Micor transmitter Supplement

By Karl Shoemaker

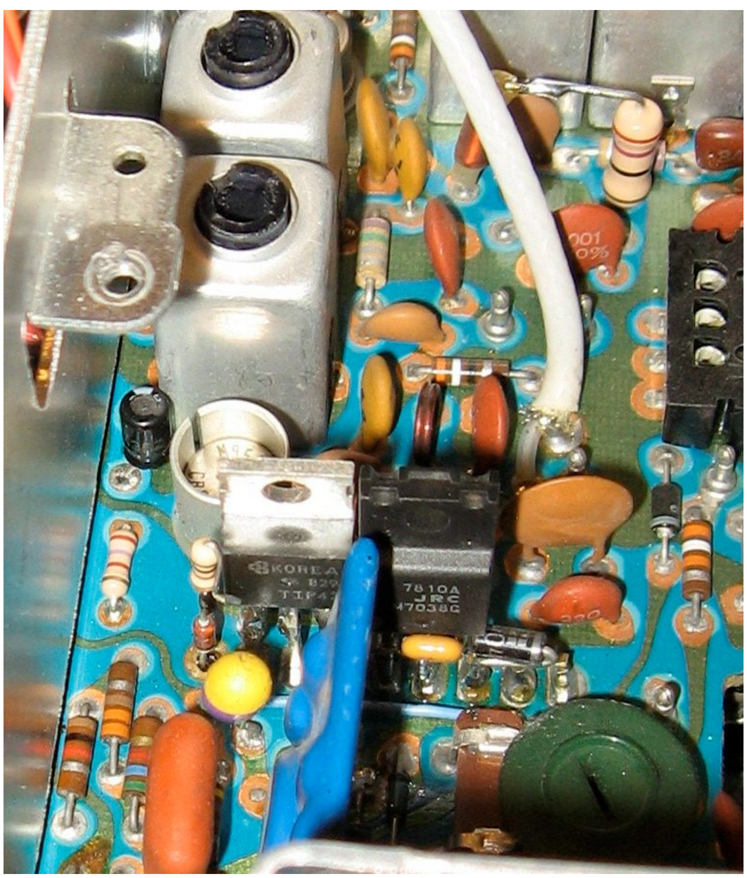
K7SRG

Introduction:

This document is written to include interested people in serious construction of a quality product. Its rather technical, however, if you have a basic electronics background with some repeater building experience this should not be an issue. Some of it's dry reading however, you need to spend time on this to better understand advanced circuits, later on. Understanding schematic drawings is required. If you are new at the repeater operation you might want to seek experienced help. Allow plenty of time to construct each radio, especially the first one. No free technical support is available however, some printed documents are available on an occasional bases, for a modest cost for P & H. The project is designed for amateur radio (not commercial) and is open for discussing, changes and improvements without notice. Should you feel qualified you are welcome to deviate from the Author's design. Images in this document may be used to illustrate a point only and may have been taken at different stages of research and development therefore, may not show the end "product" in some cases.

Overview:

Motorola made a "Micor" series of radios; both base station and mobile. This document is supplement to the repeater project found on SRG's web site. It contains additional details and notes for the construction of that project. Keep in mind this is a mobile transmitter converted to a high duty cycle therefore, some special considerations will be necessary for repeater operation success.



More details:

The main document mentioned C410 clearance. This picture better illustrates the consideration; the "rail" on the left of the chassis may come in contact with a large capacitor therefore, you would need to move it slightly to the right; with the leads at an angle. Another solution is using a smaller size cap so it clears. The picture here shows both options are done.

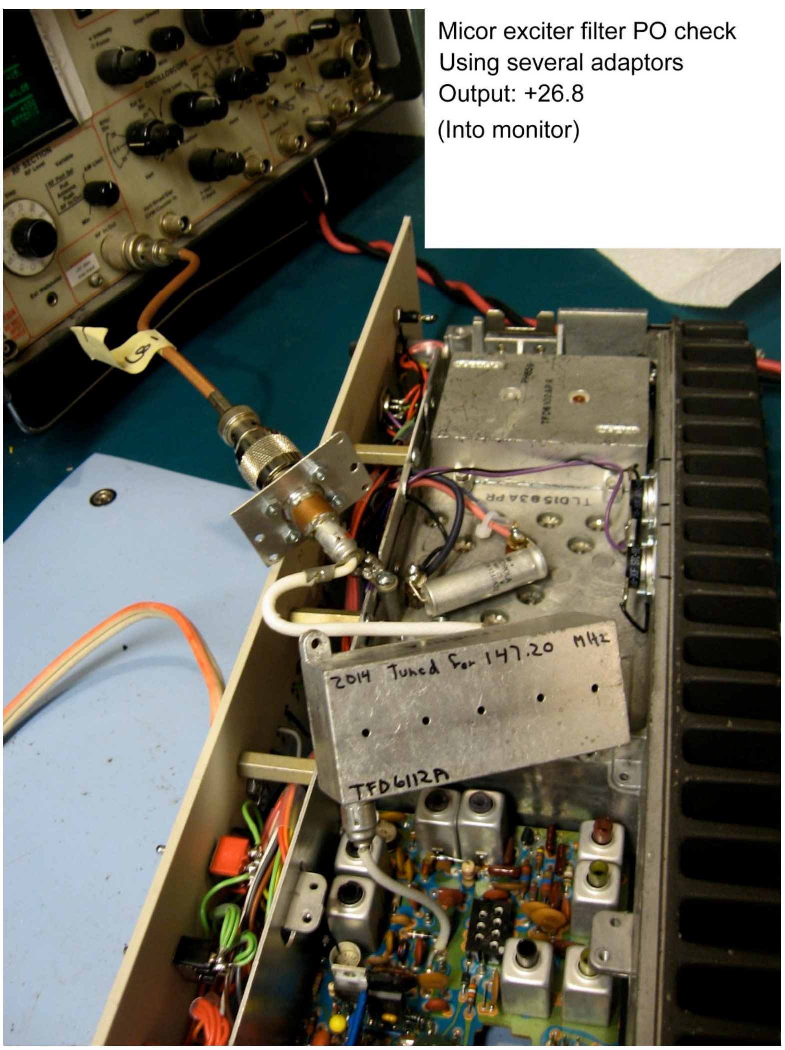
Exciter board:

