Proportional Valves

EVP SERIES

- *Fast response*
- *Long life*
- *Low friction and wear*
- *Flow proportional to input current*

pp. 54-57

DVP SERIES

- *Low hysteresis*
- *Fast response times*
- *Large flows in a small, sleek design*
- *Low heat rise*
- *Low power*

pp. 58-59

SCPV SERIES

- *2% hysteresis*
- *Excellent linearity—2.5% of full-scale*
- *2 ms reaction time*
- *Holds position for power savings or at a loss of power*

pp. 60-61

Many items also available with metric ports.
For more information, visit ***clippard.com/link/metric***

PROBLEM

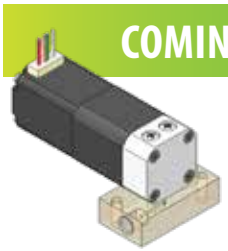
Many types of medical and analytical applications require very precise gas metering. In this case, the customer was experiencing a variety of issues with their existing system. Technicians were having a hard time calibrating the system and overall, it was proving to be very unreliable. They were interested in exploring other options that might improve their system's performance.

SOLUTION

Utilizing the industry's most robust and powerful linear actuator, Clippard's high flow stepper-controlled proportional valve provides exceptional performance and durability. A trusted solution for critical gas delivery applications requiring high resolution, high flow, and low hysteresis, Clippard's SCPV series proved to be perfectly suited for this application.

A special benefit of the SCPV series is its unique design which allows for custom flow profiles. For this application, Clippard was able to determine a very specific needle taper that was ideal for this particular use. After applying the specialized profile, the modified SCPV valve was successfully integrated into a newly designed, more compact system. In addition to providing greater reliability, the final solution also proved to be more efficient and much easier to use.

COMING SOON!



PROPORTIONAL ISOLATION SERIES

- *Specially designed for analytical and biomedical applications*
- *Precision control at low flow ranges*
- *Diaphragm isolation capability*
- *Low internal and dead volume*
- *Compact, low profile design*

p. 62

WHAT CAN CLIPPARD DO FOR YOU?

877-245-6247

EVP SERIES MOUSE VALVES

2-WAY PROPORTIONAL VALVES

- **Flow proportional to input current**
- **Fast response and long life**
- **Small, compact design**
- **Single moving part for low friction and wear**
- **Five orifice sizes**
- **Three connection styles**
- **Two mounting types**

The EVP series proportional control valves combine the features of the existing EV series valve—long life, low power, and Clippard's reputation for high quality components—with the additional capability for proportional control. The EVP series valve provides air or gas flow control and varies the output flow based on the current input to the solenoid.

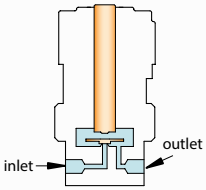
Controllability and overall value are the main features of the EVP proportional valve series. The consistent gain (see chart) of this valve provides a high degree of control for many applications. The valve may be controlled using DC current, open or closed-loop control, and even PWM (pulse width modulation) to cover a broad range of applications.

Medium	Clean, dry air or inert gases
Power Consumption	1.9 watts @ 73˚F 2.3 watts max.
Temp. Range	32 to 120˚F
Ports	#10-32 Female (in-line) #10-32 Male stud (manifold) *See p. 20 for manifold options*
Seal Material	Nitrile standard FKM, EPDM, and others available
Max. Hysteresis	10% of full current
More Details	clippard.com/link/evp

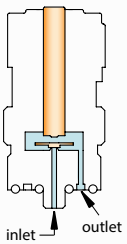
OPERATING PRESSURE

The EVP proportional valve can be calibrated for pressures less than the maximum pressure shown. Lower pressures may be substituted in increments of 5 psig, and will be used for calibration. For pressures less than 5 psig, call **877-245-6247**.

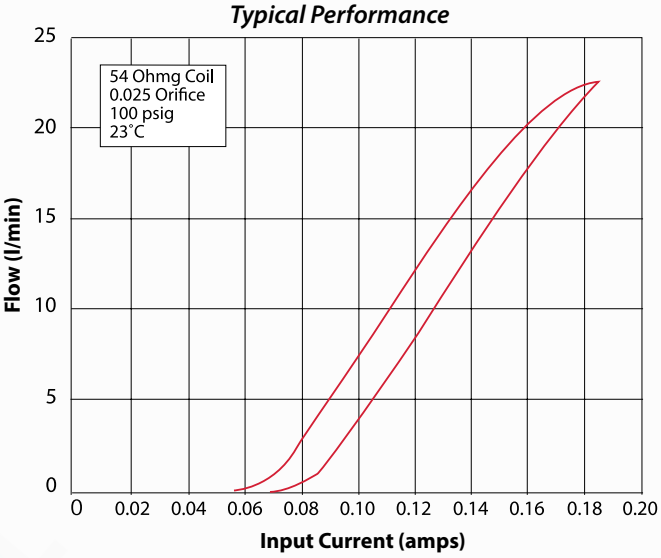
Note: *Voltage, orifice, and pressure are determined by the part number (see p. 56).*



