GEI-100559

GE Industrial Systems

Board Specification

# VSVO Servo Board

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*Issue date: 2002-06-30*

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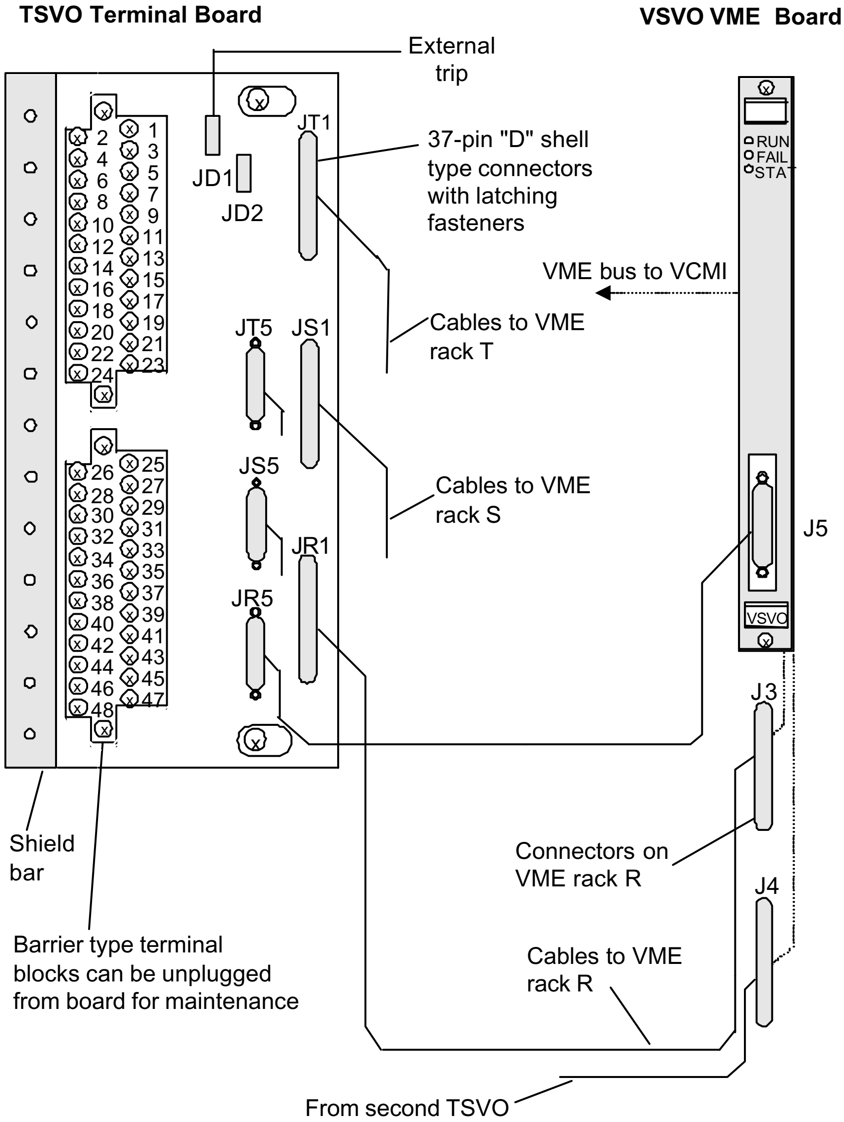
# Functional Description

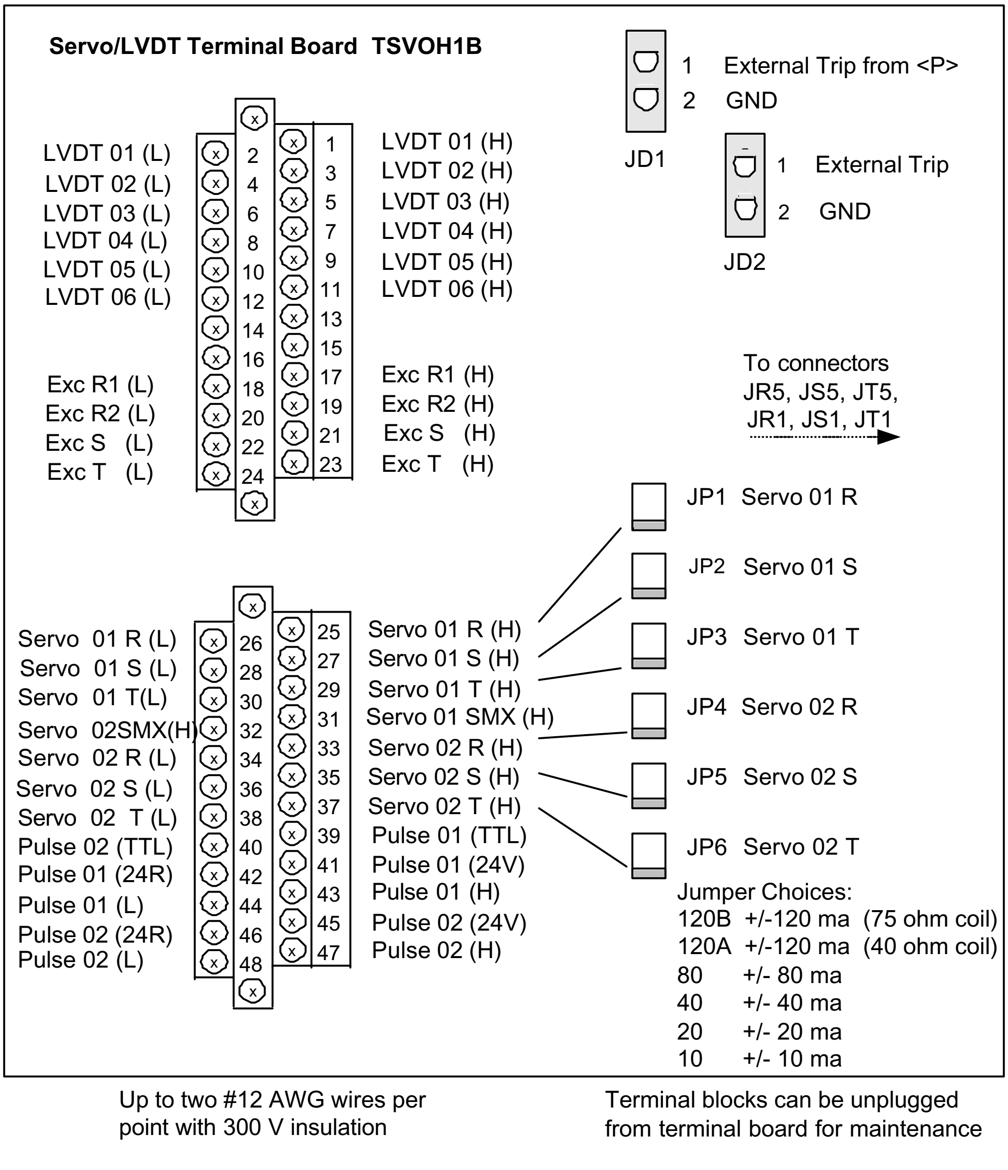
The Servo Board (VSVO) controls four electrohydraulic servo valves that actuate the steam/fuel valves. These four channels are divided between two TSVO terminal boards. Valve position is measured with linear variable differential transformers (LVDT). Three cables to VSVO use the J5 plug on the front on the board and the J3/4 connectors on the VME rack. TSVO provides Simplex signals via the JR1 connector, and fans out TMR signals to the JR, LS, and JT connectors. Plugs JD1 or JD2 are for external trip from the protection module.




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

# Installation

Sensors and servo valves are wired directly to two I/O terminal blocks mounted on the terminal board. Each block is held down with two screws and has 24 terminals accepting up to #12 AWG shield termination strip attached to chassis ground is located immediately to the left of each terminal block. External trip wiring is plugged into either JD1 or JD2. The screw connection and position choices for the servo current jumpers.



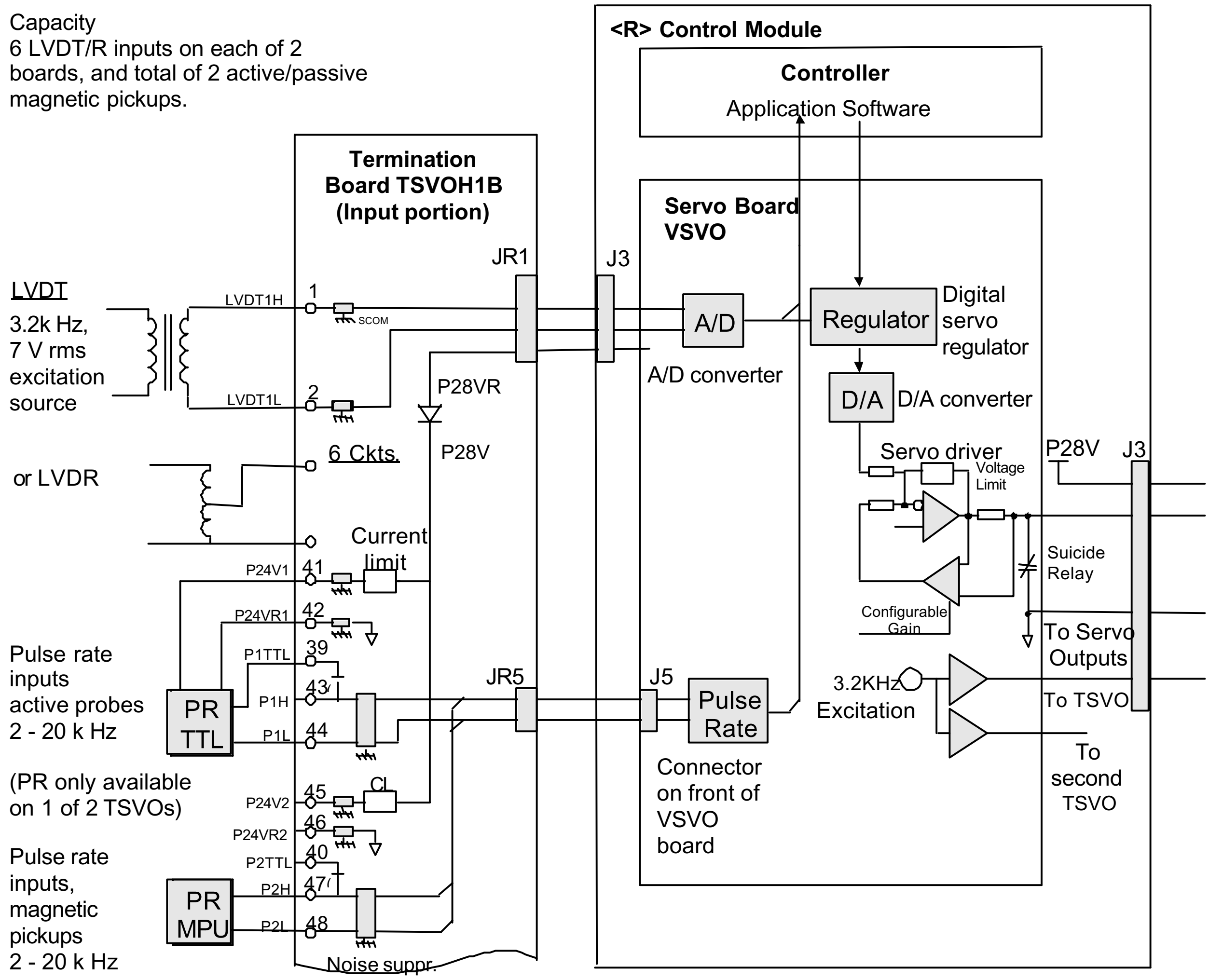

*Servo/ LVDT Terminal Board Wiring*

# Operation

*Refer to the figures for inputs and outputs.*

The servo board 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 LDTs for each servo control loop. If three inputs are used they are available for gas turbine flow measuring applications, and 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.

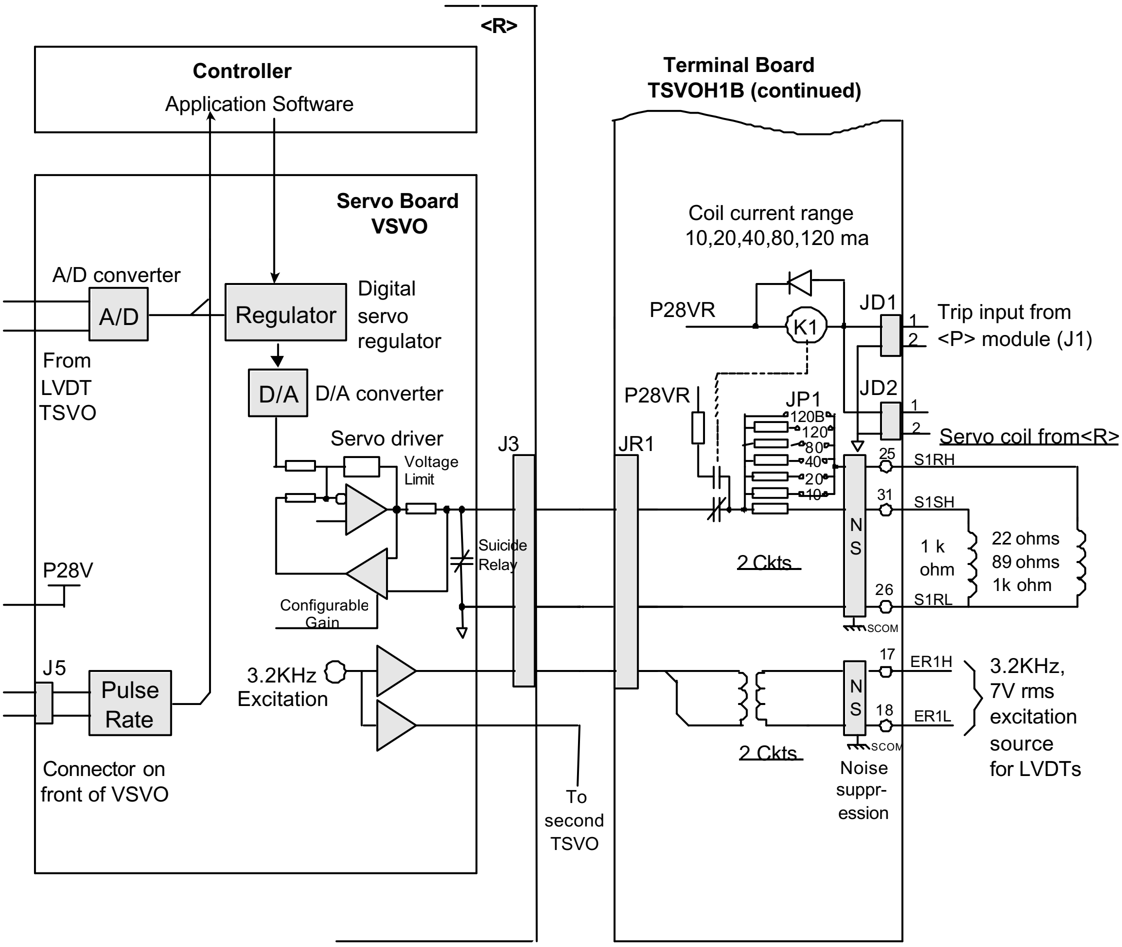



*LVDT and Pulse Rate Inputs, Simplex*

Each of the servo output channels can drive either 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 has to servo interface. Servo cable lengths up to 300 meters (984 feet) are supported with a maximum two-way cable resistance of 15 ohms. Sine there are many types of servo coils, a variety of bi-directional current sources are jumper selectable.