This board was covered in the main transmitter document however, the Author felt some more details needed to be covered. To recap, this exciter is rated at a +26dbm output however, typically can be tuned for a maximum of around a +28 with most boards. While this is fine to drive the PA unit, the second to the last transistor in the exciter board (Q405) can get too hot and fail. One solution is installing a 27-ohm (2-watt) resistor in series with the Q405's supply line. You will need to check the tuning of this area before proceeding to the next step. You may loose about 1 /4 db with enough to spare for driving the PA. You also should check the purity of the signal with a spectrum analyzer. Take all this points into consideration when building for repeater service. The Author has found satisfactory results with all these points since 1980.

Z501:

If you are lucky to find an L range mobile 136~150.8) with the TFD6111 filter it will work fine for the amateur 2-band of 144~148 MHz. However, most units from commercial service are the M range of 150.8~162 MHz with the TFD6112x filter and will need retuning for proper operation in the 2-meter band.

After making the cover holes and tuning it (for max output) you can properly check the power out with a service monitor. At this time its suspected the output impedance is something other than the (assumed) 50 ohms however, for this test we are looking for a **<u>relative change</u>** (in db).



Micor exciter filter PO check
Using several adaptors
Output: +26.8
(Into monitor)

The reason the impedance was suspected because after tuning the filter on a (50-ohm) power meter, then connecting it into the PA, further power increase could be realized out of the PA by re-tuning the filter. It's also stressed that the purity of the signal was checked in both cases to confirm this increase in apparent power was on the intended frequency under test, and not additional spurious energy.

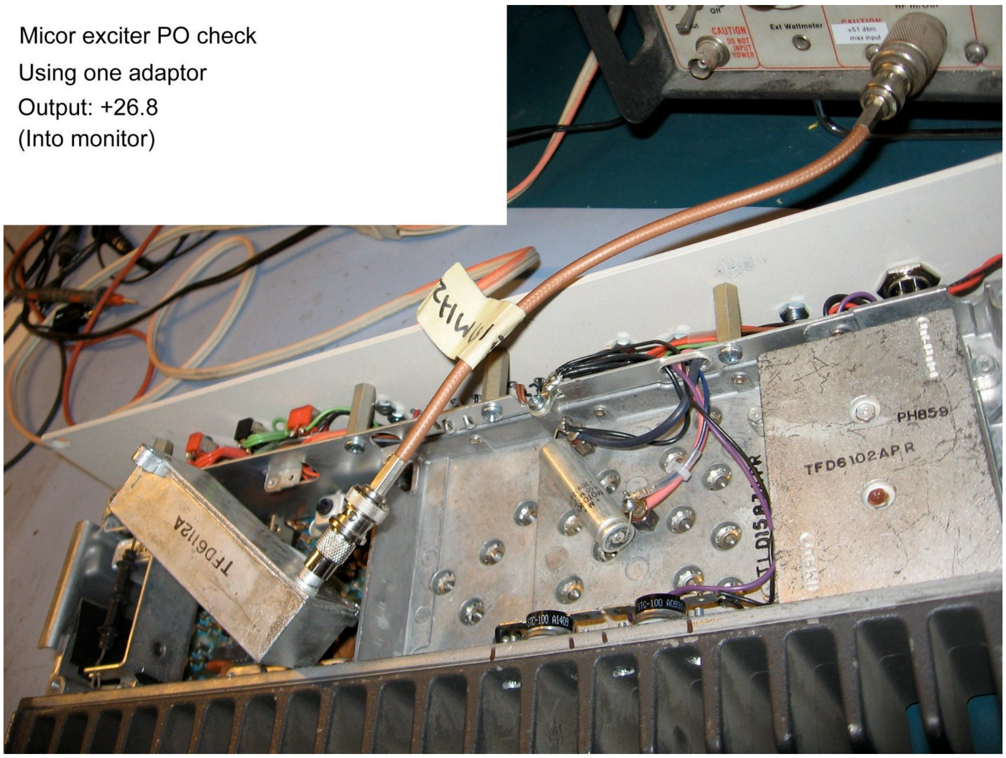
Shown here is what most amateurs might do for this type of test; using what "adapters" found around the shop. They may consist of several adapters as seen here: RCA male to a (home-made) N female adapter, then to a N to BNC adapter, then a jumper cable (RG142B) with BNCs on its ends to finally, the service monitor with its own BNC to N adapter. This seems like a lot of crap in the way however, the losses are minimal and it can be done this way.

