuse location

The Drake TR-7 Transceiver does have one internal 5 amp fuse. The fuse is a standard AG3 fuse, 5 AMP rating. This is the first place you should check if the radio is totally dead and you know the connected power supply is delivering the proper voltage.

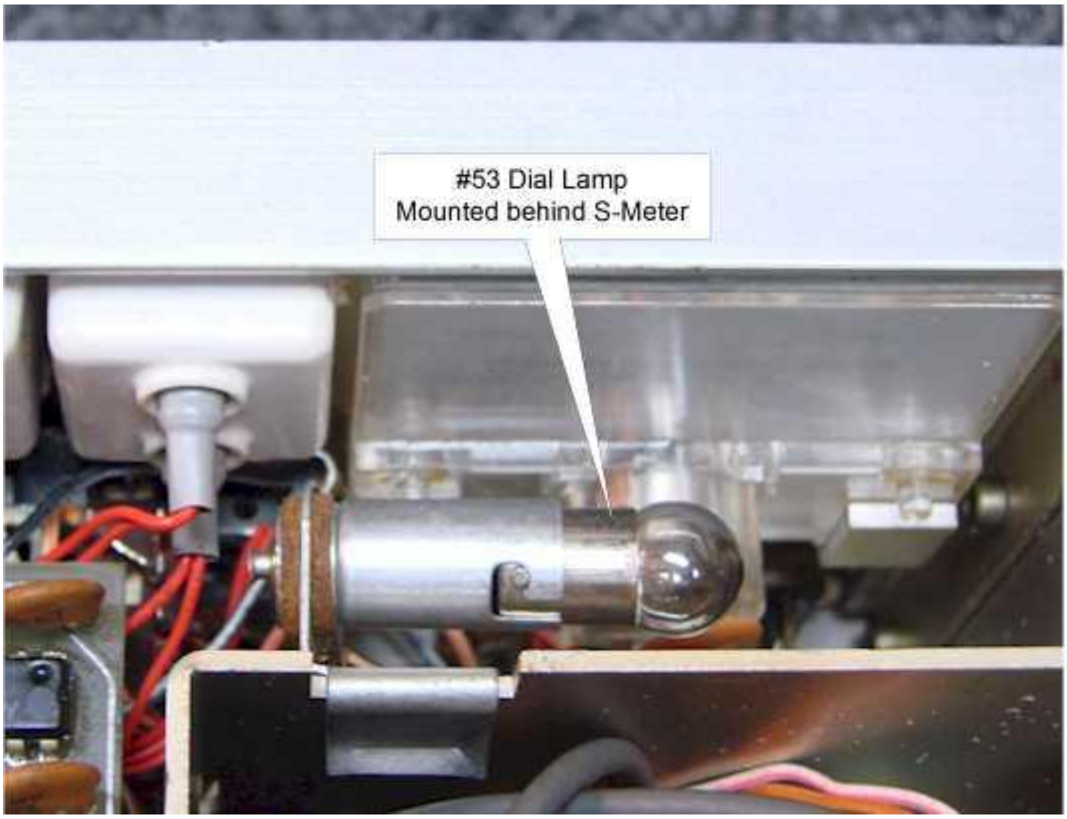
To locate the fuse first removing the top cover. The fuse holder is mounted on the right side panel in the front-right corner of the radio just beyond the edge of the Digital Display Board and directly in front of the Power Supply Board.

Before attempting to remove the fuse make sure all power is disconnected from the radio. The fuse is somewhat hard to access but with care and a small flat blade screwdriver the fuse will easily pop out from the holder. Replacing the fuse is a bit more tricky. First center the fuse over the holder clamps then push into place. Access to the fuse is easier if you work from the long side, going in behind the Digital Display Board.

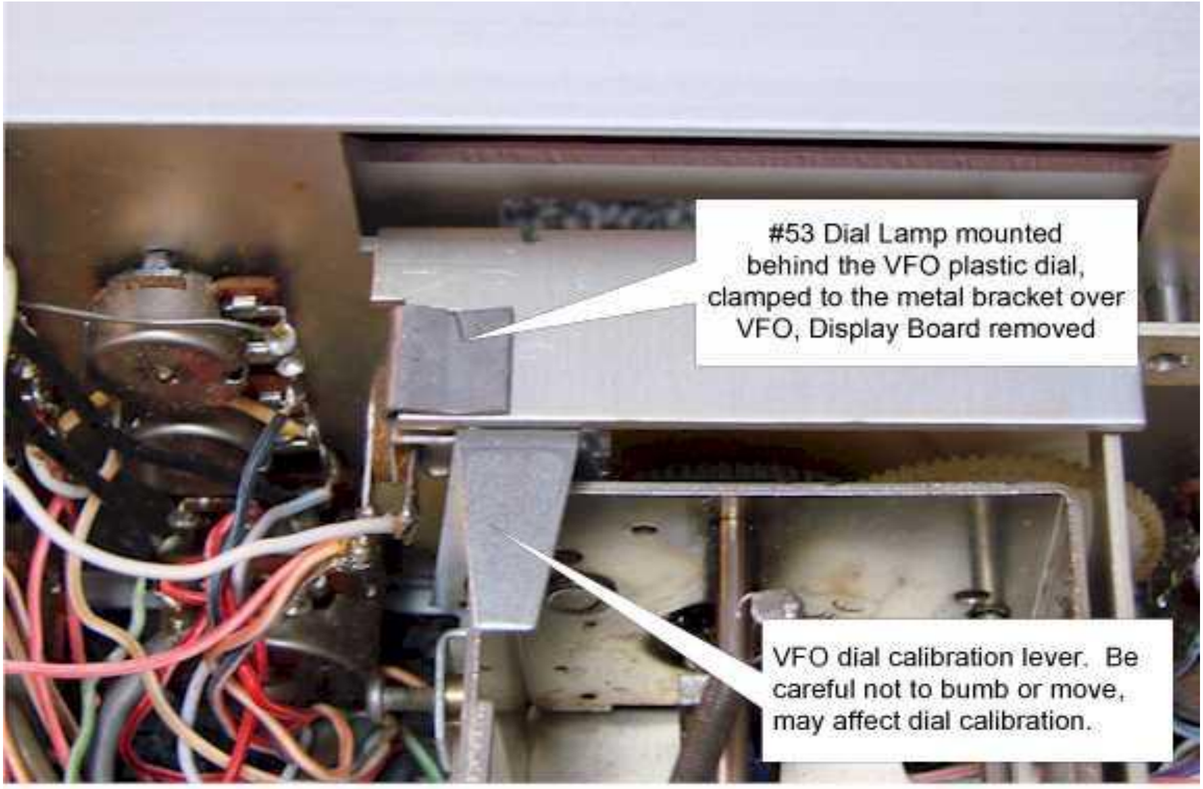
Use extreme case when replacing the fuse you do not touch or move the small blue controls on the power supply board, especially the +10VDC regulator adjustment, the first control mounted up-right closest to the outside case edge. Moving these controls could put the transceiver out of alignment and/or voltage regulation.

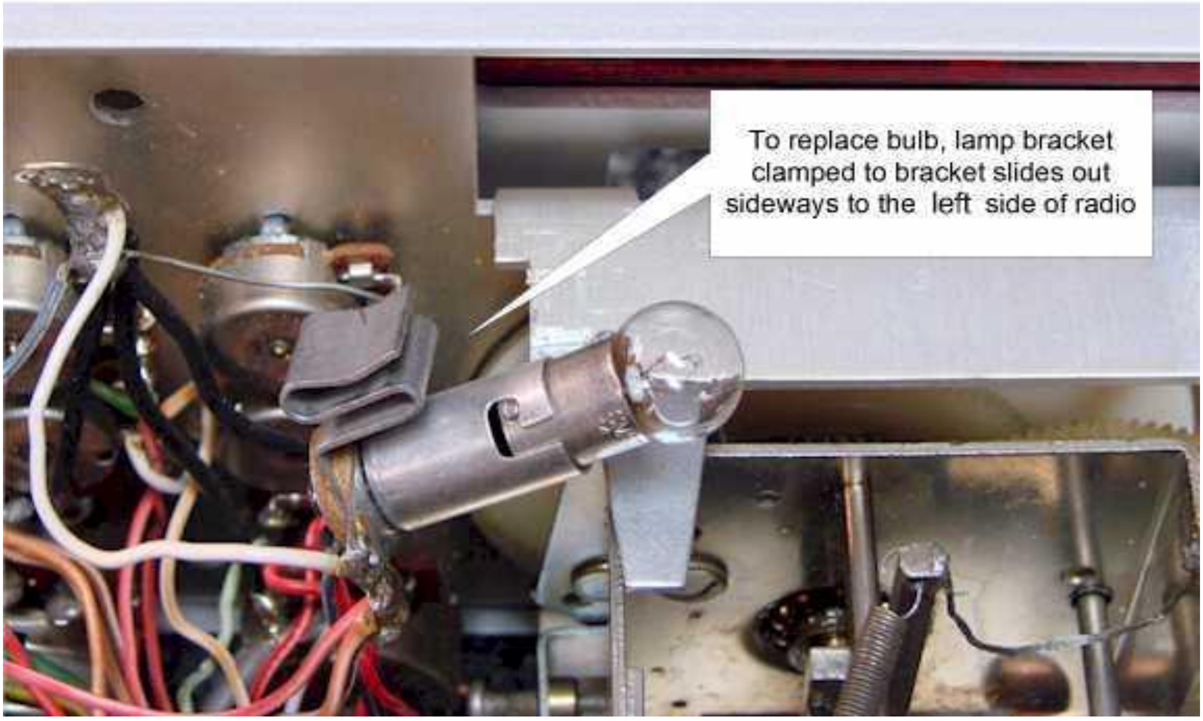
Replacing The Dial Lamps

The Drake TR-7 Transceiver has two replaceable dial lamps, one behind the S-Meter and the other behind the VFO analog frequency readout dial. The bulb is a standard #53 bulbs rated at 12VDC, replacing them ranges the two extremes, "Simple and Easy", to "Your Worst Night-mare". The bulb behind the "S-Meter" is the quick and easy choice, the bulb socket clamps to a bracket directly behind the meter. The socket assembly just lifts off the bracket by pulling upwards on the assembly to snap in a new bulb.



The picture above shows its mounting directly behind the S-Meter easily accessible once the case top is removed.





Pictured above in the top picture shows the location of the dial light bulb behind the VFO dials. The second picture shows the bulb socket assembly removed by pulling sideways to the left.

Replacing the bulb behind the analog VFO dial by some would be considered a "night-mare" just getting to it. After removing the wrap-around case your first task it to remove the top mounted Digital Display Board, thus, the night-mare. This is probably the most difficult board in the entire radio to remove and reinstall. To remove the display board first remove the wire and cable going to the High-Pass Filter and remove the one captive screw in the center of the board. Next remove the five brown connector plugs that plug into and around the board. Be sure to mark each connector and which direction the plug inserts since it goes on either way. Once everything is disconnect gently start lifting the board out starting along the back edge. As you pull up the board, remember you are pulling out two rows of connectors and it may be a bit tight.

Once the Digital Display board is removed the bulb and socket assembly clamp to a small horizontal bracket just above the VFO dials. Refer to the top picture above showing this location. The socket assembly pulls out sideways to the left, facing the radio from the rear. When pulling out this assembly sideways be careful not to hit or move the VFO dial calibration lever directly behind the bracket. Moving that lever could cause the VFO dials to move out of calibration. After replacing the bulb the assembly is repositioned by reversing the process.

I recommend replacing the bulb with a direct replacement only. The heat from this bulb has been know to attribute to VFO drift. Replacing the bulb with the high efficiency bulbs or high wattage bulbs would only add to any VFO drift problem you may already have. Also these bulbs generate excessive amounts of heat which is difficult to remove because of the close and cramped area. This heat has been know to melt the plastic VFO dial and leave a permanent brown burnt area in the plastic dial.

There is now available a high output LED replacement for the #53 bulb. These bulbs are a good replacement if you never want to worry about replacing the bulb again in the future, and eliminate the heat buildup. The solid state replacement bulb has advantages over the older incandescent bulb, but there are also a few drawbacks. The LED replacement bulbs emit a blue color but from inside the radio and the blue VFO dial filter the light turns to a purplish glow. To a Drake purist the purple glow looks weird when you expect to see that nice Drake medium blue glow. On this point its a matter of personal preference which option you choose, but knowing either way has its good and bad points.

Companion Articles

Over the last few years there have been many articles written on TR-7 transceiver modifications and upgrades. Some of those articles can be found on my "www.wb4hfn.com" website in the "Technical Tips for the User" section. Listed below are four articles written specifically for the TR-7. Click on the title to view the article, listed below the title box is a brief description of the article.

Drake TR-7 Improvements

Installing the Cumbria Designs X-Lock VFO Stabilizer, and Improving The TR7 Audio Quality

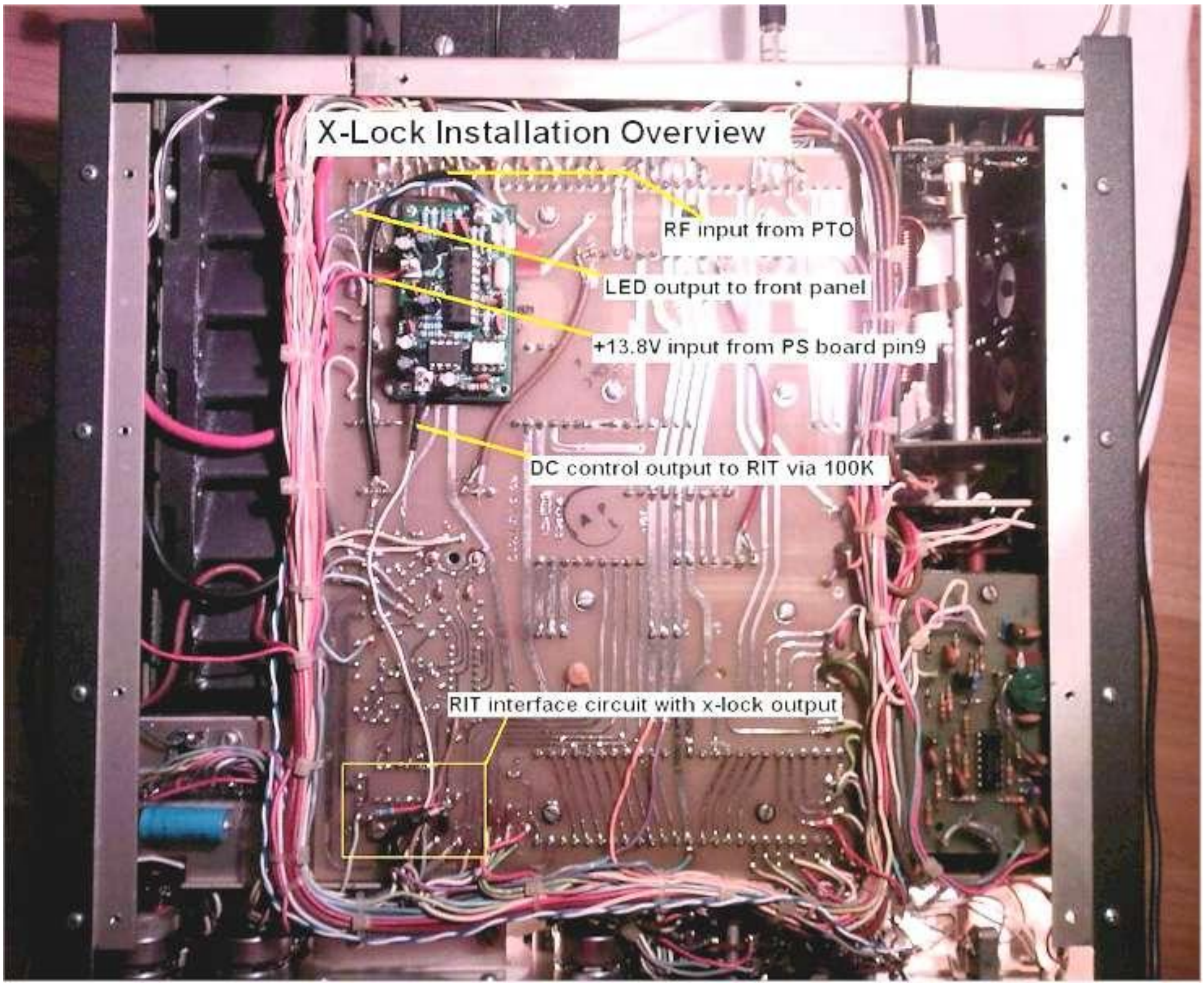
By: Marinos Markomanolakis, KI4GIN / SV9DRU

The TR-7 remains one of the top choices in a radio which offers extremely clean receiver performance. Robust construction and no infestation by the all too usual nowadays DSP sound “enhancement” gimmicks which manufacturers are using to lure customers into buying new rigs.

This excellent rig can be further improved in a couple of areas, that will bring it to the level of functionality that we have come to expect of the modern radios. This topic has been covered a few times in the past, and I would like to share my experience in two areas:

- Installing the Cumbria Designs x-lock stabilizer in the TR-7
- Improving the SSB TR7 audio quality

Drake TR-7 Improvements, By: Marinos Markomanolakis



Click here to read Marinos article. "DrakeTR-7 Improvements"

Restoring A Drake TR-7 To Full Output Power

Written By: Floyd Sense / K8AC

http://www.wb4hfn.com/DRAKE/DrakeArticles/TR7_Amp_Repair/TR7-Amp.htm

A few months ago, I acquired a TR-7 from someone on eBay and, of course, it was said to be in excellent condition. When I tested the transmitter section, I found low output on the higher bands (only 40W out on 10 meters) and sending CW for a minute or so resulted in the power out dropping to zero. A complete alignment didn't improve the situation and I began searching for a solution. I read everything published on the Web on the TR-7, and asked questions on the Drake reflector about the power output level. The general consensus was that one should be happy with 50-75 watts output on 10 meters and that "they were all that way". That wasn't a very satisfying answer, and a few knowledgeable TR-7 owners suggested that things could be better. To make a long story short, after many hours of work I was able to bring the power output up to what I considered to be a proper level, following tips from a few of the reflector members as well as using information from the Drake documentation by VE3EFJ. Since I was unable to locate a single source for all the information necessary, I've prepared this page for other TR-7 owners who might have a similar problem.

The Test Setup

Power measurements for this project were made with an old Bird 43 wattmeter with a 250 watt HF slug and a Heathkit oil-filled dummy load of around 49 ohms. When working on the PA "brick" outside the TR-7, the drive signal was provided by my trusty Boonton 103F signal generator which has a nice stepped attenuator and output level meter allowing you to supply an RF signal of known level into a 50 ohm load (up to 3 volts).

One nice feature of the TR-7 is that the entire PA unit can be removed from the TR-7, including the heat sink, so that you can work on it independently of the TR-7. Perhaps that should have been obvious to me, but it wasn't and I thank Garey Barrell for suggesting that approach. He told me how he had worked on the PA using a signal generator to supply the required drive. To do that, all you need to do is:

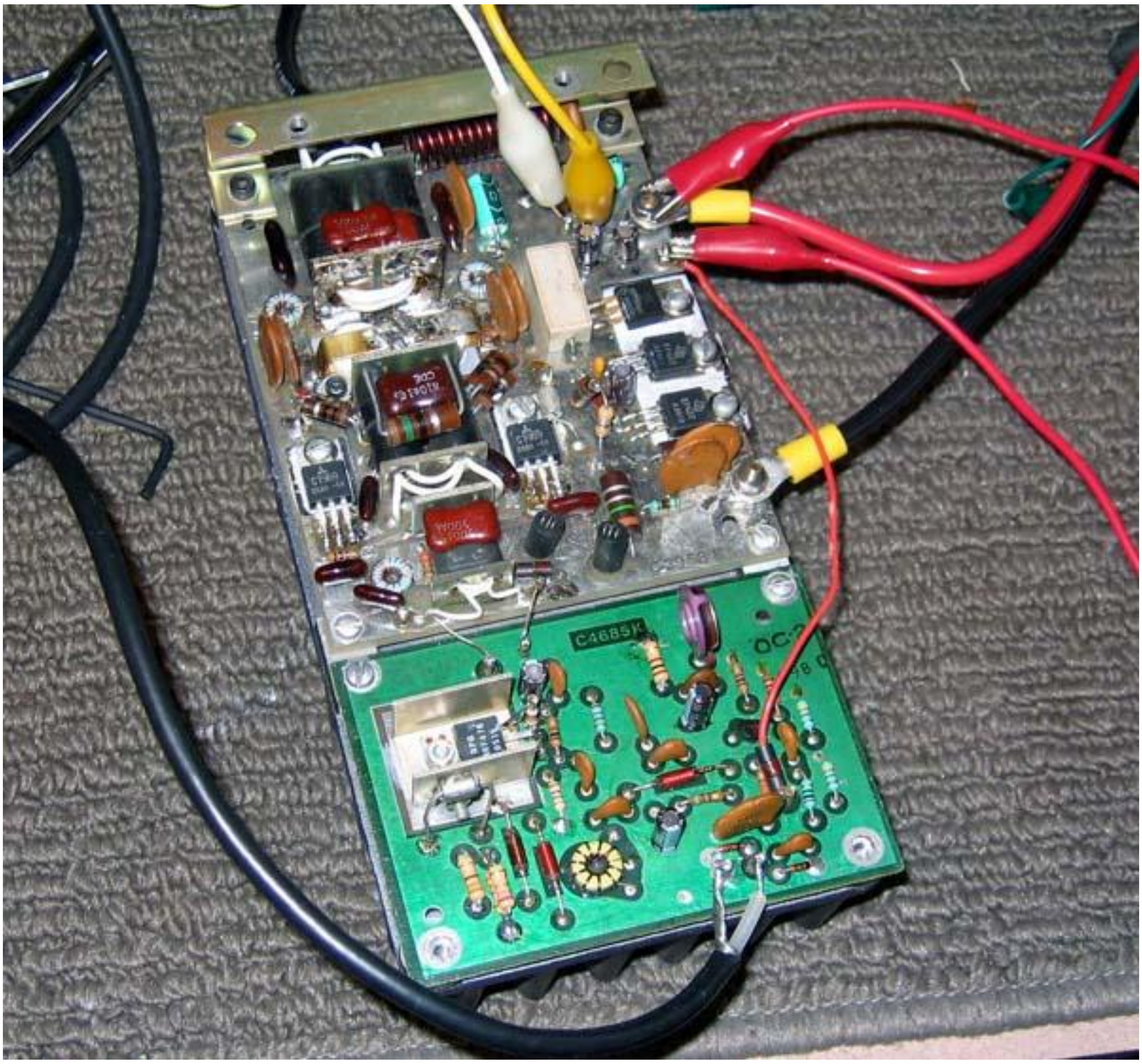
1. Remove the PA brick from the TR-7, unsolder the input and output coax lines, unbolt the two DC supply leads and unsolder the red lead that connects to the terminal post near the +DC lead.

2. Connect a wattmeter/dummy load to the output terminal posts

3. Connect the signal generator input to the input terminal posts

4. Connect (+) and (-) leads from a DC supply capable of supplying 26 amps or more

The red lead removed in step 1 supplies +13.6 VDC to run the pre-driver board and the driver transistors and feeds the regulator that supplies the bias for the finals. So, all you need to do to transmit with the PA brick is to connect the post where the red lead was connected to the nearby +DC screw terminal and then apply power. Removing the connection puts the PA in its "receive" mode state.



The PA unit sitting on the bench, in operation. The white and yellow leads near the top of the photo go to the ammeter to measure the "bias current". The red lead connecting the + power lead to the small post just below it sets the unit to "transmit" mode. The signal from the generator is applied via the coax seen at the bottom of the photo.

Solving The Problem

The first thing I did was to replace the electrolytic and tantalum capacitors on the ALC and PA boards to eliminate those as a possible problem. There was no benefit from that effort.

Upon close inspection, someone had been into the PA before me and had replaced the final transistors, the driver pair, and the pre-driver (version 2 board). The final transistors were found to be MRF-421s, the drivers MRF-475s, and the pre-driver an MRF-476. After connecting everything as described above, I applied drive from the signal generator and attempted to achieve 100 watts output on 7 bands while monitoring the drive required from the generator. Here's what I observed:

Band	Drive in mv	Watts Output
160	44	100
80	44	100
40	85	100
20	157	100
15	290	100
12	530	65
10	2250	44

The large amount of drive required on the higher bands told me that the problem was indeed in the PA brick somewhere. Furthermore, there are back-to-back silicon diodes across the pre-driver input and the signal clipping of those diodes undoubtedly would introduce some undesirable distortion of the waveform. A scope trace of the signal coming out of the pre-driver board indeed showed a pretty ugly waveform on 10 meters. At this point, I decided to tackle the problem of the power dropping off sharply if I held the key down more than a few seconds.

In VE3EFJ's well-known document covering Drake Mods (section 12.2, TR7 Mods and Tech, "Late Model Driver Boards"), Wayne described a thermal runaway problem that would produce the same symptom I was seeing. I replaced the MRF-475 transistor (no longer available from RF Parts) with one from Communications Concepts, Inc. (http://www.communication-concepts.com/) and inserted the resistors in the emitter lead as described by Wayne. That provides a degenerative bias that Wayne claimed would solve the runaway problem.

While working on that board, I also checked resistor values and found that one had drifted badly (R2213) in value and another (R2202) had been changed to another value by a previous owner. In addition, resistor R2209 in parallel with the R2210 gain adjustment pot had been cut out. I restored the resistors to the values shown in the schematic and replaced R2209. Subsequent testing showed that Wayne had been right on and the power runaway problem had been resolved. Unfortunately, there was little or no effect on the power output level on the higher bands.

Garey Barrell suggested that I change the final transistors to 2SC2879s as they have higher gain at 30 MHz and so I ordered a matched pair of them from RF Parts. I had previously installed a new pair of drivers, a matched pair of MRF-475s from RF Parts. With the new finals, the output on the higher bands was up quite a bit - 75 watts or so on 10 meters - but still not what it ought to be. I then checked the bias current at the jumper position on the PA board. While the Service Manual doesn't give a suggested bias current, Garey said Drake suggested a value of 800 ma, but that he preferred something closer to 200 ma. I measured 2.2 amps and something was clearly wrong. Note that the "bias current" at that point is really the collector current of the driver transistors - there is no bias setting capability for the final transistors.

Garey had me check the base voltage on the drivers in "receive" mode and while it should have been zero it read .64 volts. He then suggested that I lift the driver base pins from the board and check the voltage again. The voltage measured at the floating base leads was now .76 volts (slightly different on the two transistors). So, the drivers were pulling 2.2 A of collector current with the base leads open - clearly a problem with those devices. Garey had also suggested I use 2SC1969 transistors for the drivers instead of the MRF-475s, so another order to RF Parts for a matched pair of 2SC1969s. That device is used as the output stage in many current CB rigs, so is readily available, but it appears that only RF Parts supplies matched pairs. I also ordered new transistor mounting insulators, as the old ones were not in very good shape. After installing the new drivers, the bias current was observed to be 330 ma - within reason.

Band	Drive in mv	Watts Output
160	32	100
80	32	100
40	60	100
20	100	100
15	130	100
12	140	100
10	240	100

Again, Garey provided the knowledge on adjusting the bias current. By inserting an additional resistor in series with R2303, the bias on the drivers is affected, with a higher resistance lowering the "bias current". I arbitrarily added a 47 ohm resistor in series with the existing 47 ohm resistor and since the current was now within the acceptable range I decided to leave well enough alone.

Testing the output and drive levels as before showed that the output problem was solved. The drive required to produce 100 watts output was lower on the lower bands and a full 100 watts output could now be achieved on even 10 meters. The following table shows the drive required to produce 100 watts out on all bands. Compare this to the drive required prior to the transistor changes and note that the drive required on 10 meters is now far below the level that will cause the protective diodes to clip the input.

Band	Watts Output
160	105
80	127
40	130
20	130
15	115
12	112
10	111

I set the ALC pot to produce 125 watts output on 20 meters with the Carrier control full CW, then switched to 10 meters and adjusted the pre-driver gain so that the ALC light just came on full. The following table shows the output power then seen on each band when adjusting the Carrier control to a point where the ALC light came on full. Current draw as seen on the power supply ammeter was 22 amps on 20 meters and 24 amps on 10 meters

I'm not sure why the output on 160 meters is low and I didn't notice that while the PA was running outside of the TR-7. I assume that the power is being lost in the low pass filter section for 160.

I made no attempt to see just how far the output could be increased, but when testing with the signal generator, I had no trouble driving the output up to 180-200 watts on the lower bands. I ended up with the pre-driver gain pot set to a few degrees CW past 1/2 rotation. There has been no trace of instability on any of the bands, and power output is steady in RTTY and all other modes.

Based on my experience, I'd suggest the following if you are attempting to restore your TR-7 output level to where it should be:

1. Pull the PA unit and make sure all resistors are the values they should be.
2. Replace the final transistors with 2SC2879s. I don't know if a matched pair is really necessary, but RF Parts has them for a nominal price increase over an unmatched pair.
3. Replace the driver transistors with 2SC1969s. Same comment regarding the matched pair.
4. On a Version 2 pre-driver board, replace Q2202 with a fresh MRF-476 from Communications Concepts. There may be a better substitute for this application, but the MRF-476 was available and I couldn't find any advice on a better transistor for the job.
5. Follow VE3EFJ's advice and insert the appropriate resistors between the emitter of Q2202 and ground.
6. When doing the transistor replacements, be very careful not to overheat the traces where the transistor leads go through the board. If the drivers have been worked on before, chances are that the traces on top of the board are already separated from the substrate. Luckily, those traces aren't needed as they dead-end at the transistor cut-out. So if they're already lifting, you can remove them.

Thanks to all who made suggestions via the Drake reflector and private emails, and to VE3EFJ, whose Drake documentation is an important part of the hobby.

73, Floyd - K8AC
Angier, North Carolina

Useful Function for the Drake TR-7(A) "Store" Switch
Add A Transmit Key Function

By: Ronald Baker / WB4HFN
http://www.wb4hfn.com/DRAKE/DrakeArticles/TR7_Store_Switch/XmitKey.htm

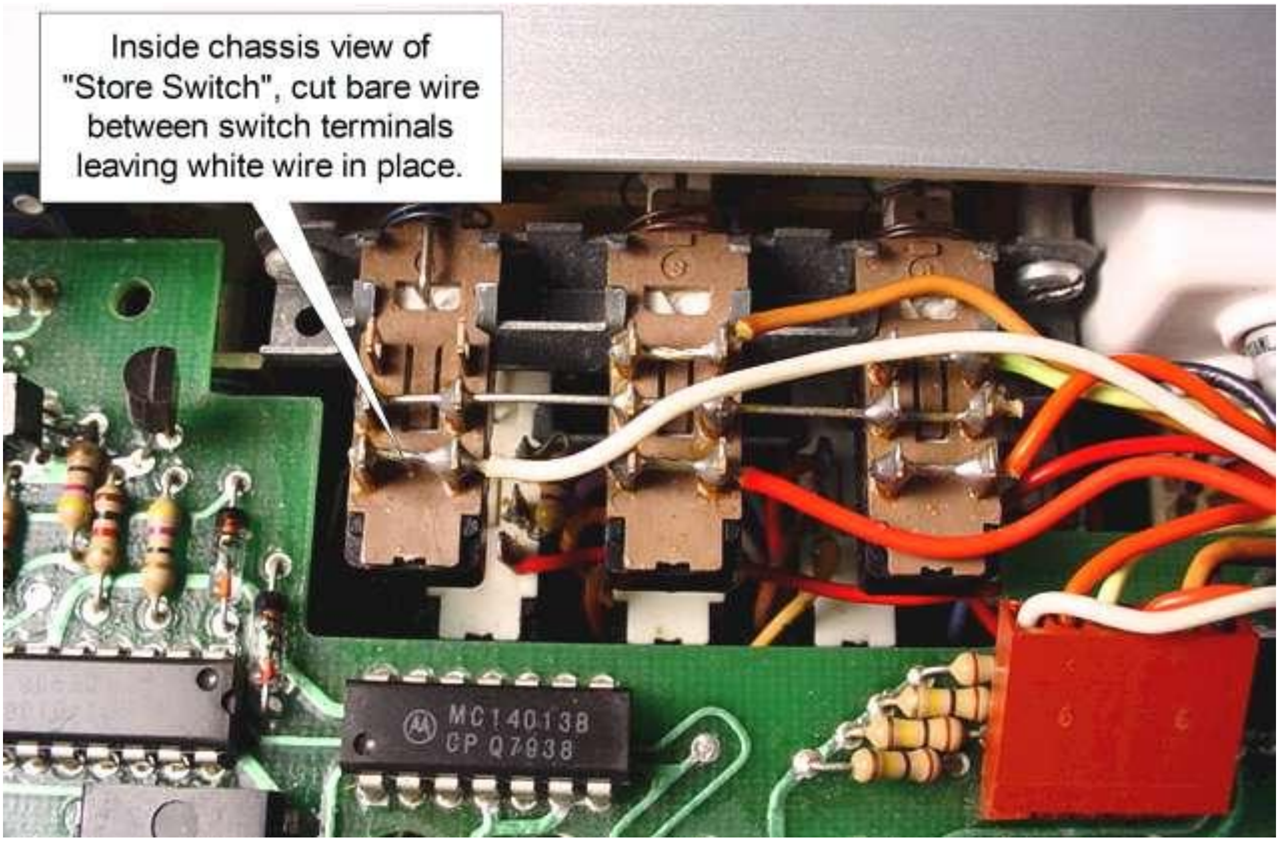
Did you ever wonder why Drake designers didn't put a transmitter key function on the front panel of the TR-7(A) Transceiver like they did on the Drake TR-5 transceiver. On the TR-5 the far right position on the function switch is "Lock Key". In this position the transmitter is keyed, a useful function when tuning up the amplifier or adjusting the antenna tuner. So, Why doesn't the TR-7(A) have a similar function? I haven't got the answer but I did start thinking about adding this function to the front panel.

The TR-7(A) has no front panel transmitter tuning controls because of it broadband design. That's cool, but how do you key the transmitter without external devices or rear panel switch. Now if your a CW operator, no problem because you probably have some sort of keyer which serves that function. What about the rest of the world that does SSB? There are of course several options but none of which are very convenient.

I searched hard and long over the front panel trying to devise a way to add a transmitter key function without adding new holes or switches, and absolutely keeping everything original. I quickly came to the conclusion there wasn't much opportunity unless I wanted to rewire an existing switch. Some time later "light dawned on marble head", as we say here in New England, what about the "Store" switch. What useful function does the switch serve anyway? After reading about the switch in the manual and playing around with it for a while I determined to was fairly useless. So the question came to mind, could I keep the same switch functionally and key the transmitter with the same switch. After some research over the diagram I discovered it was possible.

Owning a TR-7 since they were sold new I never used or found a good use for the "Store" switch, but I didn't want to eliminate that function either. Looking at the "Store" switch from the inside, when enabled, it shorts a single wire to ground. The switch is a double pole switch with jumpers across the contacts of both poles creating a single pole action. Since only one side of the switch is needed to turn on the function, by separating the switch poles I now have another set of contacts available. The center contact of the switch is already grounded so its now a simple matter of running a wire from the CW Key Jack on the rear panel of the transceiver to the front of the radio and hook it to the free side of the "Store" switch.

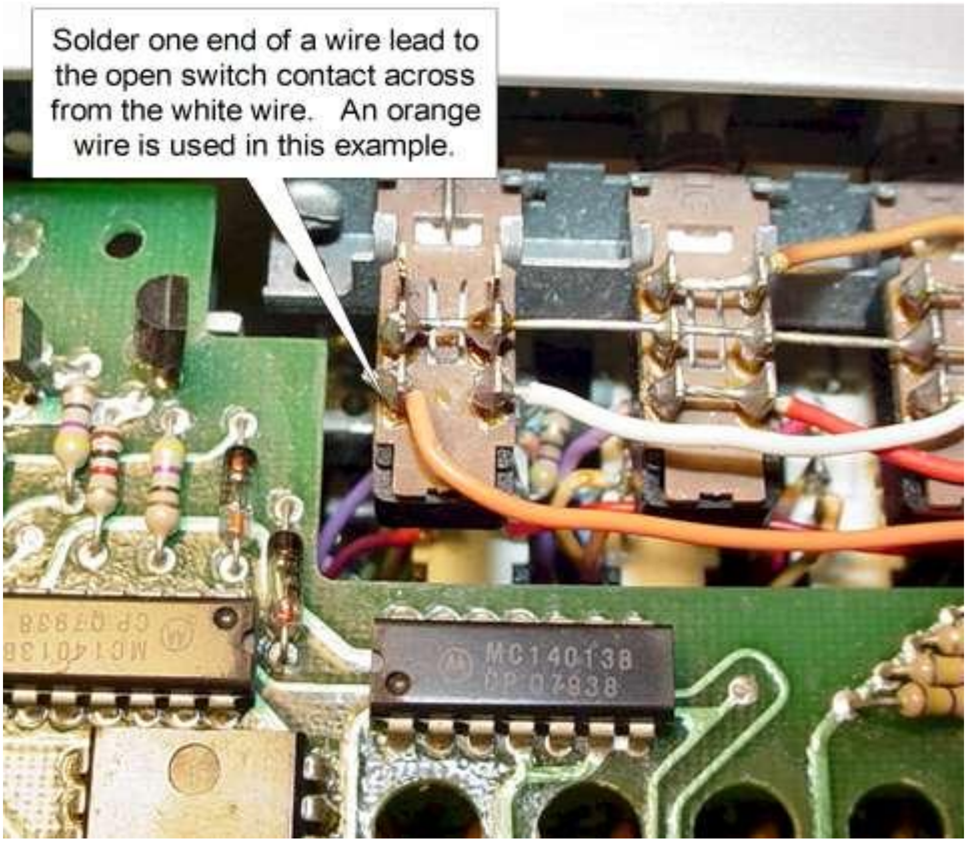
Once this modification is done, the "Store" switch still performs its function and remains unchanged. But now when the transceiver "Function" Switch is put into the "CW" position, pressing the "Store" button now keys the transmitter. The switch has a dual function, pressing it in half way for momentary key, push in all the way to latch in place, press again to release. Remember, never key the transmitter for long periods of time. Listed below is the step by step procedure for the modification.