*The primary and emergency overspeed systems will trip the hydraulic solenoids independent of this circuit.*

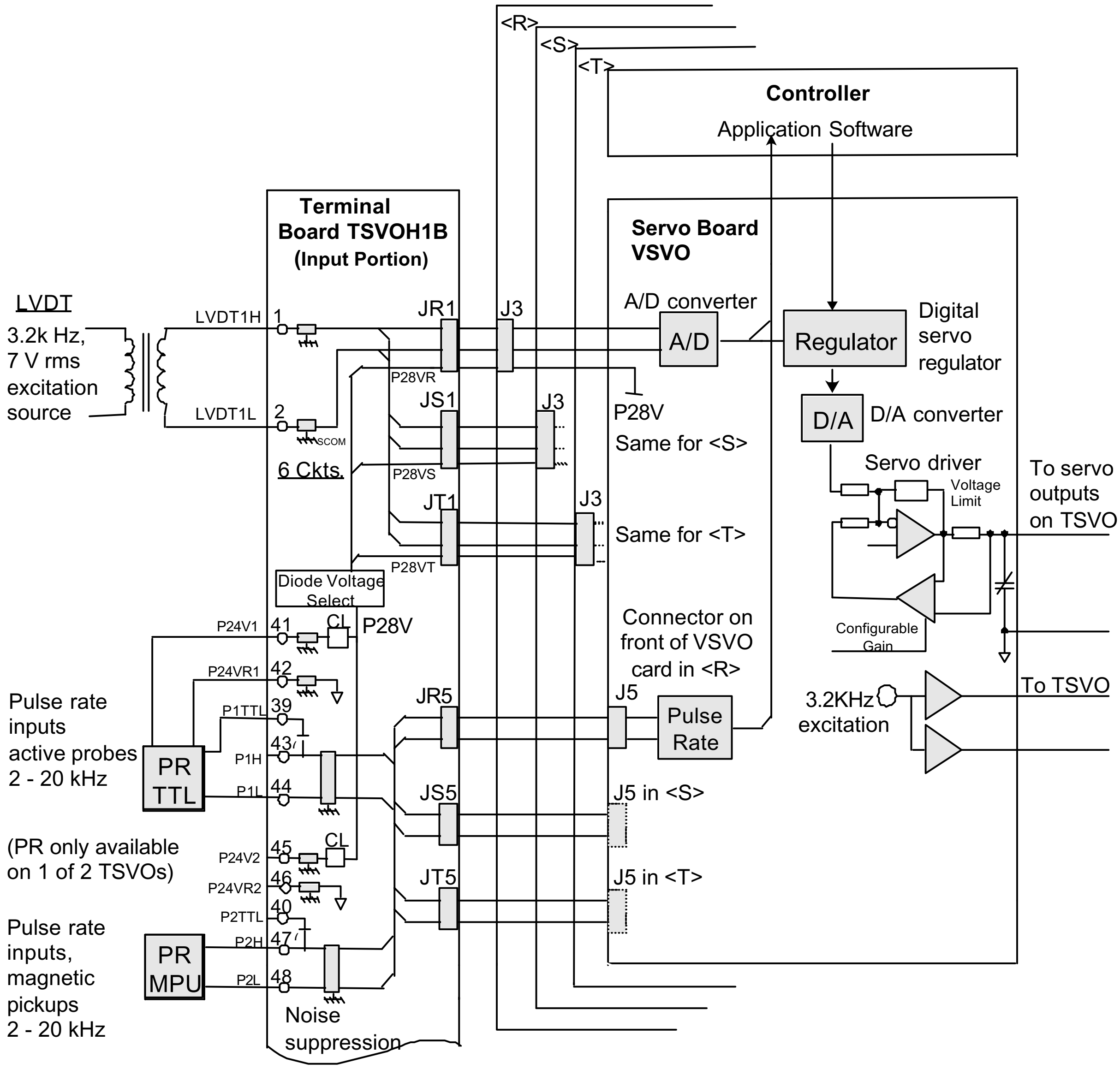
Another trip override relay K1 is provided on each terminal board which is driven from the <P> Protection Module. If an emergency overspeed condition is detected in the Protection Module, the K1 relay will energize and disconnect the VSVO servo output from the terminal block and apply a bias to drive 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>.




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

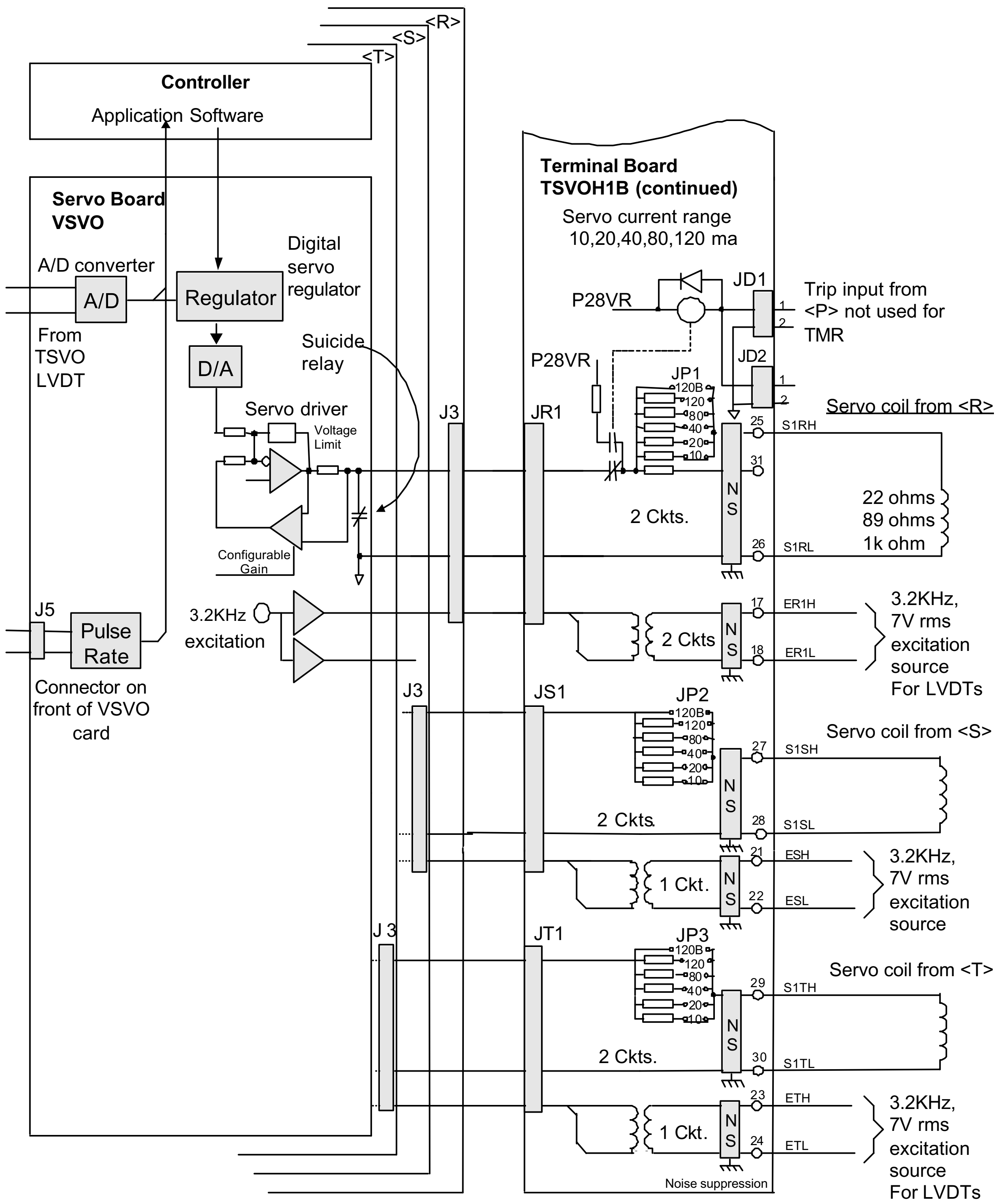
*Only two pulse rate probes on one TSVO are used.*

In TMR Applications, the LVDT signals on TSVO fan out to three racks through JR1, JS1, and JT1. Thee 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.




LVDT and Pulse Rate Inputs, TMR

For TMR systems, each servo channel has connections to three output coils with a range of current ratings up to 120 mA selected by jumper.




*Servo Coil Outputs and LVDT Excitation, TMR*

*Servo Coil Ratings*

| Coil Type | Nominal Current | Coil Resistance (Ohms) | Internal Resistance (Ohms) | Application |
|---|---|---|---|---|
| 1 | ± 10 mA | 1,000 | 180 | Simplex and TMR |
| 2 | ± 20 mA | 125 | 442 | Simplex |
| 3 | ± 40 mA | 62 | 195 | Simplex |
| 4 | ± 40 mA | 89 | 195 | TMR |
| 5 | ± 80 mA | 22 | 115 | TMR |
| 6 | ± 120 mA (A) | 40 | 46 | Simplex |
| 7 | ± 120 mA (B) | 75 | 10 | TMR |

*The total resistance would be equivalent to the standard setting.*

The following table defines the standard servo coil resistance and their associated internal resistance, selectable with the terminal board jumpers shown in the figure above. In addition to these standard servo coils, it is possible to drive non-standard coils by using a non-standard jumper setting. For example, an 80 mA, 125-ohm coil could be driven by using a jumper setting 120B.

*The excitation source is isolated from signal common (floating) and is capable of operation at common mode voltages up to 35 V dc, or 35 V rms, 50/60 Hz.*

Control valve position is sensed with either a four wire LVDT or a three-wire linear variable differential reluctance (LVDR). Redundancy implementations for the feedback devices is determined by the application software to allow the maximum flexibility. LVDT/Rs can be mounted up to 300 meters (984 feet) from the turbine control with a maximum two-way cable resistance of 15 ohms.

Two LVDT/R excitation sources are located on each terminal board for Simplex applications and another two for TMR applications. Excitation voltage is 7 V rms and the frequency is 3.2 kHz with a total harmonic distortion of less than 1% when loaded.

*The software limit check is adjustable in the field.*

A typical LVDT/R has an output of 0.7 V rms as the zero stroke position of the valve stem, and an output of 3.5 V rms at the designed maximum stoke position (some applications have these reversed). The LVDT/R input is converted to dc and conditioned with a low pass filter. Diagnostics perform a high/low (hardware) limit check on the input signal and a high/low system (software) limit check.

Two pulse rate inputs are cabled to a single J5 connector on the VSVO board front. This is a dedicated connection to minimize noise sensitivity on the pulse rate inputs.

Inputs support both passive magnetic pickups and active pulse rate transducers (TTL type) interchangeably without configuration. Normally, these inputs are not used on steam turbine applications, but are usually for liquid fuel flow measurement, and monitoring flow divider feedback in gas turbine applications. Pulse rate inputs can be located up to 300 meters (984) from the turbine control cabinet; this assumes shielded-pair cable is used with typically 70 nF single ended or 35 nF differential capacitance and 15 ohms resistance.

*The maximum short circuit current is approximately 100 mA with a maximum power output of 1 watt.*

A frequency range of 2 to 30 kHz can be monitored at a normal sampling rate of either 10 or 20 ms. Magnetic pickups typically have an output resistance of 200 ohms and an inductance of 85 mH excluding cable characteristics. The transducer is a high impedance source, generating energy levels insufficient to cause a spark.

# Specifications

*Specifications*

| Item | Specification |
|---|---|
| Number of inputs (per TSVO) | 6 LVDT windings<br>2 pulse rate signals (total of 2 per VSVO)<br>External trip signal |
| Number of outputs (per TSVO) | 2 servo valves (total of 4 per VSVO board)<br>4 excitation sources for LVDTs<br>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 ±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<br>Voltage of 7.00 +/- 0.14 V rms |
| Pulse rate accuracy | 0.05% of reading with 16-bit resolution at 50 Hz frame rate<br>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 33 mVpk, and at 12 kHz is 827 mVpk. |
| Magnetic PR pickup signal | Generates 150 V p-p into 60 K ohms |
| Active PR Pickup Signal | Generates 5 to 27 V p-p into 60 K ohms |
| Servo valve output accuracy | 2% with 12-bit resolution<br>Dither amplitude and frequency adjustable |
| Fault detection | Suicide servo outputs initiated by:<br>Servo current out of limits or not responding<br>Regulator feedback signal out of limits |

# Diagnostics

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

Servo diagnostics cover items such as out of range LVDT voltage, servo suicide, servo current open circuit, and short circuit. If any one of the signals goes unhealthy a composite diagnostic alarm, L#DIAG_VSVO occurs. If the associated regulator has two sensors, the bad sensor is removed from the feedback calculation and the good sensor is used. 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.

# Configuration

The VSVO module is configured using the toolbox. This software usually runs on a data-highway connected CIMPLICITY station or workstation. The following table defines the configuration choices and defaults. For details refer to GEH-6403, *Control System Toolbox for Configuring the Mark VI Turbine Controller*.

*Typical VSVO 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<br>2_PlsRateMAX 1_LVPosition<br>2_LV_PosMIN 2_LV_PosMID<br>2_LvpilotCyl 4_LVp/cylMAX<br>4_LV_LM 2_LV_posMAX |
| RegGain | Position loop gain in (%current/%position) | –100 to 100 |
| RegNullBias | Null bias in % current, balances servo spring force | –100 to 100 |
| DitherAmpl | Dither in % current (minimizes hysteresis) | Dither amp: 0 to 10 |
| **Monitor 1** | | |
| Monitor type | Monitor algorithm | Unused<br>1_Lvposition<br>2_LVposMIN<br>2_LVposMAX<br>3_LVposMID<br>1_LvposRatio<br>2_LVposRatio |
| **J3:IS200TSVOH1A** | Terminal board 1 connected to VSVO through J3 | Connected, not connected |
| **Servo Output1** | Measured output current in percent – Board point | Point edit (input FLOAT) |
| Reg Number | Identify regulator number | Unused, Reg1, Reg2, Reg3, Reg4 |
| Servo_MA_Out | Select current output for coil windings | 10, 20, 40, 80, 120 mA |
| EnableCurSuic | Select Suicide function based on current | Enable, disable |
| Curr_Suicide | Percent current error to initiate suicide | 0 to 100% (output current error) |
| EnablFbkSuic | Select Suicide function based on feedback | Enable, disable |
| Fdbk_Suicide | Percent position error to initiate suicide | 0 to 100% (actuator position error) |
| **Servo Output2** | Measured output current in percent - Board point | Point edit (input FLOAT) |
| **J4:IS200TSVOH1A** | Terminal Board 2 connected to VSVO via J4 | Connected, not connected |
| **Servo Output3** | Servo current output wired to valve - Board point | Point edit (input FLOAT) |
| **Servo Output4** | Servo current output wired to valve - Board point | Point edit (input FLOAT) |
| **J5:IS00TSVOH1A** | Pulse Rate inputs cabled to J5 connector | Connected, not connected |

| | | |
|---|---|---|
| **FlowRate1** | Pulse rate input selected - Board point | Point edit (input FLOAT) |
| PRType | Select speed or flow type signal | Unused, speed, or flow |
| PRScale | Convert Hz to engineering units | 0 to 1,000 |
| SysLim1Enabl | Select system limit | Enable, disable |
| SysLim1Latch | Select whether alarm will latch | Latch, not latch |
| SysLim1Type | Select type of alarm initiation | >= or <= |
| SysLimit | Select alarm level in GPM or RPM | 0 to 12,000 |
| SystemLim2 | Same as above | Same as above |
| TMR_DiffLimt | Difference limit off voted pulse inputs (EU) | 0 to 12,000 |
| **FlowRate2** | Pulse rate input selected - Board point (as above) | Point edit (input FLOAT) |

| **Board Points Signals** | **Description - Point Edit (Enter Signal Connection)** | **Direction** | **Type** |
|---|---|---|---|
| L3DIAG_VSVO1 | Board diagnostic | Input | BIT |
| L3DIAG_VSVO2 | Board diagnostic | Input | BIT |
| L3DIAG_VSVO3 | Board diagnostic | Input | BIT |
| SysLim1PR1 | Process alarm | Input | BIT |
| SysLim2PR1 | Process alarm | Input | BIT |
| SysLim1PR2 | Process alarm | Input | BIT |
| SysLim2PR2 | Process alarm | Input | BIT |
| Reg1Suicide | Reg1 suicide relay status | Input | BIT |
| : | : | Input | BIT |
| Reg4Suicide | Reg4 suicide relay status | Input | BIT |
| Reg1_PosAFlt | Reg1, LM machine only, position A failure | Input | BIT |
| : | : | Input | BIT |
| Reg4_PosAFlt | Reg4, LM machine only, position A failure | Input | BIT |
| Reg1_PosBFlt | Reg1, LM machine only, position B failure | Input | BIT |
| : | : | Input | BIT |
| Reg4_PosBFlt | Reg4, LM machine only, position B failure | Input | BIT |
| Reg1_PosDif1 | Reg1, LM machine only, position Diff failure | Input | BIT |
| : | : | Input | BIT |
| Reg4_PosDif1 | Reg4, LM machine only, position diff failure | Input | BIT |
| Reg1_PosDif2 | Reg1, LM machine only, position diff failure | Input | BIT |
| : | : | Input | BIT |
| Reg4_PosDif2 | Reg4, LM machine only, position diff failure | Input | BIT |
| RegCalMode | Regulator under calibration | Input | BIT |
| Reg1_Fdbk | Regulator 1 feedback | Input | FLOAT |
| : | : | Input | FLOAT |
| Reg4_Fdbk | Regulator 4 feedback | Input | FLOAT |
| PilotFdbk1 | Pilot/Cyl | Input | FLOAT |

| | | | |
|---|---|---|---|
| : | : | Input | FLOAT |
| PilotFdbk4 | Pilot/Cyl | Input | FLOAT |
| Reg1_Error | Null bias error Input | Input | FLOAT |
| : | : | Input | FLOAT |
| Reg4_Error | Null bias error Input | Input | FLOAT |
| Accel1 | GPM/sec | Input | FLOAT |
| Accel2 | GPM/sec | Input | FLOAT |
| Mon1 | Position monitor | Input | FLOAT |
| : | : | Input | FLOAT |
| Mon12 | Position monitor | Input | FLOAT |
| CalibEnab1 | Enable calibration reg 1 | Output | BIT |
| : | : | Output | BIT |
| CalibEnab4 | Enable calibration reg 4 | Output | BIT |
| SuicideForce1 | Force suicide reg 1 | Output | BIT |
| : | : | Output | BIT |
| SuicideForce4 | Force suicide reg 4 | Output | BIT |
| PossDiffEnab1 | Position difference enable reg 1, LM only | Output | BIT |
| : | : | Output | BIT |
| PossDiffEnab4 | Position difference enable reg 4, LM only | Output | BIT |
| Reg1_Ref | Reg 1 position ref | Output | FLOAT |
| : | : | Output | FLOAT |
| Reg4_Ref | Reg 4 position ref | Output | FLOAT |
| Reg1-GainMod | Reg 1 gain modifier | Output | FLOAT |
| : | : | Output | FLOAT |
| Reg4-GainMod | Reg 4 gain modifier | Output | FLOAT |
| Reg1_NullCor | Reg 1 null bias correction | Output | FLOAT |
| : | : | Output | FLOAT |
| Reg4_NullCor | Reg 4 null bias correction | Output | FLOAT |
| **Internal Variables** | Internal variables to service the auto-calibration display, not configurable | | |

