VariStroke-GI Product Line Overview

April 2, 2019

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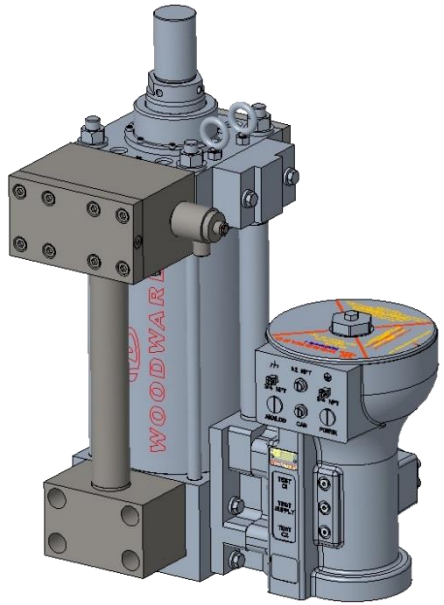
VariStroke-GI Overview

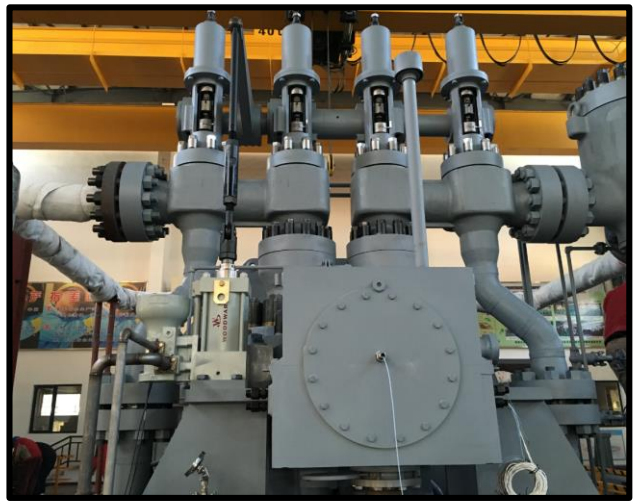
Single-Acting Electro-Hydraulic Actuator with Optional Trip Function

The VariStroke-GI is a family of linear electro-hydraulic actuators that are designed to provide the linear actuation force to operate steam turbine control valves, valve racks, and Trip & Throttle Valves. This single-acting actuator family is intended for use on mechanical drive or generator-drive steam turbines, and uses a low-pressure hydraulic oil source (typically turbine lube oil) to provide its output shaft force.

VariStroke-GI Overview

- As a product family, users can customize their order to ensure their ordered actuator has the correct bore, length, configuration, shaft threads, and return spring force to meet their specific application.
- Single-acting actuators utilize an internal or external return spring to force the output shaft and connected valve to a safe closed position upon a shutdown event and have several advantages over double-acting actuators including fail-safe action as well as not requiring the use of expensive accumulators.
- Optionally users can order VariStroke-GI actuators with or without an integrated fast-acting dump valve. This dump valve is designed to quickly dump oil from one side of the piston to the other side. Depending on the application these dump valves can be driven directly from the VariStroke-GI servo or from the turbine shutdown system.

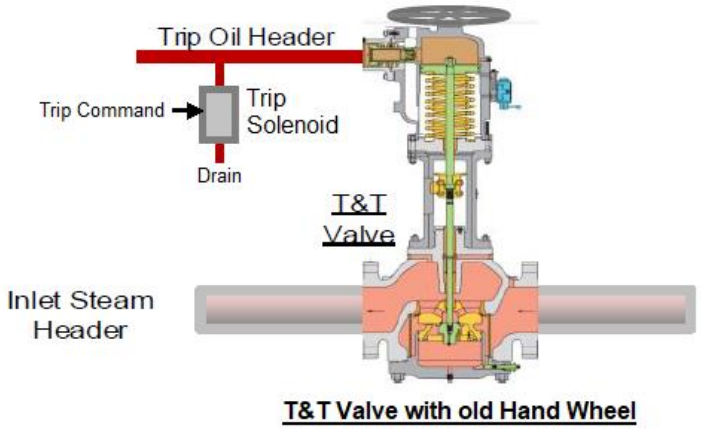




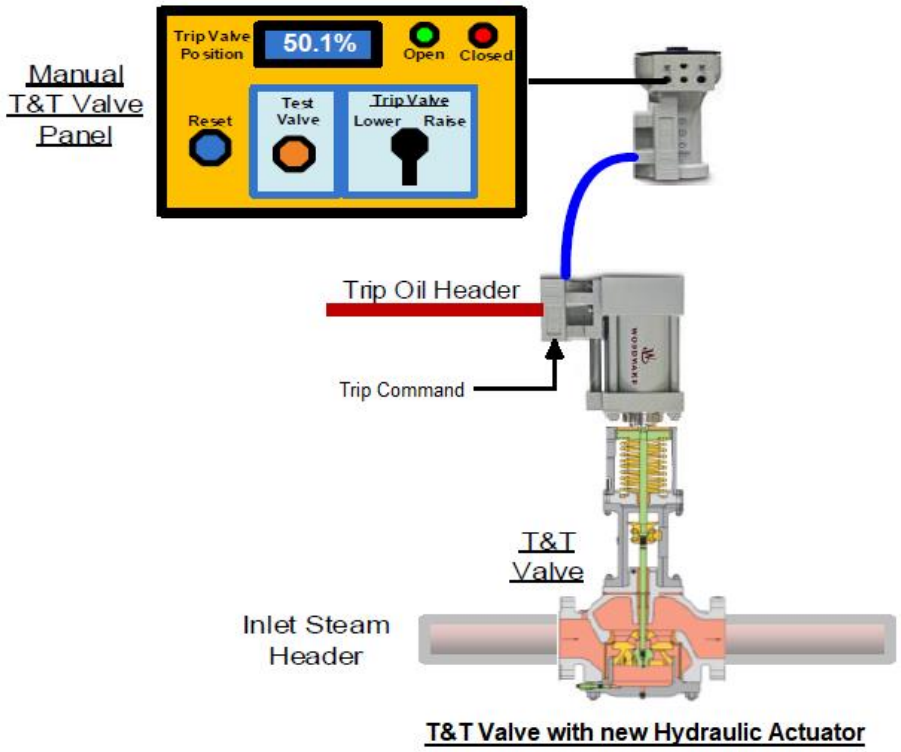
VariStroke-GI Overview – T&TV Applications

In trip & throttle valve (T&TV) applications the VariStroke-GI can be used to replace old problematic hand valve operated actuators which can stick, break or be difficult to accurately adjust during turbine starts.

- The VariStroke-GI can be configured to accept manual reset, raise/lower, and partial stroke test commands.
- Both an analog 4-20mA signal as well as discrete min & max indication output signals make it easy to for operators or the plant DCS to verify T&TV position and health.



