ARCNET – Interfaces the ARCNET signals from the UCPB daughterboard in the IO cores.

COM1 – RS232 interface signals used for the terminal interface.

FAN – Power connection to the fan that cools the 486DX CPU on the UCPB board.

J1 – Bus connection to the UCPB daughterboard.

J3 – Bus connection to the UCPB daughterboard.

JEE – Communicates between the STCA board and the QTBA or CTBA terminal boards for the COREBUS.

2PLX – Parallels 2PL connections. (Typically not used.)

The hardware document in Appendix B and the signal flow diagrams in Appendix D contain more information.

STCA Configuration

Hardware. Hardware jumper JP2 enables the test points for factory test. Hardware jumper JP4 selects the voltage needed for the flash EPROM. Refer to Appendix A and the hardware jumper screen on the operator interface for information on the hardware jumper settings for this board.

Software. I/O configuration constants for the pulse rate inputs, compressor stall detector and synchronization settings are entered in the I/O Configuration Editor on the operator interface as described below.

STCA Pulse Rate Input Circuit

The STCA board scales and conditions the pulse rate inputs read from the TCQC board. These signals originate from magnetic pick up devices whose signals are written to the TCQC board by the QTBA, TBQB, and/or PTBA terminal boards. The <R1> core reads the high pressure shaft pulse rate inputs. The pulse rate inputs in each core are independent and are used for different purposes.

STCA Synch Check Circuit

The generator and bus voltage inputs are read from the TCQC board via the 19PL connector. These signals originate on the PTBA terminal board in the <P1> core and are written to the TCTG board in the <P1> core via the JN connector. The signals are then passed through the TCTG board via the JDR/S/T connectors to the JD connector on the TCQA board in the <R1> core. The signals are passed through again to the TCQC board in the <R1> core via the JE connector. The TCQC board provides scaling and conditioning of the signals prior to writing them to the STCA board via the 19PL connector. The synchronizing check (synch check) is done on the STCA board and the results are sent back across the same path to the TCTG board where they are used in conjunction with the automatic sync signals for generator breaker synchronizing commands.

DS200TCCA – Common Analog I/O Board

The Common Analog I/O Board (TCCA), located in the <R5> core, scales and conditions analog signals from the CTBA, TBQA, and TBCA terminal boards mounted in the <R5> core. These signals include 4–20 mA inputs and outputs, RTD inputs , thermocouple inputs, shaft voltage inputs, and shaft current inputs. The signals are written to the STCA board via the 3PL connector.

TCCA Connectors

2PL – Distributes power from the TCPS board in the <R5> core.

3PL – The Data Bus between the STCA, TCCA and TCCB boards in core <R5>. Conditioned signals are carried on 3PL for transferring to the COREBUS.

JAA – Carries the 4–20 mA output signals to the CTBA terminal board.

JBB – Carries the shaft voltage and current signals and 4–20 mA input signals from the CTBA terminal board.

JCC – Carries RTD input signals from the TBCA terminal board.

JDD – Carries RTD input signals from the TBCA terminal board.

JAR/S/T – Carries Thermocouple input signals and cold junction inputs from the TBQA terminal board.

JC – Carries the Power supply diagnostic signals from TCPS.

JEE – Typically not used.

The hardware document in Appendix B and the signal flow diagrams in Appendix D contain more information.

TCCA Configuration

Hardware. There are three hardware jumpers – J1, JP2, and JP3 on the TCCA board. J1 is used to enable/disable the serial RS232 port. JP2 is used to disable the oscillator for card test. JP3 is used for factory test. Refer to Appendix A for information on the hardware jumper settings for this board.

Software. I/O configuration constants for the thermocouples, RTDs, mA inputs and outputs, and the shaft voltage and current settings are entered in the I/O Configuration Editor located on the HMI as described below.

TCCA 4 – 20 mA Input Circuit

The TCCA board provides the circuitry for the 4–20 mA input signals. The signals are read from the CTBA terminal board via the JBB connector. The transducer current is dropped across a burden resistor and the voltage drop is read by the TCCA board and written to the I/O Engine via the 3PL connector.

TCCA 4–20 mA Output Circuit

The TCCA board provides the circuitry for driving 4–20 mA outputs to the CTBA terminal board via the JAA connector. These signals are typically used to drive remote instrumentation for monitoring.

