GE Oil & Gas

## Masoneilan* Products

# SVI II ESD

**The First SIL3 Smart ESD Device That is Live During and After a Shutdown**


imagination at work

# Bringing Plant Safety & Integrity to a Whole New Level

## What is a SMART Shutdown Device?

The Masoneilan SVI II ESD Device from GE Oil & Gas incorporates the latest technology in emergency shutdown valve automation and in-service valve partial stroking, and it is designed using the proven electronic, pneumatic and non-contact technology from the SVI II AP valve positioner. SIL3 (Safety Integrity Level 3) compliant in accordance with IEC61508 per TUV and EXIDA, the SVI II ESD is suitable for use in safety instrumented functions.

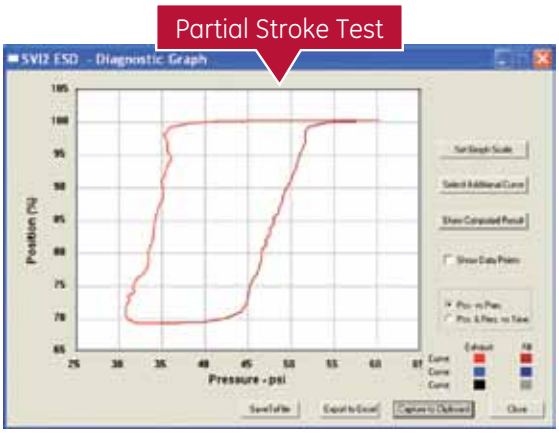
The designated function of the SVI II ESD can be implemented by using a 4/20mA signal, 0-24Vdc or a combination of both. The single 4/20mA solution is SIL3 while at 4mA, allowing the device to execute the safety function while still being active. Key benefits of this approach include capturing shutdown events as a full-proof test, allowing continuous HART® communications during a trip, providing local panel annunciation, confirming ESD operations, and using the built-in discrete outputs .

This single 4/20mA solution provides ESD function and PST (Partial Stroke Test) function on a single wire pair. This enables:

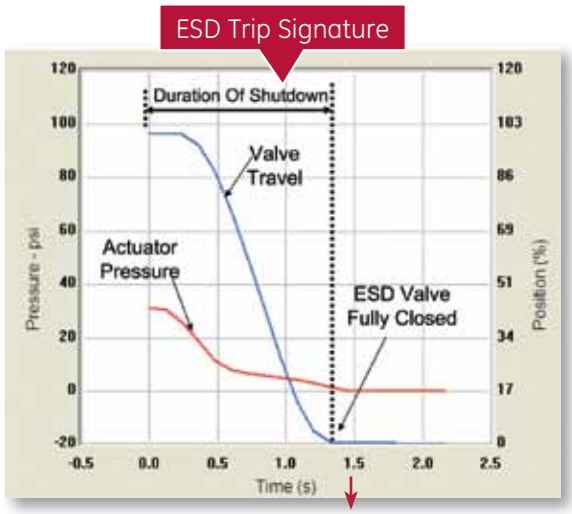
- Reduced installation cost
- Execution of ESD valve PST from any logic solver

### Automatic Analysis of the ESD Valve yields additional benefits:

- Software automatically captures PST signatures
- Integration of diagnostics with logic solvers
- High diagnostic coverage factor




ESD Partial Stroke Signature Data




ESD Shutdown Signature

T = 0 sec: Safety Demand Initiated To Close Valve

## What is SIL?

SIL, or Safety Integrity Level, is a standard governed by the International Electrical Committee (IEC). Its purpose is to:

- Establish risk reduction requirements
- Set probabilistic limits for hardware random failure
- Establish engineering procedures to prevent systematic design errors

