

Do you have a Kenwood TS-440S/AT? Is your meter bulb burned out?

This article will take you by the hand and show you how easy it is to convert the standard 80mA 12 volt bulb to a high output LED (Light Emitting Diode). By following the text and pictures, you should be able to do the job in less than 30 minutes.

Before we get into the actual swap, you have to decide what colour of LED to use. I found that the bright white units are the closest match to the frequency display, but if you want to make your radio standout, blue, green, red and yellow are commonly available.

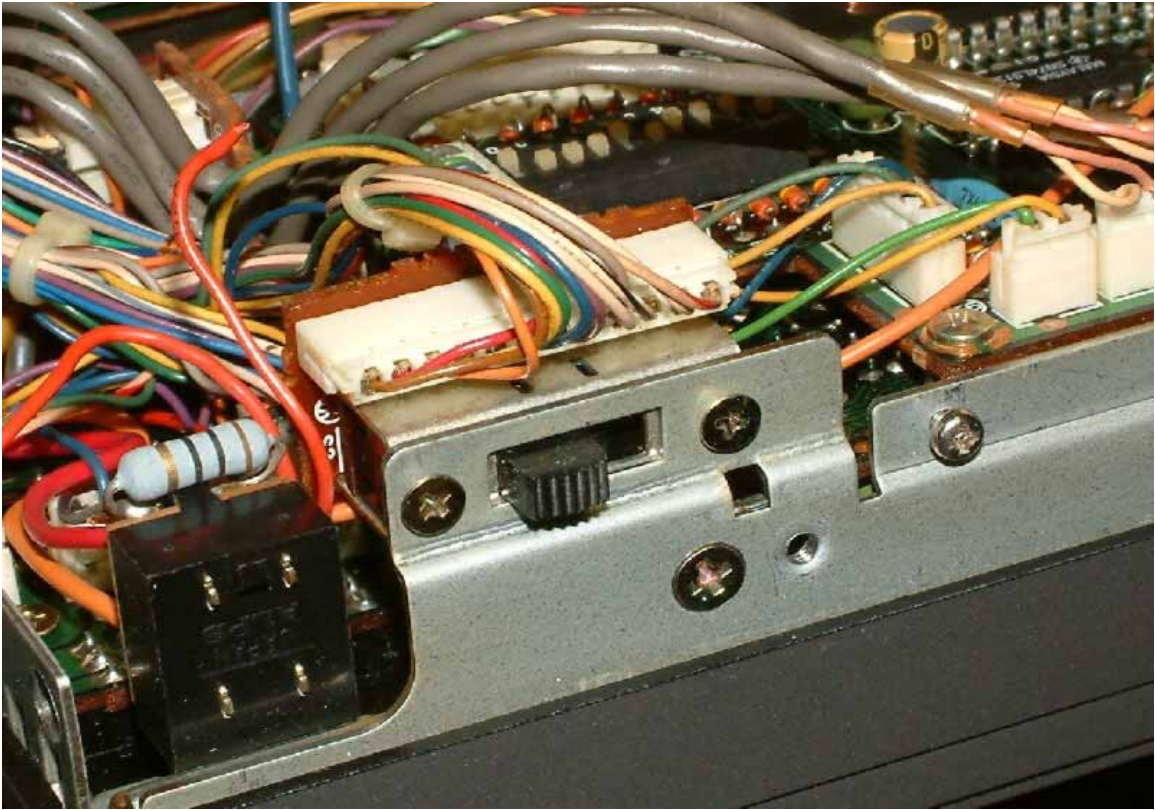
First, PLEASE make sure that the power plug has been disconnected! Working around a live radio will always produce other problems which will make changing the meter bulb seem trivial. Both the top and bottom cases have to be removed. If you can't do this by yourself, there is a basket weaving class starting at the local college next week :)

Once the cases have been removed, you will have to loosen the 4 screws which will allow the display unit to swivel down. These are on the side of the radio just behind the plastic faceplate. On all the units I've worked on, you just have to loosen them as the top two are slotted.



Picture 1: Here I'm swiveling the front display down

Next, to make life easier, the CW/VOX switch should be removed.

