My Collins KWM2 By DJ7HS

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My Collins KWM-2

by Ernst F. Schroeder DJ7HS

When I first got my amateur radio license in 1961 it was still AM time. So I built my first transmitter around a Geloso VFO and used a RL12P35 as PA with Geloso pi-network. AM modulation was done by an EL84 via the screen grid.

My elmer and good friend Waldemar, DJ6DK (sk), who taught me how to wind transformers, had started to work on SSB. From somewhere he had obtained a circuit diagram of a real SSB transceiver, a KWM-2 from Collins. So we sat down and analyzed those circuits item by item, until we had memorized that whole diagram and all its functions.

Waldemar then successfully built and used more than one single-band version for 80m with just a single 6146 as PA. This was well before the Heathkit mono-banders became available. I also tried my hands at an 80m SSB transceiver, but before I could really finish it other things became more important.

Therefore I got my first Collins device, namely this KWM-2, not before early 1991.

After I had it restored to good working order I started to look around for bits and pieces that could be added, improved and built, always in order to keep up the operational quality of that Collins transceiver.

Here are separate descriptions of some of the things I did:

- The restauration project
- RIT control
- Stabilizer for PTO supply voltage, both in KWM-2 and 312B-5
- Remove click and bump at the start of a transmission.
  This was first published in ELECTRIC RADIO MAGAZINE #267 August 2011
  Title: "The Collins KWM-2: Curing T/R Switching Transients"
- Zener diode in cathode of relay amplifier V4B
- Collins KWM-2: Installing New Parts for PA Neutralization
- Collins KWM-2: Curing A Strange Problem

My Collins KWM-2 Restauration Project

S/N 10831

by Ernst F. Schroeder DJ7HS

I got my first Collins device, namely this KWM-2, not before early 1991. I bought it from Peter, DJ0JE. He had advertized it in German amateur magazine "cq-dl" and that had arrived shortly after Christmas 1990. There was no time to hesitate, I picked up the phone and the deal was struck. Then in early 1991 I took the car and the xyl and drove about 300 miles on the autobahn from Hannover to Kaiserslautern. I got the KWM-2 with PM-2, Peter got his compensation and we both were happy. And when I left, I spotted a 312B-5 sitting in a corner. Was it ...? No way, its directional coupler was in use for a different station. I had to retreat, but I kept this firmly in mind.

On the way back home I had plenty of time to explain and talk about amateur radio. Must have been quite a good story, as the xyl made up her mind to join the ranks, even with CW. Two years later she passed the exam and got her call sign.

Back at home I carefully unpacked the KWM-2 and PS-2 and put them on the work bench. This was definitely a time before I got to know the Electric Radio magazine, the Collins Collectors Association and as well the Collins Radio Association with their wealth of information and useful help. Also before I had a chance to learn all those special cleaning methods used by the "boatanchor" community.

So, I applied common sense and standard engineering and radio repair techniques. First I carefully cleaned and got the PM-2 to work. Then I gave the KWM-2 a try with all tubes removed. Smoke!

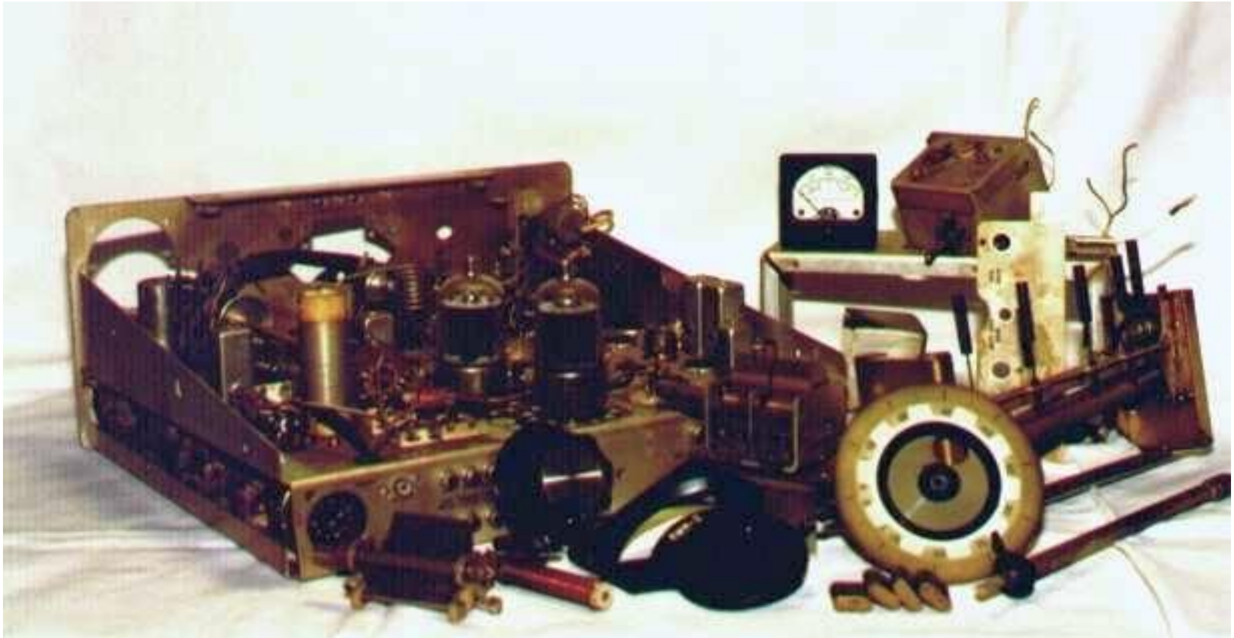
After some searching I found that the installed Waters rejecting tuning model 340A had several mechanical shorts, which had taken with them a choke in the filament circuits.

No question, the Waters had to move out and the choke was replaced. Then I started the cleaning process. First I dismantled everything that could be removed, and then I started a gentle cleaning process, not the brutal "water from a hose and let dry in the sun" that is sometimes advocated.

Yes, this is how my Collins KWM-2 looked like, after I had started with the restoration job.

Lots of brown stuff covered the characteristic grey, green and aluminum colors of the Collins S-line.

Here is another picture, seen from the back. Of course, the PA tubes are just there to show their position, not for cleaning them.



And this is how it looks now after all the work I put into it: clean and shining. A pleasure to look at, a real work of Art.

After I had the KWM-2 up and running, I spotted a 516F-2 power supply and even a 30L-1 power amplifier, which I added to the set-up. Even better, I was able to obtain a 302C-3 directional wattmeter with coupler. You guessed it? Yes, I was able to exchange this for the never forgotten 312B-5 in Kaiserslautern.

RIT control for the Collins KWM-2

by Ernst F. Schroeder DJ7HS

If you are devoted to putting the great Collins rigs to work, and unless you are the proud owner of a 312B-5 second VFO, you'll definitely miss an RIT (receiver incremental tuning) control when using the KWM-2 on the air.

If you are not afraid of semiconductors and if you like to have a small construction project, then you can solve the missing RIT problem easily. And the good message is: it can be removed in case you want to have the rig in its original state again.

There have been several proposal on how to apply an RIT circuit to a KWM-2.

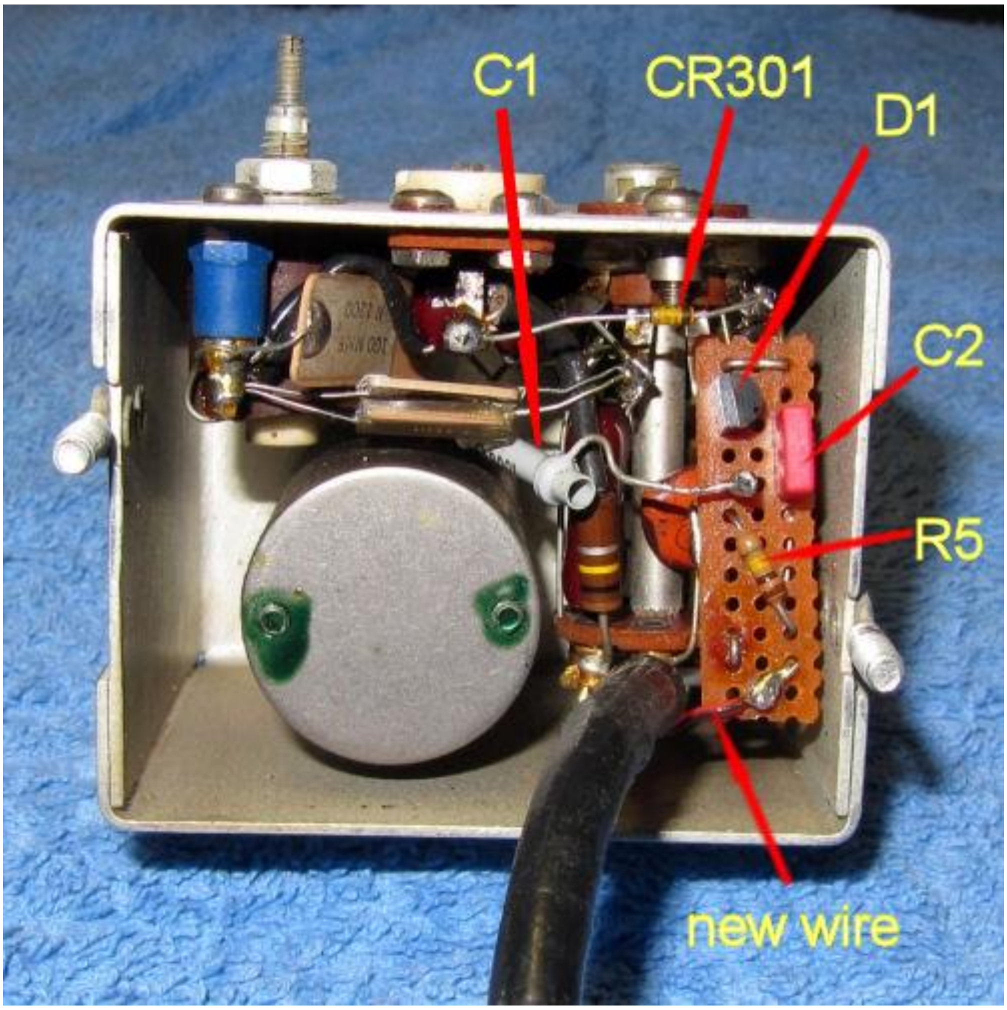
The earliest one I could find appeared in CQ in March 1963. Here Nick Taylor, K5YTO, shows a very simple circuit to tune the receiver over a 2.5 kHz range. He simply uses diode CR301 existing in every 70K-2 PTO. Instead of using CR301 as switch with two fixed bias voltages to switch C308 in and out, a variable bias will utilize CR301 as a varicap in series with C308.

