Improving the Accuracy of the WD-766A Digital Wattmeter

Background:

The WD-766A was sold with several names on the front: VIZ, Vector/VIZ, Kappa/VIZ, TENMA, and probably others. They seem to all be identical except for that name. Basic specifications are 1% accuracy +/- 1 digit for AC Volts (True RMS), AC Amps (True RMS) and AC Watts. Momentary push buttons select the desired measurement. A three-digit seven-segment LED display is used for all indications up to 999. Theoretically the voltmeter could measure up to 999 Volts and the ammeter could measure up to 99.9 Amps. A value that exceeds 999 is displayed as "EEE".

The WD-767 is similar but uses a different metering chip and has slightly better accuracy. I didn't investigate the calibration procedure or the circuitry for that unit. I leave that as an exercise for the student.

This article was written as an amendment to the WD-766A/WD-767 manual. Refer to that manual for the calibration setup and required equipment.

Initial Checkout:

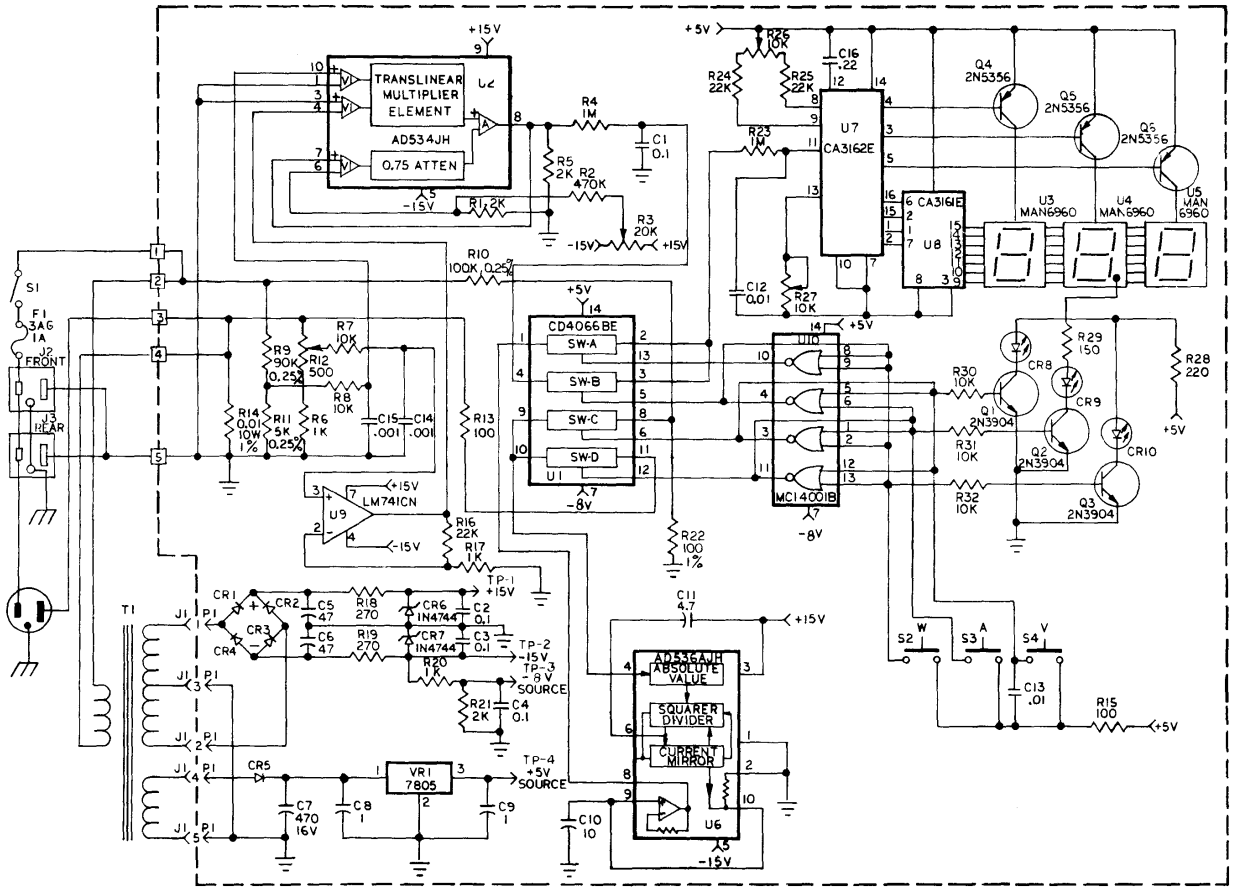
I purchased my unit from a popular auction site for $75. It was in excellent condition and worked properly when plugged in, however I suspected it needed adjustment because the Amps and Watts didn't display zero with no load. I had already downloaded the manual, which contains theory, calibration, parts lists, and schematics for the WD-766A and the higher power WD-767 (20.0A, 2000W).

I used a 600/900/1500w oil-filled radiator-style heater as a load. I was not satisfied with the accuracy of the meter. The voltage was high, the current was fine, and the wattage was low. I tried the calibration procedure in the manual first. That improved the wattage and voltage but now the current was low. I could get the voltage or the current to be fine, but not both. The calibration steps call for no load adjustments first, in the following order:

1. Adjust the A/D converter (meter) zero pot (R26) with the unit displaying Amps.
2. Adjust the wattmeter zero pot (R3) with the unit displaying Watts.
3. Adjust the A/D converter (meter) gain pot (R27) with the unit displaying Volts. (Alternately, perform this with a load and the unit displaying Amps.)
4. A purely resistive load is attached in series with an external meter shunt. The voltage across the shunt allows the user to calculate the current and thereby the wattage. Adjust the current gain pot (R12) with the unit displaying Watts until it equals the calculated value.

