

# Mini Power Pulse Modulator

A Versatile Square Pulse Generator

**Model:** PWM-OCm v2

**Type:** Compact, Low Voltage, 8A, 75V, 100kHz



## Features and Specifications

- Wide supply voltage range (12V – 30V)
- Switching voltage range from 0V to 75V
- Max output current 8A\* continuous, 80A peak
- Low on-resistance of 0.019 ohms
- Frequency range 0Hz to 100kHz \*\*
- Pulse width adjustable between 0% and 100%
- Basic transient voltage protection
- Thermal Overload Protection
- Highly compact design
- High quality double layer PTH, 2oz Copper PCB
- Dimensions: L45 x W50 x H20 mm

\* Max current varies with frequency due to switching losses. (See figure 0)

\*\* Full frequency range requires fitting capacitors (not included) to onboard socket. (See Table 2)

**Note that both models OCm and OCmi will have "PWM-OCm" printed on the PCB. You can easily distinguish between the two by the colour of the terminal connector. (Green for OCm. Black for OCmi)**

The **PWM-OCm** is an adjustable DC pulse generator designed for providing an easy way to adjust power to devices or to pulse them at a wide range of frequencies and pulse times. The frequency is independently adjustable to the pulse width which can be varied smoothly from 0% to 100%. It is designed to fit a wide range of applications and be fully adjustable so that it can be used for many different tasks. The **OCm** range of PWM circuits are highly compact and have been built so that they can easily be incorporated into projects requiring some pulse power control. The circuit is made in England on a high quality PCB with double layer design, plated thru holes (PTH), and 2oz copper (twice as much as standard circuits) for durability and performance. The built in thermal protection will help protect the circuit from overheating when powering high current loads or running it at high frequencies. If the circuit overheats, the output will be disabled until the circuit has cooled again.

## Example Applications

- LED or Light Bulb Dimming and Strobing
- Electrolysis and Electroplating
- Motor Speed Control
- Laser Pulse Experiments
- Ultrasonic Transducer Driver
- Tone Generator
- Shape Memory Alloy (Nitinol) Control
- And more...

## ELECTRICAL CHARACTERISTICS

NB: Figures may vary under different loading conditions and environments. Ratings are based on test conditions of 13.8V input and wire wound resistor load impedance of 0.4 ohms

Symbol	Parameter	Min	Max
V <sub>in</sub>	Input Supply Voltage	12V <sup>1</sup>	30 V <sup>2</sup>
V <sub>out</sub>	Output Voltage	-	V <sub>in</sub> - V <sub>drop</sub>

V <sub>sec</sub>	Secondary Switching Voltage	0 V	75 V
I <sub>sup</sub>	Supply Current (no load)	20 mA	30 mA
I <sub>out</sub>	Continuous Output Current	0 A	8 A
I <sub>pulse</sub>	Pulse Current <sup>3</sup>	-	80 A
f	Frequency	0 Hz (DC)	100 kHz
t <sub>on</sub> /t <sub>off</sub>	Switching Speed (no load)	4 us / 2 us	4 us / 6 us
t <sub>on</sub> /t <sub>off</sub>	Switching Speed (load)	3 us / 1 us	4 us / 3 us
Z <sub>out</sub>	Output Impedance	0.019 ohms	0.023 ohms
V <sub>drop</sub>	Output Voltage Drop (varies with output current)	-	0.18 V
SIG <sub>out</sub>	Signal Output (high)	9 V	12 V
INT <sub>in</sub>	Interrupter Input Voltage	1.1 V	12 V
FM <sub>in</sub>	Frequency Modulation Voltage Input	0 V	12 V
OSC <sub>out</sub>	Oscillator Output Voltage (high)	9 V	12 V
T <sub>SHUTOWN</sub>	Shutdown Temperature	90°C	110°C

Table 1: Electrical Characteristics

<sup>1</sup> Units will still oscillate when powered by a supply voltage as low as 3V but the heating in the transistor will increase significantly (and therefore reduce current capacity) due to higher Z<sub>out</sub>

<sup>2</sup> Input voltage is clamped by 3W, 33V Zener diode.

<sup>3</sup> Pulse current is transistors max rated current at 25°C.