The RITEK RIT by John K. Webb, W1ETC, must have been developed in 1992. The circuit board is attached to the back of the PTO case and uses a connection to the top of C308, a point that is identical to the cathode (pin 7) of V301. Probably a varicap is connected to this point.

That's it - there are really no secrets on how to build an RIT. Some varicap must be added to the PTO and made operational when RIT is wanted and the TRX is in receive mode. A variable bias is needed for the varicap and a switch to switch the RIT in and out.

Numerous solutions can be thought of - so you have to choose your own.

I had to open the PTO anyhow as it needed some new lubrication. That was the chance to add a few items within the PTO and to route a further wire through the PTO wire harness. For details please consult the circuit diagram.



And my KWM-2 had a defective Waters rejection module. That had to move out and the tuning capacitor that was mounted concentric with the ON/OFF switch was replaced with a potentiometer for the variable bias voltage. As there is no noise blanker installed, the NB switch position can be used as RIT-ON. That even ensures that in CAL mode the RIT is always off.

Here you can see the concentric former rejection tuning and power switch, and the RIT potentiometer mounted on the bracket that formerly held the variable capacitor.

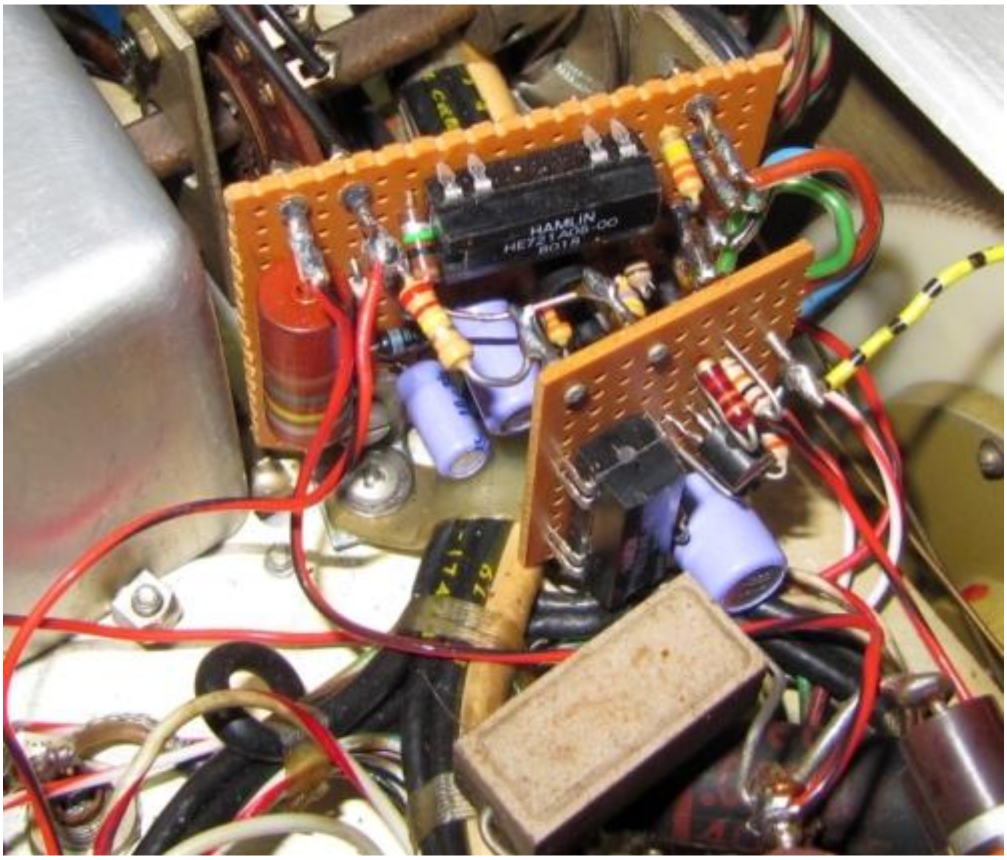
Of course, potentiometer and switch can be put anywhere, even outside in a small box. Then probably shielded wire connections should be used. And the varicap does not have to be inside the PTO. It can be placed outside the PTO box with the series connected condensor contacting the top of C308 (like done by the RITEK kit) or wrapped around pin 7 of V301.

The circuit adds capacitance to the PTO circuit and thereby lowers its frequency by about 2 kHz. Therefore the PTO has to get a new alignment after RIT installation.

Here now is the circuit diagram.

Actually, this is very simple: a varicap and 3 new parts within the PTO, a stabilized supply for about 20 V, fed from the TR275V rail, and a supply for the small relay, fed from the filament circuit. Then the small SPST relay that is driven by a logical AND. It is only energized when the ON/OFF switch is in NB position and when the R275V rail is on, i. e. in receive mode.

All this can be put on a small circuit board under the chassis, with four connections to J17, the EXT VFO POWER socket, and one connection to J24, the NB POWER socket. And of course, one connection to the varicap circuit. The board is held in place by a small metal angle under the screw that holds the wiring harness.



Actually, above you can see two boards. The one behind has the RIT components, and the one in front adds another function for CW: in transmit mode only, the PTO is shifted by the difference between the built-in sidetone frequency and the desired 800 Hz. That makes it possible to tune CW reception to 800 Hz and to be right on that frequency when transmitting.

It works, but I cannot really recommend it. The KWM-2 has not been designed for CW, and its signal generation via sidetone and SSB modulation is not the best possible. A good adaptation of the KWM-2 to CW has still to come. At least, you can have a look at my circuit diagram for this augmentation of the RIT circuit.

So you can see how easy it is to build an RIT control for your KWM-2. And, please don't hesitate to ask questions in case I left anything untold.

Zener Modification for KWM-2 and 312B-5

The "Vietnam" or "11b" Mod

by Ernst F. Schroeder DJ7HS

The Collins KWM-2 transceiver and its 312B-5 companion are equipped with a fantastically stable and reliable yet small permeability tuned oscillator (PTO). The only real drawback of this PTO is that its output frequency is slightly dependent on the supply voltage.

