

## **Replace your rig's LCD panel lamps, with Surface Mount LED's** By VA3DDN, Don Dorward

There have been a number of articles in the recent past that describe replacement of incandescent panel lamps in radios with Light Emitting Diodes (LED's).

Photo 1 shows the front panel of my treasured old Yaesu FT-6200 mobile



transceiver, with 2 of the 3 original panel lamps used to back-light the LCD display, burnt out. The service manual optimistically says to

"...unsolder the old bulbs and install replacements." Easier said than done, as I found out, due to the closely packed Surface Mount Devices (SMD) on the control head pcb and the very small copper soldering lands on the pcb used for the mini-lamps originally used. (9 volt Yaesu p/n Q10000065)

To be brutally honest, I actually did try to replace the tiny lamps, but I confess I botched the job and ended up damaging the pcb and being unable to clear the holes of solder! (highly embarrassing for me, as I have spent over 40 years in the electronics industry, and used to judge solder joint quality according to IPC standards!)

Anyway, I lived with it this way for quite a long time, but finally decided to fix it permanently.



Photo 2 shows the new, improved backlit illumination on the FT-6200, using surface mount led's instead of the tiny lamps.

So here is what I did.

As described, I concluded that my only remaining option was to find and use some small, amber-colored led's that could possibly be hot-glued in place on top of the display pcb and power them with a small wire-harness running to the outside of the radio control head. Not at all elegant, but perfectly practical.

However, I quickly found out that the standard size T1 3/4 LED (about 5mm dia.) was just too large to fit in the small places originally occupied by the mini-lamps!

Too bad, because I had some in the junk box, rated at 700 mcd. These had a clear lens which I abraded with sand-paper to simulate a diffused appearance. With the radio front bezel removed, I dangled one of these led's near to the side of the LCD display, as a trial and was very pleased at the

appearance. Even though I could not use these led's due to size, this simple test told me that I did need to use high-brightness led's for the application.

### **Side-Bar: LED specs**

The brilliance or light output of LED's is commonly given by the manufacturer as the number of milli-candelas (mcd) at a fixed forward current, usually 20 milli-amperes (mA). One "rule of thumb" suggests that standard brightness LED's have light outputs less than 100 mcd, whereas high brightness LED's typically out put > 700 or more mcd. It was also evident that a diffused led would better simulate the tiny incandescent lamps. Led's are usually available with either a diffused or clear lens.

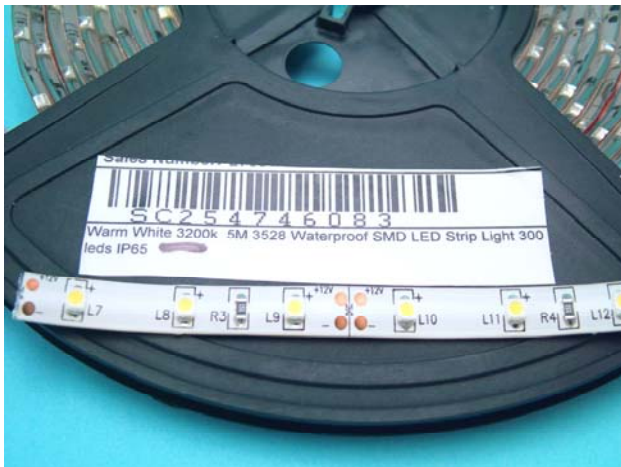
Ref: discussion at : <https://www.jameco.com/Jameco/workshop/TechTip/light-brightness-intensity.html>

I also had located some smaller 3mm T1 amber LED's, that were rated at only 10 mcd and which proved not nearly bright enough in my crude test, although the color seemed perfect!

Most importantly, I still had not figured out how to mount these radial leaded parts in the original lamp positions but fully on top of the lcd display pcb.

It was beginning to look like this project was going nowhere, as an extensive catalogue and on-line search turned up no 700 mcd, 3 mm, leaded, amber LED's.