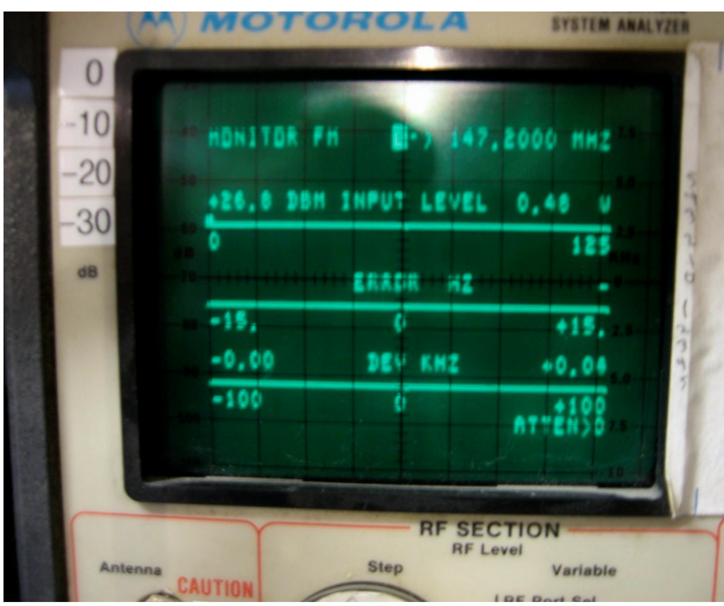
A slightly better way is shown here with the one RCA to BNC adapter plugged into the band pass filter. The test results were:

- Power out of the exciter board was a +27.4 dbm (no filter).
- One adapter; power out of the filter was a +26.8 (about the OEM rating to drive the PA)
- Numerous adapters; power out of the filter was a +26.6 dbm (previous page).

By these figures shows the numerous adapters caused an additional 2/10 of a db loss, while the filter's loss is 6/10 of a db. The Author used a Motorola R2008 monitor for these figures. Apologies for the poor focus on the bottom picture of the service monitor's screen but it's enough to see the reading of +26.8 for the filter's output, keeping in mind the monitor is a 50-ohm load.

Micor exciter PO check
Using one adaptor
Output: +26.8
(Into monitor)

