

## VRP-CH Series Valve Regulation Pilot

**VRP-CH Pilot Pressure Control System for use with double-acting (piston) operated actuators**

### Description

The Becker Model VRP-CH Double-Acting Pilot provides pressure control when utilized with a double-acting piston actuated control valve. The VRP-CH measures process sensing pressure and positions the double-acting actuator to maintain the setpoint. The VRP-CH Pilot may be utilized for pressure control applications with setpoints ranging from 1.0 psig (6.9 kPa) to 1300 psig (8964 kPa). The VRP-CH is typically utilized when Bleed to Pressure System (BPS™) may be used to completely all eliminate atmospheric bleed emissions.



**Figure 1.0** - Becker Model VRP-600-CH pressure control system shown with optional NBV-100 Non-Bleed Valve

### VRP-B-CH Applications

- Pressure Control
- Power Plant Type Pressure Control

### Compatible Actuators

- RPDA Series (small volume models)
- RPDA Series (large volume models)
- LPDA Series (small volume models)
- LPDA Series (large volume models)

### Application Guidelines

#### • Large Volume Actuators

Large Volume Actuators are defined as actuators with piston displacement (volume) greater than 2000 in<sup>3</sup> that typically require high flow volume instrumentation. For actuators larger than 2000 in<sup>3</sup>, it is recommended that a Model VRP-CH with Model VB-Series Volume Boosters be utilized.

#### • High Gain Systems:

Power plant feeds and other similar systems require fast stroking speed to satisfy required “gain” of the system. For high gain applications, it is recommended that a Model VRP-CH with Model VB-Series Volume Boosters be utilized.

#### • Two-Stage Pressure Cuts

Where two-stage (series) pressure cuts are incorporated, it is recommended to use the VRP-CH Series Pilot in conjunction with either an RPDA or LPDA Series actuator. This includes “working monitor” regulators.

#### • CVE Globe Pattern Control Valves

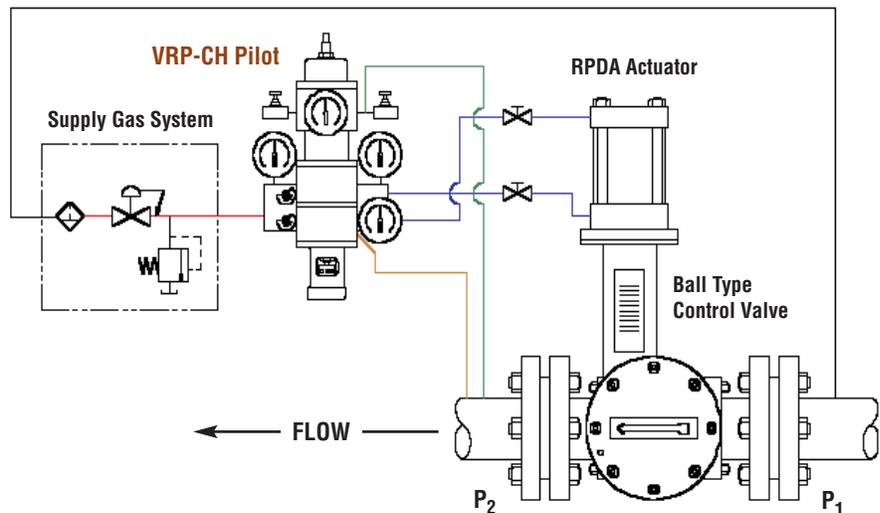
The Model VRP-CH is the only VRP Pilot compatible with LPDA Series Actuators when utilized with globe pattern control valves such as the Becker CVE Series Globe Pattern Valve.

### Schematic Legend

- Sensing Pressure ( $P_2$ )
- Upstream Pressure ( $P_1$ )
- Exhaust (Discharge)
- Supply Gas (Regulated)
- Intermediate Pressure (Actuator)

**Figure 2.0** - VRP-CH Series Pilot configured for downstream pressure control and Bleed to Pressure System (BPST™)

The VRP-CH may be utilized with any Becker double-acting series actuator and control valve combination to achieve downstream pressure control. The VRP-CH is shown utilizing the “Bleed to Pressure System” feature to eliminate all atmospheric emission.

