

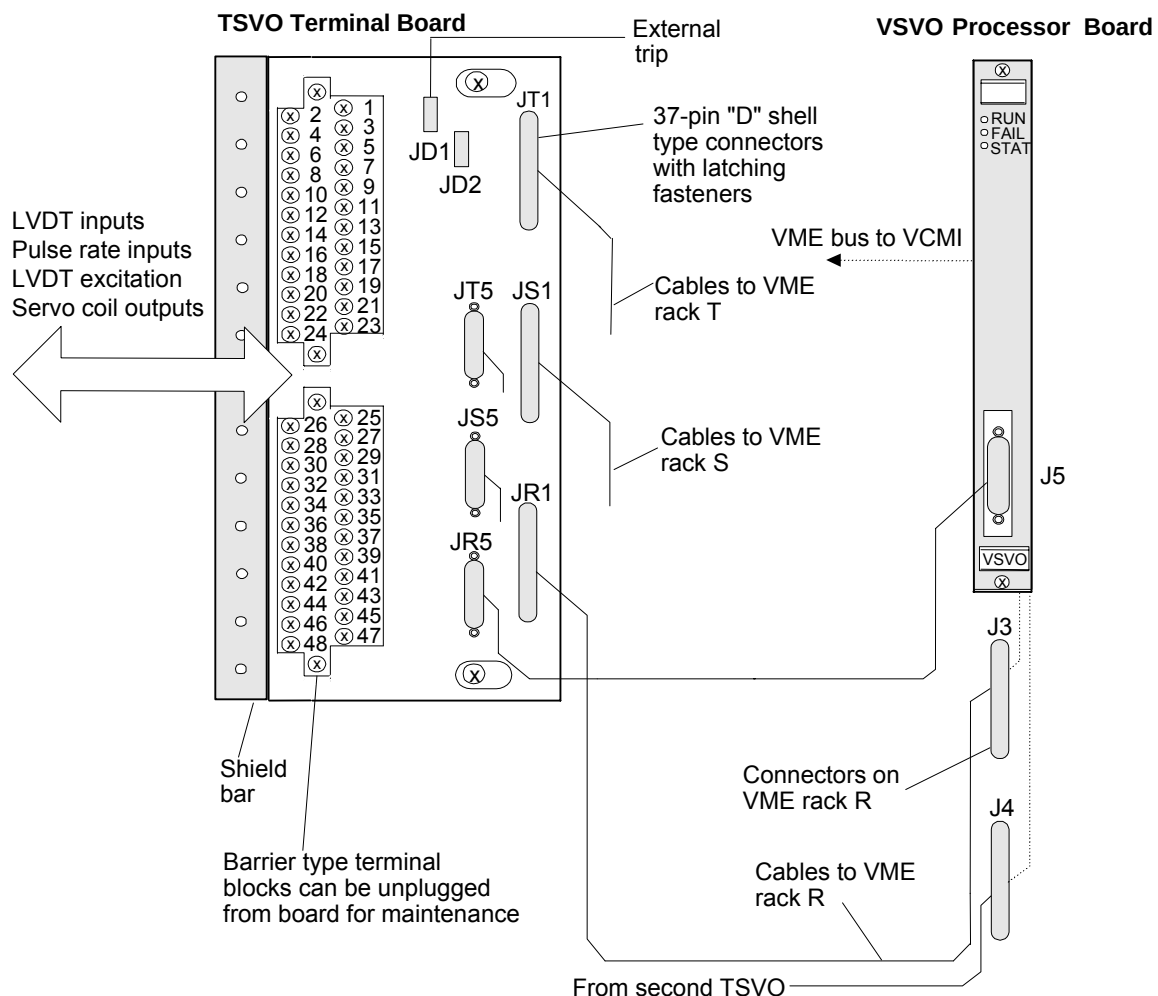
VSVO Servo Control

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Functional Description

The Servo Control (VSVO) board controls four electro-hydraulic servo valves that actuate the steam/fuel valves. These four channels are usually divided between two servo terminal boards (TSVO or DSVO). Valve position is measured with linear variable differential transformers (LVDT). The loop control algorithm is run in the VSVO.

Three cables connect to VSVO on J5 plug on the front panel and the J3/J4 connectors on the VME rack. TSVO provides simplex signals through the JR1 connector, and fans out TMR signals to the JR1, JS1, and JT1 connectors. Plugs JD1 or JD2 are for external trips from the protection module.



Servo/LVDT Terminal Board, VSVO Processor Board, and Cabling

Installation

➤ To install the V-type board

- 1** Power down the VME processor rack
- 2** Slide in the board and push the top and bottom levers in with your hands to seat its edge connectors
- 3** Tighten the captive screws at the top and bottom of the front panel

Note Cable connections to the terminal boards are made at the J3 and J4 connectors on the lower portion of the VME rack. These are latching type connectors to secure the cables. Power up the VME rack and check the diagnostic lights at the top of the front panel. For details, refer to the section on diagnostics in this document.

