GE PTUR, YTUR Turbine Specific Primary Trip

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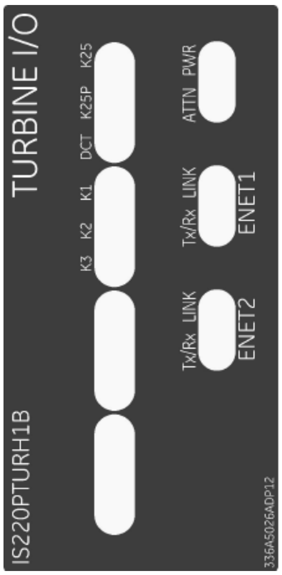
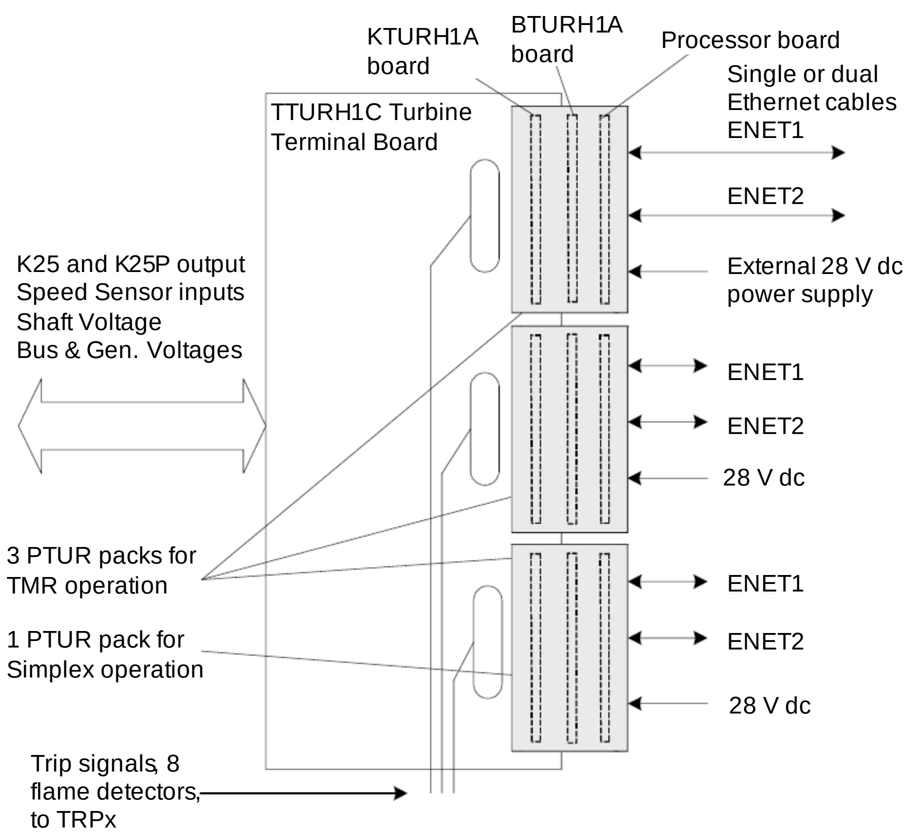
11 PTUR, YTUR Turbine Specific Primary Trip

11.1 Mark VIe PTUR Primary Turbine Protection I/O Pack



The Turbine Specific Primary Trip (PTUR) I/O pack provides the electrical interface between one or two I/O Ethernet networks and a turbine control terminal board. The PTUR contains a processor board common to the distributed I/O packs, a board specific to the turbine control function, and an analog acquisition daughterboard. The I/O pack plugs into the TTURH1C terminal board and handles four speed sensor inputs, bus and generator voltage inputs, shaft voltage and current signals, eight flame sensors, and outputs to the main breaker. Input to the pack is through dual RJ-45 Ethernet connectors and a three-pin power input. Output is through a DC-62 pin connector that connects directly with the associated terminal board connector. Visual diagnostics are provided through indicator LEDs.

As an alternative to TTURH1C, three PTUR I/O packs can be plugged directly into a TRPAH1A terminal board. This arrangement handles four speed inputs per PTUR, or alternately fans the first four inputs into all three PTURs. Two solid-state primary trip relays are provided by the TRPA. This arrangement does not support bus and generator voltage inputs, shaft voltage or current signals, flame sensors, or main breaker output. For simplex applications, the STUR terminal boards can be used.



11.1.1 Compatibility

The PTUR I/O pack includes one of the following compatible BPPx processor boards:

- The PTURH1A contains a BPPB processor board.
- The PTURH1B contains a functionally compatible BPPC processor board that is supported in the ControlST* software suite V04.07 and later.

TMR Compatible Trip and Terminal Boards

	Terminal Board		
Trip Board	**TTUR H1C**	**TRPA H1A**	**TRPA H2A**
No Trip Board	X	X	X
TRPA H1A	X		
TRPA H2A	X		
TRPG H1B	X		
TRPG H3B	X		
TRPL H1A	X		
TRPS H1A	X		

Simplex Compatible Trip and Terminal Boards

	Terminal Board				
Trip Board	**TTUR H1C**	**STUR H1A**	**STUR H2A**	**STUR H3A**	**STUR H4A**
No Trip Board		X	X	X	
TRPG H2B	X			X	X
TRPS H1A	X			X	X

11.1.2 Installation

Caution

In 240 V ac applications, do not inadvertently cross-connect the 240 V ac and the dc voltages. The peak voltage will exceed the Transorb rating, resulting in a failure.

Most ac supplies operate with a grounded neutral, and if an inadvertent connection between the 125 V dc and the ac voltage is created, the sum of the ac peak voltage and the 125 V dc is applied to Transorbs connected between dc and ground. However, in 120 V ac applications, the Transorb rating can withstand the peak voltage without causing a failure.

➢ **To install the PTUR I/O pack**

1. Securely mount the desired terminal board.
2. Directly plug the PTUR I/O pack into the terminal board connectors.
3. Mechanically secure the I/O pack(s) using the threaded studs adjacent to the Ethernet ports. The studs slide into a mounting bracket specific to the terminal board type. The bracket location should be adjusted such that there is no right-angle force applied to the DC-62 pin connector between the I/O pack and the terminal board. The adjustment should only be required once in the service life of the product.

Note The PTUR mounts directly to a TTUR, STUR, or TRPA terminal board. The TMR TTUR and TRPA have three DC-62 pin connectors for I/O packs. For simplex, either STUR or TTUR can be used.

4. Plug in one or two Ethernet cables depending on the system configuration. The I/O pack will operate over either port. If dual connections are used, the standard practice is to connect ENET1 to the network associated with the R controller.
5. Apply power to the I/O pack by plugging in the connector on the side of the I/O pack. It is not necessary to remove power from the cable before plugging it in because the I/O pack has inherent soft-start capability that controls current inrush on power application.
6. Use the ToolboxST* application to configure the I/O pack as necessary. Refer to *GEH-6700, ToolboxST User Guide for Mark VIe Control*, for more information.

11.1.2.1 Connectors

- The DC 62-pin connector on the underside of the I/O pack connects directly to a discrete output terminal board.
- The RJ-45 Ethernet connector (ENET1) on the I/O pack side is the primary system interface.
- The second RJ-45 Ethernet connector (ENET2) on the I/O pack side is the redundant or secondary system interface.

Note The terminal board provides fused power output from a power source that is applied directly to the terminal board, not through the I/O pack connector.

11.1.3 Operation

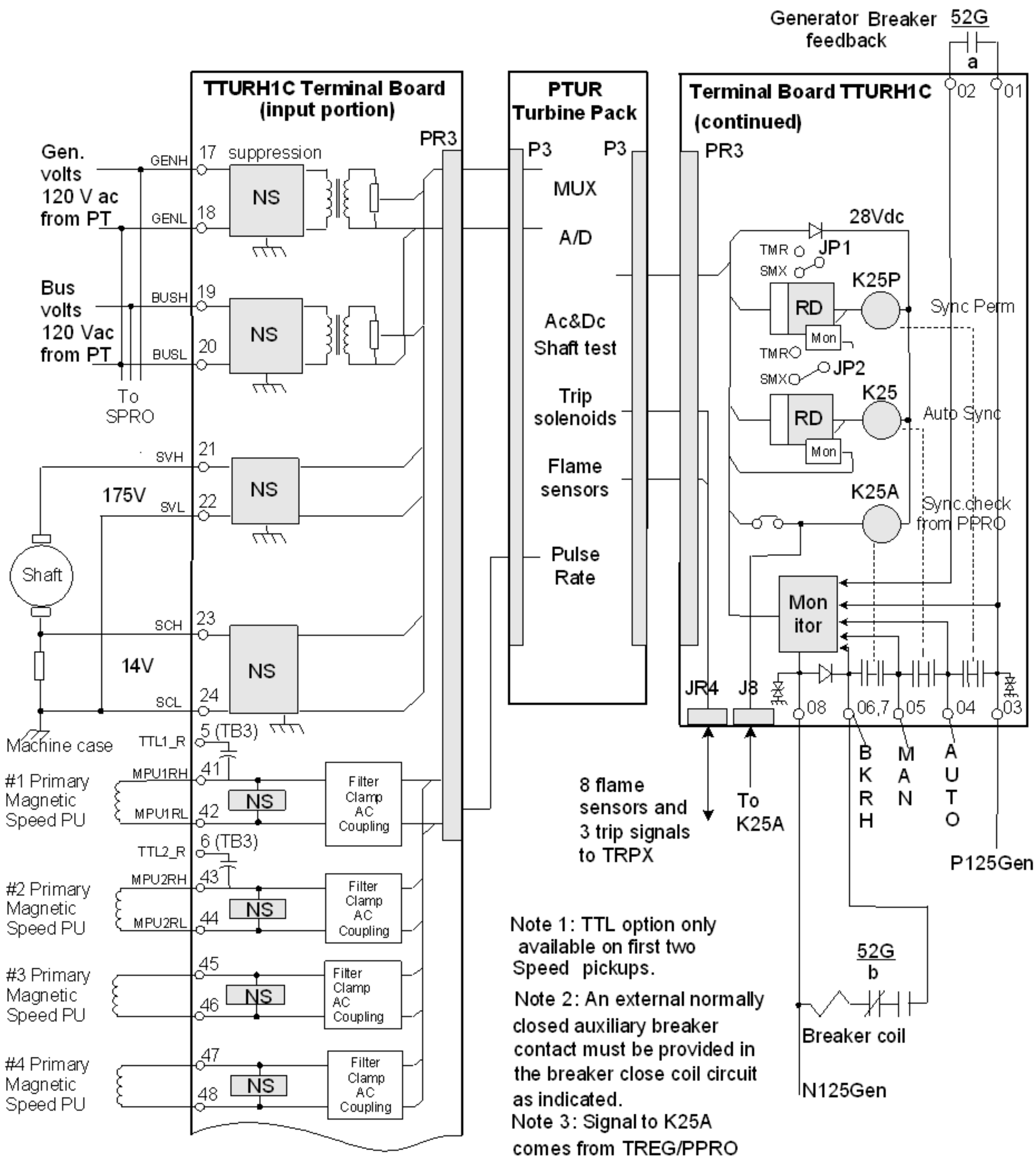
Refer to the following sections in the *GEH-6721_Vol_II*, the chapter, *Common Module Content*:

