



S-Line and KWM-2/2A PTO & Dial Removal, Replacement  
And Reassembly Instructions (Including Calibration)  
As Extracted from Collins Radio SB 1011 dated 6-26-63

**Description of S-Line and KWM-2/2A Dial Assemblies  
and Their Alignment Procedures.**

Tuning of the amateur equipment vfo is accomplished through the use of two separate adjustable components. These are:

1. The calibrating fiducial with the red calibrating line.
2. The dial assembly which includes two dial discs mounted on the vfo shaft.

The calibrating fiducial is driven by rotating the zero set knob located in the upper right-hand corner of the black escutcheon. Driving torque is transmitted to the fiducial through a set of two friction washers - one washer bearing on either side of the fiducial near the top edge.

In the event that the fiducial becomes bound, or its operation becomes irregular, the following adjustment procedure should be performed:

1. Loosen the setscrew on the zero set knob using a No. 4 Bristo wrench.
2. When the knob is turning freely on the drift shaft, rotate no fewer than five complete turns while at the same time pressing it lightly against the escutcheon. This allows the friction drive washers to center themselves with respect to the fiducial and, at the same time, keep the end play at a minimum.
3. Tighten the setscrew back in the knob and check the operation of the fiducial.

If the above procedure does not improve the operation of the fiducial, replacement parts are probably required (See complete SB1011 for a complete parts list by model) and further checks should be made by factory qualified personnel.

The two dial discs of the dial assembly are, in addition, two gears. The number of teeth on each of these two gears is not equal, and when they are brought into mesh with a common idler gear, as is done in the S-Line and the KWM-2/2A, relative motion is produced when the gears are rotated. This relative motion is used to mask out one of the two sets of numbers which are printed on the rearmost dial - thus allowing two revolutions of the assembly over a bandwidth of 200 kilocycles. This arrangement makes it possible to double the space between two consecutive kilocycle graduations and, therefore, permits more accurate tuning of the vfo.

Improper mesh of the idler pinion with the dial discs may cause the dial to malfunction in one of the following ways:

1. Too great a mesh will prevent the dial from being driven by the tuning knob, or may cause it to hesitate as it is being driven across the range in one or more places.
2. Too little mesh may cause the proper relative position between the two dials to be lost.

In the event that one of the above symptoms is present, the following procedures should be performed:

1. Dismount the light bracket by removing the two black oval-head screws from the top of the escutcheon. In the KWM-2/2A, an additional self-tapping screw must be removed from the extreme left side of the light bracket, as viewed from the front of the radio. This will expose the idler for visual inspection. Care should be taken when removing and replacing the self-tapping screw so that new threads are not created rendering the screw attachment ultimately useless.
2. Check the mesh between the idler and the two dials while rotating the dial through its range. The proper mesh is between 30 to 70 percent of the gear tooth depth.
3. If necessary, adjust the position of the idler gear by first loosening the Phillips-head screw through the hub of the gear until the idler can be moved freely. Then hold the idler in the desired mesh position while the hub screw is tightened.
4. If the relative position between the two dial discs requires correcting, the idler gear must first be taken out completely and then replaced after the correct relationship and position has been obtained.
5. Before the light bracket is replaced, the calibration of the dial must be checked with the calibration signal and corrected if necessary. For adjusting the 75S-1 (or later receivers) and the KWM-2/2A, select either SSB mode and rotate the vfo shaft for zero beat against the crystal calibrator signal. The 32S-1 transmitter calibration may be set by placing the transmitter FREQ. CONTROL in the sync position and tuning for zero beat against the receiver indicated frequency.
6. (Of course, with more modern test gear, a frequency counter can be used here for procedure 5. above)

The dial assembly, which includes the two dial discs, the black nylatron drive ring, and the aluminum hub, is assembled with six 0-80 screws whose screw heads are visible on the back of the aluminum hub. If these screws are not properly tightened, the dials may be free to turn relative to the oscillator shaft and, hence, cause the dial to drift out of calibration. If these screws require tightening, **carefully make the following check.**

On older units of the S-Line and the KWM-2, an all nylatron drive ring was used. These units can be identified by the absence of split lock washers under the 0-80 screw heads and by the presence of blue liquid varnish (blue Glyptal) applied as a liquid stake/lock for the screws.