T&T Valve with old Hand Wheel



T&T Valve with new Hydraulic Actuator

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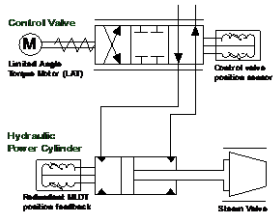
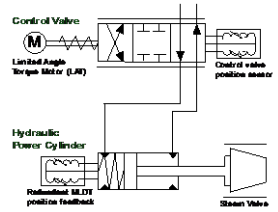
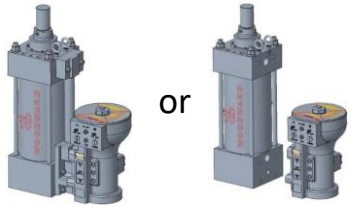
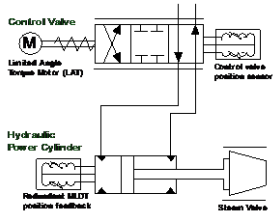
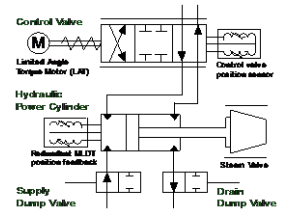
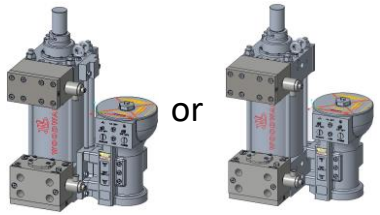
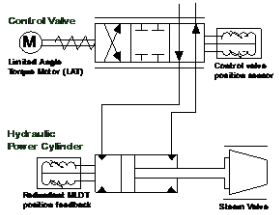
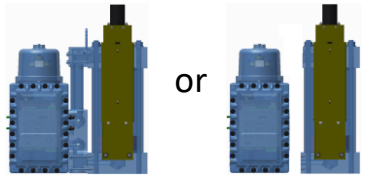
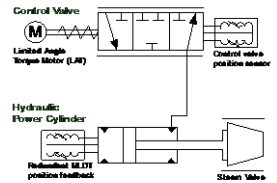
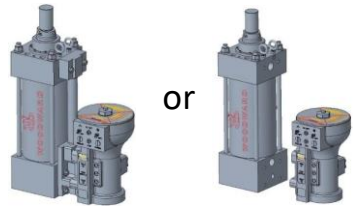
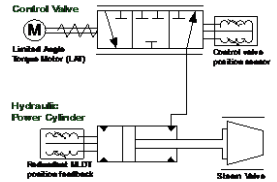
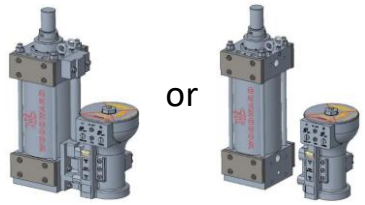
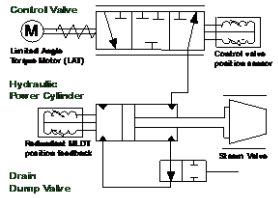
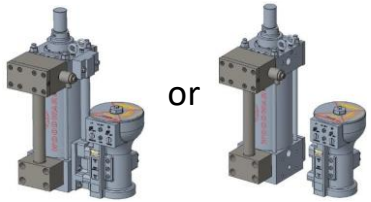
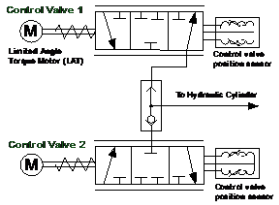
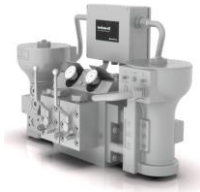
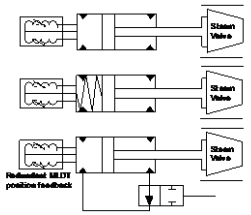
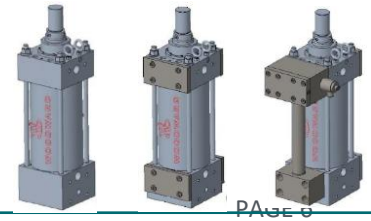
VariStroke Model Selection Guide – Double-Acting Models

Currently Available!!

Model	Servo	Picture	Primary Applications	Application Notes
VariStroke-I	Double Acting 		Compressor Drive (small, medium cylinders)	Balanced Piston Forces
VariStroke-I with Spring Assist	Double Acting 		Compressor Drive (small, medium cylinders)	Balanced Piston Forces (Internal Return Spring)
VariStroke-I with Dump Valve Ports	Double Acting 		Compressor or Generator Drive (medium, large cylinders)	Balanced Piston Forces (Fast Slew Rates with dump valves) (Used with external simplex, or redundant dump valves)
VariStroke-I with Dump Valves	Double Acting 		Compressor or Generator Drive (medium, large cylinders)	Balanced Piston Forces (Fast Slew Rates, Includes Simplex Dump Valves)
VariStroke-II	Double Acting 		Compressor or Generator Drive (large cylinders)	Balanced Piston Forces (Fast Slew Rates, Network Comm)

VariStroke Model Selection Guide – Single-Acting Models

Model	Servo	Picture	Primary Applications	Application Notes	
VariStroke-GI	Single Acting 		Generator Drive (small, medium cylinders) (control & trip valves)	Spring Return Force (Sold with or without internal spring)	Available August 2019!
VariStroke-GI with Dump Valve Ports	Single Acting 		Generator or Compressor Drive (medium, large cylinders) (control & trip valves)	Spring Return Force (Fast Slew Rates with dump valves) (External simplex, or redundant dump valves required)	Available August 2019!
VariStroke-GI with Dump Valves	Single Acting 		Generator or Compressor Drive (medium, large cylinders) (control & trip valves)	Spring Return Force (Fast Slew Rates, Includes Simplex Dump Valves)	Available August 2019!
VariStroke-DX Skid	Single Acting 		Critical Compressor Drive (small, medium, large cylinders) (control & trip valves)	Redundant VS-GI Servos (On-line repairable)	Available October 2019!
VariStroke Hydraulic Power Cylinder	Single Acting 		Compressor or Generator Drive (small, medium, large cylinders) (control & trip valves)	Rated for Zone 1 or 2 areas (Head or Base Mounting Internal Spring - Optional Regional Repair)	Available October 2019!

VariStroke-GI Configuration Options

Revision 1 | 4 Jan 2019

Single Acting VSI GI - Model Number Information

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Varistroke Product Line	Valve Size	Configuration	Action		Bore	Stroke		Rod End	Mounting Option	Fail-Safe Direction	Compliance		Specials	
V	xx	x	x	–	xx	xx	–	x	x	x	x	–	xx	x

Valve Size

Code	Description
45	VSI GI /Port 6 x .453"

Configuration

Code	Description
T	Integrated[1]
R	Remote[2]

Action

Code	Description
G	Servo working with Single Acting Cylinder[3]
K, L, M, N	Servo working with Single Acting Cylinder equipped with Internal Spring (Spring Assist)

Rod End

Code	Description
M	Male Thread
F	Female Thread
Blank	No Hydraulic Cylinder

Mounting Option

Code	Description
U	VS I Universal Mount
Blank	No Hydraulic Cylinder

Fail-Safe Direction

Code	Description
E	Extend
R	Retract

Compliance

Code	Description
1	Zone 1&2 / Division 1&2*
2	Zone 2 / Division 2
3	Zone 1&2 / Division 1&2 / GOST-TR*
4	Zone 2 / Division 2 / GOST-TR*
5	Zone 1&2 / Division 1&2 / INMETRO*
6	Zone 2 / Division 2 / INMETRO*
7	Zone 1&2 / Division 1&2 / TIIS*
8	Zone 2 / Division 2 / TIIS*
9	Zone 1&2 / Division 1&2 / CCOE*
A	Zone 2 / Division 2 / CCOE*
B	Zone 1&2 / Division 1&2 / KOSHA*
C	Zone 2 / Division 2 / KOSHA*

* Planned for future release

Specials

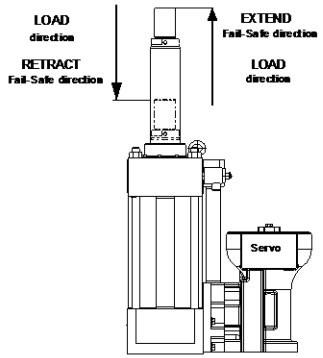
Code	Description
Blank	Standard
0	without Dump Valve installed
R	with Dump Valve installed on the Right side
L	with Dump Valve installed on the Left side

Specials

Code	Description
Blank	Standard
DV	Cylinder with Dump Valve Ports

Notes:

1) Servo installed directly on the hydraulic cylinder thru special pattern holes. Solution dedicated to work with WWD cylinders.
2) Servo can be connected to any hydraulic cylinder. Hydraulic connections SAE Code 61 Flange.
3) Select also this option in case of servo ordering (no hydraulic cylinder).