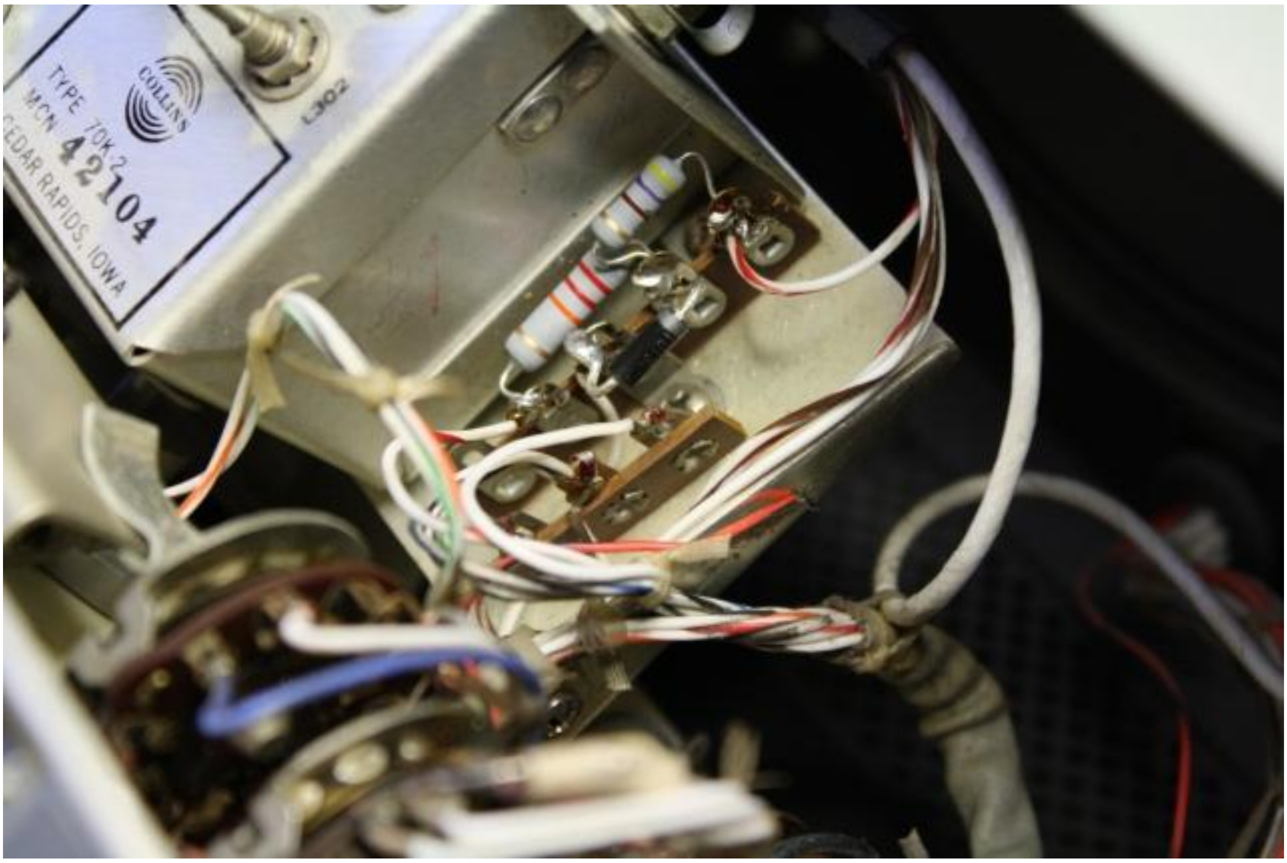
When I had my PTO on the bench for relubrication, I was able to measure this dependence with a variable power supply. Varying the supply from 100 to 200 Volts changed the output frequency by about 310 Hz or 3.1 Hz per Volt.

The nominal 275 Volt supply voltage inside the KWM-2 changes quite a bit between receive and transmit operation. In my KWM-2 I measured 301 V in RX mode and 277 V in TX mode. The resistive divider R73 / R101 with 15K and 33K Ohms translates this into a supply voltage change from 207 V to 190 V for the PTO. And this translates into a frequency change of about 53 Hz. Of course, this is too much for "being on frequency".

A 50 Hz shift between receive and transmit frequencies might have been acceptable in the early days of SSB, but very soon it became clear that a remedy was needed. And this seems to be the origin of the unofficial "Vietnam" or "#11b" mod for the KWM-2. This is best described in "The Signal Newsletter" of 4th Quarter 2001, issued by the Collins Collectors Association.

Of course, the PTO in the 312B-5 needs the same stabilizing circuit. The installation is even easier as compared to the KWM-2. Just next to the PTO box there is a nice terminal strip from where the two resistors R401 (15K) and R 402 (33K) should be removed and two new resistors and the 150V Z-diode can be placed.

Just have a look at this photo from inside the 312B-5:



Ernst F. Schroeder DJ7HS

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The Collins KWM-2: Curing T/R Switching Transients

Unexpected Service Bulletin Side Effects

When I am in a QSO using my KWM-2 and when I switch from receive to transmit, either by VOX or PTT, my partner will hear a click and bump. This noise may be masked by my first spoken syllable and it sounds a bit like mechanical noise from the relays, entering via a microphonic tube. But even when I set the Mic Gain control to "off", it is still noticeable and a bit annoying, unless we take it as a special characteristic of this fine piece of Collins equipment.

Where does it come from? Well, most of the KWM-2's circuits come from the

separate 32S-1 transmitter and 75S-1 receiver, but you won't find this click and bump sound there. So the root cause must lie in the receiver-transmitter switching circuits within the KWM-2.

But, didn't they find this when they designed the KWM-2? Oh yes, they did. And they designed a remedy into its circuits: C264, R176, R177 and CR10 in the anode supply of V3A.

Fig. 1 Components around V3A in a Collins KWM-2

Let's look at the circuit diagram in Fig. 1 and temporarily pretend that C264 and R122 are not there. First, in receive mode, the junction of C6 and R12 in the cathode of V3A is at zero volts. After switching to transmit, V3A gets its anode voltage from the T+275V supply, immediately starts to draw current through R12 and quickly charges C6 from zero to a few volts. This causes a large bump that goes via R208, L41 and L38 directly into the balanced modulator, and from there it gets converted into an RF signal at the PA output.

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You can clearly see this in Fig. 2. This oscilloscope trace has been triggered when the PTT line was actuated. The trace below shows the voltage at the cathode of V3A.

After about 12 ms, when the T+275V supply has been switched on, it quickly rises from zero to about 8 volts. The upper trace shows the RF output into a dummy load.

You can see a corresponding signal spike of about 5 ms duration, which has full

peak-to-peak PA output.

Fig. 2 RF output (top) and voltage at cathode of V3A (bottom), when switching from receive to transmit, Mic Gain off, without C264 and without R122

horizontal resolution 5 ms / division

When you compare the circuitry in Fig. 1 (without C264 and R122) with the

corresponding circuit in a KWM-1, you can see that this bump is probably also

present in a KWM-1. So at design time for the KWM-2 this effect must have been known and a remedy was searched for. As a consequence C264 and R176 have been put in the anode circuit of V3A. Now, when the T+275V line is switched on, the anode voltage of V3A is rising much slower and the current change through R12 is also slowed down. Thereby the bump into C6 is reduced. The result can be seen in

Fig. 3.

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Fig. 3 RF output (top) and voltage at cathode of V3A (bottom),

when switching from receive to transmit, Mic Gain off, with 4µF for C264 and without R122 horizontal resolution 5 ms / division

Initially C264 had a value of 4µF, which must have been a compromise between

slowing down the current increase through R12 and at the same time preventing a new side-effect that happened when the KWM-2 was switched back from transmit to receive. The charge on C264 keeps the T+275V supply line high for a short moment, when the R+275V receiver supply is already on. And although R177 has been added to quickly discharge C264, the small remaining charge is enough to cause regeneration around receiver stages. This oscillation can easily be seen at the anode of V3B, the second IF amplifier (see Fig. 4).

Fig. 4 Voltage on T+275V line (left) and voltage at anode of V3B (right), when switching back from transmit to receive, Mic Gain off, with 4µF for C264 and without CR10 horizontal resolution 20 ms / division Ernst F. Schroeder DJ7HS

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Of cause, this oscillation enters the AVC circuit and causes the S-meter on my

KWM-2 to jump to nearly S9, every time I switch back from transmit to receive.

This adverse effect was only cured after diode CR10 was introduced in October 1965 by Amateur Service Agency Bulletin ASAB 1016. Now the charge on C264 can no longer flow back unto the T+275V line and it is therefore possible to increase C264 to the later value of 22µF. This further reduces the bump into C6 and in the RF output, as can be seen in Fig. 5.

Fig. 5 RF output (top) and voltage at cathode of V3A (bottom), when switching from receive to transmit, Mic Gain off, with 22µF for C264 and without R122

horizontal resolution 10 ms / division

Not a bad result, but why does my KWM-2 still exhibit such a loud noise in the output when I switch from receive to transmit?

Again, let's look at the circuit diagram in Fig. 1. There still is R122, connected

between the R+275V supply line and C6. This resistor was introduced in May 1961 by Amateur Service Agency Bulletin ASAB 1006 to prevent an "audio squeal" when switching from transmit to receive. R122 is supposed to put a positive voltage on the cathode of V3A in receive mode, thus better cutting off V3A and preventing possible audio feed through.

The service bulletin further states “This change will have no effect on the audio

voltage to the vox circuitry.” That is certainly true, but there is another effect and it seems that it was not detected at that time, nor any time later. Ernst F. Schroeder DJ7HS

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Here is what happens when a KWM-2 switches from receive to transmit, step by

step:

· First relay K2 is activated and switches over. It first activates the RX mute line.

· On closing, K2 releases the TX mute line and activates relays K3 and K4.

· Then, after about 10 ms, the armature of K4 starts to move and first cuts off the

R+275V receiver supply.

· And then, after a further 2 ms, K4 switches the T+275V transmitter supply on.

This supply also feeds the PA screen grids.

What happens on C6?

· Before K4 is activated, C6 is charged to about 5V via R122 from the R+275V

supply.

· Then, 10 ms after K2 is activated, when K4 starts to move, R122 loses its

R+275V supply. So C6 is quickly discharged by R12 with a sharp negative transient.

· Then, a further 2 ms later, the anode voltage for V3A slowly comes on and the

current through V3A and R12 again charges C6 to a few volts with a relatively

slow positive transient.

As TX mute has already been released when K2 closes, the bumps and noise

caused by these two transients at C6 are delivered to the PA. Luckily, the PA only starts working when its screen supply is established by K4. So the very first part of bumps and noise is cut off, but the largest part still gets out to the antenna.

Fig. 6 is a further oscilloscope screen shot that shows the result. You can clearly see the new sharp negative transient at C6 and the corresponding large click at the RF output, which on my KWM-2 has about 60% of full peak-to-peak output.