- *Auto-reconfiguration*
- *BPPx Processor*
- *Processor LEDs*
- *Power Management*
- *ID Line*
- *Common Module Alarms*

11.1.3.1 Analog Input Hardware

In simplex applications, up to four pulse rate signals may be used to measure turbine speed. The PTUR I/O pack contains circuits to convert pulse rate inputs to digital speed. Generator and bus voltages are brought into PTUR for automatic synchronizing in conjunction with the turbine controller and GE 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. PTUR alarms high voltages and tests the integrity and continuity of the circuitry.

In TMR applications there are separate sets of four speed inputs for each PTUR, R, S, and T. All other inputs fan to the three PTUR I/O packs. Control signals from R, S, and T are voted before they actuate permissive relays K25 and K25P. Relay K25A is controlled by the PPRO. All three relays have two normally open contacts in series with the breaker close coil.



PTUR with TTURH1C Terminal Board, Simplex System

11.1.3.2 Speed Pickups

An interface is provided for four passive, magnetic speed inputs with a frequency range of 2 to 20,000 Hz. Using passive pickups on a sixty-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.

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

Pulse rate inputs can be configured for a variety of applications. When using the configuration parameter *PRType*, flow type is used for flow divider fuel flow measurements. Speed type is used for normal single shaft turbines. Speed_High type provides extended speed range above the standard speed type. Speed_LM type is designed for LM applications. Speed_HSNG type is used for applications where compensation for inconsistent tooth spacing on the speed wheel is desired. This pulse rate type will map the spacing of the teeth on the speed wheel to remove this periodic variation from speed measurements. Mapping locked status bits (**HSNGn_Stat**) are in signal space so that the mapping status of the algorithm can be observed. If the status indicator for a pulse rate input is false, then the mapping algorithm sees too much variation in the tooth-tooth measurements to lock onto the tooth geometry.

Note The primary overspeed trip calculations are performed in the controller using algorithms similar to (but not the same as) those in the PPRO. The optional fast overspeed trip for gas turbines runs in the PTUR.

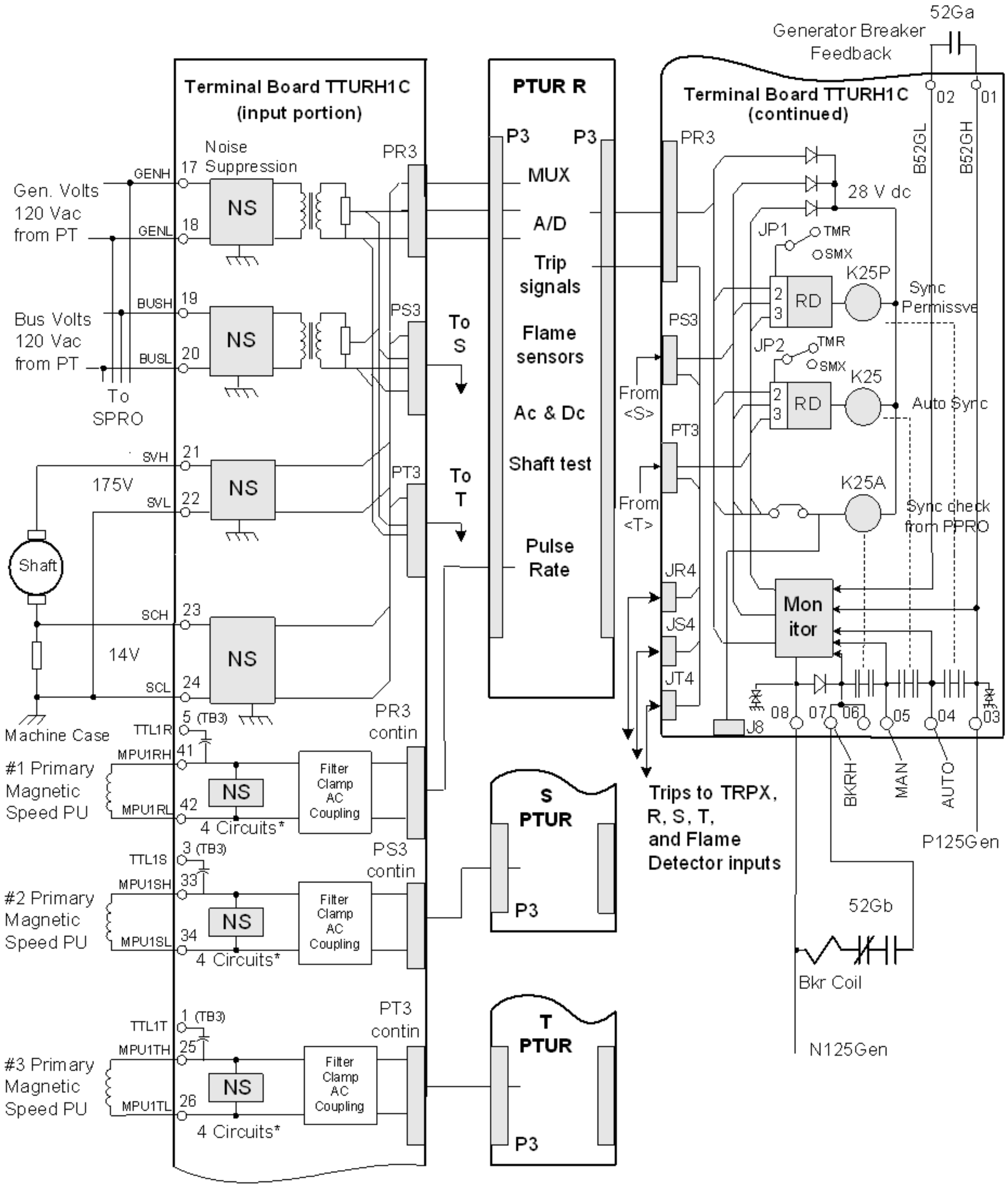
The **Lock_Limit** parameter can be adjusted in 1% increments to allow for more tooth-to-tooth variation per revolution caused by some of the following issues:

- Magnetized speed wheel
- Electro-magnetic interference from outside sources
- Improper wiring or shielding practices

Increasing the **Lock_Limit** value will allow the HSNG speed algorithm to stay locked with increased variation.

Attention

The cost for opening the Lock_Limit is that it will allow for more speed variation. If the speed variation is too high when opening up the Lock_Limit, go to the source of the problem as listed above and correct the issue there.



Note 1: TTL option only available on the first two circuits of each group of 4 pickups.

PTUR I/O Packs with TTURH1C Terminal Board, TMR System

11.1.3.3 Primary Trip Solenoid Interface

The normal primary overspeed trip is calculated in the controller and passed to the PTUR and then to the chosen primary trip terminal board. TRPx contains relays for interface with the electrical trip devices (ETD). TRPx typically works in conjunction with an emergency trip board (TREx) to form the primary and emergency sides of the interface to the ETDs. The PTUR supports up to three ETDs driven from each TRPx/TREx combination.

There are a number of different trip boards supported by the PTUR:

- TRPG is targeted at gas turbine applications and works in conjunction with TREG for emergency trip.
- TRPS is used for small and medium size steam turbine systems and is controlled by the PTUR I/O pack.
- TRPL is intended for large steam turbine systems and is controlled by the PTUR I/O pack for emergency trip.
- TRPA and TREA are used for Aero applications.

In support of the trip board operation, the PTUR provides a number of discrete inputs used to monitor signals, such as trip relay position, synchronizing relay coil drive, and ETD power status.

11.1.3.4 Synchronizing System

The synchronizing system interfaces to the breaker close coil through the TTURH1C terminal board. Three Mark VIe control relays must be picked up, plus external permissions must be true, before a breaker can be closed. Both sides of the breaker close coil power bus must be connected to the TTUR board. This provides diagnostic information and measures the breaker closure time, through the normally open breaker auxiliary contact, for optimization. The breaker close circuit is rated to make (close) **10 A at 125 V dc, but to open only 0.6 A**. A normally open auxiliary contact on the breaker is required to interrupt the closing coil current.

The K25P relay is directly driven from the controller application code. In a TMR system, it is driven from R, S, and T, using 2 out of 3 logic voting. For a simplex system, it may be configured by jumper to be driven from R only.

The K25 relay is driven from the PTUR auto sync algorithm, which is managed by the controller application code. In a TMR system, it is driven from R, S, and T, using 2 out of 3 logic voting. For a simplex system, it may be configured by jumper to be driven from R only.