Code	Description
10	101.6mm (4in) / Rod Dia 1.75"

Code	Description	Available Action
07	76.2mm (3in)	G
10	101.6mm (4in)	G, K, L, M
15	152.4mm (6in)	G

Code	Description
12	127mm (5in) / Rod Dia 1.75"

Code	Description	Available Action
07	76.2mm (3in)	G
10	101.6mm (4in)	G
15	152.4mm (6in)	G
20	203.2mm (8in)	G

Code	Description
15	152.4mm (6in) / Rod Dia 2.50"

Code	Description	Available Action
05	50.8mm (2in)	G
07	76.2mm (3in)	G, K, L, M
10	101.6mm (4in)	G, K, L, M
15	152.4mm (6in)	G
20	203.2mm (8in)	G
25	254.0mm (10in)	G
30	304.8mm (12in)	G

Code	Description
20	203.2mm (8in) / Rod Dia 3.50"

Code	Description	Available Action
07	76.2mm (3in)	K, L, M, N
10	101.6mm (4in)	G, K, L, M, N
15	152.4mm (6in)	G
20	203.2mm (8in)	G
25	254.0mm (10in)	G
30	304.8mm (12in)	G

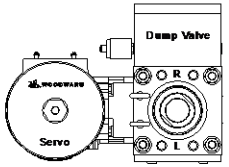
Code	Description
25	254mm (10in) / Rod Dia 4.50"

Code	Description	Available Action
10	101.6mm (4in)	G, K, L, M, N
15	152.4mm (6in)	G
20	203.2mm (8in)	G
25	254.0mm (10in)	G
30	304.8mm (12in)	G

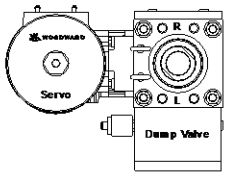
Code	Description
Blank	No Hydraulic Cylinder

Code	Description
Blank	No Hydraulic Cylinder

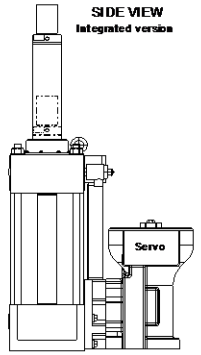
TOP VIEW
Dump valve on the RIGHT side



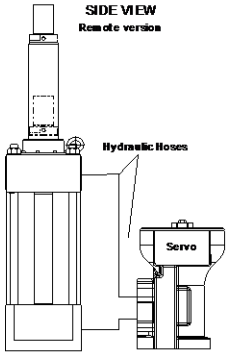
TOP VIEW
Dump valve on the LEFT side



SIDE VIEW
Integrated version



SIDE VIEW
Remote version



Example Model Number = Servo with Cylinder and without Dump Valve

V45RK-1520-FUR1

- Varistroke
- VSI GI /6 x .453"
- Remote
- Spring Assist (Spring 1.5%)
- 150 mm Bore
- 200 mm Stroke
- Female Thread Rod End
- VS I Universal Mount Cylinder
- Fail Retract
- Zone 1&2 / Division 1&2

Example Model Number = Servo with Cylinder and Dump Valve

V45TG-2030-MUE2-DVL

- Varistroke
- VSI GI /6 x .453"
- Integrated
- Single Acting Cylinder
- 200 mm Bore
- 300 mm Stroke
- Male Thread Rod End
- VS I Universal Mount Cylinder
- Fail Extend
- Zone 2 / Division 2
- Cylinder with Dump Valve Ports
- with Dump Valve installed on the Left side

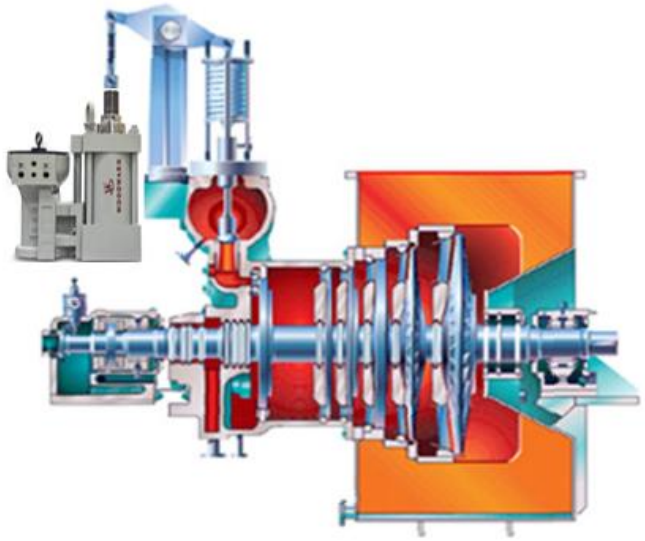
Example Model Number = Servo only

V45RG-R1

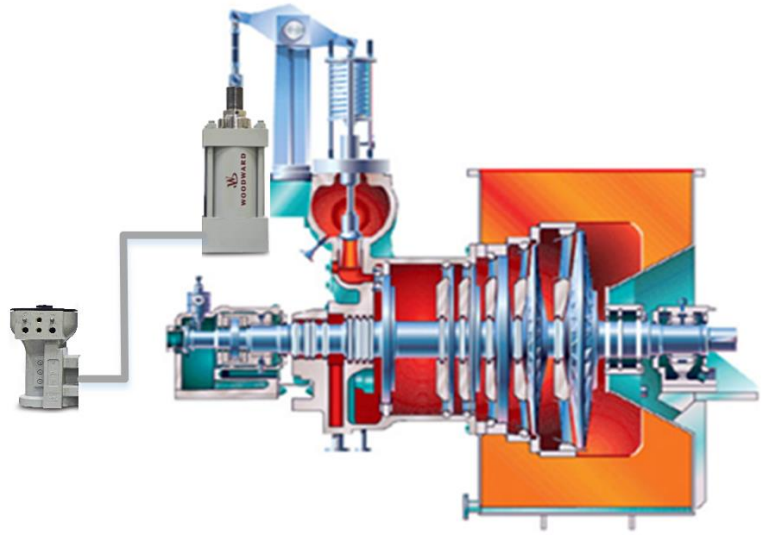
- Varistroke
- VSI GI /6 x .453"
- Remote
- Single Acting Cylinder
- Fail Retract
- Zone 1&2 / Division 1&2

Bore [in]	Stroke [in]	Spring force [lbf]	Spring K	Spring L	Spring M	Spring N
4	4	MIN	56	114	224	–
		MAX	112	226	478	–
6	3	MIN	108	235	520	–
		MAX	216	471	1040	–
	4	MIN	108	235	520	–
		MAX	216	471	1040	–
8	3	MIN	276	529	1052	1946
		MAX	510	1057	2104	4046
	4	MIN	242	528	1052	2023
		MAX	544	1058	2104	4047
10	4	MIN	354	642	1312	2744
		MAX	708	1286	2624	5488