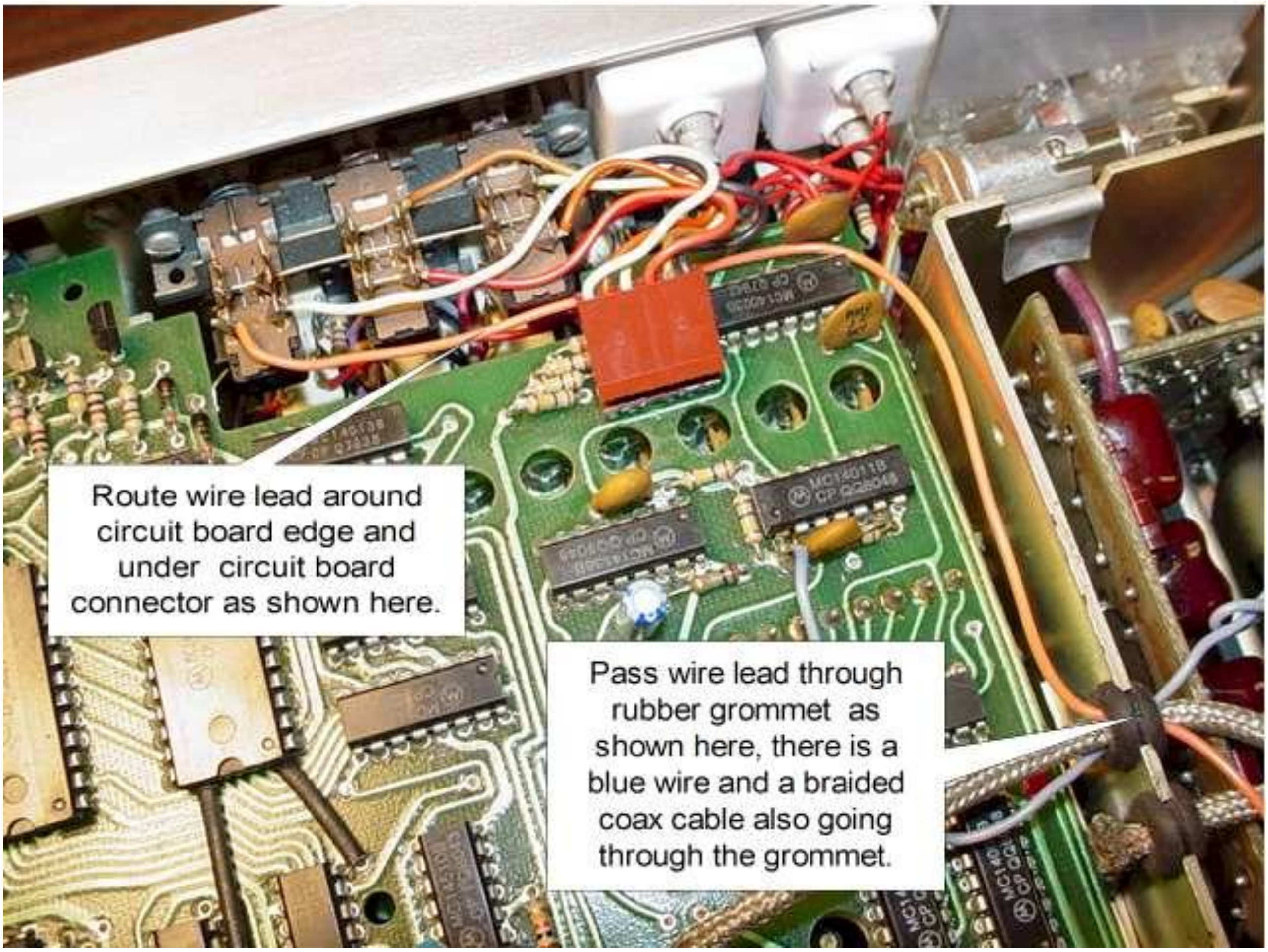
First remove the case and locate the "Store" switch contacts just behind the front panel. You will notice a white wire going to one side of the switch contact near the rear of the switch. Also notice both sides of the dual section switch are shorted together. Current flow through this switch is small so using only one side of the switch will work just fine.

Once you locate the switch and contacts you need to cut the small jumper wire between the rear most set of contacts as shown in the picture. Cut the jumper between the contacts, do not cut the white wire. That wire will remain in place.

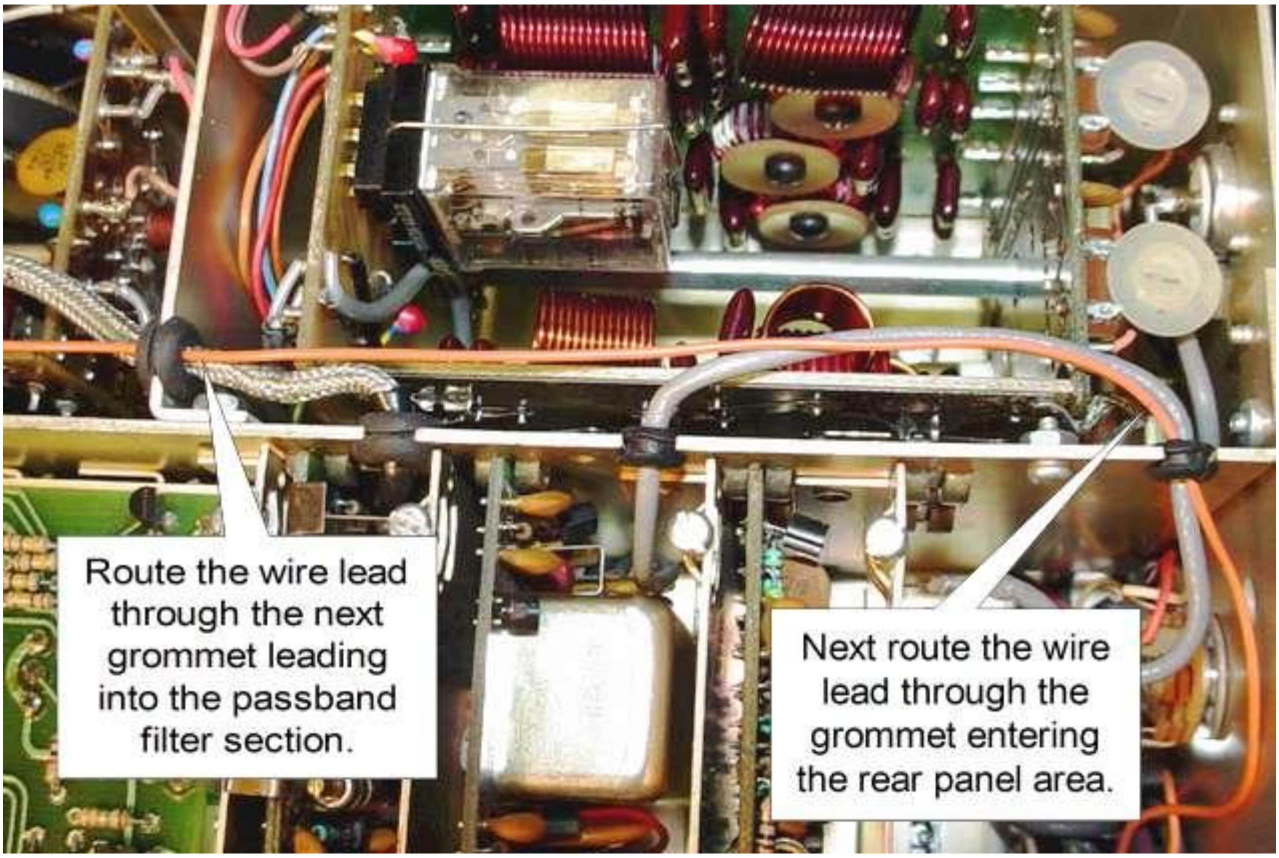
In the next step you will need an 18" piece of wire. Strip bare one end of the wire about 1/4" and solder that end to the open switch contact as shown here in the picture. After the wire is soldered in place route the wire around the radio through rubber grommets to the rear panel of the radio. As shown here shape the wire so it curves and follows the edge of the adjacent circuit board.



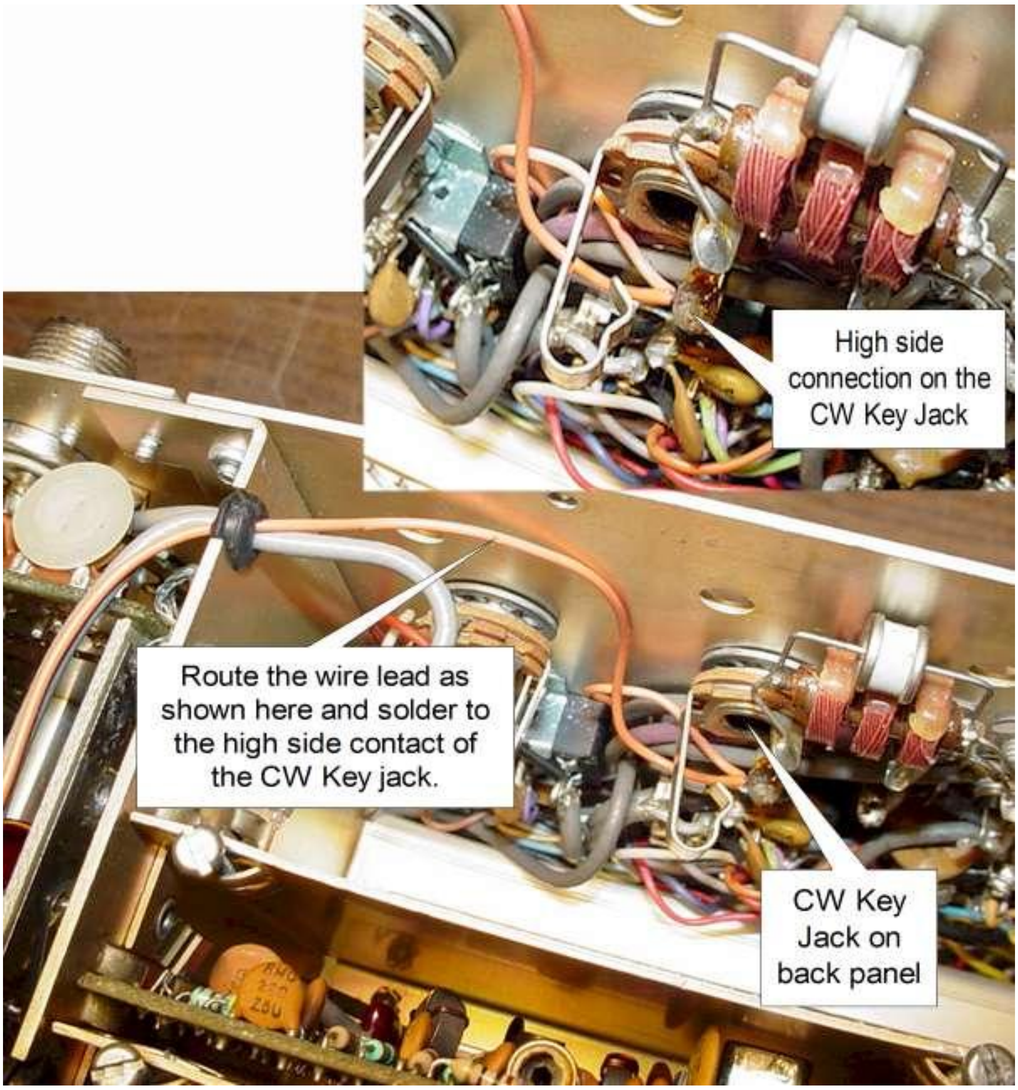
Shown in the picture below, route the wire under the brown connector plugged into the circuit board. After the connector bend the wire 90 degree and follow the edge of the circuit board towards the rubber grommet.



Going through the rubber grommet you will see a blue or purple wire and a braided coax, feed the free end of the wire through this same grommet as shown here in the picture. Once the wire is through this grommet route the wire straight back through this section to the next grommet in line.



Route the wire through the second grommet as shown here. Shape the wire so it travels as shown in the picture to the rear panel. Next route the wire through the rear grommet which enters the rear panel area. Again shape the wire to travel as shown here in the picture.



Once the wire is in the rear panel area you should remove the Receiver IF/Audio board to gain better access to the work area.

Next shape the wire as shown in the picture, cut wire to the right length and strip back 1/4" of insulation and solder this end of the wire to the high side of the CW Key jack. Refer to the enlarged picture of the CW Key Jack showing this connection. The High side will have a single wire attached. The other side of the CW Key Jack is ground potential and has a large coil and spark suppressor soldered to it. Next reinstall the Receiver IF/Audio board. This now completed the modification installation.

Next you will test to make sure everything is working.   Attach the transmitter to a 50 ohm dummy load, set the front panel function switch to the "CW" position and push in the "Store" switch. The transmitter should key and output power according to the set position of the "Carrier Level" control.   When using this to tune up your amplifier or adjust the antenna tuner use only the minimum amount of power needed to make your adjustment and never key the transmitter for long periods of time.   This now completes the circuit test, reinstall the case and your done.   When keying the transmitter current draw is the same whether power is at minimum or at full output, so ther is no concern of damaging the switch or radio.

The picture below shows the entire route of the wiring, see the orange wire as it route its way from the front panel switch to the rear panel area.   If at any point you want to put the radio back to its original condition simply reverse this process and it less than 5 minutes its removed and back to its original condition.

Identifying The Drake TR-7 Differences and Versions

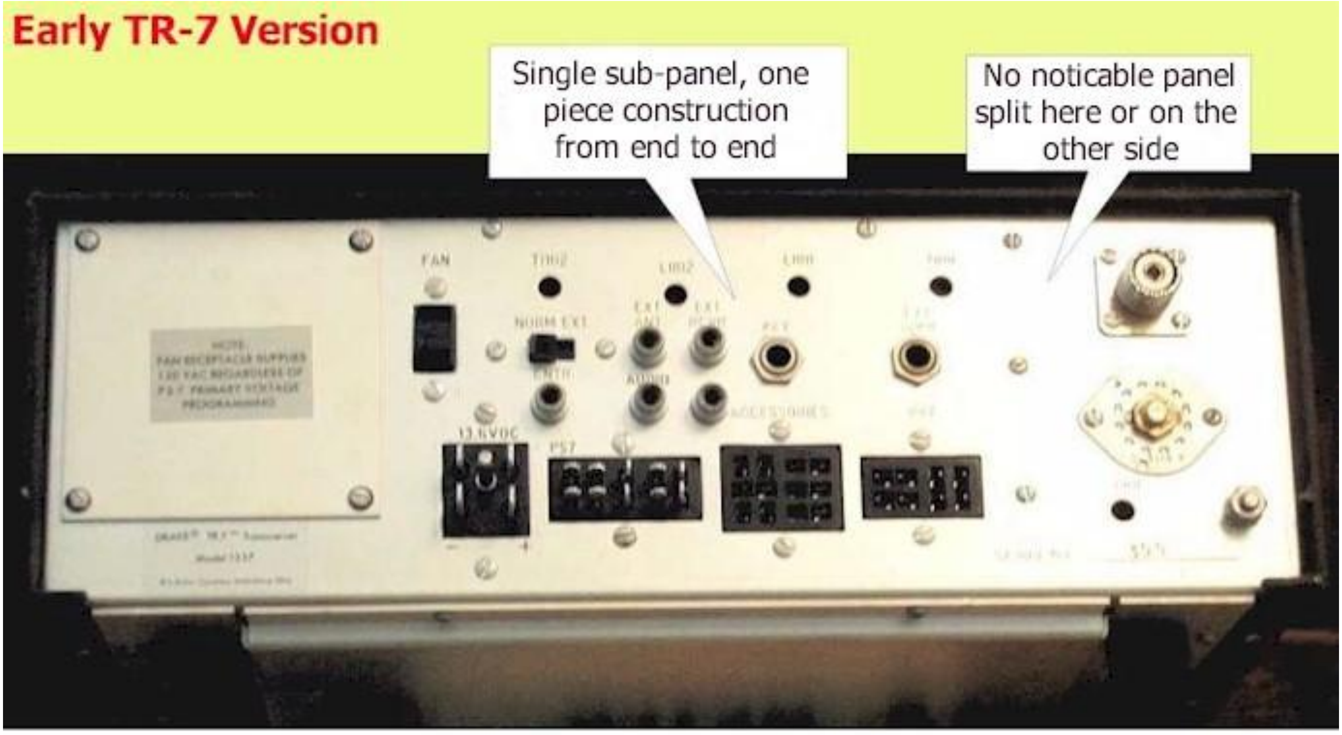
by: Ronald Baker / WB4HFN
http://www.wb4hfn.com/DRAKE/DrakeArticles/TR7_Comparison_Article/TR7_Idenity-01.htm

The Identity Question

Over the last few months there has been discussion around the Drake TR-7, what are the actual differences and how can you determine which version you really have. In recent months we have seen TR-7's for sale described as the later TR-7A version or upgraded to the TR-7A version. In some cases a front view photo of the radio appeared to actually be the "A" version, but to be revealed in other photo's that it wasn't truly the case. Need we be concerned about the possibility of counterfeit TR-7 transceivers on the market? That question I'm not going to address here, but I will give you what information I have discovered through a lot of research to help you determine for yourself that answer. Since Drake manufactured several versions of the same model, for example the Drake R-4 receiver, here we have four versions, R-4, R-4A, R-4B, R-4C, each externally looking very similar if not identical. The same is true for the solid state transceiver, the TR-7 and TR-7A. To make sure the equipment model and versions stayed the same Drake implemented a simple procedure. When you wanted to replace a damaged front panel you shipped your old front panel to the company before they would ship out the replacement panel, ensuring the radio model and version identity remained the same. Today with the advent of after-market products and the availability of new and used parts including front panels being sold over the Internet accurate product identification now becomes a gray area of concern. In this article I will discuss the Drake TR-7 transceiver, identify the best I can the differences between the models and versions within the same model. In my research I have identified three significantly different versions of the TR-7 transceiver. First there are two versions of the original TR-7, which I will classify as the early and late version, and then the last version the TR-7A model. Also, the last three pages of this article discuss the various circuit changes the TR-7 went through is its life time, these include the power amplifier, noise blanker and 2nd IF/Audio board.

The Rear Panel Configuration

First lets identify the external differences in the original TR-7 transceiver. From the front both the early and late versions look identical, the real differences was on the back panel. The early version had a one piece back panel from one side to the other. The late version incorporated a three piece sub-panel construction where a center sub-panel with all the connectors screwed to end panels on either side of the radio. Take a look at the following two pictures identifying both versions.



The early TR-7 version used a single piece rear panel. Much harder to gain access to the component side as conparied to the later version .

The late TR-7 version used a three piece split rear panel. The center sub-panel with connectors had easy access to the component side by removing the screws at each corner of the sub-panel.

The change to the late version three piece panel made it much easier to gain access to the wiring side of the connectors over the earlier version. This production change to the three piece rear sub-panel happened somewhere between July 1978 to February 1980, the best I can determine. By serial number, the best I can tell this production change occurred somewhere between 4800 and 4941. The later TR-7A transceiver used the same rear panel configurations as the TR-7 late version. On the rear panel the only difference between the TR-7 and the TR-7A was a wiring change to one of the connectors which is discussed in detail later in this article.

The Front Panel

Here is the TR-7 version front panel showing the model number. This was the same on both the early and late versions.

The next area we'll look into the the transceiver front panel. The TR-7 early and late version front panels were identical. Even with the TR-7A the front panel was left unchanged except for the model number designation in the top right corner of the radio. See the pictures showing that difference.

The TR-7 front panel was divided into two sections. The lower front panel section was identical across all both models and variations. The upper front panel section was also identical with both the TR-7 early and late version, and the only change to the TR-7A was the model number designation on the panel.

In this area you need to be careful when making a purchase. There has been a quantity of the upper front panels with the TR-7A designation available over the Internet and other sources. It is a simple task to remove the TR-7 panel and install the TR-7A panel. Doing so from the front it would now be hard to tell the difference between the TR-7 and the later TR-7A model. Since the value between the TR-7 and the TR-7A is a few hundred dollars, not thoroughly checking out the radio could be a costly mistake. Don't let the front panel model designation be the only factor in determining which model it is exactly. Use this along with the rear panel configuration and the serial number.

Regarding the serial number, the transition from the TR-7 to the TR-7A occurred somewhere between the high 10,000's and low 11,000's range. In my research the highest TR-7 serial number I seen is 10882, and the lowest TR-7A serial number is 10886, so the model transition is somewhere in the range. The TR-7 to TR-7A model change-over occurred between May and November of 1981. I also understand for a short while Drake made both models. So during that time there could have been sequential serial numbers assigned to both models as they came off the assembly line.

The only noticable front panel difference the TR-7 and the TR-7A is the model number designation.

The serial number is stamped on the rear panel just below the antenna connector. If you suspect this has been tampered with, Drake also stamped the serial number on the front aluminum sub-panel. The serial number is on the front side of the sub-panel just behind the lower front panel, left of center towards the microphone connector. By removing the lower front panel section the serial is visible from the front. With that said, be aware removing the front panel is no easy task and does require a lot of disassembly. You will need to remove the case top, the black side panels, all the knobs, remove the VFO dial assembly and disconnect and remove the microphone connector.

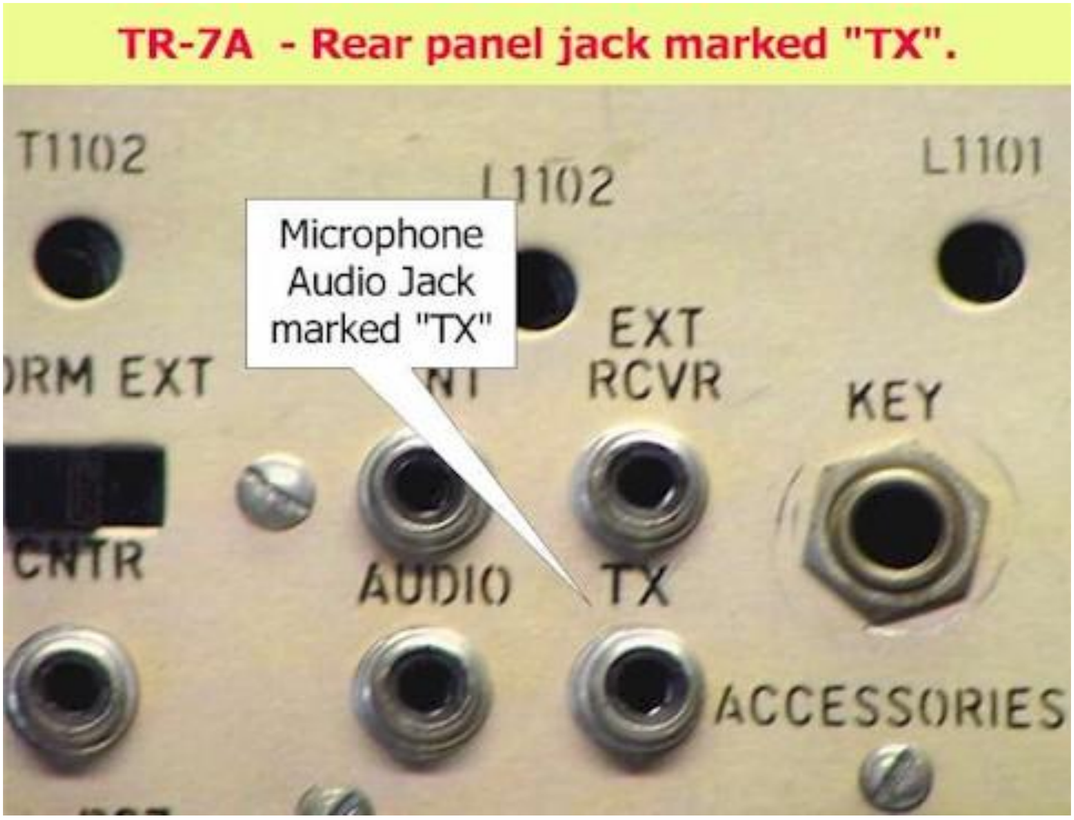
TR-7A Production Changes

What are the production differences between the original Drake TR-7 Transceiver and the later production of the TR-7A? Between the TR-7 and the TR-7A there were basically five circuit changes. Along with the circuit changes the only physical differences were the front panel (see page two for details) and the labeling of a rear panel connector. The circuit changes include:

1. A noise blanker (NB-7) has been installed.
2. A 500Hz filter (SL-500) has been installed in selectivity position "A"
3. Selectivity "B" has been adapted to provide a bandwidth of 9kHz for AM reception.
4. A surge protection device has been added to the receive antenna input to provide additional protection from static discharges from lightning.
5. The unused phono style tip-jack on the rear panel has been labeled "TX", and now provides an alternate audio input to the transmitter for

sources other than microphone. This jack is connected in parallel with pin 1 on the front panel microphone jack. See below the pictures showing the connector labeling on the TR-7A rear panel.

The TR-7A version brought out microphone audio to a rear panel jack and marked it with a "TX". The older TR-7 version this jack was a spare jack, this jack was left unconnected during production.



Here again you need to be cautious if you suspect a TR-7 identity issue. Someone could easily use black rub-on lettering for the transmit audio connector creating a look-alike TR-7A rear panel.

Other Noteworthy Items:

Here are a few other bits of information I uncovered during my research. Drake no longer has any records of how many TR-7 transceivers were manufactured. The best we can determine Drake built around 10,500 TR-7's and around 2500 TR-7A's. We know the TR-7A production started with a serial numbering around the high 10,800's range, and the highest TR-7A serial number I've seen or heard about is serial number 12269.

Some of you may have seen the TR-7 transceiver cabinets in black. Drake never built a TR-7 or TR-7A using a black cabinet. The Drake cabinets were either the early version gray sometimes referred to as the "sticky paint" cabinet, or the later version dark gray hard vinyl clad aluminum cabinet. So where did the black case come from? As I understand the story, the black case was available from Drake after they stopped manufacturing amateur radio equipment. After that time Drake was still receiving many orders for replacement cases, so Drake had a quantity of them reproduced as replacement parts and sold them as such for several years until they ceased providing spare parts and support for all the Amateur Radio equipment. But why a black case? During that time Drake's cabinet manufacturer was producing black cases for other Drake products including the TR-270 and several of their short wave radios, so Drake decided to use the same material because it was readily available.

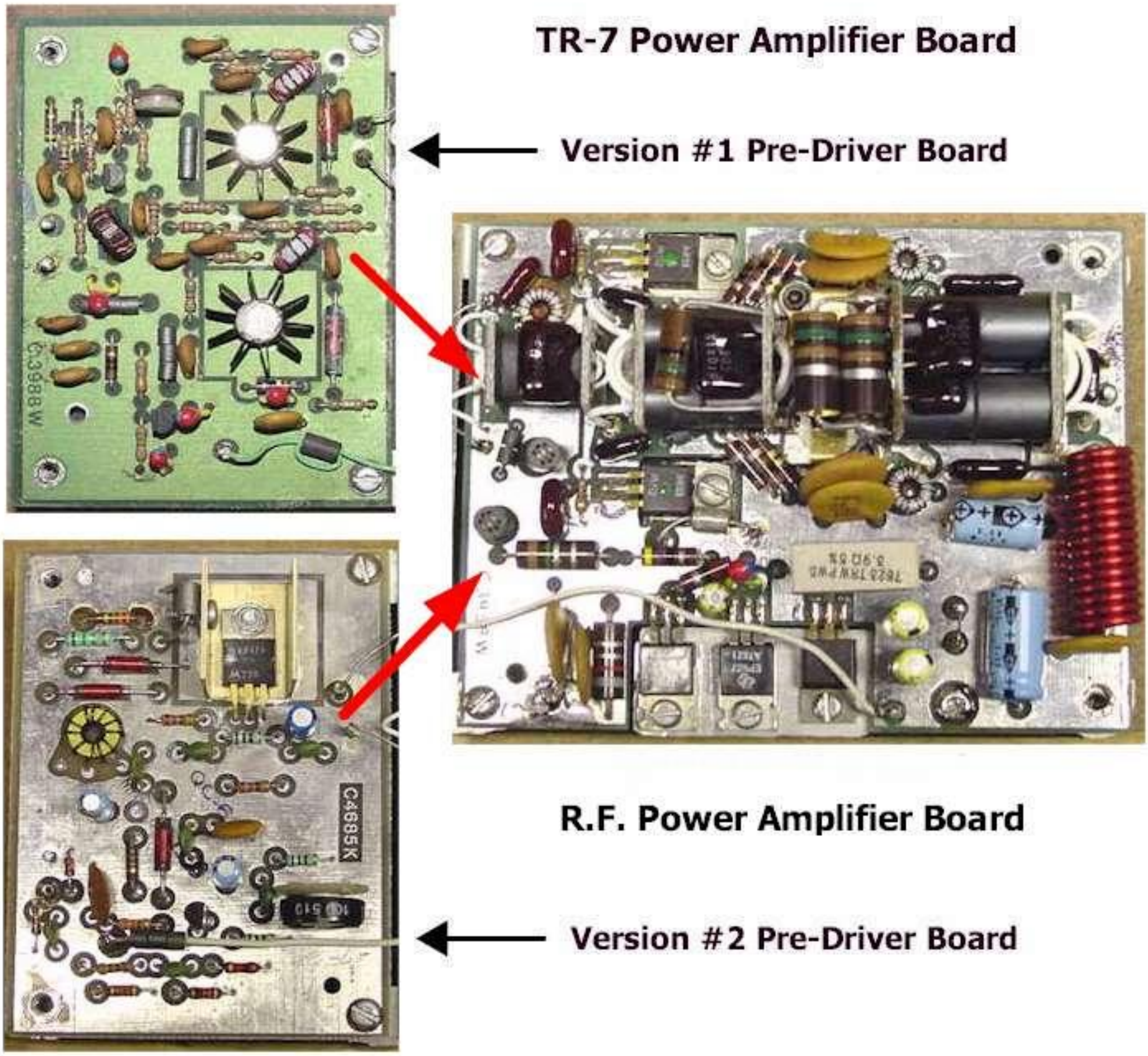
The original "sticky paint" case used a new type of paint that would resist scratches. The only problem was after a while the paint started to break-down, causing the surface to become tacky or sticky to the touch. As time went on the cabinet paint started to deteriorate and discolored creating a fairly ugly case. Fortunately, after producing around 2000 TR-7's with this style case, Drake changed to the more popular textured dark gray vinyl clad aluminum case.

Did Drake perform TR-7 to the TR-7A upgrades? Yes, for a fee Drake did offer to upgrade the TR-7 to the later TR-7A version. What Drake did was to upgrade the circuitry and internal wiring but did not change the outward appearance of the radio. Specifically, Drake did not change the front panel top strip which shows the model number.

The Transmit Power Amplifier

The Drake TR-7 power amplifier has two versions of the pre-driver board, both shown in the picture below along with the power amplifier module. The version #1 board consisted of a transistorized three stage amplifier with an on-board +8VDC regulator supplying power. The version #2 board has a two stage amplifier and is powered directly from the 13.6VDC power supply through a set of relay contacts. Both boards have signal limiting and impedance matching on the input and variable gain output to set the proper level to the power amplifier module. The advantage of the version #2 board was a simpler design with less components, and has a design change to better control and increase stability of the output level driving the power amplifier.

In the TR-7 the change-over from the version #1 to the version #2 board came very early in the production of the TR-7. The TR-7A version used the version #2 board exclusively.

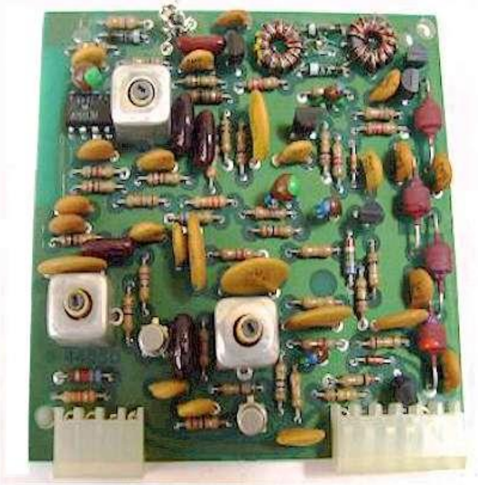


The NB-7 Noise Blanker

The NB-7 series noise blanker came in three versions. There was the original version which is used in the early TR-7 transceiver production, referred to the picture as the early version. The NB-7 later version has a totally redesigned circuit board layout, but uses basically the same circuit design, with two exceptions. First, the later version incorporated an additional stage of amplification, transistor Q816, at the input to the noise blanker to make up for some signal loss needed over the earlier version. Second, the circuit board layout was redesigned to incorporate a crystal filter, assumedly for better noise selectivity. However, the later version of the NB-7 installed in the TR-7 transceiver never used the filter, a jumper wire was installed in place of the crystal filter. Notice on the NB-7 later version the open circuit board area on the lower left side of the circuit board.

In the picture you will notice the NB-7 later version and the NB-7A circuit board layout are the same. The 2nd generation noise blanker, the NB-7A, did incorporated the crystal filter. Notice in the NB-7A picture the previously discussed open circuit board area, lower left side now has the crystal filter installed. The best I can tell is the NB-7A was used in the companion R-7 and R-7A receivers. The noise blanker, NB-7A, with the crystal filter was standard equipment in the R-7A receiver and available as an installable option in the R-7 receiver.

All three versions of the NB-7 noise blanker are interchangeable between all models of the TR-7(A) transceivers and the R-7(A) receivers. However, I have noticed when using the NB-7A with the crystal filter, when the noise blanker is switched into the circuit you will notice on the "S" meter a small drop in signal strength.



NB-7 Noise Blanker - Early Version

NB-7 Noise Blanker - Late Version

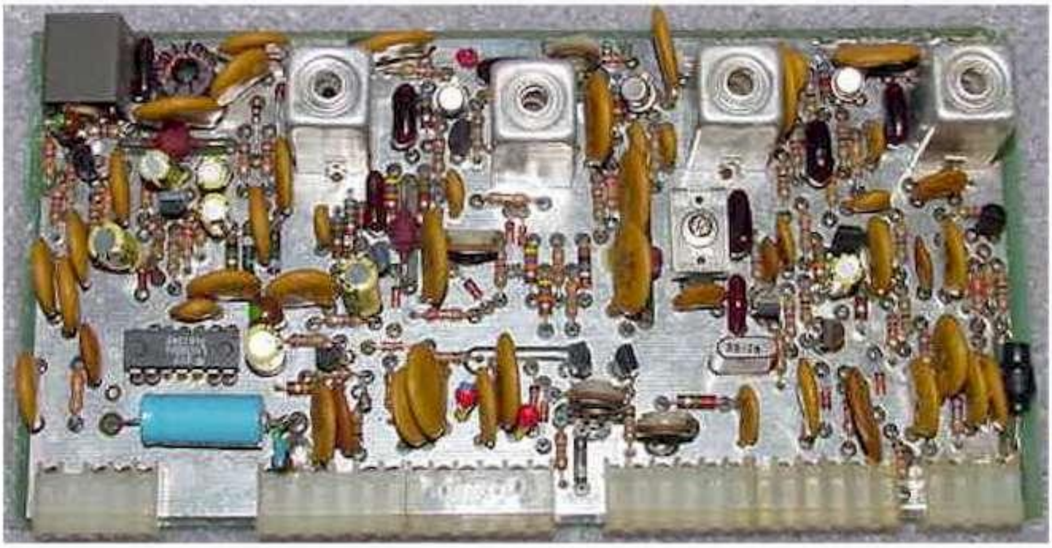
NB-7A Noise Blanker

The 2nd IF/Audio Board

At some point during the production of the TR-7 transceiver, not sure exactly when, Drake redesigned the 2ndIF/Audio Board to allow for a product detector improvement. The early version used discrete components for the product detector, which is used for the modes of SSB, CW, and RTTY. This early version used signal diodes and transistors to detect the audio signal. In the later version that entire circuit was replace with a single integrated circuit, specifically the Motorola MC1496. This circuit change gave the radio better dynamic audio range which is a definite improvement in the transceiver's receive audio over the earlier version. Other that this one change the rest of the board is approximately the same on both versions.

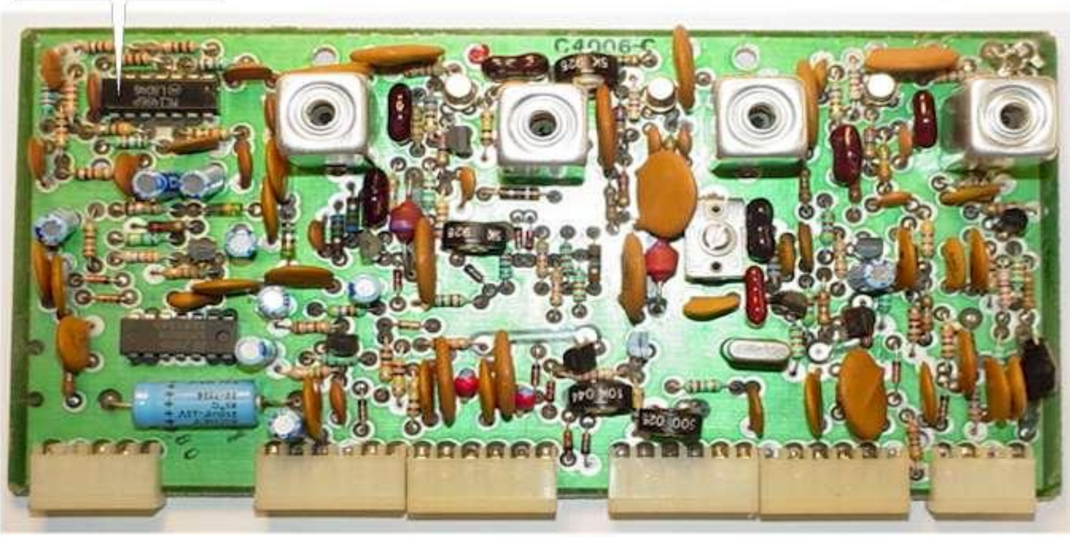
In the photos below, you can see both versions and I've marked the product detector IC on the later version board.

2nd IF/Audio Board - Early Version



New Product Detector Intregrated Circuit

2nd IF/Audio Board - Late Version



Serial number manufacturer date

http://www.wb4hfn.com/DRAKE/DrakeSNDatabase-P3.htm

Model Number	Description	Serial Number	Manufacturer Date
TR-5	Transceiver	001196	Apr 17, 1982
TR-5	Transceiver	001208	Apr 25, 1982
TR-5	Transceiver	001239	Apr 30, 1982
TR-5	Transceiver	001514	Nov 15, 1982
TR-6	6 meter Transceiver	0057	Jan 15, 1968
TR-6	6 meter Transceiver	0089	Dec 23, 1968
TR-6	6 meter Transceiver	0306	Dec 18, 1969
TR-6	6 meter Transceiver	0329	Dec 20, 1969
TR-6	6 meter Transceiver	0389	Dec 23, 1969
TR-6	6 meter Transceiver	0570	Oct 18, 1974
TR-7	Transceiver	733	Oct 04, 1978
TR-7	Transceiver	1255	Oct 19, 1978
TR-7	Transceiver	1293	Oct 19, 1978
TR-7	Transceiver	1536	Nov 28, 1978
TR-7	Transceiver	2483	Feb 01, 1979
TR-7	Transceiver	2514	Feb 22, 1979
TR-7	Transceiver	3033	Mar 03, 1979
TR-7	Transceiver	3046	Apr 16, 1979
TR-7	Transceiver	3083	Mar 03, 1979
TR-7	Transceiver	3491	Mar 23, 1979
TR-7	Transceiver	3558	Mar 30, 1979
TR-7	Transceiver	3662	Apr 26, 1979
TR-7	Transceiver	3907	May 16, 1979
TR-7	Transceiver	4041	May 23, 1979
TR-7	Transceiver	4388	July 02, 1979
TR-7	Transceiver	5151	Aug 12, 1979
TR-7	Transceiver	5462	Oct 10, 1979
TR-7	Transceiver	5472	Oct 10, 1979
TR-7	Transceiver	6085	Dec 05, 1970
TR-7	Transceiver	6317	Jan 09, 1980
TR-7	Transceiver	6358	Jan 09, 1980
TR-7	Transceiver	6436	Jan 09, 1980
TR-7	Transceiver	6627	Feb 06, 1980
TR-7	Transceiver	7128	Apr 03, 1980
TR-7	Transceiver	8110	Jun 29, 1980
TR-7	Transceiver	8915	Oct 30, 1980
TR-7	Transceiver	9164	Nov 04, 1980

Model Number	Description	Serial Number	Manufacturer Date
TR-7	Transceiver	9537	Dec 31, 1980
TR-7	Transceiver	9695	Jan 30, 1981
TR-7	Transceiver	9849	Feb 11, 1981
TR-7	Transceiver	9974	Feb 24, 1981
TR-7	Transceiver	10084	Mar 18, 1981
TR-7	Transceiver	10326	Mar 25, 1981
TR-7	Transceiver	10571	May 04, 1981
TR-7	Transceiver	10582	May 05, 1981
TR-7A	Transceiver	10822	Oct 28, 1981
TR-7A	Transceiver	10826	Nov 08, 1981
TR-7A	Transceiver	11214	Nov 18, 1981
TR-7A	Transceiver	11305	Feb 22, 1982
TR-7A	Transceiver	11960	Dec 08, 1982
TR-7A	Transceiver	12017	Dec 10, 1982

TR-7 PIN DIODE TEST PROCEDURE

http://www.wb4hfn.com/DRAKE/DrakeArticles/PinDiodeTest.htm

1) Disconnect PS-7 pr power supply from TR-7.

