# Orac - The Ring

*Before you die, you see....*

No, not *that* ring! Around the light ball, Orac has a ring of lights that chase in an orbit. The function is never defined in the TV series, but I would put my guess on it being a sensor array for detecting who/what is nearby, since Orac doesn't have any sort of optical camera built-in (except in one episode where one is plugged in to the side).

My original used a bent strip of acrylic with 16 red LEDs in it, driven by a 4-bit counter, a binary-to-linear converter and an LM555 oscillator:

I am looking at a loop of transparent ribbed tube with the LEDs in it this time. And 32 LEDs, for two orbiting lights on a closer spacing. I will salvage and reuse the binary-to-linear converter and 4-bit counter from my first Orac rather than use up 16 Arduino outputs, driving the counter with pulses from a single Arduino output so I can control the speed of the light-chase.

I was originally going to use ultra-bright red LEDs because those are the cheapest, but thanks to the [lantern project](), I have a lot of white LEDs lying about now, so will use those.

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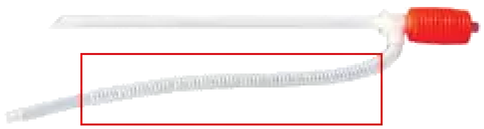
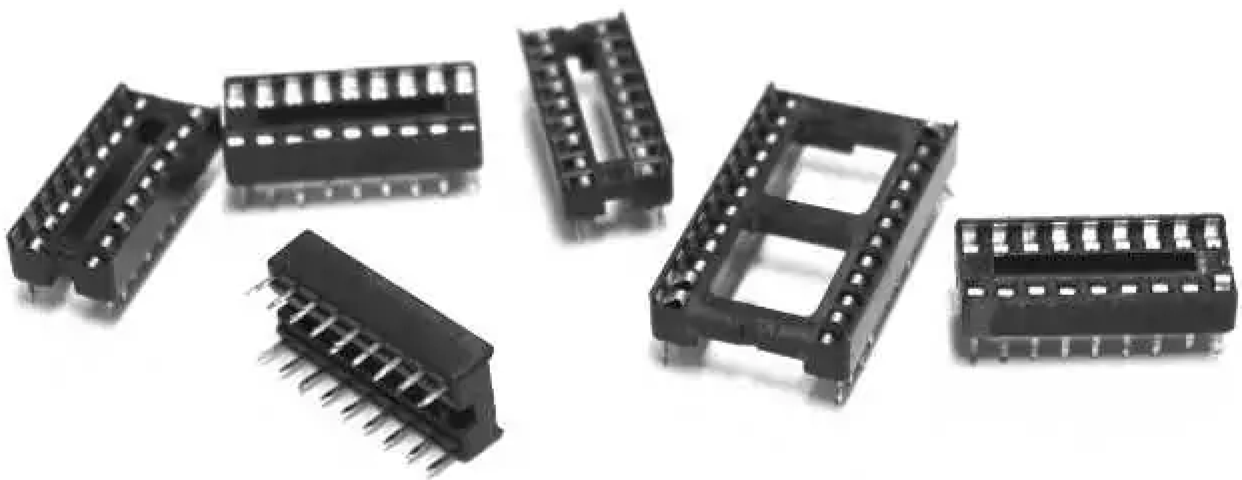
I started with a length of thick copper wire bent into a circle and soldered the positive lead of all the LEDs to it. The loop needed to be 19cm diameter, so the wire is Pi*19=60cm long. I divided it into 32x 19mm segments and soldered an LED on at each marking. Then I soldered some solid-core networking wire to the negative lead of each LED, two LEDs (16 apart) per wire, and wrapped the wire around the copper circle. I did 8 wires clockwise and 8 anticlockwise so that the wrapped wire would be the same thickness all the way around rather than having a big thick bunch at one end.