The K25A relay is located on TTUR, but is driven from the PPRO sync check algorithm, which is managed by the controller application code. The relay is driven from the PPRO, using 2 out of 3 logic voting in TREG/L/S. The sync check relay driver (located on TREG/L/S) is connected to the K25A relay coil (located on TTUR) through cabling from the J2 connector to TRPG/L/S. It then goes through JR1 (and JS1, JT1) to JR4 (and JS4, JT4) on TTUR.

11.1.3.5 Synchronizing Modes

There are four basic synchronizing modes: Off, Manual, Auto, and Monitor:

Off The breaker cannot be closed by the controller. The K25A check relay will not pick up.

Manual The operator initiates breaker close, which is still subject to the K25A Sync Check contacts driven by the PPRO or YPRO. The manual close is initiated from an external contact on the generator panel, normally connected in series with a sync mode in manual contact.

Auto The system automatically matches voltage and speed, and then closes 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 - sync check relay, checks the allowable slip or phase window, from the PPRO or YPRO
- K25 - auto sync relay, provides precision synchronization, from the PTUR or YTUR
- K25P - sync sequence permissive, checks the turbine sequence status, from the PTUR or YTUR

The K25A relay should close before the K25 or else the sync check function will interfere with the auto sync optimizing. If this sequence does not run, a diagnostic alarm occurs, a lockout signal is set to True. The application code may prevent any further attempts to synchronize until a reset is issued and the correct coordination is set up.

Monitor The monitor mode is identical to the auto sync mode except it blocks the actual closure of the K25 relay contacts. The intended K25 breaker closure command can be monitored using the parameter L25_Command. Monitor mode is used to verify that the performance of the system is correct; it is used as a confidence builder.

11.1.3.6 Automatic Synchronizing

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

Turbine speed is matched against the bus frequency. The generator and bus voltages are matched by adjusting the generator field excitation voltage from commands sent between the turbine controller and the excitation controller over the Unit Data Highway (UDH). A command is given to close the breaker when all permissions are satisfied. The breaker is predicted to close within the calculated phase or 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 database.

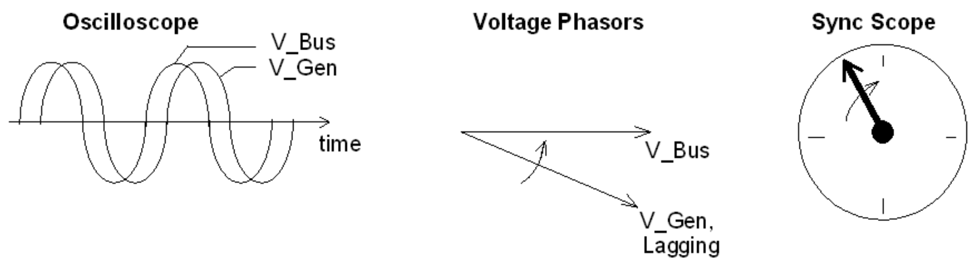
An internal K25A sync check relay is provided on the TTUR. The independent backup phase or slip calculation for this relay is performed in the PPRO or YPRO. Diagnostics monitor the relay coil and contact closures to determine if the relay properly energizes or de-energizes upon command.

11.1.3.7 Auto Sync Application Code

The application code must sequence the turbine and bring it to a state where it is ready for the generator to synchronize with the system bus. For automatic synchronization, the code must:

- Match speeds
- Match voltages
- Energize the sync permissive relay, K25P
- Arm (grant permission to) the sync check function (PPRO, K25A)
- Arm (grant permission to) the auto sync function (PTUR, K25)

The following illustrations represent positive slip (Gen) and negative phase (Gen).



11.1.3.8 Automatic Synchronizing Algorithm

The PTUR or YTUR runs the auto sync algorithm. Its basic function is to monitor two Potential Transformer (PT) inputs, generator and bus, to calculate phase and slip difference, and when armed (enabled) from the application code, and when the calculations anticipate top center, to attempt a breaker closure by energizing relay K25. The algorithm uses the zero voltage crossing technique to calculate phase, slip, and acceleration. It compensates for breaker closure time delay (configurable), with self-adaptive control when enabled, with configurable limits. It is interrupt driven and must have generator voltage to function. The configuration can manage the timing on two separate breakers.

The algorithm has a bypass function, two signals for redundancy, to provide dead bus and Manual Breaker Closures. It anticipates top dead center; therefore, it uses a projected window, based on current phase, slip, acceleration, and breaker closure time. To pickup K25, the generator must be currently lagging, have been lagging for the last 10 consecutive cycles, and projected (anticipated) to be leading when the breaker actually reaches closure. Auto sync will not allow the breaker to close with negative slip. In this fashion, assuming the correct breaker closure time has been acquired, and the sync check relay is not interfering, breaker closures with less than 1 degree error can be obtained.

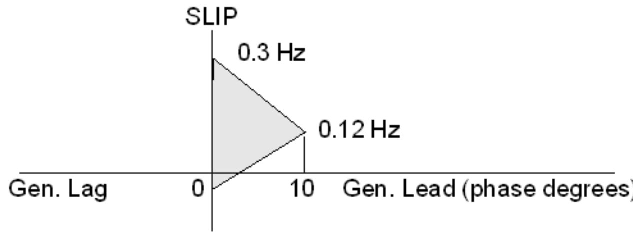
Slip is the difference frequency (Hz), positive when the generator is faster than the bus. Positive phase means the generator is leading the bus; the generator is ahead in time, or the right hand side on the synchroscope. The standard window is fixed and is not configurable. However, a special window has been provided for synchronous condenser applications where a more permissive window is needed. It is selectable with a signal space Boolean and has a configurable slip parameter.

The algorithm validates both PT inputs with a requirement of 50% nominal amplitude or greater; that is, they must exceed approximately 60 V rms before they are accepted as legitimate signals. This is to guard against cross talk under open circuit conditions. The monitor mode is used to verify that the performance of the system is correct and to block the actual closure of the K25 relay contacts. It is used as a confidence builder. The signal space Input Gen_Sync_Lo will become true if the K25 contacts are closed when they should not be closed, or if the Sync Check K25A is not picked up before the Auto Sync K25. It is latched and can be reset with Sync_Reset.

The algorithm compensates for breaker closure time delay, with a nominal breaker close time, provided in the configuration in milliseconds. This compensation is adjusted with self-adaptive control, based upon the measured breaker close time. The adjustment is made in increments of one cycle (16.6/20 ms) per breaker closure and is limited in authority to a configurable parameter. If the adjustment reaches the limit, a diagnostic alarm, *Breaker Slower/Faster Than Limits Allows* is posted.

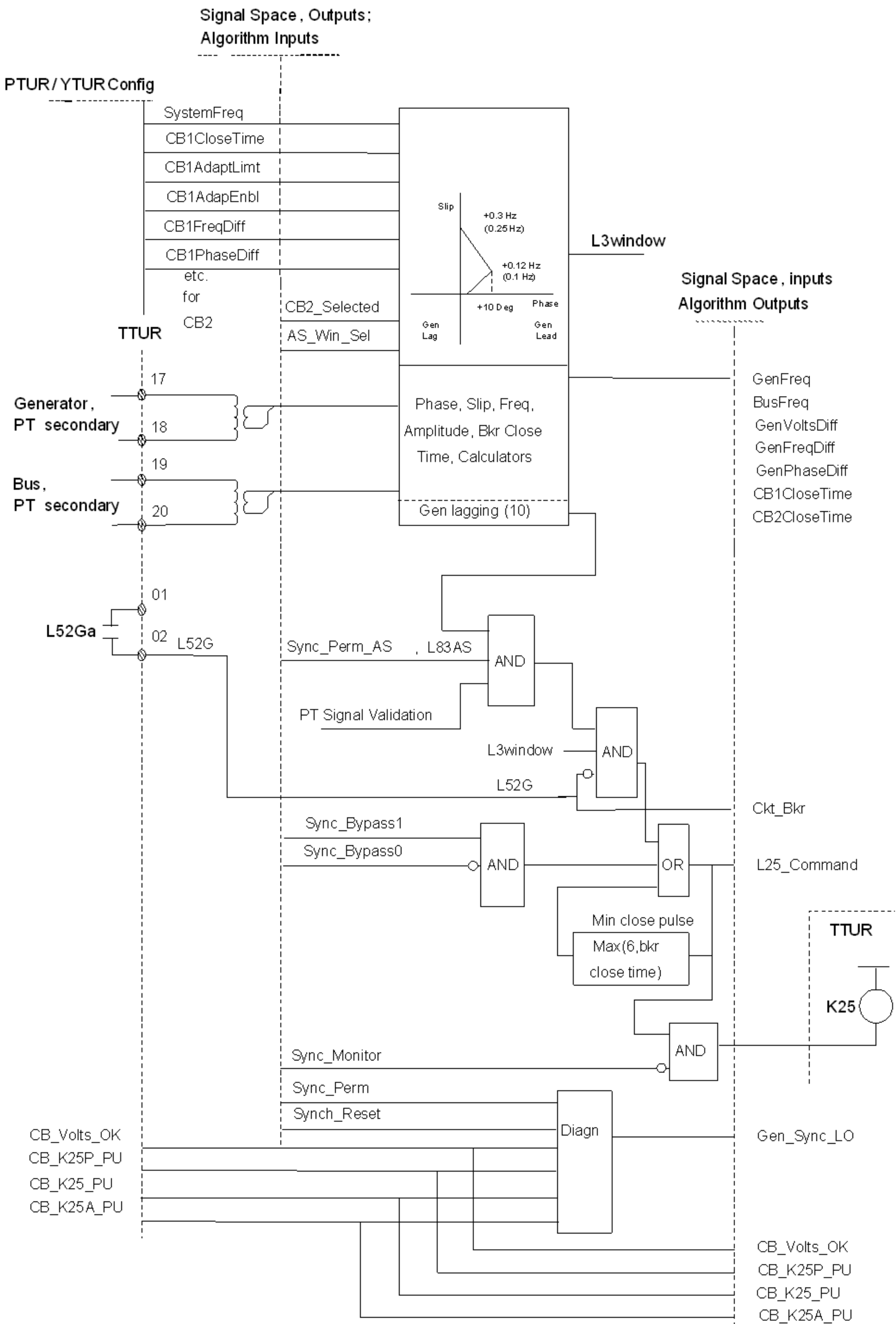
The Auto Sync K25 function uses zero voltage crossing techniques. It compensates for the breaker time delay, which is defined by two adjustable constants with logic selection between the two (for two breaker applications). The calculations, which are done on the PTUR or YTUR I/O pack, include phase, 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 sync arms logic to enable the function, and bypasses logic to provide for deadbus or manual closure. The auto sync projected sync window is displayed below, where positive slip indicates that the generator frequency is higher than the bus frequency.