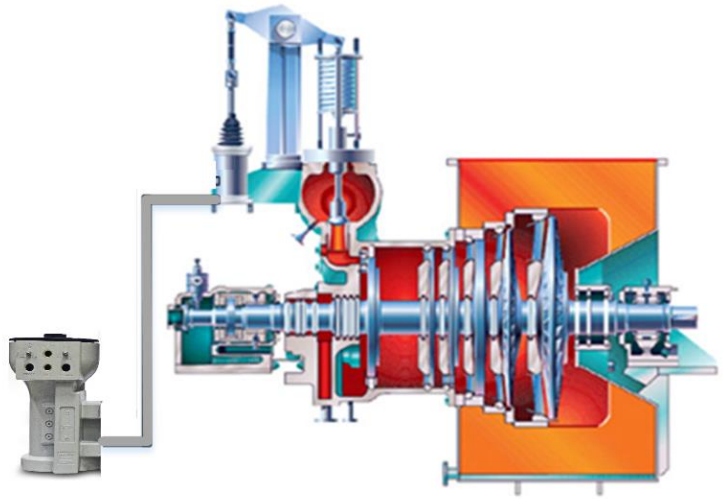
Different VariStroke-GI Applications & Configurations



Integrated Actuator Models



Remote Servo Kit Models

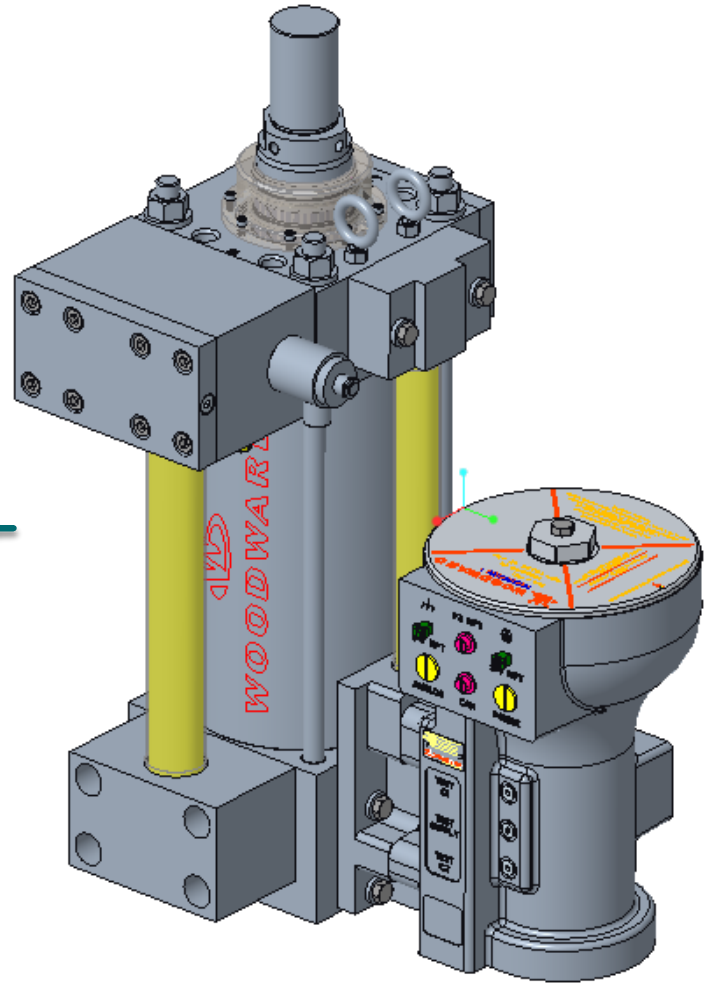


Servo Only Models

VariStroke-GI Overview – General View

ACTUATOR

- Chrome plated piston rod
- Triple Seal Technology, replaceable cartridge
- Chrome Plated Cylinder
- Return Spring
- Integrated Dual MLDTs Position Sensors



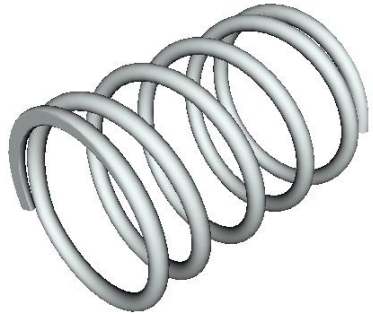
SERVO

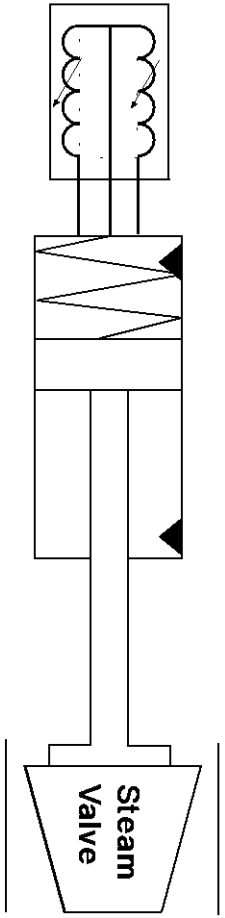
- Integrated Electronic Driver
- Dry/Sealed Motor & Electronics
- Rotating valve element/spool
- Valve return spring

VariStroke-GI Spring Force Matrix

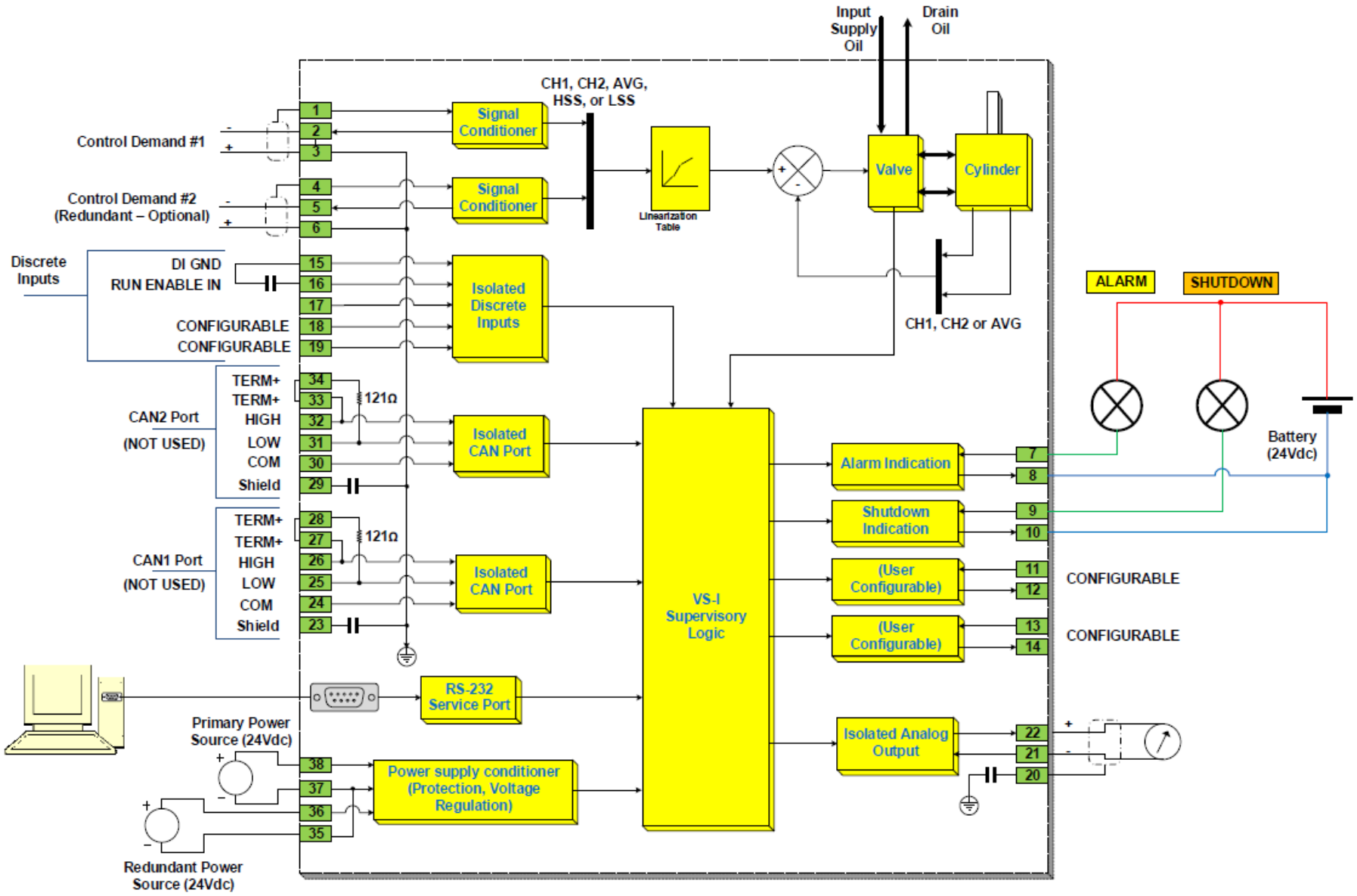
- Can be ordered to fail in either direction (extend or retract)
- Four force outputs for each cylinder diameter
- Spring designs are complete for all of the configurations shown below
- VSI LRU will productionize springs for 4”, 6”, 8”,10 and 12” diameters