Operation

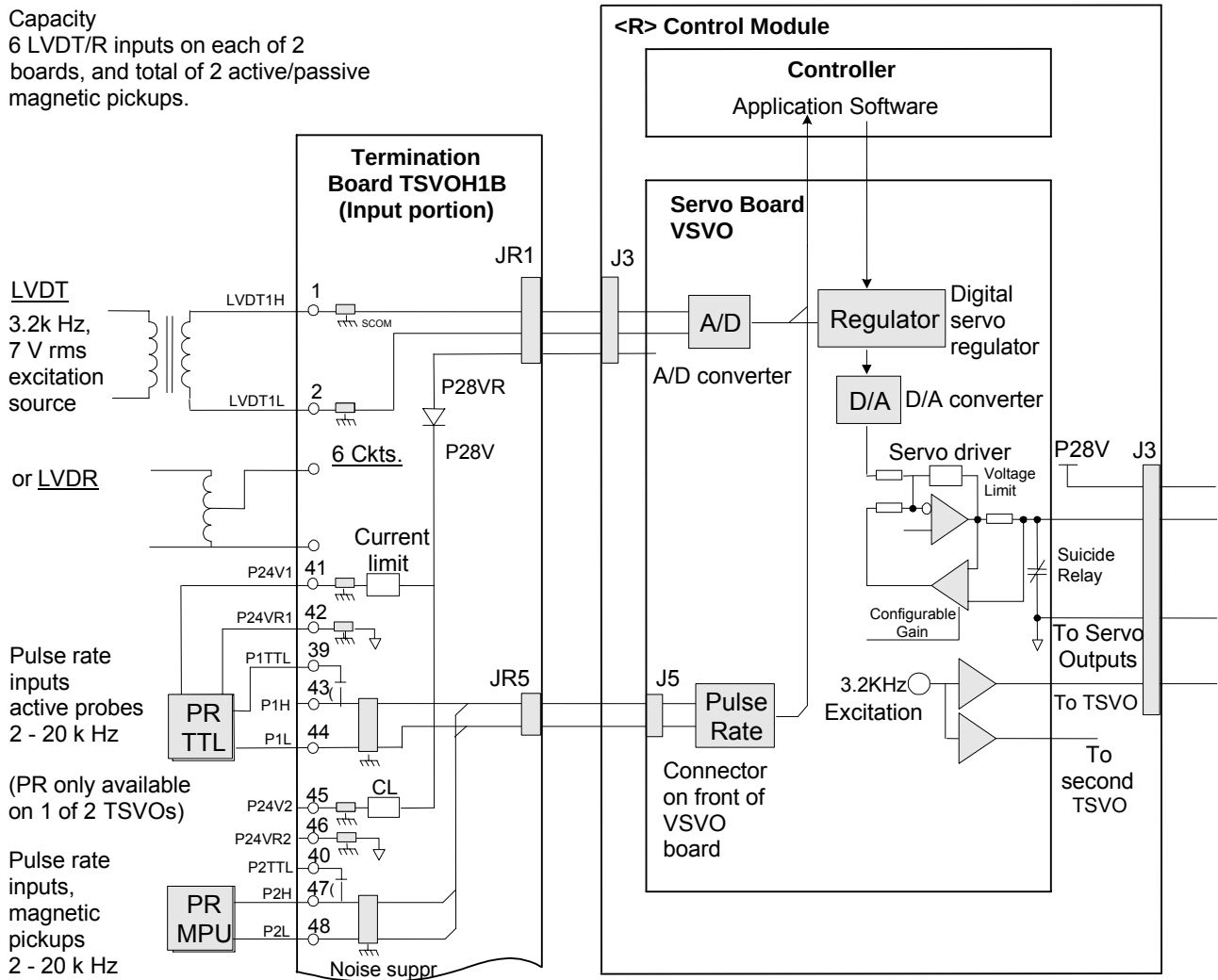
VSVO provides four channels consisting of bi-directional servo current outputs, LVDT position feedback, LVDT excitation, and pulse rate flows inputs. The TSVO provides excitation for, and accepts inputs from , up to six LVDT valve position inputs. There is a choice of one, two three, or four LVDTs for each servo control loop. Three inputs are available for gas turbine flow measuring applications. These signals come through TSVO and go directly to the VSVO board front at J5.

Each servo output is equipped with an individual suicide relay under firmware control that shorts the VSVO output signal to signal common when de-energized, and recovers to nominal limits after a manual reset command is issued. Diagnostics monitor the output status of each servo voltage, current, and suicide relay.

Simplex Systems

VSVO circuits for a simplex system are shown in the following figures.