# DSVO–Simplex DIN-rail Mounted Servo Terminal Board

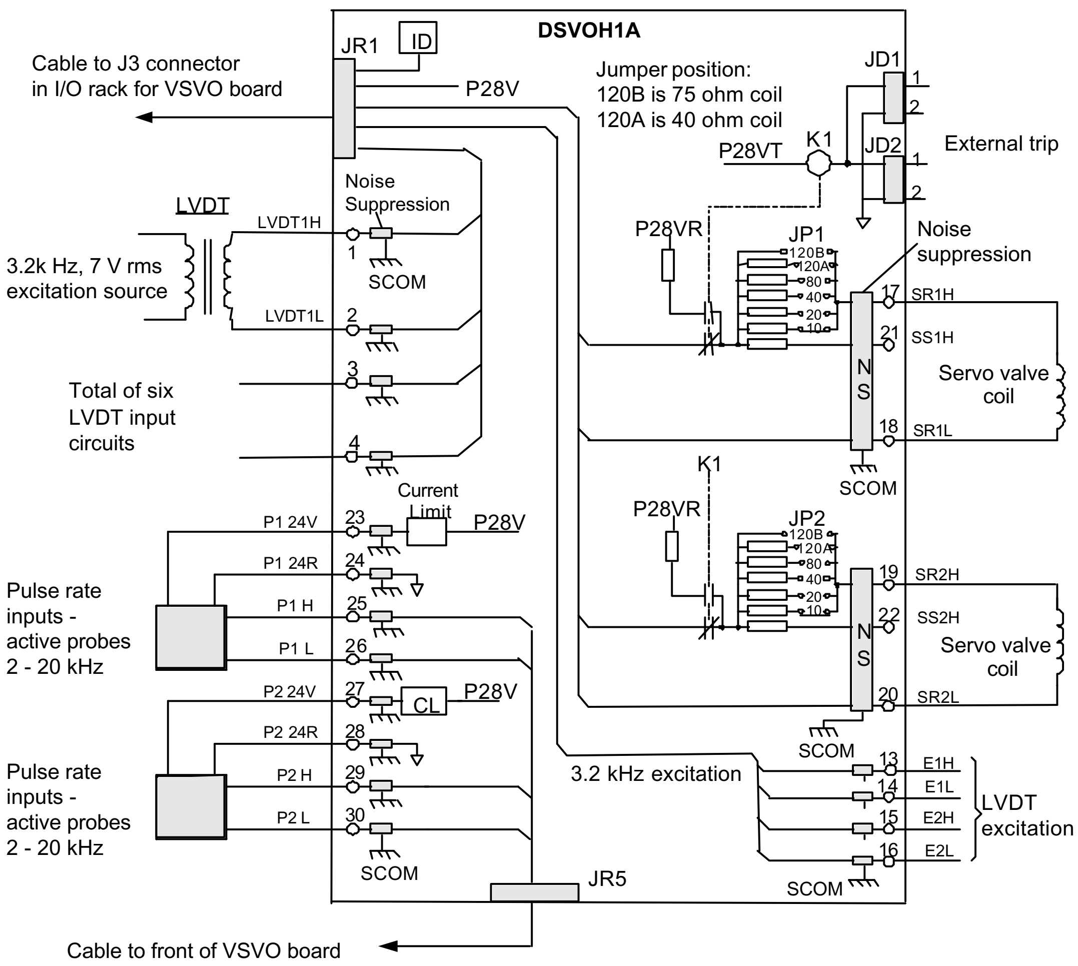
The DSVO board is a compact servo terminal board, designed for DIN_rail mounting. This board has two servo outputs, I/O for six LVDT position sensors, and two active pulse rate inputs for flow measurement (refer to the diagrams). Servo coil currents ranging from 10 to 120 mA can be jumper selected. DSVO connects to the VSVO processor board with a 37-pin cable, which are identical to those used on the larger TSVO board. The terminal boards can be stacked vertically on the DIN-rail to conserve cabinet space. Two DSVO boards can be connected to the VSVO, if required. Only the Simplex version of this board is available

The on-board functions and high frequency decoupling to ground are the same as those on the TSVO. High density Euro-Block type terminal blocks are permanently mounted to the board with six screws for the ground connection (SCOM). Each of the two connectors, JR1 and J5, connect to signals from on-board ID chips which identify the board to the VSVO for system diagnostic purposes.

There are versions of the DSVO, H1B and H2B. The H1B is a direct replacement for the previous H1A design. The H2B is certified by UL as Class 1 Division 2.

The differences between the H1B and H1B versions of DSVO are as follows:

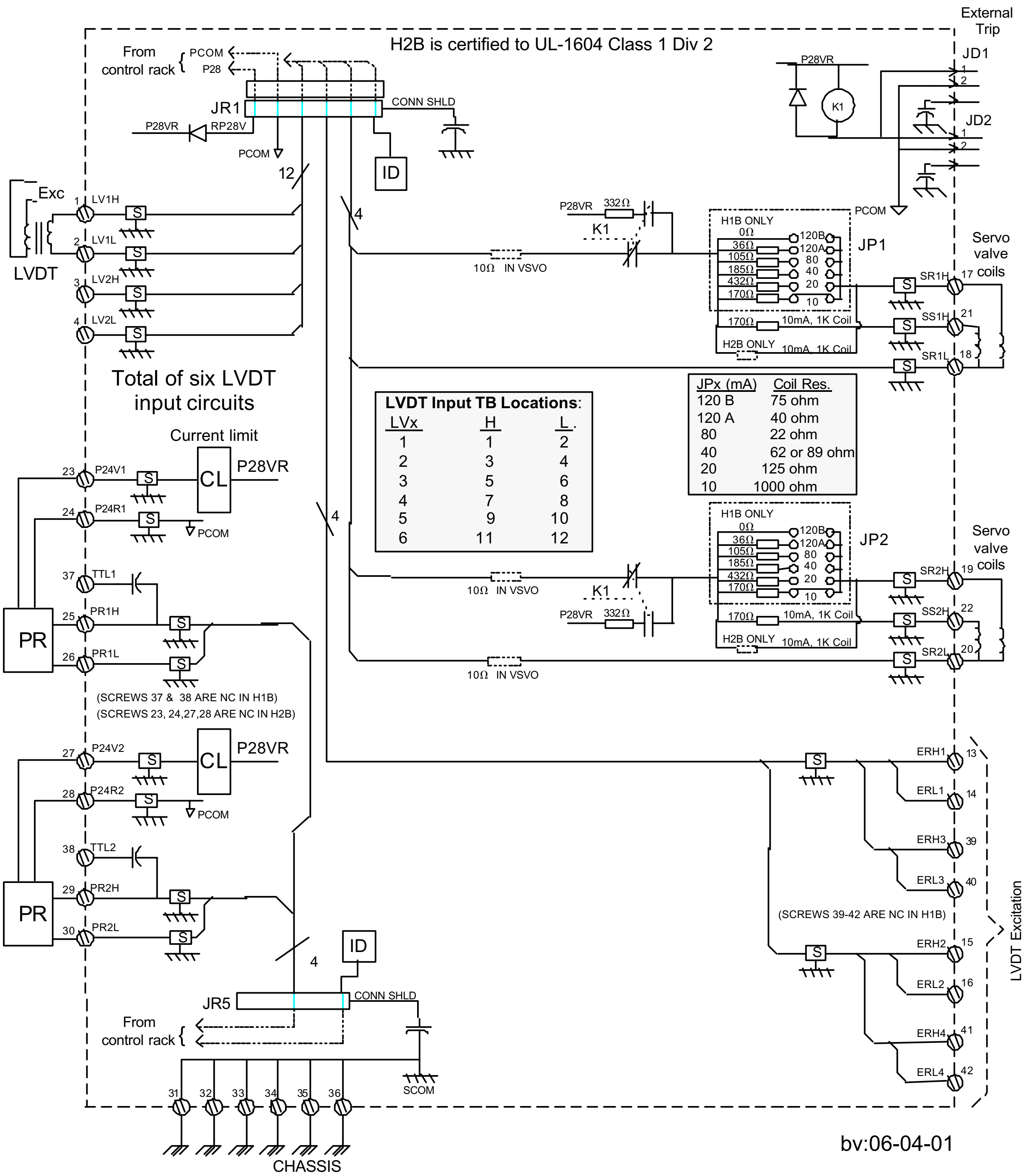
| Function | H1B | H2B |
|---|---|---|
| Class 1, Div. 2 certification | No | Yes |
| Servo valves accommodated | 75, 40, 22, 62, 89, 125, 1k ohms | 1k ohms (10 mA) |
| LVDT excitation outputs | Qty. = 2, 120 mA each | Qty. = 4, 60 mA each |
| Excitation for pulse rate probes | Qty. = 2, 24 V dc, 100 mA each | No |
| Additional pulse rate inputs for TTL signals | No | Qty. = 2 |




*DSVOH1A Board*

## Mark VI Servo Valve Terminal Board IS200DSVOH1B, H2B

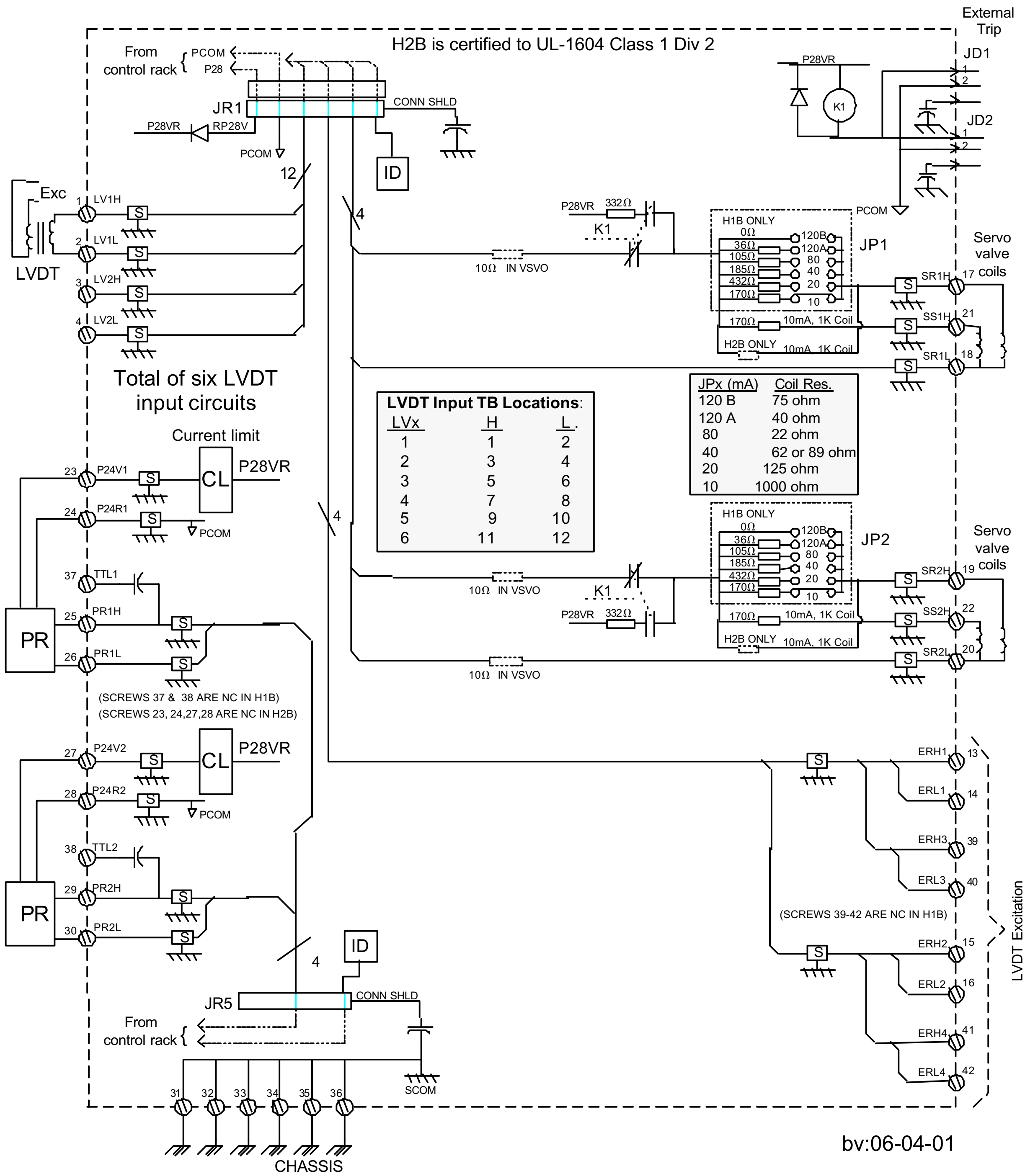
(IS200DSVOH1B Replaces IS200DSVOH1A)




*DSVOH1B, H2B Board (Part 1 of 2)*

## Mark VI Servo Valve Terminal Board IS200DSVOH1B, H2B

(IS200DSVOH1B Replaces IS200DSVOH1A)