Cylinder Diameter			Stroke, in.					
			3	4	6	8	10	12
6	Load, lbf	A		162	165	165	165	160
		B		353	353	353	353	343
		C		780	780	780	705	X
		D		X	X	X	X	X
8	Load, lbf	A	393	393	393	393	393	393
		B	793	793	793	792	792	792
		C	1578	1578	1554	1526	1509	1472
		D	2996	3035	3035	2873	2748	2523
10	Load, lbf	A		531	531	531	531	531
		B		964	954	964	964	964
		C		1968	1968	1968	1968	1968
		D		4116	4116	4116	4116	4019
12	Load, lbf	A		795	795	795	795	795
		B		1461	1461	1461	1461	1461
		C		2889	2889	2889	2889	2889
		D		6162	6162	6162	6162	6162
				Spring will buckle		No Market Need, Delete		

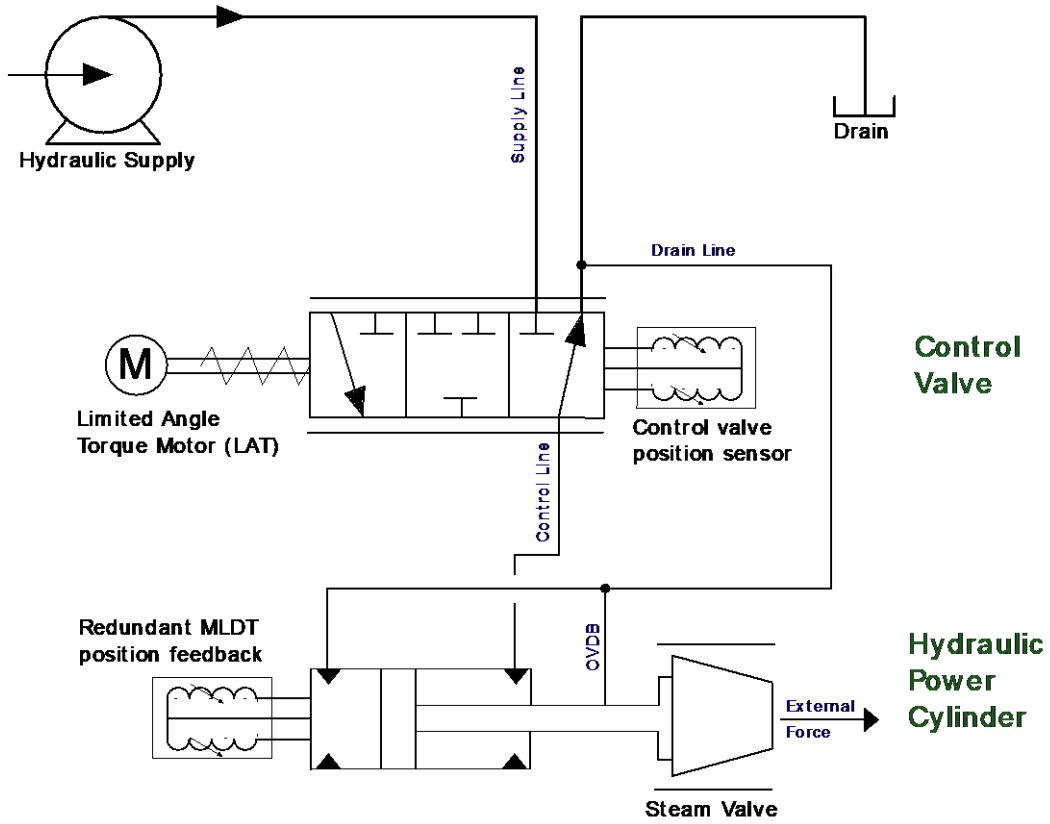




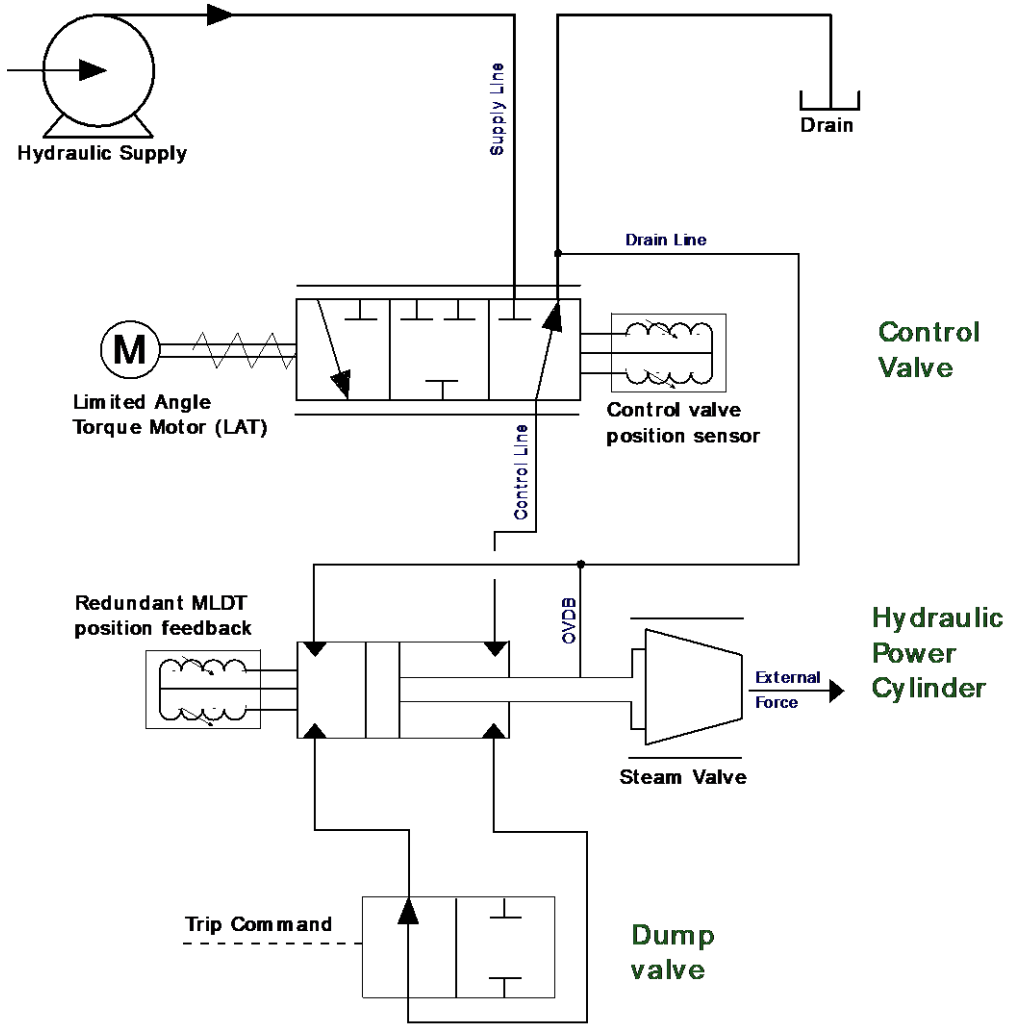
VariStroke-GI Driver Overview & System Connections