Auto Sync 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 sync will not allow the breaker to close with negative slip; speed matching typically aims at around + 0.12 Hz slip.



Automatic Synchronizing Algorithm

11.1.3.9 Synchronization Testing

The hardware interface may be verified by forcing the three synchronizing relays, individually or in combination. If the breaker close coil is connected to the TTUR terminal board, then the breaker must be disabled so as not to actually connect the generator to the system bus.

➢ **To verify the hardware interface**

1. Operate the K25P relay by forcing output signal *Sync Perm* found under PTUR, card points. Verify that the K25P relay is functional by probing TTUR screws 3 and 4. The application code has direct control of this relay.
2. Simulate generator voltage on TTUR screws 17 and 18. Operate the K25 relay by forcing TTUR, card point output signals *Sync_Bypass1* =1, and *Sync_Bypass0* = 0. Verify that the K25 relay is functional by probing screws 4 and 5 on TTUR.
3. Simulate generator voltage on SPRO screws 1 and 2. Operate the K25A relay by forcing SPRO, card point output signals *SynCK_Bypass =1*, and *SynCk_Perm 1*. The bus voltage must be zero (dead bus) for this test to be functional. Verify that the K25A relay is functional by probing screws 5 and 6 on TTUR.

➢ **To simulate a synchronization**

1. Disable the breaker.
2. Establish the center frequency of the PPRO I/O pack PLL. From the **Hardware** tab **Tree View**, select the PPRO.
3. Select the **K25A** tab and locate the signal, *K25A_Fdbk, ReferFreq*.
   a. If *ReferFreq* is configured *PR_Std*, and the PPRO is configured for a single shaft machine, apply rated speed (frequency) to input *PulseRate1*.

Terminal Board	Screw Pairs
TPRO	31/32 37/38 43/44
SPRO	19/20

   b. If *ReferFreq* is configured *PR_Std*, and the PPRO is configured for a multiple shaft machine, apply rated speed (frequency) to input *PulseRate 2*.

Terminal Board	Screw Pairs
TPRO	33/34 39/40 45/46
SPRO	21/22

   c. If *ReferFreq* is configured *SgSpace*, force the PPRO signal space output *DriveRef* to 50 or 60 (Hz), depending on the system frequency.

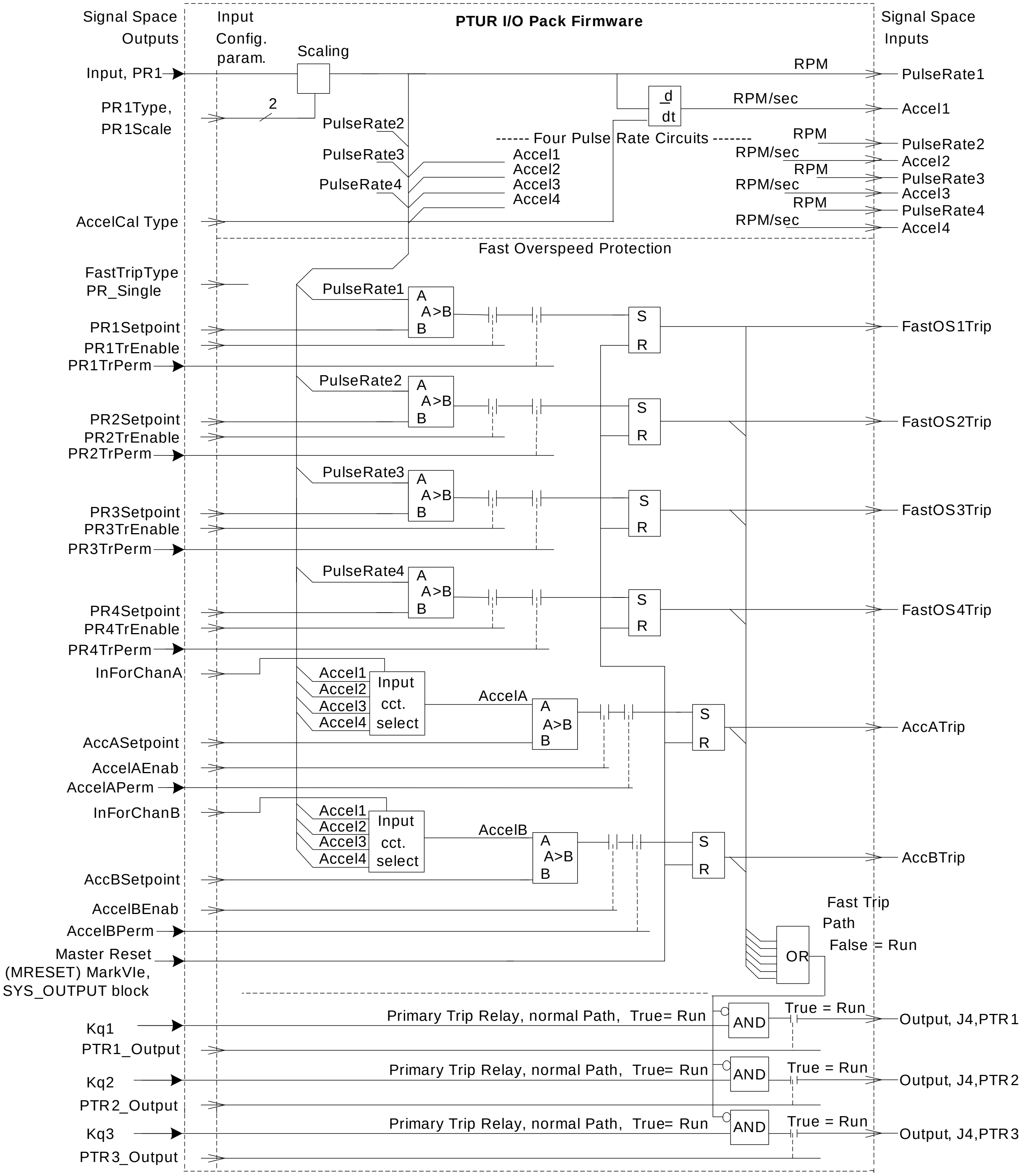
4. Apply the bus voltage, a nominal 115 V ac, 50/60 Hz, to TTUR screws 19 and 20, and to SPRO screws 3 and 4.

5. Apply the generator voltage, a nominal 115 V ac, adjustable frequency, to TTUR screws 17 and 18 and to SPRO screws 1 and 2. Adjust the frequency to a value giving positive slip, that is PTUR signal GenFreqDiff of 0.1 to 0.2 Hz. (10 to 5 sec scope).
6. Force the following signals to the TRUE state:
   - PTUR, Sync_Perm, then K25P should pick up
   - PTUR, Sync_Perm_AS, then K25 should pulse when the voltages are in phase
   - PPRO, SynCK_Perm, then K25A should pulse when the voltages are in phase
7. Verify that the TTUR breaker close interface circuit, screws 3 to 7, is being made (contacts closed) when the voltages are in phase.
8. Run a trend chart on the following signals:
   - PPRO: GenFreqDiff, GenPhaseDiff, L25A_Command, K25A_Fdbk
   - PTUR: GenFreqDiff, GenPhaseDiff, L25_Command, CB_K25_PU, CB_K25A_PU
9. Use an oscilloscope, voltmeter, synchroscope, or a light to verify that the relays are pulsing at approximately the correct time.
10. Examine the trend chart and verify that the correlation between the phase and the close commands is correct.
11. Increase the slip frequency to 0.5 Hz and verify that K25 and K25A stop pulsing and are open.
12. Return the slip frequency to 0.1 to 0.2 Hz, and verify that K25 and K25A are pulsing.
13. Reduce the generator voltage to 40 V ac and verify that K25 and K25A stop pulsing and are open.