2) Remove TR-7 wrap-a-round cover.

3) Re-connect PS-7 or power supply

4) Locate on TR-7 and select the 10 meter band, receive mode. The anode of CR-1501 should measure zero volts or no more that 300 millivolts. The anode of CR-1503 should measure +10 to +11 volts DC.

5) Connect dummy load to TR-7

6) Select CW mode and advance the gain control to full output. Key the TR-7, the anode of CR-1501 should measure +1- to +11 volts DC. The anode of CR-1503 should measure zero to no more the 800 millivolts.

7) Replace diodes accordingly to achieve proper results.

Drake TR-7 A.M. Transmit Filter Modification

By: Jeff Covelli WA8SAJ

http://www.wb4hfn.com/DRAKE/DrakeArticles/TR7_AM_Mod/TR7_AM-P1.htm

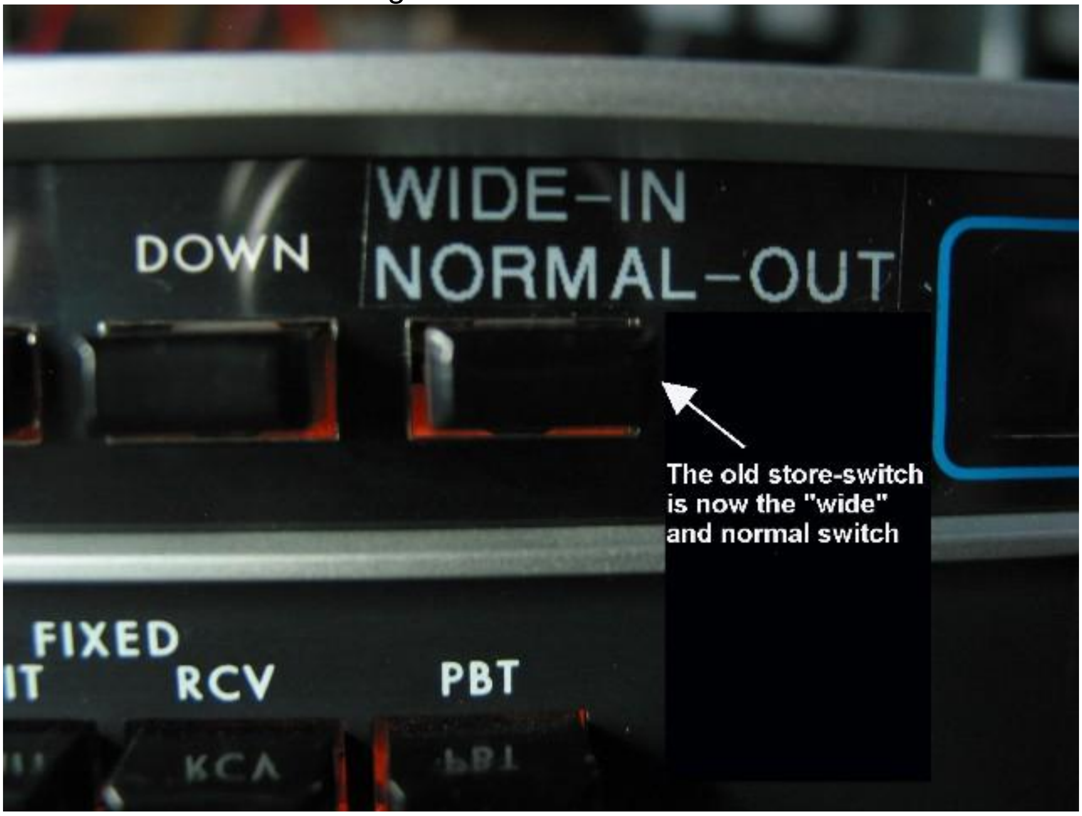
The Drake TR-7 is not your typical rig to be known for A.M. operation, since it is "solid-state" and not as famous as the old "tube" rigs that many of us folks have used through the years. I have had TR-7's for many years in my shack and until recently, was wondering what could be done to improve the transmit audio; since the receiver is great using the optional 6-Khz wide filter installed.

Description:

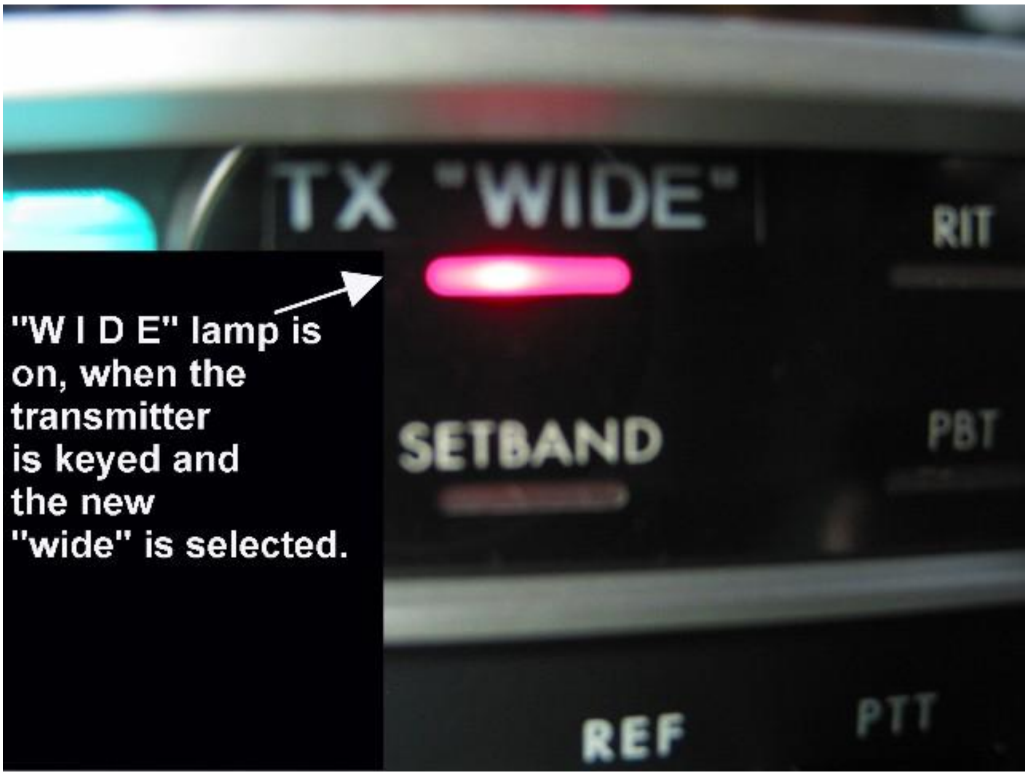
The TR-7 is an all "solid-state" transceiver including the final PA amplifier that will deliver about 120 watts output across 1.8 to 30 Mhz. Now running A.M. you have to turn down the output to about 25 watts with a little headroom for the peaks on A.M. The A.M. is derived from the balanced-modulator at the 5.645 Mhz lower I.F. by re-injecting the carrier with audio to develop the A.M. signal. This works great, except it is defaulted through the 2.3 Khz SSB filter now cutting the lower Side-Band off on transmit limiting the nice higher quality audio that is coming from the balanced modulator. The reason it is defaulted through the 2.3 Khz filter, the TR-7 has three positions for optional filters in the receive side independent of the "mode" selected. So, if the 6 Khz "wide" filter is selected and you operate SSB, then you have Double Side-Band and that would not be nice to your neighbors on the band and you might get a nice QSL from the FCC doing that!

Solution:

I looked into what Drake did to default the 2.3 Khz filter in transmit all the time and found a simple way of making the 6 Khz wide filter work on transmit. There is a diode that is used to steer the voltage toward the 2.3 Khz filter and it is only on the "transmit" 10-volt line. I also found a very seldom-used switch on the front panel, called a "store" switch. The "store" switch was a gimmick at the time to hold the digital-dial frequency (not a memory) for what reason I could never understand, but it was there and a handy one at that. There is also a seldom used “fixed” lamp that comes on for a frequency that you might use for a net or in the Marine Band when the TR-7’s were used in the Commercial Market. So now there are two items that I needed to make this all happen. I need a switch and a lamp to tell me that I am transmitting in the “WIDE” mode.



Pictured here is a front panel view of the modified and relabeled "Store" switch on the TR-7



Pictured here is a front panel view of the relabeled "Fixed" lamp on the TR-7 Transceiver.

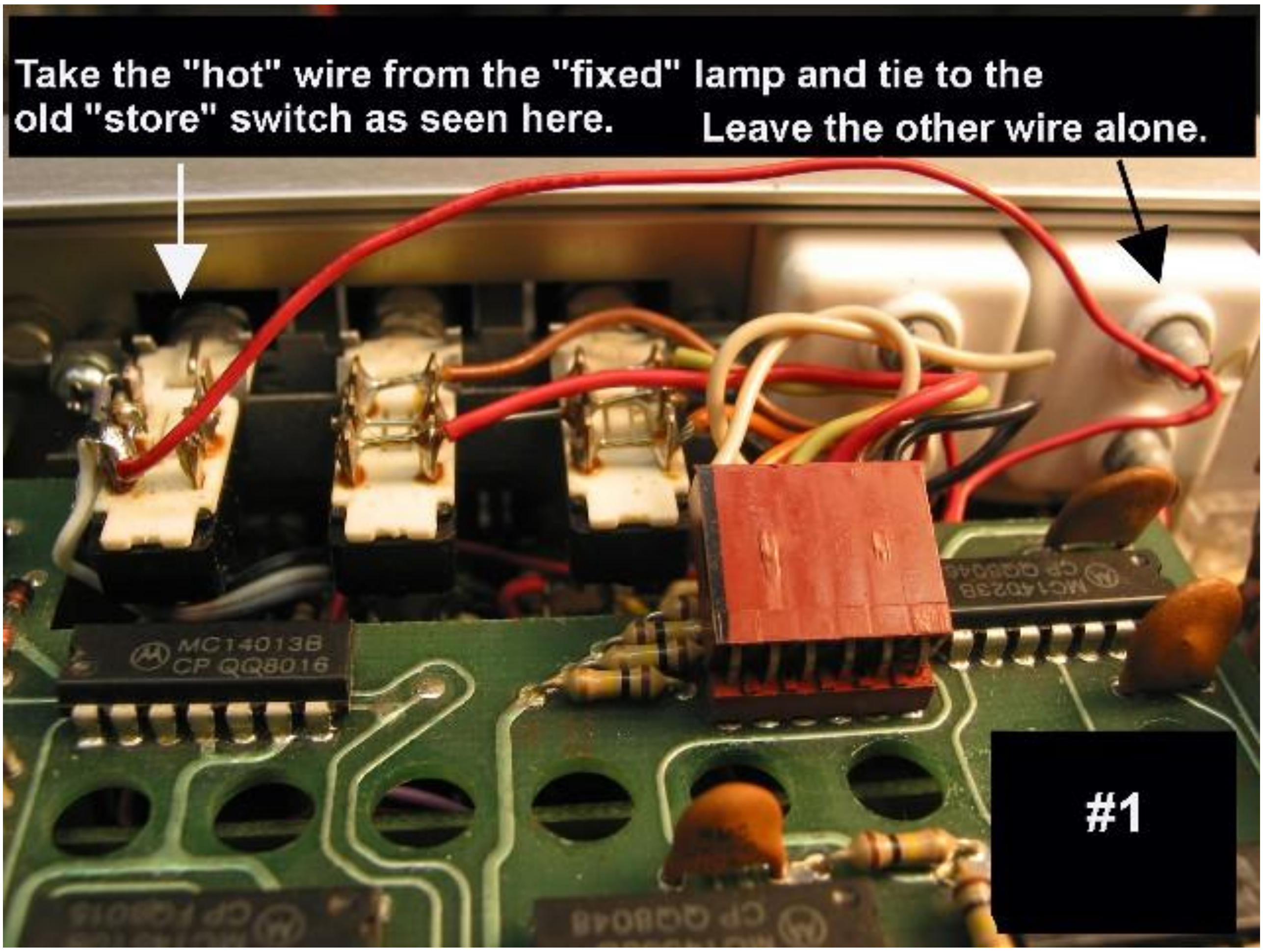
Getting Started:

Get yourself a muffin pan or small containers to put all your separate screws that will come off during this project! Taking the cover off the TR-7 is easy, just slide the cover off after removing the eight machine screws from the bottom. Next you will take off the bottom cover after removing the sheet-metal screws. The top of the radio is where you start, since the “store” switch and the lamp have to be wired first, then to the bottom of the TR-7 and the mother-board.

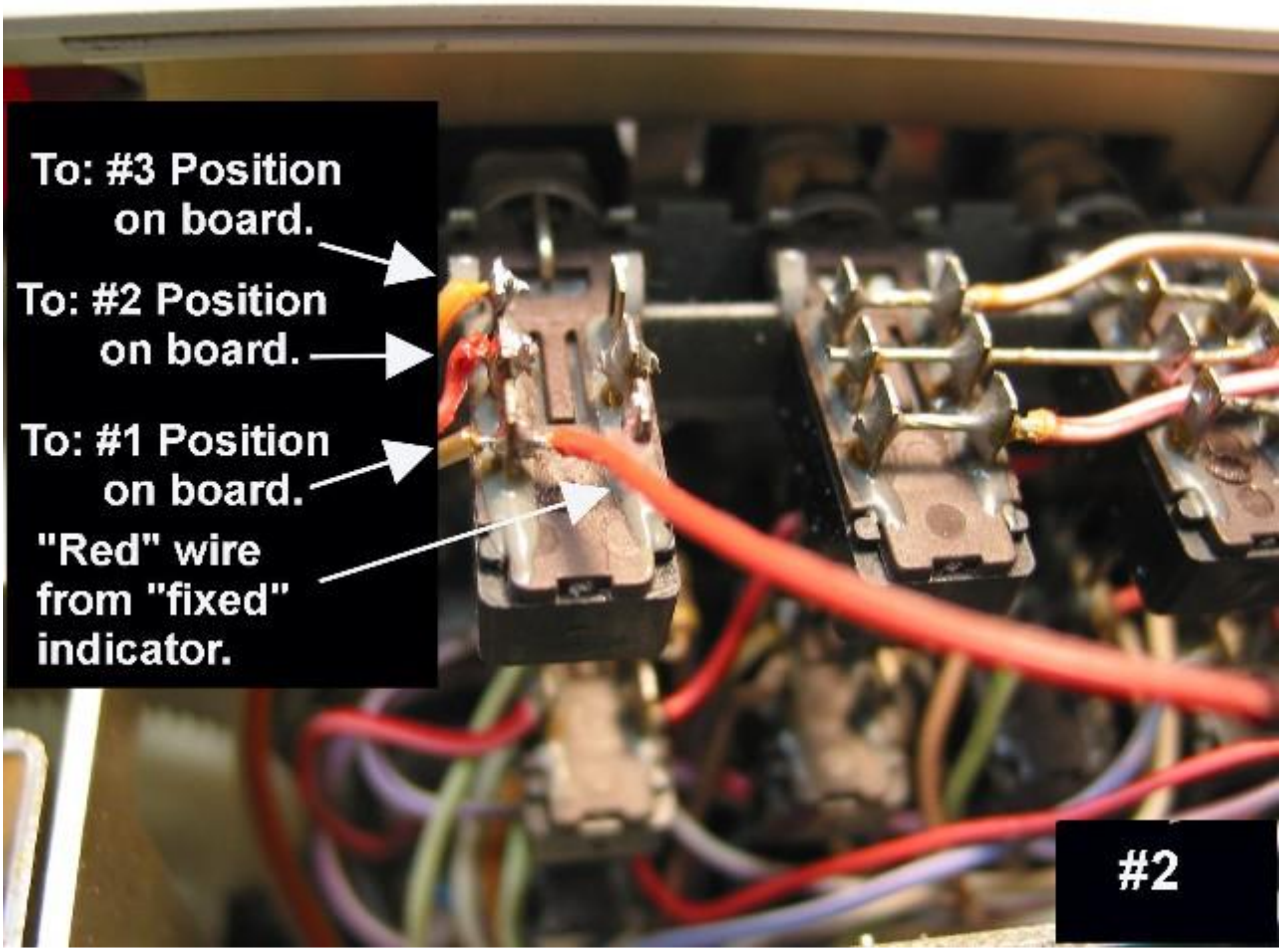
NOTE: You may not need to remove the DR-7 digital-board if the following is done this way.

1) With the back of the TR-7 towards you, start this way first.

2) Remove the existing wires from the “store” switch; these will not be used for this project.



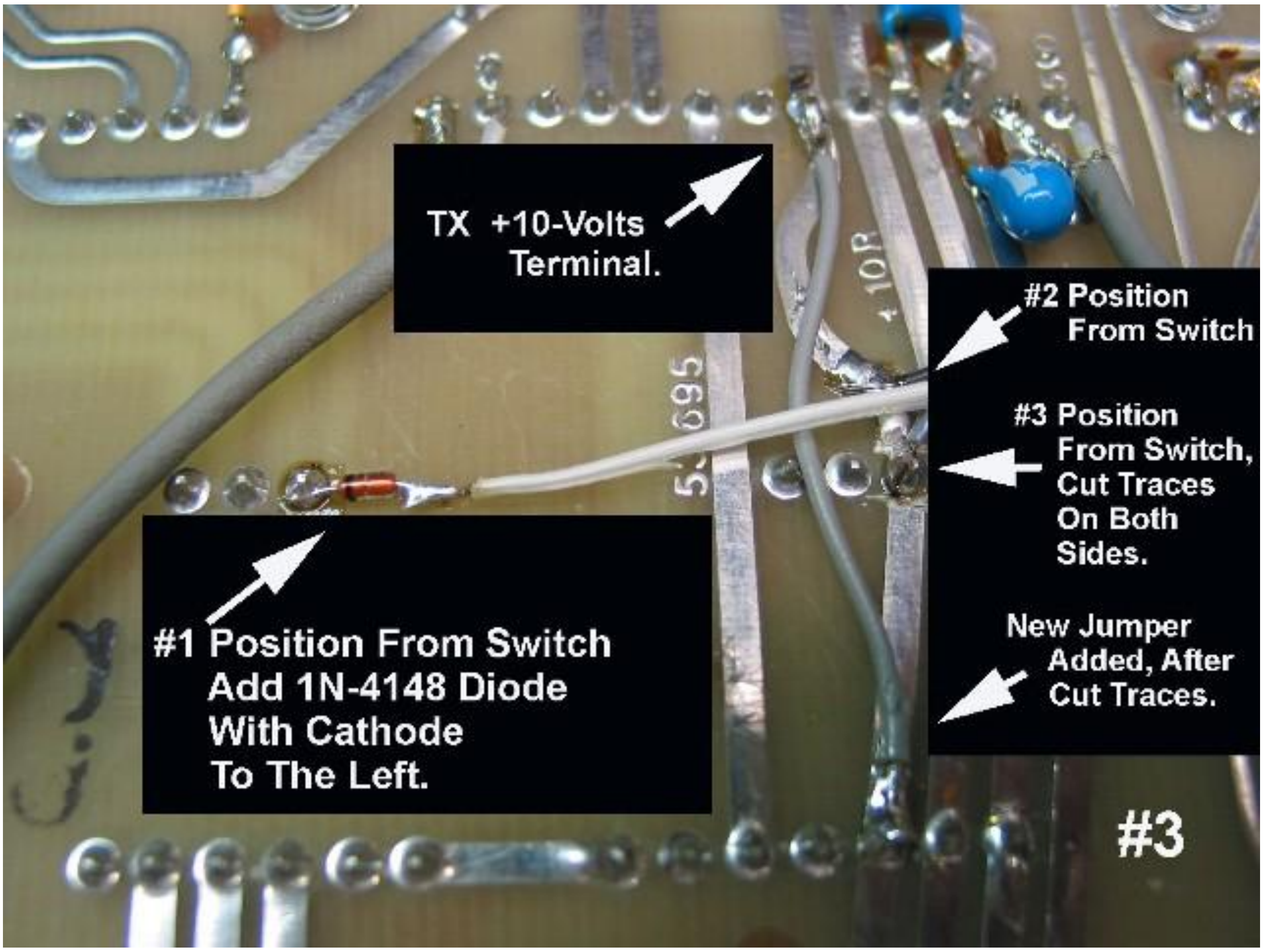
3) The hot wire from the “fixed” lamp can be cut closest to the xmit “fixed” switch. Now solder the cut wire to the “store” switch (see photo #1). If the cut wire is too short, you might have to extend it. Note: The other wire on the “fixed” lamp goes to ground already.



4) Take three wires (ribbon-wire works great) and solder them to the “store” switch (see photo #2).

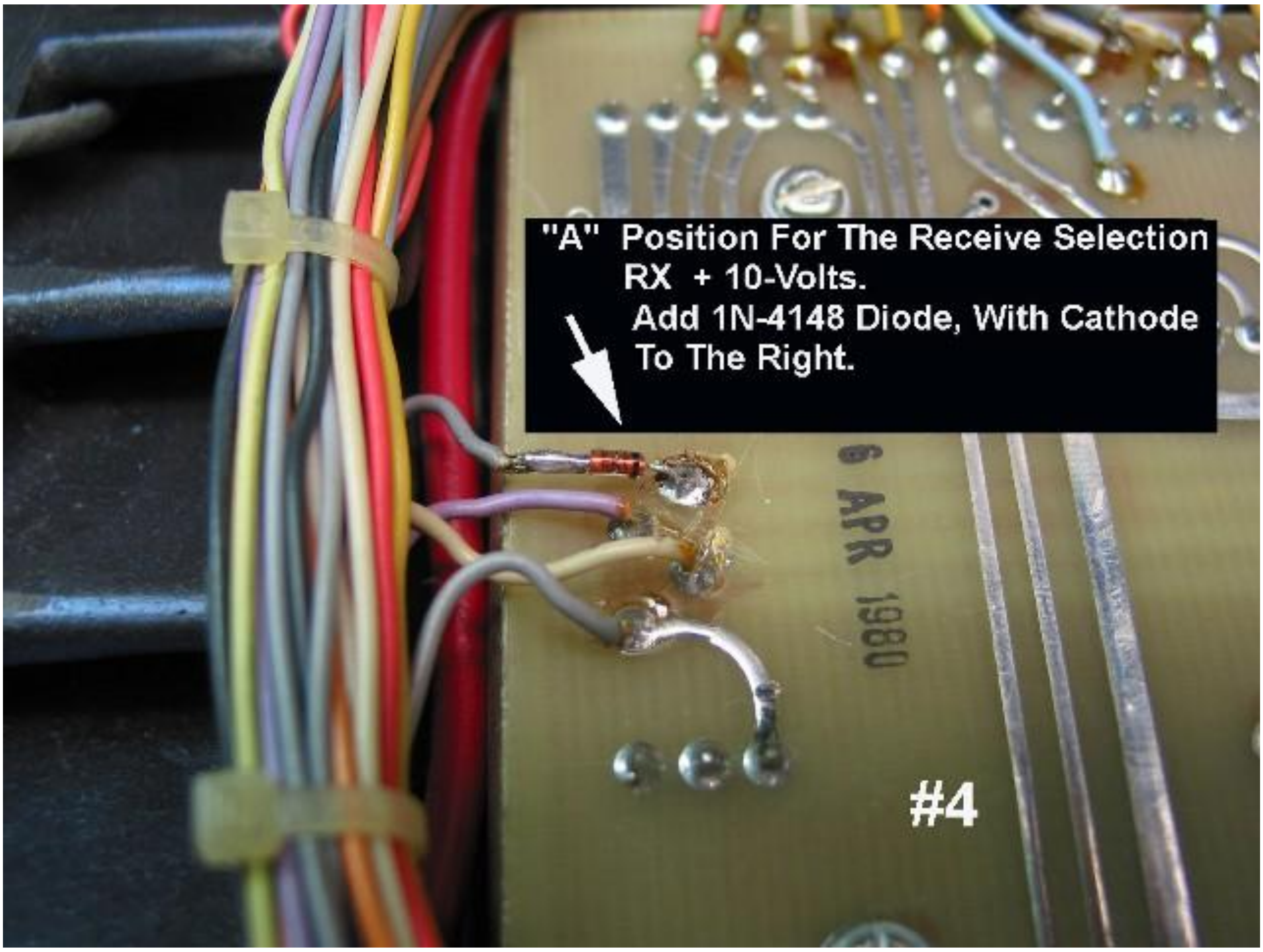
5) Now turn the TR-7 with the front panel towards you.

6) The three wires are now run down to the bottom mother-board and soldered to their connections as seen in the photo.   Note: Make sure you take notice of what #position you are applying the wires to, very important!

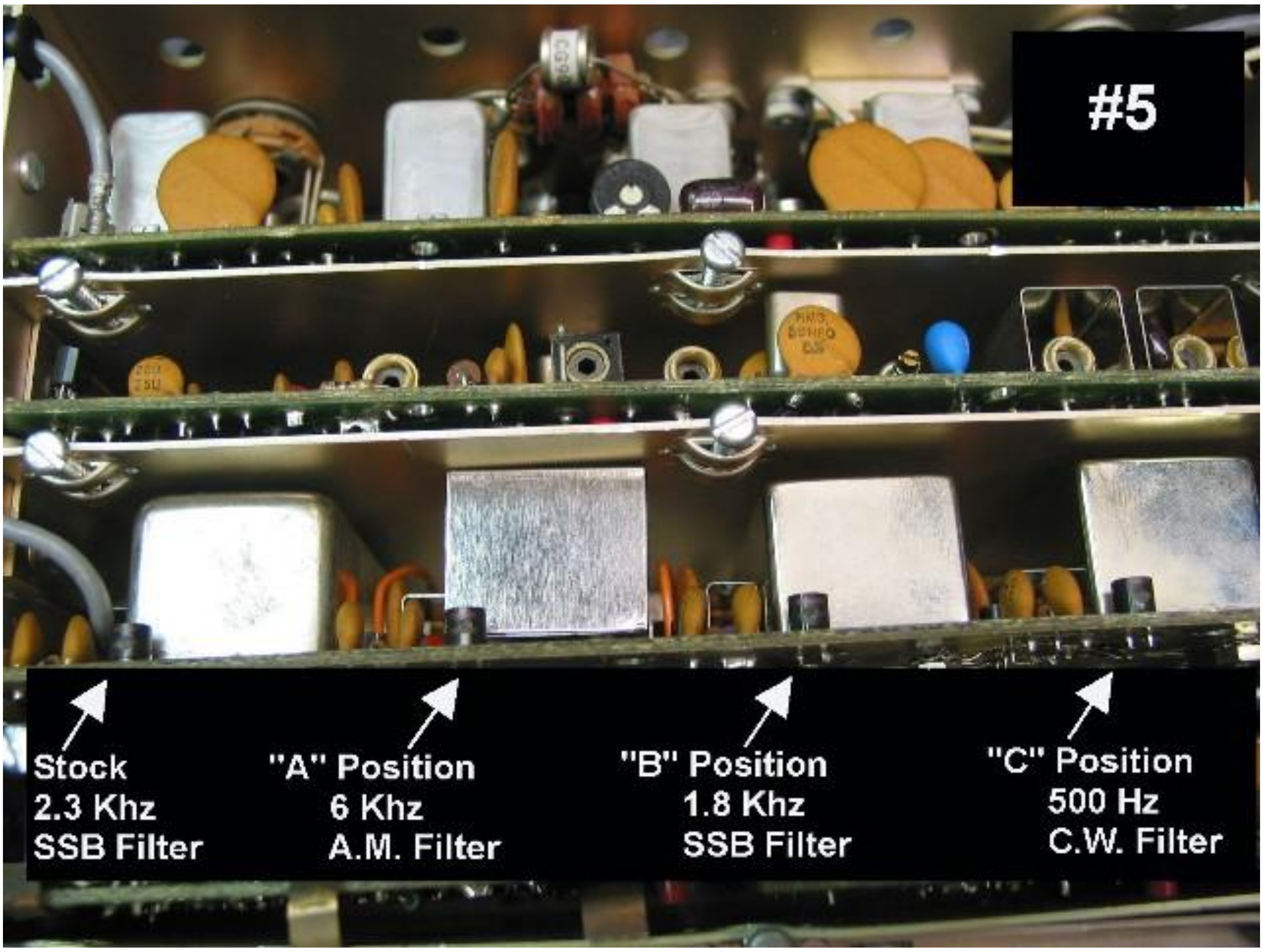


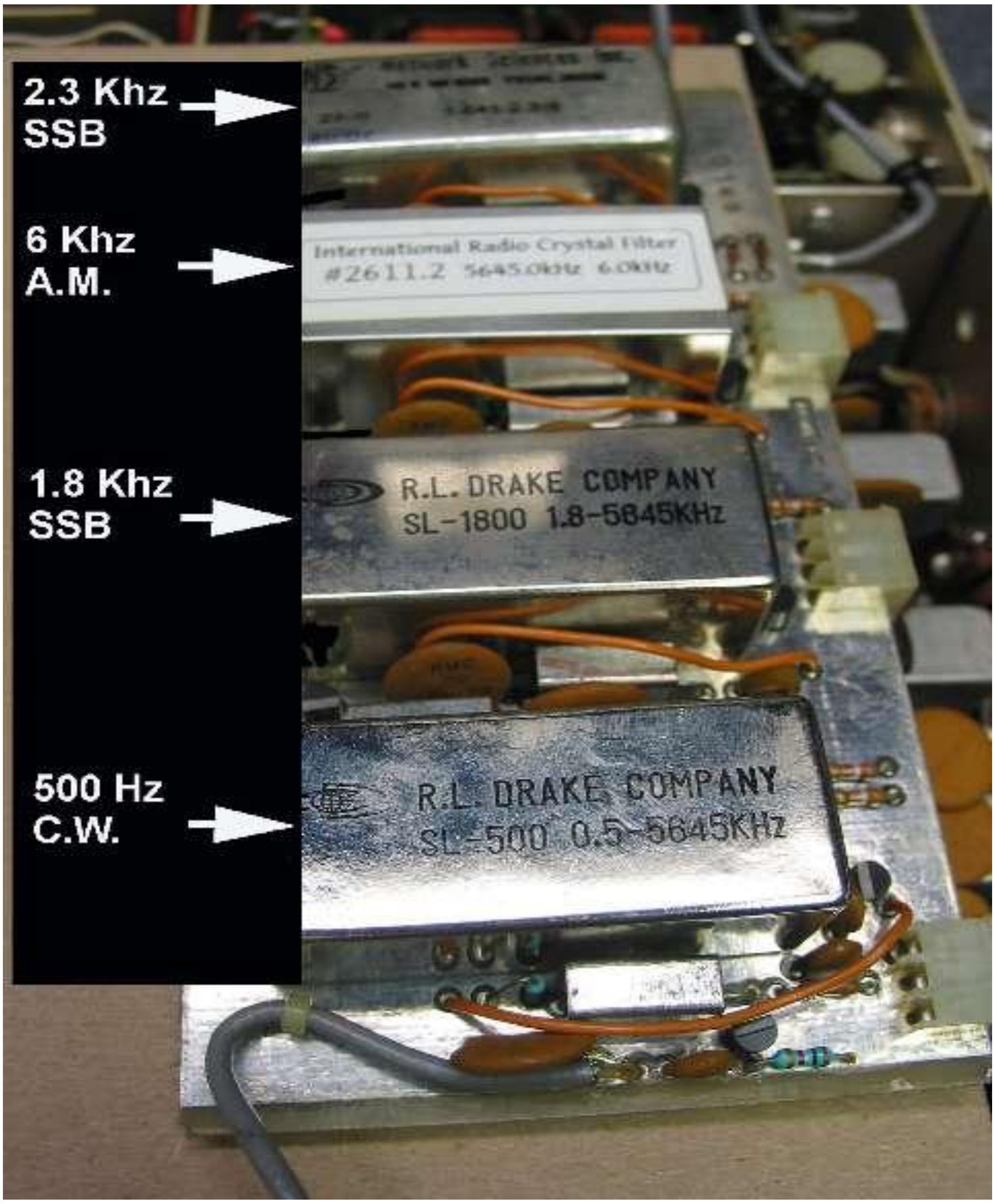
7) As seen in the (photo #3) follow the directions as to cutting the traces both sides of the #3 position and adding the jumper, then adding the one diode in series (note direction of diode) with the #1 position.

8) Install the rest of the remaining wires coming from the “store” switch for #2 and #3 position.



9) The “RX” 10-volt line (top gray wire) on the left of the mother-board has a diode added in series with it (note direction of diode). This is the ”A” position on the front-panel selection (see photo #4).


#5
Stock
2.3 Khz
SSB Filter
"A" Position
6 Khz
A.M. Filter
"B" Position
1.8 Khz
SSB Filter
"C" Position
500 Hz
C.W. Filter



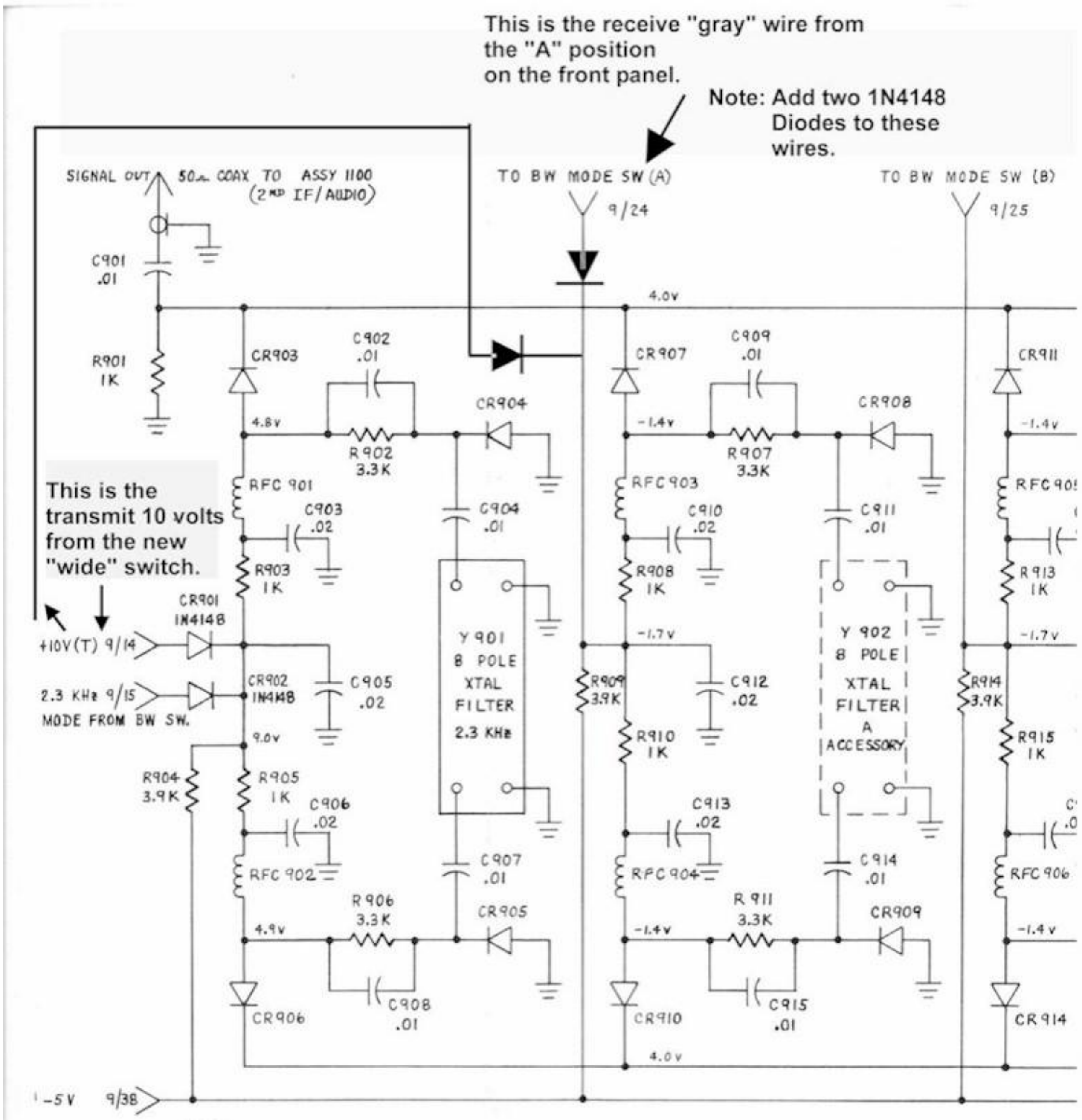
10) Mount the 6 Khz A.M. filter in the "A" position only (see photo #5) on the I.F. filter board. Note: You can try and find a used 6 Khz A.M. filter or get a new one from INRAD PO Box 2110, Aptos, CA 95001 USA. New phone number is (831) 462-5511. The e-mail is:sales@inrad.net. WEB page is:www.qth.com/inrad/

11) Now this completes the wiring of the TR-7!

How To Operate:

When you operate on A.M. with the TR-7, first make your filter selection in the "A" position for receive. The old "store" switch is now pushed in for the "W I D E" transmit, and the old "fixed" lamp will light when you transmit. The carrier should be set for no more than 25 watts for any length of time and bring the microphone gain up until the watt-meter starts to wiggle upward on voice peaks. I recommend a stock D-104 (no pre-amp) and solder the microphone audio "hot" lead to pin #4 of the microphone connector. Drake has already installed the 680 K ohm resistor; which is in series now with the microphone element and makes the D-104 sound great! Have fun with the Drake TR-7 and enjoy A.M. with a great rig.

Pictured below is the wiring diagram showing the wiring changes for this modification.



NOTE

DIODES CR903 THRU CR918 ARE TYPE MPN 3404.

ALL VOLTAGES MEASURED IN 2.3 KHz POSITION.

Programming Modules for the AUX-7 Board

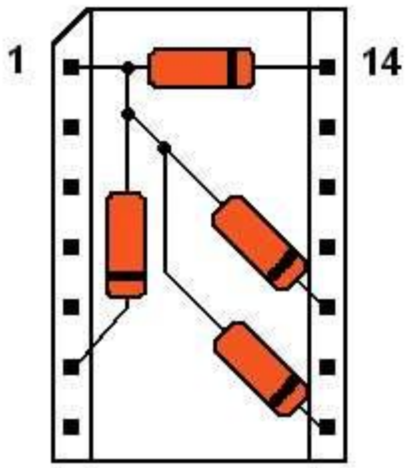
By: Gary Poland, W8PU

http://www.wb4hfn.com/DRAKE/DrakeArticles/AUX7_Modules/AUX7_Modules.htm

TR7 AUX-7 Board Programing

Leads of 1N4148 diodes will press fit into socket or can be soldered on the back of the PCB under the socket. Remaining ends of diodes are soldered together as shown. The example at the right is for 18.0 to 18.5 Mhz with transmit enabled.