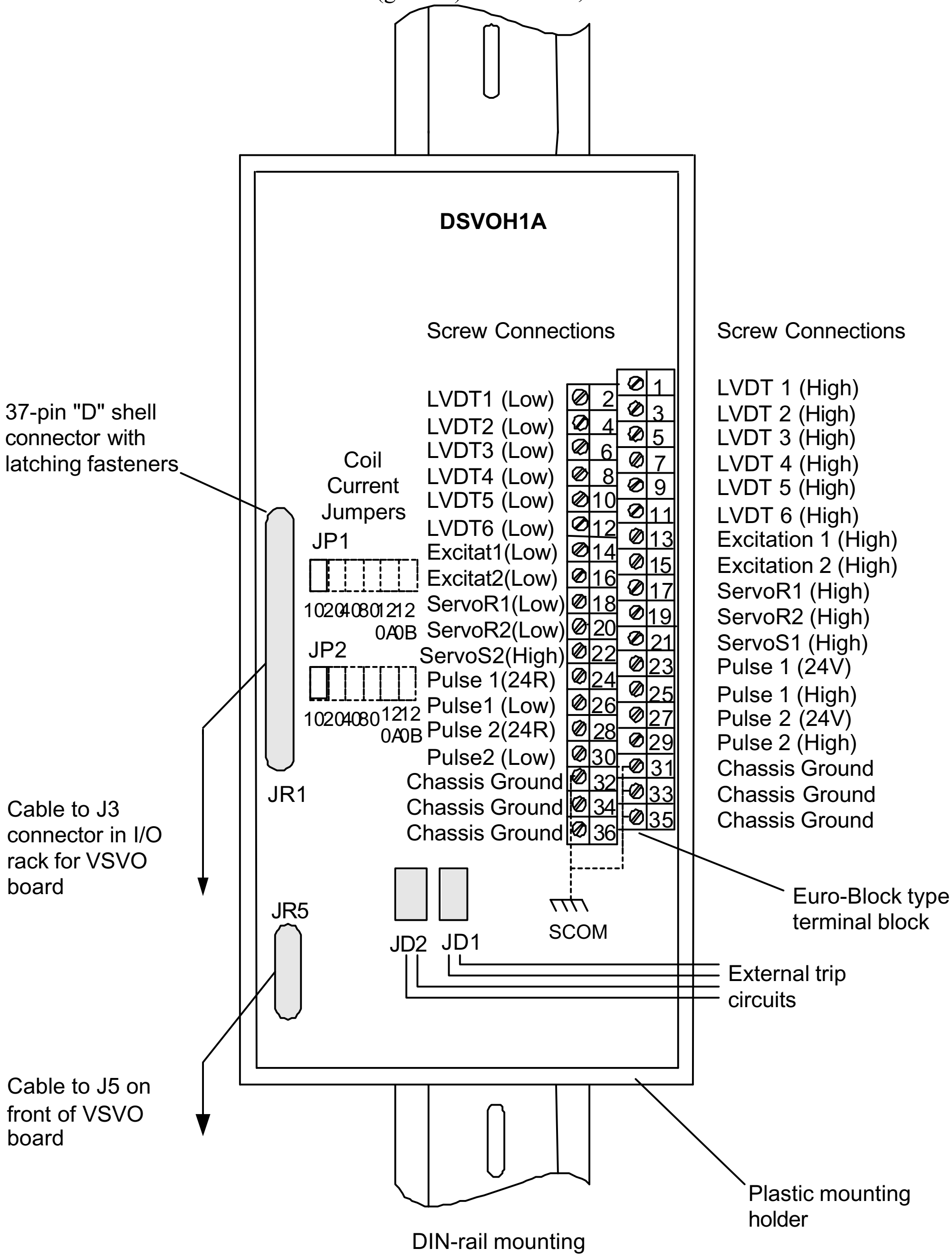



*DSVOH1B, H2B board (Part 2 of 2)*

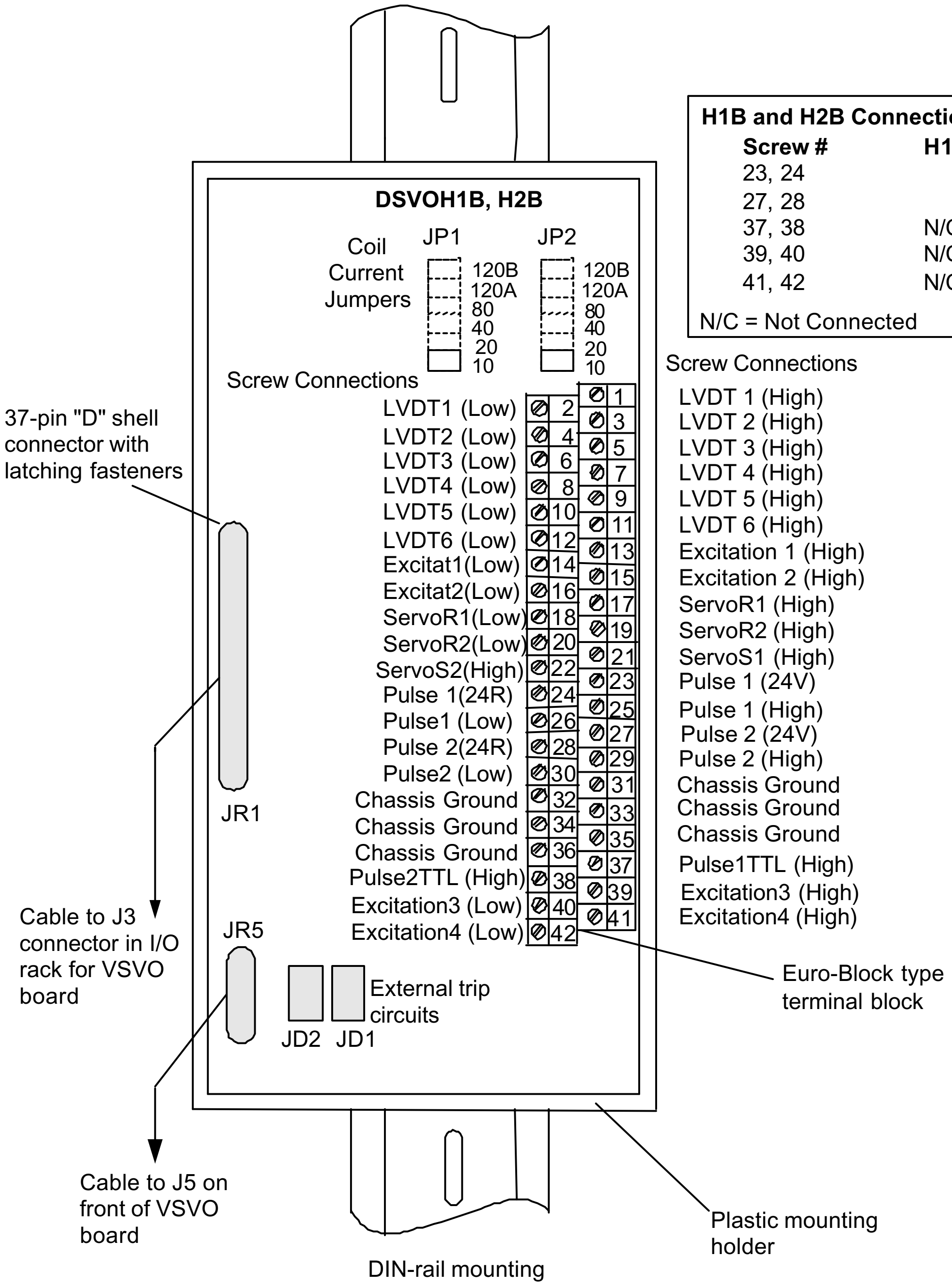
## Installation

*There is no shield termination strip with this design.*

The DSVO board slides into a plastic holder, which mounts on the DIN-rail. The servo I/O are wired directly to the Euro-Block type terminal block as shown in the following figures. This has 36 terminals (DSVOH1A) or 42 terminals (DSVOH1B, H2B); typically #18 AWG shielded twisted pair wiring is used. There are six screws for SCOM (ground) connection, which should be as short as distance as possible.




*DSVIH1A Wiring and Cabling*




**H1B and H2B Connection Differences**

| Screw # | H1B | H2B |
|---|---|---|
| 23, 24 | | N/C |
| 27, 28 | | N/C |
| 37, 38 | N/C | |
| 39, 40 | N/C | |
| 41, 42 | N/C | |

N/C = Not Connected

*DSVOH1B, H2B Wiring and Cabling*

# I/O Board Alarms

Diagnostic alarms for any I/O board can be displayed and reset from the toolbox. For troubleshooting and general diagnostic alarm information refer to GEH-6421 Volume I, Chapter 8.

*I/O Board Diagnostic Alarms*

| Board | Fault | Fault Description | Possible Cause |
|---|---|---|---|
| **VSVO** | **2** | Flash Memory CRC Failure | Board firmware programming error (board will not go online) |
| | **3** | CRC failure override is Active | Board firmware programming error (board is allowed to go online) |
| | **16** | System Limit Checking is Disabled | System checking was disabled by configuration. |
| | **17** | Board ID Failure | Failed ID chip on the VME I/O board |
| | **18** | J3 ID Failure | Failed ID chip on connector J3, or cable problem |
| | **19** | J4 ID Failure | Failed ID chip on connector J4, or cable problem |
| | **20** | J5 ID Failure | Failed ID chip on connector J5, or cable problem |
| | **21** | J6 ID Failure | Failed ID chip on connector J6, or cable problem |
| | **22** | J3A ID Failure | Failed ID chip on connector J3A, or cable problem |
| | **23** | J4A ID Failure | Failed ID chip on connector J4A, or cable problem |
| | **24** | Firmware/Hardware Incompatibility | Invalid terminal board connected to VME I/O board |
| | **30** | ConfigCompatCode mismatch; Firmware: #; Tre: # The configuration compatibility code that the firmware is expecting is different than what is in the tre file for this board | A tre file has been installed that is incompatible with the firmware on the I/O board. Either the tre file or firmware must change. Contact the factory. |
| | **31** | IOCompatCode mismatch; Firmware: #; Tre: # The I/O compatibility code that the firmware is expecting is different than what is in the tre file for this board | A tre file has been installed that is incompatible with the firmware on the I/O board. Either the tre file or firmware must change. Contact the factory. |
| | **33-44** | LVDT # RMS Voltage Out of Limits. Minimum and maximum LVDT limits are configured | The LVDT may need recalibration. |
| | **45** | Calibration Mode Enabled | The VSVO was put into calibration mode. |
| | **46** | VSVO Board Not Online, Servos Suicided. The servo is suicided because the VSVO is not on-line | The controller (R, S, T) or IONet is down, or there is a configuration problem with the system preventing the VCMI from bringing the board on line. |

| | | |
|---|---|---|
| **47-51** | Servo Current # Disagrees with Reference, Suicided. The servo current error (reference - feedback) is greater than the configured current suicide margin | A cable/wiring open circuit, or board problem. |
| **52-56** | Servo Current # Short Circuit. This is not currently used | NA |
| **57-61** | Servo Current # Open Circuit. The servo voltage is greater than 5V and the measured current is less than 10% | A cable/wiring open circuit, or board problem. |
| **62-66** | Servo Position # Feedback Out of Range, Suicided. Regulator number # position feedback is out of range, causing the servo to suicide | LVDT or board problem |
| **67-71** | Configuration Message Error for Regulator Number #. There is a problem with the VSVO configuration and the servo will not operate properly | The LVDT minimum and maximum voltages are equal or reversed, or an invalid LVDT, regulator, or servo number is specified. |
| **72** | Onboard Calibration Voltage Range Fault. The A/D calibration voltages read from the FPGA are out of limits, and the VSVO will use default values instead | A problem with the Field Programmable Gate Array (FPGA) on the board |
| **73-75** | LVDT Excitation # Voltage out of range | There is a problem with the LVDT excitation source on the VSVO board. |
| **77** | Servo output assignment mismatch. Regulator types 8 & 9 use two servo outputs each. They have to be consecutive pairs, and they have to be configured as the same range | Fix the regulator configurations. |
| **128-191** | Logic Signal # Voting mismatch. The identified signal from this board disagrees with the voted value | A problem with the input. This could be the device, the wire to the terminal board, the terminal board, or the cable. |
| **224-259** | Input Signal # Voting mismatch, Local #, Voted #. The specified input signal varies from the voted value of the signal by more than the TMR Diff Limit | A problem with the input. This could be the device, the wire to the terminal board, the terminal board, or the cable. |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Board Specification

# VTUR Turbine Control Board

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*Issue date: 2002-06-30*

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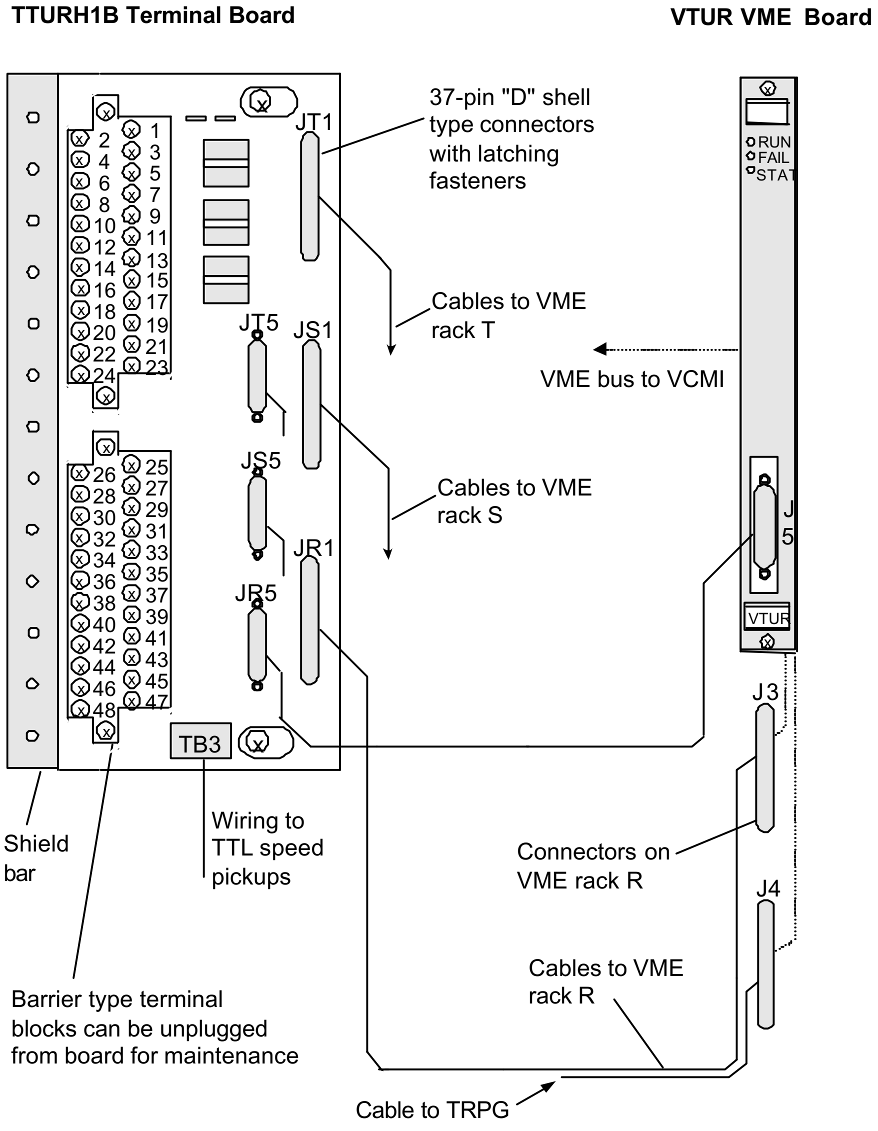
# Functional Description

The turbine control board, VTUR controls three primary overspeed trip solenoids and automatic synchronizing. It also interfaces to four passive pulse rate devices, and monitors shaft voltage and current. The speed signal cable to VTUR uses the J5 plug on the front of the board, and the other signals use the J3 connector on the VME rack. Terminal board TTUR provides simplex signals through the JR connector, and fans out TMR signals to the JR, JS, and JT connectors. J4 on the VME rack connects to the TRPG terminal board described in the Primary Trip section.

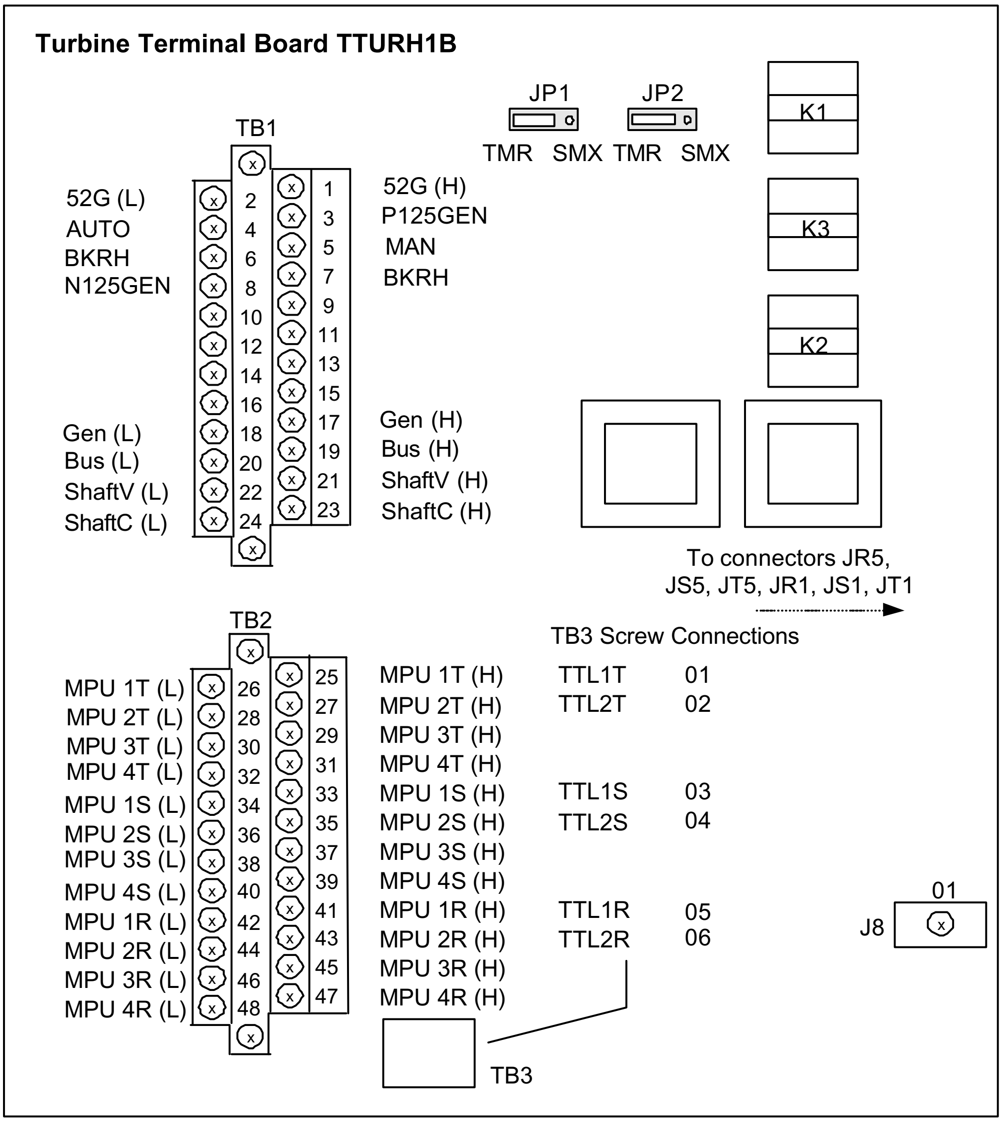
A two-slot version of this board (VTURH2) is available for driving six trip solenoids using two TRPG boards. VTURH2 only accepts eight flame detectors.