### Safe Failure Fraction and SIL - Type A

Solenoid Solutions Two (2) or More For SIL3 with a Low SFF

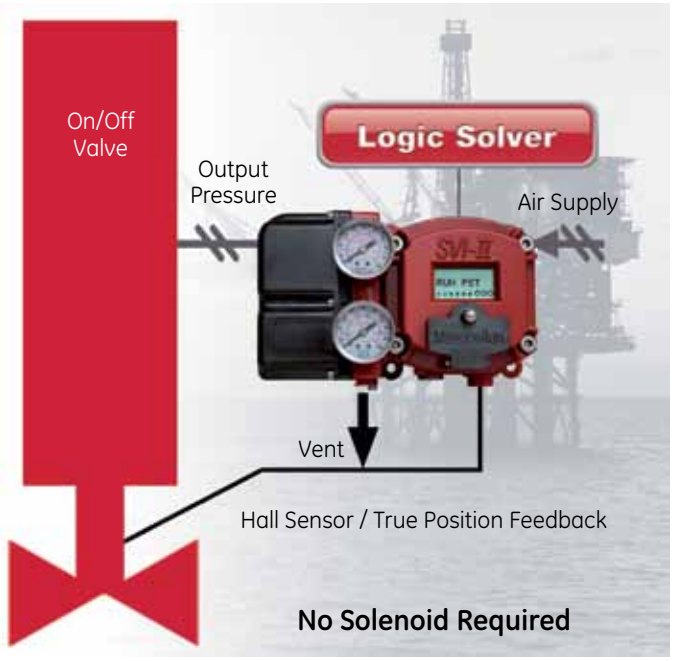
One (1) SVI II ESD Provides High SIL and High SFF

| Safe Failure Fraction (SFF) | Hardware Fault Tolerance (HFT) | | |
|---|---|---|---|
| | 0 | 1 | 2 |
| < 60% | SIL 1 | SIL 2 | SIL 3 |
| 60 % < 90 % | SIL 2 | SIL 3 | SIL 4 |
| 90% < 99 % | SIL 3 | SIL 4 | SIL 4 |
| > 99% | SIL 3 | SIL 4 | SIL 4 |

# SVI II ESD: Designed Exclusively for ON/OFF ESD Valve Applications

The revolutionary SVI II ESD design provides a designated safety function completely independent from the partial stroke testing function. The design architecture, which separates the embedded microprocessor and the safety shutdown circuitry, offers a sophisticated platform while being Type A (simple device) compliant.

As a smart ESD valve device with partial stroking functionality, the SVI II ESD includes self-diagnostics and is designed to annunciate a fault through its built-in digital output (DO) and by using the HART® protocol. Four possible launching methods for partial stroke testing (PST) are built in. For safety instrumented systems usage it is assumed that annunciation is performed through the built-in digital output or by using the HART® protocol. The safety input can either be a 4/20mA current loop (trip when current ≤ 5.6mA) or a 24Vdc discrete input (trip on < 3Vdc). Power to the unit is supplied by the 4/20mA current loop, except in a two-wire discrete input configuration, in which the power is supplied by the 24V input.



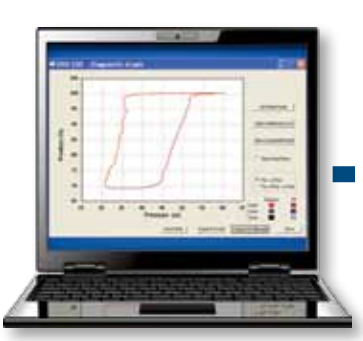

- The SVI II ESD is unique in that it is SIL3 at 4mA[1] and therefore allows the built-in microcontroller to capture HART diagnostics whenever the safety function is engaged. Compare that to other devices, which require the signal to be 0mA to provide a safety function with an SIL3 compliance. Such solutions do not allow the microprocessor to be available and active during a shutdown event.
- Furthermore, the SVI II ESD has a configurable latching feature whenever a trip occurs.

[1] Suitable with ASD and A/DSD models.

**SVI II ESD operating on a quarter turn ESD valve with NAMUR VDI/VDE 3845 mounting kit**

# Safety Function / PST / Diagnostic on One-Wire Pair

Integration shown with a typical Logic Solver and HART® Analog Output Card.