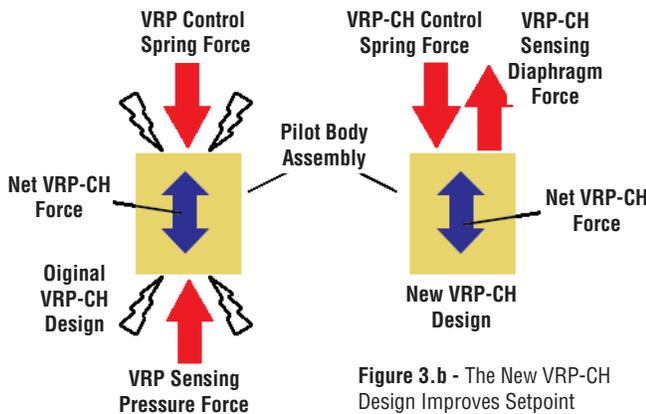


**Benefits of the New VRP-CH Combined Chamber Design**

- The VRP Sensing Pressure and the Control Spring are combined in the same “CH” combined chamber so that only the “net force” in transmitted to the VRP-Pilot Body.
- VRP-CH Pilot Sensitivity improved to  $\pm 0.75\%$ .
- The VRP-CH control spring is totally enclosed and protected from potentially corrosive effects of the atmosphere.
- The New VRP-CH design provides for substantially reduced number of models available. This makes selection and support of VRP-CH Pilots easier.
- The New “CH” combined chamber is identical in design for all Becker VRP Pilots. Additionally, new control spring designs provide for wider setpoint range and greater sensitivity.
- The increased volume of the VRP-CH combined chamber dampens noise or vibration present in the measured variable (sensing tap).

**Improve Performance and Minimize Bleed Gas Emissions!**

Optimum performance is achieved by pairing the VRP-CH with genuine Becker control valve actuators. If you already have existing control valve actuators in service, the addition of a VRP-CH can improve performance as well as minimize bleed gas emissions. Becker VRP-CH Pilots are compatible for retrofit with most manufacturer’s double-acting piston style actuators. Consult Becker Precision Equipment for more info.



**Figure 3.a** - The Original VRP Design Subjects the VRP Pilot Body to Crushing Forces

The original VRP Pilot subjects the VRP Pilot is “sandwiched” between the VRP Sensing Pressure Force and the VRP Control Spring Force. The Net Force results tends to “crush” the VRP Pilot body and reduce sensitivity and accuracy.

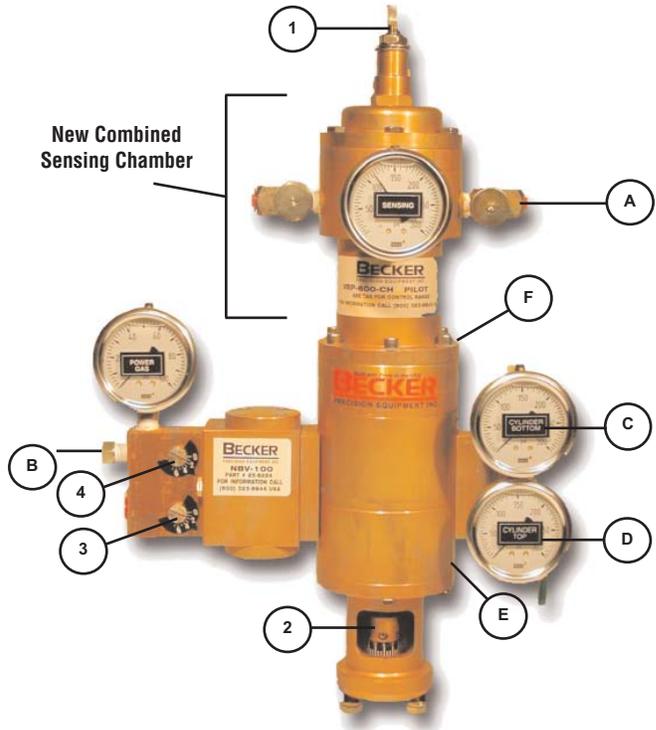
**Original VRP Accuracy =  $\pm 1.0\%$**

