

## Model 500 Peak and Hold PWM Driver



### OVERVIEW

- on/off solenoid control with coil power reduction feature
- peak (full on) solenoid pull-in followed by high frequency PWM output to reduce hold-in current
- reduce power consumption
- reduce solenoid coil heat and extend coil life

### FEATURES

- adjustable peak time and hold duty cycle using miniature rotary switches (digitally set, known precise timing, no parameter drift with temperature or age)
- dual input trigger source – use either:
  - 5 to 28V DC digital input – optically isolated
  - contact closure
- jumper option: contact closure input may be used for PWM hold disable – for override of PWM hold feature in high load conditions
- power MOSFET output with low side load control
  - output sinks up to 4A at 12V during hold
  - up to 10A during peak time
- controller operating voltage 9 to 28 V DC
- load may be operated with up to 50V DC
- built-in back emf protection diode
- I/O connection using screw-down terminal strip
- stand-alone controller, small signal conditioning size package, DIN mountable option available
- operating temperature: -40 °C to +60 °C
- designed for long service life, high reliability, and high availability (24/7) using components rated for industrial temperature range

### DESCRIPTION

The Model 500 Peak and Hold Pulse Width Modulation Driver from Applied Processor and Measurement, Inc. is designed to drive solenoid based devices with an initial full-on pull-in pulse, then provide a reduced power hold-in current by pulse width modulating the output. The Model 500 can reduce overall current in on/off based solenoid drive applications, reducing the operating solenoid coil heat, thereby extending coil life and protecting the coil from burn-out.