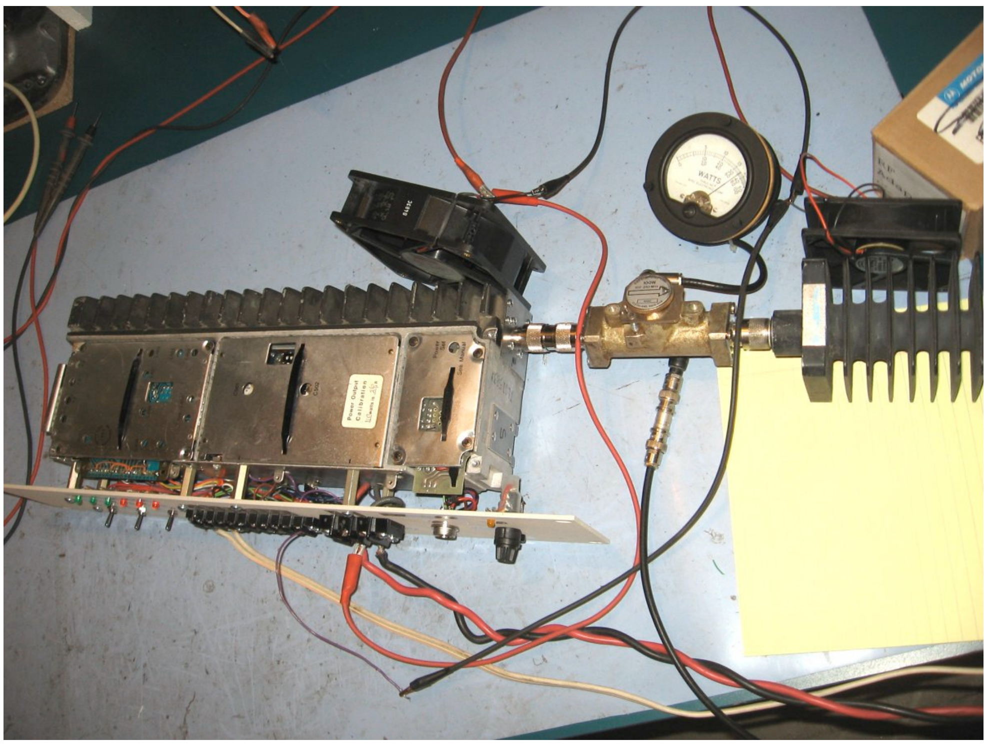




Power out of band pass filter
by Karl Shoemaker 2014

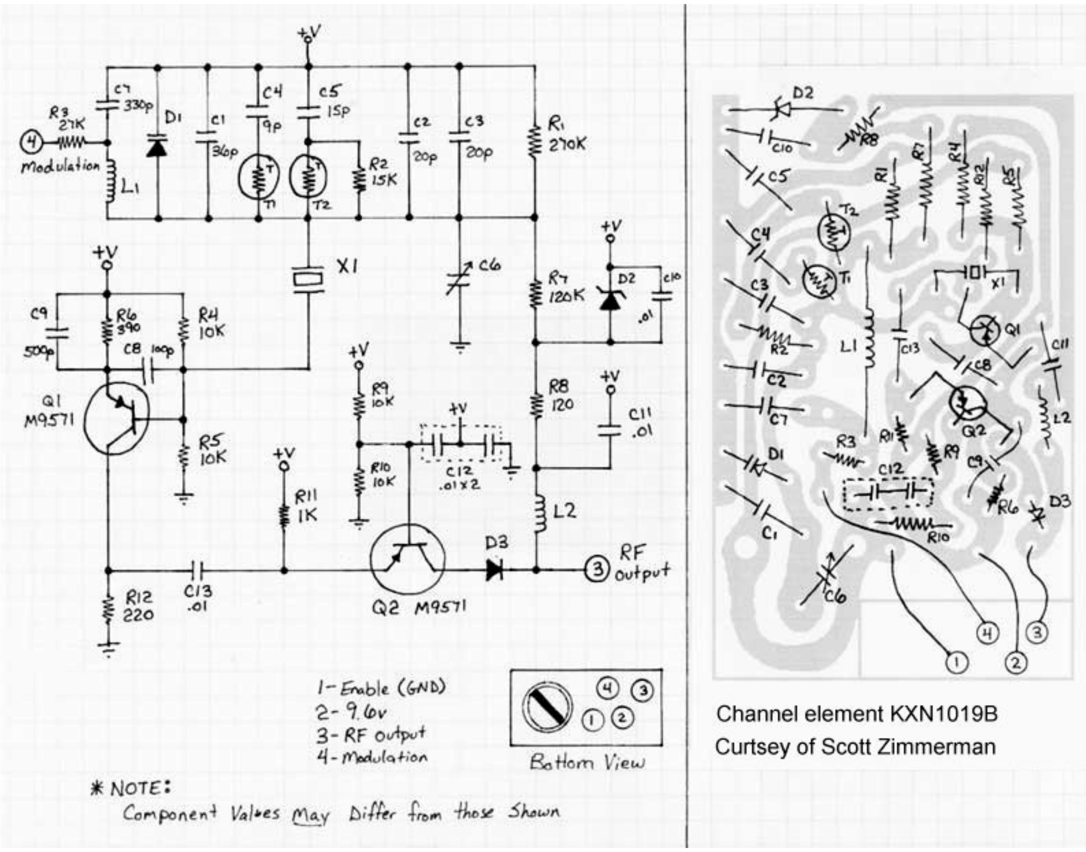
Some theory may be in order from the discussion of the monitor and filter's impedance. In the case of a purely resistive impedance load (no reactance) if you generate a (AC/RF) signal into a meter that's properly terminated at the same impedance you will get an accurate measurement. If you remove the load (high impedance) the meter reading will increase about 6-½ db. Or, if you add a second load to the meter (double terminating) the reading will decrease about 3 1/2 db. This is a simple test for your equipment and setup. This is a common issue with some technicians that are in the learning stage of signal measurement found in the telecommunication industry, especially in the analog microwave and telephone area. When measuring a circuit (in-line) you have to be aware whether to measure in the terminated or bridge mode for example, on a 4-wire telephone leased (audio) line.

When you are finished with the transmitter testing a unit-output power measurement may be in order. Also, it might be a good idea to run the transmitter at the power level you plan to run on the air. While the equipment should be mounted with plenty of free air clearance and a fan cooling unit a preliminary test can be performed on the bench. Here's a quick check for the unit's power out using a thru-line fitting and proper load. The fans are temporarily clip leaded to provide cooling on the bench.

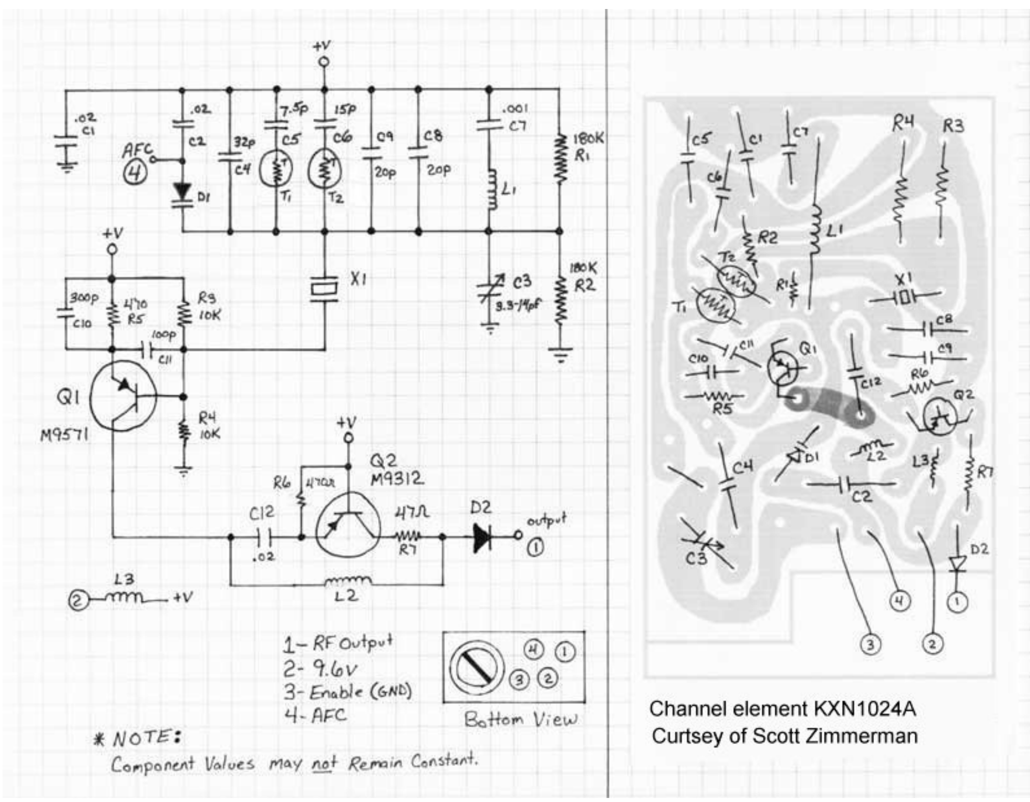


For example SRG stations are set to a +48 dbm (that's about 63 watts for math challenged folks) for transmitter port power output.