## Power Ratings

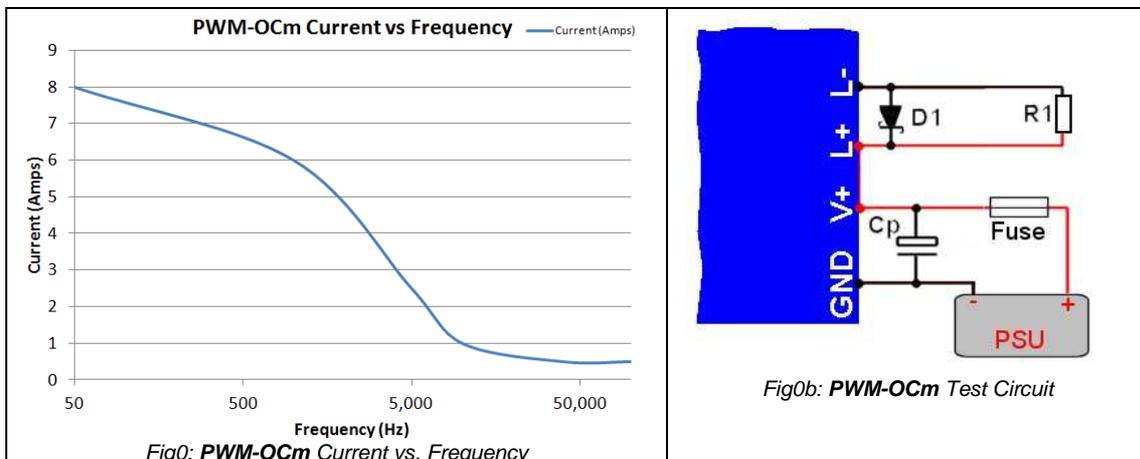
Test conditions (See Fig 0b):

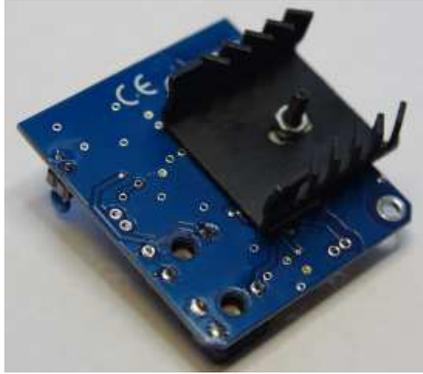
13.8V input, 0.4 ohm load (wire wound resistor) (R1), 1000uF power capacitor (Cp), schottky diode (D1).

The **PWM-OCm** continuous current rating is based on the temperature increase of the components. The ratings given are for the maximum average current possible before any component reaches a stable temperature of 99°C.

To use the circuit at full power, you need to check against this graph the maximum current you can set for your working frequency. You may also need to fit a large capacitor at the input terminals to overcome any voltage drop in your power leads and supply.

This graph is valid for the test conditions described. In your application, the performance may vary above or below what is shown here.





The current carrying capacity can be significantly increased by attaching the **OCm** to a suitable heatsink. The heatsink should be fitted to the base of the **OCm** module with an insulating heatsink spacer to prevent the heatsink from touching any part of the circuit except the power plane. The heatsink can then be secured with an M3 bolt and nut using the hole above the transistor. The example in *figure 0c* shows a standard TO-220 heatsink mounted on an **OCmi**. This increased the current capacity at 1kHz from 1A to 3.8A

fig 0c - Added Heatsink

## Connections

The main connections to the circuit are made using the 4-way terminal block at the end of the board. The input power ( $V_{in}$ ) is connected to 'GND' and 'V+', while the load is connected between L+ and L-. See the diagrams below for how to connect a secondary supply. Some other connections such as OSC, FM, SIG, and INT can be made using the solder pads provided on the PCB. See the specs above and below for further details.

If you intend to control large currents, ensure that the wire used is thick enough and that a sufficient capacitor is placed at the power input (see Fig0b). Always use a fuse to protect the circuit from accidental overloads or short circuits.

### Power Connections

Below you can see typical connections for the power supply and load. Make sure

the cables are thick enough to carry the current you want to pass, and keep them short if possible. It is possible to use a single supply to power both the circuit and your load (see fig 2), or you can use a separate secondary supply for the load. This allows you to supply a different voltage to your load than what you are using to power the circuit. For the **PWM-OCm**, this secondary voltage can be from 0V to 75V.

<b>GND</b>	Ground, Earth, 0V, or battery negative terminal.
<b>V+</b>	Input Supply Voltage, or battery positive terminal
<b>L+</b>	Load positive (internally connected to V+)
<b>L-</b>	Load negative

## Output Load Considerations

The minimum load impedance that should be connected to the device can be calculated using ohms law;

$$R_{LOAD} = V / I_{pulse}$$

### For Example:

Using a 12V supply,  $R_{LOAD} = 12 / 80 = 0.15$  ohms

If you are using long cables, install a fast diode as shown in fig 3. You must also ensure that your PSU is capable of delivering that peak current.