It finally occurred to me that there were lots of white, high-brightness **SMD LED's** around, and all one would need to do would be to put a small piece of amber color tape or film over it to act as a color filter and simulate the amber glow from the tiny lamps.



Once again rooting in the junk box turned up a part reel of high brightness strip LED's, the kind that already have a current limiting resistor in series with 3 SMD LED's and operate from a nominal 12v DC. The led's come mounted on an adhesive backed copper strip and covered with a soft protective clear silicone coating to make them waterproof. They were intended to be cut off as required in multiples

of 2". The ones I had were described as "warm-white" (Photo 3) and I visualized mounting them to the radio pcb by using a small rectangle of double-sided mounting tape. Although these led's did not have a diffused lens, they are described as having a wide viewing angle of 120 degrees.

Since the tiny lamps being replaced were mounted horizontally, they would have had a limited viewing angle of 180 degrees. Therefore I hoped that this small viewing angle trade-off would work!

### **Alternative sources of suitable SMD LED's**

No, I don't really expect everyone who reads this to have the same LED's available to them! The LED package size I used is called a PLCC2, or 1210 which is close. It is commonly used and I am sure one can locate suitable parts from distributors like Jameco, Digikey etc. Or even from eBay, with "SMD led PLCC2 3528" in the search bar. For example Jameco lists their p/n 334756. However, the difficulty of using loose, un-mounted led pieces will be in the handling, soldering wires to them and mounting to some secure surface which will not short to the radio pcb.

### **How to connect the LED's**

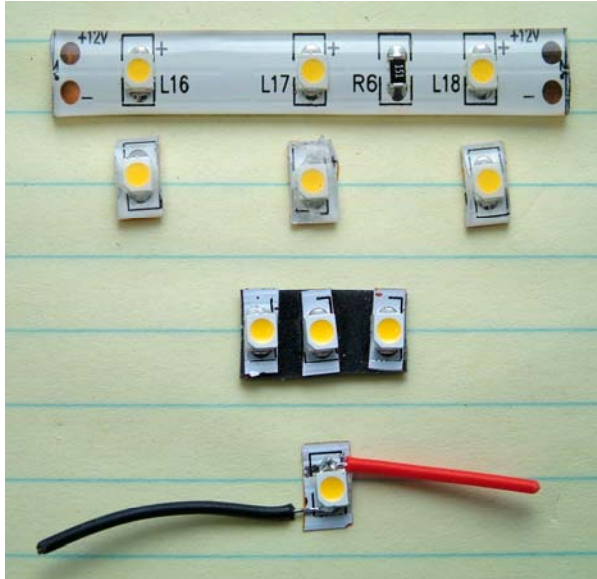
The FT-6200 front panel and display assembly is removable for remote mounting. Perhaps because of this, only a regulated +9v is available inside the display assembly. As each led has a forward voltage drop near to 3.0 volts, 3 in series will need greater than 9 volts to operate properly. The other alternative would be to connect the 3 led's in parallel and operate them from the +9v inside the display assembly with a suitable series current limiting resistor. The advantage of this approach is that no external connection would be needed for 13.8 volts. However, the big disadvantage would be the extra wiring needed to interconnect the 3 led's in parallel. This would be quite difficult to do given the very limited area for routing twice as many wires. If you look at photo 5, I think you can see what I mean. I realize of course, that the situation may be quite different with other radios.

Finally, after making this decision, I needed to find a solder point on the main pcb that was close to 13.8 volts, and also that was switched off when the radio power button was operated. Unfortunately, the service manual schematic and pcb layouts I had, didn't seem to fully agree with the actual radio layout.

I ended up using my digital multimeter to locate a suitable power-point, which was only 0.5 volt lower than the incoming 13.8 volts.

### **Preparing the LED's for mounting**

In order to "prep" the led's for mounting, refer to Photo 4.



At the top of the photo is the cut off piece of the led strip, about 2" long, showing 3 led's and the single series current limiting resistor.