TCCA RTD Circuit

The circuitry that supplies excitation to the RTDs from the TBCA terminal board is located on the TCCA board. A steady current is sent through the RTD and when the temperature changes, the resistance changes causing the voltage on the RTD to change. The TCCA board measures, scales, and conditions the voltage signal. The RTD signals are read from the TBCA terminal board by the TCCA board over the JCC and JDD connectors. The TCCA board sends the signals to the I/O Engine via the 3PL connector. The type of RTD is selected using I/O configuration constants.

TCCA Thermocouple Circuit

The thermocouple inputs are read by the TBQA terminal board. The cold junction signals are provided by the cold junction circuitry located on the TBQA terminal board. These values are used by the TCCA board to calculate the cold junction compensation. The TCCA board uses the thermocouple input and compensation value to calculate the actual temperature read by the thermocouple. The I/O Engine reads the value via the 3PL connector. Thermocouple types and curves are selected using I/O configuration constants.

TCCA Shaft Monitoring

The monitoring for the turbine shaft voltage and current is provided by the TCCA board. These signals are read from the CTBA terminal board via the JBB connector. The signals are written to the I/O Engine via the 3PL connector.

DS200TCCB – Common Extended Analog IO Board

The Common Extended Analog I/O Board (TCCB) provides scaling and conditioning for additional analog I/O signals read from the TBCB terminal Board mounted on the <R5> core and the TCEB board in the <P1> core. These signals include 4–20 mA/0–1 mA inputs, RTDs, generator and bus voltage inputs, and the line current inputs. The STCA board receives the scaled and conditioned signals via the 3PL connector.

TCCB Connectors

2PL – Distributes power from the TCPS board in the <R5> core.

3PL – The Data Bus between the STCA, TCCA and TCCB boards in core <R5>. Conditioned signals are carried on 3PL for transferring to the COREBUS.

JHH – Carries the 4–20 mA/0–1 mA input signals from the TBCB terminal board.

JII – Carries the RTD input signals from the TBCB terminal board.

JMP – Carries the potential and current transformer (PT and CT) signals from the TCEB board in the <P1> core.

JKK – Typically not used.

JTEST – Typically not used.

TCQPL – Typically not used.

The hardware document in Appendix B and the signal flow diagrams in Appendix D contain more information.

TCCB Configuration

Hardware. The hardware jumpers J1, J2, J3, J4 and J5 are used to provide the generator and bus voltage monitoring functions and the line current monitoring function in the Mark V LM. Hardware jumper J14 is used to connect the RS232 serial port to DCOM. Hardware jumpers J15 and J16 are used for testing purposes. Refer to Appendix A and the hardware jumper screen on the operator interface for information on the hardware jumper settings for this board.

Software. I/O configuration constants for the RTDs, mA inputs, the generator and bus voltage and line current settings are entered in the I/O Configuration Editor located on the HMI as described below.

TCCB 4 – 20 mA Input Circuit

The TCCB board provides the circuitry for the 4–20 mA and 0–1 mA input signals. The signals are read from the TBCB terminal board via the JHH connector. The transducer current is dropped across a burden resistor and the voltage drop is read by the TCCB board and written to the I/O Engine via the 3PL connector. Hardware jumpers on the TBCB terminal board are used to select the current range of the input signals.

TCCB RTD Circuit

The circuitry that supplies excitation to the RTDs from the TBCB terminal board is located on the TCCB board. A steady current is sent through the RTD and when the temperature changes, the resistance changes causing the voltage on the RTD to change. The TCCB board measures, scales, and conditions the voltages. The RTD signals are read from the TBCB terminal board by the TCCB board over the JCC and JDD connectors. The TCCB board sends the signals to the I/O Engine via the 3PL connector. The type of RTD is selected using I/O configuration constants.

TCCB Generator/Bus Voltageand Current Input Circuits

The voltage signals from the generator and bus and the current signals from the line, (PT and CT) are scaled and conditioned on the TCCB board. These signals are used by the TCCB to define the phase currents and voltages and to calculate the generator megawatt, power factor, and VARs used for power system monitoring. These signals are read in from the PTBA terminal board, scaled on the TCEB board in the <P1> core and written to the TCCB board via the JMP connector.

DS200TCDA – Digital IO Board

The Digital IO Board (TCDA), located in the digital I/O cores <Q11>, <Q51> and <Q21> if present. TCDA processes digital contact input signals from the DTBA and DTBB terminal boards and contact output (relay/solenoid) signals from the two TCRA boards. The signals are transmitted over the IONET to the TCQC board in <R1>, <R2> if <Q21> is installed and the CTBA terminal board in <R5>.

