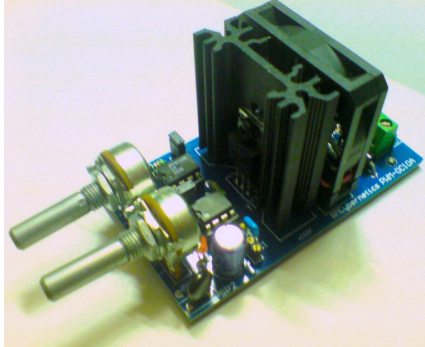


# Power Pulse Modulator

A Variable Square Pulse Generator



PWM-OC10A – rev0808

This is a multifunction variable pulse generator. It is designed to fit a wide range of applications and be fully adjustable so that it can be used for many different tasks. This is designed to be low cost so that multiple units can be used to complete a variety of tasks, or so that the same board can be used in numerous different projects or experiments where several different devices might normally be needed. The modules can be linked together in a master/slave setup, and the pulse width can be adjusted by an external analogue source.

Dimensions: L82 x H43 x W46 mm (excludes pot posts 25mm)

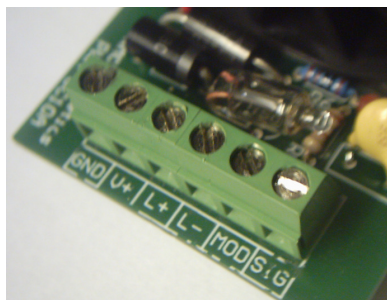
## Features and Specifications

NB: Figures may vary under different loading conditions and environments.

- Input 9 to 12V, 10A (120W) MAX
- Power Output - 9 to 12V DC Square wave 10A MAX
- Continuous/average output current up to 2.5A
- Short pulse currents up to 30A
- Open collector output allows for use of separate voltage source (up to 50V) for pulses.
- Low on resistance of 0.5 ohms
- High dV/dt (switching transition speed)
- Independent frequency and pulse width / duty cycle controls.
- Frequency adjustable between 1 Hz and 100 kHz (Includes 2 capacitors for different frequency ranges) *see page 3*
- Pulse width adjustable between 0% and 100%
- Fan cooled
- Back e.m.f / high voltage transient early warning indicator and protection
- ESD and Transient suppression included

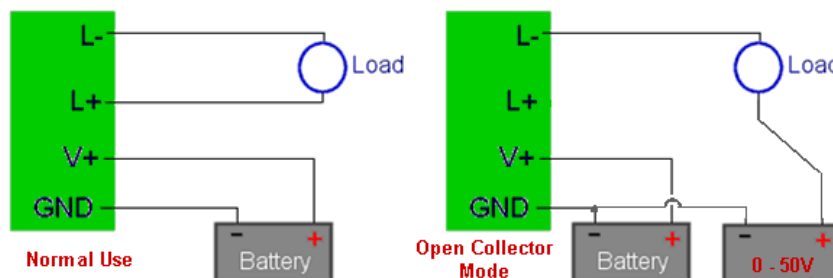
**Customisation options available ([email us your requirements](#))**

## Connections



Connections to the circuit are made using the 6 way terminal block at the end of the board. The input power is connected to 'GND' and 'V+' with a voltage from 9V to 12V.

GND	Ground, Earth, 0V, or battery negative terminal.
V+	Input Voltage 9 to 12V, 10 amps MAX
L+	Load positive
L-	Load negative
MOD	Modulation Voltage In/Out
SIG	Signal In / Out



**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 10A. The heat generated in the switching transistor will vary with your loading conditions and the settings for frequency and pulse width. When driving high power loads, **always check the temperature of the heatsink** after making any adjustments.

**Controls**

The frequency and duty cycle can be independently adjusted using the potentiometers labelled VR1 and VR2. The frequency is adjusted with VR1 while the pulse width can be adjusted with VR2. The frequency **range** of the device depends upon the capacitor value of C1. The pre fitted capacitor is 200nF which gives a range of low frequency pulses which can be seen on the output LED (LED2). Replacing C1 with a smaller value capacitor will give a range of higher frequencies. At high frequencies LED2 will appear to have a brightness that is proportional to the pulse width setting. At high frequencies the shape of the output waveform will become more distorted with increasing frequency.

