

updating the Collins KWM-2

Important modifications are described for modernizing the KWM-2 high-frequency transceiver

Introduced to the Amateur world in the fall of 1959, the Collins high-frequency KWM-2 transceiver quickly became the classic, with over 40,000 units in use worldwide by Amateurs, commercial services, and the military of numerous nations. The latest version of this popular rig is the KWM-2A. Time-proven by its robust construction and its long life in these days when circuit-boarded, solid-state gear quickly eliminates obsolete designs, this fine transceiver has more than held its own. Over the years revisions have been made to the original design. This article covers some important modifications to the KWM-2 family and describes how you can incorporate them into your unit to help bring it up to date.

the KWM-2

The Collins KWM-2 high-frequency transceiver is widely recognized as a superior piece of Amateur gear and is continuing a long and useful life. A decade ago a military overview of communications equipment in governmental service praised the KWM-2 for reliability, ruggedness, and ease of

*Gus Browning, W4BPD, tells the story of a KWM-2 he took along on a DXpedition in the Indian Ocean. It was dropped overboard by a crew member during an attempt to land on an obscure island. Native divers finally fished up the KWM-2 and brought it ashore. After flushing with fresh water and drying out for a few hours, the rig was hooked up — and it worked! The only casualty was the meter movement, which had opened up. A local artisan repaired the meter winding and Gus was back on the air.

repair. Countless thousands of Amateurs agree with this conclusion.*

While the newest KWM-2s retain the original classic appearance, numerous revisions and modifications have been incorporated over the years which make the modern version easier and better to operate than the older sets. Some of the important modifications that can be made by the advanced Amateur with adequate test equipment are described here. For those who don't want to dig into their transceiver, information is furnished on getting the more sophisticated and difficult modifications made by a professional. In any event, before undertaking any revision or modification to your KWM-2, make sure the change has not already been incorporated into your equipment. Many hams own second-hand units, so it's wise to make sure your manual agrees with the particular transceiver you own, at least as far as the schematic and voltage charts are concerned. Be suspicious of an older model KWM-2 that has a new manual. The two may not be in exact agreement.

All modifications should be made with a 40-watt (or smaller) soldering iron, so as to protect the insulation on wires next to the soldering iron. A magnifying glass is helpful, as are needle-nose pliers. You'll be working in an area with a high parts density and you don't want to damage some circuits while you modify others!

the "wing" versus the "meatball"

Around mid 1968, Collins changed their old winged emblem and adopted a new, round escutcheon known as the "meatball." This cosmetic change allows you to determine the approximate age of your

By William I. Orr, W6SAI, 48 Campbell Lane,
Menlo Park, California 94025

KWM-2, as the random serial numbers on the KWM-2 after 1968 no longer date the equipment for the layman. On the used-equipment market, the "meatball" KWM-2 commands a somewhat higher price than the older "wing" model. It's best to buy the KWM-2 on performance and appearance, however, and forget about the emblem. Sometimes you can realize a tidy savings by buying a "wing" model in good condition rather than the newer "meatball" model.

If you do buy a used KWM-2, check it carefully in both transmit and receive modes on all bands before you part with your money. Look under the chassis to make sure the previous owner hasn't made his own unique (and often unworkable) modifications. Many good KWM-2s for sale are showing up in the classified ads, as bedazzled hams trade in their units for the latest solid-state transceiver complete with bells, whistles, and a six-month wait for replacement parts. Good! Their loss is your gain if you want to own a rugged and reliable transceiver that you can service and repair yourself.

minor bugs you may not have observed the first time around

Transmitter instability? Signs of oscillation?

Before you tear things apart or attempt reneutralization of the amplifier stage, remove the amplifier-compartment lid and make sure the tube shield of the 6CL6 driver stage (V8), is firmly in place. A loose tube shield can play havoc with transmitter operation!