TCDA Connectors

JP – Distributes power from the TCPS board in the <R1>, <R2> and <R5> cores to the <Q11>, <Q21> and <Q51> cores respectively.

JQ – Connects to the JQR socket on the DTBA board. Carries the contact input signals from the DTBA board to the TCDA board.

JR – Connects to the JRR socket on the DTBB board. Carries the contact input signals from the DTBB board to the TCDA board.

JO1 – Writes the contact output (relay/solenoid) signals to the TCRA board in location four. Not used in <Q11>, since the relays in location 4 are controlled directly by TCQE in <R1>.

JO2 – Writes the contact output (relay/solenoid) signals to the TCRA board in location five.

JX1 – Shielded twisted pair for the IONET signals. The TCDA board in the <Q11> core writes the signals to the JX2 connection on the TCEA board in location five of the <P1> core. The TCDA board in the <Q51> core writes the signals to the JX connection on the CTBA terminal board in the <R5> core.

JX2 – Used for the same function as JX1. Either JX1 or JX2 can be used.

The hardware document in Appendix B and the signal flow diagrams in Appendix D contain more information.

TCDA Configuration

Hardware. There are eight hardware jumpers on the TCDA board. J1 and J8 are for factory test. J2 and J3 are for IONET termination resistors. J4, J5, and J6 are used to set up the IONET ID for the board. J7 is the stall timer enable. Refer to Appendix A and the hardware jumper screen on the operator interface for information on the hardware jumper settings for this board.

Software. I/O configuration constants for the contact input inversions are entered in the I/O Configuration Editor located on the HMI as described below.

TCDA Contact Input Circuits

The TCDA board carries contact inputs from the DTBA and DTBB terminal boards via the JR and JQ connectors. The circuitry in the TCDA board conditions the signals, time tags any change of state, and carries the signals to the IONET via the JX1 (JX2) connector. The contact signal inversions are done through software using I/O configuration constants.

TCDA Contact Output (Relay/Solenoid) Circuits

The contact output signals are carried to the TCRA boards via the JO1 and JO2 connectors.

DS200TCEA – Emergency Overspeed Board

The Emergency Overspeed Board (TCEA), located in the Protective Core <P1>, is used for the high speed protection circuitry and is often referred to as the Protective Processor. The three TCEA boards used in the <P1> core are referred to as the <X>, <Y>, and <Z> processors. These boards each bring in signals for high and low shaft speed, flame detection and automatic synchronization. The signals are scaled and conditioned and written over the IONET to the STCA board in the <R1> core via the JX1 connector located on the TCEA board in location one, (<X>).

The TCEA boards in location three, (<Y>), and five, (<Z>), transfer their information using the JX1 and JX2 connections via <X>. The I/O Engine in the <R1> core uses the data from the three TCEA boards and performs a median select on the three values and the results are transferred across the COREBUS to the Control Engine. The TCEA boards send emergency trip signals to the Turbine Trip Board (TCTG), each TCEA board sends a trip signal to different relays. The three relays on the TCTG board perform a 2/3 vote (relay driver level voting), and the results determine whether the TCTG board trips the unit. Each TCEA board has its own power supply and power supply diagnostics.

TCEA Connectors

J7 – Distributes the power from the <PD> core to each TCEA board.

JK – Carries the signals to the TCEA board from the TCEB board in location two of the <P1> core. JK connects to either JKX, JKY or JKZ connectors on the TCEB board. This board is the Protection Termination Expander Board on which all of the signals are brought in and transferred to the TCEA boards. <X> connects to JKX, <Y> connects to JKY, and <Z> connects to JKZ.

JL – Carries the trip signals to the Turbine Trip Board (TCTG) in location four of the <P1> core. Each TCEA board connects to a different connection on the TCTG board. JL on <X> connects to JLX, JL on <Y> connects to JLY, and JL on <Z> connects to JLZ.

JW – Carries the 335 V dc for the flame detectors to the TCEB board. JW connects to the JWX/Y/Z connectors on the TCEB board. <X> connects to JWX, <Y> connects to JWY, and <Z> connects to JWZ.

JX1 – Daisy chained IONET connectors. JX1 on <X> connects to the JX connector on the TCQC board in the <R1> core. This IONET connection reads/writes all of the <P1> core signals and digital I/O, <Q11>, core signals to the I/O Engine in <R1>. JX1 on <Y> connects to the JX2 socket on <X> allowing it to be on the daisy chain. The JX1 connector on <Z> connects to the JX2 socket on <Y>. Again this allows it to be on the daisy chain. All of the signals are carried from board to board over the daisy chain until they arrive at the TCQC board in the <R1> core.