**Jumper Settings – I/O connectors**

The jumpers JP1 and JP2 are used to set the status of the 'MOD' and 'SIG' connectors. With the jumper links in place (default), the 'MOD' and 'SIG' can be used as outputs while removing the jumper links causes them to act as inputs. When set as inputs the onboard manual adjustment of the relevant controls is disabled.

The voltage ratings for the I/O ports are to be kept within the voltage of the supply to the V+ connector. A 100 ohm resistor is recommended for protection when connecting to external devices.

The jumper pins shown as JP1 can be used in a variety of ways for altering how the duty cycle is controlled. In its default position the pins are connected and duty control is done using the on board potentiometer. JP1 can also be replaced by a varying resistance source such as an LDR or potentiometer. In this configuration the output duty cycle will increase as resistance decreases. The pot VR2 can now be used to adjust the offset value. To control duty cycle with an external voltage the jumper JP1 is removed and the input voltage is applied to the 'MOD' connector.

The jumper JP2 is used to set the 'SIG' connector as an input or output. With JP2 connected the device will function from the onboard signal and 'SIG' can be used as an output. With JP2 removed the device will require an external signal to be applied to the 'SIG' connector. More information about linking modules together can be found on the next page.

**LED Indicators**

LED1 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.

LED2 lights when the switching transistor is on. It is brightest when no load is on the output. This can be useful for setting the unit to match a resonant frequency of an LC circuit. With the pulse width set to around 50%, the frequency can be adjusted until the brightest (parallel LC) or dimmest (series LC) spot is found.

**Driving Inductive Loads**

Use a separate supply for both the load and the circuit power connections like shown in the diagram for 'open collector mode' on page one. This helps keep the voltage spikes to the protected part of the circuit so that high voltages don't appear between the power rails of your supply to the circuit.

The units are fitted with surge and spike protection that is suitable for most loads. When driving large inductive loads or high voltage coils, it may be necessary to add extra protection against voltage spikes. If driving car ignition coils or high voltage spark coils you must ensure that the coils output is not left unloaded when being driven at high power. An unloaded coil will reflect almost all the pulse energy back into the PWM circuit. While the circuit will attempt to dissipate this energy, it can only provide a limited amount of protection so care must be taken to avoid large amounts of back e.m.f.

The Neon indicator lamp DS1 can be used to gauge the amount of back e.m.f. being generated by your load. If the light flashes or glows orange only a small amount, the onboard protection will be adequate. If you see the neon lamp flashing or glowing brightly, your load is generating an excessive amount of back voltage. Try reducing the pulse width or increasing the frequency. If this does not help you will need to absorb this excess energy using snubber circuit or the unit may become damaged.

If your unit is damaged by voltage spikes it is likely that the output will latch on or that the pulse width will get increased so that it can not be fully reduced. The unit can sometimes be repaired by replacing IC2 (LM393 Op-Amp) or sometimes T1 (IRF740 MOSFET). There is no guarantee that replacing either of these components will fix a damaged unit as any of the other components could also be damaged by excessive back e.m.f.

**Example Applications**

**Pulse Width modulation (PWM) Motor Speed Control**

Pulse Width Modulation (PWM) is used to accurately control the speed of DC motors. The pulse frequency can be adjusted to match your motor for performance or reducing noise. The speed of the motor can be adjusted using the preset on the board, or it can be attached another variable voltage source such as the analogue output from a microcontrollers or similar device.

**Hydrogen Production (Electrolysis)**

Simple control over reaction rates with PWM control. It can switch large currents for direct connection to electrodes or use of transformers with widely adjustable