In-Line Mount



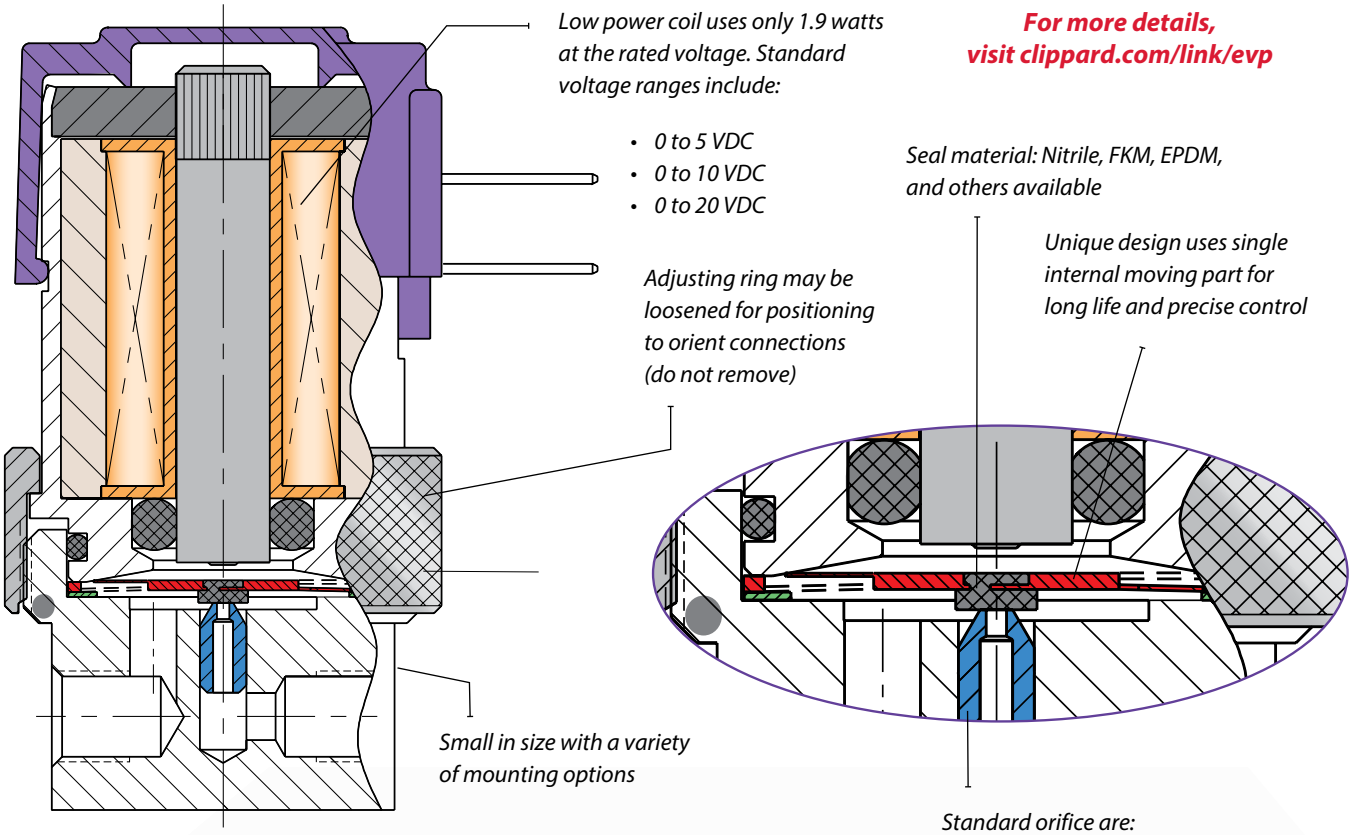
Manifold Mount



APPLICATIONS

- Analytical Instruments
- Blood pressure monitoring
- Precise pressure control
- Patient simulators
- Gas controllers
- Mass flow control
- Gas chromatography
- Respirators/ventilators

EVP Series Proportional Mouse Valves



Low power coil uses only 1.9 watts at the rated voltage. Standard voltage ranges include:

- *0 to 5 VDC*
- *0 to 10 VDC*
- *0 to 20 VDC*

For more details, visit clippard.com/link/evp

Seal material: Nitrile, FKM, EPDM, and others available

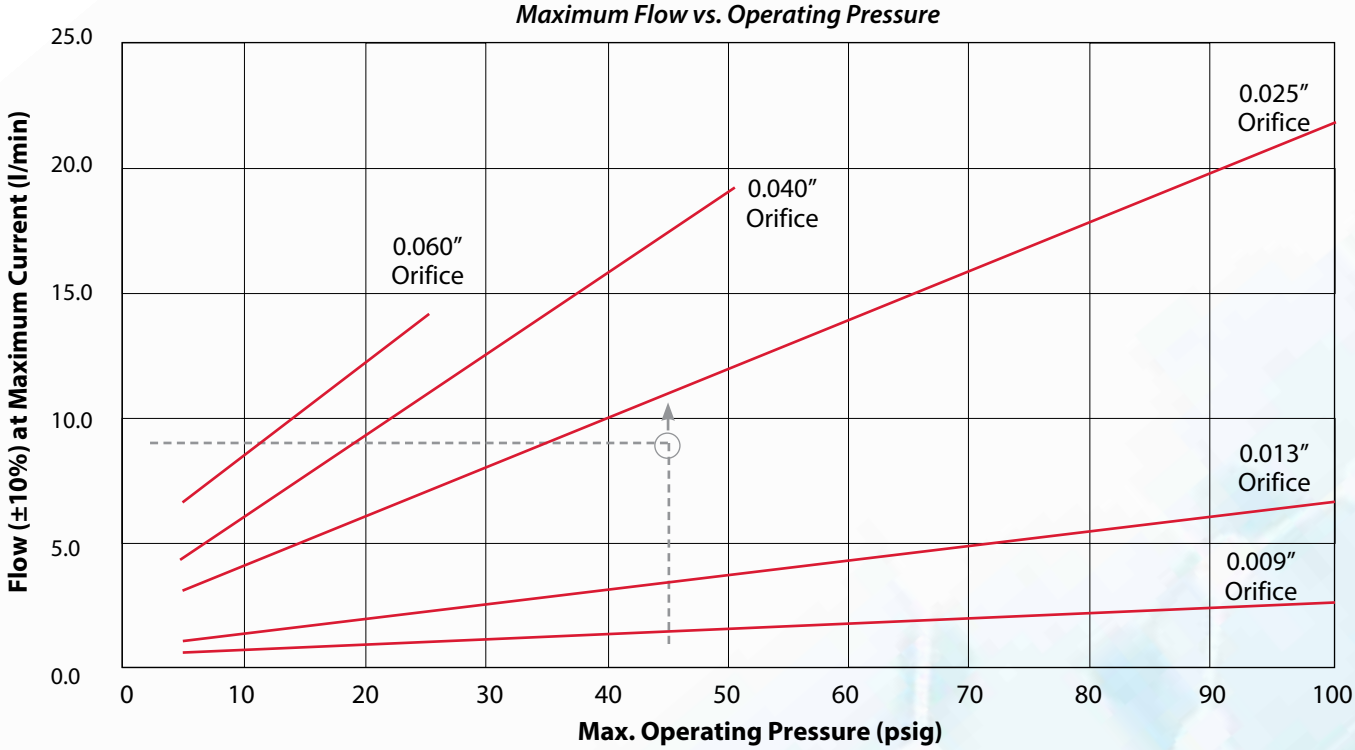
Unique design uses single internal moving part for long life and precise control