Pin 1 is the 5 volt DC common connection and Pin 10 is connected for enabling transmit.



VLF - AM BC - WARC Progamming

0.0 to 500 khz - connect diodes from pin 1 to pins 3,4,9,12

500 to 1000 khz - connect diodes from pin 1 to pins 2,4,9,12

1000 to 1500 khz - connect diodes from pin 1 to pins 4,9,12

10.0 to 10.5 Mhz - connect diodes from pin 1 to pins 3,4,7,8,10,11,12,&13.

24.5 to 25.0 Mhz - connect diodes from pin 1 to pins 2,3,4,6,7,10,11,&14.

IC Socket Pin Assignments

Program Pins
Determines 500 khz Frequency Range

1	+5 vdc	6	Range B0
2	Range A0	7	Range B1
3	Range A1	8	Range B2
4	Range A2	9	Range B3
5	Range A3	10	XMIT Enable

BAND SET Light Programming

11	Band A
12	Band B
13	Band C
14	Band D

Gary Poland W8PU 1999

Adapting the IQPro VFO to the Drake TR7

Written By: Floyd Sense - K8AC

http://www.wb4hfn.com/DRAKE/DrakeArticles/DSS-VFO/DDS-VFO.htm

The following documents what I've learned in adapting the IQPro DDS VFO for use as an external VFO for the Drake TR7 transceiver. The ultimate goal is to replace the TR7 internal PTO with the IQPro, but using the TR7's existing RV7 interface was an attractive first step since it required no modifications to the TR7 at all. When using an external VFO with the TR7, the TR7's digital readout will always read the correct frequency.

As of December 30, 2007, I have the prototype of the VFO running successfully with my TR7. Extensive changes were made to the IQPro PIC code to adapt the VFO operation to my desires.

Differences between the IQPro and RV7

The Drake RV7 remote VFO is of course a single PTO, basically the same PTO that is used in the TR7. If turned off, it has no effect on TR7 operation at all. When turned on, the function switch selects whether the RV7 will be used only on Receive, for Receive and Transmit, or only for Transmit.

The IQPro features two separate VFOs (A&B) and I elected to have the IQPro control the Receive and Transmit frequencies completely when it's turned on. I saw no need to duplicate the RV7 ability to have the TR7 PTO control transmit or receive while the IQPro controlled the other. The two VFOs in the IQPro made that function superfluous.

Aside from the increased temperature stability of the IQPro, my main reasons for using it was to achieve a lower tuning rate (fewer Khz per knob revolution) commensurate with more modern gear, and a simpler split frequency capability.

The TR7 - RV7 Interface

The RV7 connector on the rear panel requires an 8 pin Jones plug, no longer available. However, Molex makes a replacement for the Cinch Jones part (details on source go here). The TR7 and RV7 diagrams go out of their way to confuse the reader (which side of the connector am I looking at?) and for some reason they don't show the horizontal and vertical orientation of the connector pins. So, here's the pin-out information and you can look at the connector to see where pin 1 is.

Pin
1 - Ground
2 - VFO RF Out (This one is interesting, since the RV7 also applies a 13.6VDC to the RF line in order to operate the PIN diode that must conduct to switch the RV7 RF into the TR7 translator input.)
3 - 13.6 VDC (This is used to power the IQPro)
4 - Transmit disable (In the RV7, this line is grounded by the spot switch to disable the TR7 transmitter when adjusting the TR7 and RV7 VFOs to the same frequency using the Spot switch. The function is not necessary and not used with the IQPro.
5 - RV7 Enable (When the RV7 function switch is not OFF, the TR7 applies a +DC voltage to this line. The circuitry that does that is driven by pins 7 and 8 of the connector, indicating to the TR7 which VFO to use for Receive and which for Transmit. This same voltage is applied to Pin 2 by the RV7 as described above. So, if the RV7 is NOT to control the receive or transmit frequency, there will be no voltage on this pin in that mode and therefore no RF output from the RV7).
6 - RIT line (This line has a low voltage on it, controlled by the RIT pot on the TR7 front panel. It is used to change the capacitance of a varicap in the RV7 oscillator circuit, but has no function for the IQPro at this time.)
7 - "A" in diagrams, the RV7 applies 13.6VDC here to indicate that the RV7 will control the TR7 frequency in Receive mode.
8 - "B" in diagrams, the RV7 applies 13.6VDC here to indicate that the RV7 will control the TR7 frequency in Transmit mode. If the RV7 will control the frequency in both Receive and Transmit, both pins 7 and 8 will have 13.6VDC applied.

Additional IQPro Interface Requirements

In the IQPro, if you're operating in split mode using VFO A for receive and VFO B for transmit, you need a way to tell the IQPro when you're in transmit mode. The way you do that is to short the two pins of Header 6 on the Interface board. If you're not using an amplifier, the easiest way to do that is to use the VOX Relay jack on the PS-7, which grounds the center pin when the TR7 goes to transmit mode. A second approach, and one that I now use, is to pick up the 10V transmit line on pin one of the Accessory connector and use that signal to switch a 2N3904 transistor connected across Header 6. That requires a 12 pin Jones connector, but those are still available from Jameco and other sources.

I wanted to avoid using a function switch in the IQPro VFO so it was necessary to hardwire some of the RV7 interface function normally provided by the RV7. Turning on the IQPro will tie RV7 connector pins 7 and 8 to the 13.6VDC line (pin 3), indicating to the TR7 that the IQPro will be used for both receiving and transmitting.

In order to use any remote VFO with the TR7, a positive DC voltage must be applied on the VFO's RF output. That switches a PIN diode in the TR7 gating the remote VFO signal to the translator board. I supplied 13.6VDC from the IQPro power switch to the RF output terminal via a small RF choke.

The TONE frequency for the IQPro should be set to 0 Hz. The TR7 accomplishes the CW offset elsewhere and using an offset on the VFO frequency will assure that your CW transmit frequency will be different from your receive frequency - not a good thing.

IQPro Output Level

On my IQPro RF board, I use the "I" output with the transistor amplifier enabled, but no toroid installed. In setting the output level of the IQPro, I measured (using a scope) the PTO signal voltage on the pin labeled "PTO" on the bottom of the TR7 parent board. Using the internal PTO, the signal there was .6V peak-to-peak. I then connected the IQPro and adjusted R43 for .6V p-p at the same point. The output level at the "I" terminal of the RF board measured 1.5V p-p.

IQPro Hardware Changes
I wanted to keep the VFO front panel as simple as possible so decided to limit my use of the LEDs to just two: One next to the LCD display to indicate SPLIT mode, and another near the tuning knob to indicate FAST-TUNING mode. If necessary, you can always plug the full LED strip into the header to see the status of the other LEDs.

IQPro PIC Code Modifications Required
First, I want to make it clear that you won't *need* any changes to the PIC code to get the VFO working with the TR7. The TR7 readout will continue to work properly and the only catch is that the IQPro LCD will not show the operating frequency, but rather the VFO output frequency. To use the VFO in this way, you just power it up, enter the operating frequency of 5.050 MHz via the keypad, and you're ready to go on all bands. You never need to use the band up/down buttons.

The second possibility is to use the IQPro with the existing LCD formats (nothing at all wrong with that), in which case you'll just need to modify the band table to include the offsets for each band. That will get you all bands, but only the first 500 KHz of 10 meters. A deficiency in the code prevents you from adding segments to the band table for the rest of 10 meters at this time. If you really want to add those segments, my TR7 version of the code includes them, and has fixes the problem of not being able to expand the band table. The only other reason for using my version of the code is if you prefer my LCD layout to the original. The principal difference is I show both VFOs on the LCD all the time, while the original code shows one VFO at a time.

The ability to specify an IF offset is already in the IQPro code, and only minor modifications are required to use the TR7. The problem is that the TR7 VFO operates over the range of 5.05 to 5.50 Mhz regardless of the band you're operating on. Using the IF offset table in the code enables the LCD to read out the correct band and operating frequency, while telling the DDS to generate the appropriate frequency in the 5.05 to 5.50 Mhz range. Since that offset is different for each band (and 10 meter band segment), the offset had to be calculated for each segment and those values put into the offset table. The must be expanded by three rows to cover the complete 10 meter band. My code covers only up to 29.5 MHz with two additional rows since the TR7 doesn't have an FM capability anyway.

Additional Changes to the PIC Code
I made the following changes to the IQPro PIC code beyond those to the band table.

1. The number of decimal places for the frequency readout was reduced from 3 to 2. This was accomplished by just commenting out the code that writes the last digit to the LCD.

2. The LCD backlight was changed to a default state of ON instead of OFF. It can still be toggled via the backlight toggle button.

3. I wanted the VFO A and VFO B frequencies to be displayed all the time on the LCD and that took a lot of rework of routines that write to the LCD. A special indicator on the LCD shows which is the currently active VFO and if in split mode, the receive and transmit VFOs are identified. There was no need in my case to display the mode on the LCD, but I did decide that I needed to know if the VFO was in SSB or CW mode. So, another special indicator on the VFO shows when you are in CW mode. That's important since there is a user-determined CW offset applied, and the Tone button that accomplishes that only works

when you're in CW mode.

4. I disabled the UP and Down MHz buttons. There really wasn't any use for them in my application.

5. The function of the A=B button was changed to better satisfy my operating needs. I wanted the button to replace the contents of the active VFO (A or B) with the contents of the other VFO and now it does that.

6. A bandstacking register capability was added. When the VFO is first powered up and you step through the bands with the band UP/DOWN buttons, the frequency displayed on VFO A is a hard-coded frequency on each band. If you tune the VFO to a different frequency and then press band UP or DOWN, the last frequency you were tuned to on the previous band is remembered so that the next time you return to that band, VFO A will be set to that frequency. The stored frequency settings are maintained when the VFO is powered down.

Outstanding Issues

None

Possible Future Features

Implementation of the Icom CI-V interface to allow reading and writing of the VFO frequency from a logging program in the PC.

Packaging Comments

After surveying the cabinets available from the major parts suppliers, I ended up ordering a Ten Tec cabinet from their website. The cabinet features a nice powder-coated two piece outer shell, with powder-coated front and rear panels, and a nicely thought-out adjustable chassis piece inside. The cabinet is approximately 4x6x9 inches, and is overkill from a space standpoint but I wanted some heft to the cabinet wouldn't move when pressing the keypad buttons.

I spent a lot of time thinking about how to handle the keypad and at first intended to use individual tactile switches that could be mounted on the front of the panel. Luckily, I stumbled across the website of VU3WIJ, who sells a VFO similar to the IQPro and after an exchange of emails with Shaji, I decided to use the original IQPro keypad with a panel design borrowed from his work.

I used Open Office Draw to design a front panel with the keypad buttons printed precisely at the actual button locations. The original plan was to print the panel on stiff white paper and then cover it with a sheet of transparent plastic sheet with an adhesive coating. The keypad was mounted so that the buttons extended just slightly beyond the front of the panel. The buttons could then be actuated by just pressing on the buttons printed on the front panel. The adhesive covering idea didn't pan out as it was impossible to get rid of the mottled look caused by varying degrees of adhesion to the underlying printed sheet. I ended up printing the panel on gloss photo paper with my inkjet printer and then giving it two coats of clear gloss Krylon spray, followed by one coat of clear satin Krylon.

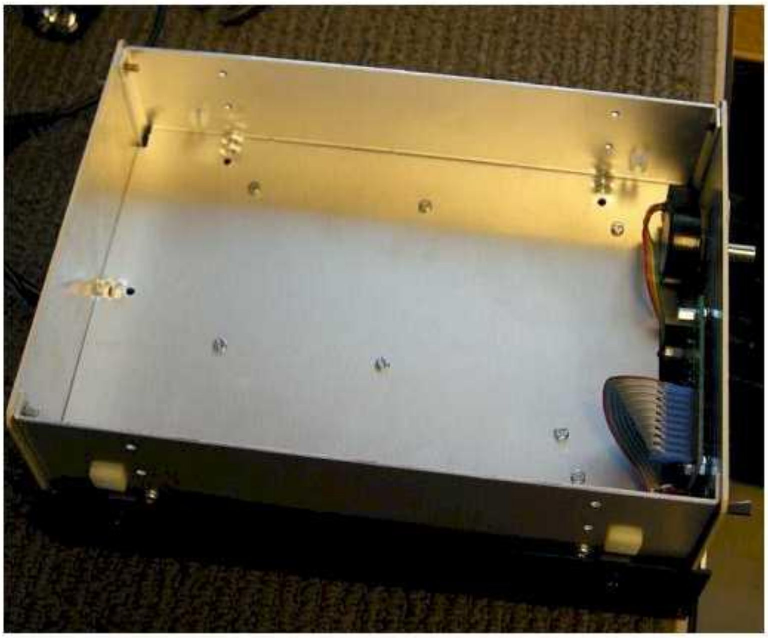
The photo paper proved to be just the right thickness and allowed the buttons to be easily pressed through the paper. I used Elmers spray adhesive on the rear of the panel sheet to secure it to the front panel. I ended up with spray glue on the front of the panel and thought all was lost until I tried a tiny bit of WD40 on a rag and that removed the glue easily without damaging the Krylon finish.

Producing a panel sheet that exactly matched the various panel holes and the LCD cutout was a real challenge, but Open Office Draw has some very nice features that help with that. I printed out many samples on plain white paper, holding them up to the front panel to see if things lined up and if not, how much the item had to be moved.

As a final touch, I used some fast-drying flat black paint (made for train hobbiests) applied with a small artists brush to coat the edge of the LCD cutout, thus hiding the aluminum edge. Holes for the LEDs were cut out after the sheet was glued to the front panel, using an Exacto knife. A fine pointed black Sharpie was then used to hide the white edge of the paper around the hole.

I spent a lot of time trying to match the color of the front panel to the front panel of the TR7, but that proved futile. It would probably be a simple matter for someone who knows something about color composition.

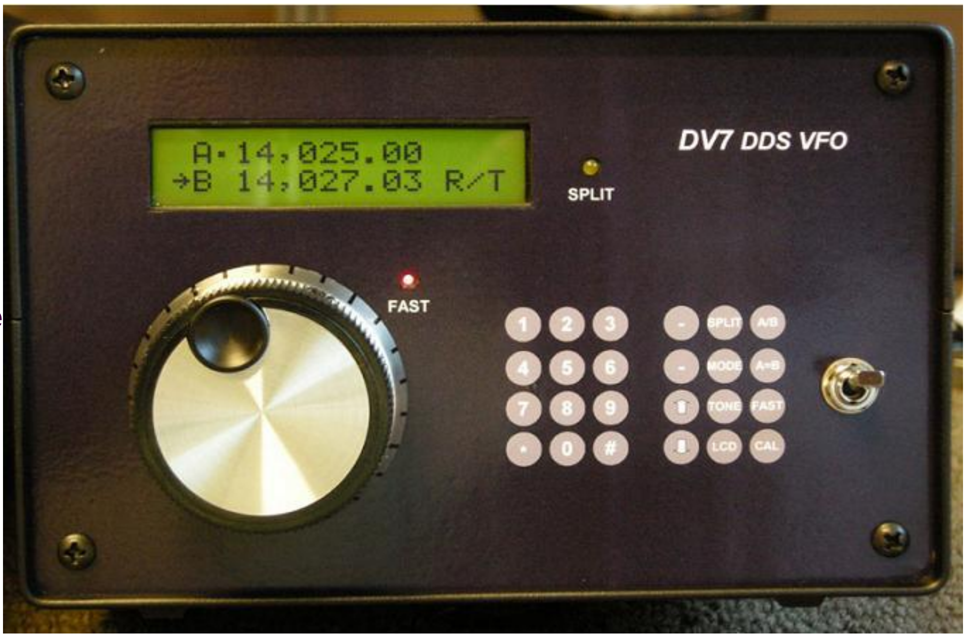
The VFO is housed in a TenTec cabinet with a front panel measuring 4x6". The length of the cabinet is 9" and as you'll see I could have used a cabinet of about 6" depth with no problem.

Lots of room inside with the IQPro boards still joined together. They could be split and stacked in a shorter cabinet if desired.

Here you can see my modified LCD display which shows both VFOs on the LCD at the same time. In SPIT mode, the RX - TX tags show which VFO will be used for receive and transmit. To the left of the VFO designator (A or B) is a right arrow that points to the active VFO. If the PTT line were grounded at this point, the arrow to the left of the A would move down to the left of the B indicating that VFO is now controlling the frequency of the TR7. When the VFO is not is split mode, the active VFO is identified with an R/T tag to the right of the frequency.

When not in split mode, the R/T tag identifies the VFO being used for both receive and transmit. Note the small square to the right of the A - that indicates we're in CW or CW-R mode. In this application, it's necessary to know only if we're in CW mode because of the offset applied to receive in CW mode and the fact that the TONE function operates only in CW mode.



Here's a close-up of the keypad buttons, printed on the front panel sheet. The buttons extend just slightly beyond the front of the panel and the sheet is flexible enough to allow the individual buttons to easily be pressed. This idea came from VU3WIJ.

Recreated TR-7 / R-7 Service Kit

http://www.wb4hfn.com/Services/W7AVK/tr7ext2.htm

HISTORY - Several years ago I purchased a TR-7 and wanting to be able to work on it obtained a copy of the Service Manual. I soon learned to do any serious work a Service Kit sold by DRAKE 20 - 25 years ago as an option was required. These kits nowdays are essentially unavailable. In a year of looking the only one I saw sold was on E-Bay going for $320. I started exploring the possibility of making my own by asking what the design was like and collecting parts. As others learned of my project several asked to be included until I determined a small lot might be produced.

The biggest problem I have had is finding parts. The printed circuit circuit cards were professionally designed and supplied. But the various connectors used by Drake were by MOLEX who only sells in very large quanties. I was lucky and found several components which had been setting in the ware house back rooms for years.

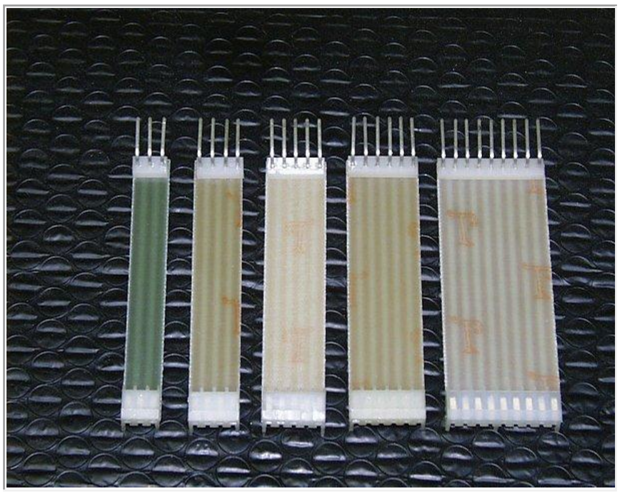
Over 75 kits have been supplied with very positive feedback

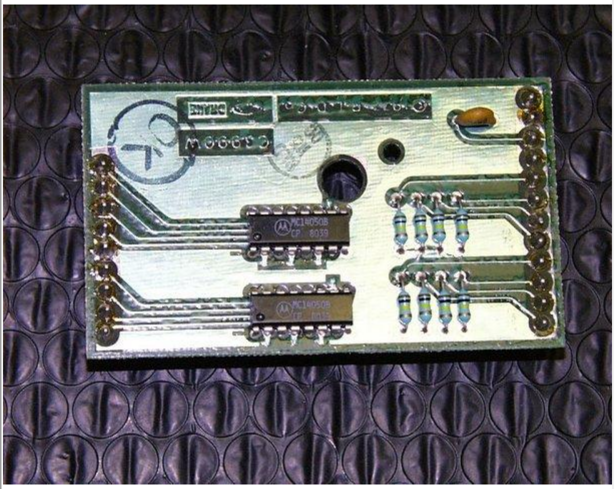
OFFER - The cost of a kit is $60 plus postage. In the USA and using priority mail the total cost is $64.80. In the EU countries air letter postage is $8.90 USD making the total $68.90 USD. My Payapl ID is w7avk@arrl.net

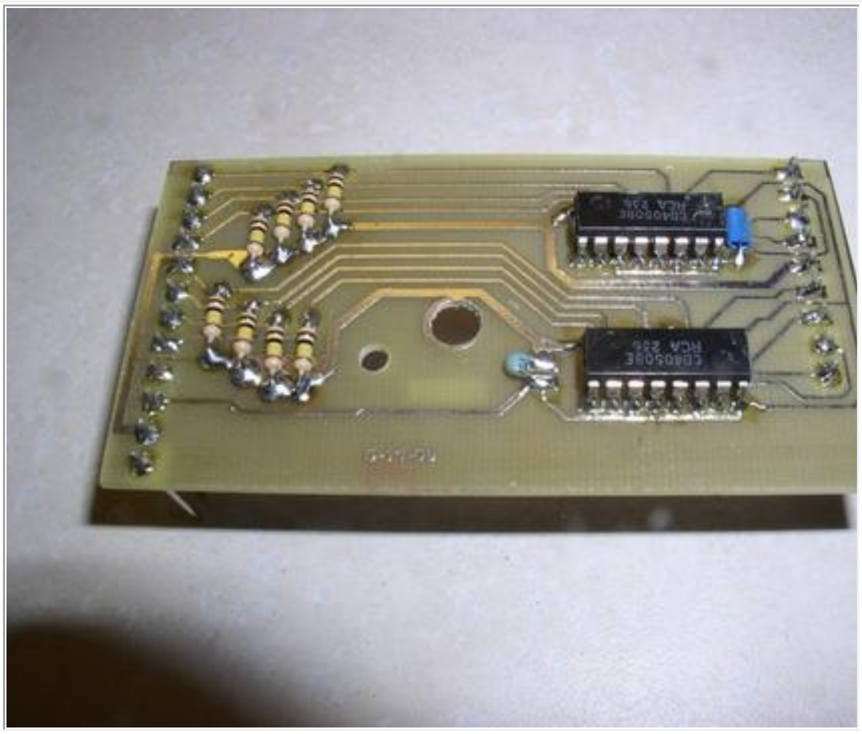
If interested or have questions I may be contacted by e-mail at: Bob W7AVK or by phone at [509] 750-7589.

These images are provided for informational purposes for the Drake community.

(photos of DRAKE gear by KF4FJH - RF Buchanan)

	
5 Sizes Extender Boards in 13 Set by DRAKE	13 Extender Board Set I Supply





DIGITAL JUMPER Board by DRAKE	DIGITAL JUMPER Board I Supply

Here is the complete inventory of the components that made up the DRAKE service kit and those items supplied in my recreated kit:

13 extender boards, made up from the 5 sizes shown above:
- **3 each 3 pin Extender Cards**
- **2 each 4 pin Extender Cards**
- **2 each 5 pin Extender Cards** **[Bold - Supplied in My Recreated Service kit]**
- **4 each 6 pin Extender Cards**
- **2 each 9 pin Extender Cards**

1 DIGITAL JUMPER board, as shown above
3 tuning tools (standard diddle sticks) [Not Supplied]
1 sheet of instructions, [Not Supplied] that reads in its entirety:

"The original TR-7 Service Kit consists of 13 extender boards, a jumper board, and three tuning tools to facilitate the repair and maintenance of the R.L. Drake TR-7 Transceiver.

"The extender boards are used to elevate printed circuit boards above their compartments to provide access to each side of the circuit board for troubleshooting. Since some circuit boards use more pins than the longest extender board, it will be necessary to assemble several extender boards to accommodate all of the circuit board pins.

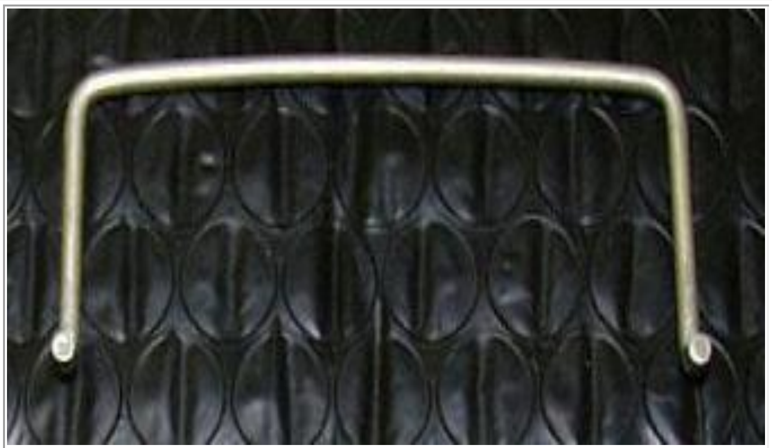
"The jumper board connects the TR-7 translator board and the digital control board together. The jumper board is required in TR-7's that have a DR-7 installed, and it allows the TR-7 to operate after the DR-7 has been removed. The DR-7 must be removed to gain access to the front half of the TR-7. Three tuning tools are provided so that adjustments can be made to variable resistors, capacitors, and inductors in the TR-7. Refer to the TR-7 Service Manual for all adjustments and technical maintenance."

OTHER

CARD PULLER

There is some discussion about the CARD PULLER supplied by DRAKE. I believe it came with those units that had the Digital Readout [DR-7] card which was sold as option.

I do not supply the CARD PULLER with my recreated service kit as it is easy to facricate from a small length of heavy wire.



MY SERVICE KIT IN USE

From the bench of Gary Poland, W8PU, one of my TR-7 Service Kits in use. Notice how several size extender cards are used in combination to elevate a TR-7 card from its normal card cage location.

Also notice the Digital Jumper Card being used so the TR-7 will operate as the DR-7 Digital Desplay board has been removed.

PTO SERVICE NOTES

by VE3EFJ

http://www.zerobeat.net/drakelist/drakemod/drmod31.html

By the time the R4B appeared, Drake had a solidly designed master oscillator - PTO (permiability tuned oscillator). From that time forward and with the exception of the TR5, Drake used pretty well the same PTO in all their equipment. Largely, the major difference was in the dial plates and gear box, but the *PTO* remained much the same. The PTO in the TR7 is much the same PTO in the TR4 which is much the same PTO in the RV7 which is ... you get the idea.

The great news about this piece of trivia is that you can swap the PTOs around quite a bit, *providing* you can deal with the dial plates.

- PTO End Play If the tuning knob can be wiggled from side to side, chances are the end play needs adjustment.

  End play can be adjusted by tightening the ball bearing on the PTO tuning worm gear. Some Drake equipment might have an extra hole on the PTO cover for this purpose. For those that do not, you must remove the PTO cover. Use a long 3/32" allen (hex) wrench. The adjustment 'nut' in question is recessed below the coil form.
  Do not overtighten or you will ruin the dial drive ball bearings and race.
  Do not disturb any placement of components or you will affect the PTO dial tracking.

- PTO General Notes
  Most of the PTO units are much the same throughout the 4 line, but the drive mechanisms and indicator plates are not. The worst things you can do to a Drake PTO is to continue tuning past the STOP indication or clean the dial plates with something that dissolves the plastic. Be very careful with cleaner on those Lexan dial plates! If in doubt, use mild soap and warm water. Dial plate replacement is impossible (there are no dial plates to be had). Drake will service the PTO for you - they have the gears and other mechanical parts and can reset the PTO for drift and linearity spec. It would be most wise, however, to not lunch the PTO gears and dial plate.
- PTO Evolution
  The PTO stayed basically the same over the years. It is a good, solid design. Early model PTO assemblies had a brass pin that was driven into a slot in the gear to provide a stop. As these assemblies wore, sometimes the pin would not extract itself and the PTO drive would end up in a locked state. If this was forced, the pin will snap, leaving no dial stop at all and the dial plate will go around and around until the slug bottoms.

  Later assemblies used nylon gears and dual dial plates on a concentric shaft. Some of these dial plates are 3 pin and some are 2 pin.

  The number of pins refers to the brass rivets that hold the dial plates to the gear faces. There is no stop to speak of in these assemblies and turning past the mechanical resistance of the drive assembly will lunch the gears. These PTO drive assemblies may have 'ears' and there may be 2 ears just behind the gear assemblies. The purpose of these ears is to allow the dial plates to be rotated for proper mechanical orientation with the dial window gradical.

- PTO Mechanical Instability
  This is usually caused by either the worm gear tension spring not hooked to the aluminium PTO cover or by the end cap on the end of the PTO coil form being loose. If the problem is not the tension spring, remove the PTO cover and look at the end of the PTO coil form. You will see a cap on the end of it. It should not be loose.

  If it is loose, carefully remove it, apply some glue and stick it back on. The coil form is delicate! The end cap just has a square hole through which the tuning slug brass rod goes through. For glue, I use GOOP.
  See also PTO End Play above.

- PTO Warble
  Sometimes the PTO will warble slightly while tuning. This is usually caused by dried out grease on the drive mech ball bearings. This is the ground path for the PTO slug drive which has a brass rod inside. Fix the dried out grease problem first. Use Teflon lube or Lubriplate. Run a flexible ground strap from the PTO drive yoke to ground. Do not grease or lube the top guide pin for the PTO slug yoke.
- PTO Lockup - B Series
  Sometimes the brass pin will insert into the gear at the 'STOP' area, but it will not extract itself, causing the PTO assembly to lock up. Wear will cause this, but in a lot of cases its caused by the gear timing being off a little bit. What happens is that you'll buy a used 'B' and use it. One day, you'll hit the stop, and the pin will lock the PTO.

Unlock the PTO first by pushing the stop pin back and rotate the tuning knob. Looking at the front of the radio, you'll notice a ny- lon gear thats spring loaded. Gently push this gear back and rotate the tuning knob ever so slightly (which way? take your pick). Now run the PTO to the stop again and see if the pin extracts. No? You went the wrong way or there are more serious problems.

- PTO Lubrication
  Given the age of these unit, the grease is starting to dry out. Its possible that it may even has run away slightly after seeing God knows what use in a car or in a hot tent on Field Day many years ago. Most important is to lubricate that worm gear. I use Teflon spray lube. Just use the slightest bit. Too much is much worse than too little. The dial mech should offer only slight resistance to the tuning knob. You should be able to fast spin the tuning knob by placing your index finger on the outside of the knob and rotating your hand. If you cannot do this, then you have some kind of a problem in the PTO dial mech.
- PTO Backlash
  Inspect the brass rod that extends from the rear of the PTO cover as the unit is tuned. It may be discolored, but it should not be covered in grease and guck. This rod and the end of the PTO tuning coil comprise the end bearing. Clean with alcohol and a paper towel. Sometimes 'junk' will accumulate in this area and actually cause some binding in the tuning slug. You'll tune the PTO and in about 5 minutes, it will 'jump' frequency up to a few hundred cycles.
- PTO Drift
  All Drakes drift. Once warmed up and settled down, they are satis- factory for all modes but RTTY. For all practical purposes, the PTO from the B series to the TR7 (excluding the TR5) are identical with the exception of the dial plates and the markings on the aluminium cover box.

  In very general terms, the PTO should settle down within about 5 minutes after turn on and be usable. It will still shuffle around a bit after that, but you should not be chasing it continuously.

  There are no PTO adjustments available to compensate for drift; components were 'selected in production'. In extreme cases, you will either replace the PTO from a junker or send the unit to Drake for a rebuild. Expect to pay for 4 quarter hours labor minimum.

  Drake PTOs are stable, but the temperature compensation is not per- fect. The PTO in the SPR4 is quite a bit more stable than the R4C. The reason is heat. The heat inside an SPR4 is neligible, but the R4C heats the PTO slightly from the audio output transistor. Thr TR7 and R7 will shuffle around a bit from the heat from the dial lamp, and the TR4any transceivers are much more stable when a fan is installed.

- PTO Skipping/Hysteresis - C series
  Inability to have the C line dial plates to indicate exactly the same frequency after moving away 100 kHz or so and returning to the same frequency is usually caused by the rubber collar under tuning knob and dish. After all these years, the rubber has hardened or has worn. Replace the PTO rubber. The C clip should not be tight against the aluminum washer and the washer should be installed such that the groove around the perimeter is on the outside.

  While you've got the knob and dish off, inspect the shaft for burrs.

  Sometimes when you push a new rubber collar on you'll displace one of the gear sets. This is easy to fix, but you'll have to remove the top cover, push the left hand ear to the right while gently rocking the tuning shaft and pulling out. Then align the dial plates again. A new collar should last for years.

- PTO Seizure
  I had one report of a PTO that locked up solid on a TR4. This apparently happened very suddenly. The clue is the knowledge that the transceivers run very warm, and the lubricant is 20 to 27 years old.

  All the PTOs are essentially the same. There is a shaft that turns a worm gear; the worm gear moves a yoke follower back and forth that moves the tuning slug. Running off this shaft is a gearbox that turns one (2 in the case of the C line) dial plate that has a bearing collar that is around the tuning shaft. The grease in that bearing area had cooked off. With the dial plate now 'locked' to the tuning shaft the shaft is locked since the dial plate is driven by the gear box and the gear box is driven by the shaft.

  The cure is to flush out the grease and replace it with Teflon lube. Teflon will not cook off, but the TR4 also needs a fan to resolve the heat 'problem' caused by vaccuum tube density.

- 4 Line Dial Plate Dish, Knobs etc.
  Personally, I don't like the plain dial skirt on the C line. I replace them with TR4 dial dishes. This does nothing except for appearance and is a matter of personal taste.

The TR7 dial dish is different than the 4 dial dish.

Some dial knobs are thicker than others depending on the PTO assembly. Most knobs are available for replacement except for TR7 band switch knobs. Unobtainium.

- Dial Plates and Plastic
  These are not available from Drake any more. Use cleaning materials with extreme caution.

  Most minor scratching of clear plastics can be polished out with toothpaste, a touch of water and a paper towel. This works amazingly well. If you use this trick on the dial plates, be careful you do not rub the lettering off. Gel does not work nearly as well as toothpaste.

- C Line Dial Alignment
  The C line allowed for dial indication alignment through the use of idler gears in the dial drive mech. Just to the left and right of the drive transmission you will find one or two 'ears'. Pushing these ears towards the PTO shaft will allow the indicator plates to be rotated such that the plates align to display the correct frequency. Depending upon the age of the C line unit in question, there may only be one ear. In order to reseat the idler gear, push the le- ver over and let go such that it snaps into place. If you do not do this, it will take some rotation of the tuning knob until the idler seats and your alignement will be off (again!).

  On the B, you can rotate the Lexan dial plate a little with a touch of brute force. Place a small screwdriver on the edge of the dial plate and flick it the few necessary degrees. Do not to this with the C line (see above).

- Dial Plate Scraping
  The dial plates are fairly large diameter Lexan disks. On the C line, there are 2 of them. One knob turn tunes the receiver 25 kHz. Sometimes the dial plates will scrape as they are rotated usually somewhere around the front panel. Over the years, some heat warping should be expected. Quite often though the scraping is caused by poor assembly after removing the front panel for cleaning. If the whole PTO had been removed, there is a little positioning adjustment available if the 3 PTO nuts are loosened.

  Ensure the dial gradical plastic is on the outside of the sub chas- sis with the red line on the inside of the window (C line).

  On all radios, the blue filter mounts on the back of the white plas- tic dial backing. Make sure the dial light wires are positioned away from the dial plates.

  If you have warped dial plates, I would not try flattening them by any method. The simple, expedient answer is to go to a craft store and buy some felt. Attach a strip of felt to the back of the sub front panel with double sided cellophane tape.

  There is no such thing as replacement dial plates except from a junker. Every time a plate scrapes, you are grinding it away. Fix the scraping as soon as it is noticed.

Drake 7-Line Solid-State Blue LED Illumination

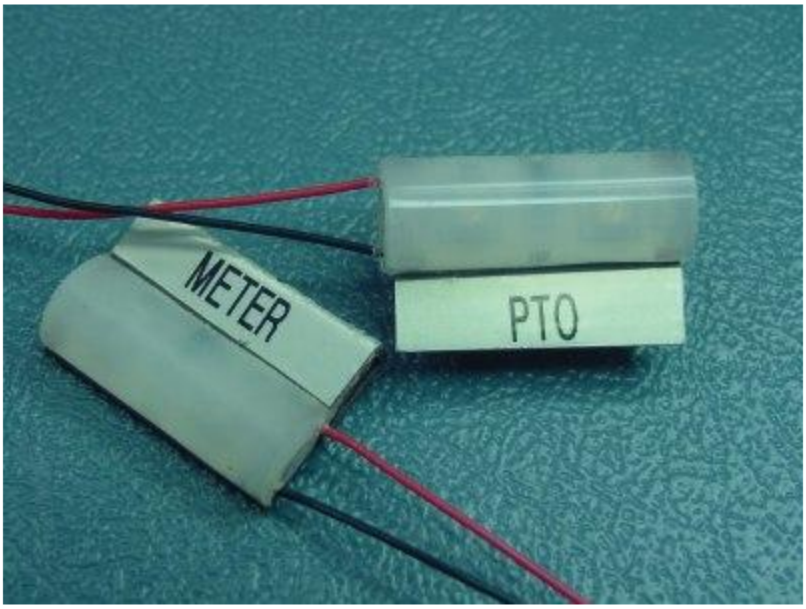
http://www.radiolabworks.com/products/tr7lamp/d7lamp.html

Drake has used blue filters since the days of the 4-Line equipment. This continued into the later 7-Line equipment including the TR7(A) transceiver and R7(A) receiver. The problem occurs in later years when the blue filters begin to change and the displays end up looking green. Since the meter and frequency displays are illuminated by incandescent lamps they emit a glow that leans toward the red end of the emission spectrum. Thus a blue filter being back lit by a yellow/red glowing filament will naturally result in a greenish illumination. In the past people would replace the blue filters with newer and perhaps darker blue filters. This was a step in the right direction, but you are still stuck with a light bulb that will eventually burn out and require replacement. In the TR7 transceiver the bulb that illuminates the analog frequency display requires the removal of the DR-7 digital readout board to access the bulb. This is not an enjoyable job and has the potential of damaging the DR-7 or other parts in the radio if the deinstall and install procedures are not followed closely. You will often see the analog display dark as the user never bothered to change a burnt out bulb.

Another problem area with the 7-Line equipment illumination is that Drake used small round glass #53 bayonet bulbs. Due to their small size they can not illuminate the total coverage area of the meter or analog display evenly. You will have light and dark areas.

To solve both the aforementioned shortcomings I have developed a Blue illumination kit to replace the existing incandescent bulbs provided with the 7-Line equipment. The kit consists of two custom manufactured LED lamps. Each lamp utalizes the latest in Surface Mount Technology (SMT) assembled on Flex PC Board. The internal lamp LED spacing was designed to provide a wide angle of light dispersion providing a very even illumination distribution across the meter or analog frequency display area. Each lamp assembly has a solid plastic diffusion lens attached to further distribute the light evenly. Since the LED's emit a true blue spectrum there is no green affect encountered with the incandescent bulbs. **There is no need to replace or add additional gel filters.**

Lamp assemblies install easily using integrated non-conductive slide-on clips. Thus no destructive changes are made to your equipment. This kit is fully reversible!



The life of an LED is long, typically 80,000-100,000 hours (almost 10 years of continuous power), and most of us will never experience it going out. Once the original lamps are replaced you should never have to replace them again. You will save on current draw! The two LED lamp assemblies only require a total of 50mA whereas the original #53 lamps have a total of 240mA current draw. That's almost 0.2 amps less current draw from the power supply and negligible heat dissipation from the LED's.