<p><b>Dimming or Flashing of LED's and Light bulbs</b> This module can be used to smoothly dim lights or make them flash at regular intervals. The brightness is adjusted by a pulse width modulated signal which can be set to and inaudible frequency.</p> <p><b>Tone Generator for small or large speakers</b> This circuit generates an adjustable square wave signal that is powerful enough to drive anything from piezoelectric sounders to large bass speakers. The frequency range can be adjusted between sub bass and ultrasonic levels.</p> <p><b>Solenoid or Relay Pulsing</b> Simple variable rate on/off function for driving relays or moving solenoids with repeated strokes or adjustable power.</p> <p><b>Coil Pulsing</b> Drive coils and electromagnets with regular current pulses of up to 10 Amps. Ideal for magnetic launchers and many other pulsed coil experiments. At higher pulse frequencies the PWM control can be used to adjust the average field strength of a coil or electromagnet.</p>	<p>frequency for impedance matching and resonating systems.</p> <p><b>SMA Wire Driver</b> The variable pulse generator can be used as an adjustable current source for powering muscle wire (Shape memory alloy SMA wire). By using a medium frequency setting, the PWM control can be used to adjust the average current flowing through the muscle wires giving precise control over the movement. At low frequencies muscle wire can be pulsed for repeated movements.</p> <p><b>Transformer Driver</b> Works with inductive loads like transformers for inverter projects or high voltage power supply's. 12V operation allows it to drive autotransformers, induction or ignition coils.</p> <p><b>Variable Voltage Source</b> Setting the frequency quite high and placing a large capacitor between L+ and L- will allow the unit to be used as a variable voltage source. The voltage output will be proportional to the pulse width.</p>
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### Capacitor Values and corresponding frequency

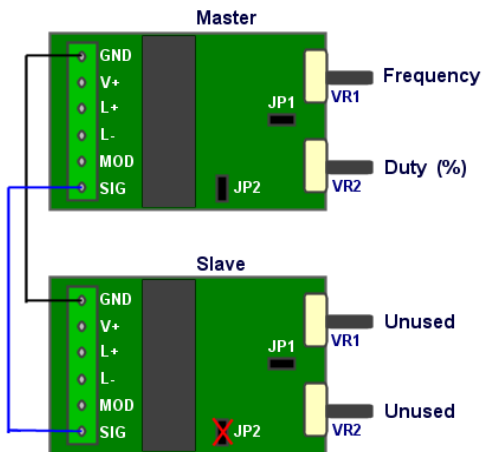
By fitting different sized (non-polar) capacitors into the position marked C1, a wide range of frequencies can be achieved. The table below gives some example values and the frequency range produced. You can use any other capacitance you desire to get other frequencies

Note that the values shown will allow the unit to oscillate above the specified frequency range, but these are for reference only. Above 100kHz 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.

Capacitance	Min Frequency	Max Frequency
220nF	3Hz	600Hz
47nF	14Hz	2.5kHz
10nF	71Hz	10kHz
1nF	710Hz	87kHz
470pF	1.5kHz	170kHz
100pF	6kHz	263kHz
47pF	10kHz	870kHz

## Linking Modules

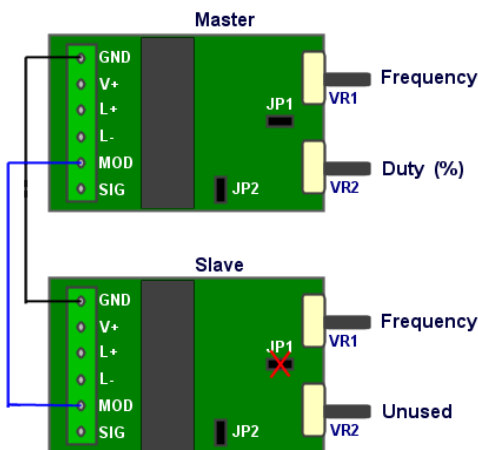
Multiple units can be linked in a number of different ways. A master/Slave arrangement can be used so that both units pulse together or at different times and rates. The diagrams below show how to link modules together. The connections for power and load are not shown for simplicity. It is assumed each module is connected to the same power source. A load can be connected to an individual module, or all modules can drive a separate load each. Any changes to the jumpers and links should be done with all power switched off.



### Master controlled Frequency and Duty

Modules linked in this way will all output the same frequency and duty which is set by the controls on the master device. You can have any number of slaves in this setup.