On newer units of the S-Line and the KWM-2/2A, a drive ring with an aluminum outer rim is used and these units can be identified by the presence of split lock washers under the 0-80 screw heads.

On the older units, the screws must be **only lightly tightened - repeat - lightly tightened**, and then liquid stake or cement can be applied to hold them. Over-tightening will strip the screws and ruin the assembly. It is recommended that each screw be removed individually (after completion of assembly) and liquid stake be applied to the threads and then re-inserted.

On the newer units, a minimum of 7 inch-ounces of torque should be applied when tightening these screws. No liquid stake is desirable.

Seven inch-ounces of torque is roughly equivalent to the maximum **normal** torque that you can apply by hand using a normal small screwdriver.

If the dial operation continues to be erratic after the above operations have been performed, no further corrective action should be attempted by the operator (sic). Special equipment and some experience are required to carry out any further adjustments and/or repair. (in other words, read the documentation and get help the first time around - proceed with caution.)

The installation of new dial parts, along with the required disassembly and re-assembly, require a complete understanding of the dial mechanism and its operation. The tools that are required are a Phillips-head screwdriver, No. 4 & 6 Bristo wrenches, a 3/16 inch Spin-Tight (nut driver) or wrench, a long nose pliers, and a thin blade small cabinet screwdriver. The new parts are lubricated before they leave the factory, and no further lubrication should be applied (sic). (60 years later, a very light coating of silicone lubricant will preserve and smooth out operation. Do not over-lubricate. Spray lubricant on a soft cloth and allow the carrier to evaporate. Then apply. Do not apply directly. Do not apply lubricant to area where the drive washers will run.)

The dial assembly used in the S-Line and the KWM-2/2A is driven by the drive washers mounted on the tuning knob shaft. The principal of the drive mechanism can be demonstrated by placing the raised inner diameter of the black nylatron drive ring between the two sets of drive washers. Then, by rotating the tuning knob shaft between the fingers, it is possible to feel the transmitted torque in the dial assembly which is held in your other hand.

The procedure followed while you are installing new parts, or cleaning and repairing, will consist of three distinct phases. These are:

1. Disassembly
2. Installation of new or repaired parts, alignment, and then reassembly
3. Calibration.

The disassembly operation will involve removing the light bracket and the oscillator from behind the dial. When this is done, access to the dial itself is possible. The final step in the disassembly will be the removal of the black plastic escutcheon from the front panel of the unit. At this point repair or replacement of parts can begin.

To read and correctly interpret the newly assembled dial, it is necessary to calibrate it using signals of a known frequency. This calibration will be the final step of the assembly.

The following is a step-by-step description for each of the above three procedures:

## **1. Disassembly**

- 1.1 Remove the chassis from the cabinet by removing the 4 rubber feet and the single Phillips-head screw from the bottom of the cabinet. Now remove the two flat-head (FHP) Phillips screws which are under the lid at the front of the chassis. Pull the chassis forward out of the cabinet. Use caution to not scratch the trim ring while removing the chassis. (This removal is best done by putting the radio panel down in your lap and sliding the cabinet up.)
- 1.2 With the chassis right-side up on the bench, remove the 6AU6 tube from the top of the oscillator (PTO) chassis (Recommend that this be done prior to removing the cabinet). Now remove other tubes in the vicinity of the oscillator. This will eliminate the possibility of breaking them and give you more working room.