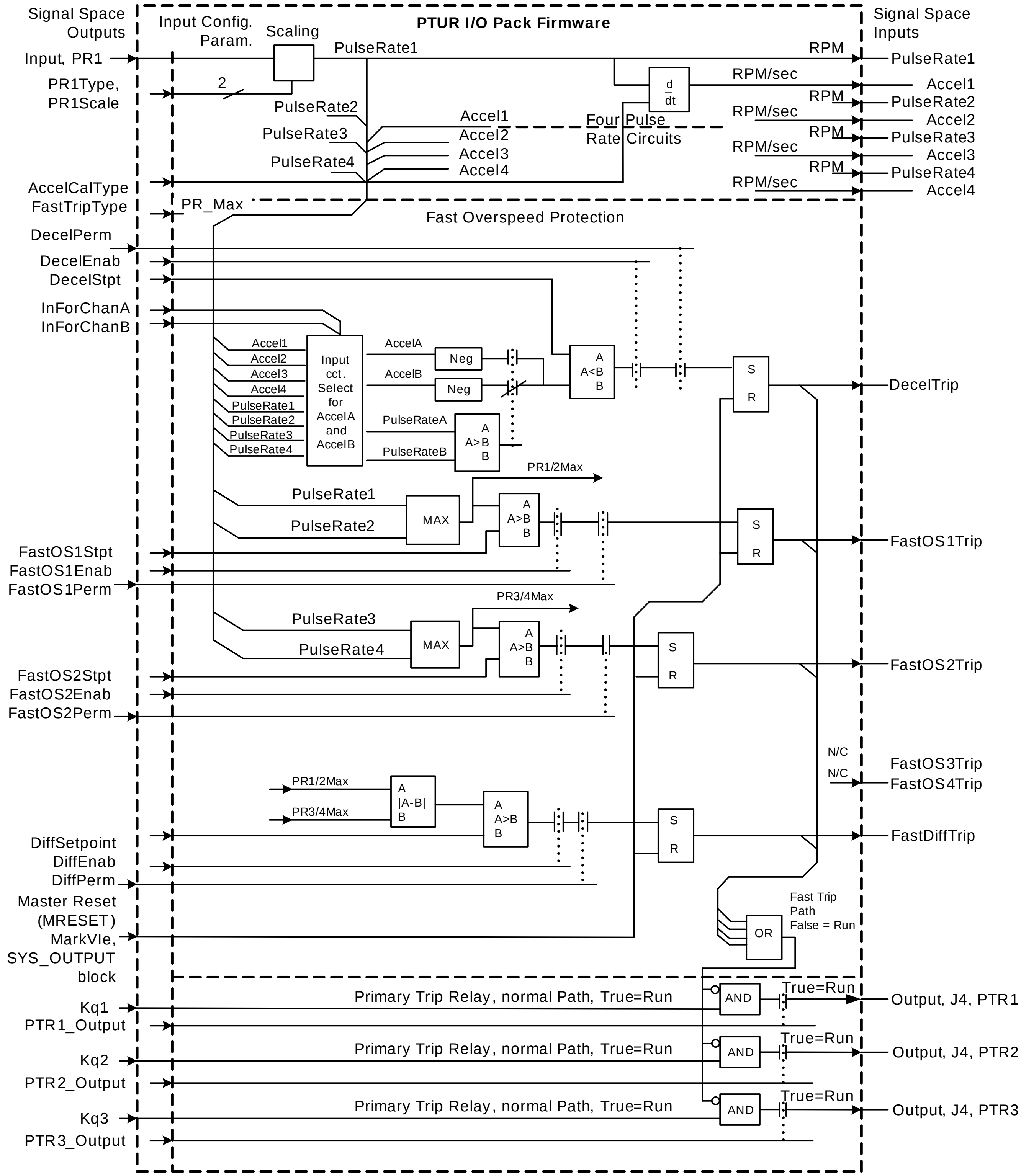
11.1.3.10 Fast Overspeed Trip

In special cases where a fast overspeed trip system is required, the PTUR Fast Overspeed Trip algorithms can be enabled. The system employs a speed measurement algorithm using a calculation for a predetermined tooth wheel. The fast trips are linked to the output trip relays with an OR-gate. The PTUR computes the overspeed trip instead of the controller, so the trip is very fast. The time from the overspeed input to the completed relay dropout is 30 ms or less. The following two overspeed algorithms are available:

PR_Single uses two redundant PTURs by splitting up the two redundant PR transducers, one to each board. PR_Single provides redundancy and is the preferred algorithm for LM gas turbines.



PR_Max uses one PTUR connected to the two redundant PR transducers. PR_Max allows broken shaft and deceleration protection without the risk of a nuisance trip if one transducer is lost.



11.1.3.11 Shaft Voltage and Current Monitor

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 builds 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 can be generated between the ends of the generator shaft due to dissymmetries in the generator magnetic circuits. If the insulated bearings on the generator shaft break down, the current flows 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.

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

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.

11.1.3.12 Flame Detectors

With the TRPG primary trip terminal board, the primary protection system monitors signals from eight flame detectors. With no flame present the detector charges up to the supply voltage. The presence of flame causes the detector to charge to a level and then discharge through the TRPG. As the flame intensity increases, the discharge frequency increases. When the detector discharges, the primary protection system converts 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. Voltage pulses above 2.5 V generate a logic high. Pulses are counted over a 40 ms period in a counter to generate the flame detector pulse rate.

Note Refer to GEH-6721_Vol_II, the chapter Power Distribution Modules, the section, PSFD Flame Detector Power Supply.

11.1.4 Specifications

Item	PTUR Specification
Number of inputs	4 Passive speed pickups 1 Shaft voltage and 1 current measurement 1 Generator and 1 bus voltage Generator breaker status Eight flame detectors from TRPG
Number of outputs	Automatic synchronizing control to main breaker Primary trip solenoid interface, 3 outputs to TRPG
Speed sensor range	MPU pulse rate range 2 Hz to 20 kHz
Speed sensor accuracy	MPU pulse rate accuracy 0.05% of reading from 2 Hz to 20 kHz The voted speed from the TMR-configured PTUR I/O packs meets the UCTE OH – Policy 1, ±10 mHz accuracy requirement for a frequency in the range of 2000 to 5600 hertz.
Speed input sensitivity Turning gear speed may be observed on a typical turbine application.	Required peak-peak (p-p) voltage rises as a function of frequency: 2 Hz requires 24 mV p-p 20 kHz requires 276 mV p-p

Item	PTUR Specification
Shaft voltage monitor	Signal is frequency of ±5 V dc (0 – 1 MHz) pulses from 0 to 2,000 Hz
Shaft voltage dc test	Applies a 5 V dc source to test integrity of the circuit. Circuit reads a differential resistance between 0 and 150 Ω within ±5 Ω. Readings above the BrushLimit ohms setting indicate a fault. Returned signal is filtered to provide 40 dB of noise attenuation at 60 Hz.
Shaft voltage ac test	Applies a test voltage of 2 kHz to the input of the PTUR shaft voltage circuit.
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. These PTs are external to the TTUR, and it is the secondary output of these PTs that ties to the PT inputs of the TTUR. Each PT input on the TTUR has less than 3 VA of loading. Allowable voltage range for sync is 75 to 130 V rms with an accuracy of ±0.5% (of the measurement range).
Synchronizing measurements	Frequency accuracy 0.05% over 45 to 66 Hz range. Zero crossing of the inputs is monitored on the rising slope. Phase difference measurement is better than ±1°.
Contact voltage sensing	20 V dc indicates high and 6 V dc indicates low. Each circuit is optically isolated and filtered for 4 ms.
Size	8.26 cm High x 4.19 cm Wide x 12.1 cm Deep (3.25 in x 1.65 in x 4.78 in)
† Ambient rating for enclosure design	PTURH1B is rated from -40 to 70ºC (-40 to 158 ºF) PTURH1A is rated from -30 to 65ºC (-22 to 149 ºF)
Technology	Surface mount

Note † For further details, refer to the *Mark VIe and Mark VIeS Control Systems System Guide, Volume I* (GEH-6721_Vol_I), the chapter *Technical Regulations, Standards, and Environments*.

11.1.5 Diagnostics

The I/O pack performs the following self-diagnostic tests:

- A power-up self-test that includes checks of RAM, flash memory, Ethernet ports, and most of the processor board hardware.
- Continuous monitoring of the internal power supplies for correct operation.
- L3BKR_GXS – the Sync Check Relay on TTUR is Slow.
- Breaker #1 Slower than Adjustment Limit Allows.
- Breaker #2 Slower than Adjustment Limit Allows.
- Synchronization Trouble – the K25 Relay on TTUR Locked Up.
- A check of the electronic ID information from the terminal board, acquisition board, and processor board to confirm that the hardware set matches, followed by a check that the application code loaded from flash memory is correct for the hardware set.
- Diagnostic information includes status of the solenoid relay driver, contact, high and low flame detector voltage, and the sync relays. If any one of the signals goes unhealthy a composite diagnostic alarm, L3DIAG_PTUR occurs.

The diagnostic signals can be individually latched, and then reset with the RESET_DIA signal if they go healthy. Details of the individual diagnostics are available from the ToolboxST application.

11.1.5.1 PTUR Application LEDs

LED	Label	Description
Yellow	K25	Indicates the presence of a command to energize the primary synchronizing relay.
Yellow	K25P	Indicates the presence of a command to energize the synchronizing permissive relay.
Yellow	DCT	Indicates the presence of a command to enable the DC Test of shaft voltage and current monitoring.
Yellow	K1, K2, and K3	Indicates a command to energize the corresponding relay.