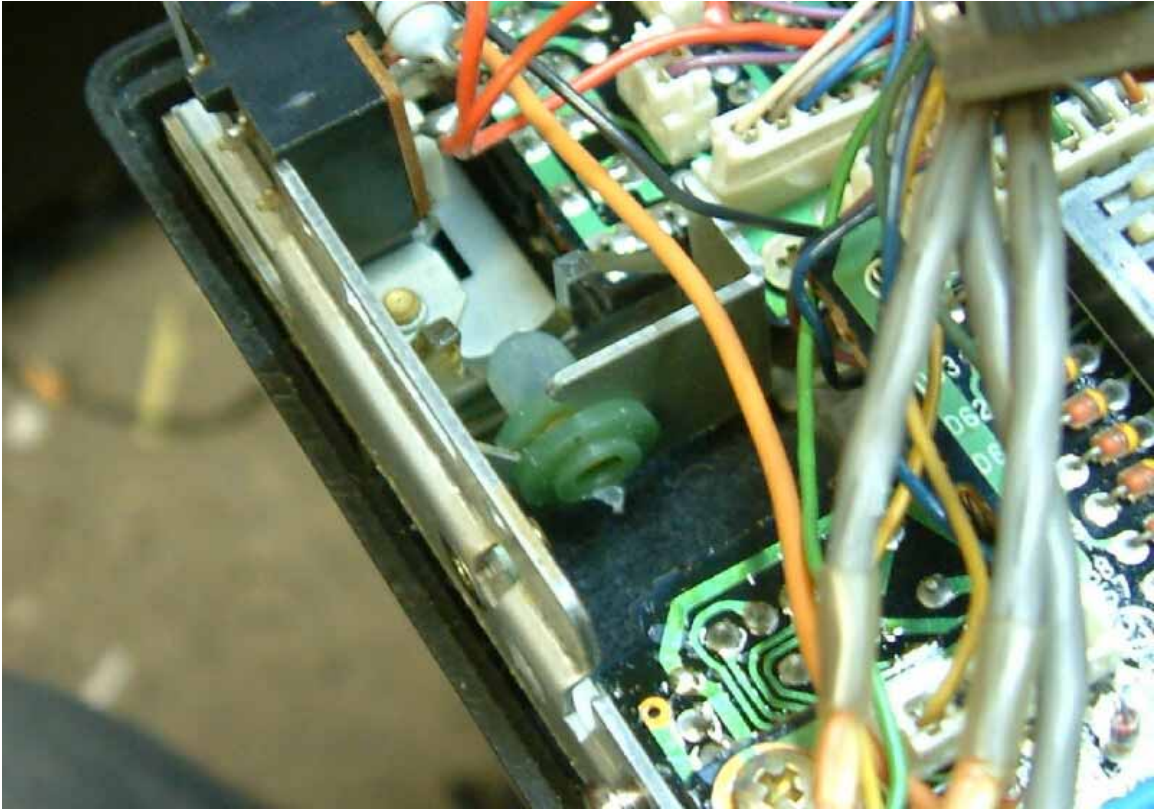


Picture 2: Here is the switch before removal



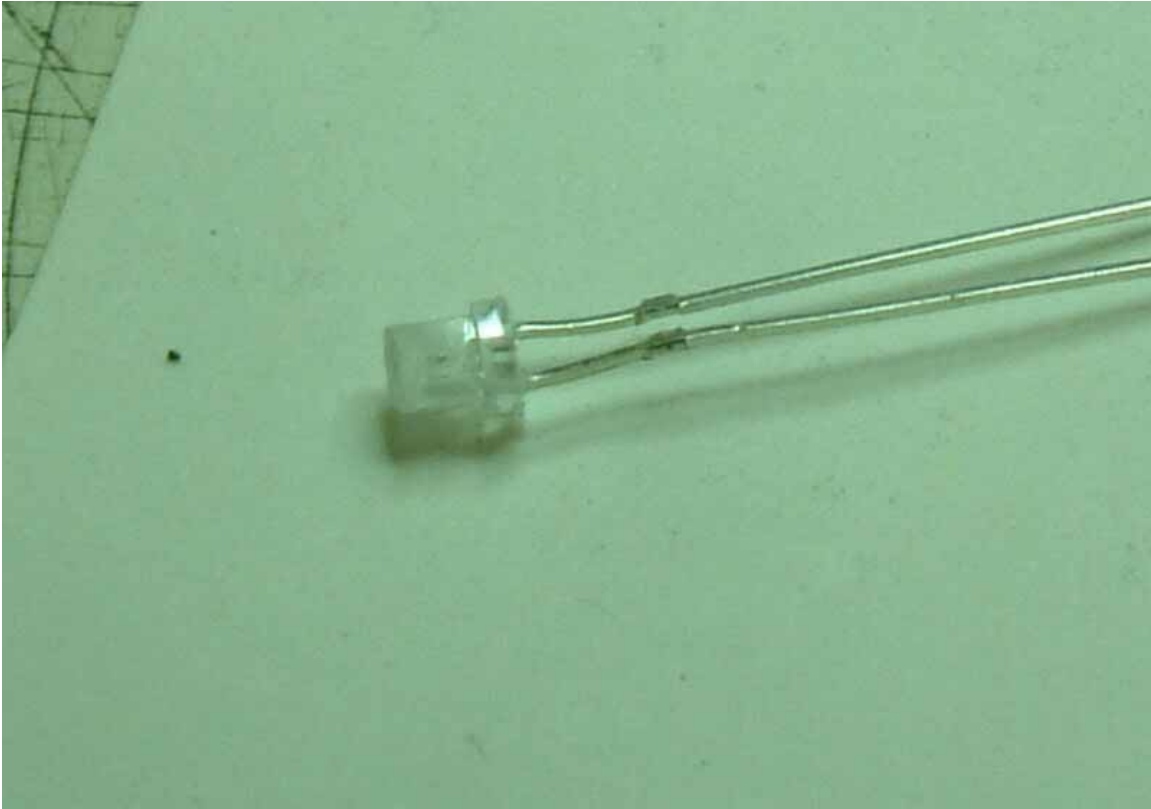
Picture 3: After switch removed (note that the wires are long enough that the switch can be tied back out of the way).