Adjusting ring may be loosened for positioning to orient connections (do not remove)

Small in size with a variety of mounting options

Standard orifice are: 0.009", 0.013", 0.025", 0.040" and 0.060"

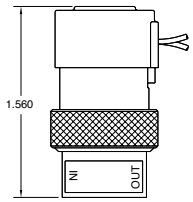
Maximum Flow vs. Operating Pressure



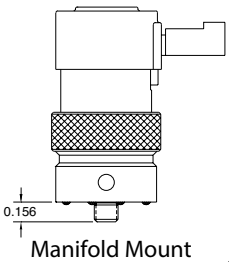
To determine the correct orifice required, locate the colored line immediately above the flow/pressure intersection
Example: 9 slpm required at 45 psig inlet. This example leads to a "-2545" valve (0.025" nozzle, 45 psig).

EVP SERIES MOUSE VALVES

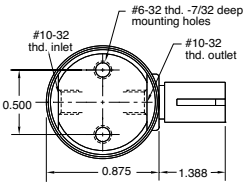
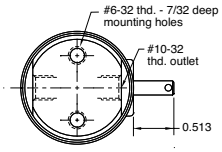
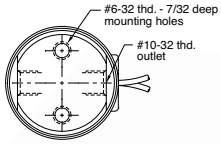
2-WAY PROPORTIONAL VALVES, IN-LINE & MANIFOLD MOUNT



In-Line Mount



Manifold Mount

		5 VDC	10 VDC	20 VDC	In-Line Mount	Manifold Mount
		Voltage			Base Part No.	
	 0.025" Pin Connector	•			EC-P-05-☐☐-☐	EC-PM-05-☐☐-☐
			•		EC-P-10-☐☐-☐	EC-PM-10-☐☐-☐
				•	EC-P-20-☐☐-☐	EC-PM-20-☐☐-☐
	 Spade Terminals	•			ET-P-05-☐☐-☐	ET-PM-05-☐☐-☐
			•		ET-P-10-☐☐-☐	ET-PM-10-☐☐-☐
				•	ET-P-20-☐☐-☐	ET-PM-20-☐☐-☐
	 Wire Leads Side (Radial)	•			EV-P-05-☐☐-☐	EV-PM-05-☐☐-☐
			•		EV-P-10-☐☐-☐	EV-PM-10-☐☐-☐
				•	EV-P-20-☐☐-☐	EV-PM-20-☐☐-☐

Operating Range & Orifice

When selecting your valve, there are many variables to choose from.

To choose the best valve for your application, focus on:

1. The control signal
2. Valve orifice
3. Operating pressure

Consult factory to discuss availability of non-standard voltages and other customization options.

Although the valves are listed by voltage, their flow is proportional to the current. It is crucial to specify and use a valve set to your operating pressure to assure to optimal performance for your exact requirements. Proportional flow is achieved by varying the current input to the valve.

The EVP valve can be calibrated for pressures less than the maximum shown. Lower pressures may be substituted in increments of 5 psig, and will be used for calibration. The pressures shown are standard options. For pressures less than 5 psig or greater than the maximum pressure listed, please consult Clippard.

CONTROL SIGNAL

Nominal Voltage Range *@ 72˚F (VDC)*	Input Current Range *(amps)*	Coil Resistance *@ 72˚F (ohms)*	Max. Voltage Required *(VDC)*
0 to 5	0 to 0.370	13.5	6.2
0 to 10	0 to 0.185	54	12.4
0 to 20	0 to 0.092	218	24.8

Do not exceed input current range

STANDARD ORIFICES & FLOW

Orifice	Max. Flow *(l/min)*	Part No. Code	Max. Pressure
0.009"	2.7 ±10%	09	100 psig
0.013"	6.7 ±10%	13	100 psig
0.025"	22.0 ±10%	25	100 psig
0.040"	18.7 ±10%	40	50 psig
0.060"	14.0 ±10%	60	25 psig

Note: *Max. flow is measured at max. pressure*

ORDERING INFORMATION

Base Part No. ☐ - ☐ - ☐ - ☐ **Options**

See chart above

Orifice*

09	0.009" dia.
13	0.013" dia.
25	0.025" dia.
40	0.040" dia.
60	0.060" dia.