Capacity
6 LVDT/R inputs on each of 2
boards, and total of 2 active/passive
magnetic pickups.

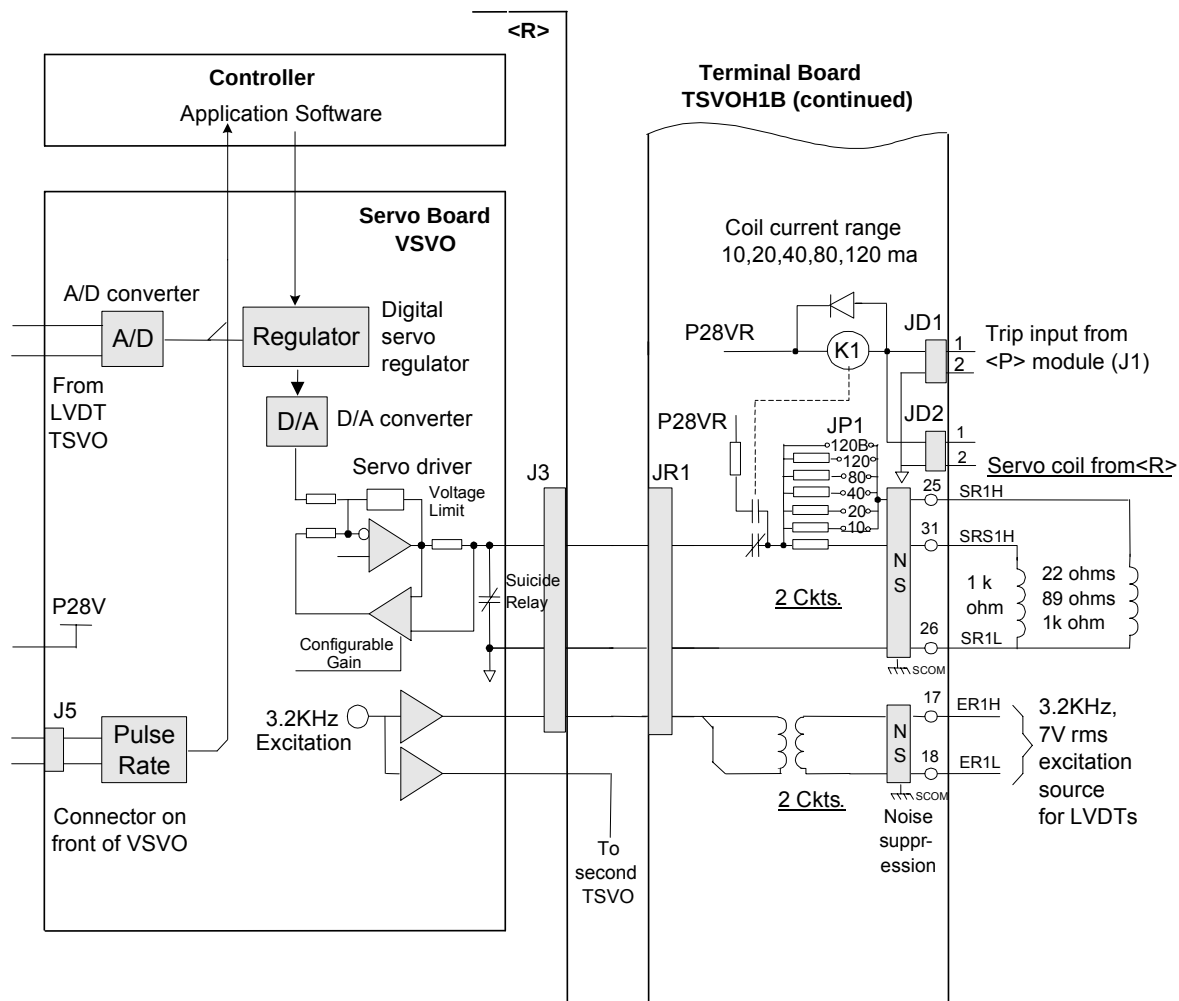


LVDT and Pulse Rate Inputs, Simplex

Each servo output channel can drive one or two-coil servos in simplex applications, or two or three-coil servos in TMR applications. The two-coil TMR applications are for 200# oil gear systems where each of two control modules drive one coil each and the third module interfaces with the servo. Servo cable lengths up to 300 meters (984 feet) are supported with a maximum two-way cable resistance of 15 ohms. Because there are many types of servo coils, a variety of bi-directional current sources are selectable by configuring jumpers.

Another trip override relay, K1, is provided on each terminal board and is driven from the <P> Protection Module. If an emergency overspeed condition is detected in the Protection Module, the K1 relay energizes and disconnects the VSVO servo output from the terminal block and applies a bias to drive the control valve closed. This is only used on simplex applications to protect against the servo amplifier failing high, and is functional only with respect to the servo coils driven from <R>.