Underneath the switch you will see the light bulb and rubber filter. I find it easier to first remove the bulb by pulling the two wires towards the right side of the radio. Once the bulb is out, grab the rubber filter and it should come right out. Save the filter as it will be used later.



Picture 4: Rubber filter

Next we will concentrate on the LED itself. When you buy an LED it will have a round lens on the "business" end of the diode. What you want to do is file this just enough so it's flat. What this will do for you is increase the beam width of the light. I usually start with a flat file, then use some 220 grit sandpaper. **DON'T GO TOO FAR!** Looking at the side of the LED, you can clearly see the cathode and anode connections within the plastic shell. Try and stay about 1 mm away from these. While you are at it, roughen up the side of the lens with the sandpaper. You want to defuse the lens so that the light energy will be a soft glow.



Picture 5: Notice how rough the surface is!

After the LED modifications are complete, bend the LED's leads so that they are at a right angle to the body. Also, because the original bulb runs off 12 volts, you will have to install a dropping resistor in series with the LED. The white LED requires 20mA of current and has a forward voltage drop of 4.5 volts (NOTE: different colour LEDs have different voltage drops). Using ohms law:

$$R=V/I$$

Where R is in Ohms, V is in Volts and I is in Amps.

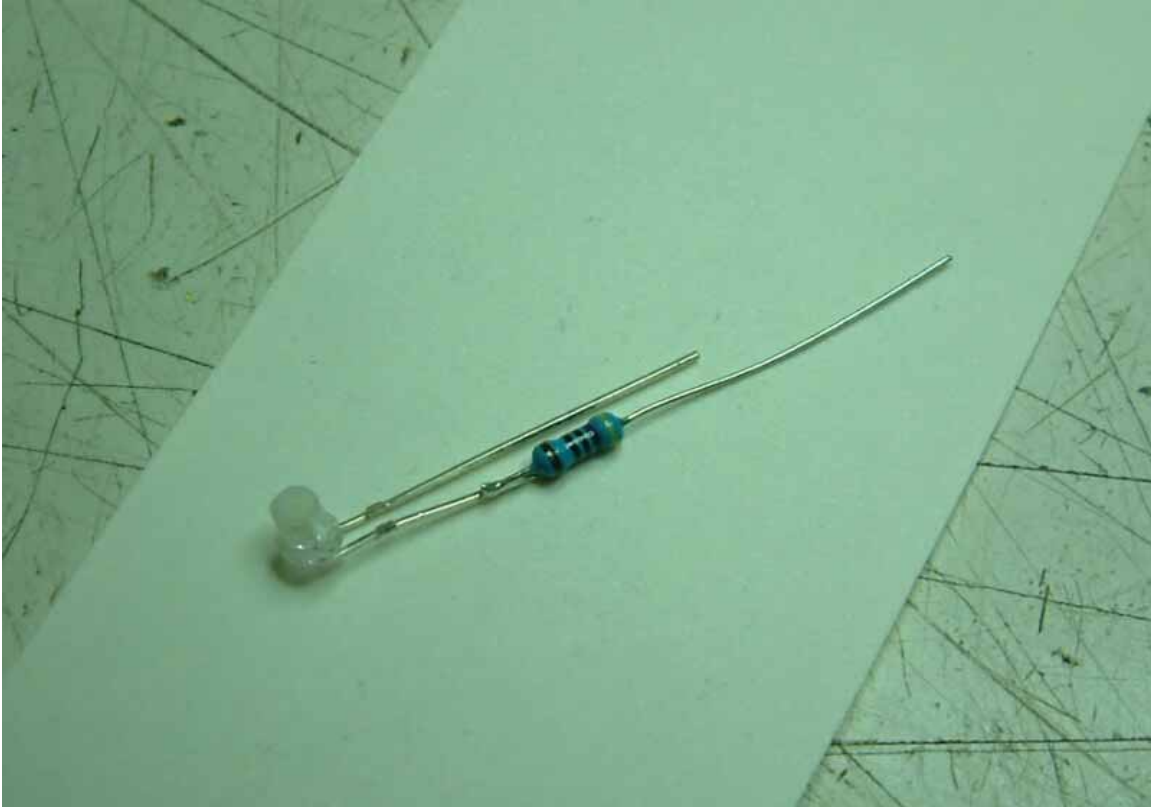
V is equal to how much voltage the resistor must DROP. In this case $14-4.5=9.5$. I always use 14 as the operating voltage because most cars will run at 14 to 14.2 volts while the engine is running.

