At the Repair Bench – Daiwa SWX-777 – September 2025

Figure 1 - Ham-Soku (Daiwa) SWX-777

A couple of months ago (as I write this), a customer brought his Ham-Soku SWX-777 SWR & Power Meter to me for repair and modification. This unit is a very early product of the Daiwa company of Japan, and is a dual-needle meter rated for frequencies from 1.8 to 30 MHz. It has two power ranges for which it is calibrated, which include 1000W forward with 200W reverse, and 200W forward with 40W reverse. His instructions to me were to clean the unit, and to install some illumination for the meter to enable its easy use in conditions of darkness.

When I examined the device, I discovered that someone had already been there to install meter illumination, and had done a clearly *terrible* job of it. First off, there are two points that must be understood right off the bat… 1) that the unit *natively* does not use any external electrical power but has circuitry that is powered by the measured signal, and 2) that the modifications that had been made had been designed to operate at 230VAC, the typical line voltage in use in the part of Africa where my customer was using this meter.

The previous modification had involved gluing to the rear panel of the unit a DPST pushbutton switch of the type typically used in a desktop computer as the main power switch. The 230VAC line cord was wired directly to this switch with one lead on each pole of the switch. The remaining two terminals of the switch held a length of line cord wire that was routed in through a drilled hole in the rear panel. There was no shock protection at the switch, and there was no chafing protection for the line cord as it passed through the drilled hole and into the unit. There also was no pushbutton cap on the switch actuator; it was the bare square post with which the switch is equipped.

Internally, the illumination circuit consisted of a small transformer, a single 1N4001 diode, a 1500µF/16V radial electrolytic capacitor, and a pair of wire leads that were routed into the meter enclosure, again through a drilled hole in that enclosure, at the upper right-hand corner of the meter face. One of these leads connected to the positive terminal of the capacitor, to which the cathode of the diode was also soldered. The diode anode was soldered to one of the transformer secondary leads. The other secondary lead was soldered to the negative terminal of the capacitor, as was the second wire lead that was routed into the meter enclosure. The capacitor was glued end-down in a vertical orientation to the floor of the unit, near the transformer. The incoming line cord, which had chafed through on the edge of the drilled hole in the rear panel, was connected to the two transformer primary leads. None of the various solder joints was taped, insulated, or covered in any way, and there was no chafe protection for the wire leads going into the small hole drilled into the meter enclosure.

A few words are in order about the meter itself as a component part of the SWX-777 overall unit. The meter is a cross-sweep dual-needle D'Arsonval movement with viewing dimensions of four inches wide by three inches high. This movement and face plate are mounted inside a steel enclosure that is four-and-an-eighth inches square, which in turn has a lens that matches the viewing area. The steel enclosure is just about an inch deep, and is closed at the back with a two-layer plastic plate through which the three meter connections pass. There is a positive lead for each needle and a common negative lead.

It was necessary for me to disassemble the meter assembly in order to access the internal illumination components. What I found surprised me. First of all, there was a small curl of steel drill shrapnel that had fallen into the meter movement and was held against the permanent magnet there, jamming one of the two needles of the meter. In addition, there was a small (half-inch diameter) circle of paper also stuck in the meter movement. This was apparently a label of some sort whose adhesive had failed, allowing the label to fall off and down into the meter. Finally, I found that the illumination had been provided by a rigid strip of miniature (0.120" x 0.140") LED's, with twelve individual LED's in the strip. The LED's had failed, which did not surprise me at all, as there was no current-limiting resistor in the LED circuit.

Figure 2 - Rear panel modifications

Before I could do anything about the illumination itself, I had to correct the incoming power problems. It was beyond unsafe as it was, and it is a miracle that nobody was shocked or killed by the unit. I began by disconnecting the incoming line cord from the transformer primary leads, and then removed the switch from the rear panel of the SWX-777. I removed the wire leads from the switch and discarded the switch. I then marked and drilled two holes in the rear panel of the unit, one on either side of the rear panel, avoiding the power-sensing tube that runs inside between the two SO-239 connectors on the rear panel. Into one of these new holes, I installed a double-pole toggle switch rated at 2A/250VAC. I then passed the line cord through the other new hole, installing a proper strain relief bushing into that hole to secure and protect the line cord. The line cord was then soldered to the toggle switch, with one lead on each pole. Next, I connected the transformer primary leads to the toggle switch. This completed the necessary corrections to the incoming power, and I could now continue with my testing and analysis of the illumination circuit.

When powered up on 230VAC via a step-up transformer on my bench (connected through my isolation transformer), I found that there was a ragged 17 volts of pulsating DC at the LED strip. Remember… in addition to the high voltage, there was no current limiting present, so it was inevitable that the LED's would fail. Of course, the reason that there was about seventeen volts there was due to the fact – as I could then infer – that the small transformer that had been installed inside the SWX-777 was one with a nominal 12VAC secondary. Standard transformer theory holds that the pulsating DC produced by a half-wave rectifier will be at the *peak voltage* of the AC input to the rectifier. A transformer that is rated at 12VAC refers to the RMS voltage of the output sinusoidal waveform from the transformer… which would in turn equate to a peak voltage of about seventeen volts (12V x 1.414 = 16.968V).

I sourced and ordered a flexible self-adhesive and trimmable LED strip that uses 12V white LED's. According to the specifications for the strip, there were 2400 LED's in the entire strip, which draws 3000mA at 12VDC. The LED spacing is set at 400 LED's per meter, or four per centimeter. I decided to install a 90mm strip of LED's inside the meter in place of the former strip that had been glued into position across the top of the meter enclosure, facing downward across the meter face plate. At four LED's per centimeter, this 90mm strip would thus include thirty-six LED's. With the entire strip of 2400 LED's drawing 3000mA, each LED would then draw 1.25mA, or 45mA for the 90mm strip. Now I could design and build a proper power supply that would power these LED's for the long term.