Before

After

Drake 7-Line Kit

One Meter Blue LED Lamp Assembly

One PTO Blue LED Lamp Assembly

Four (4) Heat Shrink Tubing Sleves (If Needed)

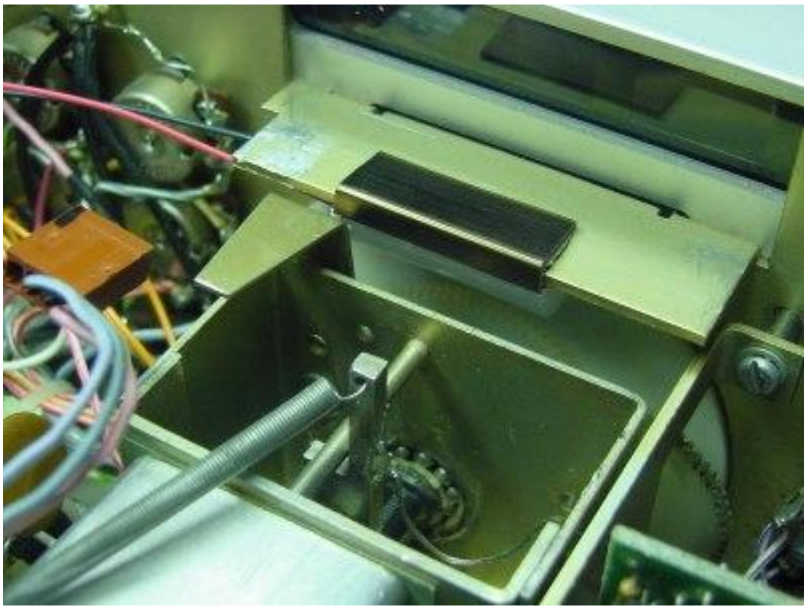
Full Installation Instruction Sheet

Simple to Install

Installation is straight forward and every attempt was made for ease of installation. Since internal wiring is performed this kit does require that the installer must be capable of basic soldering skills. If you've never soldered before, please find someone who has experience to assist you.

An inside view

Meter LED Lamp Assembly Installed

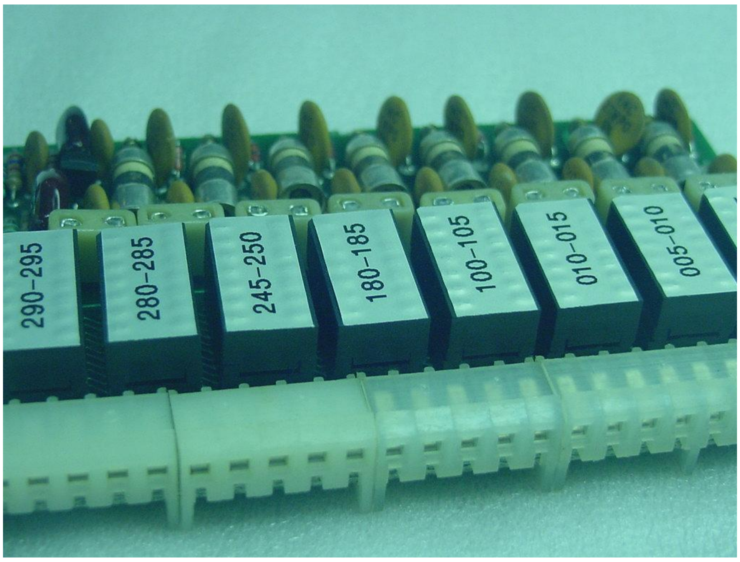


PTO LED Lamp Assembly Installed

Drake TR7 and R7 AUX7 Band Modules

http://www.radiolabworks.com/products/aux7/aux7.html

For those who have the installed AUX7 board in their TR7 or R7 you can now fill in those blank positions with your most frequently used bands. Avoids having to use the UP and DOWN buttons on the radio to cycle through the 500KHz band segments outside the normal band selections.



Each band module is made from high impact glass-filled nylon and fully enclosed. Pins are GOLD plated to prevent corrosion in even the most adverse environments. Modules are built per order and are tested on a custom built fixture that places the modules under the same operating parameters as in the Drake 7-Line equipment. Considering there are 63 different module types I can not prebuild them all. However, as time goes on I'm sure some frequency ranges will be more common than others. In those cases small stock levels will be prepared. I will do my best to keep construction turn-around-time to a few days on every order.

Simple to Install

Installation is straight forward and every attempt was made for ease of installation. The user must have an AUX7 board and the original Drake manual on its removal and installation. I will supply an instruction manual which explains how to install the modules onto the AUX7 board. All modules for the frequency bands above 1.5MHz, except 26.0 - 28.0MHz, are enabled for full transmit functionaility on the TR7 transceiver.

Band Module View

Ordering

Please Order Using these Part Numbers

Improving the TR-7 SSB audio quality

http://www.eham.net/articles/25399

The stock SSB filter in the 2nd IF is 2,3Khz wide. While this will give good communication quality audio, it leaves something to be desired, especially if you listen to it side by side with a rig using a 2,7Khz filter like a TS-830S / 930S / 940S, an Atlas 210X etc.

I am not referring to the "ESSB" sound that some fellow operators like to use, but rather to a "dryer quality" sound of the 2,3Khz audio which, without providing an appreciable improvement of selectivity compared to the 2,7Khz one, removes some high frequency spectrum form the audio which makes listening less rewarding and to some extent may even reduce the intelligibility of voice especially when listening to lower signal strength, close to the noise floor of the band.

While searching for an alternative filter, I came across an offering from Sherwood Engineering at a width of 2,85Khz. This is a little wider than the above mentioned 2,7Khz "optimum, but it does seem to have excellent shape factor, which allows for richer sound reproduction without becoming a "barn door" filter allowing excessive interference or "hiss" to spoil its performance. Practically, for 90% of SSB work I have found even the 1,8Khz filter to offer little additional selectivity or QRM suppression, with the exception of crowded band conditions.

Substituting the 2,3Khz original filter in the first position of the filter board of the TR-7 is straight forward, with caution when de-soldering the original in that you have to use a 40W soldering iron. Also I ended up prying it out gradually using a very small flat (jeweler's) screwdriver close to each of its connections while heating its connecting posts. It is rather hard to try removing all the solder from each connection since even the smallest amount of residual solder is enough to prevent any movement of the filter from its tight connection posts through the double sided PCB.

This is the first and most important step in improving both the Rx and Tx audio bandwidth. I did undertake one more step, which allowed slight further improvement of the Rx audio with little additional work or risk.

Following the suggestions seen in the PA0CMU site http://members.ziggo.nl/cmulder/drake.htm#bookmark6 I experimented with changing a few capacitors and 2 transistors in the 2nd IF board, at the final audio amplifier circuit, in order to improve its frequency response as described in the article.

After trying the proposed changes, I ended up implementing the following:

Changed **Q1111** and **Q1113** from the general purpose **2N3904** to the low noise **BC549C** model. (**Warning observe the different pinout!**). And Changed **C1116**, **C1164** and **C1167** caps from **0.01µF** to **4,7nF**. This increased the high end Rx audio response and made a significant improvement in the intelligibility of marginal SSB signals, at least to my ears.

I did not change the other caps (actually reinstalled the originals after trying the proposed changes) for 2 reasons: a) Increasing the values of C1150 and C1152 gave the audio rather too much lows, which resulted in listening fatigue (again for my taste). b) Changing the C1173 to 220pF from the original 330pF, resulted in a constant low level audio "whine" mostly noticeable when listening at low audio gain or with the antenna disconnected.

The final result after the above changes, gave my TR-7 a smooth a pleasant audio which rivals that of my Kenwood and JRC radios, while maintaining the legendary Drake clean "tube like" audio quality. All of them are easily reversible if one wants to go back to the original configuration, and with the exception of the new crystal filter, will cost less than $3 in parts. Admittedly, I did perform the changes in the audio amplifier circuit after having substituted the filter with the 2,85Khz one, so can not comment on their isolated effect, but of course these 2 steps are independent from each other.

Hope you enjoy keeping an excellent classic as a TR-7 working and improving it as much as I do.

73,
Marinos, sv9dru / ki4gin

DRAKE TR7A EXPERIENCES AND MODIFICATIONS

HTTP://MEMBERS.ZIGGO.NL/CMULDER/DRAKE.HTM

On this page you can find some experiences and modifications made to the Drake TR7/TR7A transceivers as they where gathered by my friends Rien PA0TRT, Wim PA3AJI and myself. Our goal is to present information not found elsewhere on the internet. From some other known changes our interpretation is shown. There is more interesting info available but not yet ready for publication, so look at this site from time to time to see what is added to the page. We are working on it. For those who entered this page via the Drake Web Ring, the rest of my homepage is dedicated to QRP.

- Fan replacement
- Upgrading product detector & S-meter circuit
- TR7 stabilizer
- Multi turn trimmers for PBT control voltages
- Improving audio response
- Switched Capacitor Audio Lowpass Filter
- RF preamplifier for the Drake TR7
- Board extractor

FAN REPLACEMENT

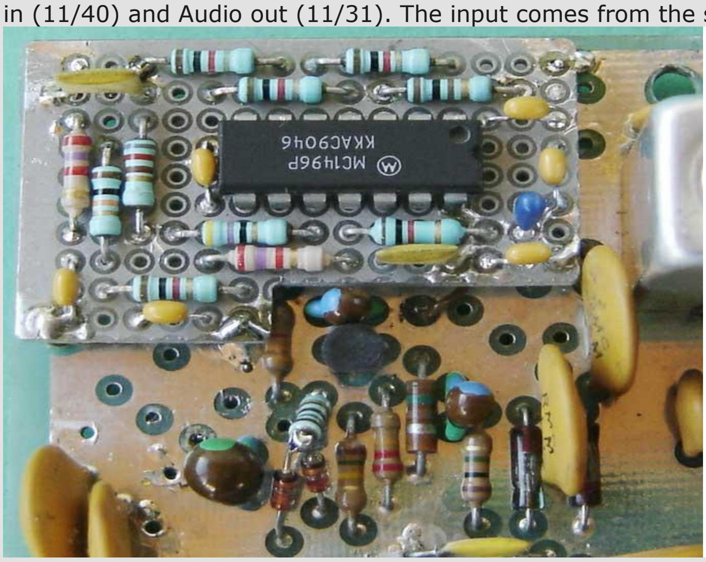
One of the first changes is no mains power wires to reach the TR7. This is for pure safety reasons and to cancel hum in the audio circuit. Here in the Netherlands (Western Europe) we use 230V/50Hz-AC so the amount of hum is significantly higher (6dB) than in the USA where 115V/60Hz-AC is used. Due to that, the 115VAC cooling fan FA-7 needed to be replaced too. We used a 12VDC computer fan running at 8VDC to reduce the noise. By the way it feels much more ensuring when working on the TR7 if you know that there is no mains power around!
The 12VDC computers fans have the same dimensions for mounting on the rear panel as the Drake FA-7. That was no problem, and the idea was to use the (not common in Europe) 110VAC mains connector for powering the computer fan. The left picture below shows the new fan with the old connector.

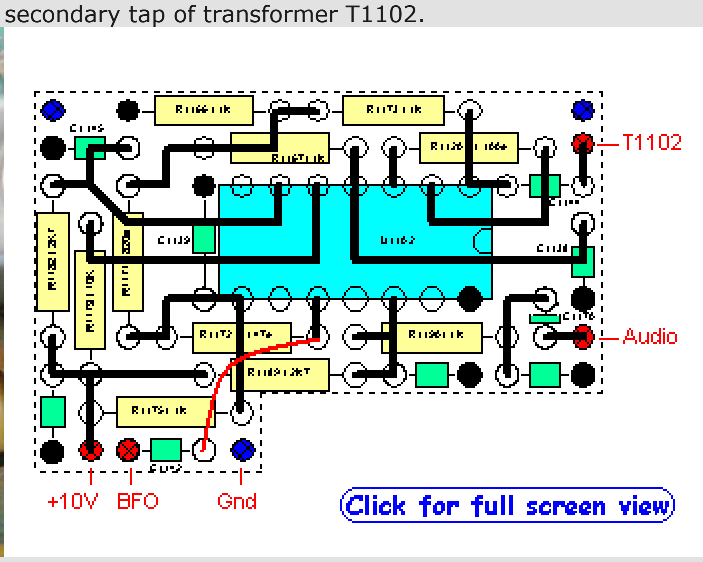
To achieve the highest possible noice reduction, the 12VDC computer fan runs at about 7.5 Volt. A LM7808 voltage regulator is mounted to the right side of the 115VAC chassis part with some super glue. To prevent damage to the fan due to reversed polarity, a 1N4007 rectifier diode is added in series with the regulator output. With this construction, the fan replacement looks like original without having to saw or file in the rear panel of the TR7.

UPGRADING PRODUCT DETECTOR

Until now, January 15th 2005, the most far-reaching modification is the upgrading of the 2nd IF/Audio Board. The version #1 product detector with 1N4148 diodes, is replaced by the version #2 circuit with an MC1496. The attenuating pi network for the out going BFO signal level on the PBT/Reference Board must be increased to match the correct level for the new product detector circuit. R1058 is changed into 68 ohm (was 220 ohm) and R1060 is removed (was 68 ohm).

I removed all components from the PC-board used by the old circuit. Then, using pictures of a version #2 board as an example, I constructed the MC1496 circuit on a piece off perforated experimenter board. The sub board is mounted close to the surface of the 2nd IF/Audio Board with three small pieces of copper wire. Other connections were made with thin wire to +10V DC (11/13), BFO in (11/40) and Audio out (11/31). The input comes from the secondary tap of transformer T1102.





Unfortunately there is an error on page 2-69 of my Service Manual. Capacitor C1142 (0.05uF) is drawn from pin 10 of the MC1496 to ground. That is wrong, C1142 is a coupling capacitor for the BFO signal and should be drawn from pin 10 to BFO IN (11/40). Perhaps Drake has modified this page in later editions of the Service Manual. I don't know, but here is the correct schematic in PDF-format. Components between the dashed lines are on the sub PCB.

Two resistors were missing on my board. R1187 (10K) in series with diode CR1119 and R1188 (180 ohm) in series with diodes CR1116/CR1117. Both are in the +10V lines to switch for CW and AM modes and without these resistors a sharp click is heard in the speaker when rotating the mode switch. Due to the charging of the empty electrolytic capacitor (C1147 and C1151, both 22uF/16V).

The S-meter circuit is the last part I changed on the 2nd IF/Audio Board to upgrade to version #2. Some minor changes were made around the Sens. Adjust potentiometer R1105. Resistor R1101 (220 ohm) is replaced by two 1N4148 diodes in series with CR1104 to ground. Diode CR1101 (AA119) is replaced by a 4.7k resistor.

HUFF PUFF STABILIZER FOR THE DRAKE TR7(A) TRANSCEIVER

This circuit is based on the stabilizer by the late PA0KSB. I have made some modifications and additions to make the circuit suitable for the Drake TR7. Read for the full explanation of the stabilizer the original publication in English QEX February 1996 or in Dutch Electron December 1996 and January 1997.

Description:

I have used the 40MHz crystal oscillator that is already built in the TR7 as reference for the stabilizer circuit. A buffer amplifier BF494 amplifies the signal to a level high enough to drive the digital mixer 74HC74.

The PTO output (as the VFO is called by Drake) is amplified to drive the binary counter 74HC4060.

The Drake PTO has already a RIT input line that is connected to a varicap diode inside the PTO. This same line can also be used for the stabilizer. The RIT control line and the output of the integrator CA3140 are added together in the summing amplifier NE5534 and go the original RIT input of the PTO.

I have added a reset circuit to the original design. When the TR7 is switched on, the output of the integrator is always set to the midrange value of 4V. A manual reset input is also available. When the reset input is made high (+2 .. +10V) the integrator will also reset to mid range. So far I have not connected this manual reset line, because the total drift was never large enough to reach the limits.

Two comparators LM258 measure the output of the integrator. If the voltage comes within .5V of the upper or lower limit the LED lights up. Optional the output of the comparators can be connected to the reset circuit. However if this auto reset takes place the PTO will jump from its set frequency. This may not always be desired.

Construction:

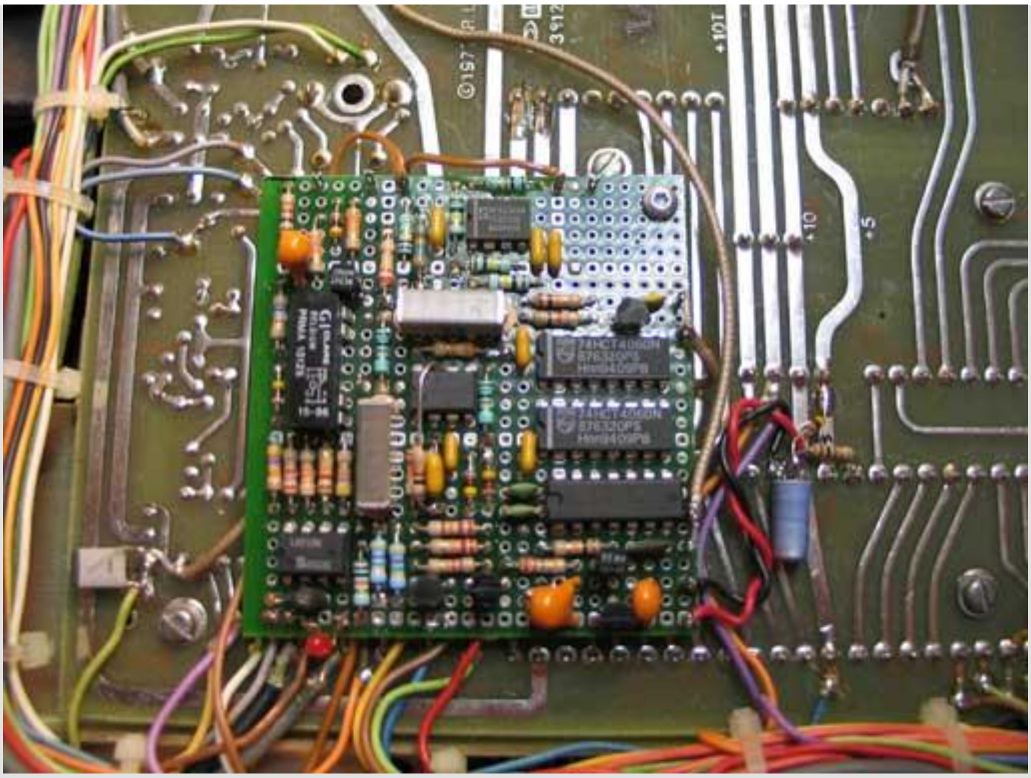
The stabilizer was constructed on a 75x75 mm piece of perforated experimenter board. All components are at one side while at the other side all connections were made with thin bare wire and isolated wrap wire where needed. There is no printed circuit board available. My layout can be used as a guideline to other design. The board is mounted under the parent board of the TR7 (see photos). At one side the board is mounted with a 5mm spacer, using an existing screw position in the parent board. The original screw was replaced by a longer one to hold the board.
At the other side of the board an isolated 5mm stand off prevents the board from touching the parent board. At the inside of the bottom cover. I have glued a plastic isolation sheet to prevent the board touching the bottom cover. All connections between the TR7 and the stabilizer are directly to the parent board, only one wire has to be removed from the parent board and extended to the stabilizer board. A 100pF capacitor is mounted directly between the connection point of the PTO to the parent board and the coaxial cable. This to minimize the capacitive loading of the PTO by the cable.

Adjustment:

After completion the RIT center position has to be readjusted.
Hold the reset line high. Exactly center the RIT control on the TR7 front. Switch the calibrator on. Switch PBT on. Center the PBT control. Switch the RIT on.
Tune the receiver to exactly zero beat to one of calibrator points. Switch the RIT off. Adjust R24 on the parent board exactly zero to beat. (R24 can be reached through the small access hole in the parent board just above the stabilizer board on the photo).

Results:

Without the stabilizer my TR7 drifted after switch on over about 500Hz in 5 hours. With the stabilizer build in, no drift took place. The locking points appear to be about 20Hz apart.



- Download this text, diagram and component layout for prototyping board
- Download original publication in English QEX February 1996

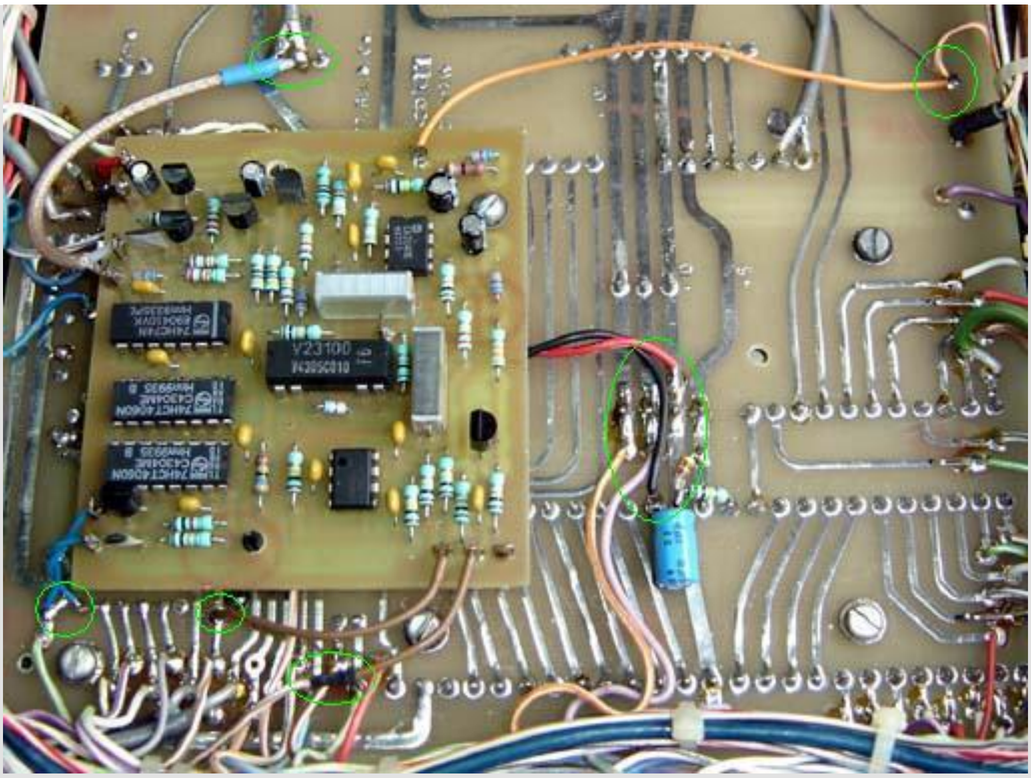
Latest version:

In July 2005 I designed a PCB for a slightly modified circuit to be build into two other TR7's and my R7. There are some minor changes to the previous circuit build on the experimenter board.

1. The range comparator was left out. (not needed)
2. Reset can be done with the CAL switch on the TR7. When pressed, the +10Rcal voltage becomes available at point 10/5 of the PBT/Reference board. This logical change resets the stabilizer circuit. During RIT ON mode, the stabilizer keeps working.

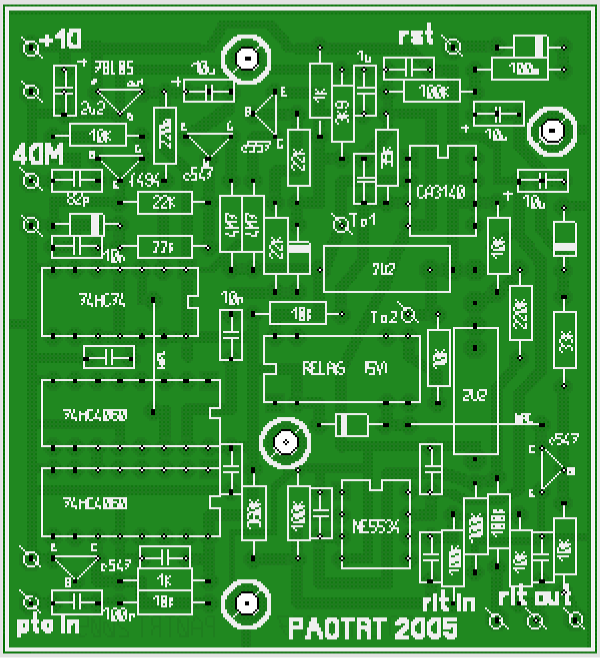
About the stability: The PTO remains locked in a frequency grid of 20Hz at the low side of the PTO range xx000.0 KHz and 23Hz at the high side xx500.0 Khz, as long as the control voltage does not reach the limits. Reset to mid range is by pushing the CAL switch on the TR7 on/off or by switching the power off/on.

The picture below shows how the board is mounted in Carel's TR7. See how the required wiring is close to the PCB.



The board is a single sided 74x68mm type. Bitmaps of the copper layer and silk screen layer are available for personal usage. The parts are all available through the normal channels. Make sure to use good low leak polyester or MKM type 2.2uF capacitors. The design is made with Sprint Layout from Abacom. The picture below shows the "photoview" option, with disabled ground plane.

Rien, PA0TRT



- Open or download modified diagram and component layout for PC board
- Download PC-board files

MULTI TURN TRIMMERS FOR PBT CONTROL VOLTAGES

Not unique, but very effective is the replacement of the sensitive potentiometers on the Power Supply Board by multi turn types. These variable resistors are for the adjustment of the PBT control voltages and the +10V supply. The exact adjustment of the old potentiometers is difficult and can be easily disrupted. We used Bourns 3296W and 3296Y top adjust types. Adjacent resistors are moved to the backside of the PCB due to the format of the multi turn potentiometers. Also here differences in PCB layout. On my board the potentiometers were mounted 180 degrees rotated from the boards of the other two TR7's.

Mounting the 10-turn trimmers on the same way like my friends boards, would cause a problem when placing the cabinet cover, so

I placed them square to the PCB, a bit lifted for a better attainability with the trimmer tool from the front side of the TR7.

IMPROVING AUDIO RESPONSE

When surfing the internet for Drake TR7 modifications, I found several more or less the same information about improvement of the audio frequency response. I gathered those info and changed the components on the 2nd IF - Audio Board as described. I'm not an audio purist, but I heard some undefined things in the audio sound after the changes that I didn't like. So, there were two ways to find out what could be improved in my rig:

1. Measure the audio response
2. Use a spice modeling program to calculate the response

We did both. The audio signal from a generator was injected via 10uF to pin 11/31 Audio Out. An AC voltmeter was connected across a 8,2 Ohm resistor connected to the headphone jack to eliminate the changing impedance of the loudspeaker during measurements. Using a logarithmic scale ranging from 120 - 5000 Hz, the AC voltage was measured in 21 steps and the results were placed in an Excel spreadsheet to display the curve of the audio response. By changing the values of some components and doing the measurements all over, we could see the difference in audio response. This method works, but costs a lot of time.

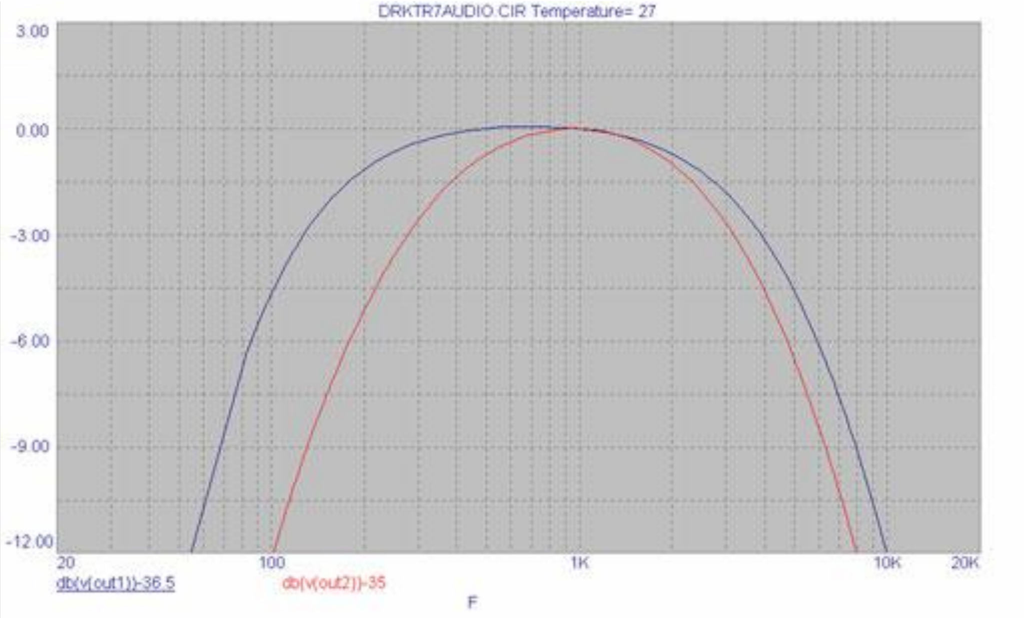
The second method was done by Rien, PA0TRT. He used the spice modeling program Micro-Cap V to simulate the audio circuit. Those kind of programs can perfectly be used for calculations where stepping of the component values is required. We found out that the components who really effects the audio circuit to get a flat (-3dB) response at 100Hz to 3Kc, were different from the described mods found on some ham pages.

We experimented with some values and finally changed the following components:

- C1150 = 150nF (50nF+100nF)
- C1152 = 32nF (10nF+22nF)
- C1167 = 4n7
- C1173 = 220pF
- R1178 = 600e (270e+330e)

To reduce noise in the audio, transistor Q1113 (2N3904) was replaced by a BC549B (Note: BC549B has different pinout). Q1111 was changed for the same reason too.

Below is a screenshot of the AC analyses from both circuits. In red the original TR7 audio circuit and in blue the modified circuit.



Rien, PA0TRT

SWITCHED CAPACITOR AUDIO LOWPASS FILTER

The Drake TR7 has always an audible hiss that causes fatigue when listening for a longer period of time. Correcting the audio amplifier does not give sufficient result. What is needed is a steep audio lowpass filter like we find in modern transceivers with DSP filters. To build in an internal DSP filter would be a daunting task. The use of an external DSP filter could be an answer. However I preferred a simpler solution.

Maxim™ produces single chip switched capacitor audio lowpass filters that uses a minimum of external components. The beauty of these filters is the very steep response of a 8th order elliptic lowpass and the capability to tune the filter with a single capacitor. There are two versions of these chips MAX7400 with a shape factor 1.5 at >82dB of the corner frequency and the MAX7403 with a shape factor of 1.2 at >58 dB of the corner frequency. I used the MAX7400, because I had that one available. Tuning the filter is very easy by varying the timing capacitor of the internal clock frequency that is 100 times the corner frequency of the filter. The capacitor is by example 12pF for a corner frequency of 2830Hz and 33pF for 1030Hz. It is also possible to use an external clock.

Some experiments showed good improvement in the audio response of the TR7. But what I wanted was a filter that could be automatically set with each operating mode CW, SSB and AM. The idea to use variable capacitors or an external clock from something like a NE555 timer as clock did not please me at all. The solution was simple, replace the clock timing capacitor by a variable capacitance diode. Now control could be done simply by a variable DC voltage.

To maintain the full dynamic range of the filter circuit, a higher signal level is needed as that is available just before the audio amplifier IC in the TR7. A leveling and DC shifting amplifier is placed before the filter. This is done with a NE5534 low noise operational amplifier. After the filter the level is attenuated to the original level. A jumper is provided to bypass the filter for test purposes.

The filter frequency is automatically selected when the operation mode of the T7 is changed. The frequency presets are set with three potentiometers, one for each mode. Optional an additional external potentiometer and switch are provided for variable mode. When the variable mode is selected the presets are overruled.

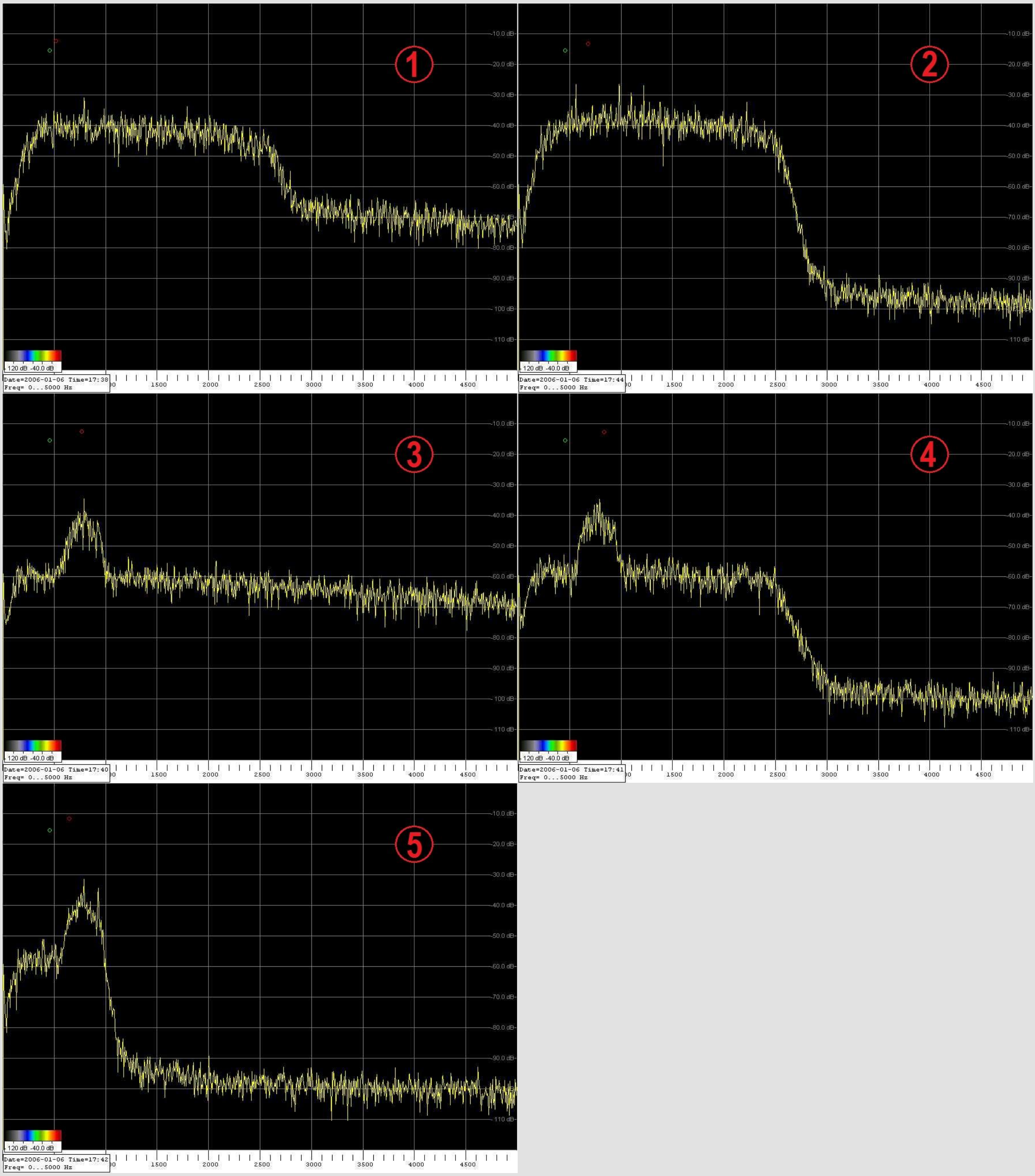
The filter frequency can set by each mode potentiometer to once personal preference. I have set CW for 1000Hz, SSB for 2500Hz and AM for 3000Hz. In the variable mode the filter can be adjusted between 800Hz and 3000Hz. The high frequency limit of the range is adjusted with trimming capacitor.

The circuit is build on a piggy-back pc board that just fits above the 2nd IF and audio board. All connections are directly on the board. The filter board is mounted with stand off wires that are soldered on the top ground plane of the 2nd IF and audio board and the free copper surfaces at the back of the filter board. To create some extra space I did remove the 115VAC fan connector from the back panel of the TR7 (I use a 12Vdc fan).

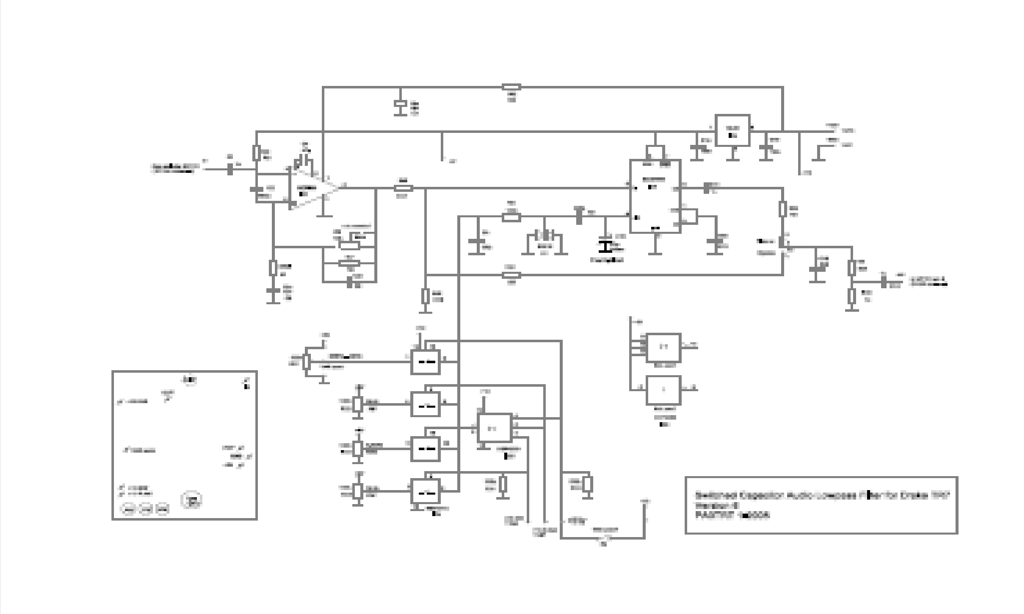
Here are some results of the old and new noise responses made in Spectrum Lab™, a great program by DL5YHF. All measurements are direct from the load speaker output of the TR7 to the PC soundcard input. Noise spectrum response shown 0 Hz to 5kHz at 10db/div; antenna disconnected and RF gain fully clock wise.

1. 2400Hz SSB filter, audio filter off. The passband of the SSB filter is visible.
2. 2400Hz SSB filter, audio filter 2500Hz. The noise above the 2500Hz passband is dramatically reduced.
3. 300Hz CW filter and audio filter off. The passband of the CW filter is visible.
4. 2400Hz CW filter, audio filter 2500Hz. The noise above the 2500Hz passband is dramatically reduced.
5. 300Hz CW filter, audio filter 1000Hz. The noise above the 1000Hz passband is dramatically reduced.

Hover the pictures to read the tooltip info, or click for a large screen photo.



What remains is the (proto-type) diagram and PC-board design. Click on the left picture to open the diagram in PDF-format. The PC-board is designed with Abacom's™ Sprint Layout 3.0 and is available on request. A bitmap of the layout is included in the ZIP-file below. To keep the board compact and to avoid a double sided layer, there are two wire bridges. One in the middle of the board and the other under IC2 The board dimensions are: 42x52mm.



Disclaimer:

I provide as much as possible information for this design. I do not supply any parts or printed circuit boards. Modifications done to the original Drake TR7 are to the full responsibility of the owner. However I am always interested in your experiences.

Rien, PA0TRT

- Open or download the MAX7400-series datasheet
- Download PC-board files

References:

- \- Maxim Integrated Products

RF PREAMPLIFIER FOR THE DRAKE TR7

The Drake TR7 and TR7A are due its fully passive front end design not as sensitive as most modern transceivers. In the R7 and R7A receiver this was improved with a switchable preamplifier between the Input Bandpass filter and the Up Converter board. Both TR7 and R7 use a similar design. Where the difference is that the R7 uses individual bandpass sections for each frequency band. While the TR7 uses combinations of lowpass and highpass filter sections to achieve preselection. In the TR7 the signal path is bi-directional, because of it's receive and transmit capability. I considered that it should be possible to add a similar pre-amp to the TR7. Using the same basic circuit as the R7 preamp was the easiest to realize the project. The RF transistor is a Philips BFW16A, what is a good replacement for the original 2N5109.