VariStroke-GI Overview – Basic Hydraulic Diagrams



VariStroke-GI Hydraulic Diagram
Intergrated version



VariStroke-GI with Dump Valves Hydraulic Diagram
Intergrated version

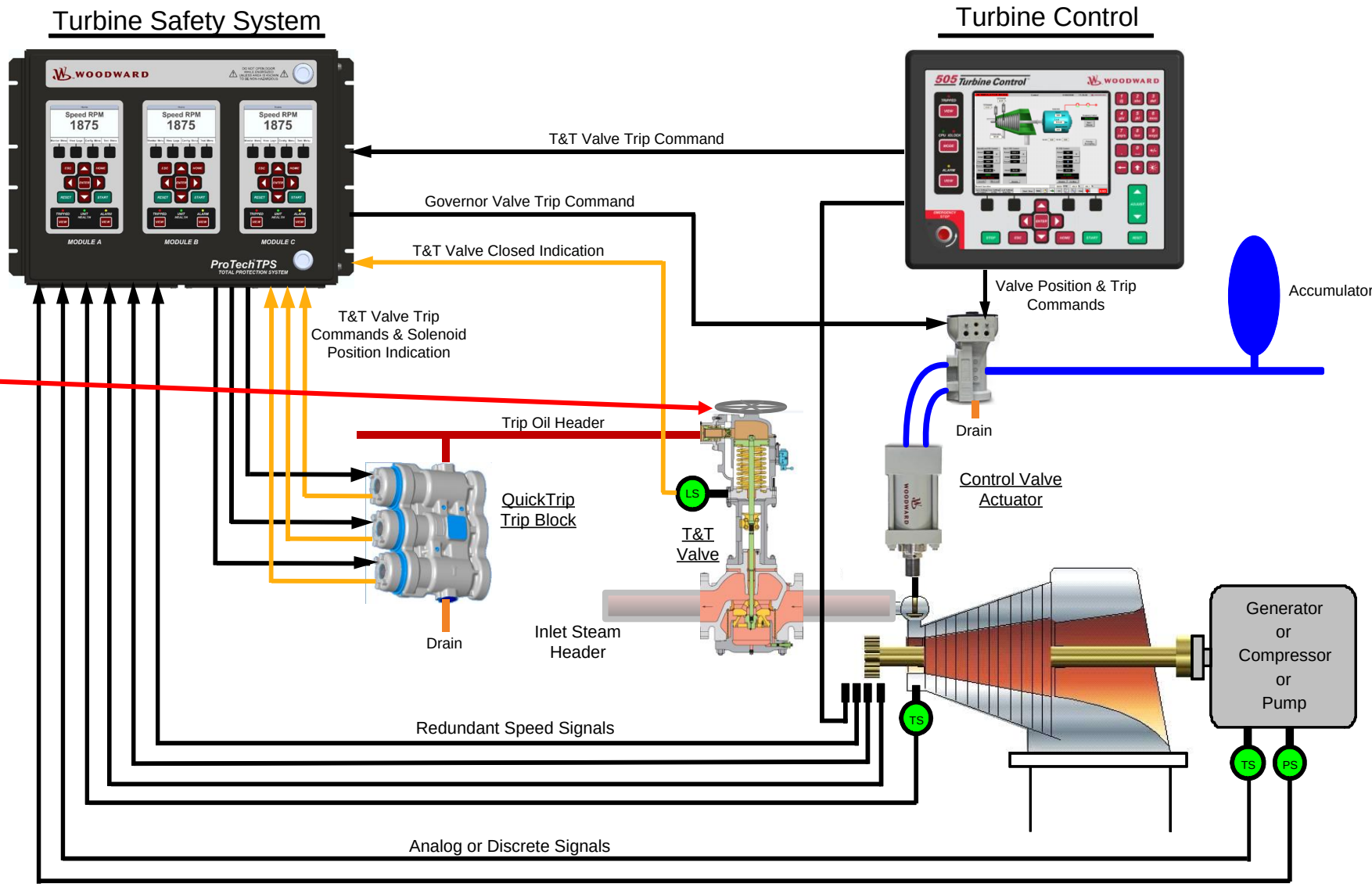
Typical Turbine Trip System Used by Many Today

Trip System Includes:

- ProTechTPS
- QuickTrip
- Oil Operated Trip Valve

System Problems:

- Cannot be Automated due to hand valve
- Hand valves stick
- Operators get hurt trying to open hand valves
- Dangerous to have operator next to turbine



