

# Masoneilan<sup>TM</sup> SVI<sup>TM</sup> II AP

Advanced Performance  
Digital Valve Positioner



**Masoneilan**  
a Baker Hughes business

# Non-Contact Position Sensing Technology

Baker Hughes SVI II AP (Smart Valve Interface, Advanced Performance) is a 32 bit microprocessor digital valve positioner with a local interface that controls a pneumatic actuator using a two-wire 4-20mA control signal. The instrument offers bi-directional communication using the HART<sup>®</sup> protocol. Its universal design offers ease of retrofit in place of existing analog positioners on Masoneilan or non-Masoneilan pneumatic actuators, either single-acting or double-acting.

## Control

### Non-Contact Position Feedback

The field-proven, non-contact sensor has no mechanical moving parts, resulting in a potentially long life-cycle and simplifying the mounting procedure. The design is compliant up to SIL2 per IEC61508.

### Designed to Survive

With no moving parts, encapsulated electronics, stainless steel wetted components, positively pressured compartments, and a metal housing, the field-proven Baker Hughes SVI II AP positioner is capable of handling tough environments and resisting the effects of vibration, temperature, and corrosion.

## Dynamic Performance

### Accuracy

The high resolution non-contact sensor, capable of measuring movements of 0.00015 percent, combined with the proven control algorithm, offers positioning performance yielding extreme flow control.

### Responsiveness

The two-stage pneumatic system has a large flow capacity (Cv) for fast filling and purging of the actuator. This technology, combined with the advanced positioning algorithm, offers fast and accurate positioning to small or large setpoint changes in order to enhance process control.



# Easy, Simple, Accurate

## User Friendliness

### Simplified Maintenance

Baker Hughes has configured the SVI II AP positioner with modularity in mind to simplify the task of replacing components. The circuit board, LCD, I/P, and pneumatic relay can be replaced in minutes.

### Increase Safety

The SVI II AP positioner is capable of remote access using the HART protocol or with the use of the Masoneilan VECTOR, a wireless HART adaptor. But in the case where local intervention is necessary, the external explosion-resistant display allows for calibration and diagnosing operations without exposing wires to a potentially explosive environment.

### Quick & Accurate Commissioning

The built-in auto-stop function accurately and repetitively sets the zero and span of the control valve while the built-in auto-tuning function sets the valve positioning parameters. The result is systematic and enhanced dynamic performance on any control valve.

### Local Display with Pushbuttons

The optional explosion-resistant display is a user friendly interface for SVI II AP positioner setup and calibration and monitoring operations and alarms. The LCD assembly can be retrofitted in the field.

## Versatile

### One Design Fits Many Applications

The instrument is capable of handling linear and rotary applications, either valve mounted or remotely mounted. In addition, the product's label encompasses explosion resistant and intrinsically safe applications with FM, CSA, ATEX, and IEC approvals. The net effect is a reduction in inventory cost to support the processing plant.

### Integrated

Baker Hughes SVI II AP positioner supports eDDL, DTM, and system specific technology for integration with most asset management software programs and control systems. Such integration offers ease of commissioning and equipment diagnosis before impacting process control. As a result, the plant can be operational in less time with greater availability.

### Low Voltage

The patented loop-powered circuitry requires 9 Vdc at 20 mA allowing compatibility with existing controllers and existing electrical barriers. Such low voltage requirements allow the plant to improve its existing infrastructure when migrating to digital valve positioners.

### Position Transmitter

The loop-powered position transmitter is built-in with the use of solid state electronics without requiring external accessories or HART to analog converters.

### Discrete Outputs

Baker Hughes SVI II AP positioner is equipped with two configurable solid state switches capable of handling 24 Vdc up to 1 A. These switches are low-maintenance and reduce the need for external accessories.



# Proven Technology

## Housing

Baker Hughes SVI II AP positioner housing is offered in aluminum or stainless steel. The aluminum version is chromated and has less than 0.5 percent copper content to resist harsh environments while the stainless steel version is made of solid 316L material for corrosive atmospheres. Furthermore, the electronic compartment is positively pressured to reduce external moisture ingress and condensation. The installation is accomplished via four external bolt holes. The design supports mounting and dismantling without exposing the wiring compartment to the atmosphere.