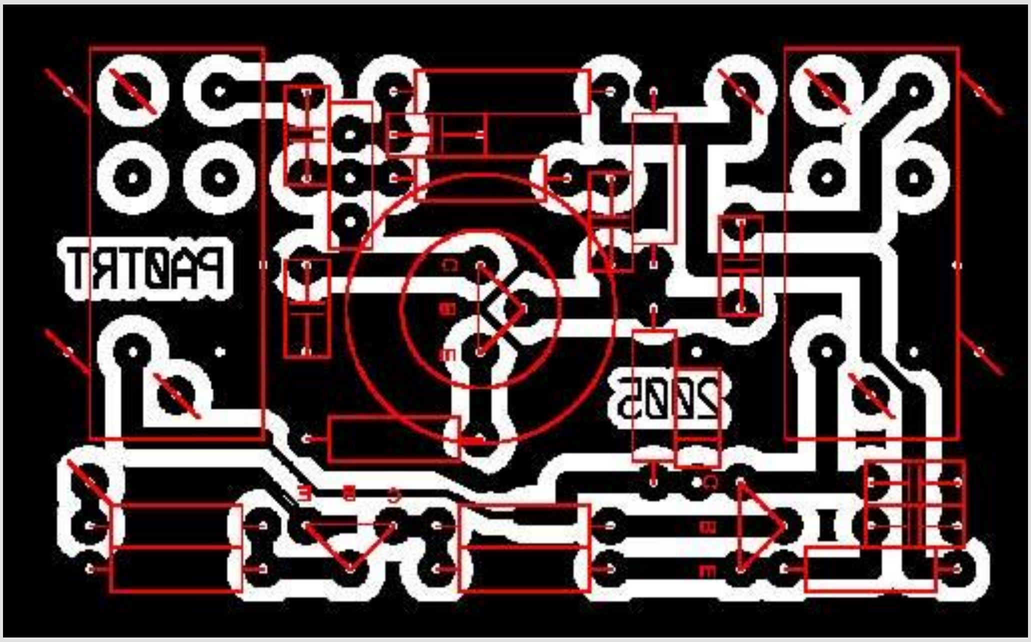
Switching the amplifier in and out the TX/RX path is done by two miniature relays. When the amplifier is off, the RF transistor is cut off from it's bias source. The power supply is directly from the +13.8VRX line on the LP filter module filter unit. The "Store" switch on the TR7 front was used for the amplifier on/off function. The amplifier is positioned in the coaxial connection between the Highpass Filter module and the Up Converter board. Just remove the the coax from the connector at the Highpass Filter module.

I have made a small female connector from a 15mm piece of an old brass ballpoint filling and inserted a pin of an IC socket with some epoxy clue in one end. Make a small dent in the tube so that the coax from the Up converter board just fits in the tube. Solder about 5cm RG174 coax to the center pin and tube. Finish off with some shrink tubing. At the other end I used a piece of RG174 coax and folded the braiding back over the outer isolation. This way it will just fit in the connector on the Low pass filter module.

Results:

- The gain of the amplifier is about 10dB and is flat within 1dB up to 30MHz.
- The measured TR7 noise floor is about -130dBm. With the amplifier switched on, this improved to about -134dBm.
- These values are similar to my measurements of the original amplifier in a R7 receiver.

Do not overestimate the use of this amplifier and preamplifiers in general, because in most cases the background noise on the HF band is high and far above the noise floor of the receiver, but on a quiet band it will just lift a weak signal enough to make it readable. In other cases leave it off, because it will do no good on the receivers dynamic performance.



The preamp in my TR7 is build on a piece of perforated experimenter board. I also designed a neat 60x37 mm single sided PCB. Bitmaps of the copper layer and silk screen layer can be downloaded. The design file (Sprint Layout 3.0 from Abacom) is available on request.

Rien, PA0TRT

- Open or download the diagram
- Download PC-board files

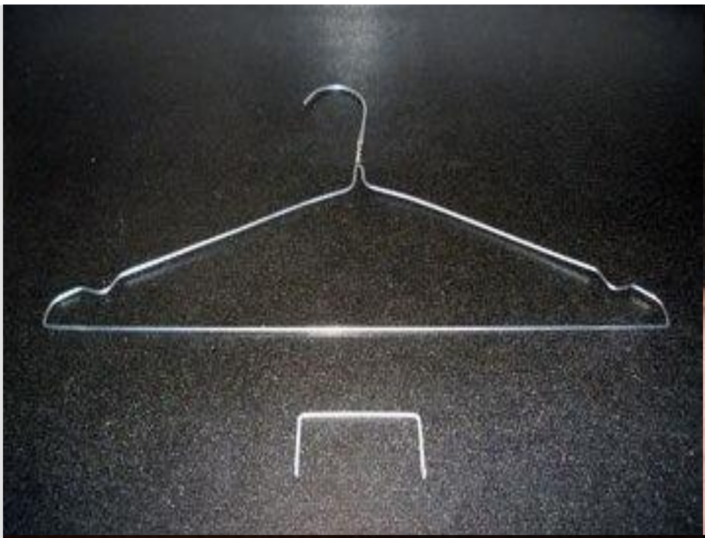
References:

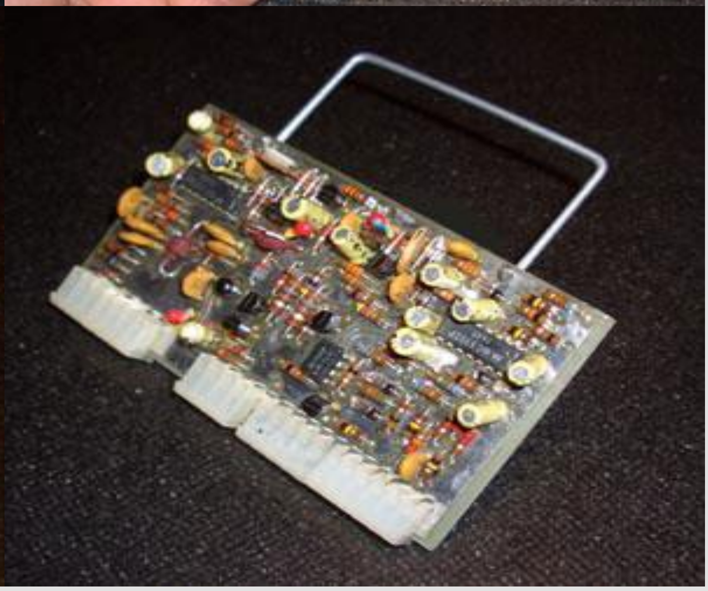
- \- Drake TR7 Operator's Manual
- \- Drake TR7 / TR7A Service Manual
- \- QEX February 1996
- \- World Wide Web

BOARD EXTRACTOR

With the original TR7 extender board kit came an extractor tool. My kit was missing this handy item. I made a replacement extractor out of an old steel wire coat hanger. The same one that make magic antennas for cars and television.

1. Cut 160mm wire out of the straight bottom part of the coat hanger.
2. Bend wire two times 46mm from both ends to get a U shape.
3. Bend wire 6mm from the ends under 135 degree angle.



Rien, PA0TRT

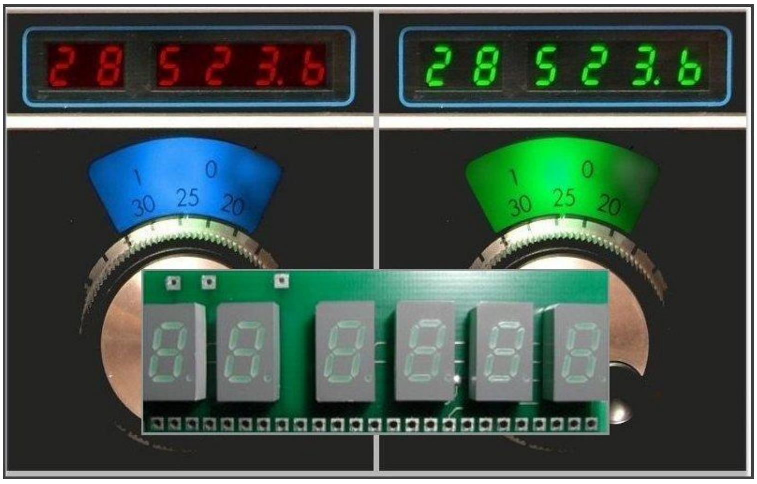
Replacement Display

http://www.df4nw.de/

by DF4NW

A single unit consists of 6 digits and is designed to replace the original 2+4 digit unit and is available with *RED or GREEN* colour LED's.

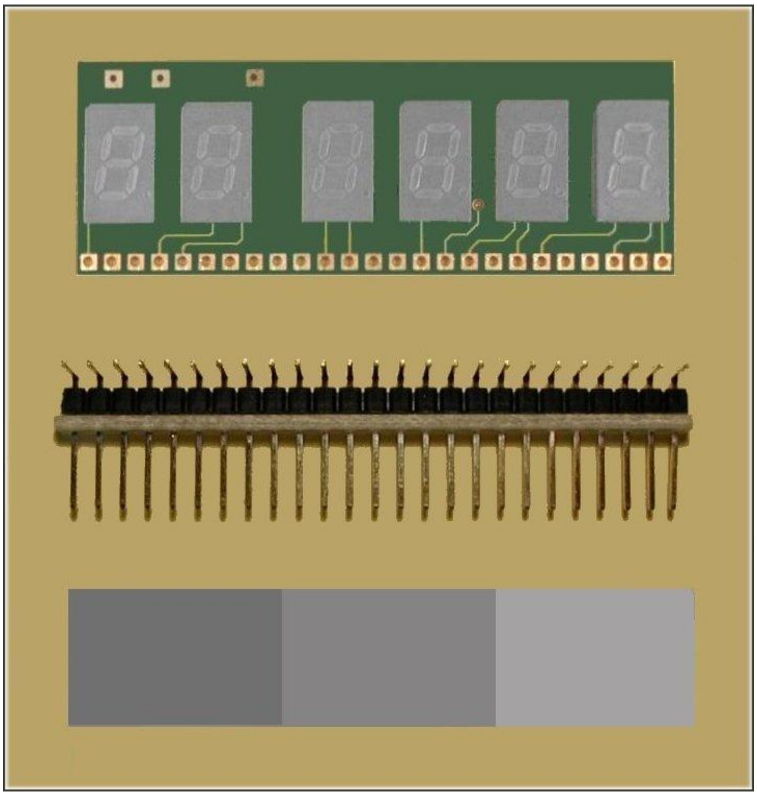
Character height .3" (7.62mm)



Price per kit (*RED* or *GREEN*): EUR 30,00

The following postage, packing and handling charges to be added:

Worldwide: EUR 8,00
Europe: EUR 5,50
Germany: EUR 4,00



Specify LED colour when ordering

One kit consists of:

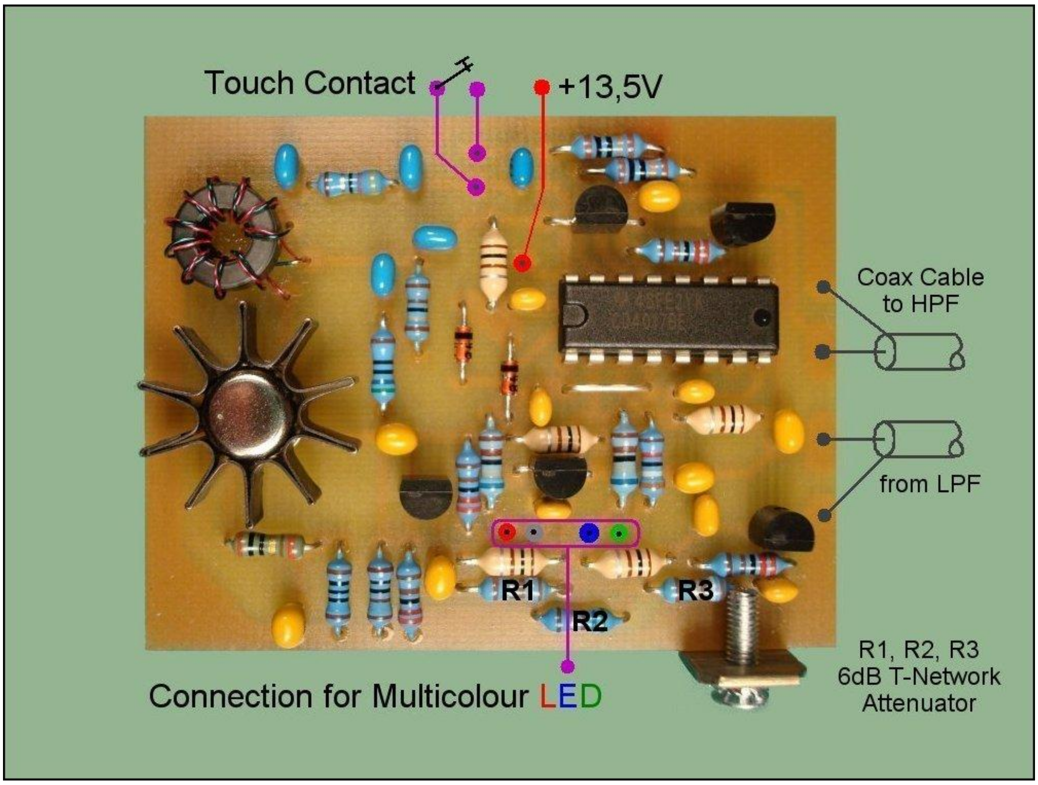
- Display board
- Right angle connector with epoxy spacer
- Filter foil - SMOKE colour
  Supplied in 3 different shades
  Suitable for all LED colours

To look at the Installation Instructions click here.

Pre-Amplifier

http://www.df4nw.de/

by DF4NW



All on one PC-Board

The board contains a pre-amplifier and gain selecting device.
With a touch contact switch a gain of 0dB, ~6dB or ~12dB can be selected.
A multi coloured LED can be connected to indicate the amplifier's actual switched-on gain.

The LED and self-adhesive **PRE-AMP** label, to paste over the **STORE** imprint on the upper panel, is supplied.

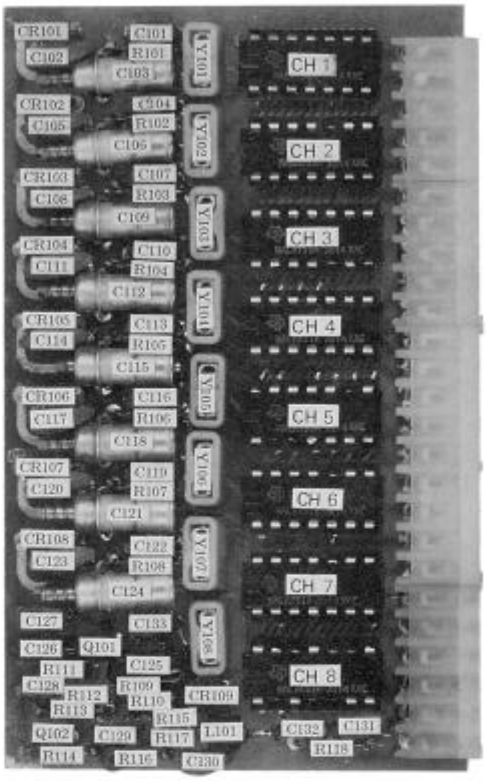
Frequency range: 1.8 to 30MHz
Size (HWL): 10x50x65mm

Price: EUR 48.00
Shipping charges see above.

For more info refer to the Installation Instructions

AUX7 AUXILIARY PROGRAM BOARD, MODEL 1536

http://www.dproducts.be/DRAKE_MUSEUM/aux-72.htm



The AUX7 is a plug-in unit which allows the user to program up to 8 auxiliary 500 kHz frequency ranges for instant selection from the front panel of a TR7 or R7. In addition, a crystal socket is provided for each of the eight auxiliary ranges to allow fixed frequency receive and/or transmit *(in the case of a TR7)* operation within a selected range

For receive only applications, programming is accomplished by using one RRM7 Range Receive Module per band segment. One of these modules is included with the AUX7. For transceive operation, one RTM7 Range Transceive Module per band segment is required

DR-7 DIGITAL READOUT

http://www.dproducts.be/DRAKE_MUSEUM/dr-7.htm

The DR-7 provides two major functions for the TR-7 - full receiver coverage from 1.8-30 MHz and digital frequency display. The two sections are completely independent. A failure in one section will usually not affect the other. A careful observation of the symptoms and a few measurements will isolate the fault to a major section. See table 4-l before removing DR-7. Refer to figure 4-2 for the parts location and figure 4-3 for the schematic.

All waveforms on the schematic are taken with the TR-7 tuned to 1.9500 MHz. All waveforms are taken with the oscilloscope set to AC trigger on the first edge shown on the schematic, i.e.: rising or falling edge. An oscilloscope with at least a 100 MHz bandwidth is required to faithfully reproduce some signals. Some signals, especially in the counter and display section, may be displayed with jitter when viewed on an oscilloscope without trigger hold-off. All levels are 0V and 5V high unless noted otherwise.

Section 4-1.1 contains the detailed theory of operation for the full coverage section and 4-1.2 for the digital frequency display. U9001 (6) refers to I.C. #9001, pin 6. Ground and supply connections are #7 and #14 for 14 pin I.C.'s, #8 and #16 for 16 pin I.C.'s, and #12 and #24 for 24 pin I.C.'s, unless noted otherwise.

If trouble is suspected with the full coverage section, remove the DR-7 and replace it with the Jumper Board for verification. If a component must be removed, USE CARE. Wicking braid and a low wattage, grounded soldering iron are recommended for component removal.

LED displays are matched for brightness. If a failure is determined to be in the display, replacement of both is advised. The recommended procedure to remove the display is to cut the connector pins close to the DR-7 P.C. Board. Remove the pins and clear the holes of solder. To replace the display, solder the displays to a new connector. The displays should be flush with the connector. The two digit and four digit displays are spaced apart one pin. Insert the display and connector assembly into the DR-7 board. Space the connector body .l inch (.254 cm) using a drill bit or other spacer. Solder the connector to the DR-7 board and remove the spacer

FULL COVERAGE SECTION

The major functions of the full coverage section are to take the synthesizer load number provided by the digital control board and increment or decrement the load number with the UP or DOWN front panel switches within the limits of the input low pass and high pass filters and to enable the transmitter on the amateur bands. When the bandswitch is changed from one band to another, U9002 (1) is momentarily grounded via the wire going to the high pass filter module. If the AUX PROGRAM switch is in NORM, U9002 (3) will go high and trigger U9004, a one shot. The negative pulse out of the one shot will cause U9002 (4) to go high, latching the BCD load number present at pins 2/ 41 through 2/48 into the programmable up-down counters U9005 and U9006. The one shot insures that the data from the band switch is valid before latching the number. In AUX PROGRAM switch positions l-8 U9002 (6) is held low, causing U9002 (4) to stay high. This allows any load number at the counter inputs to be fed directly to the outputs. The outputs of the counters are buffered by the high current drivers U9007 and U9008 and applied to the divide by N inputs of the translator board. When the UP or DOWN pushbutton is depressed, a negative pulse is generated at the output of one shot U9004 (7) and applied to the clock inputs of the counters. When the DOWN pushbutton is depressed U9002 (11) remains low, the counters will decrement by one and the VCO frequency will increase. The load number is fed to the inputs of READ ONLY MEMORY U9003. When a load number corresponding to a band edge is programmed, U9003 (12) and/or U9003 (11) will go low and disable the UP or DOWN latches. Refer to paragraph 1-3.3 to determine the proper load number for a particular 500 kHz segment.

COUNTER SECTION

The counter circuit can be divided into three major sections: the time base divider, the counter, and the display. The time base divider generates the signals required to gate the input signal into the counter, store the contents of the counters, and control the multiplexed information to the display section. The display section decodes and buffers the multiplexed information from the counter section and drives the LED display.

The **TIME BASE DIVIDER** is comprised of U9014, U9015, U9019, U9022, U9026, U9028 and U9016. The 500 kHz synthesizer reference signal is divided by 5 by U9014 producing 10 micro S pulses. The 10 micro Sec pulses are applied to the divide by 10,000 circuit consisting of U9017, U9019, and U9022, and to flip/flop U9026. After 100 mS, U9016 (13) will go low. At the next pulse from U9014, U9026 (1) will go low and U9026 (2) and U9015 (2) will go high, generating a strobe pulse at U9015 (10). On the second pulse from U9014 after the strobe pulse, a reset/load pulse is generated at U9016 (3). On the second pulse from U9014 after the reset pulse, a time base reset pulse is generated at U9016 (1). This pulse resets the dividers and sets U9026 (13) high. On the next pulse, U9026 (1) goes high and the sequence starts again. During the 100 mS gate time, the BCD output of U9019 is fed to 1 of 10 decoder U9028. The outputs of U9028 are used to multiplex the BCD information stored in the latches to the display section.

The **COUNTER CIRCUIT** consists of input amplifiers U9009 and U901 0, gating circuits U9011 and U9012, and counting circuits U9013, U90 17 through U9021, U9023 through U9025, U9027, and U9030. The VCO signal is amplified by U90 10. The external input signal is amplified by U9009. U9011 selects which signal is applied to the gate circuit. When U9012 (7) goes high, U9012 (3) will go low on the next rising edge of the selected input signal allowing the signal to be passed to decade divider U9013. The outputs of U9013 are buffered and applied to Q9002, which amplifies the ECL level signal to a TTL level. The TTL signal is applied to decade counter U9017 and then to U9019. The output of U9019 is applied to the programmable decade counter chain U9020, U9023, U9024, and U9027. The outputs of all of the counters feed latches. At the end of the gate time the BCD information is stored in latches U9018, U9021, and U9025 by the strobe signal from the time base divider section. After the strobe signal, the counters are either reset to all zeroes or loaded with an offset number by the reset/load pulse. When the DR-7 is operating in the NORMAL mode, the reset/load pulse is applied to pin 1 of the programmable counters and U9016 (5). U9016 (6) is grounded by the NORM/EXT switch preventing the load/reset pulse from resetting the counters. The counters will be preset to 5195, which will subtract the 48.05 MHz First IF from the VCO frequency. In the EXT mode the reset/load pulse is applied to both pin 1 and pin 9 of the programmable counters setting them to zero. When operating in the EXT mode and the input frequency exceeds 99.9999 MHz, U9030 (13) will go high and U9030 (1) will be latched high by the strobe pulse. When the STORE pushbutton is depressed, the strobed pulse is grounded and the information in the latches is not updated by the counters.

The **DISPLAY SECTION** is comprised of U9028, U9029, U9031, U9032, Q9005 through Q9013, and the LED display. When U9028 (2) goes low, the BCD information stored in latch U9025B is applied to the BCD to 7-segment decoder U9029.The outputs of U9029 are applied to U9032. The outputs of U9032 sink current from the common anode LED display. At the same time, the outputs of U9025B are enabled, Q9005 is turned on by U9028 (2) supplying current to the left-most digit of the display. After Dl has been lit for 100 mS, U9028 (2) will go high and U9028 (3) will go low, turning on Q9006 and enabling the information stored in U9028A to be decoded and applied to the cathodes. Each digit will be enabled sequentially for 100 mili S at a 1 kHz rate. Q9012 is turned on at D5 to illuminate the decimal point. If Dl is zero, U9029 (4), U9031 (1) and, if the counter has not exceeded 99.9999 MHz, U9029 (5) will go low and the leading zero will be blanked. U9031 (1) will remain low until a number other than BCD "0" is applied to the inputs of U9029. When the counter is operating in EXT and the frequency exeeds 99.9999 MHz, leading zeroes are not blanked. 100 MHz will display 00000.0 kHz. If power is applied without the 500 kHz input or if a failure should occur in the time base divider circuitry, the pulse at U9028 (1) will go away, causing Q9013 to turn off. When Q9013 turns off, Q9011, which supplies the ground to the display driver, will turn off preventing damage to the display.

DR7 REMOVAL (Refer to Pictorial Fig. 4-1)

1. Unplug (5) five connectors (Pl through P5) from the DR7 board. Position cables carefully so that they will be free of the DR7 Board when it is lifted out. Remove the retaining screw and lock washer (adjacent to U9006).
2. Unplug the coax and blue wire from the filter module. Slide the grommet off of the coax and wire.
3. Grasping the board along both sides, tilt the rear portion of the board upwards at an angle sufficient to fully disengage the connectors and slide the board toward the rear of the radio. As this is done, note that the LEDs should slide out of the aluminum bezel at the front panel. NOTE: Do not tilt the board excessively before the display LEDs are free of the locating aluminum bezel, or damage will result to either the displays or the DR7 board.
4. Using the card puller supplied with the radio, hook one end under the front edge of the large hole adjacent to U9008 (shown in figure 4-l). Grasp the tool and pull upwards firmly, but slowly, to disengage one 12 pin, one 9 pin and two 3 pin connectors. Once the connectors have been disengaged, remove the card puller.
5. Once the display and connectors are free, lift the DR7 board straight up, allowing the coax to slide out of the clearance hole provided for it.
6. Now either the DR7 or Jumper Board can be plugged in on extender cards and the coax plugged into the filter module to service the radio.

DR7 INSTALLATION

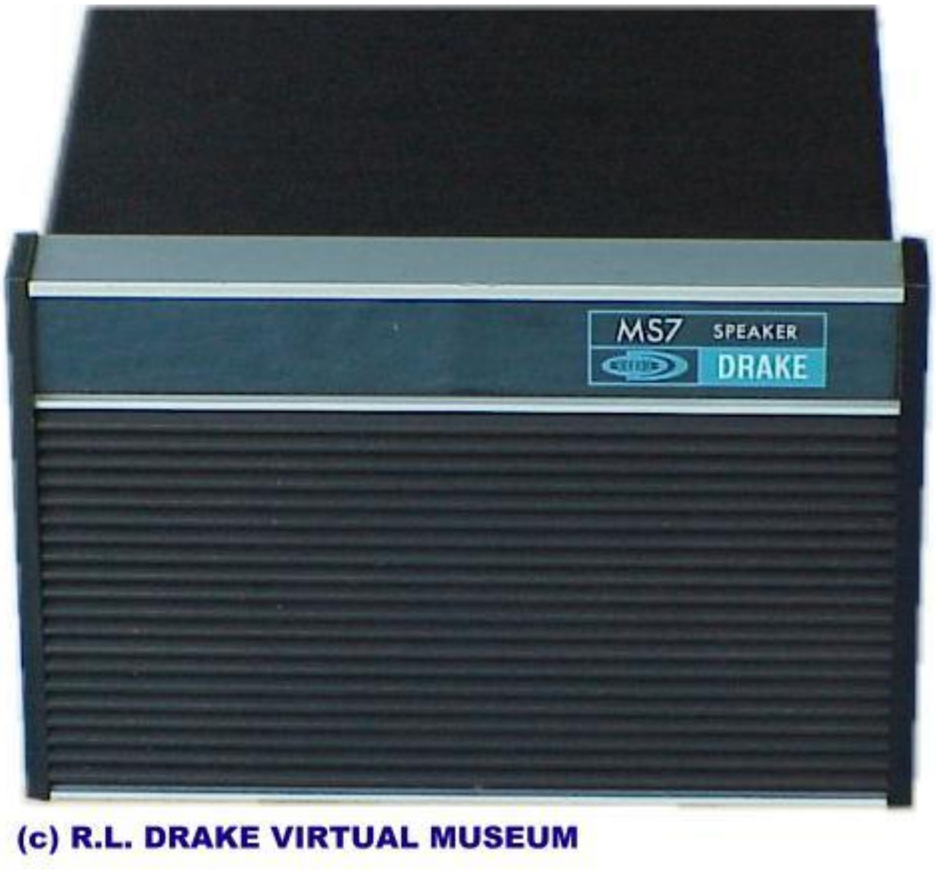
1. Position (5) five connectors (Pl through P5) and associated cables to be free of DR7 board during the installation. Check that all 27 connector pins on the DR7 board are straightened and perpendicular to the board.
2. Thread the Up-Converter coax through the hole (adjacent to C9015). Tilt the display LED portion of the DR7 board downward and slide the LEDs into the locating aluminum bezel at the front panel.
3. Start the 12 pin connector on the DR7 board (adjacent to U9006) into the receptacle on the Digital Control Board, noting visually that the connector pins are aligned properly with the receptacle
4. With the 12 pin connector sufficiently engaged, Start the 9 pin connector (adjacent to U9003) into the receptacle in the Translator board, again noting visually that the connector pins are aligned properly with the receptacle. Note that even though the alignment of the two 3 pin connectors cannot be visually inspected, their alignment will be proper if the pins were straightened and the 12 and 9 pin connectors are properly aligned.
5. Press down firmly, but carefully, on the DR7 board to fully seat all connectors.
6. Install the retaining screw and lock washer (adjacent to U9006). Plug in all (5) five connectors (P1 through P5). Slide the grommet over the coax and blue wire. Plug the coax and blue wire into the filter module, position the grommet in the chassis wall cutout.

MMk-7 Bracket

http://www.dproducts.be/DRAKE_MUSEUM/nouvelle80.htm

MS-7 External Speaker, Model 1531

http://www.dproducts.be/DRAKE_MUSEUM/nouvelle3.htm



Size : 7.5"D x 6.9"W x 4.6"H excluding feet (19 x 17.5 x 11.6 cm)

Weight : 2.5 lbs (1.13 kg)

RV-7 Remote VFO for TR-7

http://www.dproducts.be/DRAKE_MUSEUM/nouvelle2.htm

General Description

The RV-7 is designed for use with the TR-7 and offers the operator a high degree of frequency control flexibility. The RV-7 can be employed for transmit, receive or transceive frequency control or can be turned off to allow transceive frequency control from the TR-7. For added convenience, the TR-7 RIT control line is applied to the RV-7 in the receive mode. A spot switch allows the RV-7 and TR-7 PTO's to be zero beat in split mode operation. The unit is housed in a cabinet which is styled to match the TR-7.

FA-7 Cooling fan, Model 1529

http://www.dproducts.be/DRAKE_MUSEUM/fa-7_cooling_fan.htm

Cooling fan for TR-7, TR-7A, PS-7

RV-75 Synthesized Remote VFO's. Permit rcvg, xmtg or xcvg on separate frequency in same band as xcvr Model 1545

http://www.dproducts.be/DRAKE_MUSEUM/rv-75rem.htm

SYNTHESIZED FREQUENCY CONTROL
CRYSTAL CONTROLLED STABILITY. (+- 15 ppm 0" to + 50°C)
VARIABLE TUNING RATE
10 Hz RESOLUTION
800 KHz TUNING RANGE
USER SELECTABLE DIRECTION OF FREQ. CHANGE/DIAL ROTATION WITH SEPARATE ADAPTER
WEIGHTED FLYWHEEL SHAFT ENCODER
TWO PROGRAMMABLE FIXED FREQUENCIES
"RIT" CONTROL
DIAL LOCK FEATURE
COMPATIBLE WITH TR-5, TR-7, TR-7A
COMPATIBLE WITH R-7, R-7°

The RV-75 is a synthesized remote VF0 designed for use with the TR-7, TR-7A, R-7, R-7A, and the TR-5. The RV-75 provides a high degree of frequency control flexibility with crystal controlled frequency stability. The RV75 output frequency is synthesized in 10 Hz increments for smooth frequency control and the weighted flywheel of the optical shaft encoder provides a smooth, solid feel.
The unique "Variable Rate Tuning Oscillator*" circuitry of the RV-75 provides a versatile and easy to use tuning method. When rotating the tuning knob slowly, the 2 KHz/rev. tuning rate allows very precise frequency setting. As the rate of rotation increases, .the tuning rate increases linearly up to 25 KHz/rev. or higher if desired. The higher tuning rate allows smooth and rapid frequency changes without requiring a separate control for tuning rate. The smooth increase in tuning rate while still maintaining a 10 Hz resolution avoids the chance of "jumping" over desired signals.
The RV-75 also provides for two fixed frequencies in addition to the tuned frequency selectable from the front panel. The fixed frequencies are programmed by switches accessible through the rear panel. The 800 KHz tuning range provides generous over travel of the band edges. The "RIT" function allows the receiver to be offset from the transmitter up to +- 100 Hz.
The RV75 will provide outstanding performance for the 5-line or 7-line owner.

PS-7Power supply MODEL 1502

http://www.dproducts.be/DRAKE_MUSEUM/ps-7.htm

General Descripition

The PS-7 is a 13.6 volt DC regulated power supply capable of delivering up to 25 amps of continuous current. Excellent voltage regulation is provided by a silicon monolithic integrated circuit and associated circuitry. Output voltage and current are adjustable with internal controls which have been factory set, to provide 13.6 volts at up to 25 amps. Other features include short circuit and over voltage protection and programmable primary voltages.

An auxiliary 13.6 VDC output is provided on the rear panel and is fused internally at 1 amp. Primary voltages of 100, 120, 200, and 240 VAC, 5O-60 Hz may be used with the PS-7 and may be quickly changed via the programming switches. For demanding duty cycles, such as extended RTTY or SSTV transmission, the model 1529 FA-7 Cooling Fan is recommended for additional cooling, especially at ambient temperatures above 25°C.

Current Overload Protection

When the PS-7 is subjected to a current overload or short circuit condition, the regulator circuit Will automatically shut down. The unit may be reset by momentarily switching the ON-OFF switch

on the TR-7 to OFF or by removing the AC primary voltage to the PS-7. The power transformer is protected by an 8 ampere type MDL fuse on primary voltages of 100 or 120 VAC or a 4 ampere

type MDL fuse on 200 or 240 VAC. Refer to Figure 1 for location on the rear panel. This fuse should be replaced with another fuse of the same type and rating. The auxiliary DC output is internally fused with a 1 amp type MDL fuse. This is located inside the unit, on the regulator P.C. board. This fuse should be replaced only with another fuse of the same type and rating.

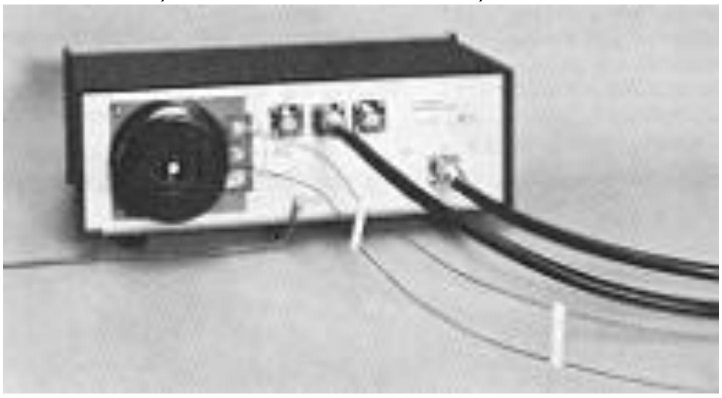
Accessory

Model 1529 FA-7 Cooling Fan

MN-75 antenna matching network, Model 1540

http://www.dproducts.be/DRAKE_MUSEUM/mn-75.htm

The Drake MN-75 manages rf radiation in the areas of impedance match to the antenna, rf power measurement, VSWR measurement, reduction of harmonic radiation, and antenna selection.



B-1000 Balun Model 1510
installed on Matching Network

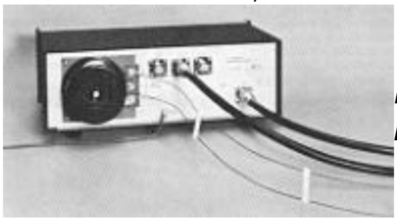
DRAKE MN-75 FEATURES

Frequency Coverage:
1.8-30.0 MHz Range switch selects one of the following frequency ranges:
1.8-3.0 MHz, 3.0-5.0 MHz, 5.0-7.0 MHz, 7.0-10.0 MHz, 10.0-14.0 MHz, 14.0-18.0 MHz, X0-23.0 MHz, 23.0-26.0 MHz and 26.0-30.0 MHz.
Input Impedance: 50 ohms (resistive).
Long Wire Antennas: Feedpoint impedances up to 5:1 VSWR referenced to 50 ohms. Also, 5 :1 referenced to 200 ohms with the Drake B-1000 balun (3:l on frequencies above 26 MHz).
Power Capability: 200 Watts average, continuous duty.
Meter: Reads VSWR or Forward power, O-300 watts.
Wattmeter Accuracy: *5% of reading *l% of full scale.
Dimensions:
Height = 4-17132" (11.5 cm)
Width = 13-3132" (33.26 cm)
Depth = 8-1/2" (21.6 cm) Including Connectors.
Weight = 8 lbs. (3.6 kg)
Front Panel Controls: Provides for the adjustment of resistive and reactive tuning and VSWR calibration, antenna switching, range switching, and selection of forward watts or VSWR functions of the meter.
Rear Panel Connectors: four type SO-239 coaxial connectors (one for input and three for output), three screw terminal connections (for long-wire and open-wire feedline systems), and a ground post.

MN-7 antenna matching network, Model 1538

http://www.dproducts.be/DRAKE_MUSEUM/mn-7.htm

The Drake MN-7 manages rf radiation in the areas of impedance match to the antenna, rf power measurement, VSWR measurement, reduction of harmonie radiation, and antenna selection.



B-1000 Balun Model 1510 installed on Matching Network

DRAKE MN-7 FEATURES

160 thru 10 Meters Frequency Coverage-With out-of-band coverage for MARS, future band expansions and other applications.

Antenne Choice-Matches antennas fed with coax, balanced line, or random wire. (For balanced line use optional Drake B-1000 Balun, which mounts on rear panel of MN-7.)

Antenna By-pass Switching-Unique design allows unit to be switch-by-passed regardless of which antenna is in use, whether coax or wire type. No need to manually disconnect feedlines. Switch also selects various antennas.

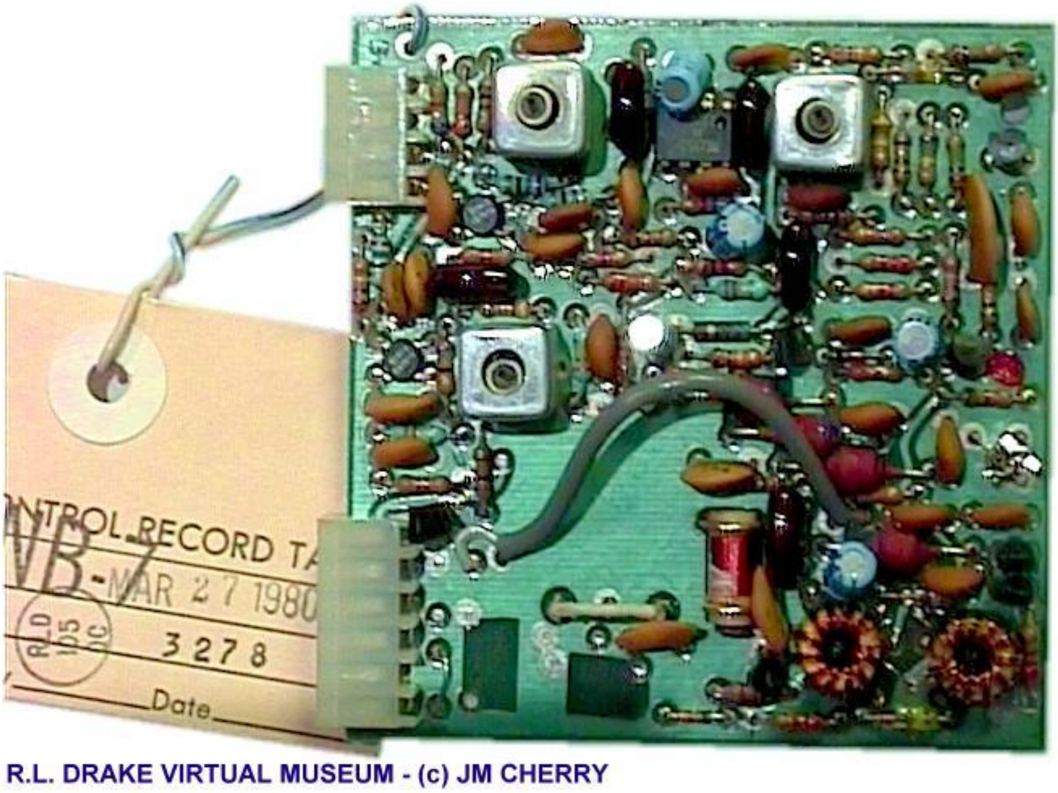
Extra Harmonic Reduction to help fight TVI-Drake Matching Networks employ special "pi-network" low-pass filter type circuitry for maximum harmonic rejection. This feature alone makes the MN-7 a worthwhile investment; it is a Drake exclusive.