The transmitter frequency is controlled by a "channel element" consisting of a (base) crystal plus, an oscillator circuit for that and a buffer/multiplier circuit, too. Normally, you don't need to know what goes on inside the element however, in the case of temperature compensation needed you will. Also, this will give you a better understanding how to properly modulate such element. There's a complete discussion about FM in the main document about the Micor transmitter found on the SRG web site. On the next page are a couple hand-drawn schematics of both the VHF (2-meters) and UHF (70-cm) versions by curtsey of past active Scott Zimmerman.



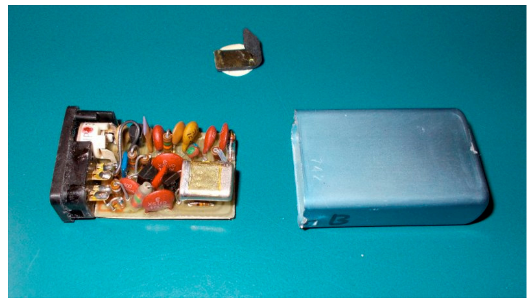
Channel element KXN1019B
Curtsey of Scott Zimmerman



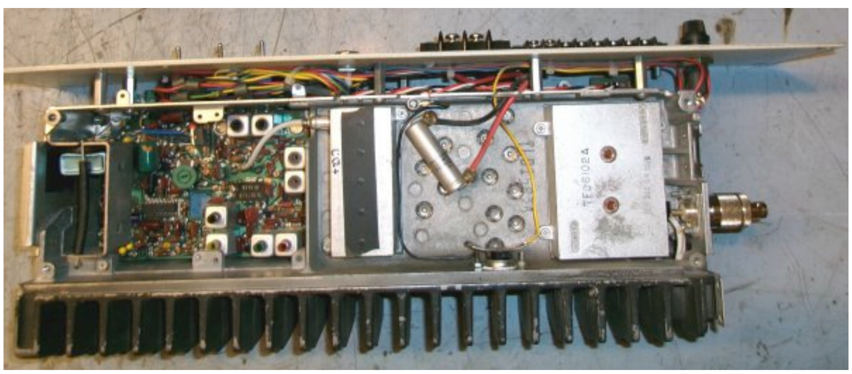
Channel element KXN1024A
Curtsey of Scott Zimmerman

The last point you need to pay close attention to is the type of transmitter channel element. The top image shows the K1007 element. It's a PM (phase modulation) used both in the mobiles and some base stations for decades (1970's and on). The bottom image shows the KXN1019B, which can be also used in the mobiles and bases/repeater station. It has the special feature of being FM (frequency modulation) to the fact it's direct (true) FM for much better low-end frequency response. This is very useful for the OEM (stock) PL/DPL feature used in the mobiles and especially the base/repeater stations. Note the very different size of the crystal can. Obviously this is very important of you are ordering a new crystal for the amateur band, presumably so the appropriate can will fit in the element you chose to use. For SRG only the KXN1019B element is used for the flat response the System is set up for.

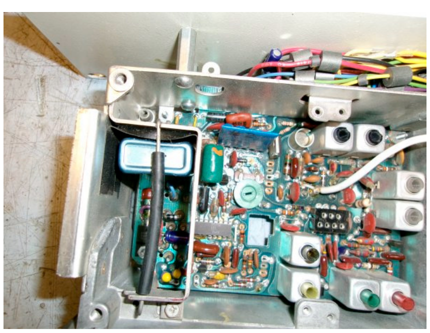
Having said that if you are only interested in a convention amateur repeater the K1007 should be fine. The other advantage of using this the K1007 is much easier to come across.

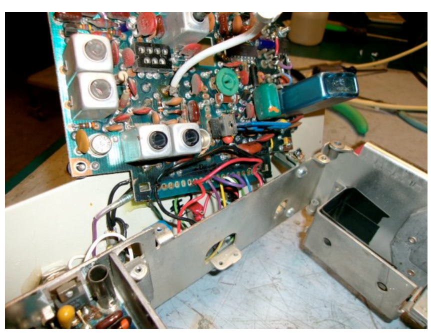


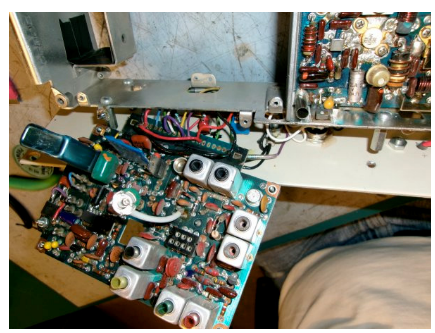
Shown here is the complete unit. From the left is the exciter, a filter, the PA and output filter.



