

 BY JOHNSON CONTROLS	STEAM TURBINE CENTRIFUGAL LIQUID CHILLERS	
SERVICE INSTRUCTIONS	Supersedes: 160.67-M3 (108)	Form 160.67-M3 (214)

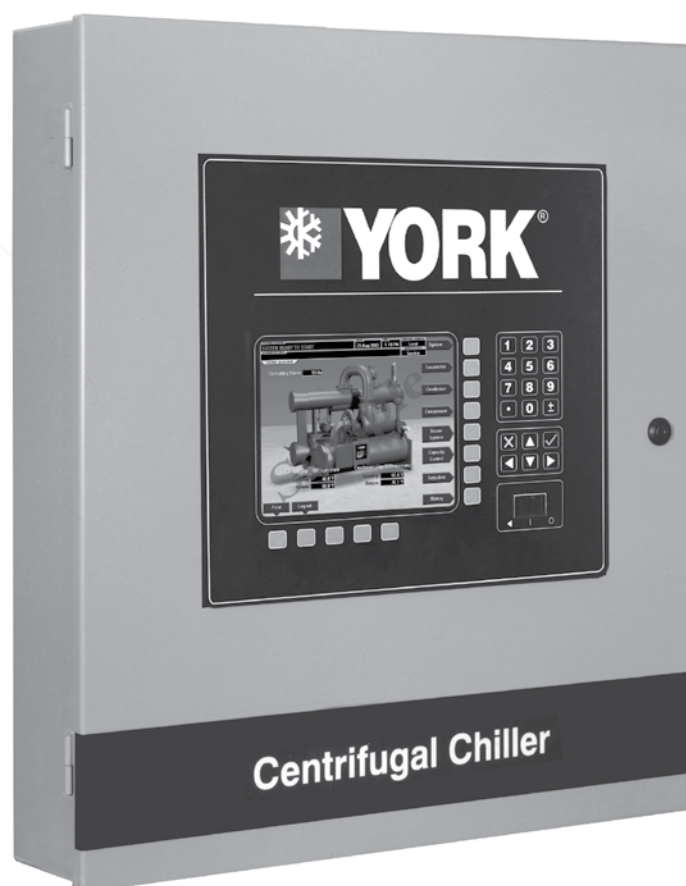
**MODEL YST
WITH OPTIVIEW CONTROL PANEL
DESIGN LEVEL F AND G
BUILT AFTER JANUARY 1, 2008**

377-12421-101 (NEMA 1)

377-12421-102 (NEMA 1 with Compressor VGD)

377-15243-101 (NEMA 4/12)

377-15243-102 (NEMA 4/12 with Compressor VGD)



LD09731



IMPORTANT!

READ BEFORE PROCEEDING!

GENERAL SAFETY GUIDELINES

This equipment is a relatively complicated apparatus. During installation, operation maintenance or service, individuals may be exposed to certain components or conditions including, but not limited to: refrigerants, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in

which it is situated, as well as severe personal injury or death to themselves and people at the site.

This document is intended for use by owner-authorized operating/service personnel. It is expected that these individuals possess independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood this document and any referenced materials. This individual shall also be familiar with and comply with all applicable governmental standards and regulations pertaining to the task in question.

SAFETY SYMBOLS

The following symbols are used in this document to alert the reader to specific situations:



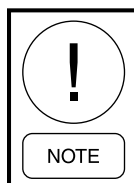
Indicates a possible hazardous situation which will result in death or serious injury if proper care is not taken.



Identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution if proper care is not taken or instructions are not followed.



Indicates a potentially hazardous situation which will result in possible injuries or damage to equipment if proper care is not taken.



Highlights additional information useful to the technician in completing the work being performed properly.



External wiring, unless specified as an optional connection in the manufacturer's product line, is not to be connected inside the control cabinet. Devices such as relays, switches, transducers and controls and any external wiring must not be installed inside the micro panel. All wiring must be in accordance with Johnson Controls' published specifications and must be performed only by a qualified electrician. Johnson Controls will NOT be responsible for damage/problems resulting from improper connections to the controls or application of improper control signals. Failure to follow this warning will void the manufacturer's warranty and cause serious damage to property or personal injury.

CHANGEABILITY OF THIS DOCUMENT

In complying with Johnson Controls' policy for continuous product improvement, the information contained in this document is subject to change without notice. Johnson Controls makes no commitment to update or provide current information automatically to the manual owner. Updated manuals, if applicable, can be obtained by contacting the nearest Johnson Controls Service office or accessing the Johnson Controls QuickLIT website at <http://cgproducts.johnsoncontrols.com>.

Operating/service personnel maintain responsibility for the applicability of these documents to the equipment. If there is any question regarding the applicability of

these documents, the technician should verify whether the equipment has been modified and if current literature is available from the owner of the equipment prior to performing any work on the chiller.

CHANGE BARS

Revisions made to this document are indicated with a line along the left or right hand column in the area the revision was made. These revisions are to technical information and any other changes in spelling, grammar or formatting are not included.

ASSOCIATED LITERATURE

MANUAL DESCRIPTION	FORM NUMBER
Unit Installation	160.67-N2
Operation & Maintenance	160.67-O2
Wiring Diagram – Model YST	160.67-PW6
Start-Up Checklist – Model YST	160.67-CL1
Renewal Parts - Controls and Instrumentation – Model YST	160.67-RP2

NOMENCLATURE

The model number denotes the following characteristics of the unit.

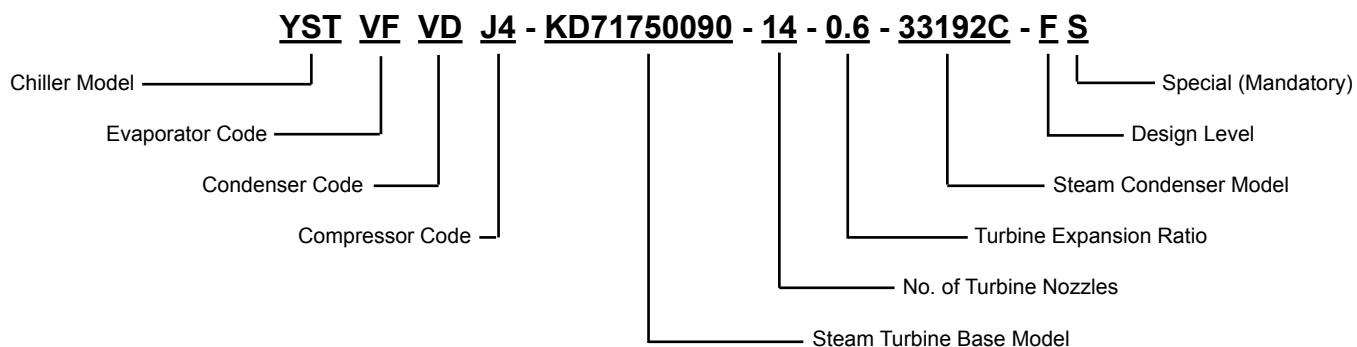


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SECTION 1 - INTRODUCTION

This document explains the operation of the printed circuit boards and major components of the OptiView Control Center to a level that allows a Service Technician to troubleshoot and locate the source of a problem.

The overall system architecture is described and illustrated with block diagrams. This describes the general function of each component and provides the system interface and signal flow. The function of each component and signal flow between components must be understood before effective troubleshooting can commence.

The operation of each printed circuit board is described and illustrated with a block diagram that is a simplified representation of board circuitry. The expected voltage level at all inputs and outputs of each board for any operating condition is provided.

Included in this document are procedures that have to be performed at chiller commissioning or during service. They should not be performed by anyone other than a Service Technician. For example, calibration procedures have to be performed or verified at system commissioning or when a component is replaced. Certain safety shutdowns require special reset procedures to be performed before the chiller can be restarted. Since the operating program supplied in each OptiView Control Center is universal to all applications, Special Setpoints, Program Jumpers and Program switches are required to configure the chiller for local operating conditions.

A System Commissioning Checklist is provided as reference of items to be performed during chiller commissioning.

In addition to this document, several levels of supporting documentation are required while servicing the system. Field Control Modifications Diagram 160.67-PW2 provides details of the interface to remote devices. Operation Manual 160.67-O1 explains the operation of the OptiView Control Center keypad, how to enter setpoints and explains all the messages displayed on the OptiView Control Center display. Wiring diagram 160.67-PW6 provides the connections between the printed circuit boards and components within the OptiView Control Center.

When the chiller shuts down on a **SAFETY** or **CYCLING** shutdown or is being prevented from starting, a message is displayed providing the reason for the shutdown. This message, along with all the chiller operating conditions at the instant of the event are stored in the Microboard battery-backed memory. This history data can be displayed or printed using an optional printer. The Operation Manual 160.67-O1 provides a detailed description of this message, including the conditions required to produce the message and conditions required to restart the chiller.

Diagnostic Routines allow service analysis of the following functions:

- Display
- Analog Inputs
- Digital Inputs
- Digital Outputs
- Serial Data Ports

Before beginning any troubleshooting, observe the shutdown message and retrieve the **HISTORY** data of that event. Refer to the Operation Manual for an explanation of the message. The conditions required to produce the message must be clearly understood before proceeding. (If this is not heeded, much time will be wasted). Armed with a knowledge of the overall system architecture and the function of each printed circuit board and signal flow provided by this manual, proceed with the appropriate wiring diagram listed above to trace the problem through the system. Use the Diagnostic Routines where appropriate.

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SECTION 2 - SYSTEM ARCHITECTURE

The OptiView Control Center performs the following functions:

- Controls chiller capacity to chill liquid to the chilled liquid temperature setpoint.
- Controls chiller solenoid valves, relays, actuators and motor contactors per the operating program.
- Displays chiller operating conditions, alarms, shutdown messages and history data.
- Accepts operator-programmed setpoints and controls the chiller accordingly.
- Allows Manual control of chiller motor contactors and actuators.
- Monitors chiller operating conditions and shuts down chiller when Safety or Cycling thresholds are exceeded.
- Allows local Manual start/stop and accepts start/stop commands from remote devices, via contact closures or serial communications.
- Allows setpoints to be changed from a remote location via 0-10VDC, 2-10VDC, 0-20mA, 4-20 mA, contact closures or serial communications.
- Provides chiller operating data and status to remote devices via serial communications and contact closures.
- Allows real-time data and history data to be printed on an optional printer.
- Controls the turbine speed from slow roll warm-up through the ramp up to rated speed.

The OptiView Control Center is a microprocessor based control system that receives analog, digital and serial data inputs and controls analog, digital and serial data outputs per instructions in the operating program. A panel mounted display and touch-sensitive keypad permit local operation.

System refrigerant and compressor oil pressures are sensed by pressure **transducers**. The output of each transducer is a DC voltage that is analogous to the pressure input. System cooling refrigerant, chilled and cooling liquid temperatures are sensed by **thermistors**. The output of each thermistor is a DC voltage that is analogous to the temperature it is sensing. Typical

output voltage range of both is 0.5 to 4.5VDC. These are **analog** inputs to the Microboard in the OptiView Control Center.

Turbine oil and steam pressures are sensed by pressure **transmitters**. The output of each transmitter is a 4-20 mA DC current that is analogous to the pressure input. Turbine oil, bearing, and steam temperatures are sensed by 100 Ohm platinum resistance temperature detectors. Each **RTD** is connected to a Temperature Transmitter located in the turbine box on the chiller which converts the resistance changes to a 4-20 mA DC signal analogous to a specific range of temperature sensed by the RTD. These are analog inputs to the Analog I/O Expansion Board in the OptiView Control Center.

Turbine shaft vibration (when supplied) is sensed by Proximity Probes monitoring two planes of shaft movement on each end of the turbine. Compressor casing vibration (when supplied) is sensed by Accelerometers monitoring two planes of vibration on the compressor rotor support. Each sensor is connected to a Vibration Transmitter located in the turbine box on the chiller which converts the vibration to 4-20 mA DC signals analogous to a specific range of vibration sensed by the Proximity Probe or Accelerometer. These are analog inputs to the Analog I/O Expansion Board in the OptiView Control Center.

Digital Inputs are on/off inputs to the OptiView Control Center in the form of switch and relay contacts. These inputs are 115VAC when the contacts are closed and 0VAC when open. These include flow switches, local start/stop switch, remote cycling and high pressure safety device, etc.

Digital Outputs are on/off outputs from the OptiView Control Center in the form of relay contacts and triacs. The relay contacts typically switch 115VAC and the triacs typically switch a nominal 30VAC. relay outputs include status/alarm, chiller solenoid valves, oil heater, oil pump starter and chilled and condenser water pump starters, etc. Triac outputs include pre-rotation vane control and Variable Geometry Diffuser (VGD) control.

Serial Data is transmitted to and received from devices in RS-232, RS-485 and TX/RX (opto-couple) form.

The OptiView Control Center supports three types of starters; Electro-Mechanical Starter, Solid State Starter and Variable Speed Drive. However, all OptiView Control Centers contain the following standard components, regardless of the starter type applied:

- Microboard
- I/O (Input/Output) Board
- Keypad
- Display
- Power Supply
- Analog I/O Expansion Board
- Digital I/O Expansion Board

Figure 1 on page 21 is the YST OptiView Control Center block diagram. On the block diagram, the standard components are shown, along with all the optional I/O points that support the available optional equipment. *Figure 2 on page 22* and *Figure 3 on page 23* are operation sequence timing diagrams of the applications available.

The microprocessor and all supporting logic circuits, along with the memory devices containing the operating program, reside on the **Microboard**. All chiller operating decisions are made here. It receives analog and digital inputs from the chiller and remote devices and provides both analog and digital outputs as well. The analog inputs are connected directly to the Microboard and also received via the **Analog I/O Expansion Board** (see below). The digital inputs are received via the **I/O Board** (see below) and the **Digital I/O Expansion Board** (see below). digital inputs are routed through both the **I/O Board** and the **Digital I/O Expansion Board**. Analog outputs are routed through the **Analog I/O Expansion Board**.

The control center on YST chillers is equipped with Microboard 031-02430-004. The program resides in non-removable onboard memory. The software version is C.OPT.14.xx.yzz, and is viewable on the DIAGNOSTICS screen in SERVICE access level. The program can be upgraded by downloading a new program from a Program Card. Program Cards are shirt-pocket-size portable memory storage devices available from YORK.

The software version C.OPT.12.xx.yzz is an alphanumeric code that is interpreted as follows. Each time the controls section or language section is revised, the respective revision level increments.

- C – Commercial chiller
- OPT - Used on Microboard 031-02430-000
- 12 – YST chiller
- xx - controls revision level (00, 01, etc)
- y – language package (0=English only, 1=NEMA, 2=CE, 3=NEMA/CE)
- zz – language package revision level (00, 01, etc)

The **I/O Board** acts as an input/output device for the Microboard. It conditions the digital input signals for the Microboard and contains relays and triacs that are controlled by the Microboard to control solenoids, motor contactors and actuators. The 115VAC digital inputs from switch and relay contacts are converted to logic level voltages by Opto-Couplers. The relays have +12VDC coils that are energized and de-energized by the Microboard. The contacts of these relays control the 115VAC system solenoids, relays and motor contactors. The triacs are turned on and off by the Microboard. The outputs of these triacs control actuators.

YST chillers are equipped with I/O Board 031-01743-002. This board is populated with the required Triacs Q3 and Q4 that apply the open and close signals to the Variable Geometry Diffuser ring actuator. Refer to Variable Geometry Diffuser *SECTION 24 - VARIABLE GEOMETRY DIFFUSER*. Relay K6, K7, K8, and K9 are also included to provide additional outputs required for control of turbine and steam condenser components.

The **Analog I/O Expansion Board** provides additional analog input/output capability for the Microboard. This board is actually a small microprocessor board and is programmed to control analog outputs, or accept analog inputs, from external electrical devices. It has the capability of 24 independent input channels. These I/O channels are dedicated through the software and external wiring, as to the function of each channel. Each channel is configured by the software for the type of device that is connected to it. The data is transferred to/from the Microboard via an RS-485 serial interface. The analog input values are converted to digital words prior to transfer to the Microboard. The analog output values are transferred from the Microboard in digital word form and converted to analog values on this board.

The **Digital I/O Expansion Board** provides additional digital input/output capability for the Microboard. It accepts AC voltage inputs and provides AC voltage outputs. Removable input modules and output modules configure each point appropriately. The digital values are transferred to/from the Microboard via an RS-485 serial interface.

A front panel-mounted **Keypad** allows Operator and Service Technician user interface. Membrane keys are used to display chiller and system parameters, enter setpoints and perform chiller and OptiView Control Center diagnostics. It also contains a **START-RUN-STOP/RESET** switch that is used to locally start and stop the chiller and perform manual reset functions.

A front panel mounted liquid crystal **Display** allows graphic animated display of the chiller, chiller subsystems and system parameters. The chiller and working components of the chiller are displayed, along with chiller operating pressures and temperatures. The keypad is used to select displays showing increasing levels of detail of chiller working components.

A self-contained **Power Supply** supplies the necessary DC voltages for all the components within the OptiView Control Center.

Style “F” (and later) chillers are supplied with **factory-mounted flow sensors** on the evaporator and condenser. These are electronic thermal-type sensors. The operating principle of the sensor is thermal conductivity. It uses the cooling effect of a flowing liquid to sense flow. The temperature of the heated sensor tip is sensed by a thermistor located in the tip. A second thermistor, located higher in the tip in a non-heated area, is only affected by changes in liquid temperature. The temperatures sensed by the thermistors are compared. Flowing liquid carries heat away from the heated sensor tip, lowering its temperature. The lower temperature differential between the two thermistors indicates the liquid is flowing. A higher differential indicates no flow. These sensors are interfaced to Microboard analog inputs. *Refer to Section 3 for a detailed explanation of this flow sensor and interface.*

FOR RETROFIT APPLICATIONS

The various chiller style/compressor combinations are equipped differently and have different control requirements. The variables include:

- Flow Sensor – “Differential Pressure” type, “Paddle” type or “Factory Mounted Thermal” type. The Differential Pressure and Paddle types apply 115 VAC to the I/O Board Digital inputs TB4-12 (evaporator) and TB4-11 (condenser) (*refer to Figure 11 on page 48*). The Factory Mounted Thermal type (available with Style “F” and later chillers), applies +5VDC to the Microboard analog inputs at J7-14 (evaporator) and J7-16 (condenser) (*refer to Figure 9 on page 42*). The YST software allows use of either the Thermal type or the Paddle type flow sensors on Style “F” and later chillers. With these versions, the actual flow sensor type present must be entered using the Flow switch Setpoint (*refer to SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES*).
- Hot Gas Bypass Valve - In order to use the analog output on the Analog I/O Expansion Board, this must be set for “Enabled” on the Operations screen.
- Subcooler Level Control - In order to use the analog output on the Analog I/O Expansion Board, this must be “Enabled” on the Operations screen. If this is set for “Disabled”, the analog output is fixed at 100% (10V).
- Variable Geometry Diffuser (VGD) - This may be set for “Enabled” or “Disabled” on the Operations screen. *Refer to SECTION 24 - VARIABLE GEOMETRY DIFFUSER.*
- Compressor Oil Pump Package - Style C and earlier chillers are equipped with Fixed Speed Oil Pumps. Style “D” and later chillers are equipped with Variable Speed Oil Pumps. This selection is made on the SETUP screen. See *SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES.*

Serial data interface to the YORK ISN Building Automation System is through the optional MicroGateway. This printed circuit board requests the required data from the Microboard and makes it available for the ISN network.

Certain compressors are equipped with a **Variable Geometry Diffuser (VGD)**. It is used to reduce rotating stall conditions and associated stall noise. Stall may occur at low load conditions with high head. A mechanical ring, located in the compressor diffuser passage is operated to open or close the diffuser gap. Stall noise is detected as gas pressure pulsations. A **Stall Pressure Transducer**, mounted in the discharge scroll of the compressor, detects the gas pressure pulsations and outputs DC voltage pulsations to the

Stall Detector Board. This board converts the voltage pulsations into an analog voltage that represents the magnitude of the stall noise. This analog voltage is input to the Microboard where it is compared to thresholds that determine if the stall noise is acceptable or unacceptable. The VGD is pulsed toward the closed position in response to unacceptable stall noise. Otherwise, it is modulated to maintain the most open position possible without stall occurring.

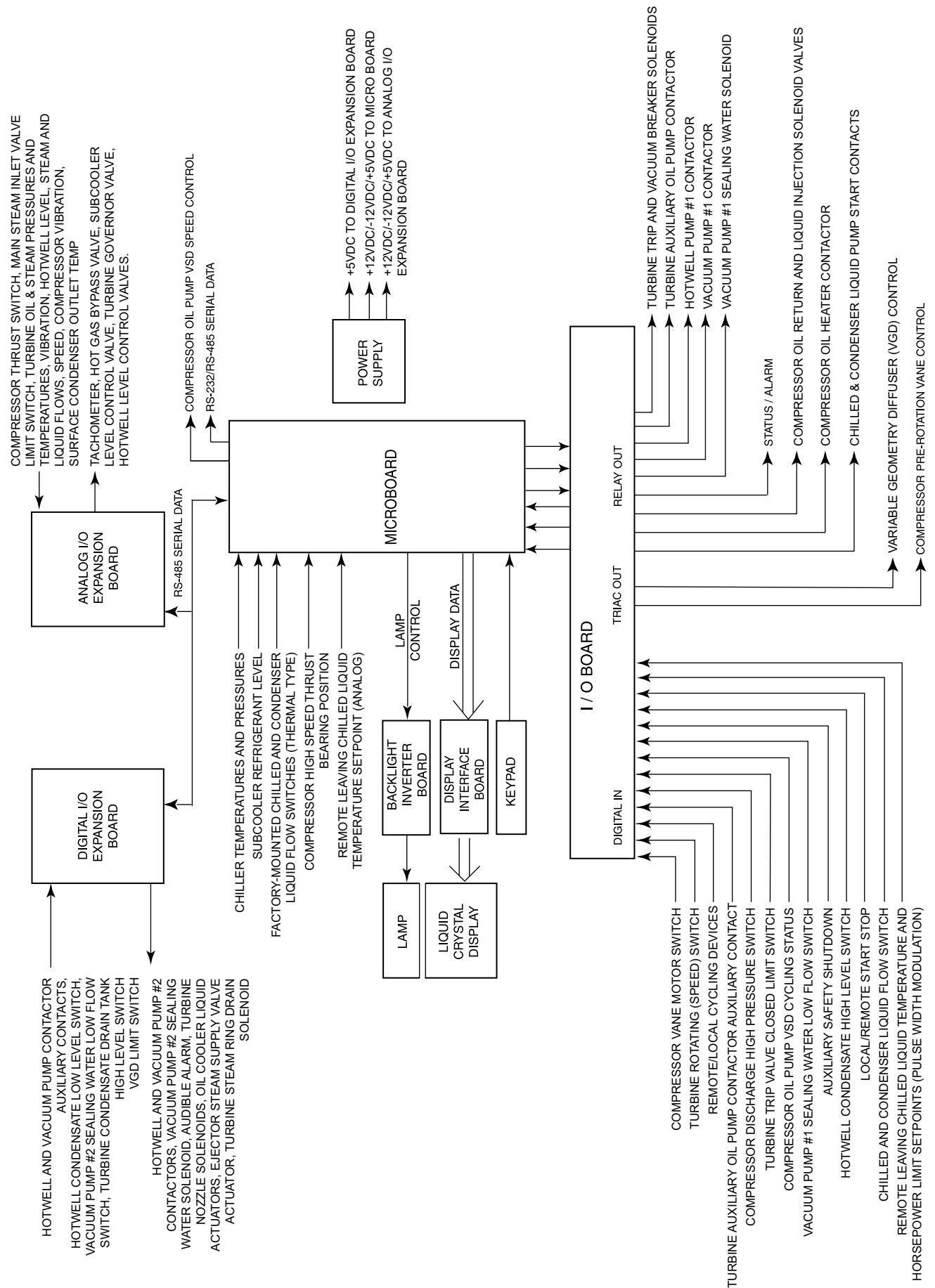
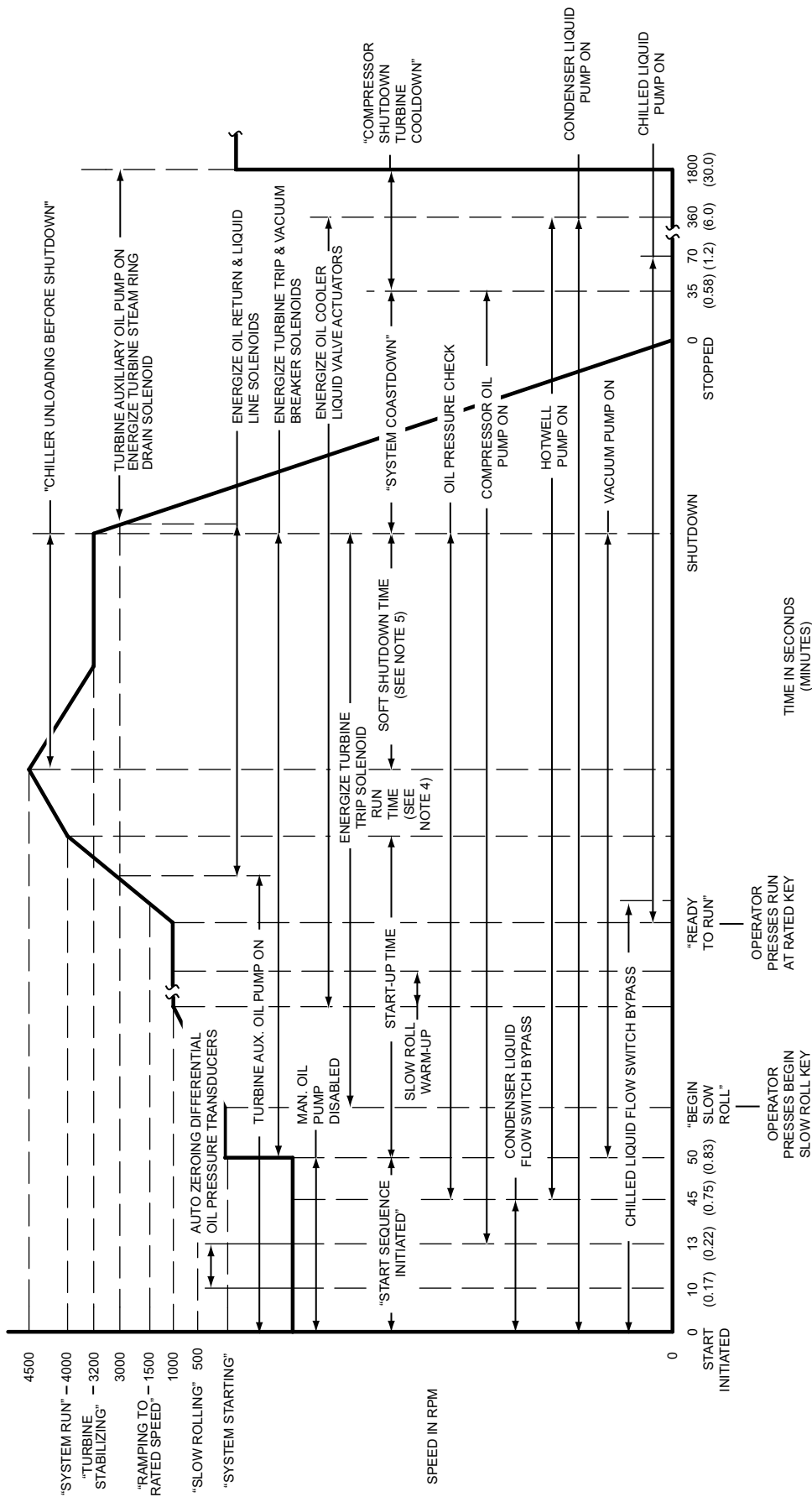


FIGURE 1 - OPTIVIEW CONTROL CENTER

LD10057A

TIMING DIAGRAM – (MANUAL START)

LD12576

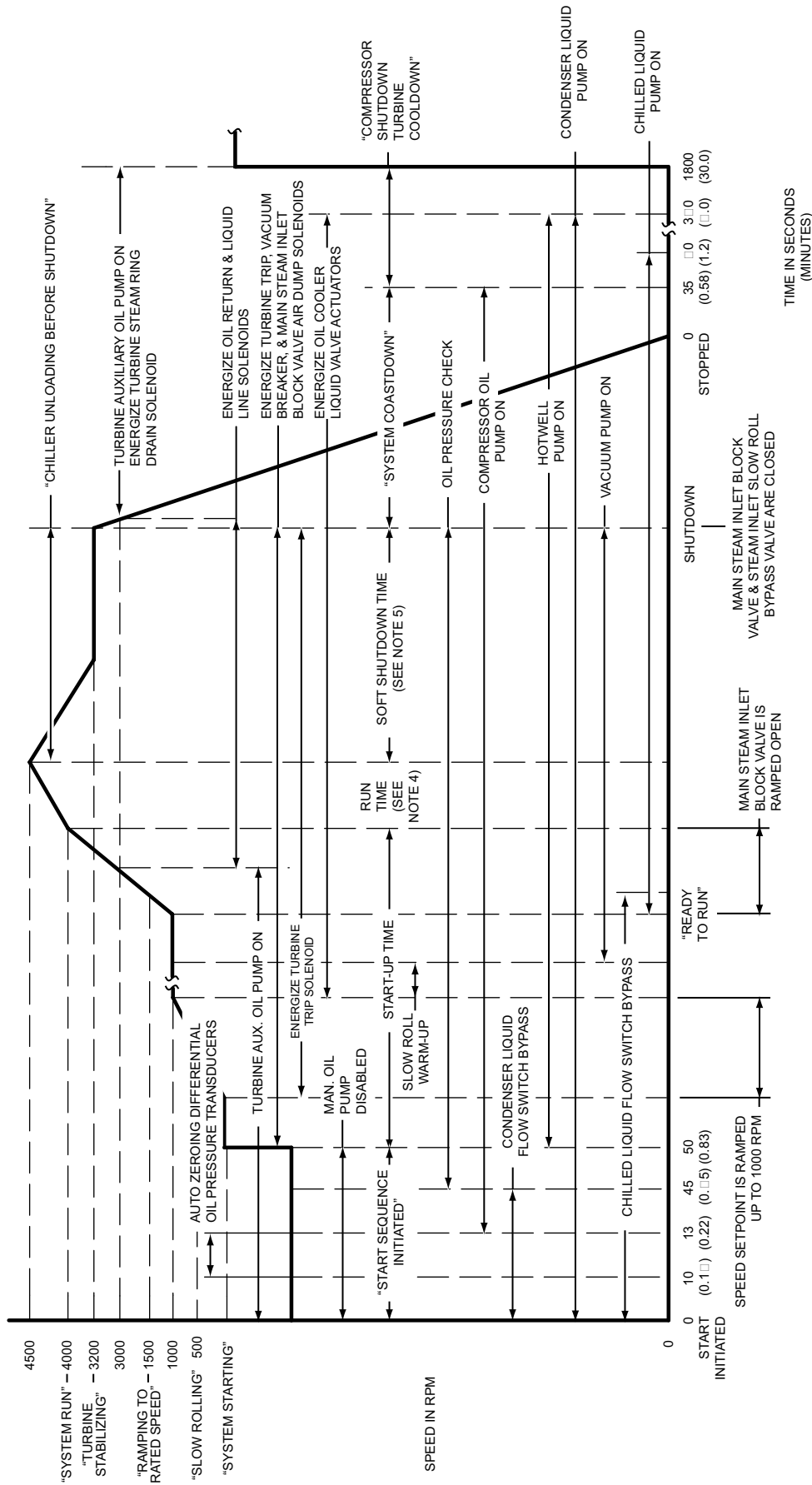


NOTES:

- 1. Text in quotations indicates a Display Message.
- 2. Start-Up Time, Run Time, Soft Shutdown Time, and System Coastdown Time will vary depending on the system conditions and programmable setpoints.
- 3. Speeds and times shown, if programmable, are shown with Default values.
- 4. During the Run Time, the Operating Speed may be anywhere from 3200-4500 RPM depending on Load and System Operating Conditions.
- 5. Only applicable to the following shutdowns: Low Water Temperature, Remote/Local Cycling (TB4-13), Remote Stop (TB4-8), Remote Stop (ISN Serial Port). Operator initiated Soft Shutdown.

FIGURE 2 - OPERATION SEQUENCE TIMING DIAGRAM (MANUAL START)

TIMING DIAGRAM – (AUTOMATIC START)



NOTES:

1. Text in quotations indicates a Display Message.
2. Start-Up Time, Run Time, Soft Shutdown Time, and System Coastdown Time will vary depending on the system conditions and programmable setpoints.
3. Speeds and times shown, if programmable, are shown with Default values.
4. During the Run Time, the Operating Speed may be anywhere from 3200-4500 RPM depending on Load and System Operating Conditions.
5. Only applicable to the following shutdowns: Low Water Temperature, Remote/Local Cycling (TB4-13), Remote Stop (TB4-8), Remote Stop (ISN Serial Port). Operator initiated Soft Shutdown.

FIGURE 3 - OPERATION SEQUENCE TIMING DIAGRAM (AUTOMATIC START)

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SECTION 3 - MICROBOARD 031-02430-004

(Refer To Figs. 4-8)

All new production YST chillers are supplied with Microboard part number 031-02430-004 (*refer to Figure 4 on page 38*).

The board is supplied with +12VDC (J1-3), -12VDC (J1-4), +5VDC (J1-1) and ground (J1-2) from the Power Supply (ref fig 5). The -12VDC is not used. The +5VDC (fused by F1) can be monitored at TP3. It is applied to a +3.3VDC regulator, +2.5VDC regulator and used directly by the Microboard circuits as the Vcc voltage. The outputs of these regulators are applied to Microboard circuits and can be monitored at TP2 and TP5 respectively. The +12VDC (fused by F2) can be monitored at TP4. It is applied to a +5VDC regulator and used directly by Microboard circuits. The output of the regulator is the +5VDC (analog) supply that powers all analog circuits and is the source voltage for all transducers and thermistors. It can be monitored at TP10 as a 2.5VDC value created by 1K Ohm resistors voltage divider circuit as shown.

TEST POINTS

(Refer Figure 6 on page 39)

The power supply voltages can be measured at following test points:

TP1 GND

TP2 +3.3VDC

TP3 +5VDC

TP4 +12VDC

TP5 +2.5VDC

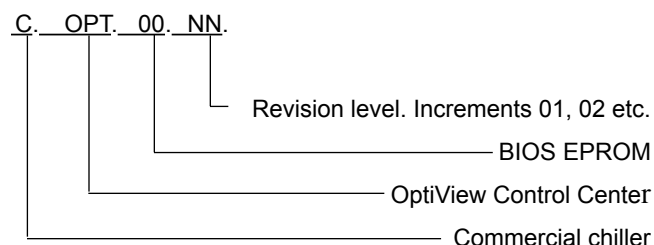
TP10 +2.5VDC

BOOT-UP PROGRAM

The BIOS (Basic Input Output System) EPROM (U37) contains the boot-up program. It is a replaceable part. The YORK part number is 031-02429-002. This BIOS is required to enable the floating point unit (FPU) in

the processor for the YST chiller horsepower limiting algorithm. It is available from the Baltimore Parts Distribution Center as a replacement part. The version is an alphanumeric code that identifies the application and the program revision level. The part number and version are printed on a label adhered to the surface of the EPROM. It is also displayed on the DIAGNOSTICS screen in SERVICE access level.

The version is as follows:



When power is first applied to the OptiView Control Center, a white screen is displayed while the boot-up is performed. During the boot-up, the program in the BIOS EPROM configures the microprocessor and related components and performs testing of certain components to assure those components are operational.

The sequence of events in the boot-up process are listed in the "Diagnostics Display Codes" table. The progress and pass/fail status of each step is displayed on the Microboard 7-segment LED display (U22). Due to the speed at which the boot-up proceeds, not all steps will be visible during the process. Not all pass/fail status is displayed on the white screen.

CHILLER OPERATING PROGRAM

The Chiller Operating Program is a set of instructions to control the chiller. It contains the Safety and Cycling shutdown thresholds (non-changeable) and display screen messages and graphics.

DIAGNOSTIC DISPLAY CODES

TEST	PASS CODE	FAIL ACTION	DISPLAY ON WHITE SCREEN
First init table complete	00	Watchdog will cause reboot	No
SDRAM regs. Configured	01	Watchdog will cause reboot	No
Switch to Protected Mode	02	Watchdog will cause reboot	No
Jump to 32-bit code	03	Watchdog will cause reboot	No
Low memory test start	04	Watchdog will cause reboot	No
Low memory test complete	P1	"F1" on display and halt	No
Full memory test complete	P2	"F2" on display and halt	No
FPGA configuration	05	"P2" will remain on LED display	No
Display Cont. configured	06	"05" will remain on LED display	No
Flash Checksum Test	P3	"F3" will remain on LED display	Yes
BRAM test	P4	"F4" will remain on LED display	Yes
Flash Query Test	"passed"	"failed" and halt	Yes
Flash checksum	"passed"	"failed",halt & display code = F3	Yes
BRAM Test	"passed"	"failed" and halt	Yes

MISCELLANEOUS CODES

LED DISPLAY CODE	Description
FF	FPGA Configuration Failed, trying again
CH	Flash Checksum Test in progress
AP	Application setup in progress

CRITICAL CODES

LED DISPLAY CODE	Description
Ni	NMI handler invoked (should never occur)
[]	GPF has occurred (should never occur)

The Chiller Operating Program is stored in a non-removable Flash Memory chip (U35) that is soldered to the Microboard. New chillers are supplied programmed with the latest program available at the time of manufacture. The program version that is currently residing in the Microboard Flash Memory chip is displayed on the DIAGNOSTICS screen in SERVICE access level.

The on-board program can be upgraded by downloading the latest version from a Program Card using the procedure in the *"Service Replacement" section of this manual.*

PROGRAM CARD

The on-board program can be upgraded by downloading the latest program version from a Program Card. This is a 2 1/8 x 3 3/8 x 1/8 inch plastic card weighing 1.1oz (*refer to Figure 5 on page 39*). It is a portable memory storage device that is programmed with the Chiller Operating Program. The Program Card part number for YST chillers is 031-02501-001 and is available from the Baltimore Parts Distribution Center (PDC). A label affixed to the Program Card contains the part number and version. The version is an alpha-numeric code that identifies the chiller model applicability, language package, language package revision level and Chiller Operating Program revision level.

The Program Card is applicable to both NEMA and CE applications. The Program Card for YST chillers has English language only.

The program version that is currently residing in the Microboard Flash Memory chip is displayed on the DIAGNOSTICS screen in SERVICE access level.

The Program Card obtained from the PDC is programmed with the latest version of the Chiller Operating Program. Program Cards can be reprogrammed.

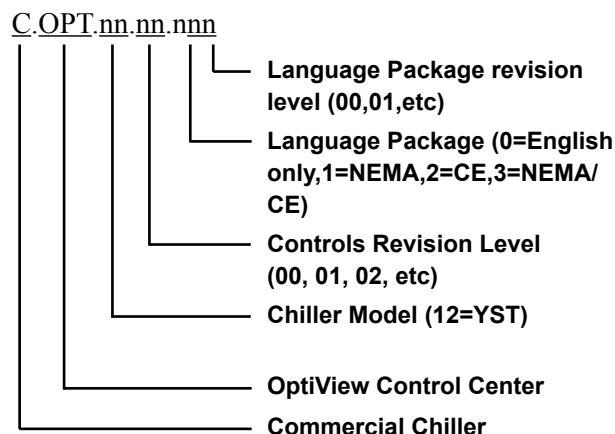
A Program Card for a particular chiller type can be used to re-program other chillers of the same type. For example, it is not necessary to have more than one YST Program Card. A single YST card can be carried to different locations to re-program other YST OptiView Control Centers.

A Write Protect switch on the edge of the Program Card prevents inadvertent writing to the card during program downloading.

Handling precautions for the Program Card include:

- Do not allow dirt to enter connector
- Carry in protective sleeve
- Storage temperature range is -20 to 65°C (-4 to 149°F)

A label adhered to the Program Card contains the version and YORK part number. The version is an alphanumeric code that identifies the chiller model applicability, language package, language revision level and chiller control revision level. The version is as follows:



The Program Card is inserted into connector U33 to download a program. *Refer to instructions under "Program Card Service Replacement".*

PROGRAM DOWNLOAD CONNECTOR U33

A Program Card is inserted into connector U33 to download a program. A protective cover prevents dirt from entering this connector. **IMPORTANT!** The protective cover must be in place at all times when not performing a program download. If dirt accumulates inside this connector, re-programming will not be successful.

PARALLEL PORT CONNECTOR

Parallel port connector J4 is for future use. It is presently not supported.

BRAM (U38)

The BRAM (Battery Backed Random Access Memory) memory device contains a battery that preserves the stored data during power failures. All of the programmed Setpoints, Sales Order Data, History Data, Time of Day and Calendar Data is stored here. It is a replaceable part. The YORK Part number is 031-02431-000 and is printed on a label adhered to the surface of the BRAM. It is available from the Baltimore Parts Distribution Center as a replacement part.

WATCHDOG CIRCUIT

The Watchdog Circuit performs two functions as follows:

- Power failure detection
- Program latch-up detection/prevention

The Watchdog Circuit monitors the +5VDC from the power supply and the +3.3VDC from the onboard regulator to determine when a power failure is occurring. If the +5VDC decreases to the threshold of (+4.75VDC to 4.5VDC) or the +3.3VDC decreases to the threshold of (3.04 to 2.8VDC), a reset is issued to the microprocessor and the chiller shuts down. When power is restored, the white screen is displayed and the boot-up is performed as described above. When the graphic screen is displayed, the message "Control Panel – Power Failure" is displayed.

The Watchdog Circuit also assures that the entire program is being executed and that the program has not latched-up, bypassing important safety checks. The Watchdog Circuit is a timer that times-out if not given a reset pulse within its time-out period (1 - 2.25 seconds). To prevent a time-out, the microprocessor sends a reset pulse to the Watchdog Circuit every time the complete program has been executed. Since it takes less than 1

second to perform the entire program, the Watchdog Circuit doesn't time-out under normal operation. However, if the entire program is not executed or something prevents the microprocessor from sending the reset pulse as described below, the Watchdog Circuit times-out and sends a reset to the microprocessor, initiating a re-boot. If running, the chiller shuts down. The display momentarily blanks and white screen is displayed while the boot-up program executes as described above. When the graphic screen is displayed, either of two messages is displayed depending on the type of Watchdog shutdown as explained below.

There are two different Watchdog initiated shutdowns; a "hardware" Watchdog initiated shutdown and a "software" Watchdog initiated shutdown.

In the "hardware" Watchdog initiated shutdown, a program problem, on-board noise or hardware problem could prevent the Watchdog time-out reset pulse. If this occurs, a re-boot is initiated and when the graphic screen is displayed, "Control Panel – Power Failure" is displayed.

In the "software" Watchdog initiated shutdown, the program intentionally initiates the reboot because it has detected program interruption. After the re-boot, "Watchdog – Software Reboot" is displayed on the graphic screen.

PROGRAM JUMPERS/PROGRAM SWITCHES

The Program Jumpers (Table 1) and Program switches (Table 2) are used to alter the program operation or configure the Microboard hardware for specific operation. This allows the program and Microboard to be universal for all standard applications. *Refer to Table 1 on page 35 for the function of each jumper and switch.* The position of some jumpers can be determined by the Service Technician to meet the desired operation. Others must be positioned according to the requirements of the size, type or style of components and thus are determined by the Johnson Controls factory. The jumpers are plastic sleeves with metal inserts that are inserted over 2-prong or 3-prong conductors. The Program switches are miniature switches that are placed in either the ON or OFF position.

KEYPAD INTERFACE

The keypad is read via J18. The keypad is a matrix of conductors arranged in rows and columns (*refer to Figures 28 and 29*). There are 4 rows and 8 columns. When a key is pressed, the conductors are pressed together at that point, creating continuity between the row conductor and the column conductor. The keypad is read by applying a logic low to a row while leaving +5VDC pullup on all other rows. The Micro then reads the 8 columns. If any column has a logic low on it, the key corresponding to that coordinate (row, column) is being pressed. The Micro reads the entire keypad by repeating this routine beginning with row 1 and ending with row 4. The entire keypad is continually read while the control center is powered. *Refer to SECTION 8 - KEYPAD.*

PRINTER INTERFACE

An optional printer can be connected to COM1 RS-232 serial data port (J2). J2-4 is TX data to the printer. J2-2 is the DSR (Data Set Ready or busy) signal from the printer. Signal levels are standard RS-232. The Microboard sends data to the printer at the selected baud rate until the printer buffer becomes full, whereupon the printer asserts its Busy signal. The Microboard suspends data transmission until the printer can accept more data. Each printer must be setup/configured to operate properly with the Microboard. The Baud, Data Bits, Parity and Stop Bits must be programmed on the Comms screen. Other printer setup is performed on the PRINTER screen. Refer to YORK manual 160.67-O1 for details of available printers and printer setup instructions.

MICROGATEWAY INTERFACE

An optional MicroGateway printed circuit board can be connected to the COM 4B RS-232 serial data port (J2). J2-7 is TX data to the MicroGateway. J2-6 is RX data from the MicroGateway. Signal levels are standard RS-232. The MicroGateway polls system pressures, temperatures and status from the Microboard. It holds it for retrieval by third-party devices. *Refer to SECTION 17 - MICROGATEWAY.*

DIGITAL INPUTS

The I/O Board converts the 115 VAC inputs to logic level inputs for the Microboard at J19. A 115 VAC input to the I/O Board is converted to a logic low (<1VDC). A 0Vac input to the I/O Board is converted to a logic high (>4VDC). *Refer to SECTION 4 - I/O BOARD.*

DIGITAL OUTPUTS

The Microboard controls 115vac relays and solenoids via the I/O Board (via J19). The I/O Board contains +12VDC relays that isolate the Microboard low voltage circuits from the 115 VAC device coils. Solid state switching devices are used to control the relays. The Microboard energizes the +12VDC relays by applying a ground to the coil input. They are de-energized by opening the ground path. The contacts of these relays switch 115 VAC to system relays and solenoids. The outputs that control the Chilled Liquid Pump and Turbine Trip Solenoid have anti-chatter (anti-recycle) timers associated with them. The output that controls relay K0 is not allowed to change at a rate greater than once every 10 seconds. The output that controls relay K13 is not allowed to change at a rate greater than once every 20 seconds.

The Microboard controls actuator motors via triacs on the I/O Board. Each actuator has an open winding and a close winding. Current flowing through a winding causes the actuator to rotate in the respective direction. Each winding is controlled by a triac. The triac is turned on to allow current to flow through a winding. The Microboard turns on the triac by applying a logic low (<1VDC) to the Triac Driver on the I/O Board. It turns it off by applying a logic high (>4VDC). *Refer to Section 4 of this manual for details of the "I/O Board".*

ANALOG INPUTS

System refrigerant and compressor oil pressures, in the form of analog DC voltages, are input from Pressure Transducers. *Refer to SECTION 18 - PRESSURE TRANSDUCERS.* Formulas and graphs are included to calculate the expected transducer output voltage for a given pressure input.

System refrigerant, chilled and cooling liquid temperatures, in the form of analog DC voltages, are input from Thermistors. *Refer to SECTION 19 - TEMPERATURE THERMISTORS.* Included are tables to convert the expected output voltage for any temperature applied to the thermistor.

Style "F" (and later) chillers are supplied with factory-mounted flow sensors on the evaporator and condenser. These are electronic thermal-type sensors. The operating principle of the sensor is thermal conductivity. It uses the cooling effect of a flowing liquid to sense flow. The temperature of the heated sensor tip is sensed by a thermistor located in the tip. A second thermistor, located higher in the tip in a non-heated

area, is only affected by changes in liquid temperature. The temperatures sensed by the thermistors are compared. Flowing liquid carries heat away from the heated sensor tip, lowering its temperature. The higher the flow rate, the lower the tip temperature and therefore a lower differential between thermistors. Lower flow rates remove less heat from the tip allowing a higher tip temperature. The lower the flow, the greater the differential between thermistors. The sensor is vendor-calibrated to turn on its output at a flow rate of 20cm(0.6 ft.)/second. This is the setpoint. There are 11 LED's on the sensor that reflect the measured flow rate. The center located amber LED illuminates at the setpoint flow rate (and above). The 4 LED's to the left of the amber reflect flow rates below the setpoint. The 6 LED's to the right of the amber reflect flow rates above the setpoint. As the flow rate decreases from the setpoint, the LED display moves to the left. As the flow rate increases above the setpoint, the LED display moves to the right. The sensor operates from a 24Vac power source and has a solid state relay output. On each sensor, one side of the solid state relay output (pin 2) is connected to the Microboard +5VDC and the other side (pin 4) is connected to a Microboard analog input (*refer to Fig. 8*). After power is applied, there is a thermal warm-up period of up to 20 seconds. During this time, the output could be unstable. When the setpoint (or greater) flow rate is sensed, the solid state relay output is turned on causing it to conduct current through the 7.5K Ohm Microboard load resistor to the +5VDC. This applies >+4VDC to the Microboard input evaporator J7-14; condenser J7-16). When a flow rate less than the setpoint is sensed, the solid state relay output is turned off, resulting in no conduction through the load resistor. This applies <1VDC to the Microboard input. To determine the state of the solid state relay, first confirm that +5VDC is present at pin 2 of the flow sensor. Then connect a voltmeter from Microboard J7-14 (evaporator) or J7-16 (condenser) to Microboard TP1(ground). The Software allows either the Thermal-Type sensors connected to the Microboard analog inputs, or the differential Pressure or Paddle-type sensor connected to the I/O Board Digital Inputs (*refer to the Flow switch Setpoint in SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES*). To assure the program reads the correct input for the flow sensor type present, the switch setpoint must be set appropriately (*refer to SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES*).

SERIAL DATA PORTS

The Microboard is equipped with 5 Serial Data Ports (ref *Figure 8 on page 41*). Each port is dedicated for a specific function as follows:

- a. COM1 (J2) – RS-232. Printer
- b. COM2 (J13) – RS-232. Not used
- c. COM3 (J12) – RS-485. Analog and Digital I/O Expansion Boards.
- d. COM4 (4A-J11), (4B-J2) – This port is actually two ports. However, they cannot be used simultaneously. The position of Program Jumper JP27 determines which port can be used (*refer to Table 3 on page 89*). COM4A – RS485 Not used. COM4B – RS-232 MicroGateway.
- e. COM5 (J15) – Opto-coupled transmit/receive. Not used.

Each port is equipped with two LED's. A red TX LED illuminates as data is transmitted to or requested from another device. A green RX LED illuminates as data is received from another device. The RS-232 voltages are industry standard +5 to +25VDC and -5VDC to -25VDC logic levels. The RS-485 voltages are industry standard 0VDC and +1.5 to +5VDC logic levels. COM5 logic levels are 0VDC and +5VDC. A diagnostic test can be performed on each serial port to confirm proper operation. *Refer to SECTION 26 - DIAGNOSTICS and TROUBLESHOOTING.*

The LED's and their functions are as follows:

- CR2 RX6 – Not used. Future COM6 serial port receive data.
- CR3 TX6 – Not used. Future COM6 serial port transmit data.
- CR4 RX1 – COM1 serial port receive data.
- CR5 TX1 – COM1 serial port transmit data.
- CR13 TX4 – COM4 serial port transmit data.
- CR14 RX4 – COM4 serial port receive data.
- CR15 TX3 – COM3 serial port transmit data.
- CR16 RX3 – COM3 serial port receive data.
- CR17 RX2 – COM2 serial port receive data.
- CR18 TX2 – COM2 serial port transmit data.
- CR19 RX5 – COM5 serial port receive data.
- CR20 TX5 – COM5 serial port transmit data.

DISPLAY INTERFACE

The graphic screens displayed on the Liquid Crystal Display are created from the program downloaded from the Program Card and stored in the flash memory chip. The data to form these screens is output from J5. This data is in the form of red, green and blue drive signals applied to each of the 303,200 the display pixels arranged in a matrix of 640 columns x 480 rows. Each pixel consists of 3 windows; red, green and blue, through which a variable amount of light from the Display Backlight, is permitted to pass to the front of the display. The drive signals determine the amount of light permitted to pass through each window. The overall pixel color is a result of the gradient of red, green and blue light allowed to pass. The drive signal for each pixel is an 18 bit binary word; 6 for each of the 3 colors. The greater the binary value, the more light is permitted to pass. The pixels are driven sequentially from left to right, beginning with the top row. To coordinate the drive signals and assure the pixels in each row are driven from left to right and the columns are driven from top to bottom, the drive signals are accompanied by a clock and horizontal and vertical sync signals.

During the boot-up, the program in the BIOS EPROM reads wire jumpers PID0 through PID3 on the Display Interface Board to determine the manufacturer of the display. Each display manufacturer requires a slightly different control. The program in the BIOS EPROM configures the Microboard for correct operation for the actual display installed.

Different display manufacturers require different supply and control voltages for their displays and backlights. Program Jumpers JP2 through JP5 and JP7 and JP8 must be configured to provide the required supply and control voltages to the display and backlight control. *Table 3 on page 89* lists the required Program Jumper configuration for each display. Also, a label attached to the display mounting plate lists the required Program Jumper configuration for that display. The position of Program Jumper JP2 determines whether the supply voltage is +5VDC or +3.3VDC.

The Microboard controls the Display Backlight via J6. The Display Backlight is the light source for the display. The Backlight Inverter Board provides a high voltage AC power source for the lamp. It converts low voltage DC via J6-1 (+12VDC or +5VDC, depending on position of Program Jumper JP5) to high voltage AC (500 to 1500Vac). This high voltage AC is applied to the lamp to cause it to illuminate. The Backlight is

turned on and off with the “Backlight Enable” signal (J6-5). The position of Program Jumper JP4 determines whether this is a +12VDC or +5VDC signal. In some displays, the backlight turns on when this signal transitions from low to high; others turn on when it transitions from high to low. The position of Program Jumper JP3 determines the transition that will occur when the Microboard outputs the Backlight Enable signal. JP3 must be positioned according to the display manufacturer’s requirement.

Under program control, the Microboard controls the backlight brightness via the lamp dimmer circuit output at J6-7. In order to extend the life of the Backlight lamp, the brightness is driven to 50% after 10 minutes of keypad inactivity. At this brightness level, the graphics are still visible. When keypad activity is detected (a key is pressed), the lamp is driven back to full (100%) brightness. Some display manufacturers require a variable voltage to vary the brightness; others require a variable resistance. Program Jumpers JP7 and JP8 must be configured to enable the appropriate technique. The lamp dimmer is an integrated circuit that is the electrical equivalent of a 10K Ohm potentiometer with 100 positions or steps (refer to *Figure 7 on page 40*). The lamp dimmer controls the position of the potentiometer. The lamp dimmer varies the brightness of the backlight by applying a variable voltage (0-5.0VDC) or a variable resistance (0-10K Ohm) to the Backlight Inverter Board. If Program Jumpers JP7 and JP8 are installed, the lamp dimmer output is a variable voltage; if both are removed, the output is a variable resistance. The lamp dimmer outputs “Brightness Control Wiper” (J6-7) to the Backlight Inverter Board. If configured for variable voltage output, the voltage between J6-7 and J6-8 can be varied from 0VDC (100% brightness) to 5.0VDC (0% brightness). If configured for variable resistance, the resistance between J6-6 and J6-7 varies from 0 Ohm (0% brightness) to 10K Ohm (100% brightness).

Refer to “Display” Sections 5, 6 and 7 of this manual for details of the display interface.

REMOTE SETPOINTS

Remote Leaving Chilled Liquid Temperature and Horsepower Limit Setpoints can be input via the RS-232 MicroGateway interface at J2 or directly to the Microboard at J22 (ref *Figure 9 on page 42*). The inputs at J22 are configured with Program Jumpers JP23 & JP24 to accept these inputs in either 0-10VDC, 2-10VDC 0-20mA or 4-20 mA form. Refer to *Table 1 on page 35* for “Program Jumper” configurations and *SECTION 20 - REMOTE SETPOINTS* of this manual for details of the “Remote Setpoints”.

CONFIGURATION/SETUP

The following functions are entered as setpoints on the SETUP screen. Refer to “Entry Instructions” in *SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual.

- Liquid Type - Must be set according to whether the chiller is cooling water or brine solution.
Brine-Leaving Chilled Setpoint range is 10°F to 70°F.
Water - Leaving Chilled Setpoint range 38°F (36°F if Smart Freeze “Enabled”) to 70°F.
- Chilled Liquid Pump Operation – Determines Chilled Liquid Pump control contacts (I/O Board TB2-44/45) operation when chiller shuts down on cycling shutdowns. Selections are:
 1. Standard – Contacts open at completion of “System Coastdown” after all shutdowns except “Leaving Chilled Liquid – Low Temperature”. On this shutdown, they remain closed, causing the pump to continue to run while the chiller is shutdown.
 2. Enhanced – Contacts open at completion of “System Coastdown” after all shutdowns except “Leaving Chilled Liquid – Low Temperature” and “System Cycling – Contacts Open”. On these shutdowns, they remain closed, causing the pumps to continue to run while the chiller is shutdown.
- Power Failure Restart – Determines the course of action required to restart the chiller, if a power failure occurs while the chiller is running. Selections are:

1. Manual – Requires a manual reset after power is restored. The chiller cannot be started until the operator moves the keypad Start-Run-Stop/Reset switch to the Stop/Reset position.
2. Auto – Chiller will automatically restart when power is restored.
 - Prelube – Determines the duration of the “System Pre-lube” period. Selections are:
 1. Standard – “System Prelube” is 50 seconds in duration.
 2. Extended – “System Prelube” is 180 seconds in duration.
 - Compressor Oil Pump Package – Configures the program for either Variable Speed Drive Oil Pump or Fixed Speed Oil Pump. Chillers equipped with the Variable Speed Drive Oil Pump have a different complement of solenoid valves than chillers equipped with a Fixed Speed Oil Pump.
1. Variable Speed (Style “D” and later) – configures the program to operate the Variable Speed Drive Oil Pump, and the following solenoid valves: Compressor Oil Return and Liquid Injection (J compressors only) connected in parallel to TB1-61.
2. Fixed Speed (style C) – Configures the program to operate the fixed speed Oil Pump and the following solenoid valves: compressor oil return and liquid injection connected in parallel to TB1-61, Vent Line connected to TB-64 and Compressor High Speed Thrust, connected to TB-62.
 - Compressor Model – Configures the program for the allowable Horsepower Limit Setpoint range based on the maximum horsepower for the compressor gearbox. It is entered at the factory and can only be changed in the TEST OP or ADMIN access level.

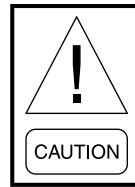
MICROBOARD SERVICE REPLACEMENT

Microboard 031-02430-004 is available from the Baltimore Parts Distribution Center (PDC) as a replacement part. It can be ordered under part number 331-02430-607. This includes the 031-02430-004 Microboard, plus the 031-02501-001 Program Card (ref *Figure 5 on page 39*) programmed with the latest YST Chiller Operating Program and all applicable languages. The Program Card and Microboard can be ordered separately as needed. Upon receipt of a

replacement board, the program must be downloaded from the Program Card per the procedure shown in this section. The Program Card is explained above.

If the Microboard is replaced within the warranty period, it is important it is returned per the Warranty Return Procedure.

Replacement 031-02430-004 microboards are supplied with BRAM (U38) 031-02431-000 and BIOS EPROM (U37) 031-02429-002. The BRAM can be transferred from the defective board to the replacement board to avoid re-programming the Sales Order Data, all of the setpoints, and recalibrating the Analog I/O Expansion Board 4-20 mA Inputs. If the BRAM is defective. *Refer to SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES for system calibration procedures after replacing the BRAM.*



If the blank BRAM supplied with the replacement Microboard is used, all Sales Order Data, Setpoints, and Analog I/O Expansion Board 4-20 mA Input Calibration will be lost and the chiller will not operate safely.

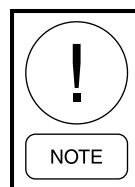
PROGRAM CARD SERVICE REPLACEMENT

Since one YST Program Card can be used to re-program other YST chillers, it is not necessary for an individual Service Technician to have more than one YST Program Card. Program Cards can be shared among Service Technicians where appropriate.

However, since chiller operating programs are occasionally revised, the Service Technician could have a Program Card that does not contain the latest program. Program Cards (031-02501-001) for YST chillers are available from the Baltimore Parts Distribution Center (PDC). The card received from the PDC is programmed with the latest version of the Chiller Operating Program.

Program Cards can be re-programmed with the latest program version.

DOWNLOADING A PROGRAM FROM A PROGRAM CARD



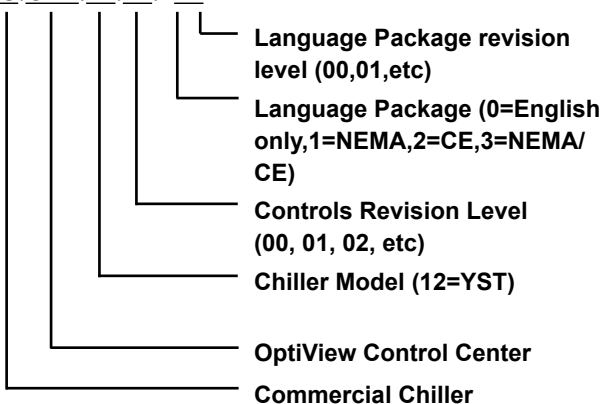
The Program Card Write Protect switch must be in the “Write Protect” position!



*There are 3 steps to the re-programming process: Erase, Program and Verification. Once the re-programming process is initiated, it automatically proceeds through these steps to completion. It cannot be manually terminated before completion. Therefore, once the process is initiated, the existing on-board program will be erased and replaced by the program in the Program Card. Before proceeding, be absolutely certain the Program Card is applicable to your chiller model. For example, if your chiller is a YST chiller, the Program Card used **MUST** be for a YST chiller. If a YK chiller program is downloaded into a YST chiller, for example, the chiller will be rendered inoperable until this procedure is repeated using the correct Program Card!*

A label affixed to the Program Card contains the card version. The version is an alpha-numeric code that identifies the chiller model applicability, language package and program revision level. The version is as follows:

C.OPT.nn.nn.nnn



Download the program as follows:

1. Remove power to OptiView Control Center.
2. Remove protective cover from Microboard connector U33.
3. Reposition Microboard Program Jumper JP6 to pins 2 & 3 (left-hand pins).
4. Insert Program Card into Microboard connector U33.
5. Restore power to OptiView Control Center. A white screen appears displaying "Flash Checksum Test:" and Microboard 7-segment LED (U22) displays "Ch". While this is displayed, the Microboard is performing a checksum test on the Program Card. This assures the integrity of the card before the download procedure can begin. If the checksum test fails, the card is defective or corrupted and the download procedure cannot be performed. If the checksum test passes, the "OptiView Flash Programmer" screen is displayed.
6. Press START key to start the downloading process. A dialog box appears asking if you want to "Erase Onboard Flash and Re-program from Pc-Card?" **Do not proceed until you understand the above caution!**
7. Use the ► key to scroll to YES.
8. Press (✓) key. The following steps will be performed:
 - a. Erasing - During this procedure, the program in the Microboard Flash Memory will be erased. A green bar reflects the progress of this procedure. The red LED next to this bar illuminates while this procedure is in progress.
 - b. Programming - During this procedure, the program in the Program Card is downloaded into the Microboard Flash Memory. A green bar reflects the progress of this procedure. The red LED next to this bar illuminates while this procedure is in progress.

- c. Verifying - During this procedure, a checksum test is performed on the new program in the Microboard Flash Memory. A green bar reflects the progress of this procedure. The red LED next to this bar illuminates while this procedure is in progress.

The Microboard 7-segment LED display (U22) displays the steps of the programming process while they are in effect. During the Erasing procedure, “Er” displayed. During the programming procedure, “Pr” is displayed. During the Verifying procedure, “Ch” is displayed.

At the completion of the re-programming process, if it is successful, “Flash Has Been Successfully Programmed” is displayed and “Operation Successful” is displayed in the Status Code box. Otherwise, a message in the status box indicates the step that failed.

9. Remove power from OptiView Control Center.
10. Remove Program Card from Microboard connector U33.
11. Install protective cover on Microboard connector U33.
12. Reposition Microboard Program Jumper JP6 to pins 1 & 2 (right-hand pins) pins.
13. Apply power to OptiView Control Center. The re-programming procedure is now complete.

TABLE 1 - MICROBOARD 031-02430-004 PROGRAM JUMPERS

JP1 – Not Used.

JP2 – Display power and logic levels - determines the power supply voltage applied to the display. Pins 1-2: +5VDC SHARP LQ10D367/368 (031-01774-000) and LQ10D421 displays. Pins 2-3: +3.3VDC NEC NL6448ACC33-24 and LG Semicon LP104V2-W (031-02046-000) displays.

JP3 – Display Backlight Enable signal level polarity - jumper must be positioned according to the voltage level required to turn on the Display Backlight. Pins 1-2: 0VDC SHARP LQ10D421 display. Pins 2-3: +12VDC or +5VDC as determined by position of JP4. SHARP LQ10D367/368 (031-01774-000), NEC NL644AC33-24 and LG Semicon LP104V2-W (031-02046-000) displays.

JP4 – Display Backlight Enable signal logic levels - determines the logic levels of the Backlight Enable signal. Pins 1-2: +12VDC/0VDC SHARP LQ10D421 display. Pins 2-3: +5VDC/0VDC SHARP LQ10D367/368 (031-01774-000), NEC NL6448AC33-24 and LG Semicon LP104V2-W (031-02046-000) displays.

JP5 – Display Backlight power - determines the power supply voltage applied to the Display Backlight Inverter Board. Pins 1-2: +12VDC. SHARP LQ10D367/368 (031-01774-000) and LQ10D421, NEC NL6448AC33-24 and LG Semicon LP104V2-W (031-02046-000) displays. Pins 2-3: +5VDC. Not used.

JP6 – Boot-up source - determines whether the boot-up is performed from the Program Card or EPROM U37. Pins 1-2: Boots-up from EPROM U37. Must be in this position unless re-programming from the Program Card. Pins 2-3: Boots-up from the Program Card. Must be in this position when re-programming from the Program Card.

JP7, JP8 – Display brightness control technique - determines whether the display brightness is controlled by a variable resistance or a variable voltage.

IN: Variable voltage (0-5.0VDC). SHARP LQ10D367/368 (031-01774-000) and LQ10D421, and LG Semicon LP104V2-W (031-02046-000) displays.

OUT: Variable resistance. NEC NL6448AC33-24 display

JP9 – Not Used.

JP10 – Not Used.

JP11 – Not Used.

JP12 – Not Used.

JP13 – Watchdog Enable/Disable - soldered wire jumper.



Never disable the Watchdog protection. Severe compressor or chiller damage could result. The ability to disable the Watchdog protection is provided for factory testing only.

IN: – Watchdog Enabled

OUT: – Watchdog Disabled

JP14 – BRAM size - soldered wire jumper. Cannot be re-positioned by field personnel. Factory positioned according to size of the on-board BRAM (U38).

IN: - 32K x 8. Installed for present production.

OUT: – 128K x 8

JP16 – COM 2 Serial Port modem selection - configures port to accept either an external modem connected to J13 or an onboard modem mounted in socket SK1. If either modem is used, JP17 must be configured for modem interface. This function is for future use. It is presently not supported.

IN: – Use external modem

OUT: – Use on-board modem

JP17 – COM 2 Serial Port configuration - configures port for either RS-232 modem interface or RS-485 interface. This port is for future use. It is presently not supported.

Pins 1-2 – RS-485

Pins 2-3 – RS-232 (modem)

JP21 – Factory mounted thermal-type flow sensor – evaporator - Style “F” and later chillers only.

Pins 1-2: Not Used

Pins 2-3: Style “F” and later chillers with factory mounted evaporator thermal-type flow sensor.

JP22 – Factory mounted thermal-type flow sensor – condenser - Style “F” and later chillers only.

Pins 1-2: Not Used

Pins 2-3: Style “F” and later chillers with factory mounted condenser thermal-type flow sensor.

JP23 – Remote Horsepower Limit Setpoint (J22) type - configures analog input for 0-10VDC, 2-10VDC, 0-20mA or 4-20 mA.

OUT: Allows 0-10VDC or 2-10VDC input on J22-1

Pins 1-2: Allows a 0-20mA or 4-20 mA input on J22-2

Pins 2-3: Not Used.

JP24 – Remote Leaving Chilled Liquid Temperature Setpoint (J22) type - configures analog input for 0-10VDC, 2-10VDC, 0-20mA or 4-20 mA.

OUT: Allows 0-10VDC or 2-10VDC input on J22-3

Pins 1-2: Allows a 0-20mA or 4-20 mA input on J22-4

JP27 – COM 4 serial communications port - configures COM 4 port for either RS-485 (COM 4A) or RS-232 for MicroGateway board (COM4B).

Pins 1-2: Enables port 4A. Allows an RS-485 connection to Microboard J11. Not used.

Pins 2-3: Enables port 4B. Allows an RS-232 connection to Microboard J2 for MicroGateway communications.

TABLE 2 - MICROBOARD 031-02430-004 PROGRAM SWITCHES

SW1-1 – Refrigerant Selection - must be set according to the refrigerant type installed in chiller.

ON – R134a

OFF – R22

SW1-2 – Turbine Type - must be set according to whether the turbine is condensing or non-condensing.

ON – Non-Condensing -special graphics and operating program as follows:

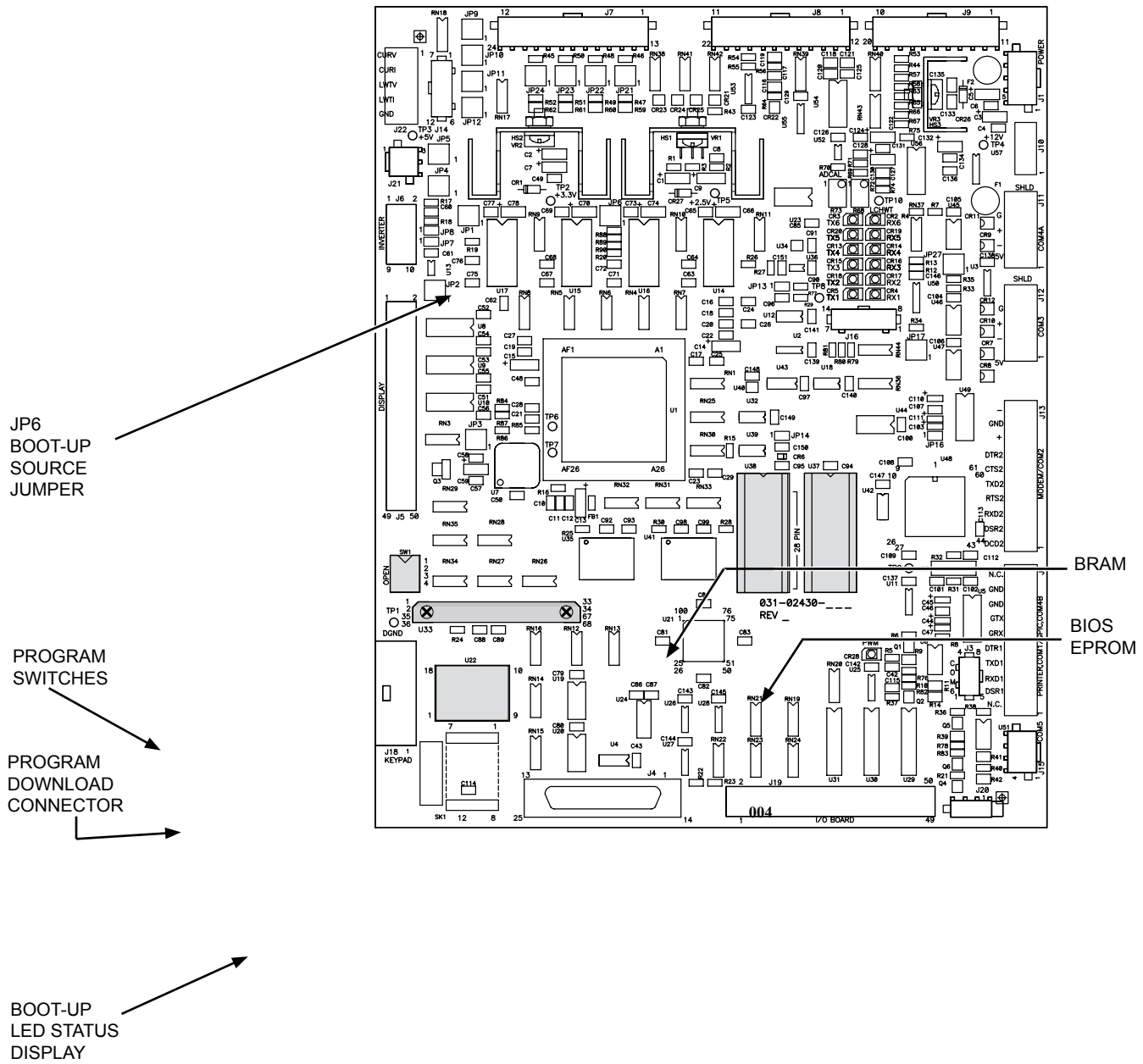
1. Several analog inputs are changed due to the higher steam pressures for this application as follows:
 - a. Turbine First Stage Steam Pressure Analog
Input range is changed to 0-150 PSIG.
 - b. Turbine Exhaust Steam Pressure display scaling is changed to indicate a compound pressure range of –14.7 to 30 PSIG.
 2. New graphics background w/o steam condenser is applied to the Home and Steam System screens; The Condensate and Hotwell screens are deleted.
 3. The “Ready To Run” logic and turbine exhaust high-pressure safety shutdown setpoints and logic are changed for positive pressure as follows:
 - a. PSP6 - Ready To Run; The adjustable range is changed to 0-20 PSIG, default to 15 PSIG. The “Run At Rated” key will not appear on the Steam System screen if the exhaust pressure is not less than this setpoint.
 - b. PSP7 - Turbine Exhaust Steam High Pressure; the adjustable range is changed to 15-25 PSIG, default to 20 PSIG. This safety logic is “Enabled” at SSP2 - Minimum Rated Speed without a time delay.
- OFF** – Condensing - Standard YST graphics and operating program.

SW1-3 – Diagnostics - Enables or Disables the software diagnostics. Refer to Section 24 of this manual.

ON – Enables diagnostics. Disables normal chiller operation.

OFF – Disables diagnostics. Enables normal chiller operation.

SW1-4 – Not Used.



LD09254

FIGURE 4 - MICROBOARD 031-02430-004

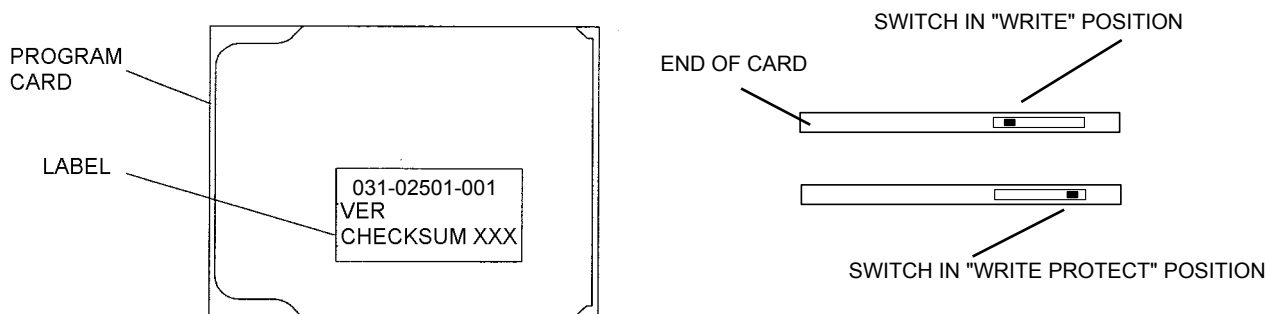


FIGURE 5 - PROGRAM CARD 031-02501-001

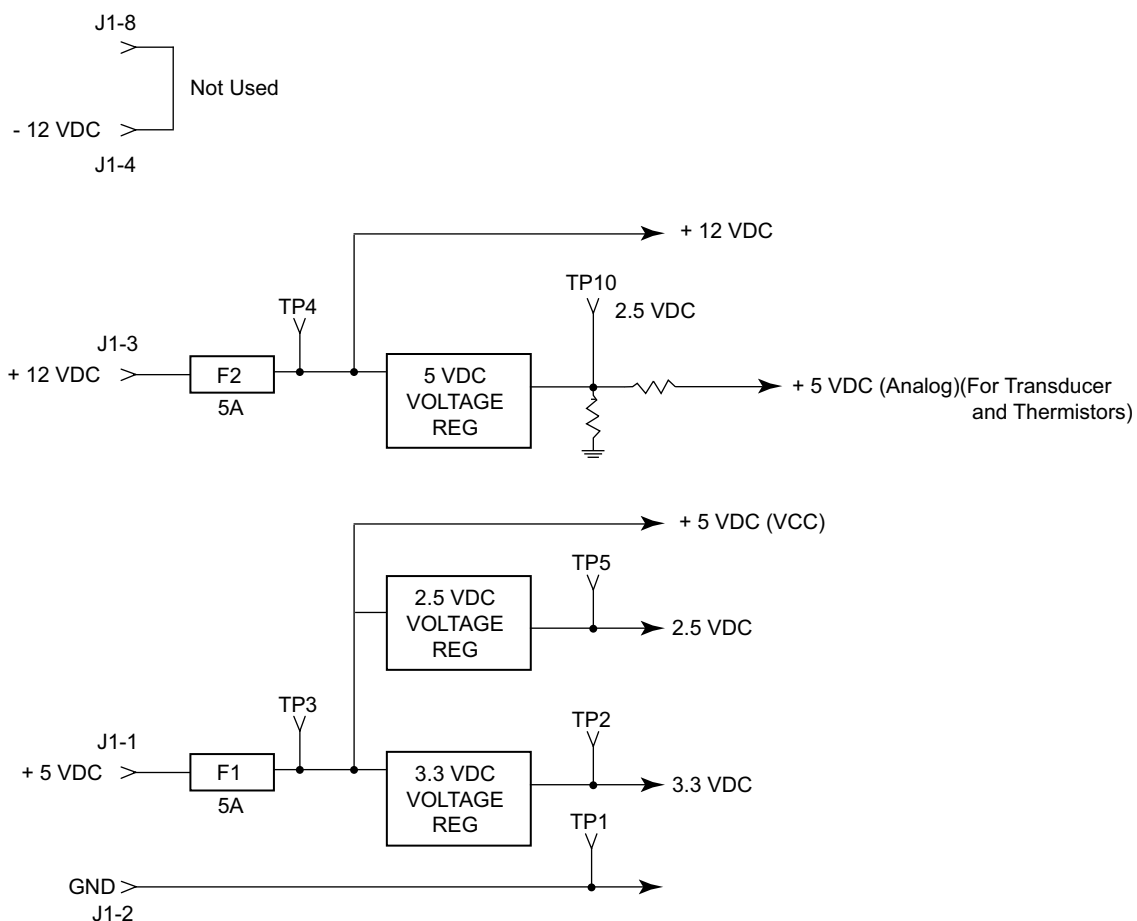
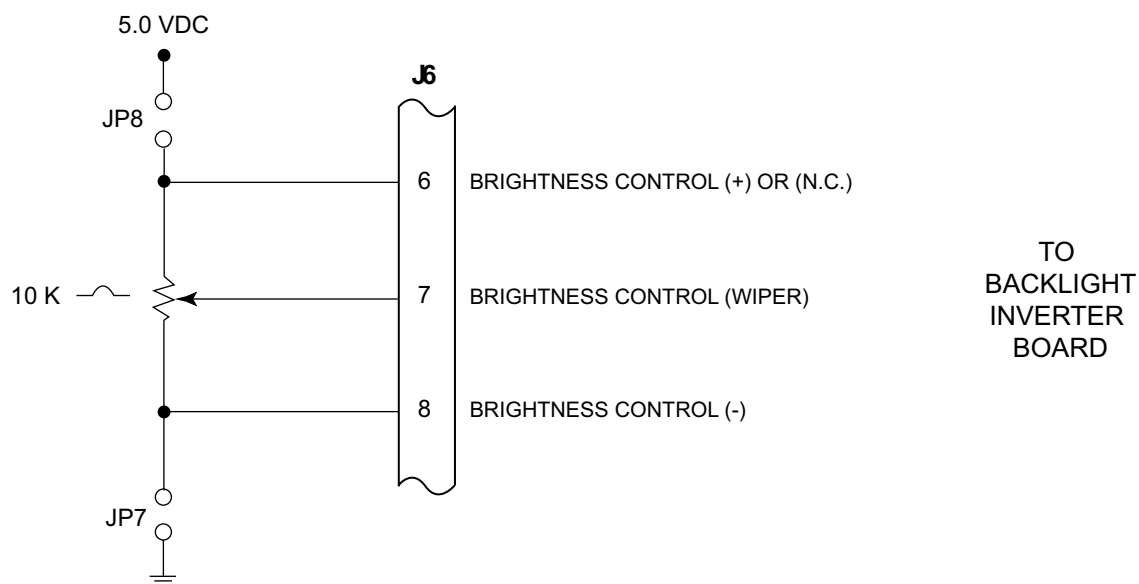


FIGURE 6 - MICROBOARD (031-02430-004) DC POWER SUPPLY TEST POINTS

LD09255

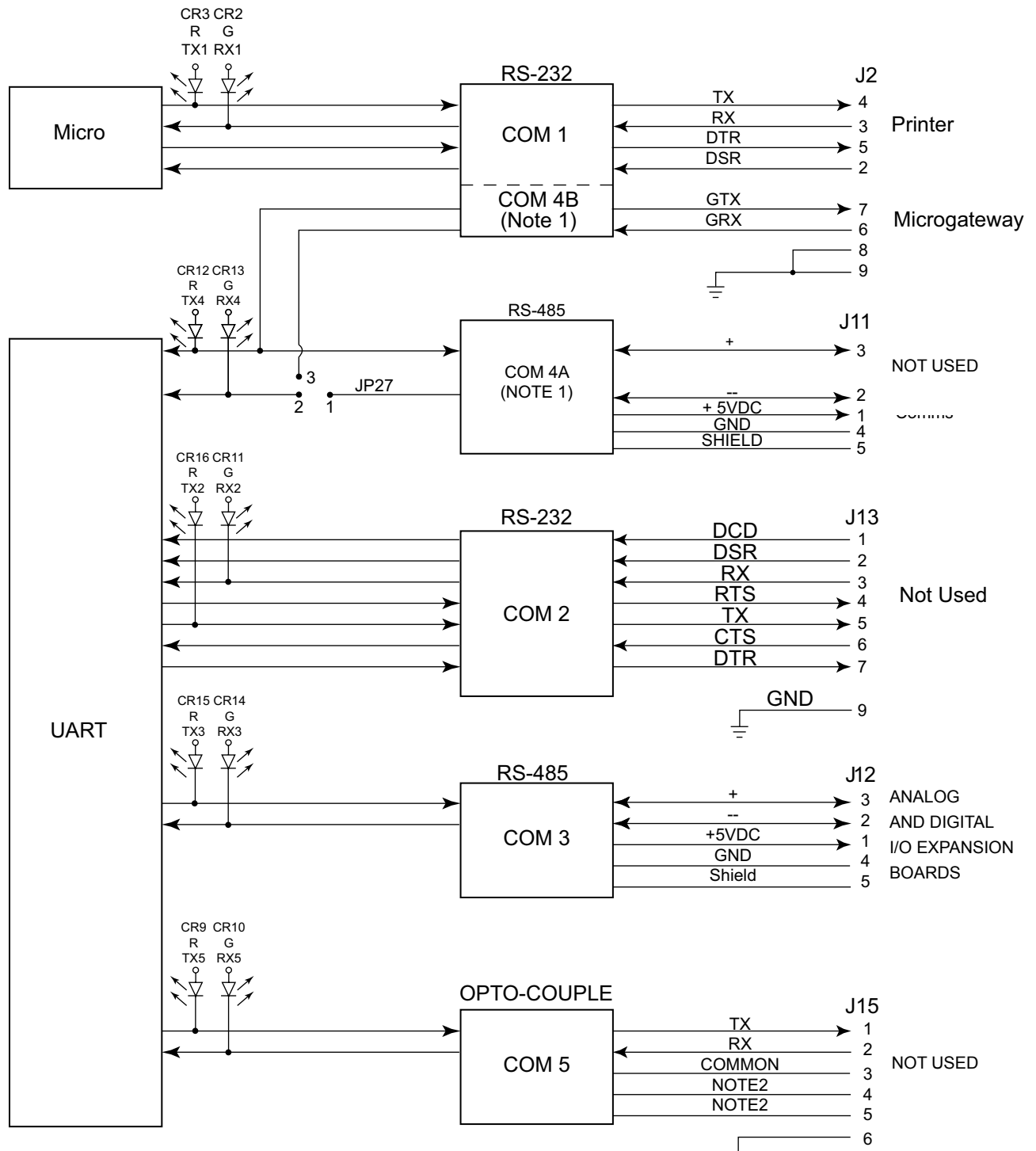


NOTES:

1. J6-6 not connected (N.C.) to Backlight Inverter Board when display is manufactured by Sharp or NEC.
2. The position of Program Jumpers JP7 & JP8 determine the output at J6-7; In = Variable Voltage; Out = Variable Resistance. Refer to Program Jumper Listing in Table 3 for applications.
3. Potentiometer is actually an integrated circuit that is the electrical equivalent of a 10K  potentiometer.

LD04054

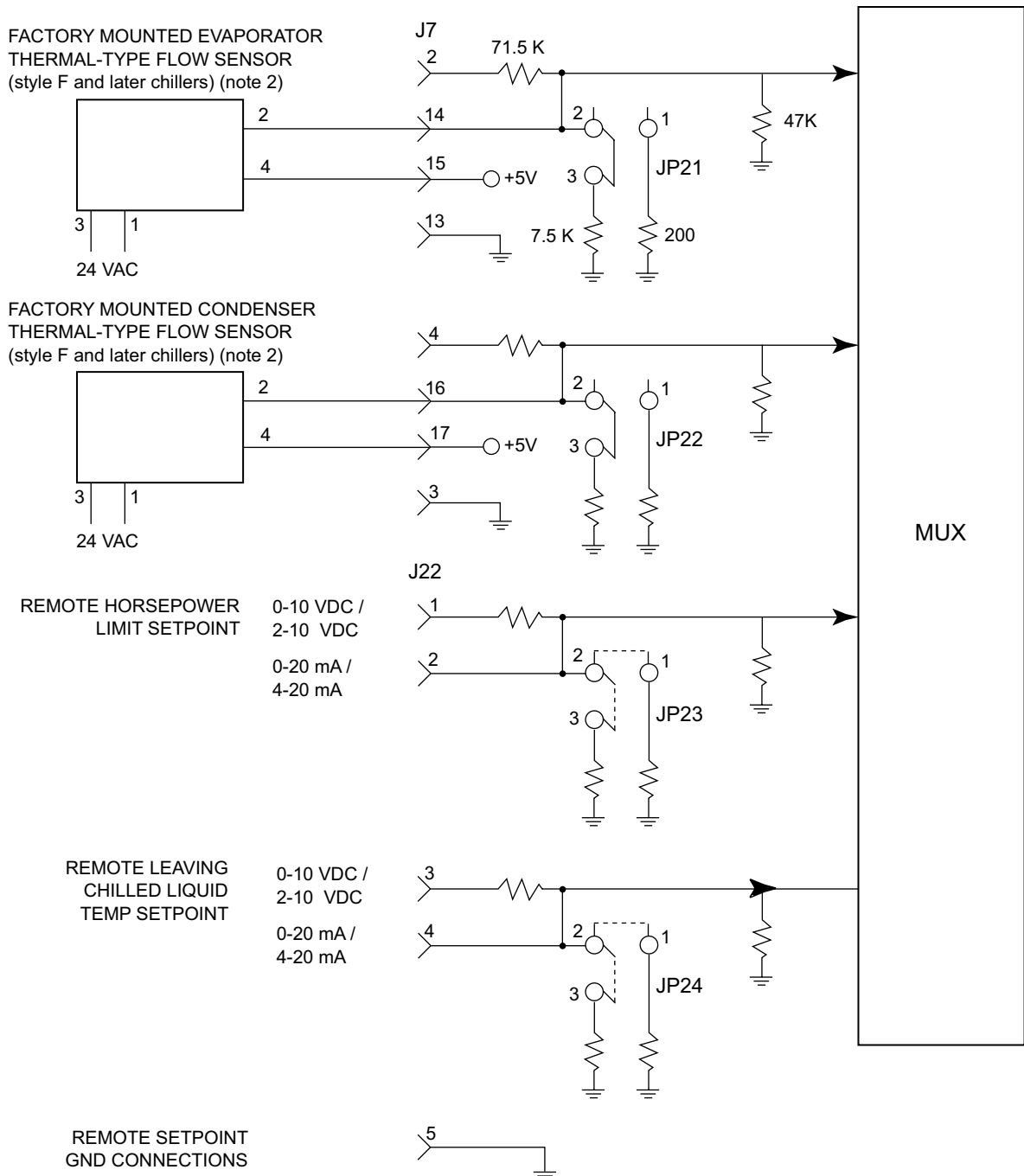
FIGURE 7 - MICROBOARD LAMP DIMMER CIRCUIT



NOTES:

1. Microboard Program Jumper JP27 determines whether COM 4A or 4B can be used. 1 & 2 - 4A, 2 & 3, 4B. Refer to Table 1.
2. J15-4 Loop-Around Test IN. J15-5 Loop-Around Test OUT. Refer to Fig. 70 for details.

FIGURE 8 - MICROBOARD SERIAL DATA COMMUNICATIONS PORTS



LD09565A

NOTE:

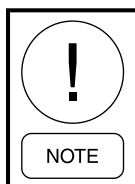
1. Program Jumpers JP23 – JP24 must be positioned on pins 1-2 or 3-4 according to input signal type. *Refer to Table 1.*
2. Program Jumpers JP21 and JP22 must be on pins 2-3 on Style "F" and later chillers equipped with factory-mounted thermal-type flow sensors.

FIGURE 9 - CONFIGURABLE ANALOG AND REMOTE SETPOINT INPUTS

SECTION 4 - I/O BOARD

031-01743-002

(Refer To Fig. 10 - 14)



For complete wiring diagrams refer to forms 160.67-PW1 (Manual Start) and 160.67-PW3 (Automatic Start).

The I/O (Input/Output) Board conditions the digital inputs for the Microboard and conditions the Microboard's digital inputs for application to other components and devices. The left side of the I/O Board performs the digital inputs function; the right side performs the digital inputs function (refer to *Figure 10 on page 47*).

Digital Inputs are on/off inputs to the Microboard from relay and switch contacts, such as flow switches, start/stop switch, and remote cycling/safety devices (refer to *Figure 11 on page 48*). The Micro reads the state of these contacts and reacts per the program instructions. The contact voltage is 115 VAC when closed and 0VAC when open. These voltages are not suitable for direct input to the Microboard. Therefore, the I/O Board converts the 115VAC/0VAC contact voltages to 0VDC/+5VDC logic level inputs for the Microboard. Individual Opto-coupler circuits (refer to *Fig. 11*) perform the conversion for each digital input. When the input is 115VAC, the output will be 0VDC; when the input is 0VAC, the output will be +5VDC.

Field connected digital inputs, such as those from external devices that cycle the chiller, are connected to Terminal Strip TB4 (refer to *Figure 11 on page 48*). These inputs are in the form of dry contacts connected as shown in Fig. 12. The 115VAC power source that is switched by the remote contacts is supplied by the I/O Board TB4-1. There are multiple TB4-1 terminals located adjacent to the field input connections, as shown in *Figure 10 on page 47*.