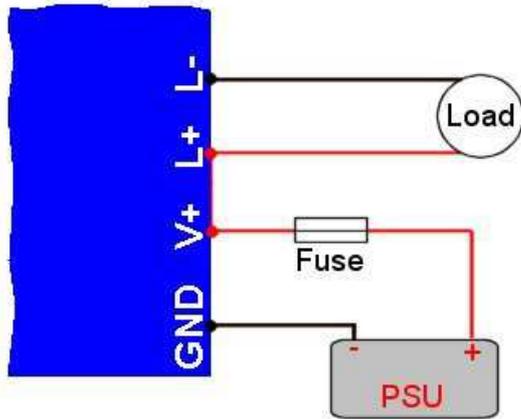


Fig 2: Typical power connections

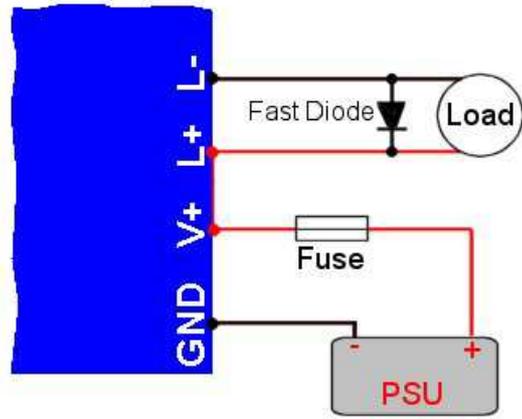


Fig 3: Typical power connections for inductive loads

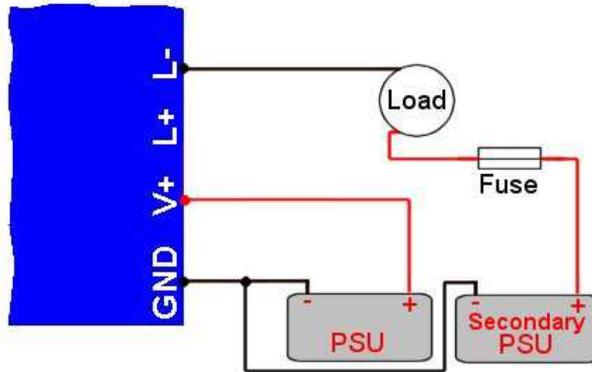


Fig 4: Typical power connections with secondary supply

## Additional I/O Signals

There are four solder pad around the edge of the PCB which allow for making connections to other PWM units or other devices.

### **SIG** Drive signal out

Sig is the voltage at the transistor gate pin. This can be used for monitoring the device frequency and duty. It can also be used for driving another transistor. At higher frequencies this signal will become less square and have rounded edges. If you need more precision, try our advanced range of Power Pulse Modulators. You can also pull this input low to disable the PWM output.

### **INT** Interrupter input

Applying a small voltage to this input pad will disable the PWM output. This is useful for modulating the main power output, or for switching the output on or off using a digital signal from a microcontroller.

### **FM** Frequency modulation input

This solder pad is for connecting an external control voltage for modulation of the output frequency. The voltage should be between 0V and 12V. When using the modulation input, the output duty may also increase when the frequency increases.

### **OSC** Oscillator output

This is the square wave output from the oscillator. It can be used as a reference signal for monitoring frequency as the output is not affected by the duty setting.

### **C1** Timing capacitor

This socket allows you to fit the timing capacitor of your choice. See table 2.

### Important Usage Notes

- Always make sure the pulse width is set to minimum (pot turned fully anti-clockwise) before connecting the circuit to a load or power source.
- Use a fused power supply to protect from accidental short circuit or overload. The fuse should be rated to suit your application and up to a maximum of the units specified pulse current. Use a quick blow type fuse.
- The heat generated in the switching transistor will vary with your loading conditions and the settings for frequency and pulse width.
- Consider the stray inductance of any power leads as this can generate significant voltage spikes due to the high current square pulses. The unit has some built in protection, but you must ensure you add adequate protection if necessary.
- Ensure an adequate power capacitor is fitted between V+ and GND if you are using a single power supply. See Figure 0.
- Do not remove the timing capacitor C1 when the unit is powered on.
- When using voltages above 30V or when driving high voltage coils, you should make sure the GND connector is suitably earthed for safety. Failure to do this risks damage to the circuit and and/or electric shock.
- The transistor/heatsink and copper surface on the PCB will be at the same voltage as your load and can be even higher if transient voltages are present. Do not touch the PCB when powered.