JX2 – Daisy chained IONET connectors. JX2 on <X> connects to the JX1 connector on <Y>. JX2 on <Y> connects to the JX1 connector on <Z>. The JX2 connector on <Z> connects to the TCDA board in the <Q11> core. This allows the digital signals to follow the daisy chain up the IONET to the <R1> core.

The hardware document in Appendix B and the signal flow diagrams in Appendix D contain more information.

TCEA Configuration

Hardware. The TCEA board's hardware jumpers J1 and J31 are used for factory test. J2 and J3 are used for IONET termination resistors. Hardware jumpers J4, J5 and J6 are used to set up the IONET address for each TCEA board. Overspeed trip frequency settings are confirmed using J12 through J21 for the high pressure shaft and J8 through J11 and J22 through 27 for the low pressure shaft. The actual configuration is done through the I/O configuration software. J28 and J29 hardware jumpers cause <Z> to always vote for a trip on emergency overspeed. J30 enables the stall timer. Refer to Appendix A and the hardware jumper screen on the operator interface for information on the hardware jumper settings for this board.

Software. The IO Configuration Editor is used to set the base speed and overspeed values for both the high and low pressure shafts and calculates the hardware jumper settings for trip frequency. The pulse rate information from the Ultra Violet (UV) flame detectors is selected and the auto-synchronization permissive values are chosen in the IO Configuration Editor as described below.

TCEA Flame Detection Circuits

Signals from the UV flame detectors are brought into the PTBA board in the <P1> core. These signals are read from the PTBA terminal board via the JVA and JU connectors to the TCEB board and are written to the TCEA board via the JK (JKX/Y/Z) connectors. The signals are scaled, conditioned and the intensity calculated using internal algorithms to determine the flame status. The flame detect signals are used by the Control Sequence Program (CSP) in the <R> core. These signals are sent via the IONET to the I/O Engine, which sends them to the Control Engine. JW (JWX/Y/Z) carries the 335 V dc to the flame detectors.

TCEA Turbine Overspeed Circuit

The I/O configuration constants determine the emergency overspeed trip level settings, and the hardware jumpers confirm the overspeed settings. The shaft speed magnetic pick-ups land on the PTBA terminal board in the <P1> core for the emergency overspeed circuit. The PTBA board parallels the signals to the <R1> core for use in Control Sequence Program for primary overspeed. The TCEA board calculates shaft speed using I/O configuration constants. The TCEA board compares the calculated shaft speeds with the I/O configuration constants trip values to detect an overspeed trip condition.

If a trip condition is detected, the circuit will de-energize the Emergency Trip Relays (ETRs) on the Turbine Trip Board (TCTG) to trip the unit. Hardware jumpers J28 and J29 on <Z> configure <Z> to always call for an emergency overspeed trip. J28 and J29 work in conjunction with the IONET address jumpers J4, J5, and J6 and embedded software. If the IONET address tells the TCEA board it is a <Z> board, the board will always vote for an emergency overspeed trip. This causes the system to have a dual redundant system for the emergency overspeed trip conditions. If either <X> or <Y> call for an emergency overspeed trip, the unit will trip. J28 and J29 must be set the same for <X>, <Y>, and <Z>.

TCEA Automatic Synchronizing Circuit

The bus and generator voltages from the PTBA terminal board are sent through the JV connector to the TCEB board where the JMP connector transferred them to the TCEA board. Embedded software in EPROMs on the TCEA board performs speed matching and voltage matching. The TCEA board sends the permissive to close the breaker after checking for proper generator and line voltages and frequencies and that the differential between the line and the generator is within the limits set by the I/O Configuration constant. The STCA board performs a separate synchronization check function, which sends a logic signal to the TCEA board. This logic must be satisfied to enable a breaker closure.

DS200TCEB – Protective Termination Expander Board

The Protective Termination Expander Board (TCEB), located in the <P1> core, scales the PT and CT signals used by the TCCB board in the <R5> core. These signals are used for the generator and bus voltages and the line current and are landed on the PTBA terminal board. Signals for emergency overspeed and flame detect come from the PTBA terminal board and are passed through the TCEB board to the TCEA boards for processing. The 335 V dc needed for the flame detector devices passes across this board from the TCEA boards, is conditioned, sent to the PTBA terminal board and out to the sensors. The alarm horn for the Mark V LM is also located on the TCEB board.