Digital Outputs are on/off outputs from the Microboard that control solenoid valves, motor contactors, actuators, system relays and provide operating status to external devices (refer to *Fig. 13*). Per program instructions, the Microboard energizes and de-energizes these devices. The coils of these devices operate on 115VAC and therefore cannot be directly connected to the Microboard. The digital inputs section of the I/O Board contains +12VDC coil relays that are driven by

the Microboard's logic level outputs. The contacts of these +12VDC relays operate the external 115VAC coil devices. On the I/O Board, one side of the each of the relay coils is permanently connected to +12VDC at J19-26/27. The other side of each relay coil is connected to the Microboard via I/O Board connector J19. The Microboard energizes each relay by driving the appropriate input at J19 to logic low voltage level (ground potential). The DC voltage at the appropriate input pin at J19 will be a logic high (>+10VDC) when the Microboard is commanding a relay to de-energize; logic low (<+1VDC) when commanding a relay to energize.

Relay K18 is different from all other relays on the I/O Board; it has a 115VAC coil. It provides the start/stop signal to the Turbine Trip Solenoid and provides Compressor Run status to remote devices (refer to *Figure 14 on page 50*). Relay K18 is controlled by DC relays K13 (start) and K14 (stop). To energize the trip solenoid (start), the Microboard energizes K13 and K14 simultaneously. The 115VAC at TB1-6 is applied to the coil of K18 via K13 contacts, energizing K18. Approximately 0.2 seconds later, K13 is de-energized. K18 remains energized through K14 contacts and holding contacts of K18. To de-energize the trip solenoid (stop), the Microboard de-energizes K14. To prevent sags in Utility Power from chattering K18, the holding contact of K18, along with the contact of K13, creates an anti-chatter circuit for relay K18. Once energized, K18 cannot be re-energized until K13 is again energized; this will not occur until after a controlled shutdown has occurred and another start sequence has been initiated.

There are conditions external to the I/O Board required to energize relay K18. The 115VAC will be present at TB1-16 only if the circuit between external Terminal Strip TB6-1 and TB6-53 is closed. The compressor discharge high pressure safety switch "PSHH-112A", must be closed and the START-RUN-STOP/RESET switch "SS1" must be in the Run position.

Triacs are used to control the Pre-rotation Vanes (PRV) actuator, and Variable Geometry Diffuser actuator (certain compressors only) (refer to *Figure 14 on page 50*). An actuator has an open winding and a close winding. Current flowing through a winding will cause

the actuator shaft to rotate in the respective direction. Each winding is controlled by a triac. When a triac is turned on, it permits current to flow through the actuator winding, causing the actuator shaft to rotate. Under program control, the Microboard turns the triacs on and off by applying control signals to the respective Triac Driver. The Triac Driver is an optocoupler device that isolates the Microboard low voltage circuits from the higher actuator voltages. To turn on the triac, the Microboard drives the Triac Driver input to logic low (<+1VDC) level. The Triac Driver responds by shorting the Triac Gate to triac terminal 2. To turn the triac off, the Microboard opens its input to the Triac Driver and allows the input to pull up to +12VDC. The Triac Driver responds by opening the short from Triac Gate to triac terminal 2. A voltmeter can be used to determine if a triac is turned on or off. Measure across the triac; from triac terminal 1 to triac terminal 2. When the triac is turned off, the voltage will be approximately 20 to 30VAC; when turned on, it will be <10VAC.

The Pre-rotation Vanes Actuator and Variable Geometry Diffuser actuator are manufactured by Barber-Coleman. This actuator has three windings; a field winding and two direction windings. One direction winding produces clockwise rotation, the other produces counterclockwise rotation. The 115VAC applied to the field winding induces a 20 to 30VAC voltage into each of the direction windings. The desired rotation is produced by shorting the actuator common terminal to the appropriate direction terminal, causing current to flow in the direction winding. As described above, triacs control the current through the open and close windings.

The I/O Board is populated with the required triacs Q3 and Q4 that apply the open and close signals to the Variable Geometry Diffuser ring actuator. Refer to Variable Geometry Diffuser SECTION 22.

RELAY TIMING

Under program control, the relays are energized and de-energized producing contact operation as follows. Unless otherwise noted, contact rating is 5 amps resistive or 2 Amps inductive @ 250VAC.

K0 - Chilled Liquid Pump Start (TB2-44/45)

Dry closure contacts - When the ramp up to rated speed is initiated, the Contacts close. Regardless of the start or ramp commands, if a speed greater than the SSP5- Chilled Liquid Pump Turn-on Speed shown on the Speed Setpoints screen is sensed, the contacts are closed after the TDSP4-Chilled Liquid Pump Turn-on

Delay shown on the time setpoints screen. Normally, they open 35 seconds after the completion of "System Coastdown" with the following exceptions:

- If a "Leaving Chilled Liquid - Low Temperature" cycling shutdown occurs, they do not open at the completion of "System Coastdown". They remain closed for the duration of the shutdown or until the keypad START-RUN-STOP/RESET switch is placed in the Stop-Reset (O) position, whereupon they open.
- If Chilled Liquid Pump Operation on the SETUP screen is set for Enhanced, they do not open at the completion of "System Coastdown" when the chiller shuts down on a "System Cycling Contacts Open", they remain closed for the duration of the shutdown or until the keypad START-RUN-STOP/RESET switch is placed in the Stop-Reset (O) position, whereupon they open.

If it is desired to supply the dry contacts with 115VAC power from the OptiView Control Panel to control the Chilled Liquid Pump Motor Starter, a field installed wire must be connected from TB5-22 to I/O Board TB2-44. Then connect I/O Board TB2-45 to the Chilled Liquid Pump Motor Starter.

K1 - Anticipatory Alarm (TB2-55/56)

Dry closure contacts - Contacts close when any "Warning" message is displayed. On most warnings, the contacts automatically open when the warning condition is no longer present. On those warnings marked with an asterisk, the contacts will open only after the warning condition is no longer present and the WARNING RESET key is pressed when logged in at Operator access level or higher. Standard Chiller Warning Messages are as follows:

Real Time Clock Failure, Condenser or Evaporator Transducer Error*, Setpoint Override*, Condenser-High Pressure Limit, Evaporator-Low Pressure Limit, Compr Standby Lube – Low Oil Pressure*.

K2 - Remote Mode Ready to Start (only operational in Digital, Analog or ISN Remote mode) (TB2-26/27)

Dry closure status contacts that are closed to indicate to a remote device that the chiller will start upon receipt of a remote start signal. The contacts open coincident with any Cycling or safety shutdown or anytime the

keypad START-RUN-STOP/RESET switch is placed in the Stop-Reset (O) position. On Cycling Shutdowns, the contacts will close when the cycling condition clears. On safety shutdowns, the contacts will close only after the safety condition clears, a manual reset is performed by placing the switch in the Stop-Reset (O) position and then back to the RUN (I) position.

K3 - Safety Shutdown Status (TB2-42/43)

Dry closure status contacts - They close coincident with a safety shutdown. They remain closed until the safety condition clears and a manual reset is performed by placing the START-RUN-STOP/RESET switch in the Stop-Reset (O) position, whereupon they open.

K4 - Cycling Shutdown Status (TB2-40/41)

Dry closure status contacts - They close coincident with a cycling shutdown. They remain closed until the cycling condition clears, whereupon they open.

K5 - Condenser Liquid Pump Start (TB2-150/151)

Dry closure contacts - Contacts close coincident with beginning of "Start Sequence Initiated". They open after "System Coastdown" rotation has stopped and the TDSP11 - Hotwell Pump Shutdown Delay has elapsed.

If it is desired to supply the dry contacts with 115VAC power from the OptiView Control Panel to control the Condenser Pump Motor Starter, a field installed wire must be connected from TB5-22 to I/O Board TB2-150. Then connect I/O Board TB2-151 to the Condenser Pump Motor Starter.

K6 - Turbine Auxiliary Oil Pump Contactor (TB2-152/153)

These contacts are used only when the turbine is supplied with an auxiliary oil pump and MSSP6-Turbine Lubrication Type is set for Pump on the Configuration screen 1. In automatic operation, these contacts close coincident with the beginning of the "Start Sequence Initiated" pre-lube period and remain closed as long as the speed is less than the SSP7-Turbine Auxiliary Oil Pump Activate setpoint shown on the Speed Setpoints screen. When the speed is greater than the SSP7-Turbine Auxiliary Oil Pump Activate setpoint and the input signal from the Turbine Supply Oil Pressure Transmitter is greater than the PSP9-Turbine Auxiliary Oil Pump Off setpoint shown on the Pressure Setpoints screen, the contact will open. At speeds above the SSP7-Turbine Auxiliary Oil Pump Activate setpoint, it will re-close anytime the input signal from the Tur-

bine Supply Oil Pressure Transmitter is less than the PSP10-Turbine Auxiliary Oil Pump On setpoint indicating that the shaft driven oil pump on the turbine is providing insufficient oil pressure and the auxiliary oil pump must be restarted. After the a shutdown, the contacts remain close for the "COMPRESSOR SHTDN; TURBINE COOLDOWN" period determined by the TDSP12 - Turbine Auxiliary Oil Pump Postlube setpoint shown on the TIME SETPOINTS screen. In manual Oil Pump operation, the contacts close for the duration of manual pump operation.

These contacts are also closed when the Turbine Rotating (Speed switch) contacts are closed or a Speed Sensor Analog Input is greater than 20 RPM without the K18 -Turbine Trip Solenoid contacts being closed. In this case, the shutdown message "STEAM VALVE MALFUNCTION" is also displayed and the contacts remain closed until 35 seconds after rotation has stopped. If the K18 -Turbine Trip Solenoid contacts were closed when this occurred, the contacts will remain closed for TDSP12 - Turbine Auxiliary Oil Pump Postlube time period.

K7 - Hotwell Pump #1 Contactor (TB2-154/155)

The operation of this contact is dependent on the MS-SP10-Hotwell Pump mode on Configuration screen 1. If set for Dual, and Hotwell Pump #1 was not operating during the last chiller run, these contacts close coincident with the end of the "Start Sequence Initiated" pre-lube period when "SYSTEM STARTING" and "BEGIN SLOW ROLL" are displayed. They will remain closed until after the chiller is shutdown, rotation has stopped, and the TDSP11 - Hotwell Pump Shutdown Delay shown on the TIME SETPOINTS screen has elapsed. If the hotwell pump contactor auxiliary contact has failed to close within 5 seconds after this contact closes, Hotwell Pump #2 contacts on the Digital I/O Expansion Board will close and these contacts will open. The "Warning" message "LEAD HOTWELL PUMP FAULT" is also displayed. If MSSP10-Hotwell Pump mode is set for Single, this contact will always close at startup regardless of the Hotwell Pump #1 status during the previous chiller run. If the hotwell pump contactor auxiliary contact has failed to close within 5 seconds after this contact closes, these contacts open, the chiller is shutdown, and the shutdown message "HOTWELL PUMP FAULT" is displayed.

K8 – Vacuum Pump #1 Contactor (TB2-156/157)

The operation of this contact is dependent on the MS-SP11-Vacuum Pump mode on Configuration screen 1. If set for Dual, and Vacuum Pump #1 was not operating during the last chiller run, these contacts close after the prelube period when the Vacuum Pump #1 Sealing Water Flow switch closes. If the vacuum pump contactor auxiliary contact has failed to close within 5 seconds after this contact closes, the Vacuum Pump #2 Sealing Water Solenoid contacts on the Digital I/O Expansion Board will close and these contacts will open. The “Warning” message “LEAD VACUUM PUMP FAULT” is also displayed. If MS-SP11-Vacuum Pump mode is set for Single, this contact will always close as described above regardless of the Vacuum Pump #1 status during the previous chiller run. If the vacuum pump contactor auxiliary contact has failed to close within 5 seconds after this contact closes, these contacts open, the chiller is shutdown, and the shutdown message “VACUUM PUMP FAULT” is displayed. These contacts will also open if the vacuum pump sealing water flow switch has not closed within 10 seconds after the pump sealing water solenoid has been energized or the sealing water flow switch opens during pump operation.

K9 – Vacuum Pump #1 Sealing Water Solenoid (TB1-1/165)

The operation of this contact is dependent on the MSSP11-Vacuum Pump mode on Configuration screen 1. If set for Dual, and Vacuum Pump #1 was not operating during the last chiller run, these contacts close after the prelube period. If the sealing water flow switch has not closed within 10 seconds after this contact closes or vacuum pump contactor auxiliary contact has failed to close within 5 seconds after the K8 contact closes, the Vacuum Pump #2 Sealing Water Solenoid contacts on the Digital I/O Expansion Board will close and these contacts will open. The “Warning” message “LEAD VACUUM PUMP SEALING WATER NO FLOW” is also displayed. If MSSP11-Vacuum Pump mode is set for Single, this contact will always close as described above regardless of the Vacuum Pump #1 status during the previous chiller run. If the sealing water flow switch has not closed within 10 seconds after this contact closes or vacuum pump contactor auxiliary contact has failed to close within 5 seconds after the K8 contact closes, these contacts open, the chiller is shutdown, and the shutdown message “VACUUM PUMP FAULT” is displayed.

K10 – Vent Line Solenoid (Style C and earlier chillers) (TB1-17/64)

Contacts close when the speed has increased above the SSP7-Turbine Auxiliary Oil Pump Activate setpoint shown on the Speed Setpoints screen. They will remain closed until after the chiller is shutdown and the speed has decreased below the SSP7-Turbine Auxiliary Oil Pump Activate setpoint.

If this contact is used, a field installed wire must be connected from TB1-17 to TB5-22 to supply 115 VAC power to the solenoid.

K11 – Compressor Oil Pump Starter (Style C and earlier chillers) (TB1-17/64)

In automatic operation, contacts close 13 seconds after “System Prelube” is initiated. Contacts open at completion of “System Coastdown”. In manual Oil Pump operation, the contacts close for the duration of manual pump operation. These contacts are also closed when the Turbine Rotating (Speed switch) contacts are closed or a Speed Sensor Analog Input is greater than 20 RPM without the K18 -Turbine Trip Solenoid contacts being closed. In this case, the shutdown message “STEAM VALVE MALFUNCTION” is also displayed and the contacts remain closed until 35 seconds after rotation has stopped. If standby lubrication is “Enabled”, contacts close for 2 minutes every 24 hours since the oil Pump was last automatically or manually run.

K12 – Compressor Oil Return Solenoid (all styles, fixed or variable speed oil pump), Liquid Injection Solenoid (Style “D” and later chillers - “J” compressor only, variable speed oil pump) (TB1-1/61)

Contacts close when the speed has increased above the SSP7-Turbine Auxiliary Oil Pump Activate setpoint shown on the Speed Setpoints screen. They will remain closed until after the chiller is shutdown and the speed has decreased below the SSP7-Turbine Auxiliary Oil Pump Activate setpoint.

K13 - Turbine Trip Solenoid (start) (TB1-6/16) Contacts close coincident with the beginning of “System Starting”. They remain closed for 0.2 seconds and then open.

K14 - Turbine Trip Solenoid (stop) (TB 1-6/16) Contacts close coincident with the beginning of "System Starting". They remain closed for the duration of the slow roll warm-up, "Ramping to Rated Speed" and "System Run". They open coincident with the beginning of "System Coastdown".

**K15 - (TB1 -1/34)
Compressor Oil Heater**

These contacts are operative when the chiller is shutdown, slow rolling, or Ramping to Rated Speed and is "Disabled" when "SYSTEM RUN" is displayed. The contacts are operated to maintain the oil temperature at a target value of 50°F above the Condenser Saturated Temperature from a minimum of 110°F to a maximum of 160°F. The contacts close when the oil temperature decreases to 4°F below target value; open at 3°F above the target value.

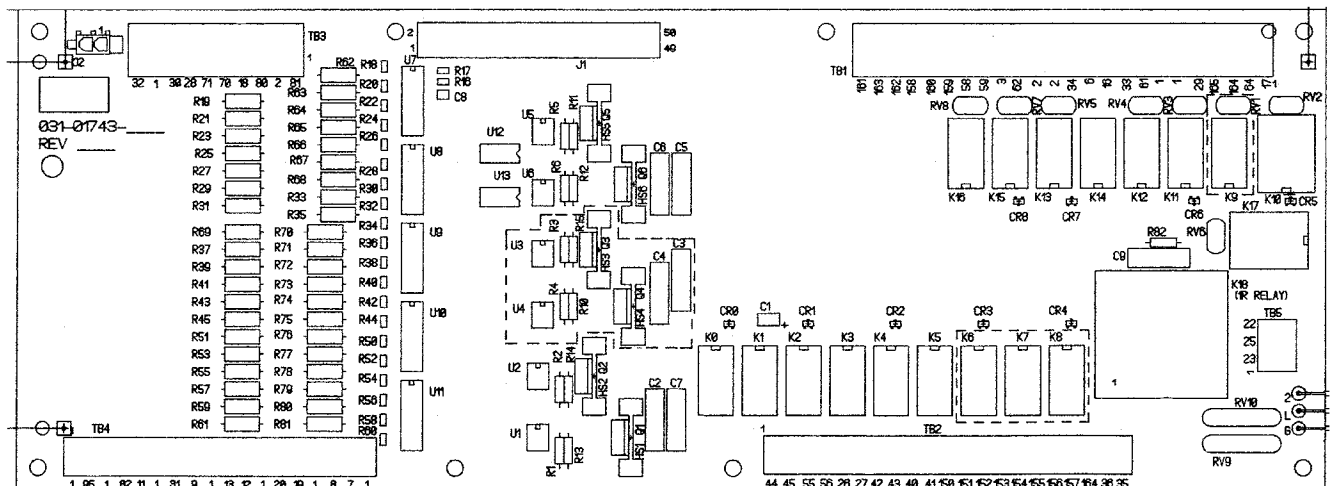
K16 – Compressor High Speed Thrust Solenoid (Style C and earlier chillers; Fixed Speed Oil Pump) (TB1-1/62)

Contacts close when the speed has increased above the SSP7-Turbine Auxiliary Oil Pump Activate setpoint shown on the Speed Setpoints screen. They will remain closed until after the chiller is shutdown and the speed has decreased below the SSP7-Turbine Auxiliary Oil Pump Activate setpoint.

K17 - Not Used

K18 - Turbine Trip Solenoid (TB5 - 22/25)

Contacts operate the same as K14.



LD04055

FIGURE 10 - I/O BOARD 031-01743-002

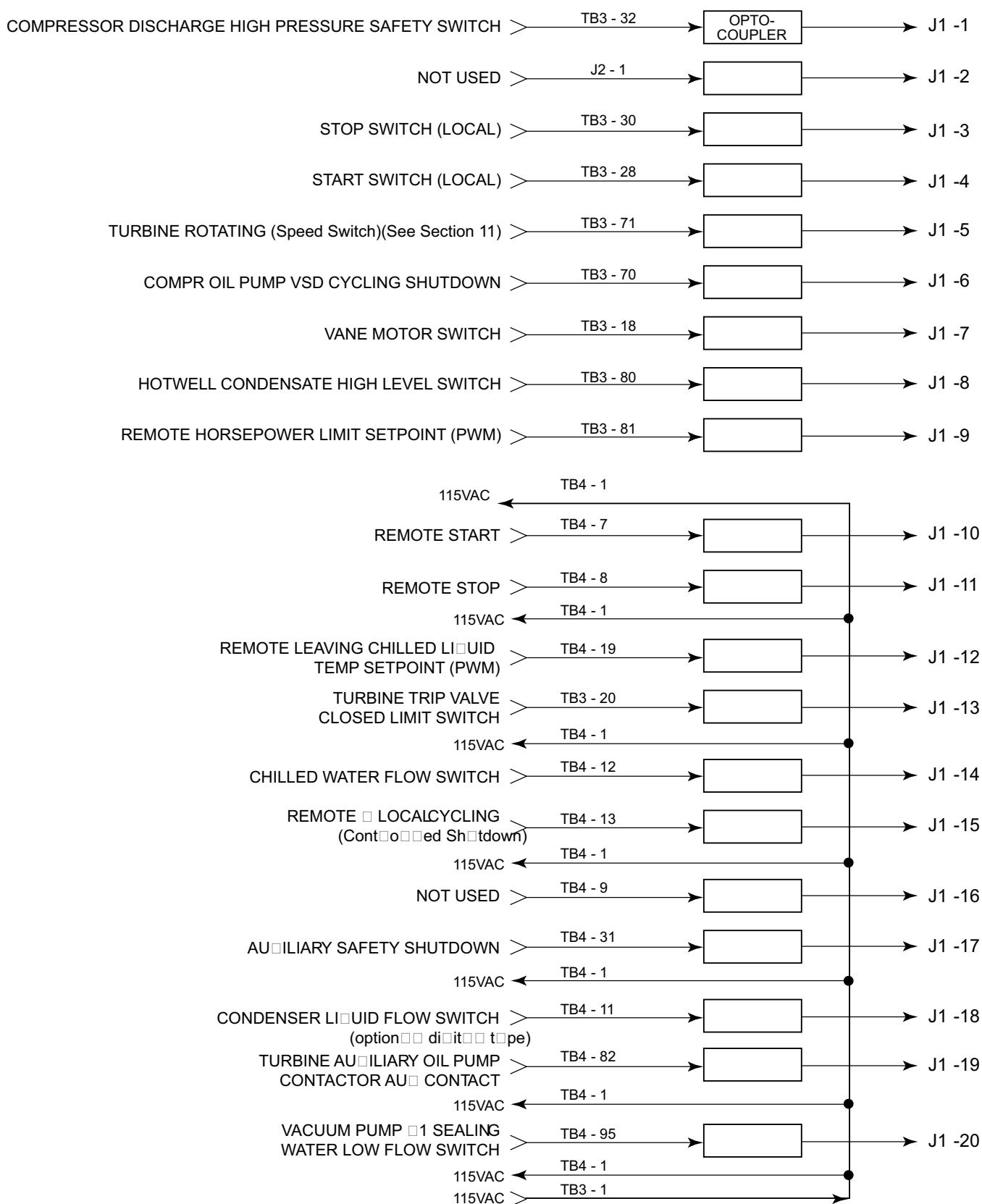
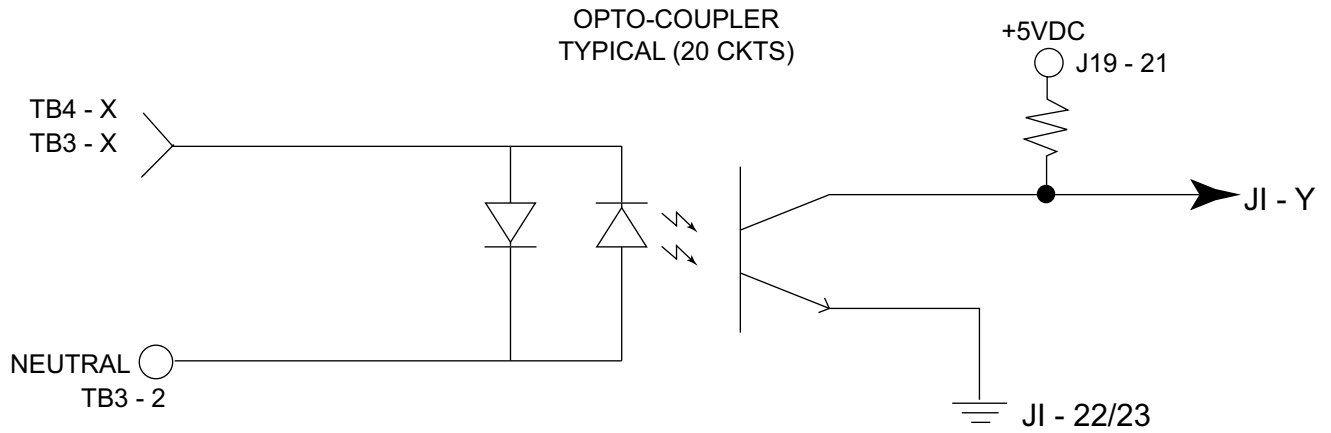


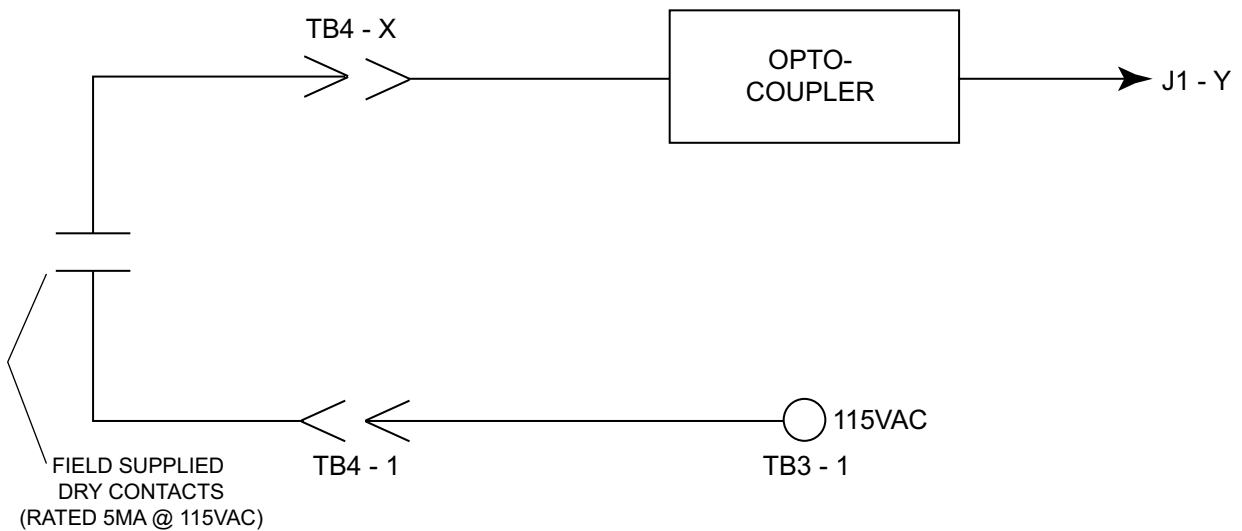
FIGURE 11 - I/O BOARD DIGITAL INPUTS

LD09734A



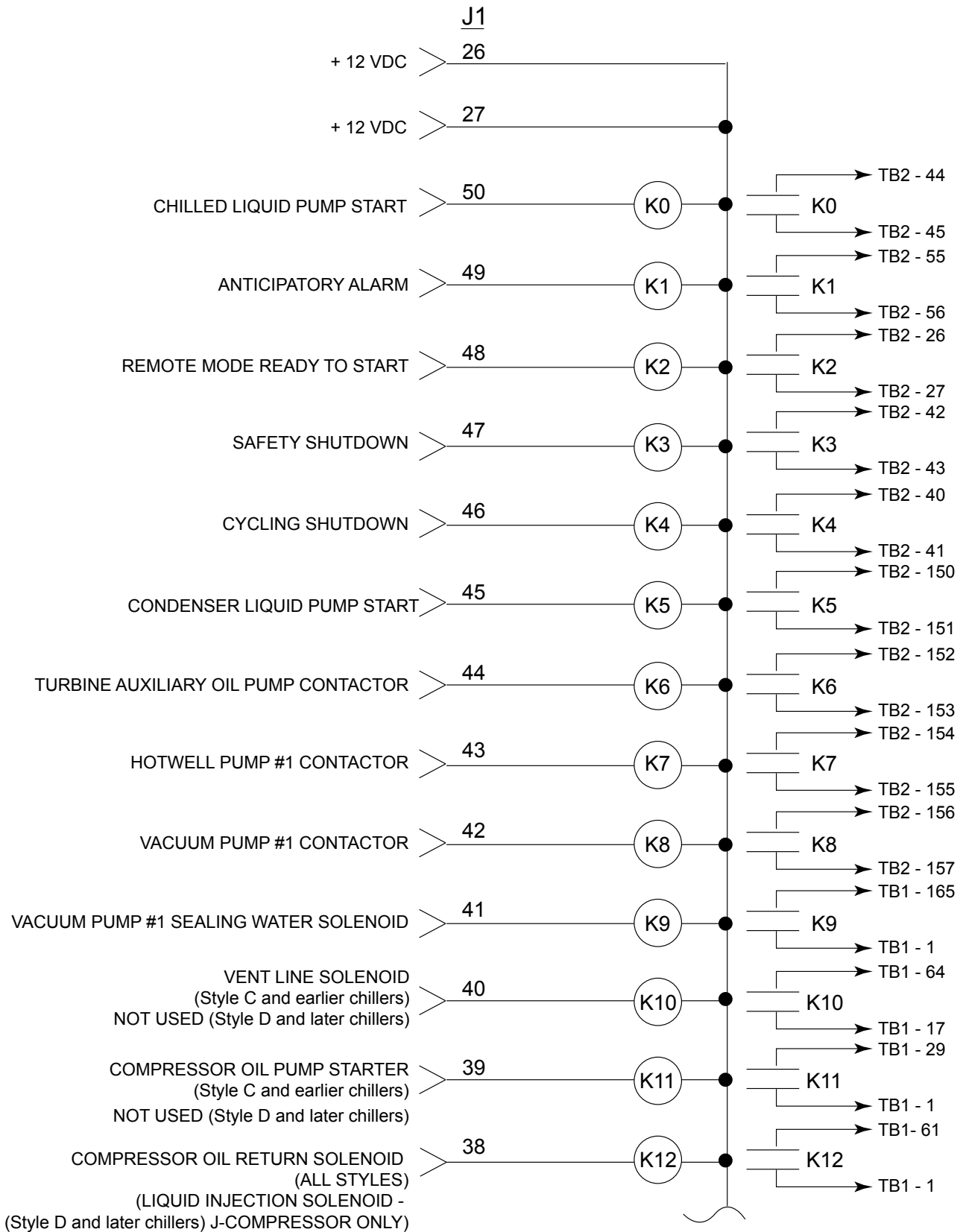
LD04057

FIGURE 12 - I/O BOARD TYPICAL OPTO-COUPLER CIRCUIT



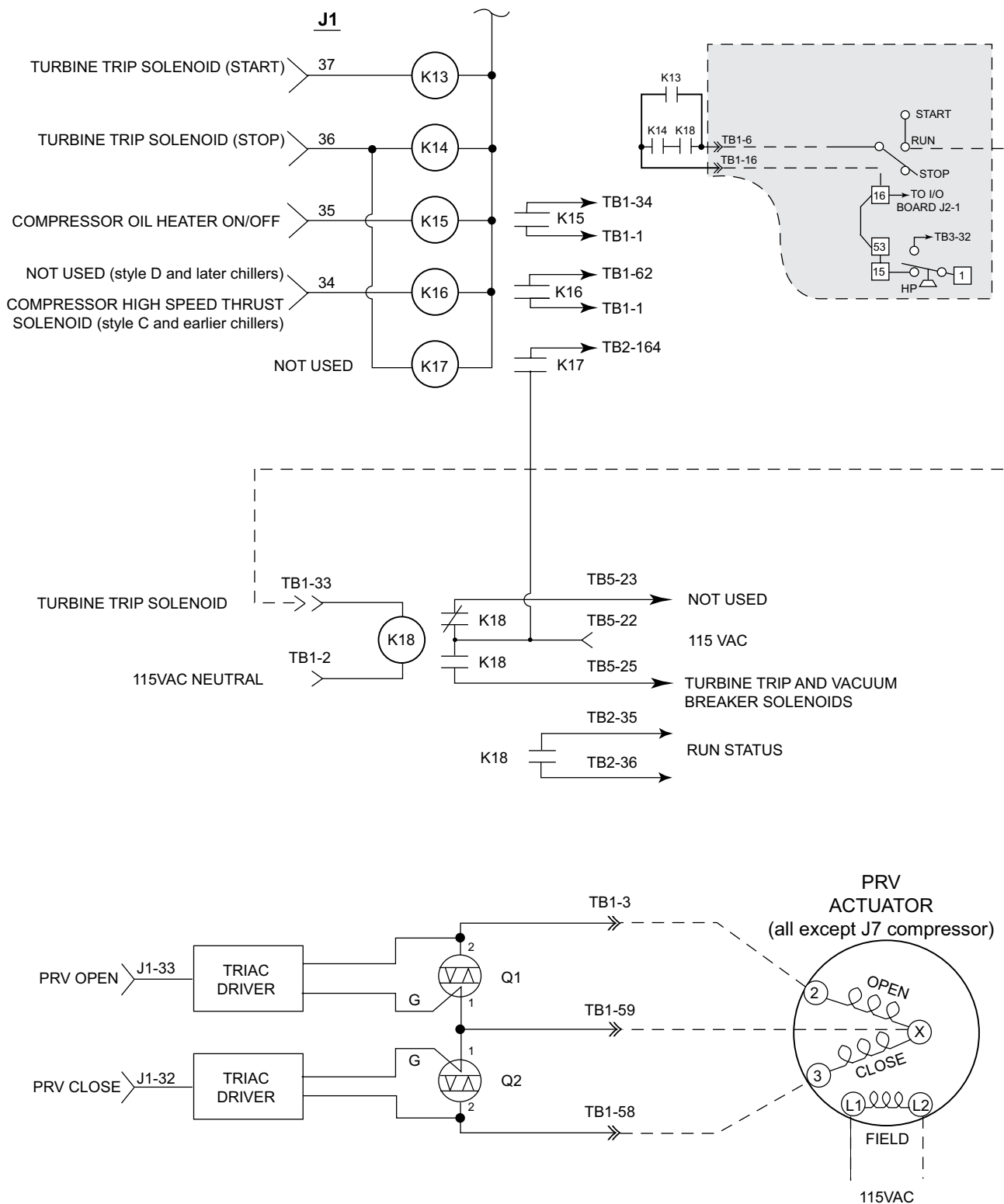
LD04058

FIGURE 13 - I/O BOARD TYPICAL FIELD CONNECTIONS



LD09733

FIGURE 14 - I/O BOARD DIGITAL OUTPUTS



NOTES:
1.----- indicates wiring external to I/O Board.

FIGURE 14 - I/O BOARD DIGITAL OUTPUTS (CONT'D)

LD09735A

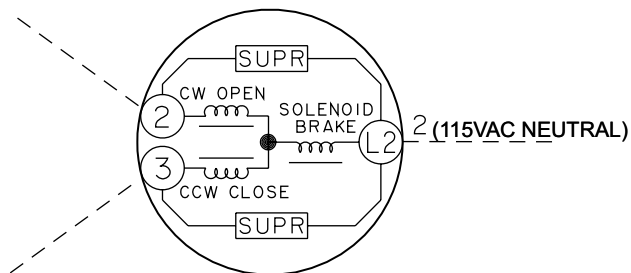
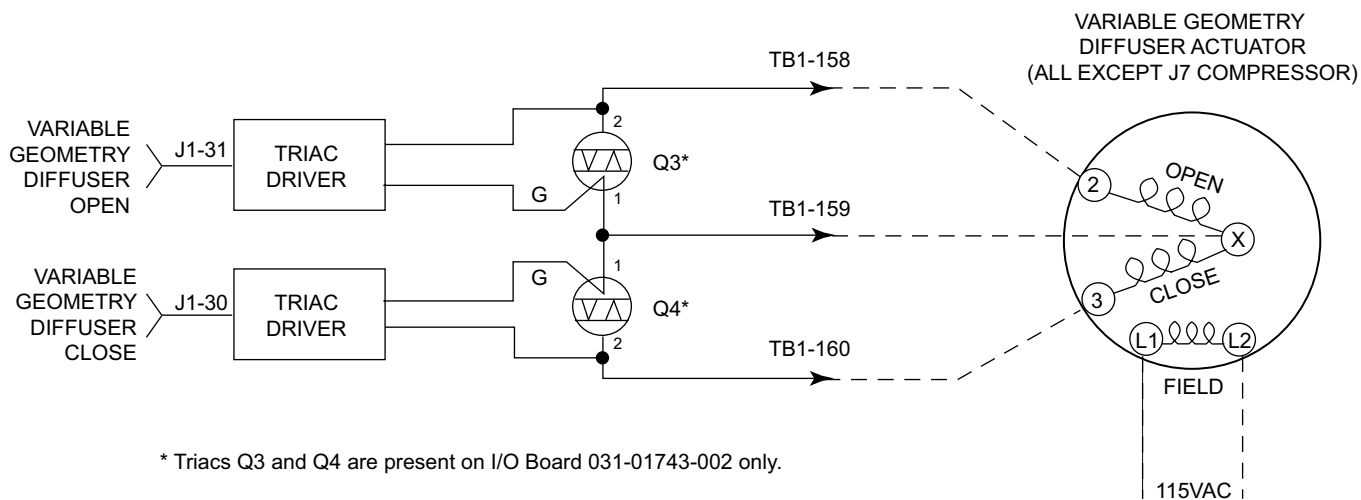


FIGURE 14 - I/O BOARD DIGITAL OUTPUTS (CONT'D)

LD12581

SECTION 5 - LIQUID CRYSTAL DISPLAY

(Refer To Fig. 15 - 28)

A 10.4 inch color **Liquid Crystal Display**, along with supporting components **Display Interface Board** and **Backlight Inverter Board** are mounted on a plate that is attached to the OptiView Control Center door. A clear Plexiglas faceplate prevents display surface damage. System operating parameters are displayed on various color graphic screens. The various display screens are selected for display using the keypad keys.

The display provided in the new chiller or from YORK as a service replacement part, could be manufactured by any of several approved manufacturers. Each display requires a specific Display Interface Board, Backlight Inverter Board, Inverter Board Interface Cable and program command set. Therefore, service replacement displays or supporting components cannot be arbitrarily selected!!! As explained below, replacement displays are provided from YORK as kits to assure compatibility of all components. Non-compatibility of components will result in incorrect operation!!! Refer to "Display Interface Board" and "Backlight Inverter Board" sections that follow this section. Displays that could be provided from YORK in new chillers or as replacement parts are:

- SHARP LQ10D367/368 (031-01774-000)
- SHARP LQ10D421
- NEC NL6448AC33-24
- LG SEMICON LP104V2-W (031-02046-000)

The YORK part numbers of the Display Interface Board, Backlight Inverter Board and Inverter Ribbon Cable provided, are listed on a label attached to the display mounting plate. These are the part numbers of the supporting components that are compatible with the installed display. These supporting components can be individually replaced. However, if the Liquid Crystal Display fails, Display Replacement Kit 331-01771-000 must be ordered as detailed below. This kit contains a replacement display and all compatible supporting components.

The display has 307,200 pixels arranged in a 640 columns X 480 rows matrix configuration. Each pixel consists of 3 windows; red, green and blue, through which a variable amount of light from the Display Backlight is permitted to pass through the front of the display. Imbedded in each window of the pixel is a transistor,

the conduction of which determines the amount of light that will pass through the window. The conduction of each transistor is controlled by a signal from the Display Controller on the Microboard. The overall pixel color is a result of the gradient of red, green and blue light allowed to pass.

Under program control, the Display Controller on the Microboard sends a drive signal for each pixel to create the image on the display. Each pixel's drive signal is an 18 bit binary word; 6 bits for each of the 3 colors, red green and blue. The greater the binary value, the greater the amount of light permitted to pass. The columns of pixels are driven from left to right and the rows are driven top to bottom. To coordinate the drive signals and assure the columns are driven from left to right and the rows are driven from top to bottom, each drive signal contains a horizontal and vertical sync signal. The **Display Interface Board** receives these display drive signals from the Microboard J5 and applies them to the display at connector CN1 (*refer to SECTION 6 - DISPLAY INTERFACE BOARD*).

Although there are variations in control signal timing between different display manufacturers, *Figure 20 on page 59* depicts typical control signals. Since these control signals occur at rates greater than can be read with a voltmeter, the following description is for information only. There are 480 horizontal rows of pixels. Each row contains 640 3-window pixels. Beginning with the top row, the drive signals are applied within each row, sequentially left to right, beginning with the left most pixel and ending with the right most pixel. The rows are driven from top to bottom. The Vertical Sync (VSYNC) pulse starts the scan in the upper left corner. The first Horizontal Sync (HSYNC) pulse initiates the sequential application of RGB drive signals to the 640 pixels in row 1. Upon receipt of the **ENABLE** signal, an RGB drive signal is applied to the first pixel. As long as the **ENABLE** signal is present, RGB drive signals are then applied to the remaining 639 pixels at the CLK rate of 25.18M Hz, or one every 39.72 nanoseconds. Typically it takes 31 microseconds to address all 640 pixels. Similarly, the next HSYNC pulse applies drive signals to row 2. This continues until all 480 rows have been addressed. Total elapsed time to address all 480 rows is approximately 16 milliseconds. The next VSYNC pulse causes the above cycle

to repeat. Displays can be operated in **FIXED** mode or **DISPLAY ENABLE** mode. In **FIXED** mode, the first pixel drive signal is applied a fixed number (48) of clock (CLK) cycles from the end of the HSYNC pulse and the drive signals are terminated a fixed number (16) of CLK cycles prior to the next HSYNC pulse. In **DISPLAY ENABLE** mode, the pixel drive signals are applied to the pixels only while **ENABLE** signal is present. This signal is typically present 4-48 CLKS after the end of the HSYNC pulse and 2-16 CLKS prior to the next HSYNC pulse. All YORK applications operate in the **DISPLAY ENABLE** mode. The state of the **ENABLE** (Display Interface Board J1-27) signal from the Microboard places the display in the desired mode as follows:

- SHARP LQ10D367/368 (031-01774-000) & LD-Q10D421 displays - When **ENABLE** maintained “low”, display operates in **FIXED** mode.
- NEC NL6448AC33-24 displays - When **ENABLE** maintained “high” or “open”, display operates in **FIXED** mode.
- LG SEMICON display (031-02046-000) does not have the **FIXED** mode feature.

As described above, in OptiView Control Center applications, the display scan is left to right, beginning with the top row and continuing sequentially through the rows to the last row. However, in display applications other than OptiView Control Centers, image reversal is sometimes required. In image reversal applications, the scan is reversed; the scan is right to left, beginning with the last row and proceeding to the top row. The SHARP or NEC display is placed in the **NORMAL** or **REVERSE** scan mode by the voltage levels on the Display Interface Board J1-30 and J1-31 (display connector CN1-30/31). These voltage levels are determined by the configuration of Wire jumpers P30 and P31 on the Display Interface Board (*refer to Figure 25 on page 65*). The display reads these voltage levels and automatically assumes **NORMAL** or **REVERSE** scan operation. *Refer to Section 6 "Display Interface Board" for jumper configurations.*

Displays by different manufacturer's can require different timing and control signals. The Microboard must know which display is present in order provide the correct signals. Therefore, when AC control power is first applied to the OptiView Control Center, as part of the power-up sequence, the Microboard reads the Panel ID wire jumpers P1D0 - P1D3 on the **Display Interface Board** and determines which display is present. It can then provide the correct timing and control

signals to produce the graphic image, as required by the display manufacturer. Since the **Display Interface Board** identifies the display for the Microboard, there is a different **Display Interface Board** required for each display application and each has a unique jumper configuration that identifies the display. A complete explanation of this process is included in the preceding “Microboard” section and the “Display Interface Board” section that follows.

The DC power source to operate the display is provided by the Microboard J5. Some display manufacturers require +5VDC; others require +3.3VDC. The position of Microboard Program Jumper JP2 determines which of these power sources is supplied to the display. JP2 must be positioned according to the display manufacturers requirements. *Refer to Table 1 on page 35, "Program Jumpers".*

The **Backlight Lamp** provides the illumination for the display. Average lamp life is 25000 hours (2.9 years). Some displays use one lamp. Others use two lamps. Lamps are replaceable, but not interchangeable between different displays. Each display manufacturer specifies the required lamp for their display. Refer to replacement parts list for appropriate replacement lamp. Service replacement lamps are stocked in the Baltimore Parts Center. The lamp is illuminated by applying a high voltage AC (500 to 1500VAC) to it. This illumination voltage is created from a low level DC voltage (+12VDC or +5VDC as required by the display manufacturer) by the **Backlight Inverter Board**. Lamp brightness is controlled by varying the high voltage AC. The greater the voltage the brighter the illumination. The lamp is controlled by on/off commands and brightness control signals applied to the **Backlight Inverter Board** from the Microboard. The Microboard Program determines when the lamp is turned on and off and the lamp brightness. Each display manufacturer specifies the **Backlight Inverter Board** to be used. Therefore, it will vary according to the display manufacturer. The ribbon cable that connects the Microboard to the Backlight Inverter Board also varies according to the display manufacturer's requirements. *Refer to Figure 26 on page 68.* Microboard Program Jumpers JP3, 4, 5, 7 and 8 determine the voltage levels of the control signals sent to the **Backlight Inverter Board** and must be configured per the display manufacturer's requirements as listed in Table 1. A detailed description of the operation of this board is in the “Backlight Inverter Board” section that follows. Also refer to the preceding “Microboard” section for a detailed description of the **Lamp Dimmer** circuit.

The actual display that is installed in the OptiView Control Center of the new chiller is determined by the display manufacturer contractual agreement in place during the time of OptiView Control Center production. Displays stocked for service replacement are a result of that same agreement. Therefore, the display received for service replacement may be by a different manufacturer than the one in the OptiView Control Center. Since each display manufacturer requires a specific Display Interface Board, Backlight Inverter Board and Inverter Ribbon Cable, replacement displays are ordered and supplied as a Display Replacement Kit (YORK Part Number 331-01771-000) to assure component compatibility. The items supplied in the kit are compatible with the supplied display. The kit consists of the following items mounted on a display mounting plate:

DISPLAY REPLACEMENT KIT 331-01771-000

1. Liquid Crystal Display with lamp
2. Appropriate Display Interface Board for item 1
3. Appropriate Backlight Inverter Board for item 1
4. Appropriate ribbon cable (Backlight Inverter Board to Microboard) for item 1
5. Ribbon cable (Display Interface Board to Microboard)
6. All mounting hardware
7. Installation instructions. A label attached to the display mounting plate lists the YORK part numbers of the display supporting components mounted on the display mounting plate and the required Microboard Program Jumper (JP2 through 8) configurations. **Microboard Program Jumpers JP2- JP8 will have to be configured appropriately for the replacement display.**

Display Handling

1. The display is made of glass. It could break if dropped.
2. The display front surface is easily scratched. If soiled, wipe with a dry cotton cloth. Use no water or chemicals.
3. The display is static sensitive. Electrostatic discharges may damage the display.
4. A laminated film is adhered to the display front glass surface to prevent it from being scratched. Peel off very slowly to prevent static damage.



Always remove control power from the OptiView Control Center before connecting or disconnecting wires to the display. Connecting or disconnecting wires to the display with power applied will damage the display!!!

BACKLIGHT LAMP REPLACEMENT

Sharp LQ10D367/368 (031-01774-000) Display (Refer to Figure 21 on page 60)

Removal

1. Remove control power from the OptiView Control Center.
2. Remove protective cover from rear of display.
3. Disconnect lamp AC power connector from Backlight Inverter Board.
4. Using fingernail or thin flat blade screwdriver, bend the locking tab outward slightly to clear the lamp housing protrusion.
5. Grasp lamp AC power connector and gently pull until lamp housing clears locking tab.
6. Grasp lamp housing and pull until lamp housing is completely removed from the display.

Installation

1. Slide new lamp into display from left to right until lamp housing protrusion locks into display locking tab.
2. Connect lamp AC power connector to Backlight Inverter Board.
3. Apply control power to OptiView Control Center.

Sharp LQ10D421 Display

(Refer to Figure 22 on page 60)

Both the top and bottom lamps slide into the display from left to right and are secured with locking tabs.

1. Remove control power from the OptiView Control Center.
2. Remove protective cover from rear of display.
3. Disconnect lamp AC power connector from defective lamp.

4. Using a thin flat blade screwdriver, press in on the small black locking tab.
5. Grasp lamp AC power connector and gently pull until lamp clears locking tab.
6. Grasp lamp housing and pull until lamp housing is completely removed from the display.

Installation

Follow instructions above for SHARP 367 display.

NEC NL6448AC33-24 Display

(Refer to Figure 23 on page 61)

Removal

Not available at this time.

Installation

Not available at this time.

LG Semicon LP104V2-W (031-02046-000) Display

(Refer to Figure 24 on page 61)

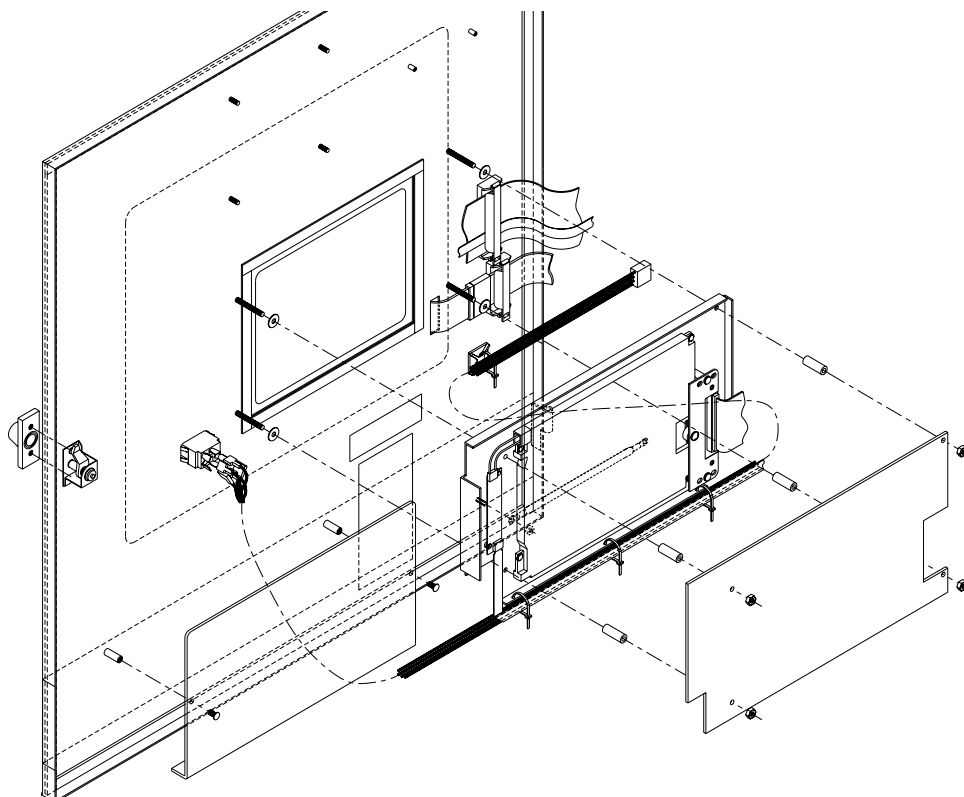
Removal

The lamp slides into the display from left to right and is secured with a screw.

1. Remove control power from the OptiView Control Center.
2. Remove protective cover from rear of display.
3. Disconnect lamp AC power connector from Backlight Inverter Board.
4. Using small Phillips screwdriver, remove lamp retaining screw.
5. Grasp lamp AC power connector and gently pull until lamp housing is completely removed from the display.

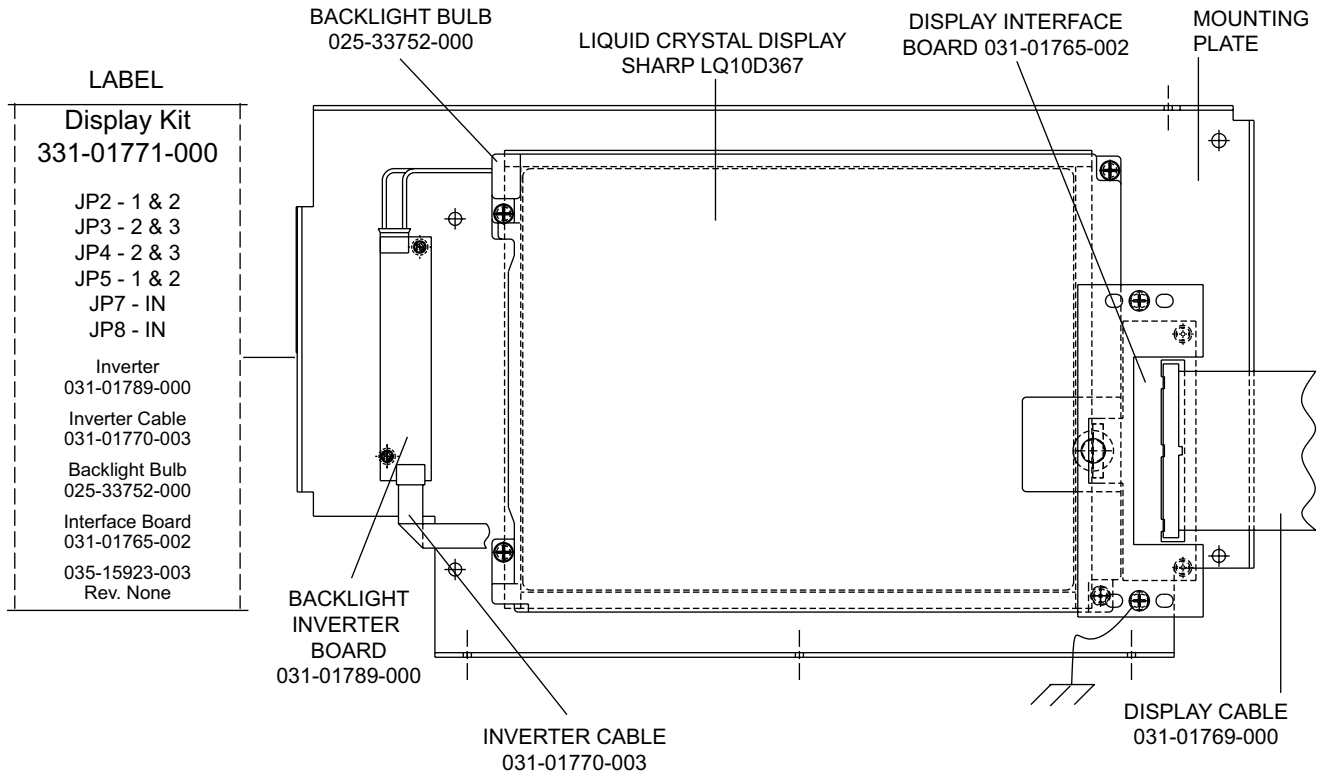
Installation

1. Slide new lamp into display from left to right until lamp housing is fully inserted.
2. Secure lamp with lamp retaining screw.
3. Connect lamp AC power connector to Backlight Inverter Board.
4. Apply AC power to OptiView Control Center.



LD04062

FIGURE 15 - DISPLAY, MOUNTING

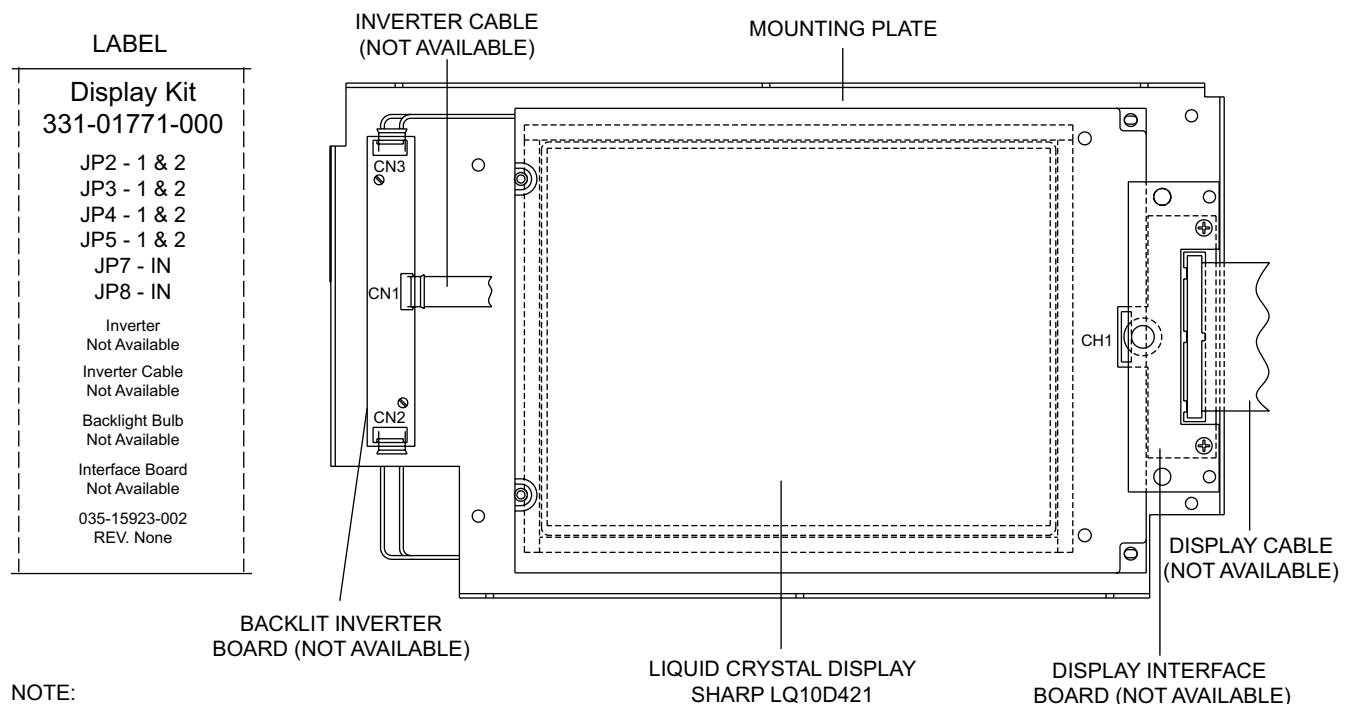


NOTE:

1. Configure Microboard Program Jumpers per label.

LD05526

FIGURE 16 - LIQUID CRYSTAL DISPLAY ASSEMBLY – SHARP LQ10D367/368 (031-01774-000) DISPLAY

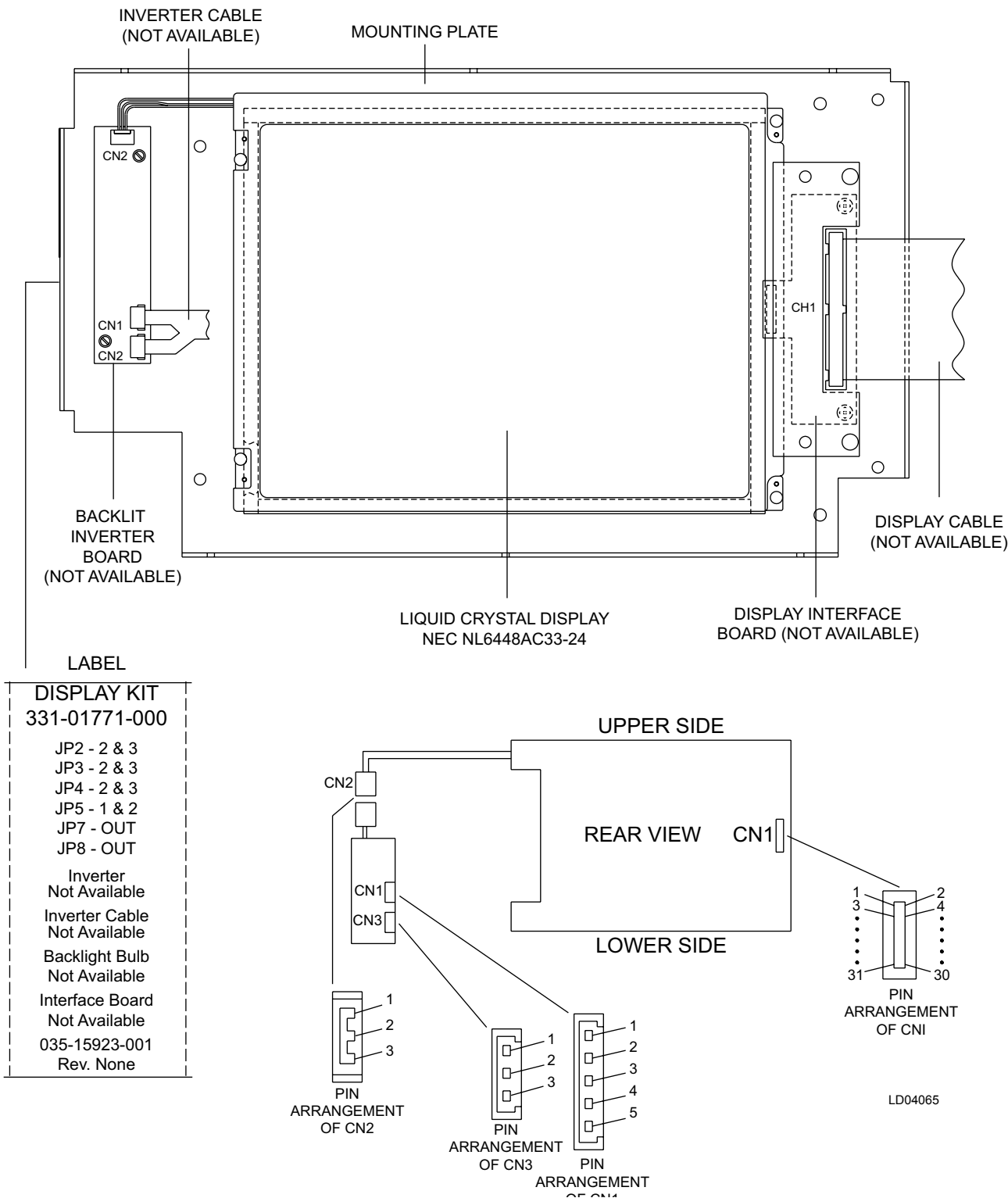


NOTE:

1. Configure Microboard Program Jumpers per label.

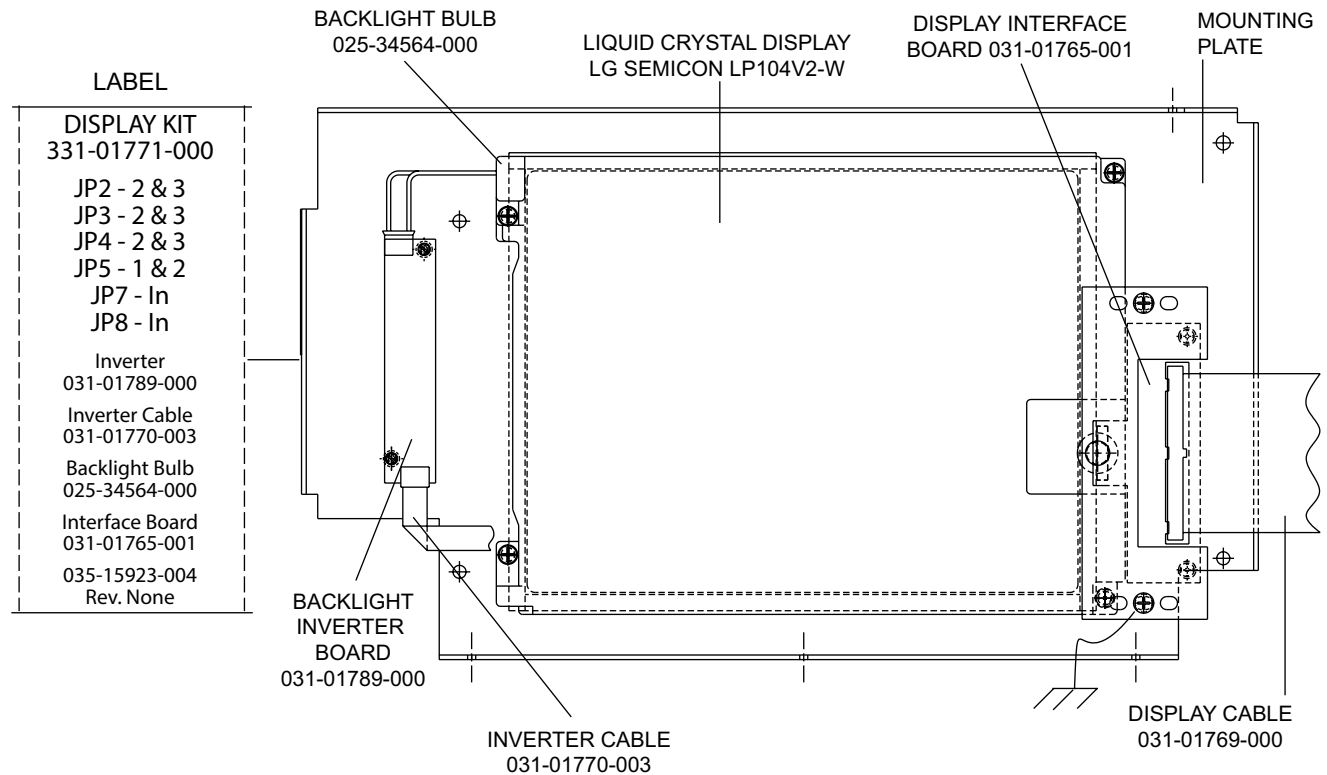
LD04064

FIGURE 17 - LIQUID CRYSTAL DISPLAY ASSEMBLY – SHARP LQ10D421 DISPLAY



NOTE:
1. Configure Microboard Program Jumpers per label.

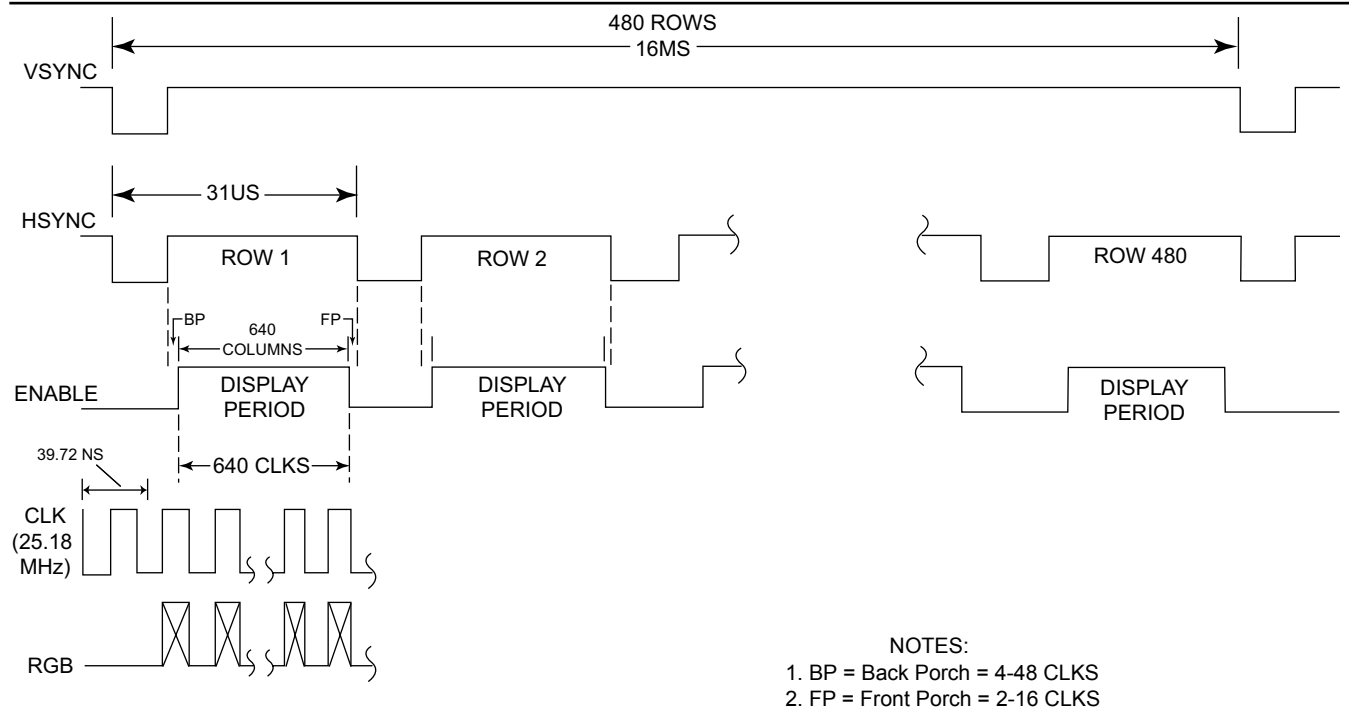
FIGURE 18 - LIQUID CRYSTAL DISPLAY ASSEMBLY – NEC NL6448AC33-24 DISPLAY



NOTE:
1. Configure Microboard Program Jumpers per label.

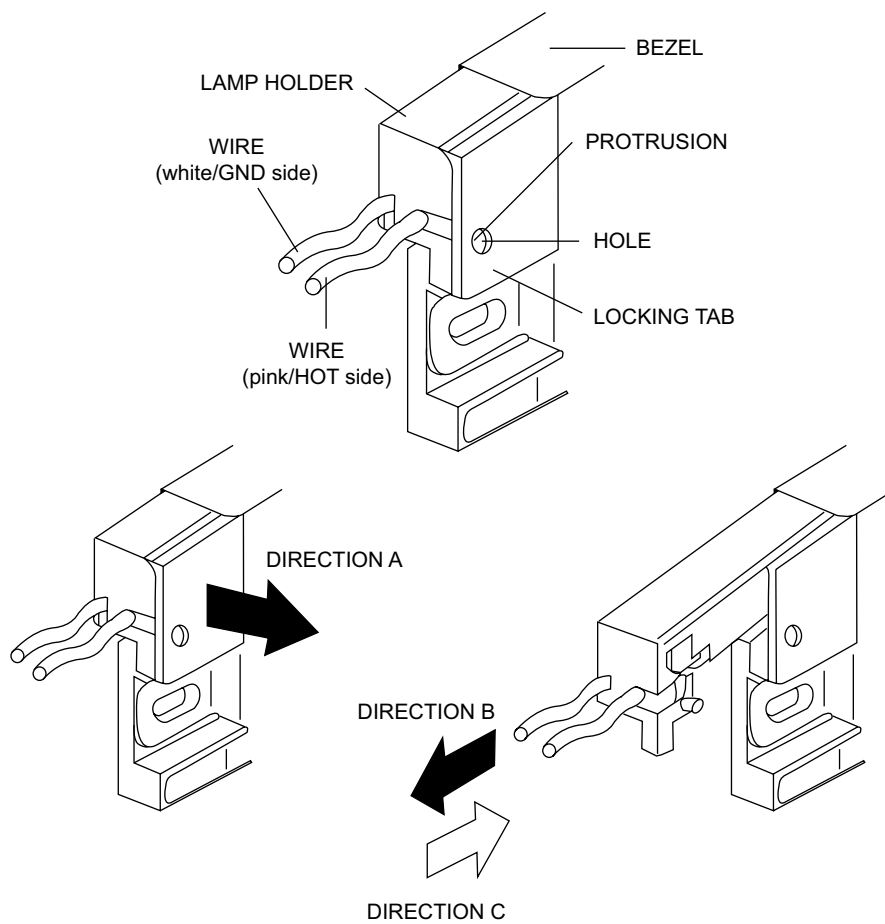
LD05525

FIGURE 19 - LIQUID CRYSTAL DISPLAY ASSEMBLY – LG SEMICON LP104V2-W (031-02046-000)

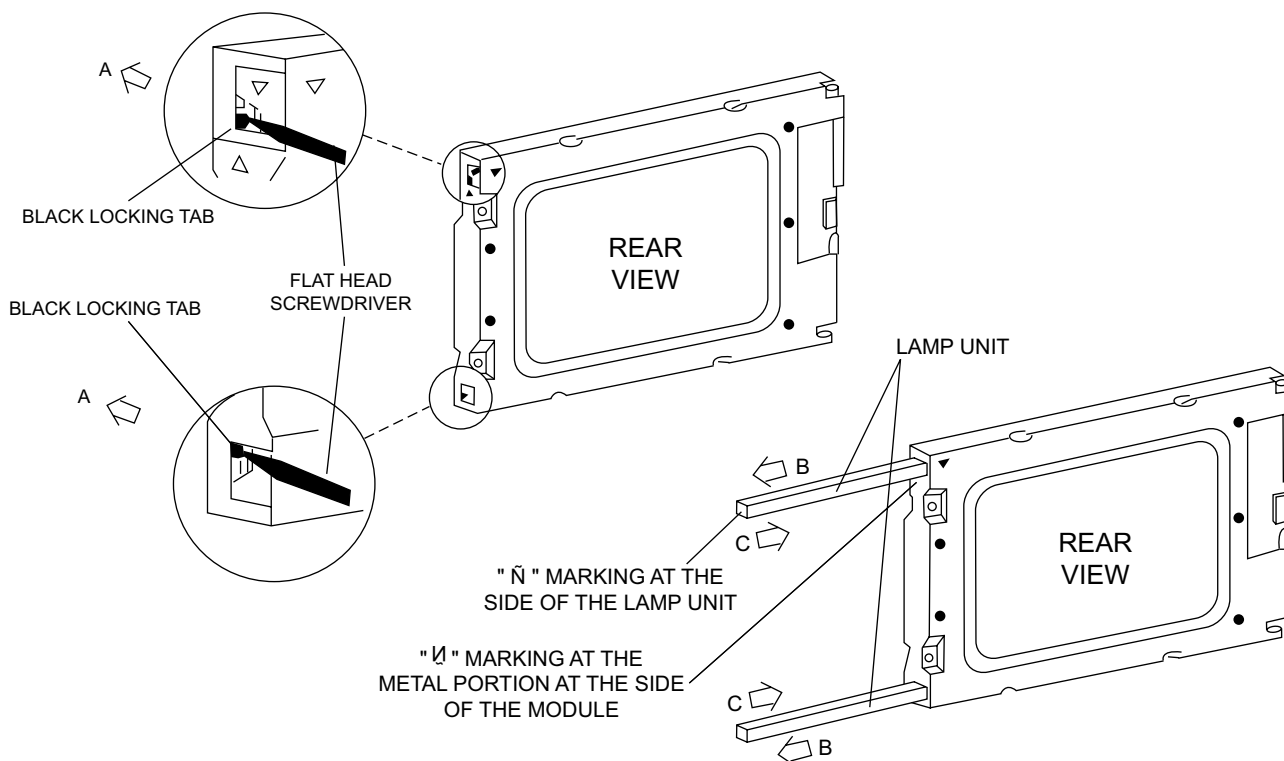


LD04066

FIGURE 20 - LIQUID CRYSTAL DISPLAY TYPICAL CONTROL SIGNAL TIMING



LD04067

FIGURE 21 - DISPLAY (SHARP LQ10D367/368) LAMP REPLACEMENT (031-02046-000)

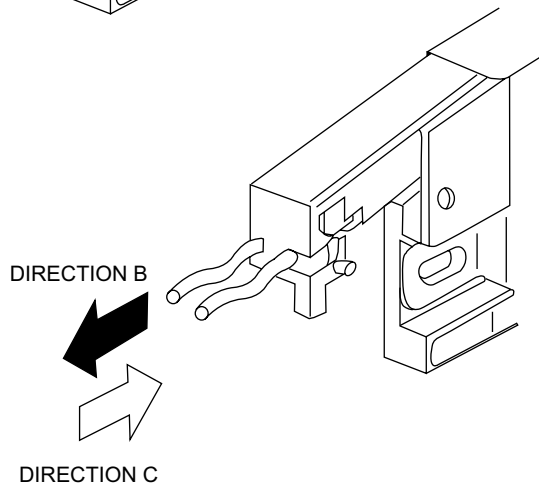
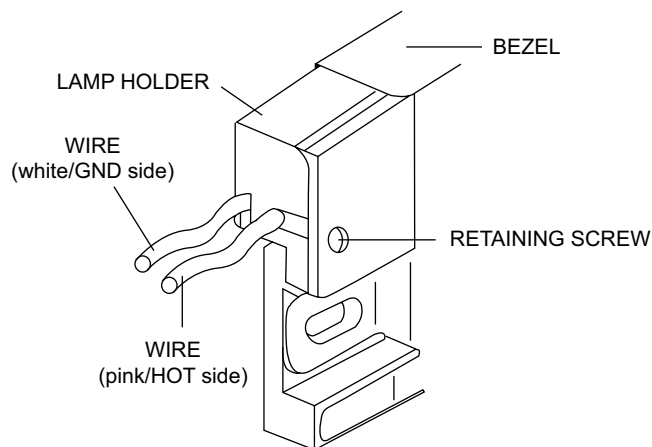
LD04068

FIGURE 22 - DISPLAY (SHARP LQ10D421) LAMP REPLACEMENT

NOT AVAILABLE AT THIS TIME

LD04069

FIGURE 23 - DISPLAY (NEC NL6448AC33-24) LAMP REPLACEMENT



LD05527

FIGURE 24 - DISPLAY (LG SEMICON LP104V2-W (031-02046-000)) LAMP REPLACEMENT

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SECTION 6 - DISPLAY INTERFACE BOARD

(Refer to Figure 25 on page 65)

The **Display Interface Board** is located on the **Liquid Crystal Display** mounting plate and is part of the Microboard interface to the display. It permits the use of displays by different manufacturers, by providing the Microboard with a means of automatically determining which display is present.

Since different display manufacturers require different timing and control signals, the Display Controller on the Microboard must be configured to meet the requirements of the actual display installed. When AC power is applied to the OptiView Control Center, as part of the power-up sequence, the Microboard reads the four Panel ID wire jumpers, PID0 through PID3, on the **Display Interface Board** to determine which display is present. The configuration of these jumpers indicates the actual display that is installed on the OptiView Control Center door. The Display Controller on the Microboard is then configured appropriately.

On Sharp and NEC displays the configuration of wire jumpers P30 and P31 determines whether the display scan orientation is **Normal** or **Reverse** (image reversal) scan. As described in the preceding “Display” section, Normal scan is left to right, beginning with the top row and continuing sequentially through the rows to the bottom row. Normal scan is used in OptiView Control Center applications. In display applications other than OptiView Control Center applications, image reversal is sometimes required. In image reversal applications, the scan is reversed; the scan is right to left, beginning with the bottom row and proceeding to the top row. The jumper configurations determine the voltage level at Display Interface Board J1-30 (P30) and J1-31 (P31). If P30 is IN, the voltage at J1-30 is +5.0VDC or +3.3VDC (as determined by position of Microboard Program Jumper JP2); if OUT, 0VDC. If P31 is IN, the voltage at J1-31 is GND; if OUT, 0VDC. The display reads these voltages and adopts a scan mode as follows:

SHARP LQ10D367/368 (031-01774-000) AND LQ10D421 DISPLAYS

SHARP displays require configuration of both jumpers to achieve total image reversal.

P30 IN - Normal scan; left to right

OUT - Reverse scan: right to left

P31 IN - Normal scan; top to bottom

OUT - Reverse scan; bottom to top

NEC NL6448AC33-24 DISPLAY

P30 Not Used

P31 IN or OUT - Normal scan; left to right, top to-bottom

The wire jumpers on this board are not field configurable, as with typical Program Jumpers. There are two variations of the **Display Interface Board**. Each board has the wire jumpers configured appropriately for the display to which it is attached, as shown below. **Display Interface Boards** are available individually for service replacement. The YORK part number of the Display Interface Board compatible with the installed display is listed on a label attached to the display mounting plate. However, service replacement displays are provided as a kit (331-01771-000) that includes, among other items, the appropriate **Display Interface Board** for the display included in the kit. Refer to explanation in “Liquid Crystal Display” section.

031-01765-001:

Display applicability - LG Semicon LP104V2-W
(031-02046-000) & NEC
NL6448AC33-24

Jumper configuration - PID0 - IN
 PID1 - OUT
 PID2 - OUT
 PID3 - OUT
 P30 - OUT
 P31 - OUT

031-01765-002:

Display applicability - SHARPLQ10D367/368 (031-01774-000) & LQ10D421

Jumper configuration - PID0 - OUT

PID1 - IN

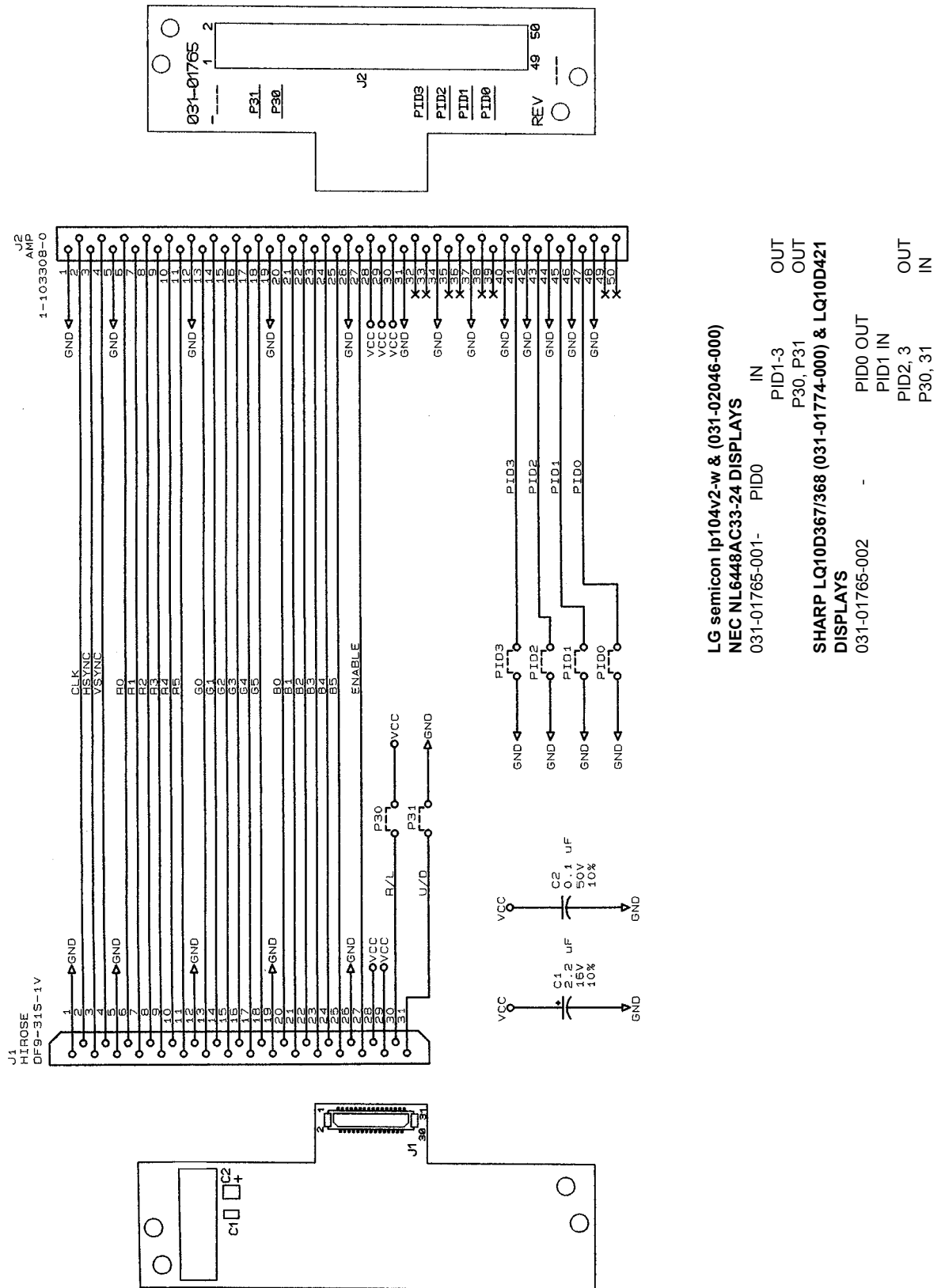
PID2 - OUT

PID3 - OUT

P30 - IN

P31 - IN

The red, green and blue display drive and control signals are simply passed through the **Display Interface Board**. The value of Vcc is either +5VDC or +3.3VDC, as determined by the position of Program Jumper JP2 on the Microboard. PID0 through PID3, when installed, connect their respective Microboard (J5) inputs to GND; when removed, the Microboard pulls these signals up to +5VDC. When P30 is installed, the display input (CN1-30) is connected to Vcc (+5VDC or +3.3VDC as determined by Microboard Program Jumper JP2). When P31 is installed, the display input (CN1-31) is connected to GND.



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FIGURE 25 - DISPLAY INTERFACE BOARD

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SECTION 7 - DISPLAY BACKLIGHT INVERTER BOARD

(Refer to Figure 26 on page 68)

The **Display Backlight Inverter Board** generates a high voltage AC signal that is applied to the backlight lamp, causing it to illuminate. The magnitude of the signal determines the lamp brightness. Displays by some manufacturers have two lamps; one at the top and one at the bottom of the display. Other display manufacturers have only a lamp at the top of the display.

An **Inverter** converts low level DC voltage (+12VDC or +5VDC, as required by the manufacturer) from the Microboard to a 500 to 1500VAC 60K Hz signal that is applied to the lamp. The higher the AC voltage, the greater the brightness of the lamp. When this voltage is not present, the lamp is turned off.



High voltage, up to 1500VAC, is present at the output of the Backlight Inverter Board. Refer to Figures 30 to 32 and locate the output connectors. Use extreme caution when working in this area!!!

Different display manufacturers require different Backlight Inverter Boards. The different board designs require different control voltage inputs. To accommodate these variations, Microboard Program Jumpers JP3 - JP5, JP7 and JP8 must be configured to provide the required voltage levels. A label attached to the display mounting plate lists the required Program Jumper configuration for that particular display. *Refer to Table 1 on page 35 for required Program Jumper configurations for the various display applications.*

Under program control, the Microboard generates the control signals that are applied to the Backlight Inverter Board. The program determines when the lamp is turned on and off. It also adjusts the lamp brightness. To increase the average lamp life of 25000 hours, the lamp brightness is normally adjusted to 50%. This brightness level will still allow the display to be visible. When the program senses a keypad key has been pressed, it adjusts the brightness to 100% (maximum).

The lamp illumination high voltage AC is generated from either +12VDC or +5VDC as required by the manufacturer. Microboard Program Jumper JP5 must be positioned to provide the required voltage. The Microboard provides the Backlight Enable signal. This signal turns the lamp on and off. Some manufacturers require this signal to be +12VDC, others require +5VDC. Program Jumper JP4 must be positioned to

provide the required voltage. Further, some applications require this signal to be a +VDC (+12VDC or +5VDC) to turn on the lamp. Others require this signal to be 0VDC to turn on the lamp. Program Jumper JP3 must be positioned to provide the required polarity.

Depending upon the display manufacturer, the brightness control input from the Microboard must be either a variable voltage or a variable resistance. Microboard Program Jumpers JP7 and JP8 are used to provide the appropriate technique (*refer to Figure 7 on page 40*). The lamp dimmer circuit on the Microboard is an IC that is the electrical equivalent of a 10K Ohm potentiometer with 100 positions or steps. The program adjusts the position of the potentiometer. When configured for variable voltage (JP7 & JP8 installed), the output between Microboard J6-7 and J6-8 is a 0 to +5.0VDC signal. Not all applications require the full 5.0VDC range. If configured for variable resistance (JP7 and JP8 removed), the output between Microboard J6-7 and J6-8 is a 0 to 10K Ohm variable resistance.

The OptiView Control Center could be supplied with any of several approved displays. Each display requires a specific Backlight Inverter Board as specified below and in *Figure 26 on page 68*. These boards are individually available as service replacement parts (the required Backlight Inverter Board part number is listed on the label attached to the display mounting plate). However, service replacement displays are provided in a kit (YORK P/N 331-01771-000) that includes the appropriate Backlight Inverter Board (refer to "Liquid Crystal Display" Section).

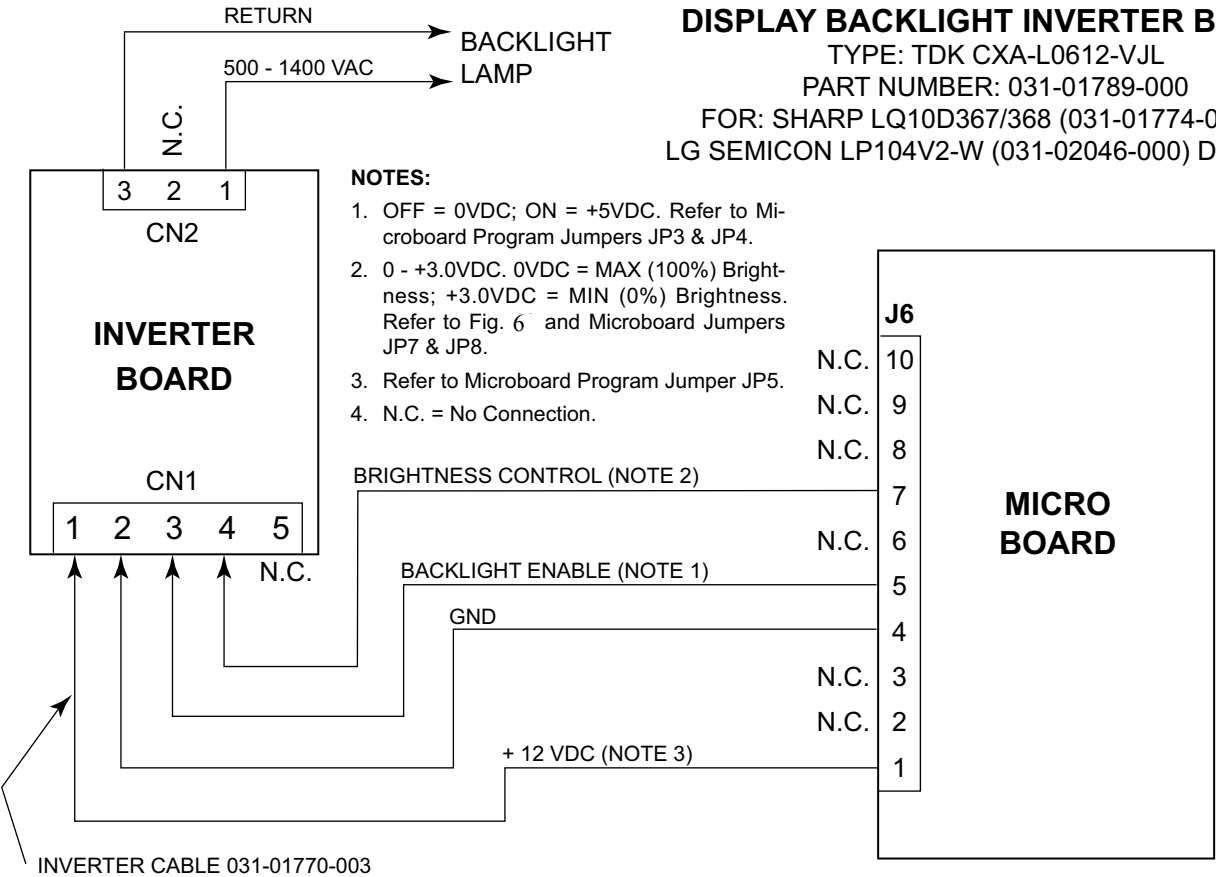
SHARP model LQ10D367/368 (031-01774-000) AND LG Semicon LP104V2-W (031-02046-000) displays require a TDK CXA-LO612-VJL Backlight Inverter Board (YORK P/N 031-01789-000) (*refer to Fig. 25*). These boards generate a lamp illumination high voltage AC from +12VDC. When the Backlight Enable signal at connector CN1-3 is +5VDC, the high voltage signal is applied to the lamp. When CN1-3 is 0VDC, the high voltage signal is removed from the lamp, turning it off. The lamp brightness is controlled by a variable voltage signal, developed by the lamp dimmer circuit on the Microboard and applied to connector CN1-4 (*refer to Figure 7 on page 40*). The lamp dimmer circuit varies the voltage at CN1-4 over the range of 0 to +3.0VDC. 0VDC produces maximum

(100%) brightness; +3.0VDC produces minimum (0%) brightness. Voltages between these values produce a linear brightness 0 and 100%. Connector CN2 applies the high voltage lamp illumination signal to the lamp.