### Magnetic Interference Protection

The housing has a built-in feature that protects the magnet array against debris. In addition, this protective feature shields the magnetic field from electromagnetic interferences.



## I/P

The heavy-duty I/P with stainless steel wetted parts has a static coil surrounding the nozzle. As it receives an electrical signal from the electronic circuit, the static coil magnetizes the nozzle attracting the flapper towards the nozzle resulting in a pneumatic signal that actuates the relay. The I/P is built with a flow regulator to sustain a steady output against air supply disturbances.



## LCD and Pushbuttons

The optional cover with external LCD and pushbuttons is explosion resistant for accessibility to the buttons in a hazardous area without the need for a hot work permit. Sophisticated circuitry detects the mechanical activation of a button, providing protection against false inputs.



## Pneumatic Volume Amplifier or Relay

The pneumatic relay consists of a floating poppet valve assembly that modulates using the pneumatic signal from the built-in I/P. The poppet valve allows the incoming air supply to feed the actuator chamber or to vent the actuator chamber to the atmosphere. The large air flow passages offer fast response and operate against airborne contaminants without possible Joules-Thomson effect (ice formation).



## Magnetic Coupling

The position of the valve is sensed with the use of two rare earth (permanent) magnets diametrically opposing each other. This type of magnet can maintain its strength and keeps its magnetic properties for many decades. The orientation of the strong magnetic field is detected through the wall of the housing by a Hall effect sensor located on the circuit board. This technology combined with a protective feature for the magnetic field and the magnets on the housing offers accurate positioning.



## Circuit Board

The electronic circuit of Baker Hughes SVI II AP positioner is encapsulated in a silicone-based material and covered with anti-fungal coating to help survive in harsh environments. A series of heavy-duty, spring-loaded connectors offer wiring termination. Such military and aerospace connector technology resists the effects of cold flow (thermal contraction and expansion of the wire), vibration, and corrosion, resulting in a sustainable electrical connection.



## Pressure Sensors

Five pressure sensors are built-in for online positioner and control valve diagnostics. These pressure sensors are factory calibrated and low-maintenance.

# Versatile

The SVI II AP positioner is versatile and easy to implement by virtue of its universal design, dual-stage amplification system, and a sophisticated patented auto-tuning algorithm.