Logic Solver

## ValVue* ESD Features

- ESD health monitoring
- PST auto-archiving
- Full-proof testing
- Setup / commission / diagnose

ESD Signal
HART Diagnostics
Analog PST[1]


### Embedded local control panel

LCD display and 3 explosion proof push-buttons for:

- Valve Configuration and Calibration
- Local PST[1]
- PST, Safety Trip and Device Status
- Position Feedback

70+ ESD Warnings

7-Language Display

English, French, German, Italian, Japanese, Portuguese, Spanish




Alternating Readings of Dynamic Variables

Safety Demand Signal Strength

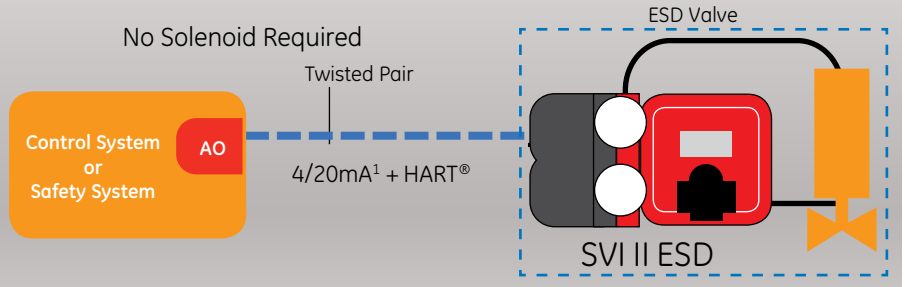
[1] Analog PST is patent pending.

# SVI II ESD Device Models and Safety Demand Implementation

No Solenoid Required

## Two-Wire Analog Safety Demand (ASD)

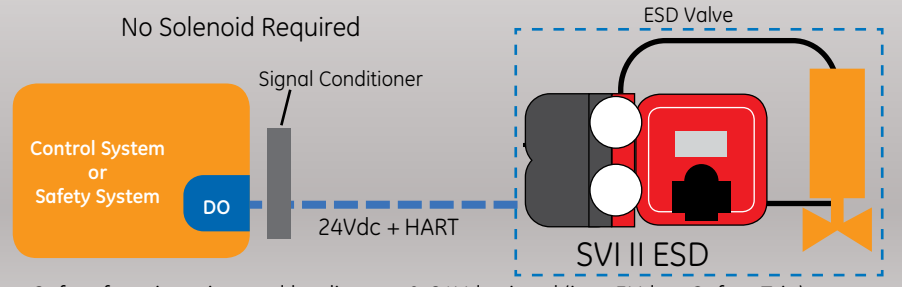
This ASD model utilizes a 4/20mA signal, where the safety function of de-energizing the pneumatic actuator is achieved with a value of < 5.6mA. This cutting-edge solution provides greatest value as it simplifies to one single wire pair for the safety function, partial stroke testing and diagnostics.




2-wire solution – Safety function triggered by current sensing (i.e. <5.6mA = Safety Trip)

## Two-Wire Discrete Safety Demand (DSD)

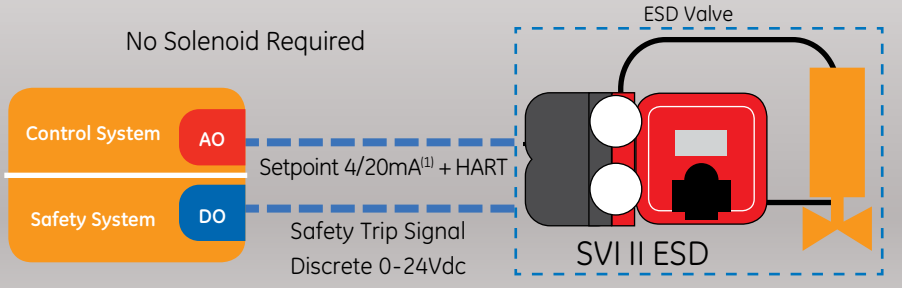
This DSD model utilizes a 0-24Vdc signal where the safety function of de-energizing the pneumatic actuator is achieved with a value of <3Vdc. This solution is ideal when retrofitting an actuator fitted with a 24Vdc solenoid.