Fig. 6 RF output (top) and voltage at cathode of V3A (bottom), when switching from receive to transmit, Mic Gain off, with 22µF for C264, CR10 and original R122 horizontal resolution 5 ms / division
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So the root cause for the bump noise is found: The addition of R122 according to ASAB 1006 may have solved one problem, but it clearly has aggravated a problem that once seemed to be solved.

Convinced? Then give it a try, remove R122 (47 KΩ) between V3 and turret E40.

Check whether the problem described in ASAB 1006 exists for your KWM-2. If not -

leave it that way. I can promise you, most of the noise when switching from receive to transmit will be gone. But also gone will be the click sound of a true Collins KWM-2, so it's up to you what you want.

In closing I should not forget to mention that the typical click at the end of a

transmission, when releasing PTT with Mic Gain open, has a completely different story. This has been dealt with by Billy Burke, WA6Q, in Electric Radio magazine

#260, January 2011.

Furthermore, I am grateful that Serge, VA3SB, and Stefan, DO3SPR have taken their time to discuss my findings and confirm my measurements.

Zener Diode in Cathode of Relay Driver V4B

by Ernst F. Schroeder DJ7HS

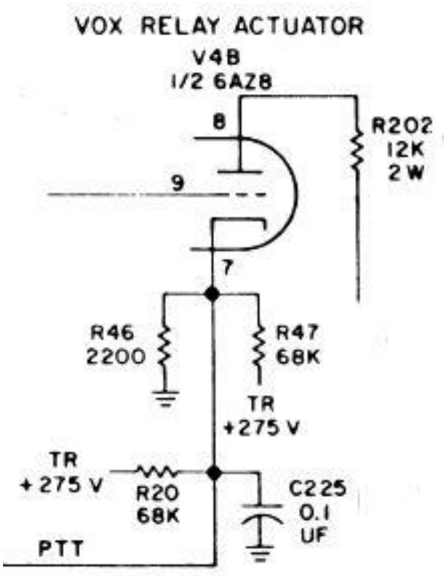
This is a modification that I picked up in 2006 from a post by Jim, VE3DSR, who used it on his 32S-1 transmitter. It can as well be used in a KWM-2.

When you look at the circuitry around the relay driver tube V4B, you see a high-power voltage divider in the cathode that consists of R20 and R47 in parallel, with 68 kOhms and 2 watts each, and R46. In reeceive mode, this divider puts about 17V DC at the cathode of V4B so that no current flows through V4B, R202 and relay K2.

This divider dissipates a bit more than 2 watts of DC power and R20 and R47 get quite hot.

When PTT is pressed, the cathode voltage at V4B goes to zero and relay K2 is activated, but in VOX mode the cathode voltage varies quite a bit. A stablized cathode voltage can make VOX activation much more stable.

Here is the original circuit diagram:

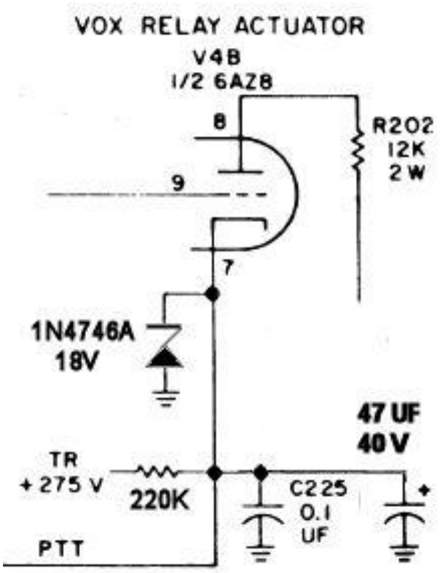


The modification is simple:

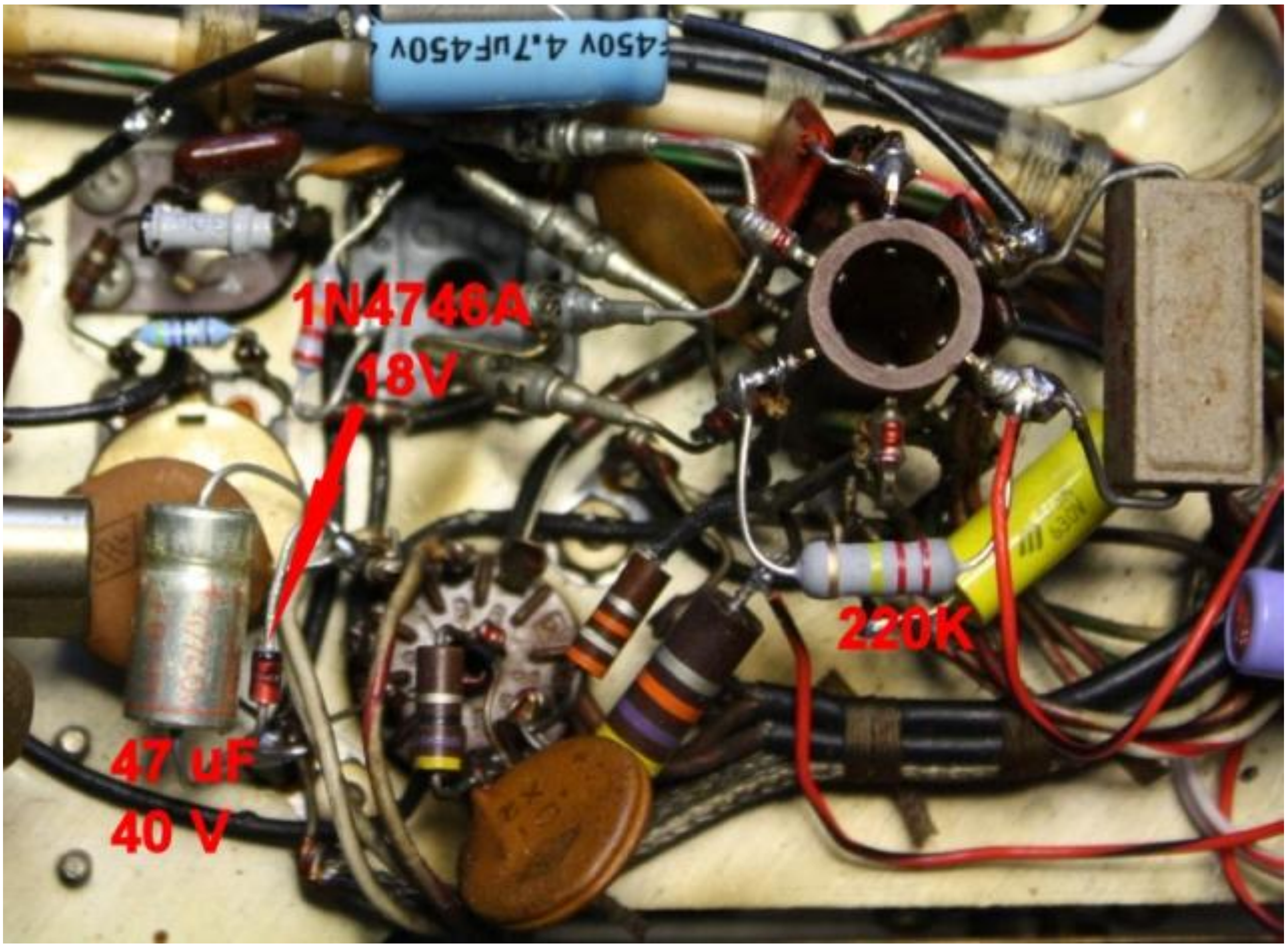
- replace R46 with a 18V 1W Zener diode like 1N4746A (tie cathode to pin7 V4B)
- replace R20 and R47 with a single 220K 1W resistor
- while you're at it: add a 47uF 40V electrolytic across C225 (tie + lead to pin7 of V4B)
  this removes the click when PTT is released.

Done.

Here is the new circuit diagram:



And here is a picture of the new components:


450V 4,7uF450V
1N4746A
18V
220K
47 uF
40 V

Collins KWM-2: Installing New Parts for PA Neutralization

by Ernst F. Schroeder DJ7HS

My KWM-2 is a winged emblem type, probably from 1962, and it was factory-equipped with the "old" PA neutralization circuit and parts. When I got it, it had 6146B tubes in the PA, but there never was a problem. But then, despite the good advice "If it ain't broke, don't fix it", the numerous stories on the CCA reflector about failing PAs with "too hot" 6146B convinced me to switch to the newer version with the air variable trimmer.