SHARP model LQ10D421 displays require a XENTEK LS520 Backlight Inverter Board (YORK P/N XXX-XXXXX-XXX) (refer to Figure 27 on page 69). These boards generate the lamp illumination high voltage AC from +12VDC. When the “Backlight Enable” signal at connector CN1-5 is 0VDC, the high voltage signal is applied to the lamp, turning it on. When CN1-5 is +12VDC, the high voltage signal is removed from the lamp, turning it off. The lamp brightness is controlled by a variable voltage signal, developed by the lamp dimmer circuit (ref. Fig.6) on the Microboard and applied to connector CN1-6 and CN1-7. The Microboard places CN1-7 at ground (GND) potential. The lamp dimmer varies the voltage at CN1-6 over the range of 0 to +2.5VDC. 0VDC produces maximum (100%) lamp brightness; 2.5VDC produces minimum (0%) brightness. Voltages between these values produce a linear brightness between 0 and 100%. This

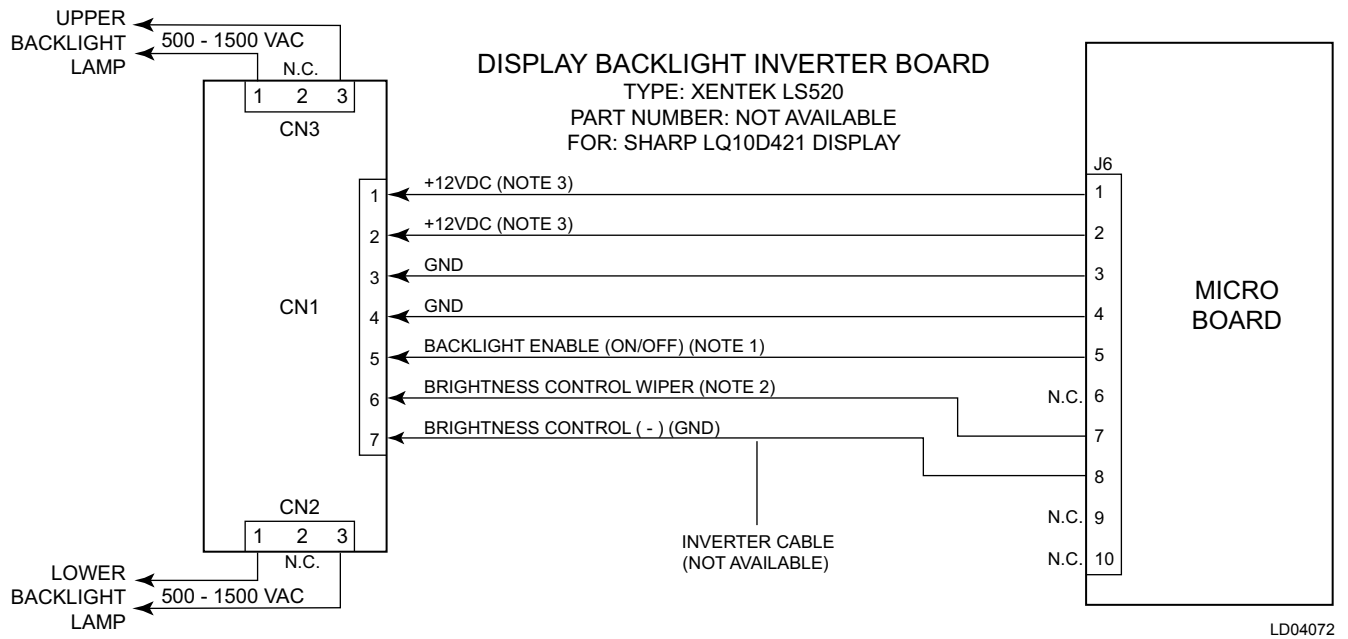
display has a lamp at the top of the display and one at the bottom of the display. Connector CN2 applies the high voltage lamp illumination signal to the lower lamp; CN3 the upper lamp.

NEC model NL6448AC33-24 displays require an NEC 104PWBR1 Backlight Inverter Board (YORK P/N XXX-XXXXX-XXX) (refer to Figure 28 on page 69). These boards generate the lamp illumination high voltage AC from +12VDC. When the **Backlight Enable** signal at connector CN3-1 is +5VDC, the high voltage signal is applied to the lamp, turning it on. When CN3-1 is 0VDC, the high voltage signal is removed from the lamp, turning it off. The lamp brightness is controlled by a variable resistance, developed by the lamp dimmer circuit on the Microboard and applied to connector CN3-2 and CN3-3 (refer to Figure 7 on page 40). The lamp dimmer varies the resistance between CN3-2 and CN3-3 over the range of 0 to 10K Ohms. 0 Ohms produces minimum (0%) brightness; 10K Ohms produces maximum (100%) brightness. Resistances between these extremes produce linear brightness between 0% and 100%. Connector CN2 applies the high voltage lamp illumination signal.



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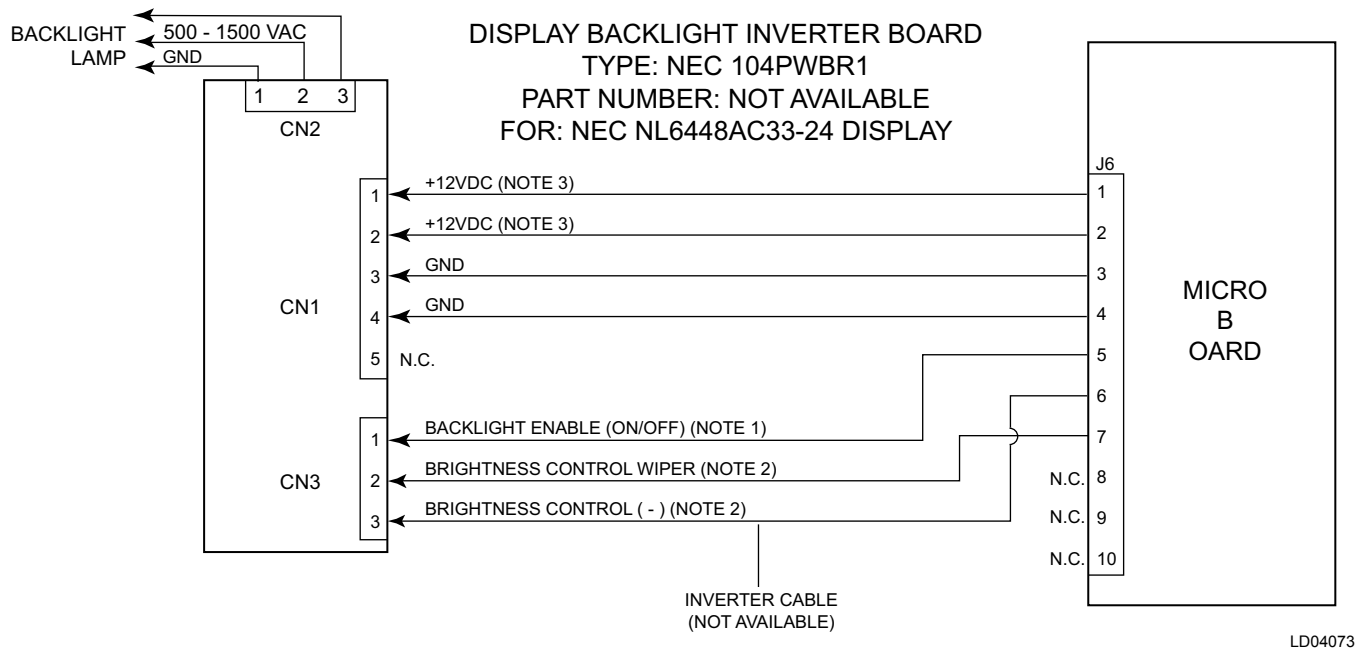
FIGURE 26 - DISPLAY BACKLIGHT INVERTER BOARD (SHARP LQ10D367/368 (031-01774-000) AND LG SEMICON LP104V2-W (031-02046-000))



NOTES:

1. ON = 0VDC; OFF = +12VDC. Refer to Microboard Program Jumpers JP3 & JP4.
2. 0 - +2.5VDC. 0VDC = MAX (100%) Brightness; +2.5VDC = MIN (0%) Brightness. Refer to Figure 7 on page 40 and Microboard Program Jumpers JP7 & JP8.
3. Refer to Microboard Program Jumper JP5.
4. N.C. = No Connection.

FIGURE 27 - DISPLAY BACKLIGHT INVERTER BOARD (SHARP LQ10D421)



NOTES:

1. ON = +5VDC; OFF = 0VDC. Refer to Microboard Program Jumpers JP3 & JP4.
2. 0 - 10K Ohms. 0 Ohms = MIN (0%) Brightness; 10K Ohms = MAX (100%) Brightness. Refer to Figure 7 on page 40 and Microboard Program Jumpers JP7 & JP8.
3. Refer to Microboard Program Jumper JP5.
4. N.C. = No Connection.

FIGURE 28 - DISPLAY BACKLIGHT INVERTER BOARD (NEC NL6448AC33-24)

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SECTION 8 - KEYPAD

(Refer To Figure 29 on page 72)

The **keypad** contains touch-sensitive keys that allow the operator to interface with the OptiView Control Center. The operator presses the keys to request the desired screens of information and enter System Setpoints.

The top layer of the keypad contains embossed areas identifying the keys. Under each embossed key area are two conductors, one on top of the other, separated by an air space. The conductors are arranged in a matrix of rows and columns and connected to the keypad connector as shown in *Figure 29 on page 72*. The embossed area of each key is located directly over the intersection point of the conductors. Pressing the embossed key area causes contact and electrical continuity between the two conductors. For example, pressing the “1” key creates continuity between the keypad connector pin 5 (column 3) and pin 13 (row 4). Since this connector is interfaced to the Microboard (J18), the Microboard senses this continuity as described below and concludes the “1” key is pressed.

The Microboard Program continuously scans the keypad to determine if a key is pressed. Beginning with row 1 and proceeding through all rows, the program places a “logic low” (<1VDC) on a row, a “logic high” (>4VDC) on the remaining rows and reads the columns. A logic low in any column indicates a key in that column and row is pressed. For example, if at the time

row 4 is being driven low, if column 3 is low, then the Micro concludes the key at coordinate of row 4 and column 3 is pressed. Since the coordinates of all keys are stored in the Microboard’s Program, it can identify which key is at this coordinate and responds accordingly. In this example the “1” key is pressed.

In order for the Microboard to reliably detect closed and open keys, each key must meet a closed circuit and open circuit resistance requirement. When a key is pressed, the contact resistance must be ≤ 100 Ohms. When a key is not pressed, the contact resistance must be ≥ 1 Meg Ohm. If the Microboard is not responding to a pressed key, or if it’s detecting a closed key when none are pressed, it could be because the contact resistance requirements are not being met. The operation of each key can be checked with an Ohmmeter. To check the open and closed contact resistance of any key, *refer to SECTION 26 - DIAGNOSTICS and TROUBLESHOOTING of this manual.*

The keypad is attached to the front of the OptiView Control Center door with an adhesive backing. If service replacement is required, start at one corner and slowly peel the keypad from the door. The rear side of the replacement keypad is coated with an adhesive covered with a paper backing. Remove the paper backing, align the display and control switch openings and apply the keypad to the door.

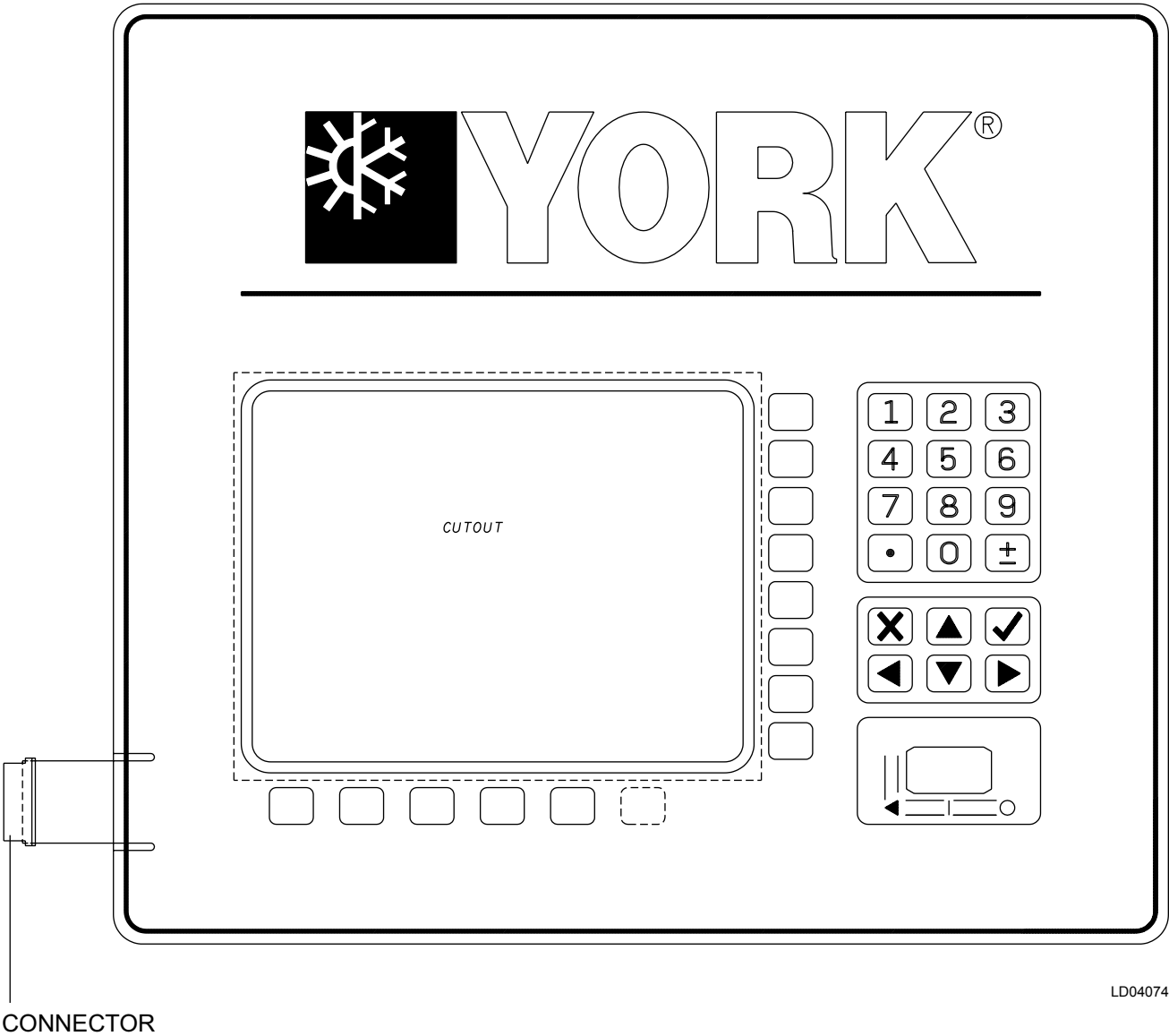
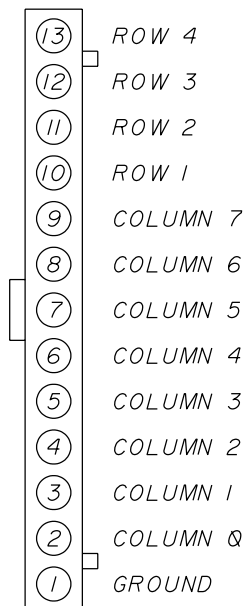
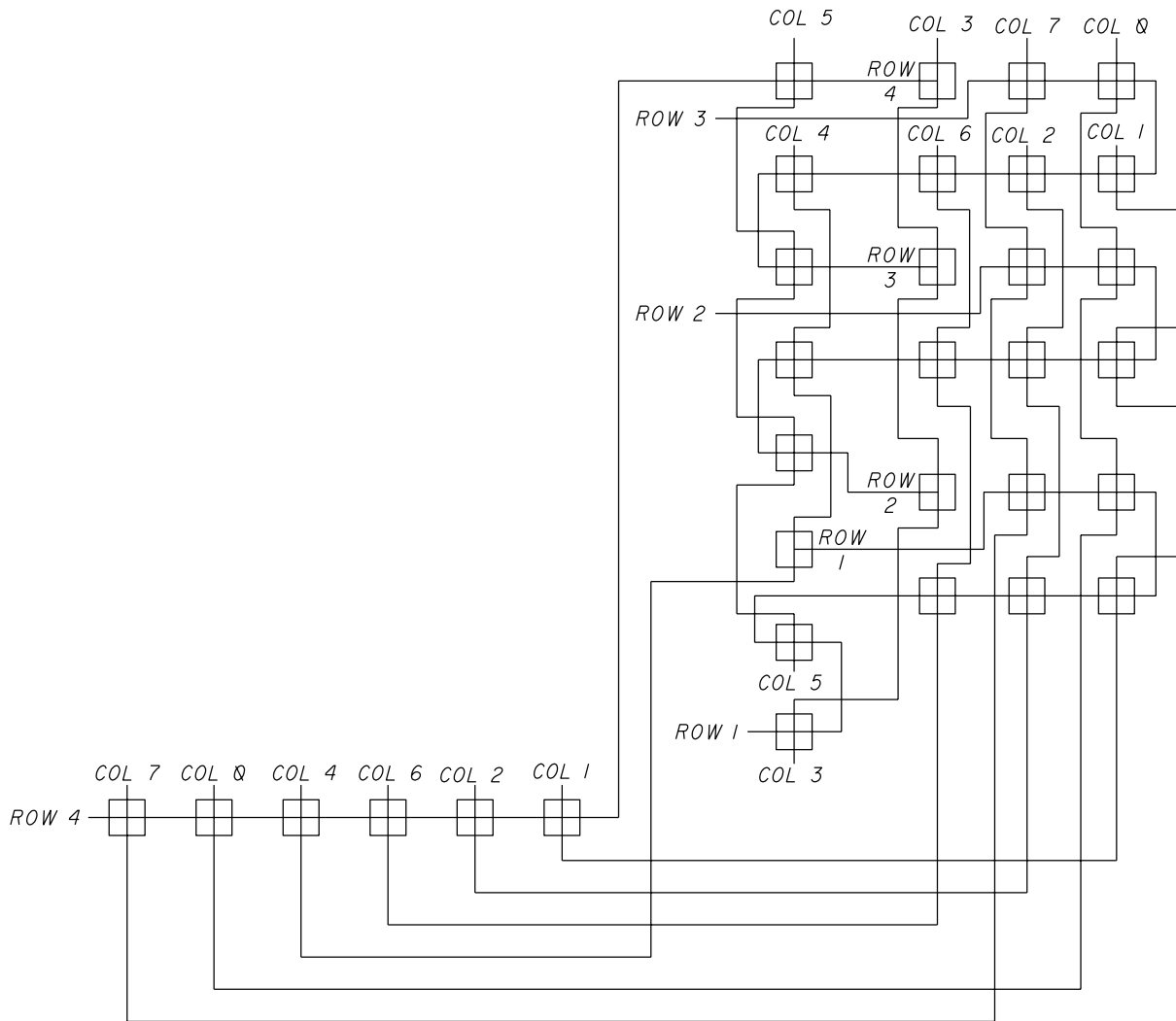


FIGURE 29 - KEYPAD



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CONNECTOR PIN OUT

LD04076

FIGURE 30 - KEYPAD

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SECTION 9 - POWER SUPPLY

(Refer to Figure 31 on page 75)

The Power Supply provides the DC power for the LCD Display and all the printed circuit boards in the OptiView Control Center. It receives a 102 to 132VAC input from an external power source and provides the following DC outputs:

- -12VDC
- +12VDC
- +5VDC
- +24VDC
- Ground

The +24VDC output provides power to the Turbine Oil, Steam, and Bearing Temperature Transmitters, Vibration Transmitters, Compressor Proximity Probe.

The -12VDC, +12VDC, GND and +5VDC outputs are applied to the Microboard. There, these voltages are applied to the circuits requiring the respective voltage. From the Microboard, the +12VDC and +5VDC are distributed to other system components requiring these voltages. These include the MicroGateway, I/O Board, VSD Oil Pump, LCD Display and Display Backlight Inverter Board.

The -12VDC, +12VDC, GND and +5VDC outputs are also applied to the Analog I/O Expansion Board. These voltages are applied to the circuits requiring the respective voltage. The +5VDC output is daisy-chained to the Digital I/O Expansion Board.

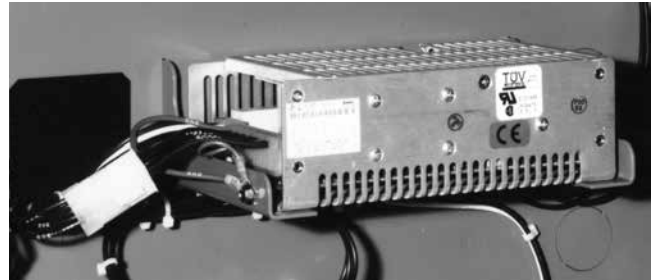


FIGURE 31 - POWER SUPPLY

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As shown in *Figure 6 on page 39*, the Microboard contains two voltage regulators that create separate +5VDC and +3.3VDC supplies. The +5VDC supply is dedicated to all the Microboard Analog circuits and is labeled as the +5VDC (Analog) supply. It is also routed to all Pressure Transducers and Temperature Thermistors. This permits all Analog circuits to be powered by the same supply, eliminating any offsets caused by voltage regulator drift. The +3.3VDC supply is utilized by the microprocessor and other digital circuits. It could also be applied to the Backlight Inverter Board, depending on the display manufacturer's requirements as explained below.

Different display manufacturers can require different supply voltages for their display and supporting circuits. To accommodate the different display manufacturer's voltage requirements, Microboard Program Jumpers JP2 and JP5 must be positioned to provide the required supply voltages to the display and the Display Backlight Inverter Board. Either +5VDC or +3.3VDC, as determined by JP2, is applied to the display. Either +12VDC or +5VDC, as determined by JP5, is applied to the Display Backlight Inverter Board. Refer to *Table 1 on page 35 "Microboard Program Jumpers"*.

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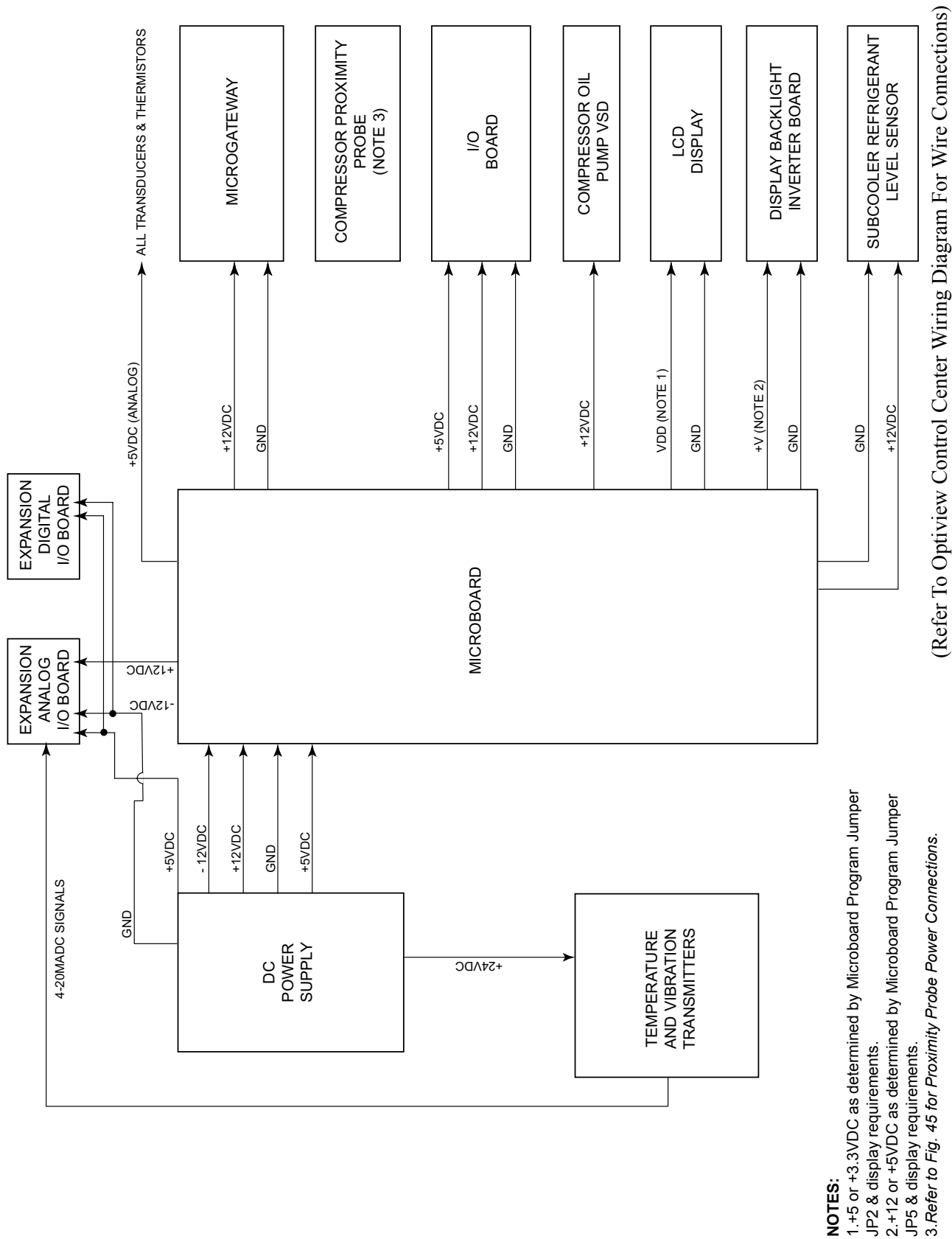
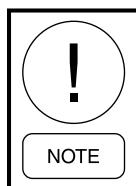


FIGURE 32 - POWER SUPPLY – DC POWER DISTRIBUTION

SECTION 10 - ANALOG I/O EXPANSION BOARD 031-02472-000

(Refer to Figure 33 on page 81)



For complete wiring diagrams refer to forms 160.67-PW1 (Manual Start) and 160.67-PW3 (Automatic Start).

The **Analog I/O Expansion Board** is actually a small microprocessor board and is programmed to control analog outputs, or accept analog inputs, from external electrical devices. Each Analog Board has the capability of 24 independent input channels. These I/O channels are dedicated through the software and external wiring, as to the function of each channel. Each channel is configured for the type of device that is connected to it per the following table:

ANALOG BOARD INPUTS	INPUT CHANNEL NUMBER
4-20 mA	1-14,16-23
0 - 5 volt	15
Not Used	24

ANALOG BOARD OUTPUTS	OUTPUT CHANNEL NUMBER
4-20 mA	1-4,7,8
0 - 10 volt	5,6

COMMUNICATIONS LED'S

The Microboard is in constant communication with the Analog (and Digital) Board(s). You will notice on each Analog and Digital board, that there is a pair of LED's that are labeled as RX and TX. These letters represent Receive (RX) and Transmit (TX). These LED's should be flashing at a high rate during normal operation. This indicates that the Microboard and the board that you are looking at are properly communicating with each other.

- See the "Jumper and Dipswitch Settings" at the end of this section. This contains the dipswitch settings for addressing the Analog I/O Board. When these switches are properly set, the Microboard is able to serially communicate with the I/O Board and provide control signals and

data exchange. If these switches are not properly set, the chiller will not be allowed to start and the Cycling Fault message "Expansion I/O Serial Communications" will be displayed.

Electrical Connections

(Refer Figure 34 on page 82)

The YST OptiView Control Center utilizes one Digital, and one Analog Board. They must be interconnected with a wiring harness that provides all of the necessary DC voltage requirements, as well as the communications capabilities.

The connectors for both boards have two rows of connections. The wires that are inserted into the positions of one row are internally daisy-chained on each I/O Board, to continue the voltages and signals to the adjacent row. Therefore, any time that a connector is unplugged from the daisy-chain, these voltages and signals cannot continue through to the next board.

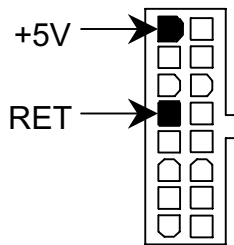
The four wires that feed from the power supply to the board provide all of the necessary DC voltage that is required (+5 VDC, -12 VDC, +12 VDC, and Return or Common). The communications signals to the I/O Boards are the RX (receive) and TX (transmit). These signals are the means by which the Microboard communicates to the I/O.

The Analog Board requires the +5 VDC for logic, the -12 VDC for internal voltage reference, and +12 VDC for external sensors (plus or +) and the Return (common or -). The communications signals (RX & TX) are required by all boards.

Logic Voltage (Power) LED's

Located on the Analog Board are two power LED's. The first of these is D1 LED (+5VDC), and will be illuminated as long as the control power switch is ON, and the proper voltage is present at Analog Board connector P3. The power supply generates the +5 VDC voltage, and passes it on through the Power-I/O harness. This LED does not indicate however that the proper voltage is necessarily present at the board, only that the voltage is enough to energize the voltage sensing circuitry. If a voltage related problem is suspected with regard to an

Analog Board, the best way to actually determine this is to read the voltage on a DVM (Digital Volt Meter). This may be accomplished by locating the white power/communications connector on the board. Notice that the Analog Board has only one of these connectors. The associated power/communications harness plugs in to it. Take the red (positive) probe of the DVM and carefully insert the end into the +5V lead and the black (negative) probe end into the "RET" (Return or Common) lead, as shown below:



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Set the DVM to read DC, and set the proper range. The voltage reading must read a minimum of +4.98 VDC. The Power-I/O harness will have an associated voltage drop at each board connection. As an example, if you are reading the voltage at the first I/O Board in the daisy-chain, and it reads 4.98 VDC, you can be assured that the voltage at the subsequent connections for the remaining board will be lower yet. The voltage will need to be corrected for proper operation of the system.

The cause for a low voltage reading could be:

- The power supply may be defective (*see "SECTION 9 - POWER SUPPLY" in this manual*).
- The Power-I/O communications harness has a problem (a new harness may be needed).
- A problem may exist with one of the I/O Boards (Digital or Analog).
- If the power LED is not lighted, check the cable for proper connectivity. Note: Each board provides the necessary connections to feed all signals to the following connectors.

The second power LED is D5 (+24VDC). This +24VDC voltage is generated on the Analog Board from the +12VDC supply being fed from the power supply. If the +12VDC is present as stated earlier, then this LED will illuminate if the on-board +24VDC supply is functioning properly.

Active LED

The Analog Boards have an active LED indicator that blinks when the board's software is running.

If the active LED is not blinking, it could be an indication that the internal program is not running. Try cycling the power to the OptiView panel off and then back on to see if the Active light starts blinking. If not, a new board may be required.

Analog Inputs

An analog input is the portion of the hardware that allows devices such as temperature and pressure transmitters, to interface with the Microboard. The software program within the Microboard is constantly looking at these Input channels, via communications, and based upon what the voltage or current level of the channel is, will provide the necessary control for an associated action.

Analog inputs arrive at the board on connectors P4 through P10. Each of these connectors can receive two channels (for a total of twenty-four). *Refer to Figure 34 on page 82 for the external interface wiring connections.*

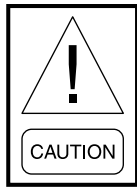
Analog Outputs

An analog output is the portion of the hardware that the Microboard uses to provide a controlled output to a pneumatic valve (via 4-20 mA DC signal to an electric-to-pneumatic transducer) or an electric actuator (0-10 VDC). The Analog Board has two connectors labeled P11A and P11B. Each connector provides the termination points for four analog output channels. *Refer to Figure 34 on page 82 for the external interface wiring connections.*

Troubleshooting the Analog Inputs

The Analog Board has twelve Analog input board connectors labeled P4A, P4B, P5A, P5B, P6A, P6B, P7A, P7B, P9A, P9B, P10A, P10B. Each connector provides the termination points for two analog input channels. *Refer to Figure 34 on page 82 for the external interface wiring connections.*

Depending on the type of transmitter connected to a channel that is configured for 4-20 mA, the (+) and (GND) positions may not be used. Refer to the applicable YST wiring diagram Form 160.67-PW1 or 160.67-PW3 for the complete schematic wiring.



In all cases, the 4-20 mA DC loop power must originate from the OptiView Control Center.

Besides properly setting the software configuration, each channel is setup through software calibration to ensure that the Microboard uses the actual count received from the A/D converter to scale the input signal into engineering units for use by the display, safety and control logic. Improper setup of either the hardware or software will result in improper operation or range.

The most common fault associated with the improper reading of the analog input channels other than hardware or software setup problems fall into one of the following categories:

- Sensor fault
- Wiring problem
- Improper grounding of system.

An open wire, shorted wire, or faulty sensor will usually give a reading at either the minimum or maximum end of the range scale. An erratic reading or a reading that seems to float up and down is usually indicative of a grounding problem. When a single transmitter or cable is shorted to earth (or system) ground, this can show up as a whole assortment of problem channels. The easiest way to find a short to earth problem is to disconnect all the sensor plugs and Ohm out each plug screw terminal to earth for open (infinite) impedance. All sensors should read open to earth.

REPLACING A DEFECTIVE ANALOG BOARD

The procedure to replace an Analog Board is outlined below:

1. Shut off control power.
2. Unplug all connectors from the board.
3. Remove the old board from the panel and remove the new board from its packing and place both on an anti-static surface.
4. Check that all jumpers and dipswitches are properly setup on the new board as it was on the old board.
5. Install the modified replacement board in the panel.
6. Plug all connectors back in.
7. Set the Diagnostic switch (SW1-3) on the Microboard to ON.
8. Turn on control power.
9. After the OptiView panel has rebooted, access the DIAGNOSTICS – EXPANSION ANALOG screen and calibrate the inputs *as described in SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES* of this manual.



If the Analog I/O Expansion Board is replaced, the counts sent to the Microboard may not be the same as the original board. This could result in unexpected oil pump and condenser water pump operation. Prior to applying power to the panel after replacing the board, place the Microboard program switch (SW1-3) in the ON position to disable chiller operation. Calibrate the 4-20 mA inputs as described in SECTION 23 of this manual in order to ensure safe operation of the chiller.

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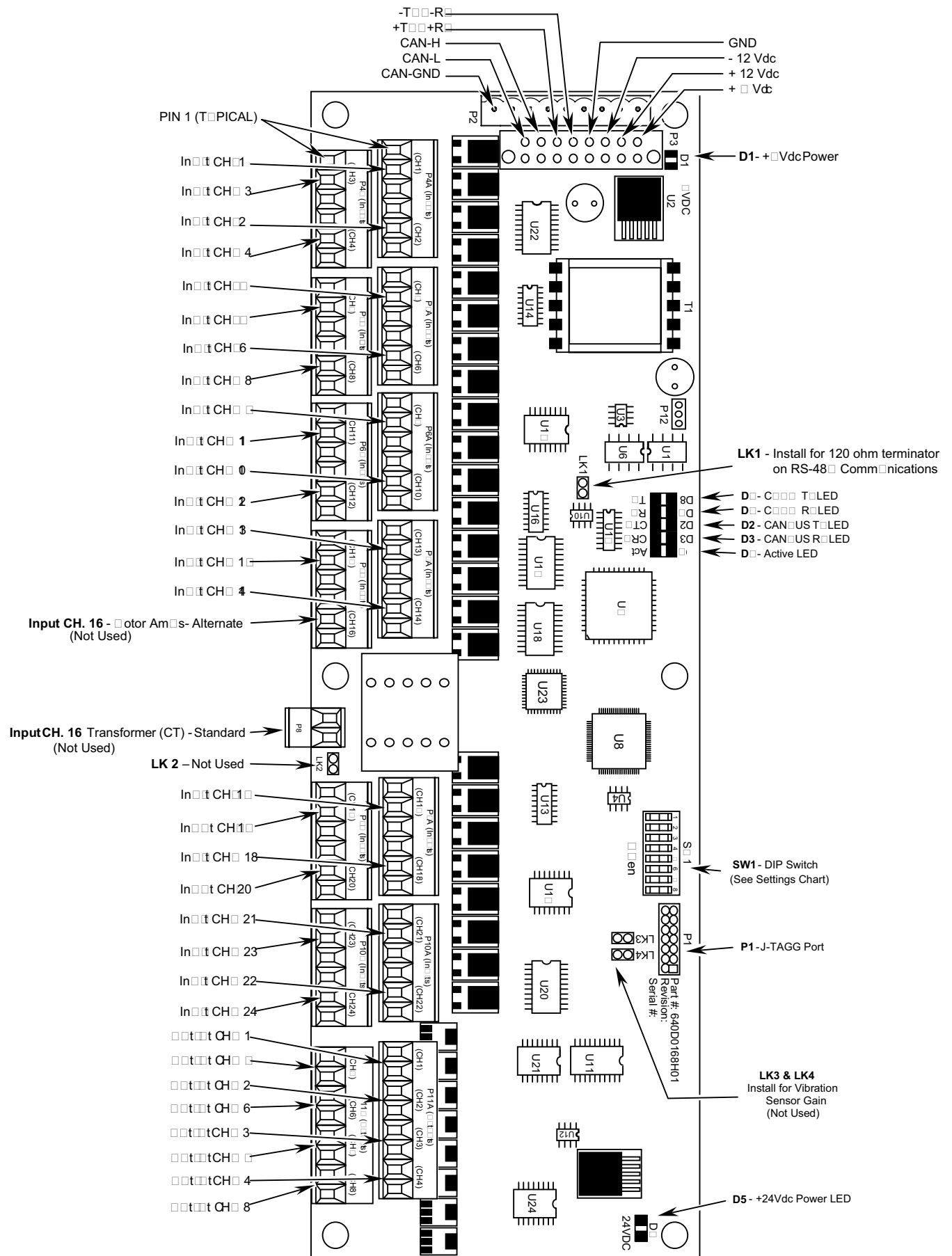


FIGURE 33 - ANALOG I/O EXPANSION BOARD 031-02472-000

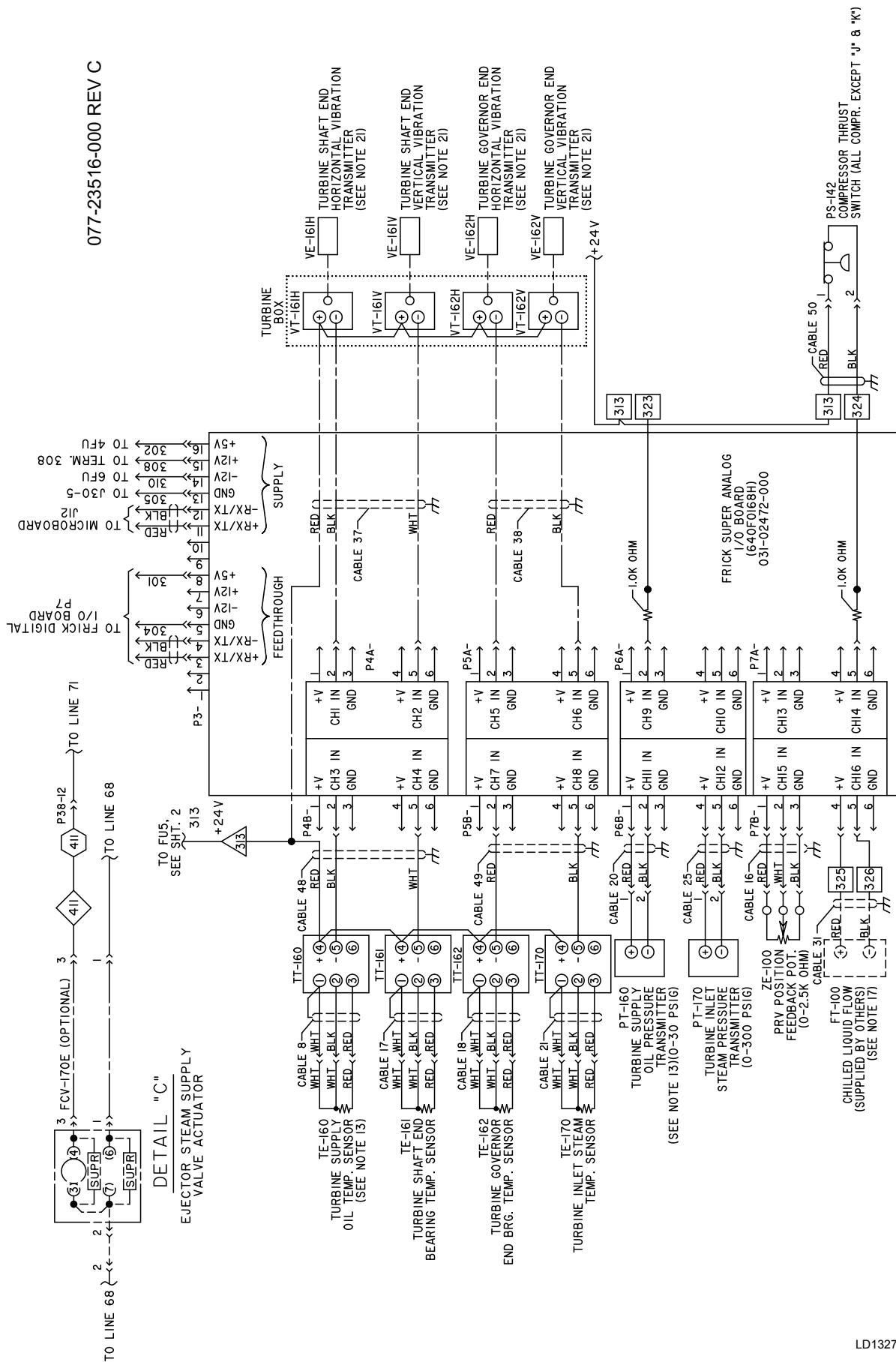


FIGURE 34 - ANALOG I/O EXPANSION BOARD INTERFACE

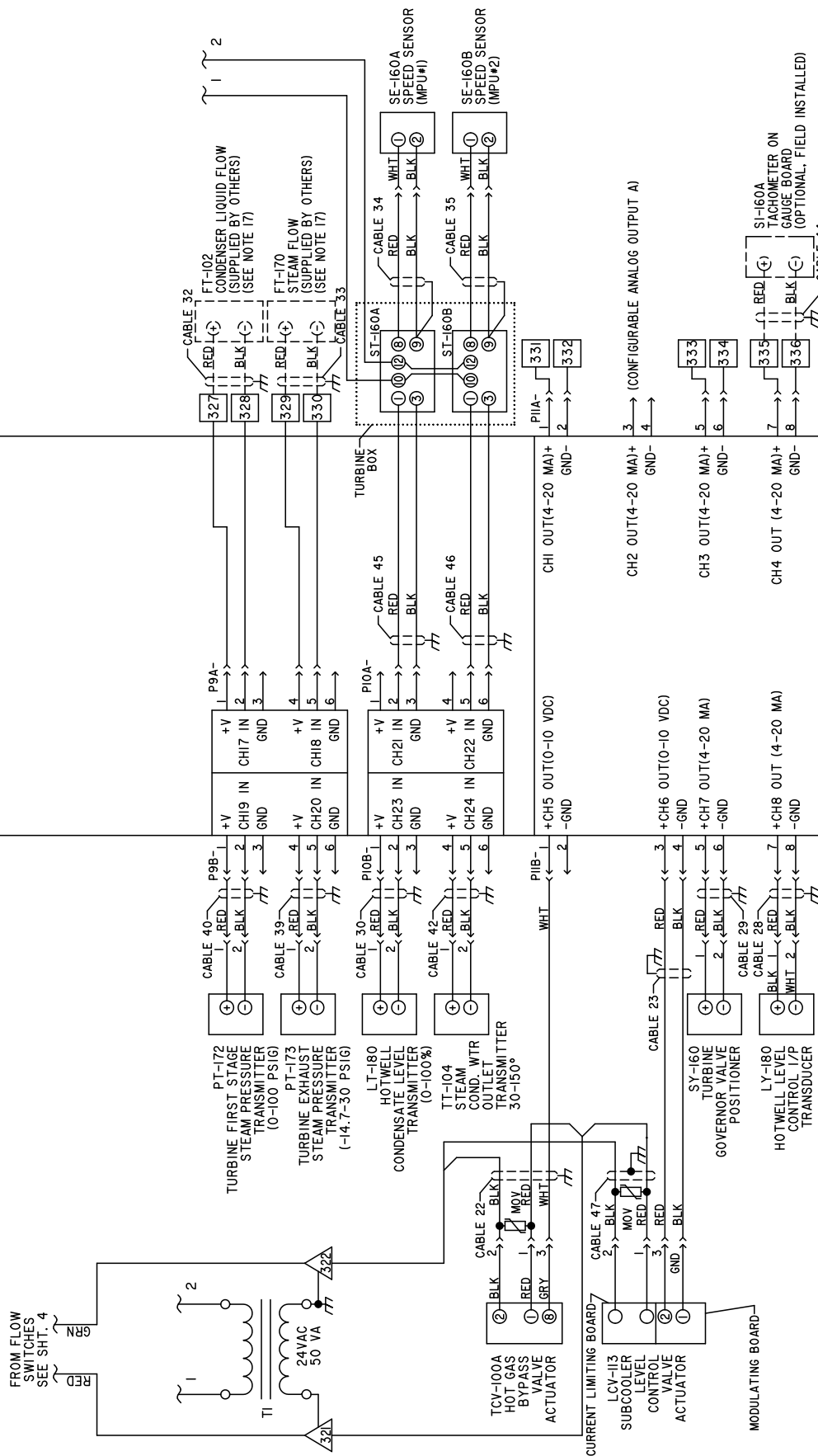
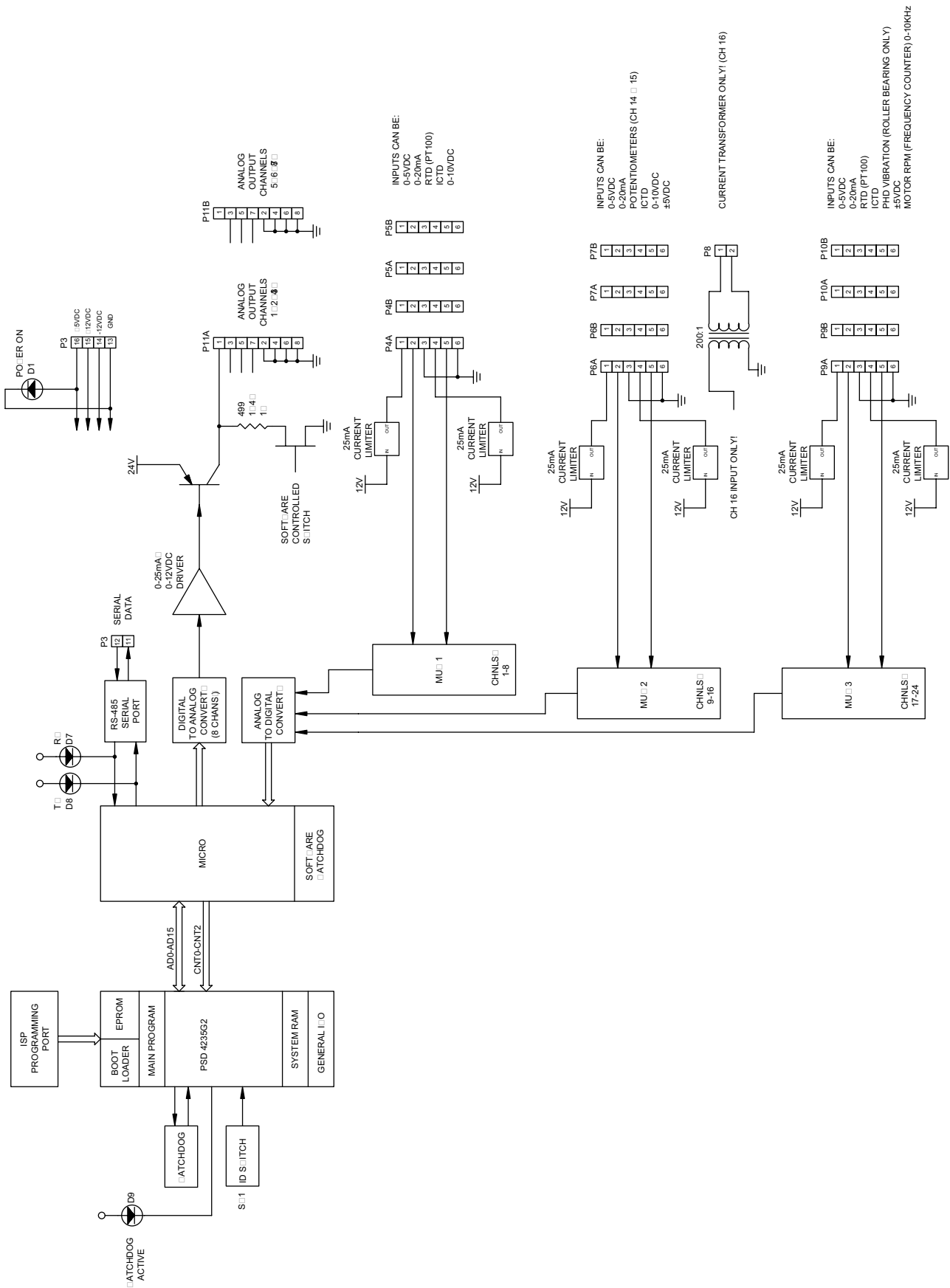


FIGURE 34 – ANALOG I/O EXPANSION BOARD INTERFACE (CONT'D)



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FIGURE 35 - ANALOG I/O EXPANSION BOARD – BLOCK DIAGRAM

JUMPER AND DIPSWITCH SETTINGS

LK1	In	120 Ohm long communications line termination.
	Out*	No termination.

* default setting

Current Transformer (CT) - Not Used

LK2	In	Install for CT (Current Transformer)
	Out*	Remove to read Motor Amps.

* default setting

Vibration - Not Used

LK3	LK4	Gain Ratio
Out *	Out *	1:1
Out	In	11:1
In	Out	21:1
In	In	31:1

* default setting

Dipswitch SW1 Settings (Used to set the board address)

SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
Off	Off	Off	Off	Off	Off	Off	Off

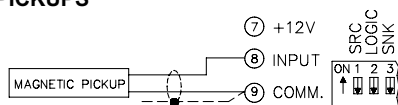
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SECTION 11 - TURBINE INSTRUMENTATION

FREQUENCY TO ANALOG CONVERTERS

The Turbine Speed Analog Input signals are provided by two magnetic pickups, Dynalco Model M139, YORK part number 025-39543-000, that will be referred to as MPUs in this section. The MPUs are installed on the shaft extension end of the turbine so that their pole pieces sense the surface speed of a 60-tooth gear. An air gap of approximately 0.040 inch is provided the required clearance for the maximum expected shaft vibration to prevent damage to the pole piece. The AC voltage output of the MPU is proportional to the rate of change of the magnetic flux through the pole piece, and therefore, in proportion to the speed of the ferrous mass (the top of each gear tooth) that causes the flux to build up and collapse. Essentially, the faster the surface speed of the gear, the higher the pickup voltage output will be. Each MPU is connected to a programmable **Frequency To Analog Converter** located in the turbine box mounted adjacent to the control center as shown below.

MAGNETIC PICKUPS



RECOMMENDED RULES FOR MAGNETIC PICKUP CONNECTIONS

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1. Connect the shield to the common Terminal “9” at the input of the IFMA. DO NOT connect the shield at the pickup end. Leave the shield “open” at the pickup and insulate the exposed shield to prevent electrical contact with the frame or case.

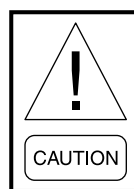
The output of each converter is a 4-20 mA DC current that is analogous to the frequency of AC voltage applied to the device. Since there are 60 teeth on the gear, the RPM will equal the actual frequency input to the converter. Each output is applied to an individual input on the Analog I/O Expansion Board in the OptiView Control Center. The current signal is converted to “counts” by the Analog-to-Digital (A/D) Converter for the input and read by the Microboard via the COM3 Serial Data Port. The program does the input scaling by interpreting the minimum counts as the lower end of the transmitter range and the maximum counts as the upper end of the transmitter range.

The converter, YORK part number 025-38775-000, is programmed at the factory to provide a 4-20 mA DC output with a 0-5000 Hz input frequency range. For example, a theoretical count of 819 would be seen at 4 mA and the program would interpret this as 0 RPM. A theoretical count of 4095 would be seen at 20 mA and the program would interpret this as 5000 RPM.

A PID algorithm does the actual speed control. The PID uses the higher of the two speed input signals to calculate the output to the governor valve I/P transducer. This is done to allow the turbine to continue to operate in the event one of the MPUs or converters fails. If the unlikely event that the failure results in a high input signal, the PID output will decrease and the chiller will be shutdown by the under-speed safety logic.

Normally, this device should not need to be reprogrammed in the field. However, in the event that field calibration is required, *the instructions are included in SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES of this manual.*

In the event that an MPU fails, install a new Dynalco Model M163, YORK part number 025-39543-000 in the housing. This MPU has 3/4-20 threads and is slightly larger than the MPU used for the speed switch (that has 5/8-18 threads) and is installed in the same housing. Set the pickup gap at 0.030 to 0.040 inch by turning the pickup all the way in to contact the gear and then backing out approximately 2/3 to 3/4 turn.



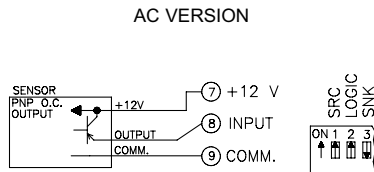
Rotate the turbine shaft until the top of a tooth is in the center of the MPU mounting hole to ensure that the gap is measured from the highest point of the gear. Failure to do this may result in damage to the MPU.

SPEED SWITCH

To provide protection for the turbine and compressor bearings in the event that steam is introduced into the turbine without a start command, a speed switch is provided in the turbine box mounted adjacent to the control center. The turbine rotation is sensed by a magnetic pickup, Dynapar Model 53Z, YORK part number 025-35232-000, which will be referred to as the MPU in this section. The MPU is installed so that its pole piece senses the surface speed of a 60-tooth gear. An air gap of approximately 0.040 inch is provided the required clearance for the maximum expected

shaft vibration to prevent damage to the pole piece. This MPU is different than the two Dynalco MPUs used for the analog speed signals in that it provides a squarewave digital output signal that is generated by the presence or absence of a ferrous metal target (the top of each gear tooth) in front of its sensing face. It provides constant amplitude pulses down to zero speed. The MPU is connected to a programmable **Speed switch** as shown below.

SENSORS WITH CURRENT SOURCE OUTPUT (PNP O.C.)



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The status of the output relay in the speed switch is indicated by the relay LED (red). Whenever the relay is in the Trip state, the LED is ON. When power is applied to the switch, if less than 0.8 Hz is detected, the relay is energized (relay LED is ON), and its normally closed output will open (no 120 VAC power is applied to I/O Board TB3-71). If a speed of 1.0 Hz or greater is detected, the output relay is de-energized and its normally closed output will close (relay LED is OFF) applying 120 VAC power to I/O Board TB3-71. This will start the compressor oil pump and turbine auxiliary oil pump (if supplied) to provide lubrication to the bearings.

The speed switch, YORK part number 025-38776-000, is programmed at the factory to provide the correct operation

Normally, this device should not need to be reprogrammed in the field. However, in the event that field calibration is required, *the instructions are included in SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES of this manual.*

In the event that an MPU fails, install a new Dynapar Model M53Z, YORK part number 025-35232-000 pickups (025-35232-000) in the housing. This MPU has 5/8-18 threads and is slightly smaller than the other two MPUs used for the frequency to analog converters (which have 3/4-20 threads) that are installed in the same housing. Set the pickup gap at 0.030 to 0.040 inch by turning the pickup all the way in to contact the gear and then backing out approximately 1/2 to 3/4 turn. **EXTREMELY IMPORTANT! Be sure that the mark on the barrel of the pickup is parallel to the gear travel!**



Rotate the turbine shaft until the top of a tooth is in the center of the MPU mounting hole to ensure that the gap is measured from the highest point of the gear. Failure to do this may result in damage to the MPU.

PRESSURE TRANSMITTERS

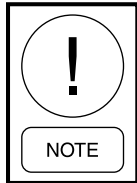
Turbine oil and steam pressures are sensed by **Pressure Transmitters**. Turbine supply oil, inlet steam, first stage steam, and exhaust steam pressures are sensed. There are different transmitters used to sense the various pressures. The required pressure range determines the actual transmitter used. The operation of the various transmitters is identical. The difference between them is simply the pressure range over which they operate. Each of the different transmitters has a different YORK part number. Table 3 lists the transmitters and the application of each one. The output of each transmitter is a 4-20 mA DC current that is analogous to the pressure applied to the device. Each output is applied to an individual input on the Analog I/O Expansion Board in the OptiView Control Center. The current signal is converted to "counts" by the Analog-to-Digital (A/D) Converter for the input and read by the Microboard via the COM3 Serial Data Port. The program does the input scaling by interpreting the minimum counts as the lower end of the transmitter range and the maximum counts as the upper end of the transmitter range.

For example, for the oil pressure input, a theoretical count of 819 would be seen at 4 mA and the program would interpret this as 0 PSIG. A theoretical count of 4095 would be seen at 20 mA and the program would interpret this as 30 PSIG.

The exhaust steam pressure transmitter has a compound range that will measure full vacuum (-14.7 PSIG) to 30 PSIG. This is interpreted as 0-45 PSIA by the program. A theoretical count of 819 would be seen at 4 mA and the program would interpret this as 0 PSIA. A theoretical count of 1911 would be seen at 9.3 mA and the program would interpret this as 15 PSIA. A theoretical count of 4095 would be seen at 20 mA and the program would interpret this as 45 PSIA.

The transmitters operate from a 26 mA current source supplied from the Analog I/O Expansion Board. Each transmitter is connected to the I/O Board with two wires. One wire provides the 26 mA loop current and the remaining wire connects the transmitter output to the I/O Board. The current output of each transmitter

can be measured with a digital multimeter connected in series between the transmitter output wire and the input terminal. For example, the output of the oil pressure transmitter would be read by disconnecting the black wire of Cable #20 from P6B-2 of the Analog I/O Expansion Board and connecting it to the red (+) lead of the meter. Connect the black lead of the meter to the P6B-2 terminal of the I/O Board. Manually start the turbine auxiliary oil pump and note the current and the pressure displayed on the supply oil pressure gauge on the turbine.



The chiller will be shutdown if the turbine supply oil pressure transmitter is disconnected while operating.

The current should match the output calculated using the following formula:

$$\text{Output mA} = [(P - \text{LRL}) / (\text{URL} - \text{LRL}) \times 16] + 4$$

Where: P = Pressure (on device process port)

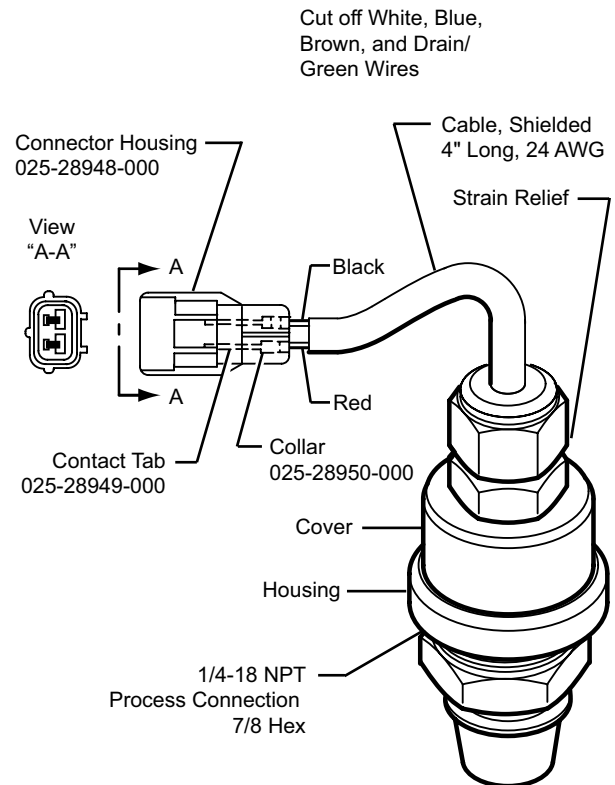
LRL = Lower Range Limit of Transmitter

URL = Upper Range Limit of Transmitter

For example, if the turbine oil pressure were 14 PSIG on the gauge in the oil piping near the transmitter, the expected output would be calculated as follows:

$$\text{Output mA} = [(14-0) / (30-0) \times 16] + 4 = 11.46 \text{ mA}$$

Since these pressure signals are used for control, warning and safety shutdowns, it is very important that the inputs are correct. If any of the displayed pressures do not appear correct (*refer to SECTION 26 - DIAGNOSTICS and TROUBLESHOOTING of this manual*).



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FIGURE 36 - PRESSURE TRANSMITTER

TABLE 3 - TURBINE PRESSURE TRANSMITTERS

MEASURED PRESSURE	CALIBRATED RANGE	YORK PART NO.
Turbine Exhaust Steam	-14.7 to 30 PSIG	025-38549-000
Turbine Supply Oil	0 to 30 PSIG	025-38550-000
Condensing Turbine First Stage Steam	0 to 100 PSIG	025-39542-000
Non-Condensing Turbine First Stage Steam	0 to 150 PSIG	025-39680-000
Turbine Inlet Steam	0 to 300 PSIG	025-38551-000

RESISTANCE TEMPERATURE SENSORS AND TRANSMITTERS

Turbine oil, bearing and steam temperatures are sensed by 100 Ohm platinum resistance temperature detectors which will be referred to as RTDs in this section. Each RTD is connected to a programmable RTD **Temperature Transmitter** located in the turbine box mounted adjacent to the control center. Turbine supply oil, shaft end bearing, governor end bearing and inlet steam temperatures are sensed. There are different transmitters used to sense the various temperatures. The required temperature range determines the actual transmitter used. The operation of the transmitters is identical. The difference between them is simply the temperature range over which they operate. There are two different transmitters and each has a different YORK part number. Table 4 lists the transmitters and the application of each one. The output of each transmitter is a 4-20 mA DC current that is analogous to the temperature applied to the RTD element. The transmitter interprets the resistance of the element as a specific temperature based on the RTD Temperature/Resistance Table below and scales the 4-20 mA DC output signal according to the programming of the device. Each output is applied to an individual input on the Analog I/O Expansion Board in the OptiView Control Center.

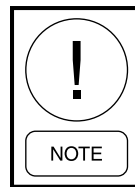
The current signal is converted to “counts” by the Analog-to-Digital (A/D) Converter for the input and read by the Microboard via the COM3 Serial Data Port. The program does the input scaling by interpreting the minimum counts as the lower end of the transmitter range and the maximum counts as the upper end of the transmitter range.

For example, for the oil temperature input, a theoretical count of 819 would be seen at 4 mA and the program would interpret this as 32 °F. A theoretical count of 4095 would be seen at 20 mA and the program would interpret this as 302 °F.

The inlet steam Temperature Transmitter has a greater range for the higher temperatures encountered. A theoretical count of 819 would be seen at 4 mA and the program would interpret this as 32 °F. A theoretical count of 4095 would be seen at 20 mA and the program would interpret this as 842 °F.

Since these transmitters require a minimum of 30 mA loop power, the +24 VDC transmitter power supply is taken directly from the control center power supply via

terminal TB7-313 as shown below. A single red wire in Cable 48 connects the +24 VDC power to one of the transmitters in the turbine box and is then daisy chained to the other 3 transmitters. Each transmitter is connected to the I/O Board with a single wire. The current output of each transmitter can be measured with a digital multimeter connected in series between the transmitter output wire and the input terminal. For example, the output of the oil Temperature Transmitter would be read by disconnecting the black wire of Cable #48 from P4B-2 of the Analog I/O Expansion Board and connecting it to the red (+) lead of the meter. Connect the black lead of the meter to the P4B-2 terminal of the I/O Board. Note the current and the temperature displayed on the supply oil thermometer on the turbine.



The chiller will be shutdown if the turbine supply oil Temperature Transmitter is disconnected while operating.

The current should match the output calculated using the following formula:

$$\text{Output mA} = [(T - \text{LRL}) / (\text{URL} - \text{LRL}) \times 16] + 4$$

Where: T = Temperature

LRL = Lower Range Limit of Transmitter

URL = Upper Range Limit of Transmitter

For example, if the turbine oil temperature were 100 °F on the thermometer located in the oil piping near the RTD, the expected output would be calculated as follows:

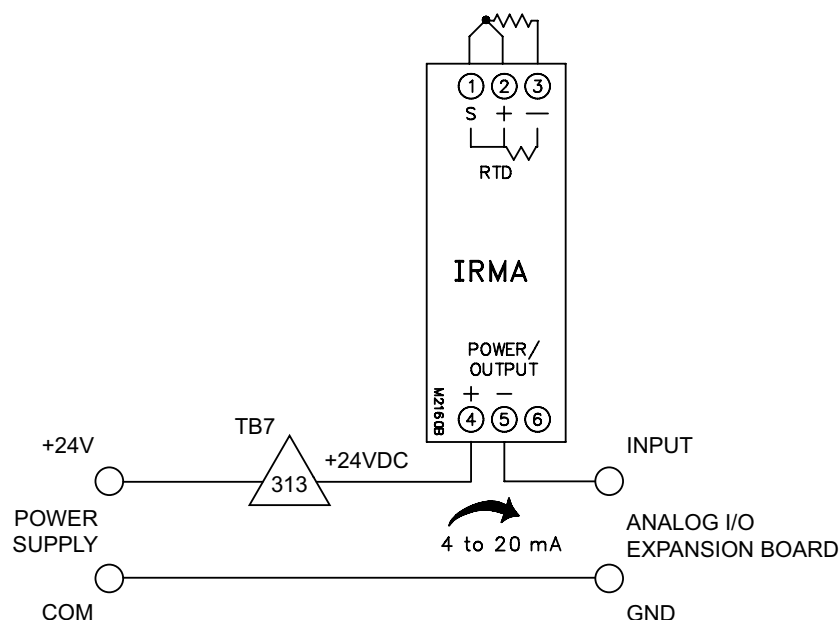
$$\text{Output mA} = [(100 - 32) / (302 - 32) \times 16] + 4 = 8.03 \text{ mA}$$

Since these temperature signals are used for control, warning and safety shutdowns, it is very important that the inputs are correct. A reading equal to the upper range limit of the transmitter is likely caused by an open RTD or wiring connection. If any of the displayed temperatures do not appear correct (*refer to SECTION 26 - DIAGNOSTICS and TROUBLESHOOTING, "Diagnostics and Troubleshooting" section of this manual*).

Normally, this device should not need to be reprogrammed in the field. However, in the event that field calibration is required, *the instructions are included in SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES of this manual.*

TABLE 4 - TURBINE TEMPERATURE TRANSMITTERS

MEASURED TEMPERATURE / SENSOR P/N	CALIBRATED RANGE	YORK PART NO. (TRANSMITTER)
Turbine Supply Oil / 025-36755-000	0 to 150 °C / 32 to 302 °F	025-39696-000
Turbine Shaft End Bearing / 025-38784-000	0 to 150 °C / 32 to 302 °F	025-39696-000
Turbine Governor End Bearing / 025-38784-000	0 to 150 °C / 32 to 302 °F	025-39696-000
Turbine Inlet Steam / 025-39545-000	0 to 450 °C / 32 to 842 °F	025-39696-001



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FIGURE 37 - TEMPERATURE TRANSMITTER WIRING CONNECTIONS

TABLE 5 - TEMPERATURE TRANSMITTER DIP SWITCH SETTINGS (FACTORY)

DESCRIPTION	SWITCH	P/N 025-39696-000	P/N 025-39696-001
OUTPUT CAL	Output Calibration	1	OFF
FIELD CAL	Field Calibration	2	OFF
BASIC CAL	Basic Calibration	3	OFF
385/392	Select RTD alpha - 0.00392 (ON) / 0.00385 (OFF)	4	OFF
OPEN SEN DN/UP	Open Sensor Detection - Upscale (ON) / Downscale (OFF)	5	ON
RTD/OHMS	Select Input Type - Ohms (ON) / RTD (OFF)	6	OFF
RANGE	Sensor Range - 2 switch Combination Setting	7	ON
		8	OFF

RTD TEMPERATURE VS. RESISTANCE IN OHMS (PT100 TCR=0.00385 $\Omega/\Omega/^{\circ}\text{C}$)

Temp (°F)	Temp (°C)	Ohms	Temp (°F)	Temp (°C)	Ohms	Temp (°F)	Temp (°C)	Ohms
			80.0	26.87	110.381	130.0	54.44	121.107
			81.0	27.22	110.598	131.0	55.00	121.321
32.0	0.00	100.000	82.0	27.78	110.812	132.0	55.56	121.535
33.0	0.56	100.217	83.0	28.33	111.027	133.0	56.11	121.748
34.0	1.11	100.434	84.0	28.89	111.242	134.0	56.67	121.962
35.0	1.67	100.651	85.0	29.44	111.458	135.0	57.22	122.176
36.0	2.22	100.868	88.0	30.00	111.673	136.0	57.78	122.389
37.0	2.78	101.083	87.0	30.58	111.888	137.0	58.33	122.602
38.0	3.33	101.302	88.0	31.11	112.103	138.0	58.89	122.815
39.0	3.89	101.519	89.0	31.67	112.318	139.0	59.44	123.029
40.0	4.44	101.736	90.0	32.22	112.533	140.0	60.00	123.242
41.0	5.00	101.953	91.0	32.78	112.748	141.0	60.56	123.455
42.0	5.56	102.169	92.0	33.33	112.964	142.0	61.11	123.668
43.0	6.11	102.386	93.0	33.89	113.178	143.0	61.67	123.882
44.0	6.67	102.603	94.0	34.44	113.393	144.0	62.22	124.095
45.0	7.22	102.820	95.0	35.00	113.608	145.0	62.78	124.308
46.0	7.78	103.036	96.0	35.56	113.823	146.0	63.33	124.521
47.0	8.33	103.253	97.0	36.11	114.038	147.0	63.89	124.734
48.0	8.89	103.469	98.0	36.67	114.253	148.0	64.44	124.947
49.0	9.44	103.686	99.0	37.22	114.468	149.0	65.00	125.160
50.0	10.00	103.903	100.0	37.78	114.682	150.0	65.56	125.373
51.0	10.56	104.119	101.0	38.33	114.897	151.0	66.11	125.586
52.0	11.11	104.335	102.0	38.89	115.112	152.0	66.67	125.799
53.0	11.67	104.552	103.0	39.44	115.326	153.0	67.22	126.011
54.0	12.22	104.768	104.0	40.00	115.541	154.0	67.78	126.224
55.0	12.78	104.985	105.0	40.56	115.755	155.0	68.33	126.437
56.0	13.33	104.985	106.0	41.11	115.970	156.0	68.89	126.650
57.0	13.89	105.201	107.0	41.67	116.184	157.0	69.44	126.862
58.0	14.44	105.417	108.0	42.22	116.399	158.0	70.00	127.075
59.0	15.00	105.833	109.0	42.78	116.613	159.0	70.56	127.288
60.0	15.58	105.849	110.0	43.33	116.828	160.0	71.11	127.500
61.0	16.11	106.252	111.0	43.89	117.042	161.0	71.67	127.713
62.0	16.67	106.498	112.0	44.44	117.258	162.0	72.22	127.925
63.0	17.22	106.714	113.0	45.00	117.470	163.0	72.78	128.138
64.0	17.78	106.930	114.0	45.56	117.685	164.0	73.33	128.350
65.0	18.33	107.148	115.0	46.11	117.899	165.0	73.89	128.563
66.0	18.89	107.362	116.0	46.67	118.113	166.0	74.44	128.775
67.0	19.44	107.578	117.0	47.22	118.327	167.0	75.00	128.987
68.0	20.00	107.794	118.0	47.78	118.541	168.0	75.56	129.200
69.0	20.58	108.009	119.0	48.33	118.755	169.0	76.11	129.412
70.0	21.11	108.225	120.0	48.89	118.969	170.0	76.67	129.624
71.0	21.67	108.441	121.0	49.44	119.183	171.0	77.22	129.836
72.0	22.22	108.657	122.0	50.00	119.397	172.0	77.78	130.049
73.0	22.78	108.872	123.0	50.56	119.611	173.0	78.33	130.261
74.0	23.33	109.088	124.0	51.11	119.825	174.0	78.89	130.473
75.0	23.88	109.304	125.0	51.67	120.039	175.0	79.44	130.685
76.0	24.44	109.519	126.0	52.22	120.253	176.0	80.00	130.897
77.0	25.00	109.735	127.0	52.78	120.466	177.0	80.56	131.109
78.0	25.56	109.950	128.0	53.33	120.680	178.0	81.11	131.321
79.0	26.11	110.166	129.0	53.89	120.894	179.0	81.67	131.533

RTD TEMPERATURE VS. RESISTANCE IN OHMS (PT100 TCR=0.00385 $\Omega/\Omega/^{\circ}\text{C}$) (CONT'D)

Temp ($^{\circ}\text{F}$)	Temp ($^{\circ}\text{C}$)	Ohms	Temp ($^{\circ}\text{F}$)	Temp ($^{\circ}\text{C}$)	Ohms	Temp ($^{\circ}\text{F}$)	Temp ($^{\circ}\text{C}$)	Ohms
180.0	82.22	131.744	230.0	110.00	142.293	280.0	137.78	152.751
181.0	82.78	131.956	231.0	110.56	142.503	281.0	138.33	152.960
182.0	83.33	132.168	232.0	111.11	142.713	282.0	138.89	153.168
183.0	83.89	132.380	233.0	111.67	142.923	283.0	139.44	153.376
184.0	84.44	132.592	234.0	112.22	143.133	284.0	140.00	153.584
185.0	85.00	132.803	235.0	112.78	143.342	285.0	140.56	153.792
186.0	85.56	133.015	236.0	113.33	143.552	286.0	141.11	154.001
187.0	86.11	133.227	237.0	113.89	143.762	287.0	141.67	154.209
188.0	86.67	133.438	238.0	114.44	143.972	288.0	142.22	154.417
189.0	87.22	133.650	239.0	115.00	144.182	289.0	142.78	154.625
190.0	87.78	133.861	240.0	115.56	144.391	290.0	143.33	154.833
191.0	88.33	134.073	241.0	116.11	144.601	291.0	143.89	155.040
192.0	88.89	134.284	242.0	116.67	144.811	292.0	144.44	155.248
193.0	89.44	134.496	243.0	117.22	145.020	293.0	145.00	155.456
194.0	90.00	134.707	244.0	117.78	145.230	294.0	145.56	155.664
195.0	90.56	134.918	245.0	118.33	145.440	295.0	146.11	155.872
196.0	91.11	135.130	246.0	118.89	145.649	296.0	146.67	156.079
197.0	91.67	135.341	247.0	119.44	145.859	297.0	147.22	156.287
198.0	92.22	135.552	248.0	120.00	146.068	298.0	147.78	156.495
199.0	92.78	135.763	249.0	120.56	146.277	299.0	148.33	156.702
200.0	93.33	135.974	250.0	121.11	146.487	300.0	148.89	156.910
201.0	93.89	136.186	251.0	121.67	146.695	301.0	149.44	157.118
202.0	94.44	136.397	252.0	122.22	146.905	302.0	150.00	157.325
203.0	95.00	136.608	253.0	122.78	147.115	303.0	150.56	157.533
204.0	95.56	136.819	254.0	123.33	147.324	304.0	151.11	157.740
205.0	96.11	137.030	255.0	123.89	147.533	305.0	151.67	157.947
206.0	96.67	137.241	256.0	124.44	147.742	306.0	152.22	158.155
207.0	97.22	137.451	257.0	125.00	147.951	307.0	152.78	158.362
208.0	97.78	137.662	258.0	125.56	148.160	308.0	153.33	158.570
209.0	98.33	137.873	259.0	126.11	148.370	309.0	153.89	158.777
210.0	98.89	138.084	260.0	126.67	148.579	310.0	154.44	158.984
211.0	99.44	138.295	261.0	127.22	148.788	311.0	155.00	159.191
212.0	100.00	138.506	262.0	127.78	148.996	312.0	155.56	159.398
213.0	100.56	138.716	263.0	128.33	149.205	313.0	156.11	159.605
214.0	101.11	138.927	264.0	128.89	149.414	314.0	156.67	159.813
215.0	101.67	139.137	265.0	129.44	149.623	315.0	157.22	160.020
216.0	102.22	139.348	266.0	130.00	149.832	316.0	157.78	160.227
217.0	102.78	139.559	267.0	130.56	150.041	317.0	158.33	160.434
218.0	103.33	139.769	268.0	131.11	150.249	318.0	158.89	160.641
219.0	103.89	139.980	269.0	131.67	150.458	319.0	159.44	160.848
220.0	104.44	140.190	270.0	132.22	150.667	320.0	160.00	161.054
221.0	105.00	140.400	271.0	132.78	150.875	321.0	160.56	161.261
222.0	105.56	140.611	272.0	133.33	151.084	322.0	161.11	161.468
223.0	106.11	140.821	273.0	133.89	151.293	323.0	161.67	161.675
224.0	106.67	141.031	274.0	134.44	151.501	324.0	162.22	161.882
225.0	107.22	141.242	275.0	135.00	151.710	325.0	162.78	162.088
226.0	107.78	141.452	276.0	135.56	151.918	326.0	163.33	162.295
227.0	108.33	141.662	277.0	136.11	152.126	327.0	163.89	162.502
228.0	108.89	141.872	278.0	136.67	152.335	328.0	164.44	162.708
229.0	109.44	142.082	279.0	137.22	152.543	329.0	165.00	162.915

RTD TEMPERATURE VS. RESISTANCE IN OHMS (PT100 TCR=0.00385 $\Omega/\Omega/^{\circ}\text{C}$) (CONT'D)

Temp (°F)	Temp (°C)	Ohms	Temp (°F)	Temp (°C)	Ohms	Temp (°F)	Temp (°C)	Ohms
330.0	165.56	163.121	380.0	193.33	173.402	430.0	221.11	183.593
331.0	166.11	163.328	381.0	193.89	173.607	431.0	221.67	183.796
332.0	166.67	163.534	382.0	194.44	173.811	432.0	222.22	183.999
333.0	167.22	163.741	383.0	195.00	174.018	433.0	222.78	184.202
334.0	167.78	163.947	384.0	195.56	174.221	434.0	223.33	184.405
335.0	168.33	184.153	385.0	196.11	174.425	435.0	223.89	184.608
336.0	168.89	164.360	386.0	196.67	174.630	436.0	224.44	184.810
337.0	169.44	164.566	387.0	197.22	174.834	437.0	225.00	185.013
338.0	170.00	164.772	388.0	197.78	175.039	438.0	225.56	185.216
339.0	170.56	164.978	389.0	198.33	175.243	439.0	226.11	185.418
340.0	171.11	165.184	390.0	198.89	175.447	440.0	226.67	185.621
341.0	171.67	165.391	391.0	199.44	175.652	441.0	227.22	185.824
342.0	172.22	165.597	392.0	200.00	175.856	442.0	227.78	186.026
343.0	172.78	165.803	393.0	200.56	176.060	443.0	228.33	186.229
344.0	173.33	166.009	394.0	201.11	176.265	444.0	228.89	186.431
345.0	173.89	186.251	395.0	201.67	176.469	445.0	229.44	186.634
346.0	174.44	166.421	396.0	202.22	176.673	446.0	230.00	186.838
347.0	175.00	166.627	397.0	202.78	176.877	447.0	230.56	187.038
348.0	175.56	166.833	398.0	203.33	177.081	448.0	231.11	187.241
349.0	176.11	167.038	399.0	203.89	177.285	449.0	231.67	187.443
350.0	176.67	167.244	400.0	204.44	177.489	450.0	232.22	187.645
351.0	177.22	167.450	401.0	205.00	177.693	451.0	232.78	187.847
352.0	177.78	167.656	402.0	205.56	177.897	452.0	233.33	188.050
353.0	178.33	167.861	403.0	206.11	178.101	453.0	233.89	188.252
354.0	178.89	168.067	404.0	206.67	178.305	454.0	234.44	188.454
355.0	179.44	168.273	405.0	207.22	178.509	455.0	235.00	188.656
356.0	180.00	168.478	406.0	207.78	178.713	456.0	235.56	188.858
357.0	180.56	168.684	407.0	208.33	178.916	457.0	236.11	189.060
358.0	181.11	168.889	408.0	208.89	179.120	458.0	236.67	189.262
359.0	181.67	169.095	409.0	209.44	179.324	459.0	237.22	189.464
360.0	182.22	169.300	410.0	210.00	179.528	460.0	237.78	189.666
361.0	182.78	169.506	411.0	210.56	179.731	461.0	238.33	189.867
362.0	183.33	169.711	412.0	211.11	179.935	462.0	238.89	190.069
363.0	183.89	169.916	413.0	211.67	180.138	463.0	239.44	190.271
364.0	184.44	170.122	414.0	212.22	180.342	464.0	240.00	190.473
365.0	185.00	170.327	415.0	212.78	180.545	465.0	240.56	190.675
366.0	185.56	170.532	416.0	213.33	180.749	466.0	241.11	190.876
367.0	186.11	170.737	417.0	213.89	180.952	467.0	241.67	191.078
368.0	186.67	170.943	418.0	214.44	181.156	468.0	242.22	191.279
369.0	187.22	171.148	419.0	215.00	181.359	469.0	242.78	191.481
370.0	187.78	171.353	420.0	215.56	181.562	470.0	243.33	191.683
371.0	188.33	171.558	421.0	216.11	181.766	471.0	243.89	191.884
372.0	188.89	171.763	422.0	216.67	181.969	472.0	244.44	192.085
373.0	189.44	171.968	423.0	217.22	182.172	473.0	245.00	192.287
374.0	190.00	172.173	424.0	217.78	182.376	474.0	245.56	192.488
375.0	190.56	172.378	425.0	218.33	182.578	475.0	246.11	192.690
376.0	191.11	172.583	426.0	218.89	182.781	476.0	246.67	192.891
377.0	191.67	172.788	427.0	219.44	182.984	477.0	247.22	193.092
378.0	192.22	172.992	428.0	220.00	183.188	478.0	247.78	193.293
379.0	192.76	173.197	429.0	220.56	183.390	479.0	248.33	193.495

RTD TEMPERATURE VS. RESISTANCE IN OHMS (PT100 TCR=0.00385 $\Omega/\Omega/^{\circ}\text{C}$) (CONT'D)

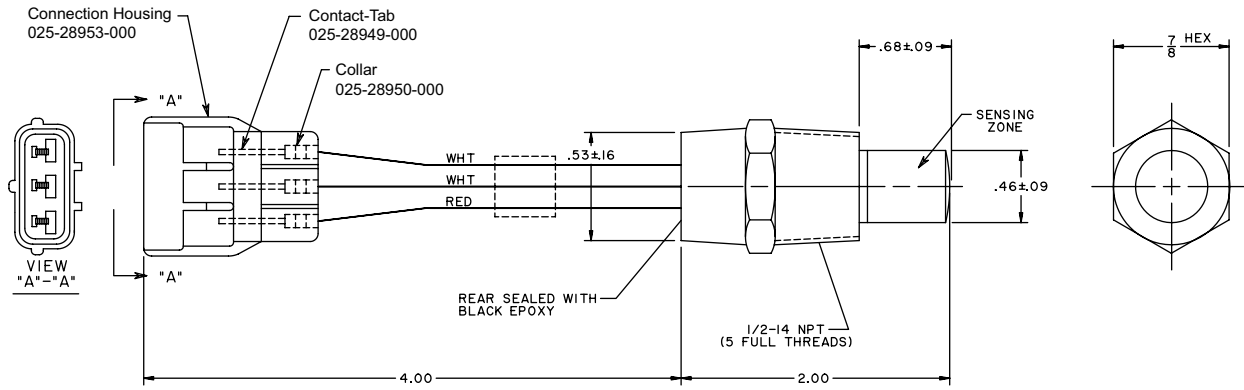
Temp (°F)	Temp (°C)	Ohms	Temp (°F)	Temp (°C)	Ohms	Temp (°F)	Temp (°C)	Ohms
480.0	248.89	193.696	530.0	276.67	230.709	580.0	304.44	213.633
481.0	249.44	193.897	531.0	277.22	203.909	581.0	305.00	213.831
482.0	250.00	194.098	532.0	277.78	204.108	582.0	305.56	214.028
483.0	250.56	194.299	533.0	278.33	204.307	583.0	306.11	214.226
484.0	251.11	194.500	534.0	278.89	204.508	584.0	306.67	214.423
485.0	251.67	194.701	535.0	279.44	204.705	585.0	307.22	214.621
486.0	252.22	194.902	536.0	280.00	204.905	586.0	307.78	214.818
487.0	252.78	195.103	537.0	280.56	205.104	587.0	308.33	215.016
488.0	253.33	195.304	538.0	281.11	205.303	588.0	308.89	215.213
489.0	253.89	195.505	539.0	281.67	205.502	589.0	309.44	215.410
490.0	254.44	195.706	540.0	282.22	205.701	590.0	310.00	215.608
491.0	255.00	195.906	541.0	282.78	205.900	591.0	310.56	215.805
492.0	255.56	196.107	542.0	283.33	206.099	592.0	311.11	216.002
493.0	256.11	196.308	543.0	283.89	206.298	593.0	311.67	216.199
494.0	256.67	196.509	544.0	284.44	206.497	594.0	312.22	216.396
495.0	257.22	196.709	545.0	285.00	206.696	595.0	312.78	216.593
496.0	257.78	196.910	546.0	285.56	206.895	596.0	313.33	216.790
497.0	258.33	197.110	547.0	286.11	207.093	597.0	313.89	216.987
498.0	258.89	197.311	548.0	286.67	207.292	598.0	314.44	217.184
499.0	259.44	197.511	549.0	287.22	207.491	599.0	315.00	217.381
500.0	280.00	197.712	550.0	287.78	207.690	600.0	315.58	217.578
501.0	260.56	197.912	551.0	288.33	207.888	601.0	316.11	217.775
502.0	261.11	198.113	552.0	288.89	208.087	602.0	316.67	217.972
503.0	261.67	198.3131	553.0	289.44	208.285	603.0	317.22	218.169
504.0	262.22	198.513	554.0	290.00	208.484	604.0	317.78	218.385
505.0	262.78	198.714	555.0	290.56	208.682	605.0	318.33	218.582
506.0	263.33	198.914	556.0	291.11	208.881	606.0	318.89	218.758
507.0	263.89	199.114	557.0	291.67	209.079	607.0	319.44	218.955
508.0	264.44	199.314	558.0	292.22	209.278	608.0	320.00	219.152
509.0	265.00	199.514	559.0	292.78	209.476	609.0	320.66	219.349
510.0	265.58	199.715	560.0	293.33	209.674	610.0	321.11	219.545
511.0	266.11	199.915	561.0	293.89	209.873	611.0	321.67	219.724
512.0	266.87	200.115	562.0	294.44	210.071	612.0	322.22	219.938
513.0	267.2	200.315	563.0	296.00	210.269	613.0	322.78	220.135
514.0	267.78	200.515	564.0	296.56	210.467	614.0	323.33	220.331
515.0	268.33	200.715	565.0	296.11	210.685	615.0	323.89	220.527
516.0	268.89	200.914	566.0	296.67	210.864	616.0	324.44	220.724
517.0	269.44	201.114	567.0	297.22	211.082	617.0	325.00	220.920
518.0	270.00	201.314	568.0	297.78	211.260	618.0	325.56	221.116
519.0	270.58	201.514	569.0	298.33	211.458	619.0	326.11	221.312
520.0	271.1	201.714	570.0	298.89	211.656	620.0	326.67	221.509
521.0	271.67	201.913	571.0	299.44	211.854	621.0	327.22	221.705
522.0	272.22	202.113	572.0	300.00	212.052	622.0	327.78	221.901
523.0	272.78	202.313	573.0	300.56	212.249	623.0	328.33	222.097
524.0	273.33	202.512	574.0	301.11	212.447	624.0	328.89	222.293
525.0	273.89	202.712	575.0	301.67	212.645	625.0	329.44	222.489
526.0	274.44	202.911	576.0	302.22	212.843	626.0	330.00	222.685
527.0	275.00	203.111	577.0	302.78	213.040	627.0	330.56	222.881
528.0	275.56	203.310	578.0	303.33	213.238	628.0	331.11	223.077
529.0	276.11	203.510	579.0	303.89	213.436	629.0	331.67	223.273

RTD TEMPERATURE VS. RESISTANCE IN OHMS (PT100 TCR=0.00385 $\Omega/\Omega/^{\circ}\text{C}$) (CONT'D)

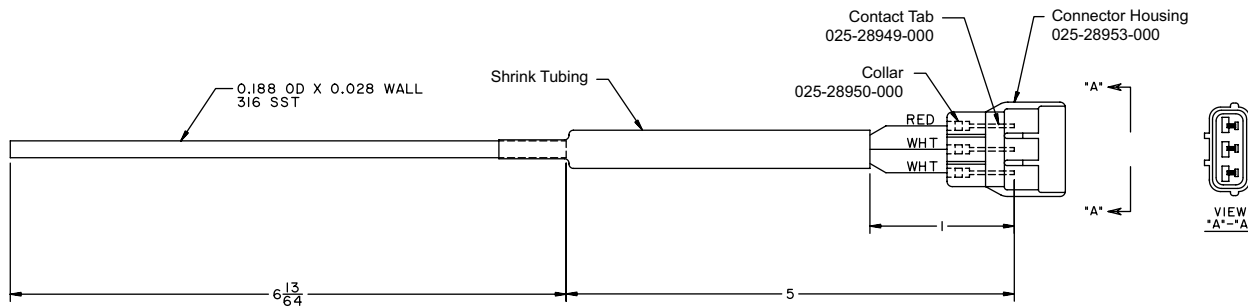
Temp (°F)	Temp (°C)	Ohms	Temp (°F)	Temp (°C)	Ohms	Temp (°F)	Temp (°C)	Ohms
630.0	332.22	223.468	680.0	360.00	233.214	730.0	387.78	242.871
631.0	332.78	223.864	681.0	360.58	233.406	731.0	388.33	243.063
632.0	333.33	223.860	682.0	361.11	233.602	732.0	388.89	243.258
633.0	333.89	224.058	683.0	361.67	233.796	733.0	389.44	243.448
634.0	334.44	224.251	684.0	382.22	233.990	734.0	390.00	243.640
635.0	335.00	224.447	685.0	362.78	234.184	735.0	390.56	243.832
636.0	335.56	224.643	686.0	383.33	234.378	736.0	391.11	244.024
637.0	336.11	224.838	687.0	363.89	234.572	737.0	391.67	244.216
638.0	336.67	225.034	688.0	364.44	234.765	738.0	392.22	244.408
639.0	337.22	225.229	689.0	385.00	234.959	739.0	392.78	244.600
640.0	337.78	225.425	690.0	365.58	235.153	740.0	393.33	244.792
641.0	338.33	225.620	691.0	366.11	235.347	741.0	393.89	244.984
642.0	338.89	225.816	692.0	366.67	235.540	742.0	394.44	245.176
643.0	339.44	228.011	693.0	367.22	235.734	743.0	395.00	245.357
644.0	340.00	226.206	694.0	367.78	235.927	744.0	395.56	245.559
645.0	340.56	226.402	695.0	368.33	236.121	745.0	396.11	245.751
646.0	341.11	226.597	696.0	368.89	236.314	746.0	396.67	245.943
647.0	341.67	226.792	697.0	369.44	236.508	747.0	397.22	246.134
648.0	342.22	226.987	698.0	370.00	236.701	748.0	397.78	246.326
649.0	342.78	227.182	699.0	370.556	236.894	749.0	398.33	246.517
650.0	343.33	227.376	700.0	371.11	237.088	750.0	398.89	246.708
651.0	343.89	227.573	701.0	371.67	237.281	751.0	399.44	246.901
652.0	344.44	227.768	702.0	372.22	237.474	752.0	400.00	247.092
653.0	345.00	227.963	703.0	372.78	237.868	753.0	400.58	247.283
654.0	345.56	226.158	704.0	373.33	237.861	754.0	401.11	247.475
655.0	346.11	228.353	705.0	373.89	238.054	755.0	401.67	247.686
656.0	346.67	228.547	706.0	374.44	238.247	756.0	402.22	247.858
657.0	347.22	228.742	707.0	375.00	238.440	757.0	402.78	248.049
658.0	347.78	228.937	708.0	375.56	238.633	758.0	403.33	248.240
659.0	348.33	229.132	709.0	376.11	238.826	759.0	403.89	248.431
660.0	348.89	229.327	710.0	376.67	239.019	760.0	404.44	246.623
661.0	349.44	229.521	711.0	377.22	239.212	761.0	405.00	248.814
662.0	350.00	229.716	712.0	377.78	239.405	762.0	405.56	249.005
663.0	350.56	229.911	713.0	378.33	239.598	763.0	406.11	249.196
664.0	351.11	230.105	714.0	378.89	239.791	764.0	406.67	249.387
665.0	351.67	230.300	715.0	379.44	239.984	765.0	407.22	249.578
666.0	352.22	230.496	716.0	380.00	240.176	766.0	407.78	249.769
667.0	352.78	230.689	717.0	380.56	240.369	767.0	408.33	248.960
668.0	353.33	230.884	718.0	381.11	240.662	768.0	408.89	250.151
669.0	353.89	231.078	719.0	381.87	240.754	769.0	409.44	250.342
670.0	354.44	231.272	720.0	382.22	240.947	770.0	410.00	250.533
671.0	355.00	231.467	721.0	382.78	241.140	771.0	410.58	250.723
672.0	355.56	231.661	722.0	383.33	241.332	772.0	411.11	250.914
673.0	356.11	231.855	723.0	383.89	241.526	773.0	411.67	251.105
674.0	356.67	232.050	724.0	384.44	241.717	774.0	412.22	251.296
675.0	357.22	232.244	725.0	385.00	241.910	775.0	412.78	251.486
676.0	357.78	232.438	726.0	385.56	242.102	776.0	413.33	251.677
677.0	358.33	232.632	727.0	386.11	242.294	777.0	413.89	251.867
678.0	358.89	232.826	728.0	386.67	242.487	778.0	414.44	252.058
679.0	359.44	233.020	729.0	387.22	242.679	779.0	415.00	252.248

RTD TEMPERATURE VS. RESISTANCE IN OHMS (PT100 TCR=0.00385 $\Omega/\Omega/^{\circ}\text{C}$) (CONT'D)

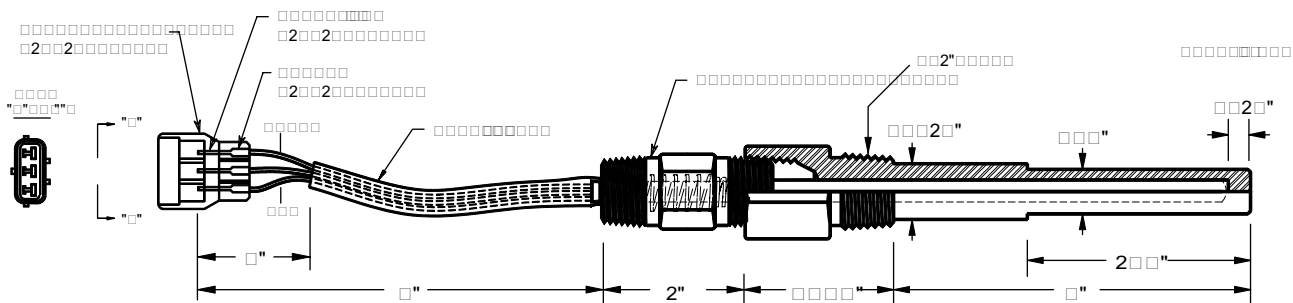
Temp ($^{\circ}\text{F}$)	Temp ($^{\circ}\text{C}$)	Ohms	Temp ($^{\circ}\text{F}$)	Temp ($^{\circ}\text{C}$)	Ohms
780.0	415.58	252.439	830.0	443.33	251.916
781.0	416.11	252.629	831.0	443.89	262.106
782.0	416.67	252.820	832.0	444.44	262.296
783.0	417.22	253.010	833.0	445.00	262.483
784.0	417.78	253.201	834.0	445.56	262.672
785.0	418.33	253.391	835.0	446.11	262.860
786.0	418.89	253.581	836.0	446.67	263.049
787.0	419.44	253.771	837.0	447.22	283.237
788.0	420.00	253.962	838.0	447.78	263.428
789.0	420.56	254.152	839.0	448.33	263.614
790.0	421.11	254.342	840.0	448.89	263.803
791.0	421.67	254.532	841.0	449.44	263.991
792.0	422.22	254.722	842.0	450.00	264.179
793.0	422.78	254.912			
794.0	423.33	255.102			
795.0	423.89	255.292			
796.0	424.44	255.482			
797.0	425.00	255.672			
798.0	425.56	255.861			
799.0	426.11	256.051			
800.0	426.67	256.241			
801.0	427.22	256.431			
802.0	427.78	256.620			
803.0	428.33	256.810			
804.0	428.89	257.000			
805.0	429.44	257.189			
806.0	430.00	257.379			
807.0	430.58	257.568			
808.0	431.11	257.758			
809.0	431.67	257.947			
810.0	432.22	258.137			
811.0	432.78	258.326			
812.0	433.33	258.518			
813.0	433.89	258.705			
814.0	434.44	258.894			
815.0	435.00	259.083			
816.0	435.56	259.273			
817.0	436.11	259.462			
818.0	436.67	259.651			
819.0	437.22	259.840			
820.0	437.78	260.029			
821.0	438.33	260.218			
822.0	438.89	260.407			
823.0	439.44	260.596			
824.0	440.00	260.785			
825.0	440.56	260.974			
826.0	441.11	281.163			
827.0	441.67	261.351			
828.0	442.22	261.540			
829.0	442.78	261.729			



LD09795

FIGURE 38 - TURBINE OIL TEMPERATURE SENSOR (025-36755-000)

LD09796

FIGURE 39 - TURBINE BEARING TEMPERATURE SENSOR (025-38784-000)

LD09797

FIGURE 40 - INLET STEAM TEMPERATURE SENSOR (025-39545-000)

SHAFT VIBRATION PROBES AND TRANSMITTERS

Chillers supplied with the optional Auto-Start equipment must be fitted with two Proximity Probes on each end of the turbine to protect the turbine from excessive shaft vibration. Turbine vibration probes can also be supplied as optional equipment on standard YST chillers that require manual start-up.