**Figure 3.b** - The New VRP-CH Design Improves Setpoint Accuracy and Sensitivity

The new VRP-CH Design combines the VRP Sensing Pressure Force and the VRP Control Spring Force both within the “CH” Combined Chamber. The new “CH” design eliminates the crushing effect of internal VRP forces and applies only the Net Force to the Pilot Body. The result is increased setpoint accuracy and sensitivity.

**New VRP-CH Accuracy =  $\pm 0.75\%$**

The new “combination chamber” of the Model VRP-CH Double-Acting Pilot provides improved performance over previous VRP Pilot designs



**Figure 4.0** - Becker Model VRP-600-CH pressure control system

The VRP-CH is specifically designed for use in natural gas pressure regulation and provides a simple, economical alternative to the controller/positioner combination. The VRP-CH is shown with optional NBV No-Bleed Valve to eliminate bleed gas when the control valve is at both full-open and full-closed positions.

VRP-CH Port Definitions	Port Size	Item
Sensing (Input)	1/4" FNPT	A
Power Gas Supply (Input)	1/4" FNPT	B
Cylinder Bottom (Output)	1/4" FNPT	C
Cylinder Top (Output)	1/4" FNPT	D
Exhaust (Discharge)	1/4" FNPT	E
Breather Vents	1/4" FNPT	F

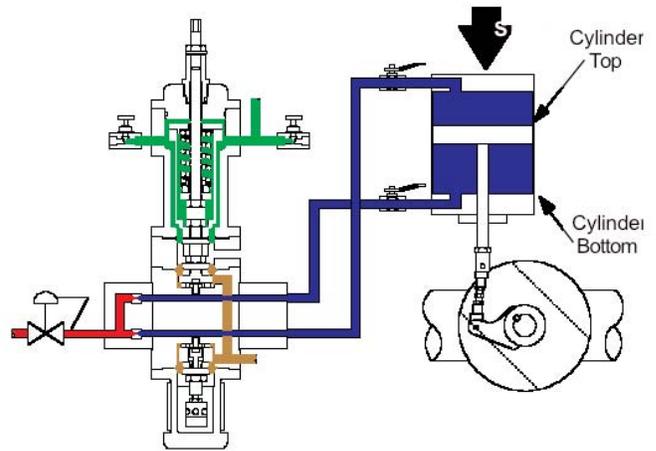
VRP-CH Adjustments	Item
Setpoint Adjustment	1
Sensitivity Adjustment	2
Cylinder Top Adjustable Orifice	3
Cylinder Bottom Adjustable Orifice	4

**How it Works (Downstream Pressure Control)**

The energy to operate the control valve is obtained from the differential between supply gas pressure and discharge gas pressure. When the measured variable is at setpoint the pilot output pressures to cylinder top and bottom are equal (figure 5.a). The control valve remains stationary. As the measured variable rises above setpoint, the pilot pistons move downward. This causes a decrease in cylinder top pressure and an increase in cylinder bottom pressure creating a force to close the valve and lessen the flow (figure 5.b). The measured variable returns to setpoint, and the pilot output pressures will automatically return to equilibrium at the new valve position. If the measured variable falls below setpoint, the opposite reaction takes place (figure 5.c).