- 1.3 Remove the two black oval-head screws from the top area of the escutcheon (the black dial plate located in the top center of the front panel). In the KWM-2/2A, an additional self-tapping Phillips-head screw must be removed from the light bracket at the extreme left, viewing the radio from the front.
- 1.4 Pull the light bracket straight back until it is free of the screws and adjacent components.
- 1.5 Loosen the two setscrews on the dial hub (Hub to shaft) using a No. 6 Bristo wrench. (**Note:** Care should be taken when moving these shaft set screws to not over-tighten and leave a burr on the shaft that will hinder removal.)
- 1.6 Remove the two self-tapping screws which hold the oscillator assembly to the chassis.
- 1.7 Keeping the dial pressed toward the front of the unit with one hand, carefully pull the oscillator assembly back until the oscillator shaft clears the dial hub. (Maintaining the correct shaft alignment during removal will aid in smooth retraction.) (Set the oscillator back out of the way on a small pad to prevent scratching.) Remove the dial and set it to one side. It is not necessary to remove any electrical connections.
- 1.8 Remove the tuning knob by pulling it firmly straight away from the front panel.
- 1.9 The fiducial is the clear plastic sheet with the red calibrating line. This is held in position by an aluminum bracket at the rear of the escutcheon. Remove this bracket by removing the two Phillips-head screws that hold it in place.

Remove the idler assembly by removing the Phillips-head mounting screw which passes through the hub, and set it to one side.

- 1.10 Remove the zero set knob by loosening its setscrew with a No. 4 Bristo wrench.
- 1.11 Push (rotate) the fiducial to one side, past its stop, and pull the zero set knob shaft through from the rear of the panel. Leave the shim washers in place on the shaft. (A small rubber band wrapped around the shaft will keep them from getting lost.)
- 1.12 Remove the flat-head screw next to the tuning knob shaft, remove the escutcheon by pulling it straight out from the front panel. **DO NOT LOOSEN THE LARGE NUT ON THE PANEL BUSHING.**
- 1.13 Remove the snap ring <sup>(Note 1)</sup> from the tuning knob shaft at the front of the escutcheon and pull the drive washer assembly through the panel bushing from behind the escutcheon.

Note 1: A very decent set of Snap Ring pliers can be purchased from Harbor Freight on-line. Worth the investment if you are doing this often.

- 1.14 Remove the shim washers and snap ring from the drive washer assembly, and place on the new or repaired drive washer assembly components in the same order they were removed. (You are now ready for repair and replacement.)

## **2. Installation of New Parts, Alignment, and Assembly.**

- 2.1 Mount the new drive assembly in the reverse order of step 1.14 above.
- 2.2 Remount the escutcheon on the front panel by reversing step 1.13 above.
- 2.3 Remount the zero set knob and the fiducial in the reverse order of steps 1.11 and 1.12, making sure that the fiducial passes between the two sets of washers. Make sure that the fiducial operates freely, smoothly and with a minimum of end play before tightening the set screw on the zero set knob.
- 2.4 Remount the fiducial bracket in the reverse order of step 1.9. A small amount of art-gum eraser or bees wax placed on the end of the screwdriver will aid in holding the screws in place on the end of the tip while they are being inserted.
- 2.5 Mesh the raised inner diameter of the black nylatron drive ring with the drive washers. This operation can be viewed through the inspection hole in the hub. Use care and make sure that the ring surface seats in the space between the drive washers.
- 2.6 Holding the dial in position, insert the oscillator shaft through the hub and into the nylon bushing in the front panel. Turn the dial by rotating the tuning knob shaft to make sure that the dial is being driven. Tighten the set screw onto the oscillator shaft.
- 2.7 At this point, the oscillator must be aligned so that no side load is applied to its shaft due to misalignment with the nylon bushing in the panel.

Viewing the radio from above, visually align the front surface of the oscillator chassis with the front panel and replace the two self-tapping screws which mount the oscillator to the chassis. As a check, turn the radio over and observe the alignment of the dial assembly with the front panel. The front surface should be parallel with the panel.

- 2.8 Loosen the two No. 6 nuts at the rear of the oscillator chassis until the chassis moves freely on the mounting bracket. Set the radio with the panel straight up, and rotate the tuning knob until the oscillator centers on the mounting bracket. The oscillator should now be aligned horizontally. (Step 2.7) and vertically. Very carefully, without moving the oscillator chassis, tighten the two No. 6 nuts, and set the radio in the upright position.