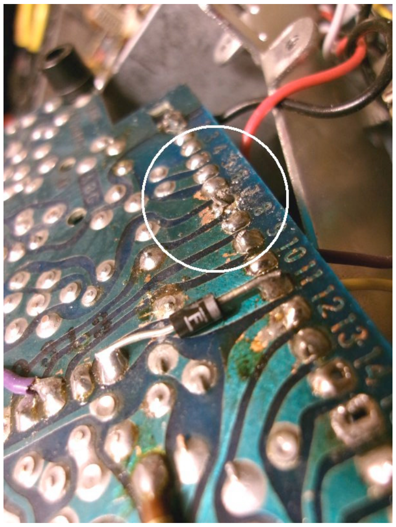
Occasionally, you will need to repair the exciter board. Remove the four board corner screws. Then it can be flipped over for access and replacement of most components as shown here.

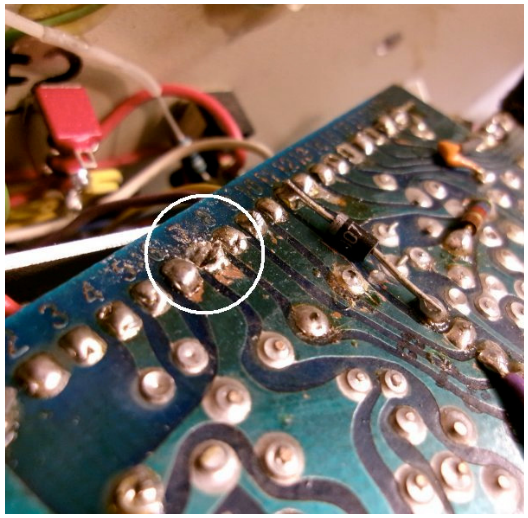






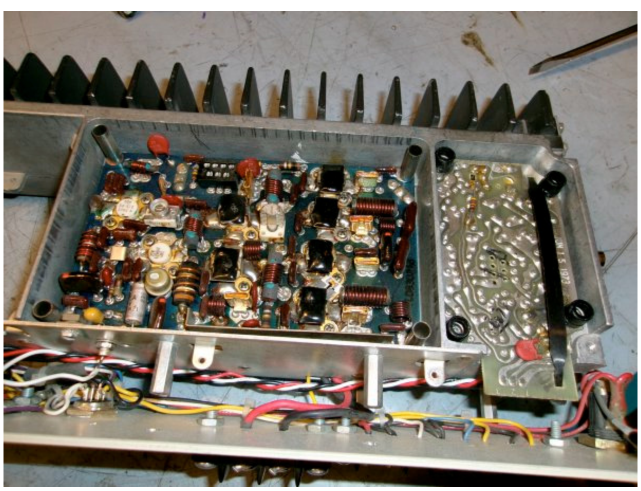
One of the units needed a rewire of the control board. For this an extra ground wire connection was needed. Shown here is two wires sharing the same hole in the PCB. By drilling this hole slightly larger allowed this arraignment.





The micor transmitter comes in either “compa” base type or mobile. For the base there are about two versions; one for intermittent duty and the other for high duty or continuous duty. The mobile is normally used for the SRG remote transmitters. Being a mobile a FCU is necessary to maintain reasonable heat dissipation. For all three types use the same PA transistors therefore, the same PA board including the power control board and it’s operation. The only other significant difference from other brands (such as the GE Mstr-II station) is the PA’s rail is based on ground (A-). It’s floating above ground, even with the SRG modified type. Therefore, one needs to remember that when measuring DC points. The exciter is not that way therefore, is easy to work with.

Shown here is the PA with the control board on the right. The heat sink’s purpose to transfer the heat generated by most of the transistors is enhanced by proper use of compound between it and the transistor’s bottom part.



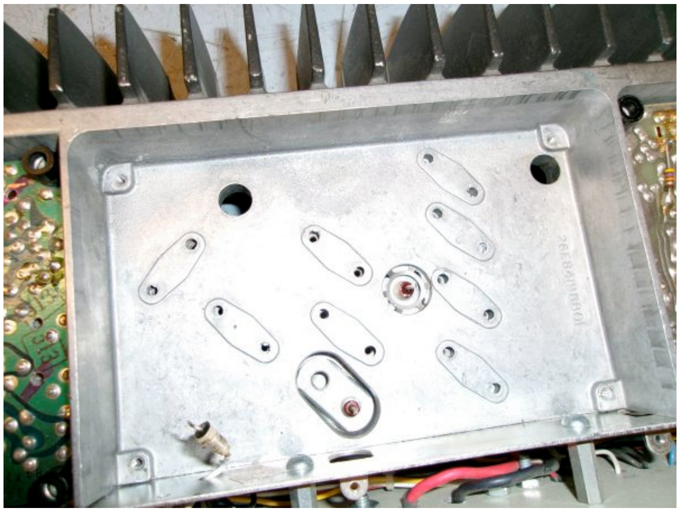
After years of service one or more of the PA section transistor may fail. Since there’s four final transistors in parallel one or two can fail with the transmitter still working but on reduced power out.