Safety function triggered by discrete 0-24Vdc signal (i.e. <3Vdc = Safety Trip)

## Four-Wire Analog Setpoint with Discrete Safety Demand (A/DSD)

This A/DSD model utilizes the 4/20mA to position the valve (Open or Close), allow for HART communications and start a PST using specific analog signal while a separate 0-24Vdc signal provides the safety function of de-energizing the actuator.




4-wire solution – Safety function triggered by discrete 0-24Vdc signal (i.e. <3Vdc = Safety Trip)

(1) The SVI II ESD provides On/Off valve positioning. Throttling capability is available in manual mode only through HART communication or local pushbuttons.

# ESD Valve Diagnostics With ValVue ESD Software

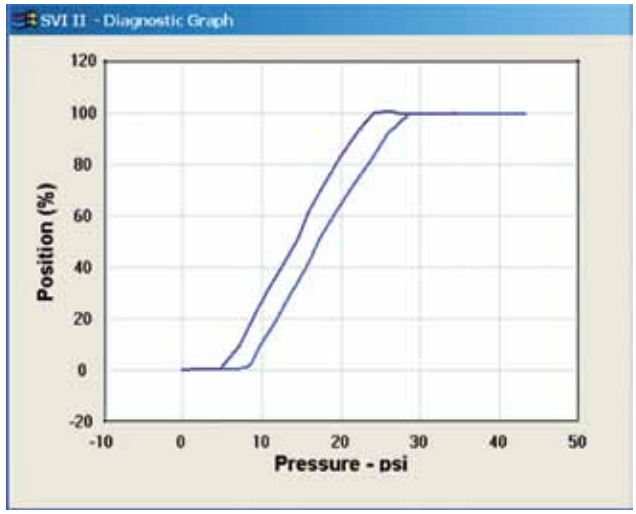
The SVI II ESD is equipped with one non-contact travel sensor, five pressure sensors, one temperature sensor, and one loop current sensor. Therefore, it can diagnose the health of the valve as well as monitor its various sub-components in real time.

The SVI II ESD provides more than 70 possible alarms/warnings including:

- Valve Stuck Open / Closed
- Feedback Linkage Drift
- Pneumatic Train Integrity
- Air Supply Low / High
- Breakout Force Exceeded

The database-driven companion software, ValVue ESD, continuously monitors the health of the ESD valves and provides a global view of the health of all ESD valves in a plant. That facilitates the planning and resources to properly maintain ESD valves. ValVue ESD software provides for the SVI II ESD setup, device alarms, PST settings, partial stroke test execution and monitoring of the installed base of ESD valves. The PST signatures are automatically stored in the software database with the built-in PST Monitor. Additionally, the software allows for proof testing signatures and stroking speed calculation signatures. The diagnostic analysis is graphically plotted over time to easily identify performance degradation.

User friendly dashboard of ESD Valve condition.




Full valve signature with valve/actuator friction, spring range and calibration, seating analysis and response time.

# How to launch a PST

The SVI II ESD includes the broadest PST-launching capabilities available, including the following standard features:

- Local using the LCD display, or using a local panel wired in-line with SVI II ESD
- Remote using HART® capable interfaces
- Remote using a specific analog signal (ASD and A/DSD models only)
- Automated with the built-in scheduler

The SVI II ESD automatically captures the PST in its non-volatile memory and stores the analysis. Two signatures can be stored, allowing the PST Monitor functionality with ValVue ESD software to automatically synchronize its database with the field data. This software can stand alone or be integrated.

| PST Launching Methods | |
|---|---|
| Analog Loop Current (Patent Pending) |  |
| Local Button |  |
| Built-In Scheduler |   |
| Host System via HART (EDDL, DTM or ValVue ESD) |  |
| HART Field Calibrators |  |