TCEB Connectors

JKX/Y/Z – Carries the emergency overspeed magnetic pick up signals and flame detection signals to the TCEA boards in locations <X>, <Y>, and <Z> respectively.

JMP – Carries the PT and CT signals to the TCCB board in the <R5> core.

JU – Carries the magnetic pick up and flame detect signals from the PTBA terminal board.

JV – Carries the PT and CT signals from the PTBA terminal board.

JVA – Carries the 335 V dc to the PTBA terminal board for the UV flame detector devices.

JWX/Y/Z – Carries the 335 V dc from the TCEA board and conditions the signal prior to the TCEB board writing the 335 V dc to the PTBA terminal board via the JVA connector.

JPU – Typically not used.

JPV – Typically not used.

JPW – Typically not used.

The hardware document in Appendix B and the signal flow diagrams in Appendix D contain more information.

TCEB Configuration

Hardware. There are no hardware jumpers on the TCEB board. The alarm horn jumper is located on the PTBA terminal board.

Software. There is no software configuration for the TCEB board.

TCEB PT and CT Circuit

The PT and CT signals are read via t JV connector from the PTBA terminal board. These signals are stepped down and written to the TCCB board in the <R5> core via the JMP connector where they are used for imbedded functions. Any configuration associated with these signals is done in the <R5> core.

TCEB Flame Detection Circuit

The flame detection signals are read via the JU connector from the PTBA board and passed through and written to the TCEA boards via JKX/Y/Z connectors. Some conditioning is done on the 335 V dc signals passed through the TCEB board prior to being written to the PTBA terminal board. The signals are read on the JWX, JWY, and JWZ connectors, and written to the PTBA board via the JVA connector.

TCEB Emergency Overspeed Circuit

The magnetic pick up signals for emergency overspeed are read from the PTBA board via the JU connector and passed through the TCEB board to the TCEA boards via the JKX, JKY, and JKZ connectors.

DS200TCPD – Power Distribution Module

The Power Distribution Board (TCPD), located in <PD>, distributes the 125 V dc power to the TCPS boards in each IO core, the Control Engine core, and the TCEA boards in <P1> core. The TCPD board provides switches for powering down each core individually. The digital I/O cores (<Q11>, <Q21> and <Q51>) do not receive their power directly from <PD>, these cores get their power from their associated IO core. The DTBC and DTBD (solenoid output power) terminal boards in the digital cores are powered directly from the TCPD board. The 120/240 V ac power for the ignition transformers connected to DTBC is supplied directly from the TCPD board. The CTBA terminal board in the <R5> receives power from the TCPD for <PD> power output monitoring.

TCPD Connectors

J1R – Distributes the 125 V dc power to the TCPS board in the <R1> core.

J1S – Distributes the 125 V dc power to the TCPS board in the <R2> core.

J1T – Distributes the 125 V dc power to the TCPS board in the <R3> core.

J1C – Distributes the 125 V dc power to the TCPS board in the <R5> core.

J1D – Distributes the 125 V dc power to the TCPS board in the <R> core

J7W – Distributes the 125 V dc power to the TCTG board in the <P1> core.

J7X – Distributes the 125 V dc power to the TCEA board in location one ,<X>, in the <P1> core.

J7Y – Distributes the 125 V dc power to the TCEA board in location three, <Y>, in the <P1> core.

J7Z – Distributes the 125 V dc power to the TCEA board in location five, <Z>, in the <P1> core.

J8A – Distributes the 125 V dc power to the DTBC board in the <Q51> core for the solenoids.

J8B – Distributes the 125 V dc power to the DTBD board in the <Q51> core for the solenoids.

J8C – Distributes the 125 V dc power to the DTBC board in the <Q11> core for the solenoids.

J8D – Distributes the 125 V dc power to the DTBD board in the <Q11> core for the solenoids.

J12A – Distributes the 125 V dc power to the DTBA board in the <Q51> core for the wetted contact inputs.

J12B – Distributes the 125 V dc power to the DTBA board in the <Q11> core for the wetted contact inputs.

J15 – Typically not used.

J16 – Typically not used.

J19 – Typically not used.

J20 – Typically not used.

JPD – Distributes power to CTBA in <R5>. Used by <R5> to monitor <PD> ac and DC power output.

JZ1 – Connection for the TCEA boards and contact input power to drop across the external resistors.

JZ2 – Incoming ac from the TB1 terminal board connected through JZ2 to the DACA, (ac to DC converter), via the JZ connector in the DACA box. Used for ac to DC conversion.

