# Faulty Chef Kitchen Scales

K. G. of One Tree Hill, SA, recently tangled with a faulty set of kitchen scales, although he freely admits that the repair was uneconomic. Here's what happened . . .

I was recently asked to have a look at a set of kitchen scales of the electronic variety. According to the owner, they had had the device for about 20 years so it was now quite old in electronic terms.

Frankly, I was rather surprised that electronic kitchen scales have been around for so long. And of course, repairing this particular unit was hardly an economic proposition considering the cost of new scales and that the owner had had 20 years of use from them. But I like a challenge.

The unit in question was a Chef Model 910 with a maximum measuring weight of 2kg. It had two membrane pushbuttons on the front alongside an LCD display, one for power and the other for zero correction or tare weights. The problem was that if switch-on was attempted soon after it had been switched off, it wouldn't come on properly or would not come on at all. Either random segments would come up on the LCD or there would be no segments at all.

My friend had removed the cover and done some preliminary work such as cleaning the switch contacts but to no avail. The scales were mostly used for weighing flour for bread making and I noticed that a certain amount of the material had found its way inside the case. So a blow-out with compressed air was high on the list of things to do.

The unit worked from two AA cells and the battery terminals looked OK but I initially checked it out using a bench power supply to make sure that these parts were OK. It made no difference – the fault was still present. There was one electrolytic capacitor and a check with an ESR meter showed it to be OK. I then replaced two of the 100nF ceramic supply rail capacitors. These are much more reliable than electrolytics but can still can give trouble. Again, there was no improvement.

During this time, the owner was looking over my shoulder and making various suggestions as to what might be wrong with it. The PCB clearly had two separate sections, one with a microcontroller that drove the LCD and the second an RC oscillator running at about 100kHz. The markings had been removed from the IC in the oscillator section but after examining the circuit, I concluded that it was probably a CMOS hex inverter.

A set of plates is used to form a variable capacitor which is included in the oscillator circuit. One plate is movable, being mounted on a spring which moves under the weight of the load on the scales. As a result, the weight is converted to a capacitance value and then to a frequency value. This frequency is then measured by the microcontroller which then does the sums and displays the corresponding weight, either in grams or pounds and ounces, on the LCD.

At about this time, we agreed that I would hang onto it and continue my investigations later. When I got back to it later that day, I traced out a section of the circuit related to the power-on button. Pressing this button grounds a resistor and provides base current to a PNP transistor in series with the positive supply rail. This wakes up the micro which then turns on an NPN transistor across the switch, thus keeping the supply on.

Additional circuitry is also included to detect a further button press to turn the unit off.

After several attempts, I managed to get the scales to turn on and operate normally. I then measured the voltages on the input and output of the PNP transistor in series with the supply rail. These appeared to be correct, with about 3V on the input and about 0.1V across the saturated transistor.

That done, I turned the unit off by pressing the button again and the display on the LCD disappeared as it should. I then measured these voltages again. There was 3V on the input as before but the output of the transistor switch was at about 1.6V instead of being close to the expected 0V.

This voltage was clearly high enough to maintain some sort of activity in the micro without being high enough to enable normal operation or to make the LCD work. What's more, it looked like this prevented the micro from starting up correctly when the unit was switched on again.

I didn't go to the trouble of examining the circuit further to see if there were any other paths around the PNP switch. Instead, I plumped for the easy way out and simply replaced the PNP transistor to see if that would fix the problem, as it had probably gone leaky.

Using an illuminated magnifier, I took a look at the type number on the transistor. It was C9012 but I know from previous experience that Japanese transistors often have the prefix 2SC and that in many cases, the "2S" is dropped from the label. So I concluded that it was a 2SC9012 and this was replaced with a general-purpose BC557 transistor.

The scales now came on normally straight away and I found that I could repeatedly switch the unit on and off without problems. A quick check showed that the voltage on the load side of the transistor switch when the device was off was now about 0.6V. My reaction was that it probably should have been lower still but in view of the fact that the unit was working, I decided not to spend any more time on it.

It has since been returned to its owner and, after several months, is still working perfectly.