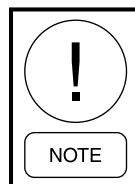
The “Horizontal” designation used on the wiring diagram refers to the Proximity Probe installed at approximately 45 degrees from the vertical center on the right side when facing the governor end of the turbine. The “Vertical” designation refers to the Proximity Probe installed at approximately 45 degrees from the vertical center on the left side when facing the governor end of the turbine. The probe has a linear range of 10-90 mils and provides a 200 mV/Mil signal to the transmitter analogous to the peak-to-peak movement of the turbine shaft. The probe is factory installed with a gap of 50 mils between the probe tip and the shaft. Each probe (YORK part number 025-38783-000) and connection cable has a 0.5 meter total length and is connected to a **Vibration Transmitter** (YORK part number 025-38782-000) located in the turbine box mounted adjacent to the control center with a 4.5 meter long extension cable (YORK part number 025-39453-000).

The output of each transmitter is a 4-20 mA DC current that is analogous to the peak-to-peak shaft movement sensed by the probe. Each output is applied to an individual input on the Analog I/O Expansion Board in the OptiView Control Center.

The current signal is converted to “counts” by the Analog-to-Digital (A/D) Converter for the input and read by the Microboard via the COM3 Serial Data Port. The program does the input scaling by interpreting the minimum counts as the lower end of the transmitter range and the maximum counts as the upper end of the transmitter range. The transmitter provides a 4-20 mA DC output with a 0-5 mils input range. For example, a theoretical count of 819 would be seen at 4 mA and the program would interpret this as 0 mils. A theoretical count of 4095 would be seen at 20 mA and the program would interpret this as 5.0 mils.

Since these transmitters require a minimum of 16-30 VDC loop power, the +24 VDC transmitter power supply is taken directly from the control center power supply via terminal TB7-313 as shown below. A single red wire in Cable 37 connects the +24 VDC power to one

of the transmitters in the turbine box and is then daisy chained to the other 3 transmitters. Each transmitter is connected to the I/O Board with a single wire. The current output of each transmitter can be measured with a digital multimeter connected in series between the transmitter output wire and the input terminal. For example, the output of the Turbine Shaft End Horizontal Vibration Transmitter would be read by disconnecting the black wire of Cable #37 from P4A-2 of the Analog I/O Expansion Board and connecting it to the red (+) lead of the meter. Connect the black lead of the meter to the P4A-2 terminal of the I/O Board.



The chiller will be shutdown if any of the Vibration Transmitters are disconnected while operating.

The current should match the output calculated using the following formula:

$$\text{Output mA} = [(M - \text{LRL}) / (\text{URL} - \text{LRL}) \times 16] + 4$$

Where: M = mils

LRL = Lower Range Limit of Transmitter

URL = Upper Range Limit of Transmitter

For example, if the turbine shaft end horizontal vibration were 2.0 mils, the expected output would be calculated as follows:

$$\text{Output mA} = [(2.0 - 0) / (5 - 0) \times 16] + 4 = 10.4 \text{ mA}$$

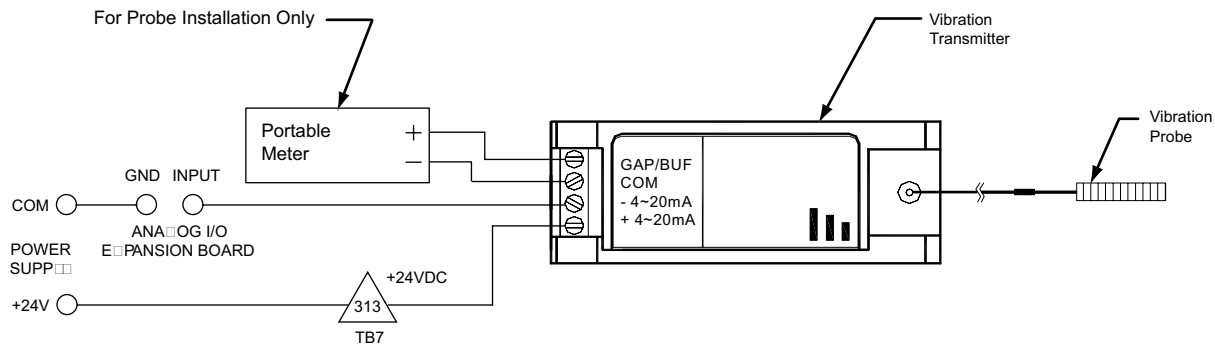
Since these vibration signals are used for warning and safety shutdowns, it is very important that the inputs are correct. If any of the displayed vibration levels do not appear correct, refer to the “Diagnostics and Troubleshooting” section of this manual.

PROBE REPLACEMENT

In the event that a vibration probe fails, install a new probe, YORK part number 025-38783-000 in the housing. Set the probe gap at 50 mils by turning the probe all the way in to contact the shaft and then backing out approximately 1 turn. Connect the probe to the extension cable. Connect the black lead of the voltmeter to the COM terminal of the transmitter and the red (+) lead of the voltmeter to the GAP terminal of the transmitter. Slowly turn the probe until the meter reads 10.0 VDC and then tighten both locknuts on the probe.

The OptiView software monitors the input signal from the transmitter to ensure that it is present while the chiller is operating. If the signal is more than 0.5 mA below the calibrated minimum input signal, the chiller

is shutdown. Therefore, after the probe cable is connected to the transmitter, it is important that the zero on the transmitter be adjusted if required to provide a 4.0 mA output to the panel prior to operating the chiller.

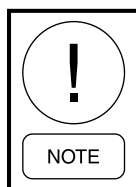


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FIGURE 41 - SHAFT VIBRATION PROBE AND TRANSMITTER WIRING

SECTION 12 - DIGITAL I/O EXPANSION BOARD 371-04182-000

(Refer to Figure 42 on page 103)



For complete wiring diagrams refer to Form 160.67-PW6.

The **Digital I/O Expansion Board** provides additional digital I/O capability for the Microboard. There are 24 ports that can accommodate signals in the form of AC or DC voltages of various levels. The function of each port is defined by the Johnson Controls factory. The board is populated with up to 24 plug-in modules of the appropriate type. The module type required in a location is determined by the port assigned function. The different functions are: AC input, AC output, DC input or DC output. Each module is field replaceable in the event of failure.

There are 2 different plug-in module types that are applied as follows: For ease of identity, each type is color-coded.

FUNCTION	VOLTAGE RANGE	TYPE	COLOR	YORK P/N
AC Input	90-140 VAC/ VDC	IACM-5	yellow	025-37817-000
AC Output	24-280 VAC	OACM-5	black	025-37818-000

The outputs are on/off type circuits that allow current to flow through an external load. The inputs sense current or the presence of an applied voltage.

This board operates from a +5VDC power source. "Power-on" LED D29 illuminates when the voltage is present.

This board communicates with the Microboard via an RS-485 serial data interface. As the command or request for data arrives on the I/O Board, RX D26 LED illuminates. As the serial data is transmitted back to the Microboard, TX D25 LED illuminates. On/off output commands are transmitted via serial data from the Microboard. The command is converted to an on/off signal for the output module. The inputs are sensed by the input module which outputs an on/off value to the Micro which converts it to serial data and transmits it back to the Microboard.

The program that coordinates the serial communications and I/O Board activity resides in the EPROM. A Watchdog Circuit assures the entire program is executed and that program latchups do not occur. Watchdog LED D28 blinks approximately 1x/second, indicating the Watchdog protection is active.

Since both the Analog I/O Expansion Board and Digital I/O Expansion Board use the same RS-485 serial communications link to the Microboard, each I/O Board must have an identification number. This number is set by ID Dipswitch DP1. The ID number is transmitted to the I/O Board along with the serial data. When the board recognizes the transmitted ID number as its own, it responds. The switch settings for the Digital I/O Expansion Board must be:

- DP1-1 - ON
- DP1-2 - ON
- DP1-3 - ON
- DP1-4 - ON
- DP1-5 - OFF
- DP1-6 - ON

The following jumpers configure the board for the RS-485 serial communications interface. The required positions are indicated by an *.

JUMPER	POSITION	FUNCTION
J5	IN	RX 120 Ohm termination
	OUT*	No termination
J7	IN	TX pullup
	OUT*	No pullup
J9	IN	RX pulldown
	OUT*	No pulldown

The plug-in I/O modules are installed in positions M1 through M24. With the module in place, a circuit is completed causing the applicable LED (D1 through D24) to illuminate. The modules are connected to connectors P1 through P6 in groups of four. M1 through M4 is connected to P1; M5 through M8 are connected to P2; etc. Within each grouping, pins 1, 2, 5 and

6 are connected to the input/output of each module. The common connection to each module is fused with fuses F1 through F24. For input modules, the common connection is Pin 4. For output modules, the common connection is Pin 3. Each fuse must be positioned to provide the correct ground connection to the respective module. The fuse is installed in the OUT position for output modules. It is installed in the IN position for input modules. These fuse positions are general guidelines. The following is the required position for each fuse.

FUSE	POSITION
F1 - F4	IN
F5	OUT
F6 - F8	IN
F9 - F20	OUT
F21	IN
F22 - F24	OUT

The on-board fuse tester can be used to test fuses. Insert the fuse into position below LED 27. LED D27 will illuminate if the fuse is OK.

AC OUTPUT MODULES

(Reference Figure 43 on page 104)

This module is in series with the output load. It is a solid-state AC switch that either allows current to flow through the load or inhibits current flow through the load. The output is turned on to allow current flow. It is turned off to inhibit current flow.

Vacuum Pump #2 Sealing Water Solenoid Valve is controlled from AC Output Module M5. Since all output modules operate the same, only M5 is explained as follows: The Energize Solenoid command is connected from P2-1 to the Solenoid Coil Pin 1. The 115 VAC source is connected to I/O Board common input P2-3 and the neutral is connected to the Solenoid Coil Pin 2. When the solenoid is commanded to energize, the solid-state switch is turned on allowing current to flow through the turned on Solid-State switch and out the I/O Board P2-1, through the solenoid Coil and out to the neutral.

AC INPUT MODULES

(Reference Figure 43 on page 104)

This module detects the presence and absence of an AC voltage applied to the module input. The state of the input is transmitted via serial data back to the Microboard.

Vacuum Pump #2 Sealing Water Low Flow switch is connected to AC Input module M6, P2-2. Since all input modules operate in the same way, only M6 will be explained as follows:

When the Flow switch is closed, it becomes an AC voltage input for M6. M6 senses the presence of 115 VAC on P2-2 and this closed state is transmitted via serial data to the Microboard.

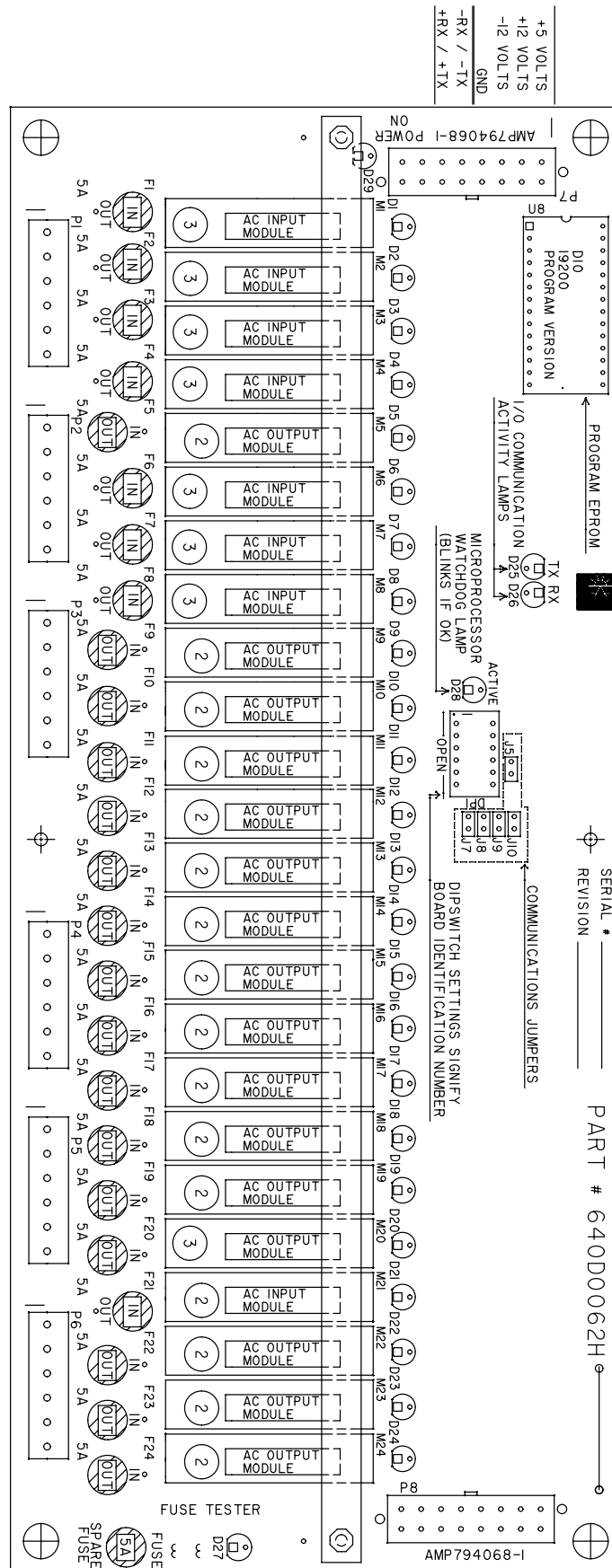
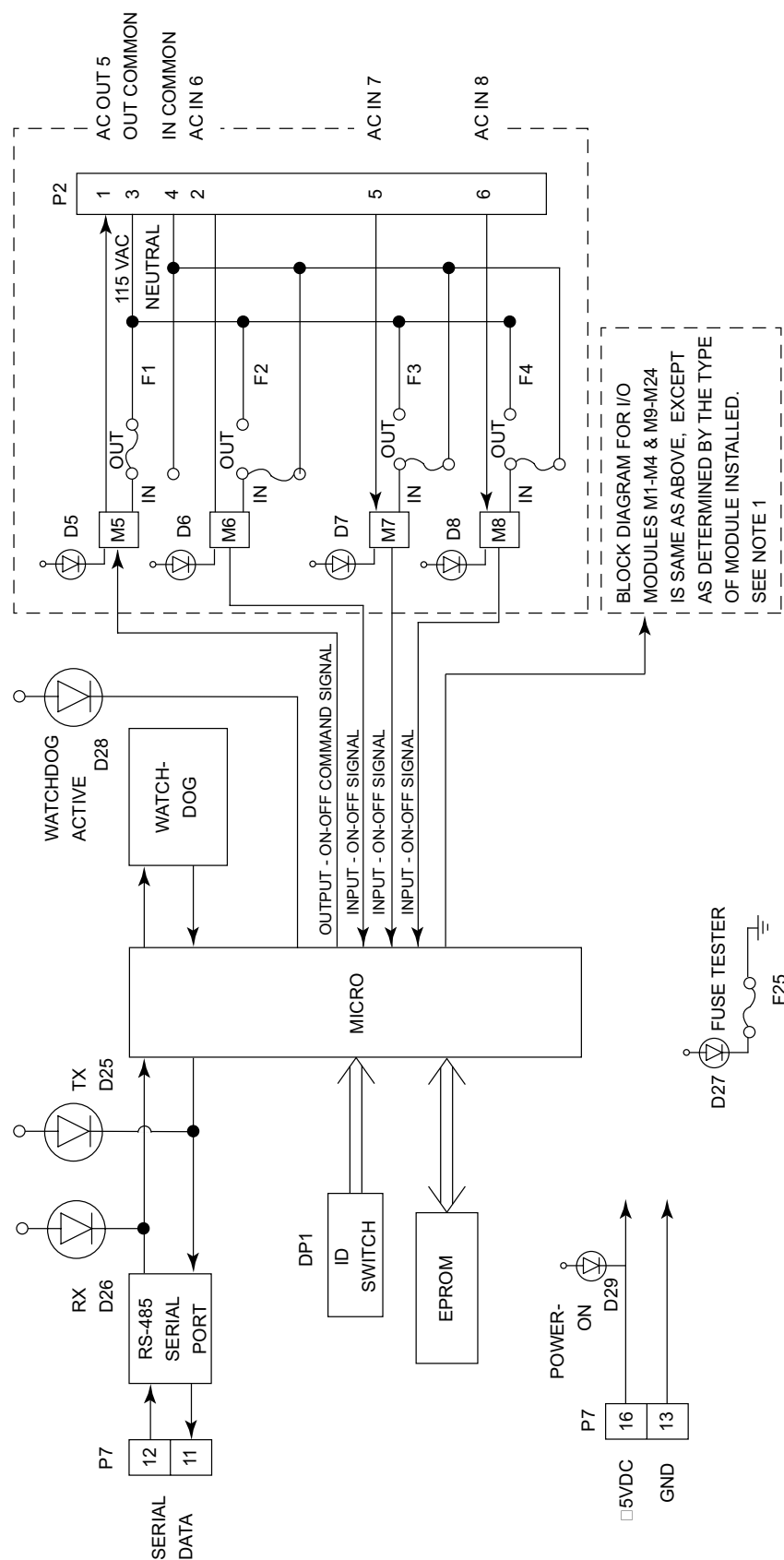


FIGURE 42 - DIGITAL I/O EXPANSION BOARD



NOTES:
1. F1 – F24 must be positioned according to whether Port is Input or Output.

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FIGURE 43 - DIGITAL I/O EXPANSION BOARD – BLOCK DIAGRAM

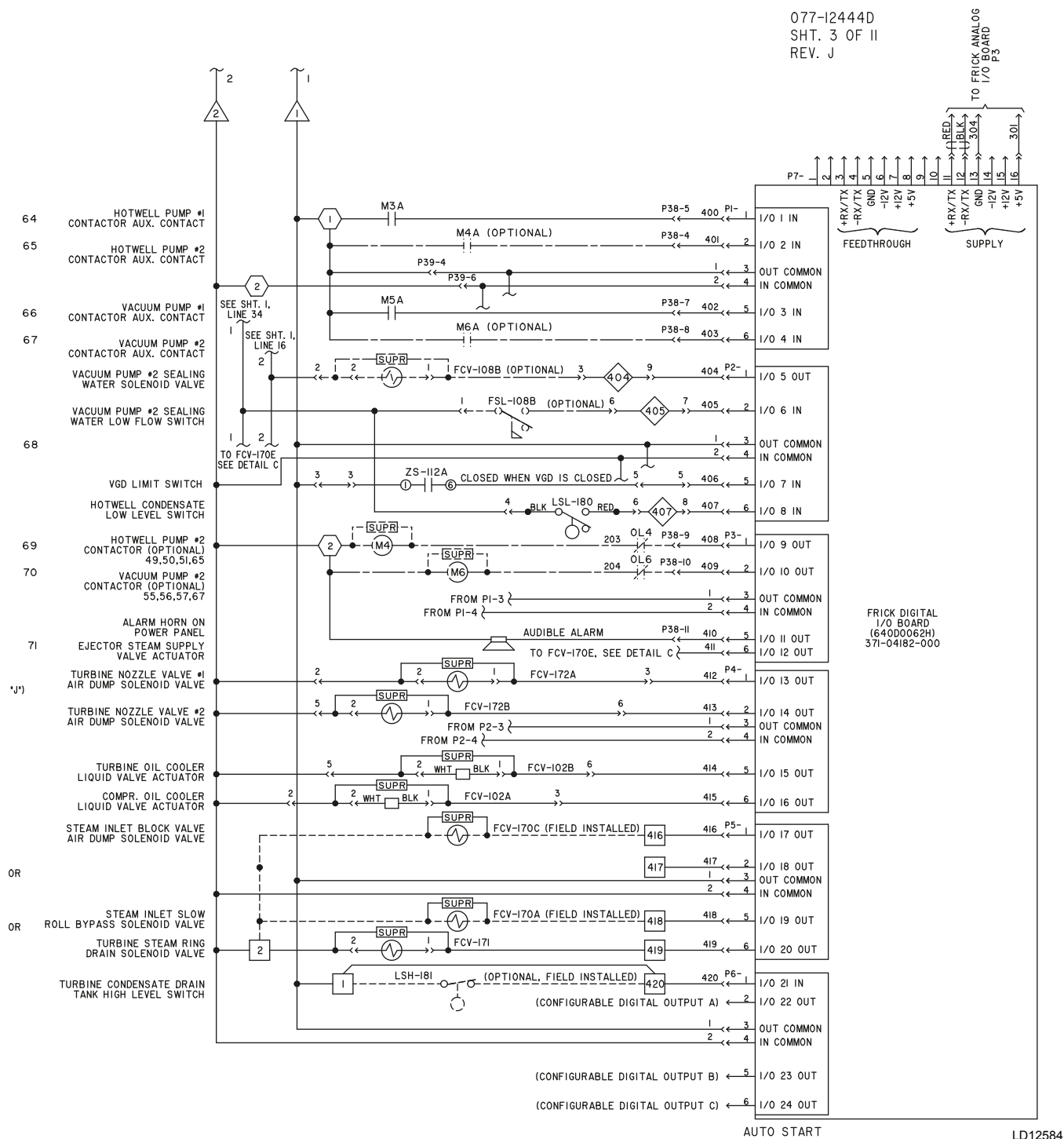
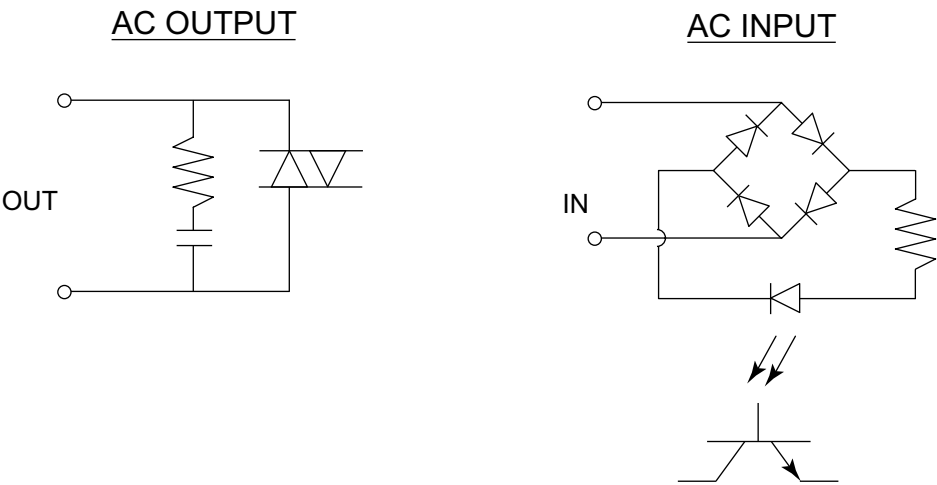


FIGURE 44 - DIGITAL I/O EXPANSION BOARD – INTERFACE

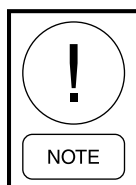


LD07918

FIGURE 45 - DIGITAL I/O EXPANSION BOARD PLUG-IN MODULES – TYPICAL CIRCUITS

SECTION 13 - COMPRESSOR PROXIMITY PROBE

(Refer to Figure 46 on page 109)



This section applies only to chillers supplied with “J” compressors. This probe must be selected on the Operations screen. Refer to Section 25.

The output of the proximity circuit is connected to the Microboard at J8-15 and is a 0 (0.089VDC) to +4.4VDC analog voltage corresponding to a measured distance of 10 to 99 mils. This is the **PROXIMITY POSITION** and is displayed as “High Speed Thrust Bearing Proximity Position = xx mils” on the Proximity Probe Calibration screen.

When the probe is installed at the time of chiller manufacture, a Reference Position is established. It is the distance between the tip of the probe and the surface of the High Speed Thrust Collar with a minimum of 25 PSID oil pressure. Any distance between 37 and 79 mils is acceptable. *It is established using a calibration procedure in the “System Calibration” section of this manual.* This value is entered at the keypad as the **REFERENCE POSITION** Setpoint using the Proximity Probe Calibration screen. Distances outside the range of 37 to 79 mils will be rejected. The value is logged on a label adhered to the inside of the OptiView Control Center door. This value remains the Reference Position until the compressor is rebuilt, whereupon the calibration procedure must be repeated to establish a new Reference Position. Since this Reference Position value is stored in the BRAM (U38) memory device on the Microboard, field replacement of either of these items requires the Reference Position Setpoint to be programmed again.

The difference between the Reference Position and the actual position is the **PROXIMITY DIFFERENTIAL** and is displayed as “High Speed Thrust Bearing Proximity Differential = xx mils” on the Compressor screen. For example, if the Reference Position is 50 mils and the actual position is 45 mils, then the differential is -5 mils; with the same reference, if the actual position is 55 mils, the differential is +5 mils.

If the differential increases to ≥ 10 mils (+10, +11, etc.) or decreases to ≥ 25 mils (-25, -26, etc.), a safety shutdown is performed and “COMPR THRUST BEARING - PROXIMITY PROBE CLEARANCE” is displayed.

The clearance is only checked during the last 20 seconds of “System Prelube”, during “System Run” and during “System Coastdown”. Therefore, the fault is only detected during those periods. The -25 threshold must be exceeded for 2 continuous seconds to initiate a shutdown. The +10 threshold must be exceeded for 2 continuous seconds to initiate a shutdown.

If the Reference Position is between 37 and 46 mils, the full -25 mil differential is not allowed; the maximum allowed distance between the tip of the probe and the surface of the Thrust Collar is 23 mils. Therefore, when the distance decreases to ≤ 22 mils, the safety shutdown is performed, regardless of the differential to the Reference Position.

If the distance decreases to ≤ -17 mils, a safety shutdown is performed and “COMPR THRUST BEARING - PROXIMITY PROBE OUT OF RANGE” is displayed.

When any of the above Thrust Bearing related safety shutdowns occur, the chiller cannot be restarted until a special reset procedure is performed by a Service Technician. Some of these shutdowns also require a Thrust Bearing inspection. The reset procedure and bearing inspection criteria is listed in the “System Calibration, Service Setpoints and Reset Procedures” section of this manual.

The Proximity Position output of the probe is measured at the Microboard at J8-15 and is calculated as follows:

$$V = \frac{D}{20.86} - 8.14$$

$$20.86$$

$$D = 20.86 \times V + 8.14$$

Where: V = VDC

D = distance in mils

The chiller is equipped with the Proximity Probe 025-35900-001.

The probe cannot accurately measure the gap distance if its +24VDC supply voltage to <19.0 VDC. To prevent an invalid proximity gap safety shutdown due to a Utility Power sag, the Microboard monitors the probe’s 24VDC power source at J9-12 on the Microboard. If it decreases to <19.0 VDC respectively, a cycling shut-

down is performed and “PROXIMITY PROBE - LOW SUPPLY VOLTAGE” is displayed. The chiller will automatically restart when the voltage increases above +19.7VDC.

TWO PIECE PROXIMITY PROBE

A new two-piece Proximity Probe is now available which provides separate parts for the probe and the electronics module. The two-piece probe is backward compatible on all YST chillers and is being factory installed on new chillers. The new probe is not compatible on compressors using a proximity switch.

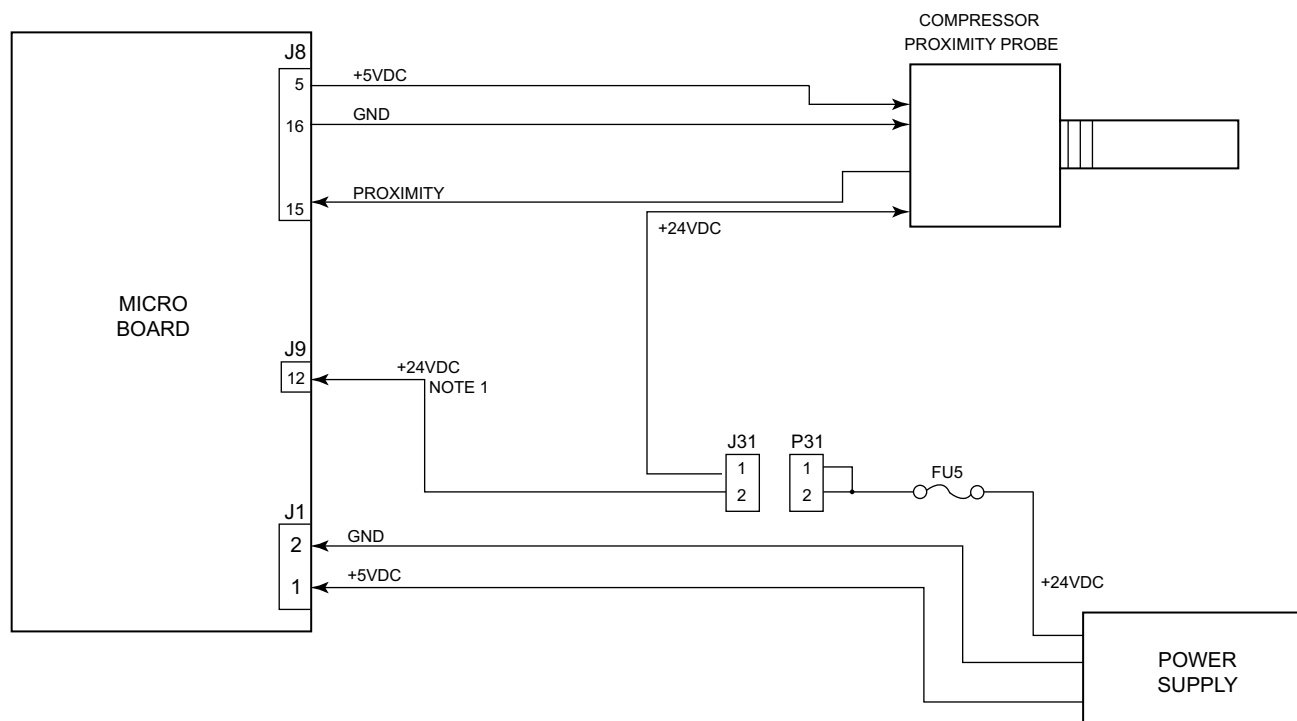
The new probe eliminates the need to evacuate the chiller refrigerant charge when replacing the electronics module portion of the Proximity Probe. The electronic module for the Proximity Probe will now be mounted into the turbine base.

The part number for the new probe is 025 40496 000. That part number includes the probe tip, electronic module, a PVC bushing and the connection cable from the probe tip to electronic module.

If retrofitting from a single piece probe, all items shown in Fig. 45A are needed. A 1-1/4" half coupling must be installed in the compressor support ring. On older chillers not utilizing a compressor support ring, a 1-1/4" half coupling and bracket must be fabricated and attached to the compressor to support the electronics module.

Installation

1. The electronic module to control panel cable should be replaced if an intermittent connection issue is suspected.
2. Installation torque values:
Probe to compressor: 20 in/lb - use 7/8" wrench
Electronic Module: 20 in/lb - use 2" wrench
Interconnecting Cable Ends: 2 in/lb - use no tools
3. When installing the interconnecting cable, plug the cable connector into the mating connector on each component. Rotate the cable connector hex nut only. Do not attempt to install the interconnecting cable by holding the cable and rotating the probe or electronic module.

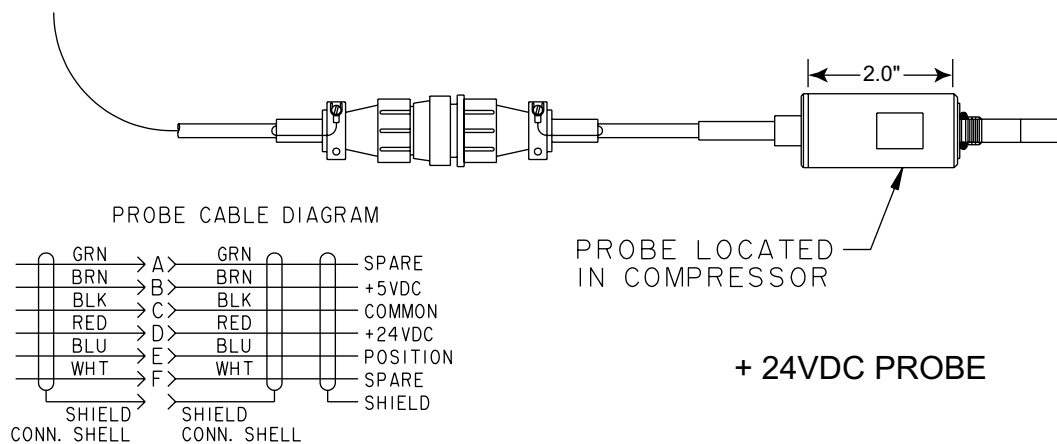


NOTES:

1. +24VDC reference for "Proximity Probe - Low Supply Voltage" Cycling Shutdown.

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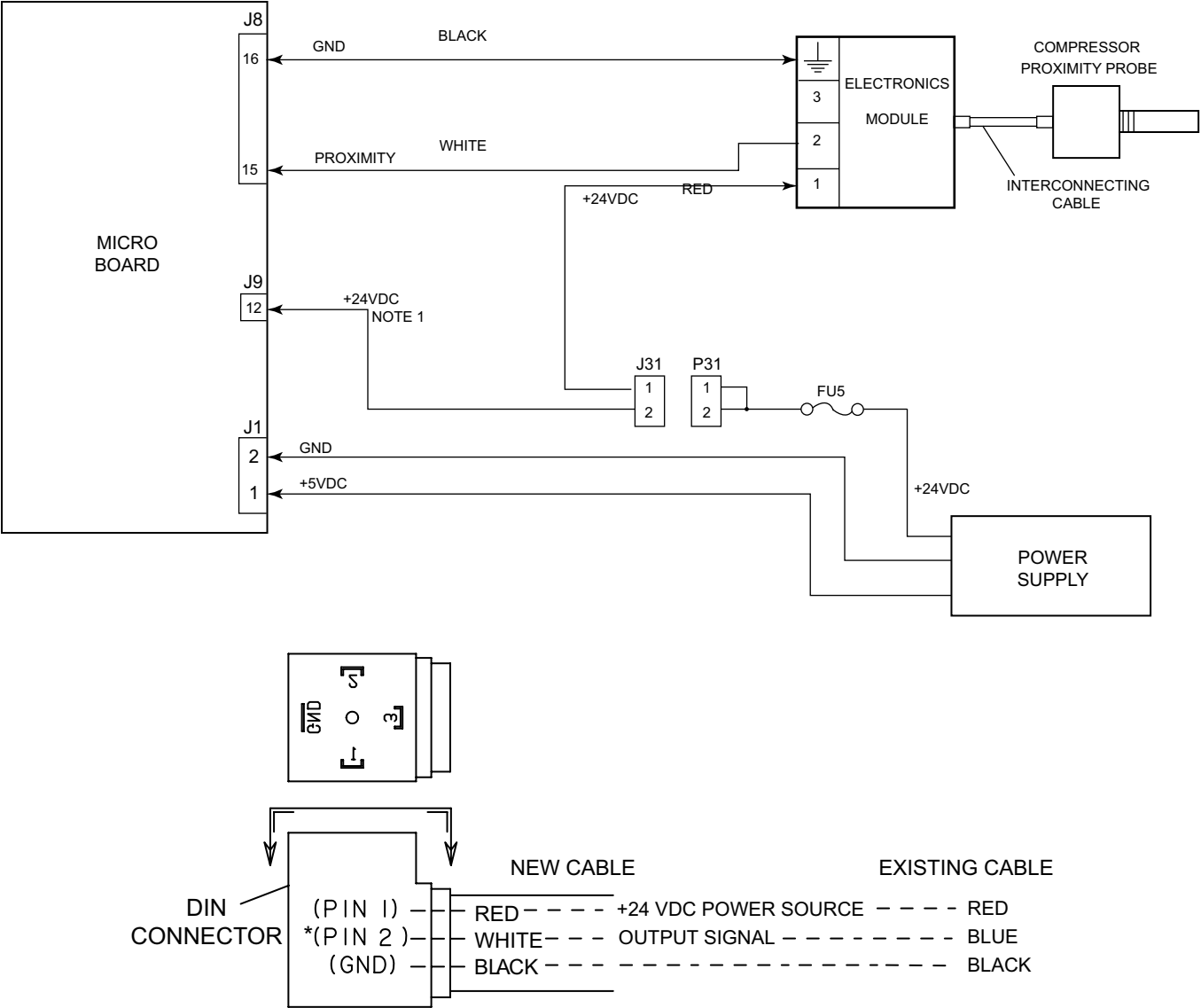
FIGURE 46 - COMPRESSOR PROXIMITY PROBE INTERFACE – PROBE PART NUMBER 025-35900-001



YORK PART NUMBER 025-35900-001

LD05529a

FIGURE 47 - COMPRESSOR PROXIMITY PROBE – PART NUMBER 025-35900-001



LD12579

FIGURE 48 - PROXIMITY PROBE INTERFACE – PROBE PART NUMBER 025-40496-000

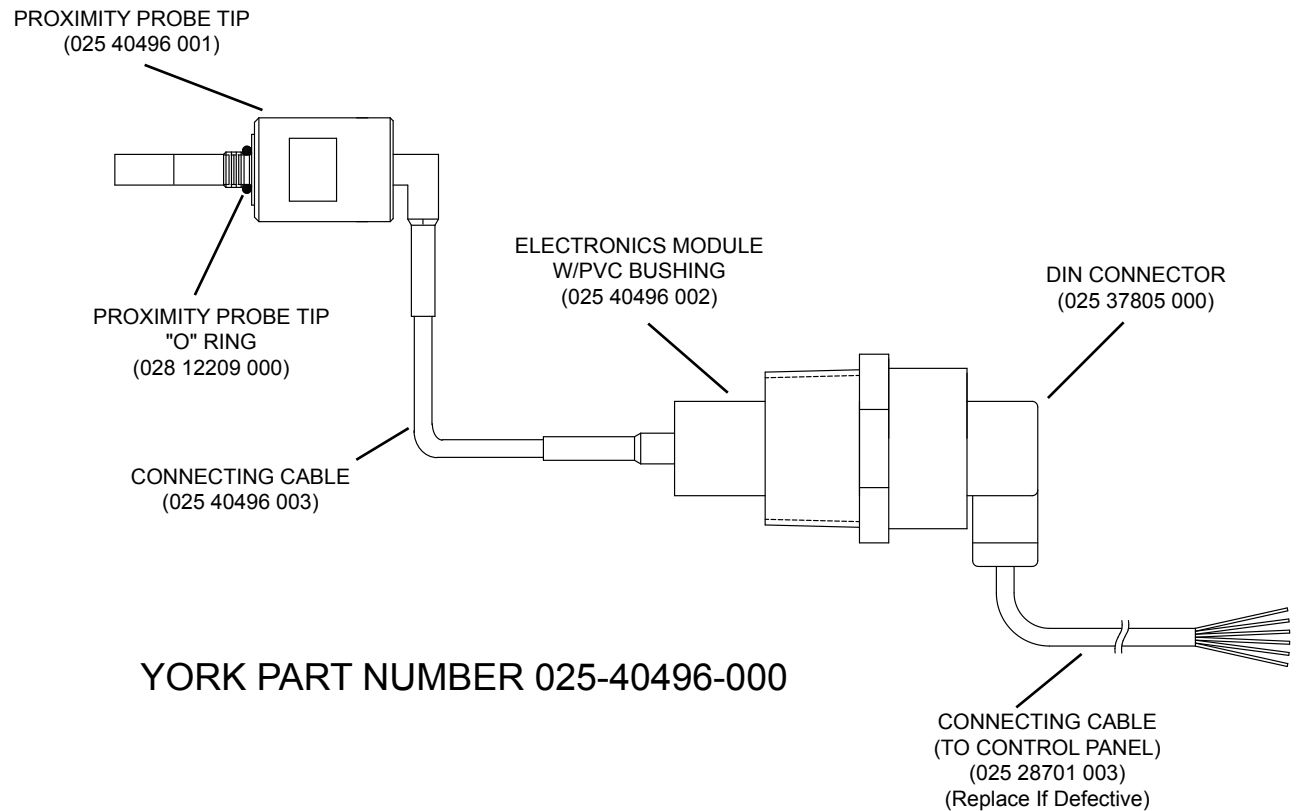


FIGURE 49 - COMPRESSOR PROXIMITY PROBE (PART NUMBER 025-40496-000)

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SECTION 14 - COMPRESSOR HIGH SPEED THRUST BEARING LIMIT SWITCH

(Refer to Figure 50 on page 113)

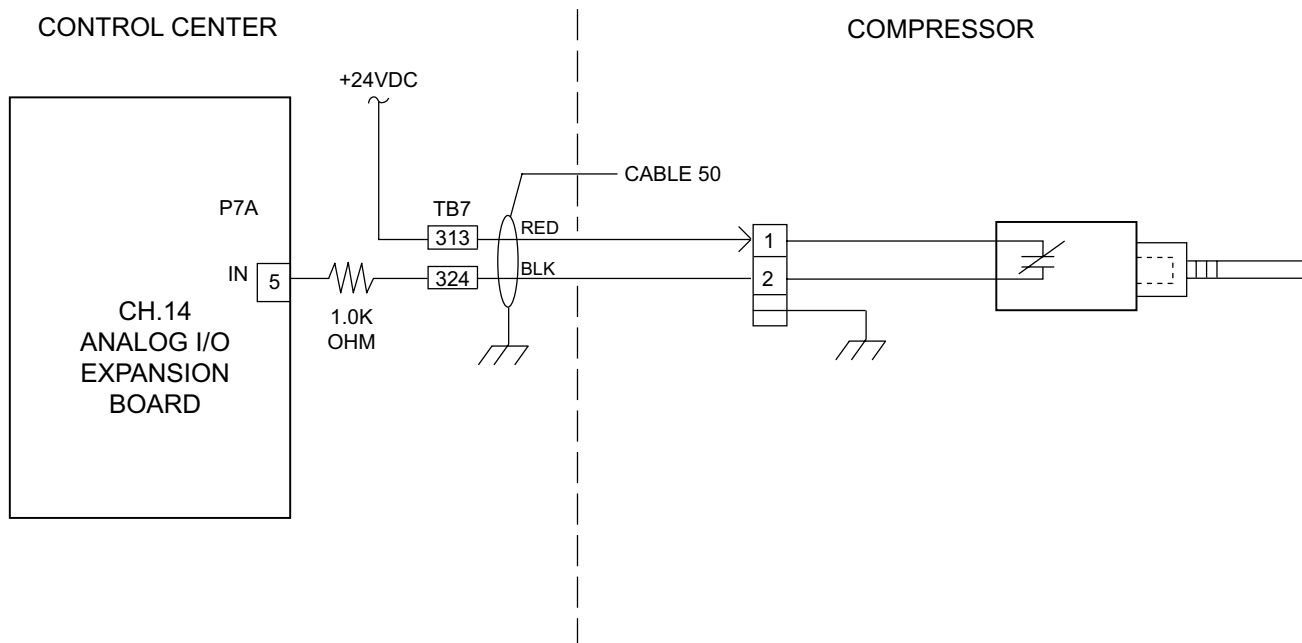
Chillers that are equipped with other than “J” compressors have a High Speed Thrust Bearing Limit switch (025-40136-000) instead of the Proximity Probe described in *SECTION 13 - COMPRESSOR PROXIMITY PROBE*. This device detects abnormal bearing position through probe contact instead of distance measurement as performed with the Proximity Probe.

The High Speed Thrust Bearing Limit switch is an assembly consisting of a pressure switch attached to a probe that protrudes into the compressor housing. When the bearing position decreases to < the allowed position, it comes into contact with the probe, causing the break-away probe to detach, exposing the pressure switch to the pressure inside the compressor. A set of normally closed contacts inside the switch open when the switch is exposed to a pressure of > 15 to 25 PSIG. One side of these contacts is connected to +24VDC. The other side connects to Analog I/O Expansion

Board P7A-5. The Microboard reads the state of these contacts through the I/O Board and when they open, a safety shutdown is performed and “COMPR THRUST BEARING – LIMIT SWITCH OPEN” is displayed on the System Details line of the display. On the COMPRESSOR screen, a red LED illuminates when the switch is closed; extinguishes when it is open.

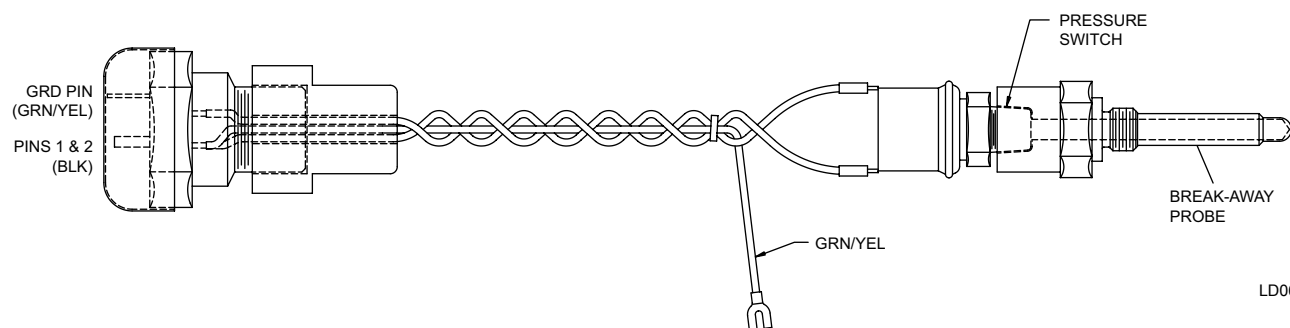


After the High Speed Thrust Bearing safety shutdown has occurred, the chiller cannot be restarted until a Thrust Bearing inspection, followed by a special reset procedure which has been performed by a qualified Service Technician. The reset procedure and bearing inspection criteria is listed in the “System Calibration and Reset Procedures” section of this manual.



LD10056

FIGURE 50 - COMPRESSOR HIGH SPEED THRUST BEARING LIMIT SWITCH – INTERFACE

**FIGURE 51 - COMPRESSOR HIGH SPEED THRUST BEARING LIMIT SWITCH**

SECTION 15 - REFRIGERANT LEVEL CONTROL

(Refer to Figure 52 on page 117)

The chiller is provided with an electrically actuated ball valve, located in the refrigerant liquid line between the Evaporator and Condenser, which is used to control the refrigerant level in the bottom of the condenser, so that the Subcooler Tubes remain covered.

The Microboard controls the Subcooler Level Control Valve by sending a positioning command over the COM 3 RS-485 serial communications link to the Analog I/O Expansion Board that is mounted inside the control Center. The Analog I/O Board converts this command into a 0-10VDC signal and applies it to the Subcooler Level Control Valve Actuator. A 0VDC signal drives the valve fully closed (0% position); a 10VDC signal drives the valve fully open (100% position). Positions between these extremes are linearly scaled. For example, 50% position would be achieved with a 5VDC signal. The valve control signal is displayed on the AUTO/MANUAL screen in the Subcooler Level Auto and Manual data fields. It is also shown on the PID SETUP screen 1 in the Subcooler Level CV data field.

“Automatic” or “Manual” level control is allowed. If “Automatic” control is selected, the program modulates the Control Valve to maintain the condenser refrigerant liquid to a programmable setpoint level. If “Manual” control is selected, the valve can be manually controlled with the keypad keys. This “Manual” control can also be used to place the valve in a fixed position.

For retrofit applications, the program operation described here may be “Disabled” on chillers not equipped with an automatic valve. This procedure is performed on the Operation screen. When set for “Disabled” the analog output for the Valve Actuator is set to 10 VDC. The programming of setpoints described below, is performed on the PID SETUP screen 1 *using instructions in the “System Calibration, Service Setpoints and Reset Procedures” section of this manual.*

A Liquid Level Sensor (LT-113) detects the Refrigerant Liquid Level in the bottom of the condenser and outputs an analog voltage to the Microboard that represents this level. The level is expressed as a percentage and is displayed on the CONDENSER screen as the “Refrigerant Level Position xxx%” and on the PID SETUP screen 1 as the “Subcooler Level PV xxx%”. The level sensor is calibrated so that the refrigerant

level is displayed as 0% when the level is at minimum; 100% when the level is at maximum. Levels between these extremes are linearly scaled. The level is at minimum when the chiller is shutdown with the valve in the fully open position. The level is at maximum when the level is above the site glass, with the sensor fully covered. The level sensor analog output voltage is rescaled by the Microboard. This rescaled voltage is viewable as input 16 on the ANALOG I/O Diagnostic screen and is the voltage value that is used for the calibration of the level sensor. The level will be displayed as 0% when input 16 on the ANALOG I/O Diagnostic screen is 0.37VDC and 100% when it is 4.31VDC. The level sensor is calibrated to output values that would produce these levels on the ANALOG I/O Diagnostic screen.

The level sensor calibration procedure is in the “System Calibration, Service Setpoints and Reset Procedures” section of this manual. There are different versions of the level sensors as shown in Fig. 47. The operation of the sensors is the same. However, the differences affect the way the sensors are calibrated. Some sensors are equipped with adjustable potentiometers, while others are equipped with pushbuttons that are used to calibrate the sensor.

The desired refrigerant level to be maintained in the condenser is the Refrigerant Level Setpoint and is displayed on the CONDENSER screen as “Refrigerant Level Setpoint xxx%” and on the PID SETUP screen 1 as the “Subcooler Level SP xxx%”.

This setpoint is programmed by a Service Technician at chiller commissioning using the PID SETUP screen 1. It is programmable over the range of 20% to 80%.

AUTOMATIC ZONE LEVEL CONTROL OPERATION

When the chiller is shutdown, the analog output controlling the valve is set to 10 VDC to drive the valve to the fully open position and the Refrigerant Level Setpoint shown on the CONDENSER screen is set to 0%. This causes the condenser refrigerant level to be approximately 0%. Elevated evaporator pressure with respect to condenser pressure could cause the level to be higher.

After the chiller is started, the ramp to rated speed has been completed, and the TDSP17-Turbine Stabilization Delay shown on the TIME SETPOINTS screen has elapsed, the level control remains inactive with the valve in its fully open position until the TDSP6-Subcooler Level Valve Pulldown Delay has elapsed. While this delay is in affect, the time remaining is displayed as “PULL DOWN TIME REMAINING XX Min” on the CONDENSER screen. After the delay time has elapsed, the Refrigerant Level Setpoint shown on the CONDENSER screen is set to the present refrigerant level and begins ramping to the Subcooler Level Setpoint (SP) shown on the PID SETUP screen 1 at the Subcooler Level Ramp Rate (RR) shown on the PID SETUP screen 1

As the level setpoint slowly increases above the present refrigerant level, the analog output to the valve actuator will decrease to close the valve and begin backing liquid up in the subcooler to bring the level up to the increasing setpoint. The minimum Subcooler Level Controller output is limited by the LCVM-Subcooler Level Valve Minimum Position setpoint shown on the Capacity Control Setpoints screen 1. If the level increases above the present setpoint, the analog output will begin to increase to open the valve allowing more liquid to pass through to the evaporator and return the level to the setpoint.

If the Liquid Level Sensor output ever increases to greater than 5.1VDC, indicating a level greater than 100%, or a possible level sensor failure “WARNING - REFRIGERANT LEVEL OUT OF RANGE” is displayed and the Orifice Actuator is driven open until the level has decreased to a level within range. When within range, the “Warning” message is automatically cleared and normal control is resumed.

The amount by which the valve is opened or closed is determined by a PID loop, with parameters specified on PID SETUP screen 1. To provide more stable operation, two zones of control are defined, each with its own PID parameters. Zone 2 should be configured for more aggressive error correction, and is used when the refrigerant level's distance from setpoint is greater than the Subcooler Zone Transition Delta (Capacity Controls Setpoints screen 2). Zone 1 should be configured for less aggressive error correction, and is used when the delta is below this same threshold. When transitioning from Zone 1 to Zone 2, there is a 1% deadband to prevent excessive switching between zones. When transitioning from Zone 2 to Zone 1, this error must stay below the threshold continuously for

the Subcooler Zone Transition Time (Capacity Controls Setpoints screen 2) before the PID parameters are switched. The CONDENSER screen displays the active Subcooler Control Zone as well as the Subcooler Zone Time Remaining. Zone control is inactive until the initial pulldown delay described above has expired

The values programmed determine the sensitivity of the level control. Smaller values generally yield lesser response for the same level change. *Refer to the “System Calibration, Service Setpoints and Reset Procedures” section of this manual for additional information on the PID Tuning Parameters.*

MANUAL OPERATION

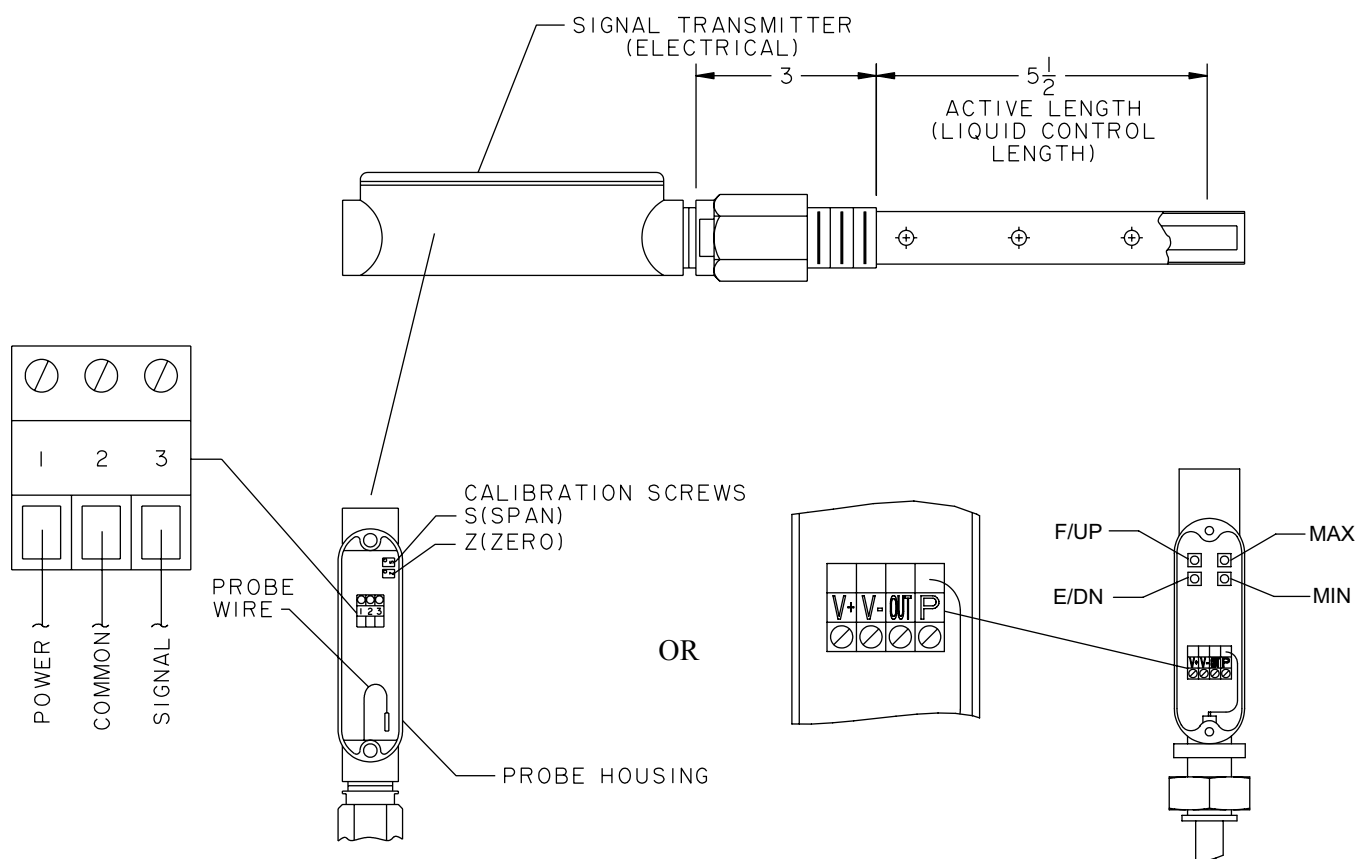
The subcooler valve can be manually controlled after logging in at **SERVICE** access level during the **Compressor Shtdn; Turbine Cooldown** and **System Ready To Start** periods and during the “**System Run**” period. Manual operation is inhibited during the “**Start Sequence Initiated**” and “**System Coastdown**” periods to ensure that the valve is positioned properly for the shutdown. The **Output Control** key must be pressed until **Subcool** appears in the keys data field. Pressing the **Switch to Manual** key displays the **Increase**, **Decrease**, and **Set** keys that are used to vary the control output to the valve actuator as follows: Each press of the **Increase** key increases the Manual control signal 1%. Each press of the **Decrease** key decreases the Manual control signal 1%. The **Set** key displays a pop-up window which allows the operator to enter a value from 0-100%. When the “✓” key is pressed, the pop-up window disappears and the manual signal ramps to the value entered at 2%/second.

When pressed, the **Switch to Manual** key text changes to Green **Switch to Auto**. If the manual output is manually changed more than 5% from the Auto signal the text changes to red and the transfer back to Auto is inhibited. In order to return to Auto, the manual output signal must be returned to within 5% of the Auto signal at which time the text changes back to green. Pressing the **Switch to Auto** key will then return the level control to automatic operation desired. The key text changes to Green **Switch to Auto**. If the manual output is manually changed more than 5% from the Auto signal the text changes to red and the transfer back to Auto is inhibited. In order to return to Auto, the manual output signal must be returned to within 5% of the Auto signal at which time the text changes back to green. Pressing the **Switch to Auto** key will then return the level control to automatic operation.

ACTUATORS

New production units use a Dodge actuator that operates with a 24VAC Power Supply and a 0-10 VDC modulating input signal. If the OptiView Control Center is retrofit to an existing chiller, the chiller could

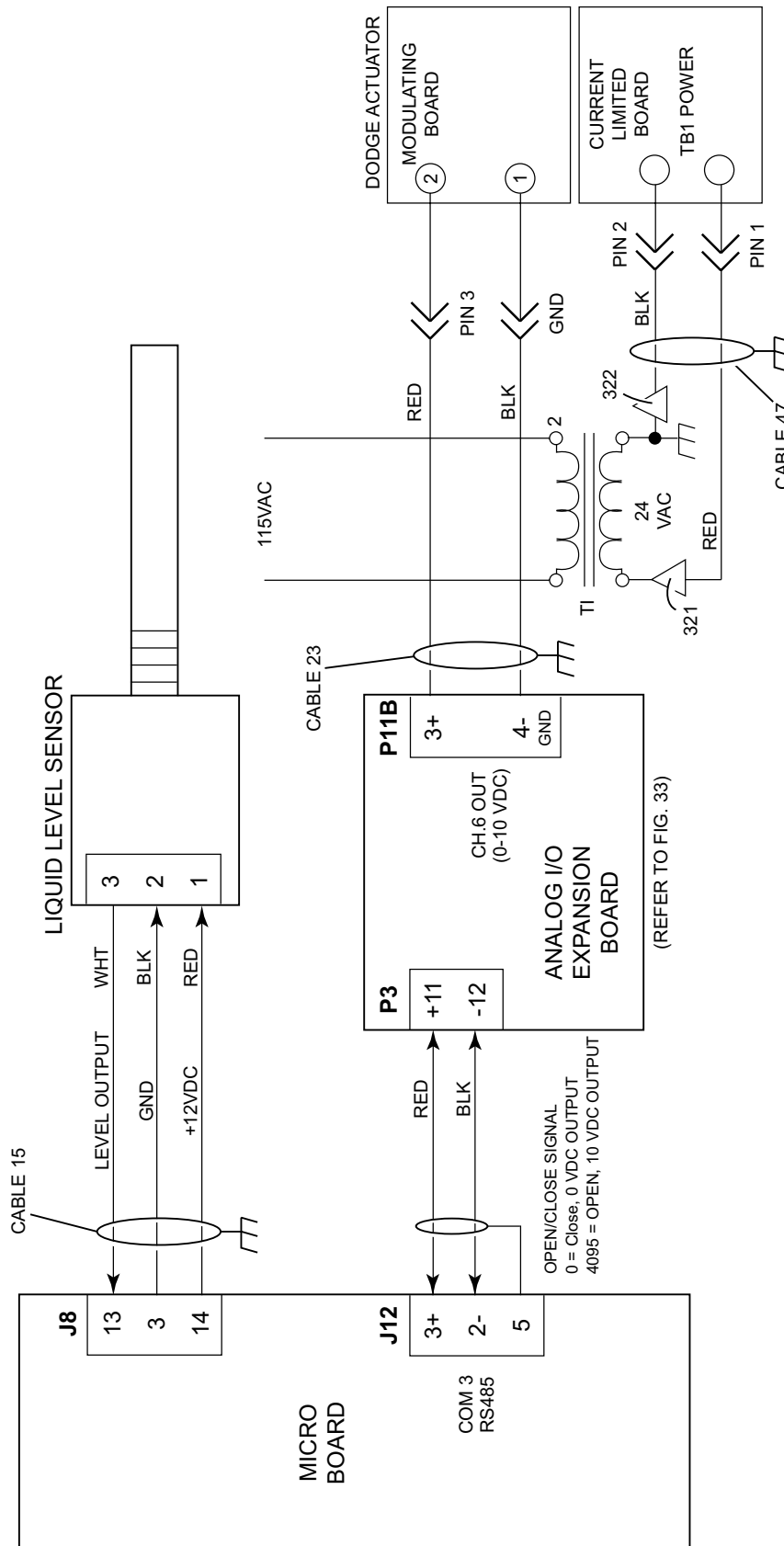
be equipped with a Barber-Coleman or Belimo actuator that must be replaced in order to operate with the new OptiView Control Center. The interface wiring is shown in Fig. 48.



15

LD09256

FIGURE 52 - REFRIGERANT LIQUID LEVEL SENSOR



LD09749

FIGURE 53 - REFRIGERANT LIQUID LEVEL CONTROL – INTERFACE

SECTION 16 - COMPRESSOR OIL PUMP VARIABLE SPEED DRIVE

(Refer to Figure 54 on page 121)

On Style “D” and later chillers, the compressor oil pump is driven by a Variable Speed Drive (VSD) (Refer to Service Manual 160.52-M2 for details of this device). In normal operation, the oil pump speed is automatically controlled to maintain a desired oil pressure. The speed can be manually controlled with the keypad keys using the OIL SUMP screen with SERVICE access level.

On those chillers equipped with the oil pump VSD, the Compressor Oil Pump Package must be set for Variable Speed on the SETUP screen after logging in at SERVICE access level.

The programming of the setpoints referred to below is performed on the OIL SUMP screen *using instructions in the “System Calibration, Service Setpoints and Reset Procedures” section of this manual*. These setpoints should not be programmed by anyone other than a qualified Service Technician. Variable speed oil pump chillers are not equipped with the High Speed Thrust Solenoid Valve. Therefore, when Compressor Oil Pump Package is set for Variable Speed on the SETUP screen, the program is configured to operate the chiller without this solenoid valve. The Microboard, under program control, controls the oil heater to maintain a specific oil temperature as described in the “Oil Heater” section below, regardless of the Compressor Oil Pump Package setting.

AUTOMATIC OPERATION

Under program control, a speed command signal from the Microboard controls the oil pump speed by varying the VSD output frequency. The speed command is in the form of a Pulse Width Modulation (PWM) Signal as explained below. During the **Start Sequence Initiated**, **Slow Rolling**, **Ramping to Rated Speed**, **Turbine Stabilizing** periods and the first 15 seconds of “**System Run**”, the program operates the oil pump VSD over the range of 25 Hz to 60 Hz to maintain the oil pressure to the target value of 45 PSID. For the remainder of “**System Run**” and the “**System Coastdown**” period, it operates it over the same frequency range to maintain the pressure to the programmed **Oil Pressure Setpoint**.

When the chiller is started, 13 seconds after the **Start** is initiated while **Start Sequence Initiated** is displayed, the Microboard (J20-3) starts the oil pump by driving the EN (enable) input of the Oil Pump VSD to a logic low level (<1VDC). The Microboard (J20-1) then applies a speed command signal to the PWM input of the VSD that ramps the VSD output frequency from 45 Hz to whatever frequency is required (up to a maximum of 60 Hz) to achieve the **Target Oil Pressure**. It is held at 45Hz for 8 seconds before releasing to normal control). The Target Oil Pressure is fixed at 45 PSID. The speed command is displayed on the OIL SUMP screen as **OIL PUMP DRIVE COMMAND FREQUENCY = XX HZ**. The speed command to the VSD is modulated as required to maintain the 45 PSID Target Oil Pressure for the remainder of **Start Sequence Initiated** period through **Slow Rolling**, **Ramping to Rated Speed**, **Turbine Stabilizing**, and the first 15 seconds of “**System Run**”. While this target is in effect, it is displayed on the OIL SUMP screen as **TARGET OIL PRESSURE = 45 PSID**. The time remaining that the Target Oil Pressure is in effect is displayed as a countdown timer in the message **PULLDOWN TIME REMAINING = XX SEC**. After the 15 seconds of “**System Run**”, the speed of the VSD is controlled to maintain the programmed **Oil Pressure Setpoint** (20 to 45 PSID). This is displayed on the OIL SUMP screen as **SETPOINT OIL PRESSURE = XX PSID**.

During Oil Pump operation, the following minimum and maximum oil pressures are allowed:

1. During **Automatic** operation, if either of the following conditions occur, a safety shutdown is performed and **COMPR OIL - VARIABLE SPEED PUMP - PRESSURE SETPOINT NOT ACHIEVED** is displayed. These conditions are not checked in **Manual** operation.
 - a. If the Oil Pressure is <35 PSID for 5 continuous seconds during the last 10 seconds of **Start Sequence Initiated** or during the first 15 seconds of “**System Run**” .
 - b. If the Oil Pressure is < the programmed Oil Pressure Setpoint and the speed command is at 60 Hz for 5 continuous seconds, any time after the first 30 seconds of “**System Run**” .

2. During **Automatic** operation, if the Oil Pressure decreases to ≤ 15 PSID, a safety shutdown is performed and **COMPR. OIL - LOW DIFFERENTIAL PRESSURE** is displayed. If it increases to ≥ 90 PSID, a safety shutdown is performed and **COMPR. OIL - HIGH DIFFERENTIAL PRESSURE** is displayed.

The Microboard controls the VSD output frequency by applying a **Pulse Width Modulation (PWM)** speed command signal to the VSD. The signal is applied every 0.7 seconds. Within the 0.7 second period, the duration of time the signal is at logic low (<1 VDC) and logic high ($+12$ VDC) level determines the VSD output frequency between 25 and 60 Hz. If it remains at a logic high for the entire 0.7 second period, it is commanding the VSD output frequency to be 25 Hz. If it is low for the entire 0.7 second period, it is commanding the VSD output frequency to be 60 Hz. Frequencies between these extremes are achieved by driving the signal low for a proportionate amount of time within the 0.7 second period. For example, if the signal is low for 50% (0.35 seconds) of the 0.7 second period, it would be commanding the VSD to operate at a frequency that is halfway between 25 and 60 Hz, or 42.5 Hz. The resolution, or smallest increment of change is 0.01 seconds. This allows the output frequency to be changed in 0.5 Hz steps. The VSD output frequency for any PWM input can be calculated as follows:

$$\text{Frequency in Hz} = (\text{On-Time in seconds} / 0.02) + 25$$

The entire oil pump run time is divided into Oil Pressure **Control Periods**. They run consecutively and continuously; when the first one ends, the next one begins, etc. This repeats until the oil pump is shutdown. The duration of the periods is determined by the **Control Period Setpoint**. This setpoint is programmed in multiples of 0.3 seconds over the range of 0.3 to 2.7 seconds. At the end of each period, the actual oil pressure is compared to the Oil Pressure Setpoint and the speed command is changed as required to invoke VSD frequency changes to increase or decrease the oil pressure. If the error between the Oil Pressure Setpoint and the actual oil pressure is $\leq \pm 6$ PSID, the frequency is increased or decreased 0.5 Hz to increase or decrease the oil pressure. However, if the error is $> \pm 6$ PSID, the value programmed for **Control Period Setpoint** determines the relative magnitude of correction applied to the VSD output frequency. The larger the programmed value, the greater the amount of correction above 0.5 Hz is applied.

To provide an operational status to the Microboard (via I/O Board TB3-70), the VSD contains a set of normally open (N.O.) relay contacts that are driven closed as long as all the internal protection circuits are satisfied. They open anytime these circuits will not permit the VSD to operate. The opening of these contacts initiates a chiller **cycling** shutdown, displaying **COMPR. OIL - VARIABLE SPEED PUMP - DRIVE CONTACTS OPEN**. After the problem has cleared, the contacts automatically close, except if the VSD experiences a short circuit on the output; this requires the VSD to be manually reset by the removal and restoration of the VSD AC Power.

MANUAL OPERATION

The oil pump can be manually operated using the OIL SUMP screen when logged in with SERVICE access level. While the chiller is running, the speed can be manually adjusted over the range of 25 to 60 Hz. When the chiller is not running (Compressor Shtdn; Turbine Cooldown), manual on/off control, as well as manual speed control is permitted. After the pump is manually turned on, it will automatically turn off after 10 minutes of operation, if not manually terminated earlier.

The **RAISE** and **LOWER** keys are used to increase and decrease the VSD output frequency in 0.5 Hz increments. Each time the **RAISE** key is pressed, the frequency is increased 0.5 Hz. Each time the **LOWER** key is pressed, the frequency is decreased 0.5 Hz. Repeated presses of these keys are required to increase or decrease the frequency by greater amounts.

If the **AUTO** key is pressed, Automatic operation, as described above, is resumed.

If the **SET** key is pressed, the VSD is driven to a specific predetermined frequency. This permits service analysis of the oil pressure at various oil pump speeds. This frequency is programmed *using instructions in the "System Calibration, Service Setpoints and Reset Procedures" section of this manual.*

During Manual operation, the OIL SUMP screen can be used to monitor the actual oil pressure and the speed command.

OIL HEATER OPERATION

On all YST chillers, the oil heater is controlled by the Microboard via I/O Board connection TB1-34 to the oil heater contactor M1 Coil in the Power Panel.

The Oil Heater Control is active when the chiller is shutdown, slow rolling, or Ramping to Rated Speed regardless of the operating status of the oil pump and is "Disabled" when "SYSTEM RUN" is displayed. The heater is turned on and off to maintain a target value of 50°F above the Condenser Saturation Temperature.

If the calculated target value is $> 160^{\circ}\text{F}$, the target value defaults to 160°F . If the calculated target value is $< 110^{\circ}\text{F}$, it defaults to 110°F . When the temperature decreases to 4°F below the target value, the heater is turned on; it is turned off at 3°F above the target.

To prevent overheating the oil in the event of an OptiView Control Center failure, thermostat TS-140 opens at 180°F .

COMPRESSOR OIL PUMP VSD

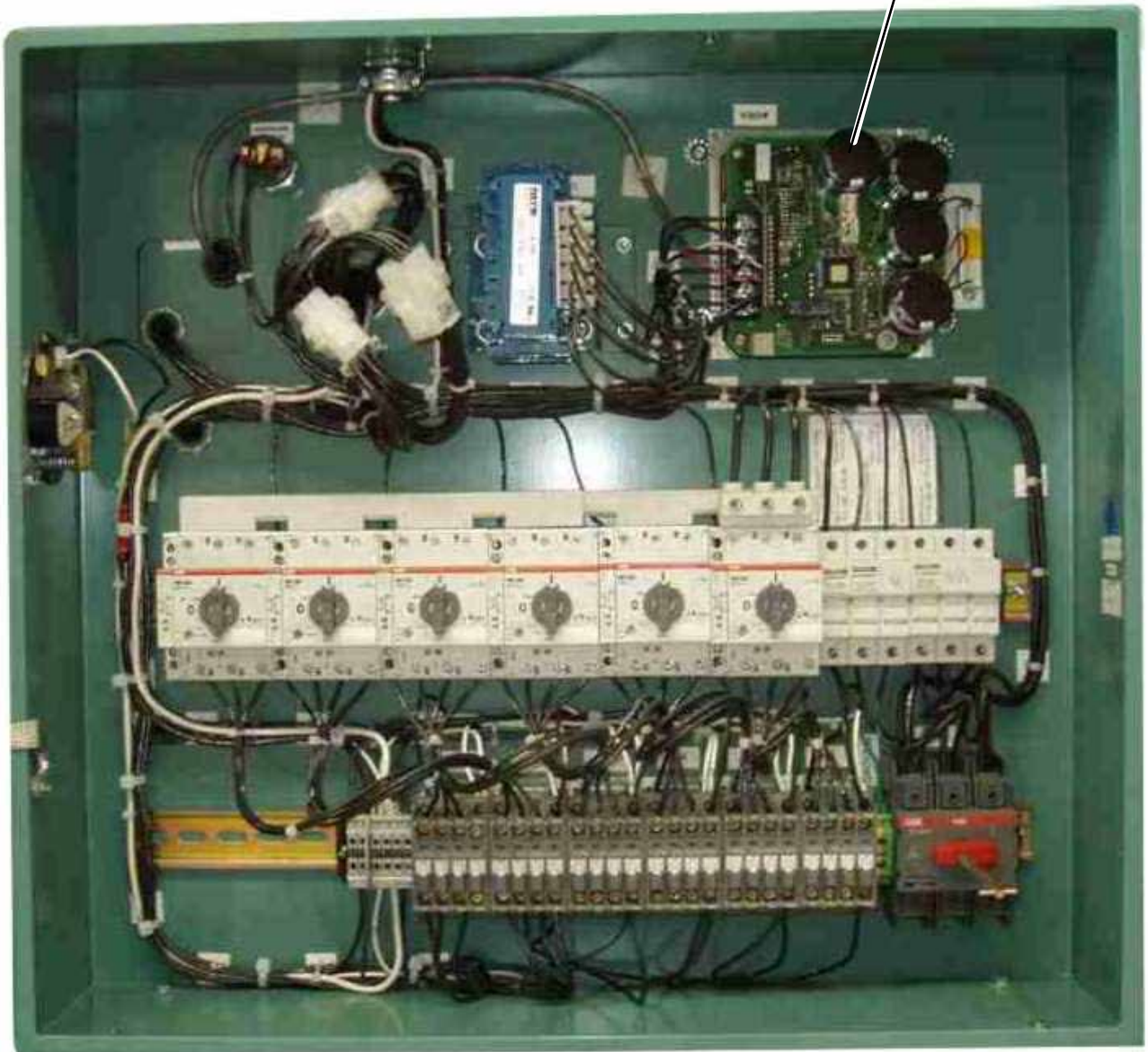


FIGURE 54 - COMPRESSOR OIL PUMP VARIABLE SPEED DRIVE (VSD)

LUU9808

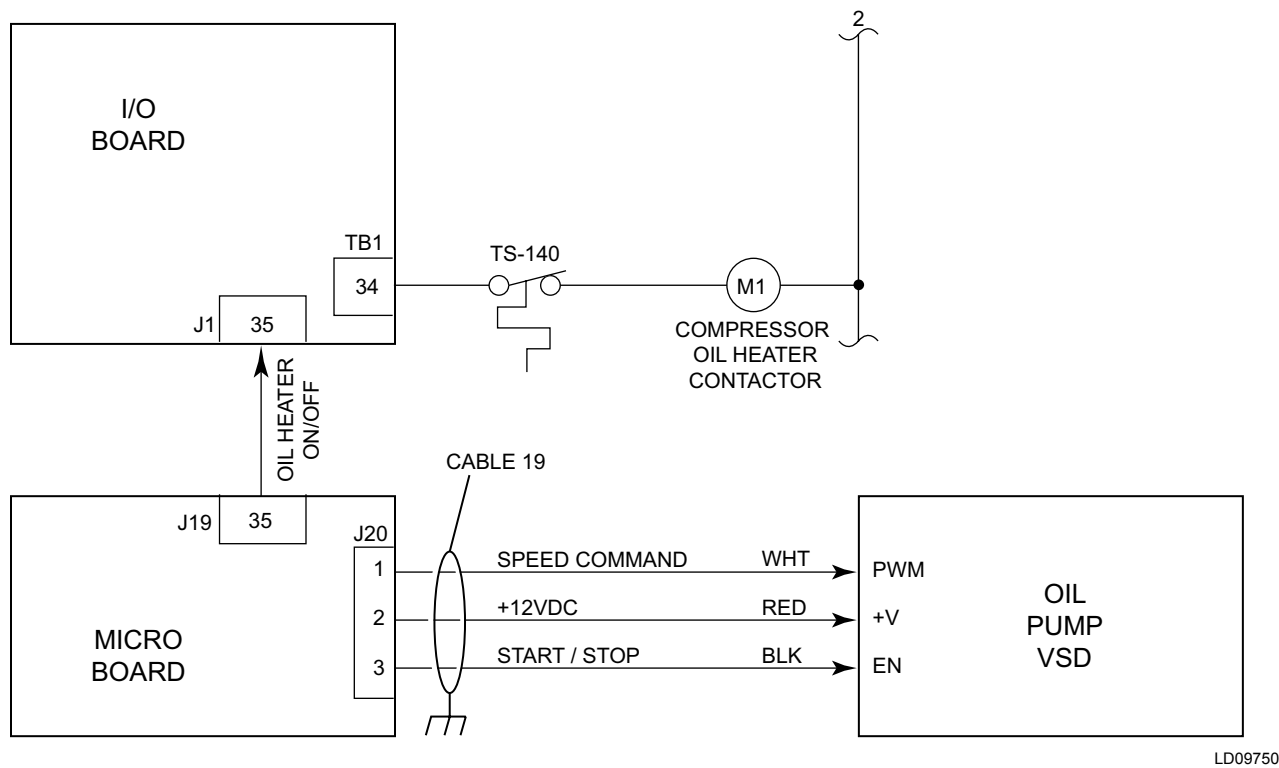


FIGURE 55 - COMPRESSOR OIL PUMP VSD / OIL HEATER CONTROL – INTERFACE

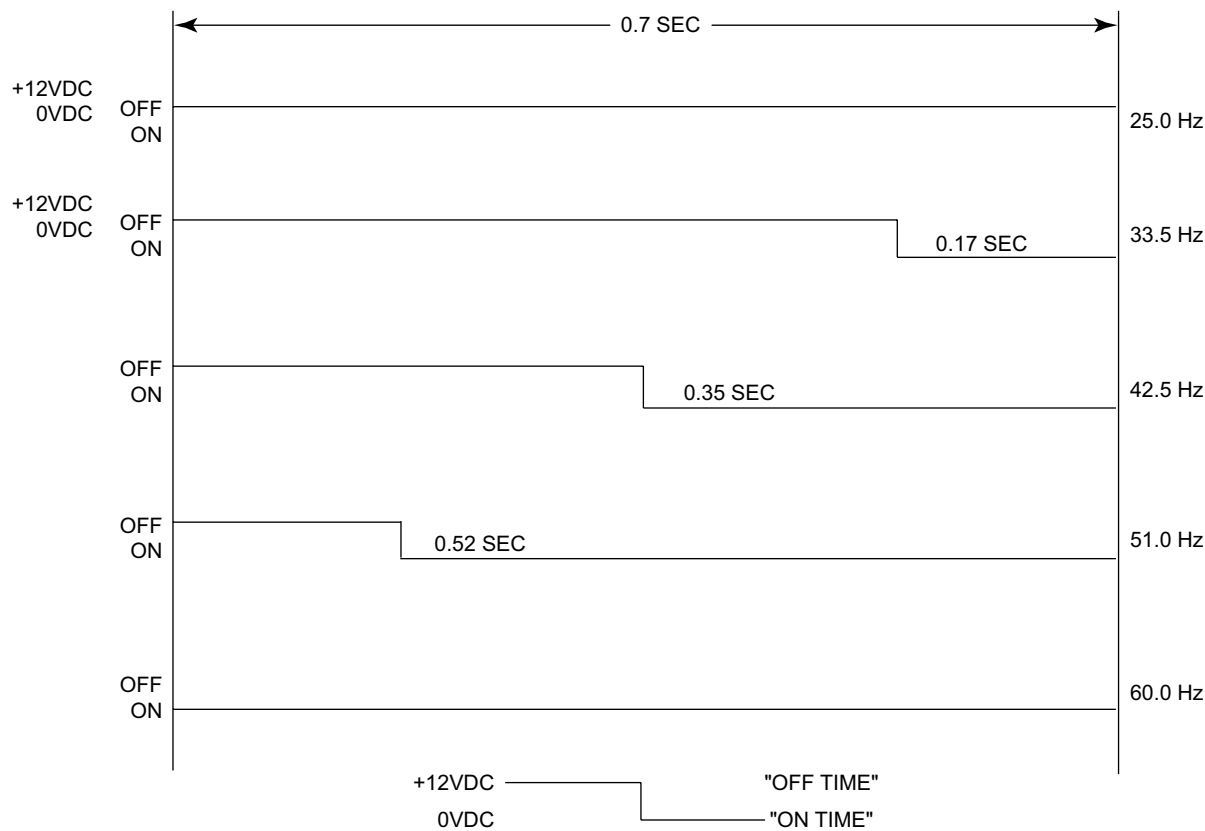
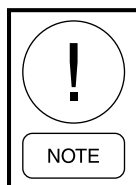


FIGURE 56 - COMPRESSOR OIL PUMP VSD SPEED CONTROL SIGNAL

SECTION 17 - MICROGATEWAY

(Refer to Figure 57 on page 123)



This section describes only one example of a Microgateway. Contact the YORK Service Office for information on available boards for communications using other protocols.

The complete description of the ISN MicroGateway installation and operation is contained in YORK form 450.20-NOM1.

The MicroGateway is an optional printed circuit board that provides an interface between the OptiView Control Center and YORK ISN (Integrated Systems Network) or other selected networks. It can be mounted on the upper corner of the left wall of the OptiView Control Center or in its own enclosure in a remote location.

If installed in the OptiView Control Center, the MicroGateway is powered by +12VDC from the Microboard.

The MicroGateway communicates with the Microboard COM 4B communications port via an RS-232 interface. As shown in *Figure 8 on page 41*, Microboard Program Jumper JP 27 must be placed on pins 2 and 3 to allow data to be received from the MicroGateway.

If the remote device that is connected to the MicroGateway is going to provide remote Start/Stop signals, and/or Remote Leaving Chilled Liquid Temperature resets, the Control Source must be set to ISN on the OPERATIONS screen. Otherwise, communications will take place in any Control Source mode.

In operation, the Microboard provides chiller pressures, temperatures and status to the MicroGateway in response to requests from the MicroGateway. Microboard status LED's illuminate when the Microboard transmits and receives data on COM 4B. Green LED CR13 (RX4) illuminates when data is being received from the MicroGateway. Red LED CR12 (TX4) illuminates when data is being transmitted to the MicroGateway. Similar LED's on the MicroGateway annunciate data transfer to/from the Microboard (refer to 450.20-NOM1).

If there is a communications problem between the Microboard and MicroGateway, use the LED's described above to analyze the problem. The COM 4B LoopBack test can be used to verify operation of the Microboard COM 4B communications port. Refer to "Diagnostics and Troubleshooting" section of this manual.

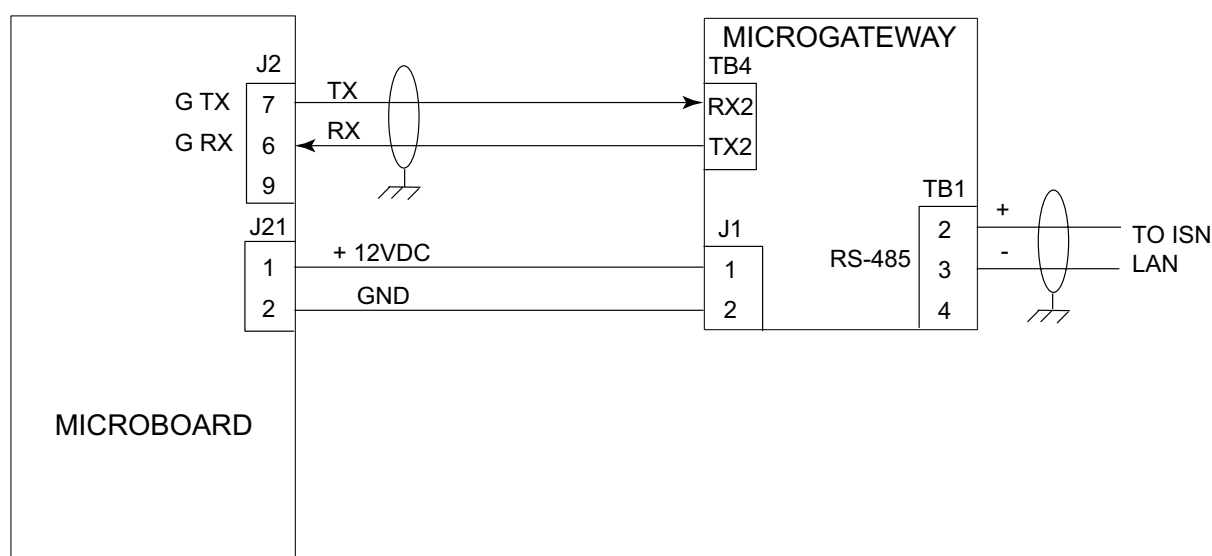


FIGURE 57 - MICROGATEWAY INTERFACE

LD06511

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SECTION 18 - PRESSURE TRANSDUCERS

(Refer to Figure 58 on page 126)

18

System Refrigerant and Compressor Oil pressures are sensed by Pressure Transducers. The Evaporator, Condenser, Pump Oil (high side) and Sump Oil (low side) pressures are sensed. If the chiller is equipped with the Variable Geometry Diffuser, a Stall Detection transducer is located in the discharge scroll of the compressor (refer to Variable Geometry Diffuser SECTION 22 for details). There are different transducers used to sense these various pressures. The actual transducer used is determined by the required pressure range and refrigerant application. The operation of the various transducers is identical. The difference between them is simply the pressure range over which they operate. Each of the different transducers has a different YORK part number. *Figure 58 on page 126* lists the transducers and the application of each one.

