Ceramic Tube Sockets & Power Relay for the Collins 516F-2

Collins Radio Association

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The Collins 516F-2 power supply has a tendency to arc across the 5R4 socket to the chassis and across the AC contacts within the power switch of the 32S- or KWM-2/2A. The modifications described here will address both issues. The first modification replaces the original 5R4 tube socket with one of two types of ceramic sockets. The second modification adds a relay to the 516F-2 to provide the actual on/off power switching. The end result of these changes is improved reliability and less maintenance.

**Part-I: The Tube Socket**

Figure 1 illustrates two types of chassis mounted ceramic octal sockets. On the left is a high quality direct replacement socket produced by E.F. Johnson. The larger socket on the right is a Millen 33008 socket. Both sockets are available through the Internet [see the addendum page at the end of this document]. Since arcing occurs at the 5R4 socket XV1 replacing the 5U4 socket XV2 is unnecessary. I decided to replace both sockets for illustration purposes. Whether you decide to replace one or both sockets the installation procedure is identical. Figure 2 shows the original socket along side the Millen replacement.
To replace the original socket with an identical size ceramic socket is a simple procedure. However, installing the Millen socket requires increasing the cutout to 1¼-inch diameter. I performed the operation in less than one hour using a 6-inch by ½-inch semi-circular hand file.

Before you remove the original socket record the wiring to each pin. Unsolder or cut each lead as close to the pin as possible. Unless the socket was replaced previously lead-length should not be an issue. Install the new socket using the same hardware. If you intend to use the larger socket consider 6-32 screws with a slightly larger head. Along with the mounting flange the larger-head screws will hide the mounting holes vacated by the original socket.

To enlarge the socket opening draw an accurate outline as a guide. First draw a line through both mounting holes. Measure out 1¼ inch and draw a circle to that diameter as accurately as possible around the original hole as in Figure 3. Apply clear cellophane shipping tape to the chassis in order to protect it from scuffing and damage. Now, with the oval side of a hand file, file the chassis cutout up to the outlined circle. Use care and watch for interference with components mounted below. As you enlarge the cutout continuously check for roundness and fit. The size of the cutout should allow the socket and its spring-steel wavy washer to fit through the enlarged hole. The mounting flange must sit flush to the chassis, and the socket should rotate without binding.
Insert and rotate the socket until the holes in the mounting flange are centered over the line you drew across the chassis. Mark the chassis through the center of the flange slot. By referencing the center of the elongated slot, a large headed Phillips screw will cover the remains of the vacated hole. The result will be a clean professional look. Center-punch the two marked locations to insure drilling accuracy. Start with a small lubricated bit and work up to the correct 6-32 size. Rotate the drill as you proceed to prevent “walking.” Figure 4 illustrates the completed cutout. Should you decide to replace both sockets [with the Millen type] I recommend that you enlarge the second cutout at this time.

With the filing completed clean and vacuum both sides of the chassis. I found it necessary to loosen the choke and transformer mounting hardware, and cut some lacing cord [or cable ties] in order to remove unseen metal chips. Clean the transformer and choke cable accesses using a moist Q-Tip. Understand the importance of removing all metal debris before proceeding. Now mount and secure the new socket using the keyway orientation pictured in Figure 5. A close inspection will show the 6-32 hardware covering the original socket’s mounting holes. Reconnect and solder all leads and components to their particular socket pins. Recheck the wiring against the schematic and the list you made earlier.

When rewiring the socket, note the possibility that lead-length may be an issue. If capacitor C1 and the harness leads are not of adequate length, Figure 6 shows an optional Cambion standoff solder terminal supporting C1. A short piece of wire then extends the run to the socket. The solder terminal threads over the original mounting screw hex nut. An internal-tooth lock-washer sits between the two. The lock-washer secures the terminal while reducing the chance of ejecting the Teflon insulator from its mounting nut.
While you’re under the chassis check and re-solder an obscure ground jumper running between the shield of the DC output cable and terminal strip TS2. The shield is an active part of the filament distribution. Figure 7 shows the shield exiting the cable jacket. Also insure that the two cable clamps are secure.