SVI II AP positioner on 21000 Series control valve

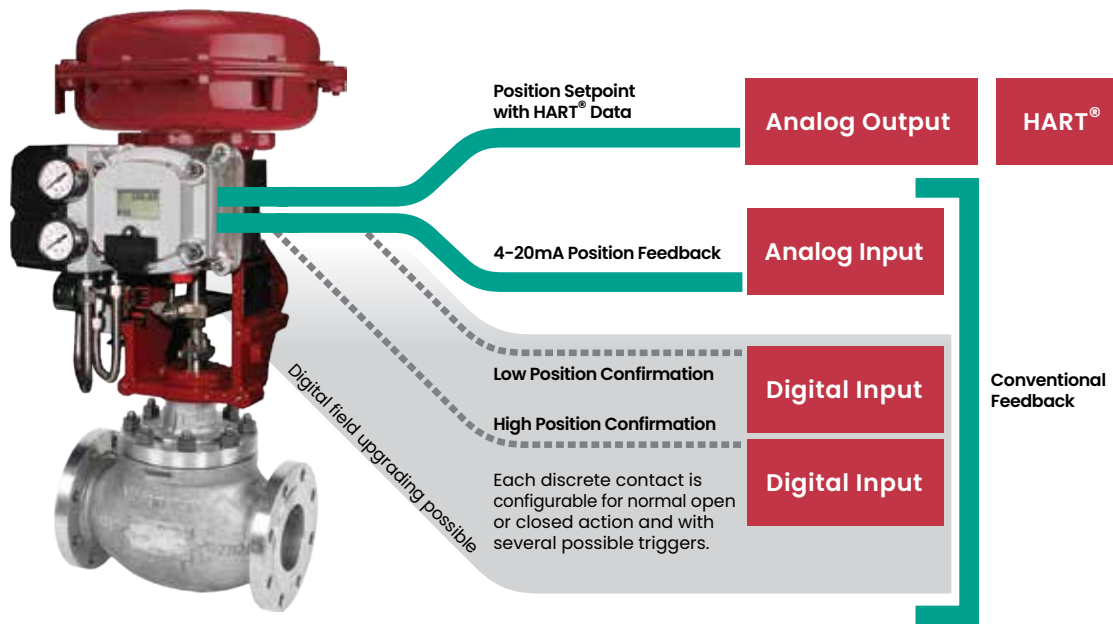


SVI II AP on severe service valve



SVI II AP on steam conditioning valve

# Electrical Implementation



## Application Benefits

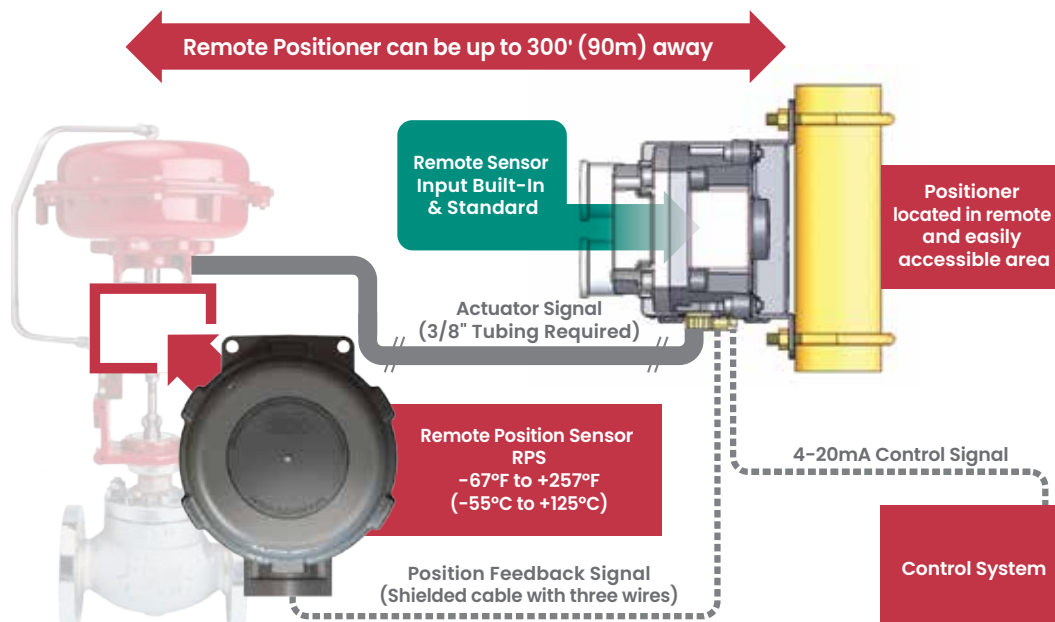
### Remote Mount Application

#### Safety

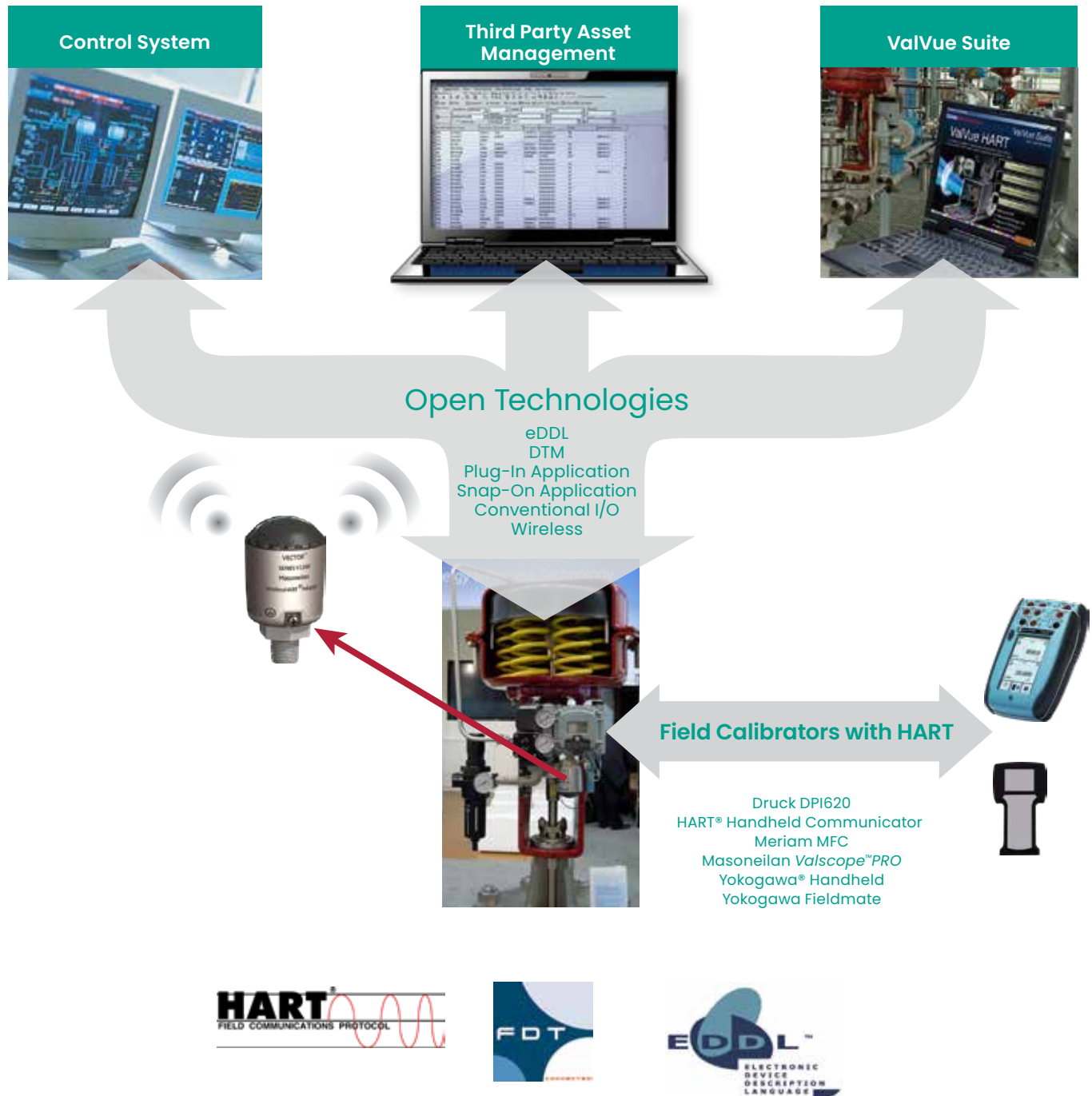
- Allows the positioner to help create a safe working zone for personnel where hazardous and unhealthy substances or radiation may be present
- Improves physical accessibility to the positioner for valves in hard-to-reach locations

#### Control

- Extends duration of elastomers when installed in temperatures near or above product's limit
- Increases robustness against harsh environments



# Integration Flexibility



# Open Technology

The SVI II AP can be integrated with a broad range of controllers, control systems, and software available in the industry.



Feature	Integration Benefit
Low compliance voltage (9Vdc at 20mA)	For legacy system, low impedance circuitry, and Masoneilan VECTOR (loop-powered wireless HART adaptor)
Built-In Analog and discrete signal	For non-HART systems and to meet specific industry requirements where digital communications is not approved