Next, the circle needs to be slid into a length of 12mm transparent ribbed flexible tube. Having not found the type of tube I wanted, I bought two siphon pumps from a local $2 shop for $1.50 each (cripes! Bunnings charges $4.50 each for these! But then, while convenient, they were never cheap - at least not since they drove all the competition out of central Wollongong) and cut the flexible hose off them:

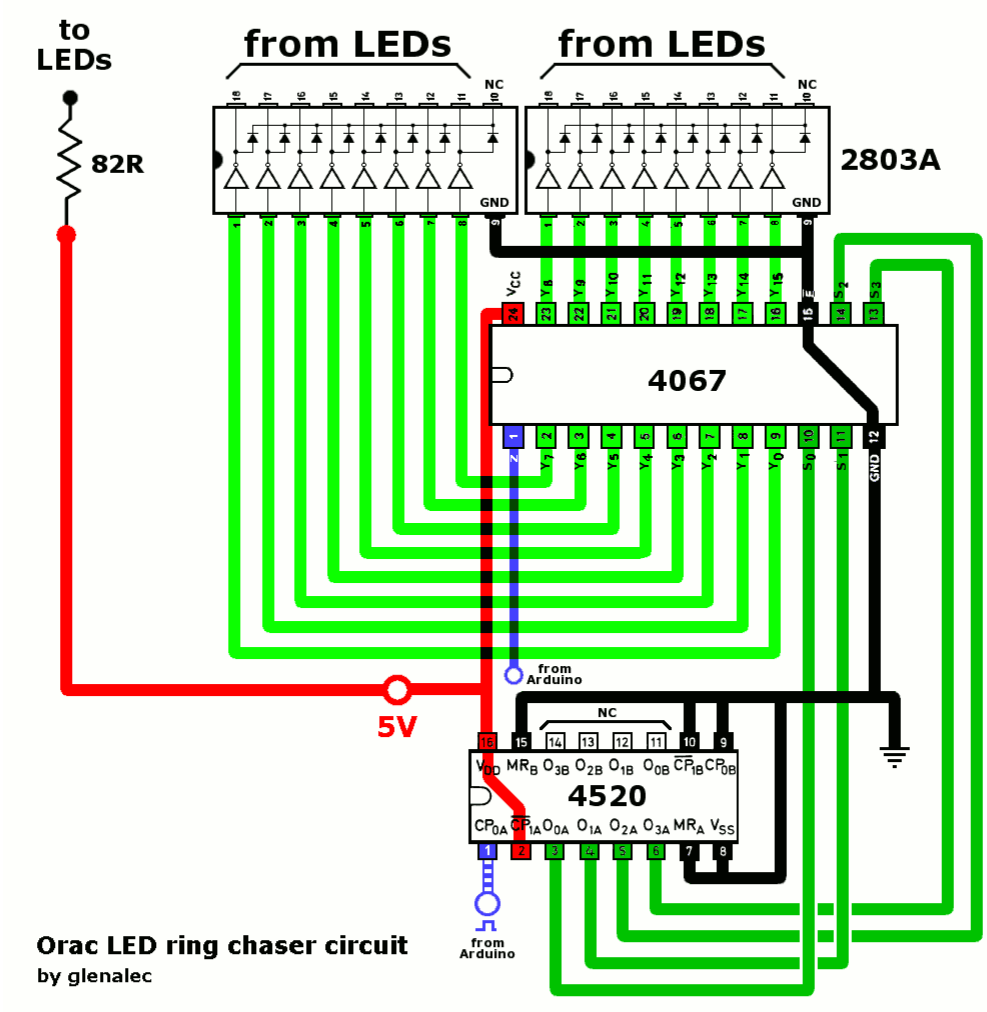


## Drive Circuit

I pulled the chips from the old drive circuit. I usually use chip-carriers (*below*), rather than soldering the chips directly into the board, as there is less chance of overheating the chip while soldering. I then de-soldered the chip-carriers (they are cheap, but why waste? And the shop to buy more is on the other side of town).