### Controls

The frequency and duty cycle can be independently adjusted using the potentiometers. Turning the control clockwise will increase the value corresponding function. The frequency range of the device depends upon the capacitor value of C1. The pre-fitted capacitor is 1nF which gives a range of medium frequency pulses which are suitable for most applications. Replacing C1 with a larger value capacitor will give a range of lower frequencies. At very low frequencies the green output LED will flash for a time that is proportional to the frequency and pulse width setting.

### Capacitor Values for C1 and Corresponding Frequency

By fitting different sized capacitors into the socket marked C1, a wide range of frequencies can be achieved. The table below gives some example values and the frequency range produced. You can use any other capacitance you desire to get other frequencies. Note that the values shown will allow the unit to oscillate above the specified frequency range, but these are for reference only. As the frequency increases, the output will become more rounded and the transistor may not switch fully on during each pulse. This can lead to excessive heating which could potentially damage the unit. Using the device above its rated top frequency is done at your own risk. See Fig0 for how frequency affects heating.

Capacitance	Min Frequency	Max Frequency
1uF	1Hz	200Hz
0.47uF	1.5Hz	400Hz
0.33uF	2Hz	600Hz
220nF	3Hz	1kHz
10nF	219Hz	21kHz
1nF	710Hz	175kHz
220pF	3kHz	546kHz
100pF	6kHz	925kHz
22pF	19kHz	1.7MHz

Table 2: Capacitor values for frequency ranges.

## Driving Inductive Loads

(Motors, Solenoids, Transformers, Relays, Coils, etc)

The **PWM-OCm** has only basic protection against high voltage transients from inductive loads. When driving inductive loads you should take extra measures (see the product tutorials on our website) to protect the **OCm** from high voltage transients. This unit is **not suitable** for use with ignition coils. You should use the high voltage models such as the OCmi, or OCXI for such loads.

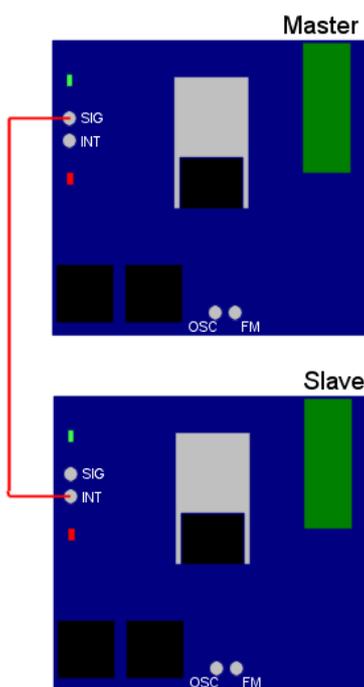
## LED Indicators

The power LED lights to indicate that power is present in the signal generation circuitry. This can also be used to indicate the overall health of your input power supply. If the LED dims when the PWM output is high, this indicates your power supply is struggling to provide enough current. This could mean a low battery or overloaded PSU. Note that running the unit in these conditions may cause it to overheat. For proper operation the LED must be well lit and steady.

The output LED lights when the switching transistor is on and power is being delivered to the outputs. At low frequencies you will see it flashing, at high frequencies it will appear to be on with a brightness proportional to the duty setting.

## Linking Modules

It is possible to link multiple units together, or link them to our other Cyber Circuits. The **OCm** or **OCmi** can be linked together so that one device modulates the output of another. Any number of modules can be linked together like this for multiple modulation frequencies. The diagrams below show how to link modules together. The connections for power and load are not shown for simplicity. It is assumed each module is connected to one or more power sources, and share a common GND. A load can be connected to any individual module, or all modules can drive a separate load each.



### Gated or Modulated Slave

It is possible to modulate the output of a slave unit with another signal. This is often called Amplitude Modulation, or Gating. Typically you would set the master to a low frequency, and the slave to a higher one. When connected in this way, each time the master outputs high, the slave will be disabled. The slaves power output is therefore a sequence of high frequency pulses like shown below.

A connection needs to be made between the 'SIG' solder pad on the master device, and the 'INT' pad on the slave.



Fig 5: Output waveforms for linked modules

Note that when connected like this, setting the duty of the master to 100% will fully disable the slave modules. Setting the master to 0% will fully enable the slaves

which will operate according to the settings of their own controls.