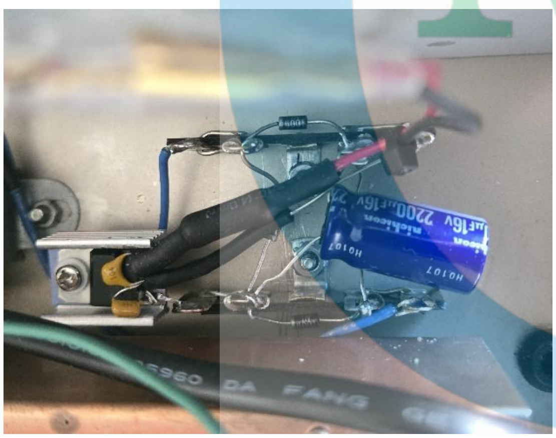

Figure 3 - Power supply components

I started with two four-terminal center-mount terminal lug strips and four 1N4001 diodes. I arranged the diodes into a full-wave bridge rectifier (FWBR) pattern and installed them to the terminal lug strips. Next, I added a 2200µF/16V aluminum electrolytic capacitor, with the positive terminal connected to the junction of two diode cathodes and the negative terminal connected to the junction of two diode anodes. These would become the positive and negative points of the power supply, respectively, with the capacitor providing filtering for the supply. Next, I added a heat-sinked LM7812 twelve-volt three-terminal voltage regulator IC, to which I had added a 0.22µF monolithic ceramic capacitor between the input (pin 1) and the ground (pin 2) terminals of the IC. In addition, I added a 0.1µF monolithic ceramic capacitor between the output (pin 3) and the ground terminals. I added a 270Ω 1% 2W metal film resistor to the output terminal of the voltage regulator IC and then soldered the input pin to the positive terminal of the FWBR and the ground pin to the negative terminal of the FWBR. To complete the power supply, I added heat shrink tubing as appropriate, and then I added a red and a black 22AWG stranded wire in about a ten-inch length each to the open lead of the 270Ω current-limiting resistor (red) and to the negative terminal of the power supply (black). Mounting holes were marked and drilled in the unit floor, and the power supply was then installed there using a pair of 4-40 x 1/4” machine screws and KEPS nuts. I was now ready to power the new LED strip.

OK – time for the “techy” stuff. How did I determine that I should use a 270Ω resistor for the current-limiting task? This is where Ohm’s Law comes in. The LED strip, with its thirty-six LED’s each drawing 1.25mA, would require 45mA total as I said earlier. The design output of my new power supply is a nominal twelve volts. According to Ohm’s Law, resistance is equal to the voltage divided by the current. Thus, we have the following:

$$R = \frac{E}{I} = \frac{12V}{0.045A} = 266.6\overline{66}\Omega$$

With a calculated value of 266.67 ohms, the closest standard value is 270 ohms. Simple, right? So then… what was the actual final voltage and current supplied to the LED strip? Well, we already know that the current was somewhere in the vicinity of 45mA for the strip, which was comprised of a parallel string of individual LED’s. Let’s see if we can get more accurate with the LED current value.

The actual measured voltage out of the voltage regulator was 12.37VDC. Let’s substitute that in for the nominal twelve volts used in the design process, but this time, we will also use the actual measured resistance of the dropping resistor installed in the circuit:

$$I = \frac{E}{R} = \frac{12.37V}{268.5\Omega} = 0.04607A \text{ or } 46.07mA$$

Enough of the “techy” stuff – let’s get back to the modification work.

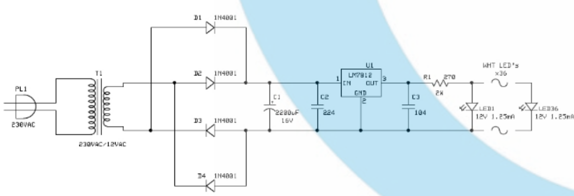

Figure 4 - Illumination circuit schematic diagram

My next task was to enlarge the very small hole that had been drilled into the meter enclosure, with two goals in mind: a) to accommodate the two 22AWG wire leads entering there without the chance of chafing the wires, and b) to allow me to slide the LED strip into place inside the enclosure and against its upper inner surface.

I then soldered the red and black leads from the power supply to the LED strip, observing the proper polarity, and tested the operation of the new LED’s. They worked as intended. Next, I cut the red and black 22AWG leads mid-length and stripped about 3/16” of each cut end. I then installed bullet-type insulated connectors to these leads, male at the meter end and female at the power supply end. This allows for easy future removal of the meter assembly from the unit without the need to cut any wires, as the meter illumination is now a plug-in affair. I removed the cover paper from the LED strip’s adhesive, applied some tape over the solder joints where the leads attached, slid the LED strip into the meter enclosure, and pressed it into place. All that remained was to reassemble the meter and then to re-install it into the SWX-777 frame.

With the meter fully assembled and the leads for the LED plugged in (observing the wire colors), I did a final in-place test of the meter illumination and was very happy with the result. A Dymo-printed label set was installed to identify the purpose of the new switch on the rear panel. Finally, I installed the unit cover and called it “done”.

This was a fairly straight-forward modification of an existing unit, but all done with an eye towards a professional and finished appearance and the utmost in safety for the equipment user. It was quite surprising that anyone would have done a job the way the original LED strip was installed here, with its complete disregard for user safety or even the norms of electrical construction and assembly. In addition, the carelessness of drilling the meter enclosure and allowing a steel chip to fall into the meter movement is inexcusable. I can truly say that I am very happy with the final results on this job, and I hope that my customer is just as pleased.