11.1.6 PTUR ToolboxST Configuration

11.1.6.1 Parameters

Parameter Name	Parameter Description	Choices
SystemLimits	Allows user to temporarily disable all system limit checks for testing purposes. Setting this parameter to Disable will cause a diagnostic alarm to occur.	Enable, Disable
ResetShuntTest	Reset shunt test OK status on SysLimit Reset (TTUR only)	Enable, Disable
No_T_PS_Req	No flame detect power supply required for T (TRPG only)	Enable, Disable
AccelCalType	Select acceleration calculation time (milliseconds)	10 to 100
TripType	Select fast trip algorithm	Unused, PR_Single, PR_Max
DecelStpt	Deceleration setpoint, rpm/sec (TripType = PR_Max)	0 to 1500
DecelEnab	Deceleration enable (TripType = PR_Max)	Disable, Enable
FastOS1Stpt	Fast Overspeed trip #1 setpoint, Max (PR1, PR2), rpm (TripType = PR_Max)	0 to 20000
FastOS1Enabl	Fast Overspeed trip #1 enable (TripType = PR_Max)	Disable, Enable
FastOS2Stpt	Fast Overspeed trip #2 setpoint, Max (PR3, PR4), rpm (TripType = PR_Max)	0 to 20000
FastOS2Enabl	Fast Overspeed trip #2 enable (TripType = PR_Max)	Disable, Enable
DiffSetpoint	Difference Speed trip setpoint, rpm (TripType = PR_Max)	0 to 20000
DiffEnable	Difference Speed trip, enable (TripType = PR_Max)	Disable, Enable
PR1Setpoint	Fast Overspeed trip #1, setpoint, PR1, rpm (TripType = PR_ Single)	0 to 20000
PR1TrEnable	Fast Overspeed trip #1, enable (TripType = PR_Single)	Disable, Enable
PR2Setpoint	Fast Overspeed Trip #2, setput, PR2, rpm (TripType = PR_ Single)	0 to 20000
PR2TrEnable	Fast Overspeed trip #2, enable (TripType = PR_Single)	Disable, Enable
PR3Setpoint	Fast Overspeed Trip #3, setput, PR3, rpm (TripType = PR_ Single)	0 to 20000
PR3TrEnable	Fast Overspeed trip #3, enable (TripType = PR_Single)	Disable, Enable
PR4Setpoint	Fast Overspeed Trip #4, setput, PR4, rpm (TripType = PR_ Single)	0 to 20000
PR4TrEnable	Fast Overspeed trip #3, enable (TripType = PR_Single)	Disable, Enable
AccASetpoint	Acceleration trip setpoint, Chan A, rpm/sec (TripType = PR_ Single)	0 to 1500
AccBSetpoint	Acceleration trip setpoint, Chan B, rpm/sec (TripType = PR_ Single)	0 to 1500
AccAEnable	Acceleration Trip Enable, Chan A (TripType = PR_Single)	Disable, Enable
AccBEnable	Acceleration Trip Enable, Chan B (TripType = PR_Single)	Disable, Enable
InForChanA	Input change selection for Accel/Decel trip (TripType = PR_Max or PR_Single)	Accel, Accel2, Accel3, Accel4

Parameter Name	Parameter Description	Choices
InForChanB	Input change selection for Accel/Decel trip (TripType = PR_Max or PR_Single)	Accel, Accel2, Accel3, Accel4
DiagSolPwrA	When using TRPL/S, Sol Power, Bus A, Diagnostic enable.	Enable, Disable
DiagSolPwrB	When using TRPL/S, Sol Power, Bus B, Diagnostic enable	Enable, Disable
DiagSolPwrC	When using TRPL/S, Sol Power, Bus C, Diagnostic enable	Enable, Disable

11.1.6.2 Pulse Rate

Pulse Rate Name	Pulse Rate Description	Choices
PRType	Define the pulse rate feedback type or basic speed range (for proper resolution). Refer to section, *Speed Pickups* for description of types.	Flow, Speed, Speed_High, Speed_HSNG, Speed_LM, Unused
PRScale	Pulses per revolution (outputs rpm)	0 to 1,000
TeethPerRev	Number of teeth on speed wheel (per revolution)	1 to 512
Speed_x_ms	Calculation rate of speed in milliseconds. Speed is calculated at this rate and averaged over the previous time interval specified by this period. **Attention** **Using a value other than an integer multiple of the application frame period can have adverse impact on use of this control.**	10 to 1000
Accel_x_ms	This is the averaging period for acceleration calculation in milliseconds. The acceleration is calculated every Accel_X_ms. It is based on the difference between two speed samples divided by the sample period. Each acceleration calculation is the average of acceleration over the period specified by this parameter. For example, if Accel_x_ms is 40 then acceleration will be the average acceleration over the previous 80 ms. **Attention** **Using a value other than an integer multiple of the application frame period can have adverse impact on use of this control.**	20 to 1000
Lock_Limit	HSNG speed type locking limit for teeth mapping (percent). Refer to the section, *Speed Pickups* for description of Lock_Limit function.	1 to 100
TMRDiffLimit	Diag Limit, TMR input vote difference, in Eng units	0 to 20,000
SysLim1Enable	Enable System Limit 1 Fault Check	Enable, Disable
SysLim1Latch	Latch System Limit 1 Fault	Latch, NotLatch
SysLim1Type	System Limit 1 Check Type	>=, <=

Pulse Rate Name	Pulse Rate Description	Choices
SysLimit1	System Limit 1 – RPM	0 to 20,000
SysLim2Enable	Enable System Limit 2 Fault Check	Enable, Disable
SysLim2Latch	Latch System Limit 2 Fault	Latch, NotLatch
SysLim2Type	System Limit 2 Check Type	>=, <=
SysLimit2	System Limit 2 – RPM	0 to 20,000

11.1.6.3 Shaft Volt Mon

Parameter	Description	Choices
TMRDiffLimt	Diag limit, TMR input vote difference, in Hertz	0 to 100

11.1.6.4 Shaft Curr Mon

Parameter	Description	Choices
ShuntOhms	Shunt ohms	0 to 100
ShuntLimit	Shunt maximum test ohms	0 to 100
BrushLimit	Shaft (Brush + Shunt) maximum ohms	0 to 100
SysLim1Enable	Enable System Limit 1 Fault Check	Enable, Disable
SysLim1Latch	Latch System Limit 1 Fault	Latch, NotLatch
SysLim1Type	System Limit 1 Check Type	>=, <=
SysLimit1	System Limit 1 – Amps	0 to 100
SysLim2Enable	Enable System Limit 2 Fault Check	Enable, Disable
SysLim2Latch	Latch System Limit 2 Fault	Latch, NotLatch
SysLim2Type	System Limit 2 Check Type	>=, <=
SysLimit2	System Limit 2 – Amps	0 to 100
TMR_DiffLimt	Diag Limit, TMR Input Vote Difference, in Eng Units	0 to 100

11.1.6.5 Potential Transformer

Parameter	Description	Choices
PT_Input	PT primary in Eng units (kV or percent) for PT_Output	0 to 1,000
PT_Output	PT output in volts rms, for PT_Input - typically 115	0 to 150
TMR_DiffLimt	Diag Limit, TMR Input Vote Difference, in Eng Units	1 to 1000

11.1.6.6 Circuit Breaker

Parameter	Description	Choices
System Frequency	Select frequency in Hz	50 or 60
CB1CloseTime	Breaker 1 closing time in milliseconds	0 to 1,000
CB1 AdaptLimit	Breaker 1 self adaptive limit in milliseconds	0 to 1,000
CB1 AdaptEnabl	Enable breaker 1 self adaptive adjustment	Enable, Disable
CB1FreqDiff	Breaker 1 special window frequency difference, Hz	0.15 to 0.66
CB1PhaseDiff	Breaker 1 special window phase Diff, degrees	0 to 20
CB1DiagVoteEnab	Enable Voting Disagreement Diagnostic	Enable, Disable
CB2CloseTime	Breaker 2 closing time in milliseconds (as above)	0 to 1,000
CB2 AdaptLimit	Breaker 2 self adaptive limit in milliseconds	0 to 1,000
CB2 AdaptEnabl	Enable breaker 2 self adaptive adjustment	Enable, Disable
CB2FreqDiff	Breaker 2 special window frequency difference, Hz	0.15 to 0.66
CB2PhaseDiff	Breaker 2 special window phase Diff, degrees	0 to 20
CB2DiagVoteEnab	Enable Voting Disagreement Diagnostic	Enable, Disable

11.1.6.7 Flame

Parameter	Description	Choices
FlmDetTime	Flame detector time interval	0.160, 0.080, 0.040 sec
FlameLimitHI	Flame threshold Limit HI (HI detection counts means LOW sensitivity)	0 to 160
FlameLimitLOW	Flame threshold Limit Low (Low detection counts means HIGH sensitivity)	0 to 160
Flame_Det	Flame detector used/unused	Used, Unused
TMR_DiffLimt	Diag Limit, TMR Input Vote Difference, in Hz	1 to 160

11.1.6.8 Relays

Parameter	Description	Choices
PTR_Output	Primary protection relay used/unused	Unused, used
DiagVoteEnab	Enable voting disagreement diagnostic	Enable, Disable

11.1.6.9 E-Stop

Parameter	Description	Choices
DiagVoteEnab	Enable voting disagreement diagnostic	Enable, Disable

11.1.6.10 Variables PTUR

Variable Name	Variable Description	Direction	Type
L3DIAG_PTUR_R,S,T	I/O Diagnostic Indication	Input	BOOL
LINK_OK_PTUR_R,S,T	I/O Link Okay Indication	Input	BOOL
ATTN_PTUR_R,S,T	I/O Attention Indication	Input	BOOL
PS18V_PTUR_R,S,T	I/O 18 V Power Supply Indication	Input	BOOL
PS28V_PTUR_R,S,T	I/O 28 V Power Supply Indication	Input	BOOL
IOPackTmpr_R,S,T	I/O Pack Temperature (deg °F)	AnalogInput	REAL
Kq1_StatNV_R,S,T	Non voted Primary Trip Relay 1 Feedback	Input	BOOL
Kq2_StatNV_R,S,T	Non voted Primary Trip Relay 2 Feedback	Input	BOOL
ShShntTst_OK	Shaft voltage monitor shunt test OK	Input	BOOL
ShBrshTst_OK	Shaft voltage brush + shunt test OK	Input	BOOL
Estop_Signal	Raw Estop Signal (unlatched)	Input	BOOL
K1FLT	K1 Shorted Contact Fault	Input	BOOL
K2FLT	K2 Shorted Contact Fault	Input	BOOL
PR1_HSNGstat	Pulse rate 1 HSNG stability status (TRUE for tooth – tooth distance inside Lock_Limit for tooth geometry compensation)	Input	BOOL
PR2_HSNGstat	Pulse rate 2 HSNG stability status	Input	BOOL
PR3_HSNGstat	Pulse rate 3 HSNG stability status	Input	BOOL
PR4_HSNGstat	Pulse rate 4 HSNG stability status	Input	BOOL
Sol1_Vfdbk	When TRPL/S, Trip Solenoid #1 Voltage	Input	BOOL
Sol2_Vfdbk	When TRPL/S, Trip Solenoid #2 Voltage	Input	BOOL
Sol3_Vfdbk	When TRPL/S, Trip Solenoid #3 Voltage	Input	BOOL
ShTestAC	L97SHAFT_AC SVM_AC_TEST	Output	BOOL
ShTestDC	L97SHAFT_DC SVM_DC_TEST	Output	BOOL
ETR1_Fdbk	ETR1 feedback, for TREL/S diag checking	Output	BOOL
ETR2_Fdbk	ETR2 feedback, for TREL/S diag checking	Output	BOOL
ETR3_Fdbk	ETR3 feedback, for TREL/S diag checking	Output	BOOL
Kq1_Status	Primary Trip Relay1 Feedback	Input	BOOL
Kq2_Status	Primary Trip Relay2 Feedback	Input	BOOL
Kq3_Status	Primary Trip Relay3 Feedback	Input	BOOL
SysLim1PR1	Pulse Rate 1 System Limit 1 Fault	Input	BOOL
↓	↓	↓	↓
SysLim1PR4	Pulse Rate 4 System Limit 1 Fault	Input	BOOL
SysLim1SHV	AC Shaft Voltage Frequency High L30TSVH	Input	BOOL
SysLim1SHC	AC Shaft Current High L30TSCH	Input	BOOL

