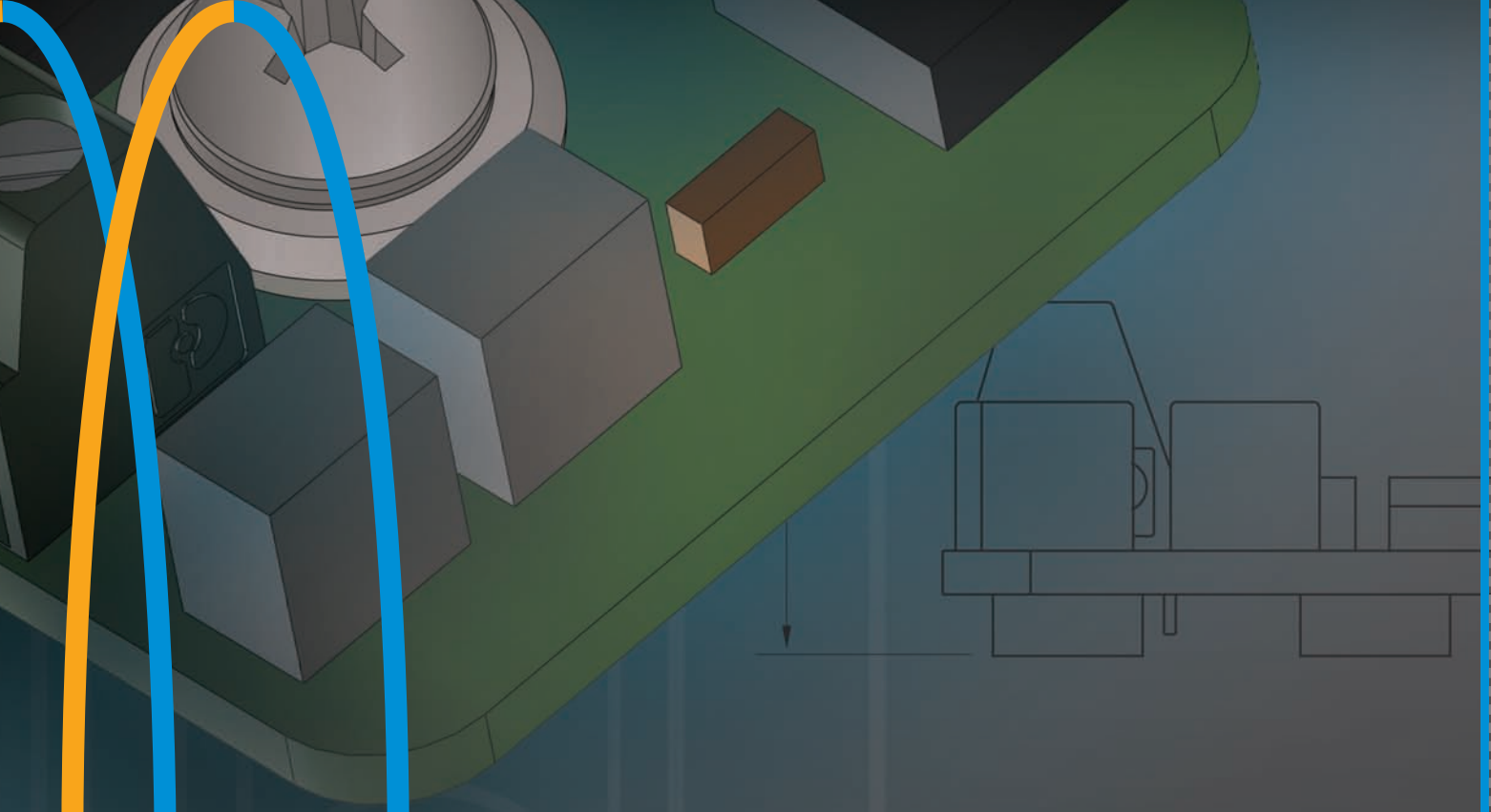


PWM CONTROL

FOR ELECTROMECHANICAL ACTUATORS

Engineered for higher performance and energy efficiency

MAGNET-SCHULTZ OF AMERICA
SPECIALISTS IN ELECTROMAGNETIC DEVICES

HARNESS THE *power* OF **COLLABORATIVE INNOVATION**

Turning our knowledge into customer value

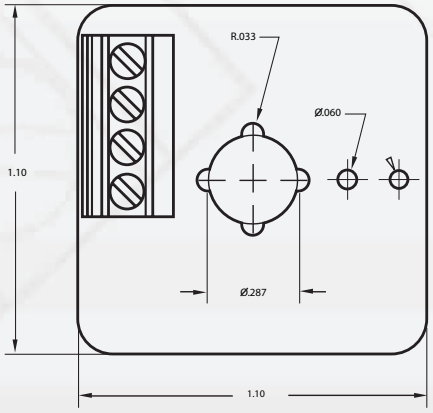
POWER CONTROL MODULES

UTILIZING PULSE WIDTH MODULATION TO DRIVE ELECTROMECHANICAL ACTUATORS

Driving electromagnetic actuators, such as solenoids, by utilizing the conventional approach of applying a constant voltage and current to the coil, throughout the range of linear travel *(called the "stroke" of a solenoid)* is an effective, but inefficient use of the total energy consumed. The power required to get a solenoid plunger to move at maximum travel is far greater than the power required to hold the plunger at the fully seated, zero travel position.