![Figure 7: Filament ground](image)

Furthermore, if you have not yet done so, consider replacing the selenium rectifier used in the BIAS supply with a silicone diode. A 1N4004 is more than adequate. The example photographed in Figure 8 shows a 1N540B mounted across a two-lug terminal strip. These two maintenance issues should be addressed whenever a 516F-2 is serviced. Lastly, spray and wipe with Armor-All the two large rubber grommets found in the 516F-2. A little Armor-All on both power cables will also prevent drying and cracking.

![Figure 8: Selenium rectifier replacement](image)

After returning the tubes to their particular sockets, connect the supply to your KWM- or 32S- and apply power to the 516F-2. Hopefully you use a Variac or a bucking transformer to maintain the AC input within 115-117 volts. Maintaining the filament voltage at 6.3vac is the best indicator for correct line voltage. Power up your equipment and measure the voltages. The chassis photo on the addendum sheet following this document shows the voltage test points. Note that if you intend to use a DVM to measure voltages, check its maximum allowable DC input level. Most DVMs can’t take 800-1200vdc without a HV probe. And lastly, while testing your transmitter take a pencil and tap the eraser on the top and sides of each tube. Should either tube arc internally replace that tube and repeat the test.

Since the completion of this project in 2000, neither of two modified power supplies has arced even during Field Day exercises when powered by generators with questionable outputs. What once was an ongoing maintenance headache is now a thing of the past. The continuing need to replace tube sockets has reached an end.
Part-II: The Power Relay

The Oak 10070-4 power switch [p/n 259-8011-010] used in the Collins KWM-2/2A and 32s-series units is another underrated component that is highly prone to arc-over. I’m referring to that small, plate-mounted “snap-switch” secured to the rear of the front panel rotary power switch. By installing a small power relay within the 516F-2 arc-over within the switch will be eliminated. The switch will last far longer since the relay reduces the power surge from amps to milliamps.

![Image of the relay](image1.png)

**Figure-9**
The NIAS/Aromat Power Relay

The relay of choice for the 516F-2 is the NAIIS/Aromat power relay model JA1A-TM-AC115V. It is a SPST, 115-vac relay with a 15-amp AC contact rating [Not available in 240-vac]. For order information see the addendum sheet. Figure 9 shows the relay as received. To inspect the contacts separate the lower housing. Dimensions (in mm) and schematic are pictured in Figure 10.

![Image of relay dimensions and schematic](image2.png)

**Figure-10**
Relay Dimensions (in mm) and Schematic

Relay operation within the 516F-2 is quite simple [Refer to the modified schematic at the end of his document]. AC neutral is applied to the cold side of the coil. AC hot goes to the N/O contact. When the PWR-ON switch from the controlling device is closed, AC from P1-5 is applied the hot side of the coil energizing K1. The N/O and COM contacts close applying AC to the primary of T1. K1 handles the full inrush surge current with only 11ma flowing through the power switch.

The key component that allows this relay to be hidden below the chassis, and defines its physical position, is the replacement and relocation of C1. As Figure 11 will show, K1 is positioned and secured to the inner chassis lip just forward of socket XV1. C1 is reinstalled after positioning K1. Since the full lead-length of C1 may be required, a replacement source is listed on the Addendum sheet. Figure 11 shows K1 mounted on the inner chassis lip between socket XV1 and the mounting hardware of choke L3.
Remove resonating capacitor C1 and position the relay as illustrated in Figure 11. Mark the drilling locations through both mounting tabs. Note the height and position of the relay at the edge of the chassis lip. Mark a reference point on the edge adjacent to the relay housing [at the arrow]. Now position the relay on the opposite side the chassis lip and again position the relay housing to that same reference point. Visually insure that the relay is just below the edge of the chassis lip and again mark the center holes of the mounting tabs. If you marked correctly the holes you drill will bore through the marks on both sides of the chassis. Drill carefully to avoid damaging internal components. Rotate the drill as you proceed. A small bit will allow some correction if you missed the mark, but complete one hole at a time. With the holes correctly positioned and sized, carefully countersink each hole. The use of flat-head hardware guarantees a flush fit when the 561F-2 is mounted inside the 30S-1.

Figure 11 illustrates the need for TS8, a standoff just to the left of C1. This solder terminal was added after installing a ceramic tube socket at XV1 [see Part-1 of this document]. The standoff supports C1 and a wire too short to reach its tube socket pin. Terminal standoff TS9, located just below C1, is necessary to extend an original lead to K1; it can be eliminated if a longer wire lead is used [see step 2, below].