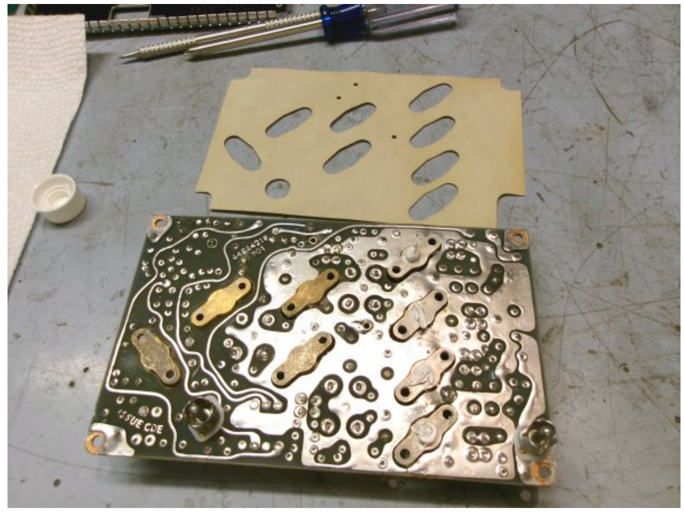
To replace the PA board one needs to remove the board corner screws (and sleeve) plus, the control transistor mounted on the side rail (in the mobile type) and the 16 screws for the 8 transistors.

It’s easier to perform this part last so you can pull up on the board while heating the connections.

Remove both filters first. This will make pulling the PA deck much easier. Heat the two power points with a medium power iron working each point while pulling on the board. The board will flex a little for this purpose.

After removing the board, clean all the surfaces of the old heat sink compound as shown here. Also, clean the excessive solder with a wick on the two power points. Examine the board for any anomalies such as debris, solder bits stuck between pads or any suspicious items observed. A lot of inspection (and finding issues) will save you a long, expensive trip to the remote site for a second repair, later.



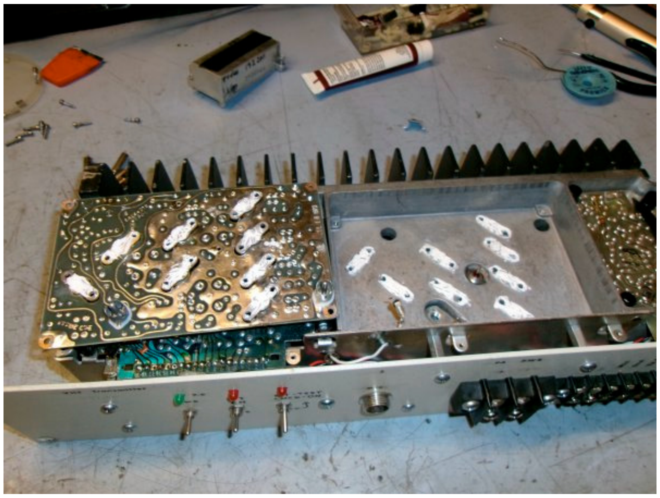


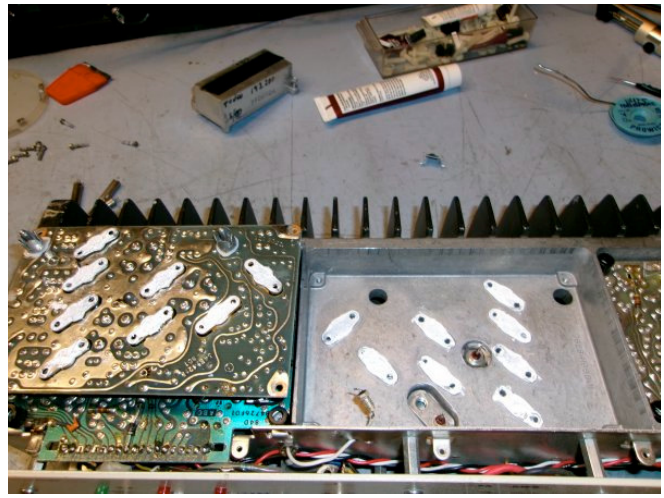
When ready to perform the final installation, remember to put the "paper" membrane (that you should have cleaned as well) back on the sink.

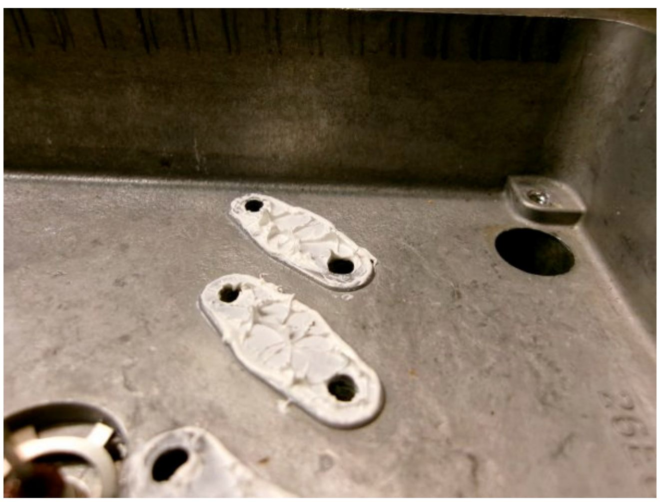
Sometimes the board is warped and/or the transistor bottoms are not "aligned" properly this can cause poor mating with the heat sink. Most of this problem can be cured by "installing" the board temporarily.

By reheating the affected areas will "train" them to level out with better contact to the sink. Shown below is most of the bottom of the transistors are better aligned to mate with the sink "islands". Then remove the board for the new compound install.

Shown here is the new compound applied to all the surfaces in this discussion. It's assumed you have already pulled a good PA deck (board) from a working mobile radio. Clean the transistor bottoms of that one. If you are using alcohol let all surfaces dry before applying new compound on both the sink "islands" and the transistor bottoms. Spread it around each area then wipe clean the excessive compound.