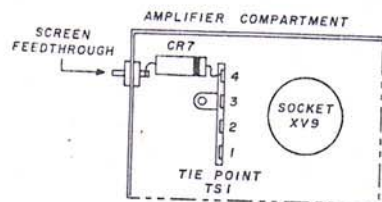
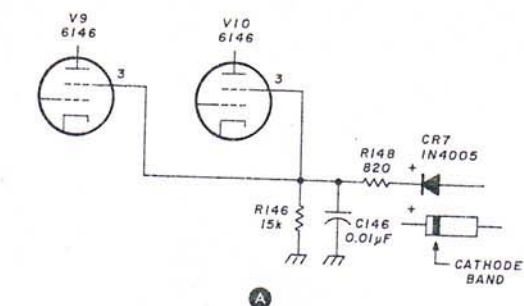


fig. 1. Diode CR7 placed in amplifier screen circuit protects receiver from blocking caused by screen emission of 6146 tubes. (A) circuit modification, (B) diode placement.

Receiver blocking on switch-over? Sometimes you'll notice a delay of up to 30 seconds during which time the receiver is blocked and no signals are heard after switch-over from the transmit mode. This problem is caused by screen emission from the 6146 amplifier tubes (V9), (V10), which paralyzes the receiver agc (automatic gain control) circuit. New 6146* tubes will sometimes cure this annoying problem, but a permanent fix is easily achieved by placing a diode in the amplifier screen power lead, which blocks negative current (fig. 1). This mod is easily and quickly made in the bottom of the amplifier compartment. The diode is substituted for the wire lead between the screen feedthrough terminal in the compartment wall and nearby socket tie-point strip (TS1). The diode anode is connected to the feedthrough terminal. Put insulated sleeving on the diode leads. This mod has no effect on transmitter performance.

ALC meter instability? Does the zero reading of the alc meter float around during transmit, or does it gradually drift up-scale as the KWM-2 warms up? This annoying fault can usually be cured by replacing capacitor C157 (0.01 µF, 200 volts) with a new low-leakage mylar or polypropylene unit. You'll find the old unit attached to pins 1 and 3 of socket XV17A (6BN8).

Equipment runs hot? Short tube life? The 6U8/6U8A and 6AZ8 tubes in the KWM-2 are said to have short lives. The grapevine suggests replacing the 6U8/6U8A with a 6EA8 for longer life. This can be done in most sockets, with no change in performance, except for the 6U8/6U8A used as the audio tone oscillator (V1). Some 6EA8s will not work in this circuit, and others will distort the audio tone signal, which then bleeds into the receiver audio system during CW operation. Stick with the 6U8/6U8A in this socket and look for short-life tube problems elsewhere.

In some KWM-2s the low-voltage dc supply (supposed to be a nominal 275 volts) runs from 300 to over 340 volts when the standard Collins 516-F2 power supply is used.† No wonder some of the small tubes are cooked! Measure your low-voltage supply. It should not run much over 290 volts on receive and

*Folklore has it that either 6146B tubes won't perform properly in the KWM-2, or that 6146Bs are the only tubes to use in the KWM-2. Forget both of these fairy tales. The differences between the 6146, 6146A, and 6146B are minimal (mostly being one-upmanship in advertising policy). All do the job equally well. It's not necessary to match 6146-type tubes, either, although it's suggested that a 6146A not be used with a 6146B.

†Overvoltage is presumed due to various manufacturers having supplied the power transformer and filter chokes. Design and windings of these components seem to vary, especially in the dc resistance of the transformer or choke coils. This could account for the voltage variance.

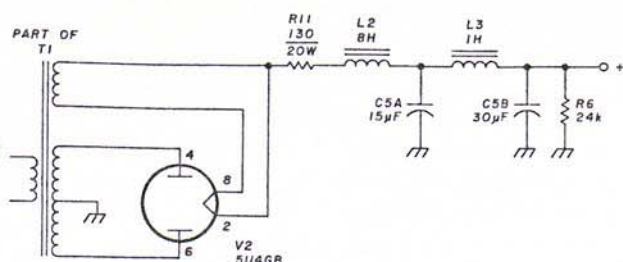


fig. 2. Voltage-dropping resistor R11 added to reduce low voltage to small tubes in KWM-2. A heat-dissipating resistor in a finned housing is recommended. This is bolted to the chassis sidewall near the 5R4GY socket. A Dale type RH-25 resistor or equivalent is suggested.