Built-in Metering-Accurate rf wattmeter/VSWR bridge is pushbutton controlled from front panel. Meter reads 0-300 watts forward power or VSWR.

Power Capability-250 watts countinuous.
13.09"W x 4.53"H x 8.5"D including connectors (33.26 x 11.5 x 21.6 cm);
Weight 10 Ibs. (4.5 kg).

NB-7 Noise Blanker

http://www.dproducts.be/DRAKE_MUSEUM/nb-7_noise_blanker.htm



The Model NB-7 noise blanker is a solid-state noise blanker to be used in TR-7 transceiver .

The NB-7 is standard in the TR-7A

Unlike noise clippers or limiters commonly found in communication equipment, the NB-7 is an advanced noise blanker which actually mutes the receiver for the duration of the noise pulse. Between noise pulses, full receiver gain is restored. (The receiver AGC is affected only by the desired signal strength, not by the noise at the antenna.)

The NB-7 is most effective on strong, periodic noise impulses such as ignition noise. The blanker is least effective on random noise. This noise is continuous in time and the information it masks cannot be recovered by either blanking or limiting techniques. However, loss of communications due to random noise is a rare occurrence, generally impulse noise is responsible for such situations.

Low level signals masked by noise impulses without the noise blanker can be copied when the blanker is used. The NB-7 is a must for the mobile operator because he can now blank ignition noise due to trucks and other cars as well as his own car.

Desk Microphone, Model 7077 (Astatic)

http://www.dproducts.be/DRAKE_MUSEUM/7077mike.htm

Audio and level characteristics custom designed to match the transmit audio requirements of the Drake TR-7.

Features both VOX and PTT operation without modification.

High Impedance

Includes coil cord and plug wired for direct connection to the Drake TR-7.

Style and color provide a beautiful match to the Drake 7-line

Size 4.3"W x 5.8"D x 9.3 "H (10.9 x 14.7 x 23.6 cm).

Weight 1 lb 7 oz (650 g).

SP-75 Speech Processor, Model 1553

http://www.dproducts.be/DRAKE_MUSEUM/nouvelle4.htm

Provides an increase in average power readability of a single sideband voice signal during weak signal, high interference conditions.
The SP-75 is connected between the microphone and microphone input of the ssb transmitter, requiring no modification of existing transmitter or transceiver.
A front panel switch allows the processor to be switched in or bypassed. Two additional inputs, such as a tape player or phone patch, may be front panel selected.
RF envelope clipping adjustable between zero and twenty decibels. LED indicates proper audio Input level.
Muting circuitry reduces gain during speech pauses, allowing VOX operation with the processor on.

SPECIFICATIONS

Processing Type: pre clipping audio compression followed by rf envelope clipping at the processor intermediate frequency.
Rf Clipping Range: Adjustable 0 to 20 dB from front panel control.
Input Level Microphone Input): 3.5 mV minimum for full processing. Gain adjustable to accommodate up to 300 mV maximum. I Input Level (Tape and Patch Inputs): 15 mV minimum for full processing. 30 mV maximum.
Input Impedance (Microphone): 1 megohm.
Input Impedance (Tape and Patch): 50 kilohm.
Output Level w/Processing: O-50 mV adjustable into 50 kilohm load.
Output Impedance: 50 kilohm.
Muting (Microphone Input Only): 10 to 20 dB attenuation during speech pauses.
Frequency Response: 400-6000 Hz@6 dB.
Distortion: Less than 5% T.H.D.@lkHz, 20 dB clipping.
Power: 11-16 V-dc@95 mA.
Size: 7"L x 6% "W x 2 1/4 "H (17.3 x 15.9 x 5.4 cm).
Weight: 1.4 lbs. (.63 kg).

CW-75 Electronic Keyer, Model 1507

http://www.dproducts.be/DRAKE_MUSEUM/nouvelle5.htm

Lambic Keying
Built-in side tone.
Optically coupled keyline for grid block or direct keying.
Speed and volume control.
Self completing dots and dashes.
Operates from external 7-14 volt supply or 9 volt battery (internal optional).
5-50 WPM.
Squeeze keyer, semi-automatic "bug" or straight key operation.
Size: 7.0"L x 6.25"W x 2.25"H (17.3 x 15.9 x 5.4 cm).
Weight: 1.4 lbs (.63 kg).

P-75 Phone Patch, Model 1520

http://www.dproducts.be/DRAKE_MUSEUM/p-75.htm

Picture : RL Drake Company

Model 1520

GENERAL

Phone patch for use with 7-line or most other transceiver or receiver/transmitter combinations.

Hybrid design nulls receiver audio at transmitter output to allow automatic VOX operation if desired.

Adjustable receiver and transmitter audio gain controls.

Built-in relay for positive receiver muting during transmit.

Provision for addition of holding coil for use in remote control applications such as repeater auto patches.

DRAKE P75 SPECIFICATIONS

Receiver Audio Input Impedance: standard 3.2-16 ohm speaker impedance.

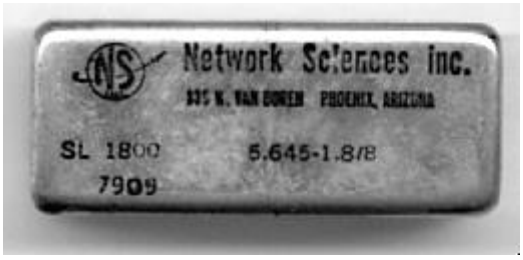
Transmitter Output Impedance: matches 1 kilo ohm or higher transmitter microphone circuit input impedance

Size: 7.0" L x 6.25" W x 2.25" H (17.3 x 15.9 x 5.4 cm).

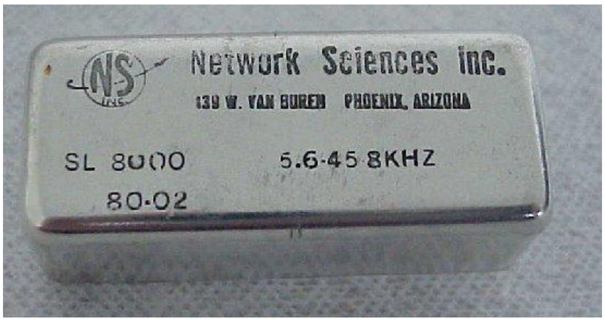
Weight: 1.4 lbs (.63 kg).

Crystal filters

http://www.dproducts.be/DRAKE_MUSEUM/if_filters.htm



(c) R.L. DRAKE VIRTUAL MUSEUM



7 line crystal filters

Click to enlarge pic

SL-2300 The 2.3 kHz standard SSB bandwidth

Click to enlarge pic

SL300 CW-filter, 300 Hz

Click to enlarge pic

SL500 CW-filter, 500 Hz

Click to enlarge pic

SL-1800 SSB/RTTY Filter, 1.8 kHz

Click to enlarge pic

SL4000 AM-filter, 4 kHz

Click to enlarge pic

SL6000 AM-filter, 6 kHz

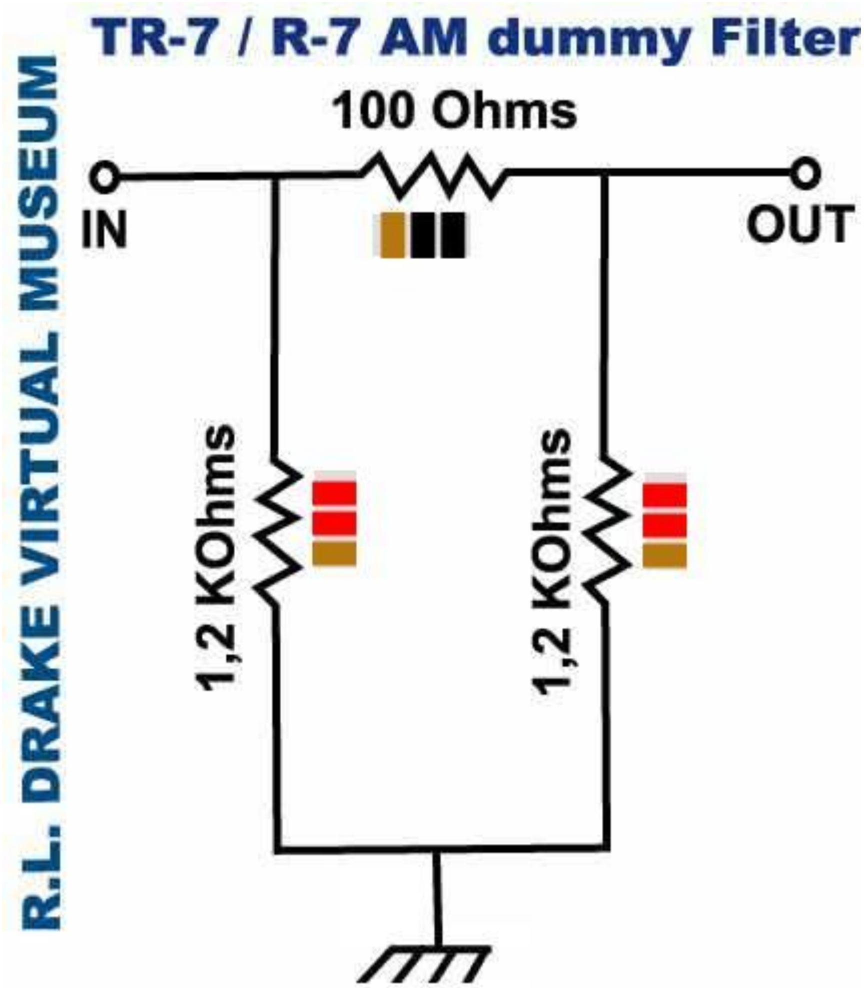
Click to enlarge pic

SL8000 AM-filter, 8 kHz

Model 7021 Drake SL-300 Cw Filter, 300 Hz
Model 7022 Drake SL-500 Cw Filter, 500 Hz
Model 7023 Drake SL-1800 SSB/RTTY Filter, 1800 Hz
Model 7026 Drake SL-4000 AM Filter, 4.0 kHz
Model 7024 Drake SL-6000 AM Filter, 6.0 kHz
Model 7025 Drake SL-8000 AM Filter, 8.0 kHz

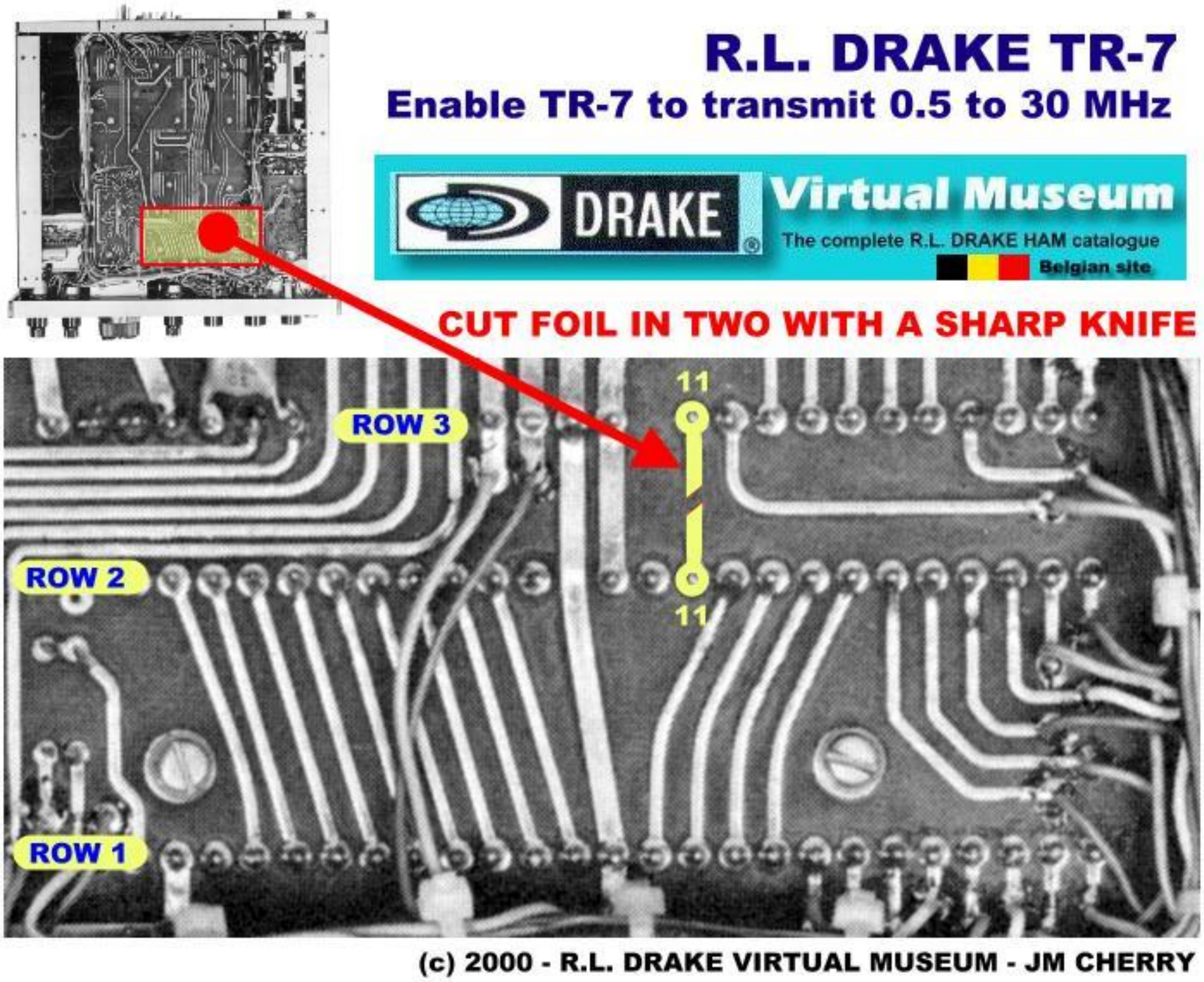
Do AM filter

http://www.dproducts.be/DRAKE_MUSEUM/do_a_am_filter.htm



ENABLE TR-7 TO TRANSMIT 1.5 - 30 MHz without AUX-7

http://www.dproducts.be/DRAKE_MUSEUM/tx_0_5-30mhz.htm



Two methods:

1. Cuts the "Transmitter Enable" on the motherboard
2. Remove a transistor on the transmit line (Bart Pulverman method)

Method 1

1. Unplug all interconnecting cables from the TR-7.
2. Place the radio upside down, with the front panel facing you.
3. Remove the Bottom cover plate by removing ten screws and sliding the plate to the rear.
4. Refer to the attached photograph and figures and identify connector pin row 1, 2 and 3 on the front right-hand comer of the parent board.
5. Carefully identify pin 11 in rows 2 and 3.
6. Note that a foil trace connects pin 11 in rows 2 and 3. Using a sharp knife cut this trace in two. Use caution, and do not disturb any other circuits.
7. Reinstall the bottom cover plate and reconnect all associated station equipment.

Method 2

About This modification, I received a very Interesting mail from:
Bart Pulverman, WB6WUW
8434 Periwinkle Drive
Buena Park, CA 90620-2119

I noticed a link on your home page titled "TR-7: How to transmit 1.5 - 30 MHz with or without AUX-7?" That method, which I have seen before, requires cutting a trace on the motherboard. That results in unnecessary permanent damage to the motherboard (from the perspective of maintaining a pristine, stock radio) and there is always the possibility of cutting the wrong trace.

Although I have an AUX-7 board on my TR-7, I did not want to pay $52 each for the three programmed chips required to add transmit capability when the WARC bands (30, 17 and 12 meters) were reassigned to hams in the mid 80's. I found that by removing Q201 (2N3904 transistor) from the Digital Control Board (see Fig 2), that the "Transmitter Enable" signal was permanently forced to the enabled state. This results in the same continuous coverage without cutting traces. I have saved the transistor.
If I ever want to delegate my TR-7 to museum status, all I need to do is solder Q201 back on the board. The method described on your web page cuts the "Transmitter Enable" trace on the mother board which is electrically equivalent, but destructive.µ

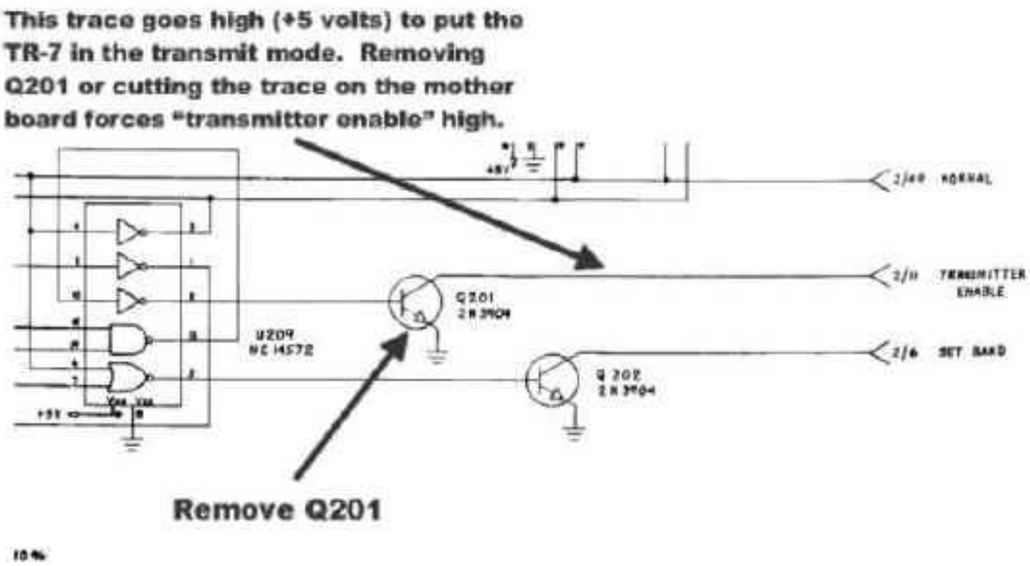


Fig. 2-4 Digital Control Board Schematic

2-10

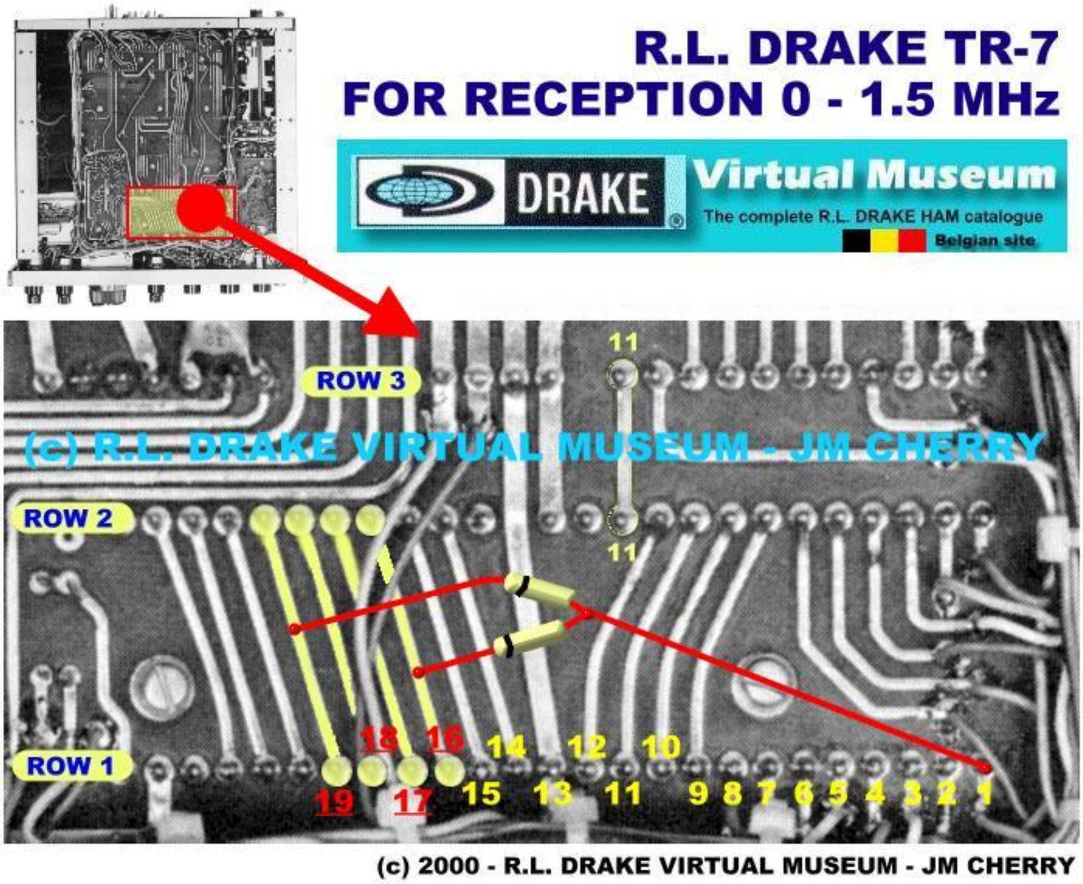
The step-by-step instructions are:
1. Remove the TR-7 top cabinet cover.
2. Remove the DR-7 Board.
3. Remove the board shield under the DR-7.
4. Remove the Digital Control Board.
5. Carefully unsolder and remove Q201 from the Digital Control Board.
6. Replace the Digital Control Board.
7. Replace the board shield.
8. Replace the DR-7 Board.
9. Replace the TR-7 top cabinet cover.

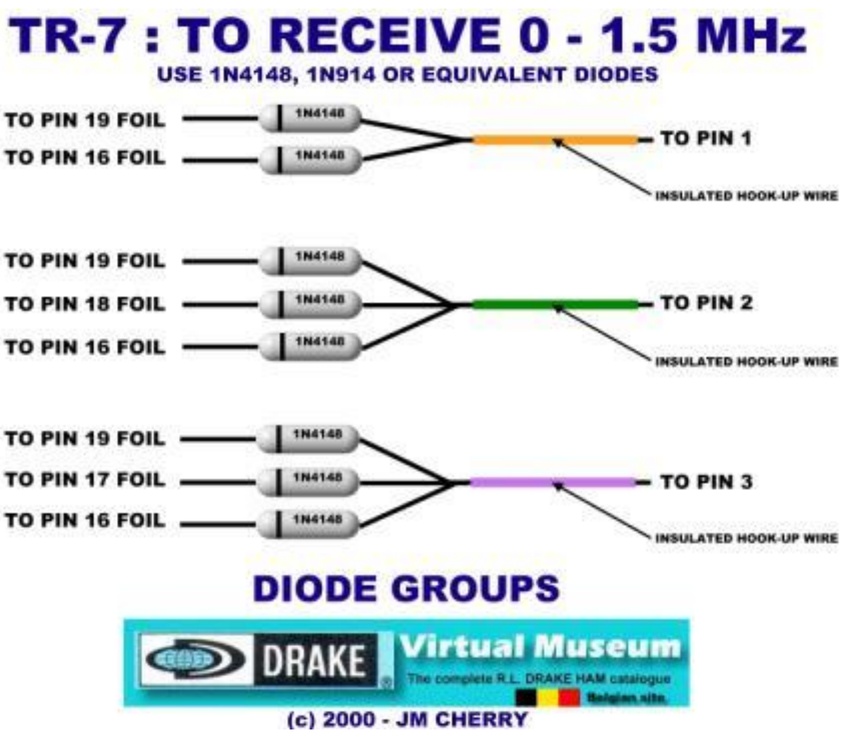
CAUTION: With "Transmitter Enable" always in the enabled state, the user is no longer protected from inadvertently transmitting outside the amateur bands.

Bart Pulverman, WB6WUW

TO RECEIVE 0 - 1.5 MHz with or without AUX-7

http://www.dproducts.be/DRAKE_MUSEUM/rx_0-1_5_mhz.htm

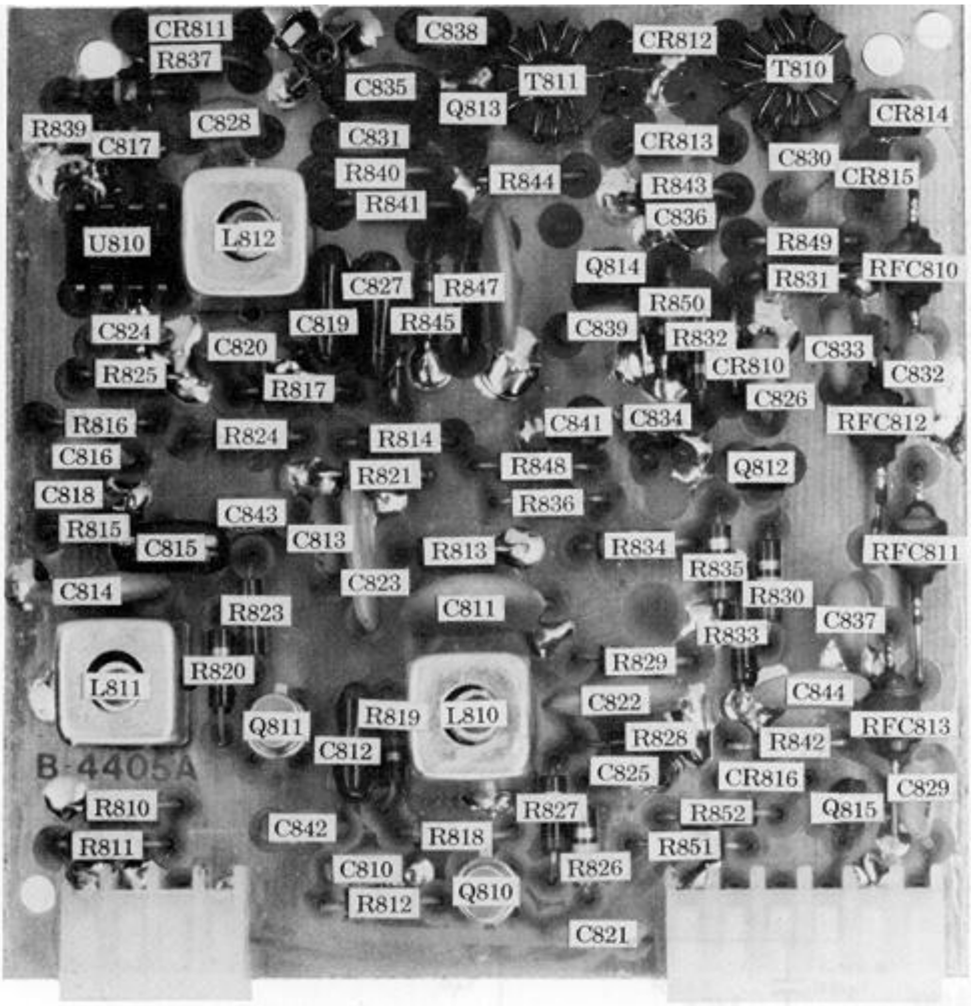


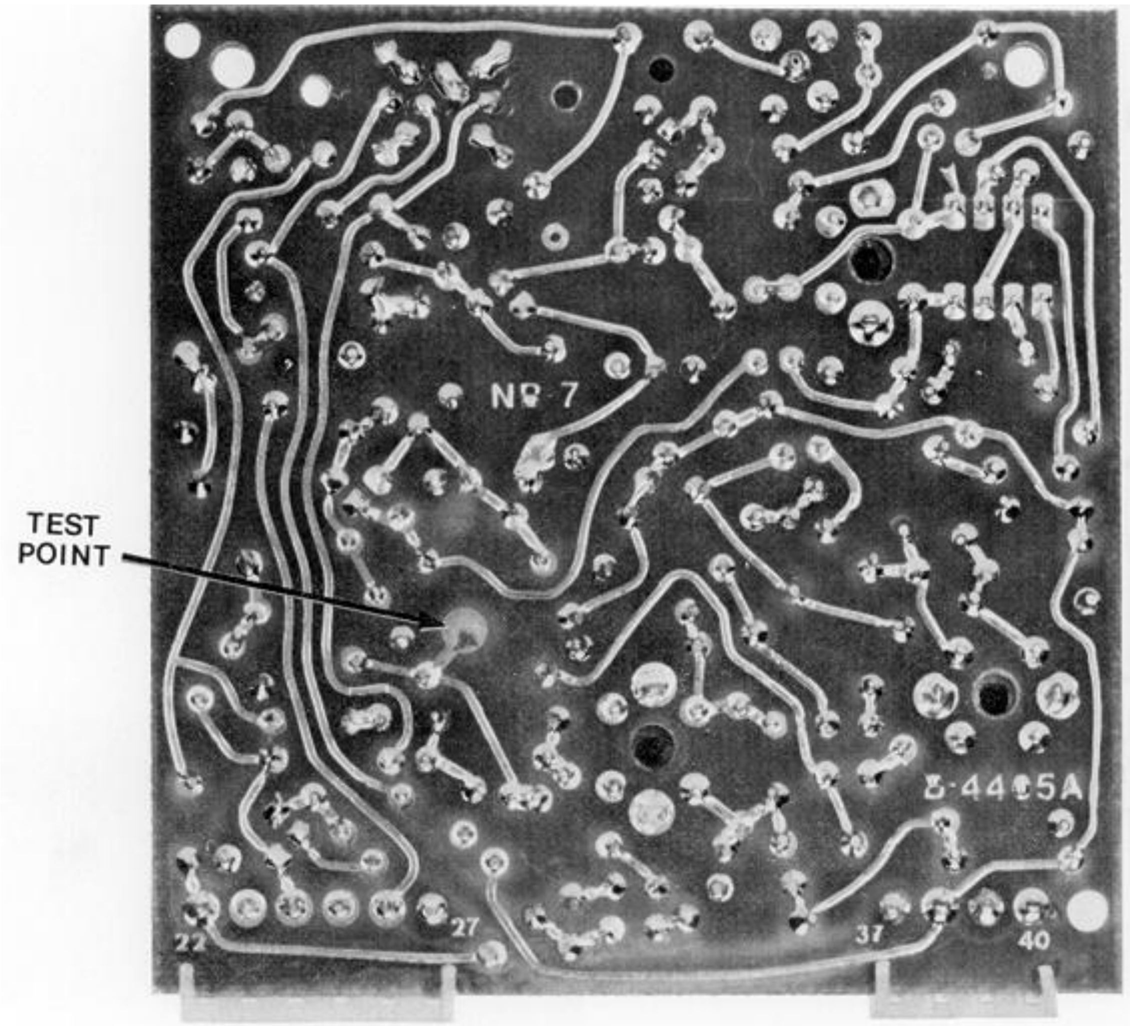


1. If the TR-7 has not been disconnected from all accessories and the bottom cover removed, do so at this time. Turn the radio upside down with the front panel facing you.
2. Refer to the attached photograph and figures and identify connector row 1 on the front right-hand corner of the parent board.
3. Carefully label connector pins 1, 2, 3, 16, 17, 18, and 19 in row 1.
4. Refer to the attached figures and prepare one group of two diodes and two groups of three diodes. Use 1N4148 or equivalent diodes. Connect the anodes of the diodes in each group together and attach a length of insulated hook-up wire to the common anodes connection of each group.
5. Carefully solder the diode groups in position per the attached figures.
   Connect the cathodes of the diodes to the indicated foils and the free end of each length of hook-up wire to the indicated connector pin. To avoid shorts, use insulated sleeving as necessary, and dress the leads neatly. Position the TR-7 wiring harness away from areas to be soldered to avoid damage to the harness.
6. If your TR-7 has an AUX7 card installed, be sure that positions 1, 2, and 3 are blank.
7. Check again for shorts, reinstall the bottom cover and reconnect the TR-7 to the other station components.
8. Your TR-7 will now receive 0-500 KHz in AUX position 3, 500-1000 KHz in position 2 and 1000-1500 KHz in position 1. It is normal for the "SET BAND" lamp to glow in this mode. Use the 1.5MHz bands witch position for 0-1500 KHz reception.

Alignment NB7, VERSION 1

http://www.dproducts.be/DRAKE_MUSEUM/nb-7_ver_1.htm





The NB7 is easily aligned via the following procedures:

Equipment Required:

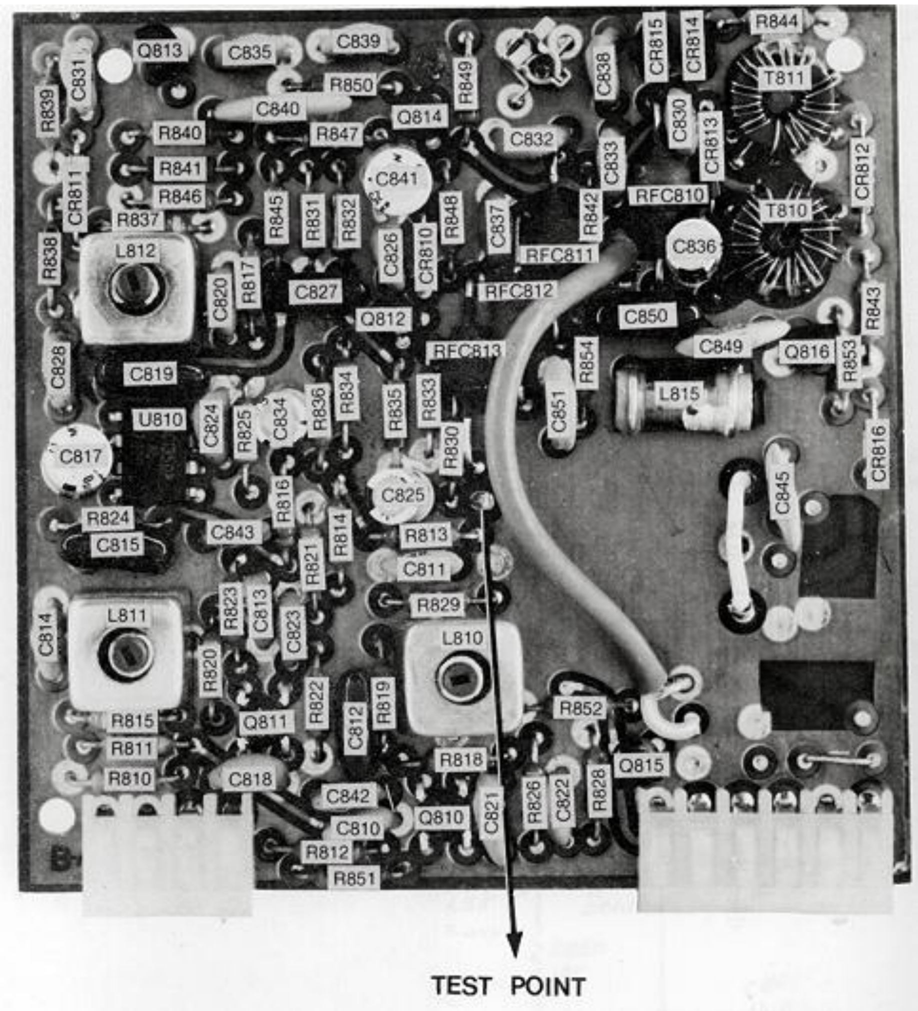
- High Input Impedance VTVM
- The following parts from the TR7 Maintenance Kit:
  - 1 6-pin extender card
  - 1 4-pin extender card
- 1 tuning tool: small white blade #SK-462

Alignment

1. Remove NB7 per Installation instructions through 4.
2. Carefully install extender cards making sure they properly match the connectors on the NB7 and the pins in the TR7 card cage.
3. Connect coax from IF Selectivity card to the coax receptacle on top of the NB7. Note if coax will not reach . Remove IF Selectivity card and cut wire tie on coax to facilitate connection of coax.
4. Turn TR7 on and depress calibrator switch. Tune in calibrator signal. Put Mode switch in CW, Band switch at 14 MHz.
5. Refer to figure 1 and connect VTVM to test pad. Depress NB switch to activate Noise Blanker.
6. Tune L810, L811 and L812 for maximum DC voltage.
7. Remove VTVM and turn off TR7.
8. Remove NB7 and extender cards.
9. Reinstall NB7 as per Installation steps 5 through

Alignment NB7, VERSION 2

http://www.dproducts.be/DRAKE_MUSEUM/nb-7_ver_2.htm



Equipment Required:

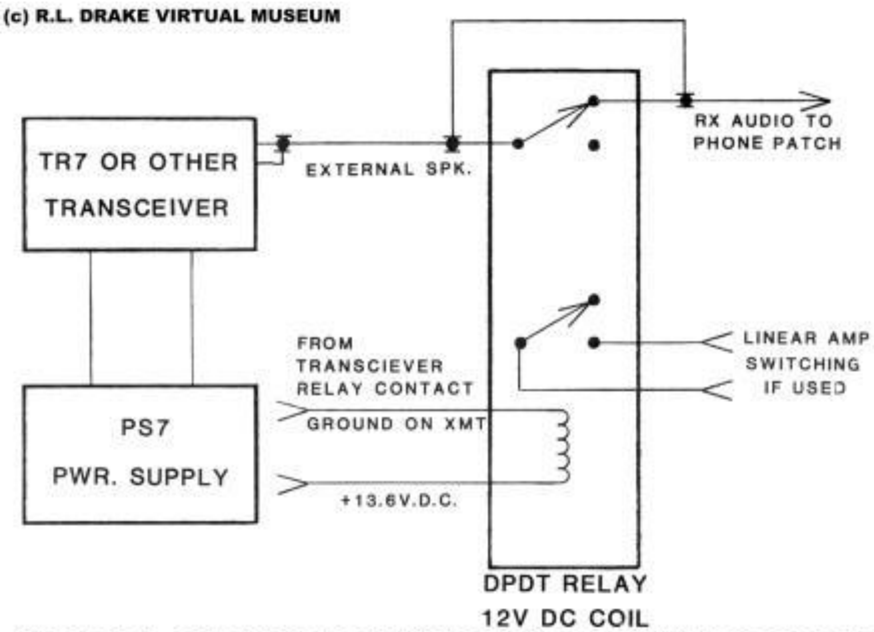
- High Input Impedance VTVM (11 megohms or greater)
- The following parts from the TR7 Maintenance Kit:
  - 6-pin extender card
  - 4pin extender card
  - tuning tools: small white Hex #SK-55
  - Small White blade #SK-462

Alignment:

1. Remove NB7 per installation instructions 1 through 4.
2. Carefully install extender cards making sure they properly match the connectors on the NB7 and the pins in the TR7 card cage
3. Connect coax from IF Selectivity card to the coax receptacle on top of the NB7. Note: If coax will not reach . Remove IF Selectivity card and cut wire tie on coax to facilitate connection of coax.
4. Turn TR7 on the depress calibrator switch. Tune in calibrator signal, band switch at 14 MHz, USB mode. Set PBT control in center and retune for maximum S-meter reading. This will be approximately zero beat. Peak L815 for maximum S-meter reading.
5. Refer to figure 4-7, and connect VTVM to test pad. Depress NB switch to activate noise blanker.
6. Peak L810, L811, and L812 for maximum DC voltage.
7. Remove VTVM and turn off TR7.
8. Remove NB7 and extender cards.
9. Reinstall NB7 as per Installation Instruction steps 5 through 9.