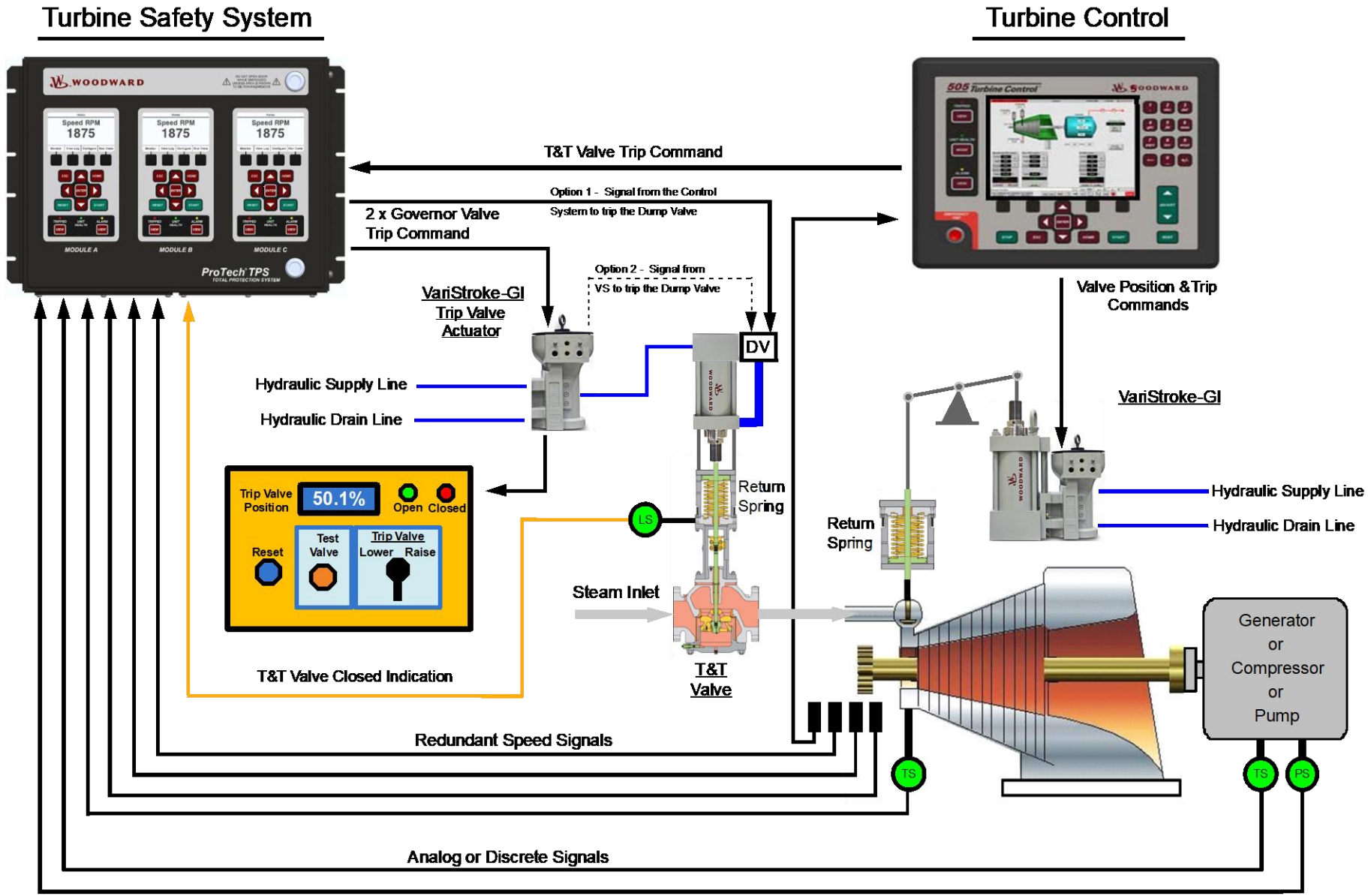
VariStroke-GI Based Trip System

Trip System Includes:

- ProTechTPS
- VariStroke with Dump Valves
- Possible Future VariStroke Control Panel

System Advantages:

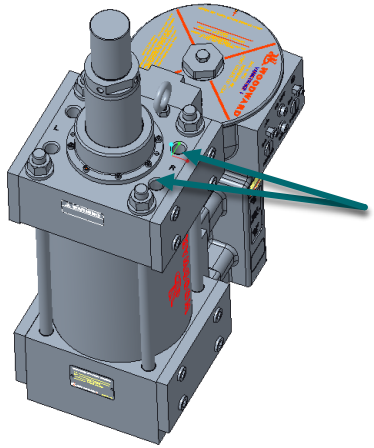
- Easy to open and close
- Does not stick
- Operators do not get hurt opening/closing
- Safe for operators
  - Can be operated away from turbine
- Can be automated
  - Optionally turbine control can issue commands



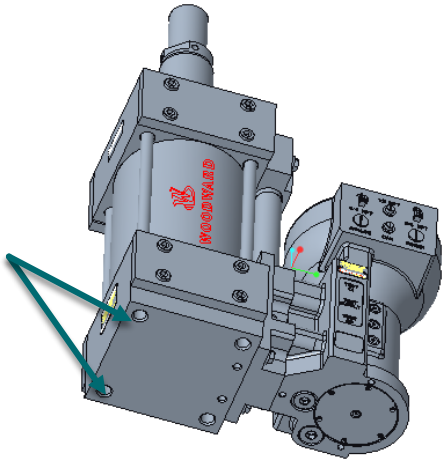
VariStroke-GI Mounting Overview

Integrated Models

- Cylinder Base
- Cylinder Head



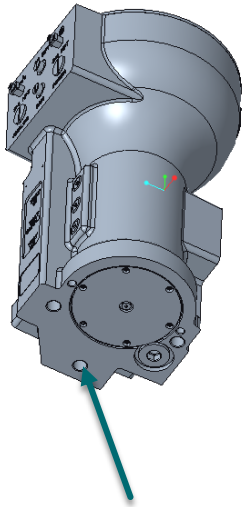
Top/Head Mounting,
4 threaded holes



Bottom/Base Mounting,
4 threaded holes

Servo Only Models

- Base Mounting

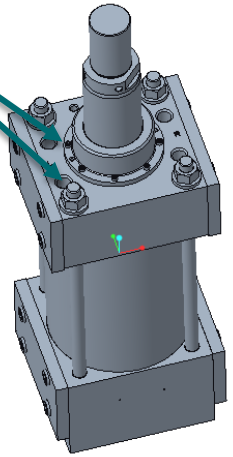


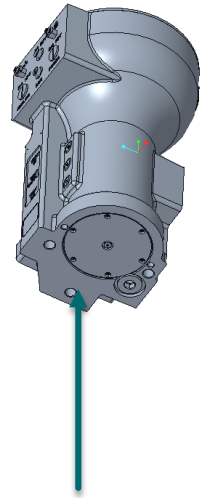
Bottom/Base Mounting,
3 threaded holes

Remote Servo Models

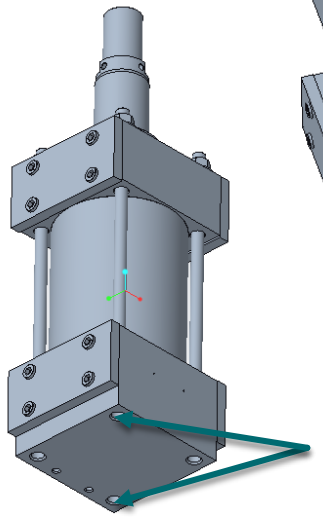
- Servo
  - Base Mounting
- Cylinder
  - Base or Head Mounting

Top/Head Mounting,
4 threaded holes





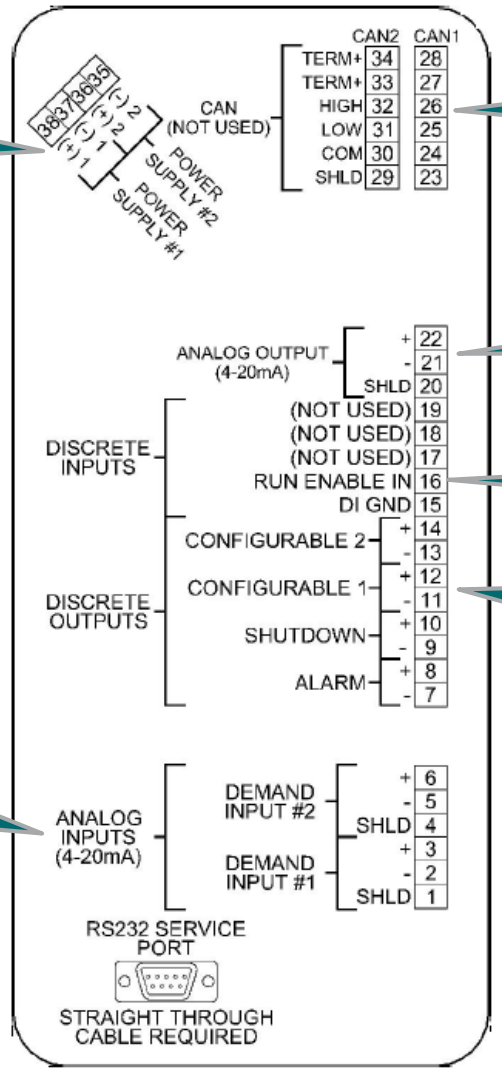
Bottom/Base Mounting,
3 threaded holes



Bottom/Base Mounting,
4 threaded holes

VariStroke-GI Wiring Diagram (Label)