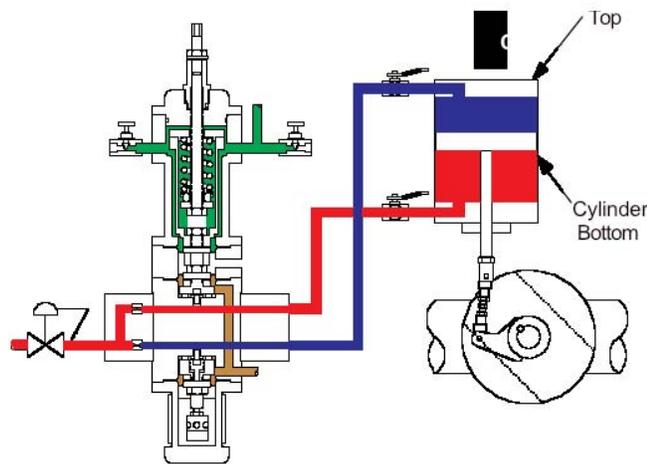
**Schematic Legend**

- Exhaust Pressure (Discharge)
- High Pressure Gas
- Intermediate Pressure Gas
- Measured Variable (Downstream Pressure)



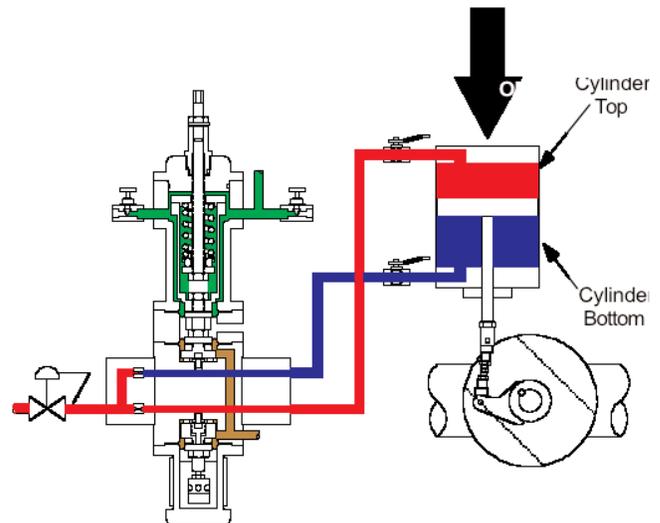
**Figure 5.1 - Setpoint satisfied**

When the measured variable is at setpoint the pilot output pressures to cylinder top (blue) and bottom (blue) are equal and the control valve remains stationary.



**Figure 5.2 - Downstream pressure climbs above setpoint**

When the measured variable rises above setpoint the pilot pistons move downward causing an increase in cylinder bottom pressure (red) and a decrease in cylinder top pressure (blue). The control valve moves toward the closed position.



**Figure 5.3 - Downstream pressure falls below setpoint**

If the measured variable falls below setpoint, the pilot pistons move upward causing a decrease in cylinder bottom pressure (blue) and an increase in cylinder top pressure (red). The control valve moves toward the open position.

**Table 1.0** - Technical Specifications for Model VRP-CH Pilot

Technical Specifications	
Steady State Gas Consumption	see table 4.0
Supply Gas	dry, filtered (100 micron) gas
Maximum Flow Capacity	500 scfh (14.2 scmh)
Maximum Supply Pressure	400 psig (2758 kPa)
Maximum Supply-Discharge Differential	150 psig (1034 kPa)
Minimum Supply-Discharge Differential	50 psig (345 kPa)
Operative Ambient Temperature Range	-20°F to 160°F (-29°C to 71°C)
Approximate Weight	12 pounds (5.4 kg)
Minimum Deadband	0.2% sensing pressure
Independent Linearity	+/- 1.0% positioning range
Resolution	0.1% of positioning range
Control Accuracy	+/- 0.75% of setpoint
Maximum Sensing Pressure	1300 psig (8963 kPa)
Setpoint Range	1.0 psig - 1300 psig (6.9 kPa - 8966 kPa)
Housing	meets NEMA 3 Classification
Installation Orientation	Vertical position recommended. Custom bracket supplied with Becker Actuators. 2" pipe mount provided for retrofit to other manufacturers actuators.
Materials of Construction	
External Parts	anodized AL 2024 316 SS available (for marine environments)
Internal Parts	316 SS and anodized AL 2024
Springs	plated steel
Diaphragms	buna-n reinforced by nylon fabric
Seats and O-rings	buna-n
Tubing and Tubing Fittings	316 SS
Guages	2 1/2 inch dial liquid filled brass connection w/stainless steel case* (standard issue with units of psig/kPa available) *stainless steel connection available