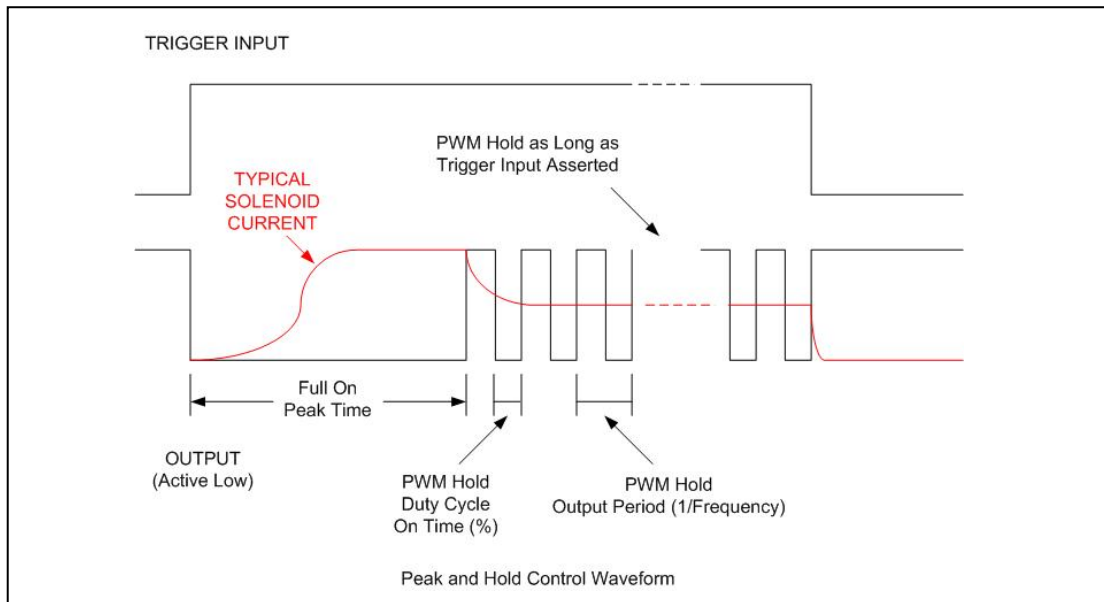


### APPLICATIONS

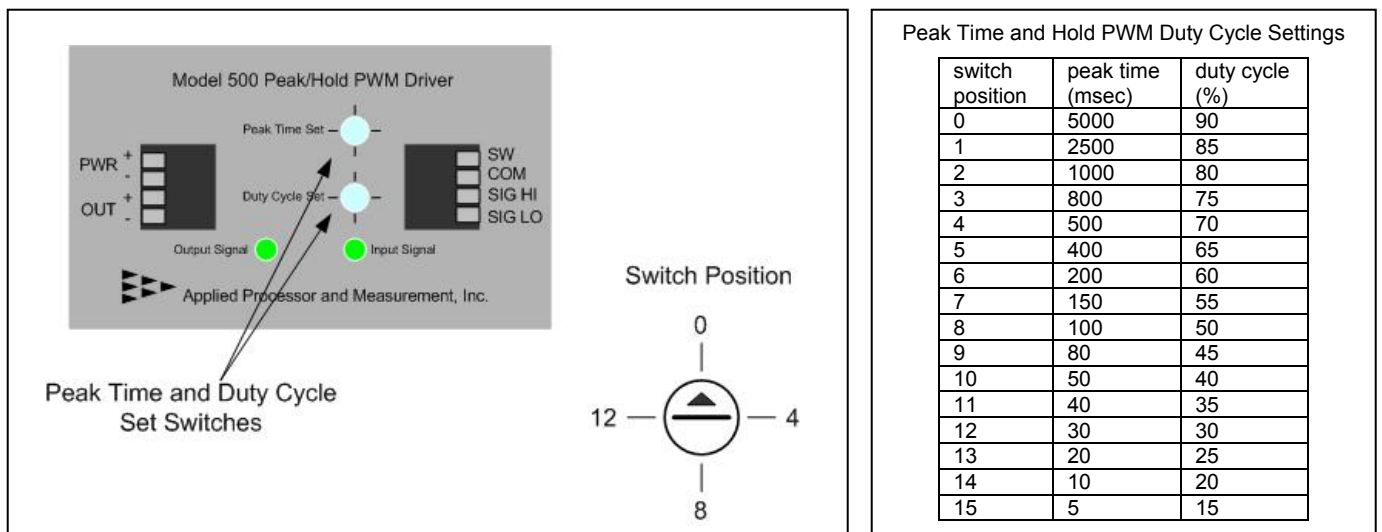
- power reduction on any on/off coil operated device
  - valves, actuators, solenoids
  - clutch coils
  - relays
  - DC motors
  - LED's / lighting systems / equipment
- extend coil life, protect coil burn-out
- easy to install in-line with existing installations to gain benefits of reduced current and solenoid wear due to overheating
- drive with PLC or PC, virtually any digital input signal, or contact closure
- industrial, automotive test, refrigeration system applications
- OEM / production applications

## OPERATION

A typical on/off sequence of the Model 500 Peak and Hold PWM driver is shown below. The output control is triggered by assertion of either trigger input. When the input is asserted, the controller will set the output at full-on for the set peak time. The peak time should be set to allow for complete solenoid engagement. When the peak time is complete, the controller will PWM at the hold duty cycle. The PWM output is cycled on and off at a very high frequency (1,000 Hz) so that the solenoid will not mechanically respond, however, the average current through the solenoid is sufficient to hold the actuator in place. The hold duty cycle should be selected to reduce current, but guarantee solenoid hold. The waveform below shows the trigger, the output (which is active low) and a typical average output current (shown in red in the figure). When the full-on peak time is executed, the solenoid current drives to its maximum. During the hold time, the output current is reduced, typically to the percentage of the maximum of the duty cycle that is set. The output remains at PWM hold until the trigger input is removed.

