

Pulse Width Modulator

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1 A Square Wave Oscillator Using the 555 Timer

The National Semiconductor data sheet for the 555 is LM555.pdf

<http://www.national.com/ds/LM/LM555.pdf>

Link to the circuit diagram for the square wave oscillator:

<http://www.stem2.org/je/swo.pdf>

The component values we used were

$$C_1 = 10\mu F$$

$$C_2 = .1\mu F$$

$$C_3 = 100pF$$

$$C_4 = 10\mu F$$

$$R_1 = 1k$$

$$R_2 = 1k$$

Resistor R_3 is to be computed to give a period of

$$T = 20\mu s.$$

The power supply is a labtop supply giving about 19 volts. The voltage from pin 1 to pin 8 should be about +10 volts. The charge time is

$$T_1 = (R_3 + R_2)(.69)C_3$$

The discharge time is

$$T_2 = R_2(.69)C.$$

So the period is

$$T = T_1 + T_2 = (R_3 + 2R_2)(.69)C_3.$$

$$R_3 + 2R_2 = \frac{T}{.69C}$$

$$R_3 = \frac{T}{.69C_3} - 2R_2$$

If we want the period to be $T = 20\mu s$ then using Matlab we have

```
osces.m  
t=20.e-6  
r2=1000.  
c3=100.0e-12  
r3 = t/(.69* c) - 2*r2
```

We find

$$R_3 = 287.86K\Omega.$$

But for testing we used

$$R_3 = 100K\Omega.$$

2 Creating a Pulse Width Modulator (PWM) Using a Second 555 Timer

We choose our rectangular wave with a duty cycle close to 100 per cent so that it maintains a constant value until near the end of the period where it dips to zero. This output from the first 555 timer, pin 3 is fed to the input pin, pin 2 of the second 555 timer running in a one shot astable mode. So at the end of the cycle the voltage dips to zero triggering the second 555. The resistor R_4 and C_5 control the length of the resulting pulse to be a portion of the cycle time T . The result is that R_4 and C_5 control the duty cycle of the rectangular wave output from the second 555 timer. This wave becomes a constant voltage when run through a low pass filter. The new PWM circuit is

<http://www.stem2.org/je/swopwm.pdf>

$$C_5 = 100pF,$$

$$C_6 = 10\mu F.$$

We used

$$R_4 = 50K$$

for testing, but ultimately we will adjust R_4 to give a duty cycle so that we get a 15 volt output of our switching power supply.