HART, wired or wireless compliant	Integration flexibility of position feedback, valve diagnostics, and device configuration
eDDL compliant	Interface that Integrates with eDDL hosts, software, portable calibrators
DTM compliant	Integrates with FDT capable hosts
System specific drivers and software	Valve diagnostic integration that eDDL or DTM technology cannot provide
Asset management compliant	Integrates with plant management software



# Diagnostics

Baker Hughes SVI II AP positioner offers three types of diagnostics — continuous, offline, and online.

The continuous diagnostics include self-monitoring of SVI II AP positioner operation, number of valve cycles, and distance traveled, hours of operation divided in three categories (time closed, near closed, and open) and a multitude of valve performance-related alarms.

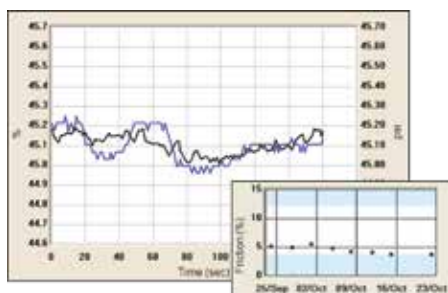
The offline diagnostics allow for bench testing of the positioner and the control valve using a variety of tests built into the firmware and within *ValVue™* software. Such tests do override the incoming control signal and are to be performed on the bench or with the valve bypassed. A useful test is the high resolution Extended Actuator Signature because it quantifies the friction, the spring initial and final, and the seating profile.