*Turbine Control Terminal Board, Processor Board, and Cabling*

# Installation

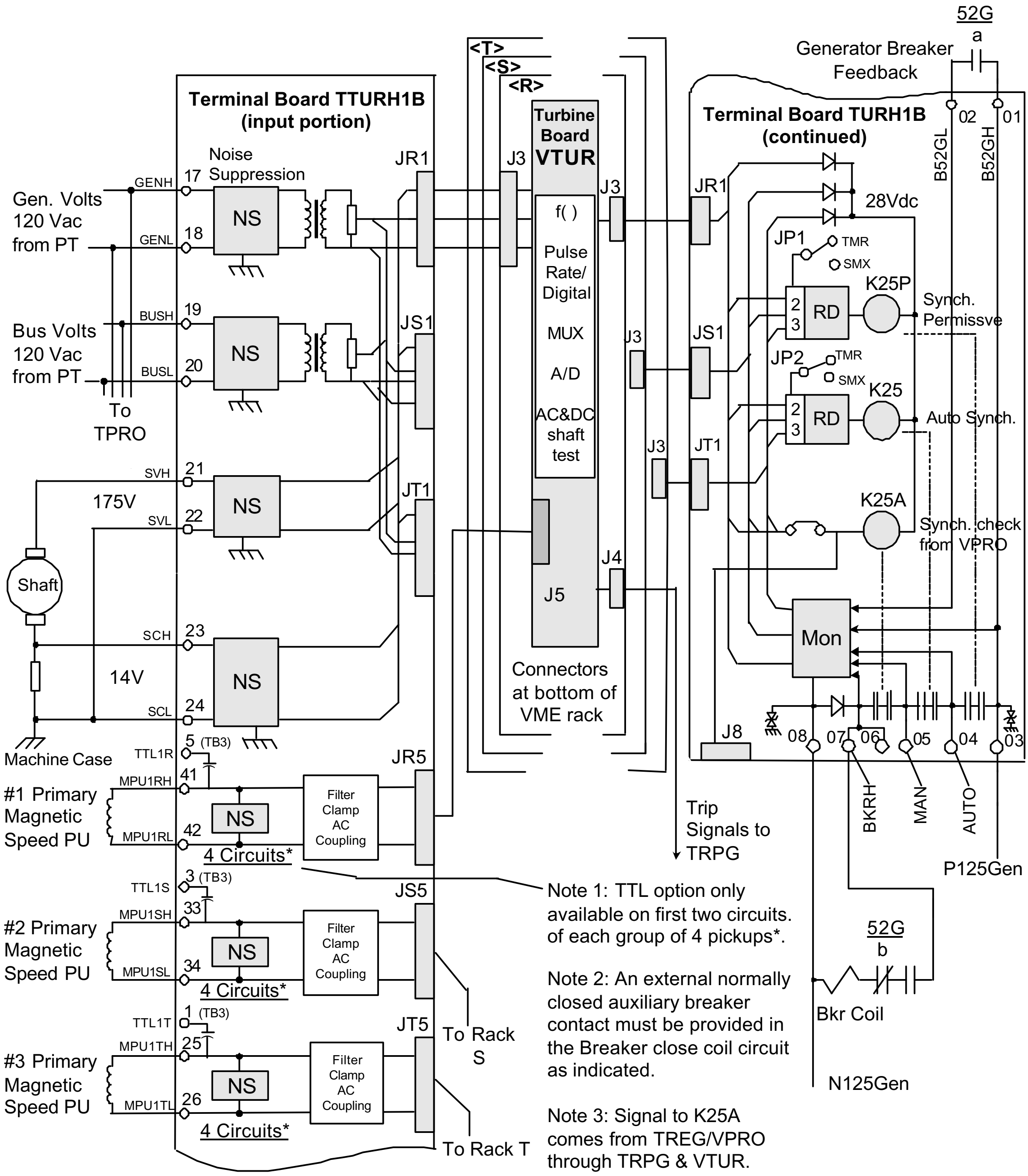
Magnetic pick ups, shaft pick ups, potential transformers, and breaker relays are wired to two I/O terminal blocks on TTUR. Each block is held down with two screws and has 24 terminals accepting up to #12 AWG wires. A shield termination strip attached to chassis ground is located immediately to the left of each terminal block. Jumpers JP1 and JP2 select either SMX or TMR for relay drivers K25 and K25P. TB3 is for optional TTL connections to active speed pickups; these require an external power supply.




*TTUR Terminal Board*

*All three relays have two normally open contacts in series with the breaker close coil.*

In TMR applications all inputs fan to the three control racks. Control signals coming into TTUR from R, S, and T are voted before they actuate permissive relays K25 and K25P. Relay K25A is controlled by the VPRO and TREG boards.

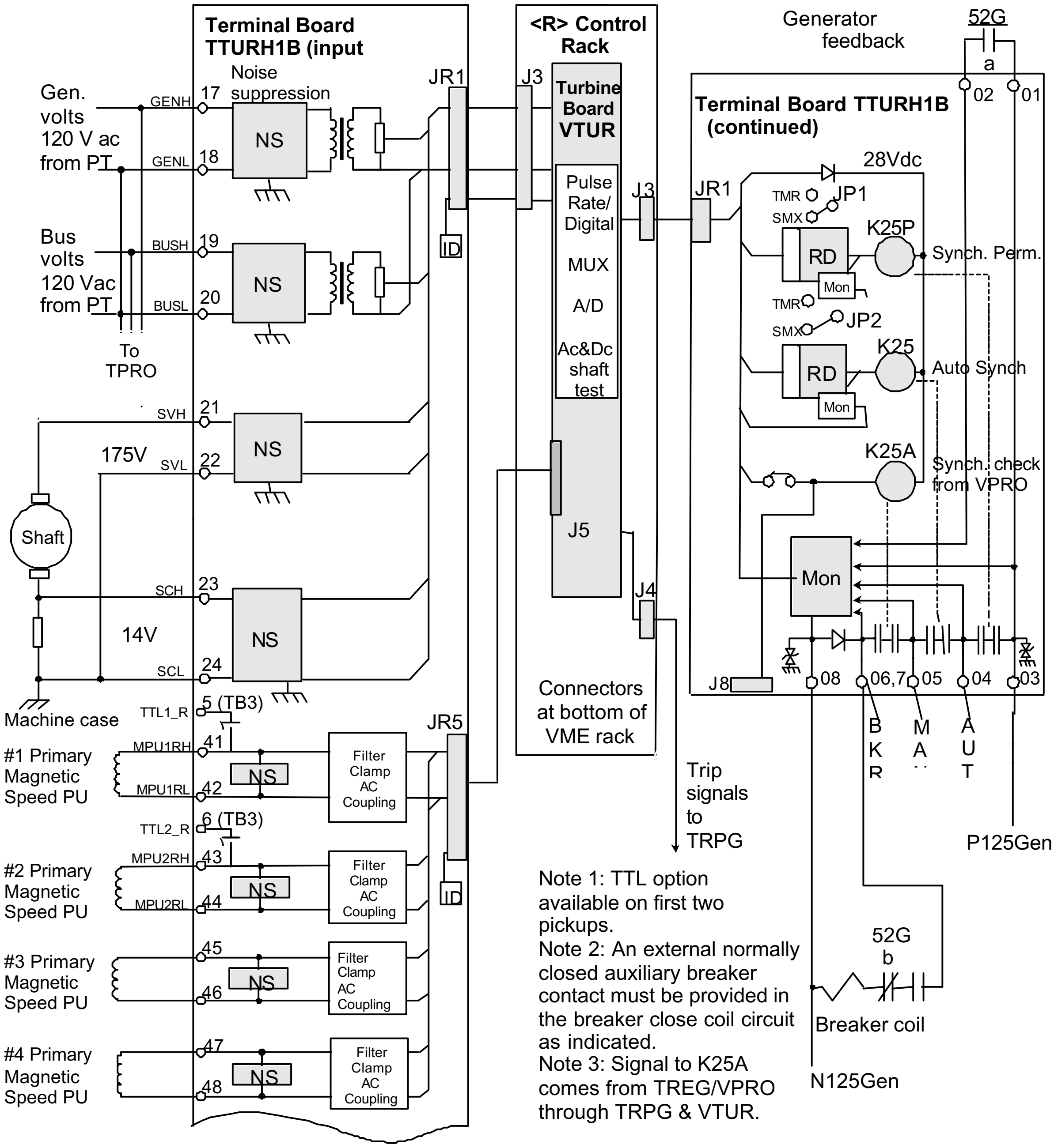



*Turbine Control Inputs, Synchronizing, and Primary Trip Interface, TMR*

# Operation

*Pulse rate to digital circuits are on the VTUR board. VTUR alarms high voltages and tests the integrity and continuity of the circuitry.*

In the simplex application, up to four pulse rate signals may be used to measure turbine speed. Generator and bus voltages are brought into VTUR for automatic synchronizing in conjunction with the turbine controller and excitation system. TTUR has permissive generator synchronizing relays and controls the main breaker relay coil 52G. Shaft voltage is picked up with brushes and monitored along with the current to the machine case.




*Turbine Control Inputs, Synchronizing, and Primary Trip Interface, Simplex*

# Features

*The median speed signal is used for speed control and for the primary overspeed trip signal.*

An interface is provided for four passive, magnetic speed inputs with a frequency range of 2 – 20,000 Hz. Using passive pickups on a 60-tooth wheel, circuit sensitivity allows detection of 2 rpm turning gear speed to determine if the turbine is stopped (zero speed). If automatic turning gear engagement is provided in the turbine control, this signal initiates turning gear operation.

The primary overspeed trip calculations are performed in the controller using algorithms similar to (but not the same as) those shown in the section on the VPRO Protection Module. The fast trip option used on gas turbines runs in VTUR and is described below.

*A metal oxide varister (MOV) and a current limiting resistor are used in each circuit.*

The normal primary overspeed trip is calculated in the controller and passed to the VTUR and then to the TRPG terminal board. TRPG contains magnetic relays for interface with the electrical trip devices (ETDs). TRPG works in conjunction with the TREG board to form the *Primary* and *Emergency* sides of the interface to the ETDs. Usually this applies to turbines which do not have a mechanical overspeed bolt and require a separate emergency overspeed (EOS) system. Three ETDs can be driven from each TRPG/TREG combination with the positive side of each solenoid connected to the TREG and the negative side connected to the TRPG.

Two different versions of the TRPG are available, with version 1 used for triple redundant (TMR) systems and version 2 used for Simplex systems. The only difference is that the TMR version has three voting relays per ETD circuit and the Simplex version has one relay per circuit. The VTUR board monitors the current flowing in its relay driver control line to determine its energize or de-energize vote/status of the relay coil. A normally closed contact from each relay on the TRPG board is monitored by the diagnostics to determine its proper operation.

Bearings can be damaged by the flow of electrical current from the shaft to the case. This current can occur for several reasons.

- A static voltage can be caused by droplets of water being thrown off the last stage buckets in a steam turbine. This voltage will build up until a discharge occurs through the bearing oil film.
- An ac ripple on the dc generator field can produce an ac voltage on the shaft with respect to ground through the capacitance of the field winding and insulation. Note that both of these sources are weak, so high impedance instrumentation is used to measure these voltages with respect to ground.
- A voltage may be generated between the ends of the generator shaft due to dis-symmetries in the generator magnetic circuits. If the insulated bearings on the generator shaft break down, the current will flow from one end of the shaft through the bearings and frame to the other end. Brushes can be used to discharge damaging voltage buildup, and a shunt should be used to monitor the current flow.

The turbine control continuously monitors the shaft to ground voltage and current, and alarms excessive levels. There is an ac test mode and a dc test mode. The ac test applies an ac voltage to test the integrity of the measuring circuit.

The dc test checks the continuity of the external circuit, including the brushes, turbine shaft, and the interconnecting wire.

***Note*** The dc test is driven from the <R> controller only. If the <R> controller is down, this test cannot be run successfully.

# Specifications

*VTUR Board Specifications*

| Item | Specification |
|---|---|
| Number of inputs | TTUR: 12 passive speed pickups<br>1 shaft voltage and 1 shaft current measurement<br>1 generator and 1 bus voltage<br>Generator breaker status contact<br>VTUR: 4 passive speed pickups<br>1 shaft voltage and 1 current measurement<br>1 generator and 1 bus voltage<br>Generator breaker status<br>8 flame detectors from first TRPG |
| Number of outputs | TTUR: Generator breaker coil, 5A at 125 V dc<br>VTUR: Automatic synchronizing<br>Primary trip solenoid interface, 3 outputs to TRPG<br>Additional 3 trip outputs from second TRPG using VTURH2 |
| Trip solenoids (TRPG) | Solenoids draw up to 1 A at 125 V dc and have a time constant of L/R = 0.1 sec. |
| Power supply voltage | TTUR: Nominal 125 V dc to breaker coil |
| MPU pulse rate range | 2 Hz to 20 kHz |
| MPU pulse rate accuracy | 0.05% of reading |
| MPU input circuit sensitivity | 27 mV pk (detects 2 rpm speed) |
| Shaft voltage monitor | Signal is frequency of ± 5 V dc (0 – 1 MHz) pulses from 0 to 2,000 Hz |
| Shaft voltage wiring | Up to 300 m (984 ft), with maximum two-way cable resistance of 15 ohms |
| Shaft voltage dc test | Applies a 5 V dc source to test integrity of the external turbine circuit and measures dc current flow. Circuit computes a differential resistance between 0 and 150 ohms within ± 5 ohms and compares against shunt limit and brush limit. Readings above 50 ohms indicate a fault.<br>Return signal is filtered to provide 40 dB of noise attenuation at 60 Hz. |
| Shaft voltage ac test | Applies a test voltage of 1 kHz to the input of the VTUR shaft voltage circuit (R module only). Shaft voltage monitor circuit on R, S, and T displays an offset of 1000 Hz from normal reading. |
| Shaft current input | Measures shaft current in amps ac (shunt voltage up to 0.1 V pp) |
| Generator and bus voltage sensors | Two single phase potential transformers, with secondary output supplying a nominal 115 V rms<br>Each input has less than 3 VA of loading.<br>Allowable voltage range for synch is 75 to 130 V rms.<br>Each PT input is magnetically isolated with a 1,500 V rms barrier.<br>Cable length can be up to 1,000 ft. of 18 AWG wiring. |
| Synchronizing measurements | Frequency accuracy 0.05% over 45 to 66 Hz range.<br>Zero crossing of the inputs is monitored on the rising slope.<br>Phase difference measurement is better than ± 1 degree. |
| Generator breaker circuits (synchronizing) | External circuits should have a voltage range within 20 to 140 V dc. The external circuit must include a NC breaker auxiliary contact to interrupt the current.<br>Circuits are rated for NEMA class E creepage and clearance.<br>250 V dc applications require interposing relays. |
| Contact voltage sensing | 20 V dc indicates high and 6 V dc indicates low.<br>Each circuit is optically isolated and filtered for 4 ms. |

# Diagnostics

Diagnostic information includes feedback from the solenoid relay driver and contact, high flame detector voltage, slow synch check relay, slow auto synch relay, and locked up K25 relay. If any one of the signals goes unhealthy, a composite diagnostic alarm L3DIAG_VTUR occurs. The diagnostic signals can be individually latched and then reset with the RESET_DIA signal if they go healthy.

Terminal board connectors JR1, JS1, JT1, JR5, JS5, JT5 have their own ID device which 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 plug location.

# Automatic Synchronizing

All synchronizing connections are located on the TTUR terminal board. The generator and bus voltages are supplied by two, single phase, potential transformers (PTs) with a fused secondary output supplying a nominal 115 V rms. Measurement accuracy between the zero crossing for the bus and generator voltage circuits is 1 degree.

Turbine speed is matched against the bus frequency, and the generator and bus voltages are matched by adjusting the generator field excitation voltage from commands sent between the turbine controller and the EX2000 over the Unit Data Highway (UDH). A command is given to close the breaker when all permissives are satisfied, and the breaker is predicted to close within the calculated phase/slip window. Feedback of the actual breaker closing time is provided by a 52G/a contact from the generator breaker (not an auxiliary relay) to update the data base. An internal K25A synch check relay is provided on the TTUR; the independent backup phase/slip calculation for this relay is performed in the <P> Protection Module. Diagnostics monitor the relay coil and contact closures to determine if the relay properly energizes or de-energizes upon command.

## Synchronizing Modes

There are three basic synchronizing modes. Traditionally, these modes are selected from a generator panel mounted selector switch:

- **Off** The breaker will not be closed by the Mark VI control. The check relay will not pickup.
- **Manual** The operator initiates breaker close, which is still subject to the K25A Synch Check contacts driven by VPRO. The manual close is initiated from an external contact on the generator panel, normally connected in series with a *Synch Mode in Manual* contact.
- **Auto** The system will automatically match voltage and speed, and then close the breaker at the right time to hit top dead center on the synchroscope. All three of the following functions must agree for this closure to occur:

  **K25A** synch check relay, checks the allowable slip/phase window, from VPRO.

  **K25** auto synch relay, provides precision synchronization, from VTUR.

  **K25P** synch sequence permissive, checks the turbine sequence status, from VTUR.

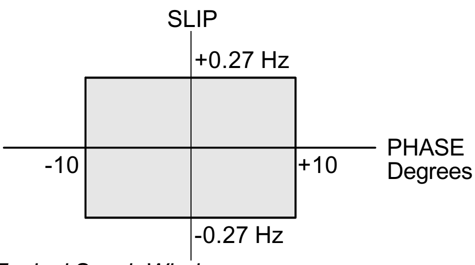
Details of the various checks are discussed in the following sections.