Note The primary and emergency overspeed systems can trip the hydraulic solenoids independent of this circuit.



Servo Coil and LVDT Outputs, Simplex (continued) LVDT Outputs, Simplex

TMR Systems

In TMR applications, the LVDT signals on TSVO fan out to three racks through JR1, JS1, and JT1. Three connectors also bring power into TSVO where the three voltages are diode high-selected and current limited to supply 24 V dc to the pulse rate active probes. VSVO circuits for a TMR system are shown in the following figures.

Note Only two pulse rate probes on one TSVO are used.

Specifications

Item	Specification
Number of inputs (per TSVO)	6 LVDT windings 2 pulse rate signals (total of 2 per VSVO) External trip signal
Number of outputs (per TSVO)	2 servo valves (total of 4 per VSVO board) 4 excitation sources for LVDTs 2 excitation sources for pulse rate transducers
Internal sample rate	200 Hz
Power supply voltage	Nominal 24 V dc
LVDT accuracy	1% with 14-bit resolution
LVDT input filter	Low pass filter with 3 down breaks at 50 rad/sec $\pm 15\%$
LVDT common mode rejection	CMR is 1 V, 60 dB at 50/60 Hz
LVDT excitation output	Frequency of 3.2 ± 0.2 kHz Voltage of 7.00 ± 0.14 V rms
Pulse rate accuracy	0.05% of reading with 16-bit resolution at 50 Hz frame rate Noise of acceleration measurement is less than ± 50 Hz/sec for a 10,000 Hz signal being read at 10 ms
Pulse rate input	Minimum signal for proper measurement at 2 Hz is 70 mVpk, and at 12 kHz is 827 mVpk.
Magnetic PR pickup signal	Generates 150 V p-p into 60 k Ω
Active PR Pickup Signal	Generates 5 to 27 V p-p into 60 k Ω
Servo valve output accuracy	2% with 12-bit resolution Dither amplitude and frequency adjustable
Fault detection	Suicide servo outputs initiated by: Servo current out of limits or not responding Regulator feedback signal out of limits

Diagnostics

Three LEDs at the top of the VSVO front panel show status information. The normal RUN condition is a flashing green, and FAIL is solid red. The third LED is STATUS and is normally off but displays a steady orange if an alarm condition exists on the board. Diagnostic checks include the following:

- The output servo current is out of limits or not responding, which creates a fault.
- The regulator feedback (LVDT) signal is out of limits. A fault is created and if the associated regulator has two sensors, the bad sensor is removed from the feedback calculation and the good sensor is used.
- The servo has suicided. This creates a fault.
- The A/D converter calibration voltage is out of limits and a default value is being used.
- The LVDT excitation voltage is out of range. A fault is created
- The input signal varies from the voted value by more than the TMR differential limit. This causes a fault to be created indicating a problem with this sensor input.
- If any one of the above signals go unhealthy a composite diagnostic alarm, L#DIAG_VSVO, occurs. Details of the individual diagnostics are available from the toolbox. The diagnostic signals can be individually latched, and reset with the RESET_DIA signal if they go healthy.
- Connectors JR1, JS1, JT1 on the terminal board have their own ID device that is interrogated by the I/O board. The ID device is a read-only chip coded with the terminal board serial number, board type, revision number, and the plug location. When the chip is read by VSVO and a mismatch is encountered, a hardware incompatibility fault is created.

Configuration

Parameter	Description	Choices
Configuration		
System Limits	Select system limits	Enable, disable
Regulator 1	LVDT/R calibration	Online LVDT calibration, yes/no
RegType	Algorithm used in the regulator	Unused 1_PulseRate 2_PlsRateMAX 1_LVposition 2_LVposMIN 2_LVposMAX 3_LVposMID 2_LvpilotCyl 4_LVp/cylMAX 4_LV_LM no_fbk
RegGain	Position loop gain in (%current/%position)	-200 to 200
RegNullBias	Null bias in % current, balances servo spring force	-100 to 100
DitherAmpl	Dither in % current (minimizes hysteresis)	Dither amp: 0 to 10
MinPOSvalue	Position at Min End Stop in engineering units.	-15 to 150
MaxPOSvalue	Position at Max End Stop in engineering units.	-15 to 150
MnLVDT1_Vrms	LVDT1_Vrms at Min End Stop (Normally set by the Calibration function)	0 to 7.1
MxLVDT1_Vrms	LVDT1_Vrms at Max End Stop (Normally set by the Calibration function)	0 to 7.1
:		
MnLVDT4_Vrms	LVDT4_Vrms at Min End Stop (Normally set by the Calibration function)	0 to 7.1
MxLVDT4_Vrms	LVDT4_Vrms at Max End Stop (Normally set by the Calibration function)	0 to 7.1