The same scenario holds for all electromagnetic actuators. When high amounts of power are applied continuously to the coil, the coil temperature can become excessively high, resulting in the degradation of performance, and potentially destroying the materials from which the device is made.

By employing Magnet-Schultz of America's electronic Power Control Modules, which employ Pulse Width Modulation (PWM) to actuate an electromagnetic device, you can avoid problems related to excessive heat and possibly enable the use of physically smaller devices.

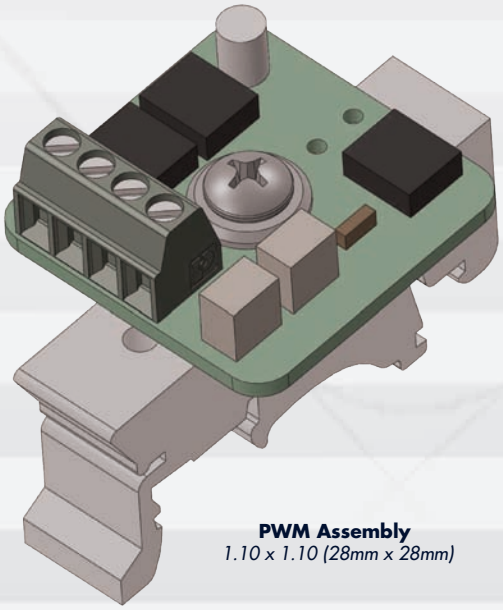


PULSE WIDTH MODULATION TERM DERIVATION

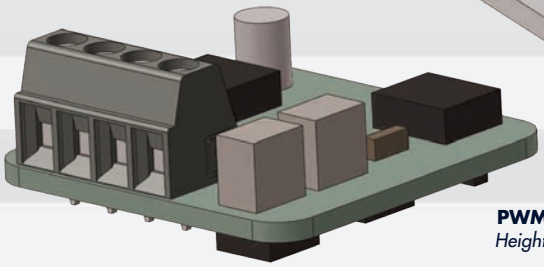
Pulse refers to the voltage pulses (and the resulting pulses of electric current) that are supplied to the coil of an electromagnetic device by the PWM circuitry.

Width refers to the percentage of time the pulse is "on" versus "off".

Modulation refers to the frequency at which the pulse is modulated.



PWM Assembly
1.10 x 1.10 (28mm x 28mm)



PWM Side View
Height: .474 (12mm)

PWM SPECIFICATIONS					
Parameter		**Minimum**	**Typical**	**Maximum**	**Unit of Measure**
Supply Voltage		7		24	Volts
Pulse Current *(250 ms)*		0		10	Amps
PWM Frequency			21		kHz
Hold Current	**VCM**	0		3	Amps
	CCM	0		2.4	Amps
Input Control Signals	**VCM & CCM**	0		5	Volts
Pull-In Time		25		250	ms
Ambient Temperature		0		85	°C

PWM CIRCUIT WORK BASICS

Initial Power

MSA's family of PWM circuits apply maximum (100%) power, for a set period of time, to achieve the desired actuation performance from an electromagnetic device—this is referred to as the PICK Mode.

Sustaining Power

By pulsing the voltage at a specific frequency, the PWM circuitry can effectively reduce the power needed to keep the device in the actuated state—this is referred to as the HOLD Mode.

Control of the PICK & HOLD Modes

- **INPUT POWER & SIGNAL**—the PWM module includes a four position input terminal block, or optional four pin terminal strip that accept both power and signal input. Wire leads are also available upon request.
- **OUTPUT**—Output voltage is supplied to the electromagnetic device via two lead wires (that are soldered to the PWM by MSA), or by thru-hole solder pads, to which customer attached wires can be soldered.

PICK & HOLD Adjustment Parameters

- During system development (and if desired, in production) both the PICK and the HOLD parameters can be modified by:
  - Manually adjusting the two on-board Potentiometers (one for PICK and one for HOLD), or
  - Manually applying an input signal (between 0 and 5 volts) to the input terminal block/strip.
- Once the final PICK and HOLD values have been determined, they can be programmed into the PWM's on-board micro-controllers, requiring no additional adjustment, and eliminating the need and cost for on-board POTS, or the complexity of external input signals.