USE OF A PHONE PATCH WITH SP75 SPEECH PROCESSOR

http://www.dproducts.be/DRAKE_MUSEUM/phone_patch_sp75.htm



USE OF A PHONE PATCH WITH SP75 SPEECH PROCESSOR

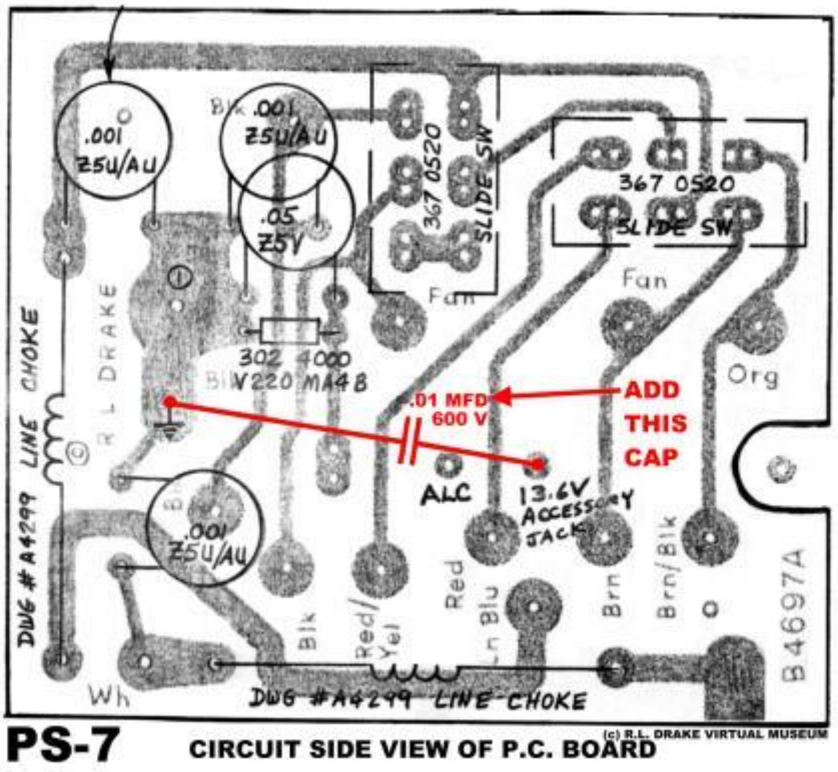
Under some conditions, use of a phone patch with a speech processor may cause a feedback condition. This condition results if the transceiver still has a very small amount of audio present at its output in the transmit mode. This can be caused because of less then 100% muting, or because of RF rectification in the receiver audio amplifier. Although this condition may be completely unnoticeable in a speaker, when connected to the phone patch, and with the added gain of the speech processor, a feed-back condition can result.

This feedback condition can be eliminated in one of two ways. In most cases using the phone patch without processing will eliminate the condition. The SP75 input switching can still be used to select the phone patch but the SP75 ON/OFF switch can be left in the OFF condition.

If processing is desired for phone patch operation, the muting of the transceiver must be improved. This can be done without modification to the transceiver itself by adding an additional relay to break the audio output (speaker) line. The relay can be controlled from the linear amplifier contact of the transceiver as shown in the schematic below.

PS-7 SHUTDOWN AND THE SP-75

http://www.dproducts.be/DRAKE_MUSEUM/ps-7_sp-75.htm



The PS-7 Power Supply may be susceptible to RF entering through the accessory 13.6 VDC phono jack in some station installations where this jack is used, such as when the SP-75 is plugged into this jack. It will cause the PS-7 protection circuit to activate, shutting down the power supply, or create power supply oscillations.

To eliminate this, a .01 MFD / 600 V disc capacitor should be added from the tip of the 13.6 VDC accessory jack to ground.

The later PS-7 power supply mounts the 13.6 VDC accessory jack into a printed circuit board. Since the board blocks access to the jack's ground lug, the ground lead of this .01 MFD disc capacitor should be connected to the ground foil of the circuit board. A small amount of spaghetti insulation should be used on the capacitor leads to prevent possible shorts.

Installing the X-Lock into the Drake TR-7

http://www.cumbriadesigns.co.uk/x-lock-TR7.htm

By Ron Wagner WD8SBB

Introduction

The free running VFO's in old or vintage rigs are subject to frequency drift due to temperature variations. Whilst the Drake TR-7 Permeability Tuned Oscillator (PTO) is generally very stable for an LC circuit, it still drifts several hundred hertz during a two hour net. To cure this drift, many have successfully used (SK) PAØKSB's Huff and Puff VFO stabilizer in the TR-7. Carel Mulder PA0CMU, has produced a very documented section on his website describing his experiences in doing this.

The Cumbria Designs X-Lock VFO Stabilizer kit is an improved version of the Huff and Puff stabilizer which instead of using discrete logic, employs a microprocessor to detect and correct drift. This compact 35 × 60 mm kit is supplied complete with all components, sockets, pin header connectors, PIC processor and a double-sided PCB. This relatively inexpensive and professional design dramatically improves stability of the TR-7 and also detects and "understands" RIT changes, something that other Huff and Puff circuits do not.

Below is my description of of how I installed the X-Lock into my Drake TR-7.

Modifications

The X-Lock generates a control voltage for tuning the VFO by means of a varicap diode. A power diode (1N4004) and several other parts are provided with the kit to build a varicap "correction" tuning circuit but I decided instead to use the existing RIT line in the TR-7. To do this I had to combine the X-Lock control voltage and the RIT voltage, I used a circuit designed by Joe KC9LAD which with only three resistors and one signal diode, does the job nicely!

The diagram in **Fig.1** below shows the additional diode and resistor network together with the interconnections for the X-Lock output and the voltage from the RIT control point on the main board.

Joe also suggested that it would help with physical installation if I were to exchange the 6 electrolytic capacitors for titaniums which are much smaller for the same electrical specification. Although I did not do this, it would be a desirable modification for installations where space is at a premium.

The clearance above my chosen mounting point for the X-Lock would have prevented me from using the straight pin headers supplied with the kit and their associated plugs. After quite a bit of analysis, I determined that I could keep the plugs provided that I installed the pin headers at 90 degrees, as shown in **Fig.2**. By carefully bending the solder side of the pin headers down 90 degrees, the pins would still be inside the PCB mounting holes a little over half way. As the PCB has high quality plated through holes, I could solder the top side and then flow the remainder of the hole with solder from the bottom. Since there is not a lot of ongoing pressure on the pin headers, this modification should last the life of the devices. NOTE: Be sure to bend the pin header pins so that the tab for the plug is downwards (against the PCB).

The assembly sequence of the board components should be altered slightly due to the modification for the pin headers. To avoid having difficulty with other components being in the way, install and solder the modified pin headers first. Remember to solder from the top first, and then flow solder the bottom. After this, follow the instructions as supplied.

The assembled X-Lock board is mounted on the bottom of the TR-7 main board. As mentioned, more space could be made available by replacing the 6 electrolytic capacitors with tantalums, but it is not an absolute necessity. All interconnects are close and easily accessible on the bottom of the TR-7 main board.

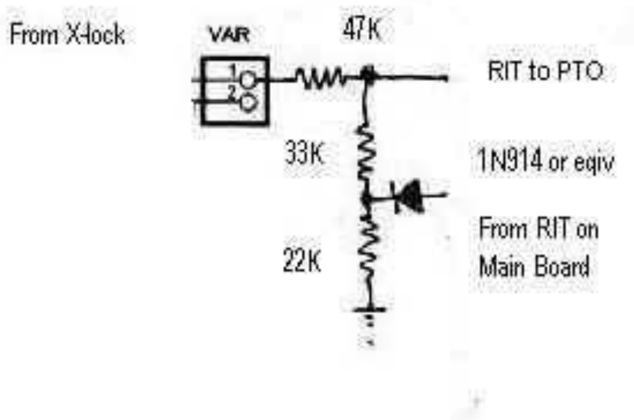
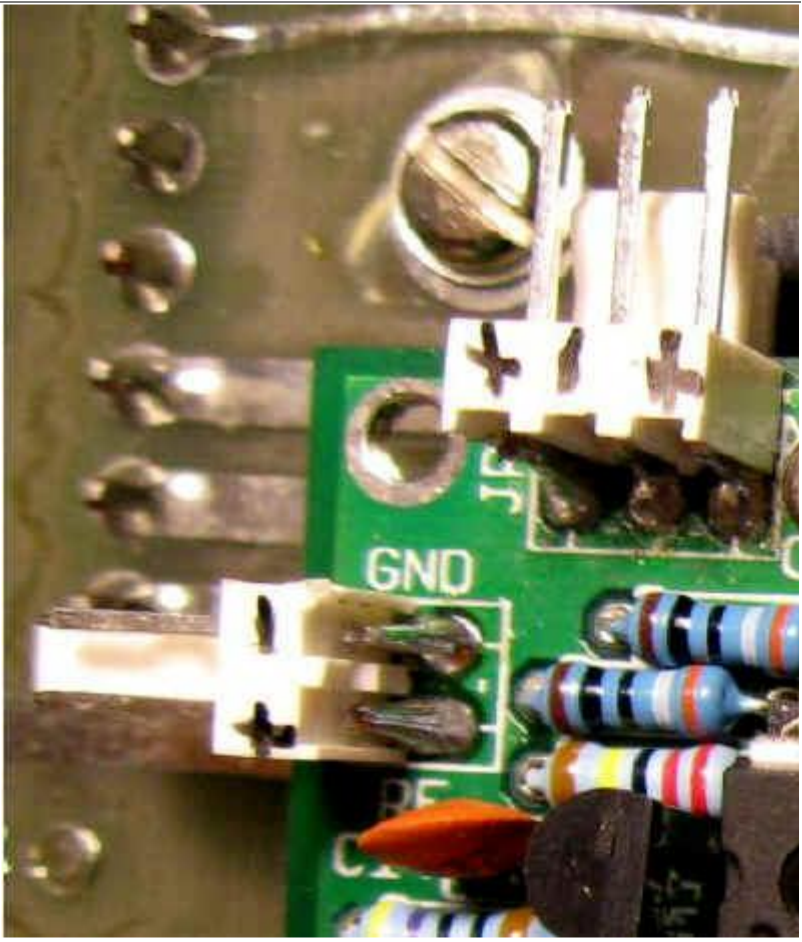


Fig.1 Diode/resistor network

The resistors carry virtually no current and can be miniature 1/8 watt.

Fig.2 (Right) Pin Header installation. The headers are mounted at 90 degrees to provide clearance for the plugs and wiring.



Installing the X-Lock

Space is somewhat tight inside the Drake TR-7 transceiver. I decided that the best approach would be to install x-lock on the bottom of the main board as shown in **Fig.3**. I used double sided foam tape, and used black electrical tape over the main board's protruding pins for added safety. A picture of the service manual with various points of interest circled in red is show in **Fig.4**. (Click on the images to enlarge).

Take a close look at the pictures, schematics and comments. These should provide you with enough information to install the X-Lock into your Drake TR-7 with minimal effort.

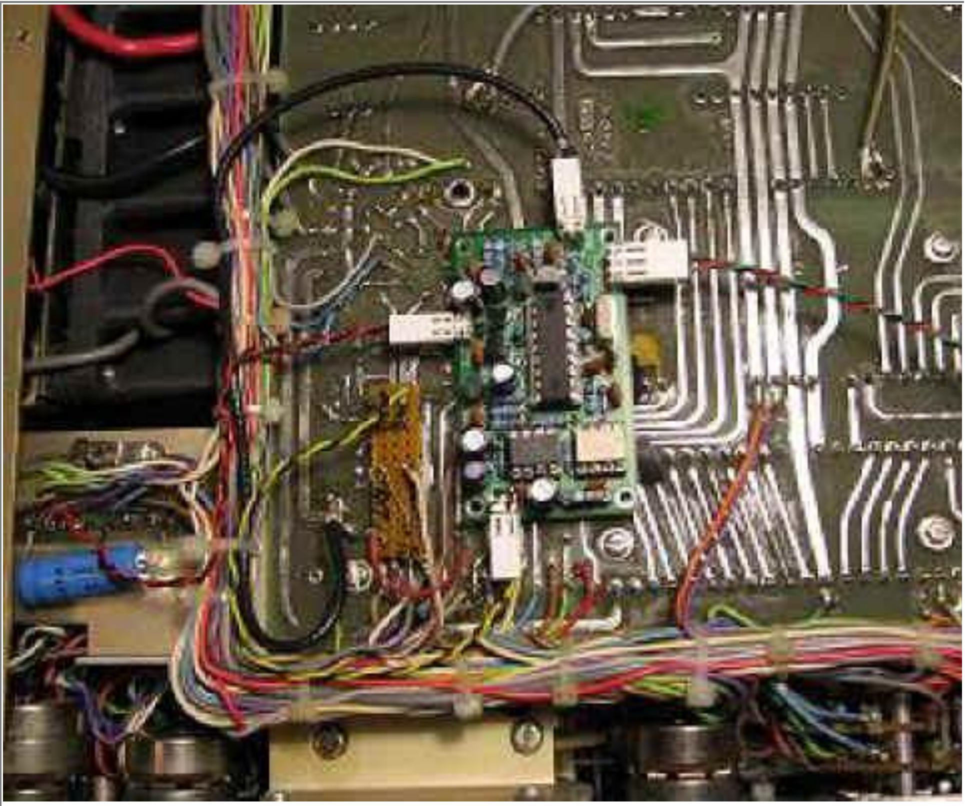


Fig.3 Installed X-Lock. In this picture, the red jumper wire to the resistor-diode network is RIT from main board, brown/white wire is RIT to PTO.

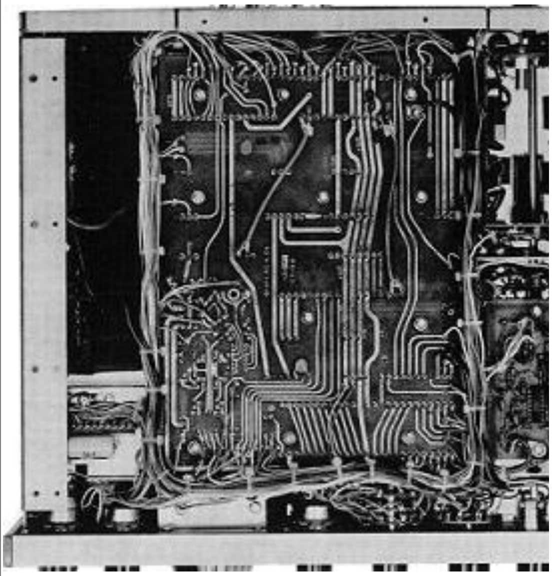


Fig.4 Service manual. Click for larger image.

General Comments

Status LED If you wish, the tri-color LED can be mounted so that it shows through the fixed "window" on the front of the transceiver, to the right of the meter.

Power I opted to get power from the power supply board. The board also has the bandpass controls on its top side. It is to the left of the main board in the pictures. Pin 3 from the right is ground, pin 9 is the +13.6VDC rail.

Assembly Time If you assemble the board with care, the X-Lock should work at power up. Mine took about 10 hours to assemble and install, and worked first try.

Conclusions

The X-Lock is an easily applied "add-on" module. It's ability to detect and respond to the rapid frequency changes during transmit and receive transitions to support RIT operation, is an invaluable feature. It does exactly what is advertised, and my Drake TR-7 now behaves like it has the optional RV75 synthesized external VFO installed. I am very enthusiastic about the X-Lock kit and recommend Cumbria Designs.

73,
Ron WD8SBB

Eliminating TR7 Key Clicks

http://www.k8ac.net/KeyClicks.html

Back in November of 2006, I fired up my freshly restored TR7 on CW and decided to check it for key clicks by listening on my Icom 781 to see how far from the operating frequency I could hear clicks. I was surprised to find quite prominent clicks that were audible 6 Khz to either side of the TR7 frequency. Just to be sure that it wasn't due to the proximity of the 781, I listened to the 781 on the TR7 and found very minor clicks that were barely audible a kHz or so away. In both cases, the transceiver used for listening had no antenna connected and when tuned to the 100 watt signal, the S-meter read around S9 + 20 dB. Clearly, there was a problem in the TR7.

I put the TR7 on the workbench and keyed it around 40 WPM into a dummy load, watching the resultant waveform on my scope. The rise time of the waveform was very steep zero to full power in about 1 millisecond and exhibited quite a bit of overshoot in the first couple of milliseconds. Following the overshoot, the output was constant for the rest of the waveform. No surprise that this waveform produced such prominent clicks. The cause of the clicks was eventually traced to two problems on the 2nd IF/Audio board (this is the board in the rear slot of the TR7, adjacent to the rear center panel). I verified that the problems existed on three different 2nd IF/Audio boards that I have here and the problem existed in both my TR7s using any of the three boards. Fortunately, the fixes can be accomplished by anyone who has a service manual and the necessary resistor and capacitor.

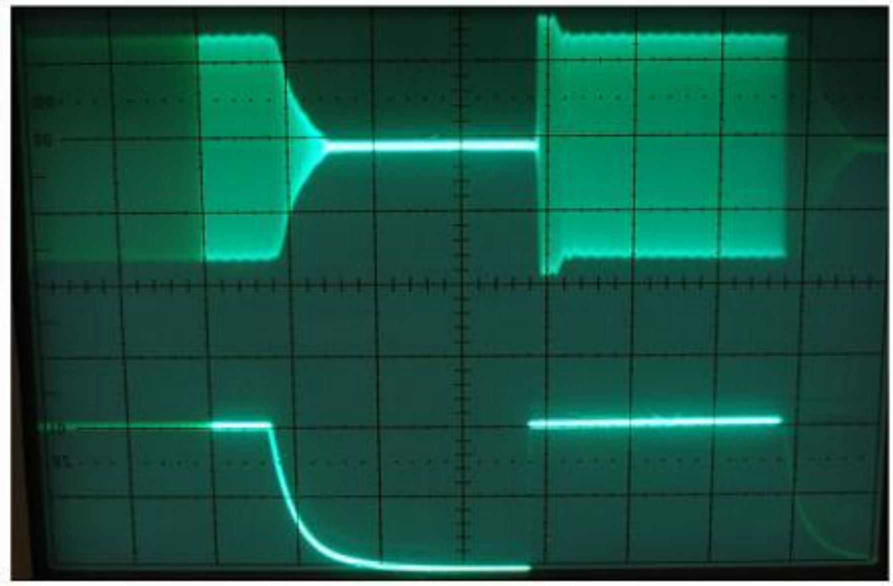


***Figure 1**: This photo shows the output waveform while sending a series of high speed dots. The upper trace is the output sampled at the dummy load and shows the leading peak area and the near vertical rise time. The horizontal scale is 10 ms. per major division. So, the tail decay time is about 7 ms. The lower trace is the key line sampled on channel B at terminal 11/7 where the keying line enters the 2nd IF/Audio board. The vertical scale is 5 volts per major division. You can see the slight delay after the key closes and before the output starts (less than a millisecond). This signal exhibited key clicks that could be heard several kHz away from the carrier frequency.*

Here's the story of the two solutions:

1. Maladjustment of T1101 on the 2nd IF/Audio board

This is a strange one, and I stumbled across it after receiving substantial technical guidance from Garey, K4OAH. T1101 is in the signal path on both receive and transmit and the alignment of this transformer is done in receive mode, peaking the single core while watching the calibrator signal on the S meter. If this adjustment is done perfectly, the overshoot disappears from the keyed waveform. But, if it's just a slight bit off in either direction, the overshoot is there. You can adjust T1101 while transmitting and watching the keyed waveform to see the effects. I'll leave it to the engineers in the audience to explain exactly why this happens, but since all three of my 2nd IF/Audio cards (all Version 2 cards) behave the same way, I'll bet that many of the TR7s in use today will exhibit the same overshoot problem

Unfortunately, after getting rid of the overshoot I still had a very sharp rise time of .5 to .6 ms. A couple of other TR7 owners told me that they measured a rise and fall time of 2.5 ms on the keying envelope but I don't know what version of the board they had nor do I know if any anti-click work had previously been done on those TR7s. Various ARRL sources say that somewhere around 5 to 5.5 ms for rise and fall is ideal, so even the 2.5 ms times might result in noticeable clicks. More work to be done!

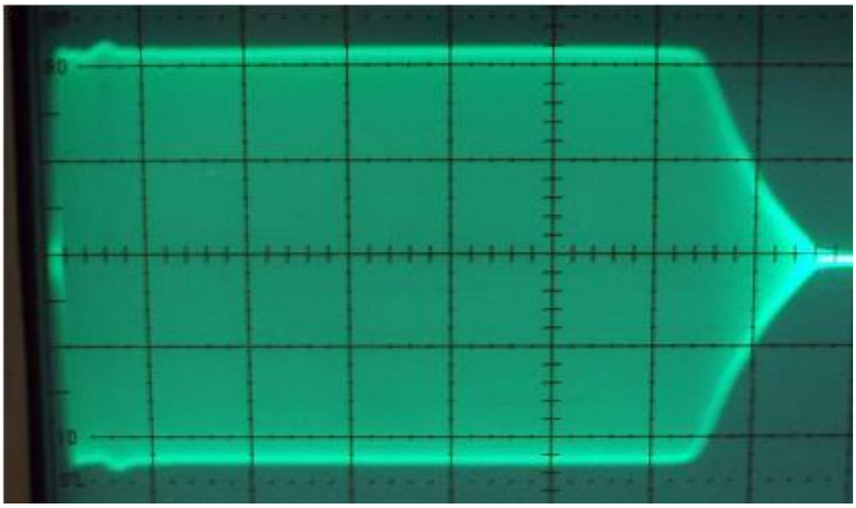


Figure 2: *After T1101 was properly adjusted, the leading edge overshoot was gone, but the sharp risetime remained along with a slight peaking of the waveform at about the 3 millisecond point. The horizontal scale is 5 milliseconds per major division. The risetime is < 1 millisecond and the tail is about 6 milliseconds.*

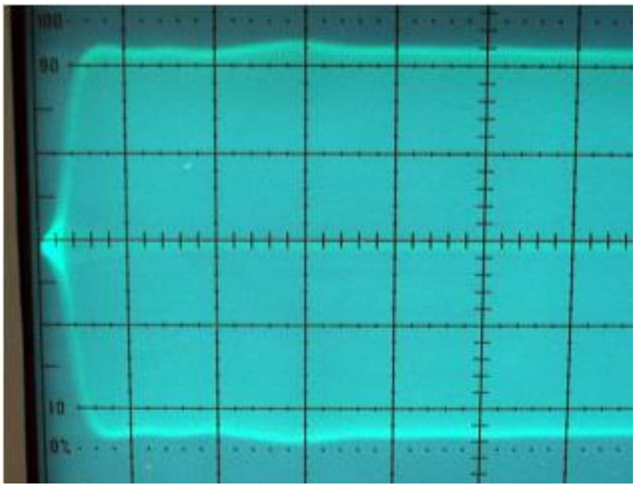


Figure 3: *This photo shows the leading edge of the waveform in more detail. Horizontal scale is 1 millisecond per major division.*

Thanks to the power of the Internet, I discovered that the key click problem had been solved and documented about 20 years ago, but it seemed that no record of the solution remained. The second problem is:

2. Q1103 on the 2nd IF/Audio board is too fast when switching the crystal CW oscillator on.

When I started working on the click problem, I acquired a spare 2nd IF/Audio board (version 2) from Evan, K9SQG, and while the rise time was certainly better on that card, it was still much too fast (around 1 ms). Somehow I got connected to Keith, G3KVW, who told me that he remembered a mod in the keying area from many years ago, done by G3HCT (now VK4OQ). When I finally tracked down John (VK4OQ), he told me that he left the documentation on the mod with a friend in England when he left there many years ago. John contacted his old friend in England who remembered the mod and was able to find the original notes on the subject. Within a few days, I had the information in hand and as you'll see in the photos, the resultant waveform is just about perfect.

Here's the exact information provided by VK4OK:
"On the 2nd IF/Audio board the xtal oscillator Q1110 and its associated buffer Q1109 are keyed by Q1103. The modification is done to Q1103. Add on the back of the board a 15K 1/8 watt resistor between the emitter and base.

Add on the back of the board a .1 ufd disc capacitor between the collector and base.   That is all there is to it but the shape will then be "Text Book"."

The board that I obtained from K9SQG already had a .1 uF disc capacitor in place, but not the 15K resistor. It's unknown whether Drake installed the capacitor on some TR7s when they were in for service.

Here's what happened to the waveform when I installed the resistor and a .17 uF capacitor on my original board:

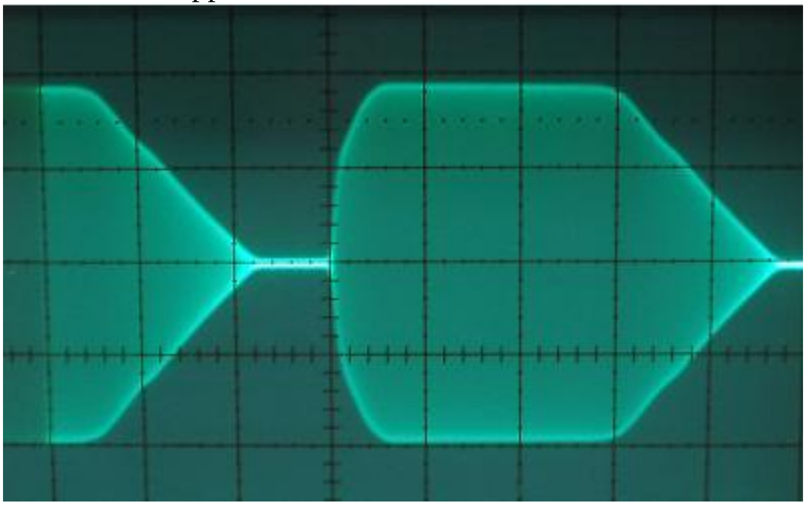


Figure 4: *The risetime looks better and is now around 3 milliseconds, but the tail has stretched out to around 8 milliseconds. This signal sounded better and the key click sidebands were noticeable less, but still considerably worse than my Icom 781.*

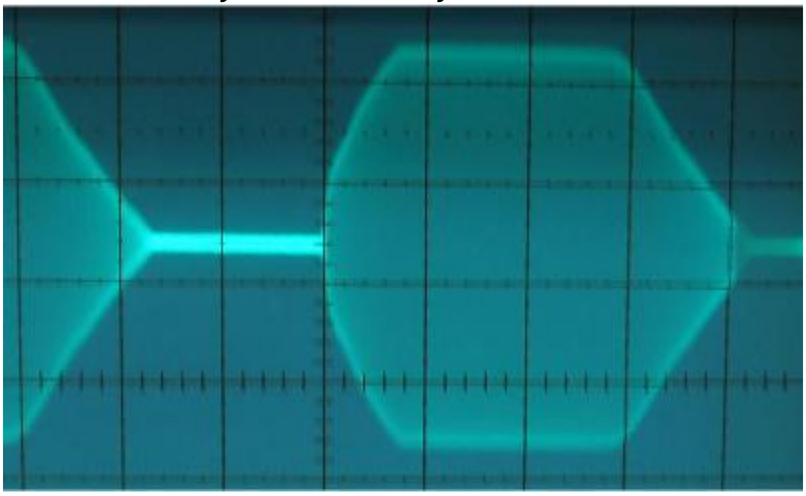


Figure 5: *Here's the dot waveform with a .22 uF capacitor between the base and collector of Q1103 and a 15K resistor between the base and emitter. The risetime has increased to around 4 ms.*

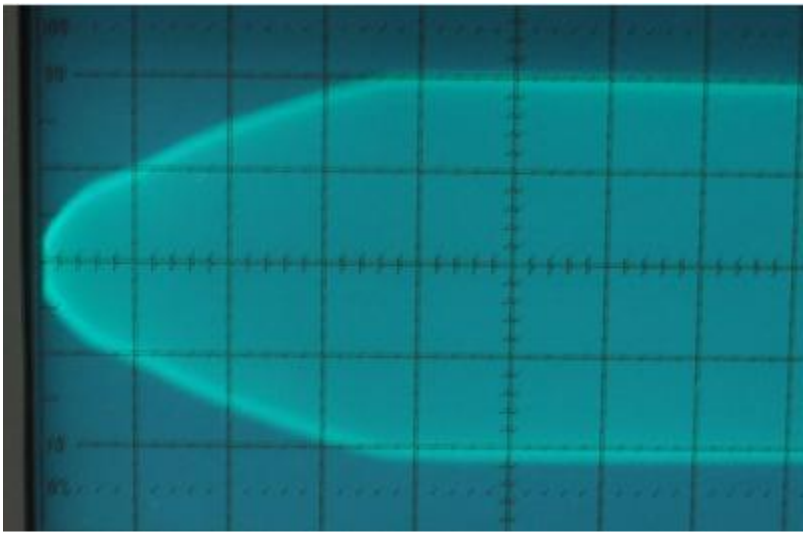


Figure 6: *Here is a closeup of the leading edge of a dot. Horizontal scale is 1 ms. per major division and a bit of the leading edge of the envelope was truncated do to syncing difficulties. The overall rise time here*

is just over 4 ms. The key clicks observed were now substantially reduced and the resultant bandwidth was only slightly wider than produced by my Icom 781.

The same value of added capacitor produced a slightly different rise time on the three different boards. On the last board I worked on, a .1 uF cap resulted in a rise time of 2.5 ms., a .22 uF cap produced 7 ms. And .15 uF cap produced 5 ms. Anything around 4-5 ms. Sounds very good.

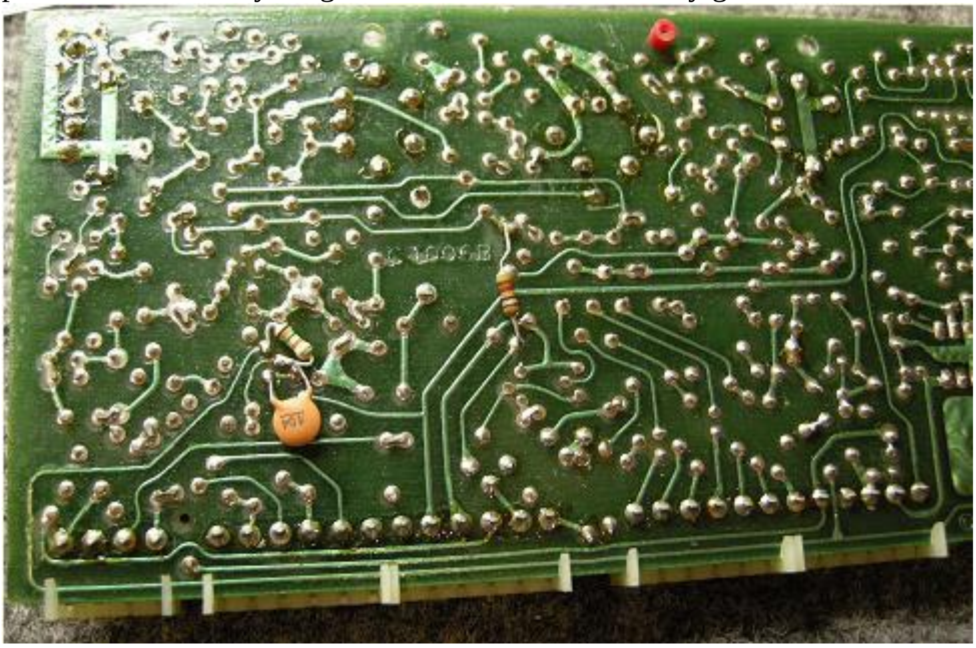


Figure 7: *Here you can see the resistor and capacitor added to the back of the 2nd IF/Audio board.*

Figure 8: *Closeup of the added components*

If you have an oscilloscope, you can easily tune the rise time to whatever you choose by playing with the capacitor value. If not, you can start with a .1 uF capacitor and add another in parallel and compare the reduction in key clicks while listening on a separate receiver. The land patterns for Q1103 are such that another capacitor can be added in parallel without having to solder to the same pins used for the first capacitor.

Many thanks to K4OAH for his technical expertise, K9SQG for the second board, G3VKW for remembering the original mod, VK4OQ for the original mod and his work in tracking down the original notes, and the unknown ham in England who hung on to the documentation for over 20 years!

Floyd Sense - K8AC
Angier, North Carolina
August 7, 2008

Drake 7-line modifications

http://www.homer.se/radio/mod7.php

1:st mixer

The first mixer-board is based on a high level double balanced diode mixer, named CM-1HF (do they mean CM-H4?) from Vari-L. This mixer is no longer available from Vari-L. The mixer is fed by a +13 dBm LO-signal so a Level-13 mixer from Mini-Circuits would work as a replacement. SRA-3MH seems to be the best match covering 0.025-200 MHz and handling up to +9 dBm RF in with a +13 dBm LO in.

This stage in the receiver could be improved by exchanging the original mixer, CM-1HF, with a mixer capable of even higher LO injection. The gain by doing this is better strong signal handling, and a better intercept point, IP3. The down side is that we need a higher LO level, this could be hard to achieve and/or create problems due to LO leakage.

For a LO injection level of +17 dBm Mini-Circuits have SRA-1H (RF: 0.5-500MHz), and SRA-3H (RF: 0.05-200 MHz), that can handle up to +10 dBm RF in. For even better RF-handling we have TAK-3H, covering 0.05-300 MHz and handling up to +14 dBm RF.

If one wants to go even further up in LO injection, Mini-Circuits have Level-23 mixers with +23 dBm LO-injection. For the Drake's RAY-6U seem to be good pick with an RF input of 0.01-100 MHz with a RF capability of up to +15 dBm. If one skip the first 100 kHz of the HF spectrum one could choose the SAY-1 mixer that can handle up to +20 dBm RF between 0.1 and 500 MHz.

The highest level Mini-Circuits got is Level-27. Here we only have VAY-1 that covers 0.5-500 MHz RF, and handles up to +24 dBm RF in.

Name	1 dB comp. (dBm)	LO level (dBm)	RF frequency (MHz)
CM-1HF	?	+13	?
SRA3-MH	+9	+13	0.025 - 200
SRA-1H	+10	+17	0.5 - 500
SRA-3H	+10	+17	0.05 - 200
TAK-3H	+14	+17	0.05 - 300
RAY-6U	+15	+23	0.01 - 100
SAY-1	+20	+23	0.1 - 500
VAY-1	+24	+27	0.5 - 500

Some data on different Vari-L mixers:

Vari-L CM-1
http://homer.se/radio/drake/varil_1.png
http://homer.se/radio/drake/varil_2.png
Vari-L CM-1H4
http://homer.se/radio/drake/varil_3.png
http://homer.se/radio/drake/varil_4.png
Vari-L CM-1H8
http://homer.se/radio/drake/varil_5.png
http://homer.se/radio/drake/varil_6.png

2:nd mixer

The second mixer consist of four 1N4148 diodes and four 15 ohms resistors (earlier TR7's had eight 1N4148.)

The improvement possible here is to replace the 1N4148 diodes with better ones. One alternative is a quad matched sets of 1N5711 hot carrier diodes (Tip from Usenet newsgroup rec.hamradio.homebrew) These diodes also goes under the name HP5082-2800, and a quad matched set of these are called HP5082-2805 (according to the HP 1N5711 Technical Data sheet.)

In a Drake TR7 I owned earlier I replaced the diodes and resistors with a HP5082-2830 Schottky diode ring mixer with good results (the receiver sounded quieter, but I did not do any measurements.) This ring mixer is no longer available from Agilent (Hewlett-Packard.)

Translator board

The 1N4148 based mixer here could be improved with an exchange to 1N5711 diodes.

Local oscillator phase noise

The Drake 7-line have at least one problem that degrades its performance. It has a rather bad phase noise of 116 dBc at 10 kHz spacing for the Drake TR7, and 114 dBc at 10 kHz spacing for the Drake R7. Take a look at Sherwood Engineerings Receiver test Data at http://www.sherweng.com/table.html

Exactly how to improve this is hard to tell, one has to analyze the circuitry used and see where they have cut corners, and then improve these corners.

There exist one important factor that might influence the phase noise of the Drake's, and that is the purity of the voltages feeding the VCO's. This is probably the point where I will do my first tests to improve the phase noise characteristics.

Another alternative is to do a complete redesign of the LO circuitry, and perhaps all other oscillators, and in the process make the Drake's steerable from a computer. Drake purist might think that this is wrong, but the technology have evolved since Drake designed the 7-line, and new technology might give us top performance, so why not use it?

AF-circuit

Ulrich Graf, DK4SX, have changed some parts in the AF-circuit to get a wider frequency response. I have not tested this myself yet. This is his message as sent to the drakelist mailing list (http://www.zerobeat.net/drakelist/drakefaq.html)

From: Graf Ulrich ICM MP UC RD IT ULM 2

To: "Drakelist Mail (E-mail)"

Subject: [drakelist] TR-7 AF-Mods

Date: Tue, 23 Sep 2003 09:10:00 +0200

Hi John, hello Twan,

these are the parts I modified to get a somewhat wider frequency response of

the audio path in my new TR-7 project (part# / new value):

C1150 / 0.47 uF

C1152 / 0.1 uF

C1155 / 100 uF

C1159 / 1000 uF

Part numbers correspond to the schematic of MC1496 version of 2nd IF/Audio

board.

C1116 should be 0.005 uF. On my board it was supplied with 0.05 uF. Audio was

rather dull. I inserted a 0.005 uF capacitor instead and added a 1k resistor

in series with C1170.

73 Uli, DK4SX

Another kind of modification made by Rob Schenck, K2CU and relayed to the Premium-RX mailing list.

From: Carcia, Frank A. HS

Date: 10/15/03 02:04 em

Subject: [Premium-Rx] FW: Changes to extend the bottom response of the TR-7

Hi All,

Enclosed the changes to improve TR7 audio from my friend Rob Schenck, K2CU

> Subject: Changes to extend the bottom response of the TR-7

>

> HI Frank,

> > Here are the components and their new values. They all have an impact,

> some more than others. The only part that is at all tricky is the 1000 uF

> that replaces the 250 uF output coupling cap from the LM 380. You need

> compact size part for it. I have some if you need one or more. I will be

> doing some more work to make the top end drop off more quickly than it

> does presently. I am also going to come up with a compact daughter board

> to add an autodyne detector for AM. I have found that you need to side

> tune the radio to optimize the use of the 4 KHz AM filter. When you do so,

> you end up with one sideband plus the carrier, as in A3H, and the extra

> distortion from the simple diode detector. It may be possible to use the

> existing 1496 by using electronic switching to replace the BFO with the IF

> signal and self detect that way. A3H is best detected with either a true

> squaring circuit, or a synchronous detector. Well, anyway, here is the

> list:

>

> Changes to extend TR-7 audio output response down to 35 Hz. top end stays

> at 2.6 KHz.

> All capacitors located on IF/detector/audio output board.

>

>

> C1159 1000uF

> C1153 100uF

> C1155 100uF

> C1152 0.1 uF

> C1150 0.47uF

> C1146 10uF

> C1170 10uF

>

> ras