Variable Name	Variable Description	Direction	Type
SysLim1GEN	Gen Voltage System Limit 1 Fault	Input	BOOL
SysLim1BUS	Bus Voltage System Limit 1 Fault	Input	BOOL
SysLim2PR1	Pulse Rate 1 System Limit 2 Fault	Input	BOOL
↓	↓	↓	↓
SysLim2PR4	Pulse Rate 4 System Limit 2 Fault	Input	BOOL
SysLim2SHV	AC Shaft Voltage System Limit 2 Fault	Input	BOOL
SysLim2SHC	AC Shaft Current System Limit 2 Fault	Input	BOOL
SysLim2GEN	Gen Voltage System Limit 2 Fault	Input	BOOL
SysLim2BUS	Bus Voltage System Limit 2 Fault	Input	BOOL

11.1.6.11 Variables Vars_Sync

Variable	Vars_Sync Variable Description	Direction	Type
CB_Volts_OK	Breaker Closing Coil Voltage is present (L3BKR_VLT). Used in diagnostics.	Input	BOOL
CB_K25P_PU	Breaker Closing Coil Voltage is present downstream of the K25P relay contacts. L3BKR_PRM Sync Permissive Relay Picked Up. Used in diagnostics.	Input	BOOL
CB_K25_PU	Breaker Closing Coil Voltage is present downstream of the K25 relay contacts. L3BKR_GES Auto Sync Relay Picked Up. Used in diagnostics.	Input	BOOL
CB_K25A_PU	Breaker Closing Coil Voltage is present downstream of the K25A relay contacts. L3BKR_GEX Sync Check Breaker Closed. Used in diagnostics.	Input	BOOL
Gen_Sync_LO	Generator Synch Lock out. Traditionally known as L30AS1 or L30AS2; it is a latched signal requiring a reset to clear (Sync_Reset). It detects a K25 relay problem (picked up when it should be dropped out) or a slow Sync Check (relay K25A) function.	Input	BOOL
L25_Command	Breaker Close Command to the K25 relay. Traditionally known as L25.	Input	BOOL
GenFreq	Generator frequency, Hz.	AnalogInput	REAL
BusFreq	Hz frequency	AnalogInput	REAL
GenVoltsDiff	KiloVolts rms-Gen Low is negative	AnalogInput	REAL
Gen Freq Diff	Slip Hz-Gen Slow is negative	AnalogInput	REAL
Gen Phase Diff	Phase Degrees-Gen Lag is negative	AnalogInput	REAL
CB1CloseTime	Breaker #1 close time in milliseconds	AnalogInput	REAL
CB2CloseTime	Breaker #2 close time in milliseconds	AnalogInput	REAL
Sync_Perm_AS	Auto sync permissive. Traditionally known as L83AS.	Output	BOOL

Variable	Vars_Sync Variable Description	Direction	Type
Sync_Perm	Sync permissive mode, L25P. Traditionally known as L25P; interface to control the K25P relay.	Output	BOOL
Sync_Monitor	Auto Sync monitor mode. Traditionally known as L83S_MTR; enables the Auto Sync function, except it blocks the K25 relays from picking up.	Output	BOOL
Sync_Bypass1	Auto Sync bypass. Traditionally known as L25_ BYPASS; to pickup L25 for Dead Bus or Manual Sync.	Output	BOOL
Sync_Bypass0	Auto Sync bypass. Traditionally known as L25_ BYPASSZ; to pickup L25 for Dead Bus or Manual Sync.	Output	BOOL
CB2_Selected	#2 Breaker is selected. Traditionally known as L43SAUTO2; to use the breaker close time associated with Breaker #2	Output	BOOL
AS_Win_Sel	Special Auto Sync window. New function, used on synchronous condenser applications to give a more permissive window.	Output	BOOL
Synch_Reset	Auto Sync reset. Traditionally known as L86MR_ TCEA; to reset the Sync Lockout function.	Output	BOOL

11.1.6.12 Variables Vars-Flame

Variable	Vars-Flame Variable Description	Direction	Type
FD1_Flame	Flame Detect 1 present	Input	BOOL
↓	↓	↓	↓
FD8_Flame	Flame Detect 8 present	Input	BOOL
FD1_Level	1=High Detection Counts Level	Output	BOOL
↓	↓	↓	↓
FD8_Level	1=High Detection Counts Level	Output	BOOL

11.1.6.13 Variables Vars-Speed

Variable	Vars-Speed Variable Description	Direction	Type
DecelTrip	Deceleration Trip (Accel1, Accel2)	Input	BOOL
FastDiffTrip	Fast Difference Trip	Input	BOOL
FastOS1Trip	Fast Overspeed Trip #1	Input	BOOL
↓	↓	↓	↓
FastOS4Trip	Fast Overspeed Trip #4	Input	BOOL
AccATrip	Acceleration Trip ChanA	Input	BOOL
AccBTrip	Acceleration Trip ChanB	Input	BOOL
Accel1	rpm/sec	AnalogInput	REAL

Variable	Vars-Speed Variable Description	Direction	Type
↓	↓	↓	↓
Accel4	rpm/sec	AnalogInput	REAL
PR1_PulseCnt_R,S,T	Pulse Rate 1 – Pulses in the last frame	AnalogInput	REAL
↓	↓	↓	↓
PR4_PulseCnt_R,S,T	Pulse Rate 4 – Pulses in the last frame	AnalogInput	REAL
FlmDetPwr1	335 V dc	AnalogInput	REAL
DecelPerm	Permissive – Deceleration Trip	Output	BOOL
FastOS1Perm	Permissive – Fast Overspeed Trip #1, from Max (PR1, PR2)	Output	BOOL
FastOS2Perm	Permissive – Fast Overspeed Trip #2, from Max (PR3, PR4)	Output	BOOL
DiffPerm	Permissive – Fast Difference Speed Trip	Output	BOOL
PR1TrPerm	Permissive – Fast Overspeed Trip #1, from PR1	Output	BOOL
↓	↓	↓	↓
PR4TrPerm	Permissive – Fast Overspeed Trip #4, from PR4	Output	BOOL
AccelAPerm	Permissive – Acceleration Trip, Chan A	Output	BOOL
AccelBPerm	Permissive – Acceleration Trip, Chan B	Output	BOOL

11.1.6.14 Variables Pulse Rate

Variable	Pulse Rate Variable Description	Direction	Type
PulseRate1	Pulse rate input, PTUR Connector J#5	AnalogInput	REAL
PulseRate2	Pulse rate input, PTUR Connector J#5	AnalogInput	REAL
PulseRate3	Pulse rate input, PTUR Connector J#5	AnalogInput	REAL
PulseRate4	Pulse rate input, PTUR Connector J#5	AnalogInput	REAL

11.1.6.15 Variables Shaft Volt Mon

Variable	Description	Direction	Type
ShVoltMon	Shaft voltage monitor, frequency (Hz)	AnalogInput	REAL

11.1.6.16 Variables Shaft Curr Mon

Variable	Description	Direction	Type
ShCurrMon	Shaft current monitor, Current (Amps)	AnalogInput	REAL

11.1.6.17 Variables Potential Transformer

Variable	Description	Direction	Type
GenPT_KVolts	Kilo-Volts RMS	AnalogInput	REAL
BusPT_KVolts	Kilo-Volts RMS	AnalogInput	REAL

11.1.6.18 Variables Circuit Breaker

Variable	Description	Direction	Type
Ckt_Bkr	Circuit breaker Closed – L52G Contact Feedback	Input	BOOL

11.1.6.19 Variables E-Stop

Variable	Description	Direction	Type
KESTOP1_Fdbk	When TPRL/S, ESTOP, inverse sense, K4 relay, True = Run	Input	BOOL

11.1.6.20 Variables Flame

Variable	Description	Direction	Type
FlameInd1	When TRPG, Intensity (Hz)	AnalogInput	REAL
FlameInd2	When TRPG, Intensity (Hz)	AnalogInput	REAL
FlameInd3	When TRPG, Intensity (Hz)	AnalogInput	REAL
FlameInd4	When TRPG, Intensity (Hz)	AnalogInput	REAL
FlameInd5	When TRPG, Intensity (Hz)	AnalogInput	REAL
FlameInd6	When TRPG, Intensity (Hz)	AnalogInput	REAL
FlameInd7	When TRPG, Intensity (Hz)	AnalogInput	REAL
FlameInd8	When TRPG, Intensity (Hz)	AnalogInput	REAL

11.1.6.21 Variables Relays

Variable	Description	Direction	Type
Kq1	L20PTR1 – Primary Trip Relay	Output	BOOL
Kq2	L20PTR2 – Primary Trip Relay	Output	BOOL
Kq3	L20PTR3 – Primary Trip Relay	Output	BOOL

11.2 PTUR Specific Alarms

The following alarms are specific to the PTUR I/O pack.