PWM FAMILY OF MODULES

Voltage Control (On-Off) Module (VCM)

This is the most basic Power Control Module offered by MSA. Functionality is primarily that of a voltage divider, providing on-off output, in both the PICK and the HOLD modes.

PICK MODE

The PICK Mode is established by determining the on-time (within a range of 25ms to 250ms) during which the PWM applies 100% power to the coil.

HOLD MODE

The HOLD Mode is established by adjusting what is referred to as the Duty Cycle (the on-time versus off-time) needed to keep the device actuated.

Examples of Typical Cycles

- **50% DUTY CYCLE** represents a scenario where the on-time is 5ms and the off-time is 5ms
- **25% DUTY CYCLE** represents a scenario where the on-time is 2.5ms and the off-time is 7.5ms
- **10% DUTY CYCLE** represents a scenario where the on-time is 1ms and the off-time is 9ms

Removing input power from the VCM Modules will remove power from the electromagnetic device to which it is connected, allowing the device to return to the unactuated state, ready to start the process all over again.

Learn more about MSA's family of PWM modules—visit Magnet-SchultzAmerica.com, or contact us directly at 630.789.0600.

Current Control Module (CCM)

As with the VCM Module, the CCM Power Control Module provides both a PICK and a HOLD mode. The difference is, the more sophisticated CCM can monitor input voltage, as well as monitor and control the output voltage/current that is sent to the electromagnetic device.

When operating in the HOLD mode, the CCM determines and maintains a firmly established "set" current throughout varying loads experienced by the actuator.

Programmable CCM Functionality

- Limits the overall power consumption to a strict minimum, providing identical behavior for:
  - fluctuating input line voltages,
  - multiple input voltages (i.e. 12 to 24 VDC)
  - all output voltage conditions
- Automatically adjusts the output voltage to the pre-set level deemed necessary to operate a specific actuator
- Accommodates and compensates for changes in both ambient temperature and coil temperature
- Prevents overheating of the electromagnetic devices, thus limiting internal heating
- Conserves and provides a more efficient use of energy in both the PICK and HOLD Modes
- Ensures proper operation of the actuator

As in the case of the VCM Module,removing input power from the CCM Modules will remove power from the electromagnetic device to which it is connected, allowing the device to return to the unactuated state, ready to start the process all over again.

VOLTAGE CONTROL (VCM) CONFIGURATIONS

PWM OPERATION	027-0124-300	024-0124-400
Inputs	**Terminal Block** 1: Power 2: Ground	**Terminal Block** 1: Power 2: Ground 3: Signal 1 Input* 4: Signal 2 Input* **DO NOT EXCEED 5V SIGNAL INPUT**
Outputs	**Thru Hole** 10% to 90% Duty Cycle after initial pull in time.	**Thru Hole** 10% to 90% Duty Cycle after initial pull in time.
Adjustability	Potentiometer 1: Will correlate to 10% to 90% Duty Cycle.	Signal 1: Will correlate to 10% to 90% Duty Cycle.
	Potentiometer 2: Will correlate to 25 to 250 ms pull in time.	Signal 2: Will correlate to 25 to 250 ms pull in time.
Max. Continuous Current	3A	3A
Dimensions	28 x 28 x 12 (mm)	28 x 28 x 12 (mm)

** Terminal block pins 3 and 4 can accept 0 to 5 V signal inputs, replacing the need to use the potentiometers.*

CURRENT CONTROL (CCM) CONFIGURATIONS

PWM OPERATION	027-0124-100	024-0124-200
Inputs	**Terminal Block** 1: Power 2: Ground	**Terminal Block** 1: Power 2: Ground 3: Signal 1 Input 4: Signal 2 Input **DO NOT EXCEED 5V SIGNAL INPUT**
Outputs	**Terminal Block** 3: Potentiometer 1* 4: Potentiometer 2* **Thru Hole** 0 to 2.4 Amps after initial pull in time.	**Thru Hole** 0 to 2.4 Amps after initial pull in time.
Adjustability	Potentiometer 1: Will correlate to 0 to 2.4 Amps set current.	Signal 1: Will correlate to 0 to 2.4 Amps set current.
	Potentiometer 2: Will correlate to 25 to 250 ms pull in time.	Signal 2: Will correlate to 25 to 250 ms pull in time.
Max. Continuous Current	2.4A	2.4A
Dimensions	28 x 28 x 12 (mm)	28 x 28 x 12 (mm)

** Terminal block pins 3 and 4 can accept 0 to 5 V signal inputs, replacing the need to use the potentiometers.*

MAGNET-SCHULTZ OF AMERICA

SPECIALISTS IN ELECTROMAGNETIC DEVICES

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MSA and MSM are certified to ISO 9001:2008

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