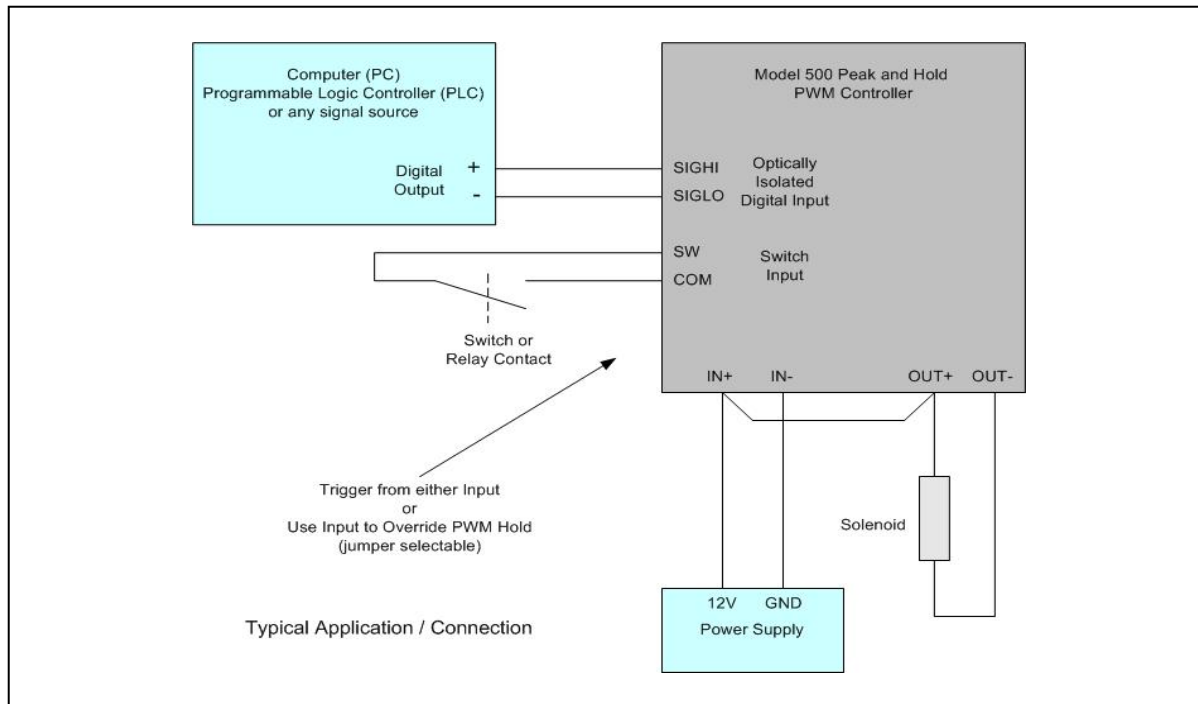


The Model 500 PWM Peak and Hold PWM Controller has two rotary switches on the face of the unit which allow for precise setting of the peak time and the hold PWM duty cycle. Timing and PWM control are generated using microcomputer circuitry internal to the Model 500 unit. Refer to the figure and tables below to set the Model 500 peak time and hold PWM duty cycle.



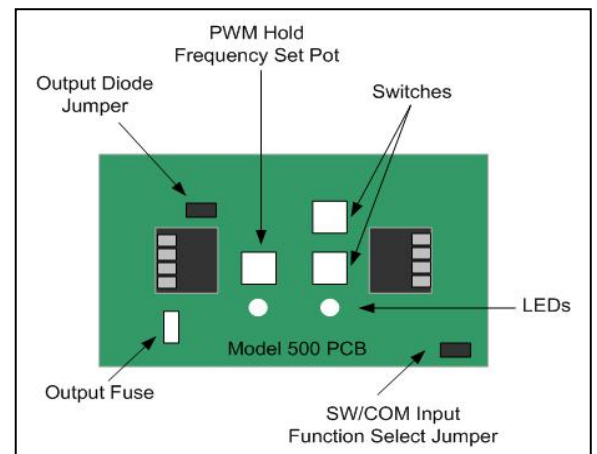
## INSTALLATION

A typical connection using the Model 500 Peak and Hold PWM controller is shown in the diagram below. The controller output is an open-drain power MOSFET output, providing low side drive of the load to be controlled. An external power source must be provided. This power source may be used to power both the load and the controller, however, the controller need not be powered by the same power source. A dual supply configuration (refer to installation guide) may be used to power the controller (9 to 28V DC) and the load (1 to 50V DC) separately. The Model 500 may be triggered using either the wide input range optically isolated digital input or a contact closure (non-isolated). This allows for virtually any digital input or computer or PLC based control to be used as the load trigger. Note that an internal jumper defines the function of the SW/COM input. By default (jumper installed), the SW/COM input is a trigger input. If the jumper is removed, the contact input becomes a PWM hold disable input. This is used to disable the PWM hold feature for high load conditions when full power is necessary for the application.