260 volts on transmit. If the voltage is much higher than these values, add a 75-150 ohm, 25-watt wire-wound dropping resistor, R11, as shown in fig. 2. The small tubes in the KWM-2 will run much cooler if you do this. The 5U4GB rectifier in the power supply should be replaced with a solid-state plug-in rectifier, and the resistance value of R11 should be chosen to deliver the correct voltage. Substitution of the rectifier improves regulation and removes 15 watts of filament power from the supply transformer.

You should also replace the 5R4GY high-voltage rectifier with a suitable solid-state plug-in device. This action will remove an additional 10 watts of filament power from the transformer and will increase the B-plus voltage by about 40 volts, providing a few more watts of power output and a cooler-running transformer. This simple substitution also boosts the 6.3-volt filament supply, which is marginal at best. You'll probably have to readjust the amplifier bias control, R9, in the supply for the correct resting plate current of the amplifier tubes after these mods have

been made (40 mA for general use or 50 mA when driving a linear amplifier).

Old filter caps in the power supply? It's a good idea to replace the high-voltage filter capacitors and the bias filter capacitor in the power supply if the KWM-2 is an older model. The capacitors become leaky with age and the capacitance value drops off at the same time. You can put more microfarads in the same space occupied by the old units and this improves the supply's dynamic stability. When you put the new capacitors into the circuit be sure to observe polarity, for the bias capacitor, which is hooked up "backwards," with the positive terminal grounded. Capacitors C2, C3, and C4 can be replaced with equivalent 80-µF, 450-volt units, and C5A-B can be replaced with a dual 30-µF, 250-volt unit. Capacitors C6, C7 can be replaced with 40-µF, 250 volt units. Unless the shunt capacitor, C1, is defective (a rare occurrence), don't bother to replace it.

Dial chatter or backlash? Underneath the VOX plate atop the main tuning dial assembly is a small idler pulley mounted to the front panel to the left of the dial mechanism (as viewed from the front). This pulley holds the two dial plates in alignment as the dial is rotated. Unbolt and lift up the VOX plate; this requires removal of one screw at the top left of the plate and two screws above the panel escutcheon. Now you can see the dial pulley. If it's loose it will rattle, and the dial will show backlash to a greater or lesser degree. The amount of mesh with the dial mechanism is determined by the center screw holding the gear. For a quick fix, loosen the screw and slide the gear into the dial mechanism a very small amount and retighten. Caution! The gear-retaining screw is very short. Don't loosen it too much or it will

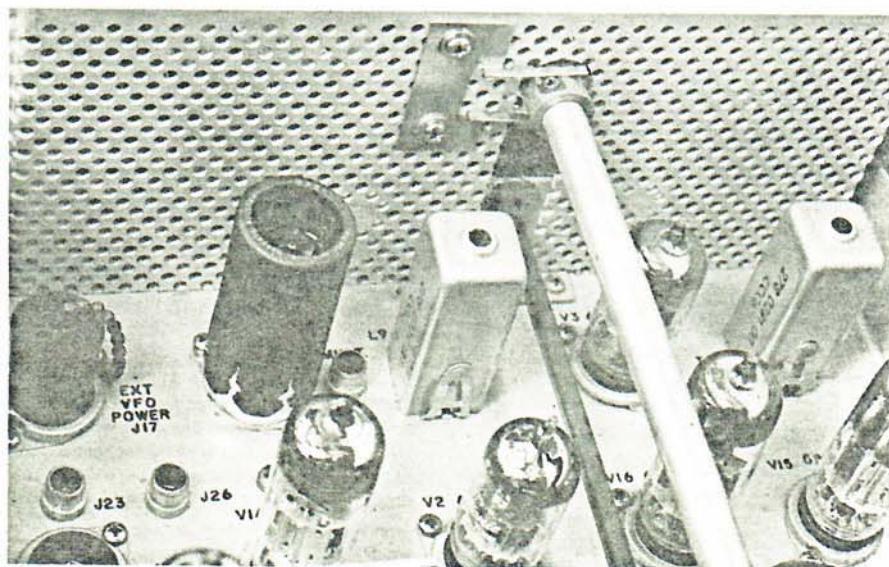


fig. 3. Grounding clip on amplifier loading shaft reduces harmonics escaping from amplifier compartment. Tube shield on V1 (6AZ8) decreases tube temperature. Heat sink shield is used.

fall out and you'll lose dial alignment. However, if you hold the two dial disks together to keep them from losing alignment, you can completely remove the idler gear and coat the gear shaft with silicone grease, which will eliminate dial rattle. Maintain the position of the dial plates so that you don't lose calibration.