The transducers output a 0.5 to 4.5VDC voltage that is analogous to the pressure applied to the device. These outputs are applied to the Microboard, where this voltage is interpreted as a pressure value in terms of PSIG (pounds per square inch gauge) in English mode or KpaG (Kilo Pascals) in Metric mode. The program converts the transducer output voltage to a pressure value with the appropriate formula in *Figure 58 on page 126*. The pressures are displayed and used for chiller control and safety shutdowns.

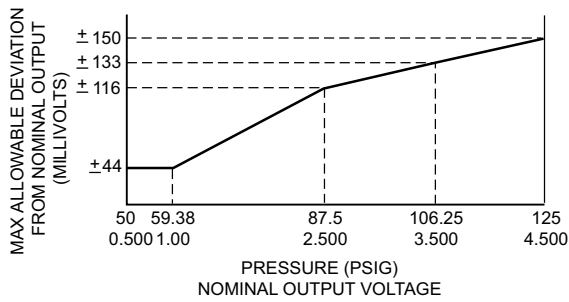
The Evaporator and Condenser pressures are converted to Saturation Temperatures per the appropriate refrigerant pressure/temperature conversion table contained in the program. These Saturation Temperatures are displayed and used for chiller control.

The outputs of the Sump and Pump Oil Pressure Transducers are displayed individually as PSIG values. However, the System Oil Pressure is displayed as a differential value in terms of PSID (pounds per square inch differential in gauge). This PSID value is arrived at by subtracting the Sump Oil Pressure Transducer value from the Pump Oil Pressure Transducer value. During the Start Sequence Initiated period, the outputs of the Oil Pressure Transducers are compared in a process called Auto-Zeroing. The differential between the Sump and Pump Oil Pressure Transducer outputs during a 3 second period beginning 10 seconds after the start of the Start Sequence Initiated period are compared to determine the offset between them. During

this period, since both of the transducers are sensing the same pressure, their outputs should indicate the same pressure. However, due to accuracy tolerances in transducer design, differences can exist. Therefore, to compensate for differences between transducers and assure differential pressure accuracy, this offset is factored with the actual differential pressure to produce the displayed PSID value. When the oil Pump is turned on following the Auto-Zeroing period, the displayed differential value then becomes the actual differential plus or minus the offset that existed during the Auto-Zeroing period. For example, if the Pump transducer indicates 1.0 PSIG greater than the Sump transducer during the Auto-Zeroing period, then 1.0 PSIG will be subtracted from the displayed PSID value while the pump is running. Similarly, if the Pump transducer indicates 1.0 PSIG less than the sump transducer during this period, then 1.0 PSIG would be subtracted from the displayed PSID value while the pump is running. The Auto-Zeroing will not be performed if either transducer is out of range.

The transducers operate from a +5VDC power source. This supply voltage is provided from the power supply via the Microboard. Each transducer is connected to the Microboard with three wires. Two wires provide the +5VDC supply voltage and ground (GND) and the remaining wire connects the transducer output to the Microboard. The voltage output of each transducer can be measured with a voltmeter at the Microboard. Measurement should be made from the transducer output to ground (GND). For example, the output of the Condenser transducer would be read from Microboard J8-21 (signal) to J8-22 (GND). To convert this output to a pressure, refer to the appropriate formula in *Figure 58 on page 126*. If the pressure is known, the transducer output can be predicted with the appropriate formula in *Figure 58 on page 126*.

If any of the displayed pressures do not appear to be correct, refer to the "Diagnostics and Troubleshooting" section of this manual.

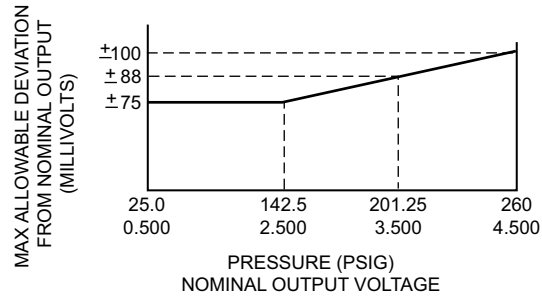


EVAPORATOR TRANSDUCER
(R22 WATER APPLICATIONS)
YORK PART NO. 025-28678-102
025-28678-113

$$V = \frac{(P \times 4) - 162.5}{75} \quad P = \frac{(75 \times V) + 162.5}{4}$$

V = VOLTS DC P = PRESSURE (PSIG)

LD05534

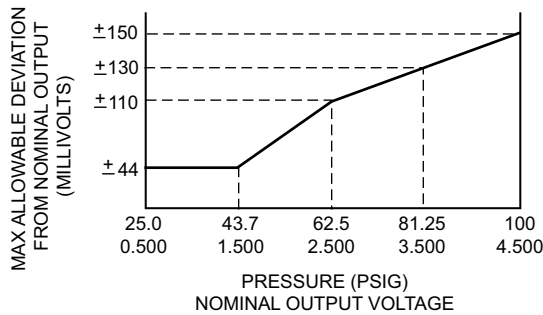


OIL PRESSURE (LOW SIDE)
(R22 WATER & BRINE APPLICATIONS)
YORK PART NO. 025-28678-004

$$V = \frac{P + 4.375}{58.75} \quad P = (58.75 \times V) - 4.375$$

V = VOLTS DC P = PRESSURE (PSIG)

LD04099

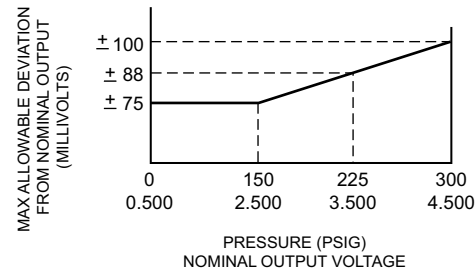


EVAPORATOR TRANSDUCER
(R22 BRINE APPLICATIONS)
YORK PART NO. 025-28678-103
025-28678-114

$$V = \frac{P - 15.6}{18.75} \quad P = 18.75 \times V + 15.6$$

V = VOLTS DC P = PRESSURE (PSIG)

LD05535

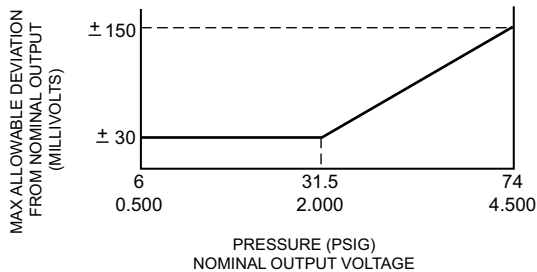


PRESSURE TRANSDUCER
YORK PART NO. 025-28678-001
025-28678-006

$$V = \frac{P + 37.5}{75} \quad P = (75 \times V) - 37.5$$

V = VOLTS DC P = PRESSURE (PSIG)

LD05537

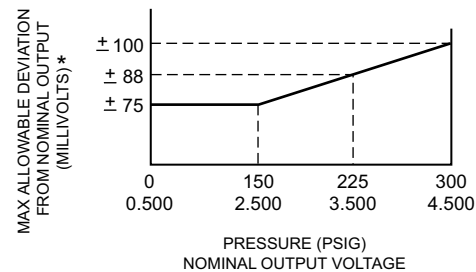


EVAPORATOR TRANSDUCER
R134a WATER & BRINE APPLICATIONS
YORK PART NO. 025-28678-112

$$V = \frac{P + 2.5}{17} \quad P = (17 \times V) - 2.5$$

V = VOLTS DC P = PRESSURE (PSIG)

LD04102



PRESSURE TRANSDUCER
YORK PART NO. 025-39464-000
025-40088-000

$$V = \frac{P + 37.5}{75} \quad P = (75 \times V) - 37.5$$

V = VOLTS DC P = PRESSURE (PSIG)

LD09569A

FIGURE 58 - PRESSURE TRANSDUCERS

PRESSURE TRANSDUCER APPLICATIONS CHART

TRANSDUCER PART NUMBER	FUNCTION	R22 APPLICATION	
		WATER	BRINE
025-28678-001	Condenser, High Oil	X	X
025-28678-102	Evaporator	X	
025-28678-113			
025-28678-103	Evaporator		X
025-28678-114			
025-28678-004	Low Oil	X	X
		R134a	
025-28678-006	Condenser, Hi & Lo Oil	X	X
025-28678-112	Evaporator	X	X
025-39464-000	Stall Detection	X	X
025-40088-000			

*Note: Transducers 025-28678-001, -004, -102 and -103 have NPTF threads. Transducers 025-28678-006, -112, -113, -114 and 025-39464-001 have straight threads with O-rings.

After the Baltimore Parts Distribution Center depletes their stock of 025-39464-000 transducers, they will be supplying the 025-40088-000 transducer for all replacement Stall Transducers.

Upon receipt of your replacement Stall Transducer, check the part number and make appropriate connections at the transducer as follows:

Transducer 025-39464-000

Pin 1 - signal out - WHT

Pin 2 - ground - BLK

Pin 3 - +5VDC supply voltage - RED

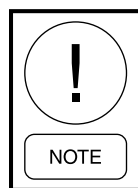
Transducer 025-40088-000

Pin 1 - +5VDC supply voltage - RED

Pin 2 - ground - BLK

Pin 3 - signal out - WHT

REPLACEMENT STALL PRESSURE TRANSDUCER



Early vintage YST chillers equipped with the Variable Geometry Diffuser were shipped with Stall Transducer(s) part number 025-39464-000. Later chillers are shipped with Stall Transducer(s) part number 025-40088-000. The operation of these transducers is exactly the same. However, they require different wiring connections as shown below.

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SECTION 19 - TEMPERATURE THERMISTORS

(Refer to Table 6 - 11)

System Refrigerant, Compressor Oil, and Chilled and Condenser (Cooling) Liquid temperatures are sensed by Thermistors. There are two different thermistor types used to sense the various system temperatures. Each type has its own YORK part number. Part numbers are listed in YORK Renewal Parts List 160.67-RP1. The Return and Leaving Chilled Liquid, Return and Leaving Condenser Cooling Liquid, Drop Leg Refrigerant and Evaporator Temperatures are sensed by 3K Ohm thermistors. The Compressor Oil and Compressor Discharge temperatures are sensed by 50K Ohm thermistors.

The 3K Ohm thermistors are defined by the characteristic of being 3000 Ohms at 77°F (25°C). Similarly, the 50K Ohm thermistors are 50,000 Ohms at the same temperature. Both thermistor types vary their resistance as the sensed temperature varies. Both are negative temperature coefficient devices. That is, as the temperature increases, the resistance decreases. As the temperature decreases, the resistance increases.

The thermistors are connected to the Microboard. A +5VDC supply voltage is applied to one side of the thermistor. The other side of the thermistor is connected to ground through a series resistor on the Microboard, thus forming a voltage divider network. The temperature applied to the thermistor determines the resistance value. The resistance value determines the amount of current that will flow through the thermistor and thus the voltage drop across it. The program reads this voltage at the input to the Microboard and converts it to a temperature value.

Each thermistor is connected to the Microboard with two wires. One wire supplies the +5VDC voltage and the other is the output of the thermistor. This output voltage can be measured with a voltmeter. Measurement should be made from the thermistor output to ground (GND). For example, the Leaving Chilled Liquid Temperature would be read from Microboard J9-20 (output) to Microboard TP1 (GND). To convert this voltage to a pressure, refer to the appropriate volts/temp chart as follows:

- Leaving Chilled Liquid Temperature – *Table 6 on page 130*
- Return Chilled Liquid Temperature – *Table 7 on page 135*
- Return and Leaving Condenser (Cooling) Liquid Temperature – *Table 8 on page 138*
- Compressor Oil and Discharge Temperature – *Table 9 on page 141*
- Drop Leg Refrigerant Temperature – *Table 10 on page 146*
- Evaporator Refrigerant Temperature – *Table 11 on page 146*

If any of the displayed pressures do not appear to be correct, refer to the “Diagnostics and Troubleshooting” section of this manual.

TABLE 6 - LEAVING CHILLED LIQUID TEMPERATURE

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
9.90	-12.28	1.4280	15.13	-9.37	1.5957	20.17	-6.57	1.7634
10.00	-12.22	1.4310	15.22	-9.32	1.5987	20.26	-6.52	1.7664
10.09	-12.17	1.4341	15.32	-9.27	1.6018	20.35	-6.47	1.7695
10.19	-12.12	1.4371	15.41	-9.22	1.6048	20.44	-6.42	1.7725
10.29	-12.06	1.4402	15.50	-9.17	1.6079	20.53	-6.37	1.7756
10.39	-12.01	1.4432	15.60	-9.11	1.6109	20.62	-6.32	1.7786
10.48	-11.96	1.4463	15.69	-9.06	1.6140	20.71	-6.27	1.7817
10.58	-11.90	1.4493	15.78	-9.01	1.6170	20.80	-6.22	1.7847
10.68	-11.85	1.4423	15.87	-8.96	1.6201	20.89	-6.17	1.7878
10.77	-11.80	1.4554	15.97	-8.91	1.6231	20.98	-6.12	1.7908
10.87	-11.74	1.4584	16.06	-8.86	1.6262	21.07	-6.07	1.7939
10.97	-11.68	1.4615	16.15	-8.81	1.6292	21.16	-6.02	1.7969
11.06	-11.63	1.4645	16.24	-8.76	1.6322	21.25	-5.97	1.8000
11.16	-11.58	1.4676	16.34	-8.70	1.6353	21.34	-5.92	1.8030
11.25	-11.53	1.4706	16.43	-8.65	1.6383	21.43	-5.87	1.8060
11.35	-11.47	1.4737	16.52	-8.60	1.6414	21.52	-5.82	1.8091
11.45	-11.42	1.4767	16.61	-8.55	1.6444	21.61	-5.77	1.8121
11.54	-11.37	1.4798	16.70	-8.50	1.6475	21.70	-5.72	1.8152
11.64	-11.31	1.4828	16.80	-8.45	1.6505	21.79	-5.67	1.8182
11.73	-11.26	1.4859	16.89	-8.40	1.6536	21.88	-5.62	1.8213
11.83	-11.21	1.4889	16.98	-8.35	1.6566	21.97	-5.57	1.8243
11.93	-11.15	1.4920	17.07	-8.30	1.6597	22.06	-5.52	1.8274
12.02	-11.10	1.4950	17.16	-8.25	1.6627	22.15	-5.47	1.8304
12.12	-11.05	1.4981	17.26	-8.19	1.6658	22.24	-5.42	1.8335
12.21	-11.00	1.5011	17.35	-8.14	1.6688	22.33	-5.37	1.8365
12.31	-10.94	1.5042	17.44	-8.09	1.6719	22.42	-5.32	1.8396
12.40	-10.89	1.5072	17.53	-8.04	1.6749	22.51	-5.27	1.8426
12.50	-10.83	1.5103	17.63	-7.98	1.6780	22.60	-5.22	1.8457
12.59	-10.78	1.5133	17.72	-7.93	1.6810	22.69	-5.17	1.8487
12.69	-10.73	1.5164	17.81	-7.88	1.6841	22.78	-5.12	1.8518
12.78	-10.68	1.5194	17.90	-7.83	1.6871	22.87	-5.07	1.8548
12.88	-10.62	1.5225	17.99	-7.78	1.6902	22.96	-5.02	1.8579
12.97	-10.57	1.5255	18.08	-7.73	1.6932	23.04	-4.98	1.8609
13.07	-10.52	1.5286	18.17	-7.68	1.6963	23.13	-4.93	1.8640
13.16	-10.47	1.5316	18.26	-7.63	1.6993	23.22	-4.88	1.8670
13.26	-10.41	1.5347	18.35	-7.58	1.7024	23.31	-4.83	1.8701
13.35	-10.36	1.5377	18.44	-7.53	1.7054	23.40	-4.78	1.8731
13.45	-10.31	1.5408	18.54	-7.48	1.7085	23.49	-4.73	1.8762
13.54	-10.26	1.5438	18.63	-7.43	1.7115	23.58	-4.68	1.8792
13.64	-10.20	1.5469	18.72	-7.38	1.7146	23.67	-4.63	1.8823
13.73	-10.15	1.5499	18.81	-7.33	1.7176	23.75	-4.58	1.8853
13.83	-10.10	1.5530	18.90	-7.28	1.7207	23.84	-4.53	1.8884
13.92	-10.05	1.5560	18.99	-7.23	1.7237	23.93	-4.48	1.8914
14.01	-10.00	1.5591	19.08	-7.18	1.7268	24.02	-4.43	1.8945
14.11	-9.94	1.5621	19.17	-7.13	1.7298	24.11	-4.38	1.8975
14.20	-9.89	1.5652	19.26	-7.08	1.7329	24.20	-4.33	1.9006
14.29	-9.84	1.5682	19.36	-7.02	1.7359	24.29	-4.28	1.9036
14.39	-9.78	1.5713	19.45	-6.97	1.7390	24.37	-4.24	1.9067
14.48	-9.73	1.5743	19.54	-6.92	1.7420	24.46	-4.19	1.9097
14.57	-9.68	1.5774	19.63	-6.87	1.7451	24.55	-4.14	1.9128
14.67	-9.63	1.5804	19.72	-6.82	1.7481	24.64	-4.09	1.9158
14.76	-9.58	1.5835	19.81	-6.77	1.7512	24.73	-4.04	1.9189
14.85	-9.53	1.5865	19.90	-6.72	1.7542	24.82	-3.99	1.9219
14.95	-9.47	1.5896	19.99	-6.67	1.7573	24.91	-3.94	1.9250
15.04	-9.42	1.5926	20.08	-6.62	1.7603	24.99	-3.89	1.9280

TABLE 6 - LEAVING CHILLED LIQUID TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
25.08	-3.84	1.9311	29.92	-1.16	2.0988	34.73	1.52	2.2665
25.17	-3.79	1.9341	30.01	-1.11	2.1018	34.82	1.57	2.2695
25.26	-3.74	1.9372	30.10	-1.06	2.1049	34.91	1.62	2.2726
25.35	-3.69	1.9402	30.18	-1.01	2.1079	34.99	1.66	2.2756
25.43	-3.65	1.9433	30.27	-0.96	2.1110	35.08	1.71	2.2787
25.52	-3.60	1.9463	30.36	-0.91	2.1140	35.17	1.76	2.2817
25.61	-3.55	1.9494	30.45	-0.86	2.1171	35.26	1.81	2.2848
25.70	-3.50	1.9524	30.53	-0.82	2.1201	35.34	1.86	2.2878
25.79	-3.45	1.9555	30.62	-0.77	2.1232	35.43	1.91	2.2909
25.87	-3.41	1.9585	30.71	-0.72	2.1262	35.52	1.96	2.2939
25.96	-3.36	1.9616	30.79	-0.67	2.1293	35.51	1.95	2.2970
26.05	-3.31	1.9646	30.88	-0.62	2.1323	35.70	2.06	2.3000
26.14	-3.26	1.9677	30.97	-0.57	2.1354	35.78	2.10	2.3031
26.23	-3.21	1.9707	31.06	-0.52	2.1384	35.87	2.15	2.3061
26.31	-3.16	1.9738	31.14	-0.48	2.1415	35.96	2.20	2.3092
26.40	-3.11	1.9768	31.23	-0.43	2.1445	36.05	2.25	2.3122
26.49	-3.06	1.9798	31.32	-0.38	2.1476	36.13	2.29	2.3153
26.58	-3.01	1.9829	31.41	-0.33	2.1506	36.22	2.34	2.3183
26.67	-2.96	1.9859	31.49	-0.28	2.1536	36.31	2.39	2.3214
26.76	-2.91	1.9890	31.58	-0.23	2.1567	36.40	2.44	2.3244
26.84	-2.87	1.9920	31.67	-0.18	2.1597	36.48	2.49	2.3274
26.93	-2.82	1.9951	31.76	-0.13	2.1628	36.57	2.54	2.3305
27.02	-2.77	1.9981	31.84	-0.09	2.1658	36.66	2.59	2.3335
27.11	-2.72	2.0012	31.93	-0.04	2.1689	36.75	2.64	2.3366
27.20	-2.67	2.0042	32.02	0.01	2.1719	36.83	2.68	2.3396
27.28	-2.62	2.0073	32.10	0.06	2.1750	36.92	2.73	2.3427
27.37	-2.57	2.0103	32.19	0.11	2.1780	37.01	2.78	2.3457
27.46	-2.52	2.0134	32.28	0.16	2.1811	37.10	2.83	2.3488
27.55	-2.47	2.0164	32.37	0.21	2.1841	37.18	2.88	2.3518
27.64	-2.42	2.0195	32.45	0.25	2.1872	37.27	2.93	2.3549
27.73	-2.37	2.0225	32.54	0.30	2.1902	37.36	2.98	2.3579
27.81	-2.33	2.0256	32.63	0.35	2.1933	37.45	3.03	2.3610
27.90	-2.28	2.0286	32.72	0.40	2.1963	37.54	3.08	2.3640
27.99	-2.23	2.0317	32.81	0.45	2.1994	37.62	3.12	2.3671
28.08	-2.18	2.0347	32.89	0.49	2.2024	37.71	3.17	2.3701
28.17	-2.13	2.0378	32.98	0.54	2.2055	37.80	3.22	2.3732
28.25	-2.08	2.0408	33.07	0.59	2.2085	37.89	3.27	2.3762
28.34	-2.03	2.0439	33.16	0.64	2.2116	37.98	3.32	2.3793
28.43	-1.98	2.0469	33.24	0.69	2.2146	38.07	3.37	2.3823
28.52	-1.93	2.0500	33.33	0.74	2.2177	38.15	3.42	2.3854
28.61	-1.88	2.0530	33.42	0.79	2.2207	38.24	3.47	2.3884
28.69	-1.84	2.0561	33.51	0.84	2.2238	38.33	3.52	2.3915
28.78	-1.79	2.0591	33.59	0.88	2.2268	38.42	3.57	2.3945
28.87	-1.74	2.0622	33.68	0.93	2.2299	38.51	3.62	2.3976
28.96	-1.69	2.0652	33.77	0.98	2.2329	38.60	3.67	2.4006
29.04	-1.64	2.0683	33.86	1.03	2.2360	38.69	3.72	2.4037
29.13	-1.59	2.0713	33.94	1.08	2.2390	38.77	3.76	2.4067
29.22	-1.54	2.0744	34.03	1.13	2.2421	38.86	3.81	2.4098
29.31	-1.49	2.0774	34.12	1.18	2.2451	38.95	3.86	2.4128
29.39	-1.45	2.0805	34.21	1.23	2.2482	39.04	3.91	2.4159
29.48	-1.40	2.0835	34.29	1.27	2.2512	39.13	3.96	2.4189
29.57	-1.35	2.0866	34.38	1.32	2.2543	39.22	4.01	2.4220
29.66	-1.30	2.0896	34.47	1.37	2.2573	39.30	4.06	2.4250
29.75	-1.25	2.0927	34.56	1.42	2.2604	39.39	4.11	2.4281
29.83	-1.21	2.0957	34.64	1.47	2.2634	39.48	4.16	2.4311

TABLE 6 - LEAVING CHILLED LIQUID TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
39.57	4.21	2.4342	44.46	6.92	2.6019	49.48	9.71	2.7696
39.66	4.26	2.4372	44.55	6.97	2.6049	49.57	9.76	2.7726
39.74	4.30	2.4403	44.64	7.02	2.6080	49.66	9.81	2.7757
39.83	4.35	2.4433	44.73	7.07	2.6110	49.75	9.86	2.7787
39.92	4.40	2.4464	44.82	7.12	2.6141	49.84	9.91	2.7818
40.01	4.45	2.4494	44.91	7.17	2.6171	49.94	9.97	2.7848
40.10	4.50	2.4525	45.00	7.22	2.6202	50.03	10.02	2.7879
40.19	4.55	2.4555	45.09	7.27	2.6232	50.12	10.07	2.7909
40.27	4.59	2.4586	45.18	7.32	2.6263	50.22	10.12	2.7940
40.36	4.64	2.4616	45.27	7.37	2.6293	50.31	10.17	2.7970
40.45	4.69	2.4647	45.36	7.42	2.6324	50.40	10.22	2.8001
40.54	4.74	2.4677	45.46	7.48	2.6354	50.50	10.28	2.8031
40.63	4.79	2.4708	45.55	7.53	2.6385	50.59	10.33	2.8062
40.71	4.84	2.4738	45.64	7.58	2.6415	50.68	10.38	2.8092
40.80	4.89	2.4769	45.73	7.63	2.6446	50.78	10.43	2.8123
40.89	4.94	2.4799	45.82	7.68	2.6476	50.87	10.48	2.8153
40.98	4.99	2.4830	45.91	7.73	2.6507	50.96	10.53	2.8184
41.07	5.04	2.4860	46.00	7.78	2.6537	51.06	10.59	2.8214
41.16	5.09	2.4891	46.09	7.83	2.6568	51.15	10.64	2.8245
41.24	5.13	2.4921	46.18	7.88	2.6598	51.24	10.69	2.8275
41.33	5.18	2.4952	46.27	7.93	2.6629	51.34	10.75	2.8306
41.42	5.23	2.4982	46.36	7.98	2.6659	51.43	10.80	2.8336
41.51	5.28	2.5012	46.45	8.03	2.6690	51.52	10.85	2.8367
41.60	5.33	2.5043	46.55	8.08	2.6720	51.62	10.90	2.8397
41.69	5.38	2.5073	46.64	8.13	2.6751	51.71	10.95	2.8428
41.78	5.43	2.5104	46.73	8.18	2.6781	51.80	11.00	2.8458
41.87	5.48	2.5134	46.82	8.23	2.6811	51.90	11.06	2.8458
41.96	5.53	2.5165	46.91	8.28	2.6842	51.99	11.11	2.8519
42.05	5.58	2.5195	47.00	8.33	2.6872	52.09	11.16	2.8549
42.14	5.63	2.5226	47.09	8.38	2.6903	52.18	11.21	2.8580
42.23	5.68	2.5256	47.18	8.43	2.6933	52.28	11.27	2.8610
42.31	5.73	2.5287	47.27	8.48	2.6964	52.37	11.32	2.8641
42.40	5.78	2.5317	47.36	8.53	2.6994	52.46	11.37	2.8671
42.49	5.83	2.5348	47.45	8.58	2.7025	52.56	11.42	2.8702
42.58	5.88	2.5378	47.55	8.64	2.7055	52.65	11.47	2.8732
42.67	5.93	2.5409	47.64	8.69	2.7086	52.75	11.53	2.8763
42.76	5.98	2.5439	47.73	8.74	2.7116	52.84	11.58	2.8793
42.85	6.03	2.5470	47.82	8.79	2.7147	52.94	11.63	2.8824
42.94	6.08	2.5500	47.91	8.84	2.7177	53.03	11.68	2.8854
43.03	6.13	2.5531	48.00	8.89	2.7208	53.13	11.74	2.8885
43.12	6.18	2.5561	48.09	8.94	2.7238	53.22	11.79	2.8915
43.21	6.23	2.5592	48.18	8.99	2.7269	53.32	11.85	2.8946
43.30	6.28	2.5622	48.27	9.04	2.7299	53.41	11.90	2.8976
43.39	6.33	2.5653	48.37	9.10	2.7330	53.51	11.95	2.9007
43.48	6.38	2.5683	48.46	9.15	2.7360	53.60	12.00	2.9037
43.57	6.43	2.5714	48.55	9.20	2.7391	53.70	12.06	2.9068
43.65	6.47	2.5744	48.64	9.25	2.7421	53.79	12.11	2.9098
43.74	6.52	2.5775	48.74	9.30	2.7452	53.89	12.16	2.9129
43.83	6.57	2.5805	48.83	9.35	2.7482	53.98	12.21	2.9159
43.92	6.62	2.5836	48.92	9.40	2.7513	54.08	12.27	2.9190
44.01	6.67	2.5866	49.01	9.45	2.7543	54.17	12.32	2.9220
44.10	6.72	2.5897	49.11	9.51	2.7574	54.27	12.37	2.9251
44.19	6.77	2.5927	49.20	9.56	2.7604	54.36	12.42	2.9281
44.28	6.82	2.5958	49.29	9.61	2.7635	54.46	12.48	2.9312
44.37	6.87	2.5988	49.38	9.66	2.7665	54.55	12.53	2.9342

TABLE 6 - LEAVING CHILLED LIQUID TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
54.65	12.58	2.9373	60.05	15.58	3.1050	65.75	18.75	3.2727
54.74	12.63	2.9403	60.15	15.64	3.1080	65.85	18.81	3.2757
54.84	12.69	2.9403	60.25	15.70	3.1111	65.96	18.87	3.2788
54.93	12.74	2.9464	60.36	15.76	3.1141	66.06	18.92	3.2818
55.03	12.80	2.9495	60.46	15.81	3.1172	66.17	18.98	3.2849
55.12	12.85	2.9525	60.56	15.87	3.1202	66.28	19.05	3.2879
55.22	12.90	2.9556	60.66	15.92	3.1233	66.39	19.11	3.2910
55.32	12.96	2.9586	60.76	15.98	3.1263	66.49	19.16	3.2940
55.41	13.01	2.9617	60.86	16.03	3.1294	66.60	19.22	3.2971
55.51	13.06	2.9647	60.96	16.09	3.1324	66.71	19.28	3.3001
55.61	13.12	2.9678	61.06	16.15	3.1355	66.82	19.35	3.3032
55.70	13.17	2.9708	61.17	16.21	3.1385	66.93	19.41	3.3062
55.80	13.22	2.9739	61.27	16.26	3.1416	67.03	19.46	3.3093
55.90	13.28	2.9769	61.37	16.32	3.1446	67.14	19.52	3.3123
56.00	13.33	2.9800	61.47	16.37	3.1477	67.25	19.58	3.3154
56.09	13.38	2.9830	61.57	16.43	3.1507	67.36	19.65	3.3184
56.19	13.44	2.9861	61.67	16.48	3.1538	67.47	19.71	3.3215
56.29	13.50	2.9891	61.78	16.55	3.1568	67.58	19.77	3.3245
56.39	13.55	2.9922	61.88	16.60	3.1599	67.68	19.82	3.3276
56.48	13.60	2.9952	61.98	16.66	3.1629	67.79	19.88	3.3306
56.58	13.66	2.9983	62.08	16.71	3.1660	67.90	19.95	3.3337
56.68	13.71	3.0013	62.18	16.77	3.1690	68.01	20.01	3.3367
56.78	13.77	3.0044	62.28	16.82	3.1721	68.12	20.07	3.3398
56.87	13.82	3.0074	62.39	16.88	3.1751	68.23	20.13	3.3428
56.97	13.87	3.0105	62.49	16.94	3.1782	68.34	20.19	3.3459
57.07	13.93	3.0135	62.59	17.00	3.1812	68.45	20.25	3.3489
57.17	13.98	3.0166	62.69	17.05	3.1843	68.56	20.31	3.3520
57.26	14.03	3.0196	62.80	17.11	3.1873	68.67	20.37	3.3550
57.36	14.09	3.0227	62.90	17.17	3.1904	68.78	20.43	3.3581
57.46	14.15	3.0257	63.01	17.23	3.1934	68.90	20.50	3.3611
57.56	14.20	3.0287	63.11	17.28	3.1965	69.01	20.56	3.3642
57.66	14.26	3.0318	63.22	17.35	3.1995	69.12	20.62	3.3672
57.76	14.31	3.0348	63.32	17.40	3.2025	69.23	20.68	3.3703
57.86	14.37	3.0379	63.43	17.46	3.2056	69.34	20.75	3.3733
57.96	14.42	3.0409	63.53	17.52	3.2086	69.45	20.81	3.3763
58.06	14.48	3.0440	63.63	17.57	3.2117	69.56	20.87	3.3794
58.15	14.53	3.0470	63.74	17.63	3.2147	69.67	20.93	3.3824
58.25	14.58	3.0501	63.84	17.69	3.2178	69.78	20.99	3.3855
58.35	14.64	3.0531	63.95	17.75	3.2208	69.89	21.05	3.3885
58.45	14.70	3.0562	64.05	17.81	3.2239	70.01	21.12	3.3916
58.55	14.75	3.0592	64.16	17.87	3.2269	70.12	21.18	3.3946
58.65	14.81	3.0623	64.26	17.92	3.2300	70.24	21.25	3.3977
58.75	14.86	3.0653	64.37	17.98	3.2330	70.35	21.31	3.4007
58.85	14.92	3.0684	64.47	18.04	3.2361	70.46	21.37	3.4038
58.95	14.97	3.0714	64.58	18.10	3.2391	70.58	21.44	3.4068
59.05	15.03	3.0745	64.68	18.16	3.2422	70.69	21.50	3.4099
59.15	15.08	3.0775	64.79	18.22	3.2452	70.80	21.56	3.4129
59.25	15.14	3.0806	64.90	18.28	3.2483	70.92	21.62	3.4160
59.35	15.20	3.0836	65.00	18.33	3.2513	71.03	21.69	3.4190
59.45	15.25	3.0867	65.11	18.40	3.2544	71.15	21.75	3.4221
59.55	15.31	3.0897	65.21	18.45	3.2574	71.26	21.81	3.4251
59.65	15.36	3.0928	65.32	18.51	3.2605	71.37	21.87	3.4282
59.75	15.42	3.0958	65.43	18.57	3.2635	71.49	21.94	3.4312
59.85	15.47	3.0989	65.53	18.63	3.2666	71.60	22.00	3.4343
59.95	15.53	3.1019	65.64	18.69	3.2696	71.72	22.07	3.4373

TABLE 6 - LEAVING CHILLED LIQUID TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
71.83	22.13	3.4404	78.42	25.79	3.6081
71.95	22.20	3.4434	78.55	25.86	3.6111
72.06	22.26	3.4465	78.67	25.93	3.6142
72.18	22.32	3.4495	78.80	26.00	3.6172
72.29	22.39	3.4526	78.93	26.07	3.6203
72.41	22.45	3.4556	79.05	26.14	3.6233
72.52	22.51	3.4587	79.18	26.21	3.6264
72.64	22.58	3.4617	79.31	26.29	3.6294
72.75	22.64	3.4648	79.44	26.36	3.6325
72.87	22.71	3.4678	79.57	26.43	3.6355
72.98	22.77	3.4709	79.69	26.50	3.6386
73.10	22.84	3.4739	79.82	26.57	3.6416
73.21	22.90	3.4770	79.95	26.64	3.6447
73.33	22.96	3.4800	80.08	26.71	3.6477
73.44	23.02	3.4831	80.20	26.78	3.6508
73.56	23.09	3.4861	80.33	26.85	3.6538
73.68	23.16	3.4892	80.46	26.92	3.6569
73.80	23.22	3.4922	80.59	27.00	3.6599
73.92	23.29	3.4953	80.72	27.07	3.6630
74.04	23.36	3.4983	80.85	27.14	3.6660
74.16	23.42	3.5014	80.98	27.21	3.6691
74.28	23.49	3.5044	81.11	27.29	3.6721
74.40	23.56	3.0575	81.24	27.36	3.6752
74.52	23.62	3.5105	81.37	27.43	3.6782
74.64	23.69	3.5136	81.50	27.50	3.6813
74.75	23.75	3.5166	81.63	27.57	3.6843
74.87	23.82	3.5197	81.76	27.65	3.6874
74.99	23.89	3.5227	81.89	27.72	3.6904
75.11	23.95	3.5258	82.02	27.79	3.6935
75.23	24.02	3.5288	82.15	27.86	3.6965
75.35	24.09	3.5319	82.28	27.94	3.6996
75.47	24.15	3.5349	82.41	28.01	3.7026
75.60	24.22	3.5380			
75.72	24.29	3.5410			
75.84	24.36	3.5441			
75.96	24.42	3.5471			
76.08	24.49	3.5501			
76.20	24.56	3.5532			
76.32	24.62	3.5562			
76.44	24.69	3.5593			
76.57	24.76	3.5623			
76.69	24.83	3.5654			
76.81	24.90	3.5684			
76.93	24.96	3.5715			
77.05	25.03	3.5745			
77.18	25.10	3.5776			
77.30	25.17	3.5806			
77.43	25.24	3.5837			
77.55	25.31	3.5867			
77.68	25.38	3.5898			
77.80	25.45	3.5928			
77.93	25.52	3.5959			
78.05	25.59	3.5989			
78.17	25.65	3.6020			
78.30	25.72	3.6050			

TABLE 7 - RETURN CHILLED LIQUID TEMPERATURE

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
15.01	-9.44	1.5918	23.03	-4.98	1.8604	30.78	-0.68	2.1289
15.16	-9.36	1.5967	23.17	-4.91	1.8652	30.92	-0.60	2.1338
15.31	-9.27	1.6016	23.31	-4.83	1.8701	31.06	-0.52	2.1387
15.46	-9.19	1.6064	23.45	-4.75	1.8750	31.20	-0.44	2.1436
15.61	-9.11	1.6113	23.60	-4.67	1.8799	31.34	-0.37	2.1484
15.76	-9.02	1.6162	23.74	-4.59	1.8848	31.48	-0.29	2.1533
15.91	-8.94	1.6211	23.88	-4.51	1.8896	31.62	-0.21	2.1582
16.05	-8.86	1.6260	24.02	-4.43	1.8945	31.76	-0.13	2.1631
16.20	-8.78	1.6309	24.16	-4.36	1.8994	31.90	-0.06	2.1680
16.35	-8.70	1.6357	24.31	-4.27	1.9043	32.04	0.02	2.1729
16.50	-8.61	1.6406	24.45	-4.19	1.9092	32.18	0.10	2.1777
16.64	-8.53	1.6455	24.59	-4.12	1.9141	32.32	0.18	2.1826
16.79	-8.45	1.6504	24.73	-4.04	1.9189	32.46	0.26	2.1875
16.94	-8.37	1.6553	24.87	-3.96	1.9238	32.60	0.33	2.1924
17.09	-8.28	1.6602	25.01	-3.88	1.9287	32.74	0.41	2.1973
17.23	-8.21	1.6650	25.16	-3.80	1.9336	32.88	0.49	2.2021
17.38	-8.12	1.6699	25.30	-3.72	1.9385	33.02	0.57	2.2070
17.53	-8.04	1.6748	25.44	-3.64	1.9434	33.16	0.64	2.2119
17.68	-7.96	1.6797	25.58	-3.57	1.9482	33.30	0.72	2.2168
17.82	-7.88	1.6846	25.72	-3.49	1.9531	33.44	0.80	2.2217
17.97	-7.80	1.6895	25.86	-3.41	1.9580	33.59	0.88	2.2266
18.11	-7.72	1.6943	26.00	-3.33	1.9629	33.73	0.96	2.2314
18.26	-7.63	1.6992	26.14	-3.26	1.9678	33.87	1.04	2.2363
18.41	-7.55	1.7041	26.28	-3.18	1.9727	34.01	1.12	2.2412
18.55	-7.47	1.7090	26.42	-3.10	1.9775	34.15	1.19	2.2461
18.70	-7.39	1.7139	26.56	-3.02	1.9824	34.29	1.27	2.2510
18.84	-7.31	1.7188	26.71	-2.94	1.9873	34.43	1.35	2.2559
18.99	-7.23	1.7236	26.85	-2.86	1.9922	34.57	1.43	2.2607
19.13	-7.15	1.7285	26.99	-2.78	1.9971	34.71	1.51	2.2656
19.28	-7.07	1.7334	27.13	-2.71	2.0020	34.85	1.58	2.2705
19.43	-6.98	1.7383	27.27	-2.63	2.0068	34.99	1.66	2.2754
19.57	-6.91	1.7432	27.41	-2.55	2.0117	35.13	1.74	2.2803
19.71	-6.83	1.7480	27.55	-2.47	2.0166	35.27	1.82	2.2852
19.86	-6.74	1.7529	27.70	-2.39	2.0215	35.41	1.89	2.2900
20.00	-6.67	1.7578	27.84	-2.31	2.0264	35.55	1.97	2.2949
20.15	-6.58	1.7627	27.98	-2.23	2.0313	35.69	2.05	2.2998
20.29	-6.51	1.7676	28.12	-2.16	2.0361	35.83	2.13	2.3047
20.44	-6.42	1.7725	28.26	-2.08	2.0410	35.97	2.21	2.3096
20.58	-6.34	1.7773	28.40	-2.00	2.0459	36.11	2.28	2.3145
20.73	-6.26	1.7822	28.54	-1.92	2.0508	36.25	2.36	2.3193
20.87	-6.18	1.7871	28.68	-1.84	2.0557	36.39	2.44	2.3242
21.01	-6.11	1.7920	28.82	-1.77	2.0605	36.53	2.52	2.3291
21.16	-6.02	1.7969	28.96	-1.69	2.0654	36.67	2.59	2.3340
21.30	-5.94	1.8018	29.10	-1.61	2.0703	36.81	2.67	2.3389
21.45	-5.86	1.8066	29.24	-1.53	2.0752	36.95	2.75	2.3438
21.59	-5.78	1.8115	29.38	-1.46	2.0801	37.09	2.83	2.3486
21.73	-5.71	1.8164	29.52	-1.38	2.0850	37.23	2.91	2.3535
21.88	-5.62	1.8213	29.66	-1.30	2.0898	37.37	2.98	2.3584
22.02	-5.54	1.8262	29.80	-1.22	2.0947	37.51	3.06	2.3633
22.17	-5.46	1.8311	29.94	-1.14	2.0996	37.66	3.14	2.3682
22.31	-5.38	1.8359	30.08	-1.07	2.1045	37.80	3.22	2.3730
22.45	-5.31	1.8408	30.22	-0.99	2.1094	37.94	3.30	2.3779
22.60	-5.22	1.8457	30.36	-0.91	2.1143	38.08	3.38	2.3828
22.74	-5.14	1.8506	30.50	-0.83	2.1191	38.22	3.46	2.3877
22.88	-5.07	1.8555	30.64	-0.76	2.1240	38.36	3.53	2.3926

TABLE 7 - RETURN CHILLED LIQUID TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
38.51	3.62	2.3975	46.37	7.98	2.6660	54.56	12.53	2.9346
38.65	3.69	2.4023	46.51	8.06	2.6709	54.72	12.62	2.9395
38.79	3.77	2.4072	46.66	8.15	2.6758	54.87	12.71	2.9443
38.93	3.85	2.4121	46.80	8.22	2.6807	55.02	12.79	2.9492
39.07	3.93	2.4170	46.95	8.31	2.6855	55.17	12.87	2.9541
39.21	4.01	2.4219	47.09	8.38	2.6904	55.33	12.96	2.9590
39.35	4.08	2.4268	47.24	8.47	2.6953	55.48	13.05	2.9639
39.50	4.17	2.4316	47.39	8.55	2.7002	55.64	13.13	2.9688
39.64	4.24	2.4365	47.53	8.63	2.7051	55.79	13.22	2.9736
39.78	4.32	2.4414	47.68	8.71	2.7100	55.95	13.31	2.9785
39.92	4.40	2.4463	47.82	8.79	2.7148	56.11	13.40	2.9834
40.06	4.48	2.4512	47.97	8.87	2.7197	56.26	13.48	2.9983
40.20	4.56	2.4561	48.11	8.95	2.7246	56.42	13.57	2.9932
40.34	4.63	2.4609	48.26	9.03	2.7295	56.57	13.65	2.9980
40.48	4.71	2.4658	48.41	9.12	2.7344	56.73	13.74	3.0029
40.62	4.79	2.4707	48.56	9.20	2.7393	56.89	13.83	3.0078
40.76	4.87	2.4756	48.70	9.28	2.7441	57.04	13.91	3.0127
40.91	4.95	2.4805	48.85	9.36	2.7490	57.20	14.00	3.0176
41.05	5.03	2.4854	49.00	9.45	2.7539	57.36	14.09	3.0225
41.19	5.11	2.4902	49.15	9.53	2.7588	57.51	14.17	3.0273
41.33	5.18	2.4951	49.30	9.61	2.7637	57.67	14.26	3.0322
41.48	5.27	2.5000	49.44	9.69	2.7686	57.83	14.35	3.0371
41.62	5.34	2.5049	49.59	9.77	2.7734	57.99	14.44	3.0420
41.76	5.42	2.5098	49.74	9.86	2.7783	58.15	14.53	3.0469
41.90	5.50	2.5146	49.89	9.94	2.7832	58.31	14.62	3.0518
42.05	5.58	2.5195	50.04	10.02	2.7881	58.47	14.71	3.0566
42.19	5.66	2.5244	50.19	10.11	2.7930	58.62	14.79	3.0615
42.33	5.74	2.5293	50.34	10.19	2.7979	58.78	14.88	3.0664
42.48	5.82	2.5342	50.48	10.27	2.8027	58.94	14.97	3.0713
42.62	5.90	2.5391	50.63	10.35	2.8076	59.10	15.06	3.0762
42.76	5.98	2.5439	50.78	10.43	2.8125	59.26	15.15	3.0811
42.90	6.06	2.5488	50.93	10.52	2.8174	59.42	15.23	3.0859
43.05	6.14	2.5537	51.08	10.60	2.8223	59.59	15.33	3.0908
43.19	6.22	2.5586	51.23	10.68	2.8271	59.75	15.42	3.0957
43.33	6.29	2.5635	51.38	10.77	2.8320	59.91	15.51	3.1006
43.48	6.38	2.5684	51.53	10.85	2.8369	60.07	15.60	3.1055
43.62	6.46	2.5732	51.68	10.93	2.8418	60.23	15.68	3.1104
43.76	6.53	2.5781	51.83	11.02	2.8467	60.39	15.77	3.1152
43.91	6.62	2.5830	51.98	11.10	2.8516	60.55	15.86	3.1201
44.05	6.69	2.5879	52.13	11.18	2.8564	60.72	15.96	3.1250
44.19	6.77	2.5928	52.28	11.27	2.8613	60.88	16.05	3.1299
44.34	6.86	2.5977	52.44	11.36	2.8662	61.04	16.13	3.1348
44.48	6.93	2.6025	52.59	11.44	2.8711	61.20	16.22	3.1396
44.62	7.01	2.6074	52.74	11.52	2.8760	61.37	16.32	3.1445
44.77	7.10	2.6123	52.89	11.61	2.8809	61.53	16.41	3.1494
44.91	7.17	2.6172	53.04	11.69	2.8857	61.69	16.50	3.1543
45.06	7.26	2.6221	53.19	11.77	2.8906	61.85	16.58	3.1592
45.20	7.33	2.6270	53.34	11.86	2.8955	62.02	16.68	3.1641
45.35	7.42	2.6318	53.50	11.95	2.9004	62.18	16.77	3.1689
45.49	7.50	2.6367	53.65	12.03	2.9053	62.34	16.86	3.1738
45.64	7.58	2.6416	53.80	12.11	2.9102	62.51	16.95	3.1787
45.79	7.66	2.6465	53.95	12.20	2.0150	62.67	17.04	3.1836
45.93	7.74	2.6514	54.11	12.28	2.9199	62.84	17.13	3.1885
46.08	7.82	2.6563	54.26	12.37	2.9248	63.01	17.23	3.1934
46.22	7.90	2.6611	54.41	12.45	2.9297	63.17	17.32	3.1882

TABLE 7 - RETURN CHILLED LIQUID TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
63.34	17.41	3.2031	73.01	22.79	3.4717
63.51	17.51	3.2080	73.20	22.89	3.4766
63.68	17.60	3.2129	73.38	22.99	3.4814
63.84	17.69	3.2178	73.57	23.10	3.4863
64.01	17.78	3.2227	73.76	23.20	3.4912
64.18	17.88	3.2275	73.95	23.31	3.4961
64.34	17.97	3.2324	74.14	23.41	3.5010
64.51	18.06	3.2373	74.33	23.52	3.5059
64.68	18.16	3.2422	74.53	23.63	3.5107
64.85	18.25	3.2471	74.72	23.74	3.5156
65.02	18.35	3.2520	74.91	23.84	3.5205
65.19	18.44	3.2568	75.10	23.95	3.5254
65.36	18.53	3.2617	75.29	24.05	3.5303
65.53	18.63	3.2666	75.48	24.16	3.5352
65.70	18.72	3.2715	75.68	24.27	3.5400
65.87	18.82	3.2764	75.87	24.37	3.5449
66.04	18.91	3.2813	76.07	24.49	3.5498
66.21	19.01	3.2861	76.26	24.59	3.5547
66.39	19.11	3.2910	76.46	24.70	3.5596
66.56	19.20	3.2959	76.65	24.81	3.5645
66.73	19.30	3.3008	76.84	24.91	3.5693
66.91	19.40	3.3057	77.04	25.02	3.5742
67.08	19.49	3.3105	77.24	25.14	3.5791
67.25	19.58	3.3154	77.44	25.25	3.5840
67.43	19.68	3.3203	77.64	25.36	3.5889
67.60	19.78	3.3252	77.84	25.47	3.5938
67.77	19.87	3.3301	78.04	25.58	3.5986
67.95	19.97	3.3350	78.24	25.69	3.6035
68.12	20.07	3.3398	78.44	25.80	3.6084
68.30	20.17	3.3447	78.64	25.91	3.6133
68.48	20.27	3.3496	78.84	26.02	3.6182
68.66	20.37	3.3545	79.04	26.14	3.6230
68.83	20.46	3.3594	79.25	26.25	3.6279
69.01	20.56	3.3643	79.45	26.36	3.6328
69.19	20.66	3.3691	79.66	26.48	3.6377
69.36	20.76	3.3740	79.86	26.59	3.6426
69.54	20.86	3.3789	80.07	26.71	3.6475
69.72	20.96	3.3838	80.27	26.82	3.6523
69.90	21.06	3.3887	80.48	26.94	3.6572
70.08	21.16	3.3936	80.68	27.05	3.6621
70.26	21.26	3.3984	80.89	27.16	3.6670
70.45	21.36	3.4033	81.10	27.28	3.6719
70.63	21.46	3.4082	81.31	27.40	3.6768
70.81	21.56	3.4131	81.52	27.51	3.6816
70.99	21.66	3.4180	81.72	27.62	3.6865
71.17	21.76	3.4229	81.93	27.74	3.6914
71.36	21.87	3.4277	82.14	27.86	3.6963
71.54	21.97	3.4326	82.35	27.97	3.7012
71.72	22.07	3.4375	82.56	28.09	3.7061
71.91	22.17	3.4424			
72.09	22.27	3.4473			
72.28	22.38	3.4521			
72.46	22.48	3.4570			
72.64	22.58	3.4619			
72.83	22.69	3.4668			

TABLE 8 - RETURN AND LEAVING CONDENSER (COOLING) LIQUID

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
40.12	4.51	1.8408	48.39	9.11	2.1094	56.61	13.67	2.3779
40.27	4.59	1.8457	48.54	9.19	2.1143	56.76	13.76	2.3828
40.42	4.68	1.8506	48.69	9.27	2.1191	56.91	13.84	2.3877
40.58	4.77	1.8555	48.84	9.36	2.1240	57.06	13.92	2.3926
40.73	4.85	1.8604	48.99	9.44	2.1289	57.21	14.01	2.3975
40.88	4.93	1.8652	49.14	9.52	2.1338	57.36	14.09	2.4023
41.03	5.02	1.8701	49.29	9.61	2.1387	57.51	14.17	2.4072
41.18	5.10	1.8750	49.44	9.69	2.1436	57.66	14.26	2.4121
41.33	5.18	1.8799	49.59	9.77	2.1484	57.81	14.34	2.4170
41.48	5.27	1.8848	49.74	9.86	2.1533	57.97	14.43	2.4219
41.64	5.36	1.8896	49.89	9.94	2.1582	58.12	14.51	2.4268
41.79	5.44	1.8945	50.03	10.02	2.1631	58.27	14.60	2.4316
41.94	5.52	1.8994	50.18	10.10	2.1680	58.42	14.68	2.4365
42.09	5.61	1.9043	50.33	10.18	2.1729	58.57	14.76	2.4414
42.24	5.69	1.9092	50.48	10.27	2.1777	58.72	14.85	2.4463
42.39	5.77	1.9141	50.63	10.35	2.1826	58.87	14.93	2.4512
42.54	5.86	1.9189	50.78	10.43	2.1875	59.02	15.01	2.4561
42.70	5.94	1.9238	50.93	10.52	2.1924	59.17	15.10	2.4609
42.85	6.03	1.9287	51.08	10.60	2.1973	59.33	15.18	2.4658
43.00	6.11	1.9336	51.23	10.68	2.2021	59.48	15.27	2.4707
43.15	6.19	1.9385	51.38	10.77	2.2070	59.63	15.35	2.4756
43.30	6.28	1.9434	51.53	10.85	2.2119	59.78	15.43	2.4805
43.45	6.36	1.9482	51.68	10.93	2.1268	59.93	15.52	2.4854
43.60	6.44	1.9531	51.83	11.02	2.2217	60.09	15.61	2.4902
43.75	6.53	1.9580	51.97	11.10	2.2266	60.24	15.69	2.4951
43.90	6.61	1.9629	52.12	11.18	2.2314	60.39	15.77	2.5000
44.05	6.69	1.9678	52.27	11.26	2.2363	60.54	15.86	2.5049
44.20	6.78	1.9727	52.42	11.35	2.2412	60.69	15.94	2.5098
44.35	6.86	1.9775	52.57	11.43	2.2461	60.85	16.03	2.5146
44.50	6.95	1.9824	52.72	11.51	2.2510	61.00	16.11	2.5195
44.65	7.03	1.9873	52.87	11.60	2.2559	61.15	16.20	2.5244
44.80	7.11	1.9922	53.02	11.68	2.2607	61.30	16.28	2.5293
44.95	7.20	1.9971	53.17	11.76	2.2656	61.45	16.36	2.5342
45.10	7.28	2.0020	53.32	11.85	2.2705	61.61	16.45	2.5391
45.25	7.36	2.0068	53.47	11.93	2.2754	61.76	16.53	2.5439
45.40	7.45	2.0117	53.62	12.01	2.2803	61.91	16.62	2.5488
45.55	7.53	2.0166	53.77	12.10	2.2852	62.06	16.70	2.5537
45.70	7.61	2.0215	53.92	12.18	2.2900	62.21	16.78	2.5586
45.85	7.70	2.0264	54.07	12.26	2.2949	62.36	16.87	2.5635
46.00	7.78	2.0313	54.21	12.34	2.2998	62.52	16.96	2.5684
46.15	7.86	2.0361	54.36	12.42	2.3047	62.67	17.04	2.5732
46.30	7.95	2.0410	54.51	12.51	2.3096	62.82	17.12	2.5781
46.45	8.03	2.0459	54.66	12.59	2.3145	62.98	17.21	2.5830
46.60	8.11	2.0508	54.81	12.67	2.3193	63.13	17.30	2.5879
46.75	8.20	2.0557	54.96	12.76	2.3242	63.29	17.38	2.5928
46.90	8.28	2.0605	55.11	12.84	2.3291	63.44	17.47	2.5977
47.05	8.36	2.0654	55.26	12.92	2.3340	63.59	17.55	2.6025
47.20	8.45	2.0703	55.41	13.01	2.3389	63.75	17.64	2.6074
47.35	8.53	2.0752	55.56	13.09	2.3438	63.90	17.72	2.6123
47.50	8.61	2.0801	55.71	13.17	2.3486	64.06	17.81	2.6172
47.65	8.70	2.0850	55.86	13.26	2.3535	64.21	17.90	2.6221
47.79	8.77	2.0898	56.01	13.34	2.3584	64.36	17.98	2.6270
47.94	8.86	2.0947	56.16	13.42	2.3633	64.52	18.07	2.6318
48.09	8.94	2.0996	56.31	13.51	2.3682	64.52	18.07	2.6367
48.24	9.02	2.1045	56.46	13.59	2.3730	64.83	18.24	2.6416

TABLE 8 – RETURN AND LEAVING CONDENSER (COOLING) LIQUID (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
64.98	18.32	2.6465	73.71	23.17	2.9150	83.04	28.36	3.1836
65.14	18.41	2.6514	73.87	23.26	2.9199	83.22	28.46	3.1885
65.29	18.50	2.6563	74.04	23.36	2.9248	83.39	28.55	3.1934
65.45	18.58	2.6611	74.20	23.45	2.9297	83.57	28.65	3.1982
65.60	18.67	2.6660	74.37	23.54	2.9346	83.75	28.75	3.2031
65.76	18.76	2.6709	74.53	23.63	2.9395	83.93	28.85	3.2080
65.91	18.84	2.6758	74.70	23.72	2.9443	84.10	28.95	3.2129
66.07	18.93	2.6807	74.86	23.81	2.9492	84.28	29.05	3.2178
66.22	19.01	2.6855	75.03	23.91	2.9541	84.46	29.15	3.2227
66.38	19.10	2.6904	75.19	24.00	2.9590	84.65	29.25	3.2275
66.54	19.19	2.6953	75.36	24.09	2.9639	84.83	29.35	3.2324
66.69	19.27	2.7002	75.52	24.18	2.9688	85.01	29.45	3.2373
66.85	19.36	2.7051	75.69	24.27	2.9736	85.19	29.55	3.2422
66.00	18.89	2.7100	75.85	24.36	2.9785	85.37	29.65	3.2471
67.16	19.53	2.7148	76.02	24.46	2.9834	85.55	29.75	3.2520
67.32	19.62	2.7197	76.19	24.55	2.9883	85.73	29.85	3.2568
67.47	19.71	2.7246	76.35	24.64	2.9932	85.92	29.96	3.2617
67.63	19.80	2.7295	76.52	24.74	2.9980	86.10	30.06	3.2666
67.78	19.88	2.7344	76.69	24.83	3.0029	86.28	30.16	3.2715
67.94	19.97	2.7393	76.85	24.92	3.0078	86.47	30.26	3.2764
68.10	20.06	2.7441	77.02	25.01	3.0127	86.65	30.36	3.2813
68.26	20.15	2.7490	77.19	25.11	3.0176	86.84	30.47	3.2861
68.41	20.23	2.7539	77.36	25.20	3.0225	87.02	30.57	3.2910
68.57	20.32	2.7588	77.53	25.30	3.0273	87.21	30.67	3.2959
68.73	20.41	2.7637	77.70	25.39	3.0322	87.39	30.77	3.3008
68.89	20.50	2.7686	77.86	25.48	3.0371	87.58	30.88	3.3057
69.05	20.58	2.7734	78.03	25.57	3.0420	87.76	30.98	3.3105
69.21	20.67	2.7783	78.20	25.67	3.0469	87.95	31.09	3.3154
69.36	20.76	2.7832	78.37	25.76	3.0518	88.13	31.19	3.3203
69.52	20.85	2.7881	78.54	25.86	3.0566	88.32	31.29	3.3252
69.68	20.94	2.7930	78.71	25.95	3.0615	88.51	31.40	3.3301
69.84	21.02	2.7979	78.88	26.05	3.0664	88.70	31.50	3.3350
70.00	21.11	2.8027	79.05	26.14	3.0713	88.88	31.60	3.3398
70.16	21.20	2.8076	79.22	26.24	3.0762	89.07	31.71	3.3447
70.32	21.29	2.8125	79.40	26.34	3.0811	89.26	31.81	3.3496
70.48	21.38	2.8174	79.57	26.43	3.0859	89.44	31.91	3.3545
70.64	21.47	2.8223	79.74	26.52	3.0908	89.63	32.02	3.3594
70.80	21.56	2.8271	79.91	26.62	3.0957	89.82	32.12	3.3643
70.96	21.65	2.8320	80.08	26.71	3.1006	90.01	32.23	3.3691
71.12	21.74	2.8369	80.26	26.81	3.1055	90.20	32.34	3.3740
71.28	21.82	2.8418	80.43	26.91	3.1104	90.39	32.44	3.3789
71.44	21.91	2.8467	80.60	27.00	3.1152	90.59	32.55	3.3838
71.61	22.01	2.8516	80.77	27.10	3.1201	90.78	32.66	3.3887
71.77	22.10	2.8564	80.95	27.20	3.1250	90.97	32.76	3.3936
71.93	22.19	2.8613	81.12	27.29	3.1299	91.16	32.87	3.3984
72.09	22.27	2.8662	81.29	27.39	3.1348	91.35	32.97	3.4033
72.25	22.36	2.8711	81.47	27.49	3.1396	91.54	33.08	3.4082
72.41	22.45	2.8760	81.64	27.58	3.1445	91.74	33.19	3.4131
72.57	22.54	2.8809	81.81	27.67	3.1494	91.93	33.30	3.4180
72.73	22.63	2.8857	81.99	27.77	3.1543	92.13	33.41	3.4229
72.89	22.72	2.8906	82.16	27.87	3.1592	92.32	33.51	3.4277
73.05	22.81	2.8955	82.33	27.96	3.1641	92.52	33.62	3.4326
73.22	22.90	2.9004	82.51	28.06	3.1689	92.72	33.74	3.4375
73.38	22.99	2.9053	82.69	28.16	3.1738	92.91	33.84	3.4424
73.54	23.08	2.9102	82.86	28.26	3.1787	93.11	33.95	3.4473

TABLE 8 – RETURN AND LEAVING CONDENSER (COOLING) LIQUID (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
93.31	34.06	3.4521	105.04	40.58	3.7207
93.51	34.17	3.4570	105.27	40.71	3.7256
93.70	34.28	3.4619	105.50	40.84	3.7305
93.90	34.39	3.4668	105.73	40.96	3.7354
94.10	34.50	3.4717	105.96	41.09	3.7402
94.30	34.61	3.4766	106.20	41.23	3.7451
94.50	34.73	3.4814	106.44	41.36	3.7500
94.70	34.84	3.4863	106.67	41.49	3.7549
94.90	34.95	3.4912	106.91	41.62	3.7598
95.11	35.06	3.4961	107.14	41.75	3.7646
95.31	35.18	3.5010	107.38	41.88	3.7695
95.52	35.29	3.5059	107.62	42.01	3.7744
95.72	35.40	3.5107	107.86	42.15	3.7793
95.93	35.52	3.5156	108.11	42.29	3.7842
96.13	35.63	3.5205	108.35	42.42	3.7891
96.34	35.75	3.5254	108.59	42.55	3.7939
96.54	35.86	3.5303	108.84	42.69	3.7988
96.75	35.98	3.5352	109.08	42.83	3.8037
96.96	36.09	3.5400	109.32	42.96	3.8086
97.17	36.21	3.5449	109.57	43.10	3.8135
97.38	36.33	3.5498	109.82	43.24	3.8184
97.59	36.44	3.5547	110.06	43.37	3.8232
97.80	36.56	3.5596	110.31	43.51	3.8281
98.01	36.68	3.5645	110.56	43.65	3.8330
98.22	36.79	3.5693	110.81	43.79	3.8379
98.43	36.91	3.5742	111.05	43.92	3.8328
98.64	37.03	3.5791	111.31	44.06	3.8477
98.86	37.15	3.5840	111.36	44.09	3.8525
99.07	37.26	3.5889	111.82	44.35	3.8574
99.29	37.39	3.5938	112.08	44.49	3.8623
99.50	37.50	3.5986	112.34	44.64	3.8672
99.71	37.62	3.6035	112.59	44.78	3.8721
99.93	37.74	3.6084	112.85	44.92	3.8770
100.14	37.86	3.6133	113.11	45.06	3.8818
100.36	37.98	3.6182	113.37	45.21	3.8867
100.58	38.10	3.6230	113.63	45.35	3.8916
100.79	38.22	3.6279	113.88	45.49	3.8965
101.01	38.34	3.6328	114.14	45.64	3.9014
101.23	38.46	3.6377			
101.45	38.59	3.6426			
101.67	38.71	3.6475			
101.89	38.83	3.6523			
102.11	38.95	3.6572			
102.33	39.08	3.6621			
102.55	39.20	3.6670			
102.78	39.33	3.6719			
103.00	39.45	3.6768			
103.22	39.57	3.6816			
103.45	39.70	3.6865			
103.67	39.82	3.6914			
103.89	39.94	3.6963			
104.12	40.07	3.7012			
104.35	40.20	3.7061			
104.58	40.33	3.7109			
104.81	40.45	3.7158			

TABLE 9 - COMPRESSOR OIL AND DISCHARGE TEMPERATURE

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
31.99	-0.01	0.2637	58.43	14.68	0.5322	75.98	24.44	0.8008
32.63	0.35	0.2686	58.81	14.90	0.5371	76.25	24.59	0.8057
33.27	0.71	0.2734	59.18	15.10	0.5420	76.53	24.74	0.8105
33.90	1.06	0.2783	59.54	15.30	0.5469	76.81	24.90	0.8154
34.51	1.39	0.2832	59.90	15.50	0.5518	77.09	25.05	0.8203
35.12	1.73	0.2881	60.26	15.70	0.5566	77.36	25.20	0.8252
35.73	2.07	0.2930	60.63	15.91	0.5615	77.63	25.35	0.8301
36.32	2.40	0.2979	60.98	16.10	0.5664	77.90	25.50	0.8350
36.91	2.73	0.3027	61.33	16.30	0.5713	78.17	25.65	0.8398
37.49	3.05	0.3076	61.69	16.50	0.5762	78.44	25.80	0.8447
38.05	3.36	0.3125	62.04	16.69	0.5811	78.71	25.95	0.8496
38.61	3.67	0.3174	62.39	16.88	0.5859	78.98	26.10	0.8545
39.18	3.99	0.3223	62.73	17.07	0.5908	79.24	26.25	0.8594
39.72	4.29	0.3271	63.07	17.26	0.5957	79.50	26.39	0.8643
40.26	4.59	0.3320	63.41	17.45	0.6006	79.77	26.54	0.8691
40.80	4.89	0.3369	63.75	17.64	0.6055	80.03	26.69	0.8740
41.33	5.18	0.3418	64.09	17.83	0.6104	80.30	26.84	0.8789
41.85	5.47	0.3467	64.43	18.02	0.6152	80.56	26.98	0.8838
42.37	5.76	0.3516	64.76	18.20	0.6201	80.82	27.12	0.8887
42.89	6.05	0.3564	65.09	18.38	0.6250	81.08	27.27	0.8936
43.39	6.33	0.3613	65.42	18.57	0.6299	81.33	27.41	0.8984
43.89	6.61	0.3662	65.75	18.75	0.6348	81.59	27.55	0.9033
44.39	6.88	0.3711	66.08	18.93	0.6396	81.85	27.70	0.9082
44.88	7.16	0.3760	66.40	19.11	0.6445	82.11	27.84	0.9131
45.36	7.42	0.3809	66.72	19.29	0.6494	82.37	27.99	0.9180
45.84	7.69	0.3857	67.04	19.47	0.6543	82.62	28.12	0.9229
46.32	7.96	0.3906	67.36	19.65	0.6592	82.87	28.26	0.9277
46.79	8.22	0.3955	67.68	19.82	0.6641	83.12	28.40	0.9326
47.25	8.47	0.4004	68.00	20.00	0.6689	83.37	28.54	0.9375
47.72	8.73	0.4053	68.31	20.17	0.6738	83.62	28.68	0.9424
48.18	8.99	0.4102	68.62	20.35	0.6787	83.88	28.82	0.9473
48.63	9.24	0.4150	68.93	20.52	0.6836	84.13	28.96	0.9521
49.07	9.48	0.4199	69.24	20.69	0.6885	84.38	29.10	0.9570
49.52	9.73	0.4248	69.55	20.86	0.6934	84.62	29.24	0.9619
49.97	9.98	0.4297	69.86	21.04	0.6982	84.87	29.37	0.9668
50.40	10.22	0.4346	70.17	21.21	0.7031	85.11	29.51	0.9717
50.83	10.46	0.4395	70.47	21.37	0.7080	85.36	29.65	0.9766
51.26	10.70	0.4443	70.77	21.54	0.7129	85.61	29.79	0.9814
51.69	10.94	0.4492	71.07	21.71	0.7178	85.85	29.92	0.9863
52.11	11.17	0.4541	71.37	21.87	0.7227	86.10	30.06	0.9912
52.53	11.41	0.4590	71.67	22.04	0.7275	86.34	30.19	0.9961
52.94	11.63	0.4639	71.96	22.20	0.7324	86.58	30.32	1.0010
53.36	11.87	0.4688	72.26	22.37	0.7373	86.82	30.46	1.0059
53.77	12.10	0.4736	72.55	22.53	0.7422	87.06	30.59	1.0107
54.17	12.32	0.4785	72.84	22.69	0.7471	87.30	30.72	1.0156
54.57	12.54	0.4834	73.14	22.86	0.7520	87.54	30.86	1.0205
54.97	12.76	0.4883	73.43	23.02	0.7568	87.78	30.99	1.0254
55.37	12.98	0.4932	73.72	23.18	0.7617	88.02	31.12	1.0303
55.76	13.20	0.4980	74.00	23.34	0.7666	88.25	31.25	1.0352
56.15	13.42	0.5029	74.29	23.50	0.7715	88.49	31.39	1.0400
56.54	13.63	0.5078	74.57	23.65	0.7764	88.72	31.51	1.0449
56.92	13.85	0.5127	74.86	23.81	0.7813	88.96	31.65	1.0498
57.31	14.06	0.5176	75.14	23.97	0.7861	89.20	31.78	1.0547
57.68	14.27	0.5225	75.42	24.12	0.7910	89.43	31.91	1.0596
58.06	14.48	0.5273	75.70	24.28	0.7959	89.67	32.04	1.0645

TABLE 9 – COMPRESSOR OIL AND DISCHARGE TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
89.90	32.17	1.0693	101.92	38.85	1.3379	112.86	44.93	1.6064
90.13	32.30	1.0742	102.13	38.96	1.3428	113.06	45.04	1.6113
90.36	32.42	1.0791	102.33	39.08	1.3477	113.25	45.14	1.6162
90.59	32.55	1.0840	102.54	39.19	1.3525	113.44	45.25	1.6211
90.82	32.68	1.0889	102.74	39.30	1.3574	113.63	45.35	1.6260
91.05	32.81	1.0938	102.95	39.42	1.3623	113.82	45.46	1.6309
91.28	32.94	1.0986	103.15	39.53	1.3672	114.01	45.56	1.6357
91.51	33.06	1.1035	103.36	39.65	1.3721	114.20	45.67	1.6406
91.74	33.19	1.1084	103.56	39.76	1.3770	114.40	45.78	1.6455
91.96	33.31	1.1133	103.77	39.88	1.3818	114.59	45.89	1.6504
92.19	33.44	1.1182	103.97	39.99	1.3867	114.78	45.99	1.6553
92.42	33.57	1.1230	104.18	40.10	1.3916	114.97	46.10	1.6602
92.64	33.69	1.1279	104.38	40.21	1.3965	115.16	46.20	1.6650
92.87	33.82	1.1328	104.58	40.33	1.4014	115.35	46.31	1.6699
93.10	33.95	1.1377	104.78	40.44	1.4063	115.54	46.41	1.6748
93.32	34.07	1.1426	104.99	40.55	1.4111	115.73	46.52	1.6797
93.54	34.19	1.1475	105.19	40.66	1.4160	115.92	46.63	1.6846
93.77	34.32	1.1523	105.39	40.78	1.4209	116.11	46.73	1.6895
93.99	34.44	1.1572	105.59	40.89	1.4258	116.30	46.84	1.6943
94.21	34.56	1.1621	105.80	41.00	1.4307	116.49	46.94	1.6992
94.43	34.69	1.1670	105.99	41.11	1.4355	116.67	47.04	1.7041
94.65	34.81	1.1719	106.19	41.22	1.4404	116.86	47.15	1.7090
94.88	34.94	1.1768	106.39	41.33	1.4453	117.05	47.25	1.7139
95.10	35.06	1.1816	106.59	41.44	1.4502	117.24	47.36	1.7188
95.32	35.18	1.1865	106.79	41.55	1.4551	117.43	47.46	1.7236
95.53	35.30	1.1914	106.99	41.66	1.4600	117.62	47.57	1.7285
95.75	35.42	1.1963	107.19	41.78	1.4648	117.80	47.67	1.7334
95.97	35.54	1.2012	107.39	41.89	1.4697	117.99	47.78	1.7383
96.19	35.66	1.2061	107.59	42.00	1.4746	118.18	47.88	1.7432
96.41	35.79	1.2109	107.79	42.11	1.4795	118.37	47.99	1.7480
96.63	35.91	1.2158	107.99	42.22	1.4844	118.56	48.09	1.7529
96.84	36.03	1.2207	108.18	42.33	1.4893	118.74	48.19	1.7578
97.06	36.15	1.2256	108.38	42.44	1.4941	118.93	48.30	1.7627
97.27	36.26	1.2305	108.58	42.55	1.4990	119.12	48.40	1.7676
97.49	36.39	1.2354	108.78	42.66	1.5039	119.31	48.51	1.7725
97.70	36.50	1.2402	108.97	42.76	1.5088	119.49	48.61	1.7773
97.92	36.63	1.2451	109.17	42.88	1.5137	119.68	48.72	1.7822
98.13	36.74	1.2500	109.37	42.99	1.5186	119.87	48.82	1.7871
98.35	36.86	1.2549	109.56	43.09	1.5234	120.05	48.92	1.7920
98.56	36.98	1.2598	109.76	43.20	1.5283	120.24	49.03	1.7969
98.77	37.10	1.2646	109.95	43.31	1.5332	120.43	49.13	1.8018
98.98	37.21	1.2695	110.15	43.42	1.5381	120.61	49.23	1.8066
99.20	37.34	1.2744	110.34	43.53	1.5430	120.80	49.34	1.8115
99.41	37.45	1.2793	110.54	43.64	1.5479	120.98	49.44	1.8164
99.62	37.57	1.2842	110.73	43.74	1.5527	121.17	49.54	1.8213
99.83	37.69	1.2891	110.93	43.85	1.5576	121.35	49.64	1.8262
100.04	37.80	1.2939	111.12	43.96	1.5625	121.54	49.75	1.8311
100.25	37.92	1.2988	111.32	44.07	1.5674	121.72	49.85	1.8359
100.46	38.04	1.3037	111.51	44.18	1.5723	121.91	49.95	1.8408
100.67	38.15	1.3086	111.70	44.28	1.5771	122.10	50.06	1.8457
100.88	38.27	1.3135	111.90	44.39	1.5820	122.28	50.16	1.8506
101.09	38.39	1.3184	112.09	44.50	1.5869	122.47	50.27	1.8555
101.29	38.50	1.3232	112.28	44.60	1.5918	122.65	50.37	1.8604
101.50	38.61	1.3281	112.48	44.71	1.5967	122.84	50.47	1.8652
101.71	38.73	1.3330	112.67	44.82	1.6016	123.02	50.57	1.8701

TABLE 9 – COMPRESSOR OIL AND DISCHARGE TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
123.21	50.68	1.8750	133.27	56.27	2.1436	143.32	61.85	2.4121
123.39	50.78	1.8799	133.46	56.37	2.1484	143.51	61.95	2.4170
123.58	50.88	1.8848	133.64	56.47	2.1533	143.69	62.05	2.4219
123.76	50.98	1.8896	133.82	56.57	2.1582	143.87	62.15	2.4268
123.94	51.08	1.8945	134.00	56.67	2.1631	144.06	62.26	2.4316
124.13	51.19	1.8994	134.18	56.77	2.1680	144.24	62.36	2.4365
124.31	51.29	1.9043	134.37	56.88	2.1729	144.43	62.47	2.4414
124.50	51.39	1.9092	134.55	56.98	2.1777	144.61	62.57	2.4463
124.68	51.49	1.9141	134.73	57.08	2.1826	144.80	62.67	2.4512
124.86	51.59	1.9189	134.91	57.18	2.1875	144.98	62.77	2.4561
125.05	51.70	1.9238	135.09	57.28	2.1924	145.17	62.88	2.4609
125.23	51.80	1.9287	135.28	57.38	2.1973	145.35	62.98	2.4658
125.42	51.90	1.9336	135.46	57.48	2.2021	145.54	63.08	2.4707
125.60	52.00	1.9385	135.64	57.58	2.2070	145.72	63.18	2.4756
125.78	52.10	1.9434	135.82	57.68	2.2119	145.91	63.29	2.4805
125.97	52.21	1.9482	136.01	57.79	2.2168	146.09	63.39	2.4854
126.15	52.31	1.9531	136.19	57.89	2.2217	146.28	63.49	2.4902
126.33	52.41	1.9580	136.37	57.99	2.2266	146.46	63.59	2.4951
126.52	52.52	1.9629	136.55	58.09	2.2314	146.65	63.70	2.5000
126.70	52.62	1.9678	136.73	58.19	2.2363	146.84	63.81	2.5049
126.88	52.72	1.9727	136.92	58.29	2.2412	147.02	63.91	2.5098
127.07	52.82	1.9775	137.10	58.39	2.2461	147.21	64.01	2.5146
127.25	52.92	1.9824	137.28	58.49	2.2510	147.39	64.11	2.5195
127.43	53.02	1.9873	137.46	58.59	2.2559	147.58	64.22	2.5244
127.62	53.13	1.9922	137.65	58.70	2.2607	147.77	64.32	2.5293
127.80	53.23	1.9971	137.83	58.80	2.2656	147.95	64.42	2.5342
127.98	53.33	2.0020	138.01	58.90	2.2705	148.14	64.53	2.5391
128.17	53.43	2.0068	138.19	59.00	2.2754	148.32	64.63	2.5439
128.35	53.53	2.0117	138.37	59.10	2.2803	148.51	64.73	2.5488
128.53	53.63	2.0166	138.56	59.20	2.2852	148.70	64.84	2.5537
128.71	53.73	2.0215	138.74	59.30	2.2900	148.88	64.94	2.5586
128.90	53.84	2.0264	138.92	59.40	2.2949	149.07	65.04	2.5635
129.08	53.94	2.0313	139.11	59.51	2.2998	149.26	65.15	2.5684
129.26	54.04	2.0361	139.29	59.61	2.3047	149.45	65.26	2.5732
129.44	54.14	2.0410	139.47	59.71	2.3096	149.63	65.36	2.5781
129.63	54.24	2.0459	139.65	59.81	2.3145	149.82	65.46	2.5830
129.81	54.34	2.0508	139.84	59.92	2.3193	150.01	65.57	2.5879
129.99	54.44	2.0557	140.02	60.02	2.3242	150.20	65.67	2.5928
130.17	54.54	2.0605	140.20	60.12	2.3291	150.38	65.77	2.5977
130.36	54.65	2.0654	140.39	60.22	2.3340	150.57	65.88	2.6025
130.54	54.75	2.0703	140.57	60.32	2.3389	150.76	65.98	2.6074
130.72	54.85	2.0752	140.75	60.42	2.3438	150.95	66.09	2.6123
130.90	54.95	2.0801	140.94	60.53	2.3486	151.14	66.19	2.6172
131.09	55.05	2.0850	141.12	60.63	2.3535	151.33	66.30	2.6221
131.27	55.15	2.0898	141.30	60.73	2.3584	151.51	66.40	2.6270
131.45	55.25	2.0947	141.49	60.83	2.3633	151.70	66.51	2.6318
131.63	55.35	2.0996	141.67	60.93	2.3682	151.89	66.61	2.6367
131.82	55.46	2.1045	141.85	61.03	2.3730	152.08	66.72	2.6416
132.00	55.56	2.1094	142.04	61.14	2.3779	152.27	66.82	2.6465
132.18	55.66	2.1143	142.22	61.24	2.3828	152.46	66.93	2.6514
132.36	55.76	2.1191	142.40	61.34	2.3877	152.65	67.03	2.6563
132.54	55.86	2.1240	142.59	61.44	2.3926	152.84	67.14	2.6611
132.73	55.97	2.1289	142.77	61.54	2.3975	153.03	67.24	2.6660
132.91	56.07	2.1338	142.95	61.64	2.4023	153.22	67.35	2.6709
133.09	56.17	2.1387	143.14	61.75	2.4072	153.41	67.46	2.6758

TABLE 9 – COMPRESSOR OIL AND DISCHARGE TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
153.60	67.56	2.6807	164.36	73.54	2.9492	175.92	79.96	3.2178
153.79	67.67	2.6855	164.56	73.65	2.9541	176.14	80.08	3.2227
153.98	67.77	2.6904	164.76	73.76	2.9590	176.36	80.21	3.2275
154.17	67.88	2.6953	164.96	73.87	2.9639	176.58	80.33	3.2324
154.36	67.98	2.7002	165.17	73.99	2.9688	176.80	80.45	3.2373
154.55	68.09	2.7051	165.37	74.10	2.9736	177.02	80.57	3.2422
154.74	68.19	2.7100	165.57	74.21	2.9785	177.25	80.70	3.2471
154.94	68.31	2.7148	165.78	74.33	2.9834	177.47	80.82	3.2520
155.13	68.41	2.7197	165.98	74.44	2.9883	177.69	80.95	3.2568
155.32	68.52	2.7246	166.19	74.56	2.9932	177.91	81.07	3.2617
155.51	68.62	2.7295	166.39	74.67	2.9980	178.14	81.20	3.2666
155.70	68.73	2.7344	166.60	74.78	3.0029	178.36	81.32	3.2715
155.90	68.84	2.7393	166.80	74.89	3.0078	178.59	81.45	3.2764
156.09	68.94	2.7441	167.00	75.01	3.0127	178.81	81.57	3.2813
156.28	69.05	2.7490	167.21	75.12	3.0176	179.04	81.70	3.2861
156.47	69.16	2.7539	167.42	75.24	3.0225	179.26	81.82	3.2910
156.67	69.27	2.7588	167.62	75.35	3.0273	179.49	81.95	3.2959
156.86	69.37	2.7637	167.83	75.47	3.0322	179.72	82.07	3.3008
157.05	69.48	2.7686	168.04	75.58	3.0371	179.94	82.20	3.3057
157.25	69.59	2.7734	168.24	75.69	3.0420	180.17	82.32	3.3105
157.44	69.69	2.7783	168.45	75.81	3.0469	180.40	82.45	3.3154
157.64	69.81	2.7832	168.66	75.93	3.0518	180.63	82.58	3.3203
157.83	69.91	2.7881	168.87	76.04	3.0566	180.86	82.71	3.3252
158.02	70.02	2.7930	169.07	76.16	3.0615	181.09	82.83	3.3301
158.22	70.13	2.7979	169.28	76.27	3.0664	181.32	82.96	3.3350
158.41	70.23	2.8027	169.49	76.39	3.0713	181.55	83.09	3.3398
158.61	70.34	2.8076	169.70	76.51	3.0762	181.78	83.22	3.3447
158.80	70.45	2.8125	169.91	76.62	3.0811	182.01	83.35	3.3496
159.00	70.56	2.8174	170.12	76.74	3.0859	182.24	83.47	3.3545
159.19	70.67	2.8223	170.33	76.86	3.0908	182.48	83.61	3.3594
159.39	70.78	2.8271	170.54	76.97	3.0957	182.71	83.73	3.3643
159.59	70.89	2.8320	170.75	77.09	3.1006	182.94	83.86	3.3691
159.78	70.99	2.8369	170.96	77.21	3.1055	183.17	83.99	3.3740
159.98	71.11	2.8418	171.18	77.33	3.1104	183.41	84.12	3.3789
160.18	71.22	2.8467	171.39	77.45	3.1152	183.65	84.26	3.3838
160.37	71.32	2.8516	171.60	77.56	3.1201	183.88	84.38	3.3887
160.57	71.43	2.8564	171.81	77.68	3.1250	184.12	84.52	3.3936
160.77	71.54	2.8613	172.02	77.80	3.1299	184.36	84.65	3.3984
160.97	71.66	2.8662	172.24	77.92	3.1348	184.59	84.78	3.4033
161.16	71.76	2.8711	172.45	78.03	3.1396	184.83	84.91	3.4082
161.36	71.87	2.8760	172.66	78.15	3.1445	185.07	85.05	3.4131
161.56	71.98	2.8809	172.88	78.27	3.1494	185.31	85.18	3.4180
161.76	72.09	2.8857	173.10	78.40	3.1543	185.55	85.31	3.4229
161.96	72.21	2.8906	173.31	78.51	3.1592	185.79	85.45	3.4277
162.15	72.31	2.8955	173.53	78.63	3.1641	186.03	85.58	3.4326
162.35	72.42	2.9004	173.74	78.75	3.1689	186.27	85.71	3.4375
162.55	72.53	2.9053	173.96	78.87	3.1738	186.51	85.85	3.4424
162.75	72.64	2.9102	174.17	78.99	3.1787	186.75	85.98	3.4473
162.95	72.76	2.9150	174.39	79.11	3.1836	186.99	86.11	3.4521
163.15	72.87	2.9199	174.61	79.23	3.1885	187.24	86.25	3.4570
163.35	72.98	2.9248	174.83	79.36	3.1934	187.48	86.38	3.4619
163.55	73.09	2.9297	175.04	79.47	3.1982	187.73	86.52	3.4668
163.75	73.20	2.9346	175.26	79.60	3.2031	187.97	86.66	3.4717
163.96	73.32	2.9395	175.48	79.72	3.2080	188.22	86.80	3.4766
164.16	73.43	2.9443	175.70	79.84	3.2129	188.46	86.93	3.4814

TABLE 9 – COMPRESSOR OIL AND DISCHARGE TEMPERATURE (CONT'D.)

TEMP (°F)	TEMP (°C)	VIN	TEMP (°F)	TEMP (°C)	VIN
188.71	87.07	3.4863	203.40	95.23	3.7549
188.96	87.21	3.4912	203.69	95.39	3.7598
189.21	87.35	3.4961	203.99	95.56	3.7646
189.46	87.48	3.5010	204.28	95.72	3.7695
189.71	87.62	3.5059	204.57	95.88	3.7744
189.96	87.76	3.5107	204.86	96.04	3.7793
190.21	87.90	3.5156	205.16	96.21	3.7842
190.46	88.04	3.5205	205.46	96.37	3.7891
190.71	88.18	3.5254	205.76	96.54	3.7939
190.96	88.32	3.5303	206.05	96.70	3.7988
191.22	88.46	3.5352	206.35	96.87	3.8037
191.47	88.60	3.5400	206.65	97.04	3.8086
191.73	88.75	3.5449	206.96	97.21	3.8135
191.98	88.88	3.5498	207.26	97.37	3.8184
192.23	89.02	3.5547	207.57	97.55	3.8232
192.49	89.17	3.5596	207.87	97.71	3.8281
192.75	89.31	3.5645	208.17	97.88	3.8330
193.01	89.46	3.5693	208.48	98.05	3.8379
193.27	89.60	3.5742	208.79	98.22	3.8428
193.53	89.75	3.5791	209.10	98.40	3.8477
193.79	89.89	3.5840	209.42	98.57	3.8525
194.05	90.03	3.5889	209.73	98.75	3.8574
194.31	90.18	3.5938	210.04	98.92	3.8623
194.57	90.32	3.5986	210.35	99.09	3.8672
194.84	90.47	3.6035	210.67	99.27	3.8721
195.10	90.62	3.6084	210.99	99.45	3.8770
195.37	90.77	3.6133	211.31	99.62	3.8818
195.63	90.91	3.6182	211.62	99.80	3.8867
195.90	91.06	3.6230	211.94	99.97	3.8916
196.16	91.21	3.6279	212.27	100.16	3.8965
196.43	91.36	3.6328	212.59	100.34	3.9014
196.70	91.51	3.6377	212.92	100.52	3.9063
196.97	91.66	3.6426	213.24	100.70	3.9111
197.24	91.81	3.6475	213.57	100.88	3.9160
197.51	91.96	3.6523	213.90	101.06	3.9209
197.78	92.11	3.6572	214.23	101.25	3.9258
198.06	92.26	3.6621	214.56	101.43	3.9307
198.33	92.41	3.6670	214.89	101.61	3.9355
198.61	92.57	3.6719	215.23	101.80	3.9404
198.88	92.72	3.6768	215.56	101.99	3.9453
199.15	92.87	3.6816	215.90	102.17	3.9502
199.43	93.02	3.6865	216.24	102.36	3.9551
199.71	93.18	3.6914	216.58	102.55	3.9600
199.99	93.34	3.6963	216.92	102.74	3.9648
200.27	93.49	3.7012	217.26	102.93	3.9697
200.55	93.65	3.7061	217.60	103.12	3.9746
200.83	93.80	3.7109	217.95	103.31	3.9795
201.11	93.96	3.7158	218.30	103.51	3.9844
201.39	94.11	3.7207	218.65	103.70	3.9893
201.68	94.27	3.7256	219.00	103.90	3.9941
201.97	94.44	3.7305	219.35	104.09	3.9990
202.25	94.59	3.7354	219.70	104.29	4.0039
202.54	94.75	3.7402	220.06	104.49	4.0088
202.82	94.91	3.7451			
203.11	95.07	3.7500			

TABLE 10 - DROP LEG REFRIGERANT SENSOR

TEMP (°F)	TEMP (°C)	VIN
0.01	-17.77	0.753
3.72	-15.71	0.831
7.21	-13.77	0.909
10.51	-11.94	0.987
13.65	-10.20	1.066
16.65	-8.53	1.144
19.56	-6.91	1.222
22.36	-5.36	1.300
25.09	-3.84	1.378
27.74	-2.37	1.456
30.34	-0.92	1.534
32.89	0.49	1.613
35.40	1.89	1.691
37.87	3.26	1.769
40.31	4.62	1.847
42.73	5.96	1.925
45.14	7.30	2.003
47.53	8.63	2.081
49.92	9.96	2.160
52.31	11.28	2.238
54.70	12.61	2.316
57.10	13.95	2.394
59.52	15.29	2.472
61.95	16.64	2.550
64.40	18.00	2.628
66.89	19.38	2.707
69.40	20.78	2.785
71.97	22.21	2.863
74.57	23.65	2.941
77.23	25.13	3.019
79.96	26.65	3.097
82.73	28.19	3.175
85.60	29.78	3.254
88.56	31.42	3.332
91.59	33.11	3.410
94.75	34.86	3.488
98.06	36.70	3.566
101.50	38.61	3.644
105.10	40.61	3.722
108.90	42.73	3.801
112.92	44.96	3.879
117.17	47.32	3.957
121.76	49.87	4.035

TABLE 11 - EVAPORATOR REFRIGERANT SENSOR

TEMP (°F)	TEMP (°C)	VIN
0.04	-17.76	1.135
2.79	-16.23	1.214
5.44	-14.76	1.292
8.02	-13.32	1.370
10.53	-11.93	1.448
12.98	-10.57	1.526
15.39	-9.23	1.604
17.75	-7.92	1.683
20.08	-6.62	1.761
22.38	-5.34	1.839
24.66	-4.08	1.917
26.92	-2.82	1.995
29.17	-1.57	2.073
31.41	-0.33	2.151
33.66	0.92	2.230
35.90	2.17	2.308
38.15	3.42	2.386
40.41	4.67	2.464
42.69	5.94	2.542
44.99	7.72	2.620
47.31	8.51	2.698
49.67	9.82	2.777
52.06	11.15	2.855
54.49	12.50	2.933
56.96	13.87	3.011
59.50	15.28	3.089
62.10	16.72	3.167
64.77	18.21	3.245
67.51	19.73	3.324
70.35	21.31	3.402
73.29	22.94	3.480
76.36	24.65	3.558
79.55	26.42	3.636
82.89	28.27	3.714
86.41	30.23	3.792
90.12	32.29	3.871
94.07	34.49	3.949
98.31	36.84	4.027
102.87	39.38	4.105
107.81	42.12	4.183
113.26	45.15	4.261
119.30	48.50	4.339
126.10	52.28	4.418

SECTION 20 - REMOTE SETPOINTS

(Refer to Figures 9, 11 & 13)

There are three different Remote Operating modes that can be selected at the keypad: Analog Remote mode, Digital Remote mode or ISN Remote mode.