Before wiring the relay remove it in order to allow one inch of additional lead-length. The extra slack will allow ease removal and replacement should it be necessary. To prevent shorting to the chassis, Spaghetti insulation should be used to protect all four solder connections.

The relay is wired as follows:

1. Follow the Power-ON control lead at P1-5 through the DC power cable to terminal strip TS1-3.

2. Remove the [GRY-WHT] wire from TS1-3 and reconnect it to K1-coil A. If this lead comes up short, splice and insulate an extension lead to a new solder terminal TS9. Extend that lead to K1. For a cleaner look replace the entire run with a longer lead.

3. Add a new [WHT] wire from TS1-1 to K1-coil B. This supplies AC neutral to the relay coil.

4. Add a new [ORN-WHT] wire from F1-Ring to K1-COM to supply fused AC to the relay armature.

5. Add a second [ORN-WHT] wire from TS1-3 to K1-N/O. This run connects the normally open relay contact to the switched side of the power transformer.

Note: [X-Y] refers to the original Collins color code
Check all wiring with the updated schematic found at the end this document. Insure that no short circuits or unsoldered connections remain. After securing K1 replace any missing lacing twine or cable ties.

Before using your 516F-2, check continuity from F1 through the Power-ON switch to K1-A. Insure the line from F1 to TS1-3 remains open until K1 is energized. With a short insulated jump wire, jump pins 5 and 7 of the DC power cable connector P1 and apply AC power to the supply. The relay should energize. Remove the jumper and the relay should de-energize. Reconnect your Collins transmitter and retest. You should hear a faint click when relay energizes. Congratulations. This completes the relay modification.

The procedures documented here focused on increasing the reliability and performance your 516F-2 without compromising its original design or internal components. Enhance with the modifications described, your 516F-2 will be prepared for another 40 years of faultless operation.

Stu Martin K2QDE
November 2005

Dedicated to Gene Senti, W0ROW
Collins Radio Company

“…a new step toward more perfect communication.”

The following pages have been updated with the modifications described above. They have been formatted for use in your manual
# 516F-2 Parts Manual Addendum

<table>
<thead>
<tr>
<th>IDENTIFIER</th>
<th>DESCRIPTION</th>
<th>PART NUMBER</th>
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<tbody>
<tr>
<td>XV1 &amp; XV2</td>
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<td>(TUA)TUBSOK8CER</td>
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<td>XV1 &amp; XV2</td>
<td>Millen Ceramic Socket</td>
<td>Millen #33008</td>
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<td>RS 900-2873</td>
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<td>TS7</td>
<td>Terminal Strip, 2 lug</td>
<td>Newark 28F651</td>
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<tr>
<td>TS8 &amp; TS9</td>
<td>Terminal Standoff</td>
<td>Newark 40F6203</td>
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<td>Relay, DigiKey 255-1142ND, or</td>
<td>Newark 94F3350</td>
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<td>C7</td>
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<td>Mouser 75-TVA1406</td>
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</table>

1. [www.suplussales.com](http://www.suplussales.com)
2. [www.jamesmillenco.com](http://www.jamesmillenco.com)
3. [www.electronicsurplus.com](http://www.electronicsurplus.com)

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**516F-2 AC Power Supply**

*Figure 7-1 (sheet A) rev 08/05 - k2qde*
NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS, AND INDUCTANCE VALUES ARE IN HENRYS.

2. SHOWN WIRED FOR 115 VAC. ROUND PIN ON P2 IS GROUND. IF MATING TYPE AC SOCKET NOT AVAILABLE, USE ADAPTOR AND GROUND GREEN WIRE.

3. REMOVE C1 WHEN USING A LINE FREQUENCY HIGHER THAN 60 HZ.

4. F1 IS 4 AMPERES FOR 115 VAC INPUT. FOR 230 VAC INPUT, REMOVE POWER RELAY K1, CHANGE F1 TO 2 AMPERES AND CONNECT PRIMARIES IN SERIES AS FOLLOWS:

5. CR1 IS A 1N4004

516F-2 AC Power Supply, Schematic Diagram
Figure 7-1