The online diagnostics are performed during normal operation while the positioner is under control. Such diagnostics are non-intrusive for the operation of the control valve and offer a wealth of information as to the performance of the SVI II AP positioner and the control valve. The SVI II AP firmware continuously monitors key performance indicators and can provide alarms using HART or the built-in solid-state switches. When combined with Valve Aware, the SVI II AP positioner offers a more comprehensive set of key performance indicators (KPIs) during normal operation.

## Valve Signatures

### ONLINE Valve Signatures

When coupled with Valve Aware, valve performance monitoring becomes possible while the process is running. Valve Aware is a software-based technology for monitoring and diagnosing the performance of any control valve during normal process operations. This



Requires as little as 0.20 percent setpoint variation to measure the control valve KPI's

### Continuous Diagnostics

- Cycles (valve reversals)
- Positioner and valve alerts
- Travel (distance traveled)
- Hours of operation
  - Time closed
  - Time near closed
  - Time open

### Offline Diagnostics

- Single or multiple-step response (position vs. time)
- Positioner signature (position vs. command signal)
- Valve / Actuator signature (actuator pressure vs. travel)

### Online Diagnostics

- Valve position, input signal, supply pressure, actuator pressure, I/P pressure
- Pneumatic system performance
- Circuit board health
- Device temperature (actual, high, low)
- Valve performance—requires Valve Aware (online valve diagnostics)
- Friction (requires Valve Aware)

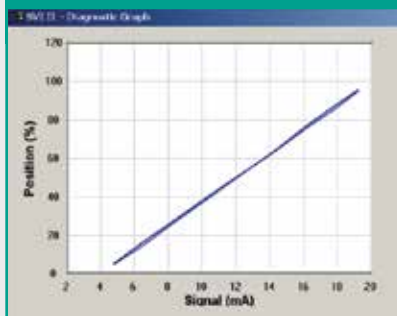
solution for final control elements assists in improving plant integrity, plant efficiencies, and plant uptime, which may result in reduced operating expenditures and increased plant profitability.

Key Performance Indicator	SV II AP SD	Model AD
Response Time	X	X
Setpoint Offset	X	X
Setpoint Error	X	X
Position Overshoot	X	X
Oscillation Frequency	X	X
Lag	X	X
Valve Friction		X
Spring Initial		X
Spring Final		X
Spring Rate		X

## OFFLINE Valve Signatures

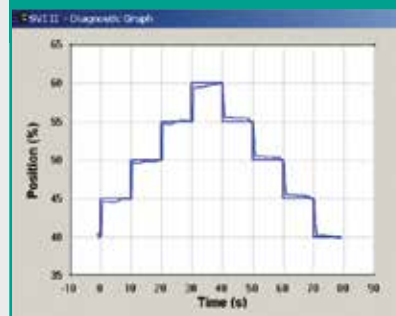
### Standard Diagnostics

Positioner Signature



- Hysteresis
- Deadband
- Position Accuracy

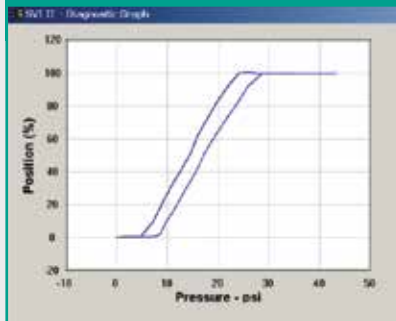
Step Test Signature



- Response Speed
- Hysteresis
- Deadband
- Overshoot
- Resolution

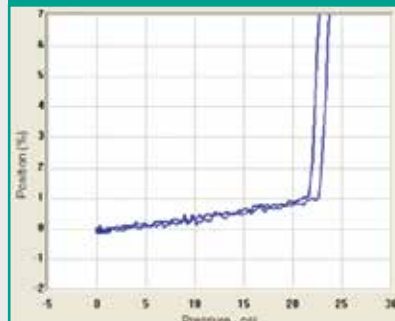
### Advanced Diagnostics

Full Valve Signature



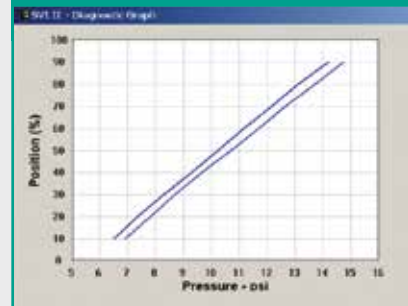
- Valve / Actuator Friction
- Spring Range and Calibration
- Actuator Pressure
- Seating Analysis
- High Resolution