JZ3 – Alternate for JZ2 if reduced voltage needed for special contact output circuit (contact output #18 on the DTBC board of the <Q51>).

JZ4 – Auxiliary ac source connection point for applications that require an isolated input for an uninterruptable power source connection(s) and/or switched back up power source. Typically used for a Black Start Inverter.

JZ5 – Standard ac power source connection for the ignition transformers.

J2R – Typically not used.

J2S – Typically not used.

J2T – Typically not used.

J7A – Typically not used.

J12C – Typically not used.

J17 – Typically not used.

J18 – Typically not used.

The hardware document in Appendix B and the diagrams in Appendix C contain more information.

TCPD Configuration

Hardware. The BJS hardware jumper is supplied for isolation of the ground reference on systems with an external reference. When the jumper is in, the ground reference is provided for the external reference systems. Refer to Appendix A for more information on the hardware jumper setting for this board.

Software. There is no software configuration for the TCPD board.

TCPD Switches

The TCPD board has several switches associated with it. Each switch toggles on and off the power for the particular core or board associated with it.

SW1 – Toggles power in the <R1> core.

SW2 – Toggles power in the <R2> core.

SW3 – Toggles power in the <R3> core.

SW4 – Toggles power in the <R5> core.

SW5 – Toggles power in the <R> core.

SW6 – Toggles power on <X> in the <P1> core.

SW7 – Toggles power on <Y> in the <P1> core.

SW8 – Toggles power on <Z> in the <P1> core.

TCPD Power

External 115/230 V ac power and 125 V dc power is brought in via TB1 mounted on the <PD> core and hard wired to the TCPD board. If ac power is provided, it is converted to the 125 V dc in a DACA (ac to DC) via the JZ2 connector. Power is distributed from <PD> to the various cores and boards via the connectors listed above. An optional JZ3 connection is available for applications requiring reduced voltages for contact #18 on the DTBC board in the <Q51> core. The power distributed to the TCEA boards in the <P1> core is additionally conditioned across resistors via the JZ1 connector. If ac power is provided, the JZ5 connector provides ac power to the ignition transformer outputs.

DS200TCPS – Power Supply Board

The Power Supply Board (TCPS) is located in <R> and each of the four IO cores to convert 125 V dc power from <PD> to the voltage levels required. These include, but are not limited to such things as, microprocessor power supply voltages, mA output power supply voltages, RTD power supply voltages, and servo valve current outputs.

TCPS Connectors

2PL – Distributes the power supply voltages to the various boards in a daisy chain fashion.

J1 – Connector that brings in the 125 V dc power into the TCPS board from the TCPD board in the <PD> core.

JC – Distributes power supply voltages for the power supply diagnostics on the TCQC board in cores <R1>, <R2> and <R3> and the TCCA board in the <R5> core.

JP1 – Distributes power supply voltages to the TCDA board in the digital cores <Q11>, <Q21> and <Q51> and to the AAHA boards in the <R> core.

JP2 – Same as JP1. Either JP1 or JP2 could be used.

X1 – CCOM bus connection.

The hardware document in Appendix B contains more information on core power distribution.

TCPS Configuration

There are no hardware jumper or software configurations for the TCPS boards.

DS200TCQA – Analog IO Board

The Analog IO Board (TCQA) scales and conditions many of the analog signals read in by terminal boards mounted on the I/O cores <R1>, <R2>, and <R3>. These signals include the LVDT inputs, servo valve outputs, thermocouple inputs, 4–20 mA inputs and outputs, vibration inputs, relay driver outputs, pulse inputs, voltage inputs, and generator and line signals. Some of the signals are written to the STCA board via the 3PL connector. The generator and line signals are exchanged with the TCQC board via the JE connector. 4–20 mA input signals such as the fuel flow pressure and compressor stall-detect signals are scaled and conditioned on the TCQA board.

TCQA Connectors

2PL – Distributes power from the TCPS board in the <R1>, <R2> and <R3> cores..

3PL – The Data Bus between the STCA and TCQA boards in cores <R2> and <R3> and between STCA, TCQA, and TCQE boards in core <R1>. Conditioned signals are carried on 3PL for transferring to the COREBUS.

JA – Carries the thermocouple inputs and cold junction compensation from the TBQA board connector JAR/S/T for cores <R1>, <R2>, and <R3> respectively.

JB – Carries the 4–20 mA inputs and outputs to/from the TBQC terminal board connector JBR.