- 2.9 Once again, loosen the two setscrews in the dial hub until the dial assembly is free to turn on the oscillator shaft. (You didn't make burrs - right) Rotate the tuning knob no fewer than 8 complete revolutions to allow the dial assembly to seat itself axially with respect to the drive washers. **Do not tighten the setscrews at this time.**
- 2.10 Set the fiducial until the red line is vertical. Then align one of the 10 kC marks behind the red line. Directly behind this, align the center digit of a 3 digit number.
- 2.11 Carefully mount the idler assembly, referring to step 1.10 and making sure that the dial alignment is not disturbed. Make sure that the washer behind the idler gear lies between the fiducial and the clear plastic dial.
- 2.12 Rotate the dial by turning the tuning knob shaft, and check for interference between the idler and the dial. If there is interference, loosen the idler mounting screw, and pull the idler away from the dial. Tighten the mounting screw and recheck the interference and the gear mesh - making sure that you have from 30 to 70 percent mesh during a complete revolution of the dial.
- 2.13 Replace the tuning knob and tighten the setscrew.

### 3. Calibration

- 3.1 Tighten one of the set screws on the dial hub, and rotate the dial counterclockwise until it comes up against the mechanical stop on the vfo.
- 3.2 Loosen the one setscrew and rotate the tuning knob counter clockwise holding the oscillator shaft absolutely fixed - until the dial has passed 6 to 7 kC marks past the zero mark. Tighten both set screws. Do not over-tighten.

(To align the numbers so that they appear centered in the window in the mask (if there is any error), loosen the VFO setscrew again, and holding the shaft from rotating, rotate the dial assembly - in the direction that corrects the error - up to several revolutions and the numbers will center themselves in the window. Again tighten the two setscrews.)

- 3.3 Rotate the dial clockwise until it comes against the stop. Check to make sure that the dial has come to a stop approximately the same number of 1 kC marks beyond the 200 mark as it did beyond the 0 mark in the counter-clockwise direction. If it does not, repeat 3.2 with the intent of getting an equal number of kC marks beyond the 0 and the 200 marks.
- 3.4 Final Calibration of the dial is accomplished as follows:
  - a. Replace the 6AU6 and the other tubes that were removed.
  - b. Make the external power connections
  - c. Adjust the zero set until the red line is vertical

- d. Turn on the receiver (or KWM-2/2A, 32S-X), and rotate for a zero beat against the calibrator. (At this point, some 50 or 60 years after manufacture, you should either put the crystal calibrator on a frequency counter using a method that will not pull the oscillator, or using a receiver, zero beat the calibrator against WWV during the last 10 second quiet period of every minute, and adjust the calibrator. We have seen many receivers calibrated to a calibrator that was as much as several kC off frequency. Get the calibrator on frequency first.) For the 32S-X, either use a frequency counter, or place the **FREQ. CONTROL** in the **SYNC** position and rotate for zero beat against the receiver indicated frequency. If the 32S-X dial is out of calibration with the calibrated receiver, loosen the setscrews on the aluminum hub in the transmitter and rotate the VFO shaft slightly for a zero beat condition. This should be done with the red fiducial line vertical. Retighten both set screws in the aluminum dial hub. Check the calibration of the dial at all three 100 kC calibration points. The dial should be within + or - 1 kC across the dial after calibration at the mid - 100 kC mark.

3.5 Remount the light bracket in the reverse order of steps 1.3 & 1.4.

3.6 Remount the chassis in the cabinet in the reverse order of step 1.1. You should again remove the 6AU6 VFO tube from its socket during the cabinet replacement. Start with the radio panel down in your lap and lower the case down over the chassis maintaining clearances so that you do not scratch the inside of the trim ring. Then reach under the trim ring with your fingers of both hands and press the panel up tight into the cabinet while you rotate the cabinet (and chassis) to the horizontal position where you can insert the screws. Watch lid alignment to the case with the lid closed as you replace all screws and you will get a nice straight case when the screws are tightened. Replace the 6AU6.

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Editor's Note: For servicing the 70K-2 S-Line or KWM-2/2A PTO internally (to remedy end point or linearity/tracking issues), please refer to the excellent article by Jim Miller, N4BE. This can be found on the CCA website at [collinsradio.org](http://collinsradio.org). Go to the home page, click on the PTO Service link on the right hand side and then select "70K-2 Stability Service".