# PST Parameters

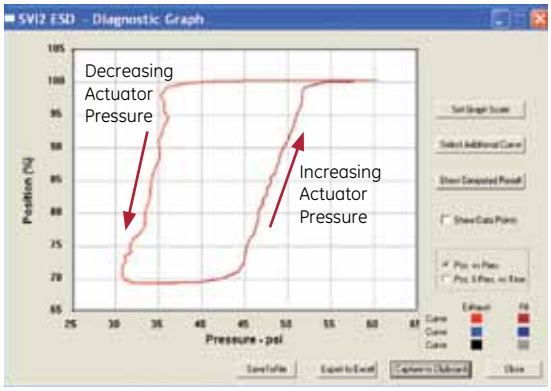
Since the SVI II ESD contains the settings to execute a PST in its non-volatile memory, the PST is reliably executed regardless of the launching method. The parameters include boundaries to prevent undesirable valve movements during a partial stroke test.

# Partial Stroke Test Overview

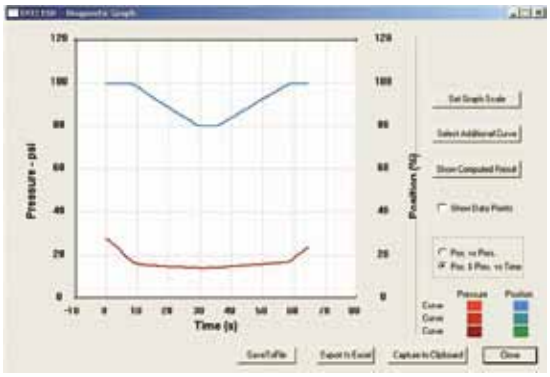
| PST Implementation Benefits With SVI II ESD Device Technology | |
|---|---|
| Integrated | The test and the results are integrated with the rest of the safety system |
| Automated | Per IEC61511 requirements, PST execution can be fully automated, which prevents human error. Test results are stored in the memory of the SVI II ESD and automatically communicated to the user, providing actionable information about potential valve performance problems. |
| Versatile and Accessible | PSTs from the SVI II ESD can be safely executed locally or remotely, and the results accessed from the logic solver. |
| User Friendly | Tests are easy to execute and the results are easy to understand. The user does not need to be an expert on ESD valves or digital shutdown devices to complete the test and interpret the results. |

# Partial Stroke Test Signature and Plotting Travel vs. Actuator Pressure

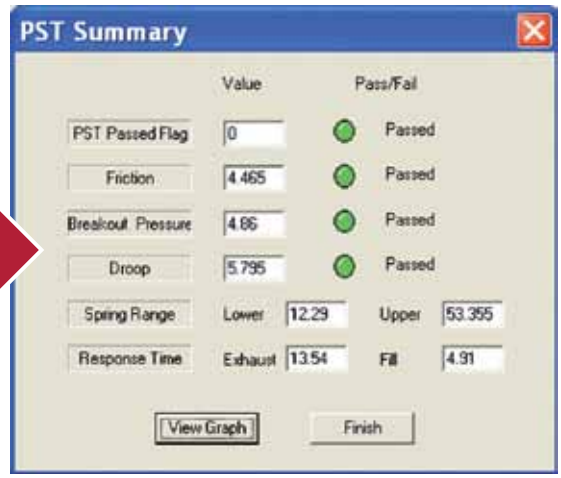
**Smart partial stroke testing allows reliable testing of emergency shutdown valves and provides greater diagnostic coverage**