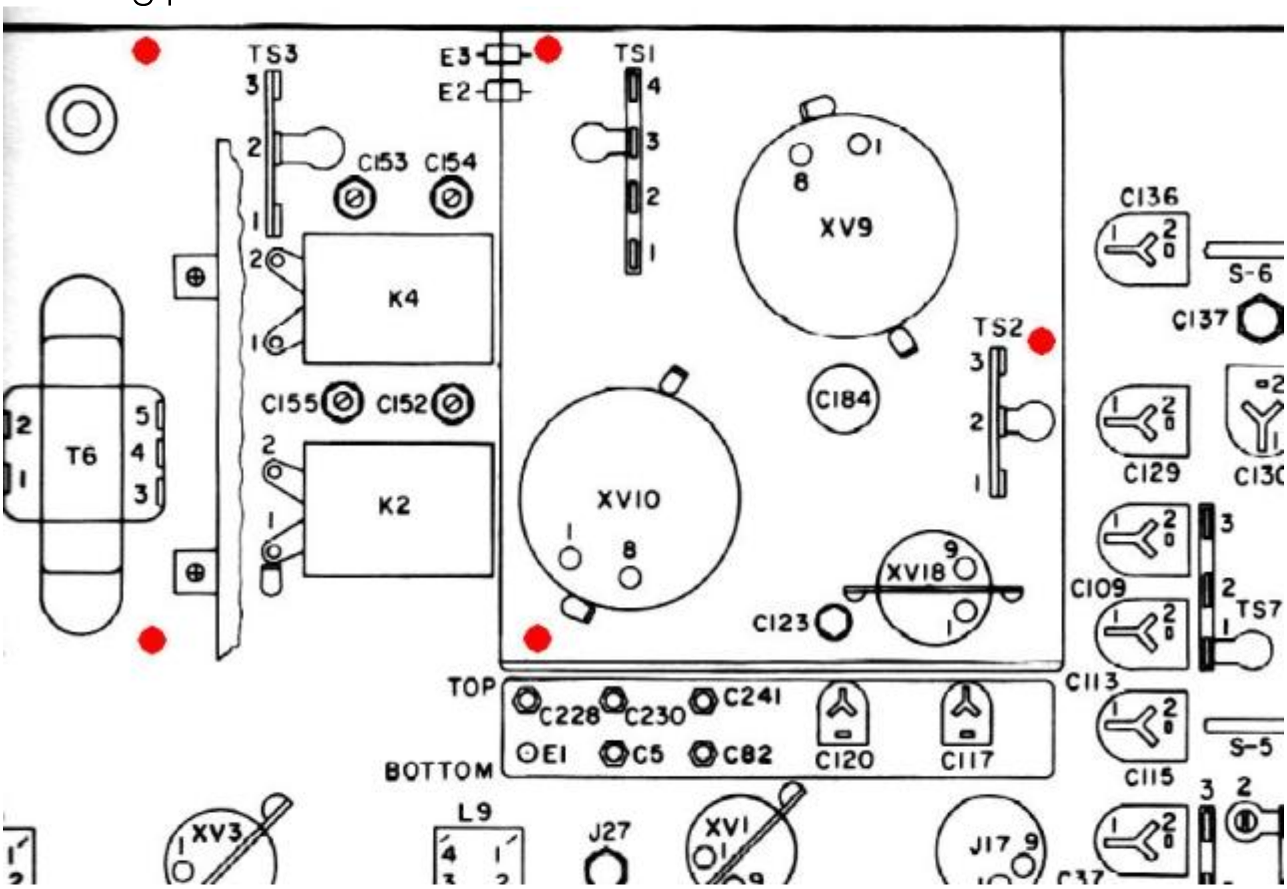
So it was just in time when J A Call, W7KSG offered a kit with the necessary electrical and mechanical parts. I got one and took the KWM-2 out of its cabinet...

After one easy afternoon's work with lots of coffee breaks the neutralization went very smooth and I put the KWM-2 back into its cabinet, just as if nothing had happened at all.

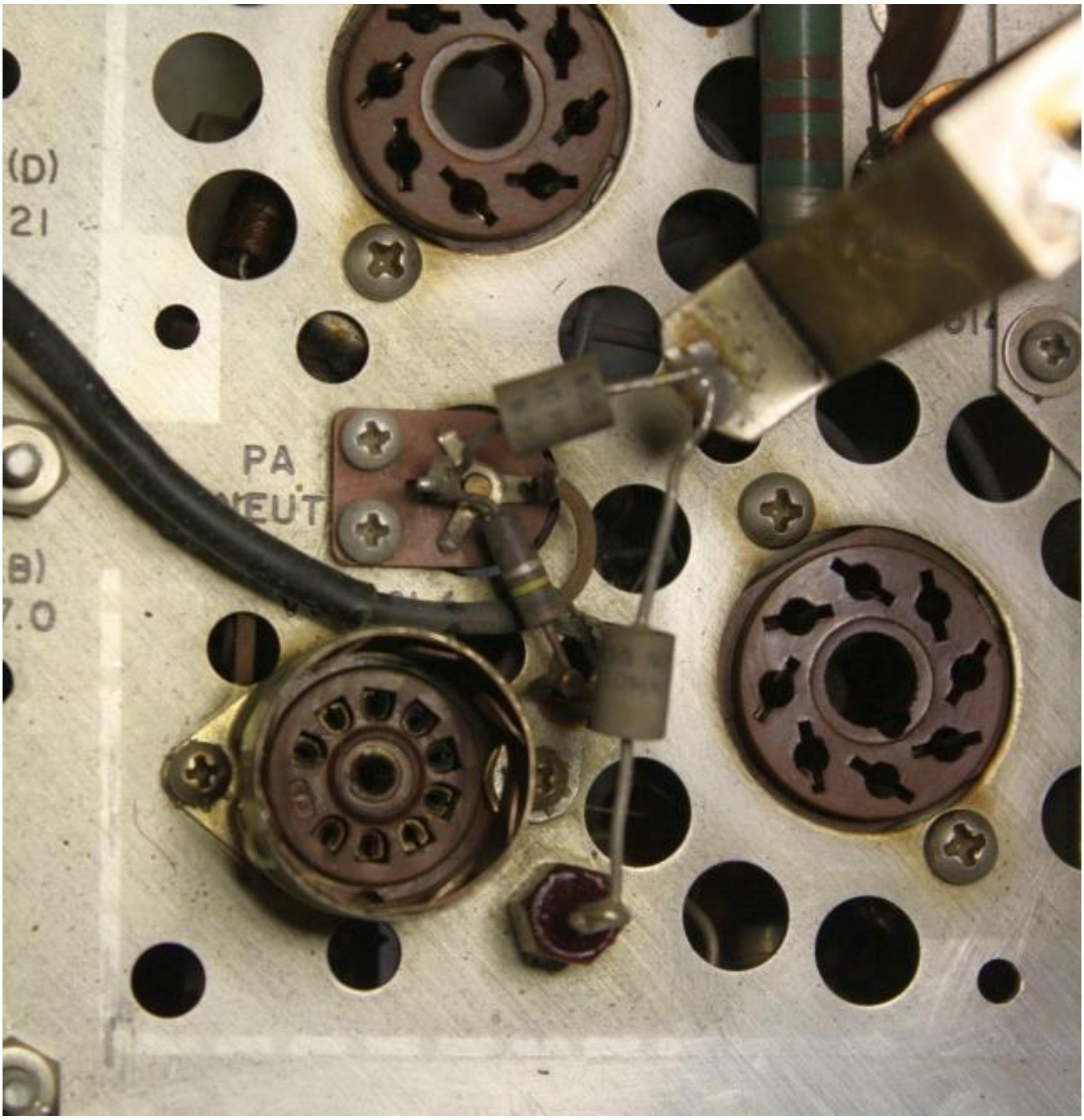
Here's how I did it. The kit included all necessary parts and a step-by-step instruction sheet. Here is my procedure - a bit more detailed and with pictures:

(1) Remove all connections at the back and, in case you have a Waters add-on, a noise blanker or a 312B-5 external PTO, also those going to J17 or J24 or J27 inside. In case that looks crowded, take one or two photos first! Then get the transceiver out of its cabinet.
(2) Put the transceiver flat on the table, then remove the top shield of the PA compartment. You only have to loosen the five screws slightly, the top shield will slide out sideways. Don't touch anything inside yet!
(3) With a suitable metal screwdriver or rod put a short from the outside of the PA cage to the top of the metal strip to which the two plate connectors and chokes are attached. This may sound overly cautious, but remember: Safety First!
(4) Remove the 6146 plate connectors and then remove the two 6146 tubes. Put them in a safe place.