## Synch Check

The K25A synch check function is based on phase lock loop techniques. The calculations for this function are done in the VPRO, but interfaces to the Breaker close circuit on the TTUR board. It performs limit checks against adjustable constants as follows:

- Generator undervoltage
- Bus undervoltage
- Voltage error
- Frequency error (slip), with a maximum value of 0.33 Hz, typically set to 0.27 Hz
- Phase error with a maximum value of 30 degrees, typically set to 10 degrees

In addition, synch check arms logic to enable the function and provides bypass logic for deadbus closure. The synch window is based on typical settings:

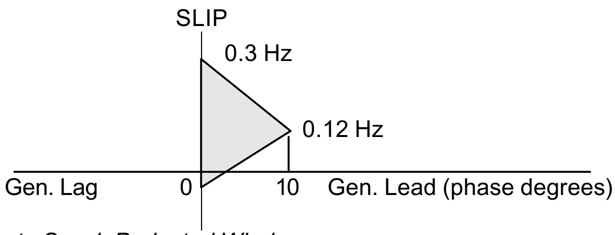



*Typical Synch Window*

## Auto Synch

The Auto Synch K25 function uses zero voltage crossing techniques. It compensates for the breaker time delay, which is defined by two adjustable constants with logic selection between the two (for two breaker applications). The calculations, which are done on the VTUR board, include phase, slip, acceleration, and anticipated time lead for the breaker delay. Based on the measured breaker close time, the time delay parameter is adjusted, up to certain limits.

In addition, auto synch arms logic to enable the function and bypasses logic to provide for deadbus or manual closure. The auto synch projected synch window is where positive slip indicates the generator frequency is higher than the bus frequency.




*Auto Synch Projected Window*

The projected window is based on current phase, current slip, and current acceleration. The generator must currently be lagging and have been lagging for the last 10 consecutive cycles, and projected (anticipated) to be leading when the breaker actually reaches closure. Auto synch will not allow the breaker to close with negative slip; speed matching typically aims at around +0.12 Hz slip.

### *Synchronization Display*

A special synchronization screen is available on the HMI with a real-time graphical phase display and control pushbuttons. The display items are listed in the following table.

*Synchronizing Display Items*

| Synch Display | Description |
|---|---|
| Dynamic parameters | Voltages: Generator, bus, difference<br>Frequencies: Generator, bus, slip (difference)<br>Phase: Difference angle, degrees |
| Status indication | Mode: Synch OFF, MANUAL, AUTO<br>Synch monitor: OFF, ON<br>Dead bus breaker: Open/close<br>Second breaker if applicable: Open/close<br>Synch permissive: K25P<br>Auto synch enabled<br>Speed adjust: Raise/lower<br>Voltage adjust: Raise/lower |
| Synch permissives | Generator voltage: OK/not OK<br>Bus voltage: OK/not OK<br>Generator frequency: OK/not OK<br>Bus frequency: OK/not OK<br>Difference volts: OK/not OK<br>Difference frequency: OK/not OK<br>Phase:K25 OK/not OK<br>K25A OK/not OK |
| Limit constants | Upper and lower limits for the above permissives |
| Breaker performance | Diagnostics: Slow check relay<br>Synch relay lockup<br>Breaker #1 close time out of limits<br>Breaker #2 close time out of limits<br>Relay K25P trouble<br>Breaker closing voltage (125 V dc) missing |
| Control pushbuttons | Synch monitor: ON, OFF<br>Speed adjust: RAISE, LOWER<br>Voltage adjust: RAISE, LOWER |

# Configuration

The following table defines the configuration choices and defaults. For details refer to GEH-6403, *Control System Toolbox for Configuring the Mark VI Turbine Controller.*

*Typical VTUR Configuration*

| Parameter | Description | Choices |
|---|---|---|
| **Configuration** | | |
| VTUR system limits | Select system limits | Enable, disable |
| SMredundancy | Select Simplex or TMR system | Simplex or TMR |
| AccelCalType | Select acceleration calculation type | Slow, medium, fast |
| FastTripType | Select Fast Trip algorithm | Unused, PR_Single, PR_Max |
| **J3J5:IS200TTURH1A** | TTUR connected to VTUR through J3 and J5 | Connected, not connected |
| **PulseRate1** | Pulse rate input 1 - board point | Point edit (input FLOAT) |
| PRType | Select Speed or Flow type input | Unused, speed, flow, Speed_LM |
| PRScale | Select pulses per revolution | 0 to 1,000 |
| SysLim1Enable | Select system limit 1 | Enable, disable |
| SysLim1Latch | Select whether alarm will latch | Latch, not latch |
| SysLim1Type | Select type of alarm initiation | >= or <= |
| SysLimit1 | Select alarm level in GPM or RPM | 0 to 20,000 |
| SysLim2Enable | Select system limit 2 (as above) | Enable, disable |
| TMRDiffLimit | Difference limit for voted PR inputs EU | 0 to 20,000 |
| **ShVoltMon** | Shaft voltage monitor - board point | Point edit (input FLOAT) |
| SysLim1Enable | Select System Limit 1 | Enable, disable |
| SysLim1Latch | Select whether alarm will latch | Latch, not latch |
| SysLim1Type | Select type of alarm initiation | >= or <= |
| SysLimit1 | Select alarm level in frequency | 0 to 100 |
| SysLim2Enable | Select system limit 2 (as above) | Enable, disable |
| **ShCurrMon** | Shaft current monitor - board point | Point edit (input FLOAT) |
| ShuntOhms | Shunt resistance | 0 to 100 |
| Shunt limit | Shunt maximum ohms | 0 to 100 |
| Brush limit | Shaft brush maximum ohms | 0 to 100 |
| SysLim1Enable | Select system limit 1 | Enable, disable |
| SysLim1Latch | Select whether alarm will latch | Latch, not latch |
| SysLim1Type | Select type of alarm initiation | >= or <= |
| SysLimit1 | Select alarm level in amps | 0 to 100 |

| | | |
|---|---|---|
| SysLim2Enable | Select system limit 2 | Enable, disable |
| **GenPT_KVolts** | Generator potential transfomer - board point | Point edit (input FLOAT) |
| PT_Input | PT input in kVrms for PT output | 0 to 1,000 |
| PT_Output | PT output in Vrms, nominal 115 V rms | 0 to 150 |
| SysLim1 | Select alarm level in kVrms | 0 to 1,000 |
| SysLim2 | Select alarm level in kVrms | 0 to 1,000 |
| **BusPT_Kvolts** | Bus potential transformer - board point | Point edit (input FLOAT) |
| **Ckt_Bkr** | Circuit breaker - board point | Point edit (input BIT) |
| System Frequency | Select frequency in Hz | 50 or 60 |
| CB1CloseTime | Breaker 1 closing time, ms | 0 to 1,000 |
| CB1 AdaptLimit | Breaker 1 self adaptive limit, ms | 0 to 1,000 |
| CB1 AdaptEnabl | Select breaker 1 self adaptive limit | Enable, disable |
| CB1FreqDiff | Breaker 1 special window frequency difference, Hz | 0 to 10 |
| CB1PhaseDiff | Breaker 1 special window phase difference, degrees | 0 to 30 |
| CB2CloseTime | Breaker 2 closing time, ms (as above) | 0 to 1,000 |
| **J4:IS200TRPGH1A** | TRPG terminal board, 8 flame detectors | Connected, not connected |

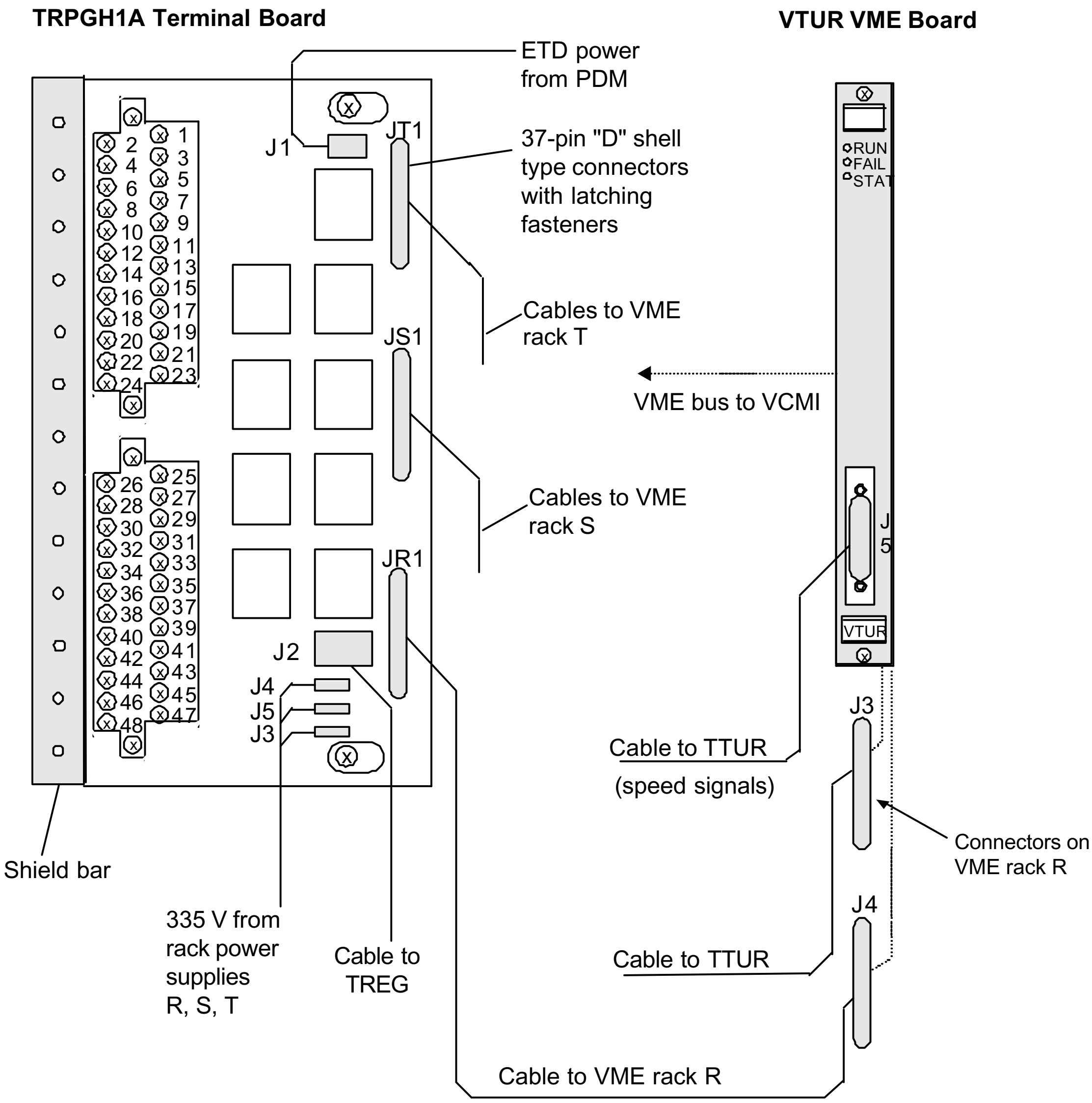
| **Board Points Signals** | **Description – Point Edit (Enter Signal Connection)** | **Direction** | **Type** |
|---|---|---|---|
| L3DIAG_VTUR1 | Board diagnostic | Input | BIT |
| L3DIAG_VTUR2 | Board diagnostic | Input | BIT |
| L3DIAG_VTUR3 | Board diagnostic | Input | BIT |
| ShShntTst_OK | Shaft voltage monitor shunt test OK | Input | BIT |
| ShBrshTst_OK | Shaft voltage brush test OK | Input | BIT |
| CB_Volts_OK | L3BKR_VLT circuit breaker coil voltage available | Input | BIT |
| CB_K25P_PU | L3BKR_PERM sync permissive relay picked up | Input | BIT |
| CB_K25_PU | L3KBR_GES auto sync relay picked up | Input | BIT |
| CB_K25A_PU | L3KBR_GEX sync check relay picked up | Input | BIT |
| Gen_Sync_LO | Generator sync trouble (lockout) | Input | BIT |
| L25_Command | -------- | Input | BIT |
| Kq1_Status | -------- | Input | BIT |
| : | : | Input | BIT |
| Kq6_Status | -------- | Input | BIT |
| FD1_Flame | -------- | Input | BIT |
| : | : | Input | BIT |
| FD16_Flame | -------- | Input | BIT |
| SysLim1PR1 | -------- | Input | BIT |
| : | : | Input | BIT |
| SysLim1PR4 | -------- | Input | BIT |

| | | | |
|---|---|---|---|
| SysLim1SHV | Ac shaft voltage frequency high L30TSVH | Input | BIT |
| SysLim1SHC | Ac shaft current high L30TSCH | Input | BIT |
| SysLim1GEN | -------- | Input | BIT |
| SysLim1BUS | -------- | Input | BIT |
| SysLim2PR1 | (same set as for Limit1 above) | Input | BIT |
| GenFreq | Hz frequency | Input | FLOAT |
| BusFreq | Hz frequency | Input | FLOAT |
| GenVoltsDiff | KiloVolts rms-Gen Low is negative | Input | FLOAT |
| Gen Freq Diff | Slip Hz-Gen Slow is negative | Input | FLOAT |
| Gen Phase Diff | Phase Degrees-Gen Lag is negative | Input | FLOAT |
| CB1CloseTime | Breaker #1 close time in milliseconds | Input | FLOAT |
| CB2CloseTime | Breaker #2 close time in milliseconds | Input | FLOAT |
| Accel1 | RPM/SEC | Input | FLOAT |
| : | : | Input | FLOAT |
| Accel4 | RPM/SEC | Input | FLOAT |
| FlmDetPwr1 | 335 V dc | Input | FLOAT |
| ShTestAC | L97SHAFT_AC SVM_AC_TEST | Output | BIT |
| ShTestDC | L97SHAFT_DC SVM_DC_TEST | Output | BIT |
| FD1_Level | 1 = high detection counts level | Output | BIT |
| : | : | Output | BIT |
| FD16_Level | 1 = high detection counts level | Output | BIT |
| Sync_Perm_AS | L83AS - auto sync permissive | Output | BIT |
| Sync_Perm | L25P - sequencing sync permissive | Output | BIT |
| Sync_Monitor | L83S_MTR - monitor mode | Output | BIT |
| Sync_Bypass1 | L25_BYP-1 = auto aync bypass | Output | BIT |
| Sync_Bypass0 | L25_BYPZ-0 = auto sync permissive | Output | BIT |
| CB2_Selected | L43SAUT2 - 2nd breaker selected | Output | BIT |
| AS_Win_Sel | L43AS_WIN - special window selected | Output | BIT |
| Sync_Reset | L86MR_SYNC - sync trouble reset | Output | BIT |
| Kq1 | L20PTR1 - primary trip relay | Output | BIT |
| : | : | Output | BIT |
| Kq6 | L20PTR6 - primary trip relay | Output | BIT |

# TRPG Primary Trip Terminal Board

The TRPG terminal board contains nine magnetic relays to interface with three trip solenoids, known as the Electrical Trip Devices (ETD). The TRPG works in conjunction with the TREG to form the *Primary* and *Emergency* sides of the interface to the ETDs. The H1A version for TMR applications has three voting relays per trip solenoid. The H2A version for simplex applications has one relay per trip solenoid. TRPG also accommodates eight Geiger Mueller flame detectors.

