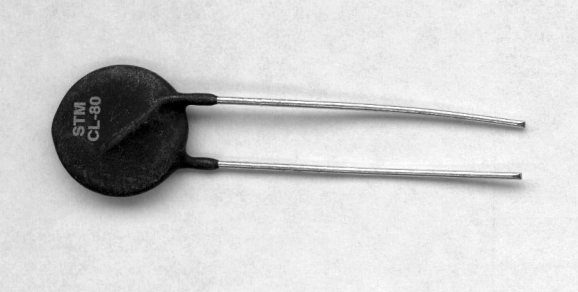
By Jan Skirrow

Taming Power-On Current Surge in the R-390A

When I bought my first R-390A, the radio lit up as soon as I plugged it in, even though the Function Switch was in the Off position.



I knew essentially nothing at that point about the R-390A, but with the help of the folks on the Boatanchors reflector I soon discovered that the microswitch used as the main power switch was notorious for welding in the On position. I was able to repair the switch, but was curious as to what might cause this problem, and what could be done to prevent it.

There seemed to be two views among R-390A enthusiasts. One was that the momentary arcing that occurs whenever a switch interrupts the current flow was the culprit. The other view was that the heavy current flow at the instant the switch closed was the problem. Having pondered this, I think both play a part!

When the switch opens, a momentary arc occurs. How significant the arc is depends upon several factors, including the point in the AC voltage cycle when the circuit is interrupted. Over time, the surface of the switch contacts will inevitably develop a certain amount of pitting from this arcing.

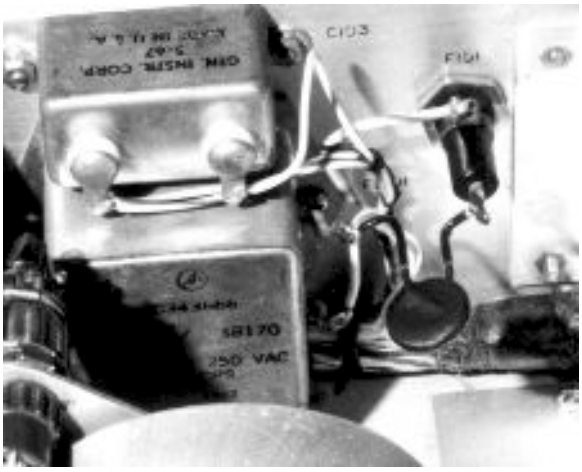
But I think the switch failure occurs on switch closure. At the moment of contact, the radio's transformer looks like a resistance of less than one ohm. Although this rapidly becomes a much higher reactance, depending upon the point in the AC cycle when contact is made the initial current flow can easily exceed the rating of the microswitch contacts. Also, with some previous arc damage, initial contact between the two switch parts is likely to be between the damaged areas (little peaks and little craters). The local heating could be enough to sooner or later weld the contacts together such that the switch will not open.

Switch designers know about these kind of effects, and design-in measures to reduce the potential for failure. But whether through poor design, or overly long operating life, the problem is one that will occur sooner or later in most R-390As. Unfortunately, satisfactory replacements for the R-390A microswitch are hard to find.

Current In-Rush Limiters

One way to reduce the initial current flow is to install a small device called a current in-rush limiter in the hot AC line. The one shown in the photos is made by Keystone Thermometrics and is available at most large electronic suppliers. The limiter is essentially a negative temperature coefficient thermistor designed to handle current. At room temp it exhibits some resistance. As current passes through and it warms up, this resistance drops by a factor of a hundred or so. Keystone limiters are rated by current handling capability (1.1 to 16 amps) and cold resistance (0.7 to 120 ohms). Not all possible combinations of resistance and current are available, but my Mouser catalog lists about twenty to choose from. They

cost a couple of bucks each, which is cheap insurance!



Many different kinds of electronic gear could benefit from such a limiter. However, it is very important to understand that these devices are essentially fancy resistors, and generate significant heat. There must be adequate air flow around them to protect other components.

The specs for in-rush limiters specify the cold (room temperature) resistance, and the maximum steady-state current rating. To pick the right unit, first determine the steady-state AC line current of your radio. That is, the current draw after it is warmed up and with all accessories turned on. Pick a unit that has a steady state current rating of 120 - 130% greater than this current, and that has the highest cold resistance. This allows a margin of safety should you live in an area subject to high line voltage and provides the greatest power-on protection.

As an example, suppose your radio draws 2.5 amps. The Keystone type CL80 is rated for 3.0 amps with a cold resistance of 47 ohms - a nice fit. The CL110 will handle 3.2 amps, but the cold resistance is only 10 ohms. While this would work, it would not provide the same level of protection.

You can probably determine the steady state current from either a tag somewhere on your radio, or from the manual. However, because line voltages do vary across the country, it might be useful to actually measure the current draw. This can be done by inserting a small resistor (say 1 ohm) in the line and measuring the AC drop across it.

Applying to the R-390A

The R-390A is nominally rated at 225 watts for 115 line volts with the Ovens switch on, and 140 watts with it off. The in-rush limiter is chosen on the basis of the maximum possible load, even though most people operate their R-390A with the Ovens switch off. The steady-state line current will thus be about 2 amps, and with the elevated line voltages found in some areas could go to 2.1 amps.

There are several possible choices: CL80 (47 ohms and 3 amps), CL160 (4 ohms and 2.8 amps) and CL170 (16 ohms and 2.7 amps). The best choice is again the CL80. It has an adequate current margin, and the highest cold resistance. Exactly the same analysis can be used to select the best limiter for any other radio.

Installing an in-rush limiter in the R-390A is very simple. There is a short wire that connects the centre lug on fuseholder F101 to the top lug (closest to the C103 bathtub capacitor) on the FL101 AC line filter mounted on the rear apron. At least this seems to be the usual configuration, but I do have one EAC chassis that connects this wire to the other FL101 lug. It doesn't matter, just be sure that your line cord is wired so that the in-rush limiter is in the hot lead between F101 and FL101.

Remove this wire and replace with the CL-80 current in-rush limiter. There is quite a lot of space here, so the device can be mounted well clear of surrounding components. Don't just tack the leads to the lugs, but make a solid physical connection so that the limiter will stay exactly where you install it!

The main change you will notice when turning the radio on is that the antenna relay now does a slow ka-chunk – which means you've been successful!

I'm indebted to the great folks on the Boatanchor reflector who helped me to understand the operation and use of in-rush limiters.

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Want Parts, Information, Pictures??

- Boatanchor Dreams - information on collecting and resurrecting fine old radios. Military, ham & broadcast.
- Classic Technology - military connectors, semiconductors, lamps, manuals etc. Small quantities, no minimum order for the collector, hobbyist & rebuilder.
- Tech Talk 1 - The R-390A RF deck is the radio's heart. There is a safe and relatively easy way to thoroughly clean it.
- Tech Talk 2 - The R-390A often comes without meters. Read why! Originals are hard to find and pricey. But there are other meters available that can be adapted!
- Tech Talk 4 - Want to Improve your R-390A Audio? Read this first!
- Tech Talk 5 - Receiver multicouplers are great! Read about the classic Collins CU-168/FRR.
- Tech Talk 6 - Another multicoupler - the RCA CU-5069 and the problem with heat.
- Tech Talk 7 - and speaking of heat - solving the excess heat problem with the Collins HF-2050 Receiver.
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