Max. Pressure *(5 psig to 100 psig)*

☐	In increments of 5, from 05 to 95
A0	100 psig

Options

(blank)	Nitrile (standard)
E	EPDM[1]
V	FKM[1]

[1]*Min. order quantity required for EPDM or FKM seals*

Example Part Number:
EC-P-05-0905-V

*See max. pressure in **Standard Orifices & Flow** chart above

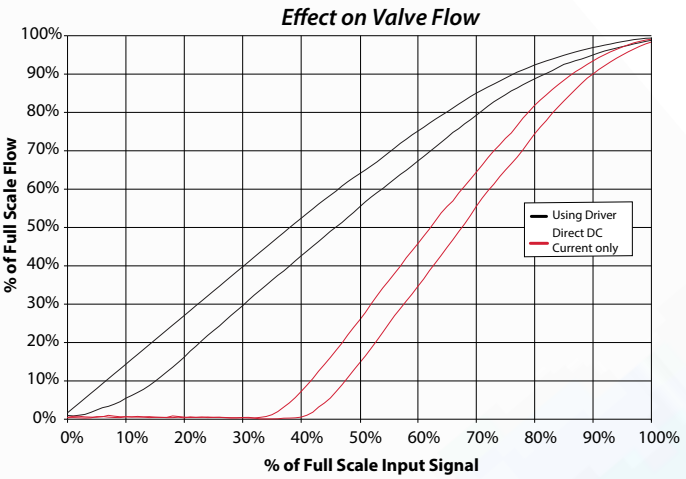
EVP SERIES MOUSE VALVE **DRIVER**

PROPORTIONAL VALVE DRIVER

The EVPD Proportional Valve Driver fast-tracks valve control applications. This product is ideal for laboratories and OEM product development, and can be customized to fit OEM applications including control parameters. The EVPD produces driver current for Clippard's EVP or DVP series valves proportional to input control signals.

- **Plug-and-play interface between Clippard's EVP and DVP series valves and PLCs or other controls**
- **Linearized valve response right "out of the box"**
- **Three selectable valve output ranges**
- **Five signal inputs to choose from**
- **Easy integration with existing machine controls**
- **User-adjustable parameters**
- **Automatic temperature compensation to maintain constant current**
- **Two configuration options: Stand-alone PCB or enclosed in housing**
- **Compact size**

Power Requirement	7 to 28 VDC @ 5 watt
Input Impedance	200 kΩ
Command Set-Point Signal Type	Selectable: 0 to 5 VDC, 0 to 10 VDC, 0 to 20 mA, 4 to 20 mA, PWM @ ≥ 2 kHz duty cycle
Adjustments	Min. drive current, max. drive current, command deadband
LED Indicators	Power, activity status, and faults
Output	0 to 0.4 (selectable range)
Temperature Range	0 to 155˚F
Size	Open card: 1.5" x 1.3" x 0.4" unmounted Enclosed: 2.2" x 1.8" x 0.7' excluding DIN clip
More Details	clippard.com/link/evpd



Power Requirements

Power input requirements are specified as supply voltage ranges for each EVP or DVP valve. Supplying voltages outside of these ranges may result in valve malfunctioning. Power requirements are determined by the valve voltage specification.

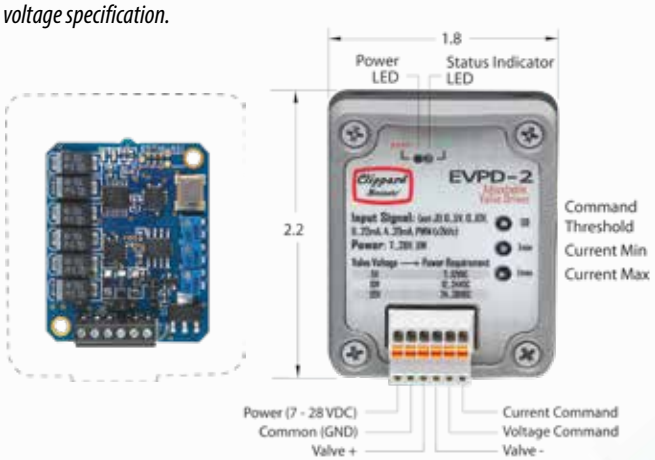


Figure 1: Effect of Driver Output on EVP or DVP Flow

EVP Valve Type	Input Voltage Range	EVPD Max. Output*
0 to 5 VDC	7 to 12 VDC	400 mA
0 to 10 VDC	12 to 28 VDC	200 mA
0 to 20 VDC	14 to 28 VDC	100 mA

**See EVP/DVP valve current requirements*

Part No.	Description
EVPD-2	EVPD Driver Assembly in Enclosure
EVPD-1	EVPD Driver Board
EVPD-2DIN	DIN Rail Mounting Clip (shown at right) with screws

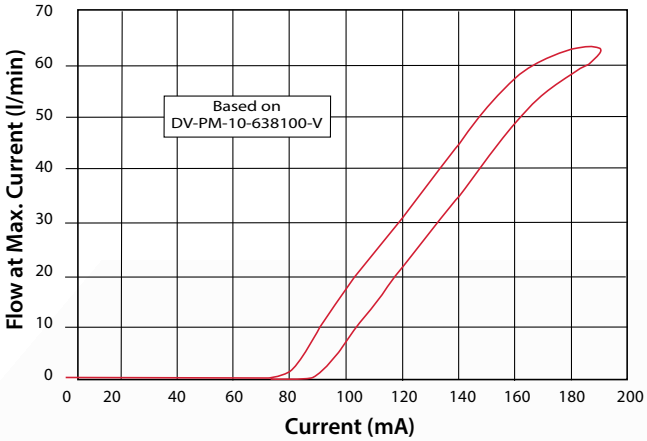
DVP SERIES HIGH FLOW VALVES

2-WAY PROPORTIONAL VALVES, MANIFOLD MOUNT

Clippard's DVP series proportional solenoid valves are precision-built 2-Way control valves. This powerful series was designed as the next generation of the well-known and trusted original EV line of Clippard "Mouse" valves. With a life of over a billion cycles, a solid, compact design, and extremely high flow rates, these valves are suitable for many applications across numerous industries.