Seating Analysis



- Unseating and Seating
- Plug and Seat Contact
- Seat Load

Valve Signature



- Valve / Actuator Friction
- Spring Range and Calibration
- Response Time
- Actuator Pressure
- Signature Stored In Memory

SVI II AP positioner can be field upgraded from SD to AD

Model	SD	AD
Positioner Signature	X	X
Step Test	X	X
Embedded Signature		X
Valve Signature		X
Seating Analysis		X

# Features vs Model

CATEGORY	FEATURE	SVI II AP Version	
		SD	AD
Housing	Low Copper Aluminum (ASTM 360, < 0.5% Copper)	✓	✓
	Stainless Steel (316L)	○ <sup>1</sup>	○ <sup>1</sup>
	Dual 1/2 NPT Electrical Port	✓	✓
Sensors	Temperature: Circuit Board	✓	✓
	Position: Non-Contact, Hall sensor	✓	✓
	Pressure: Atmospheric	✓	✓
	Pressure: Supply Pressure	✓	✓
	Pressure: I/P Pressure	○	✓
	Pressure: Actuator P1 (Direct Port)	○	✓
	Pressure: Actuator P2 (Reverse Port, Double-Acting)	○	✓
Input / Outputs	Remote Position Sensor	✓	✓
	Programmable Solid State Switches	○	○
	4-20mA Position Retransmit Feedback	○	○
Positioning	Split Ranging (Minimum Span: 5mA)	✓	✓
	Valve Characterization	✓	✓
	Autostops (Zero & Span)	✓	✓
	Live Tuning <sup>2</sup>	✓	✓
	Autotune	✓	✓
Field Upgradeable Diagnostics & Valve Signatures	Positioner Signature (Travel vs Setpoint)	✓	✓
	Multiple Step Test (Travel, Setpoint vs Time)	✓	✓
	Embedded Standard Signature		✓
	High Resolution Extended Valve Signature		✓
	Plug & Seat Profile Analysis		✓
	Online Valve Diagnostics (with Valve Aware)	✓	✓
Data Historian	Cycle Counter	✓	✓
	Travel Accumulator	✓	✓
	Time Closed	✓	✓
	Time Near Closed	✓	✓
	Time Open	✓	✓
Alerts	Position Deviation	✓	✓
	Air Supply Low	✓	✓
	Device Integrity	✓	✓
	Calibration	✓	✓
Actuator Support	Single-Acting (S) Double-Acting (D)	S or D	S or D