The OptiView Control Center can receive a Remote Horsepower Limit and/or Leaving Chilled Liquid Temperature Setpoint via the following:

ANALOG REMOTE MODE

- 0-10VDC Analog Input
- 2-10VDC Analog Input
- 0-20mA Analog Input
- 4-20mA Analog Input

DIGITAL REMOTE MODE

- Pulse Width Modulation (PWM) Input

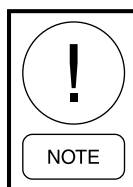
ISN REMOTE MODE

- RS-232 Serial Port via MicroGateway

The analog inputs are connected to the Microboard J22 as shown in *Figure 9 on page 42* and described below. Microboard Program Jumpers JP23 & JP24 must be positioned appropriately to receive either a 0-10VDC, 2-10VDC, 0-20mA or a 4-20mA signal. Refer to *Table 1 on page 35 "Microboard Program Jumpers"* and explanation below for required configurations.

The PWM inputs are in the form of a 1 to 11 second relay contact closure that applies 115 VAC to the I/O Board TB3-81 (Horsepower Limit) and TB4-19 (Leaving Chilled Liquid Temp) for 1 to 11 seconds (refer to *Figure 11 on page 48*). The source of 115 VAC is I/O Board TB4-1. The PWM input must be received at a frequency of at least once every 30 minutes. If not received within this time interval, the program assumes the remote device is defective and defaults the Horsepower Limit to 100% Leaving Chilled Liquid Temperature Setpoint to the locally programmed Local BASE value.

The Microboard COM 4B RS-232 Serial Port (J2) receives the setpoint in serial data form from the E-Link located inside the OptiView Control Center enclosure. The E-link receives the setpoint from a remote external device and transfers it to the Microboard.



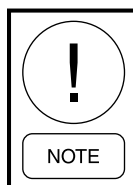
HP setpoint will default to minimum if no setpoint is sent from E-Link.

HORSEPOWER LIMIT

The local Horsepower Limit PID Setpoint is set at the factory to the lower of the compressor maximum or 115% of the turbine design horsepower.

REMOTE HORSEPOWER LIMIT SETPOINT with 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or Pulse Width Modulation Signal – The Remote Horsepower Limit Setpoint can be reset over the range of 100% to 30% of the Horsepower Limit PID local setpoint by supplying (by others) a 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or 1 to 11 second Pulse Width Modulated (PWM) signal to the OptiView Control Center. The OptiView Control Center must be configured appropriately to accept the desired signal type as follows:

- The appropriate remote mode must be selected: **ANALOG** remote mode must be selected when using a voltage or current signal input. **DIGITAL** remote mode must be selected when using a **PWM** input.
- If **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint must be set to "0-10VDC" or "2-10VDC" as detailed below, regardless of whether the signal is a voltage or current input signal type.
- Microboard Program Jumper JP23 must be positioned appropriately per the input signal type as detailed below. It is recommended that a qualified Service Technician position this jumper.



IMPORTANT! - The signal type used for Remote Horsepower Limit Setpoint reset and the signal type used for Remote Leaving Chilled Liquid Temperature setpoint reset must be the same. For example, if a 0-10VDC signal is being used for Remote Leaving Chilled Liquid Temperature Reset, then a 0-10VDC signal must be used for Remote Horsepower Limit Reset.

0-10VDC

As shown in *Figure 13 on page 49*, connect input to Microboard J22-1 (signal) and J22-5 (GND). The setpoint varies linearly from 100% to 30% as the input varies from 0 to 10VDC. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “0-10 Volts” and Microboard Program Jumper JP23 has been removed. Calculate the setpoint for various inputs as follows:

$$\text{Setpoint (\%)} = 100 - (\text{VDC} \times 7)$$

For example, if the input is 5VDC, the setpoint would be set to 65% as follows:

$$\begin{aligned}\text{Setpoint (\%)} &= 100 - (5 \times 7) \\ &= 100 - 35 \\ &= 65\%\end{aligned}$$

2-10VDC

As shown in *Figure 13 on page 49*, connect input to Microboard J22-1 (signal) and J22-5 (GND). The setpoint varies linearly from 100% to 30% as the input varies from 2 to 10VDC. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “2-10 Volts” and Microboard Program Jumper JP23 has been removed. Calculate the setpoint for various inputs as follows:

$$\text{Setpoint (\%)} = 100 - [(\text{VDC} - 2) \times 8.75]$$

For example, if the input is 5VDC, the setpoint would be set to 74% as follows:

$$\begin{aligned}\text{Setpoint (\%)} &= 100 - [(5 - 2) \times 8.75] \\ &= 100 - [3 \times 8.75] \\ &= 100 - 26.25 \\ &= 74\%\end{aligned}$$

0-20mA

As shown in *Figure 13 on page 49*, connect input to Microboard J22-2 (signal) and J22-5 (GND). The setpoint varies linearly from 100% to 30% as the input varies from 0mA to 20mA. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “0-10 Volts” and Microboard Program Jumper JP23 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

$$\text{Setpoint (\%)} = 100 - (\text{mA} \times 3.5)$$

For example, if the input is 8mA, the setpoint would be set to 72% as follows:

$$\begin{aligned}\text{Setpoint (\%)} &= 100 - (8 \times 3.5) \\ &= 100 - 28 \\ &= 72\%\end{aligned}$$

4-20mA

As shown in *Figure 13 on page 49*, connect input to Microboard J22-2 (signal) and J22-5 (GND). The setpoint varies linearly from 100% to 30% as the input varies from 4mA to 20mA. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “2-10 Volts” and Microboard Program Jumper JP23 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

$$\text{Setpoint (\%)} = 100 - [(\text{mA} - 4) \times 4.375]$$

For example, if the input is 8mA, the setpoint would be set to 83% as follows:

$$\begin{aligned}\text{Setpoint (\%)} &= 100 - [(8 - 4) \times 4.375] \\ &= 100 - (4 \times 4.375) \\ &= 100 - 17.5 \\ &= 82.5 \\ &= 83\%\end{aligned}$$

PWM

The Pulse Width Modulation input is in the form of a 1 to 11 second relay contact closure that applies 115VAC to the I/O Board TB4-20 for 1 to 11 seconds. As shown in Fig. 10, connect dry closure relay contacts between I/O Board TB3-81 (signal) and TB4-1 (115 VAC). The setpoint varies linearly from 100% to 30% as the relay contact closure time changes from 1 to 11 seconds. The relay contacts should close for 1 to 11 seconds at least once every 30 minutes to maintain the setpoint to the desired value. If a 1 to 11 second closure is not received within 30 minutes of the last closure, the setpoint is defaulted to 100%. A closure is only accepted at rates not to exceed once every 70 seconds. This input will only be accepted in **DIGITAL** Remote mode. Calculate the setpoint for various pulse widths as follows:

$$\text{Setpoint (\%)} = 100 - [(\text{pulse width in seconds} - 1) \times 7]$$

For example, if the relay contacts close for 3 seconds, the setpoint would be set to 86% as follows:

$$\begin{aligned}\text{Setpoint (\%)} &= 100 - [(3 - 1) \times 7] \\ &= 100 - (2 \times 7) \\ &= 100 - 14 \\ &= 86\%\end{aligned}$$

REMOTE LEAVING CHILLED LIQUID TEMPERATURE SETPOINT with 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or Pulse Width Modulation Signal – Remote Leaving Chilled Liquid Temperature setpoint reset can be accomplished by supplying (by others) a 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or 1 to 11 second Pulse Width Modulated (PWM) signal to the OptiView Control Center. The **LEAVING CHILLED LIQUID TEMPERATURE** setpoint is programmable over the range of 38°F to 70°F (water applications); 36°F to 70°F (water applications with Smart Freeze protection “Enabled”); or 10°F to 70°F (brine applications). The Remote input signal

changes the setpoint by creating an offset above the locally programmed Leaving Chilled Liquid Temperature Base setpoint value. The setpoint can be remotely changed over the range of 10 or 20°F (as per the locally programmed **REMOTE RESET TEMPERATURE RANGE** setpoint) above the local Leaving Chilled Liquid Temperature setpoint. For example, if the Local setpoint is 40°F and the **REMOTE RESET TEMPERATURE RANGE** setpoint is programmed for 10°F, the Leaving Chilled Liquid Temperature setpoint can be remotely reset over the range of 40°F to 50°F. The setpoint received through the COM 4B RS-232 serial port is not an offset that is applied to the locally programmed **BASE** value as described above. Rather, it is an actual setpoint value. The locally programmed value is not used as a **BASE** in this application.

The OptiView Control Center must be configured appropriately to accept the desired signal type as follows:

- The appropriate remote mode must be selected: **ANALOG** Remote mode must be selected when using a voltage or current signal input. **DIGITAL** remote mode must be selected when using a PWM input.
- If **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint must be set to “0-10VDC” or “2-10VDC” as detailed below, regardless of whether the signal is a voltage or current signal type.
- Microboard Program Jumper JP24 must be positioned appropriately per the input signal type as detailed below. It is recommended a qualified Service Technician position this jumper.

0-10VDC

As shown in *Figure 9 on page 42*, connect input to Microboard J22-3 (signal) and J22-5 (GND). A 0VDC signal produces a **REMOTE LEAVING CHILLED LIQUID TEMPERATURE SETPOINT with 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or Pulse Width Modulation Signal** – Remote Leaving Chilled Liquid Temperature setpoint reset can be accomplished by supplying (by others) a 0-10VDC, 2-10VDC, 0-20mA, 4-20mA or 1 to 11 second Pulse Width Modulated (PWM) signal to the OptiView Control Center. The **LEAVING CHILLED LIQUID TEMPERATURE** setpoint is programmable over the range of 38°F to 70°F (water applications); 36°F to 70°F (water applications with Smart Freeze protection “Enabled”); or 10°F to 70°F (brine applications). The Remote input signal changes the setpoint by creating an offset above the locally programmed Leaving Chilled Liquid Temperature Base setpoint value. The setpoint can be remotely changed over the range of 10 or 20°F (as per the locally programmed **REMOTE RESET TEMPERATURE RANGE** setpoint) above the local Leaving Chilled Liquid Temperature setpoint. For example, if the Local setpoint is 40°F and the **REMOTE RESET TEMPERATURE RANGE** setpoint is programmed for 10°F, the Leaving Chilled Liquid Temperature setpoint can be remotely reset over the range of 40°F to 50°F. The setpoint received through the COM 4B RS-232 serial port is not an offset that is applied to the locally programmed **BASE** value as described above. Rather, it is an actual setpoint value. The locally programmed value is not used as a **BASE** in this application.

The OptiView Control Center must be configured appropriately to accept the desired signal type as follows:

- The appropriate remote mode must be selected: **ANALOG** Remote mode must be selected when using a voltage or current signal input. **DIGITAL** remote mode must be selected when using a PWM input.
- If **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint must be set to “0-10VDC” or “2-10VDC” as detailed below, regardless of whether the signal is a voltage or current signal type.
- Microboard Program Jumper JP24 must be positioned appropriately per the input signal type as detailed below. It is recommended a qualified Service Technician position this jumper.

0-10VDC

As shown in *Figure 9 on page 42*, connect input to Microboard J22-3 (signal) and J22-5 (GND). A 0VDC signal produces a 0°F offset. A 10VDC signal produces the maximum offset (10 or 20°F above the Local Setpoint value). The setpoint is changed linearly between these extremes as the input varies linearly over the range of 0VDC to 10VDC. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “0-10VDC” and Microboard Program Jumper JP24 has been removed. Calculate the setpoint for various inputs as follows:

$$\text{Offset (°F)} = \frac{(\text{VDC})(\text{Remote Reset Temp Range})}{10}$$

$$\text{Setpoint (°F)} = \text{Local Setpoint} + \text{Offset}$$

For example, if the input is 5VDC and the Remote Reset Temp Range Setpoint is programmed for 10°F and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 45°F as follows:

$$\begin{aligned} \text{Offset (°F)} &= \frac{5 \times 10}{10} \\ &= \frac{50}{10} \\ &= 5^\circ\text{F} \\ \text{Setpoint} &= 40 + 5 \\ &= 45^\circ\text{F} \end{aligned}$$

2-10VDC

As shown in *Figure 9 on page 42*, connect input to Microboard J22-3 (signal) and J2-5 (GND). A 2VDC signal produces a 0°F offset. A 10VDC signal produces the maximum allowed offset (10°F or 20°F above the Local Setpoint value). The setpoint is changed linearly between these extremes as the input varies over the range of 2VDC to 10VDC. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “2-10VDC” and the Microboard Program Jumper JP24 has been removed. Calculate the setpoint for various inputs as follows:

$$\text{Offset (°F)} = \frac{(\text{VDC} - 2)(\text{Remote Reset Temp Range})}{8}$$

$$\text{Setpoint (°F)} = \text{Local Setpoint} + \text{Offset}$$

For example, if the input is 5VDC and the Remote Reset Temp Range Setpoint is programmed for 10°F and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 43.8°F.

$$\begin{aligned}\text{Offset (}^{\circ}\text{F)} &= \frac{(5 - 2)(10)}{8} \\ &= \frac{(3)(10)}{8} \\ &= \frac{30}{8} \\ &= 3.8^{\circ}\text{F} \\ \text{Setpoint (}^{\circ}\text{F)} &= 40 + 3.8 \\ &= 43.8^{\circ}\text{F}\end{aligned}$$

0-20mA

As shown in *Figure 9 on page 42*, connect input to Microboard J22-4 (signal) and J22-5 (GND). A 0mA signal produces a 0°F offset. A 20mA signal produces the maximum allowed offset (10 or 20°F above the Local Setpoint value). The setpoint is changed linearly between these extremes as the input varies over the range of 0-20mA. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “0-10VDC” and Microboard Program Jumper J24 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

$$\text{Offset (}^{\circ}\text{F)} = \frac{(\text{mA})(\text{Remote Reset Temp Range})}{20}$$

$$\text{Setpoint (}^{\circ}\text{F)} = \text{Local Setpoint} + \text{Offset}$$

For example, if the input is 8mA, the Remote Reset Temp Range Setpoint is programmed for 10°F and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 44°F as follows:

$$\begin{aligned}\text{Offset (}^{\circ}\text{F)} &= \frac{(8)(10)}{20} \\ &= \frac{80}{20} \\ &= 4^{\circ}\text{F} \\ \text{Setpoint (}^{\circ}\text{F)} &= 40 + 4 \\ &= 44^{\circ}\text{F}\end{aligned}$$

4-20mA

As shown in *Figure 9 on page 42*, connect input to Microboard J22-4 (signal) and J22-5 (GND). A 4mA signal produces a 0°F offset. A 20mA signal produces the maximum allowed offset (10 or 20°F above the Local Setpoint value). The setpoint is changed linearly between these extremes as the input varies over the range of 4-20mA. This input will only be accepted when **ANALOG** Remote mode is selected, the **REMOTE ANALOG INPUT RANGE** setpoint is set for “2-10VDC” and Microboard Program Jumper JP24 has been placed on pins 1 and 2. Calculate the setpoint for various inputs as follows:

$$\text{Offset (}^{\circ}\text{F)} = \frac{(\text{mA} - 4)(\text{Remote Reset Temp Range})}{16}$$

$$16$$

$$\text{Setpoint (}^{\circ}\text{F)} = \text{Local Setpoint} + \text{Offset}$$

For example, if the input is 8mA, and the Remote Reset Temp Range Setpoint is programmed for 10°F and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 42.5°F as follows:

$$\text{Offset (}^{\circ}\text{F)} = \frac{(8 - 4)(10)}{16}$$

$$= \frac{(4)(10)}{16}$$

$$= \frac{40}{16}$$

$$= 2.5^{\circ}\text{F}$$

$$\text{Setpoint (}^{\circ}\text{F)} = 40 + 2.5$$

$$= 42.5$$

PWM

The Pulse Width Modulation input is in the form of a 1 to 11 second relay contact closure that applies 115VAC to the I/O Board TB4-19 for 1 to 11 seconds. As shown in Fig. 10, connect dry closure relay contacts between I/O Board TB4-19 (input) and TB4-1 (115VAC). A contact closure time (pulse width) of 1 second produces a 0°F offset. An 11 second closure produces the maximum allowed offset (10 or 20°F above the Local Setpoint value). The relay contacts should close for 1 to 11 seconds at least once every 30 minutes to maintain the setpoint to the desired value. If a 1 to 11 second closure is not received within 30 minutes of the last closure, the setpoint is defaulted to the Local Setpoint value. A closure is only accepted at rates not to exceed once every 70 seconds. This input will only be accepted in **DIGITAL** Remote mode. Calculate the setpoint for various pulse widths as follows:

Offset (°F) =

$$\frac{(\text{pulse width in seconds} - 1)(\text{Remote Reset Temp Range})}{10}$$

$$\text{Setpoint (F°)} = \text{Local Setpoint} + \text{Offset}$$

For example, if the relay contacts close for 5 seconds and the Remote Reset Temp Range Setpoint is programmed to 10°F and the Local Leaving Chilled Liquid Temperature setpoint is programmed for 40°F, the setpoint would be set to 44°F as follows:

$$\begin{aligned} \text{Offset (°F)} &= \frac{(5 - 1)(10)}{10} \\ &= \frac{(4)(10)}{10} \\ &= \frac{40}{10} \\ &= 4^\circ\text{F} \\ \text{Setpoint (°F)} &= 40 + 4 \\ &= 44^\circ\text{F} \end{aligned}$$

RS-232

As shown in *Figure 8 on page 41*, a Setpoint can be received in serial data form at the Microboard COM 4B serial port (J2) from the MicroGateway.

SECTION 21 - CAPACITY / ANTI-SURGE / OVERRIDE CONTROLS

OVERVIEW

Both fixed and Variable Speed modes of operation are included. The fixed speed mode would likely only be used in plants where the condensing water is always at a high temperature so that speed reduction would not be possible due to the high system pressure differential. The Speed Control mode is factory set for Variable (default mode) to provide the greatest efficiency of operation in plants where the condensing water is cooled to as low as 55 °F. This allows the turbine speed to be reduced to the minimum rated speed and the compressor Pre-rotation Vanes to be closed completely prior to opening the hot gas valve. In this mode, the capacity controls will automatically utilize the full range of the governor, compressor PRV and hot gas valve capabilities to control the capacity of the chiller and provide anti-surge and override control functions to prevent unsafe operation.

For easy adjustments all operating mode selections and PID tuning parameters are included on various setpoint screens on the OptiView Control Center graphic display.

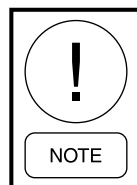


Only a qualified YORK Service Technician should make adjustments to these controls.

FIXED SPEED CHILLER CAPACITY CONTROLS OPERATION

The fixed speed mode would likely only be used in plants where the condensing water is always at a high temperature so that speed reduction would not be possible due to the high system pressure differential. During operation at a fixed speed, the vanes and hot gas valve are controlled by the output of a single PID controller that responds to changes in the leaving chilled liquid temperature. A ratio calculation is used to position the hot gas valve after the vanes have been closed to their minimum position based on the system pressure differential (condenser minus evaporator pressure). A separate PID controller is also provided to control the hot gas valve based on leaving chilled liquid temperature if operating conditions require the vanes to be fully closed at low loads. During off design operation, the outputs of the high condenser pressure, low evaporator pressure and torque limiting override PID controllers

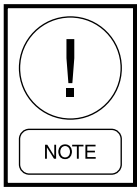
override the output of the primary Leaving Chilled Liquid Temperature Controller to maintain stable operation and prevent the chiller from shutting down. The tuning of the primary Leaving Chilled Liquid Temperature, Evaporator Pressure and Condenser Pressure PID controllers is automatically adjusted to match the response time of the process when the hot gas valve is being controlled. To achieve maximum efficiency at part load conditions, the unloading sequence is vane closure and hot gas valve opening.



Refer to the paragraphs below for a more detailed description of the operation. If any of the speeds, ramp rates, or time delays described in the following paragraphs are adjustable, the factory Default values are shown for clarity. Refer to the OptiView Control Center Operation Manual Form 160.67-01 for details on adjustable setpoints.

FIXED SPEED CHILLER LOADING SEQUENCE

The chiller is started with the Leaving Chilled Liquid Temperature Controller inactive and its output equal to the fixed speed tieback signal after LSR3. When the ramp-to-rated speed is initiated, the vane output signal is set to the minimum start-up value. After the minimum rated speed of 3200 RPM has been achieved, the vanes are ramped open and the hot gas valve is ramped closed. As the system pressure differential (condenser minus evaporator pressure) increases, if the output of the Minimum Vane Position Calculation increases above the PRV ramp output signal, HSR5 will select the higher value to open the vanes farther and prevent surging. The Leaving Chilled Liquid Temperature Controller becomes active when the vane ramp signal is at 97% or the leaving chilled liquid temperature decreases to within 2 °F of the Leaving Chilled Liquid Temperature Controller set point. The Leaving Chilled Liquid Temperature Controller will adjust the vanes as required to maintain the leaving chilled liquid temperature at set point.



For fixed speed operation, TDSP17–Turbine Stabilization Delay should be set to 0 to allow loading to begin as soon as the minimum rated speed is achieved. Refer to the OptiView Control Center Operation Manual Form 160.67-01 for details on adjustable setpoints.

FIXED SPEED CHILLER UNLOADING SEQUENCE

Fixed Speed - PRV Unloading

If the load decreases, the output of the Leaving Chilled Liquid Temperature Controller will decrease to close the vanes to the minimum position established by the Minimum Vane Position Calculation.

As the system pressure differential falls, the compressor is capable of stable operation with less refrigerant gas flow (lower minimum compressor pre-rotation vane positions). For the greatest efficiency, the compressor Pre-rotation Vanes must be used for capacity control rather than hot gas bypass whenever possible. The Minimum Vane Position Calculation output signal to HSR5 provides a minimum closure of the Pre-rotation Vanes to suite the measured pressure differential input. This output also provides one of the input signals for the Hot Gas Ratio calculation which to use in controlling the output to the hot gas valve.

Fixed Speed - Hot Gas Ratio Unloading

The Hot Gas Ratio calculation controls the hot gas bypass valve at a scaled ratio to the percentage of available Leaving Chilled Liquid Temperature Controller signal below the Minimum Vane Position Calculation output, thus providing a 0-100% control signal for the hot gas bypass valve.

To provide greater stability at very low system pressure differentials when the Minimum Vane Position Calculation would normally be 0%, a minimum vane position may be entered into the HGVRAT set point. HSR1 will select this higher value to give Hot Gas Ratio calculation a greater range of control for the hot gas valve. As long as the capacity signal from the Leaving Chilled Liquid Temperature Controller is above the Minimum Vane Position Calculation output (or the HGVRAT) signal, the hot gas valve remains closed. When the capacity signal falls below the Minimum Vane Position Calculation output, the tuning parameters for hot gas control are loaded into the Leaving Chilled Liquid Temperature Controller. The output of

the Hot Gas Ratio calculation increases, which starts to open the hot gas bypass valve. Thus at low loads, the capacity is controlled by modulating the hot gas bypass valve.

Fixed Speed - HGV Temperature Controller Unloading

In some cases, it may be desirable to allow the vanes to go completely closed which would leave no signal for the Hot Gas Ratio calculation to control the hot gas valve. A separate PID controller is provided which controls at a leaving chilled liquid temperature set point that is slightly below the main Leaving Chilled Liquid Temperature Controller set point. If the load continues to decrease with the vanes fully closed, the leaving chilled water temperature will decrease below the set point of the HGV Temperature Controller causing its output to increase. HSR6 will select this higher signal and begin opening the hot gas valve to maintain the leaving chilled liquid temperature at the lower HGV Temperature Controller set point.

FIXED SPEED - CHILLER OVERRIDE CONTROLS

Fixed Speed - High and Low Refrigerant Pressure Override

The Evaporator Pressure and Condenser Pressure controllers are inactive when the chiller is stopped with their outputs set to 100%. If the monitored parameter exceeds the set point of the controller during any abnormal operation when running at or above the minimum rated speed, the output of the appropriate controller is set to the tieback signal after LSR3, thus providing a bumpless transfer to the override control. If the monitored parameter exceeds the set point of the controller, the controller output will decrease. LSR2 and LSR1 will select the lower signal to override the Leaving Chilled Liquid Temperature Controller output and close the compressor PRV to maintain the evaporator pressure at the setpoint, thus preventing unsafe operation and an unnecessary shutdown.

If the override signal falls below the Minimum Vane Position Calculation output, the tuning parameters for hot gas control are loaded into the override controller and the hot gas valve is throttled as required to maintain the evaporator pressure at the setpoint. While any override controller is active, the primary Leaving Chilled Liquid Temperature Controller is inactivated and its output is set to equal the appropriate tieback, thus providing a bumpless transfer to normal leaving

chilled liquid temperature control. After the override controllers monitored parameter has not exceeded the set point for 5 seconds, the Leaving Chilled Liquid Temperature Controller is reactivated and its' PID algorithm begins controlling the output at the tieback value.

Fixed Speed - Turbine Governor Position Horsepower Limiting Override

In some applications, during high load/pulldown conditions, the turbine may be capable of producing more horsepower than the compressor bearings are rated for. To provide protection for retrofitted chillers that do not have the ability to monitor turbine first stage pressure, the logic monitors the governor valve actuator output from the chiller panel as done on previous chillers. The Governor Position Controller is inactive when the chiller is stopped with its' outputs set to 100%. When the chiller is running at or above the minimum rated speed, if the integrated speed control PID attempts to open the governor valve more than a preset value (determined by field testing at start up), the output of the Governor Position Controller will decrease. LSR2 and LSR1 will select the lower signal to override the Leaving Chilled Liquid Temperature Controller output and unload the chiller as described above. With the load reduced, the turbine will begin to speed up and the speed control PID will begin to close the governor valve, thus limiting the horsepower output of the turbine.

While the Governor Position Controller is active, the primary Leaving Chilled Liquid Temperature Controller is inactivated and its output is set to equal the appropriate tieback, thus providing a bumpless transfer to normal leaving chilled liquid temperature control. After the load is reduced sufficiently to return the governor valve to a safe position for 5 seconds, the Leaving Chilled Liquid Temperature Controller is reactivated and its' PID algorithm begins controlling the output at the tieback value.

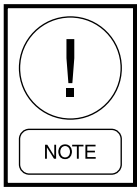
Fixed Speed - Turbine Horsepower Limiting Override

All new YST chillers are provided with a transmitter to monitor the turbine first stage pressure. This pressure used along with the steam inlet pressure and temperature and the exhaust pressure to calculate the turbines power output. A separate PID controller is provided to unload the chiller when the turbine power approaches the maximum that the compressor bearings are rated for or 115% of the turbine design horsepower, whichever

is lower. The logic will calculate the actual horsepower based on the steam inlet temperature and pressure so that the override controller automatically adapts to fluctuations in the quality of the steam supplied to the turbine inlet. If the calculated horsepower increases above the set point, the output of the Horsepower Limit Controller will decrease. LSR2 and LSR1 will select the lower signal to override the Leaving Chilled Liquid Temperature Controller output and unload the chiller as described above. With the load reduced, the turbine will begin to speed up and the speed control PID will begin to close the governor valve, thus reducing the horsepower output of the turbine. While the Horsepower Limit Controller is active, the primary Leaving Chilled Liquid Temperature Controller is inactivated and its output is set to equal the appropriate tieback, thus providing a bumpless transfer to normal leaving chilled liquid temperature control. After the turbine horsepower has not exceeded the set point for 5 seconds, the Leaving Chilled Liquid Temperature Controller is reactivated and its' PID algorithm begins controlling the output at the tieback value.

VARIABLE SPEED CHILLER CAPACITY CONTROLS OPERATION

During operation, the speed, vanes and hot gas valve are controlled by the output of a single PID controller that responds to changes in the leaving chilled liquid temperature. The Capacity Ratchet Mode Selector directs the controllers output to the appropriate controlled device depending on system load and system pressure differential (condenser minus evaporator pressure). During off design operation, the outputs of the high condenser pressure, low evaporator pressure and torque limiting override PID controllers are also directed to the appropriate device to maintain stable operation and prevent the chiller from shutting down. The tuning of the primary Leaving Chilled Liquid Temperature, Evaporator Pressure and Condenser Pressure PID controllers is automatically adjusted to match the response time of the process depending on the device being controlled. To achieve maximum efficiency at part load conditions, the unloading sequence is speed reduction, vane closure, and hot gas valve opening.



Refer to the paragraphs below for a more detailed description of the operation. If any of the speeds, ramp rates, or time delays described in the following paragraphs are adjustable, the factory Default values are shown for clarity. Refer to the OptiView Control Center Operation Manual Form 160.67-01 for details on adjustable setpoints.

VARIABLE SPEED CHILLER LOADING SEQUENCE

Variable Speed - Hot Gas Mode Loading

The chiller is started with the Leaving Chilled Liquid Temperature Controller inactive and the hot gas control signal at 100%. When the ramp-to-rated speed is initiated, the vane output signal is set to the minimum start-up value (PRVM). The chiller is first ramped up to the higher fixed rated speed set point to allow the speed control PID time to stabilize the speed prior to loading the chiller. This is done to avoid cycling the speed down into the critical speed range of the turbine as the governor is throttled during ramp up.

After the stabilization time delay has elapsed, the speed set point is ramped down to the minimum speed determined by the Minimum Speed Calculation to suite the measured pressure differential input. The Capacity Ratchet Mode Selector sets the Leaving Chilled Liquid Temperature Controller to the hot gas mode, the tuning parameters for hot gas control are loaded, and its output is set to the current hot gas control signal. The hot gas valve is ramped closed. As the system pressure differential (condenser minus evaporator pressure) increases, the outputs of the Minimum Speed and Minimum Vane Position Calculation will increase. The speed set point and vane control signals are immediately set to the higher values to prevent surging.

If the load is light and the leaving chilled liquid temperature decreases to within 2 °F of the Leaving Chilled Liquid Temperature Controller set point, the controller becomes active, and its' PID algorithm begins modulating the hot gas valve to prevent overshooting of the set point as the chilled liquid loop is pulled down to design temperature.

Variable Speed - PRV Mode Loading

If the leaving chilled liquid temperature remains above set point, the Leaving Chilled Liquid Temperature Controller will remain inactive and the hot gas valve will continue to be ramped closed. When the Capacity Ratchet Mode Selector detects a 0% HGV actuator output, the tuning parameters for PRV control are loaded into the Leaving Chilled Liquid Temperature Controller and its' output is set to the current PRV control signal which will be equal to the higher of the minimum start-up value (PRVM) or the Minimum Vane Position Calculation output. The PRV will begin ramping open.

As the system pressure differential increases, the output of the Minimum Speed Calculation will increase and the speed set point signal is immediately set to the higher value to prevent surging.

If the load is light and the leaving chilled liquid temperature decreases to within 2 °F of the Leaving Chilled Liquid Temperature Controller set point, the controller becomes active, and its' PID algorithm begins modulating the PRV to prevent overshooting of the set point as the chilled liquid loop is pulled down to design temperature.

Variable Speed - Speed Mode Loading

If the leaving chilled liquid temperature remains above set point, the Leaving Chilled Liquid Temperature Controller will remain inactive and the PRV will continue to be ramped open. When the Capacity Ratchet Mode Selector detects a 97% PRV control signal, the tuning parameters for Speed control are loaded into the Leaving Chilled Liquid Temperature Controller and its' output is set to the current speed set point in % which will be equal to the higher of the minimum rated speed in % or the Minimum Speed Calculation output in %. The Leaving Chilled Liquid Temperature Controller becomes active, and its' PID algorithm begins modulating the speed set point to maintain the leaving chilled liquid temperature at set point.

VARIABLE SPEED CHILLER UNLOADING SEQUENCE

Variable Speed - Speed Mode Unloading

If the load decreases, the output of the Leaving Chilled Liquid Temperature Controller will decrease. For the greatest efficiency, the speed must be reduced as much as possible prior to closing the compressor Pre-rotation Vanes. As the system pressure differential falls, the compressor is capable of stable operation with less refrigerant gas flow (lower minimum speeds). The Minimum Speed Calculation output signal to HSR4 provides a minimum speed to suite the measured pressure differential input. The Capacity Ratchet logic constantly monitors the Minimum Speed Calculation output signal to ensure that the chiller is always operating at the minimum speed possible while maintaining system stability.

Variable Speed - PRV Mode Unloading

When the Leaving Chilled Liquid Temperature Controller output is equal to the Minimum Speed Calculation output signal, the Leaving Chilled Liquid Temperature Controller PID calculation is halted while the tuning parameters for PRV control are loaded and its' output is set to the current PRV control signal which would be 100% since the PRV signal would be at 100% while the speed is being controlled. The controller PID algorithm then begins modulating the PRV control signal to maintain the leaving chilled liquid temperature at set point. As the vanes are closed, the system pressure differential will decrease resulting in a lower output from the Minimum Speed Calculation.

The Capacity Ratchet logic will decrease the speed set point to the lower value after 30 seconds to maintain maximum efficiency of operation. If the system pressure differential increases, the output of the Minimum Speed Calculation will increase. The speed set point is immediately set to the higher value to prevent surging.

For the greatest efficiency, the compressor Pre-rotation Vanes must be closed as far as possible prior to opening the hot gas valve. The Minimum Vane Position Calculation output signal to HSR5 provides a minimum closure of the Pre-rotation Vanes to suite the measured pressure differential input. The Capacity Ratchet logic constantly monitors the Minimum Speed Calculation output signal to ensure that the chiller is always operating at the lowest PRV signal possible while maintaining system stability

Variable Speed - Hot Gas Mode Unloading

If the load continues to decrease, the output of the Leaving Chilled Liquid Temperature Controller will decrease. When the Leaving Chilled Liquid Temperature Controller output is equal to the Minimum Vane Position Calculation output signal, the Leaving Chilled Liquid Temperature Controller PID calculation is halted while the tuning parameters for HGV control are loaded and its' output is set to a value equal to 100% minus the current HGV control signal. This value would be 100% since the HGV signal would be 0% while the vanes are being controlled. The controller PID algorithm then begins modulating the HGV control signal to maintain the leaving chilled liquid temperature at set point.

If the load continues to decrease, the Leaving Chilled Liquid Temperature Controller output will begin decreasing from 100%. This signal is subtracted from 100% to provide the increasing signal required to open the HGV. As the HGV is opened, the system pressure differential will decrease resulting in lower outputs from the Minimum Speed Calculation and Minimum Vane Position Calculation.

The Capacity Ratchet logic will decrease the speed set point and PRV control signals to the lower values after 30 seconds to maintain maximum efficiency of operation. If the system pressure differential increases, the outputs of the Minimum Speed Calculation and Minimum Vane Position Calculation will increase. The higher values are immediately moved into the speed set point and PRV control signal to prevent surging.

VARIABLE SPEED CHILLER OVERRIDE CONTROLLERS

Variable Speed - High and Low Refrigerant Pressure Override

The Evaporator Pressure and Condenser Pressure controllers are inactive when the chiller is stopped with their outputs set to 100%. If the monitored parameter exceeds the set point of the controller during any abnormal operation when running at or above the minimum rated speed, the output of the appropriate controller is set to the tieback signal for the device currently being controlled before the controller is activated, thus providing a bumpless transfer to the override control. If the monitored parameter exceeds the set point of the controller, the controller output will decrease. LSR1 will select the lower signal to override the Leaving Chilled Liquid Temperature Controller output and un-

load the chiller as described above using the Capacity Ratchet Mode Selector to direct the controllers output to the appropriate controlled device depending on system load and system pressure differential, thus preventing unsafe operation and an unnecessary shutdown. While any override controller is active, the primary Leaving Chilled Liquid Temperature Controller is inactivated and its output is set to equal the appropriate tieback, thus providing a bumpless transfer to normal leaving chilled liquid temperature control. After the override controllers monitored parameter has not exceeded the set point for 5 seconds, the Leaving Chilled Liquid Temperature Controller is reactivated and its' PID algorithm begins controlling the output at the tieback value.

Variable Speed - Turbine Governor Position Horsepower Limiting Override

In some applications, during high load/pulldown conditions, the turbine may be capable of producing more horsepower than the compressor bearings are rated for. To provide protection for retrofitted chillers that do not have the ability to monitor turbine first stage pressure, the logic monitors the governor valve actuator output from the chiller panel as done on previous chillers. The Governor Position Controller is inactive when the chiller is stopped with its' outputs set to 100%. When the chiller is running at or above the minimum rated speed, if the integrated speed control PID attempts to open the governor valve more than a preset value (determined by field testing at start up), the output of the Governor Position Controller will decrease. LSR2 and LSR1 will select the lower signal to override the Leaving Chilled Liquid Temperature Controller output and unload the chiller as described above using the Capacity Ratchet Mode Selector to direct the controllers output to the appropriate controlled device depending on system load and system pressure differential. With the load reduced, the turbine will begin to speed up and the speed control PID will begin to close the governor valve, thus limiting the horsepower output of the turbine.

While the Governor Position Controller is active, the primary Leaving Chilled Liquid Temperature Controller is inactivated and its output is set to equal the appropriate tieback, thus providing a bumpless transfer to normal leaving chilled liquid temperature control. After the load is reduced sufficiently to return the governor valve to a safe position for 5 seconds, the Leaving Chilled Liquid Temperature Controller is reactivated and its' PID algorithm begins controlling the output at the tieback value.

Variable Speed - Turbine Horsepower Limiting Override

All new YST chillers are provided with a transmitter to monitor the turbine first stage pressure of the turbines power output. A separate PID controller is provided to unload the chiller when the turbine power approaches the maximum that the compressor bearings are rated for or the logic will calculate the active horsepower based on the steam inlet temperature and pressure so that the override controller automatically adapts to fluctuations in the quality of the steam supplied to the turbine inlet. If the turbine calculated horsepower increases above the set point, the output of the Turbine Horsepower Limit Controller will decrease. LSR2 and LSR1 will select the lower signal to override the Leaving Chilled Liquid Temperature Controller output and unload the chiller as described above using the Capacity Ratchet Mode Selector to direct the controllers output to the appropriate controlled device depending on system load and system pressure differential. With the load reduced, the turbine will begin to speed up and the speed control PID will begin to close the governor valve, thus reducing the horsepower output of the turbine. While the Horsepower Limit Controller is active, the primary Leaving Chilled Liquid Temperature Controller is inactivated and its output is set to equal the appropriate tieback, thus providing a bumpless transfer to normal leaving chilled liquid temperature control. After the turbine horsepower has not exceeded the set point for 5 seconds, the Leaving Chilled Liquid Temperature Controller is reactivated and its' PID algorithm begins controlling the output at the tieback value.

SECTION 22 - CAPACITY CONTROL DEVICES

HOT GAS BYPASS OVERVIEW

(Refer to *Figure 59 on page 161*)

The hot gas bypass valve is used primarily at low loads to maintain a minimum suction gas flow required by the compressor for stability. When the compressor has reduced capacity to its minimum flow (via speed reduction and pre-rotation vane throttling), further capacity reductions are accomplished by opening the hot gas bypass valve. This maintains the flow to compressor by bypassing the condenser gas back to the evaporator. However, the hot gas flow replaces the useful evaporation in the cooler since the compressor flow is at minimum. Thus, the net chilling capacity is reduced (albeit not efficiently). The minimum suction flow via speed reduction or minimum compressor PRV position will vary. As the differential “head” pressure is lowered (due to colder condenser cooling liquid) the compressor is capable of stable operation at lower loads. The programming in the chiller panel thus uses the differential “HEAD” pressure to establish when the hot gas may be needed.

In order to reduce steam consumption and turbine horsepower requirements, the hot gas valve is held closed until it is absolutely needed. The hot gas valve will begin to open when the speed has been reduced to minimum, the compressor Pre-rotation Vanes are at their minimum position and further reduction of chiller capacity is required. At this point, the hot gas valve becomes the primary means for leaving chilled liquid temperature control. Normally, at higher loads, the control center puts out a 0 VDC signal to keep the hot gas valve closed. When the minimum speed and vanes have been reached, further requirements to reduce chiller capacity will result in an increasing signal to open the valve. This valve is opened at shutdown to allow the condenser pressure to equalize with the evaporator quickly, thus reducing backflow of high-pressure gas through the compressor to the evaporator.

The Microboard controls the hot gas valve by sending a positioning command over the COM 3 RS-485 serial communications link to the optional **Analog I/O Expansion Board** that is mounted inside the control Center. The Analog I/O Board converts this command into a 0-10VDC signal and applies it to the hot gas valve actuator. A 0VDC signal drives the valve fully closed (0% position); a 10VDC signal drives the valve

fully open (100% position). Positions between these extremes are linearly scaled. For example, 50% position would be achieved with a 5VDC signal. The valve control signal is displayed on the AUTO/MANUAL screen in the Hot Gas Bypass Auto and Manual data fields. It is also shown on the Capacity Controls screen in the Hot Gas Bypass data field.

The Auto/Manual screen, accessed from the Capacity Controls screen at the SERVICE access level, displays all the applicable parameters and allows a Service Technician to program the applicable setpoints and manually control the hot gas valve. For retrofit applications, if the chiller is not equipped with the hot gas bypass valve, it must be “Disabled” from the OPERATIONS screen using a procedure in the “*System Calibration Service Setpoints and Reset Procedures*” section of this manual. If “Disabled”, the output for the valve is set to 0VDC.

A 2.5K Ohm **PRV Potentiometer** mounted on the Pre-rotation Vanes (PRV) assembly provides the PRV position (0 to 100%) to the Analog I/O Expansion Board. Channel 15 (P7B-1, 2, 3). Pin 1 supplies a 25mA current to the potentiometer that has a maximum rotation of 37°. The input measures the voltage drop across the potentiometer. This position value is sent over the RS-485 serial communications link to the Microboard. This value is displayed on the Compressor, Variable Geometry Diffuser (VGD), Capacity Controls, and Auto/Manual screens. When the PRV are fully closed, the position is displayed as 0%; fully open displayed as 100%. Positions between these extremes are linearly scaled. To assure accuracy, a PRV Calibration procedure must be performed as detailed in the “*System Calibration, Service Setpoints and Reset Procedures*” section of this manual. The PRV position is displayed as XX on the COMPRESSOR screen and “Start Inhibit -Vanes Uncalibrated” is displayed until the calibration is performed.

The Evaporator and Condenser Pressure transducers provide these pressure values to the Microboard. The Microboard uses these values to calculate the **PRESSURE DELTA** parameter as follows: (condenser pressure – evaporator pressure). This parameter is used in the Anti-Surge Calculations. It represents compressor “Head” and is displayed on the Capacity Controls and Auto/Manual screens as “Head Pressure”.

Hot Gas Bypass Automatic Operation

When the chiller is shutdown, the analog output controlling the valve is set to 10 VDC to drive the valve to the fully open position.

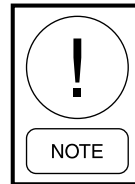
After the chiller is started, the ramp to rated speed has been completed, and the TDSP17-Turbine Stabilization Delay shown on the TIME SETPOINTS screen has elapsed, the hot gas valve control output begins ramping from 100% to 0% at the RRS2-Hot Gas Valve Ramp Rate shown on the Capacity Control Setpoints screen 1. This is used to provide a controlled loading rate. The Default value matches the approximate stroke rate of the hot gas valve actuator since the chiller will capacity will only increase as fast as the valve opens. In the Variable Speed mode, this rate may be increased to initiate a Capacity Ratchet mode change to PRV before the hot gas valve has actually closed fully. This will allow the vanes to begin opening and pull the system down to design conditions sooner. On high load startups, the hot gas valve will be driven fully closed unless an override controller becomes active and holds the valve open to prevent a chiller shutdown. On light load startups, the Leaving Chilled Liquid Temperature Controller may become active before the valve is driven completely closed and hold the valve open to prevent a low temperature shutdown.

Since the position of this valve may depend on many different operating conditions, detailed descriptions of all capacity, anti-surge, and override controls are given in *SECTION 21 - CAPACITY / ANTI-SURGE / OVERRIDE CONTROLS*.

Hot Gas Bypass Manual Operation

The hot gas valve can be manually controlled after logging in at **SERVICE** access level during the **Compressor Shtdn; Turbine Cooldown** and **System Ready To Start** periods and during the “**System Run**” period. Manual operation is inhibited during the **Start Sequence Initiated** and “**System Coastdown**” periods to ensure that the valve is positioned properly for the shutdown. The **Output Control** key must be pressed until **Hot Gas** appears in the keys data field. Pressing the **Switch to Manual** key displays the **Increase**, **Decrease**, and **Set** keys that are used to vary the control output to the valve actuator as follows: Each press of the **Increase** key increases the Manual control signal 1%. Each press of the **Decrease** key decreases the Manual control signal 1%. The **Set** key displays a pop-up window which allows the operator to enter a value from 0-100%. When the “✓” key is pressed, the pop-up window disappears and the manual signal ramps to the value entered at 2%/second.

When pressed, the **Switch to Manual** key text changes to **Green switch to Auto**. If the manual output is manually changed more than 5% from the Auto signal the text changes to red and the transfer back to Auto is inhibited. In order to return to Auto, the manual output signal must be returned to within 5% of the Auto signal at which time the text changes back to green. Pressing the **Switch to Auto** key will then return the level control to automatic operation.



In the Variable Speed mode, when the hot gas bypass valve is put in the Manual mode, the Capacity Ratchet Mode Selector will not sequence to the hot gas (HGV) mode (if not already in that mode) since that device is not available to control the capacity. If the Capacity Ratchet Mode Selector is in the HGV mode when the hot gas valve is put in Manual, the selector will immediately switch to the PRV mode (if it is not in Manual) or the speed (SPD) mode if the vanes are in Manual.

PRE-ROTATION VANES OVERVIEW

For normal operation, the compressor suction throttling vanes (PRV) are in the full open position as long as the compressor pressure differential (head) decreases in conjunction with a decrease in the load. Decreasing head will allow the turbine speed to be reduced further before the vanes must begin to throttle closed. This provides the optimum compressor efficiencies. At low head conditions, the turbine may reach its minimum speed before the load is reduced to the point where hot gas is needed. For this operating condition, closing the compressor PRV to throttle suction flow gas through the machine controls capacity. The position of the Pre-rotation Vanes is determined by a 0-100% control signal from the capacity controls/anti-surge logic. The positioning logic compares this value to the actual position signal received from the PRV potentiometer sensing the rotational position of the vane operating shaft and actuates the Q1-PRV Open and Q2-PRV Close Triacs on the I/O Board as required to achieve the position.

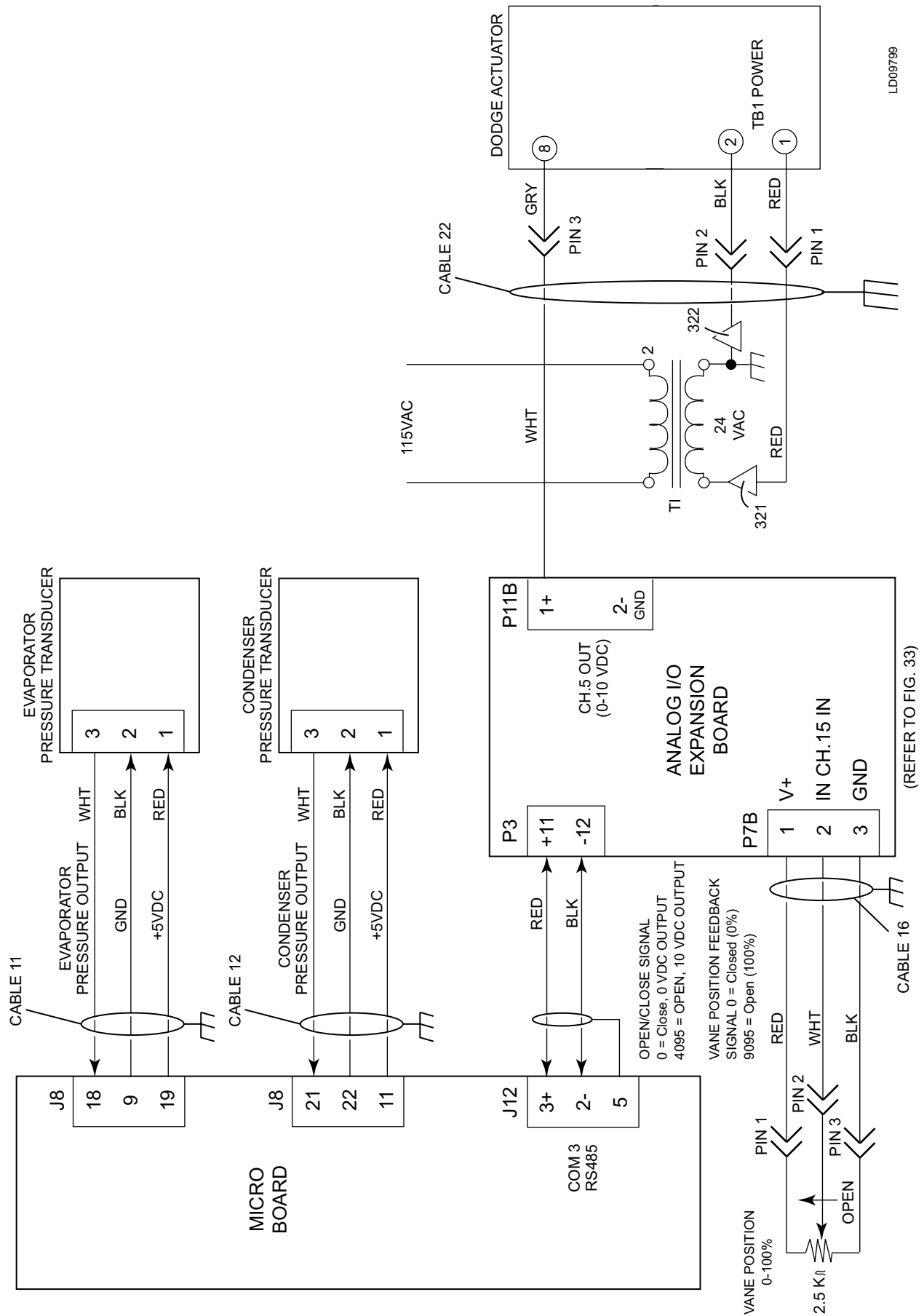


FIGURE 59 - HOT GAS BYPASS CONTROL - INTERFACE

Basically, the calculation looks at the actual feedback position vs. the command position and proportionally adjusts a 5 second pulse width if the error between the two values is 10% or less. For example, if the error is greater than 10%, the required output is held on continuously until the error drops to 10 % or less. If the error is 5%, and the feedback position is less than the target position, the vanes will be pulsed open for 2.5 seconds. If the error is less than 1%, neither of the triacs is activated.

Pre-rotation Vanes Automatic Operation

When the chiller is shutdown, the vanes are driven to the fully closed position. When the actuator closed limit switch (VMS) contact closes to energize terminal TB3-18 of the I/O Board, the chiller will be allowed to be restarted.

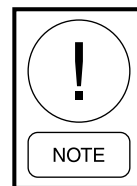
After the chiller is started, the ramp to rated speed has been initiated; the vane output signal is set to the minimum start-up value. After the TDSP17-Turbine Stabilization Delay shown on the TIME SETPOINTS screen has elapsed, the PRV control signal begins ramping from the minimum start-up value to 100% at the RRSP8-PRV Ramp Rate shown on the Capacity Control Setpoints screen 1. This is used to provide a controlled loading rate. The Default value matches the approximate stroke rate of the vane actuator since the chiller will capacity will only increase as fast as the valve opens. In the Variable Speed mode, this rate may be increased to initiate a Capacity Ratchet mode change to speed before the vanes are fully open. This will allow the speed to begin increasing and pull the system down to design conditions sooner. On high load startups, the vanes will be driven fully open unless an override controller becomes active and holds the vanes closed to prevent a chiller shutdown. On light load startups, the Leaving Chilled Liquid Temperature Controller may become active before the vanes are driven completely open and hold the vanes closed to prevent a low temperature shutdown.

Since the position of vanes may depend on many different operating conditions, detailed descriptions of all capacity, anti-surge, and override controls are given in SECTION 20.

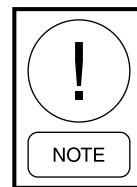
Pre-rotation Vanes Manual Operation

The vanes can be manually controlled after logging in at **SERVICE** access level during the **Compressor Shtdn; Turbine Cooldown** and **System Ready To Start** periods and during the “**System Run**” period. Manual operation is inhibited during the **Start Sequence Initiated** and “**System Coastdown**” periods to ensure that the vanes are positioned properly for the shutdown. The **Output Control** key must be pressed until **Vanes** appears in the keys data field. Pressing the **Switch to Manual** key displays the **Increase**, **Decrease**, and **Set** keys that are used to vary the control signal to the vane positioning logic as follows: Each press of the **Increase** key increases the Manual control signal 1%. Each press of the **Decrease** key decreases the Manual control signal 1%. The **Set** key displays a pop-up window which allows the operator to enter a value from 0-100%. When the “✓” key is pressed, the pop-up window disappears and the manual signal ramps to the value entered at 2%/second.

When pressed, the **Switch to Manual** key text changes to Green **switch to Auto**. If the manual output is manually changed more than 5% from the Auto signal the text changes to red and the transfer back to Auto is inhibited. In order to return to Auto, the manual output signal must be returned to within 5% of the Auto signal at which time the text changes back to green. Pressing the **Switch to Auto** key will then return the level control to automatic operation.



The Pre-rotation Vane Calibration must be accomplished prior to operating the vanes in the Manual mode. When the PRV control signal is set to 0% in the Manual mode, the vane actuator closed limit switch (VMS) may not be activated. Place the control signal back to the Auto mode to activate this switch.



In the Variable Speed mode, when the vanes are put in the Manual mode, the Capacity Ratchet Mode Selector will not sequence to the PRV mode (if not already in that mode) since that device is not available to control the capacity. If the Capacity Ratchet Mode Selector is in the PRV mode when the vanes are put in Manual, the selector will immediately switch to the speed (SPD) mode (if it is not in Manual) or the hot gas (HGV) mode if the Speed Setpoint is in Manual.

SPEED CONTROL OVERVIEW

The OptiView Control Center software provides complete speed control and overspeed protection for the turbine at all times by providing a 4-20 mA output signal to the current to pneumatic transducer controlling the pneumatic actuator on the governor valve.

Speed control is the primary means of chiller capacity control. As the leaving chilled liquid temperature increases above setpoint, the output signal to the turbine governor valve I/P transducer is increased. The increased speed provides additional R-134a flow through the compressor, and therefore increased chiller capacity. Conversely, if the leaving chilled liquid temperature falls below the setpoint, the chiller capacity may be decreased by lowering the turbine speed.

The minimum speed (or minimum suction flow) will vary. As the differential “head” pressure is lowered (due to colder condenser cooling liquid) the compressor is capable of stable operation at lower loads. The programming in the chiller panel thus uses the differential “HEAD” pressure to establish the minimum speed which determines when the compressor PRV and hot gas valve may be needed to reduce the chiller capacity.

Speed Control Automatic Operation

The speed control operates the same in fixed or Variable Speed mode from slow roll through the ramp up to rated speed. The main difference is that in Variable Speed mode, the speed will be reduced to the minimum anti-surge calculated speed based on the system pressure differential. Refer to the Startup Sequence of Operation in the YORK Operation and Maintenance Manual 160.67-O2 for a detailed description of how the chiller speed is increased from 0 to the programmed fixed speed.

Speed Control Manual Operation

The speed setpoint can be manually controlled after logging in at **SERVICE** access level during the **Compressor Shtdn; Turbine Cooldown** and **System Ready To Start** periods and during the “**System Run**” period. Manual operation is inhibited during the **Start Sequence Initiated** and “**System Coastdown**” periods to ensure that the valve is positioned properly for the shutdown.

The **Output Control** key must be pressed until **Speed** appears in the keys data field. Pressing the **Switch to Manual** key displays the **Increase, Decrease, and Set** keys that are used to vary the setpoint signal to the speed PID controller as follows: Each press of the **Increase** key increases the Manual control signal 1% (50 RPM). Each press of the **Decrease** key decreases the Manual control signal 1%. The **Set** key displays a pop-up window which allows the operator to enter a value from 0-100%. When the “✓” key is pressed, the pop-up window disappears and the manual signal ramps to the value entered at 2% (100 RPM)/second. When pressed, the **Switch to Manual** key text changes to Green **switch to Auto**.

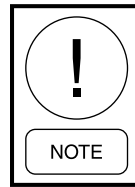
After the chiller is started, while the speed setpoint is being manually controlled, the Auto signal is driven to the manual signal plus a percentage equal to the speed increments of the present speed setpoint ramp rate depending on where the chiller is currently at in the start-up sequence. For example, if put in Manual during the ramp to rated speed at 1500 RPM with RRSP4 - Minimum Rated Speed Setpoint Ramp Rate set at 100 RPM/Sec, the manual signal is 33.3% and the Auto signal will be 34.3%.

If an attempt is made to manually adjust the speed setpoint within the critical speed band of the turbine when the turbine is ramping up to rated speed, the setpoint is automatically increased to a speed above the high end of the critical speed band. Once the turbine has achieved minimum rated speed, the setpoint may never be set below the high end of the critical speed band.

The critical speed band is programmable on the Speed Setpoints screen when logged in as TEST OPERATOR or ADMINISTRATOR and is determined by the SSP11 – Critical Band Base Speed (Range 1800-5000 RPM, Default 2000 RPM) plus the SSP12 - Critical Band Base Speed (Range 500-2000 RPM, Default 1000 RPM). Therefore, with the default setpoints, the speed cannot be set between 2000 and 3000 RPM during ramp up and cannot be set below 3000 RPM during operation.

Pressing the **Switch to Auto** key will then return the Speed Setpoint to automatic operation. When switched back to Auto, the speed setpoint is ramped from the present speed setpoint to the required setpoint depending on where the chiller is currently at in the start-up sequence.

In the example above for instance, pressing the **Switch to Auto** key will return the Speed Setpoint to automatic operation and the speed setpoint will ramp to the SSP2-Minimum Rated Speed Setpoint at 100 RPM/Sec.



In the Variable Speed mode, when the Speed Setpoint is put in the Manual mode, the Capacity Ratchet Mode Selector will not sequence to the SPD mode (if not already in that mode) since that device is not available to control the capacity. If the Capacity Ratchet Mode Selector is in the SPD mode when the Speed Setpoint is put in Manual, the selector will immediately switch to the PRV mode (if it is not in Manual) or the hot gas (HGV) mode if the vanes are in Manual.

SECTION 23 - SMART FREEZE PROTECTION

The **Smart Freeze** feature prevents nuisance chiller shutdowns due to brief periods of chilled liquid flow fluctuations or other brief operating conditions that would normally cause Low Evaporator Pressure safety shutdowns. With this feature “Enabled” and “Activated”, the chiller is permitted to ride through these temporary conditions. Also, this feature allows the Leaving Chilled Liquid Temperature Setpoint to be set as low as 36.0°F. **Smart Freeze** protection can be “Enabled” or “Disabled” at the keypad, by a Service Technician, *using a procedure detailed in the “System Calibration, Service Setpoints and Reset Procedures” section of this manual.* It **cannot** be used in Brine cooling mode.

The basis of this feature is that the chilled liquid contains an amount of heat, which cannot be eliminated immediately. Therefore, it requires a certain amount of time for the liquid to change to a solid. During this period of time, those parameters that determine when solidification will occur are evaluated and the appropriate Low Evaporator Temperature shutdown threshold is applied. This threshold could be lower, but not higher than the normal Safety threshold.

Smart Freeze protection uses the Evaporator Refrigerant Temperature as one of the variables to determine when freezing is imminent. If the chiller is equipped with the Evaporator Refrigerant Temperature Sensor (TE-111), and the sensor is “Enabled” *using the “System Calibration, Service Setpoints and Reset Procedures” section of this manual,* this value is used as the refrigerant temperature. Otherwise, the Evaporator Saturation Temperature (as derived from the output of the Evaporator Pressure Transducer. The pressure is converted to a temperature via the appropriate refrigerant “pressure/temperature lookup table”) is used as the refrigerant temperature.

When **Smart Freeze** protection is “Enabled”, the Leaving Chilled Liquid Temperature Setpoint can be set as low as 36.0°F. If set to < 38.0°F, the **LEAVING CHILLED LIQUID – LOW TEMPERATURE** cycling shutdown threshold becomes a minimum of 34.0°F.

Unless **Smart Freeze** protection is **activated**, the fixed Low Evaporator Pressure Safety thresholds (R22 – 54.3 PSIG, 29.6°F) (R134a – 25.0 PSIG, 28.7°F) are used. Smart Freeze protection is **activated** only when the feature is “Enabled” **AND** the Leaving Chilled Liquid Temperature Setpoint is < 38°F. Once activated, the

total number of seconds that the evaporator refrigerant temperature is below the freeze threshold is counted. The freeze threshold is 32.8°F (refrigerant temp. sensor RT7) or 34.0° (evaporator saturation temp. See Note 1 below.). The count is incremented once for every second the evaporator refrigerant temperature is below the freeze threshold and decremented once for every second it is above the freeze threshold (but is never decremented below zero). Thus if the evaporator refrigerant temperature goes below the freeze threshold for 30 seconds, then goes above it for 10 seconds, then goes below the threshold for 5 seconds, the total number of seconds the evaporator refrigerant temperature was below the freeze threshold was 25 seconds. If Smart Freeze is no longer activated due to the Leaving Chilled Liquid Temperature Setpoint being raised to > 38.0°F, the total number of seconds being tracked is set to zero.

The number of seconds it will take the chilled liquid to freeze is based on how far the evaporator refrigerant temperature is below the freeze threshold as follows:

Number of seconds to freezing =

$$\frac{4053.7}{\text{freeze threshold} - \text{evaporator refrigerant temperature}}$$

(freeze threshold – evaporator refrigerant temperature)

Thus, if the Evaporator Saturation Temperature is being used as the evaporator refrigerant temperature and that temperature is 26.0°F, it would take 8 minutes and 26 seconds for the chilled liquid to freeze.

When the total number of seconds the evaporator refrigerant temperature is below the freeze threshold exceeds the “Number of seconds to freezing”, a safety shutdown is performed and **“EVAPORATOR – LOW PRESSURE – SMART FREEZE”** is displayed on the System Details line of the display.

Even though **Smart Freeze** protection is “Enabled” and “Activated”, the Evaporator Low Pressure Override controller will still take control of the Speed, Pre-rotation Vanes and Hot Gas Valve, if the evaporator pressure falls below the evaporator pressure setpoint (SP) shown on the PID SETUP screen 1.

The following is a summary of the operation with **Smart Freeze** “Enabled” and “Disabled”:

SMART FREEZE DISABLED

- Minimum Leaving Chilled Liquid Setpoint: 38.0°F
- Low Chilled Liquid Temp cycling shutdown threshold: 1° to 34.0°F below the Leaving Chilled Liquid Temp Setpoint, as programmed, or a minimum of 36.0°F.
- Low Evaporator Pressure safety shutdown threshold: R22 - 54.3 PSIG (29.6°F); R134a – 25.0 PSIG (28.7°F)
- Evaporator Low Pressure Override (**Fixed Speed**): The evaporator pressure controller is inactive when the chiller is stopped with its output set to 100%. If the evaporator pressure falls below the set point of the controller during any abnormal operation when running at or above the minimum rated speed, the output of the controller is set to the tieback signal after LSR3, thus providing a bumpless transfer to the override control. If the evaporator pressure continues to fall below the set point of the controller, the controller output will decrease. LSR2 and LSR1 will select the lower signal to override the Leaving Chilled Liquid Temperature Controller output and close the compressor PRV to maintain the evaporator pressure at the setpoint, thus preventing unsafe operation and an unnecessary shutdown.

If the override signal falls below the Anti-surge Minimum Vane Position Calculation output, the tuning parameters for hot gas control are loaded into the override controller and the hot gas valve is throttled as required to maintain the evaporator pressure at the setpoint.

While any override controller is active, the primary Leaving Chilled Liquid Temperature Controller is inactivated and its output is set to equal the appropriate tieback, thus providing a bumpless transfer to normal leaving chilled liquid temperature control. After the evaporator pressure has not exceeded the override controllers set point for 5 seconds, the Leaving Chilled Liquid Temperature Controller is reactivated and its' PID algorithm begins controlling the output at the tieback value.

- Evaporator Low Pressure Override (**Variable Speed**): The evaporator pressure controller is inactive when the chiller is stopped with its output set to 100%. If the evaporator pressure falls below the set point of the controller during any abnormal operation when running at or above the minimum rated speed, the output of the controller is set to the tieback signal for the device currently being controlled before the controller is activated, thus providing a bumpless transfer to the override control. If evaporator pressure continues to fall below the set point of the controller, the controller output will decrease. LSR1 will select the lower signal to override the Leaving Chilled Liquid Temperature Controller output and unload the chiller using the Capacity Ratchet Mode Selector to direct the controllers output to the appropriate controlled device depending on system load and system pressure differential. The controls output will reduce the speed, close the vanes, and open the hot valve as required to maintain the evaporator pressure at the setpoint, thus preventing unsafe operation and an unnecessary shutdown. While the override controller is active, the primary Leaving Chilled Liquid Temperature Controller is inactivated and its output is set to equal the appropriate tieback, thus providing a bumpless transfer to normal leaving chilled liquid temperature control. After the evaporator pressure has not exceeded the override controllers set point for 5 seconds, the Leaving Chilled Liquid Temperature Controller is reactivated and its' PID algorithm begins controlling the output at the tieback value.

SMART FREEZE ENABLED

- Minimum Leaving Chilled Liquid Setpoint: 36.0°F
- *If the Leaving Chilled Liquid Temperature Setpoint is $\geq 38.0^\circ\text{F}$:*
 1. The Low Leaving Chilled Liquid Temperature Cycling shutdown threshold: 1 to 34.0°F below the Leaving Chilled Liquid Temperature Setpoint, as programmed, or a minimum of 36.0°F.
 2. The Low Evaporator Pressure safety shutdown threshold is the same as **Smart Freeze “Disabled”** above.
- *If the Leaving Chilled Liquid Temperature Setpoint is $< 38.0^\circ\text{F}$:*

1. The Low Leaving Chilled Liquid Temperature Cycling shutdown threshold: 1 to 3.0°F below the Leaving Chilled Liquid Temperature Setpoint, as programmed, or a minimum of 34.0°F.
 2. Low Evaporator Pressure shutdown threshold: Determined by how far the evaporator refrigerant temperature is below the freeze threshold of 32.8°F (refrigerant temperature sensor TE-111) or 34.0°F (Evaporator Saturation Temperature.) and the total number of seconds it remains there. Refer to explanation above.
- Evaporator Low Pressure Override (Fixed Speed) Same as Smart Freeze “Disabled” above.
 - Evaporator Low Pressure Override (Variable Speed) Same as Smart Freeze “Disabled” above.

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SECTION 24 - VARIABLE GEOMETRY DIFFUSER

(Refer to Figures 60 & 61)

Certain YORK compressors are equipped with a Variable Geometry Diffuser (VGD). It is used to reduce rotating stall conditions and associated stall noise. Stall may occur at low load conditions with high head. A mechanical ring, located in the diffuser passage after the impeller discharge, is mechanically operated through linkages via an electric actuator like that used to operate the Pre-rotation Vanes. It is closed (extended, CCW rotation) to narrow the diffuser gap. It is opened (retracted, CW rotation) to open the diffuser gap. An internal actuator end switch prevents travel beyond the fully open or closed positions. In response to a stall condition, the ring is closed as much as necessary to eliminate the stall. Since stall is caused by reduced gas flow through the compressor, narrowing the diffuser gap reduces the cross sectional area through which the gas flows, thereby increasing the gas velocity through the compressor.

The VARIABLE GEOMETRY DIFFUSER screen displays all parameters relevant to this feature. All setpoints related to this feature are maintained on the Variable Geometry Diffuser Setpoints screen.

STALL DETECTION

(Refer to Figure 60 on page 173)

Stall noise in the compressor discharge is detected as gas pressure pulsations. A **Stall Pressure Transducer** mounted in the discharge scroll of the compressor, detects the pressure pulsations and outputs DC voltage pulsations to the **Stall Detector Board** (031-02418-001). This board converts the voltage pulsations into an analog voltage that represents the magnitude of the stall noise. This analog voltage is displayed on the VARIABLE GEOMETRY DIFFUSER screen as “Stall Detector Voltage” and is input to the Microboard where it is compared to the Low Limit and HIGH LIMIT setpoint thresholds to determine if the stall noise is acceptable or unacceptable. In a typical YST chiller, a signal below 0.5 VDC indicates little or no stall. A signal above 0.8 VDC indicates stall noise is present.

EARLY VINTAGE YST

Early vintage YST chillers equipped with the Variable Geometry Diffuser were shipped with Stall Transducer(s) part number 025-39464-000. Later chillers are shipped with Stall Transducer(s) part number 025-40088-000. The operation of these transducers is exactly the same. However, they require different wiring connections as shown in *Figure 60 on page 173*.

If VGD is not operating, check the part number and confirm that appropriate connections are made at the transducer.

AUTOMATIC OPERATION

The VGD operation is illustrated in the “State Diagram” illustrated in *Figure 61 on page 174*. The “States” are shown in circles. They are Stall Waiting, Stall Reacting and Probing. Arrows on the diagram indicate actions that move the control from one “State” to another. During chiller operation, the current state is displayed as the “Control Status” on the VARIABLE GEOMETRY DIFFUSER screen.

In general, the VGD is maintained in the most open position possible that does not allow stall. It is fully open when the chiller is started and until it is running at or above the minimum rated speed. If stall occurs, it is driven toward the close position until the stall is eliminated. After a wait period, it is again pulsed open until either a stall occurs or the fully open position is reached, whereupon the cycle repeats.

The Diffuser Gap Open and Diffuser Gap Close LED's on the VARIABLE GEOMETRY DIFFUSER screen illuminate when the program is initiating the respective output.

The following describes the operating states:

Chiller Off, (all states other than “System Run”):

The VGD diffuser gap is driven fully open.

Stall Waiting:

This state is entered when the chiller enters the “System Run” mode or after a Stall Reaction. The VGD is held in last position until one of the following occurs:

- The PROBE WAIT time period (0.5 – 15 minutes; default 10; as programmed with the PROBE WAIT time setpoint) expires. When the timer expires, the Probing state is entered. The time remaining in the PROBE WAIT time period is displayed on the VARIABLE GEOMETRY DIFFUSER screen as “Time Remaining”.
- A stall is detected (Stall Detector Board output goes above the HIGH LIMIT setpoint). Enters Stall Reacting State.
- The compressor Pre-rotation Vanes (PRV) position increases more than the PRV OFFSET (1-5%; default 3; as programmed with the PRV OFFSET setpoint). Enters Probing state. The PRV position is displayed on the VARIABLE GEOMETRY DIFFUSER screen as 0% (fully closed) to 100% (fully open). Note: Setting the PRV OFFSET setpoint to 0% disables this function. Probing will be initiated based on PROBE WAIT time only.

Probing:

In this state, the VGD mechanism is opened in pulses to open the diffuser gap. The pulses are initiated every 10 seconds. The duration of the pulses are defined by the OPEN PULSE setpoint (1-9 seconds; default 2). This probing continues until the Stall Detector Board output exceeds the HIGH LIMIT setpoint (0.5 – 1.2VDC; default 0.8) to indicate stall is present. The number of times the Stall Detector Board output goes above the HIGH LIMIT setpoint threshold is displayed on the VGD SETPOINTS screen as the “VGD Count”. This count can be reset using an ADMIN access level. The accumulated time the Stall Detector Board output voltage is greater than the “High Limit” threshold is displayed on the VGD screen as “VGD Time”.

Stall Reacting:

If a stall is detected from either the Probing or Stall Waiting states, the state is changed to Stall Reacting. In this state, the diffuser gap is closed until the Stall Detector Board output drops below the LOW LIMIT setpoint (0.4 – 0.8VDC; default 0.6). After Stall Reacting, the state returns to Stall Waiting.

MANUAL OPERATION

The VGD can be manually controlled from the VARIABLE GEOMETRY DIFFUSER screen in SERVICE access level, whether the chiller is running or not. Pressing the OPEN, CLOSE or HOLD key invokes Manual operation and the VGD Control mode displays MANUAL. Each time the OPEN or CLOSE keys are pressed, the respective output is energized and the associated LED illuminates. Pressing the HOLD key causes the Hold LED to illuminate and the VGD to be held in its present position. Pressing the AUTO key invokes automatic operation and AUTO is displayed as the control mode.

SETPOINTS

The following setpoints are entered on the Variable Geometry Diffuser Setpoints screen. They require SERVICE access level.

- Enable/Disable - Enables or Disables the VGD feature. Default is “Disabled”. Chiller must be stopped to change this setpoint.
- PRV Offset (0-5%; default 3) – If the VGD control is in the Stall Waiting state and the Pre-rotation Vanes position increases by more than this value, the Probing state will be entered. If the PRV Offset is set to 0%, the Stall Waiting state is performed based only on the “Probe Wait” setpoint interval.
- Probe Wait (0.5-15 minutes; default 10) – Specifies how long the VGD control remains in the Stall Waiting state before entering the Probing state.
- Open Pulse (1-9 seconds; default 2) – Specifies the length of the open pulse applied to the VGD during 10 second periods while in the Probing state.
- High Limit (0.5-1.2VDC; default 0.8) – Specifies the Stall Detector Board output voltage that represents an acceptable amount of stall noise. Above this value is unacceptable.

The minimum difference between the HIGH LIMIT setpoint and the Low Limit setpoint is 0.1 VDC. If a Low Limit setpoint is entered which is less than 0.1VDC below the HIGH LIMIT setpoint, the HIGH LIMIT setpoint is adjusted so that it is 0.1VDC above the newly entered Low Limit value.

- Low Limit (0.4-0.8VDC; default 0.6) – in the Stall Reacting State, the VGD is driven closed until the Stall Detector Board output voltage decreases to this level.

The minimum difference between the HIGH LIMIT setpoint and the Low Limit setpoint is 0.1 VDC. If a Low Limit setpoint is entered which is less than 0.1VDC below the HIGH LIMIT setpoint, the HIGH LIMIT setpoint is adjusted so that it is 0.1VDC above the newly entered Low Limit value.

PRE-ROTATION VANES POSITION

The Pre-rotation Vanes position, as used by the VGD control, is provided by a potentiometer mounted to the PRV control arm. The potentiometer is connected to the Adaptive Capacity Control Board and the PRV position is read from there.

If the chiller is not equipped with a Variable Speed Drive, but is equipped with the Hot Gas Bypass option, the PRV potentiometer is connected to the Analog I/O Expansion Board and the PRV position is read from there.

I/O BOARD

YST chillers are supplied with I/O Board 031-01743-002. This board is populated with the required triacs Q3 and Q4 that apply the open and close signals to the VGD actuator.

VGD OVERRIDE OPERATION

Stall Sensor Validation

This feature verifies the operation of the Stall Pressure Transducer (used for the Variable Geometry Diffuser operation) by comparing its voltage output to the voltage output of the Condenser Pressure Transducer. Since both transducers are measuring essentially the same pressure, both outputs should be within an acceptable range of each other. If the Stall Transducer is not reading accurately, a “Warning” message is displayed and the Variable Geometry Diffuser (VGD) operation is “Disabled”.

While the chiller is running, the outputs of the Stall Transducer and Condenser Transducer are compared. If the difference between them exceeds 0.28 VDC for 3 continuous minutes, the VGD is driven to the full open (100%) position and “Warning – Condenser or VGD Sensor Failure” is displayed. The VGD is held in the open position until the warning is manually cleared. It can be cleared when the voltages are within the acceptable range of each other and the Warning Reset key is pressed in SERVICE access level. When the warning is cleared, the VGD returns to normal operation.

The Stall Pressure Transducer output is now directly connected to the Microboard J8-1 from the Stall Detector Board J2-2.

The Trending Feature Slot Listing Number for “Stall DC Pressure Voltage” is 8317.

Extreme Stall Monitor

The Variable Geometry Diffuser (VGD) ring can be damaged by operating in extreme stall for long periods of time. To prevent damage, the VGD is “Disabled” during Extreme Stall conditions and a “Warning” message is displayed.

While the chiller is running, if the Stall Detector Voltage (output of the Stall Detector Board) exceeds twice the HIGH LIMIT Setpoint, for the duration programmed as the EXTREME STALL DURATION Setpoint, the VGD is driven to the full open (100%) position and “Warning – Conditions Override VGD” is displayed. The VGD is held in the open position until the warning is manually cleared. It can be cleared after the Stall Detector Voltage returns to less than two times the HIGH LIMIT Setpoint. Press the Warning Reset key in SERVICE access level to clear. After it is cleared, the VGD returns to normal operation.

The Extreme Stall condition is not checked under the following conditions:

- While the VGD is in Manual control mode.
- While the VGD is fully closed (position is 0%) (VGD Limit switch closed).
- While the Pre-rotation Vanes position is greater than the PRV VGD INHIBIT Setpoint.

Setpoint

- Extreme Stall Duration (10 to 20 minutes; default 10 minutes) . Specifies the maximum allowed time an Extreme Stall condition can exist before the Variable Geometry Diffuser operation is “Disabled” (and driven full open) to protect it from damage. Requires SERVICE access level.

PRV VGD Inhibit Setpoint

A new setpoint, PRV VGD INHIBIT, has been added to the Variable Geometry Diffuser operation. This setpoint is programmable over the range of 40% to 100%; default 95%.

While the Pre-rotation Vanes position is greater than this setpoint, Extreme Stall conditions are not checked, the VGD control is inhibited and the VGD will be pulsed open according to the OPEN PULSE Setpoint. While this is in effect, "PRV Position Override" is displayed as Control Status.

This setpoint is changed on the Variable Geometry Diffuser Setpoints screen. An access level of Service is required to change this setpoint.

VGD Limit Switch

The status of the Variable Geometry Diffuser Limit switch is now displayed on the VGD screen and the VGD SETPOINTS screen. The Limit switch is closed and displayed as CLOSED when the actuator has reached the end of its CCW rotation indicating that the VGD is in the full closed (0%) position. Otherwise, it is displayed as OPEN.

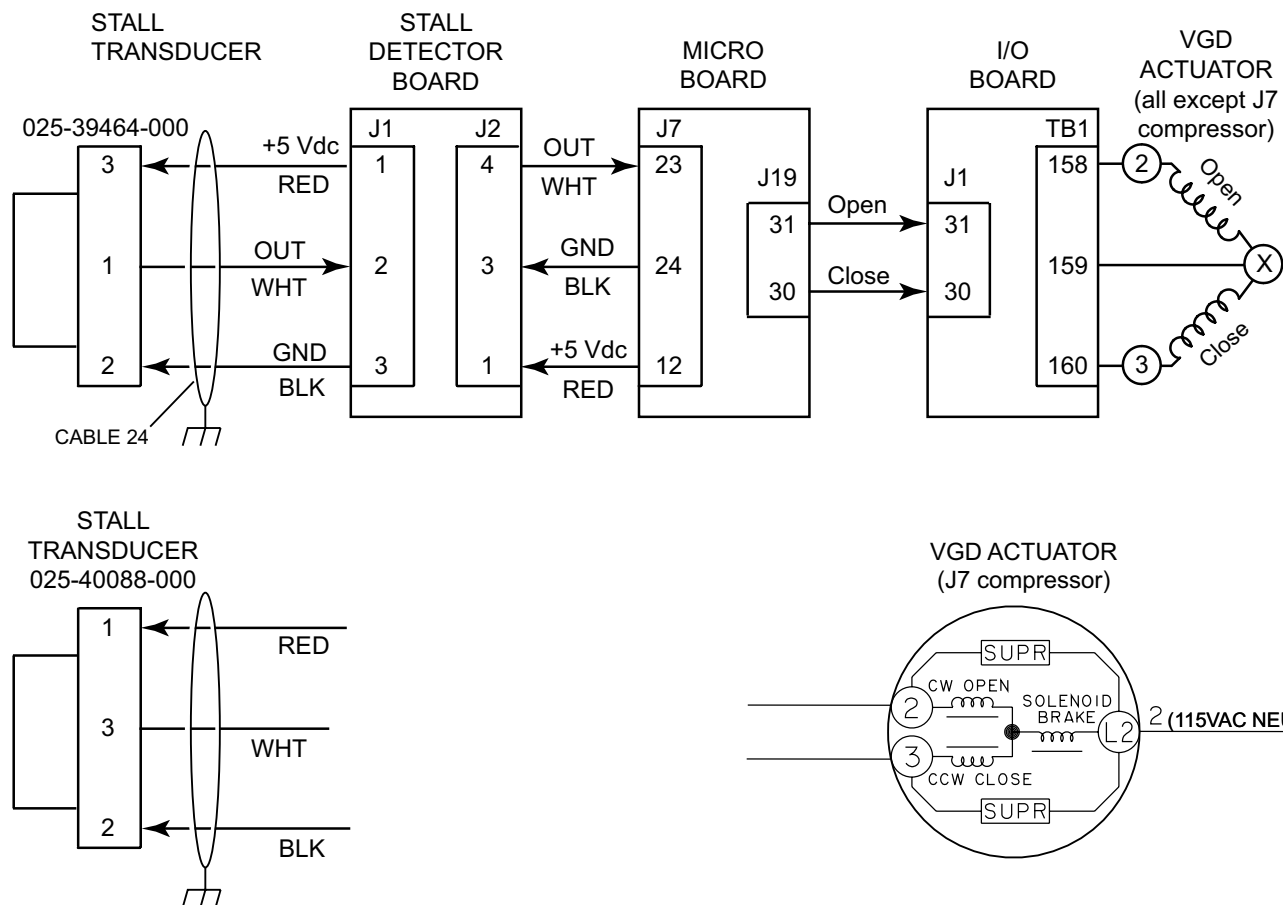
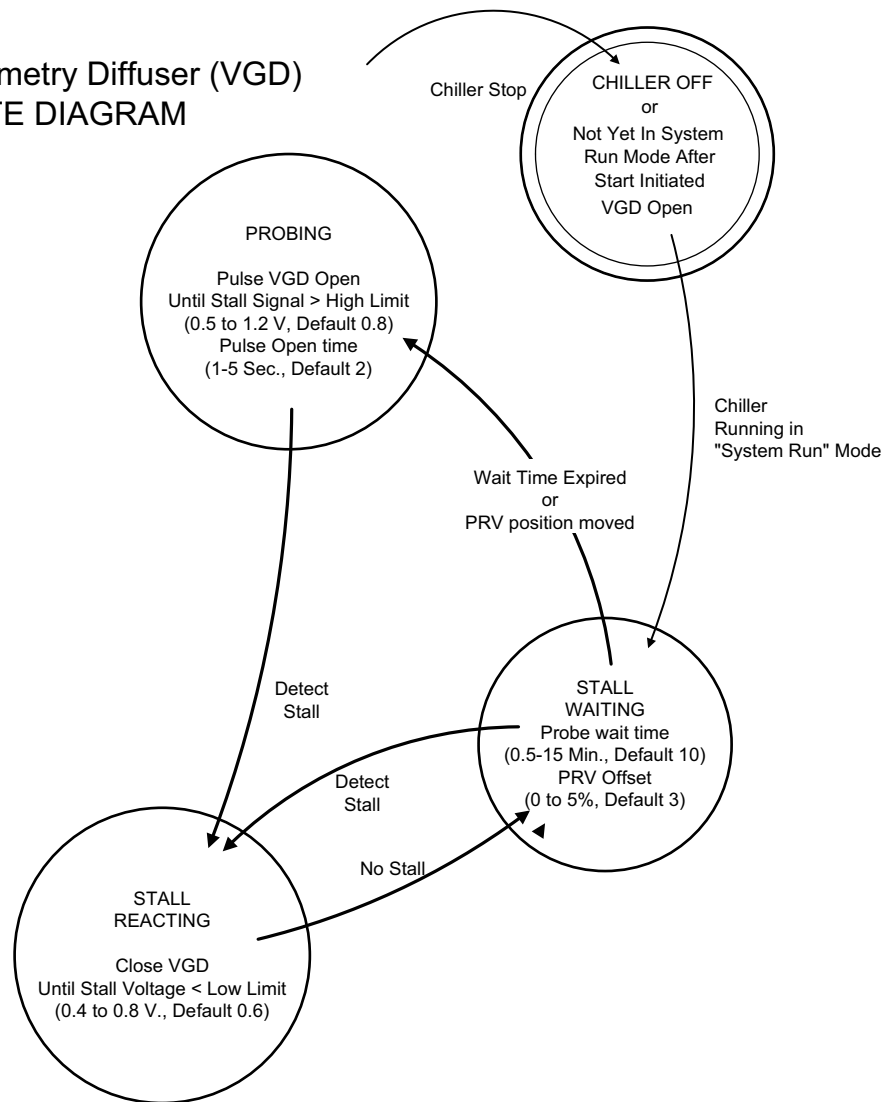


FIGURE 60 - VARIABLE GEOMETRY DIFFUSER - INTERFACE

YST Variable Geometry Diffuser (VGD)
STATE DIAGRAM

NOTE: This diagram depicts operation within normal sensor limits. Stall sensor validation, extreme stall monitoring, and VGD inhibiting logic will override this logic and drive the VGD open.

LD12578

FIGURE 61 - VARIABLE GEOMETRY DIFFUSER STATE DIAGRAM

SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES

The chiller is supplied from the Johnson Controls factory with all factory mounted components fully calibrated. The following procedures are used to verify these calibrations or calibrate a component after it has been field replaced.

Programmable Service Setpoints are used by the program to control critical chiller operation. Also, some of these setpoints can be used to enable or disable certain features. Although they have been entered at the Johnson Controls factory, they can be changed by a field Service Technician that has logged in at SERVICE access level. If the BRAM battery backed memory device (U38) is field replaced, all of the programmed setpoints will be lost. They will have to be re-entered into the new BRAM. Each of these setpoints is described below. Programming procedures and OptiView Control Center keypad operation required in the procedures below are detailed in YORK Operation Manual 160.67-O1. In general, the following procedure is used to enter setpoints in this section:

1. Unless noted otherwise in procedures below, log in at SERVICE access level using access code 1 3 8 0.
2. Select the appropriate Display screen.
3. Press the desired setpoint key.

A dialog box appears, giving the minimum and maximum allowed values, Default value and present value. The dialog box can be canceled at any time by pressing the CANCEL (X) key.

If the dialog box begins with the word “Enter”, use the numeric keys to enter the desired value. Leading zeroes are not necessary. Press the • key to place a decimal point at the appropriate place. Pressing the ▲ key displays the Default value. Pressing the ▼ key clears the entry. The ◀ key is a backspace key and causes the entry point to move back one space. If the dialog box begins with “Select” or “Enable”, use the ◀ and ▶ keys to select the desired value. The ◀ key decreases the value. The ▶ key increases the value.

4. Press the ENTER (✓) key. If the value is within range, it is accepted and the dialog box disappears. The chiller will begin to operate based on the new value. If out of range, the value is not accepted and a message describing why it is not acceptable is displayed momentarily.

Some safety shutdowns will not permit the chiller to start until a special reset procedure is performed. These reset procedures require SERVICE access level and should not be performed by anyone other than a Service Technician. Each of these procedures is described below.

PID TUNING

The PID controllers shown on the PID SETUP screen 1 and PID SETUP screen 2 are configured using the following tuning parameters:

Setpoint (SP)

This is the setpoint that the control algorithm is attempting to maintain. Each time the PID algorithm is executed, the SP is subtracted from the present input value of the process variable (PV) that the controller is measuring to determine the error for a Direct Acting controller. If the controller is Reverse Acting, the PV is subtracted from the SP.

Proportional (P)

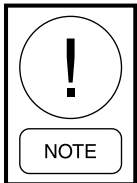
This is the Proportional Gain or Sensitivity that will produce a controller output (CV) that is proportional to the error as a percentage of the input (PV) range. For example, the Subcooler Level Control is Direct Acting, PV Range = 100, SP=50, P=5. With the PV at 60%, the error would be 60%-50% (PV-SP) or 10%. This error is 10% ($10/100 \times 100\%$) of the input range which when multiplied by the P setting of 5 would yield a CV of 50%.

Integral (I)

This is the Integral (also called Reset) that will produce a repeating output based on the proportional error over a period of time. Increasing this value will result in a faster response of the PID output (CV) to a change in the PV. Each time the PID algorithm is executed, the output (CV) will initially change to a new value based on the present proportional error and the P value. After a period of time (based on the I value) the CV will change to a new value based on the current proportional error plus the result of the integral calculation. The output will continue to change until the error is 0. Entering a value of 0 disables the integral calculation.

Derivative (D)

This is the Derivative (also called Rate) that will produce a repeating output based on the rate that the input PV is changing over a period of time. Increasing this value will result in a faster response of the PID algorithm output to a change in the rate that the PV is changing. Generally, if the rate of change is slow, this calculation will have less effect on the controller output (CV). Entering a value of 0 disables the derivative calculation.



The default for the D parameter is 0 for all PID controllers. In most applications, this calculation is not required and the tuning should not be changed. If it is used, the initial value should be 0.01 and changed in 0.01 increments only to avoid introducing extreme instability into the control loop.

Offset (O)

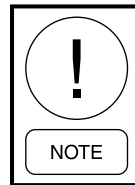
This is the continuous Offset that is added to the result of the proportional calculation to determine the controller output (CV). This parameter is used only for Hotwell Level Control. Since the level in the hotwell need not be maintained constantly at the setpoint, this controller is configured to provide only a Reverse Acting proportional response over a limited range. With the P set at 5, this range will be 20%. For example, with the SP at 50% and the hotwell level transmitter input signal (PV) at 60%, the error would be 50%-60% (SP-PV) or -10%. This error is -10% (-10/100 x 100%) of the input range which when multiplied by the P setting of 5 would yield a CV of -50%. When the Offset of 50% is added, the resulting controller output would be 0%.

This output would cause the overboard valve to be fully open and the recirculation valve to be fully closed, thus returning all the condensate to the boiler. When the level (PV) is at the setpoint, the error is 0. When the Offset of 50% is added, the resulting controller output would be 50%. This output would cause the overboard and recirculation valves to both be approximately 50% open thus returning half the condensate to the boiler and the other half to the steam condenser for recirculation.

TUNING PROCEDURE OVERVIEW

The default tuning values are based on the operation of the actual final tuning established during the commissioning of the first YST chillers using this logic and should provide adequate control for most installations.

In some cases it may be necessary to fine-tune the controllers to achieve stable operation. In general this should be done in small steps by observing how the PV responds to each change and the adjusting the value accordingly. Increasing the P value result in a greater change to the CV for a given change in the PV. Increasing the I value will cause more rapid repeats of the CV over time to return the PV to the SP quicker.



It is very important that the final tuning values be recorded so that they are available for reentry in the event that the Microboard or BRAM is replaced.

SPEED CONTROL TUNING

The OptiView Control Center software provides complete speed control and overspeed protection for the turbine at all times by providing a 4-20 mA output signal to the current to pneumatic transducer controlling the pneumatic actuator on the governor valve.

Because of variations in chiller load, inlet steam and exhaust steam pressures during various stages of start-up and operation, three different sets of tuning parameters (Slow Roll/Min Rated/Rated) may be required in order to provide stable speed control. The tuning parameters are automatically loaded into the Governor (Speed Control) PID Logic at the transition to the next speed control range to provide the proper control.