TVI on 10 meters? Why do some KWM-2s show bad TVI on 10 meters while others don't? And why does the TVI often worsen when you bring your hand near the final amplifier tuning/loading panel controls? The answer is that these concentric shafts come out of the amplifier compartment and are insulated from the front panel of the KWM-2 by an almost invisible panel bushing. In effect, the shafts act like a radiating antenna for amplifier harmonics that would otherwise remain bottled up in the amplifier compartment. A shaft grounding clip* bolted to the outside of the amplifier enclosure (as shown in fig. 3) grounds the outer shaft and reduces the harmonic signal at this escape point to near zero. The grounding clip is held in position with (4-40) hardware.

If your KWM-2 doesn't incorporate a vhf choke (L128) in the power amplifier B-plus lead immediately following plate choke L17, a 120- μ H choke should be added to prevent harmonic currents from passing into the power supply (fig. 4).

Receiver i-f tube V1B run hot? Place your hand on V1, the 6AZ8 i-f amplifier tube after the KWM-2 has been running for a few hours. Wow! Hot! No wonder this tube is said to have a very short operating life. And no wonder the S-meter zero-signal reading shifts about on the scale. The latest versions of the KWM-2 have incorporated a protective resistor (R75) in series with pin 3 (cathode) of tube V1 to ground to limit plate current. If you don't have this resistor in the circuit, a 10-ohm, 1/2-watt resistor placed in series with the ungrounded terminal of the receiver GAIN ADJUST potentiometer, R132, mounted on the VOX plate, will help reduce the tube temperature. In addition a heatsink-style tube shield† is placed over V1.

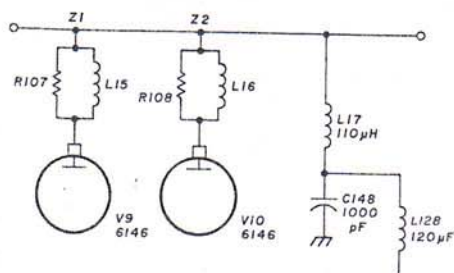


fig. 4. Vhf choke (L128) in B-plus lead to final amplifier helps suppress TVI-causing harmonics. A J.W. Miller 9360-13 choke rated at 400 mA is suggested.

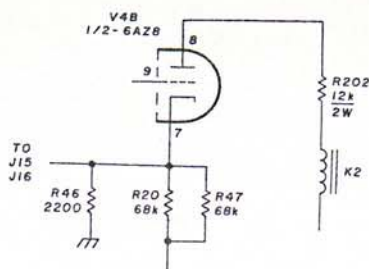


fig. 5. Modified VOX relay control circuit. Resistor R202 is added to reduce current through the relay coil. It may be necessary to reduce the value of the resistor in some cases to provide proper pull-in current. In some KWM-2s resistor R202 is 330 ohms and is located in the cathode circuit between pin 7 of socket XV4 and the circuit to J15 and J16. In this case, no plate resistor is required. In some units resistor R46 is 3.3k. It should be replaced with 2.2k for this modification.

Heat-sink shields are hard to come by, but perhaps your friendly electronics store (or the local flea market) has some. A retainer mounting shell is also required. The shell is mounted to socket XV1 using the existing mounting bolts. You'll probably find (as I did) that the mounting shell has a negative clearance with respect to the socket. The solution is to cut tiny slots around the bottom edge of the shell with metal snips. Cut to a depth of about 1.5 mm (1/16 inch) then bend out the tabs you've made with a pair of long-nose pliers. The shell will then fit snugly over the socket rim. Snap the heat-sink shield over the tube, and longer tube life will be your reward.

Relay problems? Some KWM-2 owners have found to their sorrow that the coil of VOX relay K2 burns out after prolonged use. The popular and expensive solution is to get a "meatball" KWM-2 with plug-in relays. However, a circuit modification somewhere along the long production history of the KWM-2 has solved this vexing problem, even in some of the older models. A 12k, 2-watt safety resistor (R202) is placed in series with the plate of the VOX relay amplifier tube, V4B, fig. 5. If your KWM-2 doesn't have this modification it's a good idea to incorporate it, as it might save you a destroyed relay coil. The resistor can be mounted between pin 8 of socket XV4 and a tie-point epoxied to the chassis near the socket.