PST signature shown over 20% travel




Plotting travel and actuator pressure vs time

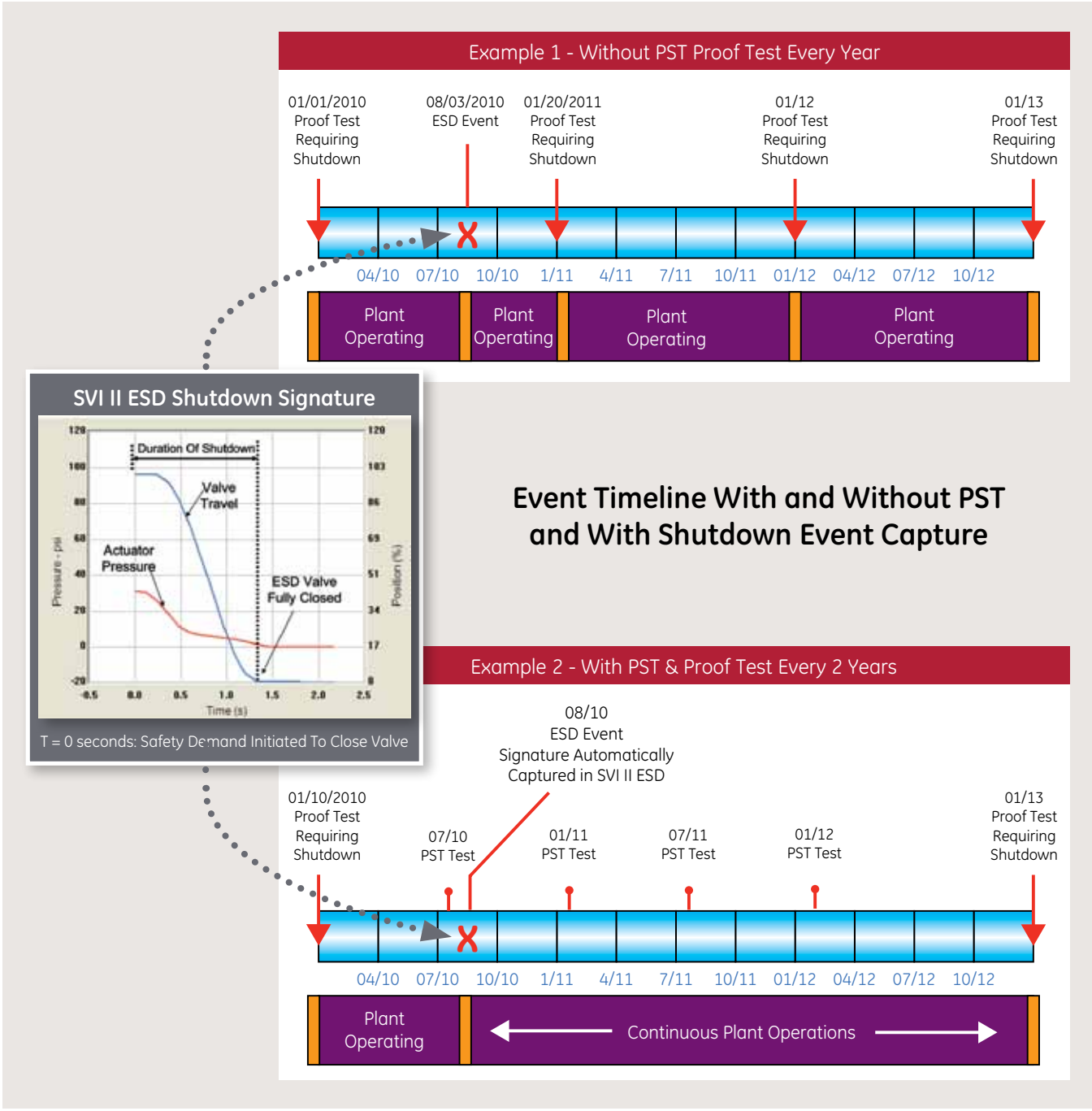



Automated Emergency Shutdown Signature

# Emergency Shutdown Signature

The SVI II ESD Device is the first SIL3-rated product capable of capturing a shutdown event during a trip using a single-wire pair[1]. This feature captures the shutdown event in non-volatile memory, which allows the safety event to be investigated and a complete proof test to be conducted. Therefore, this proof test is automatically documented and the next proof test can be rescheduled according to the required probability of failure on demand (PFD).