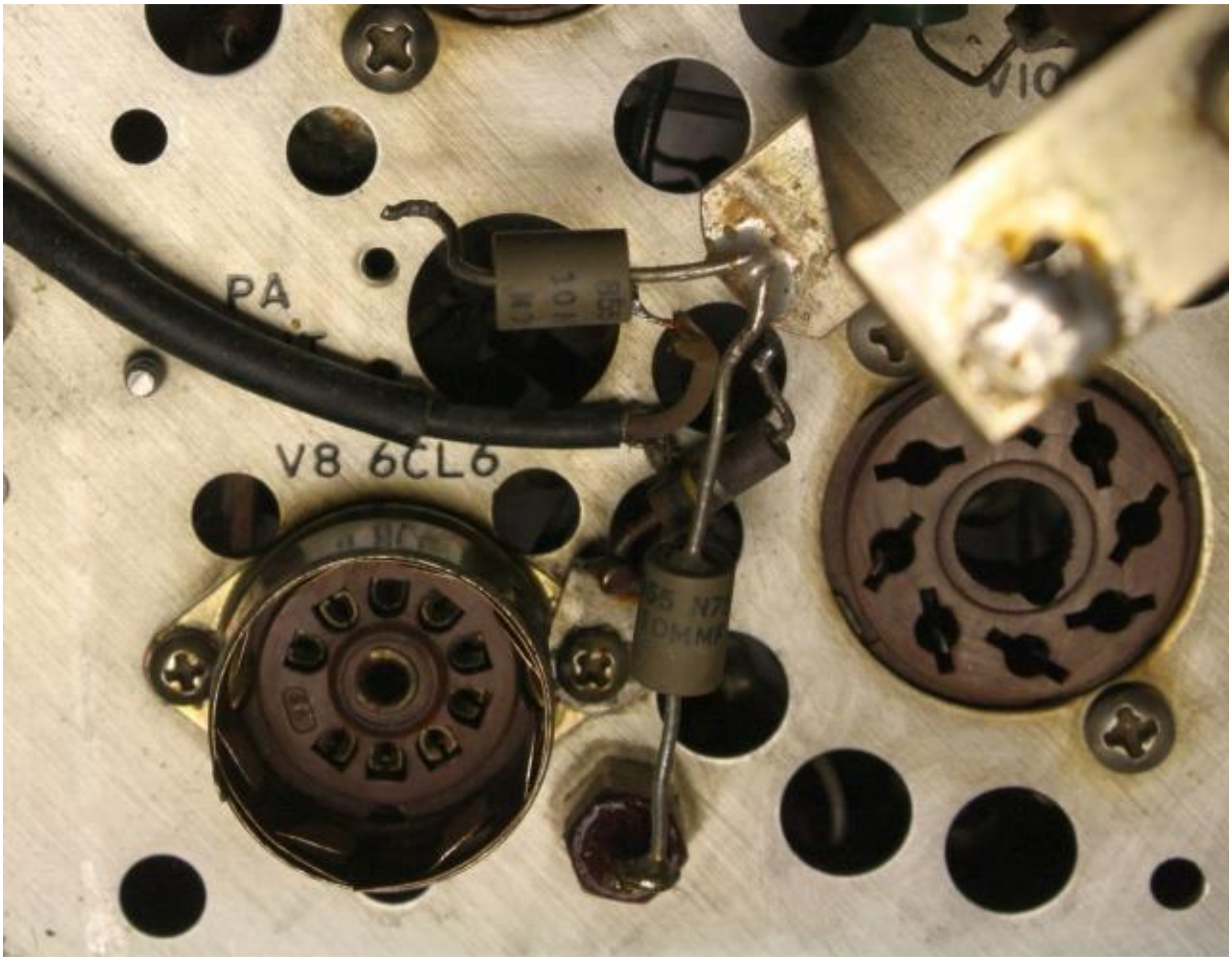
(5) Remove the shield from the 6CL6 tube, then remove the 6CL6 tube and put both in a safe place.
(6) Remove tube V301 on top of the PTO, probably a 6AU6, and put her in a safe place. You may also want to remove V1, a 6AZ8, in order to have better access to the work space. Don't forget to put it in a safe place like the others.
(7) Turn the transceiver over and lay her on her back. Be careful not to trap the plate connectors between table and PA cage.
(8) Locate the five screws that hold the PA cage to the chassis. They are roughly there, where the 5 screws are on top of the cage. There is no screw where the cage is flush with the side of the chassis. The following picture shows where these screws can be found.



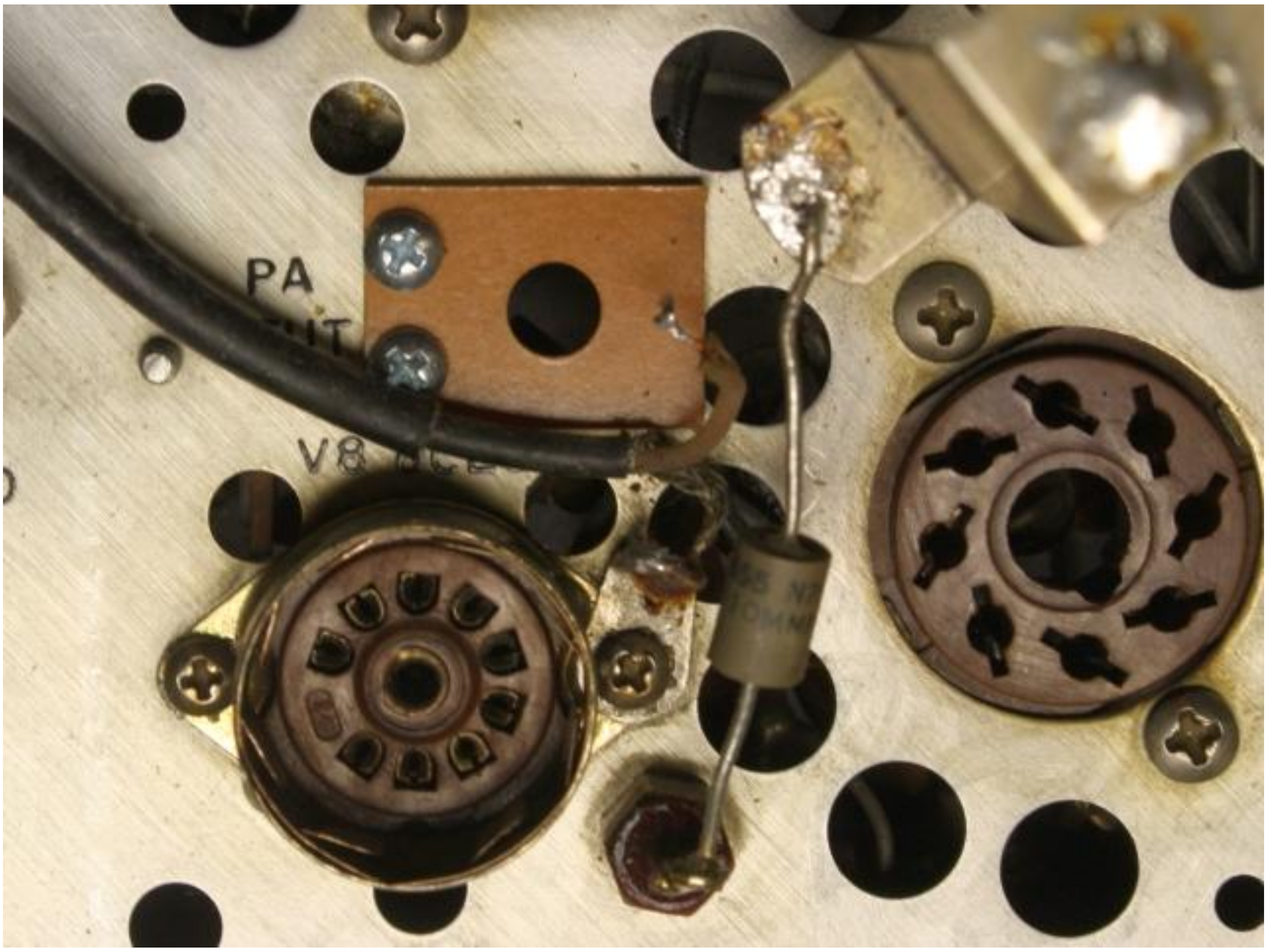
(9) Unscrew those five screws and put them aside.
(10) Carefully turn the transceiver over again, then take off the PA cage and put it in a safe place.
(11) Now, when you look at the space between the PA tube sockets, you will see something like this. And before you do anything else, take a photo to document the situation as it was.



(12) Unsolder the inner conductor of the small piece of coax cable, the 100K resistor R127, and the 10 pF capacitor C183 from the small neutralizing capacitor C148. Then remove the two screws and capacitor C184. Now it should look like this:



(13) Completely remove resistor R127 and capacitor C183. Proper unsoldering from that metal strip may need quite some heating power. Don't touch the other capacitor.
(14) Locate the phenolic mounting board and install it from the top with the two screws supplied where C184 had been. Now the place should look like this:

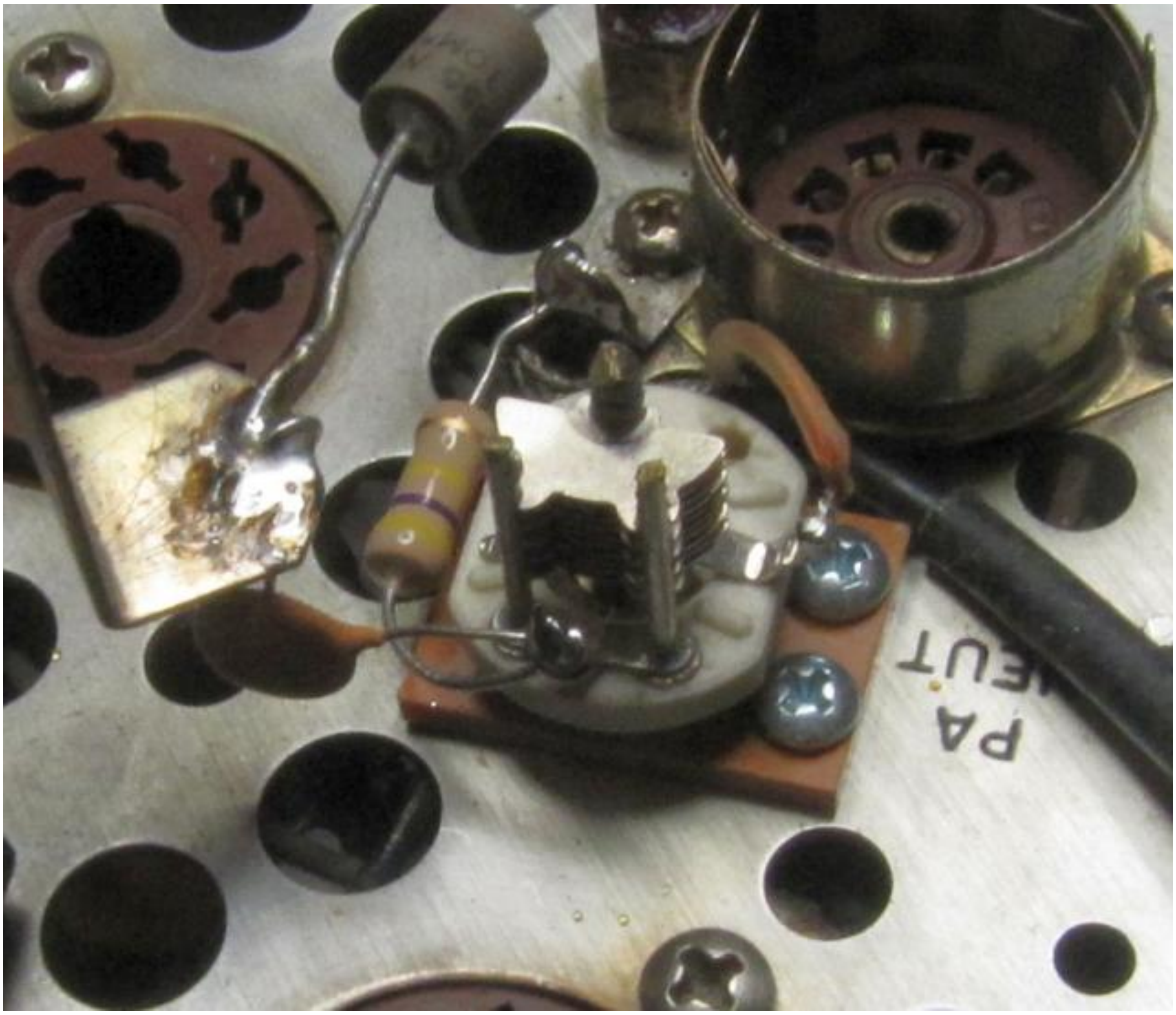


(15) Try if you can easily bend the center conductor of the small coax cable to a place right between the two new screws. If you can, then go to (17).

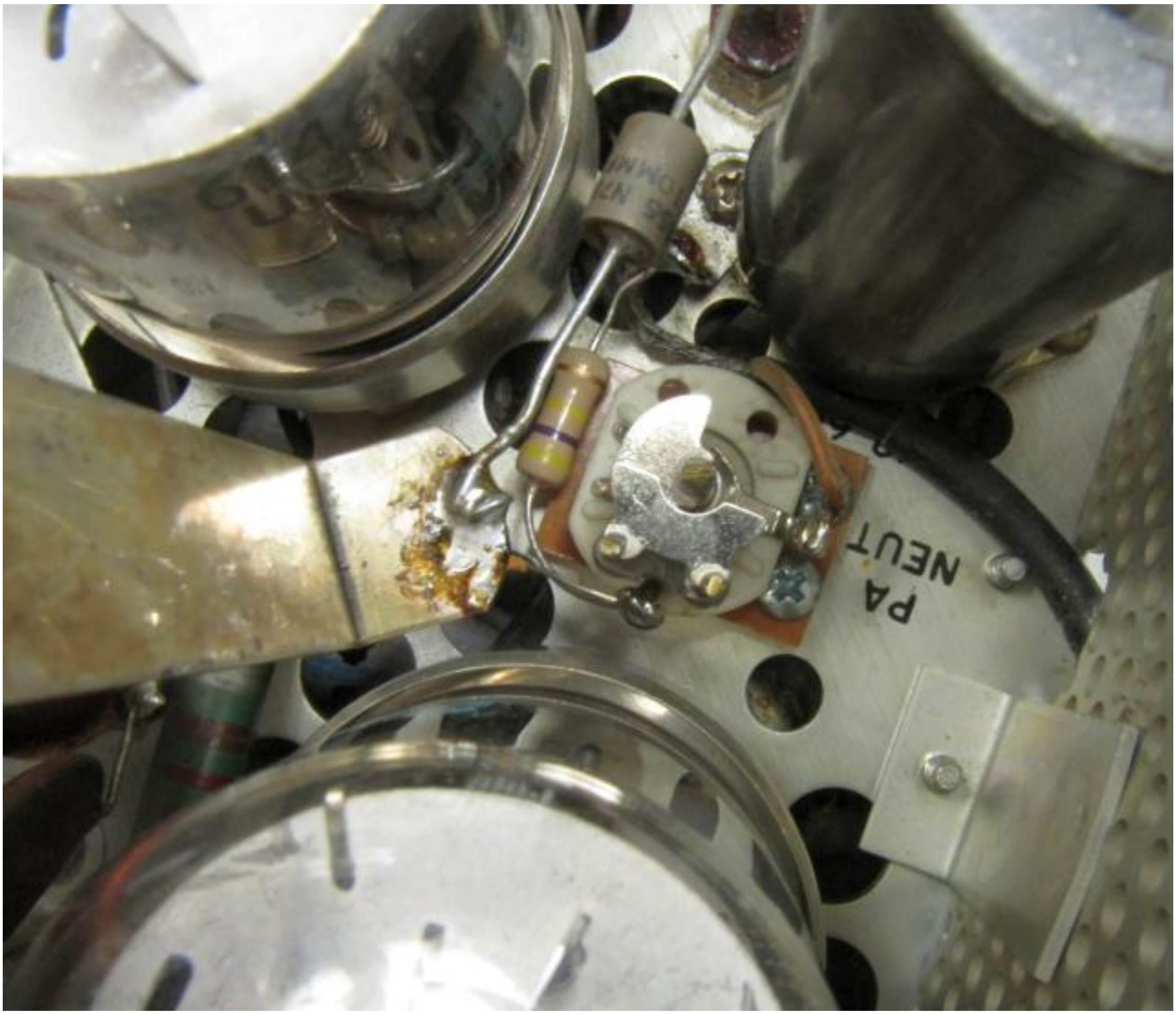
(16) Unscrew the screw that holds the V8 socket and the ground lug. Now you can work at the end of that coax cable. Carefully remove between 1/2 and 1/4 inch of its outer sleeving without cutting into the braid. With a metal pick pry a hole into the braid right where the outer sleeving now ends. Then shift the braid somewhat to loosen it and try to get the inner conductor out of that hole. This way the braid is not cut and still stable and the separate parts at the end of the coax are a bit longer than before. Put the ground lug where it had been and tighten the screw. While you are at it, re-tighten all screws in reach.

(17) Get the new air variable capacitor and make sure that rotor and stator are fully meshed. Keep it that way as long as you are working at it. Then put it with its shaft downwards into the hole in the phenolic mounting board. Stator and rotor of the new capacitor should be facing up into the PA compartment. The flat sides of the ceramic base should be parallel to the two new screws. Look at the next photo to see the correct orientation. From underneath the chassis

install the supplied lock washer and nut and tighten securely while keeping the correct orientation. Check that you did not do anything wrong while tightening that nut in the compartment below the PA tubes.
(18) While dressing and connecting the new parts you should leave enough room for the PA tubes. Their diameter is much larger than that of their sockets! Just to be sure you should get one or both of the 6146 and check the space. Also, the small coax cable should not touch the driver tube or its shield.
(19) Connect and solder the inner conductor of the small coax cable to the solder tab just above the two new screws that hold the phenolic board.
(20) Connect and solder one end of the new .001 2kV disc capacitor C183 to the metal strip, connect the other end to the solder tab on the stator of the new C184. Do not yet solder here.
(21) Connect and solder the new 470K resistor R127 to the ground lug where the coax braid goes, and connect the other end to the solder tab on the C184 stator where the new .001 capacitor is connected. Now solder both connections. The situation should now look like this:



(22) Double check your work and clean the area. Components should not touch each other.
(23) Re-install the PA cage. There is a wire going to the lower end of the PA choke. Keep that free, don't trap it somewhere. Turn the transceiver over and tighten the five screws that hold the cage.
(24) Turn the transceiver over again and put all tubes back in their sockets. Connect the plate caps to the 6146 tubes and place the shield on the driver tube V8. Don't forget V1 and the PTO tube, in case you followed step (6).
(25) Now, when you look down between the two 6146 tubes, you will see this, your completed work:



(26) Once again, double check your work, then replace the PA shield cover and tighten the five screws.
(27) Now put the transceiver on one side so you have access to the PA from above and from below. From below, adjust the new air variable capacitor so that rotor and stator are about 1/2 meshed.
(28) Reconnect the power supply cord and connect a dummy load to the antenna jack. It's not a bad idea to connect a loudspeaker, and don't forget to put that VFO plug into J17.
(29) Switch the KWM-2 on, let it warm up and check in RX mode if the calibrator is working. Always watch for smoke!
(30) With MIC GAIN still OFF, switch to TUNE and then to LOCK. Check for proper PA idle current. Increase MIC GAIN and do a quick check for proper drive and output power.
(31) Switch her off again and get that handbook out with the chapter on PA neutralizing. Follow the instructions and make sure you do **not** use a metal tool to adjust the new C184 neutralizing capacitor from below.