Lack of receiver sensitivity on some bands? Even after repeated alignment some KWM-2s show

*The Collins part number of the grounding clip is 553-2555-002. You may be able to obtain a clip from Dennis Brothers, WA@CBK, Route 1, Box 1, Potter, Nebraska 69156.

†Suitable heat-dissipating tube shields are manufactured by, and available from, International Electronic Research Corporation, 135 West Magnolia Boulevard, Burbank, California 91502. The shield cools tube bulb temperature to below that of the bare bulb. A type TR6-6020B shield is used for the 6AZ8 or 6U8/6U8A. A TR6-6025B is recommended for use with the 6CL6 driver tube.

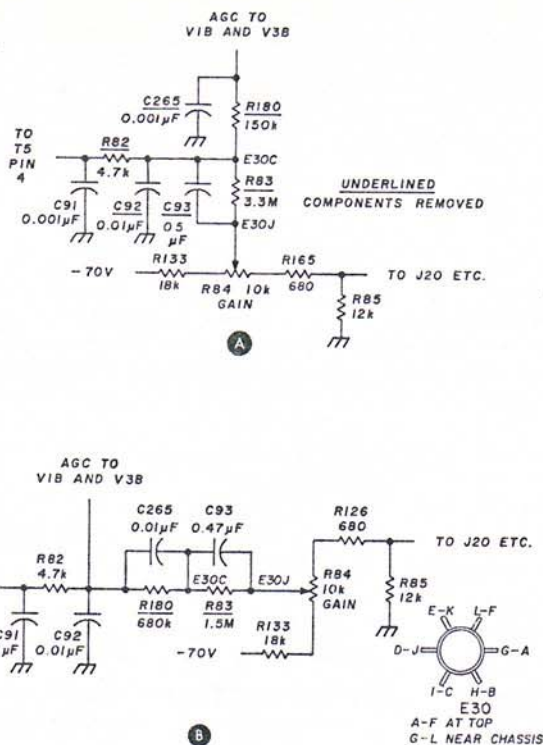


fig. 6. KWM-2 mods to improve agc response. Original circuit is shown in (A). Circuit in (B) is the modified setup as described in the text. Terminal support E30 is adjacent to the audio output transformer T6. Terminal TS8 is equidistant from E30 and T6.

poor sensitivity on some bands, or sensitivity seems to change when sidebands are switched. This problem can be caused by signal overload from low-frequency sideband oscillator V11A, whose signal is coupled into the receiver section wiring harness.

The culprit is rf choke L22 in the crystal-oscillator plate circuit. The choke is part of a tuned circuit and can radiate energy furiously. Radiation from this inductor can get into circuits where it doesn't belong and reduce overall receiver sensitivity. The cure is to remove choke L22 and replace it with a shielded rf choke. A parasitic suppressor (R195, 47 ohms, 1/2 watt) should also be placed in series with the grid, pin 2, of socket XV11A.

Receiver agc pumping and overshoot on noise pulses? Some of the older model KWM-2s use the agc time constant circuit shown in fig. 6A. A newer circuit is also shown in this illustration. The components to be changed are on terminal support E30, shown in the technical manual. These are R82 (4.7k), R83 (3.3 meg), C92 (0.01 μ F) and C93 (0.05 μ F). In addition, R180 (150k) from terminal TS8-1 to E30J, and C265 (0.001 μ F) from TS8-1 to the power-conductor grounding ring are removed. (Note that R180 and C265 are not incorporated in some early models.)

The following components are now added:

1. Connect new R83 (1.5 meg) from E30C to E30J.
2. Connect new C93 (0.47 μ F) from E30C to E30J.
3. Connect new R82 (4.7k) from T-5 terminal 4 to TS8-1. Use sleeving on leads and route around E30.
4. Connect new R180 (680k) from TS8-1 to E30C.
5. Connect new C265 (0.01 μ F) from TS8-1 to E30C.
6. Connect new C92 (0.01 μ F) from TS8-1 to ground ring on power connector J13. Check wiring against fig. 6B. Mark the modification in your manual for reference.