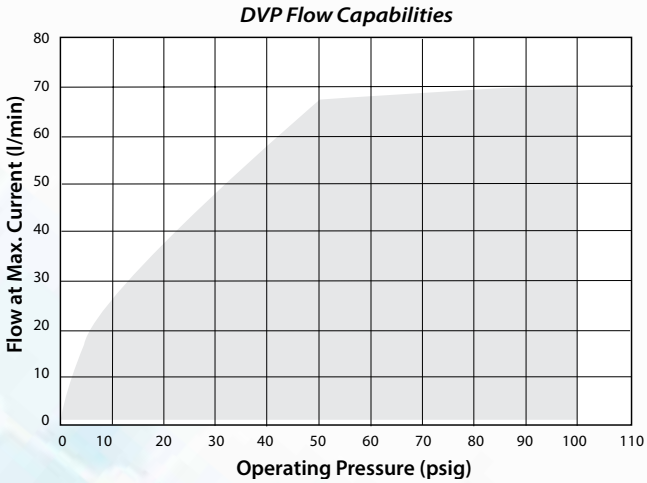
Controllability and overall value are the main features of the DVP series. The DVP valve provides air or gas flow control and varies the output flow based on the current input to the solenoid. The valve's consistent gain (see chart) provides a high degree of control. It may be controlled using DC current, open or closed-loop control, and even pulse width modulation (PWM) to cover a large range of applications.

Typical Performance



- **Industry standard for leak-free operation**
- **Over 1,000,000,000 cycles**
- **Extremely low hysteresis**
- **Fast response time**
- **Large flows in small, sleek design**
- **Low heat rise/low power**
- **Robust stainless steel "spider" flat armature spring**

DVP Flow Capabilities



Valve Type	2-Way, Proportional
Medium	Air or compatible gases (40 micron filter)
Pressure Range	Vac* to 100 psig
Max. Hysteresis	10% of full current
Max. Flow Tolerance	+10% / -0%
Power Consumption	1.9 watts at 72˚F, 2.5 watts max.
Temperature Range	32 to 120˚F
Voltage	10 or 20 VDC
Mounting	Manifold, #10-32 male stud
Seal Material	FKM standard Nitrile, EPDM, and silicone available
Wetted Materials	Stainless steel, PPS
Certifications	CE, RoHS, REACH
More Details	clippard.com/link/dvp

**Vacuum applications are reverse flow*

For custom flow and pressure configurations, call ***877-245-6247***

RoHS 100% TESTED made in the USA

DVP SERIES **VALVES** & **MANIFOLDS**

MANIFOLDS & ADDITIONAL INFORMATION

In selecting your valve, reference the **DVP Flow Chart** (opposite, p. 58) and list your nominal operating pressure in a 3-digit format (065 = 65 psig). Next, specify your desired max. flow rate for your pressure (500 = 50.0 l/min). Accurately specify your nominal operating pressure and flow to assure the best performance and resolution for your application. For nominal operating pressure under 5 psig, use a 005 designator for pressure. For vacuum applications use the positive pressure equivalent and reverse the ports.

Although the valves are listed by voltage, their flow is proportional to the current. It is crucial to specify and use a calibrated valve that matches your application. To assure you have optimal performance, be sure to use a valve set to your operating pressure. Proportional flow is achieved by varying the current input to the valve.

For more details, visit clippard.com/link/dvp

Nominal Voltage Range @ 72˚F	Input Current Range	Coil Resistance @ 72˚F	Max. Voltage Required
0 to 10 VDC	0 to 0.190 amps	52.6 ohms	13 VDC
0 to 20 VDC	0 to 0.095 amps	210.5 ohms	26 VDC

ORDERING INFORMATION

❑ - ❑ - ❑ ❑ - ❑

Base Part No.

DT-PM Spade Terminals
DV-PM Wire Leads (Axial)

Voltage

10	10 VDC
20	20 VDC

Flow

In increments of 1, from 010 to 678 (1.0 l/min to 67.8 l/min)

Example: 300 *(300 l/min)*

Operating Pressure

In increments of 1, from 005 to 100 (1 psig to 100 psig)

Example: 040 *(40 psig)*

Seals

V	FKM (standard)
(blank)	Nitrile
E	EPDM[1]
S	Silicone[1]

[1]*Min. order quantity required for EPDM or silicone seals*

Example Part Number:
DV-PM-10-300-040-V

DVP valves are equipped with a bottom stud, 5/32" long with #10-32 thread, which fits Clippard standard and special manifolds, accessory valves and subplates. Spanner holes in the valve body permit tightening.

*Call **877-245-6247** to discuss non-standard voltages and other options.*

SINGLE-STATION MANIFOLDS

Material ENP Brass
Other materials also available, call 877-245-6247.

Part No.	Description
15490-5	Single-Station Manifold

MULTI-STATION MANIFOLDS

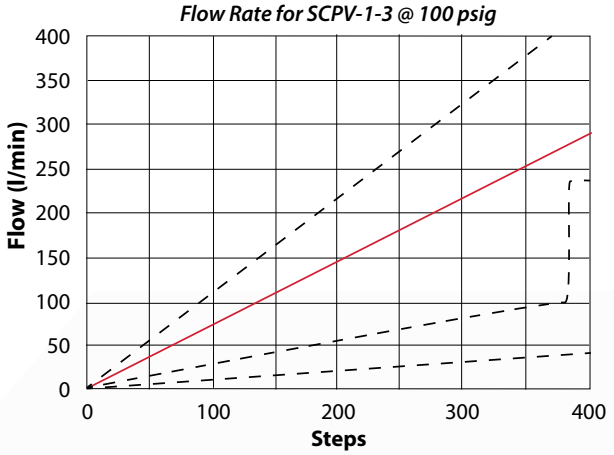
Material Black anodized aluminum
Ports 1/8" NPT

Part No.	Description
15781-2	2-Station Manifold
15781-4	4-Station Manifold
15781-6	6-Station Manifold