So now we know V (9.5) and I (.020 amps). The rest is easy:

$$R=9.5/.020=475 \text{ Ohms.}$$

As this is a non-standard value, use 470 Ohms. Another habit I got into was to install the resistor into the anode end of the LED. Why? I don't know. It will work equally well if connected to the cathode! For those of you who haven't played with LEDs much, the

cathode (or negative) lead can be determined 2 ways. It's always the shorter of the 2 leads. But what if you've cut the leads already and don't know which one was the shortest? Without power applied to the LED, look straight down the business end of the led. You will notice that somewhere around the base of the LED there is a flat section. The lead on the same side of this flat is also the cathode.



Picture 6: LED bent with resistor soldered on. I shortened the anode lead before soldering the resistor in place. The short lead is still the cathode.

At this point, go and plug in your hot glue gun so it will be ready for the next step. The following picture shows the complete LED assembly with both leads covered in heat shrink tubing. I also trim both leads to the same length. WHAT! How will I know which lead is positive and which is negative?? Remember my old trick of installing the resistor on the anode? Well, you can clearly see the resistor (by the big bump!) even with the heat shrink tubing in place.



Picture 7: After the resistor is installed, cover both leads with heat shrink tubing and trim the leads to be the same length.

At this point we have to modify the rubber filter taken out of the radio near the beginning. If you have a grommet with the same sized slot, you can use it, but due to the fact that you will never have to change the meter illumination again, use the original. All that has to be done is to cut the dome from the filter, leaving just the grommet section.

Now, put the LED assembly through the grommet so that the middle of the lens is about 7mm from the grommet and put a bead of hot glue on both sides to hold it in place. The assemble runs cool to the touch so the use of hot glue is adequate. If you are leery about using hot glue, 5 minute epoxy would work as well.



Picture 8: Complete LED assembly ready for installation

Remember the old bulb? Cut the leads from it as close to the bulb as possible. Trim about 1/8" of the insulation off of both leads. Unlike bulbs, LEDs have to be hooked up so that the anode goes to positive and the cathode goes to negative. To find out which is which, I use the continuity tester of my digital multi-meter (some call this a diode tester). Ground one of the leads of your DMM to the chassis of the radio, and connect the other lead to each one of the old bulb leads. The one that shows a lower resistance to ground is usually ground (make sure the power switch is OFF and still unplugged). You can't do any damage if you hook up the LED backwards it just won't work!

On the TS-440, the positive leads runs to the power switch, so you can verify it that way. After finding out which is positive, place some heat shrink on both of the power leads and solder the positive lead to the anode (the one with the resistor) and the negative lead to the cathode (the one without the resistor). Slide the heat shrink in place and contract (careful to not burn any other wires).

With all the hard work done, slide the completed assembly back into the metal rails on the back of the display unit, **MAKING SURE** that the business end of the LED is lined up with the plastic "light rail". This light rail delivers the light from the LED to the meter. Usually pointing the LED straight down works well.



Picture 9: Completed LED assembly in it's new home! Tuck the wires so that they don't get pinched when you put the CW/VOX switch or the display unit back in place.

Once this is completed, remount the CW/VOX switch and put the display unit back in place and tighten the 4 screws on the side. You can test it now to make sure you hooked everything up properly. Once you have verified proper operation, reinstall the top and bottom covers.

So that wasn't hard, was it?

Was it worth it YOU BETCHA! Just knowing that you should never have to change the meter bulb again makes it all worthwhile, not to mention that the colour looks great!

The next two pictures are before and afters.....



Picture 10: Is there a radio in here somewhere?



Picture 11: All done! Notice how vibrant the colours of the meter are!

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