Agc overload and audio distortion on strong SSB signals? It's recommended that this useful modification be performed along with the previous one in cases where both arrangements are missing from the transceiver. This modification adds hang agc to the receiver rf amplifier (fig. 7) and greatly improves strong-signal reception. Refer to the under-chassis layout of fig. 2 for placement of parts:

1. Remove screw and lockwasher nearest front panel used to secure audio transformer T6.
2. Install a two-terminal, lug-type strip on T6 using screw and lockwasher.
3. Disconnect the white-green-blue wire at TS8-1, pull it back through the cabling and reconnect it to terminal 1 of the newly installed lug-type strip. Call this new strip TS11.
4. Connect R213 (2.2 meg) from TS11-2 to TS11-1. Use sleeve resistor leads as necessary.
5. Connect diode CR11 (1N458) from TS11-2 (cathode) to TS11-1 (anode). Use sleeve diode leads as necessary.
6. Connect C276 (0.05 μ F) from TS11-1 to E30B.
7. Of the two white-green-blue wires connected to E40-I, disconnect and tape the end of the one showing continuity to TS11-1. You'll have to disconnect both wires to make this check, then resolder the wanted wire.
8. Connect an insulated wire from E40-I to TS11-2, routing it along the cabling. Check wiring against fig. 7. Mark the modification in your manual for reference.

Audio distortion on strong signals? Aside from the above modification, another cause exists in some KWM-2s for fuzzy audio. Place a 0.01 μ F, 600-volt capacitor from the screen of audio output tube (V16B, pin 8) to ground. Also place a 56-ohm, 1-watt

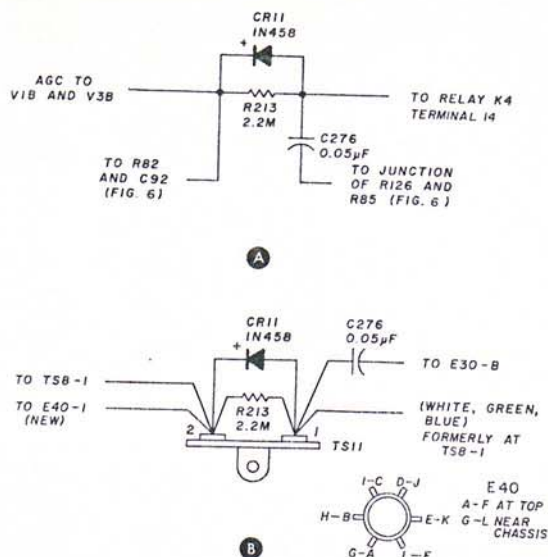


fig. 7. Adding hang agc to your KWM-2, (A). Parts placement is shown in (B). (See also fig. 2.) Terminal support E40 is between socket XV16 and inductor L9. New resistors are ½ watt.

resistor from the yellow (4-ohm) lead of output transformer T6 to ground. These mods will eliminate a weak audio parasitic oscillation sometimes encountered in some receivers.

general modification notes

Modification of the KWM-2 is not recommended for those who have no experience working with small components in cramped spaces. Many KWM-2s are wired with PVC wiring insulation, which melts quickly at the inadvertent touch of a soldering iron. Always check transceiver operation before and after each modification. After your modification, check for wiring errors or shorts and make sure that small specks of solder and wire are blown out of the chassis before power is applied. Also be aware that I've not seen *all* existing KWM-2s and that these mods may not work as shown with some transceiver variations. If you don't understand your present circuit wiring or if it doesn't match the schematics, don't attempt the modification!

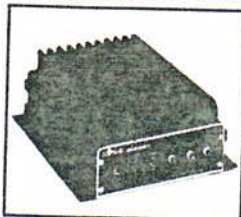
where to get help

This material has been prepared with the help of Dennis Brothers, WA0CBK, formerly an engineering technician of KWM-2 production at Collins-Rockwell Company. For those not wishing to make these (and other more sophisticated modifications) themselves, I suggest they contact Dennis at Western Nebraska Electronics, Route 1, Box 1, Potter, Nebraska 69156. A self-addressed, stamped envelope for rapid reply is requested.

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