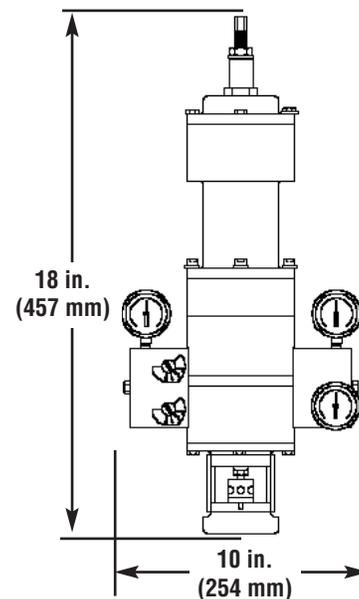
**Table 2.0** - Bleed Rates (consumption) for Becker Control Instrumentation

Becker control instrumentation features low bleed & zero bleed technologies to minimize fugitive natural gas emissions and environmental impact.

	VRP-CH Pilot	VRP-B-CH Pilot	VRP-SB-CH Pilot	VRP-SB-PID Pilot	HPP-4 Positioner	HPP-5 Positioner	HPP-SB Positioner	EFP Positioner
Bleed Rates (Consumption)								
Steady State Bleed* Non-Bleed	~100	<10	zero	zero	~100	<10	zero	zero
Full-Open/Full Closed Bleed to Pressure	Y <sub>1</sub>	Y <sub>2</sub>	Y	Y	Y <sub>1</sub>	Y <sub>2</sub>	Y	Y
Bleed to Pressure System (BPSTM) †	Y	Y	Y	Y	Y	Y	Y	Y

**Notes**

- \* Bleed rates are estimated utilizing Supply Gas Pressure = 100 psig
- 1. Requires Model PS-2 or NBV Non-Bleed Device to eliminate bleed
- 2. Requires Model DPS-2 or NBV Non-Bleed Device to eliminate bleed
- † Bleed to Pressure System (BPS™) eliminates all atmospheric Bleed