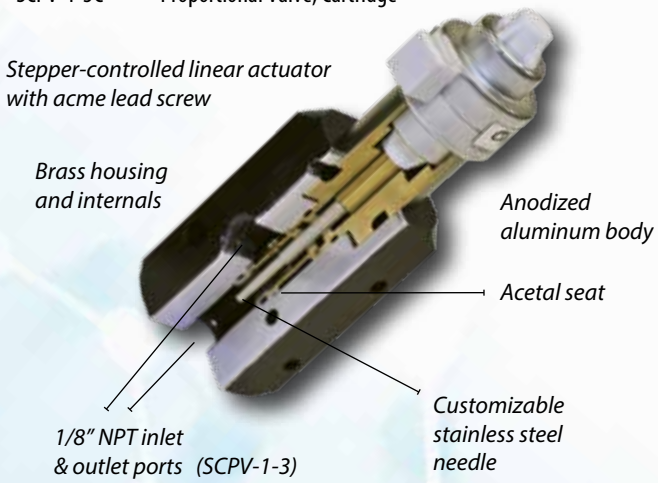
STEPPER-CONTROLLED SCPV SERIES

2-WAY PROPORTIONAL VALVES

Characteristic Curve
Flow Rate for SCPV-1-3 @ 100 psig



Part No.	Description
SCPV-1-3	Proportional Valve, In-Line
SCPV-1-3M	Proportional Valve, Manifold
SCPV-1-3C	Proportional Valve, Cartridge



RoHS 100% TESTED made in the USA

Utilizing the industry's most robust and powerful linear actuator, the high flow stepper-controlled proportional valve outperforms the competition in performance and durability. The SCPV valve is ideal in critical applications such as gas delivery, medical, analytical, and industrial automation requiring high resolution, high flow, and low hysteresis. In addition, the unique design allows for custom flow profiles when required.

- **Less than 2% hysteresis**
- **Excellent linearity—less than 2.5% of full-scale**
- **2 ms reaction time**
- **Millions of cycles**
- **Holds position for power savings or at a loss of power**

Medium	Air or compatible gases
Typical Cycle Time for Full Travel	0.95 seconds @ 100% duty cycle 0.55 seconds @ 25% duty cycle *(full open to full close or full close to full open)*
Wetted Material	Stainless steel, aluminum, brass, acetal, and FKM*
Pressure Range	Vac to 100 psig*
Flow Range	0 to 280 l/min *Special configurations over 500 l/min available**
Flow Resolution	0.7 l/min per step
Position Resolution	0.001" per step
Temperature Range	32 to 184˚F
Driver	Bipolar chopper drive required
Needle	3.5˚
Supply Voltage to Motor	5 VDC
Response Time	0.95 seconds fully-open to fully-closed
Mounting	In-line, manifold, or cartridge
Power Consumption	3.85 watts nominal only during adjustment Zero power consumption to maintain position
Seals	FKM standard, others available*
Option	Rubber seat *(add -R suffix)*
More Details	clippard.com/link/scpv

This product is highly modifiable for OEM applications—including alternate body materials, flow profiles, and more. Clippard has successfully produced special configurations of the SCPV with flows over 700 slpm at 100 psig. Call **877-245-6247 today to discuss your needs.*

STEPPER-CONTROLLED SCPV SERIES & **DRIVER**

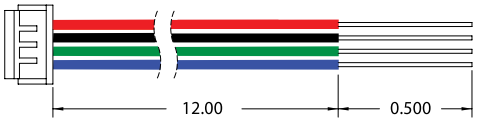
PROPORTIONAL VALVE

LINEAR ACTUATOR CHARACTERISTICS

Wiring	Bipolar
Current/Phase	385 mA
Motor Voltage	5 VDC
Resistance/Phase	13 ohms
Inductance/Phase	8.08 mH
Power Consumption	3.85 watts
Temperature Rise	135˚F
Insulation Resistance	20M ohms

Maximum Step Pulse Frequency vs. Operating Pressure

Wiring Harness (included)



Pin	Color	Pin	Color
1	Red (A+)	3	Green (B-)
2	Black (A-)	4	Blue (B+)

SCPVD BI-POLAR STEPPER MOTOR DRIVER

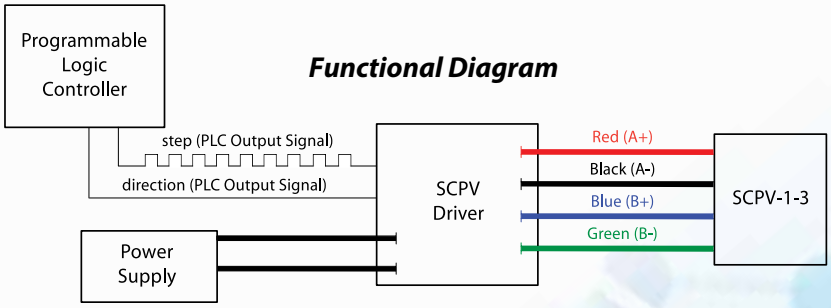
The SCPVD is a bi-polar stepper motor driver board which can be used for stepper motors up to a max 2A/phase. It is based on the Allegro A4988 motor driver. The driver requires a motor drive voltage of 7 to 35 volts. An external controller is required to deliver step and direction signals to the driver board. The SCPVD is capable of micro-stepping and defaults to a 16th step micro-stepping mode. The step mode as well as several other options such as sleep, enable, and reset can be toggled on and off.