To change the tuning, use the SELECT PID key on PID SETUP screen 2 to select the speed Governor PID to tune (Slow Roll/Min Rated/Rated). Use the CHANGE SETTINGS key (in SERVICE access level) and cursor arrow keys to select the parameter to change. Service Technicians refer to YORK OptiView Operation Manual 160.67-O1 for additional information on the PID SETUP screen 2.

Tuning in the Variable Speed Mode

During normal operation, the speed, vanes and hot gas valve are controlled by the output of a single PID controller that responds to changes in the leaving chilled liquid temperature. The Capacity Ratchet Mode Selector directs the controllers output to the appropriate controlled device depending on system load and system pressure differential (condenser minus evaporator pressure). During off design operation, the outputs of the high condenser pressure, low evaporator pressure and horsepower limiting override PID controllers are also directed to the appropriate device to maintain stable operation and prevent the chiller from shutting down.

The tuning of the primary Leaving Chilled Liquid Temperature, Evaporator Pressure and Condenser Pressure PID controllers must be adjusted to match the response time of the process depending on the device being controlled. For example, a five percent change in the controller output controlling the speed may have a greater affect on the process than a five percent change when controlling the vanes or hot gas valve. Also, if the process variable is evaporator/condenser pressure, the process response time will be faster than if the process variable is leaving chilled liquid due to the thermal lag introduced by the sensor well. To change the tuning, use the SELECT PID key on PID SETUP screen 1 to select the PID to tune (Temperature/Evaporator/Condenser). Use the CHANGE SETTINGS key (in SERVICE access level) and cursor arrow keys to select the parameter to change. Use the SELECT CONTROL key to select the mode to tune (SPD/PRV/HGV). Service Technicians refer to YORK OptiView Operation Manual 160.67-O1 for additional information on the PID SETUP screen 1.

Tuning in the Fixed Speed Mode

During normal operation at a fixed speed, the vanes and hot gas valve are controlled by the output of a single PID controller that responds to changes in the leaving chilled liquid temperature. A ratio calculation is used to position the hot gas valve after the vanes have been closed to their minimum position based on the system pressure differential (condenser minus evaporator pressure).

During off design operation, the outputs of the high condenser pressure, low evaporator pressure and horsepower limiting override PID controllers override the output of the primary Leaving Chilled Liquid Temperature Controller to maintain stable operation and prevent the chiller from shutting down. The tuning of the primary Leaving Chilled Liquid Temperature, Evaporator Pressure and Condenser Pressure PID controllers must be adjusted to match the response time of the process when the hot gas valve is being controlled.

The Hot Gas Ratio calculation controls the hot gas bypass valve at a scaled ratio to the percentage of available Leaving Chilled Liquid Temperature Controller, Evaporator Pressure or Condenser Pressure override controller output signal below the Minimum Vane Position Calculation output, thus providing a 0-100% control signal for the hot gas bypass valve. Depending on the values of MVP1 and MVP2, a five percent change in the output of the active controllers PID algorithm could result in a very large change in the output signal the hot gas valve. This will cause instability when operating below the minimum vane position unless the tuning of the controllers is adjusted to compensate for this. This will usually mean a much lower Proportional Gain setting.

To change the tuning, use the SELECT PID key on PID SETUP screen 1 to select the PID to tune (Temperature/Evaporator/Condenser). Use the CHANGE SETTINGS key (in SERVICE access level) and cursor arrow keys to select the parameter to change. Use the SELECT CONTROL key to select the mode to tune (PRV/HGV).

In some cases, it may be desirable to allow the vanes to go completely closed which would leave no signal for the Hot Gas Ratio calculation to control the hot gas valve. A separate HGV Temperature Controller is provided which controls at a leaving chilled liquid temperature set point that is slightly below the primary Leaving Chilled Liquid Temperature Controller set point. If the load continues to decrease with the vanes fully closed, the leaving chilled liquid temperature will decrease below the set point of the HGV Temperature Controller causing its output to increase. The tuning of this controller is the same as the primary Leaving Chilled Liquid Temperature Controller (HGV control mode tuning) since the response time of the process would be the same.

ANTI-SURGE TUNING

The default anti-surge tuning values were based on estimated part load conditions and minimum speed and PRV signals required at these conditions to prevent unstable operation (surging). It is very important that these controls be adjusted to suit chiller operating conditions to achieve maximum efficiency of operation. The plant condenser cooling liquid control system will determine the actual high and low head conditions depending on the range of cooling liquid temperature allowed.

Anti-Surge (Minimum Speed) Tuning

The default tuning values are as follows:

	COMPRESSOR PRESSURE DELTA (HEAD)	MINIMUM SPEED SIGNAL SETPOINT FOR STABLE OPERATION
High Head	PD1 = 75 PSID	MSP1 = 4500 RPM
Low Head	PD2 = 90 PSID	MSP2 = 3600 RPM

If testing as described below indicates that the Default values are adequate, new values must be entered for the Minimum Speed Calculation to produce the required output signals as shown in the following example:

	COMPRESSOR PRESSURE DELTA (HEAD)	MINIMUM SPEED SIGNAL SETPOINT FOR STABLE OPERATION
High Head	PD1 = 80 PSID	MSP1 = 4500 RPM
Low Head	PD2 = 40 PSID	MSP2 = 3400 RPM

The anti-surge minimum output (RPM) is calculated based on the actual differential pressure (head) as follows:

PD (Head) = Refrigerant Condenser Pressure minus Evaporator Pressure.

$$MS\% = (PD - PD2) \times (MSP1 - MSP2) / (PD1 - PD2) + MSP2$$

$$\text{at High Head (80 PSID), } MS\% = (80 - 40) \times (4500 - 3400) / (80 - 40) + 3400 = 4500 \text{ RPM}$$

$$\text{at Medium Head (60 PSID), } MS\% = (60 - 40) \times (4500 - 3400) / (80 - 40) + 3400 = 3950 \text{ RPM}$$

$$\text{at Low Head (40 PSID), } MS\% = (40 - 40) \times (4500 - 3400) / (80 - 40) + 3400 = 3400 \text{ RPM}$$

Anti-Surge (Minimum Vane Position) Tuning

The default tuning values are as follows:

	COMPRESSOR PRESSURE DELTA (HEAD)	MINIMUM PRV SIGNAL FOR STABLE OPERATION
High Head	PD1 = 75 PSID	MVP1 = 20 %
Low Head	PD2 = 90 PSID	MVP2 = 15 %

If testing as described below indicates that the Default values are adequate, new values must be entered for the Minimum Vane Position Calculation to produce the required output signals as shown in the following example:

	COMPRESSOR PRESSURE DELTA (HEAD)	MINIMUM PRV SIGNAL FOR STABLE OPERATION
High Head	PD1 = 80 PSID	MVP1 = 16 %
Low Head	PD2 = 40 PSID	MVP2 = 6 %

The Minimum Vane Position Calculation output (MV%) is calculated based on the actual calculated differential pressure (head) as follows:

PD (Head) = Compressor Discharge Pressure minus Evaporator Pressure.

$$MV\% = (PD - PD2) \times (MVP1 - MVP2) / (PD1 - PD2) + MVP2$$

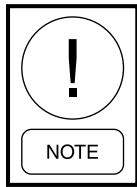
$$\text{at High Head (80 PSID), } MV\% = (80 - 40) \times (16 - 6) / (80 - 40) + 6 = 16\%$$

$$\text{at Medium Head (60 PSID), } MV\% = (60 - 40) \times (16 - 6) / (80 - 40) + 6 = 11\%$$

$$\text{at Low Head (40 PSID), } MV\% = (40 - 40) \times (16 - 6) / (80 - 40) + 6 = 6\%$$

TESTING TO DETERMINE ANTI-SURGE TUNING

In order to determine the optimum tuning, the chiller must be operated at conditions that allow the capacity controls to automatically unload and load the chiller thru its entire operating range while observing the various signals displayed on the CAPACITY CONTROLS screen. It may be necessary to do supplemental testing if the current conditions do not allow the full range of operation.



The plant condenser water control system will determine the actual high and low head conditions depending on the range of condenser water temperature allowed during the testing described below.

High Head Testing

- With the chiller running in automatic, take the condensing conditions to the highest attainable temperature in the system (without tripping on high discharge pressure) by increasing the condenser water inlet temperature and/or reducing the condenser water flow.
- At the highest condensing temperature possible, start reducing the load on the chiller, by reducing the chilled water flow and/or decreasing the chilled water inlet temperature. This will cause the capacity control system to begin an unloading sequence and decrease the speed.
- During the unloading sequence, record the operating head as PD1.
- If the compressor surges before the vanes begin to close, then the minimum speed MSP1 is too low for the current operating head. Increase MSP1 in increments of 10 RPM. The higher minimum speed will cause the vanes to close, increasing the compressor head to bring it out of surge. If MSP1 cannot be set higher, then PD1 must be set lower to provide the highest speed at a lower operating head.
- As the load continues decreasing and the vanes continue to close, if the compressor surges before the hot gas valve begins to open, then the minimum vane position MVP1 is too low for the current operating head. Increase MVP1 in increments of 5%. The higher minimum vane position will cause the hot gas valve to open, increasing the flow thru the compressor to bring it out of surge.
- If the chiller never surges down to minimum load, then the anti-surge parameters are adequate for protection, but may not be the most efficient. With the chiller operating at minimum load, decrease MVP1. As the hot gas valve closes, listen for a surge, and increase MVP1 until the compressor is no longer surging.

- Increase the load until the vane signal has increased to 98% and the Capacity Control switches to the Speed mode. Decrease MSP1 in increments of 10 RPM, listen for a surge, and increase MSP1 until the compressor is no longer surging.
- Increase the load to maximum and then decrease to minimum to verify that the compressor does not surge at any point in the high head operating range.

Low Head Testing

- With the chiller running in automatic, take the condensing conditions to the lowest attainable temperature in the system by decreasing the condenser water inlet temperature and/or increasing the condenser water flow.
- At the lowest condensing temperature possible, start reducing the load on the chiller, by reducing the chilled water flow and/or decreasing the chilled water inlet temperature. This will cause the capacity control system to decrease the speed by starting an unload sequence.
- During the unloading sequence, record the operating head as PD2.
- If the condensing temperature is low enough, the speed may be decreased to the minimum rated speed. In this case the PD2 should be set at the pressure differential recorded at the minimum rated speed with the vanes at 100% open.
- If the conditions do not allow speed reduction to minimum rated speed with the vanes at 100% open and the chiller surges before the vanes begin to close, then the minimum speed MSP2 is too low for the current operating head PD2. Increase MSP2 in increments of 10 RPM. The higher minimum speed will cause the vanes to close, increasing the compressor head to bring it out of surge.
- As the load continues decreasing and the vanes continue to close, if the compressor surges before the hot gas valve begins to open, then the minimum vane position MVP2 is too low for the current operating head. Increase MVP2 in increments of 5%. The higher minimum vane position will cause the hot gas valve to open, increasing the flow thru the compressor to bring it out of surge.

- If the chiller never surges down to minimum load, then the anti-surge parameters are adequate for protection, but may not be most efficient. With the chiller operating at minimum load, decrease MVP2. As the hot gas valve closes, listen for a surge, and increase MVP2 until the compressor is no longer surging.
- Increase the load until the vane signal has increased to 98% and the Capacity Control switches to the Speed mode. Decrease MSP2 in increments of 10 RPM, listen for a surge, and increase MSP2 until the compressor is no longer surging
- Increase the load to maximum and then decrease to minimum to verify that the compressor does not surge at any point in the low head operating range.

PRE-ROTATION VANES CALIBRATION

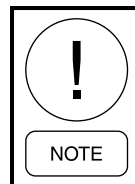
The chiller cannot be started until this procedure is accomplished. This is done during factory testing and should not be required in the field unless the Microboard or BRAM is replaced. For retrofit applications, this procedure must be done at chiller commissioning.

Prior to performing the calibration, ensure that the set screws on the PRV potentiometer linkage are tight. If not, with the vanes fully closed, turn the bushing until the PRV Voltage displayed on the PRE-ROTATION VANES CALIBRATION screen reads 0.5 VDC $\pm$ 0.2 VDC. Tighten the set-screws without turning the potentiometer shaft. After the set-screws are tightened, re-check reading to make sure that the voltage is within the range specified above. If not, loosen a set screw and re-adjust bushing as stated above. Make sure that the set screw is tightened when complete.

1. Place the keypad switch in the Stop-Reset position (O) and wait until the "System Coastdown" is complete.
2. At the keypad, login at SERVICE access level.
3. Select the PRE-ROTATION VANES CALIBRATE screen from the COMPRESSOR screen.
4. Press the START CALIBRATION key to initiate the calibration. The CALIBRATION IN PROGRESS and PRV OPENING LED will illuminate and an open signal is applied to the PRV. After a 60 second delay, the program begins evaluating the feedback voltage from the PRV potentiometer. When the feedback voltage stops increasing and remains stabilized (so that there is no more than $\pm$ 0.25VDC deviation) for 25 continuous seconds,

the feedback voltage is logged as the 100% position. A close signal is then applied to the PRV and illuminates the PRV CLOSING LED. After a 10 second delay, the program begins evaluating the feedback voltage from the PRV potentiometer. When the feedback voltage stops decreasing and remains stabilized (so that there is no more than $\pm$ 0.25VDC deviation) for 25 continuous seconds, the feedback voltage is logged as the 0% position. These endpoint voltages are stored in the BRAM as the full open and full closed positions.

5. If the difference between the endpoint voltages is greater than 0.5VDC, "PRV Calibration Successful" is displayed. Otherwise, "PRV Calibration Unsuccessful" is displayed. Also, if the endpoints are not established within 10 minutes, "PRV Calibration Unsuccessful" is displayed.



The calibration procedure can be terminated at any time during the procedure by pressing the CANCEL CALIB key. If the PRV were previously calibrated successfully, it will revert to using the previous calibration values. If they were not previously calibrated successfully, they will remain un-calibrated.

6. After completing the calibration, use the Auto/Manual screen per SECTION 22 - CAPACITY CONTROL DEVICES to verify the operation by manually driving the vanes fully open and then fully closed and observing the position indicator on the operating shaft. When the PRV control signal is set to 0% in the Manual mode, the vane actuator closed limit switch (VMS) may not be activated. Place the control signal back to the Auto mode to activate the switch.

LOAD DEFAULTS

If the Microboard is replaced, the chiller program must first be downloaded *per Section 3 of this manual*. Replacement 031-02430-004 Microboards are supplied with BRAM (U38). If the existing BRAM is not defective, it can be transferred from the defective board to the replacement board to avoid re-programming all the variable setpoints and the Sales Order Data. If the existing BRAM is not used, all setpoints must be re-programmed per the latest setpoints Report. In general, the majority of the setpoints will likely be the same as the Default values, so it will be beneficial to load all the Default values first, and then change the setpoints to match the Setpoint Report. Log in using the password 0228.

From the HOME screen, press the “HISTORY” key to go to the HISTORY screen. Press the “LOAD DEFAULTS” key to load the default set points and capacity controls tuning values into the battery backed memory (BRAM). The control panel will re-boot. Log in using the 0228 password and complete the Sales Order Data entry.

Extremely Important! If the procedure above was performed using password 0 2 2 8 to enter data into a new blank BRAM, the following procedure must be performed after all the desired data is entered. If the following procedure is performed prior to entering all of the data, the ability to enter more data will be terminated. Failure to perform this procedure after all data has been entered will result in unreliable OptiView Control Center Operation!

- a. On SALES ORDER screen, press FINISH PANEL SETUP key.
- b. Use ◀ and ▶ key to select YES.
- c. Press ENTER (✓) key.

FREQUENCY TO ANALOG CONVERTER CALIBRATION

Factory Calibration

The frequency to analog converters are calibrated by the vendor prior to shipment. The factory configuration is listed on a label affixed to the side of the device. After the Johnson Controls factory completes the wiring of the converters to the control panel, the speed inputs are tested using a function generator to simulate the square wave pulses produced by the magnetic pickups sensing a toothed gear on the turbine shaft. This is done to ensure that the output signals are correct and also allow factory calibration of the inputs to provide the best accuracy possible. The procedure below may also be performed in the field in the event that a converter or analog input board is replaced.

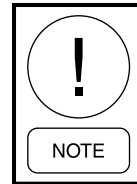
Speed Input Calibration

The access level displayed on the Status bar must be changed to ADMINISTRATOR or TEST OPERATOR in order to have access to all of the set-up parameters. To change the access level to TEST OPERATOR do the following:

1. Press the LOGIN key on the keypad (indicated at the bottom of the HOME screen). A pop-up window will appear.
2. Press the “✓” key. (This enters the default USER ID).
3. For TEST OPERATOR, press the “0”, “2”, “2”, “8” keys in succession for the password. If this level is not available, enter the ADMINISTRATOR password (changes daily). “YORK” will appear on the right side of the pop-up window.
4. Press the “✓” key to accept the password. The LOGIN label will disappear from the HOME screen and a LOGOUT label will appear. The access level on the Status bar at the top of the screen should now indicate “TEST OP” or “ADMIN”.

If a mistake is made while in the pop-up window, use the “◀” key to backspace or the “X” key to cancel and get out of the pop-up window. The “LOGIN” key will need to be pressed to re-enter the LOGIN window.

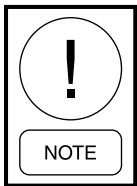
Press the SETPOINTS, SETUP, DIAGNOSTICS, and EXPANSION ANALOG I/O keys to go to the EXPANSION ANALOG I/O screen.



The following is based on using a Kenwood Model FG-273A Frequency Generator. Other equipment may be used to provide the same functionality. Connect the frequency generator to the converters as shown in Fig. 64.

5. Set the frequency range at 0.10s-10k. Remove the red wire of Cable 45 from P10A-2 of the Analog Board and connect the digital multimeter + lead to it. Connect the – lead of the multimeter to P10A-2 and verify that the input signal from Frequency-to-Analog Converter ST-160A is 3.98 – 4.1 mA with the frequency generator power off. Turn the frequency generator power on, increase the frequency to 5000 Hz, and verify that the Counts shown on the EXPANSION ANALOG I/O screen for Channel 21 are 4095 or less with an input signal on the multimeter of 19.8-20.1 mA. Set the frequency at 0 Hz and turn the frequency generator power off. Reconnect the red wire of Cable 45 to P10A-2.

6. Remove the red wire of Cable 46 from P10A-5 of the Analog Board and connect the digital multimeter + lead to it. Connect the – lead of the multimeter to P10A-5 and verify that the input signal from Frequency-to-Analog Converter ST-160B is 3.98 – 4.1 mA with the frequency generator power off. Turn the frequency generator power on, increase the frequency to 5000 Hz, and verify that the and verify that the that the Counts shown on the EXPANSION ANALOG I/O screen for Channel 22 are 4095 or less with an input signal on the multimeter of 19.8 - 20.1 mA. Set the frequency at 0 Hz and turn the frequency generator power off. Reconnect the red wire of Cable 46 to P10A-5.



For either of the speed inputs, if the Counts increase to 4095 before the frequency has increased to 5000 Hz, the program will not be capable of reading up to 5000 RPM since the maximum counts possible are 4095. The Frequency-to-Analog Converter must be recalibrated as described below so that the output signal at 5000 Hz equals the mA seen at 4095 Counts. For example, if 4095 Counts were displayed at 19.4 mA input signal, the Full Scale Value would need to be decreased to 19.4 mA.

7. Press the STEAM SYSTEM key and then the TURBINE key to go to the TURBINE screen. Press the CALIBRATE MPU LOW END key. Turn the frequency generator power on, increase the frequency to 5000 Hz. Press the CALIBRATE MPU HIGH END key. Slowly decrease the frequency from 5000 Hz to 0 Hz and confirm that the RPM displayed in the Turbine Speed data field is equal to the Hz display on the frequency generator within +/- 5 RPM. Set the frequency at 0 Hz and turn the frequency generator power off.

Kenwood FG-273A Frequency Generator, Front Panel Functions

(Refer to Fig. 63)

- 1 – Power Button
- 2 – Frequency Display
- 3 & 4 - Not Used
- 5 & 6 – kHz/Hz LED - Indicate Frequency Range (#14 Setting)
- 7 – Frequency Adjustment Knob
- 8 thru 12 – Not Used
- 13 – Amplitude Control – Set at approximately 25% of dial range.
- 14 – Frequency Range – Push the 10s-1 button in for 0.2-2 Hz range.

Push the 0.1s-10k button in for 200-5000 Hz range.
- 15 thru 18 – Not Used
- 19 – Function - Push the button in for square wave output.
- 20 thru 22 – Not Used
- 23 – Output Jack – Connect cable to devices in turbine box per Fig. 64.

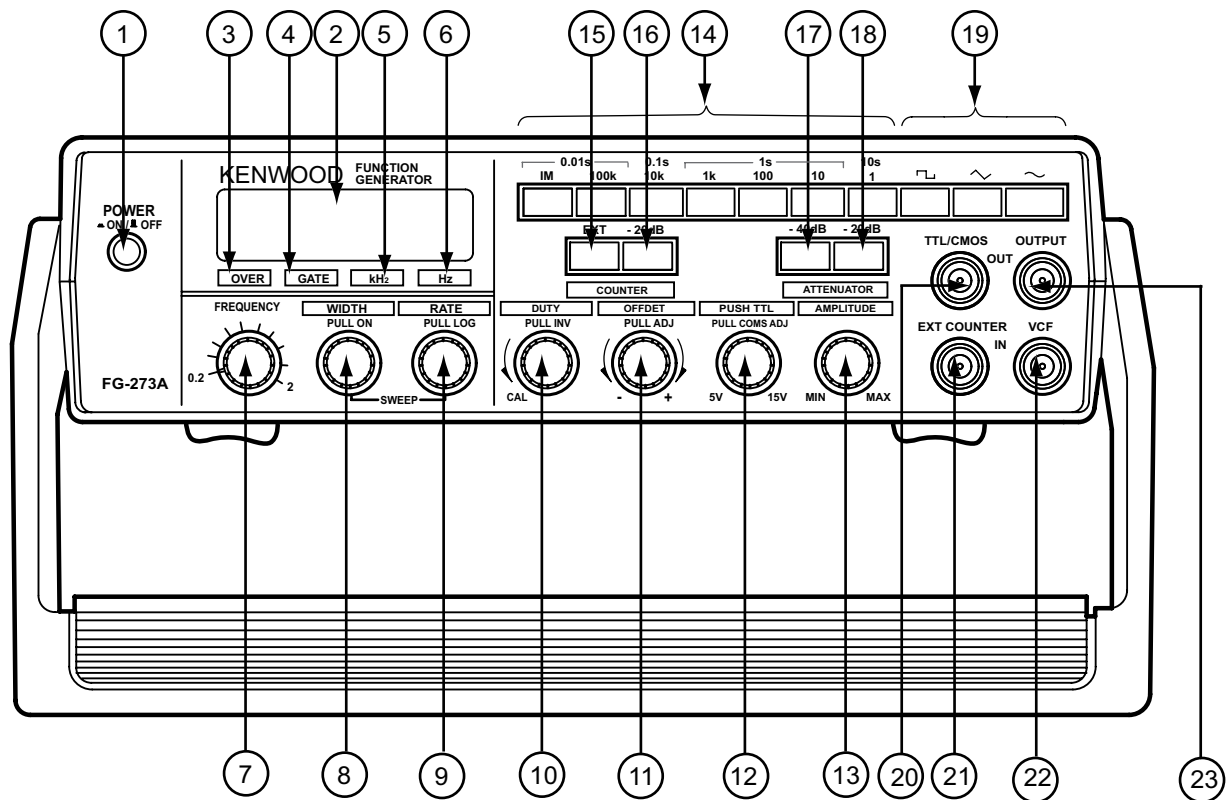


FIGURE 62 - KENWOOD MODEL FG-273A FREQUENCY GENERATOR

LD09968

FREQUENCY-TO-ANALOG CONVERTER TEST WIRING

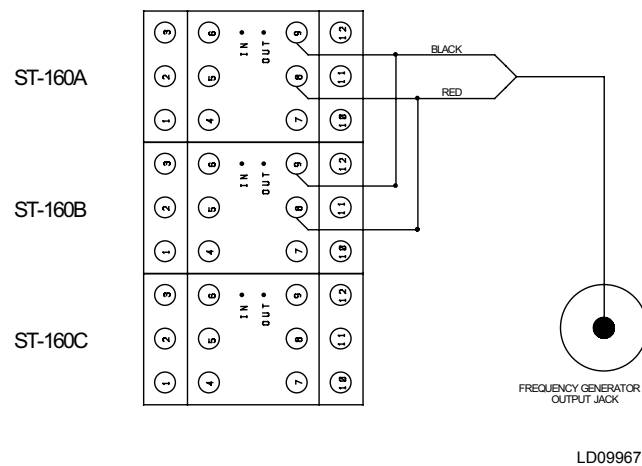
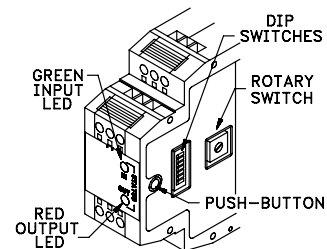


FIGURE 63 - FREQUENCY-TO-ANALOG CONVERTER TEST WIRING

LD09967

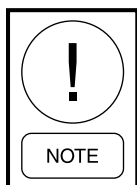
Configuring the IFMA



LD09754

To begin set-up, place DIP switch 4 to the on (up) position. DIP switches 5, 6, and 7 access unit configuration settings. Upon entry to a set-up parameter, the input LED blinks the current numerical value of a setting at a 1 Hz rate. A setting of "1" is indicated by one blink (1/2 sec on, 1/2 sec off), through a setting of "9", which is indicated by nine blinks. A setting of "0" is indicated by a single short flash (40 msec on, 1 sec off). The decimal point position is the last number blinked. After the entire value is indicated, the IFMA pauses two seconds and repeats the value.

During entry of a new value, if the mode switch (S4) or any of the CFG DIP switch positions are changed before the push button is pressed, the IFMA aborts the entry process and retains the previous setting.



To return to normal operation, place the DIP switch 4 in the down (RUN) position.

- **Invalid Entry during Set-up:** The input LED (green) and the Output LED (red) alternately blink until a valid entry is made.

Output Indication

- **Over range on the output:** The output LED (red) turns on and the Output range is “clamped” at the maximum level.
- **Low Frequency Cut-Out:** The output LED (red) turns on to indicate the input frequency is below the zero Frequency setting.

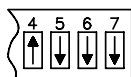
FACTORY SETTINGS		
Parameter	Setting	Value
Operating Mode	4	4 to 20 mA
Input Range	5000.0	5000 Hz
Minimum Response	3	50 msec
Maximum Response	4	100 msec

DIP SWITCH	DESCRIPTION
	Operating Mode
	Input Range Setting Using an Input Signal or Frequency Generator
	Input Range Setting Using Rotary Switch
	Minimum Response Time
	Maximum Response Time (Low Frequency Cut-Out Setting)
	Analog Output Minimum Value
	Analog Output Full Scale Value

FIGURE 64 - IFMA – DIP SWITCH SETTINGS

Operating Mode (Analog Output)

1. Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.



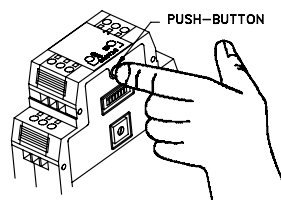
LD09759

2. The green input LED blinks the setting corresponding to the Operating mode shown below, pauses and repeats the value.

	Setting	Operating Mode
	1	0 to 5 VDC
	2	0 to 10 VDC
	3	0 to 20 mA
	4*	4 to 20 mA

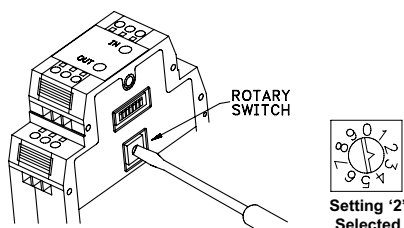
*Factory Setting

- Factory calibration values are restored when the Operating mode is changed.
 - If the existing Operating mode setting is the desired requirement, this section is complete*. Otherwise continue to Step 3.
3. Press the push-button. The green input LED blinks rapidly to indicate the Operating mode setting is now accessed.



LD09757

4. Turn the rotary switch to the selected numerical value for the output desired (see the table in step 2).



LD09758

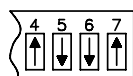
5. Press the push-button. The green input LED blinks value entered, pauses, and repeats the new Operation setting.

- If the new Operating mode setting is acceptable, this section is complete*.
- If the new Operating mode setting is not the desired setting, repeat the procedures from Step 3.
- If the red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 4 and 5.

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

On-Line Input Range Setting Using Actual Input Signal or Frequency Generator.

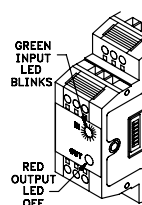
1. Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.



LD09762

2. The green input LED blinks the existing Input Range setting as shown in the examples below. Six full digits of numerical blink with a short pause between digits and a longer pause at the end, before repeating. The first five digits are the existing input range setting of the frequency magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).

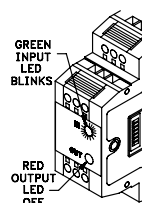
Factory Setting Example



5 blinks	5	Frequency setting
2 sec pause		
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		Resolution
single flash	0	
2 sec pause		
single flash	0	
2 sec pause		
1 blink	1	Resolution
4 sec pause		
Frequency		Resolution
5 0 0 0 0 0		1
Result: 5000.0 Hz		

LD09760

Additional Example:



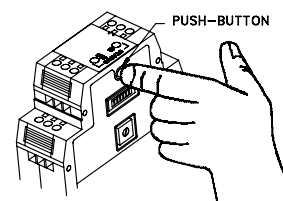
2 blinks	2	Frequency setting
2 sec pause		
5 blinks	5	
2 sec pause		
single flash	0	
2 sec pause		Resolution
5 blinks	5	
2 sec pause		
single flash	0	
2 sec pause		
2 blinks	2	Resolution
4 sec pause		
Frequency		Resolution
2 5 0 5 0 0		2
Result: 250.50 Hz		

LD09760

- If the existing Input Range setting is the desired requirements, this section is complete*. Otherwise, continue to Step 3

3. Apply the maximum input signal.

4. Press the push-button. The green input LED blinks rapidly. The acquisition process takes two seconds plus one period of the input signal.



LD09757

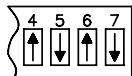
- If the new input range is valid, the green input LED turns on solid. Continue to Step 5.
- If red output LED blinks, the new input range setting is invalid, outside the acceptable 1 Hz to 25 KHz range. Repeat Steps 3 and 4.

- Press the push-button. The green input LED blinks the new Input Range setting. This section is complete*. Verify the Input Range setting as shown in Step 2.

*** Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.**

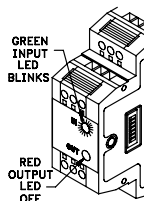
Input Range Setting Using the Rotary Switch

- Place the DIP switch 4 to the ON (up) position and DIP switches 5, 6, and 7 as shown.



LD09763

- The green input LED blinks the existing Input Range setting, pauses and repeats. Six full digits of numerical information blink with a short pause between digits and a longer pause at the end, before repeating. The first five digits are the existing Input Range setting magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).



LD09756

- If the existing Input Range setting is the desired requirements, this section is complete*. Otherwise, continue to Step 3
- Determine the Input Range frequency and record on the Note pages at the end of this manual.

5	0	0	0	0
---	---	---	---	---

Input Range Frequency
First 5 of 6 digits

1

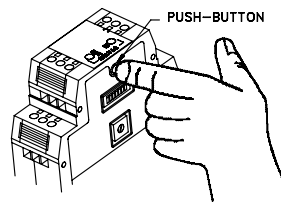
Resolution
6th digit

Example: 5000.0 Hz

5	0	0	0	0	1
---	---	---	---	---	---

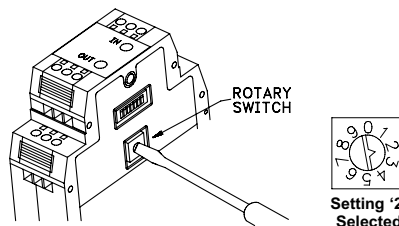
LD09761

- Press the push-button. The green input LED blinks rapidly. The Input range setting is now accessed.



LD09757

- Turn the rotary switch to the first selected numerical value. Press the push-button. The green input LED continues to blink rapidly. First of six digits is entered.



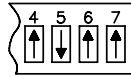
LD09758

- Turn the rotary switch to the second selected numerical value. Press the push-button. The green input LED continues to blink rapidly. Second of six digits is entered.
 - Repeat Step 6 three more times, then go to Step 8. This enters a total of five the required six numerical digits.
 - Turn the rotary switch to the selected numerical value for resolution requirement. Press the push-button. The green input LED blinks the new Input Range setting (as described in Step 2), pauses, and repeats the value.
- If the new Input Range setting is acceptable, this section is complete*.
 - If the new Input Range setting is not the desired setting, repeat the procedures from Steps 4 through 8.
 - If the red output LED blinks, the numerical value entered is invalid. Repeat Steps 3 through 8.

*** Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.**

Minimum Response Time Setting High Freq

- Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.



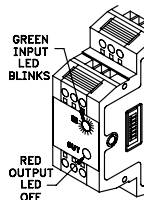
LD09764

- The green input LED blinks the existing Minimum Response Time setting (see the following list), pauses and repeats.

Setting	Time
0	5 msec
1	10 msec
2	20 msec
3*	50 msec
4	100 msec

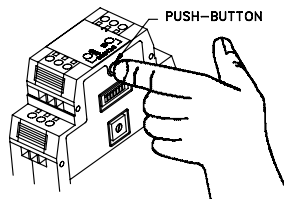
*Factory Setting

Setting	Time
5	200 msec
6	500 msec
7	1 sec
8	5 sec (not valid for input range > 3906 Hz)
9	10 sec (not valid for input range > 3906 Hz)



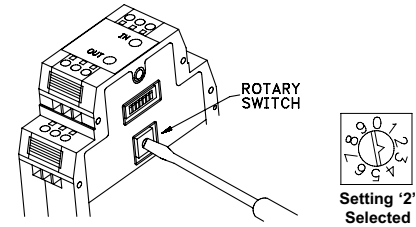
LD09756

- If the existing Minimum Response Time setting is the desired requirement, this section is complete*. Otherwise, continue to Step 3.
- Press the push-button. The green input LED blinks rapidly. The Minimum Response Time setting is now accessed.



LD09757

- Turn the rotary switch to the second selected numerical value for Minimum Response Time desired. (refer to the Table in Step 2)



LD09758

- Press the push-button. The green input LED blinks value entered, pauses, and repeats the new Minimum Response Time setting.

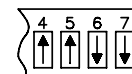
- If the new Minimum Response Time setting is acceptable, this section is complete*.
- If the new Minimum Response Time setting is not the desired setting, repeat the procedures from Steps 3 through 5.
- If the red output LED blinks, the numerical value entered is invalid. Repeat Steps 4 and 5.

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

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Maximum Response Time Setting (Low Frequency Cut-Out Setting)

- Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.

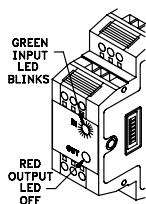


LD09765

2. The green input LED blinks the corresponding Maximum Response Time Setting (see the following table), pauses and repeats.

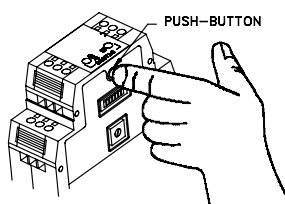
SETTING	TIME
0	1024 times Input Range Period (40 msec min., 10 sec max)
1	10 msec (100 Hz)
2	20 msec (50 Hz)
3	50 msec (20 Hz)
4*	100 msec (10 Hz)
5	200 msec (5 Hz)
6	500 msec (2 Hz)
7	1 sec (1 Hz)
8	5 sec (.2 Hz)
9	10 sec (.1 Hz)

*Factory Setting



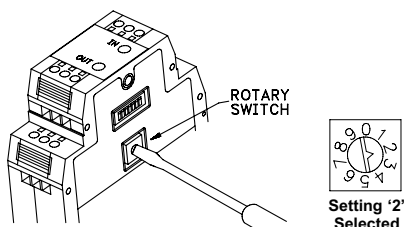
LD09756

- If the existing Minimum Response Time is the desired requirement, this section is complete*. Otherwise, continue with Step 3.
3. Press the push-button. The green input LED blinks rapidly. The Minimum Response Time setting is now accessed.



LD09757

4. Turn the rotary switch to the selected numerical value for Maximum Response Time desired. (refer to the Table in Step 2)



LD09758

5. Press the push-button. The green input LED blinks value entered, pauses, and repeats the new Maximum Response Time setting.

- If the new Maximum Response Time setting is acceptable, this section is complete*.
- If the new Maximum Response Time setting is not the desired setting, repeat the procedures from Steps 3.
- If the red output LED blinks, the numerical value entered is invalid. Repeat Steps 4 and 5.

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

Calibration

The IFMA is factory calibrated for all operating modes. These are permanently stored in the unit's configuration memory. The IFMA automatically selects the proper calibration setting for the selected Operation mode. The Minimum and Full Scale output values established at the factory can be changed using the calibration routines. The Minimum output value can be adjusted to any value less than the Full Scale Value, and the Full Scale Value can be adjusted to any value greater than the Minimum value. Changing the factory calibration setting does affect the accuracy of the unit. Specified accuracy for modes 2, 3, and 4 holds until the factory calibration range has been halved. This does not apply to mode 1, since it already uses only half of the IFMA's output range. When increasing the output range, the new calibration settings can not exceed the factory Full Scale Value by more than 10%. The 0 to 5 VDC range can be doubled. The IFMA can store user calibration settings for only one mode at a time. If calibration is changed for one operating mode, and the user then selects a different operating mode, the unit reverts to factory calibration settings. Calibration steps can be combined (added) to obtain a total calibration change. This is done by repeated push-button entries of the same value, or different values, before saving the change. The calibration steps as shown in the following table are approximations. A current or volt meter should be connected to the appropriate output pins to verify the actual calibration setting.

Approximate Calibration Increments

ROTARY SWITCH	VOLTAGE	CURRENT
1	3 mV	5 μ A
2	5 mV	10 μ A
3	10 mV	25 μ A
4	25 mV	50 μ A
5	50 mV	100 μ A
6	100 mV	200 μ A
7	200 mV	400 μ A
8	400 mV	800 μ A

Calibration Direction

The default direction for calibration changes is up (increasing values) on entry to either calibration routine. This direction can be toggled from within the routine with the following steps:

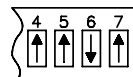
1. Enter the calibration routine you wish to change (Minimum or Full Scale).
2. Press the push-button. The green input LED blinks rapidly.
3. Turn the rotary switch to position 9. Press the push-button.
4. The red Output LED indicates the direction of calibration:

OFF = Increasing Value

ON = Decreasing Value

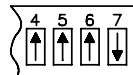
5. Connect a current or voltmeter of appropriate accuracy to the desired output pins (voltage or current).

Analog Output Minimum Value:



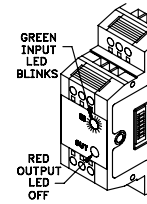
LD09766

Analog Output Full Scale Value:



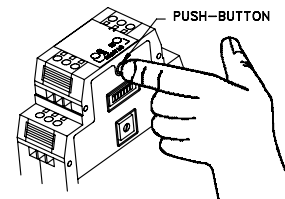
LD09767

6. Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown above. The green LED blinks slowly.



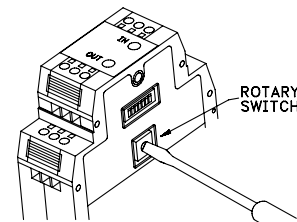
LD09756

7. Press the push-button to enable the rotary switch. The green input LED now blinks at a faster rate, indicating that calibration values are accessible.



LD09757

8. Turn the rotary switch to appropriate numerical setting for calibration. (refer to the *Approximate Calibration Increments Table*), while monitoring the output signal. Press the push-button. Calibration is raised or lowered by this approximate value, depending on calibration direction.



LD09758

- If this setting meets the requirements, go to Step 9. If more calibration is required, repeat Step 8 until the calibration meets the requirements.
 - If the desired value is missed, reverse calibration direction and continue the calibration until the value meets the requirements.
9. Turn the rotary switch to 0 and press the push-button. This saves the new user calibration setting.
 - To return to the factory calibration, exit Calibration and then re-enter. Turn the rotary switch to 0 and press the push-button twice. This reloads the factory calibration setting for the selected mode of operation.
 - When calibrating the Minimum output value, if the red output LED blinks while in the down direction, the requested calibration setting is beyond the output's absolute Minimum value. The calibration setting is held at the absolute Minimum value. Reverse direction and repeat from Step 8.
 - When calibrating Full Scale, if the red output LED blinks while in the up direction, the requested calibration setting is beyond the output's absolute Maximum value. The calibration setting is held at the Maximum value. Reverse calibration direction and repeat from Step 8.
 - If an attempt is made to calibrate the Full Scale Value lower than the Minimum value, or conversely, the Minimum value higher than the Full Scale Value, the red option LED blinks, and the IFMA sets the two values equal. Reverse calibration direction and repeat from Step 8.
5. Turn the rotary switch to position 5 and press the push-button. The digital multimeter should reflect a decrease of about 0.1 mA.
 6. Turn the rotary switch to a position lower than 5 to effect a smaller change in calibration.
 7. Continue adjusting the rotary switch and pressing the push-button until 3.9 mA is displayed on the digital multimeter.
 8. Turn the rotary switch to position 0 and press the push button. This action saves the new calibration setting for the Minimum value.

COMPRESSOR PROXIMITY PROBE

The following applies to all YST chillers supplied with “J” compressors: The logic for this probe is “Enabled” during functional testing at the factory using the COMPR THRUST PROBE key on the OPERATIONS screen while in the TEST OPERATOR access level. When the probe is installed at the time of manufacture or after the compressor is rebuilt in the field, a Reference Position is established. This remains the Reference Position until the Compressor is rebuilt. It is the distance (in mils) between the tip of the probe and the surface of the High Speed Thrust Collar with a minimum of 25 PSID oil pressure. Any distance between 37 and 79 mils is acceptable. This Reference Position is written on a label that is adhered to the inside of the OptiView Control Center door. It is also stored in the BRAM memory device (U38) on the Microboard; if the BRAM is replaced, the original Reference Position value must be programmed using the procedure below. *A complete description of the Proximity Probe and the Reference Position is contained in the “Compressor Proximity Probe” section of this manual.*

In the procedures below, the Reference Position can be established through a calibration procedure or a previously established Reference Position can be entered, without performing the calibration procedure.

Anytime the chiller shuts down on a Thrust Bearing safety shutdown, there is the potential that Compressor damage has occurred. Therefore, the shutdown must be evaluated by a qualified Service Technician prior to restarting the chiller. Depending upon the actual shutdown message, the evaluation could require a bearing inspection. To prevent the chiller from restarting without the proper evaluation, restart is inhibited until a special reset procedure is performed. This procedure is listed below and must not be performed by anyone other than a qualified Service Technician.

Calibration Example (Scaling)

When a 4 to 20 mA output range of the IFMA needs to have the Minimum value to be at 3.9 mA. Complete the following Steps.

1. Connect a digital multimeter to the output of the IFMA to monitor the output current.
2. Access Configuration mode by placing DIP switch 4 to the ON (up) position.
3. Access analog output minimum value by placing DIP switches 5 and 7 up, and DIP switch 6 down.
4. Turn the rotary switch to position 9 and press the push-button so the output LED is ON, indicating decreasing changes to the calibration value.

Calibration

Perform this procedure at the time of manufacture or if the compressor is rebuilt in the field.

1. At the keypad, login at SERVICE access level using access code 1 3 8 0.
2. Place Compressor Start/Stop switch in the Stop-Reset (O) position.
3. Select PROXIMITY PROBE CALIBRATE screen from COMPRESSOR screen.
4. On PROXIMITY PROBE CALIBRATE screen, press START CALIB key to initiate the calibration. The CALIBRATION IN PROGRESS LED will illuminate and the oil pump will start automatically. The oil pressure is displayed on the screen. If the CANCEL CALIB key is pressed during the procedure, the oil pump is turned off and the calibration is terminated.
5. When the oil pressure has reached 25 PSID, the program reads the proximity gap and the START CALIB key label changes to ACCEPT CALIB.
6. Press the ACCEPT CALIB key. The measured gap is entered as the Reference Position. Log this value on the Label adhered to the inside of the OptiView Control Center door. This remains the Reference Position until the Compressor is rebuilt.

Reference Position Entry

Perform this procedure if the Reference Position had been previously established, but lost from memory due to replacement of the BRAM (U38) or other event.

1. At the keypad, login at SERVICE access level using access code 1 3 8 0.
2. Place the Compressor Start/Stop switch in the Stop-Reset (O) position.
3. Select PROXIMITY PROBE CALIBRATE screen from COMPRESSOR screen.
4. On PROXIMITY PROBE CALIBRATE screen, press the ENTER REFERENCE key.
5. Locate previously established Reference Position that has been logged on label adhered to inside of OptiView Control Center door. Using numeric keypad keys, enter this value. Only values between 37 and 79 mils will be accepted.
6. Press ENTER (✓) key.

Safety Shutdown Reset/Inspection Procedure

As explained above, to prevent possible compressor damage, the chiller should not be restarted after a Thrust Bearing safety shutdown until the shutdown has been evaluated. Therefore, to prevent the chiller from being restarted by anyone other than a qualified Service Technician, the chiller cannot be restarted until the special reset procedure below is performed. The evaluation that has to be performed after each shutdown depends on the actual message displayed and the circumstances of the shutdown (refer to HISTORY screen) as follows:

- a. COMPR THRUST BEARING - PROXIMITY PROBE CLEARANCE - If the shutdown was caused by the gap increasing to $\geq +10$ mils from the Reference Position, perform a Bearing inspection. If there is damage, repair compressor. Otherwise, perform reset procedure below and restart chiller. If shutdown was caused by gap decreasing to ≥ -25 mils from the Reference Position, perform the reset procedure below and restart the chiller.
- b. COMPR THRUST BEARING - PROXIMITY PROBE OUT OF RANGE - Perform reset procedure below and restart chiller.

Reset Procedure

In order for the following procedure to be successful, the Proximity clearance must be between +10 and -25 mils of the Reference Position.

1. Place the keypad switch in the Stop-Reset (O) position.
2. At the keypad, login at SERVICE access level using access code 1 3 8 0.
3. After Coastdown is complete, select PROXIMITY PROBE CALIBRATE screen from COMPRESSOR screen.
4. Press FAULT ACKNOWLEDGE key. "Enter Password to Clear Fault" is displayed in a dialog box.
5. Enter 1 3 9 7 and press the ENTER (✓) key. This clears the fault and allows the chiller to be started.

COMPRESSOR HIGH SPEED THRUST BEARING LIMIT SWITCH

The following is applicable to chillers equipped with other than the “J” compressors. The logic for this switch is “Enabled” during functional testing at the factory using the COMPR THRUST PROBE key on the OPERATIONS screen while in the TEST OPERATOR access level. Anytime the chiller shuts down on a Compressor High Speed Thrust Bearing safety shutdown, displaying the message “COMPR THRUST BEARING - LIMIT SWITCH OPEN”, there is the potential that compressor damage has occurred. Therefore, a bearing inspection must be performed by a qualified Service Technician prior to restarting the chiller. To prevent the chiller from restarting without the proper bearing evaluation, restart is inhibited until a special reset procedure is performed, as detailed below.

1. Place the COMPRESSOR switch in the Stop-Reset position.
2. At the keypad, login at SERVICE access level using access code 1 3 8 0.
3. Select COMPRESSOR screen.
4. After Coastdown is complete, press FAULT ACKNOWLEDGE key. “Enter Password to Clear Fault” is displayed in a dialog box.
5. Enter 1 3 9 7 and press the ENTER (✓) key. If the Limit switch is closed, this clears the fault and allows the chiller to be started.

REFRIGERANT LEVEL AND LEVEL SENSOR CALIBRATION

A complete description of the Condenser Refrigerant Level Control and the setpoints that affect this control are provided in the “Refrigerant Level Control” section of this manual. These setpoints are listed below. The program uses these setpoints to control the refrigerant to the desired level. If the chiller is equipped with this feature, the program control must be ENABLED and the setpoints programmed using the procedure below.

The refrigerant level can be manually controlled through Manual control of the Subcooler Level Control Valve using the procedure described in the “Refrigerant Level Control” section of this manual.

The refrigerant level sensor, located in the condenser, must be properly calibrated to accurately detect the refrigerant level in the condenser. The procedure below is used to perform this calibration.

Enabled/Disabled

If the chiller is equipped with the Refrigerant Level Sensor, Level control operation must be “Enabled”. Otherwise, it must be “Disabled”. Use following procedure:

1. At the keypad, log in at SERVICE access level, using access code 1 3 8 0.
2. Select SETPOINTS screen. From SETPOINTS screen select SETUP screen. From SETUP screen select OPERATIONS screen.
3. Press the Level Control key and Use ◀ and ▶ keys to select “Enabled” or “Disabled”.
4. Press ENTER (✓) key.

Setpoints

Refer to the OptiView Operation Manual 160.67-O1 for additional information. Controller tuning parameters are defined in the “PID Tuning” section of this manual.

The following are the setpoints and range of programmable values that will effect the operation of the level control. The Default value is shown in parenthesis. The Default value should provide proper operation in most applications. However, the setpoint can be programmed to other values on the screen indicated to compensate for local operating conditions. Enter the setpoints using the procedures below:

- RRSP10-Subcooler Level RR:0.4-4%/sec, PID SETUP screen 1.
- TDSP6-Subcooler Level Valve Pulldown Delay: 0-1800 Sec (600 Sec), TIME SETPOINTS screen.
- LCVM-Subcooler Level Valve Minimum Position: 5-100% (25%), Capacity Control Setpoints screen 1.
- LSP1-Subcooler Level SP: 20-80% (50%), PID SETUP screen 1.
- ZONE 1 PID SETTINGS
 - P-Proportional: 0-5 (0.05), PID SETUP screen 1.
 - I-Integral: 0-5 (1.25), PID SETUP screen 1.
 - D-Derivative: 0-5 (0.00), PID SETUP screen 1.

- ZONE 2 PID SETTINGS
 - P-Proportional: 0-5 (0.10), PID SETUP screen 1.
 - I-Integral: 0-5 (2.50), PID SETUP screen 1.
 - D-Derivative: 0-5 (0.00), PID SETUP screen 1.
- Subcooler Zone Transition Time: 1 - 60 seconds, 10 second default, Capacity Controls screen, Setpoints screen, Page Down.
- Subcooler Zone Transition Delta: 1 - 20%, 14 % default, Capacity Controls screen, Setpoints screen, Page Down.

Changing Setpoints

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select the appropriate screen.
3. For the Time and Capacity Control Setpoints screens, press the “Change Setpoints” key, use the arrow keys to select the setpoint to be programmed, and press the (✓) key. For the PID SETUP screen 1, press the “Select Control” key until subcooler appears in the keys data field. Then use ◀ and ▶ keys to select the field to be changed and press the (✓) key.
4. Using the numeric keypad keys, enter desired value.
5. Press ENTER (✓) key.

Level Sensor Calibration

The refrigerant level in the condenser is displayed on the CONDENSER screen, Auto/Manual screen, and PID SETUP screen 1. It should be 0% when the level is at minimum (Refrigerant Level Sensor uncovered); 100% when the level is at maximum (Refrigerant Level Sensor completely covered). If the correct percentage is not displayed for these levels, the Refrigerant Level Sensor calibration might not be correct. The calibration can be verified or performed per the procedure below. In this procedure, the Service Technician will alternate between the Auto/Manual screen and the ANALOG I/O Diagnostics screen. The Auto/Manual screen is used to manually control the Subcooler Level Control Valve and the refrigerant level is displayed there. In the PV Data Field below “Subcooler Level”. Input 16 on the ANALOG I/O screen represents the Refrigerant Level Sensor output voltage. Although it represents

this value, it is different than that which is measured with a voltmeter at the output of the level sensor because it is rescaled by Microboard components. The displayed value will be used for the calibration.

There are different versions of the level sensors. The operation of the sensors is the same. However, the difference is in the calibration adjustments. Some sensors are equipped with adjustable potentiometers labeled “S” (span) and “Z” (zero). Others are equipped with calibration pushbuttons labeled “F/UP”, “E/DN”, “MAX”, and “MIN”.

1. Remove the cover plate on the Refrigerant Level Sensor to expose the printed circuit board. Locate the calibration adjustments. If equipped with calibration pushbuttons, place the Program Jumper in the “11-18V” position.
2. At the keypad, login at SERVICE access level using access code 1 3 8 0.
3. Shutdown the chiller. The Level Control Valve should be driven to the full open position. This will cause the condenser refrigerant level to be at minimum. With the level at minimum, set the 0% point as follows:
 - a. If equipped with calibration potentiometers, adjust the “Z” calibration screw to achieve 0.37VDC on input 16 of the Analog I/O screen.
 - b. If equipped with calibration pushbuttons, hold button “MIN” in while using repetitive pushes of button “F/UP” and “E/DN” as required, to achieve 0.37VDC on input 16 of the I/O screen. “F/UP” raises the voltage. “E/DN” lowers the voltage.
4. With the refrigerant level still at minimum, select the Auto/Manual screen and observe the displayed Value in the Subcooler Level PV Data Field. If < or > 0%, adjust as described above until 0% is displayed. **Do not over-adjust! Due to sample averaging to provide display stability during chiller operation, there is approximately a 10 second delay between incremental percentage updates after adjustment. Wait a minimum of 20 seconds between adjustments. Multiple 10-second intervals could be required to display the final value.**

5. Start the chiller. With the chiller running at or above Minimum Rated Speed, manually control the valve from the Auto/Manual screen using the Increase and Decrease keys to place the refrigerant level above the site glass. This places the refrigerant level at maximum. With the level at maximum, set the 100% point as follows:
 - a. If equipped with calibration potentiometers, adjust the “S” calibration screw to achieve 4.31VDC on input 16 of the Analog I/O screen.
 - b. If equipped with calibration pushbuttons, hold button “MAX” in while using repetitive pushes of “F/UP” and “E/DN” as required, to achieve 4.31VDC on the Analog I/O screen. “F/UP” raises the voltage. “E/DN” lowers the voltage.
6. With the refrigerant level still at maximum, select the Auto/Manual screen and observe the displayed Valve in the Subcooler Level PV Data Field. If < or > 100%, adjust as described above until 100% is displayed. **Do not over-adjust. Observe display delay as described in step 4 above.**
7. Due to possible interaction of 0% and 100% adjustments, recheck level percentage display on Auto/Manual screen at minimum and maximum levels.
8. If equipped with calibration potentiometer screws, seal with a small amount of sealant to secure the screws.
9. Replace level sensor cover plate.
10. On the Auto/Manual screen, select AUTO level control operation.

COMPRESSOR OIL PUMP VARIABLE SPEED DRIVE

On certain model chillers, the Compressor oil pump is driven by a small Variable Speed Drive. *A complete description of the Drive operation and the setpoints that affect this control are provided in the “Compressor Oil Pump Variable Speed Drive” section of this manual.* The setpoints are listed below. The Program Variable Speed Drive operation must be ENABLED and the setpoints programmed using the procedures below. Also, the Oil Pump Speed can be manually controlled using the procedure below.

Setup

The Compressor Oil Pump Package must be set for Variable Speed on the SETUP screen.

1. At the keypad, Login at SERVICE access level using access Code 1380.
2. Select the SETUP screen.
3. Press “Change Settings” key and use arrow keys to select the Data Field, then press the ENTER (✓) key.
4. Use the ◀ and ▶ keys to select “Variable Speed” and press the ENTER (✓) key.

Setpoints

The following are the setpoints and range of programmable values. The Default values (shown in parenthesis) are the recommended values and should provide proper operation in most applications. However, the setpoints can be programmed to other values as required. Enter setpoints using procedure below:

- a. Oil Pressure Setpoint - 20 to 45 PSID (35)
 - b. Control Period – 0.3 to 2.7 seconds in 0.3 second increments. (0.3)
1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
 2. Select OIL SUMP screen.
 3. On the OIL SUMP screen, press the appropriate key to select the setpoint to be programmed.
 4. If the Dialog box begins with the word “Enter”, use the numeric keypad keys to enter the desired value. If it begins with “Select”, use the ◀ and ▶ keys to select desired value.
 5. Press ENTER (✓) key.

Manual Control

The Oil Pump speed can be manually controlled between 25 and 60(50) Hz as follows:

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select OIL SUMP screen.
3. The speed can be increased and decreased in 0.5 Hz increments using the RAISE and LOWER keys. Each time the key is pressed, the frequency is changed 0.5 Hz.

OR

The speed can be set to a specific frequency, as programmed by the SET key as follows:

1. Press SET key.
2. Use the numeric keys to enter the desired value.
3. Press ENTER (✓) key.
4. If the AUTO key is pressed, automatic speed control is invoked.

STANDBY LUBRICATION

To maintain oil seal integrity while the chiller is shut-down, a feature can be “Enabled” that turns on the Oil Pump for 2 minutes every 24 hours if the chiller has not been run in the past 24 hours. While the Oil Pump is running, COMPR STANDBY LUBE IN PROCESS, along with a countdown timer displaying the time remaining in the lube cycle is displayed. If the chiller is style “D” equipped with an Oil Pump Variable Speed Drive, the operating oil pressure will be the programmed Oil Pressure Setpoint.

In certain low ambient temperature conditions, oil foaming when the pump is first turned on results in a sawtooth pressure ramp until it establishes a steady pressure. Although the pressure builds to 15 PSID within seconds at pump turn-on, a subsequent negative transition below 15 PSID within the first 30 seconds would be detected as a Standby Lube failure. Therefore, the low oil pressure threshold is not applied until after the first 30 seconds of oil pump operation. This allows sufficient time to establish steady pressure above 15 PSID.

If at least 15 PSID of oil pressure is not maintained after 30 seconds of Oil Pump operation, the cycle is terminated and WARNING - COMPR STANDBY LUBE - LOW OIL PRESSURE is displayed and no more standby lubrications will occur until a.) the FAULT ACKNOWLEDGE keypad key is pressed after login at SERVICE access level, at which point another lube cycle will be attempted or b.) the chiller is started.

Standby lubrication cycles will not be performed if either oil pressure transducer is reading a pressure out of its range (HOP < 6.8 PSIG; LOP < 0 PSIG). This assures that the oil pump will not be turned on with the shells at atmospheric pressure, as they would be during maintenance.

When logged in at SERVICE access level, the time remaining until the next standby lubrication cycle is displayed as NEXT OIL SEAL LUBRICATION = XX HRS on the OIL SUMP screen.

To Enable or Disable the standby lubrication cycles, proceed as follows:

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select OIL SUMP screen.
3. Use ◀ and ▶ keys to select Enable or Disable.
4. Press ENTER (✓) key.

HIGH CONDENSER PRESSURE WARNING THRESHOLD

The condenser pressure at which a High Pressure “Warning” message is displayed, is programmable over the range of 44.9 to 162.5 PSIG (R134a), or 84.0 to 246.3 PSIG (R22). The Default value for R134a is 162.5 PSIG. The Default for R22 is 246.3 PSIG. The “Warning” message will clear when the pressure decreases to 5 PSIG below the programmed value. Proceed as follows to enter this value:

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select CONDENSER screen.
3. On the CONDENSER screen, press HIGH PRESSURE WARNING THRESHOLD key.
4. Using numeric keypad keys, enter desired value.
5. Press ENTER (✓) key.

BRINE LOW EVAPORATOR PRESSURE CUTOFF

For Brine Cooling applications, the “Liquid Type” is set for “Brine” on the SETUP screen during the factory test of the chiller. On Brine cooling applications, the Low Evaporator Pressure safety shutdown threshold is programmable over the range of 25.0 to 54.3 PSIG (Default 54.3 PSIG) for R22 Refrigerant and 6.0 to 25.0 PSIG (Default 25.0 PSIG) for R134a Refrigerant. The actual percentage of Brine solution determines this threshold. It is calculated at the Johnson Controls factory and programmed at the time of manufacture. If the BRAM memory device on the Microboard is replaced, the threshold will have to be programmed in the field. The threshold is logged on an adhesive label attached to the inside of the OptiView Control Center door. Proceed as follows to enter this value:

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select EVAPORATOR screen.
3. On the EVAPORATOR screen, press the BRINE LOW EVAPORATOR CUTOUT key.
4. Using numeric keypad keys, enter desired value.
5. Press ENTER (✓) key.

DROP LEG REFRIGERANT TEMPERATURE

The chiller can be equipped with a refrigerant temperature sensor in the drop leg between the condenser and evaporator. If “Enabled” with the procedure below, this temperature is displayed on the CONDENSER screen as the “Drop Leg Temperature”. It is subtracted from the Condenser Saturation Temperature to produce “Sub Cooling Temperature”, also displayed on the CONDENSER screen. If the chiller is equipped with the Drop Leg Refrigerant Temperature sensor, the values are displayed on the CONDENSER screen only if “Enabled” with the following procedure.

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select CONDENSER screen.
3. Press DROP LEG key.
4. Use ◀ and ▶ keys to select “Enabled” or “Disabled”.
5. Press ENTER (✓) key.

SMART FREEZE PROTECTION

This feature is described in the “Smart Freeze Protection” section of this manual. When turned on, it allows the Leaving Chilled Liquid Temperature Setpoint to be as low as 36°F for water cooling applications. Along with this feature is a correspondingly lower Low Water Temperature Cycling shutdown threshold and Low Evaporator Pressure Safety Shutdown threshold. The Smart Freeze Protection feature can be turned ON or OFF using the following procedure:

1. Shutdown the chiller and wait for completion of “System Coastdown”.
2. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
3. Select EVAPORATOR screen.
4. Press SMART FREEZE key.

5. Use ◀ and ▶ keys to select ON or OFF.
6. Press ENTER (✓) key.

EVAPORATOR REFRIGERANT TEMPERATURE

If the chiller is equipped with an Evaporator Refrigerant Temperature sensor, the feature must be “Enabled” with the procedure below. If not equipped with this sensor, it must be “Disabled”. If “Enabled”, this temperature is displayed on the EVAPORATOR screen, and is also used in the Smart Freeze Protection Low Evaporator Pressure Safety Shutdown threshold calculation, *as explained in the “Smart Freeze Protection” section of this manual.*

Use the following procedure to Enable or Disable this feature:

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select EVAPORATOR screen.
3. Press REFRIGERANT key.
4. Use ◀ and ▶ keys to select “Enabled” or “Disabled”.
5. Press ENTER (✓) key.

HOT GAS BYPASS CONTROL

A complete description of the Hot Gas Bypass Control and the setpoints that affect this control are *provided in the “Capacity/Anti-Surge/Override Controls” section of this manual.* If the chiller is equipped with this valve, it must be “Enabled” using the procedure below. For retrofit applications, this valve may not exist, therefore it must be “Disabled”. The hot gas valve can be manually controlled *using the procedure described in the “Capacity Control Devices” section of this manual.*

Enabled/Disabled

If the chiller is equipped with a hot gas bypass valve, it must be “Enabled”. Otherwise, it must be “Disabled”. Use the following procedure:

1. Shutdown chiller and place the keypad switch in the Stop-Reset (O) position.
2. At the keypad, log in at SERVICE access level, using password 1 3 8 0.

3. Select SETPOINTS screen. From SETPOINTS screen, select SETUP screen. From SETUP screen, select OPERATIONS screen.
4. Press the Hot Gas key must use ◀ and ▶ keys to select “Enabled” or “Disabled”.
5. Press ENTER (✓) key.

CHILLER STARTS AND OPERATING HOURS RESET

The Number of Starts and the Operating Hours can be reset to zero or preset to a desired number. However, this should never be arbitrarily performed. Use the following procedure:

1. At the keypad, login at ADMIN access level. This password changes daily. Contact your local Johnson Controls Service Office.
2. Select OPERATIONS screen.
3. Press NUMBER of STARTS or OPERATING HOURS key as appropriate.
4. Using numeric keypad keys, enter desired number.
5. Press ENTER key (✓).

SERVICE PHONE NUMBERS

Two service phone numbers (Regional and Local), with labels, can be displayed on the OPERATIONS screen. The Default value for the Regional number is the “North American Toll Free Number” (1-800-861-1001). However, the label and number can be changed to any desired value. The Default value for the Local label and number is blank. The Service Technician enters the Local phone number and label.

The entry format consists of 4 fields (rows), vertically from the top. Up to 40 characters/numbers can be entered for each field.

- Field 1** – Regional phone number label. Default value is Johnson Controls North American Parts Center Toll Free Number 1-800-861-1001
- Field 2** – Regional phone number. Default value is 1-800-861-1001.
- Field 3** – Local service phone number label. Default value is blank.

Field 4 – Local service phone number. Default value is blank.

Use the following procedure to change any of the fields:

1. At the keypad, login at SERVICE access level using access code 1 3 8 0.
2. Select OPERATIONS screen.
3. Press EDIT PHONE NUMBERS key.
4. Use ▲ and ▼ keys to move green selection box to the desired field to be changed.
5. Press the ENTER (✓) key.
6. In the Dialog box that appears, a red box appears over the first changeable value. Use the ◀ and ▶ keys to position the red box over the number character to be changed or entered. Use the ▲ and ▼ keys to scroll sequentially through numbers, alphabet characters and punctuation marks to select the desired value. When the desired value displayed, use the ◀ and ▶ keys to move the red box to the next value to be changed. The numeric keypad keys can also be used to enter numbers. Continue this process until all desired values have been entered.
7. After all desired values have been entered in previous step, press ENTER (✓) key.

SALES ORDER DATA

All of the Sales Order Data, except the “Chiller Commissioning Date” is entered at the YORK factory at the time of chiller manufacture. The Service Technician must enter the Chiller Commissioning Date and modify the Job Name or Job Location if necessary at the completion of commissioning. Normally, the remainder of the Sales Order Data should never be modified. However, if there is a change to the chiller design, in the field, this data can be modified. If the BRAM battery-backed memory device (U38) fails and requires field replacement, all of the data will be lost and will have to be manually programmed.

There are three different Passwords used, depending on the circumstances, to change the Sales Order Data as follows:

- **Chiller Commissioning** - Service Technician must use password **1 3 8 0** to enter the Commissioning Date and modify Job Name and Job Location if necessary.

- **Modifying Sales Order Data** - Service Technician must use the ADMIN password. This password changes daily. Contact your local Johnson Controls Service Office.
- **BRAM Replacement** - If the BRAM (U38) is field replaced, the Service Technician must use password 0 2 2 8 to enter all Sales Order Data into a new blank BRAM. When logged in at this level, the access level shown will be TEST OP. This password only works with a blank BRAM.



When using this password to enter data into a new blank BRAM, the FINISH PANEL SETUP procedure (listed at the end of the entry procedure below) must be performed after all data has been entered. Failure to perform this procedure will result in unreliable OptiView Control Center operation! If this procedure is performed prior to entering all data, the ability to enter more data will be terminated.

Use the following procedure to enter data:

1. At the keypad, log in at the appropriate access level to change the desired values.
2. From the SETPOINTS screen, select SETUP screen. From the SETUP screen, select SALES ORDER screen.
3. If logged in at SERVICE access level, press SET ORDER INFO key to enter Commissioning date, Job Name or Location and proceed to step 4. If logged in at ADMIN or TEST OP level, Press SELECT key to select the data category (ORDER, DESIGN, NAMEPLATE, SYSTEM) to be entered.
4. Press CHANGE key. The first changeable area in the selected category will be outlined in a green selection box. The procedure can be terminated anytime after this by pressing the CANCEL (X) key.
5. Use the ▲ and ▼ keys to move the green selection box to the desired value to be changed, within the category selected.
6. Press ENTER (✓) key.
7. Enter the appropriate data. Use the numeric keypad keys to enter numbers. Use the • key to enter a decimal point. Use the ▲ and ▼ keys to scroll sequentially up and down through the alphabet to enter letters or a comma (,), slash (/) or minus sign (-).

Each time the ▲ key is pressed, the next higher sequential alphabet letter is displayed. Each time the ▼ key is pressed, the next lower alphabet letter is displayed. The comma, slash and minus sign can be selected after scrolling through the entire alphabet. During the entry process, the ◀ key can be used to backspace and the ▶ key can be used to forward space.

8. Press ENTER (✓) key.
9. Use ▲ and ▼ keys to select another value to be changed within the same category or press CANCEL (X) key to exit and allow selection of another category.
10. **EXTREMELY IMPORTANT!** If the procedure above was performed using password 0 2 2 8 to enter data into a new blank BRAM, the following procedure must be performed after all the desired data is entered. If the following procedure is performed prior to entering all of the data, the ability to enter more data will be terminated. Failure to perform this procedure after all data has been entered will result in unreliable OptiView Control Center Operation!
 - a. On SALES ORDER screen, press FINISH PANEL SETUP key.
 - b. Use ◀ and ▶ key to select YES.
 - c. Press ENTER (✓) key.

CUSTOM USER ID AND PASSWORDS

When logging in, the user is requested to enter a User ID, followed by a Password. The universal and default USER ID is zero (0). The universal Password to log in at OPERATOR access level is 9 6 7 5. The universal Password to log in at SERVICE access level is 1 3 8 0. No log in is required for VIEW access level. However, if desired, the Service Technician can establish up to four custom User ID's and Passwords that can be used by Operations personnel to log in at VIEW, OPERATOR, or SERVICE level.

Up to four Custom Users can be established with User ID's from 1 to 9999. Each user can be assigned a Password of 0 to 9999 and an access level of VIEW, OPERATOR or SERVICE.

Use the following procedure to establish Custom Users:

1. At the keypad, log in at SERVICE access level using 1 3 8 0.

2. From the SETPOINTS screen, select SETUP screen. From SETUP screen, select USER screen.
3. Press CHANGE USER ATTRIBUTES key. The first changeable area is outlined in a green selection box.
4. Use the ◀, ▶, ▲ or ▼ keys to move the green selection box to the desired value to be changed.
5. Press the ENTER (✓) key.
6. Using numeric keypad keys, enter desired parameter as follows:

User ID – 1 to 9999 (numbers cannot be duplicated for more than one user)

Password – 0 to 9999

Access Level – 0 = View, 1 = Operator, 2 = Service
7. Press ENTER (✓) key.
8. After all values have been entered, press CANCEL key (X) to exit.

RECORD SETPOINT CHANGES

This feature provides a record of the last 75 setpoint changes. The date and time the setpoint was changed, the new setpoint value and the access level and User ID used to make the change are stored. The SECURITY LOG screen and the SECURITY LOG DETAILS screen display levels of this information.

On the SECURITY LOG screen, accessible from the HISTORY screen, the Setpoint, Setpoint Category and New Setpoint Value are listed and numbered in reverse order in which they were changed. The most recent is listed as number 1; the next most recent as number 2, etc. A PRINT key allows printing this entire list. Since 15 changes can be displayed at one time, multiple pages could be necessary to display all the changes. PAGE-UP and PAGE-DOWN keys are provided to view the entire list. If it is desired to view the details of a particular setpoint change, select the setpoint change number with the LOG ENTRY key and then press the VIEW DETAILS key. This moves to the SECURITY LOG DETAILS screen.

The SECURITY LOG DETAILS screen displays the following setpoint change details. The setpoint is selected from the list on the SECURITY LOG screen as explained in the previous paragraph.

- Setpoint Category
- Setpoint

- Date and time of change
- Access Level and User ID used to make the change
- Old Value
- New Value

The following setpoint changes are not logged:

- Clock Mode
- Custom Screen Slot Numbers
- Advanced Diagnostics Communication Port Tests
- Advanced Diagnostics Secondary Multiplexer Freeze
- Soft Shutdown Initiated by Operator
- System Language
- Display Units
- Any Print Report
- Cancel any Print Report
- Schedule Clear
- Schedule Repeat Exception Days
- Schedule Start and Stop Times
- Log In/Log Out
- User Attributes for ID, Password and Level
- Trend Start/Stop
- Trend Slot Numbers, Minimums and Maximums
- Trend Trigger Data
- Trend Print Mode
- Trend View Mode

View the setpoint changes as follows:

1. At the keypad, login at SERVICE access level using access code 1 3 8 0.
2. From the HISTORY screen, select SECURITY LOG screen to view the complete list of setpoint changes.
3. To view the details of a particular setpoint change, select it with the LOG ENTRY key, then press VIEW DETAILS key. This causes a jump to the SECURITY LOG DETAILS screen where the setpoint change details are displayed.

FLOW SWITCH

Style “F” chillers (and later) are provided with factory mounted thermal-type flow sensors for the evaporator and condenser. YST chillers may also use or field installed Differential Pressure or paddle-type flow sensors. The thermal-type sensors interface to Microboard +5VDC analog inputs at J7-14 (evaporator) and J7-16 (condenser). The Differential Pressure or Paddle-type sensors interface to the I/O Board 115 VAC digital inputs at TB4-12 (evaporator) and TB4-11 (condenser). In order for the program to read the appropriate inputs for the flow sensor status, the actual sensor type used must be entered at the keypad OPERATIONS screen using SERVICE access level.

The selections are “Analog” (thermal-type) or “Digital” (Differential Pressure Oil paddle-type). If Analog is selected, the program reads the thermal-type flow sensor inputs at Microboard analog inputs J7-14 (evaporator) and J7-16 (condenser) and ignores the Digital inputs. If Digital is selected, the program reads the Differential Pressure or Paddle-type sensor inputs at the I/O Board Digital Inputs TB4-12 (evaporator) and TB4-11 (condenser) and ignores the analog inputs.

Enter the applicable flow sensor type as follows:

1. Select SETPOINTS/SETUP/OPERATIONS screen.
2. Press FLOW switch key.
3. Use ◀ or ▶ keys to select flow sensor type. Each time the key is pressed, Analog or Digital is alternately displayed.
4. Press ENTER (✓) key.

MICROBOARD 031-02430-004 SETUP/CONFIGURATION

The following functions are programmed as setpoints on the 031-02430-004 Microboard. Refer to SECTION 3 - MICROBOARD 031-02430-004 for explanation of each setpoint.

- Liquid Type
- Chilled Liquid Pump Operation
- Power Failure Restart
- Pre-Lube
- Compressor Oil Pump Package
- Compressor Model

Program the above setpoints as follows:

1. At the keypad, login at SERVICE access level using access code 1 3 8 0. (“Power Failure Restart” only requires OPERATOR access code 9 6 7 5). (“Liquid Type” requires TEST OP access code 0 2 2 8 or ADMIN access code).
2. Select SETUP screen from SETPOINTS screen.
3. Press CHANGE SETTINGS key.
4. A green box will appear around the first changeable setpoint. Use ▲▼ keys to place the box around the setpoint to be changed.
5. Press ✓ key. A dialog box will appear with the range of settings.
6. Use ◀ or ▶ keys to scroll to desired setting.
7. Press ✓ key.

VARIABLE GEOMETRY DIFFUSER

A complete description of the Variable Geometry Diffuser (VGD) operation and setpoints that affect this control is detailed in SECTION 24 - VARIABLE GEOMETRY DIFFUSER of this manual. The setpoints are listed below. If the compressor is equipped with this feature, it must be “Enabled” and the setpoints programmed using the procedure below. Otherwise, it must be “Disabled”. The VGD can be manually controlled using the procedure below.

Enable/Disable

If the compressor is equipped with the VGD, it must be “Enabled”. Otherwise it must be “Disabled”. Use the following procedure:

1. Shutdown chiller and place keypad switch in the Stop-Reset position.
2. At the keypad, log in at SERVICE access level, using password 1 3 8 0.
3. Select SETPOINTS/SETUP/OPERATIONS screen.
4. Use ◀ and ▶ keys to select Enable or Disable as required.
5. Press ENTER (✓) key.

VGD Count

The VGD Count is displayed on the VGD screen. It is the number of times the Stall Detector Board output goes above the HIGH LIMIT setpoint. This count can be cleared as follows:

1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
2. Select COMPRESSOR/VGD/VGD SETPOINTS screen.
3. Using numeric keypad keys, enter desired number.
4. Press ENTER (✓) key.

Setpoints

The following are the setpoints and range of programmable values. The Default value is shown in parentheses. The Default value is the recommended value and should provide proper operation in most applications. However, the setpoint can be programmed to other values to compensate for local operating conditions. Use the following procedure:

- a. PRV Offset – 0 to 5% (3)
 - b. Probe Wait Time – 0.5 to 15 minutes (10)
 - c. Open Pulse – 1 to 9 seconds (2)
 - d. High Limit – 0.5 to 1.2VDC (0.8)
 - e. Low Limit – 0.4 to 0.8VDC (0.6)
 - f. Extreme Stall Duration - 1 to 20 minutes (10)
 - g. PRV VGD Inhibit - 40 to 100% (95)
1. At the keypad, log in at SERVICE access level using access code 1 3 8 0.
 2. Select COMPRESSOR/VGD/VGD SETPOINTS screen.
 3. On the VGD SETPOINTS screen, press the appropriate key to select the setpoint to be programmed.
 4. Using the numeric keypad keys, enter the desired value.
 5. Press ENTER (✓) key.

Manual Control

The VGD can be manually controlled as follows:

1. At the keypad, log in at SERVICE access level using access level code 1 3 8 0.
2. Select VARIABLE GEOMETRY DIFFUSER screen from the COMPRESSOR screen.
3. On the VARIABLE GEOMETRY DIFFUSER screen, press the OPEN, CLOSE or HOLD key as desired. Each time the OPEN or CLOSED key is pressed, the respective output is energized for 2 seconds and the respective LED illuminates for 2 seconds. Pressing the HOLD key causes the HOLD LED to illuminate and the VGD to be held in its present position. Pressing the AUTO key invokes automatic operation.

High Condenser Pressure Fault While Shutdown – Reset Procedure

High temperature condenser liquid flowing through the condenser while the chiller is shutdown can cause a condenser high pressure condition in the condenser resulting in loss of refrigerant. This anticipatory safety fault annunciates condenser high pressure conditions when the chiller is not running as follows:

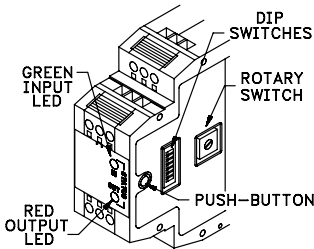
While the chiller is stopped, if the condenser pressure exceeds 160.0 PSIG (R134a), 240.0 PSIG (R22), a safety fault occurs and “Condenser – High Pressure - Stopped” is displayed. The chiller can be started after the condenser pressure decreases to less than 160.0 (R134a), 240.0 PSIG (R22) and a special reset procedure is performed as follows:

1. Place the keypad switch in the Stop-Reset position.
2. At the keypad, login at SERVICE access level using code 1 3 8 0.
3. Select COMPRESSOR screen.
4. Press the FAULT ACKNOWLEDGE key on the COMPRESSOR screen. A dialog box appears displaying “Enter Password to Clear Fault”.
5. Enter 1 3 9 7 and press the ENTER key (✓).

This anticipatory fault is only performed while the chiller is stopped. If a “Condenser – High Pressure” fault is detected while the chiller is in Start Sequence Initiated, Slow Rolling, “System Run” or “System Coastdown”, the fault is handled in the normal way and does not require the special reset procedure.

TURBINE ROTATING (SPEED SWITCH) CALIBRATION

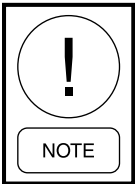
Configuring the IFMR



LD09754

To begin set-up, place the DIP switch 4 on the (ON) position. DIP switches 5, 6, and 7 access unit configuration settings. Upon entry to a set-up parameter, the input LED blinks the current numerical value of a setting at a 1 Hz rate. A setting of “1” is indicated by one blink (1/2 sec on 1/2 sec off), through a setting of “9”, which is indicated by nine blinks. A setting of “0” is indicated by a single short flash (40 msec on, 1 sec off). After the entire value is indicated, the IFMR pauses two seconds and repeats the value.

During entry of a new value, if the mode switch (S4) or any of the CFG DIP switch positions are changed before the push button is pressed, the IFMR aborts the entry process and retains the previous setting.



To return to normal operation, place the DIP switch 4 in the down (RUN) position.

Relay Indication

- **Overspeed :** The relay LED (red) turns on to indicate the input signal has exceeded the trip frequency.
- **Underspeed :** The relay LED (red) turns on to indicate the input signal is below the trip frequency setting.
- **Invalid Entry during Set-up:** The input LED (green) and the relay LED (red) alternately blink until a valid entry is made.

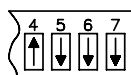
DIP SWITCH	DESCRIPTION
	Operating Mode
	Set Trip Frequency Using and Input Signal or Frequency Generator
	Set the Trip Frequency Using the Rotary Switch
	Set Minimum Response Time
	Set Relay Trip Point
	Set Relay Release Point

FIGURE 65 - IFMR – DIP SWITCH SETTINGS

FACTORY SETTINGS		
	Setting	Parameter
Operating Mode	3	Low Speed Operation, Trip on Underspeed
Trip Frequency	0000.8	0.8 Hz
Minimum Response	0	5 msec
Trip Point Offset	0	None
Trip Point Hysteresis	8	25.00%

Operating Mode

- Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.



LD09759

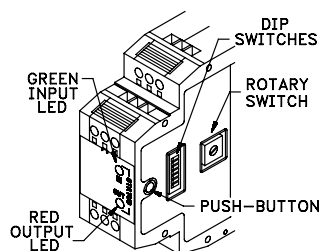
- The green input LED blinks the setting corresponding to the Operating mode shown below, pauses and repeats the value.

Setting	Operating Mode
1	Overspeed trip, automatic Release upon return to normal
2	Overspeed latched trip, Release only after ALM Reset pulled to Common
3**	Underspeed trip, automatic Release upon return to normal
4	Underspeed trip, start-up condition* ignored, automatic Release upon return to normal
5	Underspeed latched trip, Release only after ALM Reset pulled to Common
6	Underspeed latched trip, start-up condition* ignored, Release only after ALM Reset pulled to Common

* Refers to initial application of power to the IFMR, not the input frequency.

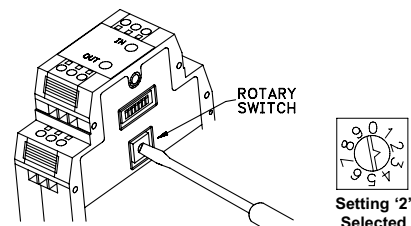
** Factory Setting.

- If the existing Operating mode setting is the desired requirement, this section is complete*. Otherwise continue to Step 3.



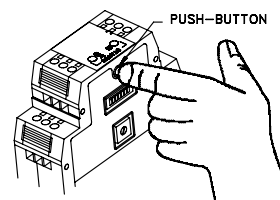
LD09754

- Press the push-button. The green input LED blinks rapidly to indicate the Operating mode setting is now accessed.



LD09758

- Turn the rotary switch to the selected numerical value for the output desired (see the table in step 2).



LD09757

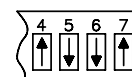
- Press the push-button. The green input LED blinks value entered, pauses, and repeats the new operation setting.

- If the new Operating mode setting is acceptable, this section is complete*.
- If the new Operating mode setting is not the desired setting, repeat the procedures from Steps 3, through 5.
- If the red output LED blinks, the rotary switch numerical value is invalid. Repeat Steps 4 and 5.

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

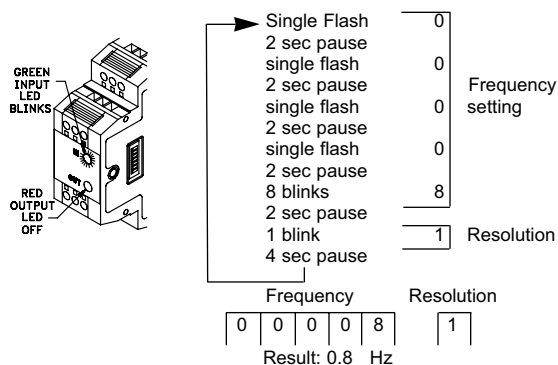
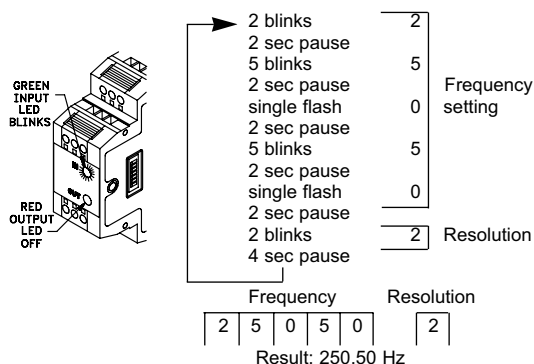
On-Line Trip Frequency Setting Using Actual Input Signal or Frequency Generator.

- Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.



LD09762

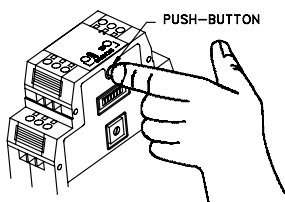
2. The green input LED blinks the existing Trip Frequency setting as shown in the following examples. Six full digits of numerical information blink with a 2 second pause between digits and a 4 second pause at the end, before repeating. The first five digits are the existing Trip Frequency magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).

Factory Setting Example**Additional Example:**

LD09769

- If the existing Trip Frequency setting is the desired requirements, this section is complete*. Otherwise, continue to Step 3.

3. Apply the desired Trip Frequency to the signal input pin.



LD09757

4. Press the push-button. The green input LED blinks rapidly. The acquisition process takes two seconds plus one period of the input signal.

- If the new input range is valid, the green input LED turns on solid. Continue to Step 5.
- If red output LED blinks, the new Trip Frequency is invalid, outside the acceptable 0.1 Hz to 25 KHz range. Repeat Steps 3 and 4.

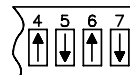
5. Press the push-button. The green input LED blinks the new Trip Frequency setting. This section is complete*.

- To verify the Trip Frequency setting, see Step 2.

** Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.*

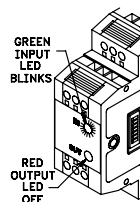
Set Trip Frequency Using the Rotary Switch

1. Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.



LD09763

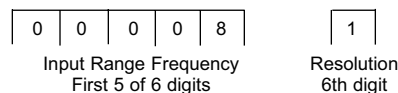
2. The green input LED blinks the existing Trip Frequency setting, pauses and repeats. Six full digits of numerical information blink with a 2 second pause between digits and a 4 second pause at the end, before repeating. The first five digits are the existing Trip Frequency magnitude. The sixth digit is the frequency resolution (the number of digits to the right of the decimal point).



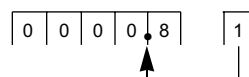
LD09756

- If the existing Trip Frequency setting is the desired requirement, this section is complete*. Otherwise, continue to Step 3.

3. Determine the Trip Frequency and record.

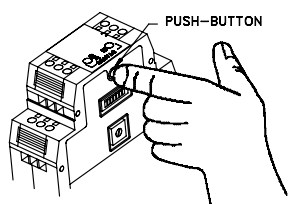


Example: 0.8 Hz



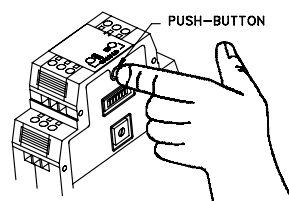
LD09776

4. Press the push-button. The green input LED blinks rapidly. The Trip Frequency setting is now accessed.



LD09757

5. Turn the rotary switch to the first selected numerical value. Press the push-button. The green input LED continues to blink rapidly. First of six digits is entered.



LD09757

6. Turn the rotary switch to the second selected numerical value. Press the push-button. The green input LED continues to blink rapidly. Second of six digits is entered.

7. Repeat Step 6 three more times, then go to Step 8. This enters a total of five of the required six numerical digits.

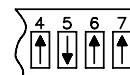
8. Turn the rotary switch to the selected numerical value for resolution requirement. Press the push-button. The green input LED blinks the new Trip Frequency setting (as described in Step 2), pauses, and repeats the value.

- If the new Trip Frequency setting is acceptable, this section is complete*.
- If the new Trip Frequency setting is not the desired setting, repeat the procedures from Steps 4 through 8.
- If the red output LED blinks, the numerical value entered is invalid. Repeat Steps 3 through 8.

** Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.*

Set Minimum Response Time

1. Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.

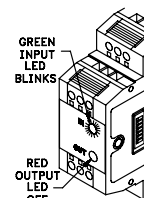


LD09764

2. The green input LED blinks the existing Minimum Response Time setting (see the following list), pauses and repeats.

SETTING	TIME	SETTING	TIME
0*	5 msec	5	200 msec
1	10 msec	6	500 msec
2	20 msec	7	1 sec
3	50 msec	8	5 sec (not valid for input range > 3906 Hz)
4	100 msec	9	10 sec (not valid for input range > 3906 Hz)

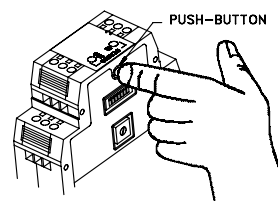
*Factory Setting



LD09756

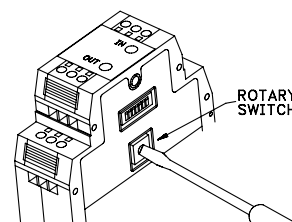
- Minimum Response Times do not include the relay's operate response time of 5 msec., or the release response time of 3 msec.

3. Press the push-button. The green input LED blinks rapidly. The Minimum Response Time setting is now accessed.



LD09757

4. Turn the rotary switch to the selected numerical value for Minimum Response Time desired. (refer to the Table in Step 2)



LD09758

5. Press the push-button. The green input LED blinks value entered, pauses, and repeats the new Minimum Response Time setting.

- If the new Minimum Response Time setting is acceptable, this section is complete*.
- If the new Minimum Response Time setting is not the desired setting, repeat the procedures from Steps 3 through 5.
- If the red output LED blinks, the numerical value entered is invalid. Repeat Steps 4 and 5.

** Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.*

Set Relay Trip Point (Offset)

For Overspeed operation, the Relay Trip Point is internally set to the Trip Frequency plus the Offset value. For Underspeed operation, the Relay Trip Point is internally set to the Trip Frequency minus the Offset value. The Offset value is equal to the Trip Frequency multiplied by the selected Offset percentage.

Example: The Offset value is calculated as shown below.

Trip Frequency = 250 Hz

Rotary Switch Setting = 4 (2.00% (0.02) = 5 Hz

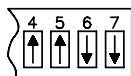
Offset Value = 250 Hz x 2.00% (0.02) = 5 Hz

Trip Point:

OVERSPEED = 250 + 5 = 255 Hz

UNDERSPEED = 250 - 5 = 245 Hz

1. Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.



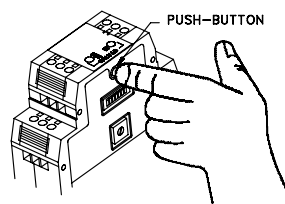
LD09765

2. The green input LED blinks the corresponding Maximum Response Time Setting (see the following table), pauses and repeats.

SETTING	TIME
0*	0.00% (NO Offset)
1	0.25% (0.0025)
2	0.50% (0.0050)
3	1.00% (0.0100)
4	2.00% (0.0200)
5	5.00% (0.0500)
6	10.00% (0.1000)
7	20.00% (0.2000)
8	25.00% (0.2500)
9	33.33% (0.3333)

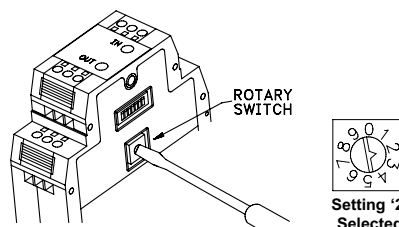
*Factory Setting

3. Press the push-button. The green input LED blinks rapidly. The Trip Point Offset setting is now accessed.



LD09757

4. Turn the rotary switch to the selected numerical value for Trip Point Offset desired (refer to the Table in Step 2)



LD09758

5. Press the push-button. The green input LED blinks value entered, pauses, and repeats the new Trip Point Offset setting.