○ = Optional and field upgrade capable using HART

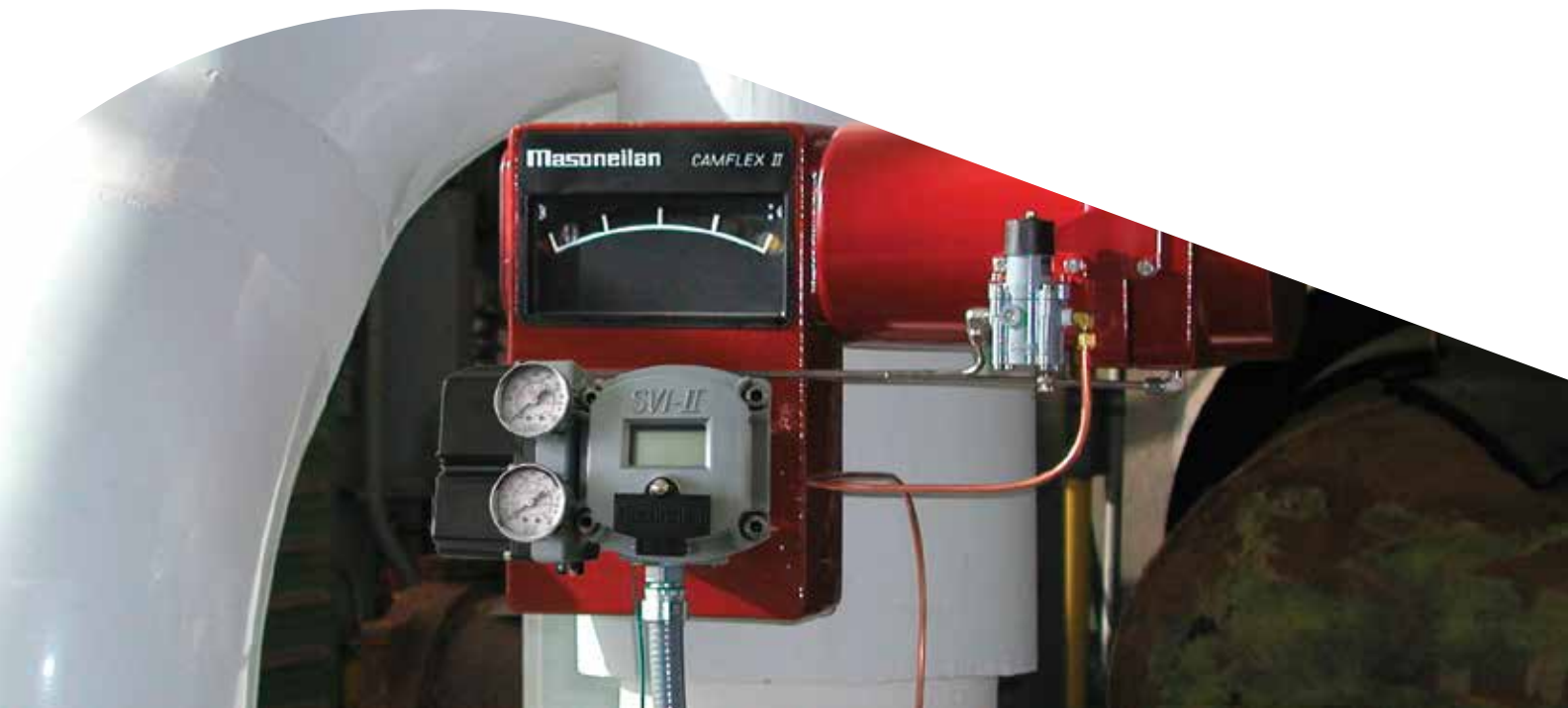
1. Factory-ordered option only. Not field upgradeable.

2. Requires ValVue Software

# Model Builder

## Series Identification SVI II AP – abcdefgh

SVI II AP–	<b>a</b>	<b>Diagnostic</b> 2. SD Version – Standard Diagnostics 3. AD Version – Advanced Diagnostics							
	<b>b</b>	<b>Pneumatics</b> 1. Single-Acting 2. Double-Acting							
	<b>c</b>	<b>Volume Capacity</b> 1. Standard Flow 2. High Flow Cv 2.6 (pending)							
	<b>d</b>	<b>LCD Interface / Housing Material</b> 1. No Display and Pushbuttons    3. Offshore 316L, No Display and Pushbuttons 2. With Display and Pushbuttons    4. Offshore 316L, With Display and Pushbuttons							
	<b>e</b>	<b>Electronics</b> 3. 4-20mA – Loop Powered							
	<b>f</b>	<b>Communications</b> 1. 4-20mA Loop Powered with – HART Communications							
	<b>g</b>	<b>Options</b> 1. None 2. Position Retransmit and Limit Switches							
	<b>h</b>	<b>Hazardous Area Certification</b> 1. ATEX / FM / CSA / IEC Intrinsic Safety & Explosion Proof							
	2 3	1 2	1	1 2 3 4	3	1	1 2	1	



# Specifications

## Safety Compliance:

- SIL2 Self Compliance Per IEC61508 section 2-3

## Diagnostics:

- Five Pressure Sensors
- Total Travel & Number of Cycles
- Valve Operations (time open/time closed/time near closed)
- Offline Control Valve Signatures with ValVue Suite or Advanced DTM
- Online Friction with Valve Aware
- Field Upgradable Diagnostic Levels