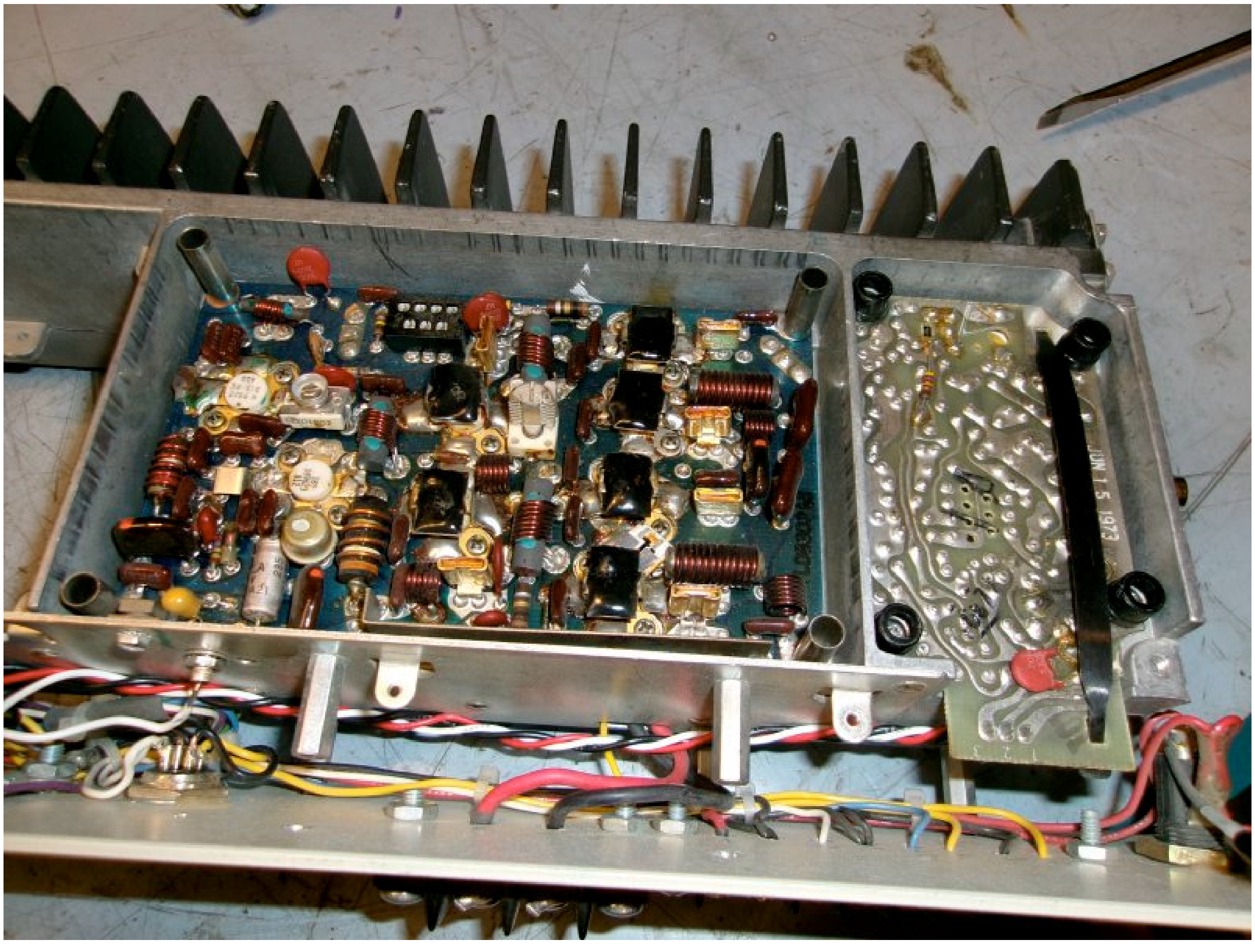


One method the Author performs is to put the replacement board back on the sink and push the board down. Then pull the board back out to confirm there's a good spread of compound on all the heat transfer areas (left image).

When satisfied with the mating of the two surfaces, install the 16 transistor screws but don't tight them as yet. Next install the other 4 board corner screws (and sleeves) the same way. This insures all the holes will freely line up. Next, torque down the transistor screws first, then the board corner ones. The last item is to install the control transistor mounted on the steel rail side, insuring the insulator, rail and transistor back has the proper spread of heat sink compound as well. Install the insulated shoulder washer, line up the mica insulator and moderately tight the screw and square nut (not too tight) enough for proper heat transfer. This is not as heat generating as the four final output RF transistors, however. Those create the most amplification and RF output, thus create a lot of heat during transmit. They run in parallel; if one goes bad the others will continue to function with reduced power out.

Install the two filters and the exciter's RF cable. Perform a last visual inspection of the entire unit prior to applying DC power.   This shows the completed task and ready for transmit testing.

When satisfied, connect the main 12v power and PA 10v power, using a proper rated termination (dummy load) to check the power control board's setting. After you set the desired power level perform a load test. The Author normally runs the transmitter continuous for one to two days in a test jig-rack. During that time the heat transfer function is checked several times by feeling the transistors vers the heat sink. A hot heat sink is one indication the heat transfer is success indicating a proper board replacement.



This may be copied in complete form only for non-profit purposes, such as for the knowledge for the amateur radio service, with AK2O credited as designer. For other arrangements please contact the author.   Copyright: AK2O 2014, with updates June 2020 and June 2023.