Accepts redundant 24Vdc inputs



Control-to-Actuator networking to be enabled in future

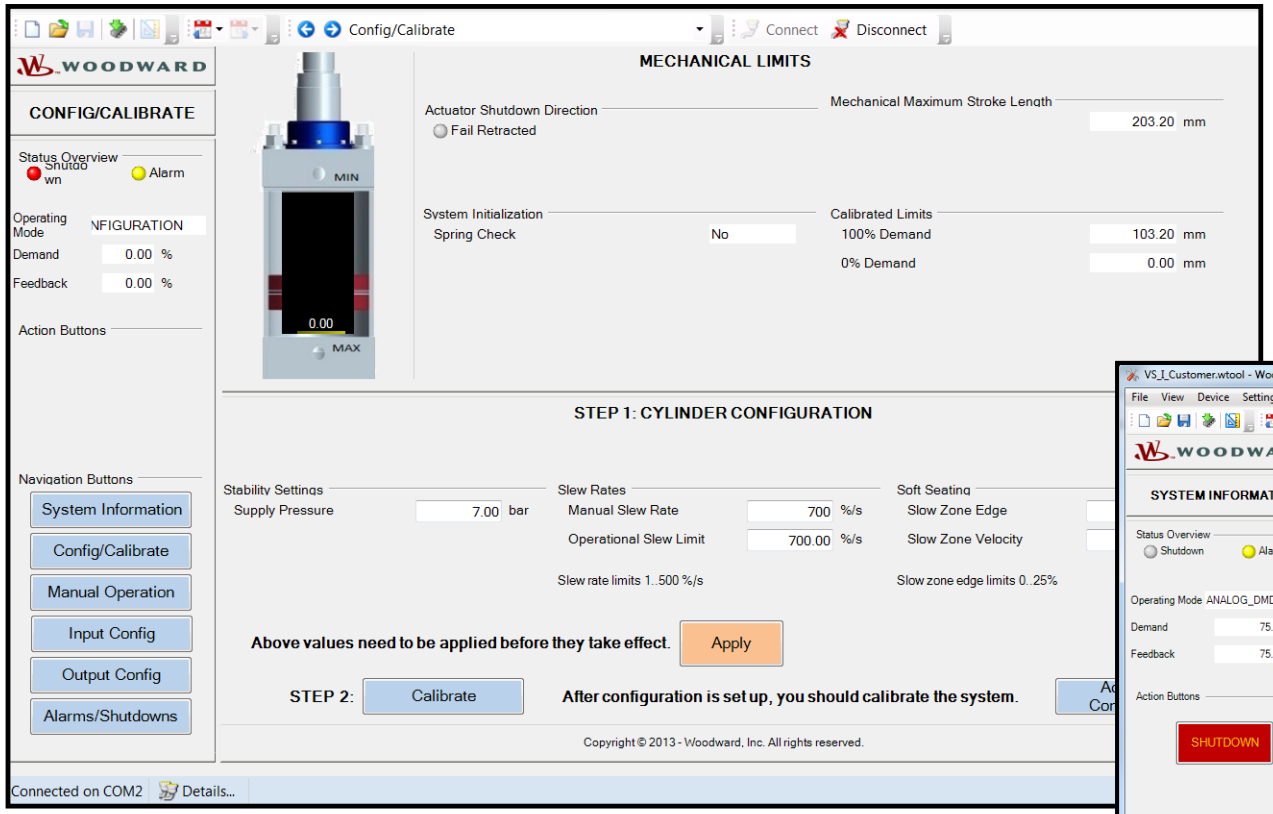
Readout can be used to verify actual valve position

Contact Input can be configured to shutdown unit (when opened)

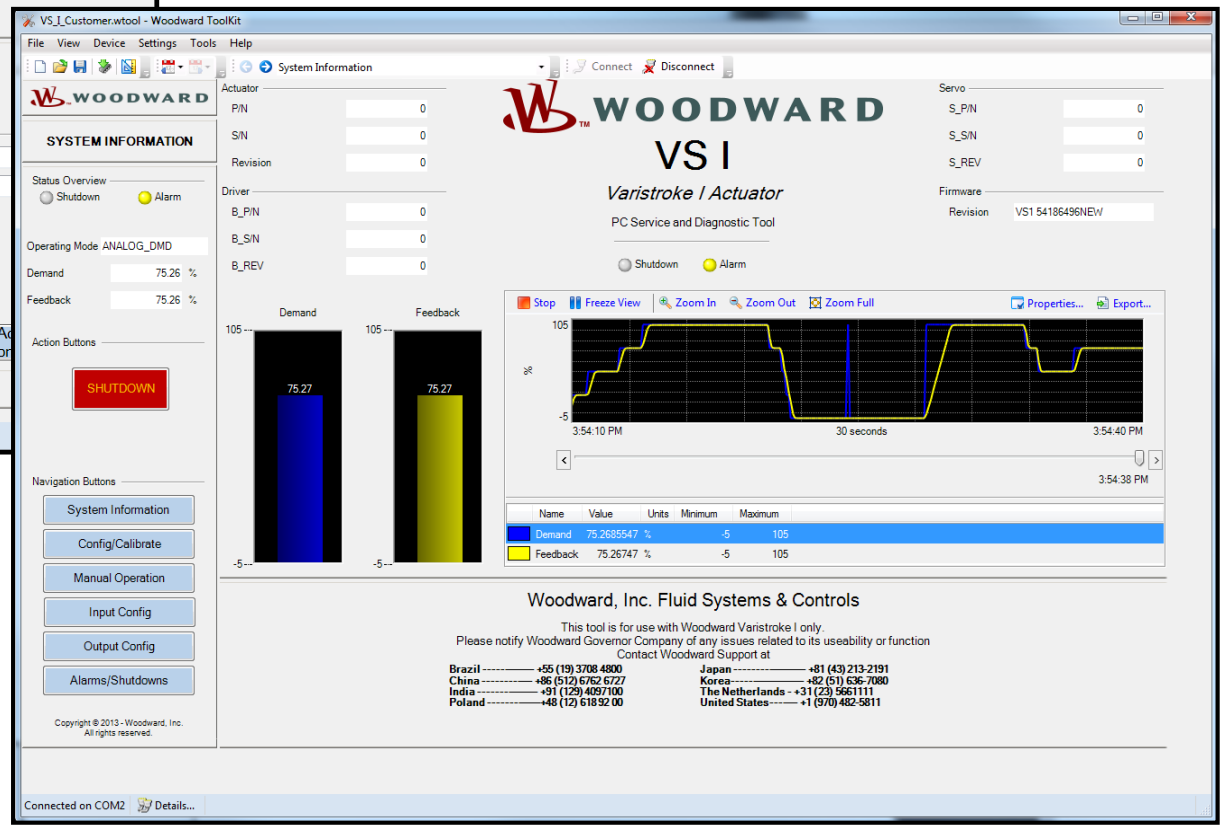
Configurable output relay drivers can be configured to indicate high and low valve position levels.

Accepts redundant demand inputs from 1 or 2 controllers

VariStroke-GI Service Tool



- **Configure**
- **Calibrate**
- **Verify Response**



User Friendly Service Tool Included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