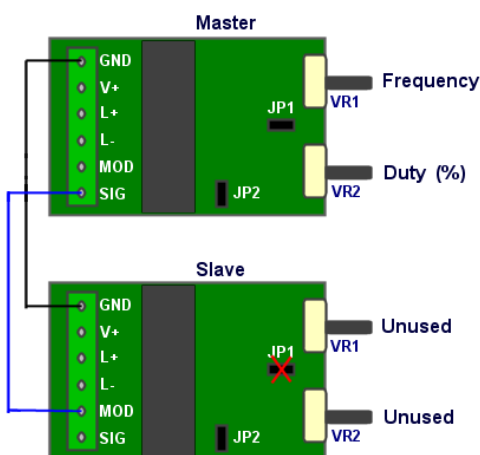
The 'SIG' connector from each module is joined together and the link jumper JP2 is removed from whichever modules are to be a slave.



### Master controlled Duty with independent Frequency control

Modules linked in this way will have independent frequency control while the duty percentage is controlled by the master device. This method can be useful for simultaneously driving reactive loads (such as transformers or capacitors) which have different impedances.

The 'MOD' connectors of two or more units are linked and the jumper JP1 is removed from whichever modules are to be a slave.

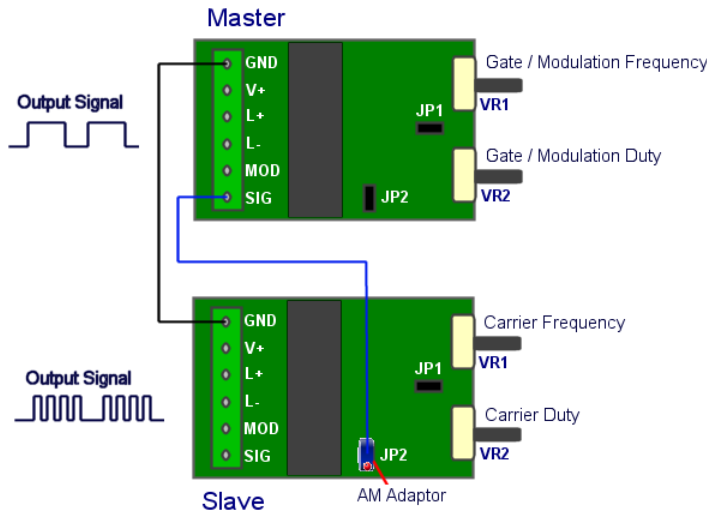


### Master Frequency and Duty with Opposite Phase

Two modules linked in this way will have the same output frequency but each signal will be of opposite phase. This means that when the output of master devices is on, the output of the slave device will be off and visa-versa. Changing the duty setting using the master control will alter which module is on longest. It can be adjusted fully between 50% each to either module having 100% while the other has 0%.

The 'SIG' connector of the master device is connected to the 'MOD' connector of the slave device and the jumper JP1 is removed.

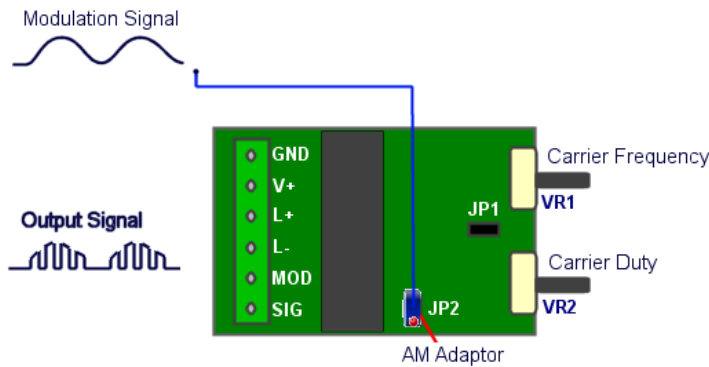
### Using an AM Adaptor (Sold Separately)



### Linking Multiple Units

The AM Adaptor can be used with a single PWM-OC10A or to link multiple modules. Two modules can be linked so that one signal is modulated by the other as shown in the diagram. The jumper JP2 is removed from the slave device and is replaced with the adaptor. The adaptor's lead is then connected to the 'SIG' output of the primary module.

### Amplitude Modulation



With the adaptor placed on JP2, the amplitude of the output pulses can be adjusted by applying different voltages to the lead of the AM Adaptor. The voltage input range is typically 0-5V, with 0V disabling the modules output and 5V enabling full output. You can adjust this voltage within this range for fully variable amplitude control. You can also apply

other varying signals such as audio which will cause the output to be modulated by the incoming signal.