Here is a circuit diagram for the drive circuit:



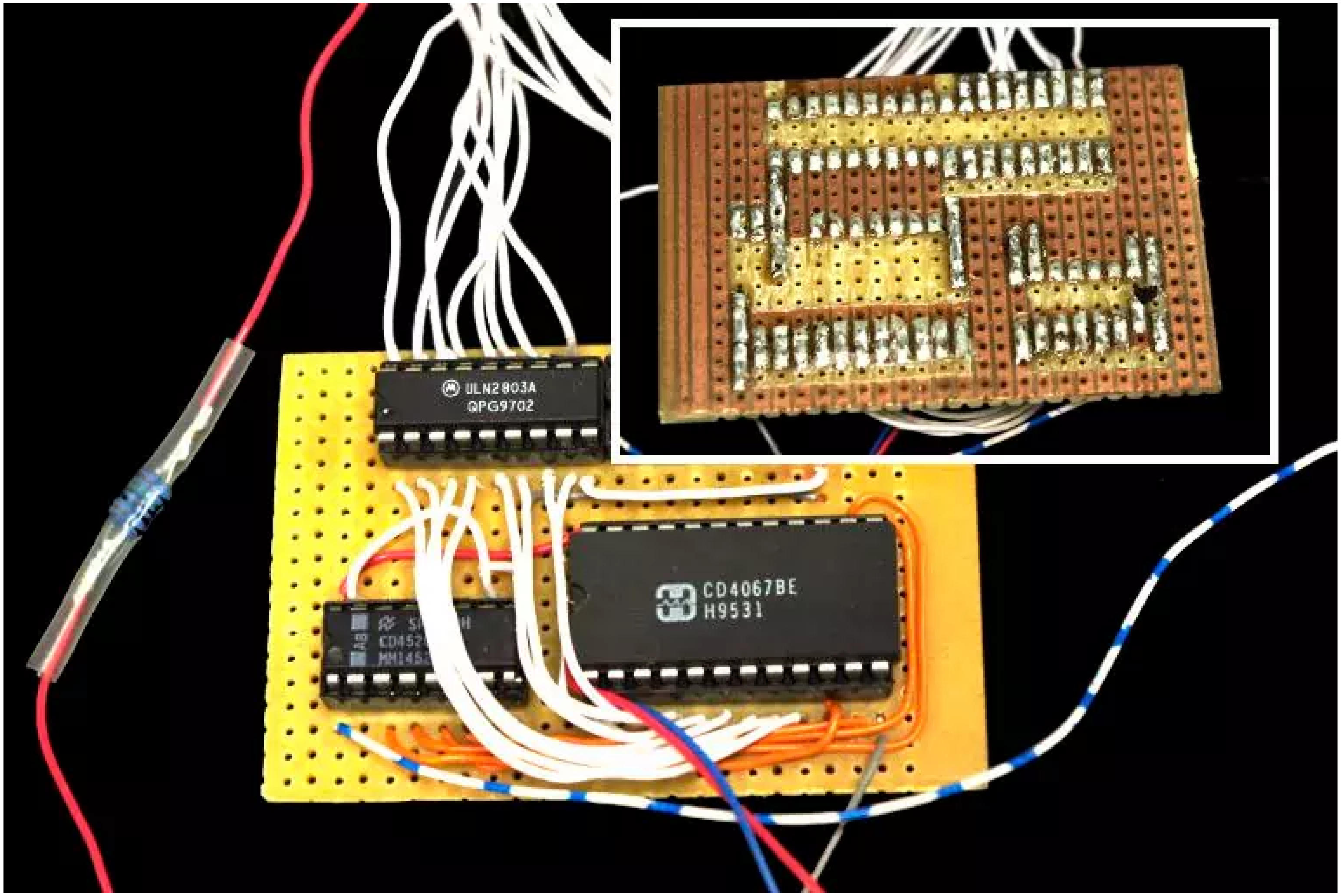

In the above circuit:

- The **[2803A]** chips are 8x Darlington Transistors each. These can drive the LEDs (regular digital circuitry can't provide enough current for LEDs, though for cheapskates and short-term work, you can get away with one LED per pin - but it stresses the chips). These devices share a common GND inside the chip, so the LEDs have to share the 5V rail and be switched on the GND side. The LEDs don't care. Honest!
- The **[4067]** chip is a binary-to-linear converter. The 4-bit binary number input on pins $S_0$-$S_3$ result in a single pin $Y_0$-$Y_{15}$ outputting whatever voltage is on pin Z. For this use, Z is fed from an Arduino output, so the LED ring can be turned off completely. If there is a spare PCM output, I can use that and also control the brightness of the ring. Pin E is *Output Enable* and the bar over the E means it is is *active low* which is why it has been tied to GND - I want the chip to *always* be enabled (Chip enable pins are very useful if you need to cascade multiple of these devices together, but is not needed in this case. I could also have fed this pin from an Arduino output to control the overall on/off state of the ring, had the Z pin not been an option.).

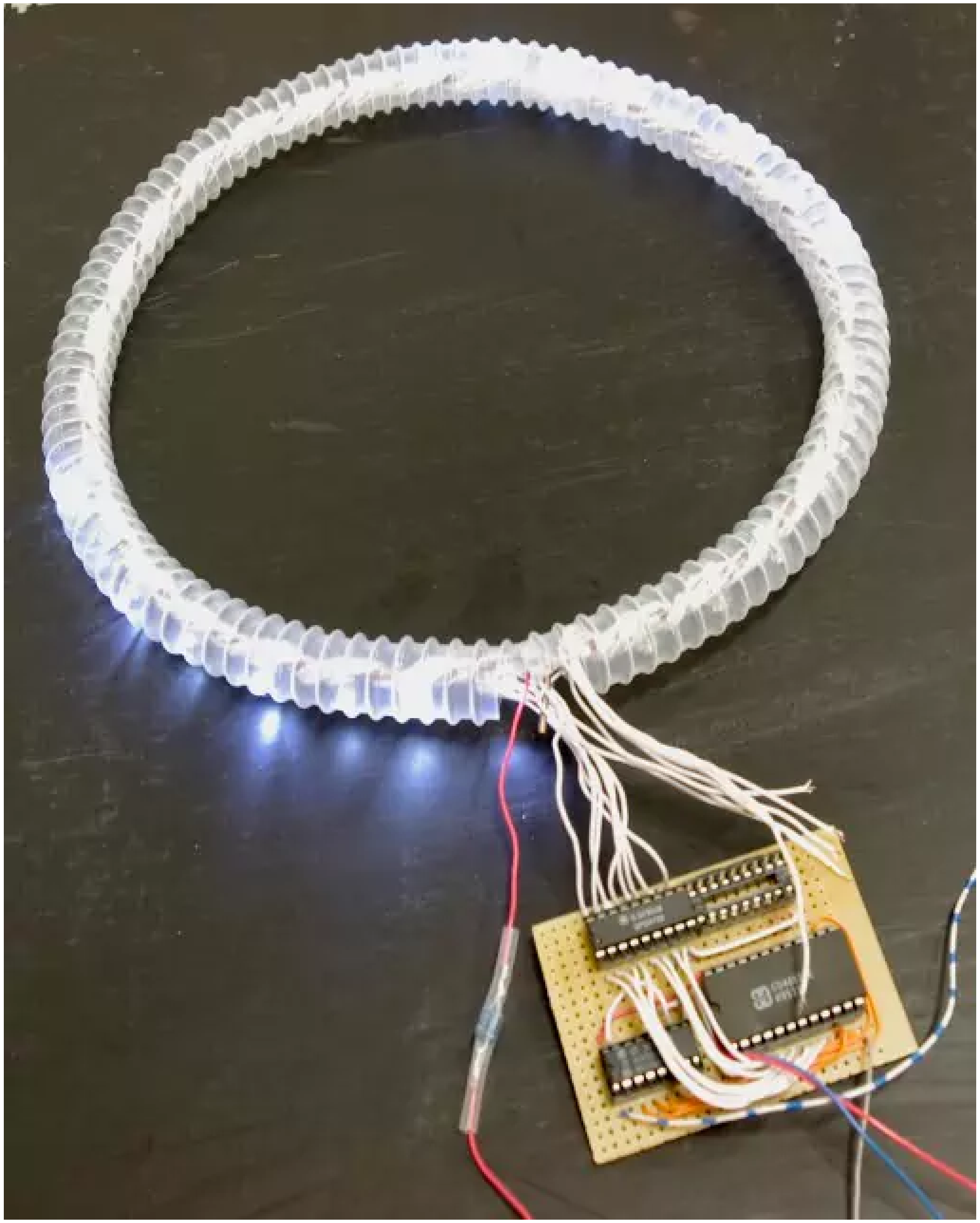
- The **4520** is a dual 4-bit counter. Each counter counts from 0 to 15 in binary, upping the count each time pin $CP_{0A}$ is pulsed up, and cycling back to zero on overflow. The other pin $CP_{1A}$ is an inverted input, so it ticks the counter when the pulse is going down. I don't need it, so tied it to 5V so it will be ignored (see data sheet for details). Pin $MR_A$ is the Master Reset for counter A. I don't need this, so tied the pin to GND. With logic chips, you should ALWAYS tie unwanted *inputs* to either 1 ($V_{CC}$/$V_{SS}$) or 0 (GND/$V_{DD}$). Leaving inputs 'floating' can lead to unpredictable behavior. I am only using counter A at this time. The input pins for Counter B are also tied to GND. Unwanted outputs are left not-connected (NC). The $CP_{0A}$ pin is to be driven by an Arduino output. This will allow the Arduino to control the speed by varying the pulse speed.
- Because I know that there will **always and only** be two LEDs active at any time in this circuit, I can use a single **load resistor** valued for a 40mA drive (2x 20mA LEDs) at 5V feeding into the common positive wire of the LED ring.