JD – Carries trip signals to the TCTG board in the <P1> core from the <R1> core, not used in <R2> or <R3>.

JE – Carries the servo valve driver outputs, relay driver outputs, generator and line signals, and the pulse signals to/from the TCQC board. Carries the power supply monitor inputs.

JF – Carries the LVDT/LVDR position inputs from the TBQC terminal board connector JFR.

JG – Carries the vibration inputs from the TBQB terminal board connector JGR and carries the +/- 10 V dc inputs.

The hardware document in Appendix B and the signal flow diagrams in Appendix D contain more information.

TCQA Configuration

Hardware. Hardware jumpers J1 and J2 are used to select the mA output circuits. J5 and J6 are used to configure the mA outputs current range, either 20 mA maximum or 200 mA maximum. J7 is used for the RS232 port for card tests. J8 enables an oscillator. Refer to Appendix A and the hardware jumper screen on the operator interface for information on the hardware jumper settings for this board.

Software. I/O Configuration constants for the thermocouples, pulse rates, vibrations, LVDT positions and the 4–20 mA inputs and outputs are entered in the I/O Configuration Editor located on the operator interface as described below.

Pulse Rate Input Circuit

The TCQA board contains the circuitry that scales and conditions the pulse rate inputs read from the TCQC board via the JE connector. These signals originate from the TTL (transistor to transistor logic) and magnetic pick up inputs whose signals are brought into the QTBA and/or PTBA terminal boards. The <R1> core receives the high pressure shaft speed inputs. The pulse rate input circuits on <R2> and <R3> may be used for other signals.

TCQA 4–20 mA Input Circuits

The TCQA board provides the circuitry for the 4–20 mA and 0–1 mA input signals. The signals are read from the TBQC terminal board via the JB connector. The transducer current is dropped across a burden resistor and the voltage drop is read by the TCQA board and written to the I/O Engine via the 3PL connector. Hardware jumpers on the TBQC terminal board are used to select the current range of the input signals.

TCQA 4–20 mA Output Circuit

The TCQA board provides the circuitry for driving 4–20 mA outputs to the TBQC terminal board via the JB connector. These signals are typically used to drive control devices.

TCQA Thermocouple Circuit

Thermocouples are connected to the TBQA terminal board. Circuits also located on the TBQA terminal board provide the thermocouple cold junction reference, which are used by TCQA to calculate the cold junction compensation. The TCQA board uses the thermocouple input and compensation value to calculate the actual temperature read by the thermocouple. The I/O Engine reads the value via the 3PL connector. Thermocouple types and curves are selected using I/O configuration constants.

TCQA LVDT/R Circuit

Linear Variable Differential Transformers (LVDT) or Linear Variable Differential Reactors (LVDR) are used to detect the position of actuators. The position signals are read from the TBQC terminal board via the JF connector. The scaled and conditioned signals are used by the Control Sequence Program (CSP). The excitation signals for the LVDT/R's are written to the QTBA terminal board via the TCQC board. The LVDT/R's are typically used for regulating servo valve outputs.

TCQA Seismic Vibration Circuit

The seismic vibration sensors are terminated on the TBQB terminal board in <R2> and <R3> and read by the TCQA board of the <R1> and <R3> cores respectively. The signals are scaled and conditioned and written to the Control Engine to be used by the CSP for monitoring and protection. Scaling values are selected in the I/O Configurator on the operator interface.

TCQA Generator And Line Circuit

In the <R1> core , the generator and line feedback signals from the Turbine Trip Board (TCTG) pass to the TCQC board through the TCQA board via JD and JE connectors .

DS200TCQC – Analog IO Expander Board

The Analog IO Expander board (TCQC) provides scaling and conditioning for additional analog signals read from the terminal boards of the I/O cores. The TCQC board provides LVDT and LVDR excitation. The IONET termination for <Q11> and <P1> is on the TCQC board in the <R1> core. If the optional <21> is installed, that IONET termination is on the TCQC in <R2>. The mA input for the megawatt transducer signal is scaled and conditioned on the TCQC board and written to the STCA board via the 19PL connector. Pulse rate inputs are scaled and conditioned on the TCQC board. In most applications, the high pressure shaft speed signals and occasionally the liquid fuel flow signals are scaled on the TCQC board and written to the TCQA board via the JE connector in the <R1> core. The TCQC board communicates the generator and line signals with the STCA board via the JE connector.

TCQC Connectors

2PL – Distributes power from the TCPS board in the <R1>, <R2> and <R3> cores.