- If the new Trip Point Offset setting is acceptable, this section is complete*.
- If the new Trip Point Offset setting is not the desired setting, repeat the procedures from Steps 3 through 5.
- If the red output LED blinks, the Rotary switch numerical value is invalid. Repeat Steps 4 and 5.

** Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.*

Set Relay Release Point (Hysteresis)

For Underspeed operation, the Relay Release Point is set to the Relay Trip Point plus the Hysteresis value. The hysteresis value is calculated by multiplying the hysteresis percentage by the current trip frequency. If No Hysteresis (setting = 0) is selected, the Relay Trip and Release points are identical, which can lead to chattering or cycling of the relay at input frequencies hovering around the Relay Trip Point.

Example: Using the Factory set Trip Frequency and Offset value; the hysteresis value is calculated as shown below.

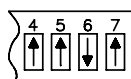
$$\text{Rotary Switch Setting} = 8 \text{ (25.00\%)}$$

$$\text{Hysteresis Value} = 0.8 \text{ Hz} \times 25\% (0.25) = 0.2 \text{ Hz}$$

Release Point:

$$\text{UNDERSPEED} = 0.8 + 0.2 = 1.0 \text{ Hz}$$

- Place the DIP switch 4 on the ON (up) position and DIP switches 5, 6, and 7 as shown.



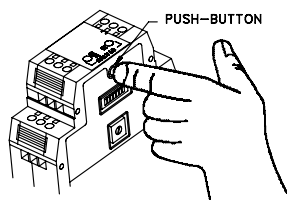
LD09766

- The green input LED blinks the existing setting (see the following table), pauses and repeats.

SETTING	TIME
0	0.00% (NO Hysteresis)
1	0.25% (0.0025)
2	0.50% (0.0050)
3	1.00% (0.0100)
4	2.00% (0.0200)
5	5.00% (0.0500)
6	10.00% (0.1000)
7	20.00% (0.2000)
8*	25.00% (0.2500)
9	33.33% (0.3333)

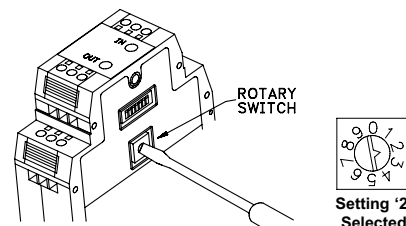
*Factory Setting

- Press the push-button. The green input LED blinks rapidly. The Trip Point Hysteresis setting is now accessed.



LD09757

- Turn the rotary switch to the selected numerical value for Hysteresis desired (refer to the Table in Step 2).



LD09758

- Press the push-button. The green input LED blinks the value entered, pauses, and repeats the new Trip Point Hysteresis setting.

- If the new Trip Point Hysteresis setting is acceptable, this section is complete*.
- If the new Trip Point Hysteresis setting is not the desired setting, repeat the procedures from Steps 3 through 5.
- If the red output LED blinks, the numerical value entered is invalid. Repeat Steps 4 and 5.

* Section complete; place DIP switch 4 to the Down position for normal operation, or change DIP switches 5, 6, and 7 for the next Configuration Section.

25

RESISTANCE TEMPERATURE TRANSMITTERS FUNCTION DESCRIPTIONS

Open Sensor Detection

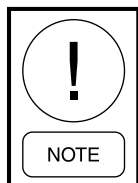
The output can be set to go Upscale or Downscale for the detection of an open sensor. The Upscale setting makes the output go to 22.5 mA (nominal). The Downscale setting makes the output go to 3.5 mA (nominal). This setting is always active, so changes in the setting are effective immediately.

Calibration Malfunction

If the unit has scaling problems (current remains at 3.5 mA nominal), check the voltage between the RTD-Input (-) and Test pad (+) [located next to the DIP switches on the side of the unit]. For normal operation the voltage is 0 V (nominal). If the voltage is +3 V (nominal), a problem occurred storing information in the EPROM. When this happens perform a Basic Calibration and then a Field Calibration. Turn Off power for 5 seconds. Turn on power and check the voltage between the Test pad (+) and RTD- Input (-). If the voltage is still +3 V (nominal), contact the factory.

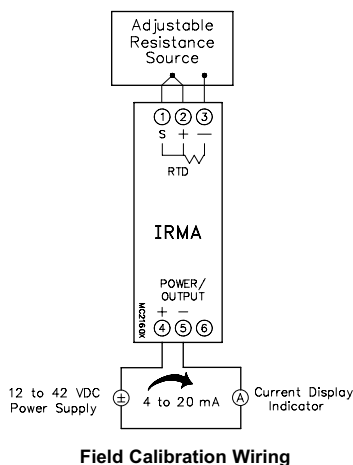
Field Calibration

Allow a 30 minute warm-up period before starting Field Calibration. Field Calibration scales the 4 to 20 mA output to a temperature or resistance input. This procedure assigns an input value to 4 mA and an input value to 20 mA. The microprocessor handles configuring the output so it is linear to the temperature or resistance input. The Field Calibration procedure is described below.

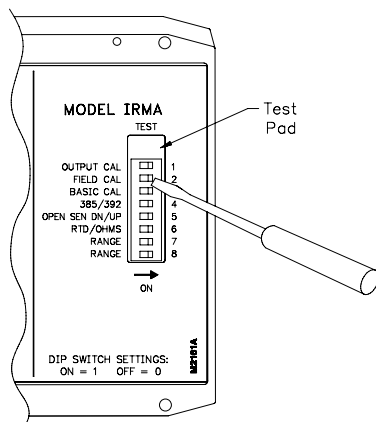


The unit needs to have the Field Calibration completed by the operator before normal operation. To abort this calibration and reset to the previous settings, set the FIELD CAL switch OFF prior to the final OFF setting of the OUTPUT CAL switch (Step 11) and turn off the power. Wait 5 seconds and then turn on power and the previous settings will be loaded.

Field Calibration with an Accurate Adjustable Resistance Source



LD09785



LD09786

1. Connect an Adjustable Resistance Source with an accuracy of 0.03% to the RTD input terminals using a third sense wire.

For 2 wire sensors short terminal #1 to terminal #2.

2. Set the Type and Range for the RTD or resistance used in your application (DIP switches #4, #6, #7, and #8). (RTD alpha = 0.00385, range 0 shown)



LD09778

3. Set the FIELD CAL switch (#2) ON [Current goes to 3.6 mA nominal]



LD09779

4. Set the resistance source to the desired resistance for the 4 mA output. For 2 wire sensors add system lead resistance to the desired value.

5. Set the OUTPUT CAL switch (#1) ON. [Current stays at 3.6 mA (nominal)]



6. Adjust the input resistance up until the output equals 4 mA.

7. Set the OUTPUT CAL switch (#1) OFF. [Current increases to 22.3 mA (nominal)]



LD09781

8. Set the resistance source to the desired resistance for the 20 mA output. For 2 wire sensors add the system lead resistance to the desired value.

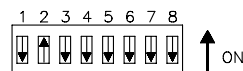
9. Set the OUTPUT CAL switch (#1) ON. [Current decreases to 20.5 mA (nominal)]



LD09782

10. Adjust the input resistance down until the output equals 20 mA.

11. Set the OUTPUT CAL switch (#1) OFF.



LD09783

12. Set the FIELD CAL switch (#2) OFF.



LD09784

13. Disconnect the resistance source from the IRMA and connect the actual sensor to be used in the application.

TURBINE NOZZLE SOLENOID SETUP

When the turbine is supplied with pneumatically actuated nozzle valves, their operation is determined by the following: PSP13-Turbine Nozzle Solenoid #1 Activate, PSP14-Turbine Nozzle Solenoid #2 Activate PSP15-Turbine Nozzle Solenoid Deadband setpoints entered on the PRESSURE SETPOINTS screen; TDSP2-Turbine Nozzle Solenoid #1 Delay and TDSP3-Turbine Nozzle Solenoid #2 Delay setpoints entered on the TIME SETPOINTS screen. When the chiller is running at or above the SSP2-Minimum Rated Speed, if the Turbine First Stage Steam Pressure has been continuously above the Activate setpoint for the preset delay, the associated nozzle valve air dump solenoid is energized to open the nozzle valve. When the pressure drops below the Activate setpoint minus the deadband, the solenoid is de-energized to close the nozzle valve. Opening a nozzle valve allows steam to flow through more nozzles in the turbine nozzle block and increases the turbines potential capacity.

Prior to operating the turbine as described below, both pressure setpoints should be set to 100 PSIG to prevent them from opening prematurely during the test.

The PSP13-Turbine Nozzle Solenoid #1 Activate pressure setpoint must be determined by increasing the load on the turbine (with both hand valves closed) and observing when the first stage pressure stops increasing even though the governor valve output signal continues increasing. The setpoint should be 1-2 PSI below the observed pressure.

The PSP14-Turbine Nozzle Solenoid #2 Activate pressure setpoint must be determined by increasing the load on the turbine (with Turbine Nozzle Solenoid Valve #1 energized) and observing when the first stage pressure stops increasing even though the governor valve output signal continues increasing. The setpoint is 1-2 PSI below the observed pressure.

The default setpoints for the time delays and deadband may be adjusted do provide more rapid cycling of the valves if required but should normally remain as is.

ANALOG EXPANSION BOARD CALIBRATION

Analog Inputs

Overview

The 4-20 mA DC current signals from a transmitter connected to Channels 1-8, 10-14, and 17-23 are converted to “counts” by the Analog-to-Digital (A/D) Converter for the inputs and read by the Microboard via the COM3 Serial Data Port. The program does the input scaling by interpreting the minimum counts as the lower end of the transmitter range and the maximum counts as the upper end of the transmitter range.

For example, for the speed transmitter inputs (Channels 21 and 22), a theoretical count of 819 would be seen at 4 mA and the program would interpret this as 0 RPM. A theoretical count of 4095 would be seen at 20 mA and the program would interpret this as 5000 RPM.

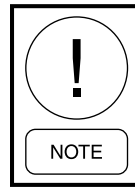
Due to manufacturing tolerances, the counts sent to the Microboard may vary between boards. This would introduce inaccuracy in the scaled value. The inaccuracy will be greater with large scaled spans and not as noticeable with smaller scaled spans. For example, a difference of 20 counts between the original board and the new board would result in a difference of +/- 24 RPM for a scaled span of 5000 RPM and only +/- 1.5 PSIG for a scaled span of 300 PSIG.

The difference in the scaled speed values could result in unexpected operation of oil pumps and condenser water pump when the panel power is turned on after replacing the board. **Therefore, the Microboard program switch SW1-3 should be placed in the ON position so that all outputs are “Disabled” and the panel boots up in the diagnostic mode. As a minimum, Channels 21 and 22 should always be recalibrated before operating the chiller after replacing the board.**

Calibration Procedure for Channels 21 and 22

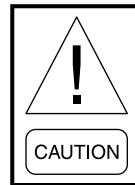
After replacing the Analog Expansion Board, the Microboard program switch SW1-3 should be placed in the ON position so the panel boots up in the diagnostic mode with the chiller operation “Disabled” and the MAIN DIAGNOSTICS screen displayed. Press the EXPANSION ANALOG I/O key to go to the EXPANSION ANALOG I/O screen.

1. Press the LOGIN key to change the access level displayed on the Status bar to ADMIN (password changes daily) or TEST OP (password 0228) in order to have access to the calibration keys.
2. Remove the input signal wiring (Cable 45) from the plug P10A, pins 2 and 3 and connect the positive (+) lead from a calibrated 4-20 mA DC source to Pin 2. Connect the negative (-) lead to Pin 3. Refer to Fig. 33 for the wiring connections. Set the calibrator output current at 4 mA
3. Press the SELECT key to toggle to CALIBRATE I/O. Press the left CALIBRATE key to toggle to INPUT. Use the “▲” or “▼” keys to move the green box to the desired input to be calibrated.
4. Press the right CALIBRATE key to toggle to LOW END. Press the “✓” key. A pop-up window will appear. The procedure can be terminated anytime by pressing the “X” (cancel) key. The NOW value shown in the pop-up window is the present count being produced by the A/D converter with a 4 mA input applied. Press the “✓” key to accept the new LOW END value.
5. Press the right CALIBRATE key to toggle to HIGH END and slowly adjust the calibrator output current to 20 mA. Verify that the Counts shown on the EXPANSION ANALOG I/O screen for Channel 21 are 4095 or less with an input signal of 19.8 - 20.1 mA.
6. Press the “✓” key. A pop-up window will appear. The NOW value shown in the pop-up window is the present count being produced by the A/D converter with a 20 mA input applied. Press the “✓” key to accept the new HIGH END value.
7. Reconnect the input signal wiring (Cable 45) to the plug P10A, pins 2 and 3.
8. Repeat the steps 3 through 7 above for Channel 22 (Cable 46) plug P10A, pins 5 (+) and 6 (-).



For either of the speed inputs, if the Counts increase to 4095 before the input signal has increased to 20 mA, the program will not be capable of reading up to 5000 RPM since the maximum counts possible are 4095. The Frequency-to-Analog Converter must be recalibrated as described in this section under Frequency to Analog Converter Calibration so that the output signal at 5000 Hz equals the mA seen at 4095 Counts. For example, if 4095 Counts were displayed at 19.4 mA input signal, the Full Scale Value would need to be decreased to 19.4 mA.

9. Reconnect the input signal wiring (Cable 46) to the plug P10A, pins 5 and 6.
10. Turn the power off to the panel and place the Microboard program switch SW1-3 in the OFF position. After the power is restored and the panel reboots, the program will scale the analog inputs based on the new low and high end counts entered during the calibration procedure.



The above calibration procedure does not verify the calibration of the frequency to analog converters and should only be used if a function generator is not available. Normally the speed inputs should be calibrated along with the converters as described in this section under Frequency to Analog Converter Calibration, Speed Input Calibration. If the above procedure is used, the accuracy of the speed inputs should be verified using a strobe light.

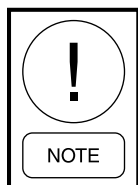
Calibration Procedure for Channels 1-8, 11-12, 16-20 and 23

Repeat the same procedures listed above for all channels as described above. Refer to Figure 34 on page 82 for the wiring connections when disconnecting the input signal wiring, connecting the calibrator leads, and reconnecting the input signal wiring to ensure that the wiring is done correctly.

Analog Outputs

Overview

The “counts” sent by the program to the digital-to-analog (D/A) converters determine the actual current/voltage outputs to drive the I/P transducers and valve actuators to the appropriate position. The program does the output scaling by recording the actual Low End counts required to produce 4 mA/0 VDC and High End counts required to produce 20 mA/10 VDC at the output terminals of the board. It then regulates the counts sent to the D/A converters linearly between the recorded Low and High End counts as dictated by the program. For the analog outputs, the program sends a count of 600 (0%) to the digital-to-analog D/A converter to drive the output to 4 mA and 3230 (100%) to drive the output to 20 mA/10 VDC.



Calibration to the 0-10VDC outputs (hot gas bypass and liquid level control valve). A single output of zero VDC will be reflected by a count of zero. A single output of 10 VDC will have a count up to 4095.

For example, for the governor I/P transducer (Channel 7), a theoretical count of 600 would be sent to produce a 4 mA output and a count of 3230 would be sent to produce a 20 mA output.

Due to manufacturing tolerances, the 600 counts sent to the D/A converter may produce varying outputs between boards. If the output is less than 4 mA, when the program begins call for increased speed and the counts are increased above 600, the governor valve will not begin opening until the counts have increased enough to produce more than 4 mA to the I/P transducer. During slow roll when the governor is operating at a nearly closed position, the governor valve will be fully closed prematurely causing instability. By calibrating the low end exactly at the counts required to produce 4 mA, the governor valve will respond exactly as dictated by the program thus allowing the PID algorithm to maintain the speed at setpoint. **Therefore, the Microboard program switch SW1-3 should be placed in the ON position so that all outputs are “Disabled” and the panel boots up in the diagnostic mode. As a minimum, Channel 7 should always be recalibrated before operating the chiller after replacing the board.**

Calibration Procedure for Channel 7

1. After replacing the Analog Expansion Board, the Microboard program switch SW1-3 should be placed in the ON position so the panel boots up in the diagnostic mode with the chiller operation “Disabled” and the MAIN DIAGNOSTICS screen displayed. Press the EXPANSION ANALOG I/O key to go to the EXPANSION ANALOG I/O screen.
2. Press the LOGIN key to change the access level displayed on the Status bar to ADMIN (password changes daily) or TEST OP (password 0228) in order to have access to the calibration keys.
3. Remove the red output signal wire (Cable 29) from the plug P11B, pin 5 and connect the positive (+) lead from a calibrated 4-20 mA DC meter to Pin 5. Connect the negative (-) lead to the red wire (Cable 29). Refer to Figure 34 on page 82 for the wiring connections.
4. Press the SELECT key to toggle to CALIBRATE I/O. Press the left CALIBRATE key to toggle to OUTPUT. Use the “▲” or “▼” keys to move the green box to the desired output to be calibrated.
5. Press the right CALIBRATE key to toggle to LOW END. Press the “✓” key. The procedure can be terminated anytime by pressing the “X” (cancel) key. The NOW value shown in the pop-up window is the present count being sent to the D/A converter. Enter the Default value of 600 and press the “✓” key. If the meter is not reading 4 mA, press the INCREASE or DECREASE key until the meter is reading 4 mA. Press the “✓” key to display the pop-up window and then press the “✓” key to accept the NOW value for the new LOW END value.
6. Press the right CALIBRATE key to toggle to HIGH END. Press the “✓” key. The NOW value shown in the pop-up window is the present count being sent to the D/A converter. Enter the Default value of 3230 and press the “✓” key. If the meter is not reading 20 mA, press the INCREASE or DECREASE key until the meter is reading 20 mA. Press the “✓” key to display the pop-up window and then press the “✓” key to accept the NOW value for the new HIGH END value.

7. Press the SELECT key to toggle the TEST OUTPUT button. Use the “▲” or “▼” keys to move the green box to Output 7. Press the “✓” key. A pop-up window will appear. Use the numeric keys to enter 4.0 and then press the “✓” key. The meter should read 4.0 mA.
8. Press the “✓” key. A pop-up window will appear. Use the numeric keys to enter 20.0 and then press the “✓” key. The meter should read 20.0 mA.
9. Reconnect the red input signal wire (Cable29) to the plug P11B, pin 5.
10. Turn the power off to the panel and place the Microboard program switch SW1-3 in the OFF position. After the power is restored and the panel reboots, the program will scale the analog outputs based on the new low and high end counts entered during the calibration procedure.



The above calibration procedure does not verify the calibration of the I/P transducers valve actuators, or tachometer.

Calibration Procedure for Channels 1-4, and 8

Repeat the same procedures listed above for all channels that are used as described above. *Refer to Figure 34 on page 82 for the wiring connections* when disconnecting the output signal wiring, connecting the meter leads, and reconnecting the output signal wiring to ensure that the wiring is done correctly.

Calibration Procedure for Channels 5 and 6

Repeat the same procedures listed above except for step 3, disconnect both signal wires and connect the 0-10 VDC meter leads directly to the output plug. *Refer to Figure 34 on page 82 for the wiring connections* when disconnecting the output signal wiring, connecting the meter leads, and reconnecting the output signal wiring to ensure that the wiring is done correctly.

SECTION 26 - DIAGNOSTICS AND TROUBLESHOOTING

The problems that could be encountered in the OptiView Control Center are in the following categories:

- Keypad
- Display
- Serial Input/Output (I/O)
- Digital Input/Output (I/O)
- Analog Inputs

There is a Diagnostic and associated Troubleshooting procedure for each category. They are described on the following pages. Each Diagnostic is accessed from the Diagnostics Main screen, which is entered using the procedure below. If there is an OptiView Control Center problem, determine the category of the problem. Then perform the applicable Diagnostic. If the Diagnostic reveals a malfunction, perform the troubleshooting procedure to locate the defective component.

There are several documents that must be referred to while performing the diagnostics and troubleshooting procedures. Each procedure references the Section and figures of this manual that describe the operation of the component being tested. Also, the applicable OptiView Control Center wiring diagram must be used as follows:

- 160.67-PW6

There are two versions of the Diagnostics screens available as follows:

1. Shown in *Figure 66 through 75 starting on page 214*. These screens are used during the diagnostics and troubleshooting process. They allow output states to be changed. Access the Diagnostics Main screen as follows:
 - a. The chiller must be stopped.
 - b. Place keypad switch in the Stop-Reset position (O).
 - c. Ensure that the Main Steam Block Valve is fully closed.
 - d. Log in at **SERVICE** access level using access code **1 3 8 0**.

- e. Move Microboard program switch SW1-3 to the ON position. A Watchdog reset will occur and the Boot-up process will commence. At the completion of the Boot-up process, the Diagnostics Main screen will appear. (Note: If SW1-3 is moved to the ON position before the above Step (d.) is performed, the “**LOG IN**” key will be displayed and Logging in at **SERVICE** access level must be performed before the Main screen is displayed.

2. Not shown. Available when logged in at **SERVICE** access level, whether the chiller is running or not. Accessed from the **SETUP** screen via the **SETPOINTS** screen. There are four screens available that allow the analog inputs voltage levels and Digital I/O states to be monitored. These screens are preceded by a general screen that provides the installed software versions.

SOFTWARE VERSIONS

Controls - Software that is currently residing in the FLASH Memory Chip on Microboard.

BIOS - BIOS EPROM on Microboard.

Kernel - Software residing in FLASH Memory.

GP - Software residing in FLASH Memory.

EXP I/O - Software that is residing in the Analog I/O Expansion Board Memory.

GUI - Software residing in FLASH Memory.

SIO - Software residing in FLASH Memory.

GPIC - EPROM in MicroGateway.

MAIN DIAGNOSTICS SCREEN

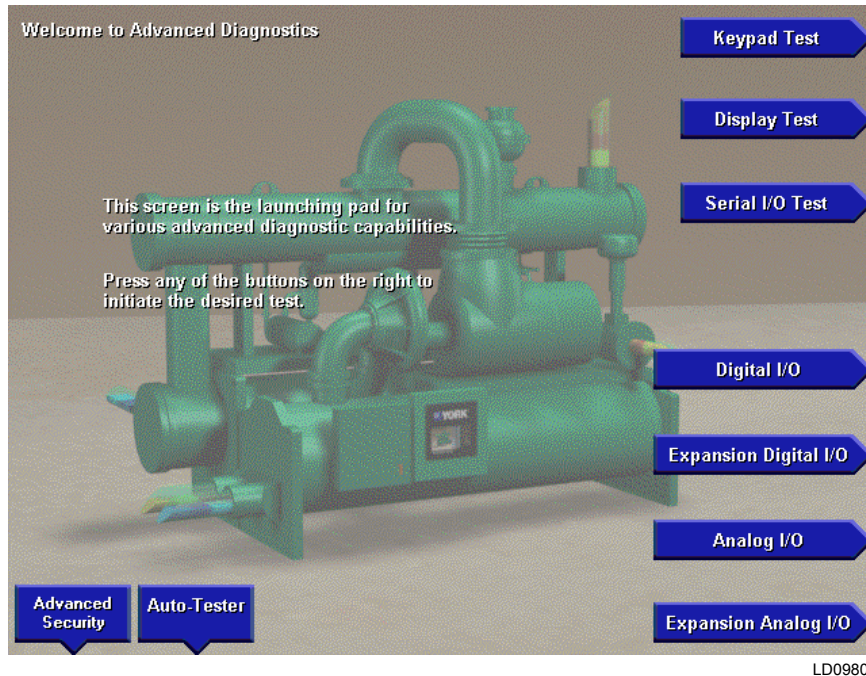


FIGURE 66 - MAIN DIAGNOSTICS SCREEN

Each of the diagnostics is accessed from this screen. Press the appropriate key to select the desired diagnostic. After each diagnostic is performed, return to this **MAIN** screen, from which the next diagnostic can be selected.

Some of the diagnostics have sub-screens that are accessed from the selected diagnostic screen. The sub-screens are shown indented below:

Main Screen

- Keypad Test
- Display Test
 - Bit Patterns Test
 - All Red
 - All Green
 - All Blue
 - All White
 - All Black
- Serial Inputs/Outputs Tests
- Digital Inputs/Outputs Tests
- Digital I/O Expansion Tests
- Analog Inputs Tests
- Analog I/O Expansion Tests

The **ADVANCED SECURITY** key is used during the manufacturing process and has no field service use.

KEYPAD TEST

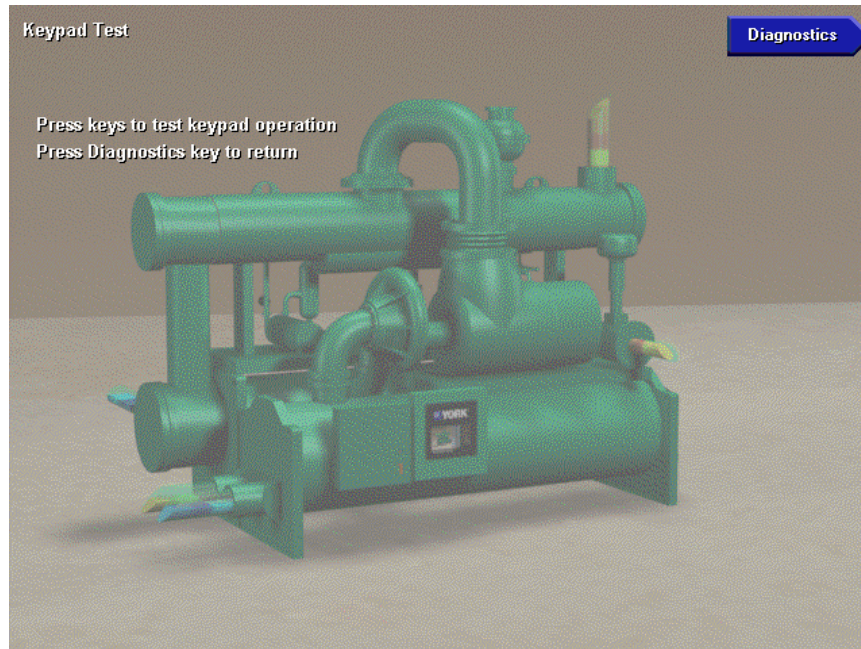


FIGURE 67 - KEYPAD TEST SCREEN

LD09801

This diagnostic is used to verify keypad operation and the Microboard's ability to respond to a pressed key. *Refer to description of keypad operation in SECTION 8 - KEYPAD of this manual.*

Procedure

1. Press each keypad key. As the key is pressed, an illuminated LED is displayed corresponding to the key location on the keypad.
2. Press the **DIAGNOSTICS** key to return to the **MAIN DIAGNOSTICS** screen.

Troubleshooting

If an LED is not displayed when a key is pressed, the keypad, keypad ribbon cable or Microboard could be defective. Use the following procedure to locate the defective component.

1. Keypad

- a. Disconnect the ribbon cable from the keypad.
- b. Identify row/column coordinate of the key to be tested (*refer to Figure 30 on page 73*).

- c. In the keypad connector, locate the pins of the row/column coordinate of the key of the key to be tested.
- d. Insert the leads of an Ohmmeter into the pins identified in step "c" above.
- e. Press the key to be tested. If the contact resistance is >100 Ohms, the keypad is defective.
- f. Release the key. If the contact resistance is < 1 Meg Ohm, the keypad is defective.

2. Ribbon Cable

Using an Ohmmeter, perform a continuity test on all conductors in the ribbon cable. An open circuit would indicate the ribbon Cable is defective.

3. Microboard

There are no checks or measurements to be made on the Microboard. If the keypad and Ribbon Cable check OK per the above procedures, the Microboard is most likely the cause of the problem.

DISPLAY TEST



FIGURE 68 - DISPLAY TEST MAIN SCREEN

LD09802

Each of the Display Diagnostics is accessed from this screen. After each diagnostic is performed, return to this screen, from which the next diagnostic can be selected. *Refer to description of Display Operation in SECTION 5 - LIQUID CRYSTAL DISPLAY through SECTION 7 - DISPLAY BACKLIGHT INVERTER BOARD of this manual.*

Procedure

1. Press the appropriate keypad key to perform the desired test from the list below.
 2. Press the **CANCEL (X)** or **ENTER (✓)** key to terminate test and return to **DISPLAY TEST MAIN** screen, from which another test can be selected.
 3. When all the desired tests have been performed, press the **DIAGNOSTICS** key to return to the **MAIN DIAGNOSTICS** screen.
- **Bit Patterns** - This test is used to detect jitter and alignment defects. It verifies proper operation and compatibility of the Microboard Display Controller with the display. Four vertical bars of green, dark blue, light blue and yellow, outlined by a red border are displayed. If the vertical bars are not stable or straight, or the red border is not completely visible, then either the Microboard Program Jumpers are not configured correctly for the installed display or the Microboard Display Controller is defective (*refer to Figure 68 on page 216*).
 - **All Red** - This test verifies the operation of all of the red pixels. All of the red pixels are turned on

to create a completely red screen. Any red pixels that do not turn on will appear as black dots on the display. If any black dots appear, first ascertain it is not caused by dirt that is lodged between the display surface and the protective plastic cover. It is normal for a small number of randomly spaced pixels to not illuminate. It is not necessary to replace the display if a small number of black dots appear. They will not be visible on the normal screens displayed outside of this diagnostic mode. However, large black areas would be indicative of a defective display.

- **All Green** - This test verifies the operation of all of the green pixels. All of the green pixels are turned on to create a completely green screen. Refer to description of “All Red” test above.
- **All Blue** - This test verifies the operation of all of the blue pixels. All of the blue pixels are turned on to create a completely blue screen. Refer to description of “All Red” test above.
- **All White** - This test verifies the display’s ability to turn on all pixels to display a completely white screen. Any pixel that does not turn on will appear as a black dot. Refer to description of “All Red” test above.
- **All Black** - This test verifies the display’s ability to turn off all pixels to display a completely black screen. Any pixel that does not turn off will appear as a red, green, blue or white dot. Refer to description “All Red” test above.

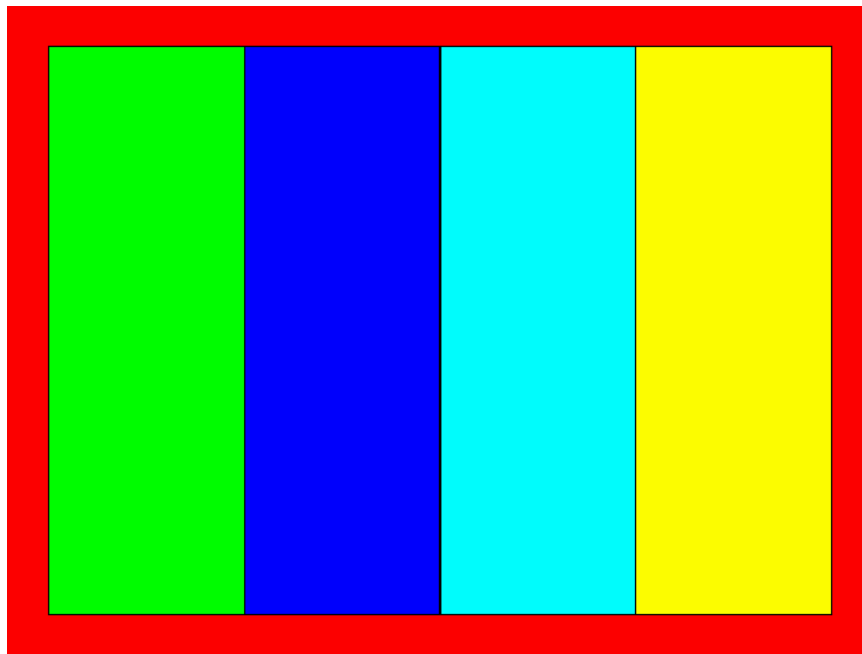


FIGURE 69 - BIT PATTERNS TEST SCREEN

00338VIP

Troubleshooting

If any of the above tests do not perform correctly as described above, perform the applicable procedure below:

Test Failed:

Bit Patterns - If the vertical bars are not straight or if the red border is not completely visible, either the Microboard Program Jumpers are not configured correctly or for the installed display or the Microboard is defective.

All Red, All Green, All Blue, All White or All Black:

If these tests do not produce appropriate solid color screens, the Display Ribbon Cable, Display Interface Board, Microboard or Display could be defective. To locate the defective component perform tests in the following order:

1. Display Ribbon Cable:

Using an Ohmmeter, perform a continuity test on all conductors in the ribbon cable. An open circuit would indicate the ribbon cable is defective.

2. Display Interface Board:

Using an Ohmmeter, perform a continuity test on all conductors of the Interface Board. An open circuit would indicate the Interface Board is defective.

3. Microboard:

- a. With the “All Red” test selected, the voltage at Microboard J5-6 through J5-11 (red drivers

bits 0-5), as measured to GND, should be > 3.0VDC. If not, the Microboard is defective.

- b. With the “All Green” test selected, the voltage at Microboard J5-13 through J5-18 (green drivers bits 0-5), as measured to GND, should be >3.0VDC. If not, the Microboard is defective.
- c. With the “All Blue” test selected, the voltage at Microboard J5-20 through J5-25 (Blue drivers bits 0-5), as measured to Grid, should be >3.0VDC. If not, the Microboard is defective.
- d. With the “All White” test selected, the voltage at Microboard J5-6 through J5-11, J5-13 through J5-18 and J5-20 through J5-25 should be >3.0VDC. If not, the Microboard is defective.
- e. With the “All Black” test selected, the voltage at Microboard J5-6 through J5-11, J5-13 through J5-18 and J5-20 through J5-25 should be <1.0VDC. If not, the Microboard is defective.

4. Display:

If the Display Ribbon Cable, Display Interface Board and Microboard check OK per the above procedures, the display is most likely the cause of the problem.

SERIAL INPUTS / OUTPUTS TESTS

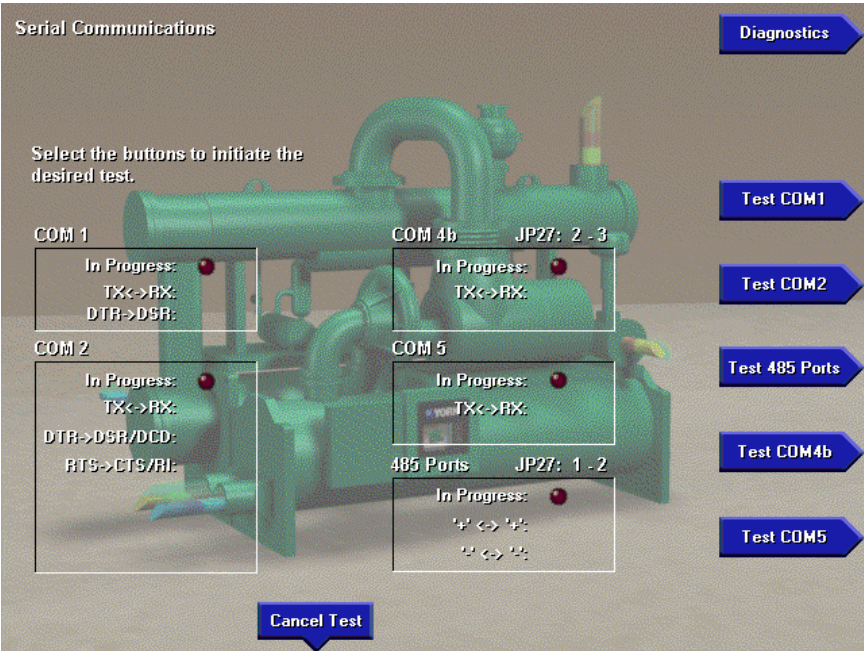


FIGURE 70 - SERIAL INPUTS / OUTPUTS TEST SCREEN

LD09803

This diagnostic is used to verify correct operation of the Serial Data Ports. There is a test for each of the five Serial Data Ports. Each RS-232 port (COM 1, 2 and 4b) is tested by transmitting serial test data from outputs to inputs of each port. Both the transmit and receive functions as well as the control lines are tested. The RS-485 ports (COM 3 and 4a) are tested by transmitting serial test data from one RS-485 port to another. The TX/RX opto-coupled port (COM 5) is tested by transmitting serial test data from the TX output to the RX input. If the received data matches the transmitted data, PASS is displayed, indicating the serial port is OK. Otherwise, FAIL is displayed, indicating the serial port is defective. Prior to performing each test, the Service Technician must install a wire loop-back connection as described below. Refer to SECTION 3 - MICROBOARD 031-02430-004 and Figure 7 on page 40 of this manual for descriptions of the Serial Data Ports.

Procedure

- 1. Using small gauge wire, fabricate loop-back connections and install as follows for each port to be tested. Failure to install the loop-back connection or configure the Microboard Program Jumper as noted will result in a FAIL outcome for the test.

	From	To
COM 1	J2-4 (TX)	J2-3 (RX)
	J2-5 (DTR)	J2-2 (DSR)

	From	To
COM 2	J13-5 (TX)	J13-3 (RX)
	J13-7 (DTR)	J13-1 (DCD) & J13-2 (DSR)
	J13-4 (RTS)	J13-6 (CTS) & J13-8 (RI)

RS-485	From	To
(COM 3 & 4a)	J12-3 (+)	J11-3 (+)
	J12-2 (-)	J11-2 (-)

Microboard Program Jumper JP27 must be installed in position 1 & 2.

	From	To
COM 4b	J2-7 (GTX)	J2-6 (GRX)

Microboard Program Jumper JP27 must be installed in position 2 & 3.

	From	To
COM 5	J15-1 (TX)	J15-4
	J15-2 (RX)	J15-5
	J15-3 (Common)	J15-6

Make individual wire connections or use YORK loop-around diagnostic connector 025-33778-000 as depicted in Figure 71 on page 219 This connector is available from the YORK Parts Distribution Center.

2. After connecting appropriate loop-back connections above, press the appropriate key to initiate the desired test. An LED will illuminate indicating the test is in progress. If it is desired to terminate the test, press the CANCEL TEST key. Test data is sent from an output to an input as described below. At the completion of each test, if the data received matches the data sent, the Serial Port operates properly and PASS is displayed. Otherwise, FAIL is displayed, indicating the Serial Port is defective. A FAIL result would be indicative of a defective Microboard. The following is a description of each test.

COM 1 – Two tests are performed. Test data is sent from TX (J2-4) to RX (J2-3) at 9600 Baud and DTR (J2-5) is set to a logic high level and read at DSR (J2-2). If any test fails, COM 1 tests are terminated.

COM 2 – Three tests are performed. Test data is sent from TX (J13-5) to RX (J13-3) at 19200

Baud. DTR (J13-7) is set to a logic high and read at DSR (J13-2) & DCD (J13-1). RTS (J13-4) is set to a logic high and read at CTS (J13-6) & R1 (J13-8). If any test fails, COM 2 tests are terminated.

RS-485 (COM 3 & 4a) – Test data is sent from COM 3 RS-485 port to COM 4a RS-485 Port at 19200 Baud. Test data is then sent from COM 4a to COM 3 at the same rate. If either test fails, RS-485 tests are terminated.

COM 4b – Test data is sent from GTX (J2-7) to GRX (J2-6) at 19200 Baud.

COM 5 – Test data is sent from TX (J15-1) to J15-4 at 1200 Baud. This output turns the Microboard's loop-around test Transistor on and off, applying 0/+5VDC pulses from J15-5 to RX (J15-2) input.

3. After all desired tests have been performed, press the **DIAGNOSTICS** key to return to the **MAIN DIAGNOSTICS** screen.

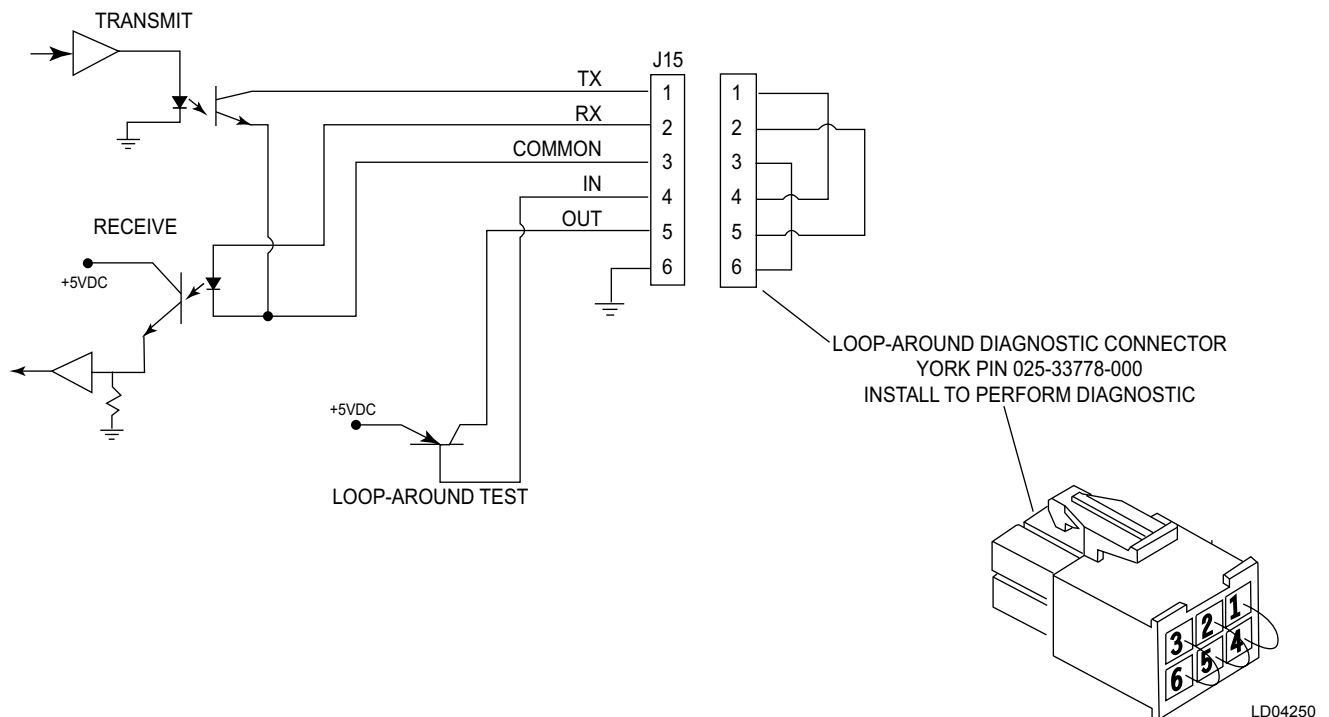


FIGURE 71 - MICROBOARD - COM 5 SERIAL DATA PORT

DIGITAL INPUTS / OUTPUTS TESTS

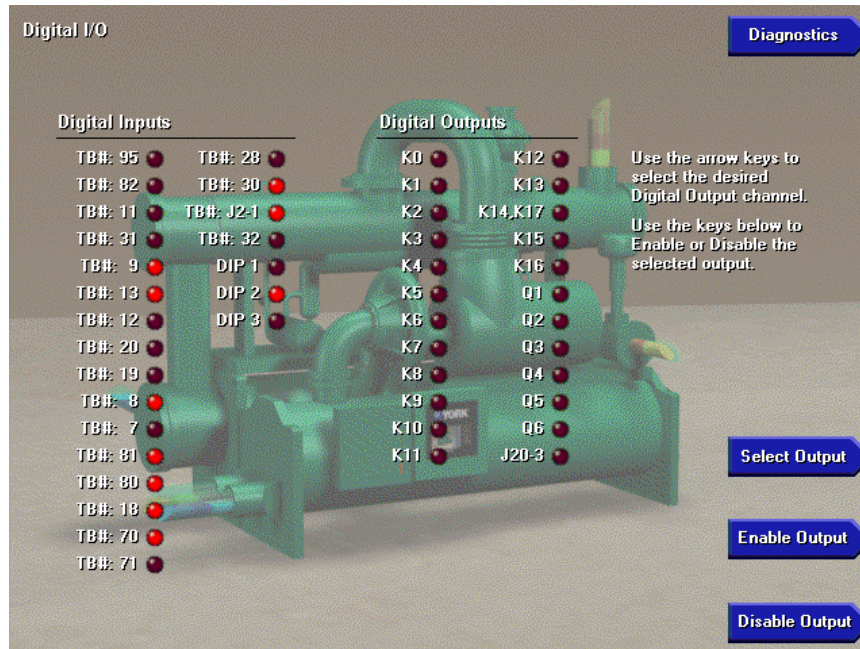


FIGURE 72 - DIGITAL INPUTS / OUTPUTS TEST SCREEN

LD09804

This diagnostic is used to analyze the digital inputs and outputs of the Microboard. *Refer to description of "I/O Board" in SECTION 4 - I/O BOARD of this manual.*

The state of each Microboard digital input, Program Jumper and Program DIP switch, as interpreted by the Microboard, is depicted by an LED. If the Microboard interprets its input as being at a logic low (<1.0VDC) level, the LED is illuminated. If interpreted as being at a logic high (>4.0VDC) level, the LED is extinguished.

The state of the Microboard's intended drive signals to each of the relays on the I/O Board is depicted by an LED. If the intended output is a logic low level (<1.0VDC), the LED is illuminated. If the intended output is a logic high level (>10.0VDC), the LED is extinguished. logic low outputs energize the relays. logic high outputs de-energize the relays. The state of any output can be manually set to either the ENABLED (logic low) or DISABLED (logic high) state.

Procedure

Digital Inputs:

1. The Digital Inputs are listed on this screen according to a.) Terminal number on the I/O Board and b.) Microboard Program DIP switches. The following shows the devices connected to these terminals, and how the program interprets the operation of the input.

DIGITAL INPUTS		
DIGITAL INPUT	DESCRIPTION	OPERATION
95	Vacuum Pump #1 Sealing Water Low Flow Switch	On = Water Flowing Off = No Flow
82	Turbine Auxiliary Oil Pump Contactor Auxiliary Contact	On = Contactor Pulled In Off = Contactor Dropped Out
11	Condenser Liquid Diff. Press. or Paddle Type Flow Switch	On = Liquid Flowing Off = No Flow
31	Auxiliary Safety Shutdown	On = Immediate Shutdown Off = Run Permissive
9	Parallel Motor Drive Subcooler Level Control	On = Parallel DL Control Off = YST Control
13	Remote/Local Cycling Devices (Controlled Shutdown)	Off = Controlled Shutdown On = Initiate Start
12	Chilled Liquid Diff. Press. or Paddle Type Flow Switch	On = Liquid Flowing Off = No Flow
20	Turbine Trip Valve Closed Limit Switch	On = Trip Valve Open Off = Trip Valve Closed

DIGITAL INPUTS		
DIGITAL INPUT	DESCRIPTION	OPERATION
19	Remote Leaving Chilled Water Temperature Control Set Point	PWM Signal
8	Remote Stop (Remote Mode Only)	On = Controlled Shutdown Off = Start Permissive
7	Remote Start (Remote Mode Only)	On = Initiate Start Off = Controlled Shutdown (if TB4-8 is On)
81	Remote Horsepower Limit Setpoint	PWM Signal
80	Hotwell Condensate High Level Switch	On = Normal Level Off = High Level
18	PRV Closed Limit Switch	On = PRV Fully Closed Off = PRV Not Fully Closed
70	VSOP Drive Auto Start Contact	On = VSOP Drive Normal Off = VSOP Drive Fault
71	Turbine Rotating Contact	On = Turbine Rotating Off = Turbine Completely Stopped
28	Panel Rocker Switch - Start	On = Initiate Start Sequence Off = Normal Run or Stop/Reset Condition
30	Panel Rocker Switch - Stop/Reset	On = Immediate Shutdown/Reset Safeties Off = Normal Start/Run Condition
J2-1	Compressor Discharge High Pressure Cutout (Hardwired)	On = Normal Run Condition Off = High Pressure Shutdown
32	Compressor Discharge High Pressure Cutout	On = High Pressure Shutdown Off = Normal Run Condition

DIGITAL INPUTS		
DIGITAL INPUT	DESCRIPTION	OPERATION
SW1-1	Refrigerant Selection	On = R134a Off = R22
SW1-2	Turbine Selection	On = Non-Condensing Off = Condensing
SW1-3	Diagnostics	On = Enable Diagnostics/Disable Chiller Operation Off = Disable Diagnostics/Enable Chiller Operation

2. With 115 VAC applied to a particular I/O Board Digital Input, the applicable LED should be illuminated. If the LED is not illuminated, perform appropriate troubleshooting procedure below.
3. With 0VAC applied to a particular I/O Board Digital Input, the applicable LED should be extinguished. If the LED is not extinguished, perform the following, appropriate troubleshooting procedure.
4. If a Program switch (SW1-3) is in the ON position, the applicable LED should be illuminated. If the LED is not illuminated, the Microboard is defective.
5. If the Diagnostics switch (SW1-3) is in the OFF position, the applicable LED should be extinguished. If the LED is not extinguished, the Microboard is defective.
6. When all desired tests have been performed, press **DIAGNOSTICS** key to return to **MAIN DIAGNOSTICS** screen.

Digital Outputs:

1. **IMPORTANT!** - The following steps cannot be performed until the Microboard program switch SW1-3 is in the ON position. The program will prevent "Manual" control of digital input devices until this connection is removed.
2. The Digital Outputs are listed on this screen according to relay and triac number (K1, Q3, etc). The following shows the external devices that are connected to these relays/triacs, the output terminal numbers, and the intended operation of the output device.

DIGITAL OUTPUTS			
DIGITAL INPUT	TERMINAL NUMBERS	DESCRIPTION	OPERATION
K0	TB2-44 & 45	Chilled Water Pump Start Contacts	On = Start Pump
K1	TB2-55 & 56	Anticipatory Alarm Contacts	On = System Trouble
K2	TB2-26 & 27	Remote Mode Ready to Start Contacts (Remote Mode Only)	On = Remote mode is selected & chiller is ready to be started.
K3	TB2-42 & 43	Safety Shutdown Alarm Contacts	On = System Safety Shutdown
K4	TB2-40 & 41	Cycling Shutdown Contacts	On = Cycling Shutdown Condition Exists / Start Inhibited Off = Restart Permitted
K5	TB2-150 & 151	Condenser Water Pump Start Contacts	On = Start Pump
K6	TB2-152 & 153	Turbine Auxiliary Oil Pump Contactor	On = Start Motor
K7	TB2-154 & 155	Hotwell Pump #1 Contactor	On = Start Motor
K8	TB2-156 & 157	Vacuum Pump #1 Contactor	On = Start Motor
K9	TB1-1 & 165	Vacuum Pump #1 Sealing Water Solenoid Valve	On = Open Valve
K10	TB1-17 & 64	Vent Line Solenoid (Style C and earlier chillers only)	On = Open Valve
K11	TB1-1 & 29	Compressor Oil Pump Starter (Style C and earlier chillers only)	On = Start Pump
K12	TB1-1 & 61	Compressor Oil Return and Liquid Injection Solenoid Valves	On = Open Valves
K13		Starting Relay	On = Start Initiated (Momentary 0.2 Seconds)
K14, K17		Stop Relay	On = Starting & Running Off = Shutdown
K15	TB1-1 & 34	Compressor Oil Heater Contactor (M1)	On = Energize Heater

DIGITAL OUTPUTS			
DIGITAL INPUT	TERMINAL NUMBERS	DESCRIPTION	OPERATION
K16	TB1-1 & 62	Compressor High Speed Thrust Solenoid (Style C and earlier chillers only)	On = Open Valve
Q1	TB1-59 & 3	PRV Actuator Open Winding	On = Open PRV
Q2	TB1-59 & 58	PRV Actuator Close Winding	On = Close PRV
Q3	TB1-159 & 158	VGD Actuator Open Winding	On = Retract VGD (Open Diffuser Gap)
Q4	TB1-159 & 160	VGD Actuator Close Winding	On = Extend VGD (Close Diffuser Gap)
Q5	TB1-162 & 163	Not Used	
Q6	TB1-162 & 161	Not Used	
J20-3	J20-3	VSOP Drive Start Signal	On = Start Pump

- Press **SELECT** key. An arrow will appear adjacent to relay KO.
- Select a relay or triac for “Manual” control by using the ▲ and ▼ keys to place the arrow adjacent to the desired device.
- Press the **ENABLE OUTPUT** key to enable the selected output. The LED adjacent to the selected output should illuminate. If it does not, perform Keypad Diagnostics test. If a relay is selected, it should energize, closing its contacts. If a triac is selected, it will turn on, energizing the device it is connected to. If the relay does not energize or triac does not turn on, perform appropriate troubleshooting procedure below.
- Press the **DISABLE OUTPUT** key to disable the selected output. The LED adjacent to the selected output should extinguish. If it does not, perform keypad diagnostic test. If a relay is selected, it should de-energize, opening its contacts. If a triac is selected, it will turn off, de-energizing the device it is connected to. If relay does not de-energize or triac does not turn off, perform appropriate troubleshooting procedure below.
- When all desired tests have been performed, press **DIAGNOSTICS** key to return to the **MAIN DIAGNOSTICS** screen.

8. Install the jumper connection from TB6-16 to TB6-53 removed in step 1 and place the Microboard program switch (SW1-3) in the OFF position.

Digital Inputs Troubleshooting:

If any of the digital inputs tests fail to perform as described above, perform the following steps in sequence. Refer to Figure 11 on page 48 and applicable wiring diagram referenced at the beginning of this Section. If a defective component is found during any of the following steps, replace the component as instructed and repeat the digital inputs procedure above to determine if the problem has been resolved.

1. Remove I/O Board ribbon cable. Using an Ohmmeter, perform a continuity check on I/O Board ribbon cable J1-21 to J19-21, J1-22 to J19-22 and applicable output pin of function that failed in procedure above. If an open circuit is detected, replace ribbon cable. Otherwise, install ribbon cable and proceed to next step.
2. Measure the +5VDC supply voltage to the I/O Board on I/O Board between J1-21 and J1-22. If >4.5VDC, proceed to next step. If < 4.5VDC, disconnect ribbon cable at I/O Board J1 and repeat the measurement at J1. If <4.5VDC, replace the Microboard. Re-install the ribbon cable.
3. With 115 VAC ($\pm 10\%$) applied to the I/O Board Digital Input that failed in procedure above, the applicable I/O Board output at J1 should be at a logic low level (<1.0VDC). If it is >1.0VDC, replace the I/O Board. If the output is at a logic low level, the applicable LED should be illuminated. If the LED is not illuminated, replace the Microboard.
4. With 0VAC applied to the I/O Board Digital Input that failed in procedure above, the applicable I/O Board output at J1 should be at a logic high level (>4.0VDC). If it is <4.0VDC, replace the I/O Board. If the output is at a logic high level, the applicable LED should be extinguished. If it is not extinguished, replace the Microboard.

Digital Outputs Troubleshooting:

If any of the digital input tests fail to perform as described above, perform the following steps in sequence. Refer to Figure 14 on page 50 and applicable wiring diagram referenced at the beginning of this Section. If a defective component is found during any of the steps, replace the component as instructed and repeat the procedure above to determine if the problem has been resolved.

1. Remove I/O Board ribbon cable. Using an Ohmmeter, perform a continuity test on the Cable J1-25 to J19-25, J1-26 to J19-26 and applicable output pin of function that failed in procedure above. If an open circuit is detected, replace ribbon cable. Otherwise, install ribbon cable and proceed to next step.
2. Measure the +12VDC supply voltage to the I/O Board on I/O Board between J1-26 (+12VDC) and J1-25 (GND). If >11.0VDC, proceed to next step. If <11.0VDC, disconnect ribbon cable at I/O Board J1 and repeat measurement at J1. If <11.0VDC, replace the Microboard. Re-install the ribbon cable.
3. Using the digital inputs procedure above, select the output that failed the digital Output test above.
4. Press **ENABLE OUTPUT** key. The LED adjacent to the selected output will illuminate. The appropriate Microboard output pin at J19 for the selected output should be at a logic low level (<1.0VDC). If it is >1.0VDC, replace the Microboard. With the output at a logic low, the following should occur:
 - a. If a relay is selected as the output, the contacts of the relay should be closed. If they are not closed, replace the I/O Board.
 - b. If a triac is selected as the output, the triac should be turned on. If the triac has not turned on, replace the I/O Board. See note 1 below for triac testing.

5. Press **DISABLE OUTPUT** key. The LED adjacent to the selected output will extinguish.

- a. If a relay is selected as the output, the appropriate Microboard output pin at J19 for the selected output should be at a logic high (>10.0VDC) level. With the output at a logic high level, the relay contacts should be open. If they are not open, replace the I/O Board. If it is <10.0VDC, remove the ribbon cable from J1 of the I/O Board. On the I/O Board, measure the resistance from J1-26 to the appropriate pin of J1 on the I/O Board for the selected relay. If the resistance is >100 Ohms, replace the I/O Board. If the resistance is <100 Ohms, replace the Microboard.
- b. If a triac is selected as the output, the appropriate Microboard output pin at J19 for the selected output should be at a logic high (>10.0VDC) level. If it is <10.0VDC, replace the Microboard. With the output at a logic high level, the triac should be turned off. If the triac has not turned off, replace the I/O Board. See note 1 below for triac testing.

Notes:

1. The load (actuator) must be connected across the triac to determine the on/off state of the triac. The on/off state of the triac can be determined by measuring across the device (for example, TB1-3 to TB1-59 or TB1-58 to TB1-59) with an AC voltmeter. If the triac is turned on, the voltage will be <10VAC. If the triac is turned off, the voltage will be >20VAC (PRV or VGD actuator).

ANALOG INPUTS TESTS

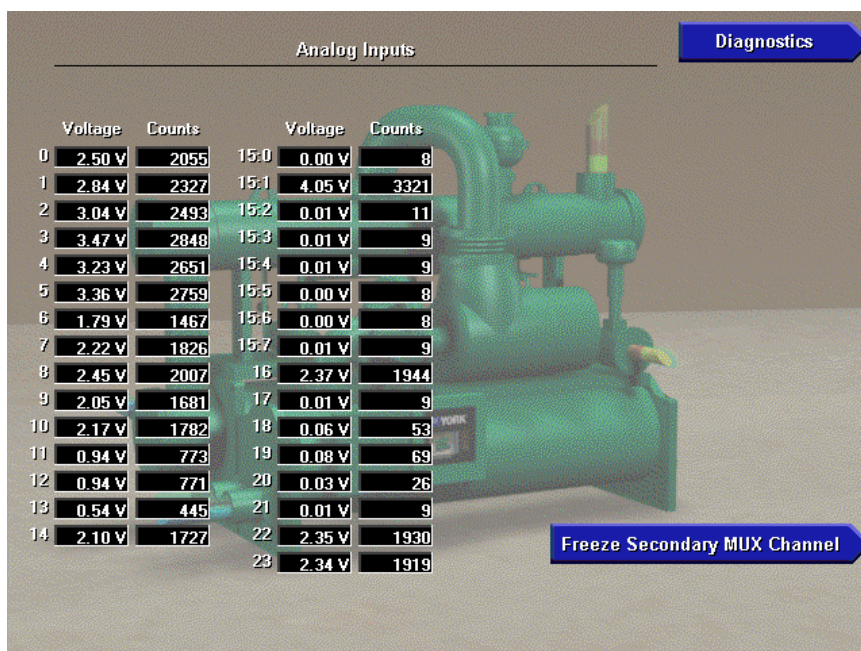


FIGURE 73 - ANALOG INPUTS TEST SCREEN

LD09805

This diagnostic is used to analyze the analog inputs to the Microboard. The voltage level of each analog input, as interpreted by the Microboard, is displayed. The “Counts” listed for each parameter is the Analog-to-Digital (A/D) converter value and is for manufacturing and engineering use only.

If the chiller is shutting down on an Analog Safety or is prevented from starting because of an analog input, there is probably an analog input problem. This screen can be used in the investigation of this problem.

Important! This test does not apply to the Leaving Chilled Liquid Temperature Analog Input, Proximity Probe DC Voltage reference or a 0-10VDC Remote Setpoint input at channels 27 and 28.

The following is a list of the Analog Inputs displayed. *Refer to the appropriate section of this manual for an explanation of each: SECTION 18 - PRESSURE TRANSDUCERS, SECTION 19 - TEMPERATURE THERMISTORS, SECTION 13 - COMPRESSOR PROXIMITY PROBE, SECTION 14 - COMPRESSOR HIGH SPEED THRUST BEARING LIMIT SWITCH, SECTION 15 - REFRIGERANT LEVEL CONTROL.* The Microboard jack-pin connection point for the input signal is shown in ().

Channel

- 0 - +2.5VDC Analog Supply Voltage Reference. Microboard TP6.
- 1 - Leaving Chilled Liquid Temperature
- 2 - Return Chilled Liquid Temperature (J9-9)
- 3 - Leaving Condenser Liquid Temperature (J9-8)
- 4 - Return Condenser Liquid Temperature (J9-7)
- 5 - Drop Leg Refrigerant Temperature (J9-6)
- 6 - Compressor Discharge Temperature (J9-5)
- 7 - Compressor Oil Temperature (J9-4)
- 8 - Evaporator Refrigerant Temperature (J9-3)
- 9 - Condenser Pressure (J8-21)
- 10 - Evaporator Pressure (J8-18)
- 11 - Compressor Sump Oil Pressure (J9-1)
- 12 - Compressor Pump Oil Pressure (J8-6)
- 13 - Compressor Proximity Probe DC Voltage Reference (J9-12)
- 14 - Compressor Proximity Probe Position (J8-15)

- 15:0 - Not Used
- 15:1 - Not Used
- 15:2 - Not Used
- 15:3 - Not Used
- 15:4 - Not Used
- 15:5 - Not Used
- 15:6 - Not Used
- 15:7 - Not Used
- 16 - Subcooler Refrigerant Liquid Level (J8-13)
- 17 - Not Used (J8-1)
- 18 - Stall Detector Board Output (chillers equipped with Variable Geometry Diffuser only) (J7-23)
- 19 - Not Used (J7-10)
- 20 - Remote Leaving Chilled Liquid Temperature Setpoint, 0-10V (J22-3) or 4-20mA (J22-4)
- 21 - Remote Horsepower Limit Setpoint, 0-10V (J22-1) or 4-20mA (J22-2)
- 22 - Condenser flow sensor (Style "F" and later chillers) (J7-16)
- 23 - Evaporator flow sensor (Style "F" and later chillers) (J7-14)

Procedure

- From the chart above, select the analog input that is malfunctioning. All inputs except channel 0, 15 through 22, 27 and 28 are sensors that connect directly to the Microboard via shielded cable. Channel 0 is a reference voltage for the Analog circuits on the Microboard. Channels 15:0 through 15:7 are multiplexed outputs which are not used on YST chillers. Channels 20 and 21 are Remote Setpoint inputs used in Analog Remote mode.
- Refer to wiring diagrams listed in front of this Section to identify the device that performs this function and the jack and pin connection to the Microboard.

3. • Channel 0:

Using a voltmeter, measure the voltage between Microboard TP6 (+2.5VDC) and TP1 (GND).

Compare this measured value to the displayed value. If the value is not within $\pm 10\%$, replace the Microboard.

• All channels except 0, 1:

Using a voltmeter, measure the analog input to the Microboard. Make the measurement between the device output and ground connection to the device. For example, measure the output of the Evaporator Transducer at Microboard J8-18 (signal) to J8-9 (GND).

• Channel 20:

IMPORTANT! This procedure only applies to a 4-20mA input. It does not apply to a 0-10VDC input. Using a voltmeter, measure the Remote Leaving Chilled Liquid Temperature setpoint input at J22-4 (signal) to J22-5 (GND).

- Compare the measured value in the previous step with the value displayed on the analog inputs screen for that value.
- If the measured value is not within $\pm 15\%$ of the displayed value, replace the Microboard. Otherwise, proceed to the troubleshooting procedure below to find the cause of the problem.
- When all desired tests have been performed, press **DIAGNOSTICS** key to return the **MAIN DIAGNOSTICS** screen.

Troubleshooting

• All Channels except 0, 1, 20, 21:

- Disconnect both ends of the cable of the analog input that is malfunctioning. Using an Ohmmeter, perform a continuity test on all conductors in the cable. An open circuit would indicate the cable is defective.
- Using a voltmeter, measure the +12VDC supply voltage input at the Microboard J1-3 (+12VDC) to J1-2 (GND). If voltage is $< 11.5\text{VDC}$, check wiring to Power Supply. If wiring is OK, the power supply is most likely defective.

3. Using a voltmeter, measure the supply voltage (+5VDC, +12VDC or +24VDC) to the sensor. If voltage is not within $\pm 10\%$ of specified voltage, disconnect J7, J8 and J9 from the Microboard. This disconnects all analog devices from the Microboard. If the voltage increases to the correct level, a Thermistor or Transducer is shorted. Locate the shorted device and replace. If, after disconnecting the connectors the supply voltage is still not within 10% of the specified value, the voltage supply source (Microboard or Power Supply) is most likely defective.
4. Verify sensor accuracy using appropriate test device. Replace sensor if necessary.

• **Channels 20, 21:**

1. Refer to Table 1 "Microboard Program Jumpers" and verify Program Jumpers JP23 and JP24 are configured correctly for the type of input (0-10VDC or 4-20mA).
2. Disconnect both ends of the cable of the remote input that is malfunctioning. Using an Ohmmeter, perform a continuity check on all conductors in the cable. An open circuit would indicate the cable is defective.
3. If steps are OK, problem most likely is in the remote device that supplies the remote signal.

DIGITAL I/O EXPANSION TESTS

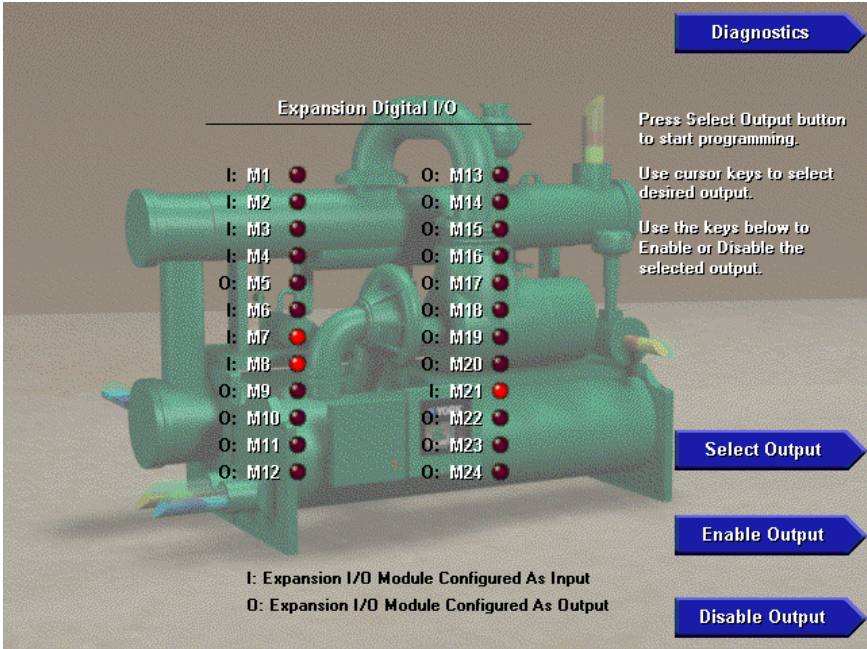


FIGURE 74 - DIGITAL I/O EXPANSION TEST SCREEN

LD09806

This diagnostic is used to analyze the digital inputs and outputs of the Microboard that pass through the Digital I/O Expansion Board. Refer to description of the “Digital I/O Expansion Board” in SECTION 12 - DIGITAL I/O EXPANSION BOARD 371-04182-000 of this manual.

This board has 24 ports (M1 through M24) that can accommodate up to 24 DC voltage or AC voltage inputs and outputs. The board is populated with up to 24 replaceable modules in locations M1 through M24. The module type required in each location is determined by the port function. There are AC or DC input modules and AC or DC Output Modules. There are different voltage ranges that can be accepted, depending on the module installed. For the YST Chiller, only 120 VAC Input and Output modules are used.

The state of each input or output is represented on this screen by LED’s M1 through M24. Each LED is pre-fixed with I or O, indicating input or output as applicable. For inputs, the LED illuminates and extinguishes with the presence or absence of the input voltage. For outputs, the LED illuminates when the Microboard sends a command to turn on the output. It’s extinguished when the Microboard commands the output to be off.

The following shows the devices connected to this board at the plug-pin shown, how the program interprets the operation of the inputs, and the intended operation of the output devices:

Digital I/O

DIGITAL EXPANSION INPUTS/OUTPUTS			
DIGITAL INPUT/ OUTPUT	PLUG-PIN NUMBER	DESCRIPTION	OPERATION
I:M1	P1-2	Hotwell Pump #1 Contactor Auxiliary Contact	On = Contactor Pulled In Off = Contactor Dropped Out
I:M2	P1-2	Hotwell Pump #2 Contactor Auxiliary Contact (Optional)	On = Contactor Pulled In Off = Contactor Dropped Out
I:M3	P1-5	Vacuum Pump #1 Contactor Auxiliary Contact	On = Contactor Pulled In Off = Contactor Dropped Out
I:M4	P1-6	Vacuum Pump #2 Contactor Auxiliary Contact (Optional)	On = Contactor Pulled In Off = Contactor Dropped Out
O:M5	P2-1	Vacuum Pump #2 Sealing Water Solenoid Valve (Optional)	On = Open Valve

DIGITAL EXPANSION INPUTS/OUTPUTS			
DIGITAL INPUT/OUTPUT	PLUG-PIN NUMBER	DESCRIPTION	OPERATION
I:M6	P2-2	Vacuum Pump #2 Sealing Water Low Flow Switch (Optional)	On = Water Flowing Off = No Flow
I:M7	P2-5	VGD Actuator Limit Switch	On = VGD Fully Closed Off = VGD Partially Open
I:M8	P2-6	Hotwell Condensate Low Level Switch	On = Normal Level Off = Low Level
O:M9	P3-1	Hotwell Pump #2 Contactor (Optional)	On = Start Motor
O:M10	P3-2	Vacuum Pump #2 Contactor (Optional)	On = Start Motor
O:M11	P3-5	Alarm Horn on Power Panel	On = Sound Horn
O:M12	P3-6	Ejector Steam Supply Valve Actuator (Optional/Auto Start)	On = Open Valve
O:M13	P4-1	Turbine Nozzle Valve #1 Air Dump Solenoid Valve (Optional/Auto Start)	On = Open Valve
O:M14	P4-2	Turbine Nozzle Valve #2 Air Dump Solenoid Valve (Optional/Auto Start)	On = Open Valve
O:M15	P4-5	Turbine Oil Cooler Liquid Actuator Valve	On = Open Valve
O:M16	P4-6	Compressor Oil Cooler Liquid Valve Actuator	On = Open Valve
O:M17	P5-1	Main Steam Inlet Block Valve Air Dump Solenoid Valve (Optional/Auto Start)	On = Open Valve
O:M18	P5-2	Not Used	
O:M19	P5-5	Steam Inlet Slow Roll Bypass Solenoid Valve (Optional/Auto Start)	On = Open Valve
O:M20	P5-6	Turbine Steam Ring Drain Solenoid Valve	On - Open Valve
I:M21	P6-1	Turbine Condensate Drain Tank High Level Switch	On = Normal Level Off = High Level

DIGITAL EXPANSION INPUTS/OUTPUTS			
DIGITAL INPUT/OUTPUT	PLUG-PIN NUMBER	DESCRIPTION	OPERATION
O:M22	P6-2	Configurable Digital Output A (Selectable in Service Mode)	
O:M23	P6-5	Configurable Digital Output B (Selectable in Service Mode)	
O:M24	P6-6	Configurable Digital Output C (Selectable in Service Mode)	

Digital Inputs

With the input voltage present, the applicable LED (M1 through M24) on the diagnostic screen above should be illuminated. With the input voltage not present, the LED should be extinguished. If the LED does not operate correctly, perform the General Checks below. If that procedure does not solve problem, perform the following steps:

1. Check applicable fuse (F1 through F24) on board. Remove and install in fuse tester position on board. LED D27 will illuminate if fuse is OK. Replace defective fuse if necessary.
2. Check wiring to applicable input. Correct is necessary.
3. If above steps have not solved problem, replace applicable digital input module.

Digital Outputs

When the Microboard is commanding a particular output to be ON, the applicable LED (M1 through M24) on the diagnostic screen above should be illuminated and the output voltage should be as described below. When the Microboard is commanding the output to be OFF, the LED should be extinguished and the output voltage should transition as described below.

The correct voltage levels for the outputs are as follows:

OUTPUT	MEASURED	OUTPUT ON	OUTPUT OFF
O:M5	P2-1(+) to P2-3(-)	<10Vac	120 VAC (nominal)
O:M9	P3-1(+) to P3-3(-)	<10Vac	120 VAC (nominal)
O:M10	P3-2(+) to P3-3(-)	<10Vac	120 VAC (nominal)
O:M11	P3-5(+) to P3-3(-)	<10Vac	120 VAC (nominal)

OUTPUT	MEASURED	OUTPUT ON	OUTPUT OFF
O:M12	P3-6(+) to P3-3(-)	<10Vac	120 VAC (nominal)
O:M13	P4-1(+) to P4-3(-)	<10Vac	120 VAC (nominal)
O:M14	P4-2(+) to P4-3(-)	<10Vac	120 VAC (nominal)
O:M15	P4-5(+) to P4-3(-)	<10Vac	120 VAC (nominal)
O:M16	P4-6(+) to P4-3(-)	<10Vac	120 VAC (nominal)
O:M17	P5-1(+) to P5-3(-)	<10Vac	120 VAC (nominal)
O:M18	P5-2(+) to P5-3(-)	<10Vac	120 VAC (nominal)
O:M19	P5-5(+) to P5-3(-)	<10Vac	120 VAC (nominal)
O:M20	P5-6(+) to P5-3(-)	<10Vac	120 VAC (nominal)
O:M22	P6-2(+) to P6-3(-)	<10Vac	120 VAC (nominal)
O:M23	P6-5(+) to P6-3(-)	<10Vac	120 VAC (nominal)
O:M24	P6-6(+) to P6-3(-)	<10Vac	120 VAC (nominal)

For testing, a selected output can be manually turned on or off using keypad keys as follows:

1. Press the SELECT OUTPUT key. A green box is placed around the first selectable output.
2. Use ◀ ▶ ▲ ▼ keys to place the box around the desired output.
3. Press ENABLE OUTPUT key to turn on the output. The LED should illuminate and the applicable output voltage should transition to correct level per the above.
4. Press DISABLE OUTPUT to turn off output. The LED should extinguish and the output voltage should transition to correct level per the above.

If the LED or the output does not operate correctly, perform the General Checks below. If that procedure does not solve problem, perform the following steps:

1. Check applicable fuse (F1 through F24) on board. Remove and install in fuse tester position on board. LED 27 will illuminate if fuse is OK. Replace defective fuse if necessary.
2. Check wiring to applicable output. Correct if necessary.
3. If above steps have not solved problem, replace applicable digital input module.

When all desired tests have been performed, press DIAGNOSTICS key to return to MAIN DIAGNOSTICS screen.

General Checks

(Refer to SECTION 12 - DIGITAL I/O EXPANSION BOARD 371-04182-000 for the following)

Perform in the following order:

1. Confirm fuses F1 through F24 (as applicable) are in the correct positions. If not, install in correct position.
2. Confirm the correct input or output module is installed in appropriate location (M1 through M24). If not, install correct module.
3. Confirm Communications Jumpers J5, J7 and J9 are configured correctly.
4. Confirm EPROM is installed correctly in socket U8. The notch should be toward connector P7.
5. Confirm DP1 Board Identification Number dipswitch settings are correct.
6. Confirm Power-on LED (D29) is illuminated. This LED illuminates when +5VDC power is applied to the board. If not illuminated, measure the +5VDC input to board at P7-16. If OK, replace the Digital I/O Expansion Board. Otherwise, trace the power source back to Analog I/O Expansion Board connector P3-8 to find cause of problem.
7. Confirm Watchdog "ACTIVE" LED D28 blinks at approximately once/second. If not, replace Digital I/O Expansion Board.
8. Confirm I/O Communication Activity LED's D25 (TX) and D26 (RX) blink rapidly. D26 (RX) illuminates when a command or request for data is received from the Microboard. D25 (TX) illuminates when data is returned to the Microboard. If either or both do not illuminate, check wiring to P7-11/12 from the Analog I/O Expansion Board P3-3 and P3-4. If wiring is OK, refer to SERIAL I/O TESTS and perform COM 3 test. If it passes, replace the Digital I/O Expansion Board. Otherwise, replace the Microboard.
9. In every location that has an input or output module installed, the corresponding LED (D1 through D24) must be illuminated. If LED is not illuminated, first confirm the module is seated properly and if this does not cause it to illuminate, replace module.

ANALOG I/O EXPANSION TESTS

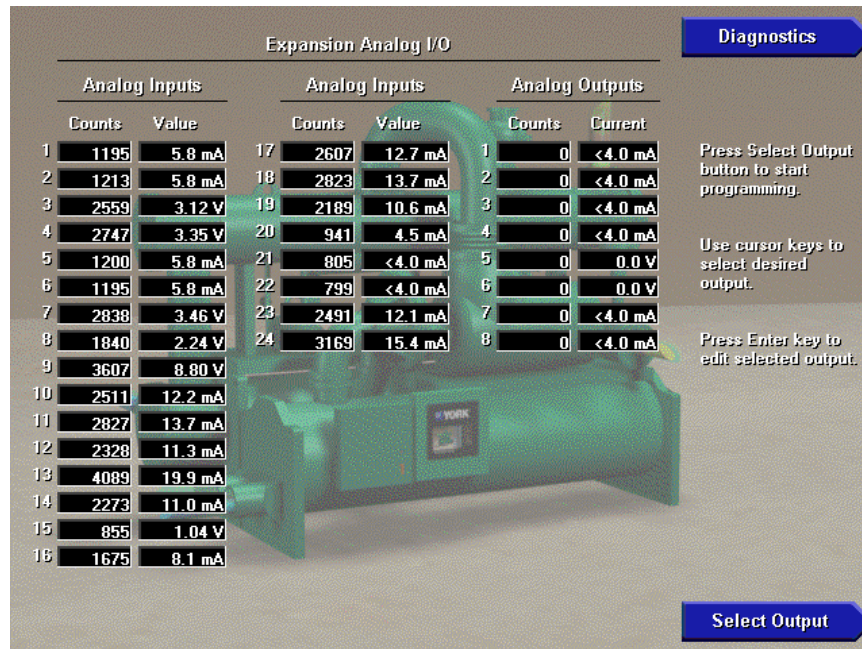


FIGURE 75 - ANALOG I/O EXPANSION TEST SCREEN

LD09807

This diagnostic is used to analyze the analog inputs and outputs of the Microboard that pass through the Analog I/O Expansion Board. Refer to the description of the “Analog I/O Expansion Board” in SECTION 10 - ANALOG I/O EXPANSION BOARD 031-02472-000 of this manual.

This board has 24 input ports and 8 output ports. The inputs are 4-20 mA current signals or DC voltage levels. The outputs are either 4-20 mA or 0-10VDC.

The “Counts” listed for each parameter is the Analog-to-Digital (A/D) Converter.

Press DIAGNOSTICS key to return to MAIN DIAGNOSTICS screen.

The following is a list of Analog Inputs displayed. The calibrated range for the input signal is also shown. Refer to SECTION 11 - TURBINE INSTRUMENTATION “Turbine Instrumentation” for detailed information on the devices used. The Plug-Pin number for the input signal is also shown.

Analog Inputs

ANALOG EXPANSION INPUTS			
ANALOG INPUTS	DESCRIPTION	PLUG-PIN NUMBERS	OPERATION/RANGE
1	Turbine Shaft End Horizontal Vibration Transmitter (Optional/Auto start)	P4A-2	4 mA = 0 Mils 20 mA = 5 Mils
2	Turbine Shaft End Vertical Vibration Transmitter (Optional/Auto Start)	P4A-5	4 mA = 0 Mils 20 mA = 5 Mils
3	Turbine Supply Oil Temp. Transmitter	P4B-2	4 mA = 32° F 20 mA = 302° F
4	Turbine Shaft End Brg Temp. Transmitter	P4B-5	4 mA = 32° F 20 mA = 302° F
5	Turbine Governor End Horizontal Vibration Transmitter (Optional/Auto Start)	P5A-2	4 mA = 0 Mils 20 mA = 5 Mils
6	Turbine Governor End Vertical Vibration Transmitter (Optional/Auto Start)	P5A-5	4 mA = 0 Mils 20 mA = 5 Mils
7	Turbine Gov. End Brg Temp. Transmitter	P5B-2	4 mA = 32° F 20 mA = 302° F

ANALOG EXPANSION INPUTS			
ANALOG INPUTS	DESCRIPTION	PLUG-PIN NUMBERS	OPERATION/RANGE
8	Turbine Inlet Steam Temp. Transmitter	P5B-5	4 mA = 32° F 20 mA = 842° F
9	Main Steam Inlet Block Valve Closed Limit Switch (Optional/Auto Start)	P6A-2	0 mA = Valve Fully Closed 20 mA = Valve Not Fully Closed
10	Compressor Horizontal Vibration Transmitter (Optional)	P6A-5	4 mA = 0 in/sec 20 mA = 2 in/sec
11	Turbine Supply Oil Pressure Transmitter	P6B-2	4 mA = 0 PSIG 20 mA = 30 PSIG
12	Turbine Inlet Steam Pressure Transmitter	P6B-5	4 mA = 0 PSIG 20 mA = 300 PSIG
13	Compressor Vertical Vibration Transmitter (Optional)	P7A-2	4 mA = 0 in/sec 20 mA = 2 in/sec
14	Compressor Thrust Switch (All Except "J")	P7A-5	0mA = Switch Open 20mA = Switch Closed
15	PRV Position Feedback Potentiometer	P7B-2	0.3-0.7 VDC=0% PRV Fully Closed Auto Calibration VDC = 100 % PRV Fully Open
16	Chilled Liquid Flow Transmitter (Optional, Supplied by Others)	P7B-5	4 mA = 0 GPM 20 mA = 6000 GPM **
17	Cond Wtr Flow Transmitter (Optional, Supplied by Others)	P9A-2	4 mA = 0 GPM 20 mA = 8000 GPM **
18	Steam Flow Transmitter (Optional, Supplied by Others)	P9A-5	4 mA = 0 LB/HR 20 mA = 24000 LB/HR **
19	Turbine First Stage Press. Transmitter	P9B-2	4 mA = 0 PSIG 20 mA = 100 PSIG *

ANALOG EXPANSION INPUTS			
ANALOG INPUTS	DESCRIPTION	PLUG-PIN NUMBERS	OPERATION/RANGE
20	Turbine Exhaust Steam Pressure Transmitter*	P9B-5	4 mA = 0 PSIA 20 mA = 45 PSIA
21	Turbine Speed (Frequency to Analog Converter) #1	P10A-2	4 mA = 0 RPM 20 mA = 5000 RPM
22	Turbine Speed (Frequency to Analog Converter) #2	P10A-5	4 mA = 0 RPM 20 mA = 5000 RPM
23	Hotwell Condensate Level	P10B-2	4 mA = 0% Level 20 mA = 100% Level
24	Steam Cond. WTR Outlet Transmitter	P10B-5	4 mA = 30°F 20 mA = 150°F

* For non-condensing turbines, the range is 20 mA = 150 PSIG.

** Default Range shown. Refer to Form 160.67-O1 for Programmable Range

If an Analog Voltage Input is malfunctioning, measure the input (referenced to GND.) with a digital multimeter. If an Analog Current Input is malfunctioning, remove the Input wire and measure the current by connecting the positive (+) lead of the meter to the Input wire, and connect the negative (-) lead of the meter to the Input terminal shown above. The measured voltage/current should be within + 10% of the value expected at the present conditions as measured by a separate calibrated device. If not, troubleshoot cause of the problem and correct the input.

Trouble Shooting Faulty Speed Inputs

- Swap the MPU#1 and MPU#2 cables at the turbine. If the problem moves, the MPU is faulty. If the problem does not move, the converter is faulty.
- Check that the 120 VAC power supply is present and that all daisy chained power supply wiring is intact.
- Verify that the cable wiring is intact by using an ohmmeter to check continuity from the MPU connector to the converter in the turbine box.
- Verify that cable shields are intact and connected per the wiring diagram.

- Verify that all DIP switches on converter are in the correct positions for normal operation (*see SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES, "Frequency to Analog Converter Calibration"*).

Trouble Shooting Resistance Temperature Sensors and Transmitters

- Connect the suspect input sensor to the adjacent transmitter in the turbine box. If the problem moves, the RTD is faulty. If the problem does not move, the transmitter is faulty.
- Check the displayed value on the control center screen. If the value is at the upper range limit of the transmitter, the RTD sensor or wiring is open
- Check that the +24 VDC power supply (taken directly from the control center power supply via terminal TB7-313) is present and that all daisy chained power supply wiring is intact.
- Verify that the cable wiring is intact by using an ohmmeter to check continuity from the sensor connector to the transmitter in the turbine box. With the sensor connected at the turbine end, measure the resistance between the white and black wires at the turbine box. The meter should show 0 (or minimal) Ohm. Measure the resistance between the black and red wires at the turbine box. The meter should show the resistance at the present temperature of the sensor *per the "RTD Temperature vs. Resistance In Ohms" Table in SECTION 11 - TURBINE INSTRUMENTATION of this manual.*
- Verify that cable shields are intact and connected per the wiring diagram.
- Verify that all DIP switches on the transmitter are in the correct positions for normal operation (*see SECTION 25 - SYSTEM CALIBRATION, SERVICE SETPOINTS AND RESET PROCEDURES – "RTD Temperature Transmitter Calibration"*).

Trouble Shooting Shaft Vibration Probes and Transmitters

- Swap the Horizontal and Vertical probe cables at the turbine. If the problem moves, the probe is faulty. If the problem does not move, the transmitter is faulty.
- Check that the +24 VDC power supply (taken directly from the control center power supply via terminal TB7-313) is present and that all daisy chained power supply wiring is intact.
- Verify that the cable wiring is intact by using an ohmmeter to check continuity from the probe connector to the transmitter in the turbine box.
- Verify that the locknuts holding the probe in place on the turbine are tight. If not the probe gap will need to be readjusted. Set the probe gap at 50 mils by turning the probe all the way in to contact the shaft and then backing out approximately 1 turn. Connect the probe to the extension cable. Connect the black lead of the voltmeter to the COM terminal of the transmitter and the red (+) lead of the voltmeter to the GAP terminal of the transmitter. Slowly turn the probe until the meter reads 10.0 VDC and then tighten both locknuts on the probe.

If all external devices are determined to be functioning correctly but the displayed value is not correct, perform the General Checks listed at the end of this section. If the problem is not revealed in the General Checks, the most likely problem is the Analog I/O Expansion Board.

Analog Outputs

ANALOG EXPANSION OUTPUTS			
ANALOG OUTPUTS	DESCRIPTION	PLUG-PIN NUMBERS	OPERATION/RANGE
1	Main Steam Inlet Block Valve I/P Transducer (Optional/Auto Start)	P11A-1	4 mA = Valve Fully Closed 20 mA = Valve Fully Open
2	Configurable Analog Output A (Selectable in Service Mode)	P11A-3	See Form 160.67-O1 for Options
3	Slow Roll Bypass Valve I/P Transducer (Optional/Auto Start)	P11A-5	4 mA = Valve Fully Closed 20 mA = Valve Fully Open
4	Tachometer on Gauge Board	P11A-7	4 mA = 0 RPM 20mA = 5000 RPM
5	Hot Gas Bypass Valve Actuator	P11B-1	0 VDC/ 4 mA = Valve Fully Closed 10 VDC/ 20 mA = Valve Fully Open
6	Subcooler Level Control Valve Actuator	P11B-3	0 VDC/ 4 mA = Valve Fully Closed 10 VDC/ 20 mA = Valve Fully Open
7	Turbine Governor Valve I/P Transducer	P11B-5	4 mA = Valve Fully Closed 20 mA = Valve Fully Open
8	Hotwell Level Control I/P Transducer (Output signal decreases on increasing level transmitter input signal to Analog I/O Expansion Input Channel 23)	P11B-7	4 mA = 3 PSIG Transducer Output (Overboard Valve 100 % Open) 20 mA = 15 PSIG Transducer Output (Recirculation Valve 100% Open)

If an Analog voltage Output is malfunctioning, measure the output (referenced to GND.) with a digital multimeter. If an Analog current Output is malfunctioning, remove the Output wire and measure the current by connecting the positive (+) lead of the meter to the Output terminal shown above and connect the negative (-) lead of the meter to the Output wire. For testing, a selected output can be manually set to a specific value using the keypad keys as follows:

1. Press the SELECT OUTPUT key. A yellow cursor is placed to the right side of the first selectable output.
2. Use the ▲ ▼ keys to place the box around the desired output.
3. Press the (✓) ENTER key, a dialog box appears. Use the numeric keys to enter the desired value. Leading zeros are not necessary. If a decimal point is necessary, press the • key (i.e. 12.5).
4. Press the (✓) ENTER key. The output voltage/current should transition to the value entered.
5. Press the (✓) ENTER key again and enter a new value. The output voltage/current should transition to the value entered.

The measured current value should be within + 10% of the displayed value in the Analog Expansion Outputs table. If it is not, perform the following General Checks. If the problem is not revealed in the General Checks, the most likely problem is the Analog I/O Expansion Board.

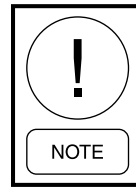
General Checks

(REFER TO SECTION 10 - ANALOG I/O EXPANSION BOARD 031-02472-000 FOR THE FOLLOWING)

Perform in the following order:

1. Confirm SW Board Identification Number Dipswitch settings are correct per the “Jumpers and Dipswitch Settings” table in Section 10.
2. Confirm input jumpers LK1-LK4 are configured correctly, per the previous table.

3. Confirm Power-on LED (D1) is illuminated. This LED illuminates when +5VDC is applied to the board. If not illuminated, measure the +5VDC input to the board at P3-16. If OK, replace the Analog I/O Expansion Board. Otherwise, trace the power source back to the power supply to find cause of problem.
4. Confirm +12VDC is present at P3-15 and -12VDC is present at P3-14 on the board. If not, trace the power source back to the power supply to find cause of problem. If +12VDC is present, then the LED D5 should be on if the Onboard +24VDC supply is functioning.
5. Confirm Watchdog "ACTIVE" LED D9 blinks at approximately once/second. Try cycling the power to the OptiView panel OFF and then back ON to see if the "Active" LED D9 starts blinking. If not, replace the Analog I/O Expansion Board.
6. Confirm I/O Communication Activity LED's D7 (RX) and D8 (TX) blink rapidly. D7 illuminates when a command or request for data is received from the Microboard. D8 (TX) illuminates when data is returned to the Microboard. If either or both do not illuminate, check wiring to P3-11/12. If wiring is OK, refer to SERIAL I/O TESTS and perform COM 3 test. If it passes, replace the Analog I/O Expansion Board. Otherwise, replace the Microboard. *Refer to Section 10 for procedures.*



If the Analog I/O Expansion Board is replaced, the counts sent to the Microboard may not be the same as the original board. This could result in unexpected oil pump and condenser water pump operation. Also, the counts sent to the Analog Board to drive the analog outputs may not be adequate. This could result in unstable speed control during slow roll and inaccurate speed indication on the tachometer. Prior to applying power to the panel after replacing the board, place the Microboard program switch (SW1-3) in the ON position to disable the chiller operation. Calibrate the 4-20 mA inputs and outputs as described in Section 23 of this manual in order to ensure safe operation of the chiller.



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