I must add: chip pin-outs are not usually this neat - the pin functions are often all over the shop rather than in nice sequential order. Just lucky in this case.

And here is the circuit assembled. The rear shot (*inset*) shows where I carved off the unwanted copper tracks with a Stanley knife. I used two identical 150Ω resistors in parallel (which halves the resistance) for the LED current limiter, simply because I had plenty of this value available and didn't have the value specified on hand. I put a bit of heat-shrink tube over them to protect the bare wire.




Here is the ring (mostly) wired to the circuit and under test. The slow shutter speed on the camera (indoor photography without a flash) blurs out the LED chase, but they trip about nicely. At this stage I have only connected the wires from one side as I need to thread the ring around the light-ball and its supports before closing the loop permanently (the copper wire inside the loop-join is bent into a hook for now and can be un-hooked). As you can see, I have cut up the siphon pumps and glued the two sections of ribbed tube together. I used a plastic-optimised super-glue for this after testing showed this type of plastic was not interested in the acrylic joiner (it is likely PVC, which is an entirely different plastic). When the joint was set, I then threaded the tube over the ring. Looks quite good, especially as it is semi-translucent rather than fully transparent, so you can make out the wires and parts inside without them being too clear (which might ruin the 'magic').



```
//quick test of Orac's light chaser ring - make lights chase

void setup()
```

```
{ pinMode(6, OUTPUT);    // Tick Channel - pulse this pin to advance lights
  pinMode(7, OUTPUT);    // Power Chanel - "HIGH" to have lights on. "Analog" PCM output is an option.
}

void loop()
{ analogWrite(7, 255);   // full brightness

  digitalWrite(6,HIGH);
  delay(10);             // pause so the pulse exists long enough to register
  digitalWrite(6,LOW);
  delay(20);             // pause before starting the loop over (lengthen pause to slow lights)
}
```

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[Next: The Box]

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