**Figure 6.0** - Overall dimensions of Becker Model VRP-600-CH Pilot Control System

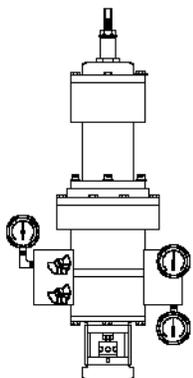
## VRP-CH Series Valve Regulation Pilot

**Table 3.0** - Selection Chart for VRP-CH Series Pilots

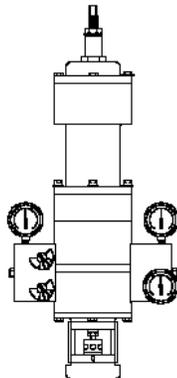
VRP-SB-CH Model Number	Control Range (psig/kPa)	Spring Color	Part Number	Setpoint change/ revolution of setpoint screw <sup>2</sup>	Maximum Remote Setpoint Range <sup>3</sup>	Repair Kit Part Number
<b>VRP-175-CH<sup>1</sup></b>	1 – 10 psig 6.9 – 69 kPa	Gold	25-8236	0.57 psig/rev 3.9 kPa/rev	3.1 psig 21 kPa	39-9002
	7 – 30 psig 48 – 207 kPa	Beige	25-8238	2.0 psig/rev 14 kPa/rev	11 psig 76 kPa	39-9002
	15 – 50 psig 103 – 345 kPa	Burgundy	25-8239	3.0 psig/rev 21 kPa/rev	16.5 psig 113.8 kPa	39-9002
	20 – 85 psig 138 – 596 kPa	Pink	25-8240	6.4 psig/rev 44 kPa/rev	35.2 psig 242.7 kPa	39-9002
	50 – 175 psig 345 – 1207 kPa	Yellow	25-1306	23 psig/rev 159 kPa/rev	125 psig 862 kPa	39-9002
<b>VRP-600-CH</b>	25 - 140 psig 172 - 965 kPa	Beige	25-8238	7.4 psig/rev 51 kPa/rev	41 psig 283 kPa	31-9004
	50 – 175 psig 345 – 1207 kPa	Burgundy	25-8239	11 psig/rev 76 kPa/rev	62 psig 427 kPa	30-9004
	135 – 300 psig 931 – 2069 kPa	Pink	25-8240	24 psig/rev 166 kPa/rev	132 psig 910 kPa	30-9004
	275 – 600 psig 1896 – 4137 kPa	Yellow	25-1306	85 psig/rev 586 kPa/rev	325 psig 2241 kPa	30-9004
<b>VRP-1000-CH</b>	550 – 1000 3792 – 6895 kPa	Yellow	25-1306	144 psig/rev 993 kPa/rev	700 psig 4826 kPa	30-9005
<b>VRP-1300-CH</b>	800 – 1300 psig 5516 – 8964 kPa	Gray	25-1562	227 psig/rev 1565 kPa/rev	900 psig 6205 kPa	30-9005

### Notes

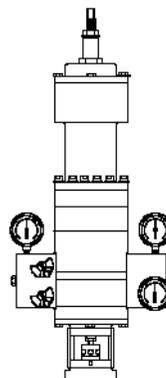
1. These models should only be used for applications that require high gain. Consult Becker prior to specifying these models.
2. Maximum Remote Setpoint Range is based upon Model SM-1140 Remote Setpoint Module with maximum motor range of 5.8 revolutions. See Becker brochure RSM for additional information.
3. Maximum Remote Setpoint Range reported is applicable to units with discrete (pulse) signal. Remote Setpoint Modules with analog (4-20 mA) signal have a Maximum Remote Setpoint Range equal to the full Control Range of the VRP-CH Pilot.



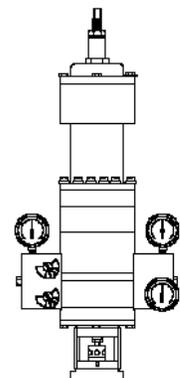
**Figure 7.1** - Model VRP-175-CH



**Figure 7.2** - Model VRP-600-CH



**Figure 7.3** - Model VRP-1000-CH



**Figure 7.4** - Model VRP-1300-CH

## VRP-CH Series Pilot Accessories

Realize Optimum Performance of your VRP-CH Series Pilot with these popular instrumentation accessories!



### Bleed to Pressure System (BPS™)

All Becker control instrumentation feature the unique capability to discharge vent gas into the downstream pipeline or alternate low pressure gas system. This feature is exclusive to Becker and provides complete elimination of atmospheric bleed gas emissions.



### VB Series Volume Boosters

VB Series Volume Boosters are utilized in conjunction with Becker control instrumentation to provide adequate instrumentation flow volume for larger volume piston actuators. Volume Boosters are typically only required for Ball Valve Regulators model 12T and larger. Additionally, Volume Boosters may be utilized to provide increased actuator stroking speed when applications require, such as power plant and other short system applications. As with all Becker instrumentation, Volume Boosters may be discharged into a lower pressure system to eliminate atmospheric bleed. Volume Boosters are compatible with the VRP-CH pilot.