The 2<sup>nd</sup> row shows the 3 led's snipped out of the strip. (we will not use the small resistor)

The 3<sup>rd</sup> row shows the led's now stuck to a small piece of 3M 414C double-sided mounting tape. Note that the clear silicone coating peeled off of the each led. (use tweezers or small needle-nose pliers to gently peel the coating off).

At the bottom is one of the led's prepared as above, but shown with

connecting leads to the anode (red) and cathode (black). This particular style of smd led is called a PLCC2 smd package. The cathode end is marked by the diagonally cut bottom left corner of the led.

Note: when soldering the leads to the led, first strip and tin the wire end. Then hold the tinned wire end to the exposed solder at the top and then the bottom of the led package, while using your smallest pointed soldering iron tip (also freshly tinned) to quickly reflow the solder. Excessive heat will damage the led.

### **Positioning and connecting the LED's**



Referring to Photo 5, the radio front panel bezel has been removed and if you look closely, you can see the left (led1) and center (led2) led's ( the yellow dots!) mounted in place. Each led has had a small amber colored piece of tape stuck on to it. This was cut from a left over bit of 3m 5413 polyimide electrical tape. (Note, you could also use a piece of amber lens

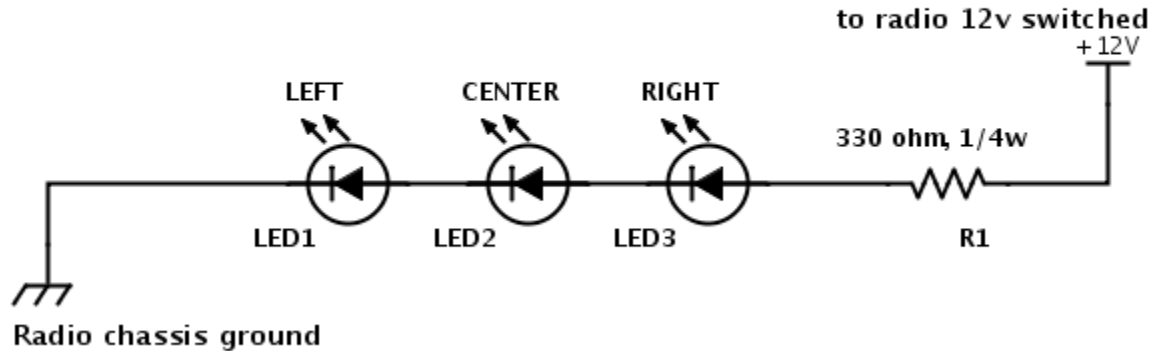


repair tape from the local auto parts store, or even better a small piece punched out of an amber color binder tab.)

The led's are connected in series as shown in Fig. 1. The cathode end of led1 is connected to the ground tab on the tuning control mount with a short piece of black #28/30 stranded, insulated wire.

FIGURE 1.

SEE TEXT FOR LEDS



Led1 was originally prepared with 3" lengths of wire. After peeling off the double-sided tape paper, the led assembly was pushed into place with tweezers. Then the connecting wires were carefully routed, clipped to length and tinned. The same procedure was followed with led2 and led3, with the last red wire (about 8") from led3 anode routed straight out as shown to the side of the 8 pin mic connector.

Photo 6 shows the red led power wire exiting the front panel bezel through a 3/32" clearance hole and taped to the radio bottom cover.



Photo 7 shows the wire routed up the rear panel near the radio 13.8 v DC power leads and into the area beneath the radio top cover. The corner of the rubber strain relief used for the radio 13.8 v DC power leads, has been shaved off with a sharp knife to permit the red led power wire to enter through the chassis. The black heatshrink covers the ¼ watt CF 330 ohm resistor, which sets the forward current and hence the brightness of the 3 led string. I used 330 ohms, to set the led current to approximately 14 mA. You may want to experiment with this value for the most pleasing appearance and brightness.