(32) Put the KWM-2 back into the cabinet and finally put all cables and connections back to as they were before you started. Remember, you had taken some photos of that state!

Collins KWM-2: Curing A Strange Problem

by Ernst F. Schroeder DJ7HS

It all began, when I came back from summer holidays in Denmark last year (2012). On my way home I visited Bent, OZ5ZD in Augustenborg and he showed me his KWM-2, RE with S/N 38057 of about 1971. That had come from the estate of K0ZQD, had been serviced in US and had been working properly. When it was sent over to Denmark it arrived in good order and worked fine, but unexpectedly it soon exhibited some strange behavior. So it was put aside until I got to see it.

This indeed was a strange rig, the calibration oscillator level was much too low and there was practically no peak from the exciter tuning. Even worse, the transceiver was very sensitive to mechanical shock. Even slight tapping would let the S-meter jump up and momentarily increase the speaker output level. I had a feeling that after tapping it would come to life for a short moment, then fall back into agony.

Some tubes had already been exchanged and also new relays K2 and K4 had been installed. No change, so no quick remedy was in sight. I opted to take it home with me and another transport followed. This time first-class, in the back seat of my car.

When I put the KWM-2 on my workbench only a few days later, I had to learn that things had changed again: now the receiver was working properly, the calibrator signal had the right level and exciter tuning was OK. But the mechanical problem persisted, more or less slight tapping anywhere on the chassis would let the S-meter jump up and produce a popping noise in the speaker. While the transceiver was warming up I noticed that I had to tap harder and harder to produce the effect. Would this problem go away by itself without a chance to become identified?

I switched the M-2 off and started thinking all over. Whatever caused the problem, it was somehow influencing the AVC and this was to be seen throughout the receiver circuits. So as a first step I fed the AVC line with a constant voltage. When I switched the transceiver back on, the effect was still there and I still had to tap quite hard to produce it. But now the S-meter did not move any more, as expected. Now I started to isolate the stage in the receiver chain from where the problem was originating. I shorted J22 to ground: gone; grid pin 9 of first mixer V13B to ground: gone; grid pin 1 of RF amplifier V7 to ground: still there. So here was the first result: there was a problem in the circuits between RF amplifier V7 and first mixer V13B.

I hooked up an oscilloscope to V7 pin 5, the anode of the RF amplifier. While tapping the chassis I was able to see a short positive spike, immediately followed by a short negative spike. Countless stories of failing coupling and bypassing capacitors came to my mind, but how could the voltage at pin 5 become more positive at all? The 275 VDC line turned out to be rock-stable and nothing could be seen on V7 pin 6, the RF amplifier's screen grid. When I came that far I really had to tap hard now, so: switch off and again sit down and think.

The spikes at the anode of V7 were short. C272 was ruled out as being too small and shorting of CR5 didn't change anything. Then there was only one further capacitor in the anode circuit: C44 with 1000pF, the coupling capacitor to the grid of driver V8. Was the problem originating from there? But we were on receive and the driver stage was biased off. Yes, biased off, the grid was at about -70 V. When this voltage would disappear by any means, there would be a positive-going spike across C44 and at the anode of V7. I hooked up the oscilloscope to V8 pin2, the driver's grid - and the problem was gone! How come?

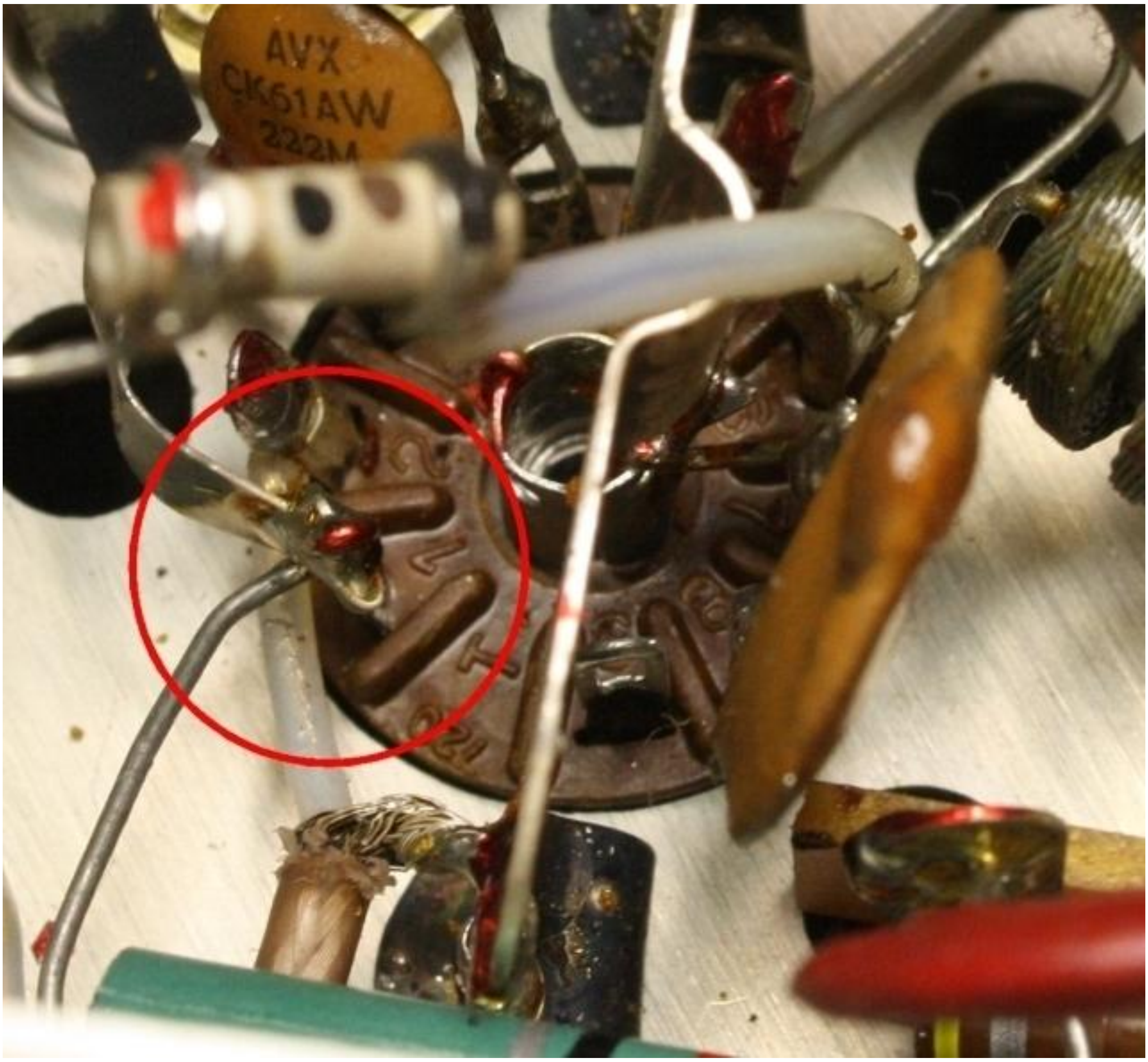
Well, the driver's grid is connected to the tuned circuit around band switch S5 via a short length of shielded wire. The braid is soldered to the shield across the 9-pin socket and the center conductor goes past pin1 to the lug for pin2 (see picture below). A closer inspection of the driver tube socket showed that the center conductor was closely touching the soldering lug for pin1. A little bending of lugs 1 and 2 separated both and the problem was solved permanently.

Now the mechanics of the problem were clear: any contact between pins 1 and 2 of V8 causes a severe de-tuning of the circuit in the anode of V7. That is why the calibrator's signal had been much too low and no peaking had been possible. The driver stage V8 would no longer be off-biased, but that would not be harmful as screen grid voltage for V8 would only be applied in TX mode. The contact between pins 1 and 2 apparently was intermittent, so upon tapping any making or breaking was introducing a large voltage spike into the anode of V7 and at the same time into the grid of first mixer V13B. This signal traveled down the IF chain, produced a large AVC signal and let the S-meter jump up.

Problem solved. And as I did not see any sense in dismantling the connection further for closer inspection, I can only speculate about the root cause. That center conductor must have been close to the lug at pin1 right from production time, maybe there even had been a tiny cut in the insulation. Vibrations and low temperature on the air transport from US to Denmark may have caused something like cold-flow of the insulation: This must have caused an even closer contact until finally an instable electrical contact was established. Tapping the chassis must have broken that contact, restoring proper operation momentarily. Repeated heating of the chassis may have relieved the strain and broken the contact again until only very hard mechanical shock was able to restore it momentarily. So, as I had feared, the problem might have disappeared altogether when the transceiver had been running in a cozy warm shack for some days. But who knows, it might have come back, haunting the operator.

Finally the KWM-2 was taken back to Denmark, this time by train and in an appropriate CC-2 carrying case. And it still works!

This picture shows the space underneath driver tube V8, the circle highlights the place where the inner conductor goes past the lug of pin 1.


AVX
CK61AW
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