## Housing Material:

- Case / Cover: Aluminum ASTM 360 (std), 316L (optional)
- Paint<sup>1</sup>: Grey Polyurethane (category C4 per ISO 12944-2)

## Input Power and Signal:

- Power Supply (taken from 4-20 mA)
- Required Terminal Voltage: 9 Vdc at 20 mA
- Minimum Current Signal: 3.2 mA

## Optional Output Signals:

- Position Transmitter: 4-20 mA - Two Wire Loop-Powered with 10-24 Vdc Compliance Voltage
- Two Configurable Digital Contacts: 30 Vdc, 1A

## Input Signals:

- Valve Setpoint: 4-20 mA, 450 Ohms Input Resistance
- Remote Position Sensor: 10 k Ohms

## Communication:

- HART Revision 5 Protocol (HART 6 Pending)

## Ambient Temperature Limits:

- -58 to 185° F (-50 to 85° C)

## Ambient Humidity Limits:

- 0 to 95 percent RH Non-condensing

## EMC Conformity Standards:

- EN 61000-4-2, 3, 5, 6, 8
- IEC 8014-2, -3, -4

## Actuator Travel Range:

- Linear Motion: 0.25" (6.4 mm) to 6" - standard mounting  
> 6" (50 mm) - extended mounting
- Rotary Motion: 18 to 140 degrees
- Travel Sensor Resolution: 0.0015 percent

## Pneumatics:

- Air or sweet natural gas - regulated and filtered

## Air Supply Pressure:

- Single-Acting: 20 to 100 psi max (1.4 to 6.9 bar)
- Double-Acting: 20 to 150 psi max (1.4 to 10.3 bar)

## Air Delivery and Air Consumption:

### Output Delivery

Air Supply	Single-Acting	Double-Acting
30 psi (2.1 bar)	10.0 scfm (280 nl/m)	7.2 scfm (200 nl/m)
60 psi (4.2 bar)	16.6 scfm (470 nl/m)	12.8 scfm (360 nl/m)
90 psi (6.3 bar)	23.3 scfm (660 nl/m)	18.3 scfm (520 nl/m)
120 psi (8.4 bar)	34.6 scfm (980 nl/m)	23.8 scfm (675 nl/m)

### Air Consumption

Air Supply	Single-Acting	Double-Acting
30 psi (2.1 bar)	0.212 scfm (6 l/m)	0.424 scfm (12 l/m)
60 psi (4.2 bar)	0.282 scfm (8 l/m)	0.565 scfm (16 l/m)
90 psi (6.3 bar)	0.424 scfm (12 l/m)	0.847 scfm (24 l/m)
120 psi (8.4 bar)	0.529 scfm (15 l/m)	1.06 scfm (30 l/m)

## Materials:

- I/P Motor and Relay are constructed of composite polymers and stainless steel (300 and 400 series)

## Control Valve Mounting System:

### Material:

- 300 Series SST Standard

### Valve Type:

- Linear or Rotary Motion Control Valve
- Single- or Double-Acting Actuator<sup>2</sup>

### Optional Remote-Mount Position Sensor Kit:

- Remote Position Sensor (RPS) Assembly
- Cabling For Up To 30 Meters (100 Feet)
- Two inch Pipe Mount Bracket

## Certifications:

- FM, CSA, ATEX, JIS, INMETRO, KOSHA, GOST, IEC
- Explosion Proof, Intrinsically Safe, Flame Proof, nL
- Enclosure protection: NEMA 4X / IP66
- CE MARK

## Performance<sup>3</sup> per ISA S75.13 / IEC61514

Accuracy	+/- 0.5 percent Full Span
Linearity	+/- 1 percent Full Scale
Hysteresis + DeadBand	+/- 0.3 percent Full Span
Repeatability	+/- 0.3 percent Full Span
Power-Up With Position Control	<150 ms
Power Interruption Without Causing Reset	<100 ms

1. The stainless steel housing is not painted.

2. Requires double-acting relay model.

3. For linear characteristic.

# Control | Performance | Intelligence



Baker Hughes SVI II AP positioner with proven electronic and pneumatic technologies, combined with multiple sensors and smart software, offers high performance valve control with real-time diagnostics. The SVI II AP positioner is configured with a non-contact position sensor, a 32 bit ARM processor, a rugged I/P, and a poppet valve volume amplifier.