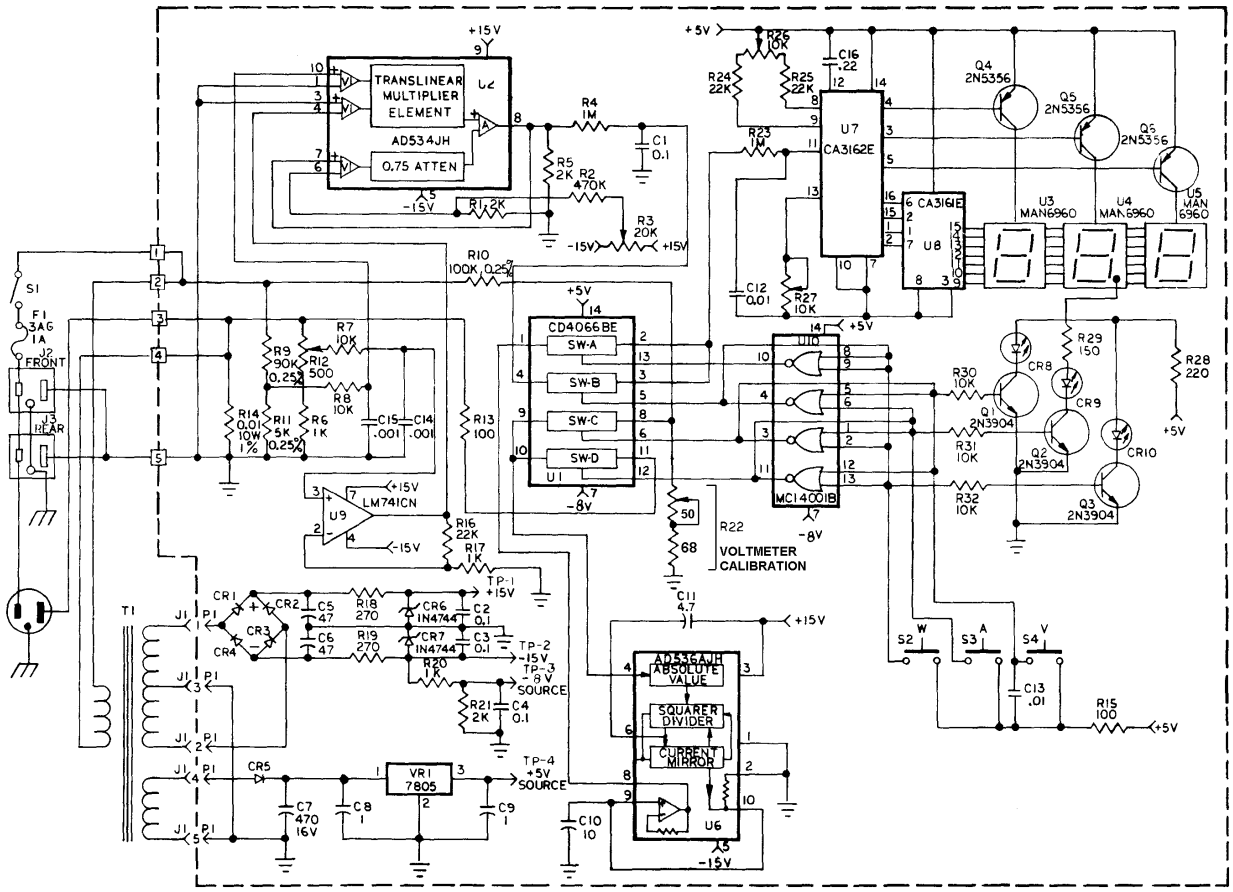
Calibration Issues:

Neither the voltmeter nor the ammeter has its own calibration pot. They use fixed high-accuracy (1% or better) resistors as voltage dividers. The only pot one could use to calibrate either Volts or Amps is the A/D converter (meter) gain pot (R27), and it will be a tradeoff. You can get one or the other to be accurate but not both. There is a gain pot (R12) for adjusting the current input into the multiplier chip that derives Watts as the product of Volts times Amps, but the voltage input is fixed. Here's the original schematic diagram:



Modifications:

After reading the theory and studying the schematic, I determined that it was possible to add my own voltage calibration pot by replacing R22 (100 ohm 1/4w 1%) with a single-turn 50-ohm pot in series with a 68-ohm resistor. Alternatively, any combination of pot and fixed resistor in series that creates a value of 90-110 ohms will do. (Initially I only had a 500-ohm 10-turn pot so I used that with no series resistor; I replaced it with the proper value parts a few weeks later.) R22 now becomes the Voltmeter Calibration pot. See the modified schematic diagram below:



Now that I had the means to calibrate the voltmeter separately, I modified the adjustment procedure slightly, shown below. Start out with no load:

1. Adjust the A/D converter (meter) zero pot (R26) with the unit displaying Amps.
2. Adjust the wattmeter zero pot (R3) with the unit displaying Watts.
3. A purely resistive load is attached in series with an external meter shunt. The voltage across the shunt allows the user to calculate the current. Adjust the A/D converter (meter) gain pot (R27) with the unit displaying Amps until it equals the calculated value.
4. Adjust the new Voltmeter Calibration pot (R22) with the unit displaying Volts.
5. Calculate the Watts as the product of Volts times Amps. Adjust the current gain pot (R12) with the unit displaying Watts until it equals the calculated value.

Results:

After adjusting the new pot, I measured the combined value: 98 ohms. This replaces the original 100 ohm 1% resistor (R22).

Now all three of the meter indications are within their specified accuracy, at least as compared to my other test equipment, which includes a Kill-A-Watt meter, a Fluke 189 DMM, a Fluke 287 DMM, an Agilent E4401A DMM, and a Simpson 06709 50A shunt.