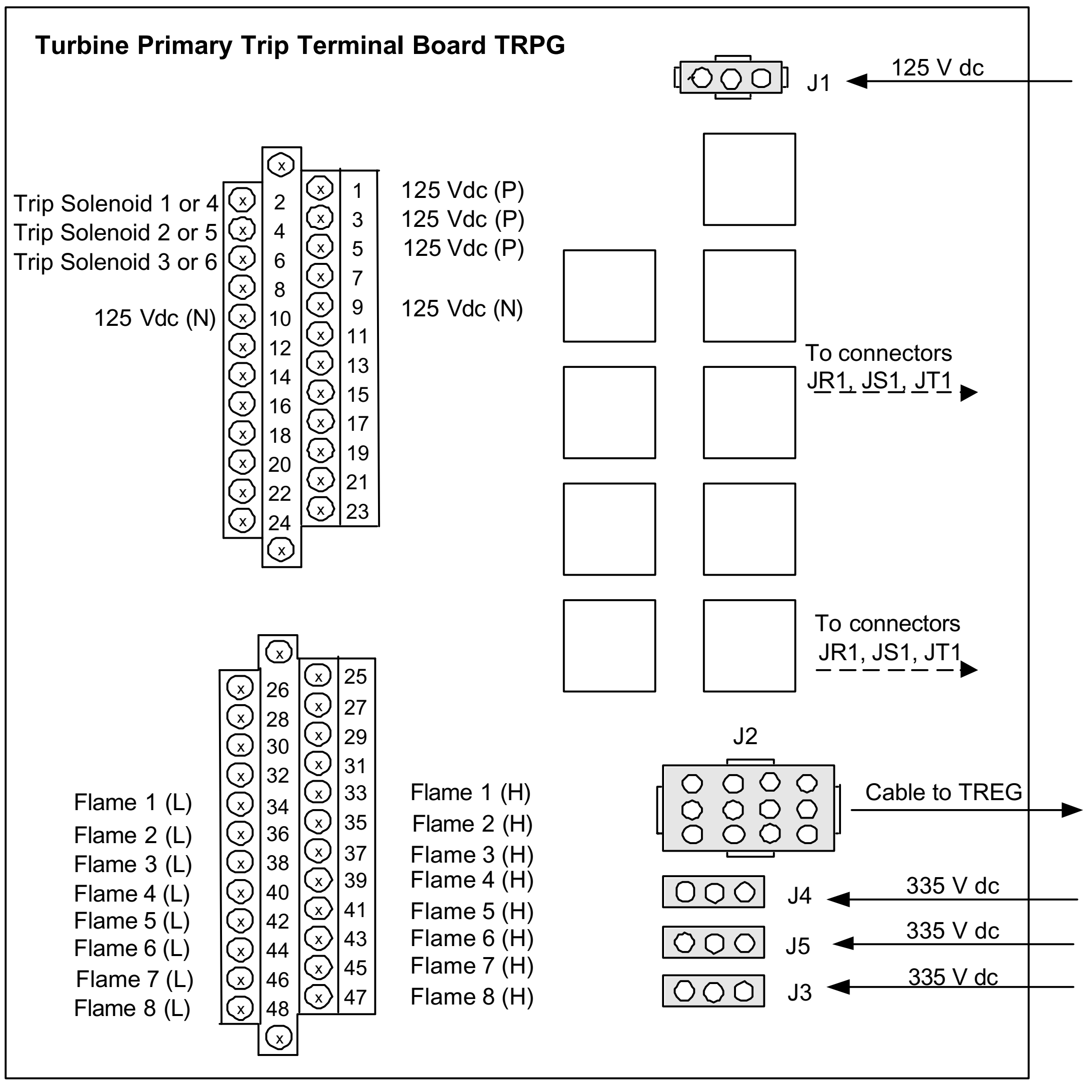
An optional double-width VTURH2A board can be cabled to a second TRPG board for interface to three additional ETDs, but **no** additional flame detectors.




*TRPG Terminal Board, I/O Board and Cabling*

## Installation

The three trip solenoids are wired directly to the first I/O terminal block and the flame detectors (if used) to the second terminal block. Power to the flame detectors is wired to J3, J4, and J5.



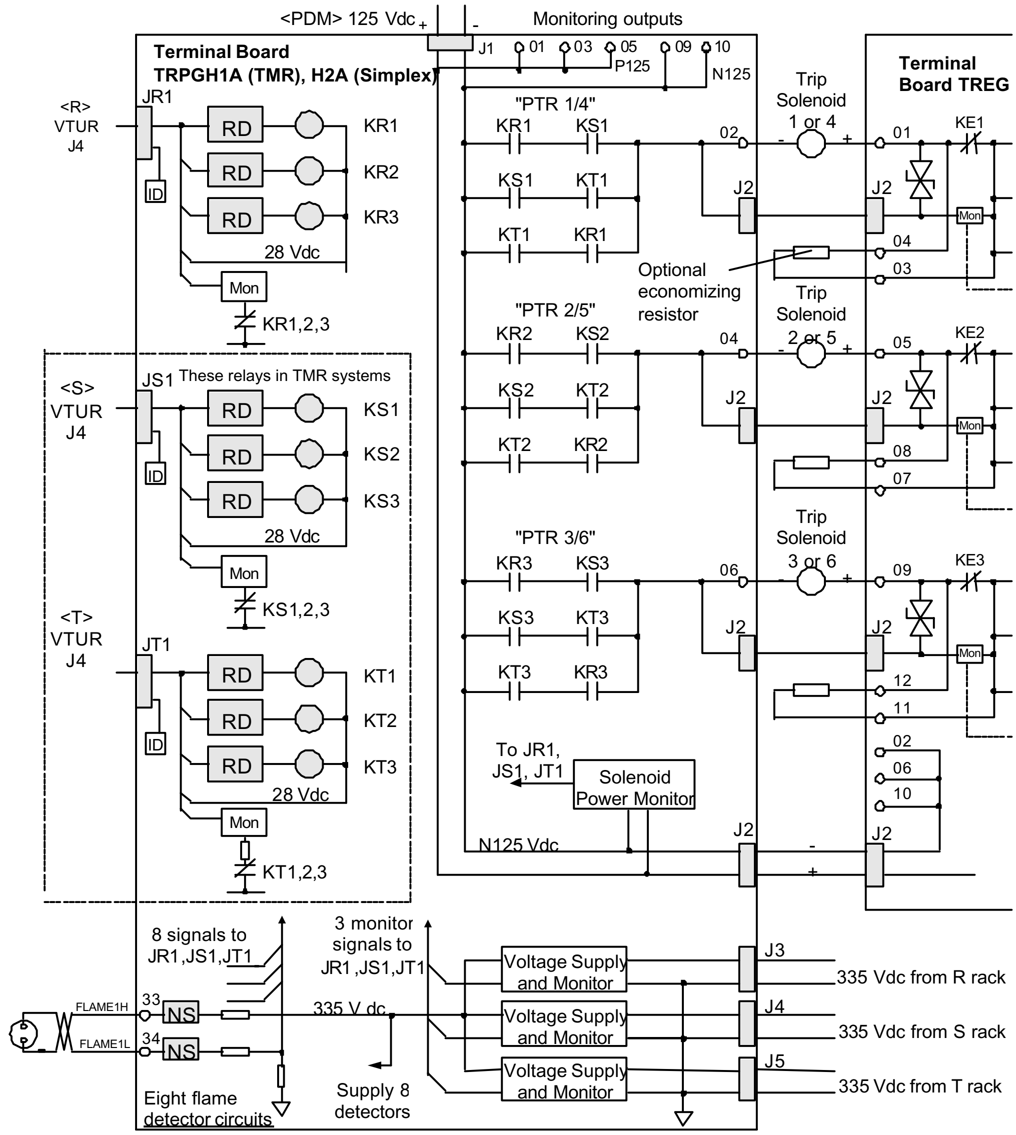

Up to two #12 AWG wires per point with 300 V insulation

Terminal blocks can be unplugged from terminal board for maintenance

*TRPG Terminal Board Wiring*

## Operation

VTUR provides the primary trip function by controlling the relays on TRPG, which trip the main protection solenoids. In TMR applications, the three inputs are voted in hardware using a relay ladder logic two-out-of-three voting circuit. Relay coil currents, contact status, and supply voltages are monitored for diagnostic purposes.




*TRPG and Trip Solenoids*

## Features

VTUR controls the main breaker through TTUR and three trip solenoids through TRPG. With a second TRPG, six trip solenoids can be controlled. In addition, VTUR handles shaft speed, generator voltage, and bus voltage inputs from TTUR, plus up to eight flame detector inputs from one TRPG board.

### Control Of Trip Solenoids

*In Simplex systems, TRPGH2 is used. This board has one relay per ETD circuit instead of three and is controlled by only one VTUR board.*

Both TRPG and TREG control the trip solenoids so that either one can remove power and close the steam or fuel valves. TRPG holds nine relays in three voting groups of three, one group for each trip solenoid. Voltage for the relay coils is supplied from the R, S, and T rack backplane. The trip solenoids are supplied with power through plug J1. A metal oxide varistor (MOV) for current suppression is on TREG, and an optional economizing current limiting resistor can be wired to the TREG terminals.

### Flame Detectors

Up to eight flame detectors can be used for gas turbine applications. The detectors are supplied with 335 V dc, 0.5 mA through plugs J3, J4, and J5.

*Voltage pulses above 2.5 volts generate a logic high, and the pulse rate over a 40 ms time period is measured in a counter.*

With no flame present, the detector charges up to the supply voltage, but presence of the flame causes the detector to charge to a level and then discharge through the TRPG board. As the flame intensity increases the discharge frequency increases. When the detector discharges, VTUR and TRPG convert the discharged energy into a voltage pulse. The pulse rate varies from 0 to 1,000 pulses/sec. These voltage pulses are fanned out to all three modules.

*TRPG Specification*

| Item | Specification |
|---|---|
| Trip solenoids | 3 solenoids per TRPG (total of 6 per VTUR) |
| Solenoid rated voltage/current | 125 V dc standard with up to 1 A draw<br>24 V dc is alternate with up to 1 A draw |
| Solenoid response time | L/R time constant is 0.1 sec |
| Current suppression | Metal oxide varister (MOV) on TREG |
| Current economizer | Terminals for optional 10 ohm, 70 watt economizing resistor |
| Control relay coil voltage supply | Relays supplied with 28 V dc from R, S, and T racks |
| Flame detectors | 8 detectors per TRPG (total of 8 per VTUR) |
| Detector supply voltage/current | 335 V dc with 0.5 mA per detector |

## Diagnostics

*The ID device is a read-only chip coded with the terminal board serial number, board type, revision number, and the plug location*

Descriptions of the TRPG diagnostics are listed under VTUR. The diagnostics include feedback from the trip solenoid relay driver and contact, solenoid power bus, and the flame detector excitation voltage too low or too high.

Connectors JR1, JS1, and JT1 on the terminal board have their own ID device, which is interrogated by the I/O board.

## *Configuration*

Like all I/O boards, the TRPG board is configured using the toolbox. This software usually runs on a data-highway connected CIMPLICITY station or workstation. The following table defines the configuration choices. For details refer to GEH-6403, *Control System Toolbox for Configuring the Mark VI Turbine Controller.*

*Typical TRPG Configuration*

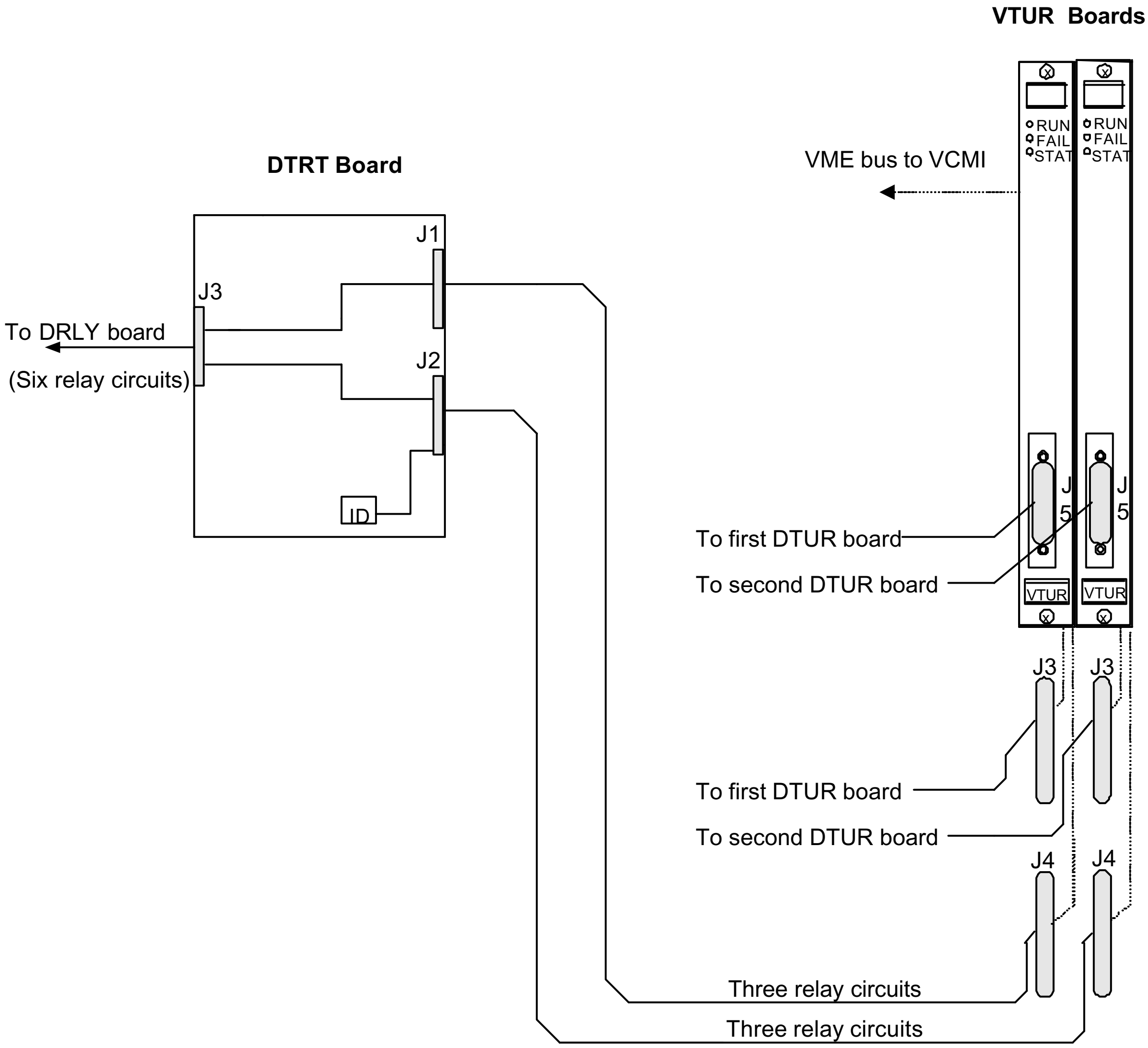
| Parameter | Description | Choices | |
|---|---|---|---|
| **Configuration** | | | |
| **J4:IS200TRPGH1A** | First TRPG terminal board | Connected, not connected | |
| **FlameInd1** | Intensity (Hz), flame detector number 1 - board point | Point edit (input FLOAT) | |
| FlmDetTime | Flame detector time interval | 0.04, 0.08, 0.16 sec | |
| FlameLimitHI | Flame threshold limit HI (HI detection cnts means LOW sensitivity) | 0 to 160 | |
| FlameLimitLOW | Flame threshold limit LO (LOW detection cnts means HI sensitivity) | 0 to 160 | |
| Flame_Det | Flame detector selected | Used, unused | |
| **FlameIndN** | Flame detectors 2 through 8 as above - board point | Point edit (input FLOAT) | |
| **Kq1_Status** | Primary trip relay status, first of 3 PTRs - board point | Point edit (input BIT) | |
| **Kq1** | Primary trip relay, first of three PTR - board point | Point edit (output BIT) | |
| PTR_Output | Primary trip relay - used/unused | Used, unused | |
| **J4A:IS200TRPGH1A** | Second TRPG board for expanded VTUR, with three more trip solenoid outputs, and flame detectors 9 through 16 (not used) | Connected, not connected | |
| **Board Points Signals** | **Description – Point Edit (Enter Signal Connection)** | **Direction** | **Type** |
| FlameInd1 | Intensity (Hz) | Input | FLOAT |
| : | Intensity (Hz) | Input | FLOAT |
| FlameInd8 | Intensity (Hz) | Input | FLOAT |

# DTRT Trip Transition Board

*Only the simplex version of this board is available.*

The DTRT board is a DIN-rail mounted trip transition board that interfaces the VTUR board with the DRLY board. DTRT allows up to six trip functions on the VTUR to interface with DRLY, instead of the normal TRPG board. Two VTUR boards can be connected to the DTRT to control a total of six relays on DRLY. DTRT transfers board identification from the ID chip on DRLY to VTUR for diagnostic purposes. DTRT has its own ID chip connnected to J2.

DTRT must be used in all applications where trips from VTUR to DRLY are required. DTRT cannot be eliminated if the application requires only one VTUR. Three 37-pin D connectors for the three cables are provided. A high density Euro-Block type terminal block is permanently mounted to the board with three screw connections for the ground connection (SCOM).