- **Medical, analytical, and industrial gas mixing**
- **Anesthesia equipment**
- **Precision flow control**
- **Cuff/bladder pressure control**
- **Process flow control**
- **Variable speed control**
- **Automation of needle valve**

For more details, visit clippard.com/scpv

Part No.	Description
SCPVD-1	SCPVD-1 SCPV Valve Driver

Functional Diagram

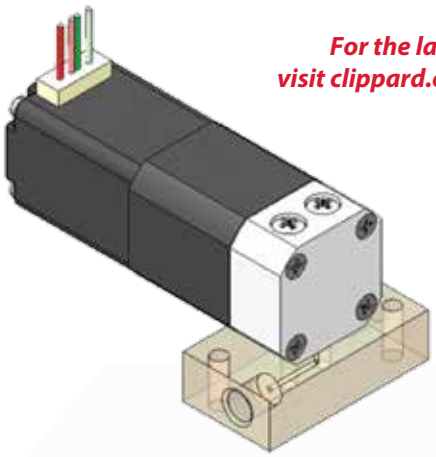


PROPORTIONAL **ISOLATION**

NEEDLE VALVE

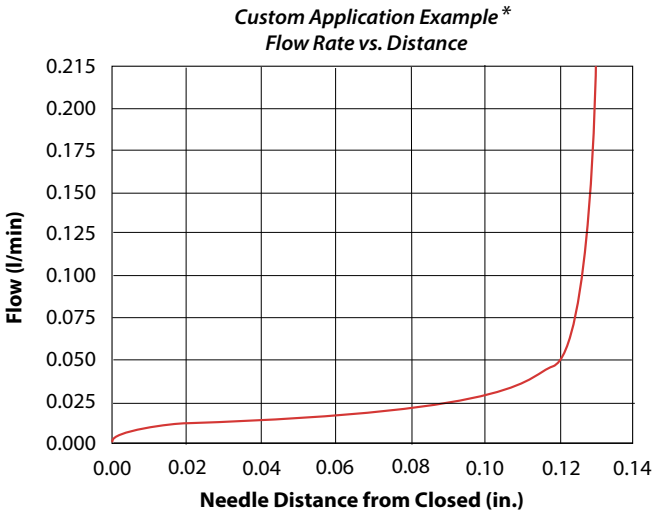
COMING SOON!

Clippard's next-generation proportional valve is specially designed for maximum controllability of fluid in medical and analytical applications. This unique valve is able to be customized to meet the specific flow, pressure, life, and control requirements your applications demand.



For the latest details, visit clippard.com/link/pro-iso

**Specifications not final.*



- **Specially designed for analytical and biomedical applications**
- **Able to handle a wide variety of flow ranges**
- **Precision control at low flow ranges**
- **Diaphragm isolation capability**
- **Low internal and dead volume**
- **Compact, low profile design**
- **Quiet operation**

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WHAT IS **HYSTERESIS**?

What is hysteresis? Is it important for your application? What effects could it have? Generally speaking, hysteresis is a lag in reaction to a force. It can be found everywhere—from physics and engineering to biology, chemistry, and even economics. In this article, we explain the fundamentals and complexities as we explore how hysteresis affects the proportional control of fluids.

THE BASICS

To understand hysteresis in some of its more complex states, it helps to first look at it in some of its simplest forms. Frictional hysteresis is relatively easy to understand because we can see—and sometimes feel—the results. Mechanical hysteresis is often referred to as "play" or "slop." Think about a single knob water fixture that you turn clockwise to turn the water on. With this knob, you know that if you turn it directly to the 12 o'clock position without going too far, you get perfect water flow. However, this is an older faucet with a little "play" in the handle. If you go past 12 o'clock, you end up needing to turn back to 11 o'clock to get that same perfect water flow. As you turn the faucet back, the "play" you are experiencing is a lag. This is an example of hysteresis.

PROPORTIONAL VALVES & HYSTERESIS

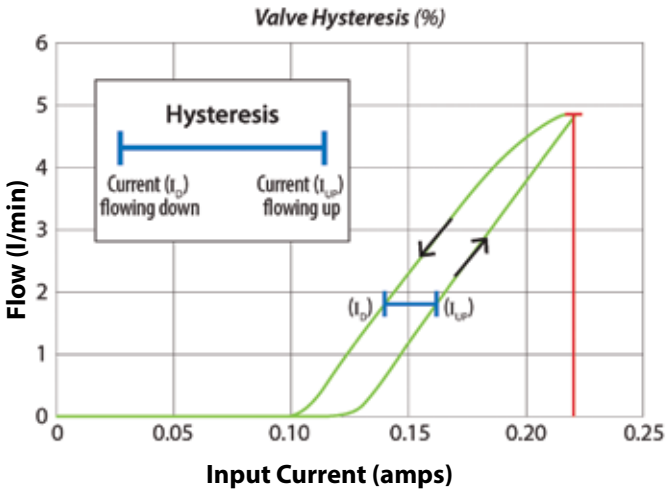
Hysteresis is the maximum difference in current required to achieve a set flow, relative to the maximum current. This can be expressed mathematically as:

$$H = \left(\frac{I_{UP} - I_D}{I_{MAX}} \right) \times 100\%$$

H = Hysteresis, I = Current (I_{UP} = *flowing up*, I_D = *flowing down*)

As it relates to proportional valves, hysteresis is the difference you see in flow when you go directly to a particular point, compared to when you go past that flow point and try to return back to it.

For example, consider a standard current driven proportional valve with a nominal hysteresis of 10%. If we apply 0.15 amps to achieve 1.0 l/min, then turn the current up to 0.2 amps for more flow, a nominal hysteresis of 10% means that when we come back down to 1.0 l/min, we would need to be about 10% lower with our supplied current to reach the original flow rate.



The hysteresis we see in current driven proportional valves is primarily magnetic. When we supply current to the valve's coil, we are producing an electromagnetic field which forces the poppet to move. It takes a greater force to open the valve than it does to close the valve—it requires more current to open on the uphill side of the flow curve than it requires on the downhill side of the flow curve.