32-34

Description Solenoid #[ ] Relay driver Feedback Incorrect

Possible Cause The I/O pack monitors the relay command for the correct state and termination into the expected trip board impedance. The I/O pack internal feedback of relay command output does not match the desired state.

Solution

- Check the mounting of the I/O pack on the terminal board.
- Check the cable from the TTUR to the trip board, if used.
- Replace the I/O pack.
- Replace the TRPx trip board.

38-40

Description Solenoid #[ ] Contact Feedback Incorrect

Possible Cause The contact state feedback from the trip board does not match the relay command.

Solution

- Check the mounting of the I/O pack on the terminal board.
- Check the cable from the TTUR to the TRPx.
- Check the operation of the relay.

44

Description Trip Board Solenoid Power Absent

Possible Cause

- The I/O pack has detected the absence of solenoid power as indicated by the connected TRPx board.
- The issue could be with the power source applied in TRPx terminal boards.

Solution

- Verify the TRPx on the J1 connector is receiving power.
- Verify that the voltage at the J1 cable is at an acceptable range. If it is out of range, there could be a problem with the source or the cable connected between source and the terminal board.
- Check the cabling to the TRPx.
- If the voltage source is good, change the cable between the power source and TRPx boards.
- If the problem persists, replace the cable between the TRPx and the TTUR or STUR board.
- If the problem persists, replace the TRPx board.

46

Description TRPG Flame Detector Volts Lower than 314.9 V

Possible Cause The voltage is less than 314.9 V dc and any flame detector is configured as *Used*.

Note The 335 V dc power required for the Honeywell flame detector is provided by the Flame Detector Power Supply (PSFD). This nominal 335 V power enters the TRPG through the J3, J4, and J5 connectors.

Solution

- If no flame detector is being used, verify that all the **Flame_Det** parameters are set to *Unused*.
- If only two PSFDs are being used, set the **No_T_PS_Req** parameter to *True*. This disables the check for power on TRPG J5.
- If the PSFD voltage is less than 314.9 V dc, replace the PSFD.
- Check the voltage at the TRPG side (J3, J4, and J5). If the voltage is above 314.9 V dc, replace TRPG.
- If the voltage reading at TRPG side (J3, J4, and J5) is below 314.9 V dc and the voltage at PSFD is nominal, replace the cable connected between the TRPG and the PSFD.

47

Description TRPG Flame Detector Volts Higher than 355.1 V

Possible Cause This power comes into the TRPG through the J3, J4, and J5 connectors. If the voltage is greater than 355.1 V dc, this fault is declared.

Solution

- If the voltage is higher than 355.1 V dc, check the power supply.
- Check the voltage on the TRPG. If the voltage is above 355 V, the monitoring circuitry on the TRPG or the cabling to the TRPG may be the problem.

50

Description L3BKRGXS - Sync Check Relay Is Slow

Possible Cause

- The K25 (auto sync) has picked up but the Sync check relay L3BKRGXS, known as K25A, on the TTUR has not picked up.
- There is no breaker closing voltage source.
- The K25A relay is not enabled on the PPRO I/O module.

Solution

- Attempt to perform a Sync Reset (set **Synch_Reset** to True).
- Check the breaker to verify closure.
- Verify that the K25A relay is enabled on the PPRO I/O module.
- Replace the TTUR.

51

Note This alarm is obsolete.

Description L3BKRGES - Auto Sync Relay Is Slow

Possible Cause

- The Auto Sync relay L3BKRGES, also known as K25, on the TTUR has not picked up when it should have.
- The K25P is not picked up.
- There is no breaker closing voltage source.

Solution

- Attempt to perform a Sync Reset (set **Synch_Reset** to True).
- Check the breaker to verify closure.
- Replace the TTUR.

52-53

Description Breaker #[ ] Slower Than Adjustment Limit Allows

Possible Cause

- The self-adaptive function adjustment of the Breaker Close Time has reached the allowable limit and cannot make further adjustments to correct the Breaker Close Time.
- The breaker is experiencing a problem, or the operator should consider changing the configuration. Both the nominal close time and the self-adaptive limit in milliseconds can be configured.

Solution

- Increase the limit setting of **CBxCloseTime** for the breaker in question.
- Review breaker feedback timing to verify that it meets the documented specifications.
- Verify that there are no interposing relays causing a delay.
- Replace the terminal board.

54

Description Synchronization Trouble - K25 Relay Locked Up

Possible Cause

- The K25 relay is picked up when it should not be.
- K25 on TTUR is most likely stuck closed, or the contacts are welded together.

Solution

- Attempt to perform a Sync Reset (set **Synch_Reset** to True).
- Isolate which relay (K25A or K25) is causing a problem by checking the diagnostics and correcting the source of the issue.
- Replace TTUR.

55

Description Trip Board required by Main Terminal Board

Possible Cause When the PTUR is used with a TTUR, STURH3, or STURH4 terminal board, an auxiliary trip board is required. However, the PTUR does not detect that a required trip board has been connected.

Solution

- Verify that the proper terminal board and trip board has been configured in the ToolboxST application. Rebuild the application, then download the firmware and application code to the affected I/O pack.
- Verify the trip board cable connections at both ends.

57

Description Hardware and Configuration Incompatibility - Main Terminal Board

Possible Cause The PTUR configuration does not match the actual terminal board hardware.

Solution

- Verify that the ToolboxST configuration matches the actual hardware.
- Rebuild the application, then download the firmware and application code to the affected I/O pack.
- Verify that the PTUR is fully seated on the terminal board.
- Verify that the installed ToolboxST version supports the configured hardware.

58

Description Hardware and Configuration Incompatibility - Trip Board

Possible Cause The configuration does not match the connected trip board.

Solution

- Review the hardware compatibility information and correct, if necessary.
- Check the I/O pack configuration to verify that the TTUR board hardware form matches the installed terminal board.
- Rebuild the application, then download the firmware and application code to the affected I/O pack.
- If the configuration is correct, rebuild the device and download the firmware and parameters to the affected I/O pack.
- Verify the trip board cable connections at both ends.
- Verify that the cable between the TTUR/STUR board and the TRPx terminal board is properly seated.
- Verify that the installed ToolboxST version supports the configured hardware.

61

Description TRPL/S Solenoid Power on Bus A is absent

Possible Cause No solenoid power is detected on the TRPL/S bus A.

Solution

- Verify that power is applied to the terminal board.
- Verify that the DC-37 cable is fully seated.
- Replace the terminal board.

62

Description TRPL/S Solenoid Power on Bus B is absent

Possible Cause No solenoid power is detected on TRPL/S bus B.

Solution

- Verify that power is applied to the terminal board.
- Verify that the DC-37 cable is fully seated.
- Replace the terminal board.

63

Description TRPL/S Solenoid Power on Bus C is absent

Possible Cause No solenoid power is detected on TRPL/S bus C.

Solution

- Verify that power is applied to the terminal board.
- Verify that the DC-37 cable is fully seated.
- Replace the terminal board.

64-66

Description TRPL/S Solenoid #[ ] Voltage Mismatch

Possible Cause Power is applied to the solenoid, but the voltage feedback is not detected.

Solution

- Verify that the J2 connector is fully seated between the primary and emergency trip boards.
- Replace the J2 cable.
- Replace the TTUR.

67

Description Speed Trip

Possible Cause

- I/O pack has detected that a speed input has exceeded the overspeed threshold
- Acceleration threshold has been exceeded
- De-acceleration speed has been exceeded
- Overspeed configuration is set too low
- Acceleration limit has been enabled and is set too low
- Noisy pulse input signal

Solution

- Verify that the overspeed configuration is correct.
- Verify that the acceleration configuration is correct.
- Check the speed sensor.
- Determine the cause of the overspeed condition; for example, input signal, configuration, or noise.

68

Description TRPA - K1 solid state relay shorted

Possible Cause TRPA provides voltage-based detection of stuck-on relays in the six voting contacts used to provide K1. Zero voltage has been detected on one or more contacts of K1 when voltage should be present.

Solution Replace the TRPA.

69

Description TRPA - K2 solid state relay shorted

Possible Cause TRPA provides voltage-based detection of stuck-on relays in the six voting contacts used to provide K2. Zero voltage has been deleted on one or more contacts of K2 when voltage should be present.

Solution Replace the TRPA.

70

Description Pack internal reference voltage out of limits

Possible Cause The calibration reference voltage is beyond the expected value, indicating a hardware failure.

Solution

- Cycle power on the I/O pack.
- Replace the I/O pack.

71

Description Pack internal null voltage out of limits

Possible Cause The calibration null voltage is beyond the expected value, indicating a hardware failure.

Solution

- Cycle power on the I/O pack.
- Replace the I/O pack.

128-223

Description Logic Signal [ ] Voting Mismatch

Possible Cause A problem exists with a status input between the R, S, and T I/O packs. This could be the device, the wire to the terminal board, or the terminal board.

Solution

- Verify that the R, S, and T I/O pack configurations are equal to the ToolboxST configuration.
- Check the I/O pack power and networking.
- Check the I/O pack mounting on the terminal board.
- Verify the operation of the device generating the specified signal.
- Verify the terminal board wiring and connections.
- Replace the I/O pack.

224-252

Description Input Signal [ ] Voting Mismatch, Local=[ ], Voted=[ ]

Possible Cause A problem exists with a status input between the R, S, and T I/O packs. This could be the device, the wire to the terminal board, or the terminal board.

Solution

- Verify that the R, S, and T I/O pack configurations are equal to the ToolboxST configuration.
- Check the I/O pack power and networking.
- Check the I/O pack mounting on the terminal board.
- Verify the operation of the device generating the specified signal.
- Verify the terminal board wiring and connections.
- Replace the I/O pack.