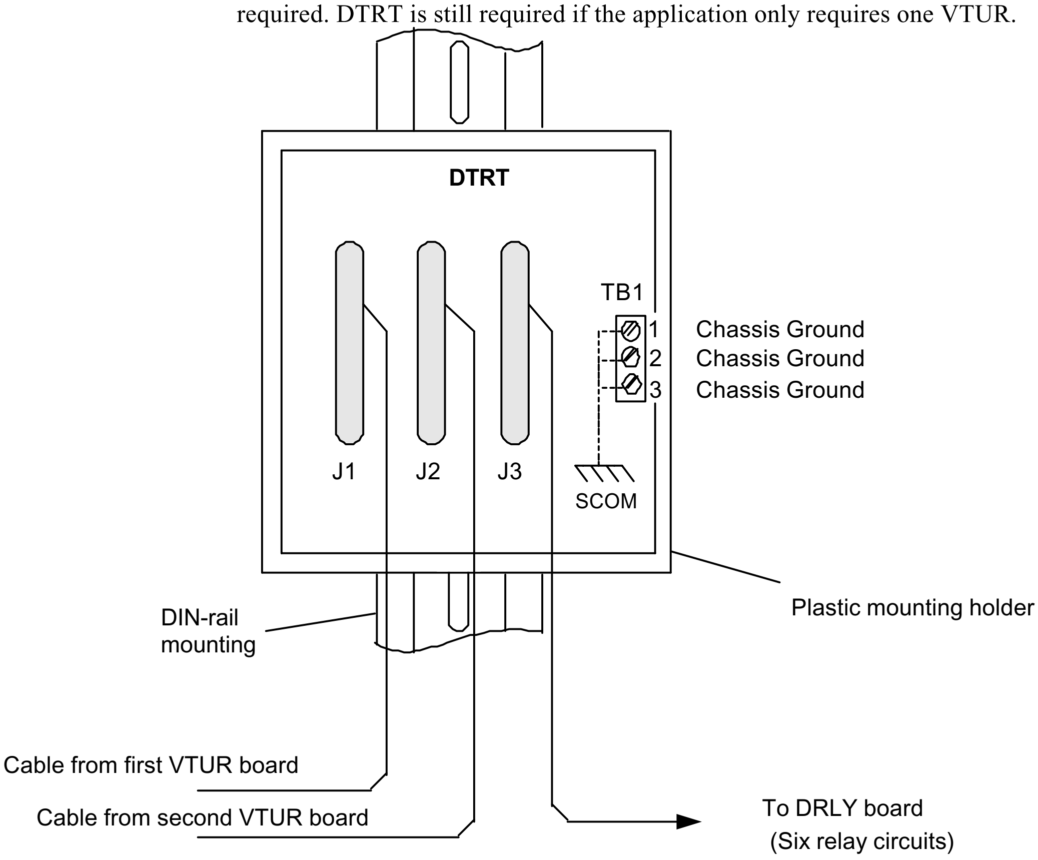

*DTRT Board*

## Installation

*There is no shield termination strip with this design.*

The DTRT board slides into a plastic holder, which mounts on the DIN-rail. The three cables connecting VTUR and DRLY plug into the 37-pin D type connector. The first three DRLY circuits are driven by the VTUR connected to J1, and the second three DRLY circuits are driven by the VTUR connected to J2. Three screws are provided on terminal block TB1 for the SCOM (ground) connection, which should be as short a distance as possible.

DTRT must be used in all applications where trips from VTUR to DRLYs are required. DTRT is still required if the application only requires one VTUR.



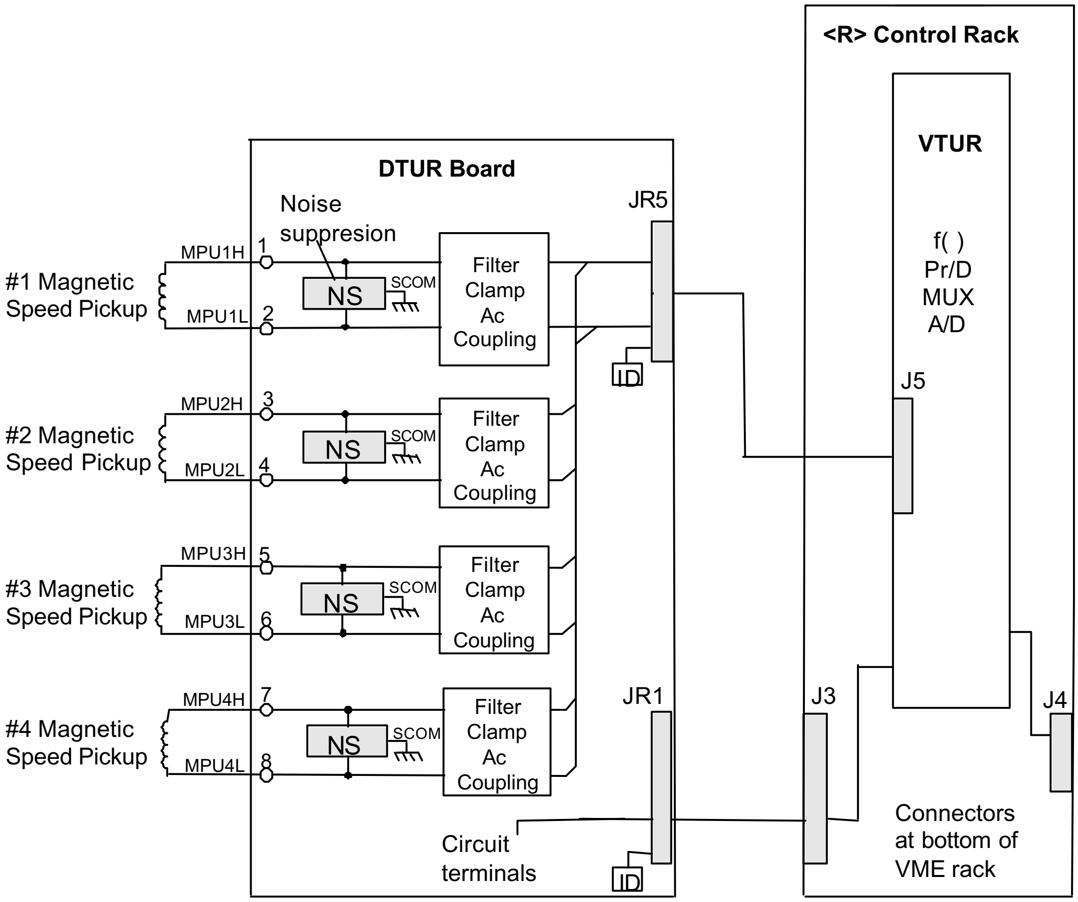

*DTRT Wiring and Cabling*

# DTUR Pulse Rate Terminal Board

*Only the simplex version is available.*

The DTUR board is a compact pulse-rate terminal board, designed for DIN-rail mounting. The board accepts four passive pulse-rate transducers (magnetic pickups) for speed and flow measurement. It connects to the VTUR processor board with a 37-pin cable and a 15-pin cable. These cables are identical to those used on the larger TTUR terminal board. DTUR boards can be stacked vertically on the DIN-rail to conserve cabinet space. VTUR only accommodates one DTUR board.

DTUR has onboard pulse rate signal conditioning identical to that on the TTUR. High density Euro-Block type terminal blocks are permanently mounted to the board with two screws for the ground connection (SCOM). Two on-board ID chips identify the connectors and board to VTUR for system diagnostic purposes.

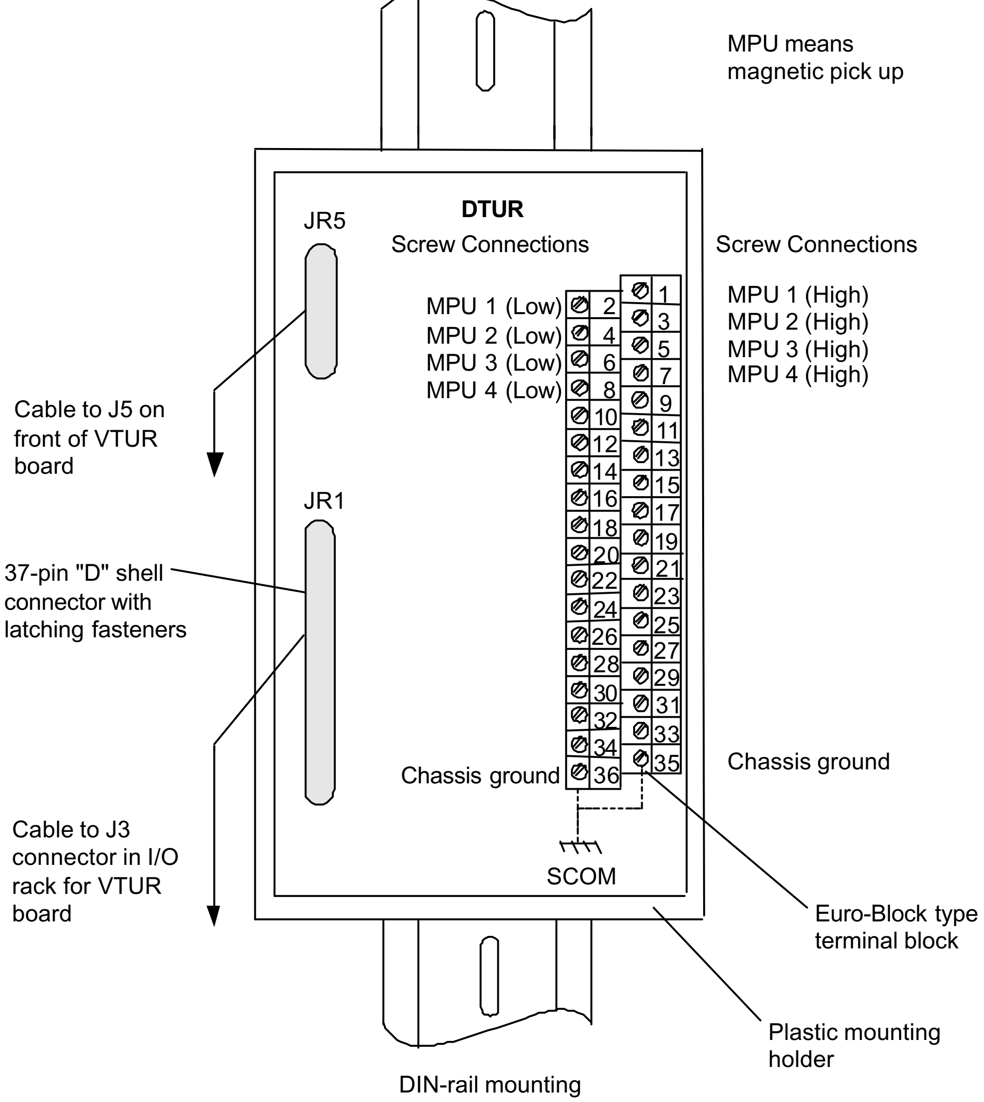



*DTUR Board*

## Installation

*There is no shield termination strip with this design.*

The DTUR board slides into a plastic holder, which mounts on the DIN-rail. The magnetic pickups are wired directly to the terminal block which has 36 terminals. Typically #18 AWG shielded twisted pair wiring is used. There are two screws for the SCOM (ground) connection, which should be as short a distance as possible.




*DTUR Wiring and Cabling*

# I/O Board Alarms

Diagnostic alarms for any I/O board can be displayed and reset from the toolbox. For troubleshooting and general diagnostic alarm information refer to GEH-6421 Volume I, Chapter 8.

*I/O Board Diagnostic Alarms*

| Board | Fault | Fault Description | Possible Cause |
|---|---|---|---|
| **VTUR** | **2** | Flash Memory CRC Failure | Board firmware programming error (board will not go online) |
| | **3** | CRC failure override is Active | Board firmware programming error (board is allowed to go online) |
| | **16** | System Limit Checking is Disabled | System checking was disabled by configuration |
| | **17** | Board ID Failure | Failed ID chip on the VME I/O board |
| | **18** | J3 ID Failure | Failed ID chip on connector J3, or cable problem |
| | **19** | J4 ID Failure | Failed ID chip on connector J4, or cable problem |
| | **20** | J5 ID Failure | Failed ID chip on connector J5, or cable problem |
| | **21** | J6 ID Failure | Failed ID chip on connector J6, or cable problem |
| | **22** | J3A ID Failure | Failed ID chip on connector J3A, or cable problem |
| | **23** | J4A ID Failure | Failed ID chip on connector J4A, or cable problem |
| | **24** | Firmware/Hardware Incompatibility | Invalid terminal board connected to VME I/O board |
| | **30** | ConfigCompatCode mismatch; Firmware: #; Tre: # The configuration compatibility code that the firmware is expecting is different than what is in the tre file for this board | A tre file has been installed that is incompatible with the firmware on the I/O board. Either the tre file or firmware must change. Contact the factory. |
| | **31** | IOCompatCode mismatch; Firmware: #; Tre: # The I/O compatibility code that the firmware is expecting is different than what is in the tre file for this board | A tre file has been installed that is incompatible with the firmware on the I/O board. Either the tre file or firmware must change. Contact the factory. |
| | **32-37** | Solenoid # Relay Driver Feedback Incorrect. Solenoid (1-6) relay driver feedback is incorrect as compared to the command; VTUR cannot drive the relay correctly until the hardware failure is corrected | The solenoid relay driver on the TRPG/L/S board has failed, or the cabling between VTUR and TRPG/L/S is incorrect. |
| | **38-43** | Solenoid # Contact Feedback Incorrect. Solenoid (1-6) relay contact feedback is incorrect as compared to the command; VTUR cannot drive the relay correctly until the hardware failure is corrected | The solenoid relay driver or the solenoid relay on the TRPG/L/S board has failed, or the cabling between VTUR and TRPG/L/S is incorrect. |

| | | |
|---|---|---|
| **44-45** | TRPG # Solenoid Power Absent. P125/24 V dc power is not present on TRPG terminal board; VTUR cannot energize trip solenoids 1 through 3, or 4 through 6 until power is present | Power may not be coming into TRPG/L/S on the J1 connector, or the monitoring circuit on TRPG/L/S is bad, or the cabling between TRPG/L/S and VTUR is at fault. |
| **46,48** | TRPG # Flame Detector Volts Low at Y Volts. TRPG 1 or 2 flame detect voltage is low; the ability to detect flame by detectors 1 through 8, or 9 through 16 is questionable | Power comes into TRPG via J3, J4, and J5. If the voltage is less than 314.9 V dc, this should be investigated. If the voltage is above this value, the monitoring circuitry on TRPG or the cabling between TRPG and VTUR is suspect. |
| **47,49** | TRPG # Flame Detector Volts High at Y Volts. TRPG 1 or 2 flame detect voltage is high; the ability to detect flame by detectors 1 through 8, or 9 through 16 is questionable because the excitation voltage is too high and the devices may be damaged | This power comes into TRPG via J3, J4, and J5. If the voltage is greater than 355.1 V dc, this should be investigated. If the voltage is below this value, the monitoring circuitry on TRPG or the cabling between TRPG and VTUR is suspect. |
| **50** | L3BKRGXS – Synch Check Relay is Slow. The auto synchronization algorithm has detected that during synchronization with no dead bus closure (synch bypass was false) the auto synch relay I3BKRGES closed before synch relay I3BKRGEX closed | The synch check relay I3BKRGXS, known as K25A, on TTUR is suspect; also the cabling between VTUR and TTUR may be at fault. |
| **51** | L3BKRGES – Auto Synch Relay is Slow. The auto synchronization algorithm has detected that the auto synch relay I3BKRGES had not closed by two cycle times after the command I25 was given | The Auto synch relay I3BKRGES also known as K25, on TTUR is suspect; also the cabling between VTUR and TTUR may be at fault. |
| **52-53** | Breaker # Slower than Adjustment Limit Allows. Breaker 1 or 2 close time was measured to be slower than the auto synch algorithms adaptive close time adjustment limit allows | The breaker is experiencing a problem, or the operator should consider changing the configuration (both nominal close time and self-adaptive limit in ms can be configured). |
| **54** | Synchronization Trouble - K25 Relay Locked Up. The auto synchronization algorithm has determined that the auto synch relay I3BKRGES, also known as K25, is locked up. Auto synch will not be possible until the relay is replaced | K25 on TTUR is most likely stuck closed, or the contacts are welded. |
| **55** | Card and Configuration File Incompatibility. You are attempting to install a VTUR board that is not compatible with the VTUR TRE file you have installed | Install the correct TRE file from the factory |
| **56** | Term Board on J5X and Config File Incompatibility. VTUR detects that the terminal board that is connected to it through J5 is different than the board that is configured | Check your configuration. |
| **57** | Term Board on J3 and Config File Incompatibility. VTUR detects that the terminal board that is connected to it through J3 is different than the board that is configured | Check your configuration. |
| **58** | Term Board on J4 and Config File Incompatibility. VTUR detects that the terminal board that is connected to it through J4 is different than the board that is configured | Check your configuration. |
| **59** | Term Board on J4A and Config File Incompatibility. VTUR detects that the terminal board that is connected to it through J4A is different than the board that is configured | Check your configuration. |

| | | |
|---|---|---|
| **60** | Term. Board TTUR and card VTUR Incompatibility. VTUR detects that the TTUR connected to it is an incompatible hardware revision | The TTUR or VTUR must be changed to a compatible combination. |
| **61** | TRPL or TRPS Solenoid Power Bus "A" Absent | Cabling problem or solenoid power source |
| **62** | TRPL or TRPS Solenoid Power Bus "B" Absent | Cabling problem or solenoid power source |
| **63** | TRPL or TRPS Solenoid Power Bus "C" Absent | Cabling problem or solenoid power source |
| **64-66** | TRPL/S J4 Solenoid # Voltage mismatch. The voltage feedback disagrees with the PTR or ETR feedback | PTR or ETR relays, or defective feedback circuitry |
| **128-223** | Logic Signal # Voting mismatch. The identified signal from this board disagrees with the voted value | A problem with the input. This could be the device, the wire to the terminal board, the terminal board, or the cable. |
| **224-251** | Input Signal # Voting mismatch, Local #, Voted #. The specified input signal varies from the voted value of the signal by more than the TMR Diff Limit | A problem with the input. This could be the device, the wire to the terminal board, the terminal board, or the cable. |

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