MINIMIZING HYSTERESIS IN APPLICATIONS

Getting to the lowest hysteresis possible is a challenge. When working with solenoid driven valves, many variables such as temperature, wear, and spring rates can affect the magnetic hysteresis. Ultimately, good control can be achieved as long as the valve performance is repeatable. Any valve with consistent performance can greatly reduce hunting—when the system overshoots and undershoots multiple times to get to a point—in closed loop systems.

The lowest hysteresis proportional valve Clippard offers is the SCPV series stepper-controlled proportional valve. This valve is driven by a miniature stepper motor which has zero magnetic hysteresis and a mere 2% (nominal) mechanical hysteresis. This is the result of small amounts of "play" in the actuator. Think of a basic needle valve that you would adjust with your fingers, then put a stepper motor on top. Clippard's SCPV stepper-controlled proportional valves have become very popular in systems without feedback, because they can be commanded to a predetermined step to achieve repeatable performance.

SPECIAL MATERIALS

Understanding the best seal material for your application is imperative. Common factors that may need to be evaluated include chemical compatibility, extreme temperatures, cleaning requirements, or sometimes even restrictions on material outgassing. Clippard offers a variety of materials to meet the needs of many different types of demanding applications.

CHEMICAL COMPATIBILITY

The most common reason to change materials in a valve is chemical compatibility. For example, a valve controlling the flow of acetone will have a short life if equipped with standard nitrile seals. In this case, selecting a different seal material that is more compatible with acetone will greatly extend the life of the valve. By referring to the Chemical Compatibility Chart (far right, top) we can see that for use with acetone, EPDM is the recommended material.

TEMPERATURE

Some applications expose valves to extreme temperatures. In these situations, it is important that the seal materials can withstand the environments they will be exposed to. For example, a valve that needs to be autoclaved for cleaning may be exposed to temperatures as high as 300°F. This extreme heat can damage standard nitrile seals, but this is easily avoided by selecting a material compatible with higher temperatures. By referring to the Material Properties Chart (far right, bottom) we can see that there are a variety of other seal materials to choose from which can handle temperatures reaching 300°F.

SPECIAL MEDIA

Depending on the application, the media being passed through the valve may sometimes necessitate other special requirements. For example, applications involving corrosive fluids place greater demand on all wetted areas of the valve. In this case, a media isolation valve often provides the ideal solution. Clippard's line of PTFE media isolation valves (p. 68) are designed such that PTFE is the only wetted material, making them well-suited for these types of applications.

In other situations, applications may involve media with large particulates, or media that is especially sensitive to contamination. In these cases, a pinch valve often provides the ideal solution. Clippard offers both pneumatic (p. 70) and electronic (p. 71) pinch valves with a variety of different types of tubing including medical/laboratory grade silicone, FDA-approved food grade silicone, and polyurethane. The tubing is disposable and easy to replace, providing cleanliness, convenience, and a completely unobstructed flow path.

For help selecting materials for your application, contact your local Clippard distributor or call **877-245-6247**.

CHEMICAL COMPATIBILITY CHART

Chemical Tests	Materials: Nitrile	EPDM	Neoprene	Urethane	Silicone	FKM
Density *(gm/cm³)*	0.98	0.86	1.24	1.20	1.65	1.67
Flame Resistance *Melts at 850˚F*	POOR *Burns*	POOR *Burns*	GOOD *Sparks*	GOOD	GOOD	FAIR
Acetone	D 125% / 3 days*	[A]	D 31% / 3 days*	D 87% / 3 days*	B 18% / 7 days*	D 200% / 7 days*
Brake Fluid	C	[A]	B	D	A	D *Dissolves*
Gasoline	[A] 9% / 7 days*	D	D 55% / 7 days*	B	D 260% / 7 days*	[A] 3% / 7 days*
MEK	D	[A]	D	D	D	D 240% / 7 days*
Mineral Spirits	[A]	D	C *Not recommended*	B	D 110% / 7 days*	A
Oil-SAE	A	D	B / C	A	B	A
Perchloroethylene	B *Not recommended*	D	D	D 60% / 7 days*	B *Not recommended*	[A]
Turpentine	[A] 9% / 3 days*	D 163% / 3 days*	D 60% / 3 days*	D 21% / 3 days*	D 98% / 3 days*	[A] 0% / 3 days*

"Burns" means that the material will continue to burn even after the flame source is removed
**Percent volumetric swelling / number of days (actual results); Volumetric swelling in 30 days: A <15%, B < 30%, C < 50%*
[A] - Recommended; D - Not Recommended

MATERIAL PROPERTIES CHART

Properties	Materials: Nitrile	EPDM	Neoprene	Urethane	Silicone	FKM
Temperature (˚F)	-40 to 250	-60 to 300	-45 to 250	60 to 225	-75 to 450	-20 to 400
Shelf Life	15 years	Unlimited	15 years	5 years	Unlimited	Unlimited
Mold Shrinkage	1.5 to 3.5%	1.9 to 3.5%	1.0 to 3.0%	1.6 to 3.3%	2.0 to 5.0%	2.0 to 4.5%
Cost	Excellent	Excellent	Good	Poor	Fair	Fair
Abrasion Resistance	Good / Excellent	Good	Good / Excellent	Excellent	Poor	Good
Compress Set	Good	Fair / Good	Fair / Good	Good / Excellent	Good / Excellent	Good
Tear Resistance	Good	Fair / Good	Good	Excellent	Poor	Fair / Good

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To locate your nearest distributor, call **877-245-6247** or visit **clippard.com/distributors**

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CA PROPOSITION 65

All products shipped to or sold to consumers in California include Proposition 65 documentation with the shipment and reference our website. There are over nine hundred (900) chemicals on the Proposition 65 list, some of which are used in Clippard materials and/or processes. Although not all products contain chemicals within the list, Clippard is being cautious and diligent in complying with the California Law.

As of August 30, 2018, chemicals we are aware of that are listed within Proposition 65 are detailed online at clippard.com/link/prop65, or for additional information please contact tech@clippard.com.