[1] Suitable with ASD model only.




| | Example 1 | Example 2 | Explanation |
|---|---|---|---|
| # Of Shutdowns for Proof Testing | 4 | 2 | The mandatory testing of ESD valves requires process downtime |
| Cost Per Shutdown | $500,000 | $500,000 | Average cost of shutdown including loss of production |
| **Possible Shutdown Costs** | **$2,000,000** | **$1,000,000** | |
| **Savings** | **-** | **$1,000,000** | |

# Applications and Specifications

| Model / Inputs / Outputs | Model ASD (Analog Safety Demand) | Model DSD (Discrete Safety Demand) | Model A/DSD (Analog Power with Discrete Safety Demand) |
|---|---|---|---|
| Analog In (4/20mA) | Safety Trip Trigger + HART® + Analog PST | – | Device Power + Analog PST + HART |
| ESD In (0-24Vdc) | – | Safety Trip Trigger + HART | Safety Trip Trigger |
| Analog Out (4-20mA) | Position Transmitter | | |
| Switch1 (1A, 24Vdc) | ESD Status | | |
| Switch2 (1A, 24Vdc) | Configurable Status [3] | | |
| DI (switch input) | Unlatch the SVI II ESD [1] | | |
| PV (1-5Vdc) | Read Tight Shutoff Flow [2] | | |
| Local LCD / Buttons | Device Configuration and Calibration, ESD Status<br>PST Configuration<br>Local PST Execution | | |

The use of HART or the ESD status switch provide ESD valve and SVI II ESD diagnostics which are necessary to claim PFD improvements.

[1] The latching function is software configurable.

[2] This variable is sent via HART Command 3 as a tertiary variable

[3] The switch can be configured as:
- Normally Open (NO) or Normally Closed (NC)

The switch can be configured to alert if one of the following events occurs:
- PST in progress
- ESD triggered
- ESD fault annunciation
- Position low limit
- Position high limit
- Failsafe
- Normal mode
- Manual or Out-Of-Service mode

IEC61508 certified TUV
Type A device (simplex, low demand)
SIL3 safety shutdown function
Safe failure fraction with PVST up to 99% upon model

## Performance

Hysteresis + deadband ±0.3%

Operating temperature range -40°C to +85°C (-40°F to +185°F)

## Input power and signal

ASD & A/DSD signal 4/20mA with HART® Communication protocol

Power supply taken from 4/20mA control Signal (ASD, A/DSD)

Power supply taken from 24Vdc signal (DSD)

Minimum terminal voltage 9.5Vdc @ 20mA

Safety function: < 5.6mA (model ASD)
< 3Vdc (A/DSD or DSD)

Energized output: > 15mA (ASD,A/DSD),
> 15Vdc (DSD)

ESD IN current draw < 9.5mA (DSD, A/DSD)

HART over 4/20mA signal (ASD,A/DSD)

HART over 24Vdc signal (DSD, requires signal conditioner)

## Pneumatics

Regulated and filtered air required

Single acting: supply pressure 30-120 psi max (2.1-7.8 bar).

Air supply regulated 10 psi above actuator spring range.

Air delivery:
325 Nl/min (11.55 scfm) at 2.1 bar (30psi) supply

765 Nl/min (27 scfm) at 6.2 bar (90 psi) supply

Air consumption 5.7 Nl/min (0.2 scfm) at 2.1 bar (30 psi) supply

$C_V$=0.53 (venting) $C_V$=0.57 (filling)

## Control valve mounting system

Non-contact hall effect position sensor (18° to 140° rotation)

Rotary NAMUR mounting kit per VDI/VDE 3845

Reciprocating kits available

Compliance with field calibrators with HART® protocol such as GE Druck DPI620 and others

## System integration

Device description (EDDL or DTM)

ValVue ESD application

ValVue ESD PRM plug-in

Interoperability with many FDT/DTM and eDDL capable hosts

## ESD and diagnostic capabilities

IEC61508 compliant up to SIL3 certified by TUV and EXIDA

Partial stroke testing initiation (HART, analog, local pushbutton, built-in scheduler)

Digital output for PST results and SVI II ESD health

Non-volatile memory for two (2) PST signature

Non-volatile memory for ESD shutdown event signature

Safety trip trigger: 4/20mA or 24Vdc input

Local PST scheduler with built-in calendar

Full stroke valve signature & positioner diagnostics

Built-in explosion proof external LCD with pushbuttons

Language support:

English
French
German
Italian
Japanese
Portuguese
Spanish

## Compliance with ANSI/API 754 specification

Process Safety Performance Indicators for the Refining and Petrochemical Industries

## Hazardous area certifications

Enclosure rating NEMA 4X / IP 66

Low copper aluminum or 316L housing

Red electrical cover and housing for clear identification as a safety related device

### ATEX approvals:

Intrinsic safety

Gas: II 1G Ex ia IIC T6 / T5 / T4

Dust: II 1D Ex iaD A20 T96°C

Flameproof

Gas: II 2G Ex dm IIB + $H_2$ T6 / T5 / T4

Dust: II 2D Ex tD A21 IP66 T96°C

Energy limited

Gas: II 3G Ex nL IIC T6 / T5

Dust: II 3D Ex tD A22 IP66 T96°C

Approval standards:
EN60079-0:2006, EN60079-1:2007, EN60079-11:2007, EN60079-15:2005, EN60079-18:2004, EN60079-26:2007, EN61241-0:2006, EN61241-1:2004, EN61241-11:2006, EN61241-18:2004, EN1127-1:2007, EN60529:1991

### CSA international certifications:

Explosion proof
CL I; Div. 1; GR B, C, D T6 / T5 / T4

Dust ignition proof
CL II/III; Div. 1; GR E, F, G T6 / T5 / T4

Certified CL II; Div. 2; GR F, G

Certified CL III; Div. 2

Certified CL I; Div. 2; GR , B, C, D

Intrinsically safe
CL I, II, III; Div. 1; GR A, B, C, D, E, F, G T6 / T5 / T4

Approval standard: CAN/CSA-C22.2 # 94-M91,142-M1987, 157-92, 213 M1987,60529:05

### FM approvals:

Explosion proof
CL I; Div. 1; GR B, C, D T6 / T5 / T4

Dust ignition proof
CL II/III; Div. 1; GR E, F, G T6 / T5 / T4

Suitable for CL II, III; Div. 2; GR F, G

Non-incendive CL I; Div. 2; GR A, B, C, D

Intrinsically safe
CL I, II, III; Div. 1; GR A, B, C, D, E, F, G

Approval standards: Class 3600, 3615, 3810, ANSI/NEMA 250, IEC 60079-18 IEC60529 +A1

### IECEx approvals:

Intrinsically safe
Ex ia IIC T6

Explosion proof
Ex d mb IIC Gb T5
Ex tD A21 IP66 T96°C; Ta=-40°C to +85°C
IP66

### Temperature class:

T6 = 60°C (160°F), T5 = 75 °C (167°F),
T4 = 85°C (185°F)

### Immunity performance:

EN61000-4-2, -3, -4, -5, -6, -8
EMC per IEC61514-2, 61326, 61326-3

### Radiation performance:

CISPR 22

### Other approvals:

INMETRO, KOSHA and NEPSI

# How to Specify the SVI II ESD Device

**Key Features:**

- SIL3 While at 4mA
- Shutdown Event Captured
- Automatic Analysis of ESD Valve Health


**b: Pneumatic**
1 Single-Acting

**c: Capacity**
1 Standard Flow

**d: Display / Housing**
2 Explosion proof Buttons / Standard (Aluminum)
4 Explosion proof Buttons / Offshore (316L)

**e: Hardware**
3 SIL3 Shutdown

**f: ESD Type**
1 ASD w/HART®
2 DSD w/HART
3 A/DSD w/HART

**g: Inputs / Outputs**
2 Position Transmitter + Switches

**h: Hazardous Certifications**
5 FM, CSA, ATEX, IEC, GOST, INMETRO, KOSHA, NEPSI

| Base Model Number | b | c | d | e | f | g | h |
|---|---|---|---|---|---|---|---|
| SVI II ESD - 6 | 1 | 1 | 2<br>4 | 3 | 1<br>2<br>3 | 2 | 5 |

**SVI II ESD - 6 b c d e f g h**

Customer must select one item from each category

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