8PL – I/O connector to the STCA boards in cores <R1>, <R2>, and <R3>. Signals include the COM1 RS232 output signals, the serial I/O signals, the acand DC power monitoring signals (TCPD), and a pulse rate magnetic pick up signal.

19PL – I/O connector to the STCA board. The I/O signals may include the megawatt, generator, bus, compressor stall detection signals, and the magnetic pick up pulse rate signals from the high pressure shaft. Power bus and neutral bus signals may also be carried in this connector (TCPS). Cores <R2> and <R3> may use the 19PL connector for other signals.

JC – Connected to the power supply board TCPS whose signals pass through the TCQC board to the TCQA board via the JE connector and to the STCA board via the 19PL connector.

JE – Writes the power supply monitoring signals to the TCQA board and reads the servo valve outputs and generator and line signals from the TCQA board.

JFF – Writes the servo outputs to the QTBA terminal board.

JGG – Writes the servo outputs and the 15 amp signals, reads magnetic pick up and megawatt transducer signals to/from the QTBA terminal board.

JH – Reads the pulse rate signal and compressor stall signals from the TBQB terminal board.

JJ – Reads the speed signals from the TCQE board in the <R1> core which originated on the PTBA terminal board in the <P1> core.

JX – Connector that terminates the IONET signal from TCEA board in the <P1> core. Used only in the <R1> core.

1PL – Typically not used.

6PL – Typically not used.

17PL – Typically not used.

VARC – Typically not used.

JBU – Typically not used.

ARCPL – Typically not used.

CARC – Typically not used.

The hardware document in Appendix B and the signal flow diagrams in Appendix D contain more information.

TCQC Configuration

Hardware. The first 16 hardware jumpers on the TCQC board configure the output current range for the servo outputs. The even numbered jumpers select the feedback scaling, while the odd numbered jumpers select the source output resistance. Hardware jumpers 25 through 36 are for added feedback scaling options for servos one through four, giving them a maximum current range of +/- 240 mA. BJ17 sets the RS232 port for card tests. BJ21 is the stall timer enable. BJ22 is the oscillator enable for factory test. BJ23 and BJ24 are not used. BJ18 and BJ20 limit the P15 and N15 supply to the proximity transducers. Hardware jumpers JP38 and JP39 set the magnetic pick up gain for liquid fuel flow signals in some applications. Refer to Appendix A and the paragraphs below for information on the hardware jumper settings for this board.

Software. There is no software configuration for the TCQC board.

TCQC Servo Valve Regulator Output Circuits

Current from the TCQA board is scaled by the TCQC board jumpers and sent to position the servo valves. Hardware jumpers on the TCQC board are used to configure the reference feedback and output current range. The TCQC board contains the servo clamp relay and the suicide relays. Energizing the suicide relays drives the signal to ground by passing the servo valves. This allows the servo valve to drift to the bias position. Energizing the servo clamp relays applies a positive current to the servo valve. A signal from the CSP that is written to the TCQA board and then sent to the TCQC board will energize the suicide relays. An emergency signal that is written directly to the TCQC board via the TCEA board will energize the servo clamp relays.

TCQC Pulse Rate Input Circuit

The high pressure shaft pulse rate signals are read from the TCQE board via the JJ connector. The TCQE board signals originate on the PTBA board in the <P1> core. The high pressure shaft signals are written to the TCQA board via the JE connector to be scaled and conditioned and then are written to the STCA board via 3PL. The pulse rate inputs from both the magnetic speed sensors and the TTL type sensors that are landed on the TBQB terminal board pass through the TCQC board via the JH connector. Additional magnetic pick up pulse rate signals are available on the QTBA board and are read by the JGG connector. Some of the signals landed on the PTBA terminal board could be landed on the QTBA terminal board and should not be used on both. The corresponding screws on the QTBA terminal board are not available if the signals are also landed on the PTBA terminal board.

TCQC Generator And Line Feedback

The signals for generator and line feedback pass through the TCQC board where they are scaled and conditioned prior to being written to the STCA board via the 19PL connector. These signals originate on the TCTG board in the <P1> core, pass through the TCQA board and are written to the TCQC board via the JE connector. The STCA board uses these signals for the synch check function.

TCQC IONET Circuit

The termination of the IONET for the <R1> core is on the TCQC board in <R1>. The signals from the TCDA board in the <Q11> core and the <X>, <Y>, and <Z> boards in the <P1> core are daisy chained on the IONET via the JX connector. These signals are written directly to the STCA board via the 8PL connector.