## ADDITIONAL SETTINGS

Additional settings for the Model 500 Peak and Hold Controller include: a jumper for the SW/COM contact closure input function (see above paragraph for jumper settings), an output fuse, a back emf protection diode jumper, and the PWM hold frequency. Referring to the illustration at left, the cover may be removed to expose the top of the circuit board in the Model 500 unit. A replaceable cartridge fuse (Littelfuse series R451) is used to protect the MOSFET output. For coils with built-in back emf diodes, the Model 500 output diode may be removed by removing the jumper. Lastly, the PWM hold frequency may be changed. The standard PWM frequency is 1,000 Hz and is suitable for most applications. The frequency may be changed from 500 to 1,500 Hz in 100 Hz steps by turning the pot counter-clockwise. Turning the pot to the full clockwise position will result in the default 1,000 Hz operating frequency.



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## **SPECIFICATIONS**

- PWM Output: open drain Power MOSFET, maximum power dissipation 50W
  - up to 4A @ 12V, pulsed
  - maximum of 10A during peak time
  - must operate within safe area of IRLR2905
  - built-in fuse on output, standard value 4A
  - back emf output protection diode across output +/- terminals
- PWM Output Operating Voltage: 50V maximum, 1V minimum
- Control Type: digital control, microcomputer based
- Peak, Full-On Times: selectable from 5 msec to 5 sec.
- Hold PWM Frequency: default 1,000 Hz
  - configurable in 100 Hz resolution from 500 to 1,500 Hz
  - typical error < +/- 2Hz
- Hold PWM Duty Cycle: 15 to 90 %, adjustable in 5 % steps, typical error < +/- 0.1% duty
- Trigger Digital Input – trigger peak and hold cycle with either input
  - opto-isolated signal input, 5V to 24V required to enable, 0V to disable
  - switch / contact input, short SW and COM pins, non-isolated, internal pull-up to 5V
- Power: requires 9V to 28V DC, regulated or un-regulated external source
  - controller power consumption: 20 mA (approximate) at 12V DC
  - dual supply required for operating loads outside of 9V to 28V controller operating range
- Operating Temperature: -40 °C to +60 °C
- Size: 3.625 in. x 2.25 in. x 1 in. (1.25 in. height with I/O connectors, not including DIN mounts)
- Warranty: 1 year, for manufacturing defects

## **ORDER NUMBERS – CONTROLLERS AND ACCESSORIES**

PWMC-500	Model 500 Peak and Hold PWM Driver
PWMC-500-DIN	Model 500 Peak and Hold PWM Driver, DIN Rail Mountable
PWMCA-FS42	Model 500 fuses, 2A, package of 10 (Littelfuse p/n 0451002.MRL)
PWMCA-FS44	Model 500 fuses, 4A, package of 10 (Littelfuse p/n 0451004.MRL)

## **CUSTOM / SEMICUSTOM CONTROLLERS**

All standard products from Applied Processor and Measurement, Inc. including the Model 500 Peak and Hold PWM Driver are available for customization. Inquire with APM, Inc. regarding any fixed peak time, or PWM hold setting, or, different settings tables. Fixed value controllers may be supplied for any application. Additionally, the Model 500 can be designed to exacting specifications for your application, reducing cost for high volume applications, changing functionality, or adding features. For more information, contact APM, Inc. via our website, or, call to talk to one of our engineers. APM, Inc has been supplying embedded electronic controls for over 20 years for a wide variety of industrial, automotive and commercial applications.