### AB Series Atmospheric Bleed Control

When conditions allow discharge to pressure system only part of the time, install an AB-Control for automatic switching that temporarily permits atmospheric bleed. The AB-Control will maintain adequate differential pressure between supply gas pressure and discharge pressure to operate the control valve actuator and the control instrumentation. The AB-Control is not applicable when the control instrumentation constantly discharges to atmosphere.

*Reference Becker AB Atmospheric Bleed Sales Literature for additional information.*



### NBV Series No-Bleed Valve

The NBV Series No-Bleed Valve eliminates bleed gas from Becker double-acting control instrumentation when corresponding control valve is at full-open and full-closed positions. This is ideal for Monitor Regulators and Standby Regulators that typically remain in the full-open or full-closed positions for extended periods of time. The NBV features bleed shutoff at both ends of valve travel with no adjustment. The NBV is the primary choice for Non-Bleed technology on Becker double-acting control instrumentation. The NBV is compatible with all Becker double acting Valve Regulator Pilots (VRP'S) and double acting High Pressure Positioners (HPP's).

*Reference Becker NBV No-Bleed Valve Sales Literature for additional information.*



### PS Series Non-Bleed Sensor

The PS Series Non-Bleed Sensor renders the VRP-CH non-bleeding when the control valve reaches full-open and full-closed positions. This is ideal for Monitor Regulators and Standby Regulators that typically remain in the full-open or full-closed positions. The PS features bleed shutoff at one end of valve travel. If bleed shutoff is required at both ends of travel, two (2) PS Non-Bleed Sensors will be required. The PS is the secondary choice for Non-Bleed technology and should be utilized only in applications where the NBV will not function such as when the VRP-CH must discharge to high pressure systems (above 60 psig).

*Reference Becker NBV No-Bleed Valve Sales Literature for additional information.*

**VRP-CH Series Pilot Accessories**

**Realize Optimum Performance of your VRP-CH Series Pilot with these popular instrumentation accessories!**



**SP Series Setpoint Pump**

Provides a simple and accurate method of applying false signal pressure during initial adjustment of the VRP-SB-CH pilot. The pump can provide a false signal pressure of 20%-50% in excess of working pipeline pressure which eliminates the need for nitrogen bottles or electronic calibration devices. The SP Series Setpoint Pump is compatible with all models and series of Becker VRP Pilots.

*Reference Becker SP Setpoint Pump Sales Literature for additional information.*



**RSM Series Remote Setpoint Module**

The Remote Set Point Module provides remote adjustment of VRP Pilot set point via an electrical input signal. All Remote Setpoint Motors are equipped with internal limit switches to prevent over-travel of setpoint. 4-20 mA feedback of Remote Setpoint Module motor standard. All Becker RSM Series Remote Setpoint Modules are rated Explosion Proof Class 1, Div. 1 for use in hazardous locations. Standard RSM input signals are:

**Digital Pulse Input**

- 24 VDC
- 120 VAC

**Analog Current Input**

- 4-20 mA command signal/24 VDC Supply Power
- 4-20 mA command signal/120 VAC Supply Power

*Reference Becker RSM Remote Setpoint Module Sales Literature for additional information.*



**Panel Mounting**

Custom panel mounting is available to suit the specific needs of your application. All panels come fully assembled, tested and adjusted per your requirements. Panel mounting simplifies retrofit of Becker instrumentation to existing equipment and ensures satisfactory performance and fit. A variety of configurations and options are available.



**Stainless Steel Option**

All Becker Precision Control instrumentation is manufactured from high-strength anodized aircraft aluminum alloy (AL2024). The standard aluminum construction typically will provide adequate durability in most installation environments. In applications where the installation environment is unusually harsh, the instrumentation may be specially ordered in a stainless steel option. The stainless steel option is typically utilized in the following areas:

- Marine environments
- Chemical plants
- Offshore platforms
- Coastal regions

**Table 4.0** - Selection table for Becker Control Valves and Actuators

	VRP-CH Pilot	VRP-B-CH Pilot	VRP-SB-CH Pilot	VRP-SB-PID Pilot	HPP-4 Positioner	HPP-5 Positioner	HPP-SB Positioner	EFP Positioner	Notes
<b>Applications</b>									
Pressure Control	•	•	•	•	•	•	•	•	1,2
Flow Control					•	•	•	•	2
Power Plant Type Pressure Control	•			•	•	•	•	•	3
Power Plant Type Flow Control					•	•	•	•	3
Surge Control					•	•			
<b>Compatible Actuators</b>									
RPDA Series (Small Models)	•	•			•	•		•	4
RPDA Series (Large Models)	•				•			•	5
RPSR Series			•	•				•	
LPDA Series (Small Models)	•	•			•	•			4
LPDA Series (Large Models)	•				•				5
LPSR Series								•	
LD Series				•	•			•	6
<b>Instrumentation Options</b>									
Bleed to Pressure System BPS™	•	•	•	•	•	•	•	•	7
AB Series Atmospheric Bleed Control	•	•	•	•	•	•	•	•	
NBV Series No-Bleed Valve	•	•			•	•			8
DPS-2 Series Non-Bleed Sensor		•				•			9
PS-2 Series Non-Bleed Sensor	•				•				9
SP Series Setpoint Pump	•	•	•	•					
RSM Series Remote Setpoint Module	•	•	•	•					
Panel Mounting	•	•	•	•					•
Stainless Steel Option	•	•	•	•	•	•	•	•	
VB Series Volume Booster	•		•	•	•	•	•	•	10
QEV Series Quick Exhaust Valve					•	•	•		
I/P Transducer					•	•	•		
SLV Series Signal Lock Valve					•	•	•		

- Pressure Control applications include: pressure letdown, primary regulation, monitors, standby, overpressure protection. Underpressure protection and relief valves.
- All Positioners require controller device to perform pressure control or flow control.
- Power Plant Regulation includes all power plants and "fast-acting" short systems.
- RPDA & LPDA Small Models are defined as actuator sizes 14L and smaller (< 2000 in<sup>3</sup> / 0.033m<sup>3</sup>)
- RPDA & LPDA Large Models are defined as actuator sizes 12T and larger (≥ 2000 in<sup>3</sup> / 0.033m<sup>3</sup>)
- LD Series Actuators are limited to Becker CVE Series Globe Valves
- BPS™ is limited to discharge pressure systems below 300 psig (2068 kPa). Consult Becker for application assistance.
- NBV No-Bleed Valves may only be utilized when P<sub>discharge</sub> ≤ 60 psig (414 kPa) and/or P<sub>supply</sub> ≤ 150 psig (1034 kPa).
- PS-2 & DPS-2 Non-Bleed Sensors must be utilized when P<sub>discharge</sub> > 60 psig (414 kPa) and/or P<sub>supply</sub> > 150 psig (1034 kPa).
- VB Series Volume Boosters are necessary for Power Plant Regulation, Surge Control Applications, or when Large Model RPDA & LPDA Series Actuators are utilized.



**Figure 8.0** - Becker Model VRP-Pilots on Globe Valve Regs  
Becker VRP-Pilots combined with Becker LPDA Series Actuators used on globe pattern valves are ideal for regulation in LDC systems. Incorporation of the BPS™ feature eliminates all atmospheric emissions.



**Figure 9.0** - Becker Model VRP-Pilots on Ball Valve Regs  
VRP-Pilot installed on RPDA Series actuator provides reliable overpressure protection in a simple instrumentation package. Note addition of the PS Non-Bleed Sensor eliminates bleed gas when control valve is full-open.

**\*CAUTION:** This information is intended as a guideline for application of Becker Precision Equipment products. Becker strongly recommends consulting Becker Engineering prior to application of any product.

[www.BPE950.com](http://www.BPE950.com)

Additional Resources are available on our website. Sales literature, sizing software, and technical manuals are available for download at [www.bpe950.com](http://www.bpe950.com)

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